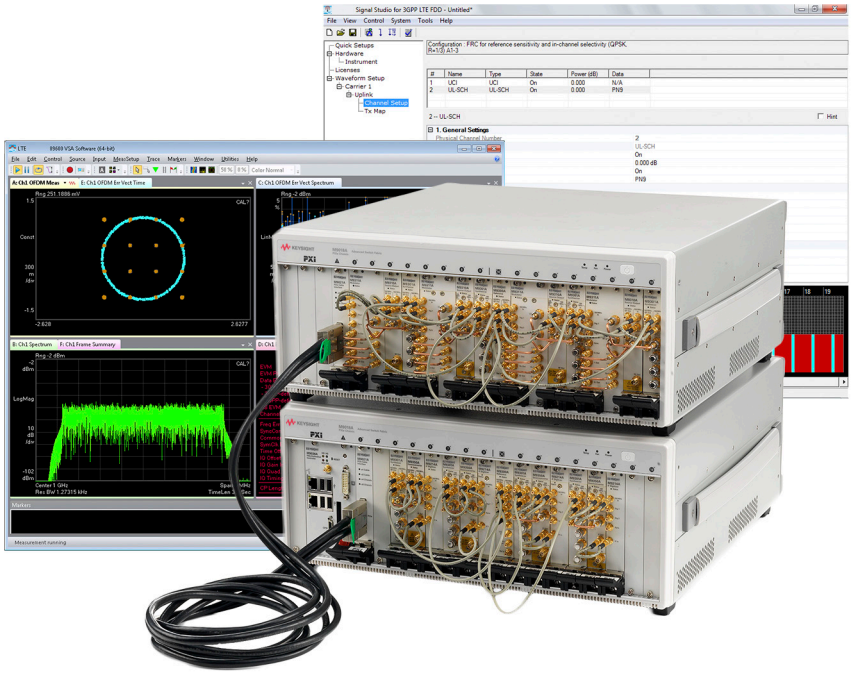
Keysight Technologies
LTE/LTE-A Multi-Channel, Reference Solution



Solution Brochure

KEYSIGHT TECHNOLOGIES

Gain greater insight faster with a compact, multi-channel PXI test solution that has proven performance with industry standard Signal Studio and 89600 VSA/WLA software.

Introduction

LTE deployments in over 124 countries worldwide with over 2,218 LTE capable devices make LTE the fastest developing mobile technology in the history of cellular communications. LTE-Advanced was developed to meet the requirements of 4G technology, mainly to provide much needed spectral efficiency of up to 30 b/s/Hz and increased data rates of up to 1 Gbps, while maintaining interoperability with legacy wireless formats.

This solution brochure describes Keysight Technologies, Inc. PXI-based multi-channel Reference Solution - hardware and world class signal generation and analysis software which provide greater insight into complex LTE/LTE-A designs. The Reference Solution also includes a convenient GUI to accelerate implementation of LTE/LTE-A multi-channel signal analysis and signal generation systems.

LTE/LTE-A Multi-Channel Test Challenges

Basestation, microcell, picocell, repeater, UL components, and RF subsystem designs are becoming more complex as engineers implement new LTE-Advanced features. These devices need to support multi-radio formats and include multiple antennas to support new carrier aggregation and spatial multiplexing MIMO enhancements. As the number of antennas increase, the characterization of the design becomes more complicated, requiring more channels and tighter synchronization between channels to support higher order MIMO and beamforming applications. And when MIMO is implemented with carrier aggregation, the tests become even more complicated.

