The most important thing we build is trust

A production ready ATE solution for RF alignment and performance verification

- UE Tx output power
- Transmit power
- PRACH time mask
- Transmit signal quality:
  - Frequency error
  - Error Vector Magnitude (EVM)
  - Spectrum flatness

- Carrier leakage (IQ origin offset)
- In-band emissions for non allocated RB
- IQ skew/gain imbalance
- Symbol clock error
- Output RF spectrum emissions:
  - Occupied bandwidth
  - Spectrum Emission Mask (SEM)
  - Adjacent Channel Leakage power Ratio (ACLR)
  - CCDF

The LTE measurement suite is a collection of software tools for use with PXI 3000 Series RF modular instruments for characterising the performance of LTE FDD and TDD mobile devices in accordance with the methods described in ETSI TS 36.521-1.

Using the measurement suite with PXI 3000 RF modular instruments simplifies test system integration and increases test speed to accelerate new product introduction and lower the cost of test.

The measurement suite is ideal for performing all non signalling mode RF alignment and performance verification measurements for mobile UE production test.
The measurement suite components can be used for applications spanning bench-top manual operation in R&D to high volume production ATE.

- Measurement and analysis component libraries provide programming APIs for highly customized ATE system integration for design validation or production.
- An easy to use and versatile graphical user interface enables bench-top manual operation using PXI Studio 2 for design integration or trouble shooting.
- A test sequencer provides an out of the box production ready ATE solution using PXI Maestro software.

The test sequencing feature provides an off the shelf production ready ATE solution for testing up to four devices in parallel. This includes fully integrated tester and device control providing the user the ability to write and execute a custom test sequence optimised for speed with ease.

The test sequencing feature is an optional extension to the measurement suite used with PXI Maestro software. Full details of PXI Maestro are described in a separate data sheet.

Manual operation uses PXI Studio 2 application software. This intuitive software, common to all measurement suites, allows the user to configure instrument and measurement parameters, execute measurements and display results. Full details are described in a separate data sheet.

LTE FDD and LTE TDD are available as separate 303x digitizer options. In each case analysis is supported for uplink (SC-FDMA) transmissions for all bandwidths, 1.4 MHz, to 20 MHz and modulation types QPSK, QAM16 and QAM64. Measurement results are provided with statistical analysis and various display traces.

To simplify operation an “Auto Detect” feature configures settings for format, modulation type, RB allocation and the demodulated reference signal (DMRS).

EVM analysis for uplink PUSCH, PUCCH and SRS is supported with user control of equalizer settings for pilot time, phase and amplitude tracking.

Analysis can be carried out over contiguous slots or active slots only. This is particularly important when analyzing LTE TDD.

Spectral Emissions can be verified against prescribed or user defined mask limits.
**SPECIFICATION**

**LTE FDD AND TDD**

All specifications are defined when used in conjunction with the 3030 Series PXI RF digitizer with option 107 (FDD) and option 108 (TDD) operating in all E-UTRA FDD and TDD bands. Test sequencing with PXI Maestro additionally requires option 207.

Measurements performed are in accordance with 3GPP 36.521-1 section 6.

LTE FDD and LTE TDD measurement suites are supplied separately.

Specifications are defined with the input signal at the RF digitizer tuned frequency and at the reference level unless otherwise stated.

**CONFIGURATION**

**Frequency**
- User defined frequency (Hz) or preset E-UARFCN bands, 1 to 21

**Level**
- Uplink (DUT output level) (dBm)

**Path Loss Correction**
- Uplink (dB)

**Physical Channel**
- Normal, PRACH

**Nominal Bandwidth**
- 1.4, 3, 5, 10, 15 and 20 MHz

**Sub-frames (link direction)**
- Uplink

**BURST SET UP**

**Burst Type**
- Uplink PUSCH: Normal data

**MEASUREMENT SET-UP**

**Cell ID**
- 0 to 503

**Cyclic Prefix Type**
- Normal or Extended

**EVM Window Position**
- Low, middle or high

**Analysis Mode**
- Random slot or Specific slot

**Spectrum Analysis Mode**
- Measure all IQ data or specified number of slots

**Number of Slots to Analyze**
- Dependent on measurement interval
- Measurements can be performed for slots which are active and also for slots which are active and contiguous.
- 1 to 360

