Overview

The T4010S CT (Conformance Test) system is the Agilent solution for LTE RF conformance testing of LTE UEs, and part of Agilent Technologies T4010S family of automated RF testers.

The T4010S CT is targeted at laboratories within UE and chipset manufacturers and third party certification test houses. It provides a comprehensive set of tools that help the user through the process of entering Device Under Test (DUT) data into the test system, defining the test plan to be executed, configuring the system to execute the tests according to the specific UE characteristics and finally, analyzing the tests results and producing the associated test reports.

The validation status over an increasing number of bands and the support of GCF and PTCRB specific requirements, together with the complete test system automation capabilities and reduced overall footprint make the Agilent T4010S CT the most competitive test platform to have in any laboratory environment.

Agilent T4010S family of test systems also includes the T4010S DV, providing LTE UE manufacturers with design verification parametric RF testing and pre-conformance capabilities. Since all systems within the T4010S family share the same underlying hardware and software platform, CT and DV versions can coexist on the same test system for maximum convenience and cost-effectiveness.

Features Highlights

The main Agilent T4010S LTE RF Conformance Test System features are listed below:

Easy to use test project management environment for streamlined testing execution and results analysis;

- All hardware configurations support all LTE defined frequency bands up to 3 GHz, out-of-the-box;
- Complete GCF and PTCRB validated test case coverage, with further ongoing validation efforts to increase validated test case and band coverage as new requirements are introduced;
- Reduced operation and maintenance costs, through the use of the most compact and equipment efficient hardware architecture in the market in terms of testing coverage;

- Automated and unattended RF path compensation procedures;
- Test system UE automation capabilities allowing unattended operation of the test system, freeing engineering resources;
- The reporting capabilities of the test system enables clear and direct access to the test result information, providing export capabilities to different formats;
Key Features

Complete 3GPP test case coverage according to GCF and PTCRB requirements

The T4010S CT test system (GCF/PTCRB test platform number 95) provides users with the complete set of 3GPP TS 36.521-1 conformance test cases, validated according to GCF and PTCRB requirements. For an up-to-date list of validated tests, please, contact Agilent Technologies.

These test cases are provided for all duplex/band/bandwidth combinations needed for certification purposes, including bands with different channel bandwidths requirements for GCF and PTCRB.

Versatile and cost-effective hardware

The Agilent T4010S CT is built around the T2010A LTE Wireless Communications Test Set. This powerful multi-RAT network emulator integrates multiple capabilities:

- FDD LTE and TD-LTE network emulator supporting all 3GPP defined bandwidths and bands, up to 3 GHz;
- Integrated LTE UL signal analyzer for in-channel measurements (3GPP TS 36-521-1, chapter 6 test cases);
- Integrated fading channel emulator, for real-life conditions receiver characterization (3GPP TS 36.521-1, chapter 8 and 9 test cases);
- Integrated interferer generator, capable to add AWGN, OCNG and arbitrary interferers to the desired signal (3GPP TS 36.521-1, chapter 8 and 9 test cases);

All together, these capabilities allow the T4010S CT to provide comprehensive LTE RF conformance testing capabilities in a single box configuration.

For out of channel measurements, the set of additional instruments required is minimal. The full configuration of the T4010S CT only requires the following additional instruments:

- External spectrum analyzer, for out-of-channel UE transmitter measurements;
- External CW signal generator, for receiver blocking measurements;
- Agilent T1250A Smart RF Switching Unit, to interconnect all of the above instruments with the T2010A LTE Wireless Communications Test Set and the DUT;

This instrument deserves special mention, since it not only handles the interconnection between the different system components, but also performs RF signal conditioning and filtering; eliminating the need to have dedicated filter banks in the system and allowing a common hardware platform that supports all existing frequency bands up to 3 GHz without the need of any hardware upgrades.

Compared to competing LTE RF test systems, the T4010S CT is the most compact and equipment-efficient test platform available. This leads to reduced maintenance/calibration costs, minimum power consumption (operation costs) and fewer laboratory real-state requirements.
Key Features (continued)

Easy upgrade options to introduce design verification test capabilities

Being based on the same hardware and software platform as the Agilent T4010S DV, the T4010S CT does not only provide test means for verifying conformance requirements, but is also easily upgradeable to support design verification parametric testing with minimal effort.

It is also possible to have both the conformance and the design validation software versions installed at the same time in the platform and switch between one and the other at will.

