

4400 Mobile Phone Tester Series 1xEV-DO Options



User's guide
Version 12.20

boosting wireless efficiency

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Ordering information This guide is issued as part of Willtek's **1xEV-DO Options**. The ordering number for a published guide is M 294 287. The ordering number for the product depends on the model of the 4400 Series as follows:

Table 1 Order numbers for the 4400 Series

Description	Order number
Willtek 4403 Mobile Phone Tester	M 101 105
Willtek 4405 Mobile Phone Tester	M 101 104
Willtek 4452 1xEV-DO Non-Call Mode Option	M 897 287
Willtek 4453 1xEV-DO Call Mode Option	M 897 288
Willtek 4479 Baseband Processing Hardware	M 248 690

Compliance statements This manual refers to the 1xEV-DO Options software. For hardware compliance with any national regulations, please refer to the getting started manual that was delivered with your 4400. The specifications for the product can be found in the data sheet.

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Index of the 1xEV-DO Options

["Safety Notes"](#) – Read before starting!

["Overview"](#) – Crash course, cabling, menus and levels, fields, parts, help on help

["Call Mode"](#) – Testing a mobile phone in service mode

["Non-Call Mode"](#) – Description of the tests and systems which can be tested using call setup

["Tools"](#) – Description of the available tools

["RAPID!"](#) – Introduction, syntax, language elements, error messages

["SCPI"](#) – General introduction and structure

SCPI Command Reference – The commands for the 1xEV-DO Options

["Warranty and Repair"](#) – Just in case that your unit should need fixing

NOTE

This manual covers all presently known variants of the Willtek 4400 Mobile Phone Tester Series: 4400M, 4400S, 4403, 4405, 4407. The manual refers to all members of the Willtek 4400 series simply as the 4400.

Purpose and scope

The purpose of this guide is to help you successfully use the 1xEV-DO Options features and capabilities. This guide includes task-based instructions that describe how to install, configure, use, and troubleshoot the 1xEV-DO Options. Additionally, this guide provides a description of Willtek's warranty, services, and repair information.

Assumptions

This guide is intended for novice, intermediate, and experienced users who want to use the 1xEV-DO Options effectively and efficiently. We are assuming that you have basic computer and mouse experience and are familiar with basic telecommunication concepts and terminology.

Related information

Use this guide in conjunction with the following information:

4400 getting started manual, order number M 295 011

Technical assistance

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

Table 1 Technical support

Region	Phone number	Fax number, e-mail address
Europe, Middle East, Asia, Africa	+49 (0) 89 996 41 311	+49 (0) 89 996 41 440
Americas	+1 973 386 9696	+1 973 386 9191
China	+86 21 5836 6669 +86 21 5835 8039	+86 21 5835 5238

Conventions

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

Table 2 Typographical conventions

Description	Example
User interface actions appear in this typeface .	Push the BS Call softkey.
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]

Table 2 Typographical conventions (Continued)

Description	Example
In conjunction with the GUI, square brackets [] indicate a marker tab.	Push [Gen. Off]
In conjunction with RAPID! or SCPI commands, square brackets [] indicate an optional argument.	login [platform name]
Slanted brackets < > group required arguments.	<password>

Table 3 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 4 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 5 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 4400 Series Mobile Phone Tester. Topics discussed in this chapter include the following:

- ["Before startup" on page xviii](#)
- ["During test" on page xviii](#)
- ["During maintenance and repair" on page xviii](#)
- ["Shutdown when defective" on page xix](#)

Before startup



Ensure proper supply voltage

Before powering on, ensure that the operating voltage which is permitted for the 4400 ($115\text{ V} \pm 20\%$ or $240\text{ V} \pm 20\%$) is identical with your line voltage. You do not need to set the voltage range; the 4400 automatically adjusts to the applied (permissible) line voltage.

The power plug of the 4400 may only be inserted in outlets with a ground contact.

Never use extension cables without grounding conductor.



Apply proper grounding

The grounding conductor must under no circumstances ever be interrupted, neither inside nor outside the test set. If there is no grounding through the grounding conductor, the cabinet of the 4400 could become live as the result of a defect. This can make the test set a potential risk.

During test



Apply proper grounding

Always plug in the power socket of the 4400 before connecting a test circuit in order to use the protective effect of the 4400 grounding.

During maintenance and repair

Live parts can be exposed when you open covers or remove components. Connecting parts can also be live.



Live parts with and without supply voltage connected

Before any adjustment, maintenance repair or replacement of parts, the test set must be separated from all voltage sources if it will be necessary to open it. If any jobs have to be performed on the 4400 while voltage is applied, they should only be undertaken by a specialist who is aware of the dangers that are involved. Capacitors in the power supply can still be charged, even though the instrument has been separated from all voltage sources.



High voltages during battery operation

High and dangerous voltages can still be present in the instrument even when it is being powered from a battery.



Use proper fuses

Defective fuses must be replaced with fuses of identical specifications. Never patch fuses or short the fuse holder.

Shutdown when defective

In the following cases, safe operation is very likely to be no longer possible:

- if the test set exhibits visible damage,
- if the test set will no longer work,
- after a longish period of storage under the wrong conditions (see data sheet),
- following transport under adverse conditions.

If you suspect that it is unsafe to continue operating the 4400, shut it down immediately and pull out all power connectors.

Secure the test set in such way that nobody else can start it up again, in order to protect any third party.

Get in touch with your nearest Willtek service center.

Overview

1

This chapter provides a general description of the 4400 Series Mobile Phone Tester. Topics discussed in this chapter include the following:

- ["About the 4400" on page 2](#)
- ["What's new" on page 3](#)
- ["Compatibility" on page 3](#)
- ["Connecting test leads" on page 4](#)
- ["The front and rear panels" on page 6](#)
- ["Menus and levels" on page 21](#)
- ["Menu fields" on page 23](#)
- ["Help on Help" on page 28](#)
- ["Accessories and options" on page 29](#)

About the 4400

The Willtek 4400 Mobile Phone Tester Series has been designed to meet the needs and requirements of service, manufacturing, quality assurance and engineering facilities. For all these areas, accuracy is the key and the 4400 provides exceptional value (superb VSWR and accuracy). For manufacturing, speed is an additional key requirement.

The 4400 features two different operating modes: The **synchronous mode (call mode)** provides call processing with multiband handovers for fast measurements in different frequency bands. The **asynchronous mode (non-call mode)** is dedicated to the board-level alignment, providing generator and analyzer capabilities.

The 4400 series of products provides solutions for:

- CDMA, AMPS (4447 CDMA2000 1xRTT Non-Call Mode Option, 4448 CDMA2000 1xRTT Call Mode Option),
- 1xEV-DO (4452 1xEV-DO Non-Call Mode Option, 4453 1xEV-DO Call Mode Option)
- GSM (4458 GSM Non-Call Mode Option, 4457 GSM Call Mode Option),
- GPRS (4454 GPRS Non-Call Mode Option, 4462 GPRS Call Mode Option),
- EGPRS (4449 EDGE Non-Call Mode Option, 4468 EDGE Call Mode Option),
- WCDMA/UMTS (4466 WCDMA Non-Call Mode Option, 4467 WCDMA Call Mode Option),
- TD-SCDMA (4450 TD-SCDMA Non-Call Mode Option, 4451 TD-SCDMA Call Mode Option).

The built-in programming tool **RAPID!** allows for easy test automation. Default standard test routines are already stored on the machine, and more enhanced sequences are available (as options).

RAPID! even allows for data input from bar code readers or the control of other external devices. For example, the ability to send AT commands to a cellular phone enables completely automatic testing. Results can be easily documented through screen dumps to an attached printer or file storage. The numerical data of graphs can be read out via GPIB or written to a floppy disk.

Since requirements for the different application areas are different, the 4400 provides a wide range of various options:

The **4470 Audio Option** allows for acoustical measurements and supports dedicated vocoders (speech codecs).

The **4473 MS Power Supply Option** works as a battery replacement for terminals.

The **4474 Current Measurement Option** allows for easy calculation of standby or talk times.

What's new

- New in version 12.20** Supports MEID in the CDMA option.
Full support of the TD-SCDMA Call Mode Option.
- New in version 12.10** Supports 1xEV-DO options
Handover capability between GSM 900/1900 and GSM 850/1800 added
Includes first features of the TD-SCDMA Call Mode Option
- New in version 12.00** WCDMA Option:
- Inner Loop Power Control
 - Open Loop Power Control
 - Code Domain Spectrum with Code Domain Power and Peak Code Domain Error (PCDE)
 - Support of all Reference Measurement Channels: 12.2 kbps, 64 kbps, 144 kbps and 384 kbps.
- TD-SCDMA System Option (non-call mode):
- Code Domain Spectrum and RX/TX switch
- GSM System Option:
- Non-residual BER measurement with CRC check.

Compatibility

From serial number 0911001 onwards, the Willtek 4400 is equipped with an enhanced PC Controller that not only offers standard USB and Ethernet interfaces, but also support for some of the system options. However, older units may be upgraded any time (see [page 30](#) for details).

As a consequence, all sections of this manual that are only dedicated to 4400s with a serial number above 0911001 are also valid for all 4400s with a lower serial number that have the enhanced PC Controller installed.

Connecting test leads

[Crash course](#) – Starting a test is easy!

[Cabling](#) – Connecting a mobile to the 4400

Crash course To perform a test on the 4400, keep to the following procedure:

- 1 Check that the 4400 is connected to mains and that its power switch on the rear panel is in its **I** position.
- 2 Switch on the 4400 by pushing the **On** button on the front panel.
- 3 Select the required communication system, e.g. GSM, EVDO or CDMA, and press the **Calls & Meas.** softkey.
- 4 Connect the mobile to the 4400.
- 5 Switch on the mobile and set up a call.
- 6 Navigate to the required test menu.



Don't exceed the maximum RF power level

Before connecting any RF equipment to the 4400, please check that the maximum input power level of the 4400 is not exceeded in any case. Otherwise, the highly sensitive input stage may be destroyed immediately. The maximum input power level is indicated on the front panel of the 4400, just besides the RF in/out socket.

Cabling For precise measurements, we strongly recommend to use an RF adapter cable between the mobile under test and the Willtek 4400. Mobile-specific RF adapter cables are available from the mobile's manufacturer or from Willtek. Please contact your local Willtek representative.

However, should the adapter cable for your mobile not be at hand, the air connection offers a simple-to-use alternative for quick tests. With the optional RF Shield, precise measurements can be achieved without interference.



Don't exceed the maximum RF power level

Before connecting any RF equipment to the 4400, please check that the maximum input power level of the 4400 is not exceeded in any case. Otherwise, the highly sensitive input stage may be destroyed immediately. The maximum input power level is indicated on the front panel of the 4400, just besides the RF in/out socket.

Cable connection



The cable connection between a mobile under test and the 4400 requires a mobile-specific RF adapter cable. This RF adapter provides the mobile-specific connector on one end and the Willtek RF-click connector on the other one. Please note that you will need the optional adapter cable 'RF click to N-type' in order to use the RF adapters on the 4400's N-type RF in/out socket.

Air connection

Using the air connection is a simple method to connect a mobile under test to the 4400 when there is no special RF adapter available. Basically, there are three possibilities to use the air connection.



The simplest possibility is to put an optional antenna on the 4400's RF in/out socket. However, the drawbacks of this solution are the unknown coupling loss and the potential interference.

The coupling loss depends on factors such as the orientation of the mobile towards the 4400, the distance and the frequency.

The possible interference depends on the type of RF radiating equipment being used in the same room or area and on the distance to e.g. a 'real' base station. Consequently, this solution only works for basic functional tests.

Please also note that you may need different antennas for different frequency bands.



Using the optional 4916 Antenna Coupler, you already have a wideband antenna built into a special casing. Because of the fixed position of the mobile, the coupling loss is much better reproducible and can be fairly compensated using a

coupling loss table. However, there is still no protection against potential interference.

The operating range of the 4916 Antenna Coupler covers all the relevant cellular frequency ranges.

As a standard, the 4916 Antenna Coupler comes with a QMA connector plus an adapter cable from QMA to N.



If you need to perform reproducible measurements without having the possibility of using a cable, we recommend to work with the optional 4921 RF Shield. This is a metal box that covers both the mobile under test and the Antenna Coupler. The 4921 RF Shield keeps radio interference away from the air connection. The achievable measurement quality can be as good as when using a cable if the attenuation is compensated with the help of the coupling loss table. The 4921 RF Shield is available with either a TNC-type or N-type connector.

NOTE

The RF Shield Package contains both the 4921 RF Shield and the 4916 Antenna Coupler.

The front and rear panels

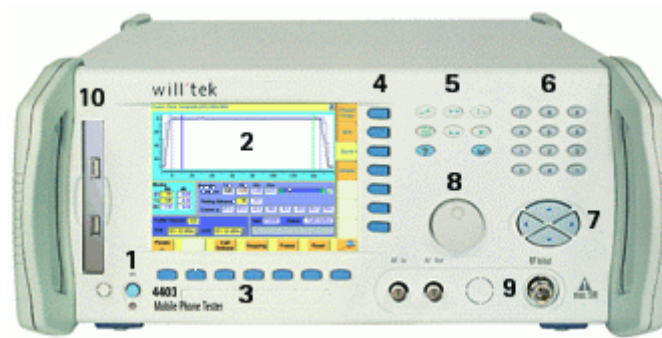
[Front panel](#) – Get to know the ten sections of the front panel.

[Rear panel](#) – Here you will find all about the rear panel of your 4400.

[Connectors](#) – The connectors on the front panel provide the interfaces to the mobile under test. The back panel features all the interfaces you need to integrate the 4400 into your test environment.

[The keys on the front panel](#) – Don't be confused about softkeys, marker tabs, function keys, numeric keys, cursor keys, the selection key or mapping the 4400's keys to an external keyboard. Here you will find all you need to know about any key.

Front panel The front panel of the 4400 is divided into ten sections.



Section 1 – On button and MS Power connector

When you bring the power switch on the rear panel of the 4400 in its **I** position, the unit goes to standby mode and the indicator just underneath the **On** button is backlit in red.

Push the **On** button to switch the 4400 into operating mode. The indicator will then turn green.

When you push the **On** button again, the 4400 will go back into standby mode.

NOTE

The power switch is located on the rear panel of the 4400. A dark standby button indicates that the 4400 is not connected to mains.

The MS Power connector is used in conjunction with the MS Power Supply and Current Measurement Options. It provides supply voltage and current for the mobile under test.

The cable for this connector is delivered with the MS Power Supply Option.

Section 2 – Display

The display is the graphical user interface of the 4400. It will show you menus with entry fields and display fields. The display also labels the software-driven softkeys (see section 3) and marker tabs (see section 4).

Section 3 – Softkeys

Softkeys call specific functions that vary with the menu displayed. For instance, when you switch on the 4400, the softkeys will allow you to select the option you want to work with (e.g. call mode or non-call mode).

Section 4 – Marker tabs

Like the softkeys, the marker tabs are software-labelled keys used for selecting a test (e.g. Phase/Frequency test), for navigating through the online help, or for loading different tools (e.g. Analyzer).

Section 5 – Function keys

Function keys are used for general operation. They have a fixed function. The **ENTER** key, for instance, confirms changes on entry fields.

Section 6 – Numeric keys

The numeric keys are mainly used to enter values on entry fields.

Section 7 – Cursor keys

The **LEFT** and **RIGHT** cursor keys are used to select the required entry field of a menu. A selected entry field is inverted and therefore easily visible on-screen. With the help of the **UP** and **DOWN** cursor keys, values on entry fields can be changed.

Section 8 – Selection key

The selection key is actually more a wheel. It is used to quickly change values on entry fields.

Section 9 – Connectors

The connectors on the front panel provide the interfaces for the mobile under test.

The connection of a mobile is outlined in section [Cabling](#).

The detailed description of all connectors on both the front and back panel of the 4400 can be found in section [Connectors](#).



HAZARD

Before connecting any equipment, please make sure that the maximum input levels of the related inputs are not exceeded. Otherwise, the highly sensitive stages of the 4400 might be destroyed immediately.

Section 10 – Floppy drive (for serial numbers below 0911001)

As with all floppy drives, the floppy disk will only fit in one direction. Please insert the floppy disk carefully. Do not use any force as this could damage both, the floppy disk and the floppy drive.

Section 10 – USB interfaces (for serial numbers 0911001 and above)

The 4400 provides two USB interfaces on its front panel that can be used to connect a USB memory stick or USB cable for transferring e.g. data or result files to or from a PC.

Please note that only USB sticks, labelled with Willtek will work on the 4400. As with all USB connectors, a USB stick will only fit in one direction. Please insert the connector carefully. Do not use any force as this could damage both, the USB stick and the USB interface.

Rear panel The rear panel of the 4400 is subdivided into three main sections.



Section 1 – The RF/IF/AF section

The RF/IF/AF section provides several interfaces that may support your tests. Most of these interfaces are related to synchronization and triggering. Section [Connectors](#) gives a detailed overview of all the connectors, their functionality and technical specifications.

Section 2 – The PC unit

The 4400 is powered by an industrial PC. Therefore, you will find all the standard PC interfaces on the back of the 4400. If you need to know anything regarding the PC interfaces, please refer to [Connectors](#).

Section 3 – The power supply

In this section, the power switch and the power connector are located.

NOTE

The power switch has to be in its **I** position before you will be able to start the 4400 using the **ON** button.



HAZARD

Before connecting the 4400 to mains, please check that the power available on your supply line is within the operating range of the 4400's power supply as indicated on the back of the unit and in the getting started manual.

Connectors

Connectors on the front panel There are four connectors on the front panel, one on the left hand side, close to the **On** switch and three on the right hand side of the 4400:



MS Power — four-pin socket. Output, providing electric power for the mobile under test. This output is only available when the MS Power Supply and Current Measurement Options are installed.

The cable for this connector is delivered with the MS Power Supply Option.



AF in — BNC socket. Input for AF (audio) signal. This input is only used when the Audio option is installed.

This input can be used either as a balanced or as an unbalanced input (software switch).

The input impedance is approx. 250 k Ω /20 pF.

The usable AC frequency range stretches from 30 Hz to 20 kHz.



HAZARD

The absolute maximum input voltage is ± 40 V DC or 30 V (rms) AC. An AF input voltage of more than ± 40 V DC or 30 V (rms) AC may result in an **immediate destruction** of the highly sensitive AF input stage of the 4400. Willtek will not accept liability for any damage of the input stage due to overload.

AF out — BNC socket. Unbalanced AF (audio) signal output of the 4400. Used only when the Audio option is installed.

Best performance is achieved on a 600 Ω load.

The maximum output voltages are 4 V (rms) for sinusoidal signals or 11 V peak-to-peak for all other signals.

RF in/out — RF signal input for transmitter measurements and output for receiver measurements. It depends on the current system test whether the 4400 measures an input signal, generates an output signal or both.



HAZARD

The absolute maximum input power is 5 W (37 dBm). An RF input power of more than 5 W may result in an **immediate destruction** of the highly sensitive RF input stage of the 4400. Willtek will not accept liability for any damage of the input stage due to overload.

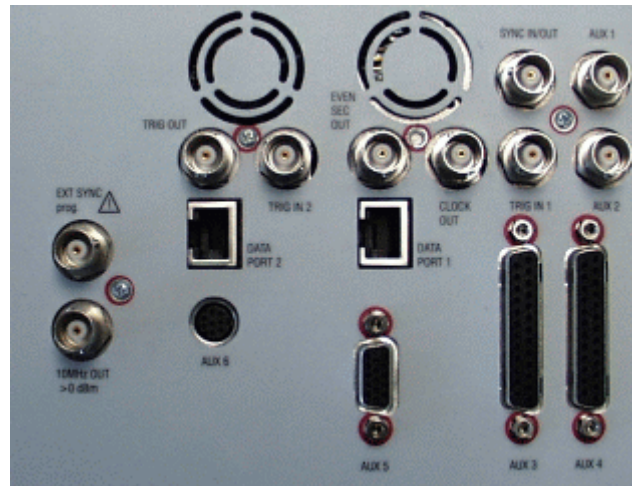
Note: There is no time limitation for applying the maximum input power.

Connectors on the rear panel

The rear panel is divided into three main sections. These are from left to right: the RF section (1), the PC unit (2) and the Power supply (3). Each section provides one or more connectors for specific functions. The connectors are described from left to right and from top to bottom.



Connectors on the RF section



Not all of the connectors may be fitted in your 4400. The connectors actually available depend on your system configuration, in particular the installed system options.

EXT SYNC — BNC socket. Input for external reference signal. If a high-precision reference signal of 5 MHz, 10 MHz or 13 MHz is connected here, the internal 10 MHz reference signal of the 4400 will not be used.

Input level: approx. 0 dBm

Frequency tuning range: approx. 1 ppm (10E-6) (equals 10 Hz at 10 MHz)

Input resistance: approx. 50 Ω

10 MHz OUT — BNC socket. Output of the 4400's internal 10 MHz reference signal. With the help of this output, the internal time base of the 4400 can be used to synchronize external equipment.

This output is very useful if the optional oven-controlled oscillator (OCXO) is installed. More information on the OCXO can be found in section [Accessories and options](#).

Output power: approx. +5 dBm

Output resistance: approx. 50 Ω

TRIG OUT / AUX 8 — BNC socket. Reserved for future CDMA use. Please do not connect anything here.

DATA PORT 2 — RJ45 connector. Reserved for future use. Please do not connect anything here.

AUX 6 — Reserved for future CDMA use. Please do not connect anything here.

TRIG IN 2 / AUX 7 — BNC socket. Reserved for future CDMA use. Please do not connect anything here.

EVEN SEC OUT — This BNC connector carries is a CDMA-related periodic TTL signal with a period of 2 seconds. A negative pulse occurs every two seconds, with a pulse width of approximately 51 nanoseconds.

DATA PORT 1 — This RJ45 connector is a test port for CDMA without any user application. Please do not connect anything here.

AUX 5 — This is a diagnostic port without any user application. Please do not connect anything here.

CLOCK OUT — This BNC connector carries a periodic TTL CDMA clock signal. Please refer to sections CDMA Call Mode and CDMA Non-call Mode in the CDMA user's guide for more information.

SYNC IN/OUT — BNC socket, providing a CMOS-TTL signal. The signal on this connector allows the GSM-specific synchronization with external units. The connector is currently configured as **Sync out**. The 4400 outputs its internally generated frame synchronization signal. This signal is TTL-low for (downlink) time slots 0 to 2 and TTL-high for time slots 3 to 7.

NOTE

In GSM, the timing of up- and downlink is shifted by three time slots to avoid that a mobile has to receive and transmit during the same time slot. The time difference between the falling and the rising edge of the Sync out signal reflects exactly that time shift.

TRIG IN 1 — BNC socket, expecting a CMOS-TTL signal. A trigger signal applied on this connector triggers all GSM-related RF measurements. The 4400 allows you to select between triggering on the rising or falling edge of the signal connected here.

The main application for this connector will be measurements in non-call mode at very low power levels, e.g. asynchronous measurements.

NOTE

For GSM the 4400 can internally trigger its asynchronous measurements as long as the RF power level transmitted by the mobile is above -30 dBm. Only in case you are working with lower RF power levels, it is necessary to supply an external trigger signal on this input.

AUX 3 — Reserved for later use. Please do not connect anything here.

AUX 1 — Reserved for later use. Please do not connect anything here.

AUX 2 — Reserved for later use. Please do not connect anything here.

AUX 4 (AUX out) – Using the Audio Option of the 4400, audio signals can be made available on this output, for example to connect the 4400 to an external loudspeaker. The output is available on **pins 8 and 9** of this connector. The output impedance is 8 Ω ; the maximum output power level is 1 W.



HAZARD

AUX out is a balanced output. This means that the voltages provided are floating. Never short-circuit these two pins and never connect them to ground as this could result in an **immediate destruction** of the AUX out output stage of the 4400.

AUX 4 (AUX in) – This input can be used to pick up audio signals with a microphone and to use those signals for audio measurements. The auxiliary input is available on **pins 12 and 13** of this connector. This unbalanced input is only used when the Audio option is installed. The input impedance is < 1 k Ω . The usable AC frequency range stretches from 30 Hz to 20 kHz.



HAZARD

The absolute maximum input voltage is 1 V (rms) AC. An AF input voltage of more than 1 V (rms) AC may result in an **immediate destruction** of the highly sensitive AUX in input stage of the 4400. Willtek will not accept liability for any damage of the input stage due to overload.

Connectors on the PC unit – below serial number 0911001



VGA – Standard connector for a VGA monitor.

NOTE

The resolution of the 4400's video output is set to 640 x 480 pixels and cannot be altered.

KEYBOARD – Standard PS/2 connector for a PC keyboard.

NOTE

An external keyboard is highly recommended for RAPID! programming (see [page 139](#)).

COM 1 – Standard 9-pin D-sub connector for serial interface 1. Mainly used to connect a PC mouse.

NOTE

A mouse is highly recommended for RAPID! programming (see [page 139](#)).

COM 2 – Standard 9-pin D-sub connector for serial interface 2.

CENTRONICS – Standard parallel port to connect a PC printer (LPT 1).

PCMCIA – These two PCMCIA slots are reserved for LAN interfacing and for future applications.

The slot takes either two Type 1 cards or one Type 2 card.

GPIO – General Purpose Interface Bus according to specification IEEE-488.2.

Connectors on the PC unit - from serial number 0911001 and above



VGA – Standard connector for a VGA monitor.

NOTE

The resolution of the 4400's video output is set to 640 x 480 pixels and cannot be altered.

COM 1 – Standard 9-pin D-sub connector for serial interface 1.

USB 1 / 2 – Standard USB connectors for USB devices like USB sticks, printer etc. These two connectors are internally connected and thus parallel to the two USB connectors on the front panel.

Please note that only USB sticks labelled with Willtek will work on the 4400.

USB 3 – Standard USB input connector. May be used e.g. to remotely control the 4400 (instead of using a serial connection on COM 1).

KEYBOARD – Standard PS/2 connector for a PC keyboard.

NOTE

An external keyboard is highly recommended for RAPID! programming (see [page 139](#)).

MOUSE – Standard PS/2 connector for a PC mouse.

NOTE

A mouse is highly recommended for RAPID programming (see [page 139](#)).

CENTRONICS – Standard parallel port to connect a PC printer (LPT 1).

LAN – Standard RJ45 connector for LAN cables.

GPIB – General Purpose Interface Bus according to specification IEEE-488.2.

Connector on the power supply



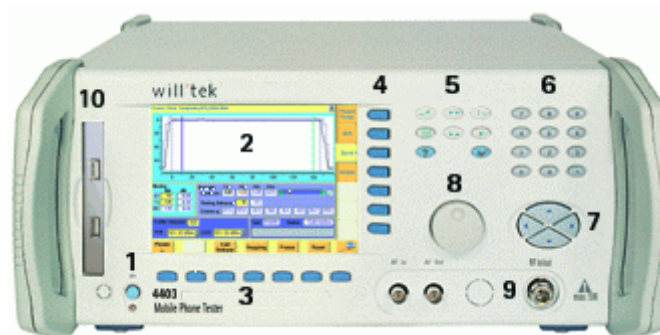
Power in – Standard IEC 320 power connector (3 pins). Please make sure that the power cable is properly grounded.



HAZARD

Before connecting the 4400 to mains, please check that the power available on your supply line is within the operating range of the 4400's power supply as indicated on the back of the unit and in the getting started manual.

The keys on the front panel



There are six different groups of keys. In the photo of the front panel above, they are marked with numbers 3 through 8.

- The softkeys (3)
- The marker tabs (4)
- The function keys (5)
- The numeric keys (6)
- The cursor keys (7)

- [The selection key](#) (8)

Notation of keys in this manual and online help



Hard keys, such as the **ENTER** key, appear in capital letters.



Either a graphical image of the softkey is used, or its label is in bold print, e.g. **Param....**

External keyboard and mouse

There is the possibility to connect a standard PC keyboard and/or a standard PC mouse to the 4400. When an external keyboard is connected, the keys on the front panel of the 4400 and the keys on the external keyboard may be used in parallel.

In order to provide access to the 4400-specific keys like the **TOOLS** function key from an external keyboard, those keys are mapped. The mapping table can be found in section [Keyboard mapping table](#).

The connectors for both the mouse (MOUSE, PS/2) and the external keyboard (KEYBOARD, PS/2) are located on the back panel of the 4400 in the PC section. Section [Connectors](#) provides you with all the information about those connectors and their locations.

The softkeys

Softkeys call specific functions that vary with the menu displayed. The specific function is written in the last two lines of the display, just above the physical key. This is what we call the label of the softkey.

Example: In the Welcome menu of the 4400, the softkeys will allow you to select between measurements in call mode and those in non-call mode.



Notes on softkeys

- When the label of the softkey ends with an ellipsis (...), this softkey will take you to a new menu (of a lower level), where you can enter e.g. additional parameters.

Example: Softkey **Param...** will take you to a new menu, where system parameters can be set.

To return from a lower menu level, push the **ESC** function key.

- When there is a test in progress, some softkeys will be **blocked**. They turn to gray to indicate that the previously started test has to be either completed or aborted, before a new selection with the softkeys is possible.

Example:



While softkey **STOP** could be pushed any time, softkey **Paging** is not accessible as long as the current test or procedure is in progress.

- While the Online help is on display, the softkeys change to navigating aids and help you to find your way through the Online manual.

The marker tabs



When there are several menus of the same level, e.g. different system tests, the seven marker tabs make it easy to switch between them.

When the Online help is on display, the marker tabs provide the links to related pages.

Selected, deselected and blocked marker tabs

Marker tabs can be selected, deselected or blocked.

A **selected marker tab** is highlighted and indicates that the current menu has been selected. Only one of the marker tabs can be selected at a time. The remaining marker tabs are either deselected or blocked.

The **deselected marker tabs** all have the same background color; their text is printed in black to indicate that they could be selected any time.

Some or all marker tabs may turn to grey to indicate that they are **blocked**, e.g. when there is a test in progress. In this case, the previously started test has to be either completed or aborted, before a new selection with the marker tabs is possible.



Marker tab [MS Info], not selected



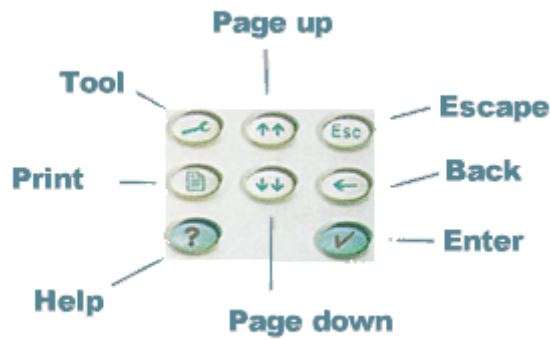
Marker tab [MS Info], selected











Marker tab [MS Info], blocked

The function keys

With the help of the function keys, you have instant access to important or useful functions of the 4400. Some of the function keys help you to navigate through the current menu.



Meaning of the function keys

Symbol	Name	Description
	TOOL	Calls the tools menu. From there, you start the special tools like the Audio measurements or the MS Power Supply.
 	PGUP, PGDN	A push selects the first entry field of the previous or next area. When the Online help is on display, these keys call the previous or next page of the Online help.
	ESCAPE	A push on this key takes you one menu level up. Should this cause a change of a parameter, you will be prompted to either confirm or discard your change in menu levels.
	BACK	Deletes the character left to the cursor on an entry field.
	ENTER	Confirms a value entered on an entry field.
	HELP	Calls the Online help on-screen. Once that you are done with the help screens, press Esc to return to the previous screen. For more information about the online help system, see section Help on Help .
	PRINT	Prints the current screen to the attached printer or generates a screenshot file on an USB stick. For more detailed information, see section Parallel Port Settings.

The numeric keys



With the help of the numeric keys, you enter parameter values on entry fields.

Important function keys mainly used in combination with the numeric keys



deletes the character left to the cursor on an entry field.





confirms all the changes or entries.

The cursor keys



With the help of the  (LEFT) or  (RIGHT) cursor keys, you navigate the cursor from one entry field to the previous or next one.

The  (UP) or  (DOWN) cursor keys allow you to increase or decrease the parameter value on a numeric entry field or to step through the predefined settings of a selection field.

The selection key



This wheel is used to quickly change values on entry fields.

When the cursor is positioned on an entry field (the entry field is then inverted), a turn on the selection key directly changes the value. Any change made with the selection key is instantly confirmed. It is not necessary to push the **ENTER** key

Altering numeric values: navigate to the required entry field.

Clockwise rotation (i.e. to the right) of the selection key increases the value, counterclockwise rotation (i.e. to the left) decreases it.

Changing the setting of selection fields: navigate to the selection field. The available predefined settings are highlighted one by one when you slowly turn the selection key clockwise or counterclockwise.

Keyboard mapping table

Every key of the 4400 is mapped to a specific key or key combination of an external PC keyboard.

Softkeys

From left to right, the seven softkeys are mapped to the key combinations **SHIFT+F1** to **SHIFT+F7**.

Marker tabs

From up to down, the seven marker tabs are mapped to the key combinations **CTRL+F1** to **CTRL+F7**.

Function keys

4400 front panel	Keyboard
HELP	F1
TOOL	F2
PRINT	F3
PgUP	PAGE UP
PgDN	PAGE DOWN
ESC	ESC
BACK	BACKSPACE
ENTER	ENTER

Numeric keys

Mapped to the numeric keys on the standard PC keyboard.

NOTE

Before using the numeric keypad of the external keyboard, please check that the **NUM LOCK** is switched on.

The following specific keys are mapped to:

± - i.e. the minus key

∴ - i.e. the dot key

Cursor keys

4400 front panel	Keyboard
LEFT	SHIFT+TAB
RIGHT	TAB
UP	ARROW UP
DOWN	ARROW DOWN

Selection key

F11 for counterclockwise turn, i.e. to the left,
F12 for clockwise turn, i.e. to the right

Menus and levels

Menus

The entire area of the display is what we call a **menu**. Any time you switch on your 4400, it first displays the start or Welcome menu. The Welcome menu is the highest menu level of the hierarchically structured user interface.



With the help of the marker tabs (on the right-hand side of the display), you select between the different system menus (e.g. [GSM] or [CDMA]).

The softkeys (just below the display) give you instant access to the various test menus (e.g. **Calls & Meas.** or **Gen/Ana**).

Levels

The user interface of the 4400 is organized in a hierarchical order. This means that there are several levels.

The Welcome menu is at the top level. As you go lower in menu levels, you will reach more specialized or detailed functions.

- When there are several menus of the same level, you can select between them using the marker tabs on the right-hand side of the display.
- To navigate to a menu of the next lower level, push any one of the softkeys.
- When you would like to return to the next level above, push the **ESC** function key.

Example: You would like to go to the GSM Burst Zoom menu.

You can use either the Calls & Meas. or the Gen/Ana menus. For tests in call mode, i.e. involving a call setup, simply push the **Calls & Meas.** softkey from the Welcome menu. This will take you to the test menu where you can select between the various tests (this is the so-called test level).

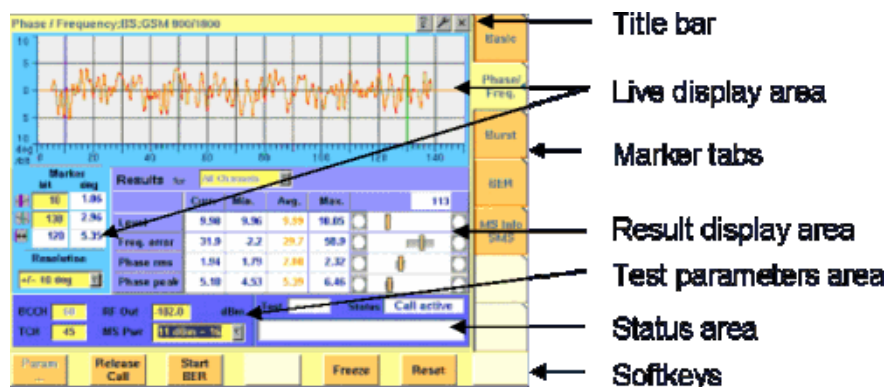
Now you push the third marker tab from the top [Burst] and the 4400 will display the Burst test menu.

The **Zoom** softkey of the Burst test menu leads you to the Zoom menu.

The areas of a test menu

Each test menu is divided into different color-coded areas, each providing different functions. These functions are described in detail in the test sections of the related system.

The figure below gives you a first overview. The example we have chosen is the Phase/Frequency test menu of the GSM system, but the principle is the same for all other test menus.



- The **title bar** shows the name of the menu you are currently working in. In the example above, this is the menu testing the phase/frequency characteristics of a mobile in a GSM 900/1800 system.
- The **live display area** shows the measurement results in real time, whether numerical or graphical.
- Below or besides the live display area, you will usually find the **result display area**. It shows the statistical analysis of the measurement results and the related bar display.

- The two lower areas of the menu are the **test parameters area** (left) and the **status area** (right).
The **test parameters area** on the left provides selected entry fields that allow you to instantly alter relevant test parameters without being forced to navigate to some parameters menu first.
The area on the right-hand side is called the **status area**. Here, the 4400 tells you if the current test has passed or failed. Furthermore, the signaling status will be shown in this area.
- The **softkey area** forms the bottom of a menu. With the help of the seven softkeys you can directly call a system parameters menu, start special test functions or zoom the test display.
- The **marker tabs area** on the right-hand side of the menu carries the labels of the seven marker tabs. They provide access e.g. to different tests.


Menu fields

In the menus of the 4400, we use two different types of fields:

- An **Entry field** is what we call a field that is accessible by the cursor and accepts an entry. Entry fields are mainly used to enter test parameters. There are entry fields that only accept numeric inputs (like e.g. a channel number) and there are entry fields that accept alphanumeric data (like e.g. an SMS text).
There are also two special forms of entry fields: the so-called **selection fields** where you may select one of several predefined possibilities (e.g. what bit class(es) you want to use for a bit error rate measurement) and the check boxes.
Check boxes are like an on/off switch. You can't enter values, you can just select or deselect them.
All entry fields have a yellow background to make them easy to allocate on-screen. The only exception to this rule are the check boxes.
- **Display fields** show the results of the performed measurements. Again, there are different types of display fields as measurement results can be purely numerical (e.g. RF power) or they can be alphanumeric (e.g. the serial number of a mobile). The **bar display** also is a display field.
To make display fields easy to distinguish from entry fields, they always have a white background.

Entry fields

The Willtek 4400 offers you different types of entry fields:

- **Alphanumeric, hexadecimal or numeric** entry fields accept text or numbers respectively.
 Example: **TCH** – Here you enter the number of the traffic channel the measurement shall be performed on.
- **Selection fields** are entry fields that offer you a choice from a list of predefined values. Click with the mouse on the triangle to see the available options, or press the **UP** or **DOWN** cursor key.



Example: **TCH Type** – This selection field enables you to choose a specific TCH type from a list.

- **Check boxes** only need a simple yes or no. The 'yes' is indicated by a green check box. To activate or deactivate the function, click on it with the mouse or go to the field and press **ENTER**.



Example: The **Call on Loc. update** check box is unchecked. This means that the function will not be performed.

- **Radio buttons** allow you to select between different options, similar to selection fields.



Example: The sine function of the audio generator radio buttons in the picture has been selected. The other functions are inactive. By selecting the rectangle function, sine would automatically be deselected.

Select a function by clicking on the appropriate radio button, or move to the radio button with the cursor keys and press **ENTER**.

Navigating to an entry field

Jump to the required area using the function keys **PgUP** or **PgDn**.

Select the entry field you want to make changes on with the help of the **LEFT** or **RIGHT** cursor keys.

The selected entry field is inverted to make it easily visible on-screen.

Entering values on numeric entry fields

There are two ways how to work with numeric entry fields: either you enter the value using the 4400's numeric keys or you use the selection key. The achievable results are basically the same. However, there is no entry discard function when you use the selection key.

- Enter the required value using the numeric keys of the 4400. While the entry field is open, entered values can also be edited using the **BACK** function key. To **confirm** the changes, push the **ENTER** function key. To discard the changes, just leave the entry field, e.g. using the **LEFT** or **RIGHT** cursor keys.
- Instead of typing in a new value, you may also turn the selection key to increase or decrease the current value of the entry field. The **UP** or **DOWN** cursor keys also increase or decrease the value. The cursor keys have a built-in 'autorepeat function': The value on the entry field will be incremented respectively decremented by one step on a short push or by a couple of steps if you push the key for a longer period of time.

NOTE

In case your entry is out of the permitted data range, the 4400 will set the entry value to the maximum or minimum value permitted and prompt you with *Data out of range* in the status area of the current menu.

NOTE

When you use the selection key or the cursor keys to change a parameter value on an entry field, the changes are confirmed automatically; pressing the **ENTER** function key is not mandatory.

Entering values on hexadecimal entry fields

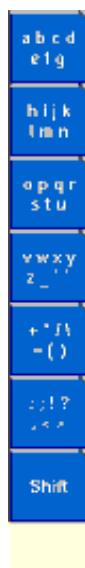
Where an entry in hexadecimal notation (0 to 9, A to F) is expected, the marker tabs change to the letters A to F. You can enter data with the numeric keys (0 to 9) and with the marker tabs [A] to [F].



Entering values on alphanumeric entry fields

On alphanumeric entry fields as e.g. **SMS to mobile phone**, texts are best entered using an external keyboard. Of course, it is also possible to enter alphanumeric values directly on the 4400:

As soon as the entry field is opened, the marker tabs change to groups of letters and symbols. The lowest marker tab incorporates the "shift" function and allows you to toggle between lowercase and uppercase letters.



As soon as you select a group of letters or symbols by pushing the corresponding marker tab, the marker tabs will change again to single letters or symbols. Push the marker tab of the desired letter or symbol. That one will appear on the entry field and the marker tabs will change back to groups of letters and symbols. While the entry field is open, entered values can also be edited using the **RIGHT** function key.

Entering values on selection fields

Again, there are two ways how to work with selection fields: either you change the selection using the 4400's cursor keys or you simply turn the selection key. The achievable results are basically the same.

- Select the required value using the **UP** or **DOWN** cursor keys. To confirm the changes, push the **ENTER** function key or just leave the selection field using the **LEFT** or **RIGHT** cursor keys.
- Instead of selecting a new value with the cursor keys, you may also turn the selection key.

NOTE

When you change a parameter value on a selection field, the changes are confirmed automatically. It is not required to push the **ENTER** key.

Switching check boxes

Any push on the **ENTER** function key toggles the currently selected check box. This means that an unchecked check box will be switched to 'on' or 'yes' with the first push and back to unchecked with the second push. Unchecked boxes are indicated in gray; checked ones are highlighted in green.

Display fields

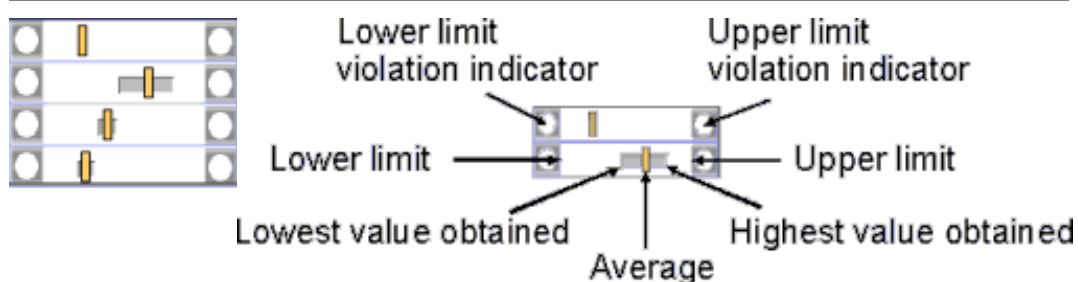
The 4400 offers you two different types of display fields:

(Alpha)numeric display fields

MS Report		
	RX Lev	RX Qual
Full	63 = -48.0 dBm	0
Sub	63 = -48.0 dBm	0

These kind of display fields are used to show test results as numeric values, as strings (text) or as graphical display of numeric values (e.g. the shape of a received burst within a template).

The bar display



The bar display is used to display measurement results that are obtained by running a specific test a certain number of times. It shows a couple of important values on a relatively small area:

- The large white area indicates the range between the lower and the upper limit of the specific test.
- The dark gray section within the white area shows the range of all measurement values obtained from the minimum to the maximum.
- The small orange rectangle marks the average value.
- The two limit violation indicators are white as long as no violations of the test limits occur.
- As soon as a measurement value obtained is smaller than the lower limit, the lower limit violation indicator will turn to red.
- The same will happen with the upper limit violation indicator when a measurement value exceeds the acceptable range.

NOTE

To reinitialize the statistics, push the **Reset** softkey.

Display Markers

For easy reading of its graphical live displays, the 4400 offers two display markers. These are vertical lines that allow to take measurements at specific positions (e.g. in a spectrum live display) or to determine distances between specific points (e.g. the length of a burst in a TDMA-based system).

Marker	kHz	dBm
	660	-42.94
	-660	-43.82
	1320	0.87

On the entry fields, you set the markers to the required horizontal positions (kHz in the example above). The corresponding result fields (dBm in the example above) show the measurement values obtained for the two positions. The third row shows the difference between the horizontal positions selected and the difference between the two corresponding measurement values.

Marker	Ix	Power	Noise
◆	1	-48.0dBm	-48.1 dBm
◆	0	-45.8dBm	-45.9dBm

In some test menus, display markers provide two result fields (see example above), e.g. in order to measure a signal to noise ratio. In these cases, the third row will not be present.



In some test menus, you can easily modify the vertical resolution of the live display. Smaller values provide a higher resolution and thus more details; higher values provide a better overview.

Help on Help

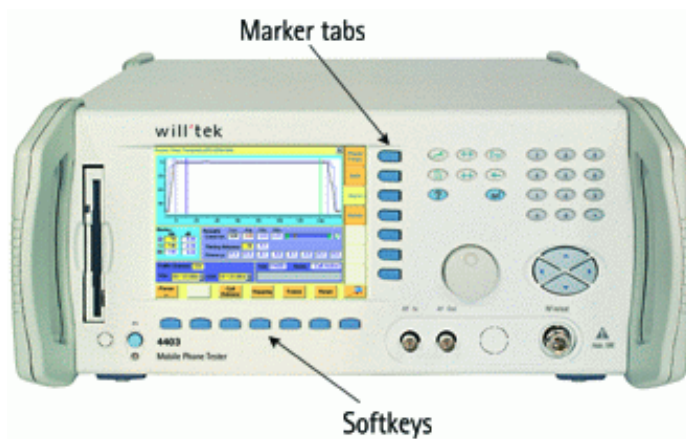
This section describes how to work with the Online help.

Notation rules

While working with the Online help, you will have to push softkeys, marker tabs, or other keys. To keep things as clear as possible, the online manual either uses the graphical image of the item as you see it on-screen or it uses the following notation rules:

Calls & Meas.	The label of a softkey is indicated like this.
[RF Gen]	The label of a marker tab is indicated in square brackets.
ESCAPE	The name of function keys, numeric keys or cursor keys is indicated in this type of letters.
Channel	Entry fields are indicated in normal letters.

Navigating help



With the help of both the marker tabs and the softkeys, it is easy to navigate through the Online help.


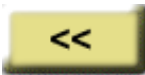



Marker tabs – the links

The Online help is a so-called hypertext document. It contains **links**. Those links allow you to jump to a different page where more detailed information about a specific topic is provided. On a PC, you would simply click the link. On the 4400, you can use the mouse or the marker tabs for 'clicking' the links.

Example: A page provides links to the documents explaining the softkeys and marker tabs in detail. Use the marker tabs to directly jump to the related pages.

Softkeys – the quick navigators

Using the softkeys you quickly navigate through a chapter or call its index. There are five softkeys available:

	This softkey calls the first page (i.e. the page directly following the index page) of the chapter. If that first page is already on display, nothing will happen.
	A push on this softkey takes you to the previous page of a chapter. When you push this softkey on any index page, you will get the last page of the previous chapter on-screen.
	Calls the subsequent page of a chapter. From the last page of a chapter, this softkey will take you to the index page of the subsequent chapter.
	A push on this softkey takes you to the index page of the current chapter. This index page shows the contents of the chapter along with links to the different topics. When you push Index on an index page, then the index page of the next level up will be shown.
	Takes you back to the help page shown last before the current page.

Accessories and options

Your 4400 is a highly integrated test set that allows you to perform most of the tests and measurements required in a standard production environment already with its basic configuration. However, there are much more areas of application for your 4400. It can even be used in R&D, for high-level service or for training your staff on digital radio systems.

Willtek has developed a broad range of accessories that help you perform specific tests or measurements, to easily connect mobiles to the 4400 and much more. Please find below a short overview of the available accessories and options, and the applications they have been designed for. Should you miss something in the list below, please check with your local Willtek representative. Due to ongoing product development and improvement, the turnkey solution to your requirement may already be available.

All the latest developments for your 4400 can also be found on the web at www.willtek.com.

NOTE

Specifications are used in this manual for illustration purposes only. Therefore, the specifications of the product delivered may be different from the specifications shown here. However, all relevant specifications for the 4400 can be found in the test set's data sheet. Should that data sheet not be at your disposal, please ask your local Willtek contact for a copy or feel free to download it from Willtek's web site (www.willtek.com).

Upgrades **Front Panel USB / PC Controller Upgrade**

From serial number 0911001 onwards, all Willtek 4400 are equipped with an enhanced PC Controller. This PC Controller not only handles the graphical user interface, but also provides additional functionality for some of the system options. However, all Willtek 4400 units with a serial number below 0911001 have to be upgraded to run software Version 12.20.

Additional functionality provided by the enhanced PC Controller:

- Support for new options like 1xEV-DO or HSDPA (these options will not work with the earlier versions of the PC Controller)
- USB interfaces
- Ethernet interface as a standard
- Remote control also through serial interfaces

Option	Willtek order number
Front Panel USB / PC Controller Upgrade	M 248 689

Options **GSM options**

To use the **4458 GSM Non-Call Mode Option** the 4460 GSM/GPRS/EDGE Hardware Option is required. This option supports asynchronous measurements for all the GSM systems, like GSM 850, GSM 900, E-GSM, GSM-R, GSM 1800 and GSM 1900. With this option, the instrument is enabled to generate a signal like continuous wave (CW), amplitude modulated (AM, with 4481 AM Signal Generator Option) or a real GSM downlink signal (GMSK modulated, burst type). Standard measurements include MS power (power level, power-time template (PTT) check), phase and frequency error.

With the 4475 ACPM (ORFS) Option spectrum measurements are also possible.

Note: Additionally many accessories are available, such as 4473 MS Power Supply Option or 4474 MS Current Measurement Option. With these options, you can charge the battery of a device under test (DUT), and also the 4400 is enabled to measure the power consumption of the DUT within a GSM time slot.

To use the **4457 GSM Call Mode Option** the 4460 GSM/GPRS/EDGE Hardware Option is required. This option supports synchronous measurements for all the GSM systems, like GSM 850, GSM 900, E-GSM, GSM-R, GSM 1800 and GSM 1900. With this option, the instrument is enabled to simulate a GSM cell site with many optional parameters. For this reason signalling procedures like

location update, MS/BS-originated call setup, MS/BS-originated call clearing, channel change/handover (within frequency band and inter-frequency band), SMS MS/BS-originated are supported.

Standard measurements: MS power (power level, power-time template check (PTT)), phase and frequency error, (R)BER (class I/II), FER, Fast BER. With the 4475 ACPM (ORFS) Option also spectrum measurements are possible.

Note: Additionally, many options and accessories are available, such as 4473 MS Power Supply Option or 4474 MS Current Measurement Option. With these options, you can charge the battery of a device under test (DUT), and also the 4400 is enabled to measure the power consumption of the DUT within a GSM time slot.

The **GSM Service Test Software** enables the 4400 to rapidly run a suite of tests on GSM mobile phones automatically. The phone type is recognized, automatic offsets are applied for the Willtek 4916 Antenna Coupler. Comprehensive transmitter, receiver and audio checks against specifications are carried out. The phone is controlled through the serial interface.

Option	Willtek order number
4458 GSM Non-Call Mode Option	M 897 306
4457 GSM Call Mode Option	M 897 305
4460 GSM/GPRS/EDGE Hardware Option	M 248 710
4480 GSM Service Test Software	M 897 160
4487 RAPID! Mobile/Carrier Test Software for GSM	M 897 279

GPRS options

The **4454 GPRS Non-Call Mode Option** requires the 4460 GSM/GPRS/EDGE Hardware Option. It supports the GSM 850, GSM 900, E-GSM, GSM-R, GSM 1800 and GSM 1900 systems. With this option, the 4400 Mobile Phone Tester series is enabled to generate signals like continuous wave (CW), amplitude modulated (AM, with 4481 AM Signal Generator Option), a real GSM downlink signal (GMSK modulated, burst type or multislots).

Supported measurements include MS Power and Phase/Frequency error.

The **4462 GPRS Call Mode Option** requires the 4460 GSM/GPRS/EDGE Hardware Option. It supports the GSM 850, GSM 900, E-GSM, GSM-R, GSM 1800 and GSM 1900 systems. This The option enables the instrument to simulate a GPRS cell site with many optional parameters. Signalling supported: location updating, GPRS attach/detach, GPRS test mode (required for TX and RX testing), channel change/handover (within frequency band and inter-frequency band).

Supported measurements include MS Ppower, Pphase/Ffrequency error, BLER-BCS, BLER-USF and multislots measurements.

The **4446 GSM/GPRS Non-Call Mode Option** consists of the 4458 GSM Non-Call Mode Option and the 4454 GPRS Non-Call Mode Option.

The **4445 GSM/GPRS Call Mode Option** consists of the 4457 GSM Call Mode Option and the 4462 GPRS Call Mode Option.

Option	Willtek order number
4454 GPRS Non-Call Mode Option	M 897 302
4462 GPRS Call Mode Option	M 897 307
4446 GSM/GPRS Non-Call Mode Option	M 897 298
4445 GSM/GPRS Call Mode Option	M 987 297
4460 GSM/GPRS/EDGE Hardware Option	M 248 710
4487 RAPID! Mobile/Carrier Test Software	M 897 279

EDGE options

The **4449 EDGE Non-Call Mode Option** is required for asynchronous measurements in the GSM 850, GSM 900, E-GSM, GSM-R, GSM 1800 and GSM 1900 systems.

Requires the 4458 GSM Non-Call Mode Option and the 4460 GSM/GPRS/EDGE Hardware Option.

Supported measurements: EDGE Power, Power-Time Template, RMS EVM, Peak EVM, 95% EVM, IQ origin offset and frequency error measurements. With the 4475 ACPM (ORFS) Option additional spectrum measurements are possible.

The **4468 EDGE Call Mode Option** is required for synchronous measurements in the GSM 850, GSM 900, E-GSM, GSM-R, GSM 1800 and GSM 1900 systems. Therefore a simulation of an EDGE cell site with many optional parameters is required and possible. Signalling supported: location updating, EDGE attach/detach, EDGE test mode A, channel change/handover (within frequency band and inter-frequency band).

Requires the 4457 GSM Call Mode Option and the 4460 GSM/GPRS/EDGE Hardware Option.

Supported measurements: EDGE power, power-time-template, RMS EVM, Peak EVM, 95% EVM, IQ origin offset and frequency error measurements. With the 4475 ACPM (ORFS) Option, additional spectrum measurements are possible.

Option	Willtek order number
4449 EDGE Non-Call Mode Option	M 897 301
4468 EDGE Call Mode Option	M 897 308
4487 RAPID! Mobile/Carrier Test Software for GSM	M 897 279

CDMA2000 1xRTT options

The **4447 CDMA2000 1xRTT Non-Call Mode Option** supports asynchronous measurements for cdmaOne and CDMA2000. The 4464 CDMA2000 1xRTT Hardware Option is required. The CDMA2000 1xRTT Non-Call Mode Option supports the following bands: 0-US Cellular, 1-US PCS, 2-TACS, 3 JTACS, 4-Korean PCS, 5-NMT-450, 6 IMT 2000, 8-1800 MHz, and 9-900 MHz.

The **4448 CDMA2000 1xRTT Call Mode Option** supports synchronous measurements. The 4464 CDMA2000 1xRTT Hardware Option is required. Supported features are:

- cdmaOne/CDMA2000 call processing
- Power measurements including Min/Max power, Open Loop power, Gated power, Closed Loop power and Access Probe Power
- Modulation quality measurements including Waveform Quality and Code Domain measurements
- Receiver performance testing including receiver sensitivity and dynamic range using the FER feature

The CDMA2000 1xRTT Call Mode Option supports the following bands: 0-US Cellular, 1-US PCS, 2-TACS, 3 JTACS, 4-Korean PCS, 5-NMT-450, 6 IMT 2000, 8-1800 MHz, and 9-900 MHz.

Option	Willtek order number
4447 CDMA2000 1xRTT Non-Call Mode Option	M 897 299
4448 CDMA2000 1xRTT Call Mode Option	M 897 300
4464 CDMA2000 1xRTT Hardware Option	M 248 711
4487 RAPID! Mobile/Carrier Test Software for CDMA	M 897 242

1xEV-DO Options

The test and measurement functionalities for 1xEV-DO are split on two separate options: 1xEV-DO Non-Call Mode Option and 1xEV-DO Call Mode Option.

The 4400 with the **1xEV-DO Non-Call Mode Option** forms a fast, accurate and reliable test system for wireless devices. Non-call mode tests are typically performed with the phone being in a manufacturer-specific service mode. The 4400's fast power measurements allows production sites to precisely align the phone's transmitter within very little time.

Supported measurements: modulation quality, the transmit power quality and the radio frequency spectrum.

A built-in signal generator can be used to stimulate the wireless device and to test the received signal strength indicator of the phone.

The **1xEV-DO Call Mode Option** features the call processing functions necessary to set up a connection. This mode resembles a real-life situation and allows both transmitter measurements and receiver measurements.

Supported measurements: transmit power quality (including min/max power, closed loop power and access probe power), modulation quality (including waveform quality and code domain measurements) and radio frequency spectrum, receiver sensitivity and dynamic range measurements using the PER (Packet Error Rate) feature.

Notes: Both 1xEV-DO options require the Baseband Processing Hardware and the enhanced PC Controller (standard from serial number 0911001 onwards; for upgrades of older units, see [page 30](#)).

The 1xEV-DO options do not require the CDMA2000 System Option. This may, however, be useful for tests of the 1xRTT modulation parameters.

Option	Willtek order number
4452 1xEV-DO Non-Call Mode Option	M 897 287
4453 1xEV-DO Call Mode Option	M 897 288
4479 Baseband Processing Hardware	M 248 690

WCDMA Options

The test and measurement functionalities for WCDMA are split on three separate options: WCDMA Non-Call Mode Option, WCDMA Call Mode Option and WCDMA Tracer Option.

The **WCDMA Non-Call Mode Option** provides basic signal generator/analyzer functionality, including a WCDMA signal either without data or containing basic data simulating a cell site (PCCPCH, PSCH, SSCH); an FM modulated signal required for the tuning of specific mobile phones and a CW signal generator. The analyzer allows basic WCDMA measurements, i.e. output power, frequency error, modulation spectrum, Occupied Bandwidth (OBW), Adjacent Channel Leakage Ratio (ACLR), Spectrum Emission Mask (SEM) and transmit modulation (EVM and PCDE). In addition the option provides a specific Staircase measurement as it is required for the tuning of specific mobile phones.

The **WCDMA Call Mode Option** provides the signalling part of WCDMA. The option supports the URA (location updating) and the call setup procedures. **Supported measurements:** maximum/minimum output power, frequency error, output power dynamics in the uplink, modulation spectrum, Occupied Bandwidth (OBW), Adjacent Channel Leakage Ratio (ACLR), Spectrum Emission Mask (SEM), transmit modulation (EVM and PCDE), reference sensitivity level and maximum input level.

The **WCDMA Tracer Option** finally is an optional software tool which records the layer 3 (RRC layer) down to layer 1 (physical layer) protocol messages between the 4400 and the device under test (DUT). You can specify which messages should be displayed, view them on your PC and record a trace in a debug file, which is created and saved automatically.

Note: All three WCDMA options require the Baseband Processing Hardware.

Option	Willtek order number
4466 WCDMA Non-Call Mode Option	M 897 248
4467 WCDMA Call Mode Option	M 897 249
4484 WCDMA Tracer Option	M 897 273
4479 Baseband Processing Hardware	M 248 690

TD-SCDMA Options

The **4450 TD-SCDMA Non-Call Mode Option** provides basic signal generator and analyzer functionality for the Chinese 3G standard. The signal generator generates a signal either without modulation (OFF-state), QPSK or 8-PSK-modulated. **Supported measurements:** output power, frequency error, modulation spectrum, Occupied Bandwidth (OBW), Adjacent Channel Leakage Ratio (ACLR), Spectrum Emission Mask (SEM) and transmit modulation (EVM and PCDE).

The **4451 TD-SCDMA Call Mode Option** provides transmitter and receiver measurements in conjunction with call setup capabilities.

Supported measurements: Channel, peak, mean, min/max power, EVM, frequency error, inner and open loop power control, transmit on/off time mask, various spectrum measurements, constellation display, BER and BLER.

Note: These options require the Baseband Processing Hardware.

Option	Willtek order number
4450 TD-SCDMA Non-Call Mode Option	M 897 255
4451 TD-SCDMA Call Mode Option	M 897 256
4479 Baseband Processing Hardware	M 248 690

Expanding the 4400's measurement capabilities

Audio measurements

In its basic configuration, the 4400 does not support audio measurements. In order to provide audio functions, you need to install the 4470 Audio Option. It adds basic audio functionality to the 4400: Direct connection of microphone and loudspeaker; the built-in generator stimulates the loudspeaker or microphone of the mobile under test; frequency, voltage, distortion and SINAD measured at the same time; spectrum analyzer displays audio frequency spectrum; multitone generation via wave files.

A special version of the Audio Option is available for CDMA2000-only 4400s.

Additional optional features for audio testing are available for the GSM, the GPRS and EDGE System Options: The 4471 Basic Codec Option and the 4472 Codec Extension Option allow you to convert the digital data exchanged between the mobile and the 4400 into audible sound. As you know, GSM currently uses three different codecs.

Full Rate is what GSM started with and what is still the most common codec type. To convert Full Rate into audible sound, the Codec Basic Option is all you need.

Enhanced Full Rate is a newer codec algorithm that provides better speech quality than Full Rate. To convert Enhanced Full Rate into audible sound, you will need the Codec Extension Option in addition to the Basic Codec Option.

Option	Willtek order number
4470 Audio Option	M 248 360
4470 Audio Option for CDMA-only units	M 248 653
4471 Basic Codec Option (for GSM)	M 248 364
4472 Codec Extension Option (for GSM)	M 897 156



Audio measurements on the 4400

ACPM or ORFS (Output RF Spectrum) Option (for GSM, GPRS and EDGE only)

The Adjacent Channel Power Measurement (ACPM) Option provides the ETSI-specified measurements on Output RF Spectrum, both due to modulation and due to switching transients. Please refer to the 4400 data sheet for specifications. The measurements are explained in the sections about ACPM Modulation Spectrum Measurements and ACPM Transient Spectrum Measurement, respectively.

Option	Willtek order number
4475 ACPM Option	M 897 163

NOTE

This option is already included with the 4400M.

AM Signal Generator (for GSM, GPRS and EDGE only)

The Amplitude Modulation (AM) Signal Generator is required by some manufacturers for testing and for alignment of mobile phones. The functionality is explained in the related Non-Call Mode sections.

Output power level: -10 dBm
Modulation frequency range: 1 to 50 kHz
Modulation depth: 50 to 90%

Option	Willtek order number
4481 AM Signal Generator Option	M 897 165

OCXO – the high-precision time base

In its basic configuration, the 4400 is equipped with a TCXO 10 MHz time base. The specified accuracy is approx. 1E-6 or 1 ppm (10 Hz). The OCXO option provides an increased accuracy of approx. 5E-8 or 0.05 ppm (0.5 Hz).

Option	Willtek order number
4477 OCXO option	M 214 028

Parallel Multiple Phone Test SW (for GSM, GPRS and EDGE only)

This option allows to connect multiple phones to a 4400 with are then tested sequentially in order to reduce setup time. This option is ideally combined with the 4940 Bidirectional RF port (4-Port).

Option	Willtek order number
4482 Parallel Multiple Phone Test SW	M 897 209
4940 Bidirectional RF port (4-Port)	M 226 055

Little aids for speeding up tests

Test SIMs (for GSM, GPRS, EDGE and WCDMA)

A Test SIM is a Subscriber Identification Module programmed with a specific mobile phone number, the so-called Test-IMSI (International Mobile Subscriber Identity). A Test SIM is available from Willtek, with the IMSI set to 001-01-0123456789. The 4400 knows this IMSI and uses it to page the mobile under test.

The Test SIM can also be used with other mobile phone testers from Willtek.

NOTE

When a mobile is tested without a SIM card, only emergency calls are possible. Receiver tests are not supported in most cases.

Option	Willtek order number
1103 USIM and GSM Test SIM Card (GSM, GPRS, EDGE, WCDMA)	M 860 164
1102 USIM Test SIM (WCDMA only)	M 860 173

Antennas for use on the 4400

When there is a need to perform quick basic tests on a mobile, an antenna might be good to have. However, there are a couple of drawbacks using an antenna for real measurements. Section [Cabling](#) provides you with all the technical background information.

If you need to perform reproducible measurements without having the possibility of using a RF adapter cable, we recommend to work with the optional RF Shield. This is a metal box that covers the mobile under test and contains the Antenna Coupler. This Antenna Coupler carries the mobile under test and provides antennas for all mobile phone frequency ranges.

The RF Shield keeps radio interference away from the air connection. Together with a coupling loss table, the achievable measurement quality is as good as using a cable.

The RF Shield is available with either a TNC-type or N-type connector.

NOTE

The RF shield package contains both the 4921 RF Shield and the 4916 Antenna Coupler.

Antennas on the
4400



Antenna Coupler



RF Shield



Accessory	Willtek order number
Antenna for GSM 900 with TNC connector	M 860 261
Antenna for GSM 1800/GSM 1900 with TNC connector	M 860 262
4916 Antenna Coupler	M 248 641
4921 RF Shield (N) (including RF cable N – N)	M 248 346
Rear panel for RF Shield customizing	M 300 850
RF Shield Package (4921 RF Shield, 4916 Antenna Coupler)	M 248 348

MS Power Supply Option and Current Measurement Option

The MS Power Supply is an option that simulates the power supply (battery) of the mobile under test. Some of the benefits are:

- It can be used to replace an extra power supply, which may be expensive and consumes space on the desktop or in a rack.
- As with any simulated battery, you can set operating, under or over voltages in a wide range to check the mobile's reaction to that on the RF side.

In conjunction with the Current Measurement option, there are even more applications feasible to test the mobile phone:

- You can measure the average and peak current the mobile draws from the battery (e.g. when it transmits a burst).
- Even a current vs. time measurement with graphical display can be obtained.
- Last but not least, the average power requirement is calculated from the measurement results.

Option	Willtek order number
4473 MS Power Supply Option	M 248 355
4474 MS Current Measurement Option (requires MS Power Supply Option)	M 248 356

Rack installation, cases

Hard case

The Carrying Case for the 4400 is a hard case that is an ideal protection whenever the 4400 needs to be shipped or transported. It also is a safe place to store the test set.

Wheels and handle of the carrying case ease transportation. The telescopic handle can be retracted when not in use.

Dimensions: 700 x 400 x 360 mm (1.040 x 400 x 360 mm with handle fully pulled out).



Option	Willtek order number
Carrying Case	M 300 808

Rack Mount Set

Your 4400 can easily be mounted in a 19 inch rack. The optional Rack Mount Set comprises all the required material including a 19 inch front panel (5 HU) with all necessary cutouts for cables etc.



Option	Willtek order number
4490 Rack Mount Set	M 378 260

1xEV-DO Call Mode

2

This chapter describes the functionality of the 4453 1xEV-DO Call Mode Option. Topics discussed in this chapter are as follows:

- ["Overview" on page 42](#)
- ["Common elements of the call mode test menus" on page 44](#)
- ["Testing the mobile on 1xEV-DO channels" on page 50](#)
- ["System parameter menus" on page 73](#)
- ["1xEV-DO basics" on page 84](#)

Overview

This section covers information on 1xEV-DO measurements in synchronous (call) mode. For information on 1xEVDO measurements, see ["Testing the mobile on 1xEV-DO channels" on page 50](#). See also ["Common elements of the call mode test menus" on page 44](#) for more information. Additional test parameters and limits are explained in section ["System parameter menus" on page 73](#), and section ["1xEV-DO basics" on page 84](#) covers some more general aspects of the 1xEV-DO standard.

A brief glossary on the 1xEV-DO wording can be found from [page 84](#).

To select the synchronous (call) mode:

- 1 Go to the Welcome menu (see picture below).
- 2 Push the marker tab for the corresponding system option [EVDO].
- 3 Push the **Calls & Meas.** softkey.



The 4453 1xEV-DO Call Mode Option can test mobile phones designed for the following 1xEV-DO frequency bands:

Table 1 1xEV-DO frequency bands supported by the 4400

Band description	Reverse link (MS transmit)	Forward link (BS transmit)
U.S. cellular (US 800)	824 to 849 MHz	869 to 894 MHz
North American PCS (US PCS)	1850 to 1910 MHz	1930 to 1990 MHz
TACS	872 to 915 MHz	917 to 960 MHz
JTACS	887 to 925 MHz	832 to 870 MHz
Korean PCS	1750 to 1780 MHz	1840 to 1870 MHz
NMT-450	450 to 484 MHz	460 to 494 MHz
IMT-2000	1920 to 1980 MHz	2110 to 2170 MHz
700 MHz	776 to 794 MHz	746 to 764 MHz
1800 MHz	1710 to 1785 MHz	1805 to 1880 MHz
900 MHz	880 to 915 MHz	925 to 960 MHz
Secondary 800 MHz	806 to 901 MHz	851 to 940 MHz
400 MHz PAMR	451 to 458 MHz	461 to 468 MHz
800 MHz PAMR	870 to 876 MHz	915 to 921 MHz

Note: Frequency bands below 430 MHz, like channels 539 to 871 of the NMT-450 band or the European 400 MHz band are not supported by the 4400.

Common elements of the call mode test menus

Test parameters

CCH	589	RF Out	-20.0 dBm
TCH	589	Appl	FTAP
Band	US 800		

These entry and display fields offer the possibility to easily view and in some cases, alter important test parameters.

CCH — Channel number for the control channel. This is the frequency channel at which the 4400 transmits the logical channels that the mobile requires to synchronize with the simulated network and to initiate a session. The valid input range depends on the selected frequency band. This entry field will become a display field once a data connection is established.

NOTE

Section "[Basic specifications of 1xEV-DO bands](#)" on page 89 gives an overview of the channel numbers used in the various 1xEV-DO bands. With the help of the information provided there, it is also possible to calculate the RF frequency from the channel number.

RF Out — RF output level of the 4400's signal, or the input level at the mobile phone if the coupling loss is selected correctly. The valid range is from -120 to -12.5 dBm.

NOTE

The output level will only be correct when the load impedance is 50 Ω .

TCH — Channel number of the TCH (= Traffic or Data Channel). During a data connection, this channel will be used for (data) transmission. If you change the setting of this entry field during a data connection, a handover to the new channel will be performed automatically (hard handover). The valid input range depends on the selected frequency band.

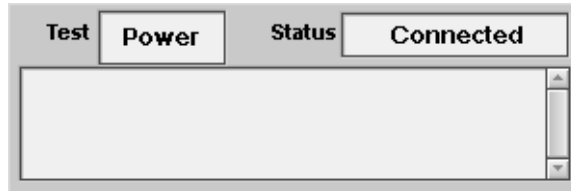
Appl — Display field, providing information about the test application protocol (TAP) used. Either FTAP (receiver measurements) or RTAP (transmitter measurements) will be displayed here. The TAP can be selected on the **Param... > Traffic Channel** menu, see [page 76](#) for details.

Band — The frequency band which is used to transmit the CCH or TCH. The channel number together with the frequency band identify the carrier frequency. For details, see section "[Basic specifications of 1xEV-DO bands](#)" on page 89.

NOTE

Further parameters as well as the limits for evaluation of the measurement results can be modified using the **Param...** menus, see section "[System parameter menus](#)" on page 73

Status



The status area shows both the overall results of the current test and the signaling status.

Test

On this display field, the 4400 will show one of the following items, depending on its current state:

PASS	All measurement results of the current test are within their limits. Note: This is only displayed for measurements, which do not have a bar display associated with them.
FAIL	This mark indicates that test limits have been violated by the measurement results. Note: This is only displayed for measurements, which do not have a bar display associated with them.
---- (Four hyphens)	Will be displayed in case - the measurement has not been started yet, or - when there are no limits available, or - when there are multiple measurements being performed on the current screen.
POWER, MIN, MAX	When performing the Min/Max power test, the display field indicates the current test type.

Status

This display field shows the signaling status from the 4400's point of view:

Idle	This is the status as long as there is no signaling between the 4400 and the mobile. In its idle state, the 4400 broadcasts all logical channels required by the mobile in order to synchronize to the 4400 and to initiate a session (i.e. transmit its access probe).
-------------	---

Session Open	<p>In 1xEV-DO, only the mobile (AT) can initialize a session by sending an UATI Request.</p> <p>If the session open parameter is enabled (Param... > Traffic Channel, see page page 78 for details), then the 4400 will respond to the UATI Request and the session negotiation will start.</p> <p>Once the session negotiation is completed successfully, the state will change to Session open (see below).</p> <p>If the session open parameter is disabled, the 4400 will not react to the mobile's access probes.</p>
Connected	<p>The connection negotiations have been completed successfully and a data connection between the 4400 and the mobile is established.</p> <p>Please note that the data connection can either be initialized by the 4400 or by the mobile.</p>
- - - - - (six hyphens)	<p>This indicates that the 4400 has not reached its Idle status yet. This will only be displayed very shortly when starting up the 1xEV-DO Call Mode option.</p>

The large display field below provides more details on the current state and a short signaling history. On some of the menus, you can even scroll back within the history using the **PgUP**, **PgDN**, **UP** and **DN** keys.

Statistical test evaluation

Results	Curr.	Min.	Avg.	Max.	Count	11
Rho	0.9991	0.9987	0.9992	0.9994		
Freq. Error (Hz)	-1892	-1895	-1891	-1888		

The following information can be found in the results table:

- Count** On some of its test menus, the 4400 provides you with statistical evaluations of the measurement results. These statistical evaluations are obtained by running a test a multiple number of times. The figure shown on this field above the bar display indicates the number of times, a test was run.
- Curr.** This column presents the current measurement value(s). These are the last measurements obtained without any statistical evaluation.
- Min.** The absolute minimum of all measurements obtained.
- Avg.** The average value calculated using the last N measurement results. See below for more information about averaging.
- Max.** The absolute maximum of all measurements obtained.

NOTE

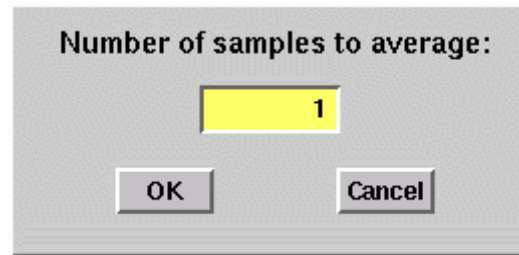
The bar display is described in section "Display fields" on page 26.

NOTE

To (re-)initialize a statistical evaluation, simply push the **Reset** softkey.

Averaging

The average value on the results screens is determined by the last N measurements. The number N can be entered on the **Number of samples to average** entry field. This entry field is located on a pop-up box (see below) that is available on some (not all) of the test menus. To access this box, push **ENTER** while on the **Avg.** entry field or click this entry field the mouse.



Entry range: any number from 1 to 100.

To exit the pop-up box, select **OK** and confirm your selection by pushing **ENTER**. Alternatively, use the mouse to click on the **OK** button.

Idle state

In its idle state, the 4400 broadcasts its forward control channel (F-CCH). The related network and access channel parameters transmitted can be set using the **Param... > Network Setup** menu (see [page 73](#) for details).

The mobile needs these parameters in order to synchronize to the 4400 and to calculate its parameters for the access probe.

Idle state at mobile

At power on, the mobile will look for the strongest forward pilot (F-Pilot). The F-Pilot is a logical channel transmitted by the 4400 on the F-CCH frequency set by the user.

Once the mobile is synchronized to the 4400 and has successfully received the access probe parameters provided on the F-CCH, it is in its idle state and ready to initiate a session.

Softkeys in idle state

In its idle state, the 4400 displays the following softkeys:



Calls a set of parameter menus on-screen. With the help of these menus, you may set and modify network, access channel, and further parameters.

See section ["System parameter menus" on page 73](#).



Pushing this softkey freezes the live display: The measurement results obtained last will be kept on display and no new measurements will be shown.

The softkey changes to **Unfreeze**. Pushing the softkey again reactivates the live display.

Note: While in idle state, a push on this softkey will be without visible effect.



This softkey re-initializes the statistical evaluation of the measurement results. All results from previous measurements will be deleted.

Note: While in idle state, a push on this softkey will be without visible effect.

Session Open State

Once a mobile is in its idle state, it may send an UATI Request message in order to initiate a session. Most mobiles will do so automatically once they reach the idle state.

Depending on the current setting of the **Session Open** parameter (**Param... > Traffic Channel**, see [page 78](#) for details), the 4400 will either respond to the mobile's request or will ignore it.

In case the 4400 responds to the mobile's UATI Request message, the parameters for the current session will be negotiated between the 4400 and the mobile. Once the parameter negotiation is completed successfully, both the 4400's and the mobile's state will change to session open.

Note: In 1xEV-DO, the base station can not initiate a session.

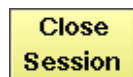
Softkeys in session open state

In its session open state, the 4400 displays the following softkeys:



Calls a set of parameter menus on-screen. With the help of these menus, you may set and modify the network, reverse channel, and further test parameters.

See section "[System parameter menus](#)" on [page 73](#).



Pushing this softkey will make the 4400 close the current session. The Call Graph will be updated accordingly.



This softkey will make the 4400 send a page message to the mobile to initiate the connection negotiate procedure. Once the connection negotiation is completed successfully, a data connection between the 4400 and the mobile is established and both the 4400's and the mobile's state changes to connected.



Pushing this softkey freezes the live display: The measurement results obtained last will be kept on display and no new measurements will be shown.

The softkey changes to **Unfreeze**. Pushing the softkey again reactivates the live display.

Note: This softkey does not affect the signaling between the 4400 and the mobile in any way.



This softkey re-initializes the statistical evaluation of the measurement results. All results from previous measurements will be deleted.

During session negotiation, the [Status](#) display field keeps you informed about the current state.

Connected State

Once a session is opened, either the mobile or the 4400 can initiate a data connection.

If the 4400 initiates the data connection (following a push on the **Connect** softkey), it will page the mobile and direct it to send a Connection Request message.

If the mobile initiates the data connection, it will just send the Connection Request message and thus initiate the connection negotiation procedure.

Once the connection negotiation is completed successfully, a data connection between the 4400 and the mobile is established and both the 4400's and the mobile's state changes to connected. All tests and measurements can now be performed.

Softkeys in connected state

In its connected state, the 4400 displays the following softkeys:



Calls a set of parameter menus on-screen. With the help of these menus, you may set and modify network parameters, test parameters, limits and so on.

See section "[System parameter menus](#)" on page 73.



Pushing this softkey will make the 4400 close the current session. The Call Graph will be updated accordingly.



This softkey will make the 4400 terminate the data connection with the mobile. Both the 4400 and the mobile will change their state to session open and the session will be maintained.

The Call Graph will be updated accordingly.



Pushing this softkey freezes the live display: The measurement results obtained last will be kept on display and no new measurements will be shown.

The softkey changes to **Unfreeze**. Pushing the softkey again reactivates the live display.

Note: This softkey does not affect the signaling between the 4400 and the mobile in any way.



This softkey re-initializes the statistical evaluation of the measurement results. All results from previous measurements will be deleted.

During connection negotiation, the [Status](#) display field keeps you informed about the current state.

Once a data connection between the 4400 and the mobile is established, you may perform any measurement.

Testing the mobile on 1xEV-DO channels

Your 4400 comes with many clever thought-through features that keep 1xEV-DO testing as simple as possible. There is no need for you to study piles of literature. With the 4400, you will achieve meaningful measurement results with just the push of a few buttons.

Section "Crash course" on page 4 gives a short guideline on how to connect a mobile and perform tests.

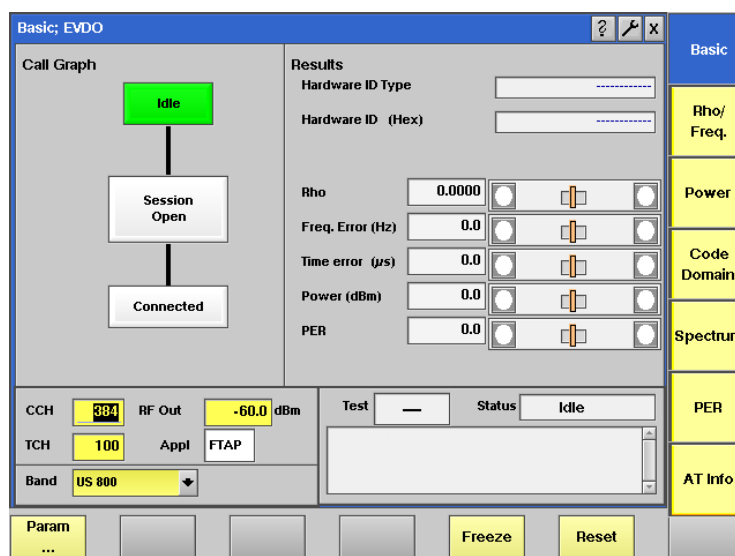
Need to know more about the user interface of the 4400? Just navigate to "Menus and levels" on page 21 and you will find all you need to know.

The structure of this chapter reflects the different test menus available with the marker tabs:

- "Basic test menu" on page 50
- "Rho/Frequency test menu" on page 55
- "Overview of power tests" on page 57
- "Min/Max power test menu" on page 57
- "Code domain power test menu" on page 60
- "Modulation spectrum test menu" on page 61
- "ACPM modulation spectrum test menu" on page 64
- "PER test menu" on page 68
- "AT Info test menu" on page 70

Basic test menu

The basic test menu provides all important tests on a single screen and thus is the ideal tool to check whether a 1xEV-DO mobile is working correctly. In combination with the possibility to adapt the main test parameters (see page 44) to your requirements, the basic test menu is an ideal test-time saver.



The basic test menu provides you with

- a graphical overview of the signaling (Call Graph)
- the most important test results of the mobile's transmitter and receiver in both graphical and numerical formats (Results)
- the mobile's hardware ID Type and ID.

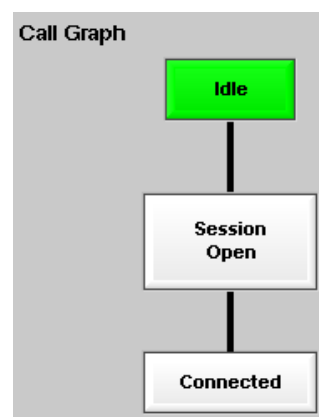
NOTES

The functions of the softkeys depend on whether or not a session or a data connection has been established. See sections "[Softkeys in idle state](#)" on page 47, "[Softkeys in session open state](#)" on page 48 and "[Softkeys in connected state](#)" on page 49 for the available softkey functions.

Details regarding the parameters of this menu can be found in section "[Test parameters](#)" on page 44.

Need to know more about the Test and Status area of this menu? All details can be found in section "[Status](#)" on page 45.

Call Graph The call graph is the call status display in graphical form. It allows you to instantly identify the current status of a call and the executable measurements.



In its idle state (see picture above), the 4400 broadcasts all required logical channels and is ready to receive the mobile's UATI Request message.

How to read the call graph



The rectangular box with the green background indicates the current state of the call.



The black lines indicate the possible paths from one state to another.



All rectangular boxes with white background indicate states that can be reached using the paths.



The orange line indicates the path that was used to achieve the current state.

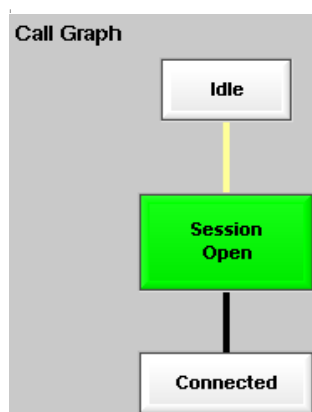
Initiating a session

Once a mobile is in its idle state, it may send an UATI Request message in order to initiate a session. Most mobiles will do so automatically once they reach the idle state.

Depending on the current setting of the **Session Open** parameter (**Param... > Traffic Channel**, see [page 78](#) for details), the 4400 will either respond to the mobile's request or will ignore it.

In case the 4400 responds to the mobile's UATI Request message, the parameters for the current session will be negotiated between the 4400 and the mobile. Once the parameter negotiation is completed successfully, both the 4400's and the mobile's state will change to session open (see picture below).

Note: In 1xEV-DO, the base station can not initiate a session.



During session negotiation, the 4400 reads out the mobile's hardware ID type and its hardware ID and displays the two items in the results area on-screen:



How to read the basic test menu's results display in session open state

Hardware ID Type This display field provides the hardware ID type as transmitted by the mobile during session negotiation.

Hardware ID The mobile's hardware ID will be displayed here in hexadecimal format. This parameter is transmitted by the mobile during session negotiation.

Once a session has been opened, the softkeys will change, see section "[Softkeys in session open state](#)" on [page 48](#) for details.

Establishing a data connection

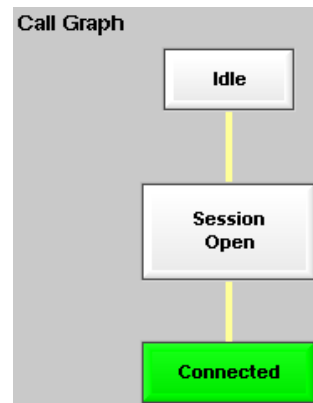
Once a session is opened, either the mobile or the 4400 can initiate a data connection.

If the 4400 initiates the data connection (following a push on the **Connect** softkey), it will page the mobile and direct it to send a Connection Request message.

If the mobile initiates the data connection, it will just send the Connection Request message and thus initiate the connection negotiation procedure.

Once the connection negotiation is completed successfully, a data connection

between the 4400 and the mobile is established, both the 4400's and the mobile's state changes to connected and the call graph will be updated as shown in the picture below.



In addition to the mobile's hardware ID type and its hardware ID, the 4400 will now also display the results of the most important tests:

Results	
Hardware ID Type	0x00010000
Hardware ID (Hex)	0x00000000
Rho	0.9994
Freq. Error (Hz)	-1887.5
Time error (µs)	2494.9
Power (dBm)	-17.7
PER	0.0

How to read the basic test menu's results display in connected state

The current measurement results are shown on the display fields. The bar displays (see page 27 for details) provide a statistical evaluation of all measurement results obtained. To reset the bar displays, push the **Reset** softkey.

Rho Rho is the waveform quality factor, a measure of the modulation accuracy. The waveform quality factor is indicated and frequently updated during a data connection. A value of 1 indicates perfect waveform quality.

Related test menu: **Rho/Freq.**

Related test limits: **Param... > Limits Cont.**

Freq. error The frequency error (displayed in Hertz) is a measure of the synthesizer accuracy. The frequency error is frequently updated during a data connection. A value of 0 Hz indicates perfect synthesizer accuracy.

Related test menu: **Rho/Freq.**

Related test limits: **Param... > Limits Cont.**

Time error The time error indicates the transmit time error (Tau) with respect to the forward channel timing. The result is displayed in microseconds (E^{-6} seconds). The ideal value for the time error is 0 μ s.

Related test menu: **Rho/Freq.**

Related test limits: **Param... > Limits Cont.**

Power The 4400 measures and displays the mobile's effective radiated power (ERP) on the R-TCH during transmission in dBm.

Related test menu: **Min/Max Power**

Related test limits: **Param... > Limits...**

Note: The mobile's ERP depends on the power control mechanism selected in the **Parameters > Traffic Channel** menu (see [page 76](#)) and on the power level the mobile receives the 4400 at. The higher the 4400's RF Out (**RF Out** entry field), the lower the mobile's transmit power will be.

PER The PER (Packet Error Rate) is a measure for the quality or sensitivity and dynamic range of the mobile's receiver. The PER is indicated in percent (related to the number of packets transmitted in total).

Related test menu: **PER**

Related test limits: **Param... > Limits Cont.**

Note: The result of this measurement will heavily depend on the 4400's RF output level (**RF Out** entry field).

For more details on the PER test, see [page 68](#).

NOTE

The limits for the tests can be set in the related parameter menus. See section "[Limits menus](#)" on [page 80](#) for details.

NOTE

A difference of some 1 dB between the expected and the measured ERP is quite normal. However, this difference could also be due to power losses on connectors and RF cables. Those losses can be compensated using the Coupling loss tool.

Further test functions

Hard handover

When entering a different TCH number (**TCH** entry field), the 4400 will automatically perform a hard handover.

Simulating a far base station

To simulate a far base station, set the 4400's RF output level (**RF Out** entry field) to low levels (e.g. -100 dBm). Reducing the 4400's RF out should make the mobile increase its output power. There will also be an effect on the PER measurement (PER rate should increase).

Simulating a near base station

To simulate that the mobile is located close to the base station, set the 4400's RF output level (**RF Out** entry field) to high levels (e.g. -20 dBm). Increasing the 4400's RF out should make the mobile decrease its output power. There will also be an effect on the PER measurement (PER rate should be around 0).

Rho/Frequency test menu

This test menu provides you with all relevant parameters required to judge the mobile's modulation and transmitter quality.

NOTES

This test can only be performed after a data connection has been established between the 4400 and the mobile under test.

Regarding the statistical test evaluation, see section "Statistical test evaluation" on page 46 for details; the bar display is described on page 27.

For a description of the softkey functions see section "Softkeys in connected state" on page 49.

Details regarding the most important parameters of this menu can be found in section "Test parameters" on page 44. The related limits of this test menu are set in the **Param... > Limits Cont.** menu, see section "Limits continued" on page 81.

Need to know more about the Test and Status area of this menu? All details can be found in section "Status" on page 45.



The Rho/Frequency test menu's results display shows the numeric measurement results and their statistical evaluation.

Results	Curr.	Min.	Avg.	Max.	Count	11
Rho	0.9991	0.9987	0.9992	0.9994		
Freq. Error (Hz)	-1892	-1895	-1891	-1888		
Time Error (µs)	-2088.44	-2088.44	36.550	3145.92		
RMS EVM (%)	3.0	2.4	2.9	3.6		
RMS Mag. Error (%)	1.6	1.5	1.6	1.6		
RMS Phase Error (deg)	1.49	1.09	1.37	1.88		
Carrier Feedthrough (dBc)	-44.6	-45.2	-44.5	-43.6		
I/Q Imbalance (dB)	-53.1	-53.9	-53.2	-52.2		

How to read the Rho/Frequency test results display

The statistical evaluation of the measurement results is displayed as current, minimum, average and maximum values. The bar displays give a graphical representation of the test results in relation to the applicable measurement limits.

Rho Rho is the waveform quality factor, a measure of the modulation accuracy. The waveform quality factor is indicated and frequently updated during a data connection. A value of 1 indicates perfect waveform quality.
Note: 3GPP2 C.S0033 specifies that Rho must be greater than 0.944.

Freq. error The frequency error (displayed in Hertz) is a measure of the synthesizer accuracy. The frequency error is frequently updated during a data connection. A value of 0 Hz indicates perfect synthesizer accuracy.
Note: The applicable measurement limits may vary with the frequency band in use (**Band** selection field).

Time error The time error indicates the transmit time error (Tau) with respect to the forward channel timing. The result is displayed in microseconds (E^{-6} seconds). The ideal value for the time error is 0 µs.
Note: 3GPP2 C.S0033 specifies that the time error must be within ± 1 µs.

RMS EVM The RMS EVM is a measure of the modulation accuracy at the constellation points (symbols). The error vector magnitude (EVM) is the difference between the vector of the received signal and that of the ideal (expected) signal. The root mean squared (RMS) value is an average of all EVMs for all constellation points over a whole measurement interval.
 The RMS EVM is given as a percentage, related to the ideal signal. Therefore, the ideal value for the RMS EVM is 0%.
Note: The error vector can be broken down into a magnitude and a phase component; see magnitude and phase errors below.

RMS Mag. Error	Here, the 4400 displays the root mean squared magnitude component of the error vector (see above) at the constellation points. The magnitude error is given as a percentage, related to the ideal signal. Therefore, the ideal value for the RMS Mag. Error is 0%.
RMS Phase Error	This is the root mean squared phase component of the error vector (see above) at the constellation points. The phase error is given as a percentage, related to the ideal signal. Therefore, the ideal value for the RMS Phase Error is 0%.
Carrier Feedthrough	The carrier feedthrough is an undesired leakage of the unmodulated carrier at the nominal R-TCH frequency. As it is caused by a DC-offset in the mobile's I/Q modulator, this measurement can be used to trim this offset. The measurement results are displayed in dBc.
I/Q Imbalance	The I/Q imbalance indicates the accuracy of the I/Q modulator's output signal spectrum. It is the ratio of the power produced in the undesired sideband(s) and in the desired sideband(s) and is expressed in dB. I/Q imbalance usually is caused by a physical differences (e.g. amplitude) between the input signals to the I/Q modulator.



Shows the total number of measurements used to calculate the statistical results.

Overview of power tests

Precise power control is an important prerequisite for optimum CDMA network performance. Multiple power measurements are defined to check proper behavior of the mobile phone in the real network.

The following power test menus are available:

- ["Min/Max power test menu" on page 57](#) – measures the minimum and maximum transmit power levels supported by the mobile.
- ["Code domain power test menu" on page 60](#) – displays the power of the code channels and the in-phase (I) and quadrature (Q) signals.

The code domain power test menu may be accessed from the 1xEV-DO basic test menu by pushing the [Code Domain] marker tab.

For the other power test menus, push the [Power...] marker tab to access the power tests. Then push the marker tab for the power measurement you would like to perform or the [Basic...] marker tab to return to the 1xEV-DO basic test menu.

Min/Max power test menu

From the 1xEV-DO basic test menu, push the [Power...] marker tab to enter the Min/Max (Mobile Transmitter RF Power) test menu.

NOTES

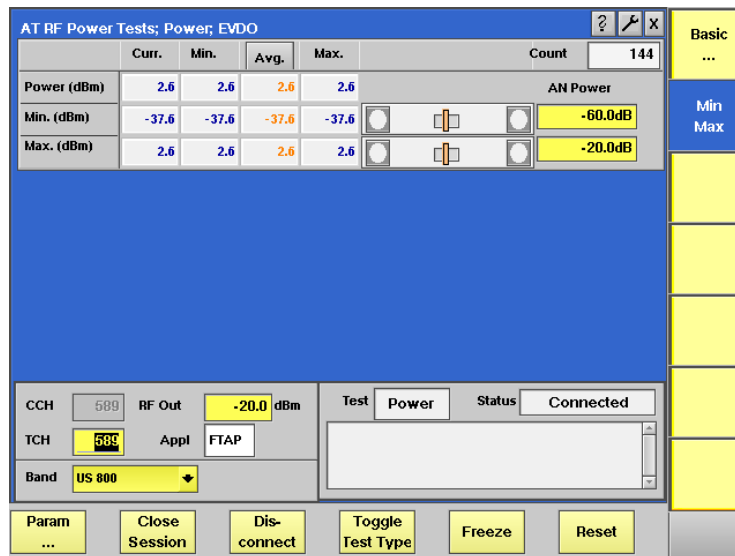
This test can only be performed after a data connection has been established between the 4400 and the mobile under test.

Regarding the statistical test evaluation, see section "Statistical test evaluation" on page 46 for details; the bar display is described on page 27.

For a description of the softkey functions see section "Softkeys in connected state" on page 49.

Details regarding the most important parameters of this menu can be found in section "Test parameters" on page 44.

Need to know more about the Test and Status area of this menu? All details can be found in section "Status" on page 45.



Function

This test menu shows three different types of measurements. Each measurement type represents the mobile's effective radiated power (ERP) under a specific condition. A toggle softkey allows to switch between the measurement types. The three measurement types are:

- The Power measurement displays the mobile's current power level, which depends on the power control mechanism selected in the Common Parameters section in the **Parameters > Traffic Channel** menu (see page 76) and on the power level the mobile receives the 4400 at. The higher the 4400's RF Out (AN Power) value, the lower the mobile's transmit power will be.
- The Min. measurement represents the minimum power level supported by the mobile. Setting the mobile to its lowest power level is achieved by a combination of open loop power control (where the 4400's output power is set to a high level) and closed loop power control (the mobile is repetitively told to decrease its power level).
- The Max. measurement displays the maximum power level supported by the mobile. The high power level of the mobile is the result of the 4400's output power being set to a very low level and the closed loop power control repetitively commanding the mobile to increase its output power.

Note: These three measurement types can not be performed simultaneously as the related power control commands for the mobile contradict each other.

NOTE

While in Min. or Max. power measurement, the 4400 will set the power control commands automatically and thus overrides the manual selection of the power control mechanism. Once you select the Power measurement type or leave this test menu, the 4400 returns to the manual power control selection.

