INTRINSICALLY SAFE UNINTERRUPTIBLE POWER SUPPLY (ISUPS 2) 300Wh

User Manual

WARNING!

The **warning** symbol highlights a potential risk of **injury or death**.

Please share these warnings with other operators.

CAUTION!

The **caution** symbol highlights a potential risk of **damage to equipment**.

Please share these cautions with other operators.

NOTE

The **note** symbol highlights **key information**.

Please share these notes with other operators.

ENVIRO

The **enviro** (environmental) symbol highlights areas which may have an impact on the surrounding **fauna and/or flora**.

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Before You Begin

We would like to take a moment to thank you for purchasing the Ampcontrol ISUPS.

WARNING!

In the interests of **safety and correct equipment operation**, please take the time to read and understand the content in this manual.

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Applicable Software Version

This user manual is applicable to ISUPS V2 units with software version 5.8.

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1 SAFETY AND OTHER WARNINGS

For safety reasons, the ISUPS must be installed, operated and serviced only by competent personnel. Please read and understand this instruction manual completely before installing, operating or servicing this equipment. Failure to install or operate this instrument in accordance with the instructions contained in this manual may create hazardous operating conditions.

1.1 Safe Use of Equipment

The equipment supplied has been designed and manufactured to ensure safe operation. The equipment must only be used within the design parameters.

The instructions within this manual must be observed as an aid towards achieving the safest possible installation.

Persons responsible for installation, maintenance, or operation, must observe the following instructions:

1.1.1 Changes to Equipment

Changes in the design and modifications to the equipment are not permitted. Unauthorised changes made to the hardware or operating firmware will void the manufacturer's warranty and may compromise the integrity of the system into which it is installed and other connected equipment.

1.1.2 Equipment Knowledge

Experience with, or understanding of, this equipment is essential for the safe installation and removal of the equipment. Therefore, please read and understand this manual prior to use. Competency based training courses are recommended and are available on request.

1.1.3 Manual Handling

Precautions have been taken to ensure all equipment is safe to handle and free from sharp edges. However, care should always be taken when handling enclosures and gloves should be worn.

1.1.4 Installation

Correct operation and safety depend on the ISUPS, and associated equipment being installed correctly. Mechanical and or electrical installation and maintenance of plant and equipment must only be carried out by appropriately qualified personnel and must be tested thoroughly prior to operation.

2 RECEIVING AND STORAGE

2.1 Receiving

All possible precautions are taken to protect the equipment against damage or losses during shipment, however, before accepting delivery, check all items against the packing list or bill of loading. If there are shortages or evidence of physical damage, notify Ampcontrol immediately.

Notify Ampcontrol immediately in the case of any discrepancies to the packing list. Keep a record of any claims and correspondence. Photographs are recommended.

Where practicable do not remove protective covers prior to installation unless there are indications of damage. Boxes opened for inspection and inventory should be carefully repacked to ensure protection of the contents or else the parts should be packaged and stored in a safe place. Examine all packing boxes, wrappings and covers for items attached to them, retain and store any approval documentation for your safety file as applicable prior to wrapping being discarded.

2.2 Inspection

Equipment that is found to be damaged or has been modified away from its published specification must not be used. Please contact Ampcontrol if the equipment is suspected to be different than that ordered or if it does not match the published specifications.

2.3 Storage after Delivery

2.3.1 General Storage Requirements

When the equipment is not to be installed immediately, proper storage is important to ensure protection of equipment and validity of warranty.

All equipment should be stored indoors, in a cool dry environment, on raised shelves, and protected from the elements. Ensure that the storage area is not an area where water will collect.

2.3.2 ISUPS Battery Care

The storage period should be as short as possible. Temperature has an impact on the self-discharge rate hence it is important to store the batteries in a fully charged condition in a cool but frost-free room.

The batteries will be shipped fully charged. The battery is non-serviceable and non-user replaceable.

WARNING!

DO NOT ATTEMPT TO REMOVE THE BATTERIES FROM THE ENCLOSURE

The ISUPS has **no internal user-serviceable parts**. All repairs must be carried out by Ampcontrol personnel only. If a fault develops return the ISUPS to Ampcontrol for repair. It is essential that no attempt be made to repair the UPS as any attempt to dismantle or repair the UPS can seriously compromise the safety and correct operation of the unit**.**

The maximum storage time at ≤ 20 °C is 12 months. Higher temperatures cause higher self-discharge and shorter storage time between recharging operations.

If it is anticipated that the UPS will not be used for some time and will remain disconnected from the mains power supply. The battery should be recharged periodically, or the batteries could be permanently damaged.

We recommend re-charging or rotating the ISUPS every 3 months while in storage.

To recharge the battery in this situation, connect a lead with mains plug to the unit's AC input terminals. Supply should be 90 ~ 250 V AC. Turn the power on for the "Charging Time" as listed in Section 9, Specifications.

2.4 Unpacking of Equipment

The method of packing used will depend on the size and quantity of the equipment. The following cautions should be interpreted as appropriate.

CAUTION!

Take care when unpacking crates as the **contents may have shifted during transport.**

ENVIRO

The disposal of packaging materials, replaced parts, or components must comply with environmental restrictions without polluting the soil, air or water.

Ensure that any timber and cardboard used as **packaging is disposed of in a safe and environmentally responsible manner.**

Where possible, dispose of all waste products i.e. oils, metals, plastic and rubber products by using an approved recycling service centre.

3 PRODUCT OVERVIEW

The 300 Wh V2 Intrinsically Safe Uninterruptible Power Supply (ISUPS 2) by Ampcontrol is designed for Group I applications. The ISUPS converts 90 ~ 250 V AC mains power into intrinsically safe low voltage DC power with a built-in Battery Backup. A user accessible keypad, LCD screen, and indicator lamps allow interrogation and configuration of the ISUPS. The ISUPS also provides several other intrinsically safe monitoring and control connections.

3.1 Key Features

- LCD Display with Keypad input
- “Mains On”, “Output On” and “Output Overload” indicator LED’s
- “Stop LED” and “Reset LED”
- Local start/stop
- Remote start/stop
- Auto shutdown on low battery
- Battery state and capacity indicators
- Configurable alarms for:
    - Output overcurrent
    - Output undercurrent
    - Output undervoltage
    - Battery over temperature
- Three output relays with voltage free NO contacts. These can be configured for multiple alarm functions. Contacts are rated at 30 V / 3 A
    - Relay 1 is suitable for use with a separate intrinsically safe circuit i.e. the contact is isolated from the UPS intrinsically safe circuit
    - Relays 2 and 3 are suitable for use on the same intrinsically safe circuit (i.e. not isolated from each other) that may be separate to the IS circuits of the UPS or those utilised on Relay 1
- Two external isolated digital inputs (DI2, DI3) that may be used to activate functions as listed in Table 6. These can be powered from a common external intrinsically safe circuit or the ISUPS output
- A non-isolated digital input (DI1) that can be configured to activate functions as listed in Table 6 as well as remote shutdown
- Modbus RTU over RS485 serial communications port to monitor the device
- Discharge Test
- Event and periodic logs
- User configurable timer to shut-down the ISUPS, while operating from battery
- Enclosure of stainless-steel construction with options for mounting by its back or base
- Screw connection terminals located inside internal connection boxes on the top of the enclosure
- Multiple gland entries

3.2 Application

Typical use of this power supply is for gas detection systems, but it is also suitable for voice communication systems, cameras, serial to Ethernet converters, and other electronic equipment requiring intrinsically safe power in Group I applications. The Intrinsically Safe UPS can be used as a simple backup system for IS circuits in line with the output parameters and the factory default configuration or can be user configured with optional functions.

The user can configure various functions of the ISUPS, as well as the use of the external I/O which includes 3 digital inputs, 3 relay contacts and Modbus communications.

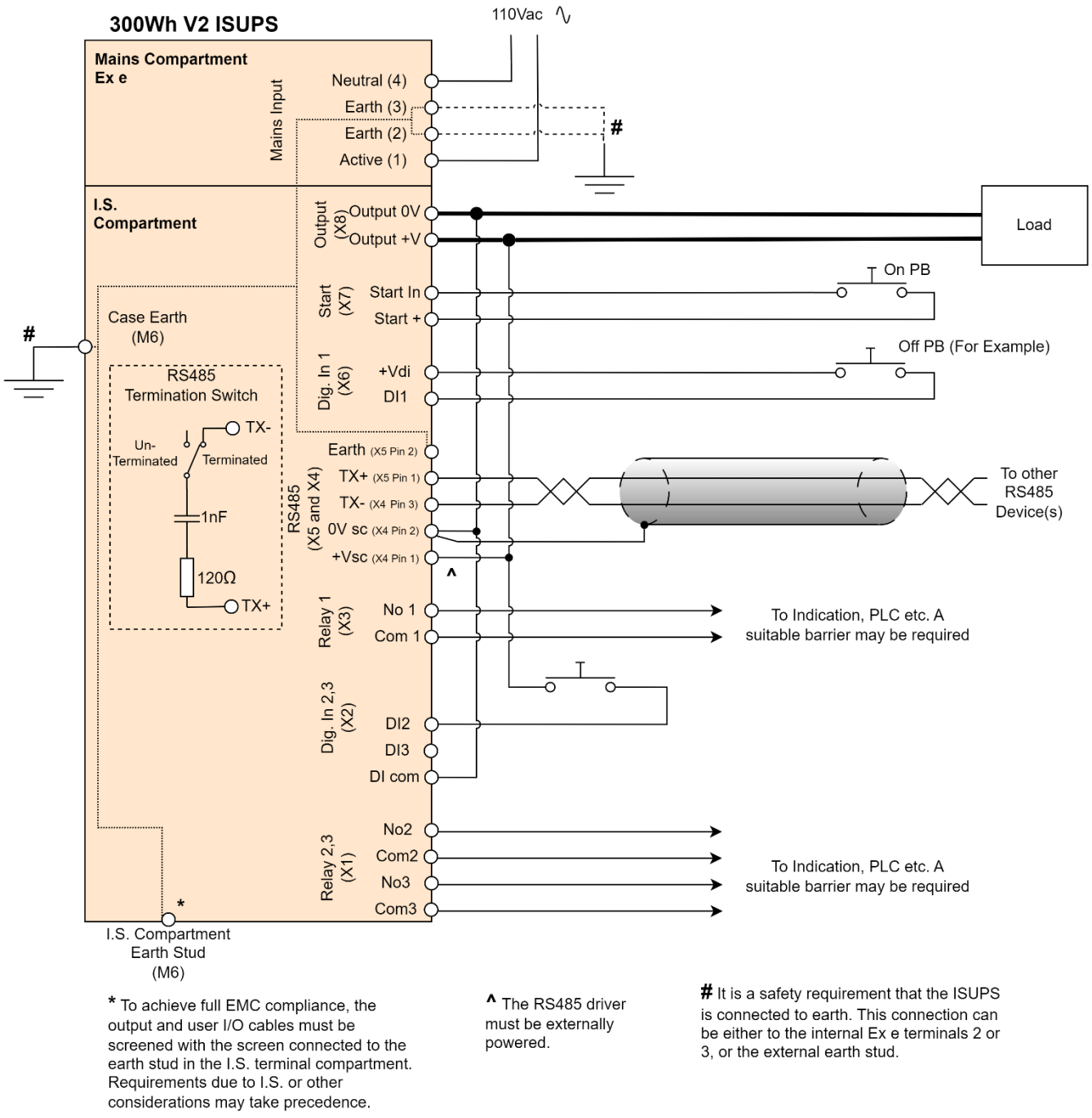

Figure 3.1: Application Example

This ISUPS must be installed in an upright position and may be mounted by its back or base using M6 screws. The enclosure is of a robust stainless-steel construction with screw connection terminals inside internal connection boxes on top of the enclosure. The ISUPS has two separate connection compartments to isolate the incoming AC power from the various Intrinsically Safe Circuits.

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The user can configure various functions of the ISUPS, as well as the use of the external I/O which includes 3 digital inputs, 3 relay contacts and Modbus communications.

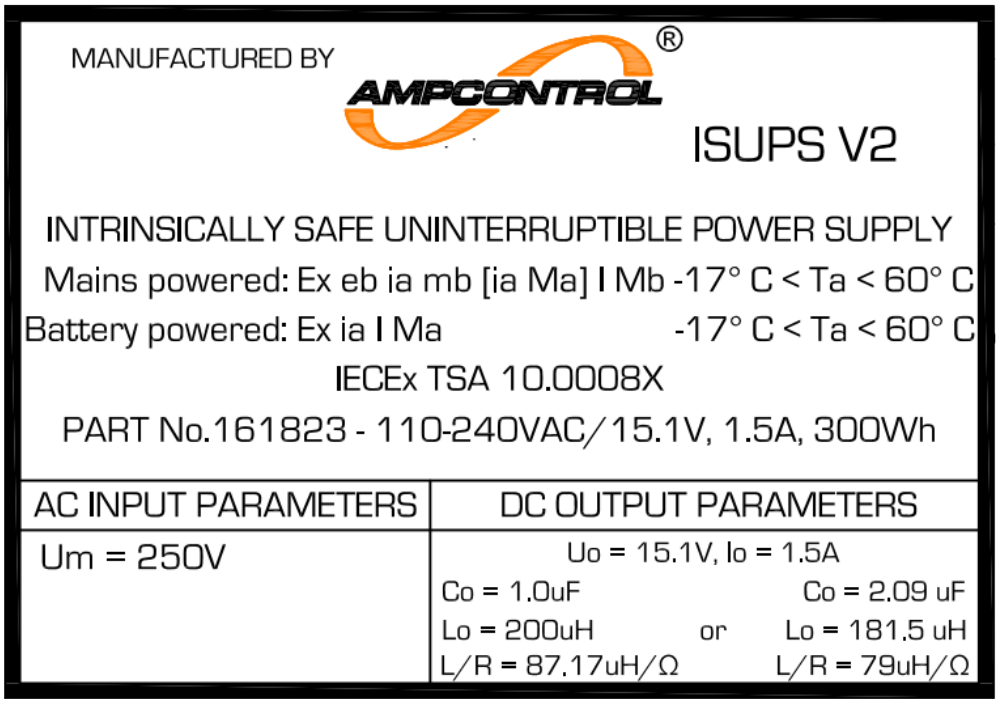


Figure 3.2: Example of ISUPS V2 Label

3.3 Certification

- The ISUPS is compliant with the following standards:
  - IEC 60079.0: 2011 Ed 6.0 – Explosive atmospheres – Part 0: General requirements
  - IEC 60079.7: 2015 Ed 5.0 – Explosive atmospheres – Part 7: Equipment protection by increase safety “e”
  - IEC 60079.11: 2011 Ed 6.0 – Explosive atmospheres – Part 11: Equipment protection by intrinsic safety “I”
  - IEC 60079.18: 2014 Ed 4.0 – Explosive atmospheres – Part 18: Equipment protection by encapsulation “m”
- The ISUPS conforms with IEC 60079.11: 2011, clause 6.3.13

3.4 Explanation of Ex Markings

An example of the marking label is shown above in Figure 3.2 and the certifications discussed below.

Mains Powered - Ex eb ia mb [ia Ma] I Mb

Techniques eb (mains input), ia (keypad) and mb (input power module) are used for **Zone 1** located equipment. The [ia] outputs can be fed into the **Zone 0** area.

Battery Powered - Ex ia I Ma

Equipment can be located in a **Zone 0** area.

4 INSTALLATION

WARNING!

This equipment is designed for a supply voltage of 90 ~ 250 V AC. It also contains battery backup which is indicated by a flashing LED. It is essential to be careful about the installation, use and storage of the ISUPS.

To ensure safe operation, avoid nullifying the warranty and contravening the Certificate of Compliance, it is important to comply with the requirements of this section.

4.1 General Warnings

These instructions have been designed to assist users of the ISUPS with installation. The ISUPS is required to be installed into a system along with appropriate devices providing input signals (sensors) and output control/indication (fan controls, beacons, sirens, SCADA systems etc.).

Before the ISUPS can be installed, there are a number of things that need to be considered and understood to prevent incorrect or unsafe operation of the ISUPS or the system into which it is installed.

Along with relevant competence, and an understanding of the target application, the following points should be considered:

4.1.1 Ensure that the information provided in this user manual, particularly Section 4.3, is fully understood.

It is extremely important that the limitations and functionality of the ISUPS are understood to prevent incorrect installation and use from creating a potentially dangerous risk. If in doubt as to the nature of the limitations or their implication, consult a competent authority such as a supervisor or Ampcontrol applications engineer.

4.1.2 Ensure that the application into which the ISUPS is being installed has been properly defined, designed and approved.

Any system intended to mitigate the risk of injury needs to be properly designed and implemented. Such a system must be the result of structured risk analysis with the outcomes used to define the system requirements. These requirements, in turn, will guide the choice of instrumentation, logic solvers and actuators needed to implement the system. Understanding the needs of the system will ensure proper selection of equipment.

4.1.3 Ensure that the ISUPS will properly perform the required functions within the system design.

It is important to understand how the ISUPS is intended to interact with other equipment within a system. For safe and reliable use, it is crucial that the ISUPS' operation is not compromised by incompatibilities with connected equipment.

4.1.4 Ensure that the intended devices to be connected to the ISUPS are compatible with the entity parameters as specified on the ISUPS certificate of compliance (conditions of safe use).

Check the terminal I.S parameters of all devices intended to be connected to the ISUPS against the ISUPS certificate of conformance. If in doubt, consult a competent authority, or contact an Ampcontrol applications engineer.

4.1.5 Modifications of any form to the ISUPS are prohibited.

The ISUPS as supplied has been designed and manufactured to comply with the requirements of electrical standards. If modifications of any form are made to the ISUPS, the equipment may no longer be fit for use. If any modifications or damage to the ISUPS is evident, do not use the equipment and contact Ampcontrol for advice.

CAUTION!

The user is responsible for maintaining the Explosion Protection rating by complying with the "List of Special Conditions" outlined in the certification

(See APPENDIX B – APPROVALS).

4.2 Mandatory Installation Practices

The following information must be adhered to when installing the ISUPS. Failure to adhere to this information may give rise to unsafe operation.

Using the ISUPS in a manner that exceeds its electrical, functional or physical specifications, or in a way that is contrary to its operating restrictions, may create risks to personnel and/or equipment resulting in injury or death.

- The ISUPS must be powered within the specified voltage range
- The Conditions of Safe Use listed in the certification must be adhered to
- The installation of the ISUPS must be carried out by suitably trained and qualified personnel
- Identification labels fixed to the ISUPS must not be damaged, removed or covered before, during or after installation
- The installation is to be in accordance with the relevant installation Standards/Codes of Practice
- Modifications must not be made to any part of the ISUPS. As supplied, the unit is built to and complies with the relevant standards. Modifications to its construction will render the unit non-compliant
- Complete and accurate records of the installation must be kept as part of the site installation

4.3 Conditions of Use

There are eighteen models of ISUPS with a range of voltage and current limits that may be selected from Table 1, following. Various output options and battery capacities that are not shown in the table can be manufactured on request as a special order.

- The input/output parameters provided in Section 4.3.1. must be taken into account when designing the system and installing the ISUPS into an existing system. An assessment of the system should be carried out to ensure compliance with IS requirements
- The mains power input (Um = 250 V) must not be applied when installed in Zone 0
- The maximum permitted supply short circuit current is 1500 A
- The ISUPS must be installed in an upright position
- The ISUPS must either be taken to a safe area for recharging when necessary or powered under the provisions covered by the local mines' regulations
- Mains power is applied to the Ex e terminal compartment. An IP65 or better M20 Ex e certified cable gland for group I is required
- The Ex e compartment must not be opened when an explosive atmosphere is present
- Unused cable entries into the Ex e terminal compartment must be closed with Ex e certified blanking elements
- The intrinsically safe output and digital IO are accessible via the intrinsically safe terminal compartment. IP66 rated M16 or M20 cable glands are required
- Unused cable entries into the Ex i terminal compartment must be closed with IP66 rated blanking elements
- It is a safety requirement that the ISUPS is connected to earth. This connection can be to either the internal Ex e terminals 2 or 3, or the external earth stud
- Cable terminations in the Ex e and Ex i compartments shall comply with the requirements set out in section 4.5.8
- It is a requirement of certification that the Ex e terminal compartment cover be secured to the housing by M4 captive screws (P/N 111534) with SS spring washers
- The installation of the ISUPS must be conducted in a manner conforming with the requirements of AS/NZS 60079, parts 0, 14, 17 and 25, in addition to any other standards relevant to the installation, industry or locale

4.3.1 IS Parameters

The following input / output parameters must be taken into account when installed.

