RE48V1200 Battery User Manual

Introduction

As a world leading manufacturer of Valve Regulated Lead-Acid (VRLA) batteries, CSB's products are utilized in over 52 countries in telecommunications, UPS, emergency lighting, security and more. CSB is committed to developing next generation VRLA products and growing its worldwide distribution network. The following document describes best practices to observe and implement when handling and operating CSB Energy Technology, Co, Ltd. VRLA-AGM batteries in the following product families as listed below. All information is subject to change without prior notification. Contact CSB for the latest information.

Disclaimer

Images contained in this manual are for illustrative purposes only. These images may not match your installation. Operator is cautioned to review the drawings and illustrations contained in this manual before proceeding. If there are questions regarding the safe operation of the batteries, please contact your local CSB Energy Technologies, Co, LTD office or your nearest CSB representative. CSB shall not be held liable for any damage or injury involving its batteries other hardware if used or operated in any manner or subject to any condition not consistent with its intended purpose or is installed or operated in an unapproved manner or improperly maintained.

RE48V1200 Battery User Manual

1. Battery Construction

Unlike the traditional flooded type of lead acid batteries, valve-regulated lead acid (VRLA) batteries use an electrolysis of water from the electrolyte caused by overcharge. This generates oxygen (O2) gas on the positive plates and can be absorbed by the hydrogen (H2) gas on the negative plates. These gases are recombined and not expelled so water can be kept without loss.

General Construction

The main components of a VRLA battery are (+) positive and (-) negative plates, separator, container, middle cover, vent caps, safety valve, electrolyte, and terminals.

Plates

Both positive and negative plates consist of the grid and the paste attached to it. The grid of the CSB VRLA is made of lead calcium (Pb-Ca) alloy with superior mechanical properties, and the active materials of the paste consist of lead oxide (PbO), sulphuric acid and other materials that can enhance battery performance.

Safety Valve

This is an explosion-proof relief valve that can help reduce pressure and is able to resist acid overflow. The open pressure of the safety valve is 0.1~0.3kgf/cm2. Whenever the internal pressure increases up to the preset limited value, this valve begins to act and will release excessive gas, and the valve automatically seals up to prevent the entrance of oxygen from the air into the cell.

Container and Cover

With the minimum level of oxygen index over UL 94-HB, the material used is flame retardant, shock proof, acid-resistant, has high mechanical strength, and resists oil organic solvent or oil-made product. Permanent airtight sealing between the cover and the container will prevent the electrolyte, lead, and air from escaping.

Electrolyte

The electrolyte contains sulfuric acid specified under the standards of JIS K 1321. The electrolyte is absorbed by a micro-porous separator without any fluid liquid present internally. Therefore, it is immobilized, leak-proof, and can prevent stratification or dry out.

Terminals

Both the positive or negative poles are made of lead-electroplated pure copper which can resist acid and corrosion. The plate group is connected to the post by soldering. Both the post and the connectors are acid resistant and anti-corrosive for the battery to provide longer service life.

Separator

The Absorbent Glass Mat (AGM) separator functions as an electrolyte retainer and offers a high oxygen recombination efficiency, low internal resistance, and is free from producing exotic organic materials. Its surface area is sufficient to cover the plate.

RE48V1200 Battery User Manual

2. Battery Safety

****ATTENTION** CAREFULLY READ THIS DOCUMENT SECTION.**

VRLA batteries are potentially dangerous and proper precautions must be observed in handling and installation. CSB recommends only knowledgeable and trained personnel can be qualified to work on batteries with proper tools and protective equipment. Keep unauthorized personnel away from the batteries during the maintenance activities. Any deviation from not following these safety guidelines can result in serious injury or death.

Always Wear Eye Protection

Prevent Electrical Shock

No Open Flames Around Batteries

Hazardous Chemicals Present

Batteries Can Explode

Always Recycle, Do Not Throw into Trash

Electrical Hazards

Battery system presents a risk of electrical shock and high current short circuit. The following precautions must be observed when handling CSB VRLA batteries:

- Store all batteries beyond the reach of children.
- Remove all personal metal objects from your person (watches, rings, etc.).
- Use insulated tools and gloves.
- Never clean battery terminals with wire brush
- Wear full eye protection and rubber gloves.
- Observe circuit polarities.
- Do not make or break live circuits.
- Do not lay metal tools on top of batteries.
- All connection cables should be well insulated and not able to short electrically. If the cables do cause an electrical short, that may cause smoke or the battery to cause a large destructive fire.

- Prior to handling batteries on a metal rack/cabinet, assure batteries are not inadvertently grounded by observing the ground fault detecting indicator.

- Do not use the VRLA batteries at a site that can get moist or immersed in water. Doing so can cause the battery's terminals to corrode, and/or cause electrical shock or fire.

- Do not use any dry fabric or other materials to clean the battery that could cause static electricity. Always use a damp cloth that has had the moisture wrung out of it.

- As appropriate, use an insulating blanket to cover exposed portions of the battery system when performing extended maintenance that could result in personal or equipment contact with the energized conductors.

- Certain types of rectifier circuits used in charging the VRLA battery may not include a line-isolating transformer. In these cases, extreme caution must be exercised when maintaining and collecting data on the battery system.

- VRLA batteries are sometimes enclosed in cabinets with very limited access. Again, extreme caution must be exercised when maintaining and collecting measurements on the battery system.

- Always use the proper charger and the charging regulations set by CSB. Not following CSB guidelines and procedures, or using non-approved charging procedures, can cause the battery to leak acid, heat up, or cause a destructive fire.

2. Battery Safety (Cont.)

Fire, Explosion, and Heat Hazards

VRLA batteries can contain an explosive mixture of hydrogen gas which can vent under overcharging conditions.

- Do not smoke, introduce an open flame, spark, or extreme heat in the vicinity of the battery.
- Do not burn the battery or throw it into a fire. Doing so may cause the battery to explode and toxic gas to be released.
- Prior to handling the battery, touch a grounded metal object, such as the rack, to dissipate any static charge that may have developed on the operator's body.
- Do not charge, discharge, or store batteries in a sealed container. The individual battery should have 5 to 10mm of space between them to allow for proper cooling. If contained, assure the container, cabinet or room has adequate ventilation to prevent and accumulation of potentially vented gas.
- Never use the VRLA battery together with other types of batteries, such as dry cells and nickel-cadmium batteries. Doing so can cause explosions, fires, or bodily injury.
- When the battery approaches the end of its life, its performance will decrease very fast. The internal exhausted electrolyte and the corrosion of the positive plate may cause a failure. If the battery continues in operation under these conditions, there could be extreme heat, leaking of even explosion.
- If there is any corrosion, cracking, deformation, heat generation, or other abnormalities to the VRLA battery upon its first use after purchase, do not use it. Please call the location where it was purchased. Using the battery with an abnormality can cause the battery to leak fluid, generate heat or explode.

