4400
Mobile Phone Tester Series

Highlights

• All major mobile communication standards
• Remote control through GPIB, LAN, USB
• Options for DC power supply and DC current measurements
• Parallel testing of TX, RX and Audio

Figure 1: 4403 Mobile Phone Tester – the ideal tool for service centres and the repair loop in production

The 4400 Mobile Phone Tester Series is a leading-edge product and a good example of Aeroflex's expertise in RF test and measurement. The instruments of the 4400 Series have been designed to meet the needs of manufacturing, quality assurance, and engineering facilities as well as the requirements in service factories and repair sites. Aeroflex fulfills these requirements with two different versions of the 4400; the 4403 for service applications and the 4405 for the production environment.

Unless indicated otherwise, all information in this data sheet relates to both the 4403 and the 4405 Mobile Phone Testers.

Improving Manufacturing Throughput

In manufacturing and production, accuracy is a key factor. Therefore the 4405 Mobile Phone Tester provides exceptional precision, see for example the Voltage Standing Wave Ratio (VSWR). In addition to this outstanding accuracy, the 4405 offers high measurement speed and stability, which makes the 4405 the first choice for production and manufacturing.

With the remote control possibility via the IEEE/IEC bus (GPIB), the 4400 will be easily integrated in every production line. Aeroflex's experienced support personnel helps manufacturers all over the world to integrate the 4400 into new and existing production lines.

Mobile Phone Repair from Incoming Inspection to Calibration and Alignment

Measurement speed and accuracy of the 4403 Mobile Phone Tester fulfill the needs of the service environment to calibrate and align a mobile phone and then perform a final test. These final tests are different and predefined by major mobile phone manufacturers, and the 4400 Series has been approved for service by all of them.

Today the 4403 Mobile Phone Tester supports and provides solutions for all major mobile communication technologies.

With its user-friendly menu concept and graphical user interface, the 4403 provides quick access to all the measurements and their results. The menus are easy to read and follow the same concept across all standards to keep training time to a minimum.
Measurements cannot only be performed in manual mode but also under remote control. The 7310 Lector and Scriptor family of test automation programs facilitates easy-to-use tests; these are started with very few mouse clicks and return a simple Pass or Fail verdict along with more technical details. See the Lector and Scriptor info sheet for more details.

The 4400 Series is approved for service by major mobile phone vendors. These provide special software to align and calibrate the phone. In most cases the vendors adapt their control software to the 4400, making use of the remote control capabilities of Aeroflex’s testers.

Research and Development
Engineering and R&D facilities such as design houses require measurement equipment which is easy to use, and which provides high accuracy. With the 4400 Mobile Phone Tester Series, Aeroflex offers two instruments with the same functionality but different performance, leaving the choice of accuracy to the customer.

SPECIFICATION
Specifications valid after 60 minutes warm-up time at ambient temperature, specified environmental conditions and typical measurement range, within a period of one year after calibration.

The published accuracies are determined in accordance with GUM (Guide to the Expression of Uncertainty in Measurement) and EA (European Co-operation for Accreditation) application document EA4/02: "Expressions of the Uncertainty of Measurements in Calibration".

BASIC RF DATA
Two independent synthesizers for RX and TX measurements.

<table>
<thead>
<tr>
<th>Frequency Range</th>
<th>430 to 500 MHz(2)</th>
<th>800 to 1000 MHz</th>
<th>1700 to 2300 MHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Additional frequency range with the 1209 Downconverter(2)</td>
<td>529.6 to 729.6 MHz</td>
<td>600.0 to 800.0 MHz</td>
<td>1564.8 to 1764.8 MHz</td>
</tr>
<tr>
<td>2329.6 to 2529.6 MHz</td>
<td>2400.0 to 2600.0 MHz</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Frequency Resolution**
10 Hz

**Frequency and Level Settling Time**
350 ms

**RF In/Out**
N-type female connector

**Input/output Impedance**
50 Ω

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VSWR
4403 1.2
4405 1.15(3), 1.2

**Attenuation of Harmonics up to 4 GHz (f0 = 800 to 1000 and 1700 to 2000 MHz)**
>40 dB

**Attenuation of Non-Harmonics up to 4 GHz at > 5 kHz from Carrier**
>43 dB

TCXO FREQUENCY BASE

<table>
<thead>
<tr>
<th>Temperature Characteristic</th>
<th>$1 \times 10^{-6}$ max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aging Characteristic</td>
<td>$1 \times 10^{-6}$ max./year (at $+25\degree C \pm 2\degree C$)</td>
</tr>
</tbody>
</table>

OCXO FREQUENCY BASE (OPTION)

<table>
<thead>
<tr>
<th>Temperature Characteristic</th>
<th>$5 \times 10^{-8}$ max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aging Characteristic</td>
<td>$1 \times 10^{-7}$ max./year</td>
</tr>
</tbody>
</table>

EXTERNAL SYNCHRONIZATION INPUT

<table>
<thead>
<tr>
<th>Input level</th>
<th>0 to +15 dBm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impedance</td>
<td>50 Ω</td>
</tr>
<tr>
<td>Frequency</td>
<td>5, 10, 13 MHz (autodetection)</td>
</tr>
</tbody>
</table>

GENERAL DATA

**Control Interfaces**
IEEE 488.2 (GPIB)
LAN (RJ-45, TCP/IP)
USB type A (two on the front, two on the back, for USB flash drive, keyboard and mouse connection)
USB type B, for remote control
VGA

**Mains Power Supply**
94 to 132 V AC
187 to 264 V AC

**Power Consumption**
Max. 140 W

**Operating Temperature**
+5°C up to +45°C

**Relative Humidity**
<80%

**H x W x L**
202 x 401 x 431 mm (8 x 15.8 x 17”)

**Weight**
10.5 kg (without options) (23 lbs.)

Delivery Includes
Mains cable
USB memory stick
Getting started guide
User’s guides (CD)
Calibration report
RAPID!

Application programming environment

RAPID! = Run Application Programs with Integrated Development environment.

RAPID!

Programming language (a modern structured BASIC dialect)

Programming environment

Input/Output Control from RAPID! Programs

GPIB

RS-232

Parallel port (printer)

Floppy and hard disk access

Screen (text-based)

Keyboard, incl. bar code reader support

Elements for Structured Programming

Global and local variables

Functions, subroutines

Libraries

Elements for Event-Driven Programming

Keyboard events

SCPI events

External interface events

Other Programming Features

Direct access to SCPI command set, to control the 4400 and collect measurement results for postprocessing

Information hiding (program files can be protected against reading by the user)

Scripting (to create or change mobile tests easily and efficiently)

Functions of Built-In Programming Environment

File manager

Editor (multiple files)

Runtime I/O screen

Debug screen, display of variables contents

Figure 2: The 1209 Downconverter is an optional frequency extension for Bluetooth, WLAN, GPS tests and Mobile TV standards.

GENERAL OPTIONS

Aeroflex provides additional options for the 4400 Mobile Phone Tester Series, facilitating tests of a mobile phone under various conditions or against special requirements.

4470 Audio Option, 4471 Basic Codec Option and 4472 Codec Extension Option

With Aeroflex's 4400 Series and the Audio and Codec options, Aeroflex provides complete testing solutions for mobile phones.

The Audio and Codec Options for the Aeroflex 4400 Series help to measure and test the audio capabilities of the mobile phone, ensuring its high quality. These options have been designed for the particular needs of R&D, production, repair/service and quality assurance.

The options can be easily integrated in the Aeroflex 4400 Mobile Phone Tester, resulting in a compact RF and AF test system.

