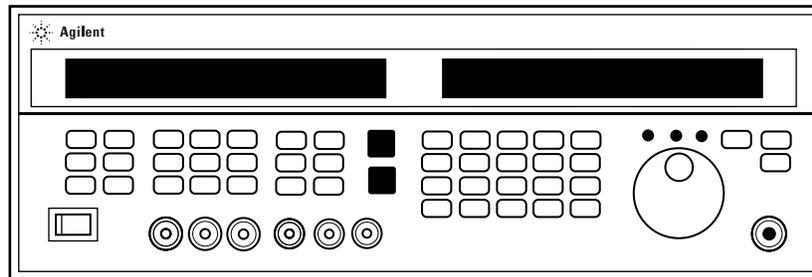


# Agilent 83711B and 83712B Synthesized CW Generators

# Agilent 83731B and 83732B Synthesized Signal Generators

Data Sheet



**10 MHz to 20 GHz**  
**1 to 20 GHz**

**Specifications** describe the instrument's warranted performance over the 0° to 55°C temperature range unless otherwise noted. **Supplemental Characteristics** are intended to provide information

useful in estimating instrument capability in your application by describing typical, but not warranted, performance. *Note: Supplemental characteristics are indicated by italic type.*



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## Frequency

### Range:

#### Synthesized CW generators

83711B, 1.0 to 20 GHz

83712B, 10 MHz to 20 GHz

#### Synthesized signal generators

83731B, 1.0 to 20 GHz

83732B, 10 MHz to 20 GHz

**Resolution:** 1 kHz (1 Hz with Option 1E8)

**Stability** (with high-stability timebase, Option 1E5)

#### Aging rate:

$<1.5 \times 10^{-9}$ /day after 24-hour warm up

#### Temperature effects:

$<1 \times 10^{-7}$  over 0 to 55° C, nominally  $<1.4 \times 10^{-9}/^{\circ}$  C

#### Line voltage effects:

$<5 \times 10^{-10}$  for 10% change in line voltage

**Stability** (without high-stability timebase)

#### Aging rate:

$<1.0 \times 10^{-8}$ /day after 72 hours at 25° C  $\pm 10^{\circ}$  C

#### Temperature effects:

$<5 \times 10^{-6}$  over 0 to 55° C referenced to 25° C

**Stability** (with external 10 MHz reference):

Same as external reference.

#### Frequency switching time

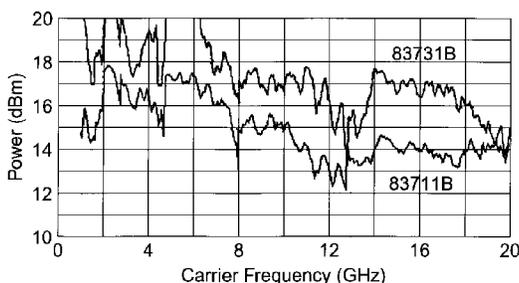
$<50$  ms to within 1 kHz for any frequency step

$<35$  ms to within 1 kHz for  $<1$  GHz steps not across the 10 GHz band switch point

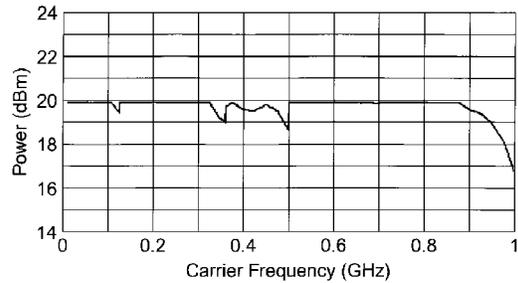
## RF Output

### Maximum leveled output power:

Frequency	Standard	with Option 1E1
0.01 to 1 GHz	+13 dBm	+13 dBm
1 to 18 GHz	+11 dBm	+10 dBm
18 to 20 GHz	+10 dBm	+8 dBm



