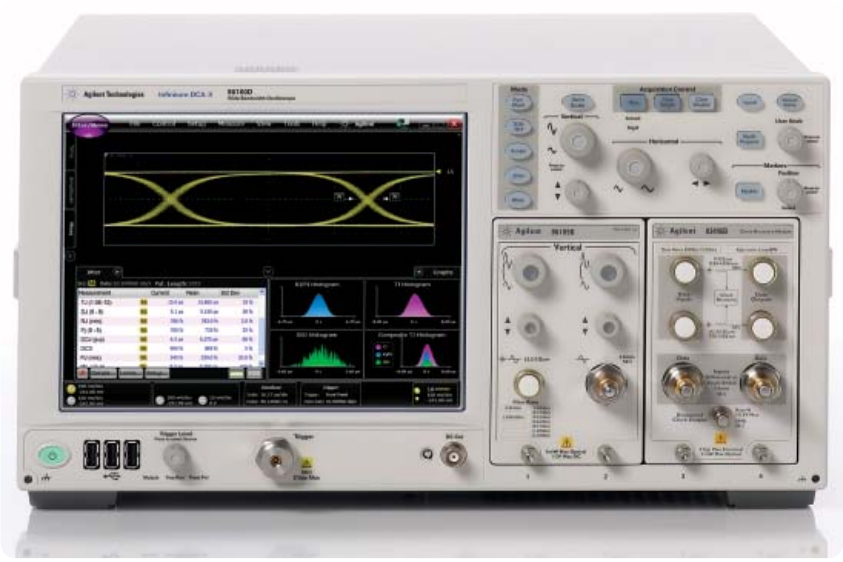
infiniium DCA-X

Agilent 86100D Wide-Bandwidth Oscilloscope Mainframe and Modules

Technical Specifications



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See the TRUE performance of your designs

The 86100D DCA-X performs precision measurements on high-speed digital designs from 50 Mb/s to over 80 Gb/s. Applications include:

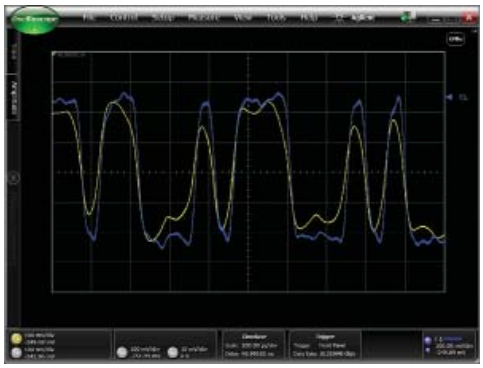
- Optical
  - Transceiver Design and Manufacturing
- Electrical
  - ASIC/FPGA/IC Design and characterization
- TDR/TDT/S-Parameter
  - Serial Bus Designs, Cables, and PCB characterization

Agilent Technologies

Overview of the 86100D Infiniium DCA-X

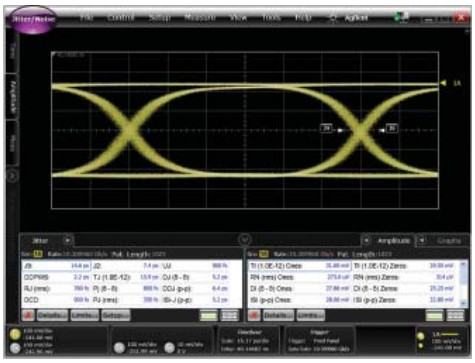
The 86100D DCA-X can be viewed as four powerful instruments in one:

Scope Mode



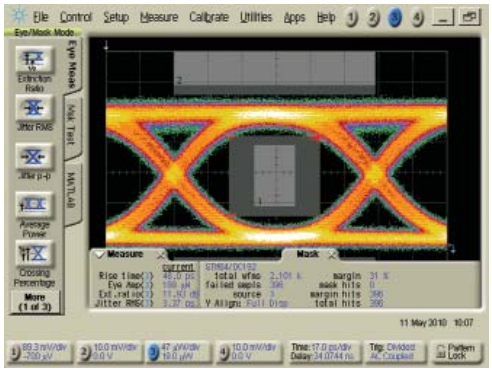
High-fidelity waveform characterization (Yellow: raw trace, Blue: de-embedded waveform)

Jitter Mode



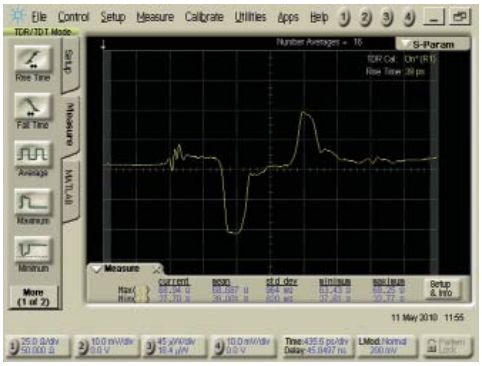
Precision jitter, amplitude, and frequency analysis capability

Eye/Mask Mode



Fast transmitter characterization using eye diagram analysis and automated mask margin measurements

TDR/TDT Mode



Accurate time domain reflectometry/transmission and S-Parameter measurements

These modes are further complimented by the following features that provide additional insight and analysis capability:

- De-embedding, embedding, equalizer capability
- Phase Noise/Jitter Spectrum Analysis
- Phase Locked Loop (PLL) Analysis
- And more...

Precision Measurements, More Margin, and More Insight

The 86100D DCA-X oscilloscope combines high analog bandwidth, low jitter, and low noise performance to accurately characterize optical and electrical designs from 50Mb/s to over 80 Gb/s. The mainframe provides the foundation for powerful insight and measurement capability, such as de-embedding of cables and fixtures, that improve margins and allow engineers to see the true performance of their designs.

Modular

The modular system means that the instrument can grow to meet your needs, when you need it. There's no need to purchase capability that you don't need now. The DCA-X supports a wide range of modules for testing optical and electrical designs. Select modules to get the specific bandwidth, filtering, and sensitivity you need. The DCA-X supports all modules in the DCA family and is 100% backwards compatible with the 86100C mainframe.

Software

The DCA-X provides powerful analysis capability that is enabled through licensed software options.

Examples include 86100D-200 for fast and accurate jitter analysis, and 86100D-SIM for de-embedding and/or embedding of fixtures and cables.

Specifications

General and mainframe

Specifications describe warranted performance over the temperature range of +10 °C to +40 °C (unless otherwise noted). The specifications are applicable for the temperature after the instrument is turned on for one (1) hour, and while self-calibration is valid. Many performance parameters are enhanced through frequent, simple user calibrations. Characteristics provide useful, non-warranted information about the functions and performance of the instrument. Characteristics are printed in italic typeface. Product specifications and descriptions in this document are subject to change without notice.

Comparing specifications

When comparing performance attributes between instruments, ensure you compare the same type of parameter. For example, compare warranted specifications from both instruments, or compare characteristics or typical performance. Warranted specifications include measurement uncertainties and are conservative compared to other types of unwarranted attributes.

Factory Calibration Cycle - For optimum performance, the instrument should have a complete verification of specifications once every twelve (12) months.

General specifications

Temperature	Operating	10 °C to +40 °C (50 °F to +104 °F)
	Non-perating	–40 °C to +65 °C (–40 °F to +158 °F)
Altitude	Operating	Up to 4,600 meters (15,000 feet)
Power (max)	100/120Vac 50/60/400 Hz	With typical modules: 150 VA to 230 VA at 25°C
	220/240Vac 50/60 Hz, 700 Watts maximum	
Weight	Mainframe without modules	20.5 kg (43 lb)
	Typical module	1.2 kg (2.6 lb)
Mainframe dimensions (excluding handle)	Without front connectors and rear feet	221 mm H x 426 mm W x 530 mm D (7 inch x 16.76 inch x 20.9 inch)
	With front connectors and rear feet	234 mm H x 426 mm W x 601 mm D (9.23 inch x 16.76 inch x 23.67 inch)
	With front cover and rear feet	234 mm H x 426 mm W x 612 mm D (9.23 inch x 16.76 inch x 24.1 inch)

Mainframe specifications

Horizontal system (time base) Scale factor (full scale is ten divisions)		Pattern lock
Minimum	2 ps/div (with 86107A: 500fs/div)	
Maximum	1 s/div	250 ns/div
Delays[1]		
Minimum	24 ns	40.1 ns default, 24 ns min
Maximum	1000 screen diameters or 10 s whichever is smaller	1000 screen diameters or 25.401 µs whichever is smaller
Time interval accuracy[2]	1 ps + 1.0% of Δ time reading[3] or 8 ps, whichever is smaller	
Jitter mode operation[4]	Time interval accuracy - jitter mode operation 1 ps	
Time interval resolution	≤ (screen diameter)/(record length) or 62.5 fs, whichever is larger	
Display units	Bits or time (TDR mode–meters)	
Vertical system (channels)		
Number of channels	16 (simultaneous acquisition)	
Vertical resolution	14 bit A/D converter (up to 15 bits with averaging)	
Full resolution channel	Adjusts in a 1-2-5-10 sequence for coarse adjustment or fine adjustment resolution from the front panel knob	
Adjustments	Scale, offset, activate filter, sampler bandwidth, attenuation factor, transducer conversion factors	
Record length	16 to 16384 samples – increments of 1	

1. *Time offset relative to the front panel trigger input on the instrument mainframe.*
2. *Dual marker measurement performed at a temperature within 5 °C of horizontal calibration temperature.*
3. *The maximum delay setting is 100 ns and delta time does not span across (28 + Nx4)ns ± 100 ps delay setting, where N=0,1,2....18. If delta time measurement spanexceeds above criteria, time interval accuracy is 8 ps +0.1% of Δ time reading.*
4. *Characteristic performance. Test configuration: PRBS of length 27 – 1 bits, Data and Clock 10 Gb/s.*

