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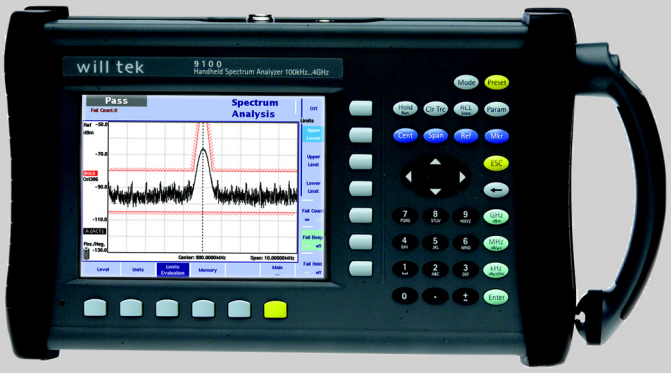
Willtek 9101

Handheld Spectrum Analyzer



user's guide

version 2.21

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Table of Contents

About This Guide xi

Purpose and scope . . . xii
Assumptions . . . xii
Related information . . . xii
Hardware-related changes . . . xii
Technical assistance . . . xiii
Conventions . . . xiii

Safety Notes xv

Safety warnings . . . xvi

Chapter 1 Overview 1

About the 9101 Handheld Spectrum Analyzer . . . 2
What's new in version 2.21 . . . 2
New in version 2.20 . . . 3
New in version 2.10 . . . 3
New in version 1.54 . . . 3
Features and capabilities . . . 4
Options . . . 4
Physical description . . . 5
Maintaining your unit . . . 5

Chapter 2 General Operation 7

Connecting the 9101 Handheld Spectrum Analyzer . . . 8
DC IN connector . . . 8
RF IN connector . . . 8
EXT. TRIG. connector . . . 9
SERIAL (RS-232) connector . . . 9
LAN connector . . . 9

Powering up the unit 9
Starting measurements 9
Using the front panel 10
Overview 10
Battery status LED 10
Display 11
Results area 11
Marker field 13
Input field 13
Softkey descriptions 14
Keypad 14
Function keys 14
Cursor keys 15
Numeric keys 16
Enter keys 16
Escape key 17
Backspace key 17
Softkeys 17
Entering numbers and text 18
Filling in a numerical input field 18
Filling in a text input field 19
Changing the input 19
Selecting the measurement mode 20
Working with the markers 21
Enabling and moving a marker 21
Disabling a marker 22
Enabling a delta marker 22
Disabling a delta marker 22
Setting a marker on a frequency relative to marker M1 22
Changing the center frequency with a marker 23
Changing the reference level with the marker 23
Assigning the marker frequency to FStep 23
Using limit lines 24
Overview 24
Using simple limits 25
Switching simple limits on and off 25
Defining upper and lower limits 25
Using limit templates 26
Selecting limit lines within the 9101 26
Activating and deactivating limit templates 26
Deleting limit files in the 9101 26
Counting limit failures 26
Resetting the counter 27
Enabling a beep upon failures 27
Viewing a failed measurement 27
Controlling the 9101 from a PC 27
Returning from remote control to local mode 27
Checking general settings 28
Reading the serial number 28
Reading the software version number 28
Reviewing the calibration 28
Checking installed options 29
Installing a new option 29
Changing the display brightness 30

Enabling and disabling beeps 30
Assigning a device name to the instrument 31
Adjusting date and time in the instrument 31
Changing the bit rate on the RS-232 port 32
Changing the IP address of the 9101 32
Changing the IP address of the PC 33
Changing the IP port used by the 9101 33
Selecting user interface colors 34
Working with stored settings 35
Storing settings on the 9101 35
Using previously stored settings 36

Chapter 3 Spectrum Analysis Operation 37
Selecting the measurement mode 38
Changing the frequency settings 38
Setting start and stop frequency 39
Setting center frequency and span 39
Changing the main menu for different frequency parameters 39
Viewing the complete frequency band 40
Performing measurements in the time domain 40
Selecting the step size for the frequency input 40
Selecting RBW, VBW and SWT 41
Setting up the level parameters 41
Setting the reference level 42
Setting the hardware attenuation 42
Changing the vertical scale 42
Selecting the level unit for input and output 43
Compensating gains and losses 43
Enabling external device compensation 43
Turning external device compensation off 43
Deleting files for external device compensation 44
Changing the input impedance 44
Applying special functions on the signal 44
Using a signal trigger 45
Performing a limited number of measurements 46
Demodulating an AM or FM signal 47
Setting up the trace 48
Selecting the trace mode 48
Turning the second trace on and off 50
Defining the number of measurements for averaging 50
Selecting the detection method 51
Copying traces inside the 9101 51
Storing and loading traces 53
Storing a trace 53
Reusing a trace name 54
Reloading a trace 54
Deleting a trace 54
Deleting all traces 54
Storing and loading instrument settings 55
Special measurement functions 55
Channel power 55
Adjacent channel power ratio (ACPR) 56

Occupied bandwidth (OBW) 56
Selecting the measurement type 57
Switching special measurement functions off 57
Changing the channel width 57
Changing the channel spacing 58
Reading the channel power 58
Changing the occupied bandwidth percentage 58
Changing general analyzer parameters 58

Chapter 4 Channel Power Operation 59

About measurement modes and types 60
Channel power 60
Adjacent channel power ratio (ACPR) 61
Occupied bandwidth (OBW) 61
Selecting the measurement mode 62
Operating in channel power mode 63
Reading the channel power 64
Changing the occupied bandwidth percentage 64
Working with communication systems and frequency settings 64
Selecting a communication system on the 9101 64
Setting up a new communication system 65
Deleting a communication system 66
Deleting all communication systems 66
Undeleting default communication systems 66
Using the 91xx Data Exchange Software with communication systems . . 67
Defining the frequency span 67
Changing the channel 67
Changing the sweep time 67
Setting up the level parameters 67
Setting the reference level 68
Setting the hardware attenuation 68
Changing the vertical scale 69
Selecting the level unit for input and output 69
Compensating gains and losses 69
Enabling external device compensation 69
Turning external device compensation off 69
Deleting files for external device compensation 70
Changing the input impedance 70
Setting up the trace 71
Selecting the trace mode 71
Turning the second trace on and off 73
Defining the number of measurements for averaging 73
Selecting the detection method 73
Copying traces inside the 9101 74
Storing and loading traces 74
Storing a trace 75
Reusing a trace name 75
Reloading a trace 75
Deleting a trace 75
Deleting all traces 76
Storing and loading instrument settings 76

Chapter 5 **Troubleshooting** **77**
Handling system errors. . . . 78

Chapter 6 **Updating the Instrument's Software** **79**
The Setup Application Software menu. . . . 80
Performing a serial update 80
Performing a LAN update. . . . 81
Determining the Host IP address 81

Chapter 7 **91xx Data Exchange Software** **83**
About the 91xx Data Exchange Software 84
Installation requirements. . . . 84
Understanding the license conditions 84
Installing the software 84
Starting the software 84
Connecting the PC to the 9101 85
Using a predefined configuration for the connection. . . . 86
Serial interface connection 86
LAN (TCP/IP) connection. . . . 86
Saving the configuration 87
Loading measurement results from the 9101 87
Viewing the actual trace on the PC. . . . 87
Transferring a saved trace to the PC 88
Saving, loading and printing results on the PC 89
Storing results on the PC. . . . 89
Loading a trace file on the PC 89
Printing measurement results. . . . 89
Saving results to a graphics file 89
Saving results to a text file 90
Working with measurement results 90
Adding a marker. . . . 90
Using a grid 91
Entering text 91
Defining and loading limit templates 91
Defining limits 92
Changing limit lines 93
Displaying an example trace in the limits editing menu 93
Storing a template on the PC 93
Loading a template from the PC 94
Transferring a template to the 9101 94
Defining and loading external coupling parameters. . . . 95
Defining the external coupling factor. . . . 96
Loading an external coupling loss file to the 9101 96
Managing communication systems for channel power measurements 96
Editing communication system parameters on the PC. . . . 97
Working with settings 97
Exchanging a settings file between 9101 and PC 97
Changing 9101 settings on the PC. . . . 98
Managing files on the PC and on the 9101. . . . 98
File types and directory structure 98

Starting the file manager menu. 99
Copying configuration files from the 9101 to the PC. 100
Deleting files. 100

Chapter 8 SCPI Command Reference 101
Overview 102
General commands 102
Commands affecting the event status register 104
Commands affecting the service register 105
System commands 106
Sense commands. 111
Input commands 125
MMemory commands. 126
Instrument commands. 134
Display commands 134
Calculate commands 136
Format commands. 142
Service commands. 143
SCPI errors. 145

Chapter 9 Programming Examples 149
Overview 150
Command examples 150
Introduction 150
Prerequisites 150
Over serial interface 150
Over LAN interface 150
Settings 150
Center frequency 150
Span 151
Resolution bandwidth. 151
Video bandwidth 151
Sweep time 151
Reference level. 152
Scale 152
Input attenuation 152
Detector. 152
Trace 153
Marker 153
Measurements 153
Trace 153
Sweep. 154
Max Peak 154
Next Peak. 155
Marker level. 155
Marker frequency. 155

Others . . . 155
Identity . . . 155
Reset . . . 156
Error queue . . . 156
Echo . . . 156
Local mode . . . 156
Application examples . . . 157
Signal monitoring . . . 157
Signal search . . . 158

Appendix A **Menu Structure** **159**
Mode hardkey menus . . . 160
Application menus . . . 161

Appendix B **Index of SCPI Commands** **163**

Appendix C **Typical Application Examples** **167**
Taking measurements on a sine wave signal . . . 168
Frequency and level measurements . . . 168
Spurious and harmonics . . . 170
Taking measurements on a burst or clocked signal . . . 172
Analyzing spurious signals, temporary spikes and glitches . . . 175

Appendix D **Warranty and Repair** **179**
Warranty information . . . 180
Equipment return instructions . . . 181

Appendix E **Software License** **183**
End-user license agreement . . . 184

Publication History **185**

About This Guide

- "Purpose and scope" on page xii
- "Assumptions" on page xii
- "Related information" on page xii
- "Hardware-related changes" on page xii
- "Technical assistance" on page xiii
- "Conventions" on page xiii

Purpose and scope

The purpose of this guide is to help you successfully use the 9101 Handheld Spectrum Analyzer features and capabilities. This guide includes task-based instructions that describe how to install, configure, use, and troubleshoot the 9101 Handheld Spectrum Analyzer. Additionally, this guide provides a description of Willtek's warranty, services, license, and repair information.

Assumptions

This guide is intended for novice and intermediate users who want to use the 9101 Handheld Spectrum Analyzer effectively and efficiently. We are assuming that you are familiar with basic telecommunication concepts and terminology.

Related information

Use this guide in conjunction with the following information:

Doc. no. M 295 004: Willtek 9101 Handheld Spectrum Analyzer – getting started manual

Willtek also offers a glossary on "Spectrum and network analysis" terms. The ordering number is SPEC/CT805/0703/EN.

Hardware-related changes

Please note that instruments with a serial number higher than 0104000 have slightly different key descriptions on the front panel. This manual uses the key descriptions valid at the time of writing; for newer units, please use the following translation table.

Table 1 New and old key assignments

Key description for units with serial number > 0104000 (colored keys)	Key description for units with serial number < 0104000 (grey and black keys)
MODE	MEAS
PRESET	PRE
CLR TRC	SYS
PARAM	?
CENT	FREQ
REF	LEVEL
MKR	MARK
ENTER	✓

Technical assistance

If you need assistance or have questions related to the use of this product or call one of Willtek's technical assistance centers. You can also contact Willtek by e-mail at customer.support@willtek.com.

Table 2 Technical assistance centers

Region	Phone number	Fax number
UK	+44 (0) 20 8408 5720	+44 (0) 20 8397 6286
Europe, Middle East, Asia, Africa	+49 (0) 89 996 41 386 +49 (0) 89 996 41 227	+49 (0) 89 996 41 440
Americas	+1 317 595 2021 +1 866 WILLTEK	+1 317 595 2023

Questions regarding the 9101 Handheld Spectrum Analyzer can also be directed to **support.9101@willtek.com**.

Conventions

This guide uses naming conventions and symbols, as described in the following tables.

Table 3 Typographical conventions

Description	Example
User interface actions appear in this **typeface**.	On the Status bar, click **Start**.
Buttons or switches that you press on a unit appear in this **TYPEFACE**.	Press the **ON** switch.
Code and output messages appear in this `typeface`.	`All results okay`
Text you must type exactly as shown appears in this **`typeface`**.	Type: **`a:\set.exe`** in the dialog box.
Variables appear in this **<typeface>**.	Type the new **<hostname>**.
Book references appear in this **typeface**.	Refer to **Newton's Telecom Dictionary**
A vertical bar | means "or": only one option can appear in a single command.	`platform [a|b|e]`
Square brackets [ ] indicate an optional argument.	`login [platform name]`
Slanted brackets < > group required arguments.	`<password>`

Table 4 Keyboard and menu conventions

Description	Example
A plus sign + indicates simultaneous keystrokes.	Press **Ctrl+s**
A comma indicates consecutive keystrokes.	Press **Alt+f,s**
A slanted bracket indicates choosing a submenu from menu.	On the menu bar, click **Start > Program Files**.

Table 5 Symbol conventions

This symbol represents a general hazard.

This symbol represents a risk of electrical shock.

NOTE

This symbol represents a note indicating related information or tip.

Table 6 Safety definitions

WARNING

Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

Safety Notes

This chapter provides the safety notes for the 9101 Handheld Spectrum Analyzer.

Safety warnings

This product is designed for indoor use. As exposure to water can damage the instrument it has to be protected against moisture when used outdoors.

WARNING

This is a safety class A equipment in accordance with EN 61326. It may produce radio interference affecting household equipment; the user may be forced to execute appropriate measures against radiation.

WARNING

Only use a 50 Ω N-type connector to connect to the **RF IN** port of the 9101. Use of any other connector may result in damage of the instrument.

WARNING

Do not cover the ventilation slits (at the bottom left-hand corner and on the top). Covering them may result in serious damage and fire.

WARNING

The maximum input power level at the **RF IN** connector is 30 dBm (1 W). Higher input levels may result in serious damage of the instrument.

WARNING

Operate the instrument within the temperature range from 5°C (40°F) to 45°C (110°F) only. Operation outside this range will lead to invalid results.

Safety advice for the battery

Do not crush. Do not heat or incinerate. Do not short-circuit. Do not dismantle. Do not immerse in any liquid, it may vent or rupture! Do not charge below 0°C (32°F) nor above 45°C (110°F).

Battery usage

The battery is for use with the 9101 only. Willtek does not accept any liability for damage of the battery or other equipment if the battery is used with other electric or electronic equipment.

Overview

1

This chapter provides a general description of the 9101 Handheld Spectrum Analyzer. Topics discussed in this chapter include the following:

- "About the 9101 Handheld Spectrum Analyzer" on page 2
- "What's new in version 2.21" on page 2
- "Features and capabilities" on page 4
- "Options" on page 4
- "Physical description" on page 5
- "Maintaining your unit" on page 5

About the 9101 Handheld Spectrum Analyzer

The 9101 is a lightweight, full-featured spectrum analyzer for many applications:

- Used in mobile phone repair to detect and locate faulty parts of mobile phones and components.
- Used in R&D labs for basic measurements and verifiying EMI clean circuits.
- Used in manufacturing to check and align the output of the unit under test (UUT).
- Used in the field to measure and verify base station emissions.

This rugged instrument is suitable for stationary and mobile usage and meets many application needs.

What's new in version 2.21

Improvements:

- Frequency offset corrected for small span (< 200 kHz) and long sweep time (> 5 s)
- Displayed battery charge corrected, automatic battery voltage check and automatic correction of battery load during startup process.
- Automatic switch off from video trigger to free run implemented, when span is changed from zero span to span ≥ 100 kHz
- "Not loaded" will be displayed when no files (Limits, Channel settings) are loaded

New in version 2.20

New features:

- External device compensation
- Impedance selection 50/75 Ω
- Low battery alarm
- Parameter screens
- Copying between traces A and B
- Marker To FStep function
- Measurement types Channel Power/ACPR/OBW within Channel Power and Spectrum Analysis modes
- Permanent demodulation
- Limit settings file displayed
- Simple limits
- Traces and settings can be transferred to the instrument

Improvements:

- Dynamic frequency button handling changed
- Various System Information menus modified

New in version 2.10

Parameter menu for channel power and spectrum analyzer mode implemented

System menu with time and date added

Automatic sweep time calculation optimized for sweep times below 24 ms

Filter transient time improved for combination of 200 kHz span and 10 Hz video bandwidth so that measurement is calibrated

Rework of IP address input

New in version 1.54

Redesigned user interface (colors, softkeys, graph)

New menu structure

AM/FM demodulation

New frequency entry mode (Start/Span) (removed in version 2.20)

Channel power measurement application selectable with measurement mode key

Video trigger (positive, negative slope)

Number of single sweeps selectable

Limit lines (lines, fail count, fail beep, fail hold)

Averaging

Frequency step functionality with cursor keys

New marker handling (absolute, relative, marker to highest peak)

Sweep counter

Battery management

Features and capabilities

Frequency range from 100 kHz to 4 GHz

Digital IF for accurate measurements

Auto mode for basic parameters

Four markers, up to three delta markers

Large and bright display

Small footprint, large front

Lightweight, high battery power

Remote control via RS-232 or LAN

Options

The following accessories are available:

Table 7 Accessories for the 9101 Handheld Spectrum Analyzer

Order number	Description
M 248 640	1205 RF Probe 20 dB (includes N to BNC adapter)
M 886 097	Adapter N (male) to BNC (female)
M 886 098	Adapter N (male) to TNC (female)
M 205 011	Standard battery (rechargeable, 4 Ah)
M 205 012	High-capacity battery (rechargeable, 8 Ah)
M 860 389	12 V car adapter
M 860 388	Null modem cable
M 241 013	Soft carrying bag
M 248 633	9190 Demo Signal Generator

Table 7 Accessories for the 9101 Handheld Spectrum Analyzer

Order number	Description
M 860 261	Antenna, 900 MHz (TNC)
M 860 262	Antenna, 1800/1900 MHz (TNC)
M 860 146	Antenna, 2400 MHz (TNC)
M 867 037	Safety lock
M 897 137	91xx Data Exchange Software

Physical description

The 9101 Handheld Spectrum Analyzer is delivered with the 91xx Data Exchange Software which can also be ordered separately.

The user-accessible parts of the 9101 can be broken down into several sections:

- Front panel with large screen, softkeys, numeric, cursor and function keys.
- Connectors accessible from the top of the 9101.
- On/off switch, power supply connector and battery shelf.
- Handle which can be turned in steps so serve as a stand, allowing the 9101 to be operated at an angle.

Maintaining your unit

Willtek seeks to permanently improve its products. Software updates are available on the Internet at www.willtek.com. For a detailed description of updating the Application Software please refer to Chapter 6 "Updating the Instrument's Software".

The 9101 Handheld Spectrum Analyzer is a measurement device. As with all such instruments, the 9101 should be calibrated on a regular basis to ensure the accuracy. Willtek recommends calibration of the 9101 at yearly intervals.

Please take also advantage of our Frequently Asked Questions and our electronic newsletter, both available on the Internet.

Further questions regarding the 9101 Handheld Spectrum Analyzer can be directed to **support.9101@willtek.com**.

General Operation

2

This chapter describes the instrument's functions that are independent of the selected mode. Topics discussed in this chapter are as follows:

- "Connecting the 9101 Handheld Spectrum Analyzer" on page 8
- "Powering up the unit" on page 9
- "Starting measurements" on page 9
- "Using the front panel" on page 10
- "Selecting the measurement mode" on page 20
- "Working with the markers" on page 21
- "Using limit lines" on page 24
- "Controlling the 9101 from a PC" on page 27
- "Returning from remote control to local mode" on page 27
- "Checking general settings" on page 28
- "Working with stored settings" on page 35

Connecting the 9101 Handheld Spectrum Analyzer

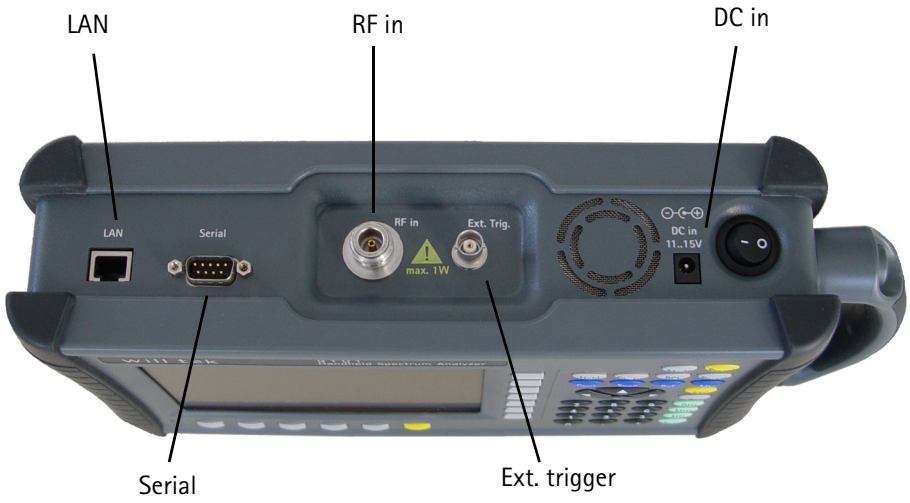


Figure 1 9101 connectors

DC IN connector

The 9101 can be operated either from the internal battery or from an external DC source such as the power supply which is delivered with the 9101. In addition, the battery is loaded when an external DC source is connected. See the specifications in your getting started manual for details of the required DC source. Here you will also find detailed information on charging the battery.

Apply the source to the **DC IN** connector at the top of the 9101.

RF IN connector

RF in is a 50 Ω N-type connector (female).

If you have a 50 Ω shielded RF cable with an N-type connector (male) to connect to the device under test, simply screw the connector tightly to the 9101.

If you have a 50 Ω shielded RF cable with a BNC connector (male), use an N to BNC adapter to connect the cable to the 9101. Willtek offers an appropriate adapter; see section "Options" on page 4.

CAUTION

The maximum allowable input level at the **RF IN** connector is 30 dBm (1 W). Higher levels at this port can damage the instrument!

CAUTION

Only use a 50 Ω N-type connector to connect to the **RF IN** port of the 9101. Use of any other connector may result in damage of the instrument.

Take care of proper termination

Use of cables and sources with an impedance other than 50 Ω results in inaccurate measurements.

If you want to test a device with an impedance of 75 Ω, refer to section "Changing the input impedance" on page 44 to adapt the 9101 settings.

The link between the device under test and the 9101 Handheld Spectrum Analyzer may be attenuated, for example because the link is an antenna or includes a power splitter, or a long cable. The effect of the attenuation on the measurement results can be compensated by entering the attenuation value in the 9101, see section "Compensating gains and losses" on page 43.

EXT. TRIG. connector

This connector has no function in this software version.

WARNING

The **EXT. TRIG.** input is designed for TTL input levels only. Higher levels at this port can damage the instrument!

SERIAL (RS-232) connector

This 9-pin sub-D connector of the 9101 Handheld Spectrum Analyzer can be used to control the instrument remotely via serial interface (RS-232). The command set and responses are explained in section "SCPI Command Reference" on page 101.

Use a null modem (PC to PC) cable to connect the 9101 to a controlling PC.

LAN connector

The 9101 can also be controlled via local area network (LAN) using a TCP/IP connection. The IP address can be set up in the system configuration menu or via RS-232. The 9101 can be operated in networks operating at 100 Mbps, but is capable of transmitting and receiving at 10 Mbps only.

The command set to control the 9101 and the responses from the 9101 are explained in section "SCPI Command Reference" on page 101.

Connect the 9101 to the LAN with a standard LAN cable with RJ-45 connectors.

Powering up the unit

The 9101 is switched on and off using the power switch located at the top of the instrument. It takes about 55 seconds for the 9101 to load and start its software.

Starting measurements

The 9101 starts measuring and displaying results automatically after powering the instrument. It starts in the measurement mode last active.

Using the front panel

Overview

The front panel is divided into different sections as follows:

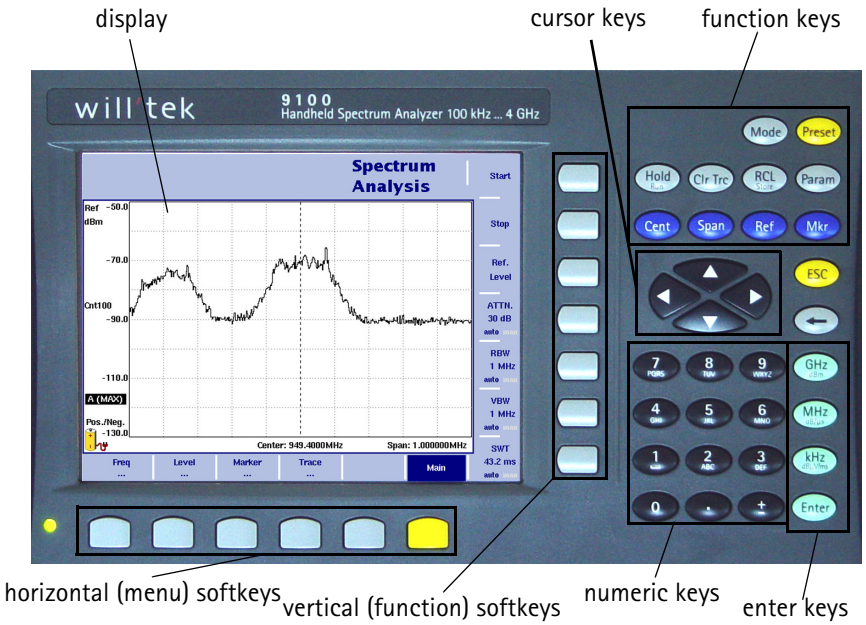


Figure 2 Front panel elements

Battery status LED

This LED has different states:

- The LED lights green when the 9101 is being operated from its battery and no external power is supplied.
- The LED lights yellow when the battery is connected to an external power supply.
- The LED may initially go on and off intermittently (yellow, qualification charge, less than three minutes).
- When the LED is flashing yellow quickly for less than a minute, the battery is being checked.
- When the LED is flashing yellow quickly and permanently, there is a problem with the battery or the charger. Please report this problem to a Willtek service center.
- The LED is off in all other cases.

NOTE

Signal level measurement results may be impaired when the battery is low, that means when the battery has less than 10% of its nominal capacity. See Table 8 on page 12 for an indication when the battery is low. For a detailed description on installing and charging the battery please refer to your Getting Started Manual.

Display

The 6.5 inch display is divided into the following sections (see Figure 3):

- Results area
- Marker field
- Input field
- Softkey descriptions

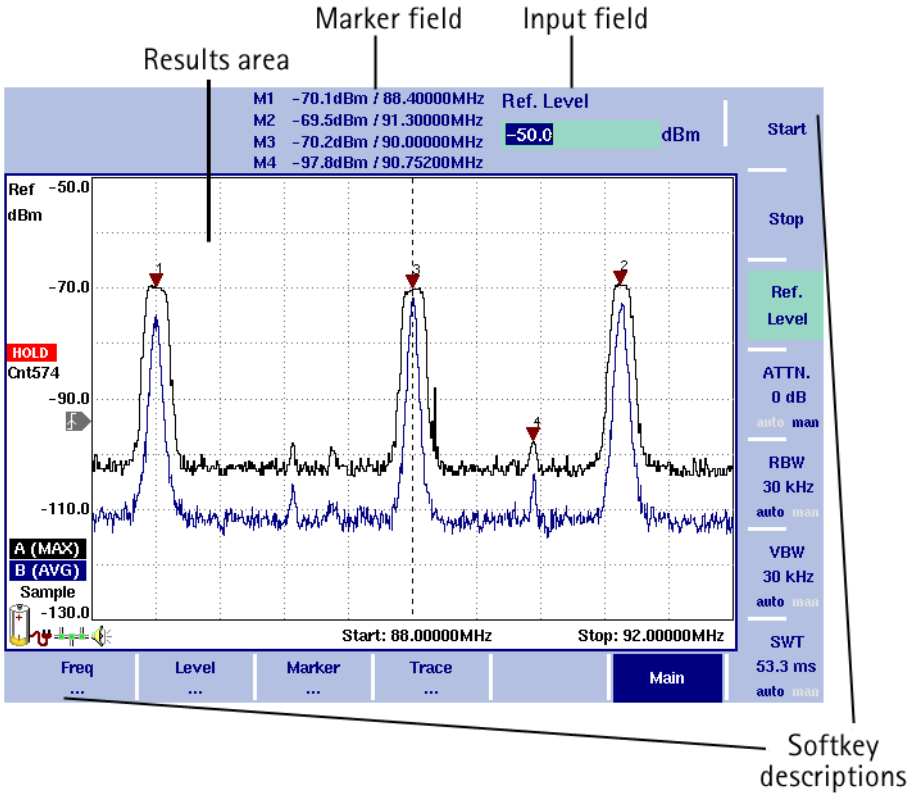


Figure 3 Display sections

Results area

Result area (graph)

The results area utilizes most of the screen and provides you with the measurement results. A grid of ten vertical and eight horizontal lines eases readability of results from the axes. There may be one or two graphs, depending on the number of traces selected.

Horizontal axis

The horizontal axis is the frequency axis for the spectral components. The zero span mode is an exception, as the horizontal axis is the time axis in this case. The values of the frequencies at both ends of the scale are indicated (start and stop frequencies).

Vertical axis

The vertical axis reflects the RF power. Depending on your choice of the level unit, the RF power is indicated in dBm, dBV, dBmV, or dBµV. The top end of the power scale is called the reference level.

Symbols (icons)

Apart from the results graph itself, several icons are available to indicate the status of the 9101 as follows:

Table 8 Icons on the display

Symbol	Meaning
	The 9101 is taking its operating current from the battery. The colored area marks how much of the capacity is still available. For 30% or more, the area is indicated in yellow; from 10% to 30%, the area is shown in red, and in white for less than 10%. The 9101 sounds a double beep when the capacity goes below 30% of its nominal value and two double beeps below 10%.
	The 9101 is connected to an external DC supply.
	The 9101 cannot determine the battery charge although the battery can still be used and recharged. Please contact Willtek service to have your battery checked.
	The 9101 cannot determine the battery charge; typically appears during the last third of operating time of battery operation. Please contact Willtek service to have your battery checked.
	The battery is not installed and the 9101 is operated from the external power supply.
	The 9101 is connected to a local area network (LAN).
	A video trigger has been set at the power level indicated. The icon also displays the slope of the trigger.
	Demodulation is switched on so that the 9101 emits the demodulated signal at the loudspeaker.

Other screen elements

The bar to the left of the vertical axis carries some or all of the elements shown below:

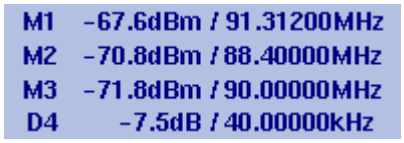
Table 9 Texts on the left-hand side

Text	Meaning
Ref. Level	Indicates the top-most level on the vertical (power) axis. Can be modified with the **REF** hardkey.
dBm dBµV dBmV dBV	Shows the unit in which power is displayed. Can be changed in the **Level > Units** menu.
HOLD	Indicates when measurements have been halted with a press of the **HOLD/RUN** key.

Table 9 Texts on the left-hand side

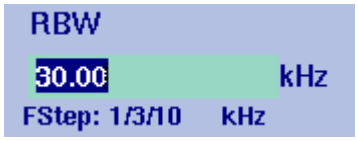
Text	Meaning
Cnt	The number following shows the progress of the measurements, that means it indicates how many measurements with the present configuration have already been taken. The counter continues while the trace hold mode is enabled. It is reset whenever a parameter affecting the measurements is changed, that means frequencies, filters or attenuation.
Ext. Dev.	Indicates that the external device compensation is turned on, that means the attenuation of any coupling device is taken into account. The external device compensation can be set up as shown in section "Compensating gains and losses" on page 43.
UNCAL	When displayed, the filter and sweep time setting do not permit proper measurements.
Pos./Neg. Pos. Peak Neg. Peak Sample	Shows the current detector setting. The detector can be changed as explained in section "Selecting the detection method" on page 51.
A/B (ACT) A/B (HLD) A/B (MAX) A/B (MIN) A/B (AVG)	Shows the currently selected trace mode for the respective trace. The background color of the text coincides with the color of the graph. For more information on trace modes, see section "Selecting the trace mode" on page 48.

Marker field



If any of the markers is active, the marker field is displayed, showing the measurement values at the marker positions. Up to four markers are displayed with their level and frequency values. A marker can be switched from absolute to relative values; the values are then shown relative to those of marker M1.

Input field



The input field allows you to enter a number or a text, depending on the selected function. The meaning of the input value is expressed by the header line. Some input fields have an additional explanation of the step size beneath; the step size applies when the value is changed using the up/down cursor keys instead of the numeric keys.

Softkey descriptions

The softkey descriptions indicate the assignment of a function to a softkey. They are aligned to the lower side with the horizontal softkeys and to the right-hand side with the vertical softkeys. See below for more information about the softkeys.

Keypad

The front panel carries a large number of keys, giving you direct access to functions and menus and allowing you to enter test parameters such as the center frequency. The keypad is divided into the following sections:

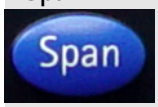
Function keys

The function keys have specific functions which do not change. The function keys are:

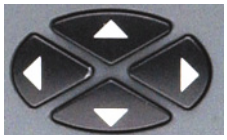
Table 10 Function keys

Key	Function
Mode 	Measurement mode selection. This key allows you to select between different predefined types of measurements for specific applications. It also provides access to system settings.
Preset 	Presets all the entry fields to the factory default settings. To prevent accidental resets, the preset function does not execute after a short keypress. Press this button for at least half a second to return to the defaults.
Hold/Run 	Stops and starts sweeps.

Table 10 Function keys

Key	Function
Param 	This key calls up the parameter pages summarizing the current settings. Use the **Previous** and **Next** softkeys to navigate between the pages, or press **ESC** or **Exit** to close the parameter pages and resume measurements. Note that the parameter pages differ between the measurement modes. Parameters that lead to an UNCAL warning are marked with a diamond.
Rcl/Store 	Provides access to the memory menus.
Clr Trc 	This key resets previous results (including averages), the sweep counter and the failure counter, and starts a new sweep.
Cent 	Direct access to the center frequency input field within the frequency menu.
Span 	Direct access to the frequency span input field within the frequency menu.
Ref 	Direct access to the reference level input field.
Mkr 	Access to the marker menu.

Cursor keys



In an input field, the up and down cursor keys are used to increase or decrease the current value. The left and right cursor keys move the cursor position by one digit.

If a marker field is active, the up and down cursors move the marker by half a division up or down, respectively. The left and right cursor keys move the marker pixelwise.

Immediate reaction

Any change of an input parameter with the cursor keys has immediate effect. With the straight feedback on the screen, you can easily adjust parameters to the optimum values with a trial-and-error approach.

Numeric keys

The numeric keys allow you to enter a value similar to a pocket calculator. On some input fields, you can enter text instead, as on a mobile phone.

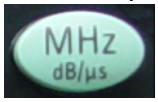
Invalid entries

If you enter an invalid number or string, the 9101 beeps and corrects the entry to the closest valid value.

Enter keys

Any input of numerical or alphanumerical entries must be closed or can be affected by one of the enter keys. The meaning of the keys is as follows:

Table 11 Enter keys

Key	Function
GHz/dBm 	In frequency input fields, closes the entry by applying the unit GHz (gigahertz). In power input fields, assigns the unit dBm to the entered value.
MHz/dB/µs 	In frequency input fields, closes the entry by applying the unit MHz (megahertz). In power input fields, assigns the unit dB to the entered value. In time parameter input fields, assigns the unit µs to the value.
kHz/dBµV/ms 	In frequency input fields, closes the entry by applying the unit kHz (kilohertz). In power input fields, assigns the unit dBµV to the entered value. In time parameter input fields, assigns the unit ms to the value.
Enter 	Confirms an entry without a unit and with the units Hertz and seconds.

Escape key

If pressed while an input field is open, the **ESCAPE** key closes this input field without changing the previous value.

Backspace key

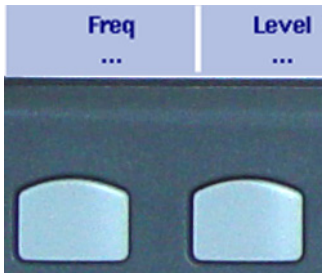
Deletes the last entered alphanumerical (backspace).

When an input field is entered, all digits are marked. By pressing the backspace key, the entire entry is deleted.

Softkeys

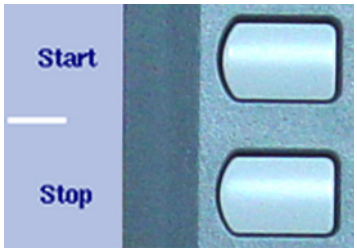
The functions of the softkeys change with the description on the screen given next to the respective key.

Horizontal (menu) softkeys



The horizontal softkeys provide access to the various menus. The name of the active menu is highlighted; the functions of a menu are offered on the vertical softkeys. Submenus are indicated with three dots ("..."); the menu softkey without the dots leads you one level up in the menu hierarchy.

Vertical (function) softkeys



The vertical softkeys allow you to change the settings of the 9101.

The vertical softkeys in the 9101 carry out one of the following functions:

– Normal settings – by pushing the softkey, an entry field appears on the top of the display, allowing you to enter numerical or alphanumerical data. The data become valid after pushing one of the enter keys. Some of the softkeys for normal settings also describe the currently set value.
  Example: The Channel softkey in channel power mode.

– Combined entry and selection – this type of softkey allows you to change a value and also to change a related setting, for example changing between automatic and manual parameter setting. The first push on the softkey opens the entry field like the normal settings softkey. Pushing it several times results in the 9101 toggling between the available options. The option currently selected is indicated in blue while the inactive options are shown in white.
Example: The RBW softkey.

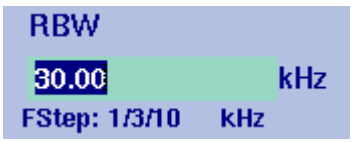
– Execution – by pushing the softkey, the function described is performed. The execution softkey is indicated by an exclamation mark.
Example: Max Peak softkey in the marker menu.

– Selection – several selection softkeys allow you to choose between different options. The selection softkeys for one function are indicated by a vertical bar connecting the softkeys, and a text describing the function. The option currently active is highlighted, i.e. indicated by inverted colors.
Example: The TrigMode softkeys in the sweep menu.

Entering numbers and text

Whenever an input field is open, it expects you to enter either numbers or characters (where characters may also include numerical digits). You will notice immediately what the 9101 expects as the numeric keys have the appropriate function.

Filling in a numerical input field



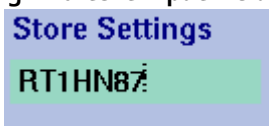
When the 9101 software expects a numerical entry, pressing a numeric key results in the appropriate digit to appear in the input field. The 9101 may or may not allow you to enter a decimal number or a signed value, so the keys for the decimal point and for changing the sign of the number are either active or not. When all digits, the sign and the decimal point have been entered as required, one of the enter keys must be pressed. Numbers often carry a unit with them; the enter keys provide the appropriate units.

Acoustical reaction on inputs

After entering a new parameter value, one of two acoustical alarms may appear:

- Short beep (hint): The parameter is out of limits, or the input affects an associated parameter; the respective parameter has been corrected by the 9101 Handheld Spectrum Analyzer.
  Example 1: An invalid stop frequency of 5 GHz has been entered, resulting in a short beep and the maximum stop frequency of 4 GHz being set.
  Example 2: The start frequency is set to 2 GHz, the stop frequency is set to 4 GHz and the user enters a new span of 3 GHz. This results in the start frequency being changed to 1 GHz and a short beep to sound.
- Long beep (error): A parameter is set to an invalid value and the 9101 Handheld Spectrum Analyzer resumes the old value, sounding an error beep.
  Example: After entering a new (invalid) attenuation value of 60 dB, the 9101 Handheld Spectrum Analyzer sounds a long beep and sets the attenuation back to the previous value.

Filling in a text input field



Some input fields can be filled with alphanumerical text instead. The numeric keys can then be used to enter characters. The keys may have several letters or numbers assigned. The assignment of the keys in this case is as follows:

Table 12 Keys for alphanumerical text entry

Key	Assignment
0	0
1	1
2	A, B, C, 2
3	D, E, F, 3
4	G, H, I, 4
5	J, K, L, 5
6	M, N, O, 6
7	P, Q, R, S, 7
8	T, U, V, 8
9	W, X, Y, Z, 9
.	not assigned
±	not assigned

To enter a character, push the key rapidly and repeatedly until the desired character appears in the input field.

