2012

Smart Monitor

User Manual

Portable device with protective function for measuring the parameters of electric and acoustic circuits

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Functions and technical features of the device

Smart Monitor from Spl-Lab will protect your car audio components from damage, will help in tuning sound in the car, as well as will measure power of your sound system and acoustics characteristics. The Smart Monitor replaces amp clamp, True RMS digital voltmeter and oscilloscope. And, in addition to this, provides protecting functions.

Ergonomics

Smart Monitor consists of a main unit with an aid of which to control major features of the device and displaying data about the state of the system is performed. Unit can be provided in a plastic case or without it for hidden installation (for example into the dashboard).

Apart from the main unit there are two detachable sensors of alternating (AC) and direct current (DC), and voltage, which are seated directly into the measured circuits of the car audio system. If the limiting value of measured current exceeds 200 ampere, there is an option of protection only by voltage. Sensors are connected to the main unit using specialized wires that are up to 5 meters long. The Direct current and voltage sensor usually should be seated under the hood of the car next to the fuse, and the Alternating current and voltage sensor should be seated in the boot, where amplifiers and subwoofers are usually placed. The power for the device is supplied from car network, 12 volt through the cigarette lighter adapter. Simultaneous connection of one Direct current and voltage sensor and one Alternating current and voltage sensor is possible.

Application

Smart monitor takes measurements of direct current and voltage (power) used by car amplifiers, as well as alternating current and voltage (power) delivered by the amplifiers to subwoofer or other acoustic components. If the current, voltage or power consumption exceeds the set values, Smart Monitor breaks the controlling circuit via remote connection, thereby switching them off and protecting them before user's interaction. For example, with this device, it is possible to define the lower limit of voltage, feeding an amplifier, at 10 volt, which will protect it from voltage drop and the upper limit at 15 volt. Then if voltage is within the limit of 10-15 volt, Smart Monitor will work as a digital voltmeter, displaying current values, but if the voltage exceeds these limits, the device will inform about it and cut off Remote circuit immediately. It works in the same way with exceeding the set limits of direct current or power. We can give another example: setting a power-handling capacity for subwoofer at 4000 watt, then in case of exceeding the power delivered by the amplifier to subwoofer the Remote circuit will be also cut off for protecting the speaker.

Using for protection

1. Protection of car amplifiers from damage caused by under-voltage or excess output voltage.

2. Protection of car subwoofers and acoustics from overheating and damage caused by overdriving the allowed current and voltage (power) of input signal.

3. Protection of the acoustic systems from overheating and damage caused by playing back the corrupt (cut, clipped) input signal.

4. Protecting the electric wiring of a car and other components from a burn-out at rapid increase of current and voltage (power) consumption by the car audio system. This does NOT excuse the requirement to use fusing throughout the vehicle as needed.

Using for measurement

1. Monitoring in real time mode of direct voltage and current (power) consumed by your amplifiers and, thereafter, delivered by your alternator and battery. This is amp clamp and digital voltmeter at the dashboard of your car.

2. Displaying voltage and current (power), delivered by the amplifier to subwoofer or other acoustics according to TRUE RMS algorithm. The devices, which measure using this algorithm, are rare and not all that cheap, but if you have Smart Monitor, you won't need them. You will be able to compare manufacturer specified amplifier characteristics with actual ones easily.

3. Monitoring of two sensors simultaneously (of AC and DC, and voltage or power).

4. Matching levels (Gain) of different channels of your amplifiers by measuring the amplitude of variable signal, delivered by the amplifier using specialized set-up CD, which is included into the delivery set. With this device tuning your car amplifier will become easier and more demonstrable for you.

5. Monitoring the coefficient of harmonic distortion of signal, played back for tuning your car audio and amplifiers with an aid of a digital system of distortion (“clip”) detection using fast Fourier transformation method. Thus you components will be protected from overheating and the sound will be clear. This feature is available as separate firmware with limited functionality.

6. Monitoring current impedance of your acoustics. The device automatically displays impedance along with the power of signal, delivered by the amplifier.