Specifications

Mainframe

	Option STR (standard trigger)	Option ETR (enhanced trigger)
Trigger modes		
Internal trigger[1]	Free run	Free run
External direct trigger[2]		
Limited bandwidth[3]	DC to 100 MHz	DC to 100 MHz
Full bandwidth	DC to 3.2 GHz	DC to 3.2 GHz
External divided trigger	N/A	3 GHz to 13 GHz (3 GHz to 15 GHz)
PatternLock	N/A	50 MHz to 13 GHz (50 MHz to 15 GHz)
Jitter		
Characteristic	< 1.0 ps RMS + 5*10E-5 of delay setting[4]	1.2 ps RMS for time delays less than 100 ns[6]
Maximum	1.5 ps RMS + 5*10E-5 of delay setting[4]	1.7 ps RMS for time delays less than 100 ns[6]
Trigger sensitivity		
	200 m Vpp (sinusoidal input or 200 ps minimum pulse width)	200 m Vpp sinusoidal input: 50 MHz to 8 GHz 400 m Vpp sinusoidal input: 8 GHz to 13 GHz 600 m Vpp sinusoidal input: 13 GHz to 15 GHz
Trigger configuration		
Trigger level adjustment	–1 V to + 1 V	AC coupled
Edge select	Positive or negative	N/A
Hysteresis[5]	Normal or High sensitivity	N/A
Trigger gating		
Gating input levels (TTL compatible)	Disable: 0 to 0.6 V, Enable: 3.5 to 5 V Pulse width > 500 ns, period > 1 µs	
Gating delay		
	Disable: 27 µs + trigger period + Maximum time displayed Enable: 100 ns	
Trigger impedance		
Nominal impedance	50 Ω	
Reflection	10% for 100 ps rise time	
Connector type	3.5 mm (male)	
Maximum trigger signal	2 V peak-to-peak	

1. *The freerun trigger mode internally generates an asynchronous trigger that allows viewing the sampled signal amplitude without an external trigger signal but provides no timing information. Freerun is useful in troubleshooting external trigger problems.*
2. *The sampled input signal timing is recreated by using an externally supplied trigger signal that is synchronous with the sampled signal input.*
3. *The DC to 100 MHz mode is used to minimize the effect of high frequency signals or noise on a low frequency trigger signal.*
4. *Measured at 2.5 GHz with the triggering level adjusted for optimum trigger.*
5. *High Sensitivity Hysteresis Mode improves the high frequency trigger sensitivity but is not recommended when using noisy, low frequency signals that may result in false triggers without normal hysteresis enabled.*
6. *Slew rate ≥ 2 V/ns.*

Computer System and Storage

Computer system and storage	
CPU Mass storage	Intel® Core 2 Duo 3.06 GHz 160 GByte internal hard drive (default) or 160 GByte removable hard drive (Option 090)
Operating system	Microsoft Windows® XP Pro
Display[1]	
Display area	210.4 mm x 157.8 mm (10.4 inch diagonal color active matrix LCD module incorporating amorphous silicon TFTs)
Entire display resolution	1024 pixels horizontally x 768 pixels vertically
Waveform colors	Select from over 16 colors; user may change color assignment of all traces (channels, waveform memory and signal processing functions)
Persistence modes	Gray scale, color grade, variable, infinite
Waveform overlap	When two waveforms overlap, a third color distinguishes the overlap area (classic DCA-J interface only)
Connect-the-dots	On/Off selectable
Persistence	Minimum, variable (100 ms to 40 s), infinite
Graticule	On/Off
Grid intensity	0 to 100%
Backlight saver	2 to 8 hrs, enable option
Dialog boxes	Opaque or transparent
Front panel inputs and outputs	
Cal output	BNC (female) and test clip, banana plug
Trigger input	APC 3.5 mm, 50 Ω, 2 Vpp base max
USB[2]	Three low-power USB 2.0 ports; Voltage: 5.00V ±0.25V; Current: 100 mA each
Rear panel inputs and outputs	
Gated trigger input	TTL compatible
Video output	VGA, full color, 15 pin D-sub (female) 10
GPIB[3]	Fully programmable, complies with IEEE 488.2
RS-232	Serial printer, 9 pin D-sub (male)
Parallel printer	25 pin D-sub (female)
LAN	
USB[2]	Four USB 2.0 ports; Voltage: 5.00 ±0.25V; Current: 500 mA each

1. *Supports external display. Supports multiple display configurations via Windows XP Pro display utility.*
2. *USB Keyboard and mouse included with mainframe.*
3. *The GPIB card interface is optional. To include this interface, order 86100D-GPI. To add a GPIB card later, order Agilent part number 82351A or contact your local Agilent service center.*

Precision Time Base Module

Measurement performance can be further enhanced by adding precision time base capability to the 86100 mainframe. The precision time base reduces the intrinsic jitter of the scope and is recommended when analyzing high-speed data signals.

Precision Time Base 86107A

	86107A Option 010	86107A Option 020	86107A Option 040
Trigger bandwidth	2.0 to 15.0 GHz	2.4 to 25.0 GHz	2.4 to 48.0 GHz
Typical jitter (RMS)	2.0 to 4.0 GHz trigger: < 280 fs 4.0 to 15.0 GHz trigger: < 200 fs	2.4 to 4.0 GHz < 280 fs 4.0 to 25.0 GHz < 200 fs	2.4 to 4.0 GHz < 280 fs 4.0 to 48.0 GHz < 200 fs
Time base linearity error	< 200 fs		
Input signal type	Synchronous clock[1]		
Input signal level	0.5 to 1.0 Vpp 0.2 to 1.5 Vpp (typical functional performance)		
DC offset range	±200 mV[2]		
Required trigger signal-to-noise ratio	≥ 200: 1		
Trigger gating Gating input levels (TTL compatible)	Disable: 0 to 0.6 V Enable: 3.5 to 5 V Pulse width > 500 ns, period > 1 µs		
Trigger impedance (nominal)	50 Ω		
Connector type	3.5 mm (male)		3.5 mm (male) 2.4 mm (male)

1. *Filtering provided for Option 010 bands 2.4 to 4.0 GHz and 9.0 to 12.6 GHz, for Option 020 9.0 to 12.6 GHz and 18 to 25.0 GHz, for Option 40 9.0 to 12.6 GHz, 18.0 to 25.0 GHz, and 39.0 to 48.0 GHz. Within the filtered bands, a synchronous clock signal should be provided (clock, sinusoid, BERT trigger, etc.). Outside these bands, filtering is required to minimize harmonics and sub harmonics and provide a sinusoid to the 86107 input.*
2. *For the 86107A with Option 020, the Agilent 11742A (DC Block) is recommended if the DC offset magnitude is greater than 200 mV.*

The 86108A can be triggered through clock recovery of the observed signal, through an external reference clock into the precision timebase section, or with the precision timebase operating on the clock signal recovered from the observed signal. The following specifications indicate the 86100 system timebase specifications achieved when using the 86108A plug-in module. (The 86100 mainframe and the 86108A module can also be triggered with a signal into the mainframe. In this configuration, the basic mainframe specifications are achieved.)

Precision Time Base 86108A

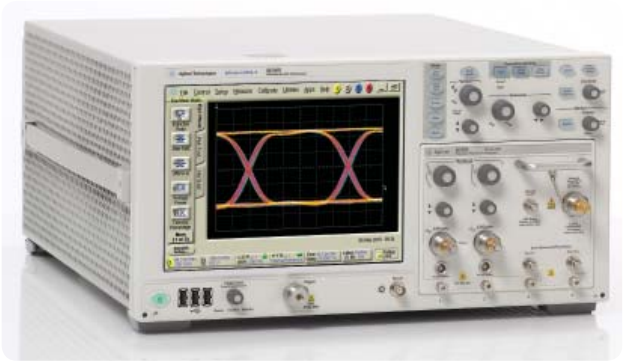
	86108A
Typical jitter (clock recovery and precision timebase configuration)	< 60 fs
Maximum jitter (clock recovery and precision timebase configuration)[1]	< 90 fs
Typical jitter (clock recovery without precision timebase active)	< 1.25 ps
Effective trigger-to-sample delay (clock recovery and precision timebase configuration, typical)	< 200 ps
Typical jitter (trigger signal applied to precision timebase input)	< 60 fs
Maximum jitter (trigger signal supplied to precision timebase input)[1]	< 100 fs
Precision timebase trigger bandwidth	2 to 13.5 GHz (1 to 17 GHz)
Precision timebase external reference amplitude characteristic	1.0 to 1.6 Vpp
Precision timebase input signal type[2]	Sinusoid
Precision timebase maximum input level	±2 V (16 dBm)
Precision timebase maximum DC offset level	±200 mV
Precision timebase input impedance	50 Ω
Precision timebase connector type	3.5 mm male
Timebase resolution (with precision timebase active)	0.5 ps/div
Timebase resolution (precision timebase disabled)	2 ps/div

1. *Verified with maximum level input signal (~800 mVpp)*
2. *The precision timebase performs optimally with a sinusoidal input. Non-sinusoidal signals will operate with some degradation in timebase linearity.*

Modules Selection Table

86100 family plug-in module matrix

The 86100 has a family of plug-in modules designed for a broad range of precision optical, electrical, and TDR/TDT measurements. The 86100 can accommodate up to 4 modules for a total of 16 measurement channels.