Battery Chemical Hazards

- Any gelled or liquid emissions from a VRLA battery is electrolyte which contains diluted sulfuric acid that is harmful to the skin and eyes. The electrolyte is also electrically conductive and corrosive.
- If the electrolyte contacts the skin, wash the area immediately and thoroughly with water. If electrolyte enters the eyes, wash eyes thoroughly for a 10-minute period with clear water or a special neutralizing eye wash solution and seek immediate medical attention.
- Neutralize any spilled electrolyte with the special solution contained in a "spill kit" or with a solution of 1 pound of bicarbonate of soda to 1 gallon of water.
- Do not disassemble, reassemble, or destroy the battery. Doing so could cause the acid inside the battery to leak and cause severe burns or other accidents.

Battery Recycling and Disposal

VRLA batteries are to be recycled. Batteries contain lead and dilute sulfuric acid. Dispose of the battery in accordance with local regulations. Do not dispose of the battery in a landfill, lake, or other unauthorized location.

3. Battery Transportation

All CSB batteries are identified as "Battery, Electric Storage, Wet, Non-spillable" when transported by air, sea or by land transportation. The batteries must be identified as above on the Bill of Lading and properly packaged with the terminals protected from short circuit. CSB batteries warning label identifies each battery as NONSPILLABLE.

CSB VRLA batteries are classified as "non-spillable" for the purpose of transportation by DOT, and IATA/ICAO as result of passing the Vibration and Pressure Differential Test described in DOT [49 CFR 173.159 (f)] AND IATA/ICAO [Special Provision A67].

CSB VRLA batteries can be safely transported on deck, or under deck stored on either passenger or cargo vessels as result of passing the Vibration and Pressure Differential Test as described in the IMDG regulations (Special Article 238).

When transporting the battery, avoid excessive vibration and impacts; CSB recommends transporting the battery in an upright position.

For all other questions, please refer to CSB SDS (Safety Data Sheet), for additional transport information.

4. Battery Storage

When placing CSB VRLA batteries into storage for later use, it is recommended to place battery indoors in a cool (25°C or less), clean and dry location. During storage, the capacity of the battery decreases due to self-discharging. The self-discharge rate of CSB VRLA batteries is approximate 3% per month at 25°C.

When removing batteries from storage and preparing for installation, it is recommended to perform a boost charge using the parameters outlined below.

During extended storage, it is essential to observe the recommended maintenance intervals based on the storage temperature.

Additionally, supplementary charging should be carried out according to the cycle shown in the table. If the open-circuit voltage (OCV) drops below 2.084V, indicating an estimated capacity of about 88%, perform a constant voltage charge at 2.4-2.5V for 8-16 hours, with a current limit of 0.14CA.

Storage temperature (°C)	Recommended supplementary charge interval	Supplementary charging methods
Lower than 25°C	Each 6 months	For supplementary charging after long storage, please recharge batteries by constant voltage charge with 2.4-2.5V/cell for 8-16 hours with current limit 0.14CA
25 - 30°C	Each 3 months	
Over 30°C	Storage to be avoided	

5. Battery Installation

Battery Unpacking
Upon arrival of batteries to desired location for installation, unpack carefully and exercise caution to not give the batteries any physical shock, which can cause damage to the blocks. Do not carry and lift batteries by its terminals.

After unpacked, check for any physical defects on the batteries. If any damage to the jar, acid leakage or any abnormality is detected, separate the blocks with mentioned issues and do not use.

Installation Design Criteria
Consideration that should be included in the design of the battery installation depends on the requirements or functions of the system. Please find the following recommended installation design criteria for CSB VRLA batteries.

Location
Space allocated for the battery and associated equipment must allow for present and future needs. Calculations must be performed to ensure that floor loading capabilities are not exceeded.

The area must be clean, dry, and well ventilated. Provide adequate space and illumination for inspection, maintenance, testing, and cell/battery replacement. Space must also be provided to allow for operation of lifting equipment and taking system electrical measurements.

Seismic Considerations
When the installation is to be in a location subject to high probability of seismic disturbances, the racks, cabinets, anchors, and installation should be able to withstand the calculated seismic forces.

Always consult the local authority having jurisdiction (AHJ) for proper code compliance for installation of a battery system in a seismic zone or area.

Hydrogen Control [Ventilation]
During the operation, there is a slow build-up of hydrogen gas inside the VRLA batteries. When the internal pressure exceeds the valve release pressure, the hydrogen gas will be vented into the atmosphere. The following battery operating conditions have the following hydrogen generation effects:

- Minimal gas emission: open circuit, discharge, and initial recharge
- Occasional gas emission: float charge.
- Potential for maximum gas emission equalize charge and near end of recharge.
- Maximum gas emission: overcharge.

Adequate ventilation must be provided to prevent the possible accumulation of hydrogen. The amount of ventilation air flow must be ensured by natural ventilation, otherwise by forced (artificial) ventilation. Battery area or cabinet requires an air inlet and an air outlet with a minimum free area of opening.

NOTE - For safety reason, CSB highly recommends limiting hydrogen accumulation to less than 1% of the total volume of the battery area/cabinet.

NOTE – Always consult the local authority having jurisdiction (AHJ) for proper code compliance for installation of a battery system.

5. Battery Installation (Cont.)

Battery Cabinet Installation

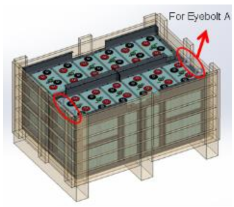
****PLEASE REFER TO APPENDIX A TO VERIFY ALL PARTS AND ACCESSORIES ARE INCLUDED IN SHIPMENT****

Visual Inspection

Ensure there is no physical damage to the battery, such as cracks, deformation, or electrolyte leakage. Verify that the safety vent on each battery is intact. Confirm that all accessories and tools listed in the packing list are available.

Required Tools

To ensure a safe and efficient installation process, it is essential to prepare the required tools and safety equipment. Protective gear such as safety goggles, insulated gloves, and safety shoes should always be worn. The necessary tools include a torque wrench, insulated screwdrivers, a level measurer, an electric drill, and a hammer. For lifting heavy components, use nylon straps (#32), with 2-meter straps for modules and 1-meter straps for single batteries, along with eyebolts A (#30) for modules and B(#31) for single batteries. Additionally, sling lifters rated for loads exceeding 500 kg should be used to handle the weight securely.



Installation Procedure

Site Preparation

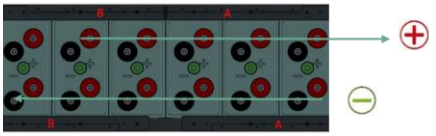
Proper site preparation is critical for the safe and stable installation of the battery cabinet. Begin by ensuring the floor is level and made of solid concrete, with at least 5 cm of clearance between the cabinet and the wall for adequate ventilation. Mark the installation points carefully, and drill holes with a diameter of 14 mm and a depth of 70 mm to secure the cabinet. After drilling, clean the area to remove any dust or debris.

