



RF Channel Emulator

TAS4500 FLEX5

Comprehensive, repeatable radio channel emulation for testing 3G wireless systems.

The TAS4500 FLEX5 possesses unique features to evaluate a wide range of wireless communications technologies, including:

- WCDMA
- CDMA2000
- Wireless LAN
- Location Based Services

The FLEX5 provides accurate and repeatable control of RF channel characteristics such as:

- Multi-Path Fading
- Path Loss
- Delay Spread
- Log Normal Shadowing

These effects result in significant signal distortion that can lead to errors and communication failures. Thorough and effective testing can lead to designs that mitigate the RF channel effects and render robust, high-quality products.

FLEX5 gives you the bandwidth you need to cover all CDMA2000, WCDMA and WLAN applications. The FLEX5 also provides, flexible radio channel emulation to meet wide range of testing

standards from 3GPP2, 3GPP, ANSI, ITU, CDG and many more. It provides an easy way to comply with industry standards and to benchmark product performance. In addition, FLEX5 gives you the tools to go beyond mere standards compliance to completely and objectively characterize product performance.

Using the powerful Dynamic Environment Emulation (DEE) feature, you can emulate dynamic channel conditions, or playback field measurements in the lab. FLEX5 dynamic channel models meet WCDMA receiver test requirements by emulating real-world propagation conditions. This is achieved by dynamically changing key channel parameters versus time. FLEX5 can re-create a time-varying power-delay channel profile either from synthesized data or previously recorded field measurements.

FLEX5 creates a wide range of realistic RF propagation conditions, so that wireless communication products can be thoroughly tested in a laboratory setting. FLEX5 creates accurate, repeatable test conditions to facilitate systematic testing. Thorough testing with FLEX5 will reduce cost and time-to-market.

Major Features:

- Provides comprehensive channel models for evaluating CDMA2000 and WCDMA communications equipment
- Includes powerful, user programmable dynamic tests to accurately reproduce real-world conditions
- Expandable up to an eight branch diversity test system with full correlation control
- Vector channel model for adaptive antenna array testing
- Combines with Spirent Interference Emulator to provide programmable interference conditions across entire range of operating frequencies
- Supports JTC'94 models for indoor WLAN applications
- Large Doppler emulation range meets high-speed mobile test specifications
- Built-in and user-programmable environment models
- Wide dynamic range provides accurate results even at the lowest signal levels

Spirent Communications
 541 Industrial Way West
 Eatontown, New Jersey
 07724, U.S.A.
 Tel: +1 732-544-8700
 Fax: +1 732-544-8347
 Sales: +1 800-348-0080
 tas.sales@spirentcom.com

Sales Contacts:
North America
 +1 800-927-2660
Europe, Middle East, Africa
 +33-1-6137-2250
Asia Pacific
 +852-2166-8382
All Other Regions
 +1 818-676-2683

www.spirentcom.com



TAS4500 FLEX5 precisely emulates time-varying RF propagation effects to facilitate thorough evaluation of wireless communications equipment.

Applications:

- Product Development
- System Performance Test
- Quality Assurance
- Manufacturing Test
- Product Evaluation
- Design Verification Test
- Conformance Test



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FLEX5 Capabilities

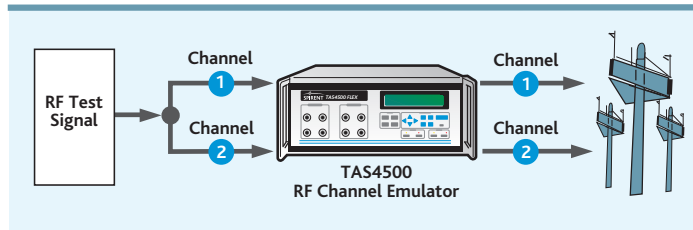
TAS4500 FLEX5 addresses a wide range of wireless communications applications. FLEX5 provides accurate, repeatable emulation of the wireless communication medium that is independent of transceiver technology, so the same FLEX5 unit can be applied to a wide range of transmission schemes. FLEX5 also operates over a broad frequency range, so applications as diverse as WLAN, audio /video broadcast, land-mobile radio, cellular and PCS can all be addressed.

