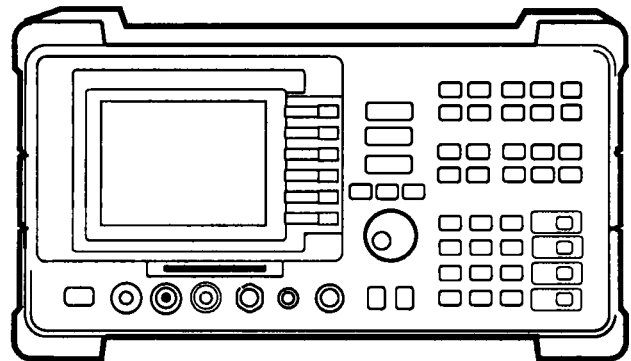


# Agilent 8590 E-Series Portable Spectrum Analyzers

Data Sheet



These specifications apply to the Agilent Technologies 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 tuned on, and after CAL FREQ and CAL AMPTD (and for the 8593E, 8595E, and 8596E CAL YTF) have been run.

## Frequency Specifications

### Frequency Range

8591E

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

8593E

9 kHz to 22 GHz

Option 026/027 9 kHz to 26.5 GHz

Band	LO harmonic = N	
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

8594E

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

8595E

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

8596E

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

Band	LO harmonic = N	
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	$\pm 2 \times 10^{-6}$ /year	$\pm 1 \times 10^{-7}$ /year
Temperature Stability	$\pm 5 \times 10^{-6}$	$\pm 1 \times 10^{-8}$
Initial Achievable Accuracy	$\pm 0.5 \times 10^{-6}$	$\pm 2.2 \times 10^{-8}$



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### Frequency Readout

#### Accuracy

(Start, Stop, Center, Marker)  $\pm(\text{frequency readout} \times \text{frequency reference error}^1 + \text{span accuracy} + 1\% \text{ of span} + 20\% \text{ of RBW} + 100 \text{ Hz} \times N^*)$

### Marker Count Accuracy

Frequency Span  $\leq 10 \text{ MHz} \times N^*$   $\pm(\text{marker frequency} \times \text{frequency reference error}^1 + \text{counter resolution} + 100 \text{ Hz} \times N^*)$

Frequency Span  $> 10 \text{ MHz} \times N^*$   $\pm(\text{marker frequency} \times \text{frequency reference error}^1 + \text{counter resolution} + 1 \text{ kHz} \times N^*)$

Counter Resolution  
Frequency Span  $\leq 10 \text{ MHz} \times N^*$  Selectable from 10 Hz to 100 kHz

Frequency Span  $> 10 \text{ MHz} \times N^*$  Selectable from 100 Hz to 100 kHz

### Frequency Span

Range 0 Hz (zero span), and

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

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

Accuracy  
Span  $\leq 10 \text{ MHz} \times N^*$   $\pm 2\%$  of span  
Span  $> 10 \text{ MHz} \times N^*$   $\pm 3\%$  of span

### Frequency Sweep Time

Range  
Span = 0 Hz,  $> 1 \text{ kHz}$  20 ms to 100 s  
Span = 0 Hz (Opt. 101) 20  $\mu\text{s}$  to 100 s

Accuracy  
20 ms to 100 s  $\pm 3\%$   
20  $\mu\text{s}$  to  $< 20 \text{ ms}$  (Opt. 101)  $\pm 2\%$

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.

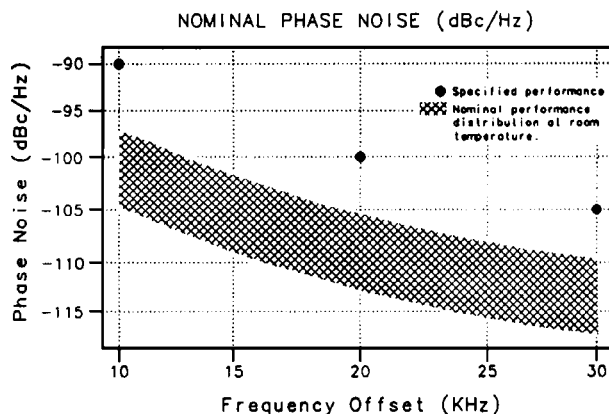
Accuracy  $\pm 20\%$

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)  
 $> 10 \text{ kHz}$  offset from CW signal  $\leq -90 \text{ dBc/Hz} + 20 \text{ Log } N^*$   
 $> 20 \text{ kHz}$  offset from CW signal  $\leq -100 \text{ dBc/Hz} + 20 \text{ Log } N^*$   
 $> 30 \text{ kHz}$  offset from CW signal  $< -105 \text{ dBc/Hz} + 20 \text{ Log } N^*$



