# Specifications

**All specifications apply over 0 °C to +55 °C. The analyzer will meet its specifications five minutes after it is turned on, when the analyzer is within one year of calibration cycle, after two hours of storage within the operating temperature range, and Auto Align All is selected. *ITALICS = supplemental information, characteristics, typical performance, or nominal values.***

## Frequency specifications

**Frequency range**

| | | |
|---|---|---|
| E4411B | | |
| 50 Ω | | 9 kHz to 1.5 GHz |
| 75 Ω(Opt. 1DP) | | 1 MHz to 1.5 GHz |
| E4403B | | 9 kHz to 3.0 GHz |
| E4408B | | 9 kHz to 26.5 GHz |
| Band | LO harmonic = N | |
| 0 | 1 | 9 kHz to 3.0 GHz |
| 1 | 1 | 2.85 GHz to 6.7 GHz |
| 2 | 2 | 6.2 GHz to 13.2 GHz |
| 3 | 4 | 12.8 GHz to 19.2 GHz |
| 4 | 4 | 18.7 GHz to 26.5 GHz |

**Frequency reference**

| | |
|---|---|
| Aging rate | $\pm 2 \times 10^{-6}$/year, *$\pm 1.0 \times 10^{-7}$/day, characteristic* |
| Settability | $\pm 5 \times 10^{-7}$ |
| Temperature stability | $\pm 5 \times 10^{-6}$ |

**Frequency readout accuracy**

| | |
|---|---|
| (Start, Stop, Center, Marker) | ±(frequency readout x frequency reference error[1] + 0.75% of span + 15% of RBW + 10 Hz + 1Hz x $N^2$) |

**Marker frequency counter**

| | |
|---|---|
| Accuracy | ±(marker frequency x frequency reference error[1] + counter resolution) |
| Resolution | Selectable from 1 Hz to 100 kHz |

**Frequency span**

| | |
|---|---|
| Range | 0 Hz (zero span), and |
| E4411B | 100 Hz to 1.5 GHz |
| E4403B | 100 Hz to 3.0 GHz |
| E4408B | 100 Hz to 26.5 GHz |
| Resolution | 2 Hz x $N^2$ |
| Accuracy | ±1% of span |

**Sweep time**

| | |
|---|---|
| Range | 4 ms to 4000 sec. |
| Accuracy | ±1% |
| Sweep trigger | Free Run, single, line, video, offset, delayed trigger, and external |
| Offset trigger range | ± 327 ms to ± 323 Ks |
| Sweep (trace) points | 401 |

**Resolution bandwidth**

| | | |
|---|---|---|
| Range | (–3 dB bandwidth) | 1 kHz to 3 MHz in 1-3-10 sequence and 5 MHz |
| | (–6 dB bandwidth) | 9 kHz and 120 kHz |
| Accuracy | | |
| 1 kHz to 3 MHz RBW | | ±15% |
| 5 MHz RBW | | ±30% |
| Selectivity | | |
| 60 dB/3 dB bandwidth ratio | | *<15:1, characteristic* |

**Video bandwidth range**

| | |
|---|---|
| (–3 dB bandwidth) | 30 Hz to 1 MHz in 1-3-10 sequence, *3 MHz, characteristic* |

**Stability**

| | |
|---|---|
| Noise sidebands (1 kHz RBW, 30 Hz VBW and sample detector)E4411B | |
| ≥10 kHz offset from CW signal | ≤–90 dBc/Hz |
| ≥20 kHz offset from CW signal | ≤–100 dBc/Hz |
| ≥30 kHz offset from CW signal | ≤–102 dBc/Hz |
| ≥100 kHz offset from CW signal | ≤–112 dBc/Hz |
| E4403B, E4408B | |
| ≥10 kHz offset from CW signal | ≤–90 dBc/Hz + (20 Log $N^2$ for frequencies > 6.7 GHz) |
| ≥20 kHz offset from CW signal | ≤–98 dBc/Hz + 20 Log $N^2$ |
| ≥30 kHz offset from CW signal | ≤–100 dBc/Hz + 20 Log $N^2$ |
| ≥100 kHz offset from CW signal | ≤–112 dBc/Hz + 20 Log $N^2$ |
| Residual FM | |
| 1 kHz RBW, 1 kHz VBW | ≤150 Hz peak-to-peak x $N^2$ in 100 ms |
| System-related sidebands | |
| ≥30 kHz offset from CW signal | ≤–65 dBc + (20 Log $N^2$ for frequencies > 6.7 GHz) |

