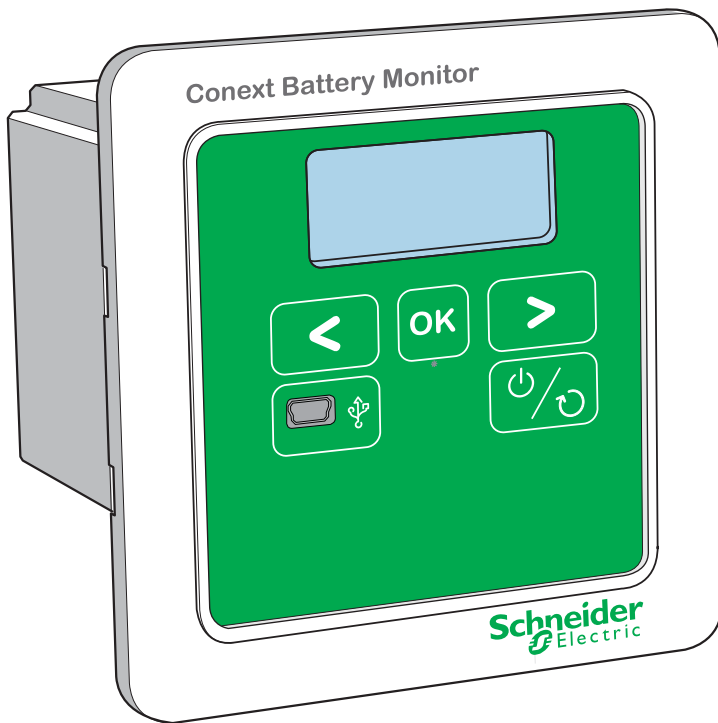


Conext™ Battery Monitor

Owner's Guide



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Serial Number _____

Product Number _____

Purchased From _____

Purchase Date _____

About This Guide

Purpose

The purpose of this Owner's Guide is to provide explanations and procedures for installing, operating, configuring, maintaining, and troubleshooting the Conext Battery Monitor.

Scope

The Guide provides safety guidelines, planning, and setup information, procedures for installing the Battery Monitor, as well as information about configuring, monitoring, and troubleshooting the unit.

Audience

The Guide is intended for use by anyone who plans to construct, install, or operate a system which includes the Battery Monitor. Certain configuration tasks should only be performed by qualified personnel in consultation with your battery manufacturer or system designer. Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel. Servicing of batteries must only be performed or supervised by qualified personnel with knowledge of batteries and their required precautions. Qualified personnel have training, knowledge, and experience in:

- Installing electrical equipment
- Applying applicable installation codes
- Analyzing and reducing the hazards involved in performing electrical work
- Installing and configuring batteries
- Selecting and using Personal Protective Equipment (PPE)

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Organization

This Guide is organized into five chapters and an appendix.

Chapter 1, "Overview", describes physical features of the Battery Monitor and introduces the user interface.

Chapter 2, "Installation", describes how to install, wire, and connect the Battery Monitor to your network.

Chapter 3, "Configuration", describes how to configure and change device settings and upgrade firmware.

Chapter 4, "Monitoring", describes how to monitor LCD indicator lights (LCDs) and device levels.

Chapter 5, "Troubleshooting", describes how to interpret events and alerts.

Appendix A, "Specifications", contains the electrical, mechanical and environmental specifications for the Battery Monitor.

Conventions Used

The following conventions are used in this guide.

⚠ DANGER

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

⚠ WARNING

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

⚠ CAUTION

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

NOTICE

NOTICE indicates important information that you need to read carefully.

Abbreviations and Acronyms

BTS	Battery Temperature Sensor
CEF	Charge Efficiency Factor
CSA	Canadian Standards Association
LCD	Liquid Crystal Display
SOC	State-of-charge
UL	Underwriters Laboratories
VDC	Volts DC

Related Information

For more information about related products, refer to:

Conext Battery Monitor Quick Start Guide

Conext XW+ Inverter/Charger Owner's Guide

Conext XW+ Inverter/Charger Installation Guide

Conext ComBox Owner's Guide

Conext Configuration Tool Owner's Guide

Conext AGS Owner's Guide

Conext SCP Owner's Guide

You can find more information about Schneider Electric as well as its products and services at www.schneider-electric.com.

For specific information on Solar products go to www.SEsolar.com.

Important Safety Instructions

READ AND SAVE THESE INSTRUCTIONS - DO NOT DISCARD

This guide contains important safety instructions for the Conext Battery Monitor that must be followed during installation and configuration procedures. **Read and keep this Installation Guide 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 bulletin or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.



The addition of this 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

HAZARD OF ELECTRIC SHOCK

- Read all instructions, cautionary markings, and all other appropriate sections of this manual before installing, operating, troubleshooting or performing maintenance on the Battery Monitor.
- Exercise extreme caution at all times to prevent accidents.
- These instructions are for use by qualified installers only.

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

⚠ ⚠ DANGER

HAZARD OF ELECTRIC SHOCK AND FIRE

- Connect only to Safety Extra Low Voltage (SELV) circuits and power sources.
- All wiring must be done by qualified personnel to ensure compliance with all applicable installation codes and regulations.
- For Indoor Use Only. Install in a dry, indoor location away from direct sunlight.
- To reduce the risk of electrical fire, replace fuses with same size, type, and rating only.
- Do not disassemble. No user serviceable parts inside.

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

⚠ ⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Apply appropriate personal protective equipment (PPE) and follow safe electrical work practices. See NFPA 70E or CSA Z462.
- This equipment must only be installed and serviced by qualified electrical personnel.
- Energized from multiple sources. Before removing covers identify all sources, de-energize, lock-out, and tag-out and wait 2 minutes for circuits to discharge
- Always use a properly rated voltage sensing device to confirm all circuits are de-energized.

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

⚡ ⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Remove watches, rings, or other metal objects.
- This equipment must only be installed and serviced by qualified electrical personnel.
- Keep sparks and flames away from the batteries.
- Use tools with insulated handles.
- Wear protective glasses, gloves and boots.
- Do not lay tools or other metal parts on top of batteries.

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

⚡ ⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Servicing of batteries must only be performed by qualified personnel knowledgeable about batteries and the required precautions. Keep unqualified personnel away from batteries.
- Disconnect the charging source prior to connecting or disconnecting battery terminals.
- Use with lead-acid batteries: Flooded, Gel, and AGM types only.
- The included shunt in the box is rated for 500 A, 50 mV. It can handle 350 A continuously and 500 A for 5 minutes. For systems designed to pass more current than rated, use a higher capacity shunt.

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

⚠ WARNING

UNINTENDED OPERATION

The use of this product with Modbus communications requires expertise in the design, operation, and programming of the device. Only qualified persons should program, install, alter, and commission this product.

When writing values to the device, ensure nobody else is working with the device.

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

NOTICE

RISK OF EQUIPMENT DAMAGE

- The Battery Monitor is intended for monitoring lead-acid batteries with a nominal voltage of up to 48 VDC.
- Do not use the device with Lithium Ion batteries.

Failure to follow these instructions can damage equipment.

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1

Overview

Chapter 1 describes the features of the Battery Monitor and provides an overview of its physical features and user interface. It includes:

- “Introduction” on page 2
- “Unpacking and Inspection” on page 5

Introduction

The Conext Battery Monitor is a meter for 24 V & 48 volt batteries designed for use in off-grid power systems as a wall/panel/DIN-rail mount device in stationary renewable energy applications. It features a local display to selectively show the voltage, current, consumed amp-hours, remaining capacity and remaining hours.

The Battery Monitor connects with other Xanbus devices such as Inverters, Solar Charge Controllers, and an Automatic Gen Start & System Control Panel through Xanbus ports to provide accurate information about the state of the connected battery. The Battery Monitor is wired to the battery through two connections, an analog signal port and BTS (Battery Temperature Sensor).

The Battery Monitor is configurable for specific system or application functions such as battery capacity and charging efficiency. It can monitor any battery system which has a voltage from approximately 18 to 64 volts, and can track energy consumption and remaining battery capacity.

The Battery Monitor operates using the included shunt board. Higher capacity shunts are required for multi-cluster systems. See “Recommended High Capacity Shunts” on page 5 for details.

Benefits of Monitoring the Battery

Batteries are used in a wide variety of applications, but regardless of the application their fundamental purpose is to store energy for later use. Therefore, it is critical to be aware of how much energy is stored in the battery at any given time. Battery knowledge and good monitoring are also essential to maximizing battery life. The lifetime of batteries is dependent on many factors and can be reduced due to under-charging, over-charging, over-discharging, overly rapid discharging and high ambient temperatures, among other reasons. An advanced battery monitor provides important feedback about the status of the batteries and thereby helps extend their lifetime.

While the main function of the Battery Monitor is to display the battery's status, it also offers other useful features. The readout of battery voltage, current and temperature (when installed with the battery temperature sensor) offer precise real-time measurements which can be used by other Xanbus devices. The ability to log, store, and retrieve historical data over time using a USB connection provides insight into historical trends. Mid-point sensing, a technique which is used to detect unbalanced battery strings, allows for a deeper understanding of the state of health of battery banks. These are just a few of the features of the Battery Monitor which are explained in more detail in the following sections of this manual.

For explanation of further advanced functionality of the Battery Monitor, such as how the State-of-charge, Charge Efficiency Factor, and Time Remaining functions are calculated and displayed by the device, see “Theory of Operation” on page 4–44 in Chapter 4, “Monitoring”.

Features

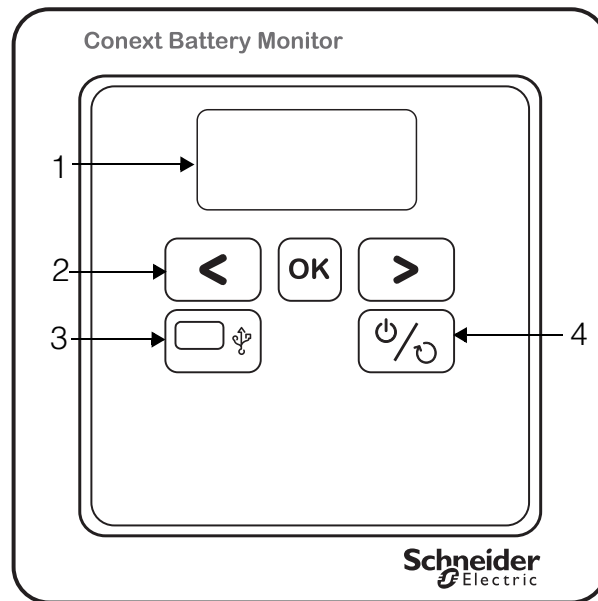


Figure 1-1 Conext Battery Monitor front panel features

1. LCD (Liquid Crystal Display) screen
2. Navigation buttons (<, **OK** and > keys)
3. Mini-USB Port
4. Reset button

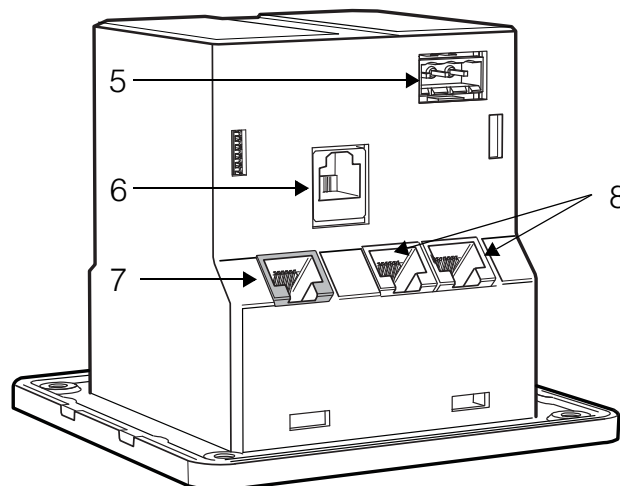


Figure 1-2 Conext Battery Monitor bottom panel ports

5. RS485 2-Wire Serial Modbus Port

-
6. BTS (Battery Temperature Sensor) Port
 7. Battery Analog Signal Port
 8. Xanbus Ports

Functions

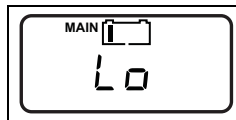
The Battery Monitor features six data monitoring functions including:

- Voltage (Battery voltage)
- Amps (Real-time charge/discharge current)
- Amp-Hours (Amount consumed. Displayed after Function **F2.0** - Nominal battery capacity is set)
- State-of-charge (Percent of capacity)
- Time Remaining (Time remaining until a battery recharge is necessary)
- Temperature (Battery temperature if BTS is installed, otherwise displays temperature setting)
- Mid Point Sensing

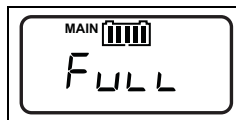
Alarms

The Battery Monitor features two alarms including:

- Low voltage indicator (shown by **Lo** on LCD display)



- Full charge indicator (shown by **Full** on LCD display)



Buzzer

The Battery Monitor has an internal buzzer which alerts the user. The buzzer will beep for the following reasons:

When the Reset button is held, the buzzer will beep once per second to indicate the amount of time required to perform the two different reset types.

