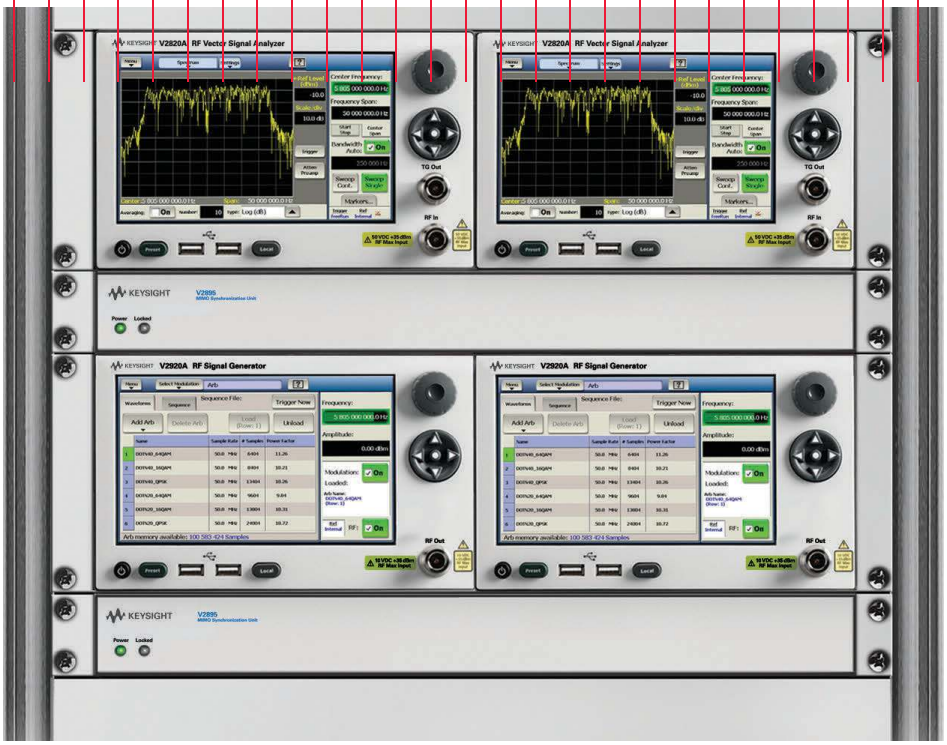
Keysight MIMO RF Signal Analysis and Generation Test Systems and Software with V2895A MIMO Synchronization Unit

Technical Overview



KEYSIGHT TECHNOLOGIES

Introduction

The MIMO RF signal analysis and generation test systems and software are ideal tools for research and development of evolving radio technologies such as multiple antenna systems known as multiple-input, multiple-output (MIMO) communication systems, MIMO configurations of wireless standards such as 802.11n WLAN, and 802.16e Mobile WiMAX Wave 2. These tools are also excellent for development and production test of wireless equipment, modules, sub-assemblies, and RFIC devices. The systems provide precise and stable synchronization with ≤±1 ns arbitrary waveform alignment, ≤1 ns arbitrary waveform jitter, ≤1° relative signal generation phase jitter, and ≤250 µs signal acquisition time record jitter.

System flexibility allows standalone MIMO-ready vector signal generators or analyzers to be configured in any MIMO configuration up to 8x8 using the V2895A MIMO synchronization unit. MIMO signal generation and analysis can be performed with the V2901A SignalMeister integrated RF signal analysis and generation toolkit, a solution perfectly suited for 802.11n WLAN and 802.16e MobileWiMAX Wave 2 applications.

MIMO RF Signal Analysis and Generation Test Systems and Software with V2895A MIMO Synchronization Unit

Radio technology is evolving from single antenna transmit-receive communication systems to MIMO antenna communication systems. MIMO systems significantly increase spectral efficiency; furthermore, they offer much higher data throughput rates and improved coverage. To maximize performance, many new wireless communication standards (WiMAX and UMTS HSPA+), and enhancements to existing standards (WLAN), include MIMO configurations. The trade-off is more complex transmitters and receivers, more elaborate transmission protocols, and substantially more signal processing.

