Keysight T4010S
LTE RF Conformance and DV Test System

Technical Overview

KEYSIGHT TECHNOLOGIES

Overview

The Keysight Technologies, Inc. T4010S family of automated test systems includes LTE and LTE-Advanced carrier aggregation (CA) RF solutions for design verification (DV) and conformance testing (CT) of LTE user equipment (UE). The T4010S family has a wide range of the network operators test plans needed for carrier acceptance, providing a complete test platform that enables the execution of 3GPP-defined LTE RF conformance test cases and more.

Compared to competing LTE RF test systems, the T4010S is the most compact and equipment-efficient test platform available. The result is reduced maintenance/calibration costs, minimized power consumption for lower operational costs, and smaller laboratory real-estate requirements.

Design verification

To address the unique testing needs of baseband and RF hardware developers, the T4010S DV system provides a comprehensive set of test cases following the 3GPP 36.521-1 test specifications for out-of-the-box pre-conformance testing of LTE UE designs.

During the early phases of development the T4010S DV system lets you create or customize test cases to verify LTE UE RF parametric design characteristics, preventing costly redesigns and modifications in later project phases. That increases confidence and reduces the time-to-market for new LTE UE designs. Its modularity and flexibility also make the T4010S DV an ideal tool for quality assurance and manufacturing screening.

Conformance testing

Catering to the specific needs of laboratories at UE and chipset manufactures and third-party certification test houses, the T4010S CT system provides a comprehensive set of tools that help you 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, analyzing the tests results, and producing the associated test reports.

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

Key Features

The Keysight T4010S CT and DV systems have the capabilities you need to accelerate getting LTE UE to market:

- Easy-to-use test project management environment stream-lines test execution and result analysis
- Every out-of-box hardware configuration supports all LTE-defined frequency bands up to 3 GHz
- Complete GCF- and PTCRB-validated test case coverage with ongoing validation efforts for future test requirements protects investment
- Reduced operation and maintenance costs—uses the most compact and efficient hardware architecture on the market in terms of testing coverage
- Automated and unattended RF path compensation procedures
- Reporting capabilities enable clear and direct access to the test result information, providing export capabilities to different formats (including html, CSV, and XML)
- Customizable RF test cases with access to major LTE signaling and test conditions configuration parameters allow engineers to test configurations outside the scope of the 3GPP conformance test specification
- T4010S DV system is based on the same hardware configurations and software architecture as the T4010S CT, ensuring maximum traceability to conformance requirements

Accelerate Achieving Your Goals

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

The T4010S CT system (GCF/PTCRB test platform number 95) provides you with the complete set of 3GPP TS 36.521-1 conformance test cases, validated according to GCF and PTCRB requirements. These test cases include all the duplex/band/bandwidths combinations needed for certification purposes, including bands with different channel bandwidths requirements for GCF and PTCRB. And, as new requirements emerge, Keysight continues to add test cases. For an up to date list of validated tests, please contact Keysight Technologies.

Complete set of RF measurement procedures for UE characterization

The T4010S DV system provides you with a complete set of standard and frequency band-independent test procedures that you can customize. These test procedures cover the complete set of measurements typically required to characterize LTE UEs including:

- Power and power control measurements
- Global in-channel measurements
- Receiver measurements
- Receiver performance measurements
- CQI, sub-band CQI, and PMI reporting measurements
- Occupied bandwidth, spectrum mask, and adjacent channel leakage power ratio measurements
- Blocking and intermodulation measurements

Versatile and cost-effective hardware

The T4010S CT and DV systems are built around the Keysight Technologies T2010A LTE wireless communications test set. The T2010A handles the interconnection between the different system components. It also performs RF signal conditioning and filtering, eliminating the need for dedicated filter banks and creating a common hardware platform that supports all existing frequency bands up to 3 GHz without the need for any hardware upgrades. A powerful multi-RAT network emulator, the T2010A integrates multiple capabilities:

- FDD LTE and TD-LTE network emulator supporting all 3GPP defined bandwidths and bands up to 3 GHz
- LTE-Advanced carrier aggregation emulator capable of emulating two MIMO component carriers in the same instrument
- Integrated LTE UL signal analyzer for in-channel measurements (3GPP TS 36-521-1, Chapter 6 test cases)
- Integrated fading channel emulator for characterization based on real-life receiver conditions (3GPP TS36.521-1, Chapter 8 and 9 test cases)
- Integrated interferer generator capable of adding AWGN, OCNG, and arbitrary interferers to the desired signal (3GPP TS 36.521-1, Chapter 8 and 9 test cases)

For out-of-channel measurements, the set of additional instruments required is minimal. The full configuration of the T4010S CT and DV systems require just the following additional instruments:

- External spectrum analyzer for out of channel UE transmitter measurements

Comprehensive test system automation capabilities

The automated T4010S systems enable unattended operation, maximizing laboratory productivity. The test systems can be easily configured to automatically control the UE under test using AT commands or non-standard, UE-specific command sets.