Module	Option	No. of optical channels	No. of electrical channels	Probe power[1]	Wavelength range (nm)	Unfiltered optical bandwidth (GHz)	Electrical bandwidth (GHz)	Fiber input (µm)	Mask test sensitivity (dBm)	155 Mb/s	622 Mb/s	1063 Mb/s	1244/1250 Mb/s	2125 Mb/s	2488/2500 Mb/s	2.666 Gb/s	3.125 Gb/s	4.25 Gb/s	5.00 Gb/s	6.25 Gb/s	8.50 Gb/s	9.953 Gb/s	10.3125 Gb/s	10.51875 Gb/s	10.664 Gb/s	10.709 Gb/s	11.096 Gb/s	11.317 Gb/s	14.025 Gb/s	25.80 Gb/s	27.70 Gb/s	39.813 Gb/s	43.018 GB/s
										Filtered data rates																							
86105C	100[2]	1	1		750-1650	8.5	20	62.5	-20	•	•	•	•	•	•	•	•	•	•	•												
	200	1	1		750-1650	8.5	20	62.5	-16												•	•	•	•	•	•	•	•					
	300[2]	1	1		750-1650	8.5	20	62.5	-16	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•					
86105D[3]		1	1		750-1650	20	35	62.5	-12												•	•	•	•	•	•	•	•	•				
86115D[3]	002	2	0		750-1650	20		62.5	-12												•	•	•	•	•	•	•	•	•				
	004[5]	4	0		750-1650	20		62.5	-11												•	•	•	•	•	•	•	•	•				
86116C[3]	025	1	1		1300-1620	45	80	9	-10																					•	•		
86116C[3]	040	1	1		1300-1620	65	80	9	-5																							•	•
54754A		0	2	•	N/A		18																									
86108[3,4]		0	2	•	N/A		32																									
86112A		0	2		N/A		20																									
86117A		0	2		N/A		50																									
86118A		0	2		N/A		70																									

1. *Module has receptacle to supply power for external probe.*
2. *Pick any 4 rates (155 Mb/s to 6.25 Gb/s).*
3. *This module is not compatible with the 86100A and 86100B Digital Communication Analyzer (DCA) mainframes. If you would like to upgrade older DCA's contact Agilent Technologies and ask for current trade-in deals.*
4. *The 86108A uses all module slots.*
5. *4 optical input ports are switched internally to 2 optical-to-electrical (O/E) converters*

Modules Specifications
Single-mode and Multimode Optical/Electrical

Multiple and single-mode optical/electrical modules	86105C	86105D	86115D Option 002	86115D Option 004
Optical channel specifications				
Optical channel unfiltered bandwidth	*8.5 GHz (9 GHz)*	*20 GHz*	*20 GHz*	*20 GHz*
Wavelength range	*750 to 1650 nm*	*750 to 1650 nm*	*750 to 1650 nm*	*750 to 1650 nm*
Calibrated wavelengths	*850 nm/1310 nm/ 1550 nm (±20 nm)*	*850 nm/1310 nm/ 1550 nm*	*850 nm/1310 nm/ 1550 nm*	*850 nm/1310 nm/ 1550 nm*
Optical sensitivity[1]	*850 nm:* *≤ 2.666 Gb/s, –20 dBm* *> 2.666 Gb/s to ≤ 4.25 Gb/s, –19 dBm* *> 4.25 Gb/s to 11.3 Gb/s, –16 dBm* *1310 nm/1550 nm:* *≤ 2.666 Gb/s, –21 dBm* *> 2.666 Gb/s to ≤ 4.25 Gb/s, –20 dBm* *> 4.25 Gb/s to 11.3 Gb/s, –17 dBm*	*850 nm:* *8.5 to 11.3 Gb/s, –9 dBm* *14.025 Gb/s, –6 dBm* *1310 nm/1550 nm:* *8.5 to 11.3 Gb/s, –12 dBm* *14.025 Gb/s, –9 dBm*	*850 nm:* *8.5 to 11.3 Gb/s, –9 dBm* *14.025 Gb/s, –6 dBm* *1310 nm/1550 nm:* *8.5 to 11.3 Gb/s, –12 dBm* *14.025 Gb/s, –9 dBm*	*850 nm:* *8.5 to 11.3 Gb/s, –8 dBm* *14.025 Gb/s, –5 dBm* *1310/1550 nm:* *8.5 to 11.3 Gb/s, –11 dBm* *14.025 Gb/s, –8 dBm*
Transition time (10% to 90% calculated from TR = 0.48/BW optical)	*56 ps*	*24 ps*	*24 ps*	*24 ps*
RMS noise				
Characteristic	*850 nm:* *≤ 2.666 Gb/s, 1.3 µW* *> 2.666 Gb/s to ≤ 4.25 Gb/s, 1.5 µW* *> 4.25 Gb/s to 11.3 Gb/s, 2.5 µW* *1310 nm/1550 nm:* *≤ 2.666 Gb/s, 0.8 µW* *> 2.666 Gb/s to ≤ 4.25 Gb/s, 1.0 µW* *> 4.25 Gb/s to 11.3 Gb/s, 1.4 µW*	*850 nm:* *8.5 to 11.3 Gb/s, 10 µW* *14.025 Gb/s, 16 µW* *1310/1550 nm:* *8.5 to 11.3 Gb/s, 5 µW* *14.025 Gb/s, 8 µW*	*850 nm:* *8.5 to 11.3 Gb/s, 10 µW* *14.025 Gb/s, 16 µW* *1310/1550 nm:* *8.5 to 11.3 Gb/s, 5 µW* *14.025 Gb/s, 8 µW*	*850 nm:* *8.5 to 11.3 Gb/s, 12 µW* *14.025 Gb/s, 20 µW* *1310/1550 nm:* *8.5 to 11.3 Gb/s, 6 µW* *14.025 Gb/s, 10 µW*
Maximum	850 nm: ≤ 2.666 Gb/s, 2.0 µW > 4.25 Gb/s to 11.3 Gb/s, 4.0 µW 1310 nm/1550 nm: ≤ 2.666 Gb/s, 1.3 µW > 2.666 Gb/s to ≤ 4.25 Gb/s, 1.5 µW > 4.25 Gb/s to 11.3 Gb/s, 2.5 µW	850 nm: 8.5 to 11.3 Gb/s, 12 µW 14.025 Gb/s, 24 µW 1310/1550 nm: 8.5 to 11.3 Gb/s, 7 µW 14.025 Gb/s, 12 µW	850 nm: 8.5 to 11.3 Gb/s, 12 µW 14.025 Gb/s, 24 µW 1310/1550 nm: 8.5 to 11.3 Gb/s, 7 µW 14.025 Gb/s, 12 µW	850 nm: 8.5 to 11.3 Gb/s, 14 µW 14.025 Gb/s, 30 µW 1310/1550 nm: 8.5 to 11.3 Gb/s, 8.5 µW 14.025 Gb/s, 14 µW
Scale factor (per division)				
Minimum	2 µW	20 µW	20 µW	20 µW
Maximum	100 µW	500 µW	500 µW	500 µW
CW[2] accuracy (single marker, referenced to average power monitor)	Single-mode: ±25 µW ±3% Multimode: ±25 µW ±10%	Single-mode: ±25 µW ±(2% (8/10 Gb/s), 4% (14 Gb/s) 6% unfiltered) Multimode: ±25 µW ±10%	Single-mode: ±25 µW ±(2% (8/10 Gb/s), 4% (14 Gb/s) 6% unfiltered) Multimode: ±25 µW ±10%	Single-mode: ±25 µW ±(2% (8/10 Gb/s), 4% (14 Gb/s) 6% unfiltered) Multimode: ±25 µW ±10%
CW offset range (referenced two divisions from screen bottom)	+0.2 µW to –0.6 µW	+1 µW/–3 µW	+1 µW/–3 µW	+1 µW/–3 µW
Average power monitor (specified operating range)	*–30 dBm to 0 dBm*	*–30 dBm to +3 dBm*	*–30 dBm to +3 dBm*	*–30 dBm to +3 dBm*

1. *Smallest average optical power required for mask test. Values represent typical sensitivity of NRZ eye diagrams. Assumes mask test with complicance filter switched in.*
2. *CW refers to an unmodulated optical signal.*