Selecting the measurement type

Use the **Toggle Test Type** softkey to change between Power, Min. and Max. measurements. The Test display field of the menu's status section (see page [page 45](#) for details) indicates the measurement type currently selected.

When the test type is set to **Power**, the 4400 will apply the output power level displayed on the **RF Out** entry field.

How to read the Min/Max power test menu's results display

The statistical evaluation of the measurement results is displayed as current, minimum, average and maximum values. The bar displays give a graphical representation of the test results in relation to the measurement limits.

Power	The 4400 measures and displays the mobile's effective radiated power (ERP) on the R-TCH during transmission in dBm. Measurement results will only be updated when this test is selected using the Toggle Test Type softkey. Note: The mobile's ERP depends on the power control mechanism selected in the Parameters > Traffic Channel menu (see page 76) and on the power level the mobile receives the 4400 at. The higher the 4400's RF Out (RF Out entry field), the lower the mobile's transmit power will be.
Min.	The minimum power level (in dBm) is measured when the Min. test type is selected.
Max.	The maximum power level (in dBm) is measured when the Max. test type is selected.



Shows the total number of measurements used to calculate the statistical results.

Selecting measurement-specific parameters

Min. AN Power — This is the power level (in dBm) received by the mobile phone. If no coupling loss compensation is active, this is the RF Out level of the 4400. The default value is -25 dBm.

Max. AN Power — This is the power level (in dBm) applied to the mobile phone receiver. If no coupling loss compensation is active, this is the RF Out level of the 4400. The default value is -104 dBm.

Min. Power Limits – To change the upper limit for the minimum power, go to the **Parameters > Limits** menu and select the Minimum Power parameter. There is no lower limit for the Minimum Power.

Max. Power Limits – The lower and upper limits for Max. power depend on the mobile's power class (and thus also from the frequency band tested on). To change these limits, go to the **Parameters > Limits** menu and select the band used and the corresponding power class of the ERP matrix.

Note: The mobile's actual power class is entered on the AT Info test menu (see page 71 for details).

Power Control – The mechanism for closed loop power control is determined in the Common Parameters section in the **Parameters > Traffic Channel** menu.

Code domain power test menu

When a mobile transmits data with a high data rate, using multiple code channels, the Code Domain test menu shows the transmit power for each code channel, relative to the absolute power for the complete transmit signal.

NOTES

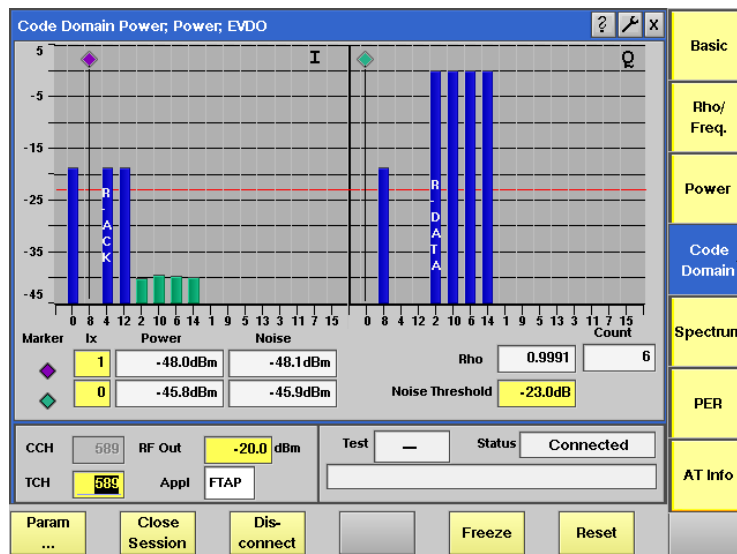
This test can only be performed after a data connection has been established between the 4400 and the mobile under test.

Regarding the statistical test evaluation, see section "Statistical test evaluation" on page 46 for details; the bar display is described on page 27.

For a description of the softkey functions see section "Softkeys in connected state" on page 49.

Details regarding the most important parameters of this menu can be found in section "Test parameters" on page 44.

Need to know more about the Test and Status area of this menu? All details can be found in section "Status" on page 45.



How to read the results display

The live display shows bars indicating the power in specific code channels. The measurements are separated by I/Q proportions. Different colors are used to mark active channels and noise:

- Active channels are shown in blue.
- The code channel noise is colored in green.
Note: The code channel noise is measured by subtracting the reference signal (i.e. the 'ideal' signal) from the signal received. The resulting error signal is then despread with all of the W_n^{16} codes. This is done for both I and Q components of the error signal.
- If the power level of an inactive code channel exceeds the noise threshold (**Noise Threshold** entry field), it is colored in red.

There is one display marker provided for each proportion (I, Q) to read out both code channel power and code channel noise.

The waveform quality factor **Rho** indicates the overall modulation quality.

Setting up code domain power test menu parameters

The only parameter of significance to this test menu is the Noise Threshold, expressed in dB relative to the power level of the active code channels. This value is used as a limit for unacceptably high noise levels in code channels. The threshold is indicated as a red horizontal line on the live display; any channel with a noise power exceeding this threshold is indicated by a red bar.

Overview of spectrum test menus

Precise spectrum management is always an important issue in radio communication systems in order to avoid interference. The spectrum analyzer menus provide test capabilities to evaluate the RF signals received by the 4400 in the frequency domain. Two different measurement menus are available: Modulation spectrum and ACPM due to modulation.

- ["Modulation spectrum test menu" on page 61](#) – provides an overview of the spectrum measurements due to modulation.
- ["ACPM modulation spectrum test menu" on page 64](#) – here you will find all information regarding ACP measurements.
- ["Softkeys" on page 67](#) – provides an overview of the softkeys used in the spectrum measurement menus.

To access the spectrum test menus, simply push the [Spectrum] marker tab. A push on **Esc** will take you back to the 1xEV-DO test menus.

Modulation spectrum test menu

This test menu provides the measurement of the mobile's signal power in the frequency domain. The signal bandwidth is a function of the chip rate. With a chip rate of 1.2288 Mcps and a BPSK modulation, the signal bandwidth is 1.2288 MHz. Because of its sharp edges, the ideal modulation spectrum display is frequently referred to as 'Bart's head'.

The measurement of the spectrum due to modulation is a useful tool for

- adjusting the mobile's I/Q modulator, and
- detecting side waves of the carrier or spurious emissions.

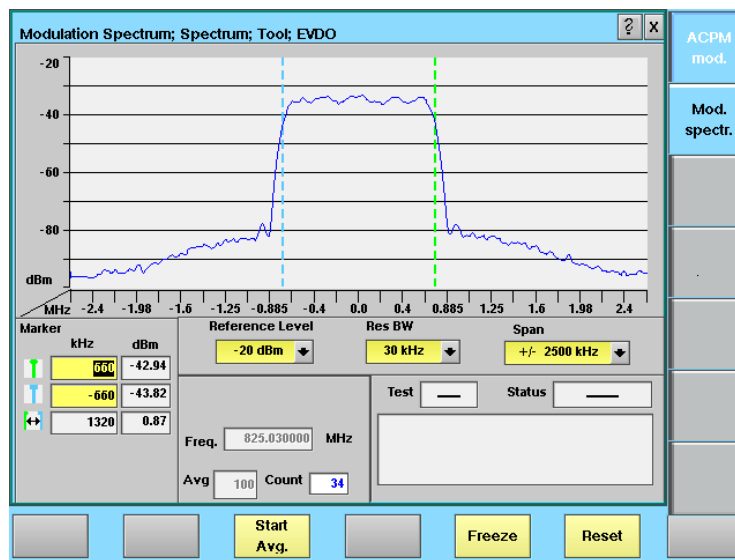
The modulation spectrum test menu provides a live display of the mobile's RF signal's spectrum. To call the menu, simply push the [Mod. spectr.] marker tab.

NOTES

This test can only be performed after a data connection has been established between the 4400 and the mobile under test.

For a description of the softkey functions see section "Softkeys" on page 67.

Need to know more about the Test and Status area of this menu? All details can be found in section "Status" on page 45.



On first sight

The mobile's modulation spectrum is displayed graphically in the test menu's live display. The live display is updated continuously (as long as it has not been frozen). The vertical axis of the spectrum live display is scaled in dBm, the horizontal axis in MHz.

To read the exact measurement at any position, simply use the display markers (see page 27 for details).

The center frequency and the current state are displayed in the lower right corner of the menu.

The softkeys provide access to important tools of the spectrum analyzer.

Entry fields

Reference Level — This selection field allows to set the RF power level that is represented by the top horizontal line of the live display.
Entry range: -40 to +40 (dBm) in increments of 10 dB.

NOTE

The value selected here should be equal or slightly higher than the expected maximum RF power level on the measurement frequency in order to avoid overload distortion and to achieve maximum vertical resolution.

Res BW — Selection field to set the horizontal resolution. A high resolution (i.e. a small value selected) will provide more details while a low resolution (i.e. a large value selected) will provide a better overview.

Selections possible: 15 kHz | 30 kHz

Span — Selection field to set the frequency range shown in the live display.

Selections possible: ± 1250 kHz | ± 2500 kHz

Center frequency

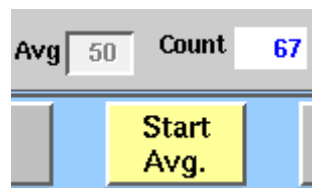
The center frequency of the spectrum analyzer is the R-TCH channel frequency. This frequency cannot be modified from the RF spectrum analyzer menus. It is given by the traffic channel number assigned in the 1xEV-DO test menus. The corresponding frequency is displayed on-screen in the Freq. display field.

Example: R-TCH channel number 1 in the US 800 band equals a center frequency of 825.030 MHz.

Averaging the Modulation Spectrum

The 4400 provides a useful tool to smoothen the RF modulation spectrum curve: the averaging function.

This means that a user-definable number of the continuous measurements will be taken and the single measurement results will be averaged. The result will be a curve that better shows the spectrum characteristics of the mobile while singular or random noise effects will disappear.



To start the averaging tool, push the **Start Avg.** softkey.

The 4400 will now start the averaging process, using the number of measurements set on the **Avg** entry field.

The entry range is from 1 to 100.

Notes on the averaging tool

- The **Avg** entry field is not accessible unless the averaging process has been started (**Start Avg.** softkey).
- As soon as you change the current setting on the **Avg** entry field, the averaging process will be reset. This means that all previous measurements will be discharged and the series of measurements will be started anew.
- A reset of the averaging process can also be achieved by pushing the **Reset** softkey.
- While the number of measurements taken is less than the value set on the **Avg** entry field, the number of measurements taken (display field **Count**) will be shown in red.
- When the number of measurements taken (display field **Count**) exceeds the number of measurements specified for the averaging process (**Avg** entry field), always the last **Avg** measurements will be averaged and displayed in the live display.

- When the live display has been frozen, a push on the **Reset** softkey will both set the live display back to unfrozen and reset the averaging tool.

For an explanation of the softkeys of this test menu, see section "Softkeys" on page 67.

ACPM modulation spectrum test menu

ACPM is an abbreviation of Adjacent Channel Power Measurement. ACPMs are used to verify that the mobile does not create sideband emissions that would then disturb transmission on adjacent traffic channels. The results of this measurement are influenced by the following internal stages of the mobile under test:

- channel synthesizer,
- baseband filter, and
- I/Q modulator.

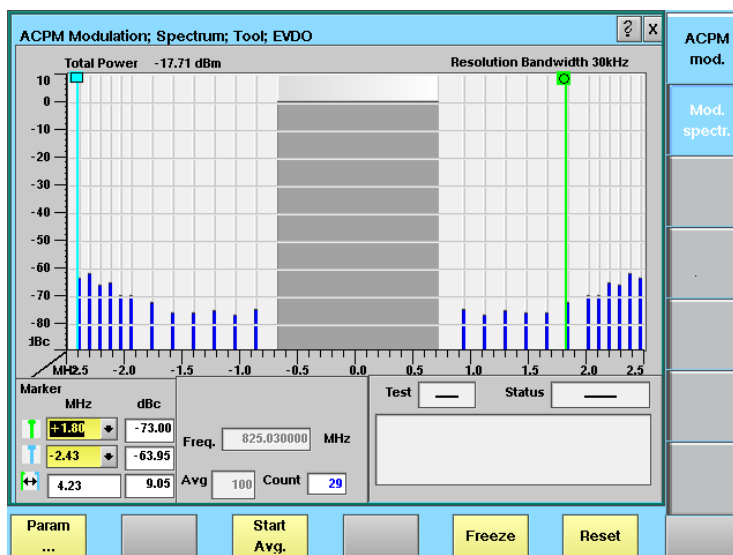
The following defects of the mobile may be detected with this measurement:

- neighboring waves of the synthesizer and
- asymmetry of the I/Q modulator.

NOTE

The results of the "Rho/Frequency test menu" on page 55 also indicate whether the internal stages of the mobile's transmitter work properly.

To call the menu, simply push the [ACPM mod.] marker tab while in the spectrum menus.



Understanding the measurement principle

First, a reference measurement at the carrier frequency (R-TCH) is performed. The absolute power level measured is displayed in the upper left corner of the test menu, above the live display (Total Power). This reference level measured equals 0 dBc.

The 4400 then performs level measurements at specific frequency offsets using

a 30 kHz bandwidth filter. The specific measurement frequencies depend on the frequency band being used (see below). The measurement results are displayed as vertical bars in relation to the reference level (in dBc).

On first sight

The ACPM spectrum is displayed graphically in the test menu's live display for the discrete frequencies given by the 1xEV-DO specification. The live display is updated continuously (as long as it has not been frozen).

To read the exact measurement at any position, simply use the display markers (see [page 27](#) for details).

The softkeys provide access to important tools of the spectrum analyzer.

The vertical axis of the spectrum live display is scaled in dBc; the horizontal axis in MHz. Both horizontal and vertical resolutions are fixed.

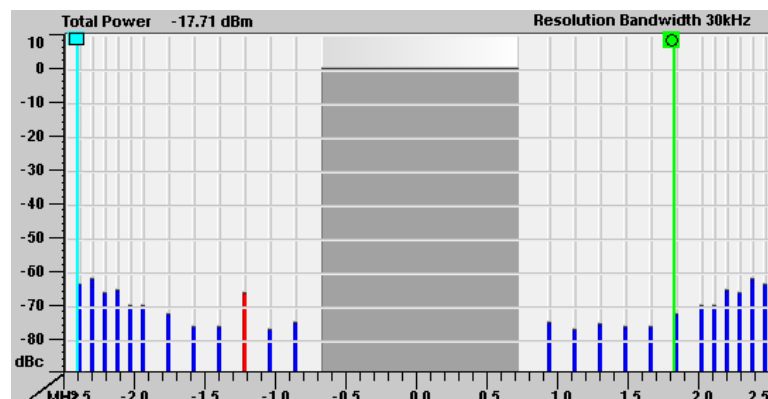
Center frequency

The center frequency of the spectrum analyzer is the frequency of the expected R-TCH. This frequency cannot be modified from the RF spectrum analyzer menus. It is given by the traffic channel number assigned in the 1xEV-DO test menus.

The corresponding frequency is displayed on-screen in the Freq. display field.

Example: R-TCH channel number 1 in the US 800 band equals a center frequency of 825.030 MHz.

How to read the spectrum live display



User-definable measurement frequencies and test limits for each band can be defined in the Parameters menu. Measurement points can be set in a range of ± 2500 kHz around the center frequency. The gray area marks the in-channel band in which adjacent channel power measurements cannot be taken.

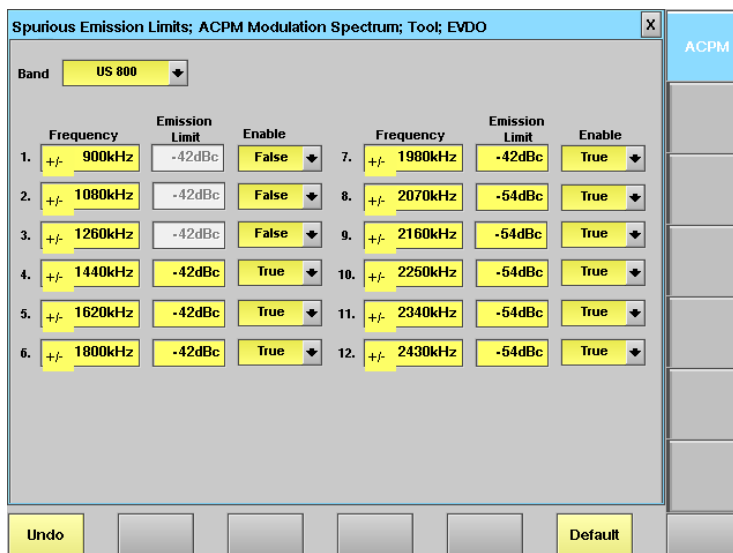
When the measurement result for an individual frequency is within the limits, the corresponding **vertical bar** will be displayed in blue.

A vertical bar displayed in red indicates that the current measurement result is beyond the limits.

Setting measurement frequencies and limits

The measurement frequencies and corresponding limit values can be defined in the spurious emission limits menu of the ACPM test menu.

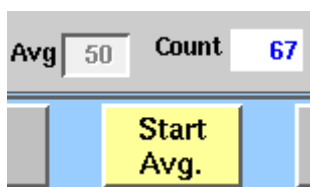
- 1 In the ACPM modulation spectrum test menu, push the **Param...** softkey. The spurious emission limits menu will be displayed.



- 2 Select the frequency band you are working on using the **Band** selection field.
Note: The Band selection field in this menu is for selecting the appropriate limits; the band can not be changed by this selection. To change the band, return to the 1xEV-DO test menus.
- 3 Enter the frequencies which you want to measure on. Valid entries are in a range of ± 2500 kHz around the center frequency with a 10 kHz resolution. Up to twelve frequencies can be defined.
- 4 If you want to apply the check of the measurement results against the upper limit for a specific frequency, set the corresponding **Enable** field to True.
Note: This parameter is set to False by default for all in-band frequencies.
- 5 If appropriate, enter an upper limit in the corresponding **Emission Limit** entry field after enabling limit checking (see step 4). The limits are expressed in dBc, relative to the power at the center frequency.

Averaging the ACPM modulation spectrum

The 4400 provides a useful tool to smoothen the ACPM modulation spectrum curve: the averaging function. This means that a user-definable number of the continuous measurements will be taken and the single measurement results will be averaged. The result will be a smoother result curve that better shows the characteristics of the mobile while singular peaks (that might be due to spikes or other measurement errors) will disappear.



To start the averaging tool, push the **Start Avg.** softkey. The 4400 will now start the averaging process, using the number of measurements set on the **Avg** entry field. The entry range is from 1 to 100.

Notes on the averaging tool

- The **Avg** entry field is not accessible unless the averaging process has been started (**Start Avg.** softkey).
- As soon as you change the current setting on the **Avg** entry field, the averaging process will be reset. This means that all previous measurements will be discharged and the series of measurements will be started anew.
- A reset of the averaging process can also be achieved by pushing the **Reset** softkey.
- While the number of measurements taken is less than the value set on the **Avg** entry field, the number of measurements taken (display field **Count**) will be shown in red.
- When the number of measurements taken (display field **Count**) exceeds the number of measurements specified for the averaging process (**Avg** entry field), always the last **Avg** measurements will be averaged and displayed in the live display.
- When the live display has been frozen, a push on the **Reset** softkey will both set the live display back to unfrozen and reset the averaging tool.

For an explanation of the softkeys of this test menu, see section "[Softkeys](#)" on page 67.

Softkeys The softkeys of the RF spectrum measurement menus provide access to special functions and features.

**Start
Avg.**

A push on this softkey starts the averaging tool of the spectrum analyzer.
When the averaging tool is running, the softkey will change to **Stop Avg.**

**Stop
Avg.**

A push on this softkey stops the averaging tool of the spectrum analyzer and takes you back to the related modulation spectrum measurement.
The softkey will change to **Start Avg.**

Freeze

To freeze the current display for further or detailed analysis (or for printing), push this softkey.
The softkey will change to **Unfreeze**.
Note: After the **Freeze** softkey has been pushed, all measurements (and any ongoing averaging process) continue in the background, but the display is not updated.

Unfreeze

To unfreeze the current display, push this softkey.
The softkey will change to **Freeze**.

Reset

A push on this softkey resets both unfreezes the live display and resets the averaging tool of the spectrum analyzer.

PER test menu

The packet error rate (PER) test menu provides measurements regarding the mobile's receiver quality. The results displayed are based on a statistical analysis over a number of data packets.

NOTES

This test can only be performed after a data connection has been established between the 4400 and the mobile under test.

Regarding the statistical test evaluation, see section "Statistical test evaluation" on page 46 for details; the bar display is described on page 27.

For a description of the softkey functions see section "Softkeys in connected state" on page 49.

Details regarding the most important parameters of this menu can be found in section "Test parameters" on page 44.

Need to know more about the Test and Status area of this menu? All details can be found in section "Status" on page 45.

	Curr.	Min.	Last Test	Max.	Count
PER	0.0	0.0	0.0	0.0	1
Status		Pass Conf.	Pass Conf.	Pass Conf.	
Packet Errors	0	0	0	0	
Packets Sent	300	650	650	650	

PER	Confidence	Max Packets
0.5%	95.0%	1000

FTAP Rate: 153.6k-QPSK

CCH: 589 RF Out: -20.0 dBm Test: — Status: Connected

TCH: 589 Appl: FTAP

Band: US 800

Buttons: Param..., Close Session, Disconnect, Freeze, Reset

Function

In this receiver test, the 4400 simulates a fading base station by transmitting at very low power levels. The test can only be performed in FTAP mode.

When using FTAP, the 4400 will send test packets to the AT (mobile). Each packet contains 16 frame check sequence (FCS) bits, providing information about the single packets. If the mobile is able to decode a packet and the information represented by the FCS matches the packet characteristics, then the packet is counted as received successfully.

The mobile then sends one or several FTAP loop back packets to the 4400 indicating how many of the FTAP test packets were successfully received.

The 4400 then calculates the ratio of erroneous packages. This rate is then expressed as a percentage related to the total quantity of packets originally transmitted by the 4400.

The PER test can be performed under different conditions; the measurement results heavily depend on the following ones:

- RF power level used by the 4400
- Power of the code channel(s) under test relative to the overall simulated signal

How to read the PER results display

The statistical evaluation of the measurement results is displayed as current, minimum, last test and maximum values. The bar display gives a graphical representation of the PER test result in relation to the measurement limit.

Count	0	Shows the total number of measurements used to calculate the statistical results.
--------------	----------	---

PER The PER (packet error rate) is provided as a percentage. It indicates the number of packets that the mobile could not decode successfully relative to the overall number of packets sent by the 4400.

Status This output field indicates one out of four different results:

- **Pass** if the maximum number of packets was transmitted and the calculated packet error rate does not exceed the user-defined limit.
- **Pass Conf.** (pass with confidence) if the test is stopped automatically (before the maximum number of frames is reached), because it is very likely that the packet error rate will be below the limit.
- **Fail** if the maximum number of frames was transmitted and the calculated frame error rate is above the user-defined limit.
- **Fail Conf.** (fail with confidence) if the test is stopped automatically (before the maximum number of frames is reached), because it is very likely that the packet error rate will exceed the limit.

Packet Errors This display field gives the number of erroneous packets returned by the mobile.

Packets Sent Here, the 4400 displays the total amount of data packets sent per test run.

NOTE

Pass / fail with confidence use a likelihood approach in order to save test time. When it is very likely (with a user-definable confidence) that a test will be passed/failed because of the measurement results achieved so far, there is no need for spending time to carry out the test to its end.

Setting the PER measurement parameters

PER	Confidence	Max Packets
0.5%	95.0%	1000
FTAP Rate		
153.6k-QPSK		

PER — This is the limit (i.e. maximum percentage of erroneous packages) in order to pass the PER measurement. If the actual PER exceeds this value, the test is failed.

The PER limit value is entered as a percentage; valid inputs range from 0 to 5 in increments of 0.1.

Confidence — The confidence is a statistical measure of the completeness of information obtained about a statistical process. A confidence level of less than 100% may result in the test being concluded before the specified number of packets has been reached, so that the test time can be shortened. See "[System parameter menus](#)" on page 73 for more information.

The valid input range for the confidence level is from 95% to 100% in steps of 0.1%.

Max Packets — This entry field defines the maximum number of packets required to complete an PER measurement and to obtain a new test result. The valid input range is from 1 to 10000.

FTAP-Rate — This selection field allows to set the forward data rate for the FTAP-PER test. The selections available range from 38.4k-QPSK to 3072k-QAM.

Note: The selections possible depend on the 1xEV-DO revision selected in the **Param... > Network Setup** menu (see [page 74](#) for details).

Once you change one of the above parameters, the PER measurement will be reset, the previous measurement results discarded and the new parameters used.

AT Info test menu

This menu displays information sent by the mobile, containing its ID, specific parameters and capabilities. The data displayed is sent by the mobile during the session negotiation process.

NOTES

The functions of the softkeys depend on whether or not a session or a data connection has been established. See sections "[Softkeys in idle state](#)" on page 47, "[Softkeys in session open state](#)" on page 48 and "[Softkeys in connected state](#)" on page 49 for the available softkey functions.

Details regarding the most important parameters of this menu can be found in section "[Test parameters](#)" on page 44.

Need to know more about the Test and Status area of this menu? All details can be found in section "[Status](#)" on page 45.

The screenshot shows the 'AT Info: EVDO' window with the following fields and values:

- Hardware ID Type: 0x00010000
- Hardware ID: 0x00000000 (Hex), 0-0 (Dec)
- Session Seed: 0x00000000
- UATI 024: 0x000000
- UATI Color Code: 0x00
- MAC Index: 6
- Max Power: Band US 800, Class 1, 31.0 dBm
- CCH: 589, RF Out: -20.0 dBm, Test: --, Status: Connected
- TCH: 589, Appl: FTAP
- Band: US 800

Navigation buttons on the right include: Basic, Rho/Freq., Power, Code Domain, Spectrum, PER, and AT Info (selected). Bottom buttons include: Param ..., Close Session, Dis-connect, Freeze, and Reset.

The display fields of this menu have the following meanings:

Hardware ID Type Provides the hardware ID type as received from the mobile in its Hardware ID Response message during the session negotiation.

Hardware ID The mobile's hardware ID will be displayed here in both hexadecimal and decimal formats.

Session Seed The session seed parameter (transmit ATI) used by the mobile in its UATI Request message is displayed here.

UATI 024 The lower 24 bits of the UATI are displayed on this field in hexadecimal format (6 symbols).
The UATI 024 is originally transmitted by the 4400 in its UATI Assignment message, its response to the mobile's UATI Request message.

UATI Color Code The UATI color code identifies the subnet, the UATI belongs to. The display field shows the UATI Color Code in hexadecimal format as received from the mobile.
The UATI color code is originally transmitted by the 4400 in its UATI Assignment message, its response to the mobile's UATI Request message.

MAC Index Here the MAC Index is displayed.
The MAC Index is transmitted by the 4400 in its Traffic Channel Assignment message.

Max Power settings

In 1xEV-DO testing, the AT will not inform the test set about its power class. This parameter - plus the related band - need to be entered by the user. The 4400 will use these parameters to correctly apply the upper power level limits in the corresponding test (see ["Min/Max power test menu" on page 57](#)).

Band On this selection field, enter the frequency band that is used by the mobile.

Class

Here, enter the mobile's power class for the band selected.

The display field right to this entry field will show the lowest value acceptable for the mobile's maximum RF output power, based on the band selected and the power class entered.

System parameter menus

These menus allow for setting system parameters as well as for defining test limits.

To gain access to these menus, simply push the **Param...** softkey.

With the help of the marker tabs, you may select between the following menus:

- "Network setup" on page 73 – allows to set the configuration data of the simulated base station.
- "Traffic channel" on page 76 – here you define the traffic channel parameters such as data rates and power control as well as specific reverse channel parameters like channel gain and data offsets.
- "Limits menus" on page 80 – allows to define the limits for the acceptable range of all power-related measurement results.
- "Limits continued" on page 81 – here you define the limits for the acceptable range of all modulation, code domain and RX sensitivity measurement results.

As long as all measurement results are within the acceptable range, a test will be marked as PASSED. Any measurement result violating the acceptable range will cause the entire test to FAIL.

NOTE

Each of the parameter menus includes an **Undo** function. By pushing this softkey, all parameter values will return to their respective state before calling up the menu in question.

NOTE

Each of the parameter menus includes a **Default** softkey, setting the parameters on the respective screen to their default (factory) settings.

Network setup

The network setup menu allows to set the configuration data of the simulated base station.

Network Setup; Parameters; EVDO

Network Information

PN Offset: 0 Protocol Revision: REV0 Sector ID: []

Color Code: 64 Subnet Mask: 104 MSW: 00000000

Country Code: 310 2nd: 00000000

Control Data Rate: 76.8 Kbps 3rd: 00000000

Pref CCH Cycle: 8096 Off LSW: 00000000

Access Channel Parameters

Power Step: 1.0dB Initial Adjust: 0dB

Preamble Length: 2 Num Steps: 5

Sequence Max: 1

Open Loop Adjust: 78dB Band for Open Loop Adjust: US 800

Undo Default

Network Setup
Traffic Channel
Limits
Limits Cont.

Network information This section allows you to enter 'network-specific' parameters that are broadcast by the 4400.

PN Offset Time offset to the PN sequence. Neighboring base stations use different PN offsets.

Entry range: 0 to 511

Default: 0

Color Code The network color code identifies the network on a national level.

Entry range: 0 to 255

Default: 64

Note: This is an important parameter that needs to match the mobile's preferred roaming list (PRL). Otherwise, it might not be possible to initiate a session.

Subnet Mask A network can be divided into a maximum of 128 (7 bit) subnets.

Entry range: 0 to 127

Default: 104

Note: This is an important parameter that needs to match the mobile's preferred roaming list (PRL). Otherwise, it might not be possible to initiate a session.

Country Code The country code identifies the network internationally.

Entry range: 0 to 999

Default: 310

Note: This is an important parameter that needs to match the mobile's preferred roaming list (PRL). Otherwise, it might not be possible to initiate a session.

Control Data Rate Data rate used by the 4400 on the control channel (CCH).

Selections available: 38.4 Kbps | 76.8 Kbps

Default: 76.8 Kbps

Pref CCH Cycle The preferred control channel cycle determines when the mobile 'returns' from the sleep state to monitor the control channel.

If you want to apply this parameter, set the selection field right to this entry field to On (default is Off).

Entry range: 0 to 32767

Default: 8096

Note: This is a critical parameter that needs to match the corresponding value for the mobile (it may be different from mobile to mobile). An improper setting will result in a rejection from the mobile during session negotiation.

Protocol Revision Allows to select the protocol revision for testing. While Rev0 allows for a maximum forward data rate of 2456.7kbps, RevA allows for 3072kbps.

Selections available: REVO | REVA

Default: REVO

Sector ID MSW These four entry fields allow for entering the 128 bit (32 hex characters) address of the 4400's sector ID. Enter the first eight hex characters on the MSW (most significant word) entry field, the second eight hex characters on the 2nd entry field, the third eight hex characters on the 3rd entry field and the remaining eight hex characters on the LSW entry field (least significant word).
Entry range: 00000000 to FFFFFFFF
Default: 00000000
Note: When moving the cursor to one of these entry fields, the marker tabs will change and thus allow to enter hex codes A to F.

Access channel parameters

This section of the network setup menu allows you to define parameters that the mobile phone shall use while accessing the network. These parameters are broadcast by the simulated base station.

Power Step The power step (in dB) reflects the amount by which the mobile phone increases its output power should the base station not react to its access probe.
Entry range: 0 to 7.5 in increments of 0.1
Default: 1.0

Preamble Length This entry field sets the length (in frames) of the access probe preamble. The access probe preamble is transmitted by the mobile in order to aid the base station in acquiring an access probe.
Entry range: 0 to 7
Default: 2

Initial Adjust The initial adjust is an offset in dB for the mobile to calculate its pilot initial power. See also entry field Open Loop Adjust below.
Entry range: -15 to 16
Default: 0

Num Steps On this entry field, the number of steps (access probes) in a single access probe sequence is specified.
Entry range: 1 to 15
Default: 5

Sequence Max This parameter represents the maximum number of access probe sequences in a single access attempt.
Entry range: 1 to 15
Default: 1

Open Loop Adjust

The open loop adjust is an offset in dB for the mobile to calculate its pilot initial power.
See also entry field Initial Adjust above.

Entry range: 0 to 255

Default: 78

Note: Different values may be specified for different bands. Therefore, first select the band you are working on (see below).

Band for Open Loop Adjust

This selection field allows to set individual open loop adjust values for every single band. To do so, select the band first and then enter the desired open loop adjust value (see above).

Entry range: US 800 | US PCS | TACS | JTACS | Korean PCS | NMT-450 | IMT-2000 | 900 MHz | 1800 MHz | SEC 800 | PAMR 400 | PAMR 800

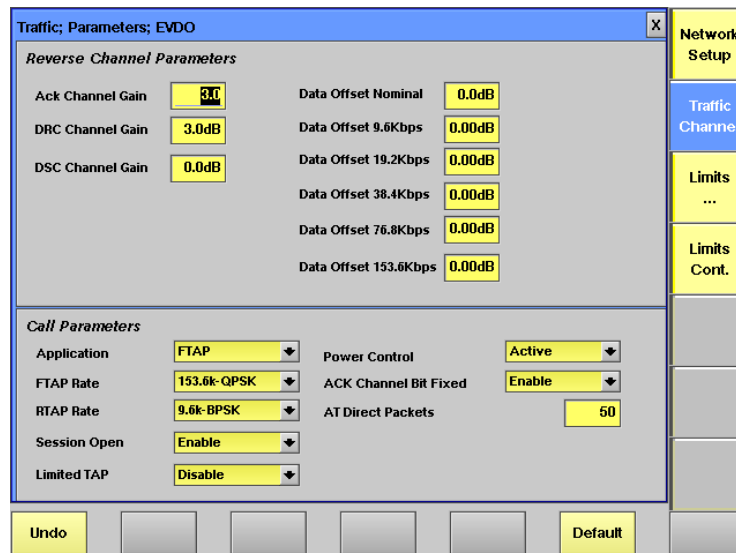
Default: US 800

Traffic channel

This menu affects the modulation, data rate and other important parameters for both the forward and reverse traffic channel during a data connection.

NOTE

While on a traffic channel, any parameter change will take effect only when returning from the Parameters menus to one of the measurement menus.



Reverse Channel Parameters

In this section, you may define important parameters for the R-TCH like e.g. the channel gains for specific channels and data rates.

Ack Channel Gain	<p>This parameter is an offset in dB to the mobile's R-pilot power. The mobile needs this offset to calculate its RF power level when transmitting data on the R-Ack (reverse acknowledgement) channel.</p> <p>Entry range: –3.0 to 6.0 in increments of 0.5 Default: 3.0</p>
DRC Channel Gain	<p>This parameter is an offset in dB to the mobile's R-pilot power. The mobile needs this offset to calculate its RF power level when transmitting data on the R-DRC (reverse data rate control) channel.</p> <p>Entry range: –9.0 to 6.0 in increments of 0.5 Default: 3.0</p>
DSC Channel Gain	<p>This parameter is an offset in dB to the mobile's R-pilot power. The mobile needs this offset to calculate its RF power level when transmitting data on the R-DSC (reverse data source) channel.</p> <p>Entry range: –12.0 to 0.0 in increments of 0.5 Default: 0.0</p>
Data Offset Nominal	<p>This parameter is an offset in dB to the mobile's R-pilot power. The mobile needs this offset to calculate its RF power level when transmitting data.</p> <p>Entry range: –3.5 to 4.0 in increments of 0.5 Default: 0.0</p>
Data Offset 9.6Kbps	<p>Offset in dB to the mobile's R-pilot power. The mobile needs this parameter to calculate its RF power level when transmitting data using a 9.6 Kbps data rate.</p> <p>Entry range: –1.75 to 2.00 in increments of 0.25 Default: 0.00</p>
Data Offset 19.2Kbps	<p>Offset in dB to the mobile's R-pilot power. The mobile needs this parameter to calculate its RF power level when transmitting data using a 19.2 Kbps data rate.</p> <p>Entry range: –1.75 to 2.00 in increments of 0.25 Default: 0.00</p>
Data Offset 38.4Kbps	<p>Offset in dB to the mobile's R-pilot power. The mobile needs this parameter to calculate its RF power level when transmitting data using a 38.4 Kbps data rate.</p> <p>Entry range: –1.75 to 2.00 in increments of 0.25 Default: 0.00</p>
Data Offset 76.8Kbps	<p>Offset in dB to the mobile's R-pilot power. The mobile needs this parameter to calculate its RF power level when transmitting data using a 76.8 Kbps data rate.</p> <p>Entry range: –2.0 to 1.75 in increments of 0.25 Default: –2.0</p>

Data Offset 153.6 Kbps
Offset in dB to the mobile's R-pilot power. The mobile needs this parameter to calculate its RF power level when transmitting data using a 153.6 Kbps data rate.
Entry range: -2.0 to 1.75 in increments of 0.25
Default: -2.0

Call Parameters In this section, important call parameters can be defined.

Application
This selection field allows to select either the use of the FTAP (Forward Test Application Protocol) or of the RTAP (Reverse Test Application Protocol).
Entry range: FTAP | RTAP
Default: FTAP

Note: All tests can be performed on both TAPs. However, you will notice that e.g. a RTAP-PER takes considerably more time than a FTAP-PER.

FTAP Rate
This selection field allows to select the data rate for the FTAP application (the data rate the 4400 will use to send test packets to the mobile).
Entry range: 38.4k-QPSK | 76.8k-QPSK | 153.6k-QPSK | 307.2k-QPSK | 614.4k-QPSK | 921.6k-8PSK | 1228.8k-QPSK | 1843.2k-QPSK | 2457.6k-QAM | 3072k-QAM
Default: 307.2k-QPSK

Note: The selections available depend on the 1xEV-DO protocol revision used for testing, see parameter Protocol Revision on [page 74](#).

RTAP Rate
The data rate for the RTAP application (the data rate the mobile shall use to send test packets to the 4400) is set on this selection field.

Entry range: 9.6k-BPSK | 19.2k-BPSK | 38.4k-BPSK | 76.8k-BPSK | 153.6k-QPSK | 230.4k-QPSK | 307.2k-QPSK | 460.8k-QPSK | 614.4k-QPSK | 921.6k-QPSK | 1228.8k-QPSK | 1843.2k-8PSK
Default: 9.6k-BPSK

Note: The selections available depend on the 1xEV-DO protocol revision used for testing, see parameter Protocol Revision on [page 74](#).

Session Open
This selection field determines whether or not the 4400 will react to the mobile's access probes.
Entry range: Enable | Disable
Default: Enable

Note: To test correct behavior of the mobile during access probe, set this parameter to Disable.

Limited TAP	<p>The 4400 supports the full range of TAP specifications (as described in the C.S0029). However, some AT chipsets only support a subset of these TAP features. Set this selection field to Enable when working with such AT chipsets.</p> <p>Entry range: Enable Disable Default: Disable</p>
Power Control	<p>The setting on this selection field determines the power control mechanism used by the 4400.</p> <p>Active - This setting means that the power control mechanism is active and will be used. Alternating - The 4400 will send an alternating (01010101) power control bit sequence to the mobile. Up - The 4400 will command the mobile to increase its power level - even if the mobile's maximum transmit power has already been reached. Down - The 4400 will command the mobile to decrease its power level - even if the mobile's minimum transmit power has already been reached.</p> <p>Entry range: Active Alternating Up Down Default: Active</p>
ACK Channel Bit Fixed	<p>The mobile can be commanded to either send the ACK (acknowledgement) channel in every slot, or not. If this selection field is set to</p> <p>Enable - then the mobile must send the R-ACK in every slot and also must set its power level for the R-ACK channel accordingly. Disable - this means that the mobile acknowledges packets as in normal system operation</p> <p>Note: To force the mobile not to transmit the R-ACH channel in any slot, set the AT Direct Packets (see entry field below) to 0.</p> <p>Entry range: Enable Disable Default: Enable</p>
AT Direct Packets	<p>The value entered on this entry field is a percentage. It determines the portion of the FTAP test packages (generated by the 4400) that is directed at the mobile under test. The remaining portion of the test packets will be transmitted by the 4400 with different MAC index numbers to simulate other users' activity.</p> <p>Entry range: 0 to 100 Default: 50 (percent)</p> <p>Note: If the mobile has enough processing power to receive more than 50% of the FTAP test packets, you may increase this parameter to speed up PER testing.</p>

Limits menus

In its test menus, the 4400 can evaluate the measurement results and display a PASS or FAIL indication for the single tests, depending on the test results obtained in relation to the test limits.

The bar displays, available for many tests, gives a graphical orientation of the measurement values in relation to the test limits.

Those limits are set in the two limits menus:

- "Limits" on page 80 - where the limits for power measurements and the power classes are defined, and
- "Limits continued" on page 81 - where you may specify limits for the modulation quality, code domain and RX sensitivity measurements.

How to read and enter the measurement limits

For most measurement parameters, there are lower and upper limits.

The lower limit gives the absolute minimum for a measurement result in order to pass the test. Any measurement result obtained being smaller than the lower limit will leave to a FAIL indication for that test.

The upper limit gives the absolute maximum for a measurement result in order to pass the test. Any measurement result obtained exceeding the upper limit will leave to a FAIL indication for that test.

If a measurement can have positive result values only, the lower limit is zero in most cases, especially for error rates where the optimum is zero (no) errors. For these measurements, only an upper limit (maximum) can be entered.

In some cases, the optimum may also be -infinity (e.g. with minimum power radiated during standby). Then, only a upper limit can be entered.

Limits

Measurement Limits cont.; Parameters; EVDO						Network Setup
Power	Lower	Upper	ERP	Lower	Upper	Traffic Channel
Access Channel	-9.5dB	9.5dB	Class I	31.0dBm	36.0dBm	Limits
Closed Loop Range	-24.0dB	24.0dB	Class II	27.0dBm	34.0dBm	...
Minimum Power	-50.0dBm	Class III	23.0dBm	30.0dBm	Limits Cont.
Standby Power	-61.0dBm	Class IV	-2.0dBm	2.0dBm	
Band for ERP Limits	US 800		Class V	-2.0dBm	2.0dBm	

Undo Default

Power limits

Minimum Power

This entry specifies the limit for the mobile's power level when the minimum output power is measured in the **Power > Min/Max** test menu.

The value entered is an absolute power level in dBm; the output power measured needs to be lower or equal to this entry in order to pass the test.

There is no lower limit in this case.

Entry range: -70.0 to 36.0 in increments of 0.1

Default upper limit: -50.0

ERP limits

For the various frequency bands, different settings for the power classes may be stored. By selecting a band, the limits for that band are displayed and may be edited using this menu.

Class I through V

The upper ERP limits represent the maximum effective radiated power (ERP) in dBm that the mobile may radiate at any time.

The lower ERP limits reflect the minimum ERP expected from a mobile of the related power class.

Usually, the actual maximum ERP of a mobile is just above the lower ERP limit in order to maximize battery time.

The ERP limits are different for each power class and may also be different from band to band.

These limits are applied during the **Power > Min/Max** power test.

Limits continued

Modulation			Lower	Upper	Code Domain	Lower	Upper
Rho	0.9440	1.0000			Code Chan. Noise	-----	-23.0dB
Freq. Error	-300Hz	300Hz					
Time Error	-1.000µs	1.000µs					
RMS EVM	-----	24.4%			Rx Sensitivity		
RMS Mag. Error	-----	24.4%			PER	0.50%	
RMS Phase Error	-----	14.00deg			Confidence Level	95.0%	
Carrier FeedThrough	-----	-20.00dBc			Band for Freq. Error Limits		
I/Q Imbalance	-----	0.00dBc			US 800		

Network Setup
Traffic Channel
Limits ...
Limits Cont.

Undo [] [] [] [] [] Default

Modulation

Rho	<p>Rho is a measure of the modulation quality. The ideal value is 1; measured values are in the range from 0 to 1. The entry field represents the minimum requirement for measurements in the Basic and in the Rho/Freq. test menus in order to pass the evaluation.</p> <p>Entry range: 0.0000 to 1.0000 in increments of 0.01 Default lower limit: 0.9440</p>
Freq. Error	<p>The upper and lower limits for the frequency error are entered in Hertz. The results (with pass/fail verdict according to these limits) are shown in the Basic and in the Rho/Freq. test menus.</p> <p>Entry range: -1000 to 1000 in increments of 1 Default lower limit: -300 / -150 Default upper limit: 300 / 150</p> <p>Note: It is possible to set different limits for different frequency bands. Ensure the correct band setting before checking or changing the limits!</p>
Time Error	<p>The upper and lower time error limits are entered in μs. The results (with pass/fail verdict according to these limits) are shown in the Basic and in the Rho/Freq. test menus.</p> <p>Entry range: -5.000 to 5.000 in increments of 0.1 Default lower limit: -1.000 Default upper limit: 1.000</p>
RMS EVM	<p>The RMS error vector magnitude is a positive number in %; the ideal value is zero. For this reason, a lower limit is not configurable. Measurement results (with pass/fail verdict according to these limits) are displayed in the Rho/Freq. test menu.</p> <p>Entry range: 0.0 to 100.0 in increments of 0.1 Default upper limit: 24.4</p>
RMS Mag. Error	<p>Results of the RMS magnitude error measurement are positive numbers in %; the ideal value is zero. A lower limit is therefore not configurable. Measurement results (with pass/fail verdict according to these limits) are available in the Rho/Freq. test menu.</p> <p>Entry range: 0.0 to 100.0 in increments of 0.1 Default upper limit: 24.4</p>
RMS Phase Error	<p>Results of the RMS phase error measurement are positive numbers in degrees; the ideal value is zero. A lower limit is therefore not configurable. Measurement results (with pass/fail verdict according to these limits) are available in the Rho/Freq. test menu.</p> <p>Entry range: 0.00 to 45.00 in increments of 0.01 Default upper limit: 14.00</p>

Carrier Feedthrough Results of the carrier feedthrough measurement are negative numbers in dBc; the ideal value is (-infinity). A lower limit is therefore not configurable. Measurement results (with pass/fail verdict according to these limits) are available in the **Rho/Freq.** test menu.

Entry range: -99.00 to 0.00 in increments of 1

Default upper limit: -20.00

I/Q Imbalance Results of the I/Q imbalance measurement are negative numbers in dBc; the ideal value is (-infinity). A lower limit is therefore not configurable. Measurement results (with pass/fail verdict according to these limits) are available in the **Rho/Freq.** test menu.

Entry range: -99.00 to 0.00 in increments of 1

Default upper limit: 0.00

Code Domain

Code Chan. Noise Results of the code channel noise measurement are negative numbers in dB, relative to the current power level on the R-TCH; the ideal value is (-infinity). A lower limit is therefore not configurable. Measurement results (with pass/fail verdict according to these limits) are available in the **Code Domain** test menu.

Entry range: -99.00 to 0.00 in increments of 1

Default upper limit: -23.00

Note: This parameter can be set directly on the code domain test menu.

RX Sensitivity

PER An upper limit (in %) for the packet error rate measurement may be defined here. The results of the PER measurement (with pass/fail verdict according to these limits) are displayed on the **Basic** and in the **PER** test menus.

Entry range: 0.00 to 5.00; increments are 0.1

Default limit: 0.50

Confidence Level This is not a limit but a confidence level (in %) for the FER measurement.

Entry range: 90.0 to 100.0; increments are 0.5

Default: 95.0

Note: Both RX Sensitivity parameters can be set directly on the PER test menu.

1xEV-DO basics

In this section, you will find a short introduction to 1xEV-DO and its system parameters.

We will look at the following aspects of a 1xEV-DO system:

- [Basic specifications of 1xEV-DO bands](#)
- [MS power classes](#)

Introduction

1x Evolution-Data Optimized, abbreviated as 1xEV-DO, is a wireless radio (broad-band) data standard adopted by many CDMA service providers all over the world. 1xEV-DO does not feature talk functionality and therefore is an ideal 'add-on standard' for service providers that already have a working wireless voice network implemented. When used in combination with a wireless voice network, 1xEV-DO requires at least two separate radio channels (for forward and reverse data respectively) with a bandwidth of 1.2288 MHz each.

1xEV-DO is standardized by the 3GPP2, as part of the CDMA family of standards and is ratified by the international Telecommunications Union (ITU) as IS-856.

1xEV-DO provides means of fast data transfer. In its first revision (Rev. 0), the maximum forward data rate (from the base station to the mobile) is 2.4576 Mbps while the reverse data rate (from the mobile to the base station) is some 0.15 Mbps. The successor to the first revision, Rev. A, will increase the forward data rate to some 3.1 Mbps, while the reverse data rate will increase by 15 times to some 1.8 Mbps. Furthermore, the latency of Rev. A will be significantly shorter compared to Rev. 0.

Since 1xEV-DO uses packet-switched data and is based on an IP network, it does not require a SS7 network or complex network switches (like e.g. a MSC). As a consequence, the network cost is considerably lower.

Like CDMA2000, 1xEV-DO is based on CDMA access technology (code division multiple access), but also uses FDD and a clocked (time) structure.

Glossary

8-PSK - abbreviation for eightfold Phase Shift Keying. 8-PSK uses eight points on the constellation diagram and thus transfers four bits per symbol, doubling its data rate compared to QPSK.

AN - abbreviation for Access Network, represented by the 4400 in the tests.

AT - abbreviation for Access Terminal. In this manual, the term 'mobile' is used as a synonym for AT.

Base station - in CDMA-based systems, this term refers to a physical antenna array. Usually, base stations have multiple antennas that occupy different sectors around the base station tower.

BPSK – abbreviation for Binary Phase Shift Keying. BPSK is the simplest form of PSK. It uses two phases which are separated by 180°. The exact location of the two points on the constellation diagram does not really matter. BPSK is very robust as it takes serious distortion to make the demodulator reach an incorrect decision. BPSK can only modulate one bit per symbol. Consequently, it is unsuitable for higher data-rate applications.

BSC – abbreviation for Base Station Controller. The BSC is the 'brain' of a base station. In fact, a BSC can control more than one base station (what makes sense e.g. in more rural areas).

Carrier/Channel spacing – the channel spacing usually is 30 kHz (carry over from analog wireless networks).

CDMA – abbreviation for Code Division Multiple Access. CDMA is a form of multiplexing and a method of multiple access that does neither divide the channel by time (as in TDMA) or frequency (as in FDMA), but instead encodes data with a special code. Thus, different users are distinguished with orthogonal codes.

As all mobile communication use the same frequency band at the same time, an efficient power control mechanism is vital to CDMA.

Chip – this term is used in CDMA-based systems to describe a single piece of information – after the signal has been spread.

Closed Loop Power Control – once a data connection is established, the base station will command every single mobile in its cell to either increase or decrease the current power level in order to adjust the power levels of all mobiles in such a way that all signals arrive at the base station's antenna at the same power level.

DRC – abbreviation for Data Rate Control (DRC) channel. The mobile continuously monitors the base station's pilot. Based on the current and past values of the signal to noise ratio of this pilot, the mobile predicts the maximum data rate that the forward link can support during the next transmit interval. The predicted maximum rate will thus vary as channel conditions vary. The mobile then informs the base station about the predicted maximum data rate on the data rate control channel.

ERP – abbreviation for Effective Radiated Power. ERP means the effective power level radiated by the mobile during transmission – including the antenna gain. In this manual, the phrases 'power' or 'power level' are used as synonyms for the ERP.

FDD – abbreviation for Frequency Division Duplex. FDD means that forward and reverse channels are transmitted the same time, but on different frequency channels. Usually, the reverse channel is on a lower frequency band and the difference between the two bands (i.e. the duplex spacing) is 45 MHz in 1xEV-DO.

Forward – in 1xEV-DO, this is communication directed from the network to the mobile. Forward channels are marked with a leading F, like e.g. F-TCH.

FTAP - abbreviation for Forward Test Application Protocol (see TAP for reference). The FTAP's objective is to aid testing the mobile's receiver. It provides procedures and messages to control the F-TCH, to configure the R-ACK and R-DRC channels, to generate and transmit test packets on the F-TCH (that are then processed at the mobile) and to make the mobile generate and transmit information about the test packets received, using loopback.

F-TCH - abbreviation for Forward Traffic Channel. This is the logical channel the network uses to transmit data to the mobile. On the F-TCH, the following logical (forward) channels are used: Pilot, MAC, Control and Data.

Handover - 1xEVDO features three kinds of handover:

Softer Handover: From sector to sector within the same BSC,

Soft Handover: From sector to a sector of a different BSC.

Hard Handover: From channel to channel.

Loopback - a special feature of the FTAP (see FTAP for reference). This means that the mobile receives test packages sent from the 4400 and determines whether it is able to decode the packets' content without error. Only the results will be returned to the 4400 and used by it to calculate the PER (see ["PER test menu" on page 68](#)).

Because the data rate on the F-TCH can be much higher in 1xEV-DO than on the R-TCH, FTAP uses the procedure described above to avoid the PER test being slowed down by a low R-TCH data rate.

MAC - abbreviation of Media ACcess channel. The MAC basically is the control channel during a data connection.

The R-MAC, for instance, contains the RRI (Reverse Rate Indicator) and the DRC (Data Rate Control) channels. The latter informs the base station about the forward data rate applicable for the current transmission.

The F-MAC transmits the control commands to the mobile (e.g. for closed loop power control).

MAC Index- Transmission on the F-TCH is time division multiplexed. At any given time, the channel is either transmitted or not. If it is transmitted, it is addressed to a single mobile. The mobile identifies the F-TCH directed to it by its MAC Index. There are 64 MAC Indices, each corresponding to a different Walsh code.

Open Loop Power Control - during access probe, the mobile has no feedback from the base station regarding power level. Therefore it has to calculate its pilot initial power level based on the level it receives the base station at - and some parameters transmitted by the base station.

The standard mechanism in CDMA-based systems is that the mobile will start at the (relatively low) pilot initial power level. Should there be no response from the network (because the power level is too low and the base station does not receive the access probe), the mobile will repeat and gradually increase its power level from access probe to access probe.

Pilot - the pilot serves as a 'lighthouse' for a mobile when it is searching for a base station. Technically speaking, the pilot is a segment of the slot, always using Walsh code 0 by definition. The pilot also aids the mobile's measurement of the base station's power level (F-Pilot) or the base station's measurement of the mobile's power level (R-Pilot).

Pilot Initial Power - the initial power level used by the mobile in open loop power control. It is calculated using the following formula:

Pilot Initial Power [dBm] = mean power level the mobile receives the AN at [dBm] + Open Loop Adjust [dB] + Initial Adjust [dB].

Example: Pilot Initial Power = -68 dBm + 78 dB + 2 dB = +12 dBm.

PN Offset - abbreviation for Pseudo-random Noise Offset. One of the 512 codes used to differentiate sectors of a base station so that the mobile always knows the sector of the base station it communicates with.

Power Control - as in CDMA all mobiles broadcast at the same time and at the same frequency, power management is very important. If a mobile transmits at a power level too high, the transmission from other mobiles will be masked (i.e. their data will not be received properly). On the other hand, the network will not be able to properly receive a message from a mobile when sent at a too low power level.

QAM - abbreviation for Quadrature Amplitude Modulation. Combining 8-PSK with amplitude modulation, QAM uses 16 points on the constellation diagram and thus transfers 8 bits (or one hex word) per symbol. QAM delivers the highest data rate of all modulation techniques used for 1xEV-DO. However, QAM demands a high signal to noise ratio (SNR) of the radio channel.

QPSK - abbreviation for Quadrature Phase Shift Keying. QPSK uses four points on the constellation diagram and thus transfers two bits per symbol, doubling its data rate compared to BPSK.

Sector - the radio hop of a base station usually is divided into sectors (e.g. three antennas covering 120° each). This physical layout makes the sector to sector handover within the same base station ('softer handover') an important function.

Reverse - in 1xEV-DO, this is communication directed from the mobile to the network. Reverse channels are marked with a leading R, like e.g. R-TCH.

RRI - abbreviation for Reverse Rate Indication. The mobile uses this logical channel to negotiate the conditions for reverse data transmission.

RTAP - abbreviation for Reverse Test Application Protocol (see TAP for reference). The RTAP's objective is to aid testing the mobile's transmitter. It provides procedures and messages to configure and control the R-TCH and to make the mobile generate and transmit test packets on the R-TCH at the configured rate.

R-TCH - abbreviation for Reverse Traffic Channel. This is the channel the mobile uses to transmit data to the network. On the R-TCH, the following logical (reverse) channels are used: Pilot, MAC, ACK and Data.

TAP - abbreviation for Test Application Protocol. This is a special feature of 1xEV-DO in order to shorten test time. There are basically two TAPs: The reverse TAP (or RTAP) and the forward TAP (or FTAP). Both TAPs provide specific functionality for testing the mobile's receiver (FTAP) and its transmitter (RTAP). There is also a version with limited functionality (called Limited TAP or LTAP) that was implemented in older 1xEV-DO chipsets.

TDMA - abbreviation for Time-Division Multiple Access. TDMA is a form of multiplexing and a method of multiple access that divides a radio channel into time slots. An example for a TDMA-based network is GSM.

UATI - abbreviation for Unicode Access Terminal Identifier. The UATI is temporarily assigned to a mobile to identify it - similar to an IMSI in a GSM network. It is used to generate the reverse link scrambling code. Without the knowledge of the scrambling code, the 4400 cannot synchronize and decode the data transmitted by the mobile.

Walsh code - this is the digital modulation code that uniquely identifies and thus separates the individual traffic and control channels on the RF carrier from each other.

Time structure The time structure of 1xEV-DO is based on slots with a time length of 1.667 ms, containing 2048 chips. 16 time slots form a frame (20 ms).

Testing is different TAP provides some important features for testing that make the mobile under test behave differently to normal 1xEV-DO operation. Probably the most important feature in this respect is the FTAP-PER test where the mobile actually does the testing and only loops back result data. Using this 'trick', the R-TCH will not become the bottleneck on PER testing. See section "[PER test menu](#)" on page 68 for details.

3GPP2 measurements supported by the 4400

Table 2 3GPP2 measurements supported by the 4400

C.S0033	Test items
3.1.1.3.1	Receiver sensitivity and dynamic range
3.1.2.1.1	Frequency coverage
3.1.2.1.2	Frequency accuracy
3.1.2.2.1	Time reference
3.1.2.2.2	Waveform quality and frequency accuracy
3.1.2.3.4	Maximum RF output power
3.1.2.3.5	Minimum controlled output power
3.1.2.3.8	Code domain power
3.1.2.3.8.1	DRC channel output power
3.1.2.3.8.2	ACK channel output power
3.1.2.3.8.3	Data channel output power
3.1.2.4.1	Conducted spurious emissions

Basic specifications of 1xEV-DO bands

The tables below give the specifications for the various 1xEV-DO bands.

Table 3 1xEV-DO frequency bands

Band class	Band description	Reverse link in MHz, (mobiles transmit)	Forward link in MHz (base stations transmit)
0	U.S. cellular	824.0 to 849.0	869.0 to 894.0
1	North American PCS	1850.0 to 1910.0	1930.0 to 1990.0
2	TACS	872.0 to 915.0	917.0 to 960.0
3	JTACS	887.0 to 925.0	832.0 to 870.0
4	Korean PCS	1750.0 to 1780.0	1840.0 to 1870.0
5	NMT-450	411.0 to 484.0	421.0 to 494.0
6	IMT-2000	1920.0 to 1980.0	2110.0 to 2170.0
7	700 MHz	776.0 to 794.0	746.0 to 764.0
8	1800 MHz	1710.0 to 1785.0	1805.0 to 1880.0
9	900 MHz	880.0 to 915.0	925.0 to 960.0
10	Secondary 800 MHz	806.0 to 900.975	851.0 to 939.975
11	400 MHz European PAMR Band	410.0 to 419.975 451.0 to 457.475	420.0 to 429.975 461.0 to 467.475
12	800 MHz PAMR Band	870.0125 to 875.9875	915.0125 to 920.9875

Table 4 Channel arrangements

Band class	Channel number	Center frequency, reverse link (MHz)	Center frequency, forward link (MHz)
0	1 to 799 991 to 1023	$0.03 \cdot n + 825.0$ $0.03 \cdot (n-1023) + 825.0$	$0.03 \cdot n + 870.0$ $0.03 \cdot (n-1023) + 870.0$
1	0 to 1199	$0.05 \cdot n + 1850.0$	$0.05 \cdot n + 1930.0$
2	0 to 1000 1329 to 2047	$0.025 \cdot n + 889.9875$ $0.025 \cdot (n-1328) + 871.9875$	$0.025 \cdot n + 934.9875$ $0.025 \cdot (n-1328) + 916.9875$
3	1 to 799 801 to 1039 1041 to 1199 1201 to 1600	$0.0125 \cdot n + 915$ $0.0125 \cdot (n-800) + 898.0$ $0.0125 \cdot (n-1040) + 887.0$ $0.0125 \cdot (n-1200) + 893.0$	$0.0125 \cdot n + 860.0$ $0.0125 \cdot (n-800) + 843.0$ $0.0125 \cdot (n-1040) + 832.0$ $0.0125 \cdot (n-1200) + 838.0$
4	0 to 599	$0.05 \cdot n + 1750.0$	$0.05 \cdot n + 1840.0$

Table 4 Channel arrangements

Band class	Channel number	Center frequency, reverse link (MHz)	Center frequency, forward link (MHz)
5	1 to 300	$0.025 \cdot (n-1) + 450.0$	$0.025 \cdot (n-1) + 460.0$
	539 to 871	$0.025 \cdot (n-512) + 411.0$	$0.025 \cdot (n-512) + 421.0$
	1039 to 1473	$0.020 \cdot (n-1024) +$	$0.020 \cdot (n-1024) +$
	1792 to 2016	451.010 $0.020 \cdot (n-1792) + 479.0$	461.010 $0.020 \cdot (n-1792) + 489.0$
6	0 to 1199	$0.05 \cdot n + 1920.0$	$0.05 \cdot n + 2110.0$
7	0 to 359	$0.05 \cdot n + 776.0$	$0.05 \cdot n + 746.0$
8	0 to 1499	$0.05 \cdot n + 1710.0$	$0.05 \cdot n + 1805.0$
9	0 to 699	$0.05 \cdot n + 880.0$	$0.05 \cdot n + 925.0$
10	0 to 719	$0.025 \cdot n + 806.0$	$0.025 \cdot n + 851.0$
	720 to 919	$0.025 \cdot (n-720) + 896.0$	$0.025 \cdot (n-720) + 935.0$
11	1001 to 1400	$0.025 \cdot (n-1001) + 410.0$	$0.025 \cdot (n-1001) + 420.0$
	1 to 400	$0.025 \cdot (n-1) + 450.0$	$0.025 \cdot (n-1) + 460.0$
12	0 to 239	$0.025 \cdot n + 870.0125$	$0.025 \cdot n + 915.0125$

MS power classes

The power classes of the mobiles vary between the 1xEVDO bands. The codes stand for different RF power levels in different 1xEVDO bands. The table below gives an overview of the maximum output power levels for each power class and band.

Power Class Code	1	2	3	4	5
Band class 0: U.S. Cellular	31 - 38 dBm	27 - 34 dBm	23 - 30 dBm	-	-
Band class 1: North American PCS	28 - 33 dBm	23 - 30 dBm	18 - 27 dBm	13 - 24 dBm	8 - 21 dBm
Band class 2: TACS band	-	31 - 38 dBm	27 - 34 dBm	23 - 30 dBm	-
Band class 3: JTACS band	31 - 38 dBm	27 - 34 dBm	23 - 30 dBm	-	-
Band class 4: Korean PCS band	28 - 33 dBm	23 - 30 dBm	18 - 27 dBm	13 - 24 dBm	8 - 21 dBm
Band class 5: NMT-450 band	33 - 40 dBm	28 - 35 dBm	23 - 30 dBm	18 - 25 dBm	-

Band class 6: IMT-2000 band	28 - 33 dBm	23 - 30 dBm	18 - 27 dBm	13 - 24 dBm	8 - 21 dBm
Band class 6: IMT-2000 band, Japan	20 - 24 dBm	20 - 24 dBm	18 - 24 dBm	13 - 24 dBm	8 - 21 dBm
Band class 7: 700 MHz band	27 - 34 dBm	23 - 30 dBm	-	-	-
Band class 8: 1800 MHz band	28 - 33 dBm	23 - 30 dBm	18 - 27 dBm	13 - 24 dBm	8 - 21 dBm
Band class 9: 900 MHz band	31 - 38 dBm	27 - 34 dBm	23 - 30 dBm	-	-
Band class 10: Secondary 800 MHz band	27 - 34 dBm	23 - 30 dBm	-	-	-
Band class 11: 400 MHz Euro- pean and 400 MHz PAMR bands	33 - 40 dBm	28 - 35 dBm	23 - 30 dBm	18 - 25 dBm	-
Band class 12: 800 MHz PAMR band	31 - 38 dBm	27 - 34 dBm	23 - 30 dBm	-	-

1xEV-DO Non-Call Mode

3

This chapter provides task-based instructions for using the 4452 1xEV-DO Non-Call Mode Option. This non signaling call mode is also referred to as generator/analyzer mode or asynchronous mode. Topics discussed in this chapter are as follows:

- ["Overview" on page 94](#)
- ["RF generator menu" on page 95](#)
- ["RF analyzer menu for rho and frequency" on page 99](#)
- ["RF analyzer menu for power" on page 100](#)
- ["RF analyzer menu for code domain power" on page 101](#)
- ["RF analyzer menus for modulation spectrum and ACPM spectrum measurements" on page 103](#)
- ["Common elements of the RF analyzer menus" on page 97](#)
- ["Parameter menus" on page 109](#)

Overview

The generator/analyzer mode of the 4400 provides test and measurement tools for asynchronous measurements; these are measurements that do not require any call setup.

This section consists of the following parts:

- [RF generator menu](#) – Describes the menu of the RF signal generator.
- [Common elements of the RF analyzer menus](#) – this section describes common entry fields, display fields and softkeys.
- [RF analyzer menu for rho and frequency](#) – This menu provides measurement results for the modulation quality.
- [RF analyzer menu for power](#) – The overall power of the signal transmitted by the mobile is measured and displayed.
- [RF analyzer menu for code domain power](#) – This menu shows the mobile's transmit power for each code channel, relative to the absolute power for the complete transmit signal.
- [RF analyzer for modulation spectrum](#) – provides an overview of the spectrum measurements due to modulation.
- [RF analyzer for ACPM modulation spectrum](#) – here you will find all information regarding ACP measurements.
- [Parameter menus](#) – The most frequently used parameters can be adjusted to your needs directly in the respective generator or analyzer menus. There are further parameters available, affecting the signal generated or the measurement views; these parameters can be modified in the parameter menus.

To gain access to the menus of the generator/analyzer mode:

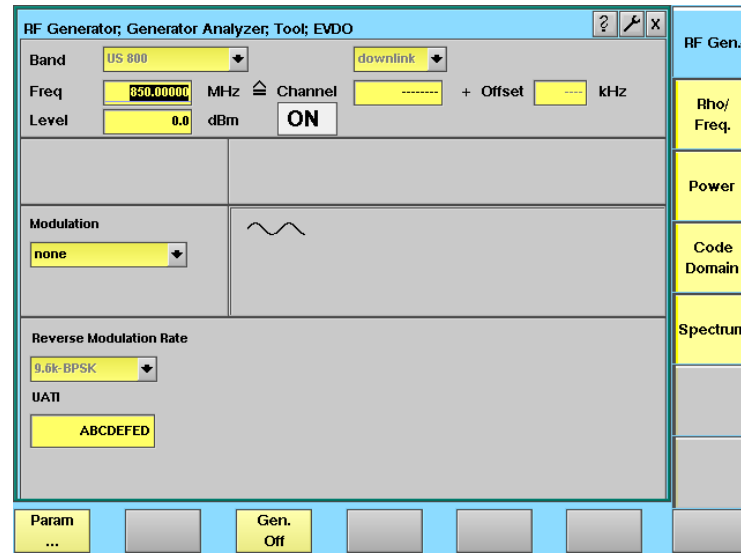
- 1 Go to the Welcome menu (see picture below).
- 2 Push the marker tab for the corresponding system option [EVDO].
- 3 Push the **Gen/Ana** softkey.



RF generator menu

To gain access to the RF generator menu, push the [RF Gen.] marker tab while working with the generator/analyzer.

This menu allows you to set the parameters of the 4400's RF generator.



What it does

The 4400 can be set up to generate an unmodulated 1xEV-DO carrier without supporting any exchange of signaling messages. The signal generated can be used to test the mobile's receiver in a special test (service or engineering) mode.

Parameters

Band — Selection field to set the frequency band.

Selections possible: US 800 | US PCS | TACS | JTACS | Korean PCS | NMT-450 | IMT-2000 | 900 MHz | 1800 MHz | SEC 800 | PAMR 400 | PAMR 800.

uplink/downlink — Selection field to specify either the uplink (reverse link) or the downlink (forward link) frequency range.

Selections possible: uplink | downlink.

NOTE

To gain access to the **Band** and **uplink/downlink** entry fields, enter a channel number on the **Channel** entry field.

For details regarding 1xEV-DO frequency ranges, check with section ["Basic specifications of 1xEV-DO bands"](#) on page 89.

Freq — Entry field to set the output frequency of the RF generator.

Entry ranges: 430 to 496 MHz, 800 to 1000 MHz and 1700 to 2300 MHz in increments of 10 Hz.

Channel — Entry field for the channel number. If you enter a new value in this field, the value displayed on the **Freq** field will be recalculated based on the entries of the **Band** and **uplink/downlink** fields (provided that the channel number exists in this band).

Entry range: 0 to 2047

Offset — Entry field for the offset from the channel frequency.

To gain access to this entry field, enter a channel number (see above).

Entry range: -999.99 to 999.99 kHz in increments of 10 Hz.

Level — Entry field for the RF output power level of the RF generator. The output signal will be available at the **RF IN/OUT** connector.

Entry range: -120.0 to 0.0 dBm in increments of 0.1 dB.

NOTE

The level set on this entry field will only be correct when the load impedance is 50 Ω .

ON/OFF — Display field for the current output status of the RF generator. When **ON** is displayed, RF signals are output; when **OFF** is displayed, the RF generator is silent.

To toggle, use the **Gen. Off** or **Gen. On** softkey, respectively.

Modulation — Selection field to turn the modulation on or off.

Selections possible: none

NOTE

Setting "none" means that the RF output signal generated by the 4400 will be unmodulated, i.e. a pure carrier at the frequency set.

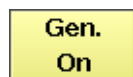
Softkeys The RF generator menu provides the following softkeys:



Calls a set of parameter menus on-screen.

See section "[System parameter menus](#)" on page 73.

Note: As the 4400 only broadcasts an unmodulated carrier, most of the parameters are not applicable.



Pushing this softkey will turn on the RF generator and **ON** will be displayed on the display field in the upper part of the menu. The softkey will change to **Gen. Off**.



A push on this softkey will turn off the RF generator. On the display field in the upper part of the menu, **OFF** will be displayed and the softkey will change to **Gen. On**.

Analyzer-related entry fields

On the RF Generator menu, there are two entry fields that belong to the RF analyzer section of the 4400:

Reverse Modulation Rate — Selection field for the data rate and modulation type used by the mobile for transmitting data.

Entry range: 9.6k-BPSK | 19.2k-BPSK | 38.4k-BPSK | 76.8k-BPSK | 153.6k-QPSK | 230.4k-QPSK | 307.2k-QPSK | 460.8k-QPSK | 614.4k-QPSK | 921.6k-QPSK | 1228.8k-QPSK | 1843.2k-8PSK

Default: 9.6k-BPSK

NOTE

The selections available depend on the 1xEV-DO protocol revision used for testing, see parameter Protocol Revision on [page 74](#).

UATI — Entry field for the UATI used by the mobile. The UATI is used to generate the reverse link scrambling code. Without the knowledge of the scrambling code, no synchronization and decoding of the data transmitted by the mobile is possible for the 4400. The parameter needs to be entered in hex(adecimal) format (8 symbols = 32 bit).

Without correct UATI, modulation quality measurements will not be possible.

Note: When you move the cursor to this entry field, the marker tabs will change to allow for entering the hexadecimal symbols A to F.

Common elements of the RF analyzer menus

Entry fields of the RF analyzer menus

The radio frequency to measure on is set in this menu area.

The screenshot shows a control panel with the following fields: 'Band' set to 'US 800', 'uplink/downlink' set to 'uplink', 'RM Rate' set to '9.6k-BPSK', 'Freq' set to '900.00000' MHz, and 'Offset' set to '-----' kHz. There is also a 'Channel' field with a small icon next to it.

Band — Selection field for the frequency band to measure on.

Selections possible: US 800 | US PCS | TACS | JTACS | Korean PCS | NMT-450 | IMT-2000 | 900 MHz | 1800 MHz | SEC 800 | PAMR 400 | PAMR 800.

uplink/downlink — Selection field to specify either the uplink (reverse link) or the downlink (forward link) frequency range.

Selections possible: uplink | downlink.

NOTE

To gain access to the **Band** and **uplink/downlink** entry fields, enter a channel number on the **Channel** entry field.

For details regarding 1xEV-DO frequency ranges, check with section "[Basic specifications of 1xEV-DO bands](#)" on [page 89](#).

Freq — Entry field to set the carrier frequency to measure on.

Entry ranges: 430 to 496 MHz, 800 to 1000 MHz and 1700 to 2300 MHz in increments of 10 Hz.

Channel — Entry field for the channel number. If you enter a new value in this field, the value displayed on the **Freq** field will be recalculated based on the entries of the **Band** and **uplink/downlink** fields (provided that the channel number exists in this band).

Entry range: 0 to 2047

Offset — Entry field for the offset from the channel frequency.

To gain access to this entry field, enter a channel number (see above).

Entry range: -999.99 to 999.99 kHz in increments of 10 Hz.

Display fields of the RF analyzer menus

RM Rate — Display field for the reverse modulation rate, i.e. the data rate and modulation type used by the mobile for transmitting data.

NOTE

The corresponding entry field is located on the RF generator menu (see [page 96](#) for details).

Softkeys of the RF analyzer menus



This softkey leads you to the parameter menu where you can set up specific parameters, like the 1xEV-DO protocol revision you intend to work with, reverse channel parameters or limits for the tests.

For details regarding the parameter menus, see section "[System parameter menus](#)" on [page 73](#).

Note: Please keep in mind that, depending on the current state of your 4400, some parameters may not be applicable (e.g. network setup parameters when working with an unmodulated RF generator signal, see [page 95](#)).



Pushing this softkey will turn on the RF generator (see [page 95](#)). The softkey will change to **Gen. Off**.



A push on this softkey will turn off the RF generator (see [page 95](#)). The softkey will change to **Gen. On**.



To freeze the current display for further or detailed analysis (or for printing), push this softkey.

The softkey will change to **Unfreeze**.

Note: After the **Freeze** softkey has been pushed, all measurements will continue in the background, but the display will not be updated.



A push on this softkey resets the statistical evaluation of the measurement results on-screen. It also resets the measurement counter and unfreezes the live display.

RF analyzer menu for rho and frequency

This menu provides you with all relevant parameters required to judge the mobile's modulation and transmitter quality in non-call mode.

To gain access to this menu, push the [Rho/Freq.] marker tab while working with the generator/analyzer.

NOTES

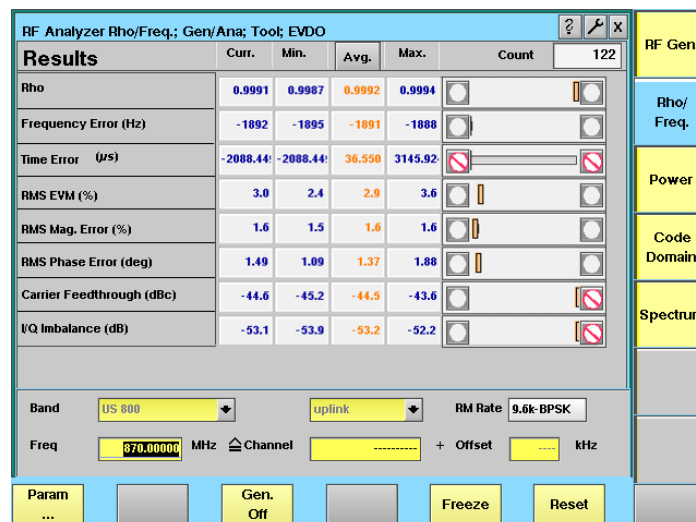
The analyzer will measure the RF signal received at the **RF IN/OUT** connector and will display measurement results assuming that the signal received is a modulated 1xEV-DO signal. In order to decode the signal received correctly, the Willtek 4400 needs to know the **Reverse Modulation Rate** and the **UATI** used by the mobile under test. These two parameters need to be entered on the RF generator menu (see [page 96](#) for details).

Regarding the statistical test evaluation, see section "[Statistical test evaluation](#)" on [page 46](#) for details; the bar display is described on [page 27](#).

For a description of the softkey functions see section "[Softkeys of the RF analyzer menus](#)" on [page 98](#).

Before starting a measurement, enter the radio frequency to be measured on. The related entry fields for these parameters are located in the lower area of the menu, just above the softkeys. See section "[Entry fields of the RF analyzer menus](#)" on [page 97](#) for details.

Any coupling loss table defined in the appropriate menu will be applied for asynchronous measurements as well. See section "[Coupling loss](#)" on [page 126](#) for details.



The RF analyzer menu for rho and frequency shows the numeric measurement results and their statistical evaluation.

Results	Curr.	Min.	Avg.	Max.	Count	11
Rho	0.9991	0.9987	0.9992	0.9994		
Freq. Error (Hz)	-1892	-1895	-1891	-1888		
Time Error (µs)	-2088.44	-2088.44	36.550	3145.92		
RMS EVM (%)	3.0	2.4	2.9	3.6		
RMS Mag. Error (%)	1.6	1.5	1.6	1.6		
RMS Phase Error (deg)	1.49	1.09	1.37	1.88		
Carrier Feedthrough (dBc)	-44.6	-45.2	-44.5	-43.6		
I/Q Imbalance (dB)	-53.1	-53.9	-53.2	-52.2		

How to read the Rho/Frequency test results display

The statistical evaluation of the measurement results is displayed as current, minimum, average and maximum values. The bar displays give a graphical representation of the test results in relation to the applicable measurement limits. These limits can be entered on the **Param... > Limits Cont.** menu, see [page 81](#).

For a detailed description of the single measurement results and their meaning, please refer to section ["Rho/Frequency test menu"](#) on [page 55](#).

RF analyzer menu for power

The power measurement displays the mobile's current power level in asynchronous mode.

To gain access to this menu, push the [Power] marker tab while working in generator/analyzer mode.

NOTES

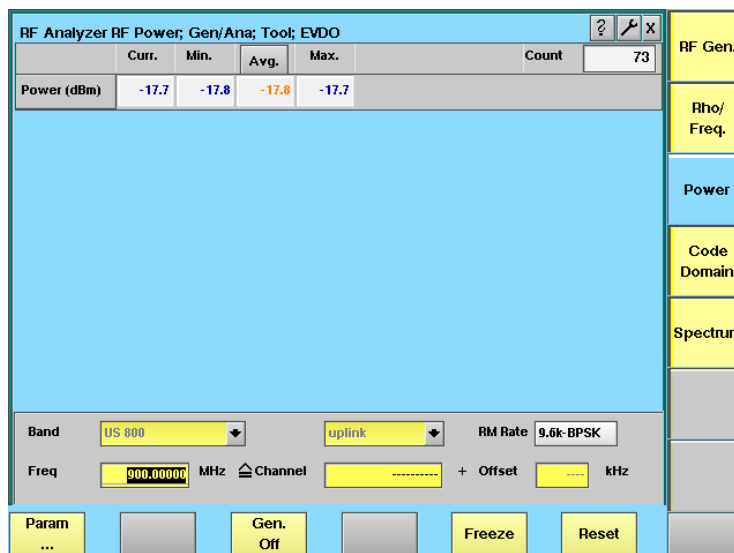
The analyzer will measure the RF signal received at the **RF IN/OUT** connector and will display measurement results assuming that the signal received is a modulated 1xEV-DO signal.

Regarding the statistical test evaluation, see section ["Statistical test evaluation"](#) on [page 46](#) for details.

For a description of the softkey functions see section ["Softkeys of the RF analyzer menus"](#) on [page 98](#).

Before starting a measurement, enter the radio frequency to be measured on. The related entry fields for these parameters are located in the lower area of the menu, just above the softkeys. See section ["Entry fields of the RF analyzer menus"](#) on [page 97](#) for details.

Any coupling loss table defined in the appropriate menu will be applied for asynchronous measurements as well. See section ["Coupling loss"](#) on [page 126](#) for details.



How to read the power results display

The 4400 measures and displays the mobile's effective radiated power (ERP) on the R-TCH during transmission in dBm. Measurement results will be updated continuously.

The statistical evaluation of the measurement results is displayed as current, minimum, average and maximum values.

RF analyzer menu for code domain power

When a mobile transmits data with a high data rate, using multiple code channels, the RF analyzer menu for code domain power shows the transmit power for each code channel, relative to the absolute power for the complete transmit signal. It is assumed that the phone is brought into a state of transmitting multiple code channels without the help of a call setup.

To gain access to this menu, push the [Code Domain] marker tab while working in generator/analyzer mode.

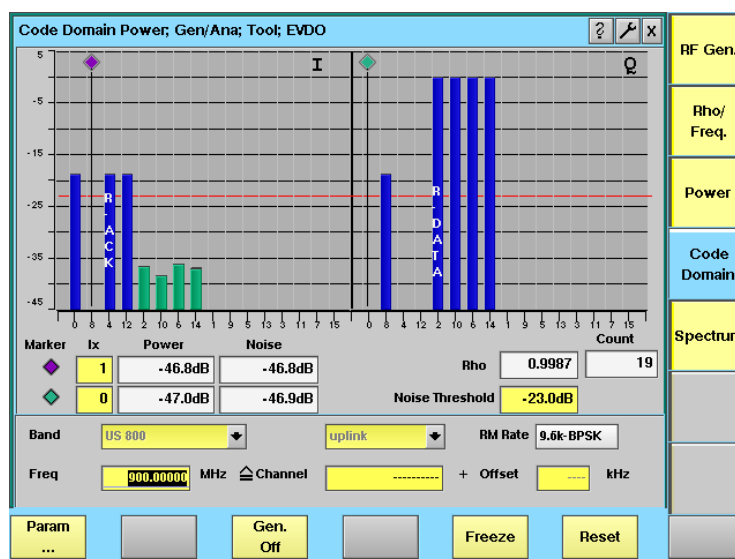
NOTES

The analyzer will measure the RF signal received at the **RF IN/OUT** connector and will display measurement results assuming that the signal received is a modulated 1xEV-DO signal, using the **Reverse Modulation Rate** and **UATI** set on the RF generator menu (see [page 96](#) for details).

For a description of the softkey functions see section "[Softkeys of the RF analyzer menus](#)" on [page 98](#).

Before starting a measurement, enter the radio frequency to be measured on. The related entry fields for these parameters are located in the lower area of the menu, just above the softkeys. See section "[Entry fields of the RF analyzer menus](#)" on [page 97](#) for details.

Any coupling loss table defined in the appropriate menu will be applied for asynchronous measurements as well. See section "Coupling loss" on page 126 for details.



How to read the code domain results display

The live display shows bars indicating the power in specific code channels. The measurements are separated by I/Q proportions. Different colors are used to mark active channels and noise:

- Active channels are shown in blue.
- The code channel noise is colored in green.
- **Note:** The code channel noise is measured by subtracting the reference signal (i.e. the 'ideal' signal) from the signal received. The resulting error signal is then despread with all of the W_n^{16} codes. This is done for both I and Q components of the error signal.
- If the power level of an inactive code channel exceeds the noise threshold (**Noise Threshold** entry field), it is colored in red.

There is one display marker (see page 27 for a description) provided for each proportion (I, Q) to read out both code channel power and code channel noise in relation to the absolute power for the complete transmit signal.

The waveform quality factor **Rho** indicates the overall modulation quality.

Setting up code domain power test menu parameters

The only parameter of significance to this test menu is the noise threshold, expressed in dB relative to the power level of the absolute power for the complete transmit signal (**Noise Threshold** entry field). This value is used as a limit for unacceptably high noise levels in code channels. The noise threshold is indicated as a red horizontal line on the live display; any channel with a noise level exceeding this threshold is indicated by a red bar.

RF analyzer menus for modulation spectrum and ACPM spectrum measurements

Precise spectrum management is always an important issue in radio communication systems in order to avoid interference.

The spectrum analyzer of the non-call mode option provides test capabilities to evaluate the RF signals received by the 4400 in the frequency domain.

Two different measurement menus are available: Modulation spectrum and ACPM due to modulation.

- ["RF analyzer for modulation spectrum" on page 103](#) – provides an overview of the spectrum measurements due to modulation.
- ["RF analyzer for ACPM modulation spectrum" on page 105](#) – here you will find all information regarding ACP measurements.

To access the spectrum test menus, simply push the [Spectrum] marker tab while working in generator/analyzer mode.

A push on **Esc** will take you back to the 1xEV-DO test menus.

RF analyzer for modulation spectrum

This test menu provides the measurement of the mobile's signal power in the frequency domain. The signal bandwidth is a function of the chip rate. With a chip rate of 1.2288 Mcps and a BPSK modulation, the signal bandwidth is 1.2288 MHz. Because of its sharp edges, the ideal modulation spectrum display is frequently referred to as 'Bart's head'.

The measurement of the spectrum due to modulation is a useful tool for

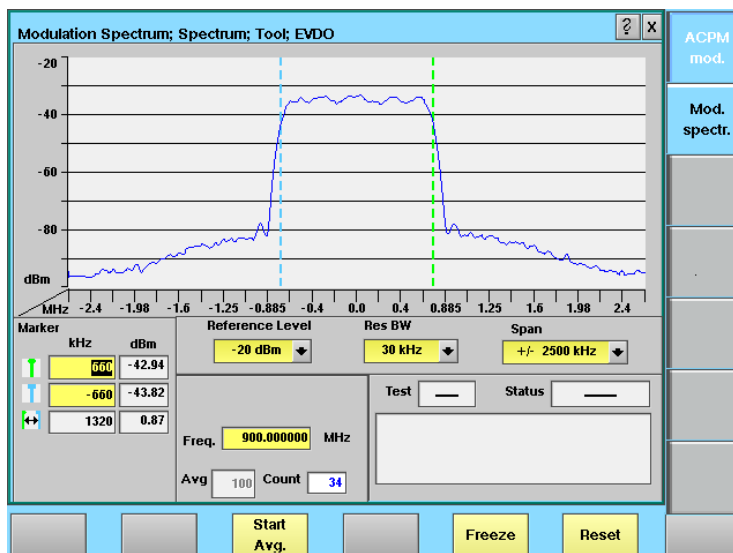
- adjusting the mobile's I/Q modulator, and
- detecting side bands of the carrier or spurious emissions.

The modulation spectrum test menu provides a live display of the mobile's RF signal's spectrum. To call the menu, simply push the [Mod. spectr.] marker tab.

NOTES

The RF spectrum analyzer will measure the RF signal received at the **RF IN/OUT** connector.

For a description of the further softkey functions see section ["Softkeys of the RF analyzer menus" on page 98](#).



On first sight

The mobile's modulation spectrum is displayed graphically in the test menu's live display. The live display is updated continuously (as long as it has not been frozen). The vertical axis of the spectrum live display is scaled in dBm, the horizontal axis in MHz.

To read the exact measurement at any position, simply use the display markers (see [page 27](#) for details).

The softkeys provide access to important tools of the spectrum analyzer.

Entry fields Center frequency

Enter the center frequency (this will usually be the R-TCH channel frequency) on the **Freq.** entry field.

Entry ranges: 430 to 496 MHz, 800 to 1000 MHz and 1700 to 2300 MHz in increments of 10 Hz.

Example: R-TCH channel number 1 in the US 800 band equals a center frequency of 825.030 MHz.

Display resolution

Reference Level — This selection field allows to set the RF power level that is represented by the top horizontal line of the live display.

Entry range: -40 to +40 (dBm) in increments of 10 dB.

NOTE

The value selected here should be equal or slightly higher than the expected maximum RF power level on the measurement frequency in order to avoid overload distortion and to achieve maximum vertical resolution.

Res BW — Selection field to set the horizontal resolution. A high resolution (i.e. a small value selected) will provide more details while a low resolution (i.e. a large value selected) will provide a better overview.

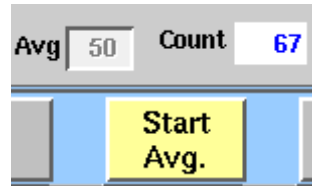
Selections possible: 15 kHz | 30 kHz

Span – Selection field to set the frequency range shown in the live display.
Selections possible: ± 1250 kHz | ± 2500 kHz

Averaging the modulation spectrum

The 4400 provides a useful tool to smoothen the RF modulation spectrum curve: the averaging function.

This means that a user-definable number of the continuous measurements will be taken and the single measurement results will be averaged. The result will be a curve that better shows the spectrum characteristics of the mobile while singular or random noise effects will disappear.



To start the averaging tool, push the **Start Avg.** softkey.

The 4400 will now start the averaging process, using the number of measurements set on the **Avg** entry field.

The entry range is from 1 to 100.

Notes on the averaging tool

- The **Avg** entry field is not accessible unless the averaging process has been started (**Start Avg.** softkey).
- As soon as you change the current setting on the **Avg** entry field, the averaging process will be reset. This means that all previous measurements will be discarded and the series of measurements will be started anew.
- A reset of the averaging process can also be achieved by pushing the **Reset** softkey.
- While the number of measurements taken is less than the value set on the **Avg** entry field, the number of measurements taken (display field **Count**) will be shown in red.
- When the number of measurements taken (display field **Count**) exceeds the number of measurements specified for the averaging process (**Avg** entry field), always the last **Avg** measurements will be averaged and displayed in the live display.
- When the live display has been frozen, a push on the **Reset** softkey will both set the live display back to unfrozen and reset the averaging tool.

RF analyzer for ACPM modulation spectrum

ACPM is an abbreviation of Adjacent Channel Power Measurement.

ACPMs are used to verify that the mobile does not create sideband emissions that would then disturb transmission on adjacent traffic channels.

The results of this measurement are influenced by the following internal stages of the mobile under test:

- channel synthesizer,
- baseband filter, and
- I/Q modulator.

The following defects of the mobile may be detected with this measurement:

- neighboring waves of the synthesizer and
- asymmetry of the I/Q modulator.

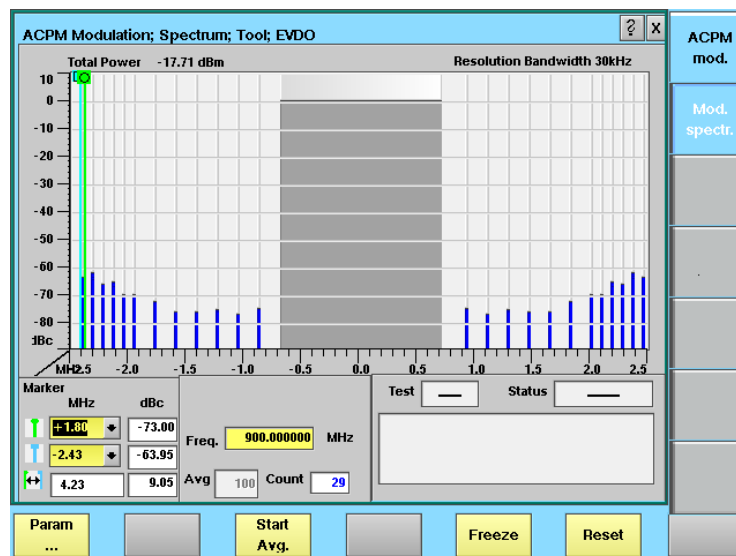
Note: The results of the "RF analyzer menu for rho and frequency" on page 99 also indicate whether the internal stages of the mobile's transmitter work properly.

To call the menu, simply push the [ACPM mod.] marker tab while in the spectrum menus.

NOTES

The RF spectrum analyzer will measure the RF signal received at the **RF IN/OUT** connector.

For a description of the further softkey functions see section "Softkeys of the RF analyzer menus" on page 98.



Understanding the measurement principle

First, a reference measurement at the center frequency is performed. The absolute power level measured is displayed in the upper left corner of the test menu, above the live display (Total Power). This reference level measured equals 0 dBc. The 4400 then performs level measurements at specific frequency offsets using a 30 kHz bandwidth filter. The specific measurement frequencies are user-definable (see below). The measurement results are displayed as vertical bars in relation to the reference level (in dBc).

On first sight

The ACPM spectrum is displayed graphically in the test menu's live display for the discrete frequencies given by the 1xEV-DO specification or defined by the user. The live display is updated continuously (as long as it has not been frozen). To read the exact measurement at any position, simply use the display markers (see page 27 for details).

The softkeys provide access to important tools of the spectrum analyzer.

The vertical axis of the spectrum live display is scaled in dBc; the horizontal axis in MHz. Both horizontal and vertical resolutions are fixed.

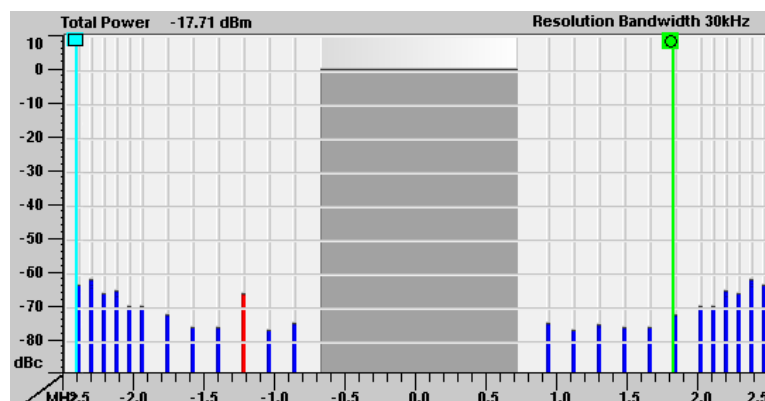
Center frequency

Enter the center frequency (this will usually be the R-TCH channel frequency) on the **Freq.** entry field.

Entry ranges: 430 to 496 MHz, 800 to 1000 MHz and 1700 to 2300 MHz in increments of 10 Hz.

Example: R-TCH channel number 1 in the US 800 band equals a center frequency of 825.030 MHz.

How to read the ACPM spectrum live display



User-definable measurement frequencies and test limits for each band can be defined in the related **Param...** menu. Measurement points can be set in a range of ± 2500 kHz around the center frequency. The gray area marks the in-channel band in which adjacent channel power measurements cannot be taken.

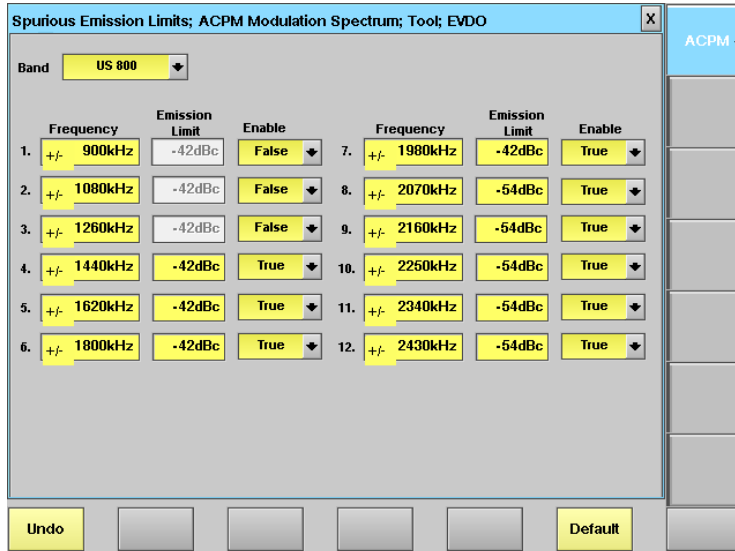
When the measurement result for an individual frequency is within the limits, the corresponding **vertical bar** will be displayed in blue.

A vertical bar displayed in red indicates that the current measurement result is beyond the limits.

Setting measurement frequencies and limits

The measurement frequencies and corresponding limit values can be defined in the spurious emission limits menu:

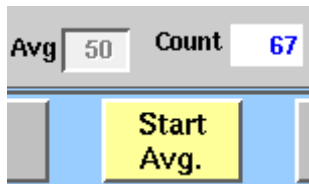
- 1 In the ACPM modulation spectrum test menu, push the **Param...** softkey. The spurious emission limits menu will be displayed.



- 2 Select the frequency band you are working on using the **Band** selection field.
Note: The Band selection field in this menu is only for selecting the appropriate limits; the band measured on will not be changed by this selection.
- 3 Enter the frequencies which you want to measure on. Valid entries are in a range of ± 2500 kHz around the center frequency with a 10 kHz resolution. Up to twelve frequencies can be defined.
- 4 If you want to apply the check of the measurement results against the upper limit for a specific frequency, set the corresponding **Enable** field to True.
Note: This parameter is set to False by default for all in-band frequencies.
- 5 If appropriate, enter an upper limit in the corresponding **Emission Limit** entry field after enabling limit checking (see step 4). The limits are expressed in dBc, relative to the power at the center frequency.