Item checklist:

1. Smart Monitor main unit;
2. Sensors of the alternating / direct current and voltage (depending on the supply package);
3. CD with and SPL-LAB Viewer audio tracks for system calibration;
4. Cables for connecting the sensor;
5. AC adaptor for cigarette lighter in a car;

Technical features

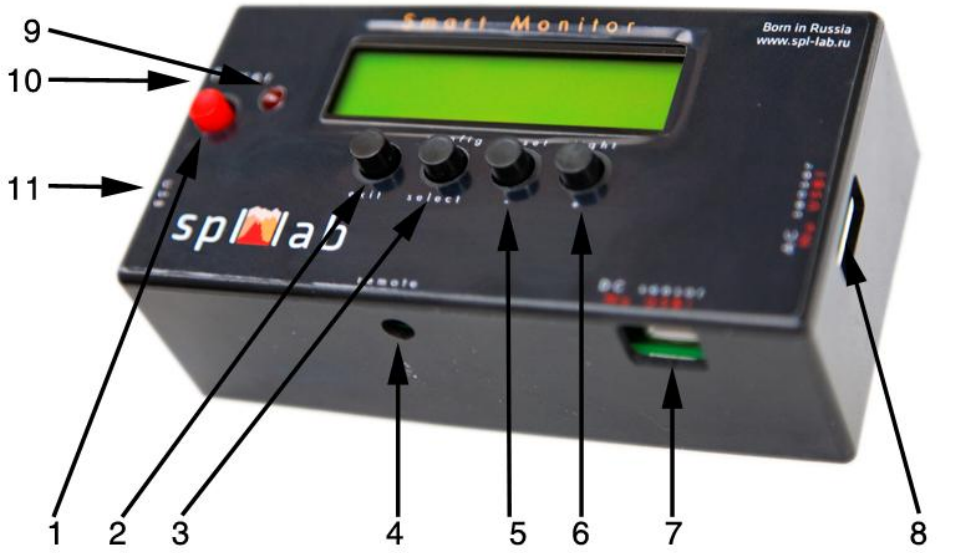
Measured value of direct current	from 0 to 200 ampere
Measured values of alternating current	from 0 to 100 ampere
Measured value of direct current voltage	from 0 to 30 Volt
Measured values of alternating current voltage	from 10 to 300 Volt
Maximum gauge of the conductor wire for measuring a current	4 AWG
Maximum current of the Remote circuit	1 ampere
Algorithm of measuring alternating current and voltage	True RMS
Measured values	Voltage, Current, Power consumption, Impedance
The algorithm of the system distortion defining	the fast Fourier transformation method.
Display	Two-line LCD with backlight
Sockets/connectors:	Power,USB, sockets for two sensors, Remote circuit.
Firmware upgrade	is possible through USB and PC.
Dimensions: (LBH)	65x125x40mm (main unit), 53x82x30mm (sensors)

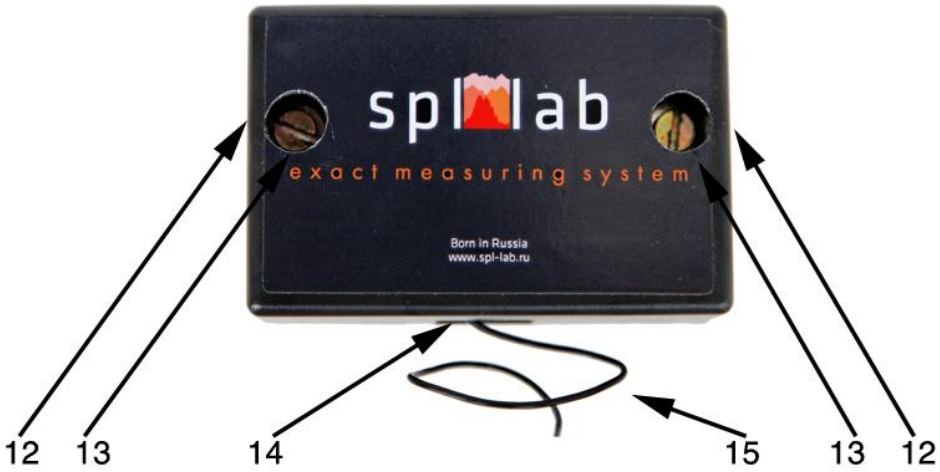
Working with the device

Important safety information:

- ! The protection features of the device are intended solely for providing information and do not exempt from using safety fuses and other classical protection elements.
- ! The manufacturer does not bear responsibility for damage, caused directly or indirectly, as a result of improper device use.
- ! Before using the device, examine its case for cracks and splits, because any depressurization of the device will result in damage.
- ! To avoid the risk of electric shock. all the connector cables should not have insulation defects.
- ! Avoid measuring load beyond the maximum limit.
- ! All operations of connecting and disconnecting cables should be performed with equipment switched off.
- ! Do not use or store the device in areas with high humidity or heat, as well as, close to devices generating a strong magnetic field.
- ! During the preventative maintenance of the device, do not use synthetic detergents, do not apply solvents. Using wet wipes is more preferable.
- ! Before starting the device and a system as a whole, ensure that all the connection cables are switched correctly.

Identifying the functional parts of the device:





Number of the element	Description
1	“Power on/off” Button
2	Functional button #1
3	Functional button #2
4	Input jack for connecting the Remote line
5	Functional button #3
6	Functional button #4
7	Input jack for connecting the Direct current and voltage sensor
8	Input jack for connecting the Alternating current and voltage sensor
9	Power indicator
10	Power socket for the 9-12 volt AC adaptor
11	Input jack for connecting a device to PC
12	Wire insert
13	Screw for tightening cable
14	Input jack for connecting a sensor to the main unit
15	Ground wire

Connecting the device

1. Disconnect the negative terminal of the car battery, ensure that the engine is not started and electrical circuits of the car and supplementary equipment are fully de-energized;
2. Connect Direct current and voltage sensor (longitudinal slot on the case of a sensor (Figure 1-14)) into the open of the positive power supply circuit of the car amplifier at any convenient point, connecting wires to the Wire insert (Figure 1-12). Fasten the fixing screws (Figure 1-13);
3. Connect the negative wire of the sensor (Figure 1-15) to the negative terminal of the battery or equivalent point.
4. If the current of the measured circuit or diameter of the cable conductors are above permitted size, connect the DC sensor in parallel with power circuit **using only one terminal** (no output on other side of sensor)(Figure 1-12) and wire(Figure 1-15). In doing so, you will be able to still keep voltage measurement and protection.
5. Connect the specialized connecting cable into the input jack of the Direct current and voltage sensor (Figure 1-14).
6. Connect Alternating current and voltage sensor - square slot on the case of a sensor (Figure 1-14) - into the opening from one single polarity wire (+ or -) at any convenient point, connecting wire to the Wire insert (Figure 1-12). Fasten the fixing screws (Figure 1-13);
7. Connect the negative wire of the sensor (Figure 1-15) to the second acoustic wire on the amplifier or speaker; If you connected the + in the Wire insert, ground the sensor by connecting it to the negative of the same speaker. If you connected the - in the Wire insert, ground the sensor by connecting it to the positive of the same speaker.
8. Connect the specialized connecting cable into the input jack of the Alternating current and voltage sensor (Figure 1-14);
9. Connecting specialized Remote circuit adapter-
   Connect the main remote wire from head unit to one of the two Remote wire outputs. Connect the other Remote wire output to the first device in the vehicle in line to be turned on with head unit. It does not matter which wire is input or output on the Remote circuit adapter.
10. Connect specialized Remote circuit adaptor into the input jack of the main unit (Figure 1-4);
11. Connect a specialized connecting cable, linking up the Direct current and voltage sensor with the main unit (Figure 1-7);
12. Connect a specialized connecting cable, linking up the Alternating current and voltage sensor with the main unit (Figure 1-8);
13. Connect the AC adapter to the cigarette lighter in the car and into the power socket on the main unit (Figure 1-10);
14. Check the correctness of all connections and connect the negative terminal of the battery, switch on the device, pressing ‘Power on/off’ button (Figure 1-1), the Power indicator will switch on (Figure 1-9) and the welcome text will appear on the screen.

Button assignment

The Smart Monitor device has two operation modes:

- Measuring mode, in which current measured values are displayed (the device enters this mode directly after start-up);
- Setup mode, in which the parameters of device operation can be defined (for entering this mode, press Functional button #2).

