

SIMPLIFIED BATTERY MANAGEMENT WITH REDFLOW'S BATTERY MANAGEMENT SYSTEM (BMS)

Each Redflow battery comes with an integrated Battery Management System (BMS) that can manage one or more flow batteries. Accessed via a standard web browser from a personal computer, tablet or smartphone, the BMS is an intuitive web-based management system that provides an easy way to set up, monitor, and control your Redflow battery. The BMS uses various industry standard protocols to integrate the Redflow battery with energy management electronics from a wide range of vendors. The BMS can also provide control signals to various external systems and interfaces.

For example, it can coordinate the operation of a backup generator using either the built in dry-contact relay output, or by triggering an external MODBUS-TCP relay unit. The BMS can send data to other devices via MODBUS-TCP, CANBUS or a directly connected relay. Transmission may be based on a periodic timer, or on a custom rule defined in the system. These rules can take into account things like bus voltage, state of charge or even time of day.

For integration with a separate EMS, it is possible to fetch a variety of data values from the BMS via MODBUS-TCP or a HTTP REST interface.

The BMS also provides integrated graphs showing a variety of key performance characteristics and allows for the downloading of detailed battery system performance data securely over any available Internet connection. Leveraging that connection to offer additional benefits, the BMS can be remotely upgraded over the Internet and also supports remotely upgrading the control firmware embedded inside each battery. Battery performance and status information can also be accessed remotely.

Redflow delivers a new type of battery

Redflow is a publicly-listed Australian company that has developed the world's smallest zinc-bromine flow battery, which can be used anywhere from individual homes right up to grid-scale deployment.



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Redflow has designed and developed **ZBM2** (Zinc Bromide Module) flow batteries for telecommunications, commercial, industrial and grid-scale applications, and **ZCell** for home energy storage. All products are manufactured in Thailand. ZBM2 batteries are available globally through an international network of authorised system integrators.

REDFLOW BATTERIES OFFER MANY ADVANTAGES OVER OTHER BATTERY TYPES

Redflow batteries deliver unique benefits over traditional battery chemistries such as lead-acid and lithium-based batteries – by providing 100 per cent daily depth of discharge and retaining their full energy storage capacity throughout their warranted life. Redflow batteries are constructed from recyclable or reusable components.



PICTURED FROM TOP:

Redflow ZBM2 (Zinc Bromide Module), ZCell home energy storage.*Products shown are not to scale.



ASX:RFX



TELECOMMUNICATION APPLICATIONS



COMMERCIAL SOLUTIONS

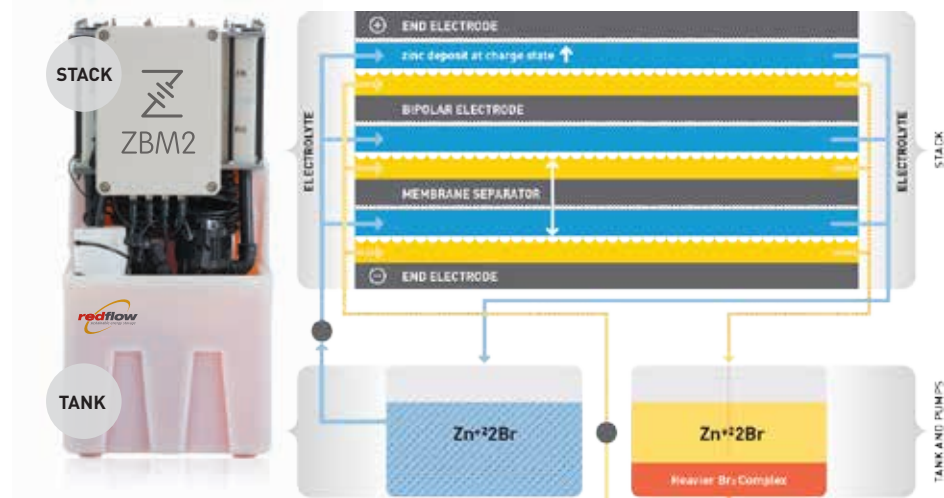


GRID SCALE APPLICATIONS



RESIDENTIAL SOLUTIONS

HOW A ZINC-BROMIDE BATTERY WORKS (CHARGE AND DISCHARGE)



WHAT'S A FLOW BATTERY AND HOW DOES IT WORK?

Each battery contains about 100 litres of a water-based zinc bromide salt solution that circulates in two separate hydraulic circuits. When charging, zinc is extracted from the zinc bromide solution and stored on a plastic membrane. During discharge, zinc is released back to the solution. A major benefit of this process is that it causes no degradation to the battery when the zinc is removed at the end of each cycle, giving it a sustained, long-life energy storage capacity.

