RedEarth
ENERGY STORAGE
Power yourself

Troppo 4841

Self-managed Lithium Battery (LFP)

Installation and Operation Manual

Safety instructions:

Installers and users are responsible for familiarising themselves with this manual.

The Troppo-4841 battery is certified to IEC62619:2017 and IEC60950. It is listed on the Australian CEC (Clean Energy Council) list of approved batteries. IEC62619 is required to be able to sell this type of battery in Australia.

The Troppo battery uses high-quality cylindrical Lithium Ferro Phosphate (LFP) cells which are safe, robust and reliable in higher ambient temperatures. The cells themselves are also certified to IEC62619 (2015) by TuV, specifically for RedEarth, and have industry leading service life. They are fully recyclable.

Each Troppo battery has an internal Battery Management System (BMS) designed together with RedEarth that provides protection against operation in over and under temperature, over and under voltage, over current (charging), as well as short circuit (discharging) protection. It also extends the service life of the battery through internal balancing of the individual cell strings.

Low voltage protection feature: The Battery Management System (BMS) has a feature that shuts down the battery if the voltage goes below 40V+/-2 volts. This is to protect the cells from damage. See the relevant section of this instruction manual to restart the battery.

The battery includes a 2-pole non-polarised circuit breaker specifically manufactured for RedEarth. A 2-pole circuit breaker is required to meet Australian standards for battery installations. A single pole circuit breaker alone is not normally sufficient in Australia as batteries are usually installed with a floating negative, unlike e.g. in the USA where the negative terminal is usually grounded to earth and so only a single-pole circuit breaker is required on the positive cable.

Other safety features of the Troppo battery include the use of touch-safe high-quality industry standard Amphenol Surlok DC connectors for safe and easy connection of the DC battery cables. These have a significant safety advantage over legacy systems using exposed bolted terminals. Bolted connections present a short-circuit risk as well as the possibility of a loose connection becoming a hot-joint.

The display included in the Troppo battery increases safety by showing the voltage and current status of the battery at all times. This is helpful when batteries are being connected in parallel, and larger balancing currents can flow if the battery voltages are not similar. Note that the BMS includes a safety feature that does not allow current to flow if the battery voltages are different by more than 2-3 volts. Bring the battery voltages closer together by charging or discharging one of the batteries before reconnecting.

The display also includes an odometer function that shows the total energy in kWh that has flowed into and out of the battery. It can also be useful for indicating if one battery in a string is not doing as much work as other batteries.

A status indicator light is also included on the battery. This is always lit when the battery circuit breaker is on and the battery is ready for use. If the battery has shutdown due to under-voltage protection shutdown, then it will not light up. The light also incorporates a momentary button feature that is for future developments of the battery.

Installation:

Installation should only be performed by qualified and experienced installers who can specify the correct cables and DC bus arrangement, external circuit protection, polarity checking and suitability of the design for the application. RedEarth provides factory built and tested energy storage systems designed and engineered to national and state requirements to simplify installation.

Transportation:

Lithium Ferro Phosphate Batteries are classed as Dangerous Goods (DG) Class 9 UN3480and therefor safe for transport. The batteries are shipped in approved transport protection packaging in a partially discharged state with terminal protection in place and the circuit breaker off.

Basic Safety and handling:

- Battery pack is intended to be a 2 person lift when being installed.
- Battery should not be exposed to temperatures above or below the temperature rating specified in this manual.
- Battery should not be installed where it is in direct sunlight, or where it can become wet.
- Battery should not be exposed to strong impacts, crushed or punctured.
- Do not short the battery terminals or connect with reverse polarity!
- Battery should not be disassembled unless qualified and approved by RedEarth to do so.
- Battery should be kept away from animals and children.
- The maximum stacking height is 8 batteries when in RedEarth's transport box.

Damaged battery:

A damaged battery must not be used and returned to RedEarth as soon as possible or disposed of via a recycling facility. Leaking electrolyte can cause skin irritation and chemical burns so contact should be avoided.

Eye Contact:	Rinse gently with running water. Seek medical attention if irritation develops.
Skin Contact:	Rinse gently with running water. Seek medical attention if irritation develops.
Ingestion:	If ingested do not induce vomiting and contact your local poisons information centre or doctor.
Inhalation:	Evacuate area and seek professional medical attention immediately, however an inhalation hazard is not expected due to product form and nature of use.