To support more involved UE automation needs Keysight provides access to the API used by the test system to implement the UE automation capabilities, allowing you to develop your own UE drivers to automate the execution of the tests. Automation in T4010S systems also includes ancillary equipment, like power supplies and climate chambers for completely unattended extreme condition testing.

Easy upgrade options to introduce test capabilities

Since all systems within the T4010S family share the same underlying hardware and software platform, it is easy to add conformance or design verification parametric testing as your needs evolve. Better still, DV and CT system software versions can coexist on the same test system, allowing you to switch between the systems at will, maximizing convenience and cost-effectiveness.

System Components

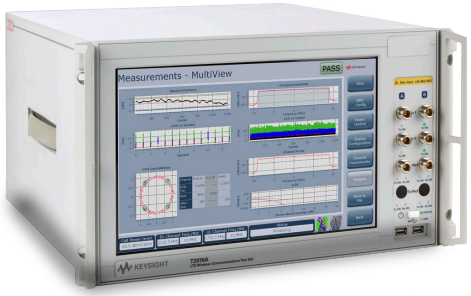
The Keysight T4010S family of LTE RF test systems is available in two distinct hardware configurations, common to both the DV and CT systems.

Bench-top configuration

To make it easy to adapt to your changing needs, scalability is one of the key aspects of the T4010S. For this reason, two different bench-top configurations are available.

A sole T2010A LTE wireless communications test set enables testing of in-channel characteristics of the UE's transmitter and receiver as well as receiver performance and CSI tests.

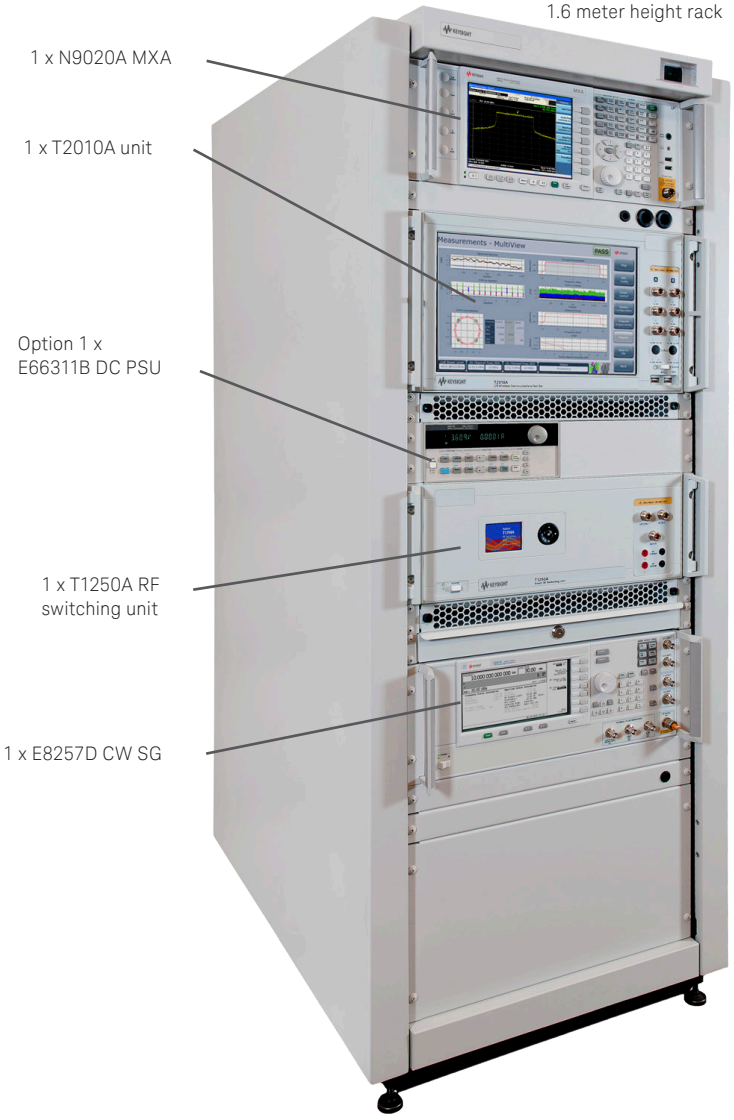
The single box solution can be easily upgraded to a higher coverage bench-top configuration by adding the Keysight Technologies N9020A MXA signal analyzer and T1250A RF switching unit if you want to cover out-of-band measurements such as spurious emissions, ACLR, OBW, and SEM.