Key test challenges faced by design engineers

- Complicated test set up for higher order MIMO that includes carrier aggregation or beamforming
- Visualizing and validating MIMO signals at the RF antenna
- Cost and footprint of test

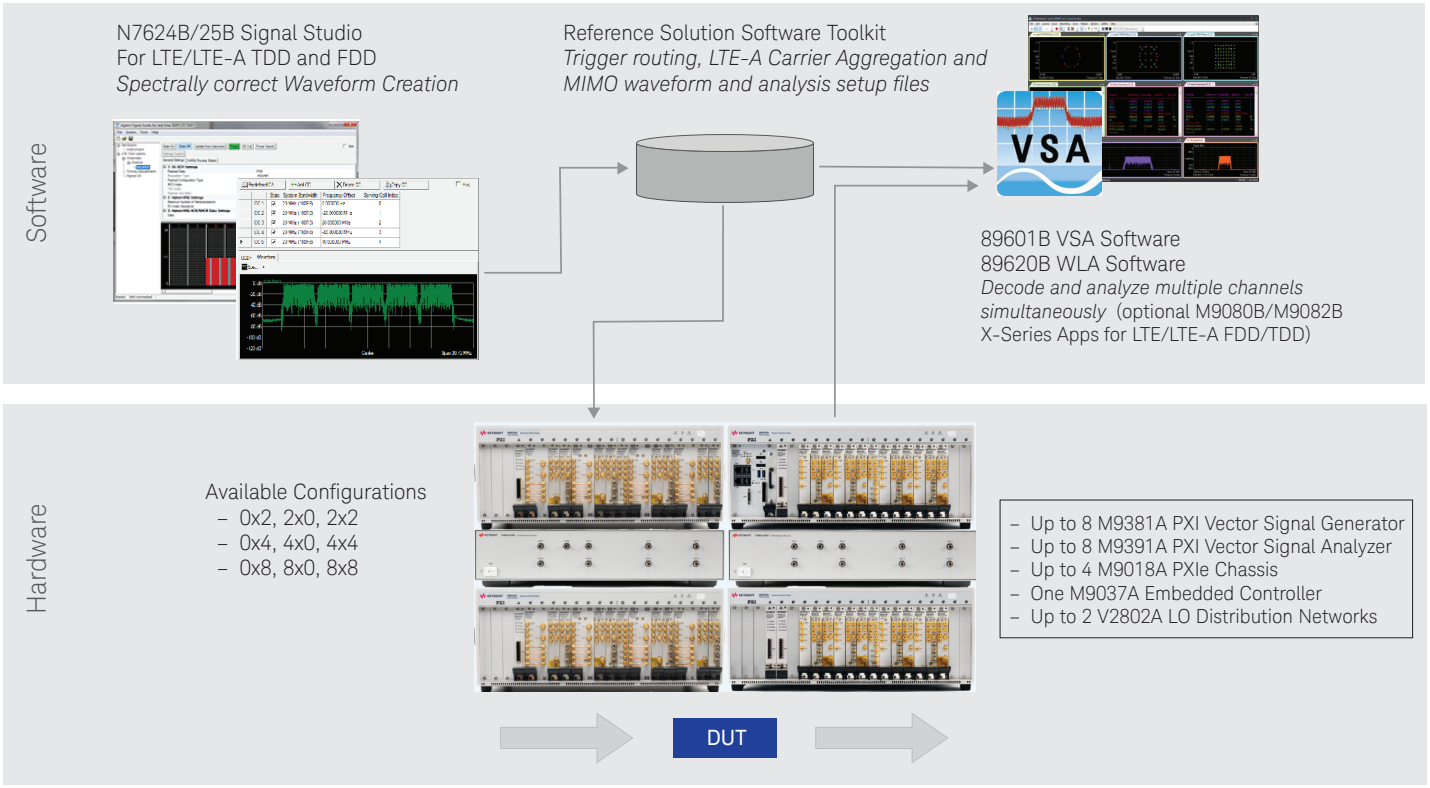
LTE/LTE-A Multi-Channel Reference Solution

To help address these test challenges, the LTE/LTE-A multi-channel Reference Solution combines the phase coherent PXI VSA and VSG instruments with configuration tools and industry leading application software to complete the LTE-A FDD or TDD signal generation or analysis solution. This enables engineers to quickly set up, measure, visualize and characterize their most complicated multi-channel carrier aggregation and MIMO designs. Keysight's Signal Studio software allows for easy generation of the most complex LTE/LTE-A multi-channel and MIMO waveforms. For signal analysis, Keysight's 89600 VSA software allows engineers to decode and display multiple channels in time, frequency, and modulation domains simultaneously, as well as measure the cross-channel performance to characterize complex MIMO designs.

