

# Electrical Sampling Modules Datasheet

80E11 • 80E11X1 • 80E10B • 80E09B • 80E08B • 80E07B • 80E04 • 80E03  
• 80E03-NV



The DSA8300 Series Sampling Oscilloscope, when configured with one or more electrical sampling modules, provides complete test solutions for multi-channel, high-bandwidth electrical applications. This highly configurable solution is well suited for debugging, characterizing and analyzing components, modules and systems with signaling rates at 10, 40 and even 100 Gb/s. The 80E00 family of electrical sampling modules provide a wide variety of capabilities, allowing the user to configure a test solution specifically adapted to their application.

## Key performance specifications

- Up to 70 GHz bandwidth and 5 ps measured rise time (10-90%)
- Lowest noise for analysis: 450  $\mu\text{V}_{\text{RMS}}$  at 60 GHz, 300  $\mu\text{V}_{\text{RMS}}$  at 30 GHz
- 15 ps reflected true differential fully integrated TDR rise time (12 ps incident) and feature resolution below 1 mm (TDR modules)
- Efficient, accurate, easy to use, and cost-effective S-parameters up to 50 GHz
- Remote samplers<sup>1</sup> enable location of sampler near DUT and ensure best signal fidelity

## Key features

- Independent sampler skew ensures easy fixture and probe de-embedding
- Dual channel (except 80E11X1)
- Precision Microwave Connectors (3.5 mm, 2.92 mm, 2.4 mm, and 1.85 mm)
- Probe support

<sup>1</sup> Integrated on 80E07B - 80E10B and optional on 80E03, 80E04, 80E11 and 80E11X1.

## Applications

- Impedance characterization and S-parameter measurements for serial data applications
- Advanced jitter, noise, and BER analysis
- Channel and eye-diagram simulation and measurement-based spice modeling
- **80E10B, 80E08B, and 80E04**
  - High-performance TDR/T measurements
  - Impedance profile, inductance, capacitance, and S-parameters
  - Transmission line quality, impedance, and crosstalk
  - True differential, common mode, and single-ended measurements
  - Efficient fault isolation
- **80E11, 80E11X1, 80E09B, 80E07B**
  - High-frequency, low-noise signal acquisition
  - Fast rise time measurements
  - Jitter analysis and waveform analysis
- **80E03, 80E03-NV**
  - Device characterization, transmission quality, waveform parameters
  - Low signal measurements

## TDR modules: 80E10B, 80E08B, and 80E04

The 80E10B, 80E08B, and 80E04 are dual-channel Time Domain Reflectometry (TDR) sampling modules, providing up to 12 ps incident and 15 ps reflected rise time in the 80E10B (18 ps incident in 80E08B and 23 ps incident in 80E04). Each channel of these modules can generate a fast step for use in TDR mode and the acquisition portion of the sampling module monitors the incident step and any reflected energy. The polarity of each channel's step can be selected independently. This allows for differential or common mode TDR or S-parameter testing of two coupled lines, in addition to the independent testing of isolated lines. The independent step generation for each channel allows true differential measurements, which ensures measurement accuracy for differential devices.

The 80E10B and 80E08B are small form factor, fully integrated independent 2-meter remote sampler systems, enabling location of the sampler near the DUT and ensuring the best signal fidelity. The modules characterize crosstalk by using TDR steps to drive one line (or line pair for differential crosstalk) while monitoring a second line (or line pair) with the other channel (or another module for differential crosstalk). The "filter" function on the 8000 series mainframes can be used with TDR or crosstalk measurements to characterize expected system performance with slower edge rates.

All modules have independent incident step and receiver deskew to remove the effect of measurement fixtures and probes, enabling faster and easier de-embedding of test fixtures. The 80E10B sampling modules provide an acquisition rise time of 7 ps, with up to 50 GHz selectable equivalent bandwidth (with 50, 40, and 30 GHz settings). The 80E08B sampling bandwidth is 30 GHz (user selectable with 30 and 20 GHz settings) and 80E04 sampling bandwidth is 20 GHz. The 20 GHz P8018 single-ended and 18 GHz P80318 differential variable pitch TDR probes provide excellent performance and compliance, ensuring easy and accurate backplane and package measurements.