Modules Specifications
Single-mode and Multimode Optical/Electrical

Multiple and single-mode optical/electrical modules	86105C	86105D	86115D Option 002	86115D Option 004
Optical channel specifications (continued)				
Average power monitor accuracy				
Single-mode	±5% ±200 nW ±connector uncertainty	± 5%±200 nW ±connector uncertainty	±5% ±100 nW ±connector uncertainty (20 to 30 °C)	± 5%±200 nW ±connector uncertainty
Multimode (characteristic)	±10% ±200 nW ±connector uncertainty	± 5% ±200 nW ±connector uncertainty	± 5% ±200 nW ±connector uncertainty	± 5% ±200 nW ±connector uncertainty
User calibrated accuracy				
Single-mode	±3% ±200 nW ±power meter uncertainty, < 5 °C change	±2% ±100 nW ±power meter uncertainty	±2% ±100 nW ±power meter uncertainty, < 5 °C change	±2% ±100 nW ±power meter uncertainty
Multimode (characteristic)	±10% ±200 nW ±power meter uncertainty, < 5 °C change	±10% ±200 nW ±power meter uncertainty	±10% ±200 nW ±power meter uncertainty	±10% ±200 nW ±power meter uncertainty
Maximum input power				
Maximum non-destruct average	0.5 mW (–3 dBm)	5 mW (7 dBm)	5 mW (7 dBm)	5 mW (7 dBm)
Maximum non-destruct peak	5 mW (+7 dBm)	10 mW (10 dBm)	10 mW (10 dBm)	10 mW (10 dBm)
Fiber input	62.5/125 µm	62.5/125 µm user-selectable connector	62.5/125 µm user-selectable connector	62.5/125 µm user-selectable connector
Input return loss (HMS-10 connector fully filled fiber)	850 nm > 13 dB 1310 nm/1550 nm > 24 dB	27 dB single-mode 14 dB multimode	27 dB single-mode 14 dB multimode	27 dB single-mode 14 dB multimode
Electrical channel specifications				
Electrical channel bandwidth	12.4 and 20 GHz	25 and 35 GHz		
Transition time (10% to 90% calculated from TR = 0.35/BW)	28.2 ps (12.4 GHz) 17.5 ps (20 GHz)	14 ps (25 GHz) 10 ps (35 GHz)		
RMS noise				
Characteristic	0.25 mV (12.4 GHz) 0.5 mV (20 GHz)	0.25 mV (25 GHz) 0.5 mV (35 GHz)		
Maximum	0.5 mv (12.4 GHz) 1 mV (20 GHz)	0.5 mV (25 GHz) 1 mV (35 GHz)		
Scale factor (per division)				
Minimum	1 mV/division			
Maximum	100 mV/division			
DC accuracy (single marker)	±0.4% of full scale ±2 mV ±1.5% of (reading-channel offset), 12.4 GHz ±0.4% of full scale ±2 mV ±3% of (reading-channel offset), 20 GHz			
DC offset range (referenced to center of screen)	±500 mV			
Input dynamic range (relative to channel offset)	±400 mV			
Maximum input signal	±2 V (+16 dBm)			
Nominal impedance	50 Ω			
Reflections (for 30 ps rise time)	5%			
Electrical input	3.5 mm (male)			

Modules Specifications
Single-mode Optical/Electrical

High bandwidth single-mode optical/electrical modules		86116C Option 025	86116C Option 040
Optical channel specifications			
Optical channel unfiltered bandwidth		45 GHz	65 GHz
Wavelength range		1300n m to 1620 nm[3]	
Calibrated wavelengths		1310 nm/1550 nm	
Optical sensitivity	1310 nm	–9 dBm (17 Gb/s) –8 dBm (25.8 Gb/s) –7 dBm (27.7 Gb/s)	–3 dBm (39.8/43.0 Gb/s
	1550 nm	–10 dBm (17 Gb/s) –9 dBm (25.8 Gb/s) –8 dBm (27.7 Gb/s)	–5 dBm (39.8/43.0 Gb/s)
Transition time (10% to 90% calculated from Tr = 0.48/BW optical)		7.4 ps (FWHM)[1]	
RMS noise			
Characteristic	1310 nm	13 µW (17 Gb/s) 17 µW (25.8 Gb/s) 20 µW (27.7 Gb/s) 60 µW (40 GHz)	54 µW (39.8/43.0 Gb/s) 75 µW (55 GHz) 105 µW (60 GHz) 187 µW (65 GHz)
	1550 nm	10 µW (17 Gb/s) 12 µW (25.87 Gb/s) 14 µW (27.7 Gb/s) 40 µW (40 GHz)	36 µW (39.8/43.0 Gb/s) 50 µW (55 GHz) 70 µW (60 GHz) 125 µW (65 GHz)
Maximum	1310 nm	18 µW (17 Gb/s) 20 µW (25.8 Gb/s) 30 µW (27.7 Gb/s) 120 µW (40 GHz)	102 µW (39.8/43.0 Gb/s) 127 µW (55 GHz) 225 µW (60 GHz) 300 µW (65 GHz)
	1550 nm	15 µW (17 Gb/s) 18 µW (25.8 Gb/s) 21 µW (27.7 Gb/s) 80 µW (40 GHz)	68 µW (39.8/43.0 Gb/s) 85 µW (55 GHz) 150 µW (60 GHz) 200 µW (65 GHz)

1. *FWHM (Full Width Half Max) as measured from optical pulse with 700 fs FWHM, 5 MHz repetition rate and 10 mW peak power.*
2. *Smallest average optical power required for mask test. Values represent typical sensitivity of NRZ eye diagrams. Assumes mask test with compliance filter switched in.*
3. *Contact Agilent for broader wavelength specifications.*

Modules Specifications
Single-mode Optical/Electrical

High bandwidth single-mode optical/electrical modules	86116C
Optical channel specifications (continued)	
Scale factor	
Minimum	200 µW/division
Maximum	5 mW/division
CW[1] accuracy (single marker, reference to average power monitor)	± 150 µW ± 4% (reading-channel offset)
CW offset range (referenced two divisions from screen button)	+8 to –12mW
Average power monitor (specified operating range)	–23 to +9 dBm
Factory calibrated accuracy User calibrated accuracy	±5% ±100 nW ±connector uncertainty, 20 to 30 °C ±2% ±100 nW ±power meter uncertainty, < 5 °C change
Maximum input power	
Maximum non-destruct average	10 mW (+10 dBm)
Maximum non-destruct peak	50 mW (+17 dBm)
Fiber input	9/125 µm, user-selectable connector
Input return loss (HMS-10 connector fully filled fiber)	20 dB
Electrical channel specifications	
Electrical channel bandwidth	80 *(93)*, 55 and 30 GHz
Transition time *(10% to 90% calculated from Tr = 0.35/BW)*	*6.4 ps (55 GHz)* *4.4 ps (80 GHz)*
RMS noise	
Characteristic	*0.5 mV (30 GHz)* *0.6 mV (55 GHz)* *1.1 mV (80 GHz)*
Maximum	0.8 mV (30 GHz) 1.1 mV (55 GHz) 2.2 mV (80 GHz)
Scale factor	
Minimum	2 mV/division
Maximum	100 mV/division
DC accuracy (single marker)	±0.4% of full scale ±3 mV ±2% of (reading-channel offset), ±2% of offset (all bandwidths)
DC offset range (referenced to center of screen)	±500 mV
Input dynamic range (relative to channel offset)	±400 mV
Maximum input signal	± 2 V (+16 dBm)
Nominal impedance	50 Ω
Reflections (for 20 ps rise time)	10% (DC to 70 GHz) 20% (70 to 100 GHz)
Electrical input	1.85 mm (male)

1. CW refers to an unmodulated optical signal.

Modules Specifications
Dual Electrical

Dual electrical channel modules	86112A	54754A
Electrical channel bandwidth	12.4 and 20 GHz	12.4 and 18 GHz
Transition time (10% to 90% calculated from TR = 0.35/BW)	*28.2 ps (12.4 GHz)* *17.5 ps (20 GHz)*	*28.2 ps (12.4 GHz)* *19.4 ps (18 GHz)*
RMS noise		
Characteristic	*0.25 mV (12.4 GHz)* *0.5 mV (20 GHz)*	*0.25 mV (12.4 GHz)* *0.5 mV (18 GHz)*
Maximum	0.5 mv (12.4 GHz) 1 mV (20 GHz)	0.5 mv (12.4 GHz) 1 mV (18 GHz)
Scale factor (per division)		
Minimum	1 mV/division	
Maximum	100 mV/division	
DC accuracy (single marker)	±0.4% of full scale ±2 mV ±1.5% of (reading-channel offset), (12.4 GHz) ±0.4% of full scale ±2 mV ±3% of (reading-channel offset) (20 GHz)	±0.4% of full scale ±2 mV ±0.6% of (reading-channel offset), (12.4 GHz) ±0.4% of full scale or marker reading (whichever is greater) ±2 mV ±1.2% of (reading-channel offset) (18 GHz)
DC offset range (referenced from center of screen)	±500 mV	
Input dynamic range (relative to channel offset)	±400 mV	
Maximum input signal	±2 V (+16 dBm)	
Nominal impedance	50 Ω	
Reflections (for 30 ps rise time)	5%	
Electrical input	3.5 mm (male)	

Dual electrical channel modules	86117A	86118A
Electrical channel bandwidth	30 and 50 GHz	50 and 70 GHz
Transition time (10% to 90% calculated from TR = 0.35/BW)	*11.7 ps (30 GHz)* *7 ps (50 GHz)*	
RMS noise		
Characteristic	*0.4 mV (30 GHz)* *0.6 mV (50 GHz)*	*0.7 mV (50 GHz)* *1.3 mV (70 GHz)*
Maximum	0.7 mv (30 GHz) 1.0 mV (50 GHz)	1.8 mv (50 GHz) 2.5 mV (70 GHz)
Scale factor (per division)		
Minimum	1 mV/division	
Maximum	100 mV/division	
DC accuracy (single marker)	±0.4% of full scale ±2 mV ±1.2% of (reading-channel offset), (30 GHz) ±0.4% of full scale ±2 mV ±2% of (reading-channel offset), (50 GHz)	±0.4% of full scale ±2 mV ±2% of (reading-channel offset), (50 GHz) ±0.4% of full scale ±2 mV ±4% of (reading-channel offset), (70 GHz)
DC offset range (referenced from center of screen)	±500 mV	
Input dynamic range (relative to channel offset)	±400 mV	
Maximum input signal	±2 V (+16 dBm)	
Nominal impedance	50 Ω	
Reflections (for 30 ps rise time)	5%	20%
Electrical input	2.4 mm (male)	1.85 mm (female)

