

# Li-ion Battery Solution Guide

## Important Safety Information

This document contains important safety instructions that must be followed during installation procedures (if applicable). Read and keep this document for future reference.

Read these instructions carefully and look at the equipment to become familiar with the device before trying to install, operate, service or maintain it. The following special messages may appear throughout this documentation or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.



The addition of either symbol to a “Danger” or “Warning” safety label indicates that an electrical hazard exists which will result in personal injury if the instructions are not followed.



This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

### **DANGER**

**DANGER** indicates a hazardous situation which, if not avoided, **will result in** death or serious injury.

### **WARNING**

**WARNING** indicates a hazardous situation which, if not avoided, **could result in** death or serious injury.

### **CAUTION**

**CAUTION** indicates a hazardous situation which, if not avoided, **could result in** minor or moderate injury.

### **NOTICE**

**NOTICE** is used to address practices not related to physical injury.

**⚡ ⚠ DANGER****HAZARD OF ELECTRIC SHOCK, EXPLOSION, ARC FLASH, AND FIRE**

This document is in addition to, and incorporates by reference, the relevant product manuals for XW Pro inverter/chargers and connected batteries. Before reviewing this document, you must read the relevant product manuals. Unless specified, information on safety, specifications, installation and operation is as shown in the primary documentation received with the product. Ensure you are familiar with that information before proceeding.

**Failure to follow these instructions will result in death or serious injury.**

## Scope

This Technical Note clarifies technical aspects of Li-ion battery integration for the XW Pro series of inverters by providing information beyond what is available in the Installation and Owner's guides. The information provided here does not modify, replace or waive any of the terms and conditions mentioned in the Installation and Owner's guides, or the limited warranty. Li-ion batteries used with static charge settings, without communication between the BMS and the XW Pro inverter are out of scope of this document. When applicable, static charge settings (open loop operation) must be provided by battery manufacturers.

**⚠ CAUTION****BATTERY TYPE HAZARD**

Ensure that the battery pack being used includes a compatible Battery Management System (BMS) with safety controls. Batteries with a compatible BMS for closed loop communication are listed in "Appendix A - Battery-Specific Information" on page 11.

**Failure to follow these instructions can result in injury or equipment damage.**

**NOTICE****RISK OF EQUIPMENT DAMAGE**

Before selecting a battery pack to use with the XW Pro inverter, MPPTs, or the accessories, be sure that the battery pack has been thoroughly tested by the battery manufacturer for safe operation for its intended application and is compatible with all Conext products. For questions or adjustments to the battery settings, contact the battery manufacturer.

**Failure to follow these instructions can result in equipment damage.**

## Overview

The XW Pro is a utility interactive inverter/charger with grid-tied, off-grid, and backup power capability. The XW Pro inverters communicate with third party devices, such as a Li-ion Battery Management System (BMS), through the Conext Gateway, InsightHome, or InsightFacility. These devices provide a CAN Bus or Modbus RTU interface for BMS communication. The BMS communication can only work with compatible batteries listed in this document.

Li-ion batteries must have an on-board BMS, that, in addition to providing functions of protection, cell balancing, state-of-charge (SOC) and state-of-health (SOH) calculation, also provide a reference for charging voltage and charging current. This reference may be optimized dynamically by the BMS, taking into account the battery SOC, SOH, temperature, or other factors. It is necessary, in such cases, to update the charging characteristics of the XW Pro dynamically as these values change. The operation described in this application note applies to all BMS communication protocols that the system is compatible with.

