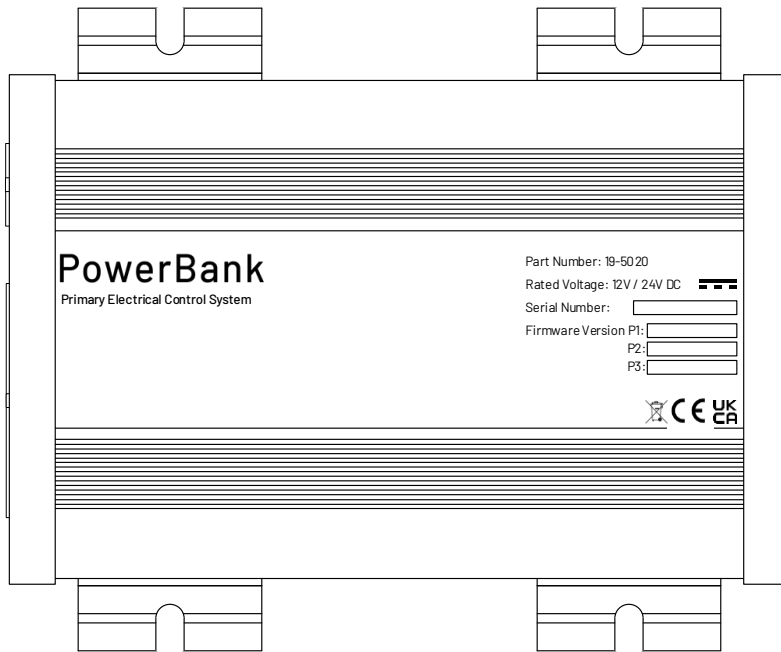# POWERBANK & POWERBANK COMBI PROGRAMMING GUIDE

Revision B

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VERSION HISTORY

Revision	Authority	Revision Date	Approved By	Approval Date	Reason
A	M. Harrison	02/11/2021	L. Harris	11/11/2021	Initial Release
B	M. Harrison	18/04/2024	M. Harrison	19/04/2024	ECR 24-010

CONTENTS

1. INTRODUCTION

PowerBank is a complete power management system designed for mobile platforms (e.g. boats or vehicles) with multiple battery banks.

The system manages the isolation (switching), split charging and flat battery protection of multiple battery banks. PowerBank can also interface with a DataCell (PowerBank Combi), battery monitoring system to introduce high levels of monitoring and control of the electrical system.

The Merlin configuration software (M Power Configuration) allows you to change or modify virtually any function of the PowerBank. It is designed for use by competent engineers. Therefore, this manual is written as an aid to getting you started.

In most cases, PowerBank will be pre-configured for your installation. You should only need to access the M Power Configuration Software (MPCS) to adjust voltage thresholds and timers. It is not recommended that you change high level configuration functions without consultation with Merlin Equipment.
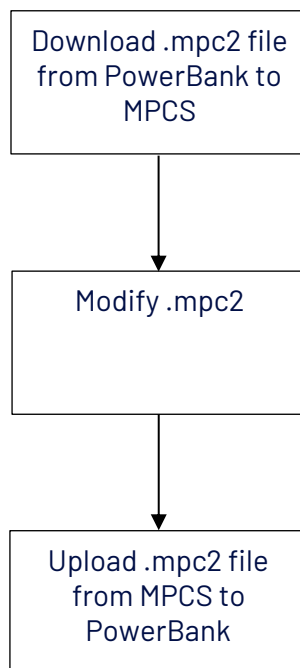
Please take the time to read and understand this manual before commencing configuration.

2. HOW CONFIGURATION WORKS

PowerBank uses a master configuration file. The configuration file sits in non-volatile memory within the PowerBank Microprocessors. The Merlin Configuration Software is a tool for downloading the file from PowerBank, modifying it and re-uploading the file back again.

The master configuration file carries the file extension .mpc2.

PowerBank can be configured on your work bench or while it's installed on a platform.

```
┌─────────────────────┐
│  Download .mpc2 file │
│  from PowerBank to   │
│        MPCS          │
└─────────────────────┘
           │
           ▼
┌─────────────────────┐
│    Modify .mpc2     │
│                     │
│                     │
└─────────────────────┘
           │
           ▼
┌─────────────────────┐
│  Upload .mpc2 file  │
│   from MPCS to      │
│    PowerBank        │
└─────────────────────┘
```

You can create a .mpc2 configuration file from scratch using MPCS. However, due to the complexity of the higher-level configuration, it is easier to download and modify the existing file.

> IMPORTANT: We highly recommend saving the file before making any modifications and keeping acopy of this in case of problems later on!

MPCS will also import and export .mpc2 files from emails, CD's and memory sticks. This means that Merlin Equipment can send you updated configuration files for straight upload to the PowerBank or that you can download a .mpc2 file and email it to Merlin for modification or review.

Because you can save .mpc2 files to your hard drive, you can batch configure multiple PowerBank systems from the same master .mpc2 file.

3. BEFORE YOU BEGIN...

3.1 Computer/Software Compatibility

MPCS is designed to operate on an PC running Windows XP or later.

3.2 FTDI Converter

PowerBank is designed to be connected to a USB port on your computer using a serial to USB converter. Due to compatibility/quality issues, PowerBank and MPCS will only work with a converter as supplied by FTDI.

These are available directly from Merlin:

US232R-10 FTDI Converter: Merlin Part Number 21-9001
Chipi-X FTDI Converter: Merlin Part Number 21-9006

Please note: Ensure you install the drivers for the FTDI converter before commencing with programming.

