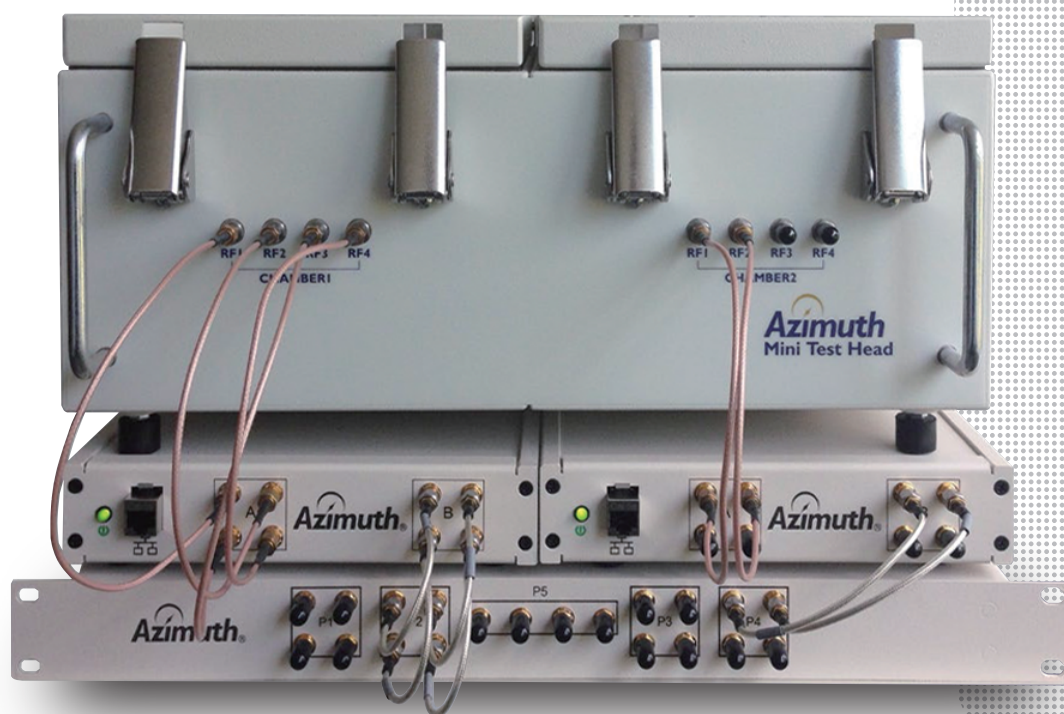


Spider

SPI-100 series

- SPI-102: Spider - Standalone
- SPI-103: Spider - Star-2 node
- SPI-104: Spider - Star-3 node
- SPI-105: Spider - Mesh



Spider SPI-100 series Features

One Platform, Multiple Solutions

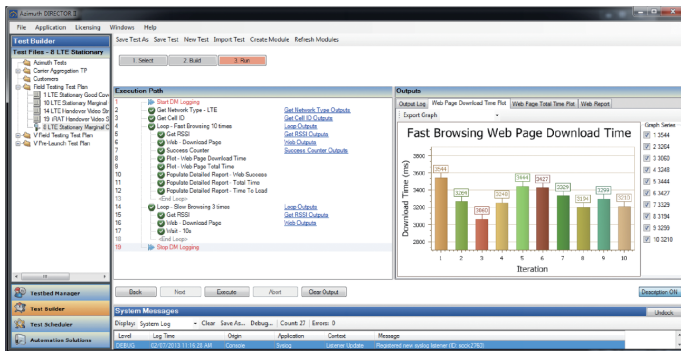
Automated, Scalable RF Platform for LTE Unlicensed, IOT, and Wi-Fi

Technologies like LTE unlicensed and Internet of Things (IoT) are ushering wireless communications away from traditional point-to-point topologies toward many-to-many topologies with the coexistence of multiple radio technologies and active communication links among multiple devices.