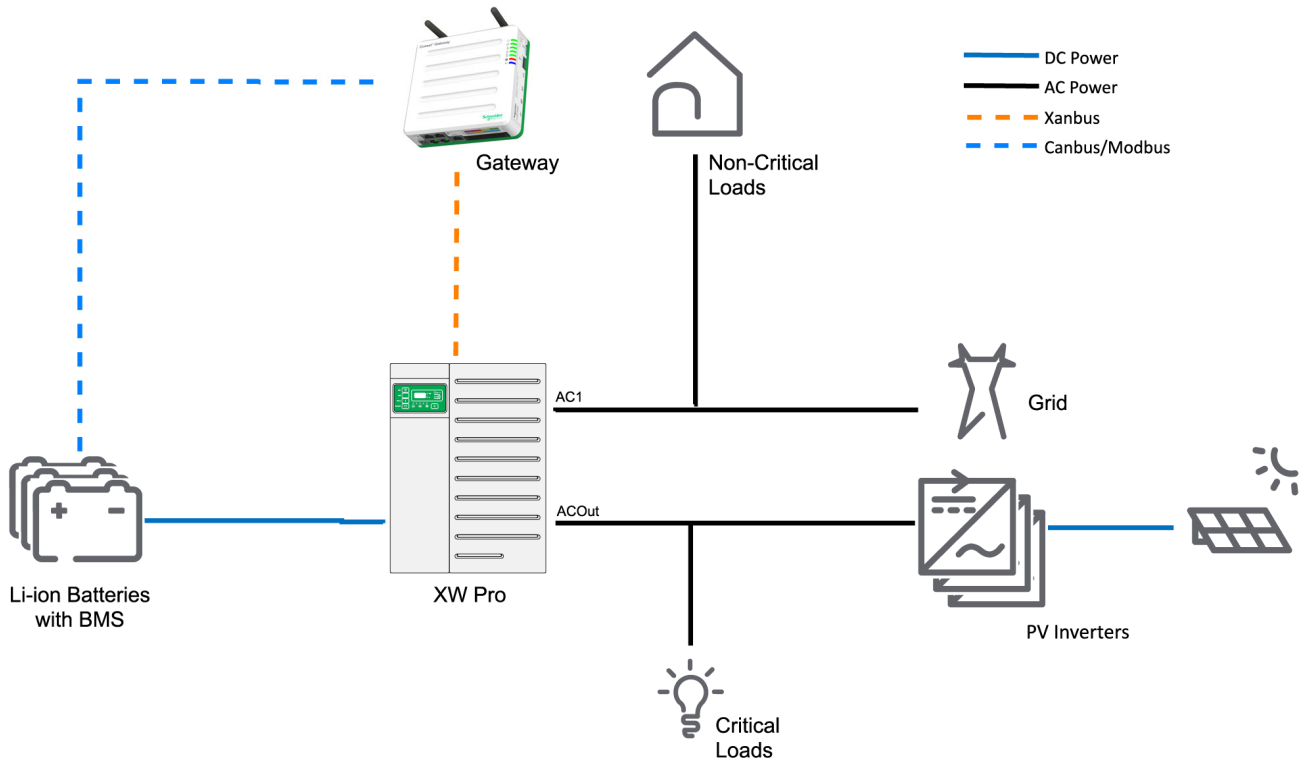
## Supported Architectures

The following diagrams provide a typical system architecture of the Conext Gateway, XW Pro, and a Li-ion battery with BMS. Currently BMS communication is supported for systems with a single XW Pro inverter and optional AC coupled PV inverters. Systems with multiple XW Pro inverters and DC coupled systems with Conext MPPT solar charge controller not currently available with BMS communication (future release). Systems with multiple XW Pro inverters and/or DC coupling with Conext MPPT solar charge controller may be installed without BMS communications subject to the battery vendor approval of the use-case. A Conext Battery Monitor is recommended for these applications to monitor the battery SOC.

### **Single XW Pro with Single Master BMS (Split-Phase and Single-Phase) with AC Coupling**

The XW Pro with compatible Li-ion batteries can be used with AC coupled PV inverters or microinverters. The XW Pro will regulate charging from the AC coupled PV inverters using frequency shifting, based on the battery charging limits and SOC information communicated by the BMS. See the XW Pro AC Coupling Solutions Guide (document part number: 990-6421) for information on the design and installation of AC coupled systems, and be sure to follow all system sizing and other application requirements as described in the document.

Figure 1 Single XW Pro with Single Master BMS (Split-Phase and Single-Phase) with AC Coupling



## System Compatibility

Each of the system architectures supports a maximum number of compatible devices within a system. Beyond the number stated in the table, normal operation of the system is not guaranteed. The following table lists maximum number of compatible devices that have been validated.

| Name  | Maximum Quantity  |
|---|---|
| <b>Single XW Pro with Single Master BMS</b> |   |
| XW Pro                                      | 1 (multi-unit support planned in a future firmware release)             |
| BMS   | 1 (master)  |
| Li-ion Battery Packs                        | See "Appendix A - Battery-Specific Information" on page 11              |
| PV Inverter                                 | See XW Pro AC Coupling Solutions Guide (document part number: 990-6421) |

# Installation and Commissioning

## Protection Coordination

### **WARNING**

#### **RISK OF FIRE, ELECTRIC SHOCK, EXPLOSION, AND ARC FLASH**

Installation of the battery must be done by qualified and licensed installers following any applicable codes and standards and requirements of local authorities. Installers must ensure that appropriate protection coordination is in place as needed.