Audio

The Audio Option can test and evaluate the individual audio components or the complete audio path of the mobile. There are different ways to stimulate the mobile phone and to verify the audio quality.

The generated signal can be fed into a loudspeaker to stimulate the microphone; it can also stimulate the mobile at the headset input. Using the codec options, you can transmit voice signals even over the GSM traffic channel.

The audio signal from the mobile can be evaluated using either the basic audio analyzer or the unique audio spectrum analyzer. A high impedance AF input, an auxiliary input for the microphone and the traffic channel (using the additional codec options) can be used as sources for the analysis.

GSM Codecs

There are two different codec options for GSM available: the 4471 Basic Codec Option for Full Rate (FR) speech and the 4472 Codec Extension Option for Enhanced Full Rate (EFR). These codecs supplement the audio measurements, allowing audio signals to be generated and tested via the air interface.
**4481 AM Signal Generator Option**

The AM Signal Generator allows the tuning of certain phones in asynchronous (or non-call) mode. The modulation index and the modulation signal can be varied to support some vendor-specific AM suppression measurements.

**4473 MS Power Supply Option**

In production lines and service centres, mobile phone testing is usually conducted using an external power supply. Now, Aeroflex helps mobile manufacturers and service factories optimise their workspace, instrument control and budget by integrating the power supply into the Aeroflex 4400 Series.

Aeroflex’s MS Power Supply Option enhances the functionality of the 4400 Mobile Phone Tester Series by enabling engineers to eliminate the external power supply. With this easy-to-use add-on, the revolutionary 4400 supplies the mobile with DC power and tests RF and audio, all from one instrument.

The option was developed in consultation with mobile phone manufacturers and service centres with the aim of improving mobile phone testing processes and environments.

This innovative testing option provides a number of benefits:

- Easier programming - The option employs remote control and RAPID! integration based on SCPI and 4400 standards.

- Streamlined troubleshooting - Quick separation of handset and power supply problems ensures faster problem resolution.

- Minimize space and cost
  The MS Power Supply Option not only reduces installation and maintenance costs but also saves money over time by reducing the number of devices manufacturers and service centers need to hold. The option’s simple-to-interpret graphical user interface, which reduces both the need for training and the time taken on each test, further enhances the cost savings.

- Multiple, simultaneous testing capabilities
  The MS Power Supply Option can support GPRS applications because it is able to feed currents for the transmission of at least two time slots per frame. The number of time slots is limited only by the current level in transmit mode.

- One-box solution
  The MS Power Supply Option is shipped with a one-meter cable, designed to plug simply and easily into the power supply socket on the front panel of your 4400. The open-ended termination on this cable provides free adaptation into an existing test system.

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**SPECIFICATIONS**

**OUTPUT VOLTAGE**

<table>
<thead>
<tr>
<th>Range</th>
<th>0 to 10 V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resolution</td>
<td>50 mV</td>
</tr>
<tr>
<td>Accuracy (with constant current)</td>
<td>±20 mV</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Maximum Output Current</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuous (&lt;4 V)</td>
</tr>
<tr>
<td>Continuous (≥4 V)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Peak (&lt;1 ms, &lt;4 V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 A</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Peak (&lt;1 ms, ≥4 V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 A</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ripple Noise (peak-to-peak)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 mV/A</td>
</tr>
</tbody>
</table>

**Proof Against Permanent Short-Circuit**

Scope of supply

A power supply connection cable of one meter length with open ends for free adaptation according to user needs is delivered with the option.
**4474 MS CURRENT MEASUREMENT OPTION**

In specific test stations at manufacturing lines and repair stations, measurement of the current from the battery is a “must” in order to identify any failure on the PCB (Printed Circuit Board). Quality assurance measures the current in order to characterize standby and talk times.

For this range of applications the 4400 plug-in option "MS Current Measurement" substitutes an external current meter and measures power and current, which the mobile drains from the battery. The user can choose between a numerical measurement and a unique graphical representation of the current versus time measurements. The current changes dynamically as the mobile’s power amplifier generates the RF bursts.

In addition the option provides a statistical evaluation for minimum, maximum, average and peak value regarding the selected duration time.

The duration of the graphical representation is 4.615 ms which enables the user to analyze a complete GSM TDMA frame.

The 4474 MS Current Measurement Option is an extension of the 4473 MS Power Supply Option. To connect the 4400 with the mobile, a power supply cable is delivered with the option. An open-ended termination on this cable provides free adaptation into an existing test system.

Both options extend the test application area of the 4400. The 4400 is now able to supply the mobile under test, measures RF and audio quality and the power consumption with one test instrument.

The benefits in brief:

- Integrated current meter, e.g. to identify short-circuit situations, eases handling for the user
- The 4400 user can test RF, audio and power consumption with one test instrument
- No additional external current meter necessary, this saves space in test systems
- Power, peak current and average current measurements possible
- Easy-to-read numerical measurement display
- Current vs. time measurements for the analysis of burst current characteristics with selectable resolutions
- Statistical evaluation and overload detection
- Battery replacement

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**SPECIFICATIONS**

### MEASUREMENT

**Range**
- 0 to 400 mA or 0 to 4 A

**Resolution (at 400 mA)**
- 0.1 mA

**Resolution (at 4 A)**
- 1 mA

**Accuracy**
- 2%

**Offset**
- ±5 mA

**Output Voltage Range**
- 0 to 10 V

**Recording Duration**
- 4.615 ms (1 TDMA frame)

**Resolution**
- 960 points

**Sample Rate**
- 192 000 samples/sec

**Connection Cable**
- A 0.5 meter long power supply connection cable with open ends for free adaptation of user needs is delivered with the option.
OPTIONS FOR WCDMA (UMTS) AND HSDPA

The WCDMA offering on the 4400 consist of two main options, the 4466 WCDMA/UMTS Non-Call Mode Option and the 4467 WCDMA/UMTS Call Mode Option. These software options are based upon the 4479 Baseband Processing Hardware.

4466 WCDMA Non-Call Mode Option

The Non-Call Mode Option, sometimes also known as asynchronous mode or non-signaling mode, offers all the functionality required to tune a WCDMA mobile phone in a production or high level service environment. It offers all the functions necessary to generate and analyze a WCDMA signal. This functionality is dedicated to the alignment and calibration of the Printed Circuit Board (PCB) of a 3G mobile phone; these two steps are necessary to guarantee that the mobile phone's radio frequency parameters are within the limits specified.

Typical tests include:

- Power measurements
- Modulation quality measurements
- Constellation display
- Code domain power measurements
- Spectrum measurements
- TX-RX sweep calibration

To tune the receiver of a 3G mobile phone the 4400 offers various signals - a Continuous Wave (CW) signal, a Frequency Modulated (FM) signal and the WCDMA-modulated signal.

There are more features available, like the power staircase measurement or the zero-span-analyzer. The power staircase test has been designed for specific measurements of the power changes; the zero-span-analyzer can perform the same in a more flexible way and displays power versus time, just as a spectrum analyzer does in zero-span mode. These features can be used to display nearly all signals which are generated within the frequency range of the 4400. Overall the non-call mode functionality is mostly used through remote control and in cooperation with service software controlling both the tester and the device under test.

4467 WCDMA Call Mode Option

The call mode option of the 4400 is prepared for the requirements of a final test. These tests are based on 3GPP/FDD Release '99 and ETSI specification TS 134.121.

Call mode or signalling tests are necessary to test the behaviour of the WCDMA (UMTS) mobile phone in a network, closer to the reality. Therefore the 4400 acts as a Node B (WCDMA base station), supporting the necessary signalling exchange.

