

# 2920

## RF Vector Signal Generator

10MHz to 4GHz or 6GHz

**What's New?**  
Now with Advanced  
Signal Generation Software

### Superior Signal Generation Accuracy over Wide Ranges

- Flexible and easy signal creation using SignalMeister
- 10MHz–6GHz frequency range
- -125dBm to +13dBm output power range
- $\pm 0.6$ dB absolute amplitude accuracy
- $\pm 0.05$ dB amplitude repeatability

### High Output Speed

- <1.3ms typical frequency switching time using List mode
- <1.6ms amplitude switching time
- 3ms nominal waveform switching time using SCPI commands
- Instantaneous waveform switching using ARB sequence mode

### Broad Operating Flexibility

- 80MHz bandwidth, 100 megasample Arbitrary Waveform Generator option
- MIMO-ready capability for WLAN and WiMAX
- Flexible analog modulation option: AM, FM, PM, pulse, AWG noise, and two-tone option
- Flexible digital modulation option: ASK, FSK, PSK, and QAM
- Standards options: GSM, EDGE, W-CDMA, cdmaOne, cdma2000, and GPS
- Advanced PC connectivity: GPIB, USB, LAN, and LXI Class C

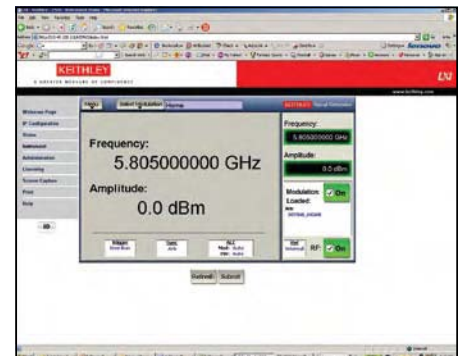
### APPLICATIONS

- R&D and production test of:
  - Wireless equipment
  - Modules and sub-assemblies
  - RFIC devices
- Immunity testing
- Education



The Model 2920 RF Vector Signal Generator is a mid-performance test instrument designed for R&D and production testing of modern RF communications equipment and devices. This next-generation instrument combines state-of-the-art RF and digital signal processing (DSP) technology to generate RF test signals with high accuracy and excellent repeatability. It also switches frequency, amplitude, or modulation type extremely rapidly. Its compact half-rack enclosure and competitive pricing make it a cost-effective solution for many test applications. The Model 2920 simplifies testing mobile phones and other wireless devices economically, by generating signals compatible with an array of RF communications standards. Today's mobile phones are designed to connect to more types of devices than ever before, so they must integrate with a growing number of wireless standards.

The instrument's Windows CE® operating system and intuitive graphical user interface allow users their choice of operating it via the touch-screen user interface, the front panel controls, or with a mouse. GPIB, USB, and 100Base-T Ethernet LAN ports offer a variety of options for connecting to a PC; it is LXI Class C compliant, so it's equally easy to connect to an internal network or the Internet. Tests can be created by developing scripts using SCPI (Standard Commands for Programmable Instrumentation) commands, with IVI-COM or IVI-C drivers, or by assembling LabVIEW® building blocks.



A built-in LXI webpage interface allows monitoring and controlling the Model 2920 from any Internet connection anywhere in the world.

Signal generator for RF communications testing

RF/MICROWAVE

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### Ordering Information

**2920 RF Vector Signal Generator**

**Configuration Choices (Specify one from each group in the format 2920-xx-yy-zzz)**

**Example: 2920-FP-BT-006**

**RF Connector Location (-xx):**

-FP Front-panel RF input  
-RP Rear-panel RF input

**Use Configuration (-yy)**

-BT Bench-top  
-RK Rack-mount

**Frequency Range (-zzz):**

-004 10MHz to 4GHz  
-006 10MHz to 6GHz

### Accessories Supplied

AC power cable

Printed Quick Start Guide

CD-ROM containing 2920 VSG System Help, SignalMeister™

Waveform Creation software, utility programs, and various PDF files (also available on-line at [www.keithley.com](http://www.keithley.com))

On-board help system

### ACCESSORIES AVAILABLE

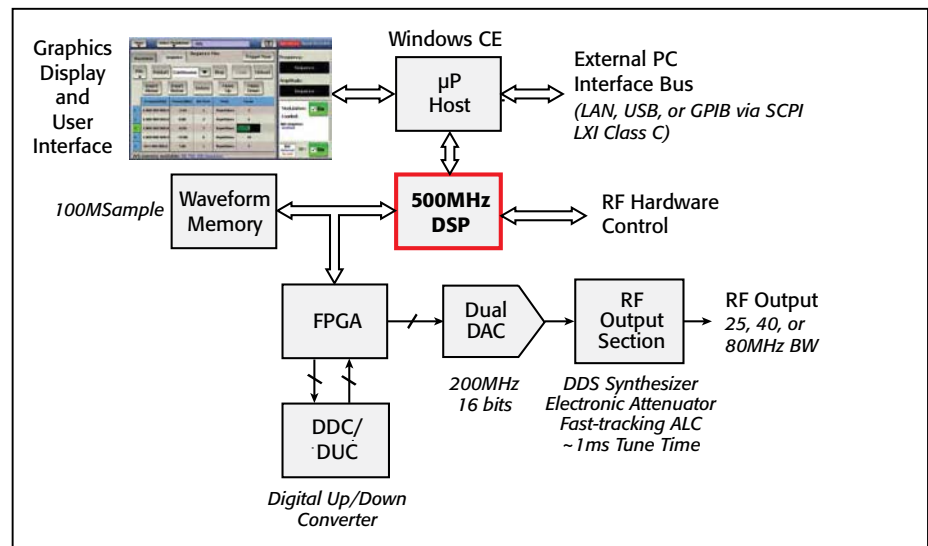
2910-DCBLOCK External RF-DC Block module  
2910-ADAPTER-KIT Cable and Adapter Accessory Kit

### Innovative Architecture

The Model 2920's Software-Defined Radio (SDR) architecture generates virtually any RF signal with up to 80MHz of modulation bandwidth, without the need for a hardware upgrade. This broad bandwidth provides exceptional flexibility in R&D and production testing and reduces capital equipment costs for producing signal types currently used in testing requirements and those that will be needed in the future.

Signal waveforms are downloaded into the Model 2920's arbitrary waveform generator (ARB) memory, then processed with the high speed DSP. With this approach, the RF signal is defined through software by the I-Q data of the waveform. Multiple waveforms can be stored in the large ARB memory. The DSP can switch rapidly between waveforms for processing.

