KROKS

SCIENTIFIC AND PRODUCTION COMPANY

THE 2-PORT VECTOR NETWORK ANALYZER

(REFLECTOMETER)

ARINST VNA-DL

1-8800 MHz

MANUAL

CONTENT

1. PURPOSE AND PRINCIPLE OF OPERATION

1.1. Two-port vector network analyzer **ARINST VNA-DL 1-8800 MHz** (hereinafter analyzer, device) is designed to measure the elements of the scattering matrix (complex reflection and transmission coefficients) of two-port networks. The device measures parameters S11 and S21, voltage standing wave ratio (VSWR), impedance, admittance, phase, group delay time, distance to cable fault.

1.2. The analyzer is used to tune and match the characteristics of passive and active radio devices[1] (antennas, cables, filters, attenuators, amplifiers), integrity checks and measurement of parameters of high-frequency cables, other radio engineering measurements.

1.3. The device is intended for radio amateur use, as it is not a professional measuring instrument.

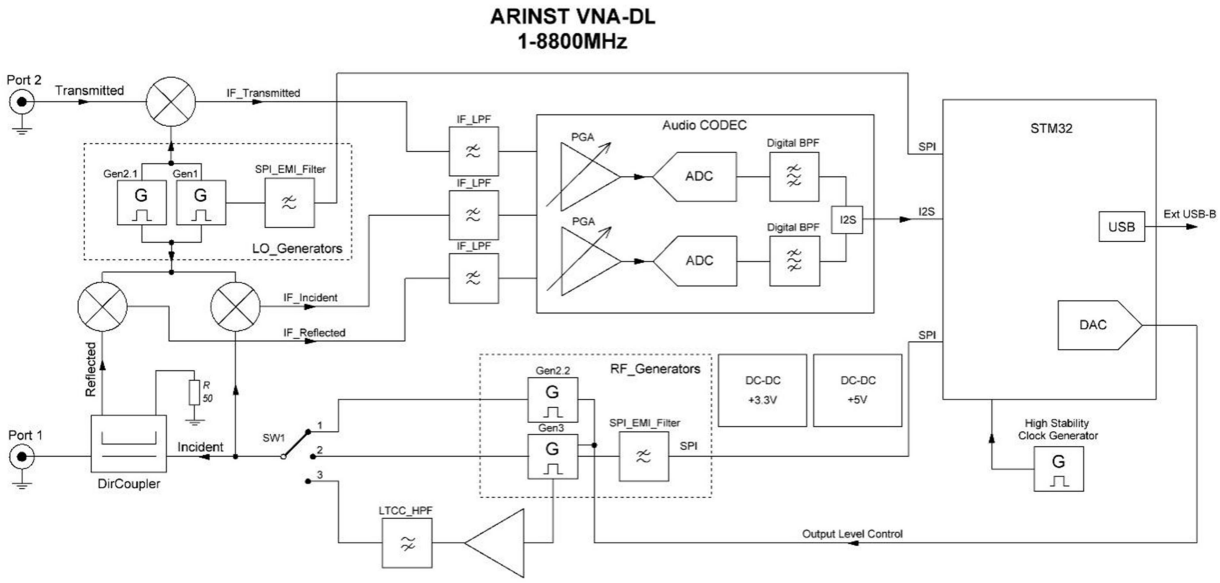

Figure 1.1 - Structure of the network analyzer

The block diagram of the analyzer is shown in Figure 1.1. The device is built according to the scheme of a superheterodyne receiver and consists of a test (probing) signal generation circuit, a heterodyne signal generation circuit, as well as mixers, a directional coupler, a high-quality codec and an STM32 microcontroller. The entire circuit is powered by two highly efficient, low-noise voltage sources. The circuit is clocked from a high-precision, thermocompensated clock signal generator. To work with the device, a personal computer with special software is required.

1 The devices must allow the possibility of applying a stimulating signal from the analyzer to the test port. The analyzer manufacturer is not responsible for the failure of devices that do not allow the supply of a stimulating signal to the test port.

