Sentinel Installation Manual
m-Senzor

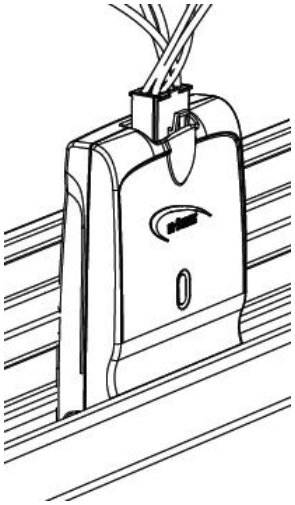
Table of Contents

1 Introduction

This manual is intended for use with SENTINEL battery monitoring systems that use the m-Senzor range of devices. This includes the full upgrade path from the voltage only m-Senzor to the voltage/temperature/ ohmic value m-Senzor.

Note: This manual does not cover the installation of SENTINEL systems that use Measurement Modules. (Refer to the document 6300-011 PowerShield Sentinel Installation Manual).

This manual describes the system hardware, and does not include information on configuring the system. For information on configuring a SENTINEL system, refer to the document 6300-002 PowerShield Configuration Software.



Part Number 6300-055F
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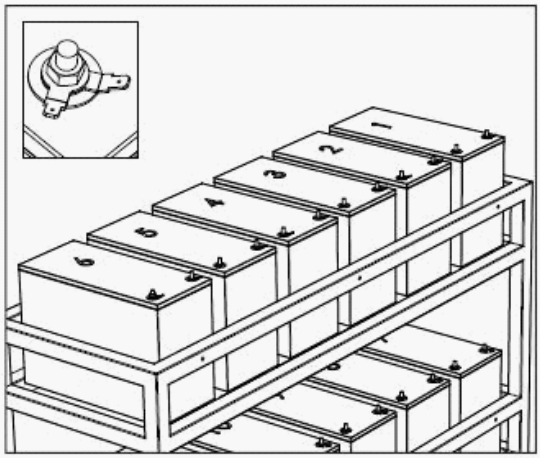
2 Definitions for this Manual

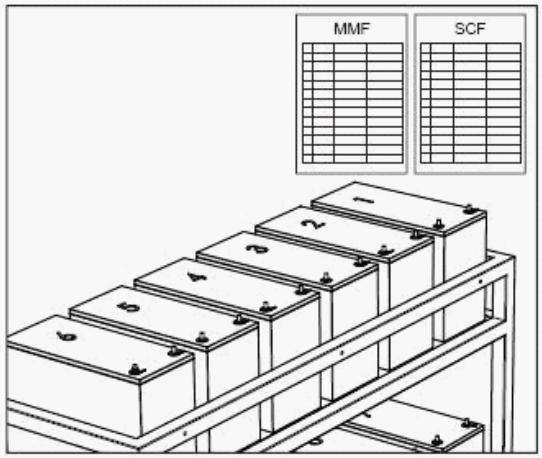
Cell	the basic electrochemical unit to receive, store, and deliver electrical energy
Monoblock	one or more cells in a container also known as a battery. The terms monoblock and jar are interchangeable. For this manual the term has been standardised as monoblock to avoid using the somewhat unwieldy convention of "monoblock/jar" throughout
String	two or more monoblocks connected in series
Battery Bank	complete system of parallel connected strings

3 Installation QuickGuide



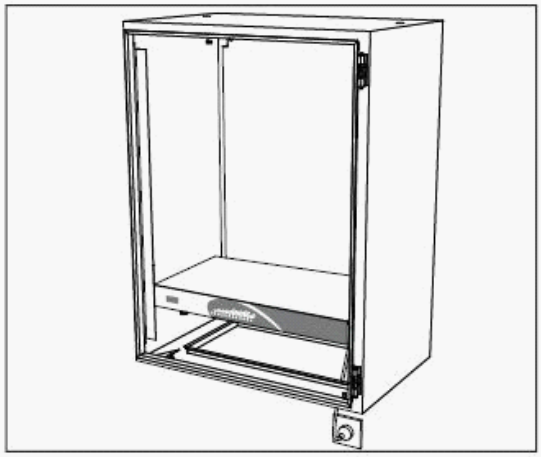
Number all monoblocks individually 1-1280
(e.g. 1-32, 33-64, 65-96, NOT 1-32, 1-32, 1-32)
Fit terminal tags, 2 per post.

1:



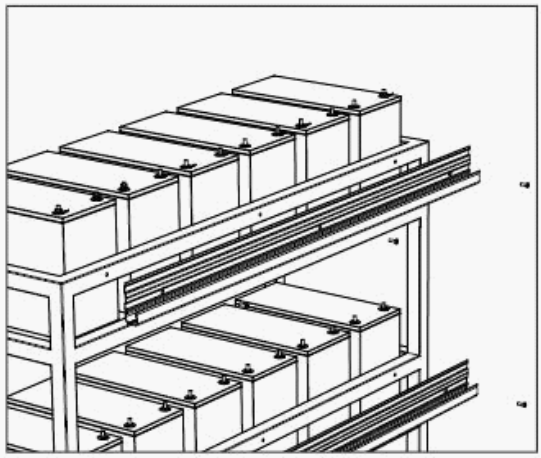
Ensure SCF and MMF forms are completed
as installation proceeds.
Refer to Installation Manual for copies.

2:



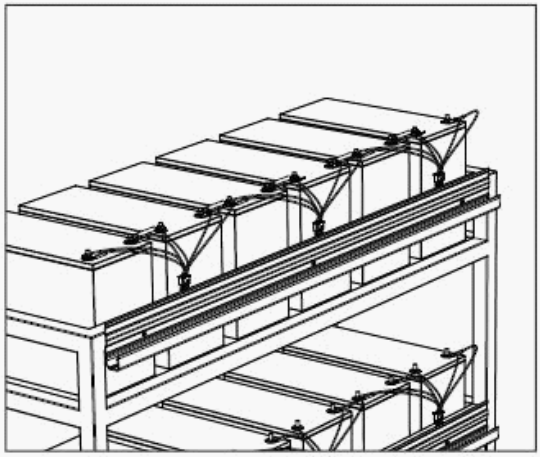
Install Monitor securely. Power up and
confirm operation.

3:



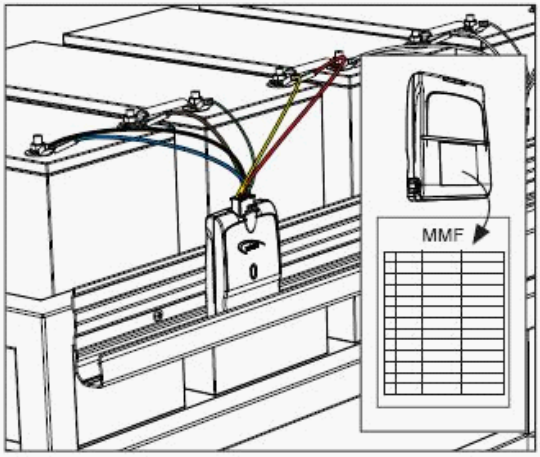
Secure the mounting rail to suit battery layout.

4:



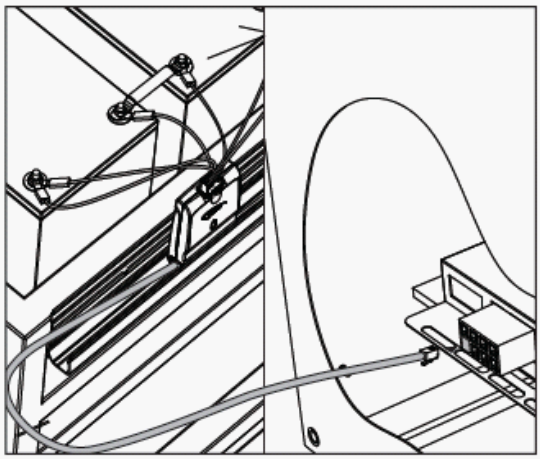
Fit m-Senzor power leads to terminal tags, confirming correct polarity.

5:



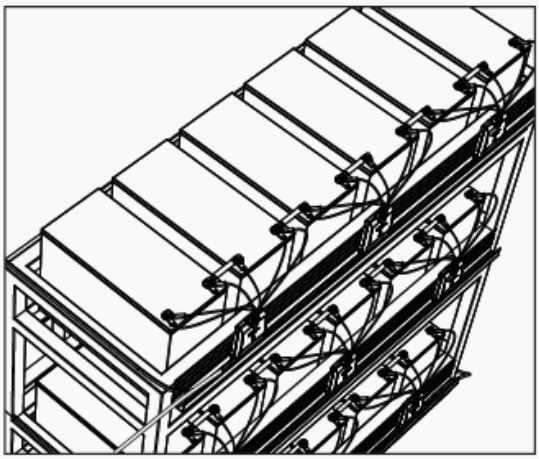
Fit m-Senzors, connect power leads, Record m-Senzor ID and battery number on MMF. The LED should turn on green.

