

Cellular Parametric Test

6413A Base Station Test System

AEROFLEX
A passion for performance.



- Comprehensive and independent 3GPP FDD Node B test tool for field use
- Designed for installation and commissioning, maintenance, fault-finding, performance verification and new feature testing
- Reduces number of times installation team needs to revisit a cell site
- Tests entire receive and transmit paths from RF to Iub
- Manufacturer-specific Iub control enables complete measurement capability
- Enables network operators to maintain Quality of Service obligations
- Full support packages to keep up to date with Node B enhancements

Comprehensive on-site testing of Node Bs using real-world scenarios, both at initial installation and then during ongoing maintenance, plays a vital role in preventing and solving performance problems before they impact on subscribers. Thorough testing also gives network operators greater confidence in the quality of the deployed network.

Poorly performing Node Bs have a significant impact on the Quality of Service experienced by users of 3G networks. Whether it is caused by incorrect configuration or installation, a gradual degradation in performance or complete failure of a particular module, the end result is that subscribers will suffer a poorer performance and be less satisfied with their service provider.

The Racal Instruments Wireless Solutions 6413A is designed specifically for network operators. A single-box portable solution, it is able to take complete control of the Node B via the Iub interface and perform all of the critical transmitter, receiver and functional tests without external control equipment or need for detailed knowledge of the Node B operation and control.

The 6413A MMI is intuitive to use. Based around an embedded PC and using touch-screen controls, all functions can be operated from the front panel. Measurement results can be viewed while tests are running or stored for later analysis. Tests can be run manually or automatically using pre-programmed test sequences.

Measurements are performed in line with the recommendations of 3GPP TS25.141.



BUILDING ON GSM EXPERIENCE

For more than 10 years, Racal Instruments Wireless Solutions 6113 GSM Base station test sets have been regarded as the industry standard and are used by virtually every network operator around the world.

The combination of transmitter, receiver and functional tests together with built-in manufacturer specific A-bis control has consistently delivered the test capabilities demanded by the mobile communications industry.

The fact that cell sites can be located anywhere - from inside buildings to the tops of hills - makes it vital that test equipment is designed to be portable and rugged.



Typical Cell Site

Based on our experience and knowledge of network operators' needs, the 6413A has been designed to meet test needs as 3G networks are rolled out and is also able to be used wherever cell sites are located. Key to this has been to ensure that the 6413A is portable and sufficiently rugged for field use.

MANUFACTURERS SUPPORTED

What sets Aeroflex products apart from other test equipment companies is the ability to comprehensively control the base station from the test instrument and make full receiver measurements. This is done by the inclusion of manufacturer-specific O&M control software. This gives a benefit in terms of more comprehensive testing, significantly simplifies operation of the test equipment and enables far greater automation.

The 6413A is able to test Node Bs from the following manufacturers:

- Ericsson
- Nokia
- Nortel
- Siemens

For information about other manufacturers and specific Node B types, please contact Aeroflex. Additional manufacturers will be added as enhancements to the 6413A.

CDMA VERSUS GSM TECHNOLOGY

Networks using CDMA technology behave differently compared to GSM networks. For example, as the load on the cell increases, the coverage radius shrinks (known as cell breathing). This will create new challenges for cell planning and optimization. If either the transmitter or receiver on the Node B is performing incorrectly this can also impact on the effective cell size. A network operator needs to be able to guarantee that when a new Node B is installed the performance is correct so that the actual cell site coverage matches the planned coverage. If not, planning models, capacity and network efficiency will all be lower than planned and subscribers are more likely to experience dropped calls or find themselves in areas with no signal.

Cell planning and optimization assumes that the network infrastructure is performing correctly. However, if it is not, problems could lead to either incorrect decisions being made about the optimum cell planning or gaps appearing in the coverage. This could result in increased capital expenditure because more Node Bs are installed than necessary or loss of revenue from the gaps in coverage and higher subscriber churn.

By ensuring that Node Bs are performing correctly, an important unknown is removed from the equation.