Fire:

In the unlikely event of a fire a dry agent fire extinguisher should be available and used. DO NOT use water. Evacuate the area and call emergency services. Toxic gas may be produced if the battery catches fire.

SDS:

Note: Refer to the SDS document for more details. The SDS is available from RedEarth Energy Storage Ltd.

Overview

The TROPPO-4841 Battery is RedEarth's own in-house developed and built lithium-ion battery.
It is an Australian-made product that is designed and assembled by RedEarth in its facility in Brisbane.
The TROPPO battery's features make it one of the easiest and safest lithium-ion batteries to install and use, and you have the support of RedEarth's experienced Brisbane-based technical team behind you. Just call. The TROPPO battery has been specifically designed to be self-managing. This means it does not need to communicate with the inverter/charger to operate. There is no need for multiple communication wires between the batteries and inverter (and the complications that go with configuring it), making installation simple. It also allows the battery to be used in systems which do not have the capability to communicate with batteries. For example, older lead-acid based battery systems that need a replacement battery.
Troppo batteries include a display that shows the battery voltage and current. It also includes an odometer that shows how many "miles" the battery has done in its lifetime (measured in total kWh into and out of the battery) Battery connectors are the industry standard, safe and easy to connect Amphenol connectors. A built-in two pole circuit breaker allows for time and cost savings during installation.
The batteries can be connected in parallel to suit applications from the smallest domestic application, right through to telecommunications and commercial sized projects (note: they are not suitable for series connection). The battery can be coupled with many of the inverters available in Australia today. RedEarth can assist you in selecting the requirements for your system and setting the appropriate parameters.
The Troppo is currently available in a 48Vdc model and is sized to be installed in standard 19" racks. RedEarth also provides its own range of purpose built 19" racks for this.

Qualified installation person (Installer)

The installation tasks described in this manual should be carried out by a suitably qualified and skilled installer with adequate skills, qualifications, and experience. They should:

- Have a thorough understanding of operations, design, and installation principles of On and Off grid electrical systems.
- Have a thorough understanding of the risks and dangers associated with installing and using electrical equipment.
- Hold all local, state and country-based qualifications to carry out such work.
- Adhere to all safety and installations requirements contained in this manual.

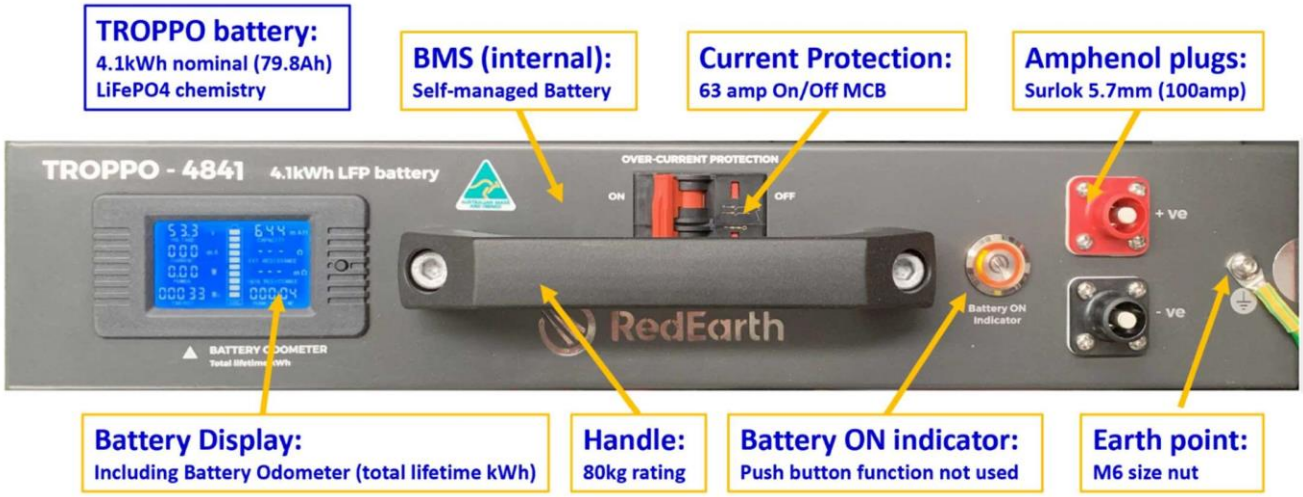
The TROPPO 4841 battery is certified to IEC62619:2017 and IEC60950 and is also listed on the CEC list of approved Battery Systems, allowing it to be used in Australia. It is supplied in the appropriate DG approved shipping carton.

