

OPERATIONS MANUAL

# ZincFive BC Series UPS Battery Cabinets



*ZincFive BC Series UPS  
Battery Cabinet*



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## IMPORTANT SAFETY INSTRUCTIONS - SAVE THESE INSTRUCTIONS

THIS MANUAL CONTAINS IMPORTANT INSTRUCTIONS AND WARNINGS FOR ZINCFIVE 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.

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## 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 dans les applications d'utilisation fin par un personnel qualifié dans l'utilisation sécuritaire des alimentations à haute énergie et de leurs batteries. La connaissance du code électrique local et de leur application sécuritaire est également suppose.
-  Pour éviter les shorts, chocs ou électrocutions accidentels, ne laissez jamais l'eau ou toute autre forme de toucher liquide, entourer ou entrer dans les batteries.
-  Ne pas faire fonctionner les batteries avec des câbles et des fils endommagés. Les câbles et les fils défectueux doivent être remplacés avant l'installation du système. Avant l'installation du système, vérifiez que tous les câbles et fils sont correctement fixés et connectés. Les connexions défectueuses peuvent interrompre le fonctionnement et causer des dommages irréparables à ce produit.
-  Le démantèlement ou l'ouverture de l'enceinte de la batterie annulera la garantie du produit et créera un risque de choc électrique.

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## 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 RENSER. MAINTENIR À NIVEAU.

**ATTENTION :** RISQUE D'INCENDIE, D'EXPLOSION OU DE BRÛLURES. NE PAS DÉMONTER, CHAUFFER AU-DESSUS DE 75°C, OU INCINÉRER.

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## Specifications

Refer to the ZincFive BC Series UPS Battery Cabinet data sheet for specifications.

[zincfive.com/zincfive-ups-bc-series](http://zincfive.com/zincfive-ups-bc-series)

# Safety Precautions

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## **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):** 50kA (instantaneous trip <10mS for any current  $\geq 7800A$ )

**ARC FLASH DETAILS:** Incident Energy at: 18in, Min. Arc Rating: 20 cal/cm<sup>2</sup>, Arc Flash Boundary: 72.5in

**MAXIMUM SHORT CIRCUIT RATING (BATTERY):** 5400A

## Tools

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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

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## 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) :** 50 kA (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/cm<sup>2</sup>, Limite d'arc électrique : 72,5 po

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

## Outils

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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

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## 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.

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## 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.
- Battery string is wired in a split string for increased safety during maintenance.
- 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 2018.
- Employs ZincFive's UL 1989 and CAN/CSA-C22.2 No. 60896-21:17



*ZincFive BC Series UPS  
Battery Cabinet*

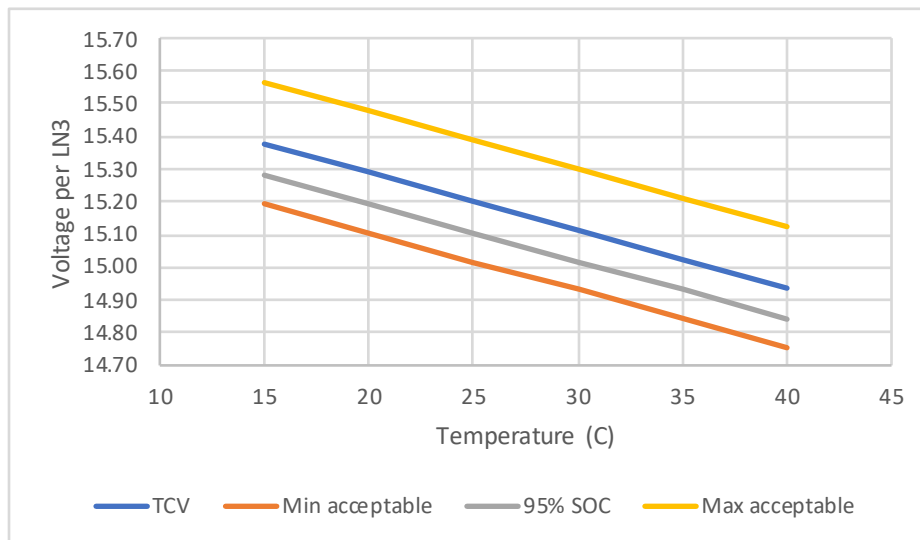
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## Physical Characteristics

ZF37A6SXXXXIAXXX.....26.6"W x 31"D x 82"H Weight: 1,925 lbs (873 kg)  
ZF38A6SXXXXIAXXX.....26.6"W x 31"D x 82"H Weight: 1,960 lbs (889 kg)  
ZF39A6SXXXXIAXXX.....26.6"W x 31"D x 82"H Weight: 1,995 lbs (905 kg)

# Setup

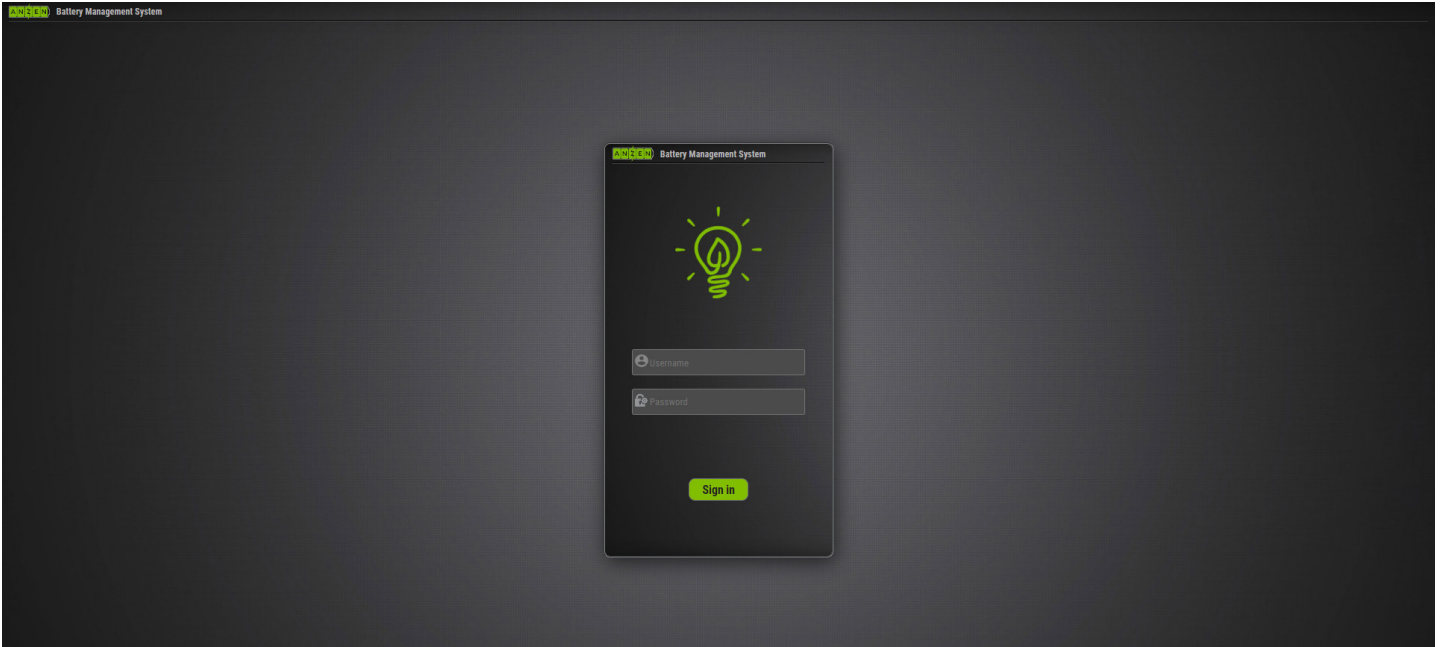
- a. All cables should be attached to the cabinet: DC Power and AC Power. Also UVR/Shunt and Aux contacts to the UPS if needed.
  - The 120Vac feed to the cabinet must be always available (from UPS, backed up—100W backup recommended). Loss of 120VAC will shut the system down and turn off the Battery 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