REDFLOW BATTERIES REDEFINE YOUR UNDERSTANDING OF HOW A BATTERY WORKS

- + Redflow batteries deliver 100 per cent cycle depth of discharge without causing any damage to the battery
- + Redflow batteries retain their full energy storage capacity throughout their expected life, unlike legacy battery types which lose considerable storage capacity with age
- + Redflow batteries require no reserved capacity, unlike legacy battery types that must reserve a significant portion of their storage capacity to prevent damage to the battery. Therefore with Redflow batteries there is no over-sizing required
- + Redflow batteries present no fire risk: Their bromide-based electrolyte is non-flammable while mechanical damage does not risk explosion or 'thermal runaway'
- + Redflow batteries can operate at ambient temperatures as hot as 50°C without active cooling
- + Redflow batteries offer unlimited shelf life: You can switch off a Redflow battery at any state of charge, hibernate it for extended periods of time, and then access its stored energy within 60 seconds
- + Redflow batteries have a great recycling story as they are made from components that are easy to recycle or reuse
- + Redflow batteries are designed and developed in Australia and available globally through a scalable manufacturing partnership in Thailand.

REDFLOW BATTERIES RETAIN FULL ENERGY STORAGE CAPACITY FOR THEIR WARRANTED LIFE

A Redflow battery can be completely discharged every single day without causing any damage to the battery. This means a Redflow battery retains its full energy storage capacity throughout its warranted life. This stands in stark contrast to other battery chemistries, such as lithium, which must reserve a significant portion of their energy storage capacity to avoid battery damage and also experience reduced storage capacity over time. As Redflow warrants its batteries to deliver 100 per cent of their original energy storage capacity for at least 10 years, this eliminates the need for oversizing capacity, making Redflow batteries capital expenditure competitive with older battery technologies.

REDFLOW BATTERIES CAN BE LEFT CHARGED OR FULLY DISCHARGED WITHOUT IMPAIRING PERFORMANCE

Redflow batteries can sustain regular outages without impairing its energy storage capacity or lifetime performance. Redflow batteries can also be suspended, stored or hibernated, with anything from no charge to a full charge, for as long as required. This sets Redflow batteries above traditional battery chemistries, which lose charge over time and require trickle charging. The ability of Redflow batteries to hibernate without harm or loss of stored energy makes them ideal for applications that require only occasional energy draws, such as seasonal businesses or an unstable grid.

REDFLOW BATTERIES ARE EXTREMELY SAFE

Redflow batteries contain a bromide-based electrolyte that is non-flammable. With a separate tank and stack, there's no chance of mechanical damage causing a thermal runaway. Redflow batteries also require no fire suppression system or safety abuse testing.

REDFLOW BATTERIES WORK WITHIN A WIDE RANGE OF TEMPERATURES

The performance, safety and lifetime of Redflow batteries are unaffected when the internal electrolyte temperature is maintained within the range of 15 to 50 degrees Celsius. No active cooling is required. If the electrolyte temperature exceeds this range, the Battery Management System (BMS) will safely shut down the battery until the temperature returns to the tolerated range.

It is important to note that the electrolyte temperature is different from ambient air temperature. As flow batteries have a large thermal mass, including 100 litres of electrolyte solution, this means that the internal battery temperature is much less volatile than the ambient air temperature.

REDFLOW BATTERIES CAN BE USED BOTH ALONE AND IN MULTIPLES

Redflow batteries are designed to enable you to deploy an energy storage system that uses as many batteries as you need to support your requirements. You can install just one Redflow battery or as many as 60 Redflow batteries, as demonstrated in the container-size Redflow LSB (Large Scale Battery) reference platform (pictured above), which can store 600kWh of energy for grid-scale deployments. Multiple containers can also be connected for larger storage requirements.

REDFLOW BATTERIES ARE WELL-SUITED FOR OFF-GRID ENVIRONMENTS

Redflow batteries are a great choice for off-grid energy systems, with many technical superiorities, including performance, lifecycle and robustness.

REDFLOW BATTERIES ARE MADE FROM RECYCLABLE OR REUSABLE COMPONENTS

The Redflow battery is constructed from easily recyclable materials, such as polyethylene plastic, aluminium and galvanised bolts. The largest, and most expensive, element of the Redflow battery is the 100 litres of water-based zinc bromide electrolyte, which weighs about 140 kg. The beauty of this electrolyte is that, unlike lithium, it is cost-effective and practical to reuse.

REDFLOW BATTERIES ARE DESIGNED IN AUSTRALIA AND MANUFACTURED GLOBALLY

Redflow is an Australian company with its head office, research and development centre in Brisbane. Redflow has the test lab and installer training centre for its ZCell residential energy storage system in Adelaide. Redflow manufactures its ZBM2 zinc-bromine flow batteries in Thailand, a central location that enables the company to service its fastest-growing markets. Redflow delivers ZBM2 batteries globally through an international network of system integrators with the experience and expertise to deploy them as part of a sustainable energy storage system.

REDFLOW BATTERIES ARE SMALLER AND MORE FLEXIBLE THAN OTHER FLOW BATTERIES

Redflow makes the world's smallest flow batteries. Alternative flow battery designs, such as vanadium, are much larger and provide a lower energy density. This means similarly rated flow batteries from other manufacturers have a much larger physical size, causing floor loading, logistics and installation issues.