The MIMO RF signal analysis and generation high performance test systems are designed to meet the challenges of MIMO technology research, product development, and production. The MIMO systems can test devices designed to operate on all MIMO-based wireless communication standards, including WLAN 802.11n, Mobile WiMAX 802.16e Wave 2, and UMTS HSPA+. The key to superior MIMO test performance in the Keysight Technologies, Inc. MIMO RF signal analysis and generation test systems is the V2895A MIMO synchronization unit that provides frequency locking, phase coherence, and time synchronization for multiple signal generation and multiple signal analysis. The high level of synchronization ensures that an Keysight MIMO system will provide highly accurate and repeatable measurements for research and development.

Each system can be configured with up to 8 V2820A RF vector signal analyzers or V2920A RF vector signal generators. The MIMO system can be initially configured as a 2×2 system then upgraded at a later date to 3, 4, or up to 8 channels by adding standard V2820A or V2920A instruments. They are MIMO-ready with the hardware connections and firmware built into every instrument. Moreover, the instruments need not be dedicated to a MIMO system. They can be configured for use either in a MIMO system or as stand-alone SISO (single-input, single-output) instruments by selecting the configuration in the firmware and changing a few rear-panel cables.

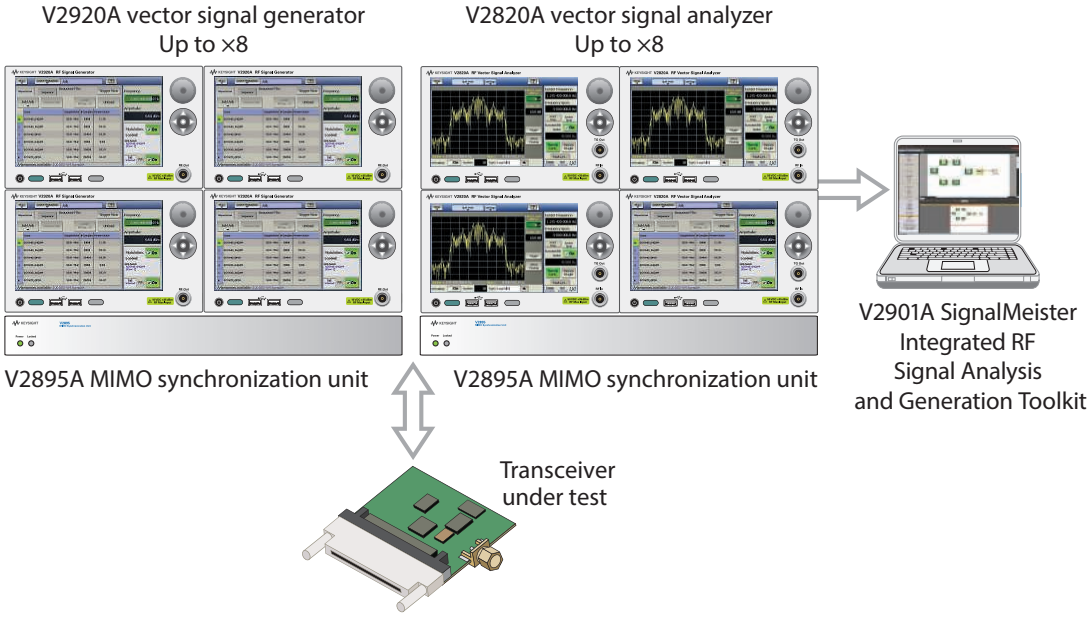


Figure 1. The MIMO RF signal analysis and generation test systems can be configured into high-performance 2, 3, 4, or up to 8-channel systems to test WiFi, WiMAX, and other MIMO-based devices and equipment.

