Electrical Sampling Modules

80E10 • 80E09 • 80E08 • 80E07 • 80E06 • 80E06X2 • 80E04 • 80E03 • 80E03-NV • 80E01 Data Sheet

Features & Benefits

All Modules

- Up to 70 GHz Bandwidth and 5 ps Measured Rise Time (10 - 90%)
- Lowest Noise for Analysis – 450 μV_{RMS} at 60 GHz, 300 μV_{RMS} at 30 GHz
- Remote Samplers*1 enable Location of Sampler Near DUT and ensure Best Signal Fidelity
- Independent Sampler Deskew ensures Easy Fixture and Probe De-embedding
- Dual Channel (Except 80E01 and 80E06)
- Precision Microwave Connectors (3.5 mm, 2.92 mm, 2.4 mm, and 1.85 mm)
- Probe Support (Except 80E06)

TDR Modules

- 15 ps Reflected True Differential Fully Integrated TDR Rise Time (12 ps Incident) and feature Resolution Below 1 mm
- Efficient, Accurate, Easy to Use, and Cost-effective S-parameters up to 50 GHz

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

80E10, 80E08, 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

80E09, 80E07, 80E06, 80E01

- 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

*1 Integrated on 80E07 - 80E10 and optional on 80E01 - 80E04 and 80E06.

TDR Modules: 80E10, 80E08, and 80E04

The 80E10, 80E08, 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 80E10 (18 ps incident in 80E08 and 23 ps incident in 80E04). Each channel of these modules is capable of generating 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 80E10 and 80E08 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. An optional 2-meter extender is available for the 80E04. 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 8200 and 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 80E10 sampling modules provide an acquisition rise time of 7 ps, with up to 50 GHz user-selectable equivalent bandwidth (with 50, 40, and 30 GHz settings). The 80E08 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.

When the user employs these modules with Tektronix IConnect® TDR and VNA software, he or she can acquire up to 1,000,000 data points and obtain 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, as well as full channel analysis, Touchstone (SnP) file output, and SPICE modeling for gigabit interconnects.

Sampling Modules: 80E09, 80E07, 80E06, 80E03, 80E03-NV, and 80E01

The 80E09 and 80E07 are dual-channel modules with remote samplers, capable of 450 μV_{RMS} noise at 60 GHz sampling bandwidth, and 300 µV at 30 GHz sampling bandwidth. Each small form factor remote sampler is attached to a 2-meter cable in order to minimize the effects of cables, probes, and fixtures, allow close location of the sampler to the DUT, and ensure best signal fidelity. User-selectable bandwidth settings (60/40/30 on 80E09 and 30/20 on 80E07) offer optimal noise/bandwidth trade-off.

The 80E06 and 80E01 are single-channel, 70+ and 50 GHz bandwidth sampling modules. The 80E06 provides the widest measurement bandwidth and fastest rise time measurements with world-class signal fidelity. Both the 80E06 and 80E01 provide a superior maximum operating range of ±1.6 V. Both of these modules can be used with the optional 2-meter extender cable, which ensures superior signal fidelity and measurement flexibility.

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. An optional 2-meter extender cable is 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 82A04 phase reference module, time-base accuracy can be improved down to 200 fs_{RMS} jitter, which together with the 300 µV noise floor and 14 bits of resolution ensures the highest signal fidelity for the measured signals.

Characteristics

Characteristic	Application Type	Channels	Input Impedance	Channel Input Connector	Bandwidth*2
80E10	True differential TDR, S-parameters, and fault isolation	2	50 ±1.0 Ω	1.85 mm female, precision adapter to 2.92 mm included with 50 Ω SMA termination	50/40/30 GHz*3, 4
80E09	High-frequency, low-noise signal acquisition and jitter characterization	2	50 ±1.0 Ω	1.85 mm female, precision adapter to 2.92 mm included with 50 Ω SMA termination	60/40/30 GHz*3, 4
80E08	True differential TDR and S-parameters	2	50 ±1.0 Ω	2.92 mm female	30/20 GHz*3, 4
80E07	Optimal noise/performance trade-off for jitter characterization	2	50 ±1.0 Ω	2.92 mm female	30/20 GHz*3, 4
80E06	High-speed electrical device characterization	1	50 ±0.5 Ω	1.85 mm female, precision adapter to 2.92 mm included with 50 Ω SMA termination	*70+ GHz*
80E04	TDR impedance and crosstalk characterization	2	50 ±0.5 Ω	3.5 mm female	20 GHz*3
80E03 80E03-NV	Device characterization	2	50 ±0.5 Ω	3.5 mm female	20 GHz*5
80E01	High-frequency, high maximum operating range signal acquisition	1	50 ±0.5 Ω	2.4 mm female, precision adapter to 2.92 mm included with 50 Ω SMA termination	50 GHz