Using Tektronix IConnect<sup>®</sup> TDR and VNA software with these modules enables acquiring up to 1,000,000 data points and obtaining up to 50 GHz differential, mixed mode, and single-ended S-parameters. IConnect also enables impedance, S-parameters, and eye-diagram compliance testing as required by various serial data standards, and full channel analysis, Touchstone (SnP) file output, and SPICE modeling for gigabit interconnects.

### **Sampling modules: 80E11, 80E11X1, 80E09B, 80E07B, 80E03, and 80E03-NV**

The 80E09B and 80E07B are dual-channel modules with remote samplers, capable of  $450 \mu\text{V}_{\text{RMS}}$  noise at 60 GHz sampling bandwidth, and  $300 \mu\text{V}$  at 30 GHz sampling bandwidth. Each small form factor remote sampler is attached to a 2-meter cable to minimize the effects of cables, probes, and fixtures, allow close location of the sampler to the DUT, and enable best signal fidelity. User-selectable bandwidth settings (60/40/30 GHz on 80E09B and 30/20 GHz on 80E07B) offer optimal noise/bandwidth trade-off.

The 80E11 and 80E11X1 are dual and single channel, 70+ GHz bandwidth sampling modules. These modules provide the widest measurement bandwidth and fastest rise time measurements with world class signal fidelity. User-selectable bandwidth settings (70/60/40 GHz) enable optimal noise/bandwidth trade-off.

You can use optional one- and two-meter module extender cables (80X01, 80X02) with the 80E11 and 80E11X1 modules to enable superior signal fidelity and measurement flexibility by placing the sampling module closer to the DUT.

The 80E03 and 80E03-NV are dual-channel, 20 GHz sampling modules. These sampling modules provide an acquisition rise time of 17.5 ps or less. Optional one- and two-meter extender cables are available.

When used with Tektronix 80SJNB Jitter, Noise, and BER software, these modules enable separation of both jitter and noise into their components, understanding precise causes of eye closure, and obtaining highly accurate extrapolation of BER and 3-D eye contour. When used with the 82A04B phase reference module, time-base accuracy can be improved down to  $<100 \text{ fs}_{\text{RMS}}$  jitter, which together with the  $300 \mu\text{V}$  noise floor and 16 bits of resolution ensures the highest signal fidelity for the measured signals.

### **Performance you can count on**

Depend on Tektronix to provide you with performance you can count on. In addition to industry-leading service and support, this product comes backed by a one-year warranty as standard.

## Specifications

All specifications are guaranteed unless noted otherwise.

### Model overview

Module	Application	Bandwidth <sup>2</sup>	Channels	Input impedance	Input connector
80E11 80E11X1	High-frequency, low-noise, signal acquisition and jitter characterization	70/60/(40) GHz <sup>3</sup>	2/1	50 ±1.0 Ω	1.85 mm female
80E10B	True differential TDR, S-parameters, and fault isolation	50/40/(30) GHz <sup>3</sup>	2	50 ±1.0 Ω	1.85 mm female
80E9B	High-frequency, low-noise signal acquisition and jitter characterization	60/40/(30) GHz <sup>3</sup>	2	50 ±1.0 Ω	1.85 mm female
80E8B	True differential TDR and S-parameters	30/(20) GHz <sup>3</sup>	2	50 ±1.0 Ω	2.92 mm female
80E7B	Optimal noise/performance trade-off for jitter characterization	30/(20) GHz <sup>3</sup>	2	50 ±1.0 Ω	2.92 mm female
80E04	TDR impedance and crosstalk characterization	20 GHz <sup>4</sup>	2	50 ±1.0 Ω	3.5 mm female
80E03 80E03-NV	Device characterization	20 GHz <sup>5</sup>	2	50 ±1.0 Ω	3.5 mm female