Precise and stable synchronization

The MIMO systems are designed to have synchronized RF carriers and a precise signal sampler alignment between all instruments in the system. This tight control is accomplished with the V2895A MIMO synchronization unit which distributes a common LO (local oscillator), common clock, and precise trigger to all the signal analyzers or generators connected in the system. Precise alignment enables the system to make accurate and repeatable measurements of W-CDMA and OFDM (orthogonal frequency-division multiplexing) MIMO signals. The V2895A includes all the connectors and cables to configure up to eight V2820A RF vector signal analyzers or V2920A RF vector signal generators.

A single oscillator provides the frequency reference and a single synthesizer provides the LO reference that reduces phase jitter and frequency jitter to an absolute minimum. The RF carrier phases have less than one degree peak-to-peak phase jitter. The arbitrary waveform outputs have a maximum sample time difference of 1 ns and peak-to-peak sampler jitter of less than 1 ns.

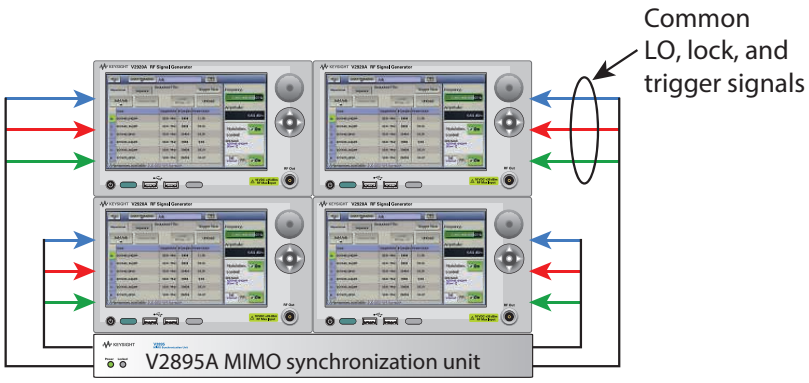


Figure 2. Precise and stable synchronization is achieved with the V2895A, which provides common LO, common clock, and precise trigger signals to all of the signal analyzer or signal generator instruments.

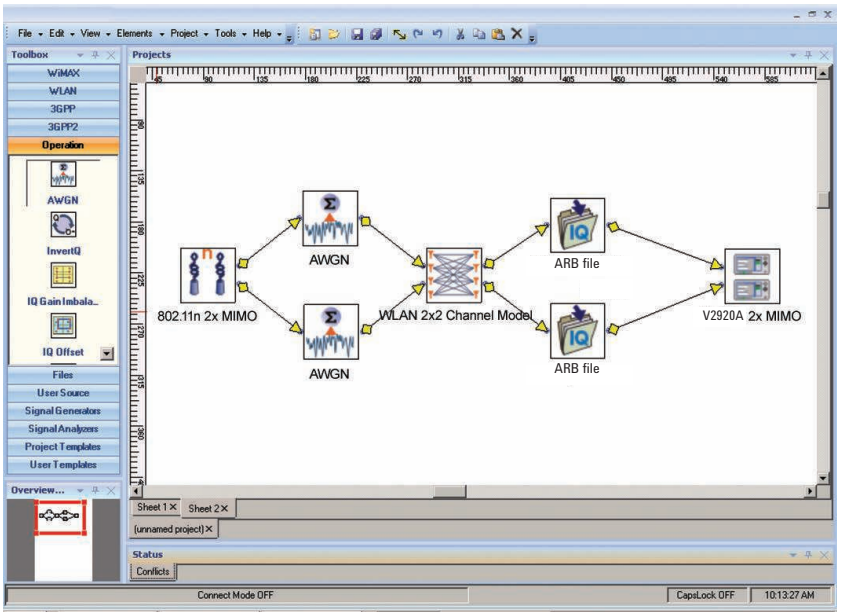


Figure 3. MIMO signals are easy to create in SignalMeister using ready-made signal libraries. Signal impairment elements can be added to create signals that have been impacted by a wide range of channel conditions.