- To perform a basic reset while retaining all settings, press and hold the reset button until you hear 3 beeps, then release the button.
- To perform a full reset and simultaneously reset all settings to factory defaults, press and hold the button until you hear 5 beeps, then release the button.

The buzzer will also beep twice after a firmware update has been installed with the Conext ComBox or Conext Configuration Tool.

Compatibility

Other capabilities of the Battery Monitor include:

- Configuration capability using the front panel, System Control Panel, Conext Configuration Tool, Conext ComBox or through 3rd party devices like PLC using RS485 Modbus.
- Ability to connect directly to Xanbus devices using RJ45 connections.
- Ability to control diesel generators using various triggers, including State-of-charge triggers when used with the Conext Automatic Generator Start (AGS).
- Ability to remotely monitor, troubleshoot or upgrade firmware with Conext ComBox.

Unpacking and Inspection

Part List

Upon receiving the Battery Monitor, check that the following items are included.

- Battery Monitor Unit
- Battery Monitor Quick Start Guide (in English, French, Spanish, and Portuguese)
- Network Terminator
- DIN Rail Clip
- Battery Temperature Sensor (BTS) (9.8 ft/3 m)
- USB 2.0 A to Mini-B Cable
- Pre-scaler Assembly
- Battery shunt (500 A/50 mV)
- 3-Position RS485 Modbus Connector
- Mounting Screws
- Cable ties and spiral wrap
- USB thumb drive with Quick Start and Owner's Guides (in English, French, Spanish, and Portuguese)

Recommended High Capacity Shunts

Schneider Electric supplies a 500 A/50 mV battery shunt with the Battery Monitor. This shunt is rated to carry 350 A of continuous current and 500 A for maximum 5 minutes. If the DC current through the shunt will be higher than the rating of this 500 A shunt, please use the following high capacity shunts or their equivalent.

Note: Always use shunts that are scaled to 50 mV or 60 mV at rated current. Check with the manufacturer's data sheet to select the shunt rating. Select a shunt with an overcurrent margin of 25% over its rated current capacity, as matched to the continuous peak current expected on the system.

Table 1-1 High Capacity Shunts

Manufacturer	Model Number	Capacity
Deltec	MKB-250-50	250 A
Deltec	MKB-500-50	500 A
Deltec	MKC-750-50	750 A
Deltec	MKC-1000-50	1000 A
Deltec	MKC-1200-50	1200 A
Deltec	SWE-1500-50	1500 A
Deltec	SWE-2000-50	2000 A
Deltec	SWE-3000-50	3000 A

2

Installation

Chapter 2 describes how to install, wire, and connect the Battery Monitor to your network. It includes:

- “Planning and Choosing a Location” on page 9
- “Materials and Tools Required” on page 10
- “Mounting the Battery Monitor” on page 10
- “Mounting the Shunt” on page 16
- “Electrical Wiring” on page 16

⚠ WARNING

OVERHEATING OF DC TERMINALS AND CABLES

Overheating of the DC terminals or DC cables to dangerous temperatures may occur due to improper installation of shunt.

- Do not put anything between the cable lug and the terminal surface.
- Do not over-tighten connections; observe all recommended torque values.
- Do not apply any type of anti-oxidant paste until after the cable connection is tightened.
- Do not under size cables; install cables sized in accordance with national electrical code requirements.
- DC cables must have crimped copper compression lugs or crimped and soldered copper compression lugs; soldered connections alone are not acceptable. Lugs must be rated for use with fine-stranded cable.
- Do not use coarse-stranded cable; the lack of flexibility may pull DC terminal connections loose.

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

NOTICE

SHORT CIRCUIT OF NETWORK COMPONENTS

- **This network is not an ethernet system.** Only connect Xanbus devices to the Xanbus system. Do not attempt to connect Xanbus devices to other networks or systems.
- Ethernet crossover cables are not compatible with the Xanbus system. Use Category 5 (CAT 5 or CAT 5e) cables to connect Xanbus devices.

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

NOTICE

EQUIPMENT DAMAGE

- Install Battery Monitor in a dry, indoor location away from direct sunlight.
- Turn OFF all devices before connecting cables. The Battery Monitor does not have an ON/OFF switch.
- Do not change any settings unless you are familiar with the device.

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

Planning and Choosing a Location

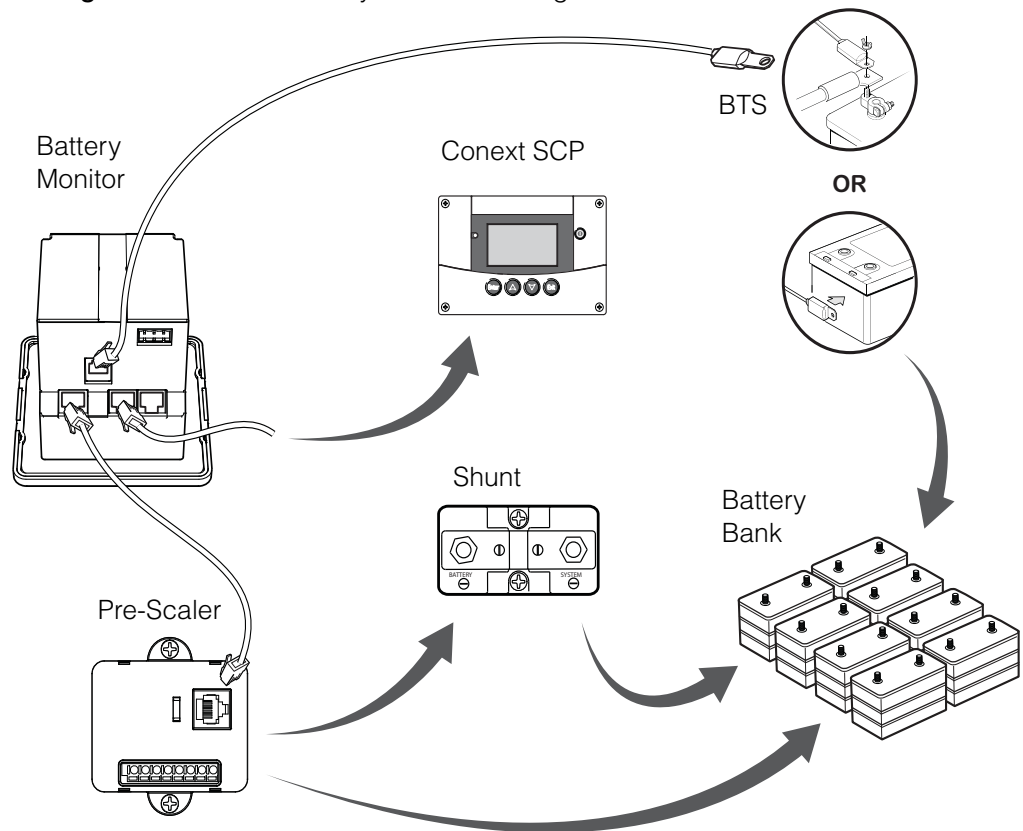
Choose a clean, dry, protected and easily accessible indoor location.

If you mount the Battery Monitor on a wall, the recommended height is at eye level so that you can clearly see the LCD display and have easy access to the data ports.

All the communication ports on the Battery Monitor are accessible from the bottom of the device when mounted on a wall, panel or DIN rail. Clearance of at least 2 in. (50 mm) below the device is recommended to allow for the bending radius of cables that connect to the Battery Monitor.

The following are recommended maximum cable lengths in a Battery Monitor system:

Figure 2-1 Conext Battery Monitor Cabling



Total Xanbus network	131 ft (40 m)
Battery to Pre-scaler	16.4 ft (5 m)
Pre-scaler to Battery Monitor	25 ft (7.6 m)

Materials and Tools Required

Materials List

The materials supplied with the Battery Monitor package are listed in the section “Part List” on page 1–5.

The following materials and tools are not supplied but are required to complete the installation:

- CAT5 or CAT5e network cable(s) for Xanbus connections - 6.5 ft (2 m) or longer
- Wire stripper
- Pencil

For panel mount:

- Four #6 (or equivalent) mounting screws
- Drill for pre-drilling
- Diagonal cutter or heavy duty scissors

For wall mount:

- Screwdriver set

For DIN rail mount:

- 35-mm “top hat” DIN rail (EN50022)
- Diagonal cutter or heavy duty scissors

Mounting the Battery Monitor

The Battery Monitor can be mounted in 3 different ways as preferred:

Wall Mount using the two key-hole slots on the rear side to allow an easy mount on two screws anchored into drywall (using provided drywall anchor screws) or concrete wall. A wall mounting template is included in the *Conext Battery Monitor Quick Start Guide* (Part # 865-1080-01) included in the box.

Panel Mount using four mounting screws which are hidden after installation with a snap-fit cover plate. A panel mounting template is included in the *Conext Battery Monitor Quick Start Guide* (Part # 865-1080-01) included in the box.

DIN Rail Mount using the included DIN rail clip which has a DIN rail mount latch mechanism. This part is bundled with the Battery Monitor and is field-installable. A 35-mm “top hat” DIN rail (EN50022) is required for mounting.

Wall Mount

To mount the Battery Monitor on a wall:

1. Choose the location for mounting the device.
2. Using the template in the *Conext Battery Monitor Quick Start Guide*, mark the mounting holes on the wall with a pencil.

Note: The holes must be at the same height and 2.36 in. (60 mm) apart.

3. Insert the two anchors and mounting screws supplied in the marked locations on the wall, leaving a space of approximately 0.13 in. (3.3 mm) between the wall and screw head. If you are mounting the Battery Monitor on concrete, the supplied anchors and mounting screws are not suitable. Use two mounting screws that are equivalent to #6 screws.

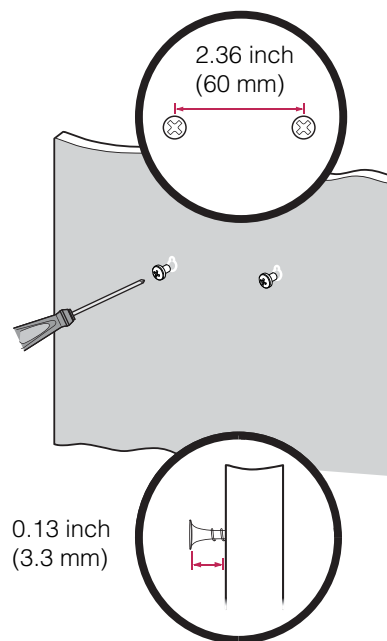


Figure 2-2 Wall mounting the Battery Monitor

-
4. Place the Battery Monitor on the mounting screws, and confirm a snug fit before going to the next step.

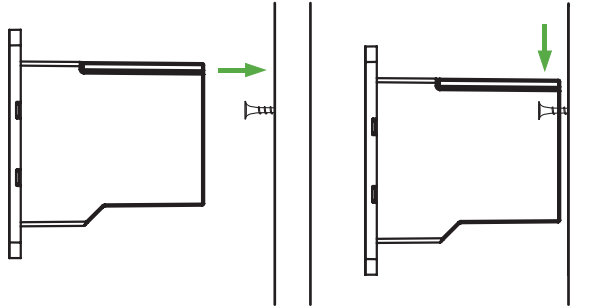


Figure 2-3 Wall mounting the Battery Monitor (continued)

5. Connect the wiring and cables. See the Battery Monitor Quick Start Guide Section “Cable Connections” for correct wiring.

Panel Mount

The Battery Monitor has a front frame for slide-in mounting into a panel cutout. Standard dimensions of a panel mount meter are 3.6 x 3.6 in. (92 x 92 mm). Mounting screws are hidden after installation with a snap-fit cover plate.

To panel mount the Battery Monitor:

1. Using the panel mounting template in the Battery Monitor Quick Start Guide, mark the mounting holes on the wall with a pencil and trace the area to cut out.
2. Cut out a square for the Battery Monitor as per the panel mounting template.
3. Pre-drill four holes as per the panel mounting template.

