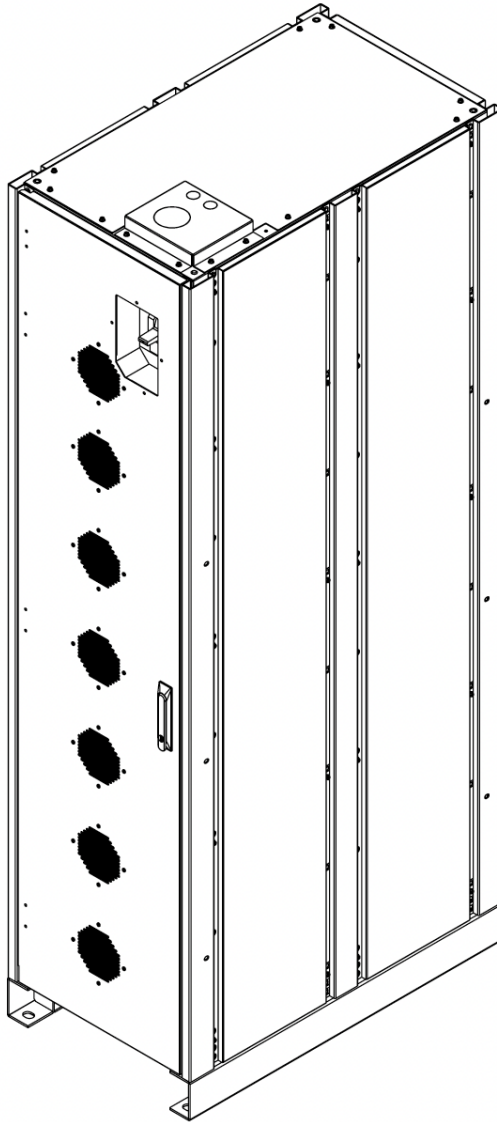


BC Series UPS Battery Cabinets

BC 2



*BC 2 UPS
Battery Cabinet*

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IMPORTANT SAFETY INSTRUCTIONS - SAVE THESE INSTRUCTIONS

THIS MANUAL CONTAINS IMPORTANT INSTRUCTIONS AND WARNINGS FOR ZINC FIVE BC SERIES UPS BATTERY CABINET THAT SHOULD BE FOLLOWED DURING INSTALLATION, OPERATION, STORAGE AND MAINTENANCE OF THE UPS AND BATTERIES. FAILURE TO HEED THESE INSTRUCTIONS AND WARNINGS WILL VOID YOUR WARRANTY.

Safety

Safety Symbols

ZincFive BC Series UPS Battery Cabinet are carefully designed and manufactured to ensure that they are safe and reliable products when used properly. To ensure the safe and proper use of ZincFive BC Series UPS Battery Cabinet, the following symbols are used throughout this manual or on the equipment. Operators, buyers, and technicians must observe each occurrence of these symbols as they appear throughout the document. Only qualified personnel should carry out instructions accompanied by these symbols.



DANGER Symbol

DANGER:

An electrical danger exists in this area. Use extreme caution at all times.

Symbole de danger

DANGER:

Un danger électrique existe dans ce domaine. Faites preuve d'une extrême prudence en tout temps.



CAUTION Symbol

CAUTION:

Important information or operating instructions. Follow them exactly.

Symbole d'attention

ATTENTION:

Informations importantes ou instructions d'exploitation. Suivez-les exactement.



Protective Earth/Ground Symbol








Used to designate a connection point to ground.

Symbole de terre de protection/ symbole de terre

Désigne un point de connexion à la terre.





Battery Safety




English

-  This battery must be installed by qualified personnel in accordance with the latest edition of the National Electrical Code ANSI/NFPA 70 and/or Canadian Electrical Code, Part I, CSA C22.1.
-  To prevent accidental shorts, shocks or electrocutions, never let water or any form of liquid touch, surround or enter the batteries.
-  Do not operate the batteries with damaged cables and wires. Defective cables and wires must be replaced before system installation. Prior to system installation, verify that all cables and wires are properly secured and connected. Faulty connections can interrupt operation and cause irreparable damage to this product.
-  Opening or attempting to dismantle the battery case will void the warranty and create a risk of electrical short circuit, burns or other physical harm
-  Do not dispose of batteries in a fire. The batteries may explode.
-  Do not open or mutilate batteries. Released electrolyte is harmful to the skin and eyes. It may be toxic.
-  A battery can present a risk of electrical shock and high short-circuit current. Contact with any part of a grounded battery can result in electrical shock. The following precautions should be observed when working on batteries:
 - a. Remove watches, rings, or other metal objects.
 - b. Use tools with insulated handles.
 - c. Wear rubber gloves and boots.
 - d. Do not lay tools or metal parts on top of batteries.
 - e. Disconnect charging source and load prior to installing or maintaining the battery.
 - f. Remove battery grounds during installation and maintenance to reduce likelihood of shock.
 - g. Remove the connection from ground if any part of the battery is determined to be grounded.

Note: Reference the Z5 13-80 H S F Safety Data Sheet for additional battery safety instructions.
<https://www.zincfive.com/subc-prismatic-material-safety-data-sheet>

French

-  Cette batterie doit être installée par un personnel qualifié conformément à la dernière édition du National Electrical Code ANSI/NFPA 70 et/ou du Code canadien de l'électricité, Partie I, CSA C22.1.
-  Pour éviter des courts-circuits, des chocs ou des électrocutions accidentels, ne jamais laisser de l'eau ou toute forme de liquide toucher, entourer ou pénétrer dans les piles.
-  Ne pas faire fonctionner les batteries avec des câbles et des fils endommagés. Les câbles et fils défectueux doivent être remplacés avant l'installation du système. Avant l'installation du système, vérifier que tous les câbles et fils sont correctement fixés et connectés. Des raccordements défectueux peuvent interrompre le fonctionnement et causer des dommages irréparables à ce produit.
-  L'ouverture ou la tentative de démontage du boîtier de la batterie annule la garantie et crée un risque de court-circuit électrique, de brûlures ou d'autres dommages physiques.


-  Ne pas jeter les batteries dans un feu. Elles peuvent exploser.
-  Ne pas ouvrir ou endommager les batteries. L'électrolyte libéré est nocif pour la peau et les yeux. Cela peut être toxique.
-  Une batterie peut présenter un risque de choc électrique et de courant de court-circuit élevé. Tout contact avec une partie quelconque d'une batterie mise à la terre peut entraîner un choc électrique. Les précautions suivantes doivent être observées lorsque vous travaillez sur des batteries :
 - a. Retirer toutes montres, bagues ou autres objets métalliques.
 - b. Utiliser des outils avec des poignées isolées.
 - c. Porter des gants et des bottes en caoutchouc.
 - d. Ne pas poser d'outils ou de pièces métalliques sur les batteries.
 - e. Déconnecter la source de charge et la charge avant d'installer ou d'entretenir la batterie.
 - f. Retirez les mises à la terre de la batterie pendant l'installation et l'entretien afin de réduire les risques de choc.
 - g. Retirer le raccordement à la terre si une partie de la batterie est déterminée comme étant mise à la terre.

Remarque : Référez-vous à la fiche de données de sécurité du Z5 13-80 H S F pour des instructions supplémentaires sur la sécurité des batteries.


zincfive.com/subc-prismaticmaterial-safety-data-sheet

Battery Warnings and Cautions

English

-  SHIELD EYES AT ALL TIMES WITH PROTECTIVE GEAR.
NO SPARKS. FLAMES. SMOKING.
ALKALINE ELECTROLYTES.
FLUSH EYES IMMEDIATELY WITH WATER.
WET NON-SPILLABLE.
DO NOT INCINERATE PUNCTURE OR IMPACT.
DO NOT SHORT CIRCUIT.
KEEP OUT OF REACH OF CHILDREN. DO NOT TIP. KEEP LEVEL.
WARNING: RISK OF FIRE, EXPLOSION, OR BURNS. DO NOT DISASSEMBLE, HEAT ABOVE 75°C, OR INCINERATE.

French

-  PROTÉGER LES YEUX EN TOUT TEMPS AVEC UN ÉQUIPEMENT DE PROTECTION.
PAS D'ÉTINCELLES OU DE FLAMMES. INTERDICTION DE FUMER.
ÉLECTROLYTES ALCALINS.
RINCER LES YEUX IMMÉDIATEMENT AVEC DE L'EAU.
HUMIDE ÉTANCHE.
NE PAS INCINÉRER, PERFORER OU COGNER.
NE PAS COURT-CIRCUITER.
TENIR HORS DE PORTÉE DES ENFANTS. NE PAS RENVERSER. MAINTENIR À NIVEAU.
ATTENTION : RISQUE D'INCENDIE, D'EXPLOSION OU DE BRÛLURES. NE PAS DÉMONTER, CHAUFFER AU-DESSUS DE 75°C, OU INCINÉRER.

Specifications

Refer to the ZincFive BC Series UPS Battery Cabinet data sheet for specifications.
zincfive.com/zincfive-ups-bc-series

Safety Precautions



DANGER: HAZARD OF ELECTRIC SHOCK, EXPOSITION OR ARC FLASH

This product must be installed by qualified personnel according to the requirements defined below. This battery cabinet must be installed according to local and national regulations. Install the battery cabinet according to the following standards (depending on your local area):

- **National Electrical Code NFPA 70**
- **Canadian Electrical Code CSA C22.1**

The battery cabinet must be installed in a temperature controlled area free of conductive contaminants. Install on a level, solid surface (e.g. concrete or floor stand) that can support the weight of the system.

Follow all safety precautions when working on this system and always wear proper safety equipment including eye protection.

Notice: To limit drift in SOC with extended storage, the batteries must not be stored more than six months without recharging.

If attached to a UPS that remains de-energized for a long period ZincFive recommends you energize the UPS system every six months for a 12 hour period in order to recharge the batteries.

HIGH VOLTAGE: The Battery Cabinet Voltage varies by model between **370Vdc - 596Vdc**

MAXIMUM FAULT RATING (BREAKER): 20kA, 35kA, and 50kA options (instantaneous trip <10mS for any current >=7800A)

ARC FLASH DETAILS: Incident Energy at: 18in, Min. Arc Rating: 20 cal/cm², Arc Flash Boundary: 72.5in

MAXIMUM SHORT CIRCUIT RATING (BATTERY): 5400A

Tools

Use insulated tools for all installation and maintenance. The batteries and all bolts come pre-torqued and marked. The tools needed for final installation include:

- An insulated Flat Head Screwdriver: For installation of AC wires to terminal block.
- Insulated 8mm or 5/16" Hex driver bit: For DC Breaker termination.
- Long and short #2 Philips head screwdriver.
- Insulated Torque Wrench with 10MM Socket: For Battery bolts.

Précautions de sécurité

DANGER : RISQUE DE CHOC ÉLECTRIQUE, D'EXPLOSION OU D'ÉCLAT D'ARC ÉLECTRIQUE

Ce produit doit être installé par un personnel qualifié conformément aux exigences définies ci-dessous. L'armoire de batterie doit être installée conformément aux règlements locaux et nationaux. Installez l'armoire de batterie selon les normes suivantes (en fonction de votre région) :

- **Code national de l'électricité NFPA 70**
- **Code canadien de l'électricité CSA C22.1**

L'armoire de batterie doit être installée dans une zone à température contrôlée exempte de contaminants conducteurs. Installez sur une surface plane, solide (par exemple, support en béton ou au sol) capable de supporter le poids du système.

Suivez toutes les précautions de sécurité lorsque vous travaillez sur le système et portez toujours l'équipement de sécurité approprié, notamment une protection oculaire.

