NOTE:
THE INFORMATION CONTAINED IN THIS FILE IS IMPORTANT TO THE INSTALLATION AND MAINTENANCE OF THIS EQUIPMENT. THE INFORMATION MAY BE PHOTOCOPIED BUT SHOULD NOT BE REMOVED FROM THE FILE.

THE FILE SHOULD BE RETAINED WITHIN THE CABINET DOOR SLEEVE.

COMMISSIONING
Commissioning of the installed equipment should be arranged with our SERVICE DIVISION.

SITE SERVICE CONTRACTS
Optimum reliability of your installation will be maintained by taking out a service contract, see leaflet enclosed.

SERVICE DIVISION: Tel. 01302 303352

TECHNICAL SUPPORT: Tel. 01302 303221

Please quote the serial number above when contacting our service/technical department.
CENTRAL BATTERY & INVERTER SYSTEMS

INSTALLATION, COMMISSIONING AND OPERATING INSTRUCTIONS
1. Temperature Compensation Notice

**Important - Temperature compensation for lead acid batteries only**

A temperature compensation probe has been supplied with this unit to optimise battery charging. If the battery is contained within the charger cubicle then this will have already been fitted.

If the battery is contained within a separate cubicle, the probe must be fitted as shown below.

When the battery is mounted on an external rack, the probe must be fitted in a blank grommet in a spare cable hole in the side of the charger cubicle. The tapered end of the probe should be outside the cubicle and adjacent to the batteries.

This probe must not be disconnected when the battery is charging. Connections of the probe must not be reversed.

**Please Note:**
This equipment is designed to be able to work in the temperature range of 0°C to 40°C.

The Lead acid batteries are designed to work best at 20°C. Temperatures above 20°C can severely degrade the lifespan of the batteries. To optimise the lifespan of the batteries, they should be located in an area with a temperature as close to 20°C as possible. If prolonged high temperatures are expected in the battery room then additional cooling may be needed.
2. Inverter Ventilation

**IMPORTANT - Inverter Ventilation Brackets**

The brackets supplied must be fitted to the rear of the inverter cubicle(s) using the supplied fixings as shown.

Inverter cubicle ventilation is at the rear and sides of the cubicle. These vents must not be obstructed.

A gap of 75mm is recommended at the rear of the cubicles and 40mm for the sides of the cubicles.

Battery cubicles only ventilate through the sides and may be backed up to a wall.

**Heat Generation In Emergency Mode**
The worst case heat production from the unit is when the static inverter is in emergency mode (running from the batteries). The inverters are actively cooled with fans. The heat produced normally only occurs for 3hrs (or 1hr depending on the unit autonomy). The heat produced by the inverters is simply 141W per KVA of load.

Eg1. AC12KVA/SLR/3 unit:  
12 x 141 = 1692W for 3hrs  
Eg2. AC25KVA/SLR/1 unit:  
25 x 141 = 3525W for 1hr

**Heat Generation In Normal Operation**
Under normal operation the only heat generation is from the battery charging circuitry which is normally negligible. The maximum heat given by the charger is when it is recharging a fully depleted battery. The amount can be approximated by the following equation(s):

For a 1Hr unit:  
KVA x 10.5 = Watts Generated  
E.g. AC10KVA/SLR/1  
10x10.5 = 105 Watts (Worst case)

For a 3Hr unit:  
KVA x 15.5 = Watts Generated  
E.g. AC6KVA/SLR/3  
6 x 15.5 = 93 Watts (Worst Case)

A loadstar static inverter would only be in emergency mode once in any 24hr period as the batteries require 24hrs to fully recharge (12hrs to 80%).
3. Installation Procedure

The equipment you have purchased has been carefully designed to provide a long and trouble-free service life, but this can only be achieved by strictly adhering to the correct installation and maintenance procedure.

**IMPORTANT**: If the equipment is likely to be stored on site for a period exceeding 2 months prior to commissioning, the equipment must be connected to the mains supply and the battery connected and charged to safeguard the battery from possible subsequent deterioration. Lead acid batteries should not be left uncharged for long periods as this can damage the battery.

**Installation Procedure**

3.1 On receipt of the equipment check that the cells/batteries and cubicle(s) are not damaged and the correct number have been received. Check the correct number of nuts, bolts, washers, terminal covers (or battery covers) and battery links have been received, along with the battery manufacturer’s maintenance instructions. Check these against the battery layout included with the unit.

3.2 When positioning the unit, ensure adequate ventilation such that the gases produced during charging are dispersed safely. Contact the manufacturer if in doubt as to the correct ventilation requirements.

**Remember**: Gases liberated during charging of batteries can ignite with explosive force therefore it is essential during maintenance and commissioning that there is NO SMOKING and NO NAKED LIGHTS in the vicinity. Any tools used during battery maintenance must be fully insulated to safeguard against short circuiting of battery terminals.

**Battery Installation**

3.3 **CAUTION** Batteries are always live, Only insulated tools should be used when working with batteries. Take care not to short circuit the battery terminals when connecting the batteries together.

3.3.1 Before starting to connect the batteries, ensure that the battery fuses within the charge cabinet have been removed. Any battery MCB’s should be open.

3.3.2 A battery layout drawing has been supplied. This should be followed carefully.

3.3.3 Cells/batteries should be connected ensuring that the positive terminal (+ or RED) of one cell/battery is connected to the negative terminal (- or BLACK/BLUE) of the adjacent cell/battery. **Positive and negative conductors should not pass through the same hole/gland.**
3.3.4 Ensure that each exposed link surface and battery terminal is covered with an even coating of petroleum jelly to ensure good electrical connection and protection against corrosion of terminals during service life.

3.3.5 Ensure that all nuts and bolts are tight. Make a visual check from the start to the finish of the battery to ensure that the cells/batteries are connected as described above and according to the battery layout.

