DEEP SEA ELECTRONICS

DSEP100 Operator Manual

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DSEP100 Operator Manual

Amendments Since Last Publication

Amd. No.	Comments
1	First release
1.1	Added accuracy of phase measurement
2	Added updates to include changes for module version 1.5
3	Update Configuration Table (additional ROCOF alarms). Correction to relay output designations (NO/NC).
4	Update wiring diagrams section and added UL information.
5	Updated document style, BS EN 60255-1 conformity and new features in V3.
6	Updated to email and website addresses, added details about DSEP100-02 and updated UL requirements.
7	Update to the G99 compliance issue number.

TABLE OF CONTENTS

Section Page

1 INTRODUCTION

This document details the installation requirements of the DSEP100 Mains Decoupling Relay, part of the DSEGenset® 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.deepseaelectronics.com.

DSEP100 is used to detect mains failure when in parallel and disconnect the mains supply from the local supply in line with common international requirements.

Typical applications able to benefit from DSEP100 are:

- *Peak Lopping*
- *Fixed Export*
- *Short Term Operating Reserve (STOR)*
- *No Break, Seamless Or Closed Transition*
- *Commercial And Domestic Local Power Generation.*

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

Text Based LCD Display With Additional LED Indications
True RMS Voltage.
Instrumentation Of All Measured Parameters.
Enables Applications To Meet The Standards Of Many European And Other Countries.
ROCOF / Vector Shift Detection.
Positive, Negative And Zero Sequence Detection.
Under / Over Voltage Detection.
Under / Over Frequency Detection.
Manual And Auto Reset Functionality.
USB Communications.
Configuration Lock Facility To Prevent Parameter Changes Being Made.

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

Access to critical operational sequences and timers for use by qualified engineers, can be protected by a PIN code and a physical configuration lock. Selected parameters can be changed from the module's front panel.

The module is housed in a robust plastic case suitable for DIN rail or chassis mounting. Connections to the module are via locking plug and sockets.

1.1 CLARIFICATION OF NOTATION

Clarification of notation used within this publication.

NOTE:	**Highlights an essential element of a procedure to ensure correctness.**
CAUTION!	**Indicates a procedure or practice, which, if not strictly observed, 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.**

1.2 GLOSSARY OF TERMS

Term	Description
DSEPxxx	All modules in the DSEPxxx range.
DSEP100	DSEP100-01 and DSEP100-02 module/controller
HMI	Human Machine Interface A device that provides a control and visualisation interface between a human and a process or machine.
LCD	Liquid Crystal Display The green flat-panel display on the fascia of the module.
PLC	Programmable Logic Controller A programmable digital device used to create logic for a specific purpose.
R.O.C.O.F.	Rate Of Change Of Frequency
SCADA	Supervisory Control And Data Acquisition A system that operates with coded signals over communication channels to provide control and monitoring of remote equipment

1.3 BIBLIOGRAPHY

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

1.3.1 INSTALLATION INSTRUCTIONS

Installation instructions are supplied with the product in the box and are intended as a 'quick start' guide only.

DSE Part	Description
053-149	DSEP100 Installation Instructions
053-159	DSE855 Installation Instructions
053-169	DSE857 Installation Instructions
053-182	DSE8610 MKII Installation Instructions
053-183	DSE8620 MKII Installation Instructions
053-184	DSE8660 MKII Installation Instructions

1.3.2 TRAINING GUIDES

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

DSE Part	Description
057-220	Options for Communications with DSE Controllers
056-006	Introduction to Comms
056-021	Mains Decoupling
056-033	Synchronising Requirements
056-051	Sending DSEGencomm Control Keys
056-069	Firmware Update
056-075	Adding Language Files
056-076	Reading DSEGencomm Alarms
056-079	Reading DSEGencomm Status
056-080	MODBUS
056-082	Override Gencomm PLC Example
056-084	Synchronising & Loadsharing
056-086	G59
056-091	Equipotential Earth Bonding
056-097	USB Earth Loop and Isolation
056-099	Digital Output to Digital Input Connection

1.3.3 MANUALS

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

DSE Part	Description
N/A	DSEGencomm (MODBUS protocol for DSE controllers)
057-151	DSE Configuration Suite PC Software Installation & Operation Manual
057-184	DSEP100 Operator Manual
057-205	DSE855 Operator Manual
057-219	DSE857 Operator Manual
057-220	Options for Communications with DSE Controllers

1.3.4 THIRD PARTY DOCUMENTS

The following third party documents are also referred to:

Reference	Description
ISBN 1-55937-879-4	IEEE Std C37.2-1996 IEEE Standard Electrical Power System Device Function Numbers and Contact Designations. Institute of Electrical and Electronics Engineers Inc
ENA (Energy Networks Association) Website	ENA Engineering Recommendation G59 Latest Issue and Amendment
ENA (Energy Networks Association) Website	ENA Engineering Recommendation G99 Latest Issue and Amendment

2 SPECIFICATION

2.1 PART NUMBERING

At the time of this document production, there are no variants of this product.

P100 - xxx - 01

Product Type

P100 DSEP100 Mains Decoupling Relay

Hardware Revision

Variant

01 Compliant with Engineering Recommendation G99 Issue 1. Frequency and Loss of Mains settings are not factory locked.

02 Compliant with Engineering Recommendation G99 Issue 1. Frequency and Loss of Mains settings are factory locked in compliance with clause 10.1.4 for a fully type-tested relay.

2.2 TEMPERATURE

Description	Specification
Surrounding Air Temperature	-30 ºC to +70 ºC (-22 ºF to +158 ºF)
Operating Temperature	-30 ºC to +70 ºC (-22 ºF to +158 ºF)
Storage Temperature	-40 ºC to +80 ºC (-40 ºF to +176 ºF)

2.3 TERMINAL SPECIFICATION

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

2.4 POWER SUPPLY REQUIREMENTS

2.4.1 DC POWER SUPPLY

Description	Specification
Minimum Supply Voltage	8 V continuous
Cranking Dropouts	Able to survive 0 V for 100 ms providing the supply was at least 10 V before the dropout and recovers to 8 V afterwards.
Maximum Supply Voltage	35 V continuous (60 V protection)
Reverse Polarity Protection	-35 V continuous
Typical Operating Current	115 mA at 12 V 62 mA at 24 V
Maximum Operating Current	256 mA at 12 V 132mA at 24V
Inrush Current	22 A spike for 50 µs, then current falls to around 2 A for 14 ms
Typical Operating Burden	1.4 VA at 12 V 1.5 VA at 24 V
Maximum Operating Burden	3.1 VA at 12 V 3.2 VA at 24 V

2.4.1.1 DC SUPPLY INSTRUMENTATION DISPLAY

Description	Specification
Range	0 V to 70 V DC (note Maximum continuous operating voltage of 35 V DC)
Resolution	0.1 V
Accuracy	1% full scale (±0.7 V)

2.4.2 AC POWER SUPPLY

Description	Specification
Minimum Supply Voltage	85 V
Maximum Supply Voltage	305 V
Typical Operating Current	14 mA at 230 V
Maximum Operating Current	23 mA at 230 V
Inrush Current	8.3 A for 780 µs
Typical Operating Burden	3.22 VA at 230 V
Maximum Operating Burden	5.29 VA at 230 V

2.5 VOLTAGE & FREQUENCY SENSING

Description	Specification
Measurement Type	True RMS conversion
Supported Topologies	2 Phase 3 Wire L1-L2. 2 Phase, 3 Wire L2-L3. 3 Phase, 3 Wire. 3 Phase, 4 Wire. 3 Phase, 4 Wire Delta. Single Phase, 2 Wire. 3 Phase, 3 Wire NVD.
Sample Rate	5 kHz or better
Harmonics	Up to 25th
Input Impedance	600 kΩ between terminals
Phase To Neutral	15 V (minimum required for sensing frequency) to 333 V AC (absolute maximum) Suitable for 270 V AC nominal (±20 % for under/overvoltage detection)
Phase To Phase	26 V (minimum required for sensing frequency) to 576 V AC (absolute maximum) Suitable for 480 V AC nominal (±20 % for under/overvoltage detection)
Burden	0.15 VA at 300 V 0.6 VA at 600 V
Resolution	1 V AC phase to neutral 1 V AC phase to phase
Timing Resolution	10 ms
Timing Accuracy	±10 ms plus measurement acquisition
Voltage Measurement Accuracy	±1 % of full scale phase to neutral ±1 % of full scale phase to phase
Phase Measurement Accuracy	±0.5 °
Minimum Frequency	3.5 Hz
Maximum Frequency	75.0 Hz
Frequency Resolution	0.01 Hz
Frequency Accuracy	±0.05 Hz

2.6 DIGITAL INPUTS

Description	Specification
Number	5 inputs each with fixed function
Polarity	Configurable
Arrangement	Contact between terminal and DC supply negative
Low Level Threshold	2.1 V_{DC} minimum
High Level Threshold	6.6 V_{DC} minimum
Maximum Input Voltage	+50 V_{DC} with respect to DC supply negative
Minimum Input Voltage	-24 V_{DC} with respect to DC supply negative
Contact Wetting Current	7 mA typical
Open Circuit Voltage	12 V_{DC} typical

2.7 RELAY OUTPUTS

NOTE: External slave relays may be required to comply with BS EN 60254-1.

Description	Specification
Number	5 configurable outputs
Polarity	Configurable
Arrangement	Volt-free single pole changeover contacts
Rated Load	8 A at 250 V_{AC} 5 A at 30 V_{DC}
Maximum Switching Voltage	250 V_{AC} 30 V_{DC}
Maximum Switching Current	8 A

2.8 REQUIREMENTS FOR UL

Description	Specification
Surrounding Air Temperature	-22 ºF to +122 ºF (-30 ºC to +50 ºC)
Operating Temperature	-22 ºF to +122 ºF (-30 ºC to +50 ºC)
Storage Temperature	-40 ºF to +176 ºF (-40 ºC to +80 ºC)
DC Power Supply	8 V to 35 V
AC Power Supply	85 V to 277 V
Voltage and Frequency Sensing	15 VPh-N to 333 VPh-N 26 VPh-Ph to 576 VPh-Ph
Digital Inputs	+30 VDC with respect to DC supply negative
Relay Outputs	5 A at 30 VDC or 250 VAC

2.9 COMMUNICATION PORTS

Description	Specification
USB Slave Port	Type B USB 2.0 For connection to PC running DSE Configuration Suite Max distance 6 m (20 feet)

2.10 COMMUNICATION PORT USAGE

2.10.1 USB SLAVE PORT

2.10.1.1 PC CONFIGURATION

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

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

NOTE: For further details of module configuration, refer to DSE Publication: 057-186 *DSEP100 Configuration Software Manual.*

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

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

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

DSEP100 Controller

DSE Configuration Suite PC Software
(Supplied on configuration suite software CD or available from www.deepseaplc.com).

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

2.10.1.2 MODBUS

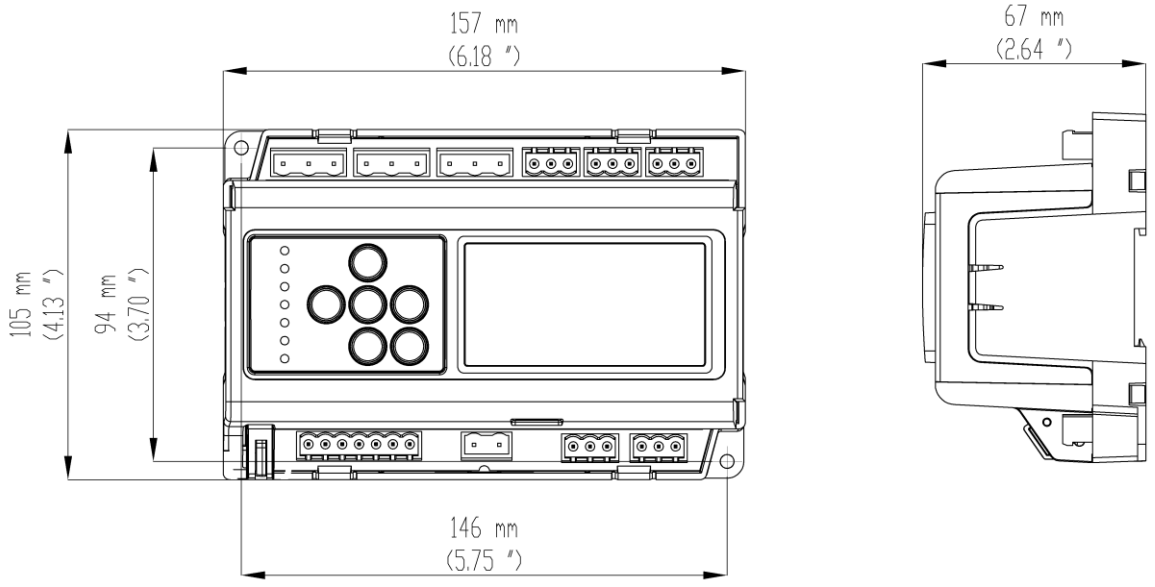
NOTE: To access the MODBUS functionality on the module's USB, an external DSE communication port converter must be used. For MODBUS TCP via Ethernet use the DSE855, for MODBUS RTU via Ethernet use the DSE857.