## Amplitude specifications

**Absolute amplitude accuracy**

| | |
|---|---|
| Overall amplitude accuracy[3] 20 °C to 30 °C | ±(0.6 dB +absolute frequency response) |
| At reference settings[6] | ±0.4 dB |

| | |
|---|---|
| **Measurement range** | Displayed average noise level to maximum safe input level |
| Input attenuator range | |
| E4411B | 0 to 60 dB, in 5 dB steps |
| E4403B, E4408B | 0 to 65 dB, in 5 dB steps |

**Maximum safe input level**

| | |
|---|---|
| Average continuous power | |
| E4411B (≥15 dB attenuation) | +30 dBm (1W) |
| E4403B, E4408B (≥30 dB attenuation) | +30 dBm (1W) |
| Peak pulse power | |
| E4411B (≥15 dB attenuation) | +30 dBm (1W) |
| E4403B, E4408B (≥30 dB attenuation) | +50 dBm (100W) |

**1-dB gain compression** (total power at input mixer)[4, 5]

| | |
|---|---|
| E4411B | 0 dBm |
| E4403B | 0 dBm |
| E4408B | |
| 50 MHz to 6.7 GHz | 0 dBm |
| 6.7 GHz to 13.2 GHz | –3 dBm |
| 13.2 GHz to 26.5 GHz | –5 dBm |

**Displayed average noise level**

(Input terminated, 0 dB attenuation, sample detector, reference level = –70 dBm, 1 kHz RBW, 30 Hz VBW)

| | |
|---|---|
| E4411B | |
| 400 kHz to 10 MHz | ≤–115 dBm |
| 10 MHz to 500 MHz | ≤–119 dBm |
| 500 MHz to 1.0 GHz | ≤–117 dBm |
| 1.0 GHz to 1.5 GHz | ≤–113 dBm |
| E4411B (Option 1DP) | |
| 1 MHz to 500 MHz | ≤–65 dBmV |
| 500 MHz to 1.0 GHz | ≤–60 dBmV |
| 1.0 GHz to 1.5 GHz | ≤–53 dBmV |

1 Frequency reference error = (aging rate x period of time since adjustment + settability + temperature stability).
2 N = Harmonic mixing mode. N = 1 for E4411B and E4403B.
3 For reference level 0 to –50 dBm: input attenuation, 10 dB; 50 MHz; RBW, 3 kHz, VBW, 3 kHz; log range 0 to 50 dB; sweep time coupled, signal input, 0 to –50 dBm; span, ≤–60 kHz.
4 Mixer Power Level (dBm) = Input Power (dBm) – Input Attenuator. (dB).
5 For RBW ≤30 kHz, maximum input signal amplitude must be ≤ reference level + 10 dB.
6 Settings are: reference level –25 dBm for E4411B, –20 dBm for E4403B and E4408B; input attenuation 10 dB; center frequency 50 MHz; resolution bandwidth 3 kHz; video bandwidth 3 kHz; span 2 kHz; sweep time coupled; signal at reference level.

# Specifications, continued

E4403B
- 10 MHz to 1.0 GHz ≤–117 dBm
- 1.0 GHz to 2.0 GHz ≤–116 dBm
- 2.0 GHz to 3.0 GHz ≤–114 dBm

E4408B
- 10 MHz to 1.0 GHz ≤–116 dBm
- 1.0 GHz to 2.0 GHz ≤–115 dBm
- 2.0 GHz to 6.0 GHz ≤–112 dBm
- 6.0 GHz to 12.0 GHz ≤–110 dBm
- 12.0 GHz to 22.0 GHz ≤–107 dBm
- 22.0 GHz to 26.5 GHz ≤–101 dBm