3.3.6 After connecting each battery link or lead, ensure that each terminal is covered with a battery terminal cover or a battery cover. The battery installation should have no exposed conductors showing.

3.3.7 Connect the battery to the battery cables with care, positive lead (RED) to the end marked + or RED end of the battery. Negative lead (BLACK) to the end marked - or BLUE/BLACK end of the battery.

3.4 Make off the incoming mains cables and load output cables in the cable gland holes or gland plate provided and connect as detailed, referring to the wiring diagram supplied. When using gland plate for cable entry, remove the gland plate before drilling.

3.4.1 Connect the live lead to the terminal (or input MCB) marked L, or in the case of 3 phase inputs L1, L2 and L3.

3.4.2 Connect the neutral lead to the terminal marked N.

3.4.3 Connect the earth lead to the earth stud provided.

3.4.4 Maintained systems only - should a remote maintained circuit switch be required, remove the factory fitted link between the terminals marked RSL or LK2 and replace with a remote switch.

3.4.5 Should remote monitor relays be required, remove the factory fitted link between terminals LK1 and connect the remote monitor contacts in a normally open series loop between the terminals.

3.4.6 Connect the load circuits to the output terminals, fuses or MCB’S observe the correct polarity.

3.4.7 If the system is complete with integral sub-circuit monitors, fire alarm relay, terminals for connection of a remote alarm unit or terminals for remote indication of system fault via volt-free changeover contacts, these should be connected as required.

3.5 Do not yet replace battery or inverter input fuses. The equipment is now ready for commissioning but a final visual check should be made to ensure that the battery is connected up correctly and that each cable is connected to the correct incoming or outgoing terminal.
4. Commissioning Procedure

The following procedure(s) should be completed to fully commission the unit.

4.1 Ensure the input MCB is in the off position.

4.2 Replace negative battery fuse F6.

4.3 Replace positive battery fuse F5. Check with a voltmeter that the battery is at the correct voltage and polarity, this may be done at an inverter input.

4.4 Replace charge fuse F3 and connect mains by switching on remote isolator.

**Warning:** Mains is now present in the cubicle.

Note: The battery fuses must never be removed whilst mains is present. Always isolate first, failure to do this will result in damage to the inverter.

4.5 Close the input MCB and isolator, if fitted. Check the charging of the battery measuring current and voltage on the integral meters, where fitted.

4.6 As the battery charges, the charge current will reduce until the battery is fully charged, which should take less than 24 hours even with a fully discharged battery. When the battery is fully charged output current will be less than 500mA, and the battery will have reached its float voltage.

4.7 Commission the inverter by inserting all module fuses one at a time, each module should display a red 'TRIPPED' LED. If not, then either a fuse has blown, or there is a fault.

4.8 When all modules have red LED’s illuminated, the MCB’S on each module should be closed. The ‘TRIPPED’ LED will go out and a green ‘READY’ LED will come on. When all units are in this condition switch the inhibit switch to RUN.

4.9 Fail the mains by means of the input MCB, at this point the inverter will run and feed the load. The output AC voltage, AC loading and inverter run indicators should now be checked, the inverter cooling fans should run at this time. Assuming fully charged batteries, the inverter will supply the rated load for the rated duration, after which it will turn off to avoid battery damage by deep discharge.

4.10 Re-connect mains and recharge batteries for 24 hours. The equipment is ready to start its service life and it only remains to make arrangements for regular routine maintenance checks to be made by qualified service engineers to ensure a long, trouble-free life. Service contracts are available from the manufacturer. Please contact our service department for details.
5. Maintenance Procedure

In order to fully test the emergency lighting connected to the static inverter unit, all normal lighting supplies that are monitored by the emergency lighting must be failed so that any hold off relays are disengaged. This will allow any non maintained emergency lighting to operate. All supplies to any HOR (Hold off relays), ACM1’s, COR (Change over relays) or non-maintained luminaries should be failed to force all emergency lighting to operate.

Central battery units should be visually checked for correct operation on a daily basis.

**Monthly**
Each central battery system should be energised from its battery by simulation of a mains failure sufficient only to ensure that each lamp is illuminated. The period of this simulated mains failure should not exceed one quarter of the rated duration of the battery.
All luminaries or signs should be examined visually to ensure that they are lit correctly.
At the end of each test period, the supply should be restored, indicators and charging function checked for proper functioning.

**Six Monthly**
For a three hour central battery system, a one hour discharge and recharge sequence: for a one hour system a 15 min discharge followed by recharge. Luminaries should be examined for correct functioning. On recharge, indicators and charging should be checked for proper functioning.

**Yearly**
Each central battery system should be tested for its full duration. [Normally Three hours or one hour] On restoring mains supply to the unit, indicators and charging arrangements should be checked for correct functioning.

(This testing should never be carried out immediately proceeding or during hours of darkness, or when the building will be occupied immediately after the test, as this could create a safety risk in the event of an emergency occurring at these times).
Battery Maintenance

Systems with Vented Lead-Acid Batteries
We recommend that this type of equipment is visually inspected each month and a topping up and recording procedure carried out each quarter as detailed below.

1. Examine regularly, record cell voltage and specific gravity in the logbook. Each should be consistent with those detailed in the maintenance booklet.
2. Check the electrolyte levels of each cell and use only distilled or de-ionised water for topping up. Do not use tap water or proprietary mixtures. Topping up must take place before the electrolyte level reaches the low level indicator on the cell side.
3. Check that the cells are clean and not leaking and that each terminal is free from corrosion. Always ensure that the vent plugs are not obstructed.
4. Ensure inter cell connections are secure and clean. Corrosion due to electrolyte spillage should be removed and carefully neutralised with an alkaline soda solution making certain that no alkaline is allowed to enter the cells, after which the cell should be thoroughly cleaned with warm water and dried before re-coating with petroleum jelly.