FLEX5 is a modular system that can be configured to fit the needs of a specific application. In addition, FLEX5 works in conjunction with other Spirent equipment such as our Interference Emulator and automatic test software to form complete test systems. All FLEX5 models come equipped with convenient front panel controls as well as TASKIT® software for Windows PC control.

Standard Test Systems for Cellular, PCS, and Next Generation Wireless Applications

TAS4500 FLEX5 emulates all RF propagation conditions required for wireless voice and data applications testing in one compact enclosure. FLEX5 tests both mobile station and base station equipment. Each FLEX5 unit can be configured with up to twelve independent signal paths, and can easily accommodate the required test

conditions for both existing and emerging wireless communication standards. In addition, built-in local oscillators keep the test system integrated and easy to operate. TASKIT® software includes a pre-defined library of test conditions for popular wireless standards.



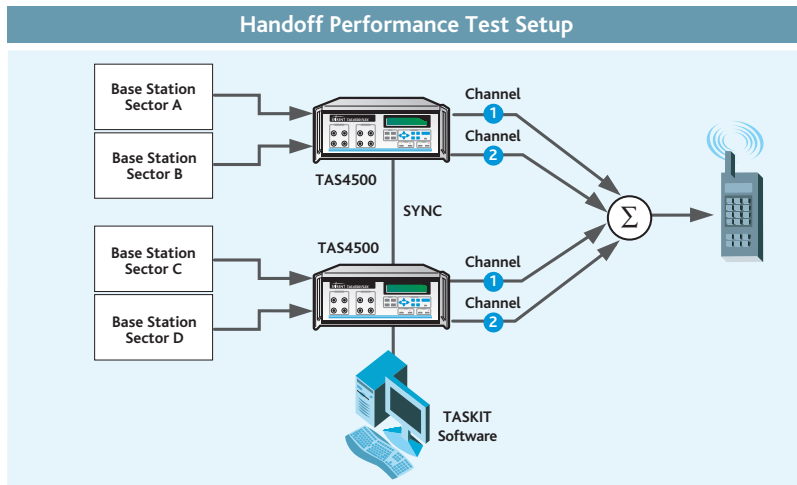
The FLEX5 family includes standard test systems for cellular, PCS, and next-generation wireless applications.

Play-back field propagation conditions in the lab using Dynamic Environment Emulation

In the past, the methods available to benchmark the performance of wireless systems under dynamic environment conditions were extremely limited. This type of comprehensive performance evaluation was typically restricted to time-consuming, costly, and unrepeatable field tests. Now, using

FLEX5's innovative Dynamic Environment Emulation (DEE) feature, real-world conditions can be recreated in the lab via TASKIT/4500 PC-software. Propagation conditions can be either synthesized or imported from field measurements to allow full, repeatable control over time-varying RF channel characteristics. DEE can help isolate potential field problems before deployment – saving both time and money.

Dynamic Environment Emulation makes it possible to synchronously emulate multiple forward and reverse links. When used in a multi-channel mode, DEE synchronizes the fading and multi-path characteristics across FLEX5 instruments enabling precise cause-and-effect correlation between channel conditions and system performance.