To accelerate multi-channel and MIMO analysis, the MIMO toolkit provides configuration utilities and a GUI that aids engineers in the setup and execution of complex multi-channel tests. The toolkit provides for proper chassis and instrument configuration and includes a correction utility that calibrates for amplitude and phase skews between channels to ensure accurate phase coherent measurements. In addition, the GUI provides flexibility for engineers to adjust the RF settings, customize waveforms, and set up VSA software for multi-channel analysis.

The Reference Solution can be configured as 2-, 4-, or 8- time or phase synchronized channels using the M9381A PXI VSGs and M9391A PXI VSAs integrated into the M9018A 18-slot PXIe chassis with the M9037A PXIe embedded controller. Multi-chassis configurations are supported using the M9021A PCIe® cable interface and V2802A LO distribution unit for phase coherent systems.

Reference Solution Architecture



Reference solution features & benefits	
Features	**Benefits**
≤ 1 ns Timing alignment, nominal ≤ 1° Phase alignment, nominal (with opt 012)	Phase synchronization for advanced MIMO including beamforming (with Phase Coherent option)
Configurable for independently turned channels	Tune to different frequencies for inter-band carrier aggregation and simultaneous UL & DL measurements
Up to 160 MHz signal generation and analysis bandwidth	Generate and analyze multiple LTE channels in intra-band carrier aggregation

Key specifications for multi-channel carrier aggregation and spatial multiplexing MIMO
M9381A PXIe vector signal generator: 1 MHz to 6 GHz
2x2, 4x4 or 8x8 time or phase synchronized MIMO
Up to 160 MHz modulation bandwidth per channel
< 0.33% LTE EVM (4x4, 10 MHz BW, 2 GHz)
Channel-to-channel synchronization
Skew: Timing ≤ *500 ps, nominal*
Jitter[1]: Timing ≤ *45 ps, nominal,* Phase ≤ *1 °, nominal*
M9391A PXIe vector signal analyzer: 1 MHz to 6 GHz
2x2, 4x4 or 8x8 time or phase synchronized MIMO
Up to 160 MHz analysis bandwidth per channel
< 0.36% LTE EVM (4x4, 10 MHz BW, 2 GHz)
Channel-to-channel synchronization
Skew: Timing ≤ *400 ps, nominal*
Jitter[1]: Timing ≤ *50 ps, nominal,* Phase ≤ *0.3 °, nominal*

1. Jitter indicates measurement-to-measurement variation and applies over short time interval at room temperature without resetting or reinitializing a driver session.

Hardware Configuration

M9381A PXIe Vector Signal Generator[1]

www.keysight.com/find/m9381a

Generate spectrally correct LTE/LTE-A multi-carrier and time or phase synchronized MIMO RF signals. Up to 160 MHz bandwidth supports intra-band carrier aggregation applications. Each channel can be configured for independent operation with cross-carrier scheduling for inter-band carrier aggregation. Provides <1 nsec channel-to-channel synchronization for spatial multiplexing MIMO applications. In addition, the fast download of waveforms through PXIe backplane accelerates multi-channel test. The M9301A synthesizer is used as a common LO for phase coherent configurations when the source is ordered with phase coherent option.