Systems with Vented Nickel Cadmium Batteries
Nickel cadmium batteries are designed to give a long service life of up to 25 years and are robust, resistant to abuse and require less routine maintenance than lead-acid batteries. We recommend that, with batteries of this type, a visual check be made each quarter to ensure the cells are topped up and free of corrosion and a twice yearly check of the individual cell voltages and specific gravities as detailed in the battery maintenance booklet.

1. Examine regularly, record cell voltage and specific gravity in the logbook. Each should be consistent with those in the maintenance booklet.
2. Check the electrolyte level of each cell and use distilled or de-ionised water for topping up. Topping up must take place before the electrolyte level reaches the low level indicator on the cell side. Do not use tap water or propriety topping up mixtures.
3. Check that the cells are clean and not leaking and that each terminal is free from corrosion. Always ensure that the vent plugs are not obstructed.
4. Ensure inter cell connections are secure and clean. Corrosion due to spillage should be removed and the terminals cleaned with warm water before being dried and re-coated with petroleum jelly.

On both of the above systems a manual PCB mounted push button boost switch, located on the charge control PCB is supplied for commissioning the battery. This switch should only be used by qualified personnel and not for longer than 24 hours.

Systems with Valve Regulated Lead-Acid Batteries (Sealed Lead acid)
We recommend that this type of equipment is visually inspected each month and a recording procedure carried out each quarter as detailed below.

1. Examine regularly, record battery voltages in the logbook. These should be consistent with those in the cell maintenance booklet.
2. Check the batteries are clean and not leaking and that each terminal is free from corrosion.
3. Ensure inter cell connections are secure and clean. Corrosion due to spillage should be removed and carefully neutralised with an alkaline soda solution making certain that no alkaline is allowed to enter the battery, after which the battery should be thoroughly cleaned with warm water and dried before re-coating with petroleum jelly.
Safety Precautions

Remember: No smoking or naked flames. The gases emitted during charging are explosive. Electrolyte is dangerous to the skin and above all to the eyes. Great care must be taken and eyes and hands protected (rubber or plastic gloves and goggles).

1. Lead Acid Batteries
   Battery acid, which comes into contact with the skin or eyes, must be washed with liberal amounts of clean water. Seek medical advice.

2. Nickel Cadmium Batteries
   Battery acid, which comes into contact with the skin or eyes, must be washed with liberal amounts of clean water. Seek medical advice.

Important: Before maintenance or repair work is carried out on the output circuits or associated fixtures, the remote input isolator should be switched off, the input MCB’s to the unit switched off, fuses F5, F6 withdrawn, the output MCB’s switched off and the inverter inhibit switch placed in the inhibit position. Wait 60 seconds before working on equipment to allow any capacitors to discharge.

To re-energise the system follow the sequence given in the commissioning procedure.
6. Controls & Indications

6.1 Display Functions - Charger Indications

**Power On**
Indicates mains power is healthy, power is being supplied to the charger and to all connected sub-circuit monitors (LK1).

**Maintained lights**
(This is not applicable to Switch Tripping units & CBU’S which have a non-maintained output)
This indicates that power is supplied to the Maintained circuit, and that any switching devices connected to LK2 are closed.

**Float mode**
Indicates that the charger is working in the constant voltage mode (and hence the charge current is low or falling). Unless the Boost Mode indicator is also lit (see below) this indicator implies that the battery voltage is at the preset float voltage.

**Current limit**
Indicates that the charger is in constant current mode (and hence the battery voltage is rising).

**Full charge**
Indicates that the charger is in constant voltage mode (at float voltage unless the boost indicator is also lit), and that the current has dropped to a low level (generally below 10-20% of current limit).

**Boost mode**
(Boost mode is not applicable to Valve Regulated Lead Acid types of batteries)
This indicates that the unit is charging towards a target voltage about 20% higher than the preset float voltage. Depending on options selected at the design stage, this can be initiated automatically or manually. If automatic, it starts and finishes on preset voltage thresholds. If initiated manually, it is terminated either manually or by a timer. Manual operation is by two push buttons on the internal PCB.

6.2 Alarm indications

**Mains fail**
Indicates that mains power has failed (or dropped below the “brown-out threshold”) either to the unit or to one of the sub-circuit monitors connected to it. The charger will then not be operating, and the output will be supplied from the battery.

**Charge fail**
This indicates that battery voltage and charge current are both low.

**Battery high volts**
This indicates that the battery charger voltage has risen above a preset threshold, normally 5% above float voltage.

**Battery low volts**
This indicates that the battery charger voltage has dropped below a preset threshold, normally 5% below float voltage.

**Earth fault**
This indicates some current leakage to earth (resistance approximately 5 k ohms or less) on any circuit connected to the battery positive or negative. (LED’s on the internal charge PCB indicate whether it is on the positive or negative connection).

**Deep discharge protection**
(Not applicable to Switch Tripping Units)
Indicates that the deep discharge protection circuit has operated, cutting off the output to avoid damage to the battery. It remains lit until mains power has been restored AND the condition has been acknowledged by pressing the Deep Discharge Protection Reset button.
6.3 **Inverter indications**  
(These only apply to inverter units)

**Inverter running**  
This indicates that the inverter is providing an output of approximately 230v AC. i.e. mains input has failed.

**Inverter Overload**  
(Optional extra)  
Indicates that current being drawn from the inverter is more than 20% above the nominal maximum. (Only on units supplied with S1008 Inverter Alarm module).

**Inverter High volts**  
(Optional extra)  
This indicates that the inverter output is above 245v AC. (Only on units supplied with S1008 Inverter Alarm module).