2. SPECIFICATIONS

2.1. The technical characteristics of the device are shown in table 1.

Table 1

Parameter		value
Working frequency range		1-8800 MHz
Frequency resolution	for frequencies 1-140 MHz	100 Hz
	for frequencies 140-8800 MHz	10 kHz
Maximum number of scan points		1000
Maximum scanning speed		500 points/s
Dynamic range S21 (BW=20 Hz)	for frequencies 1-4000 MHz	> 80 dB type 85
	for frequencies 4000-6900 MHz	> 75 dB type 80
	for frequencies 6900-8800 MHz	> 65 dB type 75
Bridge directivity uncorrected in the entire range, not less		12 dB
Directivity effective[2] (after full one-port calibration), not less		55 dB
Standing wave ratio, no more		2 (1.3 type)
Phase measurement precision[2], no more		0,7°
Magnitude measurement precision[2], no more		0,25 dB
Resolution of determining the distance to the fault[2]		$(C \times VF)/2\,S$ m
Maximum length of the measured cable[3], when VF=1		3000 m
Compensation of the electrical cable length, when VF=1		±3 m
Maximum DC Input Voltage		25 V
Maximum input power supplied to ports		+10 dBm
Maximum power of the probing signal, no more		-3 dBm
Displayed graphs	■Smith chart; ■polar chart; ■phase of reflection coefficient (RC) and transmission coefficient (TC); ■magnitude of RC and TC; ■logarithmic magnitude RC and TC;■SWR; ■distance to fault; ■cable loss; ■group delay time	
The number of stored user settings		not limited
The number of traces to remember		not limited
Working temperature range		0 … +40°C
PC connection interface		USB
Maximum current consumption, no more than		1 A
Overall dimensions (L×W×H)		155×127×29 mm
Weight		0,25 kg

2 Where C is the speed of light, m / s; VF is the speed factor (the ratio of the speed of propagation of an electromagnetic wave in a cable to the speed of propagation of an electromagnetic wave in a vacuum), takes on a value depending on the cable from 0.1 to 1; S - scanning frequency range (Hz).

3 It depends on the amount of attenuation in the cable and is the limit of the indication.

3. COMPLETENESS

3.1. The delivery set of the device is shown in Table 2.

Table 2

Name	Quantity
Vector network analyzer ARINST VNA-DL 1-8800 MHz	1 pc.
Cable 2xUSB2.0 (male) -A - USB2.0 (male) -B	1 pc.
Adapter SMA (female) - SMA (female)	2 pc.
Operation manual (product passport)	1 pc.
Package	1 pc.

Due to the constant improvement of the device and software, the manufacturer reserves the right to make changes to its technical characteristics and completeness.

4. DEVICE STRUCTURE

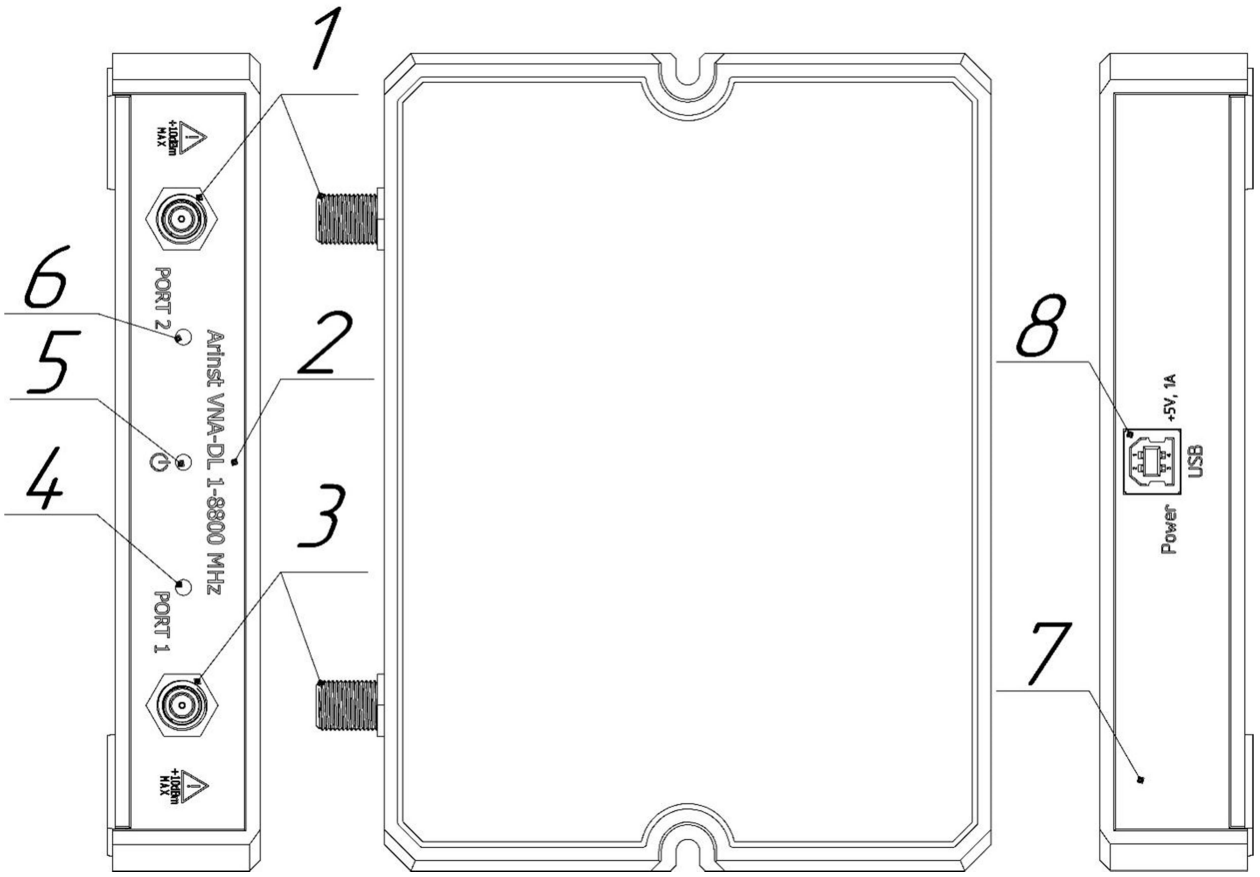

Figure 3.1 - External view of the device

1. Measurement port 1 (PORT 1) is intended for connection of the investigated devices and acts as a source and receiver of the signal.

