2026

Smart Monitor

Second Edition

Audio Amplifier Voltage-Current Characterization Monitor with Protection Function

Spl-Lab
14.01.2026

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General Information

Description

Smart Monitor SE is designed for measuring the voltage-current characteristics of audio amplifiers in both automotive and home audio systems. Depending on the type of current sensor used, the device can measure input and output power, as well as DC and AC voltage levels. The unit features two fully independent power-measurement channels and a dedicated channel for monitoring a 12-V vehicle electrical system. Thanks to its high-resolution color display and high-performance processor, Smart Monitor SE not only shows numerical measurement values but also performs real-time spectral analysis and waveform visualization. A key feature of the device is its powerful and highly configurable protection system for connected audio equipment. Smart Monitor SE continuously monitors all measured parameters and, when any value exceeds user-defined limits, automatically disables the Remote control line to prevent potential equipment damage. The device can be permanently installed in a dashboard — an energy-saving mode is provided for this purpose. Additionally, the unit supports PC connectivity via USB for advanced signal analysis.

Ergonomics

Smart Monitor (Second Edition) is a compact all-in-one unit combining a high-resolution color display, four control buttons, a status LED indicator, a USB port, and quick-release connectors for integration into an audio system. The enclosure is made of impact-resistant plastic, ensuring reliable protection during everyday use.

Package Contents

- Smart Monitor SE device
- Spl-Lab Measuring Center software for Windows
- Audio CD with calibration tracks (sine waves, sweep tones, noise)
- External current sensors

Technical Specifications

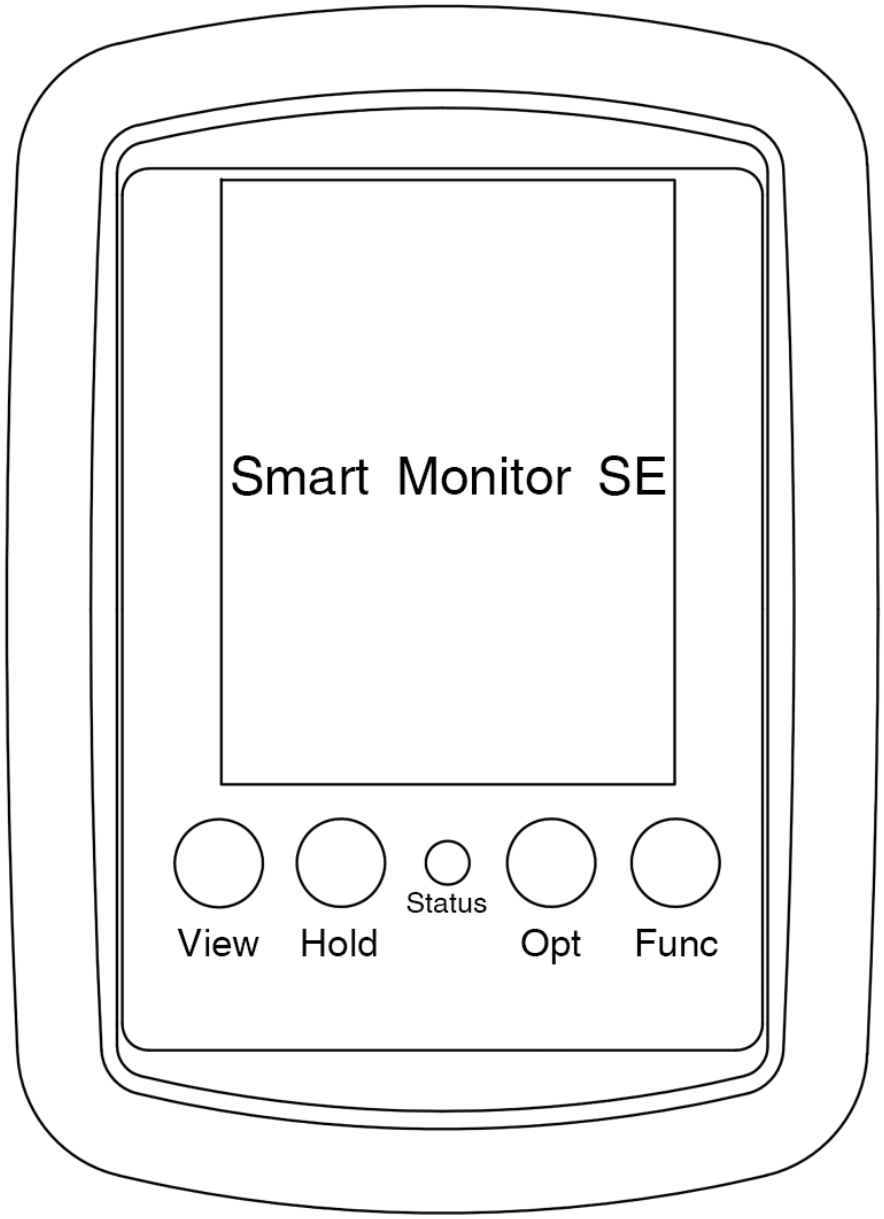
General	
Processor	ARM 32bit
Display	TFT 320*240
Controls	Push buttons
Indicators	Display, LED status indicator
Display Modes	Numeric panel, spectrum analyzer, oscilloscope
Number of Measurement Channels	2
Interfaces	
PC Communication & Power Port	USB-C
Connection Terminals	Quick-release clamp connectors
Supported Cable Cross-Section	0.2-1.5 mm^2
Operating Voltage (+12 V line)	8-20V
Current Consumption (Active Mode)	0.2 A
Current Consumption (Power-Saving Mode)	<0.1 A
Protection Features	
Protection Type	Real-time monitoring
Protection Method	Remote control line cutoff
Protection Reset	Manual or automatic
Amplifier Output Power Measurement	
Calculation Method	TRUE RMS
Voltage Measurement Range	1-150 VRMS (±1%)
Current Measurement Range	1-120 ARMS (±1%)
Power Measurement Range	1-18000 VA (±2%)
Impedance Measurement Range	0.1-10 Ohm (±2%)
Power Factor Range	0.5-1 (±1%)
Frequency Range	10-15000 Hz
Amplifier Input Power (Consumption) Measurement	
Voltage Measurement Range	1-20 V (±1%)
Current Measurement Range	1-150 A (±1%)
Power Measurement Range	1-2500 W (±2%)
Resistance Measurement Range	0.1-10 Ohm (±2%)
Efficiency Range	1-100%
Physical Characteristics	
Weight	200 G
Dimensions	83*115*32 mm

Getting Started

Safety Precautions

- **The device's protection features are intended for informational and auxiliary use only. They do not replace fuses or any other standard protective components required in audio systems.**
- The manufacturer assumes no responsibility for any direct or indirect damage resulting from the use or misuse of the device.
- Before operating the unit, inspect the enclosure for cracks, chips, or other signs of damage. Any loss of sealing may lead to malfunction or failure.
- **All connection cables must have intact insulation** to prevent accidental electric shock.
- **Do not exceed the specified measurement limits** for any monitored parameter.
- Do not use or store the device in environments with high humidity, elevated temperatures, or strong magnetic fields.
- During routine maintenance, **avoid synthetic detergents and solvents.** Use soft, slightly moistened cleaning wipes instead.
- Before powering on the device and the audio system, **verify that all cables are connected correctly and securely.**