6:



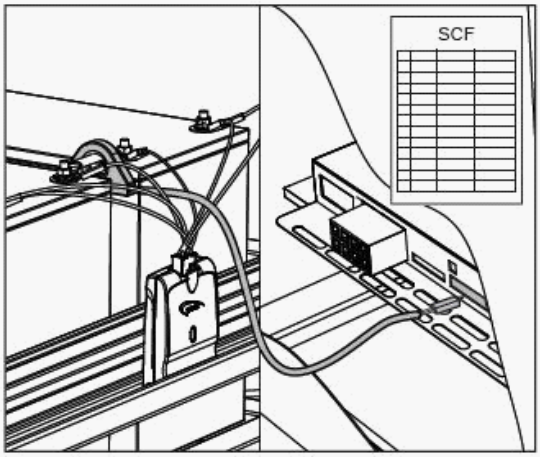
Connect Bbus Port cable from one end of m-Senzors to Monitor.

7:



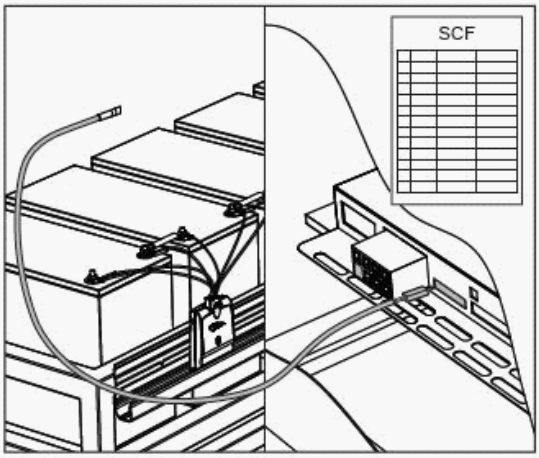
Remember-maximum ten m-Senzors per Bbus port, and each on that port must have a unique ID. The LED should flash green and red in unison.

8:



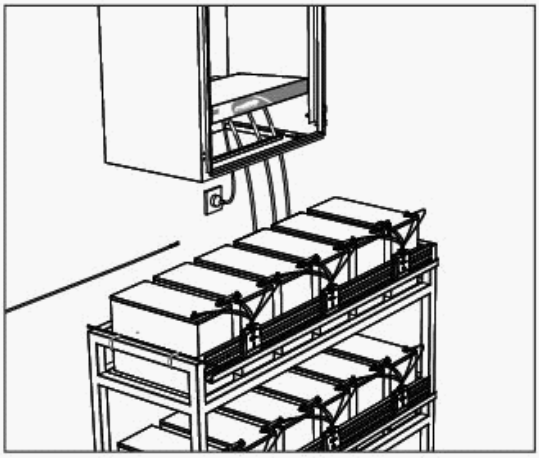
Install Current Transducer and connect with cable to Monitor. Record details on SCF.

9:



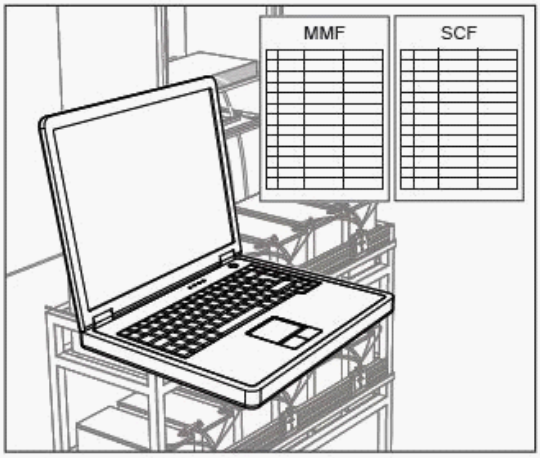
Install Temperature Probe and connect to Monitor. Record details on SCF.

10:



Confirm all m-Senzor LEDs are flashing. Secure all cables tidily.

11:



Proceed with system configuration using Config software. Ensure completed MMF and SCF forms are available.

12:

4 The SENTINEL Battery Monitoring System

The PowerShield Sentinel system is a permanent battery monitoring system developed by PowerShield Limited. The system can monitor one or more strings of monoblocks. Each monoblock is monitored via an m-Senzor connected across the monoblock terminals. The Sentinel interrogates each m-Senzor and processes the data, logging information into memory at predefined intervals. Where there are strings of different voltage monoblocks, a single Sentinel can monitor the whole battery system.

The Sentinel system incorporates hardware consisting of the Sentinel monitor and m-Senzors, and the following software:

- Configuration software for system configuration (refer to document 6300-002 PowerShield Configuration Manual)
- Link software for automated multi-site battery management (refer to document 6300-017 Link Manual)

Parameters measured include

- voltage of each monoblock
- ohmic value of each monoblock
- string current
- ambient temperature

Each system consists of at least one Sentinel monitor, an m-Senzor for each pair of monoblocks being monitored, temperature probe and current transducer. An RS232 serial communication port has been provided to be used with Configuration and Link software. For larger systems, multiple Sentinel monitors can be 'daisy-chained'. See the topic System Capacity. Optional communications hardware is available.

Important

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

The SENTINEL system operates in a potentially hazardous environment making it imperative that all installation personnel have adequate training and experience. The PowerShield m-Senzors must be installed in a Service Access area.

UL Safety Rack Mount Instructions

A) Elevated Operating Ambient - If installed in a closed or multi-unit rack assembly, the operating ambient temperature of the rack environment may be greater than room ambient. Therefore, consideration should be given to installing the equipment in an environment compatible with the maximum temperature specified in *Appendix 9 - Specifications*.

B) Reduced Air Flow - Installation of the equipment in a rack should be such that the amount of air flow required for safe operation of the equipment is not compromised.

C) Mechanical Loading - Mounting of the equipment in the rack should be such that a hazardous condition is not achieved due to uneven mechanical loading.

D) Circuit Overloading - Consideration should be given to the connection of the equipment to the supply circuit and the effect that overloading of the circuits might have on over-current protection and supply wiring. Appropriate consideration of equipment nameplate ratings should be used when addressing this concern.

E) Reliable Earthing - Reliable earthing of rack-mounted equipment should be maintained. Particular attention should be given to supply connections other than direct connections to the branch circuit (e.g. use of power strips).

4.1 Installation - Preliminaries

4.1.1 Sentinel Monitor

Width:	430mm / 17 inches (19” rack compatible)
Depth:	270mm / 10.6 inches
Height:	45mm / 1.8 inches (1U)

4.1.2 Power Supply

The Sentinel is available in the following power supply models:

48V DC Model: Range of input voltage is 20V-65VDC, max 0.4A per Sentinel.

72V DC Model: Range of input voltage is 55V-140VDC, max 0.40A per Sentinel.

Input connector is a 3 way plug and screw terminal block.
The power supply must be fused.
Must be installed in a service access area.

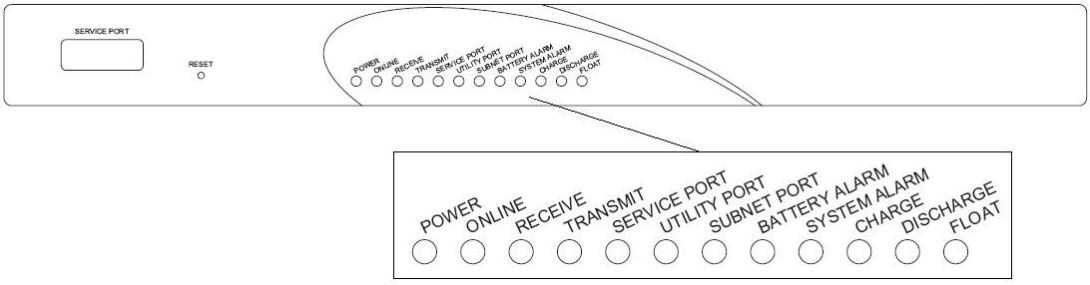
AC Model: Range of input voltage is 110V-240V AC (50/60Hz), max 0.15A per Sentinel.
Input connector is a male IEC input. IEC mains cable is supplied.

Note that the DC units cannot be powered with AC voltage and that the AC units cannot be powered with DC voltage.
Ensure that the correct power supply for Sentinel units is being used prior to applying power.

- 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.
- 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.