**Failure to follow these instructions can result in death, serious injury, or equipment damage.**

## Inrush Current

### **NOTICE**

#### **RISK OF BATTERY AND BATTERY INVERTER DAMAGE**

Always follow the recommended start-up sequence and minimum number of batteries as described in Appendix A. This is required to avoid excessive inrush current.

**Failure to follow these instructions can result in equipment damage.**

Battery-based inverter/chargers, such as the XW Pro, contain an internal DC link which is comprised of capacitors. When the DC breaker between the inverter/charger and the battery is turned On, the inverter/charger draws an inrush current to charge the capacitors. Li-ion batteries contain a supervisory protection inside the BMS which may trigger an over-current fault protection to such inrush. For some battery types, multiple battery packs should be connected to the XW Pro inverter simultaneously to share the inrush current between the batteries. This is achieved by closing an installed DC disconnect or breaker at the inverter, after turning on the batteries according to the manufacturer instructions.

## BMS Setup

Depending on the battery system brand and the number of battery packs, there might be a slave BMS present. XW Pro only supports communication with a master BMS and you must refer to the battery manufacturer's documentation for information on how to set up slave BMSs to be aggregated into the master BMS.

### **NOTICE**

#### **RISK OF BATTERY DAMAGE**

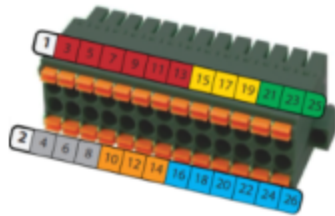
Consult the battery manufacturer's information for handling details if the battery is completely discharged.

**Failure to follow these instructions can result in equipment damage.**

## Wiring Interface

Wire CAN or RS485 interface of the BMS to the 26-pin connector referring to the below diagram. RS485 can be connected to either Port 1 or Port 2 on Conext Gateway. Once the connections are done, power on Conext Gateway and BMS. Refer to the Conext Gateway Owners Guide (Part Number: 975-0806-01-03) for more details on installation.

|   |
|---|
| <b>NOTICE</b>   |
| RISK OF BMS OR CONEXT GATEWAY DAMAGE  |
| BMS and Conext Gateway must be powered off while doing the connections.     |
| <b>Failure to follow these instructions can result in equipment damage.</b> |



| Port         | Signal         | Pin Number |
|--------------|----------------|------------|
| RS485 Port 1 | ISO2 RS485 1A  | 18         |
|              | ISO2 RS485 1B  | 20         |
|              | ISO2 RS485 GND | 16         |
| RS485 Port 2 | ISO2 RS485 2A  | 24         |
|              | ISO2 RS485 2B  | 26         |
|              | ISO2 RS485 GND | 22         |
| CAN Port 1   | ISO1 CANL      | 12         |
|              | ISO1 CANH      | 14         |
|              | ISO1 CAN GND   | 10         |

|  |
|--|
| <b>NOTICE</b>  |
| RISK OF BATTERY DAMAGE   |
| Consult the battery manufacturer's information for wiring connection details for use with a BMS. |
| <b>Failure to follow these instructions can result in equipment damage.</b>                      |

## Conext Gateway BMS Communication Setup

Only the master BMS in the system, once discovered, must be associated with the XW Pro inverter to which its battery packs are connected. The association is completed as described in *BMS Association on page 8*.

## **NOTICE**

### **RISK OF BATTERY DAMAGE**

Consult the BMS manufacturer's information for resolving any faults or errors that occur. Each BMS will have its own instructions for resolving issues.

**Failure to follow these instructions can result in equipment damage.**

### **CAN BMS Discovery**

CAN BMS systems that are supported by the Conext Gateway have auto-detection, where the Conext Gateway will see the messages from the BMS and detect the battery.

NOTE: Only 500 kbps speed is supported for CAN BMS.

1. After successful login, click **Setup** along the top bar.
2. On successful device detection, the number of devices will be shown.
3. Navigate to **Devices** and click **Device Overview**. On successful communication, various user information is available.