Changing the input

Once an input field is open, you can move the cursor with the **LEFT/RIGHT** cursor keys to place it within the number or text. Additional digits or characters can be entered, or you can delete the digit or character in front of the cursor using the **BACKSPACE** key.

Selecting the measurement mode

The 9101 provides different measurement modes:

- The spectrum analysis mode is most versatile; it provides most of the options included in all other modes. For more information on this mode, refer to page 37.
- The channel power mode allows you to measure the radiated power within a certain frequency band. Read more about channel power mode on page 59.

In addition, the Mode menu provides access to the system settings, e.g. the I/O configuration, and to version information. See section "Checking general settings" on page 28 for more details.

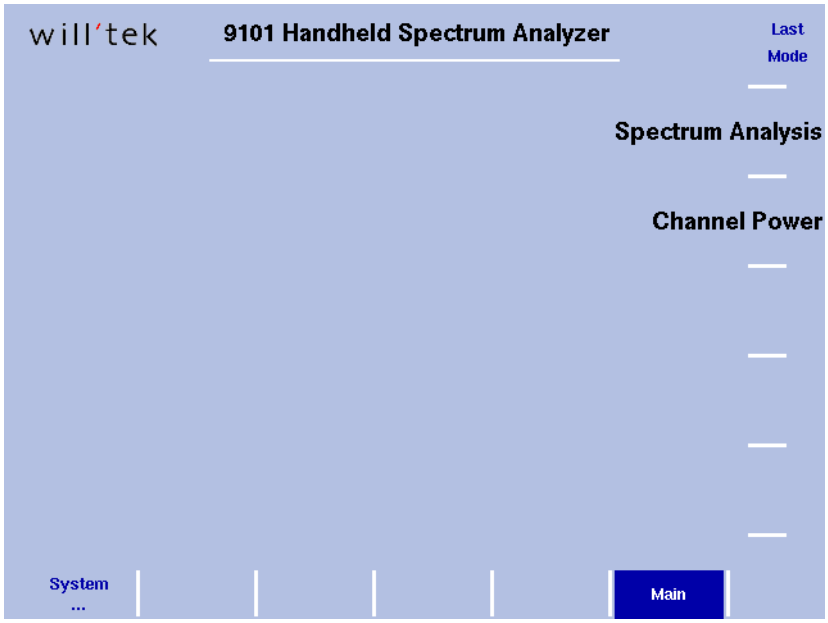


Figure 4 Selecting a measurement mode

To select the measurement mode, proceed as follows:

1 Push the **MODE** button.
The mode menu appears (see Figure 4).

2 Select a new mode or return to the mode last active by pressing the respective softkey.
The main menu of the selected mode appears. If you select a new mode, all parameters are set to the values from when the mode was last active. If, however, you resume the last active mode, measurements are continued.

Working with the markers

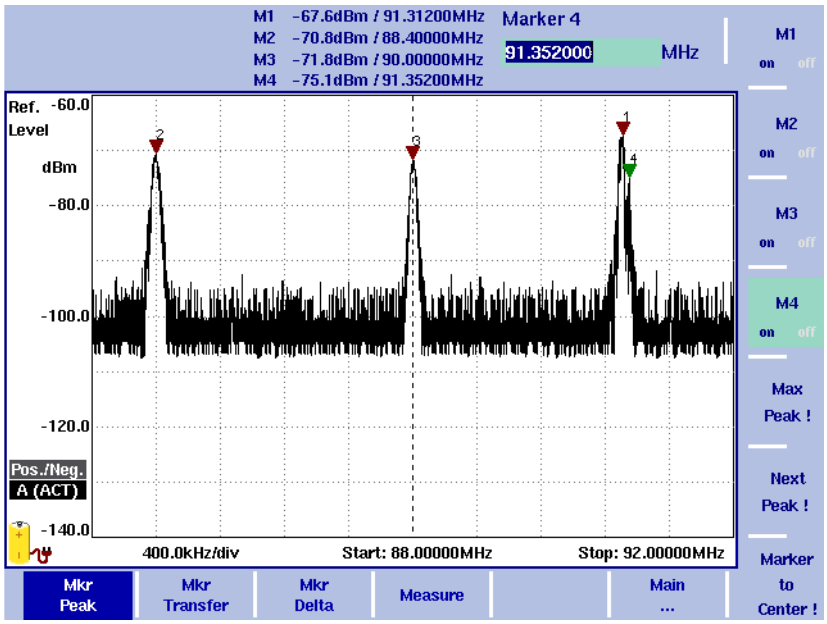


Figure 5 Example of markers

The 9101 includes powerful and easy-to-use marker functions. Up to four markers can be used; up to three of them can be delta markers. Markers are easy to place and you can easily affect the center frequency and the reference level upon a keypress.

It is important to note that if you place the cursor on a signal peak and then reduce the span, the marker position may be offset a little from the peak. This is due to the limited resolution of the displayed frequencies when using a high span. After reducing the span, the marker should be readjusted to the new peak.

Enabling and moving a marker

1 From the main menu, select **Marker**. Or push the **MKR** key in any menu.
If no marker is active, marker M1 will be enabled at the maximum peak. The input field for marker M1 appears.

2 If you want to enable another marker, push the appropriate softkey (**M1** through **M4**).
The marker is enabled and the input field opens; the selected marker appears in the marker field in the top bar of the display.

3 If required, move the marker to another position using the cursor keys, one of the softkeys **Max Peak** and **Next Peak**, or by entering the frequency with the numeric keys and the appropriate enter key.

Disabling a marker

1 From the main menu, select **Marker**. Or push the **MKR** key in any menu.
The marker menu appears and the input field for marker M1 appears.

2 Push the softkey (one of **M1** through **M4**) for the marker that you want to disable.
If previously enabled, the marker is disabled and the respective marker values disappear in the marker field at the top. A subsequent push would reenable the marker.

Enabling a delta marker

For delta markers, the power level and frequency relative to marker M1 is displayed in the marker field. Marker M1 cannot be a delta marker.

1 From the main menu, select **Marker**, or push the **MKR** key in any menu.
The marker menu and the marker M1 input field appear.

2 Select **Mkr Delta**.
The delta marker menu appears.

3 Select the marker which you want to turn into a delta marker (**M2** through **M4**).
If not already enabled, the marker is turned on.

4 Push the **rel** softkey to turn the selected marker into a delta marker.
The rel softkey is highlighted and the respective marker in the marker field is indicated as a delta marker, e.g. D2 instead of M2.

Disabling a delta marker

1 From the main menu, select **Marker**, or push the **MKR** key in any menu.
The marker menu and the marker M1 input field appear.

2 Select **Mkr Delta**.
The delta marker menu appears.

3 Select the delta marker that you want to disable (e.g. D2).

4 To disable the marker completely, push the key until **off** is highlighted.
To turn the delta marker into a normal marker displaying absolute values again, push the **abs** softkey.

Setting a marker on a frequency relative to marker M1

1 Enable a delta marker as described in "Enabling a delta marker".
For the selected delta marker, the input field shows the frequency relative to marker M1.

2 Enter a (signed) frequency relative to the frequency at marker M1, either using the numeric keys and the respective enter key, or moving the cursor to that frequency with the help of the cursor keys.
The marker field indicates the desired frequency offset for that marker, along with the power level relative to the power at marker M1.

Changing the center frequency with a marker

This function modifies the center frequency, adapting the frequency of a selectable marker.

1 From the main menu, select **Marker**, or push the **MKR** key in any menu.
The marker menu and the input field for marker M1 appear.

2 If you want to use the frequency at a marker position other than M1, push the appropriate softkey (**M2** through **M4**).

3 Push the **Marker to Center** softkey.
The center frequency changes to the frequency at which the selected marker is located. The frequency span only changes if the change in center frequency would lead to an invalid start or stop frequency.

Changing the reference level with the marker

The reference level can be changed to the level at a marker position as follows:

1 From the main menu, select **Marker**, or push the **MKR** key in any menu.

2 Select the **Mkr Transfer** menu.

3 If you want to use the power level at a marker position other than M1, push the appropriate softkey (**M2** through **M4**).

4 Push the **Marker to Ref. Lvl** softkey.
The reference level changes to the level of the selected marker.

Assigning the marker frequency to FStep

For measurements of harmonics or intermodulation products, it can be useful to easily change between frequencies in user-defined steps. The "Marker to FStep" function assigns the active marker (or delta marker) frequency to FStep, the step width for the selection of center frequency and marker frequency.

Assumption: One of the markers M1 through M4 is active.

1 From the main menu, select **Marker > Mkr Transfer** to access the marker transfer menu.

2 Push **Marker to FStep**.
The FStep parameter assumes manual mode. If the currently active marker is an absolute marker, the frequency at the marker position becomes the new FStep value. Alternatively, if the currently active marker is a relative (delta) marker, the difference between the frequencies at the active marker and M1 becomes the new FStep value.
If the new FStep value is higher than 1 GHz, the old FStep value is maintained and the 9101 sounds a hint beep.

Using limit lines

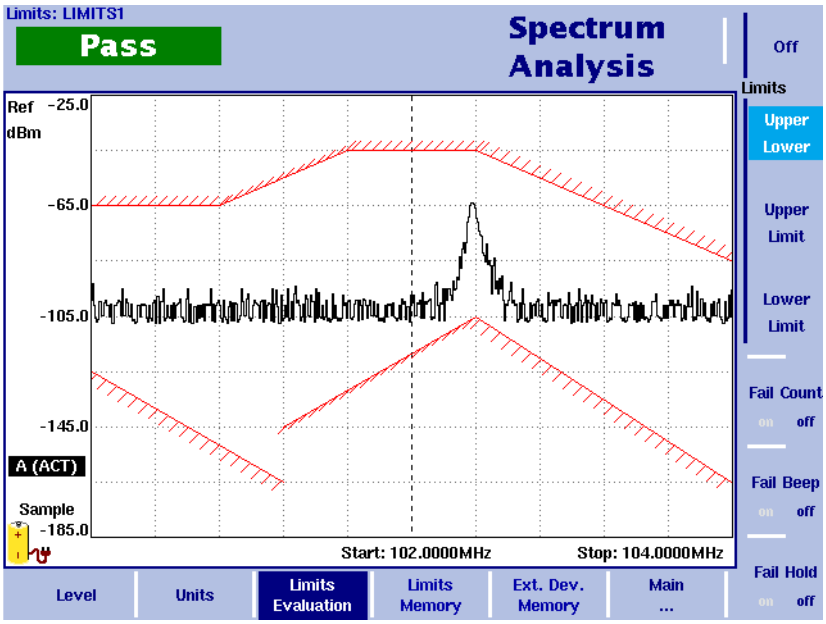


Figure 6 Example of limit lines in spectrum analysis

Overview

A very useful feature of the 9101 is the possibility to set limits for the trace A results. These are displayed on the screen and the 9101 can show if the results exceed the limits.

Two different limit modes exist in the 9101. In the first case, the limits exist of horizontal lines for the upper and lower limit. This method is called “simple limits”; the limits can be entered directly in the limits menus of the 9101.

In the second case, there are more complex limits as shown in the example in Figure 6. These limits can be entered with a comfortable tool on a PC and loaded to the 9101 via RS-232 or LAN interface. A set of limit lines can be used to define a measurement template. There are versatile tools around these limits available on the 9101, such as a fail counter, a beep when a failure occurs, or a measurement hold function upon failure. The limits can be used both in the frequency and in the time domain.
Up to 99 sets of limits can be stored on the 9101.

The actual limit values must be defined on a PC and loaded to the 9101 using the 91xx Data Exchange Software. Several limit files can be stored on the 9101. The name of the current limit file is indicated in the upper left-hand corner.

Note that the limits are defined within a grid, no matter what the units on the vertical and horizontal axes are. This way, you can apply the limits to different frequency ranges and power levels. It is your responsibility, however, to select a useful frequency range, reference level and level scale.

Note that a FAIL indication may occur if the start frequency is 0 Hz and an upper limit is set at this frequency.

Using simple limits

Simple limits consist of constant upper and lower limits. They must be activated to take effect. Once activated, each measurement is accompanied by a Pass/Fail verdict indicating whether or not the measurement result was within the limits.

Switching simple limits on and off

By switching limit lines on, any previously active limit template is disabled.

1 Press **Level > Limits Memory**.

2 Press the **Simple Limits** softkey so that the new choice (on or off) is highlighted.
When switching limits on, red horizontal lines indicating the upper and lower limits appear. A Pass/Fail verdict is displayed with every new measurement in the upper left corner of the screen. The text above the verdict ("Simple Limits") indicates that the verdict applies to simple limits.
When switching limits off, the limit lines and the verdict disappear.

Defining upper and lower limits

The limits can be changed only when simple limits are activated. The range of valid entries depends on the power scale displayed (vertical axis) as follows:

Table 13 Valid entries for upper/lower simple limits (relative to reference level)

Scale	Valid range
1 dB/division	–8 ... 0 dB
2 dB/division	–16 ... 0 dB
5 dB/division	–40 ... 0 dB
10 dB/division	–80 ... 0 dB
20 dB/division	–160 ... 0 dB

Follow the steps below to define simple upper and lower limits.

1 Press **Level > Limits Memory**.

2 Press the **Upper** softkey, enter a new value for the upper limit (in dB, relative to the reference level) (or move the upper limit with the **UP/DOWN** cursor keys) and confirm with **MHZ/DB/µS** or **ENTER**.
The upper limit line is moved to the new value.

3 Press the **LOWER** softkey, enter a new value for the lower limit (in dB) (or move the lower limit with the **UP/DOWN** cursor keys) and confirm with **MHZ/DB/µS** or **ENTER**.
The lower limit line is moved to the new value.

Using limit templates

Limits can be comfortably defined with a PC-based tool and loaded to the 9101. This is described in full detail in chapter "91xx Data Exchange Software" on page 83. The sections below describe how to recall, delete, activate and deactivate limit templates.

Selecting limit lines within the 9101

1 From the main menu, select **Level > Limits Memory**.
The limits memory menu appears.

2 Push the **Recall Limit Template** softkey.
An entry field appears, together with a file selection box.

3 Select a file either by moving the selection to its file name using the **UP/DOWN** cursor keys, or by entering the file name in the entry field and closing the input field with the **ENTER** key.
The file with the limits is loaded and the upper/lower limits are activated immediately.

Activating and deactivating limit templates

1 Select a limits file (see section "Selecting limit lines within the 9101").

2 Select **Level > Limits Evaluation**
The limits evaluation menu appears.

3 Select the limits option you want by pushing the appropriate softkey from the following choice: **Off**, **Upper/Lower**, **Upper Limit**, **Lower Limit**.
If you selected **Off**, no limits are displayed. Otherwise, the selected limits curve (upper and/or lower limits) appears on the screen. A pass/fail indication is given for each measurement trace in the upper left-hand corner.

Deleting limit files in the 9101

1 From the main menu, select **Level > Limits Memory**.

2 a. To delete an individual file, push **Delete Limit Template**, select a limits file with the **UP/DOWN** cursor keys and push **ENTER** to delete an individual file (pressing **ESC** aborts the process before the file is deleted).

b. To delete all the limit files stored in the 9101, push **Delete All Templates**. Confirm with **ENTER** if you really want to delete all the limit files.

Counting limit failures

When limit checking is enabled, a failure counter can be activated. The number of failures appears below the pass/fail verdict. The counter makes particular sense for statistical evaluations. For this application, it is important to define the number of measurements. The following sequence can be useful to obtain a failure count in conjunction with a defined number of measurement traces.

1 Select a limited number of traces (**Freq > Sweep**, see "Performing a limited number of measurements" on page 46).

2 From the main menu, push **Level > Limits Evaluation > Fail Count** to turn the failure counter on; if it was on already it should be switched off and on again.
The failure counter is reset to 0.

3 Push the **HOLD/RUN** key to start the measurement.
Both the measurement counter and the failure counter start from 0. When the selected number of traces has been reached, the measurements are stopped and you can read the failure count.

Resetting the counter

The failure counter for the limits check can be reset by turning it off and then on again (in the **Level > Limits Evaluation** menu).

Enabling a beep upon failures

1 From the main menu, push **Level > Limits Evaluation**.
The limits evaluation menu appears.

2 Push the **Fail Beep** softkey to activate or deactivate the beep counter:
If activated, a beep sounds each time the measured signal exceeds the limits.

Viewing a failed measurement

This feature can be useful if you want to stop the measurement and view the measured signal when it fails the limits. Note that the 9101 should be set to continuous measurements.

1 From the main menu, select **Level > Limits Evaluation**.

2 Push the **Fail Hold** softkey once or twice to enable or disable the hold-on-fail function.
The measurements are halted when a failure occurs. The trace of the failed signal remains on screen.

Measurements can also be stored and recalled in the 9101 for later analysis or comparison. This is shown in "Storing and loading traces" on page 53.

With the 91xx Data Exchange Software, traces can also be transferred to and viewed and stored on a PC. For more details, please refer to chapter "91xx Data Exchange Software" on page 83.

Controlling the 9101 from a PC

The 9101 can be used under remote control from a PC. The interfaces supported for this are the serial interface (RS-232) and the LAN (TCP/IP). Please refer to section "SCPI Command Reference" on page 101 for more information on remote control.

Returning from remote control to local mode

To gain manual control after using the 9101 under remote control, push the **ESCAPE** key.

Checking general settings

This section covers information about the unit, setting display brightness, time and date, and configuring the remote control interfaces of the 9101.

Reading the serial number

You can find the serial number of your 9101 as follows:

1 Push the **MODE** key.

2 Select **System > System Information**.
The system information display appears (see Figure 7), showing the serial number, the installed software version and the installed options.

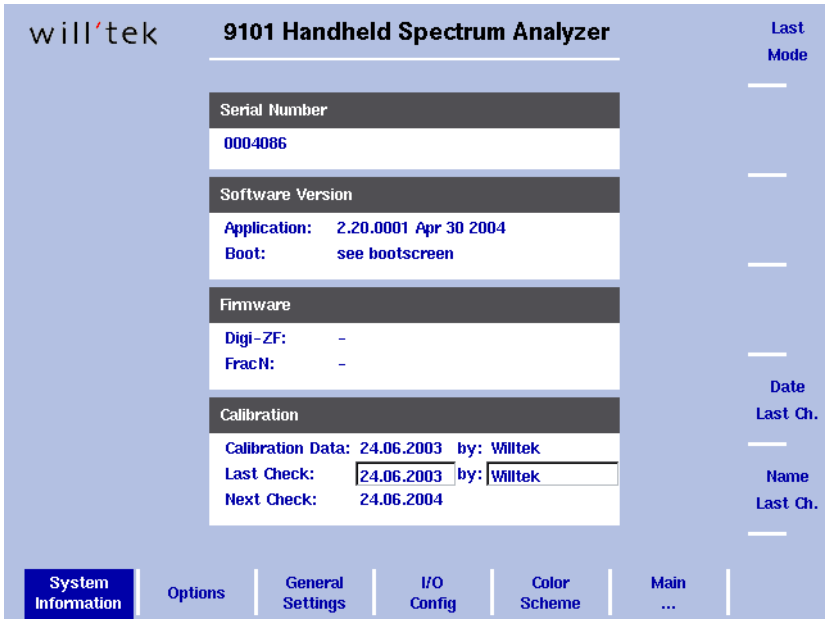


Figure 7 System information menu

Reading the software version number

Before loading a new software version or reporting problems, you may want to check the currently installed version.

1 Press hardkey **MODE**, followed by softkey **System**.
The System Information menu appears.

2 Read and note the software version number in the field entitled Application.

Reviewing the calibration

As for all test instruments, the 9101 Handheld Spectrum Analyzer accuracy should be checked against its specifications; this process is called calibration. If the 9101 accuracy falls outside the specified tolerance it may be necessary to correct the instrument.

Willtek recommends a calibration interval of one year. The 9101 stores the date of the last calibration by a Willtek-certified lab and the date when the next calibration is due. In addition, you can document when the calibration date has been reviewed last.

To check if the 9101 is due for calibration, proceed as follows:

1 Press hardkey **MODE**, followed by softkey **System**.
The System Information menu appears.

2 See the Calibration area:
The first line indicates the date of the last calibration and the organization calibrating the 9101.
The second line indicates when and by whom the calibration has been checked last.
The third line indicates when the next calibration is due. This date is typically one year after the last calibration.

3 Push softkey **Date Last Changed** to change the last check date. It will be set to the actual date as set by the built-in real-time clock.

4 Push softkey **Name Last Changed** to enter the name of the person that carried out the last calibration date review.

Checking installed options

Willtek provides different application programs and options for the 9101 Handheld Spectrum Analyzer. These may or may not be active on your instrument. To check which options are actually installed on your 9101, take the following steps:

1 Press hardkey **MODE**, followed by softkey **System**.
The System Information menu appears.

2 Select **Options**.
The Options menu appears, indicating the installed options in bold print with a tick in front; the options not installed are shown in grey.

Installing a new option

Software options can be installed by entering an activation key which you can purchase from Willtek Communications or one of its representatives. To install a new option:

1 Press hardkey **MODE**, followed by softkey **System**.
The System Information menu appears.

2 Select **Options** and press **Activate Options**.

3 Enter the activation key and press the **ENTER** key.
If the code is valid, the appropriate option is shown in bold print with a tick in front, indicating that the option is accessible now.

Changing the display brightness

1 Push the **Mode** key.

2 Select **System > General Settings**.
The general settings display appears (see Figure 8), showing the current display backlight setting as a percentage.

3 Push the **Display** softkey.
The backlight input field is highlighted.

4 Enter a new value and confirm with **ENTER**, or change the current value with the **UP/DOWN** cursor keys.
The 9101 display uses the new brightness value.

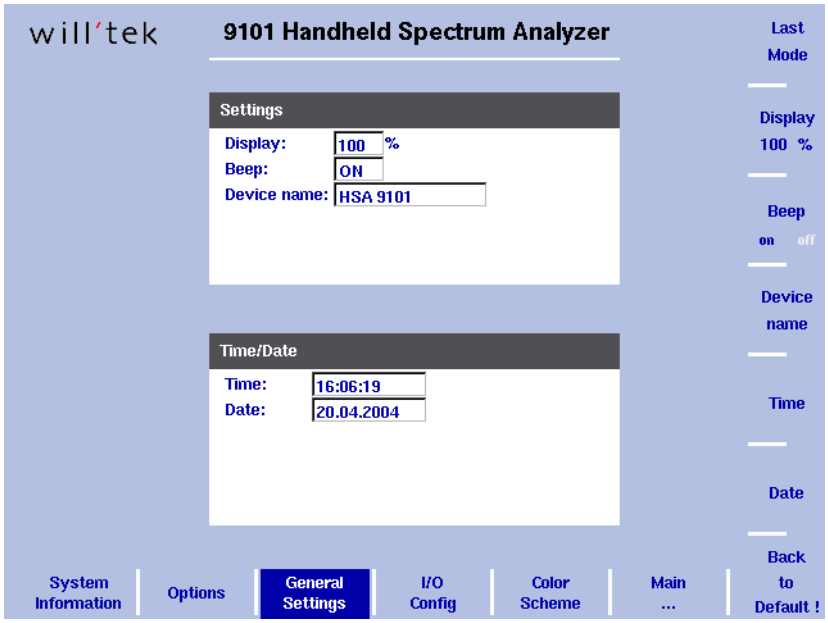


Figure 8 General settings menu

NOTE

The display setting for adjusting the brightness is not affected by a press on the **PRESET** button, but by a push on the **Back to Defaults** softkey.

Enabling and disabling beeps

Warning and error beeps can be turned off and on in the General Settings menu:

1 Push the **Mode** key.

2 Select **System > General Settings**.
The general settings display appears, showing the current setting for beeps (on or off).

3 Push the **Beep** softkey several times until the desired setting is highlighted (on or off).
The beep input field shows the current setting.

NOTE

This parameter is not affected by a press on the **PRESET** button, but by a push on the **Back to Defaults** softkey.

Assigning a device name to the instrument

A device name for the 9101 can be useful if you have several units of the 9101 Handheld Spectrum Analyzer. They can be identified if you choose different names for them. The name also appears on traces transferred to the PC with the 91xx Data Exchange Software.

A new name can be entered as follows:

1 Push the **Mode** key.

2 Select **System > General Settings**.
The general settings display appears, showing the current device name.

3 Push the **Device name** softkey.
The device name input field is active so you can overwrite the current name.

4 Enter a new name (max. 11 characters; see section "Filling in a text input field" on page 19 to learn how to do this) and close the entry field by pressing **ENTER**.
The new name is displayed in the device name field.

NOTE

This parameter is not affected by a press on the **PRESET** button, but by a push on the **Back to Defaults** softkey.

Adjusting date and time in the instrument

The 9101 Handheld Spectrum Analyzer includes a real-time clock. It can be used to show the actual date or to compare it with the date when the next calibration is due.

The date can be changed as follows:

1 Push the **Mode** key.

2 Select **System > General Settings**.
The general settings display appears, showing the current date and time.

3 Push the **Date** softkey.
The date input field is active so you can overwrite the old date with a new one or move the cursor with the **LEFT/RIGHT** cursor keys behind a digit that needs to be changed, push the **BACKSPACE** key to erase it and enter a new digit.

4 Press **ENTER** or another function key to confirm the entry.
The new date is shown in the General Settings menu.

The time can be modified as follows:

1 Push the **Mode** key.

2 Select **System > General Settings**.
The general settings display appears, showing the current date and time.

3 Push the **Time** softkey.
The time input field is active so you can move the cursor with the **LEFT/RIGHT** cursor keys behind a digit that needs to be changed, push the **BACKSPACE** key to erase it and enter a new digit.

4 Press **ENTER** or another function key to confirm the entry.
The new time is shown in the General Settings menu.

NOTE

These parameters are affected neither by a press on the **PRESET** button nor by a push on the **Back to Defaults** softkey.

Changing the bit rate on the RS-232 port

1 Push the **Mode** key.

2 Select **System > I/O Config**.
The port configuration display appears (see Figure 9), showing the current RS-232 bit rate (or baud rate) and interface settings.

3 To change the data rate, push the **Baudrate** softkey and select a new rate with the **UP/DOWN** cursor keys.
The change takes effect immediately.

NOTE

This parameter is not affected by a press on the **PRESET** button, but by a push on the **Back to Defaults** softkey.

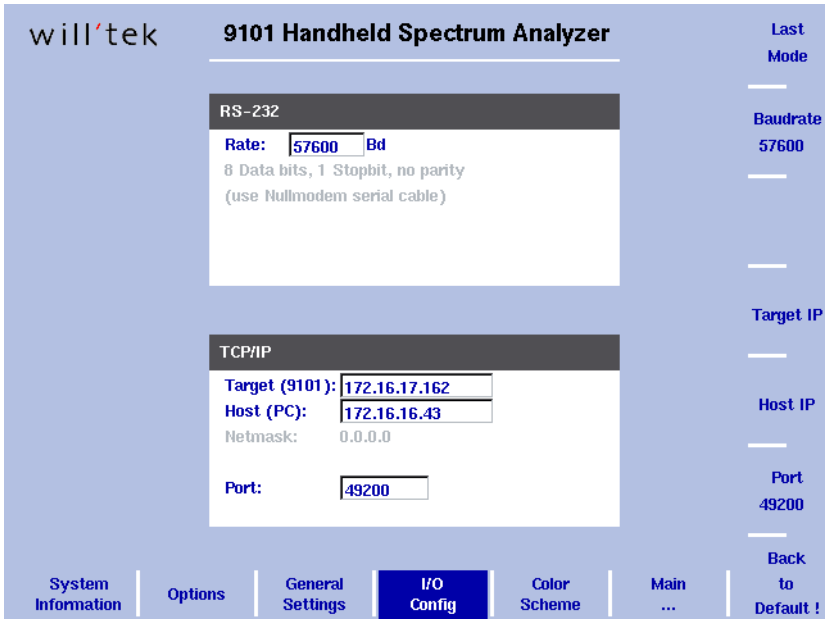


Figure 9 I/O configuration menu

Changing the IP address of the 9101

The IP address should be adapted to the address space in use in your environment and should be unique for each device on that network.

1 Push the **Mode** key.

2 Select **System > I/O Config**.
The port configuration display appears, showing the current TCP/IP settings.

3 To change the IP address of the 9101, push the **Host IP** softkey.
The address field is highlighted.

4 Overwrite the entire IP address or select a field with the **LEFT/RIGHT** cursor keys, enter a new IP address and push **ENTER**.

5 For the change to take effect, switch off and on the 9101.

6 Ensure that your application on the PC addresses the 9101 using this IP address so that the two units can communicate with each other.

Changing the IP address of the PC

For remote control of the 9101 Handheld Spectrum Analyzer from a PC, the IP address of that PC can be entered on the instrument.

1 Push the **Mode** key.

2 Select **System > I/O Config**.
The port configuration display appears, showing the current TCP/IP settings.

3 To change the IP address of the 9101, push the **Target IP** softkey.
The address field is highlighted.

4 Overwrite the entire IP address or select a field with the **LEFT/RIGHT** cursor keys, enter a new IP address and push **ENTER**.

5 Reboot the 9101 (that means, switch it off and on again) for the new settings to work.

Changing the IP port used by the 9101

When the 9101 Handheld Spectrum Analyzer is to be controlled remotely from a PC, the PC must address the remote control application within the 9101 with an IP port number. The 9101 uses a default of 49200 which can be changed easily as follows:

1 Push the **Mode** key.

2 Select **System > I/O Config**.
The port configuration display appears, showing the current TCP/IP settings.

3 To change the IP port of the 9101, push the **Port** softkey.
The address field is highlighted.

4 Overwrite the entire IP address or select a field with the **LEFT/RIGHT** cursor keys, enter a new IP address and push **ENTER**.

5 Reboot the 9101 (that means, switch it off and on again) for the new settings to work.

The **Back to Default** button resets the parameter to its default value.

Selecting user interface colors

You can change the colors of some of the user interface elements in the color scheme menu. The available colors are shown in the color palette at the top of the display and in Table 14. Color 8 is not available for all user interface elements.

Table 14 Color palette in the 9101 user interface

Color number	Color
1	black
2	grey
3	blue
4	green
5	violet
6	yellow
7	red
8	brown

The colors of the traces, the grid and the limit lines can be modified as follows:

1 Push the **Mode** key.

2 Select **System > Color Scheme**.
The color scheme display appears (see Figure 10), showing the current color settings.

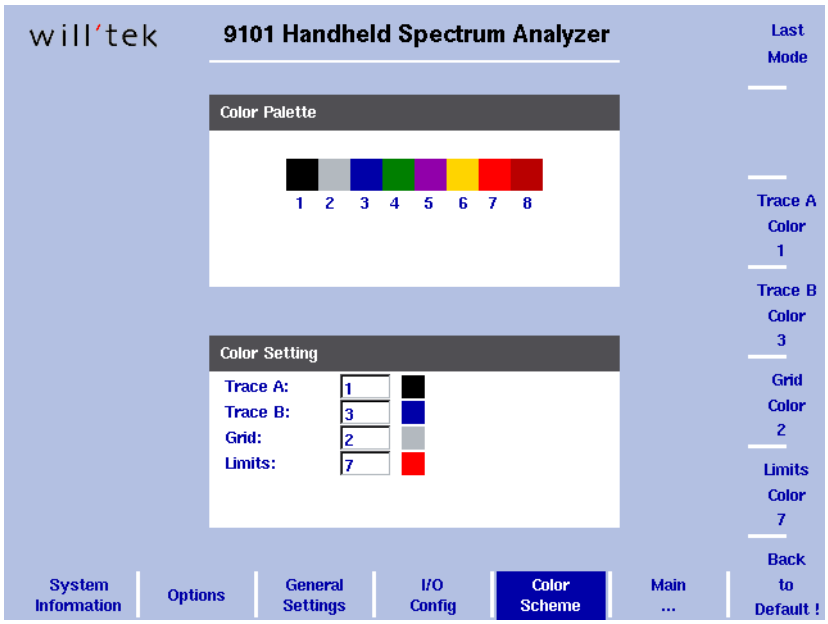


Figure 10 Color scheme menu

3 To change the color of a user interface element, push the appropriate softkey (Trace A, Trace B, Grid, or Limits Color).
The input field on the left is activated.

4 To select a new color, enter a number corresponding to the colors in the color palette and push the **ENTER** key, or use the **UP/DOWN** cursor keys to change the color.
The color field to the left of the input field changes according to the selection made.

5 Press softkey **Last Mode** to return to the measurement screen.
The new color scheme takes effect immediately.

Working with stored settings

The 9101 Handheld Spectrum Analyzer provides the capability of storing all the parameters for a particular measurement, allowing to recall these parameters whenever the measurement shall be repeated under the same conditions, and this includes the measurement mode. A large number of parameter sets can be stored under different names that allow fast and easy identification; each parameter set name may consist of up to 11 characters.

In addition to using these files of parameter sets on the same 9101, you can also transfer them to a PC for backup, easy modification and amendment using a standard text editor, or for use the same parameters on multiple 9101 instruments. This is described in more detail in sections "Working with settings" on page 97 and "Managing files on the PC and on the 9101" on page 98.

Storing settings on the 9101

To store the current settings on the 9101, take the following steps:

1 Press hardkey **RCL/STORE**.
The trace memory menu appears.

2 Select the **Settings** menu softkey.
The settings memory menu is displayed.

3 Press **Store Settings**.
An input field appears (see Figure 11).

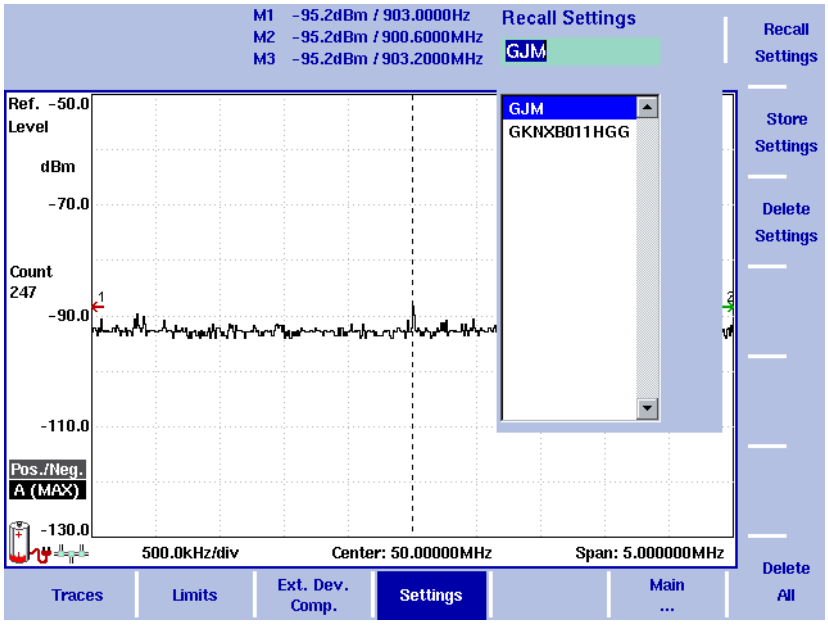


Figure 11 Recall settings menu

4 Enter a new file name of up to 11 characters, and confirm with **ENTER**.
The current parameter settings are stored in this settings file and can be recalled at any time.

Using previously stored settings

You can use settings previously stored in the memory of the 9101 by recalling the settings file.

1 Press hardkey **RCL/STORE**.
The trace memory menu appears.

2 Select the **Settings** menu softkey.
The settings memory menu is displayed.

3 Press **Recall Settings**.
An input field and a file selection box appear.

4 Select the desired settings file using the **UP/DOWN** cursor keys or enter an existing file name, and confirm with **ENTER**.
The current parameter settings are overwritten by those in the settings file and the measurement mode with the parameters stored in the file are assumed.

Spectrum Analysis Operation

3

This chapter describes the instrument's functions that are specific to the spectrum analysis mode. Topics discussed in this chapter are as follows:

- "Selecting the measurement mode" on page 38
- "Changing the frequency settings" on page 38
- "Selecting RBW, VBW and SWT" on page 41
- "Setting up the level parameters" on page 41
- "Changing the input impedance" on page 44
- "Applying special functions on the signal" on page 44
- "Setting up the trace" on page 48
- "Storing and loading traces" on page 53
- "Special measurement functions" on page 55

Selecting the measurement mode

The 9101 provides different measurement modes. To select the spectrum analysis mode, proceed as follows:

1 Push the **MODE** button.
The mode menu appears.

2 Select **Spectrum Analysis**.
The spectrum analysis main menu appears.

Changing the frequency settings

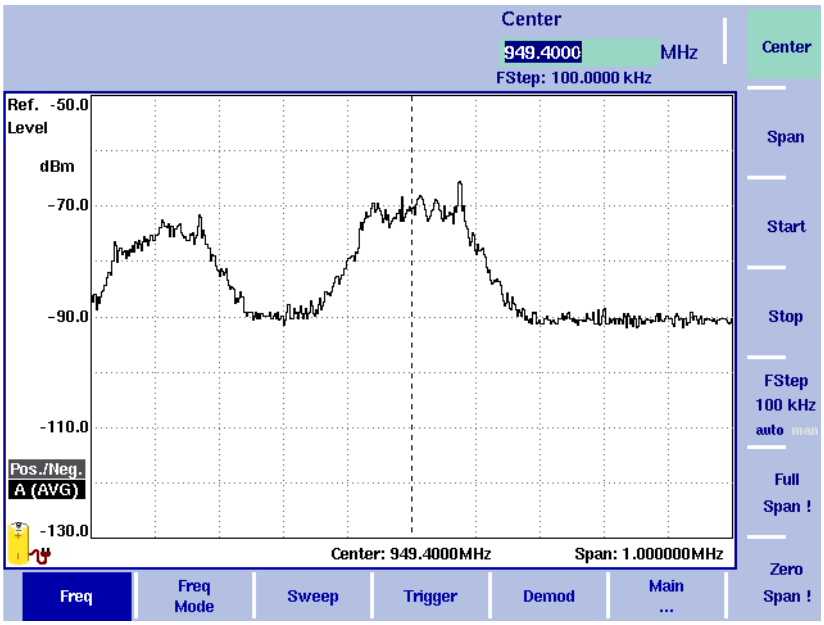


Figure 12 Frequency menu

There are different methods to set the frequency range to be measured; the range can be expressed by either the start and stop frequencies (i.e. first and last frequencies on the display), or by center frequency and span (i.e. the center and the frequency range), or by other combinations of center frequency, span, start and stop frequencies.

All four parameters are accessible in the **Freq** menu. On the main menu, however, only one of the above-mentioned combinations is shown, depending on the parameter last entered.

NOTE

Changing a frequency parameter may affect an associated parameter.
Example: If you change the span to the maximum of 4 GHz, the start and stop frequencies are changed to 0 and 4 GHz, respectively.

Setting start and stop frequency

1 Push the **CENT** function key (or the **Freq** softkey in the main menu).
The vertical softkeys include Start and Stop softkeys.

2 Push the **Start** softkey.
An entry field appears, indicating the start frequency currently set and the step size for the **UP**/**DOWN** cursor keys.

3 Enter a new frequency using the numeric keys, the cursor keys and the **BACKSPACE** key.

4 Conclude the entry by pushing an enter key for the unit (**GHz** or **MHz**).
If the start frequency entered is lower than the stop frequency, the horizontal axis will display the range from the new start to the stop frequency. If the new start frequency is higher or equal to the stop frequency, the start frequency is used as the center frequency with zero span, i.e. the signal at the selected frequency will be shown in the time domain.

5 Push the **Stop** softkey and enter the frequency for the right end of the display.

You can also place softkeys for the start and stop frequencies available on the main menu by changing the frequency mode, see page 39.

Setting center frequency and span

1 Push the **CENT** function key (or the **Freq** softkey in the main menu).
The vertical softkeys include Center and Span. An entry field appears, indicating the center frequency currently set and the step size for the up/down cursor keys.

2 Enter a new frequency using the numeric keys, the cursor keys and the **BACKSPACE** key.

3 Conclude the entry by pushing an enter key for the unit (**GHz** or **MHz**).

4 Push the **Span** softkey and enter the frequency for the range from the left to the right end of the display.

You can also place softkeys for the center frequency and the span available on the main menu by changing the frequency mode, see section "Changing the main menu for different frequency parameters" below.

Changing the main menu for different frequency parameters

The main menu shows two softkeys for the definition of the frequency range on the display. Different methods exist to define the range as depicted above; you can configure these softkeys to one of the two allowable combinations as follows:

1 From the main menu, select **Freq > Freq Mode**.

2 Select the combination of softkeys that you want to see in the main menu (**Start/Stop** or **Center/Span**).

3 Return to the main menu by pushing the **Main...** softkey.
The main menu appears and displays the selected combination of keys.

Note that the description of the horizontal frequency axis changes with the selected parameter set.

Viewing the complete frequency band

To change the frequency range to the full bandwidth supported by the 9101, proceed as follows:

1 From the main menu, push the **Freq** softkey.
The frequency menu is displayed.

2 Push the **Full Span** softkey.
The leftmost frequency changes to 0 Hz and the rightmost frequency to 4 GHz.

Performing measurements in the time domain

Measurements on a selected center frequency can also be displayed in the time domain.

