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ZBM-IBH Installation and Commissioning Manual

MNL-ZBM-001 Revision 1



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1 Introduction

This manual describes the steps sufficient for trained personnel to install and commission one or more ZBM-IBH Units.

1.1 References

- Redflow ZBM2 Safety Data Sheet

1.2 Definitions

The following acronyms, abbreviations, and terms are defined here within the context of this manual.

BMS	Battery Management System
IBH	Industrial Battery Housing
MMS	Module Management System
PPE	Personal Protective Equipment
ZBM	Zinc Bromine Module

1.3 Responsibilities

All personnel installing a ZBM-IBH Unit shall be responsible for compliance with the instructions in this manual.

1.4 Training

All personnel that install a ZBM-IBH Unit shall have sufficient training and knowledge of applicable regulations regarding the installation of batteries and completed Redflow's online Installer Training Program.

1.5 Equipment Required

1.5.1 PPE

As a minimum the following should always be adhered to while working with the ZBM-IBH Unit:

- Long sleeve cotton shirt (or as per local rules and regulations)
- Safety boots
- Eye protection
- No jewellery or loose metal

1.5.2 TOOLS

Item name	Quantity
Multimeter	1
24mm socket and ratchet	1
M5 Hex Driver Bit and driver	1
Wire cutters/strippers	1
2mm screwdriver	1
Crimping tool for Anderson Connector contacts	1
Heat gun	1

1.6 Parts List

Item name	Quantity
Anderson Connector	1 per IBH
Anderson Connector contacts	2 per IBH
Optional: S300M412 Connector	2 per 4 x IBH
Optional: HDPE Washers	2 per 1 x S300M412 Connector

1.7 Customer-Supplied Parts List

Item name	Quantity
Cable to power BMS with 1A inline fuse breaker	1
DC bus cable	2
Heatshrink (red and black)	2
Anti-seize	1
Optional: Cat.5e U/UTP RJ45-terminated patch cable	1
Optional: Certified M16 eyebolts and lifting straps	1

2 Battery Safety and Handling



DANGER

- DC cabling must conform to local standards and regulations for a maximum battery current of 125A.
- Ensure all connecting systems are completely de-energised before installation.
- Installation must only be performed by personnel with the appropriate qualifications as per local regulations and who have also received ZBM2 training.

As a minimum, apply the PPE listed in *1.5.1 PPE*.

2.1 Electrical Safety

While the ZBM2 is fitted inside an Industrial Battery Housing, none of the following risks should be encountered during installation or commissioning under normal circumstances but are included here for completeness.

A ZBM2 can have between 0V and 58V DC on the battery terminals during operation. The voltage across the battery terminals is 0V when it is fully discharged and it is not connected to any other power source. See Figure 11 to identify the battery terminals. While the ZBM2 should be fully discharged (terminal voltage close to 0V) during transportation or storage, care must be taken in case the terminals are live.

In addition, there are internal voltages in the ZBM2 of 141V that can reach up to approximately 160V. As a result, all safety guards and covers must always be fitted on the ZBM2 unless it has been de-energised and these guards need to be removed for maintenance purposes.

2.2 Chemical Safety

Note: This section should be read in conjunction with the battery Safety Data Sheet included in Redflow's *Redflow Installation and Operation Manual – ZBM2* current at the time of installation (available at <https://redflow.com/wp-content/uploads/2019/07/ZBM2-Installation-and-Operation-Manual-CE-V4.0.pdf>).

The ZBM2 is a sealed battery and there should be minimal risk of exposure to electrolyte when handled properly. If a leak or spill occurs, you must follow local policies and procedures.

The Redflow ZBM2 contains bromine. In the battery, bromine is:

- Easy to detect early by its chlorine-like smell; if you see liquid on the battery and smell the bromine, clean-up will be required.
- Easy to neutralize (e.g. with sodium bicarbonate or ammonia).

If there is an electrolyte spill, the following safety equipment must be worn:



The battery has the following protection features relating to electrolyte leaks:

- **Electrolyte leak (or leak sensor failure):** if liquid is detected, or if the sensor fails, the battery disconnects, and the pumps shut down.
- **Pump failure:** the battery disconnects and shuts down both pumps.

Rags are suitable for cleaning up small amounts of electrolyte.

The following are **unacceptable** materials:

- Nylon
- Neoprene
- Other plastic materials

HDPE containers can be used to contain leaked electrolyte.

2.3 Fire Safety

- The ZBM2 contains a non-flammable electrolyte.
- In the case of an external fire threat, use a CO₂ or dry-agent-based extinguisher as indicated by the following labels:



2.4 Handling



- Always operate, handle, store, and transport the ZBM-IBH in an upright position.
- Use appropriately rated lifting devices.
- Never lift or handle the ZBM via the battery stack; always use the fitted lifting straps to lift and handle the ZBM from the bottom tank.
- Do not remove the strapping that loops around the stack and tank.

The ZBM-IBH weighs approximately 340 kg.

3 Overview

The process for installing and commissioning a Redflow battery is:

1. Physical installation of the battery and the associated BMS (one BMS per site).
2. Communications setup including:
 - Connection of the BMS to the battery.
 - Connection of the BMS to an on-site router.
3. Electrical connection, including:
 - Connecting power cables to the battery via the Anderson connector of the IBH.
 - Connecting the power cables from the battery to the DC bus from an inverter or rectifier.
4. Battery Commissioning, including:
 - a. BMS configuration (time zone and network settings).
 - b. Updating the BMS firmware.
 - c. Set up the battery.
 - d. Upgrade battery firmware.
 - e. Enable the battery/ies.

The remainder of this document describes each of these steps in detail. If you encounter issues at any stage, contact Redflow for technical support.

4 Installation

4.1 Physical Handling & Safety

- Appropriate PPE must always be worn when handling the battery.
- The ZBM-IBH must always be handled, stored, and transported in an upright position.
- Transportation and lifting devices must be appropriately rated.
- The ZBM-IBH can be forklifted from either side.
- The IBH lid is secured with M16 bolts; these can be replaced with certified eyebolts (not supplied) of the same diameter to support lifting rather than forking the ZBM-IBH into place.