Outstanding RF measurements accuracy and repeatability

The LTE technology imposes stringent requirements in test platforms in terms of measurement accuracy and uncertainty. Accuracies/uncertainties well below 1 dB are common in the conformance test specification.

Agilent has achieved unprecedented levels of accuracy and repeatability in its T4010S CT. This was achieved by means of revised test system architecture, novel signal processing techniques, the reduction of the number of test system elements and the automation of the RF path compensation routines to minimize the impact of the human test system operator.

In order to improve repeatability and to reduce manual user intervention, the RF path compensation routines can now be executed in a completely automated manner, without the need for a test system operator to be present. Adding the fact that the RF path compensation routines are faster than ever, the T4010S LTE RF Tester family represents a huge step forward in terms system maintainability and down-time reduction.

Comprehensive test system automation capabilities

T4010S CT has been designed with automation in mind, enabling unattended operation to maximize laboratory productivity.

The test system can be configured to automatically control the UE under test, using AT commands. Furthermore, the T4010S can be easily configured to use non-standard, UE-specific command sets. Finally, for those customers with more involved UE automation needs, Agilent provides access to the API used by the tester to implement the UE automation capabilities, enabling customers to develop their own UE drivers to automate the execution of the tests.

Automation in T4010S CT also includes ancillary equipment, like power supplies and climatic chambers, so extreme condition testing can also be performed in a completely unattended fashion.

Results analysis (graphic view) and (tubular view)
The Agilent T4010S family of LTE RF testers covers two distinct hardware configurations, common to both CT and DV versions.

System Components

1 x N9020A MXA
1 x T2010A unit
Option: 1 x E66311B DC PSU
1 x T1250A RF switching unit
1 x E8257D CW SG
1.6 meter height rack

Full tester configuration

Housed in a single rack with a reduced set of instruments, this configuration enables testing of all 3GPP TS 36.521-1 test cases, adding ACS, ACLR, OBW, in- and out-of-band blocking, intermodulation and transmitter and receiver spurious tests to the set of tests supported by the bench-top configuration.

Bench-top configuration

Composed by a single Agilent T2010A LTE Wireless Communications Test Set, this configuration enables testing of more than 70% of the RF conformance test cases in 3GPP TS 36.521-1, including in-channel characteristics of UE transmitter and receiver, as well as receiver performance and CSI tests.
User Interface

The Agilent T4010S CT is delivered with an intuitive and easy to use set of software tools to support the whole testing cycle; from test project creation to results analysis through test execution.

Users are able to select the test cases to be executed from within the test case libraries developed and validated by Agilent Technologies. Different versions of these libraries can be installed at any one time for maximum convenience.

Simple drag and drop operations allow the user to select which test cases shall be run. This sequence of tests can be saved as a custom test plan, for later reuse.

Frequency band, channel bandwidth, specific frequency channels and extreme condition testing settings are automatically configured by the test system based on simple dialog boxes provided by the test system.

Furthermore, if some parameters have to be changed for the execution of the tests, this can be done from the test campaign editor window within the project management tool. The CT version of the T4010S allows the user to select a set of parameters for direct modification, allowing a certain level of test case customization.

Finally, parameters related to the DUT automation, power supply and climatic chamber management and automatic tests retrial can also be set by the test system operator. These are not specific to the T4010S CT system only, but common to most Agilent testing products.

Once the test have been performed, Agilent test systems provide data analysis tools, in both text and graphical views, that ease the processing of the RF measurement results, allowing the export of the data to several formats for easy exchange with all the involved parties.

However, RF measurement results are only one aspect of the output of Agilent T4010S CT. Very often during development it is necessary to debug issues that prevent the measurement process itself to take place. These issues are normally related to protocol IOT problems between the DUT and the test system, either due to incorrect configuration of test system/DUT or due to implementation problems.

The trace/log analysis tool delivered together with the T4010S CT allows quick identification of these issues thanks to its several data views (log, tabular, MSC, etc...) its message decoding capabilities and the depth of the collected data.

Test plan generation
Protocol analysis (MSC view)
Agilent's T4010S LTE Mobile Test Application (T4010S-MTA) is the ultimate tool for development of LTE enabled UEs.

Running on the T2010A LTE Wireless Communications Test Set, the T4010S-MTA test application provides UE and chipset developers with a bench-top LTE network emulator, a multipath fading emulator and uplink signal analyzer, effectively integrating the functionalities required for RF development within a single instrument.

