



PowerGuard^{PRO}

Flat Battery Protection System

User & Installation Guide

Revision A

**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.merlinequipment.com



WARNING

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

“Caution!” refers to practices that may cause damage to the PowerGuard ^{PRO} 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 12Volt DC and 24Volt 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.

Certificate of Conformity



Declaration of Conformity

Merlin Equipment Limited, Trading as Merlin Power Systems 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



Approval No: 10R-059235

Test report: 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 on vehicles.

Signed:

James Hortop
Managing Director
Merlin Power Systems UK

Date: 18th January 2019

Introduction

Thank you for purchasing a 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} may be used on 1 or 2 battery bank installations at either 12 or 24VDC. Those battery banks may also be of mixed voltage (e.g. a 12 and a 24V battery bank).

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

Please note that this manual refers to the PowerGuard^{PRO} retail product. PowerGuard^{PRO} is available in an OEM version. The OEM version differs slightly to the retail product. However, the main printed circuit board within PowerGuard^{PRO} is identical so this manual may also be used for setting up the OEM version.

Contents

Precautions	3
Certificate of Conformity	4
Introduction	5
Contents.....	5
Package Contents.....	6
Installation	7
Positioning of Parts	7
Wiring Layouts	8
Contactor Rating	9
Installation and Set Up.....	10
Location and Connections.....	11
Settings.....	13
Notes.....	14
After Installation - Testing	15
Product Specifications.....	16
Warranty	17

Package Contents

Single Battery

Models: 04-8101(12V) and 04-8102(24V)

- **PowerGuard^{PRO} CPU x1**
- **PowerGuard^{PRO} Contactor x1.** Part Number: SU80-5164MPL(12V) or Part Number SU80-5165(24V)
- **Remote Battery Isolator Switch x1**
- **Flat Battery Protection Reset Switch x1**
- **Fuse Kit & Rubber Blanking Plugs**
- **Installation Manual (this document)**

Twin Battery

Models: 04-8103(12V) and 04-8104(24V)

- **PowerGuard^{PRO} CPU x1**
- **PowerGuard^{PRO} Contactor x2.** Part Numbers: SU80-5164MPL(12V) or Part Numbers SU80-5165(24V)
- **Remote Battery Isolator Switch x2**
- **Flat Battery Protection Reset Switch x1**
- **Fuse Kit & Rubber Blanking Plugs**
- **Installation Manual (this document)**



PowerGuard^{PRO} CPU



Contactor



Switch

Installation

- **Warning!** Isolate power supply before starting installation.

Positioning of Parts

The following should be observed as parts of PowerGuard^{PRO} are designed for wet/dirty environments, but others are not.

Main CPU.

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

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

The CPU is designed for location in a dry environment (such as on cab side of engine room bulkhead or a cupboard). It is suitable for installation in drier engine compartments on boats. However, it is not sealed against moisture ingress. The CPU is **NOT** suitable for installation or operation in atmospheres where there is a risk of ignition or explosion.

Contactors

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

Isolator & Reset Switches

Normally located on dash panels or alongside engine controls. They are IP66 rated from the front and may be located in exterior positions.

Wiring Layouts

These wiring layouts cover the majority of installations.