Simplified MIMO Testing

SignalMeister can be used for signal creation and analysis in Mobile WiMAX 802.16e Wave 2 and WLAN 802.11n MIMO communications systems. It can also create channel conditions such as the 802.11a/b/g/j, and 802.11n channel models and impairments to model non-ideal transmitter conditions and can perform simulation studies without the use of the actual hardware. The graphical user interface (GUI) allows users to quickly and easily configure systems with drag-and-drop block diagrams. SignalMeister can seamlessly control up to eight V2820A vector signal analyzers or V2920A vector signal generators. For more information, see the technical overview for the Keysight V2901A SignalMeister Integrated *RF Signal Analysis and Generation Toolkit*, literature number 5990-5485EN.

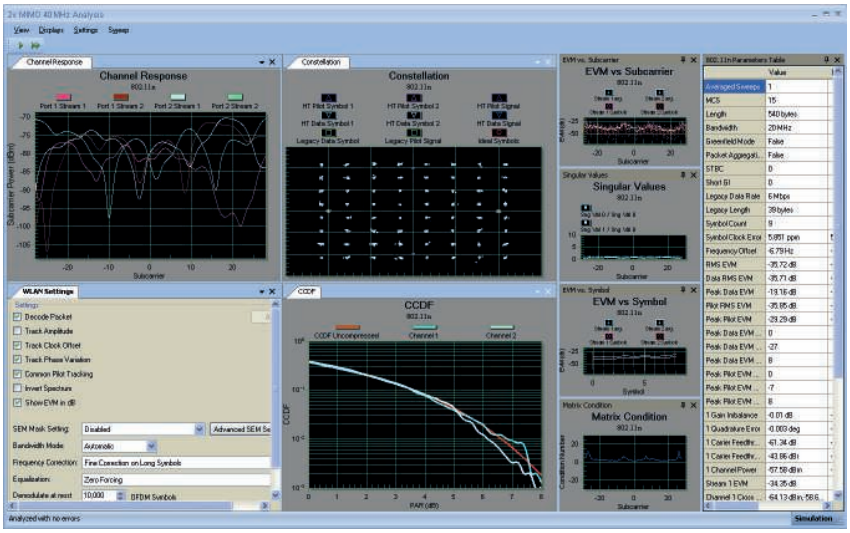


Figure 4. The V2901A SignalMeister integrated RF signal analysis and generation toolkit is a fast and powerful PC-based tool with an extensive measurement suite used to characterize WLAN, WiMAX, and MIMO communications systems in either SISO or MIMO systems.

Production Test Systems

Production testing of MIMO devices usually calibrates and tests the characteristics of each individual radio using a SISO test system. This reduces test system cost. Each radio is tested sequentially with the other radios in an inactive state.

The V2820A RF vector signal analyzer and V2920A RF vector signal generator are used with a multiplexer switch to connect to each of the DUT radio transceivers. The multiplexer may have the capability to connect and test more than one DUT in the test fixture, provide signal conditioning elements, or both.

The V2920A vector signal generators and V2820A vector signal analyzers operate seamlessly in either SISO or MIMO test systems. MIMO measurements are made on production samples to audit and to ensure that device performance has not degraded.

