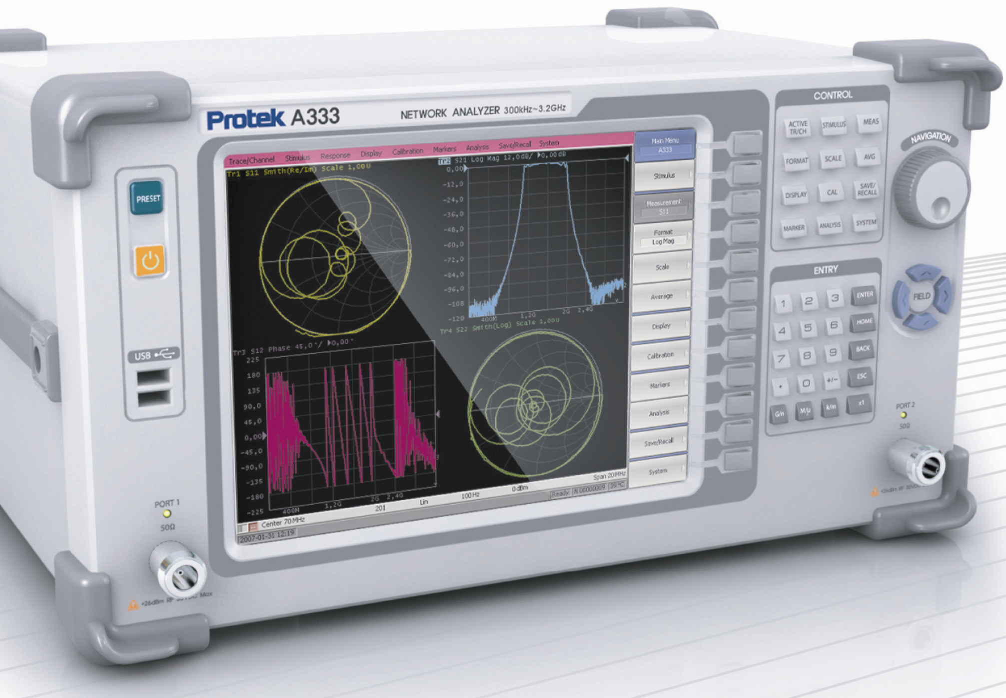
Protek A333

Network Analyzer

Operating Manual

Version 1.0



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CONTENTS

INTRODUCTION

This Operating Manual represents design, specifications, overview of functions, and detailed operation procedure of A333 Network Analyzer, to ensure effective and safe use of the technical capabilities of the instruments by the user.

Network Analyzer operation and maintenance should be performed by qualified engineers with initial experience in operating of microwave circuits and PC.

Below you will find the abbreviations used in this Manual:

PC - Personal Computer

DUT - Device Under Test

IF - Intermediate Frequency

CW - Continuous Wave

SWR - Standing Wave Ratio

1. SAFETY INSTRUCTIONS

Carefully read through the following safety instructions before putting the Analyzer into operation. Observe all the precautions and warnings provided in this manual for all the phases of operation, service, and repair of the Analyzer.

The Analyzer must be used only by skilled and specialized staff or thoroughly trained personnel with the required skills and knowledge of safety precautions.

A333 complies with INSTALLATION CATEGORY II as well as POLLUTION DEGREE 2 in IEC61010-1.

A333 is MEASUREMENT CATEGORY I (CAT I). Do not use for CAT II, III, or IV.

A333 is for INDOOR USE only.

A333 is tested with stand-alone condition or with the combination with the accessories supplied by Protek against the requirement of the standards described in the Declaration of Conformity. If it is used as a system component, compliance of related regulations and safety requirements are to be confirmed by the builder of the system.

Never use the Analyzer without secure grounding. Operation is permitted only with protective earth connection by the supplied power cable to a 3-pin grounded power outlet.

Never operate the Analyzer in the environment containing inflammable gasses or fumes.

Operators must not remove the cover or part of the housing. The Analyzer must not be repaired by the operator. Component replacement or internal adjustment must be performed by qualified maintenance personnel only.

Never operate the Analyzer if the power cable is damaged.

Never connect the test terminals to mains.

Observe all the general safety precautions related to operation of equipment powered by mains.

The definitions of safety symbols used on the instrument or in manuals are listed below.

⚠	Refer to the Manual if the instrument is marked with this symbol. .
∼	Alternating current.

⎓	Direct current.
I	On (Supply).
O	Off (Supply).
	A chassis terminal; a connection to the instrument's chassis, which includes all exposed metal structure.
WARNING	**This sign denotes a hazard. It calls attention to a procedure, practice, or condition that, if not correctly performed or adhered to, could result in injury or death to personnel.**
CAUTION	This sign denotes a hazard. It calls attention to a procedure, practice, or condition that, if not correctly performed or adhered to, could result in damage to or destruction of part or all of the instrument.
Note	This sign denotes important information. It calls attention to a procedure, practice, or condition that is essential for the user to understand.

2. GENERAL OVERVIEW

2.1. Description

A333 Network Analyzer has been designed for use in the process of development, adjustment and testing of various electronic devices in industrial and laboratory facilities, including operation as a component of an automated measurement system. A333 is designed for operation with external PC, which is not supplied with the Analyzer.

2.2. Specifications

2.2.1. Basic Specifications

The basic specifications of the Analyzer detailed in table 1.1 apply over the temperature range of 23 °C ±5 °C (unless otherwise specified) after 40 minutes of warming-up, with less than 1 °C deviation from the full two-port calibration temperature, at output power of -5 dBm, and IF bandwidth 1 Hz. The calibration requires the use of the calibration kits specified in table 6.3.

Table 1.1 Basic Specifications

Frequency range	300 kHz to 3.2 GHz
CW frequency accuracy	$\pm 5\times 10^{-6}$
Harmonic distortion	-30 dB
Non harmonic spurious	-30 dB
Output power level	-45 dBm to +10 dBm
Output power level accuracy	±1.0 dB

Table 1.1 (continued)

Magnitude transmission measurement accuracy, if $\|S_{11}\|$ and $\|S_{22}\|$ of the DUT are less than -32 dB, and $\|S_{21}\|$ and $\|S_{12}\|$ values are as follows: +5 dB to +15 dB -50 dB to +5 dB -70 dB to -50 dB -90 dB to -70 dB	0.2 dB 0.1 dB 0.2 dB 1.0 dB
Phrase transmission measurement accuracy, if $\|S_{11}\|$ and $\|S_{22}\|$ of the DUT are less than -32 dB, and $\|S_{21}\|$ and $\|S_{12}\|$ values are as follows: +5 dB to +15 dB -50 dB to +5 dB -70 dB to -50 dB -90 dB to -70 dB	2^o 1^o 2^o 6^o
Magnitude reflection measurement accuracy, if $\|S_{11}\|$ and $\|S_{22}\|$ values are as follows: -15 dB to 0 dB -25 dB to -15 dB -35 dB to -25 dB	0.4 dB 1.5 dB 4.0 dB
Phase reflection measurement accuracy, if $\|S_{11}\|$ and $\|S_{22}\|$ values are as follows: -15 dB to 0 dB -25 dB to -15 dB -35 dB to -25 dB	4^o 7^o 22^o
Receiver noise floor (IF bandwidth 10 Hz)	-120 dBm
Trace noise (IF bandwidth 3 kHz)	0.001 dB rms
Uncorrected directivity	25 dB
Uncorrected source match	-15 dB
Uncorrected load match	-25 dB

Table 1.1 (continued)

AC mains power	220 ± 22 V
Power consumption	30 W
Dimensions LxWxH	275x415x97 mm
Weight	5 kg
Operating conditions: - Temperature - Humidity at 25 °C - Altitude - Error-Corrected Temperature Range (with <1°C deviation from calibration temperature) Non- Operating conditions: - Temperature - Humidity at 25 °C - Altitude	 5 °C to 40 °C 90% 0 to 2,000m 23°C ± 5°C -10 °C to 60 °C 90% 0 to 4,572m

2.2.2. Supplemental Specifications

	Source stability within operating temperature range $\pm 5\times 10^{-6}$.
	Frequency resolution 1 Hz.
	Measurement time per test point 125 µs.
	Number of test points per sweep from 2 to 10001.
	Source to receiver port switchover time less than 10 ms.
	Power level resolution 0.05 dB.
	IF bandwidth settings from 1 Hz to 30 kHz with step of 1/1.5/2/3/5/7.
	Measurement of conversion coefficient |C21| for frequency converting DUT. |C21| measurement accuracy for |C21| values from -60 dB to +10 dB is 1.5 dB.
	External reference frequency is 10 MHz, input level is 2 dBm ± 2 dB, and input impedance at «10 MHz» input is 50 Ω. Connector type is BNC female.
	Output reference signal level is 3 dBm ± 2 dB at 50 Ω impedance. «OUT 10 MHz» connector type is BNC female.
	Connector for external trigger source is BNC female. TTL compatible inputs of 3 V to 5 V magnitudes have up to 1 µs pulse width. Input impedance at least 10 kΩ.
	Effective directivity 45 dB. Effective source match -40 dB. Effective load match -45 dB.
	Dependence of |S21| or |S11| parameter of 0 dB per 1 degree variation of environment temperature is less than 0.02 dB.
	Warm-up time 40 min.

2.2.3. Measurement Capabilities

Measured parameters	S_{11}, S_{21}, S_{12}, S_{22}
Number of measurement channels	Up to 16 independent logical channels. A logical channel is defined by such stimulus signal settings as frequency range, number of test points, power level, etc. Each logical channel is represented on the screen as an individual channel window.
Data traces	Up to 16 data traces can be displayed in each channel window. A data trace represents one of such parameters of the DUT as S-parameters, response in time domain, input power response.
Memory traces	Each of the 16 data traces can be saved into memory for further comparison with the current values.
Data display formats	Logarithmic magnitude, linear magnitude, phase, expanded phase, group delay, SWR, real part, imaginary part, Smith chart diagram and polar diagram.
Data markers	Up to 16 markers for each trace. Reference marker available for delta marker operation. Smith chart diagram supports 5 marker formats: linear magnitude/phase, log magnitude/phase, real/imaginary, R + jX and G + jB. Polar diagram supports 3 marker formats: linear magnitude/phase, log magnitude/phase, and real/imaginary.

Marker functions	
Marker search	Search for max value, min value, peak, peak left, peak right, target, target left, target right, and bandwidth parameters.
Marker search additional features	Setting of search range; a specific value tracking or single operation search functions.
Parameter setting by markers	Setting of start, stop and center frequencies by the stimulus value of the marker and setting of reference level by the response value of the marker.

Sweep features	
Sweep type	Linear frequency sweep, logarithmic frequency sweep, and segment frequency sweep, when the stimulus power is a fixed value; and linear power sweep when frequency is a fixed value.
Measured points per sweep	Set by the user from 2 to 10001.
Segment sweep features	A frequency sweep within several independent user-defined segments. Frequency range, number of sweep points, source power, and IF bandwidth should be set for each segment.
Power	Source power from –45 dBm to +10 dBm with resolution of 0.05 dB. In frequency sweep mode the power slope can be set up to 2dB/GHz for compensation of high frequency attenuation in connection wires.
Sweep trigger	Trigger modes: continuous, single, hold. Trigger sources: internal, manual, external.

Trace functions	
Trace display	Data trace, memory trace, or simultaneous indication of data and memory traces.
Trace math	Data trace modification by math operations: addition, subtraction, multiplication or division of measured complex values and memory data.
Autoscaling	Automatic selection of scale division and reference level value to have the trace most effectively displayed.
Electrical delay	Calibration plane moving to compensate for the delay in low-loss test setup. Compensation for electrical delay in a DUT during measurements of deviation from linear phase.
Phase offset	Phase offset defined in degrees.
Statistics	Calculation and display of mean, standard deviation, and peak-to-peak deviation for a data trace.

Accuracy enhancement	
Calibration	Calibration of a test setup (which includes the Analyzer, cables, and adapters) significantly increases the accuracy of measurements. Calibration allows for correction of the errors caused by imperfections in the measurement system: system directivity, source and load match, tracking and isolation.
Calibration methods	Calibration methods of various sophistication and accuracy enhancement level are available. The most accurate among them are full one-port calibration and full two-port calibration.
Reflection and transmission normalization	Magnitude and phase correction of frequency response errors for reflection or transmission measurements.
Full one-port calibration	Magnitude and phase correction of frequency response, correction of directivity, and source match errors for one-port reflection measurements.
One-path two-port calibration	Performed for reflection and one-way transmission measurements. Similar to one-port calibration for reflection measurements. Magnitude and phase correction of frequency response, and correction of source match errors for transmission measurements.
Full two-port calibration	Performed for full S-parameter matrix measurement of a DUT. Magnitude and phase correction of frequency response for reflection and transmission measurements, correction of directivity, source match, load match, and isolation. Isolation calibration can be omitted.
Directivity calibration (optional)	Correction of directivity additionally to reflection normalization.
Isolation calibration (optional)	Correction of isolation additionally to transmission normalization, one-path two-port calibration, or full two-port calibration.
Error correction interpolation	When the user changes such settings as start/stop frequencies and number of sweep points, compared to the settings at the moment of calibration, interpolation or extrapolation of the calibration coefficients will be applied.

Data analysis	
Port impedance conversion	The function of conversion of the S-parameters measured at 50 Ω port into the values, which could be determined if measured at a test port with arbitrary impedance.
De-embedding	The function allows to mathematically exclude from the measurement result the effect of the fixture circuit connected between the calibration plane and the DUT. This circuit should be described by an S-parameter matrix in a Touchstone file.
Embedding	The function allows to mathematically simulate the DUT parameters after virtual integration of a fixture circuit between the calibration plane and the DUT. This circuit should be described by an S-parameter matrix in a Touchstone file.
S-parameter conversion	The function allows conversion of the measured S-parameters to the following parameters: reflection impedance and admittance, transmission impedance and admittance, and inverse S-parameters.
Time domain transformation	Transformation of measured data from frequency domain into time domain using Chirp Z Transform.. Transformation types: bandpass, lowpass impulse, and lowpass step. Transformation windows available: minimum, normal, maximum.
Gating	Gating filter types: bandpass and notch. Gating windows available: wide, normal and minimum.

Other features	
Familiar graphical user interface	Graphical user interface based on Windows operating system ensures fast and easy Analyzer operation by the user.
Analyzer control	Using personal computer.
Diagram printout/saving	The diagram and data printout function has preview feature. The preview, saving and printout can be performed using MS Word, Image Viewer for Windows, or Analyzer Print Wizard.
Programming Functions	COM/DCOM automation

2.3. Options and Accessories

The contents of the delivery package of A333 are represented in table 1.2:

Table 1.2 A333 package contents

Description	Quantity, pcs
Analyzer Unit	1
USB Cable	1
Power Cable	1
CD with software and Operating Manual	1

2.4. Principle of Operation

A333 Network Analyzer consists of the Analyzer Unit, some supplementary accessories supporting the instrument functioning, and personal computer (which is not supplied with the package). The Analyzer Unit is connected to PC via USB-interface. The block diagram of the Analyzer is represented in figure 1.1.

The Analyzer Unit consists of source oscillator, local oscillator, source power attenuator, and switch transferring the source signal to two directional couplers, which are ending with port 1 and port 2 connectors. The incident and reflected waves from the directional couplers are supplied into the mixers, where they are converted into first IF (10.7 MHz), and are transferred further to the 4-Channel receiver. The 4-Channel receiver, after filtration, produces the signal of second IF (about 30 kHz), then digitally encodes it and supplies for further processing (filtration, phase difference estimation, magnitude measurement) into the signal processor. The filters for the second IF are digital and have passband from 1 Hz to 30 kHz. Each port of the Analyzer can be a source of the tested signal as well as a receiver of the signal transferred thought the DUT. If port 1 is a source, port 2 will be a receiver. The definition «incident and reflected» wave is correct for the port, when it is a source of the test signal. The combination of the assemblies of directional couplers, mixers and 4-Channel receiver forms four similar signal receivers.

The operation of the assemblies of the A333 is controlled by an external PC.

To fulfill the S-parameter measurement, the Analyzer supplies the source signal of the assigned frequency from one of the ports to the DUT, then measures magnitude and phase of the signals transmitted and reflected by the DUT, and after that compares these results to the magnitude and phase of the source signal.

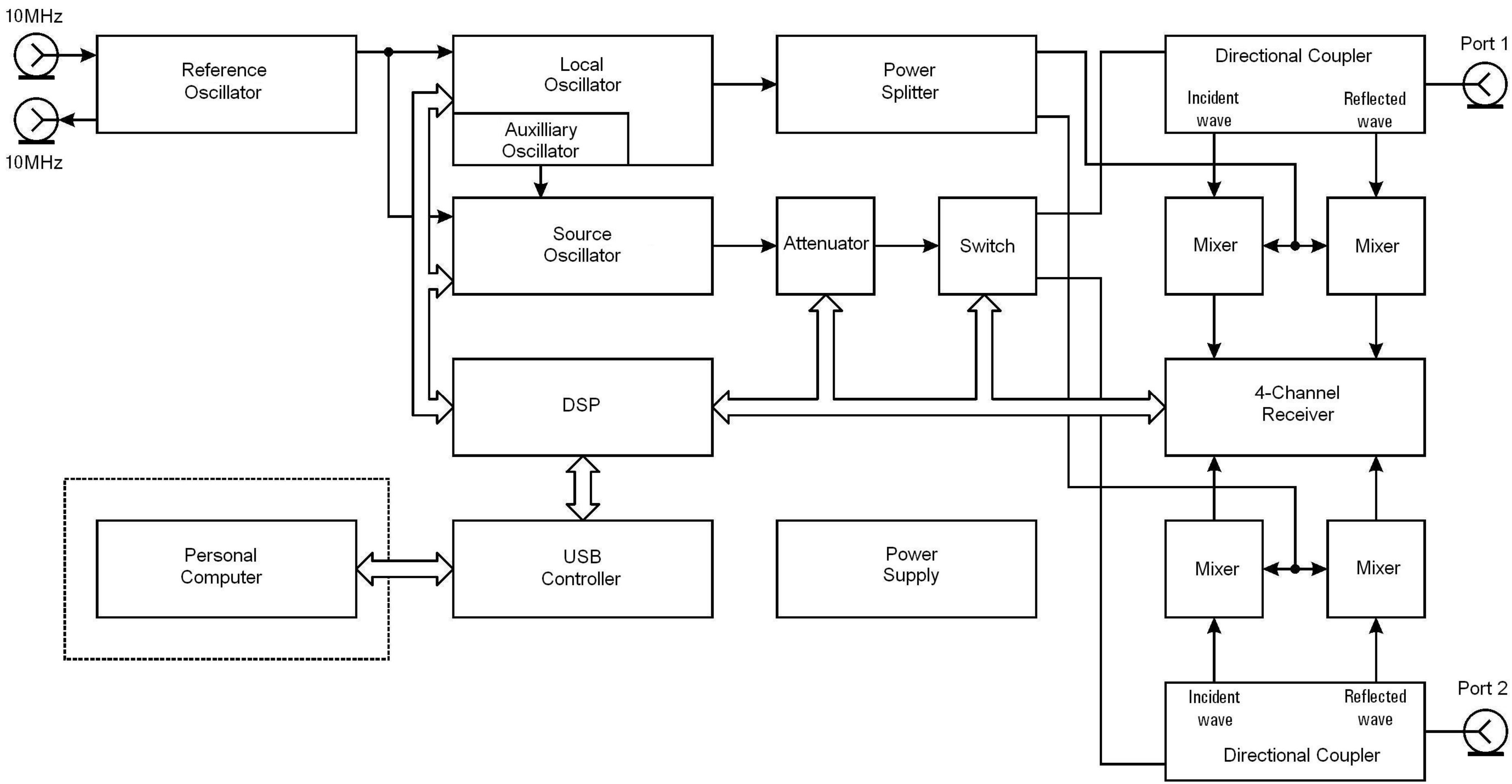


Figure 1.1 A333 Network Analyzer block diagram

3. PREPARATION FOR USE

3.1. General Information

Unpack the Analyzer and other accessories. Check the contents of the package against the list specified in table 1.2. Connect your A333 to the 220VAC/50Hz power source by means of the Power Cable supplied with the instrument. Connect USB-port of your Analyzer to the PC using the USB Cable delivered in the shipment. Install the software (supplied on the CD) onto your PC. The software installation procedure is described below in section 3.2.

Warm-up the Analyzer for 40 minutes after power-on.

Assemble the test setup using cables, connectors, fixtures, etc, which allow DUT connection to the Analyzer.

Perform calibration of the Analyzer. Calibration procedure is described in section 6.1.

3.2 Front Panel

The front view of A333 is represented in figure 3.1. The front panel is equipped with the following parts:

- «PRESET» default setting key;
- ON/STANDBY switch;
- Display;
- Functional keys (column of 12 keys);
- CONTROL and ENTRY keypads;
- Rotary knob, navigation keys;
- USB connectors;
- Test Ports 1 and 2 with LED indicators.

Figure 3.1 A333 front panel

3.2.1 «PRESET» Default Setting Key

«PRESET» key restores the initial condition of the Analyzer. The values of the default settings are represented in Appendix 1.

3.2.2 ON/STANDBY Switch

ON/STANDBY switch toggles between On and Standby states of the Analyzer.

In Standby state the Analyzer is connected to 220 V mains; internal computer and measurement circuits are power-off; power source maintains voltage to power the standby circuit.

In Standby state, pushing the key will turn on power supply, boot up Windows operating system, and will start the Analyzer program.

In On state, pushing the key will initiate Windows shutdown, followed by internal computer and measurement circuits power off. The Analyzer will come into the Standby state.

Note	Holding the key for more than 4 seconds on an operating Analyzer will turn off the power supply skipping the normal Windows shutdown process.
CAUTION	Do not disconnect the power cable from the 220 V mains when the Analyzer is operating. This can damage the Analyzer software. Do not turn an operating Analyzer off by holding the ON/STANDBY key for more than 4 seconds. This can damage the Analyze software. To disconnect the Analyzer from the mains, first activate the normal Windows shutdown process by short pushing on the ON/STANDBY key, and wait for Windows to complete this process.

3.2.3 Display

The Analyzer is equipped with 10.4" color LCD. The display can come complete with a touch screen (TS option). The touch screen LCD allows to manipulate the Analyzer by touching the LCD screen directly with a finger.

CAUTION	Do not press the touch screen with a pen, screwdriver or any other sharp-pointed object. This can damage the touch screen.

The display consists of the control elements and area for measurement result indication.

The main control element of the display is a vertical softkey menu bar in the right part of the screen.

The softkey menu bar consists of **program softkey panels**, which appear one instead of the other. Each panel represents one of the submenus of the softkey menu. All the panels are integrated into multilevel menu system and allow access to all the functions of the Analyzer.

Note	The top line of the screen represents the menu bar, which enables you direct access to the submenus of the softkey menu. This menu is an auxiliary one and can be hidden.

Control elements and measurement result indication areas of the screen are described in section 5.1.

3.2.4 Functional Keys

Functional keys block

The functional keys control the functions of the Analyzer together with the softkeys. The assignment of functional keys is defined by a current softkey panel displayed along the right side of the screen. The top functional key enables you to return to an upper level of the menu.

3.2.5 CONTROL Keypad

CONTROL keypad

The control keys enable you direct access to the control functions of the Analyzer. They allow to access a specific function just by pushing one key, e.g. pushing «Meas» key opens the measured parameter (S_{11}, S_{21}, S_{12} or S_{22}) selection submenu.

Note

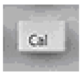
The control keys do not activate the control functions of the Analyzer. The control keys are intended for fast selection of the softkey panels, and consequently fast change of the functional key assignment. A control key pushing as a rule is followed by pushing on a functional key corresponding to the desired function.

«Active Tr/Ch» key

«Active Tr/Ch» key enables the softkey submenu for selection of active channel and trace. Active channel is a channel, which accepts the channel parameter setting commands. Active trace is similarly a trace, which accepts the trace parameter setting commands. Before sending commands for changing of a channel or trace settings, assign the active channel or trace, respectively. Channel and trace setting is described in section 5.4.

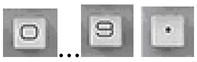
«Stimulus» key

«Stimulus» key enables the softkey submenu for active channel stimulus parameter setting. These parameters are such as the start and stop values of the frequency sweep range, number of sweep points, stimulus power, etc. Stimulus setting softkey submenu is described in section 5.5.

«Meas» key 	«Meas» key enables the softkey submenu for a measured parameter (S_{11}, S_{21}, S_{12} or S_{22}) selection. This submenu is described in section 5.7.
«Format» key 	«Format» key enables the softkey submenu for the measured data display format selection. These formats are such as logarithmic magnitude, phase, SWR, etc. Data format setting submenu is described in section 5.8.
«Scale» key 	«Scale» key enables the softkey submenu for diagram scale setting. The scale is defined by the scale division, reference level value and position, and other parameters. Diagram scale setting submenu is described in section 5.9.
«Avg» key 	«Avg» key enables the softkey submenu for data averaging setting. This submenu allows setting of IF bandwidth, averaging and smoothing parameters. This submenu is described in section 5.10.
«Display» key 	«Display» key enables the softkey submenu for display parameter setting. This submenu allows setting of number of traces, and their allocation on the screen, saving traces into the memory, trace color setting, font size and other parameters. Display setting submenu is described in sections 5.4 and 5.13.
«Cal» key 	«Cal» key enables the softkey submenu for the Analyzer calibration. This submenu allows to perform calibration, set the calibration parameters, and enable/disable error correction by the Analyzer. This submenu is described in section 6.1.
«Save/Recall» key 	«Save/Recall» key enables the softkey submenu for saving and recalling of the Analyzer state, calibration coefficients and data traces. This submenu is described in sections 8.1 and 8.2.
«Marker» key 	«Marker» key enables the softkey submenu for marker manipulations. This submenu allows to enable/disable the markers, and to set the marker parameters. This submenu is described in section 7.1.
«Analysis» key 	«Analysis» key enables the softkey submenu for data analysis. This submenu activates the fixture simulation function, time domain transformation, port Z conversion, and limit test. The data analysis submenu is described in sections 7.2 – 7.5.

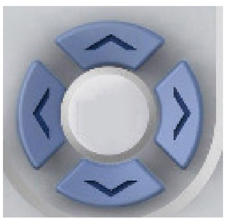
«System» key 	«System» key enables the system softkey submenu. This submenu allows to perform initial condition setting, diagram printout, reference frequency (10 MHz) source selection, and carry out performance test of the Analyzer. This submenu is described in sections 5.11, 5.12, 8.3.

3.2.6 ENTRY Keypad

ENTRY keypad 	The entry keys enable you direct entry of numerical data and metric prefixes. These keys, except for «ENTER» and «ESC», are active only if there is an activated data entry field, i.e. the cursor is placed in this field.
«0»…«9», «.» keys 	«0»…«9» numeric keys and decimal point used for entry of decimal numbers at the cursor location.
«±» key 	«±» key is used to change the sign of a decimal number.
«G/n» key 	«G/n» key is used for completion of a decimal number entry by adding the metric prefix G (Giga) x10^9 or n (nano) x10^{-9}. The prefix to be entered depends on the data type of the active data entry field.
«M/μ» key 	«M/μ» key is used for completion of a decimal number entry by adding the metric prefix M (Mega) x10^6 or μ (micro) x10^{-6}. The prefix to be entered depends on the data type of the active data entry field.
«k/m» key 	«k/m» key is used for completion of a decimal number entry by adding the metric prefix k (kilo) x10^3 or m (milli) x10^{-3}. The prefix to be entered depends on the data type of the active data entry field.
«x1» key 	«x1» key is used for completion of a decimal number entry without adding of a metric prefix. This key is equivalent to «ENTER» key.

«BACK» key 	«BACK» key deletes the character to the left of the cursor.
«ESC» key 	«ESC» key is used for the following: ▪ If there is an active data entry field, this key cancels all the data entered in the field and restores the value of the field as it was before any new numbers or characters were entered. ▪ If there is no active data entry field, this key brings the user back to an upper level of the softkey menu.
«ENTER» key 	«ENTER» key is used for the following: ▪ If there is an active data entry field, this key completes the entry process and assigns the new value to the field. ▪ If there is no active data entry field, this key enables the function of a highlighted softkey.
«HOME» key 	«HOME» key is used for the following: ▪ If there is an active data entry field, this key moves the cursor to the beginning of the field. ▪ If there is no active data entry field, this key brings the user up to the main level of the softkey menu.

3.2.7 Navigation Keys

	«UP» and «DOWN» navigation keys are used for the following: ▪ If there is an active numeric data entry field, these keys scroll up and down the list of the available numeric values. UP arrow increases the value, DOWN arrow decreases the value. ▪ If a softkey submenu is active, these keys perform selection up and down the menu. ▪ In other cases, these keys perform selection between the submenus of the softkey menu.

«LEFT» and «RIGHT» navigation keys are used for the following:

- If there is an active numeric data entry field, these keys move the cursor within the field.
- If the menu bar is active, these keys move the selection to the next/previous item of the menu.
- In other cases, LEFT arrow brings the user to an upper level of the softkey menu, RIGHT arrow brings the user to a lower level of the softkey menu.

3.2.8 Rotary Knob

The rotary knob is used for the following:

- If there is an active numeric data entry field, the rotary knob scrolls up and down the list of the available numeric values. Clockwise rotating increases the value, counterclockwise rotating decreases the value.
- In other cases, the rotary knob performs selection in the softkey menu.

3.2.9 USB Connectors

USB connectors allow connection of various external USB compatible devices, such as flash memory card, mouse, keyboard, and printer.