Wireless test systems currently available on the market focus on the testing, optimization, and validation of a single device in a point-to-point setup; there are no solutions designed specifically for accurate, repeatable, efficient testing of these newer technologies. This left developers with two options: one, manually field test over the air, which is time-consuming, unrepeatable, and (due to limited control of variables) not always accurate; or two, kludge together a solution using off-the-shelf components and test tools designed for point-to-point applications, knowing that the quantities required for a mesh network test would quickly make this cost-prohibitive. These challenges are addressed by Spider.

Spider™

The Spider™ platform comprises integrated hardware and software that provide complete RF isolation and automated control of the MIMO radio links between multiple devices. Different, turnkey solutions are built on the Spider™ platform to support LTE unlicensed, IoT, 802.11ac, and use cases such as mobility, handover, device to device, and radio coexistence testing. In addition, users can create their own solutions using the Spider platform and the modules available in the Director-II test executive. Because Spider is built specifically for testing mesh network topologies, it is much more accurate and reliable than off-the-shelf components but much more affordable than traditional wireless test systems.



Spider™ Platform

- An automated RF Platform that is modular, scalable, and cost effective
- Integrated H/W and S/W modules that provide:
 - Controllable bidirectional MIMO links in a variety of topologies with complete RF isolation
 - End-to-end automation of entire test-bed that includes devices, APs, and traffic sources
 - Turnkey, fully automated test cases and reporting
- Turnkey solutions for different technologies, applications

Technologies

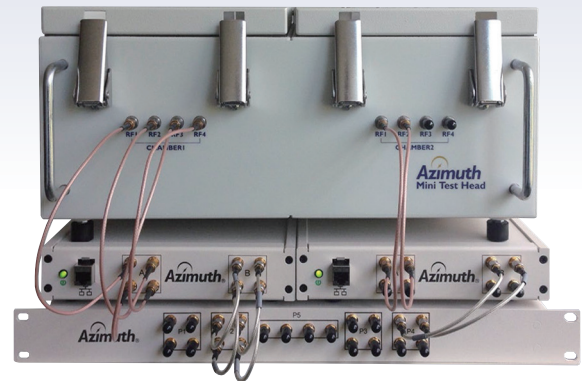
Cellular (LTE-A, LTE unlicensed, LTE, 3G/2G), Wi-Fi (IEEE 802.11a/b/g/n/ac), Bluetooth, ZigBee

Testing Areas

Performance, conformance, interoperability, coexistence

Use Cases

LTE unlicensed, IEEE 802.11ac, IoT, handover testing, coexistence testing



Spider SPI-100 series Features


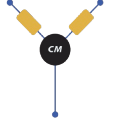
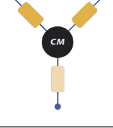
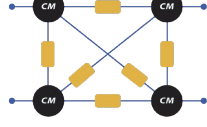
Standard Configurations

Spider™ is a modular, scalable, and cost-effective automated RF platform, comprising integrated hardware and software modules that provide:

- Controllable bidirectional MIMO links
- Wide channel bandwidth and wide frequency coverage (700 MHz–6 GHz)
- A variety of topologies with complete RF isolation (90 dB)
- Connectivity with real devices in their native form
- Automation of the entire test-bed—devices, APs, traffic sources, etc.

Different turnkey solutions built on the Spider™ platform can support LTE unlicensed, IoT, 802.11ac, and use cases such as mobility, handover, device to device, and radio coexistence testing. Spider™ is a modular, scalable system.

Build on these standard configurations—or design your own!

| | Configuration | Topology | Components | Typical Use Cases |
|---------|-----------------|---|---------------------------------|--|
| SPI-102 | Standalone RFCM |  | 1 RFCM-B | <ul style="list-style-type: none"> • Wi-Fi, cellular linklevel testing • IoT, drones |
| SPI-103 | Star 2 |  | 1 SCM-5 2 RFCM-B | <ul style="list-style-type: none"> • Wi-Fi performance • Wi-Fi roaming • Cellular handover • MIMO performance • Connected home • Medical devices |
| SPI-104 | Star 3 |  | 1 SCM-5 2 RFCM-B 1 RFCM-C | |
| SPI-105 | Mesh |  | 4 MCM-4 6 RFCM-B | <ul style="list-style-type: none"> • LTE unlicensed • Radio coexistence • M2M • Drones • Connected home • Medical devices |

 Combiner Module  RFCM-B  RFCM-C

Note: All configurations include the Director II Test Executive, the Traffic Source Automation and Control Library (iPerf), RF cables, and Near Field Adapters.

