

LTE

7100 Digital Radio Test Set

AEROFLEX
A passion for performance.



Advanced R&D test tool for LTE UE

- Bench-top instrument with embedded PC and large touch-screen display
- 6 GHz frequency range, covering all LTE spectrum allocations
- Supported Modes: LTE FDD and TDD*
- Integrated -3GPP Rel-8 LTE compliant Physical Layer and Protocol Stack included
- Comprehensive suite of RF parametric measurements
- Protocol logging and analysis
- Inter RAT handover support*
- Automatic network simulation
- Functional testing
- End-to-end IP packet data test
- Speed and precision for end-of-production line quality tests

LTE is the standard for mobile communications developed by the 3GPP standards development organization to meet the requirements of the Next Generation of Mobile Network (NGMN) operators. The standard, Rel-8 of the 3GPP specifications and referred to as E-UTRAN (Enhanced Universal Terrestrial Radio Access Network), introduces many changes in both the radio interface and the system architecture. The purpose of the changes is primarily targeted at increasing user data rates and reducing packet latency, providing a user experience more similar to wireline broadband services. In addition, LTE addresses issues relevant to the efficient and cost-effective operation of an advanced high-speed radio network: spectrum efficiency, lower cost-per-bit, seamless mobility, reliability. In addition, co-existence and compatibility with current and legacy technologies are required, allowing for the gradual roll-out of network coverage without disrupting existing, revenue-earning service.

To achieve these requirements, a major change in technology has been required. LTE networks are entirely packet-switched, allowing a wider range of services to be readily supported through the use of TCP/IP-based standards. At the radio interface, OFDMA is used in flexible bandwidth deployments and the L2 and L3 are optimized to reduce signaling overheads. The network topology has been flattened to reduce the number of interfaces, reducing end-to-end packet delays across the system. As a result, a new generation of test equipment has emerged to meet the demands of development teams working on terminals designed to meet the requirements of the next generation networks.

7100 Overview

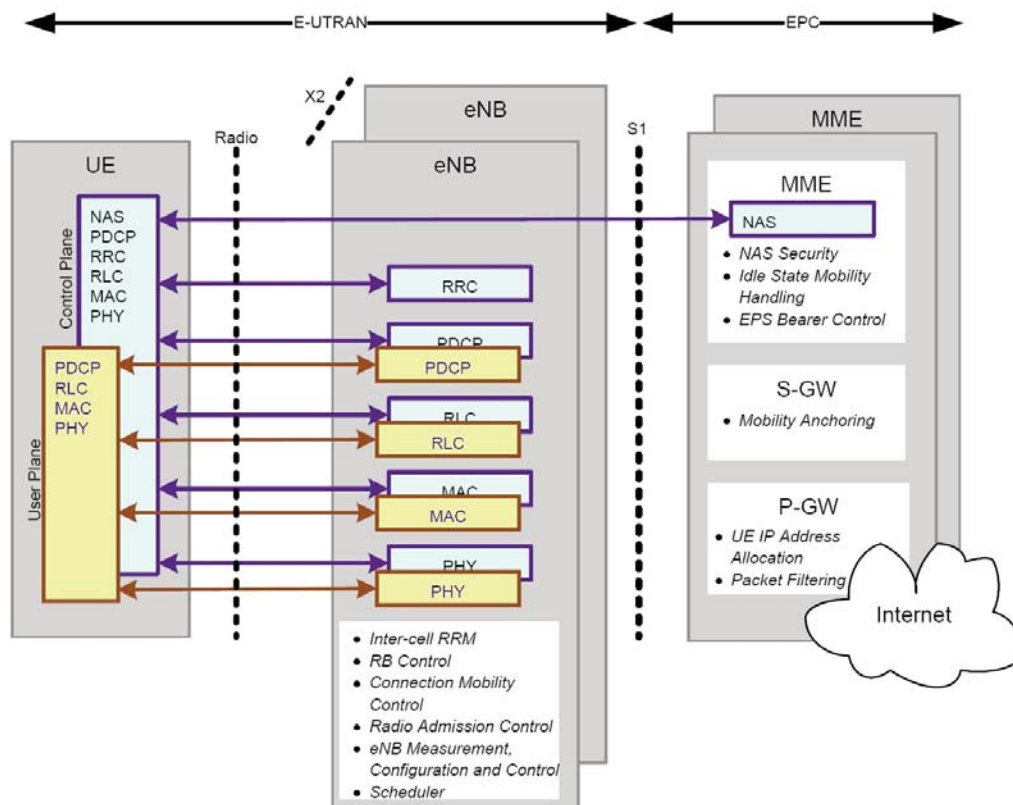
The Aeroflex 7100 LTE Digital Radio Test Set is an innovative hardware platform to support software defined instrumentation, providing a flexible platform for support of multiple wireless technologies. This combined with an intuitive touch screen GUI establishes the 7100 as the platform of choice for future wireless test technology. Released to support the design and development of LTE mobile devices it provides all the tools required during the design, development and test stages of UE chip sets and terminals meeting the new Rel-8 standards. All the key measurements are provided for characterizing the performance of LTE mobile devices, both at the radio interface and throughout the protocol stack, including the PDCP and IMS layers. With the 7100's Network Simulation mode, end-to-end performance can be accurately assessed, along with correct idle mode and connected mode behaviour.