All the relevant parameters, such as the configured downlink channels, can be configured. The 4400 supports the required call processing algorithm for call set up (mobile-terminated call, mobile-originated call) and also for loopback mode on one of the Reference Measurement Channels (RMC); these channels are specified for transmitter and receiver testing.

The 4400 Mobile Phone Tester Series provides a long list of transmitter measurements, which can be divided into modulation quality, power, code domain and spectrum measurements with additional reports from the phone. Receiver measurements are also included. Fast testing on different frequency channels is supported with the handover procedure to keep test time to a minimum.

HSDPA

High Speed Downlink Packet Access is an optimization for UMTS/WCDMA in the Downlink.

The HSDPA testing solution for the 4400 Mobile Phone Tester Series consists of two options: the 4456 HSDPA Non-Call Mode Option and the 4455 HSDPA Call Mode Option. Each of these options requires the related WCDMA option- and the 4479 Baseband Processing Hardware to be installed.

4456 HSDPA Non-Call Mode Option

The HSDPA Non-Call Mode Option provides all the necessary functionality to calibrate and align an HSDPA-capable device in production or high level service environment. For this purpose, it offers generator and analyzer functions with measurements as follows:

- Power measurements, modulation quality, code domain power and spectrum measurements

4455 HSDPA Call Mode Option

4455 HSDPA Call Mode Option offers the functionality to fully test an HSDPA-capable device according to 3GPP Release 5 specification TS 134 121. The 4400 simulates a radio cell with HSDPA capabilities, where the device can log onto (PS attach). Once successfully registered, an RMC-based connection can be established and HSDPA data is transmitted. Based on the connection settings, different tests can be performed such as:

- Power measurements (e.g. maximum power)
- Modulation quality (e.g. peak and RMS error vector magnitude (EVM))
- Code domain power measurements (e.g. peak code domain error (PCDE))
- Receiver characteristics (e.g. maximum input level)
- Receiver performance (e.g. CQI reporting, data rate throughput/BLER)
**GENERAL DATA**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>3GPP-FDD Release 5</td>
</tr>
<tr>
<td>Symbol Rate</td>
<td>3.84 Mcps</td>
</tr>
<tr>
<td>Bandwidth</td>
<td>5 MHz</td>
</tr>
</tbody>
</table>

**RF GENERATOR**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modulation Type</td>
<td>CW, FM, WCDMA, WCDMA/HSDPA</td>
</tr>
<tr>
<td>WCDMA/HSDPA SIGNAL GENERATOR</td>
<td>Frequency Resolution 10 Hz</td>
</tr>
<tr>
<td>Output Level Range</td>
<td>–120 to –20 dBm</td>
</tr>
<tr>
<td>Output Level Accuracy</td>
<td>±0.7 dB, typ. ±0.4 dB</td>
</tr>
<tr>
<td>Output Level Resolution</td>
<td>0.1 dB</td>
</tr>
<tr>
<td>Error Vector Magnitude (EVM)</td>
<td>&lt;5%</td>
</tr>
<tr>
<td>Channel Level Accuracy</td>
<td>±0.2 dB</td>
</tr>
<tr>
<td>Channel Level Resolution</td>
<td>0.1 dB</td>
</tr>
<tr>
<td>FM SIGNAL GENERATOR</td>
<td>Modulation Frequency 1 to 100 kHz</td>
</tr>
<tr>
<td>Frequency Deviation</td>
<td>250 to 1000 kHz</td>
</tr>
<tr>
<td>Deviation Tolerance</td>
<td>±2%</td>
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</tbody>
</table>

**RF ANALYZER**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>WCDMA/HSDPA POWER MEASUREMENT</td>
<td>Measurement Filter According to standard, 3.84 MHz, RRC, α = 0.22</td>
</tr>
<tr>
<td>Power Measurement</td>
<td>Peak/mean power, filtered/non-filtered</td>
</tr>
<tr>
<td>Level Range</td>
<td>–60 to +35 dBm</td>
</tr>
<tr>
<td>Accuracy</td>
<td>±0.4 dB for –25 to +35 dBm</td>
</tr>
<tr>
<td></td>
<td>±0.7 dB for –50 to –25 dBm</td>
</tr>
<tr>
<td></td>
<td>±0.9 dB for &lt;–50 dBm</td>
</tr>
<tr>
<td>Resolution</td>
<td>0.01 dB</td>
</tr>
<tr>
<td>WCDMA/HSDPA ANALYZER</td>
<td>Measurement Quality Measurements</td>
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<tr>
<td></td>
<td>According to standard, 3.84 MHz, RRC, α = 0.22</td>
</tr>
<tr>
<td>Level Range</td>
<td>–25 dBm to +35 dBm</td>
</tr>
<tr>
<td>ERROR VECTOR MAGNITUDE</td>
<td>Range Up to 30%</td>
</tr>
<tr>
<td></td>
<td>Accuracy ±2.5%</td>
</tr>
<tr>
<td></td>
<td>Resolution 0.1%</td>
</tr>
<tr>
<td>FREQUENCY ERROR</td>
<td>Range ±5 kHz</td>
</tr>
<tr>
<td></td>
<td>Accuracy ±5 Hz</td>
</tr>
<tr>
<td></td>
<td>Resolution 1 Hz</td>
</tr>
<tr>
<td>SPECTRUM ANALYZER</td>
<td>Frequency Span ±3 MHz, ±5 MHz</td>
</tr>
<tr>
<td></td>
<td>Resolution Bandwidth 15 kHz, 30 kHz</td>
</tr>
<tr>
<td>ADJACENT CHANNEL LEAKAGE RATIO</td>
<td>Measurement Bandwidth ±5 MHz first adjacent channel, ±10 MHz second adjacent channel</td>
</tr>
<tr>
<td></td>
<td>Dynamic Range &gt;48 dB first adjacent channel, &gt;58 dB second adjacent channel</td>
</tr>
</tbody>
</table>
Display Range
80 dB
Resolution
0.1 dB
Occupied Bandwidth
Range
1 to 6 MHz
Accuracy
±100 Hz
Resolution
15 kHz
SPECTRUM EMISSION MASK
Measurement Filter
±2.515 to ±3.485 MHz 30 kHz Gaussian
±4 to ±12 MHz 1 MHz Gaussian
Dynamic range
±2.515 to ±3.485 MHz: >70 dB
±4 to ±12 MHz: >65 dB
Resolution
0.1 dB
NON-CALL MODE FUNCTIONS
WCDMA/HSDPA ANALYZER
Power Measurements
Peak power, mean power
Spectrum Measurements
Occupied bandwidth (OBW), adjacent channel power leakage ratio (ACLR), spectrum emission mask (SEM)
Modulation Quality
Error vector magnitude (EVM), magnitude error, frequency error, phase error, rho, I/Q offset, I/Q imbalance, constellation display
CODE DOMAIN MEASUREMENTS
Peak code domain error (PCDE), code domain power
POWER VS. TIME
Zero-span analyzer (flexible power vs. time measurements)
Sweep Time
1 to 85 ms
Reference Level
–23 to 36 dBm
Filter
30 kHz, 100 kHz, 4.6848 MHz
GENERATOR
CW, FM and WCDMA signal
151 ms for 4.6848 MHz filter
CALL MODE FUNCTIONS
WCDMA CALL PROCESSING
Supported Bands
Band I- 1920 to 1980 MHz (UL)
2110 to 2155 MHz (DL)
Band V- 824 to 849 MHz (UL)
869 to 894 MHz (DL)
Band VI- 830 to 840 MHz (UL)
875 to 885 MHz (DL)
Band VIII-880 to 915 MHz (UL)
925 to 960 MHz (DL)
Band IX-1749.9 to 1784.9 MHz (UL)
1844.9 to 1879.9 MHz (DL)
Band X- 1710 to 1770 MHz (UL)
2110 to 2170 MHz (DL)
Supported Procedures
Universal Routing Update (URA), mobile originated call, mobile terminated call, call clearing by mobile and tester, inter-frequency handover (channel change), inter-RAT handover (to GSM/GPRS/EDGE)
Reference Measurement Channels According to 3GPP TS 134121
RMC 12.2, 64, 144, 384 kbps
HSDPA Specific Reference Channels
H-Set 1 – 6 QPSK, 16QAM with AWGN and fading (PA3)
Transmitter Measurements
Peak and mean power
Min and max output power
Inner loop power control
Open loop power control
HS-DPCCH power
Spectrum Measurements
Occupied bandwidth (OBW)
Adjacent channel power leakage ratio (ACLR)
Spectrum emission mask (SEM)
Modulation Quality Measurements
Error vector magnitude (EVM)
Magnitude error
Frequency error
Phase error
Rho
I/Q offset
I/Q imbalance
Constellation display
Phase discontinuity
HSDPA: Error vector magnitude
Phase discontinuity
Relative code domain power
Relative code domain error
Code Domain Measurements
Peak code domain error (PCDE), code domain power
Receiver Measurements
BER/BLER measurements
UE Info with UE Measurement Report
HSDPA: Maximum throughput test
BLER
Demodulation of HS-DSCH
Reporting of channel quality indicator (CQI)
OPTIONS FOR TD-SCDMA

