lxnav SMARTSHUNT Digital Battery Monitoring Installation Guide

Contents

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Safety

Symbols for warning indications
The following warning indications are used in this manual in the context of safety.

- Notes with a red triangle indicate that great potential danger exists that can lead to serious injury or death. It also describes procedures that are critical and may result in loss of data or any other critical situation.

- A Yellow triangle is shown for parts of the manual that should be read very carefully and are important when operating the E500/E700/E900.
- A bulb icon is shown when a useful hint is provided to the reader.

Pass on the safety instructions to other users.
General rules and laws concerning safety and accident prevention must always be observed.

General information

LXNAV SMARTSHUNT is a smart battery monitoring unit compatible with the NMEA2000 network standard. It accurately measures DC voltages of up to three batteries bounded in series and includes a shunt for current measurements. It estimates the state of charge, state of health and remaining time until the empty battery. Up to three temperatures can be measured. It supports multiple types of batteries and can be configured through any LXNAV Exx device or via a webpage accessible over an internal Wi-Fi hotspot. Parameters set there are available on the NMEA2000 network to any device such as LXNAV's E350, E500 etc. LXNAV SMARTSHUNT is available in four versions with 100, 300, 500 and 1000A shunt. All of them are 25 mV. For proper installation read the next chapters carefully.

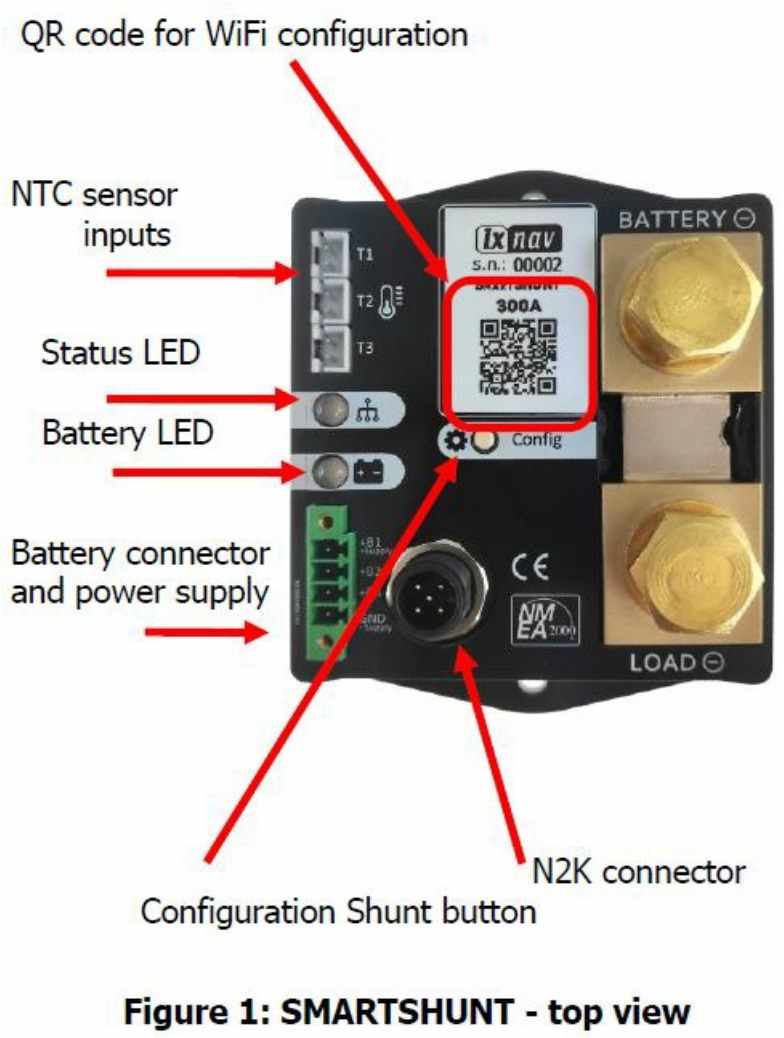


Figure 1: SMARTSHUNT - top view

Two operation modes

The SmartSHUNT operates in 2 modes:
LOW POWER MODE

To consume as little energy as possible, the SmartSHUNT goes in ‘’Low power mode’’ when the following conditions are met:

- NMEA2000 connection is offline
- No load connected
- Charger is not connected
- SOC is valid