The Model 2920's 200MHz fixed-rate dual-DAC (Digital-to-Analog Converter) helps ensure high signal integrity, which is optimized with a fixed-bandwidth, brick-wall, anti-alias filter. The Digital Up/Down Converter (DUC/DDC) compresses and decompresses waveforms to conserve RAM space and eliminates the need to switch in different anti-alias filters, which speeds signal processing. A Field Programmable Gate Array (FPGA) allows for fast triggering and high speed signal routing.



The key components of the Model 2920's DSP-based software-defined radio architecture are optimized for high accuracy and fast test throughput while reducing instrument cost and rack space requirements.

# 2920

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### Options

- 2920-BBIQ-A:** Baseband analog I-Q inputs and outputs
- 2920-LAR:** Low amplitude range, <-110dBm
- 2920-LPN:** Low phase noise

### Arbitrary Waveform Generator:

- 2900-ARB-20:** Arbitrary waveform generator, 20MHz BW
- 2900-ARB-40:** Arbitrary waveform generator, 40MHz BW
- 2900-ARB-80:** Arbitrary waveform generator, 80MHz BW

### Signal Generation Licenses:

- 2900-ALG:** Flexible Analog Modulation
- 2900-CDMA-F:** CDMA2k and IS-95A Forward Link Signal Generation
- 2900-CDMA-PC:** SignalMeister CDMA2k and 1xEV-DV Fwd and Rev
- 2900-DIG:** Flexible Digital Modulation Signal Generation
- 2900-DVB-PC:** SignalMeister License for DVB-H and T and ISDB-T
- 2900-GPS:** GPS Signal Generation
- 2900-GSM:** GSM, GPRS and EDGE Signal Generation
- 2900-GSM-PC:** SignalMeister License for GSM, GPRS and EDGE
- 2900-HSDPA-PC:** SignalMeister License for W-CDMA HSDPA
- 2900-HSUPA-PC:** SignalMeister License for W-CDMA HSUPA
- 2900-TDSCDMA-PC:** SignalMeister License for TD-SCDMA
- 2900-WCDMA-D:** W-CDMA FDD Downlink Signal Generation
- 2900-WCDMA-PC:** SignalMeister License for W-CDMA FDD Up-Downlink
- 2900-1xEVDO-PC:** SignalMeister License for 3GPP2 1xEV-DO
- 2900-80211-N-PC:** SignalMeister License for 802.11n WLAN
- 2900-80211-PC:** SignalMeister License for 802.11a-b-g-j WLAN
- 2900-80216-E-PC:** SignalMeister License for 802.16e-2005 Mobile WiMAX and WiBro

### SERVICES AVAILABLE

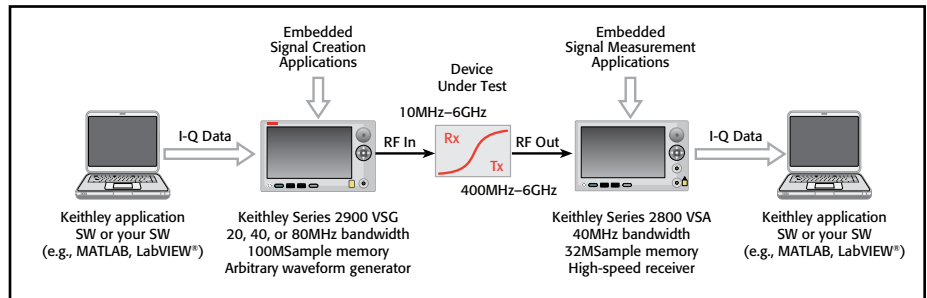
2920-3Y-EW	1-year factory warranty extended to 3 years from date of shipment
C/2920-3Y-DATA	3 (Z540-1 compliant) calibrations within 3 years of purchase*

\* Not available in all countries

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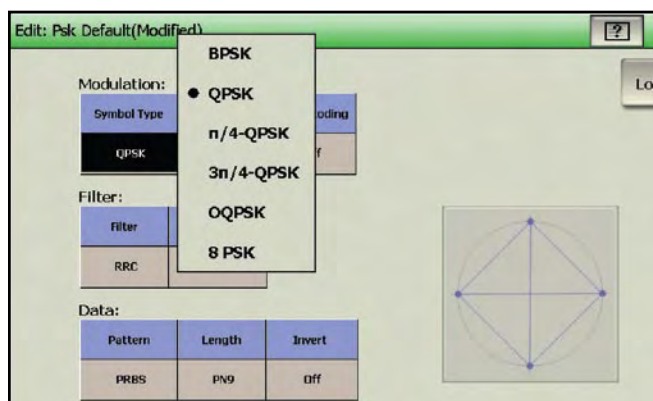
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### Get the Flexibility of Three Powerful Operating Modes



Keithley's Series 2900 RF Vector Signal Generators and Series 2800 RF Vector Signal Analyzers are engineered for operating versatility. Use built-in applications or download I-Q waveform data from a connected PC and upload signal waveforms.

- Multi-Purpose** – The Model 2920 can generate continuous wave (CW) signals and sweep the frequency and amplitude of RF signals. Choose the Model 2900-ALG Flexible Analog Modulation personality option to create traditional signals such as AM, FM, PM, pulsed RF, AWG noise, and even two-tone signals. The Model 2900-DIG Flexible Digital Modulation option generates signals with ASK, FSK, PSK, and QAM symbol types.



The Model 2900-DIG Flexible Digital Modulation option simplifies controlling a test signal's modulation format, symbol type, filter, data pattern, and data length.

- Embedded Radio-Specific Capability** – The Model 2920 offers software measurement options for testing cellular standards such as GSM, EDGE, W-CDMA FDD, cdmaOne, and cdma2000. The Model 2900-GPS option simulates the coded L1 signal of a Global Positioning System satellite with a variety of data types, including an external user file with up to 37,504 bits (12.5 minutes) of navigation data.

Signal generator for RF communications testing

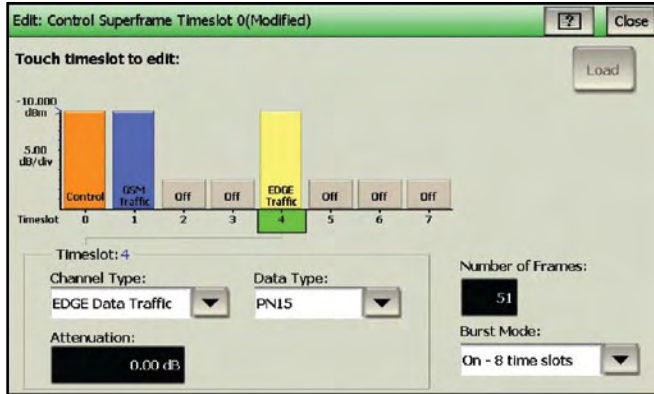
RF/MICROWAVE



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## RF Vector Signal Generator

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Use the Model 2900-GSM option's waveform edit menu to select the channel type and data type for each time slot.