Physical Specification

Battery Weight: 42.5kg
Battery Dimensions: 438mm wide x 725mm deep x 88mm high
Package weight (with battery): 44.0kg
Package dimensions: 540mm wide x 800mm deep x 160mm high

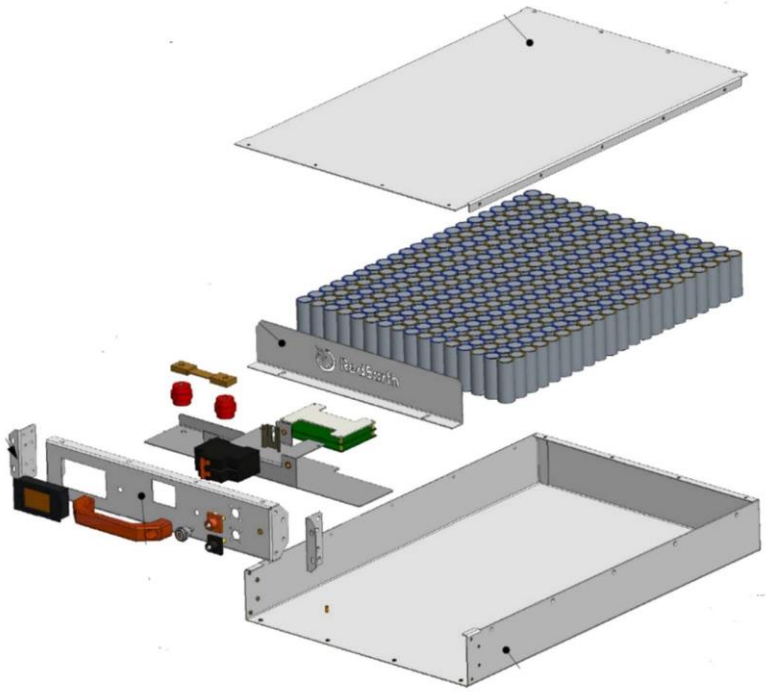
Product Description

The TROPPO 4841 battery is a lithium Ferro Phosphate (LFP) battery that contains a Battery Management System that manages the battery cells. It does not need to communicate with the charger or inverter, however it is important that the charger and inverter are programmed to provide the correct voltage and current for the TROPPO battery.



The image below shows the Battery face cover plate including where the connection and control components are located.

An exploded view of the Troppo battery is shown below. The arrangement of the cylindrical LFP cells can be seen. Each cell has a capacity of 3,800mAh and a voltage of 3.2Vdc. There are 16 cells in series which provides a battery voltage of 51.2V (48V nominal). There are also 21 cells in parallel adding up to 336 cells for the battery, and a total nominal capacity of 4,086Wh.



Note: Do not open the battery. There are no user serviceable components, and it will void the battery warranty.

Understanding the Troppo battery and its use

The Troppo battery is designed to be easy to install and use. It can be used in applications requiring a nominal 48Vdc battery bank. The Troppo battery is designed for a wide range of 48V DC applications including but not limited to renewable energy systems, telecommunications, and mining applications.
As it is designed with a self-managed BMS, it does not need to communicate with the inverter/charger to operate. This makes it suitable for a larger range of applications that the typical Lithium-ion battery that requires communication with the inverter/charger to continue to operate.
This section of the manual explains characteristics, features, and options for use of the battery.
Additional support is available through RedEarth Technical Support by calling 0487 002 451, emailing or visiting the RedEarth manufacturing facility in Brisbane, Australia.

Additional information can be found at www.redearth.energy
RedEarth offers a wide range of training options for our partners including regular training courses run at our Brisbane facility, on-site for our larger customer as well as online training options.

Charging and Discharging the Troppo battery

The battery should always be charged and discharged within the voltage, current and temperature ranges listed in the specifications for the battery at the end of this manual and in the data sheet.
When connecting to Inverters and chargers the parameters set in these devices are important for safe battery operation. The table below provides a guide to some of the key parameters to set. RedEarth also provides guides for setting up popular inverters and MPPTs. If in doubt, contact RedEarth.
All currents are maximum total charging and discharging currents and should be taken into consideration when multiple devices are charging the battery (e.g. MPPT and inverter/charger)
For full warranty coverage the battery must be operated within the voltage, current and temperature windows defined below and in the specifications in this manual and the data sheet.