M16 Eye Bolts

4.2 Unloading and Unpacking

The ZBM-IBH is delivered wrapped in a cardboard sleeve. Remove the covering before installation and dispose of responsibly.

Step 1 Inspect battery for leaks

1. Remove the IBH lid using a 24mm socket or spanner.
2. Inspect for electrolyte leaks.
3. If a leak is present, do not operate the ZBM and call Redflow for further instruction.



ZBM-IBH with top cover removed

Step 2 Install ZBM-IBH in place

1. Use a suitable lifting device to place the ZBM-IBH into the prepared location.
2. If using the eye bolts to lift the ZBM-IBH, all four lifting points are to be used at the same time, and with a minimum amount of swaying.
3. No hold down fixtures are required unless noted otherwise (e.g. wind or earthquake loadings).



Forking the ZBM-IBH from the side

4.3 Clearances and Stacking

4.3.1 General

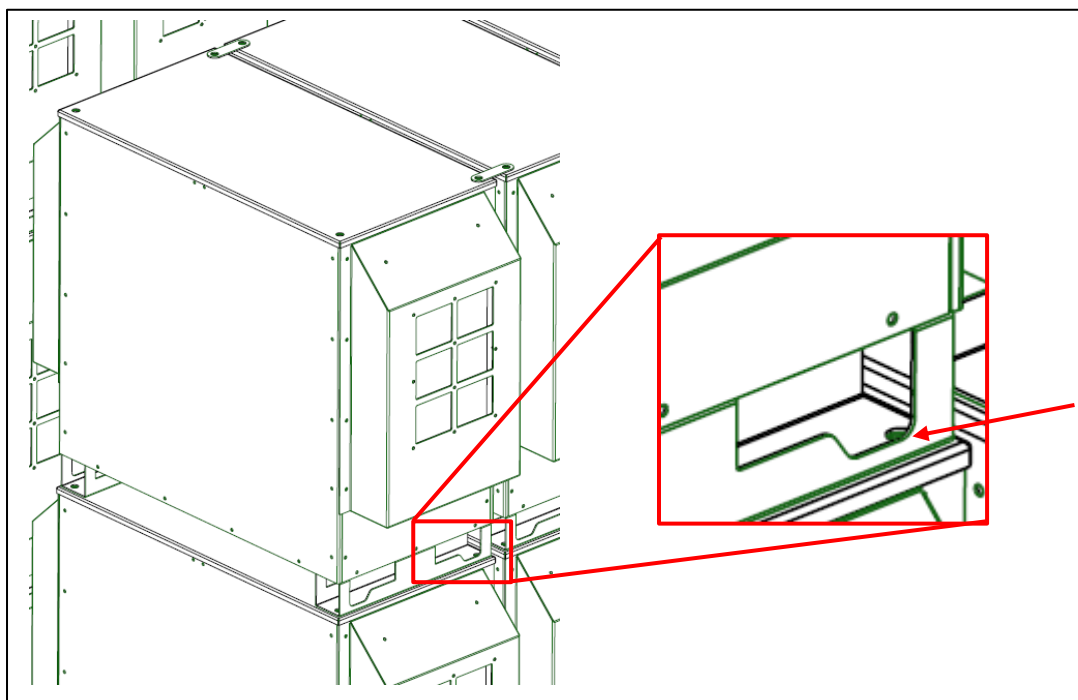
Ensure installation of each ZBM-IBH unit complies with the following:

- | | |
|-------------------|---|
| Orientation | <ul style="list-style-type: none"> • Provide sufficient clearway for air to be drawn in at the rear of the unit and expelled at the front. • Orient multiple units front-to-front or rear-to-rear to ensure heated air is not expelled into the intake of another unit. |
| Access clearances | <ul style="list-style-type: none"> • Front: 1200 mm (40 in) plus any additional clearance for a lifting device • Rear: 800 mm (32 in) • Side: 50 mm (2 in) |

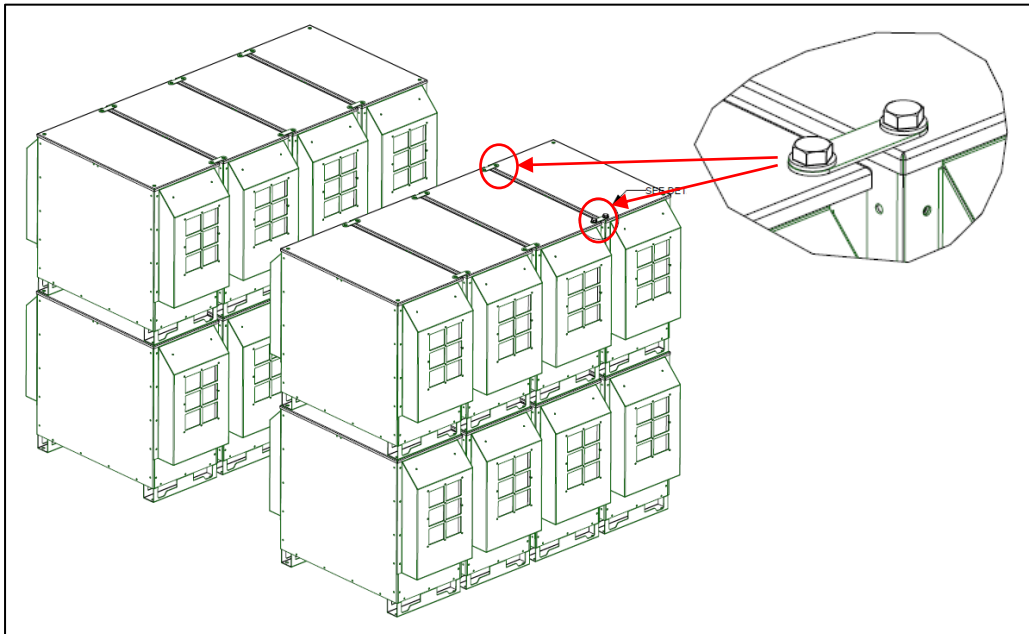
4.3.2 Stacking

Ensure the:

- Bottom unit is fixed to the flooring at all four mounting points in the feet in accordance with local regulations. Use 16 mm bolts.
- Underside of the feet of the top unit are free from contaminants to avoid scratching the lid of the lower unit.
- Top unit is fixed at all four mounting points in the feet to the receiving points in the lid of the bottom unit. For each mounting point:
 1. Remove the bolt and HDPE washer fitted in the lid of the lower unit.
 2. Apply Anti-seize (P/N S222B081) to the bolt.
 3. Fit the bolt with the HDPE washer through the foot of the upper unit into the corresponding hole in the lid of the lower unit. Use a wrench with a 24mm socket to tighten.



When multiple stacks are side-by-side, use 2 x Connector (P/N S300M412) to fix stacked units together for additional stability.



For each hole in the connector:

1. Remove the selected bolt and HDPE washer fitted in the lid.
2. Apply Anti-seize (P/N S222B081) to the bolt.
3. Fit the bolt with the HDPE washer through the connector, fit another HDPE washer onto the bolt, fit the bolt into the corresponding hole in the lid.
4. Use a wrench with a 24mm socket to tighten.

4.4 BMS Module Installation and Connection

Install the Battery Management System (BMS) module and connect to the battery and an on-site router.

4.4.1 Mount the BMS and Provide Power

Step 1 Mount the BMS and Provide Power

Mounting:

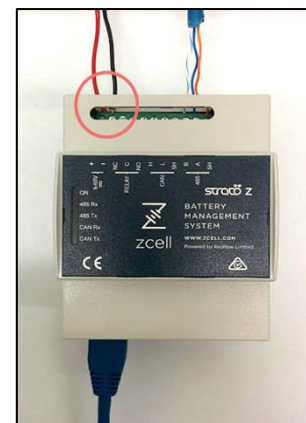
The BMS unit is DIN rail mounted, typically near the inverter/charger.

Power:

The BMS requires a DC power supply, typically from the DC bus (9-65VDC), isolated by a 1A inline fuse breaker (not supplied).

Connect:

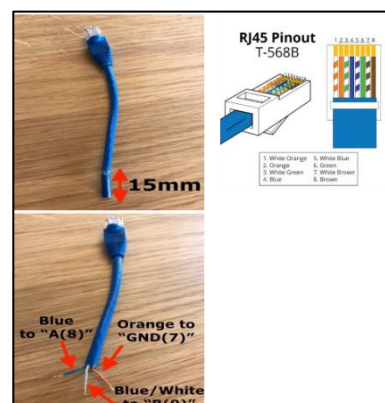
- Positive wire of power supply to position 1 (labelled "+")
- Negative wire of power supply to position 2 (labelled "-")



4.4.2 Connect the BMS Communication Cable

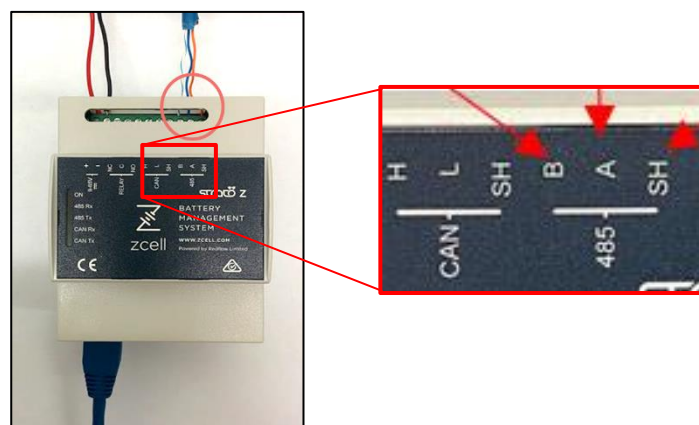
Step 1 Prepare the BMS Communication Cable

1. Use wire cutters and a wire stripper to remove the RJ45 connector from one end of the supplied CAT6 cable and remove 15mm of outer insulation.
2. For each of the BLUE, BLUE-WHITE, and BROWN-WHITE wires, remove 5 mm of insulation.



Step 2 Connect Cable to BMS

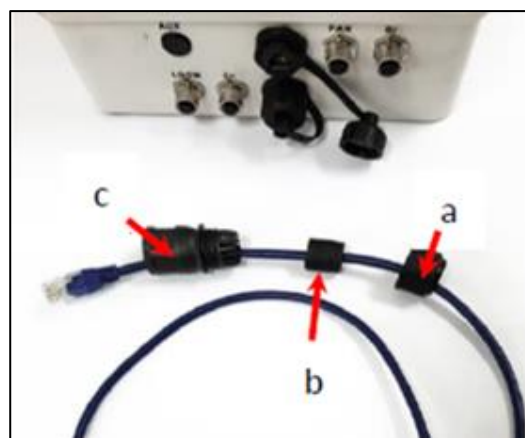
1. Connect the wires of the CAT6 cable to the BMS as follows:
 - BLUE-WHITE to position 9 (labelled "B")
 - BLUE to position 10 (labelled "A")
 - BROWN-WHITE to position 11 (labelled "SH")



CAT6 Cable Termination Locations

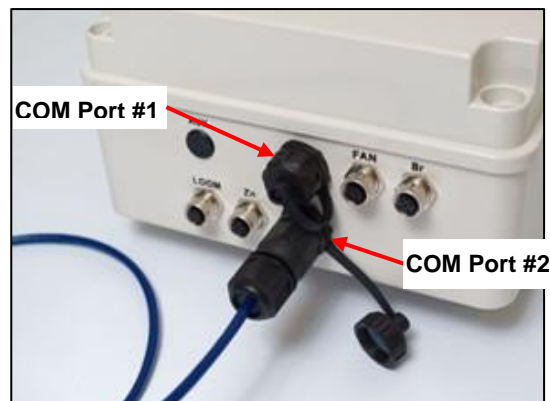
Step 3 Fit Boot to Cable

1. Thread the cable through the supplied RJ45 boot: insert the cable through the waterproof cap (a), then the rubber grommet (b), and the cable mount (c) as shown.



