DEEP SEA ELECTRONICS

DSE BC2415i Operator Manual

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DSE BC2415i Operator Manual

Amendments Since Last Publication

Issue No.	Comments
1	Initial Release
2	Safety warning added for safe installation

Typeface: The typeface used in this document is *Arial*. Care must be taken not to mistake the upper-case letter I with the numeral 1. The numeral 1 has a top serif to avoid this confusion.

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SECTION PAGE

1 INTRODUCTION

This document details the installation and operation requirements of the DSE BC2415i battery charger and is part of the DSEPower® range of products.

The manual is an integral component of the product and should be retained throughout the entire lifespan of the product. In the event that the product is transferred or provided to a different entity, please ensure that this document is also transferred to them for reference purposes.
This is not a *controlled document.* DSE do not automatically inform on updates. Any future updates of this document are included on the DSE website at www.deepseaelectronics.com

The DSE BC2415i is designed to fulfil the most common functions required of a charger in the generating set industry. Combining protected outputs, intelligent charging, and power supply operation within a robust enclosure.

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
BMS	Building Management System A digital/computer-based control system for a building's infrastructure.
HMI	Human Machine Interface A device that provides a control and visualisation interface between a human and a process or machine.
SCADA	Supervisory Control And Data Acquisition A system that operates with coded signals over communication channels to provide control and monitoring of remote equipment.
RS485	An international serial communications standard.
DSENet	The communications link between a DSE module and expansion modules.

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

WARNING!: For safe operation, the charger MUST be installed in an enclosure which prevents accidental contact with Hazardous Voltages.

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

DSE Part	Description
053-154	DSE2541 Installation Instructions
053-265	DSE BC2415i Installation Instructions

1.3.2 MANUALS

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

DSE Part	Description
N/A	DSEGencomm (MODBUS Protocol for DSE Products)
057-151	DSE Configuration Suite PC Software Installation & Operation Manual
057-220	Options for Communications with DSE Controllers
057-277	DSE2541 Operator Manual
057-353	DSE BC2415i PC Software Manual

1.3.3 TRAINING GUIDES

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

DSE Part	Description
056-006	Introduction to Comms
056-036	DSE Module Expansion
056-069	Firmware Update
056-076	Reading DSEGencomm Alarms
056-079	Reading DSEGencomm Status
056-080	MODBUS

2 SPECIFICATION

2.1 OPERATING TEMPERATURE

NOTE: The battery charger's maximum output current de-rates due to excessive temperature and low AC supply voltage. This is done to prevent damage to battery charger and the connected battery/equipment. For further information see section 2.4.1 entitled *Output De-rate Curves*.

Parameter	Specification
Operating Temperature	-30 °C to +50 °C (-22 °F to +122 °F)
Operating Temperature With De-rate to Output	-40 ºC to +70 ºC (-40 ºF to +158 ºF)
Storage Temperature	-40 ºC to +80 ºC (-40 ºF to +176 ºF)

2.2 TERMINAL SPECIFICATION

Parameter	Specification	
Connection Type	PCB mounted Screw terminal, rising clamp, no internal spring.	 Example showing cable entry and screw terminals of a 6-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")	

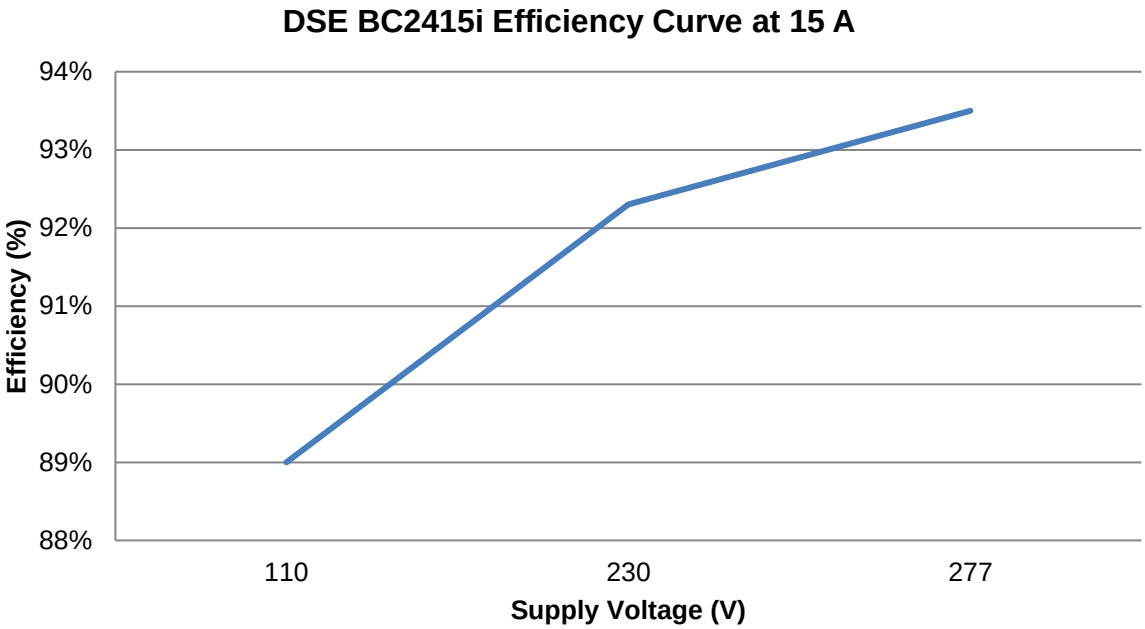
2.3 AC SUPPLY

NOTE: The battery charger's maximum output current de-rates due to excessive temperature and low supply voltage to prevent damage to itself and the battery/connected equipment. For further information see section 2.4.1 entitled *Output De-rate Curves*.

NOTE: The battery charger's efficiency varies depending on supply voltage. For further information see section 2.3.1entitled *Efficiency Curve*.

Parameter	Specification
Minimum Supply Voltage	95 V with Output Current De-rate 110 V without Output Current De-rate
Maximum Supply Voltage	305 V
Minimum Supply Frequency	48 Hz
Maximum Supply Frequency	64 Hz
Maximum Supply Current	2.3 A_{AC} at V_{in}=230 V_{AC}, V_{out}=28.8 V_{DC}, I_{out}=15 A_{DC} 4.0 A_{AC} at V_{in}=110 V_{AC}, V_{out}=28.8 V_{DC}, I_{out}=15 A_{DC}
Typical Supply Current with Charge Output Turned Off/Disconnected	0.05 A_{AC} Irrespective of Supply Voltage
Supply Inrush Current	60 A for 10 ms, 230 V_{AC} Input
Recommended Fuse	6.3 A anti-surge for 110 V 3.5 A anti-surge for 230 V
Efficiency	More Than 90 % at V_{out}=24.0 V_{DC}, I_{out}=15 A_{DC}
Maximum Power Loss	35 W