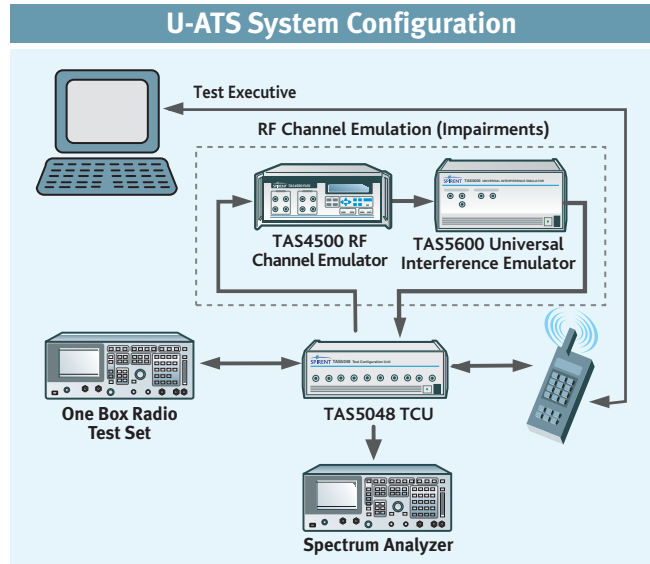
Test time-sensitive system handoff performance algorithms, using Dynamic Environment Emulation



TAS4500 FLEX5 Applications

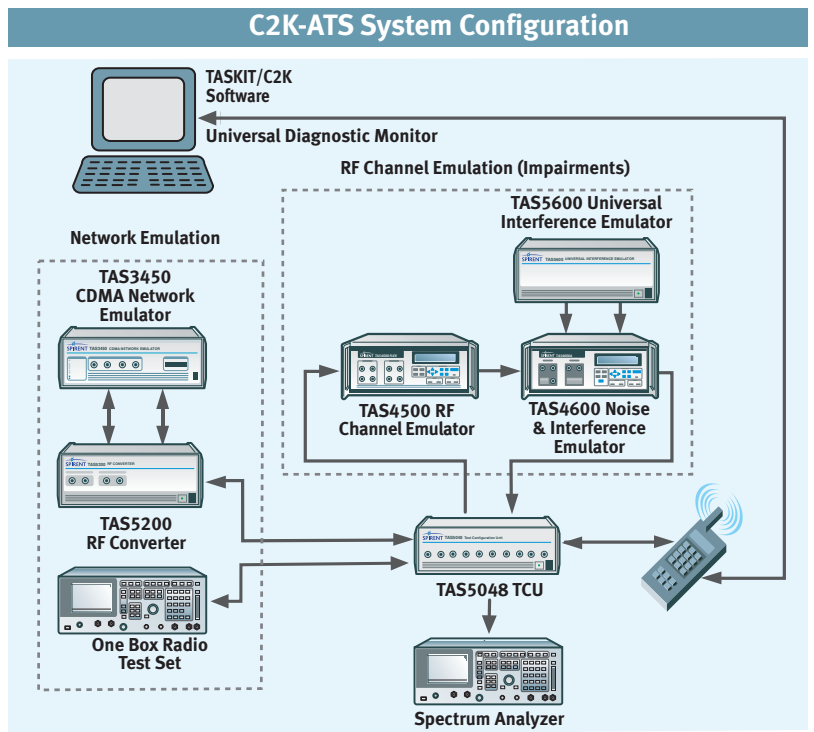
WCDMA UE Test Configuration

U-ATS is a comprehensive test setup that provides automated WCDMA performance test coverage, including 3GPP standards



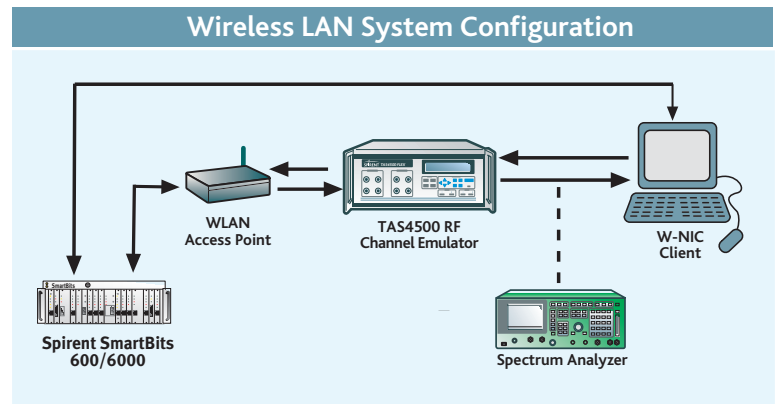
C2K-ATS CDMA2000 Automatic Test System for Evaluating Mobile Devices