Step 4 Connect the Communication Cable to the Battery

1. Remove the front hood from the IBH; set aside the hood and screws.
2. Insert the RJ45 connector of the Cat6 cable into either of the communication ports on the base of the MMS, screw the boot onto the port connector, then tighten the bottom nut of the boot to hold the cable in place.



If ...	Then
A single battery is to be connected?	Cover the unused communication port with the supplied RJ45 cap.
Multiple batteries are to be connected?	<p>Note:</p> <ul style="list-style-type: none"> • If connecting more than 12 batteries, fit an RS-485 repeater. • Connect no more than 16 batteries per BMS. <p>Daisy-chain the MMS of each battery:</p> <ol style="list-style-type: none"> 1. Select the Cat6 cable from the subsequent battery. 2. Connect the cable into the unused communication port of the current battery. 3. Remove the front hood of the subsequent IBH and connect the RJ45 connector into a communication port of the subsequent battery. 4. Repeat the above steps to connect all batteries. 5. Cover the unused communication port on the last battery with the supplied RJ45 cap.

4.4.3 Connect BMS to Router

1. Run a network cable (not supplied) from the network port on the underside of the BMS to an unused LAN port on the router.



BMS Showing LAN Cable Connection

4.5 Electrical Connection

Caution: De-energise the DC bus before proceeding.

Perform the following subsections for each battery.

4.5.1 Connect a Battery to the DC Bus

Note:

- Fit an appropriately sized (maximum 125A) DC circuit breaker (not supplied) to the DC bus to receive the DC bus cables from the battery.
- DC bus cables must be appropriately sized.

Connect the battery to the DC bus:

1. Crimp the DC bus cables to the supplied contacts for an Anderson connector, fit heatshrink and heat to seal.
2. Ensure correct polarity and fit the contacts into the supplied Anderson connector.
3. Connect the Anderson-connector-fitted DC bus cables to the Anderson connector on the IBH.
4. Switch off the circuit breaker.
5. Connect the DC bus cables to the circuit breaker.

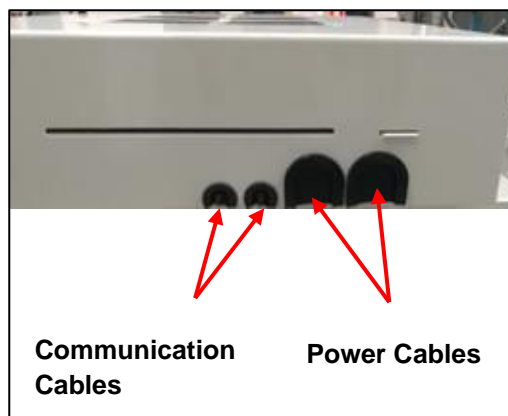


External Anderson Connector

4.5.2 Refit the IBH Hood

Caution: Use a suitable handling method when lifting the hood.

1. Select the stored Hood and screws.
2. Modify the cable seals in the base of the hood to suit (power cables, BMS communication cable).
3. Locate the hood on the IBH ensuring all cables are routed through the cable seals.
4. Fix the hood to the IBH: for each screw, apply Anti-seize (P/N S222B081), fit the screw and use a driver with an M5 Hex Bit to tighten.



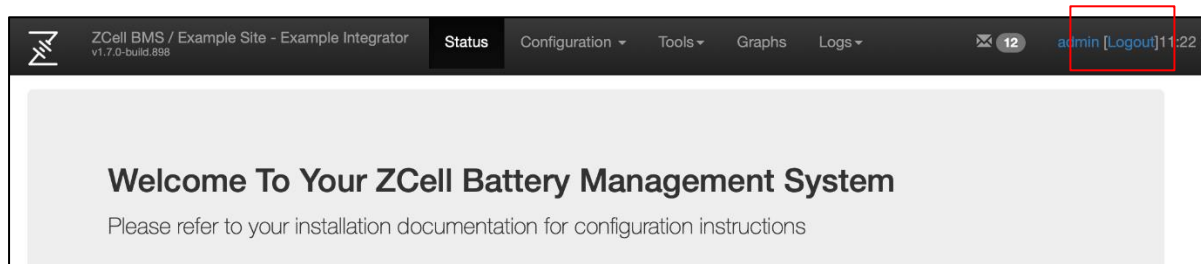
5 Commissioning and Energisation

5.1 Configure the BMS Settings

5.1.1 Connect to the BMS

A connection to the BMS can be made via a local WiFi network generated by the BMS. To do this:

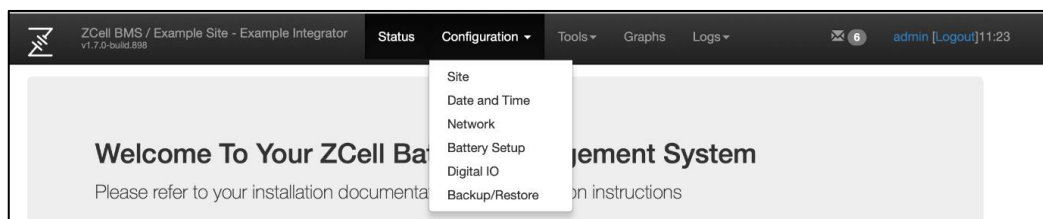
1. Go to WiFi settings on your device (laptop or mobile device).
2. Look for a WiFi network named “zcell-BMS-XXXX” (where XXXX is a four-character code).
3. Connect to this network using password *zcellzcell* (case sensitive).
4. Using a browser, navigate to IP address *172.16.29.241:3000*.
5. The *Welcome* window displays.



