# 2920

# RF Vector Signal Generator

## 10MHz to 4 or 6GHz

### Superior Signal Generation Accuracy over Wide Ranges

- 10MHz–6GHz frequency range
- -125dBm to +13dBm output power range
- ±0.6dB absolute amplitude accuracy
- ±0.05dB amplitude repeatability

### High Output Speed

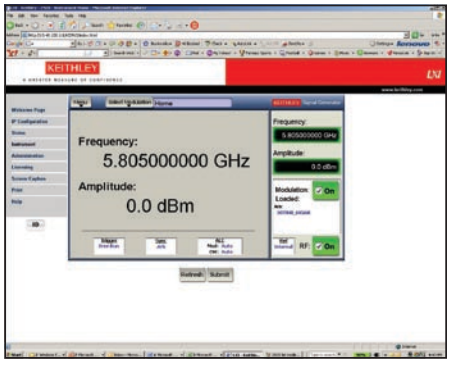
- <1.3ms typical frequency switching time using List mode
- <1.6ms amplitude switching time
- 3ms nominal waveform switching time using SCPI commands
- Instantaneous waveform switching using ARB sequence mode

### 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
- Works with SignalMeister RF Communications Test Toolkit signal generation and analysis software package


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. 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 Model 2920 simplifies testing mobile phones and other wireless devices economically, by generating signals compatible with an array of RF communications standards.

The instrument's Windows CE® operating system and intuitive graphical user interface allows 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.**

### Innovative Architecture

The Model 2920's Software-Defined Radio (SDR) architecture generates virtually any RF signal with up to 80MHz of modulation bandwidth,

Signal generator for RF communications testing

RF/MICROWAVE

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, utility programs, and PDF files (also available on-line at www.keithley.com)**

**On-board context sensitive help system**

### ACCESSORIES AVAILABLE

| | |
|---|---|
| 2890-BT | Bench Top Kit |
| 2890-RK | Rack Mount Kit |
| 2910-DCBLOCK | External RF-DC Block module |
| 2910-ADAPTER-KIT | Cable and Adapter Accessory Kit |

**CABLES/ADAPTERS**

| | |
|---|---|
| 7007-1 | Shielded IEEE-488 Cable, 1m (3.3 ft) |
| 7007-2 | Shielded IEEE-488 Cable, 2m (6.6 ft) |

**GPIB INTERFACES**

| | |
|---|---|
| KPCI-488LPA | IEEE-488 Interface/Controller for the PCI Bus |
| KPXI-488 | IEEE-488 Interfae Board for the PXI Bus |
| KUSB-488A | IEEE-488 USB-to-GPIB Interface Adapter |

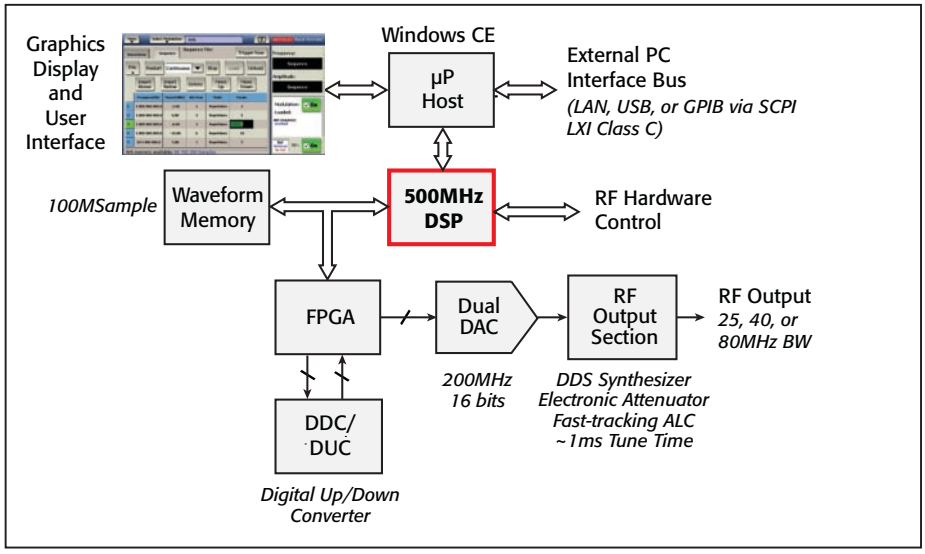
### APPLICATIONS

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

without the need for a hardware upgrade. This broad bandwidth provides exception 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.