TESTS SUPPORTED - TRANSMITTER TESTS

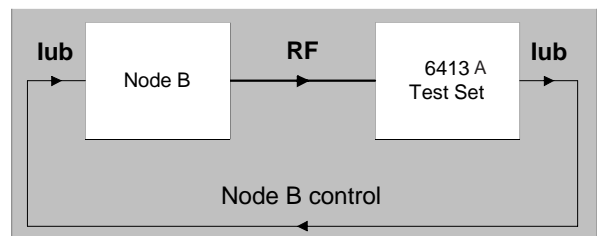
Problems with the Node B transmitter can have a number of impacts:

- Reduction in effective cell size because output power is lower than expected.
- Interference with adjoining cells leading to a reduction in overall network capacity.
- An increase in dropped calls because of poor signal quality.
- Interference with other operators resulting in potential breach of spectrum licence conditions

The 6413A enables network operators to pro-actively avoid these types of problems by offering a number of transmitter measurements:

- Maximum output power
- Frequency error
- Error Vector Magnitude (EVM)
- Peak Code Domain Error (PCDE)
- Adjacent Channel Leakage Ratio (ACLR)
- CPICH power accuracy
- Spectrum monitor
- Occupied bandwidth

Each of these is described in further detail in the section "Measurements".



Transmitter test measurement setup

Once configured for the network (which is usually a one-time operation), the 6413A is very simple to use. Using the built-in Iub controller, it takes complete control of the Node B and automatically sets it up to transmit known signals which are then measured by the 6413A.

To ensure maximum flexibility, the 6413A can also perform Node B transmitter tests without using Iub control.

RECEIVER TESTS

The 6413A's unique capability to control the Node B via Iub as well as decode information transmitted from the Node B on the Iub interface

enables BER measurements to be made which are required for the key receiver measurements. Problems with the Node B receiver can have the following impacts:

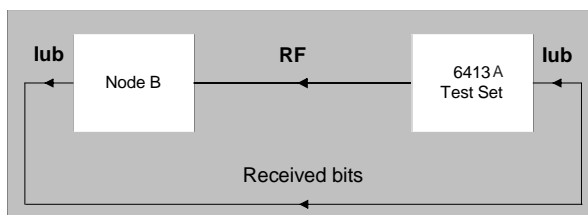
- An increase in dropped calls at the edges of the cell due to poor sensitivity.
- An increase in dropped calls because of poor signal quality.
- Inability of subscribers to utilize value-added higher data rate 3G services because of poor signal quality.

Knowing the exact sensitivity of the Node B can also benefit operators. As with their GSM equivalents, many Node Bs will actually perform better than the required specification. If this can be accurately characterised, an operator can take advantage of this to improve network capacity and reduce the number of Node Bs required in a given area.

The 6413A is able to make the following receiver tests to prevent these issues:

- Reference sensitivity level
- Absolute sensitivity level
- Dynamic range

Each of these is described in further detail in the section "Measurements".



Receiver test measurement setup

Operation is as simple as transmitter testing. Once the 6413A has been configured for the network, the 6413A acts as an RNC and configures the Node B to expect certain signals at its receiver and then transmit the received data via the Iub to the 6413A. The 6413A then performs BER measurements to allow sensitivity and dynamic range measurements to be made on the complete receive path.

FUNCTIONAL TESTS

Besides testing the transmit and receive paths, the 6413A is also able to carry out a functional test of the complete Node B. This gives the engineer the ability to confirm that the Node B is not only working correctly, but also that the configuration of the Node B correctly matches the network configuration. As a result, the engineer can leave the site with greater confidence that the Node B is functioning as expected. The following functional test is available:

- Configure Iub interface

Additional functional tests will be added as enhancements to the 6413A.

MEASUREMENTS

The following are some of the tests that are offered as the standard test package for the 6413A. Additional tests will be added as part of the ongoing software support for the 6413A.



TRANSMITTER TESTS

Maximum output power

The 6413A has been designed to connect directly to the RF output of the Node B. It can measure Node Bs with a maximum rated output power between 0 and +46 dBm without the need for external attenuators.

Frequency Error

The 3GPP specifications require that a Node B transmitter is within ± 0.05 ppm of the assigned frequency. The 6413A makes an accurate measurement to verify the frequency stability of a transmitter.