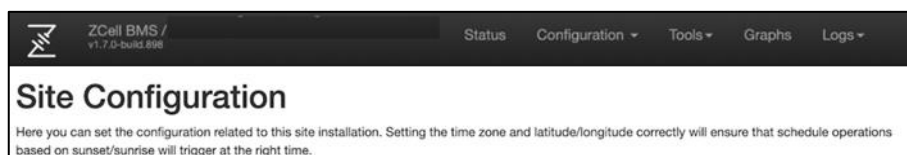
6. Select the **[Login]** button at the top right of the window and enter **admin** in the Username and Password fields.

5.1.2 Set the BMS Settings

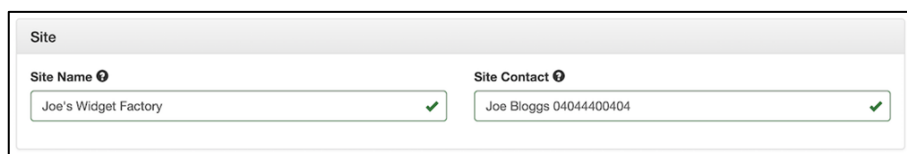
1. From the **Menu** bar, select **Configuration > Site**.



The *Site Configuration* window displays:



2. In the *Site* section, enter the details.



3. In the *Location* section, enter the details including timezone.

Location

Latitude ?

Longitude ?

TimeZone ?

Automatically set Lat/Long ?

Automatically determine timezone

These location settings are used to calculate sunrise and sunset times that are used for Maintenance timing and IO field values.

4. In the *Cloud Options* and *Firmware Update Options* sections, select:

- **Enable BMS cloud connection**
- **Allow firmware updates to be automatically installed**

Do **not** select the options for pre-release software.

Cloud Options

☒ **Enable BMS cloud connection ?**

Enabling the BMS cloud connection will allow the BMS to maintain a connection to the ZCell cloud system. This will allow you to remotely access your BMS from any web browser, anywhere in the world. Additionally, it will allow Redflow engineers to access your BMS for troubleshooting.

The connection requires only an outbound port 22 (TCP) connection to cloud.zcell.com. All data transferred over this connection is encrypted.

Firmware Update Options

Enabling automatic firmware updates will keep your BMS updated with the latest version, automatically.

You can always update the BMS manually on the [upgrade BMS](#) page.

☒ **Allow firmware updates to be automatically installed**

These two options determine whether to allow pre-release software to be installed on your BMS. Please do not enable them unless you understand the potential risks!

These options affect what firmware versions become available on the [upgrade BMS](#) page.

☐ Allow snapshot firmware to be installed on this BMS
 ☐ Allow release candidate firmware to be installed on this BMS

5. Unless advised otherwise, do **not** select the options in the *Master BMS* and *Slave BMS* sections.

Master BMS

Enabling Master BMS mode will alter this BMS to connect to other BMSs, instead of batteries. This allows you to aggregate the data from other BMSs into a single BMS.

Do not enable master mode for any BMS that is directly connected to batteries.

☐ **Enable Master Mode**

Slave BMS

Enabling Slave BMS mode will allow other BMSs to connect to this BMS. This allows you to aggregate the data from this BMS into a Master BMS.

☐ **Enable Slave Mode**

Submit

6. Select the **Submit** button at the bottom of the window.

5.1.3 Update BMS Firmware

The ZBM2 (MMS) and BMS firmware may need to be updated to the latest release to commission the ZBM.

To update the firmware:

1. From the **Menu** bar, select **Tools > Upgrade BMS**. The *Upgrades* window displays.

Available Upgrades

The BMS can be upgraded via the Internet. If upgrades are available, they will appear in a table below.

After starting the firmware download, you may navigate to other pages or close your browser. The upgrade will not occur until the "Upgrade now" link is clicked - this option will appear when the download is complete.

version	changes	upgrade
1.6.0	ChangeLog	Download (43.05 Mb)

Manual BMS Upgrade

Please only use this method if:

- You have been instructed to do so by a ZCell technician
- You are directly connected to the BMS on your LAN

no file selected

2. Identify the latest full release version (e.g. 1.11.1). Select the **Download** link for the version.

Available Upgrades

The BMS can be upgraded via the Internet. If upgrades are available, they will appear in a table below.

After starting the firmware download, you may navigate to other pages or close your browser. The upgrade will not occur until the "Upgrade now" link is clicked - this option will appear when the download is complete.

version	changes	upgrade
1.6.0	ChangeLog	Download (43.05 Mb)

3. The system displays a progress bar indicating that the software is downloading.

Available Upgrades

The BMS can be upgraded via the Internet. If upgrades are available, they will appear in a table below.

After starting the firmware download, you may navigate to other pages or close your browser. The upgrade will not occur until the "Upgrade now" link is clicked - this option will appear when the download is complete.

version	changes	upgrade
1.6.0	ChangeLog	<div>19.75%</div>

4. When the download completes, select the **Complete – Upgrade Now** link to install the software.

Available Upgrades

The BMS can be upgraded via the Internet. If upgrades are available, they will appear in a table below.

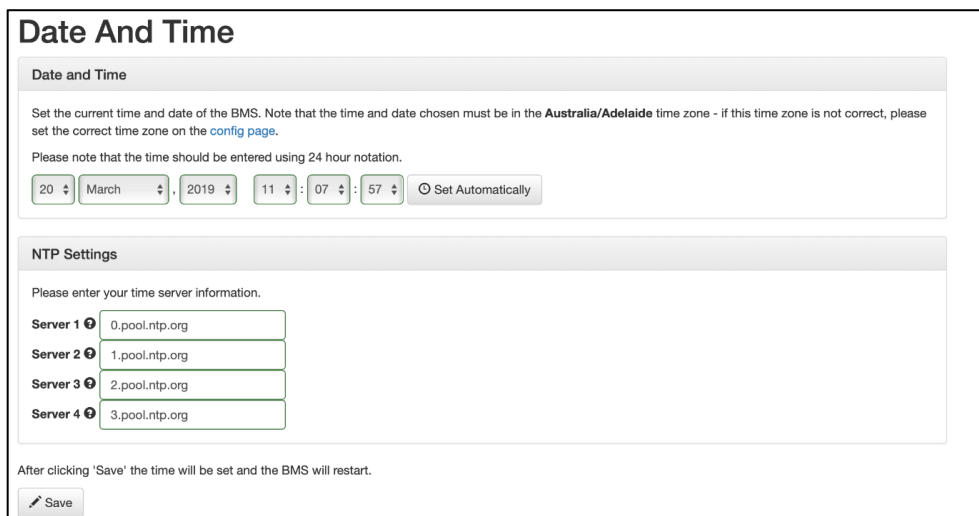
After starting the firmware download, you may navigate to other pages or close your browser. The upgrade will not occur until the "Upgrade now" link is clicked - this option will appear when the download is complete.