4.1.3 Faceplate

The faceplate, label and LED arrangement of the Sentinel is shown below. Refer to Appendix 1 for a full description of LED behaviour.



4.1.4 System Capacity

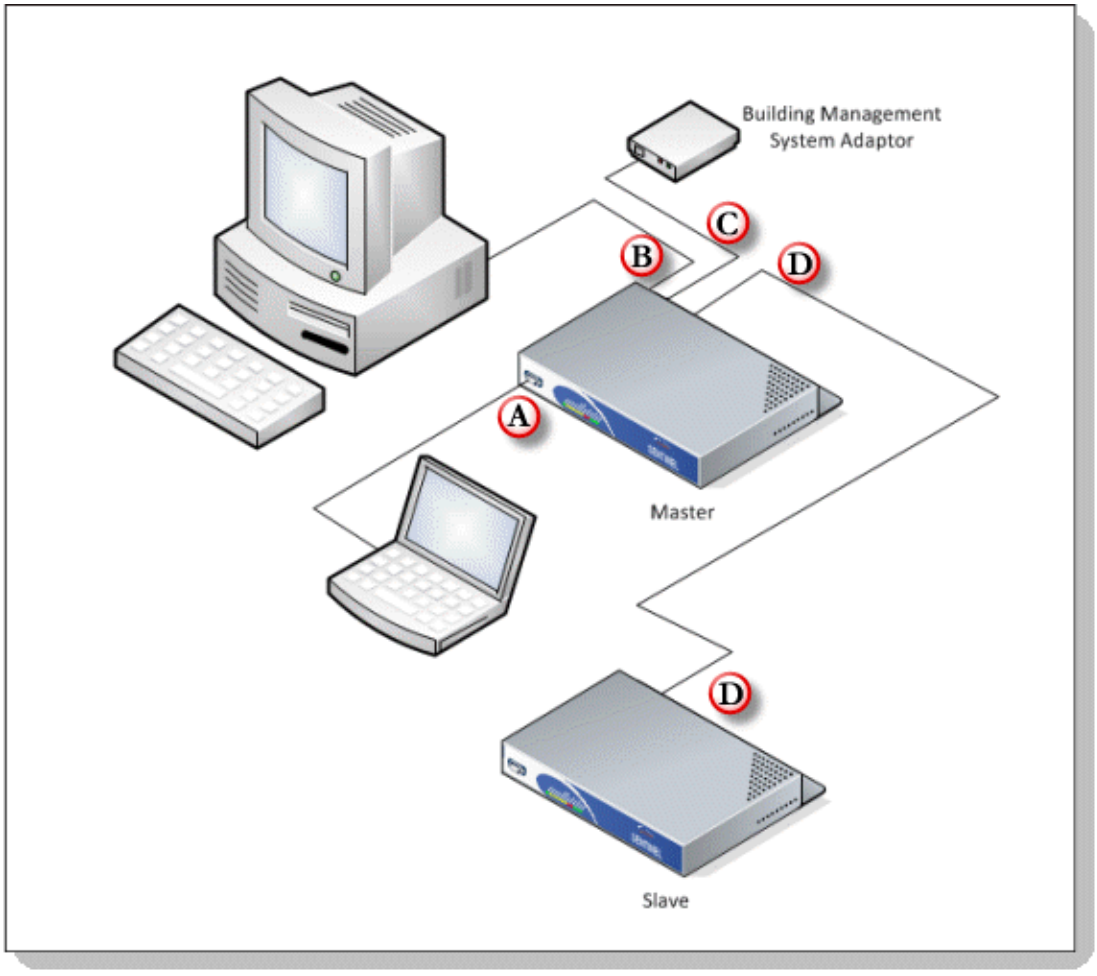
Every system must have a Sentinel master unit, and additional Sentinel units may be added as slaves to increase capacity of the overall system. The Sentinel master unit has 8 Bbus ports, with each port supporting up to 10 m-senzors (20 monoblocks). Therefore, if there are more than 160 monoblocks in a system, additional Sentinel units are required. Similarly, if there are more than 5 battery strings in a system, additional Sentinel units are required. A maximum of 16 units, including the master, can be connected.

The position of the rotary switch at the rear of the Sentinel determines the identification number of the unit. The Master must be set to **0**, Slaves may be **1-9** or **A-F**, ensuring that each figure is used only once in the system. Each unit is identified by the switch setting.

Refer to Appendix 2 for a diagram of the Sentinel rear panel.

4.1.5 Sentinel Communications

All external communications must operate through the Master unit, a Slave will not communicate.



Item	Connection	Type	Used for...
A	Service Port	RS232	Temporary local connections.
B	Port 1 (Optional)	Ethernet	Permanent local or remote monitoring connections.

Item	Connection	Type	Used for...
C	Port 2 (Optional)	RS485 or RS232	Permanent connection to third party systems.
D	Port 3		Sentinel system communications. Master to Slave and Slave to Slave.

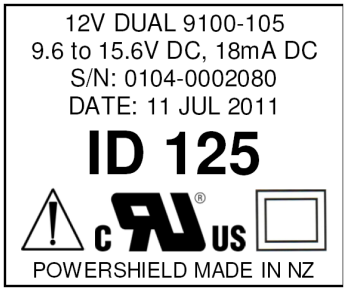
4.1.6 m-Senzor

Each m-Senzor is specific to the monoblock voltage to which it will be fitted, e.g. 2V / 6V / 12V.

The m-Senzor is a dual device and is connected across a pair of monoblocks. The pair of monoblocks must be located one after the other in a series, within the same battery string. The most positive monoblock of the pair is V1, the most negative monoblock of the pair is V2. The m-Senzor measures each monoblock individually.

Each m-Senzor has a factory set ID number between 1 and 125. Any m-Senzor can be fitted to any 'in series' pair of monoblocks, regardless of ID number; however, each m-Senzor in a single BBus must have a unique ID.

For installations containing strings with uneven numbers of monoblocks, or where layout makes pairs impossible, a one monoblock ‘single’ version of the m-Senzor is available. This is identical to and treated in the same manner as the dual version, but connected across a single block. The label on the m-Senzor will show whether it is single or dual. See sample Dual label below.



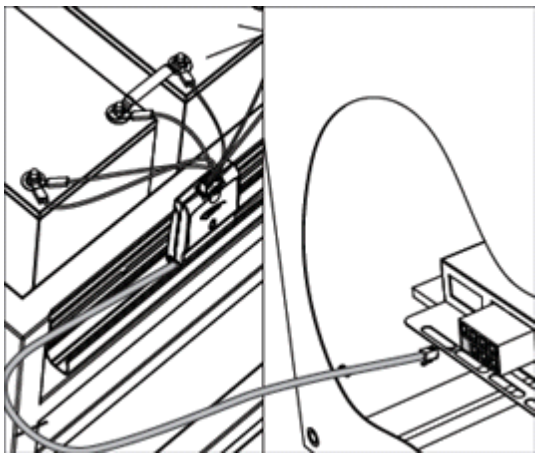
Refer to Appendix 1 for m-Senzor LED behaviour.

4.1.7 BBus

M-Senzors communicate with the Sentinel via the BBus. This connects m-Senzor to m-Senzor and m-Senzor to Sentinel in a chain. 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 m-Senzors 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 m-Senzors on one BBus and 5 on another for example.

A single BBus must not be greater than 150m in length. This is the total length of the BBus to the furthest module, including the short connecting cables between each m-Senzor.



4.2 Installation

Complete the forms as the hardware is being installed. Correct configuration of the system relies on accurate installation records.

Copies of the installation forms can be found in Appendix 6.

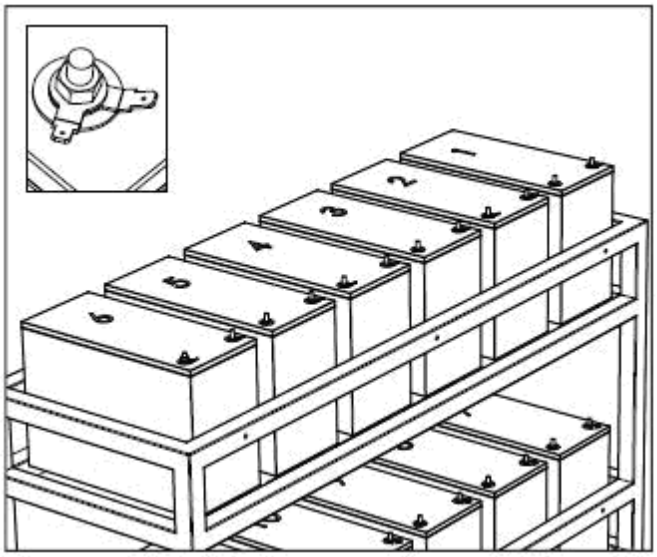
4.2.1 Step 1 - Monoblocks/Jars

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 sequence 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 that all terminals have 6.3mm tabs available for m-Senzor connection as following:

- Where a dual m-Senzor is to be used – fit two tabs on the negative (-) terminal of the most negative monoblock and two tabs on the positive (+) terminal of the most positive monoblock. Fit one tab on each of the remaining terminals.
- Where a single m-Senzor is to be used – two tabs are required on each monoblock terminal.