- The SmartSHUNT wakes up periodically (8s) from low power mode to check the conditions between LOW POWER MODE / NORMAL POWER MODE operation.
- In this mode, the shunt is measuring if the above conditions (low power mode) are still met. If so, the device continues to run in Low power mode otherwise it switches to normal operation.
- The user can force the SHUNT to enter normal operation mode by pressing the button on the unit for 8 seconds (for the whole sleep period).
- It will stay in normal operation for 10 minutes. If after 10 minutes conditions to enter low power mode are met, the shunt will re-enter low power mode.
- Every 2 hours, the SmartSHUNT goes to normal operation for 2 minutes even when all of the above conditions are met to recalculate the algorithm every once in a while.

NORMAL POWER MODE

- In normal power mode, the SmartSHUNT is visible on the NMEA2000 network, the LEDS indicates the SHUNT status (see section 4.4) and the Wi-Fi for configuration and monitoring the battery.

Installation

Mounting recommendation

- SMARTSHUNT has a flat bottom and should be mounted with two screws to a solid surface next to battery packs to minimize wire length from battery terminals to the connector on SMARTSHUNT. With this, measurement error is minimized to minimum.
- Do not work on the electrical system while it is energized.
- Do not install the SmartSHUNT near inflammable substances.
- Do not place the SmartSHUNT in wet, humid or high-temperature compartments.
- Unauthorized modifications exclude manufacturers' liability for any resulting damage.
- Do not mix batteries of various brands, voltages or capacities.

NMEA2000 specifications

Parameter	Description
Compatibility	NMEA2000 compatible
Bit rate	250 kbps
Connection	A coded M12 connector

Table 1: NMEA2000 specifications

Connectors
Power supply & battery inputs B1-B3
LXNAV SMARTSHUNT is powered by a 4-pin terminal connector from which it also measures voltages of up to three batteries. The maximum allowable voltage on each +Bx terminal is 65 V. When installing, try to make sense wires as short as possible and keep them away from high current sources like cables, electric motors etc.

Figure 2: Battery terminals

Pin name	Description
+B1 (+Supply)	Power supply for device and measuring port for the first battery
+B2	Measuring terminal for a second battery
+B3	Measuring terminal for a third battery
GND (-Supply)	Common ground terminal for all three batteries, also for power Supply

Table 2: Battery connector pinout

External temperature sensor inputs
Each external NTC 10 kΩ temperature sensor is supplied with SMARTSHUNT for additional information on battery status. With it we can calculate an even more precise capacity of the battery that changes with temperature. Besides that, the lifetime of the battery also depends on the temperature of the environment, where the battery is stored. The sensor is supplied on a 1 m long cable that fits in two pin connectors labelled from T1 to T3. On the other side of the cable is a ring lug terminal with a mounting hole diameter of 3.7 mm. When installing the system keep in mind that each sensor number refers to the same battery number. For example, sensor T1 is for battery pack B1, T2 for B2 and T3 for B3.

Figure 3: NTC sensors inputs T1-T3

Shunt
SMARTSHUNT is a low-side current sense device and it must be placed between load and ground. Wire the terminal labelled BATTERY – to battery ground and LOAD – to ground from system load. Depending on power needs use suitable cross-sections of cables and screw them with appropriate ring lugs, that are compatible with the shunt's bolt thread size of M10. Tighten the shunt bolt with a maximum torque of 21Nm.

Cont.Current	Area
1000A	2x 220mm2
500A	220mm2
400A	150mm2
300A	95mm2
200A	50mm2
100A	25mm2

Table 3: Cable cross-sectional area

NMEA2000 compatible M12 connector
The M12 5-pin A-coded connector on top of the unit is compatible with NMEA2000 and has a standard pinout. When installing, follow the recommendations of NMEA2000 network wiring. Always use a free Tee connector on the existing network. Make sure that connectors are tightened together properly to seal metal contacts inside and prevent oxidation.

