SOLUTION BRIEF

Streamlining high-volume test of 5G NR base stations

5G Multi-Band Vector Transceiver

Compact, scalable solution accelerates deployment of 5G equipment

5G New Radio (NR) network equipment manufacturers (NEMs) face a wide range of new challenges as they race through integration and verification (I&V) toward final, volume manufacturing test. The 3GPP standard dramatically expands the complexity of the physical layer, while also adding new requirements for millimeter wave (mmWave) spectrum bands, wider bandwidths and spatial/beamforming performance. This is leading to the need for connectorless “over-the-air” (OTA) testing techniques that require careful system integration. The test set-up also needs to remain flexible enough to address a wider variety of next generation equipment, all within a compressed market timeframe and cost envelope.

The Keysight S9100A 5G Multi-Band Vector Transceiver has been designed to offer users the flexibility, performance, and lean, compact efficiency they need to address these challenges. Its versatility facilitates high asset utilization and faster transition from design validation to a lean manufacturing environment.

KEYSIGHT TECHNOLOGIES

The Keysight S9100A 5G Multi-Band Vector Transceiver is streamlined for automated, non-signaling test of 5G NR infrastructure equipment in both FR1 (sub-6 GHz) and FR2 (24 to 44 GHz) spectrum bands. It uses Keysight's new M9410A PXI vector transceiver (VXT) to provide industry-leading RF performance in a compact modular design. The VXT's wide bandwidth support of up to 1.2 GHz, combined with high-performance mmWave transceiver heads deliver best-in-class EVM and ACLR performance in a small footprint.

The S9100 addresses two needs simultaneously; the need for fast, automated R&D design validation, and the need for efficiency and scalability in manufacturing test, especially in chambered OTA test environments. The S9100A leverages common hardware and software platforms including Keysight PathWave Test and 5G measurement personalities.

The S9100A enables NEMs to quickly address requirements and challenges introduced by new technologies to accelerate time-to-market.

Applications: High-volume test of 5G NR network equipment and radio components

- 5G NR base station transceiver systems
- 5G NR components, including remote radio heads (RRH), distributed units (DU), active antenna arrays, amplifiers, chipsets

Using S9100A across the workflow to accelerate time-to-volume

- RF performance for R&D testing
  - Fast, automated integration & verification (I&V)
  - 5G pre-conformance
- Lean efficiency for manufacturing
  - Fast, flexible, and compact final test
  - Ready for cloud, data analytics, and machine-learning

Scalable, compact design with superior RF performance offers clear path for 5G volume manufacturing

Lower cost of test	OTA readiness	Confidence for 5G manufacturing
Single configuration scales easily from < 6 GHz to millimeter wave	Space and cost efficient with a single bi-directional head across all 24 to 44 GHz bands	1.2 GHz bandwidth TX/RX with low EVM and ACLR for 5G NR
Reduced footprint vs. benchtop instruments	Remote heads deliver superior Power and EVM measurements at chamber port	Operates as a single instrument (including switching, heads, API, measurements), for easy automation
Extremely high test throughput (“cloud ready”)	In-head switching for 2 polarizations saves performance, cost at mmW	Calibrated system-level accuracy reduces rework and false verdicts

Figure 1: The S9100A 5G multi-band vector transceiver is a customizable system that can be tailored to fit your 5G testing requirements.

Key S9100A solution components

- M9410A PXIe vector transceiver (below, left):
  - 4G and 5G NR FR1 bands, 0.38 to 6.0 GHz, with up to 1.2 GHz TX/RX signal bandwidth
  - Also used as an IF for testing FR2 bands
  - Supports configurations with multiple measurement channels
- Remote mmW transceiver head (below, right):
  - Supports 5G NR FR2 bands across 24.25 to 43.5 GHz
  - Supports configurations with multiple heads
- PXIe chassis:
  - Includes chassis, control module, clock reference module, and all cabling
  - Can be configured with custom switching and ruggedized front panel
- Software:
  - The latest 5G NR analysis software (X-series measurement application)
  - Switching and head control, saving external programming
  - Unified API, coordinating all signal routing, calibration, and operation

Keysight offers system integration with coordinated assembly, installation, calibration, and services.

Figure 2: The Keysight S9100A solution includes the M9410A vector transceiver (up to 6 GHz, left), and the M1740A mmWave transceiver (24 to 44 GHz, right).

Common applications and configurations

Base configuration – single channel.