Mains Input

Um = 250 V AC

Mains power input must not be applied when installed in Zone 0 areas.

Terminal X8; DC Output:

Table 1: Output Parameter Details

Description	Uo	Io	Co	Lo	L/R	Um
15.1 V DC 1.50 A Output	15.1 V	1.50 A	1.0 µF	200 µH	87.17 µH/Ω	250 V
			2.09 µF	181.5 µH	79 µH/Ω	
15.1 V DC 0.51 A Output		0.51 A	1.0 µF	200 µH	87.17 µH/Ω	
15.1 V DC 0.5 A Output		0.50 A				
15.1 V DC 0.47 A Output		0.47 A	2.01 µF	520 µH		
14.5 V DC 1.50 A Output	14.5 V	1.50 A	1.0 µF	200 µH		
12.6 V DC 2.5 A Output	12.6 V	2.50 A	2.0 µF	167.2 µH	33 µH/Ω	
12.6 V DC 2.4 A Output		2.40 A				
12.6 V DC 2.0 A Output		2.00 A	502 nF	164 µH	40.1 µH/Ω	
			20.54 µF	102.1 µH	39 µH/Ω	
12.6 V DC 1.5 A Output		1.50 A	1.0 µF	200 µH	87.17 µH/Ω	
			2.09 µF	181.5 µH	79 µH/Ω	

The above output parameters Co, Lo, Lo/Ro were determined based on spark testing. The same Co, Lo, Lo/Ro values are allowed to be used with models of the ISUPS when configured with lesser Uo and / or Io values.

NOTE

Special orders will require longer lead times to manufacture.

NOTE

Some standard models of ISUPS have been tested with two different sets of I.S. parameters. The installer may select and apply only one set of parameters to the I.S. assessment, depending on the requirements of the system.

Terminal X7; External Start Push Button:
Uo = 32.5 V
Io = 24 mA
Lo = 100 µH
Co = 0.040 µF

Terminal X6; Digital Input 1:
Uo = 16.5 V
Io = 16.8 mA
Lo = 100 µH
Co = 1 µF

Terminal X4 Pin 3 & Terminal X5 Pin 1; Data for RS-485:
Ui = 7.14 V
Ci = 0.221 µF
Li = 0 µH
Uo = 5.88 V
Io = 124 mA

Terminal X4 Pins 1 & 2; Power Supply for RS-485:
Ui = 16.5 V
Ii = 2.8 A
Ci = 0 µF
Li = 0 µH

Terminal X3; Relay 1:
Ui = 30 V DC
Ii = 3 A
Uo = 0 V

Terminal X2; Digital Inputs 2 & 3
Ui = 16.5 V
Uo = 0 V

Terminal X1; Relay 2 and Relay 3:
Ui = 30 V DC
Ii = 3 A
Uo = 0 V

4.4 Mechanical Installation

- Install the ISUPS in an area that complies with the relevant parts of the specifications in Section 4.3
- The ISUPS must be installed in an upright position
- The ISUPS may be mounted by its back or base using M6 screws
- Ensure adequate space above and below the unit to allow free air movement around the unit
- Mount the ISUPS in such a way as to allow full access to the connection terminals, display and buttons. Positioning of the ISUPS should also be such to allow easy removal of the unit for repair or charging. The ISUPS should also be clearly visible to allow inspections to be carried out without having to remove parts of the installation (visual inspections)
- The ISUPS must be mounted in such a way that the battery's breather hole (located on the back plate) is not covered

4.4.1 Fasteners

It is a requirement of certification that the Ex e terminal compartment cover be secured to the housing by M4 captive screws (P/N 111534) with SS spring washers. They must only be replaced with identical ones.

The Ex ia terminal compartment cover is secured to the housing by M4 captive screws (P/N 111534) with SS spring washers.

To ensure adequate sealing and achieve the IP66 rating, all terminal covers screws must be tightened to a torque of 1.6 Nm.

CAUTION!

Wiring to the ISUPS must comply with any statutory, site or local wiring codes and Explosion Protection standards, as appropriate.

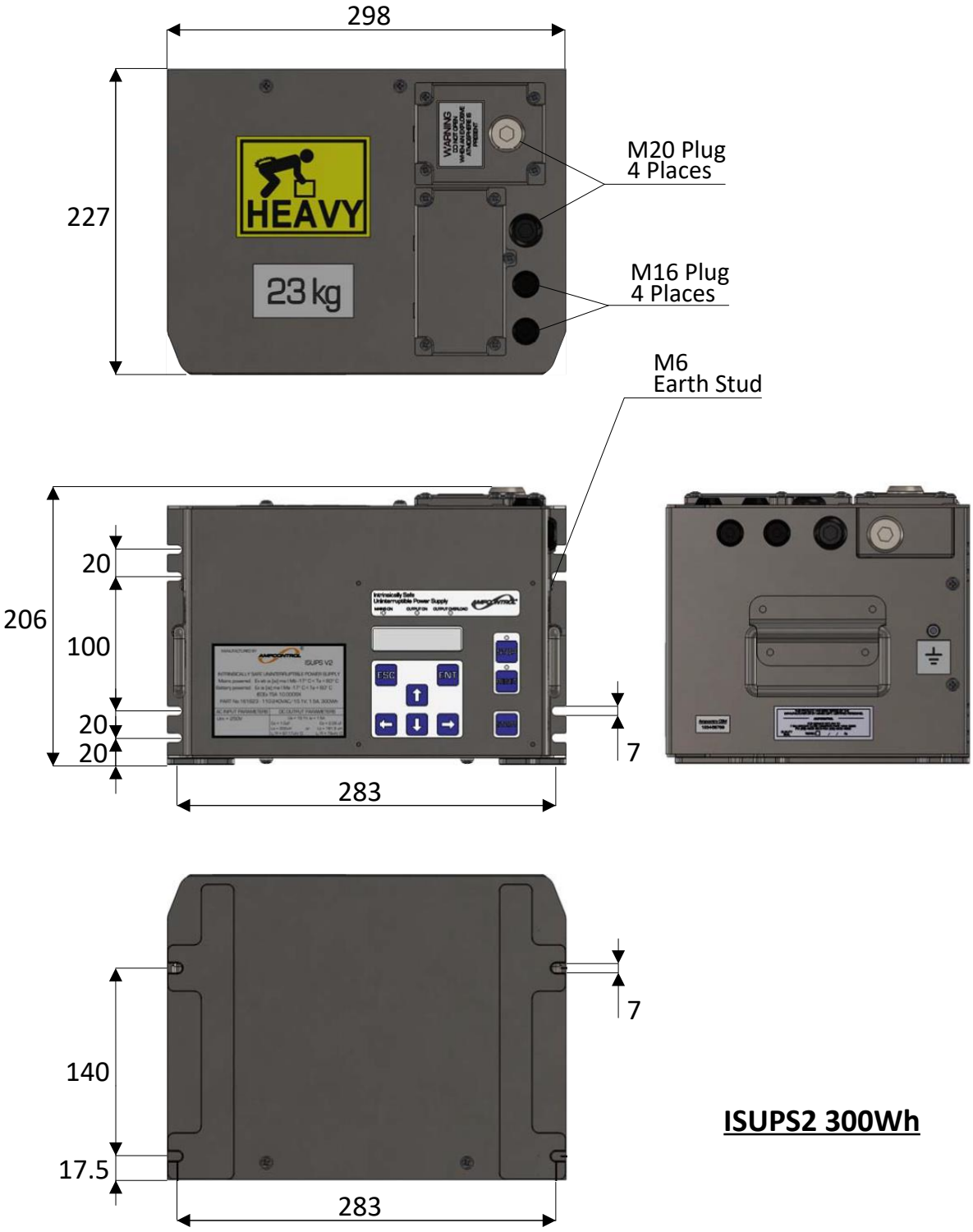


Figure 4.1: Dimensions and Mounting Details for the 300 Wh ISUPS

4.5 Electrical Installation

CAUTION!

The AC power terminal compartment should **only be opened if the external AC supply has been de-energised.** Opening this compartment in a hazardous area when the AC supply is energised is not permitted.

WARNING!

THE MAINS VOLTAGE COMPARTMENT **MUST NOT BE OPENED** WHEN AN EXPLOSIVE ATMOSPHERE IS PRESENT.

WARNING!

Mains Input power (Um = 250 V) must not be applied when installed in Zone 0 areas.

WARNING!

Due to the design of the front-end circuit of the ISUPS it should only be IR tested at 250 V. A value of approximately 0.5 MΩ is expected.

All cables enter and exit the enclosure via appropriate cable glands. The cable glands must meet a minimum requirement of IP66 to maintain the integrity of the enclosure. If the ISUPS is to be installed in a Zone 1 environment, then the gland used on the incoming AC supply will need to be certified to ‘Ex e’.

NOTE

Cable glands into the ISUPS enclosure must be a minimum of IP66. If the enclosure is going to be installed in Zone 1, then the AC Mains gland must be rated to ‘Ex e’.

When installing the ISUPS, consideration must be given to I.S. parameter matching, cable selection, cable termination, cable marking and cable restraint. The installation must be carried out with reference to standards appropriate for the application, industry and/or locale. These standards include but are not limited to: AS/NZS 3000, AS/NZS 1972, AS/NZS 60079 (Parts 14, 17 & 25) & AS/NZS 4871. Failure to comply with standards could lead to a dangerously installed system.

Good installation practices are to be followed to minimise the stress on the terminations and the ISUPS.

The various input / output parameters of Section 4.3.1 must be taken into account during installation.

- Unused cable entries into the Ex i terminal compartment must be closed with IP66 rated blanking elements
- The intrinsically safe output and digital I/O are accessible via the intrinsically safe terminal compartment. The use of applicable M16 or M20 cable glands is required to ensure the IP66 rating of the enclosure is maintained and that requirements of local Mines Regulations for Ex e and Intrinsically Safe “ia” wiring are complied with
- For terminal connection details see APPENDIX A – DRAWINGS ISUPS2Z005

4.5.1 Earthing

- It is a safety requirement that the ISUPS is connected to earth. This connection can be to either the internal Ex e terminals 2 or 3, or the external earth stud
- To achieve full EMC compliance the output and user I/O cables must be screened with the screen connected to the earth stud within the IS terminal compartment

4.5.2 Mains Supply

- Mains power is applied to the Ex e terminal compartment. An IP66 or better, M20 Ex e certified cable gland for group I applications is required
- The Ex e compartment must not be opened when an explosive atmosphere is present. Unused cable entries into the Ex e terminal compartment must be closed with Ex e or Ex d certified blanking elements. The blanking element supplied with the ISUPS must be tightened to a torque of 20 Nm to achieve an adequate seal
- **The permitted supply short circuit current is 1500 A**
- The cable size shall be between 0.5 mm2 and 4 mm2 and rated for >3.4 A
- Not more than one single or multiple strand lead shall be connected into any terminal, unless multiple conductors have been joined in a suitable manner, e.g. two conductors into a single insulated crimped bootlace ferrule
- Leads connected to the terminals shall be insulated for 275 V or greater and this insulation shall extend to within 1 mm of the metal of the terminal throat
- All terminal screws, used and unused, shall be tightened down to between 0.5 Nm and 0.7 Nm.
- Cross-connecting combs shall not be used
- The 300 Wh ISUPS Ex e terminal compartment cover shall only be secured to the housing using the Ampcontrol suppled M4 captive screws with SS spring washers

4.5.3 I.S. Output Terminals

These terminals provide the battery backed I.S. DC output. The characteristic of the output can be seen in Section 5.7. The rated voltage and current that can be provided by these terminals varies depending on the ISUPS model and is noted on the nameplate.

The I.S. Output terminals are of the Large terminal type. See section 4.5.8 for wire terminal details.

4.5.4 Remote Start

The remote start input can be used to start the ISUPS if access to the front panel is not available.

A voltage free contact or switch with compatible I.S. parameters shall be used.

The I.S. Output terminals are of the Large terminal type. See section 4.5.8 for wire terminal details.

4.5.5 Digital Inputs

There are two types of Digital Inputs.

Digital Input 1 (DI1) is a non-isolated digital input that can be configured to remotely shutdown the ISUPS. It can also be assigned to operate any of the relays.

The DI1 terminals are of the Large terminal type. See section 4.5.8 for wire terminal details.

Digital Input 2 (DI2) and Digital Input 3 (DI3) are isolated digital inputs that can be assigned to operate any of the relays. These can be powered from a common external intrinsically safe circuit or the ISUPS output.

The DI2 and DI3 terminals are of the Small terminal type. See section 4.5.8 for wire terminal details.

4.5.6 RS485

A 2-wire RS485 port is available for Modbus RTU communications with a Master device (PLC or iMac SIM-P module).

The RS485 driver requires external power to operate. RS485 Communications are not possible if the RS485 +Vc and 0V terminals are not powered. Typically, this is provided from the output terminals of the same ISUPS via manually wiring in a link. This link can be seen in Figure 3.1. Alternatively, it can be supplied from a separate ISUPS or power supply. This allows communication via Modbus with an ISUPS who's output has been turned off using the Output Toggle Time feature (See Section 7.3).

A 120 Ω termination resistor can be switched in or out of the circuit as required. Factory default is for this to be terminated. This termination resistor may need to be taken out of circuit using the switch located in the I.S. Termination compartment depending on application.

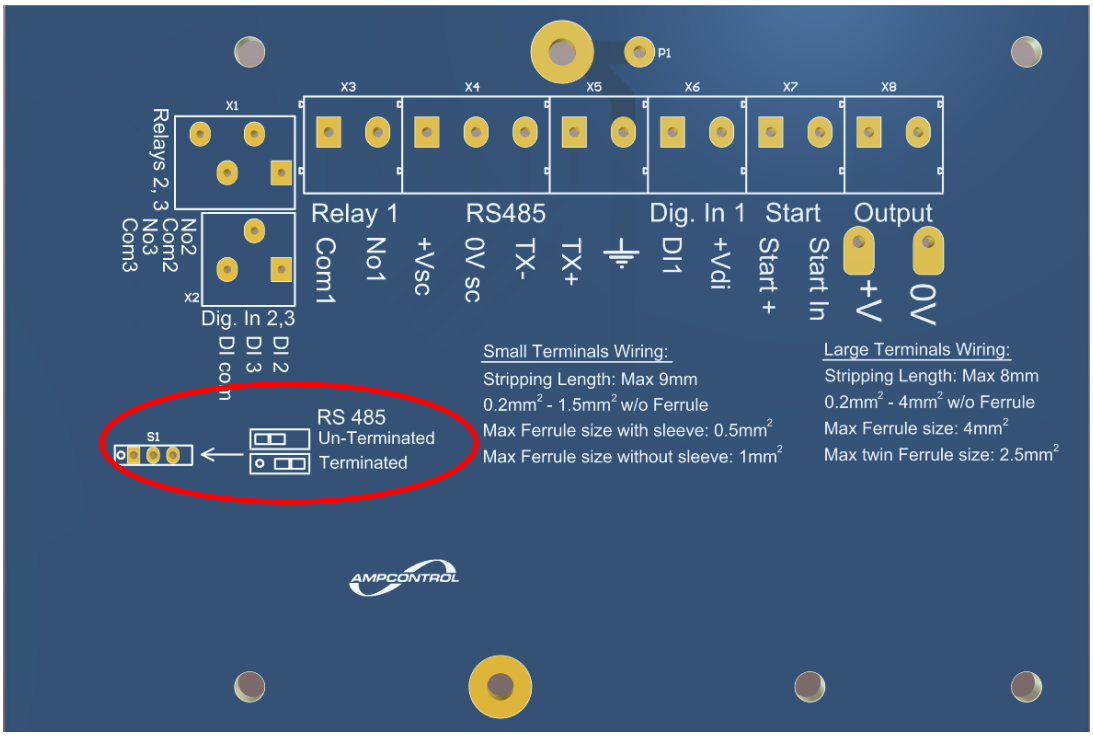


Figure 4.2: RS 485 switch location on PCB

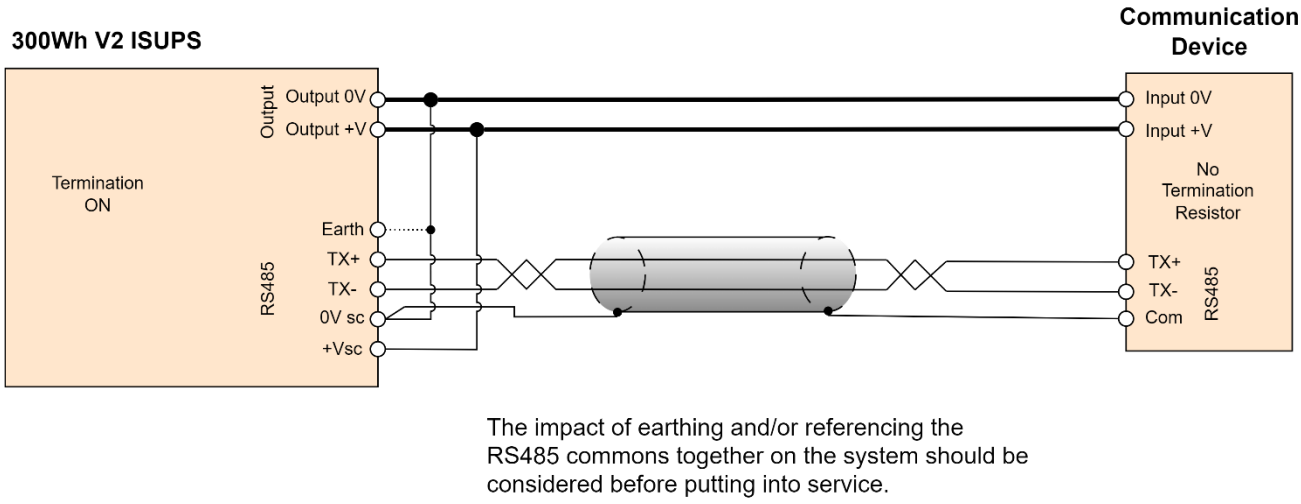


Figure 4.3: Example with one ISUPS powering RS485 communications device.

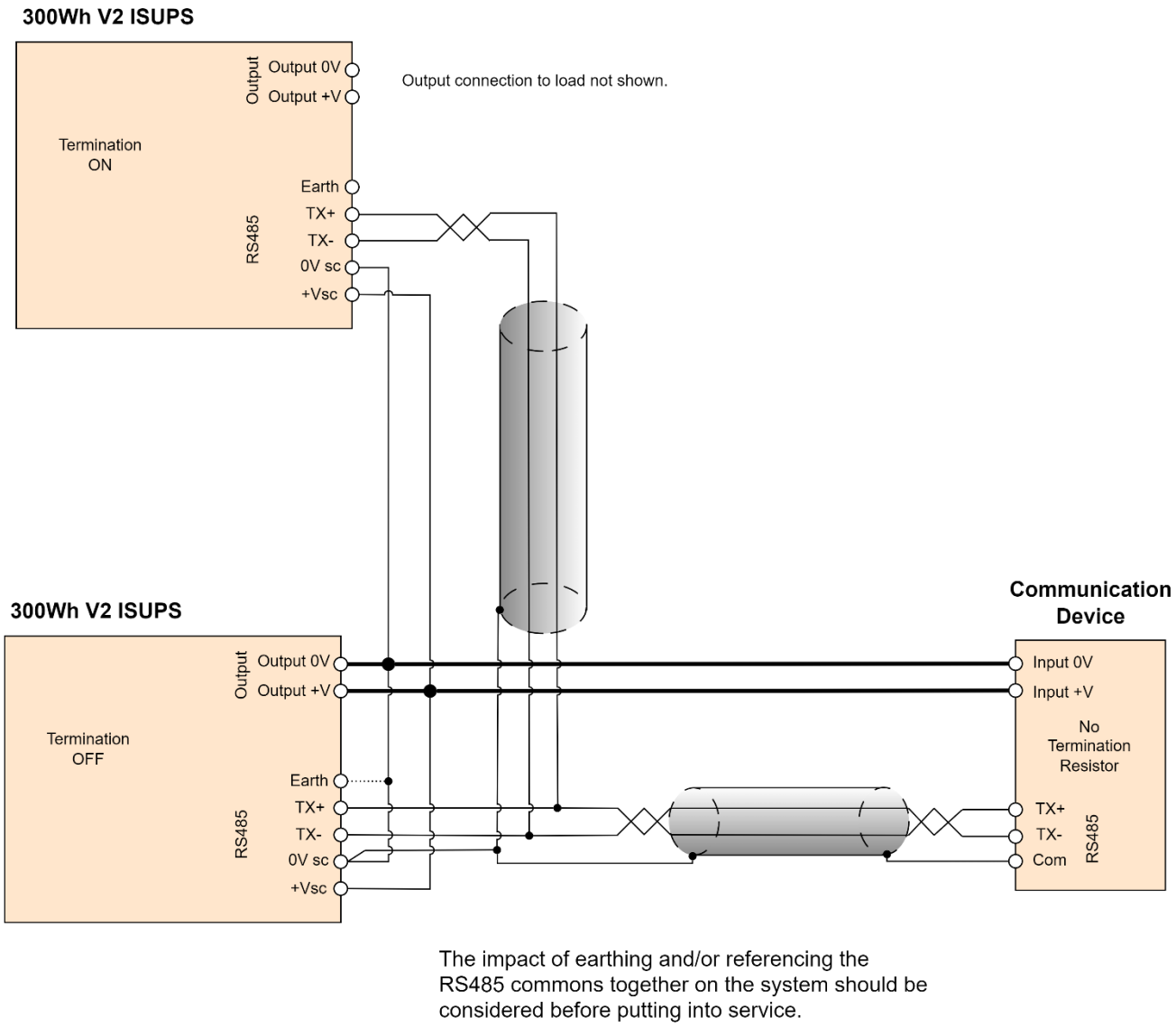


Figure 4.4: Example with two ISUPS sharing an RS485 Bus.