**Spurious responses**

Second harmonic distortion

E4411B
- 2 MHz to 750 MHz <–75 dBc for –40 dBm signal at input mixer[1]

E4403B, E4408B
- 10 MHz to 500 MHz <–60 dBc for –30 dBm signal at input mixer[1]
- 500 MHz to 1.5 GHz <–70 dBc for –30 dBm signal at input mixer[1]
- 1.5 GHz to 2.0 GHz <–80 dBc for –10 dBm signal at input mixer[1]
- 2.0 GHz to 13.25 GHz <–95 dBc for –10 dBm signal at input mixer[1]

Maximum achievable second order dynamic range
- E4411B (at 1 GHz) 76 dB (+35 dBm S.H.I.)
- E4403B (at 1 GHz) 79 dB (+40 dBm S.H.I.)
- E4408B (at 1 GHz) 78 dB (+40 dBm S.H.I.)

Third order intermodulation distortion

E4411B
- 10 MHz to 1.5 GHz <–75 dBc for two –30 dBm signals at input mixer[1], >50 kHz separation

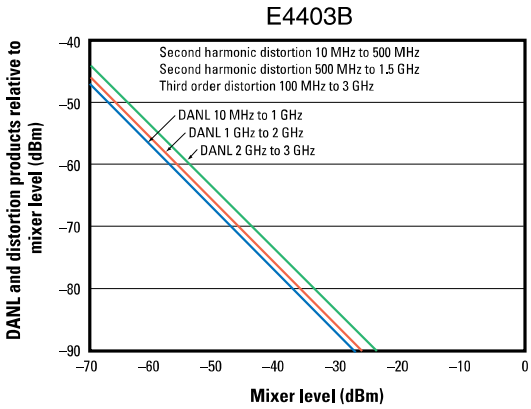
E4403B, E4408B
- 100 MHz to 6.7 GHz <–75 dBc for two –30 dBm signals at input mixer[1], >50 kHz separation
- 6.7 GHz to 26.5 GHz <–70 dBc for two –30 dBm signals at input mixer[1], >50 kHz separation

Maximum achievable third order dynamic range
- E4411B (at 1.0 GHz) 83 dB (+7.5 dBm T.O.I.)
- E4403B (at 1.0 GHz) 83 dB (+7.5 dBm T.O.I.)
- E4408B (at 1.0 GHz) 82 dB (+7.5 dBm T.O.I.)

Other input-related spurious

E4411B <–65 dBc, 30 kHz ≤ offset ≤1.2 GHz, for –20 dBm signal at input mixer[1]

E4403B, E4408B <–65 dBc, >30 kHz offset, for –20 dBm signal at input mixer[1]




**Residual responses**

Input terminated and 0 dB attenuation <–90 dBm

**Display range**

| | |
|---|---|
| Log scale | 0 to –85 dB from reference level is calibrated; 0.1, 0.2, 0.5 dB/division and 1 to 20 dB/division in 1 dB steps; ten divisions displayed. |
| Linear scale | 10 divisions |
| Scale units | dBm, dBmV, dBµV, V, W, and Hz |

**Marker readout resolution**

| | |
|---|---|
| Log scale | 0.04 dB |
| Linear scale | 0.01% of reference level |

**Reference level**

| | |
|---|---|
| Range | –149.9 dBm to maximum mixer level + attenuator setting |
| Resolution | |
| Log scale | ±0.1 dB |
| Linear scale | ±0.12% of reference level |

Accuracy (at a fixed frequency, a fixed attenuation, and referenced to –35 dBm)

Reference level – input attenuator setting
- –10 dBm to > –60 dBm ±0.3 dB
- –60 dBm to > –85 dBm ±0.5 dB
- –85 dBm to > –90 dBm ±0.7 dB

**Frequency response** (10 dB attenuation, 20 °C to 30 °C)

| | Absolute[2] | Relative[3] |
|---|---|---|
| 9 kHz to 3.0 GHz | ±0.5 dB | ±0.5 dB |
| 3.0 GHz to 6.7 GHz | ±1.5 dB | ±1.3 dB |
| 6.7 GHz to 26.5 GHz | ±2.0 dB | ±1.8 dB |