Note

Mouse and keyboard should be connected to the Mini-DIN (PS/2) connectors, the printer should be connected to the printer parallel port. These connectors are located on the rear panel of the Analyzer.

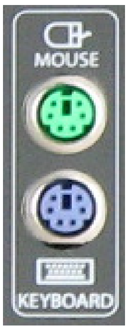
3.2.10 Test Ports 1 and 2 with LED Indicators

	The type-N 50Ω test ports are intended for DUT connection. A test port can be used either as a source of the stimulus signal or as a receiver of the response signal of the DUT. Only one of the ports can be the source of the signal in a particular moment of time. If you connect the DUT to only one test port of the Analyzer, you will be able to measure the reflection parameters (S_{11} or S_{22}) of the DUT. If you connect the DUT to the both test ports of the Analyzer, you will be able to measure the full S-parameter matrix of the DUT.
Note	LED indicator identifies the test port, which is operating as a signal source.
CAUTION	Do not exceed the maximum allowed power of the input RF signal (or maximum DC voltage) indicated on the front panel. This may damage your Analyzer.

3.3 Rear Panel

The rear view of A333 is represented in figure 3.2. The rear panel is equipped with the following parts:

- Power cable receptacle;
- GPIB connector (optional);
- Mini-DIN keyboard connector;
- Mini-DIN mouse connector;
- Printer parallel port;
- External VGA monitor port;
- COM-port;
- Ethernet connector;
- Fan;
- External trigger signal input connector;
- External reference frequency (10 MHz) input connector;
- Internal reference frequency (10 MHz) output connector;
- Reserved port.



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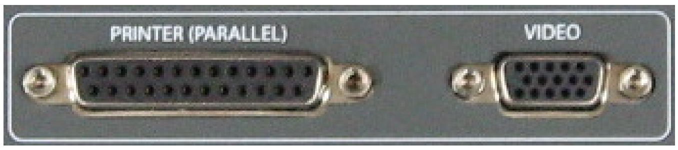

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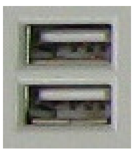
(d)



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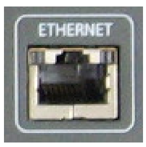


(e)

Figure 3.2 A333 rear panel interface port

3.3.1 Power Cable Receptacle

	Power cable receptacle is intended for 220 V 50 Hz power cable connection.
CAUTION	In case of emergency, to avoid danger of electric shock or the like, pull the power cable out of the power outlet or the power cable receptacle of the instrument. In normal use, do not disconnect the Analyzer from the power supply. For the correct procedure of turning off the mains see section 3.2.2.

3.3.2 GPIB Connector

GPIB (General Purpose Interface Bus) interface is optional in A333. GPIB allows connection of an external controller (e.g. computer) to perform data acquisition and control over the Analyzer.

3.3.3 Mini–DIN Keyboard and Mouse Connectors

These connectors are intended for connection of an external keyboard and mouse to enhance convenience of operation. For details on mouse manipulations see section 5.3.

3.3.4 Printer Parallel Port

25-pin parallel port for printer connection.

3.3.5 External VGA Monitor Connector

15-pin port for VGA monitor connection. Using external VGA monitor interface you can simultaneously see the same screen view on a larger monitor.

3.3.6 COM-port

9-pin port of COM interface is a reserved connector.

3.3.7 Ethernet Connector

Ethernet connector is intended for Analyzer connection to a LAN (Local Area Network). This connection enables you to control the instrument using an external PC.

3.3.8 External Trigger Signal Input Connector

This connector is intended for external trigger source connection. Connector type is BNC female. TTL compatible inputs of 3 V to 5 V magnitude have up to 1 μs pulse width. Input impedance at least 10 kΩ.

3.3.9 External Reference Frequency (10 MHz) Input Connector

External reference frequency is 10 MHz, input level is 2 dBm ± 2 dB, input impedance at «10 MHz» is 50 Ω. Connector type is BNC female.

3.3.10 Internal Reference Frequency (10 MHz) Output Connector

Output reference signal level is 3 dBm ± 2 dB at 50 Ω impedance. «OUT 10 MHz» connector type is BNC female.

4. GETTING STARTED

This section represents a sample session of the Analyzer. It describes the main techniques of measurement of reflection coefficient parameters of the DUT. SWR and reflection coefficient phase of the DUT will be analyzed.

For reflection coefficient measurement only one test port of the Analyzer is used. The instrument sends the stimulus to the input of the DUT and then receives the reflected wave. Generally in the process of this measurement the output of the DUT should be terminated with a LOAD standard. The results of these measurements can be represented in various formats.

Typical circuit of reflection coefficient measurement is shown in figure 4.1.

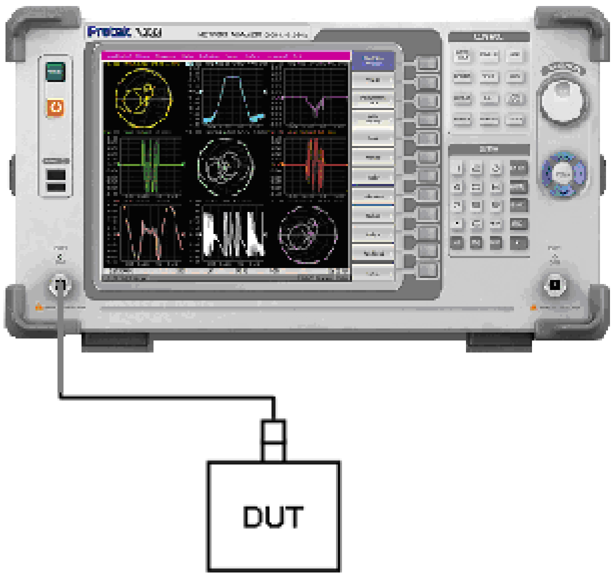


Figure 4.1 Reflection measurement circuit

To measure SWR and reflection coefficient phases of the DUT, in the given example you should go through the following steps:

- Prepare the Analyzer for reflection measurement;
- Set stimulus parameters (frequency range, number of sweep points);
- Set IF bandwidth;
- Set the number of traces to 2, assign measured parameters and display format to the traces;

- Set the scale of the traces;
- Perform calibration of the Analyzer for reflection coefficient measurement;
- Analyze SWR and reflection coefficient phase using markers.

Note	In this section the control over Analyzer is performed by the softkeys located in the right part of the screen. The Analyzer allows for other control options as well (see section 5.3).

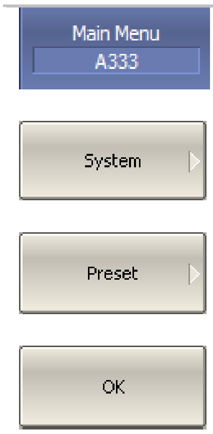
4.1. Analyzer Preparation for Reflection Measurement

Turn on the Analyzer and warm it up for the period of time stated in the specifications.

Ready state features	The bottom line of the screen should display: date and time, the Analyzer state, serial number and internal temperature. The state field should read «Ready». The sweep indicator located above the date field, should represent a progress bar.

Connect the DUT to Port 1 of the Analyzer. Use the appropriate cables and adapters for connection of the DUT input to the Analyzer test port. If the DUT input is type-N (male), you can connect the DUT directly to the port.

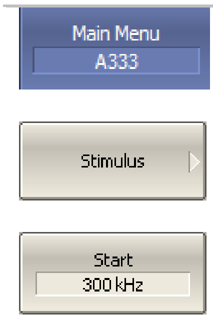
Before you start the measurement session, it is recommended to reset the Analyzer into the initial (known) condition. The initial condition setting is described in section 5.11.

	To restore the initial condition of the Analyzer, click «System» - «Preset» - «OK».

4.2. Stimulus Signal Setting

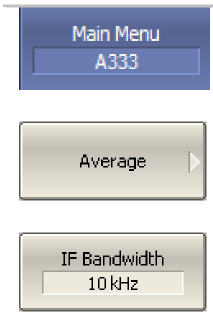
After you have restored the initial state of the Analyzer, the stimulus parameters will be as follows: frequency range from 300 kHz to 3.2 GHz, sweep type is linear, number of sweep points is 201, and power level is 0 dBm.

For the current example, set the frequency range to from 10 MHz to 2 GHz.

	To set the start frequency of the frequency range to 10 MHz, click «Stimulus» - «Start». Then enter «1», «0» from the keyboard. Complete the setting by pressing «M» key.
	To set the stop frequency of the frequency range to 2 GHz, click «Stop». Then enter «2» from the keyboard. Complete the setting by pressing «G» key.
Note	To return to the upper level of the menu, click the top softkey (colored in blue).

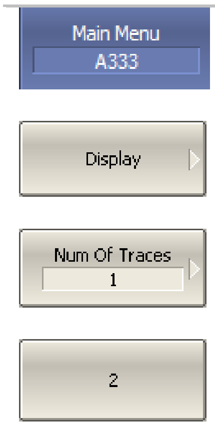
4.3. IF Bandwidth Setting

For the current example, set the IF bandwidth to 3 kHz.

	To set the IF bandwidth to 3 kHz, click «Average» - «IF Bandwidth». Then enter «3» from the keyboard and complete the setting by pressing «Enter» key.

4.4. Number of Traces, Measured Parameter and Display Format Setting

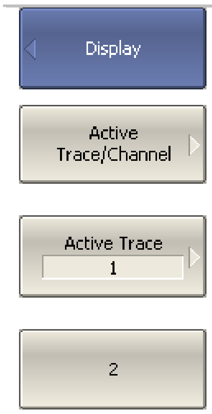
In the current example, two traces are used for simultaneous display of the two parameters (SWR and reflection coefficient phase).



To set the number of traces, click «Display» - «Num of Traces», «2».

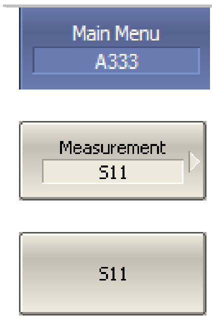
Assign S11-parameter to the second trace. To the first trace this parameter is already assigned by default.

Before assigning the measurement parameters of a trace, you need to select this trace as active.



To change the active trace, click «Active Trace/Channel» - «Active Trace».

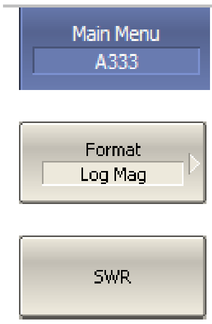
Then select the required number of the trace.



To assign a parameter to the trace, click «Measurement» - «S11» softkeys.

Then assign SWR display format to the first trace and reflection coefficient phase display format to the second trace.

Before setting the trace parameters, select this trace as active.

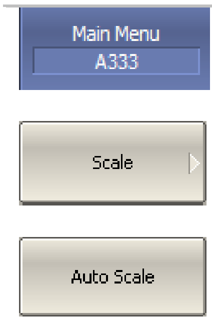


To set the trace display format, click «Format» - «SWR» or «Phase».

4.5. Trace Scale Setting

For a convenience in operation, change the trace scale using automatic scaling function.

Before setting the trace scale, select this trace as active.



To set the scale of the trace by the autoscaling function, click «Scale» - «Auto Scale».

4.6. Analyzer Calibration for Reflection Coefficient Measurement

Calibration of the whole measurement setup, which includes the Analyzer, cables and other devices, supporting connection to the DUT, allows to considerably enhance the accuracy of the measurement.

To perform full 1-port calibration, you need to prepare the kit of calibration standards: OPEN, SHORT and LOAD. Such a kit has its description and specifications of the standards. To perform proper calibration, you need to select in the program the correct kit type.

In the process of full 1-port calibration, connect calibration standards to the test port one after another, as shown in figure 4.2.

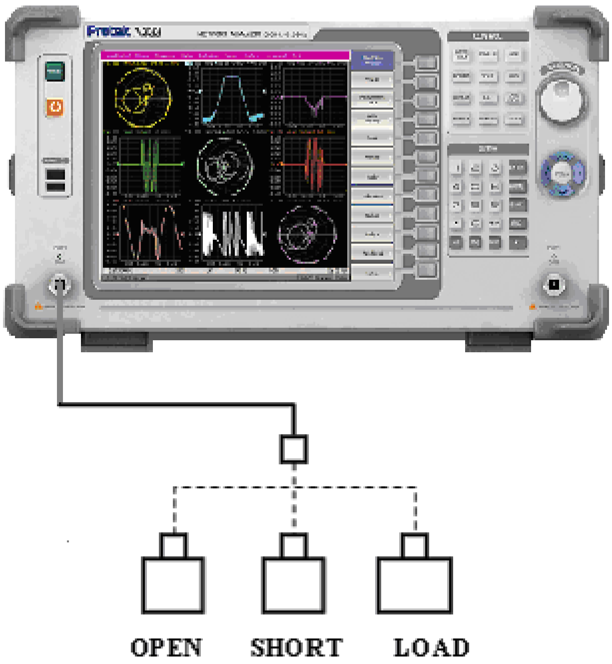
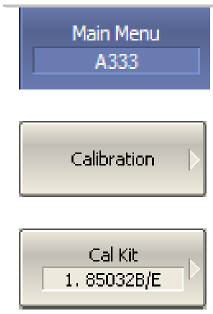


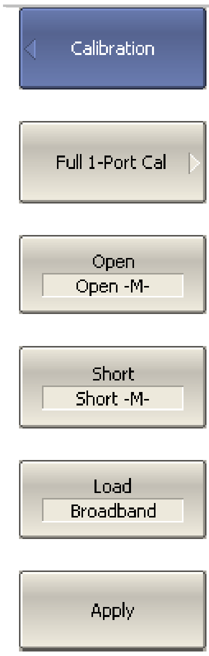
Figure 4.2 Full 1-port calibration circuit

In the current example Agilent 85032E calibration kit is used. For more information on selection and modifying of the calibration kits see sections 6.1. and 6.2.



To select the calibration kit, click «Calibration» - «Cal Kit». Then select the kit being used in the available list.

To perform full 1-port calibration, execute measurements of the three standards. After that the table of calibration coefficients will be calculated and saved into the memory of the Analyzer. Before you start calibration, disconnect the DUT from the Analyzer.



To perform full 1-port calibration, click «Full 1-Port Cal».

Connect a SHORT standard and click «Short».

Connect an OPEN standard and click «Open».

Connect a LOAD standard and click «Load».

To complete the calibration procedure and calculate the table of calibration coefficients, click «Apply» softkey.

Then connect the DUT to the Analyzer again.

4.7. SWR and Reflection Coefficient Phase Analysis Using Markers

This section describes how to define the measurement values at three frequency points using markers. The Analyzer screen view is shown in figure 4.3. In the current example, a reflection standard of SWR = 1.2 is used as a DUT.

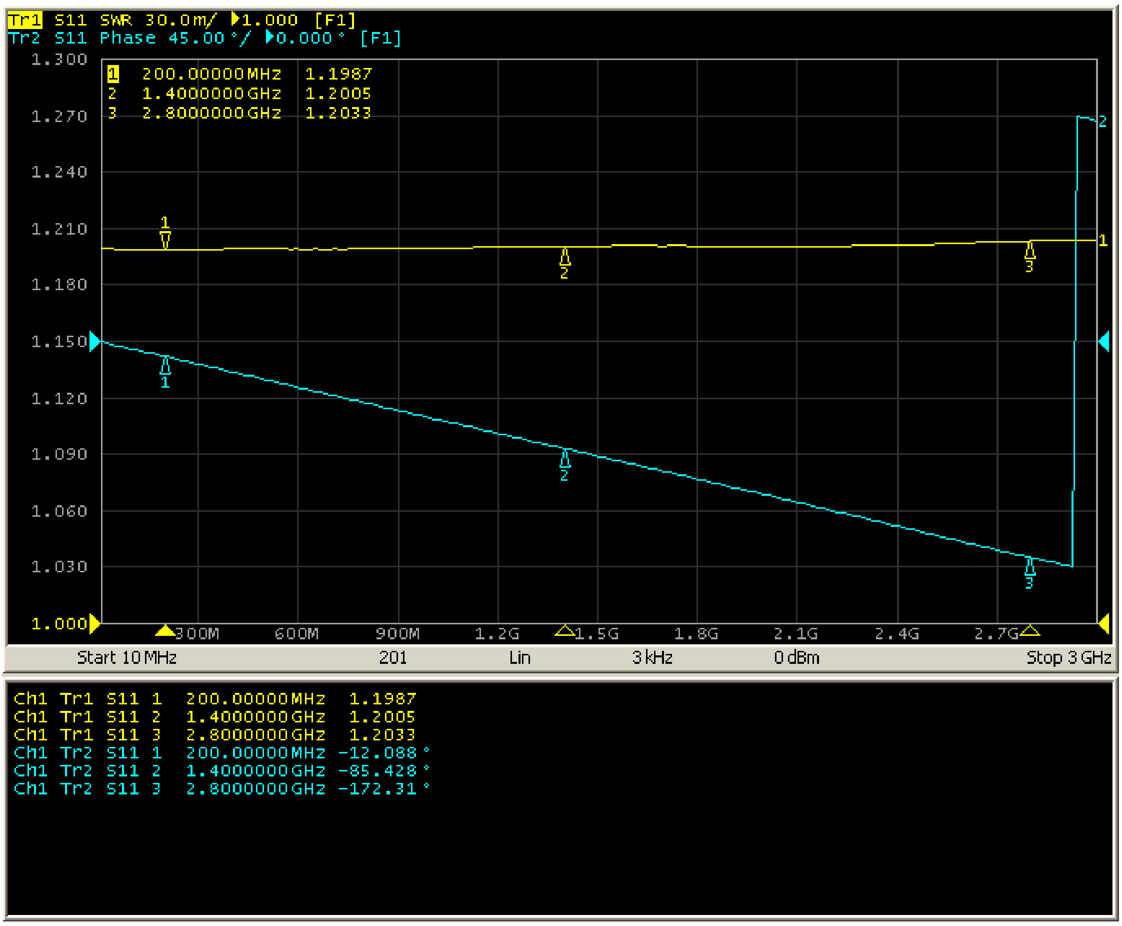


Figure 4.3 SWR and reflection coefficient phase measurement example

To enable the markers, open the marker management menu.

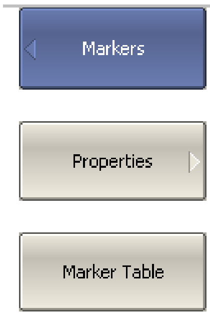
To access the marker management menu, click «Markers» softkey.

Repeat three times the procedure described below to enable three markers and assign them stimulus values (frequencies).

To enable a new marker, click «Add Marker».

Then enter the frequency value in the input field in the graph, e.g. to enter frequency 200 MHz, press «2», «0», «0» and «M» keys on the keyboard.

Open the marker table in the lower part of the screen.



To open the marker table, click «Properties» - «Marker Table».

5. MEASUREMENT SYSTEM SETTING

5.1. Screen Layout and Functions

The screen layout is represented in figure 5.1. The Analyzer screen contains the following elements:

- Softkey Menu Bar;
- Menu Bar;
- Channel Window(s);
- Instrument Status Bar.

In this section you will find detailed description of the softkey menu bar, menu bar, and instrument status bar. The channel windows will be described in the following section.

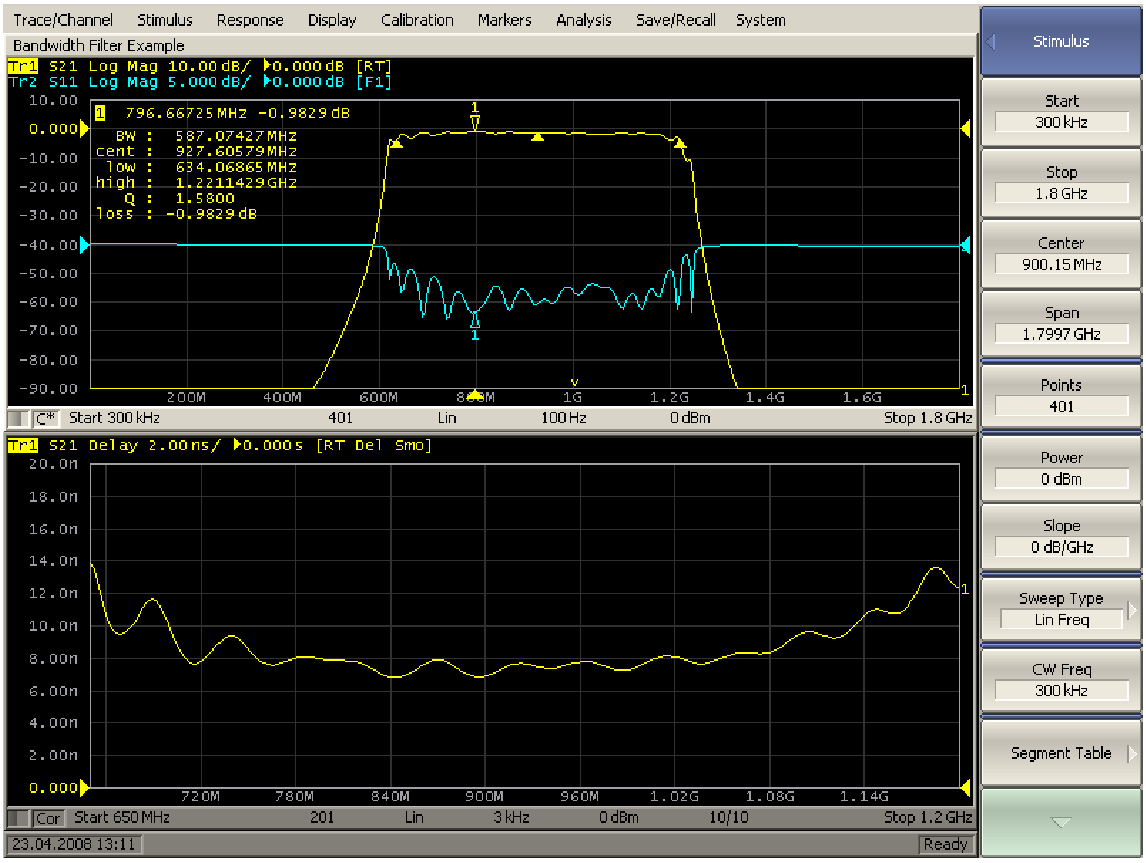


Figure 5.1 Analyzer screen layout

5.1.1. Softkey Menu Bar

The softkey menu bar is the vertical program menu located along the right side of the screen.

Note	The top line of the screen represents the menu bar, which enables you direct access to the submenus of the softkey menu. This menu is an auxiliary one and can be hidden.

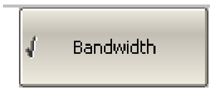
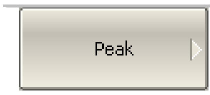
The softkey menu bar consists of panels, which appear one instead of the other. Each panel represents one of the submenus of the softkey menu. All the panels are integrated into multilevel menu system and allow access to all the functions of the Analyzer.

You can manipulate the menu softkeys by mouse-clicking.

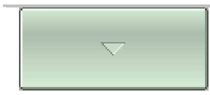
Also you can navigate the menu by «↑», «↓», «←», «→», «Enter», «Esc», «Home» keys on the external keyboard.

If you use a touch-screen monitor you can control the menu by directly touching the screen with your fingers.

The types of the softkeys are described below:

	The top softkey is the menu title key. It enables you to return to the upper level of the menu. If it is displayed in blue you can use keyboard to navigate within the softkey menu.
	If the softkey is highlighted in dark gray, pressing «Enter» key on the keyboard will activate the function of this softkey. You can shift the highlight from key to key using «↑» and «↓» arrows on the keyboard.
	A large dot on the softkey indicates the current selection in a list of alternative settings.
	A check mark in the left part of the softkey indicates the active function, which you can switch on/off.
	The softkey with a right arrow enables the access to the lower level of the menu.
	The softkey with a text field allows for the selected function indication.

The softkey with a value field allows for entering/selection of the numerical settings.



This navigation softkey appears when the softkey menu overflows the menu screen area. Using this softkey you can scroll down and up to the hidden parts of the menu.

To navigate in the softkey menu, you can also (additionally to «↑», «↓») use «←», «→», «Esc», «Home» keys of the keyboard:

- «←» key brings up the upper level of the menu;
- «→» key brings up the lower level of the menu, if there is a highlighted softkey with a right arrow;
- «Esc» key functions similar to «←» key;
- «Home» key brings up the main menu.

Note	The above keys of the keyboard allow navigation in the softkey menu only if there is no any active entry field. In this case the menu title softkey is highlighted in blue.

5.1.2. Menu Bar

The menu bar is located at the top of the screen. This menu enables you direct access to the submenus of the main menu. Also it contains the functions of the most frequently used softkeys. The menu bar is controlled by the mouse.

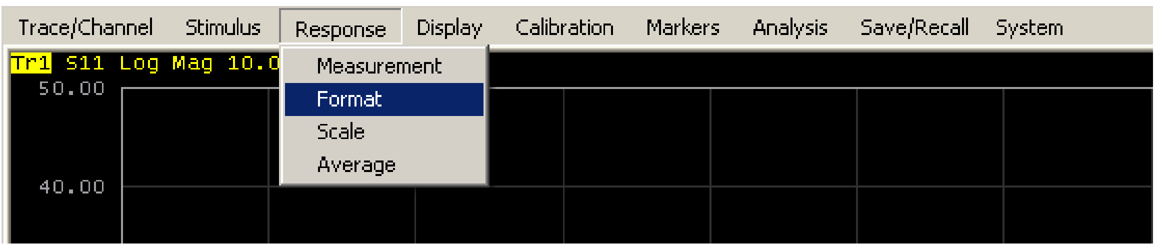


Figure 5.2 Menu bar

You can hide the menu bar to gain screen space for the diagram areas.

Note	To hide the menu bar, click on «Display» - «Properties» - «Menu Bar».

5.1.3. Instrument Status Bar

The instrument status bar is located at the bottom of the screen. It contains the following elements:

- Date and time;
- DSP processor state;
- Warning and error messages (if any);

Figure 5.3 Instrument status bar

DSP processor state:

Not Ready	No communication between DSP and computer.
Loading	Software loading onto DSP is in progress.
Ready	DSP functions normally.

The error messages will be displayed in red. The warning messages will be displayed in gray.

5.2. Channel Window Layout and Functions

The channel windows display the measurement results in the form of diagrams and numerical values. The screen can display up to 16 channel windows simultaneously. Each window corresponds to one logical channel. That is why it is called a channel window. A logical channel can be represented as a separate analyzer with the following settings:

- Stimulus signal settings (frequency range, power level, sweep type);
- IF bandwidth and averaging;
- Calibration.

Physical analyzer processes the logical channels in succession.

In turn each channel window can display up to 16 traces of the measured parameters. General view of the channel window is represented in figure 5.4.

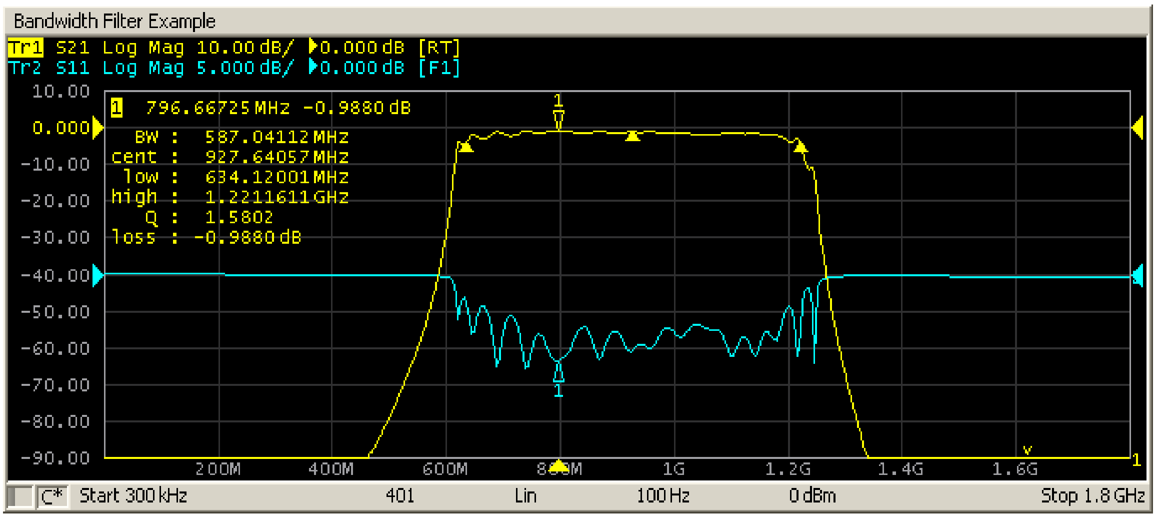


Figure 5.4 Channel window

The channel window contains the following elements:

- Channel title bar;
- Trace status field;
- Diagram area;
- Channel status bar.

5.2.1. Channel Title Bar

Figure 5.5 Channel title

The channel title feature allows you to enter your comment for each channel window. You can hide the channel title bar to gain the diagram area screen space.

Channel title bar on/off switching	You can switch the channel title bar on/off using «Display» - «Title Label» softkeys.
Channel title editing	You can access the channel title edit mode by «Display» - «Edit Title Label» softkeys, or by the mouse clicking on the title area in the channel title bar.

5.2.2. Trace Status Field

Figure 5.6 Trace status field

The trace status field displays the name and parameters of a trace. The number of lines in the field depends on the number of active traces in the channel.

Note	Using the trace status field you can easily modify the trace parameters by the mouse (as described in section 5.3).