Note that RS485 is a three-wire system and the 0V SC connection may need to be reticulated with the TX+/TX- signal.

An Earth terminal is provided for connection of Cable Screen Earth if required. This terminal is connected to the Input compartment earth terminals as well as the ISUPS case. If used, this earth should only be applied at a single location.

The impact on the system of referencing all RS485 commons (0VSC) together and earthing should be assessed before putting into service.

All RS485 terminals are of the Large terminal type. See section 4.5.8 for wire terminal details.

4.5.7 Relay Outputs

The ISUPS has 3 relay outputs. Each relay output is of Normally Open type and is isolated from each other. Each relay can be independently configured to perform one of the following functions:

- Off (not assigned)
- Output Overcurrent
- Output Undercurrent
- Output Undervoltage
- Battery Temperature Alarm
- UPS Alarm
- Mains Status
- Digital Input
- Timer Status
- Output Status

Relay 1 terminals are of the Large terminal type. See section 4.5.8 for wire terminal details.

Relay 2 and 3 terminals are of the Small terminal type. See section 4.5.8 for wire terminal details.

4.5.8 Terminal Requirements

Ex e Terminals

- The cable size shall be between 0.5 mm2 and 4 mm2 and rated for >3.4 A
- Not more than one single or multiple strand lead shall be connected into any terminal, unless multiple conductors have been joined in a suitable manner, e.g. two conductors into a single insulated crimped bootlace ferrule
- Leads connected to the terminals shall be insulated for 275 V or greater and this insulation shall extend to within 1 mm of the metal of the terminal throat
- All terminal screws, used and unused, shall be tightened down to between 0.5 Nm and 0.7 Nm
- Cross-connecting combs shall not be used

Ex i Terminals – Large Terminals Wiring:

- Stripping length: Max 8 mm
- Diameter: 0.2 mm^2 to 4 mm^2 without ferrule
- Max ferrule size: 4 mm^2
- Max twin ferrule size: 2.5 mm^2

Wires should be installed so that wire insulation extends to the terminal. i.e. there should be no copper protruding. This is necessary to maintain adequate clearance between adjacent IS circuits.

Ex i Terminals – Small Terminals Wiring:

- Stripping length: Max 9 mm
- Cross sectional area: 0.2 mm^2 to 1.5 mm^2 without ferrule
- Max ferrule size with sleeve: 0.5 mm^2
- Max ferrule size without sleeve: 1 mm^2

5 OPERATION

The Intrinsically safe uninterruptible power supply exhibits very low output impedance. The output voltage is reduced by an average of 0.4 V at full load. Precise current limiting provides maximum available current up to the Io parameter. The power supply output acts as a current limited voltage source. The load impedance can vary down to short circuit while the maximum output current is maintained. This is a safety feature; we recommend not exceeding the load that reduces the output voltage to maintain the maximum output current.

On receipt of your ISUPS, it should be in Stop mode. The front display will be off and the reset LED flashing.

The ISUPS has various configurable functions but for users who wish to use it in the simplest form an ex-factory default setting is programmed into the unit prior to delivery. Refer to Section 6.3 & Section 6.3.6 for details on programming and customising as required to suit a specific application. A brief on the functionality of the ex-factory default settings is given below:

- The programmable output on time is set to “Always ON”, the output will remain on even when the mains are switched off, and until the battery voltage reaches the low level. The output on time can be programmed to any time at 10-minute steps. In this case, the output will stop when the on time is expired. To initiate another cycle it is necessary to start the ISUPS either by using an externally wired momentary switch, or the local keypad
- Application of mains power will override any timer function and will automatically switch the DC output on if it is in an off status due to time out. If the ISUPS has been “stopped” by pressing the local “STOP” button prior to loss of mains supply the output will not be energised by the return of the mains supply
- The minimum battery voltage level will switch the output off automatically ignoring the timer activity, as a self-protection feature
- Digital inputs are mapped 1 to 1 to the relays to mimic input status
- Discharge Test is set to be performed with a Hold Up time of 240 minutes or 4 hours
- Modbus set to Slave Mode

5.1 Fuse Protection

As part of its design as an Intrinsically Safe product the input AC supply to the ISUPS is protected by both a ceramic fuse and resettable thermal fuse (NTC), which is encapsulated into the electronics assembly. It is unlikely, but possible that repeated application of the mains supply over a short timescale (the thermal fuse not having enough time to recover) could cause the ceramic fuse to blow if the AC power supply is particularly noisy or at the limit of the permitted voltage.

To reduce any possibility of this protection device being activated it is recommended to avoid cycling power to the ISUPS frequently. Please follow the time intervals shown below between the consecutive applications of mains power to the ISUPS to avoid blowing the input ceramic fuse.

Table 2: Recommended Time Intervals between Power Cycling

Mains Input Voltage	Ambient Temperature	Power Up intervals
110 V AC	≤40 °C	30-seconds
110 V AC	>40 °C	60-seconds
240 / 250 V AC	≤30 °C	90-seconds
240 / 250 V AC	>30 °C	3-minutes

CAUTION!

Maintain the time intervals between successive applications of mains power to the UPS. Multiple applications of mains power, at frequent intervals, may risk blowing the internal ceramic fuse. Replacing a blown fuse will necessitate returning the unit to Ampcontrol for repairs (See warning in Section 3, Product Overview). This repair could be time consuming & expensive. (See detail above)

5.2 Mains Supply

The AC mains supply must be above 90 V for the Mains LED to illuminate and healthy mains to be detected. The ISUPS CPU will be active with mains voltages below 90 V and functions will operate as described for mains supply not available. If the Mains LED does not illuminate with stable AC mains above 90 V, this may indicate activation of the protective fuse. In this case, the ISUPS should be returned to Ampcontrol for service.

5.3 ISUPS States

The ISUPS can be in a number of states. The three main ones are:

- On – Where the DC Output is on. Pressing the Stop Button moves to the Locked State. Stopping via a DI input moves direct to the Off State
- Locked – The DC Output is off and the ISUPS cannot be started via external inputs without being reset. Pressing the Reset button moves to the Off state
- Off – The DC Output is off, however the ISUPS can be started via the external start input or the Start button

The ISUPS can also exist in the Discharge Test (section 5.6) and Output Toggle Timer (section 7.3) states.

5.4 LED Indication

On the front facia there are 5 status indication LEDS:

5.4.1 Reset LED

When the STOP button is pressed to stop/lock the ISUPS, this LED starts flashing and remains flashing until the ISUPS is unlocked by pressing the RESET button. The LED remains flashing when the ISUPS is in lock mode. The application of mains power while the ISUPS is locked will not start the ISUPS; it will be necessary to press the RESET button to unlock and then press the START button to start the ISUPS.

5.4.2 Stop LED

When the ISUPS is unlocked (by pressing the RESET button) it forces the STOP LED to begin flashing. This means that the ISUPS is ready to start and pressing and holding the START button for 1-second will start the ISUPS. The ISUPS may also be started by momentarily closing the terminals ‘Start+’ and ‘Start In’ located at X7 on the terminal Board. The successful start is indicated by the OUTPUT LED becoming illuminated at which time output will be available at the output terminals. The application of mains power while the ISUPS is unlocked will immediately start the ISUPS.

5.4.3 Output LED

This LED illuminates when the ISUPS is on.

On		Output load is supplied with power
Off		Output load is disconnected from power
Fast Flash (2x per second)		Output load is supplied with power Holdup Time alarm - output will not be able to satisfy holdup time

5.4.4 Overload LED

This LED illuminates when the ISUPS is operating in current limit mode and extinguishes when operating normally.

On		Overload condition – ISUPS operating in current limit mode
Off		No overload fault condition
Flicker		On limit of overload condition

5.4.5 Mains On LED

This LED illuminates when the mains power is applied to the ISUPS and extinguishes when mains power is switched off.

On		Mains power detected
Off		Mains voltage not detected or below turn on threshold
Flash (Slow)		Discharge test underway. Mains charging temporarily disabled

5.4.6 LCD Backlight

The LCD display turns off 30-second after the last press on any button.

5.5 Battery Life

Provided the ISUPS is stored as per the requirements listed in Section 2, the battery within the unit can be expected to have an operational lifespan of approximately 3 years at an ambient temperature of 20 ˚C. It is important to note that the ISUPS battery life is a function of temperature, and as such, the expected life span of the battery must be degraded as the ambient temperature increases. At an ambient temperature of 40 ˚C, the life of the battery within the ISUPS is reduced to approximately 1 year (see Section 8.3 “Equipment Overhaul”).

CAUTION!

The “Reset” LED flashes continuously (<1-second intervals) to indicate that this equipment is in “Stand-by” mode and contains an operational battery pack. The battery life is 12 months for the 300 Wh ISUPS when stored in the recommended manner.

ENVIRO

Lead-acid batteries are recyclable products. Recognising the need to be involved in the whole lifecycle of a battery and to protect the environment, Ampcontrol will recycle batteries from ISUPS units that are returned to Ampcontrol at the end of their life.

5.6 Hold Up Time and Discharge Test

The Hold Up Time (HUT) and Discharge Test (DT) functionality provides a means to identify a ISUPS that has a battery with poor State of Health. Often an ISUPS is on Mains charge, and it is only on a loss of power that its state of health is known.

The Discharge Test will exercise a mains powered ISUPS by discharging the batteries using the connected load periodically in order to estimate the overall condition of the battery. On a weekly basis, a Discharge Test is conducted that will deplete the ISUPS by 10% of its perceived capacity. The Discharge Test can also be manually triggered via the screen and via Modbus. If at the end of or during the discharge test the calculated Run Time Remaining falls below the Hold Up Time alarm threshold, an alarm will be activated.

The desired Hold Up Time can be selected between 30 minutes and 99 hours in 30-minute increments. It can also be disabled; in which case the Discharge Test is not performed.

The Discharge Test has the following conditions:

- Discharge Test will not start if mains are off
- Discharge Test will abort early if the RTR falls below the HUT threshold triggering the alarm early
- Discharge Test must have the output turned on
- The average Output Current, over an hour, supplied to the connected load is used during the discharge test

The factory default is for the Discharge Test to be performed with a Hold Up Time of 4 hours for the 300 Wh ISUPS.

It is recommended that the Hold Up Time be set to a reasonable value that is below 10% of the reported maximum RTR.

Note the Discharge Test will start on a schedule - if at that time the ISUPS is at low capacity the HUT alarm will trigger, as the ISUPS has not had sufficient time to recharge. In this case allow the ISUPS to charge up to full capacity and perform the Discharge Test again.

CAUTION!

If the user does not set the HUT, the ISUPS will use the factory default without ANY knowledge of the ISUPS loading, and knowledge of desired or designed Hold Up Time requirements.

See Section 6.3.4.6 for related settings.

5.7 Output Characteristics

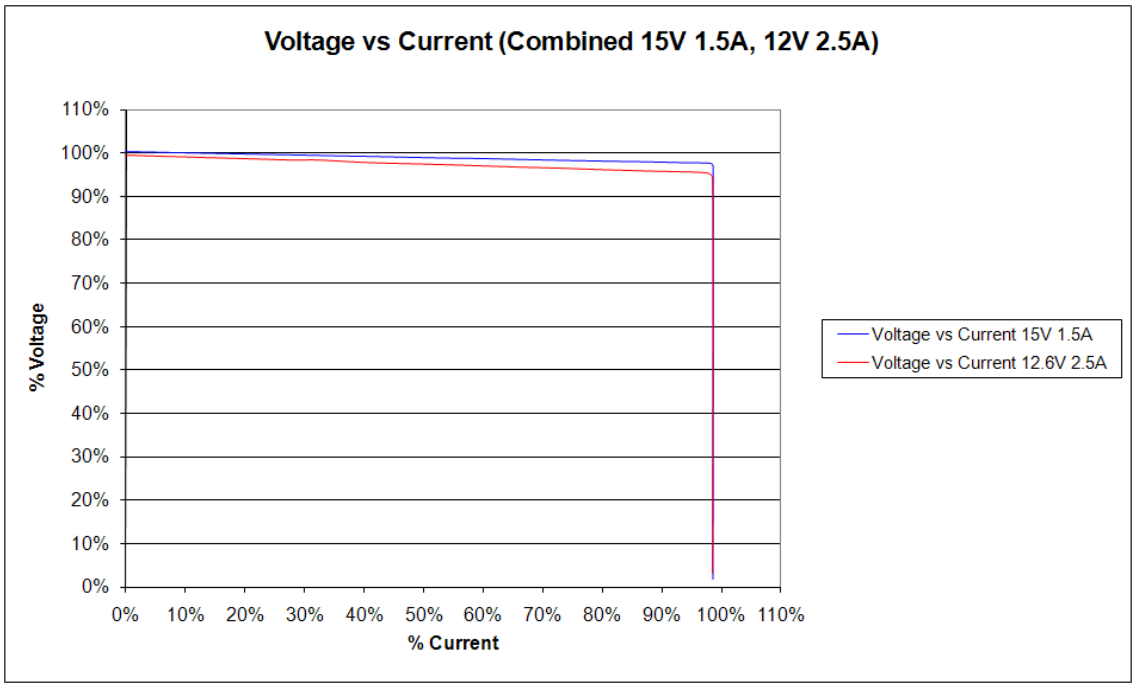


Figure 5.1: Typical Output Voltage vs. Output Load Current Curve for the ISUPS

6 USER INTERFACE

The ISUPS is managed by using a 16-character x 2-line LCD display and a keypad.

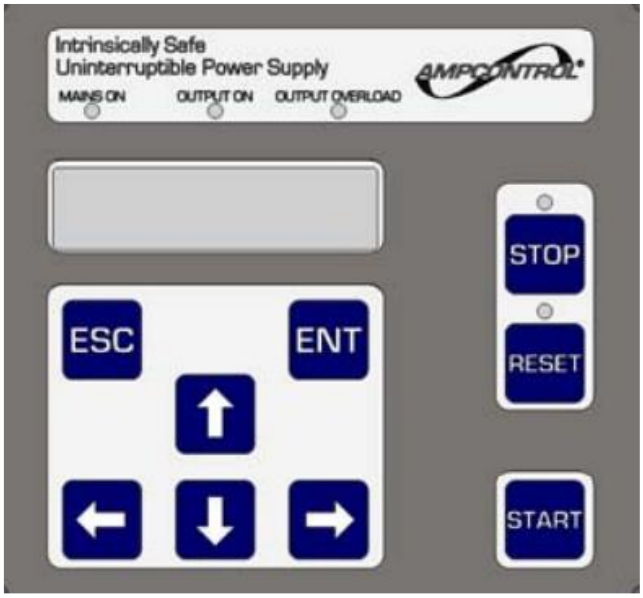


Figure 6.1: ISUPS LCD Display and Keypad

The menus are divided into two user accessible groups: the Status Menu and the Field Configurable Menus.

The Information Menus display information regarding the status of the ISUPS.

The configuration menus coordinate and display changes to the settings that control the operation of the ISUPS. A password is required to gain access to the configuration menus.

6.1 Menu Navigation

Navigation of the menu is performed by pressing the arrow keys on the keypad. The backlight will be lit for around 30 seconds whenever a key is pressed while the unit is battery powered.

UP Key (Button)

DOWN Key (Button)

LEFT Key (Button)

RIGHT Key (Button)

From the power-on-default Status Menu (Section 6.2.1) pressing the UP key will allow navigation through the major menus, and pressing the DOWN key will navigate back. Pressing the RIGHT key will select the minor menus from the sub-menus. Repeated pressing of the LEFT key will navigate back to the major menus. These key actions are typical throughout the menus.

Each menu requires different settings or responses from the user, some keys may be de-activated all together or have a different action – but this depends upon each menu. In general, the keys will operate as shown in Table 3, below.

Table 3: The Function of the Menu Keys

Key	Status Menus		Configuration Menu	
	Major Menu MM/a	Sub-Menu MM/(b-n)	Major Menu CM/a	Sub-Menu CM/(b-n)
UP	Next Menu	-	Previous Menu	Increase Setting Value
DOWN	Previous Menu	-	Next Menu	Decrease Setting Value
RIGHT	Sub-Menu	Next Sub-Menu	Sub-Menu	Next Sub-Menu
LEFT	-	Previous Sub-Menu	-	Previous Sub-Menu

6.2 Information Menu Structure

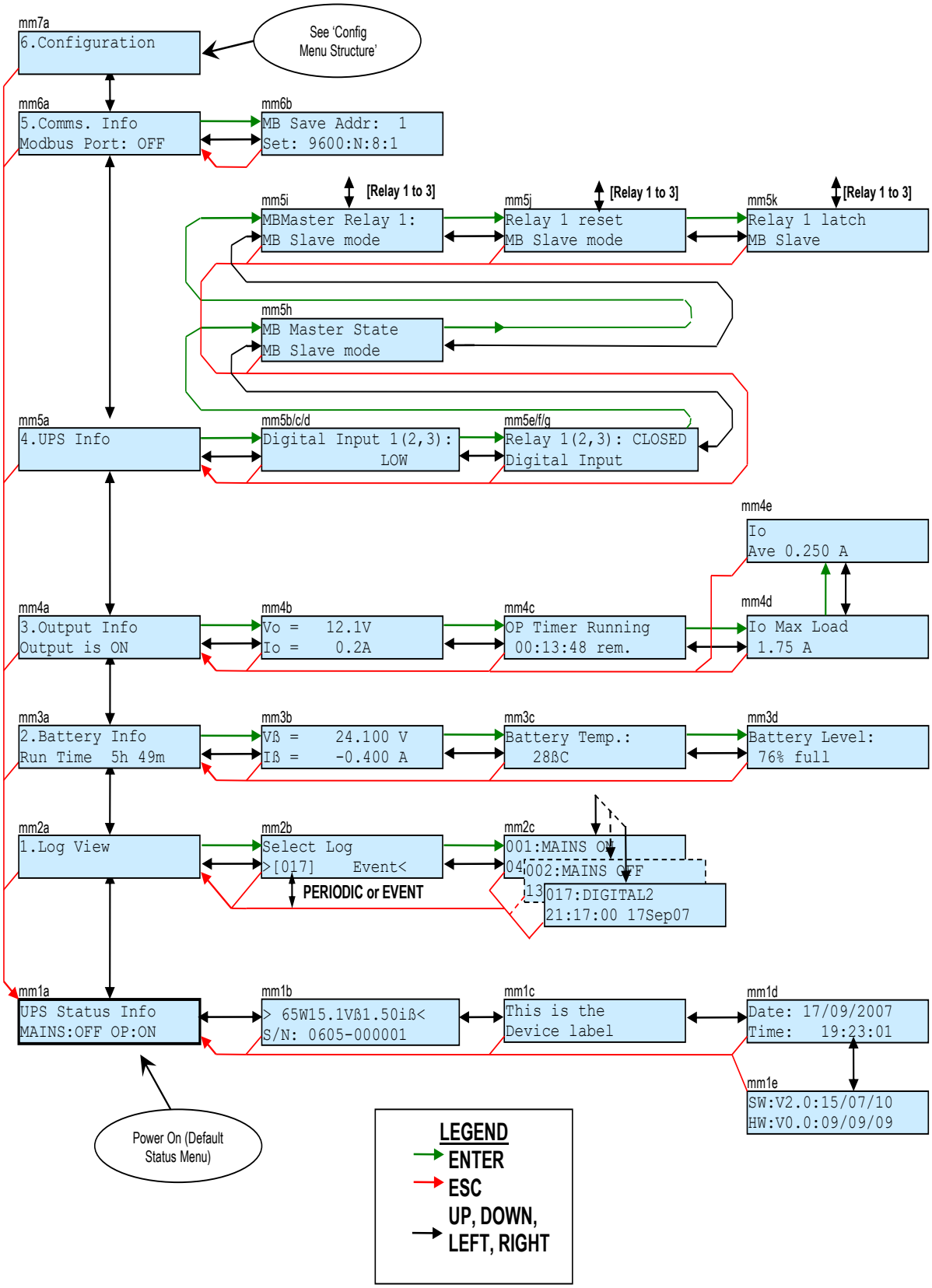
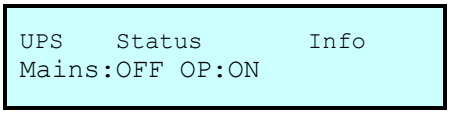


Figure 6.2: Menu Structure

6.2.1 Default Menu

The Default Status menu is displayed at power-up of the ISUPS and will be displayed after a period of time of no user input. The bottom line displays the Mains status and Output status along with any active alarms. From here, navigation to all other menus can commence. From this menu the DOWN and the LEFT button have no effect. The UP button will change the menu focus to the Log View Menu (Section 0); while the RIGHT button changes menu focus to show the Model, Serial Number, User Defined Label, Date & Time, and the SW & HW version menu. While in any of these menus the UP and DOWN button have no effect and the LEFT button changes to the previous menu.

