PowerShield
Sentinel

Installation & Wiring Manual

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The PowerShield Battery Monitoring System

PowerShield is a permanent battery monitoring system developed by PowerShield Limited. It incorporates hardware consisting of the B1000 or Sentinel monitor and Measurement Modules, and the following software:

- *Configuration* software for system configuration
- *Link* software for automated multi-site management

Each system consists of at least one B1000 or Sentinel monitor, a Measurement Module for each monoblock or a Dual Measurement Module for each pair of monoblocks being monitored, temperature probes and current transducers. A RS232 serial communication port has been provided to be used with *Configuration* and *Link* software. For larger systems, multiple Sentinel Monitors can be connected together using an RS485 local area network. Optional communications hardware is available.

A system can monitor one or more strings of monoblocks. Each monoblock is monitored using a Measurement Module or Dual Measurement Module connected across the monoblock terminals. The Sentinel interrogates each Measurement Module and processes the data, logging information into memory at predefined intervals. Where there are strings of different voltage monoblocks, a single Sentinel or B1000 can monitor the whole battery system.

This Manual

This manual relates specifically to the Sentinel monitor and Dual Measurement Modules. It is recommended that this manual is read and understood fully, prior to commencing installation.
For the installation of a B1000 and Measurement Modules, refer to the separate manual titled *PowerShield Installation & Wiring Manual* document number *6300-004B.*

This manual describes how to correctly install and wire the hardware components of a *PowerShield Sentinel* system. This consists of Dual Measurement Modules, current transducers, and temperature probes, and the connection of such cables to a Sentinel monitor.

The manual deals purely with the system hardware, and does not include information on configuring the system. For information on configuring a *PowerShield* system, refer to the separate manual *PowerShield Configuration Software* document number *6300-002C*.

Page 31 of this manual is an "Installation Checklist". It is strongly recommended that all installers use this checklist during the installation, as well as experienced installers, to ensure that all steps have been completed

correctly. However, it is not intended as a substitute for the remainder of this manual.

Note: *The* PowerShield *system must be correctly installed and configured in order to obtain accurate results. The installation of the system must be carried out only by trained personnel. Installation must be in an adequately ventilated environment or warranty may be invalidated.*

Safety: *The* PowerShield *system operates in a potentially hazardous environment making it imperative that all installation personnel have adequate training and experience.*

The PowerShield Dual Measurement Modules *must be installed in a Service Access area.*

Definitions

PSL	PowerShield Limited
PowerShield	Permanent battery monitoring system developed by PSL.
Dual Measurement Module	[Also referred to as a *dual module*] Device for monitoring a pair of monoblocks in series in a single string . Up to 80 dual measurement modules can be connected to each Sentinel in a *PowerShield* system. Note that a dual module MUST be connected across a pair of monoblocks (MB) connected in series. For installations containing strings of uneven numbers of MB or where MB layout makes pairs impossible, a one MB single version of the dual module is available.
Monoblock (MB)	Individual unit or cell.
String	A bank of monoblocks connected in series.
Battery	Complete system of connected monoblocks being monitored.
Sentinel	Central data logger for a *PowerShield* system.
Bbus	The communication bus connecting the Sentinel with each measurement module.
RS232	Serial Communication standard for connecting two pieces of equipment. An RS232 link is used to connect the Sentinel monitor to a host PC, or to a dial up modem.
RS485	Serial Communication standard for connecting multiple pieces of equipment. If more than one Sentinel is required for a *PowerShield* system, the Sentinels are networked using an RS485 bus.
System Form	The System Form is made up of 3 parts, SIF, MMF, SCF, to be completed during installation.
SIF	Site Identification Form. This form summarises site information and overall configuration of the system.
MMF	Monoblock Mapping Form. Details the placement of dual modules to monoblock and Bbus, as installed on site.
SCF	String Configuration Form. Details the arrangement of monoblocks per string, as on site, and identifies PowerShield parts allocated to each string.

PowerShield Installation QuickGuide

This Installation QuickGuide is intended as a summary only; it should not be used as a substitute for a full and complete understanding of the entire Manual.

- Assess site and determine the best layout for the Dual Measurement Modules and Sentinels prior to starting work. Ascertain if there are any specific site requirements, and requirements for single modules. See "Step 6 - Connecting the Dual Measurement Modules" on page 18 for more information.
- Ensure System Information Form is filled in as appropriate as install proceeds.
- Number monoblocks individually. 1 – 1280 max
- Ensure all monoblocks have 6.3mm QC terminal tags fitted.
- Install current transducers
- Install Sentinel rack or wall fixings
- Install Sentinel unit(s). Ensure units are secure.
- Power up Sentinels and confirm.
- Install RS485 links if required.
- Mount Dual Module rail as desired.
- Attach Dual Module power leads to monoblock terminal tags.
- Mount Dual Modules and connect to power leads.
- Connect labelled Bbus cables to Dual Modules and confirm.
- Connect labelled current transducer cables.
- Mount, label and connect temperature probe.
- Connect auxiliary input/outputs if required.
- Connect permanent communications if required.
- Confirm all connections are secure.
- Confirm all Dual Modules are secure and operating.
- Confirm System Identification Form has been completed correctly.
- Fix all cables tidily and securely.

Where possible, be systematic in layout. Faultfinding and configuration will be simplified if a coherent and logical system layout is used.

Safety: *The* PowerShield *system operates in a potentially hazardous environment, ensure all personnel have adequate training and experience. The* PowerShield Dual Module *must be installed in a Service Access area.*

System Layout

The key to successful installation of the *PowerShield* system is to prepare and identify the battery system in advance.

Before starting installation, decide the best way to wire the battery system. The *PowerShield* system is very versatile and can be wired in any configuration as long as the rules are adhered to.

Remember, a single Sentinel can monitor strings of different voltage monoblocks.

Use the guidelines below, and the examples given at the back of this manual, to decide on the best wiring configuration of the system.

Installation Forms

It is essential that the System Forms (SIF, SCF and MMF) are accurately completed during the wiring installation of the *PowerShield* system.

It is easier and more accurate to fill out the details on the form as the installation proceeds, rather than completing the form at the end of the installation.

A sample blank System Form is included as "Appendix C - System Forms" on page 35. Copy this form as required.

Installation Guidelines

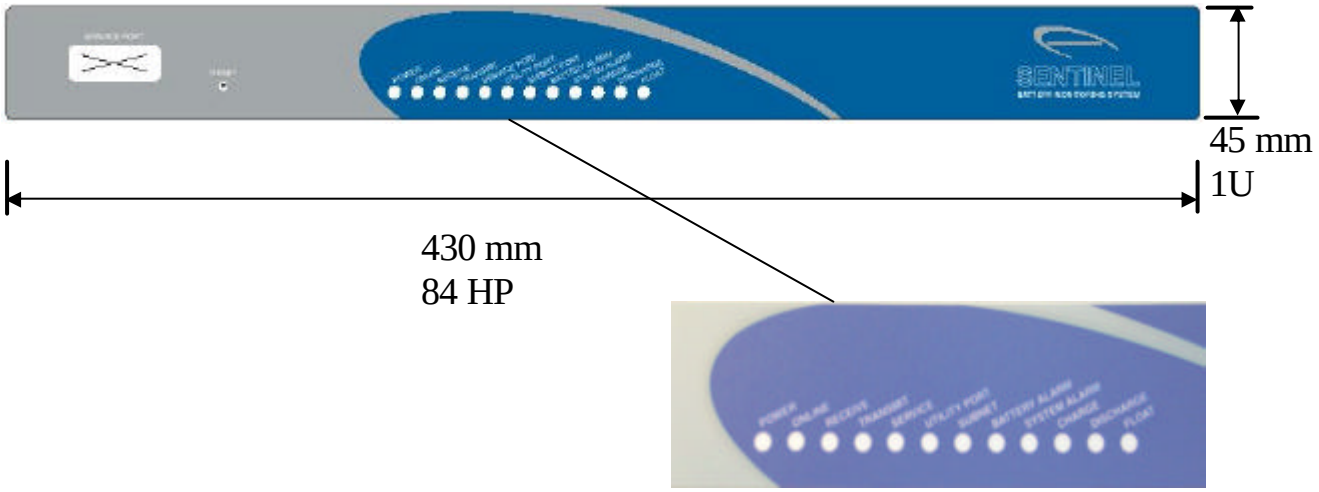
Monoblocks

Each monoblock must be uniquely identified with a number between 1 and 1280. It does not matter which numbers are allocated to which monoblock, although monoblocks in a single string must be in a single consecutive block of numbers. Where there are multiple strings in a system, ensure every monoblock is uniquely identified, ie. 1-24, 25-48, 49-72 NOT 1-24, 1-24, 1-24.