1 From the main menu, push the **Freq** softkey.
The frequency menu is displayed.

2 Push the **Center** softkey and enter the desired center frequency; close the input field by selecting the appropriate unit with one of the enter keys.

3 Push the **Zero Span** softkey.
The horizontal axis becomes the time axis. The scale width is identical to the sweep time. See Figure 13 on page 46 for an example.

Selecting the step size for the frequency input

The center, start and stop frequencies can be set by either entering a new value with the numeric keys, or by using the arrow keys (**UP**, **DOWN**) to increase or decrease the current setting. The step size for an arrow keypress can be either automatically selected by the 9101, or manually adjusted.

Manually setting the frequency step size

1 From the main menu, select **Freq**.

2 Push the **FStep** key.
The Freq Step entry field opens.

3 Enter a new frequency step value and close the entry field by pressing the appropriate enter determining the unit (**GHz/dBm** for gigahertz, **MHz/dB/µs** for megahertz, **kHz/dBµV/ms** for kilohertz, or **ENTER** for hertz).
The auto/manual selection switches to manual and the selected frequency step size is displayed on the softkey.

Setting the frequency step size selection to automatic

1 From the main menu, select **Freq**.

2 Push the **FStep** softkey several times until the “auto” selection is highlighted.

Selecting RBW, VBW and SWT

The resolution bandwidth (RBW) is the 3 dB bandwidth of the IF filter for selecting the signal to be measured. The resolution bandwidth describes the ability of the spectrum analyzer to discriminate between adjacent signals of similar amplitude. Only signals spaced at a frequency of more than the RBW can be discriminated from one another.
The 9101 can be set to automatically select the resolution bandwidth, depending on the frequency span.

The video bandwidth (VBW) is the lowpass bandwidth over which several results for one frequency point are smoothened. The lower the video bandwidth, the smoother the signal curve and the less variations there are.
The 9101 can be set to select the video bandwidth automatically as a function of the resolution bandwidth.

The sweep time (SWT) determines how long it takes for a complete sweep over the measured frequency range (span).
The 9101 can be set to automatically select the sweep time, depending on RBW and VBW. If manually set, the sweep time should be selected long enough for the filtered signal to reach steady state. The 9101 will output an "UNCALibrated" warning if the sweep time is too low.

To set the resolution bandwidth, the video bandwidth or the sweep time, proceed as follows:

1 In the main menu, select the appropriate function softkey (**RBW**, **VBW**, or **SWT**).

2 Enter the value and complete the entry with the appropriate enter key for the unit, select a new value with the help of the **UP/DOWN** cursor keys, or switch to **auto** to leave the setting to the 9101.

Changing between automatic and manual mode

Push the appropriate function softkey (**RBW**, **VBW**, or **SWT**) several times until the desired selection (auto or manual) is highlighted.

Setting up the level parameters

The accuracy and the dynamic range between the measured signal and the noise floor depend on the proper setting of the level settings. These consist of the reference level and the attenuation.

The reference level basically determines the level at the top of the display. The vertical axis is divided into eight horizontal lines; you can adjust the scale (which defaults to 10 dB per line) to your preferences.

The attenuation setting can be coupled to automatically follow the reference level setting. For reference levels of –20 dBm and lower, the attenuation is set to 10 dB; the maximum attenuation is 50 dB.

Attenuation or gain due to external coupling can be compensated by frequency-dependent coupling factors, so that the displayed measurement values reflect the power at the device under test.

WARNING

The maximum input power level at the **RF IN** connector is 30 dBm (1 W). Higher input levels may result in serious damage of the instrument.

Setting the reference level

1 In the main menu, push the **Ref. Level** softkey. Alternatively, push the **REF** function key.
The reference level input field opens.

2 Enter the new reference level either using the numeric keys, closing the input field with the appropriate enter key, or with the **UP/DOWN** arrow keys.
The new reference level appears at the top of the vertical axis. If the attenuation option is set to automatic, the new attenuation level will be shown with the **Attenuation** softkey.

Setting the hardware attenuation

1 In the main menu, push the **Attenuation** softkey.
The Attenuation input field opens.

2 Enter a new attenuation value in the range 0 to 50 dB (in 10 dB steps) and close the input field with one of the enter keys, or use the **UP/DOWN** arrow keys to select the attenuation value in the range 10 to 50 dB.
If the attenuation value is changed, the attenuation option will change to "manual".

NOTE

The attenuation value of 0 dB can be set only with the numeric keys to avoid accidental deactivation. The 0 dB setting should be selected carefully because too high input levels at the input may damage the instrument.

NOTE

For precision measurements, the input level subtracted by the attenuation should not exceed –23 dBm.

Changing the vertical scale

The scale for the vertical axis (power) can be changed in the range from 1 to 20 dB per division (vertical line in the displayed grid) in 1-2-5 steps as follows:

1 From the main menu, select **Level**.

2 Push the **Scale** softkey.
The Scale input field opens.

3 Select a new scale by entering a new number of dB per division numerically and pressing the **ENTER** or **MHz/dB/µs** key, or by pushing the **UP/DOWN** cursor keys.

Selecting the level unit for input and output

1 From the main menu, select **Level > Units**.

2 Push the required unit softkey; available choices are dBm, dBµV, dBmV and dBV.

Compensating gains and losses

If the device under test is connected to the 9101 Handheld Spectrum Analyzer via an amplifier or a device attenuating the signal, such as an antenna or a long cable, the measurement results are wrong by the gain or loss factor. This factor may be a constant or even frequency dependent.

To view the correct measurement results, the gain or loss can be compensated. The 9101 can even compensate a frequency-dependent factor; a correction curve or table can be entered on an external PC using the 91xx Data Exchange Software and loaded to the 9101. The section "Defining and loading external coupling parameters" on page 95 explains this part in more detail.

Enabling external device compensation

Once correction values are stored in the 9101, these can be selected and activated as follows:

1 From the main menu, select **Level > Ext. Dev. Memory**.

2 Push **Recall Ext. Dev. Comp.**
A pull-down menu appears with a list of names for the compensation tables available in the 9101.

3 Select a compensation table using the **UP/DOWN** cursor keys and confirm your choice with the **ENTER** key.
Compensation is still off, but the 9101 changes automatically to the Level menu.

4 Push the **Ext. Dev. Comp.** softkey until "On" is highlighted.
The text "Ext. Dev.", together with the name of the file loaded, appears on the upper left-hand corner of the results display.

NOTE

Steps 1 thru 3 may be omitted if a file had been previously selected. In this case, select the **Level** menu and continue with step 4.

Turning external device compensation off

1 From the main menu, select the **Level** menu.

2 Push **Ext. Dev. Comp.** until "Off" is highlighted.
The text "Ext. Dev." to the left of the results display disappears.

Deleting files for external device compensation

You can delete files containing compensation parameters as follows:

1 From the main menu, select **Level > Ext. Dev. Memory**.

2 a. To delete an individual compensation file from the 9101 memory, push **Delete Ext. Dev. Comp.** Select a file name and push the **ENTER** key.
The compensation file is deleted from the list. Note that there will be no warning; once you have selected and requested a file to be deleted, this will occur immediately.

b. To delete all the compensation files from the 9101, push **Delete All** and confirm with the **ENTER** key.
All compensation files are deleted.

Changing the input impedance

Most RF applications are using an impedance of 50 Ω; other applications such as cable TV apply 75 Ω. The 9101 is designed with an input impedance of 50 Ω; it can, however, be used for testing a device with an impedance of 75 Ω by using the software impedance switch. The measurement results from the 50 Ω input are recalculated to fit the different impedance.

On the 9101, simply select the correct impedance value so that the 9101 can translate the internal measurement values to the power before the coupler.

1 Connect the device under test to the 9101 Handheld Spectrum Analyzer.

2 From the main menu, select the **Level** menu.

3 In the vertical menu, select the impedance of the device, that means select **Impedance: 50** Ω or **Impedance: 75** Ω, respectively.
New measurement results are presented with the new impedance value taken into account. In addition, if the impedance is changed to 75 Ω and the power had been displayed in dBm, the new measurements are shown in dBµV. If the impedance is changed to 50 Ω and the power had been displayed in dBµV, the new measurements are shown in dBm.

NOTE

Signal reflections on the cable between the 50 Ω and the 75 Ω device affect the measurement accuracy of the 9101 Handheld Analyzer. For more accurate results, Willtek recommends using an impedance converter; such a converter will cause attenuation affecting the results. This attenuation can be compensated as explained in section "Compensating gains and losses" on page 43.

Applying special functions on the signal

This section shows how the measurement can be triggered, how the number of measurements can be limited and how you can listen to the sound of the demodulated signal.

Using a signal trigger

The 9101 can either start signal analysis at a random point in time, or start the measurement when a given signal threshold is passed. Starting measurements depending on the actual signal level is only supported in zero span mode.

Selecting untriggered signal analysis

1 From the main menu, enter the sweep menu by pushing **Freq > Trigger**.
The Trigger menu appears.

2 Push the **Free Run** softkey.
The softkey is highlighted and the 9101 is ready for measurements at random times.

Selecting a trigger threshold in the RF signal

1 From the main menu, enter the sweep menu by pushing **Freq > Trigger**.
The Trigger menu appears.

2 Push the **Video** softkey.
The Video softkey is highlighted and an input field for the trigger level appears.

NOTE

The Video trigger is available in zero span mode only, otherwise the softkey description is grayed out.

3 Enter the trigger level (in dBm) and complete the entry by pushing either the **GHz/dBm** or the **Enter** key.
The trigger threshold is displayed at the power axis; the symbol also indicates the slope (direction in which the signal passes the threshold to start the measurement).

4 If necessary, change the slope between positive and negative direction by pushing the **Slope** softkey.
The active slope is indicated at the power axis, see Figure 13.

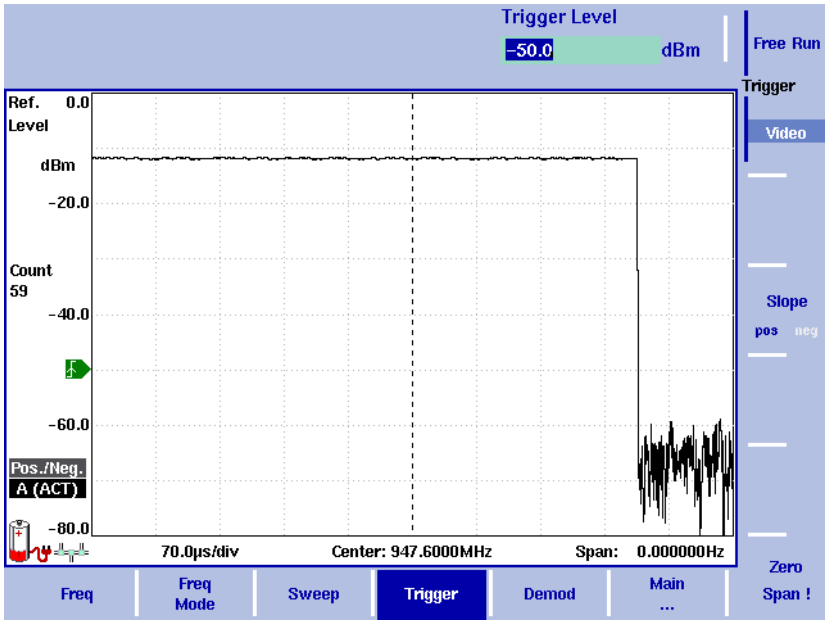


Figure 13 Triggered measurement (in the time domain)

Performing a limited number of measurements

The 9101 can run measurements continuously or a defined number of times. Limiting the number of measurements can be useful for statistical analyses.

1 From the main menu, select **Freq > Sweep**.
The sweep menu appears.

2 Select the trigger mode: Push **Cont.** for continuous measurements or **Single** for a limited number of measurements.
The selected trigger mode is highlighted.

3 To enter the number of measurements, push the **Single Count** softkey, enter a number in the range from 1 to 1000 and press the **ENTER** key.
If Trigger Mode is set to Single, the 9101 performs the defined number of measurements and enters Hold mode.

– To restart single-mode measurements, push the **HOLD/RUN** hardkey or the **Single** softkey.

– To stop a continuous measurement, push the **HOLD/RUN** key. Push it again to resume measurements.

Demodulating an AM or FM signal

The 9101 has the ability to demodulate an AM (amplitude modulation) or FM (frequency modulation) signal and to output the signal at the built-in loudspeaker. The signal should have a signal strength of at least –50 dBm; the demodulation bandwidth is about 10 kHz.

The 9101 can be set to either demodulate one signal permanently, or to toggle between the different frequencies. When set to permanently demodulate one signal, the 9101 demodulates the signal at the center position.

When the 9101 is set to toggle between frequencies, it uses the marker frequencies (marker M1 is enabled if not already active). After performing and displaying a new measurement, the 9101 demodulates and outputs the received signal for a short duration. This duration is selectable in the range from 100 milliseconds to 10 seconds. The 9101 demodulates the carrier at the marker position; the demodulated signal is output for the selected duration. If more than one marker is active, demodulation is resumed at the next marker frequency and so on until a piece of the signal at all active markers has been demodulated. The process starts anew with a new measurement.

The speaker volume can be selected as a percentage of the speaker's maximum capacity.

1 Set a marker to the center frequency of the signal to be demodulated (see section "Setting up the trace" on page 48).

2 From the main menu, select **Freq > Demod**.
The demodulation menu appears.

3 Select the demodulation method (**AM**, **FM**, or **Off**).
The selected method is highlighted.

4 Choose between permanent demodulation and intermittent demodulation at multiple markers by pressing the respective **Demod** softkey.

5 If demodulation at marker is selected, you can change the duration of the output of the demodulated signal:
   – Push the **Duration** softkey.
   The Demod Duration input field opens.
   – Enter the new duration using the numeric keys. Conclude the entry with a push on one of the enter keys with the appropriate unit: push **kHz/ dBµV/ms** for milliseconds or **Enter** for seconds.

6 To adjust the speaker volume, push the **Volume** softkey, enter a new volume level from 0 to 100% and press **Enter**.

Setting up the trace

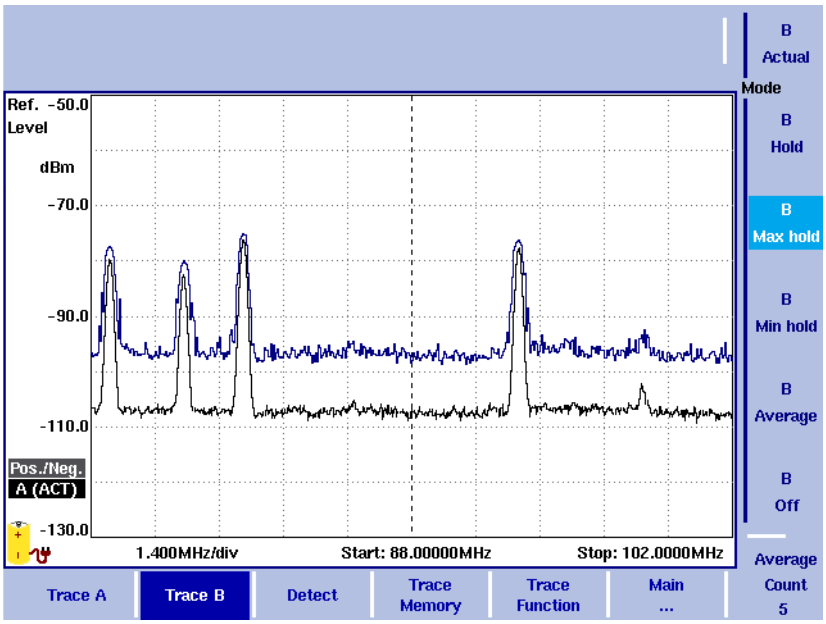


Figure 14 Example of two traces

The trace functions provide different views of the measurements, for example the actual measurement or an average over the last couple of measurements. You can even select two different views of the measurement. Another possibility is to compare the actual measurement with an older measurement which has been stored in the 9101 and loaded to one of the trace views (see section "Storing and loading traces" on page 53).

The 9101 samples many measurements for each frequency point. With the detector functions, you can define the method to select which of the samples is displayed.

Selecting the trace mode

The 9101 has five different modes to display a trace:

- In Actual mode, the 9101 shows a complete new measurement in each trace. Subsequent traces are independent of each other.
- In Hold mode, the last measurement is kept on the display; measurements continue but are not displayed.
- In Max hold mode, the 9101 takes new measurements and, for each frequency point, compares the new measurement with the previous result. If the new measurement value is higher than the previous result, the new measurement value becomes the new result value; otherwise the old result value is kept. This way, the highest result since the start of the Max hold measurement (or a parameter change) is kept and displayed.
- Similarly, in Min hold mode, the 9101 takes new measurements and compares the new measurement with the previous result. If the new measurement value is lower than the previous result, the new measurement

value becomes the new result value; otherwise the old result value is kept. This way, the lowest result since the start of the Min hold measurement (or a parameter change) is kept and displayed.

– In Average mode, the new measurement and previous ones are averaged for each frequency point displayed. The 9101 uses a recursive algorithm for averaging.

To select whether you want to view an actual measurement, stop and hold the last measurement, see the lowest or highest data for each frequency or an average value, proceed as follows:

1 In the main menu, select **Trace**.

2 Select the trace you want to modify (**Trace A** or **Trace B**) using the horizontal softkeys.

3 Select the trade mode with the vertical softkeys (**Actual, Hold, Max hold, Min hold, Average**).
The trace mode is shown at the left-hand side of the vertical axis, e.g. **`A (ACT)`**.

NOTE

For fastest valid results it is advisable to briefly activate the Actual mode before selecting any other mode.

NOTE

When the trace is on hold, the measurement and failure counters continue counting. A second trace, if active, continues updating.

Turning the second trace on and off

You can define two different trace views, e.g. one with the actual values and one with the maximum values. While the first view (Trace A) is always active, the second can be switched off. The functions of turning Trace B on or off and selecting the trace mode are combined as follows:

1 From the main menu, select **Trace > Trace B**.

2 To turn trace B on, select the trace mode (**Actual**, **Hold**, **Max hold**, **Min hold**, or **Average**). To turn trace B off, select **Off**.
If activated, the trace mode is displayed left to the vertical axis, e.g. **B (MAX)**.

Defining the number of measurements for averaging

When the trace mode is set to averaging, it may be useful to adjust the number of measurements over which the 9101 averages the results. The average count value that can be defined in the trace menus applies to both traces alike.

The 9101 uses a recursive algorithm in which a new result is added to the older averages with a weighting factor; the description below indicates how to change this weighting factor.

1 Select the trace menu (select **Trace > Trace A** or **Trace B** from the main menu).

2 Push the **Average Count** softkey.
The Average input field opens.

3 Enter the number of measurements over which to average the results, in the range from 2 to 128.

4 Push the **ENTER** key.

Selecting the detection method

For each new measurement, the 9101 selects one or two values from a number of measurements for each frequency value. The method is user-definable; the following methods are available (see also Figure 15):

- Positive/negative peak: Both the largest and smallest values are taken and displayed as a vertical bar.
- Positive peak: Only the largest value is displayed.
- Negative peak: The smallest value is shown.
- Sample: A measurement value is randomly picked.

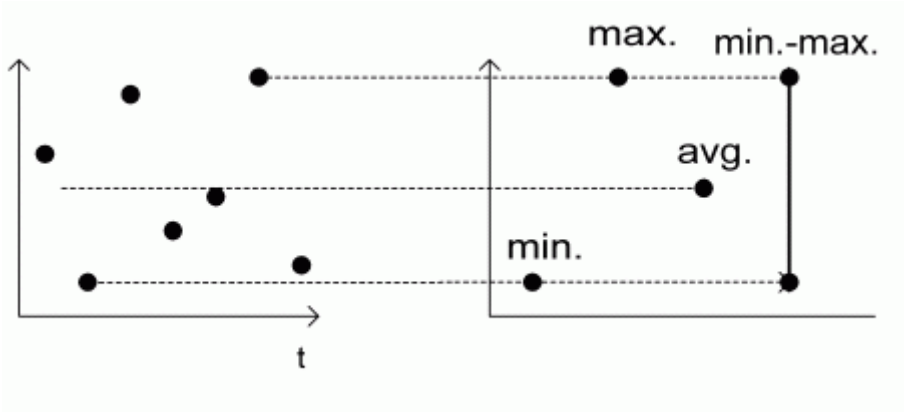


Figure 15 Trace detectors

The detection method applies to both traces. – Select the detection method as follows:

1 From the main menu, select **Trace > Detect**.

2 Select the trace method from the Detector section of the vertical softkeys. The selected detection method is indicated at left-hand side of the display.

Copying traces inside the 9101

You can copy an actual measurement from trace A to trace B or vice versa; this way you can keep the last measurement results on the screen and at the same time continue measuring or change the settings of the 9101 Handheld Spectrum Analyzer. The previous results in the target trace will be erased; the target trace will assume hold mode.

To copy the measurement data from one trace to another, proceed as follows:

1 From the main menu, select **Trace > Trace Function**.

2 To copy the measurement results in trace A to trace B, press **Copy A – > B**. To copy results from trace B to trace A, press **Copy B – > A**.

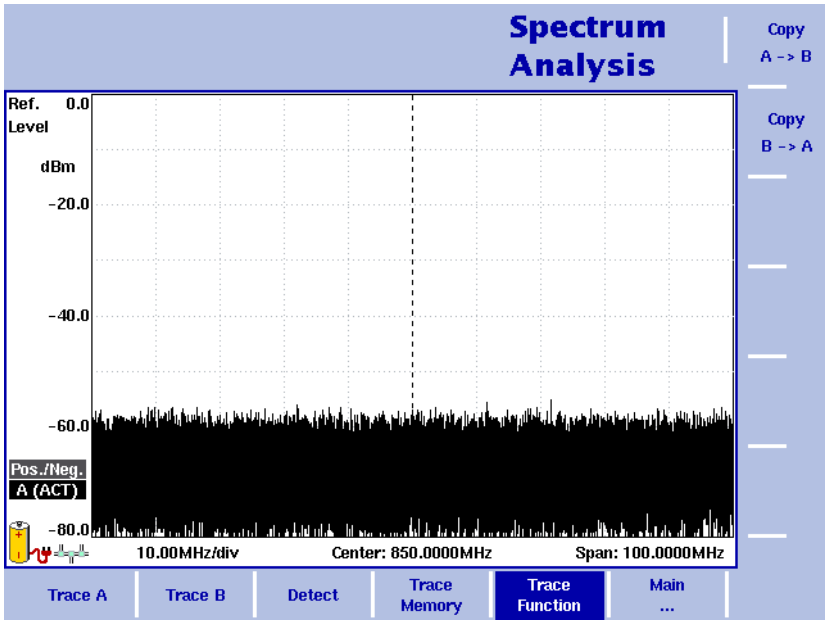


Figure 16 Trace function menu

NOTE

If you first press **Copy A – > B**, then **Copy B – > A** (or vice versa), both traces will display the same results and will be in hold mode.

Storing and loading traces

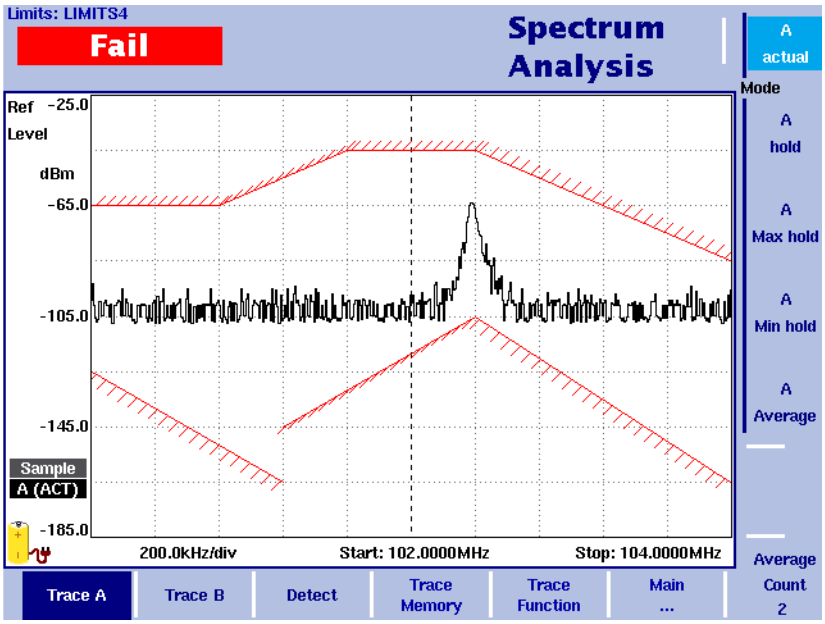


Figure 17 Trace A menu

The 9101 provides the capability to store up to 99 traces in the 9101 and load them again at random. The stored trace can then be examined or compared to a recent measurement. In addition, stored traces can also be transferred to a PC using the 91xx Data Exchange Software which is being delivered with the 9101.

Storing a trace

You can store either trace A or B. Any trace can be stored under a name with up to 11 characters. The procedure to enter text in alphanumerical input fields is explained in section "Entering numbers and text" on page 18. Note that along with the trace, the instrument settings such as frequency range, level range and markers are stored.

1 From the main menu, select **Trace > Trace Memory**.

2 Push either **Store A** or **Store B**, depending on which trace you want to save to the internal memory.
An input field opens, allowing you to enter a name for the trace. Below the input field, a list of existing traces is indicated.

3 Enter a name for the trace. To use a modified trace name, you can move the cursor to a suitable trace name with the **UP/DOWN** cursor keys. The selected trace name also appears in the input field; use the **LEFT/RIGHT** cursor keys to move the cursor to the appropriate position within the trace name to enter additional characters or delete existing ones.

4 Confirm your choice by pushing the **ENTER** key.
The input field closes and the trace is stored under the selected name.

Reusing a trace name

An existing trace stored under a name cannot be overwritten by another trace using the same name, so the old trace will first have to be deleted.

Reloading a trace

1 From the main menu, select **Trace > Trace Memory**.

2 Push either **Recall A** or **Recall B**, depending on which trace you want to load from the internal memory.
An input field opens, allowing you to enter the trace name. Below the input field, a list of existing traces is indicated.

3 Enter the name of the trace to load, or choose one with the **UP/DOWN** cursor keys.

4 Confirm your choice with the **Enter** key.
The input field closes and the trace is displayed.

NOTE

Along with the trace, the 9101 also loads the settings that were used when the trace was saved. These will overwrite the current settings such as frequency range, reference level and markers.

Deleting a trace

Stored traces can be deleted. Note that there will be no warning; once you have selected and requested a file to be deleted, this will occur immediately.

1 From the main menu, select **Trace > Trace Memory**.

2 Push **Delete Trace**.
An input field for the name of the trace to be deleted appears, together with a trace selection box.

3 Select the trace to be deleted using the **UP/DOWN** cursor keys. Alternatively, enter the trace name with the numeric keys.

4 Confirm your choice by pushing the **ENTER** key.
The trace is deleted from the trace list.

5 Select another trace for deletion, or push **ESCAPE** to leave the entry field and the trace selection box.

Deleting all traces

Instead of deleting traces individually, all traces can be deleted in one step. You will be asked to confirm this step.

1 From the main menu, select **Trace > Trace Memory**.

2 Push **Delete All**.
A query appears, asking you to confirm your selection.

3 Push the **ENTER** key to have all traces deleted.
The query disappears. All traces are deleted.

Storing and loading instrument settings

To store or load the instrument settings including frequency range, level setting and markers, proceed as described in sections "Storing a trace" and "Reloading a trace".

Special measurement functions

Within spectrum analysis mode, three different frequency-selective types of power measurements are supported:

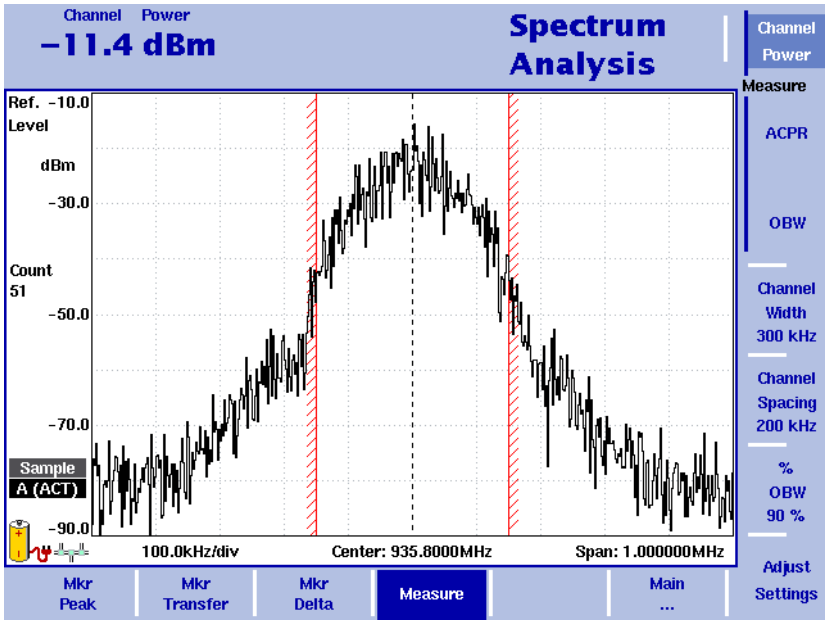
- Channel power
- Adjacent channel power ratio (ACPR)
- Occupied bandwidth (OBW)

These are similar to the measurement types in channel power mode (see chapter "Channel Power Operation" on page 59), without the restrictions that the channel power mode poses with predefined parameters such as span and resolution bandwidth.

Channel power

This measurement includes the power of the selected channel. A channel is defined by center frequency and channel width (not the span in this case); see "Changing the channel width" on page 57.

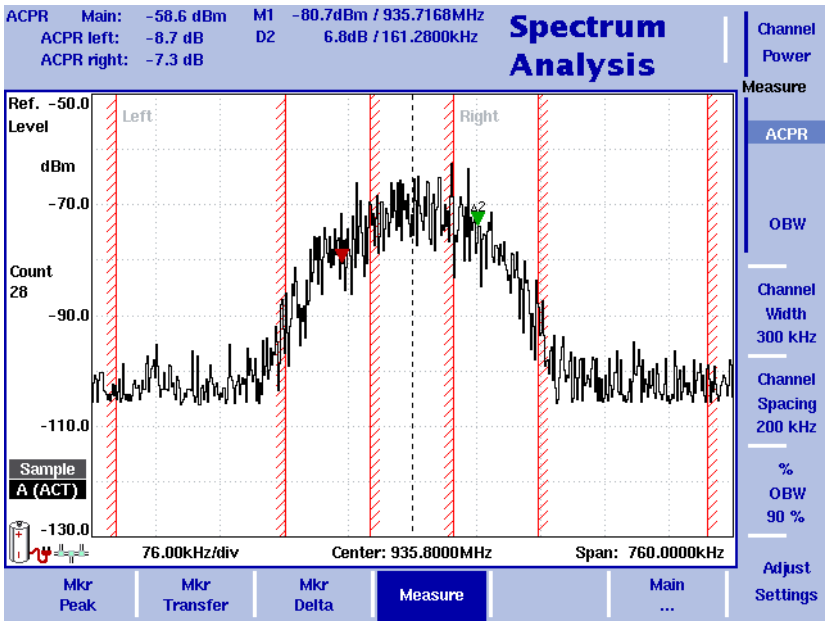
The 9101 displays the numerical result of the channel power measurement on the top-left. The measured bandwidth is indicated graphically with bandwidth boundaries shown in red.



Adjacent channel power ratio (ACPR)

ACPR is the relation between the power transmitted in a neighboring (upper or lower) channel and that in the communication channel used. The measurement can be used to assess the quality of the modulator and the transmitter; the higher the result, the worse the transmitter because transmission in other channels may interfere with another ongoing communication.

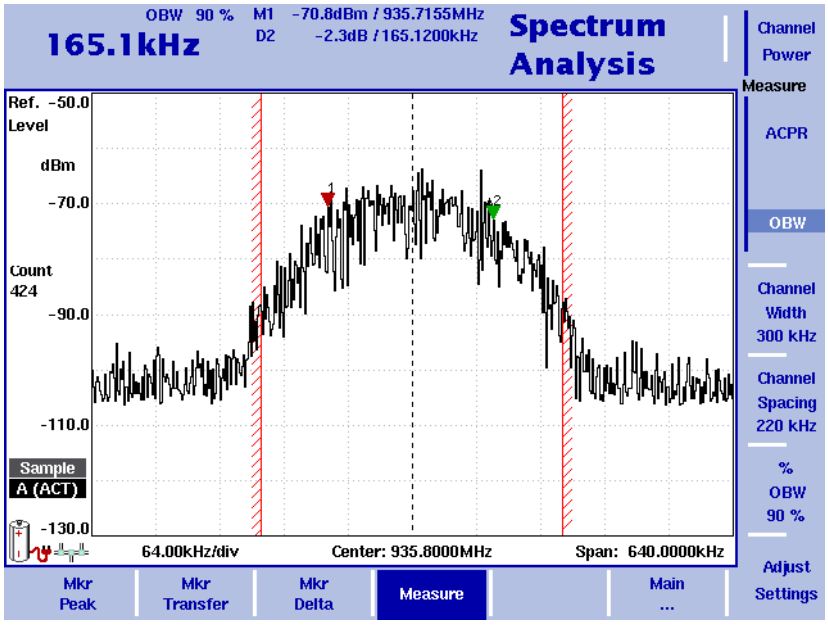
The 9101 determines the adjacent channels by the channel width and channel spacing input parameters (see sections "Changing the channel spacing" and "Changing the channel width" on page 57). It displays the numerical results of the adjacent channel power ratio measurements for the left (lower) and right (upper) channels on the top-left. The measured bands are indicated graphically with bandwidth boundaries shown in red.



Occupied bandwidth (OBW)

The occupied bandwidth identifies the frequency range into which a given percentage of the signal power falls. The frequency range is not necessarily symmetric around the center frequency but is selected so that the bandwidth to hold a certain user-defined OBW percentage is minimized. See section "Changing the occupied bandwidth percentage" on page 58.

OBW is indicated as an absolute value in the upper left-hand corner of the display, together with the OBW percentage; marker M1 and delta marker D2 are assigned the lower and upper frequencies characterizing the frequency range. The power is measured over three times the normal channel bandwidth. The red boundary indicators mark the normal channel bandwidth as selected in the channel system menu.



NOTE

If the resolution bandwidth selected is high and the occupied bandwidth very low, there may be rare cases in which all the power for the occupied bandwidth is mapped to one point in the spectrum display. In such a case, the 9101 displays "N/A" (not available) instead of the bandwidth, and the markers usually indicating the bandwidth boundaries are invisible.
Increase the occupied bandwidth or decrease the resolution bandwidth to receive results.

Selecting the measurement type

To select the type of measurement within spectrum analyzer mode, proceed as follows:

1 From the spectrum analysis main menu, select **Marker > Measure**.

2 Select a measurement type using the vertically aligned function softkeys in the **Measure** section.
The numerical result for the selected measurement appears in the upper left-hand corner of the display.

Switching special measurement functions off

To return to normal spectrum analyzer measurements without the special measurement functions, simply press the button of the selected measurement type again. This will deactivate the special measurements.

Changing the channel width

The channel width is the bandwidth which the transmission is expected to occupy. It can be set for the channel power and ACPR measurements as follows:

1 From the spectrum analysis main menu, select **Marker > Measure**.

2 Press **Channel Width**, enter a new value and press the respective entry key for the unit.
The new measurement bandwidth for channel power and ACPR is displayed with the softkey.

Changing the channel spacing

The channel spacing is distance in frequency between two adjacent channels. It can be set for the ACPR measurements as follows:

1 From the main menu, select **Marker > Measure**.

2 Press **Channel Spacing**, enter a new value and press the respective entry key for the unit.
The new channel spacing for ACPR is displayed with the softkey.

Reading the channel power

In addition to the display elements explained on page 10, the channel power mode also includes a large display of the channel power, along with the channel, resolution bandwidth and sweep time. Please see the graphs on page 55 and the following for typical measurements.

Changing the occupied bandwidth percentage

OBW measurements identify the frequency range in which a certain percentage of the transmit power falls. The percentage value can be changed as follows:

1 From the spectrum analyzer main menu, select **Marker > Measure**.

2 Press **% OBW** and enter a new percentage value in the range from 5 to 99.

3 Push **ENTER** to close the input field.
If the OBW measurement type is selected, the new OBW percentage value is indicated in the upper left-hand corner of the display.
The 9101 recalculates the frequency range based on the new percentage value.

Changing general analyzer parameters

For the channel power, ACPR and OBW measurements within the spectrum analyzer mode, the general settings such as center frequency, span, resolution bandwidth, can be changed as usual. A one-button approach to adjusting span, resolution bandwidth, video bandwidth, detector and trace mode is described below.

1 From the spectrum analyzer main menu, select **Marker > Measure**.

2 Press **Adjust Settings**.
Resolution bandwidth and video bandwidth are automatically set to optimum values (auto mode). The trace detector is set to sample and the trace mode is set to actual.
If channel power measurements are selected, the span is set to 120% of the selected channel width. For ACPR measurements, the span is adjusted to 1.2 × channel width + 2 × channel spacing. The OBW span is three times the channel width.

Channel Power Operation

4

This chapter describes the instrument's functions in channel power measurement mode. Topics discussed in this chapter are as follows:

- "About measurement modes and types" on page 60
- "Selecting the measurement mode" on page 62
- "Operating in channel power mode" on page 63
- "Reading the channel power" on page 64
- "Changing the occupied bandwidth percentage" on page 64
- "Working with communication systems and frequency settings" on page 64
- "Setting up the level parameters" on page 67
- "Changing the input impedance" on page 70
- "Setting up the trace" on page 71
- "Storing and loading traces" on page 74

About measurement modes and types

The 9101 provides different measurement modes, e.g. spectrum analysis and channel power measurements. The channel power mode allows you to measure the radiated power within a certain frequency band with a single button press. This mode reduces the complexity of all the setup possibilities for defined communication systems. Several communication systems are predefined in the 9101 or can be downloaded from a PC using the 91xx Data Exchange Software; see section "Managing communication systems for channel power measurements" on page 96 for more details.

Within channel power mode, three different frequency-selective types of power measurements are supported:

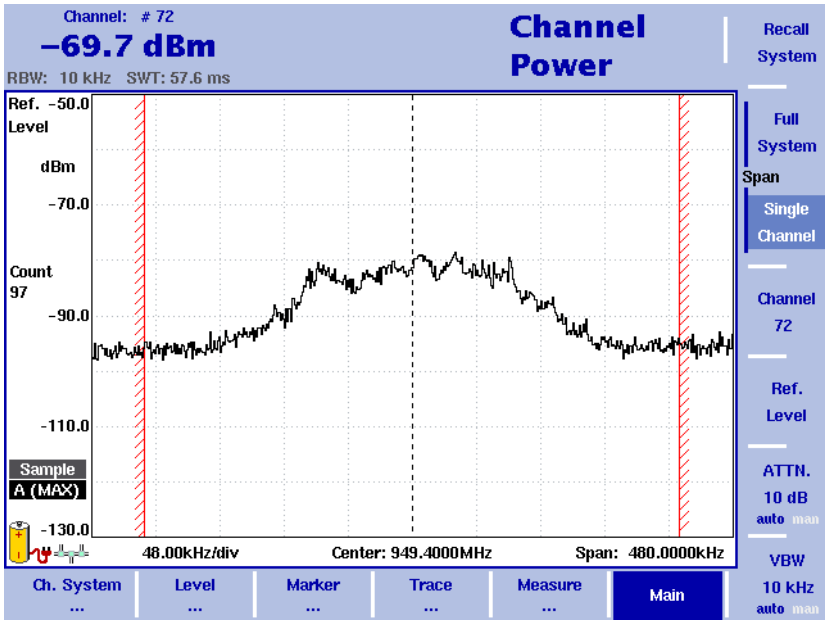
- Channel power
- Adjacent channel power ratio (ACPR)
- Occupied bandwidth (OBW)

These modes are available both in channel power and in spectrum analysis mode; in channel power mode, however, measurements on communication systems using different frequency channels are easier to perform with the predefined channel spacing and bandwidth.

Channel power

This measurement includes the power of the selected channel. The channel can be selected in the main menu whereas parameters like channel width (the measurement bandwidth) and channel spacing can be viewed and changed in the channel system menu.