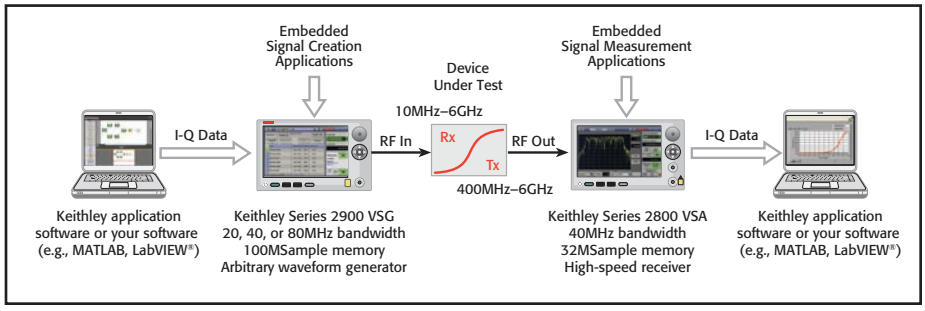
Signal waveforms are downloaded into the Model 2920's arbitrary waveform generator (ARB) memory, then processed with the high speed DSP. With this approach, the RF signal is defined through software by the I-Q data of the waveform. Multiple waveforms can be stored in the large ARB memory. The DSP can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

### 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.**

1. **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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## 10MHz to 4 or 6GHz

### 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**

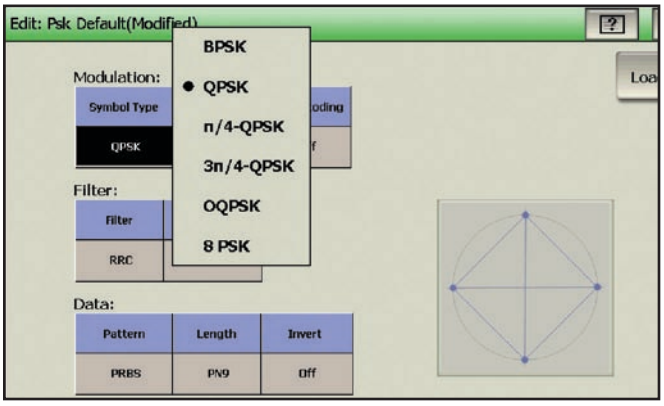
**2900-80211-N-PC: SignalMeister License for 802.11n WLAN**

**2900-80211-PC: SignalMeister License for 802.11a-b-g-j WLAN**

**2900-80216-E-PC: SignalMeister License for 802.16e WiMAX**

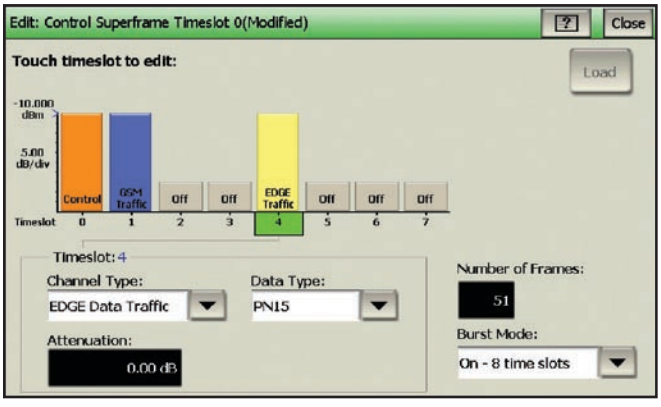
**Contact your local Keithley sales representative for the latest information on new personalities and software.**

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.**

2. **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.