Figure 4: M12 N2K connector on SMARTSHUNT

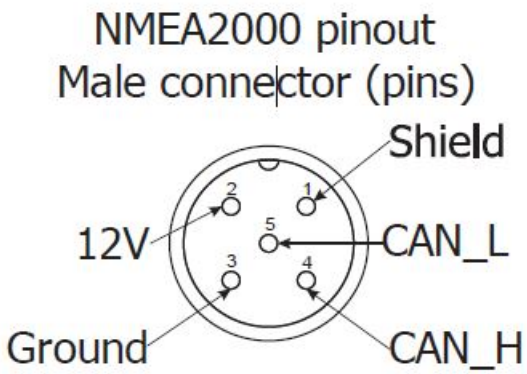


Figure 5: NMEA2000 M12 Male connector pinout (view from unit side)

LED Indications
SMARTSHUNT unit features two RGB LEDs on the top side for quick status indication. One is for the general status of the unit while the other is for battery state of charge indication. All possible modes are described in the tables below:

Status LED

Colour	Description
Blinking blue LED with 1 Hz	Working CAN network
Blinking blue LED with 10 Hz	Initialization of WIFI network
Solid blue LED	WIFI initialized, configuration disabled
Solid violet LED	WIFI initialized, configuration enabled
Blinking red LED	Hardware fault

Table 4: Status LED colour description

Battery LED

Colour	Description
Blinking red LED 1 Hz	SMARTSHUNT is not configured
Solid red LED	State of charge <30 %
Solid yellow LED	State of charge <50 %
Solid green LED	State of charge >50 %

Table 5: Battery LED colour description

Configuring SMARTSHUNT

- For proper operation, SMARTSHUNT must be configured before use. Configuration can be performed via WiFi connection or NMEA2000 network with one of LXNAV devices.
- Several parameters should be either selected from available options or written by the user.
- Selecting the right parameters is crucial for correct calculations and displaying warnings.

Battery parameter	Options
Bank type	Main battery, primary battery, secondary battery, auxiliary battery, port battery, starboard battery, bow battery, stern battery, solar battery, starter battery, battery bank 1, battery bank 2 and “other” battery
Chemistry type	Lead Acid, Li-Ion, Ni-Cad, Zn-O, Ni-Mh
Battery type	Flooded, GEL, AGM
Nominal voltage	6 V, 12 V, 24 V, 32 V, 36 V, 42 V, 48 V
Rated capacity	Should be set by the user according to battery capacity
Temperature	Celsius, Fahrenheit, Kelvin

Table 7: Battery parameters

Shunt parameter	Options
Peukert exponent	Dependency between battery capacity and discharge rate. Valid values 1.0 ~ 1.5 Initial value is set automatically based on battery che mistry.
Charging efficiency	Charger's efficiency. Valid values 0.6 ~ 1.0 Value is constantly modifie d during battery lifetime.
Temperature coefficient	Dependency between battery capacity and environment temperature. Valid values 0.0 ~ 1.0
Voltage at battery full (V)	Charger's float voltage. The initial value is set automatically based on battery chemistry and nominal voltage.
Current at battery full (A)	Charger's float current. The initial value is set automatically based on battery chemistry and rated capacity.
Voltage at battery empty (V)	Battery empty voltage. The initial value is set automatically based on battery chemistry and nominal voltage.
Config button action	No action: WiFi is always on and ready for configuration; WiFi power: button press enables or disables WiFi. When enabled, it gets automatically in config mode; WiFi config: WiFi is enabled all the time, by pressing the button SMARTSHUNT enters, or exits, config mode;
SoC low limit (%)	0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60

Table 6: Shunt parameters

Alert parameters
Parameter values in this menu can be freely selected by the user. When measurements are outside limited values, the warning message will be sent to the NMEA2000 network and shown on the screen of the Exxx device.

A list of available alerts is written below:

Table 8: Alarm parameter
Press ‘’SAVE’’ to keep your settings.

Configuring via WIFI

SMARTSHUNT has an integrated WIFI hotspot to which you can connect with a smart smartphone or any other device that allows web browsing. It can be automatically connected by scanning the QR code below the serial number. You may get a message from the system, that there may not be an available internet connection but simply run your web browser and type in **config.lxnav.com**. With pressing enter, the configuration page will show up. Before changing any parameter, the user should put SMARTSHUNT in config mode. That means the violet status LED must be lit. In any other mode, settings will not be saved. To enable WIFI or put it in config mode press the Config button for more than a second.
The configuration webpage that will show up consists of four pages easily selectable on top of the screen: Home, Battery config, Shunt config and Info page.

