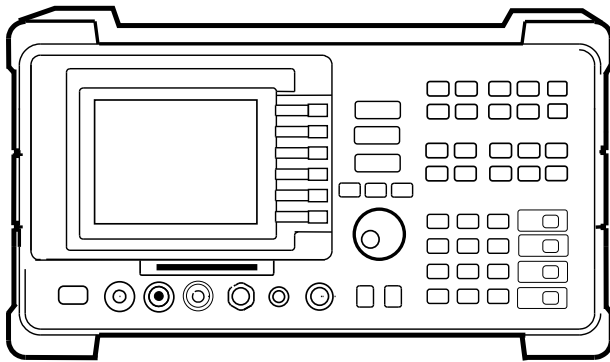


# HP 8590 E-Series Portable Spectrum Analyzers

## Technical Specifications

### Product Specifications and data



These specifications apply to the HP 8591E, 8593E, 8594E, 8595E, and 8596E spectrum analyzers.

### Specifications

All specifications apply over 0°C to +55°C. The analyzer will meet its specifications after 2 hours of storage at a constant temperature, within the operating temperature range, 30 minutes after the analyzer is turned on, and after CAL FREQ and CAL AMPTD (and for the HP 8593E, 8595E, and 8596E CAL YTF) have been run.

### Frequency Specifications

#### Frequency Range

##### HP 8591E

50 Ω	9 kHz to 1.8 GHz
75 Ω	1 MHz to 1.8 GHz

##### HP 8593E

	9 kHz to 22 GHz
Option 026/027	9 kHz to 26.5 GHz

Band	LO harmonic = N	Frequency Range
0	1	9 kHz to 2.9 GHz
1	1	2.75 GHz to 6.5 GHz
2	2	6.0 GHz to 12.8 GHz
3	3	12.4 GHz to 19.4 GHz
4	4	19.1 GHz to 22.0 GHz
4	4 (Opt. 026/027)	19.1 GHz to 26.5 GHz

##### HP 8594E

dc coupled	9 kHz to 2.9 GHz
ac coupled	100 kHz to 2.9 GHz

##### HP 8595E

dc coupled	9 kHz to 6.5 GHz
ac coupled	100 kHz to 6.5 GHz

##### HP 8596E

dc coupled	9 kHz to 12.8 GHz
ac coupled	100 kHz to 12.8 GHz

Band	LO harmonic = N	Frequency Range
0	1	9 kHz to 2.9 GHz (dc coupled)
0	1	100 kHz to 2.9 GHz (ac coupled)
1	1	2.75 GHz to 6.5 GHz
2	2	6.0 GHz to 12.8 GHz

#### Frequency Reference

		(Opt. 004)
Aging	±2 x 10 <sup>-6</sup> /year	±1 x 10 <sup>-7</sup> /year
Temperature Stability	±5 x 10 <sup>-6</sup>	±1 x 10 <sup>-8</sup>
Initial Achievable Accuracy	±0.5 x 10 <sup>-6</sup>	±2.2 x 10 <sup>-8</sup>



**Frequency Readout Accuracy**

(Start, Stop, Center, Marker) ±(frequency readout x frequency reference error<sup>1</sup>+span accuracy +1% of span +20% of RBW+100 Hz x N\*)

**Marker Count Accuracy**

Frequency Span ≤10 MHz x N\* ±(marker frequency x frequency reference error<sup>1</sup>+ counter resolution +100 Hz x N\*)

Frequency Span >10 MHz x N\* ±(marker frequency x frequency reference error<sup>1</sup>+ counter resolution +1 kHz x N\*)

Counter Resolution Frequency Span ≤10 MHz x N\* Selectable from 10 Hz to 100 kHz

Frequency Span >10 MHz x N\* Selectable from 100 Hz to 100 kHz

**Frequency Span Range**

0 Hz (zero span), and

	Opt. 130 Min. (KHz)	Std. Min. (KHz)	Max (GHz)
HP 8591E	1	10	1.8
HP 8593E	1 x N*	10 x N*	19.25
HP 8594E	1	10	2.9
HP 8595E	1	10	6.5
HP 8596E	1 x N*	10 x N*	12.8