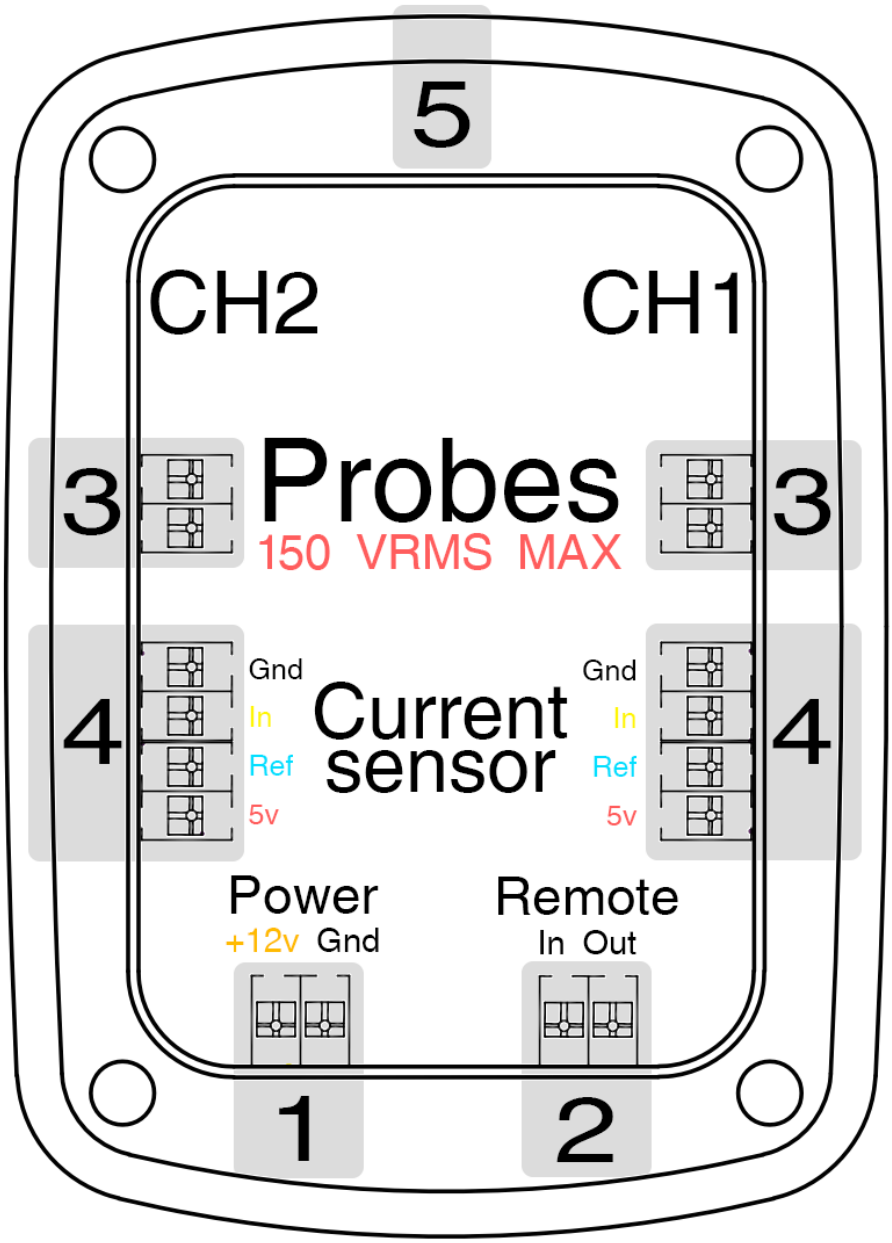
Front-Panel Controls and Indicators



The front panel of the device includes the following elements:

- **High-resolution color display —** shows measurement data, graphs, and configuration menus.
- **Status LED indicator** — displays the current operating mode and device status.
- **View Button**
  - Measurement mode: changes the number of displayed parameters on the screen.
  - Setup mode: navigates between menu items.
  - Long press: resets the device’s protection function.

- **Hold Button**
  - Measurement mode: enables or disables value hold.
  - Setup mode: returns to the previous parameter value.
- **Opt Button**
  - Measurement mode: adjusts the level of detail for the spectrum and oscilloscope views.
  - Setup mode: advances to the next parameter value.
- **Func Button**
  - Measurement mode: switches the display type — numeric panel, oscilloscope, or spectrum.
  - Setup mode: switches between menu pages.
  - Long press: toggles between measurement mode and setup mode.



Rear-Panel Connectors and Interfaces:

1. **+12 V Power Input**

   Supplies DC power to the device and is also used for measuring the DC voltage of the power line.

2. **Remote Control Line Connectors (IN and OUT)**

   Provide system-protection functions and monitor the amplifier turn-on signal.

   Maximum switching current: **5 A.**

3. **AC Voltage Probe Inputs (Channels CH1 and CH2)**

   Used for measuring the output voltage of audio amplifiers.

   Maximum allowable input voltage: 150 VAC.

4. **External Current Sensor Inputs (Channels CH1 and CH2)**

   Designed for measuring current in the corresponding channels.

   Connections must follow the color-coded markings.

5. **USB Port (located on the side of the device)**

   Used for:

   - Powering the device from a USB power source
   - Connecting to a PC for data transfer
   - Updating the device firmware

Typical Wiring Diagrams

Introduction

Connecting the device to a vehicle's power and audio circuits carries a risk of damaging system components. Work carefully and methodically. **Before beginning any installation, disconnect the 12-V power supply and turn off the vehicle's ignition.** Always use fuses in the 12-V power line to protect the equipment.

If you are unsure about any part of the installation, contact technical support or consult a qualified installer.

12-V Power Supply

The device can be powered either from the vehicle's 12-V electrical system or via USB.

Current consumption:

- ~0.2 A during normal operation
- <0.1 A in sleep mode

The power connector is also used to measure the DC voltage of the amplifier power line (both channels). For maximum measurement accuracy when working with high-power amplifiers, connect as close as possible to the amplifier's power terminals to minimize voltage drop. Direct connection to the amplifier's terminals is allowed.

Remote Control Line

The device includes **IN** and **OUT** connectors for integrating with the audio system's Remote turn-on line.

- **IN —** connects to the source of the Remote signal (e.g., head unit output or ignition signal). This is a signal-level input and does not carry load.
- **OUT** — connects to the Remote inputs of amplifiers and other equipment. Switching is performed through the 12-V power line. Maximum switching current: **5 A.**

The device functions as an equivalent of a Remote relay. The Remote line is used for the protection system: when protection is triggered, the line opens, shutting down connected

equipment and preventing damage. The Remote signal can also be used to place the device into power-saving mode.

Connecting the Remote line is recommended but not required for basic operation.

AC Voltage Measurement Inputs

The device includes two inputs for measuring the AC output voltage of audio amplifiers.
⚠️ **These inputs are not designed for measuring DC voltage!**

- Both inputs are galvanically isolated from the device circuitry and from each other
- They may be connected to the outputs of one or multiple amplifiers, including bridged configurations.
- **Maximum allowable input voltage: 150 VAC.**

For measuring amplifier output power, connect directly to the amplifier's output terminals.
For measuring power delivered to speakers, connect to the speaker terminals.

Current Sensor Inputs

The device includes two 4-pin inputs for external current sensors. If necessary, the sensor cable may be extended by several meters. A shielded cable—such as a USB cable—is recommended.

- Follow the color-coded markings when connecting.
- When extending the cable, the Ref contact may be left unconnected.
- Avoid routing signal cables near high-current power lines to reduce interference.

Sensor Placement Recommendations:

- For measuring amplifier input power — pass the +12 V power cable through the sensor.
- For measuring amplifier output power — pass the positive speaker cable through the sensor.
- For measuring power consumed by speakers — place the sensor as close to the speaker as possible.

⚠️ During the first power-on (before the Remote signal is applied), the device performs automatic calibration of the current sensors. At this moment, there must be no DC current flow. If power is already present, temporarily disconnect the sensors from the power cables.

USB Port

A USB port is located on the top edge of the device. It can be used for:

- Powering the device (when the 12-V line is not connected)
- Connecting to a PC for data transfer
- Updating the device firmware

USB connection is allowed both before and during device operation.

Below are typical wiring diagrams for integrating the device into a vehicle's power and audio system. For simplicity, you may start with a single-channel configuration.

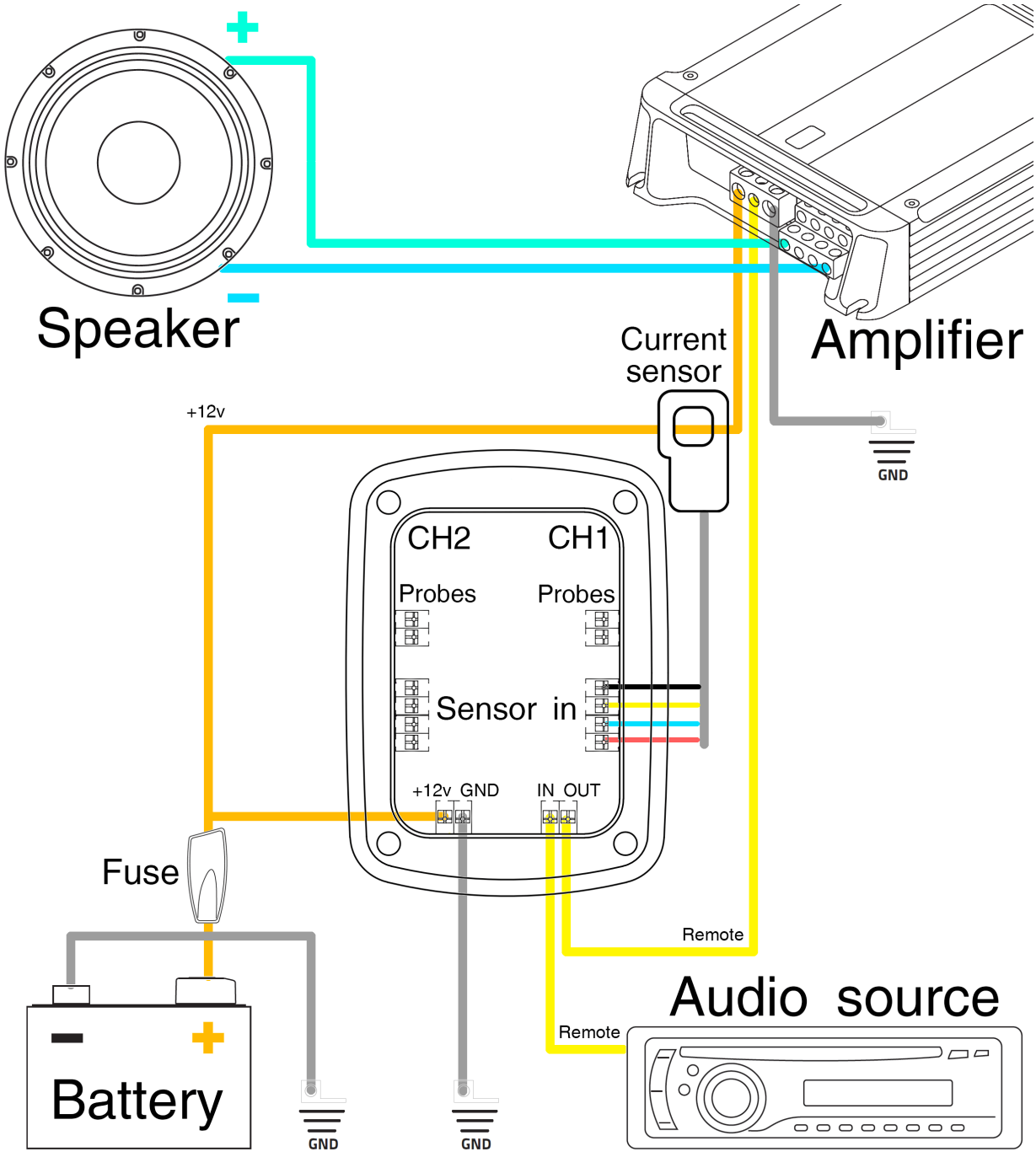
These diagrams do not cover all possible use cases. Advanced configurations may be created by qualified specialists—for example:

- Measuring alternator output current
- Measuring power of a two-channel amplifier
- Measuring amplifiers wired in bridged mode

The device is not limited to automotive audio systems; it may also be used in home, studio, and live-sound applications.