Ensure all monoblock terminals have 6.3mm tabs available for measurement module connection.

Sentinel Units

Every system must have a Sentinel master unit. Further Sentinel units are optional depending on the size of the system to be monitored.
The faceplate and label of the Sentinel is shown below.



Number of Sentinel's

The number of Sentinel units in a *PowerShield* system is dependant on the number of monoblocks.

The Sentinel master unit can be supplied fitted with up to 8 Bbus ports. Each port can support up to 10 dual modules (20 MB). Therefore, if there are more than 160 monoblocks in a system, additional Sentinel units (up to a maximum of 16 including master) are required.

It may be desirable to have spare Bbus ports to allow for future expansion of the battery system. These ports can be left unconnected without affecting the accuracy of the system.

Multiple Sentinel's in a system are networked by an RS485 communications link.

See "Wiring Procedures" on page 17 for full installation details.

Setting Sentinel Identification

Each Sentinel in a system is individually identified.

On the rear panel of the Sentinel is a 16 position rotary switch. The position of this switch determines the identification number of the Sentinel.

See "Appendix A - Sentinel " on page 33 for the location of the ID switch on the rear panel.

The master Sentinel in a system must always be set to 0. Set the remaining Sentinel units from 1-9 or A-F, ensuring that each figure is used only once in the system. If you are installing a system with only one Sentinel, set the ID switch to 0.

Note: *All Sentinel's in a single system must have unique identification numbers. Only the master Sentinel with ID = 0 will allow external communication.*

Mounting the Sentinel

The Sentinel is designed for three mounting variations - rack-mounted, conforming to standard 19" rack specifications; wall mounted; and desk mounted.

The nominal dimensions of the Sentinel unit are as follows:

- Width: 430mm [84 HP]
- Height: 44.5mm [1U]
- Depth: 275mm [including cable tray]

Angled mounting brackets are supplied with the Sentinel, use these to fix the Sentinel in the desired location. Ensure suitable clearance is maintained from battery cable runs.

Note: *Ensure correct mounting facilities are in place prior to installation. Do not attempt to fix or screw directly into Sentinel unit.*

Sentinel Power Supply

Each Sentinel unit in the system has the following power supply options and requirements:

DC Model

- Voltage range: 48 –110 V DC Input
- Earthed
- Current: 0.4A max. per Sentinel
- Power input connector is a 3 way plug and screw terminal block.

- DC model must be installed in a service access area

AC Model

- Voltage range: 110 – 230 V AC; 50 Hz
- Earthed
- Current: 0.15A max. per Sentinel
- Power connector is a male IEC input. IEC mains cable is supplied.

Both AC and DC models must be installed by a service person and connected to a socket outlet or fixed wiring with a protective earthing conductor or connector.

A readily available disconnect device shall be incorporated in the building wiring or the socket outlet, near the Sentinel, and be readily accessible.

Note that 48-110VDC units cannot be powered with 230VAC, and 230 VAC units cannot be powered with VDC. Ensure that the correct power supply for Sentinel units is being used *prior* to applying power.

See "Wiring Procedures" on page 17 for full installation details.

To ensure that the system operates during a power failure, it is recommended that the monitor is powered by a battery backed supply rather than from a mains adaptor.

Sentinel LED Identification

Each Sentinel has twelve LEDs for onsite information.
See "Installation Guidelines" on page 10 for LED and Service Port locations.
See "Appendix A - Sentinel Rear Panel" on page 33 for communication port locations.

LED Position	Description	Colour
1	Power	Green
2	Online	Orange
3	Receive	Orange
4	Transmit	Orange
5	Service	Orange
6	Utility Port	Orange
7	Subnet	Orange
8	Battery Alarm	Red
9	System Alarm	Red
10	Charge	Green
11	Discharge	Green
12	Float	Green

The 12 LEDs will exhibit varying behavior as described below:

LED 1 – Power
Internal Power – Active when unit powered

LED 2 – Online [Port 1]
Ethernet module – Active when ethernet is connected
Modem module – Active when modem link is up
RS232 module – Active when host is connected, flash if remote link is connected *and* Service port is connected.

LED 3 – Receive [Port 1]
Active when data is on receive line of Port 1.

LED 4 – Transmit [Port 1]
Active when data is on transmit line of Port 1.

LED 5 - Service
Active when host is connected. Flash when data is transmitted or received.

LED 6 - Utility Port [Port 2]
Active when host is connected. Flash when data is transmitted or received.

LED 7 – Subnet [Port 3]
Subnet LED is to indicate activity on the RS485 network between master and slave B1001's. Flash when data is transmitted or received.

LED 8 - Battery Alarm
Active if there are any voltage, temperature or current alarms. Note that String Events do not have any effect on this LED.

LED 9 - System Alarm
Active when there is a system alarm.

LED 10,11,12 – String State
When all strings within a system are in the same state, the string state LED is active. When one or more strings are in one string state, but one or more other strings are in a different state, flash both LEDs.

String State Example 1
2 string system:
String 1 is in float, String 2 is in discharge
=> Float and Discharge LEDs flashing

String State Example 2
2 string system:
String 1 is in float and string 2 is in float.
=> Float LED is active.

Dual Measurement Modules

Dual Module Version

A dual module (70mm x 50mm x 30mm) must be fitted to each pair of monoblocks in the system. This pair must be in series within a single string. Each dual module has a factory set ID number between 2 and 62. Any dual module can be fitted to any 'in series' pair of monoblocks, regardless of ID number; however, each measurement module in a single Bbus must have a unique ID.

Single Module Version

For installations containing strings of uneven numbers of MB, or where MB layout makes pairs impossible, a one monoblock single version of the dual module is available. This is identical to and treated in the same manner as the dual version, but connected across a single block. It is identifiable by having only two wires [red, black] exiting the top of the case.

See "Step 6 - Connecting the Dual Measurement Modules" on page 18 for more information on specific wiring requirements for each.

Bbus

The Bbus is the communication link between the dual modules and the Sentinel unit. One Bbus is not limited to a single string, or even consecutive monoblocks. If it is more practical, each Bbus may span between strings.
The Bbus is capable of connecting up to 10 dual modules together. However, it is not necessary to fully load each Bbus. Depending on the layout of the system, it may be more convenient to have 10 measurement modules on one Bbus and 5 on another.

A single Bbus must not be greater than 100m in length. This is the total length of the Bbus to the furthest module, including the short connecting cables between each dual module.

See "Wiring Procedures" on page 17 for full installation details.

Current Sensors

In most cases, each string in the battery system will require a current sensor to measure the current flowing through the string. A single Sentinel can accommodate five current sensors.

See "Wiring Procedures" on page 17 for full installation details.