Typical Single Battery System

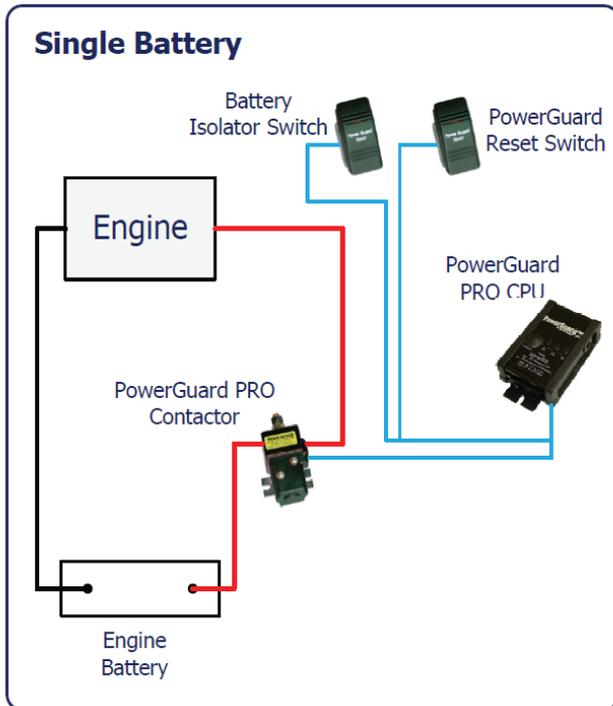


Figure 1 Single battery wiring schematic

Typical Twin Battery System

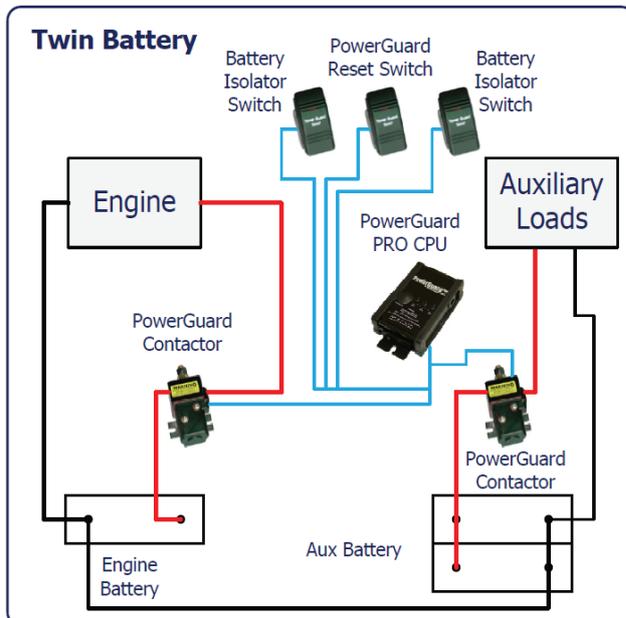


Figure 2 Twin battery wiring schematic

CPU Wiring

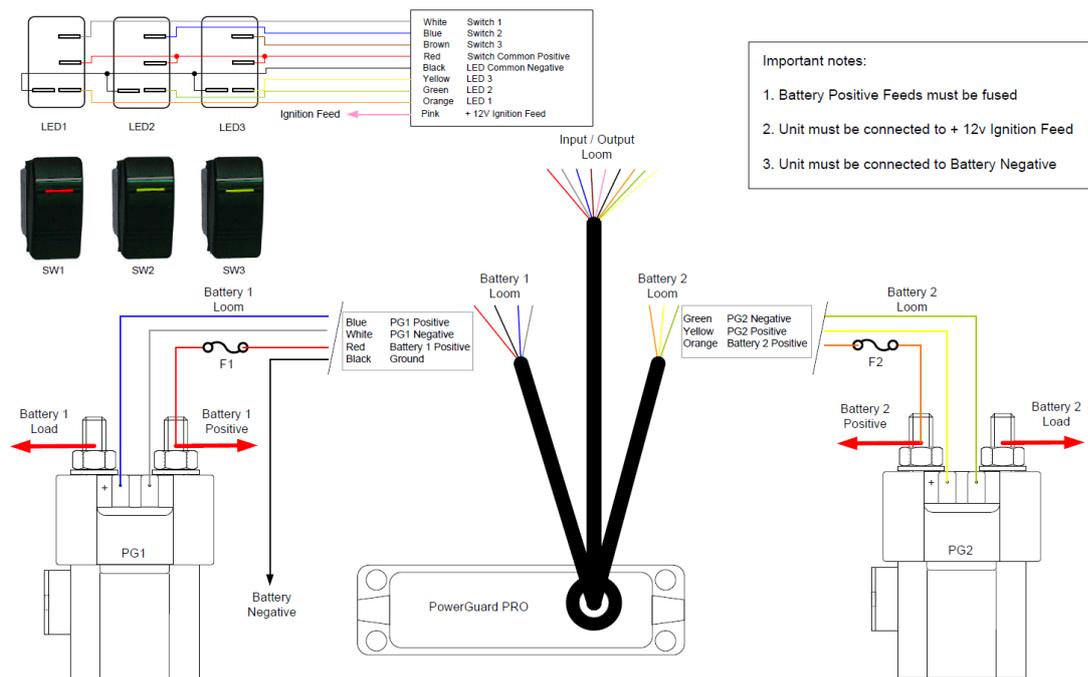


Figure 3 PowerGuard PRO General Wiring Schematic

Caution! Ensure that the correct polarity is observed for CPU and Contactor wiring. Failure to observe correct polarity of Contactor wiring will result in incorrect operation of the system and may cause serious damage.