**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.

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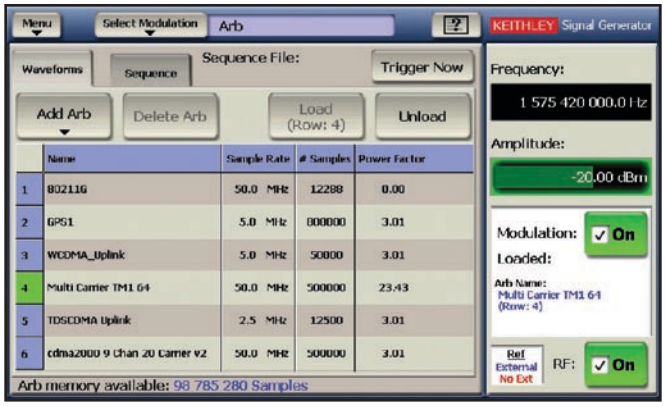
# RF Vector Signal Generator

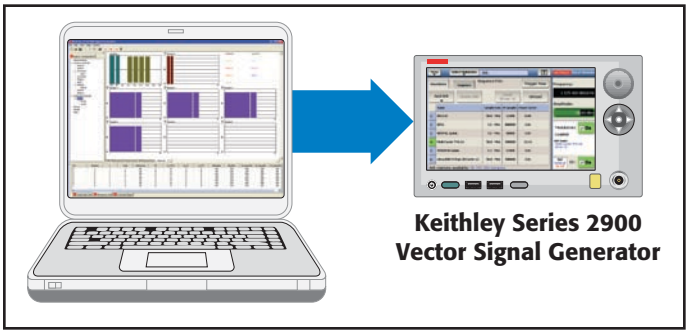
## 10MHz to 4 or 6GHz




**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 RF Communications Test Toolkit 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.




**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.**

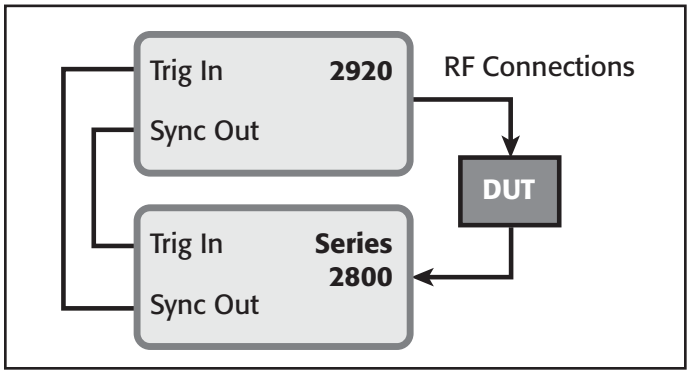
### Superior Signal Generation Accuracy and Repeatability

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:

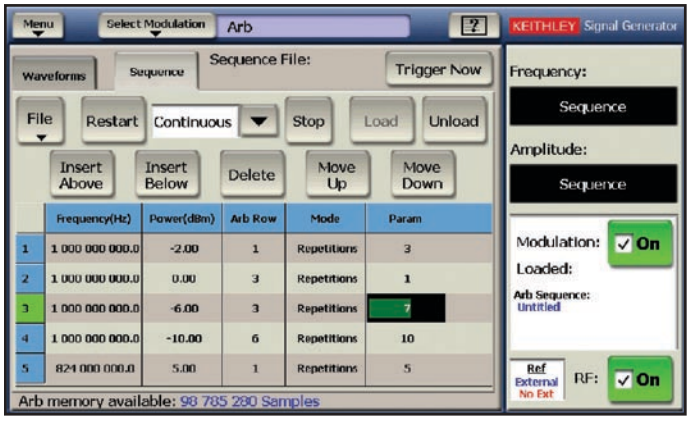
- Absolute amplitude accuracy of ±0.6dB (typically ±0.3dB) from –110dBm to +13dBm up to 3GHz
- ±0.05dB relative amplitude accuracy (linearity)
- ±0.05dB (typically ±0.01dB) amplitude repeatability
- 0.015dB/°C temperature stability

### Ultra-fast Signal Generation

The Model 2920 generates virtually any signal 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 that 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.**

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## 10MHz to 4 or 6GHz

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.