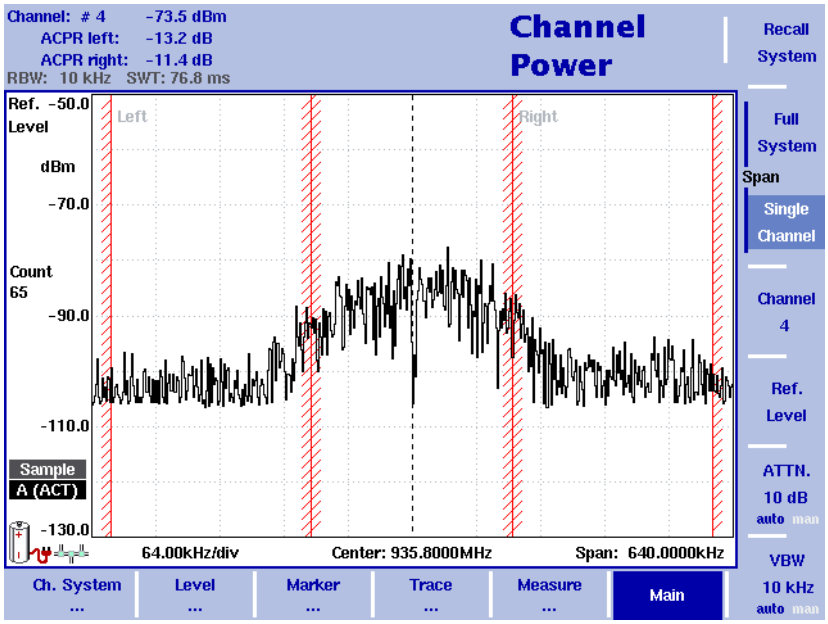
The 9101 displays the numerical result of the channel power measurement on the top-left. The measured bandwidth is indicated graphically with bandwidth boundaries shown in red.



Adjacent channel power ratio (ACPR)

ACPR is the relation between the power transmitted in a neighboring (upper or lower) channel and that in the channel used for communication. The measurement can be used to assess the quality of the modulator and the transmitter; the higher the result, the worse the transmitter because transmission in other channels may interfere with another ongoing communication.

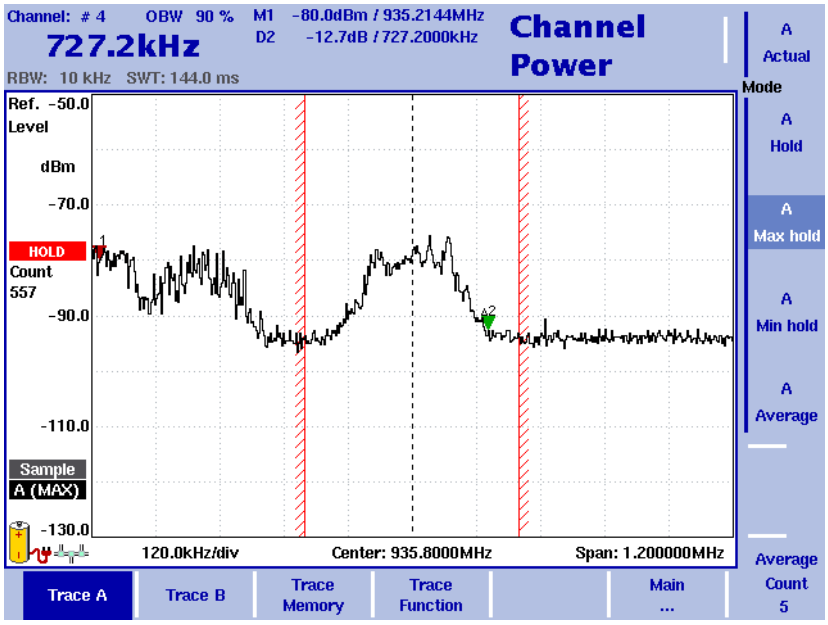
The 9101 displays the numerical results of the adjacent channel power ratio measurements for the left (lower) and right (upper) channels on the top-left. The measured bands are indicated graphically with bandwidth boundaries shown in red.



Occupied bandwidth (OBW)

The occupied bandwidth identifies the frequency range into which a given percentage of the signal power falls. The frequency range is not necessarily symmetric around the center frequency but is selected so that the bandwidth to hold a certain user-defined OBW percentage is minimized. See section "Changing the occupied bandwidth percentage" on page 64.

OBW is indicated as an absolute value in the upper left corner of the display, together with the OBW percentage; marker M1 and delta marker D2 are assigned the lower and upper frequencies characterizing the frequency range. The power is measured over three times the normal channel bandwidth. The red boundary indicators mark the normal channel bandwidth as selected in the channel system menu.



NOTE

If the resolution bandwidth selected is high and the occupied bandwidth very low, there may be rare cases in which all the power for the occupied bandwidth is mapped to one point in the spectrum display. In such a case, the 9101 displays "N/A" (not available) instead of the bandwidth, and the markers usually indicating the bandwidth boundaries are invisible.
Increase the occupied bandwidth to receive results.

Selecting the measurement mode

To select the channel power measurement mode, proceed as follows:

1 Push the **MODE** button.

2 Select the channel power mode.
The main menu of the channel power mode appears. If you select a new mode, all parameters are set to the values from when the mode was last active. If, however, you resume the last active mode, the measurements continue without any changes to the parameters.

To select the type of measurement within the channel power mode, proceed as follows:

1 Push the **Measure** softkey.

2 Select a measurement type using the vertically aligned function softkeys (channel power, ACPR, or OBW).

NOTE

Adjacent Channel Power Ratio (ACPR) measurements are available only in those communication systems where the channel bandwidth does not exceed the channel spacing; otherwise, the measurement range of the adjacent channel would overlap with that in the selected channel.
As an alternative, use the ACPR measurements within the spectrum analysis mode (page 56).

Operating in channel power mode

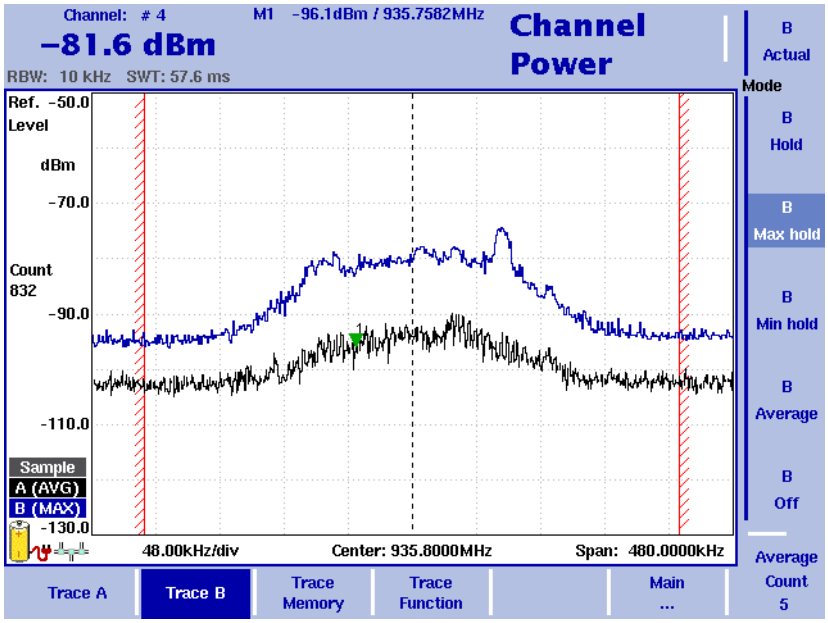


Figure 18 Example of a channel power measurement

This mode provides a measurement of the integral power within a given bandwidth. The measurement mode can be selected as desribed on page 62.

In channel power mode, the frequency parameters, filters and sweep time cannot be selected individually. Instead, a communication system can be selected or defined in which the 9101 shall measure the channel power; the frequency parameters are stored with the communication system settings.

A few communication systems such as GSM are predefined in the 9101. More predefined system settings are available in the 91xx Data Exchange Software and can be downloaded to the 9101. In addition, the settings for an alternative communication system can be defined by the user, stored in the 9101 and recalled for channel power measurements.

Reading the channel power

In addition to the display elements explained on page 11, the channel power mode also includes a large display of the channel power, along with the channel, resolution bandwidth and sweep time. In the example in Figure 18 on page 63, the 9101 indicates the frequency range over which the channel power is measured between red vertical bars.

Changing the occupied bandwidth percentage

OBW measurements identify the frequency range in which a certain percentage of the transmit power falls. The percentage value can be changed as follows:

1 From the channel power main menu, select **Channel System**.

2 Press % OBW and enter a new percentage value in the range from 5 to 99.

3 Push **ENTER** to close the input field.
If the OBW measurement type is selected, the new OBW percentage value is indicated in the upper left-hand corner of the display.
The 9101 recalculates the frequency range based on the new percentage value.

NOTE

The occupied bandwidth can also be changed from within the Measure menu.

Working with communication systems and frequency settings

Selecting a communication system on the 9101

You can activate communication system settings that are stored in the 9101 as follows:

1 In the main menu of the channel power mode, select **Ch. System > System Memory**.
The system memory menu appears.

2 Push **Recall System**.
A scroll box appears, showing the available communication systems. Enter the system name as stored in the 9101, or move the **UP/DOWN** cursor keys to move the cursor to the system to be measured.

3 Push **ENTER** to confirm.
The input field and the scroll box disappear and the spectrum of the selected band is measured. The channel power of the first channel is displayed in the upper left-hand corner.

The 9101 comes installed with the following preinstalled communication systems:

Table 15 Preinstalled communication systems

System name	System meaning	Channel numbers	Frequency range
DCS1800-DL	GSM 1800, downlink	512 thru 885	1805.2 thru 1879.8 MHz
PGSM900-DL	P-GSM 900, downlink	0 thru 124	935.0 thru 959.8 MHz
PCS1900-DL	GSM 1900, downlink	512 thru 810	1930.2 thru 1989.8 MHz
WCDMA-DL	UMTS, downlink	10562 thru 10838	2112.4 thru 2167.6 MHz
WCDMA-UL	UMTS, uplink	9612 thru 9888	1922.4 thru 1977.6 MHz
WLAN	Wireless LAN to the IEEE 802.11 standard	1 thru 13	2412 thru 2472 MHz

Setting up a new communication system

A new communication system can be defined in terms of frequency range, channel bandwidth and spacing, and channel numbering; channels can then be addressed easily by their channel number rather than the carrier or center frequency. Setting up a new communication system can be done as follows:

1 In the main menu, select **Ch. System**.
The channel system menu appears.

2 Push **First Channel** and enter the first channel number in use by the system, then close the input field using the **ENTER** key.

3 Push **Last Channel** to enter the number of the last channel in use by the system; close the input field with the **ENTER** key.

4 Push **Channel Width** to change the measurement bandwidth; ensure to select the right unit (e.g. kHz).

5 Select the **Channel Spacing** softkey, enter the spacing between channel numbers and close the input field with the **ENTER** key for the appropriate frequency unit.

6 Push the **1st Ch. Center** softkey and enter the carrier frequency for the first channel in use (channel number defined with the first softkey). Close the input field using the enter key for the appropriate unit (e.g. **MHz**).

7 For occupied bandwidth (OBW) measurements, select **% OBW** and enter the percentage value. Confirm the value with the **ENTER** key.

8 Push **System Memory > Store System**, enter a new name for the system and press the **ENTER** key.

NOTE

Existing systems cannot be overwritten; you must delete a system first.

If you delete a predefined system that is delivered with the 9101, it can be restored as depicted in section "Undeleting default communication systems" on page 66.

Deleting a communication system

To delete a the communication system settings stored on the 9101, take the following steps.

1 From the main menu, select **Ch. System > System Memory**.
The system memory menu appears.

2 Push the **Delete System** softkey.
A scroll box with the list of available communication systems appears.

3 Select the system settings to be deleted by moving the **UP/DOWN** cursor keys to the respective system settings name, and confirm with **Enter**.
The system settings are deleted from the list.

4 Push **ESCAPE** to return to close the input field and the scroll box.

Deleting all communication systems

You can clean up previously stored communication systems and easily delete all of them, including those that were originally delivered with the 9101.

1 From the main menu, select **Ch. System > System Memory**.
The system memory menu appears.

2 Push the **Delete All** softkey.
A box appears, asking to confirm that you want to delete all the communication system settings.

3 Push **ENTER** to confirm deletion or **ESC** to prevent the 9101 from deleting all the communication systems.
If confirmed, all the communication systems are deleted, that means the list of communication systems will be empty.

Undeleting default communication systems

If you have deleted communication systems that were delivered with the 9101, you can restore these system settings.

1 From the main menu, select **Ch. System > System Memory**.
The system memory menu appears.

2 Push the **Restore Default Systems** softkey.
The 9101 creates all the communication systems that were originally delivered with the 9101.

Using the 91xx Data Exchange Software with communication systems

With the 91xx Data Exchange Software, more communication systems can be defined, loaded to the 9101 and selected for use. See section "Managing communication systems for channel power measurements" on page 96 for more information.

Defining the frequency span

The 9101 can display either the full spectrum used by the system, or the channel to be measured. Select the frequency span as desired:

In the main menu, select either **Full System** or **Single Channel**.
If Full System is selected, the full frequency band as defined for the communication system is displayed. If the Single Channel softkey has been pushed, only the frequency range of the currently selected channel is shown.

Changing the channel

1 On the main menu, push the **Channel** softkey.
The Channel input field opens.

2 Enter the desired channel number within the communication system at hand, or select the channel number with the **UP/DOWN** cursor keys.

3 Push **ENTER** to confirm.
The channel power for the selected channel is indicated in the upper left-hand corner.

Changing the sweep time

The sweep time (SWT) determines how long it takes for a complete sweep over the measured frequency range (span).
By default, the 9101 automatically selects the sweep time depending on other measurement parameters such as the span. In some cases it may be an advantage to manually select a different sweep time. This is the case with pulsed signals where a longer sweep time may increase the measurement accuracy. If manually set, the sweep time should be selected long enough for the filtered signal to reach steady state. The 9101 will output an "UNCALibrated" warning if the sweep time is too low.

To change the sweep time in channel power mode, proceed as follows:

1 From the main menu, select **Measure**.

2 Push the **SWT** softkey.

3 Enter the new sweep time and confirm with the appropriate enter key for the unit.

Setting up the level parameters

The accuracy and the dynamic range between the measured signal and the noise floor depend on the proper setting of the level settings. These consist of the reference level and the attenuation.

The reference level basically determines the level at the top of the display. The vertical axis is divided into eight horizontal lines; you can adjust the scale (which defaults to 10 dB per line) to your preferences.

The attenuation setting can be coupled to automatically follow the reference level setting. For reference levels of –20 dBm and lower, the attenuation is set to 10 dB; the maximum attenuation is 50 dB.

Attenuation or gain due to external coupling can be compensated by frequency-dependent coupling factors, so that the displayed measurement values reflect the power at the device under test.

WARNING

The maximum input power level at the **RF IN** connector is 30 dBm (1 W). Higher input levels may result in serious damage of the instrument.

Setting the reference level

1 In the main menu, push the **Ref. Level** softkey. Alternatively, push the **REF** function key.
The reference level input field opens.

2 Enter the new reference level either using the numeric keys, closing the input field with the appropriate enter key, or with the **UP/DOWN** arrow keys.
The new reference level appears at the top of the vertical axis. If the attenuation option is set to automatic, the new attenuation level will be shown with the **Attenuation** softkey.

Setting the hardware attenuation

1 In the main menu, push the **Attenuation** softkey.
The Attenuation input field opens.

2 Enter a new attenuation value in the range 0 to 50 dB (in 10 dB steps) and close the input field with one of the enter keys, or use the **UP/DOWN** arrow keys to select the attenuation value in the range 10 to 50 dB.
If the attenuation value is changed, the attenuation option will change to "auto".

NOTE

The attenuation value of 0 dB can be set only with the numeric keys to avoid accidental deactivation. The 0 dB setting should be selected carefully because too high input levels at the input may damage the instrument.

NOTE

For precision measurements, the input level subtracted by the attenuation should not exceed –23 dBm.

Changing the vertical scale

The scale for the vertical axis (power) can be changed in the range from 1 to 20 dB per division (vertical line in the displayed grid) in 1-2-5 steps as follows:

1 From the main menu, select **Level**.

2 Push the **Scale** softkey.
The Scale input field opens.

3 Select a new scale by entering a new number of dB per division numerically and pressing the **ENTER** or **MHz/dB/µs** key, or by pushing the **UP/DOWN** cursor keys.

Selecting the level unit for input and output

1 From the main menu, select **Level > Units**.

2 Push the required unit softkey; available choices are dBm, dBµV, dBmV and dBV.

Compensating gains and losses

If the device under test is connected to the 9101 Handheld Spectrum Analyzer via an amplifier or a device atttenuating the signal, such as an antenna or a long cable, the measurement results are wrong by the gain or loss factor. This factor may be a constant or even frequency-dependent.

To view the correct measurement results, the gain or loss can be compensated. The 9101 can even compensate a frequency-dependent factor; a correction curve or table can be entered on an external PC using the 91xx Data Exchange Software and loaded to the 9101. Section "Defining and loading external coupling parameters" on page 95 explains this part in more detail.

Enabling external device compensation

Once correction values are stored in the 9101, these can be selected and activated as follows:

1 From the main menu, select **Level > Ext. Dev. Memory**.

2 Push **Recall Ext. Dev. Comp.**
A pull-down menu appears with a list of names for the compensation tables available in the 9101.

3 Select a compensation table using the **UP/DOWN** cursor keys and confirm your choice with the **ENTER** key.

4 Select the **Level** menu and push the **Ext. Dev. Comp.** softkey until "On" is highlighted.
The text "Ext. Dev." appears to the left of the results display.

Turning external device compensation off

1 From the main menu, select the **Level** menu.

2 Push **Ext. Dev. Comp.** until "Off" is highlighted.
The text "Ext. Dev." to the left of the results display disappears.

Deleting files for external device compensation

You can delete files containing compensation parameters as follows:

1 From the main menu, select **Level > Ext. Dev. Memory**.

2 a. To delete an individual compensation file from the 9101 memory, push **Delete Ext. Dev. Comp.** Select a file name and push the **ENTER** key.
The compensation file is deleted from the list. Note that there will be no warning; once you have selected and requested a file to be deleted, this will occur immediately.
b. To delete all the compensation files from the 9101, push **Delete All** and confirm with the **ENTER** key.
All compensation files are deleted.

Changing the input impedance

Most RF applications are using an impedance of 50 Ω; other applications such as cable TV apply 75 Ω. The 9101 is designed with an input impedance of 50 Ω; it can, however, be used for testing a device with an impedance of 75 Ω by using the software impedance switch. The measurement results from the 50 Ω input are recalculated to fit the different impedance.

On the 9101, simply select the correct impedance value so that the 9101 can translate the internal measurement values to the power before the coupler.

1 To connect a 75 Ω device, connect the device under test to the 9101 Handheld Spectrum Analyzer.

2 From the main menu, select the **Level** menu.

3 In the vertical menu, select the impedance of the device, that means select **Impedance: 50** Ω or **Impedance: 75** Ω, respectively.
New measurement results are presented with the new impedance value taken into account. In addition, if the impedance is changed to 75 Ω and the power had been displayed in dBm, the new measurements are shown in dBµV. If the impedance is changed to 50 Ω and the power had been displayed in dBµV, the new measurements are shown in dBm.

NOTE

Signal reflections on the cable between the 50 Ω and the 75 Ω device affect the measurement accuracy of the 9101 Handheld Analyzer. For more accurate results, Willtek recommends using an impedance converter; such a converter will cause attenuation affecting the results. This attenuation can be compensated as explained in section "Compensating gains and losses" on page 69.

Setting up the trace

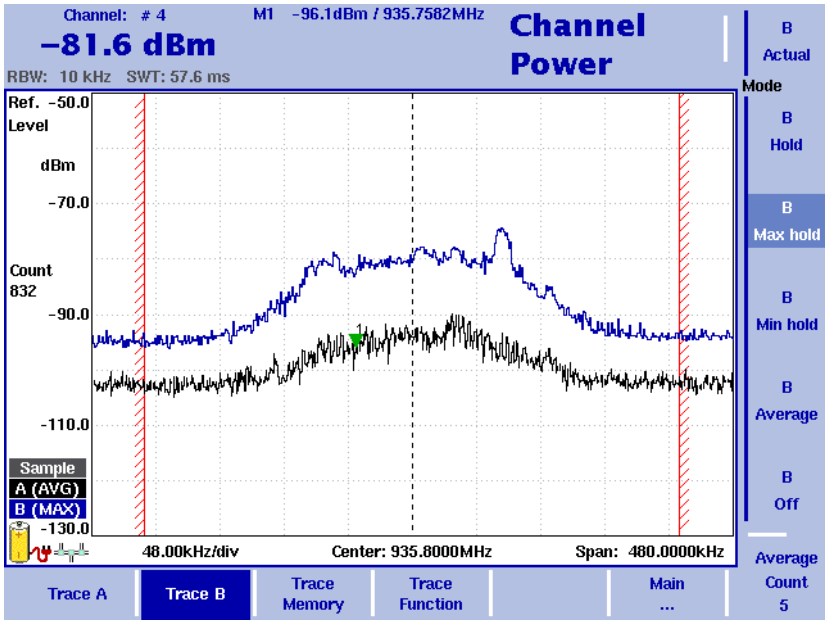


Figure 19 Example of two traces in channel power mode

The trace functions provide different views of the measurements, for example the actual measurement or an average over the last couple of measurements. You can even select two different views of the measurement. Another possibility is to compare the actual measurement with an older measurement which has been stored in the 9101 and loaded to one of the trace views (see section "Storing and loading traces" on page 74).

The 9101 samples many measurements for each frequency point. With the detector functions, you can define the method to select which of the samples is displayed.

Selecting the trace mode

The 9101 has five different modes to display a trace:

- In 'actual' mode, the 9101 shows a complete new measurement in each trace. Subsequent traces are independent of each other.
- In 'hold' mode, the last measurement is kept on the display; measurements continue but are not displayed.
- In 'max hold' mode, the 9101 takes new measurements and, for each frequency point, compares the new measurement with the previous result. If the new measurement value is higher than the previous result, the new measurement value becomes the new result value; otherwise the old result value is kept. This way, the highest result since the start of the Max hold measurement (or a parameter change) is kept and displayed.
- Similarly, in 'min hold' mode, the 9101 takes new measurements and compares the new measurement with the previous result. If the new measurement value is lower than the previous result, the new measurement

value becomes the new result value; otherwise the old result value is kept. This way, the lowest result since the start of the Min hold measurement (or a parameter change) is kept and displayed.

– In 'average' mode, the new measurement and previous ones are averaged for each frequency point displayed. The 9101 uses a recursive algorithm for averaging.

To select whether you want to view an actual measurement, stop and hold the last measurement, see the lowest or highest data for each frequency or an average value, proceed as follows:

1 In the main menu, select **Trace**.

2 Select the trace you want to modify (**Trace A** or **Trace B**) using the horizontal softkeys.

3 Select the trade mode with the vertical softkeys (**Actual, Hold, Max hold, Min hold, Average**).
The trace mode is shown at the left-hand side of the vertical axis, e.g. **A (ACT)**.

NOTE

For fastest valid results it is advisable to briefly activate the 'actual' mode before selecting any other mode.

NOTE

When the trace is on hold, the measurement and failure counters continue counting. A second trace, if active, continues updating.

Turning the second trace on and off

You can define two different trace views, e.g. one with the actual values and one with the maximum values. While the first view (Trace A) is always active, the second can be switched off. The functions of turning Trace B on or off and selecting the trace mode are combined as follows:

1 From the main menu, select **Trace > Trace B**.

2 To turn trace B on, select the trace mode (**Actual**, **Hold**, **Max hold**, **Min hold**, or **Average**). To turn trace B off, select **Off**.
If activated, the trace mode is displayed left to the vertical axis, e.g. **B (MAX)**.

Defining the number of measurements for averaging

When the trace mode is set to averaging, it may be useful to adjust the number of measurements over which the 9101 averages the results. The average count value that can be defined in the trace menus applies to both traces alike.

The 9101 uses a recursive algorithm in which a new result is added to the older averages with a weighting factor; the description below indicates how to change this weighting factor.

1 Select the trace menu (select **Trace > Trace A** or **Trace B** from the main menu).

2 Push the **Average Count** softkey.
The Average input field opens.

3 Enter the number of measurements over which to average the results, in the range from 2 to 128.

4 Push the **ENTER** key.

Selecting the detection method

In channel power mode, the detection method is set to Sample (compare with spectrum analysis mode on page 51).

Copying traces inside the 9101

You can copy an actual measurement from trace A to trace B or vice versa; this way you can keep the last measurement results on the screen and at the same time continue measuring or change the settings of the 9101 Handheld Spectrum Analyzer. The previous results in the target trace will be erased; the target trace will assume hold mode.

To copy the measurement data from one trace to another, proceed as follows:

1 From the main menu, select **Trace > Trace Function**.

2 To copy the measurement results in trace A to trace B, press **Copy A – > B**. To copy results from trace B to trace A, press **Copy B – > A**.

NOTE

If you first press **Copy A – > B**, then **Copy B – > A** (or vice versa), both traces will display the same results and will be in hold mode.

Storing and loading traces

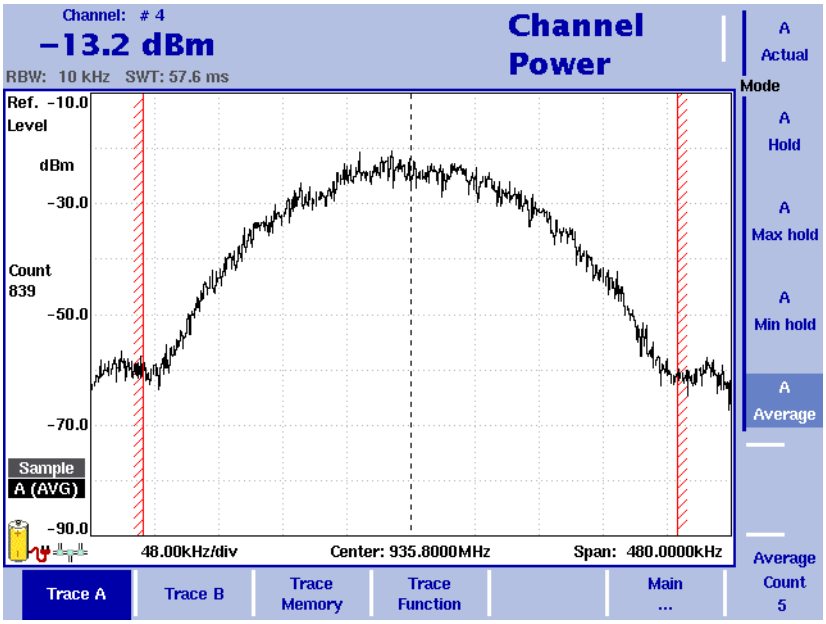


Figure 20 Trace A menu in channel power mode

The 9101 provides the capability to store up to 99 traces in the 9101 and load them again at random. The stored trace can then be examined or compared to a recent measurement. In addition, stored traces can also be transferred to a PC using the 91xx Data Exchange Software which is being delivered with the 9101.

Storing a trace

You can store either trace A or B. Any trace can be stored under a name with up to 11 characters. The procedure to enter text in alphanumerical input fields is explained in section "Entering numbers and text" on page 18. Note that along with the trace, the instrument settings such as frequency range, level range and markers are stored.

1 From the main menu, select **Trace > Trace Memory**.

2 Push either **Store A** or **Store B**, depending on which trace you want to save to the internal memory.
An input field opens, allowing you to enter a name for the trace. Below the input field, a list of existing traces is indicated.

3 Enter a name for the trace. To use a modified trace name, you can move the cursor to a suitable trace name with the **UP/DOWN** cursor keys. The selected trace name also appears in the input field; use the **LEFT/RIGHT** cursor keys to move the cursor to the appropriate position within the trace name to enter additional characters or delete existing ones.

4 Confirm your choice by pushing the **ENTER** key.
The input field closes and the trace is stored under the selected name.

Reusing a trace name

An existing trace stored under a name cannot be overwritten by another trace using the same name, so the old trace will first have to be deleted.

Reloading a trace

1 From the main menu, select **Trace > Trace Memory**.

2 Push either **Recall A** or **Recall B**, depending on which trace you want to load from the internal memory.
An input field opens, allowing you to enter the trace name. Below the input field, a list of existing traces is indicated.

3 Enter the name of the trace to load, or choose one with the **UP/DOWN** cursor keys.

4 Confirm your choice with the **Enter** key.
The input field closes and the trace is displayed.

NOTE

Along with the trace, the 9101 also loads the settings that were used when the trace was saved. These will overwrite the current settings such as frequency range, reference level and markers.

Deleting a trace

Stored traces can be deleted. Note that there will be no warning; once you have selected and requested a file to be deleted, this will occur immediately.

1 From the main menu, select **Trace > Trace Memory**.

2 Push **Delete Trace**.
An input field for the name of the trace to be deleted appears, together with a trace selection box.

3 Select the trace to be deleted using the **UP/DOWN** cursor keys. Alternatively, enter the trace name with the numeric keys.

4 Confirm your choice by pushing the **ENTER** key.
The trace is deleted from the trace list.

5 Select another trace for deletion, or push **ESCAPE** to leave the entry field and the trace selection box.

Deleting all traces

Instead of deleting traces individually, all traces can be deleted in one step. You will be asked to confirm this step.

1 From the main menu, select **Trace > Trace Memory**.

2 Push **Delete All**.
A query appears, asking you to confirm your selection.

3 Push the **ENTER** key to have all traces deleted.
The query disappears. All traces are deleted.

Storing and loading instrument settings

To store or load the instrument settings including frequency range, level setting and markers, proceed as described in sections "Storing a trace" and "Reloading a trace" on page 75.

Troubleshooting

5

This chapter provides information on handling errors and problems related to the 9101 Handheld Spectrum Analyzer.

Handling system errors

Should an error or problem occur that prevents you from controlling the instrument and thus requires the instrument's software to be set up again, the 9101 offers the Setup Application Software menu. This menu provides you with access to the instrument without starting the software and enables you to perform a software update.

Chapter 6 "Updating the Instrument's Software" contains a detailed description of the processes involved in updating the instrument's software via the Setup Application Software menu.

Updating the Instrument's Software

6

This chapter describes how to perform an update of the instrument's software via the 9101 Handheld Spectrum Analyzer's Setup Application Software menu. Topics discussed in this chapter include the following:

- "The Setup Application Software menu" on page 80
- "Performing a serial update" on page 80
- "Performing a LAN update" on page 81
- "Determining the Host IP address" on page 81

The Setup Application Software menu

The 9101 Handheld Spectrum Analyzer's Setup Application Software menu provides you with access to the instrument without starting the software. Via this menu you can perform a software update. The menu offers two options for this process: Serial update and LAN update.

Performing a serial update

Take the following steps to perform a serial update of the instrument's software via the Setup Application Software menu:

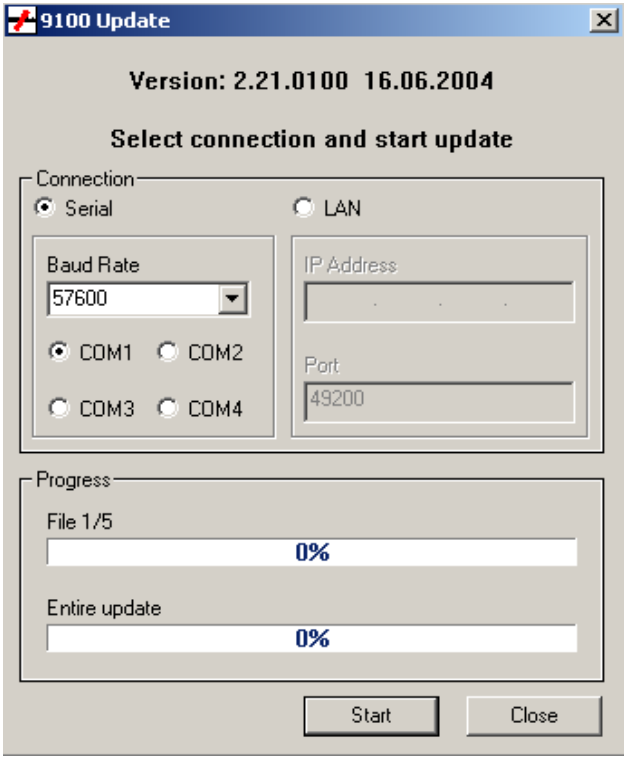
1 Connect the 9101 to an external power supply.

2 Connect the 9101 to the PC. See section"Connecting the 9101 Handheld Spectrum Analyzer" on page 8 for further details.

3 Switch on the 9101. In order to enter the Setup Application Software menu press the numeric key **0** when the input request message is displayed on the boot-up screen. Now the Setup Application Software menu is displayed.

4 Press the numeric key **1** to open the Serial Update menu.

5 In order to upload the application files from the PC to the instrument start the installation program on your PC. This will open the Update window as shown below.



6 In the Connection frame, select **Serial**.

7 To start the serial update press the numeric key **1** on the instrument.

NOTE

You do not have to click **Start** in the Update window on your PC. The update process will be started without any further input on the PC.

Performing a LAN update

Take the following steps to perform a LAN update of the instrument's software via the Setup Application Software menu:

1 Connect the 9101 to an external power supply.

2 Connect the 9101 to the PC. See section"Connecting the 9101 Handheld Spectrum Analyzer" on page 8 for further details.

3 Switch on the 9101. In order to enter the Setup Application Software menu press the numeric key **0** when the input request message is displayed on the boot up screen. Now the Setup Application Software menu is displayed.

4 Press the numeric key **2** to open the LAN Update menu.

5 Here the IP adresses of the instrument (Target IP) and the PC (Host IP) are displayed. Press the numeric key **1** to change or enter the Host IP and **2** to change the Target IP. See section "Determining the Host IP address" on page 81 for information on determining the Host PC's IP address.

6 In order to upload the application files from the PC to the instrument start the installation program on your PC. This will open the Update window (see "Performing a serial update" on page 80).

7 In the Connection frame, select **LAN**.

8 In order to start the update press the numeric key **3** on the instrument.

Determining the Host IP address

In order to determine your host PC's IP address proceed as follows:

1 On the status bar, click **Start** and select **Run** to open an input window.

2 On the input line, type **`cmd`** to open a command prompt.

3 Type **`IPconfig -all`** to display the network settings for the PC. In this list you will find its IP address.

4 To close the command prompt type **`exit`**.

91xx Data Exchange Software

7

This help file describes how to install and use the 91xx Data Exchange Software. The topics discussed in this chapter are as follows:

- "About the 91xx Data Exchange Software" on page 84
- "Installation requirements" on page 84
- "Understanding the license conditions" on page 84
- "Installing the software" on page 84
- "Starting the software" on page 84
- "Connecting the PC to the 9101" on page 85
- "Loading measurement results from the 9101" on page 87
- "Saving, loading and printing results on the PC" on page 89
- "Working with measurement results" on page 90
- "Defining and loading limit templates" on page 91
- "Defining and loading external coupling parameters" on page 95
- "Managing communication systems for channel power measurements" on page 96
- "Working with settings" on page 97
- "Managing files on the PC and on the 9101" on page 98

About the 91xx Data Exchange Software

The 9101 is delivered with a software product, the 91xx Data Exchange Software. This is a tool to load and display measurements from the 9101 to the PC and to install software updates on the 9101.

Installation requirements

To install the 91xx Data Exchange Software, you need

- a PC with Pentium II processor or equivalent
- Windows 98SE, Windows NT or later versions
- a minimum of 32 megabytes of RAM
- 50 megabytes of free space on the hard disk
- a free serial interface or a LAN connection

Understanding the license conditions

Before installing the 91xx Data Exchange Software, ensure that you understand the license terms which can be found in the appendix "Software License" on page 183. The software may only be installed on one computer at any one time!

Installing the software

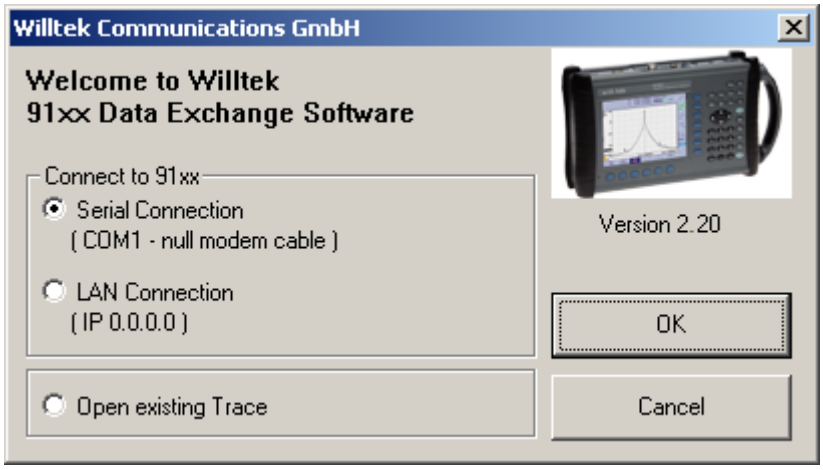
If you received the software on a CD, just insert the CD in the CD drive of your PC.

Run **`91xxDataExchange.exe`**.
This will start the install wizard which will copy the required files onto your PC.

Follow the instructions given by the install wizard.
By default, the install wizard will store the program files in the following directory (assuming an English Windows installation):
C:\Program files\Willtek\91xx Data Exchange.

Starting the software

Click **Start > Programs > Willtek > 91xx Data Exchange** to run the 91xx Data Exchange Software.
The following box appears:



To connect to the 9101 via serial connection (RS-232 interface on a COM port of the PC), select **Serial Connection**.

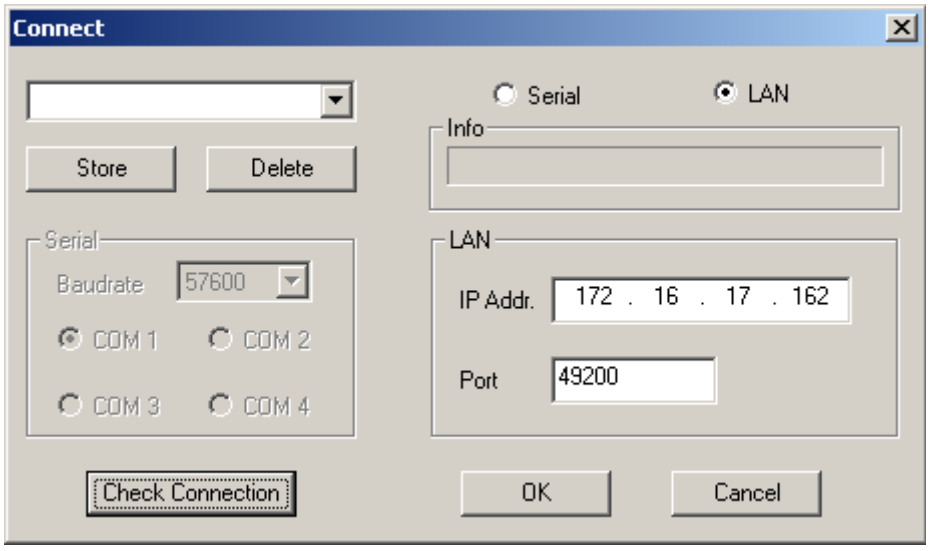
To connect to the 9101 via a local area network (LAN) over TCP/IP, select **LAN Connection**.

If you do not want to connect to the 9101 but rather open a measurement trace file that has been previously stored on the PC, select **Open existing Trace**.

Connecting the PC to the 9101

In order to connect the PC to the 9101, you need to configure the 91xx Data Exchange Software first.

From the menu bar, select **Settings > Serial / LAN**.
This will open the Connect menu as shown below:



Using a predefined configuration for the connection

If you have previously stored configuration data for a successful connection with the 9101, you can proceed as follows:

1 Connect the 9101 with the PC using a serial interface cable or the LAN, depending on the configuration you want to use.

2 In the Connect menu of the 91xx Data Exchange Software (see above), load the configuration by selecting a name from the file selector in the upper left-hand corner of the Connect menu. Click **OK** to load this configuration. The PC will now attempt to exchange messages with the 9101 over the interface defined in the configuration file. The Connect menu will disappear and if a connection has been set up successfully, the status bar of the PC software will indicate CONNECTED.

Serial interface connection

1 Select the **Serial** radio button.

2 Select the baudrate (bit rate) that is set up in the 9101 as well.

3 Select a serial port (COM1 through COM4).

4 Switch on the 9101 and connect it to the PC using a null modem cable as specified in the user's guide.

5 Click **Check Connection** to verify that the connection is working over the selected COM port.
The PC will now attempt to exchange messages with the 9101 over the cable attached to the selected serial port. The Connect menu will disappear and if a connection has been set up successfully, the status bar of the PC software will indicate CONNECTED.

LAN (TCP/IP) connection

1 Select the **LAN** radio button.

2 Enter the IP address of the 9101. The IP address of the 9101 can be read and modified over an RS-232 link using the SCPI command; see "Changing the IP address of the 9101" on page 32 for changing the IP address of the 9101.