Serious damage to the PowerGuard^{PRO} will occur if the wires to the Contactor coils are incorrectly connected or short-circuited.

Contactor Rating

Contactors are rated for charging systems of up to 200A Continuously. They will also handle intermittent cranking current of engines up to 725A.

Installation and Set Up

Operational Notes

PowerGuard^{PRO} is a remote battery switching and flat battery protection 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} combines battery protection and remote switching. By monitoring the battery voltage PowerGuard^{PRO} can disconnect the battery (or batteries) from the loads to prevent excessive and damaging discharge.

The Isolator switches provide a manual 'override' function to reconnect the battery (or batteries).

Remote Battery Switching

The Battery Isolator switches control connection or disconnection of the battery (or batteries). PowerGuard^{PRO} can switch up to 2 independent battery banks.

Flat Battery Protection

PowerGuard^{PRO} can prevent a flat battery condition by disconnecting the battery (or batteries) from the load. It achieves this by monitoring the battery voltage levels. If the voltage level falls below the threshold for longer than the pre-set time, then the system is disconnected.

EMERGENCY OVERRIDE: Pressing the 'override' switch will re-connect the battery power.

The connect/disconnect voltage threshold level(s) and the pre-set time delay are set using the trimming potentiometer ("trim-pots").

In systems with 2 batteries (or 2 battery banks) the second battery is separately monitored and has a separate contactor and Isolator switch to provide an 'override' function.

Location and Connections

Prior to installation ensure that the vehicle/boat is safely secured and the power is isolated. For example remove ignition keys, disconnect batteries, ensure parking brake is secured etc. Only connect the power feed fuses to PowerGuard^{PRO} once all wiring is completed and checked.

Install the PowerGuard^{PRO} following the schematic shown in Figure 3.

Contactors(s)

The Contactor(s) should be located adjacent to the batteries which are being protected. They may be installed under hood or within exterior lockers. The wiring and connectors used should be rated appropriately.

The main high-power cables should be terminated with heavy-duty crimp ring terminal suitable for M8 stud. The stud nuts should be tightened to a torque of 11 to 12 Nm.

Warning! *Incorrectly specifying the cable current rating or inadequate cable termination could result in malfunction, fire, injury or serious damage.*

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 & Warning! *Do NOT overtighten. However, failure to tighten the stud nuts adequately may result in an intermittent connection and/or arcing which may cause overheating or ignition.*

CPU

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

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

The CPU is designed for location in a dry environment (such as on cab side of engine room bulkhead or a cupboard). It is suitable for installation in drier engine compartments on boats. However, it is not sealed against moisture ingress. The CPU is **NOT** suitable for installation or operation in atmospheres where there is a risk of ignition or explosion.

Isolator and Reset Switches (Emergency Override)

These are usually mounted in locations such as dashboards or helm panels without needing to run heavy duty cables throughout the vehicle/boat. The switches are IP66 rated and fully waterproof.

Ignition Inhibit ('Ignition Feed' Wire – see Figure 3)

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

The Ignition Inhibit 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.

Extending wiring loom.

Caution & Warning! *Substandard wiring and connectors may cause malfunction or damage to the PowerGuard unit. Malfunctions may result in hazardous situations.*

PowerGuard^{PRO} is provided with a 1.5m (4') wiring loom. You may shorten wires as necessary. If you need to extend wires, you may do so using the same quality and size of wire as provided in the loom.

A minimum of 18AWG (0.75mm² CSA) is recommended. The cable should be high temperature thin wall low voltage cable suitable for use in automotive, marine and allied industries.

By-Pass Loads.