This is available from the Merlin Power or FTDI website: D2XX Drivers - FTDI (ftdichip.com)

4. PROGRAMMING CABLE CONNECTION

To carry out programming, you will need to connect the PowerBank to the FTDI converter using a serial adapter cable. This is available direct from Merlin (Part Number 19-5001).

Please note that a programming kit is also available direct from Merlin which includes FTDI converter, serial adapter cable and programming software (Part Number 19-5004).

Fig 1: FTDI Converter and Serial Cable

The FTDI Cable connects to a USB socket on your PC. The RJ11 connection connects to the programming socket (RS232) on the PowerBank ECU:
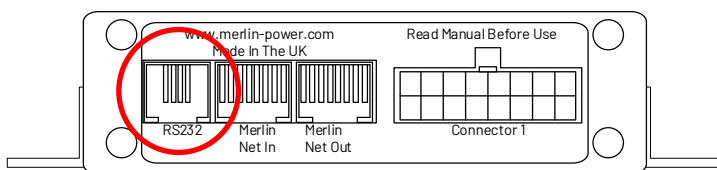

Fig 2: Programming connection

5. INSTALLING MPCS

The MPCS software will be provided by email, through a web link or on a memory stick. Install MPCS to the hard-drive of your PC. Ensure that the Drivers for the FTDI Converter are also installed (see section 3.2 and 4.0).

6. GETTING STARTED

6.1 Establish Communication with PowerBank

Prior to attempting to establish communications with the PowerBank, power will need to be supplied to the PowerBank from the platform power supply (12 or 24V DC) or a bench mounted power supply.

PowerBank connection details are as per the diagram below: As a minimum, connections to Battery 1 Positive Sense and Battery / Chassis Negative wires (x2) will be required.
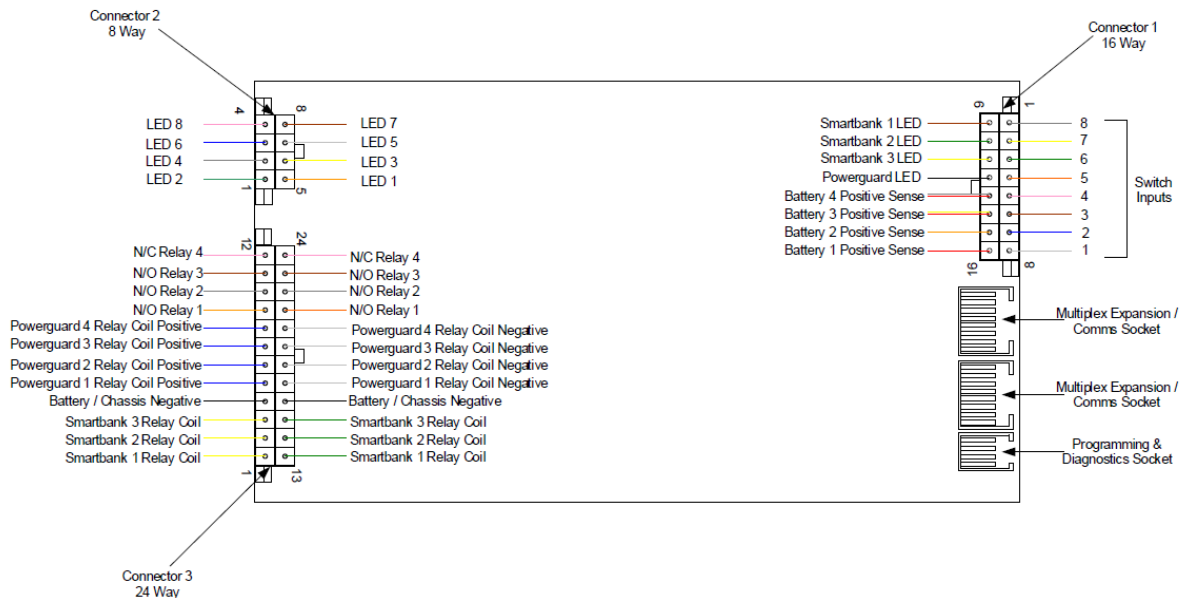

Fig 3: PowerBank Connections

Please note: Please ensure that all power supply wires are appropriately fused.

a) Establish which COM port has been assigned to the FTDI converter by your PC. This can be found by clicking on Windows Start > Control Panel > System > Device Manager > COM Ports. You will see the FDTI converter is assigned to one of these.

b) Open the MPCS software.

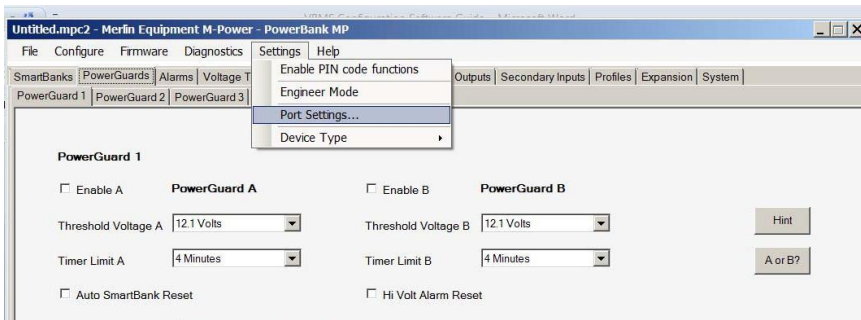c) Select 'Settings' and from the drop-down box select 'Port Settings'.