Temperature Sensors

Temperature sensors can be placed anywhere in the battery system. Each Sentinel unit can accommodate five temperature sensors. Depending on the system monitoring requirements, a temperature sensor may be required on each string.

See "Wiring Procedures" on page 17 for full installation details.

Auxiliary Inputs

The sentinel has four auxiliary inputs that may be used to accept digital input from third party equipment.
For example, it is possible to configure a string without a current sensor. In this case, the Sentinel detects the charge/discharge status of the string from the state of an Auxiliary input. This auxiliary input is a simple digital input, which must be wired to go active when the string goes into discharge.

See “Wiring Procedures” on page 17 for full installation details.

Auxiliary Relay Outputs

Four auxiliary output relays are provided so that the Sentinel can trigger a piece of external equipment when an alarm goes off. For example, the Sentinel can turn on a light, sound a beeper, or trigger an input to a SCADA/ Building Management System if an alarm goes off.

See “Wiring Procedures” on page 17 for full installation details.

Important Installation Rules

- No more than 10 dual modules on a single Bbus.
- Each dual module on a single Bbus must have a unique ID number.
- Ensure dual modules are positioned away from the monoblock ventilation valves to prevent damage by corrosion.
- A single Bbus must not be more than a total of 100m in length
- Each monoblock in the system must be uniquely identified
- Each string must be uniquely identified.
- Each Sentinel unit in a system must be uniquely addressed (the Sentinel master unit is always address 0)
- Each Bbus port cable must be labelled at each end with the Sentinel and port number
- Each current transducer cable must be labelled at each end with the Sentinel and current port number
- Each temperature probe cable must be labelled at each end with the Sentinel and temperature port number
- A System Form (SIF, SCF, MMF) must be completed for each system installation
- Ensure all hardware and cabling is properly secured.
- Where Dual Measurement Modules are used on vented batteries, ensure they are installed well clear of vents.
- Standard PowerShield Dual Measurement Modules are not intended for use in exterior situations - contact the supplier for more information.
- Current Transducers should be located as far as possible away from other cables supplying large currents, to minimise interference.

Where possible, be systematic in layout. Fault finding and configuration will be simplified if a coherent and logical system layout is used.

Safety: *The* PowerShield *system operates in a potentially hazardous environment, ensure all personnel have adequate training and experience. The* PowerShield Dual Measurement Modules *must be installed in a Service Access area.*

Wiring Procedures

Step 1 – Site Name and Site Details

The first step of the installation process is to fill in the first page of the System Form, the Site Identification Form (SIF). See "Appendix C - System Forms" on page 35.

Site Name

Each Site should have a unique name. Choose a name that describes the location of the site. Be aware that there may be many locations being monitored within a company's building or infrastructure.

Address

Identify the address of the site, there may be many similar sites, differentiated only by sitename.

Company

Record the name of the company that owns the battery system.

Total Number of Monoblocks

Record the total number of monoblocks being monitored.

Total Number of Sentinels

Record the total number of Sentinels used to monitor the site. Each Sentinel can monitor up to 160 monoblocks.

Total Number of Strings

Record the total number of strings in the site.

Installed By, Date

Record your name and company name, and the date that the installation is taking place.

Step 2 – Numbering the Strings

Each string in the system must be uniquely identified with a number between 1 and 32. Each line of the SCF describes the installation details for a single string.

Step 3 - Numbering the Monoblocks

Each monoblock in the system must be uniquely identified with a number between 1 and 1280. Number each monoblock by marking with an indelible marker or attaching a label.

For each string in the system, write the first and last monoblock numbers of the string in the columns on the SCF. Also record the Capacity of the monoblocks in Amp-Hours, and the monoblock voltage for the monoblocks in the string.

Note: *Since Strings are defined by specifying the first and last monoblock numbers, monoblocks that are in a single string must be consecutive*

numbers. Be consistent in numbering method. For example, PowerShield recommends starting at the most positive of each string.

Step 4 - Installing the Sentinel

The Sentinel unit is supplied in a 1U 84HP 19" standard case. Mount the Sentinel securely to 19" rack (not supplied), wall, shelf or similar. Ensure the Sentinel unit is unable to move when installed, cables and connections must not be allowed to be put under strain. Ensure the rear connector panel and cable tray can be safely accessed. If there is more than one Sentinel in the system [Master – Slave], ensure that each units ID switch is correctly set, and that the Master is the unit with any additional communications at Port 1 or Port 2. See appendices for more information.

Step 5 - Powering the Sentinel

DC Model

The power input connector for the Sentinel is a 3-way plug and screw terminal block. Connect and plug in the power connector for the Sentinel. Ensure the correct polarity is used; -ve to left, GND to centre, +ve to right.

AC Model

The power input connector for the Sentinel is a male IEC inlet . Plug in the mating earthed IEC power lead.

When the Sentinel is powered up, it will emit an audible alert, and the green *Power* LED will switch on. Other LEDs on the front panel may also light.

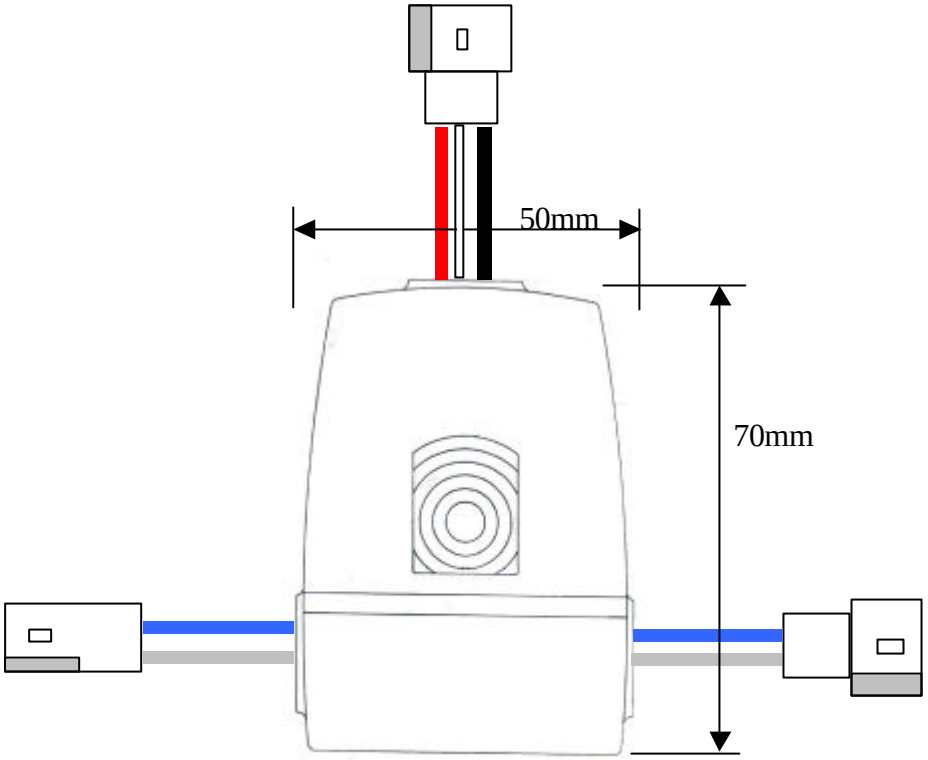
See "Appendix A - Sentinel " on page 33 for the location of the power connections.

Once the Sentinel is powered, if the Bbus port cables are connected to the Sentinel and all the modules are connected correctly, the LEDs of all the modules assigned to the Sentinel will begin to flash. Utilise this feature to assist with module installation.

Step 6 - Connecting the Dual Measurement Modules

Prior to connecting the modules, plan the layout and fixing points to ensure an efficient and tidy cabling system. Ensure all the following sections are read prior to work commencing.