Homepage
On the home page user can view all current data of the system in real time that are the result of selected values on config pages, for example, voltages, temperatures, current drawn, state of charge etc. as well as peak recorded values and history of alarm messages.

Battery Configuration

- On this page, the user configures battery type with all necessary data that are mandatory for correct calculations of battery state and health.
- Please do not access the browser via QR code for configuration, because the browser does not support popup windows and saving configuration will not be possible.
- The only way is to open a browser and visit config.lxnav.com. Then you can change and save configuration settings.

Shunt configuration
All the necessary data related to current measurements should be filled out on this page. There is also a button setting for desired WIFI action.

Info page
On this page are all device information. Its serial number, hardware and software version.

Configuration via LXNAV Exxx device
The second option for the configuration of SMARTSHUNT is via any Exxx device. Assuming that the NMEA2000 network is established battery and shunt configuration pages are accessible under different paths under setting menus. In the following two chapters are written paths where menus can be found and their window previews. For operating and calibrating external devices on Exxx units refer also to the Exxx user manual.

Battery setup
Parameters related to battery packs should be set in the menu that is accessible under this path: Settings->Network->Device calibration->Battery

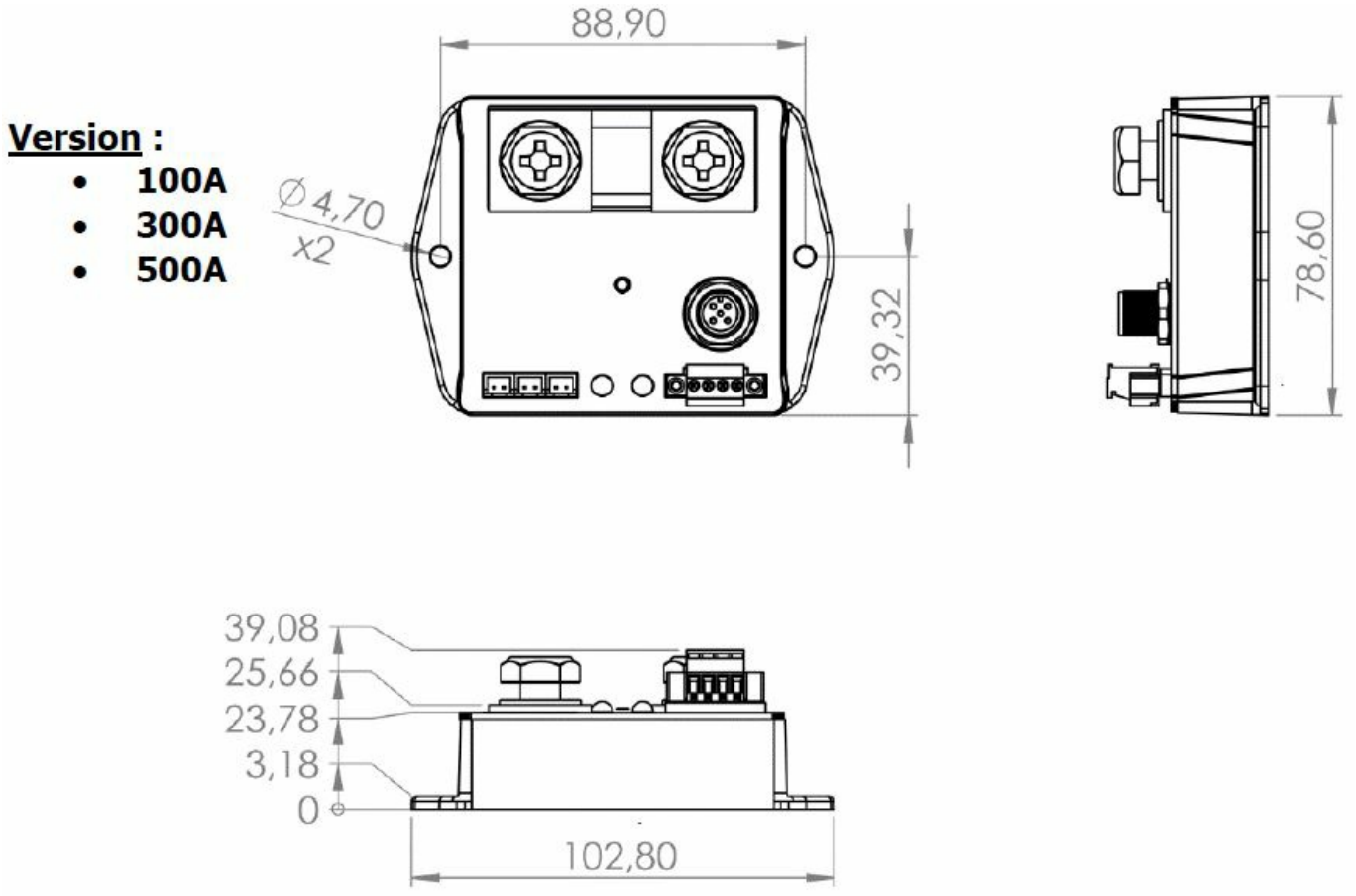
Shunt setup

- The second configuration menu is found under:
- Settings->Network->Connected devices->
- Device details->Device setup
- Parameters there relate to measurements between the shunt's terminals. There is also information about WiFi hotspot names and passwords under which is SMARTSHUNT accessible.
- Inside the shunt setup is the submenu Alerts configuration with user-selectable parameter limits for warning messages. There are seven warnings available in total.

First operation

- SmartShunt will start to operate normally and indicate real values after the initial cycle. The initial cycle is finished, when the first time is fulfilled conditions for the battery full (Voltage must be higher than the voltage setting for full and charge current must drop below full current setting)
- To get really good performance, the smart shunt will need more charge/discharge cycles, to tune other parameters like charge efficiency….

Dimensions



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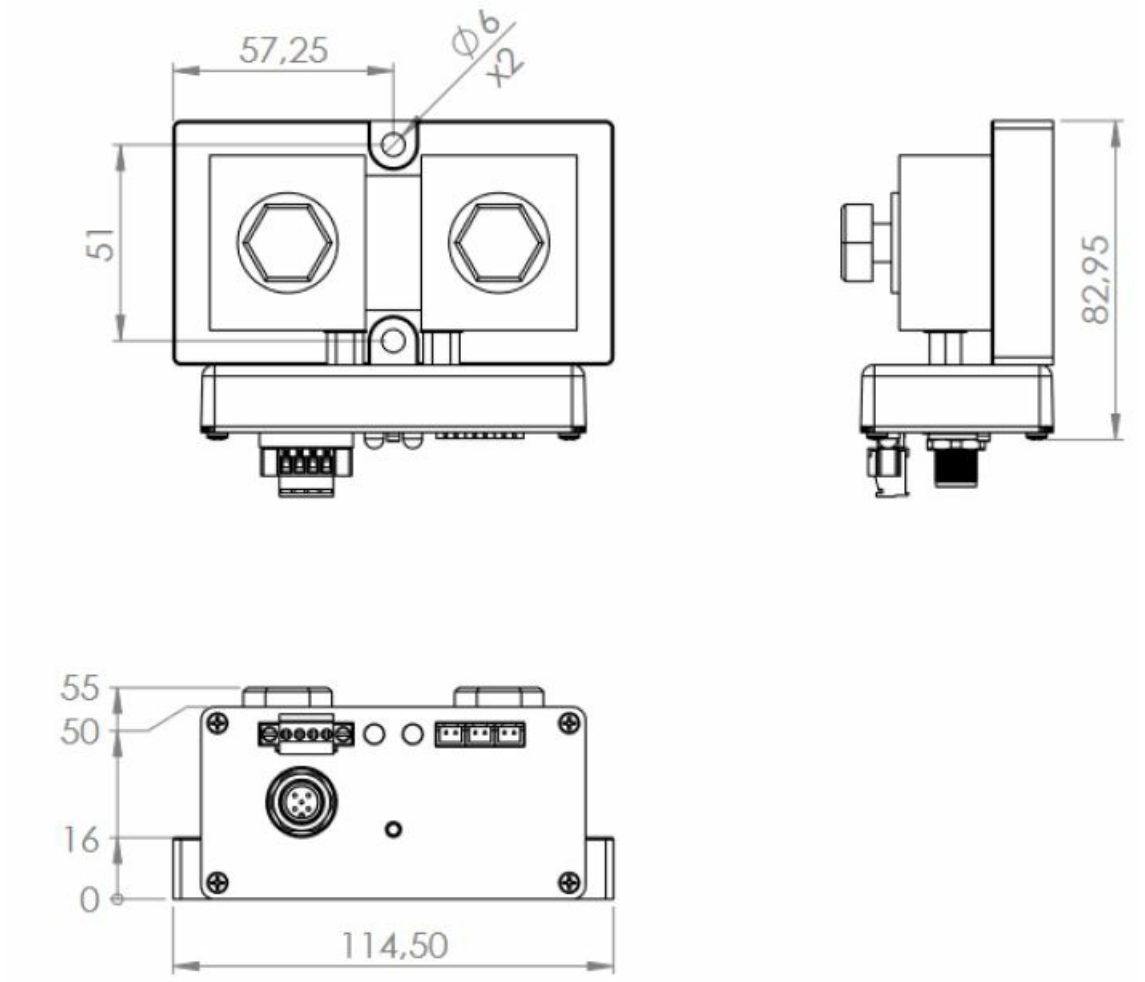