T4010S-MTA also supports the development of LTE UEs from early component testing, to integration phases, thanks to the flexible signal generation and analysis approach provided in its non-signaling operation mode.

Receiver measurements based on HARQ feedback are also available in the T4010S-MTA which, together with the integrated channel emulator, provides users with a complete receiver characterization test suite on a bench-top instrument.
LTE UE receiver measurements

The ability of the MTA to modify cell power level, AWGN, multipath fading emulation and antenna correlation during measurements without the need to drop the UE off the network makes the use of this accessory tool a key enabler in the receiver performance analysis and benchmarking. MTA also exposes the capability to exercise and measure the accuracy of the measurement reports (RSRP and RSRQ) and Channel State Information (CSI) reported by the UE.

Powerful LTE UL signal analyzer functionality

The T4010S-MTA provides developers with an embedded UL signal analyzer with advanced signal analysis capabilities (channel power, constellation, spectrum flatness, CCDF, etc). The user can easily change the reference measurement channel and the signal analyzer will be automatically reconfigured to properly analyze the quality of the signal transmitted by the LTE enabled UE.

Remote control and automation capabilities

T4010S-MTA can be remotely controlled by a comprehensive SCPI interface which allows the user remotely control and automate the system.
### Appendix 1. Technical Specifications

#### 3GPP LTE eNodeB transmitter

<table>
<thead>
<tr>
<th>Supported frequency bands</th>
<th>FDD</th>
<th>Bands 1, 2, 3, 4, 5, 7, 8, 9, 10, 11, 12, 13, 14, 17, 18, 19, 20, 21, 23, 24, 25, 26 and 27</th>
</tr>
</thead>
<tbody>
<tr>
<td>TDD</td>
<td>Bands 33, 34, 35, 36, 37, 38, 39, 40 and 41</td>
<td></td>
</tr>
</tbody>
</table>

- **Supported bandwidths**: 1.4, 3, 5, 10, 15 and 20 MHz
- **Supported cyclic prefix**: Normal, extended
- **Supported carrier spacing**: 15 kHz
- **Output level range for connector configured as TX**: –110 to 0 dBm
- **Output level range for TX/RX**: –110 to –7 dBm
- **Output level resolution**: 0.1 dB
- **Supported MIMO configuration**: 2x2, 4x2

#### 3GPP LTE eNodeB receiver

<table>
<thead>
<tr>
<th>Supported frequency bands</th>
<th>FDD</th>
<th>Bands 1, 2, 3, 4, 5, 7, 8, 9, 10, 11, 12, 13, 14, 17, 18, 19, 20, 21, 23, 24, 25, 26 and 27</th>
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<td>Bands 33, 34, 35, 36, 37, 38, 39, 40 and 41</td>
<td></td>
</tr>
</tbody>
</table>

- **Input level range**: +26 to –50 dBm

### Appendix 2. Ordering Information

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<tr>
<th>Option</th>
<th>Description</th>
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</thead>
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<td>FDD basic output power, in-channel and receiver measurements software – Intro package</td>
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<td>T4010S-C01</td>
<td>FDD transmitter output power and in-channel measurements software – Advanced package</td>
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<td>T4010S-C02</td>
<td>FDD transmitter RF spectrum, spurious and intermodulation measurements software</td>
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<td>T4010S-C03</td>
<td>FDD receiver performance measurements software – Basic package</td>
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<td>T4010S-C04</td>
<td>FDD receiver performance measurements software – CQI/PMI reporting package</td>
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<td>T4010S-C05</td>
<td>FDD receiver spurious, intermodulation and measurements with modulated and CW interferer software</td>
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<td>T4010S-C06</td>
<td>FDD Rel-9 receiver performance measurements software – Batch 1</td>
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<td>T4010S-C07</td>
<td>FDD Rel-9 receiver performance measurements software – Batch 2</td>
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<td>T4010S-C50</td>
<td>TDD basic output power, in-channel and receiver measurements software – Intro package</td>
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<td>T4010S-C51</td>
<td>TDD transmitter output power and in-channel measurement software – Advanced package</td>
</tr>
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<td>T4010S-C52</td>
<td>TDD transmitter RF spectrum, spurious and intermodulation measurements software</td>
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<td>T4010S-C53</td>
<td>TDD receiver performance measurement software – Basic package</td>
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<td>TDD receiver performance measurement software – CQI/PMI reporting package</td>
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<td>TDD Rel-9 receiver performance measurements software – Batch 2</td>
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<td><strong>T4010S support options</strong></td>
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