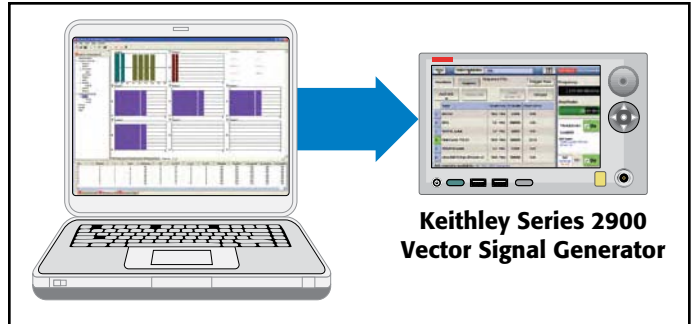
3. **User-Defined Capability** – The Model 2920-ARB option provides ARB (arbitrary waveform generator) options with up to 80MHz bandwidth. The ARB includes a 100-megasample memory to hold large waveforms or many waveforms, which the instrument can switch between quickly and easily. Custom I-Q data files can be downloaded into the signal generator's ARB memory through GPIB, USB, or LAN interfaces. Waveform creation of virtually any signal is possible with PC-based software such as MATLAB and LabVIEW.



The Model 2900-ARB-xx Arbitrary Waveform Generator option provides 100 megasamples (100MS) of memory for storage of large waveforms or multiple waveforms with up to 80MHz signal bandwidth.

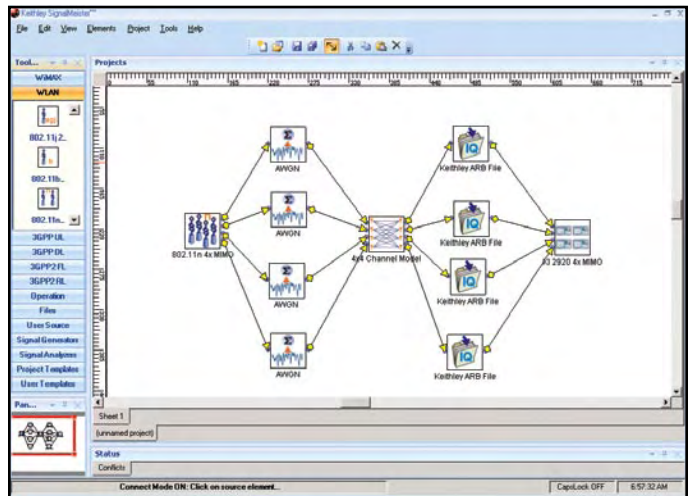
## SignalMeister™ Waveform Creation Software

The Model 290101 SignalMeister Waveform Creation Software is a PC-based software tool for creating ARB files designed to run flawlessly on any of Keithley's RF vector signal generators. An intuitive graphical user interface allows you to define signal parameter values and provides a common tool set for adding signal impairments to waveforms, such as Gaussian white noise. A common user interface is designed to be used with multiple signal formats as they become available. The software is included on the documentation CD provided with the instrument or can be downloaded from Keithley's website at [www.keithley.com](http://www.keithley.com).



Keithley Series 2900 Vector Signal Generator

Create waveform files off-line on a PC with Keithley's free SignalMeister waveform creation software, then download them to the ARB memory of any Keithley Series 2900 RF Vector Signal Generator.



SignalMeister is optimized to make MIMO signals easily and quickly, including channel impairments.

## Superior Signal Generation Accuracy and Repeatability

The Model 2920's RF output circuitry is designed to combine simplicity with high performance. High measurement accuracy and repeatability provide confidence in product quality. It allows minimizing measurement guard bands in production test applications, which helps increase product yields. Significant signal generation performance specifications include:

- Absolute amplitude accuracy of  $\pm 0.6\text{dB}$  (typically  $\pm 0.3\text{dB}$ ) from  $-110\text{dBm}$  to  $+13\text{dBm}$  up to 3GHz
- $\pm 0.05\text{dB}$  relative amplitude accuracy (linearity)
- $\pm 0.05\text{dB}$  (typically  $\pm 0.01\text{dB}$ ) amplitude repeatability
- $0.015\text{dB}/^\circ\text{C}$  temperature stability

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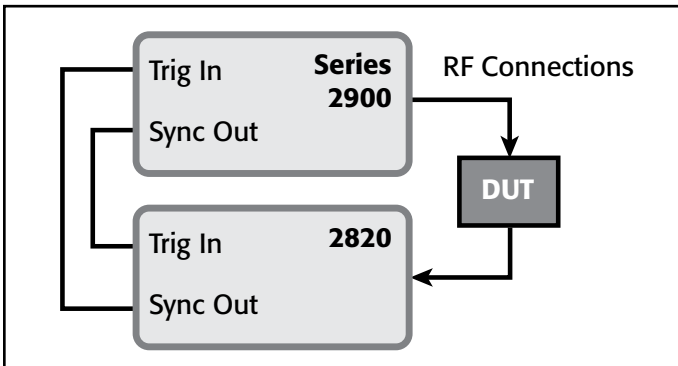
# 2920

# RF Vector Signal Generator

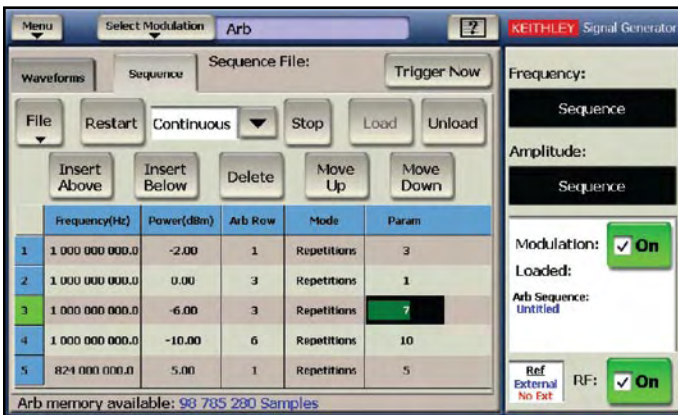
10MHz to 4GHz or 6GHz

## Ultra-fast Signal Generation

The Model 2920 generates virtually any signal types up to 80MHz bandwidth at high speed without compromising their accuracy, whether switching between these signals, changing signal frequency, or changing signal amplitude. The built-in high speed DSP controls the instrument hardware and runs measurement programs such as List mode, Sweep mode, and ARB sequencing. Flexible trigger and synchronization choices further enhance the Model 2920's speed.



