FREQUENCY SYNTHESIZERS

200 Hz to 80 MHz automatic synthesizer

Model 3335A

NEW

HP-IB

Description

Covering a frequency range of 200 Hz - 80 MHz, the 3335A Synthesizer/Level Generator has performance characteristics that make it ideally suited for the telecommunications industry, as well as for traditional synthesizer applications. The 3335A's broad frequency range allows testing of all classes of Frequency Division Multiplex (FDM) equipment as well as R & D and production testing of communications systems or components. It features precision level control, milliHertz resolution across its entire frequency range, high spectral purity, optional frequency stability of $\pm 5 \times 10^{-10}$/day, internal frequency sweep and numerous user conveniences. The 3335A offers full programmability (IEEE Std. 488-1975) as a standard feature for use in automatic test systems.

Microprocessor Power

The 3335A uses a microprocessor which performs the overall control within the instrument. In addition, the microprocessor greatly simplifies operation and provides additional powerful instrument features to include:

- Four modes of internal frequency sweep for precision sweep applications.
- Automatic correction of the output amplitude display for different impedances.
- Internal memory which will store 10 complete instrument front panel settings for rapid recall in repetitive tests.
- Out-of-limits warning for improper parameter entries.
- Arbitrary increment values for digitally stepping the output frequency, amplitude and phase.
- Selection of minimum output amplitude when instrument is turned on to prevent possible damage to the circuit under test.

Internal Storage

Characterizing a device under test often requires a selected number of spot frequencies and amplitudes. For manual testing, this generally means resetting all of the front panel settings every time a change is desired. Not so with the 3335A. Up to 10 different front panel settings (frequency, level, ø incr, etc.) can be stored in internal memory registers. Once stored, the contents of each register can be recalled to reset all front panel controls to the preprogrammed condition, or if desired, only one parameter may be altered. The DISPLAY key allows viewing of register contents without altering the synthesizer output.

Precision Amplitude

Increasing channel capacity of Frequency Division Multiplex (FDM) systems is continually placing more stringent requirements on the testing of transmission parameters. This, in turn, places further demands on test equipment used to design and maintain FDM systems. One such area where new standards of performance are being required is amplitude control. To meet these performance standards, the 3335A incorporates a state-of-the-art attenuator resulting in attenuator accuracies of up to ±0.03 dB over the 80 MHz frequency range. To achieve these accuracies, the attenuator uses thin-film tantalum nitride resistor pads in a coaxial transmission line structure. A true rms leveling loop provides ±0.15 dB flatness over the entire frequency range. For limited frequency applications, the flatness is specified at ±0.07 dB from 1 kHz to 25 MHz. For even greater flatness control or for leveling at the output of a cable, an external leveling input is provided so the output can be leveled with an external DC signal.

Programmability

The 3335A is fully programmable via the Hewlett-Packard Interface Bus (HP-IB), HP's implementation of IEEE Standard 488-1975. This industry-standard interface eliminates mechanical and electrical interface problems and greatly simplifies software development. With the ease of interface, automatic test systems are economically justifiable for limited-volume applications or even one-time tests. Most Hewlett-Packard 9800 Series Programmable Calculators as well as Models 21 MX and 2100 series minicomputers are easily interfaced to the HP-IB.

FREQUENCY SYNTHESIZERS

200 Hz to 80 MHz automatic synthesizer

Model 3335A (cont.)

Manual Tuning with Digital Precision

For applications which require manual frequency tuning, the 3335A with its Rotary Pulse Generator (RPG) provides the optimal solution. This shaft encoder uses a dual optical sensor to digit ally increment (or decrement) the output frequency. Fine or coarse tuning is accomplished simply by selecting the digit to be tuned. The benefit of this type of tuning is that the "analog feel" is preserved while fully realizing the accuracy advantage of precision digital frequency generation.