4. Remove the front panel plate from the Battery Monitor.

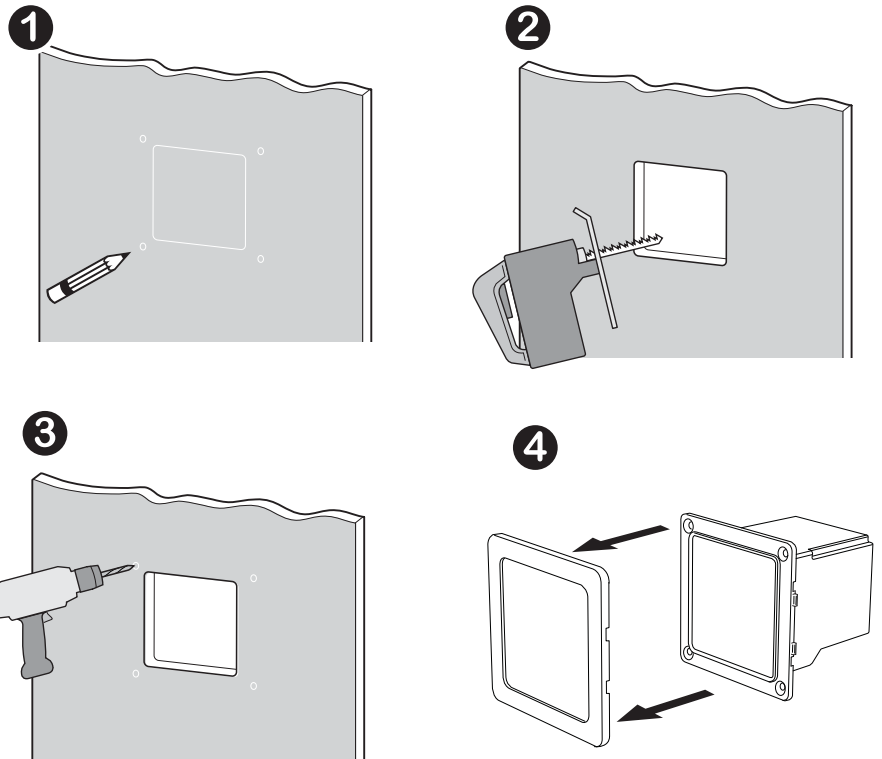


Figure 2-4 Panel mounting the Battery Monitor

-
5. Place the Battery Monitor against the four drilled holes.
 6. Connect the two Xanbus cables
 7. Screw the Battery Monitor onto the wall.
 8. Re-attach the front panel plate to the Battery Monitor.

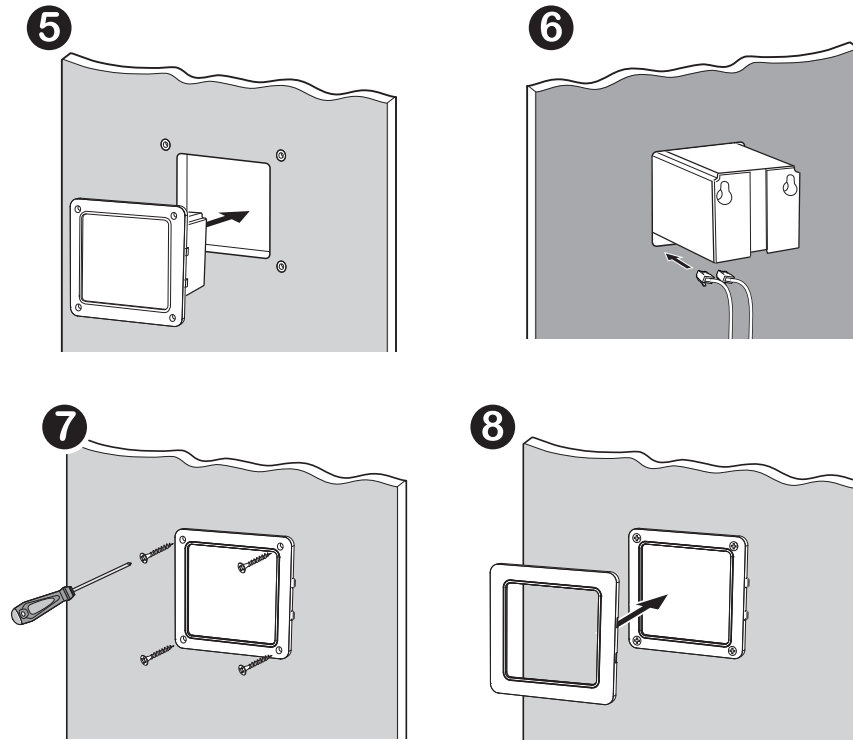


Figure 2-5 Panel mounting the Battery Monitor (Continued)

DIN Rail Mount

A standard 35-mm “top hat” DIN rail (EN50022) is required for DIN-rail mounting.

To mount the Battery Monitor on a DIN Rail:

1. Choose the location for mounting the device.
2. Use a Phillips head screwdriver to screw the DIN rail clip onto the back panel of the Battery Monitor.

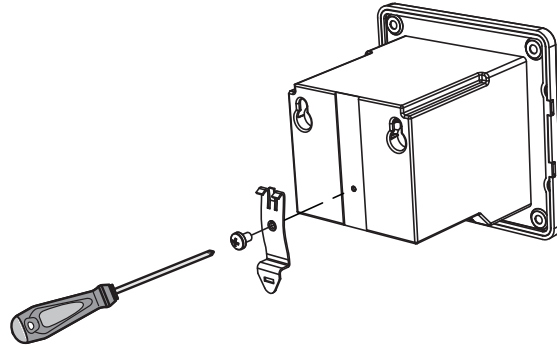


Figure 2-6 Attaching the DIN rail clip to the Battery Monitor

3. Mount the Battery Monitor on the DIN rail at an upward angle then push down and in to clip to the rail.

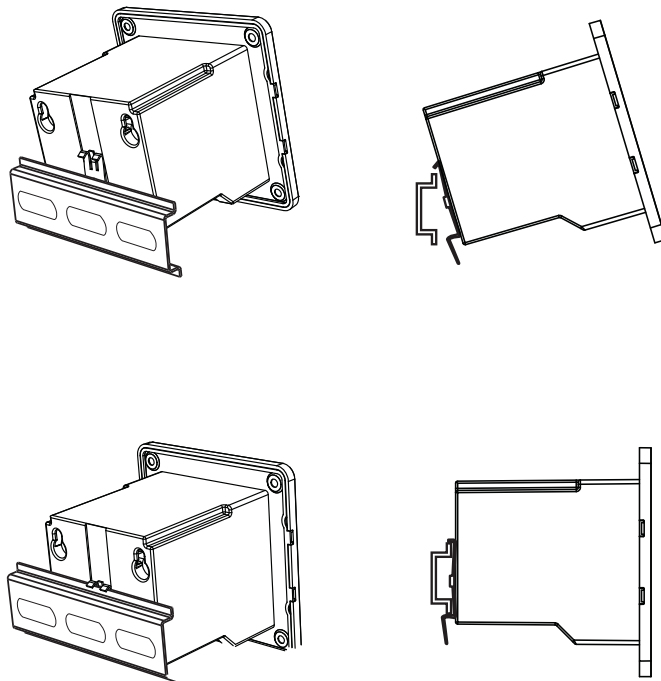


Figure 2-7 DIN Rail mounting the Battery Monitor

4. Connect the wiring and cables. See “Electrical Wiring” on page 2–16 for details.

Mounting the Shunt

NOTICE

EQUIPMENT DAMAGE

The shunt must be installed in the negative line. Installing the shunt in the positive line may result in damage to the Battery Monitor.

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

The shunt connects between the inverter and batteries in the negative (-) battery power wire.

To mount the shunt:

1. Mount the shunt on or near the battery enclosure close to the negative (-) battery terminal. If possible, install the shunt inside your battery enclosure. Use appropriate screws to secure the shunt to the battery enclosure.

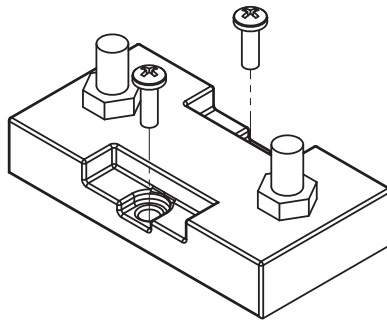


Figure 2-8 Mounting the shunt

Electrical Wiring

The Battery Monitor bottom cable connections consist of five ports, Battery Analog Signal, two Xanbus cables, BTS, RS-485. A network terminator is provided for installation where only one Xanbus Port is in use.

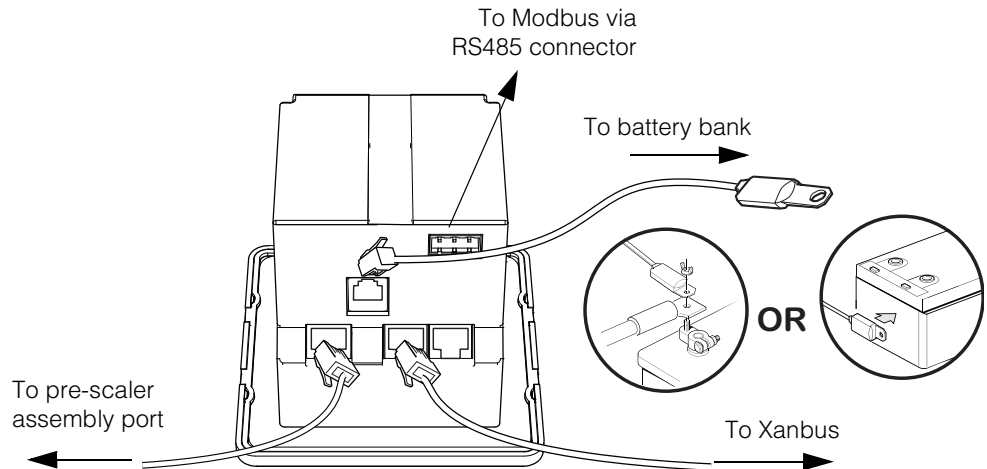


Figure 2-9 Wiring the Battery Monitor

Wiring the Battery to the Shunt

The shunt terminal labelled “BATTERY” must be wired to the negative battery terminal of the battery bank. The shunt terminal labelled “SYSTEM” connects to the inverter.

To wire the shunt:

1. Disconnect the negative cable (that connects between the inverter and battery) from the battery’s negative (–) terminal.
2. Connect the free end of the negative cable to the shunt terminal labeled “SYSTEM.” See Figure 2-10, “Wiring the battery bank” on page 2–18. Ensure all connections are tight.
3. Connect a short length of cable of the same gauge between the battery’s negative (–) terminal and the shunt’s terminal labeled “BATTERY”. Ensure all connections are tight.
4. Connect the cables and hardware to the shunt. Ensure that terminals are covered after installation.

The included in-line 2AT voltage-sensing fuses are connected to the positive and negative endpoints and the positive midpoints of the battery bank as shown below. Refer to the **Label** column of Table 2-1 on page 2-19 for details about the lettered labels below.

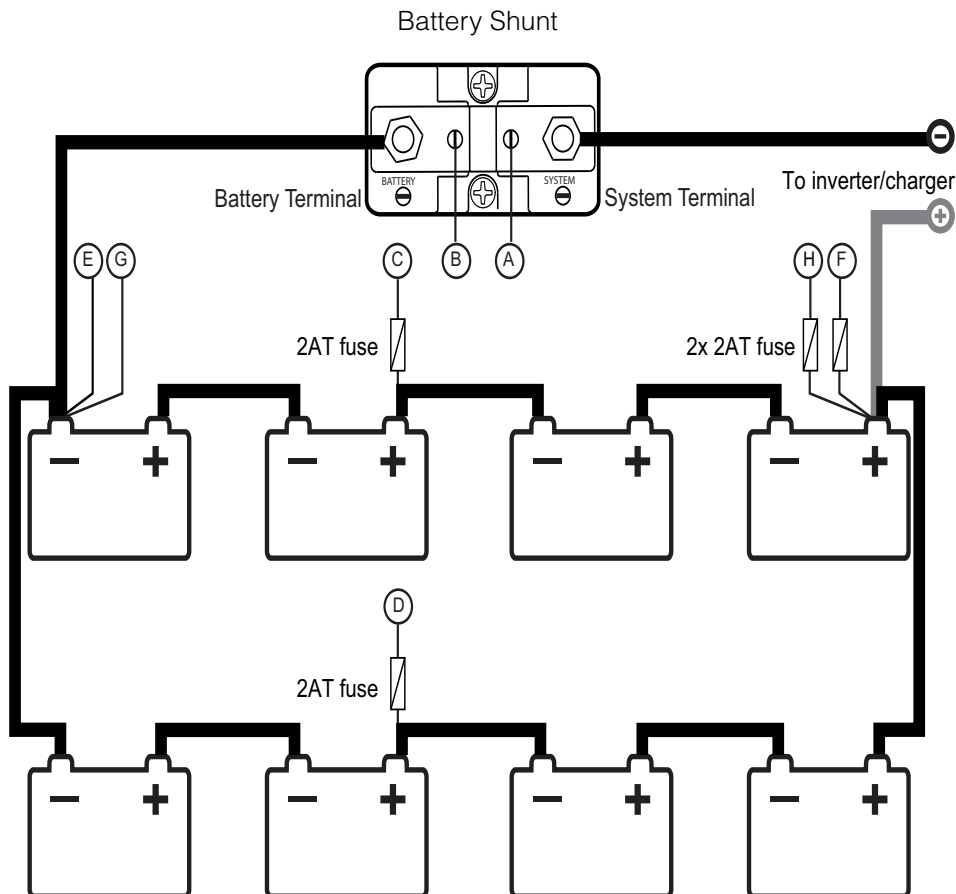


Figure 2-10 Wiring the battery bank

Note: Only the fuses included with the Battery Monitor are shown in the above diagram. Battery fuses are not shown. Refer to the *Conext XW+ Inverter/Charger Installation Guide* for information about wiring battery fuses.