Error Vector Magnitude

By using powerful DSP technology the 6413A demodulates and decodes the signal to provide an accurate base from which to calculate the EVM. The test is carried out in accordance with the recommendations in the TS 25.141 conformance specifications.

Peak Code Domain Error

Code Domain Error indicates the error between each received code channel and its ideal representation. The 6413A displays the worst case error for all of the received code channels, otherwise known as Peak Code Domain Error. This also meets the requirements of TS25.141.

Adjacent Channel Leakage Ratio

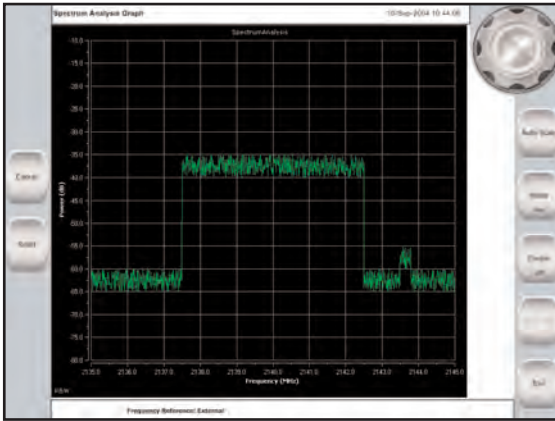
Adjacent Channel Leakage Ratio is a measure of the spectral spreading of the transmitted signal. The 6413A measures the on-channel power relative to the power in the upper and lower adjacent channels at both 5 MHz and 10 MHz offsets, in accordance with TS25.141.

CPICH Power Accuracy

The Code Domain Power of the primary Common Power Channel, CPICH, averaged over one frame is measured for power accuracy relative to its value as indicated on the Broadcast Channel, BCH, in accordance with TS25.141.

Spectrum Monitor

To aid fault-finding, the 6413A includes a spectrum monitor to allow engineers to view the Node B output across several channels.



Occupied Bandwidth

This is a useful measurement to ensure that the Node B does not occupy an excessive bandwidth and therefore cause interference with other users of the adjacent spectrum or cause the network operator to breach its licence conditions.

RECEIVER TESTS

Reference Sensitivity Level

The reference sensitivity test provides a single uplink channel at minimum power to the Node B's receiver, simulating a mobile at the edge of the cell under ideal propagation conditions. If the Node B can decode the signal and meet the BER requirement, its small signal performance is good.

The 6413A signal generator operates down to -125dBm enabling engineers to make reference sensitivity level measurements that match conditions experienced in the field.

Absolute Sensitivity Level

Reference sensitivity level is useful for determining whether a Node B meets the required 3GPP specification of -121dBm. However, some Node Bs will perform better than the minimum specification and an operator can take advantage of this to increase Quality of Service or network efficiency.

The 6413A can indicate absolute sensitivity levels down to -130dBm allowing an operator to take advantage of Node Bs that perform considerably better than the 3GPP specifications mandate.

Dynamic Range

The dynamic range test simulates the scenario where many mobiles are active, by setting up an uplink channel for a single mobile (the wanted signal), along with superimposed Additive White Gaussian Noise (AWGN) to represent the interference from all the other mobiles. The unwanted noise is much greater in overall power than the wanted signal, so the test measures the Node B receiver's ability to extract the wanted signal from the interference with a higher overall power at the Node B's receiver.

The 6413A's internal AWGN generator allows BER measurements to be made with appropriate signal powers and noise levels to verify performance.

AUTOMATED SEQUENCE TEST

Comprehensive and high performance test equipment is all very well if the users have the necessary training and experience to operate it

correctly. But even with skilled users, mistakes can still happen when different people have different interpretations of the way in which tests should be carried out.

The simplest solution to this is to automate the test process. Many GSM operators have found the test sequence mode on the 6113 base station test system to be invaluable in simplifying and accelerating operation of the product. Test sequences also guarantee consistency of measurements whether the testing is carried out by employees of the network operator or by specialist sub-contractors. The 6413A builds on this with automated sequence tests.