C2K-ATS is a comprehensive test setup that provides complete and automated coverage of IS-98 and IS-898 (CDG Stage 2)



Wireless LAN Test Configuration

Spirent solutions enable both physical and MAC layer testing for WLAN applications.

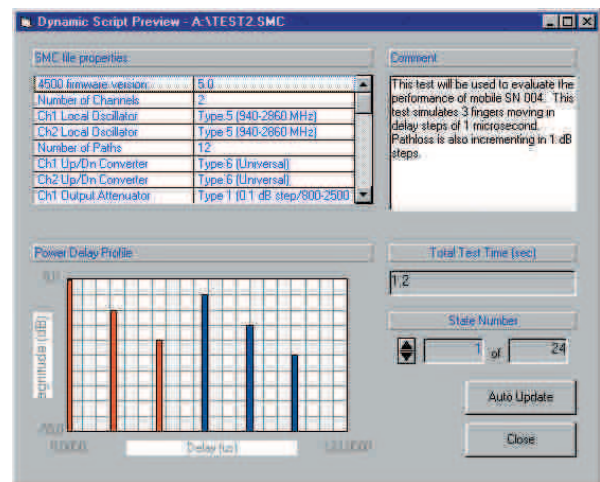


Powerful Dynamic Environment Emulation (DEE) Lets You Accurately Pinpoint Real-World Performance Problems

Dynamic Environment Emulation varies key channel parameters at precise time intervals. This innovative feature allows complete performance evaluation of time-sensitive communications algorithms such as Rake demodulator, channel equalizer, or mobile hand-off scheme. By moving the test environment into the lab, this advanced capability enables different design iterations to be evaluated over repeatable test conditions and reduces the cost of testing.

Employing an easy-to-use Windows-based GUI, DEE makes it easy to generate and play-back a series of exhaustive channel conditions. The DEE test software allows control over eight synchronous RF emulation channels from a single PC. Multi-channel synchronization makes it possible to construct a comprehensive test bed for evaluating the performance of several forward and reverse links simultaneously. State transitions can be managed by internal timers or synchronized to system events via an external trigger signal.

FLEX5's dynamic channel models meet WCDMA receiver test requirements

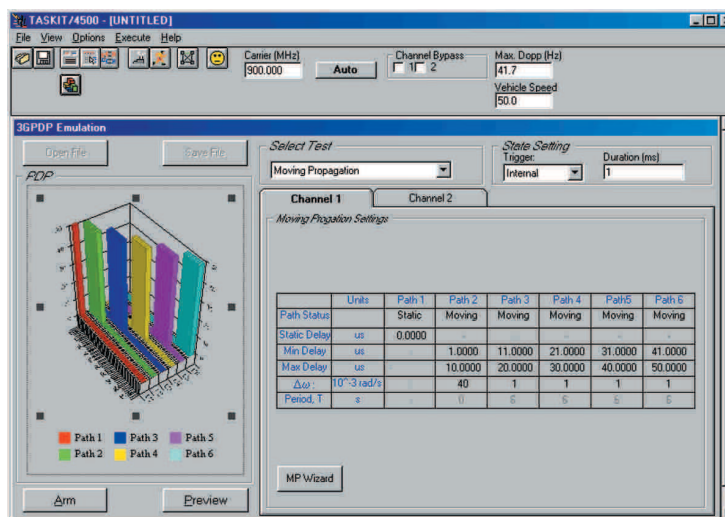


3GPDP simplifies receiver testing by allowing pre-defined WCDMA/3GPP channel models to be recalled with a touch of a button

FLEX5 with 3GPDP provides the ability to go beyond the two-path dynamic models defined in 3G standards by allowing the relative delay of the instrument's entire path to be varied over time. 3GPDP's Moving propagation and Birth-Death channel models

emulate the temporal variations in the radio channel by changing delay-spread characteristics versus time.