For simplicity, it may be easier and more efficient to fit two tabs to every terminal.



- Number all monoblocks individually 1-1280 (e.g. 1-32, 33-63, 65-96 NOT 1-32, 1-32, 1-32).
- Fit terminal tags, 2 tags per post.

IMPORTANT: Place the tags on top of the interlinks, otherwise the current flow between the interlink and the battery is reduced and could result in a 'hot spot'.

4.2.2 Step 2 - Sentinel

4.2.2.1 Set the Sentinel ID

Ensure that the rear connector panel and the cable tray can be safely accessed. If there is more than one Sentinel in the system (Master – Slave), ensure that each unit's ID switch is correctly set, and that the Master is the unit with any additional communications at Port 1 or Port 2.

4.2.2.2 Mount and Power Up the Sentinel

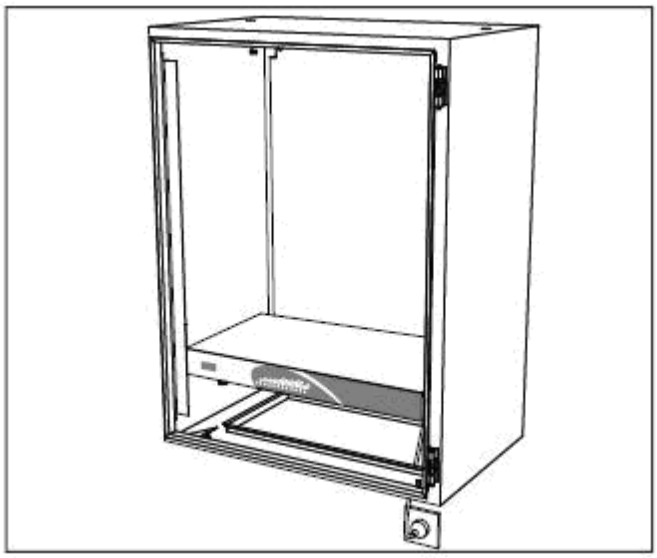
The Sentinel unit is supplied in a 1U 84HP 19" standard case. Mount the Sentinel securely to a 19" rack (not supplied), a wall, a shelf, or similar using the mounting brackets provided.

Note: Ensure the Sentinel unit is unable to move when installed - cables and connections must not 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 unit's ID switch is correctly set, and that the Master is the unit with any additional communications at Port 1 or Port 2.

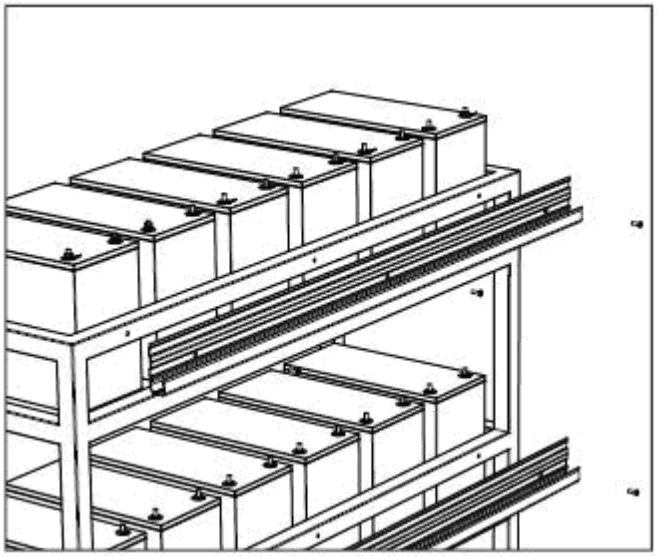
When the Sentinel is powered up, it will emit an audible alert, and the green Power LED will light. Other LEDs on the front panel may also light.

Install the Sentinel securely. Power up and confirm operation.



4.2.3 Step 3 – Mounting Rail for m-Senzors

The m-Senzor mounting rail can be fitted in any orientation and can be used with both battery racks and cabinets. Drill to suit and fasten with screws or cable ties.

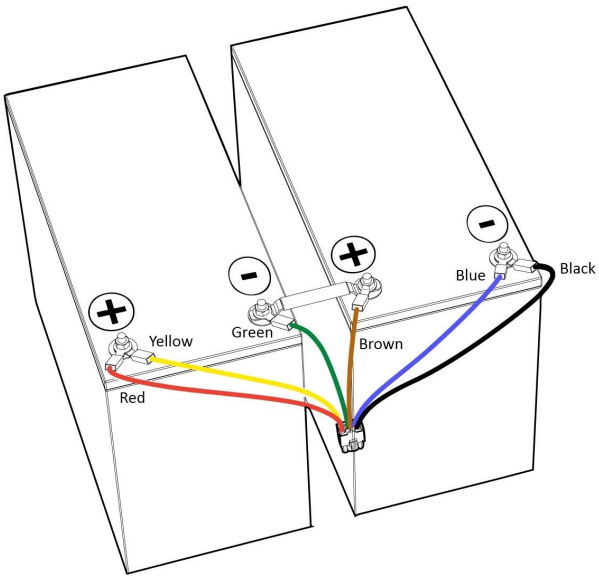


Secure the mounting rail to suit battery layout.

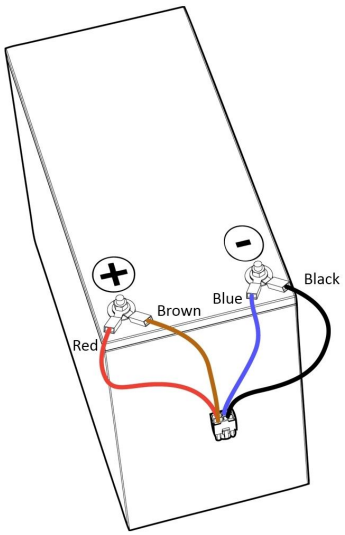
4.2.4 Step 4 – m-Senzor Power Leads

Fit the m-Senzor power leads to the battery terminals.

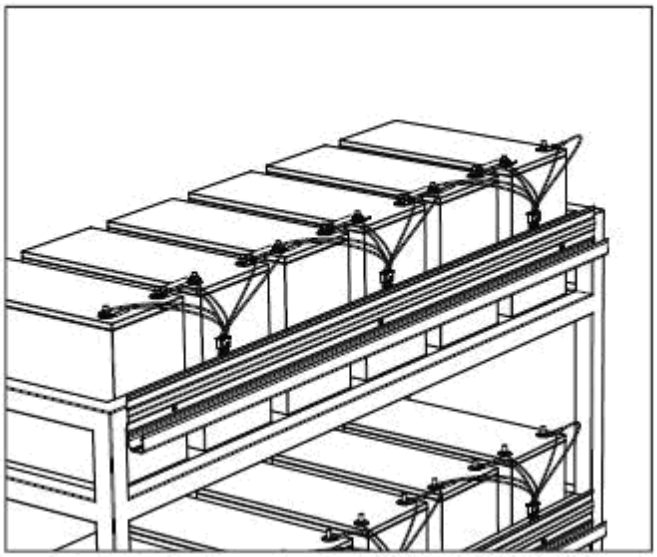
Ensure the dual power leads are connected across an ‘in series’ pair of batteries.



