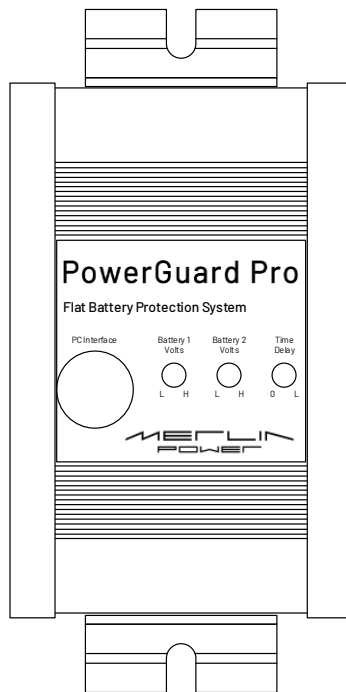




POWERGUARD PRO USER & INSTALLATION GUIDE

Revision: B



Merlin Equipment Ltd
Clyst Court
Hill Barton Industrial Estate
Exeter, Devon, EX5 1SA
United Kingdom
T: +44 (0)1202 697979

Merlin Power Systems
332-4 West Montauk Highway
Hampton Bays
New York NY11946
United States of America
T: +1(631) 594 5102

www.merlin-power.com

WARNING

Your attention is drawn to "Caution!" and "Warning!" statements throughout this manual.

"Caution!" refers to practices that may cause damage to the Merlin Product or your electrical system.

"Warning!" identifies practices that may cause injury or death.

PowerGuard Pro is designed for installation by qualified and competent electrical engineers.

Qualified and competent engineers will be familiar with safe working practices, local health & safety legislation and the proper and safe use of tools and equipment.

Therefore not all obvious practices that may lead to system damage, injury or death are detailed within this manual.

If you are in anyway unsure about any aspect of the installation or use of PowerGuard Pro, contact your Dealer or Merlin Power Systems for advice.

PRECAUTIONS

- This product is designed for use in 12 and 24 Volt DC vehicular systems depending on model. Use in other than its designed application may result in fire, electric shock or other injury.
- DO NOT disassemble, modify or alter. Doing so may result in an accident, fire or electric shock.
- USE ONLY in vehicles with a NEGATIVE GROUND. Failure to do so may result in fire, electric shock, damage or other injury.
- FUSES: Use the correct ampere rating when replacing fuses. Failure to do so may result in fire, injury, electric shock or damage.
- DO NOT install or operate the CPU in an explosive atmosphere.
- DO NOT install or expose the CPU to excessive temperatures or humidity.
- If in any doubt consult a suitably qualified and competent engineer or the supplier.
- DO NOT substitute Contactors or switches with any other types that have not been approved and tested.
- MAINTENANCE. If you have problems or suspect device failures DO NOT attempt to repair the unit yourself. Return it to your Dealer or Merlin for servicing.

APPROVALS AND CONFORMITY

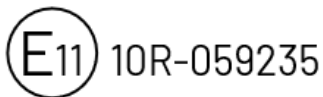
CERTIFICATE OF CONFORMITY



Declaration of Conformity

Merlin Equipment Limited, hereby declares that the product marketed as PowerGuard Pro is in compliance with the requirements of EU Electromagnetic Compatibility (EMC) Directive 2014/30/EU.

VCA Approval Number 10R-059235



Test Report No: TRA-025368-38-00A



PowerGuard Pro complies with RoHS (Reduction of Hazardous Substances) Directive 2011/65/EC. At the end of life, PowerGuard Pro should be disposed of as normal electrical waste.

PowerGuard Pro has been tested to and surpasses ISO-7637-2 for use Vehicles.

Signed:

A handwritten signature in blue ink, appearing to read 'James Hortop'.

James Hortop
Managing Director
Merlin Equipment Limited

INTRODUCTION

Thank you for choosing Merlin PowerGuard Pro!

PowerGuard Pro is a remote battery switching system. This allows you to mount battery master switches in convenient locations such as dashboards or helm panels without needing to run heavy duty cables throughout the vehicle/boat.

PowerGuard Pro is also a Flat Battery Protection System. Using sophisticated battery monitoring techniques, PowerGuard Pro detects when batteries start to run low. When the batteries have run below a certain level for a pre-set period of time, the battery will be disconnected. Note: on the primary battery circuit, this is inhibited from happening when the engine ignition is switched on.

PowerGuard Pro will operate on certain hybrid and electric vehicles and those fitted with both standard lead/acid, AGM, Gel and Lithium-Ion Batteries.

Please take the time to read and understand this manual before installation and use.