The Model 2920's trigger input and sync output connections simplify synchronizing its operation with other test instruments, such as Keithley Series 2800 RF Signal Analyzers, in high speed measurement applications.



Switching from one waveform stored in the Model 2920's ARB memory to another takes just 3ms under GPIB control or is instantaneous in the ARB Sequence mode. In this example, the waveform sampler moves from the last point of an ARB waveform to the first point of the next waveform within a single clock cycle. The ARB waveforms can be "played" in any order or pattern desired, providing added flexibility for measurement speed enhancement.

The Model 2920's RF circuitry, like its measurement circuitry, was optimized for speed without accuracy compromises. The RF Output section employs a patent-pending DDS (Direct Digital Synthesis) synthesizer design to switch frequencies in 1.3ms using List or Sweep modes and in 3ms using a remote SCPI command via GPIB.

When using the List or Sweep modes, the instrument's amplitude switching time is 1.6ms, which overlaps the frequency tune time when both are changed. Fast-tracking ALC (Automatic Level Control) circuitry and an electronic attenuator make this fast amplitude switching possible. This hardware approach has the added benefit of superior measurement repeatability over millions of cycles in production environments, unlike relatively slow mechanical attenuators, which gradually degrade after a few thousand cycles.

## Optimized for High Speed Production Test

Our instruments can be configured into sophisticated test systems that dramatically reduce device test times and lower capital costs compared to traditional rack-and-stack test systems. They are designed for demanding system applications requiring ultra-fast test times and accurate, repeatable measurements. Test script control and intra-instrument triggering work in cooperation to minimize bus traffic from the PC controller. Keithley's RF test systems have reduced test times by up to 70% in RFIC production applications. Using smart instruments instead of test modules also reduces the engineering time for system test integration. This lowers schedule risk and has greater flexibility to reconfigure the system quickly to transition new devices and equipment into production.

## MIMO Test Systems

The Model 2920 is MIMO-ready to meet the requirements of the next-generation 802.11n WiFi and 802.16e WiMAX technologies. With the addition of a Model 2895 MIMO Synchronization Unit, multiple Model 2920s can be configured into  $\times 2$ ,  $\times 3$ , or  $\times 4$  multi-output test systems. The synchronization unit distributes a common LO (local oscillator), common clock, and precise trigger to all the signal generators in the system, creating a MIMO test system with precise synchronization and low jitter between each of the signal generator outputs of the RF carrier and ARB waveform sampler.

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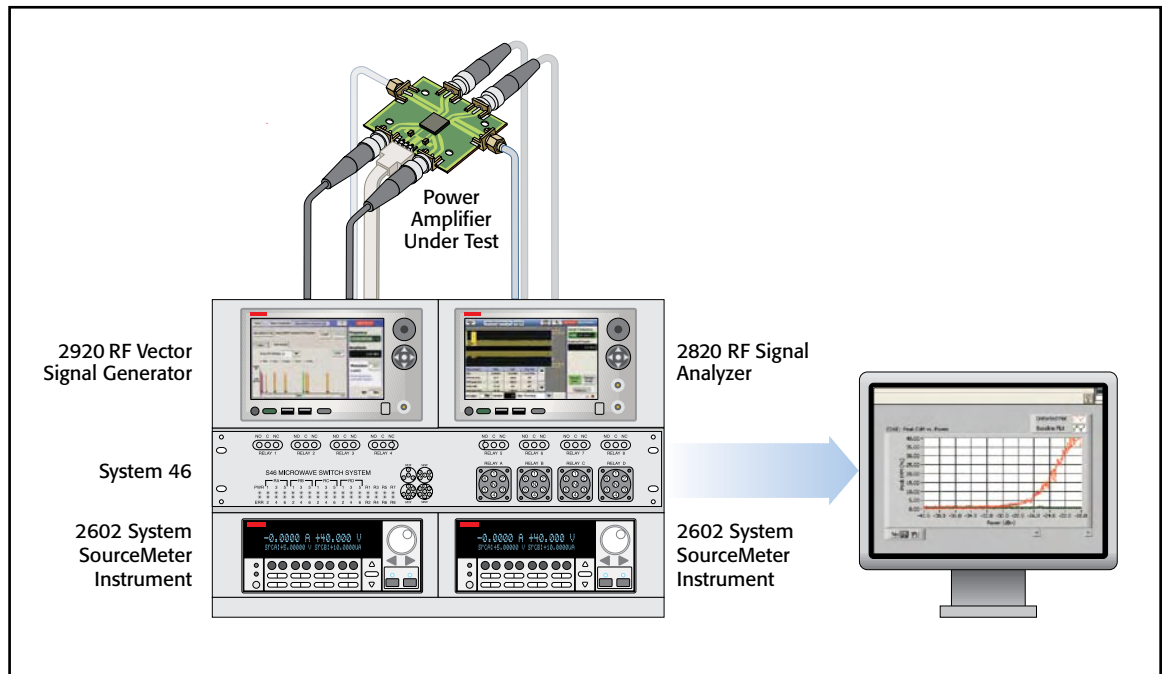
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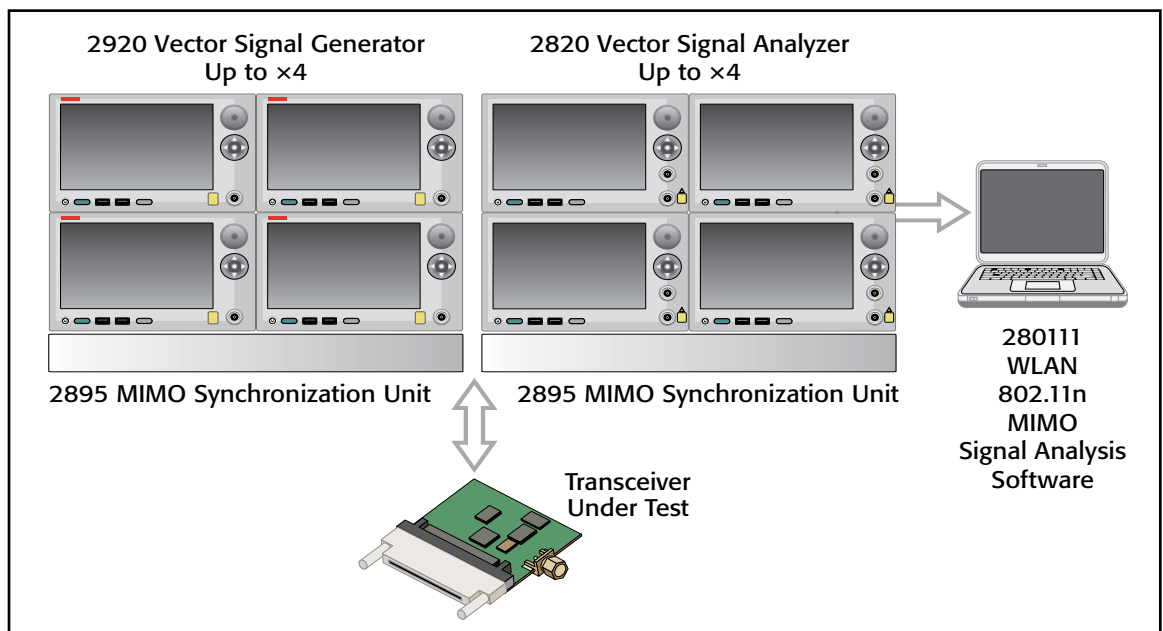
**2920**

