powerguard

Technical Description

Central Battery Static Inverter Systems

for

Emergency Lighting

1 Phase: 250 VA – 30 kVA

3 Phase: 3 kVA – 100 kVA

POWER IS OUR BUSINESS

Published by GC/PSW

Number: 105-11 – Version: 3

Table of Contents

Powerguard • Telephone: 01507 600 688 • Facsimile: 01507 600 621

Introduction

Thank you for your enquiry regarding Powerguard Standby Power Systems for essential and critical safety equipment.

Powerguard is a registered trade name.

Powerguard is a specialist supplier of Uninterruptible Power Supplies, Standby Power Supplies and Intelligent Static Transfer Modules with power outputs from 50 Watts to 4000 kWatts.

Powerguard is the largest OEM manufacturer of Static Inverter Central Battery Emergency Lighting Systems in the UK. We supply both Static Inverter Systems and AC/DC and DC Systems from 100 Watts to 100 kWatts. The Static Inverter Systems can be single or three phase input/outputs.

Our building blocks – chargers – inverters – changeover systems – static switches – are all designed and proven to give a very high performance with exceptional reliability and long life

The Uninterruptible and Standby Power Systems, Inverters and Intelligent Static Transfer Modules are state of the art using the latest technology. They are microprocessor controlled with sophisticated software to enhance the reliability and performance.

We aim to make systems that are different. We manufacture the Standby Systems, Static Transfer Modules, Inverters and Battery Chargers entirely in the UK. This is rare nowadays but it is important to achieve the quality engineering and technical support that is essential to the service we believe we should give to our customers.

You can be confident about ordering a Powerguard system because we stand behind our products absolutely. We give a no strings – no quibble free on site warranty, within the UK mainland, for the first three years of ownership dated from the date of the delivery. This covers labour, parts and travelling. This does not include emergency call out but will rely on our best efforts to attend the site as soon as possible.

The free on-site warranty applies to systems installed within the UK mainland up to a 30 mile drive north of the centre of Glasgow. An installation where access is difficult or requires special means such as the use of a ferry may not be fully covered.

However we are prepared to talk about the warranty cover for areas that fall outside the above terms either in the UK or in other countries.

Powerguard • Telephone: 01507 600 688 • Facsimile: 01507 600 621

When you contact Powerguard you will find us very helpful with an unbeatable in depth technical knowledge about our products that is entirely at your disposal both before and after your order. We usually know what we are talking about and can probably help you.

If required we carry out site surveys followed by a project plan and quotation to solve your power problems in the most effective and economical way possible. We can arrange the supply, positioning, installation and commissioning of the equipment, followed by the most cost effective after sales maintenance agreements in the industry, giving total project management to solve your power problems.

We are dedicated to giving our customers the most appropriate and cost effective power solution possible with reliability and long life a primary design objective.

The systems are manufactured and supplied according to a quality and environmental system registered to:

BS EN ISO 9001:2000

BS EN ISO 14001:2004

Powerguard Static Inverter Central Battery Systems are compliant with EN 50171

Powerguard • Telephone: 01507 600 688 • Facsimile: 01507 600 621

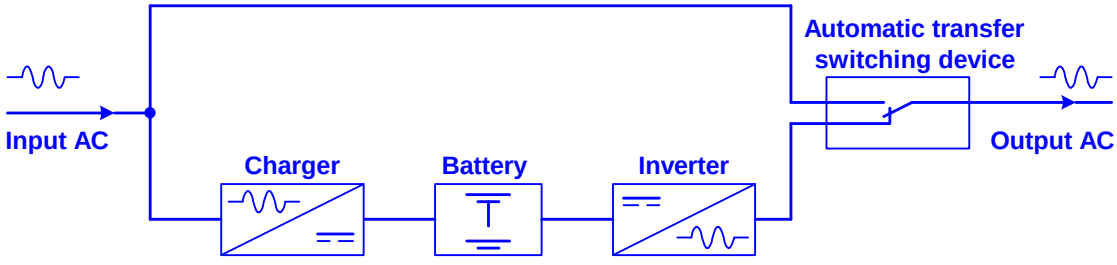
Features

- Microprocessor controlled.
- Phase controlled rectifier for reliability, ease of use and scalability.
- Constant current/voltage charger.
- Slow charger walk in to eliminate high currents caused by overshoot.
- Temperature compensated float charge voltage.
- Sophisticated operation with battery life and reliability one of the main design objectives.
- Equalises the voltage across the battery contactor before closing.
- Battery sensing mode when the charger stops charging every 4 hours for 20 seconds to check the battery connection.
- Low battery disconnect using a magnetically latched contactor.
- Timed operation of the contactors to virtually eliminate arcing.
- Control of changeover contactor to eliminate chatter.
- Volt free changeover contacts to signal BMS.
- Remote common alarm output.
- Two button operation for system shutdown.
- Sophisticated high-speed mains failure detection.
- Comprehensive monitoring and display.
- Audible alarm with manual reset.
- Dual independent power supplies with monitoring.
- System OK – green LED.
- Two-button operation for test, initiated from the front panel.
- Rugged and reliable inverter.
- Inverter is independent from the rest of the system.
- Inverter incorporates MustStart™ technology.
- PowerFlow™ ensures start up into any lighting load.
- Available single or three phase.
- Links 1 and 2 available for easy interface to lighting systems.
- Changeover contactor operation monitored by the control.
- Cooling fans have different supplies and have redundancy.

Powerguard • Telephone: 01507 600 688 • Facsimile: 01507 600 621

Mode of Operation

The machines use three 8/16-bit micro-controllers that monitor all of the system parameters and control the system to give high reliability and performance. Many years experience of the operation of emergency lighting systems, by the design team, has resulted in a sophisticated control that enhances the reliability of the system and in particular the electro mechanical components. For example it does this by reducing wear and tear on the contactors by virtually eliminating arcing and on the fans by ensuring that they only function when required and during emergency operation.



**Sketch showing a typical
Central Battery Static Inverter System**

The above sketch shows a typical Static Inverter Central Battery System operating in changeover mode.

During normal operation the incoming mains supply is fed through the system to the automatic transfer-switching device (ATSD). The normally open contacts are closed during normal operation feeding the mains supply to the load. At the same time the mains supply is fed to the charger keeping the batteries in a fully charged state ready for emergency operation.

When the mains supply fails or goes out of specification the ATSD switches to its normally closed contacts. The inverter starts up and supplies the load using power from the battery. The inverter will power the load until the mains supply is restored or the battery becomes discharged.

When the mains supply is restored the ATSD transfers the load back again and the charger charges the battery.

A micro-controller monitors all of the parameters within the system and will directly drive 10 LED indicators and a re-settable audible alarm, to indicate the system status.

Powerguard • Telephone: 01507 600 688 • Facsimile: 01507 600 621

Contactors

Overview

Wear and tear caused by making and breaking power circuits.

Electro mechanical devices such as contactors have to withstand the arduous task of making and breaking the power circuits. This causes ongoing wear and tear until the contactor eventually fails. Some contactors have a particular weakness closing the connection under load and others a weakness opening the contacts under load. One thing is sure that every time a contactor operates the contacts are damaged eventually leading to failure.