CONTENTS

WARNING.....	2
PRECAUTIONS	3
APPROVALS AND CONFORMITY	4
CERTIFICATE OF CONFORMITY	4
INTRODUCTION	5
CONTENTS.....	5
IDENTIFICATION OF SYSTEM COMPONENTS	6
INSTALLATION	7
POSITIONING OF PARTS	7
FIRST FIX INSTALLATION	7
ECU INSTALLATION	8
WIRING SCHEMATICS	9
NOTES	12
SET UP AND ADJUSTMENTS	13
PROGRAMMING.....	15
POWERGUARD PRO OPERATION	16
AFTER INSTALLATION	16
PRODUCT SPECIFICATIONS	17
PRODUCT ACCESSORIES.....	17
WARRANTY	18

IDENTIFICATION OF SYSTEM COMPONENTS

PowerGuard Pro comprises a number of components. PowerGuard Pro is configured for 1 or 2 battery bank installations, at 12 or 24 Volt DC. A number of additional components (e.g. Contactors, Switches) may also be used in the system.

PowerGuard Pro Control Unit (ECU):

Contains main CPU and battery monitoring circuitry.



PowerGuard Pro ECU

Contactors:

External contactors are used for battery isolation of battery banks.



Contactor

Standard contactors are rated at 200A continuous for both 12 & 24V systems.

Control Switches:

Illuminated rocker switches can be provided for the switched inputs into the PowerGuard Pro ECU. This can be used to control the manual battery isolation or reset of flat battery protection.



Attention: The Preview is based on a sample product; this can differ from the actual configuration supplied

Control Switches

PowerGuard Pro control status can be communicated to the user via the LED contained within the switch. Alternatively, external LEDs can be provided. Up to 3 Switches can be installed per vehicle as follows:

Switch 1 - Flat Battery Protection Reset Switch (PowerGuard)

Switch 2 - Toggle Engine Battery (1) Switch

Switch 3 - Toggle Auxiliary Battery (2) Switch

INSTALLATION

Warning! Isolate power supply before starting installation.

POSITIONING OF PARTS

PowerGuard Pro main components (ECU & Contactors) do not need to be easily accessible from a user's perspective. Only the control switch needs to be readily accessible to the user.

The following should be observed as parts of the PowerGuard Pro are designed for wet / dirty environments, but others are not.

PowerGuard Pro ECU:

The ECU is designed for location in a dry / clean environment. The ECU is **NOT** suitable for installation or operation in atmospheres where there is a risk of ignition or explosion. The ECU is **NOT** suitable for installation outside, under bonnet or in wet / damp cupboards.

Caution! Damage will occur if the ECU is allowed to get wet.

Warning! Do not install the ECU in a petrol/gas engine room environment.

Contactors:

The external isolation contactors are designed to be installed under hood, in wet engine room environments and battery compartments. The contactor is IP66 rated and will withstand hose downs. The contactors should be located as close as possible to the associated batteries.

Control Switches:

The switches are designed for location in a dry environment. They should be mounted on the dashboard or within easy view/access for the vehicle operator.

FIRST FIX INSTALLATION

Pre-Installation Preparation:

- Disconnect the main positive and negative from each battery bank to ensure no power is on the vehicle (up to 2 battery banks).
- Remove items (e.g. seats, access panels etc) to ensure easy installation.
- Survey the sites where you wish to locate components.

Mount Components:

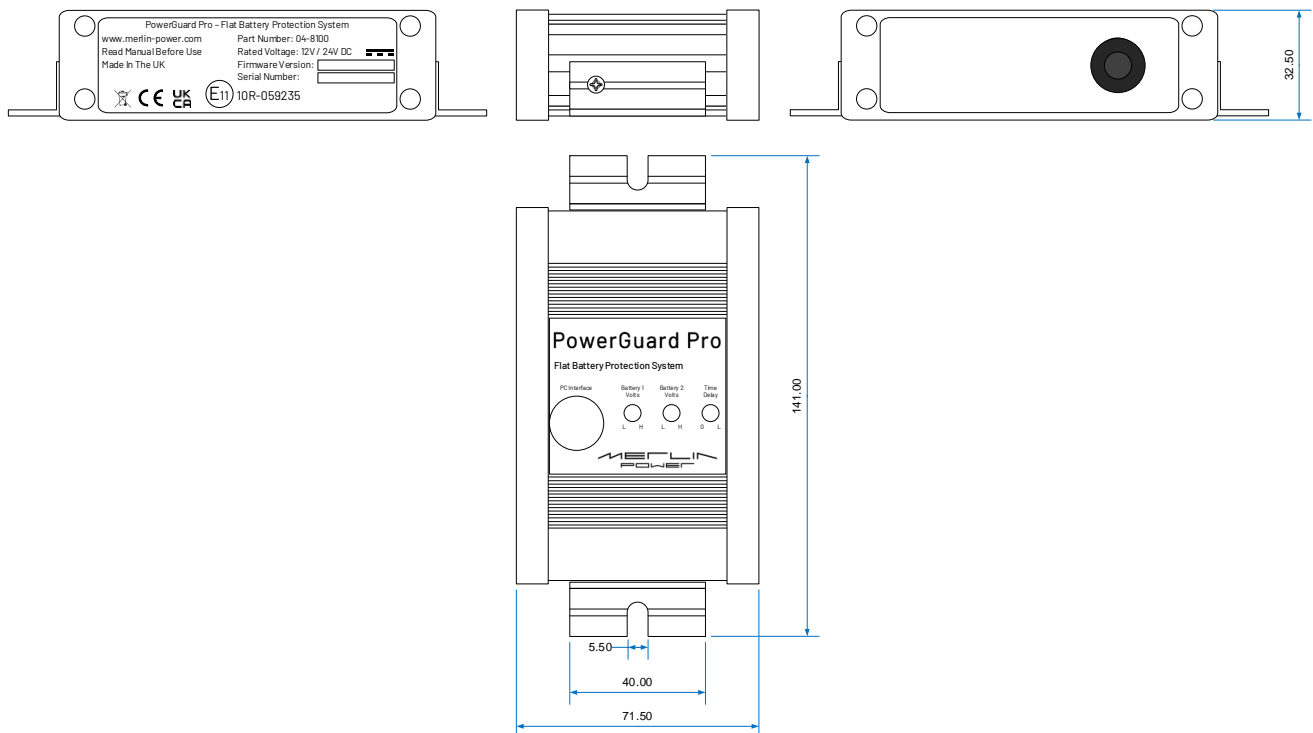
Mount the components in the agreed locations with the specifying Engineer. We recommend installing directly to bulkheads using stainless steel bolts. All nuts should be either of the Nyloc type or protected with a shake proof washer. Appropriately sized washers should be used to mount components to distribute component weight and loadings.

Plan and lay in cables:

Lay in the cables / wiring to the various components as per the system diagram supplied by the specifying / design Engineer. Ensure all cables are routed away from vehicle control devices and are suitably fixed and secured. Cables and wiring should not be installed above vehicle access points.

ECU INSTALLATION

The PowerGuard Pro ECU is supplied with 2 Mounting Flanges. Each flange has a mounting slot to enable fitment of M5 bolts. Ensure that the unit is securely mounted to the vehicle using suitable bolts, washers and nuts. Unit dimensions are as detailed below:



Note: Wiring loom omitted for clarity.

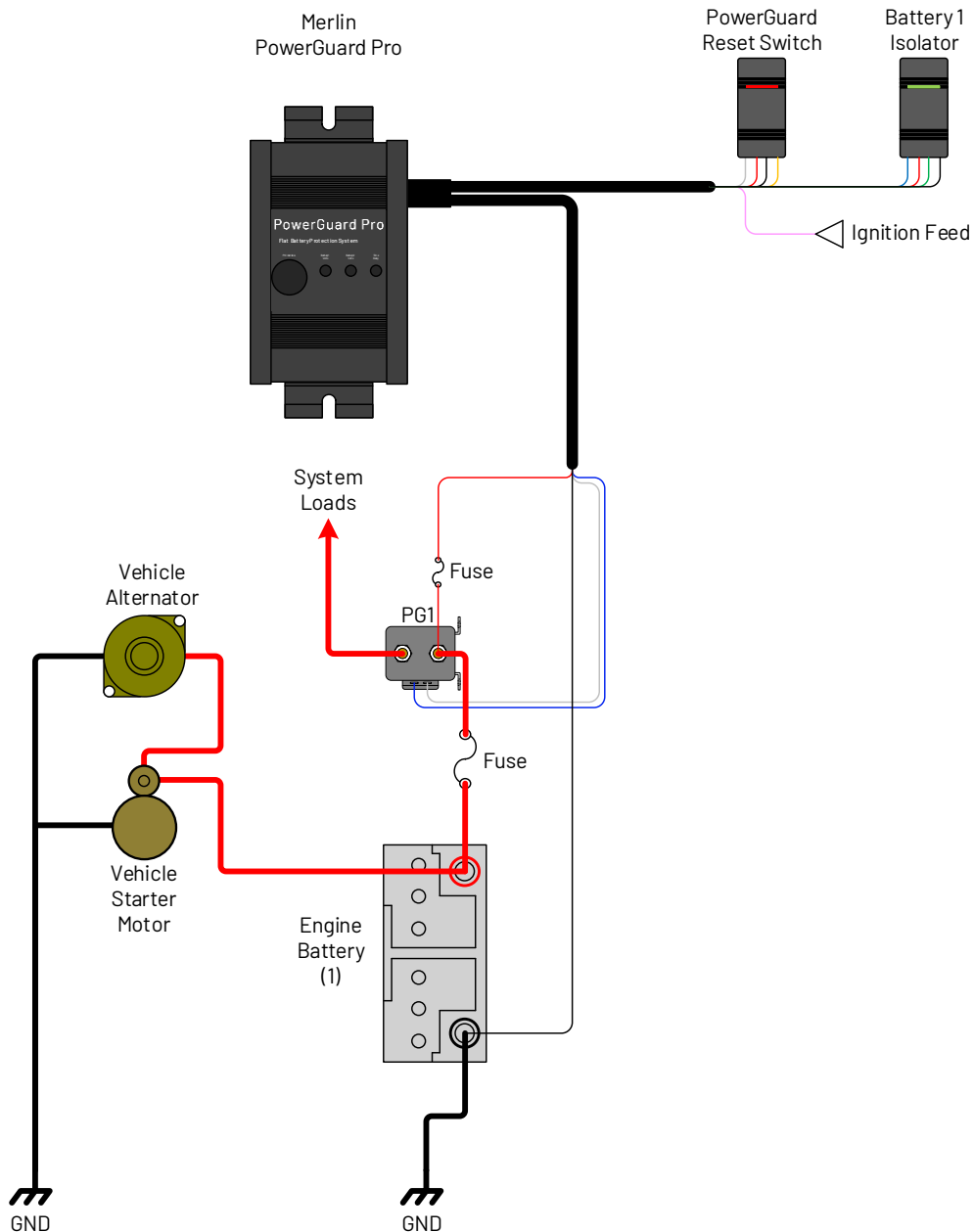
The PowerGuard Pro wiring connections are as detailed within the Interface Control Document.

