

SIGNAL ANALYZERS

HP 141T Spectrum Analyzer System: 10 MHz to 40 GHz

Models 8555A, 8444A Option 059 & 8445B

- 10 MHz to 18 GHz, external mixing to 40 GHz
- High sensitivity (-125 dBm)
- 100 Hz resolution
- Companion tracking generator to 1.5 GHz



HP 8555A (141T, 8552B) 8444A Opt 059, 8445B

The HP 8555A Tuning Section offers multiband coverage from 10 MHz to 18 GHz. The range can be extended to 40 GHz with the HP 11517A external waveguide mixer (see page 697). The HP 8555A provides high sensitivity (-125 dBm), high resolution (100 Hz) and frequency scans as wide as 8 GHz. The HP 8555A is well suited for measurements necessary during both the design and production phases of microwave devices and systems.

Amplitude Calibration

Absolute amplitude calibration permits accurate amplitude measurements over the range from $+10$ to -125 dBm. The exceptional flatness of the HP 8555A, which is ± 2 dB out to 18 GHz, enhances the accuracy of relative power measurements.

High Sensitivity

With the 100 Hz bandwidth selected, the sensitivity of the HP 8555A is -125 dBm in the fundamental mixing band and -100 dBm in the 4th harmonic band. This sensitivity permits measurements of low level signals. When these signals are close to the noise floor, a video filter of 10 kHz, 100 Hz or 10 Hz can be selected to improve discernability of the signal.

High Resolution/Stability

The low residual FM of the HP 8555A (< 100 Hz p-p) allows a 100 Hz bandwidth to be selected which permits the user to resolve sidebands due to low frequency modulations. The stability of the HP 8555A also allows measurement of the spectral purity of a DUT.



HP 8445B Tracking Preselector

The HP 8445B Tracking Preselector contains a YIG filter which tracks the tuned frequency of the analyzer over the range 1.8 to 18 GHz. The preselector suppresses the image and multiple responses which result from harmonic mixing. The preselector can also reduce distortion and increase dynamic range when signal separation exceeds the preselector bandwidth. For tuned frequencies below 1.8 GHz, a low pass filter prevents image and multiple responses.

An optional LED display provides a readout of marker frequency with 1 MHz resolution.

HP 8444A Option 059 Tracking Generator

The tracking generator provides a leveled, calibrated signal output with a frequency equal to the tuned frequency of the HP 8555A. This enables swept frequency tests such as insertion loss and return loss at frequencies up to 1500 MHz. With the addition of an external frequency counter, precise measurement of frequency is possible.

HP 8555A Specifications—with HP 8552B IF Section

Frequency Specifications

Frequency range: 0.01–40 GHz.

Tuning Range

With internal mixer: 0.01–18.0 GHz.

With external mixer: 12.4–40 GHz.

Harmonic Mixing Mode

Signal identification: not required when preselector is used. The signal identifier allows positive identification of all responses.

Scan Width

Full scan: the width of the scan depends on mixing mode. Scan width = $n \times 2000$ MHz, where n is the mixing mode; e.g. for $n = 2$, scan width is 4 GHz. Maximum scan width full screen is 8 GHz with coaxial mixer. Preselector necessary to make wide scans usable.

Per division: 16 calibrated scan widths from 2 kHz/div to 200 MHz/div in a 2, 5, 10 sequence.

Zero scan: analyzer becomes fixed-tuned receiver.

Frequency Accuracy

Dial accuracy: $n \times (\pm 15 \text{ MHz})$ where n is the mixing mode.

Scan accuracy: frequency error between two points on the display is less than $\pm 10\%$ of the indicated separation.

Stability: residual FM stabilized < 100 Hz peak-to-peak (fundamental mixing).

Noise sidebands: for fundamental mixing. More than 70 dB below CW signal 50 kHz or more away from signal, with 1 kHz IF bandwidth and 100 Hz video filter.

Frequency Drift

Long term drift: at fixed center frequency after 2-hour warm-up (Typical).

Stabilized: ± 3.0 kHz/10 min.

Unstabilized: ± 25 kHz/10 min.

Stabilization range: first LO can be automatically stabilized to internal crystal reference for scan widths of 100 kHz/div or less.

Resolution

Bandwidth range: selectable 3 dB bandwidths from 100 Hz to 300 kHz in a 1, 3, 10 sequence.

Bandwidth shape: approximately gaussian.

Bandwidth selectivity: 11:1 to 20:1 (60 dB/3 dB).

Bandwidth accuracy: individual IF bandwidth 3 dB points calibrated to $\pm 20\%$ (10 kHz bandwidth, $\pm 5\%$).

Amplitude Specifications

Measurement Range

Log reference level: from -60 dBm to $+10$ dBm.

Linear sensitivity: from $0.1 \mu\text{V/div}$ to 100 mV/div .

Sensitivity and frequency response with internal coaxial mixer noise level: specified for 1 kHz bandwidth.