TD-SCDMA (Time Division Synchronous CDMA) is a third-generation wireless communications standard for China, combining Time Division Multiplex Access (TDMA) technology with a synchronous CDMA component.

Aeroflex’s TD-SCDMA testing solution is based on the 4400 Series Mobile Phone Tester, the 4450 TD-SCDMA Non-Call Mode Option, the 4451 TD-SCDMA Call Mode Option and the 4479 Baseband Processing Hardware.

4450 TD-SCDMA Non-Call Mode Option

The 4450 TD-SCDMA Non-Call Mode Option can be seen as a combined signal analyzer and generator in one instrument used in R&D, production and high level service environments.

The analyzer functionality provides the following features:

- Power measurements, such as channel, mean, peak, off-power measurements
- Modulation quality measurements with measurements like Error Vector Magnitude (EVM RMS), frequency, magnitude and phase error
- Constellation display
- Code domain power measurements
- Spectrum measurements

Signals such as Continuous Wave (CW), burst and TD-SCDMA together with QPSK modulation and various types of payload data allow a flexible tuning of TD-SCDMA handset receivers.

4451 TD-SCDMA Call Mode Option

The Call Mode Option supports the functionality required for typical tests on a TD-SCDMA mobile phone. These tests are based on the 3GPP/TDD Release ’99 and ETSI specification TS 134.122 (Low Chip Rate – LCR).

The call processing is required to simulate a TD-SCDMA base station and test the proper behaviour of the TD-SCDMA mobile phone in a network. The 4400 in this way acts as a Node B (TD-SCDMA base station), supporting the necessary signalling. All the relevant parameters, such as the configured downlink channels, can be configured. The 4400 supports the basic registration procedure, as well as the required call processing for the call setup (mobile-terminated and mobile-originated) and for the test loopback mode on one of the Reference Measurement Channels (RMC); these channels are specified for transmitter and receiver testing.

The 4400 Mobile Phone Tester Series provides a long list of transmitter measurements, which can be divided into modulation quality, power, code domain and spectrum measurements with additional measurement reports from the mobile phone. Receiver measurements are also included and supported. In order to support fast testing on various frequency channels, handover procedures are also included – this will keep measurement time to a minimum.

GENERAL DATA

<table>
<thead>
<tr>
<th>Standard</th>
<th>3GPP-TDD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Symbol Rate</td>
<td>1.28 Mcp</td>
</tr>
<tr>
<td>Bandwidth</td>
<td>1.6 MHz</td>
</tr>
</tbody>
</table>

RF GENERATOR

<table>
<thead>
<tr>
<th>Modulation type</th>
<th>CW, burst, TD-SCDMA downlink</th>
</tr>
</thead>
<tbody>
<tr>
<td>TD-SCDMA SIGNAL GENERATOR</td>
<td></td>
</tr>
<tr>
<td>Frequency Range</td>
<td>800 to 1000 MHz, 1700 to 2300 MHz</td>
</tr>
<tr>
<td>Frequency Resolution</td>
<td>1 Hz</td>
</tr>
</tbody>
</table>
Output Level Range
–120 to –13 dBm

Output Level Accuracy
0.7 dB, typ. ±0.4 dB

Output Level Resolution
0.1 dB

Error Vector Magnitude (EVM)
<5%

Supported Physical Channels
P-CCPCH, S-CCPCH, PICH, DwPCH, FPACH, DPCH

Code Channel Level Range
Off, –30 to 0 dB to absolute level

Code Channel Level Accuracy
±0.2 dB (relative level)

Code Channel Level Resolution
0.1 dB

RF ANALYZER

TD-SCDMA POWER MEASUREMENTS

Measurement Filter
According to standard, 1.28, RRC, alpha = 0.22

Measurements
Channel power, peak/mean/off power, power on/off mask

Frequency Range
800 to 1000 MHz
1700 to 2300 MHz

Level Range
–60 to +35 dBm

Level Accuracy
±0.4 dB for high power (-25 to +35 dBm)
±0.7 dB for low power (-60 to -25 dBm)
±0.9 dB for <-60 dBm

Resolution
0.01 dB

MODULATION QUALITY MEASUREMENT

Measurement Filter
According to standard 1.6 MHz, RRC, alpha = 0.22

Frequency Range
800 to 1000 MHz
1700 to 2300 MHz

Level Range
–25 to +35 dBm

ERROR VECTOR MAGNITUDE (EVM)

Range
up to 30%

Accuracy
±2.5%

Resolution
0.1 dB

FREQUENCY ERROR

Range
±10 kHz

Accuracy
±10 Hz

Resolution
1 Hz

WAVEFORM QUALITY

Range
0.9 to 1.0

Accuracy
±0.002

Resolution
0.0001

SPECTRUM

Span
±1.2 MHz, ±2.4 MHz

Resolution Bandwidth
15 kHz, 30 kHz

ADJACENT CHANNEL LEAKAGE POWER RATIO (ACLR)

Measurement Bandwidth
±1.6 MHz, first adjacent channel
±3.2 MHz, second adjacent channel

Dynamic Range
>48 dB, first adjacent channel
>58 dB, second adjacent channel

Display Range
80 dB

Resolution
0.1 dB

OCCUPIED BANDWIDTH

Range
1 MHz to 4 MHz

Accuracy
±100 kHz

Resolution
15 kHz

SPECTRUM EMISSION MASK

Measurement Filter
±0.8 MHz to ±2.4 MHz 30 kHz Gaussian
±2.4 MHz to ±4 MHz 1 MHz Gaussian

Dynamic Range
±0.8 MHz to ±2.4 MHz >70 dB
±2.4 MHz to ±4 MHz >65 dB

Resolution
0.1 dB
NON-CALL MODE FUNCTIONS

TD-SCDMA ANALYZER

Power Measurements
Channel power, peak/mean/off power, power on/off mask

Spectrum Measurements
Modulation spectrum
Occupied bandwidth (OBW)
Adjacent Channel leakage power ratio (ACLR)
Spectrum emission mask (SEM)