**Typical maximum available output power from 1 to 20 GHz, at 25° C with output step attenuator (Option 1E1) installed**



**Typical maximum available output power from 0.01 to 1 GHz at 25° C**

**Minimum leveled output power:** -4 dBm

with Option 1E1, -110 dBm

**Display resolution:** 0.01 dB

**Accuracy** (-4 dBm<sup>1</sup> to maximum specified leveled output power<sup>2</sup>):

10 MHz to 50 MHz,  $\pm 1.3$  dB

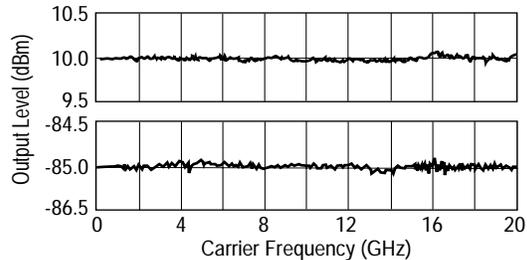
50 MHz to 20 GHz,  $\pm 1.0$  dB

**Accuracy** (over all power levels<sup>2</sup>):

10 MHz to 50 MHz,  $\pm 2.3$  dB (power  $\geq -90$  dBm)

50 MHz to 20 GHz,  $\pm 2.0$  dB (power  $\geq -90$  dBm)

10 MHz to 20 GHz,  $\pm 2.5$  dB (power  $< -90$  dBm)



**Typical output level accuracy and flatness at +10 and -85 dBm**

#### Flatness:

$\pm 0.5$  dB<sup>2</sup> (power  $\geq -90$  dBm)

$\pm 0.7$  dB<sup>2</sup> (power  $< -90$  dBm)

**Level switching time:**  $<17$  ms

(without step attenuator range change)

**Attenuator range changes occur at:**

83711B, 83712B

-1 dBm, -11 dBm, -21 dBm, etc.

83731B, 83732B

-4 dBm, -14 dBm, -24 dBm, etc.

-10 dBm, -20 dBm, -30 dBm, etc. (linear AM)

**Output SWR:**  $<2.0 : 1$  nominal

1. -10 dBm (linear AM)

2. The use of type-N RF connectors above 18.0 GHz degrades specification typically by 0.2 dB.

## User Flatness (Level) Correction

**Number of points:** 2 to 401 points/table

**Number of tables:** up to 4

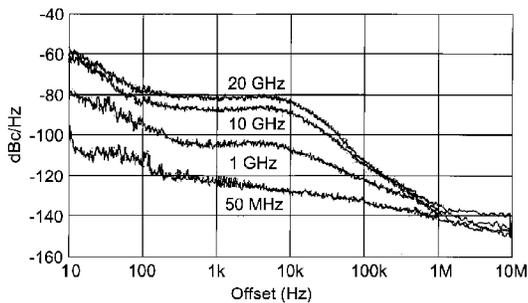
**Entry modes:** power meter, GPIB

## Spectral Purity

**SSB phase noise (dBc/Hz, CW mode):**

Carrier Freq.	Offsets			
	100 Hz	1 kHz	10 kHz	100 kHz
0.5 to <1 GHz	-78	-92	-103	-115
1 to <2 GHz	-73	-83	-92	-107
2 to <5 GHz	-70	-78	-83	-100
5 to <10 GHz	-69	-78	-82	-100
10 to 20 GHz	-65	-73	-76	-100

Phase noise decreases 6 dB/octave below 500 MHz and reaches a floor of <-140 dBc/Hz.

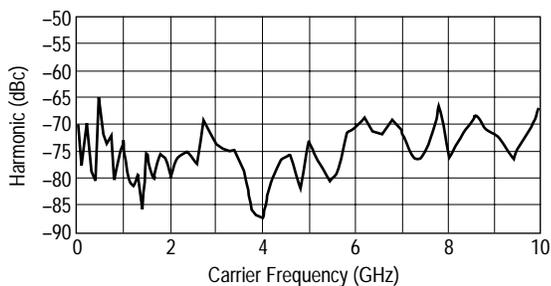


**Typical single-sideband phase noise at 50 MHz, 1 GHz, 10 GHz, and 20 GHz, 25°C, CW mode. Offsets less than 100 Hz require the high-stability timebase, Option 1E5.**

## Harmonics:

83711B/83712B, <-50 dBc (at levels < +6 dBm)

83731B/83732B, <-55 dBc (at levels < +6 dBm)



**Typical 2nd harmonic levels measured at output power of +6 dBm**

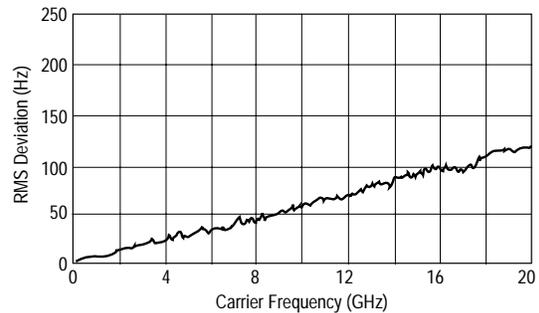
**Nonharmonic spurious ( $\geq 3$  kHz):** <-60 dBc (includes power supply and frequency synthesis spurious)

**Nonharmonic spurious (<3 kHz):** <-50 dBc

**Subharmonics:** none

## Residual FM:

At 1 GHz, in 50 Hz to 15 kHz bandwidth: < 15 Hz Residual FM decreases 6 dB per octave below 1 GHz.