Eventual failure.

Contact bounce.

When a contactor closes the contacts can bounce causing arcing, this can weld them together. When it opens again the welds are broken damaging the contacts. Sometimes it will weld so effectively that it will not open when required causing a system failure.

Arcing.

Conversely when a contactor opens whilst supplying a load an arc is produced which is extinguished as the gap between the contacts is increased or the current reverses. This causes heat and in some cases will burn the contacts and cause failure.

Have to use contactors.

Unfortunately contactors are the best way of switching power in a lot of circumstances with five main advantages over the semiconductor alternative: -

Easily switched.

1) They are easily switched by energising or de-energising the coil.

Isolated coil.

2) The coil is isolated from the supply and the load.

Very little heat.

3) When they are conducting they are nearly 100% efficient and do not require additional cooling.

Isolates input and output.

4) When the contactor is open the load is isolated from the supply.

Lower cost.

5) The cost of implementation is considerably lower.

Overcoming weakness.

Our design engineers have spent a lot of time mitigating the weaknesses inherent in contactors sometimes eliminating the

weakness completely. They have achieved this by sophisticated programming of the control micro-controllers.

Sophisticated software.

Battery Contactor

The battery contactor is required to protect the battery from damage due to deep discharge. When it is open the system does not drain the battery at all. Unfortunately this introduces a normally open contactor into what must be a fail-safe system. To virtually eliminate the possibility of contactor failure shutting down the system Powerguard use a specially designed contactor that is latched shut with a permanent magnet and only requires a pulse to open or close it.

Protects the battery from deep discharge.

Magnetically latched contactor for reliability.

When the system first powers up the charger slowly increases the charger voltage until it is approximately equal to the battery voltage. Then the battery contactor coil is pulsed closing the contacts and connecting the battery. After the battery contactor is closed the charger starts the controlled walk in again this time bringing up the battery charge current and voltage.

Equalises the voltage across the contactor before closing.

Before the battery contactor opens to isolate the battery the inverter is shut down and the load removed.

Load removed before opening.

This virtually eliminates arcing and minimises wear and tear on the contactor increasing the life and reliability.

Increases life and reliability.

Changeover Contactor

The control protects the changeover contactor in a similar manner. The inverter is not energised until the contacts are closed and is shut down before changing back to the normal supply. It is impossible to eliminate arcing on the changeover contactor but by careful control it is minimised increasing the life and enhancing reliability.

Changeover contactor protected.

Controls arcing.

When the mains supply fails and the changeover contactor operates to its normally closed position there is no supply to break because it has failed or is much reduced. So there is no arcing on those contacts.

Supply has failed so no arcing.

The system is controlled so that the inverter does not start until the normally closed contacts are already closed eliminating arcing.

Inverter off before closing

Inverter off before opening.

When the mains supply is restored the inverter is shut down before the contactor changes back eliminating arcing on the opening contacts.

Arcing reduced 3 out 4 operations.

Three out of the four operating situations are controlled with the arcing virtually eliminated. However when the mains supply is restored and the system returns to normal mode it is already applied to the normally open contacts and therefore when the contacts close the load will be applied instantly. To counter this problem Powerguard use a high quality contactor and rate it conservatively.

Potential damage.

Heavy duty contactor.

Coil failure.

When the system is normal and the changeover contactor is energised closing the normally open contacts the mains supply is powering the load. If the changeover contactor coil failed the contactor would open and connect the inverter to the load. Unfortunately on most systems available in the market place this results in the lights going out causing a major problem. This is because the system does not switch the inverter on because the mains supply has not failed.

Contactor would open .

Lights would go out.

Sophisticated programming.

Powerguard has overcome this problem by sophisticated programming in the control system. The control monitors the system all the time and when something odd happens, such as the changeover contactor operating because of coil failure, it analyses the system and takes corrective action.

Monitors and analyses the system.

Starts inverter and avoids catastrophic failure.

In this case it would start the inverter to restore the lights and give a visual and audible alarm. This would avoid what could have been a catastrophic failure.

Powerguard • Telephone: 01507 600 688 • Facsimile: 01507 600 621

Discharged Battery Shutdown

Overview

It is the policy of Powerguard to disconnect the battery using a contactor when it is discharged. This is to prevent damage caused to the battery due to deep discharge during prolonged mains supply failures. A prolonged mains supply failure does not happen very often but when it does we should try and avoid buying a new battery.

The battery is disconnected using a contactor.

Avoid buying a new battery.

Discharged Battery Alarm

To do this and still comply with EN 50171 we have programmed the micro controller to write a code into non-volatile memory just prior to shutting down the system and disconnecting the battery. When the mains supply is restored the control remembers that the system has discharged the batteries and gives an alarm. The alarm must be reset manually to make sure that it is accepted that the batteries have been fully discharged.

System remembers that the battery was discharged.

Gives a manually reset alarm.

Battery Charge Indicator

However the mains supply may have been restored for some time by the time the alarm is noticed and the system will have proportionately recharged the batteries. So that the battery capacity can be identified Powerguard have developed a unique indicator that measures the time the charger has been on and gives an approximate indication of battery capacity.

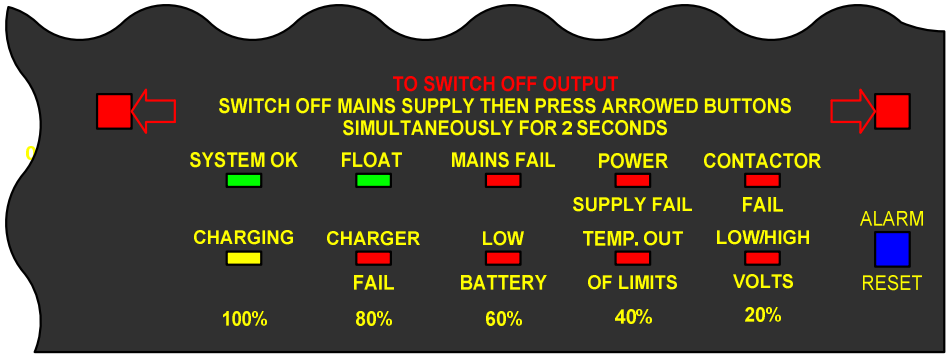
Mains supply may have been on for some time.

Battery capacity indicator.

The following sketch of the front indicator panel shows the LEDs that indicate the battery capacity.

Powerguard • Telephone: 01507 600 688 • Facsimile: 01507 600 621

Showing front panel.



Up to 5 LEDs flash to indicate restored battery capacity.

In the battery capacity indicator mode a number of the lower five LEDs are flashed to give an approximate indication of battery capacity as a percentage.

Battery discharged alarm mode.

The display is in battery capacity indicator mode during the battery-discharged alarm

Alarm reset button.

The battery discharged alarm and the display are reset by pressing the alarm-reset button.

Battery capacity indicator mode by pressing reset button.

The display can be put into battery capacity indicator mode at any time by pressing and holding the alarm reset button for 5 seconds.