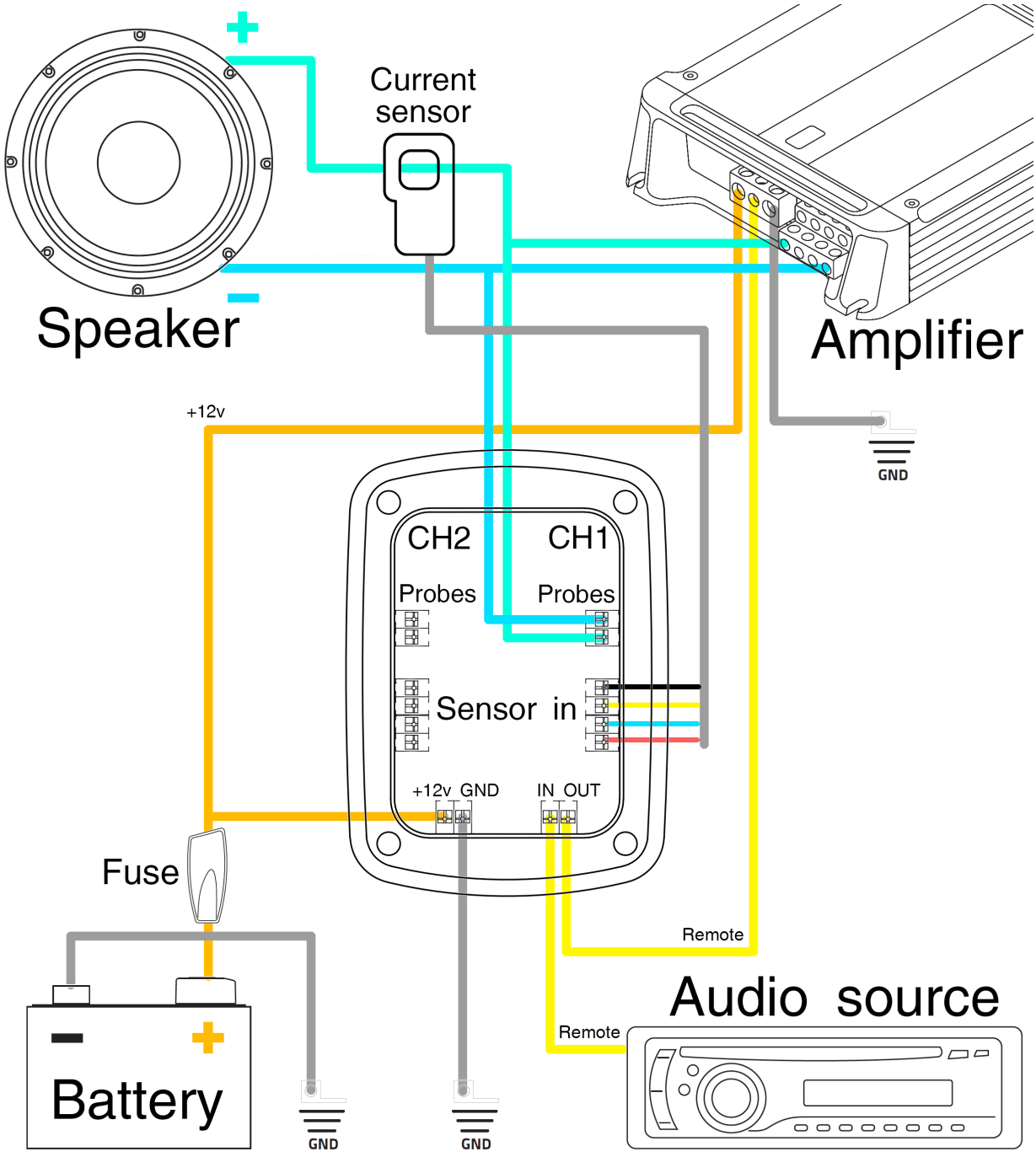
DC Mode

Single-channel connection for measuring an amplifier's input (consumed) power with protection enabled.



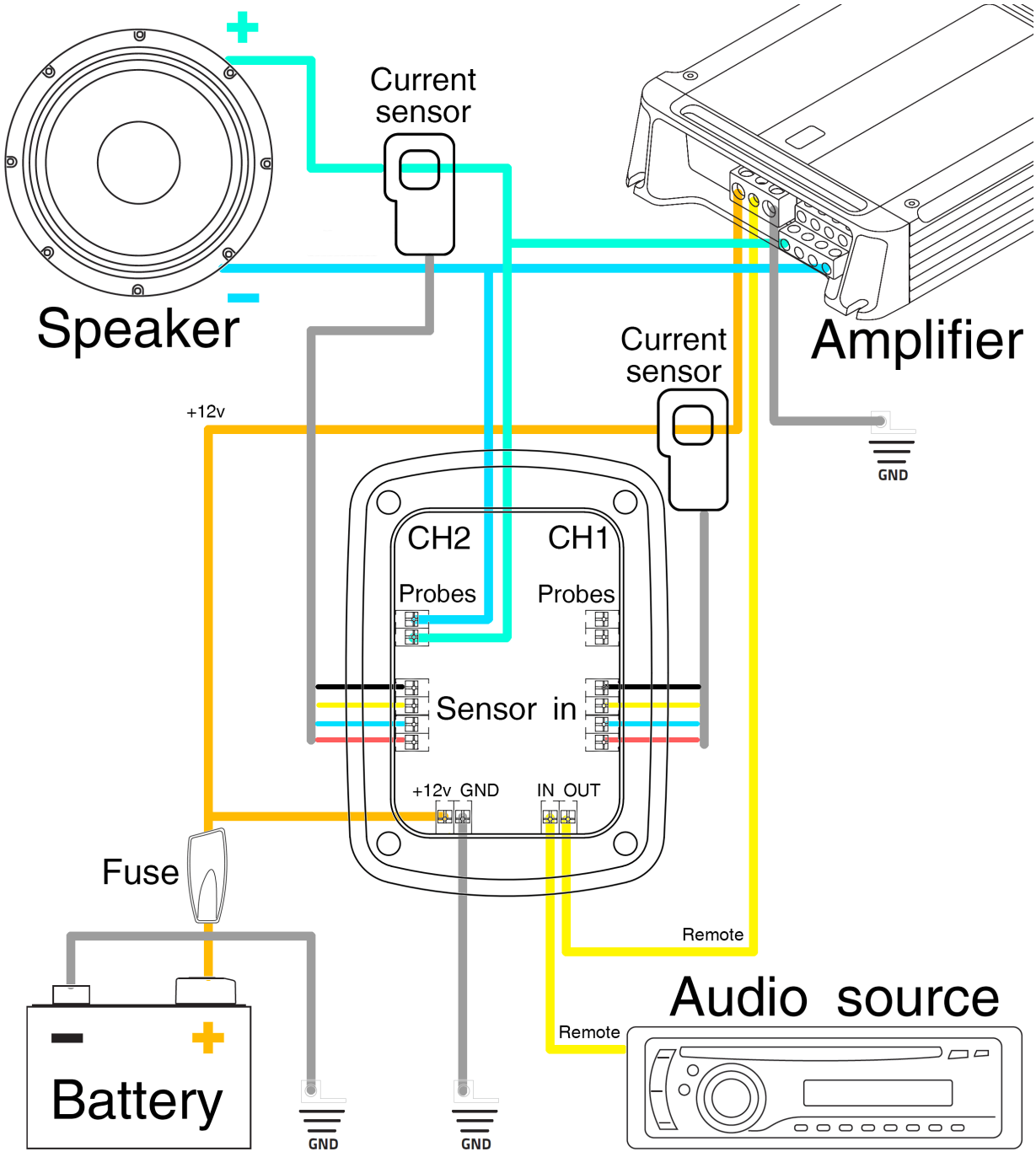
AC Mode

Single-channel connection for measuring an amplifier's AC output power with protection enabled.