Fig 4: Settings Menu

d) From the 'Port' drop down box, select the first available Comm Port.
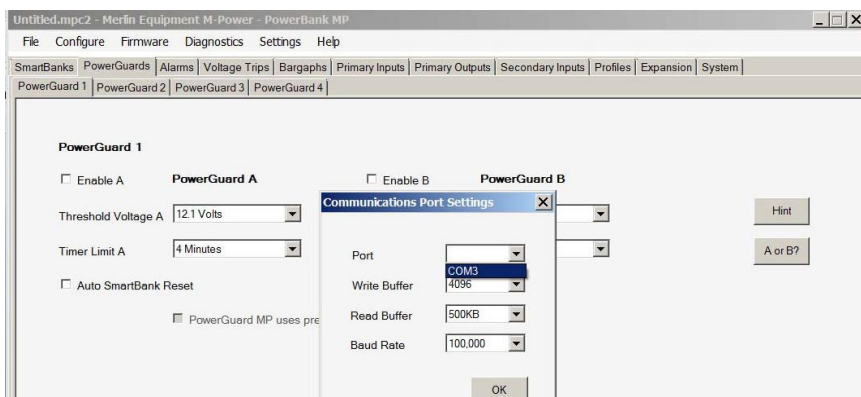

Fig 5: Com Port

e) From the 'Settings' drop-down box, select 'Device Type' and 'PowerBank MP'
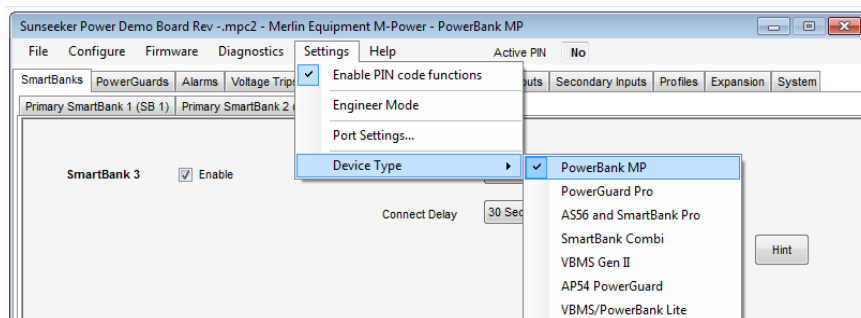

Fig 6: Device Type

f) Select 'Configure' and 'Test Communications' from the drop-down menu. The software will confirm if it has successfully detected PowerBank.
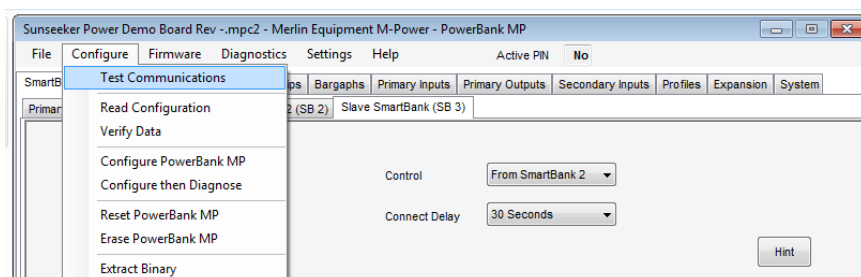

Fig 7: Test Comms

6.2 Download and Save the PowerBank Configuration File

a) Select 'Configure' and 'Read Configuration' from the drop-down menu. Reading of the PowerBank configuration takes around 30 seconds. A confirmation window will appear to confirm successful download.

b) Save the Configuration File before continuing. To do this select 'File' and 'Save As' from the drop-down menu. We would suggest that this file is saved to a convenient location such as your 'Desktop' or 'My Documents'.

Please note: Whilst making any changes to the downloaded file, we recommend regular saving of changes made to the new file, so that you can easily revert back any number of steps if configuration problems are encountered.

In addition, please ensure file names are changed to avoid overwriting original files.

6.3 Uploading a new or saved PowerBank Configuration File

a) To upload a new configuration file (whilst working within the MPCS configuration software), simply select 'Configure' and then 'Configure PowerBank MP'. After about 30 seconds a confirmation window will appear to confirm successful upload.

   Please note that whilst configuring, any connected contactors may be heard to change state (clunk), this is normal operation.

b) To upload a previously saved file (e.g. initial saved configuration file), select 'File' and 'Open'. Select the relevant saved file. The configuration settings will then be uploaded into the MPCS software.

   Select Configure' and then 'Configure PowerBank MP'. After about 30 seconds a confirmation window will appear to confirm successful upload.

   Please note that whilst configuring, any connected contactors may be heard to change state (clunk), this is normal operation.

7. MPCS COMPONENTS
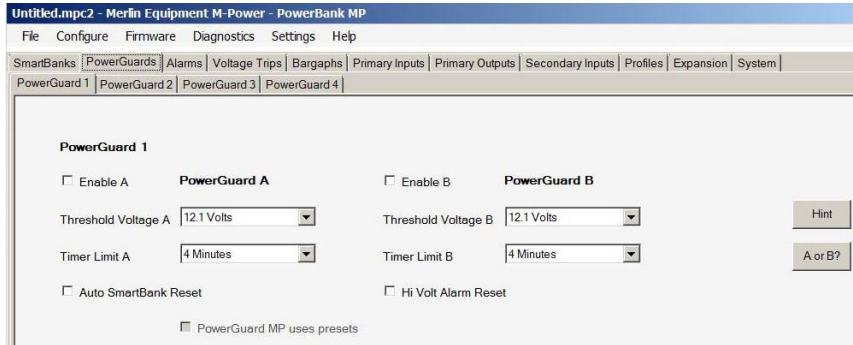
MPCS has four main windows:

1. Configuration Screens:

Fig 8: Configuration Screen

MPCS will open on the main configuration screen. Various tabs exist to access different parts of the configuration. These are logically grouped for easy reference and understanding of their functions.