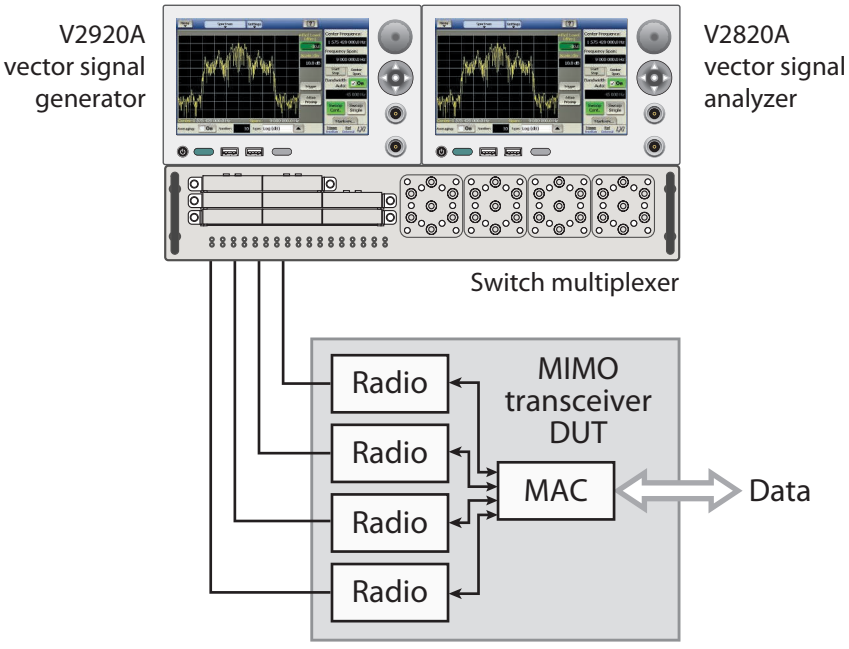


Figure 5. The V2820A and V2920A are used in a SISO configuration with a switch multiplexer to test the individual transceiver radios of MIMO devices in production applications.

Test Instrumentation

The V2820A RF vector signal analyzer and V2920A RF vector signal generator are mid-performance test instruments designed for R&D and production testing of modern RF communications equipment and devices. They are built on a next-generation instrument platform that uses state-of-the-art RF and DSP (digital signal processing) technology. This gives them the capability to measure and generate RF signals rapidly without compromising accuracy and repeatability.

The SignalMeister analysis options have extensive capabilities; however, some analysis can be performed in the individual instruments. Standards that can be analyzed in a V2820A include HSPA+, WLAN 802.11n, and Mobile WiMAX 802.16e signals. Additionally, the V2820A can display several measurement graphs, including constellation, EVM per channel, EVM per symbol, CCDF, and more.

The V2920A has arbitrary waveform generator (ARB) options with 100 Mega-samples of waveform memory and up to 80MHz bandwidth to generate WLAN, Mobile WiMAX, and virtually any other test signal required. Many different signal waveforms can be simultaneously resident in the V2920A's ARB memory. Switching between any two waveforms takes less than 3 ms using a SCPI command and is nearly instantaneous using the ARB sequence mode. Frequency switching time is 1.3 ms when using the list mode or ARB sequence mode and 3 ms using a SCPI command, and is nearly instantaneous using the ARB sequence mode. Frequency switching time is 300 µs when using the list mode or ARB sequence mode and 1 ms using a SCPI command. This results in ultra-fast test times of RF devices requiring multiple test frequencies, multiple test signals, or both.

Refer to the V2820A and V2920A technical overviews for more detailed product information.

Figure 6. The V2820A and V2920A feature DSP-based software-defined radio architecture to make accurate, high speed measurements for R&D and production test applications.

Figure 7. The V2895A MIMO synchronization unit comes with all connectors and cables to configure up to four V2820A RF vector signal analyzers or V2920A RF vector signal generators.

Figure 8. Rear panel of the V2895A MIMO synchronization unit.

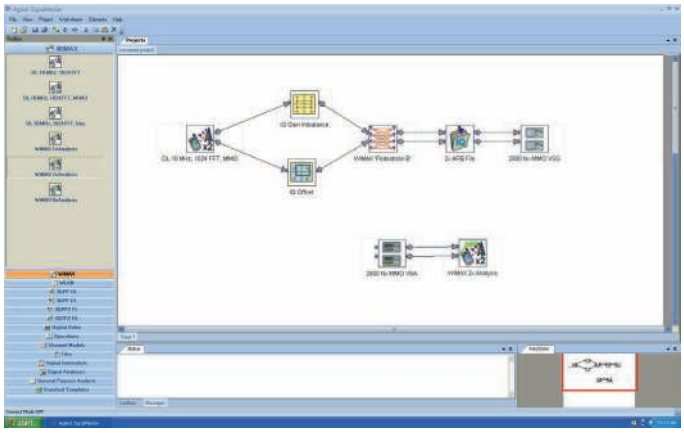


Figure 8. The V2901A SignalMeister integrated RF signal analysis and generation toolkit simplifies the creation of complex MIMO signal streams, transparently controls all the instruments in the MIMO system, and simplifies the computation and display of a wide range of parameters.