The 7100 protocol stack has been designed to allow testing to build up in a logical fashion. Testing is possible at each sub-layer, eg MAC-to-MAC, RLC-to-RLC etc, in the absence of the upper layers.

Typical users of the 7100 LTE Digital Radio Test Set include RF developers, protocol stack teams, integration test groups and pre-conformance labs that are developing sub-systems and integrated designs that meet the requirements of the LTE standards. The 7100 also supports end-of-production-line manufacturing test, allowing sample tests on high-volume production lines to be executed. These teams benefit from the ease of use, comprehensive test capability, speed and low cost of ownership offered by the 7100.

LTE PHYSICAL LAYER FEATURES AND CAPABILITY

The 7100 simulates the E-UTRAN and EPC (Evolved Packet Core) to provide a realistic test environment for LTE terminals. Test procedures control the characteristics of the simulated network to allow a wide range of repeatable test scenarios to be created.



An RF interface, suitable for direct cable connection to the device under test is provided. The interface has the following features:

- All E-UTRA frequency bands (currently Bands 1 to 40)
- UE Power classes supported: 1 to 4
- Channel bandwidths: 1.4, 3, 5, 10, 15 & 20 MHz
- Sub-carrier bandwidths 7.5 KHz and 15 KHz
- Second RF Carrier
- 2×2 MIMO*
- Uplink frequency hopping
- Fading and AWGN
- OFMDA downlink
- SC-FDMA uplink
- QPSK, 16QAM & 64QAM downlink modulation schemes
- QPSK, 16QAM uplink modulation schemes
- One-third rate Turbo Coding
- Normal Cyclic Prefix (CP)
- Extended Cyclic Prefix*
- Reference measurement channel
- Loop-back mode*

Physical Channels Supported

Transmits downlink physical channels and signals:

- Physical Downlink Shared Channel (PDSCH)
- Physical Multicast Channel (PMCH)*
- Physical Downlink Control Channel (PDCCH)
- Physical Broadcast Channel (PBCH)
- Physical Control Format Indicator Channel (PCFICH)
- Physical Hybrid ARQ Indicator Channel (PHICH)
- Primary Synchronization signal (P-SCH)
- Secondary Synchronization signal (S-SCH)
- Reference Signals

Receives uplink physical channels and signals:

- Physical Random Access Channel (PRACH)
- Physical Uplink Shared Channel (PUSCH)
- Physical Uplink Control Channel (PUCCH)
- Sounding Reference Signal*

FDD (frame structure type 1) mode

Physical layer procedures:

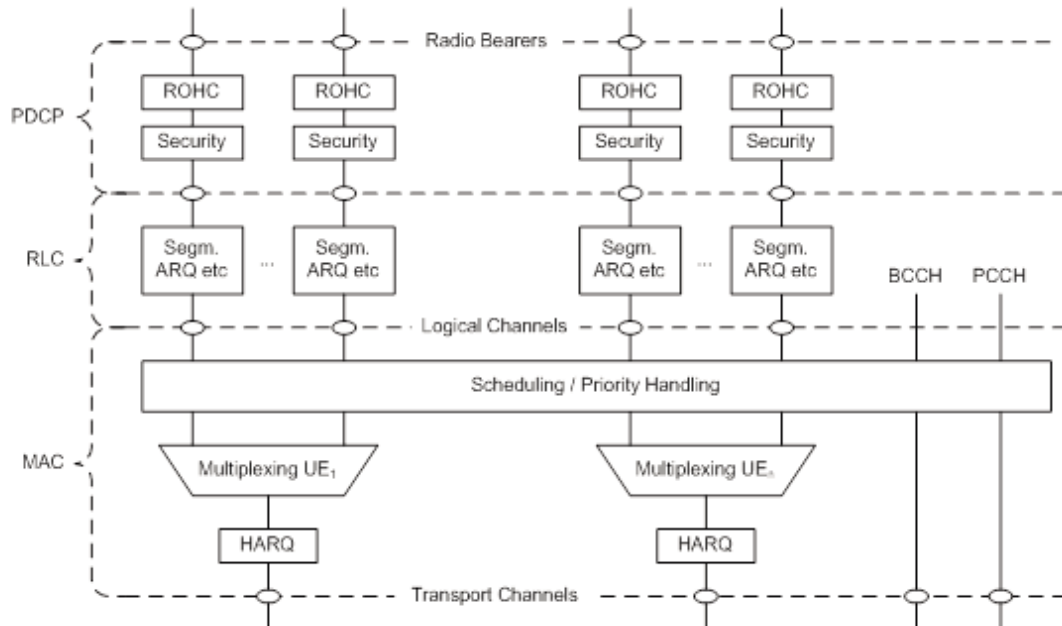
- Cell search
- Power control*
- Uplink synchronization and timing control
- RACH
- HARQ*

PROTOCOL FEATURES

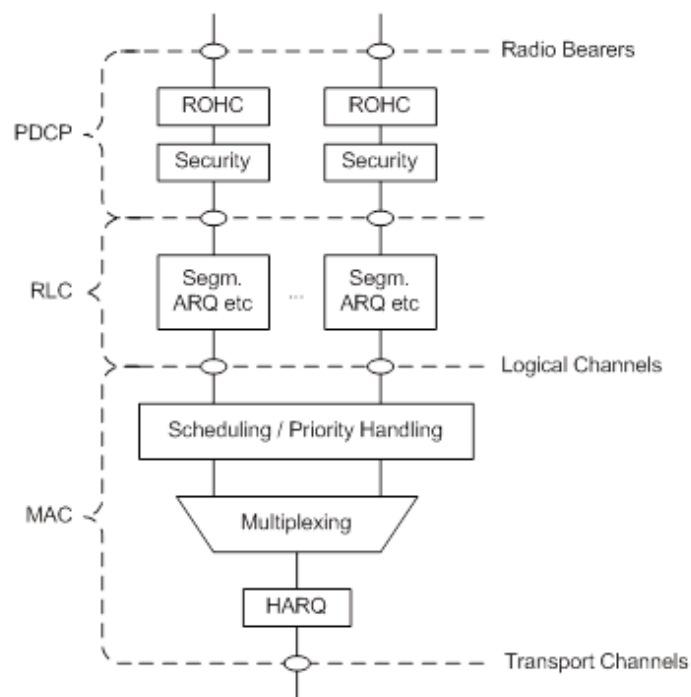
The 7100 includes an integrated LTE protocol stack that is used to establish the required signal conditions for performing RF measurements whilst a call is in process. All the required sub-layers are included in the stack, allowing the RF engineer to concentrate on the measurements without needing to have a detailed knowledge of the protocol. Test configuration options are provided, giving the user control over major parameters such as channel number and power levels.

For protocol testing, the 7100 provides three modes to give the software engineer the ability to fully exercise all aspects of the protocol stack including error handling and timeouts as well as normal behavior.