Inverter or charger programming - battery parameter settings		
Battery type	Lithium, User-defined or Sealed Lead-acid	If no Lithium or user-defined option is available then set to sealed Lead-acid
Charging method	CC-CV	Constant Current (CC) (<max. charge current of TROPPOs) ….then…. Constant Voltage (CV) setting of 57.6V
Recommended continuous Discharge Current	maximum 40A per Troppo battery	Install sufficient batteries to ensure that the batteries are not overloaded (see RedEarth recommendation)
Recommended continuous Charge Current	maximum 16A per Troppo battery	Install sufficient batteries to ensure that the batteries are not overloaded (see RedEarth recommendation)
Max. Charge / Discharge Current	maximum 63A per Troppo battery	Limited by the 63A MCB and also the fixed BMS internal charging current protection of 78amps +/- 8 amps
Charging end current	0.8amps (0.01C)	end Constant Voltage charging once current drops below 0.8 amps per TROPPO battery
Continuous Charge Voltage (Absorption voltage)	57.6Vdc	recommended charge voltage of TROPPO
Float Voltage	disable float, otherwise set to 53.5V	Float voltage charging is not required
Equalisation Voltage	disable equalisation, otherwise set to 53.5Vdc	avoid equalising the TROPPO battery
Inverter Shut Down voltage (per Warranty)	48.0V (most of battery capacity used)	Inverter stops inverting. Leaves enough capacity to avoid internal shutdown while waiting for a charging source (eg solar)
Inverter Shut Down SoC	20% if available as an option	Inverter stops inverting. This leaves enough capacity to avoid internal shutdown while waiting for recharging (eg solar)
Restart Voltage of inverter	50V	Set restart voltage of inverter at 50Vdc to allow battery to recharge enough prior to applying the load to the inverter
Peukert Exponent	1.02	if required
Cable Size	Refer relevant manual or cable sizing standard	Amphenol 5.7mm Surlok - rated at 120A with 25mm2 cable (100A with 16mm2)
The inverter (or MPPT) connected to the Troppo needs its battery parameters set as listed above. If the inverter shut down voltage is set too low there is a risk that the battery switches itself off internally for protection. This then requires a manual restart of the Troppo battery.		Refer to separate inverter-specific information in the TROPPO Installation manual, otherwise contact RedEarth

Battery Installation- Location and environment

Observe the requirements detailed in the Safety instructions at the start of this manual. The TROPPO battery is approved for use in three types of applications.

In RedEarth's pre-built and certified Energy Storage Systems: RedEarth provides complete Ready-to-Run battery systems that use the TROPPO 4841 battery. These include the BlackMax, SunRise (Mini and Maxi), HoneyBadger and DropBear systems for both on and off-grid applications. Call for details.

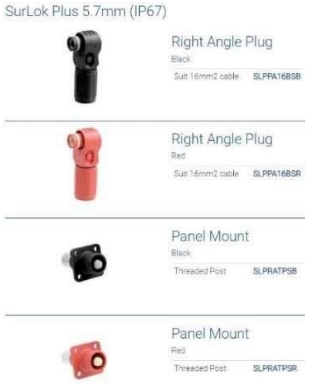
RedEarth's Vault system: This allows qualified installers to add RedEarth's CEC approved Battery System as the storage component of a 48Vdc installation. The Vault is supplied as an IP20 cabinet to house 9 or 11 batteries for indoor applications. The Vault 9 can be configured with a built in Battery Breaker (250A NOARK MCCB) and a Victron BMV-712 battery monitor. This allows monitoring of the whole stack of TROPPO batteries and includes an alarm option (eg low battery voltage) as well as Bluetooth monitoring on your phone.