Safety: *The PowerShield system operates in a potentially hazardous environment, ensure all personnel have adequate training and experience. The PowerShield Dual Measurement Modules must be installed in a Service Access area.*



Recording the Dual Measurement Module ID

Each module has a label on the rear of the case, containing the voltage model (2V, 6V, 12V), the numeric identification of the module (ID#), the hardware variant (Dual or Single), and manufacture data. The measurement module ID number, between 2 and 62, is displayed at the top right corner of the label in large print.

12V	ID52
Dual	
P/N	9100-018
S/N	1234567
DM	22 Sep 03

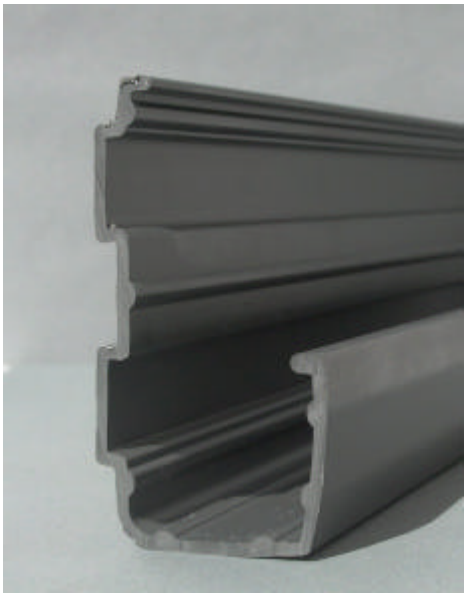
Whilst the PowerShield system is extremely versatile, it is recommended that the module arrangement and Bbus layout is defined prior to mounting the modules. This will assist with complying with the two main restrictions - a maximum of ten modules on a Bbus, and that those 10 ID numbers are unique. To assist the installer, the modules are supplied pre-packed, in a quantity of ten (10), each of the ten with a unique ID.

As each dual module is allocated to a series pair of monoblocks, record the monoblock numbers and the dual module ID number in the Port Number column which is to be used. Also record whether each monoblock is the most positive block (V1), or most negative block (V2). Record individual monoblock numbers where single modules are used. Note where there is

more than one Sentinel in a system, mark and use a single MMF sheet for each Sentinel.
Remember that there are potentially 16 Sentinel's (16 MMF pages), and 1280 modules. Ensure correct recording and labelling is maintained throughout the installation process.

Mounting the Dual Measurement Module

Supplied with the dual modules is a plastic rail, which provides a secure mounting point for each module and trunking for the local Bbus. This rail may be cut to suit the local installation, and provides a firm enough fixing for the modules that it may be mounted horizontally, vertically, or even upside down.



Locate and mount the rail securely prior to connecting the modules, ensuring it is close enough to the monoblock terminals for the module power leads to reach.

Snap each module into the rail and slide to locate.

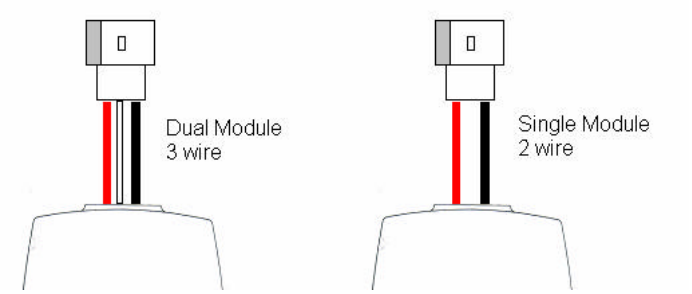
To remove a module from the rail, unplug all connections and roll it forward, or slide it out the end of the rail.

Note: *The dual module should be placed away from the ventilation valves to prevent damage by corrosion.*
Safety: *The* PowerShield Dual Measurement Modules *must be installed in a Service Access area.*

Connecting a Measurement Module

Each measurement module has a 3-way friction-fit connector on short red, white and black leads [single versions only have red and black], which exit

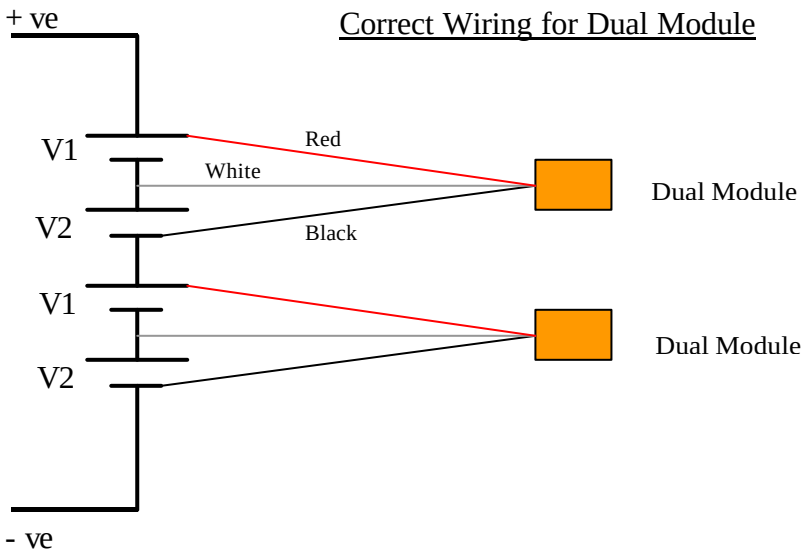
at the top of the plastic case. Supplied with each module is the inverse gender of the mate-lock connector, with module extension leads.



The friction-fit connector allows easy installation and replacement of modules. The module extension leads are fitted with insulated, Amp 250 Series Faston receptacles, for connection to a 6.3mm tab. These tabs must be installed on each monoblock terminal, if not already present.

The dual module measures an 'in series' pair of monoblocks in a string. The most positive monoblock of the pair is V1, the most negative monoblock of the pair is V2.

Of the 3 wires coming from the dual module, connect the red wire to the most positive terminal of the pair of monoblocks. Connect the black wire to the most negative terminal of the pair of monoblocks. Connect the white wire to the junction where the two monoblocks are linked together. Select the most convenient point on this link. (it may be the positive terminal of the most negative monoblock or the negative terminal of the most positive monoblock).



Where there are an odd number of monoblocks in a string, a single module should be used to measure the remaining monoblock after all the others have been allocate to dual modules. It is usual to put this at the end of a

string, but there is no functional requirement to do so - it can be placed anywhere in a string.

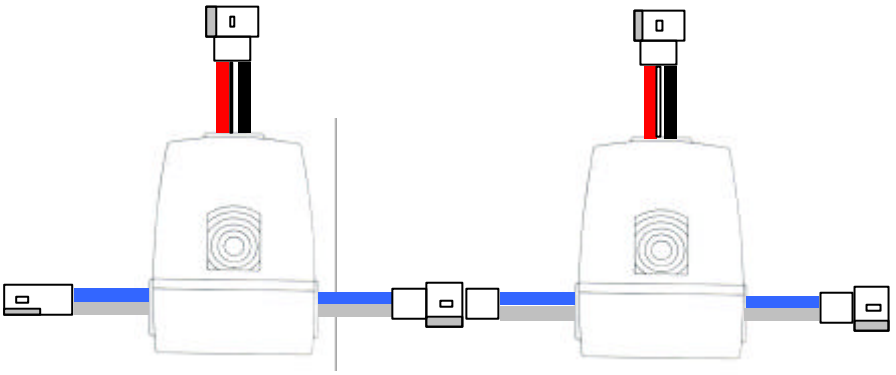
Plug a module onto the power leads, and mount in the rail in the required position.

Once a module is connected to the monoblock, it has power, causing the LED on the module to turn on. Ensure each LED turns on as modules are powered.