Wiring the Battery Terminal to the Pre-scaler Board

The pre-scaler board arrives pre-wired to the battery sense cable wires. The terminals are:

Table 2-1 Pre-scaler Board Wiring

Label	Terminal	Wire Colour	Function
A	L-	Violet Wire	Voltage across Shunt (negative)
B	L+	Blue Wire	Voltage across Shunt (positive)
C	Va1+	Orange Wire	Mid-point Voltage Sense #1
D	Va2+	Yellow Wire	Mid-point Voltage Sense #2
E	Vm-	Grey Wire	Main Battery Voltage Sense (negative)
F	Vm	Brown Wire	Main Battery Voltage Sense (positive)
G	V-	Black Wire	Battery Monitor Power (negative)
H	V+	Red Wire	Battery Monitor Power (positive)

2AT Fuses are pre-wired to V+, Vm, VA1, VA2. L+, and L- are wired together as a twisted pair, while the remaining wires are individual.

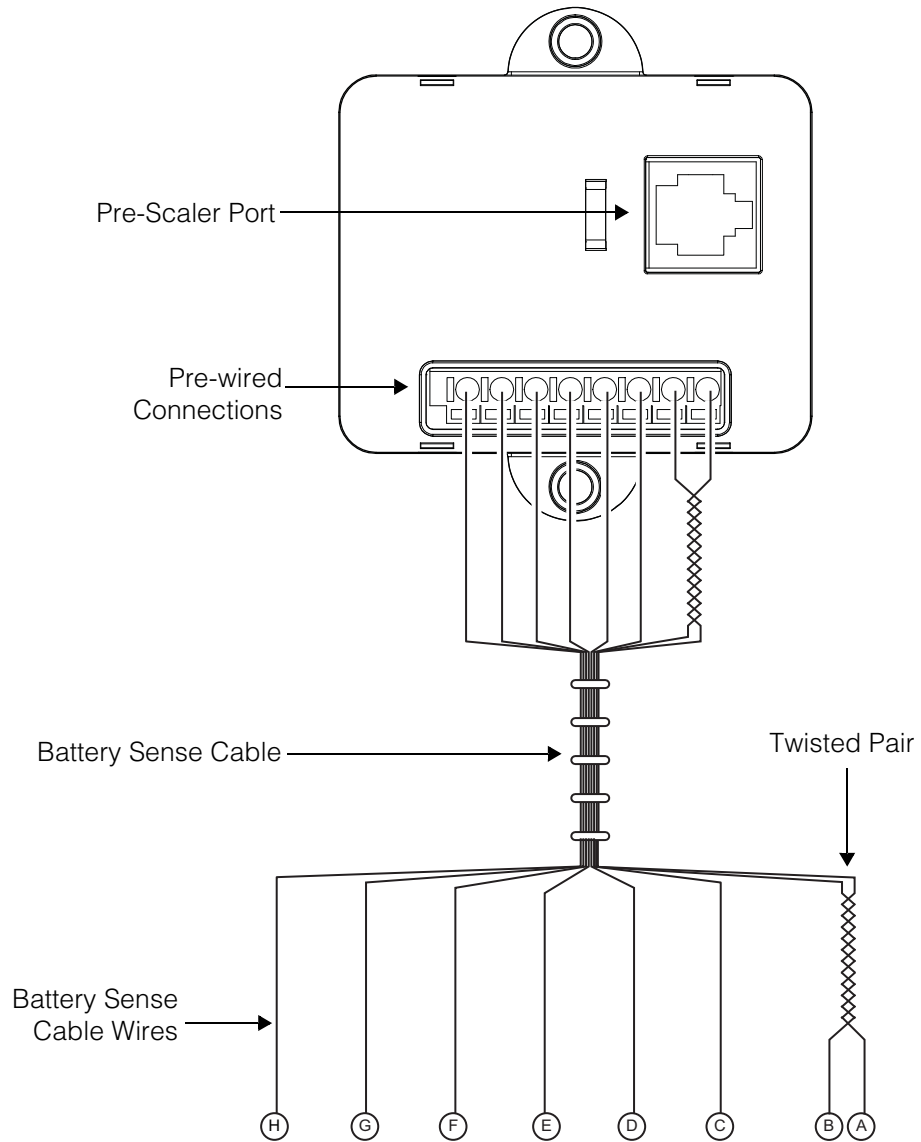


Figure 2-11 Pre-scaler terminals

To wire the battery terminal to the Pre-scaler Board:

1. Connect the black (V-) and grey (Vm-) wires to the negative (—) endpoint battery terminal.
2. Connect the red (V+) and brown (Vm) wires to the positive (+) endpoint battery terminal.

Wiring the Shunt to the Pre-Scaler Board

The Pre-scaler board is connected to the shunt via the twisted wire pair which is wired to the inner screws on the shunt.

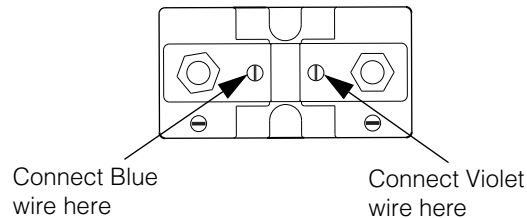


Figure 2-12 Wiring the shunt to the Pre-scaler board

Wiring the Pre-Scaler Board to the Battery Monitor

The Pre-scaler board is connected to the Battery Monitor using the orange RJ45 cable provided. Plug the RJ45 cable directly to the port on the Pre-scaler board then to the Battery Monitor as indicated in Figure 2-9, “Wiring the Battery Monitor” on page 2-17.

Wiring the RS 485 Modbus Connector to the Battery Monitor

⚡ ⚠ DANGER

ELECTRIC SHOCK AND FIRE HAZARD

Turn off all other devices prior to wiring the connectors.

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

The RS 485 Modbus connector provides three terminals for communication cable connections to the Battery Monitor. The three-conductor cable can be 16–24 AWG with 1.5 mm²–0.25 mm² wires. The cable can be shielded or non-shielded.

To wire the RS 485 Modbus connector for data communication:

1. Select a two-wire, twisted pair, shielded cable not longer than 164 ft (50 m). Refer to the local electrical code and application to select the correct cable insulation and temperature class.
2. Strip 3/8 in. (10 mm) from the end of the wires to be connected and attach ferrules to the two signal wires.

-
3. Insert the three wires into the connector terminals as shown in Figure 2-13.

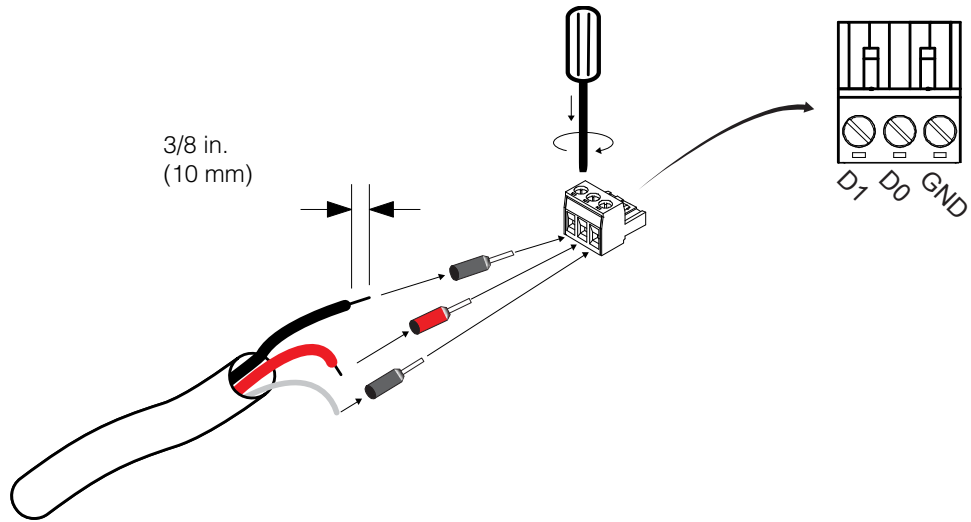


Figure 2-13 Wiring the RS 485 modbus connector

4. Secure the wires by tightening the screw on the terminal.

Note: The right terminal is not connected internally but is provided for the ground connection of the cable.

5. Plug the connector into the rear RS485 port on the Battery Monitor.

USB Mini-B Port

The USB-Mini Port can be used to connect directly to a computer using the included USB Mini-B to USB 2.0 cable to extract data logs.

Battery Temperature Sensor (BTS)

The BTS port on the back of the Battery Monitor uses a standard RJ11 type connector to connect the included temperature sensor to the BTS.

To connect the BTS cable to the battery:

1. Connect the RJ11 connector to the back of the Battery Monitor as indicated in Figure 2-9, "Wiring the Battery Monitor" on page 2-17.
2. Connect the BTS connector either by bolting it directly to a battery terminal along with the other connections or by removing the sticker on the bottom of the BTS connector and sticking it directly to a surface on the battery. The two methods are shown in Figure 2-14.

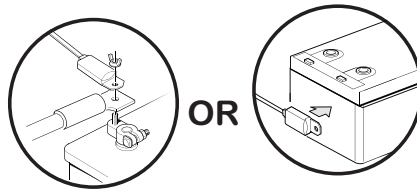


Figure 2-14 Connecting the BTS cable to the battery

Note: If multiple charge controllers or a complete Power System with Conext XW+ Inverter/Chargers are networked together using Xanbus, then only one BTS is required per battery bank. All networked devices share battery temperature information, and you can connect the BTS to a charge controller or a Conext XW+ Inverter/Charger. If more than one BTS is used within the system, then the highest reported temperature from all of the units with an attached BTS will be used as the battery temperature for the temperature compensation value of the battery charge algorithm. For a large battery bank, installing the BTS at the hottest area of the battery bank is recommended.

3

Configuration

Chapter 3 describes how to configure settings for the Battery Monitor and perform tasks such as extracting data logs upgrading device firmware. It includes:

- “Initial Startup of the Battery Monitor” on page 26
- “Function Menu” on page 28
- “Statistics Menu” on page 31
- “History Menu” on page 30
- “Reset Menu” on page 31
- “Logging” on page 32
- “Mid-point Sensing” on page 34
- “Synchronization” on page 36
- “Upgrading Firmware” on page 37
- “SCP Menu Map” on page 38

Initial Startup of the Battery Monitor

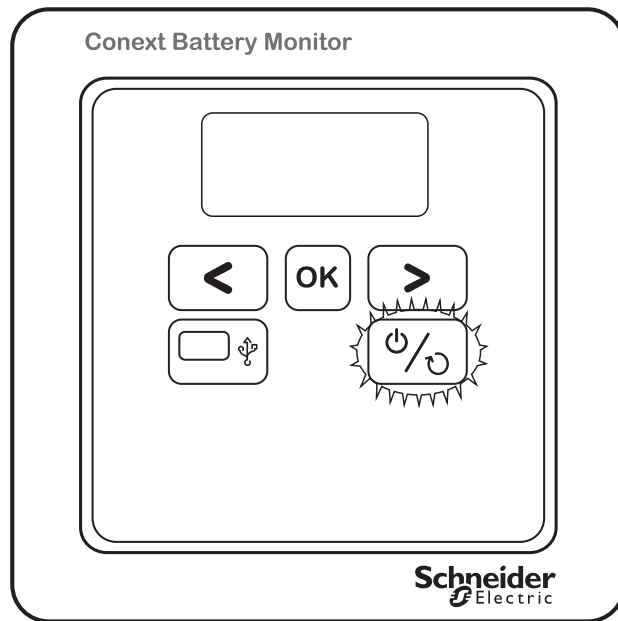


Figure 3-1 Location of front panel power LED indicator

Note: Use the front panel display for first installation. Do not connect the Xanbus cables initially because system functions on other Xanbus devices could be affected as the Battery Monitor initializes.