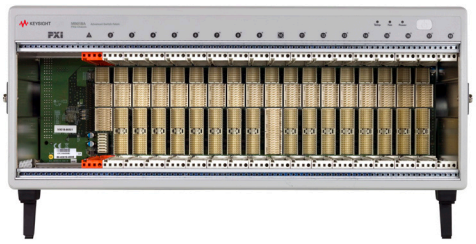
M9381A PXIe Vector Signal Analyzer

www.keysight.com/find/m9391a

Analyze multi-carrier and time or phase synchronized LTE/LTE-A MIMO signals. Provides up to 160 MHz analysis bandwidth for the widest LTE-A carrier aggregated signals. Configurable for independently tuned analyzers allows for simultaneous analysis component carriers in different frequency bands. In addition, the M9391A's fast frequency and amplitude settling times combined with the VSA software provides for very fast decoding of signals for visualization and EVM and timing measurements. The M9301A synthesizer is used as a common LO for phase coherent configurations when the analyzer is ordered with phase coherent option.

M9018A 18-slot PXIe Chassis

www.keysight.com/find/m9018a



The PXIe chassis delivers the ultimate in flexibility, compatibility, and performance with PCI Gen 2 with x8 links and up to 8 GB/s to system slot. The M9018A has sufficient power for 4 sources, analyzers or combination and has an innovated cooling design that allows for it to fit into 4U of rack space. The backplane triggers are used for time synchronization between sources and analyzers.

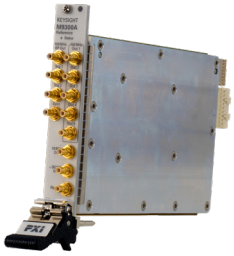
M9037A PXIe Embedded Controller

www.keysight.com/find/m9037a

The M9037A controller is ideal for multi-chassis systems. It achieves faster test time with 12 GB/s data bandwidth. Easily connect to other chassis from the x8 PCIe front panel connection and quickly boots with a preloaded operating system, drivers and Keysight I0 libraries on a solid state disk drive.

M9300A PXIe Frequency Reference

www.keysight.com/find/m9300a



This PXI module is used to drive the 10 MHz reference and provide alignment of the 10 MHz phase on multiple chassis phase coherent configurations.

1. For signal generation where real-time fading is required, select Keysight PXB

Software—Multi-Channel Signal Generation and Analysis

With the provided configuration and Reference Solution MIMO toolkit, engineers can gain deeper insight into their multi-channel designs much faster.

Signal Studio signal generation software

Create fully-coded LTE-Advanced compliant downlink and uplink signals. As shown in Figure 1, you may configure up to 5 component carriers (CC) through pre-defined scenario set-ups. The software is flexible to allow independent setup parameters like bandwidth and modulation type for each CC. Create waveforms for 2x2, 4x4, 8x8 MIMO with beamforming or carrier aggregation, or LTE-Advanced inter-band configurations with cross-carrier scheduling.

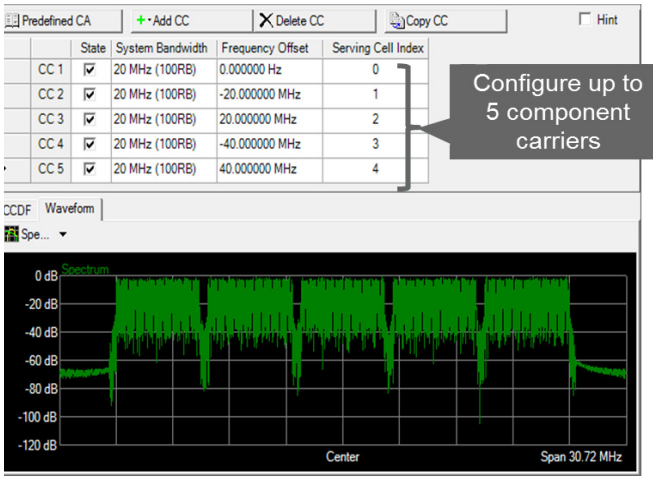


Figure 1. N7624B Signal Studio software for LTE-Advanced FDD.

89600 signal analysis software

89600 VSA software can connect to multiple instruments in a single instance to provide simultaneous measurements enabling visualization and RF analysis. View key frequency, modulation IQ constellation and EVM, and time alignment measurements side-by-side. Phase coherent analyzers also allow for beamforming measurements including common broadcast beam pattern weightings associated with each antenna element. As shown in Figure 2, the 89600 VSA software can be used for inter-band carrier aggregation analysis. It enables acquisition of all five component carriers simultaneously, demodulates the captured signals and measures the time alignments.