Step 7 - Connecting the Bbus

Each module has two, 2-way friction-fit connectors on short orange and grey leads, which exit on either side at the base of the plastic case.
These are the Bbus communication connections.

Each module has one male, and one female connector. If close enough, adjacent modules may be plugged directly to each other. If not, connect using the supplied lengths of Bbus interconnect cable.
The cables are fitted with a plug at each end, male at one end, female at the other. Match the appropriate gender connector with those of the modules, to allow increased spacing.



Continue to connect each set of measurement modules in this way, leaving the first or last connector in the set free for Bbus port connections.

Ensure all cables are correctly connected and appropriately secured.
Cable ties or clips are recommended where it is necessary to run cables outside the mounting rail.

Step 8 - Connecting the Bbus Port Cable

The Bbus port cable connects each set of measurement modules to the Sentinel unit.

Connect a Bbus port cable to one end of each set of measurement modules, and run the cable back to the Sentinel unit.

See "Appendix A - Sentinel Rear Panel" on page 33 for the location of the Bbus ports. The port cable is fitted with the same 2-way friction-fit connectors as the Bbus cables.

To connect the port cable to the Sentinel:

- Lay the cable into the final position and cut off excess length, including the connector. Allow enough length so that the cables will not become tight with any normal movement of the B1000 case.

- Strip back the outer black sheath of the Bbus Port cable for a distance of approx. 50mm to reveal the three internal wire cores. Take care not to nick the insulation on these cores.

- Mark B1000 and port numbers as appropriate. Ensure this is accurate and matches both the other end of the cable and as connected to backplane.

- Cut off the yellow core at the same point as the sheath – this core is unused.

- Strip the insulation off the black and red cores for a distance of approx. 5-6mm and tightly twist the strands so they do not become frayed.

- Unscrew the two screws on the connector if necessary (connectors are usually supplied with the screws fully retracted), insert the ends of the wires, and tighten. The red is placed in pin 1 of the connector, and black in pin 2. Pin 1 may not be clearly marked on the connector so follow the diagram below.

  Plug connector into correct port and repeat with all remaining Bbus port cables.

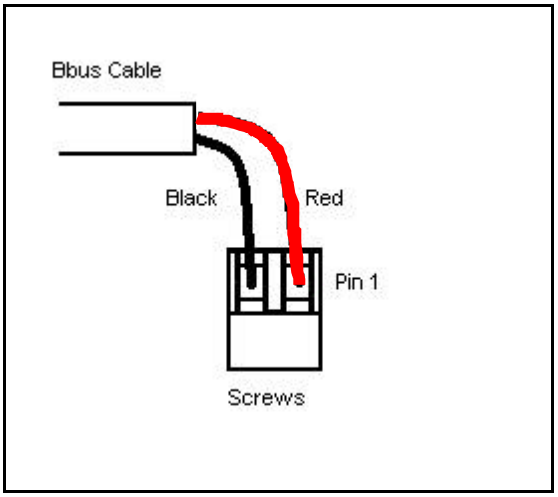


Figure 1 - Correct wiring arrangement for Bbus port cable.

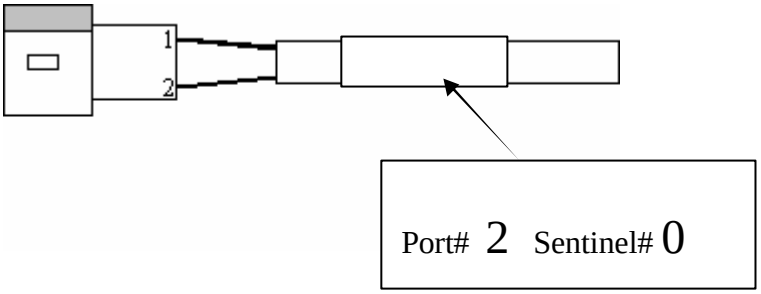
As the Bbus port cable is plugged into the Sentinel, the LED on the module (turned on when the module was connected to the monoblock) should start to flash. This flashing indicates the module is now communicating with the Sentinel.

Ensure all port cables are properly connected and appropriately secured.

The cables are identified according to how they are to be connected to the Sentinel unit. Mark cables with the appropriate port number and Sentinel number as installed.

See "Installation Guidelines" on page 10, for information on Sentinel numbers, and "Appendix A - Sentinel Rear Panel" on page 33, for port numbers.

For example, a cable that is to be connected to port 2, of the Sentinel unit with address 0, would show:



Note: *The Bbus port cable may be connected to either end of a set of measurement modules, but should not be connected to both.*

Confirm that the required information has been entered for the port number on the MMF.

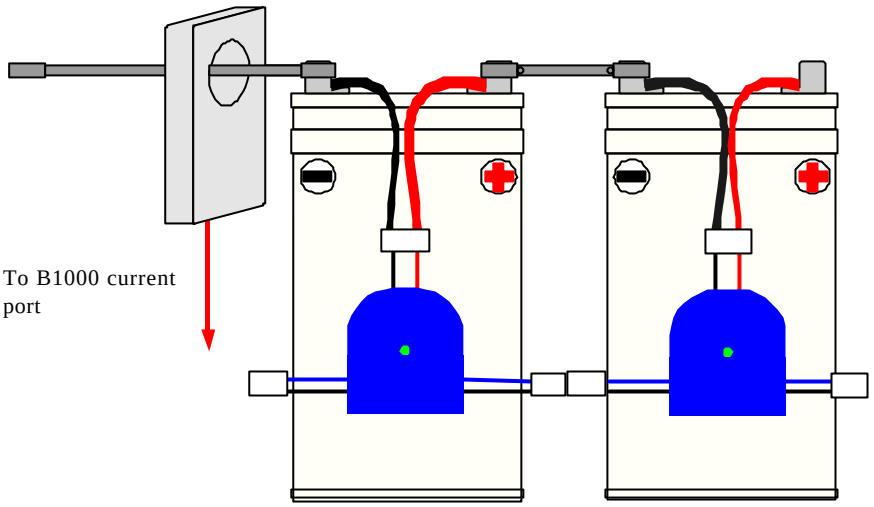
Step 9 - Current Transducers

Up to five current transducers can be fitted to each Sentinel unit in the system. The current transducers are Hall effect devices, this means they are able to accurately detect the current flow by monitoring the magnetic field being produced around the cable.

See “Appendix A - Sentinel Rear Panel” on page 33 for the location of the current ports.

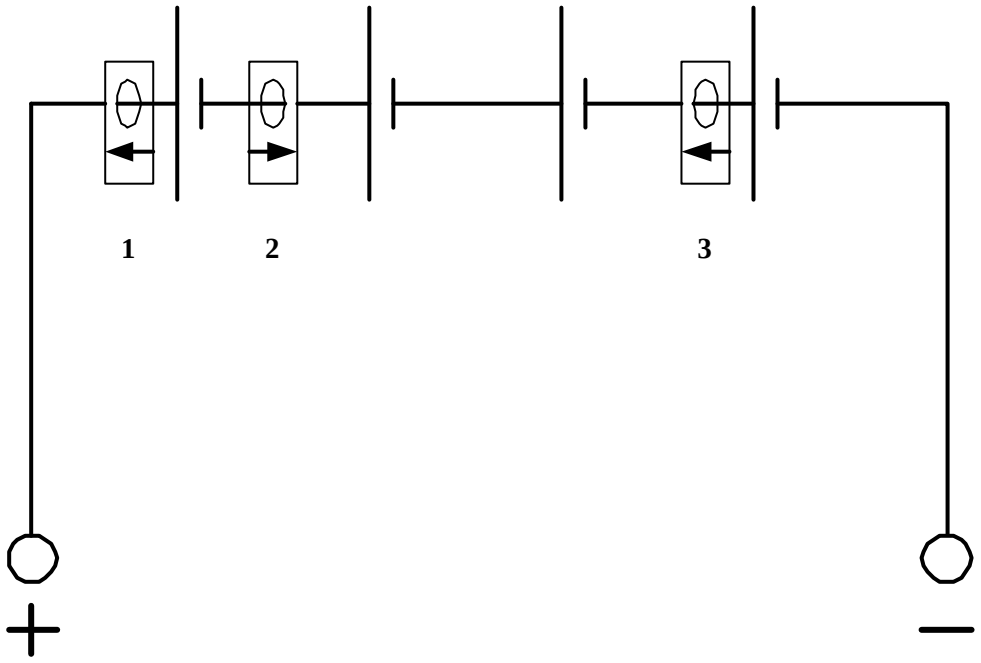
In most cases, one current transducer will be installed for every string in the system. It is, however, possible to configure a string without a current transducer. If you are installing a system that has some strings without current transducers, you will need to install a trigger input to trigger the Sentinel’s memories – see “Auxiliary Inputs” on page 14.