**Inverter Low Volts**  
(Optional extra)  
This indicates that the inverter output is below 215v AC. This alarm is inhibited with the inverter itself when mains power is available. (Only on units supplied with S1008 Inverter Alarm module).

6.4 **Push buttons**

**Press to Test**  
This simulates a mains failure to the unit.

**Display current**  
This changes the digital meter display from battery voltage to battery current. See “Meter indications” below.

**Display Temp**  
This changes the digital meter display from battery voltage to battery temperature. See “Meter indications” below.

**Mute buzzer**  
Normally an internal buzzer sounds when any alarm condition occurs. It can be silenced with this button. It will remain silent until ALL alarm conditions are reset and NOT REPEATED until another alarm condition occurs. EXCEPTION: when Deep Discharge Protection has operated, the buzzer will sound and CANNOT be muted until mains has been restored and the Deep Discharge Protection Reset push button pressed.

**Deep Discharge Protection Reset**  
(Not applicable to Switch Tripping Units)  
This must be pressed to acknowledge that Deep Discharge Protection has operated. The push button functions only after mains power has been restored, and will then cancel the Deep Discharge Protection indicator, and enable the buzzer to be muted.

6.5 **Meter indications**

**Volts**  
This indicates that the digital meter is reading Battery Voltage. This is the default indication.

**Amps**  
This illuminates when “Display Current” push button is pressed and indicates that the digital meter is reading Battery current in Amperes, positive when charging, and negative when discharging. (On units not fitted with a battery shunt, the indicator will still illuminate, but the reading will be approximately zero).

**Temperature (°C)**  
This illuminates when “Display Temp.” push button is pressed, and indicates that the digital meter is reading the temperature of the probe fitted in the battery compartment for temperature compensation. (On units not fitted with temperature compensation, or on any unit during a mains failure, the indicator will still illuminate, but the reading will be approximately zero).
## 7. Fault Finding Guide

<table>
<thead>
<tr>
<th>FAULT</th>
<th>POSSIBLE CAUSE</th>
<th>CHECKS AND SOLUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Charger</td>
<td>No charge LED or fully charged LED</td>
<td>Unit is still in between current limit and full charge</td>
</tr>
<tr>
<td></td>
<td>Over charging</td>
<td>Check temperature compensator is connected or faulty</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Charge control PCB faulty supply a serial number when replacing PCB for setting up purposes</td>
</tr>
<tr>
<td></td>
<td>Charger is not charging battery</td>
<td>Check all fuses associated with charge PCB</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Check bridge rectifier by removing wires and checking with a meter on diode range for short circuits</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Check the charge transformer is giving out the nominal voltage as stated on the transformer</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Check the battery fuses are all in good working order by removing and checking with a meter (Note there may be several banks of batteries)</td>
</tr>
<tr>
<td></td>
<td>Upon mains failure there is no output</td>
<td>Check voltage to C1 on AC/DC and AC/AC units if no voltage is present check battery voltage if all is ok contactor may be faulty</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Check the output fuses or MCB’S have not tripped or blown</td>
</tr>
<tr>
<td>Inverter</td>
<td>No led’s on the inverter modules</td>
<td>Check dc volts to the module is above 118v</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Check out going circuits for faults or short circuit faults isolate if possible</td>
</tr>
<tr>
<td></td>
<td>Inverter is giving out high voltage or ypcb2179a shows the red LED</td>
<td>The master inverter module may be Faulty. (Send back to CLS for repair)</td>
</tr>
<tr>
<td></td>
<td>With two or more inverter modules fitted some have the LEDS on and some don’t</td>
<td>Check IDC cables between modules. (Disconnect all the buss cables and connect the long inter shelf IDC cable to each inverter in turn until you find the faulty IDC cable or inverter module)</td>
</tr>
<tr>
<td></td>
<td>The inverter fails to run when mains fails to unit</td>
<td>The switch on ypcb2006110a is switched to inhibit</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Battery voltage is too low</td>
</tr>
<tr>
<td></td>
<td></td>
<td>MCB on inverter module in the off position</td>
</tr>
<tr>
<td></td>
<td>Dc mcb on the front of the inverter keeps tripping out</td>
<td>The inverter module may be faulty. (The possible cause could be the transistor on ypcb2001110a short circuit)</td>
</tr>
<tr>
<td></td>
<td>The inverter is tripping out before the intended duration is reached</td>
<td>Check that the inverter is not over loaded</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Check that all the inverter fans are operating</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Check the status of the battery. (I.e. The battery is faulty low on ampere hour getting to the end of its life)</td>
</tr>
</tbody>
</table>
Important Note
The battery cables **must** run through the space provided within the cubicle as shown in the diagram.

Battery cables run a different way may result in less space for batteries to fit on the shelves.
The batteries must be fitted as shown in the battery layout.
IMPORTANT NOTE:

DO NOT SHORTEN BATTERY CABLES

CABLES MUST BE ALL THE SAME LENGTH

This is to ensure that all the batteries discharge equally. Cutting the length of any one string to be less than the others can cause battery damage.