**Resolution bandwidth switching uncertainty**

(Referenced to 1 kHz RBW, at reference level)

| | |
|---|---|
| 3 kHz to 3 MHz RBW | ±0.3 dB |
| 5 MHz RBW | ±0.6 dB |

**Linear to log switching** ±0.15 dB at reference level

**Display scale fidelity**

| | |
|---|---|
| Log maximum cumulative | |
| 0 to –85 dB from reference level | ±(0.3 dB + 0.01 x dB from reference level) |
| Log incremental accuracy | |
| 0 to –80 dB from reference level | ±0.4 dB/4 dB |
| Linear accuracy | ±2% of reference level |

# General specifications

| **Measurement speed (characteristic)** | **E4411B** | **E4403B** | **E4408B** |
|---|---|---|---|
| Local measurement and display update rate[4] | *≥35/sec* | *≥30/sec* | *≥28/sec* |
| Remote measurement and GPIB transfer rate[5] | *≥30/sec* | *≥30/sec* | *≥30/sec* |
| RF center frequency[6] *tuning time* | *≤90ms* | *≤90ms* | *≤90ms* |

**Temperature range**

| | |
|---|---|
| Operating | 0 °C to +55 °C |
| Storage | –40 °C to +75 °C |
| Disk drive | 10 °C to 40 °C |

**EMI compatibility** Conducted and radiated emission is in compliance with CISPR Pub. 11/1990 Group 1 Class A

1 Mixer power level (dBm) = Input power (dBm) – Input attenuator, (dB).
2 Referenced to amplitude at 50 MHz.
3 Referenced to midpoint between highest and lowest frequency response deviations.
4 Autoalign Off, fixed center frequency, factory preset, RBW =1 MHz, stop frequency ≤3 GHz, span >10 MHz and ≤ 600MHz (E4411B: span >102 MHz and ≤400 MHz)
5 Display Off, factory preset, fixed center frequency, single sweep, autoalign off, RBW = 1 MHz, stop frequency ≤3 GHz, span = 20 MHz, GPIB interface
6 Includes CF tuning + measurement + GPIB transfer time, stop frequency ≤3 GHz, factory preset, autoalign off, RBW = 1 MHz, span = 20 MHz, CF tune step size = 50 MHz

# Specifications, continued

**Audible noise** (ISO 7779)

| | |
|---|---|
| Sound pressure at 25 °C | <40 dBa, (<5.3 Bels power) |

**Power requirements**

| | |
|---|---|
| ac Voltage | 90 to 132 Vrms, 195 to 250 Vrms |
| Frequency | 47 to 440 Hz, 47 to 66 Hz |
| Power consumption, on | <300 W |
| Power consumption, standby | <5 W |
| dc Voltage | 12 to 20 Vdc |
| Power consumption | <200 W |

**Weight** (without options)

| | |
|---|---|
| E4411B | *13.2 kg (29.1 lb), characteristic* |
| E4403B | *15.5 kg (34.2 lb), characteristic* |
| E4408B | *17.1 kg (37.7 lb), characteristic* |

**Dimensions**

| | |
|---|---|
| Height | 222 mm (8.75 in) |
| Width | 373 mm (14.7 in) without handle<br>408 mm (16.1 in) with handle |
| Depth | 409 mm (16.1 in) without handle<br>516 mm (20.3 in) with handle |

**Data storage**

| | |
|---|---|
| Internal | *200 traces or states, nominal* |

## Inputs/outputs

**Amplitude reference**[1]

| | |
|---|---|
| Internal | |
| E4411B | *–25 dBm, nominal* |
| E4411B, Option 1DP | *+28.75 dBmV, nominal* |
| External, BNC (f) | |
| E4403B, E4408B | *–20 dBm, nominal* |

**Front panel connectors**

| | |
|---|---|
| Input | Type N (f), *50 Ω nominal* |
| Option 1DP ( E4411B) | BNC (f), *75 Ω nominal* |
| Option BAB ( E4408B) | APC 3.5 (m) |
| RF Out | |
| Option 1DN | Type N (f), *50 Ω nominal* |
| Option 1DQ ( E4411B) | BNC (f), *75 Ω nominal* |
| Probe power, voltage/current | *+15 Vdc, –12.6 Vdc at 150 mA maximum* |
| Speaker | *Front-panel knob controls volume* |
| Headphone | 3.5 mm (1/8 in) miniature audio jack |
| External keyboard | 6-pin mini-din |