Connect the transducer on to the string as shown below. The transducer should be fitted around the main conductor of the string (the cable which connects the monoblocks together).



The polarity of the transducer is important.

For LEM transducers, if the transducer is installed in with the arrow pointing in the direction of conventional current flow when charging, you should enter a negative gain when configuring. Record the direction on the String Configuration Form.
See diagram below.



For the diagram above, transducers 1 & 3 are considered positive, transducer 2 is considered negative

Record this in the Current Direction column of the SCF.

The Current transducer should be located as far away as is practical from other cables carrying high current. Usually this means the current sensors

should not be installed in the switch box, where there is high cabling density.
Note that the transducer may be installed anywhere on the primary battery conductor. It may be installed between monoblocks or some distance from the battery. The current transducer cable has a maximum length of 10m so adjust the position to suit.

The cable from each current transducer must be run back to the Sentinel unit, and clearly labelled as a current connection, with the Sentinel unit address, and the current port number. The current cables are factory terminated and must not be modified on site.

A list of recommended Current Transducers is given in "Appendix B – Recommended Current Transducers" on page 34.

Record the Sentinel number and the Port number of each current transducer for each string in the SCF.

Step 10 - Temperature Probes

Up to five temperature probes can be connected to each Sentinel unit in the battery system.

See "Appendix A - Sentinel Rear Panel" on page 33 for the location of the temperature ports.

In most cases, the temperature sensor will be mounted in close proximity to the string it is associated with, to measure the ambient temperature of that string.

The cable from each temperature probe must be run back to the Sentinel unit and clearly labelled as a temperature connection, with the Sentinel unit address, and the temperature port number.

Record the Sentinel number and the Port number of each temperature probe for each string in the SCF.

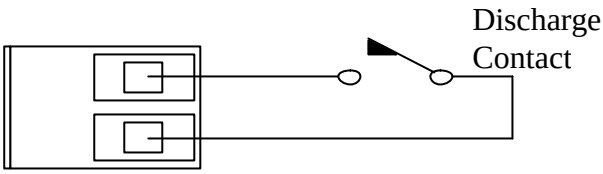
Step 11 – Auxiliary Inputs

Each Sentinel has four auxiliary inputs which may be used to take digital signals from external equipment.

For example, it is possible to configure a string without a current sensor. In this case, the Sentinel detects the charge/discharge status of the string from the state of an auxiliary input. Another use is indicating mains supply mailure.

Note: If you are configuring a Sentinel where all strings have a current transducer, you do not need to make a connection to the Auxiliary input of the Sentinel.

This auxiliary input is a simple digital input, which must be wired to go active when the string goes into discharge. The connections of the terminal blocks are shown below:

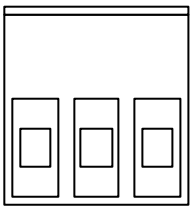


The Discharge Switch or Relay contact should be a normally open contact that closes when the string goes into discharge.

See "Appendix A - Sentinel Rear Panel" on page 33 for the location of the auxiliary input connectors.

Step 12 - Auxiliary Output Relays

Four auxiliary output relays are provided so that the Sentinel can trigger a piece of external equipment when an alarm goes off. For example, the Sentinel can turn on a light, sound a beeper, or trigger an input to a SCADA system if an alarm goes off.
Each relay output can be accessed by connecting to a three way terminal block on the rear panel. See "Appendix A - Sentinel Rear Panel" on page 33 for the location of the auxiliary output relay connectors. The connections on the terminal blocks are shown below [viewed as plug connected]:



nc – normally closed contact
no – normally open contact
c. – common
The relay will be in its normal state when the alarm it is associated with is not active. If the alarm is activated, the relay will be activated.

If you are connecting to the relay outputs of the Sentinel, note down the connections made in the "Relay Outputs" section at the bottom of the SCF. This information will be necessary for the correct configuration of the Relay Outputs.
Note that the relays may switch on power-up, and should be fused externally with a 1A fuse.

Step 13 – Port 3 Network Connection

Where there are multiple Sentinel's in a system, these need to be networked to allow user communication via the master. The network is formed by daisy chaining the system Sentinel's. Link each Sentinel via the RJ45 connectors at Port 3 on the Back-plane.

See "Appendix A - Sentinel Rear Panel" on page 33 for the location of Port 3.

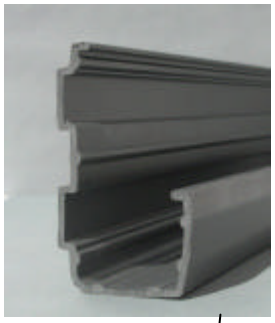
System Configuration

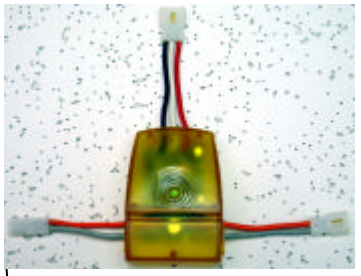
Ensure each module LED is flashing, and all connections are correct and secure, before proceeding with system configuration.

To configure the *PowerShield* system for operation, you will need:

- PSL *PowerShield Configuration* Software version 1.3.1.0 or later.
- PSL *PowerShield Configuration* Software User Manual, document number 6300-002C

PowerShield Hardware Images

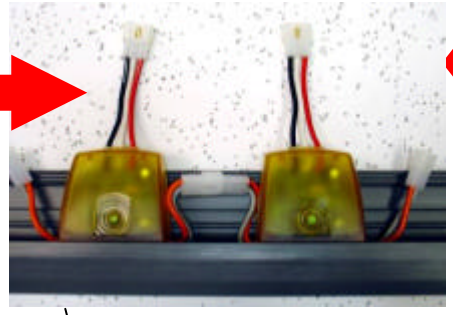




6.3mm QuickConnect battery terminal tab.
Suitable for use with Amp 250 Series Faston receptacles.
Available to suit 6.4mm, 8mm, 12.3mm terminal diameter
Ensure these are on all terminals prior to connecting Measurement Modules

