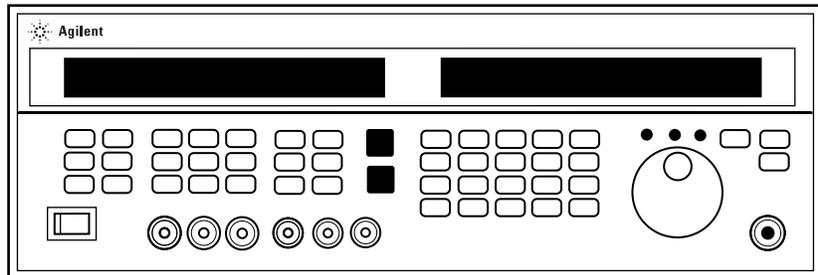


Agilent 83711B and 83712B Synthesized CW Generators

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.*



Agilent Technologies

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

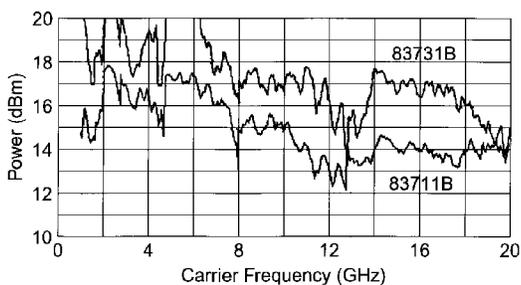
<50 ms to within 1 kHz for any frequency step

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

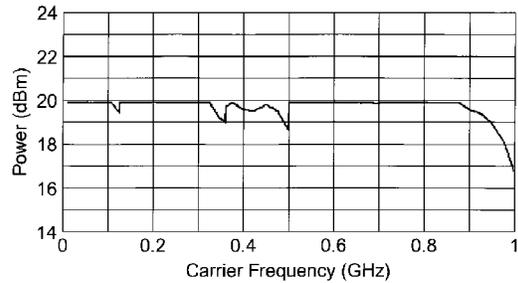
RF Output

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 dBm¹ to maximum specified leveled output power²):

10 MHz to 50 MHz, ± 1.3 dB

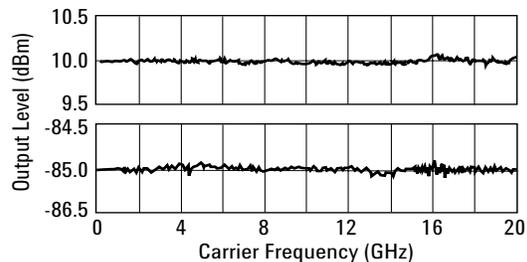
50 MHz to 20 GHz, ± 1.0 dB

Accuracy (over all power levels²):

10 MHz to 50 MHz, ± 2.3 dB (power ≥ -90 dBm)

50 MHz to 20 GHz, ± 2.0 dB (power ≥ -90 dBm)

10 MHz to 20 GHz, ± 2.5 dB (power < -90 dBm)



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

Flatness:

± 0.5 dB² (power ≥ -90 dBm)

± 0.7 dB² (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

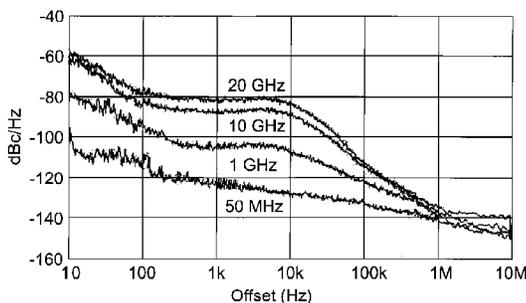
Entry modes: power meter, GPIB

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.

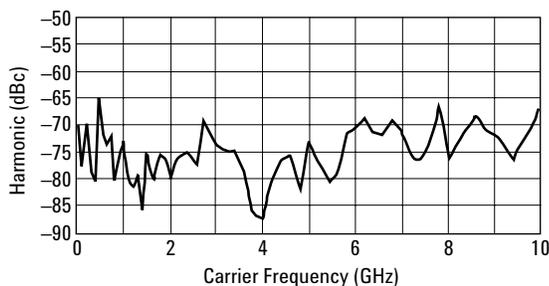


Typical single-sideband phase noise at 50 MHz, 1 GHz, 10 GHz, and 20 GHz, 25°C, CW mode. Offsets less than 100 Hz require the high-stability timebase, Option 1E5.