Modulation Quality
EVM, frequency error, magnitude error, phase error, I/Q offset, I/Q imbalance, Rho

Code Domain Measurements
Peak code domain error (PCDE), code spectrum

GENERATOR

Signal Type
CW, burst, TD-SCDMA

Modulation
None, QPSK

Downlink Timeslots
1 to 6

Payload Data
PN9, PN15, PN23, all 0s, all 1s, 1010..., 1100..., 11110000, 1...10...0

Data Rate (Reference Measurement Channel – RMC)
12.2 kbps

CALL MODE FUNCTIONS

TD-SCDMA CALL PROCESSING

Supported Bands
1900 to 1920 MHz (UL & DL)
2010 to 2025 MHz (UL & DL)
1850 to 1910 MHz: (UL & DL)
1930 to 1990 MHz: (UL & DL)
1910 to 1930 MHz: (UL & DL)

Supported Procedures
Registration, mobile originated call, mobile terminated call, call clearing by mobile and tester, inter-frequency handover (channel change)

Reference Measurement Channels according to 3GPP TS 34.122
RMC 12.2 kbps (single code and multicode)
RMC 64 kbps

Transmitter Measurements
Peak and mean power, min and max power, inner loop power control, open loop power control, Transmit ON/OFF Time mask

Spectrum Measurements
Occupied bandwidth (OBW), adjacent channel power leakage ratio (ACLR), spectrum emission mask (SEM)

Modulation Quality Measurements
Error vector magnitude (EVM), magnitude error, frequency error, phase error, rho, I/Q offset, I/Q imbalance, constellation display

Options for CDMA2000

The CDMA2000 system options for the 4400 Series enable users in R&D, manufacturing and service to test subscriber terminals which are based on the cdmaOne and CDMA2000 technologies. The 4447 CDMA2000 1xRTT Non-Call Mode Option supports asynchronous measurements and the 4448 CDMA2000 1xRTT Call Mode Option supports synchronous measurements, so the combination of the both allow the user to perform alignment as well as functional testing of terminals.

Supported features are:

- cdmaOne and CDMA2000 call processing including registration, MS/BS originated call, MS/BS termination, handovers
- Fast 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
- AM generation for calibration of terminals supporting ZIF (zero intermediate frequency) based chipsets

The CDMA2000 System 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.

Figure 7: Basic Screen CDMA2000
**RF GENERATOR**

**CDMA GENERATOR**

- **Level Range (AWGN Off)**: –120 dBm to –15 dBm
- **Level Range (AWGN On)**: –120 dBm to –27 dBm
- **Level Accuracy (AWGN Off), (-110 dBm to –15 Bm)**:
  - 4403 ±1.4 dB
  - 4405 ±0.9 dB, typ. ±0.6 dB
- **Level Resolution**: 0.1 dB
- **Waveform Quality (rho)**:
  - >0.97
  - Typ. >0.99
- **Carrier Feedthrough**: <-35 dBc
- **Code Channel Level Accuracy**: ±0.25 dB

**AWGN GENERATOR**

- **AWGN Bandwidth**: >1.8 MHz
- **AWGN, Level Range Relative to CDMA Signal**: +5 to –10 dB
- **AWGN Level Accuracy (relative to signal)**: ±0.5 dB

**CODE CHANNELS**

- **Sector A**
  - F-PICH, F-SYNC, F-FCH: –5 dB to –32 dB
  - F-QPCH: +2 to –5 dB relative to Pilot
  - F-OCNS: Level calculated by 4400

- **Sector B**
  - F-PICH, F-FCH: –5 dB to –32 dB

**F-OCNS**

Level calculated by 4400

**AMPS GENERATOR**

- **Level Range**: –120 dBm to –15 dBm
- **Level Accuracy**:
  - 4403 ±1.4 dB
  - 4405 ±0.9 dB, typ. ±0.6 dB
- **Level Resolution**: 0.1 dB
- **Modulation**: FM or none
- **FM Modulation Types**
  - Mod A 5970 Hz, 6000 Hz, 6030 Hz
  - Mod B 1 kHz or off

**RF ANALYZER**

- **CDMA/AMPS POWER METER**
  - **CDMA Level Range**: –70 dBm to +36 dBm
  - **AMPS Level Range**: –40 dBm to +36 dBm
- **Level Resolution**: 0.1 dB
- **Level Accuracy**:
  - 4403 ±1.2 dB
  - 4405 ±0.5 dB (–10 dBm to +36 dBm)
  - ±0.6 dB (–60 dBm to –10 dBm)
  - ±0.7 dB (–70 dBm to –60 dBm)

**MODULATION QUALITY FOR CDMA2000**

- **Level Range**: –30 dBm to +36 dBm
- **Frequency Error Range**: ±1 kHz
- **Resolution**: 1 Hz
- **Accuracy (relative to freq. base)**: ±10 Hz

**WAVEFORM QUALITY**

- **Range**: 0.9 to 1.0
- **Accuracy**: ±0.003

**TIME OFFSET**

- **Range**: ±5 μs
- **Accuracy**: ±100 ns

**CODE DOMAIN MEASUREMENTS (1XRTT channels)**

- **Code Channels**: W_0^4 to W_15^4
- **Code Power Range**: 0 to 40 dBc (relative to total power)
**Code Power Resolution**
0.1 dB

**Code Power Accuracy**
±0.1 dB

**Number of Code Channels**
1 to 6

**Timing Range**
0 to 200 ns

**Timing Resolution**
1 ns

**Timing Accuracy**
±2 ns

**Code Domain Power Range**
±3.75 dB (relative to reverse pilot)

**Code Domain Power Resolution**
0.1 dB

**Code Domain Power Accuracy**
±0.1 dB

**MODULATION SPECTRUM**

**Display Range**
80 dB

**Resolution Bandwidth**
5 kHz, 10 kHz, 30 kHz

**Span (selectable)**
±2.5 MHz, ±1.25 MHz, ±500 kHz

**ACPM**

**Display Range**
80 dB

**Frequencies According to IS-98D up to 2.5 MHz from Centre Frequency**

**Measurements**
Spectrum due to modulation

**MODULATION ANALYZER FOR AMPS**

**Level Range**
−15 dBm to +36 dBm

**Frequency Error Range**
±5 kHz

**Resolution**
1 Hz

**Accuracy (relative to freq. base)**
±20 Hz

**Deviation Range**
0 to 30 kHz

**Deviation Resolution**
1 Hz

**Deviation Accuracy**
±5%

**Audio Deviation Filter**
300 kHz

**SAT Frequency Range**
±5 Hz

**ST Frequency Range**
±5 Hz

**SAT & ST Frequency Resolution**
1 Hz

**SAT & ST Frequency Accuracy**
±0.1 Hz

**NON-CALL MODE FUNCTIONS**

**CDMA GENERATOR**

**Signal type**
Continuous

**Modulation**
None, BPSK/QPSK

**User-definable parameters for CDMA cell simulation**
SID, NID, MCC, MNC, PN offset

**CDMA ANALYZER**

**Supported Signal Types**
OQPSK, HPSK

**Supported transmitter measurements**
Power, waveform quality, code domain

**AMPS GENERATOR**

**Signal Types**
Continuous

**Modulation**
None, FM

**AMPS ANALYZER**

**Supported Signal Types**
FM

**Supported Transmitter Measurements**
Power, frequency error, SAT & ST frequency and deviation, audio deviation, SINAD – requires Audio Option