WIRING SCHEMATICS

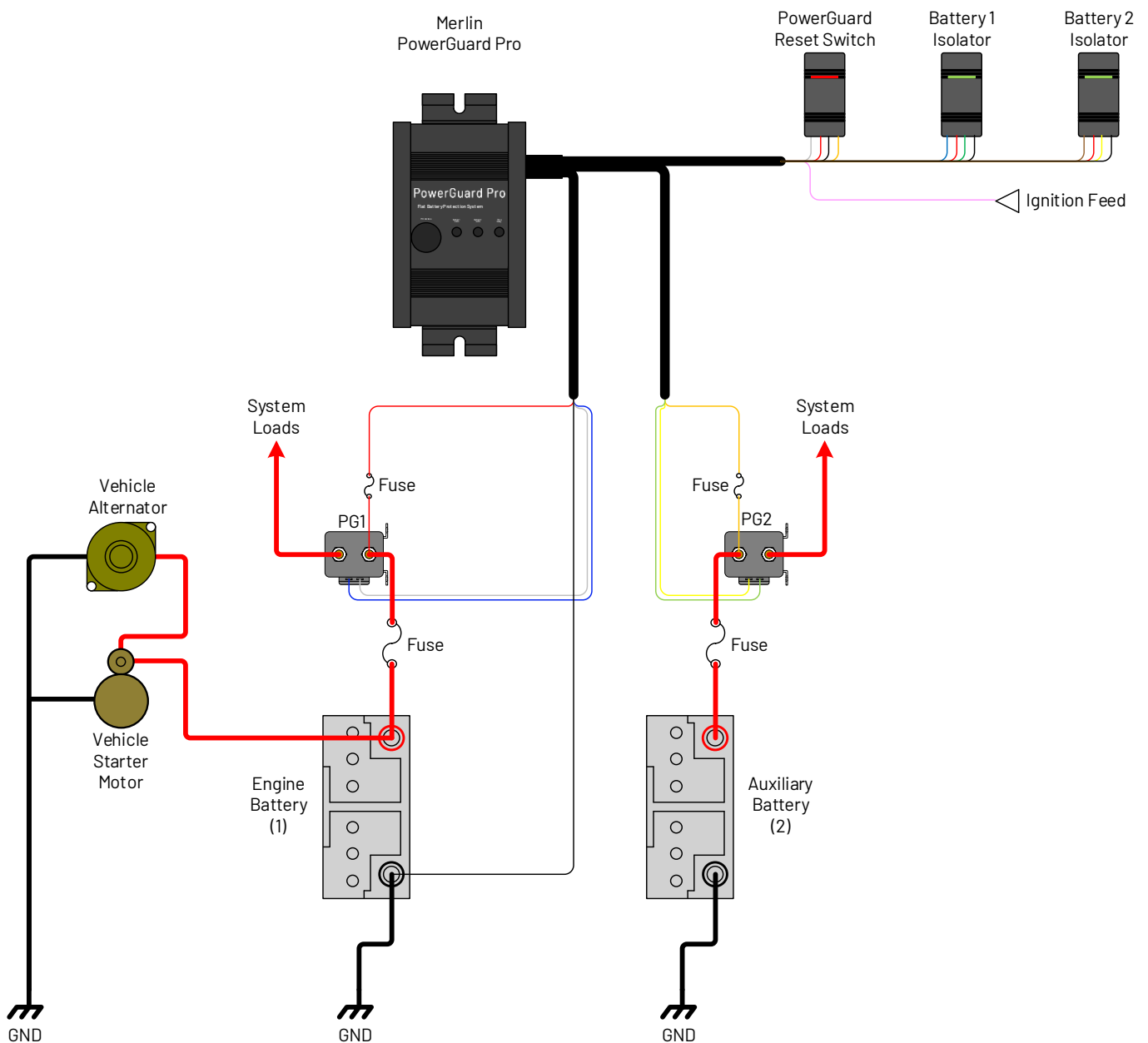
TYPICAL SYSTEM LAYOUTS:

This section is for information only. Please check with the specifying / design engineer. However, these diagrams show a typical layout which will give you an understanding of how the systems install and the component parts required.

The following 1 Battery Bank Example is based upon a typical installation:



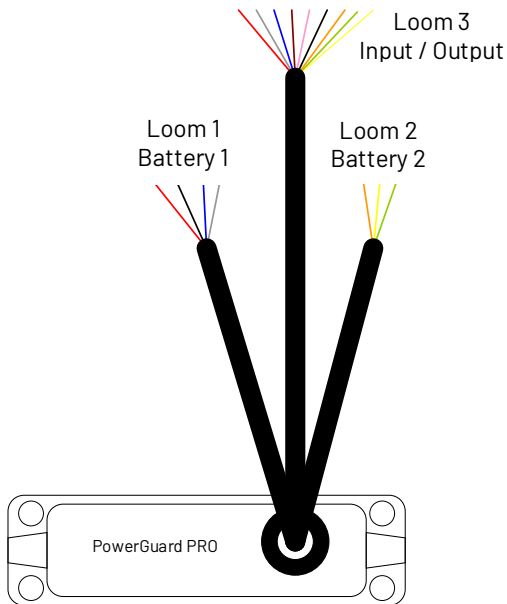
The following 2 Battery Bank Example is based upon a typical installation:



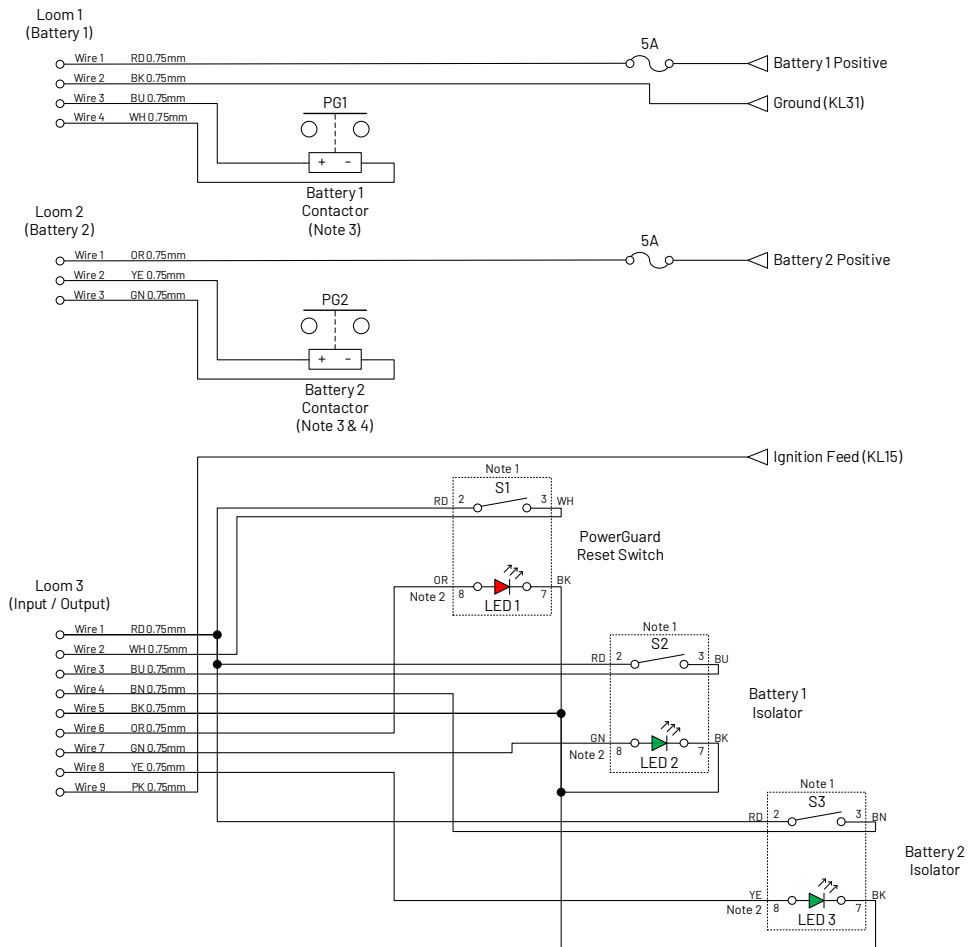
- **Caution & Warning!** Observe carefully B1 (Battery 1) and B2 (Battery 2) designations. B1 is always the engine battery, B2 is always the auxiliary battery. Any changes from this will require advanced set up. If B1 and B2 are transposed, the system will not operate correctly.
- **Caution!** Ensure always that the correct polarity is observed on the PowerGuard Pro wiring. Serious damage to the PowerGuard Pro ECU will occur if wires are shorted or connected the wrong way around.
- **Caution & Warning!** We recommend that appropriately rated fuses or circuit breakers are inserted between batteries and PowerGuard Contactors to protect against short circuits. These should be rated based upon maximum vehicle alternator output (Amps) or a maximum current rating of 200A.
- Fuses should be located as close as possible to the battery positive terminal of each battery bank.
- High current cables must have a current rating higher than that of the associated fuse.