Avis : Pour limiter la dérive de l'état de charge lors d'un entreposage de longue durée, il ne faut pas entreposer les batteries plus de six mois sans les recharger.

Si relié à une ASI qui reste inerte pendant une période prolongée, ZincFive vous recommande d'alimenter l'ASI tous les six mois pendant une période de 12 heures afin de recharger les batteries.

HAUTE TENSION : La tension d'armoire de batteries varie selon le modèle entre 370 V c.c et 596 V c.c.

VALEUR ASSIGNÉE DE RUPTURE MAXIMALE (DISJONCTEUR) : 20kA, 35kA, and 50kA options (déclenchement instantané < 10 mS pour tout courant $\geq 7\ 800$ A)

DÉTAILS DE L'ÉCLAT D'ARC ÉLECTRIQUE : Énergie incidente à : 18 po, Valeur assignée d'arc minimale : 20 cal/cm², Limite d'arc électrique : 72,5 po

TENUE MAXIMALE AU COURT-CIRCUIT (BATTERIE) : 5 400 A

Outils

Utilisez des outils isolés pour toute tâche d'installation et d'entretien. Les batteries et tous les boulons sont préserrés et marqués. Outils nécessaires pour l'installation finale :

- Un tournevis à tête plate isolé : Pour installer les fils c.a. au bornier.
- Embout de tournevis hexagonal isolé 8 mm ou 5/16 po pour le raccordement du disjoncteur c.c.
- Tournevis cruciforme no 2 long et court.
- Clé dynamométrique isolée avec douille de 10 mm : Pour les boulons de batterie.

Introduction

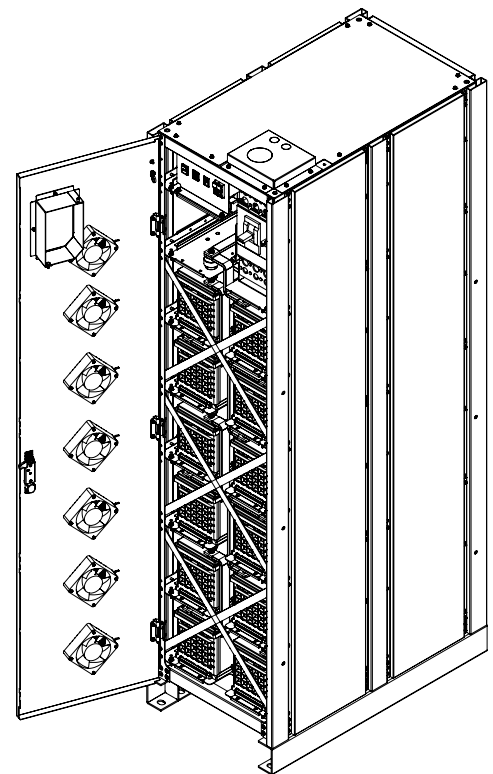
ZincFive BC Series UPS Battery Cabinet Introduction

The ZincFive BC Series UPS Battery Cabinet is comprised of ZincFive's Nickel-Zinc Batteries integrated into a battery cabinet with built in Battery Monitoring System. The ZincFive BC Series UPS Battery Cabinet can house up to 39 batteries to support various UPS runtimes and voltage requirements. This manual covers the 37 to 39 battery solutions. The integrated battery monitoring solution provides highly detailed information on the operation and performance of the battery system. The information can be accessed through the customer interface portal as detailed later in this document. The battery cabinet is designed as a long-life reliable solution for the Mission Critical Data Center Space.

ZincFive BC Series UPS Overview

The BC Series Battery Cabinet is an extremely feature rich design. Some of the major design features are highlighted below.

- Low weight and compact cabinet design for easy installation.
- Breaker is accessible through door for safer operation.
- Draw-out trays simplify battery maintenance.
- Integrated Battery Monitoring System provides real time data and alarms.
- High current discharge capability of up to 800A continuous.
- Reduced recharge times due to 160A maximum recharge current.
- Wide operating temperature range.
- Certified to UL 1778 and CAN/CSA C22.2 No. 107.3, IEC 62040-1, IEC 62040-2.
- CE and RoHs Compliance.
- Cabinet is seismic rated to IBC 2021.
- Employs ZincFive's UL 1989 and CAN/CSA-C22.2 No.60896-21:17



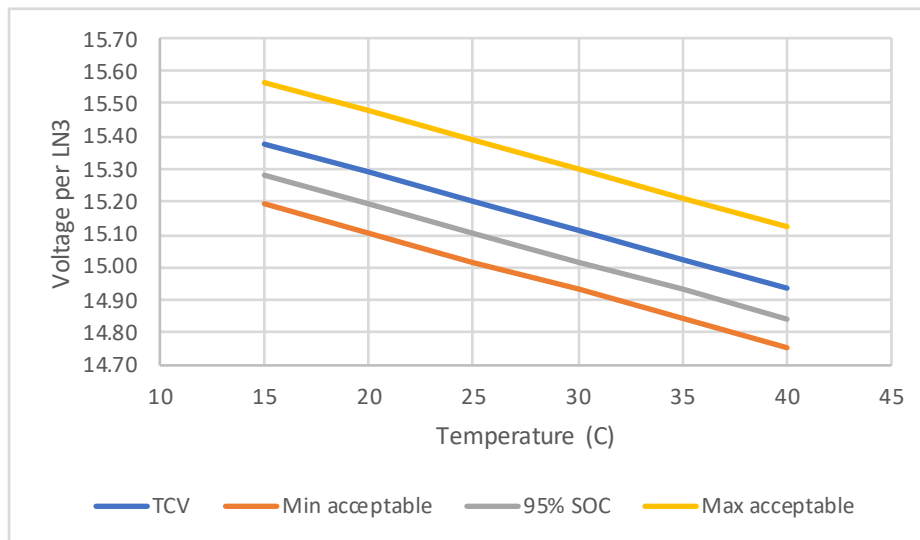
*BC 2 UPS
Battery Cabinet*

Physical Characteristics

ZF-37A6xxxxKB1-XXXXX.....21"W x 36"D x 83.5"H Weight: 2065 lbs (937kg)
ZF-38A6xxxxKB1-XXXXX.....21"W x 36"D x 83.5"H Weight: 2100 lbs (953 kg)
ZF-39A6xxxxKB1-XXXXX.....21"W x 36"D x 83.5"H Weight: 2135 lbs (968 kg)

Setup

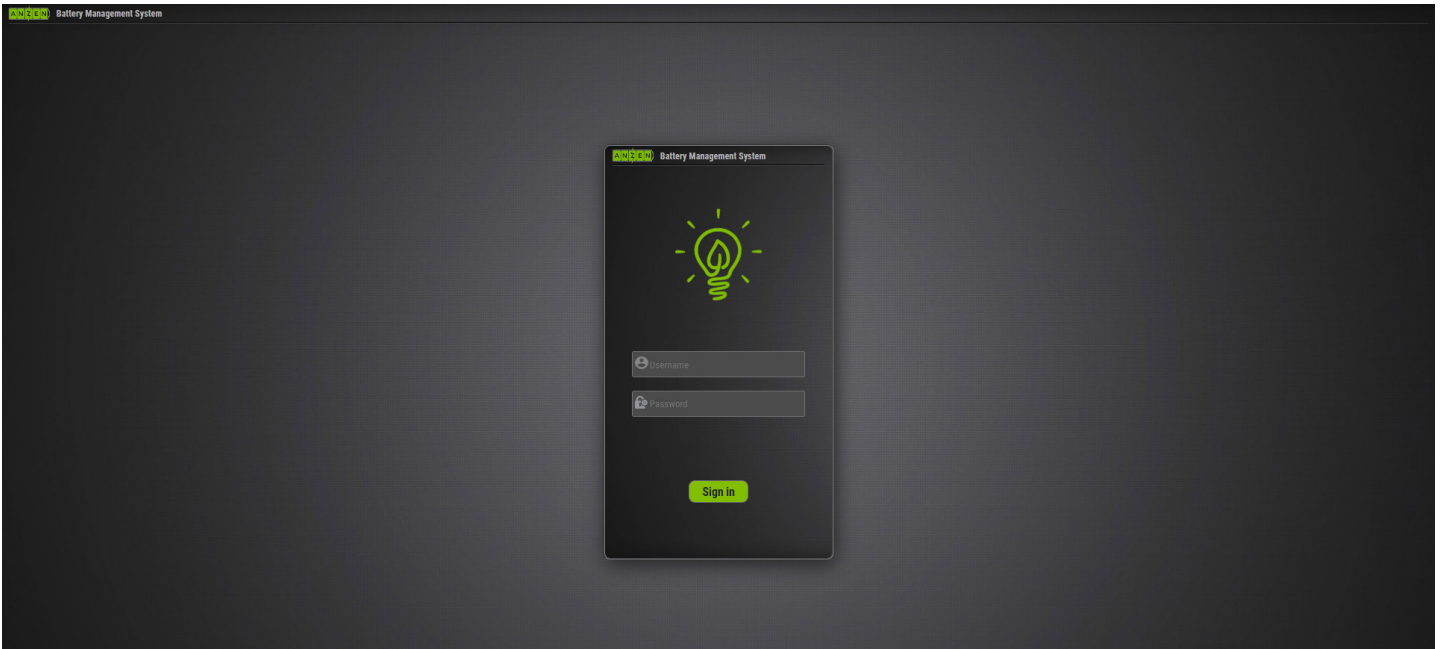
- a. All cables should be attached to the cabinet: DC Power and AC Power. Also UVR/Shunt and Aux contacts to the UPS if needed.
 - The 120-240Vac 50/60Hz feed to the cabinet must be always available (from UPS, backed up—100W backup recommended). Loss of 120-240Vac 50/60Hz will shut the system down and turn off the Battery Management System (BMS).
- b. To be installed in ambient environment between 20°C-35°C.
- c. For optimum performance we recommend the UPS charger voltage to be set as follows
 - 37 Battery Cabinet (37 BC): 559Vdc
 - If Temperature Compensated Voltage (TCV) is available then Voltage Range is: 566Vdc @20°C to 556Vdc @35°C.
 - 38 Battery Cabinet (38 BC): 574Vdc
 - If TCCV is available then Voltage Range is: 580Vdc @20°C to 571Vdc @35°C
 - 39 Battery Cabinet (39 BC): 589Vdc
 - If TCCV is available then Voltage Range is: 596Vdc @20°C to 586Vdc @35°C



Individual LN3 Minimum and Maximum acceptable charging voltages over temperature range