Scalable Hardware

RF Channel Module: controllable RF path

- Control the attenuation bidirectionally
- Butler phase/amplitude characteristics; full rank with low condition number

Combiner Module: combines nodes

- Combine 4/5/9 nodes

Shielded Enclosure: provides RF isolation

- High isolation for devices of different form factors (e.g., handsets, dongles, access points, small cells, etc.)
- Conducted and near-field coupling connectivity
- Filtered connections for Ethernet, serial, power (DC, AC), and USB

Powerful Software

Director II: Universal Test Executive Test-Bed Manager: controls all equipment and devices

- Manage Spider™ and other Azimuth products, like ACE RNX
- Manage other equipment (access points, devices, etc.)

Test Builder:

- Automate the test-bed with Azimuth-provided or user-defined modules

Test Scheduler:

- Schedule, run, and review results

LTE Unlicensed

Turnkey Solution for Testing LTE Unlicensed Performance, Coexistence, Conformance and Interoperability

Wideband traffic has grown exponentially, placing heavy demands on a fixed spectrum. One way operators can expand their coverage is to share space in the unlicensed 5 GHz band populated by Wi-Fi devices. Using LTE unlicensed to complement to their licensed bandwidth, they can tap into existing hotspots to skip coverage across short distances.

Coexistence (fair sharing) between LTE unlicensed and Wi-Fi, and among the various LTE unlicensed operators, is critical. This adds new communications testing challenges, as operators develop new mechanisms such as Listen Before Talk (LBT) and dynamic frequency hopping to facilitate coexistence.

Testing LTE unlicensed requires a solution that can do the following:

- Test coexistence, conformance, performance, and interoperability
- Satisfy the technology requirements of LTE unlicensed (controllable wideband RF, 4x4 MIMO, hub-node, and mesh architectures)
- Control and automate the entire test-bed, and run exemplar test cases

Spider™ Unlicensed

This is a fully automated, self-contained solution for LTE-U testing built on the Spider™ platform:

- All test cases developed from the LTE-U Forum's Supplementary Downlink (SDL) coexistence specifications
- Leverages the platform and modules developed by Azimuth for LTE and Wi-Fi testing
- Purpose-built but flexible solution

Spider SPI-100 series Configurations

Hardware

RF Channel Module with Butler Matrix (RFCM-B) RF Channel Module without Butler Matrix (RFCM-C)

Programmable MIMO RF Channel

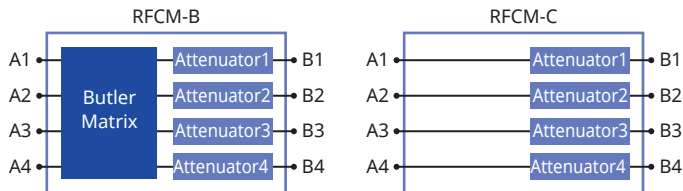
The RF Channel Module (RFCM) is a key module of the Spider™ platform that provides a MIMO path with controllable attenuation. The RFCM can be used standalone between two nodes or as a part of a star or a mesh topology in conjunction with other modules of the Spider™ platform, such as the combiner module or shielded enclosure.

Each RFCM has a total of four paths for individual or group attenuation control, so the unit can be used in a multitude of ways to test both SISO and MIMO devices and systems. The RFCM features controllable path loss and flat fading, and is available in two variants, -B and -C. RFCM-B provides an integrated Butler matrix for performing such critical test functions as running full rank/low condition analyses of MIMO channels for maximum throughput applications, beam-forming applications, and controlled combining of RF signals. RFCM-C does not.