### Residual FM

8591E  
1 kHz RBW, 1 kHz VBW  $\leq 250 \text{ Hz}$  pk-pk in 100 ms  
30 Hz RBW, 30 Hz VBW  $\leq 30 \text{ Hz}$  pk-pk in 300 ms

8593E, 94E, 95E, 96E  
1 kHz RBW, 1 kHz VBW  $\leq (250 \times N^*) \text{ Hz}$  pk-pk in 100 ms

30 Hz RBW, 30 Hz VBW  $\leq (30 \times N^*) \text{ Hz}$  pk-pk in 300 ms

System-Related Sidebands  
 $> 30 \text{ kHz}$  offset from CW signal  $\leq -65 \text{ dBc} + 20 \text{ Log } N^*$

### Comb Generator Frequency

8593E, 96E 100 MHz fundamental frequency  
Accuracy  $\pm 0.007\%$

\* 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
8591E (Opt. 001)	Displayed average noise level to +72 dBmV
<b>Maximum Safe Input Level</b>	(input attenuator $\geq 10$ dB)
Average Continuous Power	+30 dBm (1 W)
8591E (Opt. 001)	+72 dBmV (0.2 W)
Peak Pulse Power	
8591E	+30 dBm (1 W)
8591E (Opt. 001)	+72 dBmV (0.2 W)
8593E, 94E, 95E, 96E	+50 dBm (100 W) for < 10 $\mu$ s pulse width and < 1 % duty cycle, input attenuation $\geq 30$ dB.
dc	
8591E	25 Vdc
8591E (Opt. 001)	100 Vdc
8593E	0 Vdc
8594E, 95E, 96E	0 V (dc coupled) 50 V (ac coupled)

### Gain Compression

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

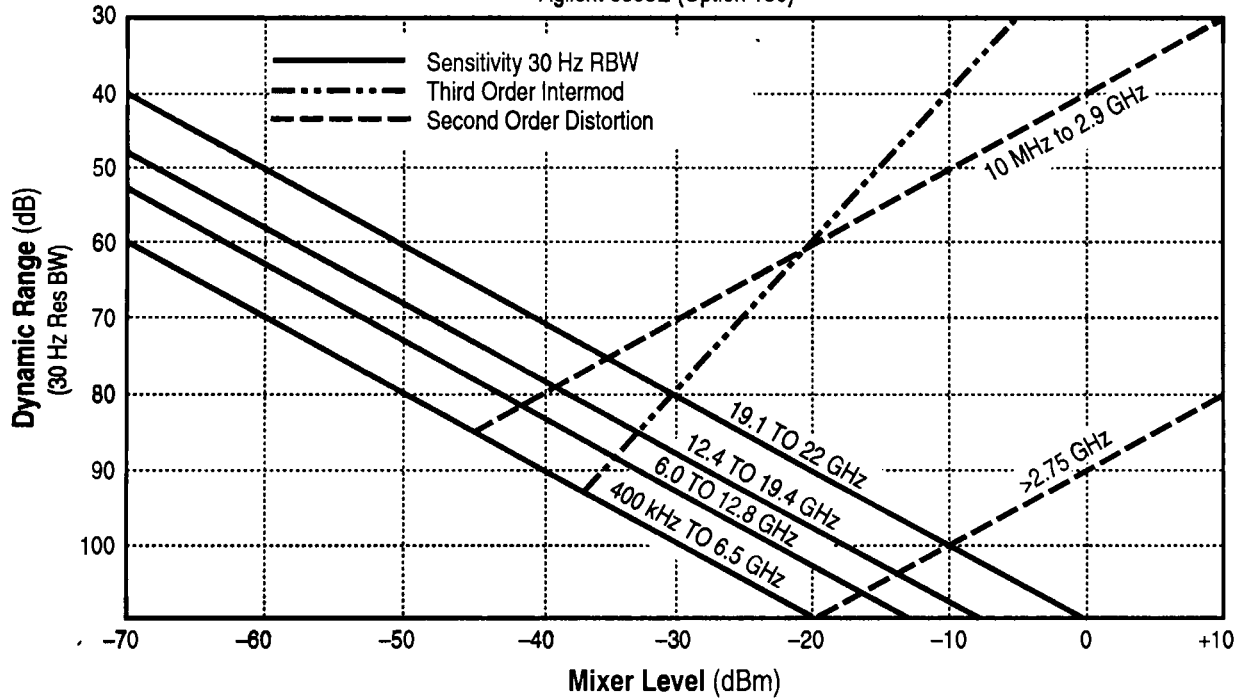
## Displayed Average Noise Level

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

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

## Nominal Dynamic Range

Agilent 8593E (Option 130)