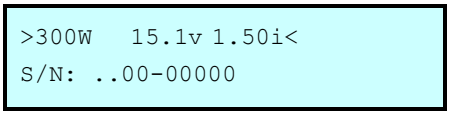
Main and Output Status menu – displays the Mains ON/OFF/DIS status and Output ON/OFF status.



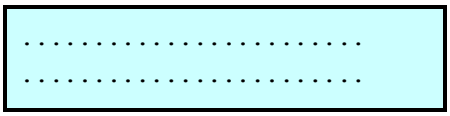
If there is an active alarm it will be displayed on the bottom line. Alarms include:

- Output Overload
- Output Undercurrent
- Output Overcurrent
- Output Undervoltage
- Trip Reset On Status
- Holdup Time Inadequate Alarm
- Discharge Testing in Progress

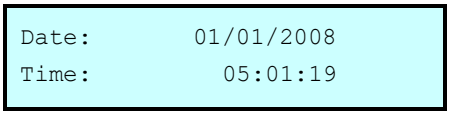
Model and Serial Number menu – displays the model and Serial Number of the ISUPS.



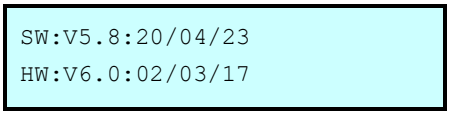
User defined Label menu – displays the blank window for user to write any identifying description etc.



Date and Time menu – displays date and time.



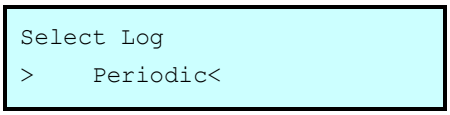
SW and HW version menu – displays Soft-Ware and Hard-Ware version. Press the LEFT or the ESC button to return to the Default Menu.



6.2.2 Log View Menu

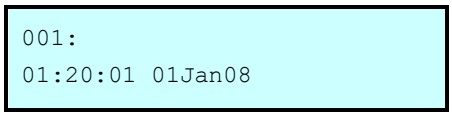
To view the log, press the UP button to select the “Log View” menu. To access the sub-menus of the log view, press the right arrow to access the log selection menu. At this menu, and subsequent sub-menus, Modbus reporting of the logs is suspended.

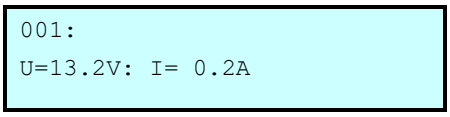
Select Log Menu



At this menu, either the Periodic Log or the Event Log may be selected for viewing either by pressing the UP or DOWN button respectively. Pressing the RIGHT button will select the currently active option.

Periodic Log Menu



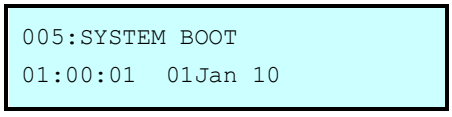


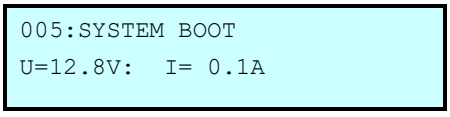
This menu will initially display ‘LOG START’. Press the UP button and the periodic log entries will be displayed, with the most recent entry being displayed first. ‘LOG END’ will be displayed when the other end of the log is reached.

The periodic log can display the entries that have been logged every 5 minutes for up to 6 days – 1,728 entries in total. To assist with rapid navigation, by continually pressing the UP (or DOWN) button, the entries will increment (or decrement) by about 12 per second (roughly 1-hour intervals).

Once an entry has been selected, the bottom line of the display will show the time and date the entry was logged (see above left example), then, after a few seconds, will display the output voltage and output current reading that was logged (see above right example).

Event Log Menu





This menu will initially display ‘LOG START’.

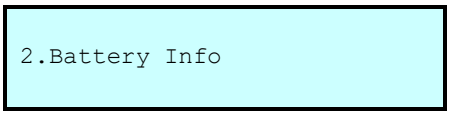
Pressing the UP button, the periodic log entries can be displayed, with the most recent entry being displayed first. ‘LOG END’ will be displayed when the other end of the log is reached.

The periodic log can display the event entries that have been logged whenever an event of significance occurs. Up to 100 events are logged. To assist with navigation through the log, the UP (or DOWN) button may be held closed to scroll forwards (or backwards) at about 5 per second through the events viewed.

Once an entry has been selected, the bottom line of the display will show the time and date the entry was logged (see above left example), then, after a few seconds will display the output voltage and output current reading that was logged (see above right example).

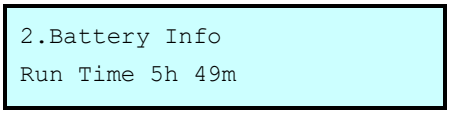
Press the ESC to return to the “Log View Menu”.

6.2.3 Battery Information Menu

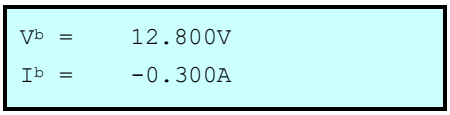


Press the UP button to select the “Battery Info” menu to view the battery status. This major menu has sub-menus that display the Battery Voltage and Current, Battery Temperature and estimated capacity remaining in the battery. To view these menus press the RIGHT button successively.

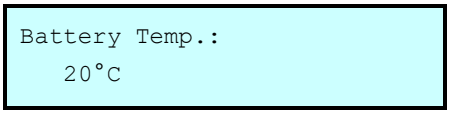
The battery Run Time Remaining (RTR) will be displayed on the Battery Info page. It may take up to 10s for the value to appear. It displays the estimated time remaining until the battery is depleted.



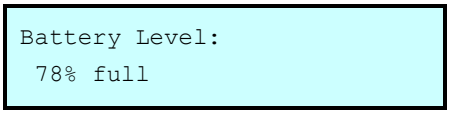
Battery Voltage and Current menu – displays the Battery Voltage and Battery Current. Current displayed with a “–ve” sign indicates that the battery is supplying the load and “+ve” sign indicates that the battery is receiving charge.



Battery Temperature menu – displays the battery temperature in degrees Celsius.

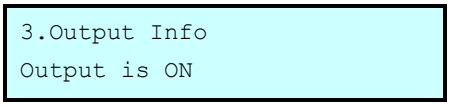


Battery Capacity Remaining menu – displays the estimated battery capacity remaining. Press the ESC button to return to the “Battery Info” menu. While in any of these sub-menus, the UP and DOWN buttons have no effect, the LEFT button changes to the previous menu. Press the LEFT or the ESC button to return to “Battery Info” menu.

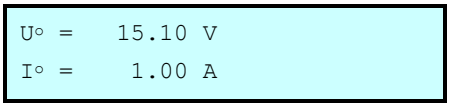


6.2.4 Output Information Menu

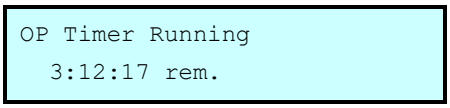
Press the UP button to select the “Output Info” menu to view the output status of the ISUPS. This major menu has sub-menus that display the Output Voltage and Current, Timer, and Remaining time that the ISUPS will run. These sub-menus can be accessed by pressing the RIGHT button.



Output Voltage and current menu – displays the output voltage and current of the ISUPS.



Timer menu displays the remaining time that the ISUPS output will run. The output will be switched off once this timer reaches 0:00:00. Press the LEFT button or ESC to return to “Output Info” menu.



Io Max can be defined by the user. It currently has no use and does not impact on the Run Time Remaining calculation.

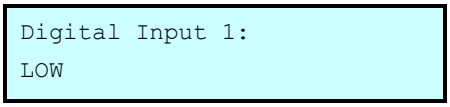
Io Ave is used in the Run Time Remaining calculation. It is calculated by the ISUPS, taking the average of 12 samples over an hour (every 5 min).

6.2.5 UPS Information Menu

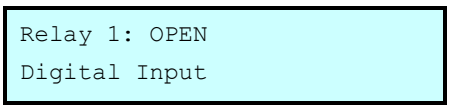
Press the UP button to select the “UPS Info” menu to view the status of the digital inputs and the relay outputs.

These menus can be viewed by pressing the RIGHT button. The first press on the RIGHT button will show the digital input-1 and its state (HIGH or LOW), and further successive presses will show the remaining options. An example of each is shown immediately following:

Digital Input-1, 2, 3: The top line displays the digital input number and bottom line displays its state HIGH/LOW.

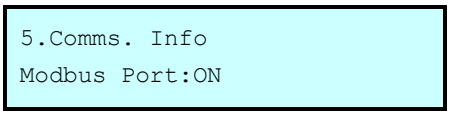


Relay 1, 2, 3: The top line displays Relay number and its state OPEN/CLOSE, the bottom line displays its driving source, as configured in the “Configuration menu”. Press ESC button to return to “UPS Info” menu.

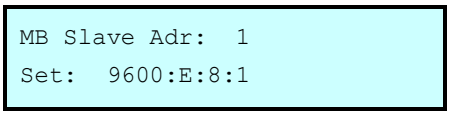


6.2.6 Communications Information Menu

Press the UP button to select the “Comms. Info” menu to view the Modbus communications port settings. This major menu also displays if the Modbus port has been switched ON (by setting the address to non-zero).



Pressing the RIGHT button progresses the display through the Modbus address and the communications settings. An example is shown immediately following. Press the ESC button to return to the “Comms. Info” menu.



6.3 Configuration Menu

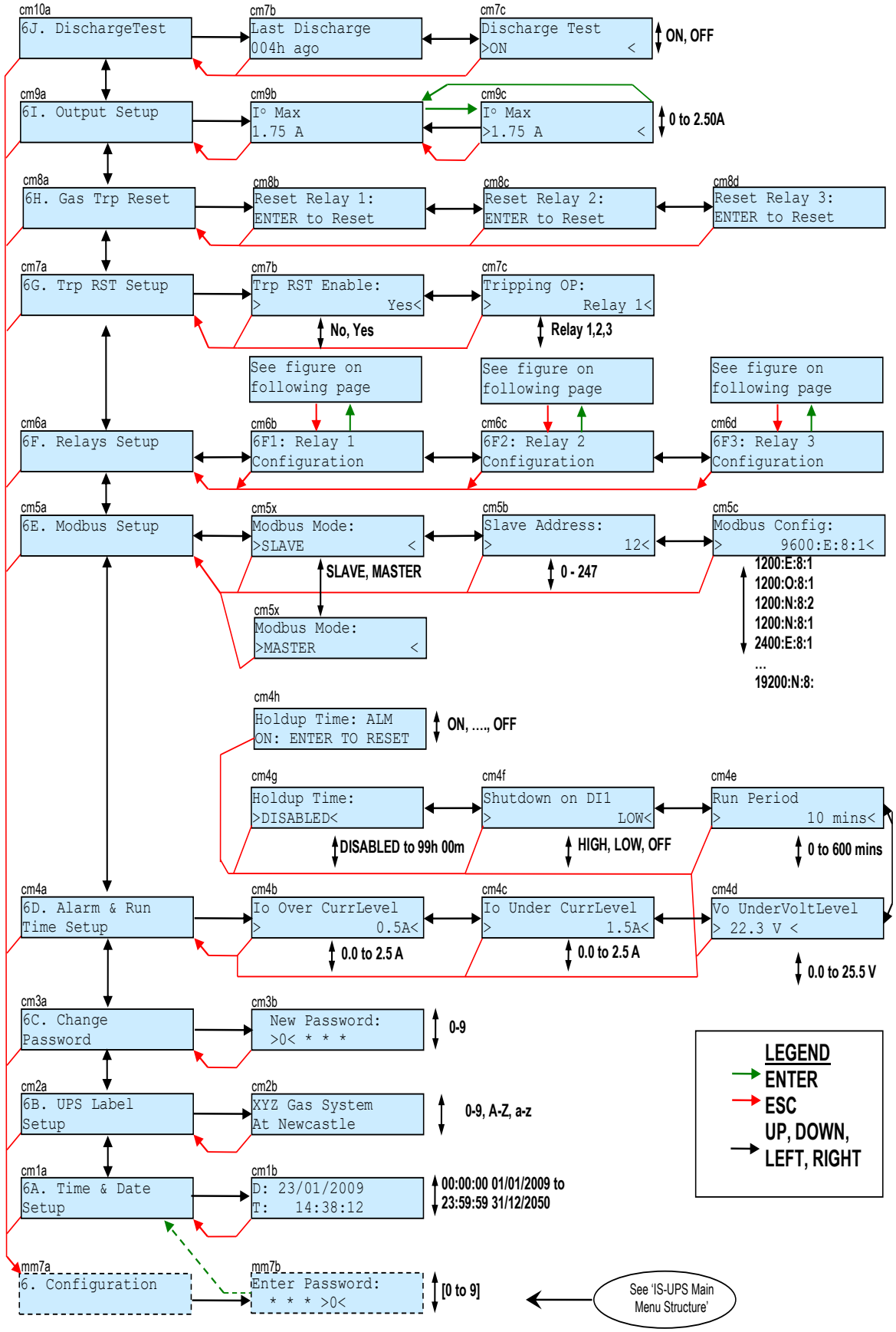


Figure 6.3: Configuration Menu

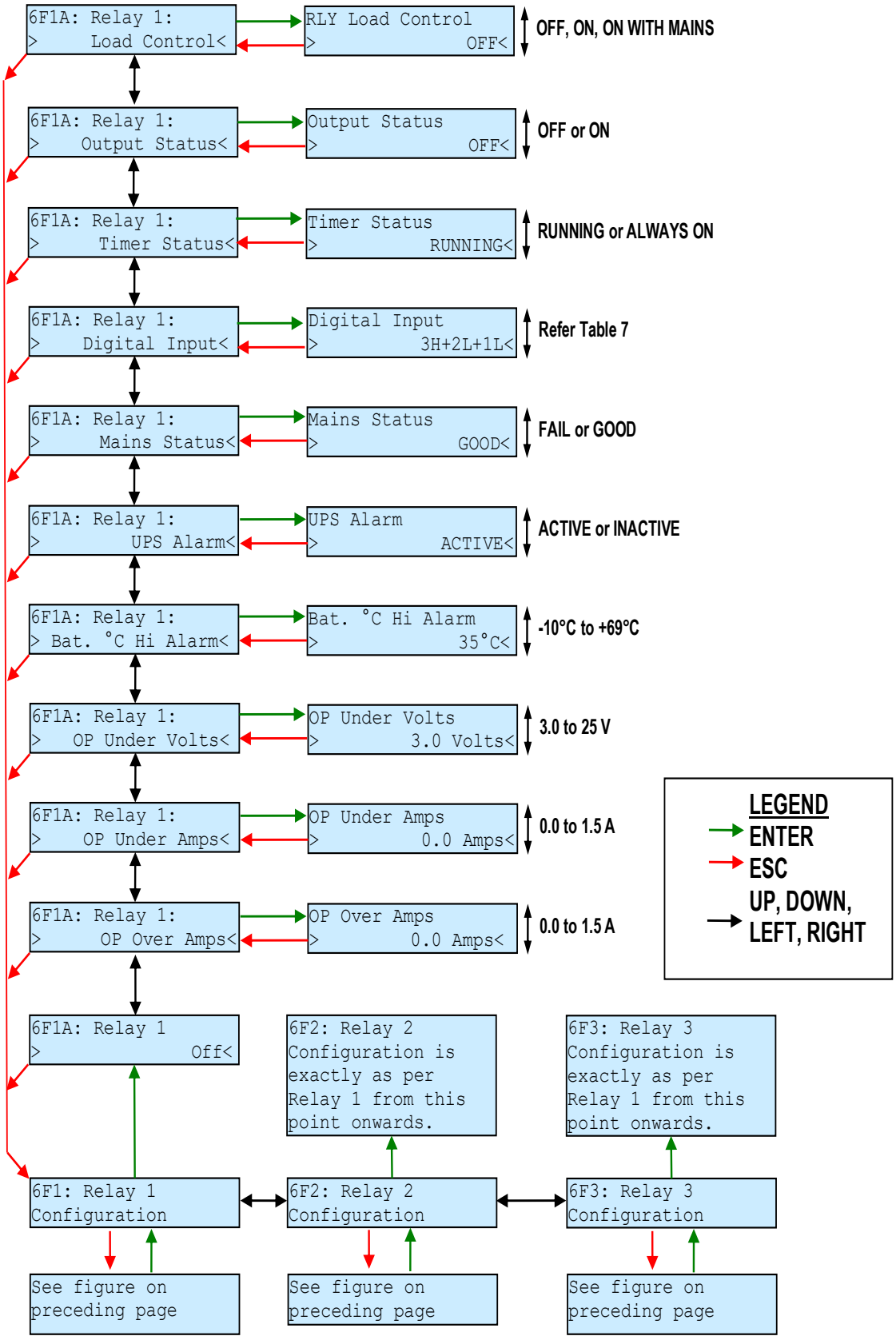
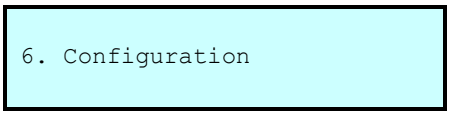


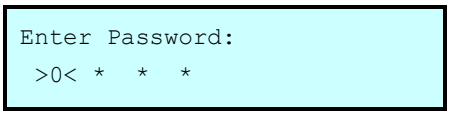
Figure 6.4: Configuration Menu – Relay

6.3.1 Configuration Menu

Press the UP button to select the “Configuration” menu. This menu can be used to View and Modify or change the configuration settings. To gain access to the configuration menus, a valid password must first be entered.



Pressing the RIGHT or ENTER button progresses the display to show the Password entry menu. An example is shown below:



Selection of the first digit of the password is done by progressive pressing of the UP and/or DOWN button. Pressing the RIGHT button will move to the next digit. Pressing the LEFT button will move to the preceding digit.

Once the four password digits have been entered, pressing the ENTER button will display the ‘6A: Time and Date Setup’ if the password is correct. If the password is not correct, the cursor will return to the left-most digit of the password entry display. After all the password entry digits are cleared, the password can be re-entered.

Press the LEFT button to move back to the previous digit or, if in the left-most digit, the previous menu.

NOTE

The correct password must be entered to gain access to the configuration menus.

The factory default password is set to ‘0000’ (four zeros).

To prevent unsolicited tampering with the configuration settings, it is recommended that the password be changed once the configuration is completed.

CAUTION!

Be sure to set the new password to a value that is easily remembered because access cannot be gained to the configuration settings without the password.

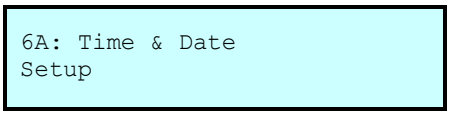
A lost or forgotten password will require returning the unit to Ampcontrol for resetting.

Refer to Section 6.3.3 for the Password Management Menu.

The “Configuration” menu has 6-submajor menus that allow access to change the settings belonging to these categories.

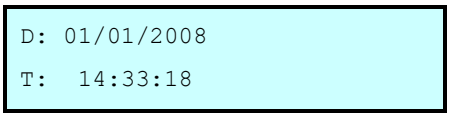
To gain access to the major sub-menus, press the UP button while in any of the major sub-menus, pressing the RIGHT button will open the sub-menu and the settings can be changed here.