Custom installations by qualified installers: Sizing the installation is often dictated by the application. In these cases, the installation location of the battery must take into consideration the IP rating and operating temperature range specified in the Specification section of this manual. The optimal ambient temperature range is 0°C to 45°C. TROPPO batteries do not vent any harmful gases and do not require special ventilation or cooling.
The Troppo battery is designed to be installed in a 19inch rack or an electrical enclosure of your choice. If the battery is to be installed outdoors a suitable IP54 enclosure should be used.
The location of the batteries should meet the following conditions,

- The batteries are not located in a salt-air environment, e.g. by the ocean. If this is unavoidable, then appropriate air filtration should be used to prevent salt air contacting the battery.
- There are no explosive or flammable materials nearby (refer to AS5139 and the CEC Best Practise guide https://batterysafetyguide.com.au/.)
- Charging and discharging outside of the optimal ambient temperature range should be limited to C5 and the battery cells should remain between the max and min operation temperature range as specified in this manual. (The internal BMS will stop the operation of the battery if the cell temperatures move outside their specifications)
- The temperature and humidity remain relatively constant to avoid condensation.
- The area is clean with minimal dust.
- The batteries and battery cabinets/housings are not exposed to direct sunlight.
- The TROPPO battery can be installed horizontally, vertically or on its left or right side. RedEarth can supply connectors, bus bars, DC battery cable, battery breakers and ancillary items to assist qualified installers in completing their installations. Call RedEarth Technical support on 1800 733 637.

DC battery cables

Each battery has a positive and negative Amphenol SurLok non keyed male connector for easy snap on connection. A full range of pre-made cable and mating connectors are available from RedEarth.



Multi-battery bus bar and DC Battery Breaker

If multiple batteries are to be connected, then RedEarth can supply a Victron busbar which is rated to 1000A. Several can be bolted together when larger numbers of batteries are required. RedEarth also uses and can supply Noark MCCBs.

Monitoring

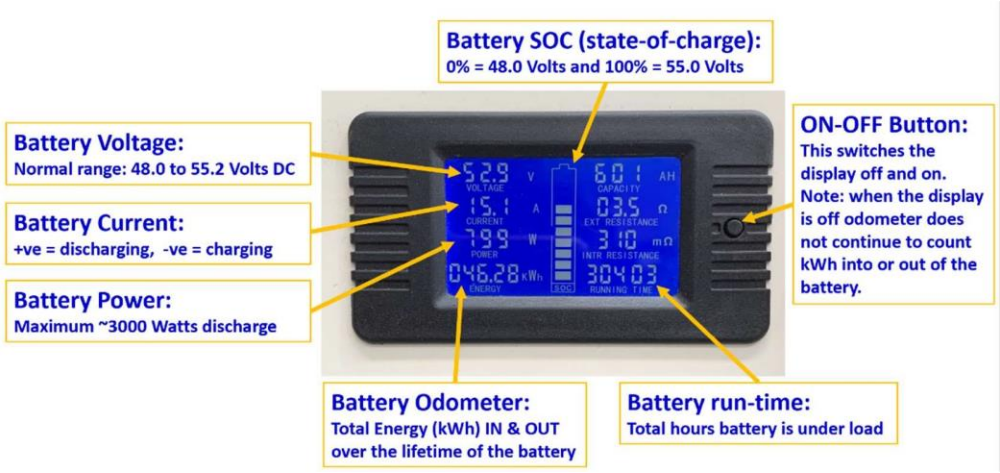
RedEarth can supply a Victron BMV-712 monitor with alarm relay and Bluetooth capability. It is included in the Vault 9 product as standard.

Battery connection and operation:

Connecting batteries together in parallel:

When connecting multiple TROPPO batteries to a single inverter/charger follow the steps below,

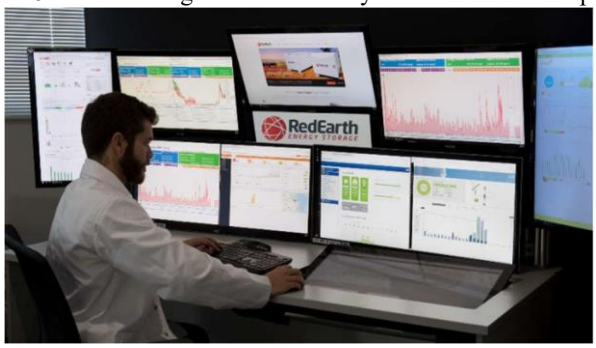
1. Confirm status of the battery: On each battery switch ON the OVERCURRENT PROTECTION MCB and confirm that the display and indicator light illuminates (blue light in grey battery). By looking at the display, confirm that the battery voltage is between 48.0 and 55.2Vdc. It is recommended that the voltages of all the batteries are within 0.5 volts of each other to avoid high current flows between the batteries once they are all connected in parallel. Note that the BMS in the batteries will not allow electrical connection if the voltage difference between the batteries is greater than 2-3 volts. Bring the battery voltages closed together by charging or discharging one of the batteries before connecting in parallel.