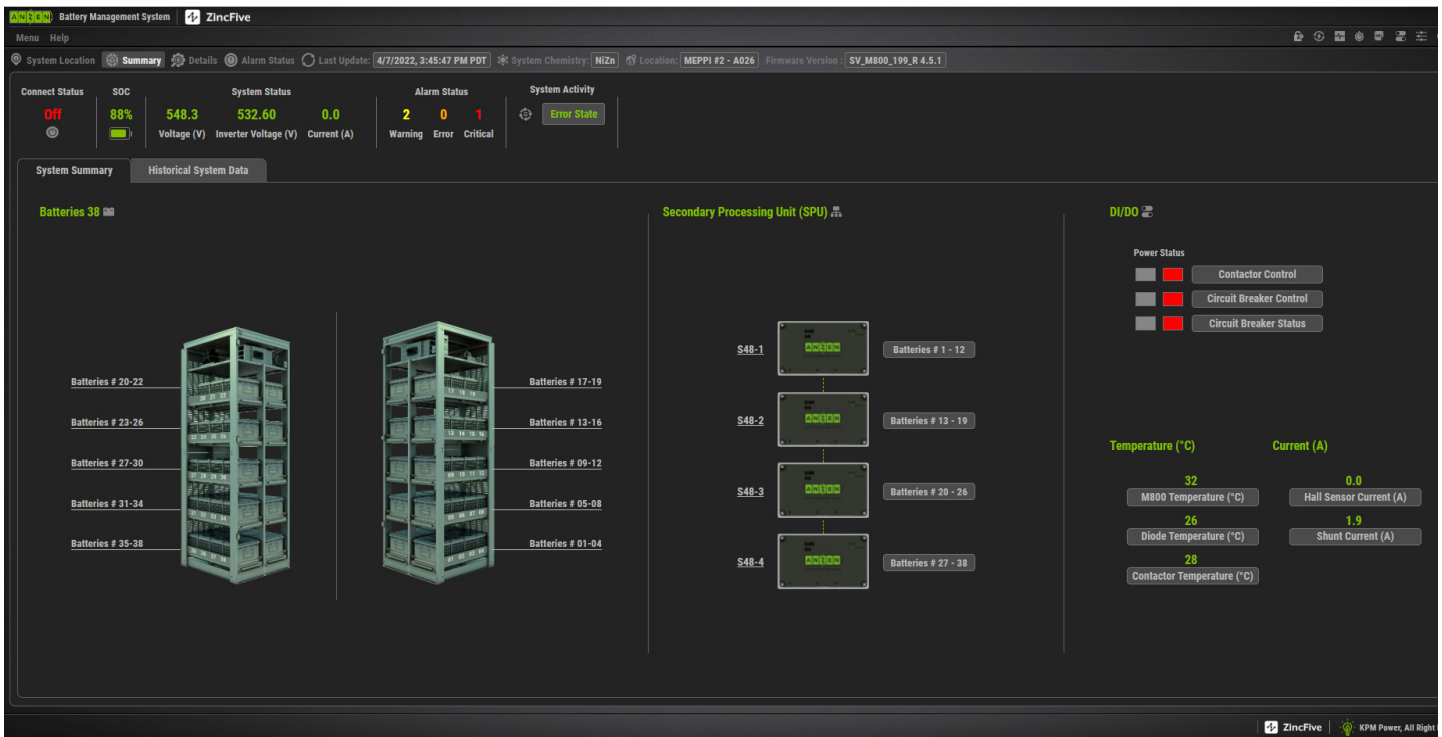
- a. Power up the system by turning ON the 120Vac to the UPS Battery Cabinet. Make sure the BMS ON/OFF switch on inside of cabinet door is turned ON.
    - Allow 1 minute for the BMS to initialize.
  - b. Log into the Web interface and verify that the BMS is Online.
    - For Cloud Server option (external 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	1bd213ba6	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 - #10	-	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 follow 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 > 581V
- 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 between -2Amp to -800Amp the system will enter a Discharge State.
- c. Discharge will end upon any of these conditions:
  - String Voltage < 380V (38 BC)
  - Any 3 Monoblock < 10V (or 1 Monoblock < 7.5V)
  - Any 3 Monoblock reaches 75°C (or 1 Monoblock reaches 85°C)
  - Current <= -800A
- d. The BMS will open the breaker if any of the above conditions are met.
- e. Alternatively, the UPS can open the circuit breaker via the UVR / Shunt relay.
- f. Specification: (Notes: Data Sheet & Table below)
- g. After a discharge, all batteries must fall below 40°C before recharge begins.
- h. Maximum current is 800Amps. Any current over 800Amps for 2s will result in the BMS remotely tripping the circuit breaker.
- i. The breaker is set to trip at 2500A for a dead short circuit.

## Controls Parameters

Item	Parameter	Number of Batteries	Operation Min/Max	Warning	Error / Fault	Critical Alarm	Email <sup>7</sup> (X)	Comments
1a	BPOV - Battery pack total voltage overvoltage (V)	36	551	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 – 14 V.
1b	BPOV - Battery pack total overvoltage (V)	37	566	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 – 14 V.
1c	BPOV - Battery pack total voltage overvoltage (V)	38	581	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 – 14 V.
1d	BPOV - Battery pack total voltage overvoltage (V)	39	596	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 – 14 V.
2a	BPUV - Battery pack total voltage undervoltage (V)	36	360	369	346	336	X	
2b	BPUV - Battery pack total voltage undervoltage (V)	37	370	380	355	346	X	
2c	BPUV - Battery pack total voltage undervoltage (V)	38	380	390	365	355	X	
2d	BPUV - Battery pack total voltage undervoltage (V)	39	390	400	374	364	X	
3	SBOV - Single battery (cell) overvoltage (V)		15.5		15.6	4.5 or 5.0 <sup>2</sup>	X	Originally 3.925V (3.925 * 4 = 15.7V). But wasn't enough margin for the system to operate without error in noisy environment or with filters.
4	SBUV - Single battery (cell) under voltage (V) <sup>9</sup>			10 / 8.6	7.5	0 <sup>2</sup>	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	Error / Fault	Critical Alarm	Email <sup>7</sup> (X)	Comments
6	Over temperature when charging or discharging (°C)		None <sup>1</sup>	75		85	X	System keeps running up to 85C reached at battery.
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 <sup>1</sup>	< 20	none			No safety issue. Warning < 20C.
9	Over current when fast charge (A)				160 <sup>8</sup>	1000	X	
10	Over current when discharge (A)				-800 <sup>6</sup>	-1000	X	Spec
11	Diode Temperature (°C)				100		X	Used table with 1000A estimate used.
12	Contactoer Temperature (°C)				150		X	Measured at Terminal. Terminal temperature.
13	ADAh <sup>4</sup> (Ah)			< 0 <sup>5</sup>	<-40		X	
14	Contactoer Stuck Closed in Standby				X		X	If in Standby and Current >2A AND (String Voltage = Inverter Voltage) (+/- 5V) then Generate Error/Fault Alarm
15	Power Supply Voltage Low					<=21V		
16	Power Supply Voltage High					>=32.5V		

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. System operating temperature should be 20-35°C. Start of charge temperature window is 15°C to 40°C. Once charge started there are no limits just Fault at 85°C.
2. Critical values are for voltage divider readings therefore they are ¼ the full module voltage.
3. N/A
4. Defined in later section.
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. Current <-1000A is Critical Alarm and requires an instantaneous trigger.
7. Emails are to be transmitted for errors and critical alarms.