Power Sequencing

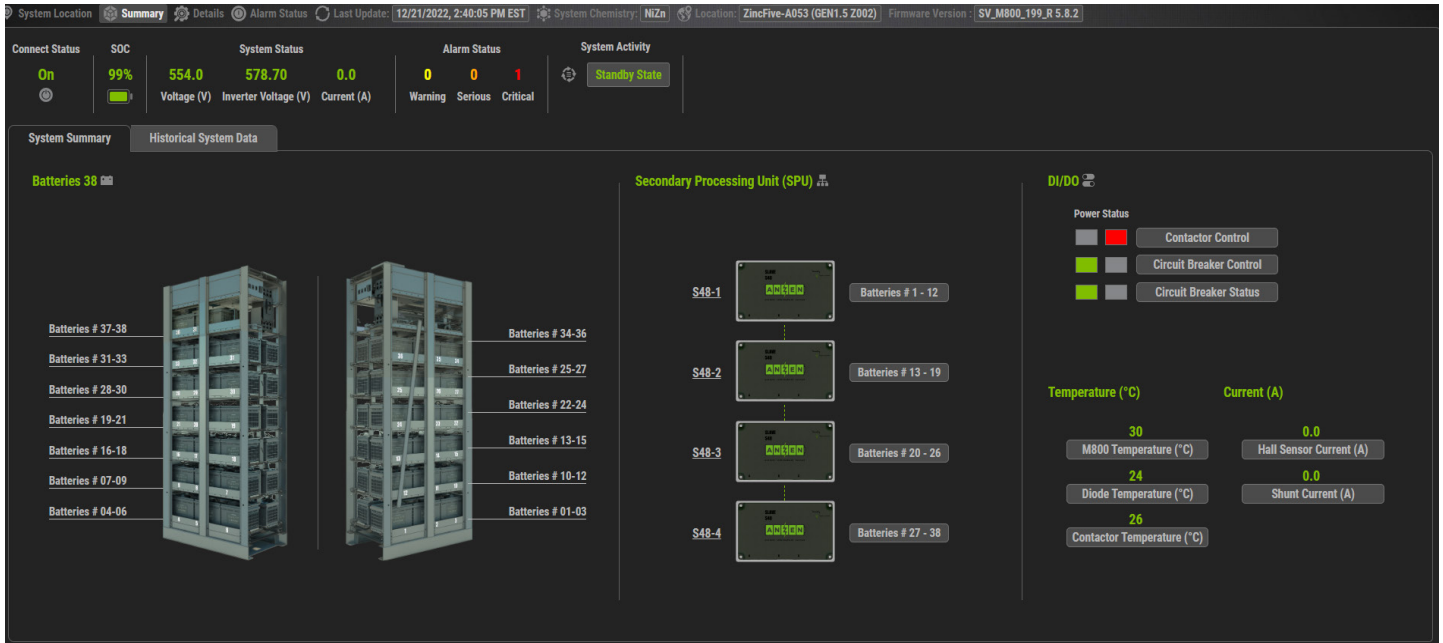
- a. Power up the system by turning ON the AC Power to the UPS Battery Cabinet. Make sure the BMS ON/OFF switch on inside of cabinet door is turned ON.
 - Allow 1 to 3 minutes for the BMS to initialize.
 - b. Log into the Web interface and verify that the BMS is Online.
 - For Cloud Server option (external Internet access required) refer to Item 1.
 - For Local Server option (BX50 internal server) refer to the BX50 Manual for how to connect.
 - For MODBUS TCP/IP refer to the MODBUS Dictionary.
1. Browse to : <https://manage.anzenbms.com/>



2. Login using your assigned login. (Example: user1@userdomain.com)
3. Select the Assigned Systems tab and then select the cabinet which is being monitored.

System Name	ZincFire ID	ID	Last Update	Alarm Status	Company Name
385 - #1	66c1-BMS-077	1db213ba6	3/22/2021, 11:33:56 AM	🔴	ZincFire Inc
385 - #2	314b398632	zincfire-j087	3/22/2021, 7:47:27 PM	🟢	ZincFire Inc
385 - #3	66c1-BMS-073	zincfire-j083	3/22/2021, 11:44:00 AM	🟢	ZincFire Inc
385 - #4	-	zincfire-j085	3/12/2021, 2:40:53 PM	🟢	ZincFire Inc
385 - #5	-	zincfire-j086	3/18/2021, 8:52:32 AM	🔴	ZincFire Inc
385 - #6	-	zincfire-j089	3/16/2021, 10:07:18 AM	🟢	ZincFire Inc
385 - #7	-	zincfire-j018	3/17/2021, 6:19:32 AM	🟢	ZincFire Inc
385 - #8	66c1-BMS-071	zincfire-j011	2/18/2021, 7:28:55 PM	🟢	ZincFire Inc
385 - #9	66c1-BMS-074	zincfire-j012	2/18/2021, 7:41:25 PM	🟢	ZincFire Inc
385 - #19	-	zincfire-j011	3/22/2021, 3:16:12 PM	🟢	ZincFire Inc

4. Verify that the "Connected Status" is On



- c. The system will start operations from the **Pre Standby**.
- d. Once the circuit breaker is closed the system will enter a **Standby, Charge, or Discharge State**.

Operation

Charging

To ready the cabinet to attempt charging the batteries, the following steps should be followed:

- a. Close the Circuit Breaker
The "System Activity" indicator should change to **Standby State**
- b. The Battery Cabinet will remain in the **Standby State** and will only begin charging when:
 - SOC < 90% and all batteries are between 15°C-40°C
 - Set the UPS to charge the Battery Cabinet with any current between 20-160Amps.
- c. The "System Activity" should change to **Charge State**
- d. Charging is complete if any of the following occur on a 38 Battery Cabinet:
 - Current < 4A AND String Voltage > 566Vdc
 - Any Monoblock Voltage > 15.5V
 - String Voltage > 585V
- e. "System Activity" will change to **Standby State**
 - If in **Standby State**, charging voltage is greater than 581Vdc, the system won't change into **Charge State**.

Discharging

- a. The discharge can start if the system is in a Standby State or Charge State.
- b. If current draw is < -5Amp the system will enter a Discharge State.
- c. In Validation Mode discharge will end with Breaker opening via BMS upon any of these conditions:
 - Any (1, 2, or 3) Monoblocks < 10V
 - Any (1, 2, or 3) Monoblocks > 75C
 - EOD Voltage: 380V - 450V
- d. In Normal Mode discharge will end once the UPS reaches its Low Voltage Cutoff (typically 383V-400V).
- e. After a discharge, all batteries must fall below 40°C before recharge begins.
- f. Maximum recommended continuous current is 800Amps.
- g. The breaker is set to trip at 1500A for a dead short circuit.

Note: A negative value signifies the battery is discharging.

Fan Function

- a. Battery Temperatures
 - Turn Fan On: During discharge - 5s after contactor closes
 - Turn Fan Off: (all battery temperatures <35°C) -OR- (all batteries <40°C and fans have been on for 5 hours)
- b. Diode and Contactor Temperatures
 - Contactor temperature >60°C, turn off <55°C
 - Diode temperature >80°C, turn off <75°C

Controls Parameters

Item	Parameter	Number of Batteries	Operation Min/Max	Warning	Serious Alarm	Critical Alarm	Email ¹ (X)	Comments
1a	BPOV - Battery pack total voltage overvoltage (V)	36	555	547		555	X	The BPOV is a hard upper limit for EOC Voltage. The normal EOC is when current is below 4A and system voltage is above a minimum threshold at BPOV – 18 V.
1b	BPOV - Battery pack total overvoltage (V)	37	570	562		570	X	The BPOV is a hard upper limit for EOC Voltage. The normal EOC is when current is below 4A and system voltage is above a minimum threshold at BPOV – 18 V.
1c	BPOV - Battery pack total voltage overvoltage (V)	38	585	578		585	X	The BPOV is a hard upper limit for EOC Voltage. The normal EOC is when current is below 4A and system voltage is above a minimum threshold at BPOV – 18 V.
1d	BPOV - Battery pack total voltage overvoltage (V)	39	600	593		600	X	The BPOV is a hard upper limit for EOC Voltage. The normal EOC is when current is below 4A and system voltage is above a minimum threshold at BPOV – 18 V.
2a	BPUV - Battery pack total voltage undervoltage (V)	36		Variable	360	346	X	
2b	BPUV - Battery pack total voltage undervoltage (V)	37		Variable	370	356	X	
2c	BPUV - Battery pack total voltage undervoltage (V)	38		Variable	380	365	X	
2d	BPUV - Battery pack total voltage undervoltage (V)	39		Variable	390	374	X	
3	SBOV - Single battery (cell) overvoltage (V)		15.5			15.6	X	
4	SBUV - Single battery (cell) under voltage (V) ¹			10.0		7.5	X	
5	Battery Low Flag Counter limit (Battlow)			1, 2	3+		X	Flag incremented for each battery < 10V during a discharge and the number of times a specific battery position exceeds the limit must be captured.

Item	Parameter	Number of Batteries	Operation Min/Max	Warning	Serious Alarm	Critical Alarm	Email ¹ (X)	Comments
6a	Over temperature when charging (°C)				55	65	X	
6b	Over temperature when discharging (°C)			75		85		
7	Battery (High) Temperature Flag Counter limit (Num Batt T High)			1, 2	3+		X	Flag incremented for each battery >75°C during a discharge and the number of times a specific battery position exceeds the limit must be captured.
8	Low temperature when charging (°C)		None ²	< 20	none			No safety issue. Warning < 20C.
9	Over current when fast charge (A)				160 ⁸	1000	X	
10	Over current when discharge (A)				-800 ⁷	-1000	X	Spec
11	Diode Temperature (°C)				100		X	Used table with 1000A estimate used.
12	Contactors Temperature (°C)				150		X	Measured at Terminal. Terminal temperature.
13	ADAh ⁴ (Ah)			< 0 ⁵	<-40		X	
14	Contactors Stuck Closed in Standby					X	X	If in Standby and Current >2A AND (String Voltage = inverter Voltage) (+/- 5V) then Generate Error. Error can only be removed if BMS is toggled.
15	R3000 over temperature (°C)					>75		
16	M800 over temperature (°C)					>100		
17	Battery Low voltage Position Warning				5 ³			
18	Battery High Temperature Position Warning				5 ³			
19	Power Supply Voltage Low					<=21V		
20	Power Supply Voltage High					>=32.5V		
21	Lost Communication			X				System will still work with lost CAN communication.
22	Voltage Check (OCV) of Batteries					<13.0V		Any battery drops below 13.0V when standing idle after a charge/re-charge.

All parameters are shown as expected. It is understood there are tolerances associated with the hardware regarding resolution of each parameter.

BMS Error / Fault Parameter reference notes:

1. Emails are to be transmitted for errors and critical alarms.
2. System operating temperature should be 20-35°C. NOTE: System will remain in Standby and not start charge until temperature window is 15°C to 40°C.
3. When a battery has risen above 75 °C multiple times or fallen below 10V multiple times (or fallen below 8.6 V) a serious alarm is set to replace the battery.
4. There are two warnings one at 10 V and the second at 8.6 V a battery below 8.6 V will need to be replaced as soon as possible. Below 7.5 V two cells have failed and the system will send a critical alarm message.
5. If the UPS voltage is too low on charge the system will undercharge the batteries and not indicate a normal end of charge. To mitigate this, if there has been enough charge to indicate: ADAh is < 0, And Current is < 4A And the EOC Voltage threshold is not met, then the system should exit charge, indicate EOC and issue a Warning.
6. Minimum current limits are exceeded, shall have persistence of 2s for Current < -800A AND > -1000A before issuing a serious alarm. Current <-1000A issues a Critical Alarm instantaneously. The breaker has short circuit protection that may open with current < -1500A.
7. Charge current is normally <= 160 A. The system will record a serious alarm if current is >160 A and < 1000A for 15 seconds and will open the contactor, the contactor will then close after another 135 seconds to attempt to continue charge. Current > 1000A will instantaneously trigger an error and open the contactor requiring BMS reset/ power cycle.

Battery Monitoring System

The BMS consists of a main processing Unit (M800) and several Secondary Processing Units (S48).

- The M800 is the master control module for performing real-time monitoring of the ZincFive Nickel-Zinc batteries.
- The S48 is a secondary module which has direct connections to the batteries monitoring voltage, temperature State of Charge (SOC) and State of Health (SOH)
- The R3000 module provides for remote monitoring of the BMS and battery status.