Resolution Four digits or 20 Hz x N\* whichever is greater

Accuracy Span ≤10 MHz x N\* ±2% of span  
Span >10 MHz x N\* ±3% of span

**Frequency Sweep Time**

Range Span = 0 Hz, >1 kHz 20 ms to 100 s  
Span = 0 Hz (Opt. 101) 20 μs to 100 s

Accuracy 20 ms to 100 s ±3%  
20 μs to <20 ms (Opt. 101) ±2%

Sweep Trigger Free run, single, line, video, external

**Resolution Bandwidth** 1 kHz to 3 MHz (3 dB) in 1-3-10 sequence.

9 kHz and 120 kHz (6 dB) EMI bandwidths.  
Option 130 Adds 30, 100, and 300 Hz (3 dB) bandwidths and 200 Hz (6 dB) EMI bandwidth.

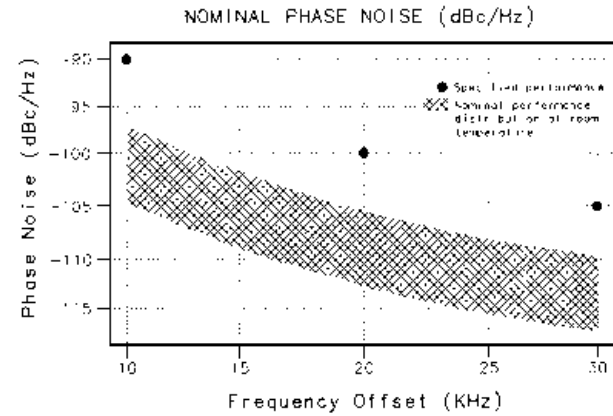
Accuracy ±20%

Selectivity (Characteristic)  
-60 dB/-3 dB  
3 kHz to 10 kHz 15:1  
100 kHz to 3 MHz 15.1  
1 kHz, 30 kHz 16:1  
-40 dB/-3 dB  
30 Hz to 300 Hz 10:1

**Video Bandwidth Range** 30 Hz to 1 MHz in 1,3 sequence  
1 Hz to 1 MHz (Opt 130)

**Stability**

Noise Sidebands (1 kHz RBW, 30 Hz VBW and sample detector)  
>10 kHz offset from CW signal ≤-90 dBc/Hz + 20 Log N\*  
>20 kHz offset from CW signal ≤-100 dBc/Hz + 20 Log N\*  
>30 kHz offset from CW signal <-105 dBc/Hz + 20 Log N\*



**Residual FM**

HP 8591E  
1 kHz RBW, 1 kHz VBW ≤250 Hz pk-pk in 100 ms  
30 Hz RBW, 30 Hz VBW ≤30 Hz pk-pk in 300 ms  
HP 8593E, 94E, 95E, 96E  
1 kHz RBW, 1 kHz VBW ≤(250 x N\*) Hz pk-pk in 100 ms  
30 Hz RBW, 30 Hz VBW ≤(30 x N\*) Hz pk-pk in 300 ms

System-Related Sidebands  
>30 kHz offset from CW signal ≤-65 dBc + 20 Log N\*

**Comb Generator Frequency**

HP 8593E, 96E 100 MHz fundamental frequency  
Accuracy ±0.007%

\* N = LO harmonic. N = 1 for 91E, 94E, 95E

1. Frequency reference error = (aging rate x period of time since adjustment + initial achievable accuracy + temperature stability).

### Amplitude Specifications

Amplitude specifications do not apply for Analog+ mode and negative peak detector mode except as noted in "Amplitude Characteristics."