Each line contains the data on one trace of the channel:

- Trace name from «Tr1» to «Tr16». The active trace name is highlighted in inverted color;
- Measured parameter: S_{11}, S_{21}, S_{12} or S_{22};
- Display format, e.g. «Log Mag»;
- Trace scale in measurement units per scale division, e.g. «10.0 dB/»;
- Reference level value, e.g. «►0.00 dB», where «►» is the symbol of the reference level;
- Trace status is indicated as symbols in square brackets (See table 5.1).

Table 5.1 Trace status symbols definition

Category	Symbols	Definition
Error Correction	**RO(+)**	OPEN response calibration (+ optional directivity calibration)
	RS(+)	SHORT response calibration (+ optional directivity calibration)
	RT(+)	THRU response calibration (+ optional isolation calibration)
	OP(+)	One-path 2-port calibration (+ optional isolation calibration)
	F1	Full 1-port calibration
	F2(+)	Full 2- port calibration (+ optional isolation calibration)
Trace Display	**No indication**	Data trace
	D&M	Data and memory traces
	M	Memory trace
	Off	Data and memory traces - off
Math Operations	**D+M**	Data + Memory
	D–M	Data – Memory
	D*M	Data * Memory
	D/M	Data / Memory
Electrical Delay	**Del**	Electrical delay other than zero
Smoothing	**Smo**	Trace smoothing - on
Gating	**Gat**	Time domain gating - on
Limit Test	**Lim**	Trace limit test - on
Conversion	**Zr**	Reflection impedance
	Zt	Transmission impedance
	Yr	Reflection admittance
	Yt	Transmission admittance
	1/S	S-parameter inversion

5.2.3. Diagram Area

The diagram area displays the graphs of the measured parameters. This area can show one or more graphs simultaneously (See figure 5.7). Apart from that the diagram area contains markers, statistics, and other data related to the graph.

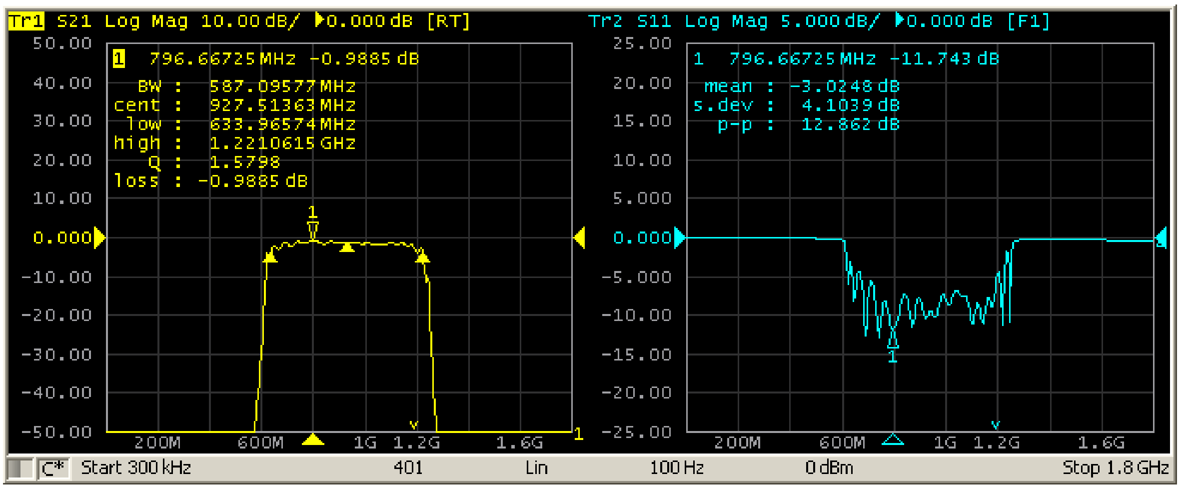


Figure 5.7 Channel window traces view

The vertical graticule label is displayed to the left from the trace area. «►» and «◄» symbols indicate the position of the reference level. For the vertical graticule label the following states are available:

- Off;
- On for active trace;
- On for all the traces.

Note	Using the vertical graticule label you can easily modify the scale and reference level position and value, by the mouse (as described in section 5.3)

Stimulus numbered scale (frequency, power level and time) is located in the bottom part of the graph. You can hide this scale to gain the graph area.

If the sweep duration is too long (more than 1.5 sec.), the moving indicator of the stimulus signal position will appear on the stimulus scale.

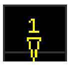
Note	Using the numbered stimulus scale you can easily modify the stimulus parameter by the mouse (as described in section 5.3).

5.2.3.1. Markers

The markers indicate the stimulus values and the measured values in the markers' points. The marker consists of the following elements:

– marker data field;

– marker stimulus indicator on the stimulus axis;



– marker value indicator on the trace.

The markers are numbered from 1 to 16. The reference marker is indicated with **R** symbol. The active marker is indicated in the following manner: its number is highlighted in inverse color, the stimulus indicator is fully colored, and the value indicator on the trace is rotated up.

Note	How to control the markers using the mouse see section 5.3.

5.2.3.2. Bandwidth Parameters

You can enable the function of bandwidth parameters search. In the left part of figure 5.7 you can see the determined values of the bandwidth parameters. The limits and the center of the bandwidth are indicated on the trace. The bandwidth parameters search function is described in section 7.1.10.

5.2.3.3. Statistics

You can enable the function of trace statistics data (mean value, standard deviation, peak-to-peak range) calculation. For more information on this function see section 7.1.11.

5.2.4. Channel Status Bar

The channel status bar is located in the bottom part of the channel window. It contains the following elements:

- Sweep progress;
- Error correction status;
- Stimulus start / center;
- Sweep points;
- Sweep type;

- IF bandwidth;
- CW power level / frequency;
- Averaging Status;
- Stimulus stop / span.

Figure 5.8 Channel status bar

5.2.4.1. Sweep Progress

This field shows a progress bar when the channel data are being updated. The bar will become still in case the sweep process is stopped for some reason.

5.2.4.2. Error Correction Status

Table 5.2 Error correction status

Symbol	Definition
Cor	Error correction is enabled for all the traces of the channel. The stimulus values are same for calibration and the measurement.
C*	Error correction is enabled for all the traces of the channel. Interpolation is applied.
C?	Error correction is enabled for all the traces of the channel. Extrapolation is applied.
–C	Error correction is enabled for some traces of the channel. The stimulus values are same for calibration and the measurement.
–C*	Error correction is enabled for some traces of the channel. Interpolation is applied.
–C?	Error correction is enabled for some traces of the channel. Extrapolation is applied.
– –	Error correction is off for all the traces of the channel.

5.2.4.3. Stimulus Start/Center

This field indicates the start and center of the stimulus span, e.g. «Start 300 kHz» or «Center 1.6 GHz».

This stimulus parameter can be specified either for frequency or for power level, depending on the sweep type, e.g. «Start -45 dBm».

Note	Using this field you can set the start / center values of the stimulus span by the mouse (as described in section 5.3).

5.2.4.4. Sweep Points

This field indicates the number of sweep points, e.g. «401». The number of sweep points can range from 2 to 10001.

Note	Using this field you can set the number of points by the mouse (as described in section 5.3).

5.2.4.5. Sweep Type

Table 5.3 Sweep types

Symbol	Definition
Lin	Linear frequency sweep.
Log	Logarithmic frequency sweep.
Segm	Segment frequency sweep.
Pow	Power sweep.

Note	Using this field you can select the sweep type by the mouse (as described in section 5.3)

5.2.4.6. IF Bandwidth

This field indicates the IF bandwidth, e.g. «100 Hz». The value of IF bandwidth can range from 1 Hz to 30 kHz.

Note	Using this field you can select the IF bandwidth by the mouse (as described in section 5.3).

5.2.4.7. Power Level / CW Frequency

If the sweep type is set to «Lin», «Log» or «Segm», this field indicates the source power level, e.g. «0 dB».

If the sweep type is set to «Pow», this field will indicate the CW frequency of the source, e.g. «300 kHz».

This field can be disabled for «Segm» sweep type if individual power control is set for each segment. For details on power control for each segment see section 7.1.7.

Note	Using this field you can set the value by the mouse (as described in section 5.3).

5.2.4.8. Averaging Status

This field indicates the averaging status (if the averaging function is enabled), e.g. «5/10». The first number is the averaging current counter value , the second one is the averaging factor.

5.2.4.9. Stimulus Stop / Span

This field indicates the stop or span of the stimulus, e.g. «Stop 3.2 GHz» or «Span 3.1997 GHz».

This stimulus parameter can be specified either for frequency or for power level, depending on the sweep type, e.g. «Stop 10 dBm».

Note	Using this field you can set the stop / span values of the stimulus span by the mouse (as described in section 5.3).

5.3. Channel Parameters Setting Using Mouse

This section describes the mouse manipulations, which will enable you to set the channel parameters fast and easy. In a channel window, over the field where a channel parameter can be modified, the mouse pointer will change its form to indicate the edit mode. Apart from that in text and numerical fields the edit mode will be indicated by the «underline» symbol appearance.

Note	The mouse manipulations described in this section will help you to perform the most frequently used settings only. All the channel functions can be accessed via the softkey menu.

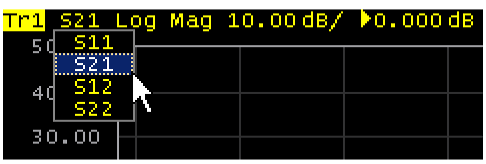
5.3.1. Active Channel Selection

You can select the active channel when two or more channel windows are open. The border area of the active window will be highlighted in light color. To make another window active, make a mouse click within its area.

5.3.2. Active Trace Selection

You can select the active trace if the active channel window contains two or more traces. The active trace name will be highlighted in inverted color. To select the active trace, make a mouse click on the required trace status line.

5.3.3. Measured Data Setting



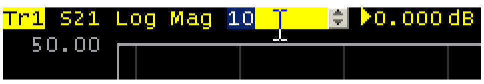
To assign the measured parameters (S_{11}, S_{21}, S_{12} or S_{22}) to a trace, make a mouse click on the S-parameter field in the trace status line and select the required parameter in the drop-down menu.

5.3.4. Display Format Setting

To select the trace display format, make a mouse click on the display format field in the trace status line and select the required format in the drop-down menu.

5.3.5. Trace Scale Setting

The trace scale means the vertical scale division value, which can be set by two methods.



The first method: make a mouse click on the trace scale field in the trace status line and enter the required numerical value.

The second method: move the mouse pointer over the numbered vertical scale until the pointer form becomes as shown in the figure. Locate the pointer in the top or bottom parts of the scale, at approximately 10% of the scale height from the top or bottom of the scale. Press left button of the mouse and holding it drag the pointer from the scale center to enlarge the scale, or to the center of the scale to reduce the scale.

5.3.6. Reference Level Setting

The value of the reference level, which is indicated on the vertical scale by «►» and «◄» symbols, can be set by two methods.

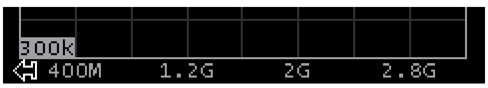
The first method: make a mouse click on the reference level value field in the trace status line and enter the required numerical value.

The second method: move the mouse pointer over the numbered vertical scale until the pointer form becomes as shown in the figure. Locate the pointer in the center part of the scale. Press left button of the mouse and holding it drag the pointer up the scale to increase the reference level value, or down the scale to reduce the value.

5.3.7. Reference Level Position

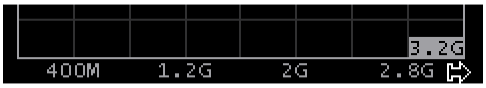
The reference level position, indicated on the vertical scale by «►» and «◄» symbols, can be set in the following way. Locate the mouse pointer on a reference level symbol until it becomes as shown in the figure. Then drag and drop the reference level symbol to the desired position.

5.3.8. Sweep Start Setting



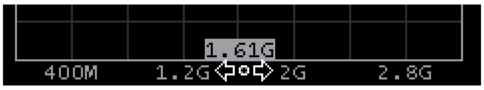
Move the mouse pointer over the stimulus numbered scale until it becomes as shown in the figure. Locate the mouse pointer in the left part of the scale, at approximately 10% of the scale length from the left. Press left button of the mouse and holding it drag the pointer to the right to increase the sweep start value, or to the left to reduce the value.

5.3.9. Sweep Stop Setting



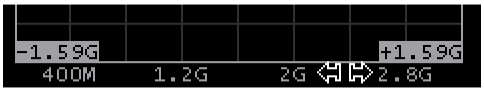
Move the mouse pointer over the stimulus numbered scale until it becomes as shown in the figure. Locate the mouse pointer in the right part of the scale, at approximately 10% of the scale length from the right. Press left button of the mouse and holding it drag the pointer to the right to increase the sweep stop value, or to the left to reduce the value.

5.3.10. Sweep Center Setting



Move the mouse pointer over the stimulus numbered scale until it becomes as shown in the figure. Locate the mouse pointer in the center part of the scale. Press left button of the mouse and holding it drag the pointer to the right to increase the sweep center value, or to the left to reduce the value.

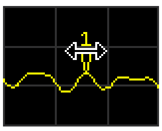
5.3.11. Sweep Span Setting

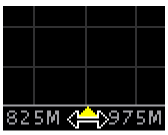


Move the mouse pointer over the stimulus numbered scale until it becomes as shown in the figure. Locate the mouse pointer in the center part of the scale, at approximately 20% of the scale length from the right. Press left button of the mouse and holding it drag the pointer to the right to increase the sweep span value, or to the left to reduce the value.

5.3.12. Marker Stimulus Value Setting

The marker stimulus value can be set by drag-and-drop operation or by entering the value using numerical keys of the keyboard.





To drag-and-drop the marker, first move the mouse pointer on one of the marker indicators until it becomes as shown in the figures.

To enter the numerical value of the stimulus, first activate its field in the marker data line by a mouse click.

5.3.13. Switching between Start/Center and Stop/Span Modes

To switch between the modes Start / Center and Stop / Span, make a mouse click in the respective field of the channel status bar. Label Start will be changed with Center,

and label Stop will be changed with Span. The layout of the stimulus numbered scale will be changed correspondingly.

5.3.14. Start/Center Value Setting

To enter the Start / Center values, activate the respective fields in the channel status bar by a mouse click on the numerical value.

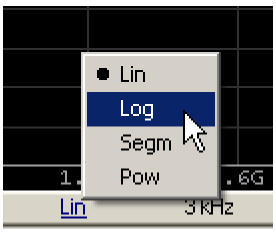
5.3.15. Stop / Span Value Setting

To enter the Stop / Span values, activate the respective fields in the channel status bar by a mouse click on the numerical value.

5.3.16. Sweep Points Number Setting

To enter the number of sweep points, activate the respective field in the channel status bar by a mouse click on the numerical value.

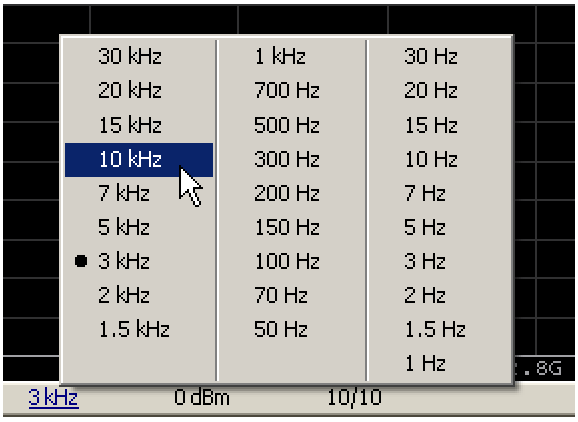
5.3.17. Sweep Type Setting



To set the sweep type, click on the respective field in the channel status bar and select the required type in the drop-down menu.

5.3.18. IF Bandwidth Setting

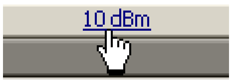
IF bandwidth can be set by selection in the drop-down menu or by entering the value using numerical keys of the keyboard.



To activate the drop-down menu, make a right mouse click on the IF bandwidth field in the channel status bar.

To enter the IF bandwidth, activate the respective field in the channel status bar by a left mouse click.

5.3.19. Power Level/CW Frequency Setting



To enter the power level / CW frequency, activate the respective field in the channel status bar by a mouse click on the numerical value. The parameter displayed in the field depends on the current sweep type.

5.4. Channel and Trace Setting

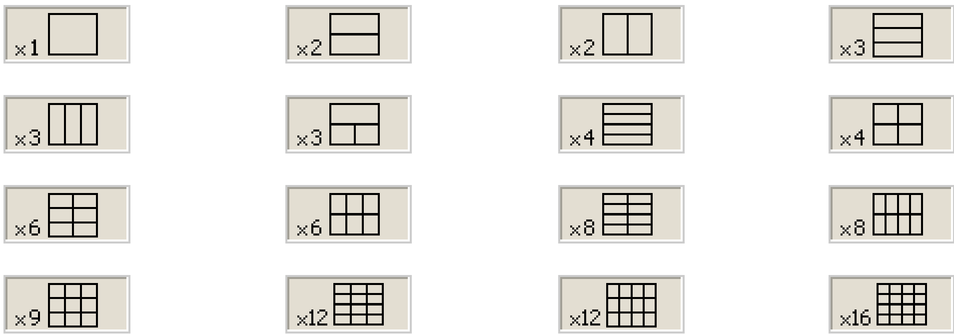
The Analyzer supports 16 logical channels, which allow measurements with different stimulus parameter settings. The parameters and control elements related to a logical channel are listed in table 5.4.

5.4.1. Channel Window Layout

A logical channel is represented on the screen as an individual channel window. The screen can display from 1 to16 channel windows simultaneously. By default one channel window opens. If you need to open two or more channel windows select one of the layouts shown below.

	To set the channel window layout, click «Display» - «Allocate Channels». Then select the required number and layout of the channel windows in the menu.

The available options of number and layout of the channel windows on the screen are as follows:



In accordance with the layouts, the channel windows do not overlap each other. The channels open starting from the smaller numbers.

For each open channel window you should set the stimulus parameters, make other settings, and perform calibration.

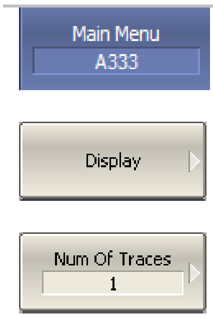
Note	Before you start a channel parameter setting or calibration you need to select this channel as active.

The measurements are executed for open channel windows in succession. Measurements for hidden channel windows are not executed.

5.4.2. Trace Number Setting

Each channel window can contain up to 16 different traces. Each trace is assigned the measured parameter (S-parameter), display format and other parameters. The parameters and control elements related to a trace are listed in table 5.5.

The traces can be displayed in one graph, crossing each other, or in separate graphs of a channel window. The trace settings are made in two steps: trace number setting and trace layout setting in the channel window. By default a channel window contains one trace. If you need to enable two or more traces, set the number of traces as described below.



To set the trace number, click «Display» - «Num Of Traces».

Then select the number of traces in the menu.

5.4.3. Trace Layout

By default all the traces are displayed in one channel window, crossing each other. If you need to display the traces in separate graphs, set the number and layout of the graphs in the channel window as shown below.

To set the display of the traces, click «Allocate Traces» softkey.

Then select the required number and layout of the separate trace graphs in the menu.

The available options of number and layout of the trace graphs of one channel window are as shown in section 5.4.1.

Compared to channel windows, number and layout of the trace graphs are not correlated. Number of traces and number of graphs are set independently.

- If the number of traces and the number of graphs are equal, all the traces will be displayed separately, each in its individual graph.

- If the number of traces is greater than the number of graphs, traces will be assigned successively (beginning from the smallest trace number) to the available graphs. When all the graphs become occupied, the process will continue from the first graph (the following in succession traces will be added in the graphs).
- If the number of traces is smaller than the number of graphs, empty graphs will be hidden.

All the traces are assigned their individual names, which cannot be changed. The trace name contains its number. The trace names are as follows: Tr1, Tr2 ... Tr16.

Each trace is assigned some initial settings: measured parameter, format, scale, and color, which can be modified by the user.

By default the measured parameters are set in the following succession: S_{11}, S_{21}, S_{12}, S_{22}. After that the measurements repeat in cycles.

- By default the display format for all the traces is set to logarithmic magnitude (dB).
- The scale parameters by default are set as follows: division is set to 10 dB, reference level value is set to 0 dB, reference level position is in the middle of the graph.
- The trace color is determined by its number. It is possible to change the color for all the traces with the same number.

Note	Before you start a trace parameter setting, you need to select this trace as active.

Full cycle of trace updating depends on the measured S-parameters and calibration type. The full cycle can consist of one sweep of Port 1 or Port 2 being a source, or can include two successive sweeps, of Port 1 then of Port 2.

If two traces are displayed in one graph, the numbered scales and markers' data will be shown for the active trace.

Note	To display the marker data for all the traces simultaneously, use markers table feature.

The Analyzer offers feature of showing the vertical graticule label for all the traces in the graph. By default this feature is set to off. For details see section 5.13.

Stimulus numbered scale is the same for all the traces of the channel, except for the conditions when time domain transformation is applied to some of the traces. In this case the displayed stimulus numbered scale will refer to the active trace.

Table 5.4 Channel parameters and control elements

N	Parameter or Control Element Description
1	Sweep Type
2	Sweep Range
3	Number of Sweep Points
4	Stimulus Power Level
5	Power Slope Feature
6	CW Frequency
7	Segment Sweep Table
8	Trigger Mode
9	IF Bandwidth
10	Averaging
11	Calibration
12	Setup Modeling

Table 5.5 Trace parameters and control elements

N	Parameter or Control Element Description
1	Measured Parameter (S–parameter)
2	Display Format
3	Reference Level Scale, Value and Position
4	Electrical Delay, Phase Offset
5	Memory Trace, Math Operation
6	Smoothing
7	Markers
8	Time Domain
9	Parameter Transformation
10	Limit Test

5.4.4. Active Channel and Trace Selection

The control commands selected by the user by keyboard or mouse are applied to one channel or one trace, which is called active.

The border area of the active channel window is highlighted in light color. The active trace belongs to the active channel and its title is highlighted in inverse color.

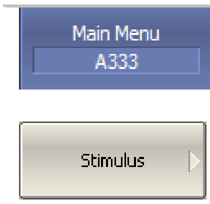
Before you set a channel or trace parameters you need to assign the active channel or trace respectively.

To set the active channel or trace, use «Display» - «Active Trace/Channel» softkey.

Then select the active channel or trace by entering the number or using «Previous Trace» or «Next Trace» softkeys.

5.5. Stimulus Setting

The stimulus parameters can be set in «Stimulus» submenu of the softkey menu.



To enter this submenu, click «Stimulus» softkey in the main menu.

Note	To make the measurement more accurate, perform calibration with the same stimulus settings as for the measurement.

5.5.1. Sweep Type Setting

For each channel you can set the following sweep types:

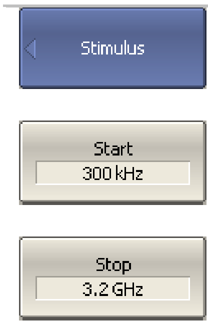
- Linear frequency sweep;
- Logarithmic frequency sweep;
- Segment frequency sweep;
- Power sweep.

To set the sweep type, click «Sweep Type» softkey.

Then select the required type.

5.5.2. Sweep Range Setting

The sweep range should be set for linear and logarithmic frequency sweeps and for linear power sweep. The sweep range can be set as Start / Stop or Center / Span values of the range.



To enter the start and stop values of the range, click «Start» and «Stop» softkeys.

To enter center and span values of the range, click «Center» and «Span» softkeys.

Note	If the power sweep is activated, the values on the «Start», «Stop», «Center», and «Span» softkeys will be represented in dBm.

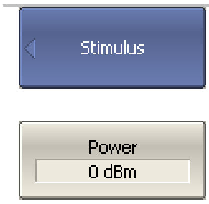
5.5.3. Sweep Points Setting

The number of sweep points should be set for linear and logarithmic frequency sweeps, and for linear power sweep.

To enter the number of sweep points, use «Points» softkey.

5.5.4. Stimulus Power Level Setting

The stimulus power level should be set for linear and logarithmic frequency sweeps. For the segment sweep type, the method of power level setting described in this section can be used only if the same power level is set for all the segments of the sweep. For setting individual power level for each segment see section 5.5.7.



To enter the power level value, use «Power» softkey.

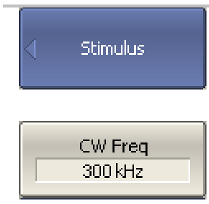
5.5.5. Power Slope Feature

The power slope feature allows for compensation of power attenuation with the frequency increase, in the fixture wire. The power slope can be set for linear, logarithmic and segment frequency sweeps.

To enter the power slope value, use «Slope» softkey.

5.5.6. CW Frequency Setting

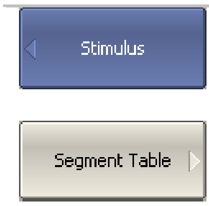
CW frequency setting defines the source frequency for the linear power sweep.



To enter the CW frequency value, use «CW Freq» softkey.

5.5.7. Segment Table Creation

Segment table can be used only when segment sweep type is activated.



To set the segment table, click «Segment Table» softkey.

When you switch to the «Segment Table» submenu, the segment table will open in the lower part of the screen. When you exit the «Segment Table» submenu, the segment table will become hidden.

The segment table layout is shown below. The table has three mandatory columns: frequency range and number of sweep points, and three columns, which you can enable/disable: IF bandwidth, power level and delay time.

	Start	Stop	Points	IFBW	Power
1	300 kHz	800 MHz	11	100 Hz	10 dBm
2	800 MHz	1.12 GHz	51	3 kHz	0 dBm
3	1.12 GHz	1.99 GHz	101	30 kHz	-10 dBm
4	1.99 GHz	2.28 GHz	51	3 kHz	0 dBm
5	2.28 GHz	3.2 GHz	11	100 Hz	10 dBm

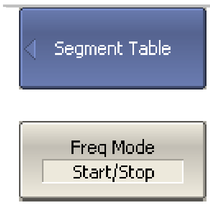
Total Points: 225

Each row describes one segment. The table can contain one or more rows, up to 10001 (the total number of sweep points of all the segments).

To add a segment to the table, click «Add» softkey. The new segment row will be entered below the highlighted one.

To delete a segment, click «Delete» softkey. The highlighted segment will be deleted.

For any segment it is necessary to set the mandatory parameters: frequency range and number of sweep points. The frequency range can be set either as Start / Stop, or as Center / Span.



To set the frequency range representation mode, click «Freq Mode» softkey to select between «Start/Stop» and «Center/Span» options.

For any segment you can enable the additional parameter columns: IF bandwidth, power level, and delay time. If such a column is disabled, the corresponding value set for linear sweep will be used.

To enable the IF bandwidth column, click «List IFBW» softkey.

To enable the power level column, click «List Power» softkey.

To enable the delay time column, click «List Delay» softkey.

To set a parameter, make a mouse click on its value field and enter the value. To navigate in the table you can use the keys of the keyboard.

Note	Adjacent segments do not cross in the frequency domain.

5.5.8. Segment Sweep Frequency Axis Display

Segment sweep graph has two methods of frequency axis representation. The axis can display the frequencies of the measurement points. For some cases it can be helpful to have the frequency axis displayed in sequential numbers of the measurement points.

To set the frequency axis display mode, click «Segment Display» softkey and select «Freq Order» or «Base Order» option.

5.5.9. Measurement Delay

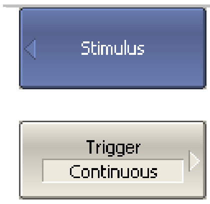
Measurement delay function allows to add additional time interval between the moment when the source output frequency becomes stable and the moment of sweep start. This capability can be useful for measurements in narrowband circuits with transient period longer than the measurement in one point.

To set the time of measurement delay, use «Meas Delay» softkey.

5.6. Trigger Setting

Each channel can operate in one of the three trigger modes. A trigger mode defines the sweep actuation of the channel at a trigger signal detection. The trigger modes are as follows:

- Continuous – a sweep actuation occurs every time a trigger signal is detected;
- Single – one sweep actuation occurs at one trigger signal detection after the mode has been enabled;
- Hold – sweep actuation is off in the channel, the trigger signals do not affect the channel.

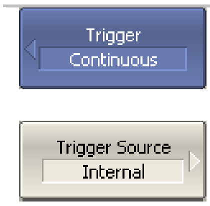


To set the trigger mode, click «Trigger» softkey.

Then select the required mode.

The trigger source, which generates the trigger signal, controls the whole Analyzer. The trigger sources available are as follows:

- Internal – the next trigger signal is generated automatically by the Analyzer on completion of the previous sweep;
- External – external trigger input is used as a trigger signal source;
- Manual – the trigger signal is generated on pressing the corresponding softkey.



To set the trigger source, click «Trigger» softkey.

Then select the required trigger source.

5.7. Measured Data Setting

5.7.1. S-Parameter Definition

For high-frequency network analysis the following terms are applied: incident, reflected and transmitted waves, transferred in the circuits of the setup (See figure 5.9).

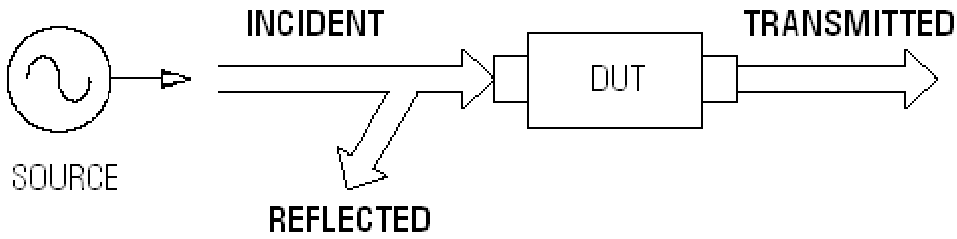


Figure 5.9

Measurement of magnitude and phase of incident, reflected and transmitted signals allow to determine the S-parameters (scattered parameters) of the DUT. An S-parameter is a relation between the complex magnitudes of the two waves:

$$S_{mn} = \frac{\textit{transmitted wave at Port m}}{\textit{incident wave at Port n}}$$

A333 Network Analyzer allows measurement of the full scattering matrix of a 2-port DUT:

$$\mathbf{S} = \begin{bmatrix} S_{11} & S_{12} \\ S_{21} & S_{22} \end{bmatrix}$$

To measure the full scattering matrix, you do not need to change the connection of the DUT to the Analyzer.