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

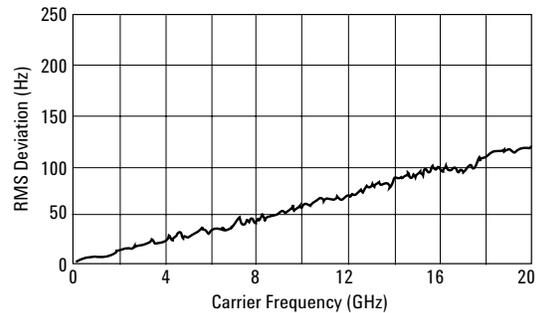
Nonharmonic spurious (≥ 3 kHz): <-60 dBc (includes power supply and frequency synthesis spurious)

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

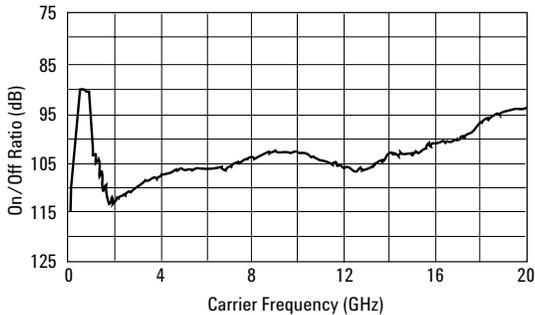
1 to 20 GHz, <-150 dBm/Hz

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 Modulation¹

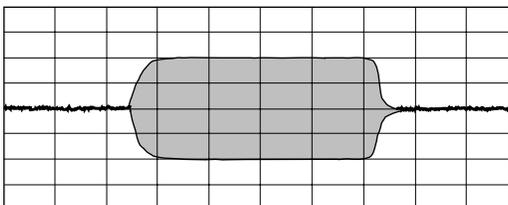
| Carrier Frequency | MHz | | | | GHz | |
|-----------------------------------|-----------------------------|-----------|-------------|-------------|------------------------------|---------|
| | <25 | 25 to <64 | 64 to <128 | 128 to <500 | 500 to <1000 | 1 to 20 |
| Minimum Pulse width | <1 μ s | | <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 | ± 150 ns | | ± 15 ns | | ± 5 ns | |
| Pulse Delay (Video out to RF out) | <1 μ 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: ± 1.0 dB (relative to CW)**
- Pulse overshoot: <10 %**
- Input impedance: 50 Ω 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 ms

Variable pulse delay

Free-run mode (T_d): ± 419 ms

Triggered with delay and doublet modes (T_d):

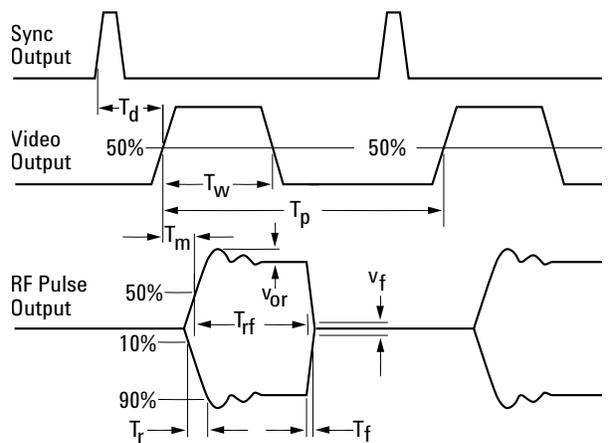
225 ns to 419 ms with ± 25 ns jitter

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_W video pulse width (variable)

T_p pulse period (variable)

T_m RF delay

T_{ff} RF pulse width

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: ± 2 dB

| Frequency | Maximum Deviation ² | 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 Ω 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 |

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

Maximum deviation:²

| 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):

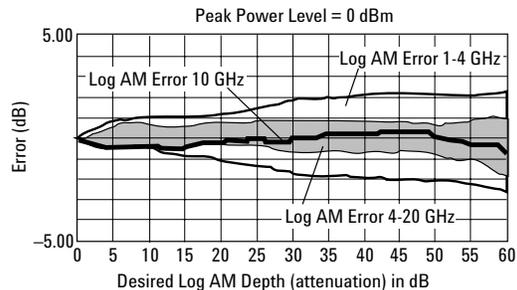
< 1 GHz, < 10 μ s rise time, < 20 μ s fall time

1 to 20 GHz, < 5 μ s rise and fall times

Input impedance: 5000 Ω 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/ Φ 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: ± 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

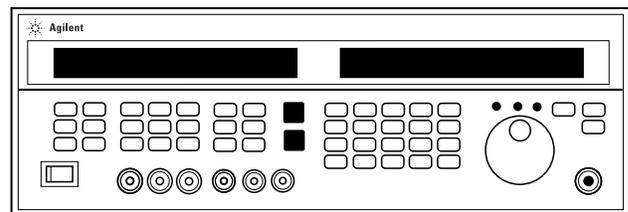
Physical dimensions

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/ Φ 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.