2. Panel of high-frequency connectors.

3. Measurement port 2 (PORT 2) is intended for connection of test devices and is a signal receiver.

4. The activity indicator of the measuring Port 1. Lights up during the measurement of Port 1.

5. Indicator «STATUS». It lights up when the device is connected to a personal computer.

6. The activity indicator of the measuring Port 2. Lights up during the measurement of the Port 2.

7. Switching panel.

8. USB-B connector. It is used to transfer data from the device to a personal computer.

5. CONNECTING TO PC

To work with the device, you will need a personal computer that meets the following requirements:

- OS Windows 7-10
- free USB port.

5.1. Before turning on, make sure that the device is not damaged externally.

5.2. The device is turned on immediately after power is supplied from the USB port of a personal computer. It is recommended to use the supplied USB cable to connect the device to a PC.

5.3. Before starting to work with the device, you need to install the special software **Arinst Virtual Lab**. The installation file is available on the website: www.arinst.net

5.4. After downloading the installation file, it must be run as administrator. The software installation procedure is standard, you just need to follow the instructions of the installer. If the PC does not have a driver for the analyzer to work correctly, the installer will offer to install it along with the software.

6. USER INTERFACE

The network analyzer application structurally includes two components: the analyzer connection interface and the control interface.

6.1. Analyzer connection interface

After starting the application, the device connection window opens:

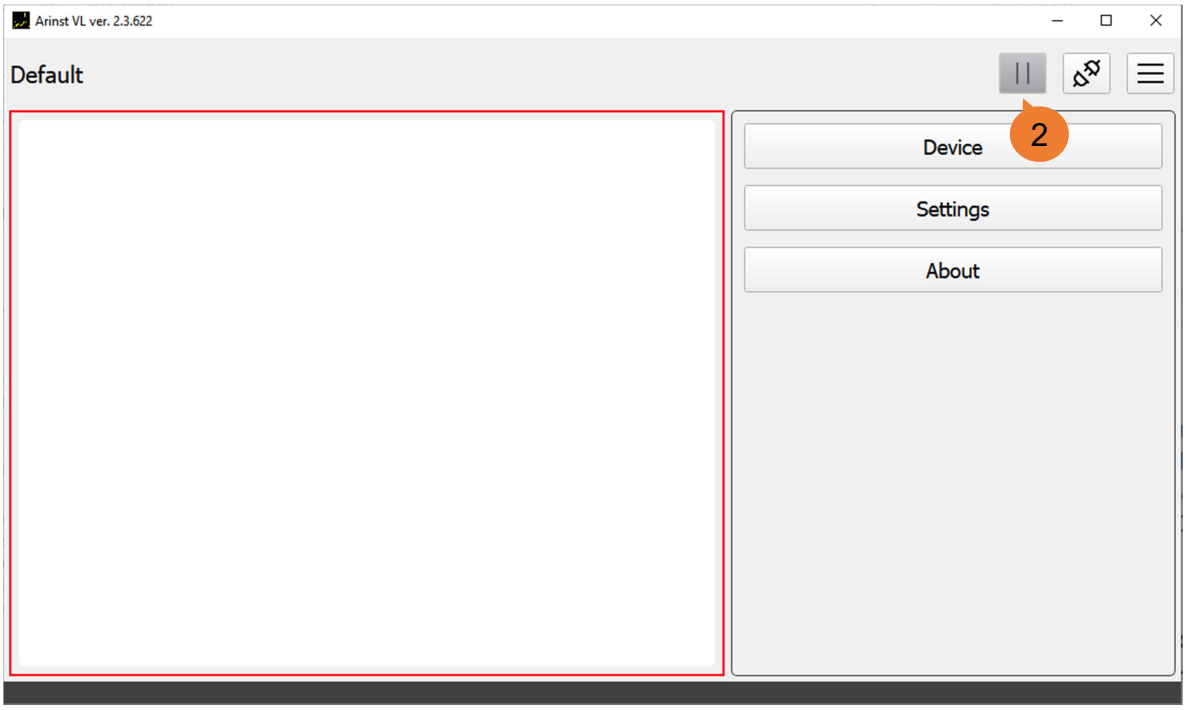

Figure 6.1 - Device connection window

To connect the device to a PC, it is necessary to connect the cable to the USB port of the computer. Then start the control software and click on the **«Connection»** button (1) in the upper right corner. After that, a window for selecting a connection port will appear.