3 Enter the IP port number in the Socket input field. Valid entries are in the range from 1024 to 65535; the default is 49200.

4 Switch on the 9101 and connect both 9101 and PC to the computer network with a normal patch cable, or connect them directly with each other using a cross patch cable.

5 Click **Check Connection** to verify that the connection is working over the selected LAN connection.
The PC will now attempt to exchange messages with the 9101 over the network. The Connect menu will disappear and if a connection has been set up successfully, the status bar of the PC software will indicate CONNECTED.

Saving the configuration

You can save the configuration in a file for later use so that you do not have to reenter the configuration each time you are using 91xx Data Exchange Software.

1 In the entry field at the upper left-hand corner, enter a configuration name that allows you to identify the configuration that you have made. Several configurations can be stored under individual names.

2 Push the **Store** button to save the current configuration.

Loading measurement results from the 9101

The 91xx Data Exchange Software can load and display a measurement (trace) from the 9101 in two different ways. The software can load either the trace currently displayed or a trace that is saved in the 9101 memory. Note that the 91xx Data Exchange Software can hold multiple windows, each with a trace.

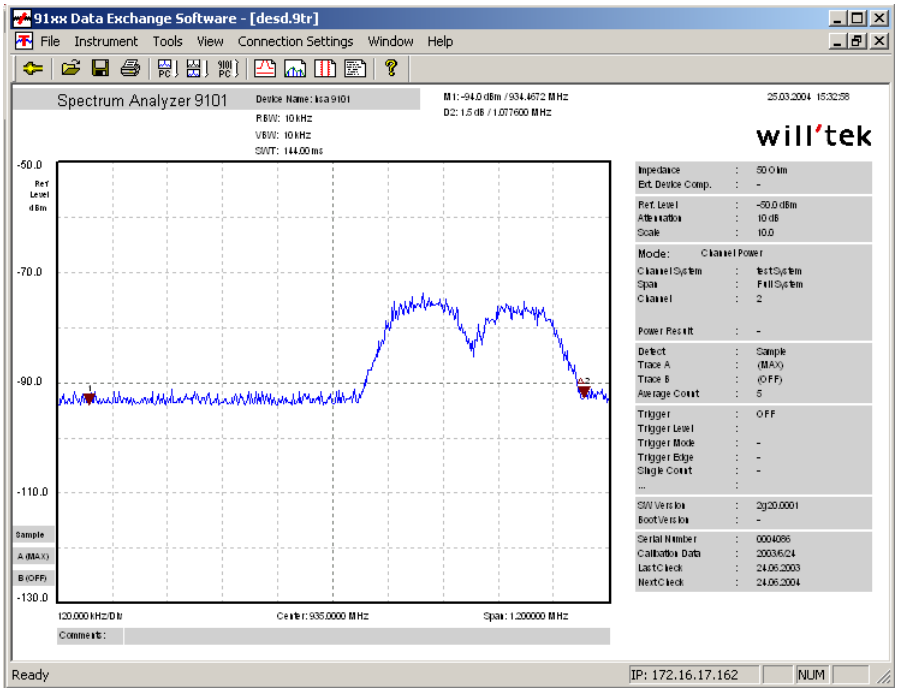
Viewing the actual trace on the PC

1 Connect the PC to the 9101 as described on page 85.

2 In the 91xx Data Exchange Software, select **Instrument > Display Trace**, or enter **Ctrl+T**, or click on the icon: 

The trace is displayed in the program window (see example below). You can resize or maximize the trace within the program window.

3 To store the results on a local PC drive, select **File > Save** or **File > Save as** and choose a directory and file name.
The trace file is stored on your PC.



NOTE

The trace will also display any active limits. When working in channel power mode, the trace will include the communication system name.

Transferring a saved trace to the PC

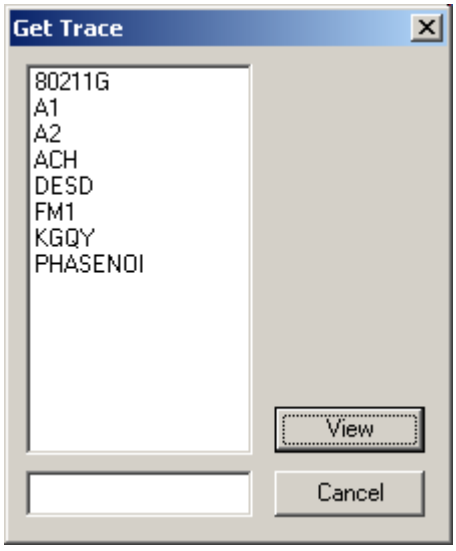
To load the data saved in the 9101 proceed as follows:

1 On the 9101, save the desired measurements in trace files.

2 Connect the PC to the 9101 as described on page 85.

3 In the 91xx Data Exchange Software, select **Instrument > Get Trace**, or press **Ctrl+G**, or click the icon: 

This will load and display a list of trace files that reside on the 9101 (see example below).



4 Select the desired trace file(s) and click **VIEW**.
The trace is displayed in the program window. You can resize or maximize the trace within the program window.

5 To store the results on a local PC drive, select the window with the trace to be stored, push **File > Save** or **File > Save as** and choose a directory and file name. The default directory is Traces inside your 91xx Data Exchange installation directory.
The trace file is stored on your PC.

NOTE

Trace data can also be transferred in both directions using the Traces tab in the **Instrument > Data Transfer** menu.

Saving, loading and printing results on the PC

Once a measurement trace has been transferred to the PC, it can be stored on the hard disk, printed or exported to a graphics or text file.

Storing results on the PC

The trace, along with the 9101 settings and markers, can be saved in a file and loaded again in a trace file. This way, information about settings and individual result values will not be lost.

1 Select **File > Save** or **File > Save As...** .
A window with a file selection box appears.

2 Select a directory and a file name to save the trace data, and confirm with **ENTER**.
The trace data are saved in a file.

Loading a trace file on the PC

Results previously stored on the PC can be retrieved and displayed in the 91xx Data Exchange Software.

1 Select **File > Open**.
A window with a file selection box appears.

2 Select the directory and the file name containing the trace data, and confirm with **ENTER**.
The trace data are loaded to the 91xx Data Exchange Software.

Printing measurement results

1 Select **File > Print Setup** and set up the correct printer, the paper orientation and printer-dependent settings. Confirm the changes made by pushing the **ENTER** key.

2 You can check the layout before printing by selecting **File > Print Preview**.

3 Go to the **File > Print** menu to select the pages to print and start printing by pushing the **ENTER** key.

Saving results to a graphics file

If you save the results in a graphics file, you can load them in other applications such as a word processor and include them in your documentation in graphical format. File formats supported are:

- Windows Bitmap (BMP)
- JPEG (JPG/JPEG)
- JPEG2000 (J2K/JP2)
- Tagged Image File Format (TIF/TIFF)
- Zsoft Paintbrush (PCX)
- Portable Network Graphics (PNG)
- Sun Raster (RAS)

– Truevision Targa (TGA)
– Portable Bitmaps (PPM/PGM)

1 Select **File > Export > Image**.
A file selection box appears ("Save image file").

2 Select a directory, a file name to save the measurement trace and a file format, and confirm with **ENTER**.
The trace data are stored as a graphics file in the selected location.

Saving results to a text file

You can use the numerical results and include them in other applications for postprocessing, e.g. in Microsoft Excel.

1 Select **File > Export > ASCII file**.
A file selection box appears ("Save Trace as ASCII File...").

2 Select a directory and a file name to save the measurement data, and confirm with **ENTER**.
The data are stored in a text file (*.TXT) in the selected location.

Each line in the resulting text file contains a parameter from the settings; the parameter name is separated from its value by a semicolon.

Working with measurement results

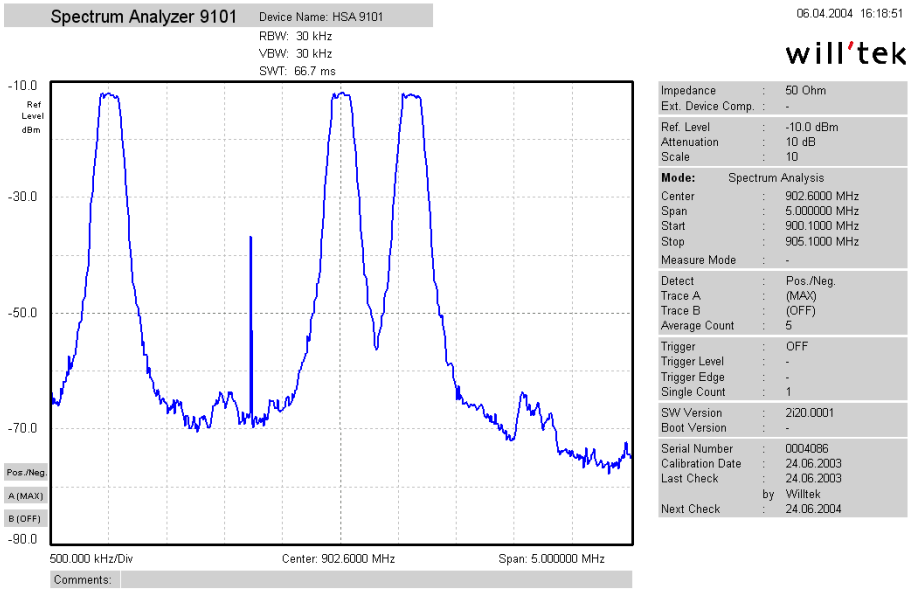
To open a measurement trace that has been previously loaded from the PC, select **File > Open**.
This will open a file selector box from which you can select a directory and a trace file.

Adding a marker

The 9101 already provides up to four markers; the marker positions are stored and transferred together with the trace.

In addition to these static markers, you can use an additional dynamic marker on the PC to read out the level values at any displayed frequency.

– To enable or disable the marker on the PC, select **View > PC Marker**.
The PC marker will be enabled at the center frequency, or will be disabled depending on the previous setting. The coordinates of the marker position will be displayed in the top-right corner of the graph.
– To move the PC marker to another frequency, drag it with the mouse. Alternatively, use the **LEFT/RIGHT** (slow movement) or **UP/DOWN** (larger steps) cursor keys on the keyboard.



Using a grid

The grid of vertical and horizontal lines can be switched on and off with **View > Grid**. The grid is the same as on the 9101, i.e. it consists of eight horizontal and ten vertical lines.

Entering text

You can add text to the trace and store it with the measurement. This way, you can add valuable information about the conditions of the measurement. The comment text will be printed and saved with the graph but not exported to a graphics or text file.

1 Select **View > Comment**.
A "Comment" window opens, allowing you to enter text.

2 Enter your text (three lines maximum), then click on **Save** to have the 91xx Data Exchange Software store the text along with the measurements.

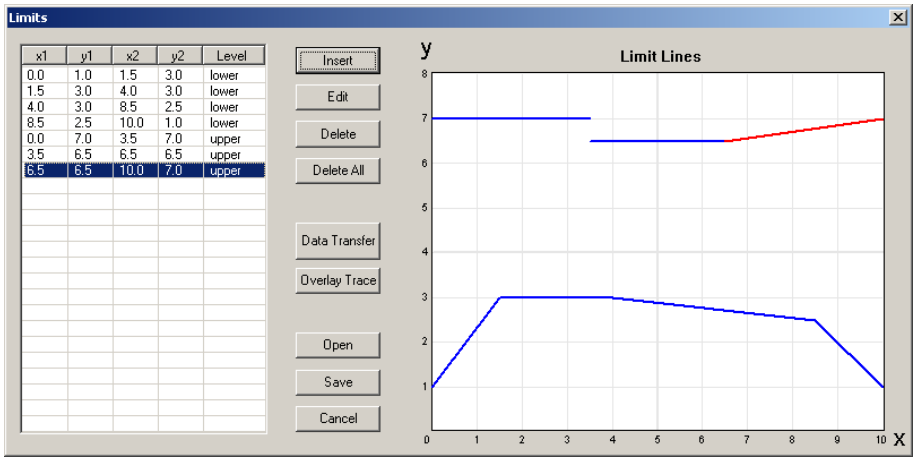
Defining and loading limit templates

One of the powerful features of the 9101 is its capability to compare the measurements with predefined limits. The limits are set in the form of a template that the actual measurement passes or fails. The template can be defined on the PC using the 91xx Data Exchange Software and then loaded to the 9101; the 9101 can hold up to 99 templates.

Editing a template may be easier when an example of a typical result trace is available. The limits editing menu of the 91xx Data Exchange Software cannot only show the actual limit curve (template) but also an example trace that is stored on the PC.

Templates can be applied to measurements in both the spectrum and the time domain. An example of a limit template in the time domain is the power/time template for GSM phones.

The limits are expressed relative to the grid on the 9101 display, not as absolute values in terms of frequency (or time) and power. This way, you can apply the same template to different power levels and frequencies provided that the scales are as intended.



Defining limits

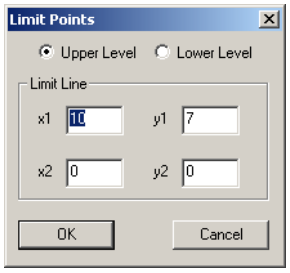
Limits can be defined as a template with an upper and and a lower limit curve. Each curve consists of a number of straight lines between points. The limits menu of the 91xx Data Exchange Software allows you to enter and display such lines.

The limits are expressed relative to the grid on the screen, with eight horizontal and ten vertical lines. The coordinates of each point (in x/y coordinates) correspond to these lines.

To define a new template, proceed as follows:

1 In the 91xx Data Exchange Software, select **Tools > Limits**.
The limits menu appears, with a limits coordinates table on the left and the limit lines on the right-hand side.

2 To enter a new limit line, push Insert.
A window appears, allowing you to enter the x/y coordinates for two points.



3 Select whether you wish to define an upper or lower limit by selecting one of the **Upper Level** and **Lower Level** buttons.

4 Enter the coordinates for the first point of the limit line (x1, y1).

5 Enter the coordinates for the second point determining the limit line (x2, y2).

6 Confirm your choice and close the window by selecting **OK**.
The window disappears. The values are entered in the limits table on the left and the limit line is shown in the limit lines graph on the right.

7 Enter more limit lines as described above to complete the template according to your requirements.

Changing limit lines

You can change the template by modifying or deleting individual limit lines:

1 In the table within the Limits menu, click on the line that you want to modify or delete.
The line within the table is highlighted and the corresponding limit line in the graph is shown in red.

2 To modify the limits, click on **Edit** or double-click on the row. A dialog box appears, allowing you to change the limits.
To delete a limit line, click on **Delete**.

Alternatively, to change the starting or ending point for an existing limit line, proceed as follows:

1 In the graph within the Limits menu, click on the starting point of a limit line that you want to modify.

2 Point the mouse to the starting or ending point of the limit line, keep the left mouse button pressed and drag the point to its new position and release it there.

Displaying an example trace in the limits editing menu

1 In the Limits menu, click on the **Overlay Trace** button.
A file selection box appears.

2 Select a trace file from the default or any other directory, and click **Open**.
The file selection box disappears and the trace data is displayed in the limit lines box on the right-hand side of the Limits menu.

NOTE

Only one trace can be displayed in this menu at a time. Once a trace is being displayed, the **Overlay Trace** button is replaced by a **Clear Trace** button. After clicking the latter, the displayed trace disappears and the **Overlay Trace** is shown again.

Storing a template on the PC

A template can be stored on the PC, e.g. to allow modifications later or to download it to different 9101 analyzers at any time.

1 In the Limits menu, click on the **Save** button.
A window opens ("Save Limits as Text File...").

2 Choose a directory and enter a file name to save your limits template.

3 Confirm your choice with the **ENTER** key.
The limits are saved in a file.

Loading a template from the PC

To modify or to load a template to a 9101 that has previously been stored on the PC, proceed as follows:

1 In the Limits menu, click on the Open button.
A file selection window appears ("Open Limits File...").

2 Select the directory and the file containing a template file previously stored with the 91xx Data Exchange Software.

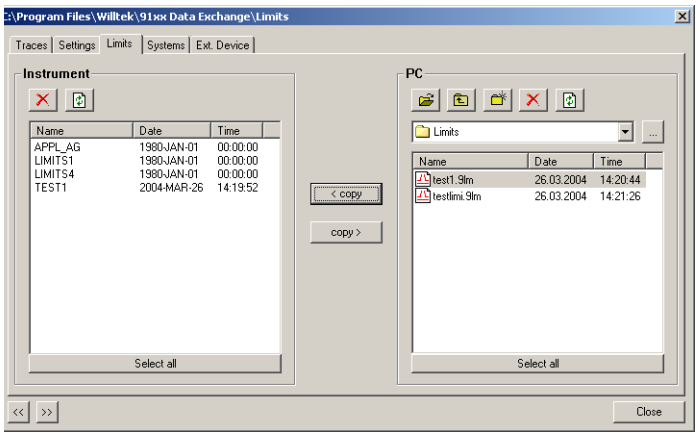
3 Confirm your choice by pushing the **ENTER** key.
The limits are loaded to the limits table and the graph. You can now modify the limits (see section "Changing limit lines" above), or download the limits to the 9101.

Transferring a template to the 9101

1 Define a template or load it from the PC's hard disk as described above.

2 Ensure that the PC is connected to the 9101 either via RS-232 or LAN.

3 Push the **Data Transfer** button.
If the template (characterized by its limit lines) is not yet stored you will be asked if you want to save it on the PC harddisk. If you choose not to store the template, your changes will be lost.
The data transfer menu pops up with the Limits tab active.



4 Choose a limits file (or multiple files) on the PC side (right-hand side) of the data transfer menu, and click **< copy**.
The 9101 will, if not done so previously, ask whether to connect to the 9101. In that case, follow the instructions in section "Connecting the PC to the 9101" on page 85.

The file name on the 9101 will only carry the first 11 characters of the file name that was used on the PC.

If a limits file on the PC has been selected for transfer and a limits file with the same name already exists on the 9101, the 91xx Data Exchange Software will display a pop-up box with the file name in question in the header bar, and offer several possibilities:

- Click **Yes** if you want to overwrite the file in question.
- Click **No** to cancel transmission of the file in question.
- Click **Yes to All** to copy all files to the 9101, irrespective of duplicate file names.
- Click **No to All** to prevent overwriting of all files with duplicate file names.
- Click **Rename** to enter a new file name applying to that file when downloaded to the 9101.
- Click **Cancel** to cancel transmission of all files, no matter whether file names already exist on the 9101 or not.

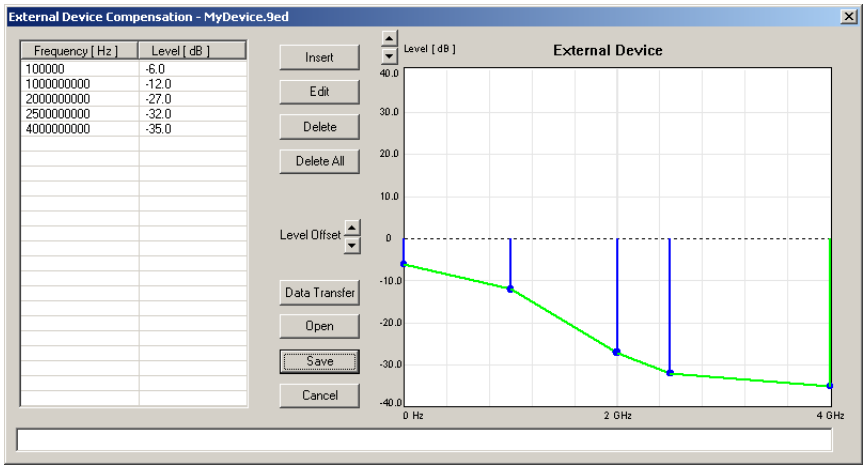
The 91xx Data Exchange Software will indicate when the download has been completed successfully.

5 On the 9101, push the **ESCAPE** key to return to local mode. You can then start using the limits template.

Defining and loading external coupling parameters

The 9101 Handheld Spectrum Analyzer can compensate a defined gain or attenuation introduced by external equipment between the device under test and the 9101. The coupling can be specified in the 91xx Data Exchange Software; several files for different devices can be defined, stored and downloaded to the 9101. Once downloaded, the compensation of effects from external devices can be switched on and off at any time. The 9101 takes the coupling factor into account before presenting the measurement result.

Gain and attenuation are frequency dependent in most cases; therefore the 91xx Data Exchange Software allows you to enter interpolation points to cover the frequency-dependent coupling factor over the whole frequency range of interest.



Defining the external coupling factor

1 Open the External Device Compensation menu by selecting **Tools > Ext. Dev. Compensation** or by pressing **Alt-E**.

2 To enter an interpolation point, select **Insert**.
A box appears, allowing you to enter frequency and level.

3 Enter the frequency, select a unit (from hertz to gigahertz) and enter the coupling factor (in dB). **Positive factors indicate signal attenuation, negative factors indicate gain in the signal line.**

4 Close the box by pushing the OK button and repeat the last two steps with as many interpolation points as available.
The frequency-dependent compensation curve appears on the right-hand side as values are entered.

5 If you want to change a factor, either select a line from the table on the left-hand side and click **Edit** to change the values numerically, or point with the mouse to an interpolation point in the graph on the right and drag it to a new position.

6 To move the whole interpolation curve up or down in steps of 1 dB, click on the **Level Offset** arrow buttons.

7 When completed, save the device compensation values in a file on the PC: Click **Save**, enter a file name and confirm with the **Save** button.

8 Push Cancel to leave the menu.

Loading an external coupling loss file to the 9101

One or more files with external coupling loss data can be transferred to the 9101 and reside in the internal memory of the 9101. They will not be taken into account until they are activated (see "Compensating gains and losses").

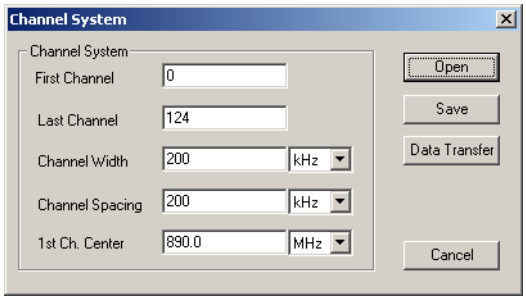
1 Select **Instrument > Data Transfer** (**Ctrl-D**), or in the External Device Compensation menu, push the **Data Transfer** button.
The Data Transfer menu opens.

2 In the **Ext. Device** tab, select a directory and file(s) on the right-hand side and push the **< copy** button.
The selected files are transferred to the 9101.

Managing communication systems for channel power measurements

Measurements in channel mode imply that a communication system with predefined channel numbers and associated frequencies has been defined. The 9101 comes with a few systems preinstalled; more systems are available for download to the 9101 in the 91xx Data Exchange Software, for example Wireless LAN, Bluetooth, TETRA and DECT. Other systems' data can be easily entered on the PC using the 91xx Data Exchange Software. Each set of system data can be stored in a separate file; one or multiple files can be downloaded to the 9101. For downloading and copying system files between the PC and the 9101, see section "Managing files on the PC and on the 9101" below. Once data are stored in the 9101, they can be used as described in section "Operating in channel power mode" on page 63.

Editing communication system parameters on the PC



1 Select **Tools > Channel System** (or **Alt-C**).
The Channel System menu appears.

2 If you want to edit a communication system that is already stored on the PC, press **Open**, select the appropriate directory and file, and press the **Open** button.

3 Enter the first and the last valid channel number of the system.

4 In the Channel Width line, enter the measurement bandwidth (separate input fields for value and unit).

5 In the Channel Spacing line, enter the frequency spacing (including the unit) between consecutive channel numbers.

6 Enter the carrier frequency (including the unit) corresponding to the first channel number in the **1st Ch. Center** line.

7 Press the **Save** button.
A dialog box appears, allowing you to enter a name for the file in which the channel system parameters of the communication system shall be stored.

8 Enter a file name and press **Save**.
The data are stored and the menu disappears.

9 To transfer the data to the 9101, press **Data Transfer**. To leave the Channel System menu, press **Cancel**.

Working with settings

The 9101 allows to store and recall settings (see section "Working with stored settings" on page 35). This can be useful when you want to perform measurements under exactly the same conditions as at an earlier time. With the 91xx Data Exchange Software, you can transfer the settings from a 9101 to the PC for backup purposes or to replicate the settings to another 9101. Another useful application is to manipulate settings on the PC; this is easily done because the settings file is editable and the format consists of SCPI commands. Changing or adding a setting is equivalent to changing or adding a line in the settings file.

Exchanging a settings file between 9101 and PC

The settings stored on the 9101 can be copied to the PC with the 91xx Data Exchange Software. Use the Settings tab within the Data Transfer utility to copy files between the PC and the 9101. See section "Managing files on the PC and on the 9101" on page 98 for more details.

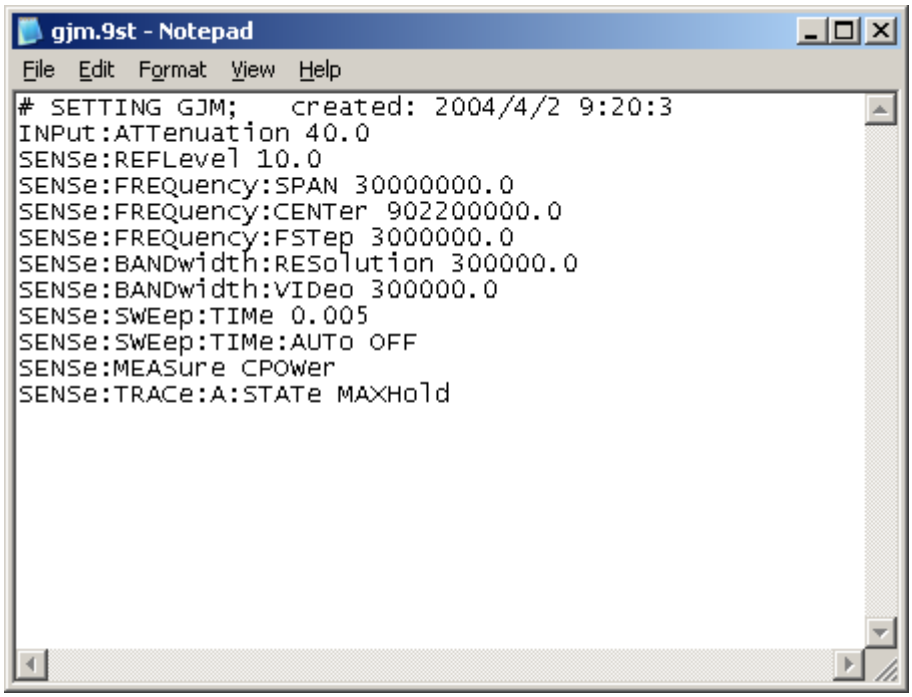
Changing 9101 settings on the PC

Take the following steps to change and amend a settings file for later transfer and usage on the 9101.

1 In the 91xx Data Exchange Software, select **Tools > Settings**.
The 91xx Settings box appears.

2 Push the **Open** button to open an existing settings file on the PC.
A file selection dialog box appears.

3 Select the directory and settings file that you want to modify, and press the **Open** button.
An additional program window with the Microsoft Windows text editor Notepad opens, and the selected file is displayed.



4 Modify or add lines with SCPI commands for the desired settings. Refer to chapter "SCPI Command Reference" on page 101 for correct syntax and value range of the parameters.

5 Save and close the file within Notepad, and return to 91xx Data Exchange Software to transfer the file to the 9101.

Managing files on the PC and on the 9101

There are various types of settings which can be maintained from the PC using the 91xx Data Exchange Software. This section explains how data can be transferred between the 9101 and the PC, maintained and deleted.

File types and directory structure

Each type of setting stored on the PC has a preferred file name extension and directory for different sets of parameters. The table below summarizes this file structure.

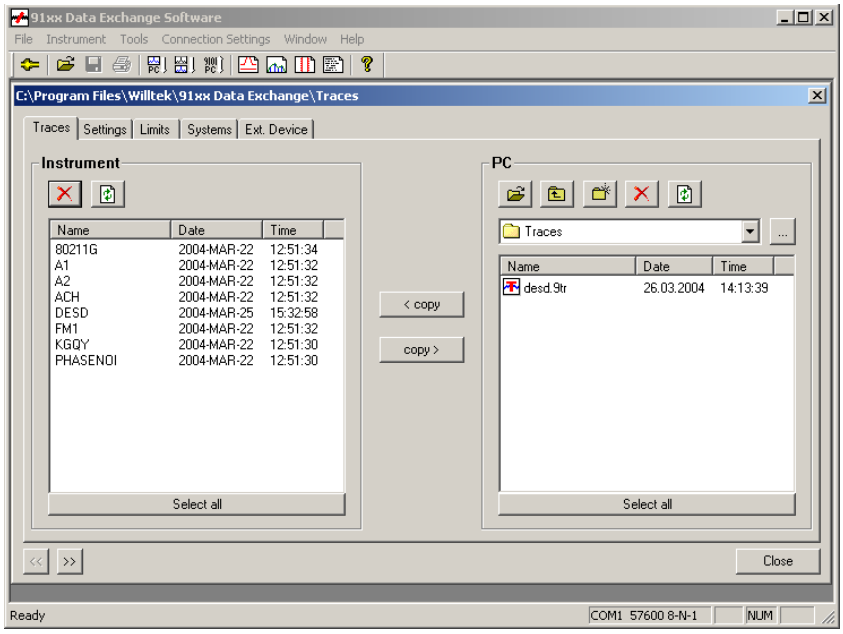
Table 16 Configuration file types

Type	File names	Directory
Traces	*.9tr	91xx Data Exchange\Traces
Settings	*.9st	91xx Data Exchange\Settings
Limits	*.9lm	91xx Data Exchange\Extdev
Systems	*.9sy	91xx Data Exchange\Systems
Ext. Device	*.9ed	91xx Data Exchange\Extdev

Starting the file manager menu

The files on the PC and on the 9101 can easily be selected, copied and deleted from the Data Transfer menu.

1 In the 91xx Data Exchange Software, select **Instrument > Data Transfer** (or **Ctrl-D**).
The Data Transfer menu appears.



2 Select the appropriate tab (Traces, Settings, Limits, Systems, Ext. Device) either by clicking on it with the mouse, or by moving the tab selection with the **<<** and **>>** buttons.
The menu displays the appropriate files available on the 9101 on the left-hand side, and the appropriate files available on the PC on the right-hand side. Files on the PC have a file extension and can be stored on any drive and in any directory; there are no directories available on the 9101.

NOTE

File names on the 9101 only carry 11 characters. When copying a file from the PC to the 9101 that has more than 11 characters, the file name will be truncated.

Copying configuration files from the 9101 to the PC

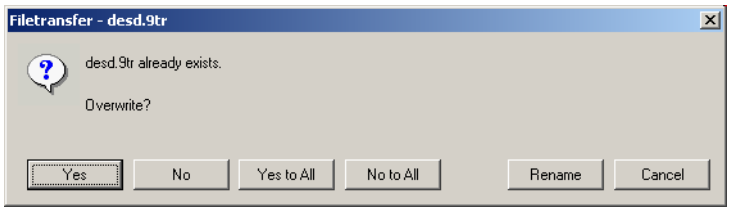
Files can be copied in both directions.

1 Select a PC directory where the file shall be stored or from which it shall be copied.

2 Select one or several files for copying, either on the PC or on the 9101.

3 Press **< copy** to transfer the files from the PC to the 9101.
or
Press **copy >** to transfer files to the PC.
If a file on one side has been selected for transfer and a file with the same name already exists on the other, the 91xx Data Exchange Software will display a pop-up box with the file name in question in the header bar, and offer several possibilities:

- Click **Yes** if you want to overwrite the file in question.
- Click **No** to cancel transmission of the file in question.
- Click **Yes to All** to copy all files, irrespective of duplicate file names.
- Click **No to All** to prevent overwriting of all files with duplicate file names.
- Click **Rename** to enter a new file name applying to that file when transferred.



4 Click **Cancel** to cancel transmission of all files, no matter whether file names already exist on the receiving side or not.

Deleting files

1 To delete a file either on the 9101 or on the PC, select (highlight) the file name first. Several files may be selected concurrently by holding the Shift or Ctrl key pressed while selecting individual files.

2 Press the Delete button  above the files marked for deletion.
A box appears asking, "Are you sure to delete the selected items?"

3 Push **Yes** to confirm deletion.
The selected files are removed.

SCPI Command Reference

8

This chapter provides a reference list of commands for remote control of the 9101 Handheld Spectrum Analyzer. Topics discussed in this chapter are as follows:

- "Overview" on page 102
- "General commands" on page 102
- "System commands" on page 106
- "Sense commands" on page 111
- "Input commands" on page 125
- "MMemory commands" on page 126
- "Instrument commands" on page 134
- "Display commands" on page 134
- "Calculate commands" on page 136
- "Format commands" on page 142
- "Service commands" on page 143
- "SCPI errors" on page 145

Overview

The command set of the 9101 Handheld Spectrum Analyzer follows the SCPI standard and is broken down into the following subsystems:

- General commands
- System commands
- Sense commands
- Input commands
- Memory commands
- Display commands
- Calculate commands
- Format commands

Each keyword in the command can be used either in its long or its short form. Uppercase letters are used to indicate the short-form command syntax. Within one keyword, either the short form or the full version can be used, but not a mix.

The syntax can be used to form either a command or a query (with a question mark behind the command form). Many SCPI commands have either a command form or a query form, but not both.

Please refer to the "Index of SCPI Commands" on page 163 for an alphabetical list of commands.

General commands

:REBoot

Syntax	`:REBoot`
Parameters	There are no parameters.
Command	Reboots the Willtek 9101. The current settings are not affected of this command.
Query	There is no query form of this command available.
Example	`:REB`

***CAL**

Syntax	`*CAL?`
Parameters	There are no parameters.
Command	The command form is not available.
Query	Returns the date of the last calibration by Willtek in the format yyyy, mm,dd.
Example	`*CAL?` Returns `2004,04,01`.

*CLS

Syntax	`*CLS`
Parameters	There are no parameters.
Command	Resets the entire status reporting system: – The service register will be cleared (all bits will be set to 0). – The event status register will be cleared (all bits will be set to 0). – The error message queue will be emptied. – All event-type registers will be cleared.
Query	There is no query form of this command available.

*IDN

Syntax	`*IDN?`
Parameters	There are no parameters.
Command	There is only a query form of this command available.
Query	Returns a string, containing the following information: – manufacturer's name – name of the device – serial number – software revision number All parameters are separated by commas. **Note:** In times of company mergers and acquisitions, it is a good idea to check the name of the device, not the manufacturer's name which may change between software updates. This does not preclude any name changes at Willtek but rather applies to instrumentation in general.
Example	`*IDN?` returns: `"WILLTEK, 9101, 0104012, 1.00"`

*RST

Syntax	`*RST`
Parameters	There are no parameters.
Command	Resets the entire test set. All parameters, limits etc. will be set to the internally predefined default values.
Query	There is no query form available.

*OPC

Syntax	`*OPC?`
Parameters	There are no parameters.
Command	Only the query form is available.
Query	Waits until the previous command is completed. In addition, the query returns the Operation Complete flag which is `1` in the successful case.

Commands affecting the event status register

The event status register contains eight bits. The meaning of these bits is outlined in the table below.
The commands working on the event status register are described below the table.

Bit	Decimal	Meaning
7	128	Power on – this bit is always set.
6	64	User Request – a **1** on this position indicates that the 9101 is no longer controlled by remote commands but by user interaction.
5	32	Command error – this bit indicates that a SCPI command error occurred (SCPI error codes 100 to 199).
4	16	Execution error – is set after a SCPI execution error did occur (SCPI error codes 200 to 299).
3	8	Device dependent error – this bit indicates that a device-specific SCPI error did occur (SCPI error codes 300 to 399).
2	4	Query error – is set after a SCPI query error occurred (SCPI error codes 400 to 499).
1	2	Request control – this bit is reserved for future use.
0	1	Operation complete flag – is set as soon as the execution of a command has been completed.

***ESE**

Syntax	`*ESE <int1>`
Parameters	`int1` is an integer. The valid range is from 0 to 255 (8 bits).
Command	Sets the enable filter (mask) of the event status register. `int1` is the decimal representation of the binary mask. The mask and the current contents of the event status register will be ANDed. If the result is not zero, then bit 5 of the Service register will be set.
Query	The query form reads out the enable filter (mask) currently set and returns its binary representation in a string.
Example	`*ESE 128` As soon as power has been switched on, bit 7 (Power on) will be set. ANDed with the mask **128**, a binary **1** will occur and thus bit 5 of the service register will be set.

***ESR**

Syntax	`*ESR?`
Parameters	There are no parameters.
Command	There is only a query form of this command available.
Query	Returns the decimal representation of the current contents of the event status register in a string. **Note:** This register is self-destructive, i.e. its contents will be cleared after reading.
Example	After power-on, the `*ESR?` query will return `"128"`. This means that bit 7 is set and all the other bits of the event status register are `0`. The command will clear the event status register and a subsequent `*ESR?` query will return `"0"`.

Commands affecting the service register

The service register represents the highest level within the report structure of the 9101.
The service register contains eight bits.
If any of the bits 0 to 5 or 7 is set, the summary status bit (bit 6) of the service register will be set as well.

NOTE

The service register is self-destructive. This means that its contents will be cleared after reading.

Bit	Decimal	Meaning
7	128	OPERational status summary. When this bit is set, an event within the general operation register group (e.g. the 9101 is waiting for a trigger) passed all filters.
6	64	Summary status bit. This bit will always be set as soon as any other bit of the service register has been set.
5	32	Event status summary. When this bit is set, an event within the event status register group (e.g. an error occurred) passed all filters.
4	16	Message available. This bit will be set to **1** as soon as a query has been completed and measurement results are available.
3	8	QUESTionable status summary. If this bit is set, an event within the general questionable status register group (e.g. 'value out of range') passed all filters.
2	4	Error queue status. When this bit is set, the error queue contains error messages. Up to 10 error messages can be logged in the error queue. The error queue can be read out, using the :SYSTem:ERRor? query.

1	2	Remote command completed. This bit will be set to **1** after a remote (SCPI) command has been completed. **Note:** When the 9101 receives a SCPI command, it will block any further input readings until the command has been completed.

***SRE**

Syntax	`*SRE <int1>`
Parameters	`int1` is an integer. The valid range is from 0 to 255 (8 bits).
Command	Sets the enable filter (mask) for the service register. `int1` is the decimal representation of this binary mask. The mask and the current contents of the service register will be ANDed.
Query	The query form reads out the mask currently set and returns its binary representation in a string.
Example	`*SRE 68` As soon as an error occurs, bits 2 and 6 of the service register will be set. ANDed with the mask (68), a binary `1` will be the result.

***STB**

Syntax	`*STB?`
Parameters	There are no parameters.
Command	There is only a query form of this command available.
Query	Returns the decimal representation of the current contents of the service register in a string. **Note:** This register is self-destructive, i.e. its contents will be cleared after reading.
Example	A `*STB?` command returns `"68"`. The return value of 68 (= 64 + 4) means that an error occurred (4).

System commands

With the system commands, the internal settings of the 9101 Handheld Spectrum Analyzer can be changed.

:SYSTem:DATE

Syntax	:SYSTem:DATE <int1>,<int2>,<int3>
Parameters	intx are three integers. The minimum value for int1 is 1998, the maximum is 2100. The default value is 1998. The minimum value for int2 is 1, the maximum is 12. The default value is 1. The minimum value for int3 is 1, the maximum is 31. The default value is 1.
Command	Sets the system date. This command uses the following format: yyyy,mm,dd where yyyy stands for the four digits of the year (int1), mm gives the current month (int2), dd represents the day of the current month (int3).
Query	Returns the current system date in a string, using the format explained above.
Example	:SYST:DATE 2001,7,6 Sets the system date to the July 6, 2001.

:SYSTem:TIME

Syntax	:SYSTem:TIME <int1>,<int2>,<int3>
Parameters	intx are three integers. The minimum value for int1 is 0, the maximum is 23. The default value is 0. The minimum value for int2 is 0, the maximum is 59. The default value is 0. The minimum value for int3 is 0, the maximum is 59. The default value is 0.
Command	Sets the system time. This command uses the following format: hh,mm,ss where hh stands for the two digits of the current hour, using a 24 hour time format (int1), mm gives the current minute (int2) and, ss represents the seconds of the system time (int3).
Query	Returns the current system time in a string, using the format explained above.
Example	:SYST:TIME? String returned: "14,56,05" meaning roughly four minutes to 3 pm.