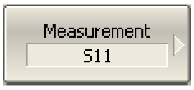
For the measurement of S_{11}, S_{21} parameters, test Port 1 will operate as a signal source. The incident and reflected waves will be measured by Port 1. The transmitted wave will be measured by Port 2.

For the measurement of S_{12}, S_{22} parameters, test Port 2 will operate as a signal source. The incident and reflected waves will be measured by Port 2. The transmitted wave will be measured by Port 1.

5.7.2. S-Parameters Setting

A measured parameter (S_{11}, S_{21}, S_{12} , S_{22}) can be set for each trace of the channel. Before you select the measured parameter, assign the active trace.

To set the measured parameter, click «Measurement» softkey.



Then select the required parameter by the corresponding softkey.

5.8. Data Format Setting

A333 offers the display of the measured S-parameters on the screen in three diagrams:

- rectangular diagram;
- polar diagram;
- Smith chart diagram.

5.8.1. Rectangular Diagram Formats

In this diagram stimulus values are plotted along X-axis and the measured data are plotted along Y-axis (See figure 5.10).

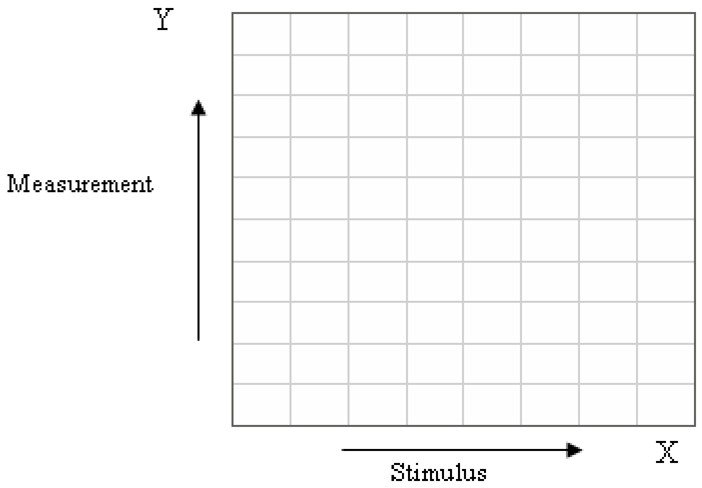


Figure 5.10 Rectangular diagram

To display S-parameter complex value in rectangular coordinates, it is necessary to transform it into real number. Rectangular diagrams involve various types of transformation of an S-parameter $S = S_{re} + j \cdot S_{im}$, where:

- S_{re} – real part of S-parameter complex value;
- S_{im} – imaginary part of S-parameter complex value.

There are eight types of rectangular formats depending on the measured value plotted along Y-axis (See table 5.6).

Table 5.6 Rectangular diagram formats

Diagram Type Description	Label	Data Type (Y-axis)	Measurement Unit (Y-axis)
Logarithmic Magnitude	Log Mag	S-parameter logarithmic magnitude: $20 \cdot \log\lvert S\rvert$, $\lvert S\rvert = \sqrt{S_{re}^{2} + S_{im}^{2}}$	Decibel (dB)
Voltage Standing Wave Ratio	SWR	$\frac{1 + \lvert S\rvert}{1 - \lvert S\rvert}$	Abstract number
Phase	Phase	S-parameter phase from –180° to +180°: $\frac{180}{\pi} \cdot arctg \frac{S_{re}}{S_{im}}$	Degree (°)
Expanded Phase	Expand Phase	S-parameter phase, measurement range expanded to from below –180° to over +180°	Degree (°)
Group Delay	Group Delay	Signal propagation delay within the DUT: $-\frac{d\varphi}{d\omega}$, $\varphi = arctg \frac{S_{re}}{S_{im}}$, $\omega = 2\pi \cdot f$	Second (sec.)
Linear Magnitude	Lin Mag	S-parameter linear magnitude: $\sqrt{S_{re}^{2} + S_{im}^{2}}$	Abstract number
Real Part	Real	S-parameter real part: S_{re}	Abstract number
Imaginary Part	Imag	S-parameter imaginary part: S_{im}	Abstract number

5.8.2. Polar Diagram Formats

Polar diagram represents the measurement results on the pie chart (See figure 5.11). The distance of a measured point from the diagram center corresponds to the magnitude of its value. The counterclockwise angle from the positive horizontal axis corresponds to the phase of the measured value.

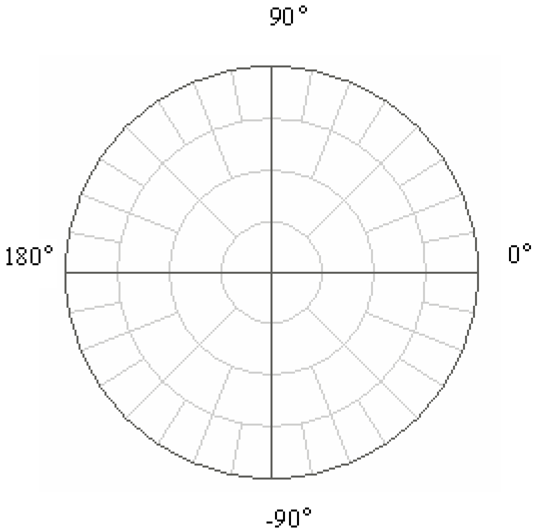


Figure 5.11 Polar diagram

The polar diagram does not have a frequency axis, so frequency will be indicated by the markers. There are three types of polar diagrams depending on the data displayed by the marker. The traces will remain the same on all the diagrams.

Table 5.7 Polar diagram formats

Diagram Type Description	Label	Data Displayed by Marker	Measurement Unit (Y-axis)
Linear Magnitude and Phase	Polar (Lin)	S-parameter linear magnitude	Abstract number
		S-parameter phase	Degree (°)
Logarithmic Magnitude and Phase	Polar (Log)	S-parameter logarithmic magnitude	Decibel (dB)
		S-parameter phase	Degree (°)
Real and Imaginary Parts	Polar (Re/Im)	S-parameter real part	Abstract number
		S-parameter imaginary part	Abstract number

5.8.3. Smith Chart Diagram Formats

Smith chart diagram is used for representation of impedance values for DUT reflection measurements. In this diagram the trace has the same points as in polar diagram.

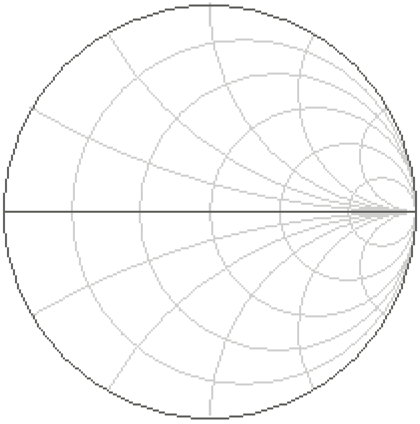


Figure 5.12 Smith chart diagram

The polar diagram does not have a frequency axis, so frequency will be indicated by the markers. There are five types of Smith chart diagrams depending on the data displayed by the marker. The traces will remain the same on all the diagrams.

Table 5.8 Smith chart diagram formats

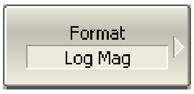
Diagram Type Description	Label	Data Displayed by Marker	Measurement Unit (Y-axis)
Linear Magnitude and Phase	Smith (Lin)	S-parameter linear magnitude	Abstract number
		S-parameter phase	Degree (°)
Logarithmic Magnitude and Phase	Smith (Log)	S-parameter logarithmic magnitude	Decibel (dB)
		S-parameter phase	Degree (°)
Real and Imaginary Parts	Smith (Re/Im)	S-parameter real part	Abstract number
		S-parameter imaginary part	Abstract number

Complex Impedance (at Input)	Smith (R + jX)	Resistance at input: $R = re(Z_{inp})$, $Z_{inp} = Z_0 \dfrac{1+S}{1-S}$	Ohm (Ω)
		Reactance at input: $X = im(Z_{inp})$	Ohm (Ω)
		Equivalent capacitance or inductance: $C = -\dfrac{1}{\omega X}, \quad X < 0$ $L = \dfrac{X}{\omega}, \quad X > 0$	Farad (F) Henry (H)
Complex admittance (at Input)	Smith (G + jB)	Conductance at input: $G = re(Y_{inp})$, $Y_{inp} = \dfrac{1}{Z_0} \cdot \dfrac{1-S}{1+S}$	Siemens (S)
		Susceptance at input: $B = im(Y_{inp})$	Siemens (S)
		Equivalent capacitance or inductance: $C = \dfrac{B}{\omega}, \quad B > 0$ $L = -\dfrac{1}{\omega B}, \quad B < 0$	Farad (F) Henry (H)

Z_0 – test port impedance. Z_0 setting is described in section 6.2.9.

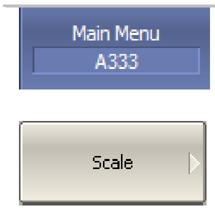
5.8.4. Diagram Format Setting

You can select the diagram format for each graph of the channel. Before you set the format, assign the active graph.

	To set the diagram format, use «Format» softkey in the main menu.
	Then select one of the formats described above by the corresponding softkey.

5.9. Diagram Scale Setting

You can set the diagram scale in «Scale» submenu.



To access this submenu, select «Scale» softkey in the main menu.

5.9.1. Rectangular Scale

For rectangular diagram you can set the following parameters (See figure 5.13):

- Scale division;
- Reference level value;
- Reference level position;
- Number of scale divisions.

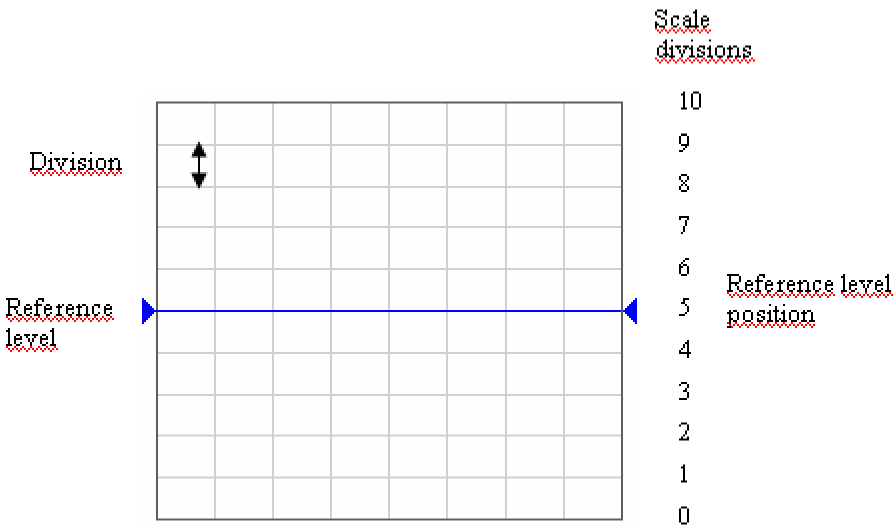
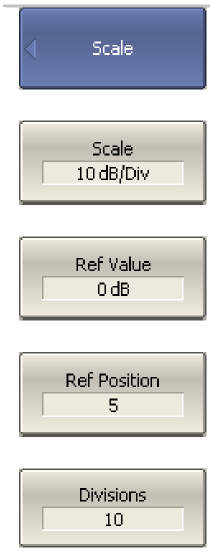


Figure 5.13 Rectangular scale

5.9.2. Rectangular Scale Setting

You can set the scale for each graph of the channel. Before you set the scale, assign the active graph.



To set the scale of a diagram, use «Scale» softkey.

To set the reference level, use «Ref Value» softkey.

To set the position of the reference level, use «Ref Position» softkey.

To set the number of trace scale divisions, use «Divisions» softkey.[1]

5.9.3. Polar Scale

For polar diagrams you can set the outer circle value (See figure 5.14).

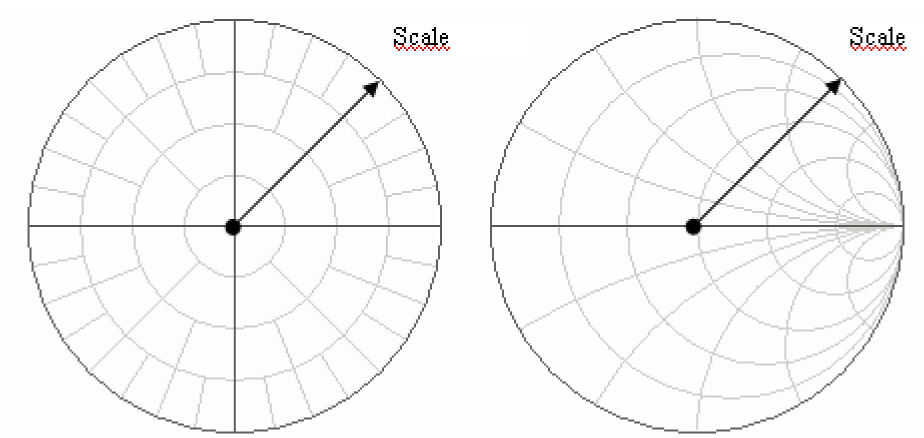
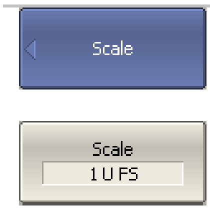


Figure 5.14 Polar scale

[1] Number of the scale divisions affect all the graphs of the channel.

5.9.4. Polar Scale Setting

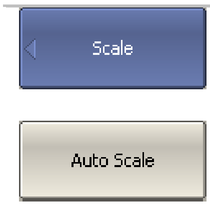


To set the scale of the polar diagram, use «Scale» softkey.

5.9.5. Automatic Scaling

The automatic scaling function automatically defines the scale division in rectangular coordinates. In polar coordinates this function defines the scale.

After this function has been executed the trace will become fit into the graph area for best display.

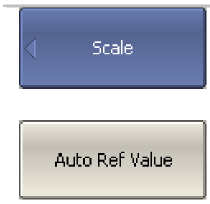


To execute the automatic scaling, use «Auto Scale» softkey.

5.9.6. Reference Level Automatic Selection

This function executes automatic selection of the reference level in rectangular coordinates.

After the function has been executed, the trace of the measured value makes the vertical shift so that the reference level would cross the graph in the middle. The scale division will remain the same.



To execute the automatic selection of the reference level, use «Auto Ref Value» softkey.

5.9.7. Electrical Delay Setting

The electrical delay function defines the compensation value for the electrical delay of a device. This value is used as compensation for the electrical delay during non-linear phase measurements. The electrical delay is set in seconds.

If the electrical delay setting is other than zero, S-parameter value will vary in accordance with the following formula:

$$S = S \cdot e^{j\cdot 2\pi \cdot f \cdot t},$$ where

f – frequency, Hz,

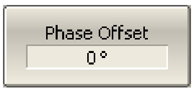
t – electrical delay, sec.

The electrical delay is set for each trace individually. Before you set the electrical delay, assign the active trace.

To set the electrical delay, use «Electrical Delay» softkey in the main menu.

5.9.8. Phase Offset Setting

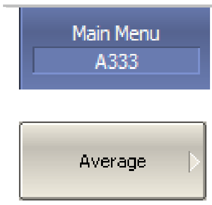
The phase offset function defines the constant phase offset of a trace. The value of the phase offset is set in degrees for each trace individually. Before you set the phase offset, assign the active trace.



To set the phase offset, use «Phase Offset» softkey in the main menu.

5.10. IF Bandwidth, Averaging and Smoothing Setting

You can set IF bandwidth, averaging and smoothing parameters in «Average» softkey submenu.



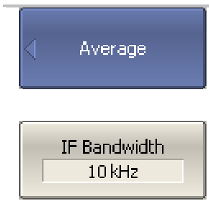
To access these functions, select «Average» softkey in the main menu.

5.10.1. IF Bandwidth Setting

The IF bandwidth parameter defines the bandwidth of the test receiver. The IF bandwidth runs through the following sequence of numbers: 1, 1.5, 2, 3, 5 and 7 within the range of 1 Hz to 30 kHz.

The IF bandwidth narrowing allows to reduce self-noise and widen the dynamic range of the Analyzer. Also the sweep time will increase. Narrowing of the IF bandwidth by 10 will reduce the receiver noise by 10 dB.

The IF bandwidth should be set for each channel individually. Before you set the IF bandwidth, assign the active channel.



To set the IF bandwidth, use «IF Bandwidth» softkey.

5.10.2. Averaging Setting

The averaging function is similar to IF bandwidth narrowing. It allows you to reduce self-noise and widen the dynamic measurement range of the Analyzer.

The averaging in every measurement point is made over several sweeps by exponential window method. The result of the averaging is defined by the iterative equation:

$$\begin{cases} M_i = S_i, & i = 0 \\ M_i = \left(1 - \frac{1}{N}\right) \cdot M_{i-1} + \frac{S_i}{N}, & i > 0 \end{cases},$$

M_i – i-sweep averaging result;

S_i – i-sweep measurement parameter (S-parameter) value;

N – averaging factor is set by the user from 1 to 999; the higher the factor value the stronger the averaging effect.

When the averaging function is enabled, the current number of iterations and the averaging factor, e.g. «9/10», will appear in the channel status bar. The averaging process is considered stable when the both numbers have become equal.

The averaging should be set for each channel individually. Before you set the averaging, assign the active channel.

To turn the averaging function on/off, use «Averaging» softkey.

To set the averaging factor, use «Avg Factor» softkey.

5.10.3. Smoothing Setting

The smoothing of the sweep results is made by averaging of adjacent points of the trace defined by the moving aperture. The aperture is set by the user in percentage against the total number of the trace points.

The smoothing does not increase dynamic range of the Analyzer. It does not affect the average level of the trace, but it reduces the noise bursts.

The smoothing should be set for each trace individually. Before you set the smoothing, assign the active trace.

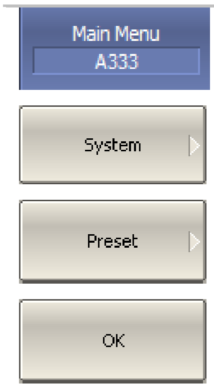
To turn the smoothing function on/off, use «Smoothing» softkey.

To set the smoothing aperture, use «Smo Aperture» softkey.

5.11. Initial Condition Setting

Initial condition setting feature allows you to restore the default settings of the Analyzer.

The default settings of your A333 are specified in Appendix 1.

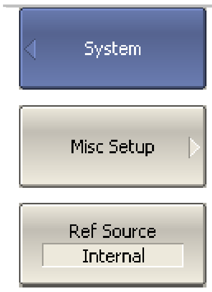


To restore the initial condition of the Analyzer, use «System» - «Preset» - «OK» softkeys.

5.12. Reference Frequency Oscillator Selection

The Analyzer can operate either with internal or with external reference frequency (10 MHz) oscillator. Initially the Analyzer is set to operation with the internal source of the reference frequency.

You can switch between these two modes in the softkey menu.



To select the reference frequency oscillator, use «System» - «Ref Source» softkeys.

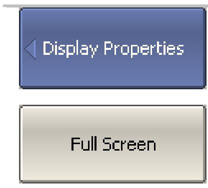
5.13. User Interface Setting

The Analyzer allows you make to the following user interface settings:

- Switch between full screen and window display
- Set color of:
  - Data traces
  - Memory traces
  - Background and grid of graph
  - Background and font of menu bar
- Style and width of:
  - Data traces
  - Memory traces
  - Graph grid
- Font size of:
  - Softkeys
  - Channel window
  - Channel status bar
  - Instrument status bar
- Invert color of graph area
- Hide / show menu bar
- Hide / show frequency label (X axis)
- Set graticule label mode (Y axis)
  - off
  - on for active trace
  - on for all traces

Note	The user interface settings are automatically saved and will restore when you next time turn the Analyzer on. No particular saving procedure is required. There is a button for restoration of the default factory settings for the user interface.

To access the user interface menu, click “Display” – “Properties”.



To switch between full screen and window display, use “Full Screen” softkey.

To change the color of the lines of data and memory traces in an active graph, click “Data Trace” or “Memory Trace” softkey.

Then select the rate (from 0 to 255) of color components.

The changes made to the color of the active data traces will affect all the traces with the same number in deferent channels.

To change the color of the background or grid of the graph, click “Background” or “Grid” softkey.

Then select the rate (from 0 to 255) of color components.

The changes made will affect the background and grid in all the graphs.

To change the color or font of the menu bar, use “Menu Bar” or “Menu Bar Font” softkeys.

Then select the rate (from 0 to 255) of color components.

To change the style and width of a data trace, click “Data Trace Style” or “Data Trace Width” softkeys.

Then select the style and enter the width of the data trace.

These changes will be automatically made for all the graphs.

To change the style and width of a memory trace, click “Mem Trace Style” or “Mem Trace Width” softkeys.

Then select the style and enter the width of the memory trace.

These changes will be automatically made for all the graphs.

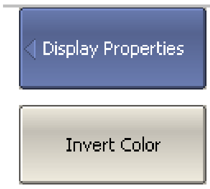
To change the grid style, click “Grid Style” softkey.

Then select the style of the grid.

These changes will be automatically made for all the graphs.

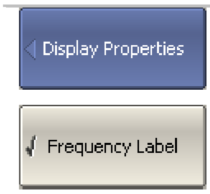
To change the font size, click “Font Size” – “Softkeys”, “Window Channel”, “Channel State”, “Instr State”.

Then select the font size from 10 to 13.



To invert the color of all the diagram area, use “Invert Color” softkey.

To hide / show the menu bar, click “Menu Bar” softkey.

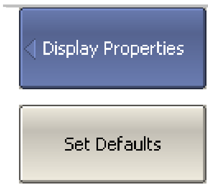


To hide / show the frequency label (X axis), click “Frequency Label” softkey.

To set the graticule label mode (Y axis), use "Graticule" softkey.

Then select one of the available options:

- off
- on for active trace
- on for all the traces



To restore the default factory settings, use "Set Defaults" softkey.

6. CALIBRATION AND CALIBRATION KIT

6.1. Calibration

S-parameter measurements are influenced by various measurement errors, which can be broken down into two categories:

- systematic errors, and
- random errors.

Random errors comprise such errors as noise fluctuations and thermal drift in electronic components, changes in the mechanical dimensions of cables and connectors subject to temperature drift, repeatability of connections and cable bends. Random errors are unpredictable and hence cannot be estimated and eliminated in calibration. Random errors can be reduced by correct setting of the source power, IF bandwidth narrowing, sweep averaging, maintaining constant environment temperature, observance of the Analyzer warm-up time, careful connector handling, and avoidance of cable bending after calibration.

Random errors and related methods of correction are not mentioned further in this section.

Systematic errors are the errors caused by imperfections in the components of the measurement system. Such errors occur repeatedly and their characteristics do not change with time. Systematic errors can be determined and then reduced by performing mathematical correction of the measurement results.

The process of measurement of precision devices with predefined parameters with the purpose of determination of measurement systematic errors is called **calibration**, and such precision devices are called **calibration standards**.

The process of mathematical compensation (numerical reduction) for measurement systematic errors is called an **error correction**.

6.1.1. Defining of Analyzer Test Ports

The test ports of the Analyzer are defined by means of calibration. The test port is a connector accepting a calibration standard in the process of calibration.

A type-N 50 Ω connector on the front panel of the Analyzer will be the test port if the calibration standards are connected directly to it.

Sometimes it is necessary to connect coaxial cable and/or adapter to the connector on the front panel for connection of the DUT with a different connector type. In such cases connect calibration standards to the connector of the cable or adapter.

Figure 6.1 represents two cases of test port defining for 2-port measurement. The use of cables and/or adapters does not affect the measurement results if they were connected in the process of calibration.

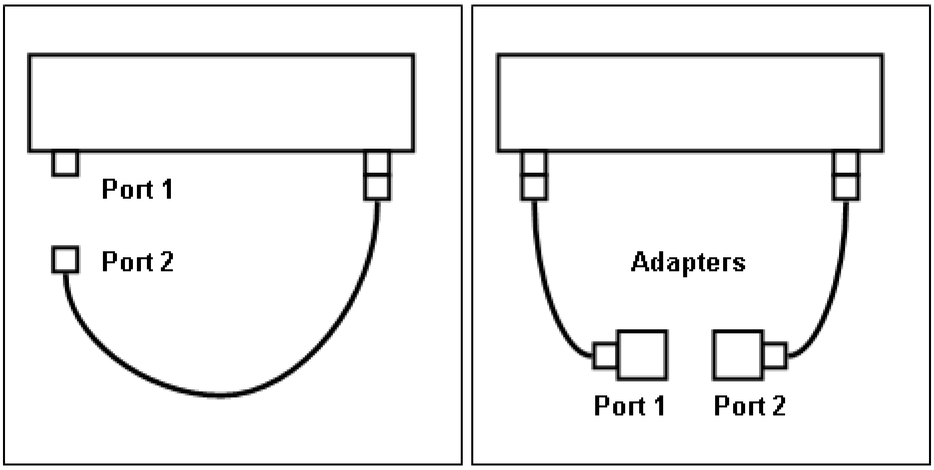


Figure 6.1 Test port defining

6.1.2. Error Modeling

Error modeling and method of signal flow graphs are applied to a system for analysis of its systematic errors. An error model describes errors, while a signal flow graph shows how these errors affect the measurement system.

Error model subdivides the systematic errors into the following categories:

- Directivity;
- Source match;
- Load match;
- Isolation;
- Reflection/transmission tracking.

The measurement results before the procedure of error correction has been executed are called **uncorrected**.

The residual values of the measurement results after the procedure of error correction are called **effective**.

6.1.2.1. Directivity Error

A directivity error (Ed) is caused by incomplete separation of the incident signal from the reflected signal by the directional coupler in the source port. In this case part of the incident signal energy comes to the receiver of the reflected signal. Directivity errors do not depend on the characteristics of the DUT and usually have stronger effect in reflection measurements.

6.1.2.2. Source Match Error

A source match error (Es) is caused by the mismatch between the source port and the input of the DUT. In this case part of the signal reflected by the DUT reflects at the source port and again comes into the input of the DUT. The error occurs both in reflection measurement and in transmission measurement. Source match errors depend on the relation between input impedance of the DUT and test port impedance when switched as a signal source.

Source match errors have strong effect in measurements of a DUT with poor input matching.

6.1.2.3. Load Match Error

A load match error (El) is caused by the mismatch between the receiver port and the output of the DUT. In this case part of the signal transmitted through the DUT reflects at the receiver port and comes to the output of the DUT. The error occurs in transmission measurements and in reflection measurements (for a 2-port DUT). Load match errors depend on the relation between output impedance of the DUT and test port impedance switched as a signal receiver.

In transmission measurements the load match error has considerable influence if the output of the DUT is poorly matched.

In reflection measurements the load match error has considerable influence in case of poor output match and low attenuation between the output and input of the DUT.

6.1.2.4. Isolation Error

An isolation error (Ex) is caused by a leakage of the signal from the source port to the receiver port escaping transmission through the DUT.

A333 has typical isolation ratio of -140 dB, what allows to ignore this error for most of measurements. The isolation error measurement is a non-mandatory option in all types of calibration.

6.1.2.5. Reflection Tracking Error

A reflection tracking error (Er) is caused by the difference in frequency response between the test receiver and the reference receiver of the source port in reflection measurement.

6.1.2.6. Transmission Tracking Error

A transmission tracking error (Et) is caused by the difference in frequency response between the test receiver of the receiver port and the reference receiver of the source port in transmission measurement.

6.1.2.7. One-Port Error Model

In reflection measurement only one port of the Analyzer is used. The signal flow graph of errors for the port 1 is represented in figure 6.2. For port 2 the signal flow graph of the errors will be similar.

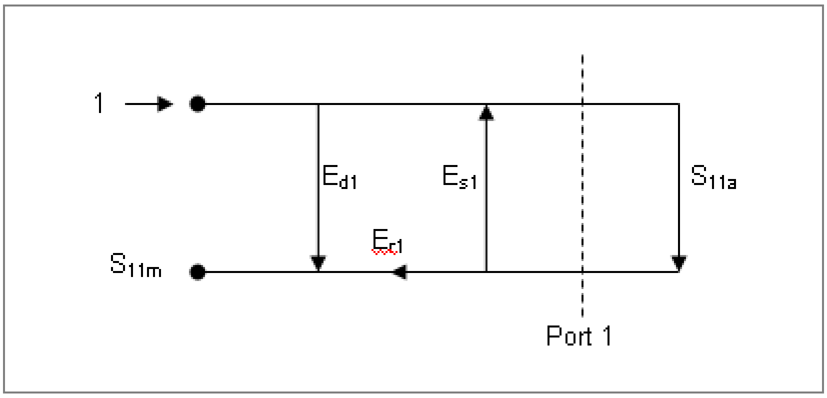


Figure 6.2 One-port error model

Where:

- S_{11a} – reflection coefficient true value;
- S_{11m} – reflection coefficient measured value.

The measurement result at port 1 is affected by the following three systematic errors:

- E_{d1} – directivity;
- E_{s1} – source match;
- E_{r1} – reflection tracking.

For normalization the stimulus value is taken equal to 1. All the values used in the model are complex.