Button	Assignment
Power	'Power on/off' Button
Functional button #1	Switching to upper menu in the Setup mode with saving parameters or exiting the Setup mode
Functional button #2	Entering a Setup mode from Measuring mode, entering the selected menu in Setup mode
Functional button #3	Resetting current measured values and restoring Remote circuit in the Measuring mode, selecting previous feature in a menu or decreasing the set value in Setup mode
Functional button #4	Switching on/off the display backlight in the Measuring mode, selecting next feature in a menu or increasing the set value in Setup mode

Setup mode

After switching the device on it is necessary to perform primary configuration of basic parameters of its operation, before that moment the device cannot perform the protective functions. For convenient work a display backlight provided in the device. You can switch it on by pressing Functional button #4, for switching it off press the same button once again.

- For entering the Setup mode press Functional button #2.
- Select the necessary group of parameters using Functional buttons #3 (previous value) and #4 (next value), after that, press Functional button #2 for entering the selected group.
- Select the necessary parameter using Functional buttons #3 (previous value) and #4 (next value), after that press Functional button #2 for changing the parameter value.
- Set up the necessary parameter value using Functional buttons #3 (decreasing a value) and #4 (increasing a value), after that, press Functional button #1 for saving changes and exiting to the menu.
- For exiting the Setup mode, press Functional button #1 several times.

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Menu item / Parameter	Assignment
Common	General settings of the device
Device mode	Setting up sources of measurement and protection actuation: **AC+DC** – data is displayed from Alternating and Direct current and voltage sensors **DC** – data is displayed only from Direct current and voltage sensor **AC** – data is displayed only from Alternating current and voltage sensor
DC mode	Setting up units for displayed data and protection actuation for Direct current and voltage sensor **Volts –** voltage in volts, current in amperes **Power –** power in watts
AC mode	Setting up units for displayed data and protection actuation for Alternating current and voltage sensor **Volts –** voltage in volts, current in amperes **Power –** power in watts, impedance in ohms
Remote protect	Setting up source of protection actuation and breaking the Remote circuit **AC+DC** – protection engages when the measured values exceed threshold for Alternating and Direct current and voltage sensors **DC** – protection engages when the measured values exceed threshold for Direct current and voltage sensor **AC** – protection engages when the measured values exceed threshold for Alternating current and voltage sensor
Values	Setting protection threshold values
AC volt max	Maximum permitted voltage value on Alternating current and voltage sensor (in volts)
AC amp max	Maximum permitted current value on Alternating current and voltage sensor (in amperes)
AC power max	Maximum permitted power value on Alternating current and voltage sensor (in watts)
DC volt max	Maximum permitted voltage value on Direct current and voltage sensor (in volts)
DC amp max	Maximum permitted current value on Direct current and voltage sensor (in amperes)
DC power max	Maximum permitted power value on Direct current and voltage sensor (in watts)
DC volt min	Minimum permitted voltage value on Direct current and voltage sensor (in volts)

Protection feature

The Smart Monitor device has protection features that help to protect supplementary equipment in a vehicle from damage. Using the protection features of this device does not excuse you from using fuses. Protection feature is executed by the way of breaking the main Remote controlling circuit from head unit.

Please note, that protection engages only when data, displayed on the screen, exceeds permitted values and only in defined units. That is, if you have defined measured values for displaying in watts and only from the Alternating current and voltage sensor, then the protection will engage only when on the power in watts on the Alternating current and voltage sensor exceeds permitted value; **voltage and current values in case of such settings are not protected**. Exceeding permitted values for Direct current and voltage sensor shall not be protected either.

The indicator for enabled Protection feature is the symbol of a bell, which will appear to the right from the displayed value; if the indicator is absent, protection feature shall not happen.

At protection execution, the device breaks Remote circuit and the value, which was exceeded, starts blinking onscreen. In this case, the value will change only if the present measured value still exceeds the permitted limits upward or downward, depending on criteria for execution. That is, if the lower limit for direct voltage has been set to 9 volts, protection will engage when the voltage falls below 9 volts, thereat values onscreen will change only if voltage falls even more. If protection happened according to upper limit, which is, for example 14 volts, value will change, if voltage becomes higher.

For resetting present measured values and restoring Remote circuit, press Functional button #3.

If the device is switched off, the Remote circuit is broken.