2. Switch OFF the OVERCURRENT PROTECTION MCB of all batteries.
3. Connect all the batteries in parallel, by connecting them to the main bus bar using the correct Amphenol 5.7mmm Surlok cables (available from RedEarth and already included in all RedEarth systems). This busbar will be connected to the inverter/charger via a separate Main Battery Breaker.

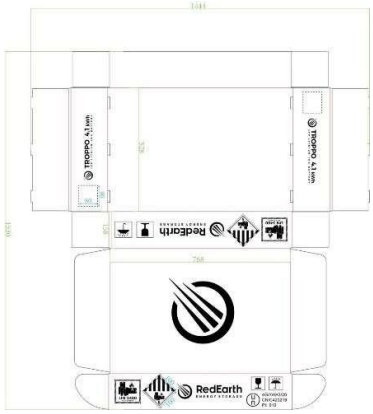
(Double check that all the battery cables are connected to the correct polarity)

4. Next, ensure the separate Main Battery Breaker connected to the inverter/charger is OFF.
5. Switch on all the OVERCURRENT PROTECTION MCBs of the batteries and monitor the displays to ensure there are no large currents flowing. These currents will reduce quickly and will balance the batteries if their SOC was not the same. Once all balancing currents are below 5amps move to the next step.
6. Switch on the Main Battery Breaker. The inverter/charger should power-up depending on the type.
7. Adjust the parameters of the inverter/charger to match the requirements of the TROPPO batteries. Refer to the settings included in this manual. This is a critical step. If you are unsure of the settings required contact RedEarth, as damage to batteries caused by incorrect settings of the inverter/charger will affect your warranty.
8. If you have purchased a RedEarth system with the RedEarth remote monitoring option, you can contact RedEarth now. RedEarth will log into your system and confirm that everything is operating correctly.



Transportation

Individual batteries are shipped in approved transport boxes that include the required shipping labels for land transportation in Australia, or in pallets of batteries up to eight batteries high.



The batteries are shipped with,

- The built-in battery switch in the off position (no voltage on the battery terminals)
- The batteries in a partial state of charge, as required for shipping in Australia. (<30% SOC)
- Plastic caps over the battery terminals for additional protection

Troppo Battery specifications

The table below includes all the specifications of the TROPPO battery that need to be understood. It also includes additional information to help the installer to understand the specifications and parameters of the battery.