### 80E11, 80E11X1

**Rise time** 5 ps (calculated from 0.35 bandwidth rise time product )

**Dynamic range** 800 mV<sub>p-p</sub>

**Offset range** ±1.1 V

**Maximum operating voltage** ±1.1 V

**Maximum Nondestruct Voltage, DC + AC<sub>p-p</sub>** 2.0 V

**Vertical number of digitized bits** 16 bits full scale

**Vertical sensitivity range** 8 mV to 800 mV full scale

**DC vertical voltage accuracy, single point, within ±2 °C of compensated temperature** ±[2 mV + 0.007 (Offset) + 0.02 (Vertical Value - Offset)]

<sup>2</sup> Normal text is warranted values. Values in parenthesis are typical (unwarranted) value to which the instrument will typically perform.

<sup>3</sup> User selectable.

<sup>4</sup> Calculated from 0.35 bandwidth rise time product.

<sup>5</sup> The 80E03 bandwidth is calculated from 0.35 bandwidth rise time product. The 80E03-NV bandwidth is directly verified.

## 80E11, 80E11X1

<b>Step response aberrations, typical</b>	$\pm 1\%$ or less over the zone 10 ns to 20 ps before step transition $+6\%$ , $-10\%$ or less for the first 400 ps following step transition $+0\%$ , $-4\%$ or less over the zone 400 ps to 3 ns following step transition $+1\%$ , $-2\%$ or less over the zone 3 ns to 100 ns following step transition $\pm 1\%$ after 100 ns following step transition
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<b>RMS noise, maximum (warranted, typical)</b>	70 GHz: $\leq 1100 \mu\text{V}$ (950 $\mu\text{V}$ ) 60 GHz: $\leq 600 \mu\text{V}$ (450 $\mu\text{V}$ ) 40 GHz: $\leq 480 \mu\text{V}$ (330 $\mu\text{V}$ ) Value in parenthesis is typical value to which the instrument will normally perform.
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## 80E10B

<b>Rise time</b>	7 ps (calculated from 0.35 bandwidth rise time product )
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<b>Dynamic range</b>	1.0 V <sub>p-p</sub>
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<b>Offset range</b>	$\pm 1.1 \text{ V}$
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<b>Maximum operating voltage</b>	$\pm 1.1 \text{ V}$
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<b>Maximum Nondestruct Voltage, DC + AC<sub>p-p</sub></b>	2.0 V
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<b>Vertical number of digitized bits</b>	16 bits full scale
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<b>Vertical sensitivity range</b>	10 mV to 1.0 v full scale
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<b>DC vertical voltage accuracy, single point, within <math>\pm 2 \text{ }^\circ\text{C}</math> of compensated temperature</b>	$\pm [2 \text{ mV} + 0.007 (\text{Offset}) + 0.02 (\text{Vertical Value} - \text{Offset})]$
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<b>Step response aberrations, typical</b>	$\pm 1\%$ or less over the zone 10 ns to 20 ps before step transition $+6\%$ , $-10\%$ or less for the first 400 ps following step transition $+0\%$ , $-4\%$ or less over the zone 400 ps to 3 ns following step transition $+1\%$ , $-2\%$ or less over the zone 3 ns to 100 ns following step transition $\pm 1\%$ after 100 ns following step transition
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<b>RMS noise, maximum (warranted, typical)</b>	50 GHz: $\leq 700 \mu\text{V}$ (600 $\mu\text{V}$ ) 40 GHz: $\leq 480 \mu\text{V}$ (370 $\mu\text{V}$ ) 30 GHz: $\leq 410 \mu\text{V}$ (300 $\mu\text{V}$ ) Value in parenthesis is typical value to which the instrument will normally perform.
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<b>TDR step amplitude</b>	250 mV (polarity of either step may be inverted)
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<b>TDR system reflected rise time</b>	15 ps
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<b>TDR system incident rise time</b>	12 ps
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<b>TDR step deskew range</b>	$\pm 250 \text{ ps}$
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**80E10B**