**Rear panel connectors**

| | |
|---|---|
| 10 MHz ref output | BNC (f), *50 Ω, >0 dBm, characteristic* |
| 10 MHz ref input | BNC (f), *50 Ω, –15 to +10 dBm, characteristic* |
| External trigger input | BNC (f), *(5V TTL)* |
| VGA output | VGA compatible, 15-pin mini D-SUB, 640 x 480 resolution |

**IF sweep and video ports** (Option A4J)

| | |
|---|---|
| Aux IF output | BNC (f), *21.4 MHz, nominal –10 to –70 dBm (uncorrected), characteristic* |
| Aux video out | BNC (f), *0 to 1 V (uncorrected), characteristic* |
| Hi swp in | BNC (f), *(5 V TTL)* |
| Hi swp out | BNC (f), *(5 V TTL)* |
| Swp out | BNC (f), *0 to +10 V ramp, characteristic* |

**GPIB interface**

| | |
|---|---|
| Option A4H | IEEE-488 bus connector |

**Serial interface**

| | |
|---|---|
| Option 1AX | 9-pin D-SUB (m), *RS-232* |

**Parallel printer interface**

| | |
|---|---|
| Option A4H or 1AX | 25-pin D-SUB (f), *printer port only* |

## Tracking generator (Option 1DN and Option 1DQ)

**Output frequency range**

| | |
|---|---|
| E4411B 50 Ω (Opt. 1DN) | 9 kHz to 1.5 GHz |
| E4411B 75 Ω (Opt. 1DQ) | 1 MHz to 1.5 GHz |
| E4403B, E4408B (Opt. 1DN) | 9 kHz to 3.0 GHz |

**Output power level**[2]

| | |
|---|---|
| Range | |
| E4411B 50 Ω | 0 to –70 dBm (20 °C to 30 °C) |
| E4411B 75 Ω | +42.75 to –27.25 dBmV |
| E4403B, E4408B 50 Ω | –2 to –66 dBm |
| Vermier | |
| E4411B | |
| Range | 10 dB |
| Output attenuator range | 0 to 60 dB, 10 dB steps |
| E4403B, E4408B | |
| Range | 9 dB |
| Output attenuator range | 0 to 56 dB, 8 dB steps |

**Output power sweep**[2]

| | |
|---|---|
| Range | |
| E4411B 50 Ω | –15 dBm to 0 dBm – (source attenuator setting) |
| E4411B 75 Ω | +27.76 dBmV to +42.76 dBmV – (source attenuator setting) |
| E4403B, E4408B 50 Ω | –10 dBm to –1 dBm – (source attenuator setting) |

**Output flatness**

| | |
|---|---|
| E4411B 50 Ω (referenced to 50 MHz, 0 dB attenuation) | |
| 10 MHz to 1.5 GHz | ±1.5 dB |
| E4411B 75 Ω (referenced to 50 MHz, 0 dB attenuation) | |
| 10 MHz to 1.5 GHz | ±2 dB |
| E4403B, E4408B 50 Ω (referenced to 50 MHz, –20 dB signal level) | |
| 10 MHz to 3.0 GHz | ±2 dB |

**Spurious output**

| | |
|---|---|
| Harmonic spurs | |
| E4411B, 50 Ω (0 dBm output), 75 Ω (+42.8 dBmV output) | |
| 20 MHz to 1.5 GHz | <–25 dBc |
| E4403B, E4408B 50 Ω (–1 dBm output) | |
| 9 MHz to 3 GHz | <–25 dBc |

| | |
|---|---|
| **Dynamic range** | Maximum output power level– displayed average noise level |

**Output tracking**

| | |
|---|---|
| E4411B | |
| Drift | No error |
| Swept tracking error | No error for coupled sweep times |
| E4403B, E4408B | |
| Drift | *1.5 kHz/5 minutes, characteristic* |
| Swept tracking error | *Usable in 1 kHz RBW after 5 minutes of warm up* |

**Output VSWR**

| | |
|---|---|
| E4411B | *<2.5:1, characteristic* |
| E4403B, E4408B | |
| 0 dB attenuation | *<2.0:1, characteristic* |
| >8 dB attenuation | *<1.5:1, characteristic* |

[1] Amplitude reference actual power might differ from the nominal value. Actual calibration power is stored internally.
[2] E4411B: 20 °C to 30 °C.