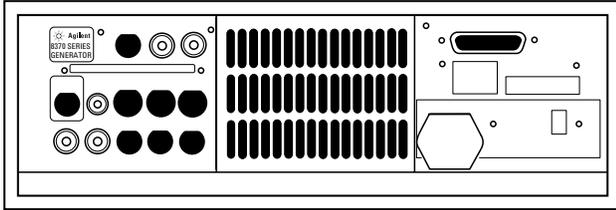
Pulse video out (83731B/83732B only)

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 ± 100 Hz, 0 to 10 dBm, external reference signal for operation from an external high stability timebase. Nominal input impedance is 50 Ω .

10 MHz output

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

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/ Φ M output (Option 1E2 only)

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

Ordering Information:

| Products | Frequency range |
|----------|---|
| 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 |

Options

To add options to a product, use the following ordering scheme:

| | |
|----------------|--|
| Model: | 837xxB (x = 11, 12, 31 or 32) |
| Model Options: | 837xxB-opt#1 837xxB-opt#2 |
| 837xxB-1E1 | Adds 110 dB output step attenuator |
| 837xxB-1E2 | Adds internal modulation generator (83731B/32B only) |
| 837xxB-1E5 | Adds high-stability timebas |
| 837xxB-1E8 | 1 Hz frequency resolution |
| 837xxB-1E9 | 3.5 mm RF output connector |
| 837xxB-800 | Analog phase modulation (83731B/32B only) |
| 837xxB-0B2 | Extra operating manual |
| 837xxB-0BV | Service documentation, component level |
| 837xxB-0BW | Service documentation, assembly level |
| 837xxB-1CM | Rack mount kit (Part number 5062-3977) |
| 837xxB-1CP | Rack mount and handle kit (Part number 5062-3983) |
| 837xxB-1CR | Rack slide kit (Part number 1494-0059) |

Warranty and Service

For warranty and service of 5 years, please order 60 months of R-51B (quantity = 60). Standard warranty is 36 months.

| | |
|-------|---|
| R-51B | Return-to-Agilent warranty and service plan |
|-------|---|

Calibration¹

For 3 years, order 36 months of the appropriate calibration plan shown below. For 5 years, specify 60 months.

| | |
|-----------|---------------------------------|
| R-50C-001 | Standard calibration |
| R-50C-002 | Standards compliant calibration |

1. Options not available in all countries.

Agilent Technologies' Test and Measurement Support, Services, and Assistance

Agilent Technologies aims to maximize the value you receive, while minimizing your risk and problems. We strive to ensure that you get the test and measurement capabilities you paid for and obtain the support you need. Our extensive support resources and services can help you choose the right Agilent products for your applications and apply them successfully. Every instrument and system we sell has a global warranty. Two concepts underlie Agilent's overall support policy: "Our Promise" and "Your Advantage."

Our Promise

Our Promise means your Agilent test and measurement equipment will meet its advertised performance and functionality. When you are choosing new equipment, we will help you with product information, including realistic performance specifications and practical recommendations from experienced test engineers. When you use Agilent equipment, we can verify that it works properly, help with product operation, and provide basic measurement assistance for the use of specified capabilities, at no extra cost upon request. Many self-help tools are available.

Your Advantage

Your Advantage means that Agilent offers a wide range of additional expert test and measurement services, which you can purchase according to your unique technical and business needs. Solve problems efficiently and gain a competitive edge by contracting with us for calibration, extra-cost upgrades, out-of-warranty repairs, and on-site education and training, as well as design, system integration, project management, and other professional engineering services. Experienced Agilent engineers and technicians worldwide can help you maximize your productivity, optimize the return on investment of your Agilent instruments and systems, and obtain dependable measurement accuracy for the life of those products.

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