For unit module assembly, verify that each module contains six batteries aligned in the same direction. Attach support bars near the positive and negative terminals using M5 screws, ensuring proper placement for stability. Confirm the alignment of modules to prevent errors during installation.

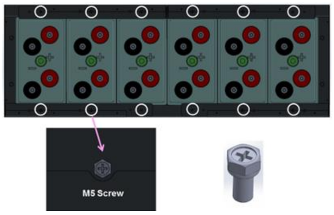
Unit Module Assembly

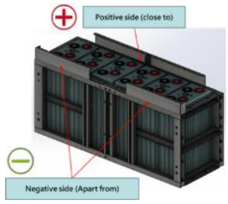
Confirm that each unit module (#2) contains six aligned batteries (#1) delivered pre-installed.

Odd-numbered modules' positive terminals should face the right; even-numbered modules' positive terminals should face the left.



Install support bars A (#6) and B (#7) near positive and negative terminals, respectively. Use M5 screws (#23) to fasten the support bars securely.





⚠ Support bar A (#6) and B (#7) could also be used as fool-proofing. Users or installation service Company can reconfirm unit modules are assembled correctly by a simple guideline, support bars near positive terminal side stay close.

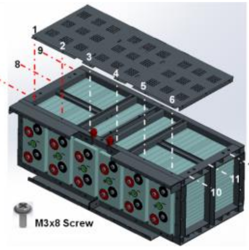
5. Battery Installation (Cont.)

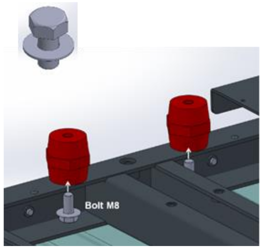
Flipping and Securing Modules

Use eyebolts A (#30) and 2-meter nylon straps (#32) for lifting modules. Rotate modules 90° so the terminal cover faces forward. Avoid any metallic contact with battery terminals during this step.

Place module #1 in position and secure it to the floor using M12 expansion bolts (#29). Tighten bolts to a torque of 107.8 N·m (1100 kgf·cm).

Securely load modules #2 and #3 on top of module #1 using M12 bolts (#22). Before loading module #4, install the insulator (#11) and upper shield (#8) using M8 bolts (#24) and M3 screws (#25).





Electrical Connections

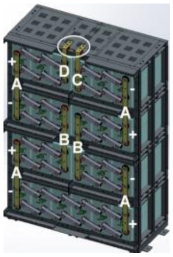
Proper preparation of battery terminals is essential for ensuring reliable connections. Begin by cleaning the battery terminals thoroughly with a copper brush to remove any dirt or residue. Once cleaned, apply a thin layer of Vaseline (#34) to protect the terminals from oxidation. To prevent accidental short circuits, always use insulated tools during this process and handle the terminals with care.

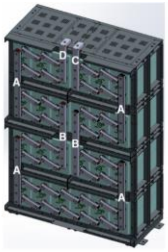
Connecting Batteries

Interconnect Bars: Connect batteries in series using interconnect bars (#26) and secure them with M10 bolts (#21). Cover connections with interconnect bar covers (#27) to prevent short circuits.

Bus Bar Installation: Install bus bars A (#12), B (#13), C (#14), and D (#15). Use M10 bolts (#21) for A and B, and M8 bolts (#24) for C and D.

Attach corresponding bus bar covers (#16-19) after confirming all connections are tight.

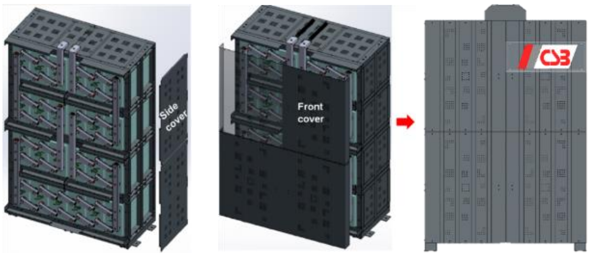




Protective Shields and Grounding

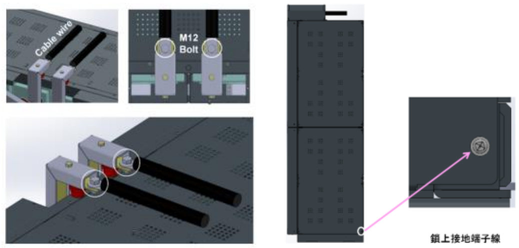
Side and Front Shields

Install side shields (#9) starting from the rear of the cabinet, securing them with M3 screws (#25). Attach the front protective shields (#10), fastening the front eight screws first, followed by the side screws.



Grounding and Final Cables

Connect the grounding wire to the cabinet's designated grounding point. Securely connect power cables using M12 bolts (#22). Insulate all exposed conductive areas with tape to prevent short circuits.



5. Battery Installation (Cont.)

Top Cover Installation

Install the top bus bar cover (#20) using M3 screws (#25). Ensure all protective covers are secure and aligned.

Making Terminal Connections

Tighten connector bolts according to CSB recommended torque values. For nut and bolt assemblies, use a second wrench for counter torque. Use insulated wrenches.

Item#	Screw/ Bolt diameter	Torque value
#25	M3	0.63 N-m (6.42 kgf-cm)
#23	M5	3.0 N-m (29.4 kgf-cm)
#24	M8 (SUS)	6.2 N-m (63.2 kgf-cm)
#28	M8 (plastic)	3.0 N-m (29.4 kgf-cm)
#22	M12 (SUS)	42.0 N-m (428 kgf-cm)
#29	M12 expansion blot	107.8 N-m (1000 kgf-cm)

- When connecting the battery to a charger or a load, keep the circuit switch OFF and connect the battery's positive (+) terminal to the positive (+) pole of the charger or the load and the battery's negative (-) terminal to the negative (-) pole of the charger or the load.
- Measure the voltage of the battery string to ensure that individual cells are connected correctly. [The total voltage should be approximately equal to the number of blocks multiplied by the individual block voltage.] If the measurement is less than expected, re-check the connections for proper polarity.
- Apply numbers to individual battery in sequences beginning with number one. CSB suggests starting from the first battery from negative polarity. For parallel strings, the blocks in each string must be numbered in the same polarity sequence starting with number one.

Freshening/Initial Charge

To compensate the self-discharge during the storage period, it is necessary to apply a freshening charge. Refer to Storage section for initial charge.

Periodically check the battery voltage, charge current, and temperature during the charge cycle. Observe the battery during the charge for unusual conditions. If the battery temperature rises more than 10°C during the charge, stop the charge and investigate. Contact CSB for technical support.

After installation, an initial check of battery capacity by voltage measurement is to verify whether each battery voltage is more than 2.11Vpc (open circuit). If not, it means battery capacity is not 100%, please proceed recommended multiple charging procedure.