The USB port on the controller supports the Modbus protocol when using a DSE communication port converter module. This enables external SCADA, PLC or BMS systems to view or change various operating parameters (such as mains voltage, output control, remote tripping etc.) of the module.

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

2.11 DIMENSIONS AND MOUNTING

Parameter	Specification
Dimensions	157 mm X 105 mm X 67 mm (6.18 ” X 4.13 ” X 2.64 ”)
Mounting Type	DIN rail or chassis mounting
DIN Rail Width	EN 50022: 35 mm (1.4 “)
Mounting Holes	M4 (0.25 ")
Mounting Hole Centres	146 mm X 94 mm (5.75 ” X 3.70 ”)
Weight	380 g (13.4 oz)



2.12 APPLICABLE STANDARDS

Standard	Description
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) LCD may temporarily darken
BS EN 60068-2-6 (Vibration)	Ten sweeps in each of three major axes 5 Hz to 8 Hz at ±7.5 mm 8 Hz to 500 Hz at 2 gn
BS EN 60068-2-27 (Shock)	Three shocks in each of three major axes 15 gn in 11 ms
BS EN 60068-2-30 (Damp heat cyclic)	20 °C to 55 °C at 95% relative humidity for 48 hours
BS EN 60068-2-78 (Damp heat static)	40 °C at 95% relative humidity for 48 hours
BS EN 60950 (Electrical safety)	Safety of information technology equipment, including electrical business equipment
BS EN 61000-6-2 (Electro-magnetic Compatibility)	EMC Generic Immunity Standard (Industrial)
BS EN 61000-6-4 (Electro-magnetic Compatibility)	EMC Generic Emission Standard (Industrial)
BS EN 60255-1 (Measuring relays and protection equipment)	Common requirements
BS EN 60255-21 (Measuring relays and protection equipment)	Vibration, shock, bump and seismic tests on measuring relays and protection equipment - Section 3: Seismic tests
BS EN 60255-26 (Measuring relays and protection equipment)	Electromagnetic compatibility requirements
BS EN 60255-27 (Measuring relays and protection equipment)	Product safety requirements
BS EN 60529 (Degrees of protection provided by enclosures)	IP31

Continued overleaf..

Standard	Description
UL508 NEMA rating (Approximate)	Enclosure type 1 (indoor use only)
IEEE C37.2 (Standard Electrical Power System Device Function Numbers and Contact Designations)	Under the scope of IEEE 37.2, function numbers can also be used to represent functions in microprocessor devices and software programs. The controller is device number 11L-8000 (Multifunction device protecting Line (generator) –module). As the module is configurable by the generator OEM, the functions covered by the module vary. Depending on module configuration, the device numbers included within the module could be: • 27 - Under Voltage • 59 - Over Voltage, Above Average Voltage, Voltage Symmetry • 81H - Over Frequency • 81L - Under Frequency • 81R - R.O.C.O.F. • 78 - Vector Shift • 47H - Negative Sequence Voltage, Zero Sequence Voltage • 47L - Positive Sequence Voltage • Phase rotation

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

2.12.1 MAINS DECOUPLING STANDARDS

DSEP100 Mains Decoupling Relay has been designed to assist system designers to meet the following standards. However as the DSEP100 is only one component in the complete system, external circuits, must also be designed to meet the required standard.

Standard	Name	Notes
G59/2 and G59/3 (United Kingdom)	"Recommendation for the connection of generation plant to the distribution systems of licensed distribution network operators".	
G99/1 (United Kingdom)	"Requirements for the connection of generation equipment in parallel with public distribution networks on or after 27 April 2019"	The DSEP100-02 is compliant with Engineering Recommendation G99 Issue 1. Frequency and Loss of Mains settings are factory locked in compliance with clause 10.1.4 for a fully type-tested relay
DTIS-250701-BDW (Republic of Ireland)	"Conditions Governing Connection to the Distribution System: Connections at MV and 38 kV, Embedded Generators at LV, MV and 38 kV"	In some applications this standard requires a directional over current alarm (not included in the DSEP100). A relay from an external protection device(s) can be fed into the 'Aux mains failure' digital input to provide this function.
DTIS-230206-BRL (Republic of Ireland)	"Conditions Governing the Connection and Operation of Micro-generation"	
C10/11 (Belgium)	"SPECIFICATION FOR MAINS DECOUPLING RELAYS (according to the document C10/11- version 06.2012)"	
DIN V VDE V 0126-1-1 (Germany)	"Automatic disconnection device between a generator and the public low voltage Grid"	This requires a DC current injection alarm and residual current alarm (not included in the DSEP100). A relay from an external protection device(s) can be fed into the 'Aux mains failure' digital input to provide these functions.
CEI 0-21 (Italy)	"Reference technical rules for the connection of active and passive users to the LV electrical Utilities"	

2.12.2 ENCLOSURE CLASSIFICATIONS

2.12.2.1 IP CLASSIFICATIONS

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

IP31 When module is installed into the control panel WITHOUT being sealed to the panel

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

2.12.2.2 NEMA CLASSIFICATIONS

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

1 When module is installed into the control panel WITHOUT being sealed to the panel

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

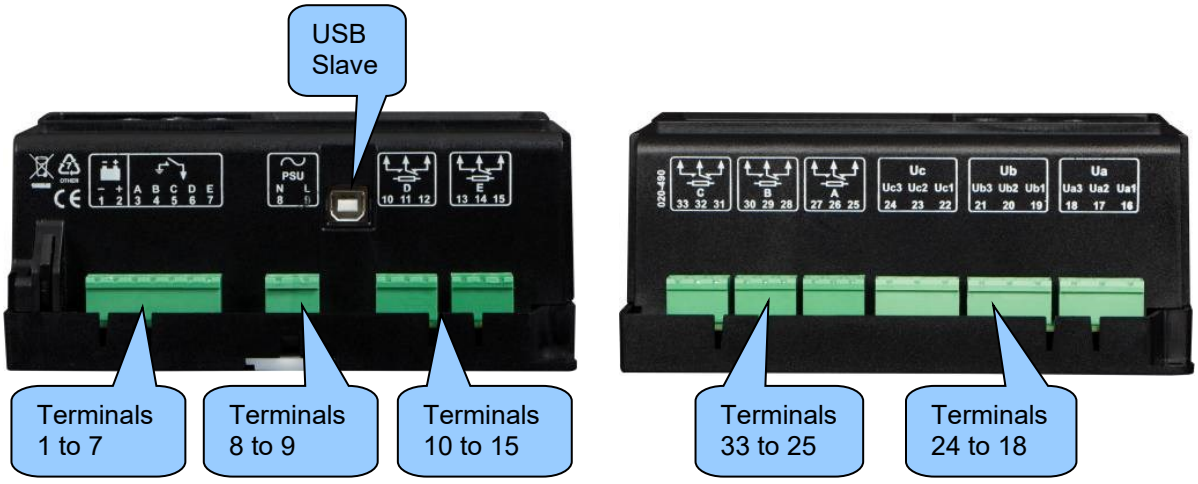
3 INSTALLATION

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

3.1 USER CONNECTIONS

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

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



3.2 CONNECTION DESCRIPTIONS

3.2.1 DC POWER SUPPLY AND DIGITAL INPUTS

NOTE: The DC Supply on terminals 1 and 2 are optional if an AC Supply is connected to terminals 8 and 9. Connecting a DC supply to terminals 1 & 2 at the same time as connecting an AC supply to terminals 8 & 9 is perfectly acceptable and has no detrimental affect on the operation of the device.

	Pin No	Description	Cable Size	Notes
	1	DC Plant Supply Input (Negative)	1.0 mm² AWG 18	Connect to ground where applicable.
	2	DC Plant Supply Input (Positive)	1.0 mm² AWG 18	Supplies the module
	3	Digital Input A (Generator Closed Auxiliary)	0.5 mm² AWG 20	Switch To DC Plant Supply Input Negative
	4	Digital Input B (Mains Closed Auxiliary)	0.5 mm² AWG 20	Switch To DC Plant Supply Input Negative
	5	Digital Input C (Alarm Reset)	0.5 mm² AWG 20	Switch To DC Plant Supply Input Negative
	6	Digital Input D (Alternative Config' Select)	0.5 mm² AWG 20	Switch To DC Plant Supply Input Negative
	7	Digital Input E (Auxiliary Mains Failure)	0.5 mm² AWG 20	Switch To DC Plant Supply Input Negative

3.2.2 AC POWER SUPPLY

NOTE: The AC Supply on terminals 8 and 9 are optional if a DC Supply is connected to terminals 1 and 2. Connecting a DC supply to terminals 1 & 2 at the same time as connecting an AC supply to terminals 8 & 9 is perfectly acceptable and has no detrimental affect on the operation of the device.

	Pin No	Description	Cable Size	Notes
	8	AC PSU Neutral	1.0 mm² AWG 18	Connect to ground where applicable.
	9	AC PSU Live	1.0 mm² AWG 18	Supplies the module

3.2.3 RELAY OUTPUT D

	Pin No	Description	Cable Size	Notes
	10	Relay Output D (NO)	1.0 mm² AWG 18	Configurable output
	11	Relay Output D (COM)	1.0 mm² AWG 18	
	12	Relay Output D (NC)	1.0 mm² AWG 18	

3.2.4 RELAY OUTPUT E

	Pin No	Description	Cable Size	Notes
 E	13	Relay Output E (NO)	1.0 mm² AWG 18	Configurable output
	14	Relay Output E (COM)	1.0 mm² AWG 18	
	15	Relay Output E (NC)	1.0 mm² AWG 18	

3.2.5 MAINS L1 MONITORING

	Pin No	Description	Cable Size	Notes
Ua3 Ua2 Ua1	16	Ua1 (Mains L1)	1.0 mm² AWG 18	Connect to Mains L1 (R) output (AC) (Recommend 2 A fuse)
	17	Ua2 (Mains N, internally connected to Ua3)	1.0 mm² AWG 18	Connect to Mains Neutral terminal (AC)
	18	Ua3 (Mains N, internally connected to Ua2)	1.0 mm² AWG 18	Connect to Mains Neutral terminal (AC)

3.2.6 MAINS L2 MONITORING

	Pin No	Description	Cable Size	Notes
Ub3 Ub2 Ub1	19	Ub1 (Mains L2)	1.0 mm² AWG 18	Connect to mains L2 (S) output (AC) (Recommend 2 A fuse)
	20	Ub2 (Mains N, internally connected to Ub3)	1.0 mm² AWG 18	Connect to Mains Neutral terminal (AC)
	21	Ub3 (Mains N, internally connected to Ub2)	1.0 mm² AWG 18	Connect to Mains Neutral terminal (AC)

3.2.7 MAINS L3 MONITORING

	Pin No	Description	Cable Size	Notes
Uc3 Uc2 Uc1	22	Uc1 (Mains L3)	1.0 mm² AWG 18	Connect to mains L3 (T) output (AC) (Recommend 2 A fuse)
	23	Uc2 (Mains N, internally connected to Uc3)	1.0 mm² AWG 18	Connect to Mains Neutral terminal (AC)
	24	Uc3 (Mains N, internally connected to Uc2)	1.0 mm² AWG 18	Connect to Mains Neutral terminal (AC)

3.2.8 RELAY OUTPUT A

	Pin No	Description	Cable Size	Notes
 A	25	Relay Output A (NC)	1.0 mm² AWG 18	Normally configured to trip open the mains switchgear on fault.
	26	Relay Output A (COM)	1.0 mm² AWG 18	
	27	Relay Output A (NO)	1.0 mm² AWG 18	

3.2.9 RELAY OUTPUT B

	Pin No	Description	Cable Size	Notes
 B	28	Relay Output B (NC)	1.0 mm² AWG 18	Normally configured to trip open the mains switchgear on fault.
	29	Relay Output B (COM)	1.0 mm² AWG 18	
	30	Relay Output B (NO)	1.0 mm² AWG 18	

3.2.10 RELAY OUTPUT C

	Pin No	Description	Cable Size	Notes
 C	31	Relay Output C (NC)	1.0 mm² AWG 18	Configurable output
	32	Relay Output C (COM)	1.0 mm² AWG 18	
	33	Relay Output C (NO)	1.0 mm² AWG 18	

3.2.11 USB SLAVE (PC CONFIGURATION) CONNECTOR

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

CAUTION!: Care must be taken not to overload the PCs USB system by connecting more than the recommended number of USB devices to the PC. For further information, consult your PC supplier.