TDR sampler deskew range	±250 ps
TDR step maximum repetition rate	300 kHz
	The TDR step maximum repetition rate is 200 kHz when this module is used in a DSA8200, TDS/CSA8200, TDS/CSA800B, or TDS/CSA8000 mainframe

**80E09B**

Rise time	5.8 ps (calculated from 0.35 bandwidth rise time product )
Dynamic range	1.0 V <sub>p-p</sub>
Offset range	±1.1 V
Maximum operating voltage	±1.1 V
Maximum Nondestruct Voltage, DC + AC <sub>p-p</sub>	2.0 V
Vertical number of digitized bits	16 bits full scale
Vertical sensitivity range	10 mV to 1.0 v full scale
DC vertical voltage accuracy, single point, within ±2 °C of compensated temperature	±[2 mV + 0.007 (Offset) + 0.02 (Vertical Value - Offset)]
Step response aberrations, typical	±1% or less over the zone 10 ns to 20 ps before step transition +6%, -10% or less for the first 400 ps following step transition +0%, -4% or less over the zone 400 ps to 3 ns following step transition +1%, -2% or less over the zone 3 ns to 100 ns following step transition ±1% after 100 ns following step transition
RMS noise, maximum (warranted, typical)	60 GHz: ≤600 μV (450 μV) 40 GHz: ≤480 μV (330 μV) 30 GHz: ≤410 μV (300 μV) Value in parenthesis is typical value to which the instrument will normally perform.

**80E08B**

Rise time	11.7 ps (calculated from 0.35 bandwidth rise time product)
Dynamic range	1.0 V <sub>p-p</sub>
Offset range	±1.1 V
Maximum operating voltage	±1.1 V
Maximum Nondestruct Voltage, DC + AC <sub>p-p</sub>	2.0 V
Vertical number of digitized bits	16 bits full scale

**80E08B**

Vertical sensitivity range	10 mV to 1.0 v full scale
DC vertical voltage accuracy, single point, within $\pm 2$ °C of compensated temperature	$\pm[2 \text{ mV} + 0.007 (\text{Offset}) + 0.02 (\text{Vertical Value} - \text{Offset})]$
Step response aberrations, typical	$\pm 1\%$ or less over the zone 10 ns to 20 ps before step transition $+6\%$ , $-10\%$ or less for the first 400 ps following step transition $+0\%$ , $-4\%$ or less over the zone 400 ps to 3 ns following step transition $+1\%$ , $-2\%$ or less over the zone 3 ns to 100 ns following step transition $\pm 1\%$ after 100 ns following step transition
RMS noise, maximum (warranted, typical)	30 GHz: $\leq 410 \mu\text{V}$ (300 $\mu\text{V}$ ) 20 GHz: $\leq 380 \mu\text{V}$ (280 $\mu\text{V}$ ) Value in parenthesis is typical value to which the instrument will normally perform.
TDR step amplitude	250 mV (polarity of either step may be inverted)
TDR system reflected rise time	20 ps
TDR system incident rise time	18 ps
TDR step deskew range	$\pm 250$ ps
TDR sampler deskew range	$\pm 250$ ps
TDR step maximum repetition rate	300 kHz The TDR step maximum repetition rate is 200 kHz when this module is used in a DSA8200, TDS/CSA8200, TDS/CSA800B, or TDS/CSA8000 mainframe

**80E07B**

Rise time	11.7 ps (calculated from 0.35 bandwidth rise time product)
Dynamic range	1.0 $V_{p-p}$
Offset range	$\pm 1.1$ V
Maximum operating voltage	$\pm 1.1$ V
Maximum Nondestruct Voltage, DC + AC <sub>p-p</sub>	2.0 V
Vertical number of digitized bits	16 bits full scale
Vertical sensitivity range	10 mV to 1.0 v full scale
DC vertical voltage accuracy, single point, within $\pm 2$ °C of compensated temperature	$\pm[2 \text{ mV} + 0.007 (\text{Offset}) + 0.02 (\text{Vertical Value} - \text{Offset})]$