2.3.1 EFFICIENCY CURVE



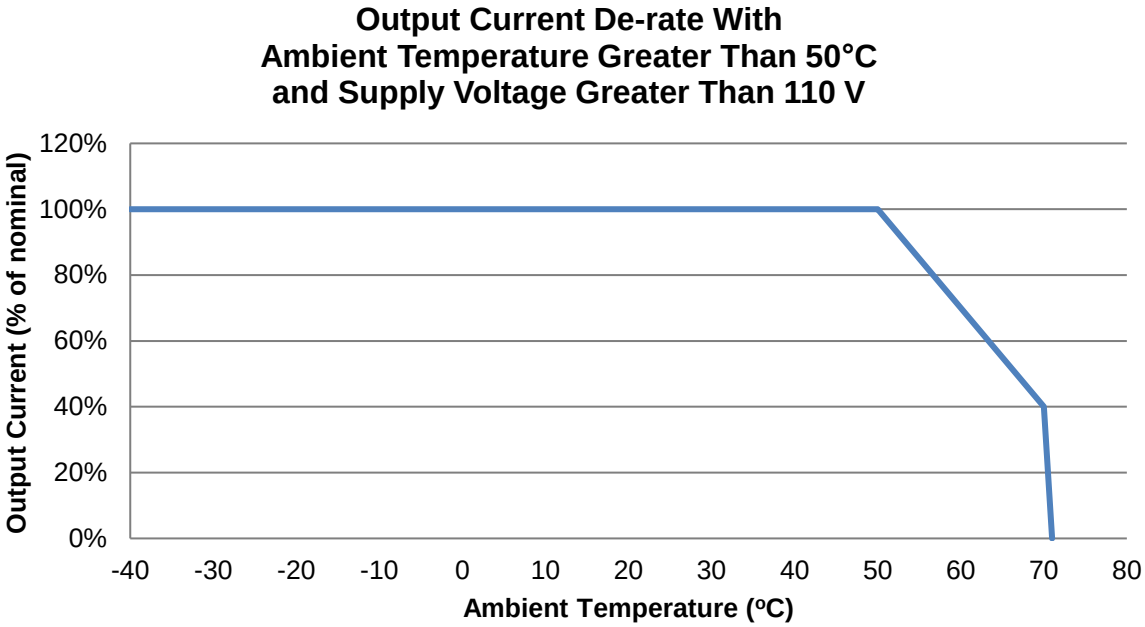
2.4 DC OUTPUT

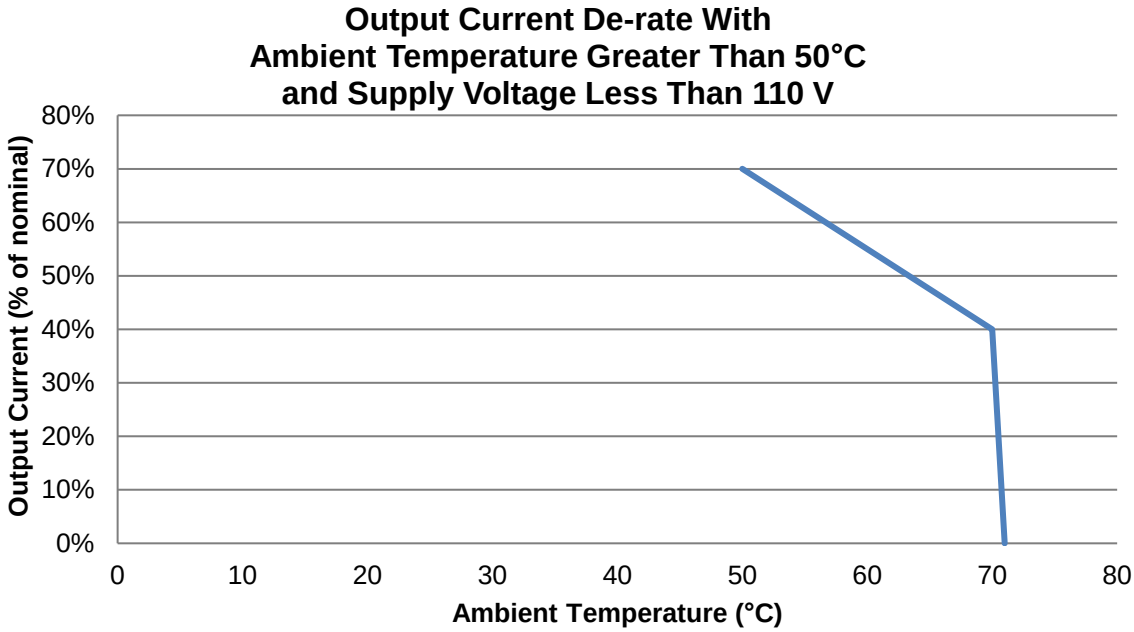
NOTE: The battery charger is factory configured to suit typical vented wet lead acid batteries. It is possible to configure the battery charger to suit other battery types. For further details of the module configuration, refer to DSE Publication: *057-353 DSE BC2415i Configuration Suite PC Software Manual.*

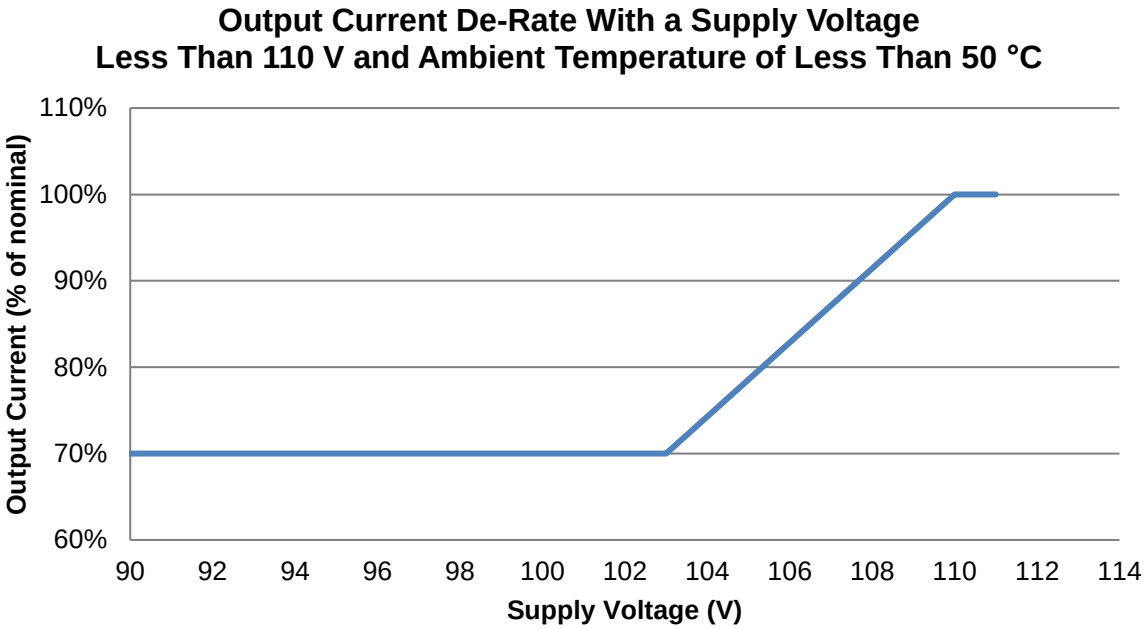
NOTE: The battery charger's maximum output current de-rates due to excessive temperature and low supply voltage to prevent damage to itself and the battery/connected equipment. For further information see section 2.4.1 entitled *Output De-rate Curves*.