NOTE: For further details of module configuration, refer to DSE Publication: *057-186 DSEP100 Configuration Software Manual.*

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

3.3 TYPICAL WIRING DIAGRAM

NOTE: The DSEP100 may be powered using AC and DC at the same time. When powering the DSEP100 from AC only, terminal 1 must be grounded to enable the digital input functions.

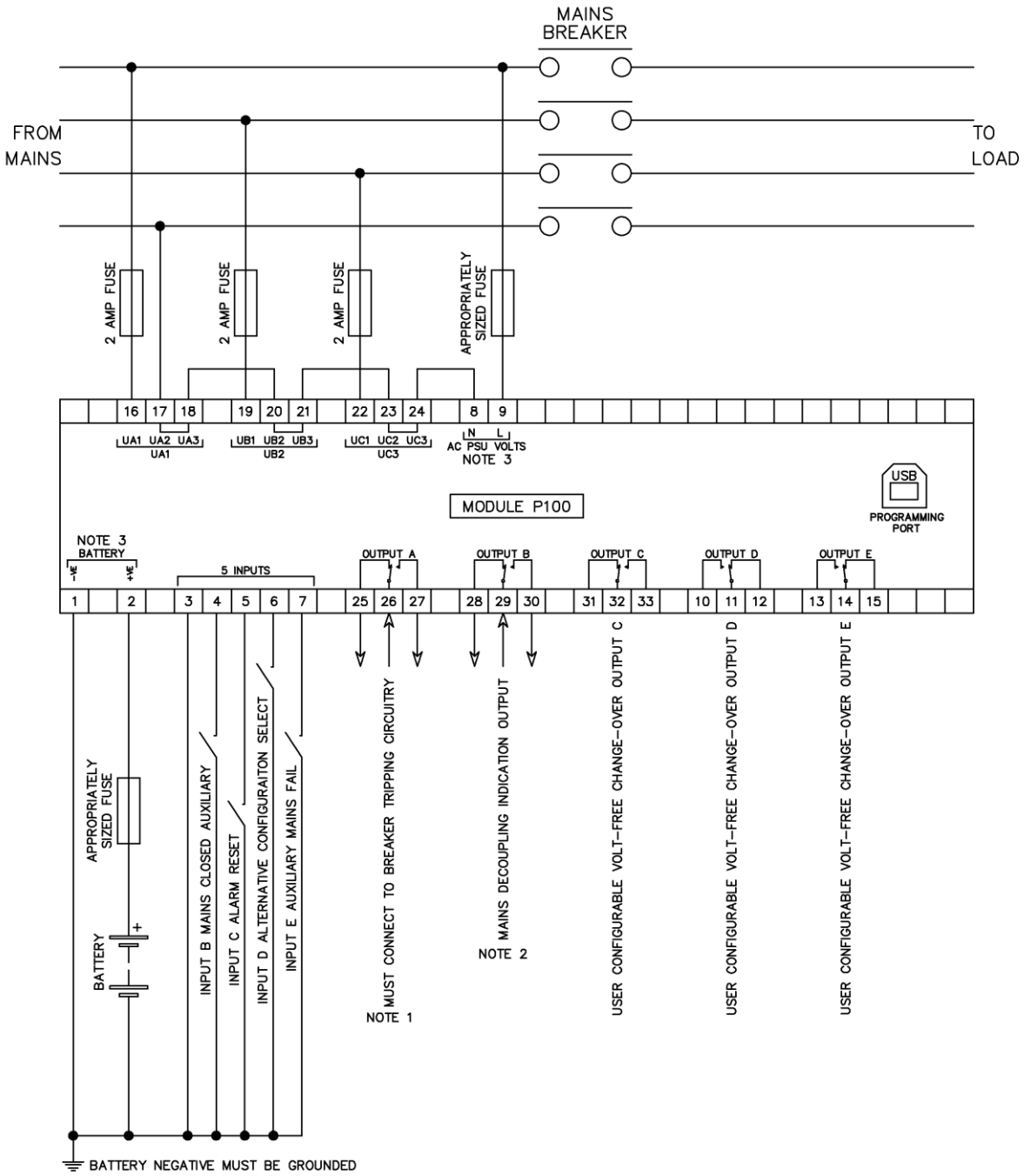
As every system has different requirements, these diagrams show only a typical system and do not intend to show a complete system.

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

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

DSE Part	Description
056-022	Breaker Control
056-091	Equipotential Earth Bonding

3.3.1 MONITORING ONLY THE MAINS BREAKER

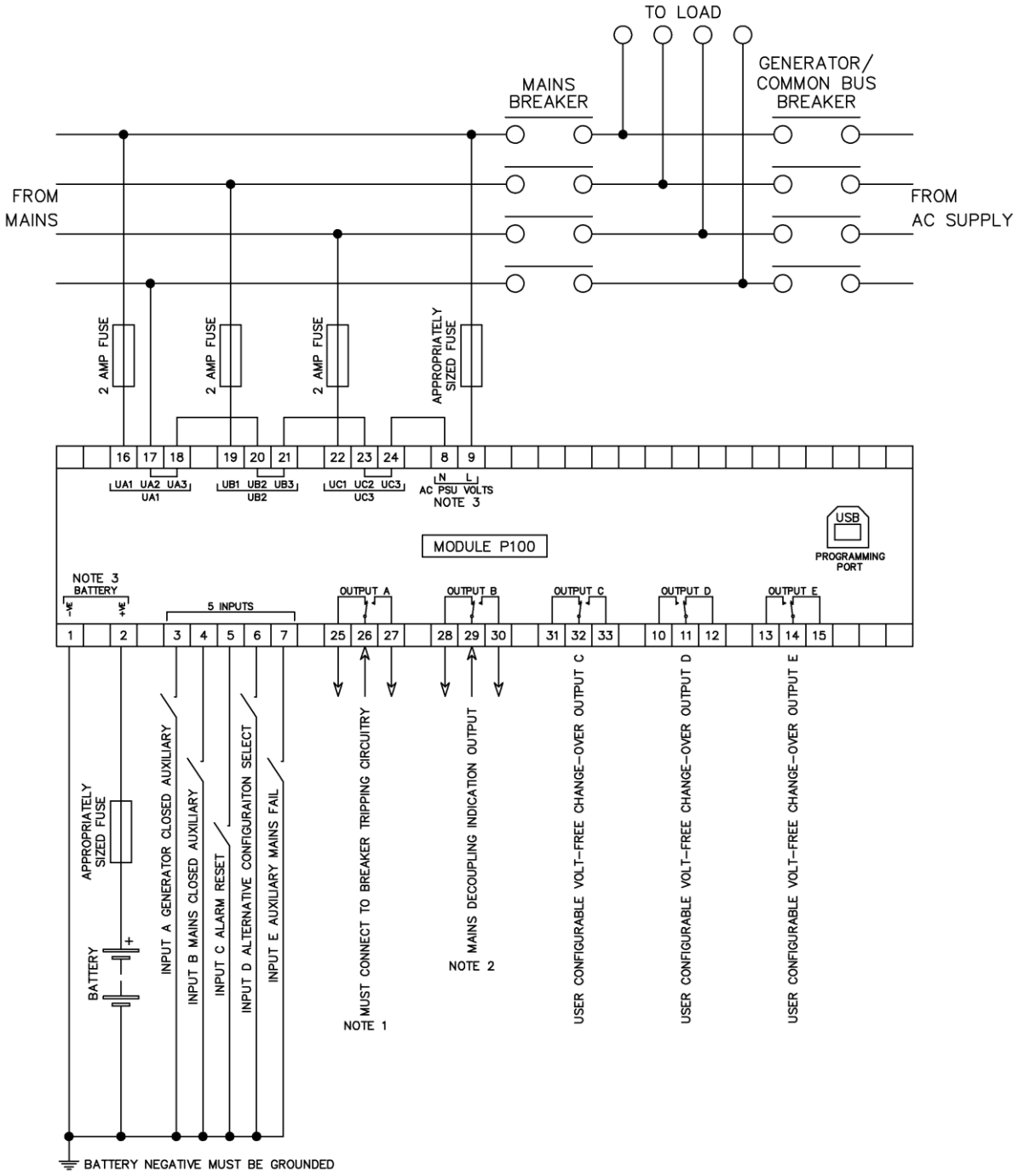


NOTE 1
DEPENDING UPON APPLICATION, ONE OR MORE BREAKERS WILL NEED TO BE TRIPPED IN CASE OF MAINS FAILURE.

NOTE 2
IT IS RECOMMENDED THAT THE MAINS DECOUPLING INDICATION OUTPUT IS GIVEN TO ANY OTHER DEVICE THAT HAS CONTROL OVER THE BREAKER BEING TRIPPED.

NOTE 3
THE MODULE CAN BE POWERED BY AC OR DC. CONNECTING BOTH WILL NOT DAMAGE THE MODULE.

3.3.2 MONITORING THE MAINS BREAKER AND GENERATOR / COMMON BREAKER



NOTE 1
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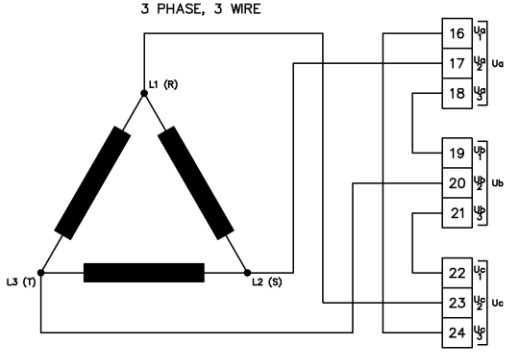
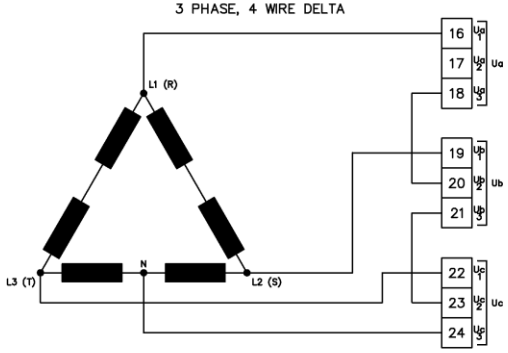
THE MODULE CAN BE POWERED BY AC OR DC. CONNECTING BOTH WILL NOT DAMAGE THE MODULE.