Averaging the ACPM modulation spectrum

The 4400 provides a useful tool to smoothen the ACPM modulation spectrum curve: the averaging function. This means that a user-definable number of the continuous measurements will be taken and the single measurement results will be averaged. The result will be a smoother result curve that better shows the characteristics of the mobile while singular peaks (that might be due to spikes or other measurement errors) will disappear.



To start the averaging tool, push the **Start Avg.** softkey. The 4400 will now start the averaging process, using the number of measurements set on the **Avg** entry field. The entry range is from 1 to 100.

Notes on the averaging tool

- The **Avg** entry field is not accessible unless the averaging process has been started (**Start Avg.** softkey).
- As soon as you change the current setting on the **Avg** entry field, the averaging process will be reset. This means that all previous measurements will be discarded and the series of measurements will be started anew.
- A reset of the averaging process can also be achieved by pushing the **Reset** softkey.
- While the number of measurements taken is less than the value set on the **Avg** entry field, the number of measurements taken (display field **Count**) will be shown in red.
- When the number of measurements taken (display field **Count**) exceeds the number of measurements specified for the averaging process (**Avg** entry field), always the last **Avg** measurements will be averaged and displayed in the live display.
- When the live display has been frozen, a push on the **Reset** softkey will both set the live display back to unfrozen and reset the averaging tool.

For an explanation of the softkeys of this test menu, see section "[Softkeys of the RF analyzer menus](#)" on page 98.

Parameter menus

The Parameter menus allow you to access additional parameters relevant in both non signaling and in call mode at a more detailed level, which do not need to be changed frequently. To access the Parameter menus, push the **Param...** softkey on any of the generator/analyzer menus and then push the appropriate marker tab.

More details about the parameter menus can be found in section "[System parameter menus](#)" on page 73.

Note: Please keep in mind that, depending on the current state of your 4400, some parameters may not be applicable (e.g. network setup parameters when working with an unmodulated RF generator signal, see [page 95](#)).


Tools

4

This chapter provides task-based instructions for additional tools within the 1xEV-DO Options. Topics discussed in this chapter are as follows:

- ["Overview" on page 112](#)
- ["Configuration" on page 112](#)
- ["Utilities" on page 132](#)
- ["Spectrum measurements" on page 138](#)

Overview

This chapter intends to introduce you to the functionality of the Willtek 4400's Tools section. To call the Tools menus onscreen, simply push the **TOOLS**  function key.

The Tools menus can be divided into the following sections:

- Section ["Configuration" on page 112](#) lets you view and change the Willtek 4400's configuration. This includes software updates, software upgrades and interface settings.
- Section ["Utilities" on page 132](#) describes general functions such as a configurable power supply and current measurements.
- Section ["Spectrum measurements" on page 138](#) provides a very brief introduction to the RF spectrum measurements available. For a detailed description, refer to section ["Overview of spectrum test menus" on page 61](#) when working with 4453 1xEV-DO Call Mode Option or to section ["RF analyzer menus for modulation spectrum and ACPM spectrum measurements" on page 103](#) when working with 4452 1xEV-DO Non-Call Mode Option.


Configuration

With the help of these menus, you may configure the interfaces of your Willtek 4400, check whether a specific option has been installed or install options and new software releases.

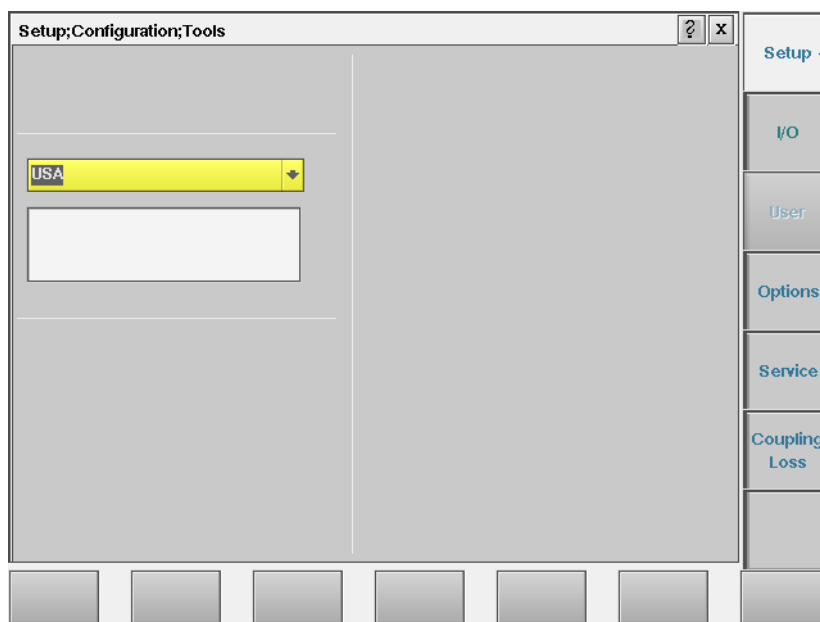
This section consists of the following parts:

- ["Setup" on page 113](#) – In this menu, you may select the language of the external keyboard as well as some other settings.
- ["I/O configuration" on page 114](#) – This menu allows to set the GPIB address, TCP/IP parameters and the external printer connected.
- ["Options" on page 121](#) – This menu provides an overview of the options installed on your Willtek 4400 and also allows to install further options.
- ["Service and software update" on page 123](#) – In this menu, you will find all details about the software revisions installed in the various subsystems of your test set. These details are very useful when discussing problems with the Willtek product specialists. Furthermore, this menu allows to install new software releases or to return to software releases installed previously.

Access to the configuration menus

Push the **TOOLS**  function key. The tool bar provides access to the configuration menus with a push on the [Config] marker tab.

Setup Push the [Setup] marker tab to gain access to this menu.



Settings of the Setup menu

External Keyboard – This selection field allows to set the language of the external keyboard connected.

The settings possible are:

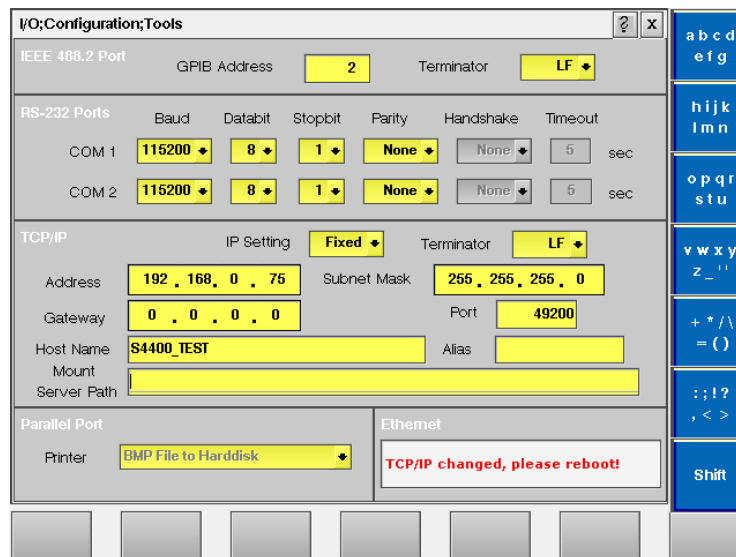
- USA (default)
- BelgiumFrench
- BelgiumDutch
- CanadaFrench
- CanadaEnglish
- Denmark
- France
- Germany
- Italy
- Japan
- LatinAmericaSpanish
- LatinAmericaPortugal
- Netherlands
- Norway
- Portugal
- Spain
- Sweden
- SwissFrench
- SwissGerman
- UnitedKingdom

NOTES

- In some cases, the language setting for the external keyboard may affect the mapping of special keys and characters and thus also the "Keyboard mapping table".
- Any change on this selection field will require a reboot of the test set. You will be reminded by the Please reboot message appearing on the display field just below this selection field.

I/O configuration

Push the [I/O] marker tab to gain access to this menu.

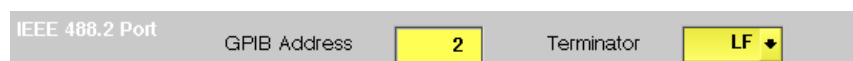


This menu consists of five areas:

- **IEEE 488.2 Port** - this is the area where you set the GPIB address and GPIB command terminator to be used by the Willtek 4400.
- **RS-232 Ports** - from serial number 0911001 onwards, the Willtek 4400 may also be controlled remotely over the serial interface. This is the area where you set the parameters for the serial interfaces COM1 and COM2.
- **TCP/IP** - in this area, you configure the TCP/IP parameters of the Willtek 4400.
- **Parallel Port** - this area provides a selection of printer drivers (or alternatively a file format) to print out the screens of the Willtek 4400.
- **PCMCIA** - informs you about the PCMCIA connections currently available. **Note:** This area of the menu will only be displayed on units with a serial number below 0911001
- **Ethernet** - this display field shows the status of the Ethernet interface. **Note:** This area of the menu will only be displayed on units with serial number 0911001 and above.

IEEE 488.2 port settings

This area of the menu provides access to the following parameters:



GPIB Address — Entry field to set the GPIB address of the Willtek 4400 in case the test set is controlled externally (and not used as the GPIB controller).
Entry range: 0 to 31. Default is 4.

Terminator — Selection field for the GPIB command line termination symbol.
Settings possible are: LF (default), CR and CR/LF.

RS-232 Ports settings

This area of the menu provides access to the parameters of the two serial interfaces (COM 1 and COM 2):

RS-232 Ports	Baud	Databit	Stopbit	Parity	Handshake	Timeout
COM 1	115200	8	1	None	None	5 sec
COM 2	115200	8	1	None	None	5 sec

Baud — Selection field to set the baud rate (data rate) for transmission over the corresponding serial interface.

Settings possible are:

110 | 300 | 600 | 1200 | 2400 | 4800 | 9600 | 19200 | 38400
| 67600 | 115200 bd.

Default is 115200 bd.

Databit — Selection field for the number of data bits per symbol.

Settings possible are: 5 | 6 | 7 | 8.

Default is 8.

Stopbit — Selection field for the number of stop bits following a symbol.

Settings possible are: 1 | 2.

Default is 2.

Parity — Selection field for the parity check.

Settings possible are: Even | Odd | None.

Default is None.

Handshake — Selection field for the type of hardware handshake.

These selection fields are not accessible in the current software release.

Timeout — Entry field for the handshake timeout (in seconds).

These entry fields are not accessible in the current software release.

NOTE

All settings for the serial port must be identical on both instruments connected. Otherwise, it will not be possible to establish a communication link.

TCP/IP port settings

The TCP/IP port provides a range of additional applications when working with the Willtek 4400 over a local area network (LAN):

- Software updates (see section ["Service and software update" on page 123](#))
- Remote control of the 4400 using SCPI commands ([page 219](#))
- Access to files on the 4400 using an NFS connection

- Access to files on the network from the 4400 using an NFS connection (see sections "File menu" on page 143 and "Commands for input/output handling" on page 184 in the RAPID! chapter).

NOTE

While the TCP/IP port is optional for units with a serial number below 0911001 (4478 TCP/IP Option), it is a standard on all units with serial number 0911001 and above.

Prerequisites for units with a serial number below 0911001

In order to setup and use the TCP/IP port of your Willtek 4400, the following things needs to be installed:

- The 4478 TCP/IP Option. This option is available through Willtek and can be installed on site.
- The Ethernet PC card. This is a PCMCIA card available through Willtek. Please ensure that the card is inserted upside down into the left PCMCIA card slot (when looking at the back panel). Please refer to the Ethernet PC card's manual for details.

Once both items are installed correctly, the Willtek 4400 automatically runs a TCP/IP protocol software and also an NFS (network file server) client/server application to allow access both from and to the Willtek 4400 over the LAN.

NOTE

The Willtek Ethernet PC card needs to be plugged into the PCMCIA slot **before** switching the Willtek 4400 on, because the TCP/IP-related software is loaded only during the boot phase.

Addressing the Willtek 4400 over the LAN

Each device in the LAN has its individual, unique IP address so that it knows which messages are intended for it, and so that other devices are able to identify the sender, when the Willtek 4400 broadcasts a message over the LAN.

The Willtek 4400 supports two ways of assigning an IP address to it:

- The IP address is assigned to the Willtek 4400 by the local network administrator and then entered in decimal format (e.g. 192.168.217.43). This configuration is frequently used in smaller or peer-to-peer networks without a dedicated server.
- The 4400 looks for a DHCP (dynamic host configuration protocol) server on the LAN and requests an IP address. This IP address, as well as other parameters like the subnet mask, are then provided by the DHCP server. This method requires that a DHCP server is present in the LAN.

TCP/IP parameters in detail

The following LAN-related parameters can be configured in the TCP/IP area:

TCP/IP		IP Setting	Fixed	Terminator	LF
Address	192 . 168 . 0 . 75	Subnet Mask	255 . 255 . 255 . 0		
Gateway	0 . 0 . 0 . 0			Port	49200
Host Name	S4400_TEST			Alias	
Mount					
Server Path					

NOTE

If you intend to access directories and files that reside on a computer on the LAN, that computer needs to run a NFS server software. Computers running a Unix-based operating system often have a NFS server software already installed. NFS server software for Windows- and for MacOS-based computers is available as a third-party product.

NOTE

If you intend to access directories and files on the Willtek 4400 from a remote computer on the LAN, that computer needs to run a NFS server software. Computers running a Unix-based operating system often have a NFS server software already installed. NFS server software for Windows- and for MacOS-based computers is available as a third-party product.

IP Setting — This selection field allows you to select how the Willtek 4400 is to obtain its IP address:

- **Fixed** means that the user enters the IP address, subnet mask and gateway address.
- **DHCP** means that the information is provided by the network's DHCP server. The Address, Subnet Mask and Gateway input fields are not accessible.

After changing the setting of this field, the Willtek 4400 needs to be rebooted for the changes to take effect.

Terminator — This selection field sets the command line termination symbol for SCPI commands when controlling the 4400 over the LAN. The possible settings are: **LF** (default), **CR** and **CR/LF**.

Address — If IP Setting is set to **Fixed**, enter a valid IP address for the Willtek 4400 on this entry field. The format of an IP address is **a.b.c.d**, where **a** through **d** are integer numbers in the range from 0 to 255 (e.g. 192.168.217.42). The IP address entered must not be identical with another device in the same LAN. Refer to the local area administrator for the assignment of a valid and accessible IP address.

If IP Setting is set to **DHCP**, the IP address of the Willtek 4400 is automatically derived from a DHCP server and this entry field is not accessible.

NOTE

If you enter a new IP address, you need to reboot the Willtek 4400 for the changes to take effect.

Subnet Mask — If IP Setting is set to `Fixed`, enter a valid subnet mask for the Willtek 4400 on this entry field. The format of a subnet mask `a.b.c.d`, where `a` through `d` are integer numbers in the range from 0 to 255 (e.g. 255.255.255.0). The subnet mask defines the IP address range for a subnet. Consult with your local network administrator for the correct setting.

One reason for creating subnets is to limit the data traffic within larger networks and hence maintain the bandwidth effectively available at a reasonable level. If IP Setting is set to `DHCP`, the subnet mask of the Willtek 4400 is automatically derived from a DHCP server and this entry field is not accessible.

Gateway — If IP Setting is set to `Fixed`, enter a valid IP address for the LAN's gateway on this entry field. The format of an IP address is `a.b.c.d`, where `a` through `d` are integer numbers in the range from 0 to 255 (e.g. 192.168.217.254). The gateway is required for LAN communication with computers outside the local subnet.

If IP Setting is set to `DHCP`, the gateway's IP address is automatically derived from a DHCP server and this entry field is not accessible.

Port — When the Willtek 4400 is controlled remotely via LAN using the SCPI command set, these commands need to be addressed to a specific port of the test set. The corresponding port number is set with the help of this entry field. The default setting is 49200. For successful remote control over the LAN, you will have to use the same port number in the application controlling the Willtek 4400 as defined on this input field.

Host Name — This parameter is used for symbolic addressing of the Willtek 4400 so that you can use a name to address it rather than a sequence of numbers.

Note: If there is more than one Willtek 4400 connected to the LAN, please ensure that they carry different host names.

Alias — Like the host name, the alias is used for symbolic addressing. The alias is for short-form addressing of computers within the same subnet.

Note: If there is more than one Willtek 4400 connected to the LAN, please ensure that they carry different alias names.

Mount Server Path — This entry field allows to specify a network path to easily access a server disk on the LAN. A valid network path consists of the server's IP address followed by a colon and the related directory or folder. A typical example for a network path is `172.16.16.21:/disk3/4400_sw`.

Typical applications include software updates and loading files from and to the network using the RAPID! environment.

In the File manager, the server disk will appear as `/io/server`.

NOTES

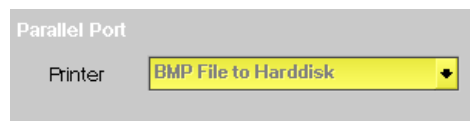
- As the Willtek 4400 is not aware of the local DNS (domain name server) IP address, you need to provide an IP address (in the a.b.c.d format) rather than a symbolic computer name.
- This entry field only allows for mounting one disk. If you need to access several server disks from a RAPID! program or from a remote control application (via GPIB or TCP/IP), you can mount more than one disk from your application program.
- To access any remote computer, that computer must grant access rights for the appropriate service, e.g. if you want to write data to a disk on the LAN, that computer's operating system must be set up to grant write access to all users for the respective directory on that disk.

TCP/IP Troubleshooting

- 1 The network connection does not appear to work at all.
 - Ensure that the network card is installed when you switch on the Willtek 4400. You may remove and re-install the same PCMCIA card once the 4400 has booted (only relevant for serial numbers below 0911001).
 - Check if the Willtek 4400 sounds a double-beep while booting. If it does, it found the network card; if not, the PCMCIA card may be defective (only relevant for serial numbers below 0911001).
 - Check if the cables are tightly connected to the LAN port on the back of Willtek 4400 and to the LAN wall outlet.
 - Ensure that the PC that tries to connect to the Willtek 4400 supports the TCP/IP protocol stack. When a network card is installed, some versions of the Microsoft Windows operating system default to another protocol such as NETBEUI. Windows can run several protocol stacks simultaneously, so installing the TCP/IP stack usually does not affect other network connections and applications.
 - check whether the IP address entered is valid and not already in use by another device within the same LAN. You can check this with any Windows PC, connected to the same subnet/LAN: Open a command shell box (usually under Start-Programs-Accessories) and enter the following command line: `ping <address>` where <address> is the IP address of your Willtek 4400.
The ping should time out if the Willtek 4400 is switched off, but there should be responses from your Willtek 4400 if it is up and running. If there are pings while the Willtek 4400 is switched off, there is another device (such as a PC or another test set) on the LAN using the same IP address. In this case, modify the IP address of one of the devices.
If there is no ping even when the Willtek 4400 is switched on, the IP address is not valid in this subnet or LAN, or the 4400 is not properly connected to the network (check cabling).
- 2 I can enter a new IP address, but the Willtek 4400 does not respond to messages over the ethernet connection.
After making changes to the IP parameters, they are only used after rebooting the Willtek 4400.

- 3 Although I have entered an IP address for the Willtek 4400 and a server path, I do not see the mounted device in the list of directories (e.g. when installing a new software version).
 - Check if the IP address is valid and not already in use by another device on the network. You can check this with any Windows PC, connected to the same subnet/LAN: Open a command shell box (usually under Start-Programs-Accessories) and enter the following command line: **ping <address>** where <address> is the IP address of your Willtek 4400. The ping should time out if the Willtek 4400 is switched off, but there should be responses from your Willtek 4400 if it is up and running. If there are pings while the Willtek 4400 is switched off, there is another device (such as a PC or another test set) on the LAN using the same IP address. In this case, modify the IP address of one of the devices. If there is no ping even when the Willtek 4400 is switched on, the IP address is not valid in this subnet or LAN, or the 4400 is not properly connected to the network (check cabling).
 - Check whether the remote PC runs an NFS server software. UNIX-like operating systems typically include an NFS server; applications for Windows are commercially available.

Parallel port settings



Printer — This selection field is not accessible as the default setting BMP File to Harddisk cannot be altered.

The current screen of the Willtek 4400 will be saved as a bit-map file (*.BMP) on the internal hard disk of the test set, in folder /io/screenshots. During this saving process, a prompt will be displayed on-screen. The saving can be aborted by pushing the **ESC** function key or the corresponding key of the external keyboard as long as the prompt is visible.

The bit-map file may then be copied or moved to a PC using the USB memory stick (from the File menu within RAPID!) or the TCP/IP interface, and processed using standard word processing or DTP software. The size of a single bit-map file is approx. 901kB.

Ethernet display field

This display field is only available for serial numbers above and including 0911001. It shows the current status of the Ethernet interface and the related network connections:



Options Push the [Options] marker tab to gain access to this menu.



This menu displays which standards are installed, and consists of two areas:

- The upper area is called the basic info area. Here you will find the basic information about your test set, like the software release currently installed.
- The largest area of the menu informs you about the standards (cellular formats) available and the ones installed. See ["Accessories and options" on page 29](#) for more details on available options.

The **Option Key** softkey is used to install additional options (see below).

More information about installed options, such as the Audio Option, is available upon a press on the **Technologies** softkey.

Basic info area This area of the menu provides the following basic information:



4405 — In the upper left corner of this area, the 4400 model is indicated (4400, 4403, 4405 or 4407).

SN 0811155 — This indicates the test set's serial number.

NOTE

The availability of features or options may be dependent on the serial number.

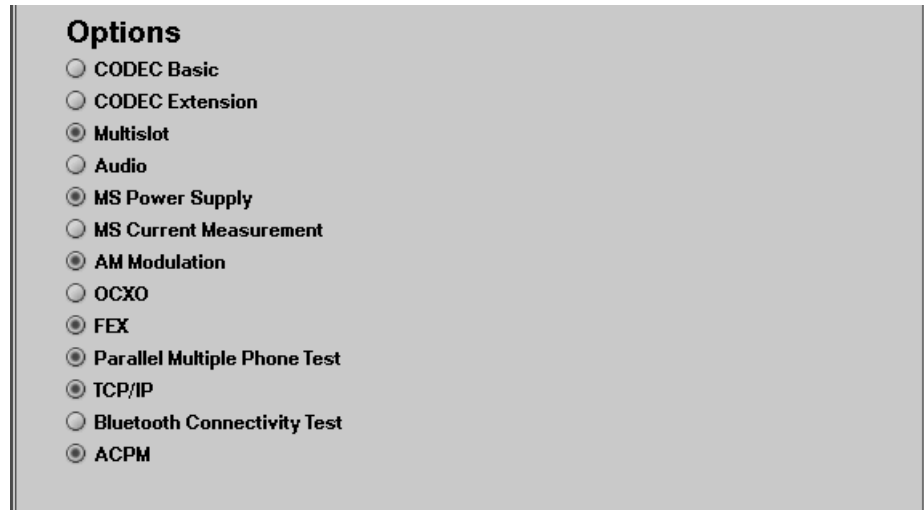
SW Version 12.10.001 — Here, the software version currently in use on this test set is displayed.

30-Jan-2006 — This is the release date of the software version installed.

Last alignment date: 06-Dec-2004 — Here, the date of the last calibration of the test set will be displayed.

In case there is no calibration date for the entire test set available, the date of the last calibration of the RF section is indicated.


Options The options area provides a quick overview of all options installed.

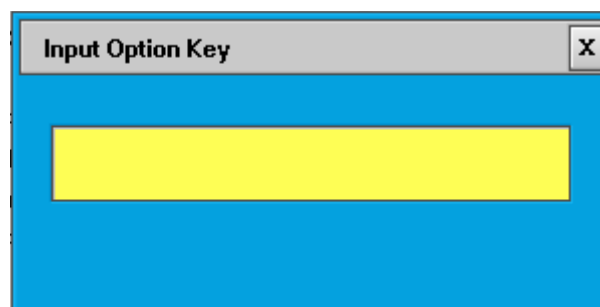


Installing additional options

Some of the options of the Willtek 4400 require both software and hardware (like e.g. the high-precision time base option or OCXO). These options can only be installed by the Willtek product specialists.

Options that are software-based only (like ACPM for instance) may be installed on-site. The only thing required then is an option key available from Willtek. When you have the option key at hands, follow the instructions below:

- 1 Push this softkey. 
- 2 The **Input Option Key** entry field will be displayed on-screen:



- 3 Enter the option key received from Willtek.
- 4 Confirm the option key entered by pushing the **ENTER** function key or the corresponding key on the external keyboard.

- 5 If the code is recognized by the Willtek 4400, it will display an ACCEPT message. Quit the prompt with a push on the **Esc** function key. The tick in front of the corresponding option is now displayed and the full functionality of the option is at your disposal.
- 6 In case the option key entered was not recognized by the Willtek 4400, you will see the NO VALID KEY! message. Try to enter the correct option key again.

Service and software update

Push the [Service] marker tab to gain access to this menu.

Service; Configuration; Tools					
PC	Board S/N	0	S/W version	12.10.001	
	OE S/N	0011155	S/W rel. date	30-Jan-2006	
GSM	Board S/N	0	Hardware	8	
	OE S/N	0011155	Mod. status	-	
	Router FPGA	2			
SIG	S/W version	5.20	S/W rel. date	20-Mar-2006	
	Firmware	2.110	Cal. date	09-Dec-2004	
	FPGA	9			
MEA	S/W version	5.23	S/W rel. date	03-Mar-2006	
	Firmware	2.010	Cal. date	06-Dec-2004	
	FPGA	6			
MRF	Board S/N	0	S/W version	7.1	
	OE S/N	0	S/W rel. date	20-Mar-2006	
	Mod. status	-	Firmware	1.010	
	Hardware	5	Cal. date	06-Dec-2004	
RXIX	Board S/N	0	Hardware	2	Mod. status AB
Synthese	Board S/N	0	Hardware	2	Mod. status A
Frontend	Board S/N	0	Type	1	
	Frontend	S400E10			

This menu provides all relevant information on the hardware and software revisions of the various subsystems of your Willtek 4400. The information on display here is very important when tracing problems or discussing upgrade possibilities with the Willtek product specialists.

Updating the system software


Willtek seeks to permanently improve its products and makes new software versions available on the Internet at www.willtek.com. Several different methods exist to upgrade the software of your Willtek 4400: From floppy disks, from a USB memory stick, from a remote PC over the LAN (TCP/IP required) and from a remote PC over GPIB.

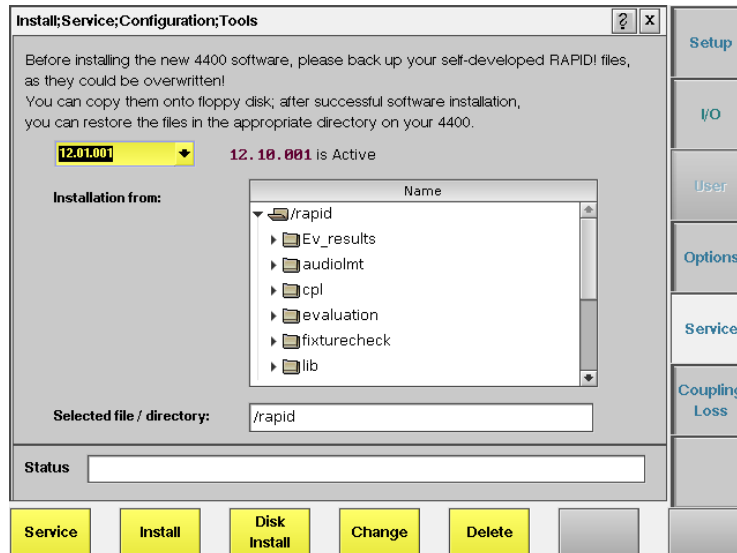


HAZARD

Be very careful using the functions provided in this menu. If used the wrong way, functions described below may leave your test set in a condition where it is not operable anymore.
Never 'play' with this menu!



- 1 A push on the  softkey provides access to the following menu:



The display field in the upper middle of the menu (**12.10.001 is Active** in this example) indicates the software version that is currently in use.

The selection field to the left of the display field allows you to select a different software version that was previously installed on this test set. This will usually be an older software version.

NOTE

The Willtek 4400 allows a maximum of five software versions to be stored internally. In case you try to update a test set where five software versions have been stored already, you will be prompted to delete one of the software versions first.

If your Willtek 4400 is connected to a LAN and a server disk is mounted, or a USB memory is connected to one of the USB ports of the 4400, the file selection box **Installation from:** allows you to select a file on the network or USB stick from which to install the new software version. The box displays the directories and files available on the mounted server disk.

The Willtek 4400 operating software versions usually carry the file extension **.tar**. A server disk can be mounted using the **Tools > Config > I/O** menu.

NOTE

The network computer with the server disk must be a NFS server.

The **status** area of the menu is where the Willtek 4400 will display additional information, comments and messages.

The softkeys of this menu



Closes the current menu and displays the service menu (toggle).
The softkey will change to **New Version**.

Install

A push on this softkey starts the **update routine via LAN (TCP/IP)** or from a **USB memory stick**. The Willtek 4400 will load and install the file selected in the file selection box. Please follow the instructions displayed on-screen.

Note: **Never** close this window nor switch off the Willtek 4400 while the software update is in progress (i.e. after copying software from the network onto the internal hard disk and before the EPLD update is completed). Otherwise, the instrument will not be operable anymore and it will be necessary to return it to the factory or to a Willtek service center.

**Disk
Install**

A push on this softkey starts the **update routine from floppy disk**. Please follow the instructions displayed on-screen.

Notes:

- To return from the update routine without updating, close the on-screen menu with the external mouse and confirm the prompt with **Yes**.
- **Never** close this window nor switch off the Willtek 4400 while the software update is in progress (i.e. after copying software from the network onto the internal hard disk and before the EPLD update is completed). Otherwise, the instrument will not be operable anymore and it will be necessary to return it to the factory or to a Willtek service center.

Change

Before pushing this softkey, consider the consequences: Some software versions, for instance, will **not allow** to return to the current software version.

This softkey allows to change from the current software version to a previously installed software version.

First, select the software version to change to, using the menu's selection field.

Changing to another softkey version takes less than one minute on most systems, but the test set needs to be rebooted.

Delete

In case five software versions have already been installed on your Willtek 4400's hard disk, the test set will prompt you to delete an older software version first when you try to install a sixth software version.

First, select the software version to be deleted with the help of the menu's selection field. Before pushing this softkey, consider the consequences.

Once a software version is deleted, it must be installed anew if you want to work with it again.

Note: The software version currently in use cannot be deleted. If you intend to delete the current software version, change to another software version first.

Initiating a software update from a remote PC

Willtek also offers a tool to update the 4400 software from a PC over the GPIB. This requires a GPIB interface in the PC. The file to download and a Windows-based program to perform the software download are available in the download section on www.willtek.com.

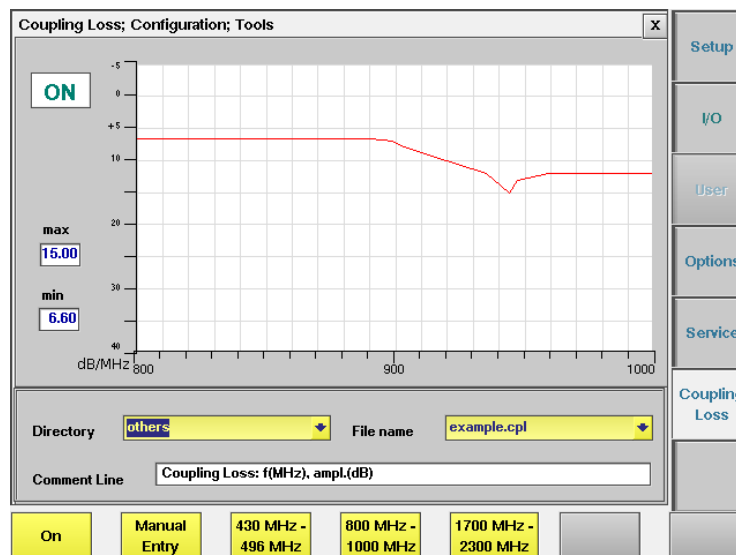
NOTE

The program download requires a National Instruments GPIB card to be installed in your PC. Please check with the Willtek product specialists in case of uncertainty.

Coupling loss

Push the [Coupling Loss] marker tab to gain access to this menu.

When inserting cables, splitters, antennas or other RF equipment between the mobile under test and the 4400, there will always be some attenuation or coupling loss. This attenuation typically varies with the type of mobile being tested, the type of coupler being used and the frequency. An example of a coupler is the Universal Antenna Coupler.



The coupling loss menu allows compensation of that attenuation. To do so, a *.cpl file is required, containing the information about losses on specific frequencies. Those *.cpl files can be created

- using the file editor within the RAPID! environment
- on an external PC and then loading the file to the 4400 using a floppy disk or an USB memory stick
- from the user-defined attenuation menu.

On first sight

In the coupling loss menu, the content of the currently selected *.cpl file will be displayed graphically for three frequency ranges: 430 to 496 MHz, 800 to 1000 MHz and 1700 to 2300 MHz. To switch the display from a frequency range to another, simply push the corresponding softkey.

On the left-hand side of either coupling loss graph, the 4400 provides two display fields giving the minimum and maximum attenuation for each frequency range.

Note: A positive value for an attenuation means a reduced RF power level while a negative value for an attenuation indicates a RF power increase.

*.cpl file format

The coupling loss parameters are stored in files.

The file and directory structure allows you to store a set of parameters for each mobile and to locate the files for the mobiles from one vendor in one directory. The 4400 comes with a number of pre installed directories for some of the larger manufacturers and a directory with parameter files for various "others". You can add more directories using the RAPID! file manager. The location of the coupling loss files and directories is */rapid/cpl*.

How to activate a previously stored coupling loss definition

Directory: others File name: example.cpl
Comment Line: Coupling Loss: f(MHz), ampl.(dB)

Directory Select the corresponding directory (e.g. for the brand of the mobile under test).

This field allows you to browse the list of coupling loss directories that are available on your 4400. In case the manufacturer of the mobile under test is not listed there, check the files in the "others" directory. The 4400 will allow you to browse through the files in the selected directory using the File name selection field.

File name Select the corresponding file name on this field. The 4400 will load the *.cpl file and display the data stored graphically. Any comments or special instructions saved in the *.cpl file will be displayed on the Comment Line field. The files are sorted in alphabetical order. Filenames starting with uppercase letters appear first.

The file names of coupling loss files created with the user-defined attenuation menu (see below) have a dot at the beginning and thus will appear at the beginning of the file list.



Push this softkey to activate the coupling loss compensation. The display field on the left top of this menu will change to **ON**.

The headline in all test menus will now show the name of the active coupling loss file in red letters (e.g. **others/example.cpl**).

How to store a coupling loss file on the 4400

- 1 Save the *.cpl file either on a floppy disk or on an USB memory stick, depending on the hardware details of your 4400.

NOTE

Coupling loss files for leading mobile types can be obtained from Willtek's support department. See www.willtek.com for contact details.

- 2 Insert the floppy disk into the 4400's disk drive or insert the USB memory stick into one of the two USB ports on the front panel.
- 3 Call the Welcome menu on-screen using the **ESCAPE** key.
- 4 Start RAPID! by first pushing the **TOOLS** key and then the [RAPID!] marker tab.
This will call the file manager on-screen.
- 5 Using the file manager, navigate to the `/io/floppy` or to the `/io/usbstick` directory.
- 6 Select the file to be stored on the 4400.
- 7 Push the **ETC** softkey and then the **Copy** softkey. This will call the File Copy menu on-screen.
- 8 Enter the path and the file name to store the file, e.g. `/rapid/cpl/nokia/filename.cpl`.

NOTE

The maximum length for `filename` is 8 characters.

- 9 To confirm the entry and to finally copy the file, push the **OK** softkey.
- 10 A push on the **Exit** softkey will leave RAPID! and take you back to the Welcome menu of the 4400.

How to edit a coupling loss definition already stored on the 4400

- 1 Call the Welcome menu on-screen using the **ESCAPE** key.
- 2 Start RAPID! by first pushing the **TOOLS** key and then the [RAPID!] marker tab.
This will call the file manager on-screen.
- 3 Using the file manager, navigate to the `/rapid/cpl` directory.
- 4 Select the file to be edited.
- 5 Push the **Open** softkey and then the [Edit] marker tab to start the editing process.

The following issues should be considered when editing coupling loss files:

- The *.cpl files are organized as tables.
- An optional comment may be placed in the first line. A comment is indicated by two slashes: `//comment`
- There are two sections within the *.cpl file, one for the frequency range around 450 MHz and from 800 to 1000 MHz and one for the frequency range from 1700 to 2300 MHz.
- Every section must contain at least one line. The maximum for each section is 10 lines.

- Every line consists of two values: the frequency in MHz and the corresponding coupling loss in dB. Those two values are separated by a comma (,).

Example:

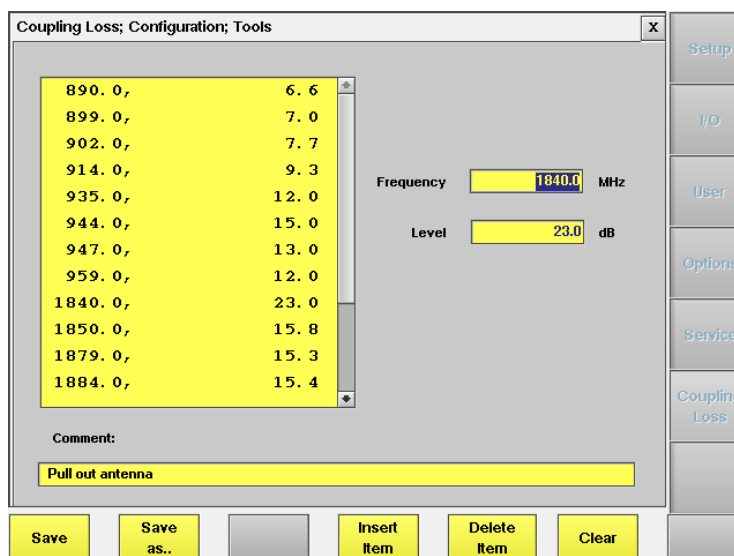
```
//Motorola P7389
825.0,15.0
1750.0,19.0
```

- To return to the file manager, push the [File] marker tab.
- To terminate editing without any changes being saved, push the **Close** softkey.
- Once editing is completed, push the **Save** softkey to save all modifications to the current file.
- A push on the **Exit** softkey will leave RAPID! and take you back to the Welcome menu of the 4400.

The user-defined attenuation menu

The user-defined attenuation menu allows you to enter coupling loss values and frequencies in a menu rather than invoking a text editor:

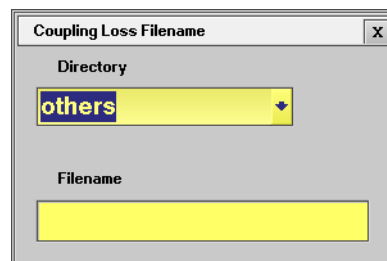
- On the coupling loss menu, select a coupling loss file that you intend to edit or to use as the base of a new coupling loss file.
- Push the **Manual Entry** softkey of the coupling loss menu to call the user-defined attenuation menu.



- There are two sections within the *.cpl file, one for the frequency range around 450 MHz and from 800 to 1000 MHz and one for the frequency range from 1700 to 2300 MHz.
- Every section must contain at least one line. The maximum for each section is 10 lines.
- The lines are sorted by frequency, starting with the lowest frequency on top of the selection field.

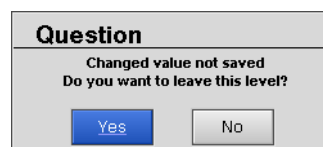
Working with the user-defined attenuation menu

- To edit an existing line (consisting of a frequency (in MHz) and the corresponding coupling loss (in dB)), first select the line in the large selection field on the left-hand side of the menu. The values will be copied to the two entry fields on the right-hand side. Now edit the values. To temporarily store the new values, push the **Insert Item** softkey.
- To add a line, enter a frequency (in MHz) and the corresponding coupling loss (in dB) in the two entry fields on the right-hand side of the menu. To temporarily store the new values, push the **Insert Item** softkey.
- To delete a line, select it in the large selection field on the left-hand side of the menu and push the **Delete Item** softkey.
- To delete all entries of the coupling loss file, push the **Clear** softkey.
- To enter a comment or working instruction, place the text in the **Comment** entry field.
- To save all modifications to the current coupling loss file, push the **Save** softkey.
- To save the modifications under a different file name and/or in a different directory, push the **Save as...** softkey. The 4400 will display a pop-up menu that allows for selecting / entering the path and a file name:



NOTES

- The maximum length for **Filename** is 8 characters.
 - The *.cpl extension will be added automatically.
 - An existing file (having the same file name as entered) will be overwritten without prompt.
- To exit the menu without saving any modifications, push the **Esc** key. The 4400 will prompt you with a safety question. Answering this safety question with **Yes** will leave the user-defined attenuation menu without any modifications being saved.
Answer **No** will take you back to the user-defined attenuation menu.



Softkeys of the user-defined attenuation menu



When pushing the **Save** softkey, all modifications will be saved to the current coupling loss file.

**Save
as..**

To save the modifications to a different or new file, push this softkey. The 4400 will display a pop-up menu (see above). The file name entered will be marked with a "." at the beginning in order to make manually created coupling loss files appear at the beginning of the file list.

Note: All coupling loss files are stored in the /rapid/cpl directory.

**Insert
Item**

The frequency and the coupling loss entered on the two entry fields on the right-hand side of the menu will be inserted as a new line.

Note: The new line will instantly appear in the selection field, sorted by frequency.

**Delete
Item**

The line currently selected in the selection field on the left-hand side of the menu will be deleted without prompt.

Clear

Clears the entire list from the selection field. This means that all entries will be deleted (see above).

After pushing the **ESCAPE** key, the coupling loss menu returns.

Utilities

The menus of this section provide useful tools for debugging when the Willtek 4400 is used in a system environment.

This section consists of the following parts:

- ["I/O trace for GPIB communications"](#) – allows to monitor communication on the GPIB in great detail.
- ["Info trace"](#) – stores internal messages of the system and is helpful when discussing problems with the Willtek product specialists.
- ["MS power supply"](#) – the MS Power Supply option provides the mobile phone with supply voltage; the current measurement option helps identify problems that are caused by shortcuts on the printed circuit board of the phone.

Access to the Utilities menus

Push the **TOOLS** function key from the Welcome menu. The tool bar provides access to the utilities menus with a push on the [Utilities] marker tab.

I/O trace for GPIB communications

This menu allows for monitoring the communication on the GPIB, e.g. to debug a new PC program for remote control of the Willtek 4400. Push the [I/O Trace] marker tab to gain access to this menu.



This menu consists of an area to show all the commands and responses going back and forth between a controlling device (such as a PC) and the Willtek 4400. This communications display is called "trace" and is written to both the screen and a trace file.

NOTE

The trace is generated only as long as the screen is active, otherwise no trace is generated (or the existing trace will not be updated with new information).

NOTE

Generating the trace consumes more processing power from the Willtek 4400 i.e. the Willtek 4400 may work slower than without tracing.

NOTE

If you don't need the trace for debugging purposes, it is strongly recommended to go back to the Welcome menu before starting remote control operation.

The softkeys of this menu

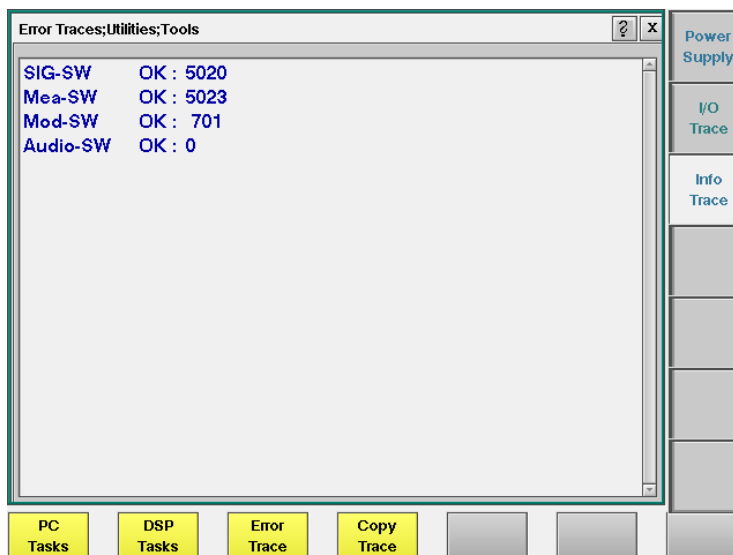


A push on this softkey resets the entire I/O Trace menu (all entries in all areas of the menu will be cleared).



Before pushing this softkey, either insert a disk in the Willtek 4400's disk drive or an USB memory stick as applicable. Then, push this softkey to copy the entire I/O Trace to the storage media. On the storage media, a text file named GPIBPROT.TXT will be generated, containing the I/O Trace in ASCII format. If the I/O Trace is empty, this file will be empty as well.

Info trace Push the [Info Trace] marker tab to gain access to the info trace menu.



This menu provides detailed information about internal procedures and messages of the Willtek 4400.

It does not contain any user-serviceable settings or entry fields.

Its main application is internal debugging at Willtek. It may, however, also provide useful information for the Willtek product specialists when tracing a problem.

The softkeys of this menu



A push on this softkey displays the trace of the procedures, running on the internal PC.



Push this softkey to display the trace of the procedures, running on the internal DSP.



A push on this softkey displays internal messages and the internal error trace.



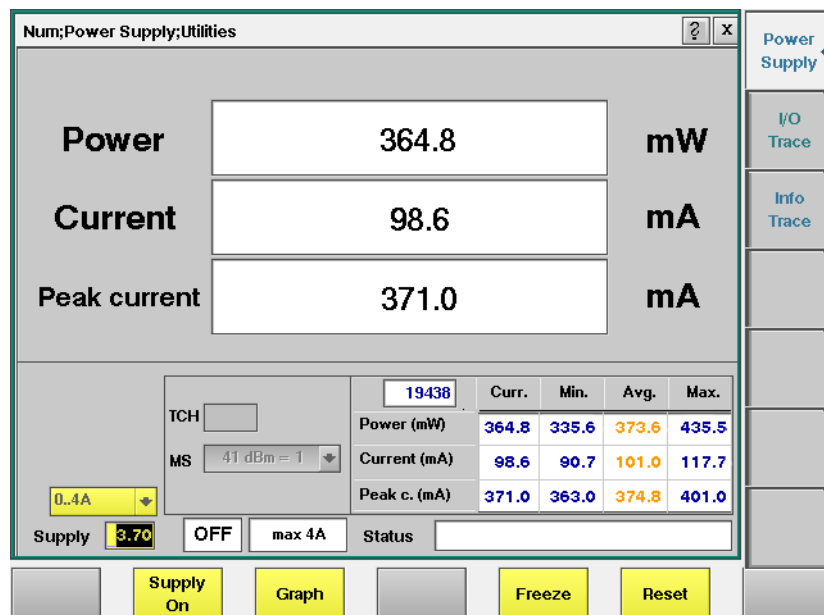
Before pushing this softkey, either insert a disk in the Willtek 4400's disk drive or an USB memory stick as applicable. Then, push this softkey to copy the entire error trace to the storage media. On the storage media, a text file named `INFODAT.TXT` will be generated, containing the error trace in ASCII format. If the error trace is empty, this file will be empty as well. The error trace file may be requested by Willtek product specialists when reporting a problem.

MS power supply

Push the [Power Supply] marker tab of the utilities section to gain access to this menu. It offers you the controls and measurements for two options: the MS Power Supply Option and the Current Measurement Option.

The MS Power Supply is an option to the Willtek 4400, therefore this screen is accessible only if the MS Power Supply Option is installed.

The MS Power Supply Option is a prerequisite for the Current Measurement Option. The Current Measurement Option is required to measure the current that the mobile phone draws from the battery simulated by the Willtek 4400. The measurement results from the Current Measurement Option will only be displayed if the option is installed.



MS Power Supply Option

This menu allows you to select and switch on/off the required supply voltage for the mobile phone, for use with the MS Power Supply option of the 4400. The MS Power Supply option is meant to replace a battery e.g. in environments where the original battery is not yet connected to the mobile (such as in manufacturing lines) or where faults must be traced back to either the phone or the battery (such as in service). Moreover, the MS Power Supply can be used to test the effect of over- or under-voltage on RF transmitter, RF receiver and audio parts.

Connection: The MS Power Supply connector can be found at the left-hand side of the 4400 front panel, below the USB ports (or floppy disk drive on old instruments). The MS Power Supply option comes with a cable of one meter length. One end of the cable can be plugged into the 4400, while the other end is open-ended. The open ends can be used to connect the power supply to a fixture holding the mobile phone. Willtek delivers the cable with open ends because these fixtures are manufacturer-specific and hence open ends are most universal.



The Supply entry field can be used to select a supply voltage in the range 0 to approximately 11 V DC, in steps of 0.05 V (i.e. 50 mV). The option is specified from 0 to 10 V; higher voltages may or may not be achievable, depending on the current being drawn from the power supply.

A status field next to the supply voltage entry field indicates the current status of the power supply, i.e. either ON or OFF. A softkey is available to turn the 'supply on' or 'supply off', respectively.

NOTE

For safety reasons, the supply voltage is always off at power-on. So the power supply has to be switched on when required.

NOTE

If the power supply is short-circuited, the supply voltage and current goes down. When the short circuit is removed again, the voltage will come back after a few seconds (PTC resistor).

Current Measurement Option

If installed, this option displays the current drawn from the simulated battery.

The menu can show the measurement results in two different modes: a numerical-only display and a combined graphical and numerical display. In both cases, the lower results section is the same, indicating a statistical representation of the results for measured power, average and peak current.

The upper results section varies depending on the selected display mode; the mode can be selected with a softkey.

- In numerical-only mode, the upper results section shows the numerical results for power and current from the latest measurement.
- In graphical mode, the upper results section displays the shape of the current over time for one TDMA frame.

Selecting the display mode and display properties

The numerical display is the default mode. To switch to the combined graphical/numerical mode, push the **Graph** softkey. As a result, the current versus time display appears and the softkey description changes to "Numeric". Push this softkey again to return to numerical-only value.

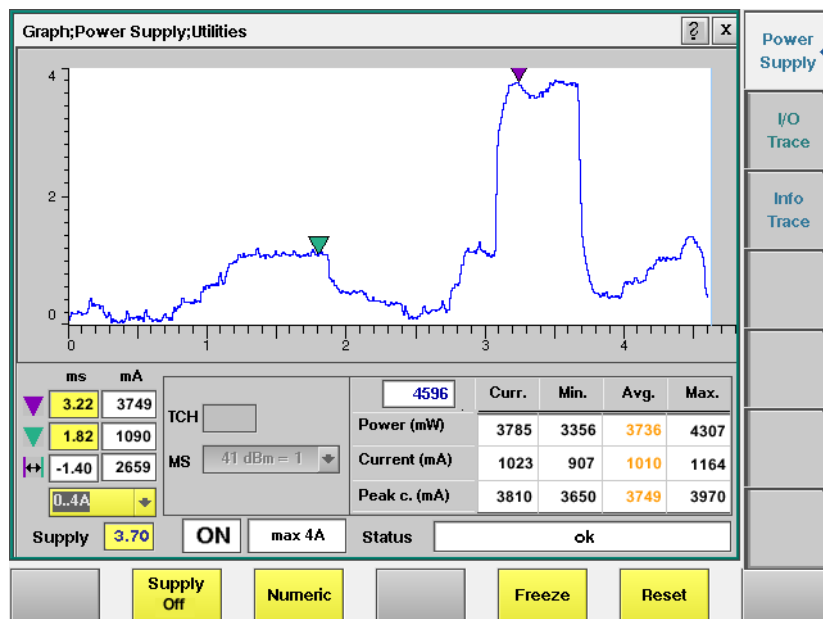
In combined graphical/numerical mode, the menu shows a graph with the current versus time. The scale of the vertical axis is mA and the horizontal axis scaling is in ms (milliseconds).

Two cursors and a cursor readout area allow you to read the measurement values.

The graphical display resolution can be changed as well: Use the scroll field in the numerical results area to change the vertical resolution.

NOTE

The Duration field is not available in this software version.



In GSM, the measurement and display range covers a complete TDMA frame from the start of a downlink frame. With a traffic channel active on time slot 3 and an offset of three time slots between downlink and uplink, the highest current level can be expected at $(3+3) * 0.54738 \text{ ms} = 3.28 \text{ ms}$.

Other current peaks may result from an active receive/demodulation process.

In the measurement example above, a period of low current can be identified in the beginning. After 1 ms, the mobile phone sets up its receiver for reception of the downlink slot. From 1.8 ms to 3 ms, the demodulated data are decoded, and the transmitter prepares for the uplink slot. Transmission of the uplink slot follows, requiring a lot of current from the mobile phone; the absolute value depends on the selected uplink power level. The final phase of the frame is characterized by preparations for the next uplink slot transmission, for example interleaving in the channel coder.

Understanding the result fields

The difference between current, minimum, maximum and average values is explained in section ["Statistical data evaluation" on page 1](#).

Power — This field shows the average power drawn from the simulated battery, measured in mW. It is calculated from the selected supply voltage and the measured current.

Current — The Current Measurement Option measures the current that the mobile draws from the MS Power Supply outlet. The result is averaged over one TDMA frame and displayed in mA.

Peak c. — This field indicates the maximum current that has been detected during the last TDMA frame. The peak current result is shown in mA.

Changing the RF parameters

While measuring the current consumption, you can also switch the RF channel or the transmitted RF power to evaluate the current consumption under different parameter settings.

Use the input fields TCH to change to a different channel.

Use the MS scroll field to change the transmit power level.

Spectrum measurements

Precise spectrum management is always an important issue in radio communication systems in order to avoid interference.

The spectrum analyzer menus provides test capabilities to evaluate the RF signals received by the 4400 in the frequency domain. Two different measurement menus are available: Modulation spectrum and ACPM (Adjacent Channel Power Measurements) due to modulation.

In order to get access to the Spectrum menu, push the **TOOLS** function key while the 4400 is in EVDO Calls & Measurement or in Generator/Analyzer mode. You can also select the [Spectrum ...] marker tab in these modes.

Call Mode When working in Call Mode, the following sections of this manual will provide detailed information regarding the spectrum measurements:

- ["Modulation spectrum test menu" on page 61](#) – provides an overview of the spectrum measurements due to modulation.
- ["ACPM modulation spectrum test menu" on page 64](#) – here you will find all information regarding ACP (Adjacent Channel Power) measurements.

Non-Call Mode When working in Non-Call Mode, the following sections of this manual will provide detailed information regarding the spectrum measurements:

- ["RF analyzer for modulation spectrum" on page 103](#) – provides an overview of the spectrum measurements due to modulation.
- ["RF analyzer for ACPM modulation spectrum" on page 105](#) – here you will find all information regarding ACP measurements.

To access the spectrum test menus, push **TOOLS > Spectrum** while in the EVDO menus.

RAPID!

5

This chapter describes how to use and how to program RAPID! applications. Main topics described in this chapter are as follows:

- ["Overview" on page 140](#)
- ["Using RAPID!" on page 140](#)
- ["RAPID! syntax" on page 157](#)
- ["Commands" on page 165](#)
- ["Functions" on page 190](#)
- ["Tables" on page 208](#)

Overview

RAPID! is a combination of the simple-to-use programming language BASIC and the powerful SCPI command language, developed for the 4400. RAPID! turns your 4400 into a fully automated radio test set that takes measurements, prompts the operators for inputs and generates a test result report that may be printed or sent to the manufacturing line control computer by LAN.

This chapter gives you all the information you need for successful editing of programs, for running and debugging them. It is divided into four subsections:

- [Using RAPID!](#) – Gives an introduction and explains everything about loading and saving files as well as editing, running and debugging programs.
- [RAPID! syntax](#) – This chapter is the 'Syntax manual' of RAPID!. It outlines the general syntax, the program line syntax, the use of variables, constants, operators and expressions.
- [Commands](#) – This part of the RAPID! reference contains a precise explanation of available commands together with application examples.
- [Functions](#) – A range of functions is available to work with numerical and string variables, as well as for input and output handling.
- [Tables](#) – Should any error occur during editing a program or during runtime, this subsection explains the reason for that in detail and gives information on how to trace back an error and to debug it.

NOTE

For all work within the RAPID! environment, we strongly recommend the use of an external keyboard (PS/2 connector) and a standard PC mouse (Sub-D 9-pin connector). For more details, please check with section "[Connectors on the rear panel](#)" on page 11.

Using RAPID!

This subsection gives an introduction and explains everything about loading and saving files as well as editing, running and debugging programs.

- [Introduction](#) – Here you will find a general explanation of what RAPID! is, and how to enter the RAPID! working environment.
- [File menu](#) – In this menu, you load, save, copy, rename or erase program files.
- [Edit menu](#) – The RAPID! editor provides powerful tools for entering code or for searching and replacing contents.
- [Run menu](#) – Here you select the file to run and start a program.
- [Debug menu](#) – This powerful menu provides you with all the features you need for successful program development: running a program in single steps, watching and altering variables and more.

Introduction

RAPID! is a programming language that turns the 4400 into a fully automated radio test set. Controlled by RAPID!, the 4400 will for instance execute a series of tests with minimal human interaction, and at the same time produce a test report with a clear evaluation of the results measured.

Of course, you may halt any program and show e.g. adjustment instructions on the display of the 4400. Once the operator responds to those instructions, the RAPID! program will continue with new measurements and/or instructions.

RAPID! is a great time saver for extensive tests that are performed frequently. Typical examples are automated acceptance tests after manufacturing or regular routine checks as part of maintenance or quality assurance.

RAPID! = BASIC + SCPI

RAPID! programs are a powerful combination of the simple-to-use BASIC programming language and the 4400 specific SCPI commands. The BASIC instructions implemented are outlined in detail in subsection [RAPID! syntax](#) while [Chapter 6](#) is fully dedicated to SCPI.

BASIC commands

BASIC (Beginner's All-purpose Symbolic Instruction Code) commands provide the required program sequence. They also enable the further processing of measured results, the entry of numeric values and texts (character strings) as well as the formatted output of reports to e.g. a printer.

SCPI commands

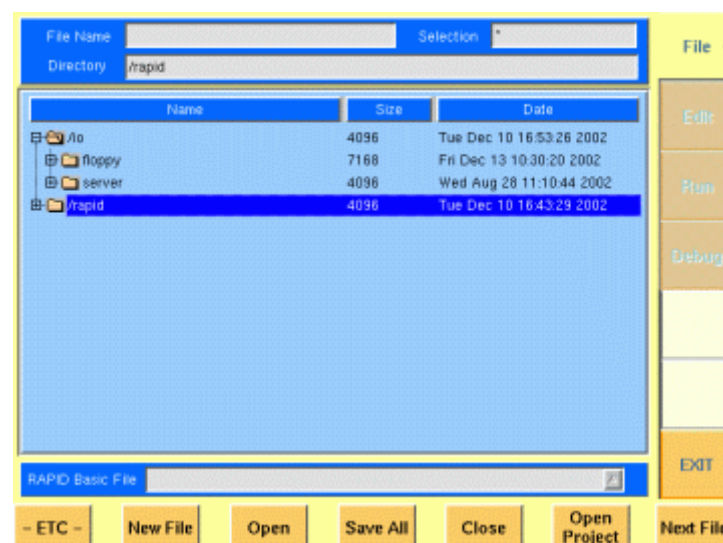
SCPI commands are used for configuring the 4400 and for executing and evaluating measurements. You'll find more about the use of SCPI commands in subsection "[SCPI and RAPID!](#)" on page 225.

Entering and exiting the RAPID! environment

How to enter

To enter the RAPID! environment, navigate to the Welcome menu. There, simply push **TOOLS** > [RAPID!].

If an AUTOSTART.bas program has been loaded and is active, the 4400 will now start that program. Otherwise the 4400 will now display the RAPID! File menu.



With the help of the File menu, you may select the file you want to edit or create a new file with the help of the related softkeys and marker tabs.

How to exit

The [Exit] marker tab quits the RAPID! environment and takes you back to the Welcome menu.

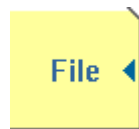
In case you did any program editing without saving the changes, the 4400 will prompt you to either save or ignore the previous editing:



You may then save the changes by pushing the **Yes** softkey, while a push on softkey **No** will discard any changes and leave the file as it was. **Cancel** takes you back to the RAPID! environment.

Marker tabs of the RAPID! environment

The marker tabs offer direct access to the menus of the RAPID! environment:



File menu – Loading, saving, copying, renaming and erasing files in general.



Edit menu – Selecting a file to edit, entering code, saving a single program file, searching for and replacing text.



Run menu – Selecting a file to run and starting a program.



Debug menu – Running a program, single-stepping a program, watching and altering variables.

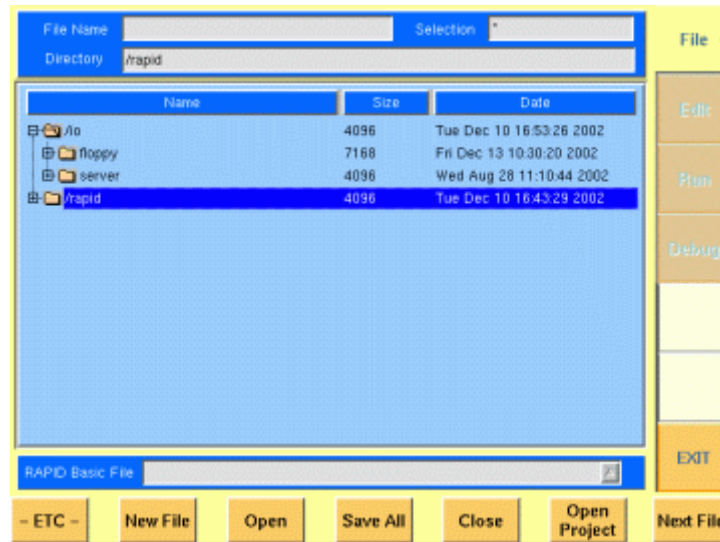


Quitting the RAPID! environment.

File menu In a similar way as e.g. Windows Explorer, the File menu gives access to the directory structure of the internal hard disk drive and allows to search for and select files.

NOTE

Some 'typical Windows' functions, e.g. double-clicking on a file name to open it, are not included.



To keep work with the File menu as simple as possible, it is subdivided into three main sections:

- **File name – directory – selection area**, where you may select directories, file names and filters for the display of file names in the browser area.
- **Browser area** – this is where the 4400 shows its directory structure and allows you to browse through all directories and files.
- **RAPID! basic file area** – this is a selection field where you may select one of the previously opened RAPID! Basic Files.

The softkeys are used to call specific file functions (as e.g. creating a new file, opening a file or deleting a file) while the marker tabs give access to the various menus of the RAPID! environment.

NOTE

As long as no file has been opened or newly created, all marker tabs (except [File]) are grayed out and cannot be selected.

File name – directory – selection area In this area, you may manually select a directory, a file name and/or the filter for the files displayed in the browser area.

To gain access to these three entry fields, simply click on the related entry field with the mouse or push the |New File| softkey in the file menu.



To navigate from one entry field to the subsequent one, simply use the **PgUP** and **PgDN** keys.

File Name — This is where you enter the name of the file (including extension). In case you enter an invalid file name, the 4400 will display a warning message on-screen.

To confirm the file name and its directory, simply push the **ENTER** key. When creating a new file, it will be added to the RAPID Basic File list automatically.

NOTE

The easiest way to enter a file name is of course with the help of the external keyboard. If it is currently not available, all characters are accessible through the [Typing tabs](#).

Directory — Here, the 4400 displays the currently selected directory. In order to save a newly created file in a different directory or to change the currently selected directory, just enter the name of the directory you want to work within.

NOTE

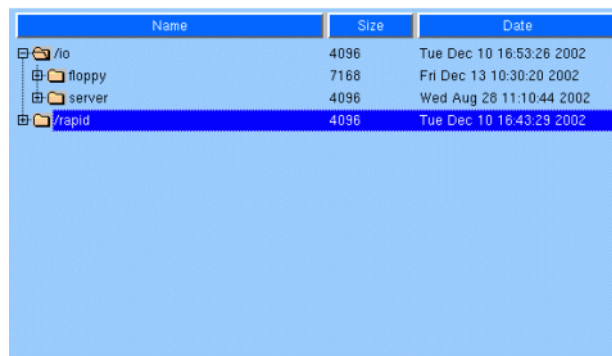
The directory path displayed here is the same as selected in the browser area, as long as you do not change it.

Selection — This entry field sets a filter for the file display within the browser area. The default setting is * and will make the browser display all files (with any extension).

Browser area

In this area, you may browse through directories just as with any other standard browser.

As soon as you enter the RAPID! environment, the file menu is automatically displayed and the browser area is active.



Name	Size	Date
/io	4096	Tue Dec 10 16:53:26 2002
floppy	7168	Fri Dec 13 10:30:20 2002
server	4096	Wed Aug 28 11:10:44 2002
/rapid	4096	Tue Dec 10 16:43:29 2002

The most convenient way to navigate through the Browser area is with the help of the mouse. Alternatively, use the **PgUP** and **PgDN** keys to scroll by pages and the **UP** and **DOWN** keys to scroll by lines.

A directory is opened or closed by a simple push on the **ENTER** key after it has been selected.

To open a file, mark it with the cursor (it is then highlighted) and push the **Open** softkey. As soon as you open a RAPID! file, it is automatically added to the RAPID Basic File list.

The top level directories are:

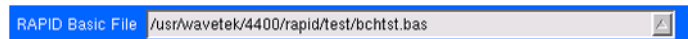
- **/io**. This directory includes the **floppy** subdirectory which in turn carries the contents of the floppy disk (if any is inserted in the floppy drive). An additional subdirectory, **server** may be available if the 4400 is equipped with an Ethernet PC card and the TCP/IP Option and if a server disk has been mounted. This disk is shown under **/io/server**.
- **/rapid**. This directory carries various subdirectories with example RAPID! programs, result files, coupling loss files and many more. You can use this area to locally save your files on the 4400.

NOTE

Access to a remote PC on the network requires NFS server software to be running on the PC; the server must grant at least read access for the directories and files. Please read section I/O Configuration for more details.

RAPID! basic file area

This area is made up by a selection field. You may select any file that has been opened or newly created before. The RAPID! Basic File selection field is available in all RAPID! menus. A simple push on the **Next File** softkey or a click on the selection field navigates the cursor to it.



To select a file, simply click on the file name. Alternatively, push the **UP** and/or **DOWN** keys until the requested file is highlighted. Then confirm your selection by pushing the **ENTER** key.

Softkeys of the file menu

The file menu contains two sets of softkeys. The **ETC** softkey toggles between them.



New File — Creates a new RAPID! program file. You specify the name (and directory) in the **File name – directory – selection area**, which is activated automatically after you push this softkey.

As soon as the file has been created, it is added to the RAPID! Basic File list by the 4400 and you may start editing any time.

NOTE

As this softkey gives access to those three entry fields, you may also use this softkey if you want to e.g. set a new filter for the files to be displayed within the browser area (see section [File name – directory – selection area](#) for details).

Open – A push on this softkey opens the file currently highlighted in the [Browser area](#). It also adds it to the RAPID! Basic File list.
After a file has been opened, you may edit, run or debug the file.

Save All – Saves all currently open files.
If there have been no changes made to a file since it was saved last, the file will remain unchanged.

Close – Closes the file currently selected on the RAPID! Basic File selection field list and removes it from the list.
If there have been any changes made to that file since it was saved last, you will be prompted to save the file.

Open Project – This softkey works similar to the **Open** softkey. Unlike the **Open** softkey, this softkey does not only open the file selected (highlighted) but also all basic files chained to this one.
All files will be added to the RAPID! Basic File list.

Next file – Pushing this softkey will activate the RAPID! basic file selection field and allow you to select one of the currently open RAPID! basic files.

New Dir – Creates a new subdirectory in the directory currently shown in the File Name – Directory – Selection display field.
The 4400 will prompt you with an entry field to enter the name of the subdirectory to be created. To enter the name, use the external keyboard or the typing tabs.

Copy – A push on this softkey allows you to copy the currently selected (= highlighted) file. Additional softkey labels will be displayed that allow the following choices:

OK – Copies the currently selected file. The 4400 will prompt you with a dialogue box that allows you to enter the destination file name (including directory). To enter the file and directory name, use the external keyboard or the typing tabs.

to IO – Copies the currently selected file to the floppy inserted in the 4400's floppy drive. The copy of the file will have the same name as the original file.

to RAPID – Copies the currently selected file to the 4400's internal hard disk drive. The test set will prompt you with a dialogue box that allows you to enter the destination file name (including directory). To enter the file and directory name, use the external keyboard or the typing tabs.

Cancel – Quits the copy function and takes you back to the second set of softkeys.

Move — With the help of this function, you may rename the file currently selected in the browser area.

The 4400 will prompt you with a dialogue box that allows you to enter the destination file name (including directory). To enter the file and directory name, use the external keyboard or the typing tabs.

Erase — Deletes the file currently selected on the RAPID Basic File selection field. Before the file is deleted, you will be prompted to confirm or discard the erasure of the file.

Print — After pushing this softkey, the 4400 will prompt you with a print output message:

Printing file

Is a Printer connected to LPT, switched on and online?
If you confirm by pushing **YES**, the 4400 will print the file highlighted (without any formatting).

Softkey **No** aborts the printing process.

NOTE

The settings for the printer are performed in the I/O menu of the configuration section. To gain access, return to the [Welcome menu](#), push the **TOOLS** key and then the [I/O] marker tab. Settings for the parallel printer port are performed in the section marked with Parallel Port.

Unmount USB — A push on this softkey unmounts the USB interfaces and thus allows to remove an USB memory stick without putting the data stored on it at risk. The 4400 will display a prompt on-screen:

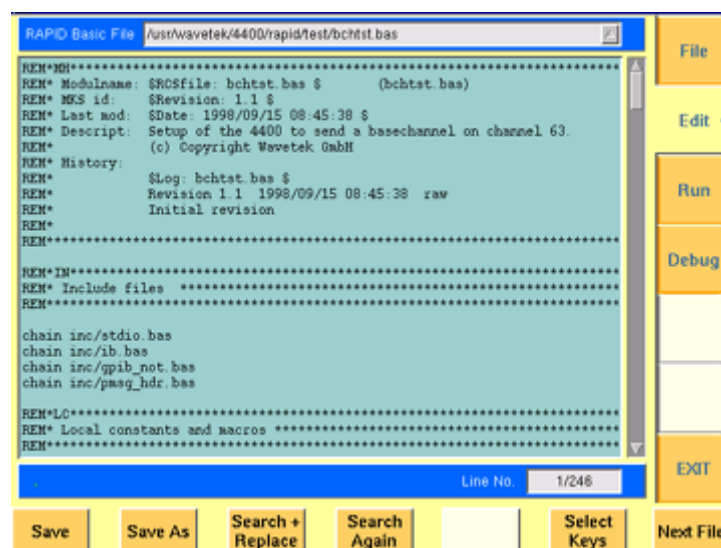
Unmount

Remove USB-stick

Confirm the removal of the USB memory stick by pushing the **OK** softkey.

Edit menu

For program developers, this is probably the most important menu of the RAPID! environment. The Edit menu is the menu you actually write programs in, before they can be run or debugged.



The Edit menu is subdivided into three main sections:

- **RAPID! basic file area.** Here you select the file you want to edit.
- **Edit area,** where the editing is carried out.
- **Status area.** This is where the 4400 displays error messages or gives the current cursor position in relation to the entire file.

The softkeys provide access to important functions of the Edit menu, like the search for text.

The marker tabs give instant access to the various menus of the RAPID! environment.

Edit area

The Edit area is where you create and edit program code, using the built-in BASIC-type language of RAPID!.

```

REM*MH*****
REM* Modulname: $RCSfile: behtst.bas $      (behtst.bas)
REM* MKS id:   $Revision: 1.1 $
REM* Last mod: $Date: 1998/09/15 08:45:38 $
REM* Descript: Setup of the 4400 to send a basechannel on channel 63.
REM*          (c) Copyright Wavetek GmbH
REM* History:
REM*          $Log: behtst.bas $
REM*              Revision 1.1  1998/09/15 08:45:38  raw
REM*              Initial revision
REM*
REM*
REM*IN*****
REM* Include files *****
REM*
chain inc/stdio.bas
chain inc/ib.bas
chain inc/gpib_not.bas
chain inc/pmsg_hdr.bas

REM*LC*****
REM* Local constants and macros *****
REM*

```

To work on program code, we strongly recommend the use of an external keyboard.

In principle, it is possible to do without, using the typing tabs, but this is a rather time-consuming way.

An external keyboard not only provides mapping of the 4400 keys. It also allows you to use the standard 'control codes' as with any usual text editor. Some of the standard control codes are listed in the table below.

Ctrl+a	Select all
Ctrl+c	Copy
Ctrl+x	Cut
Ctrl+v	Paste

Status area

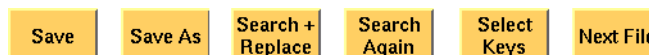


In the status area, the 4400 shows the following information:

- **Syntax errors** – these are mainly typing errors with commands or missing command elements and prevent a RAPID! program from being executable.
- **Runtime errors.** These errors occur during runtime of a RAPID! program and usually lead to an unexpected end of the program run.
- The display field `Line No.` gives both the number of the line, the cursor is currently located in and the total number of lines of the file.

Softkeys of the Edit menu

The Edit menu provides a number of file-handling functions that can easily be accessed through the softkeys.



Save – A push on this softkey saves the currently open file without changing its name.

Save As – Saves the currently open file under a new name. After a push on this softkey, the 4400 will display a dialogue box that allows you to enter the destination file name (including directory). To enter the file and directory name, use the external keyboard or the typing tabs.

Also, the labels of the softkeys change and the 4400 will offer three new softkeys:

- **Save** When you push this softkey, the 4400 will save the current file under the file name entered in the dialogue box.
- **Protect** When you push this softkey, the 4400 will save the current file under the file name entered in the dialogue box in protected mode. This means that the file will be completely inaccessible to any editing attempts.



WARNING

There is no way to edit a protected file again. Before selecting this function, please be sure that there is an unprotected copy of this file available.

- **Cancel** Quits the function and takes you back to the Edit menu with its basic softkeys.

Search+Replace – Enables you to find text passages and optionally replace them with other ones.

The text the 4400 shall search for is entered in the [Search/Replace menu](#).

Search Again – Continues the search of the text passage as entered in the [Search/Replace menu](#) before. The direction of the search is "downwards", i.e. from the current cursor position towards the end of the file.

Select Keys – Changes the marker tabs to typing tabs. While the typing tabs are active, the label of this softkey changes to **Deselect Keys**. A push on that softkey brings back the basic marker tabs of the RAPID! environment and the initial softkey label.

Next File – Activates the RAPID Basic File selection field and allows you to select a different file. After you confirm your choice, the newly selected file is then displayed in the Edit area.

Search/Replace menu

In this menu, you enter the text to find. Optionally, it can be replaced by new text, entered in the same menu.



The text to be found is entered in the upper line (**F**ind).

If the text found shall be replaced by another text, enter the new text in the lower line of this menu (**R**eplace).

To move the cursor from the upper to the lower selection field and vice versa, use the **PgUP** and **PgDN** keys.

To get back to any text entered previously on these selection fields, push the **Select Prev.** softkey and the usual drop-down menu of a selection field will appear.

Softkeys of the Search/Replace menu



Find — Searches for the text entered on the **F**ind selection field. The direction of the search is "downwards", i.e. from the current cursor position towards the end of the file.

Replace — Searches for the text entered on the **F**ind selection field and replaces it with the text entered on the **R**eplace selection field. The direction of the search is "downwards", i.e. from the current cursor position towards the end of the file.

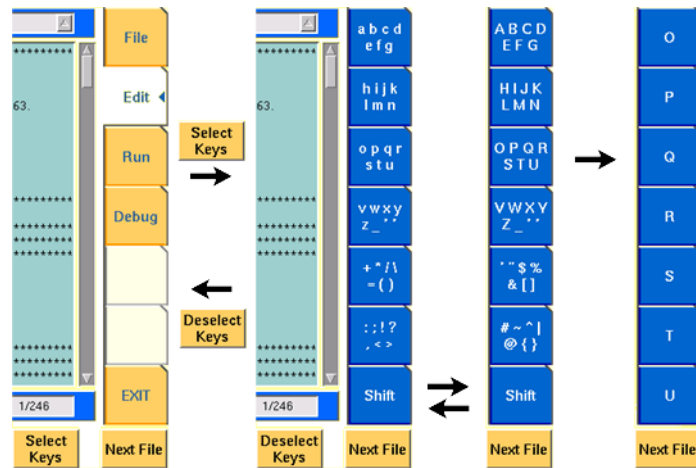
Replace All — Searches for all occurrences of the text entered on the **F**ind selection field and replaces every single one with the text entered on the **R**eplace selection field. The direction of the search is "downwards", i.e. from the current cursor position towards the end of the file.

Select Prev. — Calls the usual drop-down menu of the currently active selection field and allows you to select any text entered previously.

Cancel — Quits the Search/Replace menu and takes you back to editing.

Typing tabs

In case an external keyboard is not accessible, there is still the built-in 'type-writer' of the 4400 available. The marker tabs change to typing tabs and allow to enter and/or edit text in a way similar to an SMS on a mobile phone.



As soon as you push the **Select Keys** softkey, the marker tabs change to groups of letters and symbols.

The lowest marker tab changes to [Shift] and allows you to toggle between lower and uppercase letters.

As soon as you select a group of letters or symbols by pushing the corresponding marker tab, the marker tabs will change again to single letters or symbols. Push the marker tab of the desired letter or symbol. That one will appear on the entry field or edit menu and the marker tabs will change back to groups of letters and symbols automatically.

NOTE

Entry fields can also be edited using the **BACK** function key.

NOTE

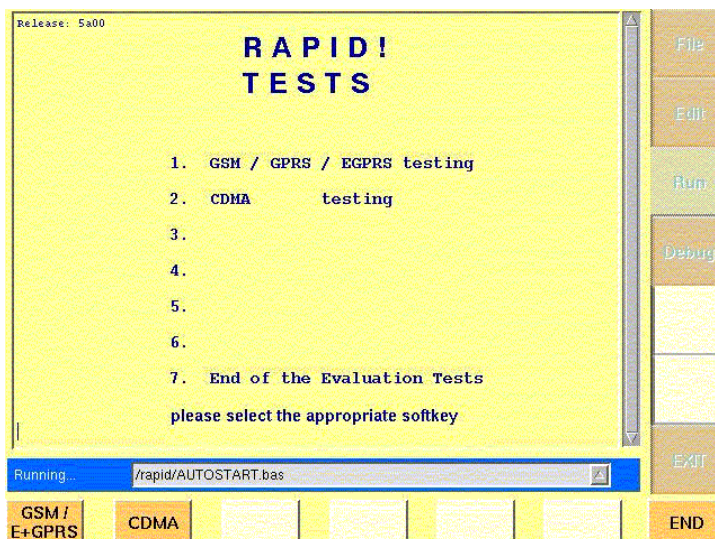
Softkey **Deselect Keys** takes you back to the usual marker tabs of the RAPID! environment.

NOTE

Use the numeric keypad to enter numerals, the minus sign (-) or a period (.).

Run menu

The Run menu is where programs are started. If there are no syntax or runtime errors encountered, the program will smoothly run until it reaches its end and will display its status messages and comments in this menu.



The Run menu is subdivided into two main sections:

- **RAPID! basic file area**. Here you select the file you want to run.
- **Output area** where the output of the running RAPID! program is displayed.

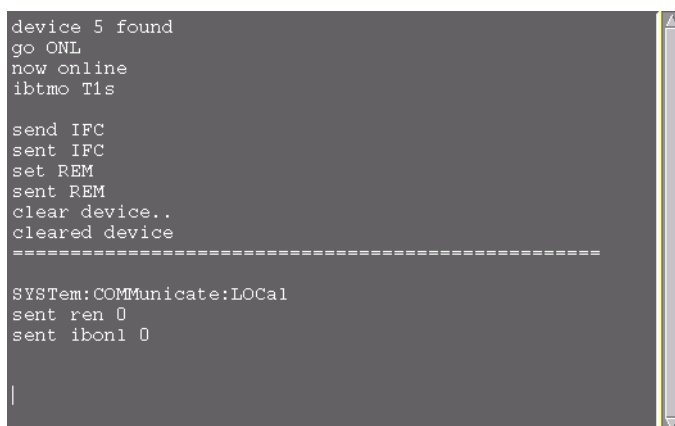
The softkeys provide access to important functions of the Run menu, like starting a RAPID! program.

The marker tabs give instant access to the various menus of the RAPID! environment.

NOTE

As long as no file has been opened or newly created, the marker tabs are grayed out and cannot be selected.

Output area In the output area, the 4400 displays the output and status messages created by a running RAPID! program.



Softkeys of the Run menu

The Run menu offers two softkeys:

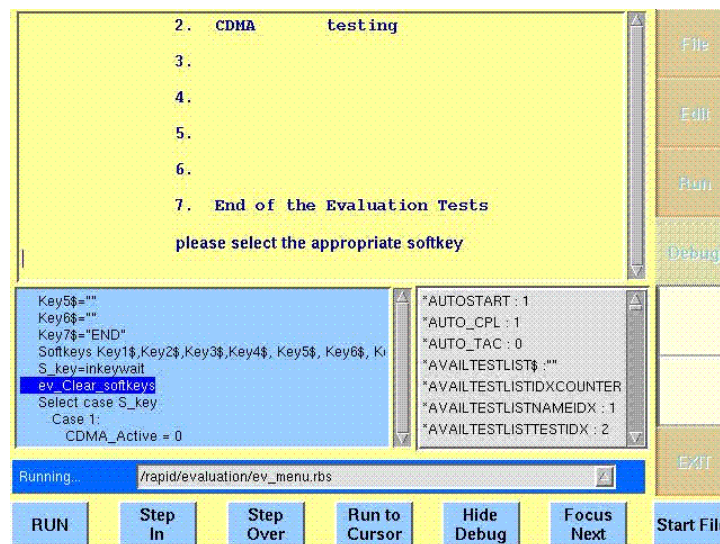


RUN — The RAPID! file, currently selected on the RAPID Basic File selection field, will be loaded and the program execution started.

Start File — Takes the cursor to the RAPID Basic File selection field and thus allows you to select the required file from the list. Next time you push the |RUN| softkey, this newly selected file will be executed.

Debug menu

The Debug menu provides you with a number of powerful tools in order to support your program development. The Debug menu consists of four areas that provide you with full information on different aspects of the program run. In order to work with this menu in an efficient way, we strongly recommend the use of an external keyboard and a mouse.



In this Debug menu only, the softkeys of the 4400 appear in blue. Thus, they can be easily distinguished from program-generated softkeys, as those appear in standard orange.

The areas are:

- **RAPID! basic file area.** Here you select the file you want to run.
- **Output area** where the output of the running RAPID! program is displayed.
- **Source area.** Here, the 4400 shows the program code being currently executed.
- The **Variable area** displays all program variables as well as their current value.

The softkeys provide access to important functions of the Debug menu, like starting a RAPID! program.

The softkeys of the Debug menu appear on blue background. Thus, they can be

easily distinguished from the program-generated softkeys.
The marker tabs give instant access to the various menus of the RAPID! environment.

NOTE

As long as no file has been opened or newly created, the marker tabs are grayed out and cannot be selected.

Source area In the Source area, the 4400 displays the program code being currently executed. The program line highlighted in blue is the line that either has just been executed (in RUN mode) or the line that will be executed next (in STEP mode).

```
param(1) = Modulationsart
param(2) = BT
param(3) = NormalHub

STOP
OUT_sendMsg SIG_DUPO, MOD_TARGET, MOD_PARAM

if DEBUG = TRUE then
  print " Anzahl parameter: ";AnzParam
```

To browse through the program, simply use the external keyboard or the cursor keys and function keys.

It is not possible to edit the program in this area. In order to do so, please use the Edit menu.

To run a program or to execute it step by step, please use the appropriate softkeys of the Debug menu.

In the Debug menu, only the first screen line of continued program lines will be highlighted.

Variable area In the variable area, the 4400 displays all variables used in the RAPID! program run, including their current values.

While a program is e.g. waiting for an input, you may access the Variable area with the mouse and have a look at all current variables.

```
BT : 0.3
CALL_NETW_STAT : 132
CAL_HF_REC_RANG : 97
CAL_HF_REC_RANG_CLE : 96
CMD$ : "Start : 11:08:42"
DEBUG : 0
DEBUG_MESSAGE : 21
```

Altering the value of variables directly

Within the variable area, the values of the variables may be altered directly:

- 1 Select the variable with the mouse. The 4400 indicates the selection of the variable by highlighting it in dark blue.



- 2 Enter the new value for the selected variable in the `edit watch:` dialogue box, using the 4400's numeric keys or the external keyboard.
- 3 Confirm the value entered with a push on the **ENTER** function key on the 4400 or a push on the external keyboard's **Enter** key.
- 4 The new value will now be used when you run or step the program using the corresponding softkeys of the Debug menu.

Alternatively

- 1 Open the Variable area by pushing the **Focus Next** softkey until the Variable area gets highlighted.
- 2 Select the variable you would like to alter with the cursor (simply use the cursor keys to do so). The currently selected variable is indicated by a thin black frame.
- 3 Activate the variable editing mode by confirming your selection with a push on the **Enter** function key on the 4400 or a push on the external keyboard's **Enter** key.
The 4400 indicates the selection of the variable by highlighting it in dark blue.

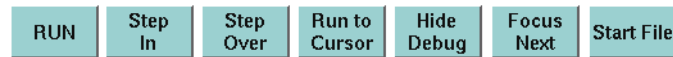


- 4 Enter the new value for the selected variable in the `edit watch:` dialogue box, using the 4400's numeric keys or the external keyboard.
- 5 Confirm the value entered by pushing the **Enter** function key on the 4400 or by pushing the external keyboard's **Enter** key.
- 6 The new value will now be used when you run or step the program using the corresponding softkeys of the Debug menu.

Note: The variable selected last will remain highlighted until you select a new variable or run a new program.

Softkeys of the Debug menu

The Debug menu provides a number of specific debugging functions that can easily be called with the help of the softkeys.



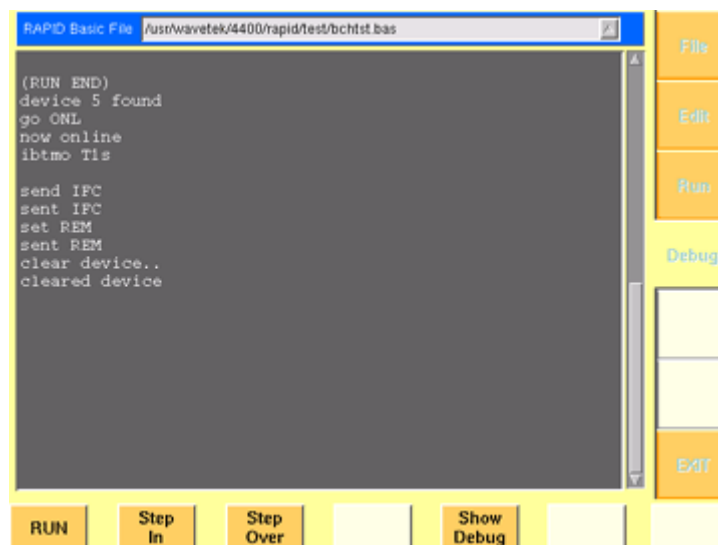
RUN — Loads the program currently selected on the RAPID Basic File selection field and starts execution of the program.
In this mode, the 4400 will highlight the last command performed in the Source area.

Step In — Executes the program line highlighted.
In case this line contains a GOSUB, CHAIN, SUB or FUNCTION call, the debugger steps in, i.e. it will follow the program branching.
In case the line contains an INKEY command, the program will be halted and wait for the push of a softkey. After the softkey was pushed, the program-defined softkey label will be displayed.
In this mode, the 4400 will highlight the next command to be performed in the Source area.

Step Over — Executes the program line highlighted.
In case this line contains a GOSUB, CHAIN, SUB or FUNCTION call, the debugger steps over it to the following line, i.e. the program branching will be ignored.
In case the line contains an INKEY command, the program will not be halted and will assume that no softkey was pushed.
In this mode, the 4400 will highlight the next command to be performed in the Source area.

Run to Cursor — Executes the program from the line currently highlighted to the line where the cursor is located.

Hide Debug — Hides the source and variable area to show the complete output area.
The label of this softkey will change to **Show Debug**. A push on **Show Debug** will display the hidden areas again.



Focus Next — Toggles the cursor location between the output, the source and the variable area.

Start File — Activates the RAPID Basic File selection field and allows you to select a different file. After you confirm your choice, the newly selected file is ready for debugging.

RAPID! syntax

This chapter gives an overview of the RAPID! syntax and is subdivided into the following sections:

- [General syntax](#) – Here you will find all about the general aspects of the syntax like program line formats, basic rules, syntax check or notation.
- [Program lines](#) – This section outlines all details on the program line format and its elements.
- [Variables](#) – Are you familiar with numeric variables, string and array variables or dimensions? Here you will find it all.
- [Constants](#) – This section gives all information on numeric and string constants.
- [Operators](#) – RAPID! provides you with a number of operators like sign, arithmetic operators, comparisons or boolean operators.
- [Expressions](#) – These are combinations of variables, constants, function results and/or operators.

General syntax

BASIC form The RAPID! programming syntax is compatible with current BASIC derivatives, such as e.g. Quick BASIC or Visual BASIC. However, RAPID! in its current form does not allow for object-oriented extensions. On the other hand, RAPID! supports a number of functions that are vital for the use of the programming language on the 4400.

Program and line formats Line labels (i.e. numbers) are optional. This means, they are not necessary.

A program line may include several BASIC commands. In that case, they have to be separated by colons (:).

The maximum length of a program line is 254 characters. However it is suggested to keep the program lines short. This increases serviceability and eases debugging of a program.

The length of a program is (in theory) only limited by the disk space available.

Basic rules The RAPID! program interpreter is not case-sensitive. This means that commands as well as constants and variables may be written in both uppercase and lowercase notation.

RAPID! commands and reserved words like `GET` or `GOTO` are not permitted as line labels or as names for constants and variables.

RAPID! commands, names of constants and variables as well as numeric values **must not** include blanks (spaces).

Syntax check The syntax check is performed by the built-in interpreter. In other words, after the start of a program, every single line is interpreted one by one and the corresponding action is initiated. If the built-in interpreter comes across a command in a program line that it can't understand, then this is regarded a syntax error.

NOTE

Most of the syntax errors are simple misspellings of commands or typing errors.

The interpreter always checks a program after it was started. A detected syntax error causes the program to be aborted and leads to an error message indicating the erroneous program line.

Notation To explain the language syntax, the following notation is used:

`[item]`

Square brackets indicate an optional item, which can also be omitted.

Example: `[sign] number` is a number with an optional + or – sign.

`item | item`

Vertical bars separate entries of a list and indicate that precisely one element must be used.

Example: The following list contains the four seasons `spring | summer | fall | winter`. One of these entries gives the current season.

`{ item }`

Brackets enclose an item or a list of items, which can be repeated several times.

Example: `{ A . . . Z }` is the notation for text.

`item1 := item2`

The colon followed by the equality symbol gives the definition of an item.

Example: `binary digit := 0 | 1` defines the digits of a dual number system in a way that a 'binary digit' can either be '0' or '1'.

NOTE

Notations can also be nested. This makes them suitable for expressing even complicated syntax.

Example: `boolExp := NOT boolExp | boolExp AND | OR | XOR boolExp`

This means by words: A boolean expression is either the negation of another boolean expression, or two boolean expressions linked with one of the three operators: AND, OR, and XOR.

Please note that this is only an example. The complete definition of [Boolean expressions](#) is a bit more complex.

Program lines

Each RAPID! program consists of a number of program lines. Those lines contain the BASIC statements and have the following structure:

```
[label:] statement [: statement]
```

```
label:
```

A program line starts with an optional label. In contrary to AUTORUN programs, line numbers are not required.

With RAPID!, labels are mainly used as branch targets.

A label must always end with a colon.

```
statement
```

A statement is a BASIC command.

Important notes

- A program line always needs to be terminated by a carriage return (CR). This symbol is equivalent to pushing the 'Enter' key at the end of a program line.
- It is not possible to show the maximum of 254 characters in one line on-screen. Therefore, a program line may stretch out over several lines on-screen. To indicate that the program line is continued, put a blank followed by an underscore '_' and then push **Enter** to start a new line.

Example: `print "RAPID!" _
; " Program"`

- There must not be empty lines between continued program lines.
- An underscore at the end of a 'REM' command will cause a syntax error.
- The debugger will only highlight the first screen line of continued program lines.
- As mentioned before, a program line may contain up to 254 characters and several statements. However, we strongly recommend to use only one statement per program line wherever possible. Several statements in a program line lower the readability of the program code and usually make servicing a program quite tricky.

Variables

Variables are used to save data for later use. There are two types of variables: numeric variables and string variables.

- **Numeric variables** contain numbers only (0...9) and are saved in the so-called double (floating point) format on the 4400. This is an eight-byte value with a range from $-1.79769313486232E308$ to $-4.94065645841247E-324$ for negative values and from $4.94065645841247E-324$ to $1.79769313486232E308$ for positive values.
- **String variables** may contain any combination of numbers (0...9) and letters (A...Z). Their name always must end with the '\$' symbol. The length of a string variable (i.e. the number of characters) may range from 0 to 65,535 characters.

Variables in the RAPID! environment are always local. This means that a variable is only valid within its own RAPID! program.

When you chain programs, a local variable is not available to the program chained. If a variable shall be global (i.e. it is available to all chained programs), simply specify it as global.

The main commands dealing with variables are DIM, GLOBAL, VARIABLE and ERASE.

Arrays

- All RAPID! variables can make up arrays of up to two dimensions. The index value per dimension may range from $-32,765$ to $+32,765$.

NOTE

An array is similar to a table or a spreadsheet.

Syntax

A variable name is not limited in length, but only the first 20 characters are significant. A variable name has the following syntax:

- $A...Z | _ \{ 0...9 | A...Z | _ \} [(\text{index1} [, \text{index2}])]$ for numeric variables and
- $A...Z | _ \{ 0...9 | A...Z | _ \} \$ [(\text{index1} [, \text{index2}])]$ for string variables.

Notes

- The first character of a variable name has to be a letter.
- Uppercase and lowercase letters have the same meaning with RAPID!.
- A...Z are uppercase or lowercase letters.
- 0...9 are numbers between 0 and 9.
- `index1` and `index2` are integer values, making up an array. The range of an integer value is from $-32,765$ to $+32,765$.

Examples

- `1_stValue` is not a valid variable name as it starts with a number.
- `myvar_1`, `MyVar_1` or `MYVAR_1` will be understood by RAPID! as being the same variable.

- `StringArray_of_Dimension_2$(1,1)` defines a valid string variable array. However, due to the length of its name, RAPID! will not distinguish it from `StringArray_of_Dimension_1$(1,1)`.

Physical units

Numeric variables and expressions can have physical units. Depending on the group they belong to, the units of those variables and expressions may be:

Group Name	Physical units
Frequency	Hz, kHz, MHz, GHz
Power	dB, dBm, μ W, mW, W
Angles	DEG or $^{\circ}$, RAD
Percent	%

Notes

- Percent values are treated as unit-less when arithmetical operations are performed.
- Additions, subtractions and comparisons may only be performed within a group as specified above.
- Divisions through a value containing a physical unit of the same group will lead to a result without physical unit.
- When multiplying values, only one factor may have a physical unit.

Constants

Constants are used to store numeric or string values, which need to be kept unchanged during runtime of a RAPID! program.

Typical examples are common mathematical constants like 'pi', the power loss factor of a cable used for testing or the type code of a mobile phone.

Numeric constants

A numeric constant is a decimal, binary, octal or hexadecimal value with an optional physical unit:

`decimal | binary | octal | hexadecimal [physical unit]`

Type of constant	Syntax	Example	Limits
Decimal	<code>{0...9} [.{0..9}]</code>	123.456	-1.79769313486232E308 to -4.94065645841247E-324 for negative values and from 4.94065645841247E-324 to 1.79769313486232E308 for positive values
Binary	<code>&tB {0...1}</code>	<code>&tB100111011</code>	2 to the power of 32 (2^{32})

Octal	&tO {0...7}	&tO37721	2 to the power of 32 (2 ³²)
Hexadecimal	&tH {0...9 A...F}	&tH4AF3	2 to the power of 32 (2 ³²)

Names of constants without any identifier (&tB, &tO, &tH) are always interpreted as double (floating point) values.

These are eight-byte values with a range from -1.79769313486232E308 to -4.94065645841247E-324 for negative values and from 4.94065645841247E-324 to 1.79769313486232E308 for positive values.

String constant

The syntax of a string constant is as follows:

```
" {any character} "
```

A string constant may contain any character accessible via the (external) keyboard and is always framed by quotation marks.