Checking data via USB

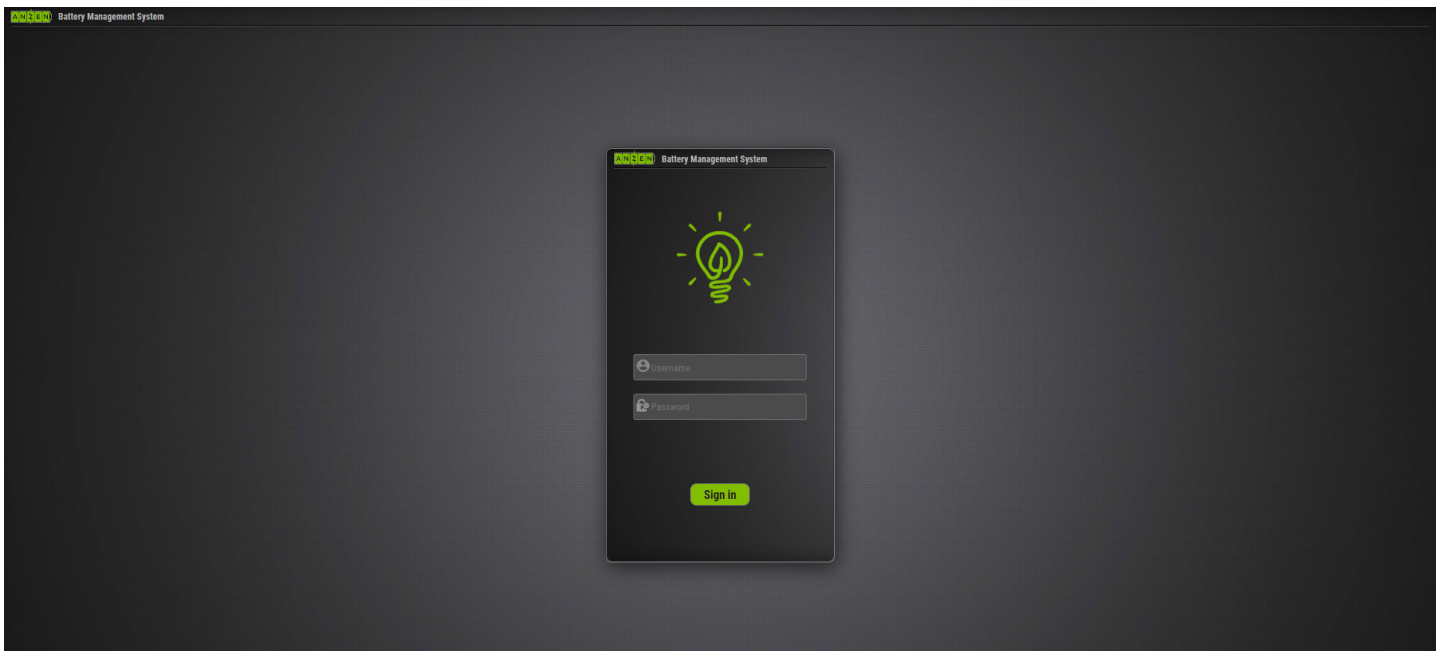
- This can provide 1-2 month's worth of logging data from batteries.
- USB Stick can be removed 3-5 minutes after inserted to retrieve the downloaded data.
- The download can only be completed by using a USB flash drive. (1GByte Flash drive minimim.)

Web Interface

The Web Interface allows for the remote monitoring of a battery cabinet.

Login & System Selection

Browse to <https://manage.anzenbms.com/> to see the login prompt:



Use the assigned login user name. (Example: user1@yourcompany.com)

Then select the "Assigned Systems" tab and select the system to be monitored:

System Name	ZincFire ID	ID	Last Update	Alarm Status	Company Name	
385 - #1	66c1-8a5-e77	16d113ba8	3/22/2021, 11:53:16 AM	🔴	ZincFire Inc	🗑
385 - #2	316c386632	zincfire-a057	3/22/2021, 2:47:27 PM	🟢	ZincFire Inc	🗑
385 - #3	66c1-8a5-c73	zincfire-a053	3/22/2021, 11:44:45 AM	🟢	ZincFire Inc	🗑
385 - #4	-	zincfire-a056	3/12/2021, 2:06:52 PM	🟢	ZincFire Inc	🗑
385 - #5	-	zincfire-a056	3/19/2021, 8:53:32 AM	🟢	ZincFire Inc	🗑
385 - #6	-	zincfire-a059	3/16/2021, 16:07:18 AM	🟢	ZincFire Inc	🗑
385 - #7	-	zincfire-a010	3/17/2021, 6:19:32 AM	🟢	ZincFire Inc	🗑
385 - #8	66c1-8a5-c71	zincfire-a011	3/18/2021, 2:28:55 PM	🟢	ZincFire Inc	🗑
385 - #9	66c1-8a5-c74	zincfire-a012	3/18/2021, 2:41:25 PM	🟢	ZincFire Inc	🗑
385 - #10	-	zincfire-a011	3/12/2021, 2:16:12 PM	🟢	ZincFire Inc	🗑

System Status

System Location: Summary Details Alarm Status Last Update: 12/21/2022, 2:40:05 PM EST System Chemistry: NiZn Location: ZincFire-A053 (GEN1.5 2002) Firmware Version: SV_M800_199_R 5.8.2

Connect Status: On SOC: 99% System Status: Voltage (V) 554.0 Inverter Voltage (V) 578.70 Current (A) 0.0 Alarm Status: 0 Warning, 0 Serious, 1 Critical System Activity: Standby State

System Summary: Batteries 38

Batteries # 37-38
Batteries # 31-33
Batteries # 28-30
Batteries # 19-21
Batteries # 16-18
Batteries # 07-09
Batteries # 04-06

Batteries # 34-36
Batteries # 25-27
Batteries # 22-24
Batteries # 13-15
Batteries # 10-12
Batteries # 01-03

Secondary Processing Unit (SPU)

S48-1 Batteries # 1 - 12
S48-2 Batteries # 13 - 19
S48-3 Batteries # 20 - 26
S48-4 Batteries # 27 - 38

DI/DO

Power Status
Contactor Control
Circuit Breaker Control
Circuit Breaker Status

Temperature (°C) Current (A)
M800 Temperature (°C) 30 Hall Sensor Current (A) 0.0
Diode Temperature (°C) 24 Shunt Current (A) 0.0
Contactor Temperature (°C) 26

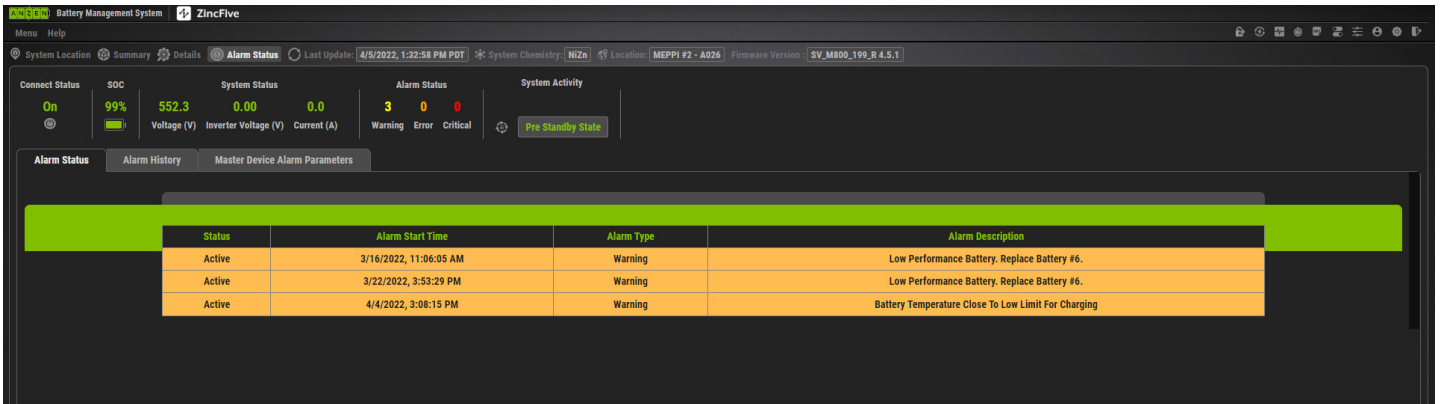
The System Summary page shows the attributes of the system:

- Connect Status: On/Off
- SOC: <Percentage>
- System Status: Voltage
- System Status: Inverter Voltage
- System Status: Current
- Alarm Status: <#Warning, #Serious, #Critical,#Error>

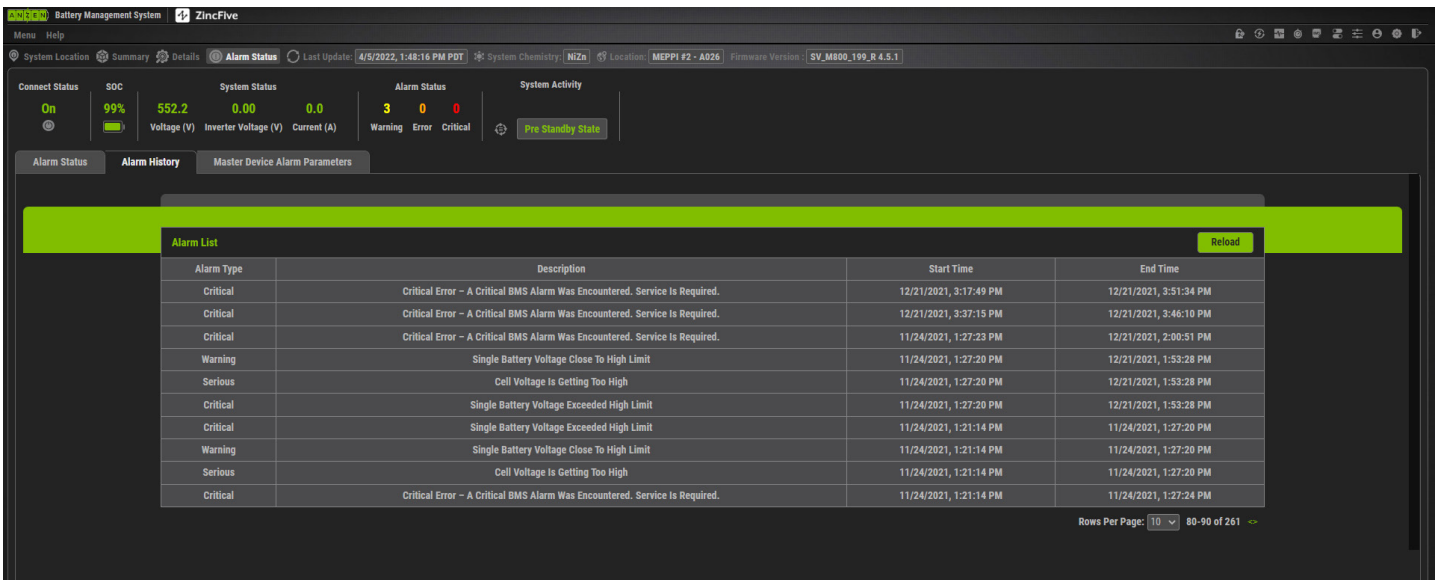
- System Activity (State)
 - **State** – Operational state of the cabinet.
 - **Pre Standby** – Breaker is open, but BMS is powered and can be viewed remotely.
 - **Standby** – BMS is powered, breaker is closed, and faults are cleared. Ready for operation.
 - **Charge** – Charging from UPS (contactor closed).
 - **Discharge** – Discharging (powering) UPS.
 - **Error** – Unknown error – check alarm status.

Note: Time zone can be adjusted by selecting the settings icon  and selecting the appropriate and then selecting accept.