3.3.3 ALTERNATE TOPOLOGY WIRING DIAGRAMS

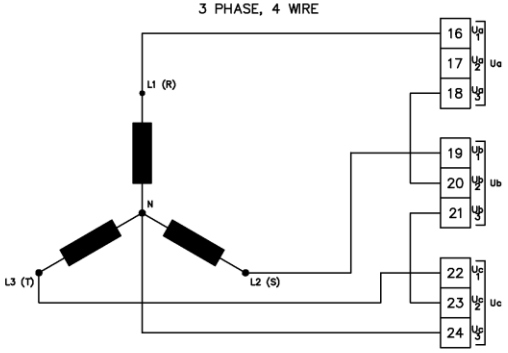
3 PHASE, 3 WIRE



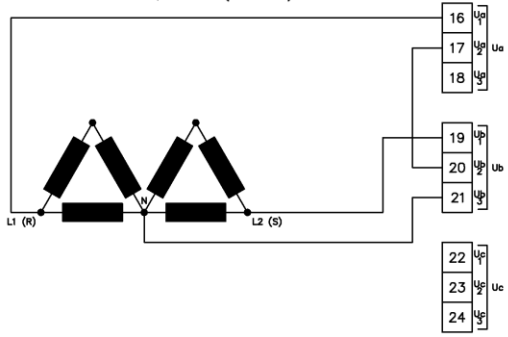
3 PHASE, 4 WIRE DELTA



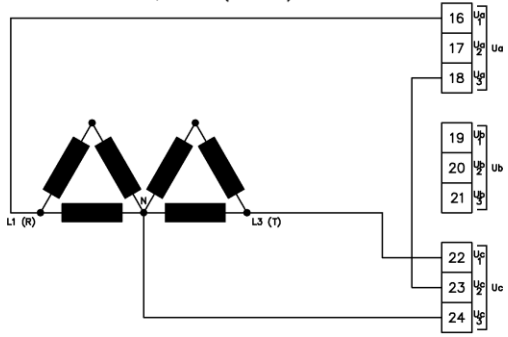
3 PHASE, 4 WIRE



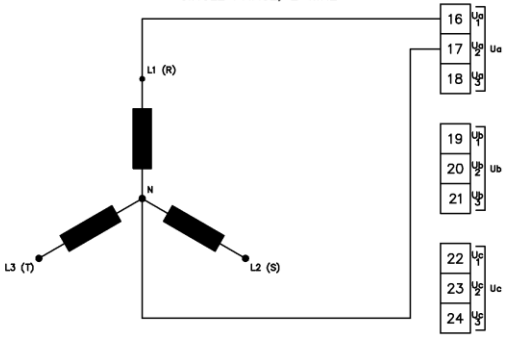
2 PHASE, 3 WIRE (L1 – L2)



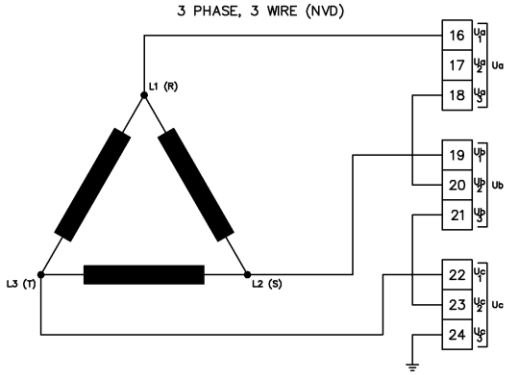
2 PHASE, 3 WIRE (L1 – L3)



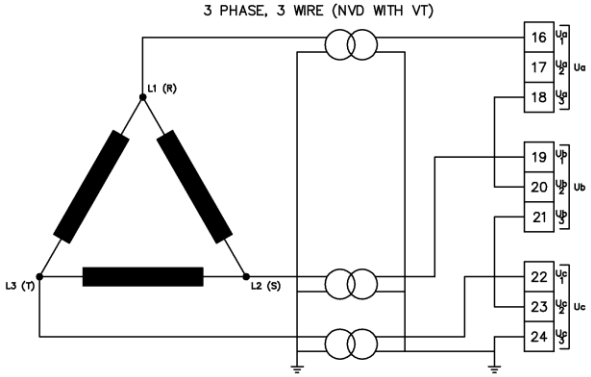
SINGLE PHASE, 2 WIRE



3 PHASE, 3 WIRE (NVD)



3 PHASE, 3 WIRE (NVD WITH VT)



3.4 INTERCONNECTION WITH THE GENERATOR CONTROLLER

The DSEP100 is intended to be placed into the application wiring in such a way as to decouple the mains and generator supplies in case of a mains failure when in parallel.

Depending upon the requirements of the system, the relay is used to open the mains breaker, generator breaker or both as described below.

Additionally, any other control logic placed between the DSEP100 and the breakers being controlled must also be designed with fast operation in mind. The combined time between the DSEP100 detecting the fault, and the time of the breaker opening must be within the specification of the legislation in place at the site. This legislation differs between countries.

3.4.1 OPEN THE MAINS BREAKER

NOTE: You must ensure that the generator(s) are capable of supplying the remaining load after the mains breaker has been opened.

It is recommended that the DSEP100 is used to open the mains breaker directly, giving signal to the opening or tripping coil. This ensures that the decoupling operation occurs as quickly as possible after the signal to open is given by the DSEP100.

In addition to this, it is recommended that the DSEP100 signal is also given to any other device that has control over the mains breaker. For example this could be a DSE8620 type controller.

Where connected to a DSE module with control over the mains breaker, this signal is fed into a digital input configured to “Auxiliary Mains Failure”. This ensures that this controller is informed about the mains decoupling operation and can take action itself to open the mains breaker.
Additionally, the DSE module must have “Immediate Mains Dropout” enabled. This configures the controller to open the mains breaker as soon as the input is received from the DSEP100 device.

Failure to do this may result in “Fail To Close” alarms caused by the mains breaker opening under control of a device other than the DSEP100.

3.4.2 OPEN THE GENERATOR OR COMMON BUS BREAKER

NOTE: You must ensure that the mains supply is capable of supplying the remaining load after the generator or common bus breaker has been opened.

It is recommended that the DSEP100 is used to open the generator or common bus breaker directly, giving signal to the opening or tripping coil. This ensures that the decoupling operation occurs as quickly as possible after the signal to open is given by the DSEP100.

In addition to this, it is recommended that the DSEP100 signal is also given to any other device that has control over the generator or common bus breaker. For example this could be a DSE8660 type controller.

Where connected to a DSE module with control over the generator or common bus breaker, this signal is fed into a digital input configured to “Electrical Trip”. This ensures that this controller is informed about the mains decoupling operation and can take action itself to open the generator or common bus breaker.

Failure to do this may result in “Fail To Close” alarms caused by the mains breaker opening under control of a device other than the DSEP100.

3.4.3 OPEN BOTH BREAKERS

This application may be required if the size of the load requires both the generator and mains supplies to be in parallel.
In this application, if the mains supply fails, the generator supply is incapable of supplying the load so both breakers must be opened.

It is recommended that the DSEP100 is used to open the mains breaker AND generator or common bus breaker directly, giving signal to the opening or tripping coil. This ensures that the decoupling operation occurs as quickly as possible after the signal to open is given by the DSEP100.

In addition to this, it is recommended that the DSEP100 signal is also given to any other device that has control over the generator or common bus breaker. For example this could be a DSE8660 type controller.

Where connected to a DSE module with control over the generator or common bus breaker, this signal is fed into a digital input configured to “Electrical Trip” and to another digital input configured to “Auxiliary Mains Failure”. This ensures that this controller is informed about the mains decoupling operation and can take action itself to open the mains breaker AND generator or common bus breaker.
Additionally, the DSE module must have “Immediate Mains Dropout” enabled. This configures the controller to open the mains breaker as soon as the input is received from the DSEP100 device.

Failure to do this may result in “Fail To Close” alarms caused by the breakers opening not under control of the DSEP100.

4 DESCRIPTION OF CONTROLS

4.1 CONTROL PUSH BUTTONS

Button	Function	Description
	Up	Cycle round the instruments in the current page / adjust parameter when in configuration mode.
	Down	Cycle round the instruments in the current page / adjust parameter when in configuration mode.
	Left	Move between the different instrumentation / configuration pages.
	Right	Move between the different instrumentation / configuration pages.
	Tick	Used in conjunction with the Front Panel Editor (FPE)
	Reset	Reset alarms (when present) if the cause of the alarm is no longer present.
	Lamp Test	Press and hold the Reset button for five seconds to perform a Lamp Test of all LEDs. During Lamp Test, the following LED colours show normal operation : ***Trip:*** Red ***U:*** Amber ***f:*** Amber ***df/dt:*** Red ***Vec:*** Red ***Alt:*** Red ***Sup:*** Green

4.2 LED INDICATIONS

LED	Colour	Function
Trip	Red	Common Alarm LED to show Trip status. ***Flashing:*** Indicates that a mains decoupling event has been detected. Further LED indication shows the type of trip. ***Unlit:*** No alarms active.
U	Multicolour (see table below)	Indicates activation of one or more of the following Voltage Alarm conditions. • Under Voltage Stage 1 • Under Voltage Stage 2 • Under Voltage Stage 3 • Under Voltage Stage 4 • Under Voltage Stage 5 • Over Voltage Stage 1 • Over Voltage Stage 2 • Over Voltage Stage 3 • Over Voltage Stage 4 • Over Voltage Stage 5 • Over Average Voltage • Zero Sequence Voltage • Negative Sequence Voltage • Positive Sequence Voltage • Asymmetry • Phase Rotation Alarm
f	Multicolour (see table below)	Indicates activation of one or more of the following Frequency Alarm conditions. • Low Frequency Stage 1 • Low Frequency Stage 2 • High Frequency Stage 1 • High Frequency Stage 2
df/dt	Red	***Lit:*** Indicates activation of one or more of the following R.O.C.O.F. Alarm conditions • R.O.C.O.F Stage 1 • R.O.C.O.F Stage 2 • R.O.C.O.F Stage 3 ***Unlit:*** R.O.C.O.F. has not been activated.
Vec	Red	***Lit:*** Indicates that the Vector Shift trip has been activated. ***Unlit:*** Vector Shift has not been activated.
Alt	Amber	***Lit:*** The device's 'alternative configuration is active. ***Unlit:*** The device's 'main configuration'.
Sup	Green	Shows the operating state of the device. ***Flashing:*** The Supervision Timer is in progress, after which the device supervision becomes active. ***Lit Steady:*** The DSEP100 is active, checking for a mains decoupling event. ***Unlit:*** The device is disabled.

U and f LEDs are multicolour LEDs. The colour of the LED indicates the exact status of the LED as below:

Colour	Function
Unlit	Alarm disabled.
Green	Alarm active and measured values are within configured normal operating parameters.
Amber	Alarm active and measured values are outside configured normal operating parameters during the trip delay timer.
Red	Alarm tripped.

4.3 VIEWING THE INSTRUMENT PAGES

It is possible to scroll to display the different pages of information by repeatedly operating the ***Left & Right Page*** buttons.

Example

If you want to view one of the instrument pages towards the end of the list, it may be quicker to scroll left through the pages rather than right!

Status **Mains** **Alarms**

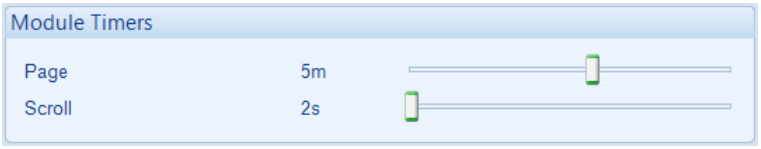
And so on until the desired page is reached. Further presses of the ***Right Button*** returns the Status page.

The complete order and contents of each information page are given in the following sections

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

If no buttons are pressed upon entering an instrumentation page, the instruments displayed are automatically subject to the setting of the *LCD Scroll Timer*.

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



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

Alternatively, to scroll manually through all instruments on the currently selected page, press the ***Up or Down*** buttons. The 'auto scroll' is disabled.

To re-enable 'auto scroll' press the ***Up or Down*** buttons to scroll to the 'title' of the instrumentation page (ie Mains). A short time later (the duration of the *LCD Scroll Timer*), the instrumentation display begins to auto scroll.

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

If an alarm becomes active while viewing the status page, the display shows the Alarms page to draw the operator's attention to the alarm condition.