Normal after 15 seconds.

It will automatically return to the normal display mode after 15 seconds.

Cooling

Fan Assisted

Fans are electro mechanical devices and wear out. Powerguard only use high quality fans with roller or ball bearings. Even so the expected life is only about 50,000 hrs. at 25°C which is 5 years of continuous operation. This does not fit into the Powerguard design philosophy of a 25-year life with minimum maintenance.

Fan life about 50,000 hours.

Not long enough.

Most Powerguard systems below 10kVA are designed to be naturally convection cooled during normal operation. The fans only come on during emergency operation. This means the fan's life without incurring maintenance is greatly prolonged beyond our target.

Systems are naturally cooled except in emergency operation.

Another major advantage with using natural cooling is that the amount of dirt and debris pulled into the cabinet is much reduced and there are no fan filters to block up.

Fan life is long enough.
Less dirt and debris.

Powerguard systems of 10kVA and above are similar to the smaller systems and use fan assisted cooling during emergency operation when the power module heat sink fans and the enclosure fans will be on.

10kVA and above have additional cooling

When the chargers on the bigger systems are supplying heavy current after a discharge some fan assisted cooling may be required.

Controlled fans on the enclosure.

The fans fitted to the enclosures are switched on when the charger is providing a high current and will be switched off when the charger goes into float mode. The high current part of the charger's life is less than 2.5% even in a system that is regularly tested every month.

Fan run time a small proportion of run time.

By careful control the fans runtime is reduced so it is a small proportion of the system "on" time extending the life of the fans.

Fans are redundant with dual supplies.

The fans are supplied from dual supplies and have redundancy built in giving a very reliable cooling system.

Powerguard • Telephone: 01507 600 688 • Facsimile: 01507 600 621

Power Supply

Battery voltage to 24 VDC converter to provide power for control circuits.

In systems that have a battery voltage over 24 VDC a DC-to-DC power supply is fitted to provide 24 VDC to power the control circuits from the battery. This is to enable the control board to keep operating in the event of a mains failure. This allows the control to monitor the battery voltage and give a warning when the battery is nearly discharged and to operate the battery contactor to prevent over discharge of the battery.

Two independent switch mode converters in parallel redundancy.

The DC-to-DC power supply has two independent switch mode converters operating in parallel redundancy each one feeding through diodes. Each of the converters is monitored by the control and if one fails a visual and audible alarm is given.

Very reliable system.

This gives a very reliable system where failure of both supplies during emergency operation is extremely unlikely.

Powerguard • Telephone: 01507 600 688 • Facsimile: 01507 600 621

Inverter

The inverter is the latest generation of a line going back 20 years and is specifically designed for emergency lighting. It is controlled by an 8/16-bit micro-controller and is very reliable and efficient.

20 year pedigree developed for emergency lighting.

It incorporates MustStart® technology and is guaranteed to start any lighting load within its rating from cold.

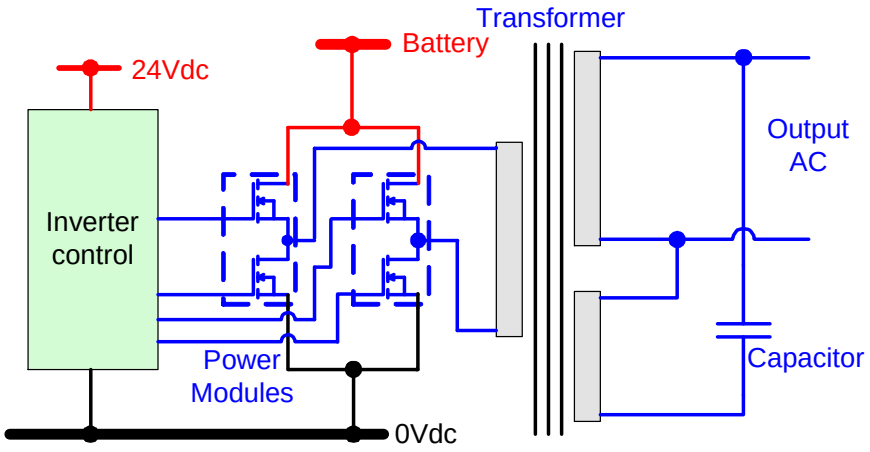
MustStart Technology.

The inverter also incorporates PowerFlow® technology. This allows the inverter to be short circuited on the output for a minimum of 5 seconds and when the short is removed it will power up the load as normal.

PowerFlow Technology.

The output is regulated and is a low distortion sine wave suitable for powering any load designed to run on the normal mains supply.

Regulated low distortion sine wave.



Sketch showing a typical inverter

Showing a typical inverter.

Inverter Control

The inverter uses an 8/16-bit micro-controller to provide all of the control and display functions. It generates the special waveforms to drive the power modules and transformer.

8/16 bit micro controller.

Special waveforms.

The current through the modules is monitored and provides an ultra high-speed dynamic current limit. This protects the power modules from damage due to short circuits and over current.

Ultra fast dynamic current limit.

Housekeeping functions.

The inverter control also looks after the housekeeping functions to keep everything running efficiently. At the same time it monitors the battery voltage and switches off the inverter when it goes too low.

Power Modules

Power modules switch Dc current.

The power modules switch the DC current through the transformer primary winding to give a 50 Hz AC drive.

Efficient and reliable.

The modules are unique and have been developed by our designers to switch heavy DC currents efficiently and very reliably. Each one has two channels and is fitted with power Field Effect Transistors (FET) as required. Each channel can take up to five 100 Amp FETs giving a notional 500 Amp switching capability. The modules can be paralleled if required to increase the current capability.

600 Amps per channel.

Very conservatively rated

However we rate the FETs at 50% of the 75°C rating so each one is rated at 45 Amps instead of 100 Amps giving a very high surge capability. This is in line with our policy of high reliability and efficiency.

Ultra fast transient spike suppressor.

Each power module incorporates a dual channel ultra high-speed transient spike suppressor to prevent damage to the FETs caused by voltage spikes. This further enhances reliability.

Transformer

Unique transformer developed for emergency lighting.

The transformer is a unique ferro-resonant type developed over 20 years to power lighting loads efficiently and very reliably. The characteristics inherent in this type of transformer have been developed to enhance the performance for lighting applications.

Can be short-circuited.

The output of the transformer is inherently protected against overloads. It can be short circuited for 30 seconds without damage. Approximately twice full load current will flow in the secondary winding.

Inherent soft start.
Will start a full lighting load from cold.

The output is regulated and is a low distortion sine wave.

The transformer has an inherent soft start capability, which will start into any lighting load from cold.

Powerguard • Telephone: 01507 600 688 • Facsimile: 01507 600 621

Overload

Policy

Powerguard has developed a policy on overload situations based on our long experience in the emergency power market. As a matter of course we do not shut the machine down when an overload occurs because in an emergency situation we think it is a mistake to save the machine from damage and as a result, inadvertently put lives at risk.

You are sometimes not too happy about the fact that our machines are bigger and weigh more than some of our competitors. This is because we design the machines with a higher thermal mass. If a severe overload is applied the temperature rise is slow and will not cause a catastrophic failure for some time.