**EVM Enable Conformance Mode**
- On / Off

**Signal Composition**
- Uplink & Downlink or Uplink only
Uplink Cyclic Prefix Type\(^{\text{a}}\)
- Normal or Extended

Downlink Cyclic Prefix Type\(^{\text{a}}\)
- Normal or Extended

\(^{\text{a}}\) Available in LTE TDD only
\(^{\text{b}}\) Available in LTE FDD only

Uplink-Downlink Configuration\(^{\text{a}}\)
- 1 to 6 as defined in table 4.2-2 of 3GPP TS36.211 v8.6.0 (2009-03)

Special Sub-frame Configuration\(^{\text{a}}\)
- 1 to 8 as defined in table 4.2-1 of 3GPP TS36.211 v8.6.0 (2009-03)

Synchronization Slot (for specific slot analysis only)
- 0 to 19

Half Subcarrier Shift
- On / Off

DTX Present\(^{\text{a}}\)
- On / Off

PILOT TRACKING

Phase Tracking
- On / Off

Amplitude Tracking
- On / Off

Symbol Time Tracking
- On / Off

PRACH ANALYSIS SETUP

High Speed Flag
- On / Off

NCS Configuration
- 0 to 15

Logical Root Sequence Number
- 0 to 837 as defined in section 5.7.2 of 3GPP TS 36.211 v8.9.0 (2009-12)

MEASUREMENTS

Start position (in μs)

Preamble ID

Preamble format

On power (dBm)

Leading off power (dBm)

Trailing off power (dBm)

Trailing gap off power (dBm)

RB offset

Trace

PRACH Power vs. Time

Power vs. Frequency
PUSCH SETUP

PUSCH Present
  On / Off

DMRS Dss
  0 to 29

n\textsuperscript{\textnu}DMRS
  0, 2, 3, 4, 6, 8, 9, 10

PUCCH SETUP

PUCCH Present
  On / Off

Delta Shift Dss
  1 to 3

Cyclic Shift
  0 to 7

Resource Index 2
  0 to 1175

Number of Reserved Resource Blocks
  1 to 98

SRS SETUP

SRS Present
  On / Off

Cyclic Shift
  0 to 7

Transmission Combination
  0 to 1

Slot Configuration

RB Auto Detect
  On / Off

Channel Type
  OFF, PUSCH, PUCCH

Number of RBs
  1 to max number of RBs for selected Bandwidth

RB Offset
  0 to max-1

Modulation Type
  QPSK, 16QAM, 64QAM

n\textsuperscript{\textnu}DMRS
  0, 2, 3, 4, 6, 8, 9, 10
MEASUREMENTS

POWER

Average power

Indication
dBm

Measurement Range
Per 3030 Series RF Digitizer maximum input

Trace
Captured power vs. time
Power vs. slot
Power vs. resource block

Accuracy
See 3030 Series module level accuracy spec

FREQUENCY ERROR

Carrier frequency error over one sub-frame excluding the guard period (Cyclic prefix)

Indication
Hz

Accuracy
<±10 Hz + (Freq Standard Error x Transmitter Freq (MHz))

EVM

The difference between the reference waveform and the measured waveform corrected by the sample timing offset and RF frequency offset with origin offset removed.

Indication
% / dB

Exclude Exclusion Period
On / Off

Traces
EVM (rms) vs. sub-carrier
EVM (rms) vs. symbol
EVM (rms) excluding non allocated carriers
Constellation (with /without non allocated carriers)

Measurement Results
EVM (rms)
EVM PUCCH (rms)
EVM PUSCH (rms)
EVM DMRS (rms)
EVM SRS (rms)
EVM Non Allocated Carriers

Indication
dB

Accuracy
<±1%
**IQ COMPONENT**

- IQ Origin Offset (carrier leak) (dB)
- IQ gain imbalance (dB)
- IQ skew (degrees)

**Symbol Clock Error**

ppm

**SPECTRUM FLATNESS**

**Mask Type**

- Normal conditions
- Extreme conditions
- User defined

**Indication**

For each slot analyzed:-

- Mask Pass / Fail
- Mask Upper Pass / Fail
- Mask Lower Pass / Fail

**Traces**

dBr values for each sub-carrier

**SYMBOL CLOCK TOLERANCE**

**Indication**

ppm

**Accuracy**

As per reference frequency

**OCCUPIED BANDWIDTH**

Bandwidth containing 99% of the total integrated mean power of the transmitted spectrum on the assigned channel.