4.3.1 STATUS

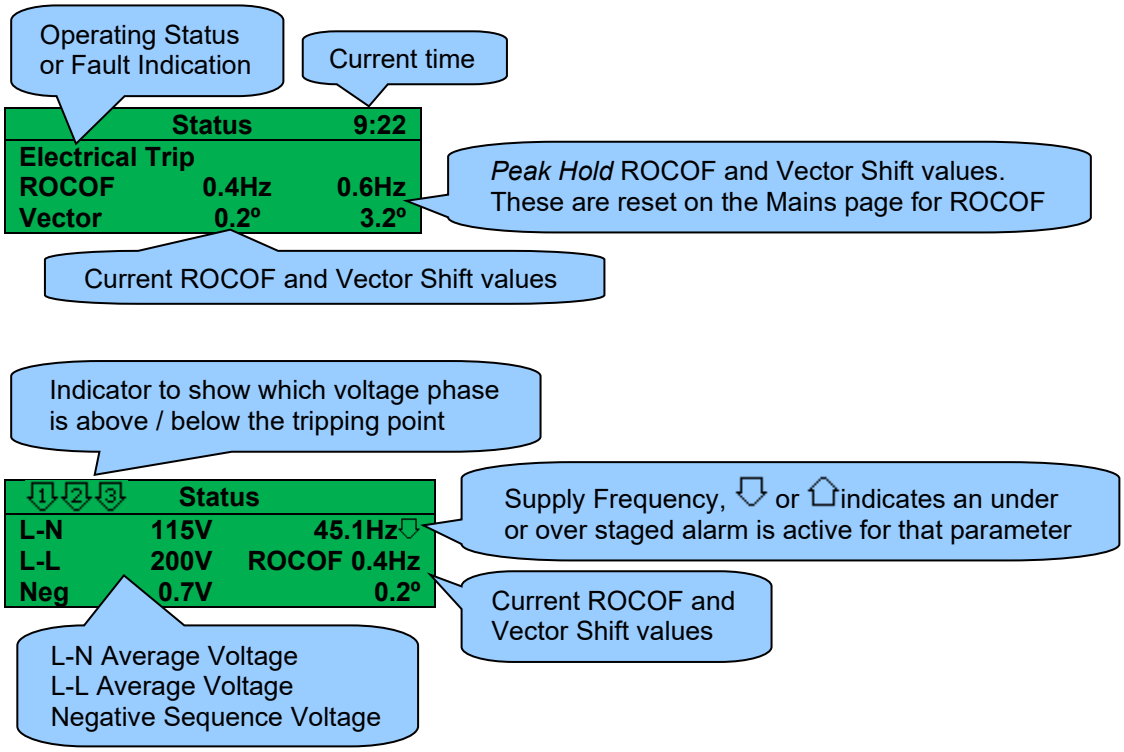
NOTE: Press the *Up or Down* buttons on the *Status Page* to view other Configurable Status Screens if configured. For further details of module configuration, refer to DSE Publication: *057-262 DSE7410 MKII & DSE7420 MKII Configuration Software Manual.*

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

Press the ***Up or Down*** buttons to cycle through the available instruments.

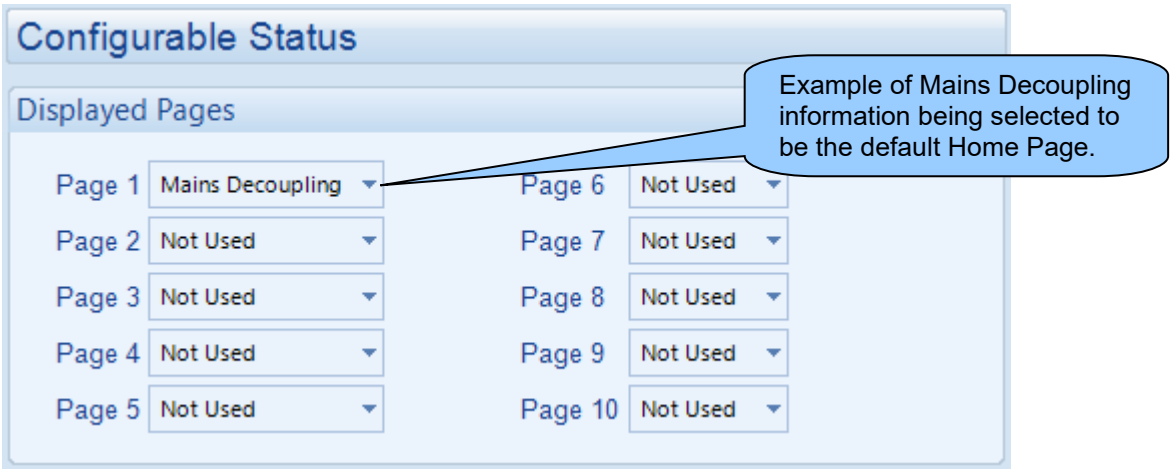
Clock.
Supervision Disabled / Enabled.
Rate of Change of Frequency (ROCOF), actual and 'peak hold'. The peak hold value is reset on the Mains page.
Vector Shift, actual and 'peak hold'. The peak hold value is reset on the Mains page.
Average L-N Voltage.
Average L-L Voltage.
Frequency
Negative Sequence Voltage.
Configurable Status Screens

Example Status Pages



4.3.1.1 CONFIGURABLE STATUS SCREENS

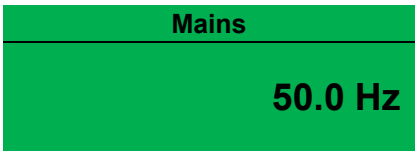
The contents of the Home Page may vary depending upon configuration by the supplier. Below is an example of the Home Page being changed to show just Mains Decoupling information.



4.3.2 MAINS

Contains electrical values of the mains (utility) and the DC supply, measured or derived from the module's voltage inputs.

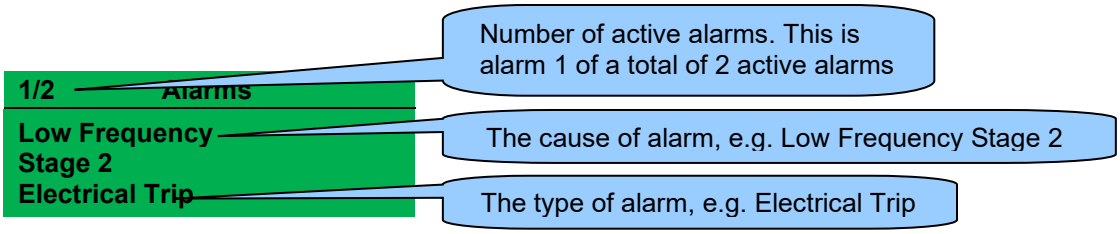
Press the ***Up or Down***  buttons scroll through the ***Mains*** parameters.



- Voltage L1-N
- Voltage L2-N
- Voltage L3-N
- Voltage L1-L2
- Voltage L2-L3
- Voltage L3-L1
- Rolling Average Voltage L1-N
- Rolling Average Voltage L2-N
- Rolling Average Voltage L3-N
- Rolling Average Voltage L1-L2
- Rolling Average Voltage L2-L3
- Rolling Average Voltage L3-L1
- Zero Sequence Voltage
- Positive Sequence Voltage
- Negative Sequence Voltage
- Voltage Asymmetry
- Mains Frequency
- Mains Phase Sequence
- Active Configuration
- Rate of Change of Frequency (ROCOF). Press and hold the ***Reset***  button for 5 seconds to reset the 'peak hold' for ROCOF and Vector Shift
- Vector Shift. Press and hold the ***Reset***  button for 5 seconds to reset the 'peak hold' for ROCOF and Vector Shift
- Battery Voltage

4.3.3 ALARMS

When an alarm is active, appropriate Alarm LED illuminates.
The LCD display jumps from the 'Information page' to display the Alarm Page



The LCD displays multiple alarms such as "*Low Frequency Stage 2*" and "*Low Voltage Stage 1*".

These automatically scroll in the order that they occurred or press the ***Up or Down***  buttons to scroll through manually.

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

Example:

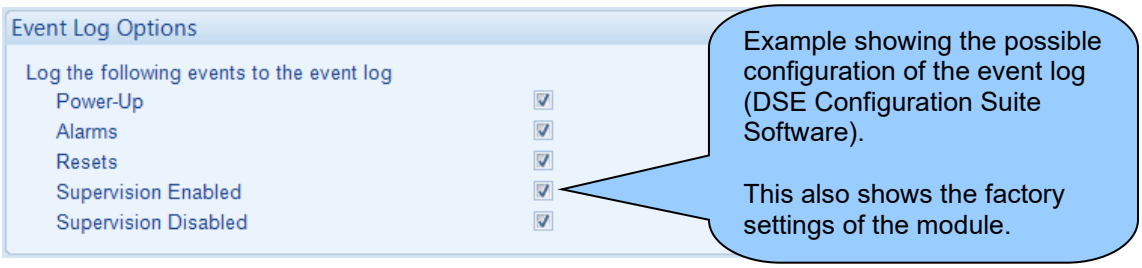
1/2 Alarms
Low Frequency Stage 2 Electrical Trip

2/2 Alarms
Low Voltage Stage 1 Electrical Trip

4.3.4 EVENT LOG

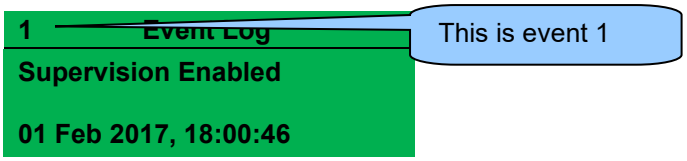
The module maintains a log of past alarms and/or selected status changes.
The log size has been increased in the module over past module updates and is always subject to change. At the time of writing, the modules log is capable of storing the last 250 log entries.

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



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

To view the event log, repeatedly press the ***Left & Right Page***  buttons until the LCD screen displays the *Event Log* page.



Press the ***Up or Down***  buttons to view the next most recent event.

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

To exit the event log and return to viewing the instruments, press the ***Left & Right Page***  buttons.to select the next instrumentation page.

4.3.5 ABOUT

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

About	
Variant	**P100-01**
Application	**V3.1.0**
USB ID	**BC614E**

Variant: P100-01 or P100-02
Application Version: The version of the module's main firmware file (Updatable using the Firmware Update Wizard in the DSE Configuration Suite Software).
USB ID: Unique identifier for PC USB connection

Press the ***Up or Down***  buttons to access more information about the module.

About	
Bootloader	**V1.2.1**
Analogue	**V1.0.1**

Bootloader: Firmware Update bootloader software version
Analogue: Analogue measurements software version

5 OPERATION AND PROTECTIONS

To allow time for the system to stabilise after paralleling takes place, the *Supervision Timer* is provided.

Supervision of the alarm system activates after both supplies are seen to be in parallel. This check is performed using the digital inputs for *Generator Closed Auxiliary* and *Mains Closed Auxiliary*.

During the *Supervision Timer*, the *Sup* LED flashes green. After the timer has expired, the Supervision of the alarms is fully active and the *Sup* LED ceases flashing and illuminates continuously green.

5.1 FAULT RESET

After the alarm has been cleared, the module must be 'reset' in order to reactivate Supervision. Reset is performed in the following ways.

- Manual Reset. Press the ***Reset*** button
- Auto-reset (when configured). After the supply returns within limits, the configurable Delay timer operates. After this, the Auto-Reset function operates.
- Fast Reset (when configured). If the supply failure occurs for less than the time of the configurable Fast Reset Window, the Fast Reset Delay timer operates. This allows for a Fast Reset upon a short term failure.

5.2 UNDER FREQUENCY / OVER FREQUENCY

NOTE: For the DSEP100-02 the *Mains Frequency Alarms* are locked and cannot be altered to comply with G99, clause 10.1.4 for a fully type-tested relay.

These are '2 stage' alarms.
Stage 1 allows for a delayed operation should the frequency stray by a small amount.
Stage 2 allows for a faster trip should the frequency change by a larger amount.

Indicates that one of more of the phases are outside the settings of the Under Frequency / Over Frequency Alarms.

5.3 UNDER VOLTAGE / OVER VOLTAGE

NOTE: DSEP100 modules before V1.5 have two stage alarms only. These modules are able to be updated using the DSE Configuration Suite PC Software.

These are '5 stage' alarms.
Stage 1 allows for a delayed operation should the voltage stray by a small amount.
Stages 2 to 5 allow for a faster trip should the voltage change by a larger amount.

Indicates that one of more of the phases are outside the settings of the Under Voltage / Over Voltage Alarms.

5.4 OVER AVERAGE VOLTAGE

Indicates that the average of the monitored voltage phases, is outside the settings of the Over Average Voltage Alarm.

The Average is calculated using voltage measurements taken over the proceeding ten seconds (10s rolling average).

5.5 BOOT IN TRIPPED MODE

When enabled, the Boot in Tripped Mode Alarm activates as soon as the module is powered. This enables the module to power up in a fault condition so that the tripping output is maintained until the module deems the mains has healthy.

This is useful in specific applications such as PhotoVoltaic (PV) connections where the module is powered by the mains supply and is used to open and close the mains switchgear.