version	changes	upgrade
1.6.0	ChangeLog	Complete - Upgrade now

5.1.4 Set BMS Date and Time

Check the date and time:

1. From the **Menu** bar, select **Configuration > Date and Time**



Date And Time

Date and Time

Set the current time and date of the BMS. Note that the time and date chosen must be in the **Australia/Adelaide** time zone - if this time zone is not correct, please set the correct time zone on the [config page](#).

Please note that the time should be entered using 24 hour notation.

20 March 2019 11:07:57

NTP Settings

Please enter your time server information.

Server 1 0.pool.ntp.org

Server 2 1.pool.ntp.org

Server 3 2.pool.ntp.org

Server 4 3.pool.ntp.org

After clicking 'Save' the time will be set and the BMS will restart.

2. Confirm the date and time are correct.

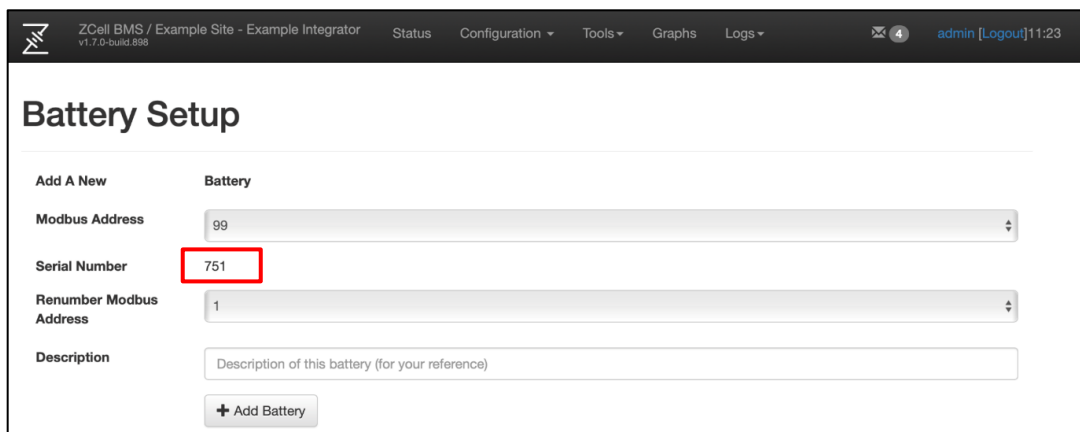
5.2 Set Up a Battery

Note: Where multiple batteries are installed, these batteries are connected to the BMS in a daisy-chain fashion: refer to section 4.4.2 *Connect the BMS Communication Cable*.

Assign each battery a unique Modbus address to enable the BMS to access the battery. Typically, set a battery as unit 1 (the default factory setting is 99), and increment the unit number as additional batteries are installed. The BMS automatically proposes an address starting at 1.

To set up the battery Modbus address:

1. Power on the battery.
2. Select **Configuration > Battery Setup**. Wait for the serial number to display to indicate that the battery has started and is communicating with the BMS.



Battery Setup

Add A New Battery

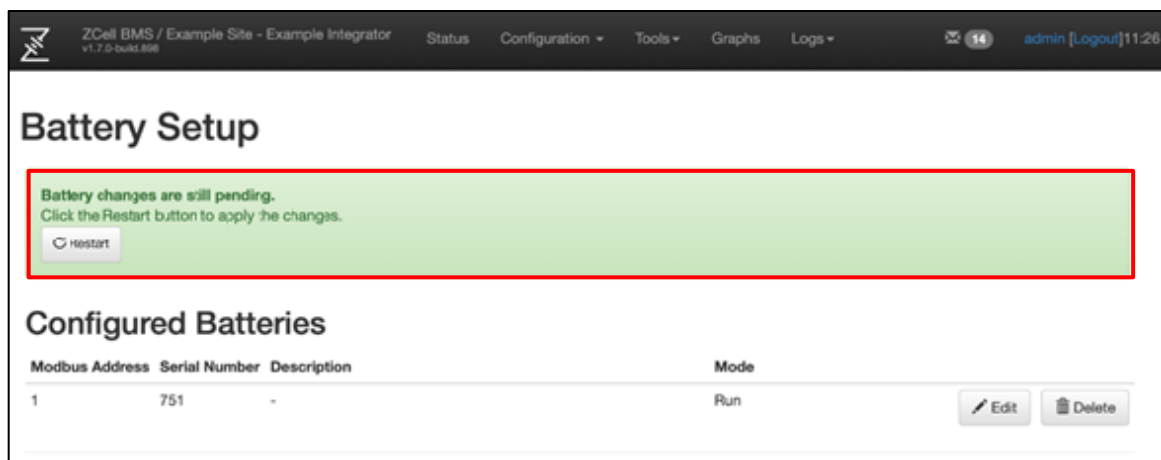
Modbus Address 99

Serial Number 751

Renumber Modbus Address 1

Description Description of this battery (for your reference)

3. Input the **Description** field.
4. Select the **Add Battery** button. The battery is added to the *Configured Batteries* section and the pending changes dialog displays.