**Indication**

Hz

**SPECTRAL EMISSION MASK**

The spectral density of the transmitted signal should lie within the spectral mask.

The mask is frequency aligned to the maximum spectrum density.

**Mask Type**

General, NS_03, NS_04, NS_06, or User defined

**Measurement BW**

As determined by Mask Type selected.

**Indication**

Global Pass/Fail

The worst case dBc level value and its corresponding frequency relative to the mask are reported.

**Traces**

FFT power spectrum and mask values

**Accuracy**

<±0.05 dB error per 10 dBc

Excluding the effects of noise
**IN-BAND EMISSIONS**

In-band emissions computed for non-allocated resources blocks.

**Measurement Results**

In-band emission measurement (General, IQ Image and Carrier leakage):

Overall Pass/Fail

**Trace**

In-band emission measurement and limits

**MAGNITUDE/PHASE ERRORS**

**Measurement Results**

Magnitude (%) and Phase Error RMS (degrees)

Magnitude (%) and Phase Error RMS PUSCH (degrees)

Magnitude (%) and Phase Error RMS PUCCH (degrees)

Magnitude (%) and Phase Error RMS DMRS (degrees)

Magnitude (%) and Phase Error RMS SRS (degrees)

Magnitude (%) and Phase Error Non Allocated Carriers (degrees)

**Trace**

Magnitude and Phase error vs. Symbol

Magnitude and Phase error vs. Carrier

Magnitude and Phase error vs. Carrier (excluding non allocated carriers)

**Sub Carrier Allocation Trace**

Provide subcarrier allocation information including modulation and channel types.

**ADJACENT CHANNEL LEAKAGE RATION (ACLR)**

**Number Channels**

1 to 15

**Frequency Offset (MHz)**

For each channel offset user specifier

**Channel Type:**

LTE, UMTS, USER*

**Bandwidth**

1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, 20 MHz

**Indication**

Reference channel power (dBm)

Offset channel power (dBc)

**Dynamic Range**

3030C/3035C/3036 typ - 65 dBc

3030A/3035 typ - 68 dBc

**Accuracy**

$\leq0.05$ dB error / 10 dBc

**CCDF (Complimentary Cumulative Distribution Function)**

Trace: Peak to average power (dB) vs. probability (%)
GENERAL

Operating System
Windows Win7/32 bit or Win 7/64 bit

Required Memory
512 Mbytes minimum, 1024 Mbytes recommended

Display Resolution
Minimum 1024 x 768

Other
PXI 3000 Series modules require NI VISA version 4.6 or later (NI Visa 4.2 or later under Windows® Vista).
PXI 3000 Series module drivers version 7.0.0 or later

ORDERING

LTE FDD Measurement Suite
When purchased with a 303x, order as: 3030 option 107
When purchased as an upgrade, then order as: RTROPT107/3030

LTE TDD Measurement Suite
When purchased with a 303x, order as: 3030 option 108
When purchased as an upgrade, then order as: RTROPT108/3030

LTE test sequencing (for use with PXI Maestro)
When purchased with a 303x, order as: 3030 option 207<sup>(c)</sup>
When purchased as an upgrade, then order as: RTROPT207/3030

PXI Studio 2 and PXI Maestro core applications are supplied as standard with PXI 3000 Series modules or may be downloaded from www.cobhamwireless.com/products/validation/modular-instrumentation/

See PXI Studio 2 and PXI Maestro data sheets for more details.

<sup>(c)</sup>Requires either opt 107 or opt 108