:SYSTem:COMMunicate:LOCal

Syntax	:SYSTem:COMMunicate:LOCal
Parameters	There are no parameters.
Command	Sets up the Willtek 9101 to allow manual operation on the front panel during SCPI operation. **Notes:** – This command may be used e.g. to allow interactive alignment procedures in a production flow. – The instrument can also be set to local mode by pressing the Escape button on the front panel.
Query	There is no query form of this command available.
Example	:SYSTem:COMM:LOC

:SYSTem:COMMunicate:ECHo

Syntax	`:SYSTem:COMMunicate:ECHo <PredefExpr>`
Parameters	`PredefExpr` is one of the following predefined expressions: `ON|OFF`. Default is `ON`.
Command	This command determines how the Willtek 9101 acts after executing a SCPI command. If echo is set to ON, there will be a response. Either "`ok`", if the execution was successful or "`ERR`" if an error occured. The echo-on mode is preferred for entering interactive commands. If echo is set to OFF, there will be no response to a SCPI command. In this case it is possible to check with the *OPC? query, when the SCPI command is finished and the Willtek 9101 is ready to receive the next command.
Query	Returns the current echo setting.

Example	`:SYST:COMM:ECH ON`
	Returns the following string: "`ok`"
	All subsequent commands returns "`ok`" or "`ERR`".
	`:SYST:COMM:ECH?`
	Returns the following string: "`ON`"
	`:SYST:COMM:ECH OFF`
	Returns nothing, all subsequent commands return nothing.

:SYSTem:COMMunicate:ETHernet:IPADdress

Syntax	`:SYSTem:COMMunicate:ETHernet:IPADdress <int1>,<int2>,<int3>,<int4>`
Parameters	`intx` are four integers. The minimum value for all integers is `0`, the maximum is `255`. The default value is `0`.
Command	This command sets the IP address of the Willtek 9101 to the parameter values. The change takes effect after reboot (e.g. after executing the `REBoot` command).
Query	Returns the current setting of the IP address as explained above.
Example	`SYST:COMM:ETH:IPAD 192,16,16,114` sets the IP address to a defined value.

:SYSTem:COMMunicate:ETHernet:TNAMe

Syntax	`:SYSTem:COMMunicate:ETHernet:TNAMe <string>`
Parameters	`string` is a string only containing the device name of the Willtek 9101.
Command	This command sets the device name of the Willtek 9101. It can be used to announce a symbolic device name for the 9101 if the network supports DHCP (Dynamic Host Configuration Protocol).
Query	Returns the current setting of the device name as explained above.
Example	`SYST:COMM:ETHernet:TNAMe "TARGET9104"` sets the device name to a defined value.

:SYSTem:COMMunicate:ETHernet:PORT

Syntax	`:SYSTem:COMMunicate:ETHernet:PORT <int>`
Parameters	`int` defines the TCP/IP port address of the Willtek 9101. The address must be in the range from 1024 to 65535. Default value is 49200.
Command	This command sets the port address on which the Willtek 9101 can be controlled via LAN.
Query	Returns the current setting of the port used by TCPIP as explained above.
Example	`SYST:COMM:ETHernet:PORT 49200` sets the TCP/IP port address to its default.

:SYSTem:COMMunicate:ETHernet:TERMinator

Syntax	`:SYSTem:COMMunicate:ETHernet:TERMinator <PredefExpr>`
Parameters	`PredefExpr` is one of the following predefined expressions: `CRLF|LF|CR`. Default is `CRLF`.
Command	Sets the terminator characters, which are appended to every SCPI respond from the Willtek 9101 LAN interface.
Query	Returns the current terminator setting for the LAN interface.

Example	`:SYST:COMM:ETH:TERM CR`
	`:SYST:COMM:ETH:TERM?`
	Returns the following string: `"CR"`

:SYSTem:COMMunicate:SER:BAUDrate

Syntax	`:SYSTem:COMMunicate:SER:BAUDrate <int1>`
Parameters	`int1` is an integer. The minimum value for `int1` is `300`, the maximum value is `57600`. The default value for `int1` is `57600`. Valid values are `300,1200,2400,4800,9600,19200,38400 and 57600`.
Command	Sets the data rate for the serial port. Only the data rate can be changed; all other parameters are fixed. The number of bits per character is set to `8`, the number of stop bits is set to `1` and parity is set to `NO`. The change takes effect immediately.
Query	Returns the serial interface data rate currently set.

Example	`:SYST:COMM:SER:BAUD 9600`
	`:SYST:COMM:SER:BAUD?`
	String returned: `"9600"`.

:SYSTem:COMMunicate:SER:TERMinator

Syntax	`:SYSTem:COMMunicate:SER:TERMinator <PredefExpr>`
Parameters	`PredefExpr` is one of the following predefined expressions: `CRLF|LF|CR`. Default is `CRLF`.
Command	Sets the terminator characters, which are appended to every SCPI response from the Willtek 9101 serial interface.
Query	Returns the current terminator setting for the serial interface.

Example	`:SYST:COMM:SER:TERM LF`
	`:SYST:COMM:SER:TERM?`
	Returns the following string: `"LF"`

:SYSTem:ERRor[:NEXT]

Syntax	`:SYSTem:ERRor[:NEXT]?`
Parameters	There are no parameters.
Command	There is solely a query form of this command available.
Query	Returns the oldest unread error message from the internal error queue of the Willtek 9101. The queue entry returned will be a string (text). The maximum length of the text is 255 characters. **Note:** A list of error messages can be found in section "SCPI errors" on page 145.

Example	`*RESET`
	`:SYSTem:ERRor:NEXT?`
	String returned: `-113,"Undefined header"`

:SYSTem:ERRor:COUNt

Syntax	`:SYSTem:ERRor:COUNt?`
Parameters	There are no parameters.
Command	There is solely a query form of this command available.
Query	Returns the number of unread error messages in the internal error queue of the Willtek 9101. The string returned will contain one integer. The maximum number of errors stored internally is 10.
Example	`:SYSTem:ERRor:COUNt?` String returned: `"0"` This means that there are no unread error messages in the error queue.

:SYSTem:ERRor:CODE[:NEXT]

Syntax	`:SYSTem:ERRor:CODE[:NEXT]?`
Parameters	There are no parameters.
Command	There is solely a query form of this command available.
Query	Returns the code of the oldest unread error message in the internal error queue of the Willtek 9101. The string returned will contain one integer (and no text). **Note:** A list of error messages can be found in section "SCPI errors" on page 145.

Example	`*RESET`
	`:SYSTem:ERRor:CODE?`
	String returned: `"-113"`
	This means that an undefined header (*RESET) was received.

:SYSTem:ERRor:CODE:ALL

Syntax	`:SYSTem:ERRor:CODE:ALL?`
Parameters	There are no parameters.
Command	There is solely a query form of this command available.
Query	Returns the error codes of all unread error messages in the internal error queue of the Willtek 9101. The string returned will contain a maximum of 100 integers, separated by commas. **Note:** A list of error messages can be found in section "SCPI errors" on page 145.
Example	`:SYSTem:ERRor:CODE:ALL?` String returned: `"-113,-112,0,0,0,0,0,0,0,0"` This means that there were two unread error messages in the error queue.

:SYSTem:DNAMe

Syntax	`:SYSTem:DNAMe <string1>`
Parameters	`string1` is a string (text) parameter. The maximum length of `string1` is 11 characters.
Command	Sets a user-definable device name for the 9101 to use this unique name on protocols.
Query	Returns the device name set on this 9101.

Example	`:SYSTem:DNAMe "Develop5"`
	`:SYST:DNAM?`
	String returned in this example: `"Develop5"`

Sense commands

These commands affect the spectrum analyzer settings, start measurements and return results.

:SENSe:BANDwidth:RESolution

Syntax	`:SENSe:BANDwidth:RESolution <real1>`
Parameters	`real1` is a floating point real number. The minimum value for `real1` is `10000`, the maximum value `1000000`. `real1` can be set as $1*10^n$ or $3*10^n$. The default value for `real1` is 10^6 (`1E6`).
Command	This command sets the resolution bandwidth of the 9101, in Hertz.
Query	Returns the current setting.

Example	`:SENSe:BANDwidth:RESolution 300000`
	`:SENSe:BANDwidth:RESolution?`
	The value returned is: `"300000"`.

:SENSe:BANDwidth:RESolution:AUTo

Syntax	`:SENSe:BANDwidth:RESolution:AUTo <PredefExpr>`
Parameters	`PredefExpr` is one of the following predefined expressions: `ON|OFF`. Default is `ON`.
Command	Switches the automatic selection of the bandwidth resolution on or off. If switched on, the 9101 selects the resolution bandwidth depending on the current span, video bandwidth, and sweep time.
Query	Returns the current setting.

Example	`:SENSe:BANDwidth:RESolution:AUTo ON`
	`:SENSe:BANDwidth:RESolution:AUTo?`
	Returns the following string: `"ON"`

:SENSe:BANDwidth:VIDeo

Syntax	`:SENSe:BANDwidth:VIDeo <real1>`
Parameters	`real1` is a floating point real number. Valid entries are `10`, `100`, `300`, `1000`, `3000`, `10000`, `30000`, `100000`, `300000`, `1000000`. The default value for `real1` is `1000000`.
Command	Sets the video bandwidth of the 9101. The unit of `real1` is Hertz.
Query	Returns the current setting.

Example	`:SENSe:BANDwidth:VIDeo 300000`
	`:SENSe:BANDwidth:VIDeo?`
	The value returned is: `"300000"`.

:SENSe:BANDwidth:VIDeo:AUTo

Syntax	:SENSe:BANDwidth:VIDeo:AUTo <PredefExpr>
Parameters	PredefExpr is one of the following predefined expressions: ON|OFF|. Default is ON.
Command	Switches the automatic selection of the video bandwidth on or off. If switched on, the 9101 selects the video bandwidth depending on the current span, resolution bandwidth, and sweep time.
Query	Returns the current setting.
Example	:SENSe:BANDwidth:VIDeo:AUTo OFF :SENSe:BANDwidth:VIDeo:AUTo? Returns the following string: "OFF"

:SENSe:FREQuency:CENTer

Syntax	:SENSe:FREQuency:CENTer <real1>
Parameters	real1 is a floating point real number. The minimum value for real1 is 5E4, the maximum value 4E9. real1 can be set in multiples of 1000. The default value for real1 is 1.8E6. Instead of 150000000 for 150 MHz, you can also use 150E6 for easier reading.
Command	Sets the center frequency of the 9101, in Hertz. When a new center frequency is selected, this affects the start and stop frequencies, leaving the span unchanged so long as the new start and stop frequencies do not exceed the limits of the 9101.
Query	Returns the current setting.
Example	:SENSe:FREQuency:CENTer 1500000000 :SENSe:FREQuency:CENTer? The value returned is: "1500000000".

:SENSe:FREQuency:SPAN

Syntax	:SENSe:FREQuency:SPAN <real1>
Parameters	real1 is a floating point real number. The minimum value for real1 is 0, the maximum value 4000000000. The minimum resolution possible for real1 is 1000. The default value for real1 is 3600000000.
Command	Sets the frequency span, i.e. the measured bandwidth, in Hertz. A new frequency span setting will leave the center frequency unchanged but affect start and stop frequencies; only if the new start or stop frequency exceeds a limit of the 9101, the center frequency will be changed accordingly.
Query	Returns the current setting.
Example	:SENSe:FREQuency:SPAN 1500000000 :SENSe:FREQuency:SPAN? The value returned is: "1500000000".

:SENSe:FREQuency:SPAN:FULL

Syntax	`:SENSe:FREQuency:SPAN:FULL`
Parameters	There are no parameters.
Command	Sets the 9101 to the maximum supported frequency span. This command affects start, stop and corresponding center frequency. **Note:** If you set the span to 0, the 9101 will perform measurements in the time rather than the frequency domain.
Query	There is no query form of this command available.
Example	`:SENS:FREQ:SPAN:FULL` Sets the start frequency of the 9101 to 0 and the stop frequency to 4 GHz.

:SENSe:FREQuency:STARt

Syntax	`:SENSe:FREQuency:STARt <real1>`
Parameters	`real1` is a floating point real number. The minimum value for `real1` is `0`, the maximum value `4000000000`. The minimum resolution possible for `real1` is `1000`. The default value for `real1` is `0`.
Command	Sets the start frequency of the 9101, in Hertz. This command leaves the span as is but affects the center frequency and the stop frequency.
Query	Returns the current setting.

Example	`:SENSe:FREQuency:STARt 1500000000`
	`:SENSe:FREQuency:STARt?`
	The value returned is: "`1500000000`".

:SENSe:FREQuency:STOP

Syntax	`:SENSe:FREQuency:STOP <real1>`
Parameters	`real1` is a floating point real number. The minimum value for `real1` is `100000`, the maximum value `4000000000`. The minimum resolution possible for `real1` is `1000`. The default value for `real1` is `3600000000`.
Command	Sets the stop frequency of the measured bandwidth, in Hertz. This command leaves the span unchanged but affects the center frequency and the start frequency.
Query	Returns the current setting.

Example	`:SENSe:FREQuency:STOP 2500000000`
	`:SENSe:FREQuency:STOP?`
	The value returned is: "`2500000000`".

:SENSe:FREQuency:MODE

Syntax	`:SENSe:FREQuency:MODE <PredefExpr>`
Parameters	`PredefExpr` is one of the following predefined expressions: `CSPan|SSTop`. Default is `CSPan`.
Command	Defines which frequency mode is active. The following modes are available: Center-Span, Start-Stop.
Query	Returns the current setting.

Example	`:SENSe:FREQuency:MODe CSPan`
	`:SENSe:FREQuency:MODe?`
	Returns the following string: `"CSPan"`

:SENSe:FREQuency:FSTep

Syntax	`:SENSe:FREQuency:FSTep <real1>`
Parameters	`real1` is a floating point real number. The minimum value for `real1` is `0`, the maximum value `1000000000`. The minimum resolution is `1000`. The default value for `real1` is `360000000`.
Command	Sets the step size for the center frequency setting using the cursor keys in manual mode.
Query	Returns the current setting.

Example	`:SENSe:FREQuency:FSTep 2.5E6`
	`:SENSe:FREQuency:FST?`
	Value returned in this example: `2500000`

:SENSe:FREQuency:FSTep:AUTo

Syntax	`:SENSe:FREQuency:FSTep:AUTo <PredefExp>`
Parameters	`PredefExpr` is one of the following predefined expressions: `ON|OFF`. Default is `ON`.
Command	Enables or disables the automatic selection of the step size for the center frequency setting using the cursor keys in manual mode.
Query	Returns the current setting.

Example	`:SENSe:FREQuency:FSTep:AUTo ON`
	`:SENSe:FREQuency:FSTep:AUTo?`
	Returns the following string: `"ON"`

:SENSe:CPOWer:SPAN

Syntax	`:SENSe:CPOWer:SPAN <PredefExpr>`
Parameters	`PredefExpr` is one of the following predefined expressions: `FULL|SINGle`. Default is `FULL`.
Command	Sets the channel power display mode of the 9101. `FULL` selects the whole system spectrum. `SINGle` displays the spectrum of the selected channel.
Query	Returns the current setting.

Example	`:CPOWer:SPAN SINGle`
	`:SENSe:CPOWer:SPAN?`
	Returns the following string: `"SINGle"`

:SENSe:CPOWer:CHANnel

Syntax	`:SENSe:CPOWer:CHANnel <int1>`
Parameters	`int1` is an integer. The minimum value for `int1` is `0`, the maximum is `1000000`. The default value is `0`.
Command	Sets the actual channel number which is displayed.
Query	Returns the current setting.

Example	`:SENSe:CPOWer:CHANnel 50`
	`:SENSe:CPOWer:CHANnel?`
	The value returned in this example is: `"50"`.

:SENSe:CPOWer:OBW

Syntax	`:SENSe:CPOWer:OBW <int1>`
Parameters	`int1` is a integer. The minimum value for `int1` is `5`, the maximum is `99`. The default value for `int1` is `90`.
Command	Sets percentage value for which the 9101 shall determine the occupied bandwidth (channnel power mode).
Query	Returns the current setting.

Example	`:SENSe:CPOWer:OBW 20`
	`:SENSe:CPOWer:OBW?`
	The value returned in this example is: `"20"`

:SENSe:CPOWer:MEASure

Syntax	`:SENSe:CPOWer:MEASure <PredefExp>`
Parameters	`PredefExpr` is one of the following predefined expressions: `CPOWer|ACPR|OBW`. Default is `CPOWer`.
Command	Sets the type of measurement in channel power mode.
Query	Returns the current setting.

Example	`:SENSe:CPOWer:MEASure ACPR`
	`:SENSe:CPOWer:MEASure?`
	Returns the following string: `"ACPR"`.

:SENSe:SWEep:TIME

Syntax	`:SENSe:SWEep:TIME <real1>`
Parameters	`real1` is a floating point real number. The minimum value for `real1` is `0`, the maximum value `20.0`. The minimum resolution possible for `real1` is `0.0001`. The default value for `real1` is `0.0432`.
Command	Sets the sweep time, i.e. the measurement time to cover the full frequency span. `real1` is the time in seconds.
Query	Returns the current setting.

Example	`:SENSe:SWEep:TIME 0.3`
	`:SENSe:SWEep:TIME?`
	The value returned is: `"0.3"`.

:SENSe:SWEep:TIME:AUTO

Syntax	`:SENSe:SWEep:TIME:AUTO <PredefExpr>`
Parameters	`PredefExpr` is one of the following predefined expressions: `ON|OFF`. Default is `ON`.
Command	Switches the automatic selection of the sweep time on or off. If turned on, the 9101 will decide on the best sweep time depending on the current settings of span, resolution bandwidth and video bandwidth.
Query	Returns the current setting.

Example	`:SENSe:SWEep:TIME:AUTO ON`
	`:SENSe:SWEep:TIME:AUTO?`
	Returns the following string: `"ON"`.

:SENSe:SWEep:STATe

Syntax	`:SENSe:SWEep:STATe <PredefExpr>[,<int1>]`
Parameters	`PredefExpr` is one of the following predefined expressions: `CONTinuous|SINGle|HOLD`. Default is `CONTinuous`. `int1` is an optional integer. It is only valid for SINGLe sweeps. The minimum value for `int1` is `1`, the maximum is `999`. The default value is `1`.
Command	Sets the measurement display mode of the 9101. `CONTinuous` selects repetitive measurements. `SINGle` lets the 9101 perform and display one (or a limited number of) measurement(s). The optional second parameter indicates how often a sweep will be performed. `HOLD` immediately stops any ongoing measurement.
Query	Returns the current setting.

Example	`:SENSe:SWEep:STATe SINGle`
	`:SENSe:SWEep:STATe?`
	Returns the following string: `"SINGle"`.

:SENSe:TRIGger

Syntax	`:SENSe:TRIGger <PredefExpr>`
Parameters	`PredefExpr` is one of the following predefined expressions: `OFF|VIDeo`. Default is `FULL`.
Command	Sets the trigger mode of the 9100. `OFF` means no trigger is active. `VIDeo` activates the trigger at choosen level.
Query	Returns the current setting.

Example	`SENSe:TRIGger VIDeo`
	`:SENSe:TRIGger?`
	Returns the following string: `"VIDeo"`.

:SENSe:TRIGger:LEVel

Syntax	`:SENSe:TRIGger:LEVel <real1>`
Parameters	`real1` is a floating point real number. The minimum value for `real1` is `-100`, the maximum value `30.0`. The minimum resolution is `0.1`. The default value is `-40`.
Command	Sets trigger level which is active if `SENSe:TRIGger` is set to `VIDeo`. `real1` is the level in dBm.
Query	Returns the current setting.

Example	`:SENSe:TRIGger:LEVel -10`
	`:SENSe:TRIGger:LEVel?`
	The value returned in this example is: `"-10"`.

:SENSe:TRIGger:EDGE

Syntax	`:SENSe:TRIGger:EDGE <PredefExpr>`
Parameters	`PredefExpr` is one of the following predefined expressions: `POSitive|NEGative`. Default is `POSitive`.
Command	Sets either the positive or the negative slope for the trigger.
Query	Returns the current setting.

Example	`SENSe:TRIGger:EDGe NEGative`
	`:SENSe:TRIGger?`
	Returns the following string: `"NEGative"`.

:SENSe:DEMod:VOLume

Syntax	`:SENSe:DEMod:VOLume <int1>`
Parameters	`int1` is an integer. The minimum value for `int1` is `0`, the maximum is `100`. The default value is `50`.
Command	Sets the speaker volume of the demodulated signal in percent.
Query	Returns the current setting.

Example	`:SENSe:DEMod:VOLume 20`
	`:SENSe:DEMod:VOLume?`
	The value returned is: `"20"`.

:SENSe:DEMod:DURation

Syntax	`:SENSe:DEMod:DURation <real1>`
Parameters	`real1` is a floating point real number. The minimum value for `real1` is `0`, the maximum value `100`. The minimum resolution is `0.001`. The default value is `2`.
Command	Sets the duration of the demodulated signal in seconds.
Query	Returns the current setting.

Example	`:SENSe:DEMod:DURation 10`
	`:SENSe:DEMod:DURation?`
	The value returned is: `"10"`.

:SENSe:DEMod[:MODulation]

Syntax	`:SENSe:DEMod[:MODulation] <PredefExpr>`
Parameters	`PredefExpr` is one of the following predefined expressions: `OFF|AM|FM`. Default is `OFF`.
Command	Sets the demodulation mode, which can be off, AM (amplitude modulation) or FM (frequency modulation). FM demodulation is performed in a 30 kHz bandwidth.
Query	Returns the current setting.

Example	`:SENSe:DEMod FM`
	`:SENSe:DEMod:MODulation?`
	Returns the following string: `"FM"`

:SENSe:DEMod:DEMod

Syntax	`:SENSe:DEMod:DEMod <PredefExpr>`
Parameters	`PredefExpr` is one of the following predefined expressions: `PERManent|ATMarker`. Default is `PERManent`.
Command	Switches between permanent demodulation at the center frequency and demodulation at the marker frequencies.
Query	Returns the current setting.

Example	`:SENSe:DEMod:DEMod PERManent`
	`:SENSe:DEMod:DEMod?`
	Returns the following string: `"PERManent"`

:SENSe:DETector:FUNCtion

Syntax	`:SENSe:DETector:FUNCtion <PredefExpr>`
Parameters	`PredefExpr` is one of the following predefined expressions: `POSNeg|SAMPle|POSitive|NEGative|`. Default is `POSNeg`.
Command	Defines which of the measurement values shall be displayed. The 9101 takes far more measurements than can be displayed on the screen, so several results are summarized into one. `POSNeg` indicates both the maximum and minimum values for each frequency point in the form of a straight vertical line between these values. `SAMPle` lets the 9101 randomly select one of the measurement values for each frequency point. `POSitive` lets the 9101 pick the highest value. `NEGative` lets the 9101 select the lowest value.
Query	Returns the current setting.

Example	`:SENSe:DETector:FUNCtion SAMPle`
	`:SENSe:DETector:FUNCtion?`
	Returns the following string: `"SAMPle"`.

:SENSe:TRACe:A[:STATe]

Syntax	`:SENSe:TRACe:A[:STATe] <PredefExpr>`
Parameters	`PredefExpr` is one of the following predefined expressions: `ACTual|MAXHold|MINHold|HOLD|AVG|OFF`. Default is `ACTual`.
Command	Sets the display mode for Trace A. `ACTual` shows measurement by measurement. `MAXHold` displays the maximum value for each frequency point over all the measurements. `MINHold` shows the minimum value for each frequency point over all the measurements. `HOLD` stops the measurement immediately. `AVG` displays, for each frequency point, an average value over all the measurements. `OFF` switches the trace off.
Query	Returns the current settings.

Example	`:SENSe:TRACe:A MAXHold`
	`:SENSe:TRACe:A:STATe?`
	Returns the following string: `"MAXHold"`.

:SENSe:TRACe:A:FETCh

Syntax	:SENSe:TRACe:A:FETCh <PredefExpr>
Parameters	PredefExpr is one of the following predefined expressions: ALL|MINimum|MAXimum|FREQuency|FMINimum|FMAXimum.
Command	There is solely a query form of this command available.
Query	Returns the data of trace A depending on the parameter: Param ALL returns: <min>,<max>,<freq>,<min>,<max>,<freq>, ... Param MIN returns: <min>,<min>, ... Param MAX returns: <max>,<max>, ... Param FREQ returns: <freq>,<freq>, ... Param FMIN returns: <min>,<freq>,<min>,<freq>, ... Param FMAX returns: <max>,<freq>,<max>,<freq>, ...
Example	:SENSe:TRACe:A:FETCh? ALL Returns the following string: "1000000.0,-50.3,-45.5,1001000.0,-53.4,-48.2,...".

:SENSe:TRACe:B[:STATe]

Syntax	:SENSe:TRACe:B[:STATe] <PredefExpr>
Parameters	PredefExpr is one of the following predefined expressions: ACTual|MAX-Hold|MINHold|HOLD|AVG|OFF. Default is OFF.
Command	Sets the display mode for Trace B. ACTual shows measurement by measurement. MAXHold displays the maximum value for each frequency point over all the measurements. MINHold shows the minimum value for each frequency point over all the measurements. HOLD stops the measurement immediately. AVG displays, for each frequency point, an average value over all the measurements. OFF switches Trace B off.
Query	Returns the current settings.
Example	:SENSe:TRACe:B MAXHold :SENSe:TRACe:B? Returns the following string: "MAXHold".

:SENSe:TRACe:B:FETCh

Syntax	:SENSe:TRACe:B:FETCh <PredefExpr>
Parameters	PredefExpr is one of the following predefined expressions: ALL|MINimum|MAXimum|FREQuency|FMINimum|FMAXimum.
Command	There is solely a query form of this command available.
Query	Returns the data of trace B depending on the parameter: Param ALL returns: <min>,<max>,<freq>,<min>,<max>,<freq>, ... Param MIN returns: <min>,<min>, ... Param MAX returns: <max>,<max>, ... Param FREQ returns: <freq>,<freq>, ... Param FMIN returns: <min>,<freq>,<min>,<freq>, ... Param FMAX returns: <max>,<freq>,<max>,<freq>, ...
Example	:SENSe:TRACe:B:FETCh? ALL Returns the following string: "1000000.0,-50.3,-45.5,1001000.0,-53.4,-48.2,..."

:SENSe:TRACe:AVGFactor

Syntax	:SENSe:TRACe:AVGFactor <int1>
Parameters	int1 is an integer. The minimum value for int1 is 2, the maximum is 128. The default value for int1 is 5.
Command	Sets the trace averaging factor.
Query	Returns the current setting.
Example	:SENSe:TRACe:AVGFactor 10 :SENSe:TRACe:AVGFactor? Value returned in this example: "10".

:SENSe:TRACe:CLEar

Syntax	:SENSe:TRACe:CLEar
Parameters	There are no parameters.
Command	Clears the current trace.
Query	There is no query form of this command available.
Example	:SENSe:TRACe:CLEar

:SENSe:TRACe:COPY

Syntax	:SENSe:TRACe:COPY <PredefExpr>[,<int>]
Parameters	PredefExpr is one of the following predefined expressions: ATOB|BTOA.
Command	Copies trace A to B or vice versa.
Query	There is no query form of this command available.
Example	:SENSe:TRACe:COPY ATOB

:SENSe:REFLevel

Syntax	`:SENSe:REFLevel <real1>`
Parameters	`real1` is a floating point real number. The minimum value for `real1` is `-113`, the maximum value `137`. The minimum resolution possible for `real1` is `1`. The default value for `real1` is `0`. The minimum and maximum value for `real1` depends on the unit set by `SENS:REFL:UNIT`. When unit is set to `dBm`, the minimum value is `-100` and the maximum value is `30`. When unit is set to `dBuV`, the minimum value is `7` and the maximum value is `137`. When unit is set to `dBmV`, the minimum value is `-53` and the maximum value is `77`. When unit is set to `dBV`, the minimum value is `-113` and the maximum value is `17`. The default value for `real1` is `0` dBm.
Command	This command sets the reference level of the 9101 (0 dB line), in the unit selected with the `:SENS:REFL:UNIT` command.
Query	Returns the current setting.

Example	`:SENSe:REFLevel -50`
	`:SENSe:REFLevel?`
	The value returned is: `"-50"`.

:SENSe:REFLevel:UNIT

Syntax	`:SENSe:REFLevel:UNIT <PredefExpr>`
Parameters	`PredefExpr` is one of the following predefined expressions: `DBM|DBUV|DBMV|DBV|.` Default is `DBM`.
Command	Defines the unit for the reference level (dBm, dBµV, dBmV or dBV). It also affects the unit in which results (on the vertical axis) are displayed.
Query	Returns the current setting.

Example	`:SENSe:REFLevel:UNIT DBMV`
	`:SENSe:REFLevel:UNIT?`
	Returns the following string: `"DBMV"`.

:SENSe:STATe

Syntax	`:SENSe:STATe?`
Parameters	There are no parameters.
Command	There is solely a query form of this command available.
Query	Returns the Uncal state. If the current settings lead to an invalid measurement (e.g. because the filters are not in steady state), the reply is "`ON`", otherwise the reply is "`OFF`".
Example	`:SENSe:STATe?` Returns the following string: `"ON"`, meaning the 9101 filter and sweep settings should be adjusted.

:SENSe:MEASure

Syntax	`:SENSe:MEASure <PredefExpr>`
Parameters	`PredefExpr` is one of the following predefined expressions: NONE|`CPOWer`|`ACPR`|`OBW`. Default is NONE.
Command	Starts measurements of the type described by `PredefExp`.
Query	Returns the current setting.

Example	`:SENSe:MEASure ACPR`
	`:SENSe:MEASure?`
	Returns the following string: "`ACPR`"

:SENSe:MEASure:OBW

Syntax	`:SENSe:MEASure:OBW <int1>`
Parameters	`int1` is an integer. The minimum value for `int1` is `5`, the maximum is `99`. The default value is `90`.
Command	Sets percentage value for which the 9101 shall determine the occupied bandwidth (spectrum analyzer mode).
Query	Returns the current setting.

Example	`:SENSe:MEASure:OBW 20`
	`:SENSe:MEASure:OBW?`
	The value returned in this example is: "`20`".

:SENSe:MEASure:CHANnel:WIDTh

Syntax	`:SENSe:MEASure:CHANnel:WIDTh <real1>`
Parameters	`real1` is a floating point real number. The minimum value for `real1` is `100000`, the maximum value `2E9`. `real1` can be set in multiples of `1000`. The default value for `real1` is `5E6`.
Command	Sets actual channel width in spectrum analyzer mode.
Query	Returns the current setting.

Example	`:SENSe:MEASure:CHANnel:WIDTh 150000000`
	`:SENSe:MEASure:CHANnel:WIDTh?`
	The value returned in this example is: "`150000000`".

:SENSe:MEASure:CHANnel:SPACing

Syntax	`:SENSe:MEASure:CHANnel:SPACing <real1>`
Parameters	`real1` is a floating point real number. The minimum value for `real1` is `100000`, the maximum value `2000000000`. `real1` can be set in multiples of `1000`. The default value is `10000000`.
Command	Sets actual channel spacing in spectrum analyzer mode.
Query	Returns the current setting.

Example	`:SENSe:MEASure:CHANnel:SPACing 1500000000`
	`:SENSe:MEASure:CHANnel:SPACing?`
	The value returned in this example is: "`1500000000`".

:SENSe:MEASure:ADJSettings

Syntax	`:SENSe:MEASure:ADJSettings`
Parameters	There are no parameters.
Command	Adjusts settings in display made with ...CHAN:WIDTh and ...SPACing in the corresponding measure mode CPOWer, ACPR or OBW.
Query	There is no query form of this command available.
Example	`:SENSe:MEASure:ADJSettings`

Input commands

With these commands, the input stage of the 9101 Handheld Spectrum Analyzer is affected.

WARNING

The maximum input power level at the **RF IN** connector is 30 dBm (1 W). Higher input levels may result in serious damage of the instrument.

:INPut:ATTenuation

Syntax	`:INPut:ATTenuation <real1>`
Parameters	`real1` is a floating point real number. The minimum value for `real1` is `0`, the maximum value `50`. `real1` can be set in steps of `10`. The default value for `real1` is `30`.
Command	This command sets the RF preattenuation of the Willtek 9101. The physical dimension of `real1` is dB.
Query	Returns the current setting.

Example	`:INP:ATT 20`
	`:INPut:ATTenuation?`
	The value returned is: `"20"`.

:INPut:ATTenuation:AUTo

Syntax	`:INPut:ATTenuation:AUTo <PredefExpr>`
Parameters	`PredefExpr` is one of the following predefined expressions: `ON|OFF`. Default is `ON`.
Command	Lets the 9101 select the preattenuation depending on the reference level.
Query	Returns the current setting.

Example	`:INP:ATT:AUTO ON`
	`:INPut:ATTenuation:AUTO?`
	Returns the following string: `"ON"`

:INPut:IMPedance

Syntax	`:INPut:IMPedance <PredefExpr>`
Parameters	`PredefExpr` is one of the following predefined expressions: `IMP50|IMP75`. Default is `IMP50`.
Command	Lets the 9100 select between 50 Ω and 75 Ω impedance. Changing the impedance automatically adjusts the display unit (as with the `:SENSe:REFLevel:UNIT` command): When switching to 75 Ω, the new unit will be dBµV. When switching to 50 Ω, the new unit will be dBm.
Query	Returns the current setting.

Example	`:INP:IMP IMP75`
	`:INPut:IMPedance?`
	Returns the following string: `"IMP75"`

:INPut:EDEVice

Syntax	`:INPut:EDEVice <PredefExpr>`
Parameters	`PredefExpr` is one of the following predefined expressions: `ON|OFF`. Default is `OFF`.
Command	Switch the external device compensation on or off. A corresponding file has to be loaded first with command `MMEMory:LOAD:EDEVice`.
Query	Returns the current setting.

Example	`:INP:EDEVice ON`
	`:INPut:EDEVice?`
	Returns the following string: `"ON"`

MMemory commands

With the MMemory commands, you can fully exploit the capabilities of the instrument to store and reload measurement results in its nonvolatile memory.

:MMEMory:STORe:STATe

Syntax	`:MMEMory:STORe:STATe <string1>`
Parameters	`string1` is a string (text) parameter. The maximum length of `string1` is 11 characters.
Command	Stores the actual parameter settings of the 9101 in the SETTINGS directory on the flash disk in a file named <string1>.
Query	Returns the file name last stored with this command.
Example	`:MMEMory:STORe:STATe "sett3"`

:MMEMory:STORe:TRACe

Syntax	`:MMEMory:STORe:TRACe <string1>[,<PredefExp>]`
Parameters	`string1` is a string (text) parameter. The maximum length of `string1` is 11 characters. `PredefExpr` is an optional parameter and one of the following predefined expressions: `A|B`. Default is `A`.
Command	Stores the current trace A or B and the parameter settings on the flash disk in the TRACE directory in a file named <string1>.
Query	Returns the file name last stored with this command.
Example	`:MMEMory:STORe:TRACe "GSM900",A`

:MMEMory:STORe:LIMit

Syntax	`:MMEMory:STORe:LIMit <string1>{,<PredefExpr>,<x1>,<y1>,<x2>,<y2>...}` `:MMEMory:STORe:LIMit? <string1>`
Parameters	`string1` is a string (text) parameter. The maximum length of `string1` is 11 characters. `PredefExpr` is one of the following predefined expressions: `LOWer|UPPer`. `x1 y1 x2 y2` are floating point real numbers. The minimum value for all these reals is `0`, the maximum value for the x values is `10`, the maximum value for the y values is `8`, the resolution for all real values is `0.1` and the default is `0`.
Command	Stores the limits defined as lines in the LIMIT directory on the flash disk in a file named <string1>. A line is defined by a parameter set `PredefExpr,x1,y1,x2,y2`. Up to 30 parameter sets can follow the string parameter.
Query	Returns the parameter sets of the limit file which is given as parameter.

Example	`:MMEMory:STORe:LIMit "lim2",UPP,2.3,4.5,6.9,7,2,LOW,2.3,1.5,6.9,3,2`
	`:MMEMory:STORe:LIMit? "lim2"`
	String returned: `UPP,2.3,4.5,6.9,7,2,LOW,2.3,1.5,6.9,3,2`

:MMEMory:STORe:CHANnel

Syntax	`:MMEMory:STORe:CHANnel <string1>, <int1>, <int2>, <real1>, <real2>, <real3>, <real4>`
Parameters	`string1` is a string (text) parameter. The maximum length of `string1` is 11 characters. `int1` is an integer. The minimum value for `int1` is `1`, the maximum is `1000000`. The default value for `int1` is `100`. `int2` is an integer. The minimum value for `int2` is `0`, the maximum is `1000000`. The default value for `int2` is `0`. `real1` is a floating point real number. The minimum value for `real1` is `0`, the maximum value `4000000000`. The minimum resolution possible for `real1` is `1000`. The default value for `real1` is `1000000`. `real2` is a floating point real number. The minimum value for `real2` is `0`, the maximum value `4000000000`. The minimum resolution is `1000`. The default value is `1000000`. `real3` is a floating point real number. The minimum value for `real3` is `0`, the maximum value `4000000000`. The minimum resolution is `1000`. The default value is `1000000000`. `real4` is a floating point real number. The minimum value for `real4` is `–100`, the maximum value `30`. The minimum resolution is `1`. The default value is `0`.
Command	This command stores the present communication system settings within the 9101 (e.g. for the channel power mode). `string1` is the name of system settings file in which the parameters are stored. `int1` sets the number of channels. `int2` sets the start channel number. `real1` sets the channel bandwidth over which to measure, in Hertz. `real2` sets the frequency spacing of the channels, in Hertz. `real3` sets the frequency of the first channel, in Hertz. `real4` sets the system reference level (0 dB line).
Query	Reads and returns the parameter set from the limit file given as a parameter.

Example	`:MMEMory:STORe:CHANnel "P-GSM9DO", 125, 0, 400000, 200000, 935000000, 0.0`
	`:MMEM:STOR:CHAN?`
	String returned: `"P-GSM9DO"`.

:MMEMory:STORe:EDEVice

Syntax	`:MMEMory:STORe:EDEVice <string1>, <real1freq>, <real1lev>, <real2freq>, <real2lev>, ... <real100freq>, <real100lev>`
Parameters	`string1` is a string (text) parameter. The maximum length of `string1` is 11 characters. `real1freq` to `real100freq` are floating point real numbers. The minimum value is `0`, the maximum value `4e9`. The minimum resolution is `1`. `real1lev` to `real100lev` are floating point real numbers. The minimum value is `–100`, the maximum value `30`. The minimum resolution is `0.01`.
Command	This command stores settings for external device compensation. `string1` is the name of the external device compensation file in which the parameters are stored. `realxfreq` and `realxlev` are pairs of frequency and level values to set the attenuation on the respective frequency. The instrument applies linear interpolation for the level between frequency points.
Query	Returns the parameter sets of the external device compensation file which is given as a parameter.

Example	:MMEMory:STORe:EDEVice "EXT_DEV2",1000000, -5.1, 2000000,-3.2,5000000,-4.1,10000000,-3.8,20000000,-2.6 :MMEM:STOR:EDEV? "EXT_DEV2" String returned: 1000000, -5.1,2000000,-3.2,5000000,-4.1, 10000000,-3.8,20000000,-2.6

:MMEMory:LOAD:FILelist[:TRACe]

Syntax	:MMEMory:LOAD:FILelist[:TRACe]? <PredefExpr>
Parameters	PredefExpr is an optional parameter and one of the following predefined expressions: SHORt|EXTent. Default is SHORt.
Command	There is only a query form of this command available.
Query	Returns the list of files stored in the TRACE directory. The file names are separated by commas.
Example	:MMEMory:LOAD:FILelist:TRACe? String returned: "trace1","trace2","trace3"

:MMEMory:LOAD:FILelist:STATe

Syntax	:MMEMory:LOAD:FILelist:STATe? <PredefExpr>
Parameters	PredefExpr is an optional parameter and one of the following predefined expressions: SHORt|EXTent. Default is SHORt.
Command	There is only a query form of this command available.
Query	Returns the list of files stored in the SETTINGS directory. The file names are separated by commas.
Example	:MMEMory:LOAD:FILelist:STATe? String returned in this example: "sett1","sett2","sett3"

:MMEMory:LOAD:FILelist:LIMit?