*2 Values shown are warranted unless printed in an italic typeface which represents an unwarranted characteristic value that the instrument will typically perform to.

*3 Calculated from 0.35 bandwidth rise time product.

*4 User selectable.

*5 The 80E03 bandwidth is calculated from 0.35 bandwidth rise time product. The 80E03-NV bandwidth is directly verified.

Module	Rise Time (10% to 90%)	Dynamic Range	Offset Range	Maximum Operating Voltage	Maximum Nondestruct Voltage, DC + AC_{p-p}	Vertical Number of Digitized Bits
80E10	7 ps*3	1.0 V_{p-p}	±1.1 V	±1.1 V	2.0 V	14 bits full scale
80E09	5.8 ps*3	1.0 V_{p-p}	±1.1 V	±1.1 V	2.0 V	14 bits full scale
80E08	11.7*3	1.0 V_{p-p}	±1.1 V	±1.1 V	2.0 V	14 bits full scale
80E07	11.7*3	1.0 V_{p-p}	±1.1 V	±1.1 V	2.0 V	14 bits full scale
80E06	5.0 ps*3	1.0 V_{p-p}	±1.6 V	±1.6 V	2.0 V	14 bits full scale
80E04	≤17.5 ps	1.0 V_{p-p}	±1.6 V	±1.6 V	3.0 V	14 bits full scale
80E03 80E03-NV	≤17.5 ps	1.0 V_{p-p}	±1.6 V	±1.6 V	3.0 V	14 bits full scale
80E01	7 ps*3	1.0 V_{p-p}	±1.6 V	±1.6 V	2.0 V	14 bits full scale

*3 Calculated from 0.35 bandwidth rise time product.

Module	Vertical Sensitivity Range	DC Vertical Voltage Accuracy, Single Point, within ±2 °C of Compensated Temperature	Typical Step Response Aberrations*2	RMS Noise*2
80E10	10 mV to 1.0 V full scale	±[2 mV + 0.007 (Offset) + 0.02 (Vertical Value – Offset)]	*±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*	50 GHz: *600 µV,* ≤700 µV 40 GHz: *370 µV,* ≤480 µV 30 GHz: *300 µV,* ≤410 µV
80E09	10 mV to 1.0 V full scale	±[2 mV + 0.007 (Offset) + 0.02 (Vertical Value – Offset)]	*±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*	60 GHz: *450 µV,* ≤600 µV 40 GHz: *330 µV,* ≤480 µV 30 GHz: *300 µV,* ≤410 µV
80E08	10 mV to 1.0 V full scale	±[2 mV + 0.007 (Offset) + 0.02 (Vertical Value – Offset)]	*±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*	30 GHz: *300 µV,* ≤410 µV 20 GHz: *280 µV,* ≤380 µV
80E07	10 mV to 1.0 V full scale	±[2 mV + 0.007 (Offset) + 0.02 (Vertical Value – Offset)]	*±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*	30 GHz: *300 µV,* ≤410 µV 20 GHz: *280 µV,* ≤380 µV
80E06	10 mV to 1.0 V full scale	±[2 mV + 0.007 (Offset) + 0.02 (Vertical Value – Offset)]	*±5% or less for first 300 ps following step transition*	*1.8 mV,* ≤2.4 mV (maximum)
80E04	10 mV to 1.0 V full scale	±[2 mV + 0.007 (Offset) + 0.02 (Vertical Value – Offset)]	*±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*	*600 µV,* ≤1.2 mV (maximum)
80E03 80E03-NV	10 mV to 1.0 V full scale	±[2 mV + 0.007 (Offset) + 0.02 (Vertical Value – Offset)]	*±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*	*600 µV,* ≤1.2 mV (maximum)
80E01	10 mV to 1.0 V full scale	±[2 mV + 0.007 (Offset) + 0.02 (Vertical Value – Offset)]	*±3% or less over the zone 10 ns to 20 ps before step transition; +12%, –5% or less for the first 300 ps following step transition; +5.5%, –3% or less over the zone 300 ps to 3 ns following step transition; ±1% or less over the zone 3 ns to 100 ns following step transition; ±0.5% after 100 ns following step transition*	*1.8 mV,* ≤2.3 mV (maximum)

