The VR5 HD replicates the real-world fading, noise and complete spatial channel conditions of even the most complex wireless channels, making it possible to isolate performance issues early in the development and design verification cycle. The VR5 is an excellent choice when you need to test with high-antenna-count MIMO and beamforming scenarios.

The VR5 platform implements proven, customer-driven Spirent channel emulator features on a future-proofed hardware and software platform: Spirent’s Dynamic Environment Emulation (DEE), Live2Lab® Virtual Drive Test - Conversion Tool, and MIMO OTA Environment Builder are available on the VR5.

Wide bandwidths, high RF density and envelope-pushing channel fidelity are added to create the advanced fading platform. Complex MIMO-OTA scenarios with many antennas and spatial channel models (SCMs) can be set up in no time. Bi-directional scenarios and complex beamforming scenarios can be run without external “RF plumbing” hardware.

Features & benefits

- **Simplified testing**—VR5 keeps receiver testing simple, preventing setup errors... no matter how many antennas are involved in the forward-looking technologies you’re working on.
- **The real world in your lab**—From captured drive-test scenarios to the most complex MIMO scenarios, the VR5 brings real-world RF scenarios to your test lab.
- **Maximum effectiveness of your resources**—Even the most complicated test cases can be set up and run, quickly and correctly, by your least experienced team members.
Spirent’s years of experience have taught us that testing loses a lot of value when the process is too complex... errors are made, anomalies go unnoticed and testing is sometimes not completed because of the time required to set it up. Even worse, a series of time-consuming tests might be completed before someone notices an error in the setup.

The potential problems become even more apparent when dealing with a complex RF environment. Basic testing should not require an expert; advanced testing might, but it should never require expertise in using the tool.

This is why the VR5 GUI has been carefully designed around years of feedback from channel emulator users.

The VR5 can implement bi-directional testing (up to and including 4x4 bi-directional MIMO scenarios) in a single 6U component, requiring no external combiners, splitters or circulators. Options enable 8x2 MIMO Beamforming, automated phase calibration (e.g. for TD-LTE and Wi-Fi testing) and much more.

Every interface between the system and the user was designed to provide pure information in a clear and consistent way. Once the user picks a network configuration to emulate, the GUI tailors itself to present block diagrams and clear, concise informational and input fields.

The VR5’s built-in touchscreen offers both detailed control and immediate feedback. You can view graphical readouts of the fading models being run (even while running Dynamic Environment Emulation), time-history charts of the levels measured by independent input and output power meters, and much more.

Finally, the VR5 offers a complete selection of ready-to-run standard models. Most test cases can be set up with just a few mouse clicks. The intuitive system interface means that you can train personnel to run tests in a matter of minutes, letting your experts concentrate on other challenges.
The real world in your lab

The VR5 HD Spatial Channel Emulator is more than just a fader. Like the SR5500 before it, the intent of the VR5 is to bring the real world into the lab and provide an absolutely realistic emulation of the real-world RF environment. This is no easy task. A realistic RF channel emulation is affected by a variety of factors: how RF parameters are captured or generated, what characteristics are important to the testing at hand, etc.

We all know that MIMO systems are dependent on the physical orientations of mobile devices. Have you considered the importance of testing under realistically time-varying orientations (in other words, non-standard mobility scenarios)? We have. The VR5’s Dynamic Correlation is ready to help you find those motion-based glitches you might have missed otherwise.

The VR5 was also designed with Over-the-Air (OTA) testing in mind. Spirent experts have been working behind the scenes for years, investigating the underlying elements of OTA testing. While much of this research has been shared with the wireless community, the VR5 is the first channel emulator designed with MIMO OTA testing in mind.

Spirent also offers support for OTA channel mapping and the creation of custom Spatial Channel Models (as well as custom non-standard spatial channel models). The result is a straightforward implementation of this highly useful but complex testing technology.
Maximizing resource effectiveness

The VR5 makes short work of even the most complex RF scenarios so that you and your team spend more time testing and less time preparing to test. Most testing can be set up with just a couple of mouse clicks using drop-down boxes. In fact, your test operator doesn’t even need to understand the finer details of RF and fading. The VR5 is designed so that standards-based testing or regression testing can be successfully and efficiently performed by even the least experienced member of your team.

When your situation demands a complicated custom dynamic scenario, it can be implemented in a few minutes using spreadsheet software (rather than spending a few days writing scripts). And when an expert is required, Spirent’s support team, always a phone call away, gives you access to the industry’s most experienced and respected fading experts.

The VR5 was designed to address one more resource-saving request from the industry: it is a highly optioned product so that you only purchase the instrument options you need right now. If you need a channel emulator to test 2x2 MIMO with 40MHz bandwidth today, but you suspect that you may need to test higher orders of MIMO such as 4x4 or 8x4 with 100MHz bandwidths in the future, the VR5 can be easily upgraded to meet your requirements as they unfold.

This future-proofed system is also designed with next-generation wireless in mind. The platform is the industry’s first choice in LTE Advanced, addressing Carrier Aggregation and the increasingly-demanding MIMO and beamforming requirements associated with upcoming technologies.