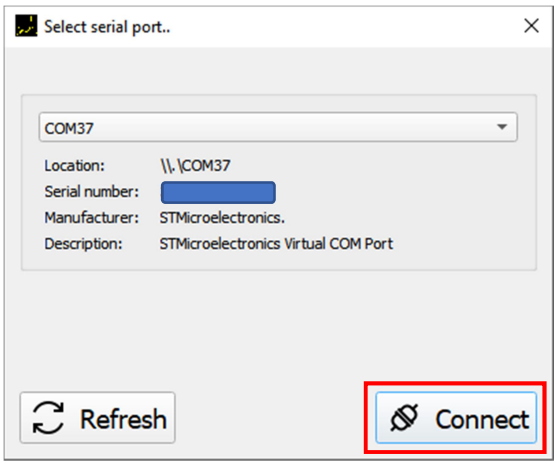

Figure 6.2 - Window for selecting the connection port

In this window, select the required port in the drop-down list and click the **«Connect»** button. When the device is connected, it checks for firmware updates. If there are updates, you will be prompted to install it.

It is recommended to install device updates. After installing the updates, you can start working with the device.

Three menu items are available in the device connection window: «**Device**», «**Settings**», «**About**». In the «**Device**» menu item, you can get information about the connected analyzer: ID, the current and up-to-date firmware version, as well as check for updates and install them.

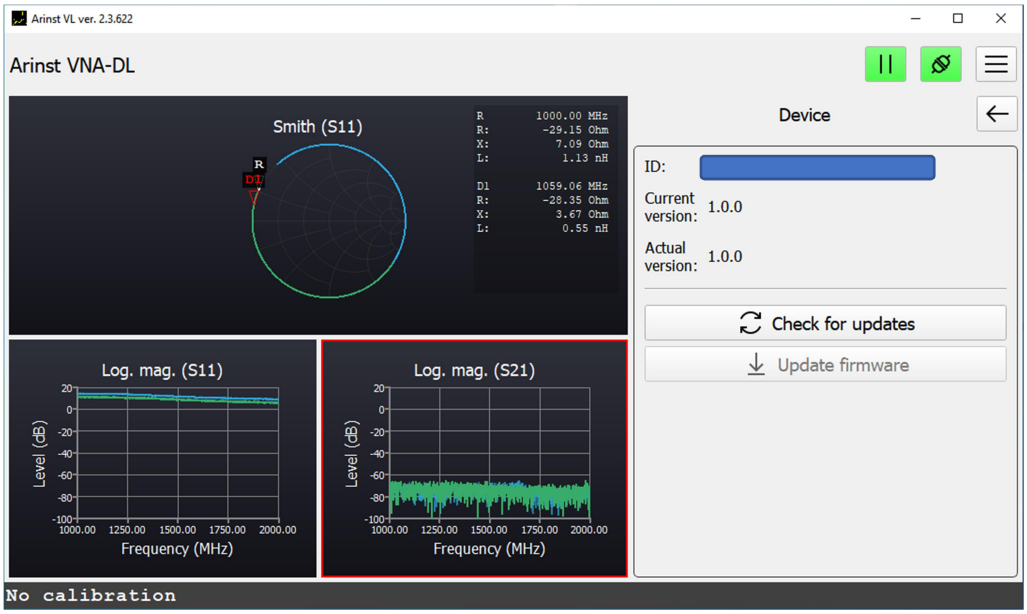

Figure 6.3 - «Device» menu

In the «**Settings**» menu, you can change the language, open the folder with the application data (where logs, calibrations, software presets are located). It is possible to download / save software presets.