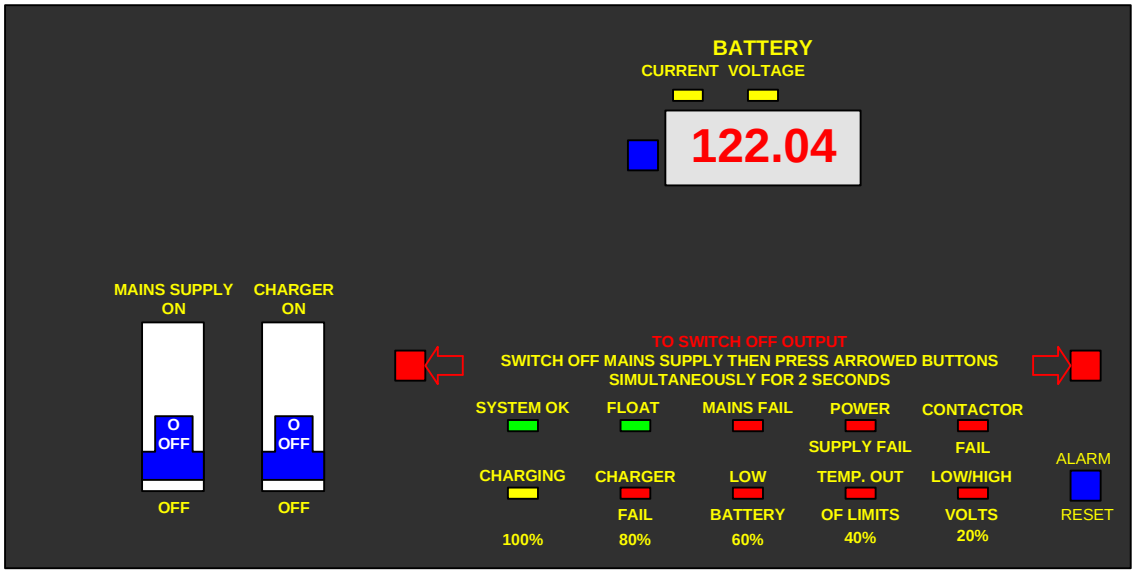
If a short circuit is applied to the output approximately twice full load current will flow. We have sustained this condition at the factory for 5 minutes without any damage. We have to use this information to choose the output and distribution breakers to the lighting circuits.

Powerguard can provide an output breaker on the machine to suit a particular application within the limits of safe operation. It is sometimes a good idea to have more than one circuit on the output of the machine so that a fault does not affect all of the emergency lights.

Powerguard will advise on the external distribution breakers if required.

Powerguard • Telephone: 01507 600 688 • Facsimile: 01507 600 621

Fascia Panel



System OK – LED

The green System OK LED is on when the system is operating in its normal operating mode.

The battery charger maintains the batteries at their optimum voltage.

The System OK LED is off when the output is sourced from the batteries, or when any fault condition exists.

Float – LED

For the green Float LED to be on the system must be within temperature limits. The battery charger will automatically shut down if the ambient temperature goes outside the normal operating range of: 0°C – 40°C. When the ambient temperature returns to the normal operating range the charger will automatically restart.

When the LED is on it shows that the charging system is OK.

The float LED is off when the mains supply is not present, when the system is out of temperature limits, when the charger has failed or the Charging LED is on.

Mains fail – LED

The red Supply Fail LED is on when the incoming mains supply fails or goes outside a preset specification.

The red LED remains on until one of the following occurs: the mains power supply is reinstated or the battery voltage falls below a preset minimum causing the system to shut down.

Power Supply Fail – LED

The system is fitted with a dual power supply with two independent outputs. If one of the power supplies fails the Red LED is on.

24 VDC systems do not have an internal power supply board.

Contactor Fail – LED

The red Contactor Fail LED is on when a failure has been detected on the changeover contactor.

Contactor Fail – LED – Flashing

The red Contactor Fail LED flashes to indicate that the battery voltage sense circuit is faulty and the charger has been shut down.

Charging – LED

The amber Charging LED is on to indicate charging is taking place prior to the system switching to float mode.

Charger Fail – LED

The Red LED is on when the battery charging system has a fault and is not charging.

The LED is off when the system is running from the batteries.

Low Battery – LED

The Red LED is on when the battery voltage falls to a predetermined level to warn of impending low battery shutdown.

Temp. Out of Limits

The red Temp Out of Limits LED is on when the ambient temperature is less than 0°C or more than 40°C. The charger shuts down.

Low/High Volts – LED

The red High Voltage LED is on when the charger output is too low or too high in the float mode.

Alarm Reset – Button

Pressing the blue reset alarm button silences the audible alarm.

Digital Meter

Over 1 kVA digital meter is fitted.

The digital meter is fitted as standard to all of the machines unless it is removed to comply with the requested specification.

8/16 bit micro controller. 10-bit accuracy.

The digital meter is controlled by an 8/16 micro-controller giving 10-bit accuracy. The value is displayed on a 4 digit LED display so it can be easily seen even in poorly lit areas.

4 digit display battery voltage and current

The digital meter indicates the battery voltage and current both charge and discharge. The reading is toggled between voltage and current by the adjacent push button. Two amber LEDs indicate the status of the displayed reading. A minus sign is displayed before the value if the battery is discharging.

Automatic Test

Automatic test sequence.

The system has an automatic test sequence programmed into it. When activated the machine goes into emergency mode and supplies the load from the batteries. The emergency condition is timed to last fifteen minutes. This will give time to check for lamp failure. The standard requires that the batteries are not run down more than 25% on a test. This is to ensure that the battery is not depleted too much in case of an emergency and that regular cycling does not shorten the life of the battery. The fifteen-minute duration was chosen because it is 25% of a one-hour autonomy system. The test sequence can be operated up to three times consecutively if the system has a three-hour autonomy battery.

Lasts 15 minutes.

25% of one hour.

Three times if the system is three hour.

Initiate from the front panel.

The two arrowed red buttons on the facia panel are used to initiate a test.

Switching Off

The two arrowed red buttons on the fascia panel are used to initiate a test sequence are also used to shut the system down. This operation is described on the front panel.

System shutdown from the front panel.

Powerguard • Telephone: 01507 600 688 • Facsimile: 01507 600 621

Ancillary Circuits

Overview

Systems easily interface with the outside world.

All Powerguard Central Battery Static Inverter systems are fitted with circuits to allow the machine to interface easily with applications requiring remote control. These include sub-circuit monitors, fire alarms and night watchmen's switches.

The interface circuits are: - Link1, Link2, Volt Free Contacts and Remote Common Alarm.

Link1

Link1 is used to put machine into emergency mode.

Link1 is installed on the same rail as the input and output terminals and is two screw terminals. These are fitted with a link when the machine leaves the factory. If the link is removed or switched a mains failure is simulated and the machine goes into the emergency mode.

The most common uses for Link1 are: -

Fire alarm panel.

1) To bring the machine into the emergency mode via the fire alarm panel.