5.6 REMOTE MAINS FAILURE

This alarm occurs if an external MODBUS master has sent a command to the module to remotely simulate a mains failure condition. This is useful in specific applications where remote testing of the system is required.

5.7 LOSS OF MAINS (R.O.C.O.F. & VECTOR SHIFT)

NOTE: For new installations, G59 and G99 have banned Vector Shift protection as it was deemed too sensitive to nuisance tripping caused by network faults.

NOTE: For the DSEP100-02 the *Loss of Mains (R.O.C.O.F. & Vector Shift)* protections are locked and cannot be altered to comply with G99, clause 10.1.4 for a fully type-tested relay.

Active if either the R.O.C.O.F. or Vector Shift alarm has been activated.

5.7.1 WHAT IS LOSS OF MAINS DETECTION (LOM)?

LOM is the automatic detection of a mains failure when in parallel with another source of power. Mains failure when in parallel leads to a section of the distribution network that is no longer connected to the rest of the National Grid. That section is known as an 'island' and may be anything from a few low voltage (LV) customers up to an area covering a substantial part of the country.

5.7.2 WHY DO WE NEED LOSS OF MAINS DETECTION (LOM)?

LOM is required in the UK by 'G99' which, although not legally binding in themselves, are required by the Distribution Code (DC). Any generator connected to the National Grid is required to comply with this.

5.7.3 WHY DOES G99 REQUIRE LOM DETECTION?

It is considered extremely dangerous for an island to be powered by one or more embedded generators. Therefore LOM is required to be fitted to each point of connection to detect the formation of an island and disconnect that generator from it, thus leaving the island without power.
Some of the risks generated by the 'island' are:

1. Linesmen may be attempting to repair a fault in the island and would be put in danger by it being kept live by embedded generator.
2. Embedded generators may not maintain the voltage and frequency within legally required limits, thus exposing other customers on the island to risk. This is due to the fact that they usually operate in power and power factor control modes when grid connected rather than voltage and frequency control modes that are used when running stand-alone.
3. The island may not be earthed appropriately and as a result protective devices may not operate in the event of a fault, or the protective devices may not be in an appropriate location to provide protection at all. Such a fault may expose people to danger e.g. a HV line laying on the ground or a fallen tree lying across a HV line. There is a very significant chance of such a fault since the operation of a protective device is one of the most likely causes of an island forming.
4. Reconnecting the island to the grid while out of phase could cause damage to both the generator and distribution network. Auto-recloser devices in the distribution network are very common place as a result of the drive to maintain continuity of supply. These devices attempt to reclose protective devices within typically 1-5 seconds of them tripping and rarely include check-sync facilities. The need to disconnect a generator before an auto-recloser operates is the drive for tripping times of less than 0.5s.

5.7.4 WHAT METHODS ARE USED FOR LOSS OF MAINS (LOM) DETECTION?

LOM consists or a set of under and over voltage and frequency alarms supplemented with either Rate of Change of Frequency (ROCOF) or Vector Shift (VS) (also known as Vector Surge). Typically only ROCOF and VS are referred to as LOM, yet the voltage and frequency alarms alone are often quite effective in detecting island formation because the embedded generators are unable to maintain stable voltage and frequency so quickly drift to one of the alarm thresholds.
These are all passive methods of detecting LOM.
Active methods that inject a signal into the mains to measure its impedance are prohibited due to the risk of interference.

5.7.5 WHY HAVE MUTLIPLE VOLTAGE AND FREQUENCY ALARM STAGES?

This was introduced in G59/2 and G83/2 to reduce the occurrence of nuisance tripping (tripping when an island has not formed). The intention is that a small excursion is permitted for a relatively long period before tripping, but a large excursion results in a rapid trip.

5.7.6 RELATIVE MERITS OF R.O.C.O.F AND VECTOR SHIFT

NOTE: For new installations, G59 and G99 have banned Vector Shift protection as it was deemed too sensitive to nuisance tripping caused by network faults.

NOTE: For the DSEP100-02 the *Loss of Mains (R.O.C.O.F. & Vector Shift)* protections are locked and cannot be altered to comply with G99, clause 10.1.4 for a fully type-tested relay.

R.O.C.O.F. and Vector Shift are both methods of detecting mains failure when in parallel with another source and both rely upon the relative stability of the AC waveform of the mains supply in normal (no fault) operation. All phases of the selected topology are monitored to ensure that the fault is detected, now matter which supply phase is affected.

However, R.O.C.O.F. and Vector Shift both employ different methods of detection leading to differences in their relative advantages and disadvantages.

For this reason, some jurisdictions specify the use of one or the other of these protections, some specify the use of both.

5.7.6.1 R.O.C.O.F. SUMMARY

- Typically responds well to many network faults with minimal spurious tripping.
- Slower to react to a mains failure than Vector Shift.
- Normal changes in frequency can lead to spurious trips. This can be an issue in some areas where the supply grid is relatively unstable. The ‘size’ of the supply grid is not a guarantee of stability. In many regions, the type of equipment used to supply power has the effect of local instability of the supply grid. A high ratio of smaller power generation systems may cause grid instability among other reasons.
- May not trip if the load level after mains failure is close to the load level before mains failure.

5.7.6.2 VECTOR SHIFT SUMMARY

- Typically responds to a mains failure event faster than R.O.C.O.F.
- Sensitive to network faults other than mains failures.
- Not sensitive to normal changes in frequency.
- May not trip if the load level after mains failure is close to the load level before mains failure.

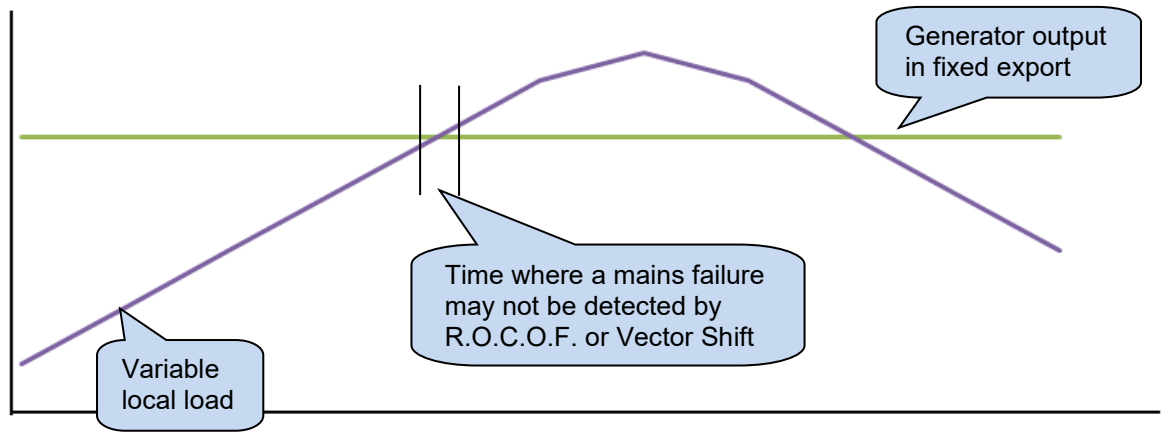
5.7.6.3 EXAMPLE OF POTENTIAL TO NOT DETECT A MAINS FAILURE

In the below example, the local generator is providing a fixed power. When the load is low, this results in power being exported to the grid. When the load is high, the generator supplies some power, the mains provides the rest.

At times of high and low load, a mains failure results in either a change in frequency (detected by R.O.C.O.F.) or a change in the supply vector (detected by Vector Shift).

During times where the load level is close to the level of power being provided by the generator, a mains failure may not generate a frequency change or vector change large enough to surpass the trip settings.

This will eventually lead to detection of a fault as the generator frequency/voltage will change in an attempt to maintain the fixed power level. However a change large enough to be detected as a fault may not occur for some time.



5.7.7 R.O.C.O.F.

NOTE: For the DSEP100-02 the *Loss of Mains (R.O.C.O.F. & Vector Shift)* protections are locked and cannot be altered to comply with G99, clause 10.1.4 for a fully type-tested relay.

Indicates that the Rate of Change of Frequency (R.O.C.O.F.) is greater than the configured settings of the R.O.C.O.F. alarm for more than the configured time.

R.O.C.O.F. detection of 'mains failure when in parallel' relies upon the relative steady state of the utility power grid frequency. Normally supplied by a myriad of large power generating stations, the frequency cannot normally change quickly over a short period of time.

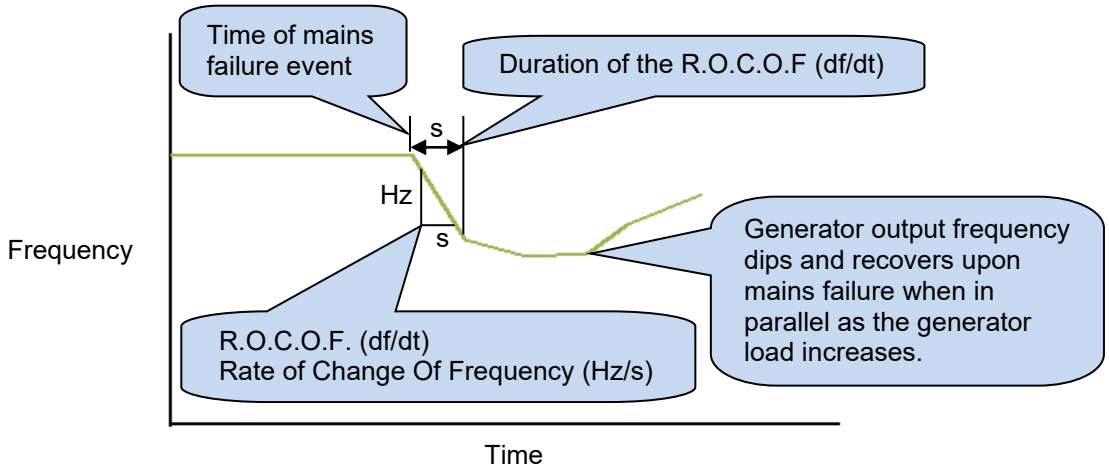
A failure of the utility supply usually leads to sudden increase or decrease in the active load of the local generator and a subsequent drop or rise in its frequency. This is detected by the R.O.C.O.F. alarm.

The frequency of the AC supply is monitored and filtered over the configured number of voltage cycles. If the frequency has changed by more than the configured amount for more than the configured time the alarm is activated.

5.7.7.1 EXAMPLE OF ROCOF (FREQUENCY DIP UPON MAINS FAILURE)

In this example, the generator is in parallel with the mains supply, with the mains supplying the majority of the load.

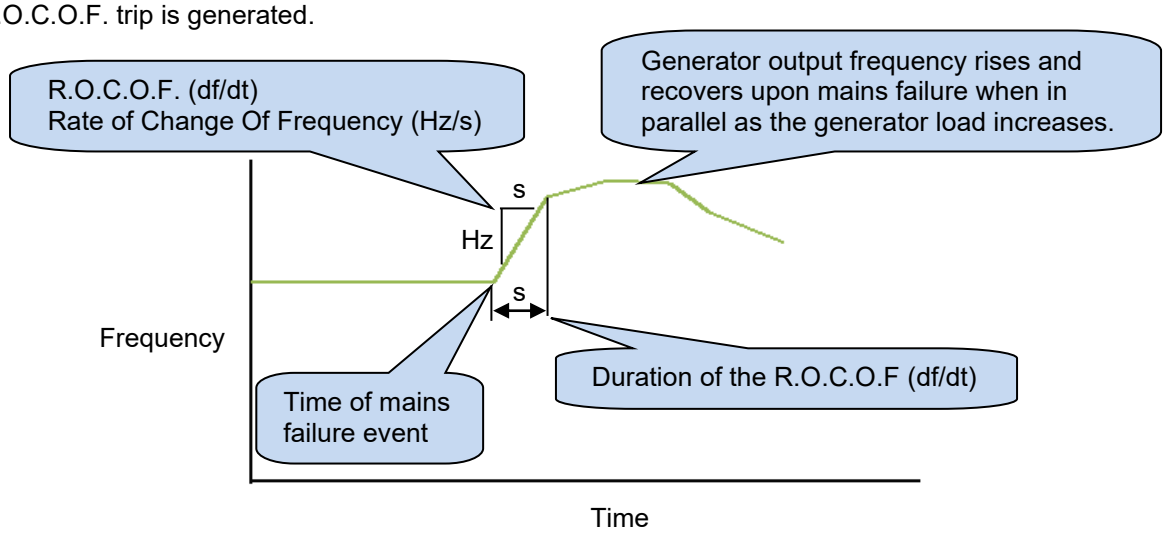
Upon the mains failure event, the frequency of the generator decreases due to the extra load being applied. This is measured over the configured number of cycles to give a Rate Of Change Of Frequency (Hz/s). If this value remains above the configured trip point for longer than the configured delay time, a R.O.C.O.F. trip is generated.