T2010A unit

Full test system configuration

Housed in a single rack with a reduced set of instruments, this configuration enables testing of all UE RF characteristics, plus 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.



User Interface

The Keysight T4010S features an intuitive and easy to use set of software tools to support the whole testing cycle:

- Test case parametrization
- Test project creation and execution
- Results analysis

Using the Keysight T4010S CT system you can select the test cases to be executed from within the test case libraries developed and validated by Keysight Technologies. Different versions of these libraries can be installed at any time for maximum convenience. Simple drag-and-drop operations make it easy to select which test cases to run and the chosen 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.

When test execution parameters need to be modified, it is easy achieve using the test campaign editor window within the project management tool. The CT version of the T4010S lets you select a set of parameters for direct modification, allowing a certain level of test case customization.

Parameters related to the DUT's automation, power supply, climate chamber management, and automatic tests retrial can also be set by the test system operator. In addition to the T4010S CT system, these parameters are common to most Keysight testing products.

Once the test have been performed, Keysight test systems provide data analysis tools in both text and graphical views, making it easy to process RF measurement results and export the data to several formats for easy exchange with all the involved parties. When common interoperability issues arise such as protocol IOT problems between the DUT and the test system, the trace/log analysis tool delivered with the T4010S CT system provides data views such as log, tabular, and MSC. Its message decoding capabilities and the depth of the collected data make identifying and resolving issues fast and easy.

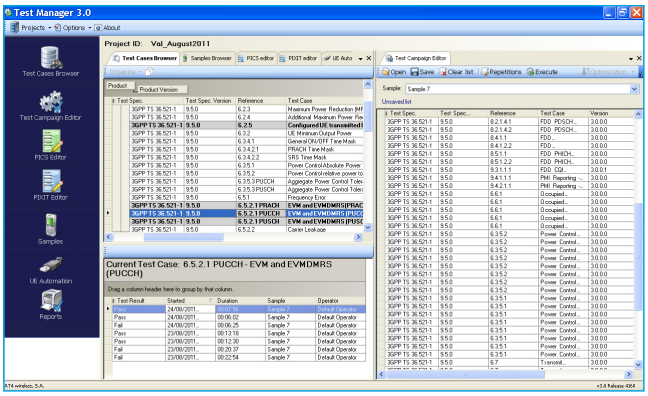


Figure 1. Test plan generation

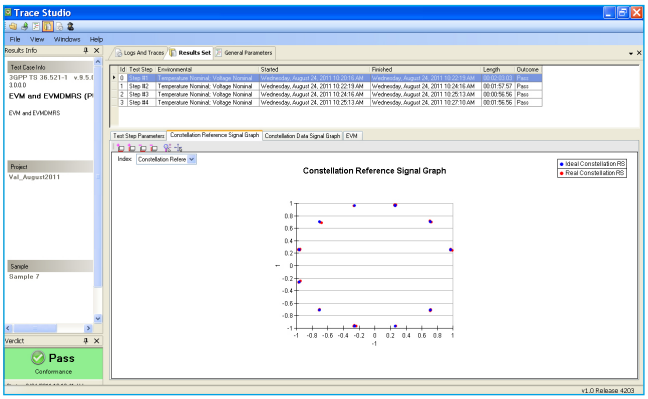


Figure 2. Results analysis (graphic view)

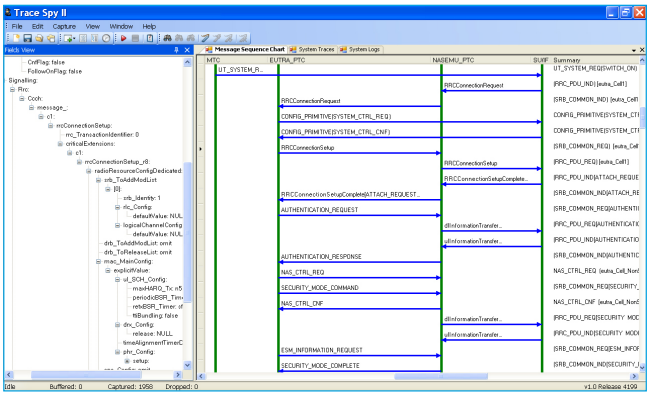


Figure 3. Protocol analysis (MSC view)

T4010S Mobile Test Application

The Keysight T4010S LTE mobile test application (T4010S-MTA) is the ultimate tool for development of LTE-enabled UEs.