**CALL MODE FUNCTIONS**

**CDMA2000 CALL PROCESSING**

**Supported CDMA2000 bands**
- band 0 – US cellular (ch 1 to 1023)
- band 1 – PCS band (ch 1 to 1199)
- band 2 – TACS band (ch 1-1000, 1329-2047)
- band 3 – JTACS band
- band 4 – Korean PCS (ch 1 to 599)
- band 5 – NMT-450
- band 6 – IMT-2000 (ch 1 to 1199)
- band 8 – 1800 MHz (ch 1 to 1499)
- band 9 – 900 MHz (ch 1 to 699)

**Supported Procedures**
Registrations, mobile-originated call, mobile-terminated call, intracell handover, cross-band handover, call clearing by MS, call clearing by 4400

**SPECIAL FUNCTIONS**

**Call State Diagram**

**MS Information Display**
Mobile ID Number (MIN), Equipment Serial Number (ESN), IMSI (class 0 and 1), type, slot class, slot index, power class, transmit mode, digits dialed

**Common Control Channel Parameters**
SID, NID, MCC, MNC, PN Offset

**Access Channel Parameters**
Nominal power, initial power, power step, number steps, request
sequences, response sequences, timeout, preamble length

**Paging Rate**
- Full

**Radio Configuration Combinations**
- F-RC1/R-RC1, F-RC2/R-RC2, F-RC3/R-RC3, F-RC4/R-RC4,
- F-RC5/R-RC4

**Service Options**

**Reverse Link Power Control Modes**
- Alternating, all up, all down, active

**Fundamental Channel Parameters**
- Walsh code, data rate, pattern (PN15, voice loop back or canned), voice loopback delay

**Fundamental channel data rates – forward**
- RC1 - 1.2, 2.4, 4.8, 9.6 kbps
- RC2, RC5 - 1.8, 3.6, 7.2, 14.4 kbps
- RC3, RC4 - 1.5, 2.7, 4.8, 9.6 kbps

**Fundamental channel data rates - reverse**
- RC1 - 1.2, 2.4, 4.8, 9.6 kbps
- RC2,RC4 - 1.8, 3.6, 7.2, 14.4 kbps
- RC3 - 1.5, 2.7, 4.8, 9.6 kbps

**CDMA2000 TRANSMITTER MEASUREMENTS**

**Power Measurements**
- Minimum/maximum RF power, open loop power (level and timing), gated output power, access probe power, closed loop power (min./max./range only), stand-by power

**Modulation Quality Measurements**
- rho, frequency error, rms vector error, time offset, amplitude imbalance, code domain power (graphical and data), code channel timeoffset, code channel phase

**CDMA2000 RECEIVER MEASUREMENTS**

**Receiver Performance**
- Sensitivity, dynamic range (frame error rate)

**Demodulator Performance**
- Demodulation of forward traffic with AWGN

**Mobile Reported**
- FER, pilot strength

**AMPS CALL MODE FUNCTIONS**

**AMPS CALL PROCESSING**

**Supported Procedures**
- Handoff CDMA to analog, handoff analog to analog, power level change, call clearing by MS or 4400

**AMPS Transmitter Measurements**
- Power, frequency error, SAT & ST frequency and deviation, Audio deviation, SINAD – requires Audio Option

**AMPS Receiver Measurements**
- Receiver sensitivity with SINAD (requires Audio Option)

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**OPTIONS FOR 1xEV-DO**

The 1xEV-DO offering on the 4400 Mobile Phone Tester Series consist of two main options, the 4452 1xEV-DO Non-Call Mode Option and the 4453 1xEV-DO Call Mode Option.

These software options are based upon the 4479 Baseband Processing Hardware.

**4452 1xEV-DO Non-Call Mode Option**

The Non-Call Mode Option, sometimes also known as asynchronous mode or non-signaling mode, offers all the functionality required to tune a 1xEV-DO Rev0 or Rev A mobile phone in a production or high level service environment. It provides all the functions required to analyze a 1xEV-DO signal. This functionality is dedicated to the alignment and calibration of the Printed Circuit Board (PCB) of a 1xEV-DO mobile terminal; these two steps are necessary to guarantee that the mobile terminal’s radio frequency parameters are within the limits specified.

Typical tests include:
- Power measurements
- Modulation quality measurements
- Code domain power measurements
- Spectrum measurements

Overall the non-call mode functionality is typically used through remote control and in cooperation with service software controlling both the tester and the device under test.

**4453 1xEV-DO Call Mode Option**

The 4453 1xEV-DO Call Mode Option enables users to perform a functional test on a 1xEV-DO Revision 0 or Revision A mobile terminal. The functional test consists of establishing a connection to the terminal in a similar manner as a connection with a live network. Once a connection is established, the appropriate RF transmitter and receiver measurements may be performed.

The Call Mode Option allows the user to setup the forward link signaling parameters and traffic channel parameters, thus allowing the user to simulate their specific network. Once the signaling parameters are setup the user may perform one of the following signaling procedures:
- AT Session Open
- AT & AN Connection
- AT & AN Release
- AT & AN Session Close
- Handover

Once the terminal is in a connection state, an array of transmitter and receiver test may be performed. The transmitter test consist of: minimum/maximum RF power, access probe power, closed loop power (min./max./range only), stand-by power, modulation quality measurements including rho, frequency error, rms vector error, time offset, amplitude imbalance and code domain error. The receiver performance may be verified by utilizing the FTAP/RTAP applications to test sensitivity and dynamic range via a packet error rate measurement.
**RF GENERATOR**

**Level Range**

-120 dBm to –15 dBm

**Level Resolution**

0.1 dB

**Level Accuracy**

(-110 dBm to –15 dBm) ±0.7 dB

Typ. ±0.4 dB

**Waveform Quality (rho)**

>0.97

Typ. >0.99

**Carrier Feedthrough**

<-35 dBc

**Code Channels**

F-PICH, F-MAC, F-CCH, F-TCH

---

**POWER METER**

**EVDO Level Range**

-60 dBm to +35 dBm

**Level Resolution**

0.1 dB

**Level Accuracy**

-25 dBm to +35 dBm ±0.4 dB

-60 dBm to –25 dBm ±0.6 dB

---

**MODULATION QUALITY ANALYZER**

**Level Range**

-25 dBm to +35 dBm

**Frequency Error Range**

±1 kHz

**Resolution**

1 Hz

**Accuracy (relative to freq. base)**

±10 Hz

---

**WAVEFORM QUALITY**

**Range**

0.9 to 1.0

**Accuracy**

±0.003

**Resolution**

0.001

---

**ERROR VECTOR MAGNITUDE**

**Range**

Up to 30%

**Accuracy**

±2.5%

**Resolution**

0.1%

---

**TIME OFFSET**

**Range**

±5 μs

**Accuracy**

±100 ns

**Resolution**

100 ns

---

**CODE DOMAIN ERROR MEASUREMENTS**

**Code Power Resolution**

0.1 dB

**Code Power Accuracy**

±0.1 dB

---

**SPECTRUM ANALYZER**

**Display Range**

80 dB
Resolution Bandwidth
15 kHz, 30 kHz

Span (selectable)
±2.5 MHz
±500 kHz

ACPM
Display Range
80 dB

Frequencies according to IS-98D
Up to 2.5 MHz from centre frequency

Measurements
Spectrum due to modulation

NON-CALL MODE FUNCTIONS
Measurements
Power measurements
Modulation quality measurements
Rho
Frequency error
Rms vector error
Amplitude imbalance
Code domain power
Modulation spectrum