The Director™ II test executive software delivers powerful, user-friendly automation and control. The RFCM can be automated through an API or our GUI-driven, end-to-end test automation platform, Test Builder™, which allows the RFCM to be automated along with the entire test-bed.

Features

- Programmable attenuation for up to 4x4 MIMO links
- Integrated Butler matrix ensures accurate phase amplitude relationship needed for MIMO, beamforming, etc.



BUTLER MATRIX PHASE CHARACTERISTICS

| Input Port | Phase at Output Ports (in Degrees) | | | |
|------------|------------------------------------|------|------|-----|
| | B1 | B2 | B3 | B4 |
| A1 | 45 | 90 | 135 | 180 |
| A2 | 135 | -45 | -135 | 90 |
| A3 | 90 | -135 | 0 | 135 |
| A4 | 180 | 135 | 90 | 45 |

- Compact form factor with all integrated components
- No more cluttered, messy setups
- Support for a wide frequency range with unlimited bandwidth



Star Combiner Module (SCM-5) Mesh Combiner Module (MCM-4)

Combine Nodes for Star, Mesh, Custom Topologies

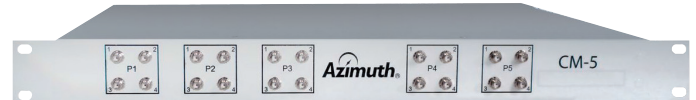
The Combiner Module, a key component of the Spider™ platform, merges the multiple MIMO paths from various modules in a star or mesh topology test configuration. Each Combiner Module can combine multiple groups of four paths each, enabling a multitude of test configurations for SISO and MIMO devices.

There are currently two versions of the Combiner Module. The Mesh Combiner Module (MCM), optimized for mesh topologies, features low loss between the master port and three split ports and higher loss among the split ports. The Star Combiner Module (SCM), optimized for star topologies, features five or nine identical ports.

The Director II™ test executive software delivers powerful, user-friendly automation and control. While the Combiner Module does not require configuration or active control, users can create and use test-beds with a Combiner Module and other Spider™ components (e.g., the RF Channel Module, or RFCM). These test-beds can be controlled actively through the graphic user interface or automated through an API or our GUI-driven, end-to-end test automation platform, Test Builder™, which supports automation of the entire test-bed.

Features

- Combine multiple nodes in different topologies —star, mesh, custom
- Compact form factor with all integrated components; no more cluttered, messy setups
- Supports a wide frequency range and unlimited bandwidth
- Supports up to 4x4 MIMO links



Spider SPI-100 series Configurations

Optional Modules

Near Field Adapter (MLA-01)

Reliable, Repeatable, Noninvasive Device Connection

Running accurate, repeatable tests requires a reliable connection with the device. The most optimal solution is a direct physical connection. Unfortunately, not all devices expose their connectors. This requires either disassembling the device to expose the connectors, which could compromise the device's integrity, or relying on a radiated connection as an alternative. A radiated connection brings with it a host of challenges, including repeatability, accuracy, loss, and cost, depending on the actual mechanism (simply radiated in an isolated environment vs. radiated in a controlled over-the-air or OTA environment).

The Near Field Adapter (NFA) enables direct, conducted connectivity to devices without requiring disassembly. This removes the uncertainty and the potential for inaccuracy and nonrepeatability.

The NFA uses magnetic coupling to connect to the antenna. Each NFA couples with a single antenna; multiple NFAs can be used to enable MIMO connectivity and allow coverage of any and all technologies and bands (if a separate antenna is used for each). The NFA's selectivity also helps ensure that it couples with only one antenna, achieving a full-rank MIMO connection even in devices with multiple antennas. Easily attachable with a Velcro™ strip, the NFAs can connect to any device, regardless of whether the antenna is exposed or not, across a wide frequency range. Our patented design ensures that the coupling between the NFA and the antenna is reliable, repeatable, and independent of antenna-to-NFA orientation. This eliminates the time-consuming and manual process of tuning and orienting devices to find the optimal position for maximum throughput—something that needs to be done for a radiated setup. The NFA also ensures a consistent pathloss to the device.