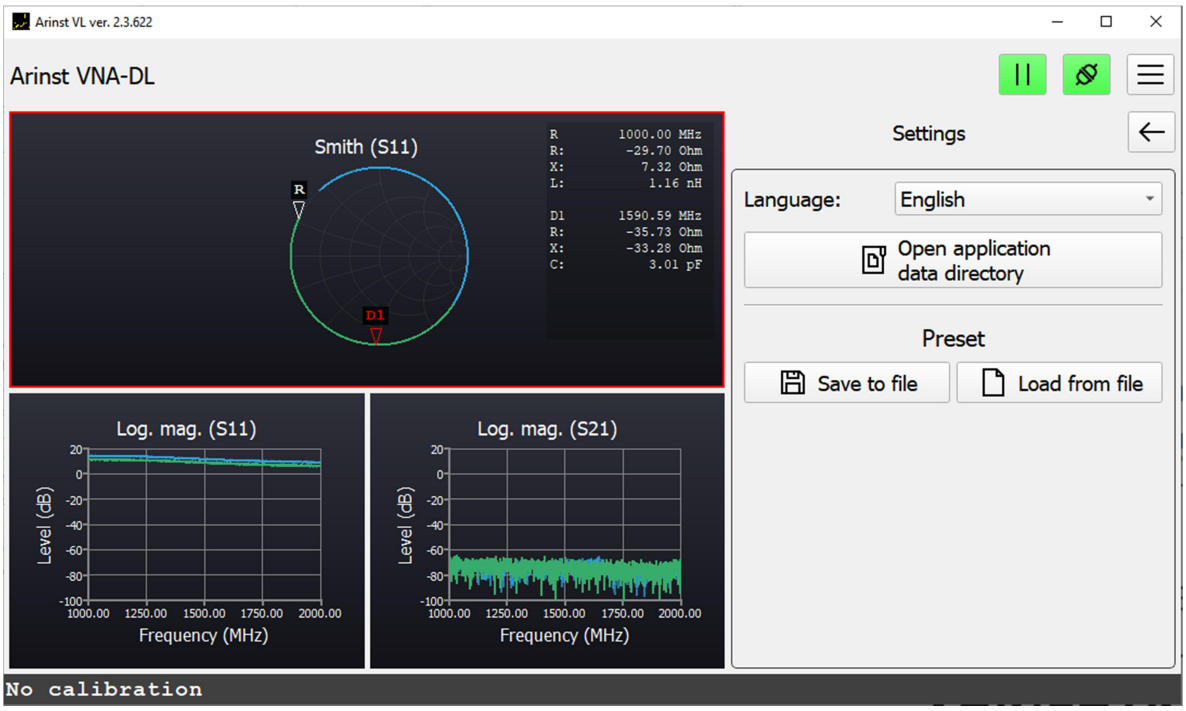

Figure 6.4-Menu «Settings»

In the «**About**» menu, information about the current version of the software, the email address of the technical support service is available.

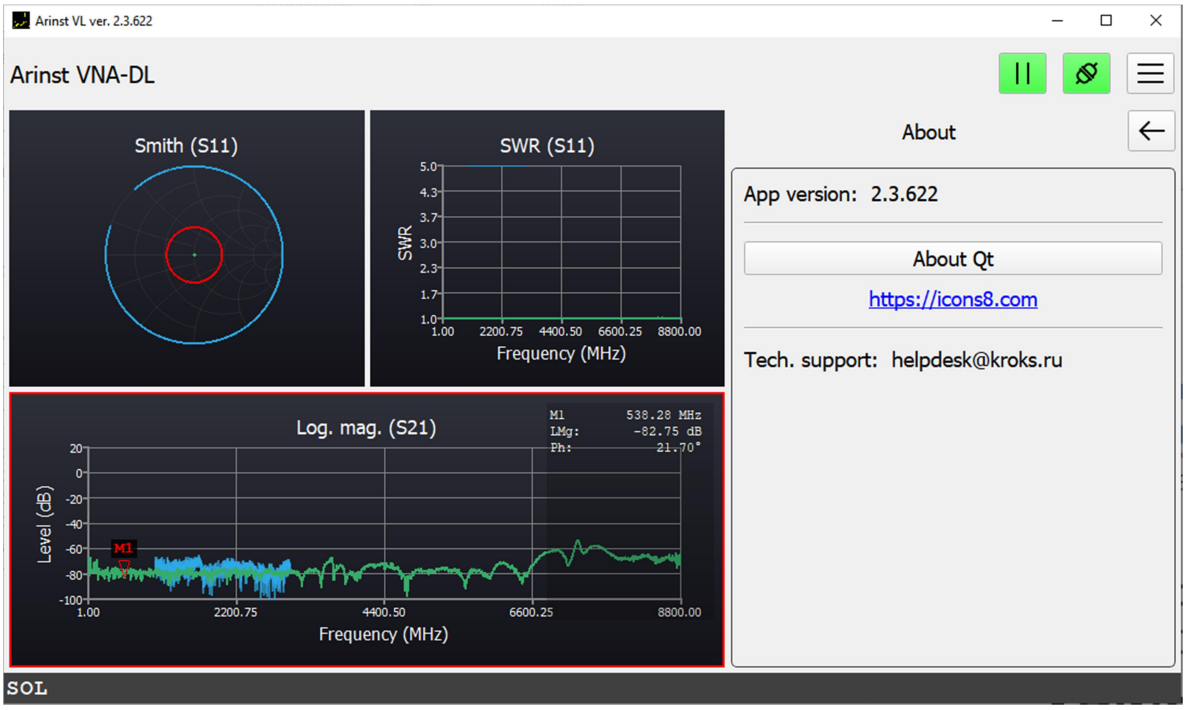

Figure 6.5 - Menu «About»

6.2. Analyzer control interface

If the firmware version of the instrument is up-to-date or an update was made when the analyzer was connected to a PC, the module suitable for the analyzer is loaded and the instrument control interface opens. The «**Connection**» button (1) glows green. The scanning process is in progress and the «**Pause**» button (2) is on.