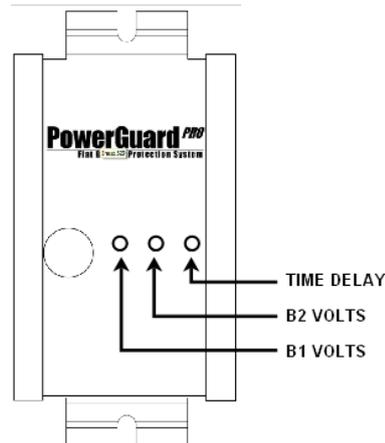
There may be certain loads attached to the battery that should not be subject to Flat Battery Protection disconnection. For example, some engine management computers, hazard warning lights etc. In some states/countries, these this may be mandated by law. Bypass loads should be identified, individually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

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

Settings

PowerGuard^{PRO} will work directly out of the box for a single or twin battery installation. To fine-tune the system the Disconnect Voltage Settings & Timings may be adjusted using the adjustment trimming potentiometers (“trim pots”) on the front of the unit. Standard set up allows normal configuration for most installations.

Caution! In order to set PowerGuard^{PRO} you will need to apply power. Double-check your wiring and connections before inserting the fuses and applying power.



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 rubber blanking plugs cover the holes and need to be carefully removed in order to adjust the trim pots.

Control	Description
B1 VOLTS	Sets the internal threshold disconnect voltage for battery 1 (Single battery system)
B2 VOLTS	Sets the internal threshold disconnect voltage for battery 2 (Twin battery system)
TIME DELAY	Adjusts the functional time delay (the delay prevents relay chatter)

The range of controls is:

B1 (PowerGuard 1) voltage threshold range = 10.5 to 12.7 V DC [21.0 to 25.4 V DC for 24V unit]
B2 (PowerGuard 2) voltage threshold range = 10.5 to 12.7 V DC [21.0 to 25.4 V DC for 24V unit]
Time Delay = 0 to 240 seconds.

The adjustment range for all three controls is linear so that, using the B1 Control as an example, the 12 o'clock position would represent 11.7 Volts DC on the 12V variant of PowerGuard^{PRO}.

The Disconnect Voltage is the threshold at which PowerGuard^{PRO} will disconnect the battery once the Disconnect Time has elapsed. The type of battery and application in which it is used determines the Disconnect Voltage and Time setting.

For engine start batteries we recommend:

System	Disconnect Voltage	Disconnect Time
Engine/Primary 12V	12.1V DC	4 minutes
Engine/Primary 24V	24.2V DC	4 minutes
Auxiliary 12V	11.6V DC	2 minutes
Auxiliary 24V	23.2V DC	2 minutes

Notes

Engine Batteries: if the engine battery capacity is very small (when using micro engine start batteries for example) or the vehicle/boat is used in very cold climates, the Disconnect Voltage and/or time may need to be adjusted to guarantee engine starting.

Auxiliary Batteries: A 12V battery is officially 'flat' at a resting voltage of 12.2V. Under load, the battery voltage is likely to be less. However, if the loads on the auxiliary battery are small <5A, or the auxiliary battery capacity is very high, 11.6V (23.2V) Disconnect Voltage may allow the auxiliary battery to discharge below 50%.

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.

While the trim pots may be adjusted while PowerGuard^{PRO} is powered up, we recommend removing the B1 and B2 sense fuses to prevent accidental shorting of components on the PCB and potential PowerGuard^{PRO} damage.

Adjustments to trim-pot settings should be carried out using an insulated trimming tool. A small 1.5mm flat blade screwdriver can be used but extra care is required not to cause a short-circuit. Verify the settings using a stop watch and your digital multimeter.

Digital Signal Processing

PowerGuard^{PRO} senses and processes voltages using a Digital Signal Processor (DSP) which filters out transient spikes and electrical noise preventing PowerGuard^{PRO} connecting/disconnecting erroneously.

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

After Installation - Testing

Once installed, PowerGuard^{PRO} should be fully tested before releasing the vehicle/boat into service. Complete a full visual inspection on all wiring, ensure that wires cannot be chaffed through, are properly supported and terminals are protected from accidental short circuits.