Modules Specifications
Dual Electrical

Dual electrical channel modules	86108A
Bandwidth[1]	*16 GHz and < 32 GHz, (35 GHz)*
Transition time (10% to 90% calculated from Tr = 0.35/BW)	*10 ps*
RMS noise	
Characteristic	240 µV (16 GHz) 420 µV (32 GHz)
Maximum	350 µV (16 GHz) 700 µV (32 GHz)
Scale factor (per division)	
Minimum	2 mV/division
Maximum	100 mV/division
DC accuracy (single marker)	±0.7% of full scale, ±2 mV ±1.5% of (reading-channel offset) (16 GHz) ±0.7% of full scale, ±2 mV ±3% of (reading-channel offset) (32 GHz)
CW offset range (referenced from center of screen)	±500 mV
Input dynamic range (relative to channel offset)	±400 mV
Maximum input signal	±2 V (+16 dBm)
Nominal impedance	*50 Ω*
Reflections (for 30 ps rise time)	*5%*
Electrical input	3.5 mm (male)
CH1 to CH2 skew	*< 12 ps*

Clock recovery	
Data rates input range	Continuous tuning 0.05 to 14.2 Gb/s (requires FW revision 8.1 or higher)
Clock frequency input range	Continuous tuning 0.025 to 6.75 GHz
Minimum input level to aquire lock	175 m Vpp
Minimum input level to aquire lock and achieve jitter specifications	*125 m Vpp*
Recovered clock random jitter (used as internal trigger)[2]	Internal recovered clock trigger < 500 fs at 2 Gb/s < 400 fs at 5 and 10 Gb/s
Clock recovery adjustable loop bandwidth range (user selectable)	0.015 to 10 MHz
Clock recovery loop peaking range	Up to 4 settings (dependent on loop BW)
Loop bandwidth accuracy	±30%
Tracking range (includes spread spectrum tracking)	*±2500 ppm ±0.25%*
Aquisition range	*±5000 ppm*
Maximum consecutive identical digits to lock	*150*
Auto relocking	If signal lock is lost, system can automatically attempt to regain phase-lock. User selectable to enable/disable
Residual spread spectrum	–72 ±3 dB @ 33 kHz
Front panel recovered clock amplitude	0.15 to 1.0 Vpp *(0.3 to 1.0 Vpp)*
Front panel recovered clock divide ratio (user selectable)	1, 2, 4, 8, 16 2, 4, 8, 16
Recovered clock front panel connector type	SMA
Internal frequency counter accuracy	±10 ppm

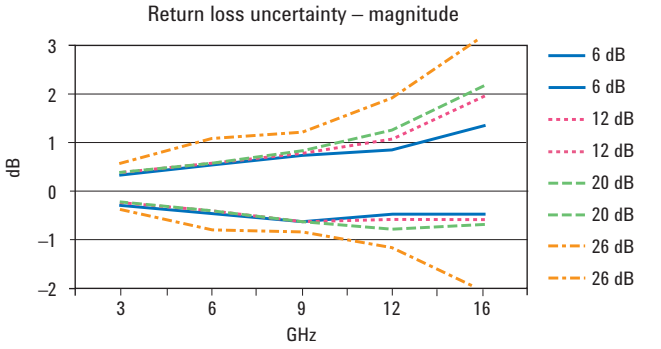
1. *Derived from time domain analysis.*
2. *This is not taking advantage of the 86108A precision timebase. With precision timebase enabled, system jitter approaches 60 fs for best performance.*

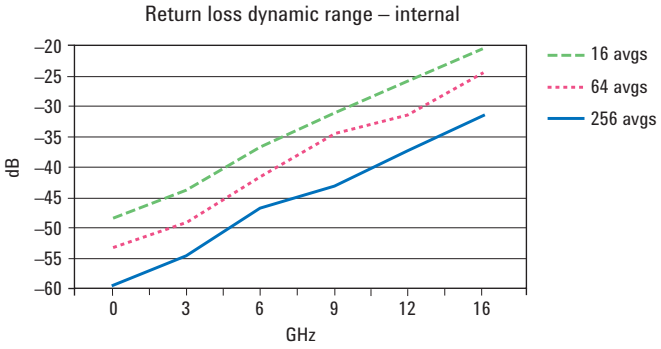
Modules Specifications
TDR System

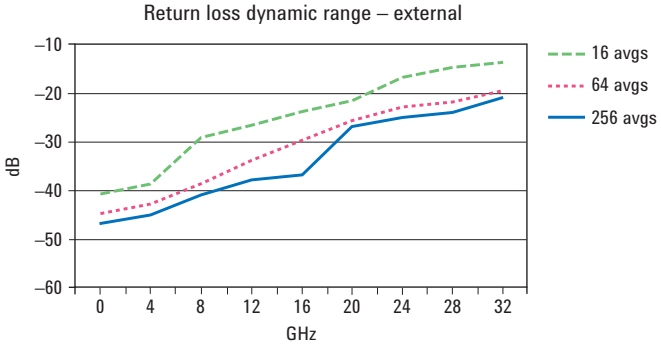
TDR system (Mainframe with 54754A module)	Oscilloscope/TDR performance	Normalized characteristics
Rise time	40 ps nominal < 25 ps normalized	Adjustable from larger of 10 ps or 0.08 x time/div Maximum: 5 x time/div
TDR step flatness	≤ ±1% after 1 ns from edge ≤ ±5%, –3% < 1 ns from edge	≤ 0.1%
Low level High level	0.00 V ±2 mV ±200 mV +2 mV	

86100D Option 202 enhanced impedance and S-parameter software characteristics

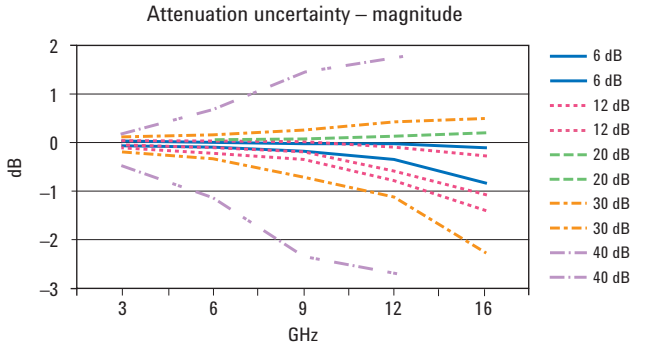
Return loss

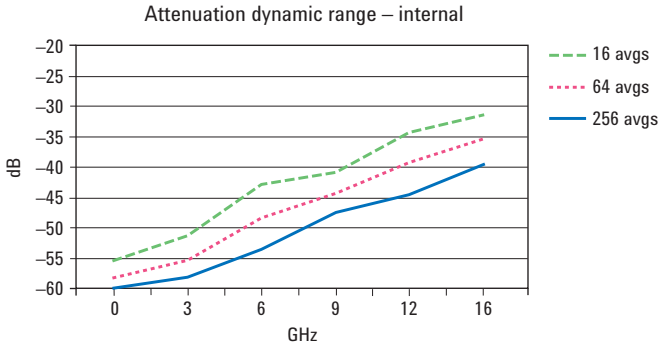


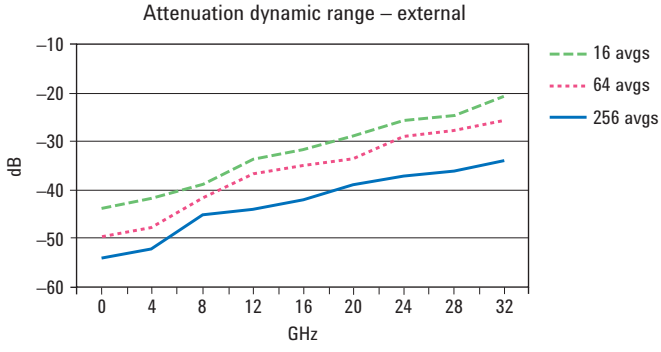




Attenuation



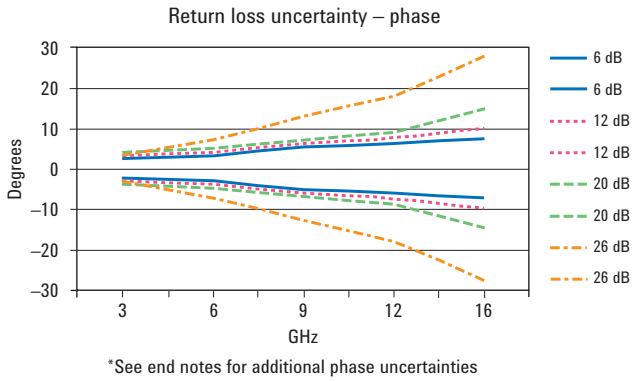




Modules Specifications
TDR System

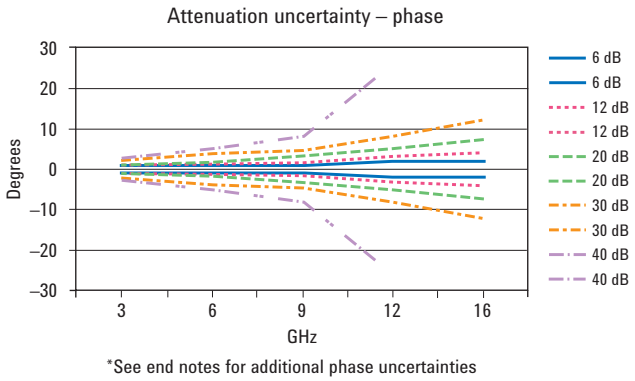
86100D Option 202 characteristics

Return loss



*See end notes for additional phase uncertainties

Attenuation



*See end notes for additional phase uncertainties

Performance characteristics for 86100D Option 202

Test conditions

- Mainframe and module have been turned on for at least one hour and have been calibrated
- TDR calibration has been performed using N1024A
- Internal measurements use 54754A as stimulus and either 54754A or 86112A as receiver
- External measurements use 54754A and Picosecond Pulse Labs Accelerator as stimulus and 86118A as receiver
- All characteristics apply to single-ended and differential
- Derived from measurements of wide range of devices compared to vector network analyzer measurements
- Averages of 256 except as noted in dynamic range