Configurable settings include split charge voltage settings (SmartBank), flat battery isolation protection settings (PowerGuard), Alarms, Switch Inputs (Primary Inputs), LED Outputs (Primary Outputs) and System configuration settings (e.g. battery voltages etc).
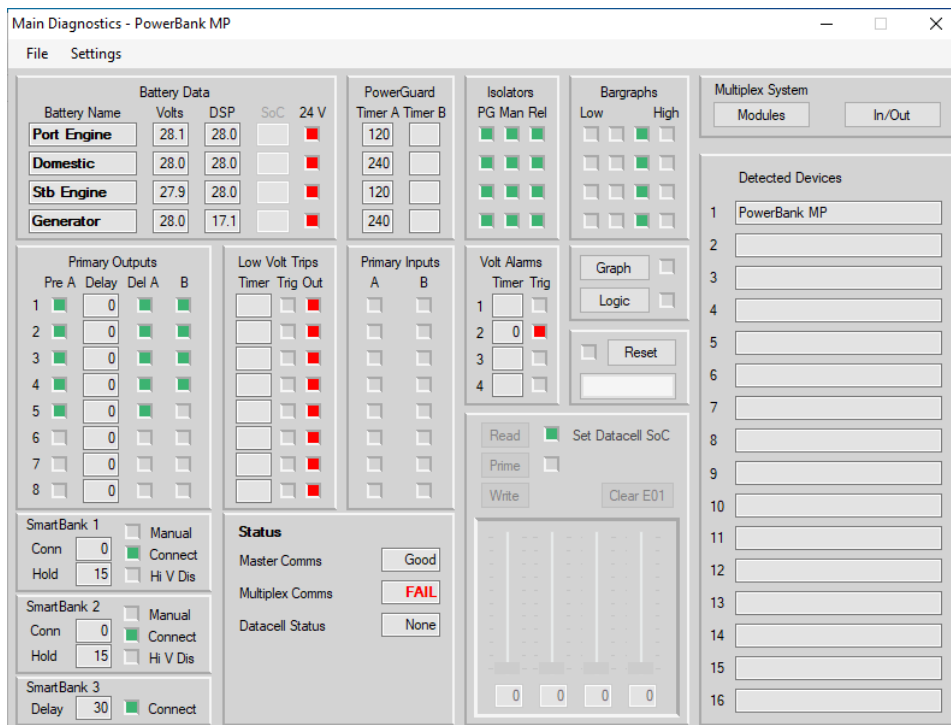
2. Main Diagnostic Screen:

Fig 9: Diagnostics

The main diagnostics screen is accessed by selecting 'Diagnostics' and selecting 'Diagnostics and Monitor' from the drop-down menu.

This screen allows you to monitor:

- Battery Voltage (Both analogue and DSP)
- Status of
  - Primary Inputs (Switch Inputs)
  - Primary Outputs (LED Outputs)
  - SmartBank (Split Charge) Status and Timers
  - PowerGuard (Flat Battery Protection) Status and Timers
- Battery Isolator Status
- Battery status (Voltage)
- Alarm and Voltage Trip Status
- Other devices on the Merlin Network

The diagnostics screen is extremely useful for getting an at-a-glance insight into the operation of the PowerBank System.

3. Graphing Utility Screen:

Clicking on the "Graph" button on the main diagnostics screen will open the Graphing Utility. This utility provides at-a-glance battery status and logs voltages. It also provides datalogging functions.
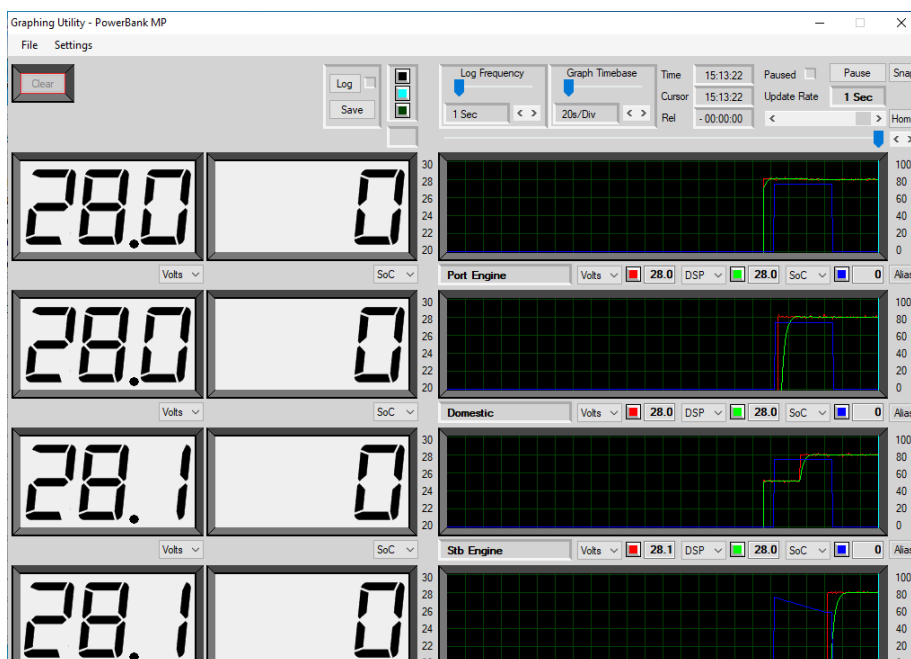