Frequency Response with 10 dB Input Attenuator Setting

Frequency Range (GHz)	Mixing Mode (n)	Average Noise Level (dBm max.)	Frequency Response* (dB max.)
0.01–2.05	1–	–115	± 1.0
1.50–3.55	1–	–117	± 1.0
2.07–6.15	2–	–108	± 1.3
2.60–4.65	1+	–117	± 1.0
4.11–6.15	1+	–115	± 1.0
4.13–10.25	3–	–103	± 1.5
6.17–10.25	2+	–105	± 1.5
6.19–14.35	4–	–95	± 2.0
8.23–14.35	3+	–100	± 2.0
10.29–18.00	4+	–90	± 2.0

*Includes mixer frequency response, RF attenuator frequency response, mixing mode gain variation, RF input VSWR.

Sensitivity and Frequency Response with HP 11517A External Wave-guide Mixer and Appropriate Waveguide Tapers

Average Noise Level 10 kHz Bandwidth (dBm typical)

Frequency Range (GHz)	Mixing Mode (n)	Average Noise Level (dBm)
12.4–18.0	6–	–90
18.0–26.5	6+	–85
26.5–40.0	10+	–75

Frequency response: typically ± 3 dB over 1 GHz frequency scans.

Residual responses: referred to input on fundamental mixing: < -90 dBm.

Display Range

Log: 70 dB, 10 dB/div and 2 dB/div, expanded on a 16 dB display.

Linear: from $0.1 \mu\text{V/div}$ to 100 mV/div in a 1, 2, sequence on an 8-division display.

Spurious Responses Due to Second Harmonic Distortion with Preselector

Frequency Range	Power Incident on Input Mixer	2nd Harmonic Distortion
0.01–1.85 GHz	–40 dBm	–63 dB
1.85–18.0 GHz	0 dBm	–100 dB

Spurious Responses Due to Third Order Intermodulation Distortion with Preselector

Frequency Range	Signal Separation	Power Incident on Input Mixer	Third Order Intermodulation Distortion
0.01–18.0 GHz	> 1 MHz < 20 MHz	–30 dBm	–70 dB
0.01–1.85 GHz	> 70 MHz	–30 dBm	–70 dB
1.85–18.0 GHz	> 70 MHz	0 dBm	–100 dB

Video filter: post detection filter used to average displayed noise. Nominal bandwidths: 10 kHz, 100 Hz, and 10 Hz.

Gain compression: for internal mixer gain compression < 1 dB for -10 dBm peak or average signal level to input mixer. 11517A External Mixer (12.4–40 GHz) gain compression < 1 dB for -15 dBm peak or average signal level to input mixer.

Amplitude Accuracy

IF gain variation with different bandwidth settings: (at 20°C .)

Log: ± 0.5 dB.

Linear: $\pm 5.8\%$

SIGNAL ANALYZERS

HP 141T Spectrum Analyzer System: 10 MHz to 40 GHz

Models 8555A, 8444A & 8445B (cont.)

Amplitude Display

Log: ± 0.25 dB/dB, but not more than ± 1.5 dB over the full 70 dB display range.
Linear: $\pm 2.8\%$ of full 8-division deflection.
Log reference level: accurate to ± 0.2 dB ($\pm 2.3\%$ linear sensitivity).
Log reference level vernier: accurate to ± 0.1 dB (1.2%) in 0, -6, and -12 dB positions; otherwise, ± 0.25 dB ($\pm 2.8\%$).
Input attenuator range: 0-50 dB in 10 dB steps, manual safety lockout for 0 dB position.
Frequency response: typically ± 0.6 dB from 10 MHz to 18 GHz.
Calibrator output: amplitude -30 dBm, ± 0.3 dB. Frequency 30 MHz ± 3 kHz.
Absolute calibration accuracy: overall accuracy is a function of measurement technique. With the appropriate technique, absolute accuracy of ± 1.6 dB (fundamental mixing) and ± 2.6 dB (4th harmonic mixing) is achievable.

Input Characteristics

Input impedance: 50 ohms nominal (0.01-18 GHz).
Reflection coefficient: < 0.13 (1.30 SWR) for 0.01-7.5 GHz; < 0.23 (1.6 SWR) for 7.5-18 GHz.
Maximum input level: peak or average power +13 dBm (1.0 V ac rms) incident on mixer (+30 dBm with Opt 002), +33 dBm incident on input attenuator.
RF input connector: type N female.
LO emission: -10 dBm without preselector, -80 dBm with preselector over recommended operating ranges (10 dB input attenuator setting).

General

Scan time: 16 internal scan rates from 0.1 ms/div to 10 sec/div in a 1, 2, 5 sequence.
Power requirements: 100, 120, 220 240 V +5%,-10%, 50-60 Hz, normally less than 225 watts (varies with plug-in units used).
Weight: net, 16.8 kg (14.9 lb). Shipping, 8.7 kg (19 lb).
Size: 102 H x 226 W x 344 mm D (4" x 8.9" x 13.5").