# RF Vector Signal Generator

10MHz to 4GHz or 6GHz



Through the use of test script control and intra-instrument triggering, this Model 2920-based RF power amplifier test system can reduce test times by up to 70%.



This 4x4 MIMO test system ensures precise synchronization and low jitter when testing WiFi, WiMAX, and other MIMO devices and equipment.

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## RF Vector Signal Generator 10MHz to 4GHz or 6GHz



Model 2920 rear panel

Signal generator for mobile communications testing

RF/MICROWAVE

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# 2920

# RF Vector Signal Generator

## 10MHz to 4GHz or 6GHz

### Modes of Operation

**STANDARD MODE:** CW Signal Generator.

**OPTIONAL MODES:** Analog modulation, Digital modulation.

GSM-GPRS-EDGE, cdmaOne-cdma2000 reverse link, W-CDMA downlink, GPS (all require ARB option).

Arbitrary Waveform modulation (ARB).

Note: All items are Specifications unless otherwise noted.

### Frequency

**FREQUENCY RANGE:** 2920-004: 10MHz to 4.0GHz<sup>1</sup>. 2920-006: 10MHz to 6.0GHz<sup>2</sup>.

**FREQUENCY INPUT UNITS:** Hz, kHz, MHz, GHz.

**FREQUENCY SETTING RESOLUTION:** 0.1Hz.

**FREQUENCY ACCURACY:** Same as frequency reference + synthesizer resolution term<sup>3</sup>.

**FREQUENCY SWITCHING TIME<sup>4</sup>:** ≤1.6ms (modulation off), ≤1.8ms (modulation on), ≤3.0ms (characteristic)<sup>5</sup>.

### INTERNAL FREQUENCY REFERENCE

**AGING RATE:** ≤1ppm per year.

**TEMPERATURE STABILITY:** ≤0.2ppm<sup>6</sup>.

### FREQUENCY REFERENCE OUTPUT

**IMPEDANCE:** 50Ω (characteristic), AC coupled.

**REF OUTPUT SIGNAL:** 10MHz, +5dBm ±3dB (characteristic).

### EXTERNAL FREQUENCY REFERENCE INPUT

**FREQUENCY LOCK RANGE:**

Hardware Lock Mode<sup>7</sup>: 10MHz ±10Hz (1 ppm).

Variable Input Frequency Mode: 1 to 20MHz<sup>8</sup>.

**AMPLITUDE LOCK RANGE:** -3 to +15dBm<sup>9</sup>.

**IMPEDANCE:** 50Ω (characteristic).

### SPECTRAL PURITY

**SSB PHASE NOISE; dBc/Hz; 20kHz OFFSET**

Carrier Frequency, GHz	Specification	Characteristic
1	≤ -117	≤ -124
2	≤ -111	≤ -118
3	≤ -108	≤ -116
4	≤ -105	≤ -113
6	≤ -101	≤ -110

**HARMONICS AND SUB-HARMONICS<sup>10</sup>**

Fundamental Frequency	Harmonics (typical)	Sub-Harmonics (typical)
10 MHz to <20 MHz <sup>11</sup>	≤ -25 dBc	Not applicable
20 MHz to <4.0 GHz	≤ -30 dBc	≤ -40 dBc
4.0 GHz to 6.0 GHz	≤ -40 dBc	≤ -40 dBc

**NON-HARMONIC SPURIOUS<sup>12</sup>**

Fundamental Frequency	Specification	Characteristic
10 MHz to <400 MHz	< -55 dBc	< -64 dBc
400 MHz to <2.5 GHz	< -55 dBc	< -60 dBc
2.5 GHz to 6.0 GHz	< -55 dBc	< -60 dBc

### FREQUENCY NOTES

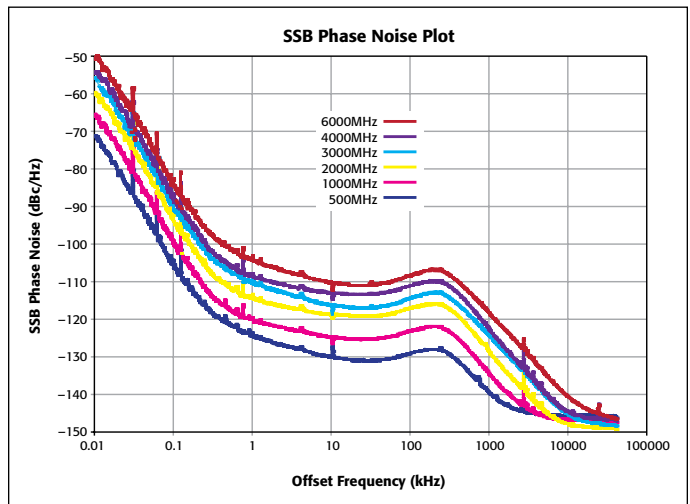
- Over-range operation is provided from 0.5MHz to 10MHz. Performance below 10MHz is not specified.
- Over-range operation is provided from 0.5MHz to 10MHz and 6.0GHz to 6.9GHz. Performance below 10MHz and above 6.0GHz is not specified.
- Synthesizer resolution term: ≤5μHz.
- To within 0.1ppm of final value. List mode or swept mode. Free run or hardware trigger. ALC Off. Modulation On or Off.
- To within 0.1ppm of final value. Via remote command after receipt of end-of-operation indicator (EOI). ALC Off. Modulation On or Off.
- Total variation from 0° to 50°C ambient temperature range.
- Factory preset setting.
- On 10Hz boundaries Freq = 1MHz + n · 10Hz. Reference accuracy: ≤±1ppm. Sine or square wave inputs acceptable. Lock time may be up to 30 seconds.
- For optimum phase noise performance use hardware lock mode and 0dBm < P<sub>out</sub> < +10dBm.
- Pout ≤ +4dBm, specifications apply to harmonic and sub-harmonic responses within the specified operating range of the instrument.
- Measured at <0.0dBm.
- Offset from carrier >10kHz, P<sub>out</sub> = 0dBm and Modulation off. Specifications apply to harmonic responses within the specified operating range of the instrument.