6.3.2 Time and Date Menu – 1st Major Sub-Menu



Press the UP button to gain access to this menu. This is the 1st Major Sub-Menu. To change the settings in it, press the RIGHT button and it will provide the editable menu.

6.3.2.1 Time and Date Setup Menu

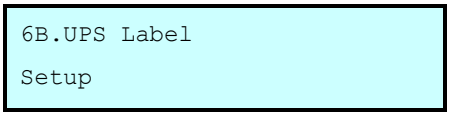


This menu allows entry of the current date and time. The element (day, month, year, hour minute or second) of date/time that is active for modification is indicated with a flashing block ('▉'). The value of the element can be increased or decreased in value using the UP or DOWN buttons. Selection of the elements can be done using the LEFT and RIGHT buttons. Press the ENTER button to save the changes. Press the ESC button to return to the Time and Date Setup Menu (1st Major Sub-Menu).

NOTE

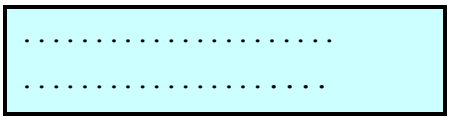
The ISUPS time and date is set to the current time in the factory.

6.3.2.2 User Defined Label – 2nd Major Sub-Menu



Press the UP button to access this menu. A user definable label to be given to the ISUPS is entered here. Normally, information that is relevant to the user regarding the installation of the ISUPS is entered at this menu. This information is displayed on the Main Status sub-menu. Press the RIGHT button to access the editable menu.

6.3.2.3 UPS Label Setup Menu



Upon entry to this menu, a flashing block will appear in the upper left corner. The UP or DOWN button can be pressed to select the desired character for the position of this label. A single press of the UP button will select the next character/digit; conversely, a single press of the DOWN button will select the previous character/digit. If either the UP or DOWN buttons are pressed, then rapid progression of the next or previous characters will be selected.

The RIGHT button will allow the next character in the label to be selected for editing. Successive presses of the RIGHT button will move the block to the last character of the bottom line, then an additional press of the RIGHT button will move focus to the top left of the menu.

The LEFT button will allow either the previous character to be selected for editing; except if the block is already in the upper-left corner of the display, the last character will be moved into focus.

The ENTER button saves the setting into memory. Press the ESC button to return to the User Defined Label Menu (2nd Major Sub-Menu).

NOTE

The Label has no default value – it will appear as a blank screen after factory initialisation

6.3.3 Password Management Menu – 3rd Major Sub-Menu

Press the UP button to access the Password Management Menu. Under this menu there is an editable menu that will allow the operator to enter the new password. To enter, press the RIGHT button.

6.3.3.1 Password Change Menu

The Password Change Menu allows the user to change the configuration menu entry password.

Pressing the UP or DOWN buttons will change the password digit with the focus up or down, respectively. Pressing the RIGHT button will move the focus to the next digit. The LEFT button will move the focus to the preceding digit, providing that it is not the first digit (left-most digit). If the focus is on the first digit, and the LEFT button is pressed, then it will move the focus to the last digit.

The ENTER button saves the setting into memory. Press the ESC button to return to the Password Management Menu (3rd Major Sub-menu).

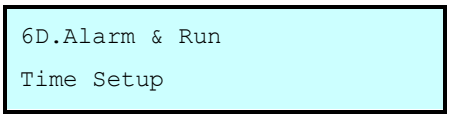
CAUTION!

Be sure to set the new password to a value that is easily remembered because access cannot be gained to the configuration settings without the password.

A lost or forgotten password will require returning the unit to Ampcontrol for resetting.

6.3.4 ISUPS Output (Alarm & Run Time) Menu – 4th Major Sub-Menu

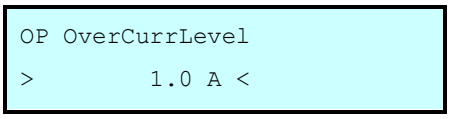
If these undervoltage or undercurrent alarms are set above 0, the undervoltage and undercurrent alarms will be active if the ISUPS CPU is active. I.e. Mains power is on and the ISUPS output is off.



Press the UP button to access this menu. This major sub-menu allows the viewing and setting of various ISUPS parameters, as follows:

- The output overcurrent level
- The output undercurrent level
- The output undervoltage level
- Run time and
- Shutdown on DI1
- Holdup Time Setup

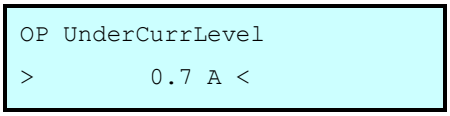
6.3.4.1 Output Overcurrent Level Menu



Press the RIGHT button to gain access to this menu. This menu allows entry of the level of current that will result in the Output Overcurrent alarm being activated. The UP/ DOWN button increments/decrements the setting in 0.1 Amp intervals. The minimum setting is 0.0 Amps, the maximum is 2.5 Amps. This is set to the maximum output current of the model in the factory. Hysteresis is 20% of the current limit from Table 1.

- The RIGHT button progresses to the next menu
- The LEFT button returns to the previous menu
- The ENTER button saves the setting into memory
- Press the ESC button to return to ISUPS Output Menu (4th Major Sub-Menu)

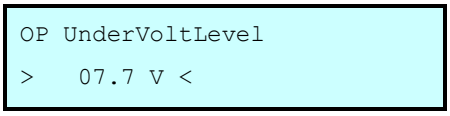
6.3.4.2 Output Undercurrent Level Menu



Press the RIGHT button to gain access to this menu. This menu allows entry of the level of current that will result in the Output Undercurrent alarm being set. The UP/DOWN button increments/decrements the setting in 0.1 Amp intervals. The minimum setting is 0.0 Amps, the maximum being 2.5 Amps. Default setting 0.0A; Hysteresis is 20% of the current limit from Table 1.

- The RIGHT button progresses to the next menu
- The LEFT button returns to the previous menu
- The ENTER button saves the setting into memory
- Press the ESC button to return to ISUPS Output Menu (4th Major Sub-Menu)

6.3.4.3 Output Under Volts Level Menu



Press the RIGHT button to gain access to this menu. This menu allows entry of the level of voltage that will result in the Output undervoltage alarm being set. The UP/DOWN button increments/decrements the setting in 0.1 Volt intervals. The minimum setting is 0.0 Volts, the maximum being 25.5 Volts. Default setting 1.8 V; Hysteresis is 20% of the voltage limit from Table 1.

- The RIGHT button progresses to the next menu
- The LEFT button returns to the previous menu
- The ENTER button saves the setting into memory
- Press the ESC button to return to ISUPS Output Menu (4th Major Sub-Menu)

6.3.4.4 Run Period Menu

```
Run Period
> 500 minutes <
```

Press the RIGHT button to gain access to this menu. This menu allows selection of how long the ISUPS will provide output (without mains power), in 10-minute intervals. The setting can be from 0 minutes through to a maximum of 600 minutes (10 hours) or 'ALWAYS ON' using the UP/DOWN buttons. In the 'ALWAYS ON' mode the timer is deactivated, and the ISUPS will continue to run until the battery low voltage is reached and the ISUPS shuts down. The run time is only active while ISUPS is running from Battery. If the ISUPS is stopped because it has exceeded the run time or low battery voltage and the mains power is returned, the ISUPS will start and remain running with the run time counter disabled. The ISUPS cannot be started while the "RESET LED" is flashing (this only happens when ISUPS is stopped by pressing the keypad Stop button). This means it is in lock mode and needs to be reset by pressing the keypad Reset button before any start command can be given. Default setting is 'ALWAYS ON'.

- The RIGHT button progresses to the next menu
- The LEFT button returns to the previous menu
- The ENTER button saves the setting into memory
- Press the ESC button to return to the ISUPS Output Menu (4th Major Sub-Menu)

6.3.4.5 Shutdown on DI1 Menu

```
Shutdown on DI1
>          HIGH<
```

Press the RIGHT button to gain access to this menu. This menu allows selection of whether the ISUPS will shut down from Digital Input-1. The available options are OFF, HIGH or LOW. For example, when set to OFF, no action will be taken when Digital Input-1 changes state. If set to HIGH, then the ISUPS will shut down when Digital Input-1 changes to a high state. If set to LOW, the ISUPS will shut down when Digital Input-1 changes to a low state.

CAUTION!

This feature only operates when the ISUPS is in Battery mode, and it can only be used to shut down the ISUPS.

To enable restart, Digital Input-1 must be in a high state if set to LOW and in a low state if set to HIGH. The local start button or an external start button from the terminal board may then be used to restart the ISUPS.

Switching mains power on after a shutdown caused by DI1 will start the ISUPS but if the mains power is disconnected the ISUPS will shut down again. To fully utilise the ISUPS ensure that the actual DI1 is opposite to the screen setting (in a high state if set to LOW and in a low state if set to HIGH) before the mains is applied. Default setting is OFF.

- The RIGHT button has no effect
- The LEFT button will return to the previous menu
- The ENTER button saves the setting into memory
- Press the ESC button to return to ISUPS Output Menu (4th Major Sub-Menu)

WARNING!

Once this setting has been saved to memory, it will be acted upon immediately and may cause the ISUPS to shut down in a 'locked out' state.
For example: If DI1 state is currently HIGH, and the setting is changed to HIGH and saved to memory, the ISUPS will shut down immediately and remain shut down until DI1 goes to the LOW state and a "Start" command is issued.

6.3.4.6 Holdup Time

```
Holdup Time
>4 h 00m          <
```

Press the RIGHT button to gain access to this menu. This menu allows selection the Hold Up Time. The available options are DISABLED and 00 h 30 m to 99 h 00 m in 30 min increments. Press ENTER and then the UP and DOWN button to cycle through the options. Press ENTER to save. When set to DISABLED OFF, the Discharge Test will not run.

NOTE

When set to DISABLED, the Discharge Test is also disabled.

If set to a value other than DISABLED, the Discharge Test will run periodically (weekly). If during or after the test the capacity of the battery is not sufficient to supply the average connected load for the time nominated, the Hold Up Time Alarm will be activated.

```
Holdup Time: ALM
ON: ENTER TO RESET
```

If the hold-up time alarm is activated, it can be reset using the above screen. Press ENTER to reset the alarm.

6.3.5 Modbus Communications Menu – 5th Major Sub-Menu

```
6E.Modbus Setup
```

Press the UP button to access this menu. The Modbus Configuration, menu allows the editing of the Modbus port settings. It has two sets of sub-menus depending on whether the Slave or Master mode is selected.

- Pressing the RIGHT button progresses the display to show the Modbus Mode Menu
- Pressing the UP or DOWN button navigates to the adjacent menus
- Pressing the LEFT button has no effect

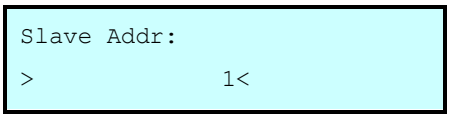
6.3.5.1 Modbus Mode Menu

```
Modbus Mode:
>SLAVE          <
```

Press the RIGHT button to access to this menu. This menu allows selection of the mode of the Modbus function. Slave mode is set by default and is used to communicate with PLCs, Computers and Gateway devices. Master mode is not available for use.

- Pressing the UP or DOWN button cycles between Slave and Master modes
- Pressing the ENTER button saves the setting into memory
- Pressing the LEFT button returns to the Modbus Setup menu
- Pressing the RIGHT button moves to the next menu which is dependent on the Mode selected

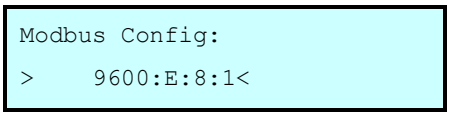
6.3.5.2 Modbus Slave Address Menu



Press the RIGHT button to access to this menu if in Slave Mode. This menu allows selection of the slave address of the device. The selection of address 0 will switch the Modbus communications OFF; any other address will cause the unit to respond to messages of the same address. By default, address 1 is selected.

- Pressing the UP or DOWN button cycles between Slave Addresses
- Pressing the ENTER button saves the setting into memory
- Pressing the LEFT button returns to the Modbus Mode menu
- Pressing the RIGHT button moves to the Modbus Configuration Menu

6.3.5.3 Modbus Configuration Menu



Press the RIGHT button to access to this menu. This menu allows selection of the baud rate, parity and stop bits for the Modbus communications. Note that the data format is fixed to 8 bits, and therefore is not selectable.

Selection is made by multiple presses of the UP or DOWN buttons. The possible settings are as in Table 4, following.

- The RIGHT button has no effect
- Pressing the UP or DOWN button cycles between the options
- The LEFT button returns to the previous menu
- The ENTER button saves the setting into memory. Press the ESC button to return to Modbus Configuration View and Modify Menu (5th Major Sub-Menu)

Table 4: Possible Modbus Communications Settings

Baud	Parity	Bits	Stop
1200	E	8	1
1200	O	8	1
1200	N	8	2
1200	N	8	1
2400	E	8	1
2400	E	8	2
2400	O	8	1
2400	N	8	2
2400	N	8	1
4800	E	8	1
4800	O	8	1
4800	N	8	2
4800	N	8	1
9600	E	8	1
9600	O	8	1
9600	N	8	2
9600	N	8	1
19200	E	8	1
19200	O	8	1
19200	N	8	2
19200	N	8	1

6.3.6 Relay Configuration Modify Menu – 6th Major Sub-Menu

```
6F.Relays Setup
```

Press the UP button to access this menu. This major sub-menu allows the viewing and setting of the Relay driving source and the level of the parameter at which it will activate the relay. Progressive pressing of the RIGHT button will access the configuration menu for Relay 1, 2 or 3 (See note below).

NOTE

The procedures and illustrations applicable to Relay 1 are discussed in this section but the method of configuration is the same for all 3 relays once the appropriate relay configuration menu has been selected.

6.3.6.1 Relay Configuration Menu

```
6F1.Relay 1
Configuration
```

Press the RIGHT button to access this menu. When in this menu, press the ENTER button to access the source selection menu to select the relay driving source. One of the sources in *Table 5* can be selected as the relay driving source by pressing the UP or DOWN buttons. Once the driving source is selected, press the ENTER button to access the editable menu for the selected source parameter. The value may then be set by pressing the UP/DOWN (increase/decrease) buttons. Press ENTER again to save the settings. The default setting for all three relays is 'OFF'.

NOTE

The "Trip Reset Latch" source cannot be selected in this menu. A separate configuration menu is used to configure the Trip Reset Latch function and to assign a relay to it.

6.3.6.2 Configure Relay 1 Using "Output Under Volts" Menu

If the undervoltage alarm is set above 0, the undervoltage alarm will be active if the ISUPS CPU is active. I.e. Mains power is on and/or the ISUPS output is on.

The following example shows the selection of 'Output Undervoltage' as the driving source for Relay-1 and its parameter value set to 10 V, at which point it will activate the Relay-1.

While in the "6F1.Relay 1 Configuration" menu, press the ENTER button, then progressively press the UP button until it displays 'Output Under Volt' in the bottom line on the display – then press the ENTER button again to open the source parameter editable menu. Here enter '10V' by pressing the UP/DOWN (increase/decrease) button, then press the ENTER button to save these settings. After these steps are completed, the Relay-1 will be activated whenever the output volts fall below 10 V. The configurable minimum and maximum values are 0.0 V & 25.5 V respectively. Hysteresis is 20% of the voltage limit from Table 1.

Press the ESC button to return to the Relay Configuration Modify Menu (6th Major Sub-Menu).

Relay Source Selection Menu

```
6F1A: Relay 1
>OP Under Volts<
```

Output Under Volts Selection Menu

```
OP Under Volts
> 10Volt<
```

NOTE

If alarm value is set above 0, the undervoltage alarm will be active if the ISUPS CPU is active. I.e. Mains power is on and/or the ISUPS output is on.

Table 5: List of Relay Driving Sources

SN	Available Relay driving Source
1	Off
2	Output Overcurrent (OP Over Amps)
3	Output Undercurrent (OP Under Amps)
4	Output Undervoltage (OP Under Volts)
5	Battery Temperature Alarm (Bat.°C Hi Alarm)
6	UPS Alarm (UPS Alarm)
7	Mains Status (Mains Status)
8	Digital Input (Digital Input)
9	Timer Status (Timer Status)
10	Output Status (Output Status)
11	Trip Reset Latch (Trip Reset Latch)
12	GG2 Modbus Master Trip

6.3.6.3 Configure Relay 1 Using "Output Overcurrent" Menu

While in the "6F1.Relay 1 Configuration" menu, press the ENTER button, then progressively press the UP button until it displays 'OP Over Amps' in the bottom line on the display – then press the ENTER button again to open the source parameter editable menu. Here enter '0.40A' by pressing UP/DOWN (increase/decrease) buttons, then press the ENTER button once again, to save these settings. After these steps are completed, the Relay-1 will be activated whenever the output current rises above 0.40 A. The configurable minimum and maximum values are 0.0 A & 2.5 A. Hysteresis is 20% of the current limit from Table 1.

Press the ESC button to return to the Relay Configuration Modify Menu.

Relay Output Overcurrent Menu

```
6F1A:Relay 1
>  OP Over Amps<
```

Output Overcurrent Setting Menu

```
OP Over Amps
> 0.40 Amps <
```

6.3.6.4 Configure Relay 1 Using "Output Undercurrent" Menu

If the undercurrent alarm is set above 0, the undercurrent alarm will be active if the ISUPS CPU is active. I.e. Mains power is on and/or the ISUPS output is on.

While in the "6F1.Relay 1 Configuration" menu, press the ENTER button, then progressively press the UP button until it displays 'Output Undercurrent' in the bottom line on the display – then press the ENTER button again to open the source parameter editable menu. Here enter '0.30A' by pressing the UP/DOWN (increase/decrease) buttons, then press the ENTER button once again, to save these settings. After these steps are completed, the Relay-1 will be activated whenever the output current drops under 0.30 A. The configurable minimum and maximum values are 0.0 A & 2.5 A. Hysteresis is 20% of the current limit from Table 1.

Press the ESC button to return to the Relay Configuration Modify Menu.

Relay Output Undercurrent Menu

```
6F1A:Relay 1
> OP Under Amps<
```

Output Undercurrent Setting Menu

```
OP Under Amps
> 0.3 Amps <
```

NOTE

If alarm value is set above 0, the undercurrent alarm will be active if the ISUPS CPU is active. I.e. Mains power is on and/or the ISUPS output is on.

6.3.6.5 Configure Relay 1 Using "Battery Temperature Alarm" Menu

While in the "6F1.Relay 1 Configuration" menu, press the ENTER button, then progressively press the UP button until it displays 'Bat °C Hi Alarm' in the bottom line on the display – then press the ENTER button again to open the source parameter editable menu. Here enter '45 °C' for example by pressing the UP/DOWN (increase/decrease) buttons until the required value is displayed, then press the ENTER button once again, to save these settings. After these steps are completed, the Relay-1 will be activated whenever the Battery temperature reaches to 45 °C. The minimum setting is 0 °C and the maximum setting is +69 °C. After the relay activates, the relay will de-energise once the Temperature has fallen
1 °C below the setting.

Press the ESC button to return to the Relay Configuration Modify Menu.

Relay Battery Temperature Alarm Menu

```
6F1A:Relay 1
>Bat. °C Hi Alrm<
```

Battery Temperature Setting Menu

```
Bat. °C Hi Alarm:
> 45 °C <
```

6.3.6.6 Configure Relay 1 Using "UPS Alarm" Menu

While in the "6F1.Relay 1 Configuration" menu, press the ENTER button, then progressively press the UP button until it displays 'UPS Alarm' in the bottom line on the display – then press the ENTER button to access the editable menu, press the UP button to select 'Active/Inactive' then press ENTER to save the settings. If the 'Active' is selected, the Relay-1 will be activated when any of the UPS alarms situation arises. These alarms settings are in the "6D.Alarm and Run Time Setup" menu.

Pressing the ESC button returns to the Relay Configuration Modify Menu.

Relay x UPS Alarm Menu

```
6F1A:Relay 1
>     UPS Alarm<
```

UPS Alarm Setting Menu

```
UPS Alarm
>      ACTIVE<
```

6.3.6.7 Configure Relay 1 Using "Mains Status" Menu

While in the "6F1.Relay 1 Configuration" menu, press the ENTER button, then progressively press the UP button until it displays 'Mains Status' in the bottom line on the display – then press the ENTER button again to open the source parameter editable menu. Here enter 'FAIL/GOOD' by pressing the UP/DOWN buttons, then press the ENTER button once again, to save these settings. If 'FAIL' is selected, the Relay-1 will be activated whenever the Mains fail. If 'GOOD' is selected the Relay-1 will be activated whenever the main is ON.