- Step 1 CC mode：Constant current charged near 0.07CA, switch whenever voltage reach 2.42Vpc.
- Step 2 CC mode：Constant current charged near 0.035CA, switch whenever voltage reach 2.42Vpc.
- Step 3 CC-CV mode：Keep 0.014CA and voltage limit is 2.42+/-0.02Vpc per cell.

6. Charging

Energy Storage

Cyclic Applications

48VRE1200 battery system is designed specifically for consistent deep cycle applications. Charging during energy storage should follow a constant voltage or constant current method. The recommended charging voltage is 2.42±0.02Vpc per cell at a standard temperature of 25°C (77°F). For temperatures outside 25°C, a temperature correction of –5 mV/°C (–2.78 mV/°F) must be applied to the charging voltage. The allowable voltage range is between 2.30 V/cell and 2.55 V/cell.

The ambient temperature during charging should be maintained between 0°C and 40°C, with an optimal range of 5°C to 35°C. Additionally, ensure the battery surface temperature does not exceed 40°C. If the surface temperature surpasses this limit, reduce the charging current or temporarily halt the process to avoid damage.

The operating method may vary depending on the specific conditions of each customer. Please operate the battery under the conditions confirmed by CSB technical support.

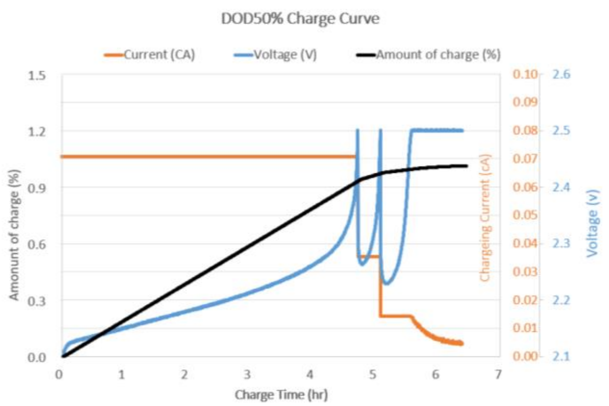


Figure 1 Charging Characteristics

Step 1: Constant Current (CC) Mode

Charge with a constant current of approximately 0.07CA (84A).
Switch to the next mode when the cell voltage reaches 2.42Vpc.

Step 2: Constant Current (CC) Model

Charge with a constant current of approximately 0.035CA (42A).
Switch to the next mode when the cell voltage reaches 2.42Vpc.

Step 3: Constant Current-Constant Voltage (CC-CV) Mode

Maintain a charging current of 0.014CA (16.8A).
The voltage limit is set to 2.42V +/- 0.02Vpc per cell.
Stop charging when the total charge amount reaches 101% of the previous discharge.

Equalization Charge

Equalizing charge (EQ) should be performed once a week after the multi-step charging process. The primary goal is to add 6% of the charging amount to compensate for the 1% daily charge loss accumulated over weekdays. The battery should be charged at 2.50 ± 0.02Vpc at 25°C, with the initial charging current limited to 0.14CA or below. By incorporating the EQ charge once a week along with the daily multi-step charge, the total weekly charge amount should exceed 102% of the previous discharge amount.

If EQ cannot be conducted, please contact CSB to discuss possible adjustments to the multi-step charging process. For RE series batteries, they are considered fully charged when the charge amount reaches 102% - 105% of the previous discharge amount. Both undercharging and overcharging can negatively impact the service life of the battery.

6. Charging

Power Fluctuation Control

In power fluctuation control, the State of Charge (SOC) must be maintained between 30% and 90% to protect the battery's performance and longevity. The minimum voltage is set at 1.8 V/cell, and the maximum voltage is 2.42 V/cell at a standard temperature of 25°C (77°F). Exceeding these limits can lead to reduced service life, internal short circuits, or battery damage.

To account for temperature variations, the charging voltage should be adjusted using a temperature correction factor of -5 mV/°C (-2.78 mV/°F) for deviations from the standard temperature. This ensures safe and efficient charging across different environmental conditions.

The operating method may vary depending on the specific conditions of each customer. Please operate the battery under the conditions confirmed by CSB technical support.

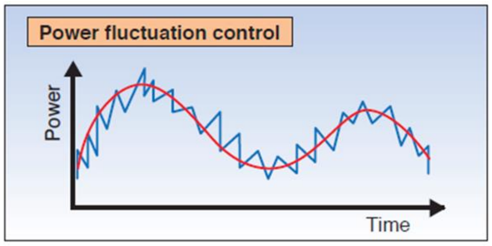


Figure 2 Charging Characteristics

Equalization Charge

The equalizing charge should be performed at 2.50 ± 0.02 V/cell at a standard temperature of 25°C (77°F). For other temperatures, apply a correction of -5 mV/°C (-2.78 mV/°F) per cell. The charge must terminate 11.8 hours after the current drops to 0.04 CA, and the set voltage is reached. Ensure the total charging process does not exceed 24 hours. To maintain battery performance, perform equalizing charges every 2 weeks.

Temperature Compensation

To optimize the service life of batteries, it is important to avoid all overcharge at high temperatures (risk of thermal runaway) or undercharge at low temperatures. Therefore, the temperature coefficient factor needs to apply.

Applications	Temperature Compensation
Energy Storage	-5 mV/°C per cell (-2.78 mV/°F per cell)
Power Fluctuation Control	-5 mV/°C per cell (-2.78 mV/°F per cell)

Temperature compensation is not necessary when the battery is charged at an ambient temperature between 5°C to 35°C, with average temperature below 25°C. At temperatures below 5°C or above 35°C, temperature compensation for charging voltage is necessary.

NOTE: The battery life will be shortened as the service temperature rises. Using the battery for a long period at the temperature over 40°C may cause thermal runaway.

Overcharge

During the overcharging process, water decomposition occurs due to electrolysis, leading to gassing phenomena and oxygen recombination reactions. Oxygen generated at the anode is absorbed at the cathode, where it combines with hydrogen in a heat-generating process. If severe overcharging persists, thermal runaway may occur, resulting in swelling and ultimately causing battery failure.

7. Discharging

The discharge capacity of a battery, typically measured in Ampere-Hours (Ah) or Watt-Hours (Wh), is denoted by "C", representing the product of the discharge current and the duration of discharge. With the RE1200 model, 1CA is defined as 1200Ah at a 100-hour rate and 1.80V. Several factors affect the discharge capacity, including:

1) Discharge Current: The magnitude of the discharge current influences capacity, with higher currents typically resulting in lower capacity.

2) Final Voltage: The voltage reached at the end of the discharge affects the total capacity, with lower voltages indicating a reduced capacity.

3) Discharge Temperature: The temperature during discharge also plays a significant role in battery performance, as extreme temperatures—either high or low—can reduce the discharge capacity.