Parameter	Specification
Output Voltage Range	24 V to 29.5 V
Output Current Range	0 A to 5 A with Maximum Output Current De-rate 0 A to 15 A without Output Current De-rate
Configurable Current Limit Range	7.5 A to 15 A
Output Voltage Ripple and Noise	Less Than 1 % of Configured *Boost Voltage* at 15 A
Output Voltage Load Regulation	2 %
Output Voltage Line Regulation	Less Than 0.01 % of Requested Output Voltage
Output Voltage Overshoot %	Less Than 5 % of Requested Output Voltage
Transient Response Peak Deviation (at 50% to 100% load step)	Less Than 4 % of Requested Output Voltage
Warm Up Voltage	Less Than 1 % of Requested Output Voltage
Output Voltage Rise Time	Less Than 200 ms
Short Circuit Protection Type	Hiccup
Switching Frequency	60 kHz
Current Limit Accuracy	±10% of Configured *Current Limit*
Maximum Current Draw from Battery During Mains Failure	Less than 70 mA
Maximum Current Draw from Battery During Mains Failure with *Sleep Mode* Enabled	Less than 12 mA
Maximum Current Draw from Battery During Mains Failure with *Deep Sleep Mode* Enabled	Less than 7 mA

2.4.1 OUTPUT DE-RATE CURVES






Output Current De-Rate With a Supply Voltage
Less Than 110 V and Ambient Temperature of Less Than 50 °C
Output Current (% of nominal)
110%
100%
90%
80%
70%
60%
90
92
94
96
98
100
102
104
106
108
110
112
114
Supply Voltage (V)

2.5 INPUTS

2.5.1 DIGITAL INPUT

Parameter	Specification
Number	1 configurable digital input
Arrangement	Contact between LK1 terminals
Low Level Threshold	2.1 V minimum
High Level Threshold	6.6 V maximum
Contact Wetting Current	7 mA typical
Open Circuit Voltage	10.2 V typical

2.5.2 TEMPERATURE SENSOR

Parameter	Specification
Temperature Sensor Input	PT1000

2.6 CHARGE FAIL OUTPUT RELAY

Parameter	Specification
Type	Volt-free changeover contacts used to switch an auxiliary circuit to indicate charger output failure.
Rating	3 A resistive at 30 V DC

2.7 COMMUNICATION PORTS

NOTE: All communication ports are usable at the same time.

Parameter	Specification
USB B Port	Type B USB 2.0 For connection to PC running DSE Configuration Suite Max distance 5 m (16 feet)
Communication Port (Configurable for RS485 or DSENet communications)	Isolated Data connection 2 wire + common Half Duplex Data direction control for Transmit (by s/w protocol) Max Baud Rate 115.2 kbaud subject to configuration External termination required (120 Ω) Max common mode offset 70 V (on board protection transorb) Max distance 1.2 km (¾ mile)

2.8 COMMUNICATION PORT USAGE

2.8.1 USB B PORT (PC CONFIGURATION)

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

NOTE: The battery must be connected to the battery charger for configuration by PC.

NOTE: For further details of module configuration, refer to DSE Publication: 057-353 *DSE BC2415i Configuration Suite PC Software Manual.*

The USB port is provided to give a simple means of connection between a PC and the battery charger. Using the DSE Configuration Suite Software, the operator is then able to configure and monitor the state of the battery charger.

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

- DSE Intelligent Battery Charger.

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

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

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

2.8.2 COMMUNICATION PORT

NOTE: The RS485 communications port is configurable for RS485 or DSENet use. For further details of module configuration, refer to DSE Publication: 057-353 *DSE BC2415i Configuration Suite PC Software Manual.*

2.8.2.1 CABLE SPECIFICATION

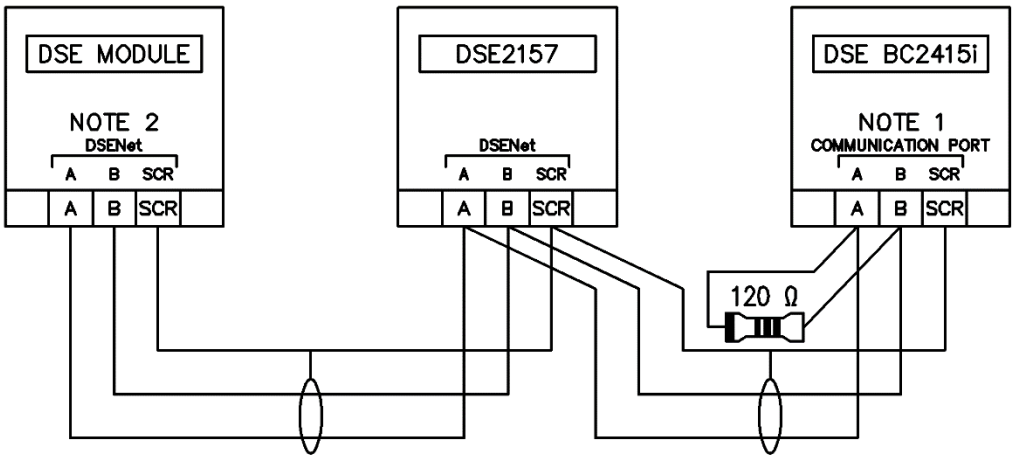
NOTE: DSE recommend Belden 9841 (or equivalent) cable for RS485 communication. This is rated to a maximum cable length of 1.2 km. DSE Stock Belden 9841 cable, DSE Part Number: 016-030.

Description	Specification
Cable Type	Two core screened and shielded twisted pair
Cable Characteristics	120 Ω impedance Low capacitance
Recommended Cable	Belden 9841 Belden 9271
Maximum Cable Length	1.2 km (¾ mile) when using Belden 9841 or direct equivalent. 600 m (656 yards) when using Belden 9271 or direct equivalent.
Topology	"Daisy Chain" Bus with no stubs (spurs)
RS485 Termination	120 Ω. Not fitted internally to module. Must be fitted externally to the 'first' and 'last' device on the link.

2.8.2.2 CONFIGURED AS A DSENET PORT

When configured for DSENet, the *Communication Port* must not be connected to any device other than DSE equipment designed for connection to the DSENet®

DSENet® is the interconnection cable between the host controller and the expansion module. It enables the host controller to display information, instrumentation, and alarms from the battery charger on its own display.



NOTE 1.
IF THE MODULE IS FIRST OR LAST UNIT ON THE LINK IT MUST BE FITTED WITH AN EXTERNAL 120 OHM TERMINATION RESISTOR ACROSS TERMINALS A AND B TERMINALS.

NOTE 2.
MUST BE FITTED AS FIRST OR LAST UNIT ON THE LINK WITH NO EXTERNAL TERMINATION RESISTOR

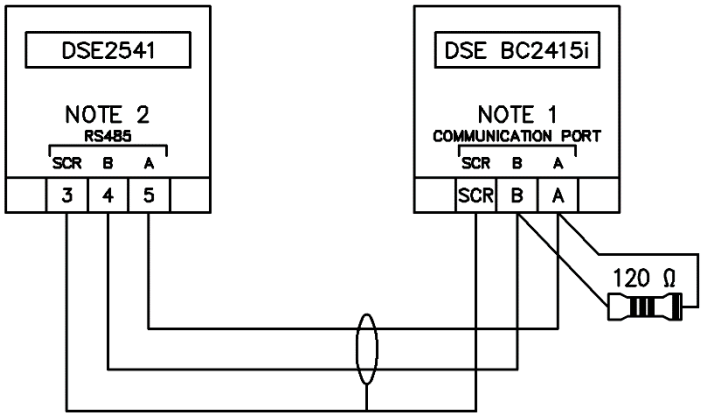
2.8.2.3 CONFIGURED AS AN RS485 PORT

When configured for RS485, the *Communication Port* must not be connected to a communication link designed for connection to the DSENet®

The RS485 port on the controller supports the MODBUS RTU protocol and is for connection to a single MODBUS client device only or a single DSE2541 remote display.