*2 Values shown are warranted unless printed in an italic typeface which represents a unwarranted characteristic value that the instrument will typically perform to.

TDR System (80E10, 80E08, 80E04 only)

Characteristic	80E10	80E08	80E04
Channels	2	2	2
Input Impedance	50 Ω nominal	50 Ω nominal	50 Ω nominal
Channel Input Connector	1.85 mm	2.92 mm	3.5 mm
Bandwidth	50 GHz	30 GHz	20 GHz
TDR Step Amplitude	250 mV (polarity of either step may be inverted)	250 mV (polarity of either step may be inverted)	250 mV (polarity of either step may be inverted)
TDR System Reflected Rise Time	*15 ps*	*20 ps*	*28 ps*
TDR System Incident Rise Time	*12 ps*	*18 ps*	*23 ps*
TDR Step Deskew Range	*±250 ps*	*±250 ps*	±50 ps
TDR Sampler Deskew Range	*±250 ps*	*±250 ps*	*+100 ns –500 ps (slot deskew only)*
TDR Step Maximum Repetition Rate	200 kHz	200 kHz	200 kHz

Physical Characteristics

Module	Dimension (mm / in.)			Weight (kg / lb.)
	Width	Height	Depth	Net
80E10*[6]	55 / 2.2	25 / 1.0	75 / 3.0	0.175 / 0.37
80E09*[6]	55 / 2.2	25 / 1.0	75 / 3.0	0.175 / 0.37
80E08*[6]	55 / 2.2	25 / 1.0	75 / 3.0	0.175 / 0.37
80E07*[6]	55 / 2.2	25 / 1.0	75 / 3.0	0.175 / 0.37
80E06	79 / 3.1	25 / 1.0	135 / 5.3	0.4 / 0.87
80E04	79 / 3.1	25 / 1.0	135 / 5.3	0.4 / 0.87
80E03 80E03-NV	79 / 3.1	25 / 1.0	135 / 5.3	0.4 / 0.87
80E01	79 / 3.1	25 / 1.0	135 / 5.3	0.4 / 0.87

*[6] Remote sampler module characteristics.

Ordering Information

80E10
Dual-channel, 50 GHz True Differential TDR Sampling Module with Remote Samplers.

Includes: User manual, certificate of traceable calibration standard, two precision adapters to 2.92 mm included with 50 Ω SMA terminations.

80E09
Dual-channel, 60 GHz Sampling Module.

Includes: User manual, certificate of traceable calibration standard, two precision adapters to 2.92 mm included with 50 Ω SMA terminations.

80E08
Dual-channel, 30 GHz True Differential TDR Sampling Module with Remote Samplers.

Includes: User manual, certificate of traceable calibration standard, two 50 Ω SMA terminations.

80E07
Dual-channel, 30 GHz Sampling Module.

Includes: User manual, certificate of traceable calibration standard, two 50 Ω SMA terminations.

80E06
70+ GHz Electrical Sampling Module.

Includes: User manual, calibration data report, precision adapter to 2.92 mm with 50 Ω SMA termination.

80E06X2 – Bundled ordering configuration provides two 80E06 modules.

80E04
Dual-channel, 20 GHz True Differential TDR Sampling Module.

Includes: User manual, calibration data report, two 50 Ω SMA terminations.

80E03 / 80E03-NV*[7]
Dual-channel, 20 GHz Sampling Module.