Frequency Stability

The 3335A synthesizes its output frequency from an internal temperature-controlled crystal oscillator which provides $\pm 1 \times 10^{-8}$/day frequency stability. For even more exacting requirements, an optional high stability crystal with a 24-hour stability of $\pm 5 \times 10^{-10}$ is available. For instant turn-on, the STANDBY position on the power switch leaves power applied to the crystal oven whenever the line cord is plugged in. Also, the 3335A can be phase-locked to any external frequency standard which is a subharmonic of 40 MHz from 1 MHz to 40 MHz.

Automatic Frequency Sweep

The 3335A combines the precision frequency accuracy and stability of a synthesizer with the time-saving convenience of a sweeper. Digital sweeping under the control of the microprocessor overcomes the major drawbacks of analog or ramp sweeping where the noise, non-linearity and inaccuracy of the analog signal is directly translated to the output signal of the sweeper.

Signal Quality

The 3335A features very high spectral purity. Harmonics are specified at greater than 45 dB below the carrier from 200 Hz to 10 MHz, and at 40 dB down for frequencies up to 80 MHz. Non-harmonically related spurious components are specified at greater than 75 dB below the carrier. Integrated phase noise is also better than −70 dB depending on output frequency.

SLMS - Tracking Generator

The 3335A operates as a tracking generator with the HP 3745A/B Selective Level Measuring Set (SLMS) for automatic or semi-automatic tsting of FDM systems. For closed-loop tracking where the 3335A and 3745A/B are in the same location, the frequency of the generator is controlled by the microprocessor in the SLMS. The 3745A/B and 3335A can sweep through any selectable frequency spectrum or cycle through the channels of a multiplex system by calling up the channel frequencies from the FDM plans stored in the memory of the SLMS. The 3335A and 3745A/B can also operate in an open loop tracking mode where they are separated by the system under test. For even more measurement power, the 3335A and 3745A/B can easily be interfaced via the HP-IB

Specifications

Frequency

Range: 200 Hz–80.999 999 999 MHz.
Resolution: 0.001 Hz.
Display: 11 digit LED display in MHz, kHz, or Hz.
Stability (higher stability available with Opt 001): $\pm 1 \times 10^{-8}$/day; $\pm 1 \times 10^{-7}$/month
External frequency reference: the 3335A may be phase-locked with a 100 mV to 1.25 V rms signal that is any subharmonic of 40 MHz from 1 MHz through 40 MHz.
Frequency switching and settling time: <20 ms to within 90° of final phase.

Spectral purity

Harmonic components (relative to fundamental, full output):
200 Hz - 10 MHz: −45 dB.
10 MHz - 80 MHz: −40 dB.
Spurious: all non-harmonically related outputs will be greater than 75 dB below the carrier or −125 dBm, whichever is greater.
Phase noise (30 kHz band, excluding ±1 Hz, centered on the carrier): 9.9 MHz: −63 dB; 20 MHz: −70 dB; 40 MHz: −64 dB; 80 MHz: −58 dB.

Amplitude

Range
50 Ω: +13.01 dBm to −86.98 dBm; 75Ω: +11.25 dBm to −88.74 dBm.
Resolution: 0.01 dB.
Display: 4 digit LED display, automatically corrected for output impedance.
Absolute accuracy (full amplitude at 100 kHz, 10°C to 35°C): ±0.05 dB.
Note: To determine absolute accuracy tolerances at other frequencies or amplitudes, the flatness and attenuator specifications must be added to the above accuracy specification.
Flatness (relative to 100 kHz, full amplitude): 1 kHz - 25 MHz: ±0.07 dB; 200 Hz - 80 MHz: ±0.15 dB.
Attenuator
Range: 98 dB in 2 dB steps.
Accuracy (1 year)

Z_0	ATTENUATION (dB)	FREQUENCY		
		200 Hz	25 MHz	80 MHz
50 Ω	0 to 18	± 0.03 dB		
75 Ω		± 0.04 dB		± 0.15 dB
50 Ω	20 to 58	± 0.07 dB		
75 Ω		± 0.09 dB		± 0.25 dB
50 Ω	60 to 98	± 0.2 dB		
75 Ω		± 0.2 dB		± 0.50 dB

Amplitude switching time: <500 ms to within ±0.02 dB of final value.