# Ordering information

- ❑ E4411B RF Spectrum Analyzer
  9 kHz to 1.5 GHz
- ❑ E4403B RF Spectrum Analyzer
  9 kHz to 3.0 GHz
- ❑ E4408B Microwave Spectrum Analyzer
  9 kHz to 26.5 GHz

### Options

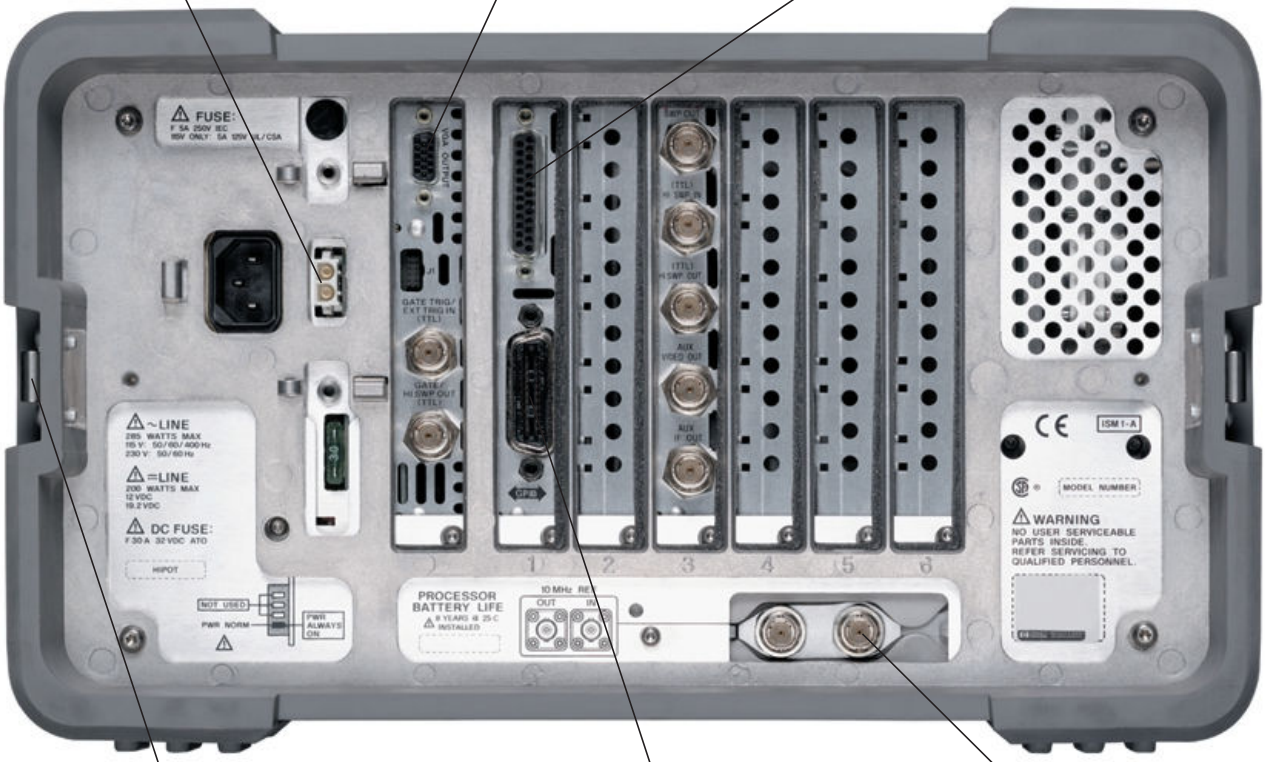
| | |
|---|---|
| ❑ **A4H** | GPIB and parallel (Centronics) interfaces (not compatible with Option 1AX) |
| ❑ **1AX** | RS-232 and parallel (Centronics) interfaces (not compatible with Option A4H) |
| ❑ **A4J** | IF, sweep, and video ports |
| ❑ **BAB** | APC 3.5mm input connector (E4408B only) |
| ❑ **1DN** | 50-Ohm tracking generator (9 kHz to 1.5 GHz for E4411B) (9 kHz to 3.0 GHz for E4403B and E4408B) |
| ❑ **1DP** | 75-Ohm input impedance (1 MHz to 1.5 GHz) E4411B only |
| ❑ **1DQ** | 75-Ohm tracking generator (1 MHz to 1.5 GHz) (requires Option 1DP) |
| ❑ **1D7** | 50 to 75-Ohm matching pad (type n (m) to BNC (f)) |
| ❑ **A5D** | 12-Vdc power cable |
| ❑ **AYT** | Soft operating/carrying case (grey) |
| ❑ **AYU** | Soft operating/carrying case (yellow) |
| ❑ **AXT** | Hard transit case |
| ❑ **UK9** | Front-panel protective cover |
| ❑ **1CP** | Rack-mount kit with handles and slides |
| ❑ **0B0** | Deletes printed manuals (retains CD-ROM manuals) |
| ❑ **0BV** | Component level service documentation |
| ❑ **0B1** | Additional user and calibration guides |
| ❑ **0BW** | Assembly-level service guide |
| ❑ **UK6** | Commercial calibration certificate with data |
| ❑ **8ZE** | Refurbished spectrum analyzer (as available) |
| ❑ **W32** | Three-year calibration |
| ❑ **W50/52** | Additional two-year service and support/ five-year calibration |