1. Turn off the engine and all charge sources
2. Cycle the Battery Isolator switches, you should hear the contactors connecting and disconnecting. Verify, using your multimeter that the contactor is actually disconnecting.
3. Turn the ignition on but do not start the engine. Cycle the B1 (engine) battery isolator switch – nothing should happen as the PowerGuard^{PRO} B1 channel should be inhibited when the ignition is on.

Warning! *If the B1 contactor continues to cycle when the battery isolator switch is pressed and the ignition is switched on, you MUST NOT release the vehicle/boat into service. Severe damage and potentially hazardous situations may occur if B1 is disconnected when the engine is running.*

4. Turn the ignition off. Note the voltage of B1. Apply loads to B1. When the voltage drops below the pre-set disconnect voltage for a period exceeding the pre-set Time Delay, you should hear the B1 Contactor disconnect. Verify that the contactor has actually disconnected using your multimeter. Check that the LED within the reset switch is illuminated.
5. Press the reset button. B1 should be reconnected.
6. Do the same for Battery 2 (if using PowerGuard^{PRO} for two batteries).
7. Make any further adjustments to Disconnect Voltages and Time Delay if required.
8. Install the rubber blanking plugs provided into the holes in the CPU enclosure.
9. Carry out a double-check of the wiring integrity, the quality of connections and cable terminations.

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

12V Models			24V Models	
Part #	04-8101	04-8103	04-8102	04-8104
Number Of Batteries	1	2	1	2
Contacto Current Continuous	200A			
Contacto Current 5 mins	250A			
Contacto Current Cranking	725A			
Power Consumption	<10mA		<6mA	
CPU Dimensions LxWxH (inch)	68x110x32mm (2.67x4.33x1.26)			
CPU Weight ex cables (lbs)	178g (0.39 lbs)			
Contacto Dimensions LxWxH (inch)	91x50x39mm (3.59x1.97x1.54)			
Contacto Weight (lbs)	375g (0.83 lbs)			

Warranty

PowerGuard^{PRO} is warranted to be free of defects caused during manufacture for a period of 2 years from purchase. The warranty may be invalidated if the device has been altered, misused, installed incorrectly or operated in adverse conditions described in the “Precautions” section of this document.

What does this warranty cover and how long does it last? This Limited Warranty is provided by Merlin Equipment Limited. (“Merlin”) and covers defects in workmanship and materials in your PowerGuard^{PRO}. This warranty period lasts for 24 months from the date of purchase at the point of sale to you, the original end user customer, unless otherwise agreed in writing (the “Warranty Period”). You will be required to demonstrate proof of purchase to make warranty claims.

This Limited Warranty is transferable to subsequent owners but only for the unexpired portion of the Warranty Period. Subsequent owners also require original proof of purchase as described in “What proof of purchase is required?”

What will Merlin do? During the Warranty Period Merlin will, at its option, repair the product (if economically feasible) or replace the defective product free of charge, provided that you notify Merlin of the product defect within the Warranty Period, and provided that Merlin through inspection establishes the existence of such a defect and that it is covered by this Limited Warranty.

Merlin will, at its option, use new and/or reconditioned parts in performing warranty repair and building replacement products. Merlin reserves the right to use parts or products of original or improved design in the repair or replacement. If Merlin repairs or replaces a product, its warranty continues for the remaining portion of the original Warranty Period or 90 days from the date of the return shipment to the customer, whichever is greater. All replaced products and all parts removed from repaired products become the property of Merlin.

Merlin covers both parts and labour necessary to repair the product, and return shipment to the customer via a Merlin-selected non-expedited surface freight within the contiguous United States and Canada. Alaska, Hawaii and outside of the United States and Canada are excluded. In Europe, this is the EMEA. Contact Merlin Customer Service for details on freight policy for return shipments from excluded areas.

How do you get service? 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, Unit 4, Cabot Business Village, Poole BH17 7BA, United Kingdom. Tel: +44 (0) 1202 697979.

REVISION PAGE – NOT FOR PUBLICATION.

Rev1.3	Correcting E number Page4. (V1.2 erroneously showed SmartBank Pro E number).
Rev1.3	Track changes set.
Rev A	Updates to standards and general revisions.