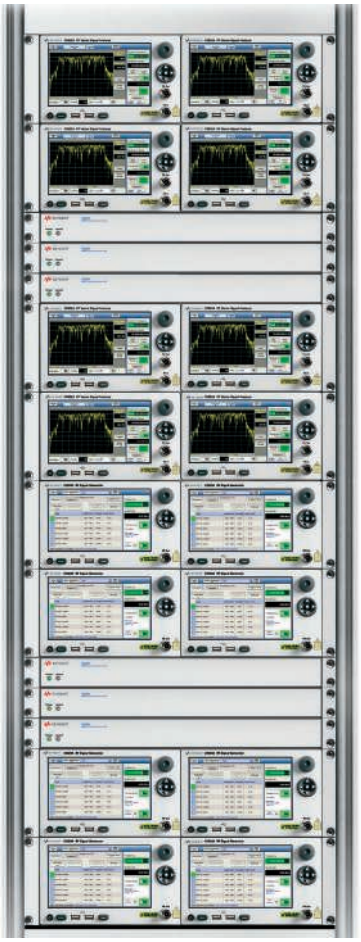


Figure 9. The 8×8 MIMO solution uses the V2895A MIMO synchronization unit for a smooth upgrade path from existing MIMO systems to 8×8. Whatever size MIMO system you need, you can easily grow your system up to 8×8, using existing instruments and synchronization units and adding more as needed.

Specifications

Note: All values are nominal unless otherwise noted.

V2820A-based MIMO RF signal analysis test system specifications (Multi-input configuration supports up to eight V2820A RF vector signal analyzers)		
Time record jitter		≤250 ps
Relative phase jitter of slave relative to master		<±1 degree
V2920A-based MIMO RF signal generation test system specifications (Multi-input configuration supports up to eight V2920A RF vector signal generators)		
Waveform ARB alignment		<±1 ns
Waveform ARB jitter		≤1 ns
Relative phase jitter of slave relative to master [1]		<±0.1 degree RMS
OFF power between bursts	> 0 dBm < 0 dBm	<–90 dBc <90 dBm
Burst rise or fall times (10–90%)		<200 ns
V2895A Inputs and Outputs		
External frequency reference input		
Frequency lock range		10 MHz ±10 Hz (1 ppm)
Amplitude lock range		Input power range: 0 to +15 dBm [2]
Impedance		50 Ω BNC connector
MIMO system interconnections		
LO IN		Connects to the master V2820A or V2920A LO output, SMA
LO OUT 1 through 4		Provides distributed LO power to the slave V2820As or V2920As and back to the master V2820A or V2920A, SMA
100 MHz OUT 1 through 4		Provides 100 MHz clock outputs to the master and slave V2820A/V2920As, SMB (m)
SYNC IN 1 through 4		Inputs from V2820A or V2920A sync outputs. Input level: 3.3 V CMOS, SMB (m)
SYNC OUT 1 through 4		Provides sync signals to V2820A or V2920A. Output level: 3.3 V CMOS, SMB (m)

[1]Calculated from phase noise measurements.
[2]For optimum phase noise performance, 0 dBm ≤ Pin ≤ +10 dBm.

Other Specifications	
Power	100 VAC to 240 VAC, 50–60 Hz (automatically detected), 40 VA max
CE EMC compliance	Compliant with the European Union EMC Directive
CE Safety compliance	Compliant with the European Union Low Voltage Directive
Calibration	1 year
Environment (for indoor use only)	
Temperature	18 °C to 28 °C specified operating, unless otherwise noted 0 °C to 50 °C operating survival, non-specified operation –25 °C to 65 °C non-operating (AC power off) storage
Altitude	2000 meters above sea level maximum specified operating
Cooling	Convection, side intake, and exhaust
Mechanical vibration and shock	
MIL-PRF-28800F CL3 random vibration, 3 axes	
Sine-Sweep test for resonances, 3 axes	
MIL-STD-810F 516.5 paragraph 4.5.7, procedure VI, bench handling	
General mechanical characteristics	
Height	44 mm (1.75 in.), 1U
Width	425 mm (16.73 in.), half-rack
Depth	559 mm (22.0 in.)
Weight	4.5 kg (10.0 lbs.)