Figure 6.6 - Analyzer control interface

The analyzer control interface window is structurally divided into a graph area on the left and a menu area on the right. Using the button ☰ in the upper right corner there is an option to hide the menu items. In this case, the area of the graphs will increase.

7. MAIN MENU

Structurally, the main menu includes 8 logically grouped tabs: **Scan, Plots, Traces, Markers, Calibration, Device, Settings, About**.

7.1. Menu «Scan»

In the «Scan» menu, it is possible to set the range of measured frequencies, the number of measurement points and the bandwidth of the IF filter.

Figure 7.1 - Menu «Scan»

7.2. Menu «Plots»

In the «Plots» menu, the user is given the opportunity to select the desired configuration of the location of the graphs. You can also assign a scan channel and a measurement type to the active graph. The active chart is highlighted with a red border. It is also possible to change the scale of the active graph, the reference level for it and parameters specific to a particular type of measurement, for example, the velocity factor (VF).

Figure 7.2 - Menu «Plots»

7.3. Menu «Traces»

In the «Traces» menu, it is possible to save the route of interest as a Touchstone file (*. snp). This type of files can be used for modeling in various CAD systems (computer-aided design systems). You can save files in 2 formats: .s1p and .s2p

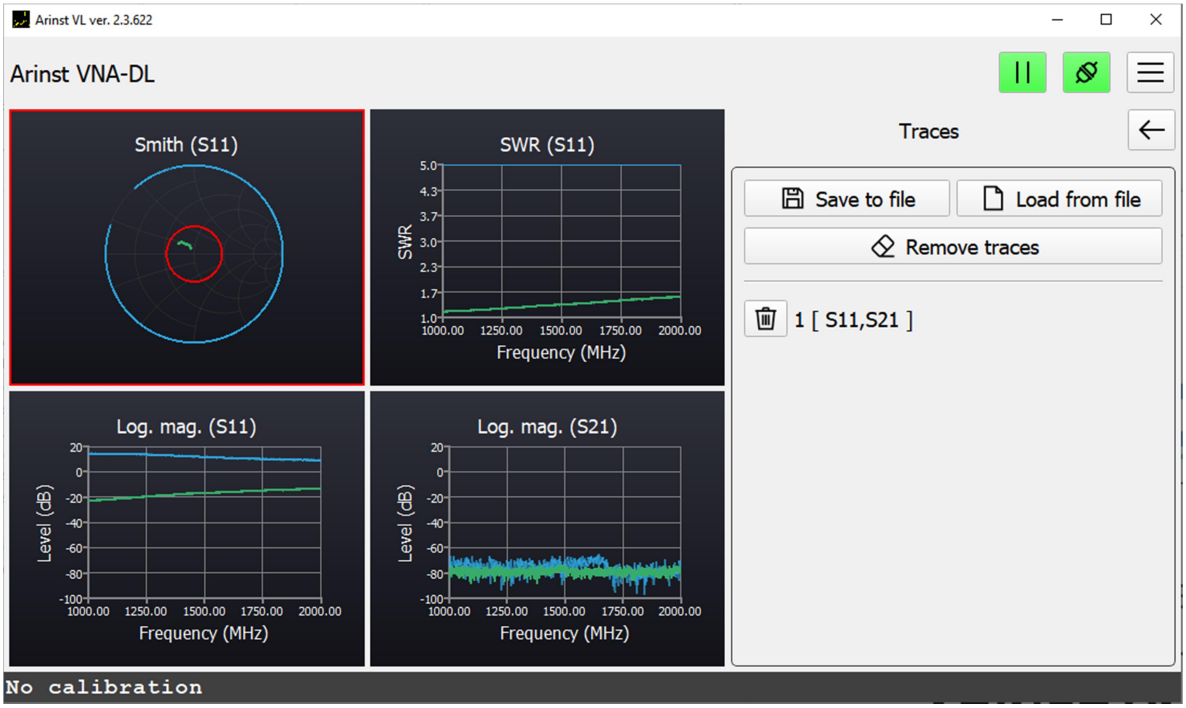

Figure 7.3 - Menu «Traces»

7.4. Menu «Markers»

The «Markers» menu provides the ability to add, remove, hide, display and position markers on charts. You can set the marker by entering a specific frequency of interest and pressing the «Enter» button after, or by pressing button ⊕. It is also possible to add markers by double-clicking the left mouse button on the graph itself in the place of interest. You can show or hide the added markers by checking or unchecking the «Show markers» field. You can delete all markers using the «Remove markers» button. Each added marker is added to the list of markers. There are several options available for each marker in the list. The first button 🔧 opens the marker settings, where it is possible to delete this marker, as well as set it as a reference marker or as a delta marker, if the reference marker is already set. By pressing the buttons "M1", "M2", etc., the active marker is selected. In this case, the button is highlighted in pink, and the marker itself on the chart is red. The drop-down list shows the types of marker display. Behind the drop-down list there is a window for entering the frequency of marker installation. You can move the marker when you select it as the active one and then move the left/right arrows on the keyboard. You can select the active marker by clicking on one of the buttons "M1", "M2", etc.Then move the arrows on the keyboard to the desired location. It is also possible to drag the marker to the desired location with the mouse.