- Emulates time-varying power-delay profiles (PDP's)
- Evaluates performance of RAKE finger management and channel estimation algorithms
- Built-in Moving Propagation and Birth-Death Channel Models
- Surpasses requirements defined in CDMA2000 and WCDMA (3GPP) test specifications



3GPDP makes it easy to recall pre-defined 3GPDP channel models or to create more sophisticated dynamic multi-path test scenarios.



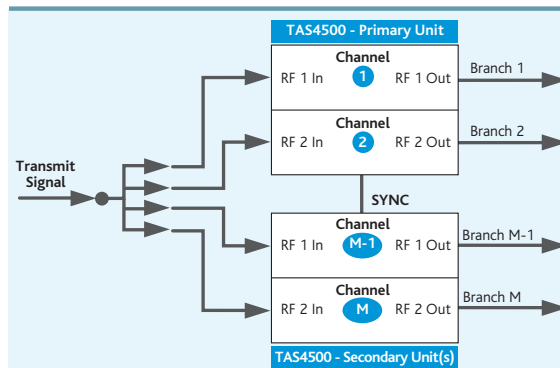
Advanced multi-branch and vector channel models for evaluation of diversity and antenna array systems

Many wireless systems utilize diversity receivers to optimize performance. Emerging networks are deploying antenna arrays to further reduce the effects of interference and increase system capacity. Diversity and antenna array systems require advanced channel models capable of synchronously emulating multiple propagation channels. Dual-branch diversity systems can be evaluated in a single TAS4500.

Diversity systems with more than two branches require additional FLEX5 instruments to be synchronized. A

system utilizing four diversity branches requires the channel characteristics of a pair of TAS4500's. Additional FLEX5 instruments can be added to emulate up to an eight-branch diversity model with full correlation control between branches.

Evaluation of antenna array systems requires a new class of channel models. These vector channel models require control of both fading correlation and relative phase between emulation channels. The TAS4500 provides the advanced vector channel models required to evaluate antenna array systems.



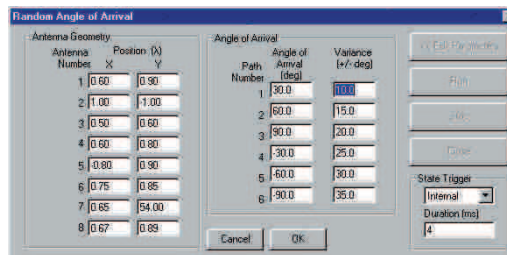
The FLEX5 is the first fading emulator that expands to an eight-branch diversity test system. TAS4500 provides full correlation control by synchronizing fading characteristics across four instruments.

TASKIT/Smart Antenna software provides quick and easy access to powerful multi-channel modeling capabilities

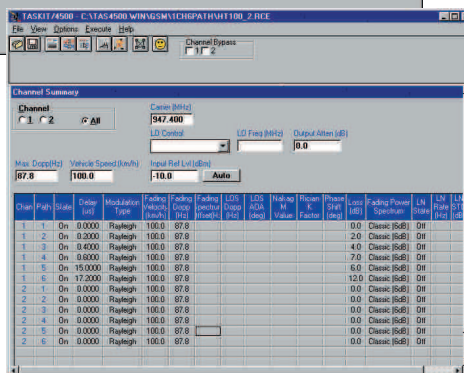
TASKIT/Smart Antenna provides access to all the parameters necessary to configure multi-branch channel models. At the heart of the Smart Antenna Test Systems, the PC-based software makes it possible to program the spatial characteristics of the antenna array using simple geometric parameters.