NOTE

If you want a quotation mark to appear within a string, simply enter two consecutive quotation marks.

Example: "Willtek 4400 "RAPID!" Program" equals the following contents of the string variable: 'Willtek 4400 "RAPID!" Program'

NOTE

The maximum length (i.e. number of characters) for a string constant is 65,535.

Operators

The following table lists the numeric, string and boolean operators, along with their priority. The smaller the number in the priority column, the higher the priority.

During calculations, first all operators with priority 1 are performed, then all of priority 2 and so on. Priorities assure that the usual sequence of operations (e.g. multiplication and division first, then addition or subtraction) are performed without the need of brackets.

Type	Operator	Priority	Meaning
Sign operators	+	1	Positive sign
	-	1	Negative sign
	NOT	1	Negation (Inversion)
Arithmetic operators	*	2	Multiplication
	/	2	Division
	\	2	Integer division
	MOD	2	Modulo division

	+	3	Addition
	-	3	Subtraction
Comparison operators	=	4	Equality
	<>	4	Inequality
	<	4	Less
	>	4	Greater
	<=	4	Less or equal
	>=	4	Equal or greater
Boolean operators	AND	5	Logical AND
	OR	5	Logical OR
	XOR	5	Logical XOR

NOTE

In case of an integer division or a modulo division, the two operands are first converted into integer values, before the operation is performed. This means, that the operands will be rounded before any operation takes place. The rounding procedure will follow usual 'commercial' rules.

Example: The result of (5 MOD 2.3) will be 1 as it is interpreted as (5 MOD 2) by RAPID!.

NOTE

Regardless of the format of the operands with comparison operators, the result will always be a boolean value, i.e. number 0|1.

How to use operators

- Numeric expressions may use any operator.
- Boolean expressions, which are in fact numbers (0 or 1), may use any operator.
- String expressions may use all comparison operators and the arithmetic addition.

Example: "Willtek " + "4400" will result in the string expression "Willtek 4400".

Expressions

An expression is a valid combination of variables, constants, function calls and operators.

Basically, there are three types of expressions:

- numeric expressions
- string expressions
- boolean expressions

Numeric expressions `numExp := [signOp] numVar | numConst | numFct |
boolExp | numExp [operator numExp]`

Where

- `signOp` is the sign operator (+ or -),
- `numVar` is a numeric variable,
- `numConst` is a numeric constant,
- `numFct` is a BASIC function that returns a numeric result,
- `boolExp` is a boolean expression, as explained below

NOTE

A numeric expression always delivers a numeric result.

Example: `OneVar + (LEN (AString$) - 2) * 5`
This is a numeric expression that contains

- a numeric variable (`OneVar`),
- a function (`LEN`) of a string variable (`AString$`),
- the operators +, - and *
- and two numeric constants (2 and 5).

The result of this expression will be a numeric value.

String expressions `stringExp := stringVar | stringConst | stringFct { +
stringVar | stringConst | stringFct }`

Where

- `stringVar` is a string variable,
- `stringConst` is a string constant,
- `stringFct` is a BASIC function that returns a string as the result.

Note: A string expression always delivers a string.

Example: `FirstName$ + " " + LastName$` is a string expression. It delivers back a string that contains the two string variables `FirstName$` and `LastName$`, separated by a blank.

Boolean expressions Boolean expressions are more complex than the preceding ones:

`boolExp := boolOperation | comparison | boolFct`

Where

- `boolOperation := NOT boolExp | boolExp AND | OR | XOR boolExp`
- `comparison := stringExp compOperator stringExp | numExp compOperator numExp`

- `compOperator` := < | <= | = | >= | >
- `boolFct` is the return value of a boolean function.

NOTE

A boolean expression always delivers either number 0 (for false) or 1 (for true) as the result. You may perform arithmetic operations with these results.

Example: `(Country$="UK") AND (NetworkPrefix>=262)`

In case that string variable `Country$` equals "UK" and at the same time the numeric variable `NetworkPrefix` is equal to or greater than 262, then this boolean expression will deliver 1 as the result. In any other case, the result delivered will be 0.

Commands

The language elements of RAPID! are BASIC commands and BASIC functions. In order to access the internal registers of the 4400, the SCPI commands are available which are described in detail in section [SCPI](#).

- Commands make up a RAPID! program. They are used to tell the 4400 what it is to do.
- Functions perform specific predefined tasks and provide values, that can be used within any RAPID! program.
- In BASIC, you may place a single command in a program line. However, placing just a single function in a program line will lead to an error.

Overview

Dependent on their general functions, the BASIC commands of RAPID! are subdivided into six groups:

- [General commands](#) are used to control the overall aspects of a program. Typical general commands are e.g. CHAIN, REM, END, WAIT or STOP.
- [Screen commands](#) control the screen output of the 4400. They comprise CLS, TEXTATTR, LOCATE, INPUT, PRINT/OUTPUT and SOFTKEYS.
- [Commands related to variables, procedures and functions](#). These are DIM, GLOBAL, VARIABLE, ERASE, SUB, FUNCTION.
- [Control commands](#) determine the flow of the program. There are two sorts of control commands: loops (FOR-NEXT, DO LOOP, WHILE, UNTIL) and conditions (IF, CASE).
- [Branch commands](#), such as GOTO, GOSUB and ON ERROR allow to change the continuous sequential flux of a program and to jump to specific areas of a program.
- [Commands for input/output handling](#) allow special input/output tasks. They are OPEN, CLOSE, INPUT, PRINT and OUTPUT.

General commands

General commands are used to control the overall aspects of a program. The following general commands are available in RAPID!:

Command	Short description
CHAIN	Connects additional RAPID! programs to the main program.
END	Ends the program.
LET	Assigns an expression to a variable.
REM or `	Comment.
STOP	Debugger breakpoint.
WAIT	Halts the program for a specified amount of time.

CHAIN

Syntax	CHAIN <i>stringExp</i>
Parameters	<i>stringExp</i> is a string expression. It must be identical with an existing RAPID! program file name.
Description	<p>Loads the specified program and executes any command lines which come before the first subroutine or function. When this is complete, control is returned to the statement following the chain command.</p> <p>Global variables of the initially calling program can be used by all chained programs.</p> <p>Subs, functions and labels are global by definition and can be used by all programs (i.e. the initially calling program and all chained programs). Consequently, all names of subs and labels have to be unambiguous.</p> <p>Note: Subs and functions of the chained program will be ignored and not run if not explicitly called (see example below).</p> <p>CHAIN is a perfect tool to split large programs into logical units or to build a library with modules for specific tasks and functions. If you do so, please keep the following hints in mind:</p> <ul style="list-style-type: none"> – In the chained program, first declare the variables required as global, – then write the required program code as a function or sub. – Use the chain statement at the beginning of the main program. This will result in the 4400 running the program code of the chained programs (with the exception of the functions themselves). Thus, the 4400 will initialize all required global variables for later use. <p>A chained program may also chain other programs down to a depth of four nested CHAINS.</p>

Example Contents of main program:

```
PRINT "Now calling chained program"
CHAIN "TESTPROG.BAS"
PRINT "Back again to main program"
testsub
```

Contents of TESTPROG.BAS:

```
PRINT "Hello from chained program
TESTPROG"
SUB testsub()
PRINT "Subroutine called"
END SUB
```

Execution of the main program will result in the following screen output:

```
Now calling chained program
Hello from chained program TESTPROG
Back again to main program
Subroutine called
```

END

Syntax END

Parameters END does not have any parameters.

Description Ends the program.

Example IF pwr > 2.2 then END
 In case the value of variable pwr exceeds 2.2, the program will be ended immediately.

LET

Syntax [LET] numVAR = numExp | stringVar = stringExp

Parameters numVAR is a numeric variable,
 numExp is a numeric expression,
 stringVar is a string variable,
 stringExp is a string expression.

Description Assigns the value of a (numeric or string) expression to a (numeric or string) variable.
Note: LET is optional and can be omitted.

Example TheString\$ = "This is a "String": +
 Inside\$ + ", in case anybody doubts
 it."

REM or ' (Comments)

Syntax REM anyText or ' anyText

Parameters	<code>anyText</code> can be any text not exceeding the current line. Note: The program line extension symbol can't be used on REM lines.
Description	Enables you to include comments in the programs. Comments not only help other people to maintain your code; it might well be that you need some hints to understand your own code when you look at it from a long distance in time.
Example	<pre>REM The next line will define a variable LET i = 42 ` Who does not call his integers "i"</pre>

STOP

Syntax	STOP
Parameters	STOP does not have any parameters.
Description	Stops the program execution, but does not end the program (important e.g. to keep the values of variables when debugging a program).
Example	If n = 10 then STOP

WAIT

Syntax	WAIT msec
Parameters	msec specifies the time the program will wait in milliseconds. msec can only be entered as an integer value. The maximum time is 32,767 milliseconds.
Description	Stops the program execution for the duration of the time specified in parameter msec.
Example	<pre>PRINT "Please connect mobile now" WAIT 2000</pre> Prints user information and then halts the program for two seconds.

Screen commands

These commands control the screen output of the 4400. The following screen commands are available in RAPID!:

Command	Short description
CLS	Clears the screen.
INPUT	Waits for a user entry and stores the value.

LOCATE	Sets the cursor position on-screen for the subsequent output command.
PRINT or OUTPUT	Shows an expression on-screen.
SOFTKEYS	Labels the 4400's softkeys.
TEXTATTR	Sets background color and text size, font and color.

CLS

Syntax	CLS [textCol] [, [bgCol] [, fontSize[b] [i]]]
Parameters	textCol is the new text color, bgCol is the new background color, fontSize is the new font setting, b stands for bold text, i stands for italic text.
Description	<p>Clears the screen and positions the cursor in the upper left screen corner.</p> <p>Optionally, new background and text settings for the subsequent output operations may be specified:</p> <p>Text and background color may be assigned one of the predefined constants BLACK, WHITE, GREY, MGREY, DGREY, RED, GREEN, BLUE, YELLOW, MAGENTA, CYAN, DGREEN, DCYAN, DBLUE, BROWN, PURPLE.</p> <p>Alternatively, you may assign a code between 0 . . &HFFFFFF. This code represents an RGB model of the screen colors, where the first two hexadecimal figures represent the red color, the middle two figures the green and the last two figures the blue color.</p> <p>The font setting is specified by the font code followed by the font size.</p> <p>The following fonts are available (corresponding codes in parentheses):</p> <p>Charter (char), Courier (cour), Courier 10 Pitch (courier), Dutch 801 (dutch), Helvetica (helv), Lucida (lu), Lucida Bright (lub), Lucida Terminal (lut) New Century Schoolbook (ncen) PC Sansserif (pcss), PC Serif (pcs), PC Terminal (pcterm), Swiss 721 (swiss), Symbol (symb) Technical (tech), Times (time) Useless (uselss), Utopia (utop) .</p> <p>The selectable font sizes are 8, 10, 12, 14, 18, 20, 24, 32, 48 pt.</p> <p>Optionally, the text can be set to bold (b) and/or italic (i).</p> <p>Note: The font codes are string values, they have to be put in quotation marks (e.g. "cour14"). Otherwise, a syntax error will occur.</p>

Examples CLS (Clears the screen and keeps the current text and background settings.)
CLS , , "cour14" (Clears the screen, keeps the colors and selects Courier 14 pt as new font.)
CLS white, blue, "lu10bi" (Clears the screen and continues with white text on blue background, font Lucida 10 pt, bold and italic.)

INPUT

Syntax INPUT [[inputPrompt\$] ,variable]

Parameters inputPrompt\$ is a string expression, variable is a numerical or string variable.

Description Causes the program to wait for user input, reads data entered on the keyboard into a variable and then continues the program run.

INPUT will first output the inputPrompt\$ on the 4400 screen. Then it waits for the user's input. INPUT can read data entered either into a numeric or a string variable. The 'signal' for input finished is the CR symbol (achieved by the user pushing the **ENTER** key). The symbols entered by the user will be stored in variable and the program will continue.

Notes:

- External keyboard and the keys of the 4400 may be used in parallel. This means that an entry on the external keyboard may be confirmed by pushing the 4400's **ENTER** key.
- In case variable has been defined as a numerical variable and the user enters any other symbol than numbers and the decimal point, this will lead to an error. A simple trick to avoid that is to always read the value entered as a string and later convert that string into a numerical value:
INPUT "Please enter channel number:" _
 , channelno\$
channelno = VAL(channelno\$)
- With the help of the INPUT command, you may also read data from a file or the SCPI system.

Examples INPUT "What's your name? ", name\$
INPUT (The program waits until the user pushes the Enter key.)

LOCATE

Syntax LOCATE x, y

Parameters x stands for the cursor's new horizontal position, y for the cursor's new vertical position.

Description	Sets the cursor to a new position on-screen. Any subsequent text output will start from that position. Parameter <i>x</i> is counted in character positions rather than in pixels; parameter <i>y</i> in screen lines. The values for <i>x</i> and <i>y</i> are dependent on the currently set font size. However, the 4400 enables the user to scroll the screen output. For practical reasons, <i>x</i> should be kept below 50 and <i>y</i> below 25.
Examples	<pre>IF (channelno > 2099) then LOCATE 24, 0 Print "Input out of range. " _ ;"Please reenter." (In case the channel number entered by the user is out of range, a prompt will appear in the 'status line' of this RAPID! program.)</pre>

PRINT (OUTPUT)

Syntax	<pre>PRINT [{ [USING usestr\$,] exp [, ; TAB(number);] }]or OUTPUT [{ [USING usestr\$,] exp [, ; TAB(number);] }]</pre>
Parameters	<p><i>exp</i> is a numeric or string expression, <i>usestr\$</i> defines an output format for numeric data, <i>number</i> stands for an integer figure, forcing the next <i>exp</i> of the same PRINT or OUTPUT command to appear on a specific position on-screen.</p>
Description	<p>Displays the specified expression(s) on-screen. In case the separator is a comma (,), the expression following the current one will be displayed at the next tabulator position. In case the separator is a semicolon (;), the expression following the current one will be displayed directly after the previous one. OUTPUT is a 100% synonym for PRINT. PRINT USING "a.b" allows to format numeric output. While <i>a</i> gives the total amount of digits to be used for the output (including decimal places, the decimal point and the sign), <i>b</i> specifies the number of decimal places (see example below). Note: The PRINT command is also available to output data to a file or the SCPI system.</p>

Examples PRINT var1, var2, var3 (Three numeric variables are displayed, separated by tabs).
 OUTPUT "Here "; "you "; "go!" (The phrase will be displayed as 'Here you go!').
 PRINT USING "10.2"; 21,5 (The value will be displayed using a total of 10 digits (including the decimal point and the sign). 2 digits will be used for the decimal places. The value will be printed as ' 21.50' with five leading blanks.)
 OUTPUT TAB(10); 9 (The number 9 will be printed on the tenth cursor position following the current one: ' 9')

SOFTKEYS

Syntax SOFTKEYS [str1\$, [str2\$, [str3\$, [str4\$, [str5\$, [str6\$, [str7\$]]]]]]]

Parameters str1\$...str7\$ are string expressions.

Description Labels the 4400's softkeys. The labels specified are assigned to the softkeys from left to right. In case less than seven string expressions are used, one or more softkeys remain without label.

Examples SOFTKEYS "Key1", "", "Key3"
 (The first and third softkey from the left are labelled and may be used for INKEY or INKEYWAIT commands.)
 SOFTKEYS
 (All softkeys remain unlabelled. There are no values that could be handed over to an INKEY or INKEYWAIT command, whatever softkey may be pushed. In case of an INKEYWAIT command, this will result in an endless loop.)

TEXTATTR

Syntax TEXTATTR [textCol] [, [bgCol] [, fontSize [b] [i]]]

Parameters textCol is the new text color,
 bgCol is the new background color,
 fontSize is the new font setting,
 b stands for bold text,
 i stands for italic text.

Description Selects new color and text settings for the subsequent output operations. For detailed parameter description, please refer to command CLS in this subsection.

Examples TEXTATTR red (Text color set to red.)
 TEXTATTR , cyan, "cour18" (Courier size 18 on cyan background.)

Commands related to variables, procedures and functions

The following commands concern the declaration, output and deletion of variables and the usage of procedures and functions:

Command	Short description
DIM	Declares local variables.
ERASE	Releases allocated memory of a variable.
FUNCTION	Declares a function.
GLOBAL	Declares global variables.
SUB	Declares a procedure (subroutine).
VARIABLE	Prints variable contents to screen or file.

DIM

Syntax	DIM varName [{ , varName }]
Parameters	varName is a valid variable name.
Description	<p>Declares a local variable. The variable is only accessible to the program element it has been declared in. This means, a local variable declared in a function is not accessible by the main program and vice versa. Variables that are accessible for all program elements are called 'global' (please see below for more details).</p> <p>Note: There is no need to declare local variables. Within the RAPID! environment, all variables are interpreted as local by definition.</p> <p>However, after a variable has been declared using the DIM command, all subsequent variables have to be declared with DIM as well.</p> <p>In order to keep programs easily maintainable and to avoid errors due to misspelled variable names, we strongly recommend to declare variables in larger programs.</p>
Example	DIM Days\$(7), Months\$(12) declares two string arrays.

ERASE

Syntax	ERASE varName [{ , varName }]
Parameters	varName is a valid variable name.

Description Deletes a variable and releases the memory used. This command is useful to keep memory consumption of a program as low as possible. Especially large variable arrays or long string variables should be erased as soon as they are no longer required.
Note: Local variables are automatically erased at the termination of the related procedure or function.

Example ERASE Journal\$

**FUNCTION – EXIT FUNCTION –
 END FUNCTION**

Syntax FUNCTION fnName [\$] ([parameter
 [{, parameter }]])
 [instructions]
 fnName [\$] = fnExp
 [EXIT FUNCTION]
 END FUNCTION

Parameters fnName is a valid name for the function (same syntax rules apply as for variable names),
 parameter may be any valid numeric or string expression,
 instructions are an (optional) number of program lines,
 fnExp is an expression (of the same data type as the function itself).

Description Declares a function (FUNCTION ... END FUNCTION). Functions are commonly used to e.g. calculate the result of mathematical expressions.
 After a function has been declared, it may be called by its name fnName.
 A function call must contain all parameters in the same order as specified in the function's declaration.
 The return value of a function will either be a numeric expression (in case of fnName) or a string expression (in case of fnName\$).
 A function may call itself recursively.
 All variables used in a function are local unless declared as GLOBAL (please see below for details).
 All parameters are treated as local.
 Using the EXIT FUNCTION command, you may leave any function at any place or condition (e.g. in case a value exceeds a certain limit, the function exits and passes on control to an error handling system).

Example The following example calculates the faculty ($n! := 1*2*3*...*n$) of a given integer number n . In order to do so, the function calls itself recursively:

```
FUNCTION Faculty(n)
  IF n<2 THEN
    Faculty = 1
  EXIT FUNCTION
  END IF
  Faculty = n * Faculty(n-1)
END FUNCTION
```

GLOBAL

Syntax GLOBAL varName [{, varName}]

Parameters varName is a valid variable name.

Description Declares a global variable. Global variables are accessible in the main program, in all programs included by [CHAIN](#) and in all related procedures and functions. Any global variable is valid and accessible from the program line, in which it has been declared.

Note: If a local variable has been declared or used before, that carries the same name as the global variable, then the global variable is not accessible.

Example GLOBAL strg\$, counter declares a global string and a global numeric variable.

SUB – EXIT SUB – END SUB – CALL

Syntax

```
SUB subName ( [ parameter [ {, parameter } ] ] )
  [ instructions ]
  [ EXIT SUB ]
END SUB
...
[CALL] subName ( [ parameter [ {, parameter } ] ] )
```

Parameters subName is a valid name for the procedure (subroutine) (same syntax rules apply as for variable names), parameter may be any valid numeric or string expression, instructions are an (optional) number of program lines.

Description SUB ... END SUB declare a procedure. Procedures are commonly used to e.g. perform certain operations that have to be carried out several times during the program run. After a procedure has been declared, it may be called by [CALL] subName. A call of a procedure must contain all parameters in the same order as specified in the procedure's declaration. A procedure may call itself recursively. All variables used in a procedure are local unless declared as GLOBAL (please see above for details). All parameters are treated as local. Using the EXIT SUB command, you may leave any procedure at any place or condition (e.g. in case a value exceeds a certain limit, the procedure exits and passes on control to an error handling system).

Example The following example defines a procedure that writes the current contents of all variables into a file with a given file name:

```
SUB VarsToFile(fileName$)
LET ff = FREEFILE
OPEN fileName$ FOR OUTPUT AS #ff
VARIABLE #ff
CLOSE #ff
END SUB
```

VARIABLE

Syntax VARIABLE [#fileNo]

Parameters fileNo is a handler of an open file.

Description Outputs the contents of all currently used variables on-screen. The currently used variables are all variables that were defined or used before the VARIABLE command appeared in the program run. In case you specify the optional file handler (#fileNo), the output will be sent to a file. **Note:** During program development, it is sometimes quite useful to know the contents of all variables. The VARIABLE command also is a good tool to unmask misspellings with variable names.

Example The following example program writes the contents of all variables to a file called 'VAR.TXT'.

```
OPEN "VAR.TXT" FOR OUTPUT AS #1
VARIABLE #1
CLOSE #1
```

Control commands

Control commands organize the process of a program. They e.g. allow to run a specific part of a program several times or to select between different sets of commands, depending on a condition.

In RAPID!, the following control commands have been implemented:

Command	Short description
DO ... LOOP	Loop with condition.
FOR ... NEXT	Loop with a specified number of cycles.
IF ... THEN	Checks a condition.
SELECT CASE	Selects one of several cases.

DO ... LOOP, WHILE, UNTIL

Syntax	Syntax 1 DO [{WHILE UNTIL} boolExp] [instructions] [EXIT DO] [instructions] LOOP Syntax 2 DO [instructions] [EXIT DO] [instructions] LOOP [{WHILE UNTIL} boolExp]
Parameters	boolExp is a boolean expression, instructions are an (optional) number of program lines.
Description	Dependent on a condition (boolExp), this command structure repeatedly runs a program segment. Syntax 1 checks the condition before the loop is run. If the condition is true in the moment the program arrives at the loop, it will not be run at all. Syntax 2 checks the condition after the loop has been run. WHILE means that the loop will be run as long as boolExp is true. UNTIL will run the loop until boolExp becomes true. EXIT DO causes the loop to be left instantly. If the optional part with the condition is left out, the loop will be run endlessly. In this case, the only way out is an EXIT DO command somewhere within the loop to prevent the program from being trapped.

Examples

The three following examples perform the same task in different manners. They all print a text to the screen until a softkey is pushed:

```
DO
PRINT "Please push a softkey! ";
IF INKEY <> 0 THEN EXIT DO
LOOP
DO WHILE INKEY = 0
PRINT "Please push a softkey! ";
LOOP
DO
PRINT "Please push a softkey! ";
LOOP UNTIL INKEY <> 0
```

FOR ... NEXT

Syntax

```
FOR countVar = numStart TO numEnd [
STEP numStep ]
[ instructions ]
[ EXIT FOR ]
[ instructions ]
NEXT countVar
```

Parameters

`countVar` is a numeric variable,
`numStart`, `numEnd`, `numStep` are numeric expressions,
`instructions` are an (optional) number of program lines.

Description

Repeats a program segment a specified number of times. To do so, a counter (`countVar`) is used.

The initial value of the counter is stated in the `numStart` expression, while the final value is stated in the `numEnd` expression.

After each run, the counter is increased by `numStep`. If the optional `STEP` part is missing, the counter will be incremented by 1 per run.

After the loop was run, the condition (`countVar = numEnd`) will be checked. If the condition is false, the loop will be run again.

If the condition is true, the program will resume with the command following the `NEXT countVar` command.

In order to immediately exit a `FOR . . .NEXT` loop, use the `EXIT FOR` command.

Examples

The following example program prints the ASCII characters A..Z to the screen:

```
FOR i=65 to 90
PRINT CHR$(i)
NEXT i
```

The following example reverts the string `Matter$` into the string `AntiMatter$`:

```
AntiMatter$ = ""
FOR i=len(Matter$) TO 1 STEP -1
AntiMatter$ = AntiMatter$ + MID$(Mat-
ter$, i, 1)
NEXT i
```

IF ... THEN, ELSE, ELSEIF, END**IF****Syntax**

```
Syntax 1
IF boolExp1 THEN instructions1 [ ELSE
instructions2 ]
Syntax 2
IF boolExp2 THEN
[ instructions3 ]
[ ELSEIF boolExp3 THEN
[ instructions4 ] ]
[ ELSE
[ instructions5 ] ]
END IF
```

Parameters

`boolExp1/2/3` are boolean expressions, `instructions1/2/3/4/5` are an (optional) number of program lines.

Description

Depending on a boolean expression or condition (`boolExp`), the program will resume with different sets of commands.

There are two different forms of this command, indicated by 'Syntax 1' and 'Syntax 2' above.

Syntax 1 is the 'one-line' command. If `boolExp1` is true (or a numeric value is $\neq 0$), the command(s) following `THEN` will be executed. If `boolExp1` is false (or a numeric value = 0), the commands following the optional `ELSE` will be executed.

Syntax 2 is the 'multiline' version of the command. This syntax should be used in case there are several commands to be executed, depending on the conditions. In case `boolExp2` is true, `instructions3` will be executed.

If `boolExp2` is false, the subsequent `ELSEIF` command will be looked for. If this is true (i.e. `boolExp3` is true), `instructions4` will be executed.

There may be several `ELSEIF` conditions within one `IF`-clause.

Should all `boolExp2/3` be false, `instructions5` will be performed.

Examples

```
IF tired THEN PRINT "Go to bed!" ELSE
PRINT "Go shopping!"
```

```
IF (i <= 0) THEN
PRINT "Not a positive number"
ELSEIF (i MOD 2 = 0) THEN
PRINT "Even"
ELSE
PRINT "Odd"
END IF
```

SELECT CASE, CASE ELSE, END SELECT

Syntax

```
SELECT CASE varName
CASE varExp [ { , varEXP } ] instruc-
tion
[ { CASE varExp [ { , varEXP } ]
instruction } ]
CASE ELSE instruction
END SELECT
```

Parameters

varName is a valid variable name,
varEXP are expressions of the same type as varName,
instruction are valid RAPID! commands.

Description

Performs one of several blocks of commands, depending on the value of varName.

If varName is identical with any one of the varExp expressions, the commands following that CASE statement will be performed until the subsequent CASE or the END SELECT command is reached. The program will then resume with the command following the END SELECT statement.

If varName is identical with several varExp, only the first one found will be executed.

Several varExp may be used in the same CASE command; they need to be separated by commas.

Examples

```
SELECT CASE Day
CASE 1: PRINT "MONDAY"
CASE 2: PRINT "TUESDAY"
CASE 3: PRINT "WEDNESDAY"
CASE 4: PRINT "THURSDAY"
CASE 5: PRINT "FRIDAY"
CASE 6, 7: PRINT "WEEKEND"
CASE ELSE
PRINT "Data out of range"
END
END SELECT
```

```

SELECT CASE Day$
CASE "MONDAY", "TUESDAY", "WEDNESDAY",
"THURSDAY", "FRIDAY"
PRINT "Got to work!"
CASE "WEEKEND" : PRINT "I'm off for
the seaside!"
END SELECT

```

Branch commands With the help of these commands, it is easy to branch program execution, e.g. depending on conditions or user entries.

Command	Short description
ERROR	Creates an error with a specified error number.
GOSUB ... RETURN	Branches to the specified label and returns at the next RETURN command.
GOTO	Branches to the specified label.
ON ERROR	Branches to the specified label, if an error occurs during program execution.

ERROR

Syntax	ERROR errNo
Parameters	errNo is an integer number.
Description	Creates a runtime error with the specified error number. This command enables you to create your own error codes. Note: For the built-in error codes, please refer to the table of Runtime errors .
Examples	The following example defines an error code based on a simple condition and gives a first idea of error handling. <pre> IF (frequ > 2 GHz) THEN ERROR 57 ... SELECT CASE err case 57 : Print "Input out of range!" END CASE </pre>

GOSUB ... RETURN

Syntax	GOSUB targetLabel [instructions] RETURN
Parameters	targetLabel is a label.

Description Branches the program to the symbolic label and continues program execution with the commands following that label.

As soon as the RETURN command is encountered, program execution will come back to the command following the initial GOSUB command.

Example

```
IF Day$="Friday" THEN GOSUB fishDay
ELSE GOSUB meatDay
...
fishDay
PRINT "Today we eat fish!"
RETURN
...
meatDay: PRINT "Today we will have a
steak!"
RETURN
```

GOTO

Syntax GOTO targetLabel

Parameters targetLabel is a label.

Description Branches to the symbolic label and continues program execution with the commands following that label.

Examples

```
...
IF i>10 THEN GOTO loopOver
...
loopOver: PRINT "Ten steps later..."
```

ON ERROR, RESUME

Syntax ON ERROR { GOTO {targetLabel | 0} | RESUME NEXT }

```
...
RESUME [ NEXT | targetLabel ]
```

Parameters targetLabel is a label.

Description	<p>If an error occurs during program execution, the program would normally be terminated.</p> <p>The <code>ON ERROR</code> command structure gives you the chance to trap the error, handle it, and then continue the program without a break.</p> <p><code>ON ERROR GOTO targetLabel</code> branches to the specified label in case an error occurs.</p> <p><code>ON ERROR GOTO 0</code> deactivates the error trapping. Any subsequent error will stop the program.</p> <p><code>RESUME</code> continues the program with the command that caused the error.</p> <p><code>RESUME targetLabel</code> continues the program at the specified label.</p> <p><code>RESUME NEXT</code> continues the program with the command following the one, that caused the error.</p> <p>Note: If an error occurs within the error handling, the program will be terminated.</p> <p>There are several built-in functions available for error handling.</p>
Examples	<p>In the first example, the 4400 prints an error message, giving the error code, the line in which the error occurred and the name of the related RAPID! program file.</p> <pre>ON ERROR GOTO errorHandler ... errorHandler PRINT "Error "; ERR; " in line "; ERL; " in file "; ERF\$; " Resuming..." RESUME NEXT</pre> <p>In the following example, a user-specific error code is generated first. Then a <code>CASE SELECT</code> command is used to print the correct error message.</p> <pre>ON ERROR GOTO errorHandler ... LET measQ = measNum / measRes IF (measRes<0) THEN ERROR 57 ... errorHandler: SELECT CASE ERR CASE 104: PRINT "Division by zero! Restart measurement!" CASE 57: PRINT "Measurement result negative! Restart measurement!" CASE ELSE PRINT "Unknown error. Program halts." END END CASE RESUME NEXT</pre>

Commands for input/ output handling

These commands enable special input/output tasks related to the 4400's disk drive, hard disk and communication ports. Frequently, input/output operations are abbreviated with I/O.

Command	Short description
CLOSE	Closes a previously opened file.
INPUT	Reads data from an open file or from an open port.
OPEN	Opens a file or a port and allows for reading or writing data.
PRINT or OUTPUT	Writes data to an open file or port.

CLOSE

Syntax	CLOSE [fileNo]
Parameters	fileNo is a numeric expression, representing a valid file number. fileNo must result in a positive integer. Software people tend to call fileNo the 'file handle'.
Description	Closes the file with the specified fileNo. After the file has been closed, fileNo is no longer related to the initial file and may be used again later to open a completely different file. If fileNo is omitted, then all currently open files will be closed. As long as a file is closed, it is not accessible for I/O operations unless it is opened again, using the OPEN command (please see below for details).
Example	The following example program reads a text file and stores the data read from the file in a string array. <pre>LET i=0 OPEN "STRINGS.TXT" FOR INPUT AS #1 DO WHILE NOT EOF(1) LET i=i+1 INPUT #1, theStrgs\$(i) LOOP CLOSE #1</pre>

INPUT

Syntax	INPUT #fileNo , variable
Parameters	fileNo is a numeric expression resulting in a valid file handle (a positive integer). variable is a numeric or string variable.

Description Reads data from a previously opened file or communication port with the specified file handle into a variable. `INPUT` will always read a complete line and then increment the line counter. This means that a second `INPUT` command with the same file handle will read the second line of the file.

Notes:

- Before `INPUT` may read from a file, it needs to be opened for input first (please see the description of the `OPEN` command and the `INPUT` mode in this subsection). If you try to read from a file that was not opened before, a runtime error will occur.
- It is recommended that you check if the end of the file was reached before you issue a subsequent `INPUT` command: if `INPUT` tries to read after the end of the file was reached, a runtime error will occur.
- With the help of the `INPUT` command, you may also prompt the user to enter data during runtime of the program. Please see subsection "[Screen commands](#)" on page 168 for reference.
- `INPUT` also reads data from the SCPI system. Please refer to section [SCPI and RAPID!](#) for details.

Example The following program reads a text file and stores the data read from the file in a string array.

```
LET i=0
OPEN "STRINGS.TXT" FOR INPUT AS #1
DO WHILE NOT EOF(1)
LET i=i+1
INPUT #1, theStrgs$(i)
LOOP
CLOSE #1
```

OPEN (on files)

Syntax `OPEN fileName$ FOR openMode AS #fileNo`

Parameters `fileName$` is a string expression containing a valid file name including an optional path or the specification for a communication port of the 4400 (please see below for details).

`openMode` := {`APPEND` | `INPUT` | `OUTPUT`}

`fileNo` is a numeric expression resulting in a positive integer (the so-called file handle).

Description Opens a file or a communication port for input or output operations. As long as a file has not been opened, I/O operations can not be performed and a runtime error will occur.

`fileName$` is a string, containing either a valid file name or a specification for a communication port of the 4400 (please see below for details).

`openMode` may either be `INPUT`, `OUTPUT` or `APPEND`. When `openMode` is `INPUT`, then the file can only be read from. If the file does not exist, a runtime error will occur.

In case, `openMode` is `OUTPUT`, then it is only possible to store data to that file. If the file does not exist, it will be created anew. Should the file already exist, then it will be **overwritten without warning**.

`openMode APPEND` is similar to `OUTPUT`. However, the file will not be overwritten with new data. Instead, new data will be added at the end of the existing file. Should there be no file, it will be created anew.

Notes:

- When a file is already open, a further `OPEN` command may open the same file as long as the mode is identical. If the mode is not identical (e.g. a file was opened for output previously and shall now be opened for input), a runtime error will occur.
- `OPEN` may also be used to open a path to the SCPI system. See section [SCPI and RAPID!](#) for details.

Examples This example writes a string to a text file.

```
LET File=FREEFILE
OPEN "STRINGS.TXT" FOR OUTPUT AS
#File
PRINT #File, "Save me"
CLOSE #File
```

OPEN (on communication ports)

Syntax

`OPEN fileName$ AS #fileNo`

Parameters

`fileName$` is a string expression containing a specification for a communication port on the 4400 or a valid file name (please see above for details).

`fileNo` is a numeric expression resulting in a positive integer (the so-called file handle).

Description

Opens a communication port for input or output operations. As long as a port has not been opened, I/O operations can not be performed and a runtime error will occur.

`filename$` is a string, containing a specification for a communication port of the 4400 or a valid file name (please see above for details).

Valid ports are GPIB0 (for the GPIB/IEEE-Bus), SCPI, COM1 and COM2 (the two serial interfaces of the 4400, please see ["Rear panel" on page 9](#) for reference).

A port name always needs to be followed by a colon (:). After the colon, you may specify parameters for the interface and the communication.

Please note that the values of parameters must be positive integers if not specified otherwise.

Parameters for GPIB:

`addr=` this parameter specifies the primary GPIB bus address. The valid range is 1...32.

`sec=` states the secondary GPIB bus address. The valid range is 0...64.

`time=` with the help of this parameter, you may set a timeout in milliseconds.

`eoI=` states, whether the hardware EOI will be used (parameter set to 1) or not (parameter set to 0).

`srq=` a '1' states that the hardware 'Service Request' will be used, while a '0' indicates that it will not be used.

`end=` specifies the end byte (usually ASCII 10 or ASCII 13). The valid range is 0...255.

Parameters for SCPI:

There are no parameters for SCPI.

Parameters for COM1/COM2:

`baud=` this parameter specifies the baud rate of the serial interface. It is highly recommended to always specify a baud rate when working with the serial ports to keep them in a defined state. The following values may be entered: 110, 300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 76800, 115200.

`bits=` states the number of data bits used. The valid range is 5...8.

`stop=` specifies the number of stop bits to be used. The entry range is 1|2.

`parity=` states, whether the parity check bit will be used. Value '0' switches the use of a parity bit off. '1' indicates odd parity and '2' even parity.

`xonoff`= defines whether the software handshake will be used. A '0' switches the software handshake off, while '1' turns it on. Software handshake means that the receiver (RAPID! program) may halt the transmission by sending ASCII 19 (Ctrl-S) to the transmitter. A Ctrl-Q (ASCII 17) sent to the transmitter will continue transmission again. Default value is '0' (no software handshake).
`rts`= defines whether the hardware handshake will be used. A '0' switches the hardware handshake off, while '1' turns it on. Hardware handshake means that the receiver (RAPID! program) will only allow the transmitter to send while it is expecting data in an `INPUT` command. Physically, pin RTS will be kept to 'low' and only turn to 'high' when the RAPID! program expects input data. Default value is '0' (no hardware handshake).

`cts`= states, whether the signal on pin CTS will be ignored (value = '1') or listened to (value = '0'). If `cts=0`, the transmitter is only allowed to send data as long as the signal on pin CTS is active (i.e. 'high'). In case CTS is to be ignored `cts=1`, the receiver (RAPID! program) will always wait until all characters have been transmitted (please see parameter `wait`=). Default value is '0' (CTS signal will be followed).

`time`= with the help of this parameter, you may set a timeout in seconds. When the timeout expires, an empty string will be delivered to the RAPID! program as input. Default is 600 seconds (5 minutes).

`end`= specifies the end byte (usually ASCII 10 or ASCII 13). The valid range is 0...255. If an end byte was specified, data will be read in until the specified end byte is recognized. If no end byte is specified (`end=0`), only the currently available bytes will be read in. Default is `end=0`.

`flush`= defines the use of the port input buffer. In case `flush=0`, all characters will be read in, even when they occurred at the port long before the port was opened with the `OPEN` command. `flush=1` however clears the input buffer in the moment, the `OPEN` command for that port occurs in the program run. Default is `flush=0` (all data stored in input buffer will be kept).

`wait`= specifies whether the program is to wait until all characters have been transmitted over the port, or not. `wait=0` will continue the program after the transmission of data has been initialized. `wait=1` will halt the program until all characters have been transmitted. Default is `wait=0`.

Notes:

The SCPI port may only be opened once. If you try to open the previously opened SCPI port, a runtime error will occur.

All other ports may be opened several times with different parameters as long as the file handles are different.

Examples

This example opens the GPIB0 port.

```
gpib=FREEFILE
OPEN "GPIB0:addr=25,sec=0,time=10,
eoi=1,srq=1,end=13" AS #gpib
PRINT #gpib, "Output to GPIB"
INPUT #gpib, ingpib$
CLOSE #gpib
```

The program segment below opens a serial interface.

```
com2=FREEFILE
open-
com$="COM2:baud=9600,bits=8,stop=1,
parity=1,xonoff=0"
opencom$=opencom$ +
"time=10,end=10,flush=1,wait=1"
open opencom$ as #com2
PRINT #com2, "Output to serial port
2"
INPUT #com2, incom2$
CLOSE #com2
```

PRINT or OUTPUT

Syntax

```
PRINT #fileNo [USING formatstring ,] exp
[ [TAB[n];] [BYTE(m)] ] [{ ,|; exp} ]
or
OUTPUT #fileNo [USING formatstring ,] exp
[ [TAB[n];] [BYTE(m)] ] [{ ,|; exp} ]
```

Parameters

exp is a numeric or string expression.
fileNo is a numeric expression resulting in a positive integer (the so-called file handle).
formatstring specifies the output format to be used, e.g. the number of decimal places.
n is an optional parameter giving the distance between the previous and this tabulator position.
m is the decimal representation of the ASCII character to be printed.

Description Writes the specified expression(s) to a previously opened file, using the specified file handle.
With the help of this command, several expressions may be printed in the same line. When the separator is a comma (,), the subsequent expression will be written at the next tabulator position.
When the separator is a semicolon (;), the subsequent expression will be written directly behind the previous one.

Notes:

- Before `PRINT` may output to a file, it needs to be opened for output or appending first (please see the description of the `OPEN` command and the `OUTPUT` and `APPEND` modes in this subsection). If you try to write to a file that was not opened before, a runtime error will occur.
- With the help of the `PRINT` command, you may also print data to the 4400's screen. Please refer to subsection "[Screen commands](#)" on page 168 for details.
- `PRINT` also reads data from the SCPI system. Please check with section "[SCPI and RAPID!](#)" on page 225 for details.

Examples This example writes a string to a text file.

```
LET File=FREEFILE
OPEN "STRINGS.TXT" FOR OUTPUT AS #File
PRINT #File, "Save me"
CLOSE #File
```

Please compare the use of the `PRINT` command in this context with the third example for the `PRINT` command in the [Screen commands](#) description, too.

Functions

The functions of the RAPID! environment are subdivided into five groups:

- [Numeric functions](#). They convert numeric values into different systems or return numerical values. Typical examples are `BIN`, `BIN$`, `CINT`, `OCT`, `OCT$`, `HEX`, `HEX$`, `VAL` or `VAL$`.
- [String functions](#) operate on strings or return string values. Typical examples are `ASC`, `CHR$`, `INSTR`, `LEN`, `LEFT$`, `MID$`, `RIGHT$` or `SPACE$`.
- [I/O functions](#) provide useful information concerning input and/or output operations. Typical examples are `DATE$`, `CLOCK`, `EOF` or `FREEFILE`.
- [Functions for error handling](#) return values or strings related to errors. `ERR`, `ERL` and `ERF$` belong to this group.
- [Mathematical functions](#) support program-internal calculations with the mathematical functions `SQRT`, `SIN`, `COS` or `TAN` just to name a few.

Numeric functions

This subsection describes functions that convert numbers or perform numeric operations.

Note: In case uninitialized variables are used as arguments, the returned values will usually be "0" or 0.

Function	Short description
BIN	Converts a binary representation of a numeric expression into its decimal equivalent.
BIN\$	Transforms a numeric expression into its binary representation.
CINT	Rounds a numeric expression to an integer, using commercial rounding.
HEX	Converts a hexadecimal representation of a numeric expression into its decimal equivalent.
HEX\$	Transforms a numeric expression into its hexadecimal representation.
OCT	Converts an octal representation of a numeric expression into its decimal equivalent.
OCT\$	Transforms a numeric expression into its octal representation.
VAL	Converts a string expression into a numeric expression.
VAL\$	Converts a numeric expression into a string expression.

BIN

Syntax	<code>BIN(string\$)</code>
Parameters	<code>string\$</code> is a string expression, containing a valid binary representation of an integer number.
Description	Returns the decimal representation of a binary expression contained in <code>string\$</code> . The value returned will be an integer.
Examples	<code>LET i=BIN("101")</code> assigns '5' to variable <code>i</code> .

BIN\$

Syntax	<code>BIN\$(aNumber [, digits])</code>
Parameters	<code>aNumber</code> is a valid numeric expression, <code>digits</code> is an expression, resulting in a positive integer.

Description Returns a string containing the binary representation of `aNumber`. In case, `aNumber` is not an integer, the decimals will be truncated (that means no rounding will take place).
When `digits` is stated, the string will be filled up with zeros (0) to the left.

Examples `LET b$=BIN$(126, 8)` assigns "01111110" to variable `b$`.

CINT

Syntax `CINT(aNumber)`

Parameters `aNumber` is a valid numeric expression.

Description Converts a numeric expression to the related integer figure, using commercial rounding.

Examples `i = CINT(1.49)` assigns '1' to variable `i`.
`j = CINT(1.50)` assigns '2' to variable `j`.

HEX

Syntax `HEX(string$)`

Parameters `string$` is a string expression, containing a valid hexadecimal representation of an integer number.

Description Returns the decimal representation of a hexadecimal expression contained in `string$`.
The value returned will be an integer number.

Examples `LET i=HEX("FF")` assigns '255' to variable `i`.

HEX\$

Syntax `HEX$(aNumber [, digits])`

Parameters `aNumber` is a valid numeric expression,
`digits` is a numeric expression, resulting in a positive integer.

Description Returns a string containing the hexadecimal representation of `aNumber`. In case, `aNumber` is not an integer, the decimals will be truncated (that means no rounding will take place).
When `digits` is stated, the string will be filled up with zeros (0) to the left.

Examples `LET a$=HEX$(254, 4)` assigns "00FE" to variable `a$`.

OCT

Syntax	<code>OCT(string\$)</code>
Parameters	<code>string\$</code> is a string expression, containing a valid octal representation of an integer number.
Description	Returns the decimal representation of an octal expression contained in <code>string\$</code> . The value returned will be an integer number.
Examples	<code>LET i=OCT("15")</code> assigns '13' to variable <code>i</code> .

OCT\$

Syntax	<code>OCT\$(aNumber [, digits])</code>
Parameters	<code>aNumber</code> is a valid numeric expression, <code>digits</code> is a numeric expression, resulting in a positive integer.
Description	Returns a string containing the octal representation of <code>aNumber</code> . In case, <code>aNumber</code> is not an integer, the decimals will be truncated (that means no rounding will take place). When <code>digits</code> is stated, the string will be filled up with zeros (0) to the left.
Examples	<code>LET a\$=OCT\$(254, 6)</code> assigns "000376" to variable <code>a\$</code> .

VAL

Syntax	<code>VAL(string\$)</code>
Parameters	<code>string\$</code> is a string expression, containing a valid numeric representation of a decimal figure like "-1.4" or "3E+5"
Description	Converts a decimal number contained in <code>string\$</code> to that decimal number. If the string does not contain a valid decimal number, '0' will be returned.
Examples	<code>i = VAL("1.234")</code> assigns '1.234' to variable <code>i</code> To avoid runtime errors due to typing errors with an <code>INPUT</code> command, first a string is read in that is later converted into the decimal representation of the figure entered. <code>INPUT "Please enter channel number:" _ , channelno\$ channelno = VAL(channelno\$)</code>

VAL\$

Syntax	VAL\$(aNumber [, digits])
Parameters	aNumber is a numeric expression. digits is a numeric expression, resulting in a positive integer.
Description	Returns a string containing the numeric representation of aNumber. The number of decimal places may be specified using the optional digits command element. In case aNumber uses more decimal places than specified with digits, the additional decimal places will be truncated (i.e. there will be no rounding). If digits is omitted, six decimal places will be used.
Examples	VAL\$(123) returns the string "123.000000". VAL\$(123.456789, 2) returns the string "123.45". VAL\$(123.456789, 0) returns the string "123".

String functions

This subsection describes functions that operate on strings.

Note: In case uninitialized variables are used as arguments, the returned values will usually be empty strings or '0'.

Function	Short description
ASC	Returns the ASCII code of the first character in a string.
CHR\$	Returns the character representing the ASCII value of an integer number as a string.
INSTR	Searches for the occurrence of a specific sequence of characters within a string.
LEN	Returns the number of characters included in a string.
LEFT\$	Reads a specific part of a string, starting from its beginning.
MID\$	Reads a specific part of a string.
RIGHT\$	Reads a specific part of a string, starting from its end.
SPACE\$	Returns a string, filled with a specific number of blanks.

ASC

Syntax	ASC(aString\$)
Parameters	aString\$ is a valid string expression.
Description	Returns the ASCII code of aString\$'s first character. If the string is empty, '0' will be returned.

Examples `ASC("A")` will return '65'.

CHR\$

Syntax `CHR$(aNumber)`

Parameters `aNumber` is a valid numeric expression.

Description Returns the character corresponding to the ASCII code of `aNumber` as a string.
If `aNumber` is outside the range 0...255, then its least significant byte will be used (i.e. a modulo 256 operation will be performed on `aNumber`).
Should `aNumber` have decimal places, then those will be truncated (this means that there will be no rounding).
If this command is used on a variable that has not been initialized before, '0' will be returned.

Examples `a$=CHR$(65)` assigns "A" to variable `a$`.

INSTR

Syntax `INSTR([startPos,] aString$, searchString$)`

Parameters `startPos` is a numeric expression, interpreted as positive integer.
`aString$` and `searchString$` are string expressions.

Description Searches `aString$` for the first occurrence of `searchString$`.
The search will start at the position given by `startPos` or, if omitted, at the beginning of `aString$`.
Return value is the position, where `searchString$` begins.
If `searchString$` is not found within `aString$`, '0' will be returned.
Should `startPos` have decimal places, then those will be truncated (this means that there will be no rounding).

Examples `a$ = "international or national"`
`i = INSTR(a$, "national")`
`j = INSTR(8, a$, "national")`
In this example, variable `i` will be set to '6', while variable `j` will be set to '18'.

LEN

Syntax `LEN(aString$)`

Parameters `aString$` is a string expression.

Description Returns the number of characters contained in `aString$`.

Examples `LEN("A short one")` will return '11'.

LEFT\$

Syntax `LEFT$(aString$, chars)`

Parameters `aString$` is a string expression,
`chars` is a numeric expression, interpreted as positive integer.

Description Returns the first `chars` characters of `aString$`, or the whole string if `chars` is greater than the amount of characters contained in `aString$`.
Should `chars` have decimal places, then those will be truncated (this means that there will be no rounding).

Examples `a$="Good morning"`
`b$=LEFT$(a$, 4)`
Will assign the string "Good" to `b$`.

MID\$

Syntax `MID$(aString$, startPos, chars)`

Parameters `aString$` is a string expression,
`startPos` and `chars` are numeric expressions, interpreted as positive integers.

Description Returns `chars` characters of `aString$`, starting at position `startPos`.
If `startPos+chars` is greater than the total amount of characters contained in `aString$`, the entire string, starting from `startPos` will be returned.
If `chars` is omitted, the entire string, starting from `startPos` will be returned.
If `startPos` is greater than the total amount of characters contained in `aString$` (i.e. `startPos` points past the end of `aString$`), then an empty string will be returned.
Should `startPos` or `chars` have decimal places, then those will be truncated (this means that there will be no rounding).

Examples `MID$("This is a test", 6, 4)` will return the string "is a".

RIGHT\$

Syntax `RIGHT$(aString$, chars)`

Parameters `aString$` is a string expression,
`chars` is a numeric expression, interpreted as positive integer.

Description Returns the last `chars` characters of `aString$`, or the whole string if `chars` is greater than the amount of characters contained in `aString$`. Should `chars` have decimal places, then those will be truncated (this means that there will be no rounding).

Examples `a$="Good morning"`
`c$=RIGHT$(a$,7)`
 Will assign the string "morning" to `c$`.

SPACE\$

Syntax `SPACE$(chars)`

Parameters `chars` is a numeric expression, interpreted as positive integer.

Description Returns a string containing a total amount of `chars` blanks.

Examples `d$ = "Long"+SPACE$(1)+"distance"`
 will assign the string "Long distance" to `d$`.

I/O functions The 4400's RAPID! environment provides a large number of I/O functions:

Function	Short description
CHDIR	Changes the current directory.
CLOCK	Returns the time since the system was last started.
CURDIR\$	Returns the currently selected directory.
DATE\$	Returns a string, containing the system date.
DIR\$	Function to read out the entries in a directory.
EOF	Checks whether the end of a file was reached.
EVENTWAIT, EVENTSTATUS	Waits for an event and returns the event code.
FREEFILE	Returns the subsequent free file handle.
INKEY	Checks whether a softkey was pushed and returns its code.
INKEYWAIT	Halts the program until a softkey is pushed.
KILL	Deletes a file.
MKDIR	Creates a new directory.
NAME	Renames an existing file.
RMDIR	Removes a directory.

SHELL Calls the operating system shell in order to perform operating system commands (e.g. so-called pipes).

TIME\$ Returns a string containing the system time.

CHDIR

Syntax CHDIR path\$

Parameters path\$ is a valid string expression.

Description Changes the current directory to the directory specified in path\$. path\$ may either contain the absolute or relative path. If path\$ is not a valid path, the current directory will be kept and a runtime error will occur.

Example CHDIR = "/usr/new"

CLOCK

Syntax CLOCK

Parameters There are no parameters.

Description Returns the time since the system was started last. The value returned is a floating-point double value, expressing the time expired since the last start of the system in seconds.

Example t = CLOCK
Assigns the time since the system was started last to variable t (t would then be set to e.g. '3724.23' (seconds)).

CURDIR\$

Syntax CURDIR\$

Parameters There are no parameters.

Description Returns the currently selected directory.

Example PRINT "Current directory:" ;CURDIR\$

DATE\$

Syntax DATE\$

Parameters There are no parameters.

Description Returns a string containing the system date in the following format: "mmm-dd-yyyy", where "mmm" represent a three-letter abbreviation of the month, "dd" stand for the integer, giving the day of the month and "yyyy" represent the current system year in four-digit code.

Examples DATE\$ would have returned "Jan-03-2001" on the day this subsection was created.

DIR\$

Syntax DIR\$ [(path\$)]

Parameters path\$ is a valid string expression.

Description Returns an entry in the directory specified with the optional command element path\$. DIR\$ will read the first entry in the specified directory only. Repeated DIR\$ function calls (without the path command element) will read out the subsequent entries of the currently selected directory one by one. If there are no more entries, an empty string will be returned. path\$ may either contain the absolute or relative path. If path\$ is not a valid path, the returned DIR\$ will be empty and a runtime error will occur.

Example The following example will print a list of all entries in the directory specified.

```
PRINT "Directory entries:";DIR$("/
home")
DO    d$ = DIR$
      IF d$ = "" THEN EXIT DO
      PRINT d$
LOOP
```

EOF

Syntax EOF(fileHandle)

Parameters fileHandle is a numeric expression, interpreted as positive integer.

Description Checks whether the end of the file, specified by fileHandle, has been reached. If so, EOF will return 1 (or true), otherwise 0 (or false). fileHandle needs to be a currently valid file handle, and the file needs to be opened first, before EOF may be used (otherwise, a runtime error will occur). **Note:** When you try to read from a file with the INPUT command after the end of the file was reached, a runtime error will occur. To avoid that, it is highly recommended to check EOF, before you issue an INPUT command.

Example

The following example program reads a text file and stores the data read from the file in a string array.

```
LET i=0
OPEN "STRINGS.TXT" FOR INPUT AS #1
DO WHILE NOT EOF(1)
    LET i=i+1
    INPUT #1, theStrgs$(i)
LOOP
CLOSE #1
```

EVENTWAIT, EVENTSTATUS

Syntax

```
EVENTWAIT(timeOut)
EVENTSTATUS
```

Parameters

`timeOut` is a numeric expression, interpreted as positive integer.

Description

EVENTWAIT

Waits for an event and returns the event code.

Events may be created by various devices or tasks (e.g. reception of a string on the GPIB bus).

`timeOut` specifies a wait time in milliseconds. During the wait time, the program will be halted and will wait for the event to occur. If the expected event does not occur, a timeout will be generated.

EVENTWAIT may be used to react on any of the following events:

KEY push of a softkey. In this case, the file handle returned will be '0'.

TIME-OUT means that there was no device or task creating an event; time simply expired without anything happening. In this case, the file handle returned will be '-1'.

GPIB an event on the GPIB bus (e.g. data have been applied and are ready to be read).

SCPI an event on the SCPI interface (e.g. a measurement value is ready to be handed over).

EVENTSTATUS

In case there is an event created by the GPIB bus, EVENTSTATUS may be used to read the status byte.

Example

The following example labels the softkeys, opens several communication ports and then waits 5 seconds for an event to occur.

Depending on the device or task creating the event, event handling will take place.

```
SOFTKEYS "OK",,,,,,"EXIT"
OPEN "GPIB0:..." AS #1
scpi = FREEFILE
OPEN "SCPI:" AS #scpi
DO
SELECT CASE EVENTWAIT(5000)
CASE -1: PRINT "Time out"
CASE 0
IF INKEY = 7 THEN END
PRINT "Softkey 'OK' was pushed."
CASE 1
INPUT #1, gpib$
PRINT "Received on GPIB:",
gpib$,EVENTSTATUS
CASE SCPI
INPUT #scpi, scpi$
PRINT "Received from SCPI:", scpi$
CASE ELSE
PRINT "Any other event occurred!"
END SELECT
LOOP
```

FREEFILE

Syntax

FREEFILE

Parameters

There are no parameters.

Description

Returns the subsequent available file handle as a positive integer.

The returned file handle may then be used by an [OPEN \(on files\)](#) command.

FREEFILE helps to avoid conflicts with file handles.

Example

This example writes a string to a text file.

```
LET File=FREEFILE
OPEN "STRINGS.TXT" FOR OUTPUT AS
#File
PRINT #File, "Save me"
CLOSE #File
```

INKEY

Syntax

INKEY

Parameters

There are no parameters.

Description Checks whether a softkey was pushed and returns the number of the softkey. The softkeys on the 4400 are numbered from '1' to '7', starting from the left. If no softkey was pushed, `INKEY` will return '0'. In contrary to the `INKEYWAIT` command, `INKEY` does not halt the program.

Note: Please be sure that there have been labels assigned to the softkeys with the [SOFTKEYS](#) command, before you use `INKEY` to read out the softkey pushed.

Example

```
SOFTKEYS "Accept", "", "", "", "", "", "",  
"Exit"  
DO  
    IF INKEY = 7 THEN GOTO endProg  
LOOP
```

INKEYWAIT

Syntax `INKEYWAIT`

Parameters `INKEYWAIT` does not have any parameters.

Description Halts program execution until the user pushes a softkey.
Notes:

- If you want to determine the softkey pushed without halting the program, choose the `INKEY` function instead.
- Please assign labels to the softkeys using the [SOFTKEYS](#) command, before using `INKEYWAIT`. Otherwise, the program may wait for eternity.

Example

```
SOFTKEYS "OK", "", "", "", "", "", "",  
"EXIT"  
IF INKEYWAIT = 7 THEN END
```

KILL

Syntax `KILL fileName$`

Parameters `fileName$` is a valid string expression.

Description Deletes the file specified in `fileName$` in the currently set directory without prompting. `fileName$` may also contain a path. If `fileName$` is not a valid file name or if `fileName$` is currently open, a runtime error will occur.

Examples `KILL "/usr/new/file.txt"`

MKDIR

Syntax `MKDIR path$`

Parameters	<code>path\$</code> is a valid string expression.
Description	Creates a new directory with the <code>path\$</code> specified. <code>path\$</code> may either be a relative or absolute directory name. If <code>path\$</code> is not a valid directory name, a runtime error will occur.
Examples	<code>MKDIR "/usr/new"</code>

NAME

Syntax	<code>NAME oldName\$ AS newName\$</code>
Parameters	<code>oldName\$</code> and <code>newName\$</code> are both valid string expressions.
Description	Changes the name of the file specified with <code>oldName\$</code> to <code>newName\$</code> . Both <code>oldName\$</code> and <code>newName\$</code> have to be valid file names. If <code>oldName\$</code> is currently open, a runtime error will occur.
Example	<code>NAME "/usr/new/file.txt" AS "/usr/new/file_2.txt"</code>

RMDIR

Syntax	<code>RMDIR path\$</code>
Parameters	<code>path\$</code> is a valid string expression.
Description	Deletes a directory with the <code>path\$</code> specified without prompting. <code>path\$</code> may be either a relative or an absolute directory name. If <code>path\$</code> is not a valid directory name or if the directory is not empty, a runtime error will occur.
Example	<code>RMDIR "/usr/new"</code>

SHELL

Syntax	<code>SHELL parameter\$</code>
Parameters	<code>parameter\$</code> is a valid string expression.

Description	Calls a command of the operating system, specified in <code>parameter\$</code> . <code>parameter\$</code> may contain all legal commands of the operating system including the pipe ('>') symbol. Thus, output generated by a command of the operating system may be routed to a file and read in by a RAPID! program. If <code>parameter\$</code> does not contain a valid command of the operating system, a runtime error will occur.
Examples	The following one-line program reads the file list of all files contained in a specified directory and stores them in a text file. <pre>SHELL "ls /usr/new > /usr/new/ls.txt"</pre>

TIME\$

Syntax	TIME\$
Parameters	There are no parameters.
Description	Returns a string containing the system time in the following format: "hh:mm:ss", where "hh" is a positive integer, giving the current system hour (in 24 h format), "mm" give the current minutes and "ss" represent the current seconds.
Examples	TIME\$ would have returned "10:29:37" at the time this table was created.

Functions for error handling

For program-internal error handling, the following functions have been implemented in RAPID!

Function	Short description
ERR	Returns the error code of the most recent error.
ERL	Gives the program line, in which the last error occurred.
ERF\$	Returns the name of program file, in which the last error occurred.

ERR

Syntax	ERR
Parameters	There are no parameters.
Description	Returns the error code of the latest error that occurred. For the meaning of the error codes, please see "Runtime errors" on page 215 for reference.

Example In this example, the 4400 prints an error message, giving the error code, the line in which the error occurred and the name of the related RAPID! program file.

```
ON ERROR GOTO errorHandler
...
errorHandler
    PRINT "Error "; ERR; " in line ";
    ERL;" in file ";ERF$
RESUME NEXT
```

ERL

Syntax ERL

Parameters There are no parameters.

Description Returns the number of the program line, in which the last error occurred.

Example Please see example with ERR function above.

ERF\$

Syntax ERF\$

Parameters There are no parameters.

Description Returns the name of the RAPID! program file, in which the last error occurred.

Examples Please see example with ERR function above.

Mathematical functions

The RAPID! environment of the 4400 provides most of the important mathematical functions:

Function	Short description
ABS	Returns the absolute value of a numeric expression.
LOG, LGT	Calculates the natural logarithm and the common logarithm, respectively.
RND, RANDOM- IZE	Functions for generating random numbers.
SIN, COS, TAN, ATAN	The most important trigonometric functions.
SQRT	Calculates the square root of a numeric expression.

SGN Returns the sign of a numeric expression.

ABS

Syntax ABS (numExp)

Parameters numExp is a valid numeric expression.

Description Returns the absolute value of numExp.
If numExp is an unassigned variable, a '0' will be returned.

Examples t = ABS (-1)
Assigns '+1' to variable t.

LOG, LGT

Syntax LOG (numExp)
LGT (numExp)

Parameters numExp is a valid numeric expression.

Description LOG returns the natural logarithm of numExp while LGT returns the common logarithm of numExp.

Examples i = LOG (1000)
j = LGT (1000)
Variable i will be set to '6.907755' while j will be set to '3'.

RND, RANDOMIZE

Syntax RND
RANDOMIZE (numExp)

Parameters numExp is a valid numeric expression, interpreted as positive integer.

Description RND generates a random double floating-point number between '0' and '1'.
RANDOMIZE is used to reinitialize the random generator.
Note: RANDOMIZE (x) will always lead to the same sequence of random numbers.

Examples The following example program reinitializes the random generator and then prints ten random numbers.
RANDOMIZE 321
FOR i = 1 TO 10
PRINT RND
NEXT i

SIN, COS, TAN, ATAN

Syntax	SIN (numExp) COS (numExp) TAN (numExp) ATAN (numExp)
Parameters	numExp is a valid numeric expression.
Description	<p>SIN (numExp) Calculates the sine of numExp and delivers back a double floating-point number. numExp is interpreted as the radiant expression of the angle (SIN(3.14...) = 0).</p> <p>COS (numExp) Calculates the cosine of numExp and delivers back a double floating-point number. numExp is interpreted as the radiant expression of the angle (COS(3.14...) = -1).</p> <p>TAN (numExp) Calculates the tangent of numExp and delivers back a double floating-point number. numExp is interpreted as the radiant expression of the angle (TAN(3.14...) = 0).</p> <p>ATAN (numExp) Calculates the arcus tangent of numExp and delivers back a double floating-point number. numExp is interpreted as the radiant expression of the angle (ATAN(3.14...) = 1.262627).</p>
Examples	Please see examples nested in the description above.

SQRT

Syntax	SQRT (numExp)
Parameters	numExp is a valid numeric expression.
Description	Returns the square root of numExp as a double floating-point number.
Examples	i = SQRT (25) Assigns '5' to variable i.

SGN

Syntax	SGN(numExp)
Parameters	numExp is a valid numeric expression.
Description	Returns the sign of numExp. If numExp is equal to or greater than '0', SGN will return '+1'. If numExp is less than '0', SGN will return '-1'.

Examples `i = SGN(234)`
 `j = SGN(-0.023)`

Variable `i` will be set to '+1', while variable `j` will be set to '-1'.

Tables

While working with RAPID!, it is quite helpful to keep the following tables at hand:

- List of all [RAPID! commands and functions](#) in alphabetic order.
- Table of all [Syntax errors](#), giving also their meaning and hints how to trace the problem.
- Table of all [Runtime errors](#), explaining their meaning and giving hints of how to solve the matter.

RAPID! commands and functions

In this table, you will find all RAPID! commands and functions in alphabetic order for a quick overview.

Command or function	Short description
ABS	Returns the absolute value of a numeric expression.
ASC	Returns the ASCII code of the first character in a string.
ATAN	Calculates the arcus tangent of a numeric expression.
BIN	Converts a binary representation of a numeric expression into its decimal equivalent.
BIN\$	Transforms a numeric expression into its binary representation.
CHAIN	Loads and executes a different RAPID! program.
CHDIR	Changes the current directory.
CHR\$	Returns the character representing the ASCII value of an integer number as a string.
CINT	Rounds a numeric expression to an integer, using commercial rounding.
CLOCK	Returns the time since the last start of the system.
CLOSE	Closes a previously opened file.
CLS	Clears the screen.

COS	Returns the cosine of a numeric expression.
CURDIR\$	Returns the currently selected directory.
DATE\$	Returns a string, containing the system date.
DIM	Declares local variables.
DIR\$	Function to read out the entries in a directory.
DO . . . LOOP	Loop with condition.
END	Ends the program.
EOF	Checks whether the end of a file was reached.
ERASE	Releases allocated memory of a variable.
ERF\$	Returns the name of program file, in which the last error occurred.
ERL	Gives the program line, in which the last error occurred.
ERR	Returns the error code of the most recent error.
ERROR	Creates an error with a specified error number.
EVENTWAIT, EVENTSTATUS	Waits for an event and returns the event code.
FOR . . . NEXT	Loop with a specified number of cycles.
FREEFILE	Returns the subsequent free file handle.
FUNCTION	Declares a function.
GLOBAL	Declares global variables.
GOSUB . . . RETURN	Branches to the specified label and returns at the next RETURN command.
GOTO	Branches to the specified label.
HEX	Converts a hexadecimal representation of a numeric expression into its decimal equivalent.
HEX\$	Transforms a numeric expression into its hexadecimal representation.
IF . . . THEN	Checks a condition.
INKEY	Checks whether a softkey was pushed and returns its code.
INPUT	Reads data from an open file or from an open port or waits for a user entry and stores the value entered.
INSTR	Searches for the occurrence of a specific sequence of characters within a string.
KILL	Deletes a file.

LEFT\$	Reads a specific part of a string, starting from its beginning.
LEN	Returns the number of characters included in a string.
LET	Assigns an expression to a variable.
LGT	Calculates the common logarithm.
LOCATE	Sets the cursor position on-screen for the subsequent output command.
LOG	Calculates the natural logarithm.
MID\$	Reads a specific part of a string.
MKDIR	Creates a new directory.
NAME	Renames an existing file.
OCT	Converts an octal representation of a numeric expression into its decimal equivalent.
OCT\$	Transforms a numeric expression into its octal representation.
ON ERROR	Branches to the specified label, if an error occurs during program execution.
OPEN	Opens a file or a port and allows for reading or writing data.
PRINT or OUTPUT	Writes data to an open file or port or displays an expression on-screen.
RANDOMIZE	Initializes the random generator.
REM or `	Comment.
RIGHT\$	Reads a specific part of a string, starting from its end.
RMDIR	Removes a directory.
RND	Generates a random number.
SELECT CASE	Selects one of several cases.
SGN	Returns the sign of a numeric expression.
SHELL	Calls the operating system shell in order to perform operating system commands (e.g. so-called pipes).
SIN	Calculates the sine of a numeric expression.
SOFTKEYS	Labels the 4400 softkeys.
SPACE\$	Returns a string, filled with a specific number of blanks.
SQRT	Calculates the square root of a numeric expression.

STOP	Debugger breakpoint.
SUB	Declares a procedure (subroutine).
TAN	Returns the tangent of a numeric expression.
TEXTATTR	Sets background color and text size, font and color.
TIME\$	Returns a string containing the system time.
VAL	Converts a string expression into a numeric expression.
VAL\$	Converts a numeric expression into a string expression.
VARIABLE	Prints variable contents to screen or file.
WAIT	Halts the program for a specified amount of time.

Syntax errors

Code	Message and Comment
1	No program file argument The argument needs to be a valid file name of an existing file.
2	Program file not found The program file was not found in the current or specified directory.
3	Expression expected A numeric expression was expected, but was not found.
4	Variable expected A valid variable name was expected, but was not found.
5	String expected In a context, where only a string is allowed, there was no string found.
6	Number expected In a context, where only a numeric parameter is allowed, there was none found.
7	String const exceeds line The string was not terminated with a quotation mark (").
8	(B)in, (O)ct or (H)ex expected After a '&t', only a binary (B), octal (O) or hexadecimal (H) number is allowed.
9	Program line too long Either the program line is more than 254 characters long or the program line continue mark ('_') was used too often.

- 10 EOL expected
The program line should end here. In many cases, the colon (:)
that separates two valid commands is missing.
- 11 '(' expected
An open round bracket was expected, but was not found.
- 12 ')' expected
A closed round bracket was expected, but was not found.
- 13 ',' expected
A comma was expected, but was not found.
- 14 '=' expected
A '=' sign was expected, but was not found.
- 15 '#' expected
A '#' symbol was expected, but was not found. '#'s are used
to indicate file handles.
- 20 CASE, CASE ELSE or END SELECT without SELECT
At the beginning of a SELECT block, there must be a
SELECT command.
- 21 CASE Command:
Number expected
When the SELECT block is used to decide on numbers, the
CASE statements need to be numeric as well.
- 22 CASE Command:
String expected
When the SELECT block is used to decide on strings, the
CASE statements need to be strings as well.
- 23 CASE Command:
Missing END SELECT
At the end of a SELECT block, there must be an END
SELECT statement.
- 24 CASE only at begin of line
The CASE statements are only allowed at the beginning of a
program line.
- 30 IF Command:
Missing END IF
When using a multiline IF . . . THEN command, an END IF
statement must be used in the last line of the block.
- 31 IF Command:
THEN expected
Every IF has to be followed by a THEN.
- 32 IF Command:
ELSEIF only at begin of line
The ELSEIF statements are only allowed at the beginning
of a program line.

- 37 DO Command:
Missing LOOP
A DO command needs always to be finished with a LOOP statement.
- 38 DO Command:
WHILE or UNTIL expected
Within a DO...LOOP command, only one of the conditions WHILE or UNTIL may be used – either with DO or with LOOP.
- 40 NEXT Variable and FOR Variable are not the same
The variable used with the FOR statement must be identical with the variable used with the NEXT statement of the same block.
- 41 FOR Command:
Missing NEXT
A FOR command block must be ended with a NEXT statement.
- 42 FOR Command:
TO expected
The FOR statement may include a range for the variable to be incremented. This range is specified with TO (e.g. FOR i = 1 TO 10).
- 46 Chain Stack overflow
The maximum depth of chained programs is 4. In case more than those 4 programs have been chained (e.g. by a chained program that itself chains other programs), this message will occur.
- 47 Chain file not found
The RAPID! program file that should be chained could not be found in the current or specified directory.
- 50 Expression: NOT,+,- are not allowed here
Signs may not be used in this context.
- 51 Expression: Command or Function is not allowed here
A command or a function is not allowed in this context.
- 52 Label expected
A symbolic label is expected (e.g. after an ON ERROR, GOTO, GOSUB or RESUME command).
- 53 Label not found
The symbolic label issued with a branch command could not be found in the program. Mostly, this is due to typing errors.
- 54 Label already exists
The symbolic label stated has already been used with a different branch command.

- 58 Variable not declared
In order to access an indexed variable, that one must be declared first, using the DIM command.
- 59 Variable already declared
This variable was declared already, using a DIM command (happens frequently when chaining programs).
- 60 Indexvariables are not allowed here
Indexed variables are not allowed in this context (probably a loop can help).
- 61 PRINT Command:
' , ' or ' ; ' expected
Several expressions may be handled, using just one PRINT command. However, the single expressions need to be separated by commas (,) or semicolons (;).
- 62 Keyword not allowed here
The keyword is not allowed in this context. Most of these errors are caused by using a reserved RAPID! name as a symbolic label.
- 63 Stack overflow
Too many loops are interlocked. Try to finish one or more of those loops before the subsequent are started.
- 64, 65 Misplaced argument
The command or argument is not allowed in this context.
- 66 Compare operand expected
The program expects an operand, expressing comparison (=, <, >, <=, >=, <>)
- 70 OPEN command:
FOR needs APPEND, BINARI, INPUT, OUTPUT or RANDOM
When opening a file with the FOR command option, a file mode has to be specified. Currently, only the following three file modes are available: INPUT, OUTPUT or APPEND.
- 71 OPEN command:
ACCESS needs READ, WRITE or READ WRITE
This message should not occur as the related functionality has not been implemented yet.
- 72 OPEN command:
AS expected
Indicates a missing file handle.
- 73 OPEN command: SHARED, LOCK READ, LOCK WRITE or LOCK READ WRITE expected
This message should not occur as the related functionality has not been implemented yet.
- 80 SUB or FUNCTION header error
Please check the declaration of your procedure or function; looks like something is missing there.

81	SUB or FUNCTION already exist There is already a procedure or function with this name. Many of those cases occur by chaining RAPID! program files.
82	SUB not declared The procedure you want to use currently has not been defined before. In order to avoid that, it is recommended to declare all procedures and functions at the beginning of the main program.
83	SUB or FUNCTION declaration misplaced A procedure or function declaration cannot be used at this place.
84	SUB END or FUNCTION END does not match to header The last program line of any procedure or function must be either an END SUB (for procedures) or an END FUNCTION (for functions).
85	SUB EXIT or FUNCTION EXIT does not match to header Any procedure must be exited with EXIT SUB. Any function must be exited with EXIT FUNCTION.
86	SUB END or FUNCTION END missing The last program line of any procedure or function must be either an END SUB (for procedures) or an END FUNCTION (for functions).
89	Too many arguments More arguments than expected were used.
97	Internal Error: Parameter A procedure or function was called, using the wrong type or the wrong number of arguments.
98	Internal Error: Command not implemented You are trying to use a command that has not been implemented yet. However, the command is a reserved RAPID! name and every attempt to use it will cause this message.
99	Internal Error: PASS2 This message indicates an internal error of the program loader. If you receive this message after a restart, please contact a Willtek support center.

Runtime errors

Code	Message and Comment
------	---------------------

100	<p>Out of memory There is no more memory available for variables. To avoid this situation, please check whether there are indexed variables that are not completely used during runtime or whether one or several indexed variables may be erased using the ERASE command.</p>
101	<p>Too many GOSUBs Overflow of the GOSUB . . . RETURN stack. To avoid this error message, reduce the number of recursive procedure calls.</p>
102	<p>RETURN without GOSUB A RETURN command was found, but the program is in no procedure currently.</p>
103	<p>VAL: Number expected The VAL function returns a numeric expression (contained in a string expression).</p>
104	<p>Division by zero This is a major problem for program-internal error-handling. To completely avoid this problem, it is recommended to check the operands of a division before the division is carried out.</p>
105, 106	<p>Index out of range The index of an indexed variable must be in the range of -32,766 to +32,766.</p>
107	<p>ON ERROR not allowed in an error handling routine Within program-internal error handling, an ONERROR command is not allowed.</p>
109	<p>Dimension Error The physical dimensions of the operands do not match (e.g. $i = 1 \text{ kHz} + 5 \text{ mW}$).</p>
110	<p>No such file or directory The file name or directory specified does not exist.</p>
111	<p>Too many open files Too many files have been opened and there is no further file handle available. To avoid this message, it is recommended to close all files as soon as they are no longer required to be open.</p>
112	<p>Permission denied There is no permission to access the specified file or directory.</p>
113	<p>Invalid access code The access code used is not valid and access is still denied.</p>

114	<p>Unexpected File error Happens e.g. when you write data to a disk and remove that one during program run. However, it may also indicate problems with the disk drives or controllers. Should this error message occur repeatedly, please contact your nearest support centre.</p>
115	<p>File not open The file specified has not been opened before. Files may only be accessed after they have been opened with the OPEN command.</p>
116	<p>Bad file number The file handle used is invalid. This happens for instance, when you try to open a file with the file handle of a file that was opened before.</p>
117	<p>File already exists The file or directory specified does exist and cannot be created anew.</p>
118	<p>Filesystem is Read Only The current file system only allows to read data. This message will occur when you try to write data to a file that is marked 'Read Only'.</p>
119	<p>A component of Path is not a directory The path specified – or parts of it – do not fulfill the naming conventions for directories. Please remember that a directory name must not contain any symbols and is restricted to a maximum length of 8 characters.</p>
120	<p>Directory busy The directory specified is currently in use by another task and cannot be accessed.</p>
121	<p>Directory not empty You tried to remove a directory, but the directory is currently not empty. Before a directory may be deleted, all entries need to be deleted first.</p>
122	<p>Filename must not be empty The string specifying a file name is empty.</p>
123	<p>File number already in use The current file handle has already been used to open a file and this file is still open. Either close the open file or open the current file with a different file handle. This problem can easily be avoided if you use the FREEFILE function to assign file handles.</p>
124	<p>SUB/FUNCTION Stack overflow Overflow of the GOSUB . . . RETUN and FUNCTION stacks. To avoid this error message, it is recommended to keep the number of recursive calls of functions and procedures to a minimum.</p>

- 125 Open GPIB failed
The GPIB port could not be opened. Please check whether all parameters used in the OPEN "GPIB0:..." command are correct.
- 126 SCPI already open
The SCPI port may only be opened once.
- 127 Input Timeout on COM
While waiting for an input on one of the serial ports of the 4400, a timeout occurred. This may be due to faulty configuration (either hardware or software) of the handshake signals. Please also check whether all parameters used in the OPEN "COMx:..." command are correct.
- 128 Output Timeout on COM
It was not possible to transmit data over the serial ports before the time limit expired. This may be due to faulty configuration (either hardware or software) of the handshake signals. Please also check whether all parameters used in the OPEN "COMx:..." command are correct.
- 199 USER BREAK
The program was terminated by the user.
- 201 Widget Error: Pos and Size must be defined
All new widgets need to carry a definition of their position and size. However, widget programming has not been implemented yet.
- 202 Widget Error: Widget not found
The program tried to use a widget that does not exist (anymore). The widget handle is no longer valid. However, widget programming has not been implemented yet.
- 203 Widget Error: No valid Widget Call
The widget call used does not correspond to the widget types available. However, widget programming has not been implemented yet.

SCPI

6

This chapter describes the remote control capabilities of the 4400. Test results described in this chapter are as follows:

- ["Overview" on page 220,](#)
- ["What SCPI is" on page 220](#)
- ["Structure" on page 221](#)
- ["Syntax and notation" on page 221](#)
- ["SCPI and RAPID!" on page 225](#)
- ["Command subsystem overview" on page 232](#)
- ["The base station and mobile station parameter subsystems" on page 242](#)
- ["The communication-related subsystems" on page 234](#)
- ["SCPI command errors" on page 261](#)

Overview

SCPI (pronounced as 'skippy') is a world-wide standard. The basic idea of SCPI is to define a command language for measurement systems that is independent of the related manufacturers.

This chapter explains how SCPI works on the 4400. It is divided into six subsections:

What SCPI is – Here you will find a short definition of SCPI and some general information.

Structure – This subsection explains the common commands, the subsystems and the command tree.

Syntax and notation – The command syntax, the parameters and the syntax of queries are explained in this subsection.

SCPI and RAPID! – SCPI and RAPID! together form a powerful time-saver for extensive tests that are performed on a regular basis, like automated acceptance tests after manufacturing or regular routine checks as part of maintenance or quality assurance.

Command subsystem overview – This subsection gives a brief overview on the subsystems into which the SCPI commands are split.

The base station and mobile station parameter subsystems

The communication-related subsystems

SCPI command errors – Here, you will find a table with explanations of syntax errors, run-time errors, device errors or any other errors.

What SCPI is

SCPI (Standard Commands for Programmable Instruments) was introduced in 1990. It is a world-wide standard, independent of single manufacturers. The SCPI specifications define a command language for measurement systems and – in principle – are based on IEEE 488.2.

SCPI is independent of the physical transmission channel of the commands. Although this chapter refers to the GPIB as the physical interface, you can also control the 4400 via a local area network (TCP/IP Option required).

The idea behind SCPI is to shorten program development times for the automated control of test equipment and to make that program development as efficient as possible.

Of course, one of the main requirements for this goal is that the language must be understood by as many measurement devices as possible. Therefore, SCPI is pushed by the SCPI consortium. Quite a number of the main test and measurement equipment manufacturers are members of the SCPI consortium.

Implementing just standard commands on a complex communications test system like the 4400 would lead to a poor performance. Therefore, we were obliged to find a compromise between standard commands and performance. This is the reason why you will find many more SCPI commands on the 4400 than specified in the standard SCPI specification. However, all SCPI commands implemented on the 4400 follow the standard SCPI syntax and rules.

For additional details on the SCPI standard, the current version can be found on page www.scpiconsortium.org/scpistandard.htm. You can download the full SCPI specification from there free of charge (some 3.5 Mb in PDF format).

Structure

SCPI defines programming commands, program messages, return values and data formats, which are consistent for all measurement systems independent of their manufacturer and purpose.

SCPI uses a device-independent command set, the so-called **Common commands**, understood by all SCPI devices.

The 4400-specific SCPI commands are called **Compound commands** and will only be understood by the 4400 and its subsystems.

A subsystem in terms of SCPI is quite abstract: it is the set of commands implemented to perform specific tasks of the SCPI device (the 'measurement subsystem' of the 4400, for instance, is the set of commands implemented for taking all kind of measurements, while the 'configuration subsystem' is the set of all configuration commands for all areas of the 4400).

All these subsystems are using the same, SCPI-based messaging and data formats.

Any SCPI command is built in a hierarchical way – similar to how a path in a file system is built.

The single command elements are separated by colons (:).

The complete set of commands of a subsystem is called the 'command tree'.

The command trees for the SCPI command set implemented on the 4400 is available in this manual.

Syntax and notation

There are two types of SCPI commands:

- compound commands and
- common commands.

Both types of commands differ in syntax.

Compound commands

Compound commands are always referred to as **commands** throughout this chapter.

- Any compound command is built in a hierarchical way. The single command elements are separated by colons (:).
- A command usually starts with a colon (:). However, the colon **must be omitted** when the subsequent command continues on the same hierarchical level (see examples below).
- The first command element always is the name of the subsystem like `CONFigure` or `MEASure`.
- Then follows one of the commands available for that subsystem like `GSM` or `RFTX`.
- The subsequent command element(s) may now be one or more subcommand(s) and/or one or more parameter term(s) (e.g. `BS:ID:BCC 5`).
- A SCPI program line may contain more than one command. In this case, the single commands have to be separated by a semicolon (;).
- There is also a short form for every command. This is usually formed of the first four letters (`CONF` instead of `CONFIGURE`). When the fourth letter is a vowel (a,e,i,o,u), only the first three letters are used (`RFG` instead of `RFGenerator`).
- Throughout this manual, the short form is always written in capitals to make it easy to identify it. However, the SCPI system of the 4400 is not case-sensitive.

Examples

- The complete SCPI command to set the base station color code (i.e. the training sequence) to 5 would be: `:CONFigure:GSM:BS:ID:BCC 5`. The short form `:CONF:GSM:BS:ID:BCC 5` is completely identical.
- `:RFGenerator:STATE ON` is identical with `:RFG:STAT ON`. However, the long version of the commands is – especially in the beginning – easier to work with.
- `:RFGenerator:STATE ON; LEVEL 20` is a valid two-command statement. `STATE ON` and `LEVEL` are both commands of the `RFGenerator` subsystem. Both are working on the same hierarchical level. Therefore, the colon in front of `LEVEL 20` has to be omitted.
An alternative with the identical meaning would be: `:RFGenerator:STATE ON; :RFGenerator:LEVEL 20`. The form `:RFGenerator:STATE ON; :LEVEL 20` would be invalid, because `LEVEL` is no subsystem of the 4400.
- `:RFGenerator:MODulation:STATE ON` is invalid. `STATE ON` is no subcommand of the `:RFG:MOD` level.
- `:RFGenerator:MODulation ON; FREQUENCY 850.2` In this case, the first part up to the semicolon(;) is valid. The second part is invalid as `FREQ` is no subcommand of the `:RFG:MOD` level.
The correct command would be: `:RFGenerator:MODulation ON; :RFGenerator:FREQUENCY 850.2`.

Parameters Many commands require parameters to be specified. Those parameters are placed behind the command, separated by at least one blank (space). The following types of parameters do exist on the 4400:

- **Numeric parameters.** These are integers, floating point numbers (with a maximum of 6 decimals) or exponential numbers (see specifications IEEE 488.2 NRf format or ANSI X3.42-1975 for details).
Some numeric parameters may carry a physical unit (details can be found in subsection variables of the RAPID! chapter).
Example: `:RFG:FREQ 930.071965 MHz` makes the RF generator switch to the specified transmission frequency.

NOTE

The decimal point of floating point numbers **must be** the dot (.) within SCPI as a comma (,) will always be interpreted as the separator between two parameters (see Notes below for details).

- **Boolean parameters** are specified using the binary numbers 0 | 1, or ON | OFF instead.
- **Enumerated parameters** are strings that only may be selected from a predefined list. To distinguish them from string parameters, the enumerated parameters **must not** be put in quotation marks.
Example: `:CONFigure:GSM:TYPE GSM9001800` sets the 4400 to work as test set for GSM 900/1800.
- **String parameters** are user-defined strings.
Example: `PROGram:NAME "/rapid/examples/ms_test.rbm"` loads the specified RAPID! program file.
- **Block parameters** are a special case and will be described with the related commands.

Queries Many commands also have a query form. These queries enable you to read out the current value of parameters or the results of measurements. For a query, simply add a question mark to the command (without any spaces or other symbols in-between).
Example: `:RFG:FREQ?` returns the current transmission frequency of the RF generator.

NOTE

The result of a query is saved internally on the 4400. Details can be found in subsection ["Using queries" on page 227](#).

Common commands Common commands are defined in IEEE 488.2. They work on the device itself (and on any subsystem) and always start with an asterisk (*).

Example: `*RST` resets the 4400 and sets all system parameters to default values.

A list of all common commands can be found in subsection "[Common commands](#)" on page 223.

NOTE

The SCPI system is not case-sensitive. It does not matter for the syntax whether commands are written using capital letters, lowercase letters, or a mixture of both.

However, for easy maintenance of SCPI programs, it is recommended to type in the short form of a command in capital letters (CONF) and the rest of it in lowercase letters (CONFigure).

NOTE

Some commands allow more than one parameter. In those cases, the single parameters are separated by commas (.). There **must not be** any spaces between the commas and the parameters.

Example: :CONF:GSM:BS:TCH:NCELL 63,45,39,17,23,9

NOTE

The SCPI notation of commands differs from the RAPID! notation. Please, do not confuse them as this could lead to severe program errors.

SCPI notation

The notation for SCPI commands is partly different from the [RAPID! syntax](#). Please, do not confuse them as this could lead to severe program errors.

[*item*] (identical with RAPID!) — Square brackets indicate an optional item, which can also be omitted.

Example: :MEASure[:CONTinuous] :RFTX:PPeak. Regardless whether the :CONTinuous command element is used or not, the 4400 will start taking continuous measurements of the peak phase error.

item | *item* (identical with RAPID!) — Vertical bars separate entries of a list and indicate that precisely one element out of that list **must** be used.

Example: Some commands require boolean parameters to be specified. This means

that either on (1) or off (0) needs to follow the command. This is expressed by using vertical bars: ON | OFF.

< *item* > (does not exist with RAPID!) — Pointed brackets indicate that either a parameter or a subcommand must be used in order to build a valid command.

Example: :RFGenerator:STATE <ON | OFF>. The RF generator can be set either on or off.

{ *item* } (usage different to RAPID!) — Braces stand for a parameter or a subcommand that has to be selected from a predefined table.

Example: :MEASure< : {measProp} > indicates all subcommands of the MEASure subsystem, like RFTX, RFRX or AFAN.

SCPI and RAPID!

This section is an application-oriented guide on how to use the functionality of SCPI through RAPID!.

[Executing SCPI commands](#) through RAPID!

[Reading SCPI data](#) through RAPID!

[Using queries](#)

[Event handling – registers](#)

[Programming examples](#)

Executing SCPI commands

RAPID! treats the SCPI system like a file. This means that

- the SCPI system needs to be opened first, before any communication may be established.
- to communicate between RAPID! and SCPI, the standard file-related RAPID! commands (like PRINT or INPUT) are used.

Example 1 This example opens the SCPI system as a communication port:

```
LET scpi = FREEFILE
OPEN "scpi" as #scpi
...
...
...
CLOSE #scpi
```

Example 2 After the SCPI system has been opened as a communication port, commands may be sent, using the PRINT or OUTPUT command:

```
...
PRINT #scpi, "*RST"
OUTPUT #scpi, ":CONFIgure:GSM:TYPE GSM9001800"
PRINT #scpi, ":MEASure:GSM:RFTX:ALL"
...
PRINT #scpi, ":FETCh:GSM:RFTX:ALL"
INPUT #scpi, rftx_result_all$ ...
```

The first command resets the 4400 to factory defaults using SCPI common command *RST.

The subsequent command configures the 4400 as a test set for GSM 900/1800. The :MEASure:RFTX:ALL command starts an internal procedure that will continuously take all RFTX measurements in a row.

The current set of measurement results can be read out, using the INPUT command.

Example 3 Converting the string read into numeric variables.

```
...
index = 0
rftx_result_all$ = rftx_result_all$ + ","
DO

    P = INSTR(rftx_result_all$, ",")
    result(index) = VAL(LEFT$(rftx_result_all$, P -
    1))
    rftx_result_all$ = MID$(rftx_result_all$, P +1))
    index = index + 1

LOOP UNTIL rftx_result_all$=""
```

This example program looks for the commas, separating the single measurement result values. Then it reads the part of the string between the commas and converts it back into a numeric variable.

More details regarding this example program can be found in section "[Standard TX measurements](#)" on page 229.

Important notes:

- Please keep in mind that RAPID! has to check the GPIB actively as there will be no automated reaction to any GPIB control sequences. However, please note that measurement results, polled through GPIB commands will also be available for any RAPID! program.
- To make sure that the 4400 is not blocked by other tasks, only perform RAPID! or SCPI measurements from the [Welcome menu](#).
- In order to prevent the 4400 from 'waiting for eternity', use a standard timeout of 10 s (allow more time for complicated measurements like RX testing).
- A timeout does not speed up things (or slow them down). A call establishment will take its time.

Reading SCPI data

To read SCPI data (such as measurement results) into RAPID!, the INPUT command is used.

Again, the SCPI system has to be opened as a communication port first.

NOTE

All results handed back from the SCPI system have the format of a string. Should there be more than one result, the single results will be separated by commas.

Example:

This example reads out the version of the 4400.

```
LET scpi = FREEFILE
OPEN "scpi" as #scpi
PRINT #scpi, "*IDN?"
INPUT #scpi, version$
CLOSE #scpi
```

SCPI common command `*IDN?` is used to read out the identification of the test set. The value returned is then stored in RAPID! string variable `version$`. The content of `version$` will be something like `"Willtek,4400,0511099"`.

Using queries

Many commands have a query form. These queries enable you to read out data from the SCPI system like measurement results or the current value of parameters (like the current transmission frequency of the RF generator).

Building queries

For a query, simply add a question mark to the command (without any spaces or other symbols in-between).

Example 1

The example below initiates the measurement of the burst length and returns the related value.

```
...
OUTPUT #scpi, ":MEASure:RFTX:LENGth?"
INPUT #scpi, burstlength$
```

Example 2

More than one query can be placed into a single command line. The individual queries must be separated by semicolons (;). The returned values will also be separated by semicolons.

The example below reads out the current system time and then queries the contents of the event status register.

```
...
OUTPUT #scpi, ":SYSTem:TIME?; :*ESR?"
INPUT #scpi, result$
```

The returned result string could be `"17,40,55;4"`, for example. This would denote a time of 5:40 PM and an event status register value of 4.

Example 3

In case, a query needs a parameter to be specified, this parameter is then placed behind the question mark. As with normal commands, there must be at least one blank between the question mark and the parameter:

```
...
OUTPUT #scpi, ":MEASure:GSM:ARRay:RFRX:BER:CIA? 2"
...
```

This command will perform the BER measurement on the class 1a bits twice and return both measurement results in a string. The string returned in this example is `"2.1,2.2"`.

Event handling – registers

Basically, measurements can be started and results can be read out using the MEASure and FETCh subsystems of the 4400. However, system events (like errors) could occur while those measurements are in progress and the measurement results read in could thus be invalid. Therefore, the 4400 is equipped with an event handling system. This system may be programmed by the user to raise an event on certain conditions. Using the programming features, the SCPI system of the 4400 will for instance generate an event in case an error occurs during the performance of the current command. Before the result string of a measurement is read out, it is a good idea to check the internal event registers of the 4400 first. Most frequently, this check is a look at the test set's service register. Bit 2 of this register will be set as soon as there is an error message in the error queue.

NOTE

To avoid confusion between the registers of the STATus subsystem and the much more general SCPI statusbyte, the latter is called the service register throughout this manual.

The programming of the event handling system is described in detail in subsection ["Understanding the STATus subsystem" on page 235](#). The use of the service register is outlined in subsection ["At the top: the service register" on page 237](#).

The scheme to use the registers for communication between a RAPID! program or the GPIB on one side and the 4400 on the other side always follows the following principles:

Step	RAPID!	GPIB
Preparing service register	:PROGram:SRE <i1>	*SRE <i1>
Set up a loop that waits for an event	DO... "read service register" ... LOOP	"SRQ"
Read service register	:PROGram:STB?	serial poll or *STB?

Section ["Programming examples" on page 228](#) shows some practical examples for the basic use of the register communication between SCPI and RAPID!.

Programming examples

In this subsection, you will find some application-oriented examples for RAPID! programs using SCPI on the 4400. These examples concentrate on the following topics:

- ["Standard TX measurements" on page 229](#)
- ["Message exchange" on page 230](#)
- ["Example of a GPIB protocol" on page 231](#)

Standard TX measurements

The example below illustrates how to perform a standard TX test using RAPID! and SCPI.

```

`FILE: RFTXDEMO.RBS
`DESCRIPTION: RAPID! program that measures
`the RMS phase error, the frequency,
`peak power and also checks whether the shape
`of the burst is within the PTT.

`Definition of variables
DIM result(5)

`Opening SCPI as communication port
LET scpi = freefile
OPEN "scpi" as #scpi

`Configuring the measurements as above as a group and
`starting a group measurement
PRINT #scpi, ":CONFigure:MEASure:GROUp:RFTX
PRMS,FREQuency,POWer,TEMPlate"
PRINT #scpi, ":MEASure:RFTX:GROUp?"

`Read out the result string
INPUT #scpi, result$

`Read out the service register to check if there was
`some error
PRINT #scpi, ":PROG:STB?"
INPUT #scpi, A$
A$ = BIN$(VAL(A$),8)

`Select reaction on event occurred
IF (MID$(A$,2,1) = "1" THEN
`Some error occurred
PRINT #scpi, ":SYST:ERR?"
INPUT #scpi, Err$
GOTO FAIL_EXIT
ELSE

`Measurements have been completed without errors
GOTO PRINT_RESULTS
END IF

`Result procedure of the program
PRINT_RESULTS:
`Converting the result string back into
`four result values
index = 0
result$ = result$ + ","
DO

```

```

' Find the position within result$, where the first
' comma appears
P = INSTR(result$, ",")
' Read out the part of result$ in front of the first
' comma and convert it into a numeric value
result(index) = VAL(LEFT$(result$, P - 1))
' Cut off the value just read from result$
result$ = MID$(result$, P + 1)
index = index + 1
LOOP UNTIL result$=""

IF result(3) = 0 THEN
A$ = "PASS"
ELSE
A$ = "FAIL"
END IF

'Print results
PRINT "RMS phase deviation :"; result(0)
PRINT "Frequency :"; result(1)
PRINT "Peak power :"; result(2)
PRINT "Burst shape:"; A$
GOTO OKAY_EXIT

'Entry point of any error handling routine
FAIL_EXIT:
PRINT "An error did occur during measurements :", Err$

'Ending the program
OKAY_EXIT:
END

```

Message exchange

This example demonstrates a message exchange between a RAPID! program and an external control computer (connected on the GPIB). The message exchange is triggered by events via the `SYSTEM:MESSAge` and the `PROGram:MESSAge` queue. Although not complete, the example below illustrates the principle.