2.8.2.3.1 REMOTE DISPLAY

Connecting the DSE2541 display to the battery chargers RS485 port provides remote monitoring and control, in addition to the battery chargers inbuilt display. The DSE2541 provides the same level of monitoring and control as the battery chargers inbuilt display and supports of variants of the battery charger.



NOTE 1.
A 120 OHM TERMINATION RESISTOR MUST BE FITTED EXTERNALLY

NOTE 2.
A 120 OHM TERMINATION RESISTOR IS FITTED INTERNALLY

2.8.2.3.2 MODBUS SERVER

NOTE: For a single module to PC connection and distances up to 5 m (16 feet) the USB connection method is more suitable and provides for a lower cost alternative to RS485 (which is more suited to longer distance connections).

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

RS485 is used for point-to-point cable connection of more than one device (maximum 32 devices) and allows for connection to PCs, PLCs, and Building Management Systems.

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

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

Recommended PC RS485 Serial Port Add-ons

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

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

Remember to check these parts are suitable for your PC. Consult your PC supplier for further advice.

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

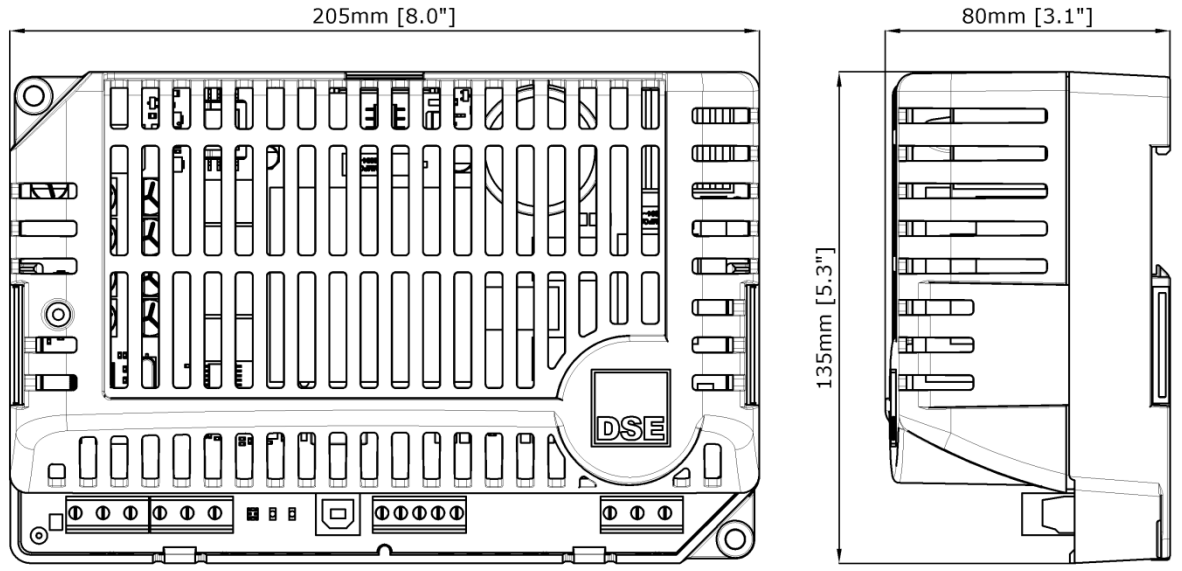
- Brainboxes UC320 PCI Velocity RS485 card (for desktop PCs)
  Set to ‘Half Duplex, Autogating” with ‘CTS True’ set to ‘enabled’

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

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

2.9 DIMENSIONS AND MOUNTING

Parameter	Specification
Overall Size	205 mm x 135 mm x 80 mm (8.0” x 5.3” x 3.1”)
Perimeter Distance From Charger for Ventilation	100 mm (3.9”)
Weight	0.78 kg (1.7 lb 27.5 oz)
Din rail type	EN 50022 35 mm type only
Mounting Type	Base mounted to a vertical surface with connection terminals to the bottom.
Mounting holes	Suitable for M4
Mounting hole centres	190 mm x 120 mm (7.5” x 4.7”)
Charge Failure Relay Rating	30 V at 3 A DC
Operating Temperature	-30 °C to +50 °C (-22 °F to +122 °F)
Operating Temperature (With De-rate To Output)	-30 °C to +70 °C (-22 °F to +158 °F)



2.10 APPLICABLE STANDARDS

Standard	Description
BS EN 60068-2-1 (Minimum temperature)	-30°C (-22 °F)
BS EN 60068-2-2 (Maximum temperature)	+80°C (176 °F)
BS EN 60950 **BS EN 60335-1** **BS EN 60335-2-29:2004+A2:2010**	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)	IP20 Protected against penetration by solid objects with a diameter of more than 12 mm. Fingers or similar objects prevented from approach. No protection against water
UL508 **NEMA Rating**	Enclosure type 1 Provides a degree of protection against contact with the enclosure equipment and against a limited amount of falling dirt
UK WEEE Regulations	Producer Registration Number WEE/BE0052TQ

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

2.10.1 ENCLOSURE CLASSIFICATIONS

2.10.1.1 IP CLASSIFICATIONS

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

IP20 Highlighted fields give a description of the of the protection level

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).

2.10.1.2 NEMA CLASSIFICATIONS

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

NEMA1 Highlighted fields give a description of the of the protection level

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

NOTE: Ensure any standing loads (loads connected to the battery charger other than the battery) are less 75% of the battery charger configured rating. This helps to ensure the charger correctly detects the required battery charge state.

The DSE battery charger is *fit-and-forget.* It can be permanently connected to the supply and the load, with no requirement to disable the charger during times of heavy load (such as engine cranking).

3.1 BATTERY SUITABLILITY

NOTE: For further details of module configuration, refer to DSE Publication: 057-353 *DSE BC2415i Configuration Suite PC Software Manual.*

The battery charger is factory configured for a *Three Stage* charging profile for Wet (Vented) Lead Acid batteries. It is possible to reconfigure the battery charger to suit other battery chemistry types using the DSE Configuration Suite PC Software. Care must be taken to ensure the batteries connected to the charger and selected profile are of the correct type.

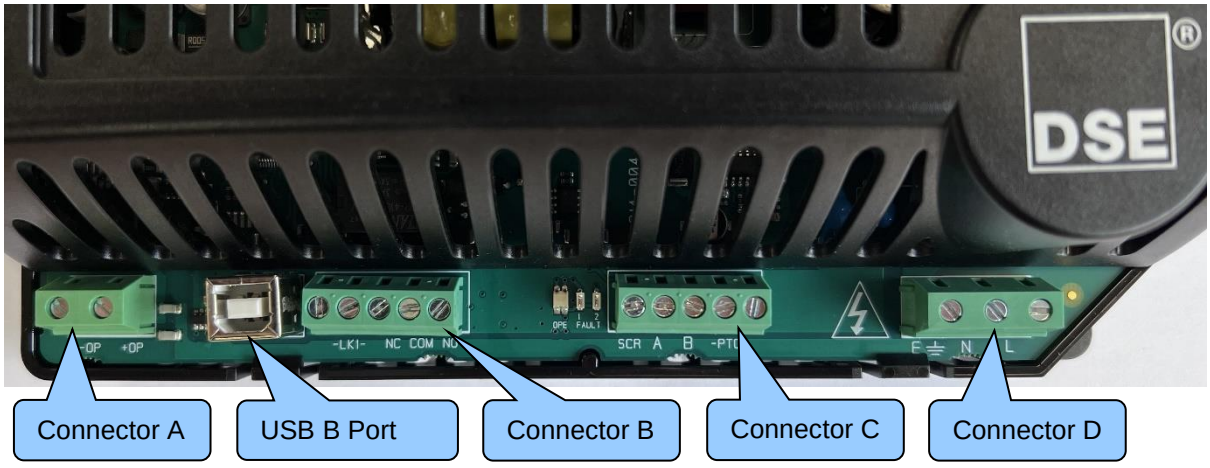
3.2 USER CONNECTIONS

3.2.1 CONNECTION

DANGER OF DEATH: LIVE PARTS exist within the enclosure. The enclosure cover must not be removed when connected to a live AC supply.