After determination of all the three errors E_{d1}, E_{s1}, E_{r1} for each measurement frequency by means of a **1-port calibration**, it is possible to calculate (mathematically subtract the errors from the measured value S_{11m}) the true value of the reflection coefficient S_{11a}.

There are simplified methods, which eliminate the effect of only one or two out of the three systematic errors.

6.1.2.8. Two-Port Error Model

For a two-port measurement, two signal flow graphs are considered. One of the graphs describes the case where port 1 is the stimulus source, the other graph describes the case where port 2 is the stimulus source.

The signal flow graphs of errors effect in a two-port system are represented in figure 6.3:

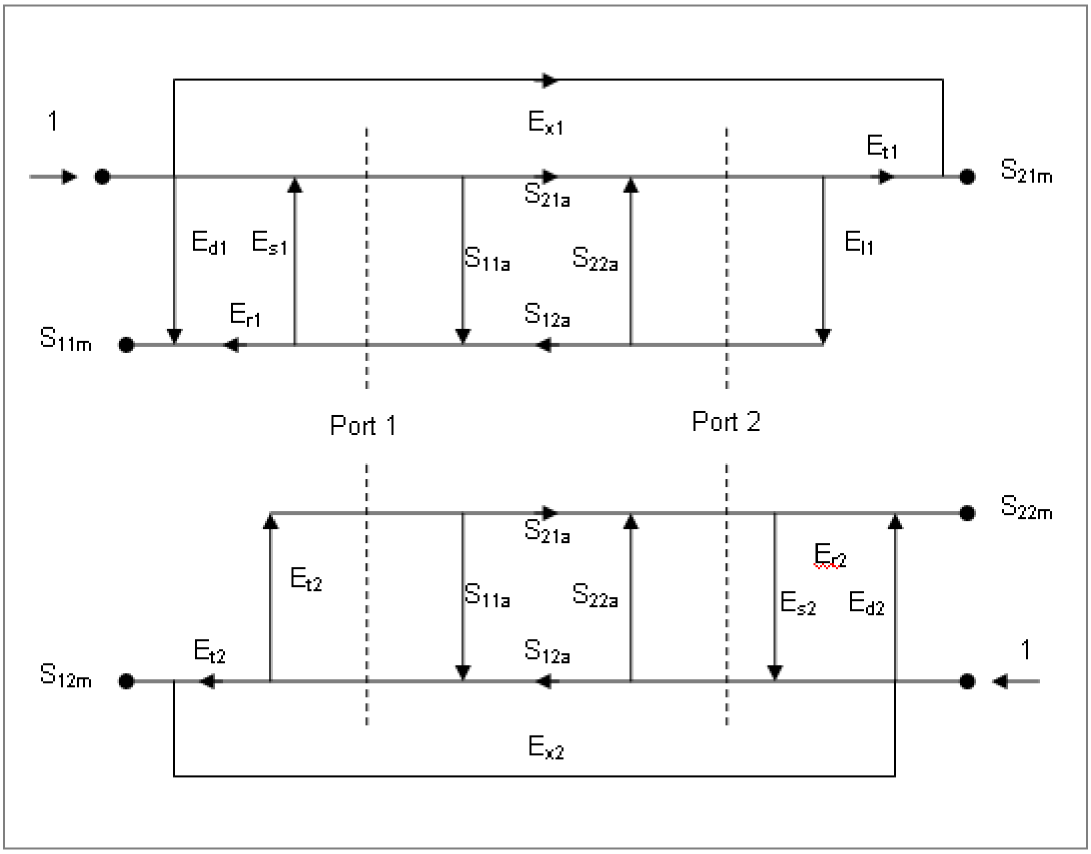


Figure 6.3 Two-port error model

Where:

- S_{11a}, S_{21a}, S_{12a}, S_{22a} – true values of the DUT parameters;
- S_{11m}, S_{21m}, S_{12m}, S_{22m} – measured values of the DUT parameters.

For normalization the stimulus value is taken equal to 1. All the values used in the model are complex.

The measurement result in a two-port system is affected by twelve systematic errors.

Table 6.1 Systematic errors

Description	Stimulus Source	
	Port 1	Port 2
Directivity	E_{d1}	E_{d2}
Source match	E_{s1}	E_{s2},
Reflection tracking	E_{r1}	E_{r2}
Transmission tracking	E_{t1}	E_{t2}
Load match	E_{l1}	E_{l2}
Isolation	E_{x1}	E_{x2}

After determination of all the twelve errors for each measurement frequency by means of a **2-port calibration**, it is possible to calculate the true value of the S-parameters: S_{11a}, S_{21a}, S_{12a}, S_{22a}.

There are simplified methods, which eliminate the effect of only one or several out of the twelve systematic errors.

Note	If you use a 2-port calibration, to determine any of S-parameters you need to know all the four measurements S_{11m}, S_{21m}, S_{12m}, S_{22m}. That is why to update one or all of the S-parameters, you need to perform two sweeps: with port 1 as a signal source, and with port 2 as a signal source.

6.1.3. Calibration Steps

The process of calibration comprises the following steps:

- Selection of the calibration kit matching the connector type of the test port. The calibration kit includes such standards as SHORT, OPEN, and LOAD with matched impedance. Magnitude and phase responses i.e. S-parameters of the standards are well known. The characteristics of the standards are represented in the form of an **equivalent circuit model**, as described below;

- Selection of a calibration method is based on the required accuracy of measurements. The calibration method defines what errors of the model (or all of them) will be compensated;

- Measurement of the standards within a specified frequency range. The number of the measurements depends on the type of calibration;

- The Analyzer compares the measured parameters of the standards against their predefined values. The difference is used for calculation of the calibration coefficients (systematic errors);

- The table of calibration coefficients is saved into the memory of the Analyzer and used for error correction of the measured results of any DUT.

Calibration is always made for a specific channel, as it depends on the hardware settings for each channel, particularly on the frequency range. This means that a table of calibration coefficients is being stored each for a particular channel.

6.1.4. Calibration Methods

The Analyzer supports several methods of one-port and two-port calibrations. The calibration methods vary by quantity and type of the standards being used, by type of error correction, and accuracy. The table below represents the overview of the calibration methods.

Table 6.2 Calibration methods

Calibration Type	Parameters	Standards	Errors	Accuracy
Reflection Normalization	S_{11} or S_{22}	▪ SHORT or OPEN ▪ LOAD [*2]	E_{r1}, E_{d1} [*1] or E_{r2}, E_{d2} [*1]	High
Transmission Normalization	S_{21} or S_{12}	▪ THRU ▪ 2 LOADs [*3]	E_{t1}, E_{x1} [*2] or E_{t2}, E_{x2} [*2]	Low
Full One-Port Calibration	S_{11} or S_{22}	▪ SHORT ▪ OPEN ▪ LOAD	E_{r1}, E_{d1}, E_{s1} or E_{r2}, E_{d2}, E_{s1}	High
One-Path Two-Port Calibration	S_{11}, S_{21} or S_{12}, S_{22}	▪ SHORT ▪ OPEN ▪ LOAD ▪ THRU ▪ 2 LOADs [*2]	E_{r1}, E_{d1}, E_{s1}, E_{t1}, E_{x1} [*2] or E_{r1}, E_{d1}, E_{s1}, E_{t1}, E_{x1} [*2]	Medium
Full Two-Port Calibration	S_{11}, S_{21} S_{12}, S_{22}	▪ SHORT ▪ OPEN ▪ LOAD ▪ THRU ▪ 2 LOADs [*2]	E_{r1}, E_{d1}, E_{s1}, E_{t1}, E_{l1}, E_{x1} [*2] E_{r2}, E_{d2}, E_{s2}, E_{t2}, E_{l2}, E_{x2} [*2]	High

6.1.5. Normalization

Normalization is the simplest method of calibration as it involves measurement of only one calibration standard for each S-parameter.

- 1-port (reflection) S-parameters (S_{11}, S_{22}) are calibrated by means of a SHORT or an OPEN standard, estimating reflection tracking error Er.

[1] If optional directivity calibration is performed.
[2] If optional isolation calibration is performed.

- 2-port (transmission) S-parameters (S_{21}, S_{12}) are calibrated by means of a THRU standard, estimating transmission tracking error Et.

This method is called normalization because the measured S-parameter at each frequency point is divided (normalized) by the corresponding S-parameter of the calibration standard.

Normalization eliminates frequency-dependent attenuation and phase offset in the measurement circuit, but does not compensate for errors of directivity, mismatch or isolation. This constrains the accuracy of the method.

Note	Normalization can also be referred to as **response open**, **response short** or **response thru** calibration depending on the standard being used: an OPEN, SHORT or THRU respectively.

6.1.6. Directivity Calibration (Optional)

A333 offers optional directivity (Ed) calibration feature, which can be used along with reflection normalization by means of additional measurement of a LOAD standard. Auxiliary directivity correction increases the accuracy of normalization.

6.1.7. Isolation Calibration (Optional)

A333 offers optional isolation (Ex) calibration along with the following three methods of calibration:

- transmission normalization,
- one-path two-port calibration,
- full two-port calibration.

This calibration is performed by isolation measurement using LOAD standards connected to the both test ports of the Analyzer. Isolation calibration can be omitted in most of tests as the signal leakage between the test ports of the Analyzer is negligible.

Note	For isolation calibration, it is recommended to set narrow IF bandwidth, attenuation, and firmly fix the cables.

6.1.8. Full One-Port Calibration

Full one-port calibration involves connection of the following three standards to one test port:

- SHORT,
- OPEN,
- LOAD.

Measurement of the three standards allows for acquisition of all the errors (Ed, Es, and Er) of a one-port model. Full 1-port calibration is the most accurate method for 1-port reflection measurements.

6.1.9. One-Path Two-Port Calibration

A one-path two-port calibration combines full one-port calibration with transmission normalization. This method allows for a more accurate estimation of transmission tracking error (Et) than using transmission normalization.

One-path two-port calibration involves connection of the three standards to the source port of the Analyzer (as for one-port calibration) and a THRU standard connection between the calibrated source port and the other receiver port.

One-path two-port calibration allows for correction of Ed, Es, and Er errors of the source port and a transmission tracking error (Et). This method does not derive source match error (El) of a 2-port error model.

One-path two-port calibration is used for measurements of the parameters of a DUT in one direction, e.g. S_{11} and S_{21}, and requires well-matched output of the DUT.

6.1.10. Full Two-Port Calibration

A full two-port calibration involves seven connections of the standards. This calibration combines two 1-port calibrations for each port, and one THRU connection, which automatically provides two measurements for each test port being a source.

Full 2-port calibration allows for correction of all the twelve errors of a 2-port error model: E_{d1}, E_{d2}, E_{s1}, E_{s2}, E_{r1}, E_{r2}, E_{t1}, E_{t2}, E_{l1}, E_{l2}, E_{x1}, E_{x2} (correction of E_{x1}, E_{x2} can be omitted).

Full 2-port calibration is the most accurate method of calibration for 2-port DUT measurements.

6.1.11. Calibration Standards and Calibration Kits

Calibration standards are precision physical devices used for determination of errors in a measurement system.

A calibration kit is a set of calibration standards with a specific connector type, and specific impedance. Generally, a calibration kit consists of standards of four types: OPEN, SHORT, LOAD, and THRU[4].

The magnitude and phase response of the calibration standards (i.e. their S-parameters) must be known or predictable within a given frequency range.

The characteristics of real calibration standards have deviations from the ideal values. For example, the ideal SHORT standard must have reflection coefficient magnitude equal to 1.0 and reflection coefficient phase equal to 180° over the whole frequency range. A real SHORT standard has deviations from these values depending on the frequency. To take into account such deviations a **calibration standard model** (in the form of an equivalent circuit with predefined characteristics) is used.

6.1.12. Calibration Kits List

The Analyzer provides memory space for eleven calibration kits. The first five items are the kits with manufacturer-defined parameters, available in the Analyzer by default. The other items are the empty templates offered for calibration kit definition by the user.

The available calibration kits include the kits of Agilent and Rosenberger companies (See table 6.3).

Table 6.3 Calibration kits

No.	Model Number	Description
1	85032B/E	Agilent 85032B or 85032E 50 Ω Type-N calibration kit, up to 6 GHz
2	05CK10A-150	Rosenberger 05CK10A-150 50 Ω Type-N calibration kit, up to 18 GHz
3	85033D/E	Agilent 85033D or 85033E 50 Ω 3.5 mm calibration kit, up to 9 GHz
4	03CK10A-150	Rosenberger 03CK10A-150 50 Ω 3.5 mm calibration kit, up to 26.5 GHz
5	85036B/E	Agilent 85036B or 85036E 75 Ω Type-N calibration kit, up to 3 GHz

[4] In many calibration kits a THRU standard is zero-length defined, i.e. its delay and loss are both defined as equal to zero. However, such a THRU standard does not exist as a physical device, and hence cannot be included into a kit. In this case, THRU calibration is performed by direct connection of test port connectors.

6	8850Q	Maury 8850Q03 50 Ω Type-N calibration kit, up to 18 GHz
7 – 11	Empty	Templates for user-defined calibration kits

To achieve the specified measurement accuracy, use a calibration kit with known characteristics. Before starting calibration select in the program the calibration kit being used among the predefined kits, or define a new one and enter its parameters. The procedure of a calibration kit definition and editing is described in section 6.2.

6.1.13. Calibration Standard Model

For description of calibration standards two models are used: reflection standard model (SHORT, OPEN, and LOAD), and transmission standard model (THRU). These models are represented in figures 6.4 and 6.5. The parameters used in these models are described in table 6.4.

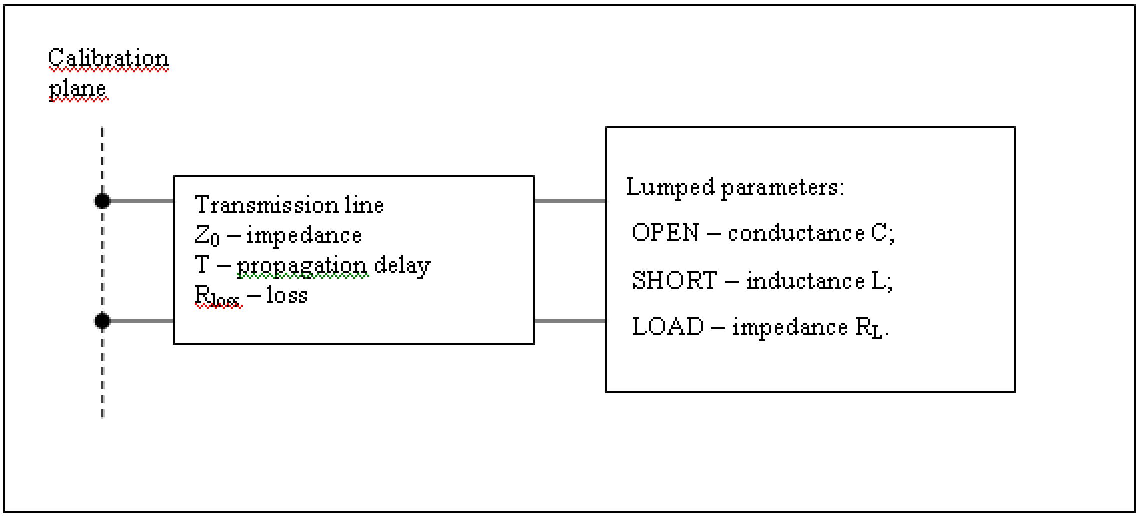


Figure 6.4 Reflection standard model (SHORT, OPEN, and LOAD)

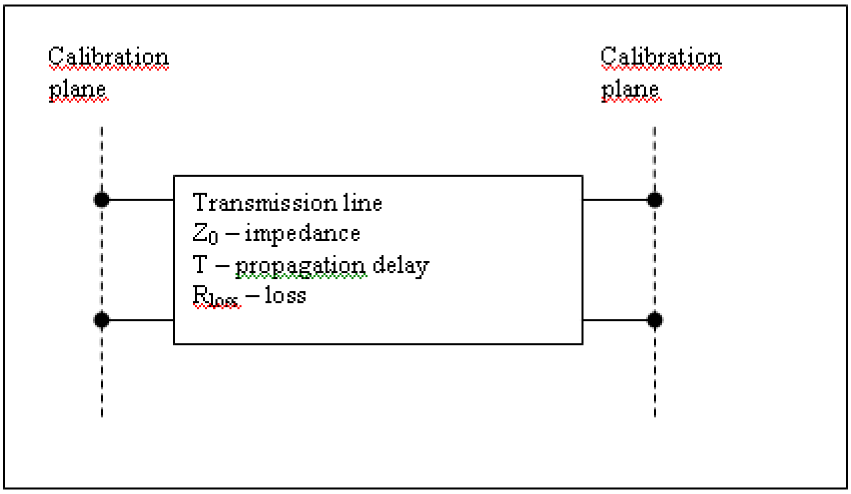


Figure 6.5 Transmission standard model (THRU)

Table 6.4 Calibration standard model parameters

Parameter (as in the program)	Parameter definition of reflection and transmission models
Z_0 (Offset Z0)	The transmission line impedance between the calibration plane and the standard to be defined. Generally it is set to the characteristic impedance of the system.
T (Offset Delay)	The delay (electrical length) of the transmission line between the calibration plane and the standard to be defined. The delay is defined as one-way propagation time (in seconds) from the calibration plane to the reflection standard, or to the other calibration plane. Each standard delay can be measured or mathematically determined by dividing the exact physical length by the propagation velocity.
R_{loss} (Offset Loss)	The loss in the transmission line between the calibration plane and the standard to be defined due to the skin effect. The loss is defined in Ω/sec at 1 GHz frequency. The loss of a standard is determined by measuring the delay T [sec] and L [dB] at 1 GHz frequency. The measured values are used in the following formula: $$Loss[\Omega/s] = \frac{L[dB] \cdot Z_0[\Omega]}{4.3429[dB] \cdot T[s]}$$
C (C0, C1, C2, C3)	The fringe capacitance of an OPEN standard, which causes a phase shift of the reflection coefficient at high frequencies. The fringe capacitance model is described as a function of frequency, which is a polynomial of the third degree: $C = C_0 + C_1 f + C_2 f^2 + C_3 f^3$, where f - frequency [Hz] $C_0 \ldots C_3$ – polynomial coefficients Units: C_0[F], C_1[F/Hz], C_2[F/Hz^2], C_3[F/Hz^3]
L (L0, L1, L2, L3)	The residual inductance of a SHORT standard, which causes a phase shift of the reflection coefficient at high frequencies. The residual inductance model is described as a function of frequency, which is a polynomial of the third degree: $L = L_0 + L_1 f + L_2 f^2 + L_3 f^3$, where f - frequency [Hz] $L_0 \ldots L_3$ – polynomial coefficients Units: L_0[H], L_1[H/Hz], L_2[H/Hz^2], L_3[H/Hz^3]

6.1.14. Calibration Kit Selection

A currently selected calibration kit is indicated on «Cal Kit» softkey and on the top softkey of each calibration method submenu.

	To select a calibration kit, click «Calibration» - «Cal Kit».
	Then select one of the kits listed in the submenu.

If the required kit is not specified, select any empty template (items 6 to 11). Assign your title and enter the parameters of the calibration standards. This kit will be saved for further use. The procedure of standard definition is described in section 6.2.

Note	Selection of calibration kit defines the system impedance in accordance with the value specified for the kit. If necessary the user can change the system impedance after selection of calibration kit.

6.1.15. Reflection Normalization

Reflection normalization is the simplest calibration method used for one-port reflection coefficient (S_{11} or S_{22}) measurements. Only one standard (SHORT or OPEN) is measured (See figure 6.6) in the process of this calibration. You can also perform directivity calibration by measuring a LOAD standard.

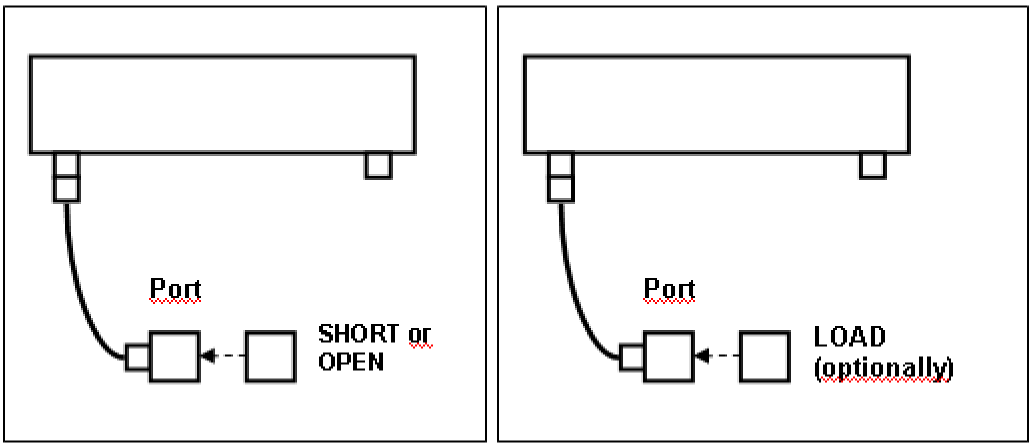


Figure 6.6 Reflection normalization

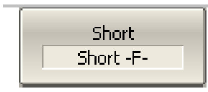
Before starting calibration perform the following settings: assign active channel, set the parameters of the channel (frequency range, IF bandwidth, etc), and select the calibration kit.

To open reflection normalization submenu, use «Response (Short)» or «Response (Open)» softkey.

Select the test port to be calibrated using «Select Port». Clicking this softkey you can switch between the test ports (measured parameters).

Note

The top softkey of the calibration submenu indicates the calibration method short title and the selected calibration kit.



Connect a SHORT or an OPEN standard to the test port as shown in figure 6.6. Perform measurement using «Short» or «Open» softkey correspondingly.

The instrument status bar will indicate «Calibration in progress...» when the measurement is in progress. On completion of the measurement a check mark will appear in the left part of the softkey.

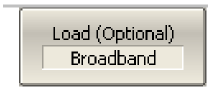
Note

The upper line of the softkey indicates the type of the standard being used (SHORT, OPEN, LOAD, or THRU). The lower line of the softkey indicates the label of the standard as it is assigned in the calibration kit.

The standard labels of the predefined kits contain the type of the connector:

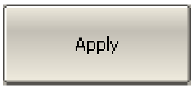
- Male -M-,
- Female -F-.

If a standard type does not match the test port to be calibrated, change the assignment of the standards to the ports in «Edit Cal Kit» submenu.



To perform the optional directivity calibration, connect a LOAD standard to the test port as shown in figure 6.6 and enable measurement using «Load (Optional)» softkey.

The instrument status bar will indicate «Calibration in progress...» when the measurement is in progress. On completion of the measurement a check mark will appear in the left part of the softkey.

	To complete the calibration procedure, click «Apply». This will activate the process of calibration coefficient table calculation and saving it into the memory. The error correction function will also be automatically enabled.
	To clear the measurement results of the standards, click «Cancel». This softkey does not cancel the current calibration. To disable the current calibration turn off the error correction function.
Note	You can check the calibration status in channel status bar (See table 6.5) or in trace status field (See table 6.6).

6.1.16. Transmission Normalization

Transmission normalization is the simplest calibration method used for two-port transmission coefficient (S_{21} or S_{12}) measurements. One THRU standard is measured (See figure 6.7) in the process of this calibration. You can also perform isolation calibration by measuring two LOAD standards.

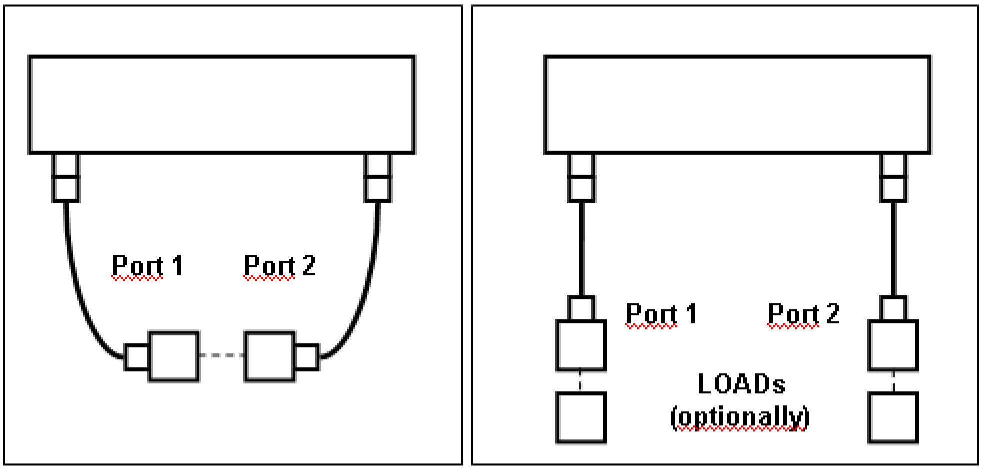
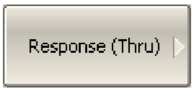


Figure 6.7 Transmission normalization

Before starting calibration perform the following settings: assign active channel, set the parameters of the channel (frequency range, IF bandwidth, etc), and select the calibration kit.



To open transmission normalization submenu, use «Response (Thru)» softkey.

Select the direction of the calibration using «Select Ports» softkey. The label on the softkey indicates the following: receiver port - source port (measured parameter).

Note

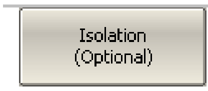
The top softkey of the calibration submenu indicates the calibration method short title and the selected calibration kit.

Connect a THRU standard between the test ports. If the port connectors allow through connection connect them directly (zero electrical length thru). Perform measurement using «Thru» softkey.

The instrument status bar will indicate «Calibration in progress...» when the measurement is in progress. On completion of the measurement a check mark will appear in the left part of the softkey.

Note

The upper line of the softkey indicates the type of the standard being used (SHORT, OPEN, LOAD, or THRU). The lower line of the softkey indicates the label of the standard as it is assigned in the calibration kit.



To perform the optional isolation calibration, connect two LOAD standards to the test ports as shown in figure 6.7 and enable measurement using «Isolation (Optional)» softkey.

The instrument status bar will indicate «Calibration in progress...» when the measurement is in progress. On completion of the measurement a check mark will appear in the left part of the softkey.

To complete the calibration procedure, click «Apply».

This will activate the process of calibration coefficient table calculation and saving it into the memory. The error correction function will also be automatically enabled.

To clear the measurement results of the standard,s click «Cancel».

This softkey does not cancel the current calibration. To disable the current calibration, turn off the error correction function.

Note	You can check the calibration status in channel status bar (See table 6.5) or in trace status field (See table 6.6).

6.1.17. Full One-Port Calibration

Full one-port calibration is the most accurate calibration method used for one-port reflection coefficient (S_{11} or S_{22}) measurements. The three calibration standards (SHORT, OPEN, LOAD) are measured (See figure 6.8) in the process of this calibration.

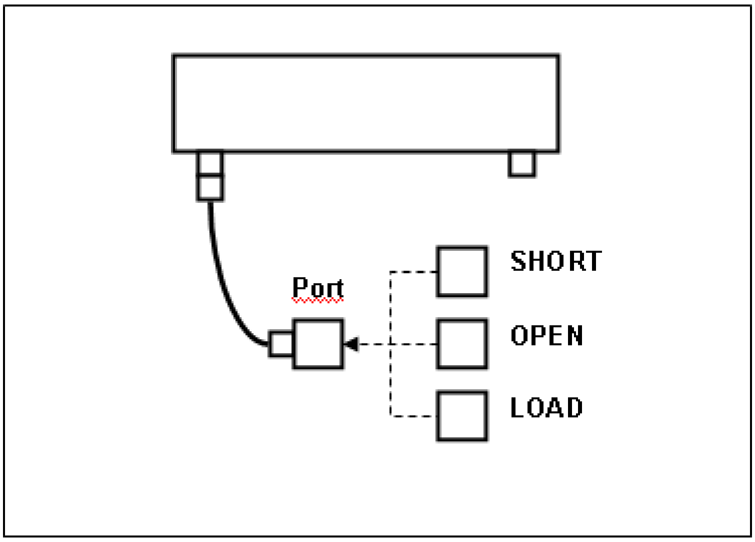
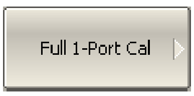


Figure 6.8 Full one-port calibration

Before starting calibration perform the following settings: assign active channel, set the parameters of the channel (frequency range, IF bandwidth, etc), and select the calibration kit.

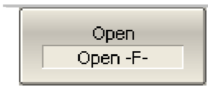


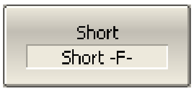
To open full one-port calibration submenu, use «Full 1-Port Cal» softkey.

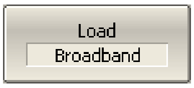
Select the test port to be calibrated using «Select Port». Clicking this softkey you can switch between the test ports (measured parameters).

Note

The top softkey of the calibration submenu indicates the calibration method short title and the selected calibration kit.







Connect SHORT, OPEN and LOAD standards to the selected test port in any consequence as shown in figure 6.8. Perform measurements clicking the softkey corresponding to the connected standard.

The instrument status bar will indicate «Calibration in progress...» when the measurement is in progress. On completion of the measurement a check mark will appear in the left part of the softkey.

Note

The upper line of the softkey indicates the type of the standard being used (SHORT, OPEN, LOAD, or THRU). The lower line of the softkey indicates the label of the standard as it is assigned in the calibration kit.

The standard labels of the predefined kits contain the type of the connector:

- Male -M-,
- Female -F-.

If a standard type does not match the test port to be calibrated, change the assignment of the standards to the ports in «Edit Cal Kit» submenu.

To complete the calibration procedure, click «Apply».