Measurement Module mounting rail
Grey PVC plastic,
available in lengths up to 3m

PowerShield Measurement Module
Available to suit
2V, 6V, 12V monoblocks

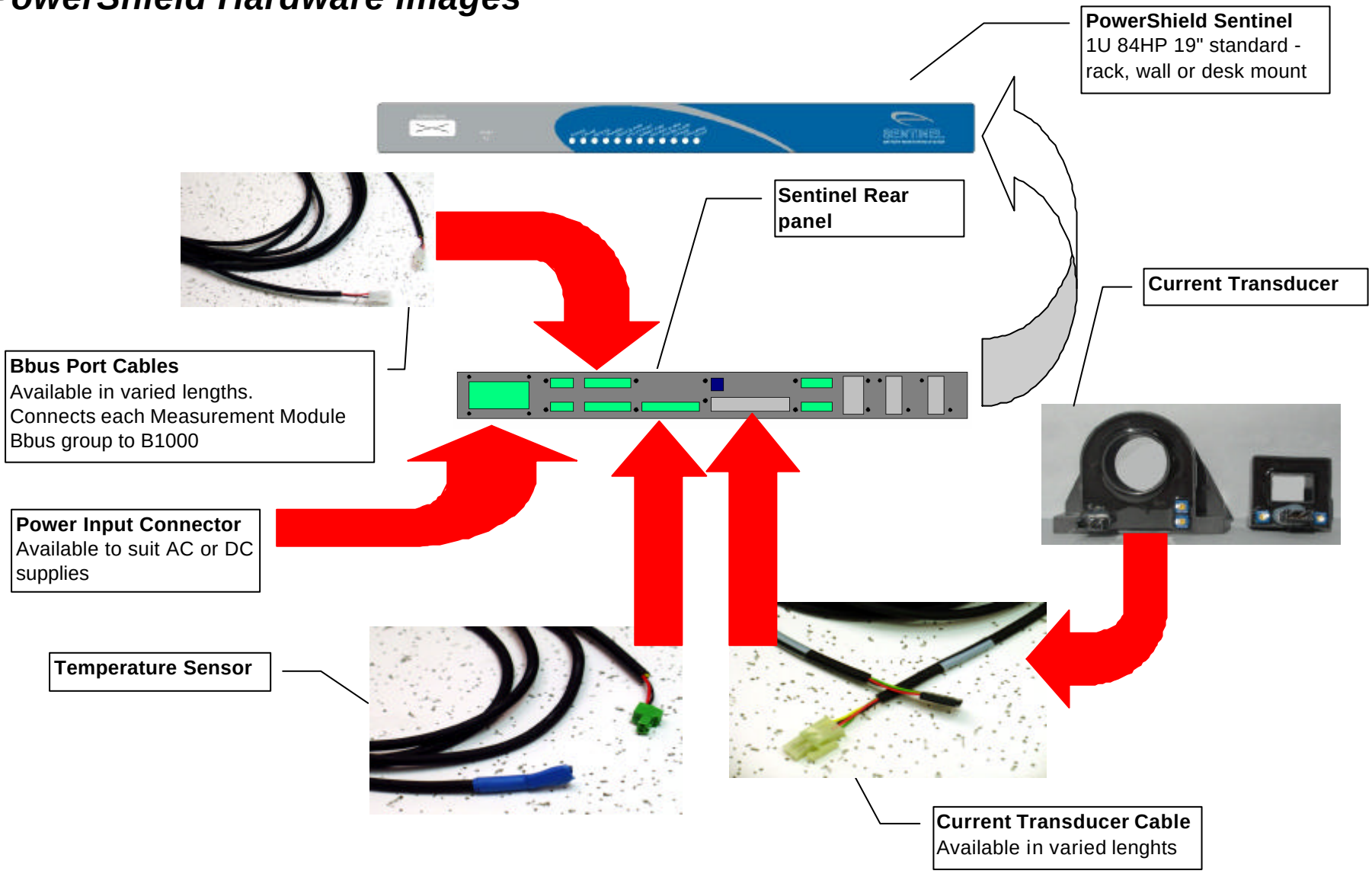


Measurement Module power leads.
Available in varied lengths
Connects Measurement Module to monoblock

Measurement Modules secured in mounting rail

Bbus Interconnects
Available in varied lengths
Connects Measurement Modules on the same Bbus, if too separated to connect directly.

PowerShield Hardware Images



Installation Checklist & Troubleshooting

At the completion of installation, if there appears to be a problem, return to the applicable section of the manual and ensure that all steps have been completed correctly. This checklist is not intended as a substitute for a full and complete understanding of this manual.

Following is a summary checklist of installation stages, and some common troubleshooting tips.

- Monoblocks numbered individually. 1 – 1280max
- Current transducers installed
- Sentinel installed and secured
- All Sentinel's powered up.
- Additional communication devices and RS485 links installed (if required).
- All Dual Measurement Modules are connected to monoblock pairs correctly. LEDs on.
- All Bbus cables, and Bbus port cables to Dual Measurement Modules, are connected at both ends, labelled and secured.
- All Dual Measurement Modules are secure and operating. LED's flashing when Bbus port cables plugged to Sentinel, and Sentinel powered up.
- All current transducer cables connected at both ends, labelled and secured.
- All temperature sensor cables connected, labelled and secured.
- Auxiliary input/outputs connected at both ends, labelled and secured (if required).
- Additional communications cables [Ports 1 & 2] connected at both ends (if required).
- All Sentinel backplane connections confirmed secure.
- Confirm System Forms (SIF, SCF, MMF) have been completed correctly.

Troubleshooting

- Sentinel not powering up ?
  Confirm the Sentinel is plugged into appropriate supply and supply is switched on.

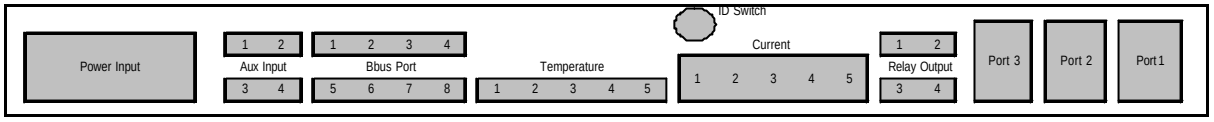
- Dual Measurement module(s) LED not turning on ?
  Confirm the dual module power leads are connected securely to the monoblock terminal tags in the correct arrangement, and that the terminal is tight.
  Confirm monoblock voltage is sufficient to power the module. Try swapping with a correctly powered module to confirm functionality.

- Measurement module(s) LED not flashing ?

Confirm the Bbus port cable has been plugged into the Sentinel backplane correctly, and the daisy-chain of modules.
Confirm the daisy-chain is continuous.
Confirm there is a maximum of ten (10) modules on the daisy-chain.
Confirm that all ten module IDs on the daisy-chain are unique.

Appendix A - Sentinel Rear Panel

The Revision 1.0 rear panel for the Sentinel Battery Monitor is shown below. It shows the position of the various connectors and Bbus ports.



Appendix B – Recommended Current Transducers

The Sentinel can be connected to open loop Hall effect current transducers with the following specifications:

- Supply Voltage +15v and –15v
- Ground Connection
- Output voltage range –10v to +10v Max

Refer to PowerShield for complete pin-out documentation.

Recommended current transducers are:

LEM HAL Series
- ±50A to ±1000A
- For rectangular conductors, up to 15mm x 20mm
- Vout ±4v

LEM HTA Series
- ±100A to ±1000A
- For round conductors, up to 32mm diameter
- Vout ±4v

LEM HAS Series
- ±50A to ±600A
- For rectangular conductors, up to 10mm x 20mm
- Vout ±4v

URD-36 Series
- ±200A to ±800A
- For round conductors, up to 36mm diameter
- Vout ±4v

URD-20 Series
- ±10A to ±200A
- For round conductors, up to 20mm diameter
- Vout ±4v

For high current applications, the maximum diameter of 32-36mm may prove restrictive. Remember that the transducer can be installed on the inter-monoblock links if required. Another alternative is to split the primary conductor into two even cables and install the transducer on one. PSL Configuration software has a multiplying factor to account for this split cable.

Note: *If the battery system being monitored has a voltage of greater than Safety Extra Low Voltage (SELV – 38v), and the busbars are not insulated, the current transducer must be appropriately isolated from the busbar. The above transducers provide sufficient isolation.*

Appendix C - System Forms

Copy the forms (SIF, MMF, SCF) on the following pages, as required.