Note: In Error State the system will display the alarm and trip the breaker:



By selecting alarm history all previous alarms will be shown:

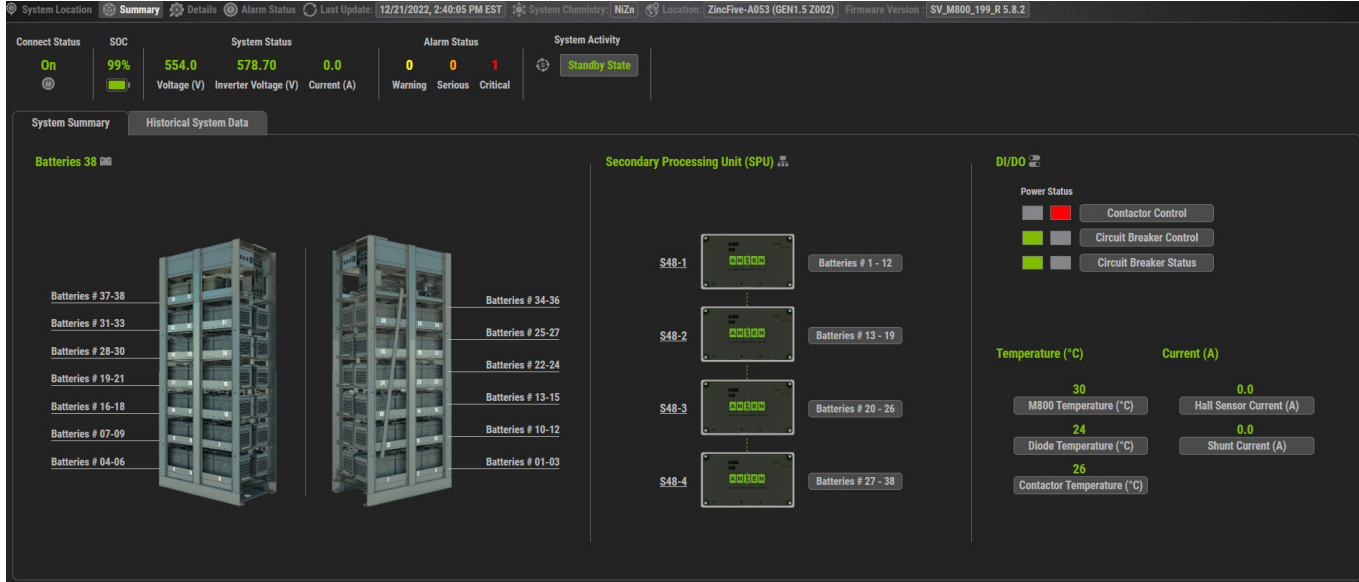


Alarm List

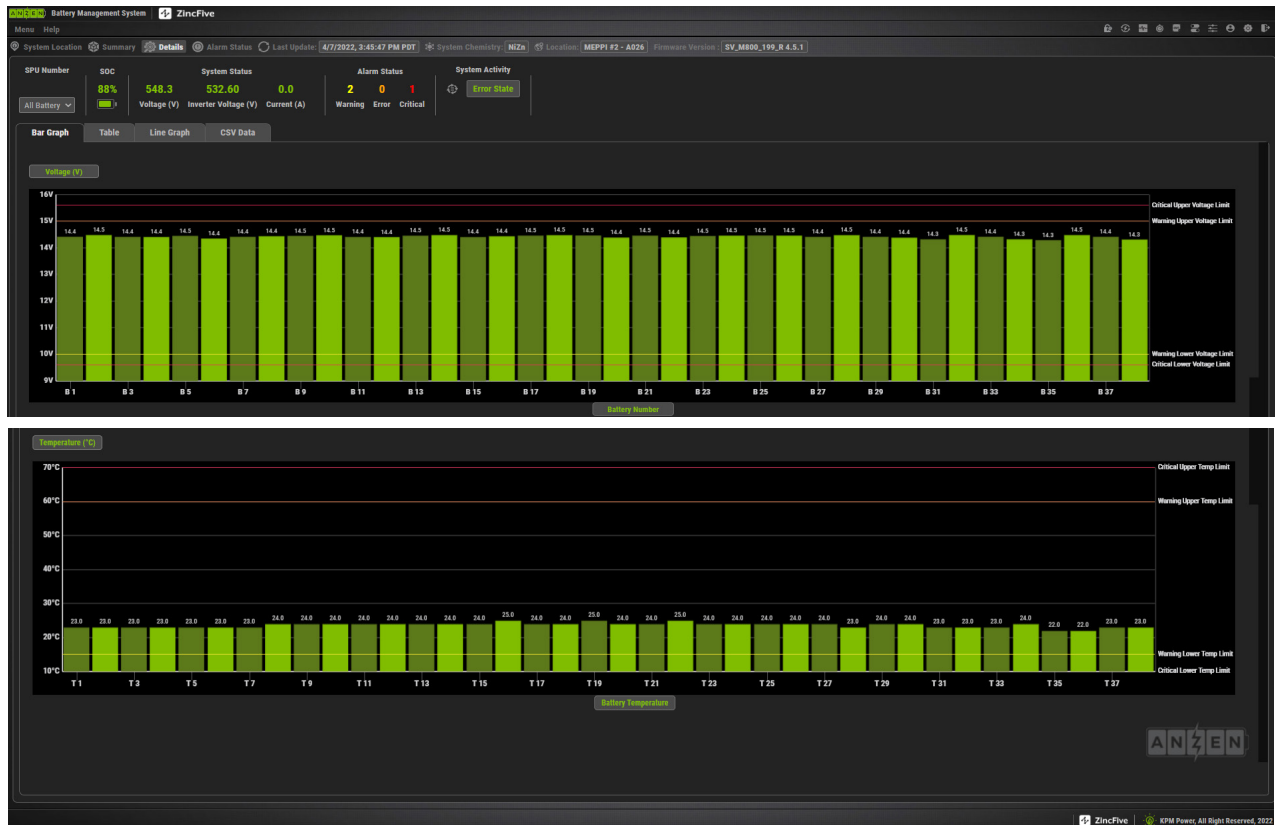
Item #	Default Back Difference	URS Parameter	Message Type	Condition	Descriptions		Action - RS.x.x	Action - RA.x.x
					Interface Display	CSV		
1	-10	BPOV	Warning Critical	String Voltage > 385 - 547V, 375 - 582V, 385 - 578V, 395 - 593V String Voltage > 385 - 559V, 375 - 570V, 385 - 585V, 395 - 600V	System Voltage Close to High Limit System Voltage Exceeded High Limit	N/A STRING_OVER_VOLTAGE	Just Warning Just Warning	Same Breaker Opens. Error State
2	10	BPUV	Warning Serious Critical	<150kW: String Voltage < 385 - 382V, 375 - 403V, 385 - 420V, 395 - 431V 150 - 199kW: String Voltage < 385 - 382V, 375 - 403V, 385 - 414V, 395 - 425V 200-249kW: String Voltage < 385 - 380V, 375 - 394V, 385 - 405V, 395 - 420V String Voltage < 385 - 360V, 375 - 370V, 385 - 380V, 395 - 390V String Voltage < 385 - 346V, 375 - 356V, 385 - 365V, 395 - 374V	System Voltage Close to Low Limit System Voltage At Low Limit System Voltage Exceeded Low Limit Single Battery Voltage Higher than Maximum Operating Voltage. Service System.	STRING_VOLTAGE_CLOSE_TO_LOW_LIMIT STRING_VOLTAGE_LOW STRING_UNDER_VOLTAGE	Just Warning Just Warning Just Warning	Same Breaker Opens. Error State Breaker Opens. Error State
3	-0.2	SB0V	Critical	Monoblock Voltage > 15.6V	Single Battery Voltage Lower than Minimum Operating Voltage. Replace Battery.	MONOBLOCK_OVER_VOLTAGE	Just Warning	Breaker Opens. Error State
4	1	SBUV	Critical	Monoblock Voltage < 7.5V	Replace Battery.	MONOBLOCK_LOW_VOLTAGE	Just Warning	Breaker Opens. Error State
5	N/A	Batlow	Custom Warning Custom Warning	Number Low Voltage Monoblocks = 1, Volt < 10V Number Low Voltage Monoblocks = 2, Volt < 10V	Number Low Voltage Monoblocks = 1, Check Battery #x. Number Low Voltage Monoblocks = 2, Check Battery #x, #y. Number of Low Voltage Monoblocks Exceeded Limit. Check Battery #x, #y, #z	MONOBLOCK_TEMP_SINGLE_WARNING MONOBLOCK_TEMP_DUAL_WARNING MONOBLOCK_TEMP_THREE_OR_MORE_WARNING	Just Warning Just Warning Just Warning	Same Same Breaker Opens. EOD
6	-10	Over Temperature (Charge)	Custom Serious Serious Critical	Number Low Voltage Monoblocks >= 3, Volt < 10V Battery Temperature > 5C	Battery Temperature At High Limit during Charge.	MONOBLOCK_LOW_VOLTAGE_THREE_OR_MORE_WARNING CHECK_TERMINAL_CONNECTION_REPLACE_BATTERY_IF_NECESSARY.	Just Warning Just Warning	n/a n/a
6	-10	Over Temperature (Discharge)	Warning Critical	Battery Temperature > 5C Battery Temperature > 5C	Battery Temperature Close to High Limit during Discharge. Battery Temperature Exceeded High Limit during Discharge	CHARGE_SINGLE_OVERTEMP CHECK_TERMINAL_CONNECTION_REPLACE_BATTERY_IF_NECESSARY. DISCHARGE_SINGLE_OVERTEMP	Just Warning Just Warning	Same Breaker Opens. Error State
7	N/A	Num Batt T High	Custom Warning	Number High Temperature Monoblocks = 1	Number High Temperature Monoblocks = 1, Check battery #x.	MONOBLOCK_TEMP_SINGLE_WARNING	Just Warning	Same
8	2	Low temperature when charging	Custom Warning	Number High Temperature Monoblocks = 2	Number of High Temperature Monoblocks Exceeded Limit. Check Battery #x, #y, #z	MONOBLOCK_TEMP_DUAL_WARNING	Just Warning	Same
8	-4	Over current when fast charge	Warning Serious	Number High Temperature Monoblocks >= 3 Battery Temperature < 20C Current > 160A persistent for 15 seconds	Battery Temperature Close to Low Limit for Charging Fast Charge Current At High Limit	MONOBLOCK_TEMP_THREE_OR_MORE_WARNING CHARGE_CURRENT_HIGH	Just Warning Open Contactor, Reset after 135 sec	Same Breaker Opens. Error State
9	N/A	Over current when fast charge	Error	Current > 1000A	Charge Current Exceeded High Limit. Fix Issue, Reset BMS required.	N/A	Just Warning	Same
10	6.5	Over current when discharge	Serious Critical	Current < 800A Current < -1000A	Discharge Current Exceeded High Limit	FASTCHARGE_OVERCURRENT_FIX_ISSUE_RESET_BMS DISCHARGE_CURRENT_HIGH	Just Warning	Breaker Opens. Error State
11	-20	Diode temperature	Serious	Diode temp > 100	System temperature #1 too high - The charge blocking diode temperature exceeded 100C	DISCHARGE_OVERCURRENT	Just Warning	Breaker Opens. Error State
12	-20	Contactor temperature	Serious	Contactor temp > 150	System temperature #2 too high - The contactor temperature exceeded 150C	DIODE_TEMPERATURE_HIGH_ERROR	Just Warning	Breaker Opens. Error State
13	N/A	ADAh	Custom Warning Custom Serious	ADAh>0 and Current < 4 A and String voltage < (BPOV-14V) ADAh < -40Ah	Charge Completed Below Lower Voltage Threshold. System Undercharged.	CONTACTOR_TEMPERATURE_HIGH_ERROR	Just Warning	Breaker Opens. Error State
14	N/A	Contactor stuck closed in Standby	Error	Standby AND Current > 2A AND (String Voltage = Inverter Voltage) (+/-5V)	System 50% Overcharge Error	CHARGE_FINISHED_STRING_VOLTAGE_LOW_WARNING EXCESSIVE_OVERCHARGE_ERROR	Contactor Open, EOC Contactor Open, EOC	Just Warning Breaker Opens. Error State
15	N/A	R3000 over temperature	Critical	R3000 temp > 75 C	Contactor Stuck Closed. Fix Issue, Reset BMS required.	CONTACTOR_STUCK_CLOSED_FIX_ISSUE_RESET_BMS	Just Warning, Document that this error is latched and can only be reset by BMS reset.	Breaker Opens. Error State
16	-2	M800 over temperature	Critical	M800 temp > 100 C	BMS Power Supply Exceeded High Limit	N/A	Just Warning	Breaker Opens. Error State
17	N/A	Battery Low voltage	Custom Serious	Batlow > 5 for 1 battery OR battery voltage < 8.6V	BMS Temperature Exceeded High Limit	BMS_TEMPERATURE_HIGH	Just Warning	Breaker Opens. Error State
18	N/A	Temperature Position	Custom Serious	Num Batt T High > 5 for 1 battery	Low Performance Battery. Replace Battery #x.	N/A	Just Warning	Same
19	0.5	Supply voltage low	Critical	Supply voltage < 21V	High Temperature Battery. Replace Battery #x.	N/A	Just Warning	Same
20	-0.5	Supply voltage high	Critical	Supply voltage > 32.5V	BMS Power Supply Exceeded Low Limit	SUPPLY_VOLTAGE_LOW	Just Warning	Breaker Opens. Error State
21	N/A	Lost Communication	Warning	One or more SPU lost CAN communication	BMS Power Supply Exceeded High Limit	SUPPLY_VOLTAGE_HIGH	Just Warning	Breaker Opens. Error State
22	N/A	OCV	Critical	Over Voltage Check OCV < 13V when enters Standby after Charge state	SPU Lost Communication. Check CAN connections. Single Battery Low OCV	LOST_COMMUNICATION SINGLE_BATTERY_LOW_OCV	Just Warning	Same n/a