Recording an Automated Sequence

The automated sequences allow an operator to record a measurement sequence which can then be replayed as many times as desired to ensure that measurements are carried out in a consistent and repeatable manner. For more complex test requirements, the sequences can also be edited manually.

LOGGING AND VIEWING RESULTS

Measurement results are displayed and continuously updated while any given measurement is being performed. At the same time, all measurement result data is stored in a database so that it can be analyzed at a later date or used for comparing current against historical performance.

For current measurements, where there are pass/fail limits defined in TS25.141, these are shown on the display to give an instant indication of whether the Node B is within specification or not.



EVM Results Display

If preferred, the pass/fail limits for any measurement can be changed to reflect the network operator's particular test specifications.

Once testing is completed, most network operators require that the results are stored for future reference. The 6413A can store this information and also provides the ability to transfer the results data to another PC, either to be added to a central database or to be printed out.

All results can be exported in PDF format to provide an electronic or paper record of the testing that has been carried out. User and Node B information can be added to the report if required. The automatic report generation increases the productivity of the field technician on-site by reducing the amount of additional paperwork or report-writing that needs to be carried out.

6413A Base Station Test System			
Summary			
This report contains the following test results			
Maximum output power	4/11/2005 3:20:47 AM		
Error vector magnitude	4/11/2005 3:21:16 AM		
Occupied bandwidth	4/11/2005 3:21:49 AM		
Multi-mode	4/11/2005 3:25:51 AM		
Test 1			
Maximum output power	Executed at: 4/11/2005 3:20:47 AM		
Test parameters used			
Test Model	Basic Cell (no DPCH)		
Downlink Primary Scrambling Code	0		
TX Diversity	Off		
Downlink UARFCN	10700		
Number of Averages	1		
Local Cell ID	46739		
Uplink UARFCN	9750		
Downlink Power	42dBm		
Expected Relative CPICH Power	-3dB		
Manufacturer	ERICSSON		
Test Mode	Single		
Downlink External Loss	28.6dB		
Max Power Upper Limit	2.7dB		
Max Power Lower Limit	-2.7dB		
Expected Output Power	42dBm		
Measured results			
4/11/2005 3:20:47 AM	MOP	40.138dBm	Pass
Overall test result		Pass	

Extract of a test report

SUPPORT

The 6413A is offered with comprehensive worldwide hardware and software support packages. Different tiers of support packages are offered to the user depending on specific needs and can be customized as required. Regardless of the level of support chosen, users have access to a helpdesk facility where any faults or issues can be logged, and are guaranteed to receive a response from Aeroflex within the next working day.

Support of the system hardware is an essential element in maximizing efficiency and return on investment of your equipment. Aeroflex offers several comprehensive hardware support packages, which are tailored to typical usage profiles. A range of extended warranty and calibration packages are also available.

Node Bs are continually being enhanced and new models introduced. Aeroflex software support packages are designed to ensure that the 6413A remains current and up to date with the latest versions of software being deployed in the network. To get the maximum benefit from the 6413A, it is important that a valid software support contract

is in place. Software updates can be downloaded by the customer from the Aeroflex Customer Download Portal avoiding the need to return units to Aeroflex.

Further details about support can be found in the support section on the Aeroflex website.

SPECIFICATION

TEST CAPABILITY

Transmitter Tests

Maximum output power
 Frequency error
 Error vector magnitude
 Peak code domain error
 ACLR
 CPICH power accuracy
 Spectrum monitor
 Occupied bandwidth

Receiver Tests

Reference sensitivity level
 Absolute sensitivity level
 Dynamic range

Functional Tests

Configure Iub interface

RF SIGNAL SOURCE

Frequency Range

800 to 960 MHz
 1.71 to 2.20 GHz

Resolution

<1 mHz

Output Power

-130 to -55 dBm

Resolution

0.25 dB

Absolute Accuracy (-55 to -125 dBm)