Features

- Test any device—even those without exposed connectors!
- No more drilling, soldering, or waiting for custom devices!
- Connect to all devices—tablets, smartphones, etc.—easily and noninvasively
- Get the reliability and repeatability of a conducted connection with the ease-of-use of a radiated connection
- MIMO connection for different bands and technologies



STACSIM-(Static Channel Simulator) (ACC-290) STACSIM-WB-(Static Channel Simulator) (ACC-339)

For Comprehensive Testing of Wi-Fi, LTE Unlicensed, 5G, and Other Wideband MIMO Applications

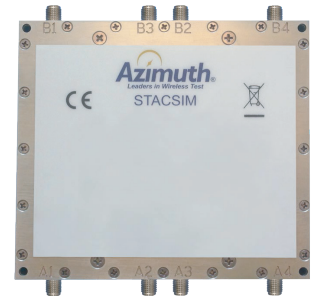
Full-scale adoption of multiple input/multiple output (MIMO) and wider bandwidths is a common theme in the evolution of cellular and Wi-Fi technologies. Regardless of the end application, testing these wideband wireless technologies requires controllable, wideband connectivity with the right phase-amplitude characteristics.

Azimuth's Static Channel Simulator (STACSIM) provides cross-path and fixed-phase shifts on a 4x4 matrix based on the commonly used Butler array, in which a signal incident at each input port provides equal amplitude signals at the N output ports.

Azimuth's STACSIM provides:

- A wideband flat channel over a wide frequency range
- A 4x4 connection with Butler phase-amplitude characteristics
- A high-rank matrix with a low condition number
- Exceptional isolation

The STACSIM is available in two variants: the standard STACSIM focuses on Wi-Fi frequencies; the STACSIM-WB (wideband) supports a wider frequency range, making it ideal for Wi-Fi, LTE unlicensed, Bluetooth, and more.



Spider SPI-100 series Configurations

Optional Modules

RadioProof Enclosures (RPE-401L/AC):

Large single-chamber shielded enclosure with AC power

RadioProof Enclosures (RPE-402):

Regular-size, dual-chamber shielded enclosure

RF Test Isolation Chambers for Quality Wireless Isolation Testing

Testing wireless devices in a controlled Radio Frequency (RF) environment that is isolated from unwanted RF interference is required to accurately characterize the conformance, performance and interoperability of wireless systems. Azimuth's RadioProof™ family of RF enclosures provide exceptional RF isolation of devices under test and easy operation.

Azimuth's RadioProof™ enclosures provide superior isolation from 700 MHz to 6 GHz, support 4 x 4 multiple-input/multiple-output (MIMO) products and are ideal for accurate and reliable testing of all wireless technologies. Azimuth's patented design enables ultrahigh isolation (90 dB) with a range of filtered connection options, and thus outperforms other solutions in terms of performance and scalability.

RadioProof™ enclosures and the high level of isolation that they offer provide device manufacturers, semiconductor vendors and service providers with dedicated equipment that significantly outperforms custom built internal solutions.

RadioProof™ enclosures combine filtered communication (Ethernet, serial) and power connections, an easy to use cover and latch design as well as active or passive cooling to enable efficient and repeatable testing of wireless devices. RadioProof™ enclosures include convenient slide rail rack mount fixtures for easy access and efficient storage.

Features

- Exceptional isolation: up to 90 dB
- Wide frequency range support
- 4x4 multiple input/multiple output (MIMO) connections
- Filtered RJ45 Ethernet, serial, power (DC and AC)
- Support for USB
- Active and passive cooling



RadioProof Enclosures
RPE-401L/AC



RadioProof Enclosures
RPE-402

Spider SPI-100 series Configurations

Software

Director II Test Executive (DIR-II)

Test Executive with End-to-End Automation

Director II, a universal test executive to control and automate a test-bed end-to-end, comprises the following components:

Test-Bed Manager: Manage the Test-Bed

- Control the ACE, Spider™, and other Azimuth products
- Manage other equipment in the test-bed (access points, devices, etc.)