#### Amplitude Range

	Displayed average noise level to +30 dBm
HP 8591E (Opt. 001)	Displayed average noise level to +72 dBmV

#### Maximum Safe Input Level (input attenuator ≥10 dB)

Average Continuous Power	+30 dBm (1 W)
HP 8591E (Opt. 001)	+72 dBmV (0.2 W)
Peak Pulse Power	
HP 8591E	+30 dBm (1 W)
HP 8591E (Opt. 001)	+72 dBmV (0.2 W)
HP 8593E, 94E, 95E, 96E	+50 dBm (100 W) for < 10 μs pulse width and <1 % duty cycle, input attenuation ≥30 dB.

dc

HP 8591E	25 Vdc
HP 8591E (Opt. 001)	100 Vdc
HP 8593E	0 Vdc
HP 8594E, 95E, 96E	0 V (dc coupled) 50 V (ac coupled)

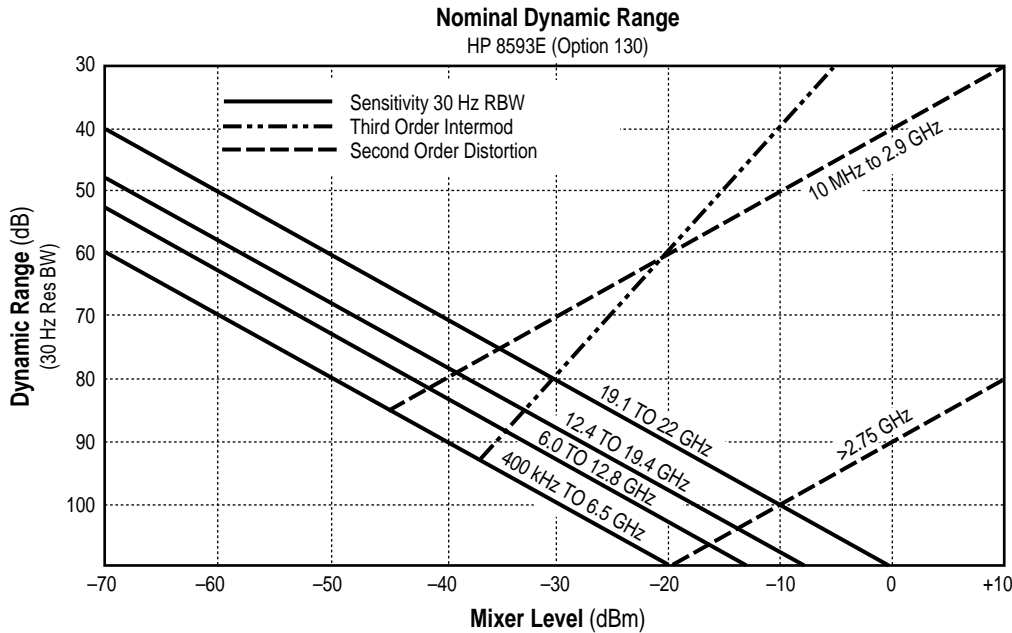
#### Gain Compression

>10 MHz ≤0.5 dB (total power at input mixer<sup>2</sup> = -10 dBm)

### Displayed Average Noise Level

(Input terminated, 0 dB attenuation, 1 Hz/30 Hz VBW, sample-detector)

HP 8591E	30 Hz RBW	1 kHz RBW
400 kHz to 1 MHz	≤-130 dBm	≤-115 dBm
1 MHz to 1.5 GHz	≤-130 dBm	≤-115 dBm
1.5 GHz to 1.8 GHz	≤-128 dBm	≤-113 dBm
HP 8591E (Opt. 001)		
1 MHz to 1.5 GHz	≤-78 dBmV	≤-63 dBmV
1.5 GHz to 1.8 GHz	≤-76 dBmV	≤-61 dBmV
HP 8593E		
400 kHz to 2.9 GHz	≤-127 dBm	≤-112 dBm
2.75 GHz to 6.5 GHz	≤-129 dBm	≤-114 dBm
6.0 GHz to 12.8 GHz	≤-117 dBm	≤-102 dBm
12.4 GHz to 19.4 GHz	≤-113 dBm	≤-98 dBm
19.1 GHz to 22 GHz	≤-107 dBm	≤-92 dBm
HP 8593E (Opt. 026/027)		
19.1 GHz to 26.5 GHz	≤-102dBm	≤-87 dBm
HP 8594E		
400 kHz to <5 MHz	≤-122 dBm	≤-107 dBm
5 MHz to 2.9 GHz	≤-127 dBm	≤-112 dBm
HP 8595E		
400 kHz to 2.9 GHz	≤-125 dBm	≤-110 dBm
2.75 GHz to 6.5 GHz	≤-127 dBm	≤-112 dBm
HP 8596E		
400 kHz to 2.9 GHz	≤-125 dBm	≤-110 dBm
2.75 GHz to 6.5 GHz	≤-127 dBm	≤-112 dBm
6.0 GHz to 12.8 GHz	≤-115 dBm	≤-100 dBm