This powerful channel modeling software precisely calculates the phase relationships between each of the antenna elements based on the user-defined antenna geometry. The result is an accurate and repeatable channel model that emulates the propagation environment seen by the diversity antenna system.

TASKIT/Smart Antenna's innovative Random Angle of Arrival Test recreates real-time dynamic test conditions. Based on the antenna array geometry and user-defined angle of arrival statistics, TASKIT/Smart Antenna plays back a time-varying multi-branch channel model. The multi-branch test system fully evaluates the adaptive algorithms employed by Smart Antenna systems by randomly varying the angle of arrival characteristics of each propagation path.



Spirent's Smart Antenna Test System can be programmed to randomly vary angle-of-arrival characteristics over time based on statistical distributions.



FLEX5 Application-Specific Systems

TAS4500 FLEX5 can be ordered in one of two ways:

- Pre-configured system, targeted for specific test applications
- A la carte, to create a custom system configuration

The following text provides a description of each available system product. The “Matrix of FLEX5 Models” shows how each specific 4500 model is equipped. The “FLEX5 Systems Components and Options” provides a brief description of each available FLEX5 option. Note that FLEX5 products are listed with the format: Part Number/Description. Please use these same part numbers and descriptions when placing an order.

FLEX5/3G - Complete RF channel emulator for third generation (3G) cellular and PCS applications. Includes two 6-path channels, two LO’s, enhanced feedthrough suppression, channel bypass function and RF output attenuators. Covers 800-2500 MHz range.

FLEX5/CELL - Complete RF channel emulator for cellular and personal communications systems (PCS) applications. Includes two 3-path channels, two LO’s, enhanced feedthrough suppression, channel bypass function and RF output attenuators. Covers 800-2500 MHz range.

SMART-LAB - Complete system for testing Smart Antenna and Antenna Diversity systems with up to eight branches. Includes up to four synchronized FLEX5 channel emulators.

Systems include the necessary accessories and TASKIT/Smart Antenna software for easy control of the test setup.

C2K-LAB - Complete emulation of RF Fading, AWGN and low-phase noise interference conditions required by cdma2000 test specifications. Includes two LO’s, enhanced feed-through suppression, channel bypass function, 5600W Universal Interference Emulator, and TASKIT software for Windows PC Control. Covers 800-2200 MHz range.

UMTS-LAB - Complete emulation of RF fading AWGN, and interference conditions required by WCDMA test specifications. Includes TAS5600W Universal Interference Emulator and TASKIT software for Windows PC control. Covers 800-2200 MHz, including IMT-2000 frequency bands.

Matrix of FLEX5 Models

	Model	Channels X Paths	Band Width (MHz)	Internal LO Type	Channel Bypass (CBP)	Enhanced Feed Through Suppression (EFX)	800-2500 MHz Output Attenuator (ATT1)	25-3000 MHz Output Attenuator (ATT3)
Base Models	FLEX5 / 2C12P	2 X 6	26	opt	opt	opt	opt	opt
	FLEX5 / 2C06P	2 X 3	26	opt	opt	opt	opt	opt
	FLEX5 / 1C06P	1 X 6	26	opt	opt	opt	opt	opt
	FLEX5 / 1C03P	1 X 3	26	opt	opt	opt	opt	opt
Pre-Configured Models	FLEX5 / 3G	2 X 6	26	LO4	yes	yes	yes	no
	FLEX5 / CELL	2 X 3	26	LO4	yes	yes	yes	no
	FLEX5 / Q1	2 X 6	26	LO4	yes	yes	yes	no

FLEX5 System Components and Options

FLEX5-ATT1

Atten. For 800-2500 MHz Range (each channel) — This option provides a precision RF attenuator to cover the 800-2500 MHz frequency range. A separate attenuator option must be purchased for each channel in the FLEX5 unit.