Test Builder: Automate the Test-Bed

- Modules to control common elements of the test-bed
- Create test cases through a drag-and-drop GUI—without writing code

Test Scheduler: Run Tests

- Schedule and run synchronized tests
- View test results

More About Test Builder

Test Builder includes baseline modules for controlling Spider™ and ACE RNX, in addition to core modules for basic logic/execution and graphic and optional software automation modules for the following:

Access Point Automation & Control Library (DIR-805)

Control access points through the Cisco 2504, 3702 controller. Configure radio, channel, bandwidth, etc.

Traffic Source Automation & Control Library - iPerf (DIR-806)

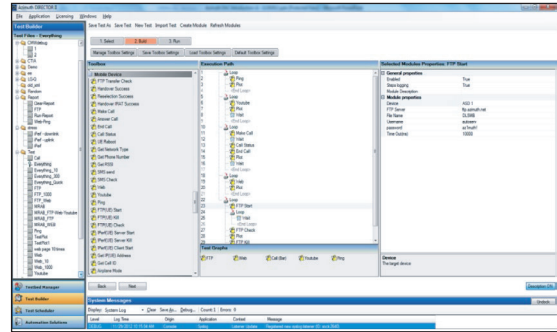
Configure iPerf3 between two endpoints (on device, PC)
Start iPerf session
Collect KPIs

Traffic Source Automation & Control Library - Chariot (DIR-807)

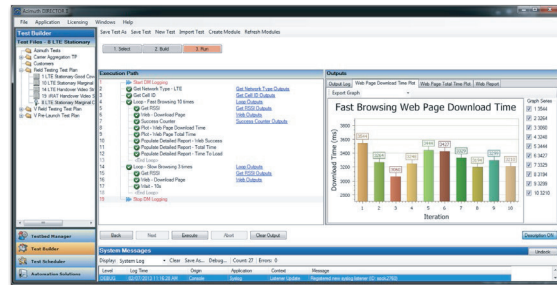
Configure Chariot between two endpoints (on device, PC)
Start Chariot session
Collect KPIs

Features

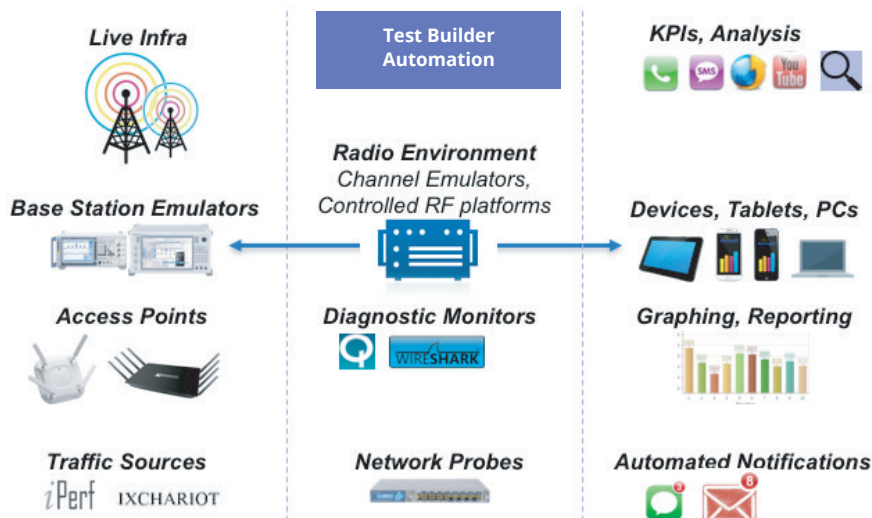
- Control and automate test-bed end-to-end
- Control handsets, access points, traffic sources, diagnostic monitors/sniffers, etc.
- Create custom test cases through drag-and-drop GUI interface without writing code
- Create slick reports and graphs
- Share test cases with other teams and ecosystems easily and securely