System Summary

The System Summary section shows a graphic of the battery cabinet, a list of all the secondary processing units and status of the digital inputs/outputs.

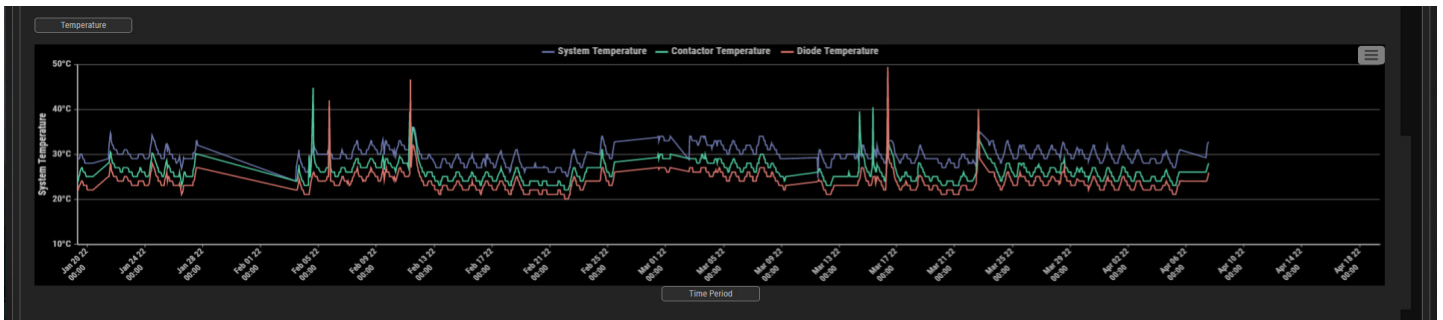


Clicking on any one of the Secondary Processing Unit icons will show the detailed voltages and temperature readings for the batteries attached to that SPU. (This is the same display as when the “Details” icon is selected.) See: 5.2.3 Details



Historical System Data

System voltage, temperature and current over time can be displayed by clicking on the Historical Data tab.



Details

The Details page allows you to see information about individual battery strings and the ability to download the historical data in a comma separated values (CSV) format formatted file.

Note: by clicking the stop watch icon  in the top right the system will be set to update measurements every second.



The SPU Number dropdown allows you to view all the batteries or concentrate on an individual string connected to a single SPU.

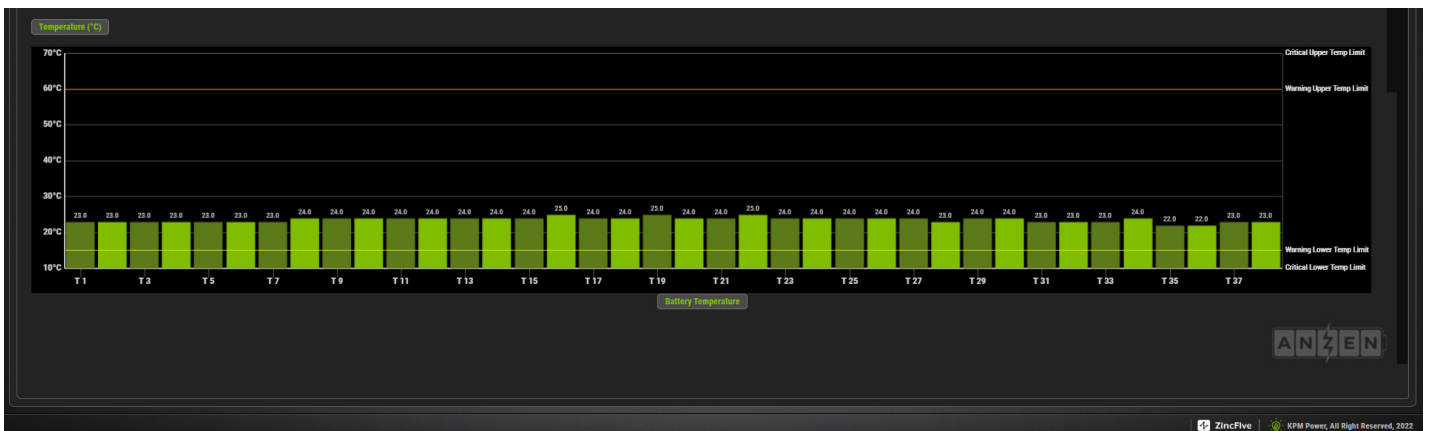
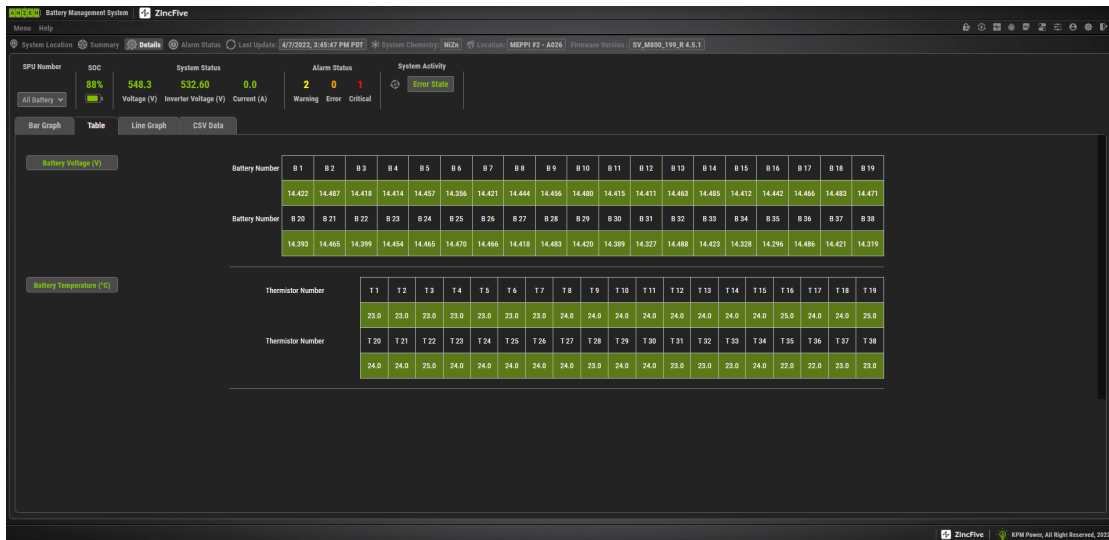


Table View

Clicking on the Table tab will show the battery voltages and temperatures in table format.



Line Graph

Clicking on the Line Graph will allow you to specify the start and end time for the monitoring data to be shown. Then press the Get Data button to update the display.



CSV Data

The CSV Data tab allows you to capture a specific date range of data and download it as a Comma Separated Value (CSV) file which can be read into MS Excel. Follow the following steps to download the data:

- Specify Monitoring Start Time
- Specify Monitoring End Time
- Press the Download to server button

The screenshot displays the ZincFive Battery Management System interface. At the top, there are navigation tabs for Summary, Details, Alarm Status (selected), and System Activity. The Alarm Status section shows 2 warnings, 0 errors, and 1 critical alarm. Below this, the Alarm List table is visible, containing 12 rows of alarm data. The table has columns for Alarm Type, Description, Start Time, and End Time. A 'Reload' button is located at the top right of the table. The footer of the interface shows 'ZincFive | KPM Power, All Right Reserved, 2022'.

Alarm Type	Description	Start Time	End Time
Warning	Battery Temperature Close To Low Limit For Charging	4/4/2022, 3:08:15 PM	4/7/2022, 11:18:54 AM
Warning	Low Performance Battery. Replace Battery #24.	12/29/2021, 8:17:17 AM	3/23/2022, 11:21:57 AM
Warning	Low Performance Battery. Replace Battery #7.	2/4/2022, 9:35:41 AM	3/23/2022, 11:21:57 AM
Warning	Low Performance Battery. Replace Battery #11.	2/4/2022, 9:35:41 AM	3/23/2022, 11:21:57 AM
Warning	Low Performance Battery. Replace Battery #36.	12/22/2021, 12:52:43 PM	3/23/2022, 11:21:57 AM
Warning	Number Low Voltage Monoblocks = 1, Check Battery #6.	3/22/2022, 3:53:29 PM	3/23/2022, 9:24:24 AM
Warning	Battery Temperature Close To Low Limit For Charging	3/22/2022, 1:43:49 PM	3/22/2022, 2:29:42 PM
Warning	Battery Temperature Close To Low Limit For Charging	3/22/2022, 8:27:49 AM	3/22/2022, 1:38:17 PM
Warning	Battery Temperature Close To Low Limit For Charging	3/18/2022, 1:09:54 PM	3/18/2022, 1:16:40 PM
Warning	Number Low Voltage Monoblocks = 1, Check Battery #6.	3/16/2022, 11:06:05 AM	3/16/2022, 11:06:06 AM

- After pressing Download to server, wait several minutes for the Status to indicate Download Complete
- Click on the Download Complete link in the Status column to download the data to your local system. By default the file will be named downloadBmsData.csv. The Web Interface and servers will make several data downloads available from the same page. Previous downloads can be deleted by clicking on the Delete link in the Delete column.
- Previous downloads will be stored in the system memory for two weeks unless manually deleted.