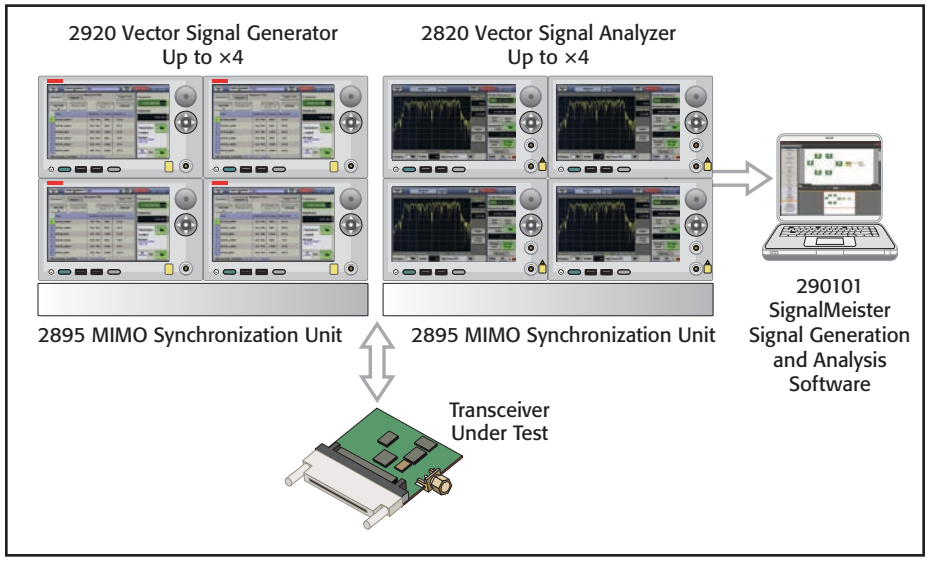
When using the List or Sweep modes, the instrument's amplitude switching time is 1.6ms, which overlaps the frequency tune time when both are changed. Fast-tracking ALC (Automatic Level Control) circuitry and an electronic attenuator make this fast amplitude switching possible. This hardware approach 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 ×2, ×3, or ×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.




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

Signal generator for RF communications testing

RF/MICROWAVE

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## 10MHz to 4 or 6GHz

## Basic Modes of Operation.

**CW SIGNAL GENERATOR MODE:** CW signal generator. Default mode.

**VECTOR SIGNAL GENERATOR PERSONALITIES:** Modulation quality source for GSM, GPRS, EDGE, GPS, cdma2000, and WCDMA mobile phone transmitter signals.

Note: All items are specifications unless otherwise noted.

## Frequency

**FREQUENCY RANGE: 2920-004:** 10MHz to 4.0GHz.
**2920-006:** 10MHz to 6.0GHz [1].

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

**FREQUENCY SETTING RESOLUTION:** 0.1Hz.

**FREQUENCY ACCURACY:** Same as frequency reference + synthesizer resolution term [2].

**FREQUENCY SWITCHING TIME [3]:** ≤1.6ms (modulation off).
≤1.8ms (modulation on).
≤3.0ms (characteristic) [4].

### INTERNAL FREQUENCY REFERENCE

**AGING RATE:** ≤1ppm/year.

**TEMPERATURE STABILITY:** ≤0.2ppm [5].

### FREQUENCY REFERENCE OUTPUT

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

**REF OUTPUT SIGNAL:** 10MHz, +7dBm ±3dB (characteristic).

### EXTERNAL FREQUENCY REFERENCE INPUT

**FREQUENCY LOCK RANGE:**

**Hardware Lock Mode [6]:** 10MHz ±10Hz (1ppm) input frequency lock range.

**Variable Input Frequency Mode:** 1 to 20MHz [7].

**AMPLITUDE LOCK RANGE:** –3 to +15dBm[8].

**IMPEDANCE:** 50Ω (characteristic).

### SPECTRAL PURITY

**SSB PHASE NOISE, 20kHz OFFSET:**

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

**HARMONICS AND SUBHARMONICS [9]:**

| Fundamental Frequency, Ff | Harmonics Specification (Typical) | Sub-Harmonics (Typical) |
|---|---|---|
| 10 MHz ≤ Ff < 20 MHz [10] | ≤ –25 dBc | Not Applicable |
| 20 MHz ≤ Ff < 4.0 GHz | ≤ –30 dBc | ≤ –40 dBc |
| 4.0 GHz ≤ Ff ≤ 6.0 GHz | ≤ –40 dBc | ≤ –40 dBc |