+18° to +28°C: ±1.5 dB
 0° to +45°C: ±2.0 dB

3GPP FDD Mode Frequency Ranges

Band I: 1.92 to 1.98 GHz
 Band II: 1.85 to 1.91 GHz

Impedance

50 Ω nominal

Connector

TNC female

Reverse power

1 W continuous

RF MEASUREMENT RECEIVER

Frequency Range

800 MHz to 2.20 GHz

Measurement Power Range

0 to +46 dBm

3GPP FDD Mode Frequency Ranges

Band I: 2.11 to 2.17 GHz
Band II: 1.93 to 1.99 GHz

Input Power Survival Level

50 W continuous, combined RF and DC power

Impedance

50 Ω nominal

Connector

N-type female

SWR

1.1:1 maximum

DATA RATES

The 6413A platform supports data rates up to a maximum of 2Mbit/s. For initial deliveries, data rates will be:

Uplink: Up to 64 kbit/s
Downlink: Up to 64 kbit/s

The maximum data rates will be increased as part of the ongoing software support of the 6413A.

3GPP FDD MODE NODE B TRANSMITTER TESTS

MAXIMUM OUTPUT POWER

Power Measurement Range

0 to +46 dBm

Absolute Accuracy

+18° to +28°C: ± 1.5 dB
0° to +45°C: ± 2.0 dB

Active Channels

Test Model 1 (16 DPCH)

FREQUENCY ERROR

Power Range

0 to +46 dBm

Frequency Error Range

0 to 500 Hz

Accuracy

$\pm \{12 \text{ Hz} + \text{freq. std error}\}$

Active Channels

Test Model 4 (-3 dB no CPICH)

ERROR VECTOR MAGNITUDE (EVM)

Power Range

0 to +46 dBm

EVM Reading Range

5.0 to 25% RMS

Accuracy

$\pm 2.5\%$ RMS

Active Channels

Test Model 4 (-3dB no CPICH)

PEAK CODE DOMAIN ERROR

Power Range

+10 to +46 dBm

Code Power Range

-30 to -36 dB for each code at SF=256, averaged over 4 readings

Active Channels

Test model 3 (16 DPCH)

ACLR (ADJACENT CHANNEL LEAKAGE RATIO)

Power Range

+10 to +46 dBm

ACLR Range

40 to 48 dB at 5 MHz offset
40 to 60 dB at 1.0 MHz offset

Active Channels

Test model 1 (16 DPCH)

CPICH POWER ACCURACY

CPICH Power Range

+10 to +46 dBm

CPICH Power

-10 dBc for Test Model 2

CPICH Power Error Range

-6 to +6 dB

Active Channels

Test Model 2

SPECTRUM MONITOR

Reference Power Level

0 to +46 dBm

Centre Frequency

800 MHz to 2.20 GHz

Span

12 MHz

Resolution Bandwidth

16.875 kHz

Averaging

1 to 100 or continuous

OCCUPIED BANDWIDTH

Power Range

0 to +46 dBm

Bandwidth Range

4 to 6 MHz

Active Channels

Test Model Basic Cell (no CPICH)

NODE B RECEIVER TESTS

DYNAMIC RANGE

RF Signal Power

-91 dBm/3.84 MHz

AWGN Power

+10 to +35 dBc/3.84 MHz relative to RF signal power; limited to -55 dBm/3.84 MHz max

Absolute Accuracy (for RF signal & AWGN combined)

+18° to +28°C: ±1.5 dB
0° to +45°C: ±2.0 dB

REFERENCE SENSITIVITY LEVEL

RF Signal Power

-125 to -100 dBm/3.84 MHz

Absolute Accuracy (-121 to -115 dBm/3.84 MHz)

+18° to +28°C: ±1.5 dB
0° to +45°C: ±2.0 dB

ABSOLUTE SENSITIVITY LEVEL

RF Signal Power

-130 to -55 dBm/3.84 MHz

IUB INTERFACE

Format

E1, T1, J1, STM-1

E1 interface

120 Ω balanced, 4 x RJ48C connectors

120 Ω to 75 Ω balanced to unbalanced convertor available as accessory

STM-1 Interface

Single mode 1300 nm

INTERFACES

Timing Markers

Timing signals are used to correlate the 6413A internal system time with external timing events and vice versa. One input and one output are supported.