Fig 10: Graphing Utility

4. Logic Utility Screen:

Pressing the "Logic" button within the Main Diagnostics screen opens the Logic Trace Utility. This utility is useful to check how PowerBank is controlling the main isolator, PowerGuard (Flat Battery Protection), SmartBank (Split Charging) contactors and alarm outputs etc.
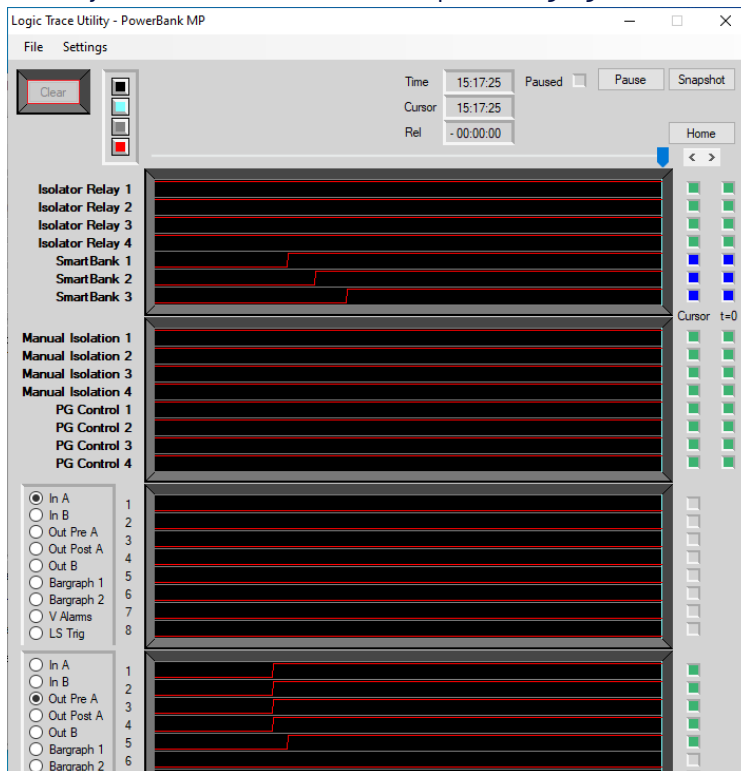

Fig 11: Logic Utility Screen

An example of how you could use the Logic Trace Facility is as follows:

In the event of a SmartBank contactor not activating when you believe it should: The logic trace would show the PowerBank ECU either attempting to (or not attempting to) activate the contactor.

The former would mean that there was a problem in the cabling between the PowerBank hub and contactor or the contactor itself. The latter would indicate that the configuration software was not properly set up.

8. HINTS

Throughout the MPCS software, are 'Hint' buttons. These provide information about the configurable settings on that page.
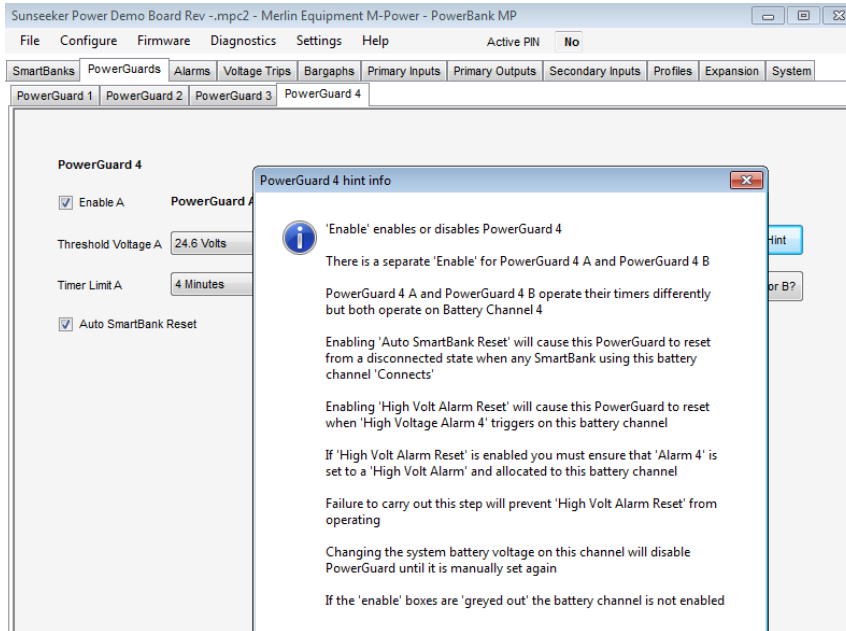

Fig 12: Hint Functions

9. SETTING ADJUSTMENTS

The main adjustments needed from an installation perspective are listed in the following sections. We would not recommend making adjustments to other settings without experience or consulting with a Merlin Engineer.

1. SmartBank (Split Charging)

PowerBank is fitted with 3x SmartBank split charge controllers. Each SmartBank is configured from its own page in the MPCS.

To access, select the 'SmartBanks' menu. A row of tabs entitled "Primary SmartBank 1", "Primary SmartBank 2" and "Slave SmartBank" will now be visible.
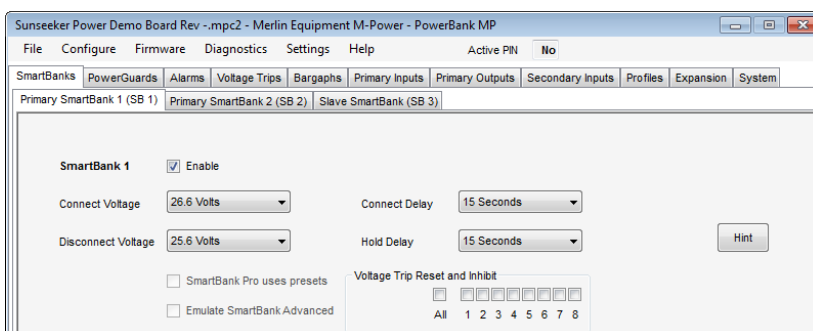

Fig 13: SmartBank Menu

- SmartBank 1 usually controls the split charge between the engine and auxiliary battery (battery banks 1 & 2 respectively).