CONTROL & SENSE CABLING:

The PowerGuard Pro is supplied with 3 separate wiring looms generally as per the diagram below:



Loom connections are as follows:



Notes

1: Drawing details Carling type momentary switch with integral LED.

Separate Switch and LED can be utilised if required.

2: LED Supply 5 Volt DC source with a 1K series limiting resistor.

3: PowerGuard contactor terminal connections are handed (Pos / Neg).

4: PG2 only used on 2 battery systems.

5: Wire / cable wiring must comply with IPC/WHMA-A-620A.

- **Caution!** Care should be taken with the contactor coil connections. Serious damage to the PowerGuard Pro will occur if wires are shorted or incorrectly connected.

IGNITION INHIBIT WIRE:

Where the PowerGuard Pro is connected to an engine start / vehicle chassis battery, the Ignition wire (pink) MUST be connected to the engine's ignition switch.

When the ignition is on, PowerGuard Pro is disabled and will not disconnect batteries. The remote battery switches will not work.

- *Caution & Warning! Failure to connect the ignition inhibit may cause damage to the engine alternator and all electrics/electronics on board. Furthermore, critical safety loads like electric power steering, ABS Brakes may cease to operate. ALWAYS connect the ignition inhibit wire.*

BYPASS LOADS:

There may be certain loads attached to the battery that should not be subject to flat battery protection disconnection. For example, some engine management computers, hazard warning lights etc. In some states/countries, these this may be mandated by law. Bypass loads should be identified, individually fused and connected directly to the battery.

Note that any bypass load will eventually flatten the battery even after PowerGuard has activated flat battery protection. However, normally, they draw only milliamps so should not interfere with the normal operation of the vehicle/boat.

NOTES

FINAL CHECKS:

Once cabling is complete. We highly recommend following the checklist below before reconnecting the main battery cables:

- *CAUTION! Incorrect and reverse polarity may damage the system.*
- *WARNING! Reverse polarity connections to batteries may cause them to explode. Check all cabling before powering up the system.*

PRE POWERUP-CHECKS:

- Check security of each component.
- Check main battery cables against system diagrams.
- Check main battery cables are correctly sized based upon rated loads.
- Check tightness of all connections.
- Ensure all live terminals are covered with rubber insulating boots.
- Check all negative connections are secure.

BATTERY CONNECTION:

Connect the batteries.

You will hear various clicks and clunks as the PowerGuard Pro determines the position of contactors. Depending on unit status the switch LEDs may light.

DIGITAL SIGNAL PROCESSING:

PowerGuard Pro senses and processes voltages using a Digital Signal Processing (DSP) which filters out transient spikes and electrical noise preventing contactors connecting and disconnecting erroneously.

The DSP operation means that the PowerGuard Pro will take time to respond to sudden changes in voltage, so it may appear that there is a time-lag between the voltage reaching a certain level and the PowerGuard Pro reacting to it. This is normal operation.

SET UP AND ADJUSTMENTS

CONFIGURATION:

PowerGuard Pro will work 'out of the box' for 1 or 2 battery bank systems.