NOTE

Only the core program code has been set in `courier` to make it easy to identify it. All comments are in 'normal' letters.

```

'FILE: MSGDEMO.RBS
'DESCRIPTION: RAPID! program to demonstrate message exchange between a
' RAPID! program and the controlling computer.

...

'Setting the mask for the service register: rising SRQ on an entry of a message
' into the message queue.
'Bits to set: SRQ (bit 6 = 64) and system.message (bit 0 = 1)
PRINT #0, "*SRE 65"

```

```
'Setting the mask for the program's service register: rising an event on an entry
' of a message. Bits to set: event (bit 6 = 64) and program.message (bit 0 = 1)
PRINT #0,":PROG:SRE 65"
```

```
DO
```

```
` Read out programm message queue
```

```
PRINT #0,":PROG:MESS?"
```

```
INPUT #0,message$
```

```
`Check message string for key letters
```

```
result$ = MID$(message$,1,2)
```

```
SELECT CASE result$
```

```
CASE "TX"
```

```
result$ = DoTXAlign(Message$)
```

```
CASE "RX"
```

```
result$ = DoRXAlign(Message$)
```

```
CASE "SP"
```

```
result$ = DoSPAlign(Message$)
```

```
CASE "AN"
```

```
result$ = DoAFANAlign(Message$)
```

```
CASE ELSE
```

```
result$=""
```

```
END SELECT
```

```
IF result$="" THEN PRINT #0,":SYST:MESS ";result$
```

```
LOOP
```

Example of a GPIB protocol

to/ from 4400	Data	Comment
to	:PROG:NAME MSG- DEMO.RBS	Load program
to	:PROG:STAT RUN	Start program on 4400
to	:PROG:MESS "TX, 1, 62, 124, -105"	Start (user-programmed) TX cali- bration process on 4400
from	SRQ	4400 raises service request after calibration
to	serial poll	Controller identifies SRQ device
from	SYST:MESS?	Controller queries system message
to	"TX Calibration OK"	4400 confirms successful TX cali- bration
from	:PROG:MESS "RX, 1, 62, 124, 15"	Start (user-programmed) RX cali- bration process on 4400

to/ from 4400	Data	Comment
	serial poll	Controller identifies SRQ device
to	SYST:MESS?	Controller queries system message
from	"RX Calibration OK"	4400 confirms successful RX cali- bration
to	:MEA- Sure:GSM:RFTX:ALL	Start relevant RFTX measurements
	serial poll	Controller identifies SRQ device
to	:CALC:GSM:RFTX :ALL:LIM:FAIL?	Controller queries the result of the limit check of the measurement result values
from	0,0,1,0,0,0,0,0, 0,0,0,0,0,0,0,0, 0,0,0	4400 delivers results

Command subsystem overview

This subsection provides information about the SCPI command subsystems.

[The Measurement subsystems](#) – MEASure, FETCh, CALCulate

[Measurement device configuration subsystems](#) – RFGenerator, RFSPectrum, RFANalyser, AFGenerator, AFANalyser, MS Power Supply

[The base station and mobile station parameter subsystems](#) – CONFigure, CALL

[The communication-related subsystems](#) – PROGram, STATus, SYSTem, FORMat

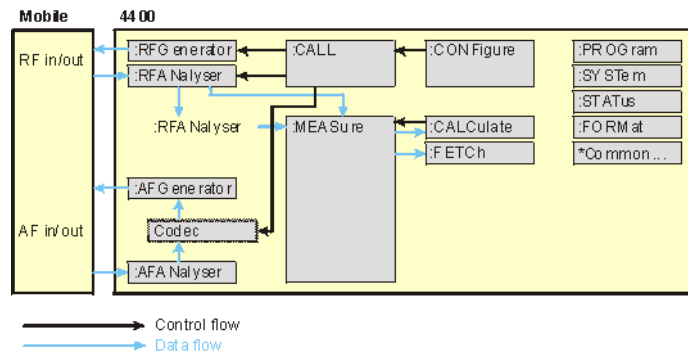
[SCPI command errors](#)

Using the SCPI commands

The various SCPI commands and their arguments/parameters are described below. Please note that any SCPI command specified with an invalid or without an argument required will be totally ignored by the system. This means that an incomplete SCPI command will not affect the current system status at all.

Schematic view of the subsystems of the 4400

This is a very simplified schematic view of the control and data flow inside the 4400.



Common commands

The common commands are understood by all SCPI and IEEE 488.2 instruments. Their purpose is to perform general tasks and to read or work with the registers common to all SCPI instruments. The following common commands have been implemented.

Command	Short description	Command group
: *CLS	Resets the entire status reporting system.	General common commands
: *ESE	Sets and queries the event status register mask.	Event status register
: *ESR?	Reads out the current contents of the event status register.	Event status register
: *IDN?	Returns device identity.	General common commands
: *OPC	Waits until previous command has been completed.	General common commands
: *RST	Resets the entire test set. All parameters, limits etc. will be set to internally predefined default values.	General common commands
: *SRE	Sets and queries service register mask.	Service register
: *STB?	Returns the current contents of the service register and clears the service register.	Service register
: *WAI	Waits until previous command has been completed.	General common commands

The communication-related subsystems

These subsystems cover system relevant tasks, which are not primarily involved in the measurement process.

SYSTEM – System parameters, such as the number of unread error messages, the test set's GPIB address etc. may be read out or set using the commands of this subsystem.

PROGRAM – This subsystem deals with all activities related to RAPID! programs.

STATUS – The STATUS subsystem controls and provides information on the state of the 4400. There are two types of states: operational states describe what is currently going on within the test set while questionable states deliver questionable states of the 4400.

FORMAT – The commands of this subsystem enable settings of the data output format in remote mode.

The SYSTEM subsystem

System parameters, such as the number of unread error messages, the test set's GPIB address etc. may be read out or set using the commands of this subsystem.

The STATUS subsystem

The STATUS subsystem delivers detailed information about the internal status of the 4400, its error conditions and special events. These three areas are dealt with in three different sections of the status subsystem. These three sections are addressed, using different commands.

Status Area	Related commands	Main functional aspects
Operation Status	STATUS:OPERation...	These commands deal with the operation status of the 4400. They describe what is currently going on inside the test set, mainly in respect of signaling and measuring.
System Errors	STATUS:QUESTionable...	This area of the internal status report system mainly deals with errors and warnings regarding the hardware stages of the 4400 (like 'RF input overload' or 'frequency out of range').
Execution Errors	*ESE, *ESR?	Mainly program or SCPI command execution errors are dealt with in this area of the internal status report system.

The status subsystem provides in-depth information about the internal status of the test set. Furthermore, powerful event processing tools allow any form of flexible control over the 4400.

However, the use of the status subsystem is a bit tricky because of the many parameters involved. Therefore, we kindly suggest to carefully read subsection ["Understanding the STATus subsystem" on page 235](#) before using the status subsystem.

A table of all registers implemented can be found in subsection ["Table of registers" on page 238](#).

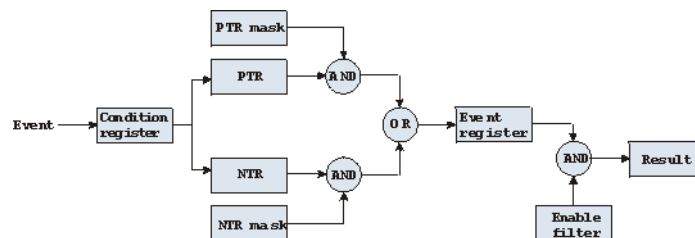
Understanding the STATus subsystem

The STATus subsystem is intended to deal with special events occurring inside the test set. It provides tools to enable any current condition to raise a system event. These system events may then be used to trigger service requests (SRQ) on GPIB, or to trigger RAPID! programs.

There are several **groups of registers**, structured in a hierarchical order. Lower-level registers work on specific conditions and single parameters while higher-level registers integrate the result of several lower-level registers and thus provide a more general view.

The highest level of these registers is the **service register**, sometimes also referred to as the **statusbyte register** or **status byte**.

The figure below gives an example of a group of registers.



A group of registers starts with a **Condition register**. An internal Event will set the corresponding bit of the Condition register (to 'set a bit' means a transition from binary 0 to a binary 1). Any Condition register will be updated continuously. This means that a bit will be reset as soon as the condition which rose that bit is no longer valid.

Example:

As soon as the 4400 starts to page a mobile under test, a certain bit of a certain condition register will be set. When the 4400 stops paging the mobile (because e.g. it responded to the paging requests), this bit will be reset. Now, there is no chance to find any evidence for a paging process in this Condition register.

Therefore, there is an **Event register** included in every group of registers. In the Event register, a bit will remain set even when the condition for it to be set is no longer valid. Any Event register, however, will be cleared after a query.

Example:

Continuing our example from above, in the related Event register, the corresponding bit would still be set. A query of this register would provide evidence that there has been some paging in progress. However, the Event register is not able to provide any information if the condition is still valid.

Summary 1: condition-type versus event-type registers

- The condition-type registers reflect the current status of the test set and is updated continuously. When you would like to know if a special condition is currently valid, then read out the related condition-type register with a query.
- The condition-type register and the event-type register have an identical structure. This means that they are of the same length and the single indicator bits are at the same positions.
- The event-type registers are the 'memory' of the status system. Once a bit has been set, it will remain set until the event-type register is read out with a query. When you want to trigger e.g. a RAPID! program with a certain event, always read out the related event-type register.
- Event-type registers are read-only and self-destructive. They will be cleared after any query.

Transition of a bit from the condition-type to the event-type register

How will a bit find its way to the Event register?

This depends on the transition filter and its settings. The transition filter works as follows:

First, there are two branches: the **Positive TRansition** and the **Negative TRansition** filter. Both only react on the corresponding transitions of bits and both contain as many bit positions as the condition register.

PTR will carry a binary 1 at a bit position only when the corresponding bit of the condition register is set, while **NTR** will carry a binary 1 at a bit position only when the corresponding bit of the condition register is reset.

Both the output of **PTR** and **NTR** will be combined with the corresponding mask, using a logical **AND** operation.

These masks are user-definable (using the **STAT:xxxx:xTR** commands) and again contain as many bit positions as the condition register.

Example:

The only chance for bit 4 (that has just been set in the condition register) to reach the Event register is that the **PTR mask** carries a binary 1 at bit position 4. The logical AND between the PTR filter and the PTR mask will then deliver a binary 1. This binary 1 will pass the logical OR and thus set bit 4 of the Event register.

Summary 2: from the condition-type to the event-type registers

- There are two detectors for every bit of a condition register: the **positive** transition and the **negative** transition branch. Positive transition means a change of a bit from a binary 0 to a binary 1 while a negative transition is a bit change from a binary 1 to a 0.
- To every branch, there is a filter mask (PTR and NTR mask). This filter mask is user-definable.
- The filter mask and the result of the transition filter are combined using a logical AND operation.
- The results of the AND operation in both branches will be combined, using a logical OR operation.
- The results of the OR operation are the contents of the related event-type register.

Moving up: an event reaches the condition register one hierarchical level up

The **Event register** contains summary bits, corresponding to the bits of the condition register. A summary bit will be set, when the initial event passes the transition filter.

The **Enable filter** is a mask to filter events that are allowed to move one level up. The Enable filter is user-definable (using the **STAT:xxxx:ENABLE** commands) and again contains as many bit positions as the condition-type register.

Again, the Enable filter mask is ANDed with the Event register and a nonzero result will finally set the **Result bit**. This Result bit may be a summary bit either in a higher-level register, or in the service register.

Summary 3: raising the Result bit

- The event-type register will be ANDed with the related Enable filter mask.
- The Enable filter mask is user-definable.
- The result of the logical AND operation between event-type register and related Enable filter will be the Result bit.
- The result bit will set the corresponding bit of the condition register one level up.

At the top: the service register

The **service register** contains eight summary bits: three for the status groups available on the 4400, two for internal queue handling, two for remote control and one bit for it's own status: the **summary status bit**.

When an event passes through and sets one of the seven corresponding summary bits of the service register, the contents of the service register will be ANDed with the service register mask. This mask can be set using the ***SRE** common command.

When the logical AND operation of the current contents of the service register and the service register mask leads to a binary 1, then the summary status bit will be set as well.

If both bit 6 of the service register mask and bit 6 (the summary status bit) of the service register are set, then a service request (SRQ) is executed.

Table of registers The STATUS subsystem uses and/or provides access the following registers:

Service register

This register represents the highest level within the report structure of the 4400. The service register contains eight bits. A detailed description of the service register can be found in the appendix (SCPI Command Reference).

Event status register group

This group of registers collects all general events of the 4400 (mostly command errors).

Depending of the setting of the event status register mask, bits set in the event status register may be transferred to bit 5 of the service register.

For further details regarding the event status register, please refer to the appendix (SCPI Command Reference).

General operation register group

This group of registers is 16 bits wide and reflects the general operation status of the 4400.

Some of the bits of this register (like bits 8 and 9) are summary bits. Those summary bits are result bits of subordinate groups of registers as described below.

NOTE

The commands related to the general operation register group and its subordinate groups of registers all start with **:STATUS:OPERation:**.

Bit	Decimal	Meaning
0	1	Set during calibration.
1	2	Set while settling.
2	4	Set while ranging.
3	8	Set while sweeping.
4	16	Set as long as any measurement is being carried through.
5	32	Set while the 4400 waits for a trigger.
6	64	Set while the 4400 waits for an arm.
7	128	Set while a correction process is in progress.
8	256	This is the SIGNaling summary bit. This is the Result bit of the signaling operation register group (see below for details).
9	512	This is the MEASure summary bit. This is the Result bit of the measuring operation register group (see below for details).

10	1024	Not in use.
11	2048	Not in use.
12	4096	Not in use.
13	8192	Instrument.
14	16384	Not in use.
15	32768	Not in use.

Signaling operation register group

This group of registers is 16 bits wide. Its main task is to deal with events related to the signaling status. The signaling operations depend on the system option and the contents of the signaling operation register group are detailed in the appendix.

The Result bit of this group of registers is forwarded to bit 8 of the general operation register group.

Measuring operation register group

This group of registers is 16 bits wide. Its main task is to deal with events related to the measurement status.

The Result bit of this group of registers is forwarded to bit 9 of the general operation register group.

Bit	Decimal	Meaning
0	1	Set while RFTX measurements are in progress.
1	2	Set while RFRX (BER) measurements are in progress.
2	4	Set while RFSPpectrum measurements are in progress.
3	8	Set while audio measurements are in progress.
4	16	Not in use.
5	32	Not in use.
6	64	Not in use.
7	128	Not in use.
8	256	Not in use.
9	512	Not in use.
10	1024	Not in use.
11	2048	Not in use.
12	4096	Not in use.
13	8192	Not in use.
14	16384	Not in use.
15	32768	Not in use.

General questionable status register group

This group of registers is 16 bits wide and reflects the general questionable status of the 4400. The events taken care of this group of registers are mainly errors and warnings.

Some of the bits of this register (like bits 9,10 and 11) are summary bits. Those summary bits are result bits of subordinate groups of registers and described below.

NOTE

The commands related to the general questionable status register group and its subordinate groups of registers all start with **:STATus:QUESTionable:**.

Bit	Decimal	Meaning
0	1	Voltage out of range. Not used on the 4400.
1	2	Current out of range. Not used on the 4400.
2	4	Time out of range. Not used on the 4400.
3	8	Power out of range. Not used on the 4400.
4	16	Temperature out of range. Not used on the 4400.
5	32	Frequency out of range. Not used on the 4400.
6	64	Phase out of range. Not used on the 4400.
7	128	Modulation out of range. Not used on the 4400.
8	256	Calibration out of range.
9	512	This is the RF summary bit. This is the Result bit of the RF questionable status register group (see below for details).
10	1024	This is the SYNChronization summary bit. This is the Result bit of the SNYChronization questionable status register group (see below for details).
11	2048	This is the AUDio summary bit. This is the Result bit of the AUDio questionable status register group (see below for details).
12	4096	Not in use.
13	8192	General warning, concerning the test set.
14	16384	Command not understood warning.
15	32768	Not in use.

RF questionable status register group

This group of registers is 16 bits wide. Its main task is to deal with warnings and errors regarding the RF stages of the 4400.

The Result bit of this group of registers is forwarded to bit 9 of the general questionable status register group.

Bit	Decimal	Meaning
0	1	Input overload. Reduce RF power immediately to avoid possible damage of the 4400's highly sensitive input stages!
1	2	Output level out of range.
2	4	Transmission frequency out of range.
3	8	Reception frequency out of range.
4...15		Not in use.

SYNChronization questionable status register group

This group of registers is 16 bits wide. Its main task is to deal with warnings and errors regarding the external synchronization of the 4400. The Result bit of this group of registers is forwarded to bit 10 of the general questionable status register group.

Bit	Decimal	Meaning
0	1	Set when an external RF synchronization signal is recognized on the EXT SNYC prog. socket.
1	2	Set when an external frame synchronization signal is recognized on the SNYC IN/OUT socket.
2...15		Not in use.

AUDio questionable status register group

This group of registers is 16 bits wide. Its main task is to deal with warnings and errors regarding the audio stages of the 4400. The Result bit of this group of registers is forwarded to bit 11 of the general questionable status register group.

Bit	Decimal	Meaning
0	1	Input overload. Reduce signal level immediately to avoid possible damage of the 4400's highly sensitive input stages!
1	2	Output level out of range.
2...15		Not in use.

The PROGRAM subsystem – overview

This subsystem contains commands related to loading and executing RAPID! program files.

The FORMat subsystem – overview

The FORMat subsystem sets and queries settings concerning the data output in remote mode.

The base station and mobile station parameter subsystems

These subsystems allow access to the base station parameters (i.e. the 4400 simulating a base station) and to the information received from the mobile under test like the measurement report. The commands of these subsystems are described here.

CONFigure – This subsystem incorporates all changeable BS parameters of all implemented communication systems.

NOTE

The settings made here directly affect all communication system-specific subsystems.

CALL – This subsystem handles call procedures and allows to read out the measurement report generated by the mobile under test. The information available is dependent on the current state of a call, i.e. some commands require an established radio communication link between the 4400 and the mobile under test.

The CONFigure subsystem

This subsystem incorporates all changeable parameters of all systems implemented. The key commands are the following:

CONFigure:CSYSstem	Selects the communications system to work with.
CONFigure:<SystemOption>:...	These commands select parameters within a communications system.
CONFigure:<SystemOption>:BS:...	These are the commands to set specific system parameters like the base station's RF output power level or its identity.
CONFigure:<SystemOption>:BER:...	These commands set the BER parameters.
CONFigure:<SystemOption>:GROup:...	With the help of these commands, groups of measurements may be defined.
CONFigure:COUPloss:...	These commands provide access to the coupling loss compensation feature of the 4400.

The CALL subsystem

This subsystem contains commands

- for call setup and handling procedures and
- to read out the measurement report, generated by the mobile.

The Measurement subsystems

The 4400 provides the following measurement subsystems:

The MEASure subsystem – This subsystem provides the commands for all kinds of measurements: Single-shot as well as series of measurements, measurements of single parameters as well as of groups of parameters.

The FETCh subsystem – To read out the latest measurement result of a specific parameter or a group of parameters.

NOTE

FETCh requires that a measurement is started first, using the MEASure commands.

NOTE

FETCh will neither start nor terminate continuous measurements.

The CALCulate Subsystem – All kinds of statistic evaluations and checks of measurement results against predefined limits.

The MEASure subsystem

The MEASure subsystem is probably the most important SCPI command subsystem of the 4400. There you will find all commands to acquire measurement results of the mobile under test.

Measurements can be taken as one-shot measurements or as series of measurements:

Type of measurement	Related command element	Short description
One-shot	[:CONTinuous]	Actually :CONT starts a measurement, that will be performed continuously. Single measurement results can be read out using the related :FETCh commands. Thus several measurements can be started (where those measurements are started first that take the longest time, like e.g. BER).
Series	:ARRay	This command element offers the possibility to carry through a specific measurement a certain number of times. All the single measurement result values can be read out with just one command. Using this feature, measurement results returned can then be used e.g. for statistic data evaluation on an external computer.

Example:

First a BER measurement command is issued to start a BER measurement (because it takes some time).

Then several RF TX measurements are performed and the measurement results are read out and used for statistic data evaluation.

After that the result of the BER measurement is read out.

Important notes:

- A newly issued RF TX MEASure command will terminate any RF TX or RF spectrum measurements currently in progress.
- A newly issued RF SPectrum MEASure command will terminate any RF TX or RF spectrum measurements currently in progress.
- A newly issued RF RX MEASure command will terminate any RF RX measurements currently in progress.
- A newly issued AF MEASure command will terminate any RF TX, RF RX, RF spectrum or AF measurements currently in progress.
- Measurements are always started, using the current system parameters and the current state of the 4400.
- In case the 4400 is in a state that does not allow a specific measurement command to be performed or completed, an error message will be added to the 4400's internal error queue. The related flag in [The STATus subsystem](#) will be set, too.
In case this is the first error message to appear within the error queue, the error indicator bit of the service register (bit 2) will be set as well.

:MEASure[:CONTInuous] MEASure commands that are stated with or without the optional :CONTInuous command element will make the 4400 perform the related measurement for an unlimited number of times.
The measurement will only be terminated if a new MEASure command of the same or related type is issued (see **Notes** above).

Syntax	:MEASure [:CONTInuous] < { :measProp } > [?]
Parameters	The one-shot measurements do not require any parameters.

Description	<p>Starts the (continuous) measurement of the specified measurable property. The <code>CONTInuous</code> command element is optional. Unless a measurement result is read out (using the <code>FETCh</code> subsystem), no measurement result values will be given back. The measurement result(s) of any measurement will be stored internally. Any previously stored result will be overwritten as soon as a new measurement result has been achieved. The latest result measured may be read out using the <code>FETCh</code> subsystem. Any <code>FETCh</code> command will wait for a measurement result value(s) to be available. In case there is more than one measurement result value, the single measurement result values are separated by commas (like e.g. "50.5,3.46"). Should the <code>FETCh</code> command fail to obtain a measurement result value (because e.g. the current state of the 4400 does not allow the measurement to be performed or completed), a timeout will occur and an error message will be added to the 4400's internal error queue. The related flag in the <code>STATus</code> subsystem will be set, too. In case this is the first error message to appear within the error queue, the error indicator bit of the service register (bit 2) will be set as well. The main application of the combination of the <code>MEAS</code> and the <code>FETC</code> subsystems: Starting a measurement that takes some time to deliver a measurement result back (e.g. the BER measurement. After the measurement has been started with the <code>MEAS</code> command, the test set 'is free' to perform other tasks. If in this case the query form of the <code>MEAS</code> command is used, the test set is blocked until a measurement result is available. Sometimes, measurement results will need to 'sweep in'. In this case, the first measurement result might be totally misleading. Using the <code>MEAS</code> command will allow the measurement result value to stabilize on a meaningful result before the latest result value is read out using the <code>FETC</code> subsystem.</p>
Query	<p>The query form of any <code>MEASure</code> command will start the (continuous) measurement of the specified measurable property. The <code>CONTInuous</code> command element is optional. After the first measurement has been completed, the measurement result value(s) will be delivered back in a string as outlined above. Should the query fail to obtain a measurement result value, a timeout will occur and an error message will be added to the 4400's internal error queue as explained above. The main application of the query form of a <code>MEAS</code> command is speed. When combined with 'fast' measurements (like e.g. the fast power level measurement), the query form of a <code>MEAS</code> command delivers measurement results as fast as possible. Note: The measurement started with the query form of the <code>MEAS</code> command will be continued in the background. Any further measurement result values may be read out, using the appropriate <code>FETCh</code> command.</p>

Examples

```
:MEASure:GSM:CONTinuous:RFTX:PPEAk and
:MEASure:GSM:RFTX:PPEAk
```

are identical. Either command will start the measurement of the peak phase error. The latest result of this measurement (like "5.84") will be stored internally. It will be overwritten as soon as a new measurement result has been achieved.

To read out the current measurement result, use the FETCh subsystem:

```
:FETCh:GSM:RFTX:PPEAk?
:MEASure:RFTX:ALL
```

This command will start the continuous measurement of all relevant RFTX parameters. After this command has been issued, you may continue with e.g. an RF RX MEASure command.

All 19 single measurement results will be stored internally. As soon as a new measurement result has been achieved, the previous value will be overwritten.

To read out the measurement results achieved by the :MEAS:RFTX:ALL command, use the :FETCh:GSM:RFTX:ALL? command.

```
:MEASure:GSM:RFTX:ALL?
```

As in the example above, the continuous measurement of all relevant RFTX parameters will be started. Unlike the example above, this command will wait until all 19 measurement results have been achieved and will return all of them in a string, separated by commas. The measurements will continue and later results may be read out, using the FETCh:GSM:RFTX:ALL? command.

How to convert a result string back into numeric variables

The example program below illustrates how the returned string can be converted back into numeric variables in a RAPID! program.

```
PRINT #scpi, ":MEAS:GSM:RFTX:ALL?"
INPUT #scpi, result$
index = 0
result$ = result$ + ","
```

```
DO
```

```
  ' Find the position within result$, where the first
  comma appears
```

```
  P = INSTR(result$, ",")
```

```
  ' Read out the part of result$ in front of the first
  comma and convert it into a numeric value
```

```
  result(index) = VAL(LEFT$(result$, P - 1))
```

```
  ' Cut off the value just read from result$
```

```
  result$ = MID$(result$, P + 1)
```

```
  index = index + 1
```

```
LOOP UNTIL result$=""
```

MEASure:ARRay

The :ARRay command element makes the 4400 perform any measurement property a user-definable number of times. All measurement result values obtained during the process will be stored in an internal array and can be read out using the related commands of the FETCh subsystem or will be returned in case the measurement process has been started using the query format of the command.

After the specified number of measurements have been performed, the measurement will be stopped and no further measurement result values will be stored

internally. Therefore, any attempt to read out data again (unless any measurement has been started before) will result in a timeout and thus in an error message.

This is one of the main differences between the [:CONTInuous] and the :ARRay command element.

Note: Any measurement will be terminated if a new MEASure command of the same or related type is issued (see Notes in section "The MEASure subsystem" on page 243 for details).

Syntax	MEASure:ARRay<{ :measProp }>[?] <numMeas>
Parameters	numMeas is the number of measurements to be performed.
Description	<p>Takes a numMeas number of measurements of the specified type measProp. The results of the single measurements will be stored in an internal array. The measurement results array can be read out using the related command of the FETCh subsystem (see examples below for reference).</p> <p>After an array has been read out using the related FETCh command, the internal array will be cleared. Any subsequent FETCh command trying to read out the same measurement result array will not be able to read any measurement results and thus result in a timeout. In this case, an error message will be added to the 4400's internal error queue (for further details, refer to section ":MEASure[:CONTInuous]" on page 244).</p>
Query	<p>The query form of any MEAS:ARR command will start the related measurement the specified number of times. After the number of measurements specified have been performed, the measurement will be stopped.</p> <p>The query will then return a string containing all the measurement results. The single result values will be separated by commas.</p> <p>Any subsequent FETCh command trying to read out the same measurement result array will not be able to read any measurement results and thus result in a timeout. In this case, an error message will be added to the 4400's internal error queue (for further details, refer to section ":MEASure[:CONTInuous]" on page 244).</p>
Examples	<pre>:MEASure:GSM:ARRay:RFTX:PPEAK 10</pre> <p>This command will make the 4400 perform 10 independent measurements of the maximum phase error in GSM.</p> <p>After those 10 results have been achieved, the measurement will be stopped. The ten result values will be stored in an internal array.</p> <p>To read out the measurement result array, use the FETCh subsystem:</p> <pre>:FETCh:GSM:RFTX:PPEAK?</pre> <p>will return the 10 values in one string (like "5.42,5.44,5.80,...5.72,5.64")</p> <p>Any subsequent :FETCh:GSM:RFTX:PPEAK? command will result in a timeout.</p> <pre>MEASure:GSM:ARRay:RFTX:ALL? 2</pre> <p>This command takes all relevant RFTX measurements twice. The measurements will be stopped as soon as the 2 x 19 result values are available.</p> <p>The 38 result values will be returned as a string; the single values will be separated by commas.</p> <p>Any subsequent :FETCh:GSM:RFTX:PPEAK? command will result in a timeout.</p>

How to convert a result string back into numeric variables

The example program below illustrates how the returned string can be converted back into numeric variables in a RAPID! program.

```
PRINT #scpi, ":MEAS:GSM:ARR:RFTX:ALL? 2"  
INPUT #scpi, result$  
index = 0  
result$ = result$ + ","  
  
DO  
  
  ' Find the position within result$, where the first  
  comma appears  
  P = INSTR(result$, ",")  
  ' Read out the part of result$ in front of the first  
  comma and convert it into a numeric value  
  result(index) = VAL(LEFT$(result$, P - 1))  
  ' Cut off the value just read from result$  
  result$ = MID$(result$, P + 1)  
  index = index + 1  
  
LOOP UNTIL result$=""
```

:MEAS[:CONT]:BLOCKdata

The `BLOCKdata` command element of this subsystem is used to read out all the single measurement results necessary to generate the following result graphics:

- shape of the TX burst (burst received by the 4400 from the mobile)
- phase error
- modulation spectrum of burst received by the 4400 from the mobile
- AF spectrum (the audio spectrum)

:MEASure:BLOCKdata:BURStshape

This command starts a continuous measurement of the mobile's burst. The corresponding result string (to be read out either with the query form of the command or with `:FETCh:BLOCKdata:BURStshape` will contain 711 floating point real numbers, representing the measurement result values. The numbers will only have one digit behind the dot. The single measurement result values are separated by commas.

The meaning of the single values within the result string is as follows:

- The first two values are necessary for the scaling of the data. All remaining 709 values represent the measurement results.
- The first value (index = 0) gives the offset of the middle of the burst (bit 73) in respect to the measurement result array.
Example: An offset of 353.0 means that the middle of the burst will be the 355th value within the array (or the value contained at index 354).
- The second value (index = 1) gives the peak power level of the burst in dBm.
- All following values (indices 2 to 710) give the RF power levels of the related positions.

The resolution on the time axis is approx. 0.875 microseconds (i.e. the distance in time between two consecutive measurement points).

:MEASure:BLOCKdata:PHASerror

First, a continuous measurement of the mobile's phase error will be started. The corresponding result string (to be read out either with the query form of the command or with `:FETCh:BLOCKdata:PHASerror` will contain 711 floating point numbers, representing the measurement result values. The single measurement result values are separated by commas. The meaning of the single values within the result string is as follows:

- The first two values are necessary for the scaling of the data. All remaining 709 values represent the measurement results.
- The first value (index = 0) gives the offset of the middle of the burst (bit 73) in respect to the measurement result array.
Example An offset of `353.0` means that the middle of the burst will be the 355th value within the array (or the value contained at index 354).
- The second value (index = 1) is always set to `0.0`.
- All following values (indices 2 to 710) give the phase error of the related positions.

The time resolution is approx. 0.25 bit period (i.e. four measurement results per bit period).

:MEAS:BLOC:MSP[:CURRent]

This command starts a continuous measurement of the modulation spectrum of the mobile's burst.

The corresponding result string (to be read out either with the query form of the command or with `FETCh:BLOCKdata:MSPpectrum` will contain floating point real numbers, representing the measurement result values. The single measurement result values are separated by commas.

The number of the measurement result values returned is dependent on the span and resolution, set with the commands `:RFSPpectrum:MSPpectrum:SPAN` and `:RFSPpectrum:MSPpectrum:RESolution`.

:MEASure:BLOCKdata:MSPpectrum:AVG

This command starts the measurement of the modulation spectrum of the mobile's burst for a user-definable number of times and averages the measurement results.

The corresponding result string (to be read out either with the query form of the command or with `FETCh:BLOCKdata:MSPpectrum` will contain floating point real numbers, representing the measurement result values. The single measurement result values are separated by commas.

The number of the measurement result values returned is dependent on the span and resolution, set with the commands `:RFSPpectrum:MSPpectrum:SPAN` and `:RFSPpectrum:MSPpectrum:RESolution`.

:MEASure:BLOCKdata:AFSPpectrum

This command starts a continuous measurement of the audio spectrum. The corresponding result string (to be read out either with the query form of the command or with `FETCh:BLOCKdata:AFSPpectrum` will contain floating point real numbers, representing the measurement result values. The single measurement result values are separated by commas. The number of the measurement result values returned is dependent on the span and resolution.

NOTE

Audio measurements can only be performed on the 4400 when the Audio Option is installed.

:MEASure:....:GROup

As mentioned before (see Notes in section “The MEASure subsystem” on page 243), a new measurement will always terminate a preceding one of the same or related type.

Therefore, the GROup command element has been implemented in the SCPI command set of the 4400. This command element allows to specify a user-definable list of measurements that can then be started with one command. The measurement results can be read out using the query form of this command – or with the related command of the FETCh subsystem..

NOTE

In this respect, :MEAS:RFTX:ALL can be regarded as a predefined ‘group’, containing all important RFTX measurements.

NOTE

The AFANalyser subsystem also allows to define ‘groups’. However, all commands of the AFANalyser subsystem will only obtain measurement results if the Audio Option has been installed.

Syntax	:CONFigure:MEASure:GROup[:RFTX] <{RFTXprop}> MEASure[:CONTInuous]:RFTX:GROup or MEASure:ARRAy:RFTX:GROup or :CONFigure:MEASure:GROup:AFANalyser <{AFANprop}> MEASure[:CONTInuous]:AFANalyser:GROup or MEASure:ARRAy:AFANalyser:GROup
Parameters	<{RFTXprop}> is one or more of the single RFTX measurements PPEAK, PRMS, FREQUency, LENGth, UTIME, POWer, TEMPLate, CORNER, FLATness <{AFANprop}> is one or more of the single AF Analyser measurements SINad, DISTortion, FREQUency, ACV:PEAKp, ACV:RMS, DCV:RMS
Description	Starting a ‘group’ measurement will take all measurements specified just with one single command. After the group command has been completed, all ‘group’ measurement results are available at the same time and can be read out using either the query form of the command or the related commands of the FETCh subsystem.
Example	:CONF:GSM:MEAS:GRO:RFTX PPEAK, FREQUency, POWer, LENGth :MEAS:RFTX:GRO This sequence of commands first defines a group of RFTX measurements and then issues a group command. As soon as all the measurements specified in the group command have been completed, the measurement result values can be read out using the :FETCh:GSM:RFTX:GRO? command.

The FETCh subsystem

The FETCh subsystem enables you to read out the currently valid measurement result value(s) of a measurement.

Important notes

- Before a measurement value may be read out with commands of the FETCh subsystem, a MEASure command has to be issued first.
- After a continuous measurement has been started, the latest measurement result value can be obtained using the related **:FETCh** command.
- In case an array measurement has been started, the related **:FETCh** command will return the entire measurement result array.
- If there are no measurement results to be read out by a **FETCh** command for any reason, a timeout will occur. The wait time until a timeout occurs is dependent on the type of measurement to be performed (see below).
- If the preceding **MEASure** command and the **FETCh** command do not match, a timeout will occur.
- When you use the query form of any **MEASure** command, all measurement results obtained will be handed back and the internal result register will be cleared afterwards. Consequently, a subsequent **FETCh** command will lead to a timeout (as above).
- The following timeouts have been implemented:
 - 5 s for all RFTX measurements
 - 30 s for all RFRX measurements
 - 10 s for all RFSpectrum measurements
 - 10 s for all AF measurements

There are two versions of a FETCh command:

- The **:FETCh:LAST?** command will read out the latest result of the last MEASurement command issued - whatever command that was. Using this command, please keep in mind that your control program then has to take care of the number and format of the measurement result values returned.
- The **:FETCh:{measProp};** commands will read out the latest result of the measurement specified with **{measProp}**.

FETCh:LAST

The **:FETCh:LAST?** command will read out the latest result of the last MEASurement command issued - whatever command that was. Using this command, please keep in mind that your control program then has to take care of the number and format of the measurement result values returned. To convert a result string back into single measurement result values, please refer to section ["How to convert a result string back into numeric variables" on page 246](#).

Syntax	FETCh:LAST?
Description	Returns a string, containing the latest measurement result(s) for the MEASure command issued last. Format and number of the measurement result values contained in the string are depending on the preceding MEASure command.
Examples	MEASure:GSM:RFTX:PPEAk FETCh:LAST? will return the latest result (e.g. 5.84). MEASure:GSM:ARRay:RFTX:PPEAk 5 FETCh:LAST? will return the entire array (e.g. 5.84,5.81,5.94,5.74,5.79). MEASure:GSM:ARRay:RFTX:PPEAk? 5 FETCh:LAST? In this case, a timeout will occur as the :MEAS query will return the entire array and there will be no measurement result values for the :FETCh command to collect.

FETCh:BLockdata:...? The commands with the **:BLockdata** command element are used to read out all the single measurement results necessary to generate the following result graphics:

- shape of the TX burst (burst received by the 4400 from the mobile)
- phase error
- modulation spectrum of burst received by the 4400 from the mobile)
- AF spectrum (the audio spectrum)

FETCh<{:measProp}> The **:FETCh<{:measProp}>** commands will read out the latest result of the measurement specified with **measProp**.

Syntax	FETCh<{:measProp}>?
Description	Returns a string, containing the last measurement result(s) obtained for measProp .

Examples

MEASure:GSM:RFTX:ALL

The result of this command will be that the 4400 continuously measures all RFTX parameters.

To read out the 19 measurement result values, use the

FETCh:GSM:RFTX:ALL?

command. It will deliver back all measurement results contained in a string. This command may be used repeatedly (as long as the corresponding **MEASure** command was not terminated by another **MEASure** command).

MEASure:GSM:ARRay:RFTX:PPEAk 10

This command will start the measurement of the peak phase error. As soon as 10 measurement results have been obtained, the measurements will be stopped.

To read out the 10 measurement results, use the

FETCh:GSM:RFTX:PPEAk?

The string delivered back contains the 10 measurement results, starting from the first one (the oldest).

MEASure:GSM:ARRay:RFTX:PPEAk? 10

Unlike the example above, this command will start the measurement of the peak phase error. As soon as 10 measurement results have been obtained, those results will be given back in a string and the measurements will be stopped.

Any

FETCh:GSM:RFTX:PPEAk?

command will lead to a timeout as there are no new measurement results to be collected.

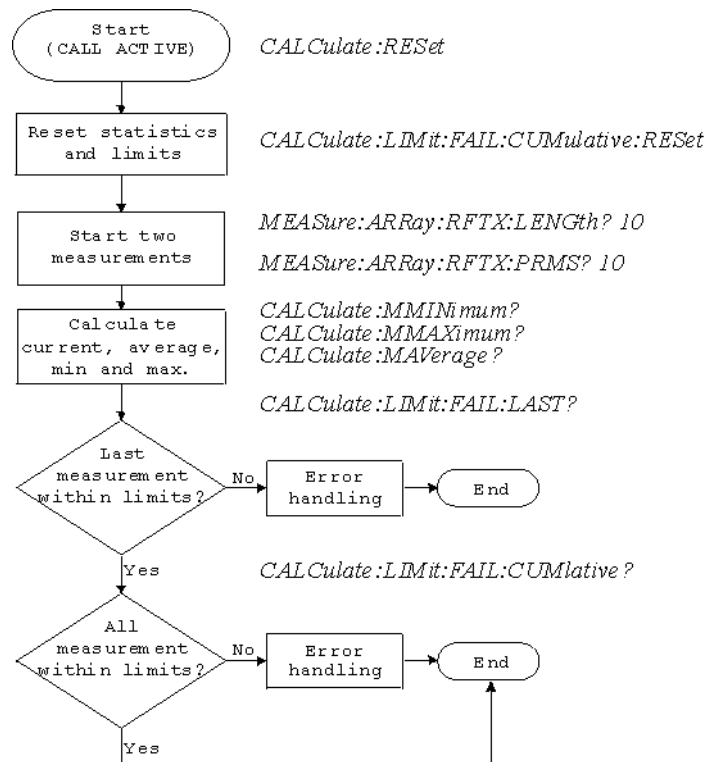
The CALCulate Subsystem

The CALCulate subsystem performs statistic evaluation of measurement results and also allows to check results against user-definable limits.

The basic scheme outlined below gives an idea of how to work with the CALCulate subsystem and to use the single queries as branching decisions within a program flow.

NOTE

Statistic evaluations on measurable properties like average, minimum or maximum will only be performed on the type of measurement started last (i.e. the **PRMS** measurement in the example below).



Reading the basic scheme

- First, the limits of the measurements to be performed are set (not shown in the basic scheme).
- After a call has been established, the CALCulate subsystem is reset using the **:CALCulate:RESet** command. Only measurements started after this command will be taken into account for the statistic evaluation. Any results from previously started (and still running) measurements will be ignored as well as all existing measurement results.
- The CALCulate subsystem of the 4400 allows to perform a cumulative check of the measurement results of a measurement. This means that all measurement results obtained (since the last reset of this part of the subsystem) will be checked against the corresponding limits. This cumulative check is reset as well in the example shown above with the **:CALCulate:LIMit:FAIL:CUMulative:RESet** command. For further details, check with section "[CALCulate:LIMit](#)" on page 255.
- Then, two measurements are started in this example (commands **:MEASure:ARRay:RFTX:LENGth? 10** and **:MEASure:ARRay:RFTX:PRMS? 10**).
- As soon as the measurements have been completed, the CALCulate subsystem is used to identify the minimum and maximum measurement result value and to calculate the average measurement result value. Please note that these commands will work **only** on the results of the measurement started last (the RMS-valued phase error in this example).
- The command **:CALCulate:LIMit:FAIL:LAST?** will return a boolean number, indicating whether the last measurement of the RMS-valued phase error was within the limits set (then a **0** will be returned) or whether it was off the limits (then a **1** will be returned.)

- The last command (**:CALCulate:LIMit:FAIL:CUMulative?**) is similar to the one above, with the main difference that this query will tell whether **all** measurements of the RMS-valued phase error taken since the last reset of the cumulative check are within the limits set (then a **0** will be returned) or whether at least one measurement result value did violate at least one of the user-definable limits (in this case, the query will deliver back a **1**).

CALCulate:LIMit The **CALCulate** commands that incorporate the **LIMit** command element

- check whether one or more measurement result(s) did violate the user-definable limits
- reset the cumulative limit evaluation system
- switch the limit evaluation system for specific measurements on or off
- set the limits

FAIL[:LAST]? - did the latest measurement result value fail?

Syntax	:CALCulate:LIMit:FAIL[:LAST]?
Returns	0 when the limits were not violated or 1 in case at least one limit was violated by the latest measurement result value.
Description	Checks whether the latest measurement result value of the measurement started last is within its limits.
Examples	<p>:MEAS:GSM:ARR:RFTX:LENG :MEAS:GSM:ARR:RFTX:PRMS :CALC:GSM:LIM:FAIL:LAST?</p> <p>This command of the CALCulate subsystem will check whether the latest measurement result value of the PRMS measurement is within its limits.</p> <p>:MEAS:GSM:ARR:RFTX:LENG 10 :CALC:GSM:LIM:FAIL:LAST?</p> <p>In this example, the :CALC command will check if all 10 measurement result values of the burst length measurement array are within their limits.</p>

{measProp}:LIMit[:FAIL] - did the latest measurement result value of a specific measurement fail?

Syntax	:CALCulate:{measProp}:LIMit[:FAIL]?
Returns	0 when the limits were not violated or 1 in case at least one limit was violated by the latest measurement result value.
Description	<p>Checks whether measurement result values of the measurement specified with the {measProp} command element are within their limits.</p> <p>In case, this command is used during a continuous measurement, only the latest measurement result will be checked.</p> <p>When this command is used subsequent to an array measurement, all measurement result values of the array will be checked against the limits. This means that a 1 will be returned if a single measurement result of an array is off the limits.</p>

Example	<pre> :MEAS:GSM:ARR:RFTX:LENG 10 :MEAS:GSM:ARR:RFTX:PRMS 10 :CALC:GSM:RFTX:LENG:LIM:FAIL? </pre> <p>In this example, the <code>:CALC</code> command will check whether all 10 measurement result values of the <code>LENG</code> measurement array are within their limits.</p>
----------------	---

FAIL:CUMulative? – did any measurement result value fail?

Syntax	<code>CALCulate:LIMit:FAIL:CUMulative?</code>
Returns	0 when the limits were not violated or 1 in case at least one limit was violated by at least one measurement result value.
Description	Checks whether all measurement result values of the measurement started last are within their limits.
Example	<pre> :MEAS:GSM:ARR:RFTX:LENG 10 :MEAS:GSM:ARR:RFTX:PRMS 10 :CALC:GSM:LIM:FAIL:CUM? </pre> <p>This command of the <code>CALCulate</code> subsystem will check whether all measurement result values of the <code>PRMS</code> measurement are within their limits.</p>

FAIL:CUM:RESet – resets the cumulative limit evaluation

Syntax	<code>CALCulate:LIMit:FAIL:CUMulative:RESet</code>
Description	Resets (clears) the cumulative check of measurement result values against their limits. Only the measurement results from <code>:MEAS:...</code> commands issued subsequent to this reset command will be taken into account for any limit checks.

{measProp}:LIMit:STATe – switches the limit check for a specific measurement on or off

Syntax	<code>CALCulate:{measProp}:LIMit:STATe</code>
Description	Switches the limit check for a measurement specified with the <code>{measProp}</code> command element either ON or OFF .
Example	<pre> :CALC:RFTX:ALL:LIM:STAT OFF </pre> <p>Switches the limit check for the 19 main RF TX measurements off.</p>

{measProp}:LIMit:UPPer[:DATA] – sets the upper limit for a specific measurement

Syntax	<code>CALCulate:{measProp}:LIMit:UPPer[:DATA]</code>
Description	Sets the upper limit for the limit check of the measurement specified with the <code>{measProp}</code> ; command element. The upper limit is the maximum measurement result allowed. Any measurement result value exceeding the value set with this command will result in a violation of the upper limit.

Example	:CALC:GSM:RFTX:PRMS:LIM:UPP 10.0 This command sets the maximum RMS-valued phase error allowed to 10.0 . Any measurement result value exceeding this limit (e.g. 10.01) will result in a violation of the limits of the RMS-valued phase error measurement.
----------------	---

:{measProp}:LIMit:LOWer[:DATA] – sets the lower limit for a specific measurement

Syntax	CALCulate: {measProp}:LIMit:LOWer[:DATA]
Description	Sets the lower limit for the limit check of the measurement specified with the {measProp}; command element. The lower limit is the minimum measurement result allowed. Any measurement result value falling below the value set with this command will result in a violation of the lower limit.
Example	:CALC:AFAN:SIN:LIM:LOW 25.5 This command sets the minimum SINAD required in order to pass the test to 25.5 . Any measurement result value falling below this limit (e.g. 25.4) will result in a violation of the limits of the RMS-valued phase error measurement.

CALCulate:{Statistics} On the results of the last measurement performed, statistic test evaluation can be used. The related commands are described in this section.

NOTE

The commands described in this section will be reset with any new **MEASure** command. Therefore, the commands described below will only deliver the statistic evaluation of the measurement started last.

Syntax	CALCulate:{Statistics}?
Parameters	{Statistics} is one command element out of the following list: MAverage MMAximum MMINimum
Returns	A floating point real number representing the result of the related statistic evaluation, performed on all available results of the measurement started last.
Description	Calculates and returns the specified statistical property referring to the most recent measurement.
Examples	MEASure:GSM:ARRay:RFTX:ALL 10 MEASure:GSM:ARRay:RFTX:PPEAk 10 CALCulate:GSM:MMINimum? The first command takes 10 measurements of all RFTX parameters (190 then all together); the second one takes ten measurements of the peak phase error. The CALC:MMIN? command will only deliver back the minimum result of the peak phase error measurement as this was the measurement started last. The value delivered back in the result string is "5.05" in this example.

Using limits The question 'do the performance characteristics of a mobile stay within the limits set by the appropriate specifications' is the core question of all GSM testing. The **LIMit** subsystem of the 4400 offers a broad range of:

- defining single or complex limits, using the **[:DATA]** command element of the **CALCulate** subsystem and
- reading out the results of the limit checks, using the **:LIMit[:FAIL]?** query.

The limit evaluation system can be switched on or off for every single measurement parameter using the **:LIMit:STATe** command element.

[:DATA] - customize or query limits

Syntax	<code>CALCulate<{measProp}>:LIMit<{limType}>[:DATA] <Val></code>
Parameters	limType is a placeholder for :UPPER or :LOWER . Val is the numeric value (floating) for the limit of the specific measurement parameter.
Description	Sets or queries the limit value(s) for the limit identified with limType . The limit evaluation will check the measurement results obtained against the limits set, using this command. Note: Some measurement types have more complex limits (such as the power/time template or the modulation spectrum). Please find a detailed explanation on those complex limits in subsection "Working with complex limits" on page 259 .
Examples	:CALCulate:GSM:RFTX:PRMS:LIMit:UPPER:DATA 4.00 Sets the upper limit of the RMS phase error to 4.00 . :CALC:GSM:RFTX:PPEA:LIM:UPP? Queries the currently set upper result limit for the peak phase error. The value will be returned as floating in the result string like 6.35 .

[:FAIL]? - pass/fail result query

Syntax	<code>CALCulate<{measProp}>:LIMit[:FAIL]?</code>
Returns	A boolean value or array (dependent on the type of measurement as defined by measProp). When all measurements of a type are within the limits, a 0 (pass) will be returned. If at least one measurement result is beyond the limits, a 1 (fail) will be returned.
Description	Checks whether any of the current measurement(s) failed to meet the limits. The type of measurement is defined by measProp .
Examples	MEASure:GSM:ARRAY:RFTX:POWer 10 Starts a series of 10 measurements of the RF peak power. CALCulate:GSM:RFTX:POWer:LIMit:FAIL? This command reads out the result of the 10 measurements checked against the limit. When all 10 measurement results are within the limits, a single 0 will be returned. If one or more measurement results are beyond the limits, a single 1 will be returned.

:STATe - switch limit evaluation on/off

Syntax	<code>CALCulate<{measProp}>:LIMit:STATe <limState></code>
Parameters	limState is either ON or OFF .

Description	<p>Activates or deactivates the check of the measurement results against the limit of the measurement type defined by measProp.</p> <p>Note: When the limit evaluation has been switched off, a :FAIL query will only return 0(s) (pass).</p>
Example	<p>CALCulate:GSM:RFTX:PRMS:LIMit:STATe OFF This command switches the limit evaluation of the RMS phase error off.</p> <p>MEASure:GSM:RFTX:PRMS Starts a series of RMS phase error measurements.</p> <p>CALCulate:GSM:RFTX:PRMS:LIMit:FAIL? This query of the pass/fail evaluation will always return 0 (pass) as the limit evaluation of this parameter has been switched off.</p>

Working with complex limits

It is not possible to define all relevant limits by just one number. Some limits are quite complex, like the power/time template, the corner points or the modulation spectrum.

Limits for the power/time template

The limits for the power/time template are made up by a total of 16 vectors; 9 for the upper limits and 7 for the lower limits.

These vectors have the following format: x,y.

- where x is the time in microseconds in relation to the beginning of the burst (i.e. the first bit of the useful part)
- and y is the RF power level in dB(c) in relation to the nominal output power level of the mobile.

Examples:

```
CALC:RFTX:TEMP:LIM:UPP -42,-47,-28,-47,-18,-28,-10,
-4,0,4, 552.8,1,560.8,-4,570.8,-28,580,-47
```

```
CALC:RFTX:TEMP:LIM:LOW 0,-150,0,-150,0,-40,20,
-1,270,-1,543,-1,543,-150
```

Limits for the corner points

The corner points are a maximum of eight positions to check critical parts of the burst. For each position, a minimum and a maximum RF power level may be specified.

- Positions are specified in microseconds in relation to the beginning of the burst (i.e. the first bit of the useful part)
- minimum and maximum RF power levels are specified in dB(c) in relation to the nominal output power level of the mobile.

Examples:

```
CALC:RFTX:CORN:POS -28,-18,-10,0,542.8,
552.8,560.8,570.8
```

```
CALC:RFTX:CORN:LIM:LOW -150,-150,-150,-150,
-150,-150,-150,-150
```

```
CALC:RFTX:CORN:LIM:UPP 4,4,4,4,4,4,4,4
```

Limits for the modulation spectrum

In case of the modulation spectrum, 23 positions (i.e. frequencies) have been predefined (see subsection Generator/Analyser for details).
With the related commands, the upper and lower limits for those 23 positions may be set. Those limits are specified in dB.

Measurement device configuration subsystems

These subsystems provide commands for setting and reading out the states of the various measurement devices of the 4400.
The following subsystems are available and described in this subsection.

RF measurement devices

RFGenerator – The radio frequency generator provides both continuous signals and bursts according to the specifications of the system (e.g. GSM) currently set. The RFGenerator subsystem controls the accessible parameters of the RF generator, such as RF level, frequency etc.

RFAnalyser – This subsystem gives access to the setup parameters of the RF Analyser, such as frequency or trigger mode.

RFSPpectrum – The commands of this subsystem are used to set span and resolution of the RF spectrum analyser.

AF measurement devices

AFGenerator – The audio frequency generator provides signals for audio measurements. The AFGenerator subsystem controls the accessible parameters of the AF generator, such as output level, frequency, multitone signals etc.

AFAnalyzer – The AF analyzer measures audio parameters. The related subsystem gives access to the settings.

MS Power Supply – The MS power supply option is an (optional) external device that simulates the power supply (battery) of a mobile under test. Together with the 4400, it provides a lot of interesting performance data of the mobile station. The related subsystem gives access to all relevant settings.

The RFGenerator subsystem

The RFG subsystem controls the accessible parameters of the RF generator.

Important notes:

- The RF generator can only be used if all communication systems have been switched off (and unloaded) before.

- The RF generator functionality of the 4400 will enable you to even provide a base channel to allow the mobile under test to synchronize to the base station. However, as long as the RF generator is active, there will be **no call setup and no reaction to signaling**.
Some of the data transmitted by the 4400 in the base channel can be set or altered using the SCPI commands described in section "[The CONFigure subsystem](#)" on page 242.
- A good way to set up the 4400 as a RF generator for **circuit-switched standard GSM** signals is the use of the **:CONFigure:CSYSTEM GCGenana** command.
While working in this mode, a base channel will **not** be provided.
- To set up the 4400 as a RF generator for **both packet-switched and circuit-switched GSM** signals, use the **:CONFigure:CSYSTEM GPGenana** command instead.
In this mode, a base channel can be provided (see command **:RFG:GSM:MOD:CHAN** for details).

The RFANalyser subsystem The RFAN subsystem controls the accessible parameters of the RF analyzer.

The RFSpectrum subsystem The RFSP subsystem controls the accessible parameters of the RF modulation spectrum analyzer.

The AFGenerator subsystem The AFG subsystem controls the accessible parameters of the audio generator. Please note that all commands of this subsystem require the Audio Option to be installed on your 4400.

The AFANalyser subsystem The AFAN subsystem controls the accessible parameters of the AF analyzer. Please note that all commands of this subsystem require the Audio Option to be installed on your 4400.

The MS Power Supply subsystem The PSUPply subsystem controls the accessible parameters of the MS Power Supply Option.

SCPI command errors

This subsection contains a table of SCPI command errors.

NOTE

If a query for an error code returns "0" then no error did occur.

Error Code	Meaning
61	QNX semaphore error. The operating system of the 4400 encountered a flag communication error.
62	TMSG QNX send error.
63	TMSG QNX sync error.
64	Internal communication error.
65	Unknown message received.
66	GPIB cannot be initialized.
67	This command is invalid.
68	Internal error of the task state system.
69	Error of the GPIB system.
70	QNX proxy error.
71	Process coordination error.
72	Message sent to the GPIB system is not understood there.
75	Error within the error message system.
78	Language expression invalid.
80	Name attachment error.
81	Proxy attachment error.
82	Proxy detach error.
83	Timer attachment error.
85	Timer delete error.
86	Parameter can not be set.
87	INI file error.
88	The file selected was not found.
89	DSP setup error.
100	Command error.
101	Invalid character.
102	Syntax error.
103	Invalid separator.
104	Data type error.
108	Parameter not allowed.
109	Parameter missing.
111	Header separator error.
112	Program mnemonic too long.
113	Undefined header.

114	Header suffix out of range.
121	Invalid character within a number.
123	Exponent too large.
128	Numeric data not allowed in this context.
131	Invalid suffix.
134	Suffix too long.
138	No suffix allowed in this context.
141	Invalid character data.
144	Character data too long.
158	No string allowed in this context.
160	Block data error.
168	No block data allowed in this context.
200	General execution error.
201	Multislot not active.
202	The external synchronization frequency is not within the ranges specified.
203	External synchronization changed during remote operation.
204	The operation is not possible in the current state of the 4400.
221	Settings of the 4400 lead to a conflict.
222	Data out of range.
225	No communication system running.
226	Timeout occurred while waiting for an uplink message to arrive from the mobile.
227	Layers 2/3 failed. Communication could not be established due to problems on the layer 2 and/or layer 3 level.
228	Mobile can not work in the enhanced frequency range.
229	No call release while an SMS is in progress.
230	Generator/Analyzer not running.
231	System running – no system expected.
250	Mass storage error.
253	Corrupt media.
256	File name not found.
272	Macro execution error.
280	Program error.
310	System error.

320	Save/recall memory lost.
330	Function not supported.
350	Queue overflow.
362	There needs to be an active call in order to start the codec option.
364	No audio hardware. The audio option would be required to complete a command, but it is not installed.
365	No codec hardware. The codec option would be required to complete a command, but it is not installed.
370	No results available.
371	Fetch: timeout occurred.
372	Fetch: no BER synchronization.
373	Fetch: arb data.
374	Measurement task error.
375	Error in burst data encountered.
376	ACPM receive error.
377	Autotemplate error.
378	Setting value for modulation spectrum out of range.
399	Invalid error code.
401	General CDMA measurement error: Invalid return code for sample acquisition.
402	CDMA Measurement error: Signal level too high for current input attenuation.
403	CDMA Measurement error: Signal level dropped below valid level during acquisition.
407	CDMA Measurement error: Sample acquisition RAM failure.
408	CDMA Measurement error: Signal level below minimum accuracy specification.
411	CDMA Measurement error: DSP EEPROM error. Default correction data loaded, measurement accuracy not verified.
413	CDMA Measurement error: synchronization to mobile signal failed.
415	CDMA Measurement error: Cannot trigger on mobile signal.

SCPI Command Reference



This appendix describes the commands for test automation using RAPID!, the General Purpose Interface Bus (GPIB) or a TCP/IP connection. The SCPI commands are divided into the following subsystems:

- ["Bluetooth commands" on page 266](#)
- ["Signaling operation register group" on page 266](#)
- ["Common commands" on page 266](#)
- ["SYSTEM subsystem" on page 271](#)
- ["STATUS subsystem" on page 279](#)
- ["FORMAT subsystem" on page 294](#)
- ["CONFIGure subsystem" on page 296](#)
- ["CALL subsystem" on page 316](#)
- ["MEASURE subsystem" on page 322](#)
- ["FETCH Subsystem" on page 351](#)
- ["CALCulate Subsystem" on page 366](#)
- ["RFANalyser subsystem" on page 417](#)
- ["RFSpectrum subsystem" on page 419](#)
- ["AFGenerator subsystem" on page 420](#)
- ["AFANalyser subsystem" on page 424](#)
- ["MS Power Supply subsystem" on page 428](#)

Bluetooth commands

The SCPI commands for the 4489 Bluetooth Connectivity Test Package can be found in the Bluetooth Connectivity Test Products user's guide, ordering number M 292 018.

Signaling operation register group

This group of registers is 16 bits wide. Its main task is to deal with events related to the signaling status. The signaling operations depend on the system option and can be found in the :STATus:OPERation:SIGNalling group of commands (see the respective EVENT command for the signaling system at hand). The Result bit of this group of registers is forwarded to bit 8 of the general operation register group.

Common commands

The common commands are understood by all SCPI and IEEE 488.2 instruments. Their purpose is to perform general tasks and to read or work with the registers common to all SCPI instruments. The following common commands have been implemented.

General common commands

*CLS

Syntax	: *CLS
Parameters	There are no parameters.
Description	Resets the entire status reporting system: <ul style="list-style-type: none">– 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.
Description	There is only a query form of this command available.

Query	Returns a string, containing the following information: <ul style="list-style-type: none"> - 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	"WILLTEK, 4400, 0511099, 3.10.0001".

***OPC**

Syntax	: *OPC
Parameters	There are no parameters.
Description	Postpones the execution of a command until all commands issued previously have been completed.
Query	Returns the 'operation complete' flag in a string. A 1 indicates that all commands have been completed while a 0 means that there is at least one command still under execution.

***RST**

Syntax	: *RST
Parameters	There are no parameters.
Description	Resets the entire test set. All parameters, limits etc. will be set to the internally pre-defined default values.
Query	There is no query form of this command available.

***WAI**

Syntax	: *WAI
Parameters	There are no parameters.
Description	Postpones the execution of a command until all commands issued previously have been completed.
Query	There is no query form of this command available.

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 4400 is no longer controlled by remote commands but by user interaction.
5	32	Command error – this bit indicates that one of the "SCPI command errors" occurred.
4	16	Execution error – is set after a SCPI execution error did occur.
3	8	Device-dependent error – this bit indicates that a device-specific SCPI error did occur.
2	4	Query error – is set after a SCPI query error occurred.
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).
Description	Sets the enable filter (mask) of the event status register. int1 is the decimal representation of the binary mask. The mask and the current content 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.
Description	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, an :*ESR? command 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? command will return "0".

Commands affecting the service register

The service register represents the highest level within the report structure of the 4400.

The service register contains eight bits.

If any one of the bits 0...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 4400 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. Note: The summary status bit may be ANDed with the service request enable filter in order to generate a Service ReQuest on GPIB. The related command is *SRE (see below for details).
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 result(s) 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? command.
1	2	Remote command completed. This bit will be set to 1 after a remote (SCPI) command has been completed. Note: However, when the 4400 receives a SCPI command, it will block the GPIB until the command has been completed.
0	1	Message queue status. This bit will be set to 1 as soon as a message is available in the 4400's internal message queue. Up to 10 messages can be logged in the message queue. To write to or to read from the message queue, use the :SYSTEM:MESSAge command.

***SRE**

Syntax	:*SRE <int1>
Parameters	int1 is an integer. The valid range is from 0 to 255 (8 bits).
Description	Sets the enable filter (mask) for the service register. int1 is the decimal representation of this binary mask. The mask and the current content of the service register will be ANDed. If the result is not zero, a service request (SRQ) will occur on the GPIB.
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 and a SRQ will occur on the GPIB.

***STB?**

Syntax	:*STB?
Parameters	There are no parameters.
Description	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 subsystem

System parameters, such as the number of unread error messages, the test set's GPIB address etc. may be read out or set using the commands of this subsystem.

:SYSTEM:ERROR[:NEXT]?

Syntax	:SYSTEM:ERROR[:NEXT]?
Parameters	There are no parameters.
Description	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 4400. The queue entry returned will be a string containing the error no. and additional text. The maximum length of the string is 255 characters. Note: An overview of all SCPI error messages can be found in section " SCPI command errors ".
Example	:SYSTEM:ERROR:NEXT? String returned: "66 GPIB cannot be initialised."

:SYSTEM:ERROR:COUNT?

Syntax	:SYSTEM:ERROR:COUNT?
Parameters	There are no parameters.
Description	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 4400. 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.
Description	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 4400. The string returned will contain one integer (and no text). Note: An overview of all SCPI error messages can be found in section " SCPI command errors ".
Example	:SYSTEM:ERROR:CODE? String returned: "66" This means that the GPIB could not be initialized.

:SYSTem:ERRor:CODE:ALL?

Syntax	:SYSTem:ERRor:CODE:ALL?
Parameters	There are no parameters.
Description	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 4400. The string returned will contain a maximum of 10 integers, separated by commas. Note: An overview of all SCPI error messages can be found in section " SCPI command errors ".
Example	:SYSTem:ERRor:CODE:ALL? String returned: "371,66" This means that there were two unread error messages in the error queue (the first one indicating that there was a time-out on a FEtCh command and the second one meaning that the GPIB could not be initialized).

:SYSTem:ERRor:REMOte:DISPlay

Syntax	:SYSTem:ERRor:REMOte:DISPlay <PredefExp>
Parameters	PredefExp is one of the following predefined expressions: OFF ON. Default is OFF.
Description	Switches the error display on the start screen on and off. If it is switched to ON, the error log will be displayed after the first error occurred.
Query	Reads and returns the current setting.
Example	:SYST:ERR:REM:DISP ON In remote case the error log window will be displayed.

:SYSTem:MESSage

Syntax	:SYSTem:MESSage <string1>
Parameters	string1 is a string (text) parameter. The maximum length of string1 is 255 characters.
Description	Writes the message specified with the string1 parameter to the Willtek 4400's internal system message queue.
Query	Reads and returns the oldest unread message in the Willtek 4400's internal message queue. The string returned will contain a maximum of 255 characters.
Example	:SYSTem:MESSage "23.17,Procedure A5" :SYST:MESS? String returned: "23.17,Procedure A5" In this example, a RAPID! program performs some internal calculations and then writes the result to the system message queue. This result is then read by the external controller.

:SYSTem:COMMunicate:LOCAl

Syntax	:SYSTem:COMMunicate:LOCAl
Parameters	There are no parameters.
Description	Sets up the Willtek 4400 to allow manual operation on the front panel during SCPI operation. Note: This command may be used e.g. to allow interactive alignment procedures in a production or quality assurance flow.
Query	There is no query form of this command available.
Example	:SYSTem:COMM:LOC

:SYSTem:COMMunicate:GPIB:ADDRESS

Syntax	:SYSTem:COMMunicate:GPIB:ADDRESS <int1>[,<int2>]
Parameters	intx are two integers. The minimum value for int1 is 1 , the maximum is 32 . The default value is 4 . The minimum value for int2 is 0 , the maximum is 30 . The default value is 1 . int1 must be specified while int2 is an optional parameter.
Description	Sets the GPIB address of the Willtek 4400. For details regarding the GPIB address, refer to section Setting the GPIB address.
Query	Reads and returns the current setting of the GPIB address as explained above.
Example	:SYST:COMM:GPIB:ADDR 14 Sets the GPIB address to 14.

:SYSTem:COMMunicate:GPIB:TERMinator

Syntax	:SYSTem:COMMunicate:GPIB:TERMinator <PredefExp>
Parameters	PredefExp is one of the following predefined expressions: LF CR CRLF . Default is LF .
Description	Sets the terminator used on the GPIB. For details regarding the terminator, refer to section Setup.
Query	Reads and returns the current setting of the terminator used on the GPIB as explained above.
Example	:SYST:COMM:GPIB:TERM CRLF Sets the GPIB terminator to 'carriage return plus line feed'.

:SYSTem:COMMunicate:TCPIP:ADDRESS

Syntax	:SYSTem:COMMunicate:TCPIP:ADDRESS <string>
Parameters	string is a string only containing the IP address for the 4400.
Description	This command sets the IP address of the 4400. See section I/O Configuration for more details.

Query	Reads and returns the current setting of the IP address as explained above.
Example	SYST:COMM:TCP:ADDR "192.16.16.114" sets the IP address to a defined value.

:SYSTem:COMMunicate:TCPIP:NETMask

Syntax	:SYSTem:COMMunicate:TCPIP:NETMask <string>
Parameters	string is a string only containing the net mask for the 4400.
Description	This command sets the net mask of the 4400. See section I/O Configuration for more details.
Query	Reads and returns the current setting of the net mask as explained above.
Example	SYST:COMM:TCP:NETM "255.255.255.0" sets the net mask to a defined value.

:SYSTem:COMMunicate:TCPIP:GATeway

Syntax	:SYSTem:COMMunicate:TCPIP:GATeway <string>
Parameters	string is a string only containing the default gateway address for the 4400.
Description	This command sets the default gateway address of the 4400. See section I/O Configuration for more details.
Query	Reads and returns the current setting of the gateway address as explained above.
Example	SYST:COMM:TCP:GAT "192.16.16.1" sets the gateway address to a defined value.

:SYSTem:COMMunicate:TCPIP:PORT

Syntax	:SYSTem:COMMunicate:TCPIP:PORT <int>
Parameters	int defines the TCP/IP port address of the 4400. The address must be in the range from 49152 to 65535.
Description	This command sets the port address on which the 4400 can be controlled via LAN. See section I/O Configuration for more details.
Query	Reads and returns the current setting of the port used by TCP/IP as explained above.
Example	SYST:COMM:TCP:PORT 49200 sets the TCP/IP port address to its default.

:SYSTem:COMMunicate:TCPIP:TERMinator

Syntax	:SYSTem:COMMunicate:TCPIP:TERMinator <PredefExp>
Parameters	PredefExp can take on one of the following values: LF or CR or CRLF . The default is LF .
Description	The command defines the delimiter for SCPI control strings. See section I/O Configuration for more details.

Query	Reads and returns the current setting of the terminator used by TCPIP as explained above.
Example	SYST:COMM:TCP:TERM CRLF sets the line terminator for SCPI commands via LAN to CR (Carriage Return) followed by LF (Line Feed).

:SYSTem:COMMunicate:TCPIP:MOUNT

Syntax	:SYSTem:COMMunicate:TCPIP:MOUNT <string1> <string2>
Parameters	string1 defines the network address which shall be mounted as a device for remote control. The maximum allowable length of the string is 255 characters. string2 is the symbolic device address used in SCPI programming. The maximum allowable length of string2 is 25 characters. The default is "server".
Description	This command mounts a server disk as a 4400 device which can be used to load or save data to/from. See section I/O Configuration for more details.
Query	Reads and returns the last settings for the mount path and the corresponding local name as explained above.
Example	:SYST:COMM:TCP:MOUNT "unixpc/disk2/results", "resdir"

:SYSTem:COMMunicate:TCPIP:DHCP

Syntax	:SYSTem:COMMunicate:TCPIP:DHCP <PredefExp>
Parameters	PredefExp can take on one of the following values: ON or OFF. The default is OFF.
Description	The command turns DHCP on or off. See section I/O Configuration for more details.
Query	Reads and returns the current setting of DHCP operation.
Example	:SYST:COMM:TCP:DHCP ON sets the software to use DHCP.

:SYSTem:COMMunicate:SERA:PARAMeter

Syntax	:SYSTem:COMMunicate:SERA:PARAmeter <int1>, <int2>, <int3>, <PredefExpr4>
Parameters	There are four parameters. int1 is the bit rate on the serial interface. Valid values are 110, 300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200 . The default value is 38400 . int2 is the number of bits per character. The minimum value is 5 , the maximum is 8 . The default value is 8 . int3 is the number of stop bits. It can take on the values 1 or 2 . The default value is 1 . <PredefExpr4> specifies the parity bit. The value is one of the following pre-defined expressions: NO ODD EVEN . Default is NO .

Description	Sets the parameters for serial port COM1. This command uses the following format: baud, bits, stop, parity where baud stands for the bit rate (int1), bits stands for the number of bits per character (int2), stop stands for the number of stop bits (int3) and parity represents the parity (No, Odd or Even)(PredefExpr4).
Query	Reads and returns the current settings of COM1 as explained above.
Example	:SYST:COMM:SERA:PAR 9600,8,1,ODD :SYST:COMM:SERA:PAR? String returned: "9600,8,1,ODD".

:SYSTEM:COMMunicate:SERA:REMOte

Syntax	:SYSTEM:COMMunicate:SERA:REMOte <PredefExpr>
Parameters	PredefExpr can take on either of the following expressions: ON OFF. Default is ON.
Description	Enables or disables remote control of the 4400 via the serial interface port COM 1. Note: The remote control capability at COM 1 should be disabled prior to controlling external equipment (e.g. the Bluetooth Connectivity Test products) through this interface.
Query	Returns the current setting.
Example	:SYST:COMM:SERA:REM OFF :SYST:COMM:SERA:REM? Returns the following string: "OFF"

:SYSTEM:COMMunicate:SERA:BAUD

Syntax	:SYSTEM:COMMunicate:SERA:BAUD <int1>
Parameters	int1 is the bit rate on the serial interface. Valid values are 9600, 19200, 38400, 57600, 115200. The default value is 57600.
Description	Sets the baud rate for serial port COM1. The other serial parameter settings are fixed at 8 bits per char, 1 stop bit, no parity.
Query	Reads and returns the current settings of COM1 as explained above.
Example	:SYST:COMM:SERA:BAUD 115200 :SYST:COMM:SERA:BAUD? Returns the following string: "9600".

:SYSTEM:KEYBoard

Syntax	:SYSTEM:KEYBoard <PredefExp>
Parameters	PredefExp is one of the following predefined expressions: USA BELGium_fr BELGium_nl CANFr CANEng DEN FR GER ITA JAP LATAm_spa LATAm_port NL NOR PORTu-gal SPA SWE SWISS_fr SWISS_ger UK. Default is USA .

Description	Selects the language for the external keyboard. Note: The language setting defines the position and type of special characters.
Query	Reads and returns the current setting of the language of the external keyboard. The string returned will contain one of the predefined expressions as explained above.
Example	:SYST:KEYB SWE Sets the language for the external keyboard to 'Swedish'.

: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 .
Description	Sets the system date. This command uses the following format: jjjjmmdd where jjjj stands for the four digits of the year (int1), mm gives the two digits of the current month (int2) and, dd represents the day of the current month (int3).
Query	Reads and 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 6th of July, 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 .
Description	Sets the system time. This command uses the following format: hhmmss where hh stands for the two digits of the current hour, using a 24 hour time format (int1), mm gives the two digits of the current minute (int2) and, ss represents the seconds of the system time (int3).
Query	Reads and returns the current system time in a string, using the format explained above.
Example	:SYST:TIME? String returned: " 12,56,05 ".

:SYSTem:VERSion?

Syntax	:SYSTem:VERSion?
Parameters	There are no parameters.
Description	There is only a query form of this command available.

Query	Reads and returns the version number of the SCPI command system used on your Willtek 4400. The command will return a string, containing one floating point real number.
Example	:SYST:VERS? String returned: "2001.7".

:SYSTEM:PRINTer

Syntax	:SYSTem:PRINTer <PredefExp>
Parameters	PredefExp is one of the following predefined expressions: HP400 HP680 EPST HPLJ EPSP EPSX EPSI EPCI EPS1 EPPX EPC2 EPC4 EPC5 EPC6 EPC8 EPC1 EPC3 BMPF CANO. Default is HP400 .
Description	Selects the printer for screen dumps. The printers selectable are: HP400 means the Hewlett-Packard (HP) deskjet 400 series, HP680 stands for the DP deskjet 680 series, EPST means the Epson (EP) stylus series, HPLJ stands for the HP laserjet series, EPSP, EPSX, EPSI, EPCI, EPS1, EPPX, EPC1, EPC2, EPC3, EPC4, EPC5, EPC6, and EPC8 stand for the corresponding Epson printer series, BMPF means that the screen dump will be output as a bit map file, while CANO will generate an output signal suitable for Canon printers.
Query	Reads and returns the current setting for the printer. The string returned will contain one of the predefined expressions as explained above.
Example	:SYST:PRIN? String returned: " HPLJ ".

STATus subsystem

The STATus subsystem offers commands to read out and deal with

- the general operation register group and its subordinate groups of registers and
- the general questionable status register group and its subordinate groups of registers.

NOTE

The commands to deal with the event status register group and the service register are part of the ["SCPI command errors"](#).

NOTE

For further details on the STATus subsystem, please refer to section ["Understanding the STATus subsystem"](#) on page 235.

:STATus:PRESet

Syntax	:STATus:PRESet
Parameters	There are no parameters.
Description	This command sets all user-definable settings of the status subsystem to their factory default values. The default values for the single commands are explained below.
Query	There is no query form of this command available.
Example	:STATus:PRESet Will reset all parameters of the status subsystem to their default values as listed below.

:STATus:OPERation[:EVENT]?

Syntax	:STATus:OPERation[:EVENT]?
Parameters	There are no parameters.
Description	Reads out the current contents of the General Operation Event Register. Note: Event-type registers are read-only and self-destructive. They will be cleared after any query.

Query	<p>There is only a query form of this command available. The query will return a string, containing one integer.</p> <p>The value returned represents all general operation events that have occurred since the last query of this register. As with any event-type register, the single bits will remain set even when the reason for the bits to be set is no longer valid. Please note that this is the main difference between event-type and condition-type registers. Condition-type registers reflect the current state of the Willtek 4400. Consequently, condition-type registers will be updated continuously.</p> <p>Notes</p> <ul style="list-style-type: none"> - For further details regarding the basic functions of the STATus subsystem, please refer to section "Understanding the STATus subsystem" on page 235. - In case, a certain event shall be trapped in a loop within a program, always query the event-type register.
Example	<p>:STATus:OPERation:EVENT?</p> <p>Value returned: "32".</p> <p>This means that bit 5 (the 'waiting for a trigger' bit) has been set. This indicates that a 'waiting for a trigger' event did occur. If you want to know whether the Willtek 4400 is still waiting for the trigger to occur, read out the related condition-type register (see command explained below).</p>

:STATus:OPERation:CONDition?

Syntax	:STATus:OPERation:CONDition?
Parameters	There are no parameters.
Description	<p>This command reads out the current contents of the General Operation Condition Register. This register reflects the current operational state of the Willtek 4400 and will be updated continuously.</p> <p>Note: This register is nondestructive. This means that it will keep its contents after any query.</p>
Query	<p>There is only a query form of this command available. The query will return a string, containing one integer. The integer will express all bits currently set in the 16 bit general operation condition register.</p> <p>Notes</p> <ul style="list-style-type: none"> - For further details regarding the basic functions of the STATus subsystem, please refer to section "Understanding the STATus subsystem" on page 235. - Bit 15 (the MSB) of this register is not used. Therefore, the maximum value returned will be "32767".
Example	<p>:STATus:OPERation:CONDition?</p> <p>Value returned: "512".</p> <p>This means that bit 9 (the MEASure summary bit) has been set, indicating that some measurement is currently in progress. Bit 9 will be reset as soon as the measurement has been completed.</p>

:STATus:OPERation:ENABLE

Syntax	:STATus:OPERation:ENABLE <int1>
Parameters	int1 is an integer. The minimum value for int1 is 0, the maximum value is 32767. The default value is 0.

Description	This command sets the Enable filter of the " General operation register group ". This mask will be ANDed with the general operation event register and thus decide what kind of events will be forwarded to bit 7 of the service register. Note: The service register is often also referred to as the status byte register or status byte.
Query	There is no query form of this command available.
Example	:STATus:OPERation:ENABLE 129 This means that any setting of bits 1 (calibrating) or 7 (correcting) of the general operation event register will rise bit 7 of the service register.

:STATus:OPERation:NTRansition

Syntax	:STATus:OPERation:NTRansition <int1>
Parameters	int1 is an integer. The minimum value for int1 is 0, the maximum value is 32767. The default value is 0.
Description	Sets the NTR mask of the " General operation register group ". This mask will be ANDed with the up to 15 bits of the NTR transition filter of the general operation condition register to allow a reset (negative transition) of any bit (i.e. a transition from logic '1' to '0') to reach the general operation event register. Notes <ul style="list-style-type: none"> - The default of this mask is 0 – that means that the mask will not allow any negative transition of the lower 15 bits of the condition-type register to reach the event-type register. - Bit 16 of the general operation condition register is not used.
Query	There is no query form of this command available.
Example	:STATus:OPERation:NTRansition 32767 This means that all of the negative transitions of the condition-type register will be forwarded to the event-type register.

:STATus:OPERation:PTRansition

Syntax	:STATus:OPERation:PTRansition <int1>
Parameters	int1 is an integer. The minimum value for int1 is 0, the maximum value is 32767. The default value is 32767.
Description	Sets the PTR mask of the " General operation register group ". This mask will be ANDed with the up to 15 bits of the PTR transition filter of the general operation condition register to allow a positive transition of any bit (i.e. a transition from logic '0' to '1') to reach the general operation event register. Notes <ul style="list-style-type: none"> - The default of this mask is 32767 – that means that the mask will allow any positive transition of the lower 15 bits of the condition-type register to reach the event-type register. - Bit 16 of the general operation condition register is not used.
Query	There is no query form of this command available.
Example	:STATus:OPERation:PTRansition 0 This means that none of the positive transitions of the condition-type register will be forwarded to the event-type register.

:STATus:OPERation:SIGNalling:EVDO[:EVENT]

Syntax	:STATus:OPERation:SIGNalling:EVDO[:EVENT]?
Parameters	There are no parameters.
Description	<p>Reads out the current contents of the signaling operation event register.</p> <p>Note: Event-type registers are read-only and self-destructive. They will be cleared after any query.</p>
Query	<p>There is only a query form of this command available. The query will return a string containing one integer.</p> <p>The value returned represents all signaling operation events that have occurred since the last query of this register. As with any event-type register, the individual bits will remain set even when the reason for the bits to be set is no longer valid. Please note that this is the main difference between event-type and condition-type registers. Condition-type registers reflect the current state of Willtek 4400. Consequently, condition-type registers will be updated continuously.</p> <p>The bits of the signaling operation event register have the following meaning:</p> <p>Bit 0 (decimal 1): Disabled – set when EVDO mode is disabled.</p> <p>Bit 1 (decimal 2): Control channel – set when the EVDO mode is on a control channel.</p> <p>Bit 2 (decimal 4): Session open – set when a terminal has opened a session.</p> <p>Bit 3 (decimal 8): Connected – set when a connection has been established with a terminal.</p> <p>Bit 4 (decimal 16): Generator/Analyzer mode – set when 4400 is in generator/analyzer mode.</p> <p>Bit 5 (decimal 32): Unit is currently performing self-calibration.</p> <p>Bit 6 (decimal 64): Session information is now available.</p> <p>Bit 7 (decimal 128): The terminal has requested a session.</p> <p>Bit 8 (decimal 256): Beginning an Access Network connection.</p> <p>Bit 9 (decimal 512): Beginning an Access Terminal connection.</p> <p>Bit 10 (decimal 1024): Reserved.</p> <p>Bit 11 (decimal 2048): Mobile power correction completed.</p> <p>Bits 12. to 15: Not used (reserved)</p> <p>Notes</p> <ul style="list-style-type: none"> – The lower five bits (0 to 4) are considered the current state, so one (and only one) of these bits is set at all times. The other bits (5 to 15) may be set independently of any other. – For further details regarding the basic functions of the STATus subsystem, please refer to section Understanding the STATus Subsystem. – In case a certain event shall be trapped in a loop within a program, always query the event-type register.
Example	<p>:STATus:OPERation:SIGNalling:EVDO:EVENT?</p> <p>Value returned in this example: " 8 "</p> <p>This means that bit 3 of the signaling operation event register has been set.</p>

:STATus:OPERation:SIGNalling:EVDO:CONDition

Syntax	:STATus:OPERation:SIGNalling:EVDO:CONDition?
Parameters	There are no parameters.

Description	This command reads out the current contents of the signaling operation condition register. This register reflects the current state of Willtek 4400 in terms of signaling and will be updated continuously. Note: This register is non-destructive. This means that it will keep its contents after any query.
Query	– There is only a query form of this command available. The query will return a string containing one integer. The integer will express all bits set in the 16 bit signaling operation condition register. Note: For further details regarding the basic functions of the STATUS subsystem, please refer to section Understanding the STATUS Subsystem .
Example	:STATUS:OPERation:SIGNalling:EVDO:CONDition? Value returned in this example: "512". This means that bit 9 has been set. Bit 9 will be reset as soon as the change of the call channel has been completed.

:STATUS:OPERation:SIGNalling:EVDO:ENABLE

Syntax	:STATUS:OPERation:SIGNalling:EVDO:ENABLE <int1>
Parameters	<i>int1</i> is an integer. The minimum value for <i>int1</i> is 0, the maximum value is 32767. The value default is 0.
Description	This command sets the enable filter of the signaling operation register group. This mask will be ANDed with the signaling operation event register and thus decide what kind of events will be forwarded to bit 8 of the general operation register group.
Query	There is no query form of this command available.
Example	:STATUS:OPERation:SIGNalling:EVDO:ENABLE 16 This means that any setting of bit 4 of the signaling operation event register will rise bit 8 of the general operation condition register.

:STATUS:OPERation:SIGNalling:EVDO:PTRansition

Syntax	:STATUS:OPERation:SIGNalling:EVDO:PTRansition <int1>
Parameters	<i>int1</i> is an integer. The minimum value for <i>int1</i> is 0, the maximum value is 32767. The value default is 32767.
Description	Sets the PTR mask of the signaling operation register group. This mask will be ANDed with the up to 15 bits of the PTR filter of the signaling operation condition register to allow a positive transition of any bit (i.e. a transition from logic '0' to '1') to reach the signaling operation event register. Note: The default of this mask is 32767 - that means that the mask will allow any positive transition of the lower 15 bits of the condition-type register to reach the event-type register.
Query	There is no query form of this command available.
Example	:STATUS:OPERation:SIGNalling:EVDO:PTRansition 0 This means that none of the positive transitions of the condition-type register will be forwarded to the event-type register.

:STATus:OPERation:SIGNalling:EVDO:NTRansition

Syntax	:STATus:OPERation:SIGNalling:EVDO:NTRansition <int1>
Parameters	int1 is an integer. The minimum value for int1 is 0, the maximum value is 32767. The value default is 0.
Description	Sets the NTR mask of the signaling operation register group. This mask will be ANDed with the up to 15 bits of the NTR filter of the signaling operation condition register to allow a reset (negative transition) of any bit (i.e. a transition from logic '1' to '0') to reach the signaling operation event register. Note: The default of this mask is 0 - that means that the mask will not allow any negative transition of the lower 15 bits of the condition-type register to reach the event-type register of this group.
Query	There is no query form of this command available.
Example	:STATus:OPERation:SIGNalling:EVDO:NTRansition 0 This means that none of the negative transitions of the condition-type register will be forwarded to the event-type register.

:STATus:OPERation:MEASuring[:EVENT]?

Syntax	:STATus:OPERation:MEASuring[:EVENT]?
Parameters	There are no parameters.
Description	Reads out the current contents of the measuring operation event register. Note: Event-type registers are read-only and self-destructive. They will be cleared after any query.
Query	There is only a query form of this command available. The query will return a string, containing one integer. The value returned represents all measuring operation events that have occurred since the last query of this register. As with any event-type register, the single bits will remain set even when the reason for the bits to be set is no longer valid. Please note that this is the main difference between event-type and condition-type registers. Condition-type registers reflect the current state of the Willtek 4400. Consequently, the condition type registers will be updated continuously. Notes <ul style="list-style-type: none"> - For further details regarding the basic functions of the STATus subsystem, please refer to section Understanding the STATus Subsystem. - In case, a certain event shall be trapped in a loop within a program, always query the event-type register.
Example	:STATus:OPERation:MEASuring:EVENT? Value returned: "8". This means that bit 3 (stands for AF measurement) has been set.

:STAT:OPERation:MEASuring:CONDition?

Syntax	:STAT:OPERation:MEASuring:CONDition?
Parameters	There are no parameters.

Description	This command reads out the current contents of the measuring operation condition register. This register reflects the current state of the Willtek 4400 in terms of measurements and will be updated continuously. Note: This register is nondestructive. This means that it will keep its contents after any query.
Query	There is only a query form of this command available. The query will return a string, containing one integer. The integer will express all bits set in the 16 bit measuring operation condition register. Notes <ul style="list-style-type: none"> - For further details regarding the basic functions of the STATus subsystem, please refer to section "Understanding the STATus subsystem" on page 235. - Bits 4 to 15 (the MSB) of this register are not used. Therefore, the maximum value returned will be "7".
Example	:STATus:OPERation:MEASuring:CONDition? Value returned: "1". This means that bit 0 has been set and that there is an RFTX measurement currently in progress. This bit will be reset as soon as the RFTX measurements have been completed.

:STATus:OPERation:MEASuring:ENABLE

Syntax	:STATus:OPERation:MEASuring:ENABLE <int1>
Parameters	int1 is an integer. The minimum value for int1 is 0, the maximum value is 32767. The default value is 0.
Description	This command sets the enable filter of the " Measuring operation register group ". This mask will be ANDed with the measuring operation event register and thus decide what kind of events will be forwarded to bit 9 of the " General operation register group ".
Query	There is no query form of this command available.
Example	:STATus:OPERation:MEASuring:ENABLE 4 This means that any setting of bit 2 (RF spectrum) of the measuring operation event register will rise bit 9 of the general operation condition register.

:STAT:OPERation:MEASuring:PTRansition

Syntax	:STAT:OPERation:MEASuring:PTRansition <int1>
Parameters	int1 is an integer. The minimum value for int1 is 0, the maximum value is 32767. The default value is 32767.
Description	Sets the PTR mask of the " Measuring operation register group ". This mask will be ANDed with the up to 16 bits of the PTR filter of the measuring operation condition register to allow a positive transition of any bit (i.e. a transition from logic '0' to '1') to reach the measuring operation event register. Note: The default of this mask is 32767 – that means that the mask will allow any positive transition of the lower 15 bits of the condition-type register to reach the event-type register.
Query	There is no query form of this command available.

Example **:STATus:OPERation:MEASuring:PTRansition 0**
 This means that none of the positive transitions of the condition-type register will be forwarded to the event-type register.

:STAT:OPERation:MEASuring:NTRansition

Syntax **:STAT:OPERation:MEASuring:NTRansition <int1>**

Parameters **int1** is an integer. The minimum value for **int1** is 0, the maximum value is 32767. The default value is 0.

Description Sets the NTR mask of the "[Measuring operation register group](#)". This mask will be ANDed with the up to 16 bits of the NTR filter of the measuring operation condition register to allow a reset (negative transition) of any bit (i.e. a transition from logic '1' to '0') to reach the measuring operation event register.
Note: The default of this mask is 0 – that means that the mask will not allow any negative transition of the 16 bits of the condition-type register to reach the event-type register of this group.

Query There is no query form of this command available.

Example **:STATus:OPERation:MEASuring:NTRansition 0**
 This means that none of the negative transitions of the condition-type register will be forwarded to the event-type register.

:STATus:QUESTionable[:EVENT]?

Syntax **:STATus:QUESTionable[:EVENT]?**

Parameters There are no parameters.

Description Reads out the current contents of the general questionable status event register.
Note: Event-type registers are read-only and self-destructive. They will be cleared after any query.

Query There is only a query form of this command available. The query will return a string, containing one integer.
 The value returned represents all general questionable status events that have occurred since the last query of this register. As with any event-type register, the single bits will remain set even when the reason for the bits to be set is no longer valid. Please note that this is the main difference between event-type and condition-type registers. Condition-type registers reflect the current state of the Willtek 4400. Consequently, condition-type registers will be updated continuously.
Notes
 – For further details regarding the basic functions of the STATus subsystem, please refer to section "[Understanding the STATus subsystem](#)" on page 235.
 – In case, a certain event shall be trapped in a loop within a program, always query the event-type register.

Example **:STATus:QUESTionable:EVENT?**
 Value returned: "256".
 This means that bit 8 has been set, indicating that the calibration of the Willtek 4400 is out of range. If you want to know whether the Willtek 4400 calibration is still out of range, read out the related condition-type register (see command explained below).

:STATus:QUESTionable:CONDition?

Syntax	:STATus:QUESTionable:CONDition?
Parameters	There are no parameters.
Description	This command reads out the current contents of the general questionable status condition register. This register reflects the current questionable state of the Willtek 4400 and will be updated continuously. Note: This register is nondestructive. This means that it will keep its contents after any query.
Query	There is only a query form of this command available. The query will return a string, containing one integer. The integer will express all bits currently set in the 16 bit questionable status condition register. Notes <ul style="list-style-type: none"> - For further details regarding the basic functions of the STATus subsystem, please refer to section "Understanding the STATus subsystem" on page 235. - Bit 15 (the MSB) of this register is not used. Therefore, the maximum value returned will be "32767".
Example	:STATus:QUESTionable:CONDition? Value returned: "512". This means that bit 9 (the RF summary bit) has been set, indicating a current problem on the RF side of the Willtek 4400.

:STATus:QUESTionable:ENABLe

Syntax	:STATus:QUESTionable:ENABLe <int1>
Parameters	int1 is an integer. The minimum value for int1 is 0, the maximum value is 32767. The default value is 0.
Description	This command sets the Enable filter of the " General questionable status register group ". This mask will be ANDed with the general questionable status event register and thus decide what kind of events will be forwarded to bit 3 of the service register. Note: The service register is often also referred to as the status byte register or status byte.
Query	There is no query form of this command available.
Example	:STATus:QUESTionable:ENABLe 512 This means that any setting of bit 9 (RF summary bit) of the general questionable status event register will rise bit 3 of the service register.

:STATus:QUESTionable:PTRansition

Syntax	:STATus:QUESTionable:PTRansition <int1>
Parameters	int1 is an integer. The minimum value for int1 is 0, the maximum value is 32767. The default value is 32767.

Description	Sets the PTR mask of the " General questionable status register group ". This mask will be ANDed with the up to 16 bits of the PTR filter of the general questionable status condition register to allow a positive transition of any bit (i.e. a transition from logic '0' to '1') to reach the questionable status event register. Note: The default of this mask is 32767 – that means that the mask will allow any positive transition of the lower 15 bits of the condition-type register to reach the event-type register.
Query	There is no query form of this command available.
Example	:STATus:QUESTionable:PTRansition 0 This means that none of the positive transitions of the condition-type register will be forwarded to the event-type register of this group.

:STATus:QUESTionable:NTRansition

Syntax	:STATus:QUESTionable:NTRansition <int1>
Parameters	int1 is an integer. The minimum value for int1 is 0, the maximum value is 32767. The default value is 0.
Description	Sets the NTR mask of the " General questionable status register group ". This mask will be ANDed with the up to 16 bits of the NTR filter of the general questionable status condition register to allow a reset (negative transition) of any bit (i.e. a transition from logic '1' to '0') to reach the general questionable status event register. Note: The default of this mask is 0 – that means that the mask will not allow any negative transition of the 16 bits of the condition-type register to reach the event-type register.
Query	There is no query form of this command available.
Example	:STATus:QUESTionable:NTRansition 0 This means that none of the negative transitions of the condition-type register will be forwarded to the event-type register of this group.

:STATus:QUESTionable:RF[:EVENT]?

Syntax	:STATus:QUESTionable:RF[:EVENT]?
Parameters	There are no parameters.
Description	Reads out the current contents of the RF questionable status event register. Note: Event-type registers are read-only and self-destructive. They will be cleared after any query.

Query	<p>There is only a query form of this command available. The query will return a string, containing one integer.</p> <p>The value returned represents all RF questionable status events that have occurred since the last query of this register. As with any event-type register, the single bits will remain set even when the reason for the bits to be set is no longer valid. Please note that this is the main difference between event-type and condition-type registers. Condition-type registers reflect the current state of the Willtek 4400. Consequently, condition-type registers will be updated continuously.</p> <p>Notes</p> <ul style="list-style-type: none"> - For further details regarding the basic functions of the STATus subsystem, please refer to section "Understanding the STATus subsystem" on page 235. - In case, a certain event shall be trapped in a loop within a program, always query the event-type register.
Example	<p>:STATus:QUESTIONable:RF:EVENT?</p> <p>Value returned: "1".</p> <p>This means that bit 1 has been set, indicating an RF input overload. If you want to know whether this RF input overload still persists, read out the related condition-type register (see command explained below).</p>

:STATus:QUESTIONable:RF:CONDition?

Syntax	:STATus:QUESTIONable:RF:CONDition?
Parameters	There are no parameters.
Description	<p>This command reads out the current contents of the RF questionable status condition register. This register reflects the current questionable state of the Willtek 4400 regarding RF and will be updated continuously.</p> <p>Note: This register is nondestructive. This means that it will keep its contents after any query.</p>
Query	<p>There is only a query form of this command available. The query will return a string, containing one integer. The integer will express all bits currently set in the 16 bit RF questionable status condition register.</p> <p>Notes</p> <ul style="list-style-type: none"> - For further details regarding the basic functions of the STATus subsystem, please refer to section "Understanding the STATus subsystem" on page 235. - Bits 4 to 15 (the MSB) of this register are not used. Therefore, the maximum value returned will be "15"
Example	<p>:STATus:QUESTIONable:RF:CONDition?</p> <p>Value returned: "8".</p> <p>This means that bit 3 has been set, indicating that the frequency currently received is out of range of the Willtek 4400 receiver.</p>

:STATus:QUESTIONable:RF:ENABLE

Syntax	:STATus:QUESTIONable:RF:ENABLE <int1>
Parameters	int1 is an integer. The minimum value for int1 is 0 , the maximum value is 32767 . The default value is 0 .
Description	<p>This command sets the enable filter of the "RF questionable status register group". This mask will be ANDed with the RF questionable status event register and thus decide what kind of events will be forwarded to bit 9 of the "General questionable status register group".</p>

Query	There is no query form of this command available.
Example	:STATus:QUESTionable:RF:ENABle 15 This means that any setting of one of the lower four bits of the RF questionable status event register will rise bit 9 of the general questionable status condition register.

:STATus:QUESTionable:RF:PTRansition

Syntax	:STATus:QUESTionable:RF:PTRansition <int1>
Parameters	int1 is an integer. The minimum value for int1 is 0 , the maximum value is 32767 . The default value is 32767 .
Description	Sets the PTR mask of the " RF questionable status register group ". This mask will be ANDed with the up to 16 bits of the PTR filter of the RF questionable status condition register to allow a positive transition of any bit (i.e. a transition from logic '0' to '1') to reach the RF questionable status event register. Note: The default of this mask is 32767 – that means that the mask will allow any positive transition of the lower 15 bits of the condition-type register to reach the event-type register of this group.
Query	There is no query form of this command available.
Example	:STATus:QUESTionable:RF:PTRansition 0 This means that none of the positive transitions of the condition-type register will be forwarded to the event-type register.