- SmartBank 2 usually controls split charge between the auxiliary Battery and a 2nd auxiliary battery (e.g. Comms). In the case of a twin-engine boat, this would be connected between the auxiliary battery (Domestic) and 2nd engine battery (Starboard).

  SmartBank 2 would be controlling split charge between battery banks 2 & 3 respectively.

- SmartBank 3 is to provide split charging to a 4th battery bank. It is slaved (with its own timer) from either SmartBank 1 or SmartBank 2 depending on configuration.

Adjustments include:

- Enable or Disable SmartBank Function
- Connect Voltage
- Connect Delay Timer
- Disconnect Voltage
- Disconnect Hold Delay Timer
- Battery Assign (SmartBank 2)
- Slave SmartBank Control (SmartBank 3)

Warning: Please consider carefully any changes you make to the Connect or Disconnect voltages.

If in doubt consult with the specifying engineer and/or Merlin Equipment. For example, in a mixed battery type system, connect voltages may be limited to prevent over voltage conditions for say, gel batteries. By selecting a lower high voltage disconnect, you may bypass this protection.

2. PowerGuard (Flat Battery Protection)

PowerBank is fitted with 4x PowerGuard flat battery protection controllers. Each PowerGuard is configured from its own page within MPCS.

To access, select the 'PowerGuards' menu. A row of tabs entitled PowerGuard 1, to PowerGuard 4 will now be visible.

PowerGuard 1 relates to battery channel 1, PowerGuard 2 relates to battery channel 2 etc.
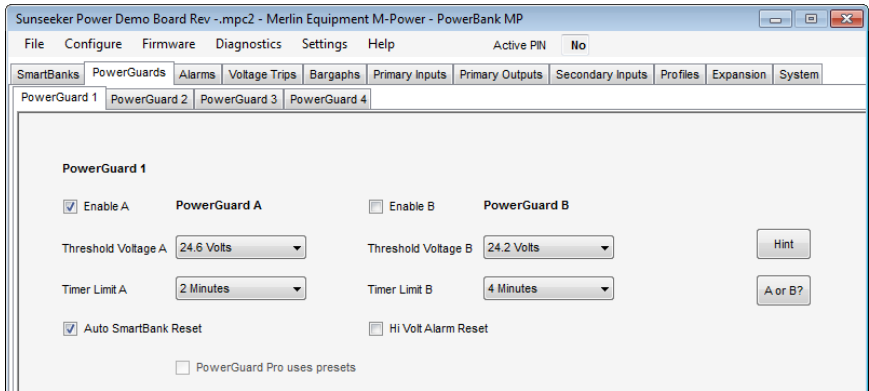
Fig 14: PowerGuard Menu

Each PowerGuard can be 'Enabled' in two ways:

a) PowerGuard Type A:

When the battery voltage drops to the PowerGuard voltage threshold setting, a timer begins (e.g. 4 minutes). If during this timer period, the battery voltage rises above the threshold again (e.g. because a big load is switched off or the engine is started) the PowerGuard timer will reset (back to 4 minutes).

If voltage drops again below the threshold, the timer will start counting again (from the 4-minute time limit programmed). Once the timer runs out, the flat battery protection will activate, and the battery will be disconnected.

b) PowerGuard Type B:

PowerGuard B works in a similar way to PowerGuard A. When the battery voltage drops to the PowerGuard voltage threshold, the timer begins. However, if the voltage now rises above the threshold, the timer does not reset, but starts to count back up towards the timer limit (e.g. 4 minutes).

PowerBank is factory configured with PowerGuard A for each battery channel set.

Adjustments include:

- Enable or Disable PowerGuard Function
- Threshold Voltage
- Delay Timer
- Auto SmartBank Reset (Resets PowerGuard when split charge is activated)
- Hi Volt Alarm Reset (Resets PowerGuard via alarm settings)

PowerGuards can be set according to the needs of each battery bank. Consideration needs to be given to ensure that the right mix of threshold voltage and timers are used to ensure that enough power is reserved for engine starting and prevention of excessive battery discharge.

Warning: Please consider carefully before adjusting PowerGuard settings as these may impact on other settings within PowerBank.

If in doubt consult with the Specifying Engineer and/or Merlin Equipment. For example, setting too lower disconnect voltage and/or timer may mean that there is not enough energy retained within the engine battery after flat battery protection is activated, so the engine won't start.

Another example is that if low battery voltage alarms are set at a certain level and PowerGuard activation voltages are set to be above this level, no alarm will activate before flat battery protection.

Such incidences must be taken into account before making adjustments. A minimum precaution should be to test any new modifications. If problems result, the previously saved .mpc2 file can be re-uploaded so you can revert back to the original configuration.

3. Alarms

There are 4x Primary Alarms within PowerBank. You can adjust each alarm to be activated from readings related to battery 1, 2, 3 or 4. The alarms can be set as High or Low voltage alarms, you can adjust the trigger delay, voltage threshold and hysteresis.

Hi Voltage Alarms, can be used to automatically reset PowerGuards (where isolated) as battery voltage increases. This could be used where a battery charger is connected to the auxiliary battery bank for example.