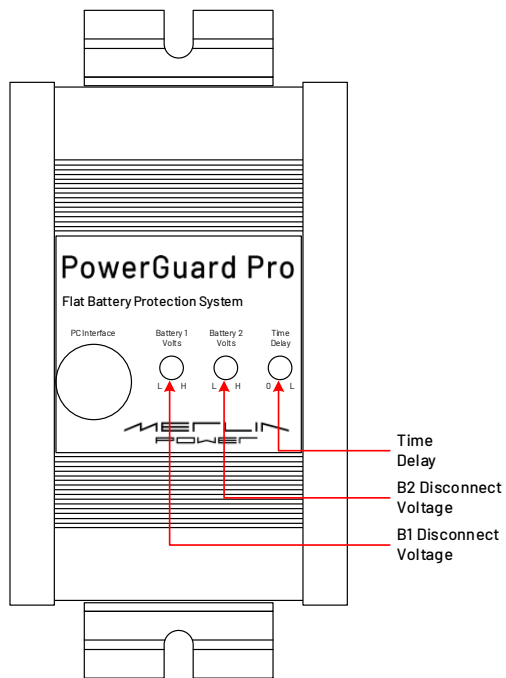
Manual adjustment of split charge settings is achieved using rotary trimming potentiometers ("trim pots") which are accessible through the front case of the ECU.

The trim pots on the front of the CPU allow you to adjust the Battery 1 & Battery 2 Disconnect Voltage and Time Delay settings.

- B1 (PowerGuard 1) disconnect range = 10.5 to 12.7 Vdc (26.0 to 27.6V for 24V unit)
- B2 (PowerGuard 2) disconnect range = 10.5 to 12.7 Vdc (26.0 to 27.6V for 24V unit)
- Timer Delay Range = 0 to 240 seconds.

Adjustment is made by rotating the trim pots using a trimming tool or a small (1.5mm) flat-blade screwdriver. These are accessed through holes in the front face of the enclosure. Protective blanking plugs cover the holes and need to be removed in order to adjust the trim pots.

- *CAUTION! Care should be taken to ensure that internal components are not short-circuited during adjustment. It is therefore recommended that fuses are removed during adjustment.*



The left-hand trim pot adjusts the disconnection voltage threshold for battery 1, the middle trim pot adjusts the disconnection voltage threshold for battery 2, the right-hand trim pot adjusts the time delay between zero and 240 seconds.

Note that potentiometer settings are almost perfectly linear.

For example, with the control in the 12 o'clock position, this would be in the middle of the adjustment range. e.g. 11.6 Vdc for disconnection voltage, 120 seconds for time delay.

The flat battery protection setting is the threshold at which the PowerGuard Pro will disconnect the battery once the disconnect voltage has been reached and the time delay has elapsed.

Please note that the battery voltage must remain below this threshold for the entire time delay period.

As a rough guide we would recommend the following settings:

- 12V Engine Start Battery: 12.1V DC 2-minute timer
- 24V Engine Start Battery: 24.2V DC 2-minute timer
- 12V Auxiliary Battery: 11.6V DC 4-minute timer
- 24V Auxiliary Battery: 23.2V DC 4-minute timer

Actual settings will be dependent upon battery type, battery capacity and installation conditions. Some experience and practice may be required to get the settings perfect for your installation, however, Merlin and its Dealers will be happy to provide advice if required.

PROGRAMMING

PowerGuard Pro is factory shipped as a pre-programmed system. The standard operation of the switch inputs and LED outputs are as follows:

SWITCH 1:

Resets flat battery protection (PowerGuard) on both engine (B1) and auxiliary (B2) batteries, reconnects manual isolation.

SWITCH 2:

If the engine battery is connected, pressing the switch will manually isolate it. If the engine battery is manually isolated, pressing the switch will reconnect it.

SWITCH 3:

If the auxiliary battery is connected, pressing the switch will manually isolate it. If the auxiliary battery is manually isolated, pressing the switch will reconnect it.

- *Caution! Switches 1-3 must be momentary (On) Off operation.*

LED 1:

LED 1 is related to the flat battery protection (PowerGuard).

LED Continuously On: Engine (B1) or Auxiliary (B2) Battery Isolated due to low battery voltage.

LED Off: Normal operation.

Note: Uses red LED switch

LED 2:

LED 2 is related to the engine battery (B1).

LED On Continuously: Battery connected.

LED Off = Manually isolated.

Note: Uses green LED switch

LED 3:

LED 3 is related to the auxiliary battery (B2).

LED On Continuously: Battery connected.

LED Off = Manually isolated.

Note: Uses green LED switch

Should the end user require custom programming, the PowerGuard Pro can be supplied as an ECU only with external components as required. In this instance a 'Specifying Guide' will need to be completed by the specifying engineer. This should include (but not be limited to) the following information:

- Vehicle type.
- Vehicle alternator rating (Amps).
- Auxiliary battery size (Ah) & type (e.g. Lead Acid / AGM).
- Maximum auxiliary battery bank loads.
- Battery split charge connect / disconnect voltages.
- System switch inputs required.