**NON-HARMONIC SPURIOUS [11]:**

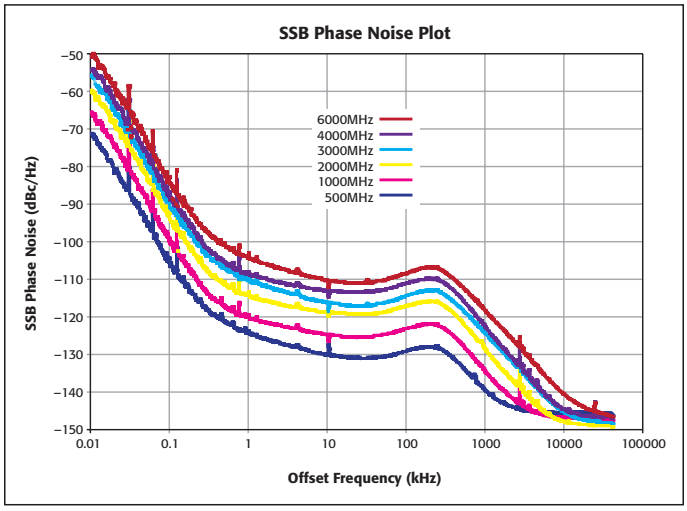
| Fundamental Frequency, Ff | Specification | Characteristic |
|---|---|---|
| 10 MHz ≤ Ff < 1.0 GHz | ≤ –55 dBc | ≤ –64 dBc |
| 1.0 GHz ≤ Ff < 3.0 GHz | ≤ –55 dBc | ≤ –60 dBc |
| 3.0 GHz ≤ Ff < 4.0 GHz | ≤ –55 dBc | ≤ –58 dBc |
| 4.0 GHz ≤ Ff ≤ 6.0 GHz | ≤ –50 dBc | ≤ –55 dBc |

## 2920-LPN Low Phase Noise Option

**SSB PHASE NOISE, dBc/Hz [12]:**

| Carrier Frequency, GHz | Specification (Characteristic) at Offset Frequency, dBc/Hz | | | |
|---|---|---|---|---|
| | 20kHz | 100kHz | 1MHz | 10MHz |
| 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) |

### OPTION 2920-LPN: CHARACTERISTIC SINGLE SIDE BAND PHASE NOISE CARRIER FREQUENCIES




## Amplitude [13]

**AMPLITUDE LEVEL RANGE (CW):**

| 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 (GSM):** | –110 to +6 dBm | –130 to +6 dBm |
| **AMPLITUDE LEVEL RANGE (EDGE):** | –110 to +6 dBm | –130 to +6 dBm |
| **AMPLITUDE LEVEL RANGE (CDMA2000) [14]:** | –110 to +3 dBm | –130 to +3 dBm |
| **AMPLITUDE LEVEL RANGE (WCDMA) [15]:** | –110 to +4 dBm | –130 to +4 dBm |

**AMPLITUDE SETTING RESOLUTION:** 0.01dB.

**AMPLITUDE INPUT UNITS:** dBm.

**ABSOLUTE AMPLITUDE LEVEL ACCURACY (CW), dB:**

| Amplitude Level Setting | Frequency (Typical) | | | |
|---|---|---|---|---|
| | 10 MHz to <330 MHz | 330 MHz to <3.0 GHz | 3.0 GHz to <4.0 GHz | 4.0 GHz to 6.0 GHz |
| Max to >+9 dBm | ≤±0.6 (0.3) | ≤±0.6 (0.3) | ≤±0.7 (0.4) | ≤±0.5 (characteristic) |
| +9 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:** | | | | |
| –110 to >–120 dBm | ≤±0.6 (0.3) | ≤±1.0 (0.6) | ≤±1.5 (0.7) | ≤±1.5 (0.7) |
| –120 to >–125 dBm | ≤±(0.6) | ≤±(0.6) | ≤(0.7) | ≤±(0.7) |

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## 10MHz to 4 or 6GHz

**USER FLATNESS CORRECTION MAX NUMBER OF POINTS:** 10 (points are amplitude correction and frequency pairs).

**POWER CHANGE OVER TEMPERATURE 0° TO 50°C (characteristic):** 0.02dB/°C.

**RELATIVE AMPLITUDE ACCURACY–LINEARITY [16] (characteristic):** ≤±0.05dB.

**AMPLITUDE REPEATABILITY [17] (characteristic):** <±0.05dB.

**AMPLITUDE SWITCHING TIME [18]:**

**List or Sweep Mode**: ≤1.6ms (Modulation Off).
≤1.8ms (Modulation On).

**Via Remote Command – after receipt of end-of-operation indicator (EOI):** ≤3.0ms (characteristic).

**OUTPUT MATCH, VSWR:**

**Carrier Frequency, Fc:** 10MHz ≤ Fc ≤ 3.0GHz: <1.45:1 (<1.3:1 typical).
3.0GHz < Fc ≤ 6.0GHz: <1.60:1 (<1.4:1 typical).