## Battery Management 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.
- See: 5 Web Interface

### 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.)

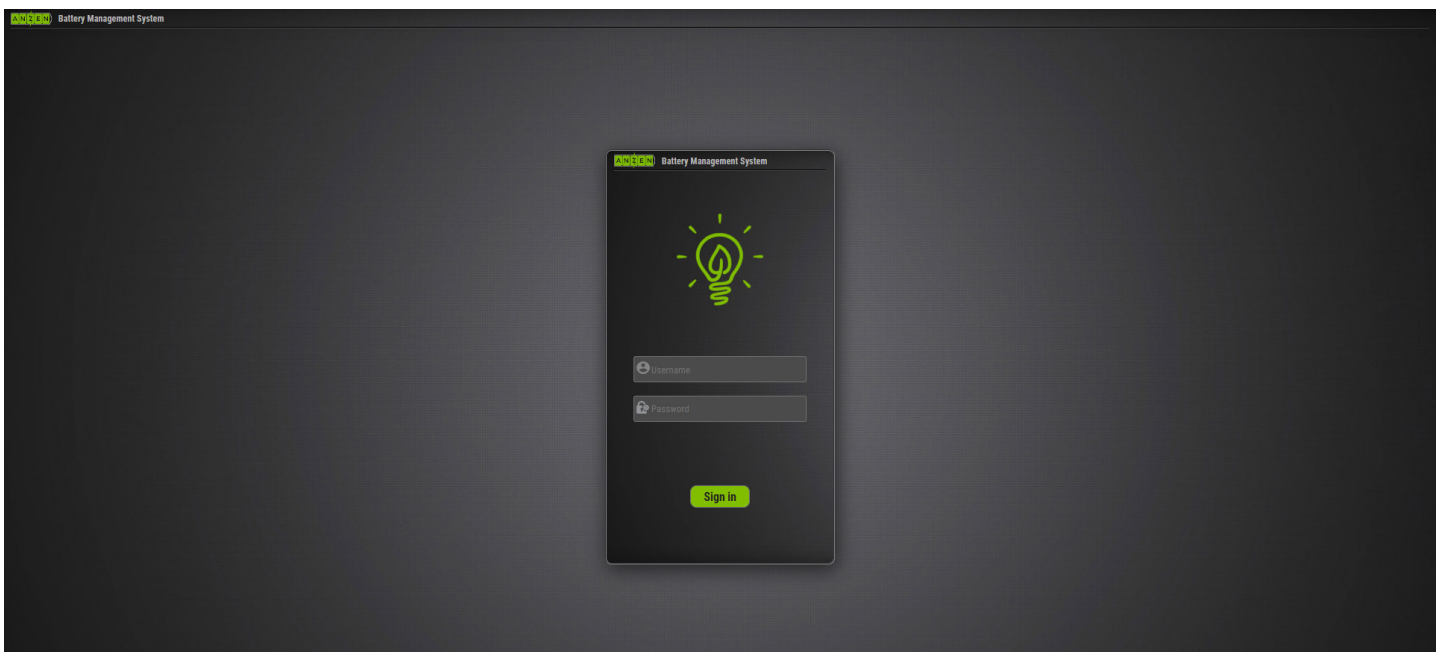


# Web Interface

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

## Login & System Selection

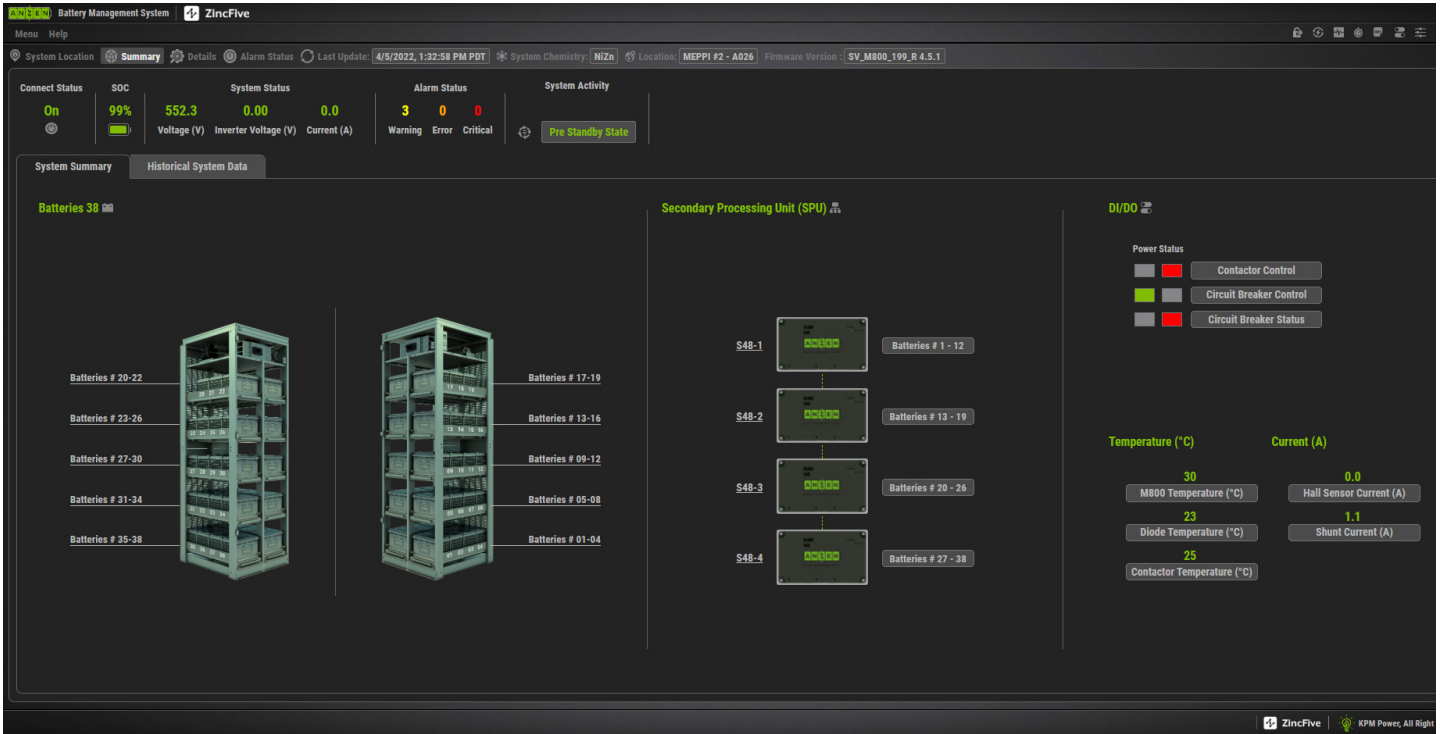
Browse to <https://manage.anzenbms.com/> to see the login prompt:



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


System Name	ZincFive ID	ID	Last Update	Alarm Status	Company Name	
385 - #1	66c1 Bds v77	16d215ba6	3/22/2021, 11:53:56 AM	🔴	ZincFive Inc	🗑️
385 - #2	316b366a32	316cfe-a087	3/22/2021, 2:47:27 PM	🟢	ZincFive Inc	🗑️
385 - #3	66c1 Bds v73	316cfe-a083	3/22/2021, 11:44:05 AM	🟢	ZincFive Inc	🗑️
385 - #4	-	316cfe-a085	3/12/2021, 2:06:32 PM	🟢	ZincFive Inc	🗑️
385 - #5	-	316cfe-a086	3/19/2021, 8:53:22 AM	🔴	ZincFive Inc	🗑️
385 - #6	-	316cfe-a088	3/16/2021, 10:07:18 AM	🟢	ZincFive Inc	🗑️
385 - #7	-	316cfe-a010	3/17/2021, 6:19:22 AM	🟢	ZincFive Inc	🗑️
385 - #8	66c1 Bds v71	316cfe-a011	2/18/2021, 2:28:50 PM	🟢	ZincFive Inc	🗑️
385 - #9	66c1 Bds v74	316cfe-a012	2/18/2021, 2:41:25 PM	🟢	ZincFive Inc	🗑️
385 - #10	-	316cfe-a011	3/12/2021, 3:16:12 PM	🟢	ZincFive Inc	🗑️