This will activate the process of calibration coefficient table calculation and saving it into the memory. The error correction function will also be automatically enabled.

To clear the measurement results of the standards, click «Cancel».

This softkey does not cancel the current calibration. To disable the current calibration, turn off the error correction function.

Note	You can check the calibration status in channel status bar (See table 6.5) or in trace status field (See table 6.6).

6.1.18. One-Path Two-Port Calibration

One-path two-port calibration is used for measurements of the DUT parameters in one direction, e.g. S_{11} and S_{21}. This method involves connection of the three calibration standards to the source port, and connection of a THRU standard between the calibrated source port and the other receiver port (See figure 6.9). You can also perform isolation calibration by measuring two LOAD standards.

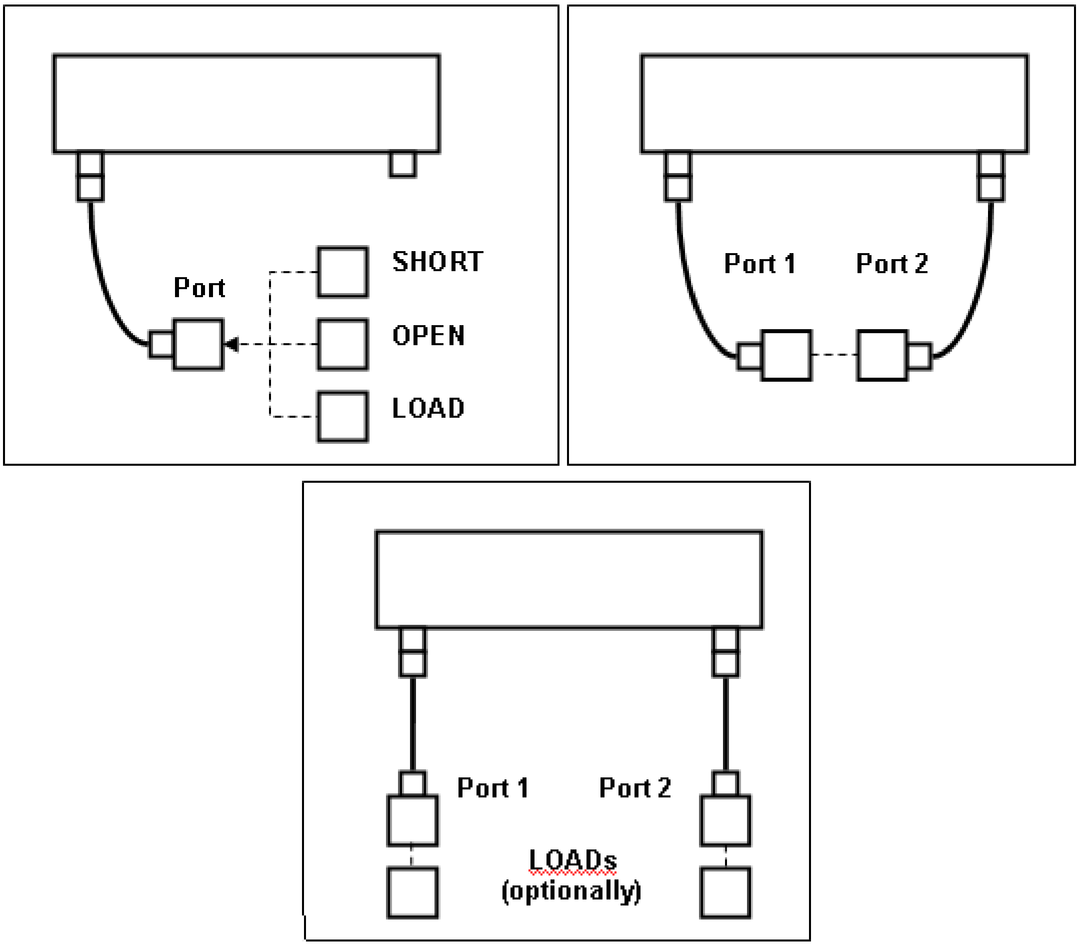
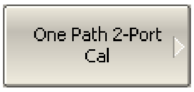


Figure 6.9 One-path two-port calibration

Before starting calibration perform the following settings: assign active channel, set the parameters of the channel (frequency range, IF bandwidth, etc), and select the calibration kit.

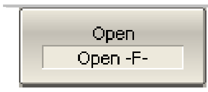


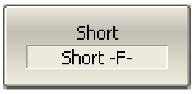
To open one-path two-port calibration submenu, use «One Path 2-Port Cal» softkey.

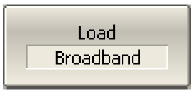
Select the direction of the calibration using «Select Ports» softkey. The label on the softkey indicates the following: receiver port - source port (measured parameters).

Note

The top softkey of the calibration submenu indicates the calibration method short title and the selected calibration kit.







Connect SHORT, OPEN and LOAD standards to the source port in any consequence, as shown in figure 6.9. Perform measurements clicking the softkey corresponding to the connected standard.

Connect a THRU standard between the test ports. If the port connectors allow through connection connect them directly (zero electrical length thru). Perform measurement using «Thru» softkey.

The instrument status bar will indicate «Calibration in progress...» when the measurement is in progress. On completion of the measurement a check mark will appear in the left part of the softkey.

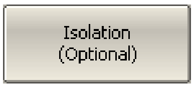
Note

The upper line of the softkey indicates the type of the standard being used (SHORT, OPEN, LOAD, or THRU). The lower line of the softkey indicates the label of the standard as it is assigned in the calibration kit.

The standard labels of the predefined kits contain the type of the connector:

- Male -M-,
- Female -F-.

If a standard type does not match the test port to be calibrated, change the assignment of the standards to the ports in «Edit Cal Kit» submenu.



To perform the optional isolation calibration, connect two LOAD standards to the test ports as shown in figure 6.9 and enable measurement using «Isolation (Optional)» softkey.

The instrument status bar will indicate «Calibration in progress...» when the measurement is in progress. On completion of the measurement a check mark will appear in the left part of the softkey.

To complete the calibration procedure, click «Apply».

This will activate the process of calibration coefficient table calculation and saving it into the memory. The error correction function will also be automatically enabled.

To clear the measurement results of the standards, click «Cancel».

This softkey does not cancel the current calibration. To disable the current calibration, turn off the error correction function.

Note

You can check the calibration status in channel status bar (See table 6.5) or in trace status field (See table 6.6).

6.1.19. Full Two-Port Calibration

Full two-port calibration is the most accurate method of calibration for two-port measurements.

Full two-port calibration combines two one-port calibrations for each test port with measurement of transmission and reflection of a THRU standard in both directions (See figure 6.10). You can also perform isolation calibration by measuring two LOAD standards.

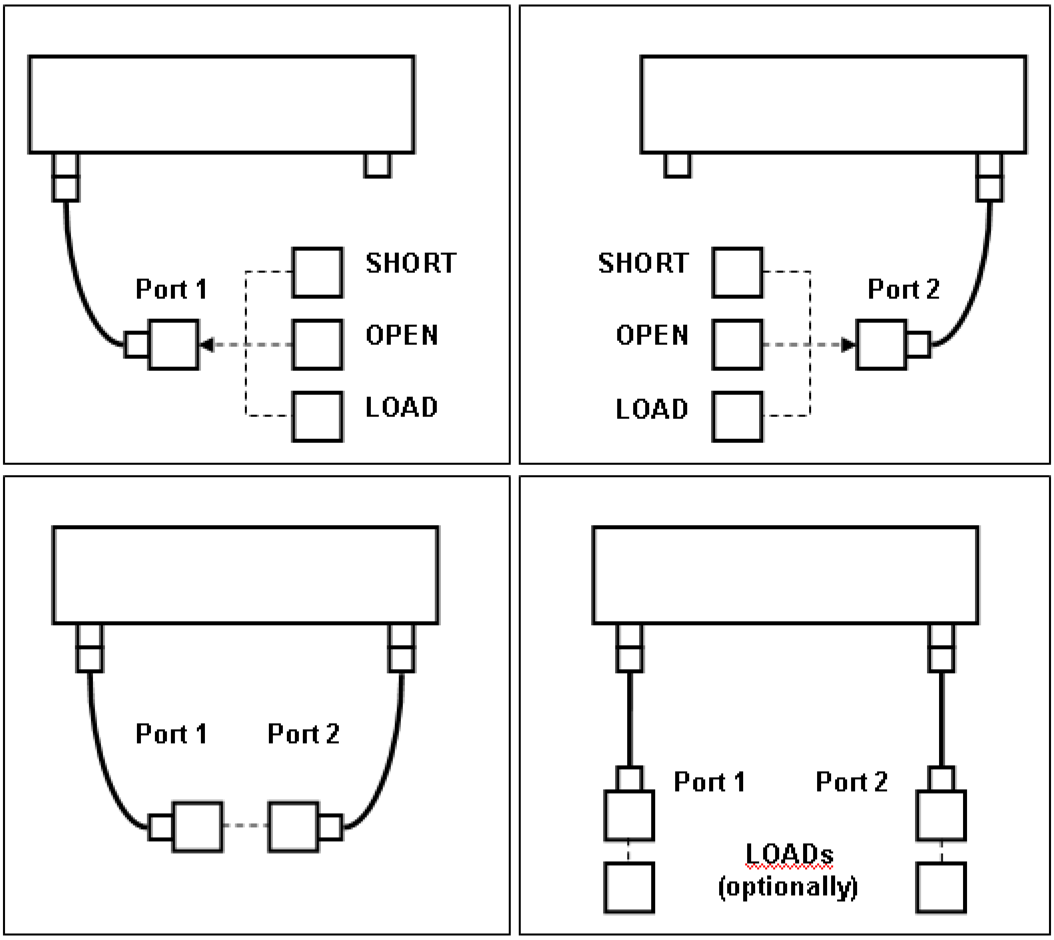


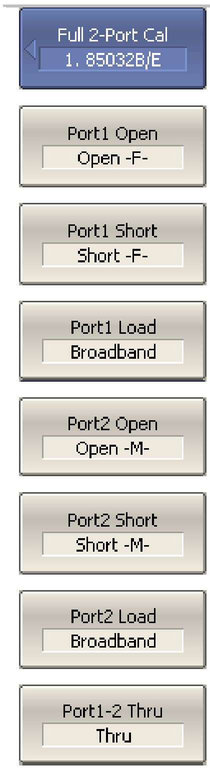
Figure 6.10 Full two-port calibration

Before starting calibration perform the following settings: assign active channel, set the parameters of the channel (frequency range, IF bandwidth, etc), and select the calibration kit.

To open full two-port calibration submenu, use «Full 2-Port Cal» softkey.

Note

The top softkey of the calibration submenu indicates the calibration method short title and the selected calibration kit.



Connect SHORT, OPEN and LOAD standards to the 1 and 2 ports in any consequence, as shown in figure 6.10. Perform measurements clicking the softkey corresponding to the connected standard.

Connect a THRU standard between the test ports. If the port connectors allow through connection connect them directly (zero electrical length thru). Perform measurement using «Port 1-2 Thru» softkey.

The instrument status bar will indicate «Calibration in progress...» when the measurement is in progress. On completion of the measurement a check mark will appear in the left part of the softkey.

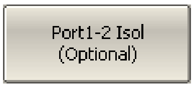
Note

The upper line of the softkey indicates the type of the standard being used (SHORT, OPEN, LOAD, or THRU). The lower line of the softkey indicates the label of the standard as it is assigned in the calibration kit.

The standard labels of the predefined kits contain the type of the connector:

- Male -M-,
- Female -F-.

If a standard type does not match the test port to be calibrated, change the assignment of the standards to the ports in «Edit Cal Kit» submenu.



To perform the optional isolation calibration, connect two LOAD standards to the test ports as shown in figure 6.10 and enable measurement using «Port 1-2 Isol (Optional)» softkey.

The instrument status bar will indicate «Calibration in progress...» when the measurement is in progress. On completion of the measurement a check mark will appear in the left part of the softkey.

To complete the calibration procedure, click «Apply».

This will activate the process of calibration coefficient table calculation and saving it into the memory. The error correction function will also be automatically enabled.

To clear the measurement results of the standards, click «Cancel».

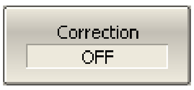
This softkey does not cancel the current calibration. To disable the current calibration, turn off the error correction function.

Note

You can check the calibration status in channel status bar (See table 6.5) or in trace status field (See table 6.6).

6.1.20. Error Correction Enabling/Disabling

This feature allows for enabling/disabling of the error correction function, provided the corresponding calibration table is stored in the memory. The function will be automatically enabled after completion of calibration of any method.



To enable or disable the error correction function, click «Correction» softkey.

6.1.21. Error Correction Status

Error correction status for a whole channel is indicated in the channel status bar (See table 6.5).

Table 6.5 Channel error correction status

Symbols	Definition
Cor	Error correction is enabled for all the traces of the channel. The stimulus values are same for calibration and the measurement.
C*	Error correction is enabled for all the traces of the channel. Interpolation is applied.
C?	Error correction is enabled for all the traces of the channel. Extrapolation is applied.
–C	Error correction is enabled for some traces of the channel. The stimulus values are same for calibration and the measurement.
–C*	Error correction is enabled for some traces of the channel. Interpolation is applied.
–C?	Error correction is enabled for some traces of the channel. Extrapolation is applied.
– –	Error correction is off for all the traces of the channel.

Error correction status for each trace is indicated in the trace status field (See table 6.6).

Table 6.6 Trace error correction status

Symbols	Definition
RO(+)	OPEN response calibration (+ optional directivity calibration)
RS(+)	SHORT response calibration (+ optional directivity calibraton)
RT(+)	THRU response calibration (+ optional isolation calibration)
OP(+)	One-path 2-port calibration (+ optional isolation calibration)
F1	Full 1-port calibration
F2(+)	Full 2-port calibration (+ optional isolation calibration)

6.2. Calibration Kit Management

This section describes how to edit a predefined calibration kit, add a user-defined calibration kit, and delete a calibration kit.

The Analyzer provides memory space for eleven calibration kits. The first five items are the predefined kits (See table 6.3). The other items are the empty templates offered for calibration kit definition by the user.

A calibration kit redefining can be required for the following purposes:

- To change the port assignment of a standard to ensure connector type (male, female) matching;
- To add a user-defined standard into the kit, e.g. a zero-length thru;
- To precise the standard parameters to improve the calibration accuracy.

A new user-defined calibration kit adding can be required if the user needs to use a calibration kit, which is not included in the list of the predefined kits.

Deleting function is available for user-defined calibration kits only.

The changes to the calibration kit definition are saved into the memory of the Analyzer and being stored until next editing by the user.

Note	To ensure trouble-free editing of a predefined calibration kit, you can always restore its initial state with a specific softkey.

6.2.1. Calibration Kit Selection for Editing

The calibration kit, which is currently active for calibration, is also available for editing. The selection of the active calibration kit is described in section 6.1.14.

6.2.2. Calibration Kit Editing

To open the calibration kit editing submenu, use «Edit Cal Kit» softkey.

6.2.3. Port Assignment of Standards

A calibration kit can include up to eleven calibration standards. The quantity of the standards of the same type is not limited (standard types are SHORT, OPEN, LOAD, and THRU). Generally, a calibration kit contains by two standards of each type in accordance with the connector gender (female -F-, male -M-).

Note	A LOAD standard can have same labels for two physical loads (female -F-, male -M-), as they have similar parameters.

In the process of calibration, the selection of the standards of the same type is made by the feature of port assignment of the standards. The port assignment is stored in the definition of each standard. A standard definition can bear one of the following four assignments:

- Port 1;
- Port 2;
- Port 1 & 2;
- Not used.

Only one standard can be assigned to one test port in a particular moment of time. In the process of calibration the Analyzer determines what standard should be used by the test port number. If a standard is not assigned to a test port it cannot be used for calibration.

To assign port to a standard, first click the softkey with this standard name.

Then click «Connection» softkey and select one of the four assignment options in the submenu.

6.2.4. User-Defined Calibration Kit Adding

The empty templates (items 7 to 11) are provided for adding of user-defined calibration kits. Select one of the empty templates (as described in section 6.1.14) to make it active.

In the section «Edit Cal Kit», assign the label of the new calibration kit and define each calibration standard of it. The label will be later indicated on the calibration softkeys.

To change the label of a user-defined calibration kit, use «Label» softkey.

The changes made by the user to the calibration kit definition are saved into the non-volatile memory of the Analyzer. For the saving no additional procedures are required.

6.2.5. User-Defined Calibration Kit Deleting and Predefined Calibration Kit Restoration

Select the calibration kit to be deleted or restored (as described in section 6.1.14) to make it active.

To delete a user-defined calibration kit or to restore a predefined calibration kit, use «Restore Cal Kit» softkey.

Note	«Restore Cal Kit» softkey is not active if the calibration kit status corresponds to the initial state.

6.2.6. Standard Adding to a Calibration Kit

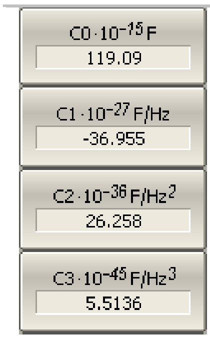
Edit Cal Kit Add STD	To add a calibration standard, use «Add STD» softkey.

6.2.7. Standard Deleting from a Calibration Kit

Edit Cal Kit Short 1. Short -F- Delete STD	To delete a calibration standard from the calibration kit, click the softkey with the label of the corresponding standard. Then click «Delete STD» softkey.
Note	The «Delete STD» softkey is located in the bottom of a standard submenu. If you do not see it, click the navigation softkey to scroll down the menu.

6.2.8. Calibration Standard Editing

Edit Cal Kit Short 1. Short -F-	To edit parameters of a calibration standard, click the softkey with the label of the corresponding standard.
Label Short -F-	The standard label is an information line, which does not affect the calibration process, and serves to the convenience of the user.
Number 1	The standard number is specified in the calibration kit data sheet. It serves to the convenience of the user and does not affect the calibration process.
STD Type Short	Select the standard type: SHORT, OPEN, LOAD, or THRU. The standard type defines the list of the standard parameters.

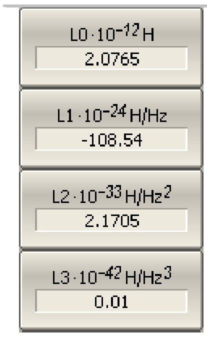


For an OPEN standard the values of fringe capacitance of an OPEN model should be defined. The fringe capacitance model is described as a function of frequency, which is a polynomial of the third degree:

$C = C_0 + C_1 f + C_2 f^2 + C_3 f^3$, where

f - frequency [Hz]

$C_0 \ldots C_3$ – polynomial coefficients.

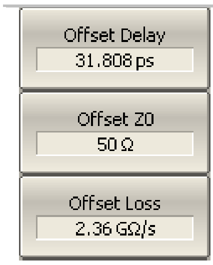


For a SHORT standard the values of residual inductance of a SHORT model should be defined. The residual inductance model is described as a function of frequency, which is a polynomial of the third degree:

$L = L_0 + L_1 f + L_2 f^2 + L_3 f^3$, where

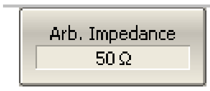
f - frequency [Hz]

$L_0 \ldots L_3$ – polynomial coefficients.



For all the standards the following transmission line parameters should be defined:

- Offset delay;
- Offset impedance;
- Offset loss.



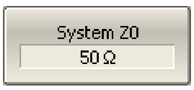
For a LOAD standard you can define arbitrary impedance other than the reference impedance of the system.

6.2.9. System Impedance Z_0 Setting

The system impedance Z_0 is a wave impedance of the test ports. It is defined by the wave impedance of the calibration standards. In the program you should specify the wave impedance of the test ports before calibration.

Note

Selection of calibration kit defines the system impedance in accordance with the value specified for the kit.



To set the system impedance Z_0, use «System Z0» softkey.

7. MEASUREMENT DATA PROCESSING FUNCTIONS

7.1. Markers

A marker is a tool for selection of a point on the trace and for numerical readout of the stimulus value and value of the measured parameter in the corresponding point. The Analyzer features enabling of up to 16 markers on each trace.

The markers allow for the following functions:

- Readout of the absolute values of the stimulus and the measured parameter in the selected points of the trace;
- Readout of the relative values of the stimulus and the measured parameter related to the reference point;
- Search for the specific point on the trace (minimum, maximum, target level, etc);
- Display of the trace statistics;
- Display of the bandwidth parameters;
- Stimulus parameters editing using markers.

The view of a trace with two markers is shown in figure 7.1.

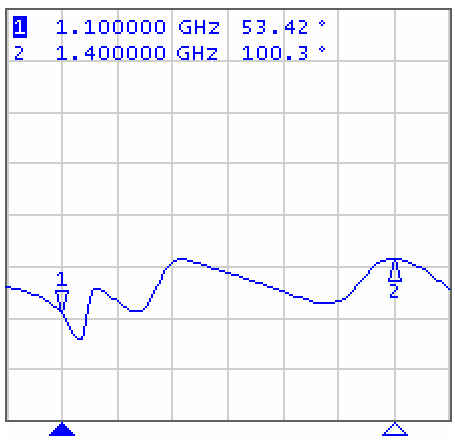


Figure 7.1

Markers can have the following indicators:

1 ∇	symbol and number of the active marker on the trace,
Δ 2	symbol and number of the inactive marker on the trace,

▲ symbol of the active marker on the stimulus axis,

∆ symbol of the inactive marker on the stimulus axis.

The marker data field contains the marker number, stimulus value, and the measured parameter value. The number of the active marker is highlighted in inverse color.

The marker data field contents vary depending on the display format (rectangular or polar). The marker number and the stimulus value comprise the mandatory part of the marker data field.

- In rectangular diagram the marker shows the measurement parameter value plotted along Y-axis in one of the display formats (See table 5.6).
- In polar diagram the marker shows two or three values listed in table 7.1

Table 7.1 Marker readings in polar diagrams

Label	Marker Readings (Measurement Unit)		
	Reading 1	Reading 2	Reading 3
Smith (Lin)	Linear magnitude	Phase (°)	–
Smith (Log)	Logarithmic magnitude (dB)	Phase (°)	–
Smith (Re/Im)	Real part	Imaginary part	–
Smith (R + jX)	Resistance (Ω)	Reactance (Ω)	Equivalent capacitance or inductance (F/H)
Smith (G + jB)	Conductance (S)	Susceptance (S)	Equivalent capacitance or inductance (F/H)
Polar (Lin)	Linear magnitude	Phase (°)	–
Polar (Log)	Logarithmic magnitude (dB)	Phase (°)	–
Polar (Re/Im)	Real part	Imaginary part	–

7.1.1. Marker Adding

To enable a new marker, click «Add Marker» softkey.

Note

The new marker appears as an active marker and indicates the stimulus start.

7.1.2. Marker Deleting

To delete a marker, click «Delete Marker» softkey.

Or click «Delete All Markers» softkey.

7.1.3. Marker Stimulus Value Setting

Before you set the marker stimulus value, you need to select the active marker. You can set the stimulus value by entering the numerical value from the keyboard, or by dragging and dropping the marker using the mouse, or enabling the search function. Marker search function is described in section 7.1.9.

To set the marker stimulus value, click «Edit Stimulus».

Then enter the value using the numerical keys or «↑», «↓» keys on the keyboard.

7.1.4. Active Marker Selection

To assign the active marker by its number, click «Active» softkey.

Then select the required marker from the opened menu.

Also you can select the active marker going through the list of markers by «Next Marker» softkey.

Note

You can assign the active marker by making a mouse click on the marker.

7.1.5. Reference Marker Feature

Reference marker feature allows for execution of relative measurements. When this feature is enabled, the reference marker will appear on the screen (See figure 7.2).

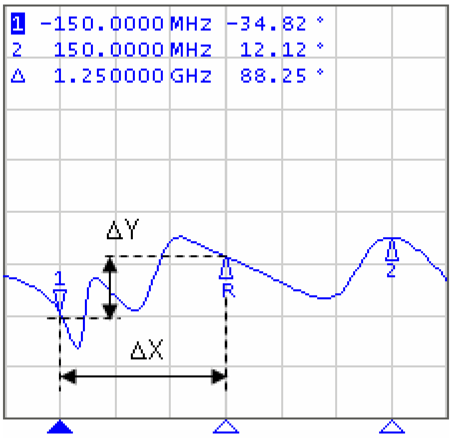


Figure 7.2

Instead of the number, **R** symbol is used for indication of the reference marker. Reference marker can be indicated on the trace as follows:

R ∇	symbol of the active reference marker on the trace;
Δ R	symbol of the inactive reference marker on the trace.

The reference marker displays the stimulus and measurement absolute values. All the rest of the markers display the relative values:

- stimulus value — difference between the absolute stimulus values of this marker and of the reference marker;
- measured value — difference between the absolute measurement values of this marker and of the reference marker.

To enable / disable the reference marker, use «Reference Marker» softkey.

7.1.6. Marker Coupling Feature

The marker coupling feature activates / deactivates independence of the markers for each trace of the channel. If the feature is turned on, the coupled markers (markers with same numbers) will move along X-axis synchronously on all the traces. If the coupling feature is off, the position of the markers with same numbers along X-axis will be independent (See figure 7.3).

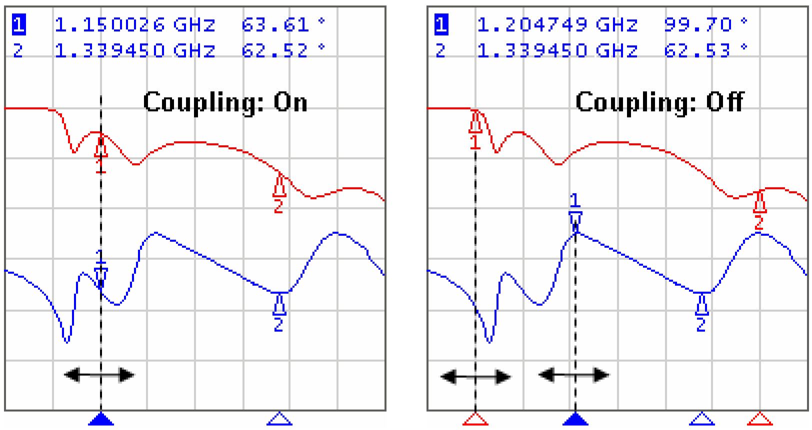


Figure 7.3 Marker coupling feature

To enable / disable the marker coupling feature, use «Marker Properties» - «Marker Couple» softkey.

7.1.7. Marker Table

If the traces of the channel overlap each other, the numerical values of the markers will be displayed only for the active trace. The marker table enables you to view the values of the markers of all the traces and all the channels simultaneously (See figure 7.4).

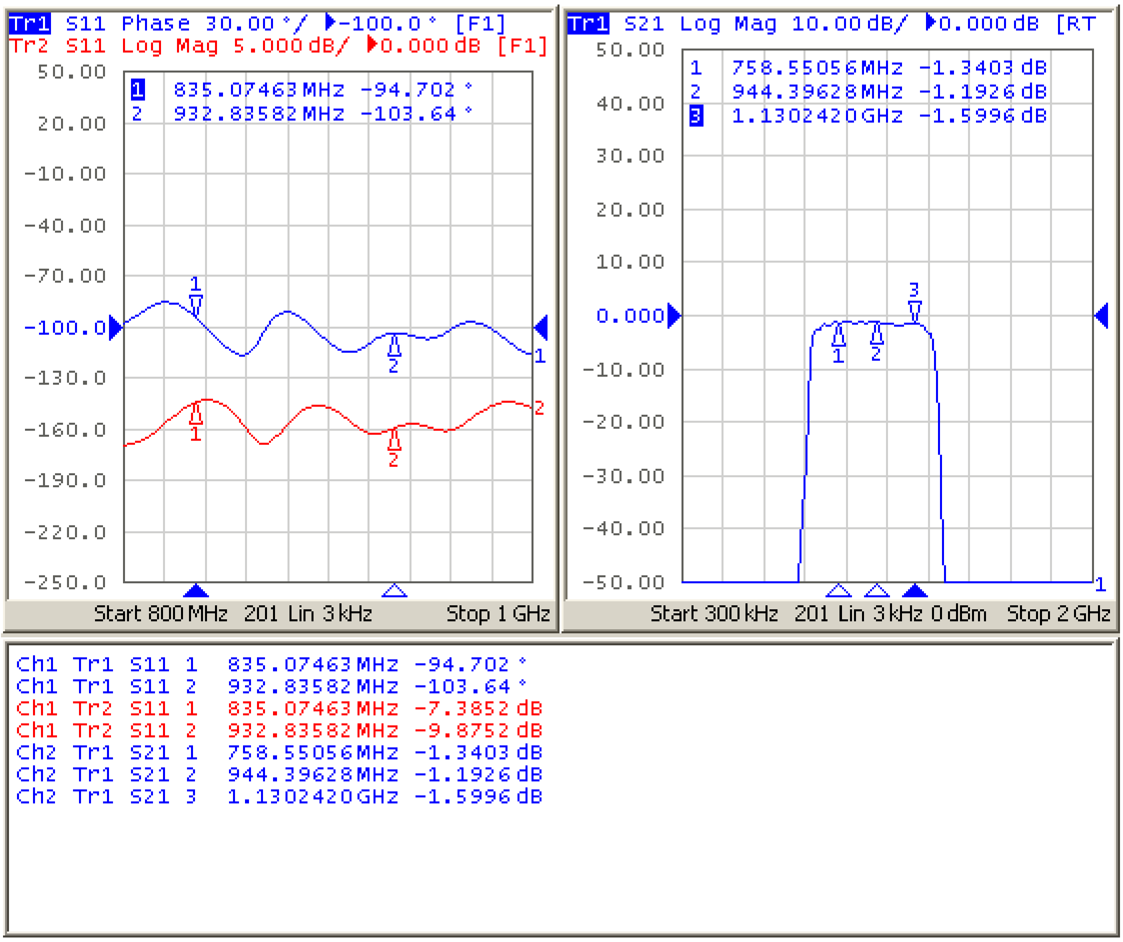
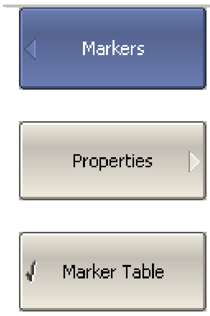


Figure 7.4 Marker table



To show / hide the marker table, use «Marker Properties» - «Marker Table» softkey.