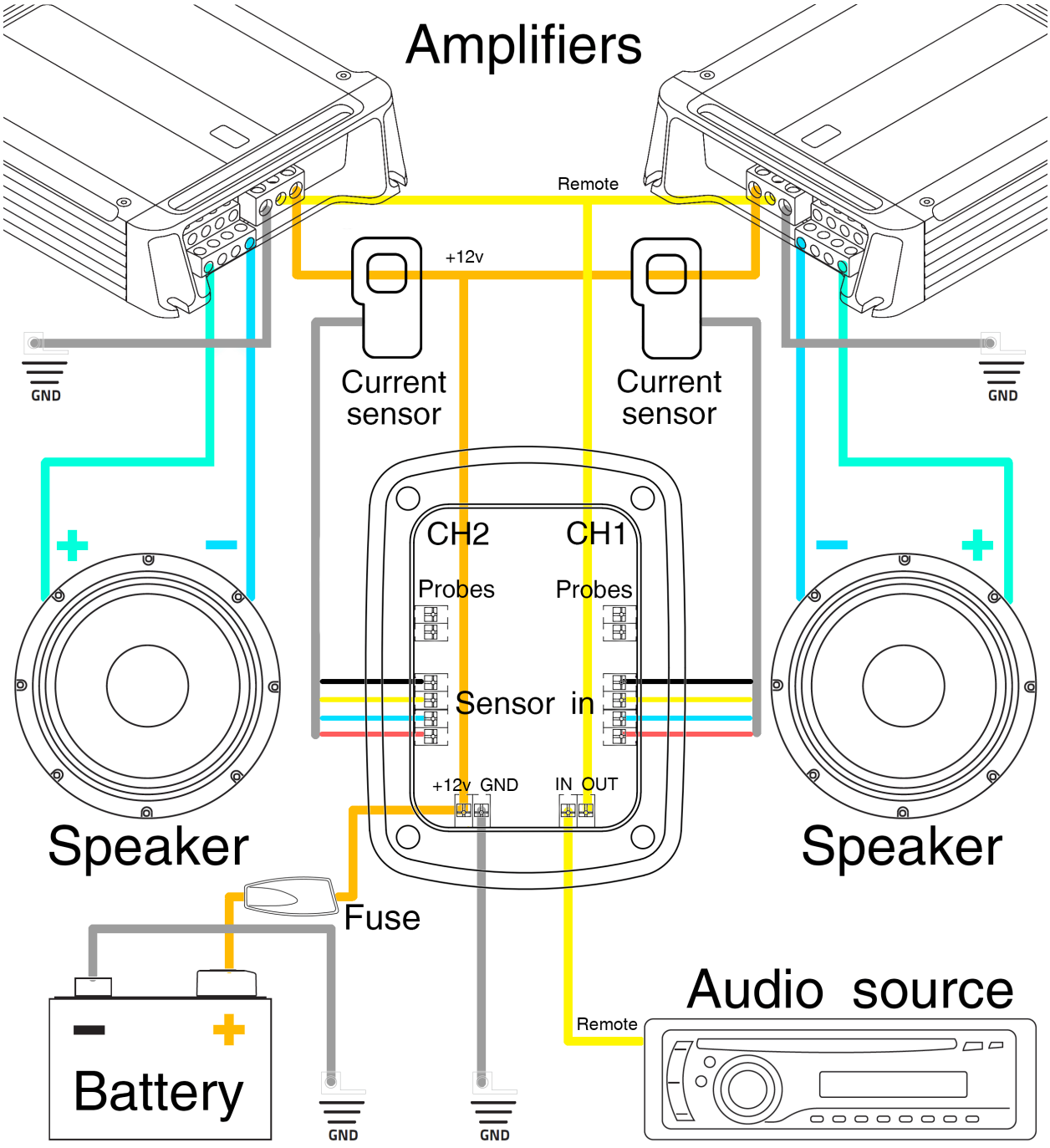
DC+AC Mode

Dual-channel connection for measuring an amplifier's DC input power and AC output power with protection enabled.



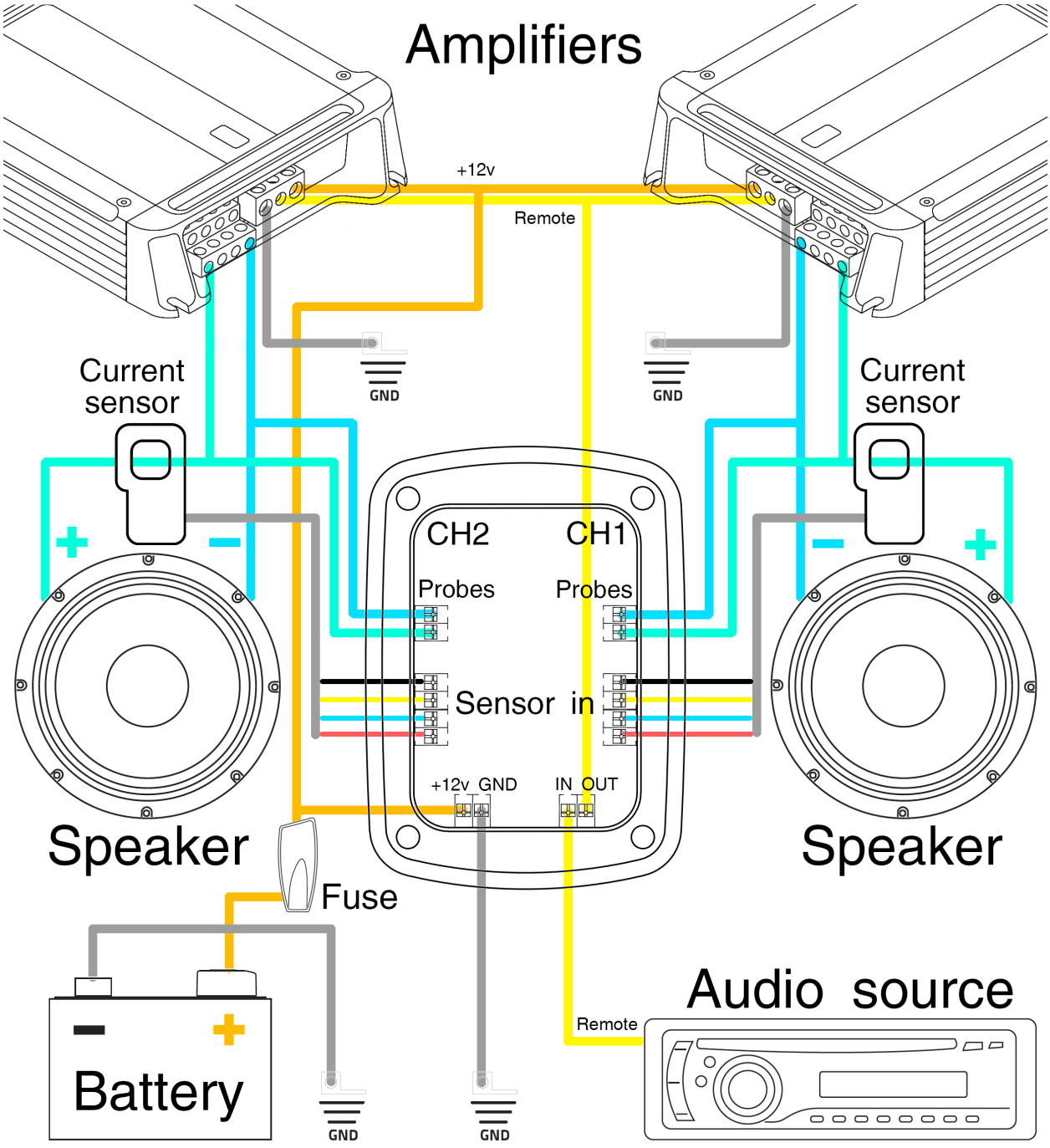
DC+DC Mode

Dual-channel connection for measuring the DC input (consumed) power of amplifiers with protection enabled.



AC+AC Mode

Dual-channel connection for measuring the AC output power of amplifiers with protection enabled.

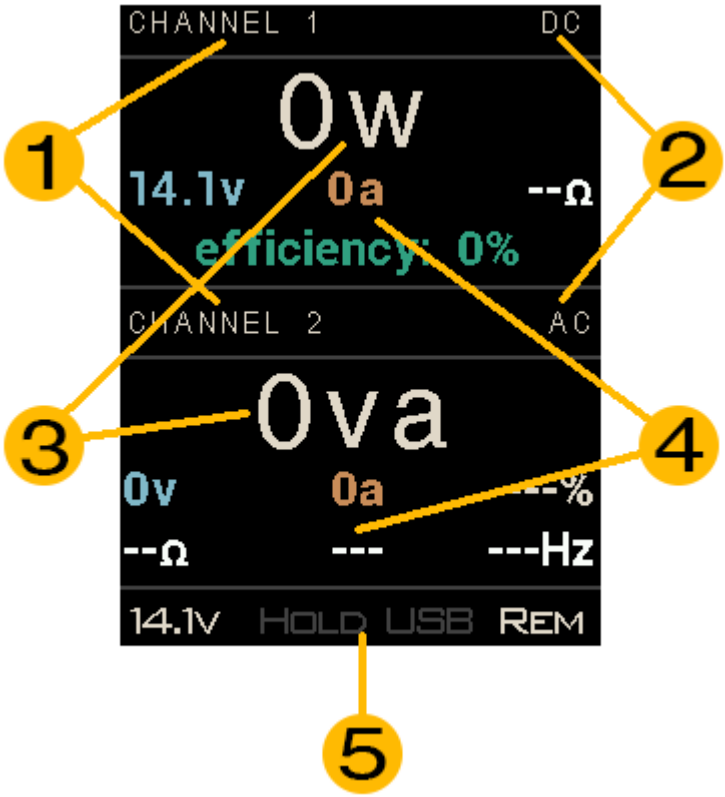


Performing Measurements

Initial Startup

After 12-V power is applied to the connector, the device performs an initial boot sequence with automatic calibration of the connected current sensors. During startup, the status LED will blink. The display will show the device logo and the firmware version. Once the boot process is complete, the unit switches to Measurement Mode.