Notes:

Specifications describe the configuration or instrument's warranted performance. Typical and nominal values are not warranted but provide additional information regarding performance of the V2895A and are provided to assist in a MIMO system configuration with V2820A RF vector signal analyzers or V2920A RF vector signal generators.

All units are warranted to meet these performance specifications under the following conditions:

- Ambient operating temperature of 18 °C to 28 °C, unless otherwise noted
- After a warm-up time of 30 minutes and self calibration at ambient temperature

Typical (mean + 3 standard deviations) values are performance that units will meet under the following conditions:

- Ambient operating temperature of 23 °C, unless otherwise noted
- After a warm-up time of 30 minutes and self calibration at ambient temperature. This performance is not warranted.

Nominal values indicate expected performance, or describe product performance that is useful in the application of the product, but is not covered by the product warranty.

Ordering Information

MIMO RF Signal Analysis and Generation Test System	
V2820A	RF Vector Signal Analyzer (2, 3, 4, up to 8 units)
V2920A	RF Vector Signal Generator (2, 3, 4, up to 8 units)
V2895A	MIMO Synchronization Unit (1 required for 1 to 4 analyzers and 3 required for 5-8 analyzers)
V2920A-B40	Arbitrary Waveform Generator, 40 MHz BW
V2920A-B80	Arbitrary Waveform Generator, 80 MHz BW
Optional software and licenses	
V2800A-101	Flexible Digital Modulation Signal Analysis License
V2800A-102	GSM, GPRS, EDGE Signal Analysis Personality License
V2800A-103	EDGE Evolution Signal Analysis Personality License
V2800A-104	cdma2000 & IS-95A Reverse Link Signal Analysis Personality License
V2800A-105	W-CDMA FDD Downlink Signal Analysis Personality License
V2800A-106	W-CDMA FDD Uplink Signal Analysis Personality License
V2800A-107	WCDMA HSPA Downlink Signal Analysis Personality License
V2800A-108	WCDMA HSPA Uplink Signal Analysis Personality License
V2800A-110	WLAN 802.11a-b-g-j-n SISO Signal Analysis Personality License
V2800A-111	802.16e WiMAX & WiBro SISO Signal Analysis Personality License
V2901A	SignalMeister Integrated RF Signal Analysis and Generation Toolkit
Optional licenses for SignalMeister Signal Analysis	
V2901A-WLN	WLAN Signal Analysis SignalMeister License
V2901A-WMX	WiMAX Signal Analysis SignalMeister License
Optional licenses for SignalMeister Signal Generation	
V2900A-201	cdma2000 & 1xEV-DV for Reverse Link Signal Generation SignalMeister License
V2900A-202	W-CDMA FDD Uplink & Downlink Signal Generation SignalMeister License
V2900A-203	HSPA including HSPA+ Signal Generation SignalMeister License
V2900A-204	3GPP Channel Model Signal Generation SignalMeister License
V2900A-205	802.11a-b-g-j WLAN Signal Generation SignalMeister License
V2900A-206	802.11n WLAN Signal Generation SignalMeister License
V2900A-207	WLAN Channel Model Signal Generation SignalMeister License
V2900A-208	802.16e-2005 mobile WiMAX & WiBro Signal Generation SignalMeister License
V2900A-209	WiMAX Channel Model Signal Generation SignalMeister License
Accessories (included)	
AC power cable	
RF, clock, and synchronization cables to connect up to four 2820A or V2920A units	
Quick start guide	
Other optional accessories	
V2999A-ADK	RF Cable and Adapter Accessory Kit
V2999A-DCB	External RF-DC Block Module

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