Remember to complete all forms fully, during installation, to allow for easy and correct system configuration.

Remember that the person installing the PowerShield system, may not be the same person configuring it.

Site Identification Form (SIF)

Site Summary:

Site Name:			
Site Address:			
Company:			
Total Number of Monoblocks:			
Total Number of Sentinels:			
Total Number of Strings:			
Installed By:		**Date:**	
Total Number of Pages (Including this page) in System Form - SIF + SCF + MMF:			

Communications Setup:

Port 1
Port 2
Firmware: ASCII / RTU

Notes:

String Configuration Form (SCF)

Site Name:		**Address:**		**Room:**	

String Number	**Monoblocks**				**Current**				**Temperature**		
	Start of string Monoblock	End of string Monoblock	Monoblock Voltage	Ah rating of Monoblock	Current Sensor		Current direction	Current sensor type	Temperature Sensor		Temperature Sensor location
					Sentinel #	Port #	(+ / -)		Sentinel #	Port #	
Example	25	48	2V	100Amp/h	0	2	–	LemHTA200	0	1	Middle rack
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											
11											
12											
13											
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26											
27											
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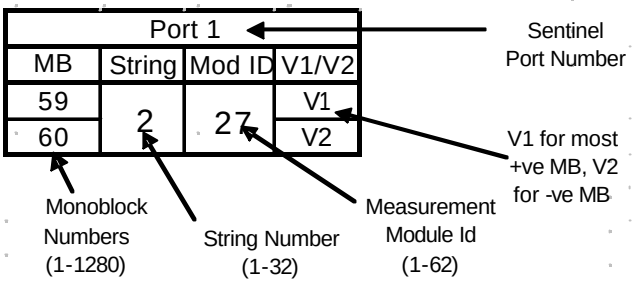
29											
30											
31											
32											

Relay Outputs		
Sentinel #	**Relay no**	**Function**

Monoblock Mapping Form (MMF)



Sentinel Number	

Site Name

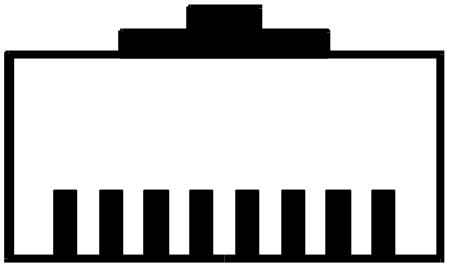
Port 1				Port 2				Port 3				Port 4			
MB	String	Mod ID	V1/V2	MB	String	Mod ID	V1/V2	MB	String	Mod ID	V1/V2	MB	String	Mod ID	V1/V2

Port 5				Port 6				Port 7				Port 8			
MB	String	Mod ID	V1/V2	MB	String	Mod ID	V1/V2	MB	String	Mod ID	V1/V2	MB	String	Mod ID	V1/V2

Appendix D – Port 3

Port 3 is only for use for networking Master and Slave Sentinels within the same system. It is not for external communication. Port 3 has two RJ45 connectors, either may be used. Simply link one Sentinel to the next in a "daisy chain".

RJ45 Modular male plug



Pinouts
5 = GND
6 = RS485 +
7 = RS485 –
8 = GND

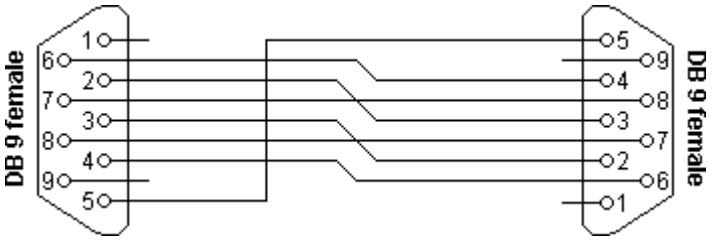
6 & 7 need to be twisted pair.

Recommended to be CAT5 cable.

Appendix E – Port 1 & Service Port

Service Port

The Service Port is located at the front of the Sentinel. The Service Port is intended as a temporary connection.
Port 1 [see below] is intended as the primary, permanent communication port, with the communication cable to remain connected. Connection to the Service Port DB9 connector at the front of the Sentinel will override communications at Port 1.
Connection to the Service Port is RS232 serial communication. Connector is DB9 Male. Connect using a full null modem cable with handshaking. Refer to diagram below for pin-out details.



Sentinel to PC cable - RS232 null modem with full handshaking

Connector 1	Connector 2	Function		
2	3	Rx	?	Tx
3	2	Tx	?	Rx
4	6	DTR	?	DSR
5	5	Signal ground		
6	4	DSR	?	DTR
7	8	RTS	?	CTS
8	7	CTS	?	RTS

Port 1 Communication Options

Port 1 is located at the extreme right of the rear of the Sentinel. It can support three different communication options – RS232, Ethernet or Modem. These are factory fitted options and must be specified at time of purchase. Only one of the three options can be fitted to a Sentinel at a time. Note that Port 1 may also remain unused.
Where a system is large enough to require a Master and Slave arrangement, only the Master shall have Port 1 fitted, a Slave cannot communicate through it's Port 1.

Port 1 is intended as the primary permanent communication port, with the communication cable to remain connected. Connection to the Service Port DB9 connector at the front of the Sentinel will override communications at Port 1. This is a hardware override and the Service Port cable must be fully disconnected for Port 1 to work.

RS232 – Connector is DB9 Male, connect using a full null modem cable with handshaking. Refer to Service Port diagram above for pin-out details.

Ethernet – Connector is RJ45, connect using standard Cat5/Cat6 Ethernet cable and pinouts. Note that if you are connecting direct from Sentinel to PC/laptop, you must use an Ethernet cable with a crossover. If you are connecting from Sentinel to PC/laptop via a network switch or hub, the crossover is not required.

Pin	Function
1	TX+
2	TX-
3	RX+
4	RX-
5	nc
6	nc
7	nc
8	nc

Modem – Connector is RJ11, connect using telephone cable fitted with mating RJ11 plug.

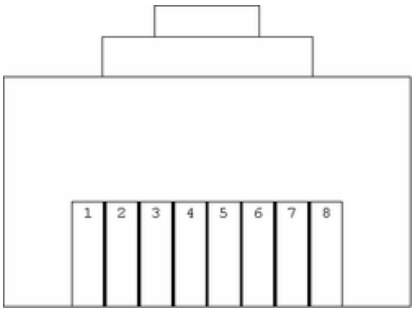
Pin	Function
1	nc
2	nc
3	TIP
4	RING
5	nc
6	nc

Appendix F – Port 2

Port 2 is intended as a secondary communication port to allow integration with third party systems.
Port 2 is located at the of the rear of the Sentinel, adjacent to port 1. It can support two different communication options – RS 485 or RS232. These are factory fitted options and must be specified at time of purchase. Only one of the two options can be fitted to a Sentinel at a time. Note that Port 2 may also remain unused.
Where a system is large enough to require a Master and Slave arrangement, only the Master shall have Port 2 fitted, a Slave cannot communicate through it's Port 2.

RS 485 – Connector is RJ45. Pin-outs are as per diagram below.
The RS485 option is intended primarily for integration with third party ModBus systems. For more information on integrating a Sentinel system with ModBus, see the separate manual *6300-049 Sentinel Modbus Port 2 Interface* and its associated document *6300-050 Sentinel Modbus Port 2 Interface Register List.*

Pin	Function
1	Not connected
2	Not connected
3	Not connected
4	Not connected
5	Not connected
6	Data + (D1)
7	Date - (D0)
8	Not connected



RS232 – Connector is DB9 Female. Refer to PowerShield limited for further details.