Specifications with Option 002; Internal Limiter Installed

All specifications are the same as for the standard unit except the following:
Frequency range: 0.1-12.4 GHz, usable over 0.01-18 GHz range.
Maximum Input Level
Continuous: 1 W (+30 dBm).
Pulse: 75 watts peak, pulse width ≤ 1 μ s, 0.001 duty cycle.
Reflection coefficient: < 0.33 (2.0 SWR).
Frequency response (flatness): $< \pm 0.5$ dB degradation in response, 0.1-12.4 GHz.

HP 8445B Tracking Preselector

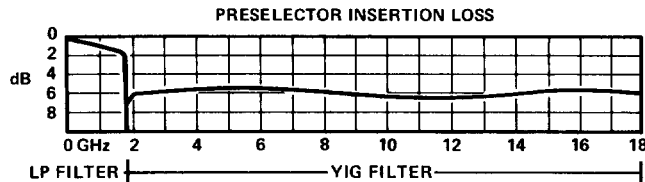
Frequency Specifications

Frequency range: dc-1.8 GHz low-pass filter. 1.8-18 GHz tracking filter.
Tracking filter 3 dB bandwidth: typically 20-45 MHz.
Tracking filter skirt roll-off: characteristics of a three-pole filter. (Nominal: 18 dB/octave.)
Insertion Loss

	Frequency	Insertion Loss (Except Opt. 004)	Insertion Loss (Opt. 004)
Low-Pass Filter	D-1.8 GHz	< 2.5 dB	*
	@2.05 GHz	> 50 dB	*
Tracking Filter	1.8-12 GHz	< 8 dB	< 7 dB
	12-18 GHz	< 10 dB	< 8 dB

*Low-Pass Filter deleted with Opt 004.

Typical Preselector Minimum Insertion Loss at 25°C.



Out-of-band rejection: for YIG filter 1 GHz from center of pass-band > 70 dB.

Digital Frequency Readout (option 003)

Function

Full scan mode: displays frequency at inverted marker.
Per division scan: displays center frequency.
Manual or remote operation of preselector: displays tuned frequency of filter.
Resolution: 1 MHz.
Accuracy: 0.01-1.0 GHz: ± 6 MHz.
 1.0-4.0 GHz: ± 8 MHz.
 4.0-18 GHz: $\pm 0.2\%$

Input Specifications

Input connector: precision Type N female.
Input VSWR: typically < 2.0 (1.8-18 GHz).
Limiting level: (maximum input level for < 1 dB signal compression), $> +5$ dBm.
Damage level: $> +20$ dBm.

General

Remote function: YIG filter frequency can be set by externally supplied voltage.
Power requirements: 100, 120, 220, or 240 V + 5%,-10%, 48 to 440 Hz, less than 110 watts.
Weight: net, 8.8 kg (19.5 lb). Shipping, 11.9 kg (26 lb).
Size: 88.2 H x 425 W x 467 mm D (3.5" x 16.8" x 18.4").

HP 8444A Opt 059 Tracking Generator

Frequency range: 0.5 MHz to 1500 MHz.
Frequency resolution: 1 kHz.
Residual FM (peak-to-peak): 200 Hz (stabilized).
Amplitude Range
Spectrum analyzer display: from -130 dBm to +10 dBm, 10 dB/div on a 70 dB display or 2 dB/div on a 16 dB display (HP 8552B only).
Tracking generator (drive level to test device): 0 to -10 dBm continuously variable.
Amplitude Accuracy
System frequency response: ± 2.7 dB.
Tracking generator calibration: 0 dBm at 30 MHz to ± 0.5 dB.
Dynamic range: > 90 dB.
Counter output: typically 0.1 V rms.

General

Power: 115 V and 230 V, 48 to 440 Hz, 12 watts max.
Weight: net, 7.1 kg (15.6 lb). Shipping, 9.5 kg (21 lb).
Size: 85.2 H x 425 W x 467 mm D (3.5" x 16.8" x 18.4").

Ordering Information

HP 8555A Tuning Section	\$10,920
Opt 001: APC-7 connectors	add \$40
Opt 002: Internal limiter	add \$210
Opt 005: Video tape	add \$105
HP 8445B Tracking Preselector, dc -18GHz	\$5,980
Opt 001: APC-7 connectors	add \$155
Opt 002: Add manual controls	add \$80
Opt 003: Add digital frequency readout	add \$670
Opt 004: Delete low-pass filter	less \$425
Opt 005: Delete interconnect rigid coax	less \$50
HP 8444A Opt 059 Tracking Generator	\$4,760
HP 11517A External Mixer (taper section req'd)	\$450
HP 11518A Taper Section, 12.4 to 18 GHz	\$275
HP 11519A Taper Section, 18 to 26.5 GHz	\$275
HP 11520A Taper Section, 26.5 to 40 GHz	\$275