:STATus:QUESTionable:RF:NTRansition

Syntax	:STATus:QUESTionable:RF:NTRansition <int1>
Parameters	int1 is an integer. The minimum value for int1 is 0 , the maximum value is 32767 . The default value is 0 .
Description	Sets the NTR mask of the " RF questionable status register group ". This mask will be ANDed with the up to 16 bits of the NTR filter of the RF questionable status condition register to allow a negative transition of any bit (i.e. a transition from logic '1' to '0') to reach the RF questionable status event register. Note: The default of this mask is 0 – that means that the mask will not allow any negative transition of the 16 bits of the condition-type register to reach the event-type register of this group.
Query	There is no query form of this command available.
Example	:STATus:QUESTionable:RF:NTRansition 0 This means that none of the negative transitions of the condition-type register will be forwarded to the event-type register.

:STATus:QUESTionable:SYNChron[:EVENT]?

Syntax	:STATus:QUESTionable:SYNChron[:EVENT]?
Parameters	There are no parameters.

Description	<p>Reads out the current contents of the synchronization questionable status event register.</p> <p>Note: Event-type registers are read-only and self-destructive. They will be cleared after any query.</p>
Query	<p>There is only a query form of this command available. The query will return a string, containing one integer.</p> <p>The value returned represents all synchronization questionable status events that have occurred since the last query of this register. As with any event-type register, the single bits will remain set even when the reason for the bits to be set is no longer valid. Please note that this is the main difference between event-type and condition-type registers. Condition-type registers reflect the current state of the Willtek 4400. Consequently, condition-type registers will be updated continuously.</p> <p>Notes</p> <ul style="list-style-type: none"> - For further details regarding the basic functions of the STATus subsystem, please refer to section "Understanding the STATus subsystem" on page 235. - In case, a certain event shall be trapped in a loop within a program, always query the event-type register.
Example	<p>:STATus:QUESTionable:SYNChron:EVENT?</p> <p>Value returned: "2".</p> <p>This means that bit 2 has been set, indicating that an external frame synchronization signal has been recognized on the SYNC IN/OUT socket on the rear panel of the Willtek 4400.</p>

:STAT:QUESTionable:SYNChron:CONDition?

Syntax	:STAT:QUESTionable:SYNChron:CONDition?
Parameters	There are no parameters.
Description	<p>This command reads out the current contents of the synchronization questionable status condition register. This register reflects the current questionable state of the Willtek 4400 regarding synchronization and will be updated continuously.</p> <p>Note: This register is nondestructive. This means that it will keep its contents after any query.</p>
Query	<p>There is only a query form of this command available. The query will return a string, containing one integer. The integer will express all bits currently set in the 16 bit synchronization questionable status condition register.</p> <p>Notes</p> <ul style="list-style-type: none"> - For further details regarding the basic functions of the STATus subsystem, please refer to section "Understanding the STATus subsystem" on page 235. - Bits 2 to 15 (the MSB) of this register are not used. Therefore, the maximum value returned will be "3".
Example	<p>:STATus:QUESTionable:SYNChron:CONDition?</p> <p>Value returned: "1".</p> <p>This means that bit 1 has been set, indicating that an external RF synchronization signal is being received on the EXT SYNC prog. socket on the rear panel of the Willtek 4400.</p>

:STATus:QUESTionable:SYNChron:ENABLe

Syntax	:STATus:QUESTionable:SYNChron:ENABLe <int1>
Parameters	int1 is an integer. The minimum value for int1 is 0, the maximum value is 32767. The default value is 0.
Description	This command sets the Enable filter of the "SYNChronization questionable status register group". This mask will be ANDed with the synchronization questionable status event register and thus decide what kind of events will be forwarded to bit 10 of the "General questionable status register group".
Query	There is no query form of this command available.
Example	:STATus:QUESTionable:SYNChron:ENABLe 3 This means that any setting of one of the lower two bits of the synchronization questionable status event register will rise bit 10 of the general questionable status condition register.

:STAT:QUES:SYNChron:PTRansition

Syntax	:STAT:QUES:SYNChron:PTRansition <int1>
Parameters	int1 is an integer. The minimum value for int1 is 0, the maximum value is 32767. The default value is 32767.
Description	Sets the PTR mask of the "SYNChronization questionable status register group". This mask will be ANDed with the up to 16 bits of the PTR filter of the synchronization questionable status condition register to allow a positive transition of any bit (i.e. a transition from logic '0' to '1') to reach the synchronization questionable status event register. Note: The default of this mask is 32767 – that means that the mask will allow any positive transition of the lower 15 bits of the condition-type register to reach the event-type register of this group.
Query	There is no query form of this command available.
Example	:STAT:QUES:SYNChron:PTRansition 0 This means that none of the positive transitions of the synchronization questionable status condition register will be forwarded to the event-type register.

:STAT:QUES:SYNChron:NTRansition

Syntax	:STAT:QUES:SYNChron:NTRansition <int1>
Parameters	int1 is an integer. The minimum value for int1 is 0, the maximum value is 32767. The default value is 0.
Description	Sets the NTR mask of the "SYNChronization questionable status register group". This mask will be ANDed with the up to 16 bits of the NTR filter of the synchronization questionable status condition register to allow a reset (negative transition) of any bit (i.e. a transition from logic '1' to '0') to reach the corresponding event-type register. Note: The default of this mask is 0 – that means that the mask will not allow any negative transition of the 16 bits of the condition-type register to reach the corresponding event-type register.
Query	There is no query form of this command available.

Example

:STATus:QUESTionable:SYNChron:NTRansition 0

This means that none of the negative transitions of the condition-type register will be forwarded to the event-type register of this group.

FORMat subsystem

The FORMat subsystem sets and queries settings concerning the data output in remote mode.

:FORMat:MRESult:STYPe

Syntax	:FORMat:MRESult:STYPe <PredefExp>
Parameters	PredefExp is one of the following predefined expressions: STB SIGNal-ling MEASuring OPERation QUESTionable ALL . Default is that no additional information will be provided with the measurement result values.
Description	Specifies the type of additional information to be returned with any measurement result obtained by a FETCh command. The meaning of the settings is as follows: STB will deliver the current contents of the "Service register". SIGNalling stands for the current contents of the signaling operation condition register. MEASuring means that the current contents of the measuring operation condition register will be delivered back. OPERation will deliver the current contents of the general operation condition register. QUESTionable stands for the current contents of the general questionable status condition register. ALL will deliver the current contents of the eight most important registers. The order is as follows: <ol style="list-style-type: none"> 1. "Service register", 2. event status register, 3. general operation condition register, 4. signaling operation condition register, 5. measuring operation condition register, 6. general questionable status condition register, 7. RF questionable status condition register, and 8. synchronization questionable status condition register. The contents of every single register will be returned as an integer; the single values will be separated by commas.
Query	There is no query form of this command available.
Example	:FORMat:MRESult:HEADer ON :FORMat:MRESult:STYPe ALL :MEASure:RFTX:PRMS :FETCh:RFTX:PRMS The first command switches the transmission of the additional information on, the second command specifies that all current contents of the eight most important registers shall be returned. The third command starts a continuous measurement. The last command finally delivers the latest measurement result value plus the current contents of the main registers. The string delivered back: "0,128,256,8,1,0,0,0,4.63" .

:FORMat:MRESult:HEADer

Syntax	:FORMat:MRESult:HEADer <PredefExp>
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Parameters	PredefExp is one of the following predefined expressions: OFF ON . Default is OFF .
Description	Switches the transmission of the additional information (see explanation of the command above) either on or off. ON means that the current contents of the corresponding register(s) will be added at the beginning of every string returned by a FETCH command.
Query	There is no query form of this command available.
Example	:FORM:MRES:HEAD This command will switch the transmission of the additional information off.

:FORMat:ADELimiter

Syntax	:FORMat:ADELimiter <PredefExp>
Parameters	PredefExp is one of the following predefined expressions: COMMa COLOn SEMIcolon . Default is COMMa .
Description	Selects the delimiter to be used to separate parameters on commands and single measurement result values. 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	There is no query form of this command available.
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.
Description	Defines the number of digits after the decimal point to be used for floating point real numbers.
Query	There is no query form of this command available.
Example	:FORM:RES 0 Defines that there will be no digits after the decimal point.

CONFigure subsystem

This subsystem incorporates all changeable parameters of all systems implemented. The key commands are the following:

CONFigure:CSYSem	Selects the communications system to work with.
CONFigure:<SystemOption>:...	These commands select parameters within a communications system.
CONFigure:<SystemOption>:BS:...	These are the commands to set specific system parameters like the base station's RF output power level or its identity.
CONFigure:<SystemOption>:...:PER:...	These commands set the PER parameters.
CONFigure:<SystemOption>:...:GROup:...	With the help of these commands, groups of measurements may be defined.
CONFigure:COUPlOSS:...	These commands provide access to the coupling loss compensation feature of the 4400.

NOTE

Always select the communication system via the `:Configure:CSYSTEM` command first before you change any parameters using different SCPI commands.

:CONFigure:CSYSTEM

Syntax	<code>:CONFigure:CSYSTEM <PredefExp></code>
Parameters	<p>PredefExp is one of the following predefined expressions: NONE GENana GSM GPRS EGPRS CDMA WCDMA TDSCdma GCGenana GPGenana CDGenana EGPGenana WCGenana TDGenana AMPS AMGenana EVDO EVGenana Default is NONE</p>

Description	<p>Selects the type of communication system to be used.</p> <p>NONE means that there is no system loaded and that there will be no basic generator or analyzer functionality available. This parameter may be used to cancel all RF radiation from the Willtek 4400.</p> <p>GENana will make the Willtek 4400 work as a generator and analyzer for circuit-switched GSM signals. This setting is identical to GCGenana. Because of the implementation of packet-data channels, we recommend not to use the GENana parameter in new programs but the GCGenana parameter as it clearly marks that the Willtek 4400 will generate and analyze circuit-switched GSM signals only with this setting.</p> <p>GCGenana will set up the Willtek 4400 as a generator and analyzer for circuit-switched GSM signals (including multislots/HSCSD). Generator/analyzer means that there will be no call setup and therefore, all measurements will be asynchronous.</p> <p>GPGenana will make the Willtek 4400 work as an asynchronous generator and analyzer for all kinds of GSM signals (circuit-switched signals in single or multislots mode as well as packet-data channels (PDTCH in GPRS)).</p> <p>GSM will set up the Willtek 4400 as a test set for circuit-switched GSM systems (including multislots/HSCSD). All tests performed with this setting require a call setup. Therefore, this test mode is called the 'call mode'.</p> <p>GPRS will bring the Willtek 4400 into call mode for standard GSM and GPRS systems. This means that this parameter will enable testing of all kinds of GSM signals (circuit-switched signals in single or multislots mode as well as packet-data channels (GPRS)).</p> <p>EVGenana will set up the Willtek 4400 to work as an asynchronous generator and analyzer for all kinds of 1xEV-DO signals. The generator may be utilized for tuning an access terminal, while the analyzer may be used for modulation quality and power measurements of the access terminal's transmitter.</p> <p>EVDO will make the Willtek 4400 to simulate a 1xEV-DO base station. The mobile will then be allowed to perform a session open and a data connection. Once in the connection mode, the user may perform transmitter and receiver tests on the access terminal.</p> <p>Note: Please keep in mind that you have to select the communication system first when working with SCPI, as the default of this command is NONE.</p>
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	<pre>:CONFigure:CSYStem GSM :CONF:CSYS? Value returned: "GSM".</pre>

:CONFigure:COUPloss:STATE

Syntax	:CONFigure:COUPloss:STATE <PredefExp1>
Parameters	PredefExp1 is one of the following predefined expressions: ON OFF . Default is OFF .
Description	This command switches the use of a coupling loss table either on or off. Note: Coupling loss tables are used to compensate e.g. losses in cables. For more details, please refer to section Coupling Loss.
Query	The query form of this command will return the current setting. The string delivered back will contain one predefined expression as explained above.

Example	:CONFigure:COUPloss:STATE ON :CONF:COUP:STAT? Value returned: "ON"
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:CONFigure:COUPloss:NAME

Syntax	:CONFigure:COUPloss:NAME <string1>
Parameters	string1 is as string, giving the complete file name (and directory) of the coupling loss file to be loaded. The maximum length of string1 is 50 characters. The default for string1 is "example.cpl".
Description	This command loads the coupling loss description file, specified with the command's parameter. Please note that the data contained in the file need to be activated (using the CONF:COUP:STAT ON command described above) before the data contained in the file specified will have any effect on the measurement results. For more details, please refer to section "Coupling Loss".
Query	The query form of this command will return the name of the currently loaded coupling loss description file. The string delivered back will contain the full file name.
Example	:CONFigure:COUPloss:NAME "m7389.cpl" :CONF:COUP:NAME? Value returned: "m7389.cpl"

:CONFigure:COUPloss:INFormation?

Syntax	:CONFigure:COUPloss:INFormation?
Parameters	There are no parameters.
Description	This command is used to read out the comments saved with the coupling loss description file currently loaded. Note: There is only a query form of this command available.
Query	The query form of this command will return the comments saved with the coupling loss description. The string delivered back will contain a maximum of 255 characters.
Example	:CONFigure:COUPloss:INFormation? Value returned: "Motorola P7389 with Antenna Coupler"

:CONFigure:COUPloss:DATA

Syntax	:CONFigure:COUPloss:DATA <string1> ,<realf1>,<reala1>,<realf2>,<reala2> [,realf3] [,reala3] [,realf4] [,reala4] [,realf5] [,reala5] [,realf6] [,reala6] [,realf7] [,reala7] [,realf8] [,reala8] [,realf9] [,reala9] [,realf10] [,reala10] [,realf11] [,reala11] [,realf12] [,reala12] [,realf13] [,reala13] [,realf14] [,reala14] [,realf15] [,reala15] [,realf16] [,reala16] [,realf17] [,reala17] [,realf18] [,reala18] [,realf19] [,reala19] [,realf20] [,reala20]
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Parameters	<p>string1 is a comment line related to the coupling loss data. The maximum length of string1 is 255 characters.</p> <p>realfx are floating point real numbers, giving frequencies in MHz while realax are floating point real numbers, giving the corresponding coupling loss in dB. All realfx have to be within two frequency ranges. The lower frequency range is from 800.0 MHz to 1000.0 MHz; the higher frequency range is from 1700.0 MHz to 2000.0 MHz.</p> <p>The minimum resolution for all realfx values is 10 Hz (0.00001 MHz). The default value for all realfx is 800.0 MHz. The minimum value for all realax is -5.0 dB. The maximum value for all realax is 40.0 dB. The minimum resolution for all realax is 0.01 dB. The default value for all realax is 0.0.</p> <p>Notes</p> <ul style="list-style-type: none"> - Please keep in mind that at least one pair of values for a frequency and the related attenuation must be specified per frequency range, while all other 18 pairs are optional. - All realax values are interpreted as an attenuation level in dB. As a consequence, negative values mean an amplification of the input signal.
Description	With the help of this command, you may create a coupling loss description table, similar to how you would do it on the graphical user interface of the Willtek 4400.
Query	There is no query form of this command available.
Example	<code>:CONFigure:COUPloss:DATA "Motorola 7389 with cable #23",825.0,15.0,1750.0,19.0</code>

:CONFigure:ESYNc

Syntax	<code>:CONFigure:ESYNc?</code>
Parameters	There are no parameters.
Description	There is solely a query form of this command available.
Query	<p>The query form will return the status of the current external synchronization. The string delivered back will contain one of the following expressions:</p> <p>NONE MHZ5 MHZ10 MHZ13.</p>
Example	<p><code>:CONFigure:ESYNc?</code></p> <p>Value returned for example: "MHZ10".</p> <p>In this example, the 4400 frequency reference is synchronized to an external 10 MHz clock signal fed into the EXT SYNC connector on the rear panel.</p>

:CONFigure:EVDO:BS:ACCess:OLADjust[:DATA]

Syntax	<code>:CONFigure:EVDO:BS:ACCess:OLADjust[:DATA] <Int>, <PredefExp></code>
Parameters	<p>Int is an integer number. The minimum value is 0, the maximum value is 255. The default value is 78.</p> <p>PredefExp is one of the following predefined expressions: US800 USPCS TACS JTACS KPCS NMT450 IMT2000 MHZ900 MHZ1800 SEC800 PAMR400 PAMR800. Default is US800.</p>

Description	This command sets the open loop adjust value. This is an offset in dB needed by the mobile to calculate its pilot initial power. As this parameter may be different for every frequency band, the related frequency band has to be stated as well.
Query	The query form of this command returns the current setting in form of one integer number, contained in a string. The frequency band needs to be specified with the query (see example below).
Example	:CONFigure:EVDO:BS:ACCess:OLADjust:DATA 81,USPC :CONF:EVDO:BS:ACC:OLAD? USPC Value returned: "81".

:CONFigure:EVDO:BS:ACCess:PREamble

Syntax	:CONFigure:EVDO:BS:ACCess:PREamble <Int>
Parameters	Int is an integer number. The minimum value is 0, the maximum value is 7. The default value is 2.
Description	This command sets the length (in frames) of the access probe preamble.
Query	The query form of this command returns the current setting in form of one integer number, contained in a string.
Example	:CONFigure:EVDO:BS:ACCess:PREamble 1 :CONF:EVDO:BS:ACC:PRE? Value returned: "1".

:CONFigure:EVDO:BS:ACCess:PROBe:IADJust

Syntax	:CONFigure:EVDO:BS:ACCess:PROBe:IADJust <Int>
Parameters	Int is an integer number. The minimum value is -15, the maximum value is 16. The default value is 0.
Description	This command sets the initial adjust. This is an offset in dB, required by the mobile to calculate its pilot initial power.
Query	The query form of this command returns the current setting in form of one integer number, contained in a string.
Example	:CONFigure:EVDO:BS:ACCess:PROBe:IADJust 3 :CONF:EVDO:BS:ACC:PROB:IADJ? Value returned: "3".

:CONFigure:EVDO:BS:ACCess:PROBe:PSTep

Syntax	:CONFigure:EVDO:BS:ACCess:PROBe:PSTep <Real>
Parameters	Real is a floating point real number. The minimum value is 0.0, the maximum value is 7.5, the resolution is 0.5. The default value is 1.0.
Description	This command sets the power step. The power step (in dB, relative to the mobile's initial pilot power level) represents the amount by which the mobile shall increase its transmit power should the base station not react to its access probe.

Query	The query form of this command returns the current setting in form of one floating point real number, contained in a string.
Example	:CONFigure:EVDO:BS:ACCess:PROBe:PSTep 2.5 :CONF:EVDO:BS:ACC:PROB:PST? Value returned: "2.5".

:CONFigure:EVDO:BS:ACCess:PROBe:NSTep

Syntax	:CONFigure:EVDO:BS:ACCess:PROBe:NSTep <Int>
Parameters	Int is an integer number. The minimum value is 1, the maximum value is 15. The default value is 8.
Description	This command sets the number of steps (access probes) in a single access probe sequence.
Query	The query form of this command returns the current setting in form of one integer number, contained in a string.
Example	:CONFigure:EVDO:BS:ACCess:PROBe:NSTep 10 :CONF:EVDO:BS:ACC:PROB:NST? Value returned: "10".

:CONFigure:EVDO:BS:ACCess:PROBe:SEQMax

Syntax	:CONFigure:EVDO:BS:ACCess:PROBe:SEQMax <Int>
Parameters	Int is an integer number. The minimum value is 1, the maximum value is 15. The default value is 8.
Description	This command sets the maximum number of access probe sequences the mobile is to use.
Query	The query form of this command returns the current setting in form of one integer number, contained in a string.
Example	:CONFigure:EVDO:BS:ACCess:PROBe:SEQMax 15 :CONF:EVDO:BS:ACC:PROB:SEQM? Value returned: "10".

:CONFigure:EVDO:BS:CCHannel:ARFCn[:DATA]

Syntax	:CONFigure:EVDO:BS:CCHannel:ARFCn[:DATA] <Int>, [<PredefExp>]
Parameters	Int is an integer number. The minimum value is 0, the maximum value is 2047. The default value is 589. PredefExp is an optional predefined expression which can take on one of the following values: US800 USPCS TACS JTACS KPCS NMT450 IMT2000 MHZ900 MHZ1800 SEC800 PAMR400 PAMR800. Default is US800.
Description	This command sets the channel number for the control channel.
Query	The query form of this command returns the current setting in form of one integer number, contained in a string.

Example	<code>:CONFigure:EVDO:BS:CCHannel:ARFCn:DATA 117</code> <code>:CONF:EVDO:BS:CCH:ARFC?</code> Value returned: "117".
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:CONFigure:EVDO:BS:CCHannel:BAND

Syntax	<code>:CONFigure:EVDO:BS:CCHannel:BAND <PredefExp></code>
Parameters	PredefExp is one of the following predefined expressions: US800 USPCs TACS JTACS KPCS NMT450 IMT2000 MHZ900 MHZ1800 SEC800 PAMR400 PAMR800. Default is US800.
Description	This command sets the frequency band for the control channel.
Query	The query form of this command returns the current setting in form of one of the pre-defined expressions explained above, contained in a string.
Example	<code>:CONFigure:EVDO:BS:CCHannel:BAND SEC800</code> <code>:CONF:EVDO:BS:CCH:BAND?</code> Value returned: "SEC800".

:CONFigure:EVDO:BS:LEVel

Syntax	<code>:CONFigure:EVDO:BS:LEVel <Real></code>
Parameters	Real is a floating point real number. The minimum value is -120.0, the maximum value is 0.0. The minimum resolution is 0.1. The default value is -60.0.
Description	This command sets the RF output power level of the Willtek 4400 (i.e. simulated base station). The physical dimension is dBm.
Query	The query form of this command returns the current setting in form of one floating point real number, contained in a string.
Example	<code>:CONFigure:EVDO:BS:LEVel -50.5</code> <code>:CONF:EVDO:BS:LEV?</code> Value returned: "-50.5".

:CONFigure:EVDO:BS:NETWork:PREVision

Syntax	<code>:CONFigure:EVDO:BS:NETWork:PREVision <PredefExp></code>
Parameters	PredefExp is one of the following predefined expressions: REV0 REVA. Default is REV0.
Description	This command specifies the protocol revision of the 1xEV-DO standard to use.
Query	The query form of this command returns the current setting in form of one of the pre-defined expressions explained above, contained in a string.
Example	<code>:CONFigure:EVDO:BS:NETWork:PREVision REVA</code> <code>:CONF:EVDO:BS:NETW:PREV?</code> Value returned: "REVA".

:CONFigure:EVDO:BS:NETWork:PLAYer:TYPE

Syntax	:CONFigure:EVDO:BS:NETWork:PLAYer:TYPE <PredefExp>
Parameters	PredefExp is one of the following predefined expressions: TYPE0 TYPE2. Default is TYPE0.
Description	This command specifies the subtype of the physical layer that is to be used if the protocol version is set to REVA (see command above). For REVO, subtype 0 (TYPE0) will always be used.
Query	The query form of this command returns the current setting in form of one of the predefined expressions explained above, contained in a string.
Example	:CONFigure:EVDO:BS:NETWork:PLAYer:TYPE TYPE0 :CONF:EVDO:BS:NETW:PLAY:TYPE? Value returned: "TYPE0".

:CONFigure:EVDO:BS:NETWork:PNOffset

Syntax	:CONFigure:EVDO:BS:NETWork:PNOffset <Int>
Parameters	Int is an integer number. The minimum value is 0, the maximum values is 511. The default value is 12.
Description	This command sets the time offset to the PN sequence.
Query	The query form of this command returns the current setting in form of one integer number, contained in a string.
Example	:CONFigure:EVDO:BS:NETWork:PNOffset 50 :CONF:EVDO:BS:NETW:PNOF? Value returned: "50".

:CONFigure:EVDO:BS:NETWork:MCCode

Syntax	:CONFigure:EVDO:BS:NETWork:MCCode <Int>
Parameters	Int is an integer number. The minimum value is 0, the maximum values is 999. The default value is 310.
Description	This command sets the mobile country code to be broadcast by the Willtek 4400. Note: This is an important parameter that needs to match the mobile's preferred roaming list (PRL). Otherwise, it might not be possible to initiate a session.
Query	The query form of this command returns the current setting in form of one integer number, contained in a string.
Example	:CONFigure:EVDO:BS:NETWork:MCCode 249 :CONF:EVDO:BS:NETW:MCC? Value returned: "249".

:CONFigure:EVDO:BS:NETWork:CCODE

Syntax	:CONFigure:EVDO:BS:NETWork:CCODE <Int>
Parameters	Int is an integer number. The minimum value is 0, the maximum values is 255. The default value is 64 (80 in hex notation).
Description	This command sets the network's color code to be broadcast by the Willtek 4400. Note: This is an important parameter that needs to match the mobile's preferred roaming list (PRL). Otherwise, it might not be possible to initiate a session.
Query	The query form of this command returns the current setting in form of one integer number, contained in a string.
Example	:CONFigure:EVDO:BS:NETWork:CCODE 10 :CONF:EVDO:BS:NETW:CCOD? Value returned: "10".

:CONFigure:EVDO:BS:NETWork:SECTor:ID:MSW

Syntax	:CONFigure:EVDO:BS:NETWork:SECTor:ID:MSW <String>
Parameters	String represents a hexadecimal value with a maximum length of eight hexadecimal symbols (0 to 9, A to F a to f).
Description	This command specifies the most significant 32 bits (i.e. bits 127 to 96) of the 128 bit long sector ID parameter.
Query	The query form of this command returns the current setting in form of eight hexadecimal symbols, contained in a string.
Example	:CONFigure:EVDO:BS:NETWork:SECTor:ID:MSW "2468ACEF" :CONF:EVDO:BS:NETW:SECT:ID:MSW? Value returned: " "2468ACEF" ".

:CONFigure:EVDO:BS:NETWork:SECTor:ID:SSW

Syntax	:CONFigure:EVDO:BS:NETWork:SECTor:ID:SSW <String>
Parameters	String represents a hexadecimal value with a maximum length of eight hexadecimal symbols (0 to 9, A to F a to f).
Description	This command specifies the second most significant 32 bits (i.e. bits 95 to 64) of the 128 bit long sector ID parameter.
Query	The query form of this command returns the current setting in form of eight hexadecimal symbols, contained in a string.
Example	:CONFigure:EVDO:BS:NETWork:SECTor:ID:SSW "1357bdfF" :CONF:EVDO:BS:NETW:SECT:ID:SSW? Value returned: " "1357bdfF" ".

:CONFigure:EVDO:BS:NETWork:SECTor:ID:TSW

Syntax	:CONFigure:EVDO:BS:NETWork:SECTor:ID:TSW <String>
Parameters	String represents a hexadecimal value with a maximum length of eight hexadecimal symbols (0 to 9, A to F a to f).
Description	This command specifies the third most significant 32 bits (i.e. bits 63 to 32) of the 128 bit long sector ID parameter.
Query	The query form of this command returns the current setting in form of eight hexadecimal symbols, contained in a string.
Example	:CONFigure:EVDO:BS:NETWork:SECTor:ID:TSW "2468ACEF" :CONF:EVDO:BS:NETW:SECT:ID:TSW? Value returned: "2468ACEF".

:CONFigure:EVDO:BS:NETWork:SECTor:ID:LSW

Syntax	:CONFigure:EVDO:BS:NETWork:SECTor:ID:LSW <String>
Parameters	String represents a hexadecimal value with a maximum length of eight hexadecimal symbols (0 to 9, A to F a to f).
Description	This command specifies the least significant 32 bits (i.e. bits 31 to 0) of the 128 bit long sector ID parameter.
Query	The query form of this command returns the current setting in form of eight hexadecimal symbols, contained in a string.
Example	:CONFigure:EVDO:BS:NETWork:SECTor:ID:LSW "FDBA9753" :CONF:EVDO:BS:NETW:SECT:ID:LSW? Value returned: "FDBA9753".

:CONFigure:EVDO:BS:NETWork:SECTor:SMASk

Syntax	:CONFigure:EVDO:BS:NETWork:SECTor:SMASk <Int>
Parameters	Int is an integer number. The minimum value is 0, the maximum value is 128. The default value is 104.
Description	This command specifies the number of consecutive 1s in the subnet mask value to use (when looking at its binary representation). Note: This is an important parameter that needs to match the mobile's preferred roaming list (PRL). Otherwise, it might not be possible to initiate a session.
Query	The query form of this command returns the current setting in form of one integer number, contained in a string.
Example	:CONFigure:EVDO:BS:NETWork:SECTor:SMASk 0 :CONF:EVDO:BS:NETW:SECT:SMAS? Value returned: "0".

:CONFigure:EVDO:BS:NETWork:CCHannel:DRATe

Syntax	:CONFigure:EVDO:BS:NETWork:CCHannel:DRATe <PredefExp>
Parameters	PredefExp is one of the following predefined expressions: R38400 R76800. Default is R76800.
Description	This command specifies the data rate for the Willtek 4400 to use on its control channel.
Query	The query form of this command returns the current setting in form of one predefined expression as explained above, contained in a string.
Example	:CONFigure:EVDO:BS:NETWork:CCHannel:DRATe R76800 :CONF:EVDO:BS:NETW:CCH:DRAT? Value returned: "R76800".

:CONFigure:EVDO:BS:NETWork:CCHannel:PCCCycle:STATE

Syntax	:CONFigure:EVDO:BS:NETWork:CCHannel:PCCCycle:STATE <Bool>
Parameters	Bool is a boolean value (0 1). The default value is 0.
Description	This command enables (parameter value set to 1) or disables (parameter value set to 0) the preferred control channel cycle.
Query	The query form of this command returns the current setting in form of one boolean value, contained in a string.
Example	:CONFigure:EVDO:BS:NETWork:CCHannel:PCCCycle:STATE 1 :CONF:EVDO:BS:NETW:CCH:PCCC:STAT? Value returned: "1".

:CONFigure:EVDO:BS:NETWork:CCHannel:PCCCycle:NUMBER

Syntax	:CONFigure:EVDO:BS:NETWork:CCHannel:PCCCycle:NUMBER <Int>
Parameters	Int is an integer number. The minimum value is 0, the maximum value is 32767. The default value is 8096.
Description	This command sets the preferred control channel cycle value. Note: This is an important parameter that needs to match the corresponding value for the mobile (it may be different from mobile to mobile). An improper setting will result in a rejection from the mobile during session negotiation.
Query	The query form of this command returns the current setting in form of one integer number, contained in a string.
Example	:CONFigure:EVDO:BS:NETWork:CCHannel:PCCCycle:NUMBER 102 :CONF:EVDO:BS:NETW:CCH:PCCC:NUMB? Value returned: "102".

:CONFigure:EVDO:BS:TCHannel:ARFCn[:DATA]

Syntax	:CONFigure:EVDO:BS:TCHannel:ARFCn[:DATA] <Int>, [<PredefExp>]
Parameters	Int is an integer number. The minimum value is 0, the maximum value is 2047. The default value is 589. PredefExp is an optional predefined expression which can take on one of the following values: US800 USPCs TACS JTACS KPCS NMT450 IMT2000 MHZ900 MHZ1800 SEC800 PAMR400 PAMR800. Default is US800.
Description	This command sets the channel number for the traffic (data) channel.
Query	The query form of this command returns the current setting in form of one integer number, contained in a string.
Example	:CONFigure:EVDO:BS:TCHannel:ARFCn 0 :CONF:EVDO:BS:TCH:ARFC? Value returned: "0".

CONFigure:EVDO:BS:TCHannel:BAND

Syntax	:CONFigure:EVDO:BS:TCHannel:BAND <PredefExp>
Parameters	PredefExp is one of the following predefined expressions: US800 USPCs TACS JTACS KPCS NMT450 IMT2000 MHZ900 MHZ1800 SEC800 PAMR400 PAMR800. Default is US800.
Description	This command sets the frequency band for the traffic (data) channel.
Query	The query form of this command returns the current setting in form of one of the predefined expressions explained above, contained in a string.
Example	:CONFigure:EVDO:BS:TCHannel:BAND TACS :CONF:EVDO:BS:TCH:BAND? Value returned: "TACS".

:CONFigure:EVDO:BS:TCHannel:APPLication[:TYPE]

Syntax	:CONFigure:EVDO:BS:TCHannel:APPLication[:TYPE] <PredefExp>
Parameters	PredefExp is one of the following predefined expressions: FTAP RTAP. The default is FTAP.
Description	This command specifies the test application protocol to be used when in connected state.
Query	The query form of this command returns the current setting in form of one of the predefined expressions explained above, contained in a string.
Example	:CONFigure:EVDO:BS:TCHannel:APPLication:TYPE FTAP :CONF:EVDO:BS:TCH:APPL? Value returned: "FTAP".

:CONFigure:EVDO:BS:TCHannel:APPLication:FTAP:DRATE

Syntax	:CONFigure:EVDO:BS:TCHannel:APPLication:FTAP:DRATE <PredefExp>
Parameters	PredefExp is one of the following predefined expressions: QPSK38 QPSK76 QPSK153 QPSK307 QPSK614 EPSK921 QPSK1228 EPSK1843 QAM2457 QAM3072. Default is QPSK307.
Description	This command specifies the forward channel data rate to be used when running FTAP.
Query	The query form of this command returns the current setting in form of one of the pre-defined expressions explained above, contained in a string.
Example	:CONF:EVDO:BS:TCHannel:APPLication:FTAP:DRATE QPSK153 :CONF:EVDO:BS:TCH:APPL:FTAP:DRAT? Value returned: "QPSK153".

:CONF:EVDO:BS:TCHannel:APPLication:FTAP:ABFMode

Syntax	:CONFigure:EVDO:BS:TCHannel:APPLication:FTAP:ABFMode <Bool>
Parameters	Bool is a boolean value 0 1. Default is 1.
Description	This command either enables the use of the ACK channel bit fixed mode (parameter value 1) or disables it (parameter value 0).
Query	The query form of this command returns the current setting in form of one boolean value, contained in a string.
Example	:CONF:EVDO:BS:TCHannel:APPLication:FTAP:ABFMode 0 :CONF:EVDO:BS:TCH:APPL:FTAP:ABFM? Value returned: "0".

:CONFigure:EVDO:BS:TCHannel:APPLication:DPACKets

Syntax	:CONFigure:EVDO:BS:TCHannel:APPLication:DPACKets <Int>
Parameters	Int is an integer number. The minimum value is 0, the maximum value is 100. The default value is 50.
Description	This command specifies the percentage of packets addressed to the mobile under test (in relation to the total amount of packets sent by the 4400). Increasing this value will increase the data handling load on the mobile.
Query	The query form of this command returns the current setting in form of one integer number, contained in a string.
Example	:CONFigure:EVDO:BS:TCHannel:APPLication:DPACKets 75 :CONF:EVDO:BS:TCH:APPL:DPAC? Value returned: "75".

:CONFigure:EVDO:BS:TCHannel:APPLication:LTAP

Syntax	:CONFigure:EVDO:BS:TCHannel:APPLication:LTAP <Bool>
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Parameters	Bool is a boolean value 0 1. Default is 0.
Description	This command specifies whether a limited subset of the test application protocol (TAP) shall be used in order to support older chipsets. A value of 0 will make the Willtek 4400 to use the standard TAP (in the direction as specified with the command described above), while a parameter value of 1 will make the test set to only use a limited TAP (LTAP).
Query	The query form of this command returns the current setting in form of one boolean value, contained in a string.
Example	:CONFigure:EVDO:BS:TCHannel:APPLication:LTAP 1 :CONF:EVDO:BS:TCH:APPL:LTAP? Value returned: "1".

:CONFigure:EVDO:BS:TCHannel:APPLication:RTAP:DRATE

Syntax	:CONFigure:EVDO:BS:TCHannel:APPLication:RTAP:DRATE <PredefExp>
Parameters	PredefExp is one of the following predefined expressions: BPSK9 BPSK19 BPSK38 BPSK76 BPSK153 QPSK230 QPSK307 QPSK460 QPSK614 QPSK921 QPSK1228 EPSK1843. Default is BPSK9.
Description	This command specifies the reverse channel data rate to be used when running RTAP.
Query	The query form of this command returns the current setting in form of one of the predefined expressions explained above, contained in a string.
Example	:CONF:EVDO:BS:TCHannel:APPLication:RTAP:DRATE BPSK76 :CONF:EVDO:BS:TCH:APPL:RTAP:DRAT? Value returned: "BPSK76".

:CONFigure:EVDO:BS:TCHannel:PCONTrol:SElect

Syntax	:CONFigure:EVDO:BS:TCHannel:PCONTrol:SElect <PredefExp>
Parameters	PredefExp is one of the following predefined expressions: ALternating ACTive UP DOWN. Default is ALternating.
Description	This command sets, how power control is to be handled with the mobile.
Query	The query form of this command returns the current setting in form of one of the predefined expressions explained above, contained in a string.
Example	:CONFigure:EVDO:BS:TCHannel:PCONTrol:SElect ACTive :CONF:EVDO:BS:TCH:PCON:SEL? Value returned: "ACTive".

:CONF:EVDO:BS:TCHannel:PCONTrol:RESet[:IMMediate]

Syntax	:CONFigure:EVDO:BS:TCHannel:PCONTrol:RESet[:IMMediate]
Parameters	There are no parameters.

Description	This command resets the power control and makes the Willtek 4400 return the mobile power to initial test conditions. Note: This command is only valid if the power control mode selected is ALternating (see above).
Query	There is no query form of this command available.
Example	:CONF:EVDO:BS:TCH:PCON:RES

:CONFigure:EVDO:BS:TCHannel:PCONtrol:ONCE

Syntax	:CONFigure:EVDO:BS:TCHannel:PCONtrol:ONCE <PredefExp>, <Int>
Parameters	PredefExp is one of the following predefined expressions: UP DOWN. The default is UP. Int is an integer number. The minimum value is 1, the maximum value is 100. The default value is 1.
Description	This command causes a number of power control bits (specified by the integer number) to be sent to the mobile in the direction specified (by the predefined expression).
Query	There is no query form of this command available.
Example	:CONF:EVDO:BS:TCH:PCON:ONCE UP,10 Commands the Willtek 4400 to send ten power increase control bits to the mobile.

:CONFigure:EVDO:BS:TCHannel:REVerse:GAIN:ACKChannel

Syntax	:CONFigure:EVDO:BS:TCHannel:REVerse:GAIN:ACKChannel <Real>
Parameters	Real is a floating point real number. The minimum value is -3.0, the maximum value is 6.0. The resolution is 0.5. The default value is 3.0.
Description	This command specifies the ACK channel gain. This is an offset in dB to the mobile's R-pilot power. This value is sent in the TCH assignment message to the mobile. The mobile needs this value to calculate its power level when transmitting data on the R-ACK (reverse acknowledgement channel).
Query	The query form of this command returns the current setting in form of one floating point real number, contained in a string.
Example	:CONFigure:EVDO:BS:TCHannel:REVerse:GAIN:ACKChannel 2.5 :CONF:EVDO:BS:TCH:REV:GAIN:ACKC? Value returned: " 2.5 ".

:CONFigure:EVDO:BS:TCHannel:REVerse:GAIN:DRCChannel

Syntax	:CONFigure:EVDO:BS:TCHannel:REVerse:GAIN:DRCChannel <Real>
Parameters	Real is a floating point real number. The minimum value is -9.0, the maximum value is 6.0. The resolution is 0.5. The default value is 3.0.

Description	This command specifies the DRC channel gain. This is an offset in dB to the mobile's R-pilot power. This value is sent in the TCH assignment message to the mobile. The mobile needs this value to calculate its power level when transmitting data on the R-DRC (reverse data rate control channel).
Query	The query form of this command returns the current setting in form of one floating point real number, contained in a string.
Example	:CONFigure:EVDO:BS:TCHannel:REVerse:GAIN:DRCChannel 2.5 :CONF:EVDO:BS:TCH:REV:GAIN:DRCC? Value returned: "2.5".

:CONFigure:EVDO:BS:TCHannel:REVerse:GAIN:DSCChannel

Syntax	:CONFigure:EVDO:BS:TCHannel:REVerse:GAIN:DSCChannel <Real>
Parameters	Real is a floating point real number. The minimum value is -12.0, the maximum value is 0.0. The resolution is 0.5. The default value is 0.0.
Description	This command specifies the DSC channel gain. This is an offset in dB to the mobile's R-pilot power. This value is sent in the TCH assignment message to the mobile. The mobile needs this value to calculate its power level when transmitting data on the R-DSC (reverse data source channel).
Query	The query form of this command returns the current setting in form of one floating point real number, contained in a string.
Example	:CONF:EVDO:BS:TCHannel:REVerse:GAIN:DSCChannel -4.0 :CONF:EVDO:BS:TCH:REV:GAIN:DSCC? Value returned: "-4.0".

:CONF:EVDO:BS:TCHannel:REVerse:GAIN:DOFFset:NOMinal

Syntax	:CONFigure:EVDO:BS:TCHannel:REVerse:GAIN:DOFFset :NOMinal <Real>
Parameters	Real is a floating point real number. The minimum value is -3.5, the maximum value is 4.0. The resolution is 0.5. The default value is 0.0.
Description	This command specifies the data offset nominal. This is an offset in dB to the mobile's R-pilot power. This value is sent in the TCH assignment message to the mobile. The mobile needs this value to calculate its power level when transmitting data.
Query	The query form of this command returns the current setting in form of one floating point real number, contained in a string.
Example	:CONF:EVDO:BS:TCH:REVerse:GAIN:DOFFset:NOMinal -1.5 :CONF:EVDO:BS:TCH:REV:GAIN:DOFF:NOM? Value returned: "-1.5".

:CONF:EVDO:BS:TCHannel:REVerse:GAIN:DOFFset:RATA

Syntax	:CONFigure:EVDO:BS:TCHannel:REVerse:GAIN:DOFFset:RATA <Real>
Parameters	Real is a floating point real number. The minimum value is -1.75, the maximum value is 2.0. The resolution is 0.25. The default value is 0.0.

Description	This command specifies the data power offset to use for the 9.6 Kbps data rate on the R-TCH. This value is relative to the R-Pilot power in dB (and is used in addition to the data offset nominal gain). The value is sent in the TCH assignment message to the mobile.
Query	The query form of this command returns the current setting in form of one floating point real number, contained in a string.
Example	:CONF:EVDO:BS:TCHannel:REVerse:GAIN:DOFFset:RATA -1.25 :CONF:EVDO:BS:TCH:REV:GAIN:DOFF:RATA? Value returned: "-1.25".

:CONF:EVDO:BS:TCHannel:REVerse:GAIN:DOFFset:RATB

Syntax	:CONFigure:EVDO:BS:TCHannel:REVerse:GAIN:DOFFset:RATB <Real>
Parameters	Real is a floating point real number. The minimum value is -1.75, the maximum value is 2.0. The resolution is 0.25. The default value is 0.0.
Description	This command specifies the data power offset to use for the 19.2 Kbps data rate on the R-TCH. This value is relative to the R-Pilot power in dB (and is used in addition to the data offset nominal gain). The value is sent in the TCH assignment message to the mobile.
Query	The query form of this command returns the current setting in form of one floating point real number, contained in a string.
Example	:CONF:EVDO:BS:TCHannel:REVerse:GAIN:DOFFset:RATB -1.25 :CONF:EVDO:BS:TCH:REV:GAIN:DOFF:RATB? Value returned: "-1.25".

:CONF:EVDO:BS:TCHannel:REVerse:GAIN:DOFFset:RATC

Syntax	:CONFigure:EVDO:BS:TCHannel:REVerse:GAIN:DOFFset:RATC <Real>
Parameters	Real is a floating point real number. The minimum value is -1.75, the maximum value is 2.0. The resolution is 0.25. The default value is 0.0.
Description	This command specifies the data power offset to use for the 38.4 Kbps data rate on the R-TCH. This value is relative to the R-Pilot power in dB (and is used in addition to the data offset nominal gain). The value is sent in the TCH assignment message to the mobile.
Query	The query form of this command returns the current setting in form of one floating point real number, contained in a string.
Example	:CONF:EVDO:BS:TCHannel:REVerse:GAIN:DOFFset:RATC -1.25 :CONF:EVDO:BS:TCH:REV:GAIN:DOFF:RATC? Value returned: "-1.25".

:CONF:EVDO:BS:TCHannel:REVerse:GAIN:DOFFset:RATD

Syntax	:CONFigure:EVDO:BS:TCHannel:REVerse:GAIN:DOFFset:RATD <Real>
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Parameters	Real is a floating point real number. The minimum value is -2.0, the maximum value is 1.75. The resolution is 0.25. The default value is -2.0.
Description	This command specifies the data power offset to use for the 76.9 Kbps data rate on the R-TCH. This value is relative to the R-Pilot power in dB (and is used in addition to the data offset nominal gain). The value is sent in the TCH assignment message to the mobile.
Query	The query form of this command returns the current setting in form of one floating point real number, contained in a string.
Example	:CONF:EVDO:BS:TCHannel:REVerse:GAIN:DOFFset:RATD -1.25 :CONF:EVDO:BS:TCH:REV:GAIN:DOFF:RATD? Value returned: "-1.25".

:CONF:EVDO:BS:TCHannel:REVerse:GAIN:DOFFset:RATE

Syntax	:CONFigure:EVDO:BS:TCHannel:REVerse:GAIN:DOFFset:RATE <Real>
Parameters	Real is a floating point real number. The minimum value is -2.0, the maximum value is 1.75. The resolution is 0.25. The default value is -2.0.
Description	This command specifies the data power offset to use for the 153.6 Kbps data rate on the R-TCH. This value is relative to the R-Pilot power in dB (and is used in addition to the data offset nominal gain). The value is sent in the TCH assignment message to the mobile.
Query	The query form of this command returns the current setting in form of one floating point real number, contained in a string.
Example	:CONF:EVDO:BS:TCHannel:REVerse:GAIN:DOFFset:RATE -1.25 :CONF:EVDO:BS:TCH:REV:GAIN:DOFF:RATE? Value returned: "-1.25".

:CONFigure:EVDO:MEASure:GROUp[:RFTX]

Syntax	:CONFigure:EVDO:MEASure:GROUp[:RFTX] <PredefExp1>[, <PredefExp2>, ... <PredefExp12>]
Parameters	PredefExpn is one of the following 12 predefined expressions: PPHAserr PHASeerr PEAKerr RMSErr FREQuency POWer PMAGerr MAGerr TIMEerr WQUALity CARRierfeed IQIMbalance. At least one parameter needs to be specified. A maximum of 12 parameters can be specified, separated by commas (see example below).

Description	Sets the group of measurements to be carried out by the :MEASure:EVDO:RFTX:GROup command. A maximum of twelve individual measurements can be specified for the group measurement: PPHAserr - peak value of the error vector's phase component PHAserr - RMS value of the error vector's phase component PEAKerr - peak value of the error vector RMSErr - RMS value of the error vector FREQuency - frequency error POWer - the mobile's effective radiated power PMAGerr - the peak value of the error vector's magnitude component MAGerr - the RMS value of the error vector's magnitude component TIMEerr - the mobile's transmit time error WQUAlity - the modulation quality (rho) CARRierfeed - the mobile's carrier feedthrough IQIMbalance - the mobile's IQ imbalance
Query	The query form of this command returns the current setting in form of one or several (up to 12) predefined expressions as described above, contained in a string.
Example	:CONFigure:EVDO:MEASure:GROup:RFTX POW,WQUA,PEAK :CONF:EVDO:MEAS:GRO? Returned string: "POW,WQUA,PEAK".

:CONFigure:EVDO:MEASure:RFRX:PER[:MAXimum]

Syntax	:CONFigure:EVDO:MEASure:RFRX:PER[:MAXimum] <Int>
Parameters	Int is an integer number. The minimum value is 100, the maximum value 10000. The default value is 1000.
Description	This command sets the maximum number of packets to be used for the packet error rate measurement.
Query	The query form of this command returns the current setting in form of one integer number, contained in a string.
Example	:CONFigure:EVDO:MEASure:RFRX:PER:MAXimum 10000 :CONF:EVDO:MEAS:RFRX:PER? Value returned: "10000".

:CONFigure:EVDO:MEASure:RFRX:PER:CONFidence

Syntax	:CONFigure:EVDO:MEASure:RFRX:PER:CONFidence <Real>
Parameters	Real is a floating point real number. The minimum value is 90, the maximum value is 100, the resolution is 0.5. The default value is 95.0.
Description	This command sets the confidence (i.e. a percentage) for the PER measurement. The confidence is a statistical measure of the completeness of information obtained about a statistical process. A confidence level of less than 100% may result in the test being concluded before the specified number of packets has been reached, so that the test time can be shortened.
Query	The query form of this command returns the current setting in form of one floating point real number, contained in a string.

Example	<pre>:CONFigure:EVDO:MEASure:RFRX:PER:CONFidence 97.5 :CONF:EVDO:MEAS:RFRX:PER:CONF? Value returned: "97.5".</pre>
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:CONFigure:EVDO:MEASure:RFRX:PER:LIMit[:MAXimum]

Syntax	:CONFigure:EVDO:MEASure:RFRX:PER:LIMit[:MAXimum] <Real>
Parameters	Real is a floating point real number. The minimum value is 0, the maximum value is 5, the resolution is 0.1. The default value is 0.5.
Description	This command specifies the limit applied by the 4400 when indicating whether a PER measurement was passed or failed.
Query	The query form of this command returns the current setting in form of one floating point real number, contained in a string.
Example	<pre>:CONFigure:EVDO:MEASure:RFRX:PER:LIMit:MAXimum 0.8 :CONF:EVDO:MEAS:RFRX:PER:LIM? Value returned: "0.8".</pre>

:CONFigure:EVDO:RANGing:MODE

Syntax	:CONFigure:EVDO:RANGing:MODE <PredefExp>
Parameters	PredefExp is one of the following predefined expressions: AUTO FIXEd UP DOWN NO FORCed_up. Default is AUTO.
Description	This command selects the ranging mode of the RF analyzer.
Query	The query form of this command returns the current setting in form of one of the predefined expressions explained above, contained in a string.
Example	<pre>:CONFigure:EVDO:RANGing:MODE FIXEd :CONF:EVDO:RANG:MODE? Value returned: "FIXEd".</pre>

CALL subsystem

This subsystem contains commands

- for call setup and handling procedures and
- to read out the mobile's ID and further mobile parameters.

:CALL:EVDO:SESSion:OPEN:ENABle

Syntax	<code>:CALL:EVDO:SESSion:OPEN:ENABle <Bool></code>
Parameters	<code>Bool</code> is a boolean value 0 1. Default is 1.
Description	This command determines whether the mobile is allowed to open a session with the base station simulated by the Willtek 4400 or not. When disabled (parameter value set to 0), the test set will not respond to the mobile's UATI request message. This will cause the mobile to repeatedly send access probes, but a session will not commence. The parameter value is normally set to 1 to allow connection of the mobile to the Willtek 4400 for testing.
Query	The query form of this command returns the current setting in form of one boolean value, contained in a string.
Example	<code>:CALL:EVDO:SESSion:OPEN:ENABle 0</code> <code>:CALL:EVDO:SESS:OPEN:ENAB?</code> Value returned: "0".

:CALL:EVDO:SESSion:OPEN:STATe

Syntax	<code>:CALL:EVDO:SESSion:OPEN:STATe? <Int></code>
Parameters	<code>Int</code> is an integer number. The minimum value is 0, the maximum value is 100. The default value is 0.
Description	This is a query-only command. This command checks whether a session has been opened with the mobile. If the parameter value is set to 0, or if a session is already open, this command will return the current session state immediately. Otherwise, it will wait for the next change of the session state with the maximum time-out specified by the parameter value (in seconds) before returning the state. Note: This is an overlapped command using the OPC_CALL_PROC bit.
Query	The query form of this command returns the current session state in form of one boolean value, contained in a string. This boolean value will be set to 1 if a session is open.
Example	<code>:CALL:EVDO:SESSion:OPEN:STATe? 10</code> This command will wait for a maximum of 10 seconds for the current session state to change. After a change in the session state, or latest after 10 seconds, it will return the current session state. If there is no session open, the query will return "0".

:CALL:EVDO:SESSion:CLOSe[:IMMediate]

Syntax	<code>:CALL:EVDO:SESSion:CLOSe[:IMMediate]</code>
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Parameters	There are no parameters for this command.
Description	This command immediately closes a session with the mobile.
Query	There is no query form of this command available.
Example	:CALL:EVDO:SESSion:CLOSe:IMMediate

:CALL:EVDO:CONNECTION:OPEN[:IMMediate]

Syntax	:CALL:EVDO:CONNECTION:OPEN[:IMMediate]
Parameters	There are no parameters for this command.
Description	This command will make the Willtek 4400 to immediately respond to the mobile's UATI request message. A session will be negotiated and opened with the mobile. Forward and reverse traffic channels will be activated.
Query	There is no query form of this command available.
Example	:CALL:EVDO:CONNECTION:OPEN:IMMediate

:CALL:EVDO:CONNECTION:OPEN:STATE

Syntax	:CALL:EVDO:CONNECTION:OPEN:STATE <Int>
Parameters	Int is an integer number. The minimum value is 0, the maximum value is 100. The default value is 0.
Description	This is a query-only command. This command checks whether there is a connection between the mobile and the Willtek 4400. If the parameter value is set to 0, or if there is already a connection open, this command will return the current connection state immediately. Otherwise, it will wait for the next change of the connection state with the maximum time-out specified by the parameter value (in seconds) before returning the state. Note: This is an overlapped command using the OPC_CALL_PROC bit.
Query	The query form of this command returns the current connection state in form of one boolean value, contained in a string. This boolean value will be set to 1 if there is a connection between the mobile and the Willtek 4400.
Example	:CALL:EVDO:CONNECTION:OPEN:STATE? 10 This command will wait for a maximum of 10 seconds for the current connection state to change. After a change in the connection state, or latest after 10 seconds, it will return the current state. If there is no connection, the query will return "0".

:CALL:EVDO:CONNECTION:CLOSE[:IMMediate]

Syntax	:CALL:EVDO:CONNECTION:CLOSE[:IMMediate]
Parameters	There are no parameters for this command.
Description	This command immediately closes a connection with the mobile and deactivates the forward and reverse traffic channels.
Query	There is no query form of this command available.

Example	:CALL:EVDO:CONNECTION:CLOSE:IMMEDIATE
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:CALL:EVDO:HANDOFF[:IMMEDIATE]

Syntax	:CALL:EVDO:HANDOFF[:IMMEDIATE]
Parameters	There are no parameters for this command.
Description	This command initiates a handoff to the channel and frequency band selected using the :CALL:EVDO:HAND commands (see below).
Query	There is no query form of this command available.
Example	:CALL:EVDO:HANDOFF:IMMEDIATE

:CALL:EVDO:HANDOFF:BAND

Syntax	:CALL:EVDO:HANDOFF:BAND <PredefExp>
Parameters	PredefExp is one of the following predefined expressions: US800 USPCs TACS JTACS KPCS NMT450 IMT2000 MHZ900 MHZ1800 SEC800 PAMR400 PAMR800. Default is US800.
Description	This command specifies the band to be used following the issue of a :CALL:EVDO:HANDOFF:IMMEDIATE command (see above).
Query	The query form of this command returns the currently set frequency band in form of one of the predefined expressions explained above, contained in a string.
Example	:CALL:EVDO:HANDOFF:BAND USPCs :CALL:EVDO:HAND:BAND? - Value returned: "US800" :CALL:EVDO:HAND :CALL:EVDO:HAND:BAND? - Value returned: "USPCs".

:CALL:EVDO:HANDOFF:ARFCN

Syntax	:CALL:EVDO:HANDOFF:ARFCN <Int>
Parameters	Int is an integer number. The minimum value is 0, the maximum value is 2047. The initial default is 29, which changes to the current channel during a call setup.
Description	This command specifies the frequency channel for the TCH to be used following the issue of a :CALL:EVDO:HANDOFF:IMMEDIATE command (see above).
Query	The query form of this command returns the currently set frequency channel in form of one integer number, contained in a string.
Example	:CALL:EVDO:HANDOFF:ARFCN 150 :CALL:EVDO:HAND :CALL:EVDO:HAND:ARFC? Value returned: "150".

:CALL:EVDO:MSINFO:PClass[:DATA]

Syntax	:CALL:EVDO:MSINFO:PClass[:DATA] <Int>, <PredefExp>
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Parameters	Int is an integer number with a minimum value of 1, the maximum value is 5. The default value is 1. PredefExp is one of the following predefined expressions: US800 USPCS TACS JTACS KPCS NMT450 IMT2000 MHZ900 MHZ1800 SEC800 PAMR400 PAMR800. Default is US800.
Description	This command specifies the mobile's power class for a specified band. It is used to indicate the maximum power the mobile can output, which will affect the maximum power test as well as the expected power value used in a power control reset.
Query	The query form of this command returns the mobile's power class in form of one integer and the corresponding maximum output power level (in dBm) in form of a floating point real number, both separated by a comma. The band needs to be used as a parameter when issuing the query form of the command (see example below).
Example	:CALL:EVDO:MSInfo:PClass:DATA 2, US800 :CALL:EVDO:MSIN:PCL? US800 String returned: "2,27.0".

:CALL:EVDO:MSInfo:MACIndex

Syntax	:CALL:EVDO:MSInfo:MACIndex?
Parameters	There are no parameters for this command.
Description	This is a query-only command, returning the MAC index assigned to the mobile.
Query	The query form of this command returns the MAC index in form of one integer number, contained in a string.
Example	:CALL:EVDO:MSInfo:MACIndex? Value returned: "6".

:CALL:EVDO:MSInfo:HARDware:IDType

Syntax	:CALL:EVDO:MSInfo:HARDware:IDType?
Parameters	There are no parameters for this command.
Description	This is a query-only command, returning the 24 bit hardware ID type for the mobile. Note: This information will only be available after a session has been opened successfully.
Query	The query form of this command returns the MAC index in form of six hexadecimal values (0 to 9, A to F a to f), contained in a string.
Example	:CALL:EVDO:MSInfo:HARDware:IDType? Value returned: " "248ACE" ".

:CALL:EVDO:MSInfo:HARDware:IDValue[:DECimal]

Syntax	:CALL:EVDO:MSInfo:HARDware:IDValue[:DECimal]?
Parameters	There are no parameters for this command.
Description	There is only a query form of this command available.

Query	<p>This is a query-only command, returning the mobile's hardware ID value.</p> <p>Note: This information will only be available after a session has been opened successfully.</p> <p>The response data is a string formatted as a 3-digit followed by a 8-digit decimal value as "DDD-DDDDDDDD" if ID Type = 0x010000 (ESN) and as a 10-digit followed by a 8-digit decimal value as "DDDDDDDDDD-DDDDDDDD" if ID Type = 0x00FFFF (MEID) and as a single 10-digit value "DDDDDDDDDD" otherwise, where D = decimal digit { 0-9 }.</p>
Example	<p>:CALL:EVDO:MSIN:HARD:IDV?</p> <p>Value returned such as: "123-45678901".</p>

:CALL:EVDO:MSInfo:HARdware:IDValue:HEX

Syntax	:CALL:EVDO:MSInfo:HARdware:IDValue:HEX?
Parameters	There are no parameters for this command.
Description	There is only a query form of this command available.
Query	<p>This query returns the mobile's hardware ID value in hexadecimal format.</p> <p>Note: This information will only be available after a session has been opened successfully.</p> <p>The response data is a string formatted as a 2-digit followed by a 6-digit hex value as "HH-HHHHHH" if ID Type = 0x010000 (ESN) and as an 8-digit followed by a 6-digit hex value as "HHHHHHHH-HHHHHH" if ID Type = 0x00FFFF (MEID) and as a single 8-digit value "HHHHHHHH" otherwise, where H = hexadecimal digit { 0-9, A-F }.</p>
Example	<p>:CALL:EVDO:MSIN:HARD:IDV:HEX?</p> <p>Value returned such as: "12-ABCDEF".</p>

:CALL:EVDO:MSInfo:UCCode

Syntax	:CALL:EVDO:MSInfo:UCCode?
Parameters	There are no parameters for this command.
Description	There is only a query form of this command available.
Query	<p>This query returns the mobile's UATI color code in decimal format.</p> <p>Note: This information will only be available after a session has been opened successfully.</p>
Example	<p>:CALL:EVDO:MSIM:UCC?</p> <p>Value returned such as: "64".</p>

:CALL:EVDO:MSInfo:UATI

Syntax	:CALL:EVDO:MSInfo:UATI?
Parameters	There are no parameters for this command.
Description	There is only a query form of this command available.
Query	<p>This query returns the 24 LSBits of the mobile's UATI value in decimal format.</p> <p>Note: This information will only be available after a session has been opened successfully.</p>

Example	<code>:CALL:EVDO:MSIN:UATI?</code> Value returned such as: "6636321".
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`:CALL:EVDO:MSINfo:SSEEd`

Syntax	<code>:CALL:EVDO:MSINfo:SSEEd</code>
Parameters	There are no parameters for this command.
Description	This command returns the 32-bit session seed value for the AT as a hexadecimal value. This information is received after a session is successfully opened.
Query	This is a query-only command. The response data is a string formatted as a 8-digit hex value "0xHHHHHHHH" otherwise, where H = hex digit { 0-9, A-F }.
Example	<code>:CALL:EVDO:MSIN:SSEE?</code> Value returned such as: "0x12345678"

MEASure subsystem

The MEASure subsystem is probably the most important SCPI command subsystem of the Willtek 4400. There, you will find all commands required to acquire measurement results of the mobile under test.

:MEASure[:CONTinuous]:AFANalyser:STOP

Syntax	<code>:MEASure[:CONTinuous]:AFANalyser:STOP</code>
Parameters	There are no parameters.
Description	Stops continuous audio measurements. Note Stopping the test is not required since a test is automatically stopped when you start a new test.
Query	The query form of this command is not available.
Example	<code>:MEAS:AFAN:SIN</code> <code>:MEAS:AFAN:STOP</code> Starts and stops a measurement.

:MEASure[:CONTinuous]:AFANalyser:GRoup

Syntax	<code>:MEASure[:CONTinuous]:AFANalyser:GRoup</code>
Parameters	There are no parameters.
Description	Starts a continuous measurement of the audio tests, specified with the <code>:CONF:MEAS:GRO:AFAN</code> command. To read out the latest measurement results, use the <code>:FETCh:AFAN:GRoup</code> command. Notes: <ul style="list-style-type: none"> – Please keep in mind that the start of a new AF test will always terminate all other measurements (see section "The MEASure subsystem" on page 243 for details). – To perform any audio measurements on your Willtek 4400, the Audio Option must be installed. – For further details regarding group measurements, please refer to section ":MEASure:::GRoup" on page 250.
Query	The query form of this command will start the measurements and deliver back a string, containing the latest set of measurement result values. All measurement result values returned will be floating point real numbers. The order of the measurement result values returned is as described below (see command <code>:MEAS:AFAN:ALL</code>). The single measurement result values are separated by commas.
Example	<code>:CONF:MEAS:GRO:AFAN SIN,FREQ</code> <code>:MEASure:CONTinuous:AFANalyser:GRoup?</code> In this example, the group of measurements is defined by a SINAD measurement, combined with an AF frequency measurement. The measurement result string returned is: <code>"1000.0,50.5"</code> . Because of the internal order, the first measurement result value delivered back is the audio frequency, the second one the SINAD.

:MEASure[:CONTInuous]:AFANalyser:ALL

Syntax	:MEASure[:CONTInuous]:AFANalyser:ALL
Parameters	There are no parameters.
Description	<p>Starts a continuous measurement of the most important audio tests. To read out the latest measurement results, use the :FETCh:AFAN:ALL command.</p> <p>The audio tests performed by this command are:</p> <p>ACVPeakp, the peak-to-peak measurement of an AC voltage, ACVRms, the RMS-valued measurement of an AC voltage, DCV is used to measure AC ripple on DC lines (this measurement gives the root-mean square voltage of the AC component of the applied DC signal). FREQuency is the measurement of the audio frequency in Hertz, DIStortion is the distortion measurement on the third harmonic of a sine wave and expressed in %, while SINad is the measurement of the signal to noise ratio, expressed in dB.</p> <p>Notes:</p> <ul style="list-style-type: none"> - Please keep in mind that the start of a new AF test will always terminate all other measurements (see section "The MEASure subsystem" on page 243 for details). - Any AF measurement will need the Audio Option to be installed on your Willtek 4400. - For further details regarding group measurements, please refer to section ":MEASure:...:GROup" on page 250.
Query	<p>The query form of this command starts the measurements and – after all measurements have been completed and all measurement results obtained – delivers a string, containing six floating point real numbers, representing the six measurement result values. The order of these measurement result values delivered back is as follows:</p> <ol style="list-style-type: none"> 1. ACVPeakp, representing the AC peak-to-peak voltage of the AF signal, 2. ACVRms, representing the RMS-valued AC voltage of the AF signal, 3. DCV, representing the RMS-valued AC voltage on an applied DC signal, 4. FREQuency, representing the audio frequency, 5. DIStortion, representing the third-harmonic distortion of the applied sine-wave AF signal and, 6. SINad, representing the signal to noise ratio of the applied AF signal.
Example	<p>:MEASure:CONTInuous:AFANalyser:ALL?</p> <p>In this case, all audio measurements will be performed in a sequence. As soon as all measurements have been completed and all measurement results obtained, a string will be delivered back containing six measurement result values:</p> <p>"0.7,0.25,0.0,1000.0,0.3,50.5".</p>

:MEASure[:CONTInuous]:AFANalyser:ACVoltage:PEAKp

Syntax	:MEASure[:CONTInuous]:AFANalyser:ACVoltage:PEAKp
Parameters	There are no parameters.
Description	<p>Starts a continuous measurement of the AC peak-to-peak voltage of the AF signal applied to the audio analyzer. To read out the latest measurement result, use the :FETCh:AFAN:ACV:PEAK command.</p> <p>Note: Any AF test command needs the Audio Option to be installed on your Willtek 4400.</p>

Query	The query form of this command starts the measurement and delivers a string, containing a floating point real number, representing the first measurement result value. The physical dimension is volt, measured peak-to-peak (V_{pp}).
Example	:MEAS:CONT:AFAN:ACV:PEAKp? String delivered back: "0.7".

:MEASure[:CONTInuous]:AFANalyser:ACVoltage:RMS

Syntax	:MEASure[:CONTInuous]:AFANalyser:ACVoltage:RMS
Parameters	There are no parameters.
Description	Starts a continuous measurement of the RMS-valued AC voltage of the AF signal applied to the audio analyzer. To read out the latest measurement result, use the :FETCh:AFAN:ACV:RMS command. Note: Any AF test command needs the Audio Option to be installed on your Willtek 4400.
Query	The query form of this command starts the measurement and delivers a string, containing a floating point real number, representing the first measurement result value. The physical dimension is volt, RMS-valued (V_{rms}).
Example	:MEAS:CONT:AFAN:ACVoltage:RMS? String delivered back: "0.25".

:MEASure[:CONTInuous]:AFANalyser:DCVoltage

Syntax	:MEASure[:CONTInuous]:AFANalyser:DCVoltage
Parameters	There are no parameters.
Description	Starts a continuous measurement of the RMS-valued AC component of an applied DC signal. To read out the latest measurement result, use the :FETCh:AFAN:DCV command. Note: Any AF test command needs the Audio Option to be installed on your Willtek 4400.
Query	The query form of this command starts the measurement and delivers a string, containing a floating point real number, representing the first measurement result value. The physical dimension is volt, RMS-valued (V_{rms}).
Example	:MEAS:CONT:AFAN:DCVoltage? String delivered back: "0.025".

:MEASure[:CONTInuous]:AFANalyser:FREQuency

Syntax	:MEASure[:CONTInuous]:AFANalyser:FREQuency
Parameters	There are no parameters.
Description	Starts a continuous measurement of the frequency of the audio signal applied to the audio analyzer. To read out the latest measurement result, use the :FETCh:AFAN:FREQ command. Note: Any AF test command needs the Audio Option to be installed on your Willtek 4400.

Query	The query form of this command starts the measurement and delivers a string, containing a floating point real number, representing the first measurement result value. The physical dimension is Hertz (Hz).
Example	:MEAS:CONT:AFAN:FREQuency? String delivered back: "1000.0".

:MEASure[:CONTInuous]:AFANalyser:DISToRTion

Syntax	:MEASure[:CONTInuous]:AFANalyser:DISToRTion
Parameters	There are no parameters.
Description	Starts a continuous measurement of the third-harmonic distortion of a sine wave applied to the audio analyzer. To read out the latest measurement result, use the :FETCh:AFAN:DIS command. Note: Any AF test command needs the Audio Option to be installed on your Willtek 4400.
Query	The query form of this command starts the measurement and delivers a string, containing a floating point real number, representing the first measurement result value. The physical dimension is percent (%).
Example	:MEAS:CONT:AFAN:DISToRTion? String delivered back: "0.3".

:MEASure[:CONTInuous]:AFANalyser:SINAd

Syntax	:MEASure[:CONTInuous]:AFANalyser:SINAd
Parameters	There are no parameters.
Description	Starts a continuous measurement of the SINAD (i.e. signal to noise ratio). To read out the latest measurement result, use the :FETCh:AFAN:SIN command. Note: Any AF test command needs the Audio Option to be installed on your Willtek 4400.
Query	The query form of this command starts the measurement and delivers a string, containing one floating point real number, representing the first measurement result value. The physical dimension is dB.
Example	:MEAS:CONT:AFANalyser:SINAd? Value delivered back: "50.5".

:MEASure[:CONTInuous]:PSUPply:STOP

Syntax	:MEASure[:CONTInuous]:AFANalyser:STOP
Parameters	There are no parameters.
Description	Stops continuous current measurements. Note Stopping the test is not required since a test is automatically stopped when you start a new test.
Query	The query form of this command is not available.

Example	:MEAS:PSUP:ALL :MEAS:PSUP:STOP Starts and stops a measurement.
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:MEASure[:CONTInuous]:PSUPply:GROup

Syntax	:MEASure[:CONTInuous]:PSUPply:GROup
Parameters	There are no parameters.
Description	Starts a continuous measurement of the power supply tests specified with the :CONF:MEAS:GRO:PSUP command. To read out the latest measurement results, use the :FETCh:PSUP:GROup command.
Notes	<ul style="list-style-type: none"> - To perform any power and current consumption measurements on your Willtek 4400, the MS Power Supply and Current Measurements Option must be installed. - For further details regarding group measurements, please refer to section :MEASure:...:GROup.
Query	The query form of this command will start the measurements and deliver back a string containing the latest set of measurement result values. All measurement result values returned will be floating point real numbers. The order of the measurement result values returned is as described below (see command :MEAS:PSUP:ALL). The single measurement result values are separated by commas.
Example	<pre>:CONF:MEAS:GRO:PSUP ACUR,APOW :MEAS:PSUP:GRO?</pre> <p>In this example, the group of measurements is defined by a power consumption measurement combined with a current consumption measurement. The measurement result string returned in this example is: "863.6,304.2". Because of the internal order, the first measurement result value delivered back is the power consumption, the second one the average current consumption measurement.</p>

:MEASure[:CONTInuous]:PSUPply:ALL

Syntax	:MEASure[:CONTInuous]:PSUPply:ALL
Parameters	There are no parameters.
Description	Starts a continuous measurement of the power and current consumption tests. To read out the latest measurement results, use the :FETCh:PSUP:ALL? query. The power supply/current measurement tests performed by this command are: APOW for the average power consumption measurement, measured in mW; ACUR for the average current consumption measurement in mA, PCUR for the peak current consumption in mA.
Notes	<ul style="list-style-type: none"> - Any power and current consumption measurement will need the MS Power Supply and the Current Measurement Options to be installed on your Willtek 4400. - For further details regarding group measurements, please refer to section :MEASure:...:GROup.

Query	The query form of this command starts the measurements and – after all measurements have been completed and all measurement results obtained – delivers back a string containing three floating point real numbers, representing the three measurement result values. The order of these measurement result values delivered back is as follows: <ul style="list-style-type: none"> – APOW, representing the average power consumption in mW, – ACUR, representing the average current consumption in mA, – PCUR, representing the peak current consumption in mA.
Example	:MEAS:PSUP:ALL? In this case, all power/current consumption measurements are performed in one go. As soon as all measurements have been completed and all measurement results obtained, a string will be delivered back containing three measurement result values, for example "863.6,304.2,1352.9".

:MEASure[:CONTInuous]:PSUPply:APower

Syntax	:MEASure[:CONTInuous]:PSUPply:APower
Parameters	There are no parameters.
Description	Starts a continuous measurement of the power consumption test. To read out the latest measurement result, use the :FETCh:PSUP:APOW? query. Note: Any power and current consumption measurement will need the MS Power Supply and the Current Measurement Options to be installed on your Willtek 4400.
Query	The query form of this command starts the measurements and – after all measurements have been completed and all measurement results obtained – delivers back a string containing the measurement result value. The value represents the average power consumption in mW.
Example	:MEAS:PSUP:APOW? In this case, all the average power consumption measurements is performed. As soon as the measurement has been completed, a string will be delivered back containing the measurement result value, for example "863.6".

:MEASure[:CONTInuous]:PSUPply:ACURrent

Syntax	:MEASure[:CONTInuous]:PSUPply:ACURrent
Parameters	There are no parameters.
Description	Starts a continuous measurement of the average current consumption test. To read out the latest measurement result, use the :FETCh:PSUP:ACUR command. Any power and current consumption measurement will need the MS Power Supply and the Current Measurement Options to be installed on your Willtek 4400.
Query	The query form of this command starts the measurement and – after the measurement has been completed and the measurement result obtained – delivers back a string containing a floating point real number representing the average current consumption in mA.
Example	:MEAS:PSUP:ACUR? In this case, the average current consumption measurement is performed. As soon as the measurement has been completed, a string will be delivered back containing the measurement result value, for example "304.2, ".

:MEASure[:CONTInuous]:PSUPply:PCURrent

Syntax	:MEASure[:CONTInuous]:PSUPply:PCURrent
Parameters	There are no parameters.
Description	Starts a continuous measurement of the peak current consumption test. To read out the latest measurement result, use the :FETCh:PSUP:PCUR command. Any power and current consumption measurement will need the MS Power Supply and the Current Measurement Options to be installed on your Willtek 4400.
Query	The query form of this command starts the measurement and – after the measurement has been completed and the measurement result obtained – delivers back a string containing a floating point real number representing the peak current consumption in mA.
Example	:MEAS:PSUP:PCUR? In this case, all the peak current consumption measurement is performed. As soon as the measurement has been completed, a string will be delivered back containing the measurement result value, for example "1352.9".

:MEASure:ARRay:AFANalyser:GROup

Syntax	:MEASure:ARRay:AFANalyser:GROup <int1>
Parameters	int1 is an integer. The minimum value for int1 is 0, the maximum value is 100. The default value for int1 is 0.
Description	Performs the audio tests, specified with the :CONF:MEAS:GRO:AFAN command for a specific number of times (set with the int1 parameter). To read out the entire measurement results array, use the :FETCh:AFAN:GROup command. Notes: <ul style="list-style-type: none"> – Please keep in mind that the start of a new AF test will always terminate all other measurements (see section "The MEASure subsystem" on page 243 for details). – To perform any audio measurements on your Willtek 4400, the Audio Option must be installed. – For further details regarding group measurements, please refer to section ":MEASure:....:GROup" on page 250. – More information regarding ARRay measurements can be found in section "MEASure:ARRay" on page 246.
Query	The query form of this command will start the sequence of audio measurements as specified with the :CONF:MEAS:GRO:AFAN command for a specific number of times (set with the int1 parameter). As soon as all measurements have been completed, a string will be delivered back. It will contain floating point real numbers, representing the measurement result values. The order of the measurement result values returned is as described below (see command :MEAS[:GSM]:ARR:AFAN:ALL). The single measurement result values are separated by commas. Note: The number of measurement result values delivered back is the number of measurement result values of a single test run multiplied with the int1 parameter.

Example **:CONF:MEAS:GRO:AFAN SIN,FREQ**
 :MEASure:ARRay:AFAN:GROup? 3
 In this example, the group of measurements is defined by a SINAD measurement, combined with an AF frequency measurement. This group of measurements will be carried out three times. After all measurements have been completed, a result string will be delivered back, containing six measurement result values.
 The measurement result values returned are:
"1000.0,50.5,1000.1,50.1,999.9,50.6".
 Because of the internal order, the first (third and fifth) measurement result value delivered back is the audio frequency, the second (fourth and sixth) one the SINAD.

:MEASure:ARRay:AFANalyser:ALL

Syntax	:MEASure:ARRay:AFANalyser:ALL <int1>
Parameters	int1 is an integer. The minimum value for int1 is 0, the maximum value is 100. The default value for int1 is 0.
Description	Performs a standard sequence of the most important audio tests a specific number of times (set with the int1 parameter). To read out the entire measurement results array, use the :FETCh:AFAN:ALL command. The tests performed by this command are: ACVPeakp , the peak-to-peak measurement of an AC voltage, ACVRms , the RMS-valued measurement of an AC voltage, DCVRms is used to measure AC ripple on DC lines (this measurement gives the root-mean square voltage of the AC component of the applied DC signal). FREQuency is the measurement of the audio frequency in Hertz, DISTortion is the distortion measurement on the third harmonic of a sine wave and expressed in %, while SINad is the measurement of the signal to noise ratio, expressed in dB. Notes: <ul style="list-style-type: none"> - Please keep in mind that the start of a new AF test will always terminate all other measurements (see section "The MEASure subsystem" on page 243 for details). - Any AF measurement will need the Audio Option to be installed on your Willtek 4400. - For further details regarding group measurements, please refer to section ":MEASure:...:GROup" on page 250.
Query	The query form of this command performs the measurements and - after all measurements have been completed and all measurement results obtained - delivers a string, containing (6* int1) measurement result values. The single measurement result values are separated by commas. All measurement result values are floating point real numbers. The order of these measurement result values delivered back is as follows: <ol style="list-style-type: none"> 1. ACVPeakp, representing the AC peak-to-peak voltage of the AF signal, 2. ACVRms, representing the RMS-valued AC voltage of the AF signal, 3. DCVRms, representing the RMS-valued AC voltage on an applied DC signal, 4. FREQuency, representing the audio frequency, 5. DISTortion, representing the third-harmonic distortion of the applied sine-wave AF signal and, 6. SINad, representing the signal to noise ratio of the applied AF signal.

Example **:MEASure:ARRay:AFANalyser:ALL? 2**
 In this case, the sequence of standard AF measurements will be performed twice. As soon as all measurements have been completed and all measurement results obtained, a string will be delivered back containing twelve measurement result values:
"0.7,0.25,0.0,1000.0,0.3,50.5,0.75,0.3,0.0,1000.0,0.25,50.9".

:MEAS:ARRay:AFAN:ACVoltage:PEAKp

Syntax **:MEAS:ARRay:AFAN:ACVoltage:PEAKp <int1>**

Parameters **int1** is an integer.
 The minimum value for **int1** is 0, the maximum value is 100. The default value for **int1** is 0.

Description Performs the measurement of the AC peak-to-peak voltage of the AF signal applied to the audio analyzer a specific number of times (set with the **int1** parameter). To read out the entire measurement results array, use the **:FETCh:AFAN:ACV:PEAK** command.
Note: Any AF test command will need the Audio Option to be installed on your Willtek 4400.

Query The query form of this command will perform the measurement the specified number of times (**int1** parameter). As soon as all measurements have been completed, all measurement result values will be returned in a string. The string delivered back will contain **int1** floating point real numbers. The physical dimension of the measurement result values is volt, measured peak-to-peak (V_{pp}). The single measurement results are separated by commas.

Example **:MEAS:ARR:AFANalyser:ACVoltage:PEAKp? 5**
 The string returned is: **"0.7,0.8,0.75,0.71,0.79"**.

:MEAS:ARR:AFAN:DCVoltage

Syntax **:MEAS:ARR:AFAN:DCVoltage <int1>**

Parameters **int1** is an integer.
 The minimum value for **int1** is 0, the maximum value is 100. The default value for **int1** is 0.

Description Performs the measurement of the RMS-valued AC component of a DC signal applied to the audio analyzer a specific number of times (set with the **int1** parameter). To read out the entire measurement results array, use the **:FETCh:AFAN:DCV** command.
Note: Any AF test command will need the Audio Option to be installed on your Willtek 4400.

Query The query form of this command will perform the measurement the specified number of times (**int1** parameter). As soon as all measurements have been completed, all measurement result values will be returned in a string. The string delivered back will contain **int1** floating point real numbers. The physical dimension of the measurement result values is volt, RMS-valued (V_{rms}). The single measurement results are separated by commas.

Example **:MEAS:ARR:AFANalyser:DCVoltage? 5**
 The string returned is: **"0.025,0.029,0.019,0.030,0.025"**.

:MEASure:ARRay:AFAN:FREQuency

Syntax	:MEASure:ARRay:AFAN:FREQuency <int1>
Parameters	int1 is an integer. The minimum value for int1 is 0, the maximum value is 100. The default value for int1 is 0.
Description	Performs the measurement of the frequency of the audio signal applied to the audio analyzer a specific number of times (set with the int1 parameter). To read out the entire measurement results array, use the :FETCh:AFAN:FREQ command. Note: Any AF test command will need the Audio Option to be installed on your Willtek 4400.
Query	The query form of this command will perform the measurement the specified number of times (int1 parameter). As soon as all measurements have been completed, all measurement result values will be returned in a string. The string delivered back will contain int1 floating point real numbers. The physical dimension of the measurement result values is Hertz. The single measurement results are separated by commas.
Example	:MEASure:ARRay:AFANalyser:FREQ? 5 The string returned is: "1000.0,1000.5,1000.9,999.9,1000.0".

:MEASure:ARRay:AFAN:DISToRTion

Syntax	:MEASure:ARRay:AFAN:DISToRTion <int1>
Parameters	int1 is an integer. The minimum value for int1 is 0, the maximum value is 100. The default value for int1 is 0.
Description	Performs the measurement of the distortion of a sine wave applied to the audio analyzer a specific number of times (set with the int1 parameter). To read out the entire measurement results array, use the :FETCh:AFAN:DIS command. Note: Any AF test command will need the Audio Option to be installed on your Willtek 4400.
Query	The query form of this command will perform the measurement the specified number of times (int1 parameter). As soon as all measurements have been completed, all measurement result values will be returned in a string. The string delivered back will contain int1 floating point real numbers. The physical dimension of the measurement result values is percentage (%). The single measurement results are separated by commas.
Example	:MEASure:ARRay:AFANalyser:DIS? 5 The string returned is: "0.5,0.7,1.1,1.2,0.9".

:MEASure:ARRay:AFANalyser:SINad

Syntax	:MEASure:ARRay:AFANalyser:SINad <int1>
Parameters	int1 is an integer. The minimum value for int1 is 0, the maximum value is 100. The default value for int1 is 0.

Description	Performs the measurement of the SINAD (i.e. signal to noise ratio) a specific number of times (set with the int1 parameter). To read out the entire measurement results array, use the :FETCh:AFAN:SIN command. Note: Any AF test command will need the Audio Option to be installed on your Willtek 4400.
Query	The query form of this command will perform the measurement the specified number of times (int1 parameter). As soon as all measurements have been completed, all measurement result values will be returned in a string. The string delivered back will contain int1 floating point real numbers. The physical dimension of the measurement result values is dB. The single measurement results are separated by commas.
Example	:MEASure:ARRay:AFANalyser:SINad? 5 The string returned is: "50.5,50.0,49.1,51.2,50.9".

:MEASure:ARRay:PSUPply:GROup

Syntax	:MEASure:ARRay:PSUPply:GROup <int1>
Parameters	int1 is an integer. The minimum value for int1 is 0, the maximum value is 100. The default value for int1 is 0.
Description	Performs the power supply measurements specified with the :CONF:MEAS:GRO:PSUP command for a specific number of times (set with the int1 parameter). To read out the entire measurement results array, use the :FETCh:PSUP:GROup command. Notes <ul style="list-style-type: none"> - To perform any power and current consumption measurements on your Willtek 4400, the MS Power Supply and Current Measurements Option must be installed. - For further details regarding group measurements, please refer to section ":MEASure:....:GROup" on page 250.
Query	The query form of this command will start the sequence of power/current consumption measurements as specified with the :CONF:MEAS:GRO:PSUP command for a specific number of times (set with the int1 parameter). The order of the measurement result values returned is as described below (see command :MEAS:PSUP:ALL).
Example	:CONF:MEAS:GRO:PSUP ACUR,APOW :MEASure:ARRay:PSUP:GROup? In this example, the group of measurements is defined by a power consumption measurement combined with a current consumption measurement. The measurement result string returned is: "863.6,304.2". Because of the internal order, the first measurement result value delivered back is the power consumption, the second one the average current consumption measurement.

:MEASure:ARRay:PSUPply:ALL

Syntax	:MEASure:ARRay:PSUPply:ALL <int1>
Parameters	int1 is an integer. The minimum value for int1 is 0, the maximum value is 100. The default value for int1 is 0.

Description	<p>Performs all measurements of the power and current consumption tests for a specific number of times (set with the int1 parameter). To read out the latest measurement results, use the :FETCh:PSUP:ALL command.</p> <p>The power supply/current measurement tests performed by this command are: APOW for the average power consumption measurement, measured in mW; ACUR for the average current consumption measurement in mA, PCUR for the peak current consumption in mA.</p> <p>Notes</p> <ul style="list-style-type: none"> - Any power and current consumption measurement will need the MS Power Supply and the Current Measurement Options to be installed on your Willtek 4400. - For further details regarding group measurements, please refer to section ":MEASure:....:GROup" on page 250.
Query	<p>The query form of this command starts the measurements for a specific number of times (set with the int1 parameter). The order of these measurement result values delivered back is as follows:</p> <ul style="list-style-type: none"> - APOW, representing the average power consumption in mW, - ACUR, representing the average current consumption in mA, - PCUR, representing the peak current consumption in mA.
Example	<p>:MEASure:ARRay:PSUP:ALL? 10</p> <p>In this case, all power/current consumption measurements are performed ten times. As soon as all measurements have been completed and all measurement results obtained, a string will be delivered back containing ten times three measurement result values.</p>

:MEASure:ARRay:PSUPply:APower

Syntax	:MEASure:ARRay:PSUPply:APower <int1>
Parameters	<p>int1 is an integer.</p> <p>The minimum value for int1 is 0, the maximum value is 100. The default value for int1 is 0.</p>
Description	<p>Performs the power consumption measurement for a specific number of times (set with the int1 parameter). To read out the latest measurement results, use the :FETCh:PSUP:APOW command.</p>
Query	<p>The query form of this command starts the measurements for a specific number of times (set with the int1 parameter). The returned string contains int1 floating point values representing the average power consumption in mW.</p>
Example	<p>:MEASure:ARRay:PSUP:APOW? 3</p> <p>In this case, the power consumption measurement is performed three times. As soon as all measurements have been completed and all measurement results obtained, a string will be delivered back containing the three measurement result values.</p>

:MEASure:ARRay:PSUPply:ACURrent

Syntax	:MEASure:ARRay:PSUPply:ACURrent <int1>
Parameters	<p>int1 is an integer.</p> <p>The minimum value for int1 is 0, the maximum value is 100. The default value for int1 is 0.</p>

Description	Performs the average current consumption measurement for a specific number of times (set with the int1 parameter). To read out the latest measurement results, use the :FETCh:PSUP:ACUR command.
Query	The query form of this command starts the measurements for a specific number of times (set with the int1 parameter). The returned string contains int1 floating point values representing the average current consumption in mA.
Example	:MEASure:ARRay:PSUP:ACUR? 3 In this case, the current consumption measurement is performed three times. As soon as all measurements have been completed and all measurement results obtained, a string will be delivered back containing the three measurement result values.

:MEASure:ARRay:PSUPply:PCURrent

Syntax	:MEASure:ARRay:PSUPply:PCURrent <int1>
Parameters	int1 is an integer. The minimum value for int1 is 0, the maximum value is 100. The default value for int1 is 0.
Description	Performs the peak current consumption measurement for a specific number of times (set with the int1 parameter). To read out the latest measurement results, use the :FETCh:PSUP:PCUR command.
Query	The query form of this command starts the measurements for a specific number of times (set with the int1 parameter). The returned string contains int1 floating point values representing the peak current consumption in mA.
Example	:MEASure:ARRay:PSUP:PCUR? 3 In this case, the peak current consumption measurement is performed three times. As soon as all measurements have been completed and all measurement results obtained, a string will be delivered back containing the three measurement result values.

:MEASure:EVDO[:CONTInuous]:RFRX:STOP

Syntax	:MEASure:EVDO[:CONTInuous]:RFRX:STOP
Parameters	There are no parameters for this command.
Description	This command stops any of the continuous EVDO RX measurements. Note: Since any measurement command automatically stops any (previously started) measurement of any type, it is not required to issue this command for switching the single measurements. It is mainly intended to switch the continuous RX measurements on/off in a more general sense.
Query	There is no query form of this command available.
Example	:MEASure:EVDO:CONTInuous:RFRX:PER:IMMediate :MEAS:EVDO:RFRX:STOP The first command configures and starts a continuous measurement of the packet error rate (PER). The second command stops it.

:MEASure:EVDO[:CONTinuous]:RFRX:PER[:IMMediate]

Syntax	:MEASure:EVDO[:CONTinuous]:RFRX:PER[:IMMediate]
Parameters	There are no parameters for this command.
Description	This command starts a continuous measurement of the packet error rate (PER).
Query	The query form of this command starts the measurement and - after it has been completed and the result obtained - returns a string containing one floating point real number, representing the mobile's PER in form of a percentage. The real number returned is in the range from 0 to 10 with a resolution of 0.1.
Example	:MEASure:EVDO:CONTInuous:RFRX:PER:IMMediate? String returned in this example: "3.1".

:MEASure:EVDO[:CONTinuous]:RFSpectrum:STOP

Syntax	:MEASure:EVDO[:CONTinuous]:RFSpectrum:STOP
Parameters	There are no parameters for this command.
Description	This command stops any of the continuous EVDO RF spectrum measurements. Note: Since any measurement command automatically stops any (previously started) measurement of any type, it is not required to issue this command for switching the single measurements. It is mainly intended to switch the continuous TX measurements on/off in a more general sense.
Query	There is no query form of this command available.
Example	:MEASure:EVDO:RFSP:MSP :MEASure:EVDO:CONTInuous:RFSpectrum:STOP The first command configures and starts a continuous spectrum measurement. The second command stops it.

:MEAS:EVDO[:CONTinuous]:RFSpectrum:MSpectrum[:DATA]

Syntax	:MEASure:EVDO[:CONTinuous]:RFSpectrum:MSpectrum[:DATA]
Parameters	There are no parameters for this command.
Description	This command starts a continuous measurement of the RF modulation spectrum. To read out the latest measurement results, use the :FETC:EVDO:RFSP:MSP command.

Query	<p>The query form of this command starts the measurement and - after it has been completed and the results obtained - returns a string containing an array of 501 floating point real numbers, separated by commas and representing the single measurement results at the discrete frequencies (250 in the range below, 250 in the range above the carrier and at the carrier itself). The discrete frequencies depend on the currently selected span of the RF modulation spectrum measurement. If the span, for example, is +/- 2500 kHz, the discrete frequencies to measure at are in steps of 10 kHz both below and above the carrier frequency.</p> <p>Value 1 of the array returned represents the result obtained for the lowest frequency, value 251 represents the result obtained for the carrier, and value 501 represents the result obtained for the highest frequency measured at.</p> <p>The real numbers returned are in the range from -100 to 30 with a resolution of 0.1. The physical units are dBm.</p>
Example	<code>:MEASure:EVDO:RFSP:MSP?</code>

:MEASure:EVDO[:CONTInuous]:RFSpectrum:MSpectrum:AVG

Syntax	<code>:MEASure:EVDO[:CONTInuous]:RFSpectrum:MSpectrum:AVG <Int></code>
Parameters	<code>Int</code> is an integer number. The minimum value is 0, the maximum value is 100. The default value is 0.
Description	This command starts a continuous measurement of the RF modulation spectrum and averages the results obtained over the number of measurements specified with the parameter value. To read out the latest measurement results, use the <code>:FETC:EVDO:RFSP:MSP:AVG</code> command.
Query	<p>The query form of this command starts the measurement and averages the measurement results obtained over the number of measurements specified with the parameter value. After this has been completed and the results obtained it returns a string containing an array of 501 floating point real numbers, separated by commas and representing the single measurement results at the discrete frequencies (250 in the range below, 250 in the range above the carrier and at the carrier itself). The discrete frequencies depend on the currently selected span of the RF modulation spectrum measurement. If the span, for example, is +/- 2500 kHz, the discrete frequencies to measure at are in steps of 10 kHz both below and above the carrier frequency.</p> <p>Value 1 of the array returned represents the result obtained at the lowest measurement frequency, value 251 represents the result obtained for the carrier, and value 501 represents the result obtained at the highest measurement frequency.</p> <p>The real numbers returned are in the range from -100 to 30 with a resolution of 0.1. The physical units are dBm.</p>
Example	<code>:MEASure:EVDO:RFSP:MSP:AVG? 10</code>

:MEASure:EVDO[:CONTInuous]:RFSpectrum:ACPM

Syntax	<code>:MEASure:EVDO[:CONTInuous]:RFSpectrum:ACPM</code>
Parameters	There are no parameters for this command.
Description	This command starts a continuous measurement of the ACPM modulation spectrum.

Query	<p>The query form of this command starts the measurement and - after it has been completed and the results obtained - returns a string, containing 25 floating point real numbers, separated by commas and representing the single results obtained at the 25 discrete measurement frequencies (12 offsets in both directions from the carrier, plus the result at the carrier itself).</p> <p>Value 1 of the string returned represents the result obtained at the lowest measurement frequency, value 13 represents the result obtained for the carrier, and value 25 represents the result obtained at the highest measurement frequency.</p> <p>The real numbers returned are in the range from -200 to 0 with a resolution of 0.1. The physical units are dB, relative to the measurement result obtained for the carrier.</p>
Example	<code>:MEAS:EVDO:CONT:RFSP:ACPM?</code>

:MEASure:EVDO[:CONTInuous]:RFTX:STOP

Syntax	<code>:MEASure:EVDO[:CONTInuous]:RFTX:STOP</code>
Parameters	There are no parameters for this command.
Description	<p>This command stops any of the continuous EVDO TX measurements.</p> <p>Note: Since any measurement command automatically stops any (previously started) measurement of any type, it is not required to issue this command for switching the single measurements. It is mainly intended to switch the continuous TX measurements on/off in a more general sense.</p>
Query	There is no query form of this command available.
Example	<code>:MEAS:EVDO:CONTInuous:RFTX:STOP</code>

:MEASure:EVDO[:CONTInuous]:RFTX:GRoup

Syntax	<code>:MEASure:EVDO[:CONTInuous]:RFTX:GRoup</code>
Parameters	There are no parameters for this command.
Description	This command starts a sequence of (continuous) RF TX measurement. The single measurements to be performed are set using the <code>:CONF:EVDO:MEAS:GRO:RFTX</code> command.
Query	The query form of this command starts the sequence of RF TX measurements as defined with the <code>:CONF:EVDO:MEAS:GRO:RFTX</code> command. After the single measurements have been completed, it returns the corresponding measurement results in their related form (i.e. usually in form of floating point real numbers), contained in a string.
Example	<p><code>:CONF:EVDO:MEAS:GRO:RFTX FREQ, POW</code></p> <p>In this example, the group of measurements is defined by a frequency error and a RF power measurement.</p> <p><code>:MEAS:EVDO:RFTX:GRO?</code></p> <p>String returned: " 503 , 26 . 9 ".</p>

:MEASure:EVDO[:CONTInuous]:RFTX:FREQuency:ERRor

Syntax	<code>:MEASure:EVDO[:CONTInuous]:RFTX:FREQuency:ERRor</code>
Parameters	There are no parameters for this command.

Description	This command starts a continuous measurement of the frequency error.
Query	The query form of this command starts the measurement and - after the measurement has been completed and the measurement result obtained - returns a string containing one floating point real number, representing the mobile's frequency error in the physical unit specified with the command explained below. The real number returned is in the range from -1000 to 1000 with a resolution of 1.0.
Example	:MEASure:EVDO:CONTinuous:RFTX:FREQuency:ERRor? Starts a frequency error measurement and returns the result, e.g.: "503".

:MEASure:EVDO[:CONTinuous]:RFTX:TIME:OFFSet

Syntax	:MEASure:EVDO[:CONTinuous]:RFTX:TIME:OFFSet
Parameters	There are no parameters for this command.
Description	This command starts a continuous measurement of the mobile's transmit time error.
Query	The query form of this command starts the measurement and - after it has been completed and the result obtained - returns a string containing one floating point real number, representing the mobile's transmit time error in microseconds (10E-6 s). The real number returned is in the range from -5 to 5 with a resolution of 0.001.
Example	:MEASure:EVDO:CONTinuous:RFTX:TIME:OFFSet? String returned in this example: "-4.334".