Parameter	Comment	
Connection type	Screw terminal, rising clamp, no internal spring	
Min cable size	0.5 mm² (AWG 20)	
Max cable size	2.5 mm² (AWG 10)	
Recommended AC fuse BC2415i 24 V 15 A Charger	**230 V AC Input** 3.5 A anti-surge	**110 V AC Input** 6.3 A anti-surge

3.2.2 CONNECTION DESCRIPTIONS



3.2.2.1 CONNECTOR A

NOTE: The battery charger must be connected directly to the battery.

Terminal	Function	Recommended Size	Comments
-OP	Charge Output	1 mm² (AWG 16)	Connected directly to the battery negative terminal
+OP	Charge Output	1 mm² (AWG 16)	Connected directly to the battery positive terminal

3.2.2.2 CONNECTOR B

Terminal	Function	Recommended Size	Comments
LK1	Link together to activate Digital Input	0.5mm² (AWG20)	Input Function Configured using DSE Configuration Suite PC Software
LK1		0.5mm² (AWG20)	
N/C	Fault relay Normally Closed terminal	0.5 mm² (AWG 22)	De-energises under Fault Conditions
Common	Fault relay Common Terminal	0.5 mm² (AWG 22)	
N/O	Fault relay Normally Open terminal	0.5 mm² (AWG 22)	

3.2.2.3 CONNECTOR C

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

Terminal	Function	Recommended Size	Comments
SCR	Communication screen	Shield	Use only 120Ω RS485 approved cable
B	Communication B (+)	0.5mm² (AWG20)	
A	Communication A (-)	0.5mm² (AWG20)	
PTC	2 wire PT1000 temperature sensor	0.5mm² (AWG20)	Use only a 2 wire PT1000 temperature sensor.
		0.5mm² (AWG20)	

3.2.2.4 CONNECTOR D

Parameter	Specification	
Recommended AC Fuse	**230 V_{AC} Input** 3.5 A anti-surge	**110 V_{AC} Input** 6.3 A anti-surge

Terminal	Function	Recommended Size
L	AC Live	1mm² (AWG 16)
N	AC Neutral	1mm² (AWG 16)
⏚	Earth	1mm² (AWG 16)

3.2.2.5 USB B (PC CONFIGURATION) CONNECTOR

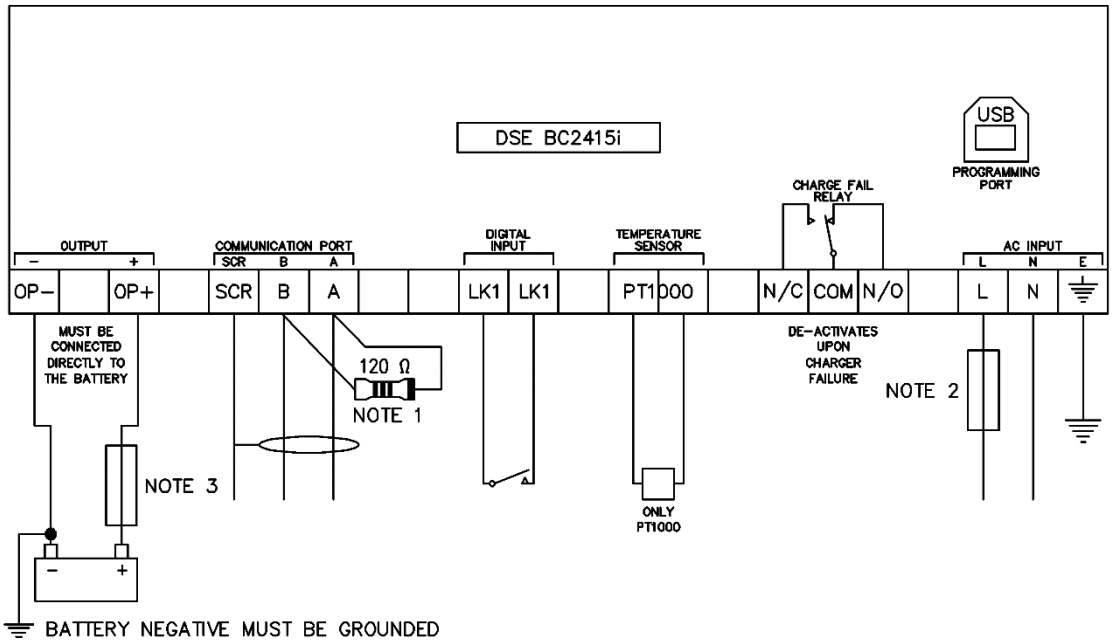
NOTE: The USB connection cable between the PC and the module must not be extended beyond 5 m (16 feet). For distances over 5 m, it is possible to use a third-party USB extender. Typically, they extend USB up to 50 m. The supply and support of this type of equipment is outside the scope of Deep Sea Electronics 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: 057-353 *DSE BC2415i Configuration Suite PC Software Manual.*

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

3.3 TYPICAL WIRING DIAGRAM



BATTERY NEGATIVE MUST BE GROUNDED

NOTE 1
A 120 OHM TERMINATION RESISTOR MUST BE FITTED IF IT IS THE FIRST OR LAST DEVICE ON THE COMMUNICATIONS LINK

NOTE 2
FUSE APPROPRIATELY WHEN BASED ON CONFIGURED CHARGE CURRENT LIMIT AND AS CLOSE TO THE BATTER CHARGER AS POSSIBLE TO PROTECT THE CABLES

NOTE 3
FUSE APPROPRIATELY AND AS CLOSE TO THE BATTERY AS POSSIBLE TO PROTECT THE CABLES AND BATTERY

3.3.1 EARTH SYSTEMS

3.3.1.1 NEGATIVE EARTH

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

3.3.1.2 POSITIVE EARTH

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

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

3.3.1.3 FLOATING EARTH

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

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

4 INDICATIONS

4.1 STATUS

NOTE: When a fault is active, the LEDs indicate the fault and not the status.

Condition	OPE	FAULT1	FAULT1
Charger Off	Off	Off	Off
Bulk Charge in Progress	Yellow Constant	Off	Off
Absorption Charge in Progress	Yellow Flashing	Off	Off
Float Charge in Progress	Green Constant	Off	Off
Storage Charge in Progress	Green Flashing	Off	Off
Battery Not Detected	Green Flashing	Red Flashing	Red Flashing
Battery Connected	Green Constant	Red Constant	Red Constant
Not Charging (Charger is operating correctly but not connect to battery)	Off	Red Constant	Red Constant

4.2 FAULT CONDITIONS

NOTE: When a fault is active, the LEDs indicate the fault and not the status.