**REVERSE POWER PROTECTION [19]:** +35dBm or 10VDC.

## List and Step Sweep Modes

**FREQUENCY STEP/SWEEP:** Start, Stop, Number of Points, Dwell Time.

**AMPLITUDE STEP/SWEEP:** Start, Stop, Number of Points, Dwell Time.

**DWELL TIME MIN/MAX:** 0 to 999.9999s.

**DWELL TIME RESOLUTION:** 0.1ms.

**ARBITRARY LIST:** List of Frequency/Amplitude/Dwell Time sets. Maximum number of sets: 1000.

## 2900-ALG
## Analog Modulation Personality [20]

### FREQUENCY MODULATION

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

**FM MODULATION FREQUENCY SETTING RESOLUTION:** 1Hz.

**FM DEVIATION INTERNAL SINE WAVE ONLY:** 0Hz to 1MHz.

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

**INTERNAL MODULATION WAVEFORM TYPES:** Sine, ramp up, ramp down, and triangle waves.

### AMPLITUDE MODULATION

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

**AM MODULATION FREQUENCY SETTING RESOLUTION:** 1Hz.

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

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

**INTERNAL MODULATION WAVEFORM TYPES:** Sine, ramp up, ramp down, and triangle waves.

### PHASE MODULATION

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

**ΦM MODULATION FREQUENCY SETTING RESOLUTION:** 1Hz.

**ΦM DEVIATION:** 0 to 100 radians.

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

**INTERNAL MODULATION WAVEFORM TYPE:** Sine wave only.

### PULSE MODULATION

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

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

**PM MINIMUM PULSE WIDTH [21]:** 1.2μs.

**PM ON-OFF RATIO [22]: Pulse Width <5μs:** >50dB (characteristic).
**Pulse Width ≥5μs:** >100dB (characteristic).

**PM RISE/FALL TIME (10% TO 90%):** <600ns (characteristic).

**TWO-TONE PARAMETERS:**

**Two-Tone CW Frequency Separation Settings:** 2Hz to 2MHz.
**Two-Tone CW 3rd Order Intermodulation [23]:** >54dBc (characteristic).
**Two-Tone CW Carrier Feed through:** >65dBc (characteristic).
**Noise modulation bandwidth [24]:** 1kHz to 2.5MHz.

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

**BASEBAND ANALOG INPUTS:**

**External IQ Input 3dB Bandwidth [25]: I channel:** (DC–200MHz).
**Q channel:** (DC–200MHz).

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

**Maximum input V (DC + AC peak) [26]:** ±3V peak damage level.

**BASEBAND ANALOG OUTPUTS:**

**0.2dB Bandwidth [27]: I channel:** (DC–40MHz).
**Q channel:** (DC–40MHz).

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

**Full Scale Output V (DC+AC peak):** ±1.0V peak.

**Maximum Reverse Input Voltage (damage level):** ±1.0V.

**IQ Offset (DC & Quadrature Adjustment):** ±12.5% of Full Scale ±10°.

**IQ Gain:** 0 to Full Scale.

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

**MAXIMUM MODULATION BANDWIDTH FOR INTERNAL MODULATION GENERATION:**
**2900-ARB-20:** 20MHz (25MS/s).
**2900-ARB-40:** 40MHz (50MS/s).
**2900-ARB-80:** 80MHz (100MS/s).

**WAVEFORM MEMORY:** 100 Megasamples.

**MINIMUM SEGMENT LENGTH:** 1000 samples.

**MAXIMUM SEGMENT LENGTH:** 100 Megasamples.

**MAX NUMBER OF SEGMENTS IN A SEQUENCE:** 400.

**NON-VOLATILE MEMORY:** 2 GBytes.

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

**FREQUENCY RANGE:** 1800–2200MHz.

**EVM [28]:** <0.85% RMS.

**ACLR [29]: Adjacent:** >66dBc (>68dBc characteristic).
**Alternate:** >72dBc (>73dBc characteristic).

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

**FREQUENCY RANGE:** 800–900MHz, 1800–1900MHz.

**RHO [30]:** >0.9995 (>0.9999 characteristic).

**ACPR [31]:**

**Adjacent at 750kHz:** >69dBc (>71dBc characteristic).
**Adjacent at 885kHz:** >73dBc (>76dBc characteristic).
**Alternate at 1980kHz:** >75dBc (>84dBc characteristic).