**Typical residual FM measured in 50 Hz to 15 kHz bandwidth, CW mode, with high-stability timebase, Option 1E5**

**AM noise floor (at 0 dBm and offsets greater than 5 MHz from carrier):**

0.01 to 1 GHz, <-140 dBm/Hz

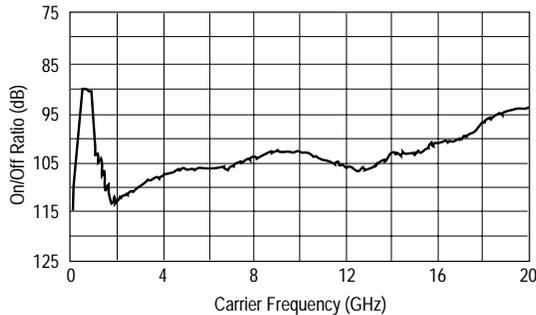
1 to 20 GHz, <-150 dBm/Hz

This page shows modulation specifications that are available only for the 83731B and 83732B, and not for the 83711B and 83712B.

## Agilent 83731B and 83732B Modulation Specifications Pulse Modulation<sup>1</sup>

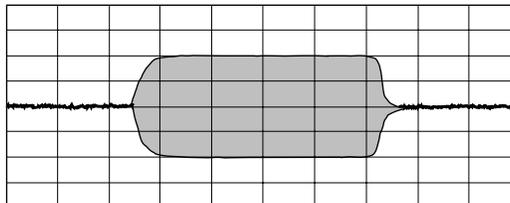
Carrier Frequency	MHz				GHz	
	<25	25 to <64	64 to <128	128 to <500	500 to <1000	1 to 20
Minimum Pulse width	<1 $\mu$ s		<100 ns		<25 ns Typically <10 ns	
Rise/Fall Time	<500 ns	<350 ns	<50 ns	<35 ns	<15 ns	<10 ns
Video Feedthrough	<2 mV peak-to-peak at 0 dBm				<20 mV peak-to-peak at 0 dBm	
Pulse Width Compression	$\pm 150$ ns		$\pm 15$ ns		$\pm 5$ ns	
Pulse Delay (Video out to RF out)	<1 $\mu$ sec		<200 ns		<125 ns	<100 ns

**On/off ratio: >80 dB**



**Typical pulse modulation on/off ratio at +8 dBm**

- Maximum pulse repetition frequency: >3 MHz**
- Minimum pulse duty cycle: no restrictions on duty cycle**
- Pulse level accuracy:  $\pm 1.0$  dB (relative to CW)**
- Pulse overshoot: <10 %**
- Input impedance: 50 $\Omega$  nominal; TTL drive levels**
- Maximum leveled output power in pulse mode: -0.5 dB (relative to CW)**



Timebase = 10.0 ns/div  
Carrier Frequency = 10.0 GHz  
Risetime = 4.9 ns  
Falltime = 2.05 ns

**Typical pulse modulation envelope illustrates the fast rise and fall times, excellent flatness, and pulse fidelity of the 83731B/83732B.**

## Internal Pulse Source

**Pulse source modes:** free-run, triggered with delay, doublet, and gated. Triggered with delay, doublet, and gated require external trigger source.