5.7.7.2 EXAMPLE OF ROCOF (FREQUENCY RISE UPON A MAINS FAILURE)

In this example, the generator is in parallel with the mains supply, in fixed export supplying all the requirements of the load and exporting the remaining power to the mains supply.

Upon the mains failure event, the frequency of the generator increases due to load being removed. This is measured over the configured number of cycles to give a Rate Of Change Of Frequency (Hz/s). If this value remains above the configured trip point for longer than the configured delay time, a R.O.C.O.F. trip is generated.



5.7.8 VECTOR SHIFT

NOTE: For new installations, G59 and G99 have banned Vector Shift protection as it was deemed too sensitive to nuisance tripping caused by network faults.

NOTE: For the DSEP100-02 the *Loss of Mains (R.O.C.O.F. & Vector Shift)* protections are locked and cannot be altered to comply with G99, clause 10.1.4 for a fully type-tested relay.

Indicates that a Vector Shift in one or more of the monitored phases of the waveform has been measured greater than the configured settings of the Vector Shift alarm.

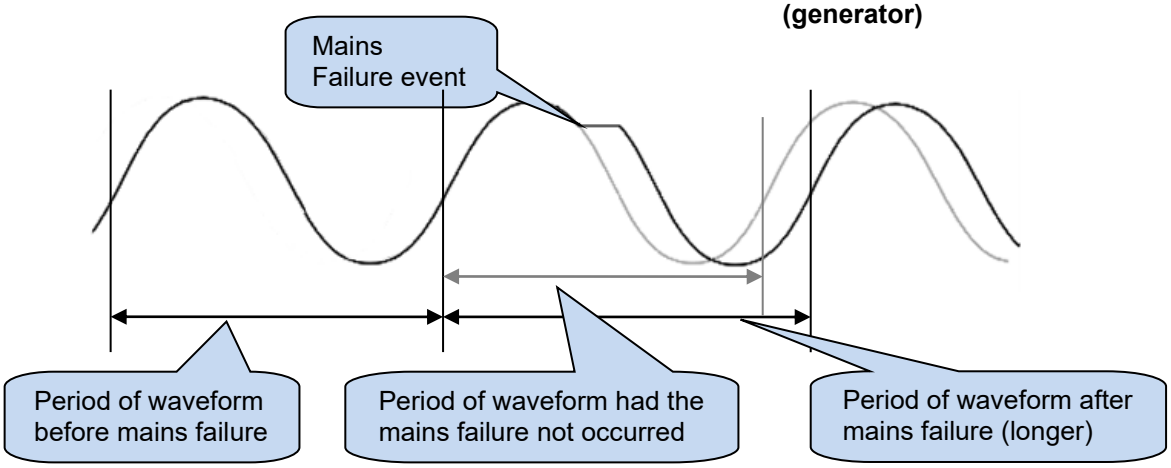
Vector Shift detection of 'mains failure when in parallel' relies upon the relative steady state of the utility power grid.

Should the utility supply fail, the resulting change in load of the local supply (example local site generator) leads to a jump in the phase of the local supply.
If this jump is greater than the setting of the Vector Shift Alarm, the trip is generated.

5.7.9 EXAMPLE OF A VECTOR SHIFT (INCREASE IN LOAD UPON MAINS FAILURE)

Waveform of Supply in normal operation

Waveform upon mains failure caused by sudden jump in load on the local supply (generator)

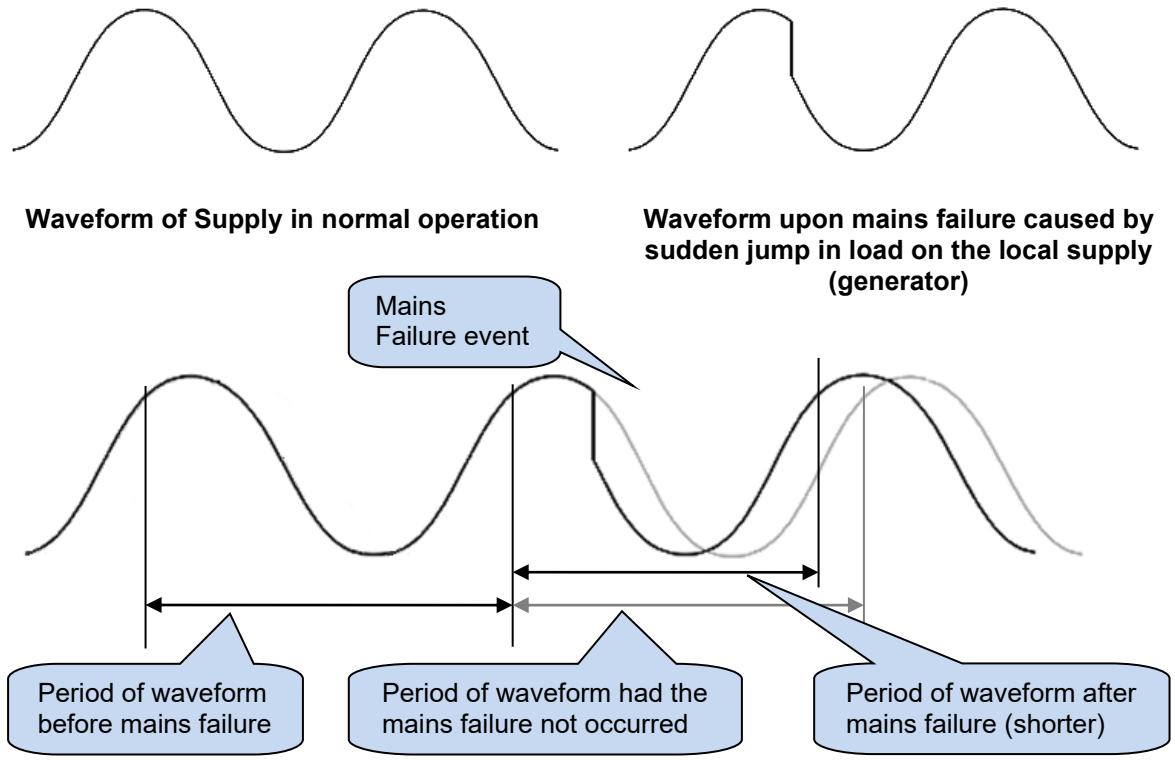


Waveform of connected supply overlaid with Waveform after mains failure

The period of the supply waveform is continuously measured. For example for a 50 Hz supply, the period is 1/50th of a second (20 ms).
Should a mains failure occur, the supply 'jumps' causing a change in the position of the waveform. This is measured as a difference in period of the supply waveform for a single cycle.
For our example we will imagine that we have measured 20 ms for the previous cycle, and 22 ms for the current cycle. From this we can calculate the difference in degrees.
As one complete cycle is 360º we can calculate the angle of the time difference (2 ms).
(2 / 20) x 360 = 36º

If this angle is greater than the setting of the Vector Shift Alarm, a trip is generated.

5.7.10 EXAMPLE OF A VECTOR SHIFT (DECREASE IN LOAD UPON MAINS FAILURE)



Waveform of connected supply overlaid with Waveform after mains failure

The period of the supply waveform is continuously measured. For example for a 50 Hz supply, the period is 1/50th of a second (20 ms).
Should a mains failure occur, the supply 'jumps' causing a change in the position of the waveform. This is measured as a difference in period of the supply waveform for a single cycle.
For our example we will imagine that we have measured 20 ms for the previous cycle, and 18 ms for the current cycle. From this we can calculate the difference in degrees.
As one complete cycle is 360º we can calculate the angle of the time difference (2 ms).
(2 / 20) x 360 = 36º

If this angle is greater than the setting of the Vector Shift Alarm, a trip is generated.

5.8 ZERO SEQUENCE VOLTAGE

Zero Sequence Voltage alarm is sometimes known as Neutral Voltage Displacement alarm and indicate a difference in potential between the Earth and the calculated Neutral position of a 3 wire delta, which ordinarily should be zero.

Zero sequence voltages can occur for a number of reasons, including:

- An earth fault in a High Voltage (H.V.) line. For example an overhead cable falling to the ground, or a large tree falling against it.
- An upstream fault causing a breaker to trip, leaving the H.V. line with no earth reference. This causes the H.V. line to ‘float’ relative to earth.

5.9 POSITIVE SEQUENCE VOLTAGE

Positive Sequence Voltage is present in all utility mains and generator supplies.

The Positive Sequence Voltage Alarm activates if the Positive Sequence Voltage falls below the configured trip level for the configured amount of time.

5.10 NEGATIVE SEQUENCE VOLTAGE

Negative Sequence Voltage occurs due to imbalance in the terminal voltages of the phases.
A small imbalance in phase voltages can lead to a larger imbalance in phase currents (negative sequence currents) and cause problems with equipment in the load such as induction motors and variable speed drives so must not be left unchecked.

5.11 ASYMMETRY

This alarm occurs if the voltage between any two phases exceeds the amount configured in the Asymmetry Alarm.

For Example:
L1=230, L2=235, L3=226
Asymmetry is *largest value* – *smallest value* = 235 – 226 = 9V

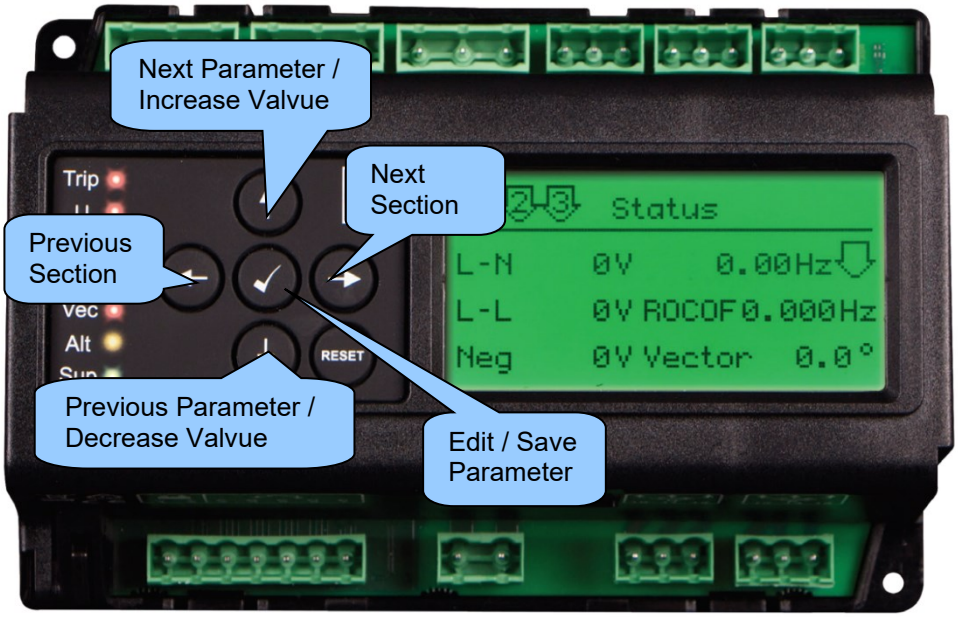
5.12 PHASE ROTATION

This alarm occurs if the phase rotation is detected as being incorrect. The DSEP100 expects the rotation to be in the order L1, L2, L3 as connected to terminal blocks Ua, Ub, Uc.

6 FRONT PANEL CONFIGURATION

This configuration mode allows the operator to partially configure the module through its display without the use of the DSE Configuration Suite PC Software.

Use the module's facia buttons to traverse the menu and make value changes to the parameters:



6.1 MAIN CONFIGURATION EDTIOR

6.1.1 CONFIGURATION LOCK

A means of attaching a small padlock or utility company seal is provided that when attached, prevents the main configuration settings being changed either from the Front Panel Editor or via Configuration Suite PC Software.