4. Switch Input Functions & Inhibits.

PowerBank is supplied with 8 configurable switch (Primary) inputs. Each switch input can be configured for any function. Each function has a wide variety of modes. Multiplied up, there are thousands of combinations available.
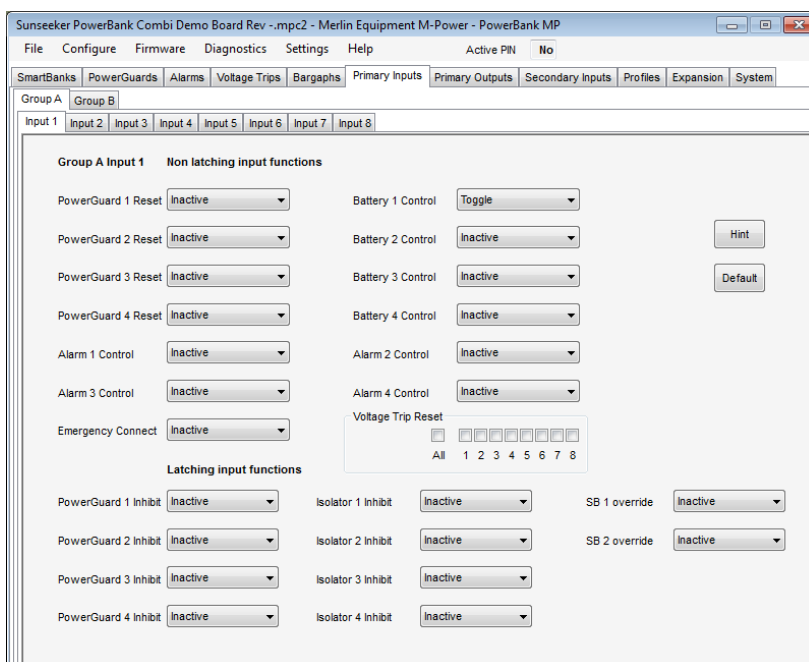

Figure 15: Primary Inputs

Each switch input can be assigned any function. These could include:

- Switching a battery (or number of batteries) on or off
- Resetting isolated flat battery protection (PowerGuard) contactor(s)
- Providing emergency connection of split charge contactors (SmartBank) to enable engine jump starting from the auxiliary battery bank
- Inhibiting engine battery disconnection. This could be connected to an ignition input/engine run signal to stop the engine battery being disconnected when running. This would prevent electrical system damage and isolation of safety systems (e.g. Power Steering or ABS).

To modify Switch input functions and inhibits some knowledge of how Grouping and Switch assignments within PowerBank is necessary. The 8 primary inputs relative to the PowerBank are normally configured within the 'Group A' menu, however 'Group B' inputs can be used based upon 'Expansion' Multiplex Module Addresses.

To configure PowerBank effectively, consideration will need to be given to installed system circuit diagrams. Using this you will be able to ascertain which switch inputs are connected. Through programming, you will then be able to assign a function to each input. Adding or changing switch functions is straightforward once an understanding of how the switch inputs are connected.

Warning: Please ensure that you save an original version of the .mpc2 file before making adjustments to switch designations and inhibits. Any modifications MUST be fully tested before releasing the vehicle to service. If modifications become problematic, you can re-upload the original configuration.

5. LED Output Functions.

PowerBank is supplied with 8 configurable LED (Primary) Outputs. Each LED Output can be configured for any function. Each function has a wide variety of modes. Multiplied up, there are thousands of combinations available.
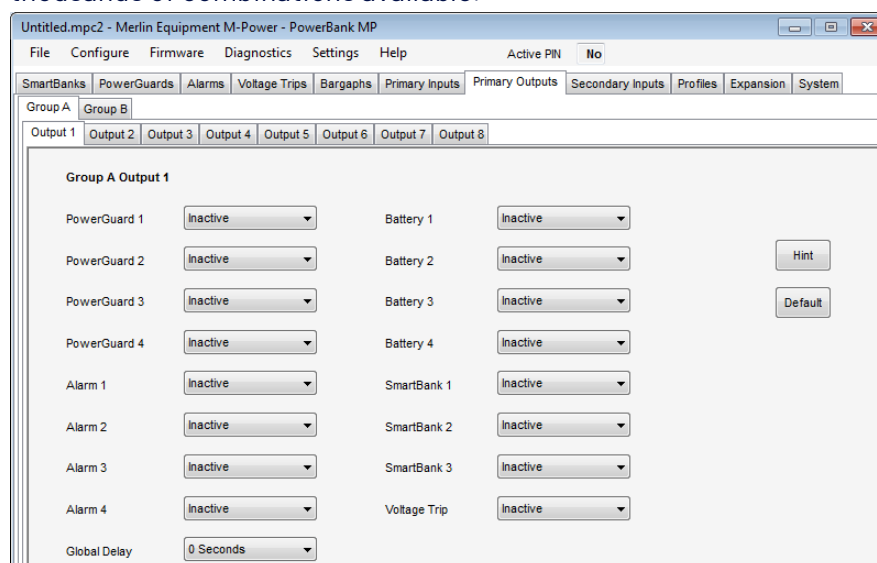

Figure 16: Primary

Outputs

Each LED output can be assigned any function. These could include:

- Indicating that a battery (or number of batteries) has been switched on or off.
- Indicating that flat battery protection (PowerGuard) is in 'Timer' mode.
- Indicating that flat battery protection (PowerGuard) contactor(s) have isolated.
- Indicating that split charge contactors (SmartBank) have connected.
- Indication that a voltage alarm (Hi or Low) is active.

Please note that global delays can also be applied to any LED activation.

To modify LED output functions some knowledge of how Grouping and LED assignments within PowerBank is necessary. The 8 primary outputs relative to the PowerBank are normally configured within the 'Group A' menu, however 'Group B' inputs can be used based upon 'Expansion' Multiplex Module Addresses.

To configure PowerBank effectively, consideration will need to be given to installed system circuit diagrams. Using this you will be able to ascertain which LED outputs are connected. Through programming, you will then be able to assign a function to each output. Again, adding or changing LED functions is straightforward once an understanding of how the outputs are connected.