**Pulse repetition frequency:** 3 Hz to >3 MHz

**Pulse repetition interval (PRI):** 300 ns to 419 ms

**Pulse width ( $T_W$ ):** 25 ns to 419 ns

**Variable pulse delay**

**Free-run mode ( $T_d$ ):**  $\pm 419$  ns

**Triggered with delay and doublet modes ( $T_d$ ):**

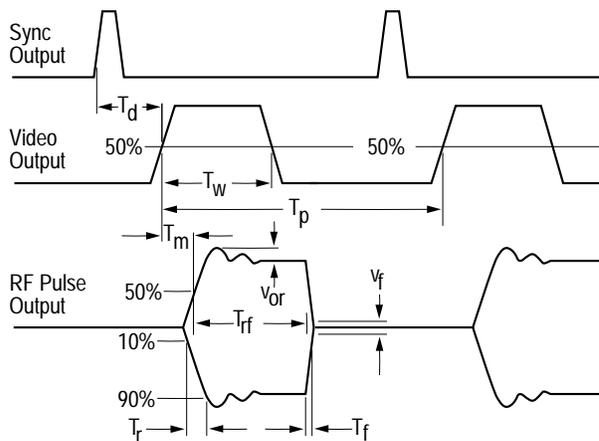
225 ns to 419 ns with  $\pm 25$  ns jitter

**Pulse width/delay/PRI resolution:** 25 ns

**Pulse delay (video to RF,  $T_m$ ):**

1 to 20 GHz, <20 ns nominal

All pulse modulation specifications and supplemental characteristics apply during use of internal pulse source.



$T_d$  video delay (variable)       $T_m$  RF delay  
 $T_W$  video pulse width (variable)       $T_{rf}$  RF pulse width  
 $T_p$  pulse period (variable)       $T_f$  RF pulse fall time  
 $T_r$  RF pulse rise time  
 $V_{or}$  overshoot and ringing  
 $V_f$  video feedthrough

1. CW power will be present for up to 10 ms when changing frequency or power level.

This page shows modulation specifications that are available only for the 83731B and 83732B, and not for the 83711B and 83712B.

## Frequency Modulation

**Rates:** 1 kHz to 1 MHz

**Flatness:**  $\pm 2$  dB

Frequency	Maximum Deviation <sup>2</sup>	Modulation Index
2 to 20 GHz	10 MHz peak	>300
1 to <2 GHz	5 MHz peak	>150
500 MHz to <1 GHz	2.5 MHz peak	>75
256 to <500 MHz	1.25 MHz peak	>37

The modulation index and maximum deviation decrease by a factor of 2 for each octave below 256 MHz.

### FM sensitivity:

Frequency	Seven ranges, selectable
1 to 20 GHz	10, 5, 3, 1, 0.3, 0.1, 0.03 MHz/V pk
256 MHz to <1 GHz	2500, 1250, 750, 250, 75, 25, 7.5 kHz/V pk
64 to <256 MHz	625, 312, 187, 62.5, 18.7, 6.25, 1.87 kHz/V pk
16 to <64 MHz	156, 78.1, 46.8, 15.6, 4.68, 1.56, 0.468 kHz/V pk
10 to <16 MHz	78.1, 39.0, 23.4, 7.81, 2.34, 0.871, 0.234 kHz/V pk

**FM sensitivity accuracy:**  $\pm 10\%$  at 100 kHz

**Incidental AM:** <5%

**FM input impedance:** 600 $\Omega$  nominal

**Harmonic distortion:** <1% (1 MHz peak deviation at 100 kHz rate)

## Option 800 Phase Modulation

**Sensitivity:**

Two ranges, selectable

Frequency	Two ranges, selectable	
	Low Range	High Range
1 to 20 GHz	1 rad/V pk	50 rad/V pk
256 MHz to <1 GHz	0.25 rad/V pk	12.5 rad/V pk
64 to <256 MHz	.0625 rad/V pk	3.12 rad/V pk
16 to <64 MHz	0.0156 rad/V pk	0.781 rad/V pk
10 to <16 MHz	0.00781 rad/V pk	0.39 rad/V pk

<b>Accuracy</b>	$\pm 5\%$ (at 1 kHz)	$\pm 10\%$ (at 100 Hz)
<b>Flatness</b>	DC to 100 kHz: $\pm 1$ dB	DC to 30 kHz: $\pm 2$ dB
<b>Bandwidth</b>	>1 MHz (3 dB)	usable to 1 MHz at low deviations
<b>Input Impedance</b>	600 ohms nominal	600 ohms nominal

### Maximum deviation:<sup>2</sup>

Frequency	Low Range	High Range
2 to 20 GHz	4 rad	200 ra
1 to <2 GHz	2 rad	100 rad
500 to <1 GHz	1 rad	50 rad
256 to <500 MHz	0.5 rad	25 rad

The maximum deviation decreases by a factor of 2 for each octave below 256 MHz.