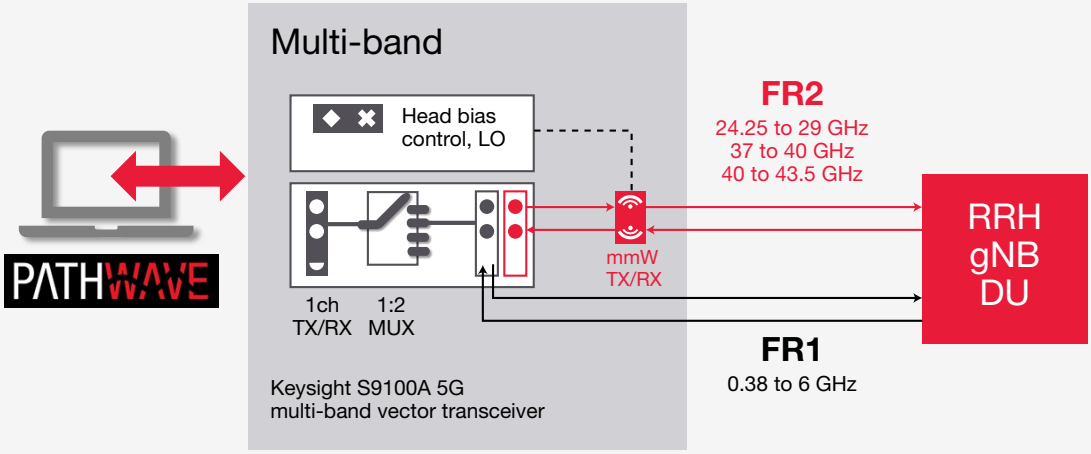

Figure 3: The S9100 base configuration (gray box) includes one TX/RX channel for FR1 and/or FR2.

The S9100A system uses the M9410A VXT at frequencies below 6 GHz. The M9410A has the accuracy and signal bandwidth to also serve as the intermediate frequency (IF) for mmWave bands. This scalable architecture lets the user minimize the number of test assets needed to serve all bands, saving space and cost relative to rigid R&D benchtop equipment and single-purpose configurations.

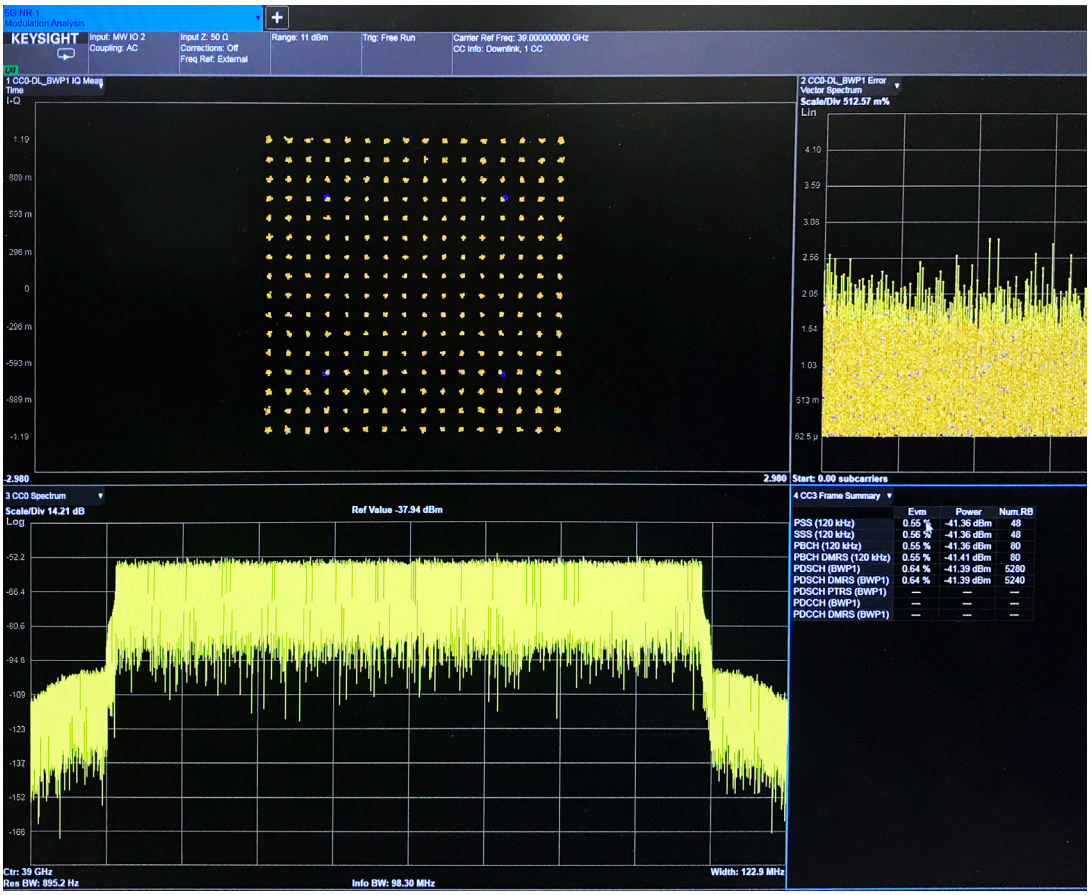

Figure 4: Typical FR2 band EVM performance is < 1% over a 40 dB power range. The above S9100 screenshot displays conducted TX/RX loopback results at 39 GHz. (5G NR signal, 100 MHz bandwidth, 256 QAM).