Please ensure all programming requirements and parameters and any customer training needs are addressed by your specifying engineer before taking delivery of the unit.

POWERGUARD PRO OPERATION

PowerGuard Pro has been developed as a remote battery switching & flat battery protection system.

During normal operation the PowerGuard will monitor the voltages of both the engine and auxiliary batteries. Depending on these voltages it will carry out the following tasks:

1. Flat battery isolation (PowerGuard)

Should the engine battery discharge to below the pre-set voltage threshold (set via the B1 trim pot) a timer will activate. If the voltage remains below this threshold for the pre-set timer period (set via the Timer trim pot), the engine contactor will isolate. The red LED in switch 1 will also illuminate.

Should the auxiliary battery discharge to below the pre-set voltage threshold (set via the B2 trim pot) a timer will activate. If the voltage remains below this threshold for the pre-set timer period, the auxiliary contactor will isolate. The red LED in switch 1 will also illuminate.

To reset the flat battery protection on either battery bank, press switch 1. The relevant contactor will reconnect. At this point charge should be applied to the batteries by either starting the engine or use of an external charge source.

2. Battery Isolators

Using switches 2 and 3 enables user control of the manual battery isolators. This facility negates the need for additional battery isolation devices within the system. The switch LEDs provide user feedback as to whether the battery is manually connected or disconnected.

AFTER INSTALLATION

After installation and set-up, the blanking plugs (provided) should be fitted into the holes in the front of the unit. Note that they are designed to be difficult to remove so make sure you are finished before inserting them! The rubber blanking plugs restrict ingress of moisture and dirt into the ECU.

If you are unsure about any aspect please consult a suitably qualified engineer, your Dealer or Merlin Equipment Ltd before commissioning the unit.

PRODUCT SPECIFICATIONS

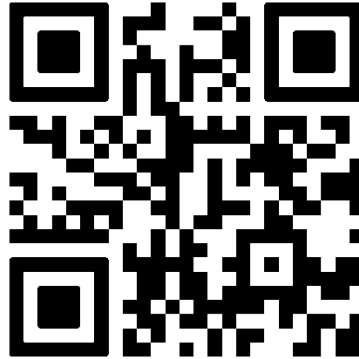
PowerGuard Pro	
Part Number(s)	04-8100 (ECU Only) 04-8101 (12V 1 Batteries) 04-8102 (24V 1 Batteries) 04-8103 (12V 2 Batteries) 04-8104 (24V 2 Batteries)
ECU Dimensions (Excluding Cables)	141 x 71.5 x 32.5mm (L x W x H)
ECU Weight	0.22Kg (Ex cabling) 0.47Kg (Inc cabling)
Voltage Rating	12 or 24V DC
Operational Input Voltage Range	6.5 to 36V DC
Operation Temperature Range (°C)	-25 to + 105°
Maximum Contactor Current	200A Continuous, 350A Peak
Current Consumption	10mA* <i>*Unit in idle state with no contactors or LEDs powered</i>
Maximum number of Battery Banks	2
Voltage Reading Range	0 to 19.3V or 38.6V (Dependant on 12 / 24V Setting)
Voltage Reading Accuracy	+/- 0.1V DC on 12V setting +/- 0.2V DC on 24V setting
LED Output	5V DC Source with 1K series limiting resistor
PC Communications	Serial - RS232 Communications

PRODUCT ACCESSORIES

Merlin Part Number	Description
19-5002	PowerGuard /SmartBank Pro Programming Lead
19-5010	Battery Isolation Contactor 12V 200A
19-5011	Battery Isolation Contactor 24V 200A
19-5018	Input Switch (On)-Off Momentary with Red LED
19-5019	Input Switch (On)-Off Momentary with Green LED
10-4012	Cable Cap Insulation Boot 2 - 2/0 AWG Red
10-4013	Cable Cap Insulation Boot 2 - 2/0 AWG Black
HWC/FHMG/1	Mega Fuse Holder
HWC/FME/200	200A Mega Fuse
HWC/ATOF/KIT	ATO Single Blade Fuse Holder
HWC/BF5	5 Amp Blade Fuse

WARRANTY

For details of our market-leading warranty policy, please refer to the FAQs section of the Merlin Power website: www.merlin-power.com



All details of the warranty policy are detailed here, to include duration, scope, claims procedure, limitations & governing law.

If your product requires troubleshooting or warranty service, contact your merchant. If you are unable to contact your merchant, or the merchant is unable to provide service, contact Merlin directly at: Merlin Equipment Ltd, Clyst Court, Hill Barton Industrial Estate, Exeter, Devon, EX5 1SA, United Kingdom. Tel: +44 (0)1202 697979.