Wiring

- The figure below shows an example of wiring with a combination of three battery packs. In case the user has fewer batteries, leave dedicated terminals empty.

Figure 6: Batteries in series

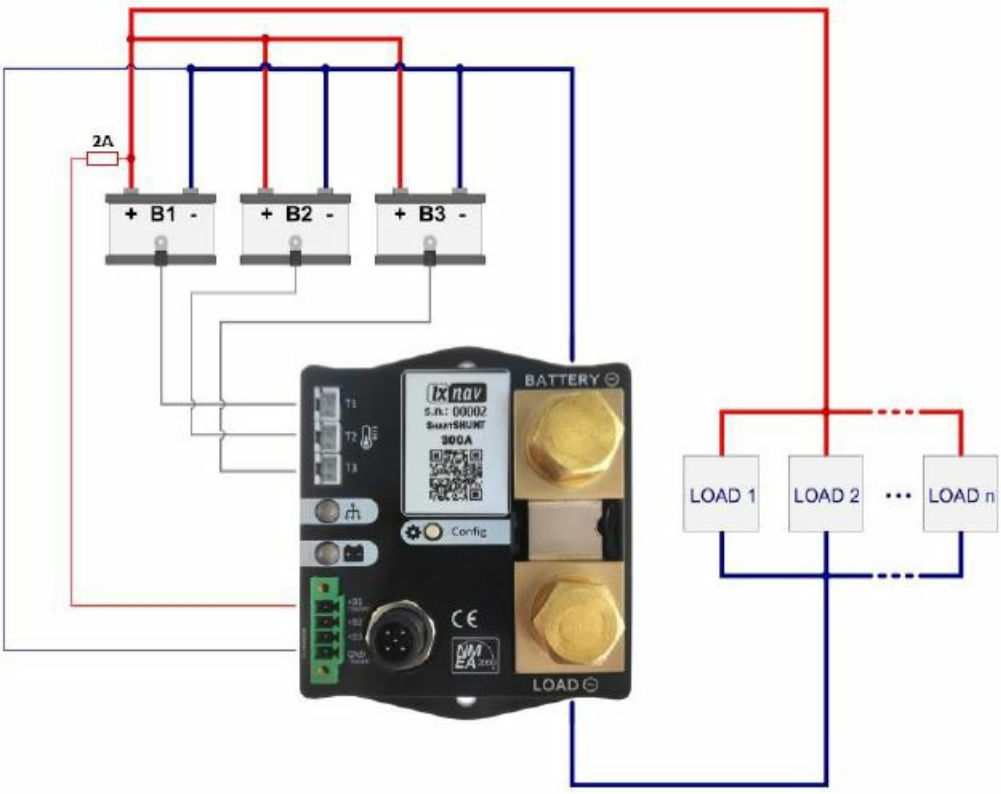

Figure 7: Batteries in parallel

Revision history

Date	Revision	Description
JUNE 2023	1	SmartSHUNT Safety updates
JULY 2023	2	SmartSHUNT 1000A integrated to the manual
SEPT 2023	3	Specifications two operation modes added

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Documents / Resources

	lxnav SMARTSHUNT Digital Battery Monitoring [pdf] Installation Guide 100A, 300A, 500A, 1000A, SMARTSHUNT, SMARTSHUNT Digital Battery Monitoring, Digital Battery Monitoring, Battery Monitoring, Monitoring

References

- Home - LXNAV Marine
- User Manual