Phase uncertainty

- Longer equipment warm-up times and careful calibration provide the best phase performance – perform module and TDR calibrations again if temperatures change
- Phase uncertainty is the sum of the uncertainty from the desired graph plus the two additional components which are estimated below
- Sampling points - S-parameters are determined from the sampling points record length[1] over the time interval, which is time per division multiplied by ten divisions. The reference plane is determined to nearest sampling point with uncertainty given by this equation:

$$\text{Uncertainty in degrees (sampling points)} = \frac{\text{time per division (sec)} * 10 \text{ divisions} * f\,(\text{Hz}) * 360}{4096 * 2}$$

Simplified version = time per division (sec) * f(Hz) / 2.28

- Time base drift with temperature - the amount of drift can be observed by placing the calibration short at the reference plane and reading the amount of time difference in picoseconds. The phase uncertainty is given by this equation:

Uncertainty in degrees (temp drift) = time diff (sec) •frequency (Hz) * 360

1. *Record length is user-defined from 16 to 16384 However, the minimum record length used for S-parameters is 4096, independent of user settings.*

Modules Specifications
Clock Recovery

Clock Recovery Modules	83496A/B-100	83496A/B-101
Channel type	Differential or single-ended electrical	Single-mode or multimode optical, differential or single-ended electrical (no internal electrical splitters)
Data rates (divide by 2 for clock signals)	Standard: 50 Mb/s to 7.1 Gb/s continuous tuning Option 200: 50 Mb/s to 14.2 Gb/s continuous tuning Option 201: 7.1 to 14.2 Gb/s continuous tuning	
Minimum inut level in aquire lock (voltage or OMA[1])	150 m Vpp	Single-mode (OMA[1]): –11 dBm @ 50 Mb/s to 11.4 Gb/s *–8 dBm @ > 11.4 Gb/s* *–12 dBm @ 7.1 Gb/s to 14.2 Gb/s (w/Opt 200)* *–14 dBm @ 1 Gb/s to 7.1 Gb/s* *–15 dBm @ 50 Mb/s to 1 Gb/s* Multimode 1310 nm (OMA[1]): –10 dBm @ 50 Mb/s to 11.4 Gb/s *–7 dBm @ > 11.4 Gb/s* *–11 dBm @ 7.1 Gb/s to 14.2 Gb/s (w/Opt 200)* *–13 dBm @ 1 Gb/s to 7.1 Gb/s* *–14 dBm @ 50 Mb/s to 1 Gb/s* Multimode 850 nm (OMA[1]): –8 dBm @ 50 Mb/s to 11.4 Gb/s *–7 dBm @ > 11.4 Gb/s* *–9 dBm @ 7.1 Gb/s to 14.2 Gb/s (w/Opt 200)* *–11 dBm @ 1 Gb/s to 7.1 Gb/s* *–12 dBm @ 50 Mb/s to 1 Gb/s*
		Electrical: 150 m Vpp
Output random jitter (RMS)[2]	Internal recovered clock trigger < 500 fs 7.2 Gb/s to 11.4 Gb/s *(300 fs @ 10 Gb/s)* < 700 fs 4.2 Gb/s to 7.2 Gb/s, 11.4 Gb/s to 14.2 Gb/s *(400 fs @ 4.25 Gb/s, 500 fs @ 2.5 Gb/s)* < 3 mUI 50 Mb/s to 4.2 Gb/s *(700 fs @ 1.25 Gb/s)*	
	Front panel recovered clock < 700 fs 7.2 Gb/s to 11.4 Gb/s *(300 fs @ 10 Gb/s)* < 900 fs 4.2 Gb/s to 7.2 Gb/s, 11.4 Gb/s to 14.2 Gb/s *(400 fs @ 4.25 Gb/s, 500 fs @ 2.5 Gb/s)* < 4 mUI 50 Mb/s to 4.2 Gb/s *(700 fs @ 1.25 Gb/s)*	
Clock recovery adjustable loop bandwidth range (user selectable)	Standard: *270 kHz or 1.5 MHz*[3]; Option 300: 15 kHz to 10 MHz[4] continuous tuning (fixed value or a constant rate/N ratio)	
Loop bandwidth accuracy	Standard: ±30% Option 300: ±25% for transition density = 0.5 and data rate 155 Mb/s to 11.4 Gb/s *(±30% for 0.25 ≤ transition density ≤ 1.0 and all data rates)*	
Tracking range	*±2500 ppm 83496B, ±1000 ppm 83496A*	
Aquisition range	*±5000 ppm*	
Internal splitter ratio	*50/50*	*50/50 single-mode* *30/70 multimode* *Electrical signals have input only* *(no internal power dividers)*
Input return loss	*22 dB (DC to 12 GHz) electrical* *16 dB (12 to 20 GHz) electrical*	*20 dB single-mode, 16 dB multimode* *22 dB min (DC to 12 GHz) electrical* *16 dB min (12 to 20 GHz) electrical*
Input insertion loss	*7.2 dB max (DC to 12 GHz) electrical* *7.8 dB max (12 to 20 GHz) electrical*	2.5 dB max single-mode optical, 3 dB max multimode optical (no electrical data output signal path)

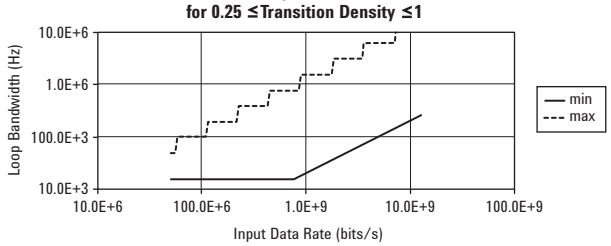
See footnotes on next page.

Modules Specifications
Clock Recovery

Clock Recovery Modules	83496A/B-100	83496A/B-101
Electrical through-path digital amplitude attenuation[5]	7.5 dB	(No electrical data output signal path)
Wavelength range		750 to 1330 nm multimode 1250 to 1650 nm single-mode
		Electrical: 150 m Vpp
Front panel recovered clock output amplitude	1 Vpp max, 220 mVpp min, 300 mVpp	
Consecutive identical digits (CID)	*150 max*	
Front panel recovered clock output divide ratio (user selectable)[6]	N=1 to 16 @ data rates 50 Mb/s to 7.1 Gb/s N=2 to 16 @ data rates 7.1 Gb/s to 14.2 Gb/s	
Data input/output connectors	3.5 mm male	FC/PC[7] 9/125 µm single-mode optical FC/PC[7] 62.5/125 µm multimode optical 3.5 mm male electrical (input only)
Front panel recovered clock output connector	SMA	

1. *To convert from OMA to average power with an extinction ratio of 8.2 dB use: PavgdBm = OMAdBm –1.68 dB.*
2. *Verified with PRBS7 pattern, electrical inputs > 150 mVp-p and optical inputs > 3 dB above specification for minimum input level to acquire lock. Output jitter verification results of the 83496A/B can be affected by jitter on the input test signal. The 83496A/B will track jitter frequencies inside the loop bandwidth, and the jitter will appear on the recovered clock output. Vertical noise (such as laser RIN) on the input signal will be converted to jitter by the limit amplifier stage on the input of the clock recovery. These effects can be reduced by lowering the Loop bandwidth setting.*
3. *At rates below 1 Gb/s, loop bandwidth is fixed at 30 KHz when Option 300 is not installed.*
4. *Without Option 200 loop bandwidth is adjustable from 15 KHz to 6 MHz. Available loop bandwidth settings also depend on the data rate of the input signal. For transition density from 0.25 to 1, the Loop Bandwidth vs Rate chart shows available loop bandwidth settings. Higher loop bandwidths can be achieved when average data transition density is maintained at or above 50%.*
5. *20*log(Vampout/Vampin) measured with PRBS23 at 14.2 Gb/s.*
6. *Minimum frequency of divided front panel clock output is 25 MHz.*
7. *Other types of optical connectors are also available.*

Selectable Loop Bandwidth vs Rate for 0.25 ≤Transition Density ≤1



Typical System Configurations

86100D Infiniium DCA-X Mainframe

86100D Hardware Options

Trigger Options (select one only):
STR - Standard – for basic eye measurements only
ETR – Enhanced - for pattern waveforms, jitter analysis

Remote Connection Options (select one only):
GPI - GPIB card interface installed
GPN - No GPIB card

86100D Software Options (select any):

061/062 – Add Matlab Analysis Package
200 – Enhanced Jitter Analysis
201 – Advanced Waveform Analysis
202 – Enhanced Impedance and S-Parameters
300 – Advanced Amplitude Analysis / RIN /Q-scale
SIM – InfiniiSim-DCA de-embedding / embedding
86100DU-400 PLL and Jitter Spectrum Analysis
86100DU-401 Advanced Eye Analysis (Jitter on PRBS31)

DCA plug-in modules (for typical[1] applications)

Electrical / PLL
1 to 12 Gb/s
86112A
Dual channels
BW > 20 GHz each
83496B
Electrical clock recovery
(#100, 200, 300)

Electrical / PLL
1 to 14.2 Gb/s
(high-performance)
86108A
Dual remote heads
BW > 32 GHz each
with integrated
precision timebase
and clock recovery

Electrical
20, 40 Gb/s
(high-performance)
86118A
Dual remote heads
BW > 70 GHz each
86107A
precision timebase
(#40)

Optical
1 to 12 Gb/s
86105C
9 GHz optical channel
20 GHz electrical channel
86107A
precision timebase
(#40)

Optical
20, 40 Gb/s
86116C
65 GHz optical channel
80 GHz electrical channel
86107A
precision timebase
(#40)

TDR/TDT
54754A
Differential TDR/TDT
Duel 18 GHz Channels
Note -also performs as
an 18 GHz duel channel
electrical receiver

1. *Contact your local Agilent sales representative to help configure a system for your specific application.*

Measurements

The 86100D DCA-X features two user interfaces for optimum ease-of-use. It includes the classic DCA interface for complete backwards compatibility with earlier DCA mainframes. It also includes the new FlexDCA interface that provides new measurements and powerful analysis capability in a fully customizable application.