# System Status



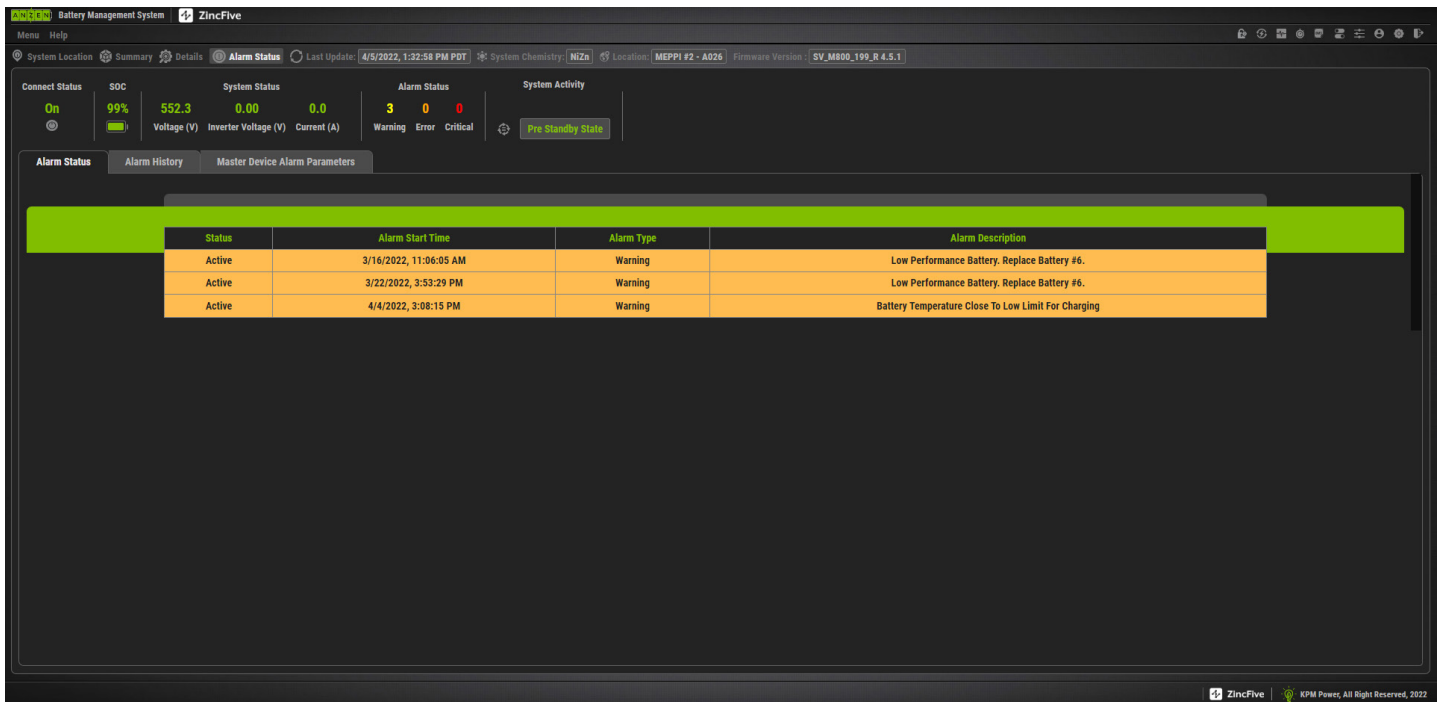
The System Summary page shows the attributes of the system:

- Connect Status: On/Off
- SOC: <Percentage>
- System Status: Voltage
- System Status: Inverter Voltage
- System Status: Current
- Alarm Status: <#Warning, #Serious, #Critical>
- 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.
  - **End of Discharge** – Cabinet is completely discharged.
  - **Error** – Unknown error – check alarm status.

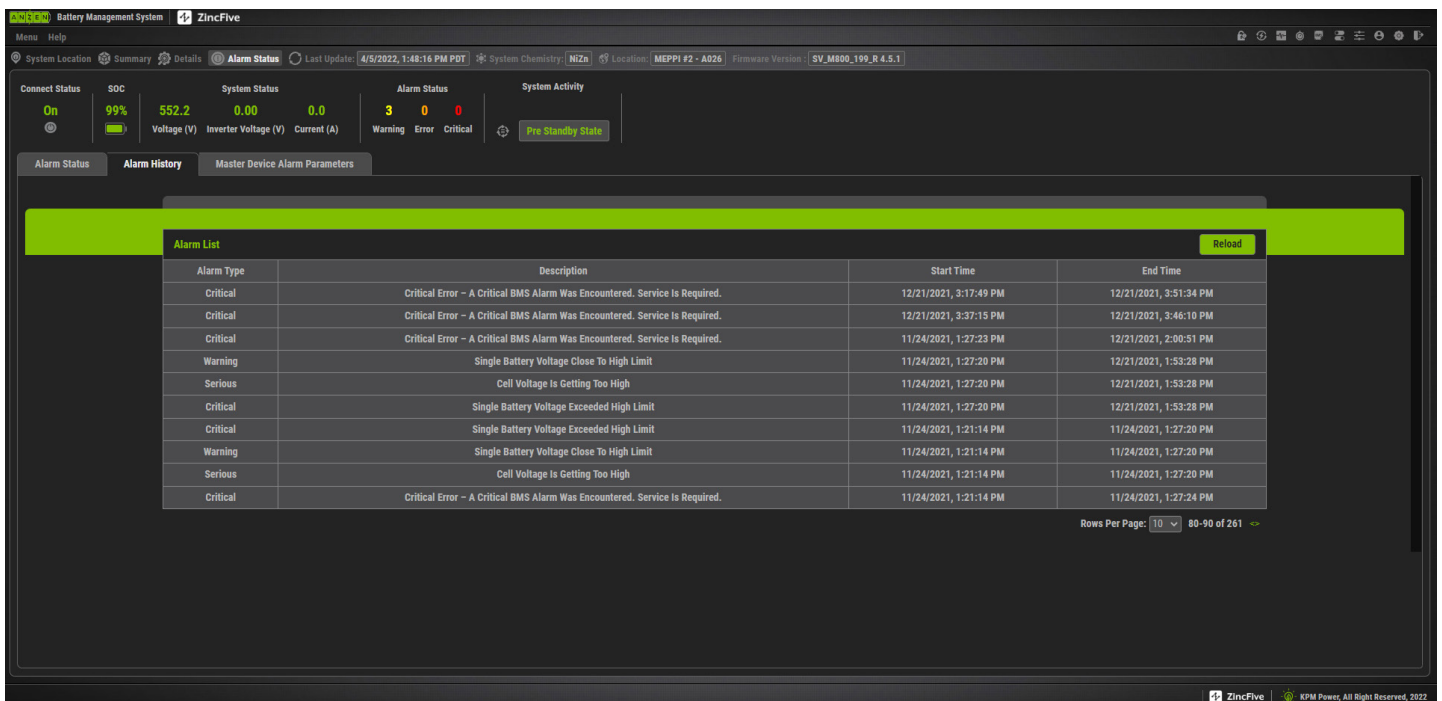
**Note:** Time zone can be adjusted by selecting the settings icon  and selecting the appropriate and then selecting accept.



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



By selecting alarm history all previous alarms will be shown:



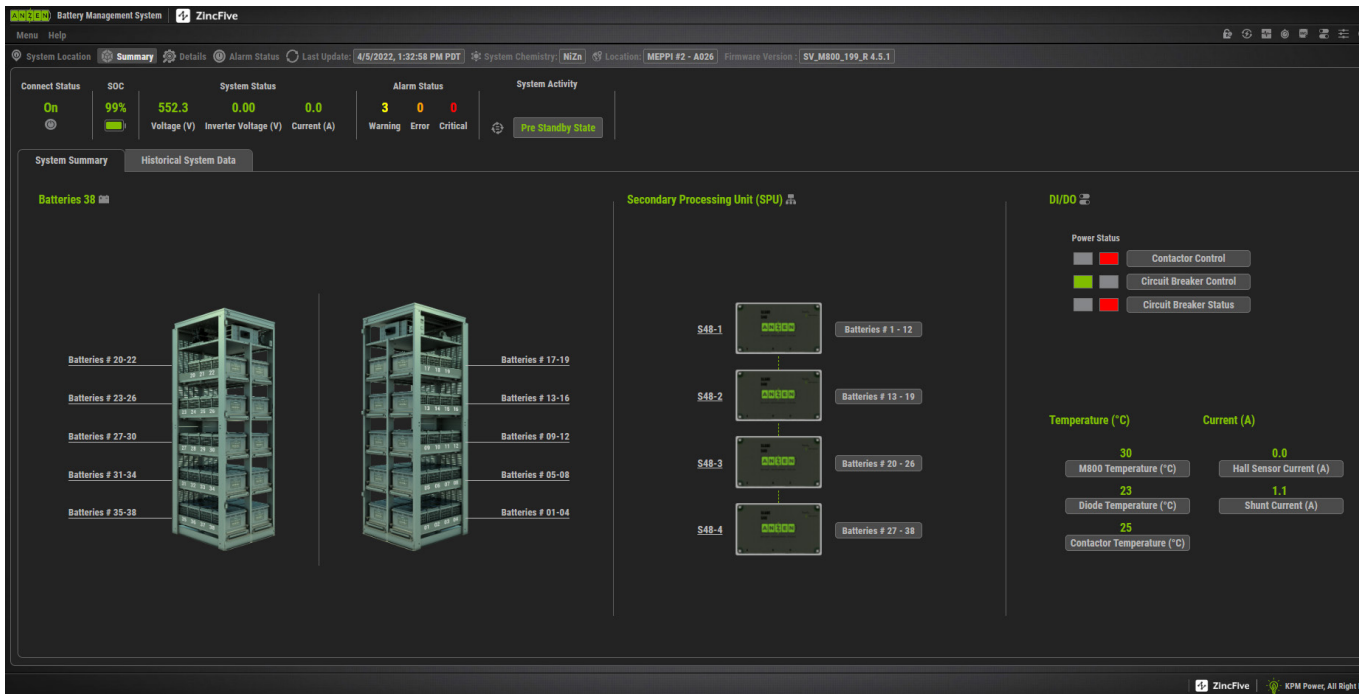
# Alarm List

UIS Parameter	Message Type	Condition	Interface Display	Descriptions		Result
				Interface Display	CSV	
BP OV	Warning	String Voltage > 365 - 547V, 375 - 562V, 385 - 578V, 395 - 593V	System Voltage Close to High Limit	N/A	N/A	Just Warning
	Critical	String Voltage > 365 - 555V, 375 - 570V, 385 - 585V, 395 - 600V	System Voltage Exceeded High Limit	ANZEN_SAFETY_ALARM_STRING_OVER_VOLTAGE	ANZEN_SAFETY_ALARM_STRING_OVER_VOLTAGE	Breaker Opens. Error State
BP UV	Warning	String Voltage < 365 - 369V, 375 - 380V, 385 - 390V, 395 - 400V	System Voltage Close to Low Limit	N/A	N/A	Just Warning
	Error	String Voltage < 365 - 346V, 375 - 355V, 385 - 365V, 395 - 374V	System Voltage Low	STRING_VOLTAGE_LOW_ERROR	ANZEN_SAFETY_ALARM_STRING_UNDER_VOLTAGE	Breaker Opens. Error State
SBOV	Critical	String Voltage < 365 - 336V, 375 - 346V, 385 - 355V, 395 - 364V	System Voltage Exceeded Low Limit	ANZEN_SAFETY_ALARM_STRING_UNDER_VOLTAGE	ANZEN_SAFETY_ALARM_STRING_UNDER_VOLTAGE	Breaker Opens. Error State
	Error	Monoblock Voltage > 15.6V	Single Battery Voltage Higher than Maximum Operating Voltage. Service System.	MONOBLOCK_LOW_VOLTAGE_ERROR	MONOBLOCK_LOW_VOLTAGE_ERROR	Breaker Opens. Error State
SBUV	Critical	Single Battery (Cell) Voltage > 4.5V - No filter boards; >5V - filters	Single Battery Voltage Exceeded High Limit	ANZEN_SAFETY_ALARM_SINGLE_OVER_VOLTAGE	ANZEN_SAFETY_ALARM_SINGLE_OVER_VOLTAGE	Breaker Opens. Error State
	Error	Monoblock Voltage < 7.5V	Single Battery Voltage Lower than Minimum Operating Voltage. Replace Battery.	MONOBLOCK_HIGH_VOLTAGE_ERROR	MONOBLOCK_HIGH_VOLTAGE_ERROR	Breaker Opens. Error State
Over Temperature	Critical	Single Battery (Cell) Voltage < 0V	Single Battery Voltage Exceeded Low Limit	ANZEN_SAFETY_ALARM_SINGLE_UNDER_VOLTAGE	ANZEN_SAFETY_ALARM_SINGLE_UNDER_VOLTAGE	Breaker Opens. Error State
	Warning	Number Low Voltage Monoblocks = 1	Number Low Voltage Monoblocks = 1. Check Battery #.	MONOBLOCK_LOW_VOLTAGE_SINGLE_WARNING	MONOBLOCK_LOW_VOLTAGE_SINGLE_WARNING	Just Warning
Battflow	Warning	Number Low Voltage Monoblocks = 2	Number Low Voltage Monoblocks = 2. Check Battery #.	MONOBLOCK_LOW_VOLTAGE_DUAL_WARNING	MONOBLOCK_LOW_VOLTAGE_DUAL_WARNING	Just Warning
	Warning	Number Low Voltage Monoblocks >= 3	EOD. Number of Low Voltage Monoblocks Exceeded Limit. Check Battery #.	MONOBLOCK_LOW_VOLTAGE_THREE_OR_MORE_WARNING	MONOBLOCK_LOW_VOLTAGE_THREE_OR_MORE_WARNING	Breaker Opens. EOD
Num Batt T High	Warning	Battery Temperature > 75C	Battery Temperature Close to High Limit during Charge	N/A	N/A	Just Warning
	Critical	Battery Temperature > 85C	Battery Temperature Exceeded High Limit during Charge	ANZEN_SAFETY_ALARM_CHARGE_SINGLE_OVERTEMP	ANZEN_SAFETY_ALARM_CHARGE_SINGLE_OVERTEMP	Breaker Opens. Error State
Over current when fast change	Warning	Battery Temperature > 75C	Battery Temperature Close to High Limit during Discharge	N/A	N/A	Just Warning
	Critical	Battery Temperature > 85C	Battery Temperature Exceeded High Limit during Discharge	ANZEN_SAFETY_ALARM_DISCHARGE_SINGLE_OVERTEMP	ANZEN_SAFETY_ALARM_DISCHARGE_SINGLE_OVERTEMP	Breaker Opens. Error State
Diode temperature	Warning	Number High Temperature Monoblocks = 1	Number High Temperature Monoblocks = 1. Check Battery #.	MONOBLOCK_TEMPERATURE_SINGLE_WARNING	MONOBLOCK_TEMPERATURE_SINGLE_WARNING	Just Warning
	Error	Number High Temperature Monoblocks = 2	Number High Temperature Monoblocks = 2. Check Battery #.	MONOBLOCK_TEMPERATURE_DUAL_WARNING	MONOBLOCK_TEMPERATURE_DUAL_WARNING	Just Warning
Low temperature when charging	Warning	Number High Temperature Monoblocks >= 3	EOD. Number of High Temperature Monoblocks Exceeded Limit. Check Battery #.	MONOBLOCK_TEMPERATURE_THREE_OR_MORE_WARNING	MONOBLOCK_TEMPERATURE_THREE_OR_MORE_WARNING	Breaker Opens. EOD
	Warning	Battery Temperature < 20C	Single Battery Temperature Close to Low Limit for Charging	N/A	N/A	Just Warning
Over current when fast change	Error	Current > 160A	Maximum Charge Current Exceeded	MAX_CHARGE_CURRENT_ERROR	MAX_CHARGE_CURRENT_ERROR	Breaker Opens. Error State
	Critical	Current > 1000A	Charge Current Exceeded Critical Limit	ANZEN_SAFETY_ALARM_FASTCHARGE_OVERCURRENT	ANZEN_SAFETY_ALARM_FASTCHARGE_OVERCURRENT	Breaker Opens. Error State
Over current when discharge	Error	Current < -800A	Maximum Discharge Current Exceeded	DISCHARGE_CURRENT_HIGH_ERROR	DISCHARGE_CURRENT_HIGH_ERROR	Breaker Opens. Error State
	Critical	Current < -1000A	Discharge Current Exceeded Critical Limit	ANZEN_SAFETY_ALARM_DISCHARGE_OVERCURRENT	ANZEN_SAFETY_ALARM_DISCHARGE_OVERCURRENT	Breaker Opens. Error State
Diode temperature	Error	Diode temp > 100	System temperature#1 too high - The charge blocking diode temperature exceeded 100C	DIODE_TEMPERATURE_HIGH_ERROR	DIODE_TEMPERATURE_HIGH_ERROR	Breaker Opens. Error State
	Error	Contactor temp > 150	System temperature#2 too high - The contactor temperature exceeded 150C	CONTACTOR_TEMPERATURE_HIGH_ERROR	CONTACTOR_TEMPERATURE_HIGH_ERROR	Breaker Opens. Error State
ADAh	Warning	ADAh<0 and Current <4 A and String voltage<(BP OV+14V)	Charge Completed Below Lower Voltage Threshold. System Undercharged.	CHARGE_FINISHED_STRING_VOLTAGE_LOW_WARNING	CHARGE_FINISHED_STRING_VOLTAGE_LOW_WARNING	Just Warning
	Error	ADAh < -40Ah	System 50% Overcharge	ACTUAL_DISCHARGE_ERROR	ACTUAL_DISCHARGE_ERROR	Breaker Opens. Error State
Contactor stuck closed in StandBy	Error	StandBy and Current > 2A AND (String Voltage = Inverter Voltage) (+/- 5V)	Contactor Stuck Closed	CONTACTOR_STUCK_CLOSED	CONTACTOR_STUCK_CLOSED	Breaker Opens. Error State
	Critical	R3000 temp > 75 C	R3000 Temperature Exceeded High Limit	N/A	N/A	Breaker Opens. Error State
Battery Low voltage	Critical	M800 temp > 100 C	BMS Temperature Exceeded High Limit	ANZEN_SAFETY_ALARM_BMS_TEMPERATURE_HIGH	ANZEN_SAFETY_ALARM_BMS_TEMPERATURE_HIGH	Breaker Opens. Error State
	Warning	Battlow > 5 for 1 battery OR battery voltage < 8.6V	Low Performance Battery. Replace Battery #.	N/A	N/A	Just Warning
Position Warning	Warning	Num Batt T High > 5 for 1 battery	High Temperature Battery. Replace Battery #.	N/A	N/A	Just Warning
	Critical	Supply voltage < 21V	BMS Power Supply Exceeded Low Limit	ANZEN_SAFETY_ALARM_SUPPLY_VOLTAGE_LOW	ANZEN_SAFETY_ALARM_SUPPLY_VOLTAGE_LOW	Breaker Opens. Error State
Supply voltage high	Critical	Supply voltage > 32.5V	BMS Power Supply Exceeded High Limit	ANZEN_SAFETY_ALARM_SUPPLY_VOLTAGE_HIGH	ANZEN_SAFETY_ALARM_SUPPLY_VOLTAGE_HIGH	Breaker Opens. Error State
	Critical	One or more SPU lost. CAN communication	SPU Lost Communication. Check CAN connections.	ANZEN_SAFETY_ALARM_LOST_COMMUNICATION	ANZEN_SAFETY_ALARM_LOST_COMMUNICATION	Just Warning
Anzen Critical Error	Critical	When any critical alarm is triggered	Critical Error Notification - A critical BMS Alarm was encountered. See alarm history.	ANZEN_SAFETY_ALARM_ERROR	ANZEN_SAFETY_ALARM_ERROR	Breaker Opens. Error State