## Linear Amplitude Modulation

**Sensitivity:**

Two ranges, selectable: 30%/Vpk and 100%/Vpk

**Sensitivity accuracy:**

(1 kHz)  $\pm 8\%$  of value  $\pm 2\%$ , (15 to 35°C)

**Maximum Depth:** 90%

**Bandwidth:** (3 dB, 30% depth) DC to >100 kHz

**Incidental phase modulation:** (30% depth) <0.4 radians peak

**Maximum carrier level in linear AM mode** (relative to CW):

With no modulation input	<1 GHz	1 to 4 GHz	>4 GHz
	0 dB	-4.5 dB	-1.0 dB

With modulation degrades up to 6 dB depending on depth

## Logarithmic Amplitude Modulation (Scan Modulation)

**Maximum depth:** > 60 dB

**Sensitivity:** -10 dB/V; (0 to +6V for 0 to -60 dBc)

**Step response** (50 dB change in level):

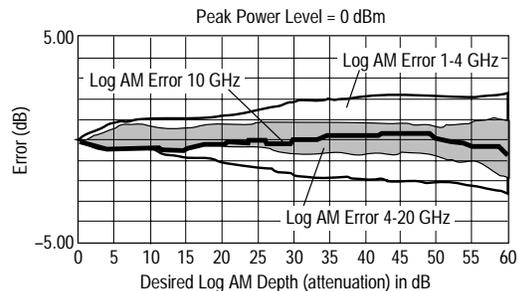
< 1 GHz, < 10  $\mu$ s rise time, < 20  $\mu$ s fall time

1 to 20 GHz, < 5  $\mu$ s rise and fall times

**Input impedance:** 5000 $\Omega$  nominal

**Maximum leveled output power in log AM mode** (relative to CW):

<1 GHz	1 to 4 GHz	>4 GHz
0 dB	-4.5 dB	-1.0 dB



**Typical log AM error (deviation from desired depth) at 25°C for carrier frequencies between 1.0 and 20 GHz**

## Simultaneous Modulations

Full AM bandwidth and depth is available at any pulse rate or width. FM/ $\Phi$ M is completely independent of AM and pulse modulation.

2. With sine wave modulation only.

## Option 1E2: Internal Modulation Generator

Available in 83731B and 83732B models only. Specifications for internal modulation are same as base instrument, unless noted below.

### Waveforms

**Sine wave:** 0.5 Hz to 1 MHz rates

**Ramp, square, triangle:** 0.5 Hz to 100 kHz rates  
Uniform noise, Gaussian noise

**Rate accuracy:**  $< \pm .01\%$

### Internal scan modulation

**Rate:** 0.5 Hz to 20 kHz

**Rate Resolution:** 0.5 Hz (3 digits displayed)

**Depth resolution:** 0.01 dB

### Internal linear AM

**Rate:** 0.5 Hz to 100 kHz

**Rate Resolution:** 0.5 Hz (3 digits displayed)

**Depth resolution:** 0.1%

### Internal FM

**Rate:** 1 kHz to 1 MHz

**Rate Resolution:** 0.5 Hz (3 digits displayed)

**Deviation resolution:** 0.01 Hz

**Flatness:**  $\pm 2$  dB (1 to 500 kHz)

### Internal phase modulation (with Option 800 only)

**Rate:** 0.5 Hz to 1 MHz

**Rate Resolution:** 0.5 Hz (3 digits displayed)

**Deviation resolution:** 0.01 rad

**Bandwidth:** 700 kHz (3 dB) on low range

## General

### Noise figure meter compatibility

Agilent 8370 sources are fully compatible with and can be controlled by the 8970B noise figure meter through Special Function 41.5.

### Programming

These instruments are fully compatible with the Standard Commands for Programmable Instruments (SCPI). SCPI complies with IEEE 488.2-1987.

In addition, these instruments will emulate most applicable Agilent 8673 commands, providing general compatibility with ATE systems which include 8673 series signal generators.