Sub circuit monitors.

2) To interface with sub-circuit monitors to bring the machine on in the emergency mode if a sub circuit fails somewhere in the building.

Link2

Link2 is used to turn off the maintained lights but still have emergency cover.

Link2 is installed adjacent to Link1 in the enclosure and is two screw terminals. In machines below 2 kVA the link is carrying the load current. If the link is removed or switched the maintained lights will be off but they would come back on in an emergency.

In machines of 2 kVA and above the link is interfaced with a contactor inside the machine and it needs to be linked or switched to operate and switch the maintained lights off. The lights will still come on in an emergency.

The most common use for Link2 is to switch off the maintained lights to save power but to make sure that the system will power up in an emergency.

Volt free common alarm contacts

Volt free common alarm contacts.

A set of volt free alarm changeover contacts are wired to three orange screw terminals adjacent to the input and output terminals.

These allow an interface to either a remote common alarm unit or the buildings control circuits or both.

Normally Open (NO), normally Closed (NC) and Common (C) contacts are available.

If any of the systems alarms is triggered the contacts will give an alarm.

Remote Common Alarm Output

Remote common alarm output.

The Remote Common Alarm contacts are wired to two orange screw terminals adjacent to the volt free alarm contacts. When a common alarm is active 24VDC is applied to the output. This can be used to power a remote alarm panel.

Full remote alarm panel

Full remote alarm panel.

If a full alarm panel is required remote from the machine an interface can be fitted. A six core signal cable would be required from the machine to the remote alarm panel.

Powerguard • Telephone: 01507 600 688 • Facsimile: 01507 600 621

Automatic Battery Charger

Introduction

Total charging system.

The Powerguard thyristor controlled battery charger is conceived as a total charging system and is designed to ensure maximum life and reliability from the battery.

Maximum battery life.

The charger is microprocessor controlled and has many standard functions.

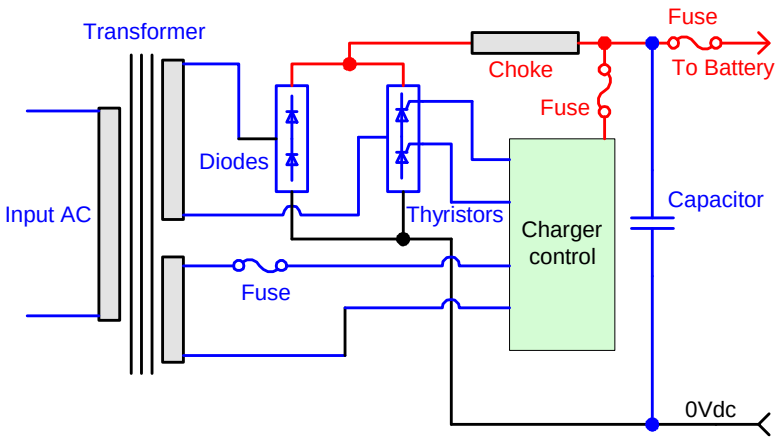
Regulates the voltage and the current.

The charger uses a micro-controller that alters the phase angle of the gate firing point of the thyristor to regulate the voltage and limit the current. The output of the thyristor controlled bridge rectifier is fed into a critical inductance choke filter to minimize the ripple on the battery and the interference sent back into the mains supply.

Choke filter

The charger is a three-stage design.

Showing a typical charger.



Sketch showing a typical charger

Three Stage Charging

Three stage design. Quicker charge.

This method will restore full capacity to the battery quicker than with a standard float charge type and is the standard method used in our inverter systems. Powerguard systems easily exceed the minimum requirement to recharge the battery within 12 hours to a capacity that will enable the system to operate for at least 80% of its rated autonomy at rated load after a full discharge.

Exceeds the minimum requirement.

When the charger is powered up into a discharged battery the current is constant at a pre-set level. The voltage control is set at a higher level during this stage, ensuring that the current is maintained for a longer period which charges the battery quicker. As the battery becomes charged the voltage rises and the current reduces. The current is monitored and when it falls to a predetermined level the voltage on the battery is reduced to the float charge value keeping the battery charged without causing damage by excessive charging.

Constant current.

Higher voltage to maintain current.

Current falls indicating battery is charged switches to float.

Temperature

As the temperature rises from the median point of 20°C the electrochemical activity in the battery increases and, conversely, decreases as the temperature falls. To prevent damage due to the over or under charging of the battery the charge voltage is compensated. The charger measures the ambient temperature and for every °C change will adjust the voltage on the battery by a pre-set amount. The charger will turn off if the ambient temperature goes over 40°C or below 0°C. These limits can be factory set at different levels to suit special applications. For example the upper and lower temperature limits could be adjusted to ensure that the battery is charged in cooler periods such as overnight

Please see the following temperature compensation chart

Float voltage is temperature compensated

Charger will turn off at temperature below 0°C and above 40°C.

Auto Check

The charger shuts down every four hours for twenty seconds to check that it is properly connected to the battery. If there was a bad connection, the contactor was open or a fuse blown it would give a visual and audible alarm.

Temperature compensation chart follows.

Charger shuts down every 4 hours to check connections.

Temperature Compensation Chart

Temperature °C	Float Voltage				Additional Information
	24 VDC	48 VDC	108 VDC	216 VDC	
0	**27.84**	**55.68**	**125.28**	**250.56**	To check the float voltage you will require a thermometer with a minimum resolution of 1°C and a good quality DVM. When a system is commissioned or visited on site the float voltage should be checked against the table on the left. If it is outside tolerance the charger float voltage should be adjusted. To adjust the float voltage the preset variable resistor R24 on the control board should be adjusted. The resistor is turned clockwise to lower the voltage. Alternatively the PCB mounted DIL switch SW2&3 on the control board can be switched onto a fixed resistor and the voltage adjusted to the 20°C value. The switch is then returned to the thermistor position. There will be inaccuracies in the system but it is important that the float voltage is as accurate as possible.
1	27.8	55.61	125.12	250.24	
2	27.77	55.54	124.96	249.91	
3	27.73	55.46	124.79	249.59	
4	27.70	55.39	124.63	249.26	
5	27.66	55.32	124.47	248.94	
6	27.62	55.25	124.31	248.62	
7	27.59	55.18	124.15	248.29	
8	27.55	55.10	123.98	247.97	
9	27.52	55.03	123.82	247.64	
10	27.48	54.96	123.66	247.32	
11	27.44	54.89	123.50	247.00	
12	27.41	54.82	123.34	246.67	
13	27.37	54.74	123.17	246.35	
14	27.34	54.67	123.01	246.02	
15	27.30	54.60	122.85	245.70	
16	27.26	54.53	122.69	245.38	
17	27.23	54.46	122.53	245.05	
18	27.19	54.38	122.36	244.73	
19	27.16	54.31	122.20	244.40	
20	**27.12**	**54.24**	**122.04**	**244.08**	
21	27.08	54.17	121.88	243.76	
22	27.05	54.10	121.72	243.43	
23	27.01	54.02	121.55	243.11	
24	26.98	53.95	121.39	242.78	
25	26.94	53.88	121.23	242.46	
26	26.90	53.81	121.07	242.14	
27	26.87	53.74	120.91	241.81	
28	26.83	53.66	120.74	241.49	
29	26.80	53.59	120.58	241.16	
30	26.76	53.52	120.42	240.84	
31	26.72	53.45	120.26	240.52	
32	26.69	53.38	120.10	240.19	
33	26.65	53.30	119.93	239.87	
34	26.62	53.23	119.77	239.54	
35	26.58	53.16	119.61	239.22	
36	26.54	53.09	119.45	238.90	
37	26.51	53.02	119.29	238.57	
38	26.47	52.94	119.12	238.25	
39	26.44	52.87	118.96	237.92	
40	**26.40**	**52.80**	**118.80**	**237.60**	
Tolerance +/-	0.03	0.06	0.13	0.26	Volts