4.2.1 FAULT CONDITIONS WHILE CHARGING

Condition	OPE	FAULT1	FAULT2
High Output Voltage (DC)	Off	Red Constant	Off
Mains Under Voltage Shutdown (AC input < 85 V) Mains Over Voltage Shutdown (AC input > 305 V)	Off	Red Flashing	Off
Mains Under Voltage Warning	Green Constant	Red Slow Flash	Off
Mains Over Voltage Warning	Green Constant	Red Flashing	Off
High Ambient / Charger Temperature Warning or High Battery Temperature Warning	Green Constant	Off	Red Constant
High Ambient / Charger Temperature Shutdown or High Battery Temperature Shutdown	Off	Off	Red Constant
Short Circuit / Reverse Polarity	Green Constant	Off	Red Flashing
Battery Under / Over Voltage Warning	Green Constant	Red Flashing	No Change
DC Output Short Circuit	Off	Red Flashing	Red Flashing
DC Output Overcurrent	Off	Red Flashing	Red Constant
Digital Input DC Output Off (Stop Charging)	Off	Red Constant	Red Constant
Charger Self-Test Failure	Green Constant	Red Constant	No Change
Charger Failure	Off	Off	Red Flashing

5 OPERATION

The battery charger is multifunctional and can be utilized both as a battery charger and a DC Power Supply Unit (PSU). It offers the flexibility to power the control panel while simultaneously charging either the control panel's batteries or the engine starter batteries.

When a suitable AC supply is connected and no fault is detected, the operation of the battery charger depends upon its configuration, and the load/batteries connected to its output terminals.

5.1 CHARGE FAIL RELAY

When the battery charger detects an issue that prevents it from charging the battery, the Charge Fail Relay is de-energised. This relay, which is free of voltage, can be utilized to indicate that the battery charger is no longer charging the battery due to a failure in the AC power supply or a general alarm notifying a shutdown of the battery charger.
For further details about the available protection within the battery charger and how it operates, refer to section 6 entitled *Protections*.

5.2 DIGITAL INPUT

NOTE: For further details of module configuration, refer to DSE Publication: 057-353 *DSEBC2415i Configuration Suite PC Software Manual.*

The Battery Charger is fitted with a configurable digital input. Configuration is made using the DSE Configuration Suite PC Software.

The default settings for the digital input provides a *Lamp Test* function.

5.3 CHARGING MODE

NOTE: Ensure any standing load (loads connected to the battery charger other than the battery) are less than 75 % of the battery charger's configured current limit. This helps to ensure the charger correctly detects the battery's charge state.

Constant Voltage & Current Limit

The battery charger operates in *Constant Voltage* and *Current Limited* mode.
The charger output voltage is maintained at a voltage level that varies depending on the battery charge state. This is done to allow the battery to charge while the load does not exceed the maximum rating of the charger.

If the load on the battery charger (charging current + standing load) exceeds the configured current limit, the charging current is limited to configured limit and the voltage is reduced if required.
The voltage rises to the required voltage level again once the total load drops below the configured current limit of the battery charger.

Charging Time

Charge time is often of little consequence when the battery is used in a *standby* operation. An example of this is when the battery is used to supply the starting system of a diesel generator. During normal operation, the battery is at full capacity and the battery charger is used to maintain the *Float Voltage* of the battery. The battery is only drained when the generator is called to start. As the generator has a DC charging alternator fitted, the battery is quickly recharged when the generator is running. Should the generator stop before the battery is fully recharged, the battery charger continues to recharge the battery until it is fully charged.

Typically, a battery charges from 0 % capacity to 80 % capacity in roughly 16 hours when charged at C/10. For example, charging a 50 Ah battery for 16 hours at 5 A (50 Ah / 10) charges the battery to 80 % of its full capacity.
Remember to consider any other standing load such as control panel requirements when calculating how much power is 'left' to charge the battery.

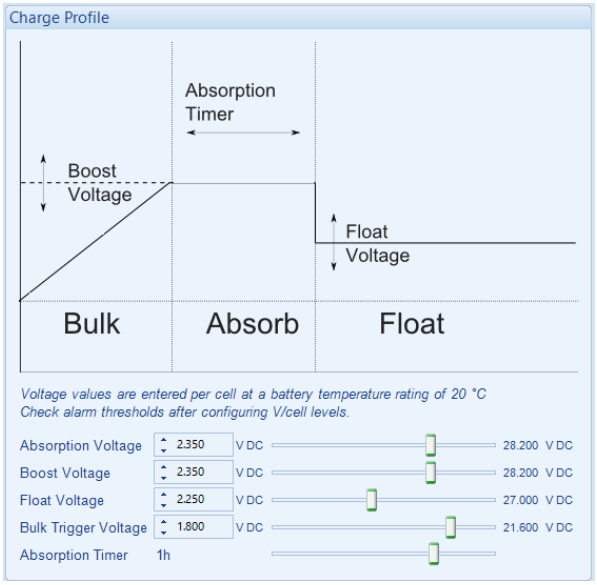
Once the battery is fully charged, the battery charger switches to an economy power mode to reduce power consumption.

5.3.1 CHARGING PROFILE

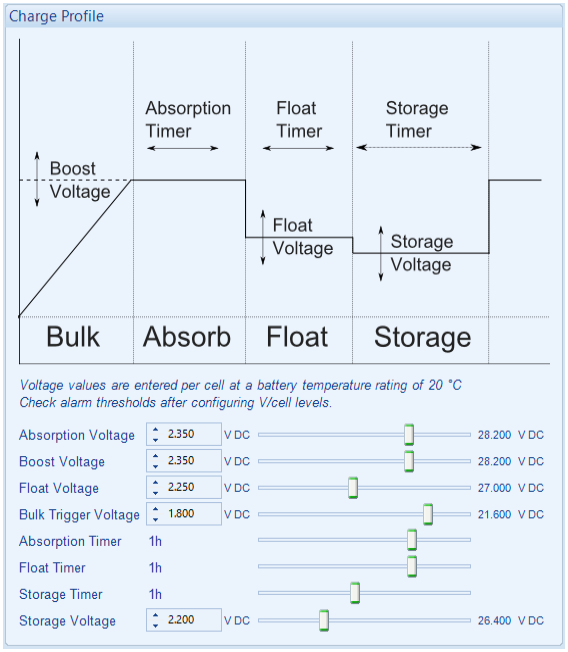
NOTE: The battery charger is programable to suit three or four stage charging profiles. For further details of module configuration, refer to DSE Publication: 057-353 *BC2415i Configuration Suite PC Software Manual.*

NOTE: If a two stage charging profile is required, select a three stage profile, and configure *Boost Voltage* and *Float Voltage* to the same value.

The battery charging is configured to perform a three or four stage charging profile, selection between a three and four stage charging profile is based on battery type and application. A three stage charging profile contains a *Bulk, Absorption* and *Float* stage whereas a four stage charging profile contains a *Bulk, Absorption, Float* and *Storage* stage. At each charging stage the output voltage the battery charger produces as shown in the example four stage charging profile.



3-Stage Charge Profile Configuration



4-Stage Charge Profile Configuration

<u>Bulk (Boost) Stage</u>

The battery charger enters this mode at the beginning of the charge cycle or when the battery voltage drops below the configured *Bulk Trigger Voltage* level, indicating a discharged battery.