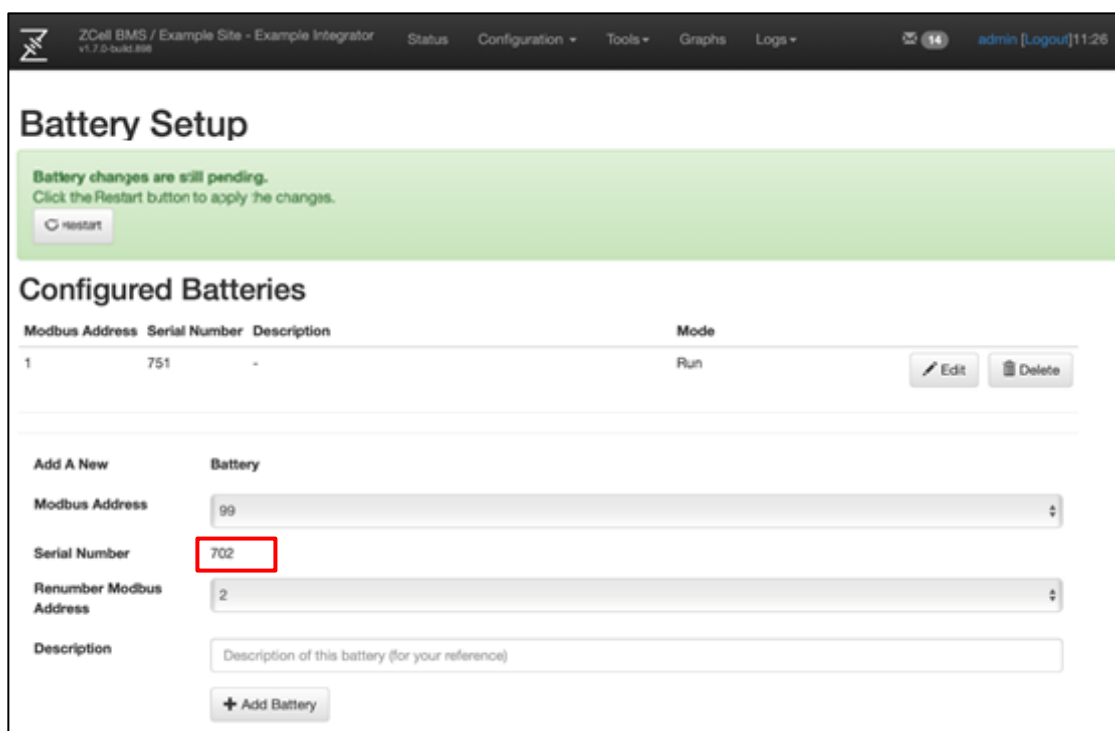
Battery Setup

Battery changes are still pending.
Click the Restart button to apply the changes.

Configured Batteries

Modbus Address	Serial Number	Description	Mode	
1	751	-	Run	<input type="button" value="Edit"/> <input type="button" value="Delete"/>

5. For any additional batteries:
 - a. Power on the battery.
 - b. Wait for the serial number to display to indicate that the battery has started and is communicating with the BMS.



Battery Setup

Battery changes are still pending.
Click the Restart button to apply the changes.

Configured Batteries

Modbus Address	Serial Number	Description	Mode	
1	751	-	Run	<input type="button" value="Edit"/> <input type="button" value="Delete"/>

Add A New Battery

Modbus Address:

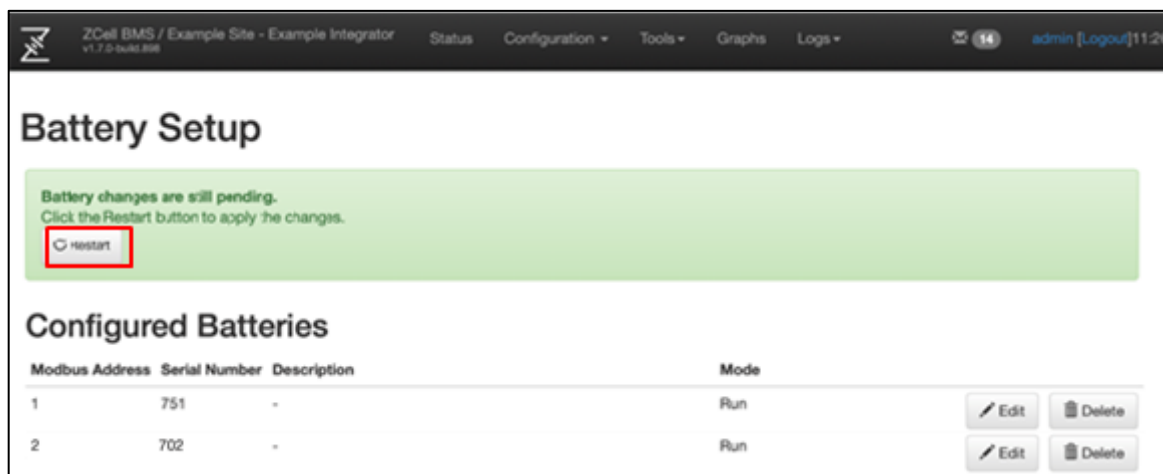
Serial Number:

Renumber Modbus Address:

Description:

- c. Input the **Description** field, then select the **Add Battery** button.