The total cable length in each string must be the same length!
9. Health and Safety Information for Standby Batteries

Description: VENTED NICKEL CADMIUM CELLS

9.1 Composition
9.1.1 Plates - Pocket plate electrodes of perforated nickel plated steel strip containing active material. Several pockets connected to form plates.
9.1.2 Active material - Positive plates Nickel Hydrate and graphite. The negative plates Cadmium hydroxide.
9.1.3 Separators - Thin corrugated plastic.
9.1.4 Connectors - Nickel plated copper. Containers - Either plastic or stainless steel. (Steel cells are mounted in insulated wooden crates).
9.1.5 Electrolyte - Solution of Potassium Hydroxide with Lithium Hydroxide additive.

a) Active materials
Cadmium and its compounds are classified as "highly toxic. Nickel and its compounds are classed as "Highly toxic. However, the materials are well contained within the battery and are in a wet, dust free condition. It is essential that the cells should not be dismantled under any circumstances and as such, the possibility of exposure is negligible.

b) Electrolyte - liquid
The electrolyte is a dilute solution of Potassium Hydroxide with a small additive of Lithium Hydroxide (Used to increase life of positive electrode - effective at higher operational temperatures).
The electrolyte is an alkaline solution, Class 8 Corrosive and consequently great care should be taken when handling the cells. Transit bungs are fitted for shipment and must be removed before use. An Installation/Maintenance manual is supplied with each battery.

c) Electrolyte – dry
Cells supplied for export are normally in a dry empty state. Electrolyte is provided in dry form (White flakes) in sealed plastic bags (either in wooden crates or steel drums) ready for despatch. Containers should be stored in a cool dry place. Mixing instructions are provided with the Installation / Maintenance manual.

9.2 Handling
Most of the cells are heavy and awkward to handle, especially steel cells in wooden crates. Care should be taken and the correct technique employed when using manual or other lifting methods.
Ensure that the cells are maintained in a clean, dry condition to avoid the possibility of corrosion and short circuits developing.
Cells must always be kept upright with transit bungs in place to avoid spillage (bungs must be removed prior to charging or commissioning).
Only distilled or deionised water should be used for topping up. Other substances may cause a dangerous reaction. Do not overfill.
Never allow acid or tools contaminated with acid from a lead acid battery to come in contact with nickel cadmium cells.
9.3 Explosion hazard
A mixture of hydrogen and oxygen is emitted during charging and may also be
emitted if the cells are shaken. The gases may produce an explosive mixture in the
atmosphere if the concentration of the hydrogen exceeds 4% and consequently, the
following precautions must always be taken.
Always charge and store the cells in well-ventilated areas. Louvers or airbrick
ventilation is normally sufficient but calculations of specific required air changes are
available.
No smoking or naked flames should be permitted in the charging area or elsewhere
during installation, inspection or any other work on the battery cells. Notices to this
effect should be posted in the locations of the system.
Always switch off the circuit before connecting or disconnecting the cells otherwise a
spark could cause an explosion.

9.4 Fire hazard
High currents may be generated if the terminals are short circuited by conductive
objects, which may cause the object to get hot and sparks and molten metal to be
ejected. It is essential to prevent conductive objects from shorting terminals and the
following precautions must be observed.

9.4.1 Remove any metallic items from hands, wrist, neck etc. (e.g. rings,
watches, necklaces) or items which may fall from pockets.
9.4.2 Always use insulated tools and spanners with open ends.
9.4.3 Do not place tools or other metallic objects on top of cells.
9.4.4 Switch off chargers before any connection or disconnection is made.
9.4.5 The plastic cell cases under normal usage are inert. In the case of fire,
the plastic components could decompose and may give off toxic
vapours, and so suitable respiratory protection must be used during fire
fighting.

9.5 Repairs / disposal
As stated earlier, although the cells contain toxic materials, they are safe if handled
according to the accompanying guide. The cells must never be dismantled. No
attempt should be made to repair cells and they should be treated as disposable
units once they have outlived their use.
Cells must be disposed of in accordance with current waste disposal and pollution
legislation and in particular; The Environmental Protection Act 1990, Special Waste
Regulations 1996.
It is strongly recommended that the following authorities are contacted before any
attempt is made to dispose of cells; Environment Agency Local office, Local
Authority Environmental Health or Waste Handling department. Further advice is
available.
Potassium hydroxide solid / batteries wet filled with alkali - data sheet
Product:
   a) Potassium Hydroxide - White odourless flakes - strongly alkaline
   b) Caustic Potash Liquor - colourless, odourless liquid, miscible with water.
Toxicology - Corrosive causes severe burns to tissue. This reacts with water to
produce caustic solution and heat.

Occupational exposure standard (OES): 2mg/cubic metre (8hr TWA) (EH40/92)
Classification: Corrosive substance.
Eyes: Goggles giving total eye protection (BS2092).
Hands: Suitable corrosive resistant gloves e.g. PVC.
Body: Suitable corrosive resistant apron and rubber boots.

Protective clothing must be worn when carrying out work on / with cells.
9.6 Emergency action
Inhalation of mist:
Remove from exposure. Ensure plentiful supply of fresh air. Administer oxygen if necessary. Obtain immediate medical attention.

Splash on eye:
Irrigate with copious amounts of water for at least 15 min. Obtain immediate medical attention.

Splash on clothes or body:
Remove contaminated clothing. Drench affected area with water for 15 mins and seek immediate medical attention.

Ingestion:
Drink copious amounts of milk or water. Obtain immediate medical attention. Do not induce vomiting.

Following emergency action, obtain Medical Advice / attention at the earliest opportunity.

Spillages:
Keep public away. Cover with earth or sand and transfer to another container. Arrange disposal according to Environmental regulations. Flush area away to a drain with large amounts of water.

Fire fighting:
Non - combustible - keep containers cool to avoid bursting.

Description: LEAD ACID STANDBY POWER BATTERY
These can be recombination (sealed) batteries, Flooded cells (Flat plate, Planté or Tubular monobloc)

Note 1
Recombination (sealed) batteries are sealed for life. No attempt must be made to open or top-up these batteries, otherwise damage will occur and any warranty will be invalidated.

Note 2
Recombination (sealed) batteries are not classed as hazardous goods for transport purposes.