To turn on the Battery Monitor:

1. Insert the pre-scaler cable into the RJ45 analog-signal port. The Battery Monitor will power on using battery power.
2. Wait for up to two minutes while the LCD display and Power LED (Figure 3-1) flash intermittently during the startup and initialization sequence.
3. When the Power LED stops blinking, Hold the **OK** button for 3 seconds to enter Setup Mode.
4. When the display reads **StAt**, press the **>** key twice. The display should now switch to read **FUnc**.
5. Press **OK**. The display should read **F1.0**
6. Press **OK** then use the arrow buttons to adjust Function **F1.0** so that it is set to the float charge voltage level of your battery charger. (i.e. 52.8 V).
7. Press **OK**, navigate to Function **F2.0** then use the arrow buttons to adjust Function **F2.0** to the nominal battery capacity value of your battery system. (i.e. 200 Ah).

-
8. The default State-of-charge at startup is 75%. Before synchronizing the Battery Monitor to a State-of-charge of 100%, charge the batteries completely and allow the batteries to remain in float state for at least 2 hours. Refer to “Synchronization” on page 3–36 for synchronization instructions.

Battery Sizing

The amp-hour setting on the Battery Monitor should be set to a value equal or lower than the actual amp-hour capacity of the system’s battery bank. If a Battery Monitor is installed on a battery bank that is not brand new, it is likely that the batteries have aged and lost some Ah capacity. In this case, it is recommended to set the Ah lower than the rating after conducting a capacity test or consulting the battery manufacturer. Using a number that is lower than the actual amp-hour capacity allows the Battery State-of-Charge meter to provide a more conservative indication for the use of the batteries to avoid excessively discharging them.

Also note the temperature at which the battery capacity is rated. The amp-hour capacity of the batteries decreases at temperatures lower than the rated value.

The amp-hour rating is usually printed on the battery’s label. If the system contains batteries in parallel, then the amp-hour rating of the parallel batteries is added together (i.e., two 120 amp-hour rated batteries in parallel equals 240 amp-hours). The amp-hour capacity of a bank does not increase for series-wired batteries and is equal to the lowest rated battery in the series string. If the amp-hour capacity is not listed on the battery, consult the battery manufacturer or dealer for assistance.

Changing Settings from the Front Panel

To change settings, press and hold the **OK** key for three seconds to enter Setup Mode. Press the **>** key until the desired setup menu appears.

To enter a menu, press the **OK** key. The desired settings can then be selected by pressing the **<** or **>** keys.

To alter a specific setting, press **OK** when the setting is highlighted. The value of the setting can then be changed by pressing the **<** or **>** keys again. When the desired value is set, press **OK** to select other settings which need to be changed. When all settings are correctly configured, press and hold the **OK** key for three seconds to save the settings and return to Display Mode.

Note: When no keys are pressed in Setup Mode for 90 seconds, the Battery Monitor will automatically return to Display Mode without saving any changed settings. Be sure to press and hold the **OK** key for three seconds to save all settings.

Function Menu

In the **FUnc** (Function) setup menu, the Battery Monitor can be adjusted to fit your system. Parameters called Functions can be set according to your needs. This menu can be accessed by following the sequence in “Changing Settings from the Front Panel” on page 3–27.

The Function menu is divided into three types of settings: System Property Settings (represented by F1), Main Battery Settings (represented by F2), and Battery Monitor settings (represented by F3). The following settings are available.

System Property Settings

F1.0	Charger's float voltage. This value must be equal to your battery charger's float voltage, which is the last stage of the charging process. In this stage the battery is considered full.	
Default	Range	Step size
52.8 V	16.0 – 64.0 V	0.1 V
F1.1	Charger's float current. When the charge current is below this percentage of the battery capacity (see Function F 2.0), the battery will be considered as fully charged. Make sure this Function value is always greater than the minimum current at which the charger maintains the battery or stops charging.	
Default	Range	Step size
2.0%	0.5 – 10.0%	0.5%
F1.2	Auto-sync time. This is the time the Auto-sync parameters F1.0 and F1.1 must be met in order to consider the battery as fully charged.	
Default	Range	Step size
240 sec.	5-300 sec.	Variable
F1.3	Discharge floor. This is the reference point at which the battery needs to be recharged. When the State-of-charge percentage falls below this value the Charge battery indicator starts flashing while the time remaining readout shows 0:00 and the State-of-charge bar is empty.	
Default	Range	Step size
50%	0.0 – 99.0%	1.0%
F1.4	Battery temperature. With this Function, the average battery temperature can be manually adjusted. This value is used for SOC calculation only. The Battery Monitor will only broadcast temperature on Xanbus if there is a Battery Temperature Sensor connected.	
Default	Range	Step size
+20°C	-20 – +50°C	1.0%
F1.5	Time remaining averaging filter. Specifies the time window of the moving averaging filter. There are three settings, where setting 0 gives the fastest Time remaining readout response and setting 2 gives the slowest. The best setting will depend on the type of battery load and your personal preference. The setting represents the effect of reducing battery capacity at higher discharge rates.	
Default	Range	Step size

	1	0-2	1
F1.6	Auto-sync sensitivity. Changes sensitivity of the auto-sync function. If it takes too long to activate the synchronization function, lower this value. If it synchronizes too early, increase this value for a later synchronization.		
	Default	Range	Step size
	5	0-10	1

Main Battery Settings

F2.0	Battery capacity. Your Main battery's capacity in Amp hours (Ah).		
	Default	Range	Step size
	200	20-9990	Variable
F2.1	Nominal discharge rate (C-rating). Set in conjunction with battery capacity, F2.0 .		
	Default	Range	Step size
	20h	1-20h	1
F2.2	Nominal temperature. The temperature at which the battery manufacturer rates your battery's capacity. Set in conjunction with battery capacity, F2.0 .		
	Default	Range	Step size
	+20°C	0 – 40°C	1°C
F2.3	Temperature coefficient. This is the percentage that your battery's capacity changes with temperature. The unit of this value is percent capacity per degree Celsius. The setting "OFF" disables temperature compensation.		
	Default	Range	Step size
	0.50% capacity	0.01 – 1.00% capacity	0.01% capacity
F2.4	Peukert's Exponent. Represents the effect of reducing battery capacity at higher discharge rates. Properly setting Peukert's exponent ensures a more accurate display of time remaining and percent remaining. Note: Consult your battery manufacturer to understand the value to use based on your model. Refer to "Peukert's Exponent for Battery Rating" on page 4–45 for further details.		
	Default	Range	Step size
	1.25	1-1.50	0.01
F2.5	Self-discharge rate. Rate at which the battery loses capacity by itself when not used.		
	Default	Range	Step size
	OFF	0.1-25% / Month	0.1
F2.6	Charge Efficiency Factor. Ratio between the energy removed from a battery during discharge and the energy used during charging to restore the original capacity. See "How the Charge Efficiency Factor is used" on page 4–44 for more information.		
	Default	Range	Step size
	AUTOMATIC	50-100%, AUTOMATIC	N/A

Battery Monitor Settings

F3.0	Internal firmware version. (Reserved, Read-only value)		
F3.1	Shunt Amp Rating. This Function is linked to F3.2 and represents the Amp rating of your shunt at the given sensing voltage as set in F3.2 . Included with your Battery Monitor is a 500 Amp/50 mV shunt, meaning that at 500 A flowing through the shunt, a voltage of 50 mV is generated across the small 'Kelvin' screw terminals of the shunt. This voltage is used by the Battery Monitor to measure the battery current.		
	Default	Range	Step size
	500 A	10 – 9000 A	Variable
F3.2	Shunt millivolt Rating. This value represents the millivolt rating of your shunt at the rated current. The Battery Monitor supports 50 mV and 60 mV shunts.		
	Default	Range	Step size
	50mV	50 – 60 mV	1
F3.3	Backlight mode. Represents the duration of backlight activation in seconds after key-press. The backlight can also be set to be always "ON" or always "OFF". Function setting "AU", activates the backlight automatically when charge / discharge current exceeds 1 Amp or when a key is pressed.		
	Default	Range	Step size
	30 sec	OFF / 5 – 300 / ON	Variable
F3.4	Temperature scale selection. Enables selection between degrees Celsius (°C) and degrees Fahrenheit (°F) in the temperature readout.		
	Default	Range	Step size
	°C	°C/°F	N/A
F3.5	Setup lock. When set to "ON", all functions except the Setup lock function itself are locked and cannot be altered. The Reset menu is also locked.		
	Default	Range	Step size
	OFF	OFF/ON	N/A

History Menu

The History menu is a read-only menu that shows the Battery Monitor's Historical data. Historical data consists of special events that are stored in internal memory. This menu can be accessed by following the sequence in "Changing Settings from the Front Panel" on page 3-27.

The following History menu settings are available.

Battery History Settings

H1 . 0	Average discharge in Ah. This number will be recalculated after each synchronization.
H1 . 1	Average discharge in %. This number will be recalculated after each synchronization.
H1 . 2	Deepest discharge in Ah.
H1 . 3	Deepest discharge in percent.
H1 . 4	Total Amp-hours removed. The total number of Amp-hours removed from the battery. When exceeding 10000 Ah, the units are kAh and the value displayed must be multiplied by 1000.
H1 . 5	Total Amp-hours charged. The total number of Amp-hours charged to the battery. These Amp-hours are not compensated by the Charge Efficiency Factor (CEF). When exceeding 10000 Ah, the units are kAh and the value displayed must be multiplied by 1000.
H1 . 6	Number of charge/discharge cycles.
H1 . 7	Number of synchronizations. This is the number of times the battery is fully charged meeting the Auto-sync Functions.
H1 . 8	Number of full discharges. The number of times the battery has been fully discharged reaching a state-of-charge of 0.0%.

Statistics Menu

The Statistics menu is a read-only menu that shows the Battery Monitor's current statistics for several items. This menu can be accessed by following the sequence in "Changing Settings from the Front Panel" on page 3-27.

The following Statistics menu items are available:

- **St . 1** Days running. The number of days the Battery Monitor has been monitoring the battery. This item resets when a battery reset is executed (see Reset menu).
- **St . 2** Days since last synchronized. The number of days since the Battery Monitor has not been synchronized. This item resets when the Battery Monitor is synchronized or when a battery reset is executed (see Reset menu).
- **St . 3** Charge Efficiency Factor (CEF). The charge efficiency factor used by the Battery Monitor. Depending on the value set in Function **F2 . 6**, this item displays the automatically calculated CEF or a manually set CEF.

Reset Menu

In the Reset menu, you can reset Battery Monitor settings such as Function and Statistics. This menu can be accessed by the following sequence:

Hold the **OK** key for 3 sec until **stat** appears on the LCD display, then press the right arrow button three times. **rst** appears on the LCD display. Press the **OK** key again, then use the arrow keys to toggle the various items.

The default value for all Reset menu settings is “OFF”. If required, use the **<** and **>** keys to change the value from “OFF” to “ON”. Pressing the **OK** key again will step back to the Reset menu. All Reset menu settings which have been set to “ON” will only be reset once Display Mode is accessed by pressing the **OK** key for 3 seconds. The following Reset menu items are available:

- **rst.b** Reset Battery status. Used to reset the current battery status (Charge Efficiency Factor, State-of-charge and Battery History). This setting is intended to be used after installing a new, unused battery which has the same specifications as the previous battery.
- **rst.c** Reset zero-offset current. Use this reset item to remove small current readings on the display when no current is flowing in or out of the battery. When performing this reset action, ensure that all DC consumerschargers are disconnected or turned off.
- **rst.F** Reset Functions. Used to reset all Function values to factory default values.

Logging

Data logging is an integral function of the Battery Monitor. Data logs record vital information about the battery over time, such as energy consumption, battery charging status, and battery state-of-charge (SOC). This information cannot be displayed in a useful manner without taking data out of data logs. Logging is also useful for those who wish to gain more detail than provided by the front panel or who wish to retrieve historical data.

The Battery Monitor keeps data logs of 7 principal functions on an ongoing basis whenever it is powered on. These functions are:

- Battery Voltage
- Battery Current
- Battery Temperature
- Battery State-of-charge
- Battery Amp-hours Removed
- Mid-point Voltage VA1
- Mid-point Voltage VA2

The record period of the Data Logger function defaults to 300 seconds.

Extracting data logs

To extract data logs, a Mini-USB to USB cable is used to connect from the Battery Monitor's Mini-USB port to the computer's USB port. The data logs are available in a spreadsheet comma separated values (.csv) format.

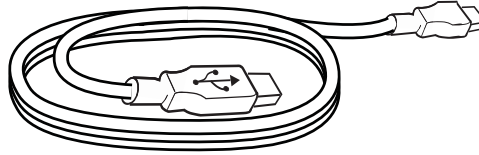


Figure 3-2 Mini-USB to USB cable

To extract data logs:

1. Plug the Mini-USB to USB cable directly from the Battery Monitor's Mini-USB port directly to the computer's USB port.
2. Use "My Computer" or equivalent function to browse for a new drive called "Logs" as indicated below. The new drive will appear as a device with removable storage.