Measurement Mode



In Measurement Mode, the screen is divided into three independent sections. Two sections correspond to the measurement data of each channel, and the third section displays the DC voltage measurement. A status bar is located at the bottom of the screen.

1. **Channel name**
2. **Type of displayed data** — DC (direct current) or AC (alternating current)
3. **Primary measurement value** — power of the selected type, or supply voltage in single-channel mode
4. **Secondary measurement values**
5. **Status bar**, showing:
    - +12-V supply voltage
    - Hold mode indicator
    - USB data-transfer indicator
    - Remote control line status

Depending on the selected measurement mode in the settings, you can switch the display view between **numeric panel**, **oscilloscope**, and **spectrum analyzer** using the **Func** button.

A table below shows the correspondence between the selected measurement mode and the available display types.

Measurement Mode	Available Views
AC Mode	Panel 1, Oscilloscope 1, Spectrum 1
DC Mode	Battery Panel, Panel 1
AC+AC Mode	Panel 1, Panel 2, Oscilloscope 1, Oscilloscope 2, Spectrum 1, Spectrum 2
DC+AC Mode	Panel 1, Panel 2, Oscilloscope 1, Spectrum 1
DC+DC Mode	Panel 1, Panel 2

Panel View

Depending on the selected measurement mode, the panel displays the corresponding set of data.

In Panel View, you can adjust the number of displayed data rows. Press the View button several times to cycle through the available display layouts.

Below are the data sets shown for each panel type, along with examples of different row configurations.

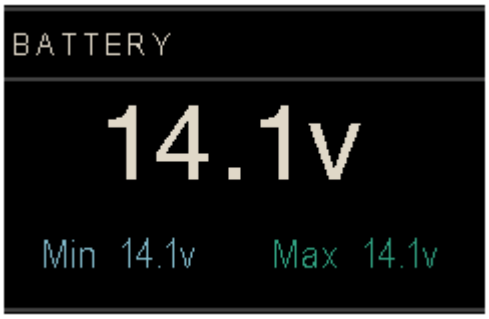
AC

- Apparent power (VA) or active power (W)
- AC voltage (V)
- AC current (A)
- Total harmonic distortion (THD, %)
- Impedance (Ω)
- Power factor
- Frequency (Hz)

DC

- Power (W)
- DC voltage (V)
- DC current (A)
- Resistance (Ω)
- Efficiency (%) — **available only in DC+AC Mode**

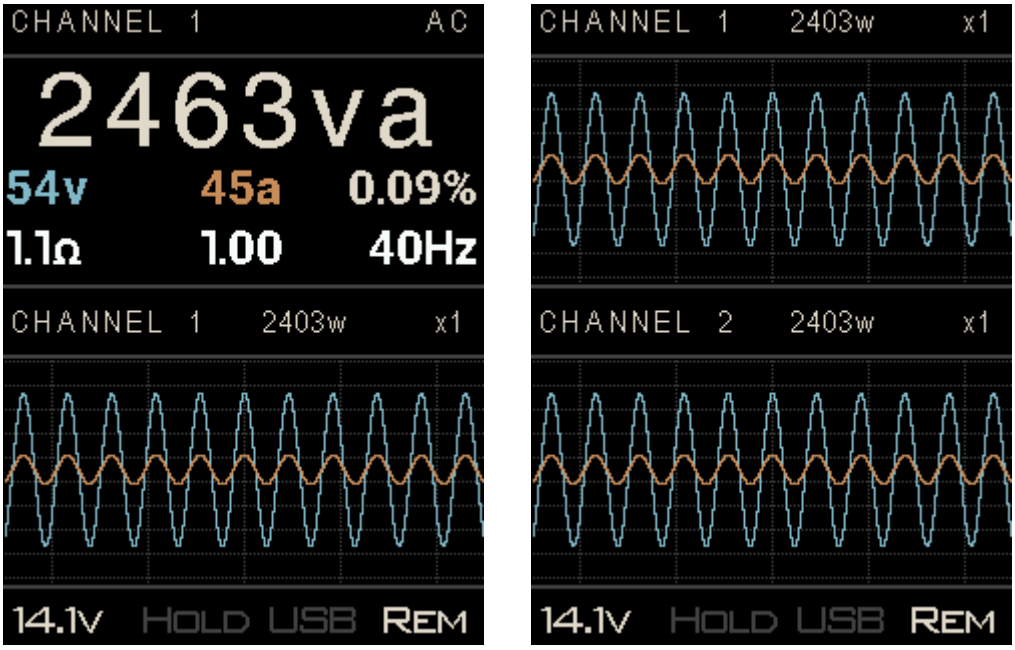
Battery



- DC voltage (V)
- Minimum DC voltage (Min V)
- Maximum DC voltage (Max V)

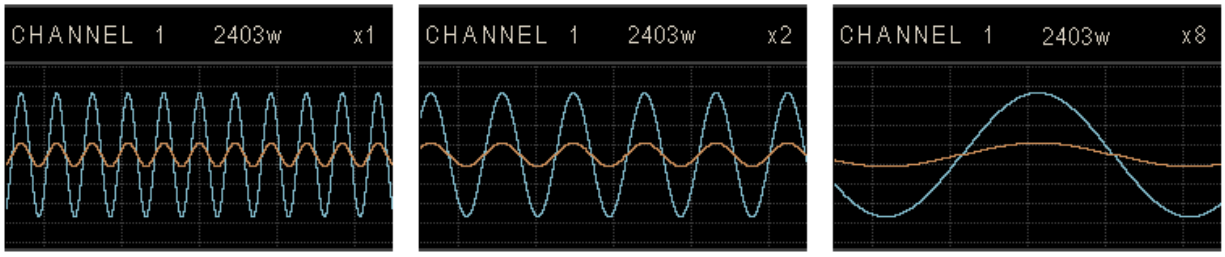
Oscilloscope View

The Oscilloscope View displays the waveform of the measured AC voltage and current for a single channel.



The oscilloscope can be shown either alongside the panel view or together with a second oscilloscope window, depending on the selected measurement mode and display configuration.

The waveform amplitude is automatically scaled based on the signal level. The time scale can be adjusted by pressing the Opt button, up to a maximum zoom factor of ×32.

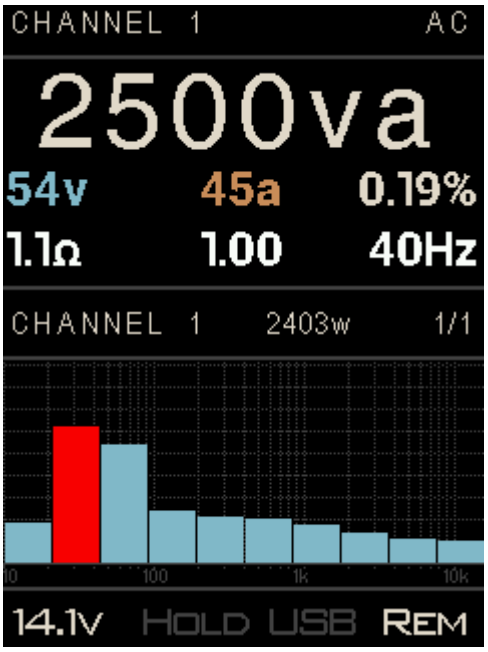


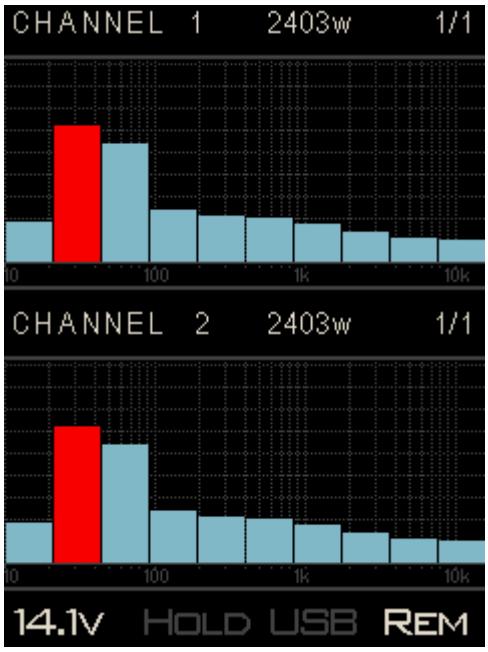
The current time scale is shown in the upper-right corner of the screen. The power value for the active channel is displayed above the waveform.

When the oscilloscope is shown together with the panel view of the same channel, the displayed power type will be the opposite of the one selected in the panel view. In all other cases, the power type matches the selected measurement mode.

Spectrum View

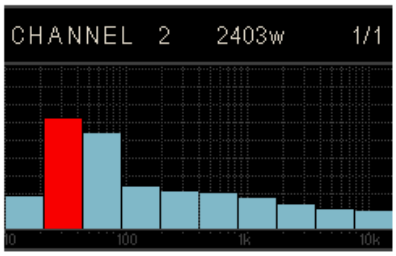
The Spectrum View displays an octave-band spectrogram of the measured AC voltage for a single channel.