6.1.2 ACESSING THE MAIN CONFIGURATION EDTIOR

- Press the ***Tick***  and ***Reset***  buttons simultaneously to enter the main configuration editor. This is not possible if the *Configuration Lock*

6.1.3 ENTERING PIN

NOTE: The PIN is not set by DSE when the module leaves the factory. If the module has a PIN code set, the generator supplier has entered this. Contact the generator supplier if the code is required. If the code has been 'lost' or 'forgotten', the module must be returned to the DSE factory to have the PIN removed. A charge is made for this procedure. This procedure cannot be performed away from the DSE factory.

NOTE: The PIN is automatically reset when the editor is exited (manually or automatically) to ensure security.

- If a module security PIN has been set, the PIN request is then shown.
- The first '#' changes to '0'. Press the ***Up*** or ***Down***  buttons to adjust it to the correct value.
- Press the ***Right***  button when the first digit is correctly entered. The digit previously entered now shows as '#' for security.
- Repeat this process for the other digits of the PIN number. Press the ***Left***  button to move back to adjust one of the previous digits.
- When the ***Tick***  button is pressed after editing the final PIN digit, the PIN is checked for validity. If the number is not correct, the PIN must be re-entered.
- If the PIN has been successfully entered (or the module PIN has not been enabled), the editor is displayed.

6.1.4 EDITING A PARAMETER

NOTE: Pressing and holding the *Menu Navigation*  buttons provides the auto-repeat functionality. Values can be changed quickly by holding the navigation buttons for a prolonged period of time.

- Press the ***Right*** or ***Left***  buttons to cycle to the section to view/change.
- Press the ***Up*** or ***Down***  buttons to select the parameter to view/change within the currently selected section.
- To edit the parameter, press the ***Tick***  button to enter edit mode. The parameter begins to flash to indicate editing.
- Press the ***Up*** or ***Down***  buttons to change the parameter to the required value.
- Press the ***Tick***  button to save the value. The parameter ceases flashing to indicate that it has been saved.

6.1.5 EXITING THE MAIN CONFIGURATION EDITOR

NOTE: The editor automatically exits after 5 minutes of inactivity to ensure security.

- Press and hold the ***Reset***  button to exit the editor without saving changes.
- Press and hold the ***Tick***  button to exit the editor and save the changes.

6.1.6 ADJUSTABLE PARAMETERS

NOTE: A select number of parameters on the DSEP100-02 are locked and cannot be adjusted to comply with G99, clause 10.1.4 for a fully type-tested relay.

Section	Parameter As Shown On Display	Value	P100-02
Display	Contrast	0%	
	Language	English, others.	
	Current Date And Time	dd mmm yyyy, hh:mm:ss	
Config	Config To Edit	Default Config / Alternative Config	
Mains	Display Volts as PhPh	Active / Inactive	
	Nominal Voltage	0.0 V	
	Under Voltage Stage 1	Active / Inactive	
	Under Voltage Stage 1	0.0 V	
	Under Voltage Stage 2	Active / Inactive	
	Under Voltage Stage 2	0.0 V	
	Under Voltage Stage 3	Active / Inactive	
	Under Voltage Stage 3	0.0 V	
	Under Voltage Stage 4	Active / Inactive	
	Under Voltage Stage 4	0.0 V	
	Under Voltage Stage 5	Active / Inactive	
	Under Voltage Stage 5	0.0 V	
	Over Voltage Stage 1	Active / Inactive	
	Over Voltage Stage 1	0.0 V	
	Over Voltage Stage 2	Active / Inactive	
	Over Voltage Stage 2	0.0 V	
	Over Voltage Stage 3	Active / Inactive	
	Over Voltage Stage 3	0.0 V	
	Over Voltage Stage 4	Active / Inactive	
	Over Voltage Stage 4	0.0 V	
	Over Voltage Stage 5	Active / Inactive	
	Over Voltage Stage 5	0.0 V	
	High Average Voltage	Active / Inactive	
	High Average Voltage	0.0 V	
	Nominal Frequency	0.00 Hz	
	Under Frequency Stage 1	Active / Inactive	
	Under Frequency Stage 1	0.00 Hz	
	Under Frequency Stage 2	Active / Inactive	
	Under Frequency Stage 2	0.00 Hz	
	Over Frequency Stage 1	Active / Inactive	
	Over Frequency Stage 1 Trip	0.00 Hz	
	Over Frequency Stage 1 Return	0.00 Hz	
	Over Frequency Stage 2	Active / Inactive	
	Over Frequency Stage 2	0.00 Hz	
	Mains ROCOF Stage 1	Active / Inactive	
	Mains ROCOF Stage 1 Hz/S	0.000 Hz	
	Mains ROCOF Stage 2	Active / Inactive	
	Mains ROCOF Stage 2 Hz/S	0.000 Hz	
	Mains ROCOF Stage 3	Active / Inactive	
	Mains ROCOF Stage 3 Hz/S	0.000 Hz	
	Mains ROCOF Cycles	0	
	Mains Vector Shift	Active / Inactive	
	Main Vector Shift	0.0 º	

Continued Overleaf.

Section	Parameter As Shown On Display	Value	P100-02
Mains (continued)	Over Zero Seq Volts	Active / Inactive	
	Over Zero Seq Volts	0.0 V	
	Under Positive Seq Volts	Active / Inactive	
	Under Positive Seq Volts	0.0 V	
	Over Negative Seq Volts	Active / Inactive	
	Over Negative Seq Volts	0.0 V	
	Asymmetry High	Active / Inactive	
	Asymmetry High	0.0 V	
	Phase Rotation Wrong	Active / Inactive	
	Auto-Reset	Active / Inactive	
	Reset If Unhealthy	Active / Inactive	
	Manual Reset If Unhealthy	Active / Inactive	
	Fast Reset	Active / Inactive	
	Boot In Tripped Mode	Active / Inactive	
	Standard Compliance	G59/2 / G59/3 and G99	
	Breaker Failed to Open	Active / Inactive	
	Use Gen Closed Auxiliary	Active / Inactive	
Timers	LCD Page Timer	0 h 0 m 0 s	
	Scroll Delay	0 h 0 m 0 s	
	Under Voltage Stage 1	0.0 s	
	Under Voltage Stage 2	0.0 s	
	Under Voltage Stage 3	0.0 s	
	Under Voltage Stage 4	0.0 s	
	Under Voltage Stage 5	0.0 s	
	Over Voltage Stage 1	0.0 s	
	Over Voltage Stage 2	0.0 s	
	Over Voltage Stage 3	0.0 s	
	Over Voltage Stage 4	0.0 s	
	Over Voltage Stage 5	0.0 s	
	Under Frequency Stage 1	0.0 s	
	Under Frequency Stage 2	0.0 s	
	Over Frequency Stage 1	0 m 0.0 s	
	Over Frequency Stage 2	0.0 s	
	Mains ROCOF Delay Stage 1	0.0 s	
	Mains ROCOF Delay Stage 2	0.0 s	
	Mains ROCOF Delay Stage 3	0.0 s	
	Over Zero Seq Volts Delay	0 m 0.0 s	
	Under Positive Seq Volts Delay	0 m 0.0 s	
	Over Negative Seq Volts Delay	0 m 0.0 s	
	Asymmetry High Delay	0 m 0.0 s	
	Auto-Reset Delay	0 h 0 m 0.0 s	
	Fast Reset Window	0.0 s	
	Fast Reset Delay	0.0 s	
	Supervision Delay	0 h 0 m 0.0 s	
	Breaker Failed to Open	0.0 s	
	Delayed Fault Reset Delay	0.00 s	
	Delayed Fault reset Pulse Length	0.00 s	

6.2 DISPLAY CONFIGURATION EDITOR

6.2.1 ACCESSING THE DISPLAY CONFIGURATION EDITOR

- Press and hold the ***Tick***  button to access the *Display Editor.*

6.2.2 ENTERING PIN

NOTE: The PIN is not set by DSE when the module leaves the factory. If the module has a PIN code set, the generator supplier has entered this. Contact the generator supplier if the code is required. If the code has been 'lost' or 'forgotten', the module must be returned to the DSE factory to have the PIN removed. A charge is made for this procedure. This procedure cannot be performed away from the DSE factory.

NOTE: The PIN is automatically reset when the editor is exited (manually or automatically) to ensure security.

Even if a module security PIN has been set, the PIN is not requested whilst entering the *Display Editor*.

6.2.3 EDITING A PARAMETER

NOTE: Pressing and holding the *Menu Navigation*  **buttons provides the auto-repeat functionality. Values can be changed quickly by holding the navigation buttons for a prolonged period of time.**

- Press the ***Right*** or ***Left***  buttons to cycle to the section to view/change.
- Press the ***Up*** or ***Down***  buttons to select the parameter to view/change within the currently selected section.
- To edit the parameter, press the ***Tick***  button to enter edit mode. The parameter begins to flash to indicate editing.
- Press the ***Up*** or ***Down***  buttons to change the parameter to the required value.
- Press the ***Tick***  button to save the value. The parameter ceases flashing to indicate that it has been saved.

6.2.4 EXITING THE MAIN CONFIGURATION EDITOR

NOTE: The editor automatically exits after 5 minutes of inactivity to ensure security.

- Press and hold the ***Reset***  button to exit the editor without saving changes.

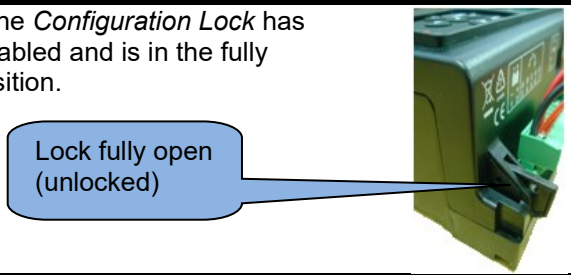
- Press and hold the ***Tick***  button to exit the editor and save the changes.

6.2.5 DISPLAY EDITOR PARAMETERS

NOTE: A select number of parameters on the DSEP100-02 are locked and cannot be adjusted to comply with G99, clause 10.1.4 for a fully type-tested relay.

Section	Parameter As Shown On Display	Values	P100-02
Display	Contrast	0%	
	Language	English	

7 FAULT DIAGNOSIS

Nature of Problem	Suggestion
Unable to enter the Front Panel Editor. Unable to 'write' a configuration using DSE Configuration Suite PC Software.	Ensure the *Configuration Lock* has been disabled and is in the fully open position. 
Module not detecting faults *Sup* (Supervision) LED not lit	The DSEP100 begins the *Supervision Timer* and subsequently enters *Supervision Mode* when the two supplies are in parallel. This is indicated to the DSEP100 using digital inputs A and B.
Phase Rotation alarm not resetting	If the *Manual Reset if Mains Out of Limits* option is not enabled, the fault must be corrected and then the DSEP100 power must be cycled (powered off and then back on) in order to reset the Phase Rotation alarm.
All LEDs illuminate for a short time Trip – Red U – Amber F – Amber df/dt – Red Vec – Red Alt – Amber Sup - Green 	All LEDs illuminate for a short time upon DC power being applied to the controller.

8 MAINTENANCE, SPARES, REPAIR AND SERVICING

The controller is *Fit and Forget*. As such, there are no user serviceable parts within the controller. In the case of malfunction, you should contact your original equipment manufacturer (OEM).

If you require additional plugs from DSE, please contact our Sales department using the part numbers below.

Module Terminal Designation		Description	Part No.
1-7		7 way 5.08mm	007-447
8-9		2 way 7.62mm	007-448
10-12		3 way 5.08mm	007-174
13-15		3 way 5.08mm	007-174
16-18	Ua1 Ua2 Ua3	3 way 7.62mm	007-464
19-21	Ub1 Ub2 Ub3	3 way 7.62mm	007-464
22-24	Uc1 Uc2 Uc3	3 way 7.62mm	007-464
25-27		3 way 5.08mm	007-174
28-30		3 way 5.08mm	007-174
31-33		3 way 5.08mm	007-174
		PC Configuration interface lead (USB type A – USB type B)	016-125

9 WARRANTY

DSE Provides limited warranty to the equipment purchaser at the point of sale. For full details of any applicable warranty, refer to the original equipment supplier (OEM)

10 DISPOSAL

10.1 WEEE (WASTE ELECTRICAL AND ELECTRONIC EQUIPMENT)

If you use electrical and electronic equipment you must store, collect, treat, recycle and dispose of WEEE separately from your other waste

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