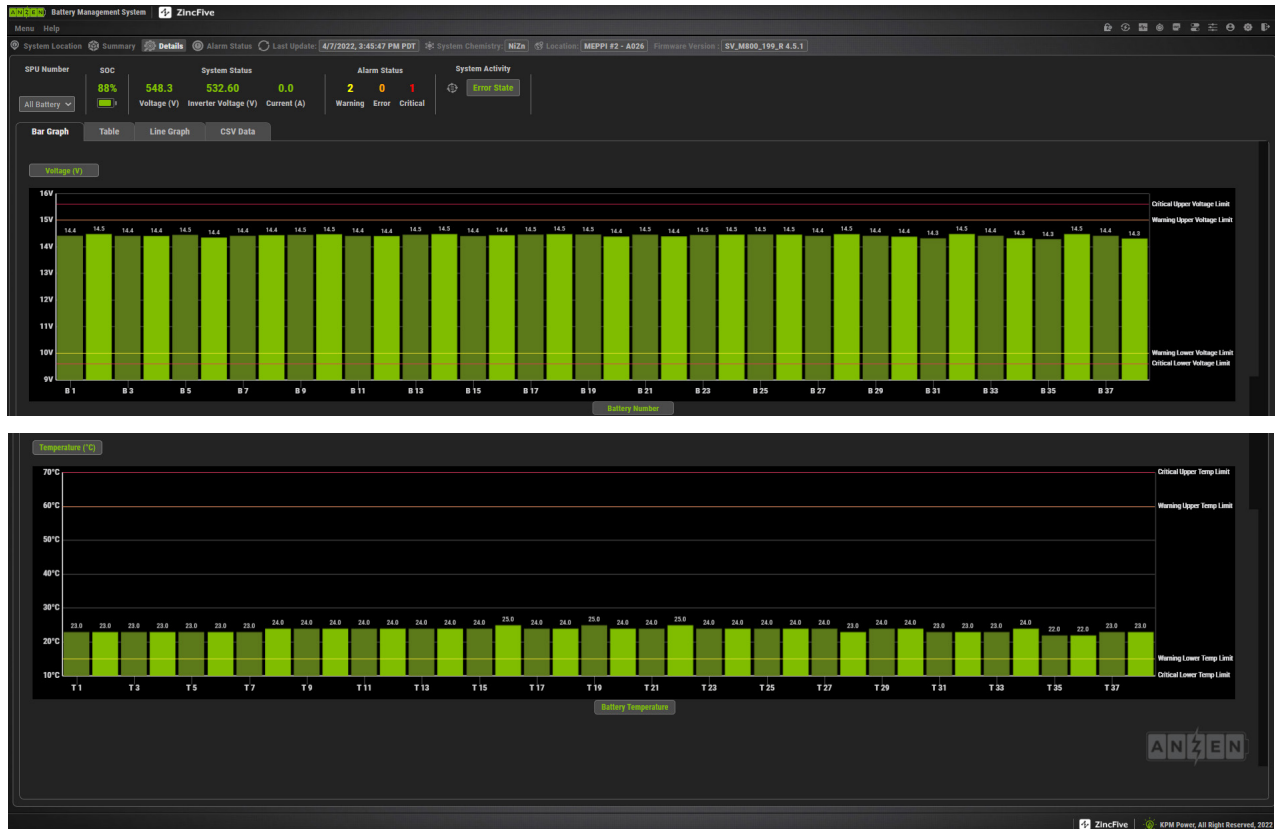
**Note: By selecting validation mode, the BMS will end discharge if one battery goes below 10VDC or one battery exceeds 75C. This is to help maintain cabinet balance during battery validation testing.**

# 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.

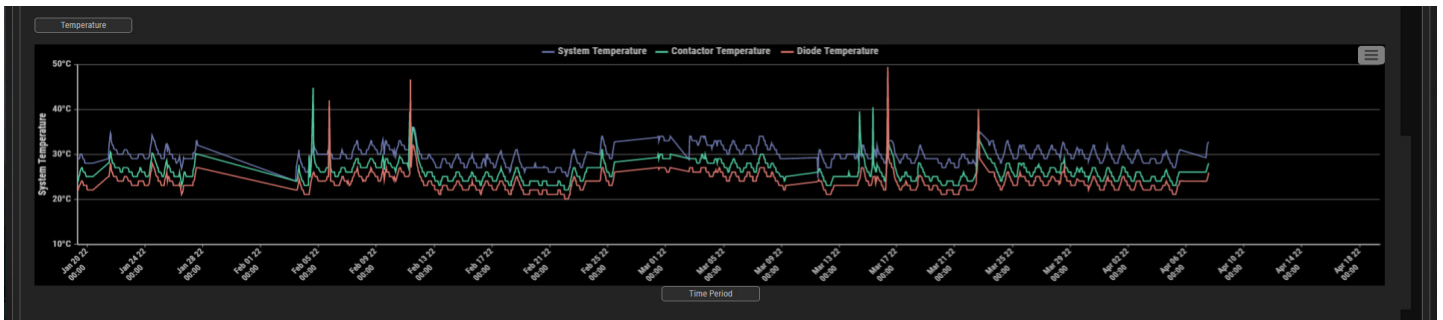


Clicking on any one of the Secondary Processing Unit icons will show the detailed voltages and temperature readings for the batteries attached to that SPU. (This is the same display as when the “Details” icon is selected.) See: 5.2.3 Details