Dual power lead connection



Single power lead connection



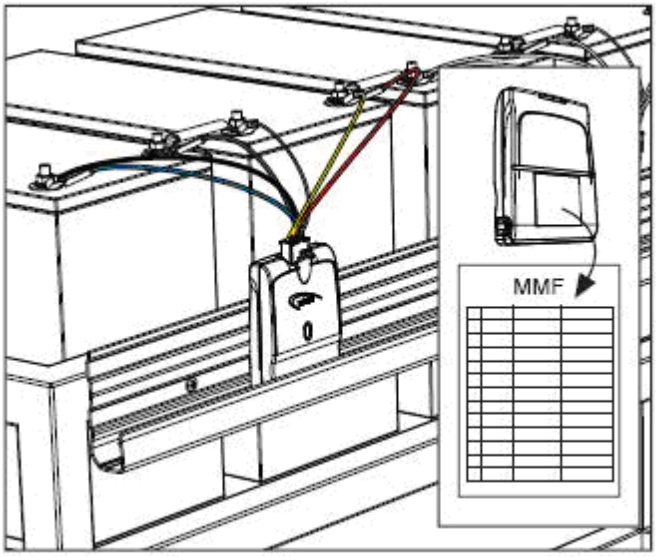
- Fit all m-Senzor power leads to terminal tags, confirming polarity

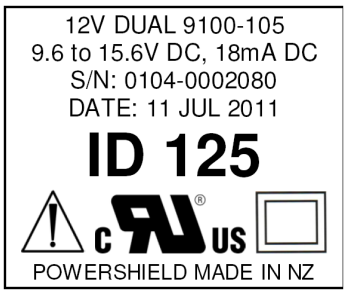
4.2.5 Step 5 – Connect m-Senzors

Connect the m-Senzors to the power leads and snap into mounting rail. Ensure the ID and monoblock number are recorded on the Monoblock Mapping Form (MMF). Without this information the system cannot be properly configured. The ID range is 1-125, however the m-Senzors can be installed in any arrangement. The only requirement is that when connected to the Sentinel each m-Senzor on a BBus port has a different ID.

The LED should light solid green when the m-Senzor is powered correctly. If the LED lights red, check the connections of the power lead.

A full list of m-Senzor LED states is available at Appendix 1



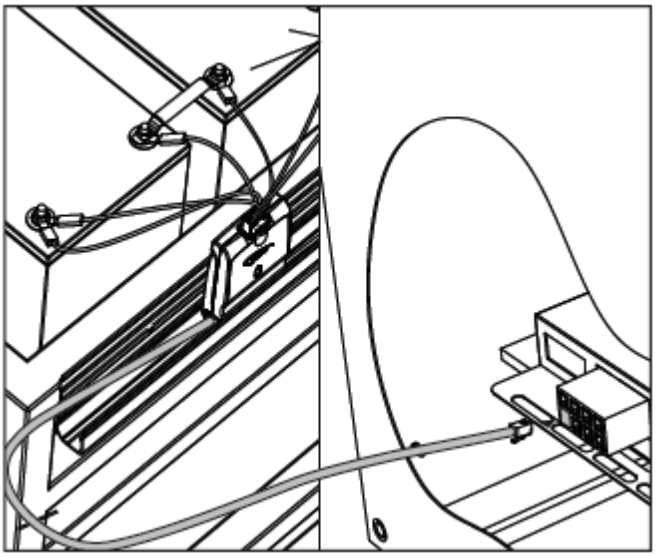


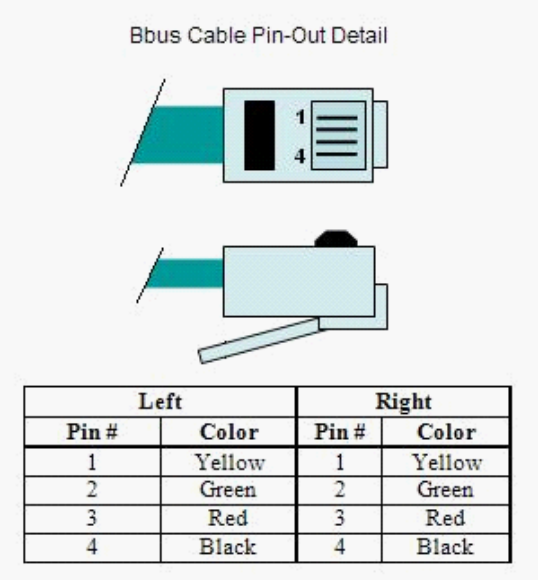
- Fit modules and connect power leads
- The LED should turn green
- Record m-Senzor ID and monoblock number on MMF form

4.2.6 Step 6 – Connect the BBus

The BBus is the communications link between m-Senzors and Sentinel. The BBus is single ended [not a loop] and connects up to ten m-Senzors to a single Sentinel BBus port. The m-Senzors can be connected in any arrangement, so long as each m-Senzor on a BBus has a different ID number.

Use the short BBus interconnect cables from m-Senzor to m-Senzor, and the longer BBus port cables from m-Senzor to Sentinel.

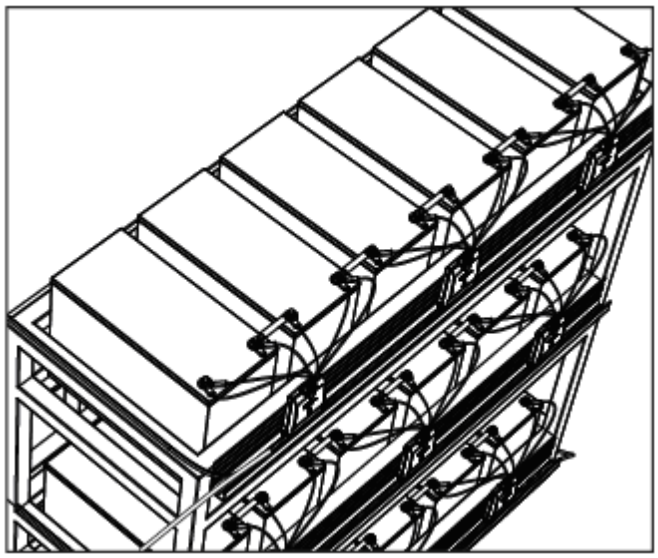




Left		Right	
Pin #	Color	Pin #	Color
1	Yellow	1	Yellow
2	Green	2	Green
3	Red	3	Red
4	Black	4	Black

Connect BBus port cable from one end of the m-Senzors to the Monitor.

Once the BBus is connected to a powered Sentinel, the m-Senzor LEDs should flash green and red in unison.

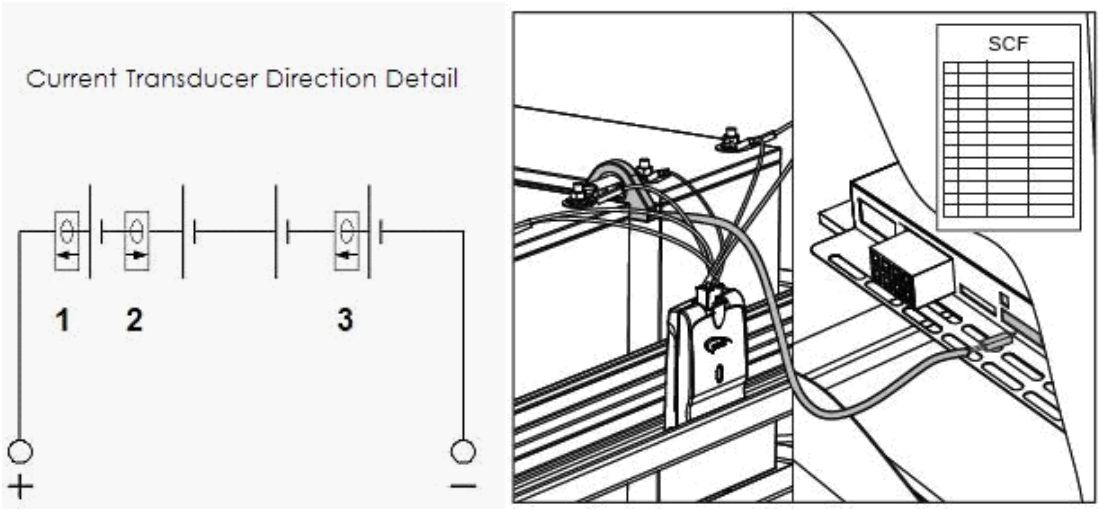


Note a maximum of 10 m-Senzors per BBus and each on that port must have a unique ID.

4.2.7 Step 7 – Connecting the Current Transducer

A current transducer is required per battery string to measure the battery current. Up to 5 transducers can be connected to a Sentinel.

The transducer can be fitted anywhere on the primary battery conductor, but polarity is important. For URD and LEM transducers, if the transducer is installed 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. For example, in the diagram below, transducers 1 & 3 are considered positive while transducer 2 is considered negative.