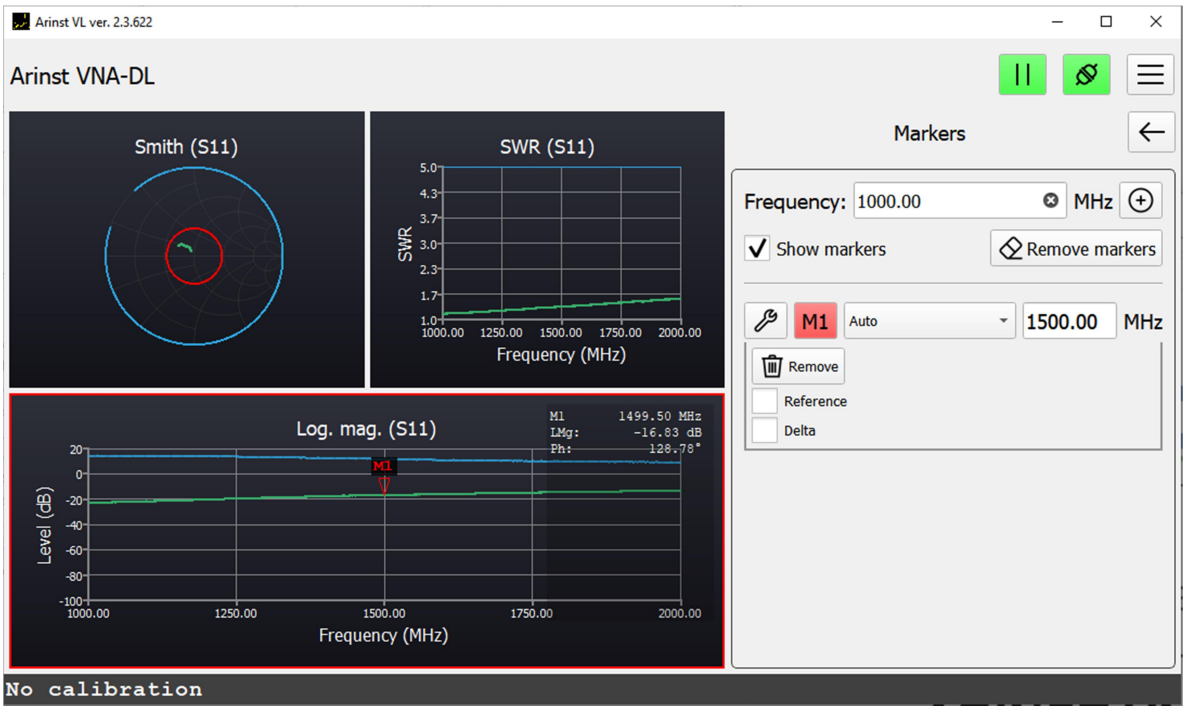

Figure 7.4 - Menu «Markers»

7.5. Menu «Calibration»

In the «Calibration» menu, it is possible to perform a complete calibration using the SOL+T method, as well as to calibrate only one measuring port **Port 1** using the SOL method.

7.5.1. Calibration is performed after the device has been warmed up for at least five minutes. The change in the ambient temperature from the moment of calibration to the measurement should not exceed ±3 °C. Before making responsible measurements, always calibrate the device to exclude the influence of ambient temperature.

7.5.2. Connect the necessary accessories (connectors, adapters and cables) to the ports of the device **Port 1** and **Port 2**, through which the device will be connected to the test device. Thus, as a result of calibration, the calibration plane is transferred from the device ports **Port 1** and **Port 2** to the ends of the connected accessories.

7.5.3. Connect the loads from a standard set of calibration standards (not included in the delivery set) to the cable or connector connected to **Port 1**:

- open-load and press the **Open** button in the software interface;
- short-load circuit and press the **Short** button in the software interface;
- matched-load, and click the **Load** button.

If you are performing a full two-port calibration of the device, connect the cables connected to ports **Port 1** and **Port 2** through the jumper and press the **Through** button.

After calibration, the buttons on the screen will turn green. To delete one or another calibration, click on the button with the designation of the basket opposite the calibration you want to delete. Connect the appropriate calibration standard and calibrate the instrument. Also, the program interface allows you to remove all calibrations by clicking on the «Remove all» button

The following calibration information is displayed on the screen in the lower left corner:

- **No calibration** – there is no custom calibration. To make measurements, it is necessary to perform calibration.
- **SOL / SOL+T** – performed one-port / two-port calibration. Calibration and frequency range are the same. In this mode, the measurement results are the most accurate.