Powerguard • Telephone: 01507 600 688 • Facsimile: 01507 600 621

Batteries

Type of battery

The type of battery normally used in Central Power Systems (CPS) for emergency lighting is a valve regulated lead acid (VRLA) – gas recombination – sealed type. These are very convenient and as long as the charger is high quality and temperature compensated virtually no gassing will take place. This allows them to be sited without preparing a special ventilated room. Powerguard has high quality VRLA batteries available with a 10-year and 20 year design life.

Normally uses valve regulated sealed lead acid batteries.

No need for a special room.

Other types of battery such as the high performance Planté positive type, lead acid pasted positive plate type and vented nickel-cadmium type will require to be installed in a room with adequate ventilation. These batteries are often specified because of their longer expected life of at least 20 years. They can also be serviced making it more likely that they will achieve their stated design life. However with the introduction of our 20-year design life VRLA batteries the extra cost is not justified.

Other types of flooded cell batteries will need special consideration on siting.

20 year sealed batteries.

Standards

Powerguard supply the type of battery that our customers require for a particular installation but normally it will be the valve regulated lead acid sealed type. They will be of a 10-year or 20 year design life and be fully compliant with the standard: BS6290 Pt.4

10 & 20 year design life and compliant to BS6290 Pt 4.

We can state from experience that the batteries we supply and recommend will give a long and reliable life usually in excess of the stated design life when used with our systems.

Long life.

Please ask for the data sheet on our range of batteries.

Powerguard • Telephone: 01507 600 688 • Facsimile: 01507 600 621

Enclosures

Type

Fully welded construction.

The enclosures for all machines are manufactured in a fully welded construction with a single hinged front door up to 1000mm wide and double doors for the 1200mm wide. The cable entry is in the top of the enclosure through an undrilled gland plate.

Three point locking mechanism.

The doors are locked using a key that is provided with the system. This operates a three-point mechanism locking the doors evenly and securely.

IP21

The ingress rating is IP21

Strong base.

The base is a strong construction using 150mm x 75mm channel section and facilitates the use of a forklift for ease of handling.

Material

Sheet steel.

The enclosures are manufactured from 1.5mm sheet steel and are an all welded construction.

The door is manufactured from 2mm sheet steel with stiffening tubular rails.

The mounting plate with four folded edges is manufactured from 2.5mm sheet steel.

Finish

Colour RAL7035 textured.

The enclosure and doors are pre-prepared and then finished with thermosetting epoxy polyester powder coating.

The colour is RAL7035 with a textured finish.

Mounting plate zintec or equivalent.

The mounting plate is manufactured from zintec and is not given any further treatment.

Powerguard • Telephone: 01507 600 688 • Facsimile: 01507 600 621

UPS Systems versus Central Battery Static Inverter Systems

Overview

We sell UPS systems.

We sell and install many Uninterruptible Power Supplies (UPS) and Central Battery Static Inverter Systems. So we believe that we are one of the few companies that can make a comparison as to the use of UPSs for emergency lighting applications completely objectively.

Our comparison is objective.

UPS drive critical applications.

UPS systems are designed primarily to supply good quality power to computer systems. Computers control many critical applications from your desktop to large communication centres. Lives and millions of pounds can be at risk if they do not perform effectively. The UPSs we sell are of the highest quality available and they do the job efficiently and reliably.

Lives and millions of pounds at risk.

We do not recommend UPS for lighting applications.

However we do not recommend the use of UPSs or their derivatives for emergency lighting except in exceptional applications where the different performance can be accounted for.

UPS loads are normally stable without heavy surges.

Generally speaking the designers know the characteristics of the normal load applied to UPS systems and the machine is optimised very effectively to power that load at an economic cost. Virtually all UPSs are designed to power loads that are relatively stable that do not demand surges during normal operation.

Powering the load

UPS static switch.

All online UPSs and that includes almost all machines with a power greater than a few kilowatt, are fitted with a static switch bypass which serves two purposes: -

Bypass the incoming supply on some failures or overload.

1) It will bypass the incoming mains supply to the load in event of the UPS inverter failing.
2) It will bypass the incoming mains supply to the load to supply a surge of power.

Powerguard • Telephone: 01507 600 688 • Facsimile: 01507 600 621

The bypass is of benefit to the user.

The first bypass mode is of benefit to the user because it gives an added security to the load in event of some failures.

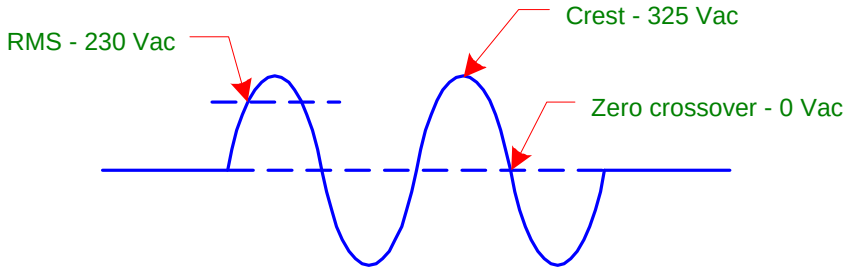
The second bypass mode is also of benefit to most users with computer-based loads. It allows the inverter to be smaller because it does not have to provide large surges. This reduces size, weight and cost.

Cannot bypass a failed mains supply.

The bypass cannot transfer the mains supply to the load when it has failed so any surges caused by emergency lights coming on will have to be handled by the UPS inverter. To make this reliable the UPS will have to be considerably oversized and probably fitted with a soft start capability.

UPS will have to be oversized.

Showing a sine wave.



Sketch showing the crest of a sinewave

Crest factor shutdown is a risk.

Even then sophisticated measuring equipment should be used to measure the crest factor of the load to make sure it is well within the UPS rating. Otherwise spurious unexplained failures can occur which may not be noticed when the machine can bypass to the mains supply but could have serious consequences if the mains supply has failed.

Most UPSs have a crest factor rating of 3 to 1. This is the ratio of current that passes at the peak of the voltage in the cycle to the normal. Some lighting loads have a crest factor greater than 3 to 1.

Efficiency

Efficiency is an important consideration.