FLEX5-ATT3

Atten. For Extended Freq. Range (each channel) — This option provides an RF attenuator to cover the extended (25-3000 MHz) frequency range. A separate attenuator option must be purchased for each channel in the FLEX5 unit. ATT3 control not available when using DEE.

FLEX5-EFX

Enhanced Feedthrough Suppression (each channel) — This option adds LO and Image Feedthrough suppression filtering over the 800 - 3000 MHz frequency range. A separate suppression filter must be purchased for each channel in the FLEX5 unit.

FLEX5-CBP

Channel Bypass Option (each channel) — This option for the enhanced front end provides software controlled bypass of the channel. This option is not available with the FLEX5-FBP option.

FLEX5-EXTnn

Extended Delay Option — Extended delay is available for all FLEX5 models. The FLEX5 has a 2000 msec relative path delay range when equipped with the extended delay option. The part number for extended delay depends on the number of paths contained in the FLEX5 system, as follows:

- 12-path systems – FLEX5-EXT12
- 6-path systems – FLEX5-EXT06
- 3-path systems – FLEX5-EXT03



FLEX5 Technical Specifications

The following specifications describe warranted performance over the temperature range 0-50 degrees C and include a 30 minute warm-up time from ambient conditions. Supplemental characteristics are in italics and provide useful information by giving non-warranted performance parameters.

RF Channel Specifications

RF Input Signal Frequency Range	25 to 3000 MHz
RF Bandwidth	26 MHz
Number of Independent RF Channels	1 or 2
RF Input Signal Level Range	+5 to -30 dBm

RF Bandwidth Peak to Peak Typical Amplitude Variation 1 dB

RF Channel Options

RF Image and LO Feedthrough Suppression (EFX Option)	
Frequency Range	800 to 3000 MHz
RF Image Feedthrough on RF Out	-50 dBc maximum
RF LO Feedthrough on RF Out	-75 dBm
RF Output Attenuator	
ATT1:	
Attenuation Range	0 to 80 dB
Resolution	0.1 dB
Frequency Range	800 to 2500 MHz
ATT3:	
Attenuation Range	0 to 90 dB
Resolution	0.1 dB
Frequency Range	25 to 3000 MHz

Local Oscillator (LO) Characteristics

Internal Local Oscillators (LO4 option) (All specs refer to LO OUT unless noted)	
LO Frequency Range	940-2860 MHz
Carrier Frequency Range (RF IN)	800-3000 MHz
Level	+13 dBm
External Local Oscillators (All specs refer to LO IN unless noted)	
LO Frequency Range	165-3860 MHz
LO Offset from Carrier Frequency (Fc)	F _c >800 MHz F _c - 140 MHz F _c <800 MHz F _c + 140MHz
Level Range	+12 to +15 dBm

Channel Emulation Characteristics

Number of Independent Paths per Channel	3, 6 or 12
Path Modulation	None, Rayleigh, Frequency Shift, Phase Shift, Rayleigh with Frequency Shift, Rician with Frequency Shift, Nakagami, Rician
Fading Emulation Method Programmable with 2 modes:	Jakes, Filtered Noise
Fading Power Spectrum	Classical 6dB Flat Classical 3dB Rounded
<i>Fading (Rayleigh) Amplitude Distribution Deviation from Theoretical CPDF exceeds the following requirements (exceeds IS-137/138, and TIA/EIA-97/98 requirements):</i>	<i>From +10 to -30 dB of mean power level</i> $\leq \pm 0.5$ dB
<i>Level Crossing Rate (LCR) Accuracy exceed the following requirements (exceeds IS-137/138, and TIA/EIA-97/98 requirements):</i>	<i>From +3 to -30 dB of mean power level</i> $\leq \pm 2.5\%$ deviation theoretical LCR curve of the simulated vehicle velocity
<i>Fading Repetition Interval Emulation Method = Filtered Noise Programmable with 3 modes:</i>	<i>27 seconds, 20 minutes, 24 hours</i>
Correlation Coefficient (Between Channel 1 and Channel 2 Paths)	
Range	0 to 1
Resolution	0.01
Velocity	
Range (fc = 900 MHz)	± 0.1 to ± 1199.2 km/hr (± 0.1 to ± 745.1 mph)
Resolution	0.1 units
Fading Doppler Frequency	
Range	± 0.1 to ± 1000 Hz
Resolution	0.1 Hz
Doppler Shift Frequency (Frequency Shift)	
Range	± 0.01 to ± 1000 Hz
Resolution	0.01 Hz
Line of Site (LOS) Arrival Angle (Modulation = Rician or Nakagami)	
Range	0 to 360 degrees
Resolution	0.1 degrees
Relative Phase Between Paths (Modulation = Phase)	
Range	0 to 360 degrees
Resolution	0.1 degrees