1. L1/L2 Command Line Mode: Provides precise L1/L2 control
2. Scenario Wizard: Graphical Interface for creating test scenarios using all LTE sub-layers
3. Script Development Environment: using industry standard IDE's (e.g MSVisual Studio) and open 7100 API for complete control



Layer 2 Downlink



Layer 2 Uplink

Protocol Sub-Layers

MAC:

1ms TTI

Type 1 frame structure

HARQ, Normal and TTI Bundling

Logical control channels:

Broadcast Control Channel (BCCH)

Paging Control Channel (PCCH)

Common Control Channel (CCCH)

Multicast Control Channel (MCCH)*

Dedicated Control Channel (DCCH)

Traffic channels:

Dedicated Traffic Channel (DTCH)

Multicast Traffic Channel (MTCH)*

RLC:

Transparent Mode (TM)

Unacknowledged Mode (UM)

Acknowledged Mode (AM)

PDPC:

Robust Header Compression (RoHC)*

Ciphering and integrity protection

RRC:

Supports all RRC protocol states and state transitions

RRC_IDLE

RRC_CONNECTED

Configurable system information

NAS:

NAS message transfer with and without concatenation with RRC messages

User-defined message transfer*

IMS:*

Support for VoIP call control procedures

Context establishment

CSCF discovery

Registration and de-registration

Emergency calls

Invalid behavior

IPv4 and IPv6* support

MBSFN*

TEST FEATURES

The 7100 LTE Digital Radio Test Set provides a comprehensive range of tests covering both Protocol and RF measurements, as well as system-level functional and performance tests.

The RF tests are a mixture of standard parametric measurements (for example spectrum analysis) and LTE-specific, 3GPP-defined test procedures, as specified in TS 36.521. These tests use the protocol stack built into the 7100 LTE Digital Radio Test Set to configure the appropriate test conditions. The tests cover transmitter, receiver and performance measurements. The list below shows the range of tests available:

Transmitter tests

Uplink SC-FDMA signal analysis

Maximum Output Power

Complementary Cumulative Distribution Function

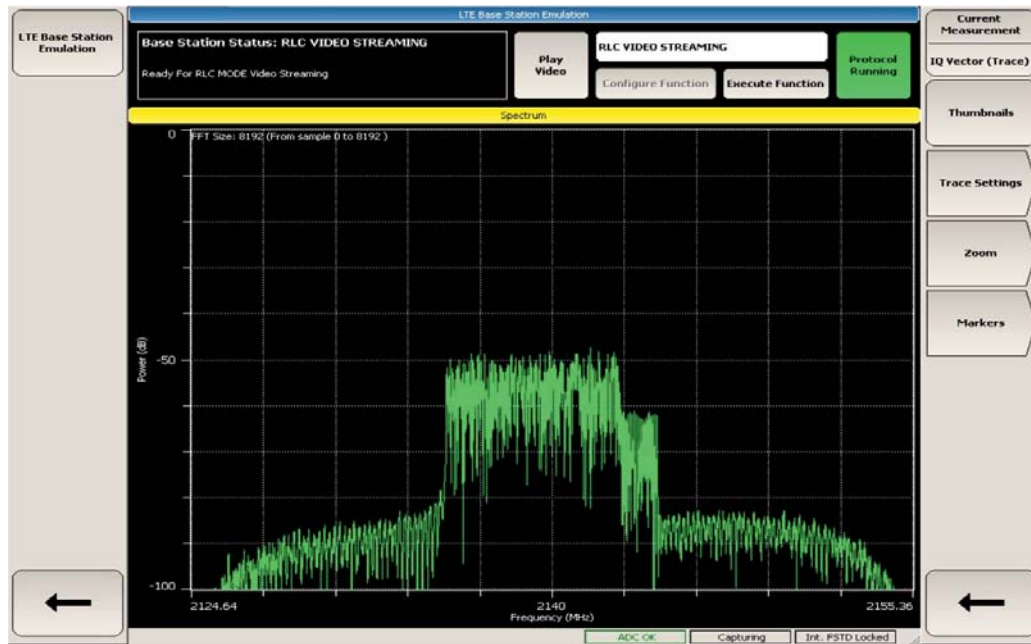
Frequency Error

Occupied Bandwidth

Spectrum Emission mask

Adjacent Channel Leakage Ratio

Transmit signal quality: Composite EVM, Data EVM, pilot EVM



Receiver Tests

Reference Sensitivity

Protocol tests

Cell selection

RRC connection & release

Context activation & release

Location update

Session establishment (UE originating, UE terminating*)