6. In the pending changes dialog, select the **Restart** button.

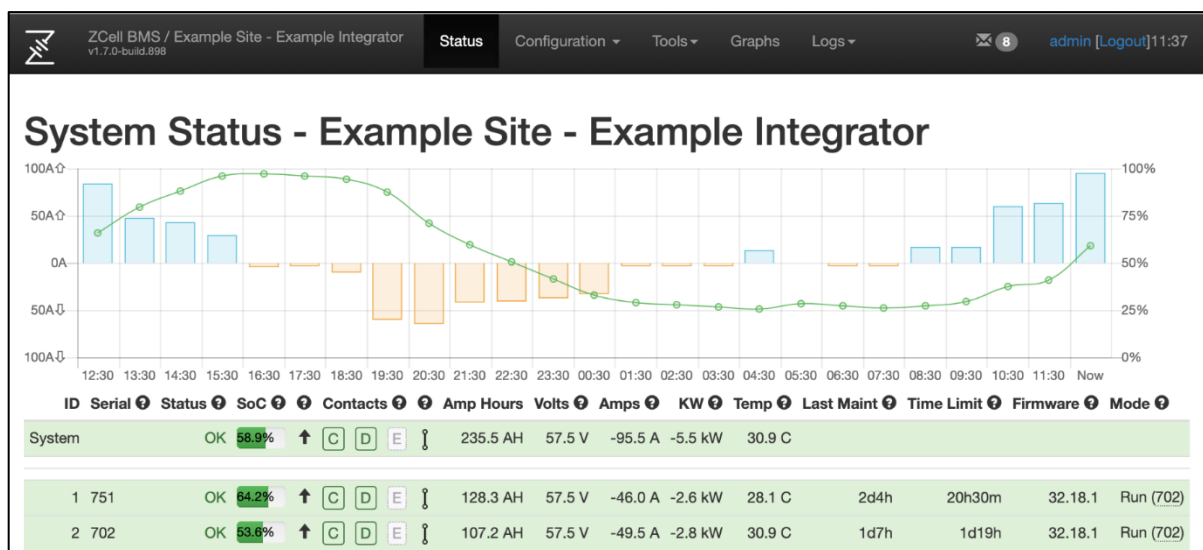


7. For each battery, use a permanent marker to record the Modbus Address on the serial number label on the front of the IBH.



5.3 Check Visibility of a Battery in the BMS

1. Wait a few minutes for the battery settings to be activated in the BMS.
2. On the Menu bar, select the **Status** option. The BMS displays each battery that it can connect to.



5.4 Upgrade Battery Firmware

Upgrade each battery to the latest firmware release.

1. From the **Menu** bar, select **Tools > Upgrade Battery**. The *Battery Firmware Upgrade* window displays.



2. If not selected, select the checkbox for each battery.
3. Select the **Upgrade** button.
4. The upgrade parameters window displays.



5. Select the **Upgrade** button.
6. A progress bar dialog displays; once the upgrade is indicated as complete, close the progress bar dialog.

5.5 Enable the Batteries

Step 1 Set each battery to Run mode:

1. From the **Menu** bar, select **Status**.
The batteries for the BMS display.
2. Select a battery serial number.

ID	Serial	Status	SoC	Contacts	Amp Hours	Volts	Amps	KW	Temp	Last Maint	Time Limit	Firmware	Mode
System		OK	58.9%	↑ [C] [D] [E] ⓘ	235.5 AH	57.5 V	-95.5 A	-5.5 kW	30.9 C				
1	751	OK	64.2%	↑ [C] [D] [E] ⓘ	128.3 AH	57.5 V	-46.0 A	-2.6 kW	28.1 C	2d4h	20h30m	32.18.1	Run (702)
2	702	OK	53.6%	↑ [C] [D] [E] ⓘ	107.2 AH	57.5 V	-49.5 A	-2.8 kW	30.9 C	1d7h	1d19h	32.18.1	Run (702)

The *Battery Detail* window displays.

ZCell BMS / Example Site - Example Integrator v1.7.0-build.898													
Status Configuration Tools Graphs Logs admin [Logout] 11:29													
1 - 751													
Change Operations													
Basics													
Operational Mode run													
ZBM State Bubble Purge before Run - Purge air bubbles and pre-charge (701)													
State of Charge 61.66%													
Amp Hours 123.3Ah													
Voltage 53.0V													
Bus Voltage 57.9V													

3. Select the **Operations** button.

The Battery Operations window displays.

ZCell BMS / Example Site - Example Integrator v1.7.0-build.898													
Status Configuration Tools Graphs Logs admin [Logout] 11:29													
Battery Operations ZBM 1 (751)													
Operation Description													
Bring Battery Online Connect this battery to the DC bus for charging and discharging													
Put Battery in SPS Mode Change the battery to SPS mode. This will change the operation mode to SPS, where it will charge to full, then hibernate until the DC bus voltage drops.													
Clear Status Flags This will clear any hardware failure flags in the battery. This should only be attempted after an attempt has been made to rectify whatever fault caused the alarm.													
Discharge Only Start the maintenance cycle by putting the battery into 'Discharge Only' mode.													
Force Maintenance Start the maintenance cycle by putting the battery full maintenance mode.													
Decommission Battery The battery will immediately go into discharge only until empty, then shut down.													

4. Select the **Bring Battery Online** button.
5. Repeat the preceding sub-steps for each battery.

Step 2 Confirm Batteries Are Operational

1. On the Menu bar, select the **Status** option.
2. Confirm that all batteries are operational (“Run” state).



Appendix A Physical Electrical Protection Mechanisms

MMS Cover

- The MMS cover protects the user from hazardous voltages inside the MMS.
- Do not open!



Electrolyte Pump Cover

- The pump covers prevent direct contact with the ZBM2's pump casings, which may become live with a hazardous voltage of 141V (with respect to electrical ground) in a fault situation,
- Do not open!



Fan Cover

- IP2X-rated
- Prevents direct contact with the ZBM2's fan blades, which can present a cutting hazard.
- Do not open/remove!



Electrical Protection

The battery has the following protection features:

- Over current: the battery disconnects at set currents and set tolerance times
- Over voltage: the battery does not connect if the voltage is too high or too low
- Series resistance failure: the battery disconnects and shuts down if it detects that the battery is compromised via a series resistance failure
- Short circuit: in the case of a short circuit, the battery will automatically disconnect from the bus

Document Revision History

Version	Date	Details of Change	Author
1.0	22-Feb-2022	First Release	P.Brighthouse

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Telecommunication
Application



Renewables
Integration



On and Off Grid
Remote Power



Micro Grid and
Smart Grid



Transmission and
Distribution Deferral