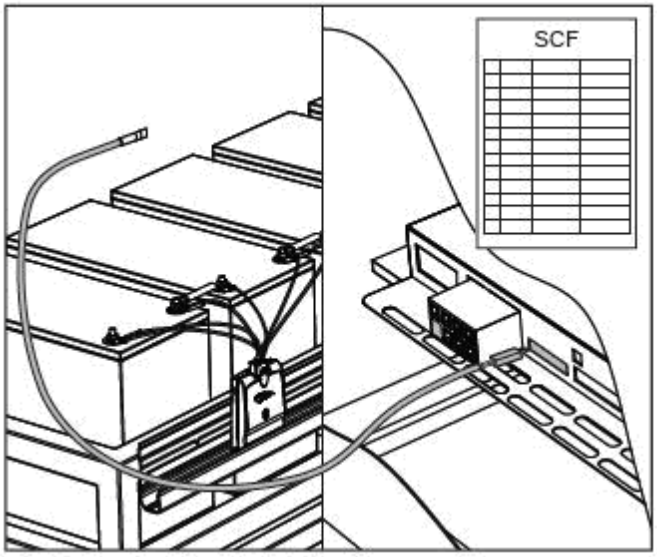


- Install current transducer and connect with cable to Monitor
- Record details on SCF form

4.2.8 Step 8 – Connecting the Temperature Probe

A temperature probe is required per battery string to measure the ambient temperature. Up to 5 transducers can be connected to a Sentinel.

Locate the probe in the middle of the battery rack or cabinet, but be aware of other items that may be affecting the local environment – HVAC, plant etc.



- Install temperature probe and connect to Monitor
- Record details on SCF form

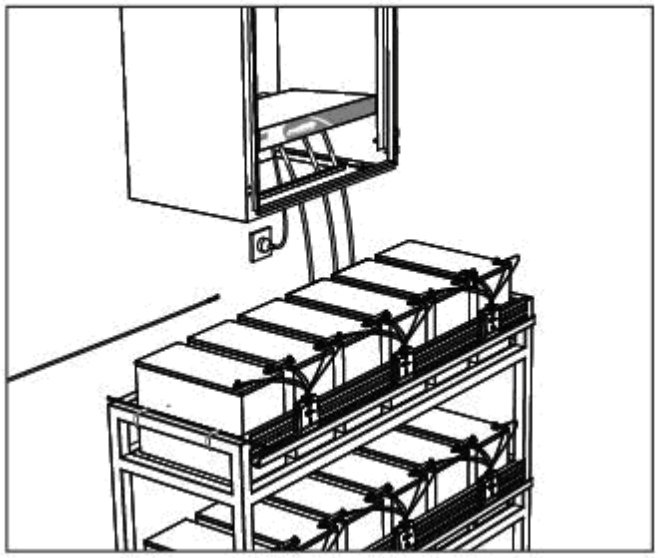
4.2.9 Step 9 – Communications

Connect appropriate communications cabling and devices. The Sentinel supports a range of external communications.

See Appendix 3 for more information on specific options and wiring.

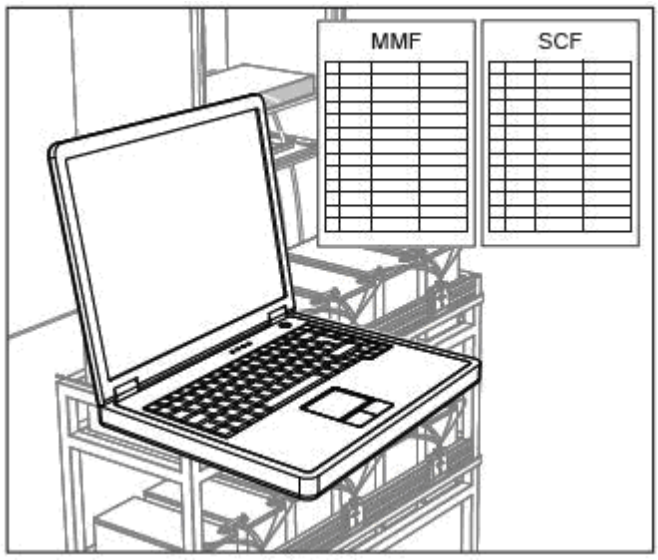
4.2.10 Step 10 – Confirmation

Check that all installed parts are performing as expected and that the installation forms are complete.
Secure all cables with appropriate strain relief.



- Confirm all module LEDs are flashing
- Secure all cables tidily

Your SENTINEL system is now ready for configuration.
You will require Config software and the associated manual, *6300-002 PowerShield Configuration Manual*.



- Proceed with system configuration using Config software
- Ensure completed MMF and SCF forms are available

5 Appendix 1 - LED Behaviour

5.1 Sentinel

Each Sentinel has twelve LEDs on the front panel for onsite information. They will exhibit varying behavior as described below:

LED	Name	Colour	Description
LED 1	Power	Green	Active when unit powered.
LED 2	Online	Orange	Active when the host is communicating via the Ethernet on Port 1.
LED 3	Receive	Orange	Active when data is on receive line of Port 1 or the Service Port.
LED 4	Transmit	Orange	Active when data is on transmit line of Port 1 or the Service Port.
LED 5	Service Port	Orange	Active when host is connected via the Service Port.
LED 6	Utility Port	Orange	Active when host is connected on Port 2.
LED 7	Subnet Port	Orange	Indicates activity on the Port 3 Subnet network between Master and Slave units. Flash when data is transmitted or received. Note: Does not indicate that a Slave is online.
LED 8	Battery Alarm	Red	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	Red	Active when there is a system alarm.
LED 10	Charge	Green	• When all strings within a system are in the same state, the LED is active. • When one or more strings are in one string state, but one or more other strings are in a different state, LED flashes (refer examples below).
LED 11	Discharge	Green	• When all strings within a system are in the same state, the LED is active. • When one or more strings are in one string state, but one or more other strings are in a different state, LED flashes (refer examples below).
LED 12	Float	Green	• When all strings within a system are in the same state, the LED is active. • When one or more strings are in one string state, but one or more other strings are in a different state, LED flashes (refer examples below).

String State Example 1

2 String system: String 1 is in Float and String 2 is in Discharge
=> Float and Discharge LEDs flash

String State Example 2
4 String system: All Strings are in Float
=> Float LED is active

5.2 m-Senzor

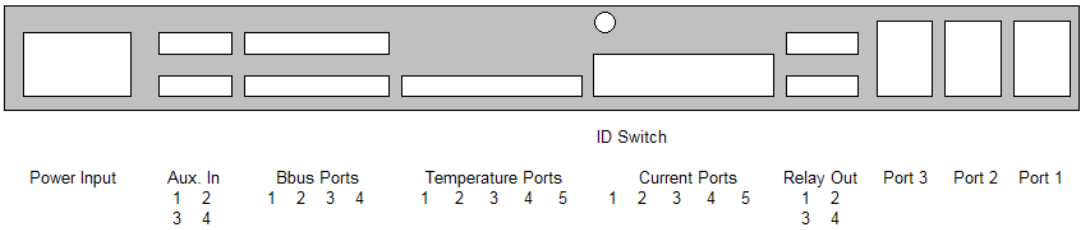
The m-Senzor has a bi-colour [red and green] LED. It will exhibit varying behavior as described below:

LED Behaviour		
Colour	**State**	**Description**
Green	Continuous	m-Senzor connected to the wiring harness and battery with no problems detected.
Green and Red	Flashing	m-Senzor is connected to battery and an active BBus but has not yet been detected.
Green	Flashing	Normal operation. m-Senzor is connected to battery and an active BBus and has been detected.
Red	Continuous	m-Senzor has detected a problem with the wiring harness or battery.

6 Appendix 2 – Sentinel Rear Panel

The Sentinel rear panel is shown below.
The power input connector will vary to match the supply.
Port 1 & 2 are optional and may not be fitted. Connectors will vary to match the fitted communications.

Sentinel Rear Panel Detail



7 Appendix 3 - Communications

7.1 Service Port

The Service Port is located at the front of the Sentinel. The Service Port is intended as a temporary connection whereas Port 1 [see below] is intended as the primary permanent communication port, with the communication cable to remain connected. Communication via the Service Port will override communications at Port 1.

Connection to the Service Port is RS232 serial communication via a DB9 Male connector. Connect using a full null modem cable with handshaking.

The diagram below shows the pin-out details of the Service Port connector.

Pin	Function
1	Not connected
2	Data In
3	Data Out
4	DTR
5	Ground
6	DSR
7	RTS
8	CTS
Body	Chassis Earth

Data In means data from external device in to the Sentinel.

Data Out is data from the Sentinel out to the external device.

RTS and CTS are handshaking control lines and are only required if RTS/CTS handshaking is enabled.

7.2 Port 1

Port 1 is intended as the primary permanent communication port, with the communication cable to remain connected. Communication via the Service Port will override communications at Port 1. Port 1 can support Ethernet communications but 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 its Port 1.

The Port1 Ethernet connector is RJ45 with the pin-out as shown below. Connection is made using standard Cat5/Cat6 Ethernet cable. Note that if you are connecting direct from Sentinel to PC/laptop, you must use a crossover Ethernet cable. If you are connecting from Sentinel to PC/laptop via a network switch or hub, you do not need a crossover Ethernet cable.