Press the ESC button to return to the Relay Configuration Modify Menu.

Relay x Mains Status Menu

```
6F1A:Relay 1
>  Mains Status<
```

Mains Supply Setting Menu

```
Mains Status
>          FAIL<
```

6.3.6.8 Configure Relay 1 Using “Digital Input” Menu

This option allows various combinations of the Digital Inputs to drive each of the relays. While in the “6F1.Relay 1 Configuration” menu, press the ENTER button, then progressively press the UP button until it displays ‘Digital Input’ in the bottom line on the display – then press the ENTER button again to open the source parameter editable menu. Here enter ’3H 2L 1L’ by pressing the UP/DOWN buttons, then press the ENTER button once again, to save these settings. After these steps are completed, the Relay-1 will be activated whenever the three Digital Inputs match the set up. See Table 6 ‘Available Digital Input setting list’ following for various options of setting.

The options for each input are as follows:

- Ignored (I) – The state of the input is not considered in the logic of the relay operation
- High (H) – The input needs to be in the high state, i.e. input on
- Low (L) – The input needs to be in the low state, i.e. input off

For example, 3H+2L+1L means the relay will close if input 3 is on and input 2 and 1 are off. In all other states the relay will be open. If the setting is changed to 3I+2H+1H the relay will close if both input 2 and 1 are on. Input 3 can be in any state as it is ignored.

Pressing the ESC button returns to the Relay Configuration Modify Menu.

Relay Digital Input Menu

```
6F1A:Relay 1
> Digital Input<
```

Digital Input Setting Menu

```
Digital Input
>      3H+2L+1L<
```

Table 6: Available Digital Input Setting List

Index	Digital Input-3 Non-Isolated	Digital Input-2 Isolated	Digital Input-1 Isolated
1	IGNORED	IGNORED	IGNORED
2			LOW
3			HIGH
4		LOW	IGNORED
5			LOW
6			HIGH
7		HIGH	IGNORED
8			LOW
9			HIGH
10	LOW	IGNORED	IGNORED
11			LOW
12			HIGH
13		LOW	IGNORED
14			LOW
15			HIGH
16		HIGH	IGNORED
17			LOW
18			HIGH
19	HIGH	IGNORED	IGNORED
20			LOW
21			HIGH
22		LOW	IGNORED
23			LOW
24			HIGH
25		HIGH	IGNORED
26			LOW
27			HIGH

6.3.6.9 Configure Relay 1 Using “Timer Status” Menu

While in the “6F1.Relay 1 Configuration” menu, press the ENTER button, then progressively press the UP button until it displays ‘Timer Status’ in the bottom line of the display – then press the ENTER button again to open the source parameter editable menu. Here enter ‘RUNNING/ALWAYS ON’ by pressing the UP/DOWN buttons, then press the ENTER button once again, to save these settings. If ‘RUNNING’ is selected, the Relay-1 will be activated when the ISUPS is running from the battery and the timer is running (Refer Section 6.3.4.3 “Run Period Menu”). If ‘ALWAYS ON’ is selected, the Relay-1 will be activated if the timer is set to ‘ALWAYS ON’.

Pressing the ESC button returns to the Relay Configuration Modify Menu.

Relay Timer Status Menu

```
6F1A:Relay 1
>  Timer Status<
```

Timer Status Setting Menu

```
Timer Status
>     ALWAYS ON<
```

6.3.6.10 Configure Relay 1 Using “Output Status” Menu

The Relay-1 Output Status Setting assigned the operation of the relay to the state of the main DC output. . While in the “6F1.Relay 1 Configuration” menu, press the ENTER button, then progressively press the UP button until it displays ‘Output Status’ in the bottom line on the display – then press the ENTER button again to open the source parameter editable menu. Here enter ’ON/OFF’ by pressing the UP/DOWN buttons, then press the ENTER button to save these settings. If ‘ON’ is selected, the Relay-1 will be activated when the Output is enabled. If ‘OFF’ is selected, the Relay-1 will be activated when the Output turns off.

Pressing the ESC button returns to the Relay Configuration Modify Menu.

Relay Output Status Menu

```
6F1A:Relay 1
> Output Status<
```

Output Status Setting Menu

```
Output Status
>           ON<
```

Relay Off Menu

```
6F1A:Relay 1
>           OFF<
```

6.3.6.11 Configure Relay 1 Using “Load Control” Menu

This Function is not currently implemented.

6.3.6.12 Configure Relay 1 Using “Trip Rst Latch” Menu

Assigning a relay to the trip reset latch function cannot be done in this configuration menu but is instead done in the “Trip Reset Latch” configuration menu.

It is displayed in this menu only to inform the operator that the relay has been assigned to this function.

6.3.7 Trip / Reset Latch – 7th Major Sub-Menu

```
6G. Trp RST Setup
```

Press the UP button to access this menu. This major sub-menu allows the viewing and setting of the trip reset function. When active, this function allows trips from external devices to be latched.

6.3.7.1 Enable / Disable Menu

```
Trp RST Enabled:
>           Yes<
```

Press the RIGHT button to access this menu.

The Enable / Disable menu allows the trip reset latch function to be enabled or disabled. Pressing UP or DOWN will change the enable state between “Yes” and “No”. Pressing ENTER will save the state.

When set to “Yes” the trip reset latch function is enabled and the below functions are automatically assigned to the digital inputs shown below.

NOTE

Assigning the below inputs to the Trip / Reset Latch function DOES NOT override any previous assignments. I.e. If the “Shutdown on DI1” function is enabled the ISUPS will shut down on DI1 regardless of the Trip / Reset Latch function.

Table 7: Trip / Reset Latch Operation

DI2 (Trip Input)	DI1 (Reset Input)	State	Relay (Selectable) (Output)
Low	Low	Healthy	Closed
	High		
	Toggle (Low-High-Low)		
High	Low	Tripped	Open
	High		
	Toggle (Low-High-Low)		
Low	Low		
	High		
	Toggle (Low-High-Low)	Healthy	Closed

6.3.7.2 Tripping Output Menu

```
Tripping OP:
>       Relay 1<
```

Press the RIGHT button to access this menu.

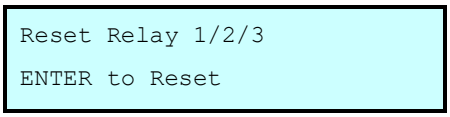
The Tripping Output menu allows the output relay to be selected. Pressing UP or DOWN will select the relay. Pressing ENTER will save the selection.

NOTE

Selecting a relay on this menu will override any other function assigned to the relay. De-selecting a relay or turning off the Trip / Reset Latch function will not return the relay to its’ previous setting. This must be done manually on the relevant menu.

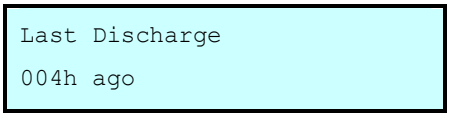
6.3.8 Output Setup

Press the UP button to access the Output Setup menu. This menu can be used to select Io Max. At this stage Io Max has no assigned function.

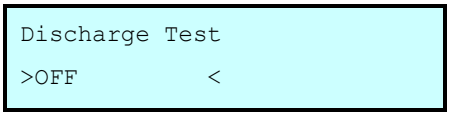


6.3.9 Discharge Test

Press the UP button to access the Discharge Test Setup menu. The first menu to the right allows the user to see the time the last discharge was performed. This could be due to a Discharge test or a mains off event.



Pressing RIGHT again takes you to a menu allowing a Discharge Test to be manually started.



Once on the screen press UP and then ENTER to commence a Discharge Test.

7 MODBUS & MEMORY MAP

A two-wire RS485 interface is provided to allow Modbus Master to query the ISUPS using RTU Modbus protocol. The various Modbus registers exposed by the device are shown in the Memory Map section following. The RS485 configuration is shown in the Modbus Configuration Menu in Section 6.3.5.3. An external dc power supply is required to enable the RS485 communications.

7.1 Memory Map

7.1.1 Discrete Outputs (0X Reference)

Discrete outputs (0X References)			
Bit Address	**Name**	**Comment**	**Modbus Functions Supported**
1	Mains Status	0 = Off, 1 = On	Read Coil Status(0X01)
2	Output Status	0 = Off, 1 = On	Read Coil Status(0X01)
3	Modbus Status	0 = Off, 1 = On	Read Coil Status(0X01)
4	Relay 1	0 = Off, 1 = On	Read Coil Status(0X01), Write Single Coil(0X05)
5	Relay 2	0 = Off, 1 = On	Read Coil Status(0X01), Write Single Coil(0X05)
6	Relay 3	0 = Off, 1 = On	Read Coil Status(0X01), Write Single Coil(0X05)
7	Reserved		
8	Reserved		
9	Up Button	1 = Pressed	Read Coil Status(0X01), Write Single Coil(0X05)
10	Down Button	1 = Pressed	Read Coil Status(0X01), Write Single Coil(0X05)
11	Left Button	1 = Pressed	Read Coil Status(0X01), Write Single Coil(0X05)
12	Right Button	1 = Pressed	Read Coil Status(0X01), Write Single Coil(0X05)
13	ESC Button	1 = Pressed	Read Coil Status(0X01), Write Single Coil(0X05)
14	ENTER Button	1 = Pressed	Read Coil Status(0X01), Write Single Coil(0X05)
15	START Button	0 = Pressed	Read Coil Status(0X01)
16	STOP Button	1 = Pressed	Read Coil Status(0X01)
17	Reserved		
18	Reserved		
19	Reserved		
20	Reserved		
21	Digital Input 1	0 = Low, 1 = High	Read Coil Status(0X01)
22	Digital Input 2	0 = Low, 1 = High	Read Coil Status(0X01)
23	Digital Input 3	0 = Low, 1 = High	Read Coil Status(0X01)
24	Reserved		
25	Overload Current Sense 1	OLC1 Input	Read Coil Status(0X01)
26	Overload Current Sense 2	OLC2 Input	Read Coil Status(0X01)
27	Overload Current Sense 3	OLC3 Input	Read Coil Status(0X01)
28	Reserved		
29	Latched Overload Current Sense 1	OLC1 Latch	Read Coil Status(0X01)
30	Latched Overload Current Sense 2	OLC2 Latch	Read Coil Status(0X01)

Discrete outputs (0X References)			
Bit Address	**Name**	**Comment**	**Modbus Functions Supported**
31	Latched Overload Current Sense 3	OLC3 Latch	Read Coil Status(0X01)
32	Reserved		
33	Reserved		
34	Reserved		
35	Reserved		
36	Reserved		
37	Reserved		
38	Reserved		
39	Reserved		
40	Reserved		
41	Reserved		
42	Reserved		
43	Reserved		
44	Reserved		
45	Reserved		
46	Reserved		
47	Reserved		
48	Reserved		
49	Reserved		
50	Reserved		
51	Reserved		
52	Reserved		
53	Reserved		
54	Reserved		
55	Reserved		
56	Reserved		

7.1.2 Input Registers (3X References)

Input Registers (3X References)			
Bit Address	**Name**	**Comment**	**Modbus Functions Supported**
1	System Timer (MSW)	Seconds	Read Input Registers(0X04)
2	System Timer (LSW)		Read Input Registers(0X04)
3	Battery Temperature	ºC	Read Input Registers(0X04)
4	Battery Bus Voltage	mV	Read Input Registers(0X04)
5	Mains Input Voltage (Indicative only)	V	Read Input Registers(0X04)
6	DC Output Voltage	mV	Read Input Registers(0X04)
7	DC Output Current	mA	Read Input Registers(0X04)
8	Battery Voltage	mV	Read Input Registers(0X04)
9	Battery Discharge Current	mA	Read Input Registers(0X04)
10	Battery Charge Current	mA	Read Input Registers(0X04)

7.1.3 Condensed Input Registers (3X References)

These registers support Read Input Registers (0X04).

Input Registers (3X References)			
Register	**Name**	**Comment**	**READ/WRITE**
101	Output Timer Run Time	Minutes See section 0	R
102	Battery Run Time Remaining	Battery Run Time Estimate in Minutes 00 h 00 m – 99 h 59 m (0-5999 min)	R
103	Output Current and Battery Voltage	Bits 15:08 = Io / 10 mA (0-2.54 A in 10 mA steps) Bits 07:00 = (Vb-20000 mV)/0.05 mV (20-32.7 V in 50 mV steps)	R
104	Mains Fail, Battery Temperature and Mains Voltage	Bits 15:15 = Mains Fail (1=no mains) Bits 14:08 = Tbat (0 to 64 in 1 °C Steps) Bits 07:00 = Vmains (0-254 V in 1 V steps)	R
105	Mains Input Voltage (Indicative only)	Bits 15:15 = Io OL (1 = Overload) Bits 14:14 = Io UC (1= Undercurrent) Bits 13:13 = Uo UV (1 = Undervoltage) Bits 12:12 = DI3 (1 = on) Bits 11:11 = DI2 (1 = on) Bits 10:10 = DI1 (1 = on) Bits 9:9 = RL3 (1 = on) Bits 8:8 = RL2 (1 = on) Bits 7:7 = RL1 (1 = on) Bits 6:0 = SoC (0-100% in 1% steps)	R
106	Battery Charge and Discharge Currents	Bits 15:08 = Ib Discharge (0-2.54 A in 10 mA steps) Bits 07:00 = Ib Charge (0-2.54 A in 10 mA Steps)	R
107	Battery Bus and DC Output Voltage	Bits 15:08 = (Vbb-20000 mV)/0.05 mV (20-32.7 V in 50 mV steps) Bits 07:00 = Uo / 100 mV (0-25.4 V in 100 mV steps)	R

7.1.4 Holding Registers (4X References) – Control Registers Support Read/Write

Holding Registers (4X References) – Control Registers Support Read/Write			
Bit Address	**Name**	**Comment**	**Modbus Functions Supported**
1	Periodic Log Index	16-bit index of the **Periodic Log** to show at Holding Register starting : 101	Read Holding Registers(0X03), Pre-set Single Register(0X06)
2	Event Log Index	16-bit index of the **Event Log** to show at Holding Register starting : 201	Read Holding Registers(0X03), Pre-set Single Register(0X06)
3	Output Toggle Timer	16-bit timer in **seconds** to activate the output toggle operation. Setting this to a value greater than 0, immediately switches the output Off. The output would come on when this timer expires.	Read Holding Registers(0X03), Pre-set Single Register(0X06)
4 -100	Reserved		

7.1.5 Holding Registers (4X References) – Periodic Log Supports Read Only

Holding Registers (4X References) – Periodic Log Supports Read Only			
Bit Address	**Name**	**Comment**	**Modbus Functions Supported**
101	Periodic Log Entry Index	Register Index H	Read Holding Registers(0X03)
		Register Index L	Read Holding Registers(0X03)
102	Total Periodic Log Entries	Total Log Entries H	Read Holding Registers(0X03)
		Total Log Entries L	Read Holding Registers(0X03)
103	Time	Seconds	Read Holding Registers(0X03)
		Minutes	Read Holding Registers(0X03)
104		Hours (24 Hr Format)	Read Holding Registers(0X03)
		0 (Reserved)	Read Holding Registers(0X03)
105	Date	Day (1 – 31)	Read Holding Registers(0X03)
		Month (1 -12)	Read Holding Registers(0X03)
106		Year (– 2000)	Read Holding Registers(0X03)
		0 (Reserved)	Read Holding Registers(0X03)
107	Output Current (mA)	Output Current H	Read Holding Registers(0X03)
		Output Current L	Read Holding Registers(0X03)
108	Output Voltage (mV)	Output Voltage H	Read Holding Registers(0X03)
		Output Voltage L	Read Holding Registers(0X03)
109	Battery Current (mA)	Battery Current H	Read Holding Registers(0X03)
		Battery Current L	Read Holding Registers(0X03)
110	Battery Voltage (mV)	Battery Voltage H	Read Holding Registers(0X03)
		Battery Voltage L	Read Holding Registers(0X03)
111	Battery Temperature (ºC)	Battery Temperature	Read Holding Registers(0X03)
	ISUPS Status	ISUPS Status	Read Holding Registers(0X03)
112-200	Reserved		

7.1.6 Holding Registers (4X References) – Event Log & LCD Data Supports Read Only

Holding Registers (4X References) – Event Log & LCD Data Supports Read Only				
Bit Address	**Name**	**Comment**		**Modbus Functions Supported**
		Hex	**ASCII**	
201	Event log entry number	0x30	0	Read Holding Registers(0X03)
		0x31	1	Read Holding Registers(0X03)
202		0x37	7	Read Holding Registers(0X03)
		0x2C	,	Read Holding Registers(0X03)
203	Total event log entries	0x30	0	Read Holding Registers(0X03)
		0x39	9	Read Holding Registers(0X03)
204		0x39	9	Read Holding Registers(0X03)
		0x2C	,	Read Holding Registers(0X03)
205	Entry description	0x20		Read Holding Registers(0X03)
		0x20		Read Holding Registers(0X03)
206		0x20		Read Holding Registers(0X03)
		0x20		Read Holding Registers(0X03)
207		0x4F	O	Read Holding Registers(0X03)
		0x56	V	Read Holding Registers(0X03)
208		0x45	E	Read Holding Registers(0X03)
		0x52	R	Read Holding Registers(0X03)
209		0x20		Read Holding Registers(0X03)
		0x43	C	Read Holding Registers(0X03)
210		0x55	U	Read Holding Registers(0X03)
		0x52	R	Read Holding Registers(0X03)
211		0x52	R	Read Holding Registers(0X03)
		0x45	E	Read Holding Registers(0X03)
212		0x4E	N	Read Holding Registers(0X03)
		0x54	T	Read Holding Registers(0X03)
213		0x2C	,	Read Holding Registers(0X03)
	Output Current (Amps)	0x20		Read Holding Registers(0X03)
214		0x20		Read Holding Registers(0X03)
		0x20		Read Holding Registers(0X03)
215		0x20		Read Holding Registers(0X03)
		0x20		Read Holding Registers(0X03)
216		0x20		Read Holding Registers(0X03)
		0x20		Read Holding Registers(0X03)
217		0x20		Read Holding Registers(0X03)
		0x30	0	Read Holding Registers(0X03)
218		0x2E	.	Read Holding Registers(0X03)
		0x32	2	Read Holding Registers(0X03)
219		0x41	A	Read Holding Registers(0X03)
		0x2C	,	Read Holding Registers(0X03)
220	Output Voltage (Volts)	0x20		Read Holding Registers(0X03)
		0x20		Read Holding Registers(0X03)
221		0x20		Read Holding Registers(0X03)
		0x20		Read Holding Registers(0X03)
222		0x20		Read Holding Registers(0X03)
		0x20		Read Holding Registers(0X03)
223		0x20		Read Holding Registers(0X03)

Holding Registers (4X References) – Event Log & LCD Data Supports Read Only				
Bit Address	**Name**	**Comment**		**Modbus Functions Supported**
		Hex	**ASCII**	
		0x20		Read Holding Registers(0X03)
224		0x30	0	Read Holding Registers(0X03)
		0x2E	.	Read Holding Registers(0X03)
225		0x30	0	Read Holding Registers(0X03)
		0x56	V	Read Holding Registers(0X03)
226		0x2C	,	Read Holding Registers(0X03)
	Time recorded	0x30	0	Read Holding Registers(0X03)
227		0x39	9	Read Holding Registers(0X03)
		0x3A	:	Read Holding Registers(0X03)
228		0x35	5	Read Holding Registers(0X03)
		0x37	7	Read Holding Registers(0X03)
229		0x3A	:	Read Holding Registers(0X03)
		0x32	2	Read Holding Registers(0X03)
230		0x35	5	Read Holding Registers(0X03)
		0x20		Read Holding Registers(0X03)
231		0x30	0	Read Holding Registers(0X03)
		0x36	6	Read Holding Registers(0X03)
232		0x44	D	Read Holding Registers(0X03)
		0x65	e	Read Holding Registers(0X03)
233		0x63	c	Read Holding Registers(0X03)
		0x30	0	Read Holding Registers(0X03)
234		0x37	7	Read Holding Registers(0X03)
		0x0a	‘\n’	Read Holding Registers(0X03)
235	Current LCD Top Line		U	Read Holding Registers(0X03)
			P	Read Holding Registers(0X03)
236			S	Read Holding Registers(0X03)
				Read Holding Registers(0X03)
237			S	Read Holding Registers(0X03)
			t	Read Holding Registers(0X03)
238			a	Read Holding Registers(0X03)
			t	Read Holding Registers(0X03)
239			u	Read Holding Registers(0X03)
			s	Read Holding Registers(0X03)
240				Read Holding Registers(0X03)
			I	Read Holding Registers(0X03)
241			n	Read Holding Registers(0X03)
			f	Read Holding Registers(0X03)
242			o	Read Holding Registers(0X03)
				Read Holding Registers(0X03)
243	LCD Bottom Line		M	Read Holding Registers(0X03)
			a	Read Holding Registers(0X03)
244			i	Read Holding Registers(0X03)
			n	Read Holding Registers(0X03)
245			s	Read Holding Registers(0X03)
			:	Read Holding Registers(0X03)
246			O	Read Holding Registers(0X03)

Holding Registers (4X References) – Event Log & LCD Data Supports Read Only				
Bit Address	**Name**	**Comment**		**Modbus Functions Supported**
		Hex	**ASCII**	
			F	Read Holding Registers(0X03)
247			F	Read Holding Registers(0X03)
				Read Holding Registers(0X03)
248			O	Read Holding Registers(0X03)
			P	Read Holding Registers(0X03)
249			:	Read Holding Registers(0X03)
			O	Read Holding Registers(0X03)
250			N	Read Holding Registers(0X03)
				Read Holding Registers(0X03)
251-300	Reserved			

7.1.7 Holding Registers (4X References) – Date & Time Registers Support Read/Write

Holding Registers (4X References) – Control Registers Support Read/Write			
Bit Address	**Name**	**Description**	**Modbus Functions Supported**
301	Seconds In BCD format	Seconds of the Time and Date in BCD format. Valid range = 0X00 to 0X59	Read Holding Registers(0X03), Pre-set Multiple Registers(0X10)
302	Minutes In BCD format	Minutes of the Time and Date in BCD format. Valid range = 0X00 to 0X59	Read Holding Registers(0X03), Pre-set Multiple Registers(0X10)
303	Hours In BCD format	Hours of the Time and Date in BCD format. Valid range = 0X00 to 0X23	Read Holding Registers(0X03), Pre-set Multiple Registers(0X10)
304	Date In BCD format	Date of the Time and Date in BCD format. Valid range = 0X01 to 0X31	Read Holding Registers(0X03), Pre-set Multiple Registers(0X10)
305	Month In BCD format	Month of the Time and Date in BCD format. Valid range = 0X01 to 0X12	Read Holding Registers(0X03), Pre-set Multiple Registers(0X10)
306	Year In BCD format	Year of the Time and Date in BCD format. Valid range = 0X00 to 0X99	Read Holding Registers(0X03), Pre-set Multiple Registers(0X10)
306-400	Reserved		

7.2 Log Reports

There are two separate logs kept in the ISUPS, a periodic log and an event log. These logs are accessible through the Modbus interface using the 'Read Holding Registers' command as per the Memory Map.