9.7 Composition - See note (A)
9.7.1 Plates and active material - Lead and lead compounds with small amounts of arsenic, antimony, calcium, tin and aluminium, depending on the battery type.
9.7.2 Pillars - As (i) above, but some types have copper or brass inserts.
9.7.3 Connectors - As (i) above, but some types have lead plated copper or pure copper connectors.
9.7.4 Boxes, lids, separators - Various inert plastics and glass fibre material.
9.7.5 Electrolyte - Sulphuric acid - See note (B).

A. Lead and lead compounds - Lead and its compounds can be toxic if ingested or if dust containing them is inhaled. However, they are well contained within the battery and are in a wet, dust free form. It is essential that battery cells are not dismantled and as such, the possibility of lead exposure is negligible. Due to the presence of small amounts of arsenic and antimony in some types of batteries (flooded types), there is a chance that arsine or stibine may be given off
during charging. However, it should be stressed that the concentrations are negligible and do not present any risk to health, their presence is mentioned merely for completeness. For guidance on arsine or stibine, consult guidance notes EH11 and EH12 prepared by the Health & Safety Executive.

**B. Electrolyte - sulphuric acid**

The electrolyte is dilute sulphuric acid. The acid is both corrosive and poisonous and great care should be taken when handling flooded type cells. In some circumstances minute droplets may be evolved during charging. It should be noted however, that there is negligible chance of any evolution of acid (or gases) from the cells since the electrolyte is fully absorbed within the battery, which operates on a gas recombination principle.

A data sheet on the handling of battery strength acid is appended. The level of protection necessary will depend on the likelihood of contact with any acid. For example, if splashes could occur to the face or body whilst handling the batteries, suitable eye and skin protection should be worn, whereas this is unnecessary when skin contact with acid or disturbance of the battery is not involved.

In the event of spillage, prompt action is recommended to prevent any chemical attack by the acid. For small-scale spillages, the acid may be absorbed on to paper towelling. Rubber or PVC gloves and suitable eye protection (BS2092C) should be worn during this procedure. The contaminated towelling should be stored in plastic bags and sealed prior to disposal by a registered waste carrier. Advice on larger spillages is contained in the attached data sheet.

**9.8 Handling**

Most batteries are heavy and awkward to handle. Care should be taken and the correct technique employed when using manual or other lifting methods. Ensure that the batteries are maintained in a clean, dry condition to avoid the possibility of corrosion and short circuits developing.

**9.9 Flooded type cells**

The battery must always be kept upright to avoid spillage of acid. Only distilled or deionised water is to be used for topping up as other substances may cause a dangerous reaction. Do not overfill.

**9.10 Explosion hazard**

Recombination batteries, when operated as recommended by the battery manufacturers, have negligible rates of gas evolution. In flooded type cells and batteries, a mixture of hydrogen and oxygen is emitted when charging and may also be emitted if the battery is shaken. The gases may produce an explosive mixture if the concentration of the hydrogen exceeds 4% and consequently, the following precautions must be taken.

9.10.1 Always charge and store the batteries in well-ventilated areas.

9.10.2 No smoking or naked flames should be permitted in the charging area or elsewhere during installation, inspection or other work on the batteries. Notices should be posted in key locations.

9.10.3 Always switch off the circuit before connecting or disconnecting the battery otherwise a spark may cause an explosion.

**9.11 Fire hazard**

High currents are generated if the battery terminals are short circuited by conductive objects, which may cause the object to get hot and sparks and molten metal to be ejected. It is essential to prevent conductive objects from shorting terminals and the following precautions must be observed.

9.11.1 Remove any metallic items from hands, wrist, neck etc. (e.g. rings, watches, necklaces) or items which may fall from pockets.
9.11.2 Always use insulated tools and spanners with open ends.
9.11.3 Do not place tools or other metallic objects on top of batteries.
9.11.4 Switch off chargers before connection or disconnection is made.
9.11.5 The boxes and lids are made from various plastics, which under normal usage are inert. In case of fire, the plastic components could decompose and may give off toxic vapours, and so suitable respiratory protection must be used during fire fighting.

9.12 Repairs / disposal
Although batteries contain lead and small amounts of antimony and arsenic, they are safe if handled according to the accompanying guide. The battery cells must not be dismantled as this involves several hazards, which are best handled under controlled conditions, using specialised equipment. No attempt should be made to repair any batteries; they should be treated as disposable when they have outlived their use. The only exception is where qualified personnel carry out repairs on the plates of type Planté cells.
Batteries must be disposed of in accordance with current waste disposal and pollution legislation and in particular; The Environmental Protection Act 1990, Special Waste Regulations 1996. It is recommended that the following authorities are contacted before any attempt is made to dispose of batteries; Environment Agency Local office, Local Authority Environmental Health or Waste Handling department. Further Advice is available if required.

Appendix A - Sulphuric acid - Data sheet
Toxicology - Contact with the body results in the rapid destruction of soft tissue causing severe burns. Repeated contact with dilute solutions may cause dermatitis.

Occupational exposure standard (OES): 1mg/cu metre (8hr TWA) (EH40/92).
Classification: Corrosive substance (1830).
Eyes: Goggles giving total eye protection (BS2092)
Hands: Suitable acid resistant gloves e.g. PVC
Body: Suitable acid resistant apron and rubber boots.
Protective clothing should be worn when carrying out work on / with batteries.

9.13 Emergency action
Inhalation of mist: Remove from exposure; ensure plentiful supply of fresh air.
Splash on eye: Irrigate with copious amounts of water or eye wash solution.
Splash on clothes or body: Drench affected area with water and, if necessary, remove affected clothing.

Do not neutralise acid while in contact with skin.
Ingestion: Drink copious amounts of water followed by milk of magnesia.

Do not induce vomiting. Following emergency action obtain medical advice and attention at the earliest opportunity.

Spillages - Neutralise as soon as possible using an alkali e.g. soda ash, sodium carbonate, sodium bicarbonate, and flush away to a drain with large amounts of water. Do not absorb acid on to sawdust.