If a UPS is used in a lighting application where the emergency lights are powered all the time so that any surges are already taken care of before an emergency can arise then the question of efficiency has to be considered. In these days of rising power costs and taxes levied on fuel

not to mention our concerns for the environment efficiency is becoming more and more important. A state of the art UPS system will operate at around 90% efficiency in ideal conditions. This can deteriorate considerably during normal operation.

Best UPS 90% efficient.

Even if we take the figure of 90% efficiency compared with the efficiency of a Powerguard Central Battery Static Inverter system of >98% it represents a considerable waste of energy.

Powerguard Inverter System 99% efficient

A 10 kW UPS system will consume an extra unit of electricity per hour compared with the Static Inverter.

At 10 kW one unit of electricity per hour is wasted.

Battery charging

EN 50171

6.2.3 The charger shall be capable of automatically charging the associated battery that has been discharged so that it can perform at least 80% of the specified duration with the rated load applied, within 12 hours on charge at a room temperature of (20 ± 5)°C

Charger must recover the battery capacity at least 80% in 12 hours.

6.2.3 Battery chargers shall be capable of automatically recharging the discharged battery so that it can perform 100% of its specified emergency duration within 24 hours on charge.

100% in 24 hours.

6.2.3 In the case of parallel standby mode (UPS) where the load is supplied from the charger, the nominal output current of the charger shall be equivalent to at least 110% of the sum of the specified load and battery recharge current required to enable the requirements of 1) and 2) to be achieved.

UPS must be able to give 110% of the sum of full load and full charge current.

6.2.5 Automatic temperature compensation of battery charge voltage shall be provided if the battery is of the lead acid type or is a requirement of the battery manufacturer.

Temperature compensation for long battery life.

Most emergency lighting systems are specified for 3 hours battery autonomy with some working in conjunction with a generator specified at 1 hour. This means that a large capacity battery is required. It is our experience that very few if any standard UPS systems have chargers rated to comply with the requirement.

UPS will struggle with large capacity batteries.

Powerguard • Telephone: 01507 600 688 • Facsimile: 01507 600 621

UPSs are fitted with 5-year life batteries

Batteries

UPS systems are usually fitted with 5-year batteries

EN 50171

Batteries must be compliant.

6.12.1 Batteries for central power systems (CPS) shall be fully compliant with all appropriate standards from the following publications:

BS 6290 Pt. 4 Lead acid stationary cells and batteries – Specification for lead acid valve regulated sealed type.

10 year design life.

6.12.2 Batteries for central power systems (CPS) shall be a type having a declared design life expectancy of at least 10 years at 20°C ambient temperature.

Inverters

Inverters must handle 120% of load for rated duration.

EN.50171

6.5.3 Inverters shall be capable of permanently handling 120% of the load requirement for the rated duration. Inverters shall also be able to start the full load of a previously unpowered system within the response time of EN1838 in the mains failed mode.

Inverters must be able to cold start the load.

Inverters must be able to clear faults and then power up as normal

6.5.8 The inverter shall be capable of clearing any associated final circuit or distribution circuit fused without shutting down or rupturing its output fuse. Inverters shall recover to normal output automatically within 5 s of the fuse being cleared.

A UPS will struggle.

In our experience few UPS inverters will meet the above requirement and have to be drastically oversized to come close.

Maintenance

UPS are designed for a shorter working life and maintenance will become harder and more expensive.

UPS systems are designed to give service for 4 to 5 years with minimal maintenance after that the batteries and fans would need replacing. The UPS should then run for another 4 to 5 years with maintenance. Spare parts become increasingly difficult to get as the machines age beyond the first 5 years and nearly impossible after 10 years.

However a Powerguard Static Inverter Central Battery System is designed to give a life of 25 years with minimum maintenance.

Summary

We are aware that some manufacturers can upgrade their UPS or derivatives to comply with the published standards and best practice. However if a UPS is upgraded in this way it becomes very uneconomic compared to the Central Battery Static Inverter System.

UPSs can be upgraded but become expensive.

There are also facilities on Powerguard Static Inverter Central Battery Systems that are used in emergency lighting installations such as Link 1 and Link 2. These allow the unit to be controlled remotely by sub-circuit monitors, fire alarms and night watchmen in a straightforward and traditional way. Without these facilities the installation will be more complex, expensive and unreliable.

Standard features reduce cost of installation.

Powerguard • Telephone: 01507 600 688 • Facsimile: 01507 600 621

Other Products and Services

Powerguard supply a wide range of power equipment and services including: -

- Uninterruptible Power Supplies
- Engine Driven Generators
- Central Battery Emergency Lighting Systems
- 5 Year Design Life Batteries
- 10 Year Design Life Batteries
- 20 Year Design Life Batteries
- Deep Discharge Batteries
- Battery Chargers
- Inverters
- Rectifier Systems for 24 VDC or 48 VDC
- Static Switches
- Site Surveys
- Full Installation, Commissioning and Maintenance

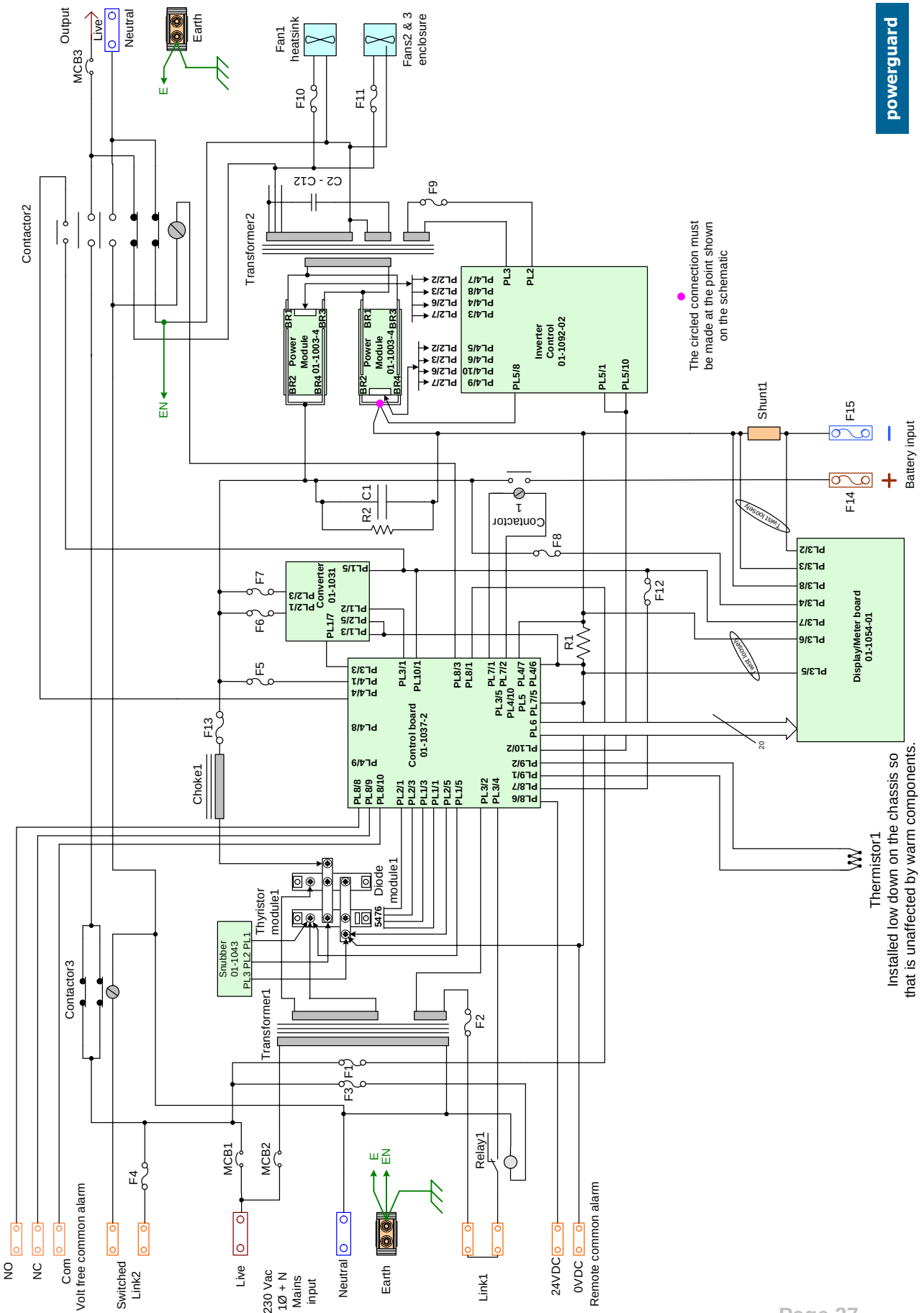
Powerguard • Telephone: 01507 600 688 • Facsimile: 01507 600 621