:MEASure:EVDO[:CONTinuous]:RFTX:POWER[:MEAN]

Syntax	:MEASure:EVDO[:CONTinuous]:RFTX:POWER[:MEAN]
Parameters	There are no parameters for this command.
Description	This command starts a continuous measurement of the mobile's transmit power level.
Query	The query form of this command starts the measurement and - after it has been completed and the result obtained - returns a string containing one floating point real number, representing the mobile's transmit power level in dBm. The real number returned is in the range from -70 to 36 with a resolution of 0.1.
Example	:MEASure:EVDO:RFTX:POW? String returned in this example: "-45.3".

:MEASure:EVDO[:CONTinuous]:RFTX:POWER:MINimum

Syntax	:MEASure:EVDO[:CONTinuous]:RFTX:POWER:MINimum
Parameters	There are no parameters for this command.
Description	This command starts a continuous measurement of the mobile's minimum RF power.
Query	The query form of this command starts the measurement and - after it has been completed and the result obtained - returns a string containing one floating point real number, representing the mobile's minimum power level in dBm. The real number returned is in the range from -70 to 36 with a resolution of 0.1.

Example	<code>:MEAS:EVDO:RFTX:POW:MIN?</code> String returned in this example: "-68.1".
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:MEASure:EVDO[:CONTinuous]:RFTX:POWer:MAXimum

Syntax	<code>:MEASure:EVDO[:CONTinuous]:RFTX:POWer:MAXimum</code>
Parameters	There are no parameters for this command.
Description	This command starts a continuous measurement of the mobile's maximum RF power.
Query	The query form of this command starts the measurement and - after it has been completed and the result obtained - returns a string containing one floating point real number, representing the mobile's maximum power level in dBm. The real number returned is in the range from -70 to 36 with a resolution of 0.1.
Example	<code>:MEASure:EVDO:CONTInuous:RFTX:POWer:MAXimum?</code> String returned in this example: "22.7".

:MEASure:EVDO[:CONTinuous]:RFTX:VERRor:RMS

Syntax	<code>:MEASure:EVDO[:CONTinuous]:RFTX:VERRor:RMS</code>
Parameters	There are no parameters for this command.
Description	This command starts the continuous measurement of the RMS-averaged error vector.
Query	The query form of this command starts the measurement and - after it has been completed and the result obtained - returns a string containing one floating point real number, representing the mobile's RMS vector error in form of a percentage. The real number returned is in the range from 0 to 200 with a resolution of 0.1.
Example	<code>:MEASure:EVDO:CONTInuous:RFTX:VERRor:RMS?</code> String returned in this example: "10.1".

:MEASure:EVDO[:CONTinuous]:RFTX:VERRor:PEAK

Syntax	<code>:MEASure:EVDO[:CONTinuous]:RFTX:VERRor:PEAK</code>
Parameters	There are no parameters for this command.
Description	This command starts the continuous measurement of the peak vector error.
Query	The query form of this command starts the measurement and - after it has been completed and the result obtained - returns a string containing one floating point real number, representing the mobile's peak vector error in form of a percentage. The real number returned is in the range from 0 to 200 with a resolution of 0.1.
Example	<code>:MEASure:EVDO:RFTX:VERR:PEAK</code> String returned in this example: "23.9".

:MEAS:EVDO[:CONTinuous]:RFTX:VERRor:MAGNitude:RMS

Syntax	<code>:MEASure:EVDO[:CONTinuous]:RFTX:VERRor:MAGNitude:RMS</code>
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Parameters	There are no parameters for this command.
Description	This command starts the continuous measurement of the RMS-averaged magnitude component of the vector error.
Query	The query form of this command starts the measurement and - after it has been completed and the result obtained - returns a string containing one floating point real number, representing the measurement result, expressed as a percentage. The real number returned is in the range from 0 to 200 with a resolution of 0.1.
Example	:MEASure:EVDO:CONTInuous:RFTX:VERRor:MAGNitude:RMS? String returned in this example: "17.9".

:MEAS:EVDO[:CONTInuous]:RFTX:VERRor:MAGNitude:PEAK

Syntax	:MEASure:EVDO[:CONTInuous]:RFTX:VERRor:MAGNitude:PEAK
Parameters	There are no parameters for this command.
Description	This command starts the continuous measurement of the peak magnitude component of the vector error.
Query	The query form of this command starts the measurement and - after it has been completed and the result obtained - returns a string containing one floating point real number, representing the measurement result, expressed as a percentage. The real number returned is in the range from 0 to 200 with a resolution of 0.1.
Example	:MEAS:EVDO:RFTX:VERR:MAGN:PEAK? String returned in this example: "23.6".

:MEAS:EVDO[:CONTInuous]:RFTX:VERRor:PHASe:RMS

Syntax	:MEASure:EVDO[:CONTInuous]:RFTX:VERRor:PHASe:RMS
Parameters	There are no parameters for this command.
Description	This command starts the continuous measurement of the RMS-averaged phase component of the vector error.
Query	The query form of this command starts the measurement and - after it has been completed and the result obtained - returns a string containing one floating point real number, representing the measurement result in degrees. The real number returned is in the range from -45 to 45 with a resolution of 0.01.
Example	:MEASure:EVDO:CONTInuous:RFTX:VERRor:PHAS:RMS? String returned in this example: "9.07".

:MEAS:EVDO[:CONTInuous]:RFTX:VERRor:PHASe:PEAK

Syntax	:MEASure:EVDO[:CONTInuous]:RFTX:VERRor:PHASe:PEAK
Parameters	There are no parameters for this command.
Description	This command starts the continuous measurement of the peak phase component of the error vector.

Query	The query form of this command starts the measurement and - after it has been completed and the result obtained - returns a string containing one floating point real number, representing the measurement result in degrees. The real number returned is in the range from -45 to 45 with a resolution of 0.01.
Example	:MEAS:EVDO:RFTX:VERR:PHAS:PEAK? String returned in this example: "-12.23".

:MEASure:EVDO[:CONTinuous]:RFTX:VERRor:IQOFset

Syntax	:MEASure:EVDO[:CONTinuous]:RFTX:VERRor:IQOFset
Parameters	There are no parameters for this command.
Description	This command starts the continuous measurement of the carrier feedthrough.
Query	The query form of this command starts the measurement and - after it has been completed and the result obtained - returns a string containing one floating point real number, representing the mobile's IQ offset in dBc. The real number returned is in the range from -60 to 0 with a resolution of 0.1.
Example	:MEASure:EVDO:CONTinuous:RFTX:VERRor:IQOFset? String returned in this example: "-40.1".

:MEASure:EVDO[:CONTinuous]:RFTX:VERRor:IQIMbalance

Syntax	:MEASure:EVDO[:CONTinuous]:RFTX:VERRor:IQIMbalance
Parameters	There are no parameters for this command.
Description	This command starts the continuous measurement of the IQ imbalance.
Query	The query form of this command starts the measurement and - after it has been completed and the result obtained - returns a string containing one floating point real number, representing the mobile's IQ imbalance in dB. The real number returned is in the range from -99 to 0 with a resolution of 0.1.
Example	:MEAS:EVDO:RFTX:VERR:IQIM? String returned in this example: "-53.2".

:MEASure:EVDO[:CONTinuous]:RFTX:WQQuality|RHO

Syntax	:MEASure:EVDO[:CONTinuous]:RFTX:WQQuality RHO
Parameters	There are no parameters for this command.
Description	This command starts a continuous measurement of the modulation quality factor rho.
Query	The query form of this command starts the measurement and - after it has been completed and the result obtained - returns a string containing one floating point real number, representing the mobile's modulation quality factor rho. The real number returned is in the range from 0.9 to 1.0 with a resolution of 0.0001.
Example	:MEASure:EVDO:CONT:RFTX:RHO? String returned in this example: "0.9989".

:MEAS:EVDO[:CONTInuous]:RFTX:CODEdomain[:IMMediate]

Syntax	:MEASure:EVDO[:CONTInuous]:RFTX:CODEdomain[:IMMediate]
Parameters	There are no parameters for this command.
Description	This command starts the continuous measurement of the code domain power.
Query	The query form of this command starts the measurement and - after it has been completed and the result obtained - checks the results against the corresponding limits. It will return one of the following predefined expressions, contained in a string: <ul style="list-style-type: none"> - PASS - if the measurement results were within their limits, - FAIL - if one or several measurement results did violate their limits, - NONE - if a measurement result could not be obtained for any reason.
Example	:MEASure:EVDO:RFTX:CODE:IMM? String returned in this example: "PASS".

:MEASure:EVDO[:CONTInuous]:RFTX:CODEdomain:IPower

Syntax	:MEASure:EVDO[:CONTInuous]:RFTX:CODEdomain:IPower
Parameters	There are no parameters for this command.
Description	This command starts the continuous measurement of the channel power levels in the 16 single code channels of the I proportion.
Query	The query form of this command starts the measurement and - after it has been completed and the results obtained - returns a string containing 16 floating point real numbers, separated by commas and representing the related measurement results in dB (relative to the power level of the active code channels). The first value represents code channel 1; the last one code channel 16. The real numbers returned are in the range from -40 to 0 with a resolution of 0.1.
Example	:MEASure:EVDO:RFTX:CODE:IPOW? String returned in this example: "-40.0,-39.9,-39.8,-0.3,-33.7,-0.2,-37.6,-39.9,-0.2,-29.7,-32.9,-39.6,-1.1,-36.8,-39.7,-29.9".

:MEASure:EVDO[:CONTInuous]:RFTX:CODEdomain:INoise

Syntax	:MEASure:EVDO[:CONTInuous]:RFTX:CODEdomain:INoise
Parameters	There are no parameters for this command.
Description	This command starts the continuous measurement of the channel noise levels in the 16 single code channels of the I proportion.
Query	The query form of this command starts the measurement and - after it has been completed and the results obtained - returns a string containing 16 floating point real numbers, separated by commas and representing the related measurement results in dB (relative to the power level of the active code channels). The first value represents code channel 1; the last one code channel 16. The real numbers returned are in the range from -40 to 0 with a resolution of 0.1.

Example :MEASure:EVDO:CONTInuous:RFTX:CODEdomain:INOIse?
String returned in this example: "-32.6,-39.9,-39.8,-27.5,-33.7,-30.2,-37.6,-39.9,-32.7,-29.7,-32.9,-39.6,-31.1,-26.8,-39.7,-29.6".

:MEASure:EVDO[:CONTInuous]:RFTX:CODEdomain:QPOWer

Syntax :MEASure:EVDO[:CONTInuous]:RFTX:CODEdomain:QPOWer

Parameters There are no parameters for this command.

Description This command starts the continuous measurement of the channel power levels in the 16 single code channels of the Q proportion.

Query The query form of this command starts the measurement and - after it has been completed and the results obtained - returns a string containing 16 floating point real numbers, separated by commas and representing the measurement results in dB (relative to the power level of the active code channels). The first value represents code channel 1; the last one code channel 16.
The real numbers returned are in the range from -40 to 0 with a resolution of 0.1.

Example :MEASure:EVDO:RFTX:CODE:QPOW?
String returned in this example: "-40.0,-39.9,-39.8,-0.3,-33.7,-0.2,-37.6,-39.9,-0.2,-29.7,-32.9,-39.6,-1.1,-36.8,-39.7,-29.9".

:MEASure:EVDO[:CONTInuous]:RFTX:CODEdomain:QNOIse

Syntax :MEASure:EVDO[:CONTInuous]:RFTX:CODEdomain:QNOIse

Parameters There are no parameters for this command.

Description This command starts the continuous measurement of the channel noise levels in the 16 single code channels of the Q proportion.

Query The query form of this command starts the measurement and - after it has been completed and the results obtained - returns a string containing 16 floating point real numbers, separated by commas and representing the related measurement results in dB (relative to the power level of the active code channels). The first value represents code channel 1; the last one code channel 16.
The real numbers returned are in the range from -40 to 0 with a resolution of 0.1.

Example :MEASure:EVDO:CONTInuous:RFTX:CODEdomain:QNOIse?
String returned in this example: "-32.6,-39.9,-39.8,-27.5,-33.7,-30.2,-37.6,-39.9,-32.7,-29.7,-32.9,-39.6,-31.1,-26.8,-39.7,-29.6".

:MEASure:EVDO:ARRAy:RFRX:PER[:IMMediate]

Syntax :MEASure:EVDO:ARRAy:RFRX:PER[:IMMediate] <Int>

Parameters Int is an integer number. The minimum value is 0, the maximum value is 100. The default value is 0.

Description This comand performs a packet error ratio (PER) measurement as many times as specified by the parameter value.

Query	The query form of this command starts the measurements and - after the number of measurements specified by the parameter value have been completed and the measurement results obtained - returns a string containing <code>Int</code> floating point real numbers, representing the measurement results in form of a percentage. The real numbers returned are in the range from 0 to 10 with a resolution of 0.1.
Example	<code>:MEASure:EVDO:ARRay:RFRX:PER:IMMediate? 4</code> String returned in this example: "2.7,3.9,2.8,4.9".

:MEASure:EVDO:ARRay:RFSpectrum:ACPM

Syntax	<code>:MEASure:EVDO:ARRay:RFSpectrum:ACPM <int></code>
Parameters	<code>Int</code> is an integer number. The minimum value is 0, the maximum value is 100. The default value is 0.
Description	This comand performs a measurement of the ACPM modulation spectrum as many times as specified by the parameter value.
Query	The query form of this command performs the measurement <code>Int</code> times and returns a string, containing (<code>Int*25</code>) floating point real numbers, separated by commas and representing the single results obtained at the 25 discrete measurement frequencies (12 offsets in both directions from the carrier, plus the result at the carrier itself). The first of the 25 measurement results always represents the result obtained at the lowest measurement frequency, value 13 represents the result obtained for the carrier, and value 25 represents the result obtained at the highest measurement frequency. The floating point real numbers returned are in the range from -200 to 0 with a resolution of 0.1. The physical units are dB, relative to the measurement result obtained at the carrier frequency.
Example	<code>:MEAS:EVDO:ARR:RFSP:ACPM? 5</code> The string returned will contain 125 floating point real numbers, representing the 25 measurement result values of each of the five measurement runs.

:MEASure:EVDO:ARRay:RFTX:GRoup

Syntax	<code>:MEASure:EVDO:ARRay:RFTX:GRoup <Int></code>
Parameters	<code>Int</code> is an integer number. The minimum value is 0, the maximum value is 100. The default value is 0.
Description	This command performs a RF TX group measurement as many times as specified by the parameter value.
Query	The query form of this command starts the sequence of RF TX measurements as defined with the <code>:CONF:EVDO:MEAS:GRO:RFTX</code> command. After the single measurements have been completed, it returns the corresponding measurement results in their related form (i.e. usually in form of floating point real numbers), contained in a string.
Example	<code>:CONF:EVDO:MEAS:GRO:RFTX RHO,POW</code> In this example, the group of measurements is defined by a measurement of the modulation quality and a RF power measurement. <code>:MEASure:EVDO:ARRayRFTX:GRoup? 2</code> String returned: "0.9989,26.9,0.9987,27.1".

:MEASure:EVDO:ARRAY:RFTX:FREQUENCY:ERROR

Syntax	:MEASure:EVDO:ARRAY:RFTX:FREQUENCY:ERROR <Int>
Parameters	Int is an integer number. The minimum value is 0, the maximum value is 100. The default value is 0.
Description	This command performs measurements of the frequency error as many times as specified by the parameter value.
Query	The query form of this command starts the measurements and - after the number of measurements specified by the parameter value have been completed and the measurement results obtained - returns a string containing Int floating point real numbers, representing the mobile's frequency error in the physical units specified with the :MEAS:EVDO:RFTX:FREQ:UNIT command. The real numbers returned are in the range from -1000 to 1000, resolution is 1.0.
Example	:MEAS:EVDO:RFTX:FREQ:UNIT HZ Sets the physical units of the frequency error measurement to Hz. :MEASure:EVDO:ARRAY:RFTX:FREQUENCY:ERROR? 5 Starts five measurements, the results of which are returned in string: "47.1,91.5,13.6,-4.8,15.3".

:MEASure:EVDO:ARRAY:RFTX:TIME:OFFSET

Syntax	:MEASure:EVDO:ARRAY:RFTX:TIME:OFFSET <Int>
Parameters	Int is an integer number. The minimum value is 0, the maximum value is 100. The default value is 0.
Description	This command performs measurements of the mobile's transmit time error as many times as specified by the parameter value.
Query	The query form of this command starts the measurements and - after the number of measurements specified by the parameter value have been completed and the measurement results obtained - returns a string containing Int floating point real numbers, representing the mobile's transmit time error in microseconds (10E-6 s). The real numbers returned are in the range from -5 to 5 with a resolution of 0.001.
Example	:MEASure:EVDO:ARRAY:RFTX:TIME:OFFSET? 5 String returned in this example: "-0.103,0.247,1.101,-0.034,1.109".

:MEASure:EVDO:ARRAY:RFTX:POWER[:MEAN]

Syntax	:MEASure:EVDO:ARRAY:RFTX:POWER[:MEAN] <Int>
Parameters	Int is an integer number. The minimum value is 0, the maximum value is 100. The default value is 0.
Description	This command performs measurements of the mobile's transmit power level as many times as specified by the parameter value.
Query	The query form of this command starts the measurements and - after the number of measurements specified by the parameter value have been completed and the measurement results obtained - returns a string containing Int floating point real numbers, representing the mobile's transmit power level in dBm. The real numbers returned are in the range from -70 to 36 with a resolution of 0.1.

Example :MEASure:EVDO:ARR:RFTX:POW? 3
 String returned in this example: "27.1,26.9,27.0".

:MEASure:EVDO:ARRay:RFTX:POWer:MINimum

Syntax :MEASure:EVDO:ARRay:RFTX:POWer:MINimum <Int>
Parameters Int is an integer number. The minimum value is 0, the maximum value is 100. The default value is 0.
Description This command performs measurements of the mobile's minimum power level as many times as specified by the parameter value.
Query The query form of this command starts the measurements and - after the number of measurements specified by the parameter value have been completed and the measurement results obtained - returns a string containing Int floating point real numbers, representing the mobile's minimum power level in dBm. The real numbers returned are in the range from -70 to 36 with a resolution of 0.1.
Example :MEASure:EVDO:ARRay:RFTX:POWer:MINimum? 4
 String returned in this example: "-62.9,-64.2,-59.5,-61.8".

:MEASure:EVDO:ARRay:RFTX:POWer:MAXimum

Syntax :MEASure:EVDO:ARRay:RFTX:POWer:MAXimum <Int>
Parameters Int is an integer number. The minimum value is 0, the maximum value is 100. The default value is 0.
Description This command performs measurements of the mobile's maximum power level as many times as specified by the parameter value.
Query The query form of this command starts the measurements and - after the number of measurements specified by the parameter value have been completed and the measurement results obtained - returns a string containing Int floating point real numbers, representing the mobile's maximum power level in dBm. The real numbers returned are in the range from -70 to 36 with a resolution of 0.1.
Example :MEAS:EVDO:ARR:RFTX:POW:MAX? 4
 String returned in this example: "30.7,30.9,30.7,30.5".

:MEASure:EVDO:ARRay:RFTX:VERRor:RMS

Syntax :MEASure:EVDO:ARRay:RFTX:VERRor:RMS <Int>
Parameters Int is an integer number. The minimum value is 0, the maximum value is 100. The default value is 0.
Description This comand performs a measurement of the RMS-averaged vector error as many times as specified by the parameter value.
Query The query form of this command starts the measurements and - after the number of measurements specified by the parameter value have been completed and the measurement results obtained - returns a string containing Int floating point real numbers, representing the measurement results in form of a percentage. The real numbers returned are in the range from 0 to 200 with a resolution of 0.1.

Example :MEASure:EVDO:ARRay:RFTX:VERRor:RMS? 19

:MEASure:EVDO:ARRay:RFTX:VERRor:PEAK

Syntax	:MEASure:EVDO:ARRay:RFTX:VERRor:PEAK <Int>
Parameters	Int is an integer number. The minimum value is 0, the maximum value is 100. The default value is 0.
Description	This comand performs a measurement of the peak vector error measurement as many times as specified by the parameter value.
Query	The query form of this command starts the measurements and - after the number of measurements specified by the parameter value have been completed and the measurement results obtained - returns a string containing Int floating point real numbers, representing the measurement results in form of a percentage. The real numbers returned are in the range from 0 to 200 with a resolution of 0.1.
Example	:MEASure:EVDO:ARRay:RFTX:VERRor:PEAK? 3 String returned in this example: "12.7,13.9,16.1".

:MEASure:EVDO:ARRay:RFTX:VERRor:IQOFFset

Syntax	:MEASure:EVDO:ARRay:RFTX:VERRor:IQOFFset <Int>
Parameters	Int is an integer number. The minimum value is 0, the maximum value is 100. The default value is 0.
Description	This comand performs a measurement of the carrier feedthrough as many times as specified by the parameter value.
Query	The query form of this command starts the measurements and - after the number of measurements specified by the parameter value have been completed and the measurement results obtained - returns a string containing Int floating point real numbers, representing the measurement results in dBc. The real numbers returned are in the range from -60 to 0 with a resolution of 0.1.
Example	:MEAS:EVDO:ARR:RFTX:VERR:IQOF? 10

:MEASure:EVDO:ARRay:RFTX:VERRor:IQIMbalance

Syntax	:MEASure:EVDO:ARRay:RFTX:VERRor:IQIMbalance <Int>
Parameters	Int is an integer number. The minimum value is 0, the maximum value is 100. The default value is 0.
Description	This comand performs a measurement of the IQ imbalance as many times as specified by the parameter value.
Query	The query form of this command starts the measurements and - after the number of measurements specified by the parameter value have been completed and the measurement results obtained - returns a string containing Int floating point real numbers, representing the measurement results in dB. The real numbers returned are in the range from -99 to 0 with a resolution of 0.1.
Example	:MEASure:EVDO:ARRay:RFTX:VERRor:IQIMbalance? 10

:MEASure:EVDO:ARRay:RFTX:VERRor:MAGNitude:RMS

Syntax	:MEASure:EVDO:ARRay:RFTX:VERRor:MAGNitude:RMS <Int>
Parameters	Int is an integer number. The minimum value is 0, the maximum value is 100. The default value is 0.
Description	This comand performs a measurement of the RMS-averaged magnitude component of the error vector as many times as specified by the parameter value.
Query	The query form of this command starts the measurements and - after the number of measurements specified by the parameter value have been completed and the measurement results obtained - returns a string containing Int floating point real numbers, representing the measurement results in form of a percentage. The real numbers returned are in the range from 0 to 200 with a resolution of 0.1.
Example	:MEAS:EVDO:ARR:RFTX:VERR:MAGN:RMS? 10

:MEASure:EVDO:ARRay:RFTX:VERRor:MAGNitude:PEAK

Syntax	:MEASure:EVDO:ARRay:RFTX:VERRor:MAGNitude:PEAK <Int>
Parameters	Int is an integer number. The minimum value is 0, the maximum value is 100. The default value is 0.
Description	This comand performs a measurement of the peak magnitude component of the error vector as many times as specified by the parameter value.
Query	The query form of this command starts the measurements and - after the number of measurements specified by the parameter value have been completed and the measurement results obtained - returns a string containing Int floating point real numbers, representing the measurement results in form of a percentage. The real numbers returned are in the range from 0 to 200 with a resolution of 0.1.
Example	:MEASure:EVDO:ARRay:RFTX:VERRor:MAGNitude:PEAK? 10

:MEASure:EVDO:ARRay:RFTX:VERRor:PHASe:RMS

Syntax	:MEASure:EVDO:ARRay:RFTX:VERRor:PHASe:RMS <Int>
Parameters	Int is an integer number. The minimum value is 0, the maximum value is 100. The default value is 0.
Description	This comand performs a measurement of the RMS-averaged phase component of the error vector as many times as specified by the parameter value.
Query	The query form of this command starts the measurements and - after the number of measurements specified by the parameter value have been completed and the measurement results obtained - returns a string containing Int floating point real numbers, representing the measurement results in degrees. The real numbers returned are in the range from -45 to 45 with a resolution of 0.01.
Example	:MEASure:EVDO:ARRay:RFTX:VERRor:PHASe:RMS? 10

:MEASure:EVDO:ARRay:RFTX:VERRor:PHASe:PEAK

Syntax	:MEASure:EVDO:ARRay:RFTX:VERRor:PHASe:PEAK <Int1>
Parameters	Int is an integer number. The minimum value is 0, the maximum value is 100. The default value is 0.
Description	This comand performs a measurement of the peak phase component of the error vector as many times as specified by the parameter value.
Query	The query form of this command starts the measurements and - after the number of measurements specified by the parameter value have been completed and the measurement results obtained - returns a string containing Int floating point real numbers, representing the measurement results in degrees. The real numbers returned are in the range from -45 to 45 with a resolution of 0.01.
Example	:MEAS:EVDO:ARR:RFTX:VERR:PHAS:PEAK? 10

:MEASure:EVDO:ARRay:RFTX:WQUality|RHO

Syntax	:MEASure:EVDO:ARRay:RFTX:WQUality RHO <Int>
Parameters	Int is an integer number. The minimum value is 0, the maximum value is 100. The default value is 0.
Description	This comand performs a measurement of the mobile's modulation quality factor (rho) as many times as specified by the parameter value.
Query	The query form of this command starts the measurements and - after the number of measurements specified by the parameter value have been completed and the measurement results obtained - returns a string containing Int floating point real numbers, representing the measurement results. The real numbers returned are in the range from 0.95 to 1.0 with a resolution of 0.0001.
Example	:MEASure:EVDO:ARR:RFTX:RHO? 10

:MEASure:EVDO:ARRay:RFTX:CODEdomain:IPower

Syntax	:MEASure:EVDO:ARRay:RFTX:CODEdomain:IPower <Int>
Parameters	Int is an integer number. The minimum value is 0, the maximum value is 100. The default value is 0.
Description	This comand performs a measurement of the channel power levels in the 16 single code channels of the I proportion as many times as specified by the parameter value.
Query	The query form of this command performs the measurement Int times and returns a string containing (Int*16) floating point real numbers, separated by commas and representing the related code channel power levels in dB (relative to the power level of the active code channels). The first of the 16 values always represents code channel 1; the last one code channel 16. The real numbers returned are in the range from -40 to 0 with a resolution of 0.1.
Example	:MEASure:EVDO:ARRay:RFTX:CODEdomain:IPower? 7

:MEASure:EVDO:ARRay:RFTX:CODEdomain:INOIse

Syntax	:MEASure:EVDO:ARRay:RFTX:CODEdomain:INOIse <Int>
Parameters	Int is an integer number. The minimum value is 0, the maximum value is 100. The default value is 0.
Description	This comand performs a measurement of the channel noise levels in the 16 single code channels of the I proportion as many times as specified by the parameter value.
Query	The query form of this command performs the measurement Int times and returns a string containing (Int*16) floating point real numbers, separated by commas and representing the related code channel noise levels in dB (relative to the power level of the active code channels). The first of the 16 values always represents code channel 1; the last one code channel 16. The real numbers returned are in the range from -40 to 0 with a resolution of 0.1.
Example	:MEASure:EVDO:ARR:RFTX:CODE:INOIse? 1

:MEASure:EVDO:ARRay:RFTX:CODEdomain:QPOwer

Syntax	:MEASure:EVDO:ARRay:RFTX:CODEdomain:QPOwer <Int>
Parameters	Int is an integer number. The minimum value is 0, the maximum value is 100. The default value is 0.
Description	This comand performs a measurement of the channel power levels in the 16 single code channels of the Q proportion as many times as specified by the parameter value.
Query	The query form of this command performs the measurement Int times and returns a string containing (Int*16) floating point real numbers, separated by commas and representing the related code channel power levels in dB (relative to the power level of the active code channels). The first of the 16 values always represents code channel 1; the last one code channel 16. The real numbers returned are in the range from -40 to 0 with a resolution of 0.1.
Example	:MEAS:EVDO:ARR:RFTX:CODE:QPOW? 1

:MEASure:EVDO:ARRay:RFTX:CODEdomain:QNOIse

Syntax	:MEASure:EVDO:ARRay:RFTX:CODEdomain:QNOIse <Int>
Parameters	Int is an integer number. The minimum value is 0, the maximum value is 100. The default value is 0.
Description	This comand performs a measurement of the channel noise levels in the 16 single code channels of the Q proportion as many times as specified by the parameter value.
Query	The query form of this command performs the measurement Int times and returns a string containing (Int*16) floating point real numbers, separated by commas and representing the related code channel noise levels in dB (relative to the power level of the active code channels). The first of the 16 values always represents code channel 1; the last one code channel 16. The real numbers returned are in the range from -40 to 0 with a resolution of 0.1.
Example	:MEASure:EVDO:ARR:RFTX:CODEdomain:QNOIse? 1

FETCh Subsystem

The commands of this subsystem are used to read out measurement result values both from continuous and array measurements.

:FETCh:LAST?

Syntax	:FETCh:LAST?
Parameters	There are no parameters.
Description	There is solely a query form of this command available.
Query	Returns in a string the latest measurement result value(s) of the measurement started last. The number and format of the measurement result values returned is dependent on the type of measurement.
Example	<p>:MEAS:GSM:RFTX:PRMS :MEAS:GSM:RFRX:RBER:ALL :FETCh:LAST?</p> <p>In this example, the FETCh:LAST command will return the three residual bit error ratios (three floating point real numbers) as this is the measurement started last.</p>

:FETCh:BLOCKdata:AFSPectrum?

Syntax	:FETCh:BLOCKdata:AFSPectrum?
Parameters	There are no parameters.
Description	There is solely a query form of this command available.
Query	The query form of this command returns the latest data block describing the graph of the audio spectrum measurement. For further details regarding this measurement, please refer to the description of the :MEAS:BLOC:AFSP command and the explanations given in section :MEASure:BLOCKdata . There, you will also find all information about the number, type and order of the measurement result values returned in the result string.
Example	<p>:MEAS:BLOC:AFSP :FETCh:BLOCK:AFSP?</p> <p>The FETCh command will return a data array. The number of measurement result values delivered back is dependent on the span and resolution settings of the audio spectrum analyzer.</p>

:FETCh:AFANalyser:GROup?

Syntax	:FETCh:AFANalyser:GROup?
Parameters	There are no parameters.
Description	There is solely a query form of this command available.

Query	<p>The query form of this command will return the latest measurement result values of the sequence of AF measurements as specified with the <code>:CONF:MEAS:GRO:AFAN</code> command and measured with the <code>:MEAS[ARRay]:AFAN:GRO</code> command. The string returned contains the related measurement result values, separated by commas. All measurement result values are floating point real numbers. The number of measurement result values handed back depends on the number and type of measurements defined with the <code>:CONF:MEAS:GRO:AFAN</code> command. The order of the measurement result values within the result string is as described below for the <code>:FETCh:AFANalyser:ALL</code> command.</p>
Example	<pre>:CONF:MEAS:GRO:AFAN SIN,FREQ :MEAS:AFAN:GRO :FETCh:AFAN:GRO?</pre> <p>In this example, the group of measurements is defined by a SINAD measurement combined with an audio frequency measurement. The values returned are: "1000.0,53.5". Because of the internal order (see description of the command below), the first measurement result value delivered back is the audio frequency, the second one the SINAD.</p>

:FETCh:AFANalyser:ALL?

Syntax	<code>:FETCh:AFANalyser:ALL?</code>
Parameters	There are no parameters.
Description	There is solely a query form of this command available.
Query	<p>The query form of this command will return the latest measurement result values of the <code>:MEAS[:ARRay]:AFAN:ALL</code> measurement in a string. All measurement result values of the AF measurements will be floating point real numbers, separated by commas.</p> <p>The order of the measurement result values within the result string is as follows:</p> <ol style="list-style-type: none"> 1. ACVPeakp, representing the AC peak-to-peak voltage of the AF signal, expressed in V(pp) 2. ACVRms, representing the rms-valued AC voltage of the AF signal, expressed in V(rms), 3. DCVRms, representing the rms-valued AC voltage on an applied DC signal, expressed in V(rms), 4. FREQuency, representing the audio frequency, expressed in Hertz, 5. DISTortion, representing the third-harmonic distortion of the applied sine-wave AF signal (expressed in percent), 6. SINad, representing the signal to noise ratio of the applied AF signal, expressed in dB. <p>Note: Any AF test will need the audio option to be installed on your Willtek 4400.</p>
Example	<pre>:MEAS:ARR:AFAN:ALL 2 :FETCh:AFAN:ALL?</pre> <p>In this example, the six most important AF measurements are performed twice in a sequence. The measurement result string in this example is: "3.2,2.7,0.1,1000.0,1.1,53.5,2.7,1.7,0.08,1000.0,0.9,55.2".</p>

:FETCh:AFAN:ACVoltage:PEAKp?

Syntax	:FETCh:AFAN:ACVoltage:PEAKp?
Parameters	There are no parameters.
Description	There is solely a query form of this command available.
Query	The query form of this command will return the latest measurement result value(s) of the :MEAS[:ARRay]:AFAN:ACV:PEAKp measurement. The string delivered back will contain at least one floating point real number. Note: Any AF test will need the audio option to be installed on your Willtek 4400.
Example	:MEAS:ARR:AFAN:ACV:PEAK 5 :FETC:AFAN:ACV:PEAK? The string delivered back is: "3.2,3.1,3.3,3.2,2.9".

:FETCh:AFAN:ACVoltage:RMS?

Syntax	:FETCh:AFAN:ACVoltage:RMS?
Parameters	There are no parameters.
Description	There is solely a query form of this command available.
Query	The query form of this command will return the latest measurement result value(s) of the :MEAS[:ARRay]:AFAN:ACV:RMS measurement. The string delivered back will contain at least one floating point real number. Note: Any AF test will need the audio option to be installed on your Willtek 4400.
Example	:MEAS:AFAN:ACV:RMS :FETC:AFAN:ACV:RMS? The string delivered back is: "1.7".

:FETCh:AFAN:DCVoltage?

Syntax	:FETCh:AFAN:DCVoltage?
Parameters	There are no parameters.
Description	There is solely a query form of this command available.
Query	The query form of this command will return the latest measurement result value(s) of the :MEAS[:ARRay]:AFAN:DCV measurement. The string delivered back will contain at least one floating point real number. Note: Any AF test will need the audio option to be installed on your Willtek 4400.
Example	:MEAS:AFAN:DCV :FETC:AFAN:DCV? The string delivered back is: "1.7".

:FETCh:AFANalyser:FREQuency?

Syntax	:FETCh:AFANalyser:FREQuency?
Parameters	There are no parameters.

Description	There is solely a query form of this command available.
Query	The query form of this command will return the latest measurement result value(s) of the :MEAS[:ARRay]:AFAN:FREQ measurement. The string delivered back will contain at least one floating point real number. Note: Any AF test will need the audio option to be installed on your Willtek 4400.
Example	:MEAS:ARR:AFAN:FREQ 5 :FETC:AFAN:FREQ? The string delivered back is: "1000.5,1497.0,2004.7,2491.2,3005.0".

:FETCh:AFANalyser:DISToRTion?

Syntax	:FETCh:AFANalyser:DISToRTion?
Parameters	There are no parameters.
Description	There is solely a query form of this command available.
Query	The query form of this command will return the latest measurement result value(s) of the :MEAS[:ARRay]:AFAN:DIS measurement. The string delivered back will contain at least one floating point real number. Note: Any AF test will need the audio option to be installed on your Willtek 4400.
Example	:MEAS:AFAN:DIS :FETC:AFAN:DIS? The string delivered back is: "1.5".

:FETCh:AFANalyser:SINad?

Syntax	:FETCh:AFANalyser:SINad?
Parameters	There are no parameters.
Description	There is solely a query form of this command available.
Query	The query form of this command will return the latest measurement result value(s) of the :MEAS[:ARRay]:AFAN:SINad measurement. The string delivered back will contain at least one floating point real number. Note: Any AF test will need the audio option to be installed on your Willtek 4400.
Example	:MEAS:ARR:AFAN:SIN 3 :FETC:AFAN:SIN? The string delivered back is: "53.5,55.2,54.2".

:FETCh:PSUPply:GRoup

Syntax	:FETCh:PSUPply:GRoup?
Parameters	There are no parameters.
Description	There is solely a query form of this command available.

Query	<p>This query returns the latest measurement result values of the sequence of power/ current consumption measurements as specified with the <code>:CONF:MEAS:GRO:PSUP</code> command and measured with the <code>:MEAS[ARRAY]:PSUP:GRO</code> command. The string returned contains the related measurement result values, separated by commas. All measurement result values are floating point real numbers. The number of measurement result values handed back depends on the number and type of measurements defined with the <code>:CONF:MEAS:GRO:PSUP</code> command.</p> <p>The order of the measurement result values within the result string is as described below for the <code>:FETCh:PSUP:ALL</code> command.</p>
Example	<pre>:CONF:MEAS:GRO:PSUP ACUR,APOW :MEAS:PSUP:GRO :FETCh:PSUP:GRO?</pre> <p>In this example, the group of measurements consists of the average current consumption and the average power consumption measurements. The values returned in this example are: "859.2,293.7".</p> <p>Because of the internal order (see description of the command below), the first measurement result value delivered back is the power consumption (in mW), followed by the average current consumption (in mA).</p>

:FETCh:PSUPply:ALL

Syntax	<code>:FETCh:PSUPply:ALL?</code>
Parameters	There are no parameters.
Description	There is solely a query form of this command available.
Query	<p>This query returns the latest measurement result values of the <code>:MEAS[:ARRAY]:PSUP:ALL</code> measurement in a string. All measurement result values of the power and current consumption measurements are floating point real numbers, separated by commas.</p> <p>The order of the measurement result values within the result string is as follows:</p> <ol style="list-style-type: none"> APOW, representing the average power consumption (in mW), ACUR, representing the average current consumption, expressed in mA, PCUR, representing the peak current consumption, expressed in mA. <p>Note: Any current measurement will need the MS Power Supply and Current Measurement options to be installed on your Willtek 4400.</p>
Example	<pre>:MEAS:PSUP:ALL :FETCh:PSUP:ALL?</pre> <p>Returns a string like "893.5,395.4,1256.2".</p>

:FETCh:PSUPply:APOWer

Syntax	<code>:FETCh:PSUPply:APOWer?</code>
Parameters	There are no parameters.
Description	There is solely a query form of this command available.

Query	This query returns the latest measurement result values of the :MEAS[:ARRAY]:PSUP:APOW measurement in a string. The measurement result value is a floating point real numbers representing the average current consumption, expressed in mA. Note: Any current measurement will need the MS Power Supply and Current Measurement options to be installed on your Willtek 4400.
Example	:MEAS:PSUP:APOW :FETCh:PSUP:APOW? Returns a string like "893.5" giving the average power consumption in mW.

:FETCh:PSUPply:ACURrent

Syntax	:FETCh:PSUPply:ACURrent?
Parameters	There are no parameters.
Description	There is solely a query form of this command available.
Query	This query returns the latest measurement result values of the :MEAS[:ARRAY]:PSUP:ACUR measurement in a string. The measurement result value is a floating point real numbers representing the average current consumption, expressed in mA. Note: Any current measurement will need the MS Power Supply and Current Measurement options to be installed on your Willtek 4400.
Example	:MEAS:PSUP:ACUR :FETCh:PSUP:ACUR? Returns a string like "395.4" giving the average current consumption in mA.

:FETCh:PSUPply:PCURrent

Syntax	:FETCh:PSUPply:PCURrent?
Parameters	There are no parameters.
Description	There is solely a query form of this command available.
Query	This query returns the latest measurement result values of the :MEAS[:ARRAY]:PSUP:ALL measurement in a string. All measurement result values of the power and current consumption measurements are floating point real numbers, separated by commas. The order of the measurement result values within the result string is as follows: 1. APOW , representing the average power consumption (in mW), 2. ACUR , representing the average current consumption, expressed in mA, 3. PCUR , representing the peak current consumption, expressed in mA. Note: Any current measurement will need the MS Power Supply and Current Measurement options to be installed on your Willtek 4400.
Example	:MEAS:PSUP:PCUR :FETCh:PSUP:PCUR? Returns a string like "1256.2" giving the peak current consumption in mA.

:FETCh:EVDO:LAST

Syntax	:FETCh:EVDO:LAST?
Parameters	There are no parameters for this command.
Description	This is a query-only command, returning exactly the same result values as returned by the FETCh or MEASure command issued last.
Query	The query form of this command returns the measurement result obtained last in its related form (i.e. usually in form of floating point real numbers), contained in a string.
Example	:MEAS:EVDO:RFTX:FREQ:ERR? Starts the measurement of the mobile's frequency error and returns the result, e.g.: "-53" :FETCh:EVDO:LAST? String returned in this example: "-53".

:FETCh:EVDO:RFRX:PER[:IMMediate]

Syntax	:FETCh:EVDO:RFRX:PER[:IMMediate]?
Parameters	There are no parameters for this command.
Description	This is a query-only command, returning the measurement result(s) of a previously issued :MEAS:EVDO:CONT ARR:RFRX:PER command.
Query	Once the related measurement type is completed, the query form of this command returns a string containing one (continuous measurement) or several (array measurement) floating point real number(s), representing the packet error rate (PER). The real numbers returned are in the range from 0 to 10 with a resolution of 0.1.
Example	:FETCh:EVDO:RFRX:PER?

:FETCh:EVDO:RFRX:PER:FRAMe:ERRor

Syntax	:FETCh:EVDO:RFRX:PER:FRAMe:ERRor?
Parameters	There are no parameters for this command.
Description	This is a query-only command, returning the number of erroneous packets obtained during the last PER test run. The Willtek 4400 uses this number to calculate the PER.
Query	Once the related measurement type is completed, the query form of this command returns a string containing one integer number, representing the number or erroneous packets.
Example	:FETCh:EVDO:RFRX:PER:FRAMe:ERR?

:FETCh:EVDO:RFRX:PER:FRAMe:TRANsmitted?

Syntax	:FETCh:EVDO:RFRX:PER:FRAMe:TRANsmitted?
Parameters	There are no parameters for this command.

Description	This is a query-only command, returning the total number of packets sent by the Willtek 4400 during the last PER test run. The test set uses this number to calculate the PER.
Query	Once the related measurement type is completed, the query form of this command returns a string containing one integer number, representing the total number of packets transmitted.
Example	:FETCh:EVDO:RFRX:PER:FRAMe:TRANsmitted?

:FETCh:EVDO:RFRX:PER:STATus[:IMMediate]

Syntax	:FETCh:EVDO:RFRX:PER:STATus[:IMMediate]?
Parameters	There are no parameters for this command.
Description	This is a query-only command, returning the result status of the last PER test performed.
Query	Once the related measurement type is completed, the query form of this command checks the results against the corresponding limits. It will return one of the following predefined expressions, contained in a string: <ul style="list-style-type: none"> - PASS - if the measurement results were within their limits, - FAIL - if one or several measurement results did violate their limits, - CONPASS - if the test was passed with confidence, - CONFFAIL - if the test was failed with confidence, - NONE - if a measurement result could not be obtained for any reason.
Example	:MEAS:EVDO:RFRX:PER :FETCh:EVDO:RFRX:PER:STAT? The first command starts a PER measurement. The second command checks the measurement results against their limits and returns the final test verdict in form of one of the predefined expressions explained above, like "CONPASS" in this example.

:FETCh:EVDO:RFSPectrum:MSpectrum[:DATA]

Syntax	:FETCh:EVDO:RFSPectrum:MSpectrum[:DATA]?
Parameters	There are no parameters for this command.
Description	This is a query-only command, returning the measurement results of a previously issued :MEAS:EVDO[:CONT]:RFSP:MSP[:DATA] :AVG command.
Query	Once the related measurement type is completed, the query form of this command returns a string containing an array of 501 floating point real numbers, separated by commas and representing the single measurement results at the discrete frequencies (250 in the range below, 250 in the range above the carrier and at the carrier itself). The discrete frequencies depend on the currently selected span of the RF modulation spectrum measurement. If the span, for example, is +/- 2500 kHz, the discrete frequencies to measure at are in steps of 10 kHz both below and above the carrier frequency. Value 1 of the array returned represents the result obtained for the lowest frequency, value 251 represents the result obtained for the carrier, and value 501 represents the result obtained for the highest frequency measured at. The real numbers returned are in the range from -100 to 30 with a resolution of 0.1. The physical units are dBm.

Example	<code>:MEAS:EVDO:RFSP:MSP:AVG 10</code> <code>:FETCh:EVDO:RFSpectrum:MSpectrum:DATA?</code>
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:FETCh:EVDO:RFSpectrum:ACPM

Syntax	<code>:FETCh:EVDO:RFSpectrum:ACPM?</code>
Parameters	There are no parameters for this command.
Description	This is a query-only command, returning the measurement results of a previously issued <code>:MEAS:EVDO:CONT ARR:RFSP:ACPM</code> command.
Query	Once the related measurement type is completed, the query form of this command returns a string containing 25 (continuous measurement) or a multiple of 25 (array measurement) floating point real numbers, separated by commas and representing the single results obtained at the 25 discrete measurement frequencies (12 offsets in both directions from the carrier, plus the result at the carrier itself). The first of the 25 values always represents the result obtained at the lowest measurement frequency, value 13 represents the result obtained for the carrier, and value 25 represents the result obtained at the highest measurement frequency. The real numbers returned are in the range from -120 to 0 with a resolution of 0.1. The physical units are dB, relative to the measurement result obtained for the carrier.
Example	<code>:MEAS:EVDO:RFSP:ACPM</code> <code>:FETCh:EVDO:RFSpectrum:ACPM?</code>

:FETCh:EVDO:RFTX:GRoup

Syntax	<code>:FETCh:EVDO:RFTX:GRoup?</code>
Parameters	There are no parameters for this command.
Description	This is a query-only command, returning exactly the same measurement results as a <code>MEAS:EVDO:RFTX:GR?</code> command. The group of measurements is defined using the <code>:CONF:EVDO:MEAS:GRO:RFTX</code> command.
Query	The query form of this command returns the last measurement results of the group of measurements, defined with the <code>:CONF:EVDO:MEAS:GRO:RFTX</code> command. The measurement results are returned in their related form (i.e. usually in form of floating point real numbers), contained in a string.
Example	<code>:FETCh:EVDO:RFTX:GRoup?</code>

:FETCh:EVDO:RFTX:FREQuency:ERRor

Syntax	<code>:FETCh:EVDO:RFTX:FREQuency:ERRor?</code>
Parameters	There are no parameters for this command.
Description	This is a query-only command, returning the measurement result(s) of a previously issued <code>:MEAS:EVDO:CONTinuous ARRay:RFTX:FREQ:ERR</code> command.

Query	Once the related measurement type is completed, the query form of this command returns a string containing one (continuous measurement) or several (array measurement) floating point real number(s), representing the mobile's frequency error. The physical units are set using the <code>:MEAS:EVDO:RFTX:FREQ:UNIT</code> command. The real numbers returned are in the range from -1000 to 1000 with a resolution of 1.0.
Example	<pre>:MEAS:EVDO:RFTX:FREQ:UNIT HZ :MEAS:EVDO:ARR:RFTX:FREQ:ERR 5 :FETCh:EVDO:RFTX:FREQuency:ERRor?</pre> <p>The first command sets the physical units to Hz. The second command starts an array measurement of the frequency error. The results returned in this example by the third command are: "-53,-48,-39,47,63".</p>

:FETCh:EVDO:RFTX:Time:OFFSet

Syntax	<code>:FETCh:EVDO:RFTX:Time:OFFSet?</code>
Parameters	There are no parameters for this command.
Description	This is a query-only command, returning the measurement result(s) of a previously issued <code>:MEAS:EVDO:CONTinuous ARRay:RFTX:TIME:OFFS</code> command.
Query	Once the related measurement type is completed, the query form of this command returns a string containing one (continuous measurement) or several (array measurement) floating point real number(s), representing the measurement results in microseconds (10E-6 s). The real numbers returned are in the range from -5 to 5 with a resolution of 0.001.
Example	<code>:FETCh:EVDO:RFTX:Time:OFFSet?</code>

:FETCh:EVDO:RFTX:POWer[:MEAN]

Syntax	<code>:FETCh:EVDO:RFTX:POWer[:MEAN]?</code>
Parameters	There are no parameters for this command.
Description	This is a query-only command, returning the measurement result(s) of a previously issued <code>:MEAS:EVDO:CONTinuous ARRay:RFTX:POW</code> command.
Query	Once the related measurement type is completed, the query form of this command returns a string containing one (continuous measurement) or several (array measurement) floating point real number(s), representing the measurement results in dBm. The real numbers returned are in the range from -70 to 36 with a resolution of 0.1.
Example	<code>:FETCh:EVDO:RFTX:POW?</code>

:FETCh:EVDO:RFTX:POWer:MAXimum

Syntax	<code>:FETCh:EVDO:RFTX:POWer:MAXimum?</code>
Parameters	There are no parameters for this command.
Description	This is a query-only command, returning the measurement result(s) of a previously issued <code>:MEAS:EVDO:CONTinuous ARRay:RFTX:POW:MAX</code> command.

Query	Once the related measurement type is completed, the query form of this command returns a string containing one (continuous measurement) or several (array measurement) floating point real number(s), representing the measurement results in dBm. The real numbers returned are in the range from -70 to 36 with a resolution of 0.1.
Example	:FETCh:EVDO:RFTX:POW:MAX?

:FETCh:EVDO:RFTX:POWer:MINimum

Syntax	:FETCh:EVDO:RFTX:POWer:MINimum?
Parameters	There are no parameters for this command.
Description	This is a query-only command, returning the measurement result(s) of a previously issued :MEAS:EVDO:CONTinuous ARRy:RFTX:POW:MIN command.
Query	Once the related measurement type is completed, the query form of this command returns a string containing one (continuous measurement) or several (array measurement) floating point real number(s), representing the measurement results in dBm. The real numbers returned are in the range from -70 to 36 with a resolution of 0.1.
Example	:FETCh:EVDO:RFTX:POWer:MINimum?

:FETCh:EVDO:RFTX:VERRor:RMS

Syntax	:FETCh:EVDO:RFTX:VERRor:RMS?
Parameters	There are no parameters for this command.
Description	This is a query-only command, returning the measurement result(s) of a previously issued :MEAS:EVDO:CONT ARR:RFTX:VERR:RMS command.
Query	Once the related measurement type is completed, the query form of this command returns a string containing one (continuous measurement) or several (array measurement) floating point real number(s), representing the measurement results in form of a percentage. The real numbers returned are in the range from 0 to 200 with a resolution of 0.1.
Example	:FETCh:EVDO:RFTX:VERRor:RMS?

:FETCh:EVDO:RFTX:VERRor:PEAK

Syntax	:FETCh:EVDO:RFTX:VERRor:PEAK?
Parameters	There are no parameters for this command.
Description	This is a query-only command, returning the measurement result(s) of a previously issued :MEAS:EVDO:CONT ARR:RFTX:VERR:PEAK command.
Query	Once the related measurement type is completed, the query form of this command returns a string containing one (continuous measurement) or several (array measurement) floating point real number(s), representing the measurement results in form of a percentage. The real numbers returned are in the range from 0 to 200 with a resolution of 0.1.
Example	:FETCh:EVDO:RFTX:VERRor:PEAK?

:FETCh:EVDO:RFTX:VERRor:MAGNitude:RMS

Syntax	:FETCh:EVDO:RFTX:VERRor:MAGNitude:RMS?
Parameters	There are no parameters for this command.
Description	This is a query-only command, returning the measurement result(s) of a previously issued :MEAS:EVDO:CONT ARR:RFTX:VERR:MAGN:RMS command.
Query	Once the related measurement type is completed, the query form of this command returns a string containing one (continuous measurement) or several (array measurement) floating point real number(s), representing the measurement results in form of a percentage. The real numbers returned are in the range from 0 to 200 with a resolution of 0.1.
Example	:FETCh:EVDO:RFTX:VERRor:MAGNitude:RMS?

:FETCh:EVDO:RFTX:VERRor:MAGNitude:PEAK

Syntax	:FETCh:EVDO:RFTX:VERRor:MAGNitude:PEAK?
Parameters	There are no parameters for this command.
Description	This is a query-only command, returning the measurement result(s) of a previously issued :MEAS:EVDO:CONT ARR:RFTX:VERR:MAGN:PEAK command.
Query	Once the related measurement type is completed, the query form of this command returns a string containing one (continuous measurement) or several (array measurement) floating point real number(s), representing the measurement results in form of a percentage. The real numbers returned are in the range from 0 to 200 with a resolution of 0.1.
Example	:FETCh:EVDO:RFTX:VERRor:MAGNitude:PEAK?

:FETCh:EVDO:RFTX:VERRor:PHASe:RMS

Syntax	:FETCh:EVDO:RFTX:VERRor:PHASe:RMS?
Parameters	There are no parameters for this command.
Description	This is a query-only command, returning the measurement result(s) of a previously issued :MEAS:EVDO:CONT ARR:RFTX:VERR:PHAS:RMS command.
Query	Once the related measurement type is completed, the query form of this command returns a string containing one (continuous measurement) or several (array measurement) floating point real number(s), representing the measurement results in degrees. The real numbers returned are in the range from -45 to 45 with a resolution of 0.01.
Example	:FETCh:EVDO:RFTX:VERRor:PHASe:RMS?

:FETCh:EVDO:RFTX:VERRor:PHASe:PEAK

Syntax	:FETCh:EVDO:RFTX:VERRor:PHASe:PEAK?
Parameters	There are no parameters for this command.

Description	This is a query-only command, returning the measurement result(s) of a previously issued <code>:MEAS:EVDO:CONT ARR:RFTX:VERR:PHAS:PEAK</code> command.
Query	Once the related measurement type is completed, the query form of this command returns a string containing one (continuous measurement) or several (array measurement) floating point real number(s), representing the measurement results in degrees. The real numbers returned are in the range from -45 to 45 with a resolution of 0.01.
Example	<code>:FETCh:EVDO:RFTX:VERRor:PHASe:PEAK?</code>

:FETCh:EVDO:RFTX:VERRor:IQOffset

Syntax	<code>:FETCh:EVDO:RFTX:VERRor:IQOffset?</code>
Parameters	There are no parameters for this command.
Description	This is a query-only command, returning the measurement result(s) of a previously issued <code>:MEAS:EVDO:CONT ARR:RFTX:VERR:IQOF</code> command.
Query	Once the related measurement type is completed, the query form of this command returns a string containing one (continuous measurement) or several (array measurement) floating point real number(s), representing the measurement results in dBc. The real numbers returned are in the range from -60 to 0 with a resolution of 0.1.
Example	<code>:FETCh:EVDO:RFTX:VERRor:IQOffset?</code>

:FETCh:EVDO:RFTX:VERRor:IQIMbalance

Syntax	<code>:FETCh:EVDO:RFTX:VERRor:IQIMbalance?</code>
Parameters	There are no parameters for this command.
Description	This is a query-only command, returning the measurement result(s) of a previously issued <code>:MEAS:EVDO:CONT ARR:RFTX:VERR:IQIM</code> command.
Query	Once the related measurement type is completed, the query form of this command returns a string containing one (continuous measurement) or several (array measurement) floating point real number(s), representing the measurement results in dB. The real numbers returned are in the range from -99 to 0 with a resolution of 0.1.
Example	<code>:FETCh:EVDO:RFTX:VERRor:IQIMbalance?</code>

:FETCh:EVDO:RFTX:WQUality

Syntax	<code>:FETCh:EVDO:RFTX:WQUality?</code>
Parameters	There are no parameters for this command.
Description	This is a query-only command, returning the measurement result(s) of a previously issued <code>:MEAS:EVDO:CONT ARR:RFTX:WQU RHO</code> command.
Query	Once the related measurement type is completed, the query form of this command returns a string containing one (continuous measurement) or several (array measurement) floating point real number(s), representing the modulation quality factor. The real numbers returned are in the range from 0.9 to 1.0 with a resolution of 0.0001.
Example	<code>:FETCh:EVDO:RFTX:WQUality?</code>

:FETCh:EVDO:RFTX:CODEdomain:IMMediate

Syntax	:FETCh:EVDO:RFTX:CODEdomain:IMMediate?
Parameters	There are no parameters for this command.
Description	This is a query-only command, returning the measurement result(s) of a previously issued :MEAS:EVDO:CONT ARR:RFTX:CODE:IMM command.
Query	Once the related measurement type is completed, the query form of this command checks the results against the corresponding limits. It will return one of the following predefined expressions, contained in a string: <ul style="list-style-type: none"> - PASS - if the measurement results were within their limits, - FAIL - if one or several measurement results did violate their limits, - NONE - if a measurement result could not be obtained for any reason.
Example	:FETCh:EVDO:RFTX:CODEdomain?

:FETCh:EVDO:RFTX:CODEdomain:IPower

Syntax	:FETCh:EVDO:RFTX:CODEdomain:IPower?
Parameters	There are no parameters for this command.
Description	This is a query-only command, returning the measurement results of a previously issued :MEAS:EVDO:CONT ARR:RFTX:CODE:IPOW command.
Query	Once the related measurement type is completed, the query form of this command returns a string containing 16 (continuous measurement) or a multiple of 16 (array measurement) floating point real numbers, separated by commas and representing the related measurement results in dB (relative to the power level of the active code channels). The first of the 16 values always represents code channel 1; the last one code channel 16. The real numbers returned are in the range from -40 to 0 with a resolution of 0.1.
Example	:FETCh:EVDO:RFTX:CODE:IPower?

:FETCh:EVDO:RFTX:CODEdomain:INOise

Syntax	:FETCh:EVDO:RFTX:CODEdomain:INOise?
Parameters	There are no parameters for this command.
Description	This is a query-only command, returning the measurement results of a previously issued :MEAS:EVDO:CONT ARR:RFTX:CODE:INOI command.
Query	Once the related measurement type is completed, the query form of this command returns a string containing 16 (continuous measurement) or a multiple of 16 (array measurement) floating point real numbers, separated by commas and representing the related measurement results in dB (relative to the power level of the active code channels). The first of the 16 values always represents code channel 1; the last one code channel 16. The real numbers returned are in the range from -40 to 0 with a resolution of 0.1.
Example	:FETCh:EVDO:RFTX:CODE:INOise?

:FETCh:EVDO:RFTX:CODEdomain:QPOWer

Syntax	:FETCh:EVDO:RFTX:CODEdomain:QPOWer?
Parameters	There are no parameters for this command.
Description	This is a query-only command, returning the measurement results of a previously issued :MEAS:EVDO:CONT ARR:RFTX:CODE:QPOW command.
Query	Once the related measurement type is completed, the query form of this command returns a string containing 16 (continuous measurement) or a multiple of 16 (array measurement) floating point real numbers, separated by commas and representing the related measurement results in dB (relative to the power level of the active code channels). The first of the 16 values always represents code channel 1; the last one code channel 16. The real numbers returned are in the range from -40 to 0 with a resolution of 0.1.
Example	:FETCh:EVDO:RFTX:CODE:QPOWer?

:FETCh:EVDO:RFTX:CODEdomain:QNOIse

Syntax	:FETCh:EVDO:RFTX:CODEdomain:QNOIse?
Parameters	There are no parameters for this command.
Description	This is a query-only command, returning the measurement results of a previously issued :MEAS:EVDO:CONT ARR:RFTX:CODE:QNOI command.
Query	Once the related measurement type is completed, the query form of this command returns a string containing 16 (continuous measurement) or a multiple of 16 (array measurement) floating point real numbers, separated by commas and representing the related measurement results in dB (relative to the power level of the active code channels). The first of the 16 values always represents code channel 1; the last one code channel 16. The real numbers returned are in the range from -40 to 0 with a resolution of 0.1.
Example	:FETCh:EVDO:RFTX:CODE:QNOIse?

CALCulate Subsystem

The CALCulate subsystem provides a large number of commands in order to set limits, check measurement result values against those limits and to perform statistic evaluation of measurement result values.

:CALCulate:RESet

Syntax	<code>:CALCulate:RESet</code>
Parameters	There are no parameters.
Description	Resets the CALC subsystem and brings it into a defined operating state. We kindly recommend to use this command to initialize the CALC subsystem when starting a new test run. For further details, refer to the example shown in section " The CALCulate Subsystem " on page 253.
Query	There is no query form of this command available.
Example	<p>:CALCulate:RESet :MEAS:GSM:ARR:RFTX:LENG 10 :CALC:MAVerage?</p> <p>This example first resets the CALC subsystem and then starts the measurement of the frequency error for 10 measurement runs. The average measurement result value of those ten measurement runs will then be calculated and returned by the :CALC:MAV? query (see below for details regarding this command).</p>

:CALCulate:LIMit:FAIL[:LAST]?

Syntax	<code>:CALCulate:LIMit:FAIL[:LAST]?</code>
Parameters	There are no parameters.
Description	There is solely a query form of this command available.
Query	<p>Checks whether the result(s) of the last measurement performed did violate the user-defined measurement result limits or not. As long as all single measurement results are within the limits, a 0 will be returned. A 1 indicates that at least one measurement result did violate at least one limit.</p> <p>The limits for the single measurements can be set using the appropriate commands of the CALC subsystem (as explained in this section).</p>
Example	<p>:CALCulate:RESet :MEAS:GSM:RFTX:ALL :CALC:LIM:FAIL?</p> <p>This example first resets the CALC subsystem and then starts the measurement of all relevant RF TX parameters. If a measurement result of the current sequence violates the corresponding measurement result limits, the query will return a 1. When all measurement results are within their limits, a 0 will be returned.</p>

:CALCulate:LIMit:FAIL:CUMulative?

Syntax	<code>:CALCulate:LIMit:FAIL:CUMulative?</code>
Parameters	There are no parameters.

Description	There is solely a query form of this command available.
Query	Checks whether any result(s) of the measurement started last did violate their corresponding, user-defined measurement result limits. As long as all single measurement results are within their limits, a 0 will be returned. A 1 indicates that at least one measurement result did violate at least one limit. The limits for the single measurements can be set using the appropriate commands of the CALC subsystem (as explained in this section). To reset the cumulative check of the measurement results, use the :CALC:LIM:FAIL:CUM:RES command as explained below.
Example	:CALC:LIM:FAIL:CUM:RES :MEAS:GSM:RFTX:TEMP ... (other SCPI commands) ... :CALC:LIM:FAIL:CUM? This example first resets the cumulative process then starts the continuous check of the UL burst against the power/time template (PTT). After that, other SCPI commands are performed. After a while, the :CALC:LIM:FAIL:CUM command is used to check whether there has been any violation of the PTT since the start of the :MEAS:GSM:RFTX:TEMP measurement.

:CALCulate:LIMit:FAIL:RESet

Syntax	:CALCulate:LIMit:FAIL:RESet
Parameters	There are no parameters.
Description	This command resets the cumulative process as explained above (see description of command :CALC:LIM:FAIL:CUM for details).
Query	There is no query form of this command available.
Example	:CALC:LIM:FAIL:RES :MEAS:GSM:RFTX:TEMP ... (other SCPI commands) ... :CALC:LIM:FAIL:CUM? This example first resets the cumulative process then starts the continuous check of the UL burst against the power/time template (PTT). After that, other SCPI commands are performed. After a while, the :CALC:LIM:FAIL:CUM command is used to check whether there has been any violation of the PTT since the start of the :MEAS:GSM:RFTX:TEMP measurement.

:CALCulate:MAverage?

Syntax	:CALCulate:MAverage?
Parameters	There are no parameters.
Description	There is solely a query form of this command available.
Query	Calculates and returns the average measurement result value of the measurement started last. The string delivered back will contain as many average values as measurement types performed. The single average values will always have the format of floating point real numbers and will be separated by commas.

Example **:CONF:MEAS:GRO:RFTX POW,PRMS**
 :CALC:RES
 :MEAS:GSM:ARR:RFTX:GROup 20
 :CALCulate:MAverage?

In this example, first the group of measurements is defined by a power measurement combined with a RMS phase error measurement. This group of measurements is performed 20 times. After that, the single measurement result values will be averaged and returned. The values returned in this example are:
"4.53,9.98".

:CALCulate:MMINimum?

Syntax **:CALCulate:MMINimum?**

Parameters There are no parameters.

Description There is solely a query form of this command available.

Query Returns the **minimum** measurement result value of the measurement started last. The string delivered back will contain as many minimum values as measurement types performed. The single minimum values will always have the format of floating point real numbers and will be separated by commas.

Example **:MEAS:AFAN:SIN**
 :CALC:RES
 ...(other SCPI commands)...
 :CALCulate:MMIN?

In this example, first a continuous SINAD measurement is started. After some time, the **:CALC:MMIN** command is used to read out the minimum SINAD measured. The string returned in this example is **"42.6"**.

:CALCulate:MMAximum?

Syntax **:CALCulate:MMAximum?**

Parameters There are no parameters.

Description There is solely a query form of this command available.

Query Returns the **maximum** measurement result value of the measurement started last. The string delivered back will contain as many maximum values as measurement types performed. The single maximum values will always have the format of floating point real numbers and will be separated by commas.

Example **:MEAS:GSM:RFTX:FREQ**
 :CALC:RES
 ...(other SCPI commands)...
 :CALCulate:MMAx?

In this example, first a continuous measurement of the mobile's frequency error is started. After some time, the **:CALC:MMAx** command is used to read out the maximum frequency error of the mobile. The string returned in this example is **"22.1"**.

:CALCulate:MSIGma?

Syntax	:CALCulate:MSIGma?
Parameters	There are no parameters.
Description	There is solely a query form of this command available.
Query	Returns the mean value and the standard deviation of the measurement results since the last measurement start. The string delivered back contains as many pairs of mean and standard deviation values as measurement types performed. The individual values all have the format of floating point real numbers and will be separated by commas.
Example	<pre> :MEAS:GSM:RFTX:FREQ :CALC:RES ... (other SCPI commands) ... :CALC:MSIG? </pre> <p>In this example, first a continuous measurement of the mobile's frequency error is started. After some time, the :CALC:MSIG command is used to read out the mean frequency error and its standard deviation. The string returned in this example is "22.1, 3.4"</p>

:CALCulate:AFANalyser:MAVerage?

Syntax	:CALCulate:AFANalyser:MAVerage?
Parameters	There are no parameters.
Description	There is solely a query form of this command available.
Query	Calculates and returns the average measurement result value of the Audio measurement started last. The string delivered back will contain as many average values as measurement types performed. The single average values will always have the format of floating point real numbers and will be separated by commas.
Example	<pre> :CALC:RES :MEAS:ARR:AFAN:ALL :CALC:AFAN:MAV? </pre>

:CALCulate:AFANalyser:MMINimum?

Syntax	:CALCulate:AFANalyser:MMINimum?
Parameters	There are no parameters.
Description	There is solely a query form of this command available.
Query	Returns the minimum measurement result value of the Audio measurement started last. The string delivered back will contain as many minimum values as measurement types performed. The single minimum values will always have the format of floating point real numbers and will be separated by commas.
Example	<pre> :CALC:RES :MEAS:ARR:AFAN:ALL :CALC:AFAN:MMIN? </pre>

:CALCulate:AFANalyser:MMAximum?

Syntax	:CALCulate:AFANalyser:MMAximum?
Parameters	There are no parameters.
Description	There is solely a query form of this command available.
Query	Returns the maximum measurement result value of the Audio measurement started last. The string delivered back will contain as many maximum values as measurement types performed. The single maximum values will always have the format of floating point real numbers and will be separated by commas.
Example	:CALC:RES :MEAS:ARR:AFAN:ALL :CALC:AFAN:MMAx?

:CALCulate:AFANalyser:MSIGma?

Syntax	:CALCulate:AFANalyser:MSIGma?
Parameters	There are no parameters.
Description	There is solely a query form of this command available.
Query	Returns the mean value and the standard deviation of the audio measurement results since the last measurement start. The string delivered back contains as many pairs of mean and standard deviation values as measurement types performed. The individual values all have the format of floating point real numbers and will be separated by commas.
Example	:CALC:RES :MEAS:AFAN:ACV ...(other SCPI commands)... :CALC:AFAN:MSIG? In this example, first a continuous measurement of the audio voltage is started. After some time, the :CALC:AFAN:MSIGma command is used to read out the mean voltage and its standard deviation. The string returned in this example is " 1.1, 0.2 ".

:CALC:AFANalyser:ALL:LIMit[:FAIL]?

Syntax	:CALC:AFANalyser:ALL:LIMit[:FAIL]?
Parameters	There are no parameters.
Description	There is solely a query form of this command available.

Query	<p>This command delivers six boolean numbers in a string, separated by commas. These numbers indicate whether the six single measurement result values of the MEAS:AFAN:ALL measurement did violate their individual limits (set with the commands explained below) or not.</p> <p>The position of the boolean number within the string returned indicates the result of the check of following measurements:</p> <ol style="list-style-type: none"> 1. the peak-to-peak measurement of the AC voltage, 2. the root-mean square value of the AC voltage, 3. the RMS-valued AC ripple on a DC voltage, 4. the audio frequency measurement, 5. the measurement of the third-harmonic distortion (THD) of a sine wave and 6. the SINAD measurement. <p>While a 0 on any position indicates that the related measurement result value is within the limits specified, a 1 indicates that the measurement result value did violate at least one of the limits set for the related test.</p>
Example	<pre>:MEAS:AFAN:ALL :CALC:AFAN:ALL:LIM? String returned:"0,0,0,0,1,0" The 1 on position 5 indicates that the distortion measurement is off its limits.</pre>

:CALCulate:AFANalyser:ALL:LIMit:STATe

Syntax	:CALCulate:AFANalyser:ALL:LIMit:STATe <PredefExp>
Parameters	PredefExp is one of the following predefined expressions: ON OFF . Default is ON .
Description	This command switches the check of the measurement result values of the MEAS:AFAN:ALL measurement against their user-definable limits either on or off.
Query	There is no query form of this command available.
Example	<pre>:CALC:AFAN:ALL:LIM:STAT ON Switches the limit check of the main audio measurements on.</pre>

:CALCulate:AFANalyser:ALL:LIMit:UPPer[:DATA]

Syntax	:CALCulate:AFANalyser:ALL:LIMit:UPPer[:DATA] <real1>,<real2>,<real3>,<real4>,<real5>,<real6>
Parameters	<p>realx are six floating point real numbers.</p> <p>real1: The minimum value is 0.0, the maximum is 30.0. The minimum resolution possible is 0.0001, the default value is 5.0.</p> <p>real2: The minimum value is 0.0, the maximum is 30.0. The minimum resolution possible is 0.0001, the default value is 5.0.</p> <p>real3: The minimum value is -40.0, the maximum is 40.0. The minimum resolution possible is 0.0001, the default value is 5.0.</p> <p>real4: The minimum value is 0.0, the maximum is 20,000.0. The minimum resolution possible is 1.0, the default value is 5,000.0.</p> <p>real5: The minimum value is 0.0, the maximum is 100.0. The minimum resolution possible is 0.1, the default value is 5.0.</p> <p>real6: The minimum value is 0.0, the maximum is 100.0. The minimum resolution possible is 0.1, the default value is 20.0.</p>

Description	<p>Sets the upper limits for the six main audio frequency measurements with one command. The order of the floating point real numbers defines their meaning:</p> <p>real1 represents the upper limit of the peak-to-peak AC voltage measurement; the physical dimension of the number stated is V(pp).</p> <p>real2 represents the upper limit of the RMS-valued AC voltage measurement; the physical dimension of the number stated is V(rms).</p> <p>real3 represents the upper limit of the RMS-valued measurement of an AC voltage ripple on a DC voltage; the physical dimension of the number stated is V(rms).</p> <p>real4 represents the upper limit of the audio frequency measurement; the physical dimension of the number stated is Hertz.</p> <p>real5 represents the upper limit of the distortion measurement, carried out on the third harmonic of a sine wave. The physical dimension of the number stated is percentage.</p> <p>real6 represents the upper limit of the SINAD signal-to-noise ratio measurement; the physical dimension of the number stated is dB.</p>
Query	The query form of this command is not supported.
Example	<p>:CALC:AFAN:ALL:LIM:UPP 3,3,1,4000,5,100</p> <p>Sets the upper limits for the audio measurements: 3 V for the peak-to-peak AC voltage, 3 V for the rms-valued AC voltage, 1 V for the rms-valued ripple voltage, 4 kHz for the audio frequency, 5% for THD, and 100 dB for SINAD.</p>

:CALCulate:AFANalyser:ALL:LIMit:LOWer[:DATA]

Syntax	<pre>:CALCulate:AFANalyser:ALL:LIMit:LOWer[:DATA] <real1>,<real2>,<real3>,<real4>,<real5>,<real6></pre>
Parameters	<p>realx are six floating point real numbers.</p> <p>real1: The minimum value is 0.0, the maximum is 30.0. The minimum resolution possible is 0.0001, the default value is 1.0.</p> <p>real2: The minimum value is 0.0, the maximum is 30.0. The minimum resolution possible is 0.0001, the default value is 1.0.</p> <p>real3: The minimum value is -40.0, the maximum is 40.0. The minimum resolution possible is 0.0001, the default value is -5.0.</p> <p>real4: The minimum value is 0.0, the maximum is 20,000.0. The minimum resolution possible is 1.0, the default value is 1,000.0.</p> <p>real5: The minimum value is 0.0, the maximum is 100.0. The minimum resolution possible is 0.1, the default value is 0.0.</p> <p>real6: The minimum value is 0.0, the maximum is 100.0. The minimum resolution possible is 0.1, the default value is 0.0.</p>
Description	<p>Sets the lower limits for the six main audio frequency measurements with one command. The order of the floating point real numbers defines their meaning:</p> <p>real1 represents the lower limit of the peak-to-peak AC voltage measurement; the physical dimension of the number stated is V(pp).</p> <p>real2 represents the lower limit of the RMS-valued AC voltage measurement; the physical dimension of the number stated is V(rms).</p> <p>real3 represents the lower limit of the RMS-valued measurement of an AC voltage ripple on a DC voltage; the physical dimension of the number stated is V(rms).</p> <p>real4 represents the lower limit of the audio frequency measurement; the physical dimension of the number stated is Hertz.</p> <p>real5 represents the lower limit of the distortion measurement, carried out on the third harmonic of a sine wave. The physical dimension of the number stated is percentage.</p> <p>real6 represents the lower limit of the SINAD signal-to-noise ratio measurement; the physical dimension of the number stated is dB.</p>

Query	The query form of this command is not supported.
Example	:CALC:AFAN:ALL:LIM:LOW 1,1,0,400,0,25 Sets the lower limits for the audio measurements.

**:CALCulate:AFANalyser
:ACVoltage:PPEak:LIMit[:FAIL]?**

Syntax	:CALCulate:AFANalyser :ACVoltage:PPEak:LIMit[:FAIL]?
Parameters	There are no parameters.
Description	There is solely a query form of this command available.
Query	This command delivers one boolean number, indicating whether the user-definable limits of the peak-to-peak measurement of the AC voltage applied to the audio analyzer were violated by a measurement result value or not. A 0 means that the measurement result value is within the limits set, while a 1 indicates that at least one measurement result value did violate at least one of the limits. The limits can be set using the commands described below.
Example	:MEAS:ARRay:AFAN:ACV:PPEA 10 :CALC:AFAN:ACV:PPEA:LIM? String returned: " 1 " This string delivered back indicates that at least one measurement result value did violate the limits of the peak-to-peak AC measurement.

:CALCulate:AFANalyser:ACVoltage:PEAKp:LIMit:STATe

Syntax	:CALCulate:AFANalyser:ACVoltage:PEAKp:LIMit:STATe <PredefExp>
Parameters	PredefExp is one of the following predefined expressions: ON OFF . Default is ON .
Description	This command switches the check of the measurement result values of the MEAS:AFAN:ACV:PEAK measurement against their user-definable limits either on or off.
Query	There is no query form of this command available.
Example	:CALC:AFAN:ACV:PEAK:LIM:STAT ON Switches the limit check of the peak-to-peak AC voltage measurement on.

**:CALCulate:AFANalyser
:ACVoltage:PEAKp:LIMit:UPPer[:DATA]**

Syntax	:CALCulate:AFANalyser :ACVoltage:PEAKp:LIMit:UPPer[:DATA] <real1>
Parameters	real1 is a floating point real number. The minimum value is 0.0 , the maximum is 30.0 . The minimum resolution possible is 0.0001 , the default value is 5.0 .
Description	Sets the upper limit for the peak-to-peak measurement of the AC voltage applied to the audio analyzer. The physical dimension of the number stated is V(pp).
Query	The query form of this command is not available.

Example **:CALC:AFAN:ACV:PEAK:LIM:UPP 3**
Sets the upper limit of the peak-to-peak AC voltage measurement to 3 V.

:CALCulate:AFANalyser
:ACVoltage:PEAKp:LIMit:LOWer[:DATA]

Syntax **:CALCulate:AFANalyser**
:ACVoltage:PEAKp:LIMit:LOWer[:DATA] <real1>

Parameters **real1** is a floating point real number. The minimum value is **0.0**, the maximum is **30.0**. The minimum resolution possible is **0.0001**, the default value is **1.0**.

Description Sets the lower limit for the peak-to-peak measurement of the AC voltage applied to the audio analyzer. The physical dimension of the number stated is V(pp).

Query The query form of this command is not available.

Example **:CALC:AFAN:ACV:PEAK:LIM:LOW 0**
Sets the lower limit of the peak-to-peak AC voltage measurement to 0 V.

:CALCulate:AFANalyser
:ACVoltage:RMS:LIMit[:FAIL]?

Syntax **:CALCulate:AFANalyser**
:ACVoltage:RMS:LIMit[:FAIL]?

Parameters There are no parameters.

Description There is solely a query form of this command available.

Query This command delivers one boolean number, indicating whether the user-definable limits of the RMS-valued measurement of the AC voltage applied to the audio analyzer were violated by a measurement result value or not. A **0** means that the measurement result value is within the limits set, while a **1** indicates that at least one measurement result value did violate at least one of the limits. The limits can be set using the commands described below.

Example **:MEAS:ARRAY:AFAN:ACV:RMS 5**
:CALC:AFAN:ACV:RMS:LIM?
String returned: **"0"**
This string delivered back indicates that there was no violation of the limits set.

:CALCulate:AFANalyser
:ACVoltage:RMS:LIMit:STATE

Syntax **:CALCulate:AFANalyser**
:ACVoltage:RMS:LIMit:STATE <PredefExp>

Parameters **PredefExp** is one of the following predefined expressions: **ON** | **OFF**. Default is **ON**.

Description This command switches the check of the measurement result values of the **MEAS:AFAN:ACV:RMS** measurement against their user-definable limits either on or off.

Query There is no query form of this command available.

Example **:CALC:AFAN:ACV:RMS:LIM:STAT ON**
Switches the limit check of the RMS-valued AC voltage measurement on.

:CALCulate:AFANalyser
:ACVoltage:RMS:LIMit:UPPer[:DATA]

Syntax	:CALCulate:AFANalyser :ACVoltage:RMS:LIMit:UPPer[:DATA] <real1>
Parameters	real1 is a floating point real number. The minimum value is 0.0 , the maximum is 30.0 . The minimum resolution possible is 0.0001 , the default value is 5.0 .
Description	Sets the upper limit for the RMS-valued measurement of the AC voltage applied to the audio analyzer. The physical dimension of the number stated is V(rms).
Query	The query form of this command is not available.
Example	:CALC:AFAN:ACV:RMS:LIM:UPP 3 Sets the upper limit of the rms-valued AC voltage measurement to 3 V.

:CALCulate:AFANalyser
:ACVoltage:RMS:LIMit:LOWer[:DATA]

Syntax	:CALCulate:AFANalyser :ACVoltage:RMS:LIMit:LOWer[:DATA] <real1>
Parameters	real1 is a floating point real number. The minimum value is 0.0 , the maximum is 30.0 . The minimum resolution possible is 0.0001 , the default value is 1.0 .
Description	Sets the lower limit for the RMS-valued measurement of the AC voltage applied to the audio analyzer. The physical dimension of the number stated is V(rms).
Query	The query form of this command is not available.
Example	:CALC:AFAN:ACV:RMS:LIM:LOW 0 Sets the lower limit of the rms-valued AC voltage measurement to 0 V.

:CALCulate:AFANalyser
:DCVoltage:LIMit[:FAIL]?

Syntax	:CALCulate:AFANalyser :DCVoltage:LIMit[:FAIL]?
Parameters	There are no parameters.
Description	There is solely a query form of this command available.
Query	This command delivers one boolean number, indicating whether the user-definable limits of the RMS-valued measurement of the AC ripple on a DC voltage were violated by a measurement result value or not. A 0 means that the measurement result value is within the limits set, while a 1 indicates that at least one measurement result value did violate at least one of the limits. The limits can be set using the commands described below.

Example	<pre> :MEAS:ARRay:AFAN:DCV 10 :CALC:AFAN:DCV:LIM? String returned: "0" This string delivered back indicates that there has been no violation of the limits set. </pre>
----------------	--

```

:CALCulate:AFANalyser
:DCVoltage:LIMit:STATe

```

Syntax	<pre> :CALCulate:AFANalyser :DCVoltage:LIMit:STATe <PredefExp> </pre>
Parameters	PredefExp is one of the following predefined expressions: ON OFF . Default is ON .
Description	This command switches the check of the measurement result values of the :MEAS:AFAN:DCV measurement against their user-definable limits either on or off.
Query	There is no query form of this command available.
Example	<pre> :CALC:AFAN:DCV:LIM:STAT ON </pre> Switches the limit check of the RMS-valued AC voltage ripple measurement of a DC voltage on.

```

:CALCulate:AFANalyser
:DCVoltage:LIMit:UPPer[:DATA]

```

Syntax	<pre> :CALCulate:AFANalyser :DCVoltage:LIMit:UPPer[:DATA] <real1> </pre>
Parameters	real1 is a floating point real number. The minimum value is -40.0 , the maximum is 40.0 . The minimum resolution possible is 0.0001 , the default value is 5.0 .
Description	Sets the upper limit for the RMS-valued measurement of the AC voltage component on a DC voltage, applied to the audio analyzer. The physical dimension of the number stated is V(rms).
Query	The query form of this command is not supported.
Example	<pre> :CALC:AFAN:DCV:LIM:UPP 6 </pre> Sets the upper limit of the rms-valued ripple voltage measurement to 6 V.

```

:CALCulate:AFANalyser
:DCVoltage:LIMit:LOWer[:DATA]

```

Syntax	<pre> :CALCulate:AFANalyser :DCVoltage:LIMit:LOWer[:DATA] <real1> </pre>
Parameters	real1 is a floating point real number. The minimum value is -40.0 , the maximum is 40.0 . The minimum resolution possible is 0.0001 , the default value is -5.0 .
Description	Sets the lower limit for the RMS-valued measurement of the AC voltage component on a DC voltage, applied to the audio analyzer. The physical dimension of the number stated is V(rms).
Query	The query form of this command is not supported.

Example **:CALC:AFAN:DCV:LIM:LOW 1.75**
Sets the upper limit of the rms-valued ripple voltage measurement to 1.75 V.

:CALCulate:AFANalyser
:FREQuency:LIMit[:FAIL]?

Syntax	:CALCulate:AFANalyser :FREQuency:LIMit[:FAIL]?
Parameters	There are no parameters.
Description	There is solely a query form of this command available.
Query	This command delivers one boolean number, indicating whether the user-definable limits of the AF frequency measurement were violated by a measurement result value or not. A 0 means that all measurement result values were within the limits set, while a 1 indicates that at least one measurement result value did violate at least one of the limits. The limits can be set using the commands described below.
Example	:MEAS:AFAN:FREQ :CALC:AFAN:FREQ:LIM? String returned: " 1 " This string delivered back indicates that there has been a violation of the limits set.

:CALCulate:AFANalyser:FREQuency:LIMit:STATe?

Syntax	:CALCulate:AFANalyser:FREQuency:LIMit:STATe? <PredefExp>
Parameters	PredefExp is one of the following predefined expressions: ON OFF . Default is ON .
Description	This command switches the check of the measurement result values of the MEAS:AFAN:FREQ measurement against their user-definable limits either on or off.
Query	There is no query form of this command available.
Example	:CALC:AFAN:FREQ:LIM:STAT ON Switches the limit check of the AF frequency measurement on.

:CALCulate:AFANalyser
:FREQuency:LIMit:UPPer[:DATA]

Syntax	:CALCulate:AFANalyser :FREQuency:LIMit:UPPer[:DATA] <real1>
Parameters	real1 is a floating point real number. The minimum value is 0.0 , the maximum is 20,000.0 . The minimum resolution possible is 1.0 , the default value is 5,000.0 .
Description	Sets the upper limit for the AF frequency measurement. The physical dimension of the number stated is Hertz.
Query	The query form of this command is not available.

Example	:CALC:AFAN:FREQ:LIM:UPP 10000 Sets the upper limit of the audio frequency measurement to 10 kHz.
----------------	--

:CALCulate:AFANalyser
:FREQUENCY:LIMit:LOWer[:DATA]

Syntax	:CALCulate:AFANalyser :FREQUENCY:LIMit:LOWer[:DATA] <real1>
Parameters	real1 is a floating point real number. The minimum value is 0.0 , the maximum is 20,000.0 . The minimum resolution possible is 1.0 , the default value is 1,000.0 .
Description	Sets the lower limit for the AF frequency measurement. The physical dimension of the number stated is Hertz.
Query	The query form of this command is not available.
Example	:CALC:AFAN:FREQ:LIM:LOW 950 Sets the lower limit of the audio frequency measurement to 950 Hz.

:CALCulate:AFANalyser
:DISTortion:LIMit[:FAIL]?

Syntax	:CALCulate:AFANalyser :DISTortion:LIMit[:FAIL]?
Parameters	There are no parameters.
Description	There is solely a query form of this command available.
Query	This command delivers one boolean number, indicating whether the user-definable limits of the distortion measurement were violated by a measurement result value or not. A 0 means that all measurement result values were within the limits set, while a 1 indicates that at least one measurement result value did violate at least one of the limits. The limits can be set using the commands described below.
	Notes
	<ul style="list-style-type: none"> - The distortion measurement is carried through on the third harmonic of a 1 kHz sine wave. - All audio measurements require the Audio Option to be installed on your Willtek 4400.
Example	:MEAS:ARRAY:AFAN:DIST 10 :CALC:AFAN:DIST:LIM? String returned: "1" This string delivered back indicates that there was a violation of the limits set.

:CALCulate:AFANalyser
:DISTortion:AFAN:DIST:LIMit:STATE

Syntax	:CALCulate:AFANalyser :DISTortion:LIMit:STATE <PredefExp>
Parameters	PredefExp is one of the following predefined expressions: ON OFF . Default is ON .

Description	This command switches the check of the measurement result values of the MEAS:AFAN:DIST measurement against their user-definable limits either on or off.
Query	There is no query form of this command available.
Example	:CALC:AFAN:DIST:LIM:STAT ON Switches the limit check of the distortion measurement on.

:CALCulate:AFANalyser
:DISTortion:LIMit:UPPer[:DATA]

Syntax	:CALCulate:AFANalyser :DISTortion:LIMit:UPPer[:DATA] <real1>
Parameters	real1 is a floating point real number. The minimum value is 0.0 , the maximum is 100.0 . The minimum resolution possible is 0.1 , the default value is 5.0 .
Description	Sets the upper limit for the distortion measurement. The physical dimension of the number stated is percent (the relation of the AC voltage measured for the third harmonic of a 1 kHz sine wave in relation to the AC voltage measured for the nominal frequency).
Query	The query form of this command is not available.
Example	:CALC:AFAN:DIST:LIM:UPP 4.5 Sets the upper limit of the distortion measurement to 4.5%.

:CALCulate:AFANalyser
:DISTortion:LIMit:LOWer[:DATA]

Syntax	:CALCulate:AFANalyser :DISTortion:LIMit:LOWer[:DATA] <real1>
Parameters	real1 is a floating point real number. The minimum value is 0.0 , the maximum is 100.0 . The minimum resolution possible is 0.1 , the default value is 0.0 .
Description	Sets the lower limit for the distortion measurement. The physical dimension of the number stated is percent (the relation of the AC voltage measured for the third harmonic of a 1 kHz sine wave in relation to the AC voltage measured for the nominal frequency).
Query	The query form of this command is not available.
Example	:CALC:AFAN:DIST:LIM:LOW 0.0 Sets the lower limit of the distortion measurement to 0%.

:CALCulate:AFANalyser
:SINad:LIMit[:FAIL]?

Syntax	:CALCulate:AFANalyser :SINad:LIMit[:FAIL]?
Parameters	There are no parameters.
Description	There is solely a query form of this command available.

Query	<p>This command delivers one boolean number, indicating whether the user-definable limits of the SINAD measurement were violated by a measurement result value or not. A 0 means that all measurement result values were within the limits set, while a 1 indicates that at least one measurement result value did violate at least one of the limits.</p> <p>The limits can be set using the commands described below.</p> <p>Notes</p> <ul style="list-style-type: none"> - The SINAD measurement is carried through with a 1 kHz sine wave. - All audio measurements require the Audio Option to be installed on your Willtek 4400.
Example	<pre>:MEAS:ARRay:AFAN:SIN 5 :CALC:AFAN:SIN:LIM?</pre> <p>String returned: "1"</p> <p>This string delivered back indicates that there was a violation of the limits set.</p>

```
:CALCulate:AFANalyser
:SINad:LIMit:STATe
```

Syntax	<pre>:CALCulate:AFANalyser :SINad:LIMit:STATe <PredefExp></pre>
Parameters	PredefExp is one of the following predefined expressions: ON OFF . Default is ON .
Description	This command switches the check of the measurement result values of the MEAS:AFAN:SIN measurement against their user-definable limits either on or off.
Query	There is no query form of this command available.
Example	<pre>:CALC:AFAN:SIN:LIM:STAT ON</pre> <p>Switches the limit check of the SINAD measurement on.</p>

```
:CALCulate:AFANalyser
:SINad:LIMit:UPPer[:DATA]
```

Syntax	<pre>:CALCulate:AFANalyser :SINad:LIMit:UPPer[:DATA] <reall></pre>
Parameters	reall is a floating point real number. The minimum value is 0.0, the maximum is 100.0. The minimum resolution possible is 0.1, the default value is 20.0.
Description	Sets the upper limit for the SINAD measurement. The physical dimension of the number stated is dB.
Query	The query form of this command is not available.
Example	<pre>:CALC:AFAN:SIN:LIM:UPP 100</pre> <p>Sets the upper limit of the SINAD measurement to 100%nbsp;dB.</p>

```
:CALCulate:AFANalyser
:SINad:LIMit:LOWer[:DATA]
```

Syntax	<pre>:CALCulate:AFANalyser :SINad:LIMit:LOWer[:DATA] <reall></pre>
---------------	--

Parameters	real1 is a floating point real number. The minimum value is 0.0 , the maximum is 100.0 . The minimum resolution possible is 0.1 , the default value is 0.0 .
Description	Sets the lower limit for the SINAD measurement. The physical dimension of the number stated is dB.
Query	The query form of this command is not available.
Example	:CALC:AFAN:SIN:LIM:LOW 30 Sets the lower limit of the SINAD measurement to 30 dB.

:CALCulate:AFSPectrum:TEMPlate:LIMit[:FAIL]

Syntax	:CALCulate:AFSPectrum:TEMPlate:LIMit[:FAIL]?
Parameters	There are no parameters.
Description	There is solely a query form of this command available.
Query	This command delivers ten boolean numbers, indicating whether the user-definable limits of the audio spectrum measurement were violated by a measurement result value or not. A 0 means that the measurement result values for the respective section of the template were within the limits set, while a 1 indicates that at least one measurement result value did violate at least one of the limits. The limits can be set using the commands described below.
Example	:MEAS:ARRay:AFSP 10 :CALC:AFSP:TEMP:LIM:FAIL? String returned: "0,1,0,0,0,0,0,0,0,0" This string delivered back indicates that there was a violation of the limits set for the second area.

:CALCulate:AFSPectrum:TEMPlate:LIMit:STATE

Syntax	:CALCulate:AFSPectrum:TEMPlate:LIMit:STATE <PreDefExp>
Parameters	PreDefExp is one of the following predefined expressions: ON OFF . Default is ON .
Description	This command switches the check of the measurement result values of the MEAS:AFSP:TEMPlate and MEAS:ARR:AFSP:TEMPlate measurements against their user-definable limits either on or off.
Query	There is no query form of this command available.
Example	:CALC:GSM:RFTX:TEMP:LIM:STAT ON Switches on the limit check of the audio spectrum measurement against the user-defined template.

:CALCulate:AFSPectrum:TEMPlate:LIMit:LOAD

Syntax	:CALCulate:AFSPectrum:TEMPlate:LIMit:LOAD <string1>
Parameters	string1 is a string giving the name of the file containing the audio limits. The maximum length of string1 is 50 characters. The default for string1 is "example.lmt" .

Description	This command loads the audio template description file. Please note that the data contained in the file need to be activated (using the CALC:AFSP:TEMP:LIM:STAT ON command described above) before the template will have any effect on the measurement results.
Query	There is no query form of this command available.
Example	:CALC:AFSP:LIM:LOAD "example.lmt" Loads the audio spectrum template file example.lmt which resides in the /rapid/audiolmt directory.

:CALCulate:AFSPectrum:TEMPlate:LIMit:STORE

Syntax	:CALCulate:AFSPectrum:TEMPlate:LIMit:STORE <string1>
Parameters	string1 is a string giving the name of the file in which the current audio limits are to be saved. The maximum length of string1 is 50 characters.
Description	This command saves the current audio template in a file. The template can be defined by the FREQ , UPPER , LOWER and COMMENT comments.
Query	There is no query form of this command available.
Example	:CALC:AFSP:LIM:STORE "example.lmt" Stores the currently defined audio spectrum template in the file example.lmt in the /rapid/audiolmt directory. If a file of this name already exists, it will be overwritten.

:CALCulate:AFSPectrum:TEMPlate:LIMit:COMMENT

Syntax	:CALCulate:AFSPectrum:TEMPlate:LIMit:COMMENT <string1>
Parameters	string1 is a comment line related to the coupling loss data. The maximum length of string1 is 80 characters.
Description	Defines a comment line for storage in the audio template file and for display in the Comment line field on the Limits screen. Note: The comment can be saved with the STORE command, together with the other template parameters.
Query	There is no query form of this command available.
Example	:CALC:AFSP:LIM:COMM "Audio template for Siemens S35"

:CALCulate:AFSPectrum:TEMPlate:LIMit:FREQuency

Syntax	<code>:CALCulate:AFSPectrum:TEMPlate:LIMit:FREQuency <real1>,<real2>,<real3>,<real4>, <real5>,<real6>,<real7>,<real8>,<real9>,<real10></code>
Parameters	real1 through realxp are floating point real numbers. The minimum value for all numbers is 0.0 , the maximum value 20000.0 . The minimum resolution possible for all realxt is 0.1 . The default values are: for real0t : -41.0 , for real1t : -28.0 , for real2t : -18.0 , for real3t : -10.0 for real4t : 0.0 , for real5t : 553.0 for real6t : 561.0 , for real7t : 571.0 for real8t : 580.0 . The minimum value for all realxp is -150.0 , the maximum value 5.0 . The minimum resolution possible for all realx is 0.1 .
Description	Sets the frequency values for the user-definable audio spectrum template. The values are in Hz. They are used in conjunction with the definitions for the upper and lower limits.
Query	The query form of this command is not available.
Example	<code>:CALC:AFSP:TEMP:LIM:FREQ 25, 50, 100, 200, 500, 1000, 2000, 4000, 8000, 16000</code> This command sets the frequency values for the upper and lower limits. Note: These are the default values after an instrument reset.

:CALCulate:AFSPectrum:TEMPlate:LIMit:UPPer

Syntax	<code>:CALCulate:AFSPectrum:TEMPlate:LIMit:UPPer <real1>,<real2>,<real3>,<real4>, <real5>,<real6>,<real7>,<real8>,<real9>,<real10></code>
Parameters	The realx values are floating point real numbers. The minimum value is -120 , the maximum value is +10 . The resolution for all values is 0.1 . The values are the upper limits for the audio template in dB, relative to the reference level.
Description	Sets the upper limits for the user-definable audio spectrum template. These upper limits refer to the frequencies defined in the FREQuency command above.
Query	The query form of this command is not available.
Example	<code>:CALC:AFSP:TEMP:LIM:UPP 5, 5, 5, 5, 5, 5, 5, 5, 5, 5</code> This command sets all upper limits to +5 dB at the frequencies defined with the <code>:CALC:AFSP:TEMP:LIM:FREQ</code> command.

:CALCulate:AFSPectrum:TEMPlate:LIMit:LOWer

Syntax	:CALCulate:AFSPectrum:TEMPlate:LIMit:LOWer <real1>, <real2>, <real3>, <real4>, <real5>, <real6>, <real7>, <real8>, <real9>, <real10>
Parameters	The realx values are floating point real numbers. The minimum value is -120 , the maximum value is +10 . The resolution for all values is 0.1 . The values are the lower limits for the audio template in dB, relative to the reference level.
Description	Sets the lower limits for the user-definable audio spectrum template. These upper limits refer to the frequencies defined in the FREQuency command above.
Query	The query form of this command is not available.
Example	:CALC:AFSP:TEMP:LIM:LOW -25, -25, -25, -25, -25, -25, -25, -25, -25, -25 This command sets all lower limits to -25 dB at the frequencies defined with the :CALC:AFSP:TEMP:LIM:FREQ command.