Fire fighting - Use carbon dioxide or dry powder. Do not use water/water spray extinguishers.

Miscellaneous hazards - Owing to the violent action that occurs when water is added to concentrated acid, it is recommended that when preparing any acid solutions, the acid should be slowly added to the water.
10. Ventilation Requirements For Batteries

**Vented Batteries (NiCad, Wet Cell Lead Acid & Plante)**

Vented batteries, such as nickel cadmium, plante and flat plate lead acid emit potentially explosive gases under charge conditions. Therefore it is important when selecting rooms for emergency lighting central battery systems with these types of battery, to calculate the amount of ventilation required. The required number of air changes per hour \( (A) \) is given by the following formula:

\[
A = 0.045 \times N \times I / V
\]

Where:
- \( N \) = Number of cells in the battery
- \( V \) = Volume of room in cubic metres
- \( I \) = Charge rate in Amperes

This formula will give the number of air changes per hour required during boost charge conditions. Boost charge is only available of vented battery systems.

**Sealed Lead Acid**

On float charge (sealed lead acid systems are on float charge for all of their service life), the amount of gas emitted is approximately 1.5% of that liberated whilst on boost charge (above) and under most circumstances this will be dissipated by natural ventilation, and will not present a hazard.

We would recommend that the boost charge condition is allowed for at the design stage to ensure the appropriate decision on ventilation requirements is made. Although valve regulated Lead-Acid Batteries require little ventilation under normal operating conditions, it is good practice to apply the formula to calculate the number of air changes required to achieve minimum risk under battery fault or failure conditions.
11. Testing Of Emergency Lighting Equipment

The following routine is recommended for the testing of this equipment:-

**Monthly** – each central battery system should be energised from its battery by simulation of a mains failure sufficient only to ensure that each lamp is illuminated. The period of this simulated mains failure should not exceed one quarter of the rated duration of the battery.

All luminaries or signs should be examined visually to ensure that they are lit correctly.
At the end of each test period, the supply should be restored, indicators and charging function checked for proper functioning.

**Six Monthly** – for a three hour central battery system, a one hour discharge and recharge sequence: for a one hour system a 15 min discharge followed by recharge. Luminaires to be examined for correct functioning. On recharge, indicators and charging should be checked for proper functioning.

**Yearly** – each central battery system should be tested for its full duration.” [three hours or one hour].
On restoring mains supply to the unit, indicators and charging arrangements should be checked for proper functioning.

See “Installation, commissioning and operating Instructions” for full procedures

**Maintenance Contractors, Site managers and Caretakers Please Note!**

The above procedures must not be exceeded. Frequent discharge of standby storage batteries will seriously shorten the life of the batteries. Standby batteries are not designed for frequent charge / discharge cycles.

Previously experienced reasons for battery failures include;

“Switched battery charger off to save power. [This switches the emergency lighting on!]”
“Switched emergency lighting on every week while walking round building to test light fittings”
“Emergency lighting is useful as night-lights”
“Switched off power in the building at the main switch every night. [This included the emergency lighting unit]”

Any of the above can damage the batteries and must be avoided!
12. Cubicle Dimensions

**932 CUBICLE**

![932 CUBICLE Diagram]

**934 CUBICLE**

![934 CUBICLE Diagram]
13. Distribution MCB/FUSE Sizing

It is a requirement in both the Central Battery Systems standard (EN50171) and also in the IEE Wiring Regulations (BS7671) that, an inverter must be capable of clearing any final circuit distribution protection device. This includes both MCB’s and also Fuses.

Loadstar Static Inverters are electronically current limited in order to protect the output stage of the inverter system. The table below shows the maximum size of MCB and Fuse that should be used in the final circuit distribution. Multiple devices, equal to or smaller then those listed, can be used in the distribution.

<table>
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<tr>
<th>Static Inverter KVA Rating</th>
<th>Largest EN60947-2 Breaker That can be used</th>
<th>No of Inverters</th>
<th>Maximum BS88 Fuse</th>
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<td>AC 6</td>
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<td>2.5KVA Slave module</td>
<td>DC 32</td>
<td>AC 10</td>
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<tr>
<td>7IN1102K5S</td>
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<td>7IN1104KS</td>
<td>4KVA Slave Module</td>
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<td>AC 20</td>
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<tr>
<td>7IN1104KM</td>
<td>4KVA Master Module</td>
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<td>AC 20</td>
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</table>
Due to the design of all emergency lighting inverter systems, any Earth Loop Impedance Tests carried out downstream of the system will result in high impedance readings. The inverter system cannot be considered the same as the mains supply due to the current limiting action of the inverter output. All emergency lighting static inverter systems are designed in accordance with the relevant standards which are EN 50171, EN50091 and others.

Emergency lighting inverters generally operate as a passive standby system. The output power to the critical load is supplied by the standard mains supply via a contactor under normal conditions. If the mains supply fails then the output is switched to an electronically generated sine wave which is connected to the load via a transformer. The inverter is completely isolated from the incoming mains supply. An inverters output current is generally limited by the electronic hardware used in its output stage. When the inverter is running into a normal load, it produces a stable and regulated output voltage regardless of the backup battery voltage or output load conditions. This independency is referred to as VFI (Voltage and Frequency Independent) as defined in EN 62040-3. The inverters can and will electronically limit the maximum amount of current and voltage they produce to ensure they are not damaged under faulty load conditions.

When carrying out Earth Loop Impedance Tests, the values obtained will reflect the impedance of the output stage of the inverter. The inverter output is manufactured using high frequency switching and filtering circuits, and at no time will replicate the impedance of the supply transformer or generator alternator winding. The inverter is simply not analysable as a linear voltage source. The inverter output power is limited to the size of the components from which it is manufactured; these components are electronically protected to ensure that the inverter can continue to operate without any consequential damage following an output overload or short circuit. In fact the inverters are designed to be able to operate into a pure short circuit with no damage or excessive heat being generated.