Connecting the device to the PC

1. Using an USB cable, connect the device to the PC via USB port (Figure 1-11); **Do NOT connect USB cable to DC or AC port!**
2. When connected for the first time, the notification will appear that a new device is detected and the necessary drivers have been installed. If necessary, you can use the driver from the CD supplied with the device.
3. After driver installation, the new item “USB Serial Port” will be added to the list of “COM and LPT ports”.

Detecting Distortion System

Application

The system of detecting distortion or clipping of the signal - the Clip Detector - will help you calibrating the audio system settings in such a way, that the signal played back by your audio system is always clear, and will protect you acoustic components from damage. The Alternating current and voltage sensor is a source of measured signal. The system measures signal voltage and calculates the harmonic distortion coefficient. When exceeding the threshold value of the harmonic distortion coefficient, the system informs a user that the signal is distorted.

System setup

The Clip Detector is provided as a separate module(firmware) that should be loaded to the Smart Monitor device instead of general microcode. Simultaneous use of the basic functions of Smart Monitor and Clip Detector system is impossible.

1. Connect the device to a PC using USB cable.
2. Upload Clip Detector module using a program Loader, which is provided on disc; for starting upload, you have to switch the device off and then on.
3. Turn off device and disconnect the device from the PC after upload is complete.

Working with a Clip Detector system

- Connect the Alternating current and voltage sensor to the acoustic wire to be measured, in such a case that running single speaker wire is not possible through device, splicing off from the source of the speaker wire is allowed as only voltage is being measured and can be inserted into the AC Wire insert with no required output from Wire insert.
- Switch on the device, if necessary, switch backlight on or off using Functional button #4.
- Depending on the frequency range of the acoustic channel, define a mode of operation for Clip Detector using Functional button #2; current operation mode will be displayed in the top left corner of the screen.
  Low-frequency mode (L) range from 40 to 200 Hertz
  High-frequency mode (H) range from 200 to 2000 Hertz
- Using the supplied CD or sinusoidal signal generator, send to your amplifier a frequency, corresponding with the selected range. Normally 100 or 200 Hertz for low-frequency and 1000 hertz for high-frequency range.
- If the Clip Detector has detected the signal correctly, its frequency will be reflected in the top line of the display; If the signal exceeds limits of the pre-set range, you will see notification "**A is too high**" (Frequency is too high) or "**F is too low**" (Frequency is too low). In such case change signal frequency or switch over to another Clip Detector operation mode.
- Set the amplitude of measured signal on amplifier and\or other devices that influence the output of the amplifier. If the amplitude of measured signal is too low, you will see

notification “**Signal is too low**” in the bottom line; if the amplitude of measured signal is too high notification will state “**Signal is too high**”.

- If amplitude of the measured signal has permissible value, you will see status of measured signal: “**Clipped**” stands for distorted signal, and “**Fine no Clip!**” for clear signal.
- Using controls of your audio-system, define optimal settings for getting unclipped signal.
- After completing the setup with the help of the Clip Detector, you can return the device to its initial state uploading the standard microcode using the utility program, Loader, to the device via PC.

Description of the CD tracks

No. of track	Description
1	**Pink noise 20-20000 Hz**
2	**Pink noise 40-60 Hz**
3	**Pink noise 60-80 Hz**
4	**Pink noise 80-100 Hz**
5	**Pink noise 100-120 Hz**
6	**Pink noise 120-140 Hz**
7	**Pink noise 140-160 Hz**
8	**Pink noise 160-180 Hz**
9	**Sweep-tone 30-20 Hz.** Level – 0dB.
10	**Sweep-tone 35-25 Hz.** Level – 0dB.
11	**Sweep-tone 40-30 Hz.** Level – 0dB.
12	**Sweep-tone 45-35 Hz.** Level – 0dB.
13	**Sweep-tone 50-40 Hz.** Level – 0dB.
14	**Sweep-tone 55-45 Hz.** Level – 0dB.
15	**Sweep-tone 60-50 Hz.** Level – 0dB.
16	**Sweep-tone 65-55 Hz.** Level – 0dB.
17	**Sweep-tone 70-60 Hz.** Level – 0dB.
18	**Sweep-tone 75-65 Hz.** Level – 0dB.
19	**Sweep-tone 80-70 Hz.** Level – 0dB.
20-80	Sinusoidal tone. The number of track corresponds to the signal frequency. Level – 0dB.
81	**Sweep-tone 20-20000 Hz.** Level – 0dB.