### Accessories

| | |
|---|---|
| ❑ **C2950A** | Parallel printer cable (2 meter) |
| ❑ **10833A** | GPIB cable (1 meter) |
| ❑ **24542U** | RS-232 cable (3 meter, 9 pin F to 9 pin F) (for serial 9 pin PC connection to analyzer) |
| ❑ **24542G** | RS-232 cable (3 meter, 25 pin M to 9 pin F) (for serial 25 pin PC or printer connection to analyzer) |
| ❑ **24542M** | RS-232 cable (3 meter, 25 pin M to 9 pin F) (for serial 25 pin modem connection to analyzer) |
| ❑ **87405A** | Preamplifier (10 MHz to 3 GHz, 24 dB gain) (fastened to RF input, powered from analyzer) |
| ❑ **85905A** | 75 Ohm preamplifier (45 MHz to 1 GHz, 20 dB gain) (powered from analyzer) |
| ❑ **41800A** | Active probe (5 Hz to 500 MHz) |
| ❑ **85024A** | High frequency active probe (300 kHz to 3 GHz) |
| ❑ **E1779A** | Battery pack |
| ❑ **E4444A** | BenchLink Spectrum Analyzer software (PC image and data transfer) |
| ❑ ***VXIplug&play*** | instrument drivers available via the World Wide Web at: http://www.agilent.com/find/inst_drivers (Click on *VXIplug&play* universal instrument drivers.) |

### Literature

| | |
|---|---|
| ❑ ESA Self-Guided demo | 5968-3658E |
| ❑ Spectrum Analysis Basics, AN 150 | 5952-0292 |
| ❑ ESA-E series spectrum analyzer brochure | 5968-3278E |
| ❑ ESA-E series specifications | 5968-3386E |
| ❑ 8560 EC-series spectrum analyzer brochure | 5968-9571E |
| ❑ E4444A BenchLink spectrum analyzer product overview | 5966-0676E |
| ❑ E1779A rechargeable battery pack | 5966-1851E |
| ❑ ESA cable TV service and installation analyzer product overview | 5980-0845E |


12 Vdc operation with optional power cable
VGA connector for large screen monitor
Parallel printer port supports PCL 3/5 HP printers (optional)
Snap on battery pack for portability (optional)
GPIB or RS232 interfaces provide remote control and PC connectivity (optional)
Improve frequency accuracy with external frequency reference