The general discharge characteristics of the RE series are shown below, illustrating how these factors combine to affect the battery's overall discharge behavior.

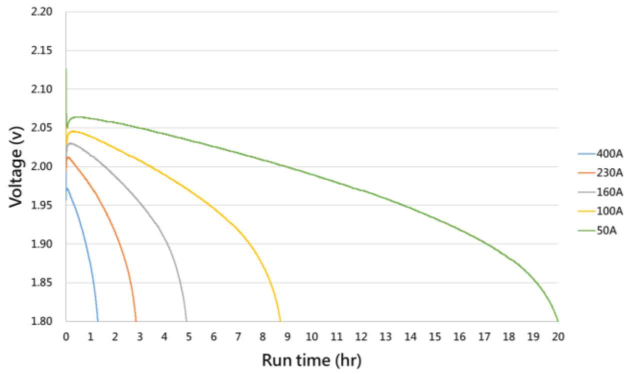
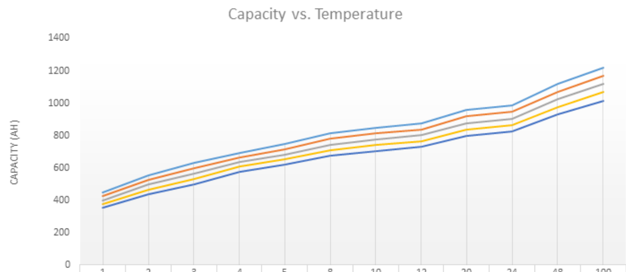


Figure 3 Discharging Characteristics

Capacity vs. Temperature

Batteries perform optimally at room temperature, with the ideal range being between 5°C and 35°C. Performance can be significantly affected if the temperature deviates from this range, either becoming too hot or too cold. The figure below illustrates the general impact of temperature on the performance of VRLA batteries, showing how temperature extremes can negatively affect their efficiency and lifespan.



	1	2	3	4	5	8	10	12	20	24	48	100
25 degC	447	554	629	694	745	813	848	875	957	988	1117	1220
20 degC	424	525	596	665	714	779	812	839	917	947	1070	1169
15 degC	401	496	564	636	683	745	777	802	877	906	1024	1118
10 degC	378	468	531	607	652	711	741	766	837	865	977	1067
5 degC	355	439	499	578	621	677	706	729	797	823	930	1016

Figure 4 Temperature vs Discharge Capacity

Overdischarge

Over discharge occurs when a battery is discharged below its recommended final voltage, causing serious damage and should be avoided.

It overuses the battery's active material, making it difficult to fully recover during recharge, which can lead to material shedding, reduced performance, damage to the internal structure, cracks, a permanent drop in capacity, and even short circuits during recharge, further compromising the battery's health.

To maintain battery performance and extend its lifespan.

11F, No. 150, Sec. 4, Chengde Rd., Shilin Dist., Taipei City 111052, Taiwan (R.O.C.)
Tel: +886-2-2880-5600 Mail: service@csb-battery.com.tw

8. Maintenance

For optimum reliability, it is recommended that the battery system be monitored regularly. If the battery system incorporates an automatic monitoring system to gather the electrical and environmental data, the quarterly checks are limited to the evaluation of the recorded data and a visual inspection of the battery. In general, the types of inspections to be made during periodic maintenance include:

- Visual battery inspection
- Battery system capacity test
- Battery system voltage inspection
- Ambient temperature
- Individual battery float voltage inspection
- High-rate load test
- Electrical resistance and tightness of inter-unit connections.

A test of the individual unit resistance, impedance, or conductance, while optional, is also recommended on a periodic basis. This data and its trends can be a valuable aid in troubleshooting the system and predicting the need for a system capacity test.

Prior to starting the periodic maintenance activity assure that all the required maintenance tools and equipment is available and functional. Notify anyone who will be affected by the intended maintenance or troubleshooting activity. All units in the battery should be numbered to facilitate the recording and analysis of data unique to each unit.

Tools and Equipment
At a minimum, the following tools and equipment are required to maintain and troubleshoot CSB's VRLA battery.

- Digital voltmeter
- Current clamp
- Impedance tester
- System load bank
- Recorder
- Insulated socket wrenches
- Insulated box end wrenches
- Torque wrench
- Screwdriver
- Rubber gloves
- Face shield or goggles
- Portable eyewash
- Fire extinguisher

Inspections
CSB recommends the following maintenance inspections with the following frequency below.

Frequency	Actions
Quarterly (Every 3 Months)	Check that batteries are clean, free of debris. Ensure all facility safety equipment is available and functional. Visually inspect the battery for cleanliness, terminal damage, or evidence of heating container or cover damage. Measure DC voltage from each polarity of the battery to ground and detect any ground faults. Measure and record the DC float charging voltage, and current. Measure temperature of battery cabinet + inspections.
Semi-Annual (Every 6 Months)	Repeat quarterly inspections + randomly measure and record resistance/conductance of the individual units to trend the condition of the individual units over time and to detect dramatic differences between individual units and the average.
Annual (Every 12 Months)	Repeat the semiannual inspection + re-torque all the inter-unit connecting hardware.
Bi-Annual (Every 24 Months)	Capacity tests every two years at the service load or at the battery rating related to the service requirements.

9. Troubleshooting

The following inspections, symptoms, and solutions are provided for reference. The actual judgments should be performed by CSB technical support. For assurance of system reliability, it is necessary to perform the recommended periodic maintenance. The recommended inspections should be performed at least on a quarterly basis. The recommended periodic inspections can be performed either manually or via automated monitoring systems. The recommended periodic inspections are designed to determine the gradual degradation of the system's capacity and to detect any abnormal system or individual battery condition which could impact system reliability.

Battery Visual Inspections

Symptom	Possible Causes	Possible Results	Corrective Actions
Cover /container cracked	Handling or impact damage	Cell dry out or ground fault. Potential internal gas ignition	Replace damaged unit
Cover /container explosion	Ignition of cell's internal gases due to external source, fusing of internal conductive path, or internal spark due to shorting. This potential exists for batteries left in service beyond their useful service life.	Personal injury and equipment damage at time of explosion. Failure to support load.	Replace damaged unit and evaluate any additional batteries
Signs of overheating on battery container	Crack in container causes leaking of electrolyte to grounded rack, etc. Ground fault	Could result in personnel hazard due to conductive path to rack, etc. Could result in smoke or a battery fire Could result in a thermal runaway	Clear the grounded fault and replace defective unit. Evaluate balance of string
Permanently deformed (swollen) container	Thermal runaway possibly caused by a high temperature environment, overcharging, excessively high recharge current, shorted cells, ground fault or a combination of these causes	Could result in the emission of hydrogen sulfide which is detectable as a rotten egg odor, battery fire and the inability to support the load	Replace the battery system and correct the items leading to the thermal runaway condition
Rotten egg odor	Possibly caused by a high temperature environment, overcharging or an excessively high recharge current, shorted cells of a combination of these causes	Odor is a product of extended thermal runaway	Replace the battery system and correct the items leading to the thermal runaway condition

Symptom	Possible Causes	Possible Results	Corrective Actions
Melted grease at terminal	Connections were hot due to excessive resistance caused by a loose connection, dirty contact surfaces or corrosion within the connection	Excessive voltage drop, perhaps leading to short operating time or damaged terminals. In extreme case, could lead to melted terminal and ignition of the battery cover	Clean and reassemble the connection if undamaged. Replace any battery with damaged terminals
Corrosion at terminals	These is possibly either residual electrolyte from manufacturing or electrolyte leaking from the battery terminal seal that is attacking the inner-unit connector	Increased connection resistance in the connection, lead to increased heating and voltage drop at high-rate discharge	Disassemble connection, clean, coat connecting surfaces and terminal area and seal with anti-oxidation grease and appropriately reassemble the connection. If leakage about the terminal area is obvious, the battery should be replaced.