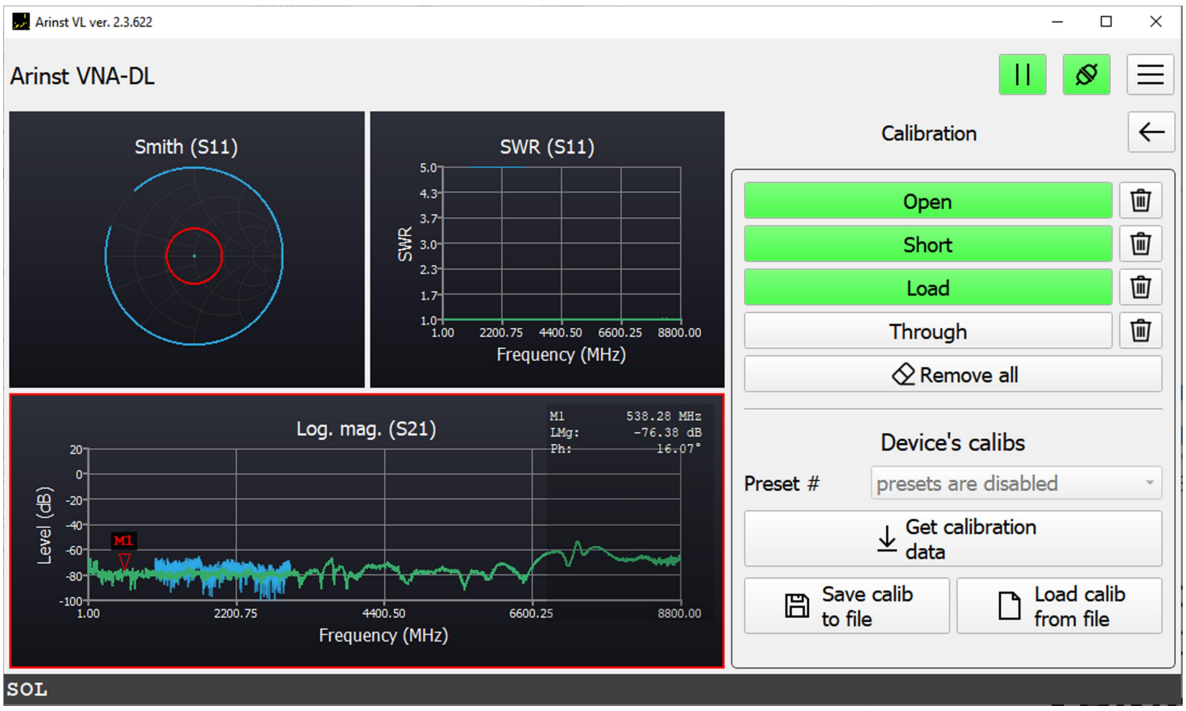

Figure 7.5 - Menu «Calibration»

If, during the measurement, the frequency range does not coincide with the range in which the calibration was performed, but the frequencies lie within the calibration range, the device uses a mathematical method for calculating calibrations based on interpolation. The measurement accuracy will be lower, and the calibration type will be displayed in blue.

If the frequency range is outside the calibration range, the device uses a mathematical method for calculating calibrations based on extrapolation. The calibration type will be displayed in red on the screen. The measurement accuracy is the lowest.

7.6. Menu «Device», «Settings», «About»

The functionality of these menu items is described in paragraph 6.1. of this manual.

8. COMPLETING THE WORK

To complete work with the device and turn it off, follow these steps:

8.1. In the user interface menu, end the session with the device by clicking on the «**Connection**» button. In the window that appears, Figure 8.1, click on the «**Disconnect**» button. In this case, the port activity indicators will stop flashing, only the «**STATUS**» indicator will remain on, the device will switch to standby mode.

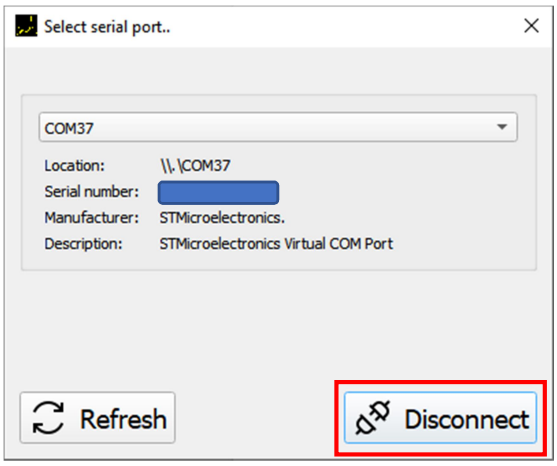

Figure 8.1-Shutdown

8.2. To completely turn off the device, disconnect the USB cable from the personal computer.