Session release (UE originating, UE terminating)

Ciphering

Handover (channel change) interruption time*

Transmit timing accuracy*

Measurement reporting

NAS message transfer

End-to-end tests

Data throughput

Voice over IP call*

Packet latency

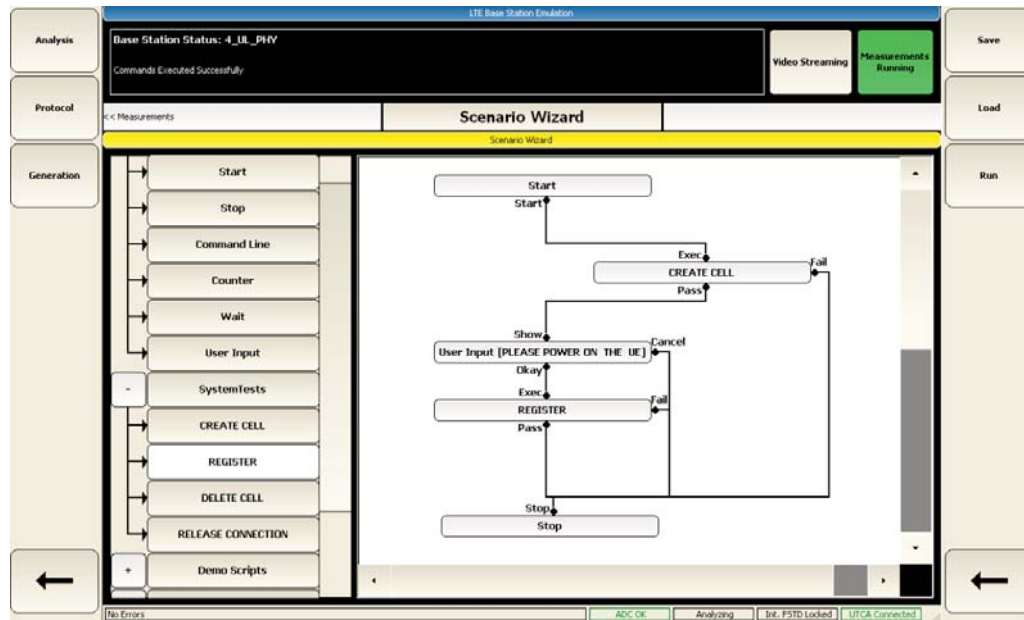
User-corrupted packets

Back-to-back test configuration (requires 2 units)

* Future Release

USER INTERFACE

The 7100 user interface is based on a large (12.1") LCD touch-screen, providing an innovative and easy-to-learn means of accessing all functionality very quickly. Large, clear screens provide clear unambiguous graphical information. Up to four measurements can be simultaneously displayed, providing comprehensive insight into the signal being analyzed.



The touch-screen interface presents familiar-looking soft 'keys' for accessing configuration menus as well as allowing easy on-screen dragging to define marker positions, zoom regions, axis re-scaling amongst other functions. The touch screen provides an intuitive and easy to use test system. In addition to the touch screen the 7100 can be fully controlled by a mouse and keyboard. A monitor port is available for other display alternatives.

Post-Sales Support

Support of the instrument is an essential element in maximizing efficiency and return on investment of your equipment. There are several features of the support available, including routine hardware calibration and warranty support for repairs plus software support, essential for keeping your equipment up to date. Hardware and software support for the first two years of ownership are included in the purchase price of the 7100.

With a new technology such as LTE it is essential to track changes in the 3GPP standards. Software updates for the 7100 are made available via the internet-based Aeroflex Customer Download Portal. Under the software support scheme you will be provided with an account, giving instant, round-the-clock access to all relevant releases, updates and release notes. Subscribing to the software support service is a very efficient and effective way to keep up to date.

The support service also provides access to the Aeroflex Helpdesk, which provides the first point of contact in case of a need for support. The Helpdesk provides a guaranteed response, allocating a reference number for internal tracking of progress and reporting.