# Historical System Data

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



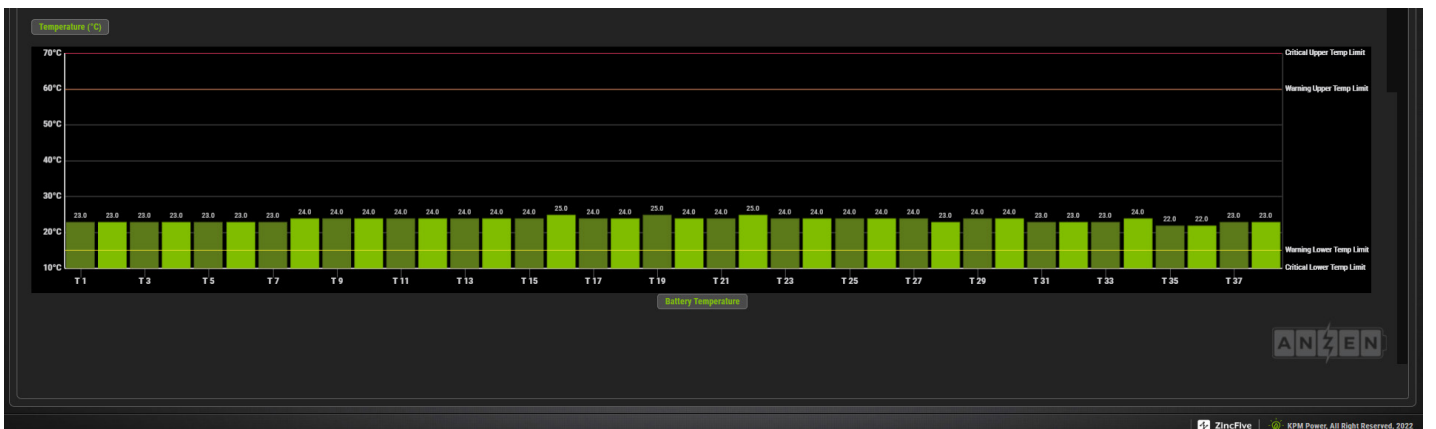
## Details

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.

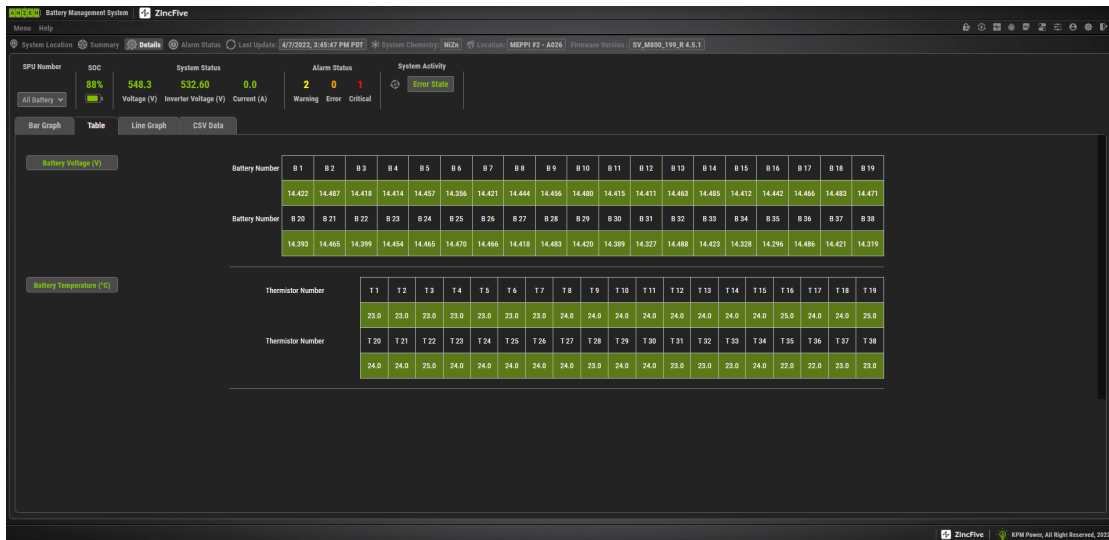


The SPU Number dropdown allows you to view all the batteries or concentrate on an individual string connected to a single SPU.



## 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 Menu, Help, System Location, Summary, Details, Alarm Status, and Last Update: 4/7/2022, 3:45:47 PM PDT. Below these are various status indicators: Connect Status (Off), SOC (88%), System Status (Voltage: 548.3, Inverter Voltage: 532.60, Current: 0.0), Alarm Status (2 Warning, 0 Error, 1 Critical), and System Activity (Error State). The main section is titled 'Alarm List' and contains a table with the following data:

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

At the bottom right of the table, there is a 'Rows Per Page' dropdown set to 10 and a total of 0-10 of 262 rows. A 'Reload' button is located at the top right of the table area.

- 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 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.



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

Field Name	Notes
<b>Timestamp</b>	Time stamp of the record.
<b>Battery Voltage 1-38</b>	One column per battery.
<b>Battery Temperature 1-38</b>	One column per battery.
<b>System Temperature</b>	
<b>Diode Temperature</b>	150C Max
<b>Contactor Temperature</b>	100C Max
<b>State</b>	<ul style="list-style-type: none"> <li>• Pre-Standby</li> <li>• Standby</li> <li>• Charge</li> <li>• Discharge</li> <li>• Error</li> </ul>
<b>Previous Timestamp State</b>	
<b>Previous State</b>	
<b>Error Msg</b>	Error Message when in Error State.
<b>Battery System Voltage</b>	
<b>Inverter Voltage</b>	
<b>Supply Voltage</b>	24 Supply Voltage
<b>System Current</b>	
<b>Hall Current</b>	Hall Effect Sensor Current
<b>Shunt Current</b>	
<b>SOC</b>	State of Charge
<b>SOH</b>	State of Health
<b>cdah</b>	Cumulative Discharge Amp Hours
<b>adah</b>	Actual Discharge Amp Hours
<b>Firmware Version</b>	
<b>Months Sense Commissioning</b>	
<b>Circuit Breaker Status</b>	ON or OFF
<b>Contactor Control</b>	ON or OFF
<b>Circuit Breaker Control</b>	ON or OFF
<b>Elapse Discharge Time</b>	
<b>Cumulative Discharge Energy (kWh)</b>	
<b>Instant Power (kWh)</b>	



# Troubleshooting

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## Critical Alarms:

- Battery Pack Overvoltage - BMS failure to stop during normal charging sequence. Call Service Technician for BMS evaluation.
- Battery Pack Undervoltage – On discharge the breaker will open when reaching the operational limits. Critical Alarm level will only be reached if multiple battery failures occur. Call Service technician for evaluation and replacement of bad batteries.
- Single Battery Overvoltage / Undervoltage – This will only be reached if the BMS fails to stop a charge or discharge. Portions of the BMS Main or Secondary Processor Units may 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 from the battery charger for more than 15 seconds. The BMS will open breaker and not allow charging when greater than this.
- Over-Current on Discharge – The Battery Cabinet will open the breaker if current exceeds 800Amps for more than 2 seconds. A critical Alarm will occur if the cabinet every sees greater than 880Amps. Reduce the load to resolve exceeding the discharge current limits.
- 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.

## Discharge ended earlier than expected with a Over Temperature Critical Alarm: Battery Unit temperature too high – A battery exceeded 75°C

- This means 3 batteries reached 75°C (or higher) on the Positive Terminal Post during the discharge. The system historical data will need to be evaluated during the failed discharge to determine which batteries reached >75°C. Any battery that exceeded >85°C should be replaced for optimum system performance.

## 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)



## Multiple Power Outages Occurrence

- If the battery cabinet has a FULL discharge and opens the breaker it WILL NOT be available for any subsequent discharges until the breaker is manually closed.

## 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 maybe 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 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. Annually, withdraw one battery shelf at a time and measure individual battery voltages and intercell connector resistance.
  - 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 cabling has been connected and torqued correctly.