**80E07B**

<b>Step response aberrations, typical</b>	$\pm 1\%$ or less over the zone 10 ns to 20 ps before step transition $+6\%$ , $-10\%$ or less for the first 400 ps following step transition $+0\%$ , $-4\%$ or less over the zone 400 ps to 3 ns following step transition $+1\%$ , $-2\%$ or less over the zone 3 ns to 100 ns following step transition $\pm 1\%$ after 100 ns following step transition
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<b>RMS noise, maximum (warranted, typical)</b>	30 GHz: $\leq 410 \mu\text{V}$ (300 $\mu\text{V}$ ) 20 GHz: $\leq 380 \mu\text{V}$ (280 $\mu\text{V}$ ) Value in parenthesis is typical value to which the instrument will normally perform.
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**80E04**

<b>Rise time</b>	$\leq 17.5$ ps (calculated from 0.35 bandwidth rise time product)
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<b>Dynamic range</b>	$1.0 V_{\text{p-p}}$
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<b>Offset range</b>	$\pm 1.6$ V
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<b>Maximum operating voltage</b>	$\pm 1.6$ V
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<b>Maximum nondestruct voltage, DC + AC<sub>p-p</sub></b>	3.0 V
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<b>Vertical number of digitized bits</b>	16 bits full scale
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<b>Vertical sensitivity range</b>	10 mV to 1.0 v full scale
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<b>DC vertical voltage accuracy, single point, within <math>\pm 2</math> °C of compensated temperature</b>	$\pm [2 \text{ mV} + 0.007 (\text{Offset}) + 0.02 (\text{Vertical Value} - \text{Offset})]$
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<b>Step response aberrations, typical</b>	$\pm 3\%$ or less over the zone 10 ns to 20 ps before step transition $+10\%$ , $-5\%$ or less for the first 300 ps following step transition $\pm 3\%$ or less over the zone 300 ps to 5 ns following step transition $\pm 1\%$ or less over the zone 5 ns to 100 ns following step transition $\pm 0.5\%$ after 100 ns following step transition
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<b>RMS noise, maximum (warranted, typical)</b>	20 GHz: $\leq 1.2$ mV (600 $\mu\text{V}$ ) Value in parenthesis is typical value to which the instrument will normally perform.
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<b>TDR step amplitude</b>	250 mV (polarity of either step may be inverted)
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<b>TDR system reflected rise time</b>	28 ps
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<b>TDR system incident rise time</b>	23 ps
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<b>TDR step deskew range</b>	$\pm 50$ ps
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**80E04**

<b>TDR sampler deskew range</b>	+100 ns, -500 ps (slot deskew only)
<b>TDR step maximum repetition rate</b>	300 kHz The TDR step maximum repetition rate is 200 kHz when this module is used in a DSA8200, TDS/CSA8200, TDS/CSA800B, or TDS/CSA8000 mainframe

**80E03, 80E03-NV**

<b>Rise time</b>	≤17.5 ps (calculated from 0.35 bandwidth rise time product)
<b>Dynamic range</b>	1.0 V <sub>p-p</sub>
<b>Offset range</b>	±1.6 V
<b>Maximum operating voltage</b>	±1.6 V
<b>Maximum nondestruct voltage, DC + AC<sub>p-p</sub></b>	3.0 V
<b>Vertical number of digitized bits</b>	16 bits full scale
<b>Vertical sensitivity range</b>	10 mV to 1.0 v full scale
<b>DC vertical voltage accuracy, single point, within ±2 °C of compensated temperature</b>	±[2 mV + 0.007 (Offset) + 0.02 (Vertical Value - Offset)]
<b>Step response aberrations, typical</b>	±3% or less over the zone 10 ns to 20 ps before step transition +10%, -5% or less for the first 300 ps following step transition ±3% or less over the zone 300 ps to 5 ns following step transition ±1% or less over the zone 5 ns to 100 ns following step transition ±0.5% after 100 ns following step transition
<b>RMS noise, maximum (warranted, typical)</b>	20 GHz: ≤1.2 mV (600 μV) Value in parenthesis is typical value to which the instrument will normally perform.