CALL MODE FUNCTIONS
Supported Revisions
Rev. 0, Rev. A

Supported Bands
band 0 - US cellular (ch 1 to 1023)
band 1 - PCS band (ch 1 to 1199)
band 2 - TACS band (ch 1-1000, 1329-2047)
band 3 - JTACS band (ch 1-799, 801-1039, 1041-1199, 1201-1600)
band 4 - Korean PCS (ch 1 to 599)
band 5 - NMT-450 (ch 1-300, 1039-1473, 1792-2016)
band 6 - IMT-2000 (ch 1 to 1199)
band 8 - 1800 MHz (ch 1 to 1499)
band 9 - 900 MHz (ch 1 to 699)

Supported Procedures
AT Session Open
AT & AN Connection
AT & AN Release
AT & AN Session Close
Handover
Terminal information
Hardware ID
Hardware ID type
Session seed
UATI 024
UATI color code

Access Parameters
Open loop adjust (0 to 255 dB)

Reverse Channel Gain Parameters
Ack channel (-3 to +6 dB)
DRC channel (-9 to +6 dB)
Data offset nominal (-3.5 to 4.0 dB)
Data offset rate (for various rates)

General Parameters
Control channel number
Total RF power
PN offset (0 to 511)

Call Parameters
Physical Layer Subtype
Application
FTAP/FETAP rate
RTAP/RETAP rate
ACK channel bit fixed mode attrib
AT directed packets
Reverse closed loop power control
AT max power
MAC index

Transmitter Measurements
Power measurements
Minimum/maximum RF power
Modulation quality measurements
Rho
Frequency error
Rms vector error
Time offset
Amplitude imbalance
Code domain power

Receiver Measurements
Receiver performance sensitivity
Dynamic range (packet error rate)
The 4400 Mobile Phone Tester Series supports GSM and its enhancements GPRS and EDGE with different basic options: the GSM non-call mode and call mode options, the GPRS non-call mode and call mode options, and the EDGE non-call mode option and call mode options.

**GSM System Options**

Worldwide the GSM standard is being applied in four different frequency bands, all of which are supported by the GSM system options.

The 4457 GSM Call Mode Option offers a signaling mode in which the 4400 is able to emit a signal similar to that of a GSM base station. Various signaling parameters can be adjusted to test a GSM mobile phone under different conditions.

The parameter menu allows signaling parameters to be easily changed. From the GSM cell parameters, across the definition of SMS message class, to the call set up procedure details, a lot of parameters are accessible in the 4400. A range of measurements are supported to test frequency and phase error, power, spectrum, and various receiver quality parameters.

The call mode option includes a generic test script to run tests automatically, without user intervention. This test script consists of a final test of a GSM mobile phone operating in one or several of the GSM frequency bands, which are GSM 850 (U.S. cellular band), GSM 900, GSM 1800 and GSM 1900 (U.S. PCS band).

The generator/analyzer mode of the 4458 GSM Non-Call Mode Option provides basic signal generation capabilities as well as frequency and phase, burst (power) and spectrum measurements. This functionality is not limited to GSM channels but available for the whole frequency range supported by the 4400.

**GPRS System Options**

GPRS (General Packet Radio Service) adds higher data rate capabilities to GSM by combining a packet data protocol with bundling of multiple time slots. The 4462 GPRS Call Mode Option allows testing of the packet data protocol capability as well as the multislot transmit and receive quality during a connection. Tests without the connection setup can be done with the 4454 GPRS Non-Call Mode Option.

Users who need to test both GSM and GPRS in call mode and non-call mode, can also use the 4463 GSM/GPRS System Option combining the capabilities of all the four system options.

**EDGE System Options**

A further increase in data throughput is achieved with EDGE (Enhanced Data rates for the Global Evolution), also called Enhanced GPRS. EGPRS introduces a higher modulation format (8-PSK) which requires new tests and measurements.

The modulation quality for EDGE-enabled mobile phones is expressed in Error Vector Magnitude (EVM), origin offset and I/Q imbalance.
Graphical Display

Phase Error vs. Time

Marker Functions

2 markers, difference indication

Vertical Display Range

±2°, ±5°, ±10°, ±20°, ±50°

Horizontal Display Range

150 bit periods

FREQUENCY ERROR

Display

Current/average/min./max.

Range

±100 kHz

Resolution

1 Hz

Accuracy at 800 MHz to 1000 MHz

Within ±10 kHz error 15 Hz + freq. base
Within ±100 kHz error 20 Hz + freq. base

Accuracy at 1700 MHz to 2000 MHz

Within ±10 kHz error 25 Hz + freq. base
Within ±100 kHz error 30 Hz + freq. base

PHASE ERROR RMS

Display

Current/average/min./max.

Range

0° to 15°

Resolution

0.1°

Accuracy

0.5°, typ. 0.3°

PHASE ERROR PEAK

Display

Current/average/min./max.

Range

0° to 45°

Resolution

0.1°

Accuracy

1° to 15° error 3.2°
15° to 25° error 4.2°

8-PSK (EDGE) Measurements (EDGE System Options)

Level Range

–25 dBm to +36 dBm

FREQUENCY ERROR

Range

±10 kHz

Resolution

1 Hz

Accuracy

Same as GSM specification

RMS EVM

Display

Current/average/min./max.

Range

0 to 50%

Resolution

0.1%

Accuracy

<1.0%

PEAK EVM

Display

Current/average/min./max.

Range

0 to 75%

Resolution

0.1%

Accuracy

<3%

95th PERCENTILE

Display

Current/average/min./max.

Range

0 to 50%

Resolution

0.01%

Accuracy

<1.5%

ORIGIN OFFSET

Display

Current/average/min./max.

Range

0 to 50%

Resolution

±0.5 dB

I/Q IMBALANCE

Display

Current/average/min./max.

Range

0 to 50%

Resolution

±0.5 dB

BURST MEASUREMENTS

Peak Level Accuracy

4405 0.37 dB, typ. 0.15 dB
4403 0.8 dB

1 if RX signal >–32 dBm and TX signal >10 dBm
Level Repetition
4405 0.01 dB
4403 0.03 dB

Level Resolution
0.01 dB

Relative Accuracy of 4405
1 dB at –60 dBc
3 dB at –72 dBc

GRAPHICAL DISPLAY
Measurement
Power vs. time
Marker Functions
2 markers, difference indication
Power vs. Time Display Modes
Full burst, edges, flat part
Corner Points
8 measurement points on the burst
Selectable Range
–10 bits to +160 bits
Accuracy
See relative accuracy
Resolution
0.1 dB

TIMING ADVANCE AND TIMING ERROR MEASUREMENT
Setting Range
0 to 63 bit periods
Measurement Resolution
0.1 μs
Measurement Range
± half a time slot (relative to 4400 timing)

MODULATION SPECTRUM
Graphical Display
Power vs. frequency
Display Range
80 dB
Resolution Bandwidth
10 kHz, 30 kHz
Span (selectable)
±1.8 MHz
±500 kHz
±200 kHz
Marker Functions
2 markers, difference indication
Statistical Functions
Current, average
ACPM (ORFS) OPTION
Graphical Display
Bar chart, power vs. frequency
Display Range
80 dB
Frequencies
According to ETSI GSM 11.10 up to 1.8 MHz from centre frequency
Measurements
Spectrum due to modulation
Spectrum due to switching transients

NON-CALL MODE FUNCTIONS

ASYNCHRONOUS RF GENERATOR
Carrier Frequency Selection
By frequency or channel number
Signal Types
Continuous, burst
Modulation
None, GMSK, AM (optional)
Training Sequence
0 to 7 or none
Burst Contents
Fixed bit patterns, PRBS (PN-9, PN-15, PN-23)