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

T4010S-MTA also supports the development of LTE UEs from early component testing thru 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 you 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. The MTA also makes it easy 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 an embedded UL signal analyzer with advanced signal analysis capabilities including channel power, constellation, spectrum flatness, and CCDF. This feature makes it easy to change the reference measurement channel, which automatically reconfigures the signal analyzer to properly analyze the quality of the signal transmitted by the LTE-enabled UE.

Figure 4. Measurements – MultiView

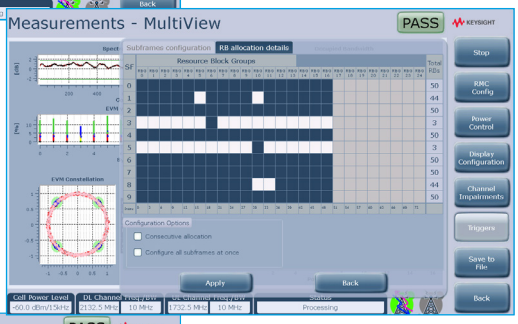


Figure 5. RB allocation

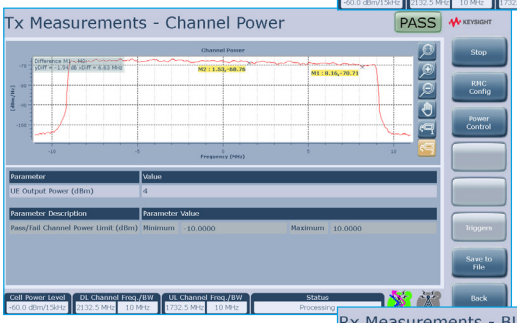


Figure 6. Tx measurements – channel power

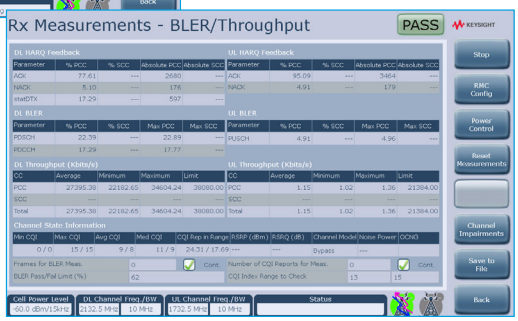


Figure 7. Rx measurements – BLER/throughput

Remote control and automation capabilities

The comprehensive SCPI interface in the T4010S-MTA allows you to remotely control and automate the system.

Technical Specifications

3GPP LTE eNodeB transmitter		
Supported frequency bands	FDD	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
	TDD	Bands 33, 34, 35, 36, 37, 38, 39, 40 and 41
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
	Tx/Rx	–110 to –7 dBm
Output level resolution		0.1 dB
Supported MIMO configuration		2x2, 4x2
3GPP LTE eNodeB receiver		
Supported frequency bands	FDD	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
	TDD	Bands 33, 34, 35, 36, 37, 38, 39, 40, and 41
Input level range		+26 to –50 dBm