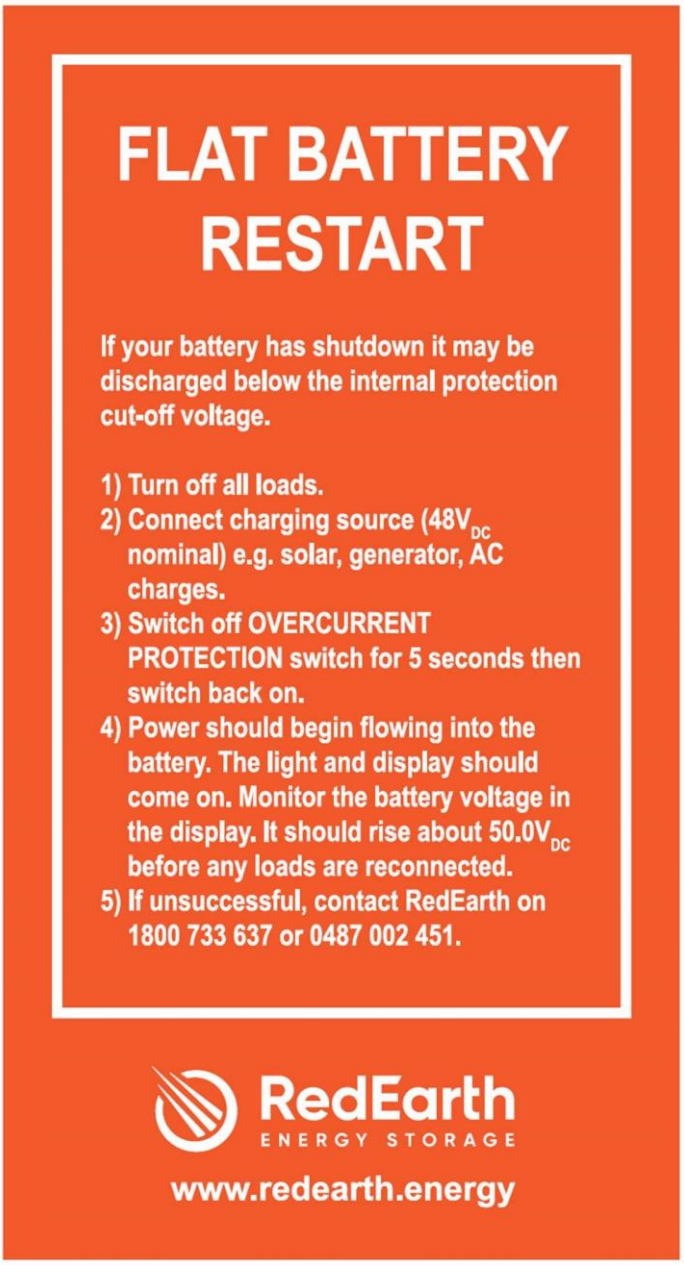
1 Self-Managed LFP Battery Module	
battery incorporates a self-managed BMS that does not require communication with the er to operate. It does however require the inverter/charger settings to be within the of the battery as listed below.	
characteristics	**Installer Information**
acity	4.1kWh / 79.8Ah
acity	3.69kWh (90% of nominal capacity)
Voltage	51.2V
scharge Current	63A (Limited by circuit breaker)
ntinuous Discharge Current	40amps (C2)
arge Current	63A (Limited by circuit breaker)
ntinuous Charge Current	16A
wer on discharge (kW)	approx. 3kW
ed operating voltage range	48.0 - 57.6 Vdc
charge Cycles of certified 3,800 mAh te to 80% Residual Capacity)	2,000@100% DoD / 4,000@80% DoD / 7,000@50% DoD @25°C operating temp.
Wh delivered over battery lifetime	13.08 MWh at 80% DoD
fficiency	>98%
ection	from 4.1kWh to 100kWh+
ection	Not designed for series connection
endar Life @25°C	>10 years when used as per warranty terms
ntial characteristics	
mperature Range - Discharging	Discharge: -20°C to 60°C (+/-5°C)
mperature Range - Charging	Charge: 0°C to 50°C (+/-5°C)
	Natural convection
haracteristics	
nting Options	In a standard 19" Rack or horizontally, vertically or on either side
minal Connections	Amphenol Surlok 100A Non Keyed
it Breaker	2-Pole 63A 360VDC (K-Curve)
ensions	725mm D x 438mm W x 88mm H
ht	42.5kg
	IP20
meters and certification	
current	400 amps per battery in parallel
position	Lithium Ferro Phosphate (LiFePO4 or LFP)
- TROPPO 4841 Battery - LiFePO4 3,800mAh Cell	IEC 62619:2017 & CEC listed IEC 62619:2017, UN38.3
	yes
nagement System (BMS) protection settings	
and number of cells in series	LiFePO4 (16S)
ut cut off	58.4Vdc
/olt cut off	40V
er-current protection	76±8A
er-current protection (2 levels)	250±60A(20-400mS) & 400±100A(10-100mS)
acitors - starting capability	14,600uF
ature - discharge protection	60±5°C
ature - charge protection	50±5°C
ature - discharge protection	-20±5°C
ature - charge protection	0±5°C
g method	Passive equalisation at 57.6Vdc
	Custom BMS designed for RedEarth
	Maintain battery between 48.0 & 57.6 Vdc
	Battery will switch off internally - follow Flat Battery Restart procedure to restart the battery
	Battery will stop charging above this level
	2 levels: 250+/-60A delay 20-400mSec 400+/-100A delay 10-100mSec
	Battery will not discharge if the two temperature sensors in the cell pack are reading above this temperature
	Battery will not charge if one of the two temperature sensors in the cell pack are reading above this temperature
	Battery will stop discharging if one of the two temperature sensors reads below this temperature
	Battery will stop charging if temp sensors below this temperature - **Required feature of all installed battery**
	Top balancing (ie during charging once each row of cells reaches 3.65V)

forts towards constant product enhancement this specification is subject to change to at ut notice

More detailed information on specific settings required for Victron, Selectronics, Voltronics and SunGrow hybrid inverters are available separately. These are the inverter brands currently used by RedEarth. If your inverter is not included in the above, please contact RedEarth for further instructions.