In this mode the battery charger operates in a *Boost Mode* and the load output rises to the configured *Boost Voltage*. If the load on the battery charger (charging current + standing load) exceeds the configured current limit, the charging current is limited to configured limit and the load output is reduced if required. The load output rises to the *Boost Voltage* level again once the total load drops below the configured current limit of the battery charger.

Absorption Stage

The battery charger enters this mode once the charger's output current falls below the configured *Bulk to Adoption Trigger Level.*

In this mode the battery charger load output falls to the configured *Absorption Voltage* and is maintained there for the duration of the *Absorption Timer.* During this time, the charge current continues to decrease.

Float Stage

The battery charger enters this mode once the *Absorption Timer* has expired.

In this mode the battery charger load output falls to the configured *Float Voltage* to prevent damage to the battery due to excessive gassing. Float Charge is used to provide a small amount of current to the battery to overcome internal losses and keep the battery at its 100% charged state.

Storage Stage

NOTE: *Storage Stage* is not applicable to three stage charging profiles.

The battery charger enters this mode once the *Float Timer* has expired.

In this mode the battery charger output voltage falls to the configured *Storage Voltage* to minimise gassing and corrosion of the positive plates. Once a week, the battery charger output voltage is raised back to the *Absorption Voltage* for the *Absorption Timer* to equalize the battery cells. This feature prevents stratification of the electrolyte and sulphation, which is a major cause of early battery failure.

5.3.2 MANUAL BOOST OPERATION

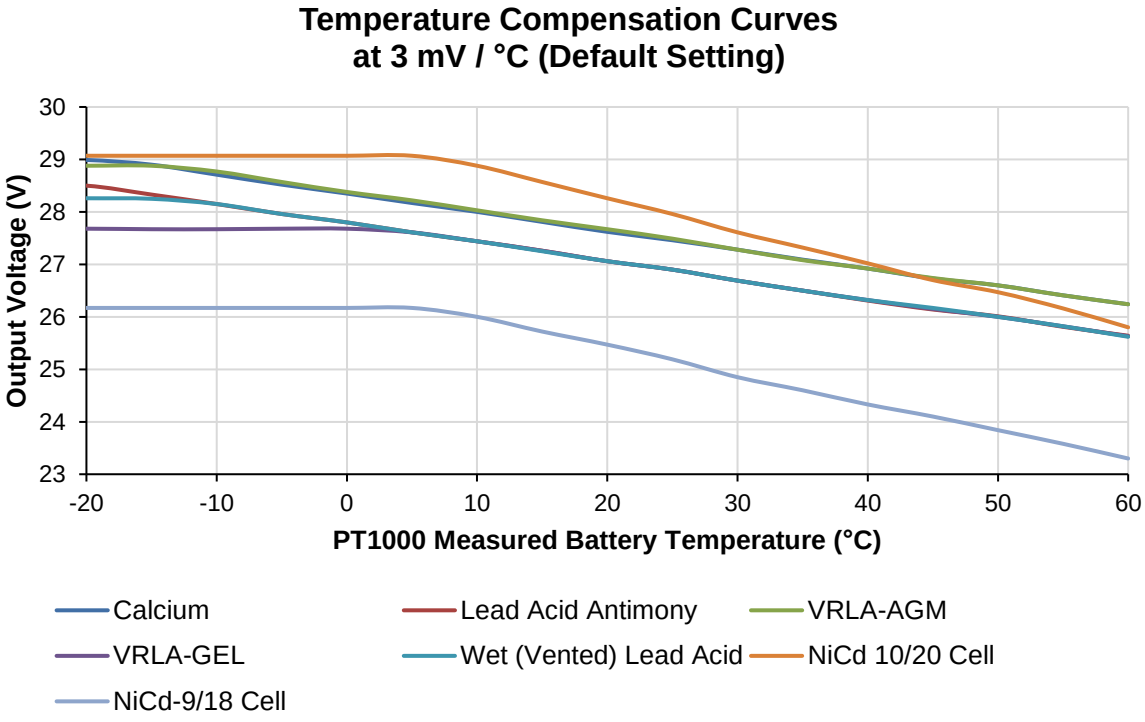
Boost mode is activated manually using the battery charger's display, activating the battery charger's digital input when it is configured for *Manual Boost* or by MODBUS command. The battery charger's output voltage rises to the configured *Boost Voltage* until the output current falls below the configured *Bulk to Adoption Trigger Level.*

The battery charger enters *Boost Mode* again when the battery voltage drops below the configured *Bulk Trigger Voltage* level.

5.3.3 TEMPERATURE COMPENSATION

A temperature compensation function is available when the battery charger is operating in its *Float Stage*. The function is enabled in the battery charger's configuration and requires a 2 wire PT1000 temperature sensor to be connected to the battery and charger.

The temperature compensation causes the battery charger's output voltage to automatically vary by a configured mV per cell per 1°C deviation from 20°C, within the range of -20°C to 60°C. Increasing battery temperature decreases the battery charger's output voltage and vice versa.



6 PROTECTIONS

Alarms fall into two categories:

- Shutdown Alarms, non-adjustable alarms.
- User Configurable (Warning) Alarms, adjustable by DSE Configuration Suite PC Software.

6.1 SHUTDOWN ALARMS

NOTE: The Shutdown alarm are factory set and cannot be changed.

NOTE: When the AC supply source falls outside the hardware voltage limits, the DSE charger is instantly switched off for safety reasons, and the alarm is activated (Fault Relay De-energises).

Shutdown Alarms are critical fault conditions that disable the battery charger's output and de-activate the *Charge Failure Relay*. Majority of the Shutdown Alarms are self-resetting when the fault condition is removed or rectified.

Alarm	Description
Battery Over Voltage	The battery charger has detected that the battery voltage has risen above 32 V and has exceeded the operating specification. This alarm must be manually reset by disconnecting the battery charger. If the problem persists the battery charger must be replaced or repaired.
Charger Over Current	The battery charger has detected that the output current has risen above 115 % of the configured current limit. This alarm must be manually reset by disconnecting the battery charger. If the problem persists the battery charger must be replaced or repaired.
Mains Over Voltage	The battery charger has detected that the AC Supply voltage has risen above 310 V and has exceeded the operating specification. The alarm automatically clears once the AC Supply voltage has fallen below 305 V.
Mains Under Voltage	The battery charger has detected that the AC Supply voltage has fallen below 90 V and has exceeded the operating specification. The alarm automatically clears once the AC Supply voltage has risen above 95 V.
Charger Over Temperature	The battery charger has detected that the ambient temperature has risen above 81 °C and has exceeded the operating specification. The alarm automatically clears once the ambient temperature falls below 50 °C.
Short Circuit or Reverse Polarity	The battery charger has detected that a battery was connected with a reverse polarity, or a short circuit has occurred to its output voltage terminals for longer than the configured *Delay* time. The alarm automatically clears once the reverse polarity or short circuit fault has been rectified.
Battery Detection Test Failed	The battery charger has failed to detect that a battery was connected to its output voltage terminals. The alarm automatically clears when the battery voltage rises above the *Battery Detection Threshold* value at the next scheduled *Battery Detection Test.*
Battery Charger Failure	The battery charger has detected an internal failure. This alarm does not automatically reset, and the battery charger must be replaced or repaired.

6.2 WARNING ALARMS

NOTE: For details of Battery Charger Configuration, you are referred to DSE Publication: 057-353 DSE BC2415i PC Software Configuration Manual.