## Battery Replacement

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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 Status Report   ADAH Reset   SOH Reset   Commission Date

Reset Cumulative Discharge Amp Hours (CDAH) to 0 in the event that all batteries have been replaced at the same time.

**Reset**

**Note:**  
To fully reset State of Health (SOH) to 100%, Commission Date must be reset through the Commission Date tab



Battery Status Report   ADAH Reset   SOH Reset   Commission Date


Current Commission Date: **N/A**

When the rack construction is completed or ALL batteries are replaced, set the Commission Date.

mm/dd/yyyy

**Set**

**Notes:**  
The Commission Date cannot be in the future. To fully reset State of Health (SOH) to 100%, CDAH must be reset through the SOH Reset tab.



# APPENDIX

## Current Sensor Calibration

### ONLY AUTHORIZED PERSONNEL CAN PERFORM MAINTENANCE.

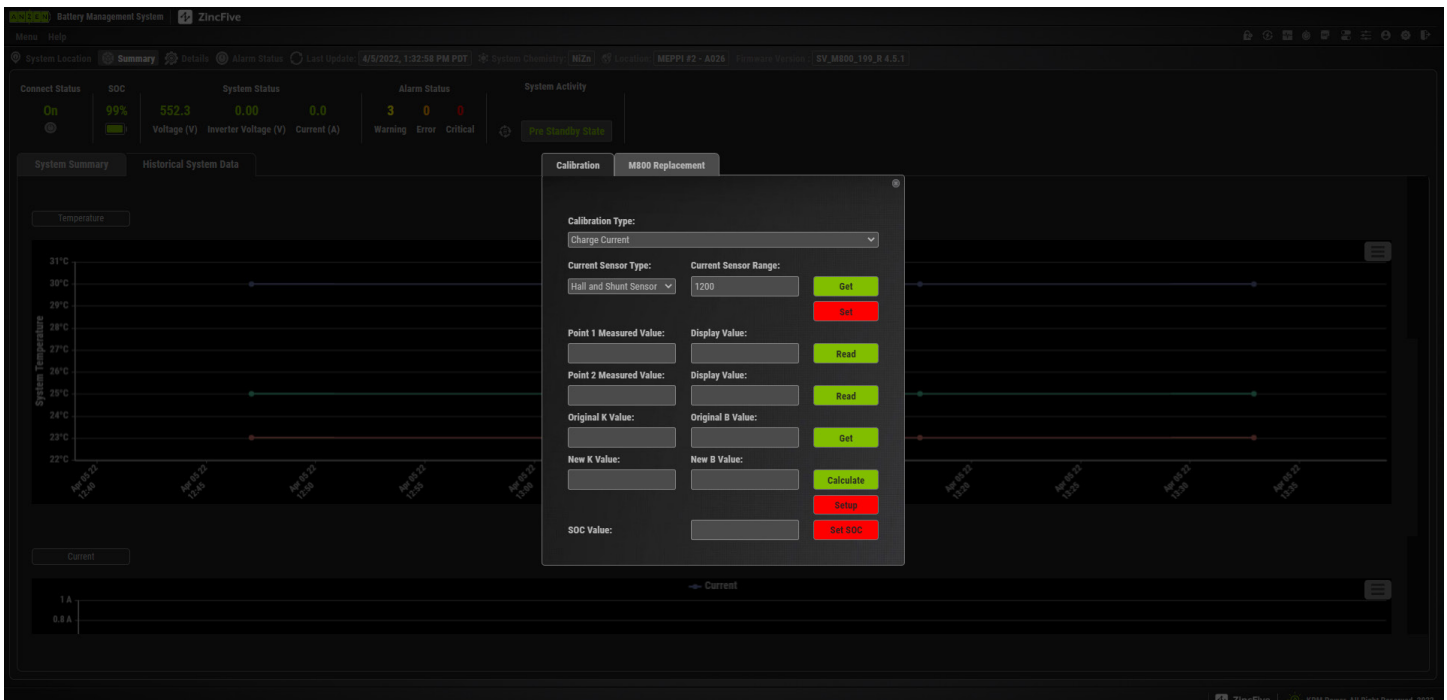
The current Sensor calibration is done in the factory prior to shipment of the battery cabinet. This step should NOT need to be done unless BMS components are replaced, settings are lost, or when tested the system calibration is off by more than 10%.

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 (Left 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:

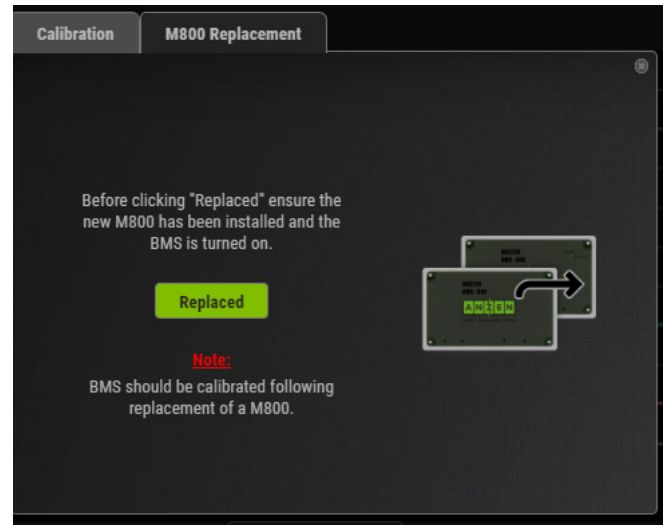
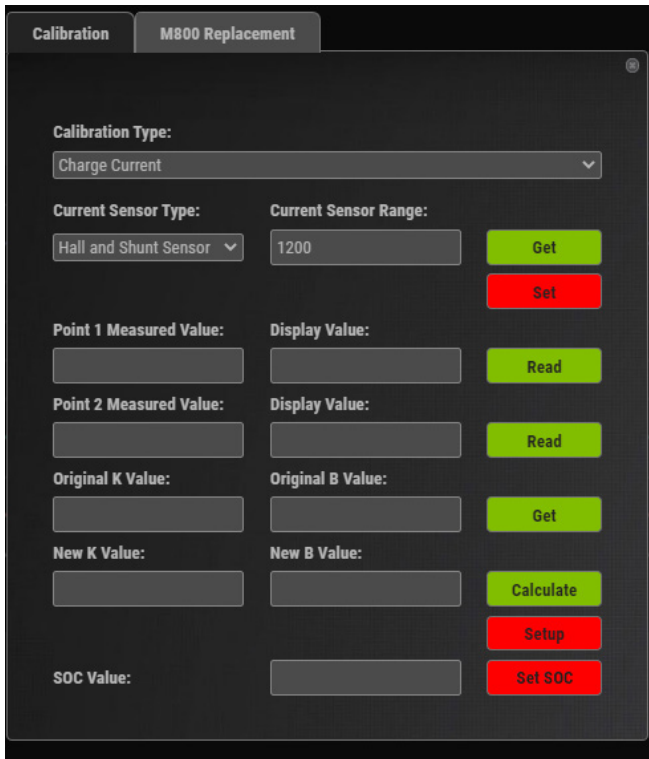


4. Start calibration with hall effect sensor. Select "Hall Sensor" under the Current Sensor Type. Select Current Sensor Range to be 500. Click set.



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

9. To start charging the batteries set SOC to 50% so that the positive current would start to flow.
10. Acquire the Point 2. For Measured Value input the value from multimeter and press read to input the display value.
11. Calculate and setup new K/B values by clicking Calc and Setup.
12. 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.
13. Repeat steps 8-12 until the measured and displayed current values are as accurate as possible.
14. This is the end of calibration for "Charge current".
15. Select Calibration Type to be "Discharge Current".
16. Repeat steps 6 to 8.
17. Start discharging the batteries, so that the negative current would start to flow.
18. Repeat steps 10 to 13. This is the end of calibration for "Discharge Current"
19. Continue calibration with current shunt. Select "Shunt Sensor" under the Current Sensor Type. Select Current Sensor Range to be 1200. Click set.
20. Repeat steps 5 to 18.
21. Finish calibration by selecting "Hall and Shunt Sensor" under the Current Sensor Type. Select Current Sensor Range to be 1200. Click set.



### BMS replacement

1. If a M800 has been replaced select the M800 replaced icon and then follow the current sensor calibration procedure above





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