Finally, Spirent’s global network of service and metrology laboratories ensure that no matter where your VR5 is when you need help, our staff of experts can offer the industry’s best turnaround times... so your team spends more time testing and less time waiting.

While most testing can be set up with a few mouse clicks, the GUI provides all the low-level control needed for the most advanced testing.
The VRS provides comprehensive real-time graphical feedback, helping ensure that a setup error doesn’t go unnoticed.

The VRS GUI graphically delivers a wide selection of critical feedback. In this example (created in DEE), a DUT is run through handover scenarios as noise ratios gradually change.
### Technical Specification

| **RF Configurations** | Support from SISO, 2x2 up to 8x4 with bi-directional fading  
Multiple VR5s can be synchronized for more complex custom connection setups  
Multi-band carrier aggregation for LTE-A is supported internally |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>RF Inputs</strong></td>
<td>8</td>
</tr>
<tr>
<td><strong>RF Outputs</strong></td>
<td>8</td>
</tr>
<tr>
<td><strong>RF Local Oscillators</strong></td>
<td>4 – up to four independent carrier frequencies</td>
</tr>
<tr>
<td><strong>Digital Channels</strong></td>
<td>up to 32</td>
</tr>
<tr>
<td><strong>Bandwidth</strong></td>
<td>Up to 100MHz</td>
</tr>
</tbody>
</table>
| **RF Input**          | Frequency Range: 380 – 3850, 4100 – 6000MHz  
Input Level Range: -50 to +15 dBm (< 4GHz)  
-40 to +15 dBm (4 - 6GHz)  
Level Resolution: 0.1dB  
Damage Level: +33dBm (peak) |
| **Input and Output Power Meters** | Modes: Continuous  
RF Burst-triggering for gated input signals |
| **RF Output Level**   | Max/Min Range: -110 to -20dBm (RMS, <4GHz)  
-110 to -30dBm (RMS, 4-6GHz)  
(Up to +5dBm peak power)  
Resolution: 0.1 dB |
| **Residual EVM**      | -40dB typical                                                      |
| **Residual Noise**    | Better than -165dBm/Hz at a set output level of -45dBm                                                        |
| **RF Port VSWR**      | 1.5:1                                                             |
| **Independent Paths** | Up to 24 paths per digital channel                               |
| **Delay**             | 0 to 4000µs, 0.1ns resolution                                      |
| **Relative Path Loss**| 0 – 40dB                                                           |
| **Dynamic Channel Parameters** | Sliding delay (moving propagation)  
Birth-death delay  
3GPP High-Speed Train (HST) profiles  
Log normal (shadow fading) |
| **Dynamic Environment Emulation** | Controllable Parameters  
Channel Model Update Rate: 50 times per second  
Start Method: Triggered (hardware/software), Free Play  
Play Method: Run for N loops, Wrap Around |
| **Standards-Based Models** | LTE, Wi-Fi (802.11n, 802.11 ac), IMT-A, WiMAX, UMTS, CDMA2000®, HSPA, GSM, SCM/SCME (ITU-R M.2135), WINNER, Butler |
| **Custom Models**     | Easy-to-use interface allows the user to create custom channel models or edit any of the above standard channel models |
## Technical Specification (cont’d)

### Real-time Fading

<table>
<thead>
<tr>
<th>Types</th>
<th>Rayleigh, Rician, Pure Doppler, Frequency Shift, Phase Shift</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fading Doppler</td>
<td>Up to 4000 Hz</td>
</tr>
<tr>
<td>Repetition Interval</td>
<td>&gt; 7 days</td>
</tr>
<tr>
<td>Relative Phase</td>
<td>0 – 360 degrees, 0.1 degree resolution</td>
</tr>
<tr>
<td>Rician K Factor</td>
<td>-30 to +30 dB</td>
</tr>
<tr>
<td>Level Crossing Rate (LCR) Accuracy</td>
<td>&lt; ± 2.5% deviation from theoretical LCR curve of the simulated vehicle velocity</td>
</tr>
<tr>
<td>Fading Power Spectrum</td>
<td>Classical 6 dB, Flat, Classical 3 dB, Rounded, Rounded 12 dB, Bell</td>
</tr>
<tr>
<td>Correlation</td>
<td>Programmable complex correlation between paths</td>
</tr>
</tbody>
</table>

### AWGN (Option)

<table>
<thead>
<tr>
<th>C/N Ratio</th>
<th>-40 to +32 dB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accuracy</td>
<td>±0.1 dB</td>
</tr>
<tr>
<td>Bandwidth</td>
<td>Up to 100 MHz</td>
</tr>
</tbody>
</table>

### Control Interface

- Touchscreen front panel-based GUI
- PC-based GUI
- Remote programming through Ethernet

### Other

- 10 MHz internal reference accuracy: 1 ppm, can be locked to external reference
Spirent services

Spirent Global Services provides a variety of professional services, support services and education services—all focused on helping customers meet their complex testing and service assurance requirements. For more information, visit the Global Services website at www.spirent.com or contact your Spirent sales representative.

Ordering information

Due to the wide range of available system configurations, please contact your regional Spirent sales representative for detailed ordering information.