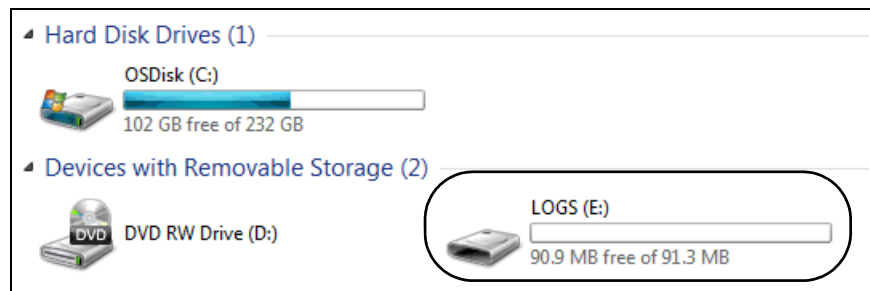
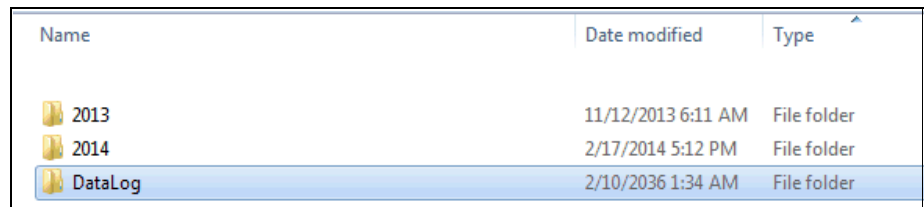


Figure 3-3 Example of Battery Monitor logs folder

3. Double click the "Logs" drive then double click the "DataLog" folder.



Name	Date modified	Type
2013	11/12/2013 6:11 AM	File folder
2014	2/17/2014 5:12 PM	File folder
DataLog	2/10/2036 1:34 AM	File folder

Figure 3-4 Example of log folders

4. Double click the folder for the year to be viewed, then double click the folder for the month to be viewed.

-
- Find the .csv file for the current day and open the file in your preferred spreadsheet software. The data file is formatted by using a comma to delimit items. The file can be opened and viewed by most popular spreadsheet programs such as Microsoft® Excel® or a text editor (i.e. Notepad).


Name	Date modified	Type	Size
 20140304.csv	3/4/2014 2:20 PM	Microsoft Office E...	1 KB

Figure 3-5 Example log file (CSV format)

Mid-point Sensing

Mid-Point voltage sensing is a technique used to detect unbalanced battery strings. The Battery Monitor is capable of sensing three voltage inputs - the main battery string voltage and two additional voltages on the same battery string. These two additional voltage measurement inputs can be used to keep track of voltages across the cells in a string to determine various attributes of battery health. By having more precise measurements, it is possible to detect issues such as cell divergence or a dead cell. The voltage inputs are sensed every 5 seconds and updated for monitoring purposes, and they are stored in the log files at a resolution of every 300 seconds.

Mid-point Sensing Configurations

To use the mid-point sensing feature, wire the battery bank using one of the 2 methods illustrated below, depending on the size of the battery bank. In both examples, the Va1 and Va2 terminals are connected to the mid-point positive terminals of the battery cells. Voltages are then measured with reference to the negative terminal of the battery bank.

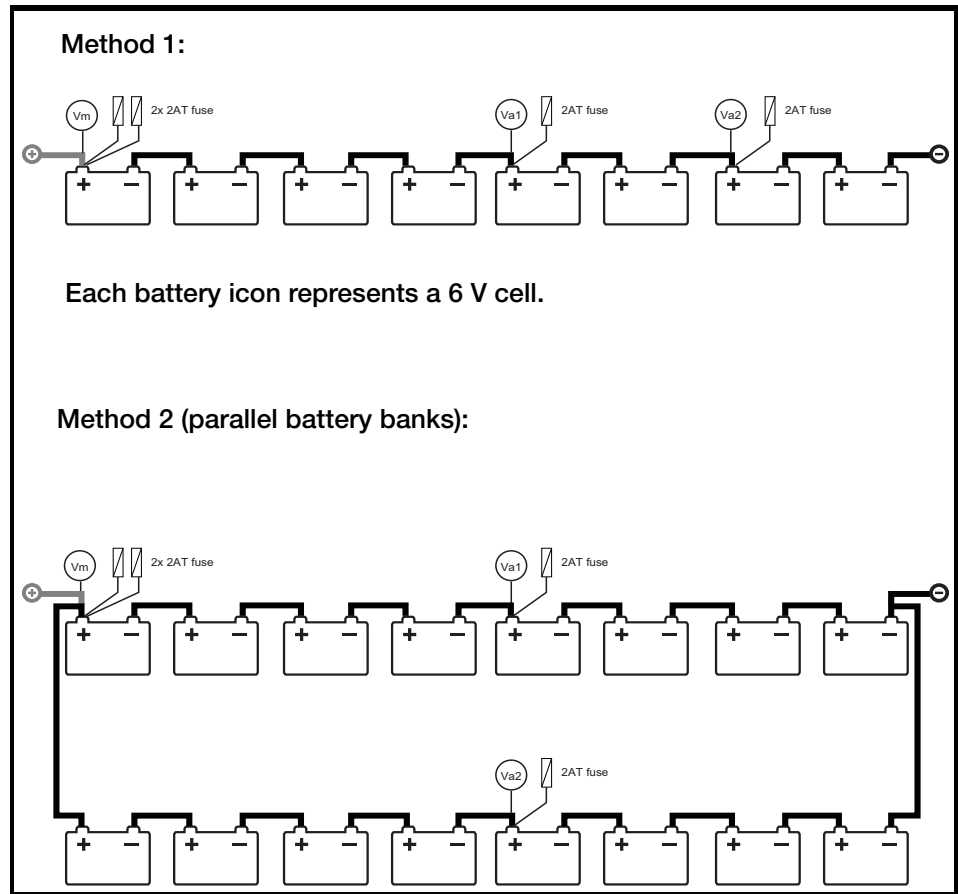


Figure 3-6 Mid-point sensing configurations

To display the mid-point voltages on the Battery Monitor, press the right arrow key until the **AUX** Voltage label is shown. The voltage display on the LCD display will alternate every 5 seconds between VA1 and VA2 voltages.

Trending Mid-point Voltages in Data Logs

By keeping track of the mid-point Va1 & Va2 between the two battery strings, it is possible to know if both strings are remaining balanced during charge and discharge cycles. The most obvious differences can be observed when the battery is in the range of 70-50% SOC. The effect gets more pronounced as the cell voltage nears the knee voltage common with lead-acid batteries (i.e. discharge voltage of the battery after which there is little energy capacity left). Typical voltage difference of less than 0.5 V to 1 V are acceptable, but when voltages start to differ beyond 1.5 V for two center taps of a parallel battery string, it usually means the cells of one string have diverged and need periodic maintenance (a visual check, water top-up, or equalization, etc.)

It is not practical to monitor the mid-point voltage throughout the day. Therefore, a more practical approach is to look at periodic log files stored inside the Battery Monitor and examine the minimum values recorded for Va1 & Va2. If they differ beyond 1.5 V, maintenance may be required. Another option is to compare these minimum voltages to double (two times) the value of Vm. If these are close in value, it can reasonably be inferred that the batteries are healthy.

Note: The above explanation is provided as a recommendation and not expected to be an accurate method of determining the state of health for the type of batteries you own. Consult with the battery manufacturer to determine how the sensing of mid-point and logging over a period of time can be used for determining information about battery health and maintenance needs.

Synchronization

In order to keep the Battery Monitor delivering accurate status information about the battery, it is important to synchronize it regularly. Synchronisation is also needed before the Battery Monitor can initially be used. During operation, the Battery Monitor automatically indicates when a synchronisation is required by displaying the message **SYNCHRONIZE**.

Performing synchronizations regularly is also important to increase battery life and keep the battery healthy. If charge cycles are being performed regularly, the Battery Monitor will most likely not display the **SYNCHRONIZE** message since the battery is already being kept in sync with the Battery Monitor.

To manually synchronize the Battery Monitor:

In addition to automatic synchronizations for meeting the Auto-Sync Functions, the Battery Monitor can be manually synchronized with the battery when the battery is fully charged. This is done by pressing and holding both < and > keys simultaneously for three seconds or until the flashing **Fu11** message appears on the display, just like when it is automatically synchronized.

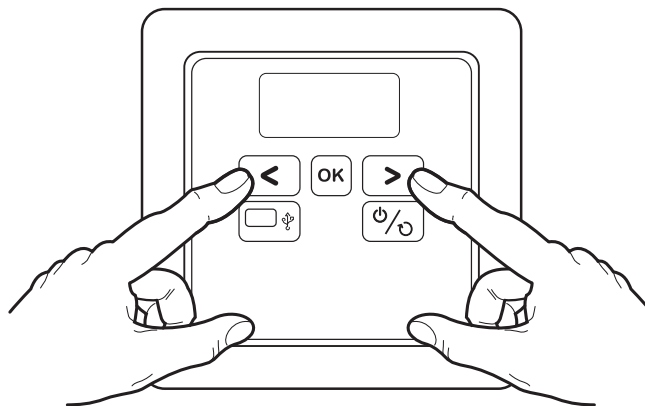


Figure 3-7 Button press for synchronization

A synchronisation step means performing a charge cycle on the battery. A charge cycle will be considered complete when all discharged energy is restored in the battery and Auto-sync parameters **F1.0**, **F1.1** and **F1.2** are met (see “System Property Settings” on page 3–28). This typically occurs when the battery charger switches to float mode. By meeting these conditions, the battery is considered full, which will be indicated by a flashing **Full** message on the display. The State-of-charge readout will also be set to 100% and the Amp-hour readout reset to 0 Ah. The **Full** message will disappear when a key is pressed or automatically when the battery starts discharging again.

Upgrading Firmware

Firmware upgrades for the Battery Monitor and other Xanbus-enabled devices can be performed whenever required. These upgrades are only possible through Xanbus communication and can be completed using the Conext Configuration Tool and included dongle, or with the Conext ComBox.

Be sure to back up all data log files prior to upgrading the firmware. Upgrades for the Battery Monitor can take five minutes or more depending on various factors, so be sure to allow enough time for the upgrade to complete. Do not reset any devices while the upgrade is taking place.

New firmware updates can be found at www.SEsolar.com.

For detailed instructions about upgrading device firmware, refer to the *Conext Configuration Tool Owner's Guide* and the *Conext ComBox Owner's Guide*.

Multiple Battery Monitors on the same Xanbus network

When running multiple Battery Monitors on the same Xanbus network, a maximum of up to 4 Battery Monitors can be connected to various battery sizes as needed. If multiple Battery Monitors are installed, they should each be assigned a different Battery Association (e.g. HouseBatt1-HouseBatt4) using the Conext Configuration Tool, Conext ComBox, or Conext SCP (Multi Menu).

SCP Menu Map

The Conext System Control Panel (SCP) provides remote configuration and monitoring capability for the Battery Monitor and other Xanbus-enabled devices in the network. Below is a map of Battery Monitor menu functions.