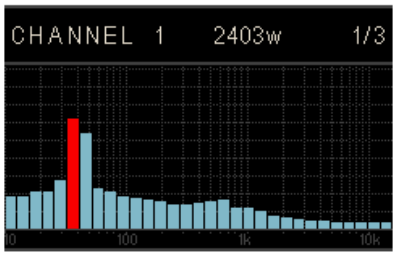


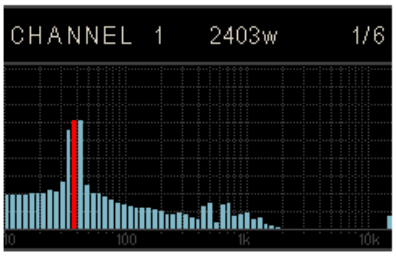


The spectrum can be shown either alongside the panel view or together with a second spectrum window, depending on the selected measurement mode and display configuration. The peak component of the spectrum is highlighted in red.

The amplitude of the spectrum is automatically scaled. The octave resolution can be adjusted by pressing the **Opt** button, up to a maximum resolution of **1/6 octave**.







The current octave type is shown in the upper-right corner of the screen. The power value for the active channel is displayed above the spectrogram.

When the spectrum is shown together with the panel view of the same channel, the displayed power type will be the opposite of the one selected in the panel view. In all other cases, the power type matches the selected measurement mode.

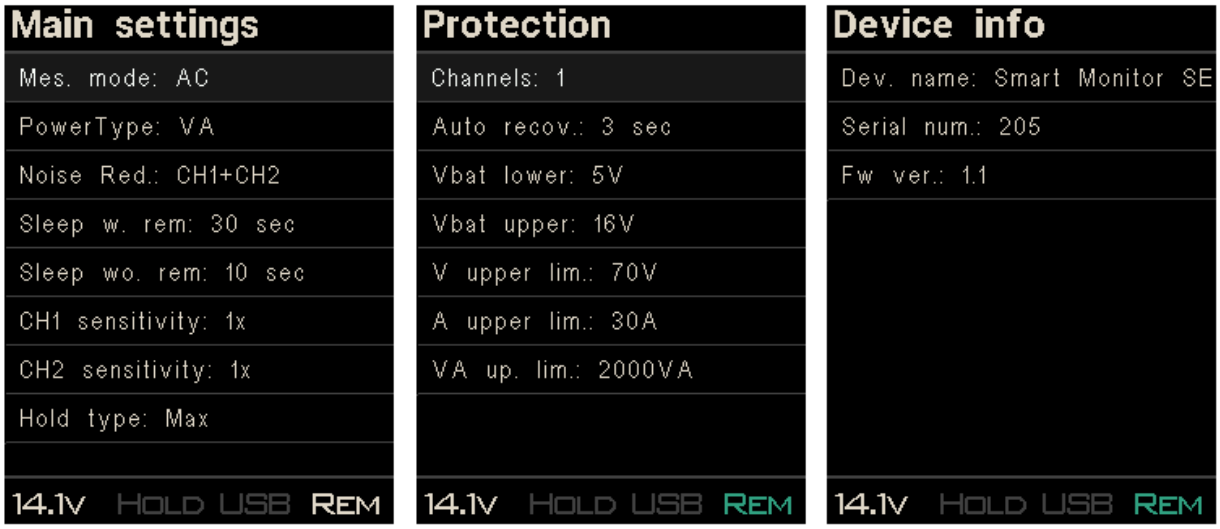
When Hold mode is enabled, the device will retain either the peak spectrum or the averaged spectrum, depending on the hold type selected in the settings.

Device Configuration

Setup Mode

After power-up, the device automatically enters Measurement Mode.

To switch between Measurement Mode and Setup Mode, press and hold the **Func** button.

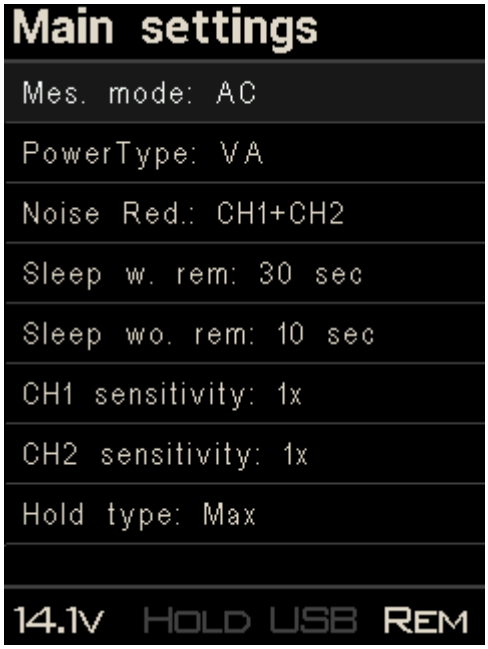


When Setup Mode is activated, one of the configuration pages with a list of parameters will be displayed.

Menu Navigation

- **View** - select the next menu item
- **Hold** – increase the value (press and hold for fast adjustment)
- **Opt**- decrease the value (press and hold for fast adjustment)
- **Func** - switch between configuration pages

Main Settings



Mes. mode — Measurement Mode and Channel Configuration

- **AC** — single-channel mode for measuring AC output power on Channel 1.
- **DC** — single-channel mode for measuring DC input (consumed) power on Channel 1. The DC voltage source is the 12-V power-supply input.
- **AC+AC** — dual-channel mode for measuring AC output power on both Channel 1 and Channel 2.
- **DC+AC** — dual-channel mode where:
    - Channel 1 measures DC input (consumed) power
    - Channel 2 measures AC output power. The DC voltage source is the 12-V power-supply input. This mode enables **efficiency (η)** calculation.
- **DC+DC** — dual-channel mode for measuring DC input (consumed) power on both Channel 1 and Channel 2. The DC voltage source is the 12-V power-supply input.

Power type — AC Power Display Format

- **VA** — displays apparent power (volt-amperes)
- **W** — displays active (real) power (watts)

Noise red. — Noise Reduction Channel Selection

This function reduces high-frequency interference when measuring high-power Class-D amplifiers. Noise reduction is applied by filtering current and voltage components above 1000 Hz. Recommended for low-frequency signal measurements.

- **None —** noise reduction disabled
- **CH1 —** noise reduction enabled on Channel 1
- **CH2 —** noise reduction enabled on Channel 2
- **CH1+CH2** — noise reduction enabled on both channels

Sleep w. rem. — Sleep Timer with Remote Signal

Defines the timeout (in seconds) before the device enters power-saving mode and turns off the display when the **Remote signal is present**.

Press any button to wake the device.

Sleep w/o. rem. — Sleep Timer without Remote Signal

Defines the timeout (in seconds) before the device enters power-saving mode and turns off the display when the **Remote signal is not present**. The device wakes when any button is pressed or when the Remote signal becomes active.

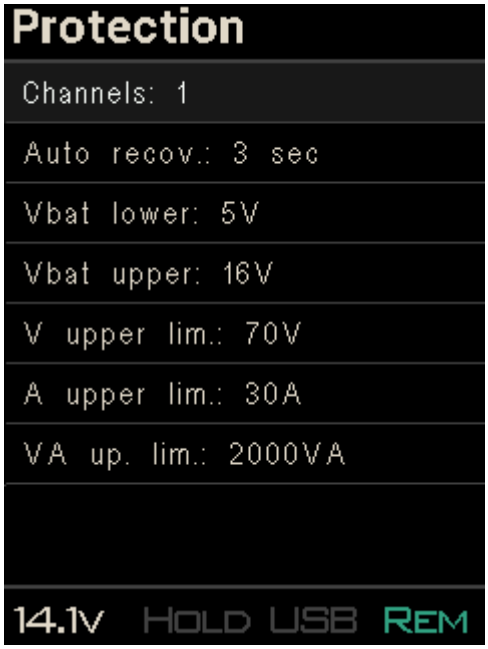
CH1/CH2 sensitivity — Current Sensor Sensitivity Adjustment

This setting improves measurement accuracy for low currents. To increase sensitivity, loop the measured cable through the current sensor multiple times and specify the number of turns. The device automatically divides the measured current by the number of turns, increasing resolution and accuracy.

Hold type — Hold Mode Behavior for Both Channels

- **Max —** holds maximum values of power, voltage, and current. All other parameters are fixed according to the maximum power. In Spectrum View, peak values of each band are held.
- **Min —** holds minimum values of power, voltage, and current. All other parameters are fixed according to the minimum power.
- **Avg —** displays averaged values of all measured parameters in the panel view. In Spectrum View, averaged values of each band are shown.
- **Min THD —** holds values corresponding to the minimum total harmonic distortion (THD) for AC signals on the AC channel. In DC+AC Mode, the DC channel holds values corresponding to the minimum THD detected on the AC channel.

Protection System Settings



This section defines the criteria used by the device's protection system.

To enable protection, at least one parameter must be configured — exceeding that threshold will trigger equipment shutdown.

When protection parameters are set and a valid Remote signal is present:

- The Rem indicator in the status bar turns green, indicating normal operation of the Remote control line.

If one or more parameters exceed their configured limits:

- The protection system is activated
- The Rem indicator turns red
- The Status LED begins flashing red
- The Remote control signal is automatically disabled to prevent equipment damage

To reset the protection state, press and hold the View button. An automatic recovery timer (in seconds) may also be configured.