2. Mixer Power Level (dBm) = Input Power (dBm) - Input Atten. (dB)

**Spurious Responses**

Second Harmonic Distortion 5 MHz to 1.8 GHz (91E)	<-70 dBc for -45 dBm tone at input mixer. <sup>2</sup>
10 MHz to 2.9 GHz (93E)	<-70 dBc for -40 dBm tone at input mixer. <sup>2</sup>
>10 MHz (94E, 95E, 96E)	<-100 dBc for -10 dBm tone at input mixer. <sup>2</sup> (or below displayed average noise level).
>2.75 GHz (93E, 95E, 96E)	
Third Order Intermodulation Distortion	
5 MHz to 1.8 GHz (91E)	<-70 dBc for two -30 dBm tones at input mixer <sup>2</sup> and >50 kHz separation.
>10 MHz (93E, 94E, 95E, 96E)	
Other Input Related Spurious	
≤1.8 GHz (91E)	<-65 dBc at ≥30 kHz offset, for -20 dBm tone at input mixer <sup>2</sup>
≤2.9 GHz (94E)	
≤6.5 GHz (95E)	
≤12.8 GHz (96E)	
≤18 GHz (93E)	
≤22 GHz (93E)	<-60 dBc at ≥30 kHz offset, for -20 dBm tone at input mixer <sup>2</sup>

**Residual Responses** (input terminated and 0 dB attenuation)

1 MHz to 1.8 GHz (91E Opt. 001)	<-38 dBmV
150 kHz to 1.8 GHz (91E)	<-90 dBm
150 kHz to 2.9 GHz (94E)	<-90 dBm
150 kHz to 6.5 GHz (93E, 95E, 96E)	<-90 dBm

**Display Range**

Log Scale	0 to -70 dB from reference level is calibrated; 0.1, 0.2, 0.5 dB/division and 1 to 20 dB/division in 1 dB steps; eight divisions displayed.
Linear Scale	Eight divisions
Scale units	dBm, dBmV, dBuV, V, and W

**Marker Readout Resolution** 0.05 dB for log scale

	0.05% of reference level for linear scale
Fast Sweep Times for Zero Span (Opt. 101 or 301)	
20 μs to 20 ms	
≤1 GHz	0.7% of reference level for linear scale
>1 GHz	1.0% of reference level for linear scale

**Reference Level**

Range	same as amplitude range
Resolution	0.1 dB for log scale, 0.12% of reference level for linear scale
Accuracy	±0.3 dB @ -20 dBm
0 dBm to -59.9 dBm	±(0.3 dB +.01 x dB from -20 dBm)