#### SECAN\_BMS 20

Online

|                    |                      |
|--------------------|----------------------|
| Voltage            | 48 V                 |
| Temperature        | 20.00 °C             |
| State of Charge    | 95 %                 |
| State of Health    | 100 %                |
| Device Number      | 0                    |
| Device Name        | BMS                  |
| Device Association | House Battery Bank 1 |



### **Modbus BMS Discovery**

Modbus BMS systems can be detected through a Modbus discovery feature from the Conext Gateway UI during commissioning. Once completed the device will be remembered unless manually removed from the device list in the Conext Gateway.

1. After successful login, click **Setup** along the top bar.
2. Click **Configuration** on the left-hand side, and then click **Modbus settings**.
3. Configure the Modbus settings. This should be same as the Modbus BMS settings.

4. After configuring the Modbus settings, click **Device Detection** on the left-hand side.
5. Under **Detect Devices**, enter the address range of the Modbus device and click **Detect**. This should trigger device detection.
6. On successful device detection, the number of devices will be shown. Navigate to **Devices** and click **Device Overview**. On successful communication, various user information is available.

## SECAN\_BMS 20

Online

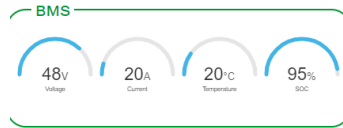
|                    |                      |
|--------------------|----------------------|
| Voltage            | 48 V                 |
| Temperature        | 20.00 °C             |
| State of Charge    | 95 %                 |
| State of Health    | 100 %                |
| Device Number      | 0                    |
| Device Name        | BMS                  |
| Device Association | House Battery Bank 1 |



## BMS Association

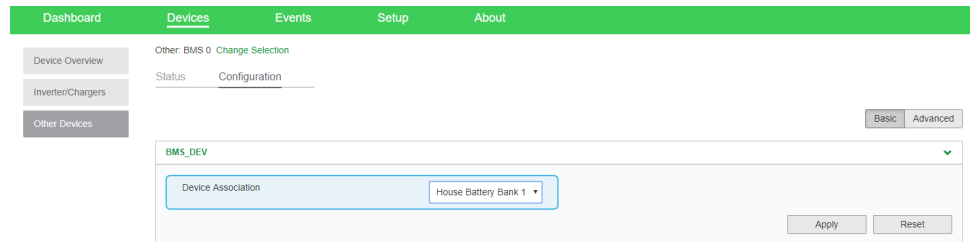
1. Click the BMS device to open BMS Status information.
2. Check the status information to validate various data parameters.