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

<b>Marker Readout Resolution</b>	0.05 dB for log scale 0.05% of reference level for linear scale
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### 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 ±(0.3 dB +.01 x dB from -20 dBm)
	0 dBm to -59.9 dBm

## Frequency Response

	(10 dB input attenuation)
<i>8591E</i>	Absolute <sup>3</sup> Relative Flatness <sup>4</sup>
9 kHz to 1.8 GHz	±1.5 dB      ±1.0 dB
<i>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>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>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

<b>Linear to Log Switching</b>	±0.25 dB at reference level
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## 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

3. Referenced to 300 MHz CAL OUT.

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

## Option Specifications

### Option 010 and 011 Tracking Generator

#### Frequency Range

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

#### Output Level

Range	
8591E	0 to -70 dBm
8591E (Opt. 011)	+42.8 to -27.2 dBmV
8593E, 94E, 95E, 96E	-1 to -66 dBm
Resolution	0.1 dB
Absolute Accuracy	
(@ 300 MHz, -20 dBm, +28.8 dBmV)	
8591E	±1.0 dB
8593E, 94E, 95E, 96E	±0.75 dB

#### Vernier

Range	
8591E	10 dB
8593E, 94E, 95E, 96E	9 dB
Accuracy	
8591E	±0.75 dB
8593E, 94E, 95E, 96E	±0.5 dB

#### Output Attenuator

Range	
8591E	0 to 60 dB, 10 dB steps
8593E, 94E, 95E, 96E	0 to 56 dB, 8 dB steps

#### Output Flatness

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

#### Effective Source Match (Characteristic)

8591E	1.6:1 (10 dB attenuation)
8593E, 94E, 95E, 96E	1.5:1 (8 dB attenuation)

#### Spurious Output

Harmonic Spurs	
8591E	
(0 dBm, +42.8 dBmV output)	<-25 dBc
8593E, 94E, 95E, 96E	
(-1 dBm Output)	
Nonharmonic Spurs	
8591E	<-30 dBc
8593E, 94E, 95E, 96E	
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
8591E	106 dB	≤-106 dBm
8591E (Opt. 011)	100 dB	≤-57.24 dBmV
8593E (> 400 kHz)	111 dB	≤-112 dBm
8594E (> 400 kHz)	106 dB	≤-107 dBm
(> 5 MHz)	111 dB	≤-112 dBm
8595E (>400 kHz)	109 dB	≤-110 dBm
8596E (> 400 kHz)	109 dB	≤-110 dBm

#### Power Sweep

Range	
8591E	(-15 dBm to 0 dBm) -(source attenuator setting)
8591E (Opt 011)	(+27.8 to 42.8 dBmV)-(source attenuator setting)
8593E, 94E, 95E, 96E	(-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 Specifications

##### Temperature Range

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

##### EMI Compatibility

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

##### Audible Noise

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

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 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 (85700A) 32 Kbytes

**Inputs/Outputs**

**Front Panel Connectors**

Input 50 Ω Type N  
 (Opt 001) 75 Ω BNC female  
 (Opt 026) APC 3.5 mm male  
 (Opt 027) 50 Ω Type N female  
 Cal Output 50 Ω BNC, -20 dBm, 300 MHz  
 100 MHz Comb Out 100 MHz ±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 Ω SMA Female, 3.0 to 6.8214 GHz  
 TV Trigger Output BNC, TTL levels, negative edge  
 (Opt 101 and 102) trigger after sync pulse  
 Gate Trigger Input (Opt 105) 50 Ω BNC, Pulswidth >30 ns (TTL)  
 Gate Output (Opt 105) 50 Ω BNC (TTL)  
 SWEEP + Tune Output 2 k Ω BNC, 0 to +10V,  
 (Opt 009) 0.36V/GHz of CF  
 -66 dBV to +6 dBV  
 Ext. ALC Input 1 MW, BNC, 5 k W, 0 to +10 V ramp  
 Sweep Output BNC, high TTL = sweep,  
 High Sweep In/Out low TTL = Retrace  
 Aux Video Out 50 Ω BNC, 0-1 V Uncalibrated  
 Aux IF Output 50 Ω 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 key boards  
 Ext. Trigger Input BNC, TTL levels, positive edge trigger  
 GPIB 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 Ω BNC, 10 MHz, -2 to +10 dBm  
 10 MHz Ref Output 50 Ω 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 ±5%; 150 mA max  
 Pin 8 +5 vdc ±5%; 150 mA max  
 Pin 9 +15 vdc ±5%; 150 mA max  
 50 Ω BNC,  
 Monitor Out NTSC, 15.75 kHz, 60 Hz  
 Selectable Format 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)

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

