DATA SHEET

Beam MIMO Detect

Massive MIMO Testing Solution

Fully Exploit the Massive MIMO Potential

Massive MIMO and MU-MIMO technologies enable 5G resource scheduling not only in frequency and time, but also in space. For this reason, comprehensive testing of MU-MIMO functionality is at the core of any Radio Access Network testing needs. Currently available test setups for MU-MIMO are based on chambers or phase shifters, making it complex and cumbersome.

Complete Solution for MU-MIMO and Beamforming Testing

Beam MIMO Detect enables customers to replace the limited testing options currently on the market with a compact benchtop solution, allowing for powerful and extensive MU-MIMO configuration testing. Beam MIMO Detect – first on the market – is a complete solution for MU-MIMO and beamforming testing, adding the capability to simulate MU-MIMO on a large scale, with realistic field environment, dynamic mobility and auto calibration on vendor specific implementations.

5G

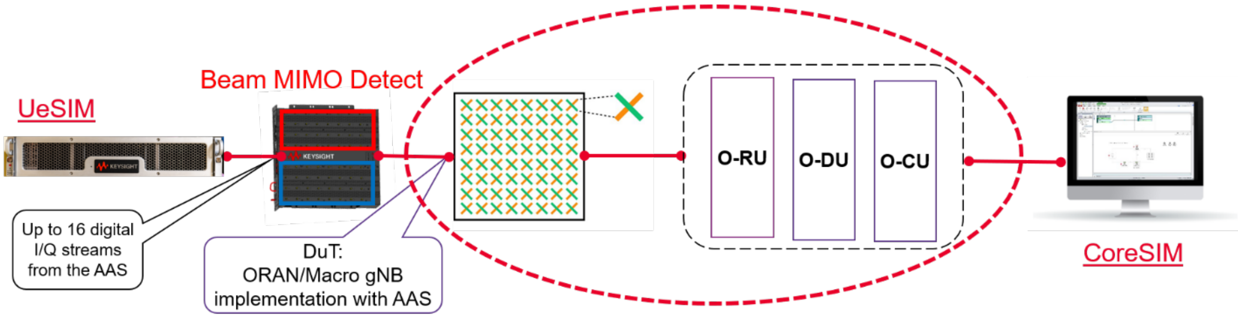
MU-MIMO Verification

Beam MIMO Detect is a massive connectivity radio frequency frontend for UeSIM, Keysight's UE emulation solution. It provides integrated dynamic phase shifting on all links to support the massive MIMO (mMIMO) requirements for current and future mobile communications industry standards.

KEYSIGHT TECHNOLOGIES

Beam MIMO Detect in Tandem with UeSIM

Beam MIMO Detect (BMD) is a massive connectivity RF front-end for UeSIM, Keysight's UE emulation solution (UEE). Beam MIMO Detect allows to simulate in a lab a population of spatially distributed and moving UEs. It provides integrated dynamic phase shifting on all links to support the Massive MIMO (mMIMO) requirements for current and future mobile communications industry standards.



Up to 64 separate bidirectional radio ports operating in FR1 up to 5GHz TDD bands can be used with different MU-MIMO configurations.

In a usual application scenario, Beam MIMO Detect is configured to be included with UeSIM to implement a full-stack configuration. The beam separation and composition are performed in the digital domain; the digital streams corresponding to the separated beams are routed to UeSIM which emulates the UEs.

The Active Antenna System (AAS) and Beam MIMO Detect are installed in a half size rack. The whole simulation is controlled by UeSIM and is fully integrated with Beam MIMO Detect. This complete end-to-end setup, fully reprogrammable, enables massive testing, mobility and ability to reproduce complex test cases.