Marker In Resolution

$(12 \times 10^6)^{-1}$ s (approx 83 ns)

Marker Out Clock Frequency Range

24 to 36 MHz

Marker In and Out Connectors

BNC female

Ethernet, USB and serial

USB: 2 ports, Revision 2.0 compatible, Support connection of mouse, keyboard or USB memory drive

Ethernet: 2 ports, 10Base-T, 100Base-TX, 1000Base-TX formats

RS-232: 1 port, RJ45 connector, 9600 baud rate

DIMENSIONS, ENVIRONMENTAL AND SAFETY

Typical Weight (excluding accessories)

18.5 kg

Width x Height x Depth

380 x 245 x 450 mm

Voltage Range (AC)

85 to 130 V & 180 to 264 V

Frequency Range

45 to 66 Hz

Power Consumption

330 W max

Operating Temperature

0° to 45°C

Storage Temperature

-40° to 70°C

Altitude Range

0 to 2000 m

Humidity

0 to 75% (non-condensing), (when used with the Padded Environmental Carrying Bag Option 6413-Opt61)

Calibration Interval

1 year

Safety

Complies with EN61010-1:2001

Overvoltage Category II, Pollution Degree 2

EMC

Complies with EN61326-1:1997+A1:1998+A2:2001, Class A (emissions)

EN61326-1 :1997+A1 : 1998+A2:2001, Table 1 (immunity)

Environmental Classifications

According to EN60721 'Classification of environmental conditions'

Exceeds the requirements of BS EN60721-3-7: 1996 'Portable and non-stationary use', classification IE72.

Exceeds the requirements of BS EN60721-3-7: 1996 'Portable and non-stationary use', classification IE73 (when used with the Padded Environmental Carrying Bag Option 6413-Opt61)

Exceeds the requirements of BS EN60721-3-2: 1997 'Transportation', classification IE23 (in transit packaging)

Exceeds the requirements of BS EN60721-3-1: 1997 'Storage', classification IE11

ORDERING INFORMATION

HARDWARE

6413A Base Station Test System

CELLULAR STANDARD SOFTWARE

Should be specified on all units

6413-FDD 3GPP FDD mode R99

6413-R5 3GPP FDD mode R99 and R5

Iub INTERFACES

At least one should be specified

6413-E1T1 E1/T1/J1 Iub protocol module

6413-STM1 STM-1 optical Iub protocol module

MANUFACTURER-SPECIFIC CONTROL SOFTWARE

At least one should be specified. A software support option must also be ordered for each control software option. Please specify the Node B Manufacturer's software version used on the network at time of order.

6413-ERIC Ericsson software

6413-NOK Nokia software

6413-NORT Nortel software

6413-SIE Siemens software

ACCESSORIES

6413-Opt61 Environmental protection case

6413-Opt62 Rigid transit case

6413-Opt64 Front panel protection cover

6413-BALUN Single G.703 120 Ω to 75 Ω convertor

USB-DRIVE 128MB USB memory drive

USB-HUB USB hub

USB-488 USB-IEEE488 converter

USB-PRINT USB-Parallel printer converter

Aeroflex is able to provide a range of cables and adapters if required. Please contact Aeroflex for further information.

SUPPORT OPTIONS ORDERING INFORMATION

CALIBRATION AND EXTENDED WARRANTY OPTIONS

All 6413A units come with one year warranty as standard. Longer warranty periods may be ordered if required. The calibration interval is 1 year.

CALFB6413A Calibration certificate

W6413A/203C Extended standard warranty 36 months with 2 scheduled calibrations

W6413A/205C Extended standard warranty 60 months with 4 scheduled calibrations

Silver and Gold service contracts are also available in some countries and provide enhanced levels of support including loan units during repair. For further information, please contact Aeroflex.

SOFTWARE SUPPORT OPTIONS

Provides support for first cellular standard software and first Iub control software.

6413-S1 One year Software Support

6413-S2 Two year Software Support

6413-S3 Three year Software Support

If more than one cellular standard or manufacturer's software option is fitted then a second 'S' charge is payable on each subsequent option. E.g. A unit with 2 cellular and 2 Iub options would require one 6413-S1 and two 6413-SS1 for one year software support

6413-SS1 One year Second Software Support

6413-SS2 Two year Second Software Support

6413-SS3 Three year Second Software Support



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