Due to Aeroflex's global presence, technical support is available in region to help you get the best out of your instrument. Local, factory-trained Application Support Engineers keep you up to date via phone calls, e-mail or, if necessary on site visits.

Users can elect to purchase the 7100 LTE Digital Radio Test Set with optional warranty extensions. Standard Extended Warranty provides either 36 months or 60 months warranty period plus the benefits of guaranteed product repair times in the event of failure. Standard Extended Warranty can also be provided inclusive of scheduled calibration.

On request Aeroflex can provide customized Premium Warranty support designed around your specific needs.

SPECIFICATION

SIGNAL GENERATOR

FREQUENCY

Range

70 MHz to 6 GHz continuous

Resolution

Up to 3 GHz: 1 Hz

Above 3 GHz: 2 Hz

Accuracy

As per frequency reference

LEVEL

RF In/Out port

Output level

CW -8 dBm 70 MHz to 3 GHz, -14 dBm 3 GHz to 3.5 GHz, -16 dBm 3.5 GHz to 5 GHz, -19 dBm 5 GHz to 6 GHz

PEP -11 dBm 70 MHz to 3 GHz, -17 dBm 3 GHz to 3.5 GHz, -19 dBm 3.5 GHz to 5 GHz, -22 dBm 5 GHz to 6 GHz

-25 dBm Modulated RMS with 14 dB PAR 70 MHz to 3 GHz, -31 dBm 3 GHz to 3.5 GHz, -33 dBm 3.5 GHz to 5 GHz, -36 dBm 5 GHz to 6 GHz

Max Reverse Power: +33 dBm

VSWR: 1.3:1, 70 MHz to 3 GHz, 1.5:1, 3 GHz to 5 GHz, 1.6:1, 5 GHz to 6 GHz

RF Out port

Frequency Range: 1 MHz to 6 GHz

Output level

CW 0 dBm 1 MHz to 3 GHz, -6 dBm 3 GHz to 5 GHz, -7 dBm 5 GHz to 6 GHz

PEP -3 dBm 1 MHz to 3 GHz, -9 dBm 3 GHz to 5 GHz, -10 dBm 5 GHz to 6 GHz

-17 dBm Modulated RMS with 14 dB PAR 1 MHz to 3 GHz, -23 dBm 3 GHz to 5 GHz, -24 dBm 5 GHz to 6 GHz

Max reverse power: +27 dBm

VSWR: 1.5:1, 1 MHz to 5 GHz, 1.6:1, 5 GHz to 6 GHz

Output level accuracy (23°C ±5°C):

<3 GHz typically ±0.4 dB

>3 GHz typically ±0.7 dB

SPECTRAL PURITY

SSB Phase Noise

Typical at 2 GHz and at ambient room temperature: -115 dBc/Hz at 20 kHz offset

Phase noise below 100 Hz offset is dependent upon reference phase noise.

Typical phase noise at 5 GHz -108 dBc/Hz 20 kHz offset

Noise Floor (10 MHz offset from 2 GHz)

Typically -140 dBc/Hz

Non-Harmonic Related Spurious

Typically -60 dBc at >10 kHz

Typically -65 dBc at >10 kHz offset for CW signals

Sub harmonics

-30 dBc, typically -55 dBc

Harmonics

2nd Harmonic: <-28 dBc, (typ -40 dBc)

3rd Harmonic: <-30 dBc, (typ -55 dBc)

SIGNAL ANALYZER

FREQUENCY

Range

70 MHz to 6 GHz

Resolution

Up to 3 GHz: 1 Hz

Above 3 GHz: 2 Hz

Measurement Bandwidth

Maximum instantaneous bandwidth: 90 MHz

Accuracy

As per frequency reference

LEVEL

Maximum RF input

RF In/Out Port:

+33 dBm

RF Input Attenuator

0 to 31 dB in 1 dB steps

IF attenuator

0 to 35 dB in 1 dB steps

Level Accuracy (23 °C ±5 °C):

RF In/Out Port:

<500 MHz, typically ±0.6 dB

500 MHz to 3 GHz, typically ±0.4 dB

>3 GHz, typically ±1 dB

SPECTRAL PURITY

SSB Phase Noise

Typical at 2 GHz and at ambient room temperature: -116 dBc/Hz at 20 kHz offset

Phase noise below 100 Hz is dependent upon reference phase noise.