Beam MIMO Detect at a Glance

Feature	Description
Mode Support	TDD
Frequency Bandwidth	Up to 100 MHz
RF Ports	Up to 64 RF ports, TX/RX combined Supporting 64T64R, 32T32R, 15T16R, 8T8R active antennas
Supported Streams	Up to 16 streams
Frequency Bands	FR1 TDD from 2 GHz to 5 GHz
MU-MIMO Combinations	Supports up to 4 Independent 4x4 MIMO UE groups or up to 8 2x2 MIMO groups
Output Power	14 dBm @2.6 GHz EVM <1% (support for 5G NR 256 QAM) 8 dBm @3.8 GHz EVM 1.2% (support for 5G NR 256 QAM)
Receiver	-39 dBm 5G NR signal EVM 0,9% (support for 5G NR 256 QAM)

Beam MIMO Detect Functionalities

Feature	Description
Beam separation (downlink) and composition (uplink)	• Splits and re-groups multiplexed MU-MIMO transmission layers present at the antenna reference point into groups of spatially filtered sets for standard co-scheduled UE SU-MIMO reception • Prepares and multiplexes multiple sets of different "incidence of arrival" SU-MIMO transmission layer groups from different co-scheduled UEs
Compatible with all vendor MU-MIMO and beamforming mobility techniques	• 3GPP 32 port CSI-RS set for PMI based UE reporting • Multiple CSI-RS sets for reporting best beam candidates • Standard UCI reporting for CRI, PMI, LI, CQI, L1 RSRP, SSBRI, HARQ • TCI State Indicators • Provides complete "incidence of arrival" simulation for SRS based beamforming
Customised spatial filters (for Multi-UE environments)	• In nature a spatially located UE will combine equally all antenna radiating elements with standardised phase shifts determined by its spatial position. (i.e., standard rectangular UE reference point window) • Beamforming is determined by the RU antenna element weights. (i.e., a beamformed antenna reference point window). • The two windows are completely independent. The resulting transfer function of the system is a multiplication of the two windows in the array domain or a convolution in the spatial domain • A rectangular window at the UE reference point models Nature closely. But optimises for "more or less" single UE locations • Tapered UE reference point windows (although not modelling nature) allow a greater reception coverage to simulate large populations for multi-UE environments. This is an essential requirement for testing the new spatial domain requirements of Network Schedulers
Dynamically moving spatial filters for complete mobility scenarios	• A given UE spatial position determines the simulated phase shifts to be used for the UE reference point window • The UE window coefficients can change dynamically to simulate a moving UE position • The changing of the BMD window coefficients is done in co-ordination with the UEE Advanced Mobility Management service (AMM) • Higher layer UE reporting is in complete synchronisation with the physical BMD channel simulation

Feature	Description
Dynamic calibration	• A calibration process is required in either conducted or Near Field OTA connectivity • Some external solutions for the MU-MIMO to SU-MIMO conversion (e.g., Butler matrix) require a high tolerance unique delay set of cables. The calibration process can remove this requirement. It can compensate for connector losses, cable losses, and cable delays • A calibration process is essential for a near field OTA configuration. The channel matrix between the antenna (RU and BMD) needs to be measured and then inverted • These calibration processes can be continually updated to constantly adapt to even slightly changing physical parameters of the system (temperature, etc.) • Various calibration techniques are possible. Some NEMs provide specific test patterns for their RUs for a high-fidelity calibration. Standard 3GPP reference signals can be used such as SSB and CSI-RS. Alternatively, a learning sequence can be performed with a single UE roaming through all possible beam positions

Ordering Information

Product	Description
P88206A	Beam MIMO Detect
P88901A	5G NR mMIMO and Beamforming Verification (up to 16 layers)

Beam MIMO Detect: Massive MIMO Testing Made Simple

Current massive MIMO testing techniques are based on external phase shifters or Butler matrixes, where testing is limited to just a few static beams with RF quality degradation. These testing methodologies depend on the specific Radio Access Network implementation.

Other testing methodologies require chambers or large spaces which support separation of devices with dedicated antennas, but they are limited to just a few devices.

Beam MIMO Detect overcomes these limitations by adding the capability to simulate mMIMO on a large scale, with realistic field environment, dynamic mobility and auto calibration on vendor specific implementations.

- Massive RF connectivity
- Supports Keysight's VSA/VSG software for testing up to 64T64R Radio Units/RRH with OpenStudio
- Supports UeSIM, simulating many groups of spatially distributed UEs in MU-MIMO configurations on a large scale
- Dynamically moving spatial filters for complete mobility scenarios for groups of multi UEs
- Compatible with all vendors MU-MIMO and beamforming mobility techniques

Learn more at: www.keysight.com

For more information on Keysight Technologies' products, applications, or services, please contact your local Keysight office. The complete list is available at: www.keysight.com/find/contactus