**Frequency Response**

	(10 dB input attenuation)	
<i>HP 8591E</i>	Absolute <sup>3</sup>	Relative Flatness <sup>4</sup>
9 kHz to 1.8 GHz	±1.5 dB	±1.0 dB
<i>HP 8593E</i>	Preselector peaked in band > 0	
	Absolute <sup>3</sup>	Relative Flatness <sup>4</sup>
9 kHz to 2.9 GHz	±1.5 dB	±1.0 dB
2.75 GHz to 6.5 GHz	±2.0 dB	±1.5 dB
6.0 GHz to 12.8 GHz	±2.5 dB	±2.0 dB
12.4 GHz to 19.4 GHz	±3.0 dB	±2.0 dB
19.1 GHz to 22 GHz	±3.0 dB	±2.0 dB
19.1 GHz to 26.5 GHz	±5.0 dB	±2.0 dB
<i>HP 8594E, 95E, 96E</i>	(dc coupled preselector peaked)	
	Absolute <sup>3</sup>	Relative Flatness <sup>4</sup>
9 kHz to 2.9 GHz	±1.5 dB	±1.0 dB
2.75 GHz to 6.5 GHz	±2.0 dB	±1.5 dB
6.0 GHz to 12.8 GHz	±2.5 dB	±2.0 dB

**Calibrator Output**

Amplitude	-20 dBm ±0.4 dB
<i>HP 8591E Opt.001</i>	+28.75 dBmV ±0.4 dB

**Resolution Bandwidth Switching Uncertainty**

(Referenced to 3 kHz RBW, at ref. level)

3 kHz to 3 MHz RBW	±0.4 dB
1 kHz RBW	±0.5 dB
30 Hz to 300 Hz RBW	±0.6 dB

**Linear to Log Switching** ±0.25 dB at reference level**Display Scale Fidelity**

Log Maximum Cumulative	0 to -70 dB from reference level
3 kHz to 3 MHz RBW	± (0.3 + 0.01 x dB from reference level)
30 Hz to 1kHz RBW	± (0.4 + 0.01 x dB from reference level)
Log Incremental Accuracy	±0.4 dB/4 dB
	0 to -60 dB from reference level
Linear Accuracy	±3% of reference level

**Option Specifications****Option 010 and 011 Tracking Generator****Frequency Range**

<i>HP 8591E</i>	100 kHz to 1.8 GHz
<i>(Opt. 011, 75 Ω)</i>	1 MHz to 1.8 GHz
<i>HP 8593E, 94E, 95E, 96E</i>	9 kHz to 2.9 GHz

3. Referenced to 300 MHz CAL OUT.

4. Ref. to midpoint between highest and lowest freq. response deviations.

**Output Level**

## Range

<i>HP 8591E</i>	0 to -70 dBm
<i>HP 8591E (Opt. 011)</i>	+42.8 to -27.2 dBmV
<i>HP 8593E, 94E, 95E, 96E</i>	-1 to -66 dBm

Resolution 0.1 dB

## Absolute Accuracy

(@ 300 MHz, -20 dBm, +28.8 dBmV)

<i>HP 8591E</i>	±1.0 dB
<i>HP 8593E, 94E, 95E, 96E</i>	±0.75 dB

**Vernier**

## Range

<i>HP 8591E</i>	10 dB
<i>HP 8593E, 94E, 95E, 96E</i>	9 dB

## Accuracy

<i>HP 8591E</i>	±0.75 dB
<i>HP 8593E, 94E, 95E, 96E</i>	±0.5 dB

**Output Attenuator**

## Range

<i>HP 8591E</i>	0 to 60 dB, 10 dB steps
<i>HP 8593E, 94E, 95E, 96E</i>	0 to 56 dB, 8 dB steps

**Output Flatness**

<i>HP 8591E</i>	±1.75 dB
<i>HP 8593E, 94E, 95E, 96E</i> (>10 MHz)	±2.0 dB

**Effective Source Match** (Characteristic)

<i>HP 8591E</i>	1.6:1 (10 dB attenuation)
<i>HP 8593E, 94E, 95E, 96E</i>	1.5:1 (8 dB attenuation)

**Spurious Output**

## Harmonic Spurs

<i>HP 8591E</i> (0 dBm, +42.8 dBmV output)	<-25 dBc
<i>HP 8593E, 94E, 95E, 96E</i> (-1 dBm Output)	

## Nonharmonic Spurs

<i>HP 8591E</i>	<-30 dBc
<i>HP 8593E, 94E, 95E, 96E</i> 300 kHz to 2.0 GHz	≤-27 dBc
2.0 GHz to 2.9 GHz	≤-23 dBc