:CALCulate:AFSPectrum:VALue?

Syntax	:CALCulate:AFSPectrum:VALue? <real1>
Parameters	real1 is a floating point real number. It provides the position on the frequency axis for which the audio spectrum value is being requested.
Query	Provides the measurement value (audio spectrum level) for the given frequency value. If there is no measurement value at exactly this frequency, the value is interpolated.
Example	:MEAS:BLOC:AFSP:AVG :CALC:AFSP:VAL? 1200 Delivers the audio spectrum value at the frequency of 1.2 kHz.

:CALCulate:AFSPectrum:MAXPeak

Syntax	:CALCulate:PSUPply:MAverage?
Parameters	There are no parameters.
Description	There is solely a query form of this command available.
Query	The query form of this command delivers back the frequency (in Hz) and the maximum audio spectrum level of the measured audio spectrum curve. The string returned will contain two floating point real numbers. The physical dimension of the measurement result values returned is for the first value Hz and for the second value dB. Note: Please note that you need to have a audio measurement taken before this command will return any meaningful result. We recommend to use the :MEAS:BLOC:AFSP:AVG command to do so.
Example	:MEAS:BLOC:AFSP:AVG 10 :CALC:AFSP:MAXP? This command will read at the audio spectrum measurement maximum the frequency and the measurement result value. The values returned in this example is: "1230.0, -5.2".

:CALCulate:PSUPply:MAverage?

Syntax	:CALCulate:PSUPply:MAverage?
Parameters	There are no parameters.
Description	There is solely a query form of this command available.
Query	Calculates and returns the average measurement result value of the current measurement started last. The string delivered back will contain as many average values as measurement types performed. The single average values will always have the format of floating point real numbers and will be separated by commas.
Example	<p>:CALC:RES :MEAS:ARR:PSUP:ALL :CALC:PSUP:MAV? 603.1,215.8,908.2</p> <p>Returns the average values for average power consumption (603.1 mW), average current consumption (215.8 mA) and peak current consumption (908.2 mA).</p>

:CALCulate:PSUPply:MMINimum?

Syntax	:CALCulate:PSUPply:MMINimum?
Parameters	There are no parameters.
Description	There is solely a query form of this command available.
Query	Returns the minimum measurement result value of the current measurement started last. The string delivered back will contain as many minimum values as measurement types performed. The single minimum values will always have the format of floating point real numbers and will be separated by commas.
Example	<p>:CALC:RES :MEAS:ARR:PSUP:ALL :CALC:PSUP:MMIN?</p> <p>Returns the minimum values for average power consumption (in mW), average current consumption (in mA), and peak current consumption (in mA).</p>

:CALCulate:PSUPply:MMAximum?

Syntax	:CALCulate:PSUPply:MMAximum?
Parameters	There are no parameters.
Description	There is solely a query form of this command available.
Query	Returns the maximum measurement result value of the current measurement started last. The string delivered back will contain as many maximum values as measurement types performed. The single maximum values will always have the format of floating point real numbers and will be separated by commas.
Example	<p>:CALC:RES :MEAS:ARR:PSUP:ALL :CALC:PSUP:MMAx?</p> <p>Returns the maximum values for average power consumption (in mW), average current consumption (in mA), and peak current consumption (in mA).</p>

:CALCulate:PSUPply:MSIGma?

Syntax	:CALCulate:PSUPply:MSIGma?
Parameters	There are no parameters.
Description	There is solely a query form of this command available.
Query	Returns the mean value and the standard deviation of the current measurement started last. The string delivered back will contain as many pairs of mean and standard deviation values as measurement types performed. All values have the format of floating point real numbers and are separated by commas.
Example	<p>:CALC:RES :MEAS:ARR:PSUP:ALL :CALC:PSUP:MSIG?</p> <p>Returns three pairs of mean value and standard deviation for average power consumption (in mW), average current consumption (in mA), and peak current consumption (in mA).</p>

:CALCulate:PSUPply:ALL:LIMit[:FAIL]?

Syntax	:CALCulate:PSUPply:ALL:LIMit[:FAIL]?
Parameters	There are no parameters.
Description	There is solely a query form of this command available.
Query	<p>This command delivers three boolean values, indicating whether the user-definable limits of the current measurements were violated by a measurement result value or not.</p> <p>For each of the three boolean values, a 0 means that all measurement result values were within the limits set, while a 1 indicates that at least one measurement result value violated at least one of the limits.</p> <p>The limits can be set using the commands described below. The results are in the sequence power consumption, average current consumption, peak current consumption.</p>
Example	<p>:MEAS:ARR:PSUP:CPEA 5 :CALC:PSUP:ALL:LIM?</p> <p>String returned: "1,0,0"</p> <p>This string delivered back indicates that there was a violation of the limits for the power consumption while the other two types of measurements passed the limits.</p>

:CALCulate:PSUPply:ALL:LIMit:STATe

Syntax	:CALCulate:PSUPply:ALL:LIMit:STATe <PredefExp>
Parameters	PredefExp is one of the following predefined expressions: ON OFF . Default is ON .
Description	This command switches the check of the measurement result values of the MEAS:PSUP:ALL measurement against their user-definable limits either on or off.
Query	There is no query form of this command available.
Example	<p>:CALC:PSUP:ALL:LIM:STAT ON</p> <p>Switches the limit check for the current measurements on.</p>

:CALCulate:PSUPply:ALL:LIMit:UPPer[:DATA]

Syntax	<code>:CALCulate:PSUPply:ALL:LIMit:UPPer[:DATA]</code> <code><real1>,<real2>,<real3></code>
Parameters	real1, real2 and real3 are floating point real numbers. <ul style="list-style-type: none"> - real1 is the upper limit for the average power consumption. Its minimum value is 0.0, the maximum is 2000.0, the default value is 2000.0. - real2 is the upper limit for average current consumption. Its minimum value is 0.0, the maximum is 1000.0, the default value is 1000.0 - real3 is the upper limit for peak current consumption. Its minimum value is 0.0, the maximum is 4000.0, the default value is 4000.0
Description	Sets the upper limits for the current measurements.
Query	The query form of this command is not available.
Example	:CALC:PSUP:ALL:LIM:UPP 2.3, 200.0, 1400.0 Sets the upper limit of the current measurements to 2.3 W for the average power, 200 mA for the average current and 1400 mW for the peak current.

:CALCulate:PSUPply:ALL:LIMit:LOWer[:DATA]

Syntax	<code>:CALCulate:PSUPply:ALL:LIMit:LOWer[:DATA]</code> <code><real1>,<real2>,<real3></code>
Parameters	real1, real2, real3 are floating point real numbers. <ul style="list-style-type: none"> - real1 is the lower limit for power consumption. Its minimum value is 0.0, the maximum is 2000.0, the default value is 2000.0. - real2 is the lower limit for average current consumption. Its minimum value is 0.0, the maximum is 1000.0, the default value is 1000.0 - real3 is the lower limit for peak current consumption. Its minimum value is 0.0, the maximum is 4000.0, the default value is 4000.0
Description	Sets the lower limits for the current measurements.
Query	The query form of this command is not available.
Example	:CALC:PSUP:ALL:LIM:LOW 0,0,0 Sets the lower limit of the current measurements to all 0.0.

:CALCulate:PSUPply:APOWer:LIMit[:FAIL]?

Syntax	<code>:CALCulate:PSUPply:APOWer:LIMit[:FAIL]?</code>
Parameters	There are no parameters.
Description	There is solely a query form of this command available.
Query	This command delivers one boolean number, indicating whether the user-definable limits of the average power consumption measurement were violated by a measurement result value or not. A 0 means that all measurement result values were within the limits set, while a 1 indicates that at least one measurement result value did violate at least one of the limits. The limits can be set using the commands described below.

Example	<pre> :CALC:PSUP:APOW:LIM:UPP 2.3 :CALC:PSUP:APOWER:LIM:LOW 0 :MEAS:ARRAY:PSUP:APOWER 5 :CALC:PSUP:APOWER:LIM? String returned in this example:"1" This string delivered back indicates that there was a violation of the limits set. </pre>
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:CALCulate:PSUPply:APOWER:LIMit:STATe

Syntax	:CALCulate:PSUPply:APOWER:LIMit:STATe <PredefExp>
Parameters	PredefExp is one of the following predefined expressions: ON OFF. Default is ON.
Description	This command switches the check of the power consumption measurement result values of the MEAS:PSUP:APOWER measurement against their user-definable limits either ON or OFF. Note: All current measurements require the MS Power Supply and Current Measurement options to be installed on your Willtek 4400.
Query	There is no query form of this command available.
Example	<pre> :CALC:PSUP:APOW:LIM:STAT ON Switches the limit check of the current measurement on. </pre>

:CALCulate:PSUPply:APOWER:LIMit:UPPer[:DATA]

Syntax	:CALCulate:PSUPply:APOWER:LIMit:UPPer[:DATA] <real1>
Parameters	real1 is a floating point real number. The minimum value is 0.0, the maximum is 2000.0. The resolution is 1, the default value is 2000.0.
Description	Sets the upper limit for the power consumption measurement. The physical dimension of the number stated is mW.
Query	The query form of this command is not available.
Example	<pre> :CALC:PSUP:APOW:LIM:UPP 100 Sets the upper limit of the power consumption measurement to 100 mW. </pre>

:CALCulate:PSUPply:APOWER:LIMit:LOWer[:DATA]

Syntax	:CALCulate:PSUPply:APOWER:LIMit:LOWer[:DATA] <real1>
Parameters	real1 is a floating point real number. The minimum value is 0.0, the maximum is 2000.0. The resolution is 1, the default value is 2000.0.
Description	Sets the lower limit for the power consumption measurement. The physical dimension of the number stated is mW.
Query	The query form of this command is not available.
Example	<pre> :CALC:PSUP:APOW:LIM:LOW 10 Sets the lower limit of the power consumption measurement to 10 mW. </pre>

:CALCulate:PSUPply:ACURrent:LIMit:STATE

Syntax	:CALCulate:PSUPply:ACURrent:LIMit:STATE <PreDefExp>
Parameters	PreDefExp is one of the following predefined expressions: ON OFF. Default is ON.
Description	This command switches the check of the current measurement result values of the MEAS:PSUP:ACURrent measurement against their user-definable limits either ON or OFF. Note All current measurements require the MS Power Supply and Current Measurement options to be installed on your Willtek 4400.
Query	The query form of this command is not available.
Example	:CALC:PSUP:ACUR:LIM:STAT ON Switches the limit check of the average current measurement on.

:CALCulate:PSUPply:ACURrent:LIMit:UPPer[:DATA]

Syntax	:CALCulate:PSUPply:ACURrent:LIMit:UPPer[:DATA] <real1>
Parameters	real1 is a floating point real number. The minimum value is 0.0, the maximum is 1000.0. The resolution is 1, the default value is 1000.0.
Description	Sets the upper limit for the average current measurement. The physical dimension of the number stated is mA.
Query	The query form of this command is not available.
Example	:CALC:PSUP:ACUR:LIM:UPP 400 Sets the upper limit of the average current measurement to 400 mA.

:CALCulate:PSUPply:ACURrent:LIMit:LOWer[:DATA]

Syntax	:CALCulate:PSUPply:ACURrent:LIMit:LOWer[:DATA] <real1>
Parameters	real1 is a floating point real number. The minimum value is 0.0, the maximum is 1000.0. The resolution is 1, the default value is 0.0.
Description	Sets the lower limit for the peak current consumption measurement. The physical dimension of the number stated is mA.
Query	The query form of this command is not available.
Example	:CALC:PSUP:ACUR:LIM:LOW 10 Sets the lower limit of the current consumption measurement to 10 mA.

:CALCulate:PSUPply:PCURrent:LIMit[:FAIL]?

Syntax	:CALCulate:PSUPply:PCURrent:LIMit[:FAIL]?
Parameters	There are no parameters.
Description	There is solely a query form of this command available.

Query	<p>This command delivers one boolean number, indicating whether the user-definable limits of the peak current measurement were violated by a measurement result value or not.</p> <p>A 0 means that all measurement result values were within the limits set, while a 1 indicates that at least one measurement result value did violate at least one of the limits.</p> <p>The limits can be set using the commands described below.</p>
Example	<pre>:CALC:PSUP:PCUR:LIM:UPP 1000.0 :CALC:PSUP:PCURrent:LIM:LOW 0 :MEAS:ARRay:PSUP:PCURrent 5 :CALC:PSUP:PCURrent:LIM?</pre> <p>String returned in this example: "1"</p> <p>This string delivered back indicates that there was a violation of the defined limits.</p>

:CALCulate:PSUPply:PCURrent:LIMit:STATe

Syntax	:CALCulate:PSUPply:PCURrent:LIMit:STATe <PredefExp>
Parameters	PredefExp is one of the following predefined expressions: ON OFF. Default is ON.
Description	<p>This command switches the check of the peak current measurement result values of the MEAS:PSUP:PCURrent measurement against their user-definable limits either ON or OFF.</p> <p>Note All current consumption measurements require the MS Power Supply and Current Measurement options to be installed on your Willtek 4400.</p>
Query	There is no query form of this command available.
Example	<pre>:CALC:PSUP:PCUR:LIM:STAT ON</pre> <p>Switches the limit check of the peak current measurement on.</p>

:CALCulate:PSUPply:PCURrent:LIMit:UPPer[:DATA]

Syntax	:CALCulate:PSUPply:PCURrent:LIMit:UPPer[:DATA] <real1>
Parameters	real1 is a floating point real number. The minimum value is 0.0, the maximum is 4000.0. The resolution is 1, the default value is 4000.0.
Description	Sets the upper limit for the peak current consumption measurement. The physical dimension of the number stated is mA.
Query	There is no query form of this command available.
Example	<pre>:CALC:PSUP:PCUR:LIM:UPP 1000.0</pre> <p>Sets the upper limit of the peak current consumption measurement to 1000 mA.</p>

:CALCulate:PSUPply:PCURrent:LIMit:LOWer[:DATA]

Syntax	:CALCulate:PSUPply:PCURrent:LIMit:LOWer[:DATA] <real1>
Parameters	real1 is a floating point real number. The minimum value is 0.0, the maximum is 4000.0. The resolution is 1, the default value is 0.0.

Description	Sets the lower limit for the peak current consumption measurement. The physical dimension of the number stated is mA.
Query	There is no query form of this command available.
Example	:CALC:PSUP:PCUR:LIM:LOW 10 Sets the lower limit of the peak current consumption measurement to 10 mA.

:CALCulate:EVDO:RFSPectrum:MSpectrum:VALue

Syntax	:CALCulate:EVDO:RFSPectrum:MSpectrum:VALue <Real>
Parameters	Real is a floating point real number. The minimum value is -5,000,000.0, the maximum value is 5,000,000.0, the resolution is 0.1. The default is 0.
Description	This query-only command returns an interpolated measurement result of the modulation spectrum curve at the frequency offset specified by the parameter value (relative to the carrier or transmission frequency).
Query	The query form of this command returns one floating point real number, contained in a string. The physical dimension is dBc. Notes: Before this command is able to return any meaningful result, you need to have a spectrum measurement taken. We recommend to use the command sequence as stated in the example below. This command is not really a measurement - it is an interpolation of the spectrum curve at the frequency specified.
Example	:MEAS:EVDO:RFSP:MSP:AVG 20 :CALC:EVDO:RFSPectrum:MSpectrum:VALue? -50000 The second command will interpolate the modulation spectrum measurement at an offset of -50 kHz to the carrier. The string returned in this example is "-5.7".

CALCulate:EVDO:RFSPectrum:MSpectrum:MAXPeak

Syntax	:CALCulate:EVDO:RFSPectrum:MSpectrum:MAXPeak
Parameters	There are no parameters for this command.
Description	This query-only command searches for the peak value in the modulation spectrum curve and returns both frequency offset and measurement result.
Query	The query form of this command returns (contained in a string) <ul style="list-style-type: none"> - the frequency offset from the carrier in Hertz, related to - the maximum value of the modulation spectrum curve in dBc. The query will return two floating point real numbers, separated by a comma. Note: Before this command is able to return any meaningful result, you need to have a spectrum measurement taken. We recommend to use the command sequence as stated in the example below. This command is not really a measurement - it is a readout of the maximum of the modulation spectrum curve and the related frequency offset from the carrier.
Example	:MEAS:EVDO:RFSP:MSP:AVG 20 :CALC:EVDO:RFSPectrum:MSpectrum:MAXPeak? The second command will read out both the curve's maximum and the related frequency offset. The string returned in this example are "-67000,-5.2"

:CALC:EVDO:RFSPectrum:ACPM[:MODulation]:FREQ[:DATA]

Syntax	:CALCulate:EVDO:RFSPectrum:ACPM[:MODulation]:FREQ[:DATA] <Int1>, ..., <Int12>, <PredefExp>
Parameters	Int1 through Int12 are integer numbers, representing frequency offsets in kHz. The minimum value is 700, the maximum value is 2500. PredefExp is one of the following predefined expressions: US800 USPCs TACS JTACS KPCS NMT450 IMT2000 MHZ900 MHZ1800 SEC800 PAMR400 PAMR900. Default is US800.
Description	This command sets the 24 frequency offsets from the carrier at which the adjacent channel power shall be measured. In fact, only 12 parameter values need to be specified; the command interprets each value both as an offset left and right to the carrier (e.g. a parameter value of 890 will be interpreted as two offsets, with -890 and +890 kHz from the carrier respectively). A set of 12 offset parameter values can be specified for each frequency band.
Query	The query form of this command returns (in a string) 12 integer numbers, separated by commas and representing the frequency offsets in kHz. The corresponding frequency band needs to be specified with the query (see example below).
Example	:CALC:EVDO:RFSP:ACPM:FREQ 700,750,800,890,1000,1250,1400,1600,1800,1980,2200,2400,US800 :CALC:EVDO:RFSPectrum:ACPM:MODulation:FREQ:DATA? US800 String returned: "700,750,800,890,1000,1250,1400,1600,1800,1980,2200,2400".

:CALCulate:EVDO:RFSP:ACPM[:MODulation]:LIMIT[:FAIL]

Syntax	:CALCulate:EVDO:RFSPectrum:ACPM[:MODulation]:LIMIT[:FAIL]
Parameters	There are no parameters for this command.
Description	This query-only command returns 12 boolean values. These values indicate whether the 24 single measurement result values of the :MEAS:EVDO:RFSP:ACPM measurement did violate their individual limits (set with the commands explained below) or not. Each boolean value represents the logical AND combined result of two independent limit checks at a given offset (both left and right of the carrier). In case both measurement results do not violate their limits, a 0 is returned at the corresponding position., otherwise, a 1 is returned at the related position. The first boolean value represents the first frequency offset specified with the :CALC:EVDO:RFSP:ACPM:FREQ command, the second boolean value represents the second offset and so on. Note: All measurements are performed with a 30 kHz measuring bandwidth.
Query	The query form of this command returns (contained in a string) 12 boolean numbers, separated by commas.

Example	<pre>:CALC:EVDO:RFSP:ACPM:FREQ 700,750,800,890,1000,1250, 1400,1600,1800,1980,2200,2400,US800 :MEAS:EVDO:RFSP:ACPM:AVG 20 :CALC:EVDO:RFSPpectrum:ACPM:MODulation:LIMit:FAIL? The string returned in this example is "0,0,1,0,0,0,0,0,0,0,0,0" and indicates, that the measurement results obtained for the third offset specified (800 kHz) did violate their limits.</pre>
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:CALC:EVDO:RFSPpectrum:ACPM[:MODulation]:LIMit:STATE

Syntax	<pre>:CALCulate:EVDO:RFSP:ACPM[:MODulation]:LIMit:STATE <PredefExp></pre>
Parameters	PredefExp is one of the following predefined expressions: ON OFF. Default is ON.
Description	This command switches the check of the measurement result(s) against the user-definable limits either on or off.
Query	There is no query form of this command available.
Example	<pre>:CALC:EVDO:RFSPpectrum:ACPM:MODulation:LIMit:STATE ON Switches on the check of the measurement results against the user-definable limits.</pre>

:CALCulate:EVDO:RFSP:ACPM[:MODulation]:UPPer[:DATA]

Syntax	<pre>:CALCulate:EVDO:RFSPpectrum:ACPM[:MODulation]:UPPer [:DATA] <Real1>,<Real2>, ... <Real12> [,<PredefExp<>]</pre>
Parameters	<p>Real1 through Real12 are twelve floating point real numbers. The minimum value is -100.0, the maximum is 10.0, the resolution is 0.01.</p> <p>PredefExp is an optional predefined expression used to select the band for which the upper limit values apply. Selectable values are: US800 USPCs TACS JTACS KPCS NMT450 IMT2000 MHZ900 MHZ1800 SEC800 PAMR400 PAMR900. Default is US800.</p>
Description	This command sets the upper limits at the 12 frequency offsets used in the ACPM measurement. The parameter values are in dBc.
Query	The query form of this command returns (in a string) 12 floating point real numbers, representing the 12 ACPM upper limit values for the frequency band specified.
Example	<pre>:CALC:EVDO:RFSP:ACPM:UPP -42,-42,-42,-42,-42,-42,-42,- 42,-42,-42,-54,-54,US800 :CALC:EVDO:RFSPpectrum:ACPM:MODulation:UPPer:DATA? US800 The string returned in this example: "-42,-42,-42,-42,-42,-42,-42,-42,-42,-42,-54,-54".</pre>

:CALCulate:EVDO:RFSP:ACPM[:MOD]:UPPer:ENABle[:DATA]

Syntax	<pre>:CALCulate:EVDO:RFSPpectrum:ACPM[:MODulation]:UPPer :ENABle[:DATA] <Booll1>, ... <Booll2> [,<PredefExp>]</pre>
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Parameters	<p>Boo11 through Boo112 are twelve boolean (0 1) values. The default value for Boo11 through Boo13 is 0; for all the others it is 1. PreDefExp is an optional predefined expression used to select the band for which the upper limit values apply. Selectable values are: US800 USPCs TACS JTACS KPCS NMT450 IMT2000 MHZ900 MHZ1800 SEC800 PAMR400 PAMR900. Default is US800.</p>
Description	<p>The 12 boolean numbers of this command specify, whether the upper limit check of the ACPM results shall be applied at the corresponding offset (boolean value set to 1) or not (boolean value set to 0). The optional parameter specifies the corresponding frequency band. The upper limits themselves are set using the :CALC:EVDO:RFSP:ACPM:UPPER command (see above).</p>
Query	<p>The query form of this command returns (in a string and separated by commas) 12 boolean values, representing the current enabling settings for the ACPM upper limits.</p>
Example	<pre>:CALC:EVDO:RFSP:ACPM:UPP:ENAB 0,0,0,1,1,1,1,1,1,1,1,1, 1,1,1,US800 :CALC:EVDO:RFSPpectrum:ACPM:MOD:UPPER:ENABLE:DATA? US800</pre> <p>The string returned in this example: "0,0,0,1,1,1,1,1,1,1,1,1,1,1".</p>

:CALCulate:EVDO:RFSP:ACPM[:MODulation]:LOWER[:DATA]

Syntax	<pre>:CALCulate:EVDO:RFSPpectrum:ACPM[:MODulation]:LOWER [:DATA] <Real1>,<Real2>,... <Real12> [,<PreDefExp>]</pre>
Parameters	<p>Real1 through Real12 are twelve floating point real numbers. The minimum value is -100.0, the maximum is 10.0, the resolution is 0.01. PreDefExp is an optional predefined expression used to select the band for which the upper limit values apply. Selectable values are: US800 USPCs TACS JTACS KPCS NMT450 IMT2000 MHZ900 MHZ1800 SEC800 PAMR400 PAMR900. Default is US800.</p>
Description	<p>This command sets the lower limits at the 12 frequency offsets used in the ACPM measurement. The parameter values are in dBc.</p>
Query	<p>The query form of this command returns (in a string) 12 floating point real numbers, representing the 12 ACPM lower limit values for the frequency band specified.</p>
Example	<pre>:CALC:EVDO:RFSP:ACPM:LOW -10,-10,-10,-60,-60,-60,-60,- 80,-80,-80,-100,-100,US800 :CALC:EVDO:RFSPpectrum:ACPM:MODulation:LOWER:DATA? US800</pre> <p>The string returned in this example: "-10,-10,-10,-60,-60,-60,-60,-80,-80,-80,-100,-100".</p>

:CALCulate:EVDO:RFSP:ACPM[:MOD]:LOWER:ENABLE[:DATA]

Syntax	<pre>:CALCulate:EVDO:RFSPpectrum:ACPM[:MODulation]:LOWER :ENABLE[:DATA] <Boo11>,... <Boo112> [,<PreDefExp>]</pre>
Parameters	<p>Boo11 through Boo112 are twelve boolean (0 1) values. The default value for Boo11 through Boo13 is 0; for all the others it is 1. PreDefExp is an optional predefined expression used to select the band for which the upper limit values apply. Selectable values are: US800 USPCs TACS JTACS KPCS NMT450 IMT2000 MHZ900 MHZ1800 SEC800 PAMR400 PAMR900. Default is US800.</p>

Description	The 12 boolean numbers of this command specify, whether the lower limit check of the ACPM results shall be applied at the corresponding offset (boolean value set to 1) or not (boolean value set to 0). The optional parameter specifies the corresponding frequency band. The lower limits themselves are set using the :CALC:EVDO:RFSP:ACPM:LOWer command (see above).
Query	Returns 12 boolean numbers, representing the current settings for the twelve lower limits.
Example	:CALC:EVDO:RFSP:ACPM:LOW:ENAB 0,0,0,1,1,1,1,1,1,1,1,1,US800 :CALC:EVDO:RFSPectrum:ACPM:MOD:LOWer:ENABle:DATA? US800 The values returned in this example: "0,0,0,1,1,1,1,1,1,1,1,1,1".

:CALCulate:EVDO:RFTX:ALL:LIMit[:FAIL]

Syntax	:CALCulate:EVDO:RFTX:ALL:LIMit[:FAIL]?
Parameters	There are no parameters for this command.
Description	This query-only command checks all single EVDO RFTX measurement results against their limits.
Query	Once the measurements are performed and the results obtained, the query form of this command checks the measurement results against their corresponding limits. It will return a total of 13 boolean values, representing the verdict of the following measurement: 1) frequency error, 2) power, 3) RMS vector error, 4) RMS phase error, 5) RMS magnitude error, 6) time offset, 7) rho, 8) carrier feedthrough, 9) IQ imbalance, 10) standby power, 11) minimum power, 12) access probe power and 13) closed-loop measurement. A 0 at any position indicates that the corresponding measurement result was within the limits, while a 1 indicates that the result for the related measurement type did violate its limits. All 13 boolean values are contained in a string and separated by commas.
Example	:CALC:EVDO:RFTX:ALL:LIMit:FAIL? String returned in this example: "0,0,1,0,0,0,0,0,0,0,0,0,0", meaning that all single measurements went ok - with the exception of the RMS vector error.

:CALCulate:EVDO:RFTX:ALL:LIMit:STATE

Syntax	:CALCulate:EVDO:RFTX:ALL:LIMit:STATE <PredefExp>
Parameters	PredefExp is one of the following predefined expressions: ON OFF. Default is ON.
Description	This command switches the check of the measurement result(s) against the user-definable limits either on or off.
Query	There is no query form of this command available.
Example	:CALC:EVDO:RFTX:ALL:LIMit:STATE OFF

:CALCulate:EVDO:RFTX:ALL:LIMit:UPPer[:DATA]

Syntax	:CALCulate:EVDO:RFTX:ALL:LIMit:UPPer[:DATA] <Real1>, <Real2>, ..., <Real13>
Parameters	Real1 to Real13 are 13 floating point real numbers, representing the upper limits of the 13 single tests addressed with the :CALC:EVDO:RFTX:ALL:LIM command.
Description	This command sets the upper limits, applied by the CALC:EVDO:RFTX:ALL:LIM command. The parameter values represent the upper limits of the following measurement types: 1) frequency error, 2) power, 3) RMS vector error, 4) RMS phase error, 5) RMS magnitude error, 6) time offset, 7) rho, 8) carrier feedthrough, 9) IQ imbalance, 10) standby power, 11) minimum power, 12) access probe power and 13) closed-loop measurement. For a detailed description of the single values and their ranges, please refer to the description of the related commands below.
Query	The query form of this command returns 13 floating point real numbers, separated by commas and representing the upper limits for the 13 measurement types as described above.
Example	:CALC:EVDO:RFTX:ALL:LIMit:UPPer:DATA?

:CALCulate:EVDO:RFTX:ALL:LIMit:LOWer[:DATA]

Syntax	:CALCulate:EVDO:RFTX:ALL:LIMit:LOWer[:DATA] <Real1>, <Real2>, ..., <Real13>
Parameters	Real1 to Real13 are 13 floating point real numbers, representing the lower limits of the 13 single tests addressed with the :CALC:EVDO:RFTX:ALL:LIM command.
Description	This command sets the lower limits, applied by the CALC:EVDO:RFTX:ALL:LIM command. The parameter values represent the lower limits of the following measurement types: 1) frequency error, 2) power, 3) RMS vector error, 4) RMS phase error, 5) RMS magnitude error, 6) time offset, 7) rho, 8) carrier feedthrough, 9) IQ imbalance, 10) standby power, 11) minimum power, 12) access probe power and 13) closed-loop measurement. For a detailed description of the single values and their ranges, please refer to the description of the related commands below.
Query	The query form of this command returns 13 floating point real numbers, separated by commas and representing the lower limits for the 13 measurement types as described above.
Example	:CALC:EVDO:RFTX:ALL:LIMit:LOWer:DATA?

:CALCulate:EVDO:RFTX:FREQuency:LIMit[:FAIL]

Syntax	:CALCulate:EVDO:RFTX:FREQuency:LIMit[:FAIL]?
Parameters	There are no parameters for this command.

Description	This query-only command checks the results of a :MEAS:EVDO:CONT ARR:RFTX:FREQ:ERR measurement against its limits and returns a test verdict.
Query	The query form of this command returns one boolean value (contained in a string), indicating whether the measurement result(s) did violate the corresponding limits (value returned: 1) or not (value returned: 0).
Example	:MEAS:EVDO:ARR:RFTX:FREQ:ERR 20 :CALC:EVDO:RFTX:FREQuency:LIMit:FAIL? The :MEAS command will make the Willtek 4400 perform 20 frequency error mea- surements. The query returns "1" if any of the 20 measurement results was out of limits, or "0" if none of the results was out of limits.

:CALCulate:EVDO:RFTX:FREQuency:LIMit:STATe

Syntax	:CALCulate:EVDO:RFTX:FREQuency:LIMit:STATe <PreDefExp>
Parameters	PreDefExp is one of the following predefined expressions: ON OFF. Default is ON.
Description	This command switches the check of the measurement result(s) against the user- definable limits either on or off.
Query	There is no query form of this command available.
Example	:CALC:EVDO:RFTX:FREQ:LIM:STAT ON Switches the limit check for the frequency error measurement on.

:CALCulate:EVDO:RFTX:FREQuency:LIMit:UPPer[:DATA]

Syntax	:CALCulate:EVDO:RFTX:FREQuency:LIMit:UPPer[:DATA] <Int>, <PreDefExp>
Parameters	Int is an integer number. The minimum value is 0, the maximum is 1000. The default value is 300. PreDefExp is one of the following predefined expressions: US800 USPCs TACS JTACS KPCS NMT450 IMT2000 MHZ900 MHZ1800 SEC800 PAMR400 PAMR800. Default is US800.
Description	This command sets the upper limit for the frequency error measurement by band. The physical dimension of the parameter value is Hz.
Query	The query form of this command returns the current setting of the Willtek 4400 in form of one integer number, contained in a string. The related band needs to be spec- ified by the query (see example below).
Example	:CALC:EVDO:RFTX:FREQ:LIM:UPP 310, US800 :CALC:EVDO:RFTX:FREQuency:LIMit:UPPer:DATA? US800 String returned: "310".

:CALCulate:EVDO:RFTX:FREQuency:LIMit:LOWer[:DATA]

Syntax	:CALCulate:EVDO:RFTX:FREQuency:LIMit:LOWer[:DATA] <Int>, <PredefExp>
Parameters	Int is an integer number. The minimum value is -1000, the maximum is 0. The default value is -300. PredefExp is one of the following predefined expressions: US800 USPCs TACS JTACs KPCS NMT450 IMT2000 MHZ900 MHZ1800 SEC800 PAMR400 PAMR800. Default is US800.
Description	This command sets the lower limit for the frequency error measurement by band. The physical dimension of the parameter value is Hz.
Query	The query form of this command returns the current setting of the Willtek 4400 in form of one integer number, contained in a string. The related band needs to be specified by the query (see example below).
Example	:CALC:EVDO:RFTX:FREQ:LIM:LOW -175, JTACs :CALC:EVDO:RFTX:FREQuency:LIMit:LOWer:DATA? JTACs String returned: "-175".

:CALCulate:EVDO:RFTX:POWER[:MEAN]:LIMit[:FAIL]

Syntax	:CALCulate:EVDO:RFTX:POWER[:MEAN]:LIMit[:FAIL]?
Parameters	There are no parameters for this command.
Description	This query-only command checks the results of a :MEAS:EVDO:CONT ARR:RFTX:POW measurement against its limits and returns a test verdict.
Query	The query form of this command returns one boolean value (contained in a string), indicating whether the measurement result(s) did violate the corresponding limits (value returned: 1) or not (value returned: 0).
Example	:MEAS:EVDO:ARR:RFTX:POW 20 :CALC:EVDO:RFTX:POWER:LIM? Returns "1" if one or more of the 20 power measurement results was out of limits, and a "0" if all results were within the limits.

:CALCulate:EVDO:RFTX:POWER[:MEAN]:LIMit:STATE

Syntax	:CALCulate:EVDO:RFTX:POWER[:MEAN]:LIMit:STATE <PredefExp>
Parameters	PredefExp is one of the following predefined expressions: ON OFF. Default is ON.
Description	This command switches the check of the measurement result(s) against the user-definable limits either on or off.
Query	There is no query form of this command available.
Example	:CALC:EVDO:RFTX:POWER:MEAN:LIMit:STATE ON Switches the limit check for the power measurement on.

:CALC:EVDO:RFTX:POWer[:MEAN]:LIMit:UPPer[:DATA]

Syntax	:CALCulate:EVDO:RFTX:POWer[:MEAN]:LIMit:UPPer[:DATA] <Real>, <PredefExp1>, <PredefExp2>
Parameters	Real is a floating point real number. Its minimum value is 0.0, the maximum is 99.0, the resolution is 0.01. The default value is 2.0. PredefExp1 is one of the following predefined expressions: PCL1 PCL2 PCL3 PCL4 PCL5. Default is PCL1. PredefExp2 is one of the following predefined expressions: US800 USPCS TACS JTACS KPCS NMT450 IMT2000 MHZ900 MHZ1800 SEC800 PAMR400 PAMR900. Default is US800.
Description	This command sets the upper limit for the mobile's RF output power. The physical dimension of the parameter value is dBm. Both the related power class and frequency band need to be stated as command parameters as well (see example below).
Query	The query form of this command returns the current setting of the Willtek 4400 in form of one floating point real number, contained in a string. The related power class and frequency band need to be stated by the query (see example below).
Example	:CALC:EVDO:RFTX:POW:LIM:UPP 34.0, PCL2, US800 :CALC:EVDO:RFTX:POW:LIM:UPP? PCL2, US800 String returned: " 34.0".

:CALC:EVDO:RFTX:POWer[:MEAN]:LIMit:LOWer[:DATA]

Syntax	:CALCulate:EVDO:RFTX:POWer[:MEAN]:LIMit:LOWer[:DATA] <Real>, <PredefExp1>, <PredefExp2>
Parameters	Real is a floating point real number. Its minimum value is -99.0, the maximum is 99.0, the resolution is 0.01. The default value is -2.0. PredefExp1 is one of the following predefined expressions: PCL1 PCL2 PCL3 PCL4 PCL5. Default is PCL1. PredefExp2 is one of the following predefined expressions: US800 USPCS TACS JTACS KPCS NMT450 IMT2000 MHZ900 MHZ1800 SEC800 PAMR400 PAMR900. Default is US800.
Description	This command sets the lower limit for the mobile's RF output power. The physical dimension of the parameter value is dBm. Both the related power class and frequency band need to be stated as command parameters as well (see example below).
Query	The query form of this command returns the current setting of the Willtek 4400 in form of one floating point real number, contained in a string. The related power class and frequency band need to be stated by the query (see example below).
Example	:CALC:EVDO:RFTX:POW:LIM:LOW 27.0, PCL2, US800 :CALC:EVDO:RFTX:POW:LIM:LOW? PCL2, US800 String returned: " 27.0".

:CALCulate:EVDO:RFTX:VERRor:RMS:LIMit[:FAIL]

Syntax	:CALCulate:EVDO:RFTX:VERRor:RMS:LIMit[:FAIL]?
Parameters	There are no parameters for this command.

Description	This query-only command checks the results of a :MEAS:EVDO:CONT ARR:RFTX:VERR:RMS measurement against its limits and returns a test verdict.
Query	The query form of this command returns one boolean value (contained in a string), indicating whether the measurement result(s) did violate the corresponding limits (value returned: 1) or not (value returned: 0).
Example	:MEAS:EVDO:ARR:RFTX:VERR:RMS 20 :CALCulate:EVDO:RFTX:VERRor:RMS:LIMit:FAIL? Returns a "1" if any of the 20 measurement results is out of limits.

:CALCulate:EVDO:RFTX:VERRor:RMS:LIMit:STATe

Syntax	:CALCulate:EVDO:RFTX:VERRor:RMS:LIMit:STATe <PredefExp>
Parameters	PredefExp is one of the following predefined expressions: ON OFF. Default is ON.
Description	This command switches the check of the measurement result(s) against the user-definable limits either on or off.
Query	There is no query form of this command available.
Example	:CALC:EVDO:RFTX:VERR:RMS:LIM:STAT ON Switches the limit check of the RMS-averaged error vector measurement results on.

:CALCulate:EVDO:RFTX:VERRor:RMS:LIMit:UPPer[:DATA]

Syntax	:CALCulate:EVDO:RFTX:VERRor:RMS:LIMit:UPPer[:DATA] <Real>
Parameters	Real is a floating point real number. The minimum value is 0.0, the maximum is 200.0, the resolution is 0.1. The default value is 24.4.
Description	This command sets the upper limit for the RMS-averaged error vector measurement results. The physical dimension of the parameter value is a percentage.
Query	The query form of this command returns the current setting of the Willtek 4400 in form of one floating point real number, contained in a string.
Example	:CALC:EVDO:RFTX:VERR:RMS:LIM:UPP 29.9 :CALC:EVDO:RFTX:VERRor:RMS:LIMit:UPPer:DATA? String returned: "29.9".

:CALCulate:EVDO:RFTX:VERRor:RMS:LIMit:LOWer[:DATA]

Syntax	:CALCulate:EVDO:RFTX:VERRor:RMS:LIMit:LOWer[:DATA] <Real>
Parameters	Real is a floating point real number. The minimum value is 0.0, the maximum is 200.0, the resolution is 0.1. The default value is 0.0.
Description	This command sets the lower limit for the RMS-averaged error vector measurement results. The physical dimension of the parameter value is a percentage.
Query	The query form of this command returns the current setting of the Willtek 4400 in form of one floating point real number, contained in a string.

Example	:CALC:EVDO:RFTX:VERR:RMS:LIM:LOW 0.0 :CALC:EVDO:RFTX:VERRor:RMS:LIMit:LOWer:DATA? String returned: "0.0".
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:CALCulate:EVDO:RFTX:VERRor:PHASe:RMS:LIMit[:FAIL]

Syntax	:CALCulate:EVDO:RFTX:VERRor:PHASe:RMS:LIMit[:FAIL]?
Parameters	There are no parameters for this command.
Description	This query-only command checks the results of a :MEAS:EVDO:CONT ARR:RFTX:VERR:PHAS:RMS measurement against its limits and returns a test verdict.
Query	The query form of this command returns one boolean value (contained in a string), indicating whether the measurement result(s) did violate the corresponding limits (value returned: 1) or not (value returned: 0).
Example	:MEAS:EVDO:ARR:RFTX:VERR:PHAS:RMS 10 :CALC:EVDO:RFTX:VERRor:PHASe:RMS:LIMit:FAIL? Returns a "0" if all measurement results are within their limits.

:CALCulate:EVDO:RFTX:VERRor:PHASe:RMS:LIMit:STATE

Syntax	:CALCulate:EVDO:RFTX:VERRor:PHASe:RMS:LIMit:STATE <PredefExp>
Parameters	PredefExp is one of the following predefined expressions: ON OFF. Default is ON.
Description	This command switches the check of the measurement result(s) against the user-definable limits either on or off.
Query	There is no query form of this command available.
Example	:CALC:EVDO:RFTX:VERRor:PHASe:RMS:LIMit:STATE ON Switches on the check of the measurement results against the user-definable limits.

:CALC:EVDO:RFTX:VERRor:PHASe:RMS:LIMit:UPPer[:DATA]

Syntax	:CALCulate:EVDO:RFTX:VERRor:PHASe:RMS:LIMit:UPPer [:DATA] <Real>
Parameters	Real is a floating point real number. Its minimum value is 0, the maximum is 45, the resolution is 0.01. The default value is 14.0.
Description	This command sets the upper limit for the RMS-averaged measurement results of the vector error's phase component in degrees.
Query	The query form of this command returns the current setting of the Willtek 4400 in form of one floating point real number, contained in a string.
Example	:CALC:EVDO:RFTX:VERR:PHAS:RMS:LIM:UPP 22.5 :CALC:EVDO:RFTX:VERRor:PHASe:RMS:LIMit:UPPer:DATA? String returned: "22.5".

:CALC:EVDO:RFTX:VERRor:PHASe:RMS:LIMit:LOWer[:DATA]

Syntax	:CALCulate:EVDO:RFTX:VERRor:PHASe:RMS:LIMit:LOWer[:DATA] <Real>
Parameters	Real is a floating point real number. Its minimum value is 0, the maximum is 45, the resolution is 0.1. The default value is 0.0.
Description	This command sets the lower limit for the RMS-averaged measurement results of the vector error's phase component in degrees.
Query	The query form of this command returns the current setting of the Willtek 4400 in form of one floating point real number, contained in a string.
Example	:CALC:EVDO:RFTX:VERR:PHAS:RMS:LIM:LOW 0.0 :CALC:EVDO:RFTX:VERRor:PHASe:RMS:LIMit:LOWer:DATA? String returned: "0.0".

:CALC:EVDO:RFTX:VERRor:MAGNitude:RMS:LIMit[:FAIL]

Syntax	:CALCulate:EVDO:RFTX:VERRor:MAGNitude:RMS:LIMit[:FAIL]?
Parameters	There are no parameters for this command.
Description	This query-only command checks the results of a :MEAS:EVDO:CONT ARR:RFTX:VERR:MAGN:RMS measurement against its limits and returns a test verdict.
Query	The query form of this command returns one boolean value (contained in a string), indicating whether the measurement result(s) did violate the corresponding limits (value returned: 1) or not (value returned: 0).
Example	:MEAS:EVDO:ARR:RFTX:VERR:MAGN:RMS 10 :CALC:EVDO:RFTX:VERRor:MAGNitude:RMS:LIMit:FAIL? Returns a "0" if all measurement results are within their limits.

:CALC:EVDO:RFTX:VERRor:MAGNitude:RMS:LIMit:STATE

Syntax	:CALCulate:EVDO:RFTX:VERRor:MAGNitude:RMS:LIMit:STATE <PredefExp>
Parameters	PredefExp is one of the following predefined expressions: ON OFF. Default is ON.
Description	This command switches the check of the measurement result(s) against the user-definable limits either on or off.
Query	There is no query form of this command available.
Example	:CALC:EVDO:RFTX:VERRor:MAGNitude:RMS:LIMit:STATE ON Switches on the check of the measurement results against the user-definable limits.

:CALC:EVDO:RFTX:VERR:MAGN:RMS:LIMit:UPPer[:DATA]

Syntax	:CALCulate:EVDO:RFTX:VERRor:MAGNitude:RMS:LIMit:UPPer[:DATA] <Real>
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Parameters	Real is a floating point real number. Its minimum value is 0, the maximum is 200, the resolution is 0.1. The default value is 24.4.
Description	This command sets the upper limit for the RMS-averaged measurement results of the vector error's magnitude component in form of a percentage.
Query	The query form of this command returns the current setting of the Willtek 4400 in form of one floating point real number, contained in a string.
Example	:CALC:EVDO:RFTX:VERR:MAGN:RMS:LIM:UPP 100.0 :CALC:EVDO:RFTX:VERRor:MAGNitude:RMS:LIMit:UPPer:DATA? String returned: "100.0".

:CALC:EVDO:RFTX:VERR:MAGN:RMS:LIMit:LOWer[:DATA]

Syntax	:CALCulate:EVDO:RFTX:VERRor:MAGNitude:RMS:LIMit:LOWer[:DATA] <Real>
Parameters	Real is a floating point real number. Its minimum value is 0, the maximum is 200, the resolution is 0.1. The default value is 0.0.
Description	This command sets the lower limit for the RMS-averaged measurement results of the vector error's magnitude component in form of a percentage.
Query	The query form of this command returns the current setting of the Willtek 4400 in form of one floating point real number, contained in a string.
Example	:CALC:EVDO:RFTX:VERR:MAGN:RMS:LIM:LOW 0.0 :CALC:EVDO:RFTX:VERRor:MAGNitude:RMS:LIMit:LOWer:DATA? String returned: "0.0".

:CALCulate:EVDO:RFTX:TIMEoffset:LIMit[:FAIL]

Syntax	:CALCulate:EVDO:RFTX:TIMEoffset:LIMit[:FAIL]?
Parameters	There are no parameters for this command.
Description	This query-only command checks the results of a :MEAS:EVDO:CONT ARR:RFTX:TIM:OFFS measurement against its limits and returns a test verdict.
Query	The query form of this command returns one boolean value (contained in a string), indicating whether the measurement result(s) did violate the corresponding limits (value returned: 1) or not (value returned: 0).
Example	:MEAS:EVDO:ARR:RFTX:TIM:OFFS 10 :CALC:EVDO:RFTX:TIMEoffset:LIMit:FAIL? The :MEAS command will make the Willtek 4400 perform 10 time offset measurements. The query returns "1" if any of the 10 measurement results was out of limits, or "0" if none of the results was out of limits.

:CALCulate:EVDO:RFTX:TIMEoffset:LIMit:STATE

Syntax	:CALCulate:EVDO:RFTX:TIMEoffset:LIMit:STATE <PredefExp>
Parameters	PredefExp is one of the following predefined expressions: ON OFF. Default is ON.

Description	This command switches the check of the measurement result(s) against the user-definable limits either on or off.
Query	There is no query form of this command available.
Example	:CALC:EVDO:RFTX:TIM:LIM:STAT ON Switches the limit check for the time offset measurement on.

:CALCulate:EVDO:RFTX:TIMEoffset:LIMit:UPPer[:DATA]

Syntax	:CALCulate:EVDO:RFTX:TIMEoffset:LIMit:UPPer[:DATA] <Real>
Parameters	Real is a floating point real number. The minimum value is -5.0, the maximum is 5.0, the resolution is 0.1. The default value is 1.0.
Description	This command sets the upper limit for the mobile's transmit time error measurement in microseconds (10E-6 s).
Query	The query form of this command returns the current setting of the Willtek 4400 in form of one floating point real number, contained in a string.
Example	:CALC:EVDO:RFTX:TIM:LIM:UPP 3.0 :CALC:EVDO:RFTX:TIMEoffset:LIMit:UPPer:DATA? String returned: "3.0".

:CALCulate:EVDO:RFTX:TIMEoffset:LIMit:LOWer[:DATA]

Syntax	:CALCulate:EVDO:RFTX:TIMEoffset:LIMit:LOWer[:DATA] <Real>
Parameters	Real is a floating point real number. The minimum value is -5.0, the maximum is 5.0, the resolution is 0.1. The default value is 1.0.
Description	This command sets the lower limit for the mobile's transmit time error measurement in microseconds (10E-6 s).
Query	The query form of this command returns the current setting of the Willtek 4400 in form of one floating point real number, contained in a string.
Example	:CALC:EVDO:RFTX:TIM:LIM:LOW -3.0 :CALC:EVDO:RFTX:TIMEoffset:LIMit:LOWer:DATA? String returned: "-3.0".

:CALCulate:EVDO:RFTX:WQUality|RHO:LIMit[:FAIL]

Syntax	:CALCulate:EVDO:RFTX:WQUality RHO:LIMit[:FAIL]?
Parameters	There are no parameters for this command.
Description	This query-only command checks the results of a :MEAS:EVDO:CONT ARR:RFTX:WQU RHO measurement against its limits and returns a test verdict.
Query	The query form of this command returns one boolean value (contained in a string), indicating whether the measurement result(s) did violate the corresponding limits (value returned: 1) or not (value returned: 0).

Example :MEAS:EVDO:ARR:RFTX:WQQuality 10
:CALC:EVDO:RFTX:RHO:LIM?
Returns a "0" if all measurement results are within their limits.

:CALCulate:EVDO:RFTX:WQQuality|RHO:LIMit:STATe

Syntax :CALCulate:EVDO:RFTX:WQQuality|RHO:LIMit:STATe
<PredefExp>

Parameters PredefExp is one of the following predefined expressions: ON|OFF. Default is ON.

Description This command switches the check of the measurement result(s) against the user-definable limits either on or off.

Query There is no query form of this command available.

Example :CALC:EVDO:RFTX:WQQuality:LIM:STAT ON
Switches on the check of the measurement results against the user-definable limits.

:CALC:EVDO:RFTX:WQQuality|RHO:LIMit:UPPer[:DATA]

Syntax :CALCulate:EVDO:RFTX:WQQuality|RHO:LIMit:UPPer[:DATA]
<Real>

Parameters Real is a floating point real number. Its minimum value is 0.9, the maximum is 1.0, the resolution is 0.001. The default value is 1.0.

Description This command sets the upper limit for the modulation quality factor.

Query The query form of this command returns the current setting of the Willtek 4400 in form of one floating point real number, contained in a string.

Example :CALC:EVDO:RFTX:WQQuality:LIM:UPP 0.975
:CALC:EVDO:RFTX:RHO:LIMit:UPPer:DATA?
String returned: "0.975".

:CALC:EVDO:RFTX:WQQuality|RHO:LIMit:LOWer[:DATA]

Syntax :CALCulate:EVDO:RFTX:WQQuality|RHO:LIMit:LOWer[:DATA]
<Real>

Parameters Real is a floating point real number. Its minimum value is 0.9, the maximum is 1.0, the resolution is 0.001. The default value is 0.944.

Description This command sets the lower limit for the modulation quality factor.

Query The query form of this command returns the current setting of the Willtek 4400 in form of one floating point real number, contained in a string.

Example :CALC:EVDO:RFTX:WQQuality:LIM:LOW 0.950
:CALC:EVDO:RFTX:RHO:LIMit:LOWer:DATA?
String returned: "0.950".

:CALCulate:EVDO:RFTX:VERRor:IQOFFset:LIMit[:FAIL]

Syntax :CALCulate:EVDO:RFTX:VERRor:IQOFFset:LIMit[:FAIL]?

Parameters	There are no parameters for this command.
Description	This query-only command checks the results of a :MEAS:EVDO:CONT ARR:RFTX:VERR:IQOF measurement (i.e. carrier feedthrough measurement) against its limits and returns a test verdict.
Query	The query form of this command returns one boolean value (contained in a string), indicating whether the measurement result(s) did violate the corresponding limits (value returned: 1) or not (value returned: 0).
Example	:MEAS:EVDO:ARR:RFTX:VERR:IQOF 10 :CALC:EVDO:RFTX:VERRor:IQOFFset:LIMit:FAIL? Returns a "0" if all measurement results are within their limits.

:CALCulate:EVDO:RFTX:VERRor:IQOFFset:LIMit:STATE

Syntax	:CALCulate:EVDO:RFTX:VERRor:IQOFFset:LIMit:STATE <PredefExp>
Parameters	PredefExp is one of the following predefined expressions: ON OFF. Default is ON.
Description	This command switches the check of the measurement result(s) against the user-definable limits either on or off.
Query	There is no query form of this command available.
Example	:CALC:EVDO:RFTX:VERRor:IQOFFset:LIMit:STATE ON Switches on the check of the measurement results against the user-definable limits.

:CALC:EVDO:RFTX:VERR:IQOFFset:LIMit:UPPer[:DATA]

Syntax	:CALCulate:EVDO:RFTX:VERRor:IQOFFset:LIMit:UPPer [:DATA] <Real>
Parameters	Real is a floating point real number. Its minimum value is -99.0, the maximum is 0.0, the resolution is 0.1. The default value is -20.0.
Description	This command sets the upper limit for the carrier feedthrough measurement. The physical dimension of the parameter value is dBc.
Query	The query form of this command returns the current setting of the Willtek 4400 in form of one floating point real number, contained in a string.
Example	:CALC:EVDO:RFTX:VERR:IQOF:LIM:UPP -25.0 :CALC:EVDO:RFTX:VERRor:IQOFFset:LIMit:UPPer:DATA? String returned: "-25.0".

:CALC:EVDO:RFTX:VERR:IQOFFset:LIMit:LOWer[:DATA]

Syntax	:CALCulate:EVDO:RFTX:VERRor:IQOFFset:LIMit:LOWer [:DATA] <Real>
Parameters	Real is a floating point real number. Its minimum value is -99.0, the maximum is 0.0, the resolution is 0.1. The default value is -99.0.
Description	This command sets the lower limit for the carrier feedthrough measurement. The physical dimension of the parameter value is dBc.

Query	The query form of this command returns the current setting of the Willtek 4400 in form of one floating point real number, contained in a string.
Example	:CALC:EVDO:RFTX:VERR:IQOF:LIM:LOW -95.0 :CALC:EVDO:RFTX:VERRor:IQOfset:LIMit:LOWer:DATA? String returned: "-95.0".

:CALC:EVDO:RFTX:VERRor:IQIMbalance:LIMit[:FAIL]

Syntax	:CALCulate:EVDO:RFTX:VERRor:IQIMbalance:LIMit[:FAIL]?
Parameters	There are no parameters for this command.
Description	This query-only command checks the results of a :MEAS:EVDO:CONT ARR:RFTX:VERR:IQIM measurement against its limits and returns a test verdict.
Query	The query form of this command returns one boolean value (contained in a string), indicating whether the measurement result(s) did violate the corresponding limits (value returned: 1) or not (value returned: 0).
Example	:MEAS:EVDO:ARR:RFTX:VERR:IQIM 10 :CALC:EVDO:RFTX:VERRor:IQIMbalance:LIMit:FAIL? Returns a "0" if all measurement results are within their limits.

:CALCulate:EVDO:RFTX:VERRor:IQIMbalance:LIMit:STATE

Syntax	:CALCulate:EVDO:RFTX:VERRor:IQIMbalance:LIMit:STATE <PredefExp>
Parameters	PredefExp is one of the following predefined expressions: ON OFF. Default is ON.
Description	This command switches the check of the measurement result(s) against the user-definable limits either on or off.
Query	There is no query form of this command available.
Example	:CALC:EVDO:RFTX:VERRor:IQIMbalance:LIMit:STATE ON Switches on the check of the measurement results against the user-definable limits.

:CALC:EVDO:RFTX:VERR:IQIMbalance:LIMit:UPPer[:DATA]

Syntax	:CALCulate:EVDO:RFTX:VERRor:IQIMbalance:LIMit:UPPer [:DATA] <Real>
Parameters	Real is a floating point real number. Its minimum value is -99.0, the maximum is 0.0, the resolution is 0.1. The default value is 0.0.
Description	This command sets the upper limit for the IQ imbalance measurement results. The physical dimension of the parameter value is dB.
Query	The query form of this command returns the current setting of the Willtek 4400 in form of one floating point real number, contained in a string.
Example	:CALC:EVDO:RFTX:VERR:IQIM:LIM:UPP -25.0 :CALC:EVDO:RFTX:VERRor:IQIMbalance:LIMit:UPPer:DATA? String returned: "-25.0".

:CALC:EVDO:RFTX:VERR:IQImbalance:LIMit:LOWer[:DATA]

Syntax	:CALCulate:EVDO:RFTX:VERRor:IQIMbalance:LIMit:LOWer[:DATA] <Real>
Parameters	Real is a floating point real number. Its minimum value is -99.0, the maximum is 0.0, the resolution is 0.1. The default value is -99.0.
Description	This command sets the lower limit for the IQ imbalance measurement results. The physical dimension of the parameter value is dB.
Query	The query form of this command returns the current setting of the Willtek 4400 in form of one floating point real number, contained in a string.
Example	:CALC:EVDO:RFTX:VERR:IQIM:LIM:LOW -95.0 :CALC:EVDO:RFTX:VERRor:IQIM:LIMit:LOWer:DATA? String returned: "-95.0".

:CALCulate:EVDO:RFTX:POWER:MINimum:LIMit[:FAIL]

Syntax	:CALCulate:EVDO:RFTX:POWer:MINimum:LIMit[:FAIL]?
Parameters	There are no parameters for this command.
Description	This query-only command checks the results of a :MEAS:EVDO:CONT ARR:RFTX:POW:MIN measurement against its limits and returns a test verdict.
Query	The query form of this command returns one boolean value (contained in a string), indicating whether the measurement result(s) did violate the corresponding limits (value returned: 1) or not (value returned: 0).
Example	:MEAS:EVDO:ARR:RFTX:POW:MIN: 5 :CALC:EVDO:RFTX:POW:MIN:LIM? Returns "1" if one or more of the 5 minimum power measurements was out of limits, and a "0" if all results were within the limits.

:CALCulate:EVDO:RFTX:POWER:MINimum:LIMit:STATE

Syntax	:CALCulate:EVDO:RFTX:POWer:MINimum:LIMit:STATE <PredefExp>
Parameters	PredefExp is one of the following predefined expressions: ON OFF. Default is ON.
Description	This command switches the check of the measurement result(s) against the user-definable limits either on or off.
Query	There is no query form of this command available.
Example	:CALC:EVDO:RFTX:POWer:MINimum:LIMit:STATE ON Switches the limit check for the minimum power measurement on.

:CALC:EVDO:RFTX:POWER:MINimum:LIMit:UPPer[:DATA]

Syntax	:CALCulate:EVDO:RFTX:POWer:MINimum:LIMit:UPPer[:DATA] <Real>
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Parameters	Real is a floating point real number. Its minimum value is -99.0, the maximum is 36.0, the resolution is 0.1. The default value is -60.0.
Description	This command sets the upper limit for the minimum transmit power level measurement. The physical dimension of the parameter value is dBm.
Query	The query form of this command returns the current setting of the Willtek 4400 in form of one floating point real number, contained in a string.
Example	:CALC:EVDO:RFTX:POW:MIN:LIM:UPP -65.0 :CALC:EVDO:RFTX:POW:MIN:Lim:UPP? String returned: "-65.0".

:CALC:EVDO:RFTX:POW:MIN:Lim:LOW [:DATA]

Syntax	:CALCulate:EVDO:RFTX:POW:MIN:Lim:LOW [:DATA] <Real>
Parameters	Real is a floating point real number. Its minimum value is -99.0, the maximum is 36.0, the resolution is 0.1. The default value is -99.0.
Description	This command sets the lower limit for the maximum transmit power level measurement. The physical dimension of the parameter value is dBm.
Query	The query form of this command returns the current setting of the Willtek 4400 in form of one floating point real number, contained in a string.
Example	:CALC:EVDO:RFTX:POW:MAX:LIM:LOW -95.0 :CALC:EVDO:RFTX:POW:MIN:Lim:LOW? String returned: "-95.0".

:CALCulate:EVDO:RFTX:VERRor:PEAK:LIMit [:FAIL]

Syntax	:CALCulate:EVDO:RFTX:VERRor:PEAK:LIMit [:FAIL]?
Parameters	There are no parameters for this command.
Description	This query-only command checks the results of a :MEAS:EVDO:CONT ARR:RFTX:VERR:PEAK measurement against its limits and returns a test verdict.
Query	The query form of this command returns one boolean value (contained in a string), indicating whether the measurement result(s) did violate the corresponding limits (value returned: 1) or not (value returned: 0).
Example	:MEAS:EVDO:ARR:RFTX:VERR:PEAK 20 :CALC:EVDO:RFTX:VERRor:PEAK:LIMit:FAIL? Returns a "1" if any of the 20 measurement results is out of limits.

:CALCulate:EVDO:RFTX:VERRor:PEAK:LIMit:STATe

Syntax	:CALCulate:EVDO:RFTX:VERRor:PEAK:LIMit:STATe <PredefExp>
Parameters	PredefExp is one of the following predefined expressions: ON OFF. Default is ON.
Description	This command switches the check of the measurement result(s) against the user-definable limits either on or off.

Query	There is no query form of this command available.
Example	:CALC:EVDO:RFTX:VERR:PEAK:LIM:STAT OFF Switches the limit check for the peak error vector measurement results off.

:CALCulate:EVDO:RFTX:VERRor:PEAK:LIMit:UPPer[:DATA]

Syntax	:CALCulate:EVDO:RFTX:VERRor:PEAK:LIMit:UPPer[:DATA] <Real>
Parameters	Real is a floating point real number. The minimum value is 0.0, the maximum is 200.0, the resolution is 0.1. The default value is 200.0.
Description	This command sets the upper limit for the peak error vector measurement results. The physical dimension of the parameter value is a percentage.
Query	The query form of this command returns the current setting of the Willtek 4400 in form of one floating point real number, contained in a string.
Example	:CALC:EVDO:RFTX:VERR:PEAK:LIM:UPP 45.0 :CALC:EVDO:RFTX:VERRor:PEAK:LIMit:UPPer:DATA? String returned: "45.0".

:CALCulate:EVDO:RFTX:VERRor:PEAK:LIMit:LOWer[:DATA]

Syntax	:CALCulate:EVDO:RFTX:VERRor:PEAK:LIMit:LOWer[:DATA] <Real>
Parameters	Real is a floating point real number. The minimum value for parameter is 0.0, the maximum is 200.0, the resolution is 0.1. The default value is 0.0.
Description	This command sets the lower limit for the peak error vector measurement results. The physical dimension of the parameter value is a percentage.
Query	The query form of this command returns the current setting of the Willtek 4400 in form of one floating point real number, contained in a string.
Example	:CALC:EVDO:RFTX:VERR:PEAK:LIM:LOW 10.0 :CALC:EVDO:RFTX:VERRor:PEAK:LIMit:LOWer:DATA? String returned: "10.0".

:CALC:EVDO:RFTX:VERRor:MAGNitude:PEAK:LIMit[:FAIL]

Syntax	:CALCulate:EVDO:RFTX:VERRor:MAGNitude:PEAK:LIMit[:FAIL]?
Parameters	There are no parameters for this command.
Description	This query-only command checks the results of a :MEAS:EVDO:CONT ARR:RFTX:VERR:MAGN:PEAK measurement against its limits and returns a test verdict.
Query	The query form of this command returns one boolean value (contained in a string), indicating whether the measurement result(s) did violate the corresponding limits (value returned: 1) or not (value returned: 0).

Example	<pre>:MEAS:EVDO:ARR:RFTX:VERR:MAGN:PEAK 10 :CALC:EVDO:RFTX:VERRor:MAGNitude:PEAK:LIMit:FAIL? Returns a "0" if all measurement results are within their limits.</pre>
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:CALC:EVDO:RFTX:VERRor:MAGNitude:PEAK:LIMit:STATE

Syntax	<pre>:CALCulate:EVDO:RFTX:VERRor:MAGNitude:PEAK:LIMit:STATE <PredefExp></pre>
Parameters	PredefExp is one of the following predefined expressions: ON OFF. Default is ON.
Description	This command switches the check of the measurement result(s) against the user-definable limits either on or off.
Query	There is no query form of this command available.
Example	<pre>:CALC:EVDO:RFTX:VERRor:MAGNitude:PEAK:LIMit:STATE ON Switches on the check of the measurement results against the user-definable limits.</pre>

:CALC:EVDO:RFTX:VERR:MAGN:PEAK:LIMit:UPPer[:DATA]

Syntax	<pre>:CALCulate:EVDO:RFTX:VERRor:MAGNitude:PEAK:LIMit:UPPer [:DATA] <Real></pre>
Parameters	Real is a floating point real number. Its minimum value is 0, the maximum is 200, the resolution is 0.1. The default value is 200.
Description	This command sets the upper limit for the peak measurement results of the vector error's magnitude component in form of a percentage.
Query	The query form of this command returns the current setting of the Willtek 4400 in form of one floating point real number, contained in a string.
Example	<pre>:CALC:EVDO:RFTX:VERR:MAGN:PEAK:LIM:UPP 100.0 :CALC:EVDO:RFTX:VERRor:MAGNitude:PEAK:LIMit:UPPer:DATA? String returned: "100.0".</pre>

:CALC:EVDO:RFTX:VERR:MAGN:PEAK:LIMit:LOWer[:DATA]

Syntax	<pre>:CALCulate:EVDO:RFTX:VERRor:MAGNitude:PEAK:LIMit:LOWer [:DATA] <Real></pre>
Parameters	Real is a floating point real number. Its minimum value is 0, the maximum is 200, the resolution is 0.1. The default value is 0.0.
Description	This command sets the lower limit for the peak measurement results of the vector error's magnitude component in form of a percentage.
Query	The query form of this command returns the current setting of the Willtek 4400 in form of one floating point real number, contained in a string.
Example	<pre>:CALC:EVDO:RFTX:VERR:MAGN:PEAK:LIM:LOW 10 :CALC:EVDO:RFTX:VERRor:MAGNitude:PEAK:LIMit:LOWer:DATA? String returned: "100.0".</pre>

:CALCulate:EVDO:RFTX:VERRor:PHASe:PEAK:LIMit[:FAIL]

Syntax	:CALCulate:EVDO:RFTX:VERRor:PHASe:PEAK:LIMit[:FAIL]?
Parameters	There are no parameters for this command.
Description	This query-only command checks the results of a :MEAS:EVDO:CONT ARR:RFTX:VERR:PHAS:PEAK measurement against its limits and returns a test verdict.
Query	The query form of this command returns one boolean value (contained in a string), indicating whether the measurement result(s) did violate the corresponding limits (value returned: 1) or not (value returned: 0).
Example	:MEAS:EVDO:ARR:RFTX:VERR:PHAS:PEAK 10 :CALC:EVDO:RFTX:VERRor:PHASe:PEAK:LIMit:FAIL? Returns a "0" if all measurement results are within their limits.

:CALCulate:EVDO:RFTX:VERRor:PHASe:PEAK:LIMit:STATe

Syntax	:CALCulate:EVDO:RFTX:VERRor:PHASe:PEAK:LIMit:STATe <PredefExp>
Parameters	PredefExp is one of the following predefined expressions: ON OFF. Default is ON.
Description	This command switches the check of the measurement result(s) against the user-definable limits either on or off.
Query	There is no query form of this command available.
Example	:CALC:EVDO:RFTX:VERRor:PHASe:PEAK:LIMit:STATe ON Switches on the check of the measurement results against the user-definable limits.

:CALC:EVDO:RFTX:VERR:PHASe:PEAK:LIMit:UPPer[:DATA]

Syntax	:CALCulate:EVDO:RFTX:VERRor:PHASe:PEAK:LIMit:UPPer[:DATA] <Real>
Parameters	Real is a floating point real number. Its minimum value is -45.0, the maximum is 45.0, the resolution is 0.01. The default value is 45.
Description	This command sets the upper limit for the peak measurement results of the vector error's phase component in degrees.
Query	The query form of this command returns the current setting of the Willtek 4400 in form of one floating point real number, contained in a string.
Example	:CALC:EVDO:RFTX:VERR:PHAS:PEAK:LIM:UPP 10.0 :CALC:EVDO:RFTX:VERRor:PHASe:PEAK:LIMit:UPPer:DATA? String returned: "10.0".

:CALC:EVDO:RFTX:VERR:PHASe:PEAK:LIMit:LOWer[:DATA]

Syntax	:CALCulate:EVDO:RFTX:VERRor:PHASe:PEAK:LIMit:LOWer[:DATA] <Real>
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Parameters	Real is a floating point real number. Its minimum value is -45.0, the maximum is 45.0, the resolution is 0.01. The default value is 45.0.
Description	This command sets the lower limit for the peak measurement results of the vector error's phase component in degrees.
Query	The query form of this command returns the current setting of the Willtek 4400 in form of one floating point real number, contained in a string.
Example	:CALC:EVDO:RFTX:VERR:PHAS:PEAK:LIM:LOW -10.0 :CALC:EVDO:RFTX:VERRor:PHASe:PEAK:LIMit:LOWer:DATA? String returned: "-10.0".

:CALCulate:EVDO:RFTX:CODEdomain:NOISE:LIMit[:FAIL]

Syntax	:CALCulate:EVDO:RFTX:CODEdomain:NOISE:LIMit[:FAIL]?
Parameters	There are no parameters for this command.
Description	This query-only command checks the results of a code domain power measurement against its limits and returns a test verdict.
Query	The query form of this command returns one boolean value (contained in a string), indicating whether the measurement result(s) did violate the corresponding limits (value returned: 1) or not (value returned: 0).
Example	:MEAS:EVDO:ARR:RFTX:CODE:NOIS 10 :CALC:EVDO:RFTX:CODEdomain:NOISE:LIMit:FAIL? Returns a "0" if all measurement results are within their limits.

:CALCulate:EVDO:RFTX:CODEdomain:NOISE:LIMit:STATE

Syntax	:CALCulate:EVDO:RFTX:CODEdomain:NOISE:LIMit:STATE <PredefExp>
Parameters	PredefExp is one of the following predefined expressions: ON OFF. Default is ON.
Description	This command switches the check of the measurement result(s) against the user-definable limits either on or off.
Query	There is no query form of this command available.
Example	:CALC:EVDO:RFTX:CODE:NOIS:LIM:STAT ON Switches on the check of the measurement results against the user-definable limits.

:CALC:EVDO:RFTX:CODEdomain:NOISE:LIMit:UPPer[:DATA]

Syntax	:CALCulate:EVDO:RFTX:CODEdomain:NOISE:LIMit:UPPer [:DATA] <Real>
Parameters	Real is a floating point real number. Its minimum value is -40.0, the maximum is 0.0, the resolution is 0.1. The default value is -23.0.
Description	This command sets the upper limit for the noise level in inactive code channels (i.e. the noise threshold). The physical dimension of the parameter value is dB (relative to the power level of the active code channels).

Query	The query form of this command returns the current setting of the Willtek 4400 in form of one floating point real number, contained in a string.
Example	:CALC:EVDO:RFTX:CODE:NOIS:LIM:UPP -18.0 :CALC:EVDO:RFTX:CODEdomain:NOISe:LIMit:UPPer:DATA? String returned: "-18.0".

:CALC:EVDO:RFTX:CODEdomain:NOISe:LIMit:LOWer[:DATA]

Syntax	:CALCulate:EVDO:RFTX:CODEdomain:NOISe:LIMit:LOWer [:DATA] <Real>
Parameters	Real is a floating point real number. Its minimum value is -40.0, the maximum is 0.0, the resolution is 0.1. The default value is -40.0.
Description	This command sets the lower limit for the noise level in inactive code channels. The physical dimension of the parameter value is dB (relative to the power level of the active code channels).
Query	The query form of this command returns the current setting of the Willtek 4400 in form of one floating point real number, contained in a string.
Example	:CALC:EVDO:RFTX:CODE:NOIS:LIM:LOW -35.7 :CALC:EVDO:RFTX:CODEdomain:NOISe:LIMit:LOWer:DATA? String returned: "-35.7".

RFGenerator subsystem

The RFG subsystem controls the accessible parameters of the RF generator.

Important notes:

- The RF generator can only be used if all communication systems have been switched off (and unloaded) before.
- The RF generator functionality of the 4400 will enable you to provide a base channel to allow the mobile under test to synchronize to the base station. However, as long as the RF generator is active, there will be **no call setup and no reaction to signaling**.
Some of the data transmitted by the 4400 in the base channel can be set or altered using the SCPI commands described in section "[CONFigure subsystem](#)" on page 296.
- The RF generator and analyzer are enabled using the appropriate `:CONFigure:CSYSem` command.

:RFGenerator:EVDO:STATE

Syntax	<code>:RFGenerator:EVDO:STATE <PredefExp></code>
Parameters	PredefExp is one of the following predefined expressions: ON OFF. The default is OFF.
Description	Switches the RF generator on or off. The Willtek 4400 may be used as RF signal generator for all kinds of RF and EVDO signals. Note: While the RF generator of the Willtek 4400 is active, there is no signaling available. This means that the Willtek 4400 does not respond to any signaling messages sent by the mobile nor does the test set expect the mobile under test to react in any way.
Query	The query form of this command returns the current setting of the Willtek 4400 in the form of one of the predefined expressions explained above, contained in a string.
Example	<code>:RFGenerator:EVDO:STATE ON</code> <code>:RFG:EVDO:STAT?</code> String returned: "ON".

:RFGenerator:EVDO:LEVel

Syntax	<code>:RFGenerator:EVDO:LEVel <Real></code>
Parameters	Real is a floating point real number. The minimum value is -120.0, the maximum value is 0.0, the resolution is 0.1. The default value is -70.0.
Description	This command sets the RF generator's output power level (RF in/out socket). The physical dimension of the parameter value is dBm.
Query	The query form of this command returns the current setting of the Willtek 4400 in the form of one floating point real number, contained in a string.
Example	<code>:RFGenerator:EVDO:LEVel -50.5</code> <code>:RFG:EVDO:LEV?</code> String returned: "-50.5".

:RFGenerator:EVDO:FREQuency

Syntax	:RFGenerator:EVDO:FREQuency <Real>
Parameters	Real is a floating point real number. The minimum value is 430,000,000, the maximum value is 2,300,000,000, the resolution is 10. The default value is 800,000,000.
Description	This command sets the RF generator's frequency. The physical dimension of the parameter value is Hz.
Query	The query form of this command returns the current setting of the Willtek 4400 in the form of one floating point real number, contained in a string
Example	:RFGenerator:EVDO:FREQuency 880200010 :RFG:EVDO:FREQ? String returned: "880200010".

:RFGenerator:EVDO:MODulation

Syntax	:RFGenerator:EVDO:MODulation <PredefExp>
Parameters	PredefExp is one of the following predefined expressions: NONE CDMA. The default is NONE.
Description	This command selects the type of modulation to be used on the RF output signal. <ul style="list-style-type: none"> - NONE means that the RF output signal will be not be modulated (unmodulated carrier). - CDMA means that the RF output signal will be CDMA modulated.
Query	The query form of this command returns the current setting of the Willtek 4400 in the form of one of the predefined expressions explained above, contained in a string.
Example	:RFGenerator:EVDO:MODulation NONE :RFG:EVDO:MOD? String returned: "NONE".

:RFGenerator:EVDO:BS:CCH:ARFCn

Syntax	:RFGenerator:EVDO:BS:CCH:ARFCn <Int>, [<PredefExp>]
Parameters	Int is an integer number. The minimum value is 0, the maximum is 2047. The default value is 29. PredefExp is an optional predefined expression which can take on one of the following values: US800 USPCS TACS JTACS KPCS NMT450 IMT2000 MHZ900 MHZ1800 SEC800 PAMR400 PAMR800. The default is US800.
Description	This command sets RF generator's frequency by frequency band and corresponding channel number. The Willtek 4400 will automatically calculate the corresponding RF frequency from the parameter values specified.
Query	The query form of this command returns the currently set channel number and the related frequency band, both contained in a string and separated by commas.
Example	RFG:EVDO:BS:CCH:ARFC 0,US800 RFGenerator:EVDO:BS:CCH:ARFCn? String returned: "0,US800"

RFANalyser subsystem

The RFAN subsystem controls the accessible parameters of the RF analyzer.

:RFANalyser:EVDO:BS:CCH:ARFCn

Syntax	:RFANalyser:EVDO:BS:CCH:ARFCn <Int>, [<PredefExp>]
Parameters	Int is an integer number. The minimum value is 0, the maximum is 2047. The default value is 29. PredefExp is an optional predefined expression which can take on one of the following values: US800 USPCS TACS JTACS KPCS NMT450 IMT2000 MHZ900 MHZ1800 SEC800 PAMR400 PAMR800. The default is US800.
Description	This command sets the RF analyzer's center frequency by frequency band and corresponding channel number. The Willtek 4400 will automatically calculate the corresponding RF frequency from the parameter values specified.
Query	The query form of this command returns the currently set channel number and the related frequency band, both contained in a string and separated by commas.
Example	RFAN:EVDO:BS:CCH:ARFC 0,US800 :RFANalyser:EVDO:BS:CCH:ARFCn? String returned: "0,US800"

:RFANalyser:EVDO:FREQuency

Syntax	:RFANalyser:EVDO:FREQuency <Real>
Parameters	Real is a floating point real number. The minimum value is 430,000,000, the maximum is 2,300,000,000, the resolution is 10. The default value is 800,000,000.
Description	This command sets the RF analyzer's center frequency. The physical dimension of the parameter value is Hz.
Query	The query form of this command returns one floating point real number contained in a string, representing the currently set analyzer center frequency in Hertz.
Example	:RFANalyser:EVDO:FREQuency 880200000 :RFAN:EVDO:FREQ? String returned: "880200000".

:RFANalyser:EVDO:LCMask:ATI

Syntax	:RFANalyser:EVDO:LCMask:ATI <String>
Parameters	String is a text, representing a 32-bit value in the form of up to eight hexadecimal symbols (0 to 9, A to F a to f).
Description	This command sets the access terminal identifier (ATI) used by the mobile. This parameter is required by the Willtek 4400 in order to perform waveform quality measurements.
Query	The query form of this command returns a string, containing a maximum of eight hexadecimal symbols. This string represents the ATI currently set on the Willtek 4400.

Example	<pre>:RFANalyser:EVDO:LCMask:ATI 2468ACEF :RFAN:EVDO:ELCM:ATI? String returned: "2468ACEF".</pre>
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:RFANalyser:EVDO:REVerse:DRATe

Syntax	<pre>:RFANalyser:EVDO:REVerse:DRATe <PredefExp></pre>
Parameters	PredefExp is one of the following predefined expressions: BPSK9 BPSK19 BPSK38 BPSK76 BPSK153 QPSK230 QPSK307 QPSK460 QPSK614 QPSK921 QPSK1228 EPSK1843. Default is BPSK9.
Description	This command sets the (reverse) data rate and modulation type as used by the mobile under test to transmit data. The RF analyzer needs to know these settings in order to correctly decode the data received.
Query	The query form of this command returns one of the predefined expressions as explained above, contained in a string and representing the Willtek 4400's current setting.
Example	<pre>:RFANalyser:EVDO:REVerse:DRATe BPSK76 :RFAN:EVDO:REV:DRAT? String returned: "BPSK76".</pre>

RFSPpectrum subsystem

The RFSP subsystem controls the accessible parameters of the RF modulation spectrum analyzer.

:RFSPpectrum:EVDO:MSpectrum:SPAN

Syntax	:RFSPpectrum:EVDO:MSpectrum:SPAN <PredefExp>
Parameters	PredefExp is one of the following predefined expressions: SP500 SP2500. Default is SP2500.
Description	This command sets the span (i.e. the spectral bandwidth) of the modulation spectrum analyzer. <ul style="list-style-type: none"> - SP500 sets a span of 500 kHz, - SP2500 sets a span of 2.5 MHz.
Query	The query form of this command returns one of the predefined expressions explained above contained in a string, representing the current setting of the Willtek 4400.
Example	:RFSPpectrum:EVDO:MSpectrum:SPAN SP500 :RFSP:EVDO:MSP:SPAN? String returned: "SP500".

:RFSPpectrum:EVDO:MSpectrum:RESolution

Syntax	:RFSPpectrum:EVDO:MSpectrum:RESolution <PredefExp>
Parameters	PredefExp is one of the following predefined expressions: RES15 RES30. Default is RES30.
Description	This command sets the spectral resolution of the modulation spectrum analyzer. RES15 sets a resolution of 15 kHz, RES30 sets a resolution of 30 kHz.
Query	The query form of this command returns one of the predefined expressions explained above contained in a string, representing the current setting of the Willtek 4400.
Example	:RFSPpectrum:EVDO:MSpectrum:RESolution RES15 :RFSP:EVDO:MSP:RES? String returned: "RES15".

AFGenerator subsystem

The AFG subsystem controls the accessible parameters of the audio generator. Please note that all commands of this subsystem require the Audio Option to be installed on your 4400.

:AFGenerator:STATe

Syntax	:AFGenerator:STATe <PredefExp>
Parameters	PredefExp is one of the following predefined expressions: ON OFF . Default is OFF .
Description	Switches the AF (audio frequency) generator on or off. Note: This command requires the Audio Option to be installed on your Willtek 4400.
Query	The query form of this command returns the current setting. A query will return a string, containing one of the predefined expressions explained above.
Example	:AFGenerator:STATe ON :AFG:STAT? Value returned: "ON".

:AFGenerator:MODE

Syntax	:AFGenerator:MODE <PredefExp>
Parameters	PredefExp is one of the following predefined expressions: SINGLE REPLay . Default is SINGLE .
Description	This command sets the AF generator either to SINGLE tone generator mode or to wave file REPLay generator.
Query	The query form of this command returns the current setting. A query will return a string containing the short-form version of one of the predefined expressions explained above.
Example	:AFGenerator:MODE REPLay :AFG:MODE? Value returned: "REPL".

:AFGenerator:OUTPut

Syntax	:AFGenerator:OUTPut <PredefExp>
Parameters	PredefExp is one of the following predefined expressions: AF . Default is AF .
Description	This command routes the signal of the AF generator. AF means that the generator's signal will be available at the AF out connector, located on the front panel of the Willtek 4400. Notes <ul style="list-style-type: none"> - RF cannot be signal source and generator destination the same time. Please check the current setting of the AFG:OUTP command before issuing the AFAN:INP COD command and vice versa to avoid measurement conflicts. -
Query	The query form of this command returns the current setting. A query will return a string, containing the short-form version of one of the predefined expressions explained above.

Example	<code>:AFGenerator:OUTPut AF</code> <code>:AFG:OUTP? Value returned: "AF".</code>
----------------	--

:AFGenerator:LEVel[:RELative]:AF

Syntax	<code>:AFGenerator:LEVel[:RELative]:AF <real1></code>
Parameters	real1 is a floating point real number. The minimum value for real1 is 0.000 , the maximum value is 4.000 . The resolution for real1 is 0.001 . The default value for real1 is 0.000 .
Description	This command sets the output voltage of the signals, available at the "AF out" connector, located on the front panel of the Willtek 4400. The value specified for real1 is the peak voltage of the AF signal. Notes <ul style="list-style-type: none"> - This command will only have an effect when AF has been selected as the output with the AFG:OUTP command explained above. - The maximum output voltage for sinusoidal signals is 4 V (rms) (that is equivalent to 5.6 V peak).
Query	The query form of this command will return the current setting. The string delivered back will contain one floating point real number.
Example	<code>:AFGenerator:LEVel[:RELative]:AF 2.5</code> <code>:AFG:LEV:AF? Value returned in this example: "2.5".</code>

:AFGenerator:SINGLE:FREQuency

Syntax	<code>:AFGenerator:SINGLE:FREQuency <real1></code>
Parameters	real1 is a floating point real number. The minimum value for real1 is 20.0 , the maximum value is 20000.0 . The minimum resolution for real1 is 0.1 . The default value for real1 is 1000.0 .
Description	This command sets the frequency of the AF generator as long as it is run in single-tone generation mode. The physical dimension of real1 is Hertz. Note: Please refer to the description of the :AFG:MODE command for further details regarding the single-tone generation mode.
Query	The query form of this command will return the current setting. The string delivered back will contain one floating point real number.
Example	<code>:AFGenerator:SINGLE:FREQuency 2500</code> <code>:AFG:SING:FREQ? Value returned: "2500.0".</code>

:AFGenerator:SINGLE:SHAPE

Syntax	<code>:AFGenerator:SINGLE:SHAPE <PredefExp></code>
Parameters	PredefExp is one of the following predefined expressions: SINE RECTangle TRIangle POSitive NEGativep . Default is SINE .

Description	Sets the waveform of the AF signal to be generated. SINE selects a sine wave, while RECTangle will generate a rectangular waveform. TRIangle selects a triangular waveform. POSitivep will generate a sawtooth with a rising (positive) slope, while NEGativep switches to a sawtooth with a falling (negative) slope. Note: This command will only work in single-tone generation mode. Please refer to the description of the :AFG:MODE command for further details regarding the single-tone generation mode.
Query	The query form of this command returns the current setting. A query will return a string, containing the short-form version of one of the predefined expressions explained above.
Example	:AFGenerator:SINGLE:SHAPE TRIangular :AFG:SING:SHAP? Value returned: "TRI".

:AFGenerator:AUXout:STATE

Syntax	:AFGenerator:AUXout:STATE <PredefExp>
Parameters	PredefExp is one of the following predefined expressions: ON OFF . Default is OFF .
Description	Switches the routing of AF signals to the "AUX 3" of the Willtek 4400 either on or off. The source of the signal to be output to the auxiliary output connector can be selected using the :AFG:SPEA:SOUR command as described below.
Query	The query form of this command returns the current setting. A query will return a string containing one of the predefined expressions explained above.
Example	:AFGenerator:AUXout:STATE ON :AFG:AUXout:STAT? Value returned: "ON".

:AFGenerator:AUXout:SOURce

Syntax	:AFGenerator:AUXout:SOURce <PredefExp>
Parameters	PredefExp is one of the following predefined expressions: AFIN AFOUt . Default is AFIN .
Description	This command routes signals coming from a selectable source to the "AUX 3" of the Willtek 4400. AFIN means that the signal applied to the Willtek 4400 AF in connector will be made available at the auxiliary output connector, while AFOUt will route the signals from the AF out connector to AUX out. Notes <ul style="list-style-type: none"> – For further details regarding the connectors of the Willtek 4400, please refer to section "Connectors" on page 9. – Please note that the auxiliary output needs to be switched on first (see command AFG:SPEA:STAT above for details).
Query	The query form of this command returns the current setting. A query will return a string, containing the short-form version of one of the predefined expressions explained above.
Example	:AFGenerator:AUXout:SOURce AFOUt :AFG:SPE:SOUR? Value returned: "AFOU".

:AFGenerator:AUXout:VOLume

Syntax	<code>:AFGenerator:AUXout:VOLume <int1></code>
Parameters	int1 is an integer. The minimum value for int1 is 0, the maximum value is 100. The default value for int1 is 0.
Description	This command sets the output volume of the external speaker connected to the Willtek 4400 using the "AUX 3". int1 represents a relative volume in percentages of the maximum volume.
Query	The query form of this command will return the current setting. The string delivered back will contain one integer.
Example	:AFGenerator:AUXout:VOLume 20 :AFG:SPE:VOL? Value returned: "20". This means that the volume at the auxiliary output is at 20% of its maximum.

AFANalyser subsystem

The AFAN subsystem controls the accessible parameters of the AF analyzer. Please note that all commands of this subsystem require the Audio Option to be installed on your 4400.

:AFANalyser:INPut

Syntax	<code>:AFANalyser:INPut <PredefExp></code>
Parameters	PredefExp is one of the following predefined expressions: AF AUXin . Default is AF .
Description	Selects the input signal for the AF analyzer of the Willtek 4400. AF means that the signals applied to the test set's "AF in" connector will be forwarded to the AF analyzer, while AUXin means that the signals applied to the test set's AUX in input will be forwarded to the AF analyzer. The AUX in input is available on the AUX 4 connector on the back panel of the Willtek 4400 (RF section). Notes <ul style="list-style-type: none">- This command requires the Audio Option to be installed on your Willtek 4400.- The codec is an option to the Willtek 4400. For details, please refer to section "Accessories and options" on page 29.- Input voltage limitations apply on the AF in and the AUX in connectors of the Willtek 4400. Please refer to section "Connectors" on page 9 for details.
Query	The query form of this command returns the current setting. A query will return a string, containing the short-form version of one of the predefined expressions explained above.
Example	<code>:AFANalyser:INPut AUXin</code> <code>:AFAN:INP?</code> Value returned: "AUX".

:AFANalyser:SAMPlerate

Syntax	<code>:AFANalyser:SAMPlerate <PredefExp></code>
Parameters	PredefExp is one of the following predefined expressions: KHZ8 KHZ11 KHZ22 KHZ33 KHZ44 KHZ48 . Default is KHZ48 .
Description	Selects the fixed sampling rate for the AF analyzer's input signals. KHZ8 means a sampling rate of 8 kHz, KHZ11 a sampling rate of 11 kHz, KHZ22 a sampling rate of 22 kHz, KHZ33 a sampling rate of 33 kHz, KHZ44 a sampling rate of 44.1 kHz, while KHZ48 stands for a sampling rate of 48 kHz.
Query	The query form of this command returns the current setting. A query will return a string, containing one of the predefined expressions explained above.
Example	<code>:AFANalyser:SAMPlerate KHZ22</code> <code>:AFAN:SAMP?</code> Value returned: "KHZ22". This means a fixed sampling rate of 22 kHz.

:AFANalyser:COUPLing

Syntax	:AFANalyser:COUPLing <PredefExp>
Parameters	PredefExp is one of the following predefined expressions: AC DC DCLP . Default is AC .
Description	This command allows to select between AC and DC measurements of the audio signal applied to the "AF in" connector of the Willtek 4400. If AC is selected, the audio analyzer measures the AC signal only, i.e. any DC component in the signal is filtered out before the measurement. With the DC setting, the signal is measured directly, including any AC and DC components. If DCLP is chosen, the AC components will be filtered out and the Willtek 4400 only measures the DC component of the signal.
Query	The query form of this command returns the current setting. A query will return a string, containing one of the predefined expressions explained above.
Example	:AFANalyser:COUPLING DC :AFAN:COUP? Value returned: " DC ".

:AFANalyser:BALEnced

Syntax	:AFANalyser:BALEnced <PredefExp>
Parameters	PredefExp is one of the following predefined expressions: ON OFF . Default is OFF .
Description	Selects whether "AF in" shall be used as an unbalanced input (setting OFF) or as a balanced input (setting ON). Note: While a balanced signal requires a differential amplifier as an input stage, an unbalanced input doesn't. Balanced signal transmission usually is substantially less sensitive to electromagnetic interference.
Query	The query form of this command returns the current setting. A query will return a string, containing one of the predefined expressions explained above.
Example	:AFANalyser:BALEnced OFF :AFAN:BALE? Value returned: " OFF ". This means that the AF in socket will be used as a standard input for 'grounded' signals.

:AFANalyser:VRANge

Syntax	:AFANalyser:VRANge <PredefExp>
Parameters	PredefExp is one of the following predefined expressions: AUTO V30 V3 MV300 MV30 . Default is AUTO .

Description	<p>This command sets the range of the expected input voltage on the Willtek 4400 "AF in" connector.</p> <p>AUTO means that the Willtek 4400 will take sample measurements first and then – based on these measurement results – will decide automatically which setting to use.</p> <p>V30 means that an input voltage of up to 30 volts (rms) is expected and that the resolution of the signal measured will be 100 mV.</p> <p>V3 means that an input voltage of up to 3 volts (rms) is expected and that the resolution of the signal measured will be 10 mV.</p> <p>MV300 expects a maximum input voltage of 300 mV (rms) and delivers a resolution of 1 mV, while</p> <p>MV30 means that the maximum input voltage will be 30 mV (rms) and the resolution will be 100 µV.</p> <p>Notes</p> <ul style="list-style-type: none"> – The better the current input voltage corresponds to the range setting performed with this command, the more precise the measurement results will be. – Whenever fast availability of measurement results is an issue, AUTO ranging should be avoided as it is time-consuming.
Query	The query form of this command returns the current setting. A query will return a string, containing one of the predefined expressions as explained above.
Example	<pre>:AFANalyser:VRANge V30 :AFAN:VRAN? Value returned: "V30".</pre>

:AFANalyser:MRANge

Syntax	:AFANalyser:MRANge <PredefExp>
Parameters	PredefExp is one of the following predefined expressions: AUTO V1 MV100 . Default is AUTO .
Description	<p>This command sets the range of the expected input voltage on the Willtek 4400 "AUX 4 (AUX in)" connector.</p> <p>AUTO means that the Willtek 4400 will take sample measurements first and then – based on these measurement results – will decide automatically which setting to use.</p> <p>V1 means that an input voltage of up to 1 Volt (rms) is expected and that the resolution will be 1 mV.</p> <p>MV100 expects a maximum input voltage of 100 mV (rms) and delivers a resolution of 100 µV.</p> <p>Notes</p> <ul style="list-style-type: none"> – The better the current input voltage corresponds to the range setting performed with this command, the more precise the measurement results will be. – Whenever fast availability of measurement results is an issue, AUTO ranging should be avoided as it is time-consuming.
Query	The query form of this command returns the current setting. A query will return a string, containing one of the predefined expressions as explained above.
Example	<pre>:AFANalyser:MRANge MV100 :AFAN:MRAN? Value returned: "MV100".</pre>

:AFANalyser:FILTer

Syntax	:AFANalyser:FILTer <PredefExp>
Parameters	PredefExp is one of the following predefined expressions: NONE CCITt CMESsage . Default is NONE .

Description	Selects the type of filter to be inserted between the signal input and the AF analyzer. NONE means that there will be no filtering. CCITT selects a speech filter as defined by CCITT regulations. CMESsage is a speech filter according to US standards.
Query	The query form of this command returns the current setting. A query will return a string, containing the short-form version of one of the predefined expressions explained above.
Example	:AFANalyser:FILTer NONE :AFAN:FILT? Value returned: "NONE" .

:AFANalyser:SPECTrum:RLEVel

Syntax	:AFANalyser:SPECTrum:RLEVel <real1>
Parameters	real1 is a floating point real number. The minimum value for real1 is 0.001 , the maximum value is 30.0 . The minimum resolution for real1 is 0.001 . The default value for real1 is 1.0 .
Description	This command sets the level of the reference voltage (i.e. the 0 dB line of the AF spectrum display). The physical unit of real1 is volt if the signal source is AF in . Notes <ul style="list-style-type: none"> - When the signal source is RF in, the 0 dB line is interpreted as full scale. - A typical audio standard is 0.775 volts for 0 dB.
Query	The query form of this command will return the current setting. The string delivered back will contain one floating point real number.
Example	:AFANalyser:SPECTrum:RLEVel 13.0 :AFAN:SPEC:RLEV? Value returned: "13.0" .

MS Power Supply subsystem

The PSUPply subsystem controls the accessible parameters of the MS Power Supply Option.

:PSUPply:STATe

Syntax	<code>:PSUPply:STATe <PredefExp></code>
Parameters	PredefExp is one of the following predefined expressions: ON OFF . Default is OFF .
Description	Switches the output of the power supply option of the Willtek 4400 either on or off. Please note that this command needs the power supply option to be installed on your Willtek 4400. Details regarding this option can be found in section " Accessories and options " on page 29.
Query	The query form of this command returns the current setting. A query will return a string, containing one of the predefined expressions explained above.
Example	<code>:PSUPply:STATe ON</code> <code>:PSUP:STAT?</code> Value returned: "ON" .

:PSUPply:LEVEl

Syntax	<code>:PSUPply:LEVEl <real1></code>
Parameters	real1 is a floating point real number. The minimum value for real1 is 0.0 , the maximum value is 10.0 . The minimum resolution for real1 is 0.05 . The default value for real1 is 0.0 .
Description	This command sets the output voltage of the optional power supply. The value specified for real1 is the output voltage in volt. Please note that this command needs the power supply option to be installed on your Willtek 4400. Details regarding this option can be found in section " Accessories and options " on page 29.
Query	The query form of this command returns the current setting. The query will return a string, containing one floating point real number.
Example	<code>:PSUPply:LEVEl 3.65</code> <code>:PSUP:LEV?</code> Value returned: "3.65" .

:PSUPply:MEASure:CMAX

Syntax	<code>:PSUPply:MEASure:CMAX <PredefExp></code>
Parameters	PredefExp is one of the following predefined expressions: A4 A2 A1 MA400 . Default is A4 .

Description	<p>Selects the range of the maximum current the mobile under test is expected to draw. For a maximum current of up to 400 mA, the MA400 setting can be used. If the mobile will not draw more than 400 mA, the MA400 setting is appropriate. In case the maximum power requirement of the mobile is unknown, setting A4 (the default setting) is recommended as it will allow the mobile to draw a maximum current of 4 A.</p> <p>Please note that this command needs both the power supply option and the current measurement option to be installed on your Willtek 4400. Details regarding these options can be found in section "Accessories and options" on page 29.</p>
Query	<p>The query form of this command returns the current setting. A query will return a string, containing one of the predefined expressions explained above.</p>
Example	<pre>:PSUPply:MEASure:CMAX MA400 :PSUP:MEAS:CMAX? Value returned: "MA400".</pre>

Warranty and Repair

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This chapter describes the customer services available through Willtek. Topics discussed in this chapter include the following:

- ["Warranty information" on page 432](#)
- ["Equipment return instructions" on page 433](#)

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.

Publication History

Revision	Comment
0702-122-A	First revision, for software version 12.20.

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