Includes: User manual, calibration data report, two 50 Ω SMA terminations.

80E01
Single-channel, 50 GHz Sampling Module.

Includes: User manual, calibration data report, precision adapter to 2.92 mm included with 50 Ω SMA termination.

*[7] For the 80E03-NV, bandwidth is directly verified and the Calibration Certification Report includes test data on the module's bandwidth test results.

Service Options

Opt. C3 – Calibration Service 3 Years.
Opt. C5 – Calibration Service 5 Years.
Opt. D1 – Calibration Data Report (not available with 80E07 - 80E10).
Opt. D3 – Calibration Data Report 3 Years (with Opt. C3).
Opt. D5 – Calibration Data Report 5 Years (with Opt. C5).
Opt. R3 – Repair Service 3 Years (including warranty).
Opt. R5 – Repair Service 5 Years (including warranty).

Other Accessories

Sampling Module Extender Cable (2-meter length) – Order 80N01 (not for use with 80E07 - 80E10).
2X Attenuator (SMA Male-to-Female) – Order 015-1001-xx.
5X Attenuator (SMA Male-to-Female) – Order 015-1002-xx.
Adapter (2.4 mm male to 2.92 mm female – can also be used as 1.85 mm male to 2.92 mm female) – Order 011-0157-xx.
P8018 – 20 GHz Single-ended TDR Probe. 80A02 module (below) recommended for static protection of the sampling or TDR module.
P80318 – 18 GHz Differential TDR Probe. 80A02 module (below) recommended for static protection of each channel of the sampling or TDR module.
80A02 – EOS/ESD Protection Module (1 channel). P8018 or P80318 TDR probe (above) recommended.

Interconnect Cables (3rd party)

Tektronix recommends using quality high-performance interconnect cables with these high-bandwidth products in order to minimize measurement degradation and variations. The W.L. Gore & Associates' cable assemblies, accessible at www.gore.com/tektronix, are compatible with the 2.92 mm, 2.4 mm, and 1.85 mm connector interface of the 80Exx modules. Assemblies can be ordered by contacting Gore (at the URL above).

Calibration Kits and Accessories (3rd party)

To facilitate S-parameter measurements with these electrical modules and IConnect® software, we recommend precision calibration kits, adapter kits, connector savers, airlines, torque wrenches, and connector gauges from Maury Microwave. These components, accessible at www.maurymw.com/tektronix.htm, are compatible with the 2.92 mm, 2.4 mm, and 1.85 mm connector interface of the 80Exx modules. Cal kits and other components can be ordered by contacting Maury Microwave (at the URL above).

CE

ISO 9001 Product(s) are manufactured in ISO registered facilities.

Contact Tektronix:

ASEAN / Australasia (65) 6356 3900
Austria +41 52 675 3777
Balkans, Israel, South Africa and other ISE Countries +41 52 675 3777
Belgium 07 81 60166
Brazil +55 (11) 3759-7627
Canada 1 (800) 661-5625
Central East Europe, Ukraine, and the Baltics +41 52 675 3777
Central Europe & Greece +41 52 675 3777
Denmark +45 80 88 1401
Finland +41 52 675 3777
France +33 (0) 1 69 86 81 81
Germany +49 (221) 94 77 400
Hong Kong (852) 2585-6688
India (91) 80-42922600
Italy +39 (02) 25086 1
Japan 81 (3) 6714-3010
Luxembourg +44 (0) 1344 392400
Mexico, Central/South America & Caribbean 52 (55) 54247900
Middle East, Asia, and North Africa +41 52 675 3777
The Netherlands 090 02 021797
Norway 800 16098
People's Republic of China 86 (10) 6235 1230
Poland +41 52 675 3777
Portugal 80 08 12370
Republic of Korea 82 (2) 6917-5000
Russia & CIS +7 (495) 7484900
South Africa +27 11 206 8360
Spain (+34) 901 988 054
Sweden 020 08 80371
Switzerland +41 52 675 3777
Taiwan 886 (2) 2722-9622
United Kingdom & Ireland +44 (0) 1344 392400
USA 1 (800) 426-2200

For other areas contact Tektronix, Inc at: 1 (503) 627-7111

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