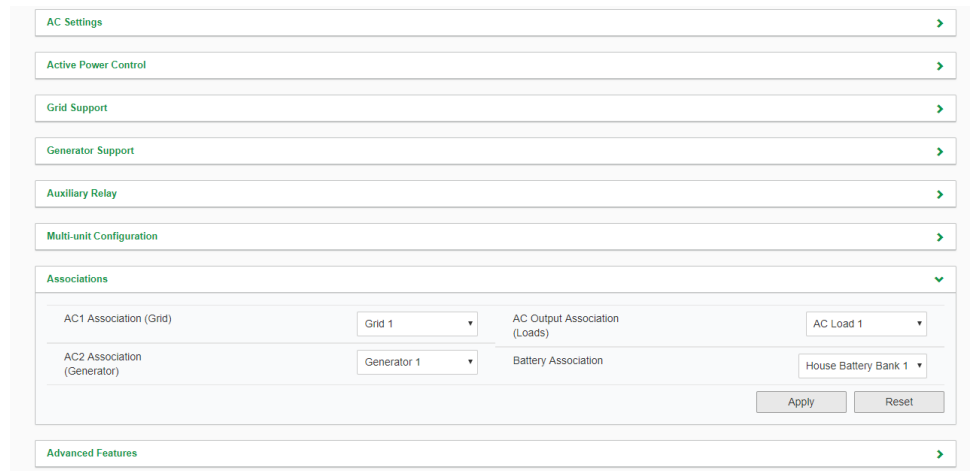


|  |                      |  |           |
|--|----------------------|--|-----------|
| Modbus Address                           | 3                    | Battery Type                           | SECAN_BMS |
| Device Association                       | House Battery Bank 1 | Device Name                            | BMS       |
| Device Number                            | 0                    | Current                                | 20 A      |
| Voltage                                  | 48 V                 | Maximum Discharge Current              | -25 A     |
| Maximum Charge Current                   | 25 A                 | Maximum Charge Voltage                 | 54 V      |
| Minimum Discharge Voltage                | 42 V                 | Force Charge Low SOC                   | 0         |
| Force Charge Request Calibration SOC     | 0                    | Charge Permitted                       | 1         |
| Discharge Permitted                      | 1                    | State                                  | SelfCheck |
| Temperature                              | 20.00 °C             | State of Charge                        | 95 %      |
| State of Health                          | 100 %                | Discharge Over Current Fault           | 0         |
| Charge Over Current Fault                | 0                    | Under Temperature Fault                | 0         |
| Over Temperature Fault                   | 0                    | Under Voltage Fault                    | 0         |
| Over Voltage Fault                       | 0                    | Cell Voltage Difference Too High Fault | 0         |
| Communication Error Fault                | 0                    | System Error Fault                     | 0         |
| Discharge Current High Warning           | 0                    | Charge Current High Warning            | 0         |
| High Temp Warning                        | 0                    | Low Temp Warning                       | 0         |
| Voltage High Warning                     | 0                    | Voltage Low Warning                    | 0         |
| Cell Voltage Difference Too High Warning | 0                    | Communication Error Warning            | 0         |

3. Click **Configuration** and then click **Device Association**.



4. In the **Devices** section click **Inverter/Chargers**. Click the respective XW Pro and click **Configuration > Associations** menu set the **Battery Association** to same bank as BMS.



## System Configuration

### NOTICE

#### RISK OF DAMAGE TO THE BATTERY AND BATTERY INVERTER

Always configure Battery Model to match the actual battery model installed in the system. The system is configured automatically with the settings which are intended to operate the batteries within their recommended ranges and minimize BMS tripping.

**Failure to follow these instructions can result in equipment damage.**

For list of supported batteries and sizing recommendations, see "*Appendix A - Battery-Specific Information*" on page 11. To configure the XW Pro with a respective BMS, follow the below steps:

1. Navigate to **Setup > BMS Setup** in the Gateway UI menu.

The screenshot shows the Gateway UI interface. At the top, there is a navigation bar with tabs for Dashboard, Devices, Events, Setup, and About. The Setup tab is active. On the left, there is a sidebar menu with options: Configuration, Network, Manage Passwords, Device Detection, Smart Energy Manager, and BMS Setup. The main content area is titled "BMS Setup" and contains the following elements:

- A header "BMS Setup" with a help icon.
- A sub-header "Setup external Battery Management System (BMS)".
- A "Battery Model" dropdown menu currently set to "BYD LVS 16".
- A "Battery Model Quantity" input field with a value of "1".
- "CLEAR" and "APPLY" buttons.

On the right side, there is an "Information" section with the following text:

This setup menu automatically configures the inverter according to selected battery model and the number of batteries in the system. It also configures the inverter's Charge Cycle to External BMS, Battery Type to Li-ion and SOC Control to Enabled. Ensure the following steps are completed before applying these settings:

1. Setup the **Battery Device Association**. Inverter and battery must have the same association.
2. For BMS connected with RS-485, ensure that **Modbus Device Detection** is completed.
3. Setup the **Inverter Device Association**. Select Advanced > Association > configure to match the battery association. Click Apply Inverter and battery must have the same association.
4. For systems using external BMS, all batteries must be connected to the same DC bus.

2. Select the installed battery model from the **Battery Model** drop-down.
3. Enter the **Battery Model Quantity**.
4. Click **Apply**.

## Appendix A - Battery-Specific Information

The following table summarizes the battery models that are compatible with the XW Pro inverter using BMS communication. Batteries that are used with the XW Pro inverter without BMS communication (static manual charge/discharge settings) are out of scope of this document. The recommended number of batteries listed in the table below describe the number of batteries that could optimally utilize the XW Pro inverter's power ratings during backup power operation. For smaller battery banks, the inverter will limit power according to the BMS and inverter settings. The system designer can size the batteries based on the expected loads and the desired autonomy.