**Dynamic Range** (Characteristic)

	Dynamic Range <sup>5</sup>	TG Feedthrough
<i>HP 8591E</i>	106 dB	≤-106 dBm
<i>HP 8591 E (Opt. 011)</i>	100 dB	≤-57.24 dBmV
<i>HP 8593E (&gt; 400 kHz)</i>	111 dB	≤-112 dBm
<i>HP 8594E (&gt; 400 kHz)</i>	106 dB	≤-107 dBm
(> 5 MHz)	111 dB	≤-112 dBm
<i>HP 8595E (&gt;400 kHz)</i>	109 dB	≤-110 dBm
<i>HP 8596E (&gt; 400 kHz)</i>	109 dB	≤-110 dBm

5. Maximum output level minus TG feedthrough.

6. Up to 1 V<sub>s</sub> jitter due to 1 μs resolution of gate delay clock.

7. With GATE ON enabled and triggered, CW Signal, Peak Detector Mode.

**Power Sweep**

## Range

<i>HP 8591E</i>	(-15 dBm to 0 dBm) -(source attenuator setting)
<i>HP 8591E (Opt 011)</i>	(+27.8 to 42.8 dBmV)-(source attenuator setting)
<i>HP 8593E, 94E, 95E, 96E</i>	(-10 dBm to -1 dBm)-(source attenuator setting)

Resolution 0.1 dB

**Option 103 Quasi-Peak Detector**

Amplitude response conforms with Publication 16 of Comité International Spécial des Perturbations Radioélectriques (CISPR) Section 1, Clause 2.

**Option 105 Time Gated Spectrum Analysis****Gate Delay**

Range	1 μs to 65.535 ms
Resolution	1 μs
Accuracy	±(1 μs + 0.01% x Gate Delay Readout) <sup>6</sup> (From Gate Trigger Input to positive edge of Gate Output)

**Gate Length**

Range	1 μs to 65.535 ms
Resolution	1 μs
Accuracy	±(0.2 μs + (0.01% x Gate Length Readout))

(From positive edge to negative edge of Gate Output)

**Additional Gate Amplitude Error<sup>7</sup>**

Log Scale	<2 μs	±0.8 dB
	≥2 μs	±0.5 dB

**General Specification****Temperature Range**

Operating	0°C to +55°C
Storage	-40°C to +75°C

**EMI Compatibility**

Conducted and radiated interference CISPR Pub. 11 and Messempefaenger Postverfuegung 526/527/79.

**Audible Noise**

<37.5 dBa pressure and <5.0 Bels power (ISODP7779)

**Power Requirements**

ON (Line 1)	90 to 132 V rms, 47 to 440 Hz 195 to 250 V rms, 47 to 66 Hz Power consumption <500 VA; <180W
Standby (Line 0)	Power consumption <7 W

**User Program Memory**

238 Kbytes non-volatile RAM

**Data Storage** (nominal)

Internal	24 traces or 32 states
External	50 traces, 8 states
Memory card (HP 85700A)	32 Kbytes

## Inputs/Outputs

### Front Panel Connectors

Input	50 $\Omega$ Type N
(Opt 001)	75 $\Omega$ BNC female
(Opt 026)	APC 3.5 mm male
(Opt 027)	50 $\Omega$ Type N female
Cal Output	50 $\Omega$ BNC, -20 dBm, 300 MHz
100 MHz Comb Out	100 MHz $\pm$ 0.007%, SMA
Probe Power	+15 Vdc, -12.6 Vdc, and Gnd (150mA max each)