Syntax	:MMEMory:LOAD:FILelist:LIMit? <PredefExpr>
Parameters	PredefExpr is an optional parameter and one of the following predefined expressions: SHORt|EXTent. Default is SHORt.
Command	There is only a query form of this command available.
Query	Returns a **comma-separated** list of file names. Each file contains spectrum limit values stored on the 9101.
Example	:MMEMory:LOAD:FILelist:LIMit? String returned: "lim1","lim2"

:MMEMory:LOAD:FILelist:CHANnel

Syntax	`:MMEMory:LOAD:FILelist:CHANnel? <PredefExpr>`
Parameters	`PredefExpr` is an optional parameter and one of the following predefined expressions: `SHORt|EXTent`. Default is `SHORt`.
Command	There is only a query form of this command available.
Query	Returns a **comma-separated** list of file names. Each file contains channel values stored on the 9101.
Example	`:MMEMory:LOAD:FILelist:CHANnel?` String returned: `"GSM900","GSM1800"`

:MMEMory:LOAD:FILelist:EDEVice

Syntax	`:MMEMory:LOAD:FILelist:EDEVice? <PredefExpr>`
Parameters	`PredefExpr` is an optional parameter and one of the following predefined expressions: `SHORt|EXTent`. Default is `SHORt`.
Command	There is only a query form of this command available.
Query	Returns a **comma-separated** list of file names. Each file contains external device compensation values stored on the 9101.
Example	`:MMEMory:LOAD:FILelist:EDEVice?` String returned in this example: `"EXT_DEV2","EXT_DEV5"`

:MMEMory:LOAD:STATe

Syntax	`:MMEMory:LOAD:STATe <string1>`
Parameters	`string1` is a string (text) parameter. The maximum length of `string1` is 11 characters.
Command	Loads 9101 parameter settings from file `string1` located in the SETTINGS directory on the flash disk.
Query	Returns the file name last loaded with this command.
Example	`:MMEMory:LOAD:STATe "sett3"`

:MMEMory:LOAD:TRACe

Syntax	`:MMEMory:LOAD:TRACe? <string1>[,<PredefExpr>]`
Parameters	`string1` is a string (text) parameter. The maximum length of `string1` is 11 characters. `PredefExpr` is an optional parameter and one of the following predefined expressions: `A|B`. Default is `A`.
Command	Loads 9101 traces from file <string1> located in the TRACE directory on the flash disk to trace A or B.
Query	Returns the file name last loaded with this command.
Example	`:MMEMory:LOAD:TRACe "TESTTRACE2"` `:MMEM:LOAD:TRAC "TTR3",B`

:MMEMory:LOAD:LIMit

Syntax	`:MMEMory:LOAD:LIMit <string1>`
Parameters	`string1` is a string (text) parameter. The maximum length of `string1` is 11 characters.
Command	Loads 9101 limit settings from file <string1> located in the LIMIT directory on the flash disk.
Query	Returns the file name last loaded with this command.
Example	`:MMEMory:LOAD:LIMit "sett3"`

:MMEMory:LOAD:CHANnel

Syntax	`:MMEMory:LOAD:CHANnel <string1>`
Parameters	`string1` is a string (text) parameter. The maximum length of `string1` is 11 characters.
Command	Load saved channel data from file <string1> in the CHANNEL directory on the flash disk.
Query	Returns the file name last loaded with this command.
Example	`<TT>:MMEMory:LOAD:CHANnel "GSM900"`

:MMEMory:LOAD:EDEVice

Syntax	`:MMEMory:LOAD:EDEVice <string1>`
Parameters	`string1` is a string (text) parameter. The maximum length of `string1` is 11 characters.
Command	Load saved channel data from file <string1> in the external device directory on the flash disk.
Query	Returns the file name last loaded with this command.
Example	`:MMEMory:LOAD:EDEVice "EXT_DEV2"`

:MMEMory:DELete:STATe

Syntax	`:MMEMory:DELete:STATe <string1>`
Parameters	`string1` is a string (text) parameter. The maximum length of `string1` is 11 characters.
Command	Deletes file `string1` in the SETTINGS directory on the flash disk. Files in this directory usually contain parameter settings of the device.
Query	Returns the name of the file last deleted with this command.
Example	`:MMEMory:DELete:STATe "sett3"`

:MMEMory:DELete:STATe:ALL

Syntax	`:MMEMory:DELete:STATe:ALL`
Parameters	There are no parameters.
Command	Deletes all the files in the SETTINGS directory on the flash disk. These files usually contain parameter settings of the 9101.
Query	There is no query form of this command available.
Example	`:MMEMory:DELete:STATe:ALL`

:MMEMory:DELete:TRACe

Syntax	`:MMEMory:DELete:TRACe <string1>`
Parameters	`string1` is a string (text) parameter. The maximum length of `string1` is 11 characters.
Command	Deletes file <string1> (saved trace data and parameter settings) from the TRACE directory on the flash disk.
Query	Returns the name of the file last deleted with this command.
Example	`:MMEMory:DELete:TRACe "GSM900"`

:MMEMory:DELete:TRACe:ALL

Syntax	`:MMEMory:DELete:TRACe:ALL`
Parameters	There are no parameters.
Command	Deletes all the TRACE files in the 9101 memory.
Query	There is no query form of this command available.
Example	`:MMEMory:DELete:TRACe:ALL`

:MMEMory:DELete:LIMit

Syntax	`:MMEMory:DELete:LIMit <string1>`
Parameters	`string1` is a string (text) parameter. The maximum length of `string1` is 11 characters.
Command	Deletes file <string1> in the LIMIT directory. Files in this directory contain limit settings of the device.
Query	Returns the name of the file last deleted with this command.
Example	`:MMEMory:DELete:LIMit "lim3"`

:MMEMory:DELete:LIMit:ALL

Syntax	`:MMEMory:DELete:LIMit:ALL`
Parameters	There are no parameters.
Command	Deletes all the files in the LIMIT directory on the flash disk. These files contain spectrum limit settings of the 9101.
Query	There is no query form of this command available.
Example	`:MMEMory:DELete:LIMit:ALL`

:MMEMory:DELete:CHANnel

Syntax	`:MMEMory:DELete:CHANnel <string1>`
Parameters	`string1` is a string (text) parameter. The maximum length of `string1` is 11 characters.
Command	Deletes file <string1> from the CHANNEL directory. Files in this directory contain channel settings of the device.
Query	Returns the name of the file last deleted with this command.
Example	`:MMEMory:DELete:CHAN "P-GSM"`

:MMEMory:DELete:CHANnel:ALL

Syntax	`:MMEMory:DELete:CHANnel:ALL`
Parameters	There are no parameters.
Command	Deletes all the files in the CHANNEL directory on the flash disk.
Query	There is no query form of this command available.
Example	`:MMEMory:DELete:CHANnel:ALL`

:MMEMory:DELete:EDEVice

Syntax	`:MMEMory:DELete:EDEVice <string1>`
Parameters	`string1` is a string (text) parameter. The maximum length of `string1` is 11 characters.
Command	Deletes file `string1` in the external device directory on the flash disk. Files in this directory contain external device compensation settings on the 9101.
Query	Returns the name of the file last deleted with this command.
Example	`:MMEMory:DELete:EDEVice "lim3"`

:MMEMory:DELete:EDEVice:ALL

Syntax	`:MMEMory:DELete:EDEVice:ALL`
Parameters	There are no parameters.
Command	Deletes all the files in the external device directory on the flash disk.
Query	There is no query form of this command available.
Example	`:MMEMory:DELete:EDEVice:ALL`

Instrument commands

:INSTrument:SELect

Syntax	`:INSTrument:SELect <PredefExpr>`
Parameters	`PredefExpr` is one of the following expressions: `SANalyzer|CPOWer`. Default is `SANalyzer`.
Command	Selects the measurement mode. Available modes are spectrum analyzer and channel power.
Query	Returns the current setting.

Example	`:INSTrument:SELect CPOWer`
	`:INSTrument:SELect?`
	String returned: `"CPOWer"`

Display commands

The display command subsystem affects the screen of the instrument.

:DISPlay:TRACe:Y[:SCALe]

Syntax	`:DISPlay:TRACe:Y[:SCALe] <int1>`
Parameters	`int1` is an integer. Valid entries are `1`, `2`, `5`, `10`, `20`. The default value is `10`.
Command	Holds the upper limit of the power scale but changes the resolution (and the lower limit) of the scale. `real1` defines how many dB per scale unit are shown on the display.
Query	Returns the current setting.

Example	`:DISPlay:TRACe:Y:[SCALe] 20`
	`:DISPlay:TRACe:Y:[SCALe]?`
	The value returned is: `"20"`.

:DISPlay:BACKlight

Syntax	`:DISPlay:BACKlight <int1>`
Parameters	`int1` is an integer. The minimum value for `<int1>` is `0`, the maximum is `100`. The default value is `100`.
Command	Sets the brightness of the screen. A setting of `100` leads to the maximum brightness.
Query	Returns the current setting.

Example	`:DISPlay:BACKlight 50`
	`:DISPlay:BACKlight?`
	The value returned is: `"50"`.

:DISPlay:BEEP

Syntax	`:DISPlay:BEEP <PredefExpr>`
Parameters	`PredefExpr` is one of the following predefined expressions: `ON|OFF`. Default is `ON`.
Command	When on, the 9101 sounds a beep in case of an error or warning. When turned off, the sound is omitted.
Query	Returns the current setting.

Example	`:DISPlay:BEEP ON`
	`:DISPlay:BEEP?`
	Returns the following string: `"ON"`

:DISPlay:COLor:TRACe:[A|B]

Syntax	`:DISPlay:COLor:TRACe:[A|B] <int1>`
Parameters	`int1` is an integer. The minimum value for `<int1>` is `1`, the maximum is `8`. The default value is `1` for trace A and `3` for trace B.
Command	Sets the color from the color palette for trace A or B.
Query	Returns the current setting.

Example	`:DISPlay:COLor:TRACe:A 5`
	`:DISPlay:COLor:TRACe:A?`
	The value returned in this example is: `"5"`.

:DISPlay:COLor:GRATicule

Syntax	`:DISPlay:COLor:GRATicule <int1>`
Parameters	`int1` is an integer. The minimum value for `<int1>` is `1`, the maximum is `8`. The default value is `2`.
Command	Sets the color from the color palette for the grid.
Query	Returns the current setting.

Example	`:DISPlay:COLor:GRATicule 5`
	`:DISPlay:COLor:GRAT?`
	The value returned in this example is: `"5"`.

:DISPlay:COLor:LIMits

Syntax	`:DISPlay:COLor:LIMits <int1>`
Parameters	`int1` is an integer. The minimum value for `<int1>` is `1`, the maximum is `8`. The default value is `7`.
Command	Sets the color from the color palette for the limit lines.
Query	Returns the current setting.

Example	`:DISPlay:COLor:LIM 5`
	`:DISP:COL:LIMits?`
	The value returned in this example is: `"5"`.

Calculate commands

The markers of the 9101 can be set using the calculate commands.

:CALCulate:MARKer:AOFF

Syntax	`:CALCulate:MARKer:AOFF`
Parameters	There are no parameters.
Command	All marker are switched off.
Query	There is no query form of this command available.

Example	`:CALC:MARK:A:STAT NORM`
	`:CALC:MARK:B:STAT DELT`
	`:CALC:MARK:C:STAT DELT`
	`:CALC:MARK:AOFF`

:CALCulate:MARKer:{A|B|C|D}[:STATe]

Syntax	`:CALCulate:MARKer:{A|B|C|D}[:STATe] <PredefExpr>`
Parameters	`PredefExpr` is one of the following predefined expressions: `OFF|NOR-Mal|DELTa`. Default is `OFF`.
Command	Selects an active marker and sets it to one of the modes: `OFF|NORMal|DELTa`. `OFF` is used to switch off the selected marker. `NORMal` switches the selected marker on. `DELTa` changes the marker to a delta marker; the REF marker is always A (marker 1).
Query	The query form of this command will return the current setting. The string delivered back will contain the short-form version of one of the predefined expressions explained above.

Example	`:CALC:MARK:A:STAT NORM`
	`:CALC:MARK:A:STAT?`
	Value returned: `"NORM"`.

:CALCulate:MARKer:{A|B|C|D}:Y

Syntax	`:CALCulate:MARKer:{A|B|C|D}:Y?`
Parameters	There are no parameters.
Command	There is solely a query form of this command available.
Query	The query form of this command returns the level value at the current marker position set by CALCulate:MARKer:{A|B|C|D}:X. The string delivered back will contain one floating point real number with the physical dimension that has been selected for the reference level (`:SENSe:REFLevel:UNIT`).

Example	`:CALCulate:MARKer:B:X 2200000000`
	`:CALCulate:MARKer:B:Y?`
	The value returned is: `"-22.4"`.

:CALCulate:MARKer:{A|B|C|D}:X[:FREQuency]

Syntax	`:CALCulate:MARKer:{A|B|C|D}:X[:FREQuency] <real1>`
Parameters	`real1` is a floating point real number. The minimum value for `real1` is `0`, the maximum value `4000000000`. The minimum resolution possible for `real1` is `1`. The default value for `real1` is `1.8E9`.
Command	This command sets the marker frequency for one of the four markers of the Willtek 9101 when in spectrum mode. The physical dimension of `real1` is Hertz.
Query	The query form of this command will return the current marker frequency setting of the respective marker of the Willtek 9101 (A, B, C or D). The string delivered back will contain one real number.

Example	`:CALCulate:MARKer:C:X 1500000000`
	`:CALCulate:MARKer:C:X?`
	The value returned is: `"1500000000"`.

:CALCulate:MARKer:{A|B|C|D}:X:TIMe

Syntax	`:CALCulate:MARKer:{A|B|C|D}:X:TIMe <real1>`
Parameters	`real1` is a floating point real number. The minimum value for `real1` is `0.001`, the maximum value `100.0`. The minimum resolution possible for `real1` is `1`. The default value for `real1` is `0.0432`.
Command	This command sets the marker time for zero-span measurements for one of the four markers of the Willtek 9101. The physical dimension of `real1` is seconds.
Query	The query form of this command will return the current marker time setting of the respective marker of the Willtek 9101 (A, B, C or D). The string delivered back will contain one real number.

Example	`:CALCulate:MARKer:C:X:TIME 0.5`
	`:CALCulate:MARKer:C:X:TIME?`
	The value returned in this example is: `"0.5"`.

:CALCulate:{A|B|C|D}:MARKer:FSTep

Syntax	`:CALCulate:MARKer:{A|B|C|D}:FSTep`
Parameters	There are no parameters.
Command	This command sets the step frequency (fstep) to be the frequency at the respective marker position.
Query	There is no query form of this command available.
Example	`:CALCulate:MARKer:A:FSTep`

:CALCulate:MARKer:MAXPeak

Syntax	`:CALCulate:MARKer:MAXPeak`
Parameters	There are no parameters.
Command	Sets the currently selected marker to the maximum measured level. A marker is "selected" by way of the `:CALCulate:MARKer:{A|B|C|D}[:STATe]` command.
Query	There is no query form of this command available.
Example	`:CALCulate:MARKer:MAXPeak`.

:CALCulate:MARKer:NPEak

Syntax	`:CALCulate:MARKer:NPEak`
Parameters	There are no parameters.
Command	Sets the currently selected marker to the next highest level value.
Query	There is no query form of this command available.
Example	`:CALCulate:MARKer:NPEak`.

:CALCulate:MARKer:MCENter

Syntax	`:CALCulate:MARKer:MCENter`
Parameters	There are no parameters.
Command	The center frequency is changed to the current marker frequency.
Query	There is no query form of this command available.
Example	`:CALCulate:MARKer:MCENter`.

:CALCulate:MARKer:MREFlevel

Syntax	:CALCulate:MARKer:MREFlevel
Parameters	There are no parameters.
Command	The REFerence level is changed to the level at the marker position.
Query	There is no query form of this command available.
Example	:CALCulate:MARKer:MREFlevel.

:CALCulate:LIMit[:STATe]

Syntax	:CALCulate::LIMit[:STATe] <PredefExpr>
Parameters	PredefExpr is one of the following predefined expressions: OFF|UPPer|LOWer|UPPLow. Default is OFF.
Command	Selects the limit lines to one of four different modes: OFF|UPPer|LOWer|UPPLow. OFF is used to switch off the limit lines. UPPer switches only the upper limit line on. LOWer switches only the lower limit line on. UPPLow switches both upper and lower limit lines on.
Query	The query form of this command will return the current setting. The string delivered back will contain the short-form version of one of the predefined expressions explained above.
Example	CALC:LIM:STAT UPPLOW :CALC:LIM? Value returned: "UPPL".

:CALCulate:LIMit:FCOunt

Syntax	:CALCulate:LIMit:FCOunt <PredefExpr>
Parameters	PredefExpr is one of the following predefined expressions: ON|OFF. Default is OFF.
Command	Enables (and resets) or disables the failure counter. When enabled, requires that limit checking is also active (see CALC:LIM:STAT).
Query	Returns the current setting.
Example	:CALCulate:LIMit:FCOunt ON :CALCulate:LIMit:FCOunt? Returns the following string: "ON"

:CALCulate:LIMit:FCOunt:COUNt

Syntax	`:CALCulate:LIMit:FCOunt:COUNt?`
Parameters	There are no parameters.
Command	There is solely a query form of this command available.
Query	Gets the current count of fails in the limit check.
Example	`:CALCulate:LIMit:FCOunt:COUNt?` The value returned in this example is: `"5"`.

:CALCulate:LIMit:FBEep

Syntax	`:CALCulate:LIMit:FBEep <PredefExpr>`
Parameters	`PredefExpr` is one of the following predefined expressions: `ON|OFF`. Default is `OFF`.
Command	Enables or disables a sound that can be output each time a measurement fails the limits.
Query	Returns the current setting.

Example	`:CALC:LIMit:FBEep ON`
	`:CALCulate:LIMit:FBEep?`
	Returns the following string: `"ON"`.

:CALCulate:LIMit:FHOLd

Syntax	`:CALCulate:LIMit:FHOLd <PredefExpr>`
Parameters	`PredefExpr` is one of the following predefined expressions: `ON|OFF`. Default is `OFF`.
Command	If on, stops measurement updates and holds the last measurement result when it had a limit failure.
Query	Returns the current setting.

Example	`:CALCulate:LIMit:FHOLd ON`
	`:CALCulate:LIMit:FHOLd?`
	Returns the following string: `"ON"`.

:CALCulate:LIMit:SIMPle

Syntax	`:CALCulate:LIMit:SIMPle <PredefExpr>`
Parameters	`PredefExpr` is one of the following predefined expressions: `ON|OFF`. Default is `OFF`.
Command	Enables or disables the simple limit lines.
Query	Returns the current setting.

Example	`:CALCulate:LIMit:SIMPle ON`
	`:CALCulate:LIMit:SIMPle?`
	Returns the following string: `"ON"`.

:CALCulate:LIMit:SIMPle:UPPer

Syntax	`:CALCulate:LIMit:SIMPle:UPPer <real1>`
Parameters	`real1` is a floating point real number. The minimum value for `real1` is `-160`, the maximum value `0.0`. The minimum resolution possible for `real1` is `0.1`. The default value for `real1` is `-10.0`.
Command	Sets the upper limit line for simple limits.
Query	Returns the current setting.

Example	`:SENSe:LIMit:SIMPle:UPPer -10`
	`:SENSe:LIMit:SIMPle:UPPer?`
	The value returned is: `"-10"`.

:CALCulate:LIMit:SIMPle:LOWer

Syntax	`:CALCulate:LIMit:SIMPle:LOWer <real1>`
Parameters	`real1` is a floating point real number. The minimum value for `real1` is `-160`, the maximum value `0.0`. The minimum resolution possible for `real1` is `0.1`. The default value for `real1` is `-70.0`.
Command	Sets the lower limit line for simple limits.
Query	Returns the current setting.

Example	`:SENSe:LIMit:SIMPle:LOWer -70`
	`:SENSe:LIMit:SIMPle:LOWer?`
	The value returned is: `"-70"`.

:CALCulate:MEASure:ACPR

Syntax	`:CALCulate:MEASure:ACPR?`
Parameters	There are no parameters.
Command	There is solely a query form of this command available.
Query	Returns a string containing three floating point values; these represent the relative power in the lower adjacent channel (in dB), the in-channel power (in dBm) and the relative power in the upper adjacent channel (in dB).
Example	`:CALCulate:MEASure:ACPR?` Returns the following string: `"-14.9,-31.5,-14.1"`.

:CALCulate:MEASure:OBW

Syntax	`:CALCulate:MEASure:OBW?`
Parameters	There are no parameters.
Command	There is solely a query form of this command available.
Query	Returns a string with the floating point value for the occupied bandwidth, in Hz.
Example	`:CALCulate:MEASure:OBW?` Returns the following string: `"2694000.0"`.

:CALCulate:MEASure:CPOWer

Syntax	`:CALCulate:MEASure:CPOWer?`
Parameters	`There are no parameters.`
Command	There is solely a query form of this command available.
Query	Returns the measured in-channel power, in dBm.
Example	`:CALCulate:MEASure:CPOW?` Returns the following string: `"-32.2"`.

Format commands

These commands are used for formatting the SCPI output of the 9101 Handheld Spectrum Analyzer.

:FORMat:ADELimiter

Syntax	`:FORMat:ADELimiter <PredefExp>`
Parameters	`PredefExp` is one of the following predefined expressions: `COMMa|COLOn|SEMIcolon`. Default is `COMMa`.
Command	Selects the delimiter to be used to separate parameters in SCPI commands, and also to separate the individual measurement result values in a result return string. `COMMa` stands for commas (default), `COLOn` sets the delimiter to be a colon (:), while `SEMIcolon` will use and expect a semicolon (;) to be used.
Query	Returns the current setting.
Example	`:FORM:ADEL` Defines the comma to be used as delimiter for both commands and measurement results.

:FORMat:RESolution

Syntax	`:FORMat:RESolution <int1>`
Parameters	`int1` is an integer. The minimum value for `<int1>` is `0`, the maximum is `20`. The default value is `6`.
Command	Defines the number of digits after the decimal point to be used for floating point real figures.
Query	Returns the current setting.
Example	`:FORM:RES 0` Defines that there will be no digits after the decimal point.

Service commands

These commands are used for information regarding the status of the 9101.

:SERVice:BOOTversion

Syntax	`:SERVice:BOOTversion?`
Parameters	There are no parameters.
Command	There is only a query form of this command available.
Query	Returns the version of the boot software of your Willtek 9101. The command will return a string.
Example	`:SERVice:BOOTversion?` String returned in this example: `"1.80"`.

:SERVice:BATTery

Syntax	`:SERVice:BATTery?`
Parameters	There are no parameters.
Command	There is only a query form of this command available.
Query	Returns the the current loading state of the battery in %. The command will return an integer.
Example	`:SERVice:BATTery?` String returned in this example: `"40"`.

:SERVice:CHECk:LAST

Syntax	`:SERVice:CHECk:LAST <int1>,<int2>,<int3>,<string>`
Parameters	`intx` are three integers. The minimum value for `int1` is `1998`, the maximum is `2100`. The default value is `1998`. The minimum value for `int2` is `1`, the maximum is `12`. The default value is `1`. The minimum value for `int3` is 1, the maximum is `31`. The default value is `1`. `string` is a string (text) parameter. The maximum length of `string1` is 16 characters.
Command	Sets date and operator's name of the last check when calibration is due.
Query	Returns the current settings of the last calibration check and operator's name. The command will return 3 integers and a string.
Example	`:SERVice:CHECk:LAST?` String returned in this example: `2004,04,01,"John Williams"`.

:SERVice:CHECk:NEXT

Syntax	`:SERVice:CHECk:NEXT?`
Parameters	There are no parameters.
Command	There is only a query form of this command available.
Query	Returns the current settings of the last calibration check and operator's name. The command will return 3 integers and a string. Returns the date of the next check to be performed on this device. The command will return 3 integers for year, month and date.
Example	`:SERVice:CHECk:NEXT?` String returned in this example: `2005,04,01`.

SCPI errors

The following table lists the error numbers that the 9101 may return in case of a problem.

Error number	Error description
	Command errors
-100	Internal error only, for debugging purposes (Command error)
-101	Invalid character in command string
-102	SCPI syntax error: Command is not available as a query, or vice versa
-103	Invalid separator between parameters
-104	Data type error (mismatch between parameters and allowable data formats)
-108	Parameter not allowed (too many parameters)
-109	Missing parameter (too few parameters)
-111	Header separator error (probably colon missing between command keywords)
-112	Program mnemonic too long (i.e. longer than 12 characters)
-113	Keyword not found in command list
-114	Header suffix out of range (invalid character in command keyword)
-121	Invalid character in number (not a digit, or exponent value missing)
-123	Exponent out of range
-128	Numerical data not allowed
-131	Invalid suffix (appended unit not found)
-134	Suffix too long (appended unit is longer than 12 characters)
-138	Suffix not allowed (parameter type is not real)
-141	Invalid character data (parameter expression is not in predefined list)
-144	Character data too long (string data longer than allowed)
-158	String data not allowed for this parameter type
-160	Internal error only, for debugging purposes (Block data error)
-168	Internal error only, for debugging purposes (Block data not allowed)

	Execution errors
-201	Internal error only, for debugging purposes (SCPI execution function not defined)
-202	Internal error only, for debugging purposes (SCPI query function not defined)
-210	Internal error only, for debugging purposes (Out of memory)
-222	Data out of range
-230	Internal error only, for debugging purposes (Invalid token received by EXEC)
-231	Internal error only, for debugging purposes (Invalid index for parameter)
-232	Internal error only, for debugging purposes (Invalid parameter)
-233	Internal error only, for debugging purposes (Parameter has wrong type)
-234	Internal error only, for debugging purposes (Parameter missing)
-235	Internal error only, for debugging purposes (Index error)
-236	Parameter out of range
-260	File name not found in defined directory
-261	File creation failed in defined directory
-262	Internal error only, for debugging purposes (Label not found, config file)
-264	Error while saving or recalling trace file
	Device-dependent errors
-300	SYSTEM_ERROR
-310	Internal error only, for debugging purposes (error no. not found)
-311	Internal error only, for debugging purposes (Function not yet supported)
-319	Error queue overflow (more than 10 entries)
-320	Wrong password
-321	Internal error only, for debugging purposes (Serial number error)
-322	Wrong option key
-323	Option not available
-330	Download command error
-331	Upload command error
	Query errors
-400	Checkrule conflict, parameters outside limits
-401	Internal error only, for debugging purposes (EPROM write error)

-402	Internal error only, for debugging purposes (EPROM read error)
-410	Result not valid

Programming Examples

9

This chapter provides examples how to use the SCPI commands to set up and control the 9101 Handheld Spectrum Analyzer.

- "Overview" on page 150
- "Command examples" on page 150
- "Application examples" on page 157

Overview

This chapter describes how to control the 9101 from a personal computer via a serial or LAN connection. It explains the basic commands for the 9101 Handheld Spectrum Analyzer and describes a few typical applications together with the SCPI command sequence.

This documents does not show every command possible. It is assumed that the user has some basic knowledge about remote control and also some experience in the use of a spectrum analyzer.

Command examples

Introduction

The whole command set can be divided into three categories: settings, measurements and others. Each category is descriped in a separate section.

The word <val> stands for a numerical value.

The word <enum> is a placeholder for a string.

Prerequisites

Over serial interface

The 9101 must be powered on. A serial cable (null modem cable with crossed lines) must connect the 9101 with the PC. The interface settings should be set to 57600 bps, 8 bits per character, no parity, 1 stop bit.

Over LAN interface

The 9101 must be powered on. A cross patch LAN cable must connect the 9101 with the PC, or a normal LAN cable must connect the 9101 to a local area network. The 9101 must be programmed with its own IP address.

Settings

Please note that the 9101 always tries to execute the commands. However under some circumstances, the 9101 must adjust or change other settings. If this happens, please check all previous settings and try to resolve this conflict.

Center frequency

`SENSe:FREQuency:CENTer <val>`

Sets the center frequency in Hz.

Examples:

Long format:

```
SENSE:FREQUENCY:CENTER 96500000
```

Center frequency set to 96.5 MHz

Short format:
`SENS:FREQ:CENT 96.5E06` Center programmed to 96.5 MHz

Span `SENSe:FREQuency:SPAN <val>` Sets the span (dimension Hz)

Examples:

Long format:
`SENSE:FREQUENCY:SPAN 20000000` Span programmed to 20 MHz

Short format:
`SENS:FREQ:SPAN 20E06` Span programmed to 20 MHz

`SENS:FREQ:SPAN:FULL` Full span programmed

`SENS:FREQ:SPAN 0` Zero span activated

Resolution bandwidth `SENSe:BANDwidth:RESolution <val>`
Sets the resolution bandwidth (dim. Hz)

Valid values for <val>: 10 kHz, 30 kHz, 100 kHz, 300 kHz or 1 MHz.

Examples:

Long format:
`SENSE:BANDWIDTH:RESOLUTION 30000` Resolution set to 30 kHz

Short format:
`SENS:BAND:RES 30E03` Resolution set to 30 kHz

`SENS:BAND:RES:AUTO ON` Automatic selection active

Video bandwidth `SENSe:BANDwidth:VIDeo <val>` Sets the video bandwidth (dim. Hz)

Valid values for <val>: 100, 300 Hz. 1, 3, 10, 30, 100, 300 kHz or 1 MHz.

Examples:

Long format:
`SENSE:BANDWIDTH:VIDEO 300000` Video set to 300 kHz

Short format:
`SENS:BAND:VID 10E03` Video set to 10 kHz

`SENS:BAND:VID:AUTO ON` Automatic selection active

Sweep time `SENSe:SWEep:TIME <val>` Sets the sweep time (dimension ms)

Valid values for <val>: 1, 2, 5, 10, 20, 50, 100, 200 or 500 ms; 1, 2, 5, 10 or 20 s.

Examples:

Long format:
`SENSE:SWEEP:TIME 200` Sweep time set to 200 ms

Short format:
`SENS:SWE:TIME 10` Sweep time set to 10 ms

`SENS:SWE:TIME:AUTO ON` Automatic selection active

Reference level `SENSe:RFLevel <val>` Defines the reference level (in dBm)

Examples:

Long format:
`SENSE:RFLEVEL -30.0` Reference level set to -30.0 dBm

Short format
`SENS:RFL 10` Reference level set to +10 dBm

Scale `DISPlay:TRACe:Y <val>` Defines scale per div. (in dB)

Examples:

Long format:
`DISPLAY:TRACE:Y 10` Scale set to 10 dB per division

Short format:
`DISPL:TRAC:Y 20` Scale set to 20 dB per div.

Input attenuation `INPut:ATTenuation <val>` Sets the input attenuation (in dB)

Valid input attenuation values: 0, 10, 20, 30, 40 or 50 dB.

WARNING
Be careful with 0 dB. This value may damage the unit if the actual power is too high.

Examples:

Long format:
`INPUT:ATTENUATION 10` 10 dB attenuation

Short format:
`INP:ATT 20` 20 dB attenuation

Detector `SENSe:DETector:FUNCtion <enum>`
Sets the behavior of the detector

Valid entries for <val>: POSNeg, SAMPle, POSitive or NEGative.

Examples:

Long format:
SENSE:DETECTOR:FUNCTION POSITIVE — Positive sampling

Short format:
SENS:DET:FUNC NEG — Negative sampling

Trace SENSe:TRACe:<x> <enum> — Sets the trace behavior for trace A or B

<x> is the trace (A or B)

Valid entries for <enum> are: ACTual, MAXHold, MINHold, HOLD, AVG or OFF.

Examples:

Long format:
`SENSE:TRACE:A ACTUAL` — Normal trace for A

Short format:
`SENS:TRAC:B AVG` — Average trace for B

Marker `CALCulate:MARKer:<x>:X <val>` — Sets the marker frequency (in Hz)

<x> is the trace (A to D)

Examples:

Long format:
`CALCULATE:MARKER:B:X 98500000` — Marker B set to 98.5 MHz

Short format:
`CALC:MARK:A:X 1.2E09` — Marker A set to 1.2 GHz

`CALC:MARK:AOFF` — All markers disabled

`CALC:MARK:C:OFF` — Only marker C disabled

`CALC:MARK:MAXP` — Selected marker set to MaxPeak

`CALC:MARK:NPE` — Selected marker set to NextPeak

Measurements

Trace `SENSe:TRACe:<x>:FETCh? <enum>`
Reads the trace data in a definable format

<x> is the trace (A or B)

Valid entries for <enum>: ALL, MIN, MAX, FREQ, FMIN or FMAX.

Examples:

Long format:
`SENSE:TRACE:A:FETCH? ALL` All measured data requested

Short format:
`SENS:TRAC:B:FETC? MAX` Trace B (only MAX) requested

Format examples:

ALL: <min level>, <max level>, <freq>, <min level>, ...

MAX: <max level>, <max level>, ...

MIN: <min level>, <min level>, ...

FREQ: <freq>, <freq>, ...

FMAX: <max level>, <freq>, <max level>, <freq>, <max level>, ...

FMIN: <min level>, <freq>, <min level>, <freq>, <min level>, ...

Note: One trace contains 500 samples.

Sweep `SENSe:SWEep:STATe <enum>` Controls the sweep

Valid entries for <enum>: CONTinuous, SINGle or HOLD

Examples:

Long format:
`SENSE:SWEEP:STATE SINGLE` One sweep performed

Short format:
`SENS:SWE:STAT CONT` Repetitive sweeps started

Max Peak `CALCulate:MARKer:MAXPeak` Sets the marker to the maximum peak

Examples:

Long format:
`CALCULATE:MARKER:MAXPEAK` Marker set to max. peak

Short format:
`CALC:MARK:MAXP` Marker set to max. peak

Note: A marker must be activated first using the following command:
`CALC:MARKer:<x>[:STATE] {NORMal|DELTa|NOISe}`.

Next Peak `CALCulate:MARKer:NPEak` Sets the marker to the next highest peak

Examples:

Long format:
`CALCULATE:MARKER:NPEAK` Marker set to the next peak

Short format:
`CALC:MARK:NPE` Marker set to the next peak

Note: A marker must be activated first using the following command:
`CALC:MARKer:<x>[:STATE] {NORMal|DELTa|NOISe}.`

Marker level `CALCulate:MARKer:<x>:Y?` Reads the level at the actual marker position

<x> selects the trace (A to D)

Examples:

Long format:
`CALCULATE:MARKER:B:Y?` Marker B level requested

Short format:
`CALC:MARK:A:Y?` Marker A level requested

Marker frequency `CALCulate:MARKer:<x>:X?` Reads the actual marker frequency

<x> selects the trace (A to D)

Examples:

Long format:
`CALCULATE:MARKER:B:X?` Marker B frequency requested

Short format:
`CALC:MARK:A:X?` Marker A frequency requested

Others

Identity `*IDN?` Reads serial number of the instrument

Format returned: "<Manufacturer>, <Model>, <Serial number>, <Software version>"

Manufacturer: `Willtek`

Model: `9101`

Serial number: (seven digits)

Software version: `2.00` (for example)

Reset `*RST` Resets the unit

Example:

`*RST` Unit set to idle state

Error queue `SYST:ERR?` Queries the error queue

Format returned: <Error number>, "<Error description>"

If no error is present, 0,"No Error" is returned.

Note: The error queue can hold up to 10 error messages. Read always until the NO ERROR is given back.

Echo `SYST:COMM:ECHO <enum>` Enables/disables echo function

Range: ON or OFF.

Example:

`SYST:COMM:ECHO ON` Echo feature activated

Note: We recommend to always activate the echo. It gives back "OK" after a command was successfully executed or in case of errors "ERR".

The additional advantage of this is to create a kind of handshake mechanism.

Local mode `SYST:COMM:LOCAL` Switches unit back to local mode

Example:

`SYST:COMM:LOCAL` Remote session finished

Application examples

The below application examples use three subroutines which transmit a command (Output9100), read a result (Input9100) or send a command and read the acknowledgement (OutAck9100). These subroutines are not printed here but available from Willtek on request. The program examples are written in BASIC.

Signal monitoring

Task: Permanently monitor a signal and check if it is still present. The signal frequency is 97.3 MHz and the signal strength is around -40 dBm.

```
OutAck9100 ("SENS:FREQ:CENT 97300000")  ' set the center to the frequency
OutAck9100 ("SENS:FREQ:SPAN 2E06")      ' set span to 2 MHz

OutAck9100 ("SENS:REFL -30")            ' set a sensitive ref level
OutAck9100 ("INP:ATT 10")               ' set a low attenuation
OutAck9100 ("SENS:TRAC:A ACT")          ' activate an normal trace
OutAck9100 ("SENS:DET:FUNC POS")        ' use only positive samples

OutAck9100 ("CALC:MARK:AOFF")           ' switch all markers off
OutAck9100 ("CALC:MARK:A NORM")         ' activate marker A
SIG_FLAG = True

While SIG_FLAG = True
  OutAck9100 ("SENS:SWE:STAT SING")     ' do one measurement

  OutAck9100 ("CALC:MARK:A:X 97.3E06")  ' set marker to the signal

  Output9100 ("CALC:MARK:A:Y?")         ' read the signal level
  Lvl  = Val(Input9100())

  If Lvl < -45 Then SIG_FLAG = False    ' Signal lost
Wend

Print "Signal disappeared!!!"
```

Signal search

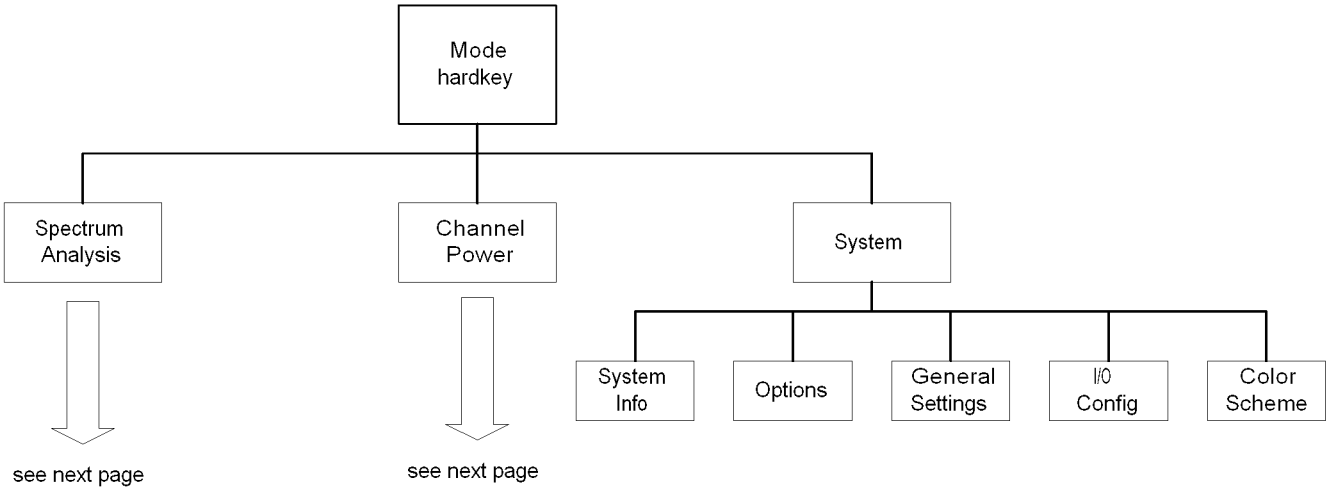
Task: Search for transmitters within a frequency band. If a signal is present and higher than a level of -80 dBm, the frequency is printed.

```
OutAck9100 ("SENS:FREQ:SPAN 2000000")    ' set span to 2 MHz
OutAck9100 ("SENS:FREQ:CENT 936000000")' start with channel 0

OutAck9100 ("SENS:REFL -40")                ' set a sensitive ref-level
OutAck9100 ("INP:ATT 0")                    ' remove any attenuation !!
OutAck9100 ("SENS:TRAC:A MAXH")             ' activate a max hold trace
OutAck9100 ("SENS:DET:FUNC POS")            ' use only positive samples

OutAck9100 ("CALC:MARK:AOFF")               ' switch all markers off

channel = 1
For I = 9360 To 9594 Step 18             ' scan the gsm band in small portions
   Msg$ = "SENS:FREQ:CENT" & Str$(I) & "00000"
   OutAck9100 (Msg$)                        ' set frequeny

   For J = 0 To 4
      OutAck9100 ("SENS:SWE:STAT SING")    ' do the measurements 5 times
   Next J

   Output9100 ("SENS:TRAC:A:FETC? MAX")
   MXdata$ = Input9100()                    ' read trace data

   For J = 0 To 499                         ' isolate the data into an array
      P = InStr(MXdata$, ",") ' search for the COMMA between two values
      Yfeld(J) = Val(Mid$(MXdata$, 1, P))
      MXdata$ = Right$(MXdata$, Len(MXdata$) - P)
                                            ' remove the actual value
   Next J

   For J = 45 To 445 Step 50
      P = -120
      For K = 0 To 8                        ' do a maximum search
         If Yfeld(J + K) > P Then
            P = Yfeld(J + K)                ' store the new maximum
         End If
      Next K

      If P > -80 And channel < 125 Then     ' blocked channel found
         Print "Channel " & Str$(channel) & " = " & Str$(P) & " dBm."
      End If
      channel = channel + 1
   Next J
Next I
```

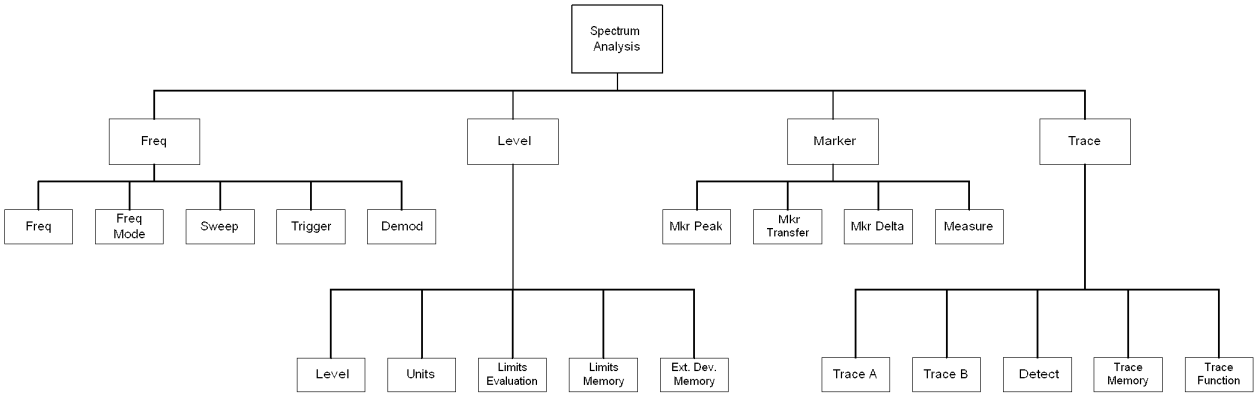
Menu Structure

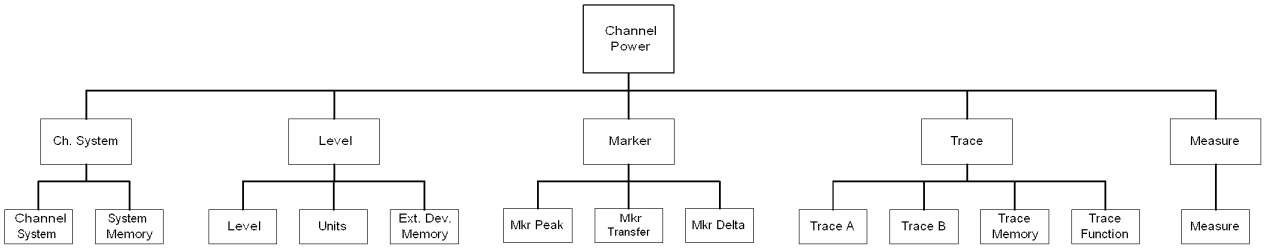
This appendix provides an overview of the menu structure of the 9101 Handheld Spectrum Analyzer.