Sweep characteristics

Sweep Modes:
Single 10 sec: 10 second single sweep from min. to max. frequency.
Single 50 sec: 50 second single sweep from min. to max. frequency.
Manual: bidirectional sweep, rate and direction controlled by the frequency tuning knob (RPG).
Auto: repetitive sweep from min. to max. frequency at a nominal rate of 125 ms per sweep.
Center frequency: may be set to any frequency from 200 Hz - 80 MHz.
Sweep width: may be set to any width from 1 Hz to 80 MHz provided the resultant sweep does not exceed the 200 Hz - 80 MHz instrument frequency range.
Number of steps: 10 sec., 50 sec., MANUAL: 1000 steps; AUTO (125 ms): 100 steps.
Phase discontinuities: there will be no significant phase discontinuities provided the following breakpoints are not crossed:
200 Hz - <10 MHz: 1 MHz points, e.g. 1 MHz, 2 MHz, etc.
10 MHz - <20 MHz: 250 kHz points, e.g. 10.25 MHz, 10.5 MHz, etc.
20 MHz - <40 MHz: 500 kHz points.
40 MHz–80 MHz: 1 MHz points.

Opt 001 (high stability frequency reference)

Aging rate: $\pm 5 \times 10^{-10}$/day; $\pm 2 \times 10^{-8}$/month; $\pm 1 \times 10^{-7}$/year.
Temperature coefficient: $< 7 \times 10^{-9}$ frequency change (0 to 50°C range).
Warm up: reference will be within 5×10^{-9} of final value 20 minutes after turn-on at 25°C (final value is defined as the frequency 24 hours after turn-on).

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Opt 002/004

For specifications not listed below, refer to standard instrument specifications.

Frequency

Range: 75 Ω: 200 Hz - 80.999 999 999 MHz; 124 Ω: 10 kHz - 10 MHz; 135 Ω: 10 kHz - 2 MHz.
Resolution: .001 Hz.

Spectral purity

Harmonic components [relative to fundamental, full output (75Ω), 0 dBm (124Ω/135Ω)]: 200 Hz-10 MHz: −45 dB; 10 MHz-80 MHz: −40 dB.
Nonharmonic spurious signals (25°C ±10°C):
75Ω: 75 dB below the carrier or −125 dBm, whichever is greater.
124Ω: 75 dB below the carrier or −97 dBm, whichever is greater.
135Ω: 75 dB below the carrier or −100 dBm, whichever is greater.

Amplitude

Range: +11.25 dBm to −88.74 dBm.
Resolution: 0.01 dB.
Flatness (relative to 100 kHz at full amplitude):
75 Ω: 1 kHz - 25 MHz: ±0.07 dB; 200 Hz - 80 MHz: ±0.15 dB
124 Ω: 50 kHz - 10 MHz: ±0.15 dB; 10 kHz - 10 MHz: ±0.40 dB
135 Ω: 10 kHz - 2 MHz: ±0.18 dB
Accuracy at full output (100 kHz, 10°C to 35°C): 75 Ω: ±0.05 dB; 124Ω/135Ω: ±0.10 dB
Amplitude accuracy (includes the effects of flatness and attenuator)

75 Ω

OUTPUT LEVEL (dBm)	200 Hz	1 kHz	25 MHz	80 MHz
+11.25				
− 8.74	± 0.25 dB	± 0.15 dB	± 0.35 dB	
-48.74	± 0.30 dB	± 0.20 dB	± 0.45 dB	
-88.74	± 0.40 dB	± 0.30 dB	± 0.70 dB	

124 Ω

OUTPUT LEVEL (dBm)	10 kHz	50 kHz	10 MHz
+ 11.25			
− 8.74	± 0.60 dB	± 0.35 dB	
− 48.74	± 0.65 dB	± 0.40 dB	
− 70.0*	± 1.1 dB	± 0.85 dB	

135 Ω

OUTPUT LEVEL (dBm)	10 kHz	2 MHz
+ 11.25		
− 8.74	± 0.35 dB	
− 48.74	± 0.40 dB	
− 70.0*	± 0.85 dB	

*Levels down to -88.74 dBm can be selected, however, accuracies are unspecified due to spurious noise floor of -100 dBm.