Warning: Please ensure that you save an original version of the .mpc2 file before making adjustments to LED outputs. Any modifications should be fully tested before releasing the vehicle to service. If modifications become problematic, you can re-upload the original configuration.

10.   POWERBANK COMBI

The PowerBank can be connected to other devices using 'MerlinNet'. This is a proprietary low power multiplex network developed by Merlin Equipment.

In the PowerBank Combi, the PowerBank is connected to a DataCell via the MerlinNet to provide battery monitoring, including Battery Voltage and State of Charge (SoC) for up to four battery banks. The two devices are located within one enclosure for ease of installation and convenience.

Fig 17: PowerBank Combi

All PowerBank programming functions for this device remain as per the information as previously stated within this document. Programming relative to the DataCell are accessed via the 'DataCell I' menu under the 'Expansion' and 'Multiplex' tabs.

From here, Battery Types, Default State of Charge (Soc) and SoC Alarms can also be programmed.

Battery SoC and Alarms can be viewed via the MPCS, or LED outputs assigned within the expansion programming.

11. EXPANSION DEVICES

The use of MerlinNet enables additional devices to be connected to the PowerBank to enable remote control and status indication.

An example of where this facility may be required could include a large motorboat. In this installation the PowerBank is fitted within the engine room to provide multiple battery control, however the user also requires remote battery switching and status information on the bridge of the vessel.

In this instance the user could fit either a PowerBank Remote Panel which would provide 6 control buttons, LCD / LED Display and LED outputs.
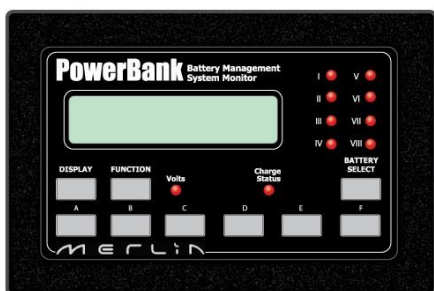

Fig 18: PowerBank Remote Panel

Alternatively, an Expansion Module could be fitted, which would provide 16 configurable (switch) inputs and 16 configurable (LED) outputs.

Please note that multiple devices can be connected to a MerlinNet multiplex network, therefore the devices can be configured for specific needs in different locations.

To enable correct operation of the devices on the network, each unit will require configuring within the MPCS software. The first part of this process is to assign 'Module Address' locations. This is accessed via the 'Module Address' menu under the 'Expansion' and 'Multiplex' tabs.

The MerlinNet is used to connect multiple devices to a PowerBank ECU. This is used to enable remote switching, LED outputs or Display panels to be connected in different locations yet still provide the functions of the PowerBank ECU. A typical example of this would be a large boat where multiple switching / feedback locations are required (e.g. Engine Room / Cabin / Bridge).

The following devices can be connected on a PowerBank MerlinNet network: PowerBank ECU, DataCell I, Expansion Module, Display Panel. Each device is assigned an 'Address' depending in where it is located on the network. The address is then used within the PowerBank programming to assign the inputs and outputs at that location.

The following notes must be considered when setting up / configuring a PowerBank network:

1. PowerBank Hub is always Address 1
2. Devices take up the following address values on the Network:

PowerBank:	1 Address
DataCell 1:	1 Address
Expansion Module:	2 Addresses (Low and High)
Display Panel:	1 Address

3. Loop back plugs must be installed at either end of the network to allow data communications
4. DataCell II does not work on the MerlinNet

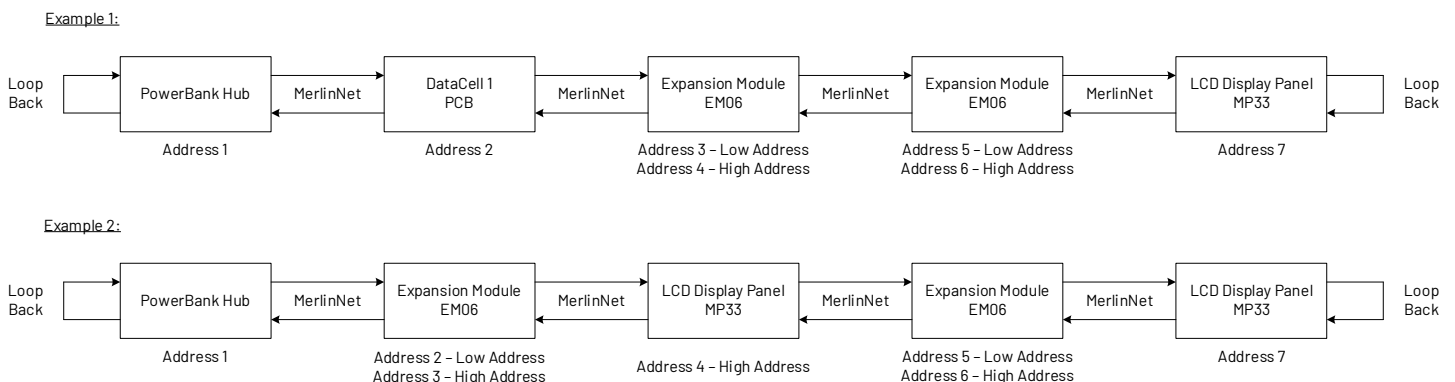The following examples show potential MerlinNet configurations and address locations:

Fig 20: – MerlinNet Address Connections

Group A or Group B inputs / outputs are then assigned at each module address location (where applicable). These inputs and outputs would have been programmed within section 9 of this document.

Please note: Due to the complexity of multiple address and device programming, we would strongly suggest that Merlin Equipment are contacted for advice prior to undertaking any changes to the PowerBank programming.

In addition, please ensure that you save an original version of the .mpc2 file before making any changes.

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.