# 2920

# RF Vector Signal Generator

## 10MHz to 4 or 6GHz

## 2900-GSM Modulation Personality

**FREQUENCY RANGE:** 800–900MHz, 1800–1900MHz.

**EVM FOR EDGE [32]:** <0.60% RMS (typical), <0.35% RMS (characteristic).

**PHASE ERROR FOR GSM [33]:** <0.25° RMS (typical), <0.15° RMS (characteristic).

**ORFS FOR EDGE (Characteristic):**

| | Carrier Frequency, Fc | |
|---|---|---|
| Frequency Offset, kHz | 1 GHz $P_{OUT}$ = 0 dBm | 400 MHz to 2.5 GHz −10 ≤ $P_{OUT}$ ≤ +6 dBm |
| 200 | >36 dBc | >37 dBc |
| 400 | >69 dBc | >63 dBc |
| 600 | >76 dBc | >69 dBc |

**ORFS FOR GSM (Characteristic):**

| | Carrier Frequency, Fc | |
|---|---|---|
| Frequency Offset, kHz | 1 GHz $P_{OUT}$ = 0 dBm | 400 MHz to 2.5 GHz −10 ≤ $P_{OUT}$ ≤ +6 dBm |
| 200 | >36 dBc | >35 dBc |
| 400 | >69 dBc | >65 dBc |
| 600 | >76 dBc | >69 dBc |

## 2900-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 [0 1], 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-DIG General Purpose Digital Modulation Generation Personality

**SYMBOL RATE:**
**Symbol Rate Resolution:** 1 Sps (Symbols per second).
**Minimum Symbol Rate:** 500 Sps.
**Maximum Symbol Rate:** 2msps for NRZ, Gaussian, and Wideband. 25msps 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 3.0.

**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.

| Modulation Format | Modulation Type | Parameter | Specification |
|---|---|---|---|
| ASK | OOK (ASK2), ASK4, SASK2, SASK4 | See Common Parameters | See Common Specifications |
| FSK | FSK2 | Frequency Separation Resolution | 1Hz |
| | | Frequency Separation Range | 0 to 2 × symbol rate in Sps |
| PSK | BPSK, QPSK, QPSK-π/4, QPSK-3π/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 |

**EVM CHARACTERISTICS [34]:**

| Format | Filter Conditions | RMS EVM, % |
|---|---|---|
| QPSK | RRC, α = default (0.35) | ≤1.5% |
| 16QAM | RRC, α = default (0.35) | ≤1.5% |
| FSK | Gaussian BT = 0.7 | ≤1.5% |

## Supplementary Characterisitics

**EVM: 802.11n WLAN, 20 and 40MHz BW, 64 QAM:**
**2.4 and 3.5GHz:** <–41dB. **5.8GHz:** <–37dB.

## 2900-TDSCDMA-PC SignalMeister™ License For TD-SCDMA

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

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

## Trigger and Synchronization Inputs and Outputs

**TRIGGER MODES:**
Free Run
Trigger sweeps in sweep or list mode
Trigger a sweep or list
Trigger start of arb waveform.

**ARB SEQUENCE TRIGGER MODES:**
Stepping Only
Start and Step.

**TRIGGER SOURCES:**
SCPI or Rear Panel Trigger
Rising edge of external TTL input
Falling edge of external TTL input.

**EXTERNAL TRIGGER CHARACTERISTICS:**
Minimum input pulse width required 50ns (characteristic).
Trigger repeatability ±10ns.

**TRIGGER DELAY:** 0 to 1 second.

**SYNC OUTPUT MODES: Generate a sync pulse:**
Never (Off)
On arb waveform wrap
At beginning of sweep, list or sequence
At end of each step in sweep, list or sequence
At end of dwell in sweep, list or sequence
At end of sweep, list or sequence.