Outputs

Output Impedances: 75Ω unbalanced, 124Ω balanced, 135Ω balanced
Signal Balance (100 kHz): >60 dB.
Opt 002
75 Ω: commercial equivalent of WECO type 477B (accepts WECO plug 358A).
124Ω: commercial equivalent of WECO type 477B at 16 mm (0.625″) spacings (accepts WECO plug 372A)
135 Ω: commercial equivalent of WECO type 223A at 16 mm (0.625″) spacings (accepts WECO plug 241A).
Opt 004
75 Ω: commercial equivalent of WECO type 560A (accepts WECO plug 439A or 440A).
124 Ω: commercial equivalent of WECO type 560A at 12.7 mm (0.5″) spacings (accepts WECO plug 443A).
135 Ω: commercial equivalent of WECO type 223A at 16 mm (0.625″) spacings (accepts WECO plug 241A).

Opt 003

Frequency

Range: 75 Ω: 200 Hz - 80.999 999 999 MHz; 150Ω: 10 kHz - 2 MHz.
Resolution: .001 Hz.

Spectral purity

Harmonic components [relative to fundamental full output (75Ω), 0 dBm (150Ω)]: 200 Hz-10 MHz: −45 dB; 10 MHz-80 MHz: −40 dB.
Nonharmonic spurious signals
75 Ω: 75 dB below the carrier or −125 dBm, whichever is greater.
150Ω: 75 dB below the carrier or −100 dBm, whichever is greater.

Amplitude

Range: +11.25 to −88.74 dBm.
Resolution: 0.01 dB.
Flatness (relative to 100 kHz at full amplitude): 75 Ω: 1 kHz-25 MHz: ±0.07 dB, 200 Hz-80 MHz: ±0.15 dB; 150 Ω: 10 kHz-2 MHz: ±0.18 dB.
Accuracy at full output (100 kHz, 10°C to 35°C): 75 Ω: ±0.05 dB; 150 Ω: ±0.10 dB.
Amplitude accuracy (includes the effects of flatness and attenuator)

75 Ω

OUTPUT LEVEL (dBm)	200 Hz	1 kHz	25 MHz	80 MHz
+ 11.25				
− 8.75	± 0.25 dB	± 0.15 dB	± 0.35 dB	
− 48.74	± 0.30 dB	± 0.20 dB	± 0.45 dB	
− 88.74	± 0.40 dB	± 0.30 dB	± 0.70 dB	

150 Ω

OUTPUT LEVEL (dBm)	10 kHz	2 MHz
+ 11.25		
− 8.74	± 0.35 dB	
− 48.74	± 0.40 dB	
− 70.0*	± 0.85 dB	

*Levels down to -88.74 dBm can be selected, however accuracies are unspecified due to spurious noise floor of -100 dBm.

Outputs

Output Impedances
75Ω Unbalanced, 150Ω Balanced
Signal Balance (100 kHz): >60 dB
Connectors
75Ω: BNC; 150Ω: Pair of BNC's at 20 mm (0.8 ″) spacings

General

Warm-up Time
Standby to "ON": <20 s to full frequency specifications, <30 min. to full amplitude specifications.
Application of power to "ON": <30 min. to meet amplitude specifications and to be within 1×10^{-7} of final frequency. (final value is defined as the frequency 24 hours after turn-on).
Operating environment
Temperature: 0°C to 55°C.
R.H.: <95%, 0°C to +40°C.
Storage temperature: −40°C to +75°C.
Power: 100/120/220/240 V, +5%, −10%; 48 to 66 Hz; 195 VA.
Weight: net: 18.2 kg. (40 lbs). Shipping: 26.8 kg. (59 lb).
Size: 132.6 H × 425.5 W × 497.8 mm D (5¼″ × 16¾″ × 19⅝″).

Ordering information

	Price
3335A	$7000
Opt 001	add $580
Opt 002	add $300
Opt 003	add $200
Opt 004	add $300

Prices effective in U.S.A. only.