FLEX5 Technical Specifications: *(continued)*

Channel Emulation Characteristics - (Continued)

Rician K Factor (Modulation = Rician)	
Range	-30 to +30 dB
Resolution	0.1 dB
Nakagami M Value (Modulation = Nakagami)	
Values	1, 3, 5, 10, 15, 25, 100
Relative Path Delay	
Range	
Standard System	0 to 125 µsec
Extended Delay	0 to 2000 µsec
Resolution	0.5 nsec
Relative Path Loss	
Range	0 to 50 dB
Resolution	0.1 dB
Log Normal Fading Standard Deviation (Relative Path Loss = 25 dB)	
Range	0 to 12 dB
Resolution	1 dB
Log Normal Fading Rate	
Range	0 to 20 Hz
Resolution	0.001 Hz

Channel Models

FLEX5 performs these standard multi-path fading environments and many more:

3GPP	
WCDMA	TS 25.141 TS 34.121 TS 25.142 TS 34.122 TR 25.943
3GPP2	
	IS-97-D IS-98-D

Dynamic Environment Emulation

Number of States	>2 billion
Minimum State Duration	10 msec.
State Duration Resolution	1 msec.
State Transition Trigger	internal, external
Programmable Parameters	Delay, Path loss, RF Attenuation (ATT1 only), Modulation type, Doppler frequency, velocity, LOS Component, Spectrum Offset, Rician K, Nakagami M, Phase Shift, Fading Power Spectrum

3GPPD

Test Profiles	Moving Propagation Birth-Death
Minimum State Duration	1 msec
State Duration Resolution	1 msec
State Transition Trigger	Internal/External
Modified Parameters	Path Delay
Moving Propagation	
Period of Oscillation (10 ⁻³ rad/sec)	1 to 32767
Number of Moving Paths	1 to 6
Birth-Death	
Number of Delay Bins	1 to 64
Number of Active Paths	1 to 6

Interface and Environmental Characteristic

Power Requirements	
Voltage	85-265 VAC (auto sensing)
Frequency	47 - 63 Hz
Operating Environment	
Temperature	0 to 50 degrees C (32 to 122 degrees F)
Dimensions and Weight	
Height	6.9 inches, 175 mm
Width	17.7 inches, 450 mm
Depth	19.9 inches, 505 mm
Weight	45 pounds, 20.5 kg
Control Interfaces	
Interfaces Provided	RS-232 (DCE) and IEEE-488 (GPIB)
External 10 MHz Reference Requirements	
Input Frequency	10.000 MHz

Spirent Communications
 541 Industrial Way West
 Eatontown, New Jersey
 07724, U.S.A.
 Tel: +1 732-544-8700
 Fax: +1 732-544-8347
 Sales: +1 800-348-0080
 tas.sales@spirentcom.com

Sales Contacts:
North America
 +1 800-927-2660
Europe, Middle East, Africa
 +33-1-6137-2250
Asia Pacific
 +852-2166-8382
All Other Regions
 +1 818-676-2683

www.spirentcom.com