To set the desired log entry to be reported for a Periodic or Event log, the entry number (index) needs to be set in holding registers 1 and 2 respectively.

If a log entry is requested that does not exist in the log, then a Modbus error will be returned to the Modbus master.

7.2.1 Event Log

The Event Log contains a text representation of the log entry. The entry details that are sent are (in order), the Entry code (that is, the numeric value of the cause of the log entry), the Entry description (that is, a short text summary of the cause of the log entry), the output current, the output voltage and the date and time when the entry was logged.

Each entry detail is always the same size – it will be padded with spaces to ensure the details remain the same length. This allows the Modbus master to request sections of the string, if needed.

7.2.2 Periodic Log

The Periodic Log is reported in a raw binary manner – i.e. strings do not represent the Periodic Log records, but absolute raw values. The Periodic Log can hold up to 1,728 records.

7.3 Output Toggle Time

This timer can be used to toggle the output of the ISUPS remotely through Modbus. Setting this timer immediately turns the output of the ISUPS off (if the output is already off it is kept off). The timer value setting would be used to determine when to turn the output on after it was turned off. It is a read/write register, and the timer countdown is visible by reading this register.

7.4 Time and Date

The system Time and Date is available in the Holding Registers as per the memory map shown previously. Each of the registers; for seconds, minutes, hours, date, month and year are in BCD (Binary Coded Decimal) format. Each of these registers can be read (using Read Holding Registers (0X03)) and write can be done using Pre-set Multiple Registers (0X10). When the write is performed, the system checks for validity and the system Time and Date is updated only if all the fields are valid.

NOTE

The system only checks for upper and lower bounds and not if the date is valid. For example: if the external system sets the month as Feb and Date as 31, though the date is invalid the ISUPS would save it as valid since 31 is within the bounds of 01 to 31.

8 SERVICE, MAINTENANCE & DISPOSAL

8.1 Equipment Service

During service, a number of external system-based checks should be completed on a regular basis. These 'routine inspections' must be carried out by suitably trained people with knowledge of the ISUPS and the systems into which it is fitted. Routine inspections may take the form of either visual-only checks, or visual and 'hands-on' checks.

The ISUPS requires an overhaul every 3 years.

8.1.1 Visual Only Inspections

A basic visual inspection focuses on looking at the installation for signs of physical damage, water or dust ingress and the condition of cables and labels. This type of inspection may involve opening cabinets to gain access to the ISUPS and other equipment. This level of inspection may also include cleaning display windows that have become obscured by dirt.

For a list of required visual inspections for Ex "e" enclosures, refer to AS/NZS 60079.17.

CAUTION!

The ISUPS enclosure and display window must only be cleaned using anti-static cleaning materials. Do not clean the ISUPS with any cleaning products that may cause the build-up of static charge.

Observations would typically be:

- Check that equipment enclosures, cable trays, conduits, etc. are in good order with no physical damage
- Check that sealed wall boxes are free from water and dust ingress internally. Door seals are in good condition
- Check that connected cables are free from cuts, abrasions and obvious signs of damage. Cable restraints are in good order and correctly fitted
- Check that labels on equipment, wall boxes and cables are present and in good condition (especially certification labels)
- Check that no modifications have been carried out to installed equipment

8.1.2 Hands-On (Detailed) Inspections

A more detailed inspection would include all of the elements of a visual inspection, plus some checks that cover the integrity of connections, fixtures and fittings.

In **addition** to basic visual observations, more detailed integrity checks would involve:

- Verify that equipment housings, wall boxes and other mechanical fixtures are secured in place. This includes terminal box lids, tightness of cable glands, integrity of wall-box mountings, security of equipment fixing to walls/DIN rails etc
- Verify all electrical connections are secure with no loose screw terminals or DIN rail terminals not fitted to rails etc
- Verify that the terminal compartment O-rings and seal arrangements are intact, effective and show no signs of degradation such as flat spots, splits or cracks

For a list of required tasks for a detailed inspection of Ex "e" enclosures, refer to AS/NZS 60079.17.

8.2 Equipment Maintenance

WARNING!

The ISUPS has no internal user-serviceable parts.

All repairs must be carried out by Ampcontrol only.

If a fault develops, return the ISUPS to Ampcontrol for repair. It is essential that no attempt be made to repair the ISUPS as any attempt to dismantle or repair the ISUPS can seriously compromise the safety of the unit, and the consequence can be fatal.

If, during an inspection, it is determined that there is damage to the ISUPS terminal compartment covers or seats, these may be replaced. Replacement kits must be obtained from Ampcontrol in order to maintain the Ex protection of the device. See SPECIFICATIONS for relevant item numbers.

If, during an inspection, it is determined that there is damage to the ISUPS glands, these may also be replaced. Replacement glands for the IS terminal compartments must be minimum IP66 rated and sized according to APPENDIX A – DRAWINGS.

Replacement glands for the AC terminal compartment must be selected in consideration of the requirements of Ex e installations as outlined in AS/NZS 60079, parts 0, 7 and 14. They must be sized according to APPENDIX A – DRAWINGS.

8.3 Equipment Overhaul

For continued reliable and safe performance, Ampcontrol recommends an overhaul period of no more than 3 years. To overhaul the ISUPS, it must be returned to an Ampcontrol repair facility.

Ampcontrol does not guarantee the performance of the batteries for longer than this 3-year overhaul period.

8.4 Disposal

ENVIRO

The electronic equipment discussed in this manual **must not be treated as general waste**. By ensuring that this product is disposed of correctly you will be helping to prevent potentially negative consequences for the environment which could otherwise be caused by incorrect waste handling of this product.

The ISUPS contains Sealed Lead Acid Batteries. Please return unwanted units to the vendor for disposal/recycling. Do not attempt to remove batteries individually or in groups or attempt to charge/discharge batteries with other equipment.

9 SPECIFICATIONS

Electrical Specifications	
Input Voltage	90 ~ 250 V AC. 50/60 Hz
Max. Current Draw	1 A @ 100 V AC
Permitted supply short-circuit current	1500 A
Charging Time (from fully discharged)	19 hrs
Output Voltage	Model Dependent; refer to Part Number Table below.
Output Current	Model Dependent; refer to Part Number Table below.
Battery Back-Up Time	By taking the safe discharge level of the battery into account, a conservative estimation of the battery backup time in hours = 190 / (User's Load in Watt). *For Example,* if 15.1 W (15.1 V x 1 Amp) is the user load on the 300 Wh 15.1 V / 1.5 A rated ISUPS, then the estimated battery backup time in hours will be '190 / (15.1x1)' = 12.52 hours.

Mechanical Specifications	
Dimensions (W x H x D)	298 x 206 x 227 mm
Weight	23 kg
Terminal Cover Screw Torque Value	1.6 Nm
Operating Temperature	-17 ˚C < Ta < 60 ˚C (Increased operating temperature will result in a decreased battery lifespan (refer to Section 5.5).
IP Rating	The Ex e terminal compartment is rated to IP65 in accordance with IEC 60079.0:2011. The ISUPS (including Ex e terminal compartment) is rated to IP66 in accordance with IEC 60529:2013.

Certification	
IS Certificate	IECEx TSA 10.0008X

10 EQUIPMENT LIST

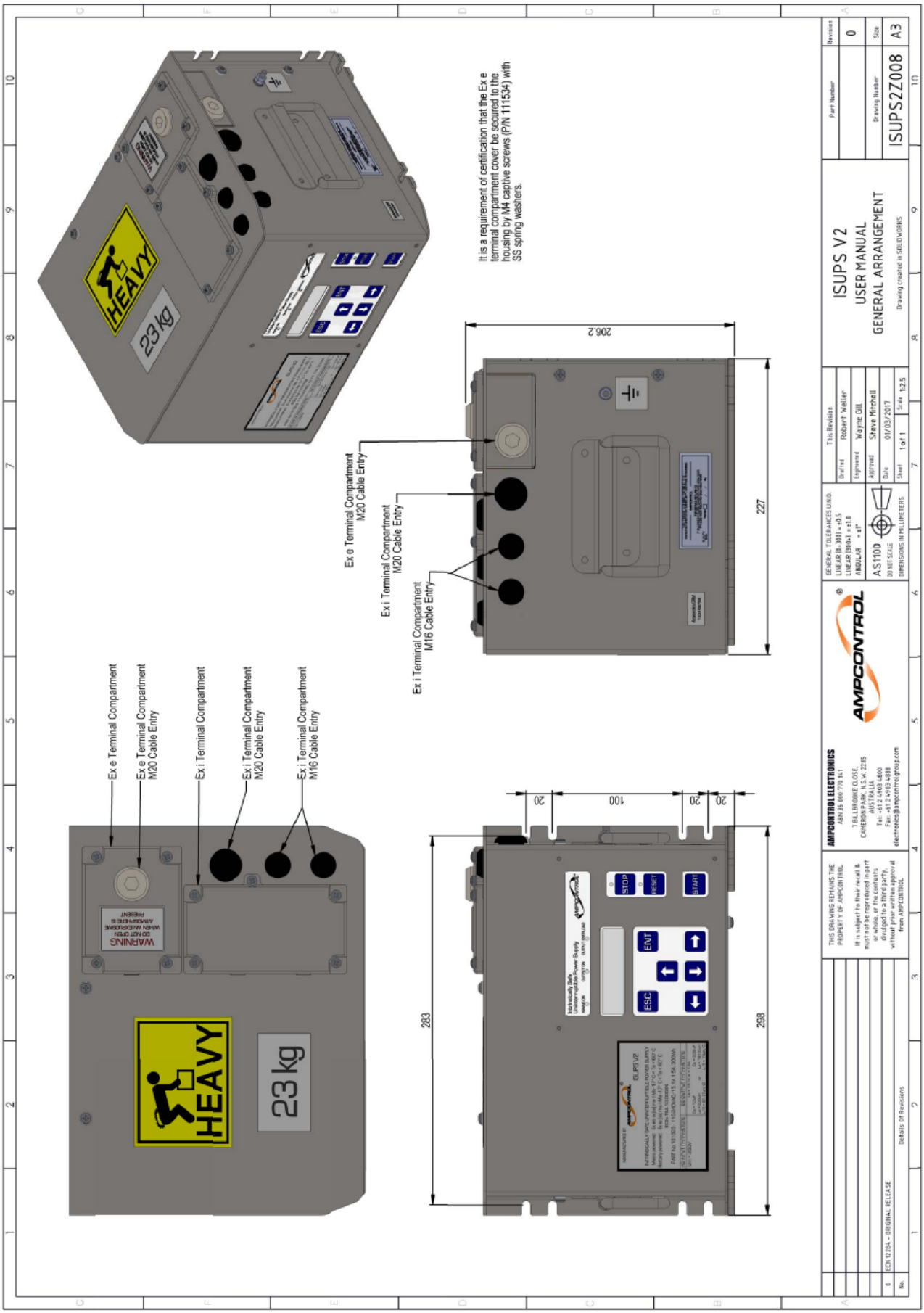
ISUPS Part Numbers & Associated Intrinsically Safe Parameters							
Mains input with Ex e protection							
Description	**300 Wh Part No.**	**Uo**	**Io**	**Co**	**Lo**	**L/R**	**Um**
15.1 V DC 1.50 A Output	161823	15.1 V	1.50 A	1.0 µF	200 µH	87.17 µH/Ω	250 V
				2.09 µF	181.5 µH	79 µH/Ω	
15.1 V DC 0.51 A Output	177263		0.51 A	1.0 µF	200 µH	87.17 µH/Ω	
15.1 V DC 0.5 A Output	177262		0.50 A				
15.1 V DC 0.47 A Output	177260		0.47 A	2.01 µF	520 µH		
14.5 V DC 1.50 A Output	177261	14.5 V	1.50 A	1.0 µF	200 µH		
12.6 V DC 2.5 A Output	174622	12.6 V	2.50 A	2.0 µF	167.2 µH	33 µH/Ω	
12.6 V DC 2.4 A Output	161826		2.40 A				
12.6 V DC 2.0 A Output	161825		2.00 A	502 nF	164 µH	40.1 µH/Ω	
				20.54 µF	102.1 µH	39 µH/Ω	
12.6 V DC 1.5 A Output	177259		1.50 A	1.0 µF	200 µH	87.17 µH/Ω	
				2.09 µF	181.5 µH	79 µH/Ω	

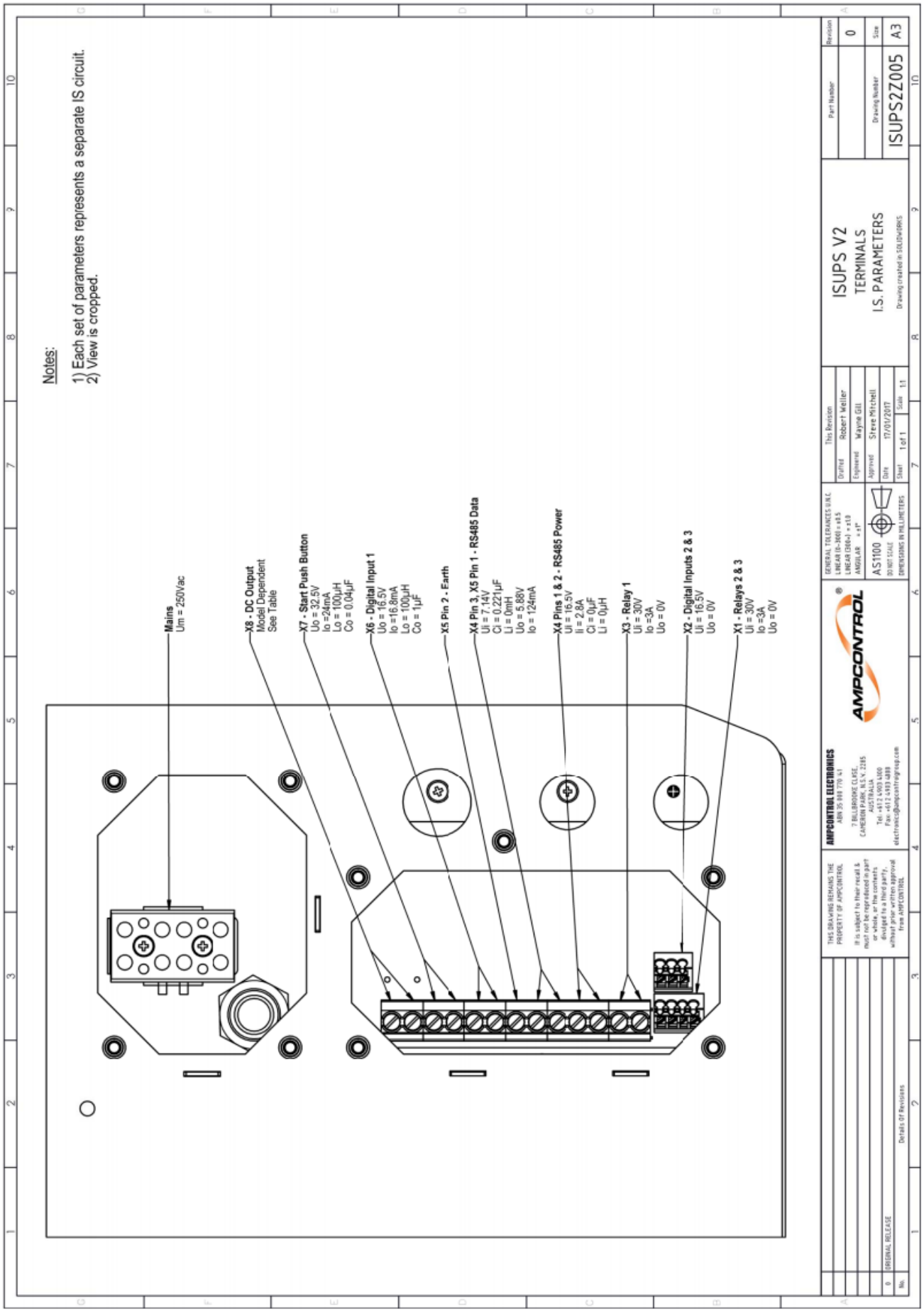
Terminal Cover Part Numbers	
Part No.	**Description**
179493	KIT ISUPS2 COVER TERM AC 300WH
179494	KIT ISUPS2 COVER TERM IS 300WH

APPENDIX A – DRAWINGS

Drawing Number	Description
ISUPS2Z008	ISUPS V2 User Manual General Arrangement
ISUPS2Z005	ISUPS V2 Terminals I.S. Parameters

The drawings appear in the following pages in the same order in which they are listed in the table above.


It is a requirement of certification that the Ex e terminal compartment cover be secured to the housing by M4 captive screws (P/N 111534) with SS spring washers.
Ex e Terminal Compartment M20 Cable Entry
Ex i Terminal Compartment M20 Cable Entry
Ex i Terminal Compartment M16 Cable Entry
206.2
227
HEAVY
23 kg
Ex e Terminal Compartment
Ex e Terminal Compartment M20 Cable Entry
Ex i Terminal Compartment
Ex i Terminal Compartment M20 Cable Entry
Ex i Terminal Compartment M16 Cable Entry
WARNING
DO NOT OPEN WHEN AN EXPLOSIVE ATMOSPHERE IS PRESENT
20
100
20
20
283
298
STOP
RESET
START
ENT
ESC
ISUPS V2
USER MANUAL
GENERAL ARRANGEMENT
AMPCONTROL ELECTRONICS
ABN 35 000 770 761
TBALLBROOKE CLOSE,
CAMERON PARK, N.S.W. 2285
AUSTRALIA
Tel: +61 2 4903 4800
Fax: +61 2 4903 4888
electronics@ampcontrol.com.au
AMPCONTROL
THIS DRAWING REMAINS THE PROPERTY OF AMPCONTROL
It is subject to their recall & must not be reproduced in part or whole, or the contents divulged to a third party, without prior written approval from AMPCONTROL
GENERAL TOLERANCES U.N.O.
LINEAR (0-300) +-0.5
LINEAR (300+) +-1.0
ANGULAR +-1°
AS1100
DO NOT SCALE
DIMENSIONS IN MILLIMETERS
This Revision
Drafted Robert Weller
Engineered Wayne Gill
Approved Steve Mitchell
Date 01/03/2017
Sheet 1 of 1
Scale 1:2.5
Drawing created in SOLIDWORKS
Part Number
Revision 0
Drawing Number ISUPS2Z008
Size A3
ECN 02304 – ORIGINAL RELEASE
No. Details Of Revisions


Notes:
1) Each set of parameters represents a separate IS circuit.
2) View is cropped.
Mains
Um = 250Vac
X8 - DC Output
Model Dependent
See Table
X7 - Start Push Button
Uo = 32.5V
Io =24mA
Lo = 100µH
Co = 0.04µF
X6 - Digital Input 1
Uo = 16.5V
Io =16.8mA
Lo = 100µH
Co = 1µF
X5 Pin 2 - Earth
X4 Pin 3, X5 Pin 1 - RS485 Data
Ui = 7.14V
Ci = 0.221µF
Li = 0mH
Uo = 5.88V
Io = 124mA
X4 Pins 1 & 2 - RS485 Power
Ui = 16.5V
Ii = 2.8A
Ci = 0µF
Li = 0µH
X3 - Relay 1
Ui = 30V
Io =3A
Uo = 0V
X2 - Digital Inputs 2 & 3
Ui = 16.5V
Uo = 0V
X1 - Relays 2 & 3
Ui = 30V
Io =3A
Uo = 0V
ISUPS V2
TERMINALS
I.S. PARAMETERS
ISUPS2Z005
A3
AMPCONTROL

APPENDIX B – APPROVALS

The Ampcontrol ISUPS, in all of its revisions, is Ex-certified equipment - designed for use in explosive atmospheres. The following list is the Certifications, which are relevant for the ISUPS.