Battery Capacity Test Results

Symptom	Possible Causes	Possible Results	Corrective Actions
Reduced run time at 25°C with smooth voltage decline	Normal wear out	Eventual failure to support the load followed by potential for shorted cells.	Replace battery system when at 80% of rated capacity or before
Reduced run time at 25°C with steep voltage decline or voltage plateaus	Individual low-capacity cells	Reversed cells during discharge. Reversed cells will become very hot and will not recharge	Replace the isolated low-capacity batteries
Excessive initial voltage drop even to the point of dropping load in the first several Seconds	Battery is cold		Warm up the battery
	Cabling is too small	Excessive voltage drop	Add parallel cables
	High resistance connections	Excessive voltage drop	Clean and reassemble connections
	Battery is undersized		Add required parallel strings
	Shorted cells	Cells will become hot, could develop thermal runaway, internal arcing could result in explosion	Replace isolated units with shorts and evaluate entire string

Battery Float Current

Symptom	Possible Causes	Possible Results	Corrective Actions
Float current to the string is zero	A battery or connection in the series string is open. This can be verified via the float voltage or impedance check of the individual batteries.	Failure to support the load. If an internal arc should occur during discharge, it could ignite the internal gases of the cell.	Replace the battery with the open cell or repair the open/loose external connection.
		If there is an open/loose connection in the external conductive path, it could damage the termination under load.	
Float current exceeds 0.03CA at 25°C with float charge.	Batteries are not yet fully recharged	Not at 100% of capability	Determine the specific cause and take the necessary corrective action
	Batteries are above 25°C	Leads to thermal runaway	
	Potentially shorted cells in battery	Leads to thermal runaway	
	Depending on the degree, the battery may be entering or in thermal runaway	Thermal runaway results in eventual meltdown of the battery and the potential of hydrogen sulfide emissions and fire	
AC ripple current exceeds 5 amperes per 100 Ah rated battery capacity	Poor filtering of the charger	Excessive AC ripple current will result in battery heating	Improve the charger output filtering

Battery DC Voltage

Symptoms	Possible Causes	Possible Results	Corrective Actions
System float voltage greater than 2.3 V/cell at an average temperature of 25°C	Charger output voltage set incorrectly	Overcharging will cause excessive gassing and drying of the electrolyte, potential of thermal runaway	Reset the charge output voltage to the recommended value
System float voltage less than an average of 2.25 V/cell	Charger output voltage set incorrectly	Undercharging will result in gradual loss of operation time and capacity with successive discharge cycles. If allowed to persist, an irreversible level of lead sulfate will develop on the plates with the result of a permanent loss of capacity.	Reset the charger output voltage to the recommended value. Equalize the battery system for 48 to 72 hours and perform a capacity test. If loss is permanent, replace the total battery system
System equalize voltage is greater than an average of 2.45 V/cell	Charger equalization voltage is set incorrectly	Overcharging will cause excessive gassing and drying of the electrolyte and will contribute to potential thermal runaway	Reset the charger output voltage to the recommended value
System equalize voltage is less than an average of 2.45 V/cell	Charger equalization voltage is set incorrectly	Equalization and boost charging will be less effective and will require extended time	If possible, reset the charger output voltage to the recommended value or accept a longer equalization time
Individual battery float voltage less than an average of 2.2 V/cell (13.3 VDC for 6 cell battery, 11.1 VDC for 5 cell battery, 6.6 VDC for 3 cell battery)	Potentially the individual battery has a shorted cell. This could be verified with an impedance or conductance check	Reduced operating time under a load, increased float current, heating during discharge, contributes to potential thermal runaway	Replace the individual battery
Individual battery float voltage greater than an average of 2.42 V/cell (14.5 VDC for 6 cell battery, 12.1 for 5 cell battery, 7.3 for 3 cell battery)	Potentially there may be an open cell in the individual battery. This can be confirmed by checking for zero float current or checking for a very high impedance of the battery.	Failure to support the load. Could result in an internal arc which could ignite the gasses within the cell	Replace the individual battery
DC voltage measured between either of the battery system output terminals and ground (rack) or a ground fault indicated by automatic monitoring equipment	Damaged battery container allowing electrolyte to leak out to the grounded surface (rack)	Personnel shock hazard which could result in serious injury or electrocution. Potential burning of the container at damaged area or battery fire	Determine the source of the ground fault and replace the battery

Battery Temperature

Symptom	Possible Causes	Possible Results	Corrective Actions
Elevated room temperature	Lack of adequate air conditioning/ventilation	Reduced battery life	Cool the room or accept reduced battery life
Elevated battery temperature	Elevated room temperature	Reduced life and potential thermal runaway	Improve room air conditioning
	Inadequate cabinet ventilation	Reduced life and potential thermal runaway	Improved cabinet ventilation and temperature
	Discharge-Charge cycle	Can be normal if not exceeding 10°C increase	Limit recharge current
	AC ripple current greater than 5 amperes rms/100 Ah battery capacity	Reduced life and potential thermal runaway	Determine the cause of the excessive AC ripple current and correct
High current recharge	High charging voltage	The combination can lead to thermal runaway	Limit recharge current
			Reduce to within specifications
	Shorted cells		Reduce shorted cells and evaluate total string

Battery High-Rate 10 Second Load Test

Symptom	Possible Causes	Possible Results	Corrective Actions
Terminal voltage is marginally below the minimum voltage specified for 10 Second point	Battery could not be fully charged or is an older battery that has been in service and has a somewhat lower capacity	Could have a reduced operating time	Fully recharge the battery
Terminal voltage is significantly below the minimum voltage specified for 10 Second point	Battery is discharged or there is deterioration of the conductive path, plate grid, active material, or electrolyte volume	Reduced operating time	Charge and reset battery or replace as required
	Shorted	Conductive to thermal runaway	
	Open cells	Will not support load	