When carrying out Earth Loop Impedance Testing to determine the fault current and therefore the breaker or fuse discrimination, the two operational states of the system must be taken into consideration; these being normal operation when the mains or generator supply is present and emergency battery operation when no mains or generator supply is present.

During normal operation when the mains supply is present to the unit, the load is bypassed through the emergency lighting system to the normal mains supply. If a fault occurs downstream of the emergency lighting system then the load current is generated by the normal mains supply. So to test this scenario the earth loop impedance testing must be carried out with mains present to the unit. During this test the values obtained should be normal.

During battery operation when no mains supply is present, the emergency lighting system must attempt to clear the fault using the power supplied by the batteries via the inverter. However the inverter does not have an unlimited amount of current available, and to protect the inverter and prevent a failure within the emergency lighting system, the unit is limited to provide a maximum short circuit current of up to 200% (current limited) for 10 seconds. After this time, the inverter output will be automatically shutdown. Shutting down the inverter protects the inverter as well as preventing any cables, luminaries overheating, damage or fire.

The emergency lighting static inverter systems are specifically designed to operate this way, during manufacture the inverter overload protection shut down is tested in the factory on all units to ensure perfect and safe operation.
15. Inverter Technical Specification

**Inverter Technical Information.**

**Output voltage**
Pre-settable in the range 220-240V AC. Default setting is 230V AC.
Voltage tolerance is 2% on loads of 0-100% of system rating

**Frequency**
50 or 60Hz ± 0.01% Standard setting 50Hz. Waveform: Sinusoidal

**Voltage regulation**
Static 2%, dynamic 6%

**Isolation**
2kv RMS between the input and output terminals

**Total harmonic distortion**
Less than 3% into a linear load

**Power factor**
Will supply loads in the range of 0.3 lag - 0.3 lead

**Overload**
200% for 10 seconds with voltage reduction and 125% for 20 minutes without any reduction in output voltage.

**Start-up time**
Standard 30mS soft start, up to 10 seconds if required

**Noise level**
Less than 55dBA at 1 metre

**Efficiency**
85 - 89%

**Protection**
DC input and AC output MCB's
DC input reverse polarity protection
Short circuit protection
Pre-charge protection fuse
Reverse-fed mains proof

**Low voltage shut down**
Inverter module(s) automatically shut down when battery discharges to a pre set level. Reset is following a combination of the restoration of the mains supply and an increase in battery voltage above the disconnect threshold level Residual current drain when the disconnect circuit has operated is less than 1mA per module

**Inhibit**
An inhibit switch to control the inverter is fitted on a user control PCB in the cubicle

**Technology**
Pulse width modulation with high frequency switching.
16. General Operation Diagram

Generic wiring diagram:

Showing typical connections for emergency lighting while using maintained lighting and switching as well as a hold-off relay (for non-maintained lighting). ACM1 switching module and a CB0112 charge relay.
17. Operation With Sub Circuit Monitors & Hold Off Relays

**Operation Of Link 1**
The wire link inside the unit can be taken to a remote switch to enable the simulation of a mains failure to the unit. Any contact capable of switching 230V 4A is suitable.

1. Link one can be used in conjunction with a BMS (building management system) or (Lockable) remote test switch so that the routine testing can be carried out when the building is unoccupied.
2. Link one is often used with non maintained systems along side SCM (sub circuit monitoring) boxes. The SCM enables you to monitor general lighting circuits so if you have one that fails you will then get the emergency output to the emergency fittings.

**Operation Of Link 2**
This wire link controls whether the output of the system is maintained (link in) or non Maintained (link open). This can also be taken to a remote switch or other equipment.

1. Link two can be used in conjunction with a time clock so that the maintained lights can be switched off when the building is unoccupied.
2. Link two can also be used in conjunction with a switch for night watchman purposes i.e. so the lights can be switched on whilst on his rounds.

**Sub Circuit Monitors (SCM’S)**
SCM’S are used in conjunction with non maintained systems via link one in the central battery system. The operation of the SCM is to monitor the general lighting circuits in the building. If there is a failure to one or several SCM units then the unit will switch into mains fail operation putting the emergency lighting on so the occupants can safely evacuate.

![Typical circuit with SCM units.](image-url)
Hold off relay (HOR).

Hold Off Relays are normally used when you have a maintained system and you require some non-maintained lights. This allows a mixture of maintained and non-maintained lighting to be used on one system. This would be achieved by connecting the general lighting circuits to the HOR unit along with the emergency supply. The output of a HOR unit is not connected while all the monitored lighting supplies are healthy. If any monitored supply fails or in the event of a total mains failure you would get a feed from the emergency supply to the fittings.

Typical circuit with HOR units.
## Battery Voltage Log Sheet

| BATTERY MAKE & TYPE: _______________________ | NUMBER: ___________________ |
| INSTALLED DATE: ___________________________ | UNIT: ___________________ |
| AMBIENT ROOM TEMPERATURE: __________ °C | |

### Periodic Terminal Voltage Records

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| Battery No. | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|-------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| Volts       |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Connections |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Tested      |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |

| Battery No. | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 |
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| Tested      |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |

| Battery No. | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 |
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| Connections |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Tested      |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |

| Battery No. | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 |
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| Volts       |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
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| Battery No. | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100|
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| Volts       |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Connections |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Tested      |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |

Date: ___________________________________________________________
### 20. Cell Record Card

**Project:**

**Address:**

**Area:**

**Equipment Type:**

**Location:**

**Battery Details:**

**Type:**

**No of Batteries in system:**

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