**Physical characteristics**

	<b>Width</b>	<b>Height</b>	<b>Depth</b>	<b>Weight</b>
80E11 80E11X1 80E04 80E03 80E03-NV	79.0 mm (3.1 in)	25.0 mm (1.0 in)	135 mm (5.3 in)	0.4 kg (0.87 lb)
80E10B 80E09B 80E08B 80E07B <sup>6</sup>	55 mm (2.2 in)	25.0 mm (1.0 in)	75 mm (3.0 in)	0.175 kg (0.37 lb)

<sup>6</sup> Remote sampler module characteristics for 80E10B, 80E09B, 80E08B, and 80E07B)

## Ordering information

For more detailed information about the 80E00 Electrical Sampling Modules, download the *DSA8300 Digital Serial Analyzer, 80C00 Series Sampling Modules, 80E00 Series Sampling Modules, 80A00 Modules Specifications Technical Reference* (Tektronix part number 077-0571-xx) from [www.Tektronix.com](http://www.Tektronix.com).

### Models

80E11	Dual channel, 70+ GHz sampling module
80E11X1	Single channel version of 80E11
80E10B	Dual-channel, 50 GHz true differential TDR sampling module with remote samplers
80E09B	Dual-channel, 60 GHz sampling module
80E08B	Dual-channel, 30 GHz true differential TDR sampling module with remote samplers
80E07B	Dual-channel, 30 GHz sampling module
80E04	Dual-channel, 20 GHz true differential TDR sampling module
80E03/80E03-NV	Dual-channel, 20 GHz sampling module <sup>7</sup>

### Instrument options

80E04 Opt. 09	Include two 80A09 EOS/ESD Protection Devices with the 80E04 module
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### Service options

Opt. C3	Calibration Service 3 Years
Opt. C5	Calibration Service 5 Years
Opt. D1	Calibration Data Report
Opt. D3	Calibration Data Report 3 Years (with Opt. C3)
Opt. D5	Calibration Data Report 5 Years (with Opt. C5)
Opt. G3	Complete Care 3 Years (includes loaner, scheduled calibration, and more)
Opt. G5	Complete Care 5 Years (includes loaner, scheduled calibration, and more)
Opt. R3	Repair Service 3 Years (including warranty)
Opt. R5	Repair Service 5 Years (including warranty)

<sup>7</sup> For the 80E03-NV, bandwidth is directly verified and the Calibration Certification Report includes test data on the module's bandwidth test results.

**Recommended accessories**

<b>80E04UP Opt. 09</b>	80E04 Upgrade kit that provides two 80A09 EOS/ESD Protection Devices in a case that can hold an 80E04 module
<b>015-1001-xx</b>	2X attenuator (SMA Male-to-Female)
<b>015-1002-xx</b>	5X attenuator (SMA Male-to-Female)
<b>011-0157-xx</b>	Adapter (2.4 mm male to 2.92 mm female – can also be used as 1.85 mm male to 2.92 mm female)
<b>P8018</b>	20 GHz single-ended TDR probe. 80A02 module (below) recommended for static protection of the sampling or TDR module
<b>P80318</b>	18 GHz differential TDR probe. 80A02 module (below) recommended for static protection of each channel of the sampling or TDR module
<b>80A09</b>	26 GHz ESD Protection Accessory
<b>80A02</b>	EOS/ESD isolation module (1 channel). P8018 or P80318 TDR probe (above) recommended
<b>80X01</b>	One-meter sampling module extender cable (for 80E11, 80E11X1, 80E04, 80E03, 80E03-NV)
<b>80X02</b>	Two-meter sampling module extender cable (for 80E11, 80E11X1, 80E04, 80E03, 80E03-NV)



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