The following measurements are available from the tool bar, as well as the pull down menus. The available measurements depend on the DCA-X operating mode.

Oscilloscope mode

- Time
  Rise Time, Fall Time, Jitter RMS, Jitter p-p, Period, Frequency, + Pulse Width, – Pulse Width, Duty Cycle, Delta Time, [Tmax, Tmin, Tedge—remote commands only]
- Amplitude
  Overshoot, Average Power, V amptd, V p-p, V rms, V top, V base, V max, V min, V avg, OMA (Optical Modulation Amplitude)

Eye/mask mode

- NRZ eye measurements
  Extinction Ratio, Jitter RMS, Jitter p-p, Average Power, Crossing Percentage, Rise Time, Fall Time, One Level, Zero Level, Eye Height, Eye Width, Signal to Noise, Duty Cycle Distortion, Bit Rate, Eye Amplitude
- RZ eye measurements
  Extinction Ratio, Jitter RMS, Jitter p-p, Average Power, Rise Time, Fall Time, One Level, Zero Level, Eye Height, Eye Amplitude, Opening Factor, Eye Width, Pulse Width, Signal to Noise, Duty Cycle, Bit Rate, Contrast Ratio

Mask Test

- Open Mask, Start Mask Test, Exit Mask Test, Filter, Mask Test Margins, Mask Margin to a Hit Ratio, Mask Test Scaling, Create NRZ Mask

Advanced measurement options

The 86100D's software options allow advanced analysis. Options 200, 201, and 300 require mainframe Option ETR. Option 202 does not require Option 86100-ETR. Option 401 does not require Options ETR and 200 unless a DDPWS measurement is required.

Option 200 enhanced jitter analysis software

- Measurements
  Total Jitter (TJ), Random Jitter (RJ), Deterministic Jitter (DJ), Periodic Jitter (PJ), Data Dependent Jitter (DDJ), Duty Cycle Distortion (DCD), Intersymbol Interference (ISI), Sub-Rate Jitter (SRJ), Asynchronous periodic jitter frequencies, Subrate jitter components
- FlexDCA adds the following measurements:
  Data Dependent Pulse Width Shrinkage (DDPWS), Uncorrelated Jitter (UJ), J2, J9
- Data displays
  TJ histogram, RJ/PJ histogram, DDJ histogram, Composite histogram, DDJ versus Bit position, Bathtub curve (log or Q scale)

Option 201 advanced waveform analysis

- Measurements
  Deep memory pattern waveform, user-defined measurements through MATLAB interface,
- Data displays
  Equalized waveform

Option 202 enhanced impedence and S-parameters

Option 300 amplitude analysis/RIN/Q-factor (requires Option 200)

- Measurements
  Total Interference (TI), Deterministic Interference (Dual-Dirac model, DI), Random Noise (RN), Periodic Interference (PI), and Inter-symbol Interference (ISI), RIN (dBm or dB/Hz), Q-factor
- Data Displays
  TI histogram, RN/PI histogram, ISI histogram

Option 400 PLL and jitter spectrum measurement software

- Jitter spectrum/phase noise measurements
  Integrated Jitter: Total Jitter (TJ), Random Jitter (RJ), Deterministic Jitter (DJ); DJ Amplitude/Frequency, Jitter Spectrum Graph, Jitter versus Time Graph, Frequency versus Time Graph, JitterHistogram, Post Processed Jitter Measurements, Phase Noise Graph dBc/Hz versus frequency
- Phase Locked Loop (PLL) measurements
  PLL Bandwidth, PLL Peaking, Data Rate, Jitter Transfer Function (JTF) Graph, Observed Jitter Transfer (OJTF) Graph, JTF Model

Measurements

Option 401 advanced EYE analysis

- Jitter measurements
  Total Jitter (TJ), Random Jitter (RJ), Deterministic Jitter (DJ), J2 Jitter (J2), J9 Jitter (J9), Data Dependent Pulse Width Shrinkage (DDPWS)*
  ** Requires 86100D-200*
- Amplitude measurements
  Total Interference (TI), Random Noise (RN), Deterministic Interference (DI), Eye Opening
- Mask test
  Pass/Fail Status, BER limit

Option SIM InfiniiSim-DCA

2-port de-embedding and embedding; 4-port de-embedding and embedding; add simulated random jitter and noise

TDR/TDT mode (requires TDR module)

- Quick TDR, TDR/TDT Setup,
  Normalize, Response, Rise Time, Fall Time, Δ Time, Minimum Impedance, Maximum Impedance, Average Impedance, (Single-ended and Mixed-mode S-parameters with Option 202)

Additional capabilities

Standard functions

Standard functions are available through pull down menus and soft keys, and some functions are also accessible through the front panel knobs.

Markers

- Two vertical and two horizontal (user selectable)

TDR markers

- Horizontal — seconds or meter
- Vertical — Volts, Ohms or Percent Reflection
- Propagation — Dielectric Constant or Velocity

Limit tests

- Acquisition limits
- Limit Test "Run Until" Conditions — Off, # of Waveforms, # of Samples
- Report Action on Completion — Save waveform to memory, save screen image

Measurement limit test

- Specify Number of Failures to Stop Limit Test
- When to Fail Selected Measurement — Inside Limits

Outside Limits, Always Fail, Never Fail

- Report Action on Failure — Save waveform to memory, save screen image, save summary
- Mask limit test
- Specify Number of Failed Mask Test Samples
- Report Action on Failure — Save waveform to memory, save screen image, save summary

Configure measurements

Thresholds

10%, 50%, 90% or 20%, 50%, 80% or Custom

Eye Boundaries

- Define boundaries for eye measurments
- Define boundaries for alignment

Format Units for

- Duty Cycle Distortion — Time or Percentage
- Extinction/Contrast Ratio — Ratio, Decibel or Percentage
- Eye Height — Amplitude or Decibel (dB)
- Eye Width — Time or Ratio
- Average Power — Watts or Decibels (dBm)

Top Base Definition

Automatic or Custom

Δ Time Definition

- First Edge Number, Edge Direction, Threshold
- Second Edge Number, Edge Direction, Threshold

Jitter Mode

- Units (time or unit interval, watts, volts, or unit amplitude)
- Signal type (data or clock)
- Measure based on edges (all, rising only, falling only)
- Graph layout (single, split, quad)

Quick measure configuration

When using the classic DCA interface, "Quick Measure" measurements are initiated by pressing the <Multi-Purpose> button on the front panel.

- Four user-selectable measurements for Each Mode, Eye-mask,TDR, etc.
- Default Settings (Eye/Mask Mode) Extinction Ratio, Jitter RMS, Average Power, Crossing Percentage
- Default Settings (Oscilloscope Mode) Rise Time, Fall Time, Period, V amptd

Measurements

Histograms

Configure

- Histogram scale (1 to 8 divisions)
- Histogram axis (vertical or horizontal)
- Histogram window (adjustable window via marker knob)

Math measurements - Classic DCA User Interface

- Four user-definable functions Operator — magnify, invert, subtract, versus, min, max
- Source — channel, function, memory, constant, response (TDR)

Signal Processing Measurements - FlexDCA

- Math — Add, Subtract, Multiply, Average, Invert, Maximum, Minimum, Median
- Signal Processing — Difference (Differentiate), Summation (Integrate), Interpolation (Linear, Sin(x)/x), Filters: 4th Order Bessel, Butterworth, Gaussian
- Transforms — FFT, Versus
- Equalizer (Option 201) — Linear Feed-forward Equalizer (LFE, up to 64 taps)
- Simulation (Option SIM) — De-embedding, Embedding, Random Jitter, Random Noise

Calibrate - Classic DCA User Interface

All calibrations

- Module (amplitude)
- Horizontal (time base)
- Extinction ratio
- Probe
- Optical channel

Front panel calibration output level

- User selectable –2 V to 2 V

Utilities

Set time and date
Remote interface

- Set GPIB interface

Touch screen configuration/calibration

- Calibration
- Disable/enable touch screen

Upgrade software

- Upgrade mainframe
- Upgrade module

Additional capabilities

Waveform autoscaling

Autoscaling provides quick horizontal and vertical scaling of both pulse and eye-diagram (RZ and NRZ) waveforms.

Gated triggering

Trigger gating port allows easy external control of data acquisition for circulating loop or burst-data experiments. Use TTLcompatible signals to control when the instrument does and does not acquire data.

Easier calibrations

Calibrating your instrument has been simplified by placing all the performance level indicators and calibration procedures in a single high-level location. This provides greater confidence in the measurements made and saves time in maintaining equipment.

Stimulus response testing using the Agilent N490X BERTs

Error performance analysis represents an essential part of digital transmission test. The Agilent 86100D and N490X BERT have similar user interfaces and together create a powerful test solution. If stimulus only is needed, the 81133A and 81134A pattern generators work seamlessly with the 86100D.