NOTE: When a *Shutdown Alarm* is active at the same time as a *Warning Alarm,* the *Shutdown Alarm* takes priority and switches the charger off.

Warning Alarms are pre-critical fault conditions and when active cause the battery charger's output voltage to fall to the configured *Float Voltage* level. The *Charge Failure Relay* de-activates based on Warning Alarms. All Warning Alarms are self-resetting when the fault condition is removed or rectified.

The following alarms are user configurable using DSE Configuration Suite PC Software. In each case, the Fault relay de-energises.

Alarm	Description
Battery Over Voltage	The battery charger has detected that the battery voltage has risen above the configured *Over Voltage Alarm* level for longer than the *Alarm Delay*. The alarm automatically clears once the battery voltage has fallen below the configured *Over Voltage Return* level for longer than the *Return Delay*.
Battery Under Voltage	The battery charger has detected that the battery voltage has fallen below the configured *Under Voltage Alarm* level for longer than the *Alarm Delay*. The alarm automatically clears once the battery voltage has risen above the configured *Under Voltage Return* level for longer than the *Return Delay*.
Charger Over Current	The battery charger has detected that its output current has risen above the configured *Over Current Alarm* level for longer than the *Alarm Delay*. The alarm automatically clears once the output current has fallen below the configured *Over Current Return* level for longer than the *Return Delay*.
Mains Over Voltage	The battery charger has detected that the AC Supply has risen above the configured *Mains Over Voltage Alarm* level for longer than the *Alarm Delay*. The alarm automatically clears once the AC Supply has fallen below the configured *Mains Over Voltage Return* level for longer than the *Return Delay*.
Mains Under Voltage	The battery charger has detected that the AC Supply has fallen below the configured *Mains Under Voltage Alarm* level for longer than the *Alarm Delay*. The alarm automatically clears once the AC Supply has risen above the configured *Mains Under Voltage Return* level for longer than the *Return Delay*.
Battery Over Temperature	The battery charger has detected that the battery temperature has risen above the configured *Battery Temperature Warning Alarm* level for longer than the *Alarm Delay*. The alarm automatically clears once the battery temperature has fallen below the configured *Battery Temperature Warning Return* level for longer than the *Return Delay*.
PTC Failure	The battery charger has detected that the PT1000 temperature sensor has failed (open/short circuit or above/below measurable range). The alarm automatically clears once a valid battery temperature is detected.

7 MODBUS

The DSE Battery Charger supports the MODBUS RTU protocol over half-duplex RS485 communications.

RS485 Parameter	Setting
Start Bits	1
Data Bits	8
Parity	None
Stop Bits	2
Baud Rate	Configurable using DSE Configuration Suite PC Software *(4800, 9600, 19200, 28800, 38400, 57600, 115200)* ***Factory Setting:*** 38400
MODBUS Server ID	Configurable using DSE Configuration Suite PC Software *(1 to 247)* ***Factory Setting:*** 10

7.1 READING VALUES

Values must be read using MODBUS *Function Code 3 – Read Multiple Registers*.

Using the DSE Configuration Suite PC Software, MODBUS registers are defined by the system designer in MOBUS Page 166.

An example of customer configuration is shown below, the screen image is taken from the DSE Configuration Suite PC Software.

MODBUS Parameter	Value
MODBUS Register Start	**NOTE: Some Legacy MODBUS Client devices may require a suffix of 40,000 to the address, making the base address 82496.** **NOTE: Some MODBUS Client devices may require '1' to be added to the address.** Address Page 166 Absolute Hexadecimal Address A600 Absolute Decimal Address 42496 (166 x 256).
MODBUS Register Size / Sign	32 bit, signed
MODBUS Register Type	Holding Registers (MODBUS function code 3 supported)

7.2 WRITING VALUES

Writing values to the battery charger is used to perform functions below.
Two values must be written using the same write function.

Using MODBUS *Function Code 16 – Write Multiple Registers*, write the required Control Key and One's Compliment of the Control key to the specified registers:

7.2.1 TOGGLE BOOST MODE

Writing this control key enables or disables boost mode. When in boost mode, the battery is charged at the configured *boost voltage*.

Single MODBUS Write using MODBUS *Function Code 16 – Write Multiple Registers*

Address	Control Key	One's Compliment of Control Key
Decimal Address 4104 & 4105 (Hexadecimal 1008 & 1009)	35772	27963

7.2.2 TOGGLE CHARGER ON/OFF

Writing this control key enables or disables the charger's DC output.

Single MODBUS Write using MODBUS *Function Code 16 – Write Multiple Registers*.

Address	Control Key	One's Compliment of Control Key
Decimal Address 4104 & 4105 (Hexadecimal 1008 & 1009)	35773	29762

8 FAULT DIAGNOSIS

Problem	Suggestion
The charger is not operating	Check that the incoming AC supply is correctly connected and within limits and check the integrity of any external fuse that may be fitted. Ensure the charger is not being operated above the maximum temperature specification.
Charge fail relay continuously operated	Check the connected load of the charger is not reverse connected or short circuit.
Batteries fail to charge	Check the batteries using the battery manufacturers recommendations.
Charge time is too long	Typically, a battery will charge from flat to 80% capacity in 16 hours when charged at C/10. For example, charging a 50 Ah battery for 16 hours at 5 A charges the battery to 80% of its full capacity. Remember to consider any other standing load such as control panel requirements when calculating how much power is ‘left’ to charge the battery.

9 EFFICIENCY CALCULATIONS

The power dissipation, power consumption and power factor of a device are often required during the design process of an application. These values are calculated using the following equations and values listed in the section 2 entitled *Specification* .

9.1 MAXIMUM POWER DISSIPATION

$$P_{DC} = V_{DC} \times I_{DC}$$

$$P_{Loss} = P_{DC} \times \left({}^{100 - \eta}/_{100}\right)$$

Where:

V_{DC} = Maximum configured DC voltage in battery profile
I_{DC} = Configured DC current limit
P_{DC} = Calculated maximum DC power generation
η = Battery charger efficiency at supply AC voltage (V_{AC})
P_{Loss} = Calculated Dissipated Power

9.2 MAXIMUM POWER CONSUMPTION

$$P_{DC} = V_{DC} \times I_{DC}$$

$$P_{AC} = P_{DC} \times \left({}^{100}/_{\eta}\right)$$

Where:

V_{DC} = Maximum configured DC voltage in battery profile
I_{DC} = Configured DC current limit
P_{DC} = Calculated maximum DC power generation
η = Battery charger efficiency at supply AC voltage (V_{AC})
P_{AC} = Calculated AC power consumption

9.3 POWER FACTOR AT MAXIMUM POWER

$$S_{AC} = V_{AC} \times I_{AC}$$

$$pf = {}^{P_{AC}}/_{S_{AC}}$$

Where:

V_{AC} = Supply AC voltage
I_{AC} = Maximum battery charger current draw at maximum load
S_{AC} = Calculated apparent power
P_{AC} = Calculated AC power consumption
pf = Calculated power factor at full load

10 MAINTENANCE, SPARES, REPAIR AND SERVICING

The DSE battery chargers are designed to be *Fit and Forget*. As such, there are no user serviceable parts. In the case of malfunction, contact the Original Equipment Supplier (OEM).

11 WARRANTY

DSE provides limited warranty to the equipment purchaser at the point of sale. For full details of any applicable warranty, you are referred to your original equipment supplier (OEM).

12 DISPOSAL

12.1 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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