Typical phase noise at 5 GHz: -108 dBc/Hz 20 kHz offset

LINEARITY AND NOISE

Intermodulation

Typically 75 dB intermodulation free dynamic range (2 tone input with maximum +14 dBm input power for each tone)

Adjacent Channel Leakage Ratio

Better than 60 dB ACLR on 3GPP (downlink test model 1)

Typically 65 dB ACLR on 3GPP uplink

Spurious

Typically -70 dBc

Residual Responses (No Input)

<-81 dBm, typically -86 dBm to 3 GHz with RF input terminated into 50 ohms and minimum RF and IF attenuation

<-78 dBm, typically -83 dBm 3 GHz to 5 GHz,

<-76 dBm, typically -81 dBm 5 GHz to 6 GHz

FREQUENCY REFERENCE

Frequency

10 MHz

Aging Rate

1 in 10⁹ per day, 1 in 10⁷ per year.

Temperature Stability (0 to 50°C)

Typically better than ±1 × 10⁻⁸

Warm up Time

<5 minutes

For the very latest specifications visit www.aeroflex.com

SPECTRUM ANALYZER MEASUREMENTS

Frequency span

Variable between 2 kHz to 200 MHz and zero span, Resolution 1 Hz

RBW

Variable between 1 Hz to 10 MHz, Resolution 1 Hz

Window Type

NEBW: Gaussian 3 dB: Gaussian fixed: Blackman Harris 5 term

Sample Time

Up to 333 seconds resolution 1 ns

LTE MEASUREMENTS

This section will be expanded as specification 3GPP TS 36.521-1 is developed.

Tx Measurements

Occupied Bandwidth

Percentage range: 1% to 99.99%

CCDF

Peak to Average power distribution

Markers

4 markers plus delta marker

Marker Functions

Marker peak search, next peak, peak track

Power and time

Frequency and time

Traces

Live, avg, max. min. hold

Spectrum trace

Power versus time trace,

ACLR

Spectrum emission mask

EVM, including EVM/Symbol and EVM/subcarrier

Frequency error

IQ component (Origin offset or carrier leakage power)

INTERFACES

RF

Front panel

RF In/Out: Duplex port N Type

RF Out: RF output N Type

Rear panel

Freq standard: 10 MHz I/O BNC rear panel

Trigger input TTL BNC (Trigger Generator, Trigger Analyzer, System Trigger)

Connectivity

Front panel

2 x USB 2.0 (keyboard and mouse)

12.1" LCD touch-screen display, 1280 × 768 resolution

Ethernet

Rear Panel

VGA, 15 pin D-type connector

2x USB 2.0

Ethernet

Power Supply

Voltage range: 100 to 240 VAC

Frequency range: 50 to 60 Hz

Power consumption: 650 W

GENERAL

Standard Warranty

24 months

Calibration Interval

Recommended 24 months

Electromagnetic Compatibility

EN 61326-1:2006, Emissions Class A, Immunity Table 1

Safety

EN 61010-1:2001 Safety requirements for electrical equipment for measurement, control and laboratory use-Part 1, General requirements

Certification

CE Compliant, Class A

RATED RANGE OF USE

Operating Temperature

0 to 40°C, meets IEC-60068-2-1 and 60068-2-2

Operating Humidity

10 to 90% non-condensing, meets IEC-60068-2-56

WEIGHT AND DIMENSIONS

Dimensions W×D×H

Without handles:

443 mm × 580 mm × 237 mm (17.4" x 22.8" x 9.3")

With handles:

480 mm x 632 mm x 237 mm (18.9" x 24.9" x 9.3")

Mass

Minimum: 21 Kg (46.3 lbs.)

Maximum: 22.5 Kg (49.6 lbs.)

CONDITIONS OF STORAGE AND TRANSPORT

Storage Temperature

-20 to +70°C, meets IEC-60068-2-1 and 60068-2-2

Storage Humidity

5 to 93% non-condensing, tested to IEC-60068-2-56