7.1.8. Marker Value Indication Capacity

You can customize the accuracy of marker value display.

To set the marker value indication capacity, use «Marker Properties» - «Stimulus Digits» or «Response Digits» softkeys.

Then enter the number of decimal digits for stimulus or measured value indication respectively.

7.1.9. Marker Position Search Function

For trace analysis you can use the marker position search function, which will enable you to locate the position of the markers meeting the specified conditions:

- Search for maximum value of the trace;
- Search for minimum value of the trace;
- Search for peak value;
- Search for target level.

The search can be turned on as a single operation or as a search tracking. The single search operation is a search executed only with pressing on the search activation softkey. The tracking is a function, which is active constantly and is performing search for the specified conditions continuously.

The search can be limited to the stimulus range set by the user. The search range feature can be enabled / disabled by the specific softkey.

To access the options of the marker position search function, click «Marker Search» softkey.

To enable / disable tracking, use «Tracking» softkey.

To set the search range, click «Search Range» softkey.

Then enable the feature and set the limits of the range.

7.1.9.1. Search for Maximum and Minimum

Maximum and minimum search functions enable you to determine the maximum and minimum values of the measured parameter and move the marker to these positions on the trace (See figure 7.5).

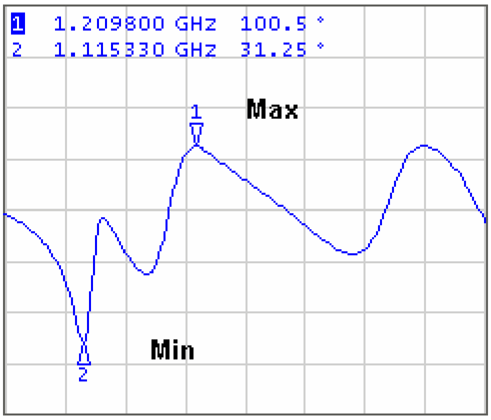
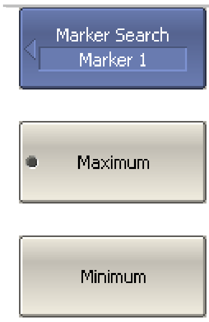


Figure 7.5 Maximum and minimum search

Note	In Smith chart and polar diagrams the maximum or minimum search is executed for the first out of the three values of the marker.

Before you start maximum or minimum search, assign the active marker.

	To locate the maximum or minimum values, use «Maximum» or «Minimum» softkeys respectively.
Note	The large dot on the softkey indicates the active search function when tracking is enabled. For a single search operation the marker position can be other than this indication.

7.1.9.2. Search for Peak

Peak search function enables you to determine the peak value of the measured parameter and move the marker to this position on the trace (See figure 7.6).

Peak is a local extremum of the trace.

Peak is called **positive** if the value in the peak is greater than the values of the adjacent points.

Peak is called **negative** if the value in the peak is smaller than the values of the adjacent points.

Peak excursion is the smaller of the two values: absolute difference between the measured value in the peak point and the two adjoining peaks of the opposite polarity, or the limiting points of the trace.

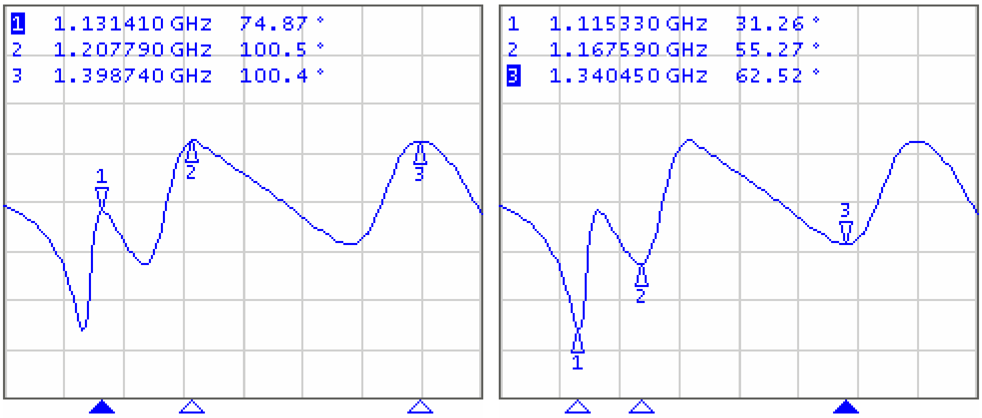


Figure 7.6 Positive and negative peaks

The peak search is executed only for the peaks meeting the following conditions:

- The peaks must have the polarity (positive, negative, or both) specified by the user;
- The peaks must have the peak deviation not less than the value assigned by the user.

The following options of the peak search are available:

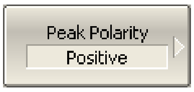
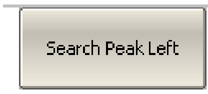
- Search for nearest peak;
- Search for greatest peak;
- Search for left peak;
- Search for right peak.

The nearest peak is a peak, which is located most near to the current position of the marker along the stimulus axis.

The greatest peak is a peak with maximum or minimum value, depending on the current polarity settings of the peak. The search for the greatest peak is deferent from the search for maximum or minimum as the peak cannot be located in the limiting points of the trace even if these points have maximum or minimum values.

Note	In Smith chart or polar diagrams the peak search is executed for the first out of the three values of the marker.

Before you start the peak search, select the active marker, assign the peak polarity and deviation value.

 	To set the polarity of the peak, use «Peak Polarity» softkey. Then select in the menu one of the available options: positive, negative, or both.
	To enter the peak excursion value, click «Peak Excursion» softkey. Then enter the value using numerical keys or by «↑», «↓» keys on the keyboard.
	To activate the nearest peak search, use «Search Peak» softkey.
	To activate the greatest peak search, use «Search Max Peak» softkey.
	To activate the left peak search, use «Search Peak Left» softkey.
	To activate the left peak search, use «Search Peak Right» softkey.
Note	The large dot on a softkey indicates the active search function when tracking is enabled. For single search operation the marker position can be other than this indication.

7.1.9.3. Search for Target Level

Target level search function enables you to locate the marker with the given level of the measured parameter (See figure 7.7).

The trace can have two types of transition in the points where the target level crosses the trace:

- transition type is positive if the function's derivative (trace slope) is positive at the intersection point with the target level;

- transition type is negative if the function's derivative (trace slope) is negative at the intersection point with the target level.

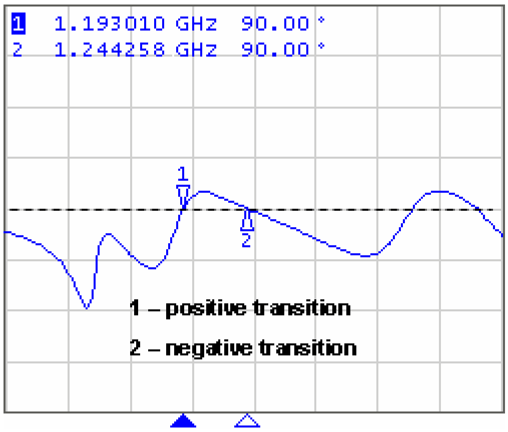


Figure 7.7 Target level search

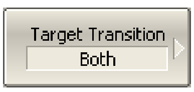
The target level search is executed only for the intersection points, which have the specific transition polarity selected by the user (positive, negative, or both).

The following options of the target level search are available:

- Search for nearest target;
- Search for left target;
- Search for right target.

Note	In Smith chart or polar diagrams the target level search is executed for the first out of the three values of the marker.

Before you start the target level search, assign the active marker, set the transition polarity and the target level value.

 	To set the transition polarity, click «Target Transition» softkey. Then select in the menu one of the available options: positive, negative, or both.
	To enter the target level value, click «Target Value» softkey. Then enter the value using numerical keys or by «↑», «↓» keys on the keyboard.

	To activate the nearest target search, use «Search Target» softkey.
	To activate the left target search, use «Search Target Left» softkey.
	To activate the right target search, use «Search Target Right» softkey.
Note	The large dot on a softkey indicates the active search function when tracking is enabled. For single search operation the marker position can be other than this indication.

7.1.10. Search for Bandwidth

The bandwidth search function enables you to determine the bandwidth parameters of the trace (See figure 7.8).

The bandwidth search function is based on the position of the active marker. Place the marker within the bandwidth. It is recommended to use maximum search function.

The bandwidth search function determines the lower cutoff frequency of the filter to the left from the marker, and the upper cutoff frequency of the filter to the right from the marker. The user specifies the bandwidth determination level, which is plotted from the value in the marker point.

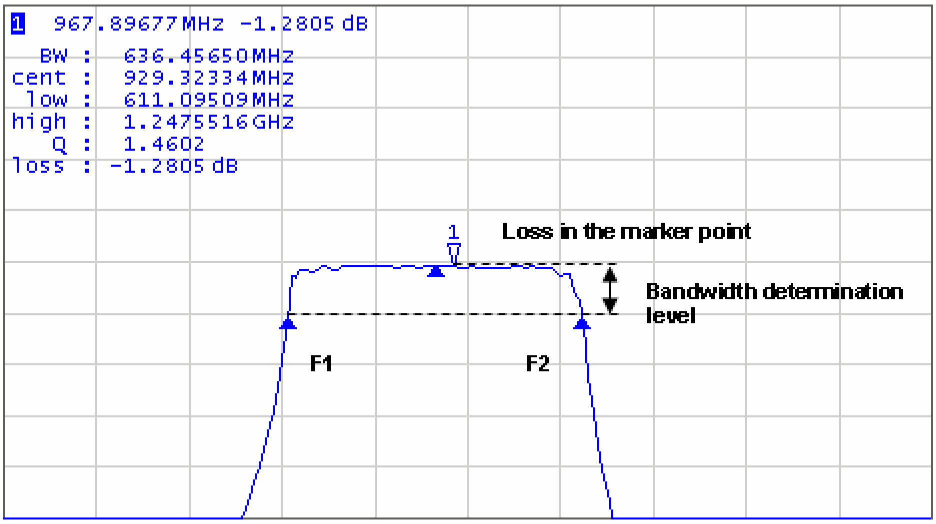


Figure 7.8 Bandwidth search

The bandwidth search determines and displays the following parameters (See table 7.2).

Table 7.2

Parameter Description	Symbol	Definition	Formula
Bandwidth	BW	The difference between the higher and lower cutoff frequencies	F2 – F1
Center Frequency	cent	The midpoint between the higher and lower cutoff frequencies	(F1+F2)/2
Lower Cutoff Frequency	low	The lower frequency point of the bandwidth cutoff level and the trace intersection	F1
Higher Cutoff Frequency	high	The higher frequency point of the bandwidth cutoff level and the trace intersection	F2
Quality Factor	Q	The ratio of the center frequency to the bandwidth	Cent / BW
Loss	loss	The measured value in the active marker point (the loss in «Log Mag» display format)	

Before you start the bandwidth search, assign the active marker and set the bandwidth cutoff level. Place the active marker into the maximum point within the bandwidth.

To turn the bandwidth search on/off, use «Search/Statistics» - «Bandwidth» softkey.

To set the bandwidth cutoff level, click «Bandwidth Value».

Then enter the value using numerical keys or by «↑», «↓» keys on the keyboard.

The value must be below zero.

7.1.11. Trace Statistics

The trace statistics feature allows for the data analysis of the trace (See figure 7.9).

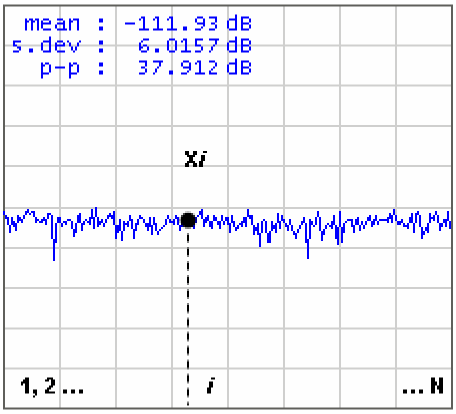


Figure 7.9 Trace statistics

The trace represents the measured data (X*i*) array, where *i* = 1…N, N – number of points.

The trace statistics function determines and displays the following parameters (See table 7.3).

Table 7.3

Parameter Description	Symbol	Definition	Formula
Mean Value	mean	Mean value of the measured data array	$M = \frac{1}{N} \cdot \sum_{i=1}^{N} x_i$
Standard Deviation	s.dev	Standard deviation of the measured data array	$\sqrt{\frac{1}{N-1} \cdot \sum_{i=1}^{N} (x_i - M)^2}$
Peak-to-Peak	p-p	Difference between the maximum and minimum values of the measured data array	Max – Min

7.1.12. Parameter Setting Using Markers

Using the current position of a marker you can perform settings of the following parameters:

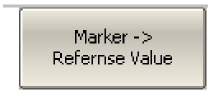
- Stimulus start;
- Stimulus stop;
- Stimulus center;
- Reference level;
- Electrical delay.

Before making the settings, assign the active marker.

To set the stimulus start, use «Marker–>Start» softkey.

To set the stimulus stop, use «Marker–>Stop» softkey.

To set the stimulus center, use «Marker–>Center» softkey.



To set the reference level, use «Marker–>Ref Value» softkey.

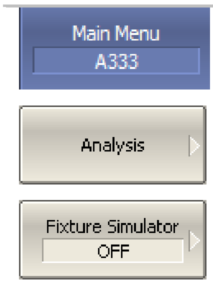
To set the electrical delay, use «Marker–>Delay» softkey.

7.2. Fixture Simulation

The fixture simulation function enables you to emulate the measurement conditions other than those of the real setup. The following conditions can be simulated:

- Port Z conversion;
- De-embedding;
- Embedding;

Before starting the fixture simulation, assign the active channel. The simulation function will affect all the traces of the channel.

	To open the fixture simulation menu, use «Analysis» - «Fixture Simulator» softkey.
Note	Label «ON» on the «Fixture Simulator» softkey indicates that one of the three simulation functions is enabled.

7.2.1. Port Z Conversion

Port Z conversion is a function of conversion of the S-parameters measured at 50 Ω port into the values, which could be determined if measured at a test port with arbitrary impedance (See figure 7.10).

Note	The value of the test port impedance is determined in the process of calibration. It is defined by the wave impedance of the calibration kit and the value is entered in the «Calibration» submenu.

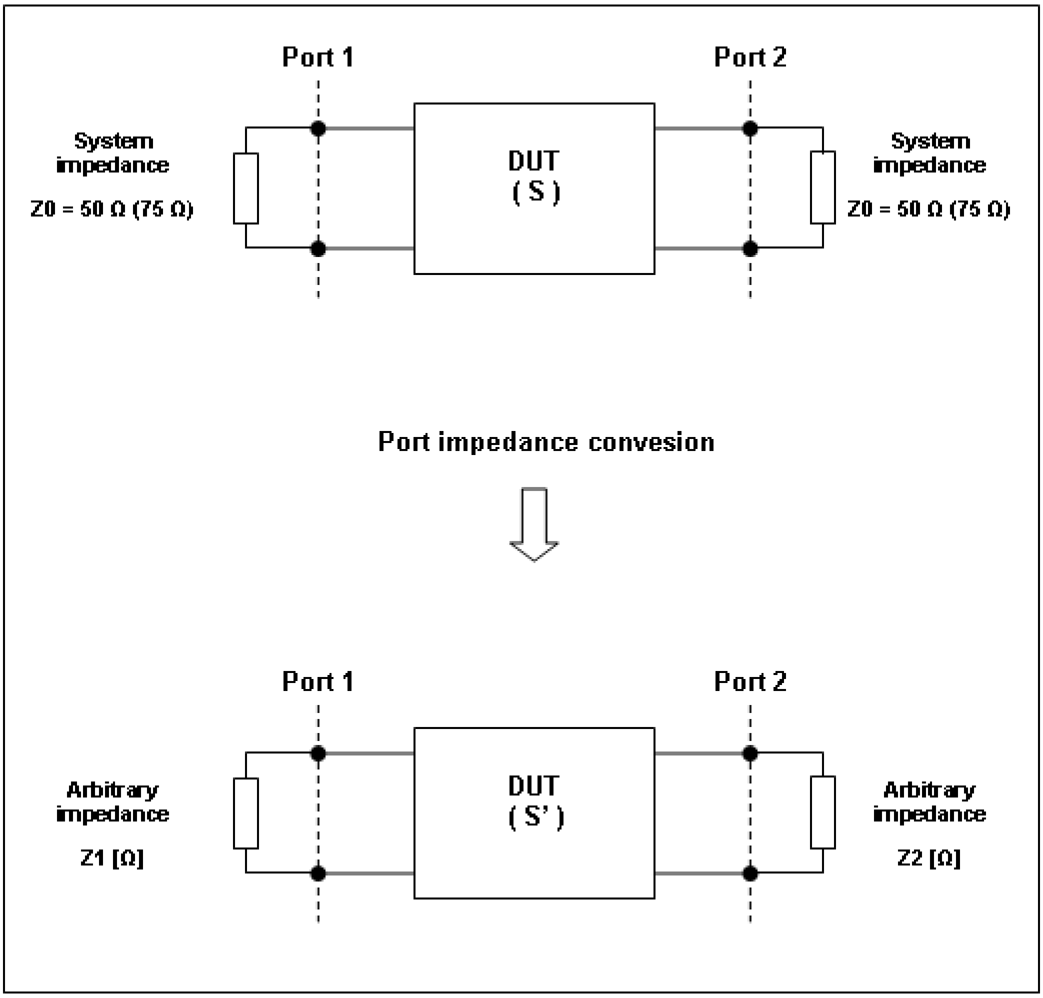


Figure 7.10 Port Z conversion

 	To enable the Port impedance conversion function, use «Port Z Conversion» softkey. The label on the softkey indicates the status of the function — On/Off.
	Then enter the value of the simulated impedance of Port 1 using «Port 1 Z0» softkey.
	Then enter the value of the simulated impedance of Port 2 using «Port 2 Z0» softkey.

7.2.2. De-embedding

De-embedding is a function of DUT S-parameter transformation by virtual removing of some circuit of the DUT, which is required to be excluded from the measurement results.

The circuit being removed should be defined in the data file containing S-parameters of this circuit. The circuit should be described as a 2-port in Touchstone file (extension .s2p), which contains the S-parameter table: S_{11}, S_{21}, S_{12}, S_{22} for a number of frequencies.

The de-embedding function allows to mathematically exclude from the measurement results the effect of the fixture circuit existing between the calibration plane and the DUT in the real network. The fixture is used for the DUTs, which cannot be directly connected to the test ports.

The de-embedding function shifts the calibration plane closer to the DUT, so as if the calibration has been executed of the network with this circuit removed (See figure 7.11).

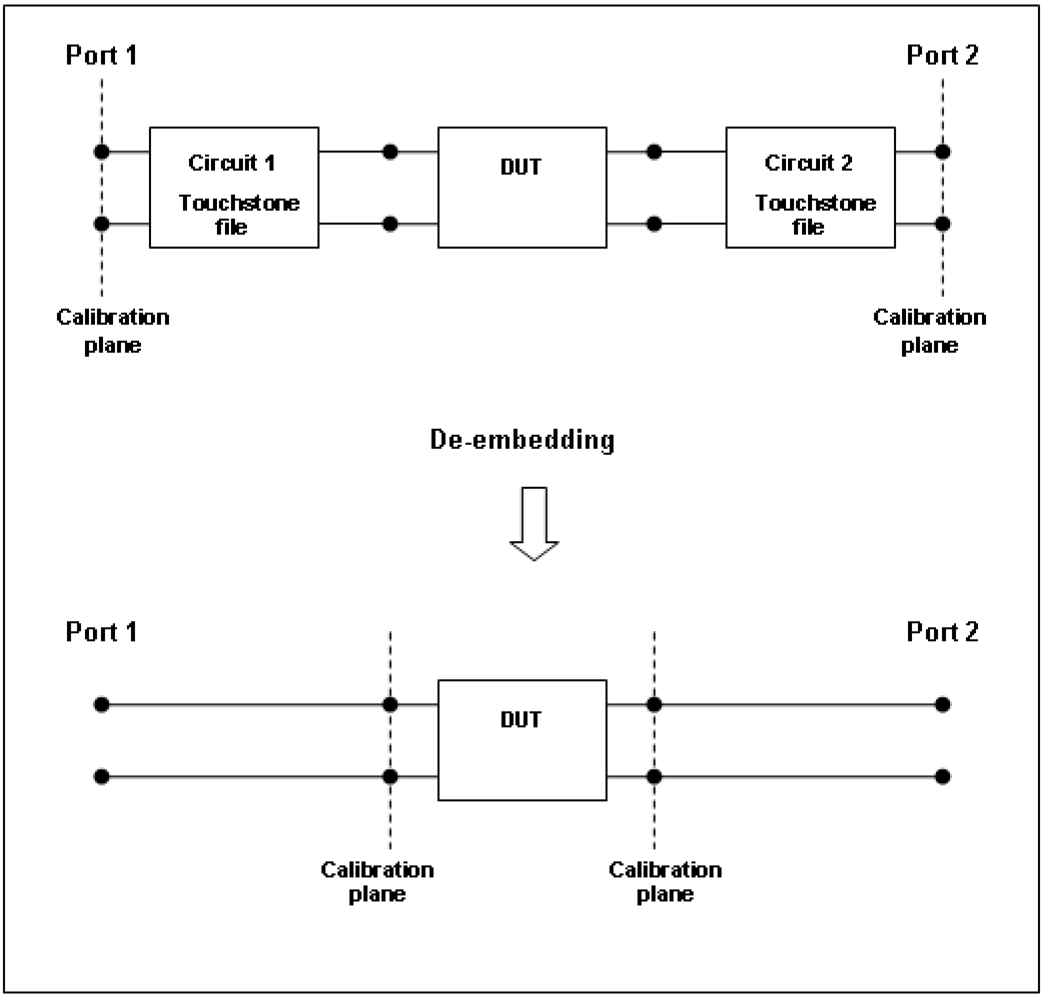
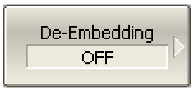
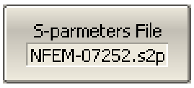


Figure 7.11 De-embedding



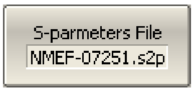
To enable de-embedding function, use «De-embedding» softkey.

The label on the softkey indicates the status of the function. «On» label means that the de-embedding function is enabled at least for one of the test ports.



To enter the file name of the de-embedded circuit S-parameters of Port 1, use «S-parameters File» softkey.

After you have specified the file, you can enable the function for Port 1 using «Port 1» softkey. If the file is not specified this softkey is inactive.



To enter the file name of the de-embedded circuit S-parameters of Port 2, use «S-parameters File» softkey.

After you have specified the file, you can enable the function for Port 2 using «Port 2» softkey. If the file is not specified this softkey is inactive.

7.2.3. Embedding

Embedding is a function of DUT S-parameter transformation by virtual integration of some circuit into the real network (See figure 7.12). The embedding function is an inverted de-embedding function.

The circuit being integrated should be defined in the data file containing S-parameters of this circuit. The circuit should be described as a 2-port in Touchstone file (extension .s2p), which contains the S-parameter table: S_{11}, S_{21}, S_{12}, S_{22} for a number of frequencies.

The embedding function allows to mathematically simulate the DUT parameters after adding of the fixture circuits.

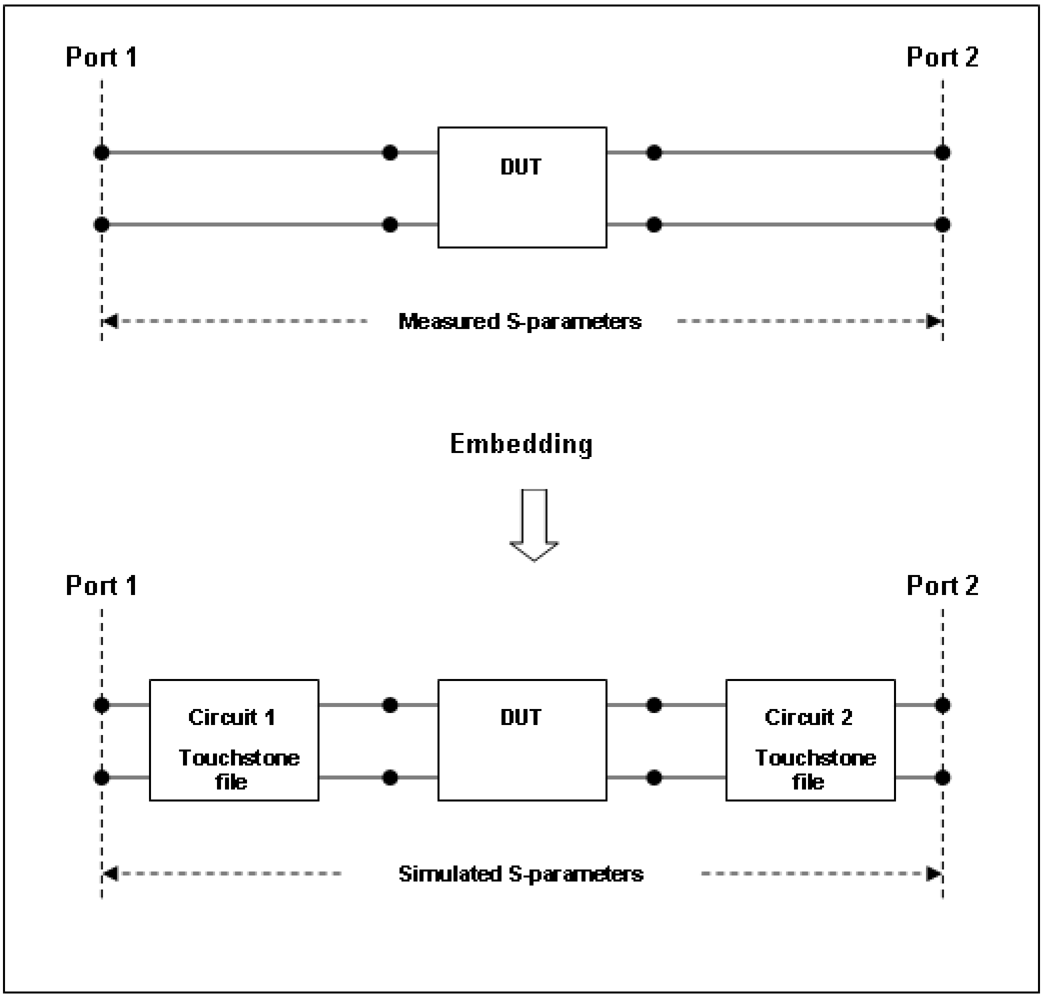
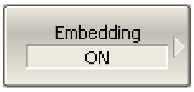
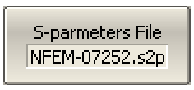


Figure 7.12 Embedding



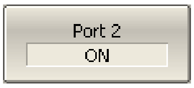
To enable embedding function, use «Embedding» softkey.

The label on the softkey indicates the status of the function. «On» label means that the embedding function is enabled at least for one of the test ports.

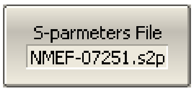


To enter the file name of the embedded circuit S-parameters of Port 1, use «User File» softkey.

After you have specified the fil, you can enable the function for Port 1 using «Port 1» softkey. If the file is not specified this softkey is inactive.



To enter the file name of the embedded circuit S-parameters of Port 2, use «User File» softkey.



After you have specified the file, you can enable the function for Port 2 using «Port 2» softkey. If the file is not specified this softkey is inactive.

7.3. Time Domain Transformation

The Analyzer measures and displays parameters of the DUT in frequency domain. Time domain transformation is a function of mathematical modification of the measured parameters in order to obtain the time domain representation.

For time domain transformation Z-transformation and frequency domain window function are applied.

The time domain transformation can be activated for separate traces of a channel. The current parameters (S_{11}, S_{21}, S_{12}, S_{22}) of the trace will be transformed into the time domain.

Note	Traces in frequency and time domains can simultaneously belong to one channel. The stimulus axis label will be displayed for the active trace, in frequency or time units.

The transformation function allows for setting of the measurement range in time domain within Z-transformation ambiguity range. The ambiguity range is defined by the measurement step in the frequency domain:

$$\Delta T = \frac{1}{\Delta F}; \quad \Delta F = \frac{F\max - F\min}{N-1}$$

The time domain function allows to select the following transformation types:

- **Bandpass mode** allows to obtain the response for circuits incapable of direct current passing. The frequency range is arbitrary in this mode. The impulse bandpass response will be represented. The time domain resolution in this mode is twice lower than it is in the lowpass mode;
- **Lowpass mode** should be applied to the circuits passing direct current, and the direct component (in point F=0) is interpolated of the adjacent measurements. In this mode the frequency range represents a harmonic grid where the frequency value at each frequency point is an integer multiple of the start frequency of the range Fmin. Lowpass impulse and step responses will be represented. The time domain resolution is twice higher than it is in the bandpass mode.