The following information is included in the CSV file for the timespan specified:

Field Name	Notes
R3000 Timestamp	Time stamp of the record in the current time zone.
UTC Timestamp	Time stamp in UTC time zone.
R3000 Time Zone	Current Time Zone location.
Battery Voltage 1-38	One column per battery.
Battery Temperature 1-38	One column per battery.
System Temperature	
Diode Temperature	100C
Contactor Temperature	150C
State	One of the following: Service States: <ul style="list-style-type: none"> • Service • Pre-Standby • Standby • Charge • Discharge • Error
Previous Timestamp State	
Previous State	
Error Msg	Error Message when in Error State.
Battery System Voltage	
Inverter Voltage	
Supply Voltage	24VDC Supply Voltage
System Current	
Hall Current	Hall Effect Sensor Current
Shunt Current	
SOC	State of Charge
SOH	State of Health
cdah	Cumulative Discharge Amp Hours
adah	Actual Discharge Amp Hours
Firmware Version	
Months Since Commissioning	
Fan Status	NA, OFF, ON
Circuit Breaker Status	ON or OFF
Contactor Control	On or OFF
Circuit Breaker Control	On or OFF
Elapse Discharge Time	Na, On or OFF
Cumulative Discharge Energy (kWh)	
Instant Power (W)	

Troubleshooting

Critical/Serious/Error Alarms:

- Serious – Something is wrong with UPS or battery cabinet and some action or investigation is recommended.
- Critical – A potential UPS or battery damaging situation has occurred and some action or investigation is required.
- Error – The Battery cabinet encountered an ERROR condition that requires resetting of the BMS due to an over current condition or contactor stuck condition.
- Single Battery Voltage Higher/Lower than Maximum/Minimum Operating Voltage. Service System. Will only be reached if batteries are out of balance. It indicates a condition where a battery or batteries will need to be replaced.
- Over temperature when charging or discharging – Battery should be inspected to see if there is a problem on any charge or discharge where it reaches the Critical Alarm temperature. It will likely need to be replaced.
- Over-Current on Charge – Max current should not exceed 160Amps per string from the battery charger for more than 15 seconds. The BMS will open contactor for 135s and not allow charging. Contactor time will reset and system may try to accept charge again if SOC < 90%.
- Monoblock Voltage Differential – No battery in the system should differ from the remainder of the batteries by 1.2V. If they do then that battery has lost a cell and will need to be replaced for the system to function properly.

Conditions where the BMS intervenes:

Charging: Contactor Opens

When charging current > 160Amps persists for 15 seconds the CONTACTOR will open. Contactor will remain open for 135s before resetting itself and allowing charge again. This is to prevent the batteries from receiving too much current. When charging current > 1000Amps. The CONTACTOR will open and a latching ERROR will occur. The charge current exceeded the high limit setting. This requires fixing the issue that resulted in the over charge current situation. A reset of the BMS is required to unlatch this condition.

System was undercharged as noted by ADAh <0, Current < 4A and String Voltage < (BPOV-14V) The contactor will open and a warning will notify user.

Overcharging of the batteries (System 50% overcharge Error) The contactor will open in the case that ADAh < -40Ah which signifies an overcharge. (This works the same as All prior releases)

Power Cycle: Breaker Opens

- If the BMS loses power the Breaker will be tripped and Battery Cabinet will no longer provide any discharge ability. (This works the same as ALL prior releases)

Validation Mode: Breaker Opens

- Discharge ended earlier than expected only possible in Validation Mode
- If the system encounters 1 or more monoblock <10V or >75C the breaker will open on a discharge (ie. Discharge ended earlier than expected).

System is not going into Charge state (SOC < 90% and all batteries between 15°C – 40°C) – Contactor Control Power Status is Red.

- Open and close the breaker and the state should be reset.

Battery voltage or temperature is not reading correctly:

- Check for loose or poor connections on the spade/quick connect terminals on the battery terminals.
- Check for connection issues like shown in the picture where the Quick Connect is not attached correctly (did not go over the QC correctly). Also the Torque Seal is broken here, so this bolt should be re-torqued. (Torque to: 9.1 +/- 0.9 N-m)
- After checking connections, power cycle the BMS via the ON/OFF switch to verify if condition persists.

During a charge or discharge the battery voltages are not aligned.

- Generally all the batteries will be within +/-0.3V of one another. If that is not the case there may be a short to chassis ground or problem with the harness.
- Check to see which Secondary Processing Unit batteries have the issue and inspect connections and measure voltages around those batteries. Try to plug and re-plug the SPU connections near batteries and in the BMS box.

Maintenance Instructions

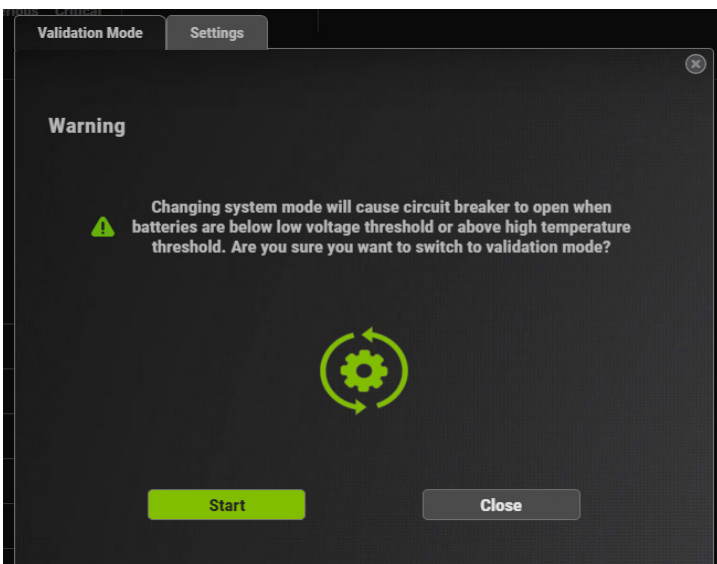
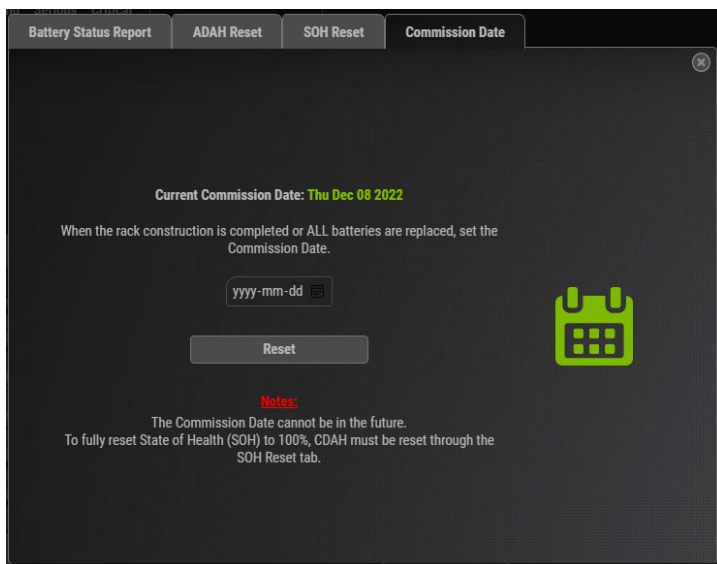
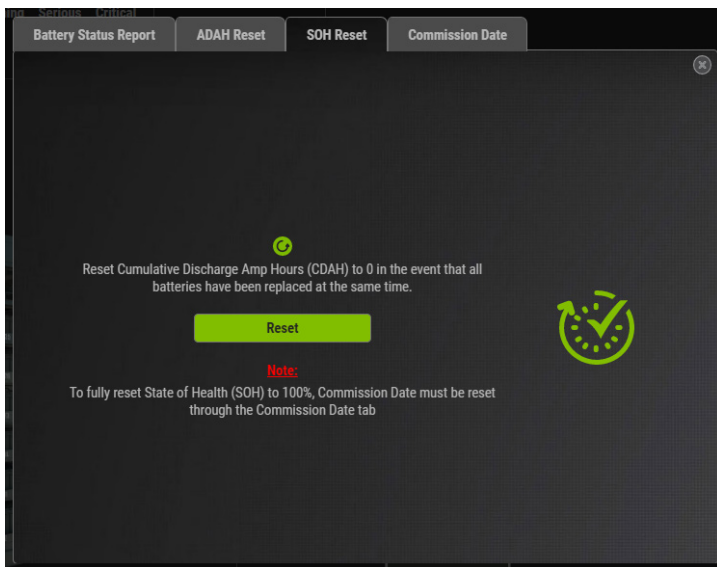
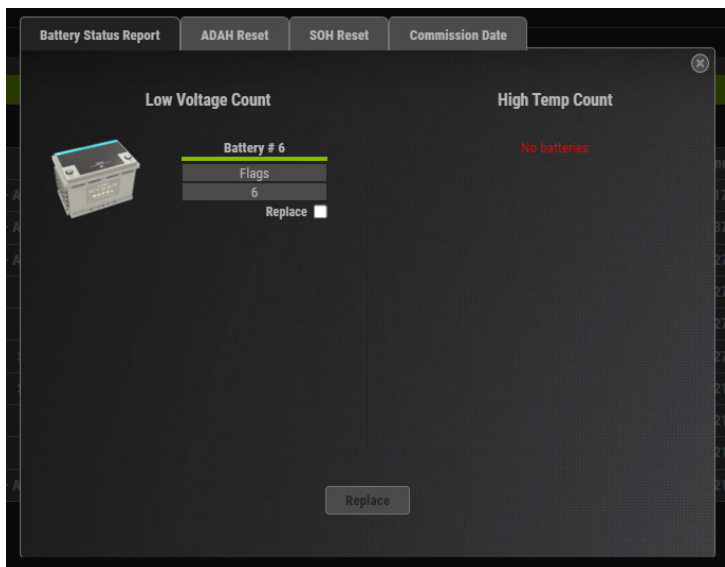
ONLY AUTHORIZED PERSONNEL CAN PERFORM MAINTENANCE.

- a. Ensure that the battery string circuit breaker is open before performing any maintenance action that creates the potential for making contact with any battery or exposed conductive components.
- b. Perform visual inspection of battery trays, batteries, fans, and visible cabling to ensure that all components are clean and don't exhibit any indications of heat, breakage, or chaffing of any wire or cable.
- c. If required, annual inspection and measurement of individual battery voltage and intercell connector resistance can be accomplished by withdrawing one battery shelf at a time.
 - If intercell connection resistance is more than 15% higher than the string average, disconnect, clean and reconnect the cable, retorquing to the proper torque value. (9.1 +/- 0.9 N-m)
- d. There is no need for discharge on an annual basis. The discharge requirement will be on a site by site basis as directed by the customer.

Note: Before energizing the system, verify that the busbars has been connected and torqued correctly.

Battery Replacement

The Battery Management System will recommend batteries to be replaced in the maintenance tab. Follow the Battery Replacement Method of Procedure document for a detail battery replacement procedure. Upon completion of this procedure select the battery has been replaced in the maintenance tab and select the replace icon. If all batteries are replaced select the SOH Reset tab and reset SOH to 100% by selecting the reset icon. The Commissioning date must also be set to the day the batteries were replaced on the Commissioning Date Tab. Once the date is set the set icon must be selected.