### 2920-LPN Low Phase Noise Option

**SSB PHASE NOISE, dBc/Hz<sup>1</sup>**

Carrier Frequency, GHz	Specification (characteristic) at Offset Frequency			
	20 kHz	100 kHz	1 MHz	10 MHz
0.5	≤ -127 (-130)	≤ -125 (-128)	≤ -135 (-139)	≤ -142 (-145)
1.0	≤ -121 (-125)	≤ -119 (-122)	≤ -129 (-134)	≤ -143 (-146)
2.0	≤ -115 (-118)	≤ -113 (-116)	≤ -123 (-128)	≤ -144 (-147)
3.0	≤ -112 (-116)	≤ -110 (-114)	≤ -121 (-124)	≤ -142 (-145)
4.0	≤ -109 (-113)	≤ -107 (-110)	≤ -117 (-122)	≤ -139 (-144)
6.0	≤ -106 (-110)	≤ -104 (-108)	≤ -115 (-118)	≤ -136 (-140)

- RF output power set to 0dBm.



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# RF Vector Signal Generator

## 10MHz to 4GHz or 6GHz

### Amplitude

#### AMPLITUDE LEVEL RANGE (CW) SPECIFICATION: <sup>1</sup>

Carrier Frequency	Standard	2920-LAR
10 MHz to < 330 MHz	-110 to +10 dBm	-130 to +10 dBm
330 MHz to ≤ 3.0 GHz	-110 to +13 dBm	-130 to +13 dBm
3.0 GHz to ≤ 6.0 GHz	-110 to +10 dBm	-130 to +10 dBm
Amplitude Level Range	Standard	2920-LAR
GSM	-110 to +6dBm	-130 to +6dBm
EDGE	-110 to +6dBm	-130 to +6dBm
cdma2000 <sup>2</sup>	-110 to +3dBm	-130 to +3dBm
WCDMA <sup>3</sup>	-110 to +4dBm	-130 to +4dBm

AMPLITUDE SETTING RESOLUTION: 0.01dB.

AMPLITUDE INPUT UNITS: dBm.

ABSOLUTE AMPLITUDE LEVEL ACCURACY (CW), dB:

#### Specification (typical) at Carrier Frequency

Amplitude Level	10MHz to	330MHz to	3.0GHz to	5.0GHz to
	≤ 330MHz	≤ 3.0GHz	≤ 5.0GHz	≤ 6.0GHz
Max. to ≤ -75 dBm	≤ ±0.6 (0.3)	≤ ±0.6 (0.3)	≤ ±0.7 (0.4)	≤ ±0.7 (0.4)
-75 to ≤ -110 dBm	≤ ±0.6 (0.3)	≤ ±0.6 (0.3)	≤ ±0.8 (0.4)	≤ ±0.8 (0.4)
2920-LAR Option				
-110 to ≤ -120 dBm	≤ ±0.6 (0.6)	≤ ±1.0 (0.6)	≤ ±1.5 (0.7)	≤ ±1.5 (0.7)
-120 to ≤ -125 dBm	(≤ ±0.6)	(≤ ±0.6)	(≤ ±0.7)	(≤ ±0.7)

POWER CHANGE OVER TEMPERATURE 0 TO 50°C: 0.015dB/°C.

RELATIVE AMPLITUDE ACCURACY (Linearity) <sup>4</sup>: ≤±0.05dB.

AMPLITUDE REPEATABILITY <sup>5</sup>: ≤±0.05dB.

USER AMPLITUDE OFFSET TABLE: 10 amplitude vs. frequency pairs per table. Frequencies need not be equally spaced. Linear interpolation between points. Multiple tables can be stored in user memory.

AMPLITUDE SWITCHING TIME: <sup>6</sup>

List or Sweep Mode <sup>7</sup>: ≤1.6ms (Modulation Off), ≤1.8ms (Modulation On).

Via Remote Command (after receipt of end-of-operation indicator, EOI) <sup>8</sup>: ≤3.0ms (characteristic).

ALC On <sup>9</sup>: <2.6ms (Mod Off), <4.1ms (Mod On) (characteristic).

VSWR, RF<sub>OUT</sub> PORT: <1.45:1 (<1.3:1 typical), 10MHz to <3GHz carrier frequency.  
<1.6:1 (<1.4:1 typical), 3GHz to <6GHz carrier frequency.

REVERSE POWER PROTECTION <sup>10</sup>: +35dBm or 10VDC.

#### AMPLITUDE NOTES

- Specifications apply when in auto-coupled mode unless otherwise stated.
- +3dBm max. for Pilot only. +0.5dBm max. for Forward 9 channel.
- +4dBm max. for CPICH only. -1.0dBm max. for Test Model 1 with 16 DPCH.
- 110dBm < Pout < +2dBm, modulation Off.
- 110dBm < Pout < +2dBm, ALC mode = fast, modulation Off.
- To within ±0.05dB of final value (to within ±0.15dB for power changes that cross Pmax - 11dB). For Pmax see amplitude level range values for each modulation.
- Free run or hardware trigger, ALC Off.
- ALC Off, modulation On or Off.
- ALC mode = auto (Sample and hold mode for Modulation On. Fast mode modulation Off).
- Up to 50VDC with optional external DC block Keithley part number 2910-DCBLOCK.

### List and Step Sweep Modes

FREQUENCY SWEEP: Start Freq., Stop Freq., Number of Steps and Dwell Time.

AMPLITUDE SWEEP: Start Power, Stop Power, Number of Steps and Dwell Time.

DWELL TIME RANGE: 0 to 1 second.

DWELL TIME RESOLUTION: 0.1ms.

ARBITRARY LIST: List of Frequency, Amplitude and Dwell Time sets.  
Maximum number of sets = 1000.

### 2920-BBIQ-A Baseband Analog I-Q Inputs and Outputs Option

#### BASEBAND ANALOG INPUTS

External I-Q Input, 3dB bandwidth <sup>1</sup>: I channel: (200MHz). Q channel: (200MHz).

Input Impedance (single ended only): 50Ω (characteristic), DC coupled, SMB (m) connector.

Maximum Input (DC + AC peak): ±1V peak.

#### BASEBAND ANALOG OUTPUTS

0.2dB Bandwidth: I channel: (40MHz). Q channel: (40MHz).