Battery AC Ripple Voltage

Symptom	Possible Causes	Possible Results	Corrective Actions
AC ripple (p-p) voltage on the system is greater than 4% of the value of the DC float voltage	Poor filtering of the charger output	Excessive AC ripple could cause the battery to cycle at the ripple frequency and result in heating and deterioration of the active plate material	Improve the charger output filtering
Individual battery in string exhibits AC ripple voltage of twice that of the other typical batteries in the string	Battery with the high AC ripple voltage has proportionately higher impedance and should be further evaluated for performance. Subject battery could have a deteriorating conductive path or a dry, shorted, or open cell	Reduce operating time Potential conditions could be conductive to thermal runaway	Verify the battery condition and replace as required

Battery Connection Hardware

Symptom	Possible Causes	Possible Results	Corrective Actions
Connection resistance increase of 20% or more from original value	Repetitive cycles resulting in heating and cooling of connection can result in relaxation of torque and an increase in connection resistance	Loose connections can result in heat damaged or melted terminals during high-rate discharge	Re-torque the connection as required
	Contamination within the connection can result in corrosion and high terminal resistance	Excessive voltage drop during high-rate discharge resulting in reduced operating time	
Connection hardware tightness is less that the specified re-torque value	Repetitive cycles resulting in heating and cooling of connection can result in relaxation of torque and an increase in connection resistance	Loose connections can result in heat damaged or melted terminals during high-rate discharge	Re-torque the connection as required
When new impedance/resistance increases by 50% from original value or conductance declines to 50%	Battery is discharged or there is deterioration of the conductive path, plate grid, active material, or electrolyte volume	Reduced operating time	Charge and reset battery or replace as required
	Shorted cells	Conductive to thermal runaway	
	Open cells	Will not support load	

10. Warranty

Terms and Conditions

CSB Energy Technology Co., LTD ("CSB") conditionally warrants to PURCHASER of the Products, that the Product, as delivered: (i) is free from defects in material, workmanship and title; (ii) conforms to CSB's published or designated specifications for the Product's physical characteristics, operating parameters and performance ("the Specifications"), and (iii) should PURCHASER discover and report any defects or nonconformities in the Product to CSB within a warranted time frame as listed in matrix below, CSB, upon satisfactory investigation of PURCHASER's claim, shall correct such defect or nonconformity either, at its sole option, (i) by repairing any defective or damaged part or parts of the Products; (ii) making available FOB PURCHASER's facility, a replacement Product or any necessary repaired or replacement parts; or (iii) providing a credit to PURCHASER in the amount of the purchase price of the Product, each exclusive of any labor, installation, transportation, service or test related costs or charges ("the Warranty"). Upon return by PURCHASER under the Warranty, all defective or nonconforming Products that are replaced by CSB shall become the property of CSB. The Warranty is subject to the following conditions:

1. 48VRE1200 is designed to be used in deep cycle applications where consistent cycling is performed in accordance with recommended product operation guidelines. Any deviation from this specific application's usage and recommended guidelines will result in warranty being void.
2. The Product must have been installed, charged, discharged, stored, used, and maintained in accordance with CSB's current printed instructions and the Specifications in this manual.
3. The Warranty Period for any Product which has been installed in an environment where the temperature exceeds 25°C (77°F) shall be proportionately reduced by fifty percent (50%) for every 8°C increase in temperature above 25°C unless otherwise stated. Operation or storage of the Product for any length of time in an environment having a temperature above 50°C will void the Warranty.
4. The Warranty shall be void for any product to the extent that the depth and number of discharges exceed the following:
    a. 3,800 cycles during the Warranty Period with a 50% depth of discharge.
    b. Batteries will be subject to teardown analysis of batteries in question.
    c. All supporting data showing proper cycle control, maintenance, and any other pertinent records supporting proper operation must be provided to CSB for warranty consideration.
5. Unless otherwise stated in writing from CSB for specific warranty conditions in an intended application, for products used in an application not intended or designed to perform as outlined shall be considered void of Warranty and not eligible for warranty replacement or credit.
6. A Product will be considered defective or nonconforming if it has not delivered at least seventy percent (70%) of its rated capacity during the Warranty Period. This will be determined by recharging the battery for 48 hours, then discharging and measuring the amount of Ah used versus the Ah capacity of the battery.
    a. Total batteries usage to be within 2,700 cycles at 70% depth of discharge during warranty period.
    b. Maximum current to be limited to Charging 0.2CA, Discharging 0.4CA.
    c. Operating voltage to be within 1.8Vpc – 2.42Vpc.
    d. Every cycle shall be controlled less than 70% depth of discharge and between 30% - 90% state of charge for partial state of charge (PSoC) operation.
7. Product must be of proper capacity and size for the intended application.

8. The Product has not been subjected to misuse, abuse, or physical damage.
9. PURCHASER has promptly notified CSB of any defects or nonconformities and cooperated with CSB by making the Product available for assessment and/or repair by CSB.
10. It shall not be deemed necessary for defective or nonconforming Products to be returned to the CSB for credit if the quantity involved is < 4 individual 2V cell units. However, the claim must be accompanied by a field service report containing the relevant readings and details of the failure. Quantities of > 4 individual 2V cell units must be returned for CSB to determine the failure mode.
11. Upon request of CSB, PURCHASER shall have promptly returned to CSB, FOB shipping point-freight prepaid, any Product believed to be defective or nonconforming. PURCHASER must request and receive from CSB a Return Material Authorization (RMA) for any Product believed to be defective or nonconforming prior to returning such Product to CSB.
12. The Warranty shall be enforceable by the PURCHASER of the Products and is non-transferable.
13. The Warranty shall be rendered void if the Product is serviced by any party other than a representative from one of PURCHASER's authorized Service Centers or a party which PURCHASER's Service Department has pre-approved in writing or if Product has not been serviced per PURCHASER’s instructions.
14. The warranty will be void if the Product becomes unserviceable due to fire, wreckage, neglect, freezing, abuse, any act of God, the use of battery additions.
15. CSB makes no warranty and shall have no obligation for any damage to the Product caused by or resulting from abuse, misuse, neglect or any unauthorized repairs, maintenance, or alterations of the Product.

The preceding paragraphs set forth the exclusive remedies of PURCHASER for all claims based on a defect in or nonconformity of the Product, whether the defect or nonconformity arises before or during the warranty period, and whether a claim, however instituted, is based on contract, indemnity, warranty, tort (including negligence and strict liability), or otherwise.

CSB ENERGY TECHNOLOGY CO., LTD LIABILITY FOR ANY BREACH OF THE WARRANTY IS LIMITED AS SET FORTH IN THE WARRANTY. THE WARRANTY IS EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES, EXPRESS, IMPLIED OR STATUTORY INCLUDING, WITHOUT LIMITATION, IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.
UNDER NO CIRCUMSTANCES SHALL CSB BATTERY BE SUBJECT TO ANY CONSEQUENTIAL, INCIDENTAL, INDIRECT, SPECIAL OR CONTINGENT DAMAGES WHATSOEVER, INCLUDING BUT NOT LIMITED TO DAMAGES FOR LOST PROFITS OR GOODWILL.