Pin	Function
1	TX+
2	TX-

3	RX+
4	RX-
5	nc
6	nc
7	nc
8	nc

The Ethernet option has two LEDs that show the following states:

Link LED (left side)		**Activity LED (right side)**	
Colour	**State**	**Colour**	**State**
Off	No link	Off	No activity
Amber	10Mbps	Amber	Half duplex
Green	100Mbps	Green	Full duplex

7.3 Port 2

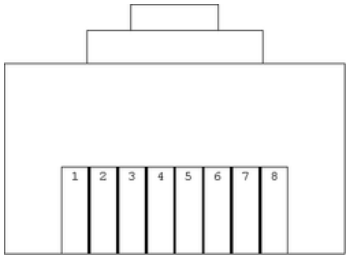
Port 2 is intended as a secondary communication port to allow integration with third party systems. It is located on the rear of the Sentinel, adjacent to Port 1. It can support two different communication options – RS485 or RS232. These are factory fitted options and must be specified at time of purchase. 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 its Port 2.

Port 2 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.*

RS 485 – Connector is RJ45 with pin-outs as per the diagram below. This diagram also shows a modular connector facing towards viewer with latch upwards.

Pin	**Function**
1	Not connected
2	Not connected
3	Not connected
4	Not connected
5	Not connected
6	Data + (D1)



7	Data - (D0)
8	Not connected

RS232 – Connector is DB9 Female. Pin-outs are as per diagram below.

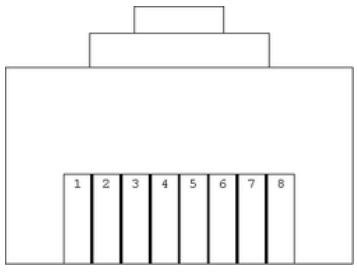
Pin	Function
1	Not connected
2	Data In
3	Data Out
4	Not connected
5	Ground
6	RTS
7	CTS
8	Not connected
Con. Body	Chassis Earth

Data In means data from external device in to the Sentinel.
Data Out is data from the Sentinel out to the external device.
RTS and CTS are handshaking control lines and are only required if RTS/CTS handshaking is enabled.

7.4 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” fashion. The interconnection cable should use CAT5 specification cable with conductors 6 & 7 twisted. The connector pin-out is shown below.

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

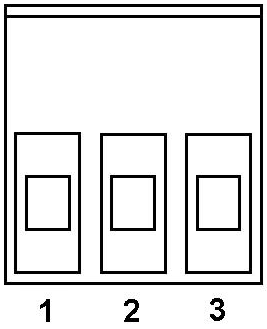


8 Appendix 4 - Relay Outputs and Auxillary Inputs

8.1 Alarm 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/Building Management System if an alarm goes off. 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.

Each relay output can be accessed by connecting to a three way terminal block on the rear panel. The connections on the terminal blocks are shown below (viewed as plug connected). Also shown is a representation of the relay contacts.



Pin	Name	Function
1	normally closed contact	The Common Contact is connected to this pin when the relay is not activated. Connect external circuit to this pin and the Common Contact if you want the circuit to be on when the relay is not activated.
2	normally open contact	The Common Contact is connected to this pin when the relay is activated. Connect external circuit to this pin and the Common Contact if you want the circuit to be on when the relay is activated.
3	common contact	Connects to Normally Open or Normally Closed contact depending on relay state.

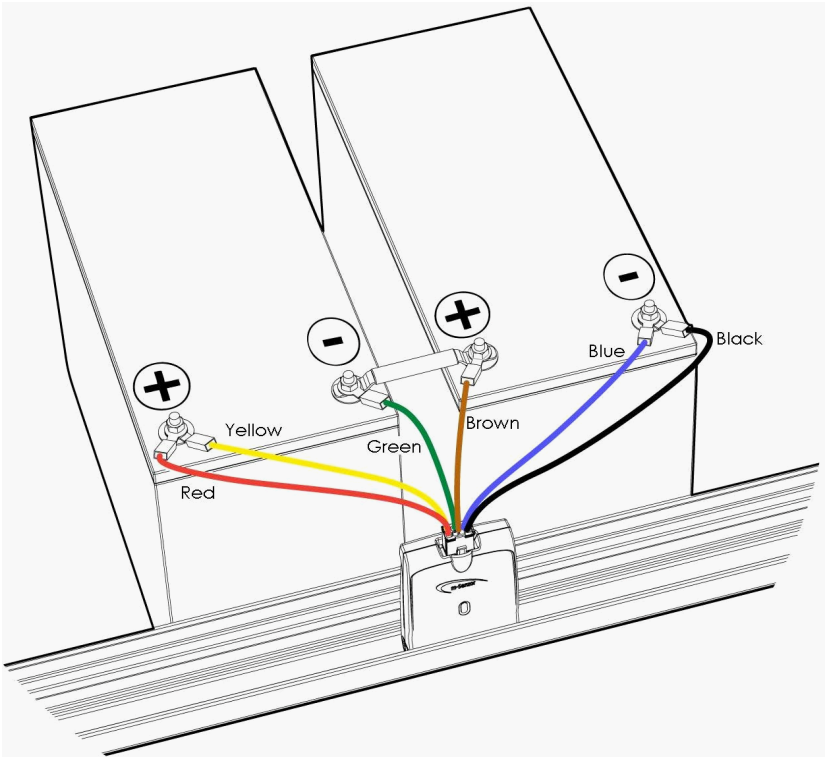
8.2 Auxillary Inputs

Four auxiliary inputs are provided 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. Refer to the following table:

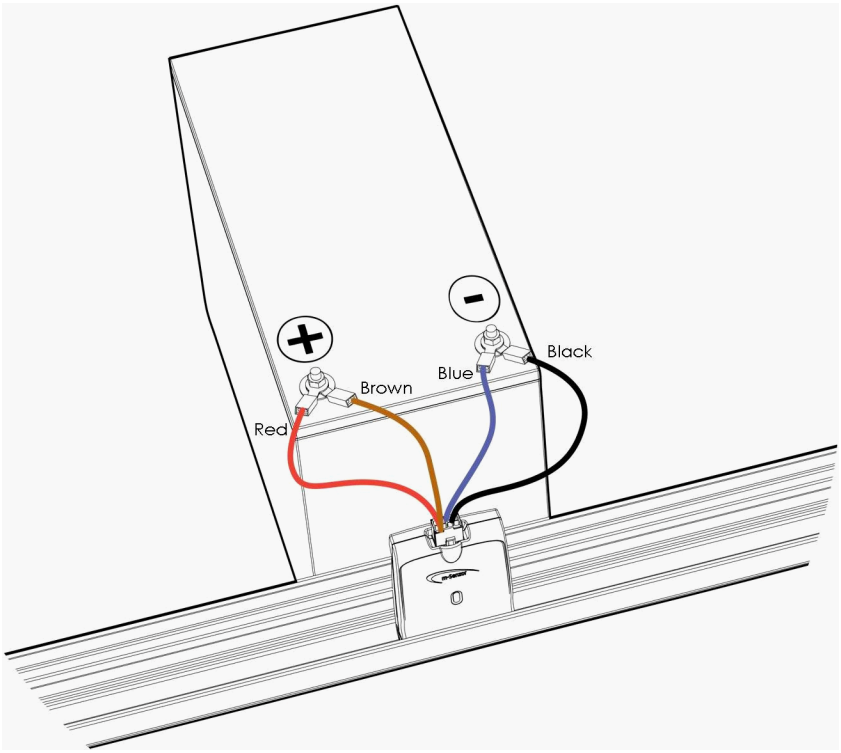
To activate an auxiliary input simply short the terminals of the two way connector.