Ordering Information

Option	Description
T4010S hardware options	
T4010S-H01	T4010S LTE RF bench-top single box H01
T4010S-H02	T4010S LTE RF bench-top H02
T4010S-H05	T4010S LTE RF bench-top dual-cell H05, single box
T4010S-H06	T4010S LTE RF bench-top dual-cell H06
T4010S-H10	T4010S LTE full conformance RF test system
T4010S-H11	T4010S LTE full conformance and supplemental RF test system
T4010S platform software options	
T4010S-SOP	T4010S LTE RF operational software package
T4010S-DRV	T4010S LTE RF external instrumentation drivers package
T4010S-TCC	T4010S LTE RF DV test cases configuration tool
T4010S-MTA	T4010S LTE mobile test application
T4010S CT measurement software options	
T4010S-C00	FDD basic output power, in-channel and receiver – Intro package
T4010S-C01	FDD transmitter output power and in-channel – Advanced package
T4010S-C02	FDD transmitter RF spectrum, spurious, and intermodulation
T4010S-C03	FDD receiver performance – Basic package
T4010S-C04	FDD receiver performance – CQI/PMI reporting package
T4010S-C05	FDD receiver spurious, intermodulation, and measurements with modulated and CW interferer
T4010S-C06	FDD Rel-9 receiver performance – Batch 1
T4010S-C07	FDD Rel-9 receiver performance – Batch 2
T4010S-C08	FDD Rel-9 receiver performance – Batch 3
T4010S-C20	FDD Rel-10 CA RF Inter-Band 1 UL in-channel test cases – Batch 1
T4010S-C21	FDD Rel-10 CA RF Inter-Band 1 UL out-of-channel test cases – Batch 1
T4010S-C22	FDD Rel-10 CA RF Inter-Band 1 UL performance – Batch 1
T4010S-C50	TDD basic output power, in-channel, and receiver – Intro package
T4010S-C51	TDD transmitter output power and in-channel – Advanced package
T4010S-C52	TDD transmitter RF spectrum, spurious, and intermodulation
T4010S-C53	TDD receiver performance – Basic package
T4010S-C54	TDD receiver performance – CQI/PMI reporting package
T4010S-C55	TDD receiver spurious, intermodulation, and measurement with modulated and CW interferer
T4010S-C56	TDD Rel-9 receiver performance – Batch 1
T4010S-C57	TDD Rel-9 receiver performance – Batch 2
T4010S-C58	TDD Rel-9 receiver performance – Batch 3

Ordering Information (continued)

Option	Description
T4010S DV software test method package options	
T4010S-D00	FDD power and power control measurements
T4010S-D01	FDD global in-channel measurements
T4010S-D02	FDD receiver measurements
T4010S-D03	FDD receiver performance measurements
T4010S-D04	FDD CQI, sub-band CQI, and PMI reporting measurements
T4010S-D05	FDD OBW, spectrum mask, and ACLR measurements
T4010S-D06	FDD spurious measurements
T4010S-D07	FDD blocking measurements
T4010S-D08	FDD Rel-9 receiver performance measurements – Batch 1
T4010S-D09	FDD Rel-9 receiver performance measurements – Batch 2
T4010S-D10	FDD Rel-9 receiver performance measurements – Batch 3
T4010S-D20	FDD Rel-10 CA RF DV Inter-Band 1 UL in-channel test cases – Batch 1
T4010S-D21	FDD Rel-10 CA RF DV Inter-Band 1 UL out-of-channel test cases – Batch 1
T4010S-D22	FDD Rel-10 CA RF DV Inter-Band 1 UL performance – Batch 1
T4010S-D50	TDD power and power control measurements
T4010S-D51	TDD global in-channel measurements
T4010S-D52	TDD receiver measurements
T4010S-D53	TDD receiver performance measurements
T4010S-D54	TDD CQI, sub-band CQI, and PMI reporting measurements
T4010S-D55	TDD OBW, spectrum mask, and ACLR measurements
T4010S-D56	TDD spurious measurements
T4010S-D57	TDD blocking measurements
T4010S-D58	TDD Rel-9 receiver performance measurements – Batch 1
T4010S-D59	TDD Rel-9 receiver performance measurements – Batch 2
T4010S-D60	TDD Rel-9 receiver performance measurements – Batch 3
T4010S LTE 10776 R1 supplementary options	
T4010S-AT1	In-band test cases – Batch 1
T4010S-AT2	Out-of-band test cases – Batch 1
T4010S-AT3	In-band test cases – Batch 2
T4010S-AT4	Out-of-band test cases – Batch 2
T4010S LTE supplementary RF Band 13 test cases	
T4010S-VZ1	In-band test cases – Batch 1
T4010S-VZ2	Out-of-band test cases – Batch 1
T4010S LTE T-Mobile US supplementary RF test cases	
T4010S-TM1	In-band test cases – Batch 1
T4010S LTE supplementary RF Band 25 test cases	
T4010S-SP1	In-band test cases – Batch 1
T4010S-SP2	Out-of-band test cases – Batch 1
T4010S LTE TELEC RF test cases	
T4010S-TL1	FDD test cases – Batch 1
T4010S-TL2	TDD test cases – Batch 1
T4010S support options	
T4010SC	T4010S LTE RF test system yearly support contract

Other Keysight Test Systems

Keysight test systems portfolio offers a broad range of wireless technologies testing solutions, including:

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- UMTS, HSPA

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