**SYNC OUTPUT POLARITY SELECT:** Sync out is on rising edge, Sync out is on falling edge.

**SYNC OUTPUT CHARACTERISTICS:** 3.3V CMOS, SMV (m). Minimum pulse width 200ns.

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

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

# 2920

# RF Vector Signal Generator

## 10MHz to 4 or 6GHz

## 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:** Annual calibration cycle in system.

**ENVIRONMENT (for indoor use only):**
18° to 23°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:** Maximum 2000 meters above sea level.

**Cooling:** Forced air top, bottom and side intakes, and rear exhaust. For proper cooling in a rack, use Keithley Instruments 2910-RMK 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 MIL-PRF–2880 CL3 random vibration, 3 axes.

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

## NOTES

1. Over range operation provided: 10MHz to 6.9GHz. Performance above 6.0GHz is not specified.
2. Synthesizer resolution term: ≤5μHz.
3. To within 0.1ppm of final value. List mode or swept mode. Free run or hardware trigger. ALC on or off. Modulation on or off.
4. To within 0.1ppm of final value. Via remote command after receipt of end-of-operation indicator (EOI). ALC no or off. Modulation on or off.
5. Total variation relative to 0° to 50°C ambient temperature range.
6. Factory preset setting.
7. On 10Hz boundaries Freq = 1MHz + n * 10Hz. Reference accuracy: ≤±1ppm. Sine or square wave inputs acceptable. Lock time may be up to 30 seconds.
8. For optimum phase noise performance use hardware lock mode. Reference input power 0 to +10dBm.
9. $P_{OUT} \leq +4$dBm, specifications apply to harmonic and sub-harmonic responses within the specified operating range of the instrument.
10. $P_{OUT} \leq 0.0$dBm.
11. Valid for responses offset from carrier >10kHz, $P_{out}$ = 0dBm and Modulation off, specifications apply to responses within the specified operating range of the instrument.
12. RF output power set to 0dBm.
13. Specifications apply when in autocoupled mode unless otherwise stated.
14. +3dBm max for Pilot only. +0.5dBm max for Forward 9 channel.
15. +4dBm max for CPICH only. –1.0dBm max for Test Model 1 with 16 DPCH.
16. –110dBm < $P_{OUT}$ < +2dBm, ALC mode = on, modulation off.
17. –110dBm < $P_{OUT}$ < +2dBm, ALC mode = on, modulation off.
18. To within ±0.05dB of final value <3.4GHz, ±0.25dB of final value ≥3.4GHz.
19. Up to 50VDC with optional external DC block Keithley part number, 2910-DCBLOCK.
20. Frequency ranges and resolution can be multiplied by up to 40 times with 2900-ARB-XX license. For example, FM deviation can be extended to 40MHz.
21. Can be decreased by up to 40 times with 2900-ARB-XX license.
22. Only valid when Pulse Modulation is only active modulation type.
23. Relative to power of desired tones. $P_{OUT}$ = 0dBm.
24. 6dB double sided.
25. 3dB BW. With inputs applied directly to I/Q modulator. User needs to provide correction for I/Q AC and DC amplitude and phase skew and offsets.
26. Maximum voltage includes Offsets and Signal for nominal input of 50Ω. Optimal drive voltage ±0.8V.
27. Into 50Ω impedance.
28. $P_{OUT} \leq -10$dBm.
29. CPICH only, $P_{OUT} \leq -1$dBm, Adjacent spacing 5MHz offset. Alternate spacing 10MHz offset.
30. Pilot only.
31. Pilot only. $P_{OUT} \leq -4$dBm.
32. Measured at $P_{OUT}$ = 0dBm.
33. Measured at $P_{OUT}$ = +4dBm.
34. Characterized at 2.5 and 6.0GHz. Symbol rates from minimum to maximum. For best results at low symbol rates, use the 2920 external reference hardware lock mode.

## 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):**

*Specifications* indicate 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 specified warm-up time of 30 minutes and self calibration at ambient temperature.

**Typical (mean + 3 standard deviations):**

*Typical* indicates performance that units will meet under the following conditions:

- Ambient operating temperature of 23°C, unless otherwise noted.
- After specified warm-up time of 30 minutes and self calibration at ambient temperature.

This performance is not warranted.

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

*Characteristic* indicates nominal performance that units are expected to have under the following conditions:

- Ambient operating temperature of 23°C, unless otherwise noted.
- After specified warm-up time of 30 minutes and self calibration at ambient temperature.

This performance is not warranted.