Troubleshooting

The Troppo battery is a self-managed lithium battery system. This simplifies installation as no communication cables are required between the inverter/charger and TROPPO batteries.
It does however require the inverter/charger settings to be correct to operate without any issues. Contact RedEarth if the following information does not solve your problem:



Flat battery

Field experience has shown that the most common problem is the battery being discharged to the point where the internal BMS in the TROPPO shuts down the battery. Follow the procedure shown above to restart the battery.
If this is unsuccessful you will need to apply a 48Vdc voltage to the terminals of the battery to “jump-start” it. RedEarth can supply a suitable charger, which needs to be plugged into 230Vac.

Adding additional batteries

It is possible to add additional batteries to an existing TROPPO installation at a later date. If you are to add extra capacity the battery must be of the same type, part number, and specification.
Before adding the new battery, the original battery bank and the new battery must be bought up to a similar same voltage (within 0.5 volts as shown on the battery displays). This is achieved by discharging or recharging the existing battery until it is the same voltage as the new battery. The new battery can then be connected to the existing batteries.

Repairable TROPPO

The TROPPO battery is designed to be repairable, however this is only able to be done by RedEarth or by personnel trained and qualified by RedEarth. This could be a larger partner with technical repair capabilities. Attempting to repair the RedEarth Troppo will void the warranty.

Support from RedEarth

RedEarth has additional information on the website: www.redearth.energy, including instructional videos.
RedEarth contact details:

RedEarth Energy Storage Ltd
15 Fienta Place, Darra
Brisbane QLD 4076,
Australia

RedEarth office: (07) 3279 6707
1800 733 637
Technical support: 0487 002 451
Email: info@redearth.energy

Maintenance

The Battery system should be checked regularly as part of your system maintenance cycle, or at least every 6 months. These checks include,

- Check the battery Display to confirm all batteries are operating as expected. Current and odometer readings are similar in each battery (within +/-5%) □ All LED indicators on the batteries are on.
- Check for any obstructions placed around the battery that may reduce ventilation.
- Check for animals, insects or creatures nesting in or around the battery system.
- Check for build-up of any foreign objects in or around the cabinet.
- Check battery connections and cables for secure fitting or cable damage. (eg rats eating the cables)

Options available from RedEarth Additional batteries

One of the key advantages of the modular self-managed TROPPO battery design is that additional batteries can be added to an existing TROPPO installation at a later date. Additional battery modules can be ordered from RedEarth together with the required battery cables. Some parameters of the inverter/charger may need to be adjusted to get the best performance from the new larger battery bank, e.g. increase the charging current setting. RedEarth's own systems that are being monitored by RedEarth can often be remotely updated. Talk to RedEarth's technical support team when you order your extra batteries.

Vault 9 or Vault 11:

RedEarth can supply Indoor rated (IP20) systems in the following sizes:

- Vault 9 - 9 x Troppo batteries with Victron BMV-712, 250A braker and the option for remote monitoring
- Vault 11 - 11 x Troppo batteries

Other components

Busbars, DC cable, MCCB battery breakers and battery connectors are available to qualified installers from RedEarth. RedEarth can also provide a LiFePO4 charger for an emergency should a TROPPO battery have discharged to the point where it has turned off internally and will not restart. Call us to see how we can help you.

Warranty

RedEarth provides a 10-year repair/replace warranty for the battery.
Refer to RedEarth's warranty document for details.
These four things will void your warranty,

1. Incorrect battery wiring (e.g. connecting with reverse polarity or connecting batteries in series instead of in parallel)
2. Connecting the battery to incompatible equipment (e.g. 12V battery charger)
3. Incorrect inverter and/or charger settings.
4. Incorrect battery bank sizing, e.g. too few batteries for the size of the inverter. RedEarth does not warrant for damage or defects caused by or from the following:

- Incorrect storage or transportation
- Incorrect installation and wiring
- Not installed according to this manual
- Incorrect operation of the battery
- Inappropriate environmental conditions when operating the battery
- Failure to follow safety requirements
- Tampering with the battery
- Unauthorised repairs or modifications to the battery
- External influences such as physical damage, over-charging or electrical damage Use outside of warranty terms and conditions