RE48V1200 Battery User Manual

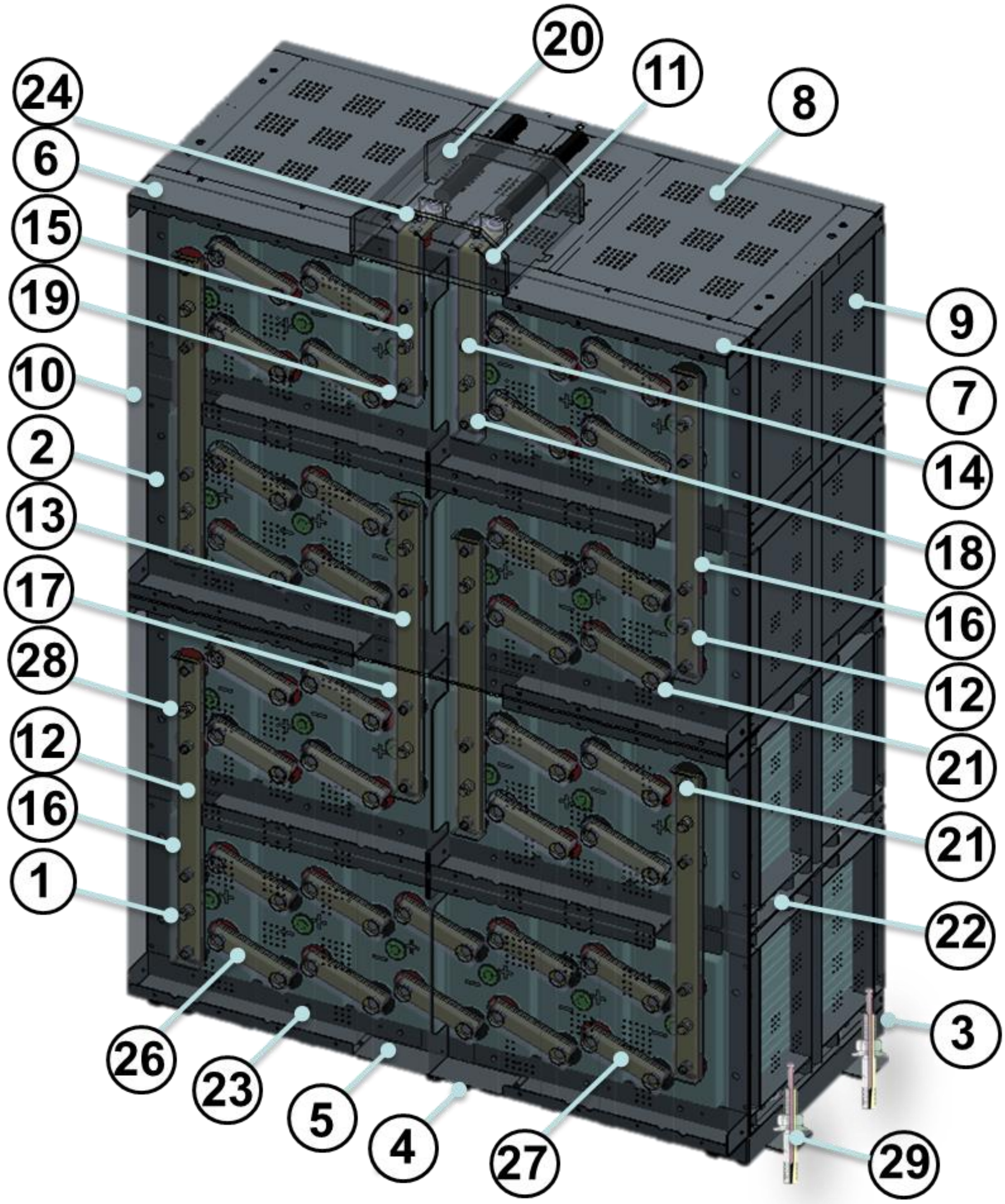
Filing A Warranty Claim
Should the need arise to file a warranty claim, please fill out the form below along with supporting data readings from system for claim submit to your local CSB sales office or sales representative. Someone will be in touch with you regarding the status of your claim.

Warranty Claim Form

Customer Name/Company Name	
Customer Address	
Customer Phone	
Customer Email	
General Description of Issue	
Original SO/PO	
Installation Date	

Model	Date Code	Install Date	Battery Temperature	Vdc Float (No Load)	Vdc Under Load	Vdc Open Circuit

11. Appendix A – 48VRE1200 Diagram + Part List



Item	Description	Specifications	QTY	Remark
1	Battery	RE 1200 2Vdc Battery Cell	24	2V/1200Ah
2	Unit module	1122.4*479*386mm	4	Each includes 6pcs batteries
3	I beam A	478*125*55*4T	2	Two sides
4	I beam B	478*80*55*4T	1	Center
5	Protection sheet	302*67*2.8*0.8T	1	
6	Support bar A	509.5*72*46*2T	8	
7	Support bar B	509.5*72*46*2T	8	
8	Upper shield	1010.6*430.85*24.8*0.8T	1	On top of whole cabinet
9	Side shield	764.2*471.2*12.8*0.8T	4	Each side needs 2 covers
10	Front protective shield	768*560.5*73.5*0.8T	4	
11	Insulator	M8*35mm (GF-60A)	2	
12	Bus bar A	580*40*3T	4	
13	Bus bar B	560*40*3T	2	
14	Bus bar C	341.8*115*40*3T	1	
15	Bus bar D	301.8*115*40*3T	1	
16	Bus bar cover A	590*51*29*4T	4	
17	Bus bar cover B	570*51*29*4T	2	
18	Bus bar cover C	377.3*104*51*4T	1	
19	Bus bar cover D	337.3*104*51*4T	1	
20	Bus bar cover E [TOP]	287*307.6*110.8*0.8T	1	
21	M10 screw	M10B30W-A	96	For batteries
22	M12 screw	M12B25NW-C	20	Assembly of unit module
23	M5 screw	M5B12W-AC	48	
24	M8 screw	M8B16W-A	4	
25	M3 screw	M3*P0.5*6L (flat cross)	94	
26	Interconnect bar	150*40*3T	34	
27	Interconnect bar cover	161*46*29	34	
28	Plastic bolt M8	M8*P1.25*30L	16	
29	Expansion bolt M12	M12	4	

30	Eyebolt A	M12 XP1.75	4	For modules
31	Eyebolt B	M10 XP1.5	2	For batteries
32	Nylon strap	2 meters	2	For modules
33	Nylon strap	1 meter	1	For batteries
34	Vaseline	50 ml	1	For terminals
35	Warning Label	-	4	
36	Specification Label	RE1200	24	

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