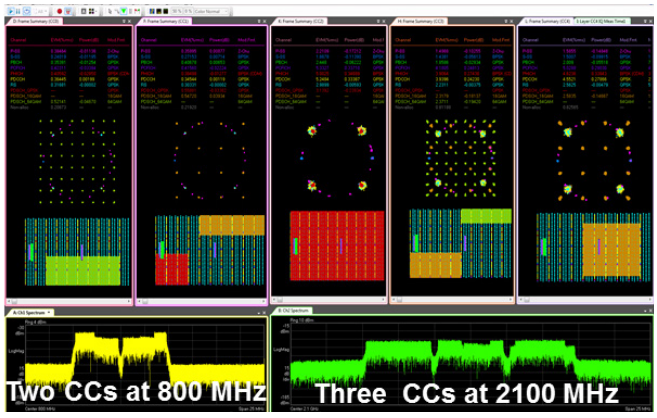


Figure 2. 89600 VSA software for inter-band carrier aggregation analysis.

89620B WLA software

WLA software is an add-on to the 89600 VSA software and provides for MAC, RRC, RLC multi-frame and up to four layer analysis for DL LTE FDD.

Y1299A PXI multi-channel/MIMO Reference Solution kit

This Reference Solution includes the Y1299A MIMO toolkit that provides configuration and set up tools to accelerate complex multi-channel and MIMO analysis. The configuration utilities route chassis backplane triggers for proper synchronization and include a correction utility to align timing, amplitude and phase between channels for accurate measurements at the device under test. A GUI enables quick LTE/LTE-A waveform generation with sample multi-carrier and MIMO waveforms provided by Signal Studio software (license required) which can be played out “as is” or in a predefined sequence. VSA set up files are also generated through these tools to support the specific multi-channel configuration.

This test solution is scalable. Buy what you need today and as your requirements change, add more channels, frequency or bandwidth to address future needs.

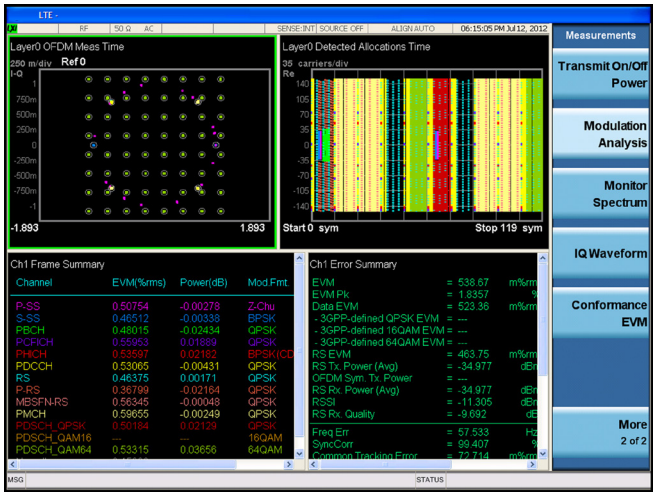


Figure 3. LTE-FDD X-series measurement application for modular instruments.

X-Series measurement application software

Optional X-series measurement application software for LTE/LTE-Advanced FDD/TDD, as shown in Figure 3, provides one-button measurements that can be used in conjunction with your VSA measurement analysis software of a single channel.

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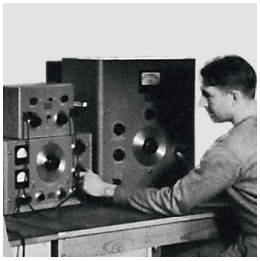

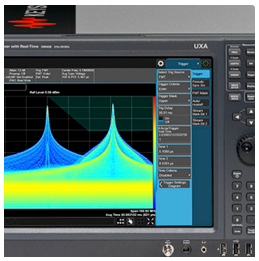

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