Channels — Protection Trigger Logic

The Channels parameter defines under which conditions the protection system activates, depending on which measurement channels exceed their limits:

- **1 —** protection triggers if Channel 1 exceeds its limits
- **2 —** protection triggers if Channel 2 exceeds its limits
- **1 or 2 —** protection triggers if either channel exceeds its limits
- **1 and 2 —** protection triggers only if both channels exceed their limits simultaneously.

Auto recov. — Automatic Protection Reset

Sets the time interval (in seconds) after which the device automatically resets the protection state and restores the Remote signal, provided that all parameters have returned to acceptable ranges.

Vbat lower limit — Minimum Allowed 12-V Supply Voltage

If the 12-V supply voltage drops below this threshold, the device activates protection and disables the Remote signal.

Vbat upper limit — Maximum Allowed 12-V Supply Voltage

If the 12-V supply voltage exceeds this threshold, the device activates protection.

V upper limit — Maximum Allowed AC Voltage

If the AC voltage on any AC measurement channel exceeds this value, protection is triggered.

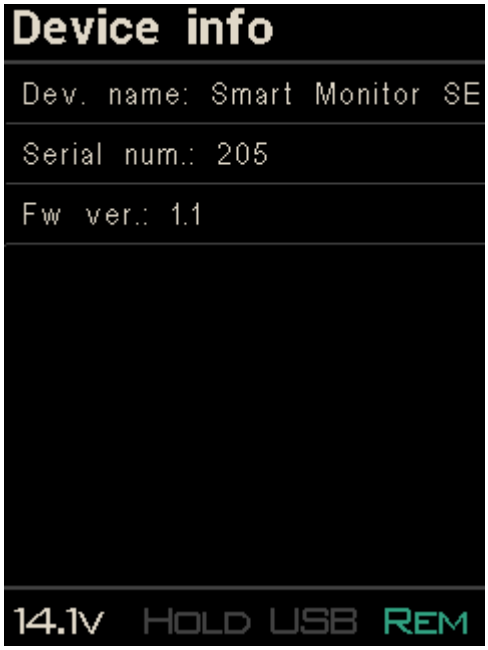
A upper limit — Maximum Allowed Current

Limits both DC and AC current. If the current on the corresponding channel exceeds the configured threshold, protection is activated.

P upper limit — Maximum Allowed Power

Limits power in both DC and AC measurement modes. If the measured power exceeds this value, the device disables the Remote signal.

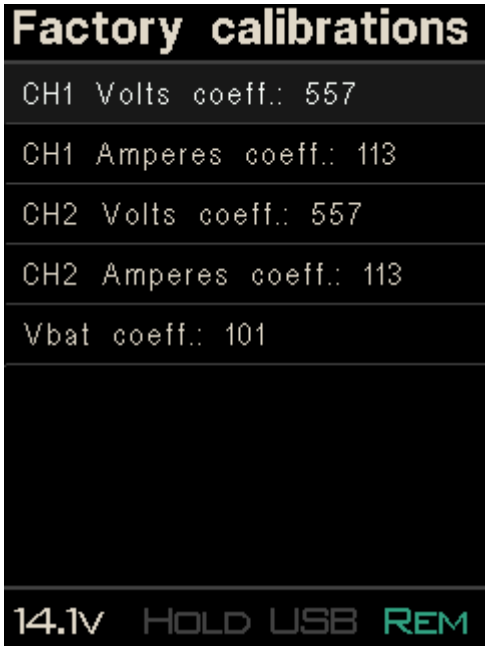
Device Information



This page displays the factory parameters of the device and may be required when contacting Support. No settings on this page can be modified.

- **Dev. name.** – device name
- **Serial num.** – device serial number
- **FW ver.** – firmware version

Calibration



The calibration page is hidden by default to prevent accidental modification of factory parameters.

Accessing the Calibration Page

To open the calibration settings page:

- Press and hold **Hold** and **Opt** simultaneously during the initial boot sequence immediately after power is applied.
- After the device finishes booting and enters Setup Mode, a special calibration page becomes available.
- The calibration page remains accessible until the next reboot.

⚠️ Warning: Use extreme caution when modifying factory calibration parameters. It is strongly recommended to take a photo of the current values before making any changes so you can restore them if needed.

Current Sensor Calibration

If the included current sensors have a label with an individual calibration coefficient:

- Enter the corresponding value into **CH1 Amperes coeff.** or **CH2 Amperes coeff.**
- Select the parameter based on which channel the sensor is connected to.

This ensures correct interpretation of measured currents and accurate power calculations.

Voltage Calibration

To ensure accurate voltage measurements, the device allows manual adjustment of voltage calibration coefficients.

For AC voltage calibration:

- **CH1 Volts coeff**. — for Channel 1
- **CH2 Volts coeff.** — for Channel 2

For DC voltage calibration of the 12-V power input:

- **Vbat coeff.**

Adjusting these coefficients compensates for component tolerances and ensures precise measurement readings.

Connecting the Device to a PC

Introduction

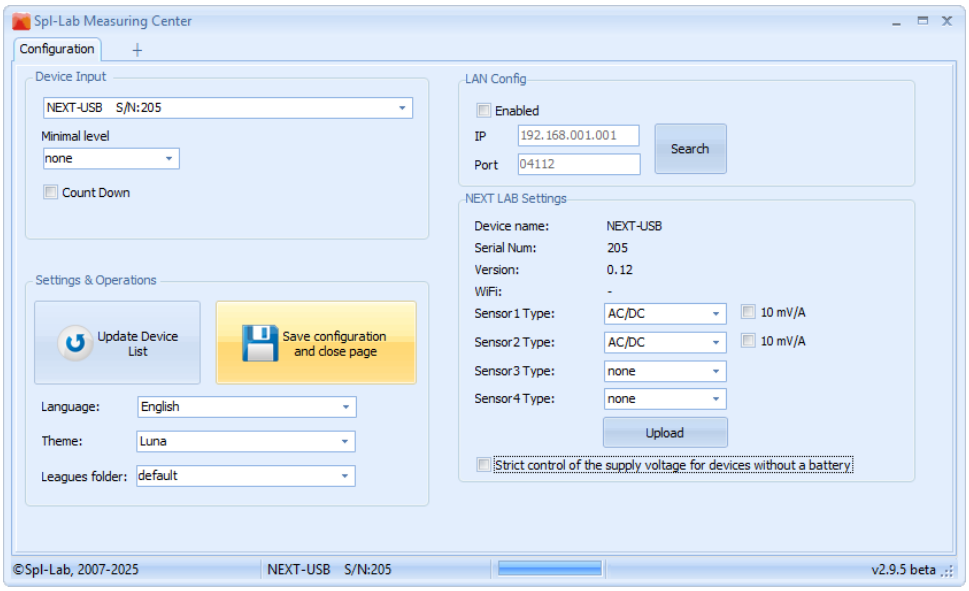
The Smart Monitor SE can be connected to a personal computer via the USB port located on the device. USB connectivity allows you to:

- Stream measurement data in real time
- Update the device's firmware

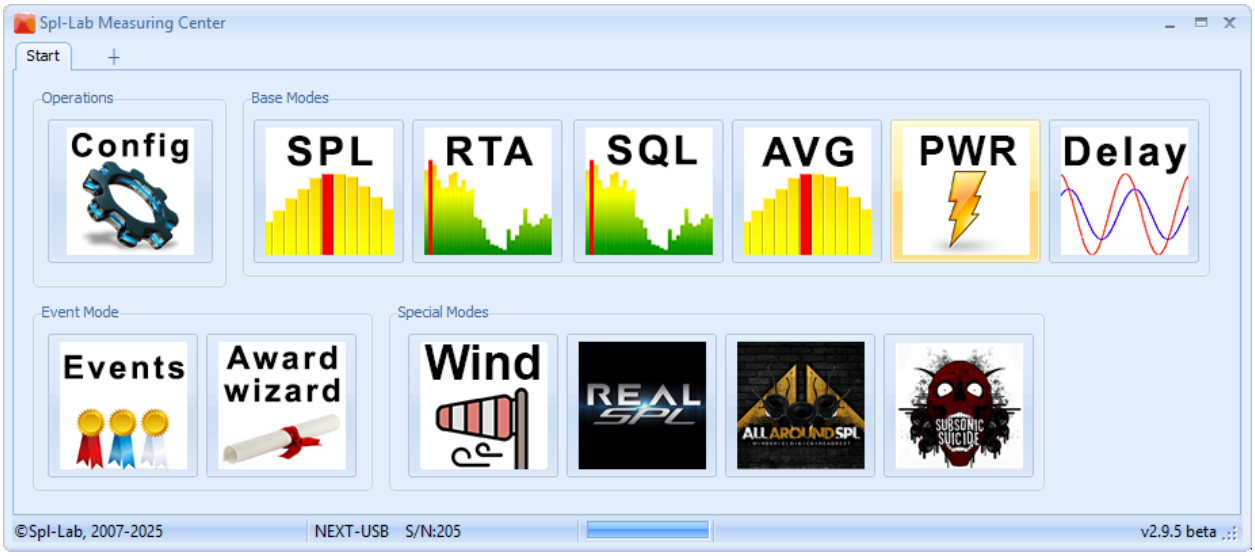
For advanced analysis and visualization, it is recommended to use the **Spl-Lab Measuring Center** software included with the device. The software provides extended data-processing features such as spectral analysis, power/voltage/current graphs, and measurement logging.