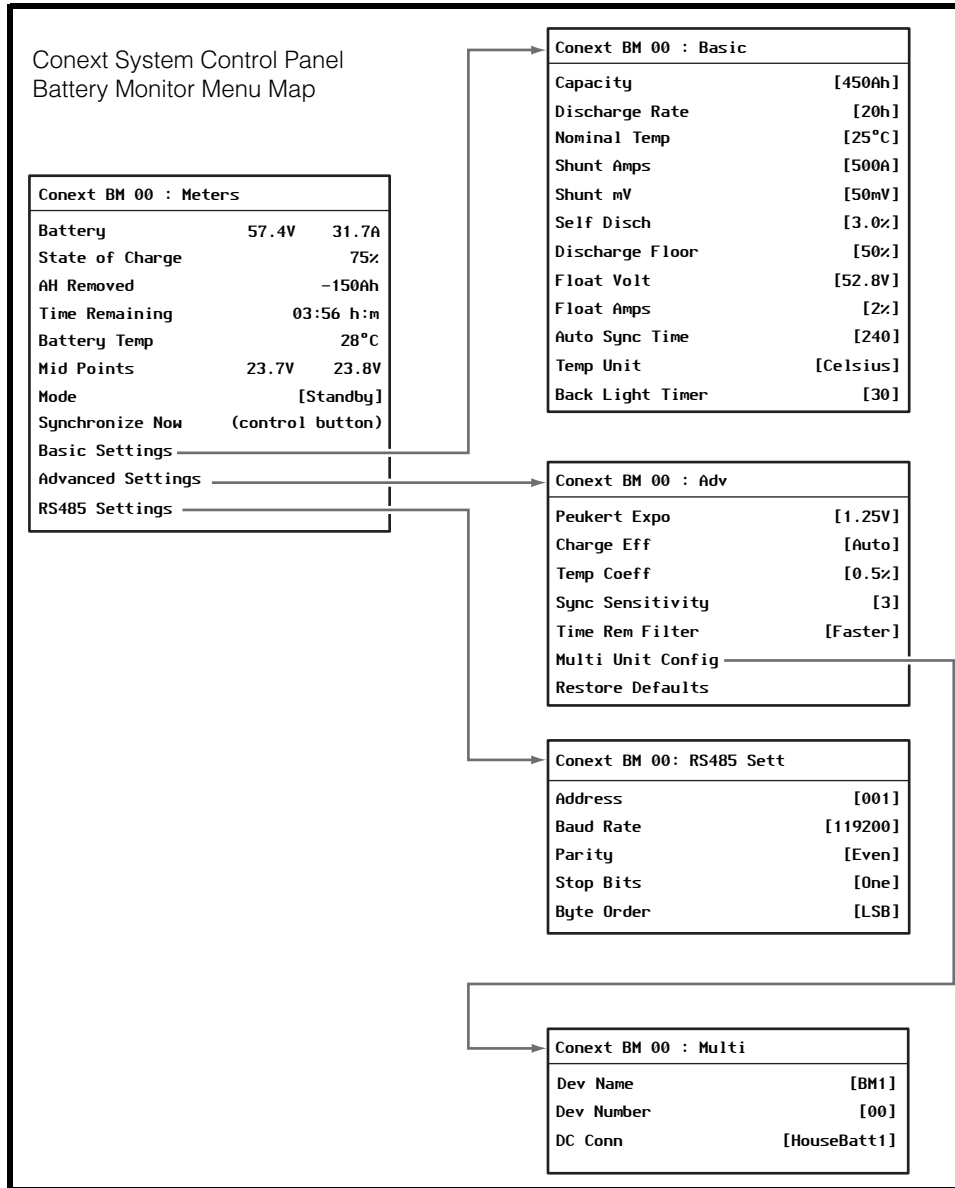


Figure 3-8 Conext SCP Battery Monitor Menu Map

Note: All data in Figure 3-8 is sample data and may not necessarily correspond with the data on your system.

Note: If more than one Battery Monitor is present in a system and DC associations are given default names, the names on other devices could be

duplicated, which could cause system-wide battery bank status readings to be inaccurate. Be sure to manually configure a unique DC association number for each Battery Monitor when multiple Battery Monitors are present in a system to avoid this issue.

4

Monitoring

Chapter 4 describes how the Battery Monitor can monitor system components and explains how displays and functions are calculated. It includes:

- “Indicators and Controls” on page 42
- “Meters” on page 43
- “Theory of Operation” on page 44

Indicators and Controls

The Battery Monitor contains the following controls and indicators:

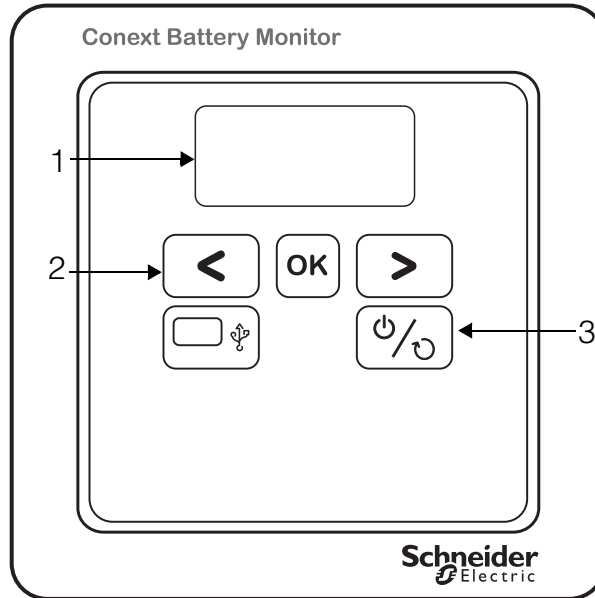


Figure 4-1 Conext Battery Monitor Controls and Indicators

1. LCD display screen
2. Navigation buttons (<, **OK** and > keys)
3. Reset button

The LCD display screen displays alphanumeric messages with a three-digit resolution (0.00). The screen will flash amber when the battery is in an emergency state requiring attention.

Meters

When not being actively configured, the Battery Monitor is operating in display mode. By default, it displays the main battery voltage readout. To display one of the other meters:

- Press the **OK** button repeatedly until the desired indicator illuminates.
- The LCD display will indicate the values for the currently selected function.

All readout selections can be navigated by using the **<** and **>** keys.

The standard readout selection sequence is as follows:

V (battery voltage) > A (charge/discharge current) > Ah (Amount of consumed Amp-hours) > % (State-of-charge (SOC)) > h (Time remaining until a battery recharge is necessary) > °C (Battery temperature, or temperature setting if BTS is installed) > V (Mid Point Voltage, if configured).

Available Meters

V (Volts)	When this indicator is displayed, the LCD display shows the voltage currently present at the battery. The range is 0 to 70 Volts. The accuracy is $\pm 0.3\%$.
A (Amps)	When this indicator is displayed, the LCD display shows the currently occurring charge or load current in amps. The range is from ± 0.1 to ± 9999 amps with a refresh rate of one second. The accuracy is $\pm 0.4\%$.
Ah (Amp-hours)	When this indicator is displayed, the LCD display shows the total amp-hours used since the last time the amp-hour meter was reset. The range is from ± 0.00 to ± 9990 amp-hours. When the decimal point flashes, it means that more than 10,000 amp-hours have accumulated. In this case, multiply the reading by 1000 (i.e., 111 = 111,000). This meter automatically resets to zero approximately one minute after the Full LCD stops flashing.
% (State-of-charge)	When this indicator is displayed, the LCD display shows the battery's State-of-charge based upon the amp-hour reading divided by the amp-hour capacity of the batteries (or battery bank). The values displayed are: <ul style="list-style-type: none">• Lo (when battery is below 27.5%)• 30 to 90% numerical value (in 5% increments)• Full (when the battery's State-of-charge is over 92.5% capacity)
h (Time Remaining)	Time remaining until recharge. Limit represented in HH:mm remaining time. This readout displays "-----" when charging.
°C (Battery Temp)	Battery temperature. Indicates the battery temperature if the Battery Temperature Sensor (BTS) is installed. Otherwise, this will display the temperature as set in Function F1.4 .
V (AUX Volts)	Displays the mid-point voltages Va1 and Va2 when mid-point voltage sensing is used. When selected, this setting will alternate between displaying Va1 and Va2. See "Mid-point sensing configurations" on page 3–35 for more information.

Theory of Operation

How State-of-charge and Amp-hours are Calculated

The capacity of a battery is rated in amp-hours (Ah). A battery that can deliver a current of 5 A for a period of 20 hours is rated at 100 Ah ($5 \times 20 = 100$) at a C20 discharge rate. The Battery Monitor continuously measures the current flow in or out of the battery and calculates the amount of energy removed from or added to the battery. However, battery age, discharge current, and temperature all influence the battery's capacity. When the same 100 Ah battery is discharged completely in only two hours (a C2 rate) it will provide only 56 Ah. In this case, the battery's effective capacity is almost halved. Additionally, when the temperature of a battery is low, its battery capacity is decreased even more. This is why simple amp-hour counters or voltmeters cannot provide an accurate state-of-charge indication.

The Battery Monitor can display both amp-hours removed (not compensated) and actual state-of-charge. Reading state-of-charge is the best way to read the battery. This parameter is given as a percentage, where 100.0% represents a fully charged battery and 0.0% a completely flat battery. It can be thought of in comparison to a fuel gauge in a car. Discharging lead-acid batteries lower than 50% of SOC is typically not recommended as it may affect battery life.

How the Charge Efficiency Factor is used

Charge Efficiency can be defined as the ratio between the energy removed from a battery during discharge and the energy replaced into the battery during charging. Not all energy transferred into the battery during battery charging is available during subsequent use of the battery. The charge efficiency of a brand new battery is approximately 90%, which means that 10 Ah must be transferred into the battery to get 9 Ah actually stored in the battery. This efficiency figure is called Charge Efficiency Factor (CEF) and decreases as batteries age. The Battery Monitor automatically calculates the CEF of the battery as the battery is used. The level at which the CEF is recalculated is variable and is linked to the discharge floor set in **F1 . 3**.

The CEF algorithm starts operating when 10% of the difference between 100% and the discharge floor is discharged from a fully charged battery. For example, assume the discharge floor is set to 50%. Then the CEF algorithm starts operating when $100\% - 50\% / 10 = 5\%$ is discharged from a fully charged battery. When the discharge floor is set to 0%, this level is $100\% - 0\% / 10 = 10\%$.

How Time Remaining is Computed

The Battery Monitor calculates how long the battery can support the currently active load. This is referred to as Time Remaining. Time Remaining indicates the time left until the battery needs to be charged again. If the battery load is fluctuating heavily, it is best not to rely on this reading since it is a momentarily calculated readout. This means that it will always reflect the time remaining as

based on the load at the time of readout. Therefore, it should be used as a guide only. The use of the state-of-charge readout generally gives a more accurate indication of the overall percentage of battery life remaining.

Time Remaining is still an important readout in certain cases. For example, when there is a heavy and sustained load, it can be useful to know how much longer the load can be operated. The time remaining readout will display the total time available to run the load with the amount of energy available in the battery at the present time.

Note: The Peukert's Coefficient is only used to adjust the SOC and Time Remaining value during a discharge. It is not applied to the Amp-hours Removed value.

Peukert's Exponent for Battery Rating

Peukert's Equation describes the effect of different discharge rates on battery capacity. As the discharge rate increases, the available battery capacity decreases.

The Battery Monitor uses Peukert's equation for calculating the Time Remaining function. The amp hours display always shows the actual number of amp hours consumed. This means that if the battery is rapidly discharged, the time remaining number may show zero hours remaining before showing the total number of amp hours of battery capacity consumed.

5

Troubleshooting

Chapter 5 describes troubleshooting for common issues that might be encountered when installing or operating the Battery Monitor. It also describes how the Battery Monitor works with other Xanbus Devices. It includes:

- “Troubleshooting Common Issues” on page 48
- “Interoperability with other Xanbus Devices” on page 49

Troubleshooting Common Issues

To troubleshoot commonly encountered issues, look up the issue in the troubleshooting table below for possible solutions. If you're unable to find the issue, Contact Customer Service for further assistance. Please be prepared to describe details of your system installation and provide the model and serial number of the unit. See page 1-i for contact information.

Table 5-1 Troubleshooting Common Issues

Problem	Possible cause	Solution(s)
The Battery Monitor doesn't operate (no display)	Battery not connected or battery voltage low.	Check Battery Monitor and battery side connections. Check battery voltage. Battery might be flat. Vbatt must be >18 VDC.
Current readout gives wrong polarity (e.g. positive current instead of negative when discharging)	Current sense leads from the shunt are reversed.	Confirm proper wiring of leads using the installation guide.
The Battery Monitor resets frequently.	Battery might be flat or defective.	Check the wiring for corrosion and / or loose contacts.
No changes can be made in the Function setup.	The Battery Monitor might be locked by the setup lock function.	Check that the setup lock function is OFF (Function F3.5). Ask the installer for the password to unlock the monitor.
"Charge" or "Synchronize" keeps flashing on LCD display.	Battery is not fully charged. Incorrect parameters.	Charge battery full (synchronize your battery with the monitor). Check the Auto-sync parameters in Functions F1.0 , F1.1 , and F1.2 for possible incorrect settings.
State-of-charge and/or time-to-go readout not accurate.	Charger or Load connected directly to Battery negative Current sense leads from the shunt are reversed. Battery Monitor needs to be synchronized.	Connect all charger and load negative terminals to the system negative side of the shunt. Check all Battery properties Functions (F2) Check if Battery Monitor is synchronized.
Display returns '----' in temperature readout	Connection with temperature sensor is lost.	Check for failed connections and/or cable damage.

Problem	Possible cause	Solution(s)
Battery voltage readout is inaccurate	Voltage drop within the circuit.	Check connections and verify that the cable lengths are within the limits. See “Planning and Choosing a Location” on page 9 for correct cable lengths.
Battery State-of-Charge displays 100% when voltage is low.	Amp-hour setting is too low.	Reconfigure the Amp-hour setting using Function F1.1 (Charger float current) to an appropriate value. See “System Property Settings” on page 3–28 for further information.
“ Fu11 ” continues to display on the LCD screen even though the current flow is negative (battery discharging) continuously for one minute.	Charger float voltage may be set too low.	Reconfigure the charged voltage using Function F1.0 (Charger float voltage) to an appropriate value. See “System Property Settings” on page 3–28 for further information.
Battery Monitor SOC jumpst to 100% prematurely.	Fluctuations in charging current around boundary limits for Synchronization conditions.	Change the F1.0 (Charger float voltage) to the Absorption voltage, ensuring 100% synchronization only happens after all Ah are put back into batteries.