The time domain transformation function offers selection of frequency domain window types. The window function allows to reduce the ringing (side lobes) in the time domain. The ringing is caused by the abrupt change of the data at the limits of the frequency domain. But while side lobes are reduced, the main pulse or front edge of the lowpass step becomes wider. The following three preprogrammed types of windows are available:

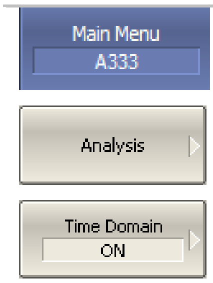
- **Minimum** (rectangular) window;
- **Normal** window;
- **Maximum** window.

You can smoothly fine-tune the window settings from minimum to maximum, entering the numerical values.

Table 7.4 Preprogrammed window types

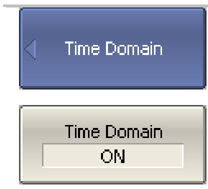
Window	Lowpass Impulse		Lowpass Step	
	Side Lobes Level	Pulse Width	Side Lobes Level	Edge Width
Minimum	– 13 дБ	$\frac{0.6}{F\max - F\min}$	– 21 dB	$\frac{0.45}{F\max - F\min}$
Normal	– 44 dB	$\frac{0.98}{F\max - F\min}$	– 60 dB	$\frac{0.99}{F\max - F\min}$
Maximum	– 75 dB	$\frac{1.39}{F\max - F\min}$	– 70 dB	$\frac{1.48}{F\max - F\min}$

The time domain transformation function can be applied to a separate trace of the channel. Before modeling a time domain, select the active trace.



To access the time domain submenu, use «Analysis» - «Time Domain» softkeys.

7.3.1. Time Domain Transformation Enabling/Disabling



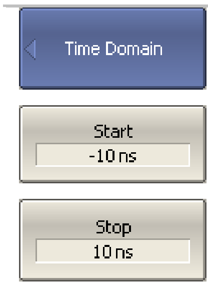
To enable or disable time domain transformation function, use «Time Domain» softkey.

The label on the softkey indicates the status of the function.

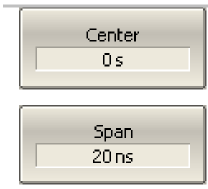
Note: Time domain transformation function is accessible only in linear frequency sweep mode.

7.3.2. Time Domain Transformation Range

To define the range of time domain representation you can set start and stop, or center and span, values of the range.

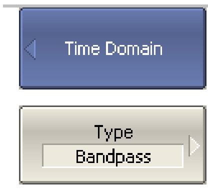


To set the start and stop limits of the time domain range, use «Start» and «Stop» softkeys respectively.



To set the center and span of the time domain, use «Center» and «Span» softkeys respectively.

7.3.3. Time Domain Transformation Type

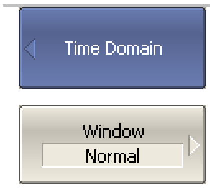


To set the time domain transformation type, click «Type» softkey.

Then select the required type using the corresponding softkey:

- Bandpass;
- Lowpass Impulse;
- Lowpass Step.

7.3.4. Window Layout Setting



To set the window layout, click «Window».

Then select the required type in the submenu:

- Minimum;
- Normal;
- Maximum.

To set the window layout for the specific impulse width or front edge width, use «Impulse Width» softkey. The setting values are limited by the specified frequency range. The bottom limit corresponds to the value implemented in the minimum (rectangular) window. The top limit corresponds to the value implemented in the maximum window.

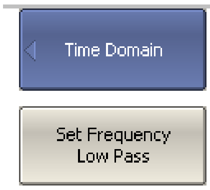
To set the window layout for the specific β-parameter of the Ka The frequency range will be transformed as follows:iser-Bessel filter, use «Kaiser Beta» softkey. The available β values are from 0 to 13. 0 corresponds to minimum window, 6 corresponds to normal window, 13 corresponds to maximum widow.

Note

The impulse width and β of the Kaiser-Bessel filter are the dependent parameters. When you set one of the parameters the other one will be adjusted automatically.

7.3.5. Frequency Harmonic Grid Setting

If lowpass impulse or lowpass step transformation is enabled, the frequency range will be represented as a harmonic grid. The frequency values in measurement points are integer multiples of the start frequency Fmin. The Analyzer is capable of creating a harmonic grid for the current frequency range automatically.



To create a harmonic grid for the current frequency range, use «Set Frequency Low Pass» softkey.

Note

The frequency range will be transformed as follows:

Fmax > N x 0.3 MHz	Fmax < N x 0.3 MHz
Fmin = Fmax / N	Fmin = 0.3 MHz, Fmax = N x 0.3 MHz

7.4. S-Parameter Conversion

S-parameter conversion function allows conversion of the measurement results (S_{ab}) to the following parameters:

- Equivalent impedance (Zr) and equivalent admittance (Yr) in reflection measurement:

$$Z_r = Z_{0a} \cdot \frac{1 + S_{ab}}{1 - S_{ab}}, \qquad Y_r = \frac{1}{Z_r}$$

- Equivalent impedance (Zt) and equivalent admittance (Yr) in transmission measurement:

$$Z_t = \frac{2 \cdot \sqrt{Z_{0a} \cdot Z_{0b}}}{S_{ab}} - (Z_{0a} + Z_{0b}), \qquad Y_t = \frac{1}{Z_t}$$

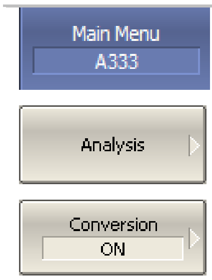
- Inverse S-parameter ($\frac{1}{S_{ab}}$).

Where:

Z_{0a} – characteristic impedance of Port a,

Z_{0b} – characteristic impedance of Port b.

S-parameter conversion function can be applied to the individual traces of the channel. Before enabling the function assign the active trace.



To access S-parameter conversion submenu, use «Analysis» - «Conversion» softkeys.

Then enable the parameter conversion using «Conversion» softkey.

To set the type of conversion, click «Function» softkey and select the required type in the submenu:

- Z: reflection;
- Z: transmission;
- Y: reflection;
- Y: transmission;
- 1/S: inverse.

Note	The trace status field will indicate the conversion type, if enabled.

7.5. Limit Test

The limit test is a function of automatic pass/fail judgment for the trace of the measurement result. The judgment is based on the comparison of the trace to the limit line set by the user.

The limit line can consist of one or several segments (See figure 7.13). Each segment checks the measurement value for failing whether upper or lower limit. The limit line segment is defined by specifying the coordinates of the beginning (X_0, Y_0) and the end (X_1, Y_1) of the segment, and type of the limit. The MAX or MIN limit types check if the trace falls outside of the upper or lower limit respectively.

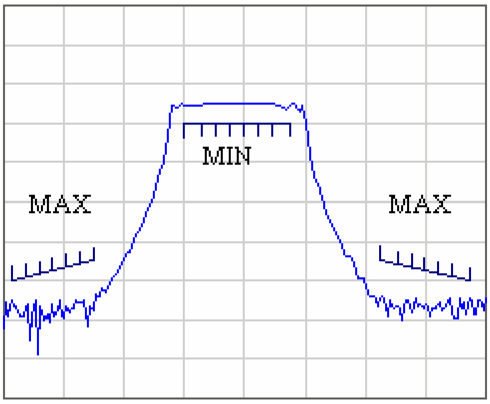


Figure 7.13 Limit line

The limit line is set by the user in the limit table. Each row in the table describes one segment of the line. Limit table editing is described below. The table can be saved into a *.lim file.

The limit test function can be enabled/disable by the user. The indication of the limit line on the screen can be turned on/off independently of the status of the function.

If the limit test function is enabled, the [Lim] label will be indicated in the trace status field. If the measurement result passed the judgment the label will remain unchanged.

If the measurement result failed the judgment the Analyzer will indicate it in the following ways (See figure 7.14):

- «Fail» label will be displayed in red in the trace status field;
- The points of the trace, which failed the judgment will be highlighted in red in the graph;
- «Fail» label will appear in the center of the graph, this feature can be disabled.

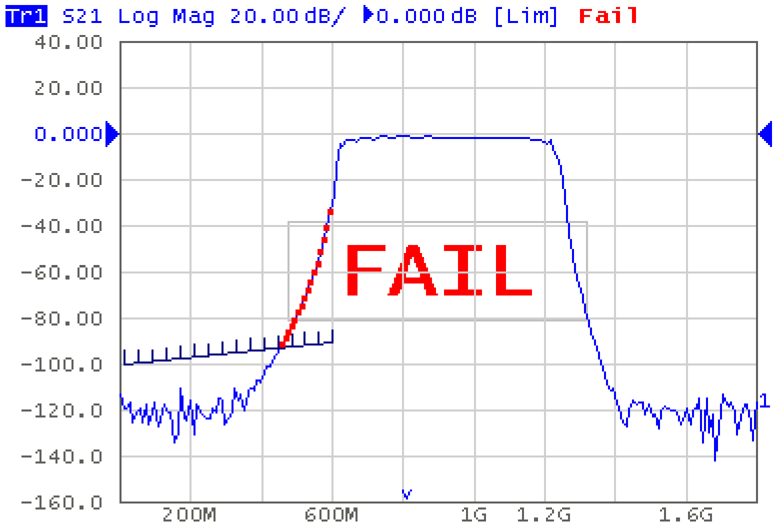
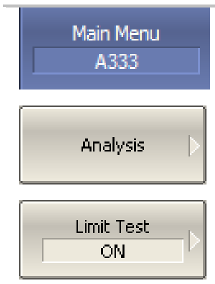


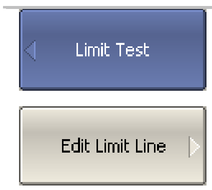
Figure 7.14 Judgment failing indication

The limit test can be applied to the individual traces of the channel. Before enabling the limit test assign the active trace.



To access the limit test submenu, use «Analysis» - «Limit Test» softkeys.

7.5.1. Limit Line Editing



To access the limit line editing mode, click «Edit Limit Line» softkey.

In the editing mode the limit table will appear in the lower part of the screen (See figure 7.15). The limit table will be hidden when you quit the submenu.

	Type	Begin Stimulus	End Stimulus	Begin Response	End Response
1	MAX	10 MHz	400 MHz	-100 dB	-90 dB
2	MIN	700 MHz	1.2 GHz	-6 dB	-6 dB
3	MAX	1.4 GHz	2 GHz	-90 dB	-100 dB
4					

Figure 7.15 Limit line table

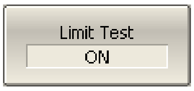
Edit Limit Line Add	To add a new row in the table, click «Add». The new row will appear below the highlighted one.
Delete	To delete a row from the table, click «Delete». The highlighted row will be deleted.
Clear Limit Table	To clear the entire table, use «Clear Limit Table» softkey.
Save Limit Table	To save the table into *.lim file, use «Save Limit Table» softkey.
Restore Limit Table	To open the table from a *.lim file, use «Restore Limit Table» softkey.

You can navigate in the table using arrow keys on the keyboard or by the mouse. Enter the values of the following parameters of a limit line segment:

Type	Select the limit type among the following: ▪ MAX – upper limit ▪ MIN – lower limit ▪ OFF — segment not used for the limit test
Begin Stimulus	Stimulus value in the beginning point of the segment.
End Stimulus	Stimulus value in the ending point of the segment.

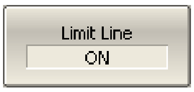
Begin Response	Response value in the beginning point of the segment.
End Response	Response value in the ending point of the segment.

7.5.2. Limit Test Enabling/Disabling



To enable/disable limit test function, use «Limit Test» softkey.

7.5.3. Limit Test Indication Management



To turn on/off the display of a limit line, use «Limit Line» softkey.

To turn on/off the display of «Fail» label in the center of the graph, use «Fail Sign» softkey.

7.6. Memory Trace Function

For each data trace displayed on the screen a so-called memory trace can be created. The memory trace is displayed in the same color as the main data trace, but its brightness is twice lower[5].

The data trace shows the currently measured data and is continuously being updated as the measurement goes on.

The memory trace is a data trace saved into the memory. It is created by the user by clicking the corresponding softkey. After that the new memory trace automatically becomes displayed on the screen simultaneously with the data trace. The user can show/hide both traces independently of each other. The trace status field will indicate the following:

- **D&M** – data trace and memory trace are displayed;
- **M** – memory trace is displayed;

[5] The color and brightness of the data and memory traces can be customized by the user (See section 4.6).

- **OFF** – both traces are not displayed**.**

When only data trace is displayed on the screen, the trace status field shows no specific indication.

The memory trace bears the following features of the data trace (which if changed, will **clear** the memory):

- frequency range,
- number of points,
- sweep type.

The memory trace has the following settings common with the data trace (which if changed, modifies the both traces):

- format,
- scale,
- smoothing,
- electrical delay.

The following data trace settings (if changed after the memory trace creation) do not influence the memory trace:

- stimulus auxiliary parameters (e.g. power in frequency sweep mode),
- measured parameter (S-parameter),
- IF bandwidth,
- averaging,
- calibration.

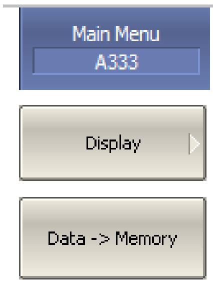
The memory trace can be used for math operations with the data trace. The resulting trace of such an operation will replace the data trace. The math operations with memory and data traces are performed in complex values. The following four math operations are available:

Data / Memory	Divides the measured data by the data in the memory trace. The trace status field indicates: **D/M**.
Data * Memory	Multiplies the measured data by the memory trace. The trace status field indicates: **D*M**.

Data – Memory	Subtracts a memory trace from the measured data. The trace status field indicates: **D–M**.
Data + Memory	Adds the measured data and the data in the memory trace. The trace status field indicates: **D+M**.

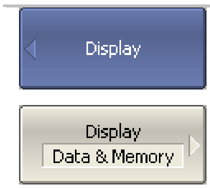
7.6.1. Saving Trace into Memory

The memory trace function can be applied to the individual traces of the channel. Before you enable this function, assign the active trace.



To save a trace into the memory, use «Display» and «Data->Memory» softkeys.

7.6.2. Trace Display Setting

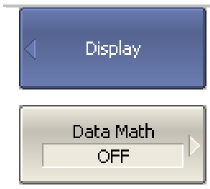


To set the type of data to be displayed on the screen, click «Display» softkey.

Then select the required trace type in the submenu:

- Data;
- Memory;
- Data & Memory;
- OFF

7.6.3. Mathematical Operations



To access math operations, click «Data Math» softkey.

Then select the required operation from the submenu:

- Data / Mem;
- Data * Mem;
- Data – Mem;
- Data + Mem;
- OFF

8. ANALYZER DATA OUTPUT

8.1. Analyzer State Saving and Recalling

The Analyzer state, calibration and measured data can be saved on the hard disk drive into an Analyzer state file and then can be uploaded back into the Analyzer program. The following four types of saving are available:

State	The Analyzer settings.
State & Cal	The Analyzer settings and the table of calibration coefficients.
State & Trace	The Analyzer settings and data traces[6].
All	The Analyzer settings, table of calibration coefficients, and data traces[1].

The Analyzer settings that become saved into the Analyzer state file are the parameters, which can be set in the following submenus of the softkey menu:

- All the parameters in «Stimulus» submenu;
- All the parameters in «Measurement» submenu;
- All the parameters in «Format» submenu;
- All the parameters in «Scale» submenu;
- All the parameters in «Average» submenu;
- All the parameters in «Display» submenu except for «Properties»;
- All the parameters of «Markers» submenu;
- All the parameters of «Analysis» submenu;
- «Ref Source» parameter in «System» submenu.

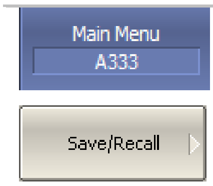
[6] When recalling the state with saved data traces, the trigger mode will be automatically set to «Hold», so that the recalled traces cannot be erased by the currently measured data.

To save and recall a state file, you can use ten softkeys labeled *State01, ... State10*. Each of the softkeys correspond to a **.sta* file having the same name.

To have the Analyzer state automatically recalled after each start of the instrument use *Autorecall.sta* file. Use «Autorecall» softkey to save the corresponding file and thus enable this function.

To disable the automatic recall of the Analyzer state, delete the *Autorecall.sta* file using the specific softkey.

You can save and recall the files with arbitrary names. For this purpose use «File...» softkey, which will open the «Save as» dialog box.



To open the menu for saving and recalling of the Analyzer state, use «Save/Recall» softkey.

8.1.1. Analyzer State Saving

To set the type of saving, use «Save Type» softkey.

Then select one of the options:

- State
- State & Cal
- State & Trace
- All

Then click «Save State» softkey.

...

To save a state into one of the ten files, use *State01…State10* softkeys.

A check mark in the left part of the softkey indicates that the state with the corresponding number is already saved.

To save the state, which will be automatically recalled after each start of the Analyzer, use «Autorecall» softkey.

A check mark on the softkey indicates that such a state is already saved.

File...	To save a state into the file with an arbitrary name use «File...» softkey.

8.1.2. Analyzer State Recalling

Save/Recall Recall State	To recall the state from a file of Analyzer state, use «Recall State» softkey.
State01 … State10	Click the required softkey of the available *State01…State10.* If the state with some number was not saved the corresponding softkey will be inactive.
Autorecall	You can select the state automatic recall file by clicking «Autorecall» softkey.
File...	To recall a state from the file with an arbitrary name, use «File...» softkey.

8.2. Data File Saving

The Analyzer allows saving the measured parameters of the active channel into a Touchstone file. For 2-port measurements the file will be *.s2p. All the four S-parameters along with the corresponding frequency points are saved into the file. If the active channel does not contain the traces of all the S-parameters, then the parameters which were not measured will be represented as zeros in the file.

Note	If full 2-port calibration is active, all the four S-parameters are measured in the channel independently of the number of traces.

The format of a Touchstone file for 2-port measurement is shown below:

 # Hz S FMT R Z0

F[0] $\{S_{11}\}'$ $\{S_{11}\}''$ $\{S_{21}\}'$ $\{S_{21}\}''$ $\{S_{12}\}'$ $\{S_{12}\}''$ $\{S_{22}\}'$ $\{S_{22}\}''$

F[1] $\{S_{11}\}'$ $\{S_{11}\}''$ $\{S_{21}\}'$ $\{S_{21}\}''$ $\{S_{12}\}'$ $\{S_{12}\}''$ $\{S_{22}\}'$ $\{S_{22}\}''$

...

F[N] $\{S_{11}\}'$ $\{S_{11}\}''$ $\{S_{21}\}'$ $\{S_{21}\}''$ $\{S_{12}\}'$ $\{S_{12}\}''$ $\{S_{22}\}'$ $\{S_{22}\}''$

Hz – frequency measurement unit (kHz, MHz, GHz)

FMT – data format:

- RI – real and imaginary parts,
- MA – linear magnitude and phase in degrees,
- DB – logarithmic magnitude in dB and phase in degrees.

Z0 – reference impedance value

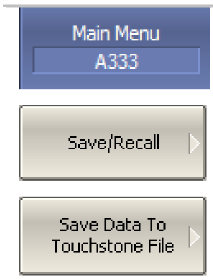
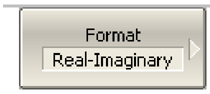
F[n] – frequency at measurement point n

{…}′ – real part (RI), linear magnitude (MA), logarithmic magnitude (DB)

{…}″ – imaginary part (RI), phase in degrees (MA), phase in degrees (DB)

8.2.1. Touchstone File Saving

The Touchstone file saving is applied to individual channels. Before you enable this function, assign the active channel.

	To save the data into a Touchstone file, use «Save/Recall» - «Save 2-Port Touchstone File» softkeys.
	Set the formant of the data using «Format» softkey. Select one of the options: ▪ Real-Imaginary – real / imaginary part

- Magnitude-Angle – linear magnitude / phase
- dB-Angle – logarithmic magnitude / phase

	Click «Save File...» softkey to open «Save as» dialog box.

8.3. Diagram Printout

This section describes the print/save procedures for the graphic data.

The print function is provided with the preview feature, which allows the user to view the image to be printed on the screen, and/or save it into a file.

You can print out the diagrams using three different applications:

- MS Word;
- Image Viewer for Windows;
- Print Wizard

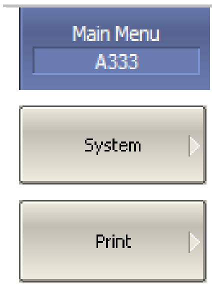
Note	MS Word application must be installed in Windows system.
Note	Image Viewer for Windows must be properly assigned.
Note	The Print Wizard requires at least one printer to be installed in Windows.

You can select the print color before the image is transferred to the printing application:

- Color (no changes);
- Gray Scale;
- Black & White.

You can invert the image before it is transferred to the printing application.

You can add current date and time before the image is transferred to the printing application.

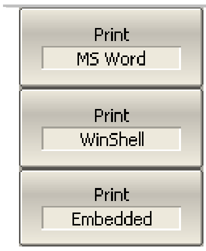
	To print out diagrams, click «System» - «Print».

Select the print color using «Print Color» softkey:

- Color
- Gray Scale
- Black & White

If necessary, invert the image by «Invert Image» softkey.

If necessary, select printing of date and time by «Print Date & Time» softkey..



Then select the printing application using one of the following softkeys:

- «Print: MS Word»
- «Print: WinShell»
- «Print: Embedded»

9. MAINTENANCE AND STORAGE

9.1. Maintenance Procedures

This section describes the guidelines and procedures of maintenance, which will ensure fault-free operation of your Analyzer.

The maintenance of the Analyzer consists in cleaning of the instrument, factory calibrations, and regular performance tests.

9.1.1. Instrument Cleaning

This section provides the cleaning instructions required for maintaining the proper operation of your Analyzer.

To remove contamination from parts other than test ports and any connectors of the Analyzer, wipe them gently with a soft cloth that is dry or wetted with a small amount of water and wrung tightly.

It is essential to keep the test ports always clean as any dust or stains on them can significantly affect the measurement capabilities of the instrument. To clean the test ports (as well as other connectors of the Analyzer), use the following procedure:

- using compressed air remove or loosen the contamination particles;

- clean the connectors using a lint-free cleaning cloth wetted with a small amount of ethanol and isopropyl alcohol (when cleaning a female connector, avoid snagging the cloth on the center conductor contact fingers by using short strokes);

- dry the connector with low-pressure compressed air.

Always completely dry a connector before using it.

Never use water or abrasives for cleaning any connectors of the Analyzer.

Do not allow contact of alcohol to the surface of the insulators of the connectors.

When connecting male-female coaxial connectors always use a calibrated wrench.

Warning	**Never perform cleaning of the instrument if the power cable is connected to the power outlet.** **Never clean the internal components of the instrument.**

9.1.2. Factory Calibration

Factory calibration is a regular calibration performed by the manufacturer or an authorized service center. We recommend you to send your Analyzer for factory calibration every three years.

9.1.3. Performance Test

Performance test is the procedure of the Analyzer performance verification by confirming that the behavior of the instrument meets the published specifications.

Performance test of the Analyzer should be performed in accordance with «Performance Test Instructions for A333 Network Analyzers».

The Analyzer software is provided with "System"->"Performance Test" submenu for automatic verification execution.

Performance test period is one year.

9.2. Storage Instructions

Before first use store your Analyzer in the factory package at environment temperature from 0 to +40 ºC and relative humidity up to 80% (at 25 ºC).

After you have removed the factory package store the Analyzer at environment temperature from +10 to +35 ºC and relative humidity up to 80% (at 25 ºC).

Ensure to keep the storage facilities free from dust, fumes of acids and alkalies, aggressive gases, and other chemicals, which can cause corrosion.

10. WARRANTY INFORMATION

1. The manufacturer warrants the Network Analyzer to conform to the specifications of this Manual when used in accordance with the regulations of operation detailed in this Manual.

2. The manufacturer will repair or replace without charge, at its option, any Analyzer found defective in manufacture within the warranty period, which is twelve (12) months from the date of purchase. Should the user fail to submit the warranty card appropriately certified by the seller with its stamp and date of purchase the warranty period will be determined by the date of manufacture.

3. The warranty is considered void if:

a) the defect or damage is caused by improper storage, misuse, neglect, inadequate maintenance, or accident;

b) the product is tampered with, modified or repaired by an unauthorized party;

c) the product's seals are tampered with;

d) the product has mechanical damage.

4. The batteries are not included or covered by this warranty.

5. Transport risks and costs to and from the manufacturer or the authorized service centers are sustained by the buyer.

6. The manufacturer is not liable for direct or indirect damage of any kind to people or goods caused by the use of the product and/or suspension of use due to eventual repairs.

7. When returning the faulty product please include the accurate details of this product and clear description of the fault. The manufacturer reserves the right to check the product in its laboratories to verify the foundation of the claim.

Technical Support

Phone:

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Write:

GS Instruments, Co., Ltd.
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Revision History

Date	Version	Changes
11/2007	Original	

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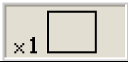
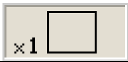
Specifications and features of this manual are subject to change without notice or obligation.

Appendix 1 — Default Settings Table

Below are the default values defined in the process of the initial factory setting.

Parameter Description	Default Setting	Parameter Setting Object
Data Saving Type	State and Calibration	Analyzer
Touchstone Data Format	Real-Imaginary	Analyzer
Allocation of Channels		Analyzer
Active Channel Number	1	Analyzer
Marker Value Identification Capacity (Stimulus)	7 digits	Analyzer
Marker Value Identification Capacity (Response)	4 digits	Analyzer
Marker Table	OFF	Analyzer
Reference Frequency Source	Internal	Analyzer
Trigger Signal Source	Internal	Analyzer
Reference Channel Error Correction	ON	Analyzer
Factory Calibration	ON	Analyzer
Allocation of Traces		Channel
Vertical Divisions	10	Channel
Channel Title Bar	OFF	Channel
Channel Title	Empty	Channel
«FAIL» Label Display (Limit Test)	OFF	Channel
Segment Sweep Frequency Axis Display	Frequency Order	Channel
Traces per Channel	1	Channel
Active Trace Number	1	Channel
Marker Coupling	ON	Channel
Sweep Type	Linear Frequency	Channel
Number of Sweep Points	201	Channel
Stimulus Start Frequency	300 kHz	Channel
Stimulus Stop Frequency	3.2 GHz	Channel
Stimulus CW Frequency	300 kHz	Channel
Stimulus Start Power Level	-45 dBm	Channel
Stimulus Stop Power Level	10 dBm	Channel
Stimulus CW Power Level	0 dBm	Channel
Stimulus Power Slope	0 dBm	Channel
Stimulus IF Bandwidth	10 kHz	Channel

Sweep Measurement Delay	0 sec.	Channel
Sweep Range Setting	Start / Stop	Channel
Number of Segments	1	Channel
Points per Segment	2	Channel
Segment Start Frequency	300 kHz	Channel
Segment Stop Frequency	300 kHz	Channel
Segment Sweep Power Level	0 dBm	Channel
Segment Sweep IF Bandwidth	10 kHz	Channel
Segment Sweep Measurement Delay	0 sec.	Channel
Segment Sweep Power Level (Table Display)	OFF	Channel
Segment Sweep IF Bandwidth (Table Display)	OFF	Channel
Segment Sweep Measurement Delay (Table Display)	OFF	Channel
Segment Sweep Range Setting	Start / Stop	Channel
Averaging	OFF	Channel
Averaging Factor	10	Channel
Trigger Mode	Continuous	Channel
Table of Calibration Coefficients	Empty	Channel
Error Correction	OFF	Channel
Port Z Conversion	OFF	Channel
Port 1 Simulated Impedance	50 Ω	Channel
Port 2 Simulated Impedance	50 Ω	Channel
Port 1 De-embedding	OFF	Channel
Port 2 De-embedding	OFF	Channel
Port 1 De-embedding S-parameter File	Empty	Channel
Port 2 De-embedding S-parameter File	Empty	Channel
Port 1 Embedding	OFF	Channel
Port 2 Embedding	OFF	Channel
Port 1 Embedding User File	Empty	Channel
Port 2 Embedding User File	Empty	Channel
Measurement Parameter	S_{11}	Trace
Trace Scale	10 dB / Div.	Trace
Reference Level Value	0 dB	Trace
Reference Level Position	5 Div.	Trace
Data Math	OFF	Trace
Phase Offset	0°	Trace
Electrical Delay	0 sec.	Trace

S-parameter Conversion	OFF	Trace
S-parameter Conversion Function	Z: Reflection	Trace
Trace Display Format	Logarithmic Magnitude (dB)	Trace
Time Domain Transformation	OFF	Trace
Time Domain Transformation Start	-10 nsec.	Trace
Time Domain Transformation Stop	10 nsec.	Trace
Time Domain Kaiser-Beta	6	Trace
Time Domain Transformation Type	Bandpass	Trace
Smoothing	OFF	Trace
Smoothing Aperture	1%	Trace
Trace Display Mode	Data	Trace
Limit Test	OFF	Trace
Limit Line Display	OFF	Trace
Defined Limit Lines	Empty	Trace
Number of Markers	0	Trace
Marker Position	300 kHz	Trace
Marker Search	Maximum	Trace
Marker Tracking	OFF	Trace
Marker Search Target	0 dB	Trace
Marker Search Target Transition	Both	Trace
Marker Search Peak Polarity	Positive	Trace
Marker Search Peak Excursion	3 dB	Trace
Bandwidth Parameter Search	OFF	Trace
Marker Search Bandwidth Value	-3 dB	Trace
Marker Search Range	OFF	Trace
Marker Search Start	0	Trace
Marker Search Stop	0	Trace

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