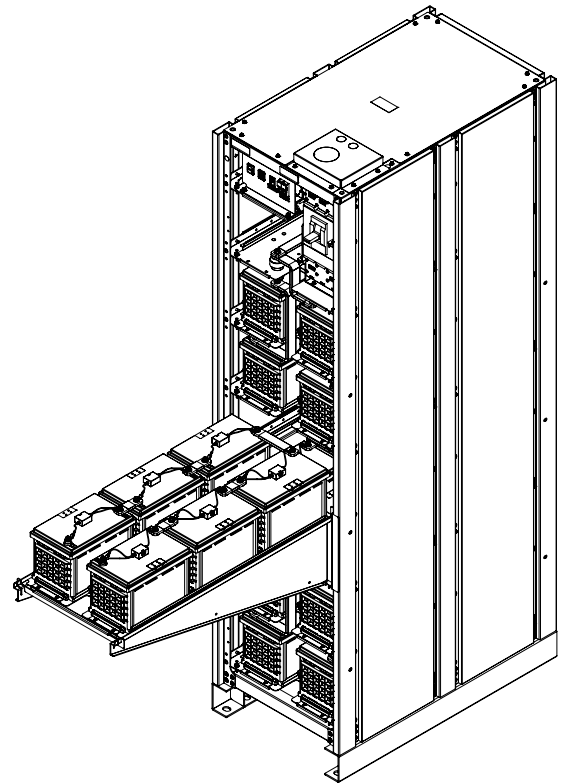
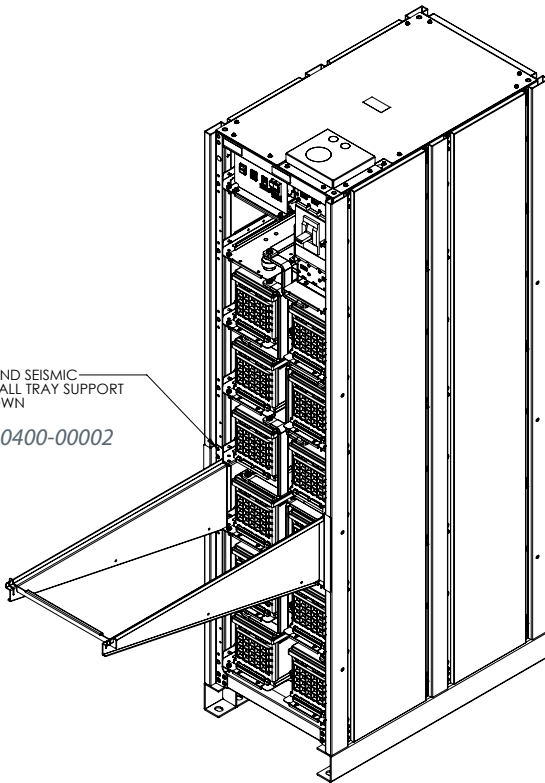
Battery Replacement Procedure Using Tray Support

Steps:

- Disconnect door GND cable and fan harness.
- Remove door from hinges.
- Remove seismic braces (if installed).
- Remove door hinges from cabinet (if necessary to gain access to specific battery trays).
- Remove front busbars for affected battery trays.
- Install LH and RH tray supports using the included M6 flange nuts.
- Install tray support center brace / stop.
- Remove tray locking screws (2).
- Slide out battery tray and service. Note, the tray support center brace / stop will prevent the battery trays from sliding too far out of the cabinet.
- Repeat the above steps in reverse order to reassemble cabinet.

REMOVE DOOR AND SEISMIC BRACES AND INSTALL TRAY SUPPORT BRACKETS AS SHOWN

P/N: 00910-00400-00002



PULL BATTERY TRAY OUT FULLY TO SERVICE COMPONENTS.
DO NOT ATTEMPT TO PULL BATTERY TRAY OUT WITHOUT TRAY SUPPORT IN PLACE.

APPENDIX

Current Sensor Calibration

ONLY AUTHORIZED PERSONNEL CAN PERFORM MAINTENANCE.

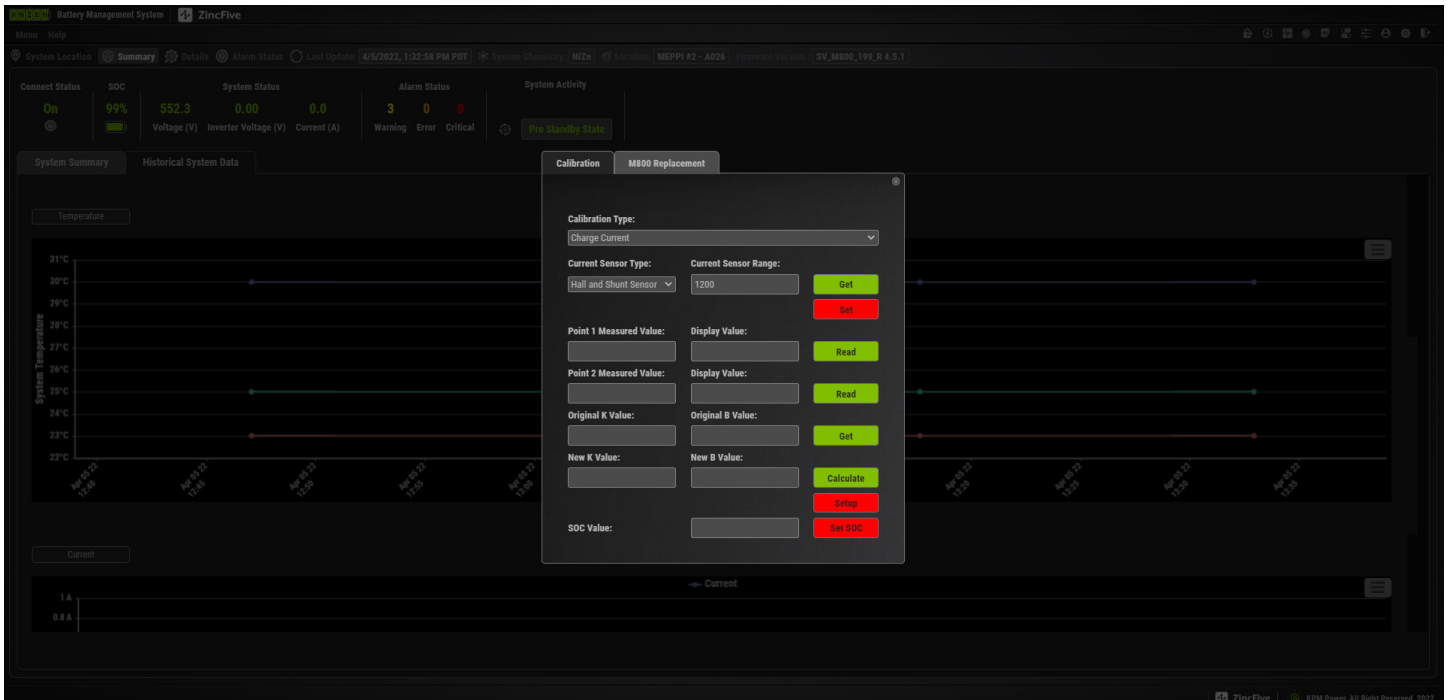
The current Sensor calibration is done in the factory prior to shipment of the battery cabinet. This step should NOT need to be done unless BMS components are replaced, settings are lost, or when tested the system calibration is off by more than 10%.

To calibrate the hall effect and current shunt sensors on the system the following steps need to be taken:

1. Install a Fluke (or similar) Clamp on Digital Meter (Top side of C/B on negative cables.) to get current measurements.
2. Make sure the System Activity displays “Standby State”.
3. Open current calibration window on the Web interface by pressing the Calibration icon on the upper right:



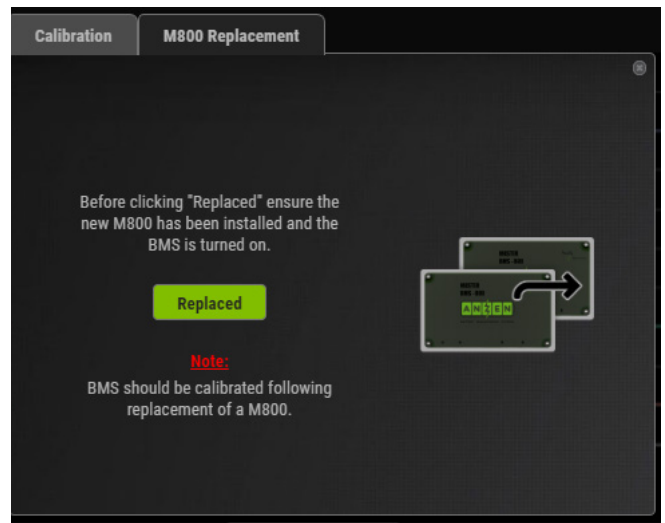
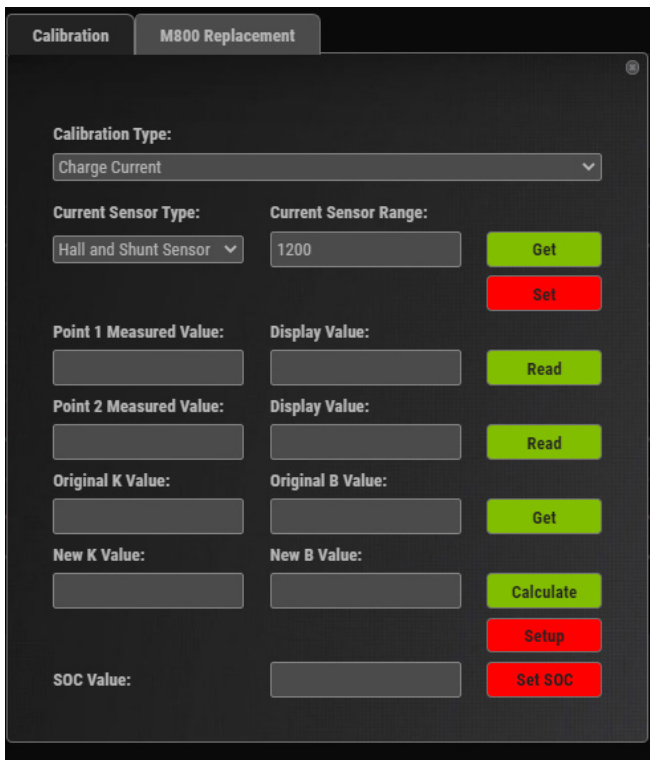
4. Start calibration with hall effect sensor. Select “Hall Sensor” under the Current Sensor Type. Select Current Sensor Range to be 500. Click set.



5. Input 1 for New K Value and 0 for New B Value. Press Setup.
6. Check that the new values are set by clicking read next to original K/B values.
7. Acquire the Point 1. For Measured Value input the value from multimeter and press read to input the display value.

8. To start charging the batteries set SOC to 50% so that the positive current would start to flow.

9. Acquire the Point 2. For Measured Value input the value from multimeter and press read to input the display value.
10. Calculate and setup new K/B values by clicking Calc and Setup.
11. Check that the new values are set by clicking read next to original K/B values. The values should be the same as the calculated values from step 11.
12. Repeat steps 8-12 until the measured and displayed current values are as accurate as possible.
13. This is the end of calibration for "Charge current".
14. Select Calibration Type to be "Discharge Current".
15. Repeat steps 6 to 8.
16. Start discharging the batteries, so that the negative current would start to flow.
17. Repeat steps 10 to 13. This is the end of calibration for "Discharge Current"
18. Continue calibration with current shunt. Select "Shunt Sensor" under the Current Sensor Type. Select Current Sensor Range to be 1200. Click set.
19. Repeat steps 5 to 18.
20. Finish calibration by selecting "Hall and Shunt Sensor" under the Current Sensor Type. Select Current Sensor Range to be 1200. Click set.





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01100-00400-00105, rev H02