### Environmental

**Operating temperature range:** 0° to 55°C

**EMC:** complies with CISPR Pub. 11/1990, Class A, and Mil-Std-461C, Part 2, Methods CE03, CS01, CS02, RE02, RS03

### Power requirements

**Power:** 90 to 132V, 48 to 440 Hz; 198 to 264V, 48 to 66 Hz; 260 VA maximum

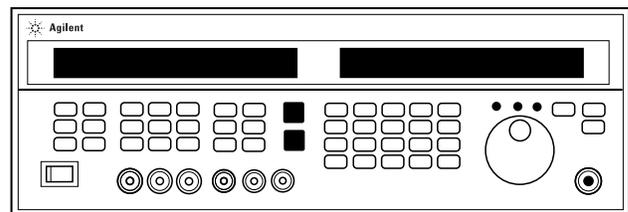
### Physical dimensions

**Net weight:** <16 kg (35 lb) Shipping: <23 kg (49 lb)

**Size:** 498 mm D x 426 mm W x 133 mm H  
(19.6in x 16.8in x 5.2in)

Transit case available by ordering Agilent part number 9211-2655.

## Front Panel Connectors



### 83731B/83732B front panel

#### RF output

Type-N precision, or 3.5 mm precision (Option 1E9). Nominal impedance is 50 ohms.

#### ALC in

Used for external leveling with either a power meter or a positive- or negative-polarity diode detector.

#### AM in (83731B/83732B only)

Accepts input signal for external linear AM or log AM. Nominal impedance is 5k ohms.

#### FM/ $\Phi$ M in (83731B/83732B only)

Accepts input signal for external FM or phase modulation (Option 800 only). Nominal impedance is 600 ohms.

#### Pulse/trigger gate in (83731B/83732B only)

Accepts input signal for external pulse modulation. Also accepts external trigger pulse input for internal pulse modulation. TTL-level compatible, nominal impedance is 50 ohms.

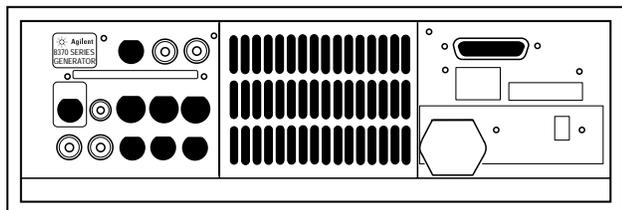
#### Pulse video out (83731B/83732B only)

Outputs a signal that follows the RF output in all pulse modes. TTL-level compatible, nominal source impedance is 50 ohms.

#### Pulse sync out (83731B/83732B only)

Outputs a synchronizing pulse, nominally 50 ns width, during internal and triggered pulse modulation. TTL-level compatible, nominal source impedance is 50 ohms.

## Rear Panel Connectors



### 83731B/83732B rear panel

#### 10 MHz input

Accepts a 10 MHz  $\pm 100$  Hz, 0 to 10 dBm, external reference signal for operation from an external high stability timebase. Nominal input impedance is 50 $\Omega$ .

#### 10 MHz output

Outputs the 10 MHz reference signal, nominally +3 dBm, for use as an external reference signal. Nominal source impedance is 50 $\Omega$ .

#### 0.5V/GHz output

Supplies a voltage proportional to output frequency for use with mm-wave frequency multipliers, including the Agilent 83550 Series Millimeter Wave Source Modules.

#### AM output (Option 1E2 only)

Provides a sample of the modulating signal from the internal AM generator or external AM input.

#### FM/ $\Phi$ M output (Option 1E2 only)

Provides a sample of the modulating signal from the internal FM/ $\Phi$ FM generator or external FM/ $\Phi$ FM input.

## Ordering Information

**83711B** 1 to 20 GHz synthesized CW generator

**83712B** 0.01 to 20 GHz synthesized CW generator

**83731B** 1 to 20 GHz synthesized signal generator

**83732B** 0.01 to 20 GHz synthesized signal generator

**Option 1E1** Adds 110 dB output step attenuator

**Option 1E2** Adds internal modulation generator (83731B/32B only)

**Option 1E5** Adds high-stability timebase

**Option 1E8** 1 Hz frequency resolution

**Option 1E9** 3.5 mm RF output connector

**Option 800** Analog phase modulation (83731B/32B only)

**Option 0B2** Extra operating manual

**Option 0BV** Service documentation, component level

**Option 0BW** Service documentation, assembly level

**Option 1CM** Rack mount kit (Part number 5062-3977)

**Option 1CP** Rack mount and handle kit (Part number 5062-3983)

**Option 1CR** Rack slide kit (Part number 1494-0059)

**Option W30** Two additional years return-to-Agilent-service

**Option W32** Three-year return-to-Agilent calibration service

**Option W34** Three-year Mil-Std calibration service

Longer term warranty and calibration services are available.

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