9 Appendix 5 - m-Senzor Connections

9.1 Dual m-Senzor Power Lead Connection Detail



9.2 Single m-Senzor Power Lead Connection Detail



10 Appendix 6 - Installation Forms

10.1 Site Identification Form (SIF)

Company:	
Site Name:	
Site Address:	
Total Number of Monoblocks:	
Total Number of Strings:	
Total Number of Sentinels:	
Port 1 Communications:	
Port 2 Communications:	
Installed By:	
Installation Date:	
Total Number of Pages [incl this]:	
Notes:	

10.2 String Configuration Form (SCF)

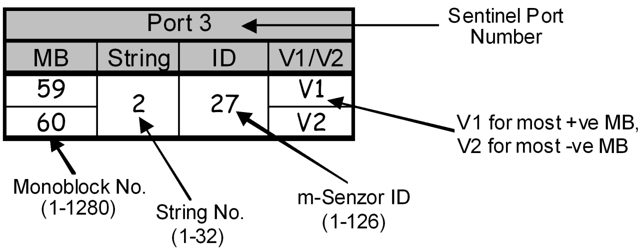
	Monoblocks Refer *Installation Step 1* for monoblock numbering				Current Transducers Refer *Installation Step 7* for Current Transducer installation				Temperature Probes Refer *Installation Step 8* for Temperature Probe installation		
String Number	Number of first monoblock in string	Number of last monoblock in string	Monoblock voltage	Monoblock Ah	Sentinel Number	Port Number	Direction (+ / -)	Sensor Type	Sentinel Number	Port Number	Sensor Location
Example	25	48	*2V*	*100*	0	2	–	*LEM HAT 200-S*	0	1	*Middle rack*
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											

10.3 Monoblock Mapping Form (MMF)

Site Name:	
Sentinel Number:	

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

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



11 Appendix 7 - Monitor & m-Senzor Replacement

11.1 Replace a Monitor

Follow these steps if replacement or movement of a monitor is required.

Step	Action
1.	If the monitor is configured, back up the configuration to a PC. Refer to 6300-002 PowerShield Configuration Manual for further details.
2.	Turn off the power to the monitor and remove the power cord.
3.	Ensure ALL incoming cables are well marked and identified by the relevant input number. Remove the cables.
4.	Where there are multiple monitors networked together in a Master-Slave arrangement, mark each monitor.
5.	Remove any fixings from the monitor and remove the unit.
6.	Fit the replacement monitor and ensure it is secure.
7.	Fit all the cables, ensuring they are correct located.
8.	Fit the power cord and turn on the power. Ensure the monitor starts up correctly.
9.	If a configuration has been backed up from an earlier monitor, restore this to the new unit(s). Refer to 6300-002 PowerShield Configuration Manual for further details.

11.2 Replace an m-Senzor

Follow these steps if you are required to replace an m-Senzor or move it for battery work.

Step	Action
1.	Follow the local authority health and safety procedure for opening the battery string breaker/fuse.
2.	Ensure all cables are well marked and identified prior to any work beginning.
3.	Unplug the power lead via the white 8-way connector at the m-Senzor.
4.	Disconnect any BBus cables from either side of the m-Senzor.
5.	Roll the m-Senzor forward to disengage it from the mounting rail.
6.	Fit the replacement m-Senzor, ensuring the ID numbers are appropriate. See the topic **Connect m-Senzors** for more information.

Step	Action
7.	Fit the BBus cables and connect the power lead via the white 8-way connector at the m-Senzor.
8.	The green LED should illuminate within 4 seconds. If it does not, DO NOT proceed to Step 9. Check the connections to the battery.
9.	Follow the local authority health and safety procedure for closing the battery string breaker/fuse.

12 Appendix 8 - Models and Part Numbers

12.1 Sentinels

The tables below list the available Sentinel models and part numbers with the associated Port1 or Port2 communication options:

Part No.	Base Model	Port 1	Port 2
9100-027	Sentinel 48VDC Monitor	-	-
9100-028	Sentinel 48VDC Monitor	-	RS485
9100-029	Sentinel 48VDC Monitor	-	RS232
9100-030	Sentinel 48VDC Monitor	Ethernet	-
9100-031	Sentinel 48VDC Monitor	Ethernet	RS485
9100-032	Sentinel 48VDC Monitor	Ethernet	RS232

Part No.	Base Model	Port 1	Port 2
9100-108	Sentinel 72VDC Monitor	-	-
9100-109	Sentinel 72VDC Monitor	-	RS485
9100-110	Sentinel 72VDC Monitor	-	RS232
9100-111	Sentinel 72VDC Monitor	Ethernet	-
9100-112	Sentinel 72VDC Monitor	Ethernet	RS485
9100-113	Sentinel 72VDC Monitor	Ethernet	RS232

Part No.	Base Model	Port 1	Port 2
9100-039	Sentinel AC Monitor	-	-
9100-040	Sentinel AC Monitor	-	RS485
9100-041	Sentinel AC Monitor	-	RS232
9100-042	Sentinel AC Monitor	Ethernet	-
9100-043	Sentinel AC Monitor	Ethernet	RS485
9100-044	Sentinel AC Monitor	Ethernet	RS232

12.2 m-Senzors

The tables below list the available m-Senzor models and part numbers.

Generation 2 Range	
Part Number	**Model**
9100-081	2V Dual m-Senzor
9100-082	4V Dual m-Senzor
9100-089	6V Single m-Senzor
9100-090	6V Dual m-Senzor
9100-087	8V Single m-Senzor
9100-088	8V Dual m-Senzor
9100-085	12V Single m-Senzor
9100-086	12V Dual m-Senzor

Generation 3 Range	
Part Number	**Model**
9100-094	NiCad Single m-Senzor
9100-095	NiCad Dual m-Senzor
9100-096	2V Single m-Senzor
9100-097	2V Dual m-Senzor
9100-098	4V Single m-Senzor
9100-099	4V Dual m-Senzor
9100-100	6V Single m-Senzor
9100-101	6V Dual m-Senzor
9100-102	8V Single m-Senzor
9100-103	8V Dual m-Senzor
9100-104	12V Single m-Senzor
9100-105	12V Dual m-Senzor
9100-106	16V Single m-Senzor
9100-107	16V Dual m-Senzor

12.3 m-Senzor Leads

The table below lists the available m-Senzor leads and part numbers.

Module Power Leads	
Part Number	**Description**
8102-000	300mm m-Senzor Single Module Power Lead
8102-001	400mm m-Senzor Single Module Power Lead
8102-002	500mm m-Senzor Single Module Power Lead
8102-003	700mm m-Senzor Single Module Power Lead
8102-004	1000mm m-Senzor Single Module Power Lead
8102-010	300mm m-Senzor Dual Module Power Lead
8102-011	400mm m-Senzor Dual Module Power Lead
8102-012	500mm m-Senzor Dual Module Power Lead
8102-013	700mm m-Senzor Dual Module Power Lead
8102-014	1000mm m-Senzor Dual Module Power Lead

BBus Cables	
Part Number	**Description**
8101-041	5m Sentinel to m-Senzor BBus cable
8101-042	10m Sentinel to m-Senzor BBus cable
8101-043	15m Sentinel to m-Senzor BBus cable
8102-030	100mm m-Senzor to m-Senzor BBus cable
8102-031	200mm m-Senzor to m-Senzor BBus cable
8102-032	400mm m-Senzor to m-Senzor BBus cable
8102-033	700mm m-Senzor to m-Senzor BBus cable
8102-034	1000mm m-Senzor to m-Senzor BBus cable

13 Appendix 9 - Specifications

13.1 Sentinel

General	
Environment	Indoor use only in an Overvoltage Category II, Pollution Degree 2 environment. The monitor must be installed in a location that allows 30mm space at the top and sides of the unit for adequate air circulation. Installation must allow unrestricted airflow.
Humidity	Maximum relative humidity of 80 % for temperatures up to 31°C decreasing linearly to 50 % relative humidity at 40°C.
Maximum altitude	2000 metres
Power supply	• AC model: 110V-240V AC (50/60Hz), max 0.15A • 48V DC model: 20V-65V DC. max 0.4A • 72V DC model: 55V-140V DC. max 0.4A
Physical dimensions	• Width: 430mm / 17 inches (19" rack compatible) • Depth: 270mm / 10.6 inches • Height: 45mm / 1.8 inches (1U)
Operating temperature	0°C to 50°C / 32F to 122F
Storage temperature	0°C to 70°C / 32F to 158F
Number of batteries monitored	Up to 160 per Sentinel. Scalable to 1280 using Slave units
String voltage	2V-600V

Current Sensors	
Number of sensors	Up to 5 per Sentinel Scalable to 16 using Slave units
Measuring range	50A to 1500A depending on sensor installed
System accuracy	±1% + sensor accuracy
Maximum distance	15m / 50ft (Greater distances may be used in a benign electrical environment.)

Temperature Sensors	
Number of Inputs	Up to 5 per Sentinel Scalable to 16 using Slave units
Measuring range	0°C to 50°C/32F to 122F
System accuracy	±1°C / 1.8F

Maximum distance	15m/50ft

Communications	
Service port	RS232
Port 1 (optional)	Ethernet - 10Base-T
Port 2 (optional)	• RS485 • RS232 • Modbus ASCII or Modbus RTU protocols supported

Relay Outputs	
Number of Inputs	4
Rating	1.25A @ 24VDC

Digital Inputs	
Number of Inputs	4