*Table 1 Single XW Pro with Single Master BMS with AC Coupling*

| Manufacturer     | Model          | Nominal Rating | Protocol | DC Coupling <sup>1</sup> | AC Coupling | Start-Up Sequence   | Recommended Number of Batteries in Parallel Single XW Pro |
|------------------|----------------|----------------|----------|--------------------------|-------------|---|---|
| BYD              | LVS 4          | 4 kWh          | CAN      | See note 1               | YES         | Close DC disconnect on the inverter, then start batteries.                      | 3   |
| BYD              | LVS 8          | 8 kWh          | CAN      | See note 1               | YES         | Close DC disconnect on the inverter, then start batteries.                      | 2   |
| BYD              | LVS 12         | 12 kWh         | CAN      | See note 1               | YES         | Close DC disconnect on the inverter, then start batteries.                      | 1   |
| BYD              | LVS 16         | 16 kWh         | CAN      | See note 1               | YES         | Close DC disconnect on the inverter, then start batteries.                      | 1   |
| BYD              | LVS 20         | 20 kWh         | CAN      | See note 1               | YES         | Close DC disconnect on the inverter, then start batteries.                      | 1   |
| BYD              | LVS 24         | 24 kWh         | CAN      | See note 1               | YES         | Close DC disconnect on the inverter, then start batteries.                      | 1   |
| BYD              | LVL 15.4       | 15.36 kWh      | CAN      | See note 1               | YES         | Close DC disconnect on the inverter, then start batteries.                      | 1   |
| Discover Battery | AES 42-48-6650 | 6.65 kWh       | CAN      | See note 1               | YES         | With DC disconnect open, start batteries in sequence. Then close DC disconnect. | 2   |
| Discover Battery | AES 44-48-3000 | 3 kWh          | CAN      | See note 1               | YES         | With DC disconnect open, start batteries in sequence. Then close DC disconnect. | 4   |

<sup>1</sup> Schneider Electric MPPT charge controllers integration with the BMS is planned in a future release. If connected with manual (static) charge settings, it is recommended to configure a charge block on the XW Pro during daylight hours when the battery may be charging from the MPPT charge controllers.

| Manufacturer | Model         | Nominal Rating | Protocol | DC Coupling <sup>1</sup> | AC Coupling | Start-Up Sequence   | Recommended Number of Batteries in Parallel Single XW Pro |
|--------------|---------------|----------------|----------|--------------------------|-------------|---|---|
| Pylontech    | US2000        | 2.4 kWh        | CAN      | See note 1               | YES         | With DC disconnect open, start batteries in sequence. Then close DC disconnect. | 6   |
| Pylontech    | US3000        | 3.55 kWh       | CAN      | See note 1               | YES         | With DC disconnect open, start batteries in sequence. Then close DC disconnect. | 4   |
| Pylontech    | Force L1 (x3) | 10.65 kWh      | CAN      | See note 1               | YES         | Close DC disconnect on the inverter, then start batteries.                      | 2   |
| Pylontech    | Force L1 (x4) | 14.2 kWh       | CAN      | See note 1               | YES         | Close DC disconnect on the inverter, then start batteries.                      | 2   |
| Pylontech    | Force L1 (x5) | 17.76 kWh      | CAN      | See note 1               | YES         | Close DC disconnect on the inverter, then start batteries.                      | 2   |
| Pylontech    | Force L1 (x6) | 21.31 kWh      | CAN      | See note 1               | YES         | Close DC disconnect on the inverter, then start batteries.                      | 2   |
| Pylontech    | Force L1 (x7) | 24.86 kWh      | CAN      | See note 1               | YES         | Close DC disconnect on the inverter, then start batteries.                      | 2   |
| Pylontech    | Force L2 (x3) | 10.65 kWh      | CAN      | See note 1               | YES         | Close DC disconnect on the inverter, then start batteries.                      | 2   |
| Pylontech    | Force L2 (x4) | 14.2 kWh       | CAN      | See note 1               | YES         | Close DC disconnect on the inverter, then start batteries.                      | 2   |

## **NOTICE**

### **RISK OF DAMAGE TO THE BATTERY AND BATTERY INVERTER**

Always follow the recommended settings, which are intended to operate the batteries within their recommended ranges and minimize BMS tripping. Consult the battery manufacturer if adjustments are required.

**Failure to follow these instructions can result in equipment damage.**

<sup>1</sup> Schneider Electric MPPT charge controllers integration with the BMS is planned in a future release. If connected with manual (static) charge settings, it is recommended to configure a charge block on the XW Pro during daylight hours when the battery may be charging from the MPPT charge controllers.

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**Date:** March 2021

### **Contact Information**

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