Interoperability with other Xanbus Devices

The Conext Battery Monitor is operable with most of the battery-based XanBus devices offered by Schneider Electric. Common examples are the Conext XW+ Inverter/Charger, AGS & SCP. The Conext MPPT 60 150, MPPT 80 600 & Conext SW Inverter/Charger are also capable of operating with the Conext Battery Monitor with firmware upgrades.

Battery Status

When the Battery Monitor is available on the XanBus network, the voltage, current & SOC% information which it broadcasts are displayed, reported and used at the system level. Each device individually reports a different DC voltage as measured at its input terminals.

Time

The Battery Monitor has a real-time clock with a battery backup. This clock is set to the PST time zone (UTC-08:00) when shipped. When the Battery Monitor is plugged into a XanBus network with a ComBox or System Control Panel, it will synchronize the time in the following order of hierarchy:

1. ComBox

-
2. SCP (if ComBox is not present)

Temperature

The Battery Monitor can be connected to a Battery Temperature Sensor (BTS) to provide status information on the temperature (in °C) at which the connected battery is operating. This information is used in SOC% and reserve capacity calculation. The Battery Monitor broadcasts this temperature information on the XanBus network which can then be used by other XanBus devices that are charging batteries to compensate voltage based on the highest temperature reported by devices on the same battery bank.

Operation with System Control Panel

The Conext SCP features configuration and status monitoring for the Battery Monitor. See “SCP Menu Map” on page 3–38 for the menu maps and available fields accessible through SCP.

Operation with Automatic Generator Start

The Battery Monitor allows for one additional trigger to start and stop a generator based on SOC%. When the Conext Battery Monitor is present on the XanBus network with other battery based devices, the Conext AGS uses Battery Voltage status information from the Battery Monitor.

Operation with Conext XW+ Inverter/Charger

The Battery Monitor broadcasts State-of-charge information using XanBus. This allows The Conext XW+ Inverter/Charger to use the Battery Monitor's date instead of its own internal State-of-charge calculation. This technique helps to achieve a more accurate and consistent State-of-charge display on all XW units connected to same battery bank. In the future, advanced charging algorithms for lead-acid batteries will also be implemented using the Battery Monitor.

Operation with Conext ComBox

The Battery Monitor behaves like a regular XanBus device on the ComBox and provides functionality similar to the Conext SCP through the ComBox. In addition, the ComBox uses the battery status information broadcast by the Battery Monitor to display a daily summary of the Voltage, Amps, SOC, and Temperature trends.

The following table provides the firmware version necessary for device operation with the Battery Monitor:

Table 5-2 Device Compatibility with Conext Battery Monitor

Device Name	Firmware Version
Conext XW+ Inverter/Charger	2.0.0 and higher
Conext AGS	2.07 and higher
Conext SCP	2.00 and higher

Table 5-2 Device Compatibility with Conext Battery Monitor

Device Name	Firmware Version
Conext ComBox	1.04 and higher
Conext ComBox App	1.0.20 and higher

A

Specifications

Appendix A contains the electrical, mechanical, and physical specifications for the Conext Battery Monitor. It also contains regulatory standards, supplementary data and information about compatible devices.

Note: All specifications are subject to change without notice.

Electrical Specifications

Supply Voltage	18 to 66 VDC
Supply Current (backlight Off, logging- disabled)	80 mA @ VIN=48 VDC, 150 mA @ Vin=24 VDC
Input Voltage Range (main battery)	0 to 70 VDC
Input Current Range	-9999 to +9999A
Battery Capacity Range	20 to 10,000 Ah
Operating Temperature Range	-20 to +50°C (-4 to 122°F)
Power Consumption	<4 W

Resolution

Voltage	0 to 70 V (+0.01 V)
Current	0 to 200 A / 200 to 9999 A (+0.1 A / +1 A)
Amp-hours	0 to 200 AH / 200 to 9990 AH (+0.1 Ah / +1 Ah)
State-of-Charge	0 to 100% (+0.1%)
Time Remaining	0 to 24hrs / 24 to 240hrs (+1 min / +1 hr)
Temperature	-20 to +50°C / -4 to 122°F (+0.1°C)

Accuracy

Voltage Measurement	±0.3%
Current Measurement	±0.4%

Connections

Battery Voltage, Shunt/ Temp Sensor	RJ45 / RJ11 (cables included)
USB mini-B - Device	Connector: USB mini-B, Protocols: MSD (data extraction)

Features

Network	Protocol: Xanbus / Connectors: RJ45
USB 2.0	Protocol: MSD (data extraction) Connector: USB mini-B

ModBus	Isolated RS-485, half-duplex, 2-wire serial
Data Logging	10 data points every 10 minutes for 10 years
Display	Backlit LCD
User interface	3 front panel menu buttons, 1 power button
Battery string- imbalance detection	Two-point sensing
Temperature Sensor (included)	762 cm (300 in.)
Warranty	2-5 years depending on country

Mechanical Specifications

Dimensions (H x W x D)	8.5 x 8.5 x 9.0 cm (3.3 x 3.3 x 3.5 in.)
Product/Shipping Weight	0.2 kg (0.4 lb) / 1.95 kg (4.3 lb)
Mounting System	Panel mount, Wall mount, DIN rail: 35mm
IP Rating/Location	IP 20, NEMA 1, Indoor Only
Storage Temperature Range	-30 to +70°C (-22 to 158°F)
Part number	865-1080-01

Battery Interface Kit with Shunt (Included)

Connection to Battery	300 cm cable with ring terminals
Connection to Battery Monitor	500 cm CAT5 cable RJ45
Shunt	500 A / 50 mV
Shunt dimensions	8.7 x 4.5 x 3.5 cm (3.4 x 1.6 x 1.3 in.)
Shunt weight	0.15 kg (0.3 lb)

Regulatory Standards

Markings	CE
EMC	Directive 2004/108/EC, IEC/EN61000-6-3, IEC/EN61000-6-1, FCC Part 15 Class B, Industry Canada ICES-003 Class B

Schneider Electric Products compatible with the Battery Monitor

- Conext XW+ 5548 NA (865-5548-01)
- Conext XW+ 6848 NA (865-6848-01)
- Conext XW+ 7048 E (865-7048-61)
- Conext XW+ 8548 E (865-8548-61)
- Conext SW 2524 230 (865-2524-61)
- Conext SW 4024 230 (865-3524-61)
- Conext SW 2524 120 (865-2524)
- Conext SW 4024 120 (865-3524)
- Conext MPPT 60 150 (865-1030-1)
- Conext MPPT 80 600 (865-1032)
- Conext SCP (865-1050)
- Conext AGS (865-1060-01)
- Conext ComBox (865-1058)

B

Modbus Maps

Appendix B contains the Modbus register address maps.

Note: All data is subject to change without notice.

⚠ WARNING**UNINTENDED OPERATION**

The use of this product with Modbus communications requires expertise in the design, operation, and programming of the device. Only qualified persons should program, install, alter, and commission this product.

When writing values to the device, ensure nobody else is working with the device.

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

Overview

This appendix describes the structure of the Modbus register address map, which is used to configure and control the Conext Battery Monitor. The information in this document is intended for use only by qualified persons who have a detailed technical understanding of the Modbus protocol.

The Modbus map is divided into rows of Modbus registers. Each row indicates the Modbus register address, its SYSVAR names, Modbus address, Access types and data types. External Modbus Master devices can read and write the Modbus registers to configure, control, or monitor the device remotely.

Supported Modbus Data Types

Table 1 lists the supported data types.

Table 1 Modbus Data Types

Data Type	Description
uint16	unsigned 16-bit integer [0,65535]
uint32	unsigned 32-bit integer [0,4294967295]
sint32	signed 32-bit integer [-2147483648,2147483647]
str<nn>	packed 8-bit character string, where <nn> is the length of characters in the string. Two characters are packed into each Modbus register. Example: str20 = 20-character string (packed into 10 Modbus registers) str16 = 16-character string (packed into 8 Modbus registers)

Converting Data to Units of Measurement

Data from a Modbus register is converted to units of measurement using the following algorithm:

$$\text{result} = [(\text{data @ Modbus Register}) * \text{scale}] + \text{offset}$$

Example: Read the Nominal Temperature

The following example shows a conversion of the nominal temperature located at Modbus Address 0x0400.

Modbus Address = 0x0400
 Scale = 0.01
 Offset = -273.0
 Data type = uint16 (one Modbus register)
 units: degree C

Reading one Modbus Register from address 0x0400 yields 0x7440
 Apply the offset and scale as follows:

$$\begin{aligned} \text{result} &= (0x7440 * 0.01) + (-273.0) \\ &= (29760 * 0.01) + (-273.0) \\ &= 297.60 + (-273.0) \\ &= 24.60 \end{aligned}$$

The conversion yields a nominal temperature of 24.60 degrees Celsius.

Writing Modbus Registers

Modbus does not provide an error response when data written to a Modbus Register is out of range or invalid. To confirm that a Modbus Register is correctly written, you should read it back and compare it with the expected value.

Battery Monitor Device Modbus Map

Modbus Address	Name	Type	Access	Units	Scale	Offset	Notes
0x0100	Device Name	str16	r				
0x010A	FGA Number	str20	r				
0x0114	Firmware Version	str15	r				
0x011E	Hardware Serial Number	str20	r				
0x0200	Operating Mode	uint16	r				Enum1
0x0201	Battery Voltage	sint32	r	V	0.001	0	
0x0203	Battery Current	sint32	r	A	0.001	0	
0x0205	Battery Temperature	uint16	r	degree C	0.01	0	

Modbus Maps

Modbus Address	Name	Type	Access	Units	Scale	Offset	Notes
0x0206	Battery State of Charge	uint16	r	%	1	0	
0x0207	Battery Midpoint VA1	sint32	r	V	0.001	0	
0x0209	Battery Midpoint VA2	sint32	r	V	0.001	0	
0x020B	Battery AH remaining	uint16	r	Ah	1	0	
0x020C	Battery AH removed	uint16	r	Ah	1	0	
0x020D	Temperature Sensor	uint16	r				0= Not Present 1=Present
0x020E	Time to Discharge	uint16	r	Min	1	0	
0x0300	Average Discharge	uint16	r	Min			
0x0301	Average Discharge %	uint16	r	%			
0x0302	Deepest Discharge	uint16		Ah			
0x0303	Deepest Discharge %	uint16		%			
0x0304	AH Removed	uint32		Ah			
0x0306	AH Returned	uint32		Ah			
0x0308	Number of Charge Cycles	uint16					
0x0309	Number of Synchronizations	uint16					
0x030A	Number of Discharges	uint16					
0x0400	Nominal Temperature	uint16	rw	degree C	0.01	-273	
0x0401	Temperature Unit	uint16	rw				0=Fahrenheit 1=Celsius
0x0402	Nominal Discharge	uint16	rw	Hours	1	0	
0x0403	Self Discharge	uint16	rw	%	0.1	0	
0x0404	Shunt Amp rating	uint16	rw	A			Enum2
0x0405	Shunt Volt rating	uint16	rw	mV			0 = 50mV 1 = 60mV
0x0406	Backlight Duration	uint16	rw	Sec			Enum3
0x0407	Float Voltage	uint16	rw	V	0.001	0	
0x0408	Float Current	uint16	rw	%	0.1	0	
0x0409	Discharge Floor	uint16	rw	%	1	0	
0x040A	Auto Synchronization Time	uint16	rw	Sec			Enum4
0x040B	Battery AH Capacity	uint16	rw	Ah	1	0	
0x0500	Battery Association	uint16	r				Enum5
0x0501	Battery Temp Coeff	uint16	rw	%Ah/ degree C	0.01	0	
0x0502	Lock Settings	uint16	rw				0=Off 1=On

Modbus Address	Name	Type	Access	Units	Scale	Offset	Notes
0x0503	Time Remaining Filter	uint16	rw				00 = Fastest 01 = Faster 02 = Fast
0x0504	Auto Synchronization Sens	uint16	rw		1	0	
0x0505	Battery Peukert Expo	uint16	rw		0.002	1	
0x0506	Charge Eff Calc Mode	uint16	rw				0=Manual 1=Auto
0x0507	Charge Efficiency Factor	uint16	rw	%	1	0	
0x0508	Default Battery Temperature	sint16	rw	degree C	1	0	
0x0600	Modbus Address	uint16	rw		1	0	
0x0601	Modbus BaudRate	sint32	rw	bps	1	0	Enum6
0x0603	Modbus Parity	str2	rw				00 = None 01 = Odd 02 = Even
0x0604	Modbus Stop Bits	uint16	rw		1	0	1=1 2=2
0x0605	Modbus Byte Order	uint16	rw		1	0	0=LSB 1=MSB

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