Output Impedance (single ended only): 50Ω (characteristic), DC coupled, SMB (m) connector.

Maximum Output (DC+AC) Peak: ±1.0V peak.

IQ Offset (DC+Phase): ±12.5% of full scale, ±10°.

IQ Gain: 0 to full scale.

#### NOTES

- 3dB bandwidth. Inputs applied directly to I-Q modulator. Optimal drive voltage is ±0.8V. I-Q AC and DC amplitude and phase skew and offsets to be provided by user.
- Into 50Ω impedance.

### 2900-ARB-xx: Arbitrary Waveform Generator

#### MAXIMUM MODULATION BANDWIDTH INTERNAL MODULATION GENERATION

(<1dB flatness):

2900-ARB-20: 20MHz.

2900-ARB-40: 40MHz.

2900-ARB-80: 80MHz.

Waveform Memory: 100MSamples in 400MB of memory.

Minimum Segment Length: 100 samples.

Maximum Segment Length: 100MSamples.

Maximum Number of Segments: 1,000.

Maximum Number of Segments in a Sequence: 400.

NON-VOLATILE USER MEMORY: 2 Gbytes.

#### NOTES

For sampling rates (Fs) ≤ 10MSa/s, 1000 samples minimum for Fs > 10MSa/s.

Model 2920 specifications

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# 2920

# RF Vector Signal Generator

## 10MHz to 4GHz or 6GHz

Model 2920 specifications

### 2900-GPS: GPS Signal Generation Personality

**CARRIER FREQUENCY:** 200MHz to 2.5GHz. Button provided to set carrier frequency to L1 (1575.42MHz).

**C/A CODE ID RANGE:** 1 through 37, Default value = 1.

**DATA PATTERN:**

**Selectable:** PN9 (default), PN15, all ones, all zeros, square 1-bit [01] and square 2-bit [0011].  
**User Defined:** Pattern from a file, length range of 1 to 37,504 bits. Default Pattern = PN9.

**DOPPLER SHIFT RANGE:** -10kHz to +10kHz, default value = 0Hz.

**EVM:** 3.5% (characteristic).

### 2900-ALG: Flexible Analog Modulation Personality<sup>1</sup>

#### AMPLITUDE MODULATION

**MODULATION FREQUENCY RANGE:** 1Hz to 100kHz.

**MODULATION FREQUENCY RESOLUTION:** 1Hz.

**MODULATION DEPTH RANGE:** 0 to 100%.

**MODULATION WAVEFORM:** Internal sine wave, triangle wave, or up/down ramp.

**AM DISTORTION:** <1.0% (characteristic).

#### FREQUENCY MODULATION

**MODULATION FREQUENCY RANGE:** 1Hz to 100kHz.

**MODULATION FREQUENCY RESOLUTION:** 1Hz.

**MODULATION DEVIATION RANGE:** 0Hz to 1MHz.

**MODULATION WAVEFORM:** Internal sine wave, triangle wave, or up/down ramp.

**FM DISTORTION:** <1.5% (characteristic).

#### PHASE MODULATION

**MODULATION FREQUENCY RANGE:** 1Hz to 100kHz.

**MODULATION FREQUENCY RESOLUTION:** 1Hz.

**MODULATION DEVIATION RANGE:** 0 to 100 radians.

**MODULATION WAVEFORM:** Internal sine wave.

**ΦM DISTORTION:** <1.5% (characteristic).

#### PULSE MODULATION

**PULSE REPETITION RATE RANGE:** 1Hz to 100kHz.

**PULSE REPETITION RATE RESOLUTION:** 1Hz.

**MINIMUM PULSE WIDTH:** 1.2μs.

**ON-OFF RATIO<sup>2</sup>:** >50dB (characteristic), pulse width <50μs.  
>100dB (characteristic), pulse width ≥50μs.

**RISE/FALL TIME (10% to 90%):** <600ns (characteristic), pulse width <50μs.  
<2μs (characteristic), pulse width ≥50μs

#### TWO-TONE

**TWO-TONE CW FREQUENCY SEPARATION RANGE:** 2Hz to 80MHz.

**TWO-TONE CW 3rd ORDER INTERMODULATION<sup>3</sup>:** <-54dBc (characteristic).

**TWO-TONE CW CARRIER FEED-THROUGH:** <-65dBc (characteristic)

#### NOISE MODULATION

**NOISE BANDWIDTH RANGE<sup>4</sup>:** 1kHz to 2.5MHz.

#### NOTES

- All 2900-ALG analog modulation frequency ranges and pulse repetition rates can be increased up to 20 times by storing the waveforms and up-sampling if option 2900-ARB-xx is installed.
- Valid when Pulse Modulation is the only active modulation type.
- Relative to power of fundamental tones at Pout = 0dBm.
- 6dB double-sided.

### 2900-WCDMA: W-CDMA FDD Downlink Signal Generation Personality

**FREQUENCY RANGE:** 1.8 to 2.2GHz.

**EVM:** <0.85% RMS (typical).

**ACP<sup>1</sup>:** **Adjacent:** <-66dBc (typical), <-68dBc (characteristic).

**Alternate:** <-72dBc (typical), <-73dBc (characteristic).

#### NOTES

- CPICH only, Adjacent spacing 5MHz offset. Alternate spacing 10MHz offset.

### 2900-CDMA-F: CDMAONE-CDMA2000 Forward Link Signal Generation Personality

**FREQUENCY RANGE:** 800 to 900MHz and 1.8 to 1.9GHz.

**RHO<sup>1</sup>:** >0.9995 (typical), >0.9999 (characteristic).

**ACP<sup>2</sup>:** **Adjacent at 750kHz:** <-60dBc (typical), <-61dBc (characteristic).

**Adjacent at 885kHz:** <-74dBc (typical), <-76dBc (characteristic).

**Alternate:** <-75dBc (typical), <-84dBc (characteristic).

#### NOTES

- Pilot only.
- Pilot only. Adjacent spacing 750kHz offset. Alternate spacing 1.98MHz offset.