Connecting to a PC via USB

- Install the USB drivers from the included CD, or download them (Next-Lab – USB driver) from the **Support** section of the **Spl-Lab website**.
- Copy the Spl-Lab Measuring Center software from the included CD, or download and extract it from the **Support** section of the website into any folder (for example, the desktop).
- Connect the device to the PC using the USB port and wait for it to initialize.
- Launch Spl-Lab Measuring Center to begin working.



- Open the **CONFIG** tab in the software and save the settings.



- On the main page of the program, select and open the **PWR** mode.

⚠️ For more detailed information on using the software, refer to the Spl-Lab Measuring Center User Manual.

Updating the Device Firmware via PC

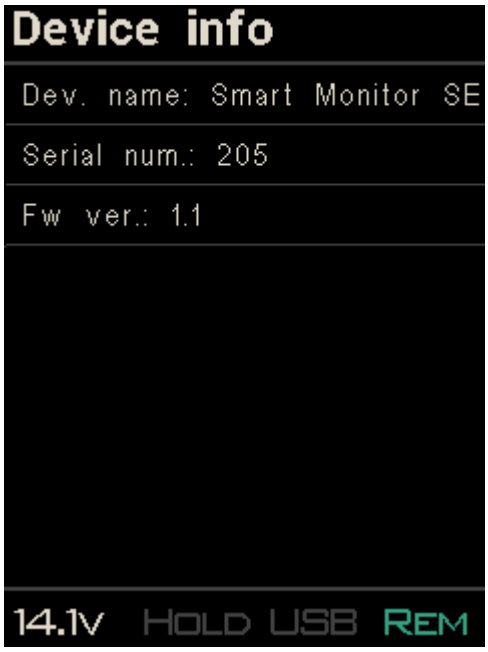
The device supports firmware updates using a personal computer. Updated firmware versions may include bug fixes and new functionality.

⚠️ **Firmware updates carry a risk of rendering the device inoperable.**

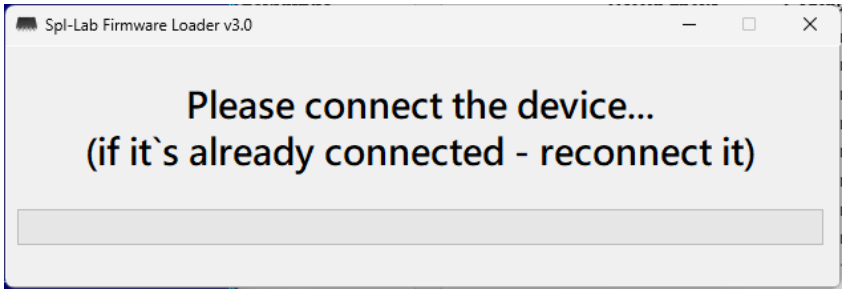
Use only high-quality, short USB cables. Disconnect the device completely from all measurement circuits. Do not use a laptop running on battery power during the update.

Firmware Update Procedure

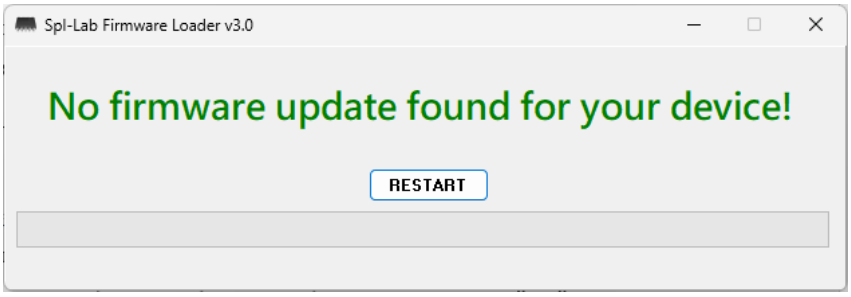
- Install the USB drivers from the included CD, or download them (Next-Lab – USB driver) from the **Support** section of the **Spl-Lab website**.
- Download the **Firmware Loader Tool for Windows** from the **Spl-Lab Support** section and extract it into any folder (for example, the desktop).
- If the device is operational, check the serial number and current firmware version in the **Device Info** section of the settings.



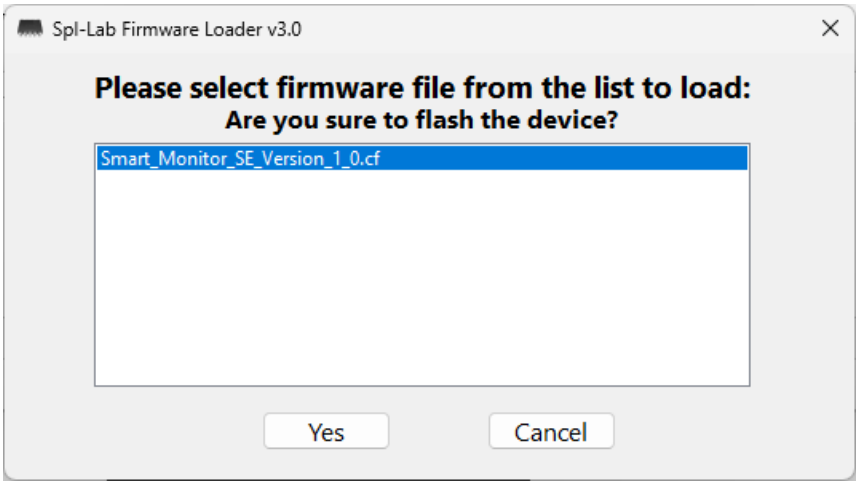
- Disconnect and fully power off the device.
- Run the **Spl_Lab_Firmware_Loader.exe** file from the extracted folder.



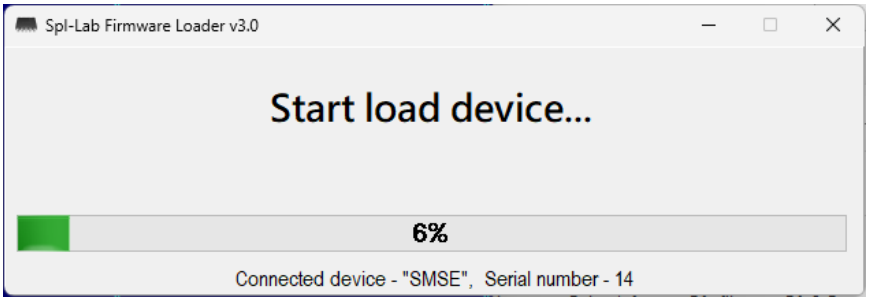
- Connect the device to the computer's USB port.



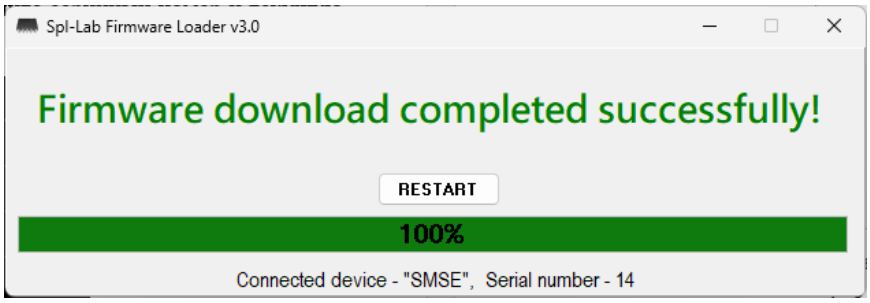
- The program will notify you if no suitable firmware files are found for your device. Otherwise, a list of compatible firmware files will be displayed.



- Select the required file and click Yes. Updating is not recommended if the firmware version is lower than or identical to the version shown in the device settings.



- Wait for the update process to complete



- After a successful update, the device will reboot automatically. If it does not reboot, restart the device manually.

Audio Test Tracks Description

The CD included with Spl-Lab equipment contains not only software but also specialized audio test tracks used for system tuning.

These tracks are recorded as Audio-CD tracks, not as individual audio files. To play them, use a CD player or software capable of reading Audio-CD format.

Some CD players may not recognize the audio content. If this occurs—or if you prefer using audio files—you can download a ZIP archive containing all test signals from the **Support** section of the **Spl-Lab website**.

The table below describes the contents of each track:

Track Number	**Description**
Track 1	Pink noise 20–20,000 Hz
Track 2	Pink noise 40–60 Hz
Track 3	Pink noise 60–80 Hz
Track 4	Pink noise 80–100 Hz
Track 5	Pink noise 100–120 Hz
Track 6	Pink noise 120–140 Hz
Track 7	Pink noise 140–160 Hz
Track 8	Pink noise 160–180 Hz
Track 9	Sweep tone 30–20 Hz, 0 dB
Track 10	Sweep tone 35–25 Hz, 0 dB
Track 11	Sweep tone 40–30 Hz, 0 dB
Track 12	Sweep tone 45–35 Hz, 0 dB
Track 13	Sweep tone 50–40 Hz, 0 dB
Track 14	Sweep tone 55–45 Hz, 0 dB
Track 15	Sweep tone 60–50 Hz, 0 dB
Track 16	Sweep tone 65–55 Hz, 0 dB
Track 17	Sweep tone 70–60 Hz, 0 dB
Track 18	Sweep tone 75–65 Hz, 0 dB
Track 19	Sweep tone 80–70 Hz, 0 dB
Tracks 20–80	Sine wave; track number corresponds to frequency (Hz), 0 dB
Track 81	Sweep tone 20–20,000 Hz, 0 dB
Track 82	Sine wave 100 Hz
Track 83	Sine wave 200 Hz
Track 84	Sine wave 1000 Hz