Mode hardkey menus



Application menus





Index of SCPI Commands

B

*CAL 102
*CLS 103
*ESE 104
*ESR 105
*IDN 103
*OPC 103
*RST 103
*SRE 106
*STB 106
:CALCulate:{A|B|C|D}:MARKer:FSTep 138
:CALCulate:LIMit:FBEep 140
:CALCulate:LIMit:FCOunt 139
:CALCulate:LIMit:FCOunt:COUNt 140
:CALCulate:LIMit:FHOLd 140
:CALCulate:LIMit:SIMPle 140
:CALCulate:LIMit:SIMPle:LOWer 141
:CALCulate:LIMit:SIMPle:UPPer 141
:CALCulate:LIMit[:STATe] 139
:CALCulate:MARKer:{A|B|C|D}:X:TIMe 137
:CALCulate:MARKer:{A|B|C|D}:X[:FREQuency] 137
:CALCulate:MARKer:{A|B|C|D}:Y 137
:CALCulate:MARKer:{A|B|C|D}[:STATe] 136
:CALCulate:MARKer:AOFF 136
:CALCulate:MARKer:MAXPeak 138
:CALCulate:MARKer:MCENter 138
:CALCulate:MARKer:MREFlevel 139
:CALCulate:MARKer:NPEak 138
:CALCulate:MEASure:ACPR 141
:CALCulate:MEASure:CPOWer 142
:CALCulate:MEASure:OBW 141
:DISPlay:BACKlight 135
:DISPlay:BEEP 135
:DISPlay:COLor:GRATicule 135
:DISPlay:COLor:LIMits 136

:DISPlay:COLor:TRACe:[A|B] 135
:DISPlay:TRACe:Y[:SCALe] 134
:FORMat:ADELimiter 142
:FORMat:RESolution 142
:INPut:ATTenuation 125
:INPut:ATTenuation:AUTo 125
:INPut:EDEVice 126
:INPut:IMPedance 126
:INSTrument:SELect 134
:MMEMory:DELete:CHANnel 133
:MMEMory:DELete:CHANnel:ALL 133
:MMEMory:DELete:EDEVice 133
:MMEMory:DELete:EDEVice:ALL 134
:MMEMory:DELete:LIMit 132
:MMEMory:DELete:LIMit:ALL 133
:MMEMory:DELete:STATe 131
:MMEMory:DELete:STATe:ALL 132
:MMEMory:DELete:TRACe 132
:MMEMory:DELete:TRACe:ALL 132
:MMEMory:LOAD:CHANnel 131
:MMEMory:LOAD:EDEVice 131
:MMEMory:LOAD:FILelist:CHANnel 130
:MMEMory:LOAD:FILelist:EDEVice 130
:MMEMory:LOAD:FILelist:LIMit? 129
:MMEMory:LOAD:FILelist:STATe 129
:MMEMory:LOAD:FILelist[:TRACe] 129
:MMEMory:LOAD:LIMit 131
:MMEMory:LOAD:STATe 130
:MMEMory:LOAD:TRACe 130
:MMEMory:STORe:CHANnel 128
:MMEMory:STORe:EDEVice 128
:MMEMory:STORe:LIMit 127
:MMEMory:STORe:STATe 126
:MMEMory:STORe:TRACe 127
:REBoot 102
:SENSe:BANDwidth:RESolution 112
:SENSe:BANDwidth:RESolution:AUTo 112
:SENSe:BANDwidth:VIDeo 112
:SENSe:BANDwidth:VIDeo:AUTo 113
:SENSe:CPOWer:CHANnel 116
:SENSe:CPOWer:MEASure 116
:SENSe:CPOWer:OBW 116
:SENSe:CPOWer:SPAN 116
:SENSe:DEMod:DEMod 119
:SENSe:DEMod:DURation 119
:SENSe:DEMod:VOLume 118
:SENSe:DEMod[:MODulation] 119
:SENSe:DETector:FUNCtion 120
:SENSe:FREQuency:CENTer 113
:SENSe:FREQuency:FSTep 115
:SENSe:FREQuency:FSTep:AUTo 115
:SENSe:FREQuency:MODE 115
:SENSe:FREQuency:SPAN 113
:SENSe:FREQuency:SPAN:FULL 114

:SENSe:FREQuency:STARt 114
:SENSe:FREQuency:STOP 114
:SENSe:MEASure 124
:SENSe:MEASure:ADJSettings 125
:SENSe:MEASure:CHANnel:SPACing 124
:SENSe:MEASure:CHANnel:WIDTh 124
:SENSe:MEASure:OBW 124
:SENSe:REFLevel 123
:SENSe:REFLevel:UNIT 123
:SENSe:STATe 123
:SENSe:SWEep:STATe 117
:SENSe:SWEep:TIME 117
:SENSe:SWEep:TIME:AUTO 117
:SENSe:TRACe:A:FETCh 121
:SENSe:TRACe:A[:STATe] 120
:SENSe:TRACe:AVGFactor 122
:SENSe:TRACe:B:FETCh 122
:SENSe:TRACe:B[:STATe] 121
:SENSe:TRACe:CLEar 122
:SENSe:TRACe:COPY 122
:SENSe:TRIGger 118
:SENSe:TRIGger:EDGE 118
:SENSe:TRIGger:LEVel 118
:SERVice:BATTery 143
:SERVice:BOOTversion 143
:SERVice:CHECk:LAST 143
:SERVice:CHECk:NEXT 144
:SYSTem:COMMunicate:ECHo 108
:SYSTem:COMMunicate:ETHernet:IPADdress 108
:SYSTem:COMMunicate:ETHernet:PORT 109
:SYSTem:COMMunicate:ETHernet:TERMinator 109
:SYSTem:COMMunicate:ETHernet:TNAMe 108
:SYSTem:COMMunicate:LOCal 107
:SYSTem:COMMunicate:SER:BAUDrate 109
:SYSTem:COMMunicate:SER:TERMinator 110
:SYSTem:DATE 107
:SYSTem:DNAMe 111
:SYSTem:ERRor:CODE:ALL 111
:SYSTem:ERRor:CODE[:NEXT] 111
:SYSTem:ERRor:COUNt 110
:SYSTem:ERRor[:NEXT] 110
:SYSTem:TIME 107

Typical Application Examples

C

This appendix describes typical applications of spectrum analysis and how to solve a concrete measurement task. The topics discussed in this appendix are as follows:

- "Taking measurements on a sine wave signal" on page 168
- "Taking measurements on a burst or clocked signal" on page 172
- "Analyzing spurious signals, temporary spikes and glitches" on page 175

Taking measurements on a sine wave signal

A sine wave is a typical signal being measured because it appears at many places in radio and electronic equipment. For example, a sine wave is the basic signal from which clock signals in computers are generated. Also, two sine waves can be the product of a carrier and a modulating audio tone.

Typical parameters of the sinusoidal (sine waveform) signal are level, frequency, and harmonics. These can be easily measured with the Willtek 9101 Handheld Spectrum Analyzer.

Frequency and level measurements

The correct frequency is vital for radio and computer equipment to work properly. For computers, a deviation of 10% may be tolerable, but radio signals must apply frequencies with a tolerance of less than 1%.

In most cases it is also important that the level (power or voltage) of the sine wave is at least in the right order of magnitude. Before being able to take a measurement, the spectrum analyzer must be set up to display the signal in the right frequency range and with optimum reference level and attenuation.

In order to view a specific frequency range, for example close around the carrier frequency of the signal to be measured, the horizontal scale can be adjusted. The frequency range measured and displayed is usually called frequency span.

Any signal has its own amplitude. A very large signal may exceed the upper limit of the display, while a very low signal may be hidden in the noise floor at the bottom end of the display. The noise floor comes from the fact that any spectrum analyzer has a limited dynamic range, that is the range between the lowest and highest signal it can measure accurately. To reach the best dynamic range for the signal that you want to measure, it is important to adjust the reference level, that is the level at the top of the display. Most spectrum analyzers automatically adjust the internal attenuation when the user selects the reference level, so that the analyzer shows the best possible level range for the selected reference level.

Let's assume that we expect a sine wave signal at 10 MHz. This frequency is comparatively low and it is sufficient to view the spectrum from 0 to 20 MHz which narrows down the displayed spectrum to the significant range and provides a reasonable frequency resolution. If the expected sine wave frequency is significantly higher, it is more useful to select a range of a couple of Megahertz around this frequency.

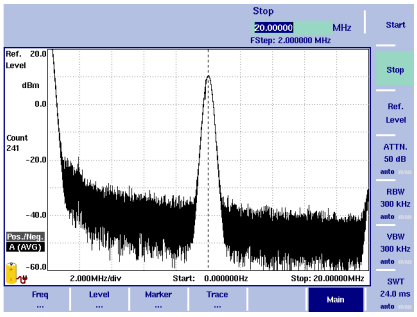
The following steps help to analyze the signal frequency and level:

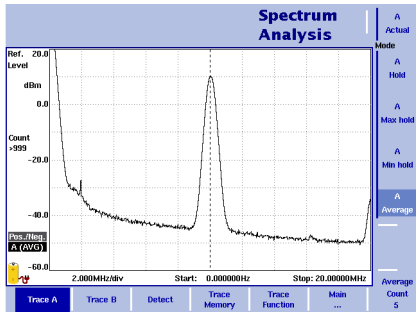
1 Press **PRESET** to set the 9101 to a known state.
The start and stop frequencies are 0 and 3.6 GHz, respectively, so the spectrum in this range is visible, with a line representing the sine wave signal at 10 MHz.

2 Set the stop frequency to 20 MHz by pressing the **Stop** softkey, entering **20** on the numerical keypad and pressing the **MHz** hardkey.
A signal curve appears in the right half of the display, with the peak at 10 MHz. This is a view of the signal at a higher resolution of the bandwidth.

3 It may be necessary to enhance the dynamic range displayed on the screen by adjusting the reference level (the maximum displayed level); this sets the internal attenuation of the 9101 accordingly:
Press the **Ref. Level** softkey and push the **UP/DOWN** cursor keys so that the signal peak appears about 5 to 10 dB below the top.
This leaves enough margin for temporary changes of the signal level.

4 You may see a relatively high noise floor. This can be decreased by averaging the measurements: Select **Trace > Mode: A Average**.

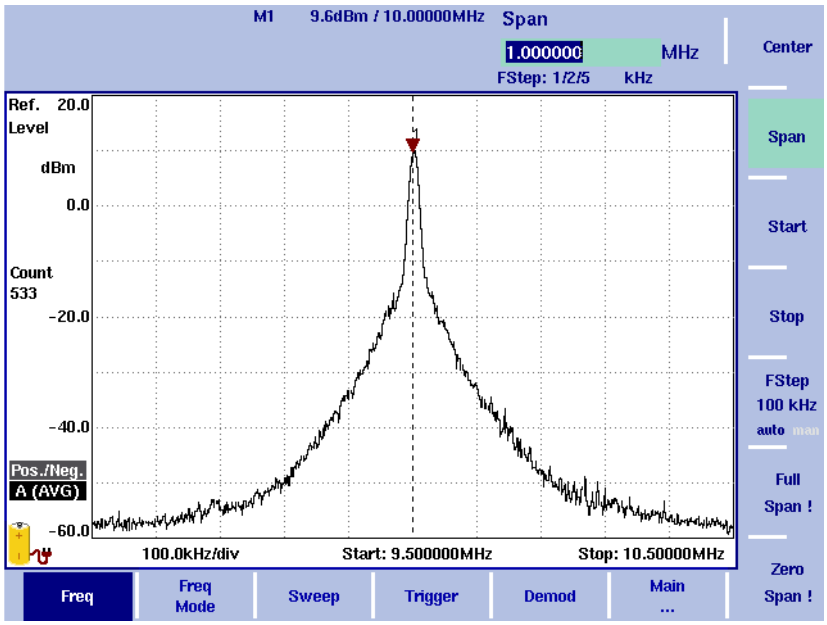




5 One or several markers can be set to point to individual frequencies of the measured spectrum. The numerical values for level and frequency at these points are displayed at the top:
Push the **MKR** hardkey to set a marker at the highest peak.
If no higher signals are present, this will set a marker, indicated by a small triangle, at the peak of the signal to be measured.

6 If you need the frequency displayed with higher accuracy, select a smaller frequency span (range) around the signal:

- Press **Marker to Center**.
  This centers the signal on the display.
- Press hardkey **SPAN** and enter a lower value, e.g. 1 MHz.



Spurious and harmonics

Side waves appear when the sine wave signal is of low spectral purity. In extreme cases, the signal has many strong side waves because the signal isn't really a sine wave but e.g. a square wave. The signal is then composed of a main wave and side waves that are also called harmonics. These harmonics may be multiples of the main wave or multiples of a modulating frequency. This means they can be in the range of 100 kHz around the carrier or may be multiples of the original frequency.

While a square wave generates wanted harmonics, unwanted side waves are called spurious emissions.

Frequencies with harmonics can best be tracked with the markers. Markers point to a displayed frequency (and level), so the resolution at which a point on the measurement curve is measured depends on the frequency resolution on the screen. The smaller the frequency span, the higher the frequency resolution on the display and hence of the marker. When reducing the span, it can be a good idea to readjust the markers to benefit from the higher frequency resolution.

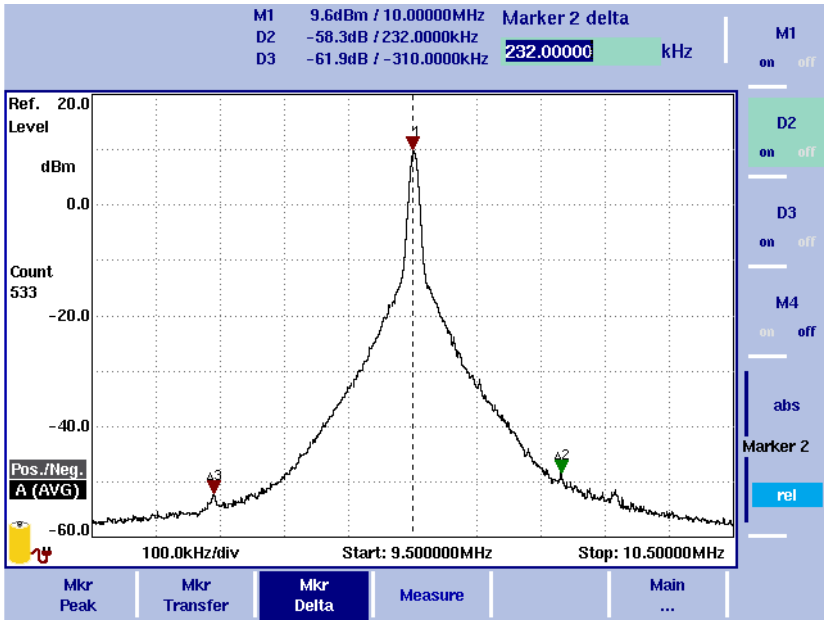
To check spurious emissions and harmonics, proceed as follows (from the last example):

1 Select a small frequency span (range) of ±250 kHz around the signal:
   - Press **MKR > Marker to Center**.
     This centers the signal on the display.
   - Press hardkey **SPAN** and enter a lower value, e.g. 500 kHz.

2 Add markers and place them on the next significant peaks (several dB above the slope of the signal):
   - Press the **MKR** hardkey.
   - Press softkeys **M2**, followed by several pushes on **Next Peak** until the marker is on the next significant peak.
   - Press softkeys **M3**, followed by several pushes on **Next Peak** until the next significant peak is reached.

3 Turn the absolute markers M2 and M3 into delta markers indicating values relative to marker M1:
   - Press softkeys **Mkr Delta > Marker 3: rel**.
   - Press softkeys **M2 > Marker 2: rel**.

4 Check the spectrum and the markers: Are additional peaks high enough to seriously affect the signal quality? How high are they relative to the main signal (sine wave)? The pass/fail criteria for the spurious emissions depend on the actual signal requirements.

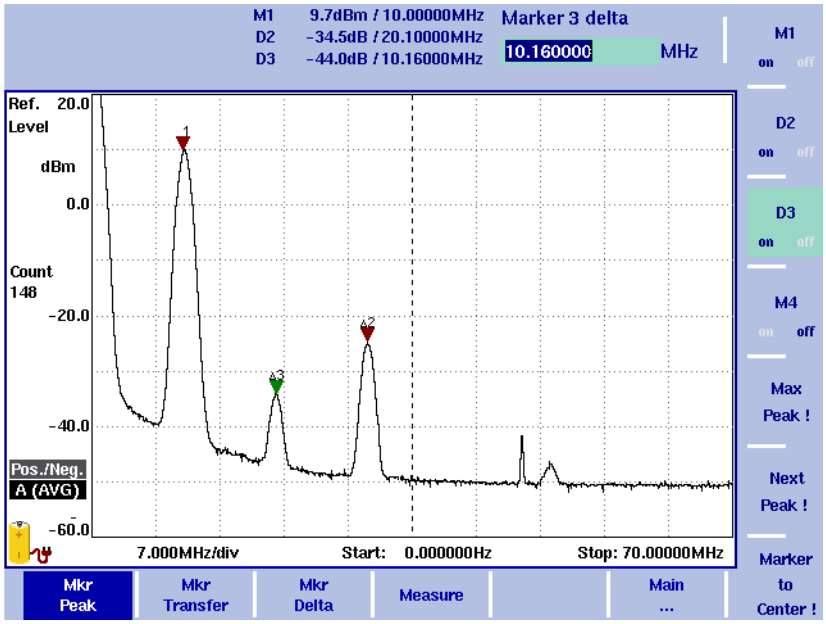


5 Select a larger frequency span of at least five times the original signal to observe harmonics:
Select **SPAN**, enter **70** and close the input field with the **MHz** key.

6 Place delta markers D2 and D3 on the second and third significant peak:

- Press hardkey **MKR** > **D2 > Max Peak > Next Peak** (repeat **Next Peak** if the peak found does not differ much from the surrounding level).
- Press **D3 > Max Peak > Next Peak > Next Peak** (repeat **Next Peak** if the peak found does not differ much from the surrounding level).

7 Check the spectrum and the markers: Are additional peaks high enough to seriously affect the signal quality? How high are they relative to the main signal (sine wave)? The pass/fail criteria for the harmonics emissions depend on the actual signal requirements.



Taking measurements on a burst or clocked signal

Burst or clocked signals combine the characteristics of modulated signals with those of discontinuous signals. Modulated signals, on the one hand, have a wider spectrum that may vary to a certain extent. On the other hand, discontinuous signals appear and disappear, so the right moment for taking measurements is important.

The spectrum of a modulated signal does not have a constant, single peak but consists of a wider lobe (e.g. about 50 kHz for a typical FM radio signal, 800 kHz for a GSM signal or 1.2 MHz for an IS-95 CDMA signal). As the information transmitted on the carrier isn't always the same, the spectrum slightly varies. So if the typical spectrum is of importance, it is a good idea to average the spectrum measurements. If, however, the worst-case spectral components shall be measured, you will want to view the peaks from several spectrum measurements and hence the max-hold mode should be selected.

Periodic, discontinuous signals can be measured, but require additional settings to ensure that the measurements include the active part of the signal; otherwise the Willtek 9101 Handheld Spectrum Analyzer could measure during time intervals when the signal is not present. – In addition to the modulation spectrum, the burst length and shape are important parameters. These can be measured in the time domain, not in the frequency domain.

The following considerations should be made when measuring time-domain parameters:

- Measuring in the time domain means that the spectrum analyzer displays the signal over time, not over frequency, that means the frequency span is zero.
- The start of the measurement should be triggered by the rising edge of the signal, that means a signal level threshold must be defined that is above the noise floor and below the level when the signal is active (on).
- The duration of the measurement (sweep time) must be equal to or exceed the length of the burst, otherwise only a part of the burst will be shown.

Measuring frequency-domain parameters requires slightly different considerations when setting up the spectrum analyzer:

- Defining a video trigger in the frequency domain makes no sense because the frequency observed by the spectrum analyzer is changing permanently.
- The duration of the measurement (sweep time) should be so high that for each measurement point, the interval of at least two bursts is measured to ensure that the measurement includes the wanted signal. Note that the spectrum measured this way includes both modulation and switching components.

The following example is the measurement of a burst signal from a GSM mobile phone transmitting on channel 63, that means on a carrier frequency of 902.6 MHz. The signal level at the input of the 9101 Handheld Spectrum Analyzer is –10 dBm.

To take measurements, proceed as follows:

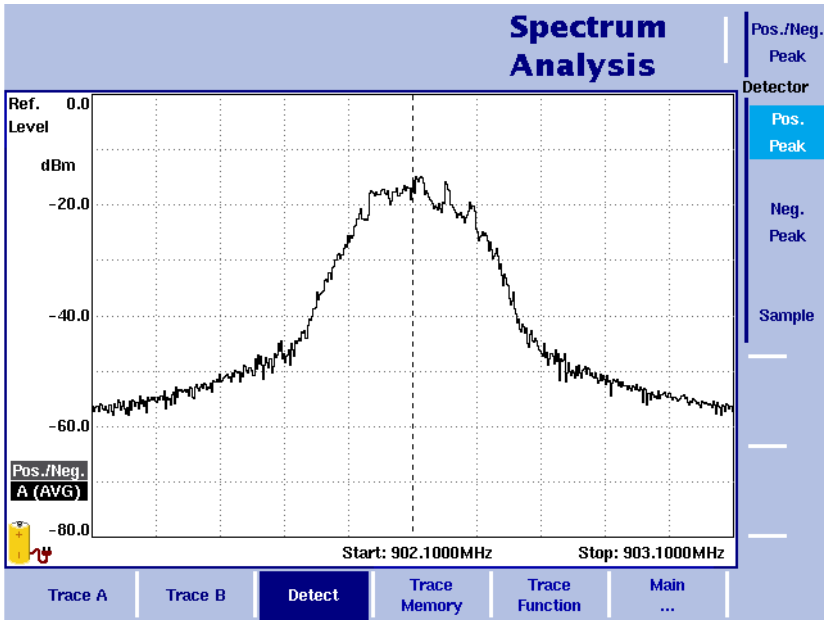
1 Press **PRESET** to set the 9101 to a known state.
The start and stop frequencies are 0 and 3.6 GHz, respectively.

2 Press hardkey **CENT** and enter the center frequency of 902.6 MHz.

3 Press hardkey **SPAN** and enter a span of 1 MHz.
A chopped version of the spectrum appears.

4 Change the sweep time to the maximum: Select **Main > SWT** and enter 5 s.
The spectrum appears; the positive/negative peak detector is enabled and thus the display shows both values with a black line between peaks for each frequency point.

5 To eleminate the black lines, select the positive peak detector: Press **Trace > Detect > Detector: Pos. Peak**.
A curve appears as shown below.



6 To measure the level over time, press **SPAN** and select 0 MHz.

7 Set a measurement bandwidth that includes the significant spectrum components: Press **Main > RBW** and enter 1 MHz.

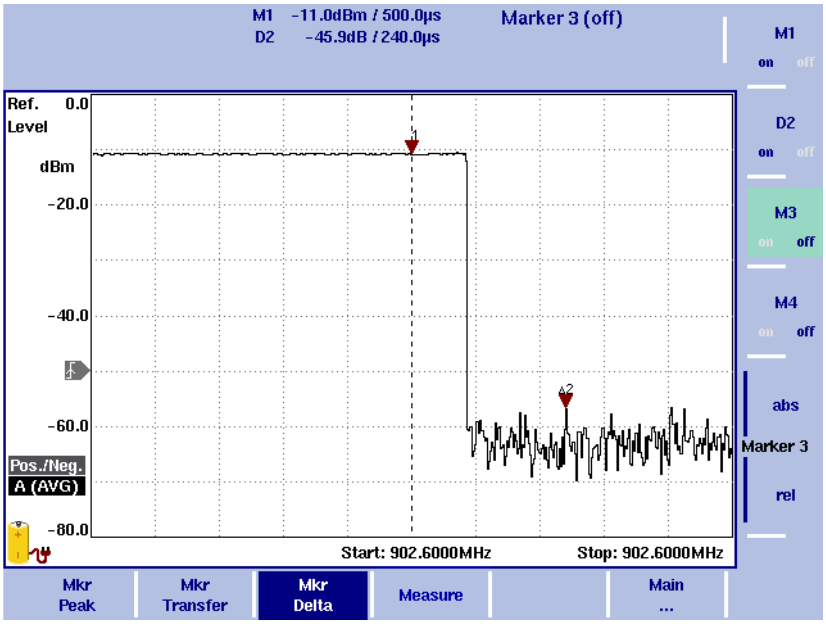
8 Select a sweep time slightly higher than the burst length: Press **Main > SWT** and select 1 ms.

9 Set the video bandwidth to a high level to avoid smoothing to corrupt the signal shape: Press **VBW** and enter 1 MHz.
Burst measurements appear in arbitrary intervals.

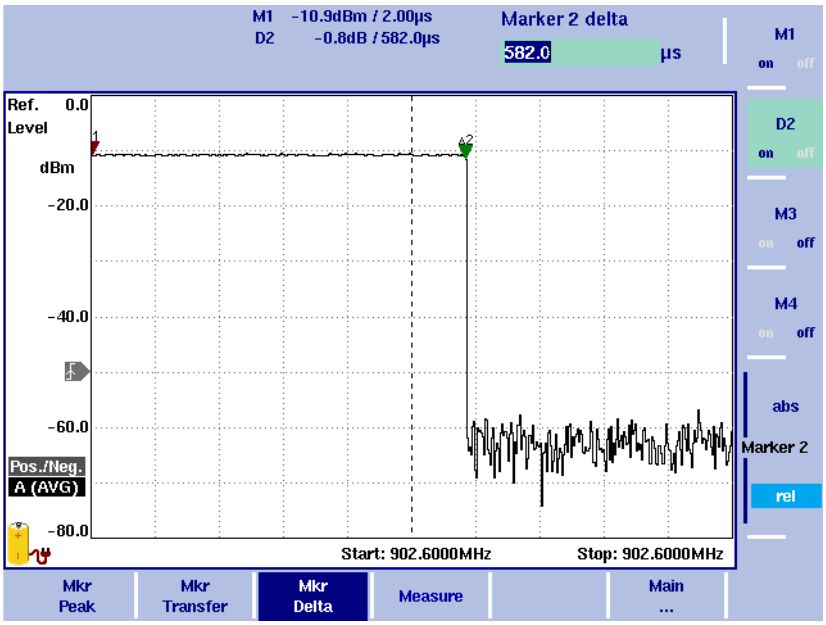
10 Enable the video trigger with a trigger threshold of about 40 dB below the burst level: Press **Freq > Trigger > Video** and enter –50 dBm.
Burst measurements appear frequently.

11 Burst flatness: Use a marker and a delta marker to view variations of the power level in the active part of the burst.

12 Burst versus noise level: Use a marker and a delta marker to view the difference between the signal level and the noise level (in the picture below, the difference is 45.9 dB).



13 Burst length: Place a marker at the beginning of the burst and a delta marker at the end of the burst. Read the burst length (582 µs in the example below).



Analyzing spurious signals, temporary spikes and glitches

Spurious signals are components close to or far from the desired frequency band. They are part of the overall signal, although usually outside the frequency range containing the desired signal, and can originate from crosstalk or active components in the electronics.

Temporary spikes and glitches result in spectrum components that may not be observed immediately on the spectrum analyzer. It takes some time and a peak-hold function to get them onto the screen.

Spurious signals and temporary spikes may be tolerable within certain limits, but may harm system performance when they exceed the limits. On the 9101, limit lines can be used to mark go/nogo areas and a pass/fail verdict clearly indicates if the signal is inside or outside limits.

Markers and delta markers can indicate the frequencies at which critical signal components occur and can be used to read absolute levels as well as levels relative to the main signal component.

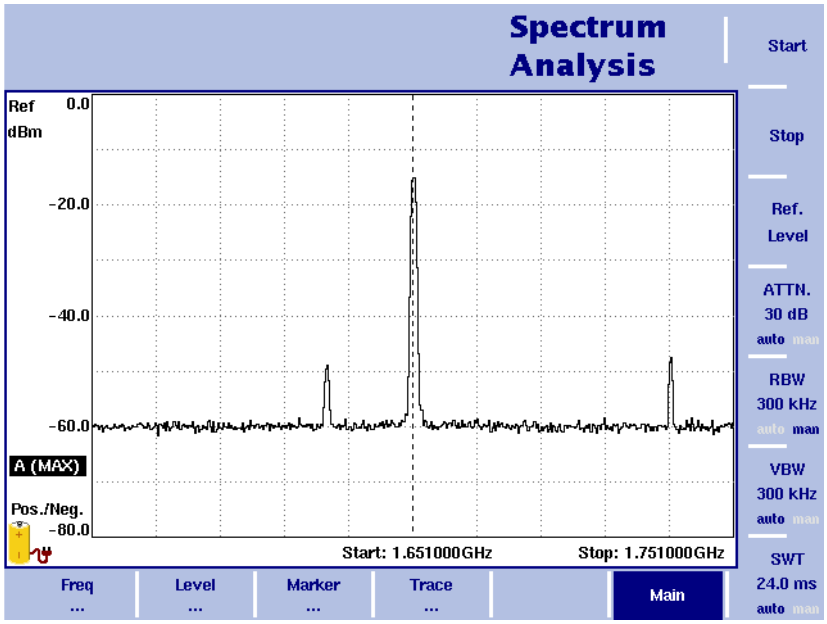
These unwanted signal components can be analyzed as follows:

1 Press **PRESET** to set the 9101 to a known state.
The start and stop frequencies are 0 and 3.6 GHz, respectively.

2 Press **CENT** and enter the center frequency of the signal to be observed.

3 Press **SPAN** and enter a frequency range to be observed, e.g. 100 MHz.

4 Select **Main > Trace > Mode: A Max hold** to catch intermittent signals.
After some time, the display may look like as follows (wanted signal at the center frequency, two spurious or unwanted signals).

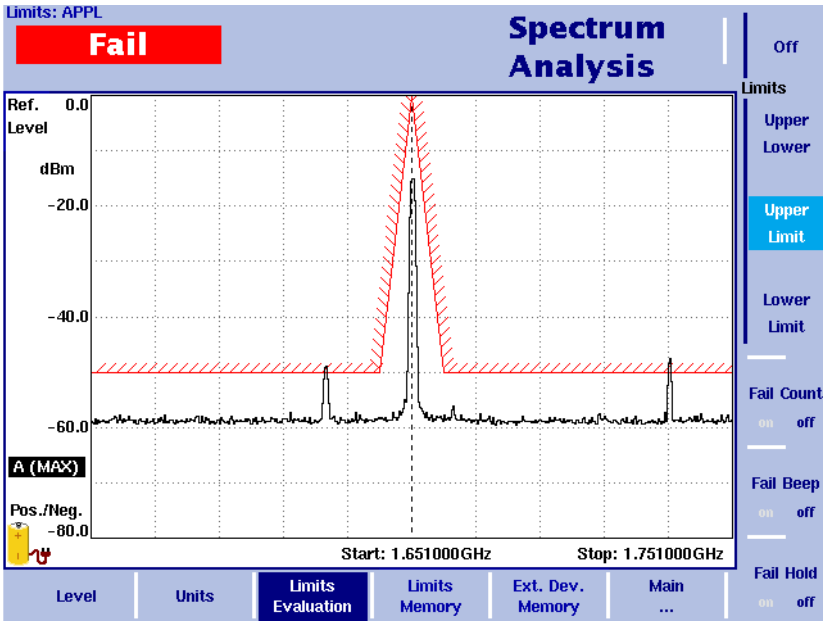


5 If you need this measurement frequently, it might be a good idea to define a template, that means limit lines. These can form the basis for a clear pass/ fail statement that is easy to read and understand.
The limit lines (template) can be defined on a PC, see section "91xx Data Exchange Software" on page 83.

6 To load the template (limit lines) from the PC to the 9101, first save it locally on the PC and then push the **Send to 91xx** button.

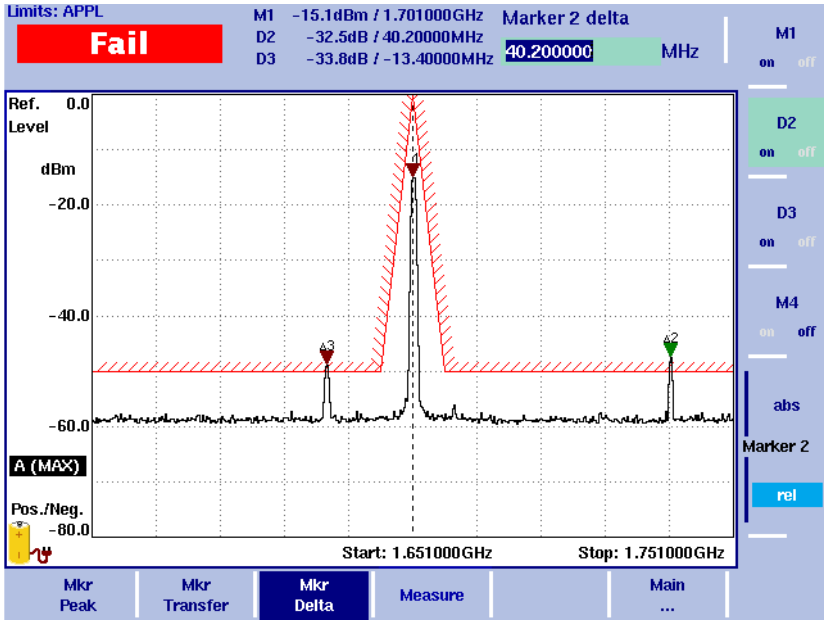
7 Press **Level > Memory > Recall Limits** to select one out of a number of available templates.

8 Select **Limits Evaluation > Upper Limit** to enable the limits (upper limit). The template or upper limit is drawn and the 9101 displays a pass or fail indication at the upper left-hand corner.



9 Enable markers and place them on the wanted signal and the spurious signals: Press hardkey **MKR** to enable the marker menu and the first marker, which is placed on the highest peak. Press **M2** and move it to the spurious signal by pressing **Next Peak** several times. Repeat this step with **M3** and the next spurious signal.
Frequency and level of the spuriuos signals are indicated at the top.

10 In the Mkr Delta menu, enable delta markers for M2 and M3 (softkey **rel**). You can now view the frequency and level of each spurious signal relative to the wanted signal, which is required in many specifications and signal comparisons.


Limits: APPL
Fail
M1 -15.1dBm / 1.701000GHz
D2 -32.5dB / 40.20000MHz
D3 -33.8dB / -13.40000MHz
Marker 2 delta
40.200000 MHz
M1
on off
D2
on off
D3
on off
M4
on off
abs
Marker 2
rel
Ref. 0.0
Level
dBm
-20.0
-40.0
-60.0
A (MAX)
Pos./Neg.
-80.0
Start: 1.651000GHz
Stop: 1.751000GHz
Mkr Peak
Mkr Transfer
Mkr Delta
Measure
Main ...

Warranty and Repair

D

This chapter describes the customer services available through Willtek. Topics discussed in this chapter include the following:

- "Warranty information" on page 180
- "Equipment return instructions" on page 181

Warranty information

Willtek warrants that all of its products conform to Willtek's published specifications and are free from defects in materials and workmanship for a period of one year from the date of delivery to the original buyer, when used under normal operating conditions and within the service conditions for which they were designed. This warranty is not transferable and does not apply to used or demonstration products.

In case of a warranty claim, Willtek's obligation shall be limited to repairing, or at its option, replacing without charge, any assembly or component (except batteries) which in Willtek's sole opinion proves to be defective within the scope of the warranty. In the event Willtek is not able to modify, repair or replace nonconforming defective parts or components to a condition as warranted within a reasonable time after receipt thereof, the buyer shall receive credit in the amount of the original invoiced price of the product.

It is the buyer's responsibility to notify Willtek in writing of the defect or nonconformity within the warranty period and to return the affected product to Willtek's factory, designated service provider, or authorized service center within thirty (30) days after discovery of such defect or nonconformity. The buyer shall prepay shipping charges and insurance for products returned to Willtek or its designated service provider for warranty service. Willtek or its designated service provider shall pay costs for return of products to the buyer.

Willtek's obligation and the customer's sole remedy under this hardware warranty is limited to the repair or replacement, at Willtek's option, of the defective product. Willtek shall have no obligation to remedy any such defect if it can be shown: (a) that the product was altered, repaired, or reworked by any party other than Willtek without Willtek's written consent; (b) that such defects were the result of customer's improper storage, mishandling, abuse, or misuse of the product; (c) that such defects were the result of customer's use of the product in conjunction with equipment electronically or mechanically incompatible or of an inferior quality; or (d) that the defect was the result of damage by fire, explosion, power failure, or any act of nature.

The warranty described above is the buyer's sole and exclusive remedy and no other warranty, whether written or oral, expressed or implied by statute or course of dealing shall apply. Willtek specifically disclaims the implied warranties of merchantability and fitness for a particular purpose. No statement, representation, agreement, or understanding, oral or written, made by an agent, distributor, or employee of Willtek, which is not contained in the foregoing warranty will be binding upon Willtek, unless made in writing and executed by an authorized representative of Willtek. Under no circumstances shall Willtek be liable for any direct, indirect, special, incidental, or consequential damages, expenses, or losses, including loss of profits, based on contract, tort, or any other legal theory.

Equipment return instructions

Please contact your local service center for Willtek products via telephone or web site for return or reference authorization to accompany your equipment. For each piece of equipment returned for repair, attach a tag that includes the following information:

- Owner's name, address, and telephone number.
- Serial number, product type, and model.
- Warranty status. (If you are unsure of the warranty status of your instrument, include a copy of the invoice or delivery note.)
- Detailed description of the problem or service requested.
- Name and telephone number of the person to contact regarding questions about the repair.
- Return authorization (RA) number or reference number.

If possible, return the equipment using the original shipping container and material. Additional Willtek shipping containers are available from Willtek on request. If the original container is not available, the unit should be carefully packed so that it will not be damaged in transit. Willtek is not liable for any damage that may occur during shipping. The customer should clearly mark the Willtek-issued RA or reference number on the outside of the package and ship it prepaid and insured to Willtek.

Software License

E

This chapter contains the license conditions for use of the 9101 Handheld Spectrum Analyzer and the 91xx Data Exchange Software.

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Publication History

Revision	Comment
0303-100-A	First revision.
0312-210-A	Redesigned user interface; channel power measurements, AM/FM demodulation, video trigger, limit template, additional marker functions added.
0404-220-A	New features of software version 2.20; new chapters Spectrum Analysis and Channel Power Operation, Menu Structure, Typical Application Examples.
0406-221-A	Additional battery icons; IP address of PC not required; maximum input power level must not exceed 30 dBm at any attenuator setting.
0409-221-A	New chapters: Troubleshooting and Updating the Instrument's Software.

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