Test Builder



Test Scheduler



Spider SPI-100 series Specifications

RF Channel Module with Butler Matrix (RFCM-B) RF Channel Module without Butler Matrix (RFCM-C)

| | |
|------------------------------|--|
| Usable Frequency Range | 700 MHz to 6000 MHz |
| Number of Paths | 4 |
| Controlled Attenuation Range | RFCM-B 700 MHz to 3000 MHz: 54 dB 3001 MHz to 6000 MHz: 52 dB RFCM-C 700 MHz to 6000 MHz: 55 dB |
| Attenuation Resolution | 0.5 dB |
| Attenuation Accuracy | ±0.5 dB |
| Insertion Loss | RFCM-B 700 MHz to 3000 MHz: 15 dB 3001 MHz to 6000 MHz: 19.5 dB RFCM-C 700 MHz to 6000 MHz: 6 dB 3001 MHz to 6000 MHz: 9 dB |
| Return Loss | >10 dB |
| Isolation | 15 dB typical for An to Am, where n≠m, and for Bn to Bm, where n≠m, with attenuators set to nominal 0 dB |
| Input Power | +20 dBm max. |
| Channel Configuration | RFCM-B: Butler RFCM-C: Bypass |
| Control Interface | Ethernet 10/100/1000 |
| Control Software Included | Configure Unit Set Attenuator value: each path, all paths |
| Power | 120 V(ac)/240 V(ac), 1.5/0.75A 50 Hz to 60 Hz |

Star Combiner Module (SCM-5) Mesh Combiner Module (MCM-4)

| | |
|---------------------------|---|
| Usable Frequency Range | 700 MHz to 6000 MHz |
| Insertion Loss (Typical) | SCM-5 3 GHz: 5 dB 6 GHz: 14 dB MCM-4 Master Port (M) to any Split Port (S1, S2, S3) 3 GHz: 5 dB 6 GHz: 5 dB |
| Return Loss | MCM-4 Split Port (S1, S2, S3) to any other Split Port (S1, S2, S3) >20 dB |
| Input Power | SCM-5 +30 dBm average MCM-4 M Port: +43 dBm max. S Ports: +29 dBm max. |
| Number of Groups | SCM-5: 5 MCM-4: 4 |
| Number of Paths Per Group | 4 |
| Channel Configuration | Identity Matrix |

Near Field Adapter (MLA-01)

| | |
|------------------------|--------------------------------|
| Usable Frequency Range | 700 MHz to 6000 MHz |
| Coupling Loss | Typically up to 25 dB at 5 GHz |
| RF Connection | SMA, female |
| Physical Connection | Velcro™ fastener |

STACSIM-(Static Channel Simulator) (ACC-290) STACSIM-WB-(Static Channel Simulator) (ACC-339)

| | | | | | | |
|-------------------------------------|---|-----|-------------|------|------|------|
| Frequency | ACC-290 2.4 GHz to 2.5 GHz and 4.9 GHz to 5.9 GHz ACC-339 700 MHz to 6 GHz | | | | | |
| Topology | Up to 4x4 (full rank) | | | | | |
| Isolation | At least 20 dB | | | | | |
| Butler matrix phase characteristics | ACC-290 | | Output port | | | |
| | | | B1 | B2 | B3 | B4 |
| | Input port | A1 | -45 | -90 | -135 | -180 |
| | | A2 | -135 | 0 | 135 | 270 |
| | | A3 | 270 | 135 | 0 | -135 |
| | | A4 | -180 | -135 | -90 | -45 |
| | ACC-339 | | Output port | | | |
| | | | B1 | B2 | B3 | B4 |
| Input port | A1 | 45 | 90 | 135 | 180 | |
| | A2 | 135 | -45 | -135 | 90 | |
| | A3 | 90 | -135 | 0 | 135 | |
| | A4 | 180 | 135 | 90 | 45 | |