OTA-ready configurations – switching and multiple heads

Millimeter-wave signal routing in OTA chambers introduces measurement challenges, including lossy switch matrixes and cable runs (typically 2 to 4 meters) that compromise achieved signal quality. In the Keysight S9100A system, signals are routed at lower IF frequencies (3 to 5 GHz), avoiding these losses, and are converted to FR2 mmWave bands at the chamber. This typically results in 8 to 12 dB improved signal power at the point of measurement (in other words, at the DUT and not at the instrument), with significant benefits for dynamic range, EVM, and calibration stability. Keysight's architectural advantages result in better raw performance, which yields faster insights and higher confidence at lower overall cost.

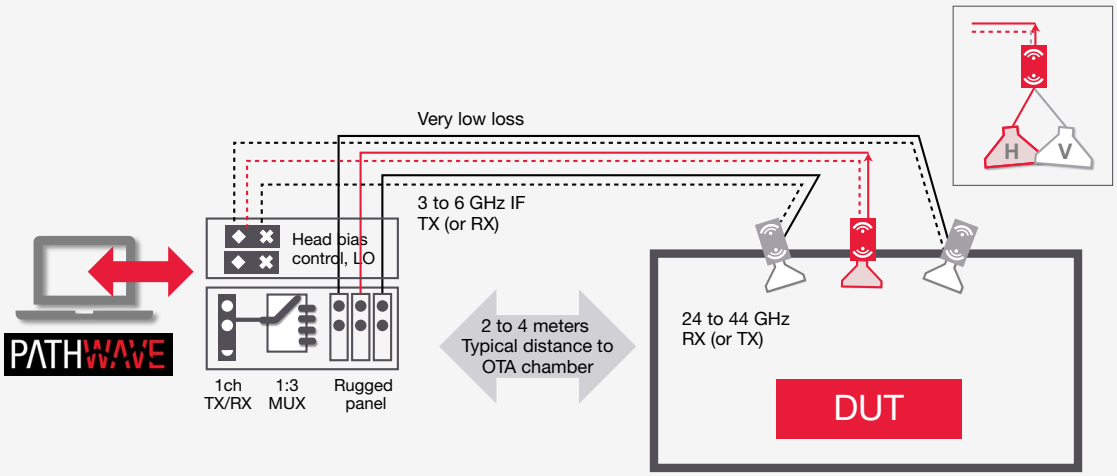

Figure 5: The S9100 is well-suited for use with over-the-air (OTA) chambers, with flexibility to accommodate dual polarization and multiple remote heads.

Figure 5 shows a single measurement channel that is multiplexed across multiple heads to perform spatial testing. The transceiver and receiver can be switched independently at either FR1 or FR2 bands, and the ability to choose between polarizations is integrated directly into the head itself. This latter capability reduces cost and signal loss of external mmWAve components.

Advanced configurations

The flexibility of the modular form factor and the high system throughput allow for compact, reconfigurable test architectures that lower cost-of-test, increase asset utilization, and improve responsiveness to dynamic market demands. Multiple different kinds of tests can be incorporated in a single chassis, such as S-parameter, DC/parametric testing, waveform generation, and digital control.

With its superior connectivity and transfer rates, the Keysight S9100A makes an excellent technology base to scale to distributed, enterprise-level test architectures.

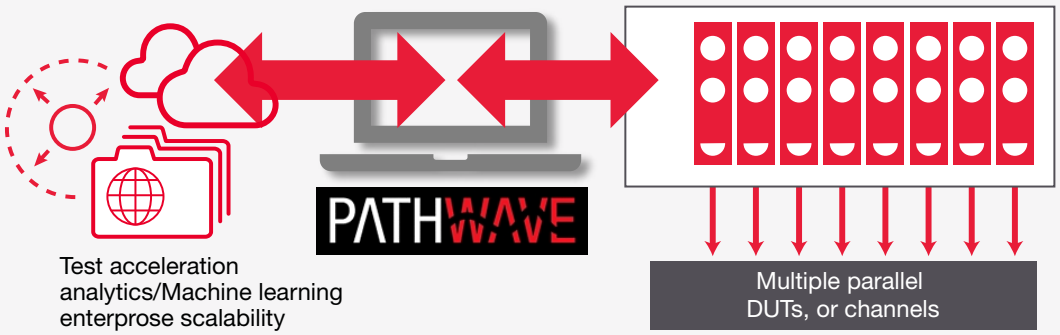

Figure 6: The S9100 can be configured with up to eight M9410A VXT modules in a single chassis, allowing for multiple concurrent measurements, MIMO, and high levels of automation and test throughput.

Customizing your system

S9100A systems are typically tailored for integration into specific manufacturing test stands. Common system customizations include:

- Adding a ruggedized front panel
- Additional transmit/receive channels
- Additional mmWave measurement heads, for spatial/beam characterization and polarizations
- custom RF signal routing, switching, and control
- DC and baseband subsystems;
- Integration with OTA or environmental chambers, fixturing, material handlers, and test automation software.

To explore your requirements and available services, please contact your local Keysight representative.

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