### 2900-GSM: GSM-GPRS-EDGE Signal Generation Personality

**FREQUENCY RANGE:** 800 to 900MHz and 1800 to 1900MHz.

**PHASE ERROR FOR GSM:** <0.20° RMS (typical), <0.15° RMS (characteristic).

**EVM FOR EDGE:** <0.35% RMS (typical), <0.20% RMS (characteristic).

**ORFS FOR GSM (characteristic):**

Frequency Offset, kHz	Carrier Frequency, Fc	
	1GHz Pout = 0dBm	400MHz to 2.5GHz -10dBm ≤ Pout ≤ +6dBm
200	< -36 dBc	< -35 dBc
400	< -69 dBc	< -65 dBc
600	< -76 dBc	< -69 dBc

**ORFS FOR EDGE (characteristic):**

Frequency Offset, kHz	Carrier Frequency, Fc	
	1GHz Pout = 0dBm	400MHz to 2.5GHz -10dBm ≤ Pout ≤ +6dBm
200	< -36 dBc	< -37 dBc
400	< -69 dBc	< -63 dBc
600	< -76 dBc	< -69 dBc

### 2900-TDSCDMA-PC: SignalMeister™ License for TD-SCDMA

**FREQUENCY RANGE:** 800 to 900MHz and 1850 to 2025MHz.

**CHANNELS:**

**Physical:** DwPCH, UpPCH, P-CPCH, S-CCPCH, FPACH, PICH, PRACH, PUSCH, PDSCH, DPCH, DPCHo.

**Transport:** BCH, DCH, RACH.

**MODULATION ACCURACY:** EVM: <0.3%. ACP: <-62dBc.

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# RF Vector Signal Generator

## 10MHz to 4GHz or 6GHz

### 2900-DIG: Flexible Digital Modulation Signal Generation Personality

FORMATS: 8-PSK, 128QAM, 256QAM.

**SYMBOL RATE:**

Symbol Rate Resolution: 1Sps (Symbols per second).

Minimum Symbol Rate: 500Sps.

Maximum Symbol Rate: 2MSps for NRZ, Gaussian, and Wideband, 12.5MSps for RC and RRC.

FILTERS: Filter Types: NRZ, RC, RRC, Gaussian and Wideband.

FILTER FACTOR: RC, RRC: 0.2 to 1.0. Gaussian: 0.1 to 2.0.

SYMBOL FORMAT: Differential Encoding, On/Off.

SEQUENCE FORMAT: Output Inversion, On/Off.

DATA PATTERN: PRBS: PN5, PN9, PN11, PN15. Count: Radix. Alternating 0,1: 1–16.

EVM: QPSK, RCC Filter,  $\alpha = 0.35$ : <1.5% RMS (characteristic).

16 QAM, RCC Filter,  $\alpha = 0.35$ : <1.5% RMS (characteristic).

FSK, Gaussian Filter, BT = 0.7: <1.7% RMS (characteristic).

Modulation Format	Modulation Type	Parameter	Specification
ASK	OOK (ASK2), ASK4, SASK2, SASK4	See Common Parameters	See Common Specifications
FSK	FSK2	Frequency Separation Resolution	1 Hz
		Frequency Separation Range	0 to 2 × symbol rate in Sps
PSK	BPSK, QPSK, QPSK- $\pi/4$ , QPSK- $3\pi/4$ , OQPSK, 8PSK	See Common Parameters	See Common Specifications
QAM	QAM 16, QAM 32, QAM 64, QAM 128, QAM 256	See Common Parameters	See Common Specifications

### Supplementary Characteristics

EVM (802.11n WLAN, 20MHz and 40MHz Bandwidth, 64QAM Signal):  
2.4 and 3.5GHz: <-41dB. 5.8GHz: <-37dB.

### Trigger and Synchronization Inputs and Outputs

**TRIGGER MODES:** Free Run

- Trigger steps in Sweep or List mode
- Trigger a sweep or list
- Trigger start of ARB waveform
- Bus
- Bus arm using external trigger

TRIGGER DELAY RANGE: 0 to 1 second.

**TRIGGER SOURCE:** SCPI or front panel trigger

- Rising edge of external TTL input
- Falling edge of external TTL input
- 50ns minimum input pulse width required (characteristic)
- Trigger repeatability  $\pm 1$ ns (characteristic)

**SYNC OUTPUT MODES: Generate a sync pulse:** Off (never)

- On ARB waveform wrap
- At end of each step in List or Sweep modes
- At beginning of each sweep or list
- At end of each sweep or list

SYNC OUTPUT POLARITY SELECT: Rising or falling edge.

SYNC OUTPUT: TTL level, 3.3V CMOS, SMB(m). 200ns minimum pulse width (characteristic).

EVEN SECOND CLOCK INPUT: External even second clock (TTL), 3.3V CMOS, SMB(m).

EVEN SECOND CLOCK OUTPUT: External even second clock (TTL), 3.3V CMOS, SMB(m).

### GENERAL SPECIFICATIONS

POWER: 100VAC to 240VAC, 50, 60Hz (automatically detected), 175VA max.

CE EMC COMPLIANCE: EU Directive 89/336/EEC; EN 61326-1.

CE SAFETY COMPLIANCE: CE; EU Directive 73/23/EEC, EN 61010-1

CALIBRATION: 1 year.

ENVIRONMENT (for indoor use only): 18° to 28°C specified operating, unless otherwise noted.

0° to 50°C operating survival, non-specified operation.

-25° to 65°C. non-operating (AC power off) storage.

Altitude: 2000 meters above sea level maximum specified operating

Cooling: Forced air top, bottom, and side intakes and rear exhaust. For proper cooling in a rack, use Keithley Instruments 2890-RK Rack Mount Kit.

DIGITAL INPUTS/OUTPUTS: 4 bits, TTL-compatible.

**INTERFACES:**

IEEE-488.1 compliant. Supports IEEE-488.2 common commands and status model topology.

LAN: 10/100BT Ethernet, RJ45, LXI Class C, no auto MDIX.

IVI-COM.

USB: USB full speed.

Supports Keithley Model 3500 in pass-through mode via USB.

RF Out: Type N connector.

**MECHANICAL VIBRATION AND SHOCK:**

MIL-PRF-2880 CL3 random vibration, 3 axes.

Sine-Sweep test for resonances, 3 axes.

MIL-STD-810F 516.5 paragraph 4.5.7 procedure VI bench drop.

GENERAL MECHANICAL CHARACTERISTICS: Height: 133mm (5.25 in.), 3U. Width: 213mm (8.4 in.), half-rack. Depth: 464mm (18.25 in.). Weight: 9.3kg (20.5 lbs.).

WARRANTY: 1 year.

### SPECIFICATION NOTES

Specifications describe the instrument's warranted performance. Typical and characteristic values are not warranted, but provide additional information regarding performance of the Model 2920 and are provided to assist in application of the Model 2920.

**SPECIFICATIONS (warranted performance):**

Specification values are performance that is warranted. 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):**

Typical 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.

**CHARACTERISTIC (mean or expected value):**

Characteristic values are nominal performance that units are expected to have 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.

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## RF Vector Signal Generator 10MHz to 4GHz or 6GHz

Signal generator for mobile communications testing

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