RadioProof Enclosures (RPE-401L/AC) RadioProof Enclosures (RPE-402)

| | | |
|----------------------|---|---|
| Model | RPE-401L/AC | RPE-402 |
| Number of Chambers | 1 | 2 |
| RF Ports | 12 | 6 per chamber |
| RF Port Type | 8 SMA (front) 4 N-type (rear) | 4 SMA (front), 2 N-type (rear) per chamber |
| Filtered Connections | <ul style="list-style-type: none"> • 2 x RJ45 Ethernet 10/100/100 • RJ45 for serial • DC power • 110-240V AC power • Cooling fan | <ul style="list-style-type: none"> • 2 x RJ45 Ethernet 10/100/100 • RJ45 for serial • DC power |
| Isolation | 90 dB, 1.0 GHz to 6.0 GHz | 90 dB, 1.0 GHz to 6.0 GHz |
| Configuration | Desktop or rack mount | Desktop or rack mount |
| Ventilation | Fan | Passive |
| Exterior Dimensions | 422 (W) x 323 (H) x 686 (D) mm | 422 (W) x 191 (H) x 407 (D) mm |
| Interior Dimensions | 381 (W) x 254 (H) x 524 (D) mm | 211 (W) x 121 (H) x 350 (D) mm |
| Mass | 22.3 kg | 15.5 kg |

Ordering Information

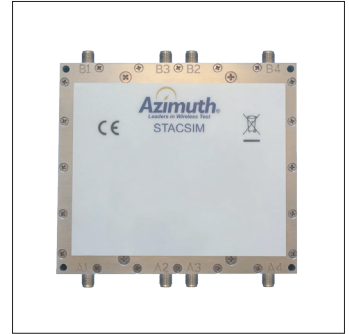
Spider SPI-100 series

Please specify the model/order number, name and quantity when ordering.
The names listed in the chart below are Order Names. The actual name of the item may differ from the Order Name.

| Model/Order No. | Name |
|-----------------|---|
| | Main Frame |
| SPI-102 | Spider - Standalone (include RFCM-B, MLA-01 (x2)) |
| SPI-103 | Spider - Star - 2 node (include RFCM-B (x2), SCM-5, MLA-01 (x4)) |
| SPI-104 | Spider - Star - 3 node (include RFCM-B (x2), RFCM-C, SCM-5, MLA-01 (x4)) |
| SPI-105 | Spider - Mesh (include RFCM-B (x6), MCM-4 (x4), MLA-01 (x6)) |
| | Standard software |
| DIR-II | Director-II Test Executive |
| DIR-805 | Access Point Automation & Control Library |
| DIR-806 | Traffic Source Automation & Control Library - iPerf |
| DIR-807 | Traffic Source Automation & Control Library - Chariot |
| | Standard accessories |
| | Power Cord: 1 pc |
| | Configuration items |
| | -Hardware- |
| RFCM-B | RF Channel Module with Butler Matrix |
| RFCM-C | RF Channel Module without Butler Matrix |
| SCM-5 | Star Combiner Module |
| MCM-4 | Mesh Combiner Module |
| MLA-01 | Near Field Adapter |
| | Hardware options |
| TERM-4 | 4 port 50ohm Terminator |
| ACC-290 | STACSIM – (Static Channel Simulator) |
| ACC-339 | STACSIM-WB – (Static Channel Simulator) |
| RPE-401L/AC | RadioProof Enclosures |
| RPE-402 | RadioProof Enclosures |
| | Support services |
| SVC-101 | Engineering and/or Training Service per hour |
| SVC-701 | Annual Software Maintenance and System Technical Support |
| SVC-703 | Advanced Replacement Service |
| SVC-710 | Return To Factory Repair Evaluation |



Near Field Adapter MLA-01



STACSIM ACC-290



RadioProof Enclosures
RPE-401L/AC



RadioProof Enclosures
RPE-402