- IECEx TSA 10.0008X (Certificate of Conformity)
    - IEC 60079.0: 2011 Ed 6.0 – Explosive atmospheres – Part 0: General requirements
    - IEC 60079.7: 2015 Ed 5.0 – Explosive atmospheres – Part 7: Equipment protection by increase safety “e”
    - IEC 60079.11: 2011 Ed 6.0 – Explosive atmospheres – Part 11: Equipment protection by intrinsic safety “I”
    - IEC 60079.18: 2014 Ed 4.0 – Explosive atmospheres – Part 18: Equipment protection by encapsulation “m”

Copies of this certificate may be obtained in the following ways:

- From the Ampcontrol website,
- By contacting customer service, or
- From the IECEx website

EMC Compliance

IEC 61204-3: 2011 - Low-voltage switch mode power supplies - Part 3: Electromagnetic compatibility (EMC)

Mains Powered - Ex eb ia mb [ia Ma] I Mb

Techniques eb (mains input), ia (keypad) and mb (input power module) are used for **Zone 1** located equipment. The [ia] outputs can be fed into the **Zone 0** area.

Battery Powered - Ex ia I Ma

Equipment can be located in a **Zone 0** area.

APPENDIX C – MSDS

Panasonic®

BATTERY SALES GROUP

MATERIAL SAFETY DATA SHEET

SLA VALVE REGULATED LEAD ACID BATTERY SERIES

Section I: Chemical Product and Company Identification

Product Identity:
VRLA Lead Acid Battery

Trade Name:
Panasonic LC and UP-RW Valve Regulated Lead Acid Battery Series

For Chemical Emergency
Spill, Leak, Fire, Exposure or Accident
Call CHEMTREC – Day or Night - 24 hours
1-800-424-9300
Outside the USA: 1-703-527-3887 (collect)

Distributor:
Panasonic Industrial Company
Two Panasonic Way/7A-1, Secaucus, New Jersey 07094

Manufacturer:
Matsushita Battery Industrial
Osaka, 570, Japan

Telephone Number for General Information
Toll Free 1-877-726-2228
Internet: www.panasonic.com/batteries

Section II: Hazardous Ingredients / Identity Information

Component	Common Name	Chemical Name	Approximate % by wt. or vol.	OSHA PEL	ACGIH TLV	CAS#
Lead	(Negative Electrode and Grid)	Pb	48~53 wt%	0.05 mg/m^3	0.15 mg/m^3	7439-92-1
Lead Oxide	(Positive Electrode)	PbO_2	23~26%	0.05 mg/m^3	0.15 mg/m^3	1309-60-0
Lead Sulfate	(Positive and Negative Electrode)	$PbSO_4$	< 1. wt%	0.05 mg/m^3	0.15 mg/m^3	7446-14-2
Sulfuric Acid	(Electrolyte)	H_2SO_4	7~10 wt%	1.0 mg/m^3	1.0 mg/m^3	7664-93-9

Percentages of components are dependant both on the model of the battery and state of charge/discharge of the battery. Sulfuric Acid is reportable under Sections 302, 311, 312 and 313 of the Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA). Reportable Quantity: 500 lbs for sulfuric acid and 10,000 lbs for lead. See Section XII, Page 3 for more information.

Overall Chemical Reaction: $PbO_2 + Pb + 2H_2SO_4 \rightleftharpoons 2PbSO_4 + 2H_2O$

Note: Panasonic Valve Regulated Lead Acid batteries are a non-spillable design. Under normal use and handling the customer has no contact with the internal components of the battery or the chemical hazards. Under normal use and handling these batteries do not emit regulated or hazardous substances. Warning: Battery terminals/posts and related accessories contain lead and lead compounds, chemicals known to the State of California to cause cancer and reproductive harm. Wash hands thoroughly after working with batteries and before eating, drinking or smoking.

Section III: Physical / Chemical Characteristics

Boiling Point:	Electrolyte 110°C - 112°C
Vapor Pressure:	Electrolyte 11.7 mm Hg. at 20°C
Vapor Density (AIR = 1):	Electrolyte 3.4
Solubility in Water:	Lead, Lead Oxide and Lead Sulfate are insoluble in water. Sulfuric Acid is 100% soluble in water.
Appearance and Odor:	The entire battery is a solid article consisting of an opaque plastic case with two protruding lead terminals. The battery is odorless. Sulfuric Acid is a liquid.
Specific Gravity (H2O = 1)	Electrolyte 1.300

Health Hazard Information (Acute and Chronic) - Sulfuric Acid only.

The International Agency for Research on Cancer (IARC) has classified "strong inorganic acid mist containing sulfuric acid" as a Category I carcinogen, a substance that is carcinogenic to humans. This classification does not apply to liquid forms of sulfuric acid or sulfuric acid solutions contained within the battery. Inorganic acid mist (sulfuric acid mist) is not generated under normal use of this product. Misuse of the product, such as overcharging, may however result in the generation of sulfuric acid mist.

Routes of Entry:	By inhalation (mist), skin and eyes, ingestion.
Acute:	Tissue destruction on contact. May cause 2nd and 3rd degree burns or blindness. Ingestion will cause corrosive burns on contact. May be fatal if swallowed.
Chronic:	Inhalation of mists may cause upper respiratory irritation.
Signs and Symptoms:	Irritation and burning of exposed tissues.
Medical Conditions:	Respiratory disorders may be aggravated by prolonged inhalation of mists.

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BATTERY SALES GROUP

MATERIAL SAFETY DATA SHEET

SLA VALVE REGULATED LEAD ACID BATTERY SERIES

Section IV: Emergency and First Aid Procedures

Battery Electrolyte

Inhalation:	Remove to fresh air. Give oxygen or artificial respiration if needed. **Get immediate medical attention.**
Eye Contact:	Flush with plenty of water for at least 15 minutes. **Get immediate medical attention.**
Skin Contact:	Remove contaminated clothing and flush affected areas with plenty of water for at least 15 minutes.
Ingestion:	Do not induce vomiting. Dilute by giving large quantities of water. If available give several glasses of milk. Do not give anything by mouth to an unconscious person. **Give CPR if breathing has stopped. Get immediate medical attention.**

Section V: Fire and Explosion Hazard Data

Flash Point:	Not Applicable
Flammable Limits:	Lower 4.10% (Hydrogen gas) Upper 74.20%
Extinguishing Media:	Dry chemical, foam, halon or CO_2.

Special Fire Fighting Procedures:
If batteries are on charge, turn off power. Use positive pressure, self-contained breathing apparatus in fighting fire. Water applied to electrolyte generates heat and causes it to splatter. Wear acid resistant clothing. Ventilate area well.
Unusual Fire and Explosion Hazards:
Hydrogen and oxygen gases are generated in cells during normal battery operation or when on charge. (Hydrogen is flammable and oxygen supports combustion). These gases enter the air through the vent caps during battery overcharging. To avoid risk of fire or explosion, keep sparks and other sources of ignition away from the battery. Do not allow metal objects to simultaneously contact both positive and negative terminal of batteries. Ventilate area well.

Section VI: Reactivity Data

Stability:	Stable under normal conditions.
Conditions to Avoid:	Sparks and other sources of ignition. Prolonged overcharge. Fire or explosion hazard due to possible hydrogen gas generation.

Incompatibility:
Combination of sulfuric acid with combustibles and organic materials may cause fire and explosion. Avoid strong reducing agents, most metals, carbides, chlorates, nitrates, picrate.
Hazardous Decomposition Products: Hydrogen gas may be generated in an overcharged condition, in fire or at very high temperatures. CO, CO_2 and sulfur oxides may emit in fire.
Hazardous polymerization will not occur.

Section VII: Precautions for Safe Handling and Use

Steps to be Taken in Case of Broken Battery Case or Electrolyte Leakage:
Neutralize any electrolyte or exposed internal battery parts with soda ash (sodium bicarbonate) until fizzing stops. Keep untrained personnel away from electrolyte and broken battery. Place broken battery and clean-up materials in a plastic bag or non-metallic container. Dispose of clean-up materials as a hazardous waste. Ventilate area as hydrogen gas may be given off during neutralization.
Waste Disposal Method:
Federal and State laws prohibit the improper disposal of all lead acid batteries. The battery end users (owners) are responsible for their batteries from the date of purchase through their ultimate disposal. The only legally acceptable method of disposal of lead acid batteries is to recycle them at a Resource Conservation and Recovery Act (RCRA) approved secondary lead smelter. The Panasonic SAV-LEAD Recycling Program allows for the recycling of lead-acid batteries in an environmentally sound manner. For more information on the SAV-LEAD Recycling Program call toll-free, 1-800-SAV-LEAD (1-800-728-5323). These batteries are chemically identical to common automotive starter batteries and can be recycled with automotive lead-acid batteries.
HAZARDOUS WASTE CODES: D002, D008.
Precautions to be Taken in Handling, Storing and Transportation:
Store in cool, dry area away from combustible materials. Do not store in sealed, unventilated areas. Avoid overheating and overcharging.
Other Precautions:
Do not charge in unventilated areas. Do not use organic solvents or other than recommended chemical cleaners on battery.

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BATTERY SALES GROUP

MATERIAL SAFETY DATA SHEET

SLA VALVE REGULATED LEAD ACID BATTERY SERIES

Section VIII: Control Measures / Personal Protection

General:
Normal room ventilation is sufficient during normal use and handling. Recommend 2 to 3 room air changes per hour to prevent buildup of hydrogen gas.
Personal Protective Equipment (In the Event of Battery Case Breakage):
Always wear safety glasses with side shields or full face shield.
Use rubber or neoprene gloves.
Wear acid resistant boots, apron or clothing.
Work/Hygienic Practices:
Remove jewelry, rings, watches and any other metallic objects while working on batteries. All tools should be adequately insulated to avoid the possibility of shorting connections. DO NOT lay tools on top of battery. Be sure to discharge static electricity from tools and individual person by touching a grounded surface in the vicinity of the batteries, but away from cells. Batteries are heavy. Serious injury can result from improper lifting or installation. DO NOT lift, carry, install or remove cells by lifting or pulling the terminal posts for safety reasons and because terminal posts and post seals may be damaged. DO NOT wear nylon clothes or overalls as they can create static electricity. DO KEEP a fire extinguisher and emergency communications device in the work area.
IMPORTANT:
Wash hands thoroughly after working with batteries and before eating, drinking or smoking.

Section IX: Regulatory Information

NFPA Hazard Rating for Sulfuric Acid:
Flammability (Red) = 0 Health (Blue) = 3 Reactivity (Yellow) = 2

Section X: Transportation Information

DOT - Unregulated, meets the requirements of 49 CFR 173, 159 (d).
IATA/ICAO - Unregulated, meets the requirements of Special Provision A67.
IMO - Unregulated.
***For all modes of transportation, each battery and outer package must be labeled: "Non-Spillable" or "Non-Spillable Battery." This label must be visible during transportation. * Batteries must be securely packed to prevent short-circuiting.**

Section XI: California Proposition 65 Information

The State of California has determined that certain battery terminals contain lead and lead compounds, chemicals known to the State of California to cause cancer and reproductive harm. IMPORTANT: WASH HANDS THOROUGHLY AFTER WORKING WITH BATTERIES AND BEFORE EATING, DRINKING OR SMOKING.

Section XII: Other Information - Notice to Readers

General Product Description – LC and UP-RW VRLA Batteries
Panasonic LC and UP-RW Batteries are valve regulated non-spillable lead-acid batteries with pasted lead-calcium plates. The electrolyte is held captive in an Absorbed Glass Mat (AGM) separator between plates that immobilize the electrolyte in the cell. AGM separator material is a highly porous, absorbent micro fiberglass mat mixed with polymer fibers. There is no "free" electrolyte to leak out if the cell is tipped over (cell case and cover are sealed together) or if the cell is punctured. The AGM separator material immobilizes the electrolyte and creates a situation where the spill of electrolyte is highly unlikely. Typical accidents where a battery case is punctured results in a slight drip or a slow ooze of material out of the cell that cannot be characterized as a spill.

Panasonic LC and UP-RW VRLA batteries are also different from conventional **unsealed** (wet/flooded) cells because they contain only a minimum amount of electrolyte. VRLA battery electrolyte is a dilute mixture of sulfuric acid in water, which typically has a specific gravity between 1.270 and 1.3. Specific Gravity is a measure of the density of a liquid as compared to that of water, which has a specific gravity of 1.000. Pure sulfuric acid has a specific gravity of 1.835.

NOTE: Panasonic LC and UP-RW batteries do not contain a gel electrolyte.

Panasonic®

BATTERY SALES GROUP

MATERIAL SAFETY DATA SHEET

SLA VALVE REGULATED LEAD ACID BATTERY SERIES

General Product Description - LC and UP-RW VRLA Batteries (continued)

During normal battery installation, operation and maintenance, the user has NO contact with the internal components of the battery or its internal hazardous chemicals.

Panasonic LC and UP-RW batteries are UL recognized under the file number: Matsushita Electric Industrial Co. Ltd., Matsushita Electric Corp. of America, File #MH13723, 1 Panasonic Way, Secaucus, NJ 07094.

NOTICE TO READERS: DISCLAIMER

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Supplemental Information on Panasonic Valve-Regulated Lead Acid Batteries

Transportation

All Panasonic valve-regulated lead acid batteries are considered "non-spillable" for purposes of transportation by the U.S. Department of Transportation (DOT), International Civil Aviation Administration (ICAO), the International Air Transport Association (IATA) and the International Maritime Dangerous Goods regulations (IMDG). They are considered "non-spillable" by DOT by passing the Vibration Test and Pressure Differential Test as required in 49 CFR 173.159(d). They are also considered to be "non-spillable" by both ICAO and IATA by exceeding the requirements of Special Provisions "A67" as defined in their 1998 Handbooks.

Our batteries are authorized for transportation on deck or under deck storage on either a passenger or cargo vessel by passing the Vibration and Pressure Differential Tests as described in the International Maritime Dangerous Goods Regulations (IMDG).

To transport these batteries as "non-spillable" they must be shipped in a condition that would protect them from short-circuits and be securely packaged so as to withstand conditions normal to transportation. For transportation by a consumer, in or out of a device, they are unregulated thus requiring no additional special handling or packaging.

All of our lead acid batteries and their outside packaging, manufactured after September 30, 1995 are labeled "NON-SPILLABLE" per 49 CFR 173.159(d). If you repackage our batteries either as batteries or as a component of another product you must label the outer package "NON-SPILLABLE" per 49 CFR 173.159(d).

Assure Proper Recycling!

Valve-Regulated Lead Acid batteries destined for recycling can be managed under the federal *Universal Waste Rule* codified at 40 CFR Part 273.

In the event of disposal, dispose only in accordance with federal, state and local regulation. Batteries generated as a waste are subject to the Resource Conservation and Recovery Act (RCRA) as a D008 (lead) hazardous waste.

Panasonic VRLA Recycling Program

The Panasonic 1-800-SAV-LEAD Recycling Program for the collection and recycling of valve-regulated lead acid batteries (VRLA) covers all Panasonic Valve-Regulated Lead Acid Batteries. The proper disposal of spent VRLA batteries is becoming more of a critical issue, both from the viewpoint of environmental stewardship and from compliance with federal and state environmental regulations. Panasonic recognizes the burdens and responsibilities that have been placed on our customers to properly dispose of spent VRLA batteries and is proud to offer this voluntary nationwide battery recycling program.

Federal and State Requirements for Proper Disposal

Federal and State laws prohibit the improper disposal of all lead acid batteries. The battery end users (owners) are responsible for their batteries from the date of purchase through their ultimate disposal. The only legally acceptable method of disposal of lead acid batteries is to recycle them at Resource Conservation and Recovery Act (RCRA) approved secondary lead smelter. This Panasonic 1-800-SAV-LEAD Recycling Program will allow for you to arrange for the recycling of your VRLA batteries from anywhere in the United States. The Program will accept Panasonic and other VRLA batteries regardless of manufacturer. Panasonic will handle all VRLA batteries returned in an environmentally sound manner designed to comply with all applicable Federal and State laws and regulations. Panasonic will send batteries only to fully-permitted secondary lead smelters that we believe meet the highest environmental standards. Once the VRLA batteries are received by Panasonic, the cost to transport the batteries to the secondary lead smelter and the actual recycling costs will be borne by Panasonic.

See the next page for How the 1-800-SAV-LEAD Recycling Program Works

Supplemental Information on Panasonic Valve-Regulated Lead Acid Batteries (Cont.)

How the 1-800-SAV-LEAD Recycling Program Works

1) We encourage all of our customers to serve as VRLA collection centers for your customers, thereby establishing a reverse distribution network between the end user and the secondary lead recycling facility.
2) All shipments to our national consolidation facility must be prepaid. No freight collect shipments will be accepted. All freight collect and non-VRLA batteries will be returned to the shipper.
3) Panasonic will maintain on file all necessary documentation for EPA reference. A copy will be provided upon request.
4) All batteries must be shipped, prepaid to Ebco Battery Company that serves as our national consolidation facility. (See *exception* below).

SHIPPING ADDRESS:
Ebco Battery Company
4017 Warm Springs Road
Columbus, Georgia 31909

5) Only VRLA batteries that meet the U.S. Department of Transportation (DOT) "NON-SPILLABLE" (49 CFR 173.159d) requirements will be accepted by this program.
6) Panasonic reserves the right to alter or discontinue this program at any time.

Packaging Requirements

1) All VRLA batteries must be fully discharged and packaged in a manner as to insure safe handling and conform to all applicable DOT regulations. (49 CFR 173.159d). A dab of silicon caulking or non-conductive tape on each terminal will ensure that no direct shorts occur during shipment.
2) VRLA battery shipments should be made in pallet quantities whenever possible.
3) Palletized shipments should be secured with metal bands or poly-wrapped with stack height limited to four (4) feet.
4) VRLA batteries shipped on pallets should be of uniform size or be stacked with the larger batteries on the bottom.
5) VRLA batteries should be stacked upright in a head-to-base arrangement. Each layer should be separated by cardboard to prevent accidental shorting.
6) Smaller quantities of VRLA batteries may be shipped via standard UPS. Be sure that each box does not exceed the UPS weight limit of 70 lbs. A dab of silicon caulking or non-conductive tape on each terminal will ensure that no shorts occur during shipment.
7) The outside of every pallet and individual box must be labeled "NON-SPILLABLE" as required by DOT regulations. This label must be visible during transportation.

Exception:

Full-Truck-Loads – All full-truck-load shipments of VRLA batteries must be scheduled 48 hours in advance. To schedule shipments to our consolidation site, please be sure to fax a scheduling request (including contact name and phone number) to Ebco Battery Company at fax: (706) 569-6774.

Consumer Users of Panasonic VRLA Batteries

All Panasonic VRLA batteries are chemically identical to common automotive starter batteries and can be returned to any site that accepts automotive lead acid batteries for recycling. Examples include retailers of automotive batteries, automotive service centers, scrap metal dealers, etc...

For additional information on this program or information on how to recycle other Panasonic batteries please call your local Panasonic Battery Sales Group sales office.

Panasonic Batteries

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