Notes

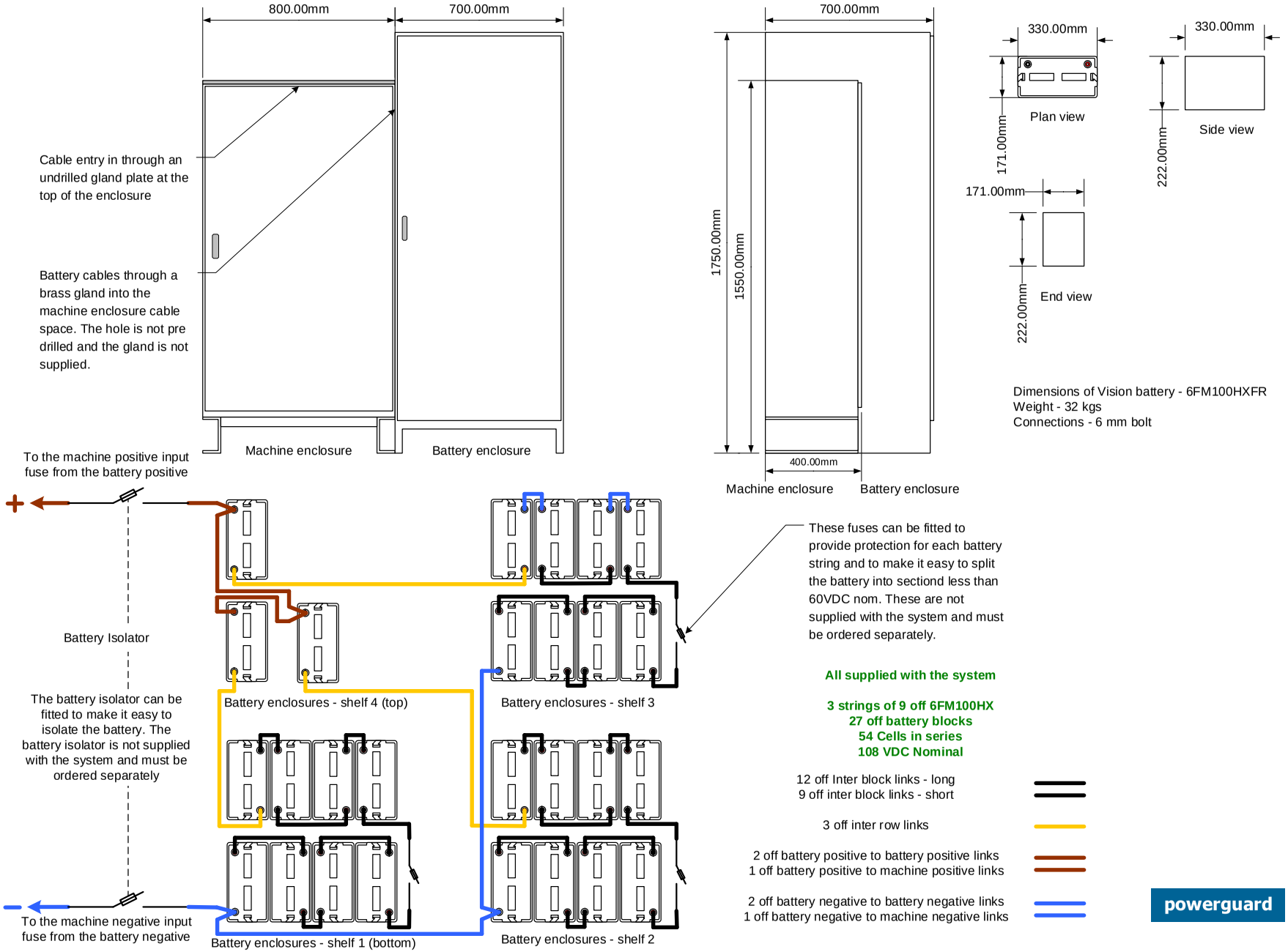
Powerguard • Telephone: 01507 600 688 • Facsimile: 01507 600 621

Notes

Powerguard • Telephone: 01507 600 688 • Facsimile: 01507 600 621


powerguard
Output
MCB3
Live
Neutral
Earth
E
Fan1 heatsink
Fans2 & 3 enclosure
F10
F11
C2 - C12
F9
Contactor2
Transformer2
EN
Power Module 01-1003-4
Inverter Control 01-1092-02
The circled connection must be made at the point shown on the schematic
Shunt1
F15
F14
Battery input
R2
C1
Contactor 1
F8
F7
F6
F5
F12
R1
Converter 01-1031
Control board 01-1037-2
Display/Meter board 01-1054-01
F13
Choke1
Thyristor module1
Diode module1
Snubber 01-1043
Thermistor1
Installed low down on the chassis so that is unaffected by warm components.
Contactor3
Transformer1
F2
F1
F3
F4
MCB1
MCB2
Relay1
NO
NC
Com
Volt free common alarm
Switched Link2
Live
230 Vac 1Ø + N Mains input
Neutral
Earth
Link1
24VDC
0VDC
Remote common alarm

Powerguard • Telephone: 01507 600 688 • Facsimile: 01507 600 621



This information is given for guidance only and it is up to the installer to make sure that the installation conforms to best practice and any applicable safety and technical standards that apply. Battery shapes and wire colours shown are indicative only. When the battery pack has been assembled use a voltmeter to check that the voltage is compatible to the rating plate on the machine.