### Rear Panel Connectors

Earphone (Opt 102 and 103)	1/8 inch monaural jack
LO Output (Opt 009)	50 $\Omega$ SMA Female, 3.0 to 6.8214 GHz
TV Trigger Output (Opt 101 and 102)	BNC, TTL levels, negative edge trigger after sync pulse
Gate Trigger Input (Opt 105)	50 $\Omega$ BNC, Pulsewidth >30 ns (TTL)
Gate Output (Opt 105)	50 $\Omega$ BNC (TTL)
SWEEP + Tune Output (Opt 009)	2 k $\Omega$ BNC, 0 to +10V, 0.36V/GHz of CF -66 dBV to +6 dBV
Ext. ALC Input 1 MW, Sweep Output	BNC, 5 k W, 0 to +10 V ramp
High Sweep In/Out	BNC, high TTL = sweep, low TTL = Retrace
Aux Video Out	50 $\Omega$ BNC, 0-1 V Uncalibrated
Aux IF Output	50 $\Omega$ BNC, -10 to -60 dBm, 21.4 MHz
Keyboard (Opt. 041 or 043)	5 Pin mini-DIN, compatible with HP C1405B and most IBM/AT keyboards
Ext. Trigger Input	BNC, TTL levels, positive edge trigger
HPiB and Parallel (Opt 041)	SH1, AH1, T6, L4, ST1, RL1, PPO, DC1, C1 C2, C3, & C28 and 25 Pin subminiature D-shell female for parallel
RS-232 and Parallel (Opt 043)	9 Pin subminiature D-shell female and 25 Pin subminiature D-shell female for parallel
Ext Ref In	50 $\Omega$ BNC, 10 MHz, -2 to +10 dBm
10 MHz Ref Output	50 $\Omega$ BNC, 10 MHz, 0 dBm
Aux Interface	9 pin 'D' subminiature Pin 1-4, TTL Output Pin 5 TTL Input Pin 6 Gnd Pin 7 -15 vdc $\pm$ 5%; 150 mA max Pin 8 +5 vdc $\pm$ 5%; 150 mA max Pin 9 +15vdc $\pm$ 5%; 150 mA max
Monitor Out	50 $\Omega$ BNC,
Selectable Format	NTSC, 15.75 kHz, 60 Hz PAL, 15.625 kHz, 50 Hz

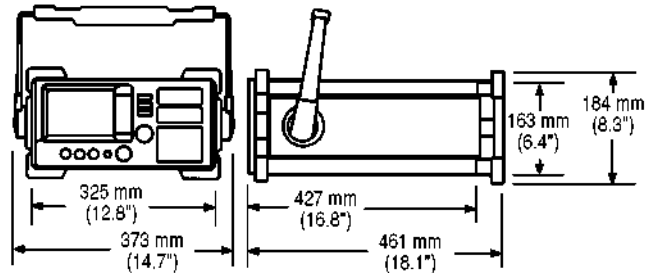
### Dimensions (Nominal)

(Without handle, feet,  
or cover) 163 mm (H) x 325 mm (W)  
x 427 mm (D)

(Overall) 184 mm (H) x 373 mm (W)  
X 461 mm (D)

### Weight (Nominal)

HP 8591E	15.4 kg (34 lb)
HP 8593E	16.4 kg (36 lb)
HP 8594E	16.4 kg (36 lb)
HP 8595E	16.4 kg (36 lb)
HP 8596E	16.4 kg (36 lb)



## Literature Reference Index

### General Purpose Information

HP 8590L and HP 8592L Product Overview	5962-7275E
HP 8590C/E/L and EM Series Configuration Guide	5963-6858E
HP 8590 E-Series Brochure	5963-6908E

### Product Feature Briefs

Analog + Display	5091-4054E
Transmitter Power Measurements (ACP, OBW)	5091-4055E
Zoom Window	5091-4051E
Measuring AM with FFT	5091-4049E
Time Gated Spectrum Analysis	5091-4053E
Editing Keyboard	5091-4048E
Marker and Peaks Table	5091-4050E
Third Order Intermodulation, N & B Bandwidth and Percent AM	5091-4052E

### Product Notes

Time-Gated Spectrum Analysis (HP 8590-2)	5952-3685
Analog + Display	5091-2364E
Maximizing Accuracy in Noise Figure Measurements (HP 85791-1)	5091-4801E

### Application Notes

Spectrum Analysis Basics (150)	5952-0292
Amplitude and Frequency Modulation (150-1)	5954-9130

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