ASYNCHRONOUS RF GENERATOR
(Additional specifications for GPRS Non-Call Mode Option)
Signal Type
Continuous, burst, multislot
Selectable channel combinations
Raw GMSK signal
PDTCH (channel comb. 13)
BCH + PDTCH (channel comb. 5 on time slot 0,
Channel comb. 13 on other time slots)
PDTCH Content
RLC/MAC header + data payload
Multislot PDTCH Operation
1 time slot generated and duplicated
PDTCH Data Payload
PN-9, PN-15, PN-23, 1010...
Multislot Power Level
Individually selectable for each time slot

ASYNCHRONOUS RF ANALYZER
Carrier Frequency Selection
By frequency or channel number
Supported Signal Type
GMSK-modulated burst signal
GMSK-modulated continuous signal
Time Synchronisation of MS with 4400
Not required
RF Power Conditions
> –20 dBm
Supported Transmitter Measurements
Peak power
Burst power (full range)
Corner points
Frequency/phase error measurements
Spectrum measurements

ASYNCHRONOUS RF ANALYZER
(Additional specifications for GPRS Non-Call Mode Option)
In multislot mode, the specified measurement accuracy applies to the time slot with the highest power level.

Maximum Number of Time Slots
Up to 4 adjacent time slots

Supported Transmitter Measurements
Same as for GSM, displayed results for selectable time slot, results via SCPI for one selectable slot or for all time slots

ASYNCHRONOUS RF ANALYZER
(Additional specifications for EDGE Non-Call Mode Option)
In multislot mode, the specified measurement accuracy applies to the time slot with the highest power level.

Maximum Number of Time Slots
Up to 4 adjacent time slots

Supported Transmitter Measurements
Frequency error, RMS EVM, peak EVM 95th percentile, origin offset, I/Q imbalance displayed results for selectable time slot, results via SCPI for 1 selectable of for all time slots

CALL MODE FUNCTIONS

Supported Bands
GSM 850 (channels 128 to 251)
P-GSM (channels 1 to 124)
E-GSM (channels 975 to 1023, 0 to 124)
R-GSM (channels 955 to 1023, 0 to 124)
GSM 1800 (channels 512 to 885)
GSM 1900 (channels 512 to 810)

GSM CALL PROCESSING

Supported Procedures
Location update
Mobile-originated call
Mobile-terminated call
Intracell handover
Cross-band intracell handover
Call clearing by MS
Call clearing by 4400
Open loop, closed loop procedures
Early or late assignment
SMS to mobile (idle mode)
SMS to mobile (on TCH/FS)
SMS from mobile (idle mode

Special Functions
Call state diagram
Paging test
Reduced signalling

TCH Slot
Selectable, range 2 to 6

GPRS CALL PROCESSING
Time slot selection automatic, according to multislot class

Supported Procedures
GPRS attach/detach
Routing area update
Downlink TBF establishment
Uplink TBF establishment
(Using ETSI-defined GPRS test mode command) reduced signalling

Uplink Data Mode According to GSM 04.14 test mode a)
(Without data loopback in the mobile)

Uplink Power Control Method
Closed loop

EDGE CALL PROCESSING
Time Slot Selection
Automatic, according to multislot class

Supported Procedures
EDGE attach/detach
Uplink TBF establishment
ETSI test mode A only

GPRS Transmitter Measurements
The measurement accuracy specified for the base unit applies to the time slot with the highest power level.

Supported Number of Time Slots
Transmitter measurements: 1 through 4

RF Power Conditions
At least 1 time slot at >-20 dBm
Max. adjacent slot power difference: 30 dB

Power Measurements
Peak power for selectable time slot
Min., max., average, current values
8 corner points for selectable time slot
Power vs. time for selectable no. of time slots

Frequency/phase Error Measurements
Measurements for selectable time slot
Min., max., average, current values

Spectrum Measurements
Modulation spectrum (for selectable slot)
Spectrum due to modulation (selectable slot)
Spectrum due to switching transients

EDGE TRANSMITTER MEASUREMENTS
The measurement accuracy specified for the base unit applies to the time slot with the highest power level.

Supported Number of Time Slots
Transmitter measurements: 1 through 4

RF Power Conditions
At least 1 time slot at >-20 dBm
Max. adjacent slot power difference: 30 dB

Power Measurements
Peak power for selectable time slot
Min., max., average, current values
8 corner points for selectable time slot
Power vs. time for selectable no. of time slots
MODULATION QUALITY MEASUREMENTS
Frequency error, RMS EVM, peak EVM
95th percentile, origin offset, I/Q imbalance
Min., max., average, current values

Spectrum Measurements
Modulation spectrum (for selectable slot)
Spectrum due to modulation (selectable slot)
Spectrum due to switching transients

GSM RECEIVER MEASUREMENTS
Supported Measurements
Bit Error Rate (BER)
Residual Bit Error Rate (RBER)
Fast Bit Error Rate (FBER, C loop)
Frame Erasure Rate (FER)

Selectable Patterns
Fixed bit patterns, PRBS (PN-9, PN-15, PN-23)

Displayed Results
Current, average, min., max.

Number of Samples
BER 1000 to 106 bits
RBER 10 to 106 bits
Fast BER 100 to 106 bits

Supported Channels
TCH/FS, TCH/EFS

GPRS RECEIVER MEASUREMENTS
Displayed Results
Minimum, maximum, average BLER/BER

Coding Scheme
CS-1
Data
PRBS (PN-9, PN-15, PN-23)

BLER-BCS Measurement
Number of time slots Up to 4
Concurrent TX tests No
Number of blocks 10 to 999

BLER-USF Measurement
Number of time slots Up to 4
Concurrent TX tests Yes, up to 4 time slots
Number of blocks 10 to 999

EDGE RECEIVER MEASUREMENTS
Displayed Results
Minimum, maximum, average BLER

Coding Scheme
CS-1

BLER-USF MEASUREMENT
Number of time slots Up to 4
Concurrent TX tests Yes, up to 4 time slots

ORDERING DETAILS
Aeroflex 4403 Mobile Phone Tester AG 101 105
Aeroflex 4405 Mobile Phone Tester AG 101 104

System Options
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4446 GSM/GPRS Non-Call Mode Option AG 897 298
4447 CDMA2000 1xRTT Non-Call Mode Option AG 897 299
4448 CDMA2000 1xRTT Call Mode Option AG 897 300
4449 EDGE Non-Call Mode Option AG 897 301
4450 TD-SCDMA Non-Call Mode Option AG 897 255
4451 TD-SCDMA Call Mode Option AG 897 256
4452 1xEV-DO Non-Call Mode Option AG 897 287
4453 1xEV-DO Call Mode Option AG 897 288
4454 GPRS Non-Call Mode Option AG 897 302
4455 HSDPA Call Mode Option AG 897 303
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4457 GSM Call Mode Option AG 897 305
4458 GSM Non-Call Mode Option AG 897 306
4460 GSM/GPRS/EDGE Hardware Option AG 248 710
4462 GPRS Call Mode Option AG 897 307
4463 GSM/GPRS System Option AG 248 712
4464 CDMA2000 1xRTT Hardware Option AG 248 711
4466 WCDMA/UMTS Non-Call Mode Option AG 897 248
4467 WCDMA/UMTS Call Mode Option AG 897 249
4468 EDGE Call Mode Option AG 897 308
4479 Baseband Processing Hardware AG 248 690
7312 Lector Enhanced AG 897 310
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General Options
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4474 MS Current Measurement Option AG 248 356
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