Transitioning from the Agilent 83480A and 86100A/B/C to the 86100D

While the 86100D has powerful new functionality that its predecessors don't have, it has been designed to maintain compatibility with the Agilent 86100A, 86100B, 86100C and Agilent 83480A digital communications analyzers and Agilent 54750A wide-bandwidth oscilloscope. All modules used in the Agilent 86100A/B/C, 83480A and 54750A can also be used in the 86100D. Since the 86100D includes the classic DCA interface, the remote programming command set for the 86100D designed for the 86100A/B/C will work directly. Some code modifications are required when transitioning from the 83480A and 54750A, but the command set is designed to minimize the level of effort required.

IVI-COM capability

Interchangeable Virtual Instruments (IVI) is a group of new instrument device software specifications created by the IVI Foundation to simplify interchangeability, increase application performance, and reduce the cost of test program development and maintenance through design code reuse. The 86100D IVI-COM drivers are available for download from the Agilent Web site.

VXII.2 and VXII.3 instrument control

The 86100D DCA-X provides LAN based instrument control.

Ordering Information

86100D Infiniium DCA-X mainframe

86100D Hardware Options
86100D-STR Standard trigger
86100D-ETR Enhanced trigger
86100DU-ETR Enhanced trigger upgrade kit
86100D-GPI GPIB card interface installed (default)
86100D-GPN No GPIB card interface[3]
86100DC-090 Removable hard drive
86100D-092 Internal hard drive (default)

86100D Software Options
86100D-061 MATLAB - Basic Oscilloscope Package
86100D-062 MATLAB - Standard Oscilloscope Package
86100D-200 Jitter analysis software
86100DU-200 Enhanced Jitter analysis software upgrade
86100D-201 Advanced waveform analysis software
86100DU-201 Advanced waveform analysis software upgrade
86100D-202 Enhanced impedance and S-parameter software
86100DU-202 Enhanced impedance and S-parameter SW upgrade
86100D-300 Amplitude analysis/RIN/Q-factor
86100DU-300 Amplitude analysis/RIN/Q-factor upgrade
86100DU-400 PLL and Jitter Spectrum software
86100DU-401 Advanced EYE analysis software
86100D-SIM InfiniiSim-DCA software
86100DU-SIM InfiniiSim-DCA software upgrade

Misc Options
86100D-AFP Module slot filler panel
86100D-AX4 Rack mount flange kit
86100D-AXE Rack mount flange kit with handles
86100D-UK6 Commercial cal certificate with test data

NOTE:

Options 200, 201, and SIM require Option ETR (enhanced trigger).

Option 300 requires Options 200 and ETR.

Option 300 is included with the purchase of 86100D-200 or 86100DU-200.

Option 400 and 401 require Microsoft Office Excel 2003/2007.

Option 401 requires Options ETR/200 for DDPWS measurement.

Optical/electrical modules

86105C	9 GHz optical channel; single-mode and multimode, amplified (750 to 1650 nm) 20 GHz electrical channel
86105C-100	155 Mb/s through 8.5 Gb/s (choose 4 filter rates from Options 86105C-110 through 86105C-197)
86105C-110	155 Mb/s
86105C-120	622 Mb/s (also covers 614 Mb/s)
86105C-130	1.063 Gb/s
86105C-140	1.244/1.250 Gb/s (also covers 1.229 Mb/s)
86105C-150	2.125 Gb/s
86105C-160	2.488/2.500 Gb/s (also covers 2.458 Gb/s)
86105C-170	2.666 Gb/s
86105C-180	3.125 Gb/s (also covers 3.072 Gb/s)
86105C-190	4.250 Gb/s
86105C-193	5.0 Gb/s
86105C-195	6.250 Gb/s (also covers 6.144 Gb/s)
86105C-197	8.5 Gb/s legacy applications[1]
86105C-200	8.5, 9.953, 10.3125, 10.519, 10.664, 10.709, 11.096, 11.317 Gb/s
86105C-300	Combination of rates available in 86105C-100 and 86105C-200
86105D[2]	20 GHz optical channel; single-mode and multimode, (750-1650 nm); filters for 8.5, 9.953, 10.3125, 10.519, 10.664, 10.709, 11.096, 11.317, 14.025 Gb/s; 35 GHz electrical channel
86115D[2]	20 GHz multi-optical port plug-in module; single-mode and multimode (750-1650 nm); filters for 8.5, 9.953, 10.3125, 10.519, 10.664, 10.709, 11.096, 11.317, 14.925 Gb/s
86115D-002	Two optical channels
86115D-004	Four optical ports mulitplexed to two optical channels through 2 integral 1X2 optical switches
86116C[2]	40 to 65 GHz optical / 80 GHz electrical sampling module, 1300 to 1620 nm

Select exactly one reference receiver option:

86116C-025:	40 GHz opt./80 GHz elec. channels, 17.0/25.8/27.7 Gb/s reference receiver
86116C-040:	65 GHz opt./80 GHz elec. channels, 39.8/42.0 Gb/s reference receiver

This module is not compatible with the 86100A and 86100B DCA mainframes. If you want to upgrade older DCAs, contact Agilent Technologies to discuss current trade-in deals.

All optical modules have FC/PC connectors installed on each optical port. Other connector adapters available as options are: Diamond HMS-10, DIN, ST and SC.

1. *86105C Option 197 provides a 6.375 GHz BT filter and is compatible with early drafts of the 8X Fibre Channel standard. The final version of INCITS FC-PI-4 requires compliance test to be done with the 10.3125 Gb/s Ethernet filter that is provided only in Options 200 or 300.*
2. *This module is not compatible with the 86100A and 86100B DCA mainframes. If you want to upgrade older DCAs, contact Agilent Technologies to discuss current trade-in deals.*
3. *To add a GPIB card later, order Agilent part number 82351A or contact your local Agilent service center.*

Ordering Information

Dual electrical channel modules

86112A Dual 20 GHz electrical channels
86117A Dual 50 GHz electrical channels
86118A Dual 70 GHz electrical remote sampling channels
86118A-H01 Differential De-Skew

TDR/TDT modules

Included with each of these TDR modules is a TDR demo board, programmers guide, two 50 Ω SMA terminations and one SMA short.

54754A Differential TDR module with dual 18 GHz TDR/electrical channels

Precision timebase module

86107A Precision timebase reference module
86107A-010 2.5 and 10 GHz clock input capability
86107A-020 10 and 20 GHz clock input capability
86107A-040 10, 20 and 40 GHz clock input capability

Clock recovery modules

The following modules provide a recovered clock from the data signal for triggering at indicated data rates:

83496A 50 Mb/s to 7.1 Gb/s Clock recovery module
83496A-100 Single-ended and differential electrical with integrated signal taps
83496A-101 Single-mode (1250 to 1620 nm) and multimode (780 to 1330 nm) optical. Integrated signal taps. Single-ended or differential electrical inputs (no signal taps).
83496A-200 Increase operating range to 50 Mb/s to 14.2 Gb/s
83496AU-200 Upgrade data rate 0.05 Gb/s to 14.2 Gb/s
83496A-300 Add tunable loop bandwidth "golden PLL" capability
83496AU-300 Upgrade adjustable loop bandwidth

83496B 50 Mb/s to 7.1 Gb/s Clock recovery module. This module is not compatible with the 86100A and 86100B DCA mainframes. If you want to upgrade older DCAs, contact Agilent Technologies and ask for current trade-in deals.
83496B-100 Single-ended and differential electrical with integrated signal taps
83496B-101 Single-mode (1250 to 1620 nm) and multimode (780 to 1330 nm) optical. Integrated signal taps. Single-ended or differential electrical inputs (no signal taps).
83496B-200 Increase operating range to 50 Mb/s to 14.2 Gb/s
83496BU-200 Upgrade data rate 0.05 Gb/s to 14.2 Gb/s
83496B-201 Shift operating range to 7.1 to 14.2 Gb/s
83496BU-201 Upgrade shift operating range to 7.1 to 14.2 Gb/s
83496B-300 Add tunable loop bandwidth "golden PLL" capability
83496BU-300 Upgrade adjustable loop bandwidth

Precision waveform analyzer module

Dual electrical channel module with integrated clock recovery and precision timebase.

86108A-100 Dual 32 GHz electrical channels, integrated clock recovery (50 Mb/s to 14.2 Gb/s) with integrated precision timebase
86108A-001 Two 3.5 mm phase trimmers for skew adjustment
86108A-002 Two precision 3.5 mm 18 inch cables
86108A-400 Auxiliary Clock Recovery Input

Warranty options (for all products)

R1280A Customer return repair service
R1282A Customer return calibration service

Accessories

11898A Extender module for plug-in modules
86101-60005 Filler panel
1150-8021 USB keyboard (included with 86100D)
0960-2670 USB mouse (included with 86100D)
9300-1308 ESD Heel strap
9300-1367 ESD Wrist strap
9300-1484 ESD Desk mat
9300-0980 ESD Wrist strap ground cord

Optical connector adapters

Note: Optical modules come standard with one FC/PC connector adapter

81000 AI Diamond HMS-10 connector
81000 FI FC/PC connector adapter
81000 SI DIN connector adapter
81000 VI ST connector adapter
81000 KI SC Connector adapter

RF/Microwave accessories

11636B Power divider, DC to 26.5 GHz, APC 3.5 mm
11636C Power divider, DC to 50 GHz, 2.4 mm

11742A 45 MHz to 26.5 GHz DC blocking capacitor
11742A-K01 50 GHz DC blocking capacitor

8490D-020 2.4 mm 20 dB attenuator

11900B 2.4 mm (f-f) adapter
11901B 2.4 mm (f) to 3.5 mm (f) adapter
11901C 2.4 mm (m) to 3.5 mm (f) adapter
11901D 2.4 mm (f) to 3.5 mm (m) adapter
5061-5311 3.5 mm (f-f) adapter
1250-1158 SMA (f-f) adapter

1810-0118 3.5 mm termination
0960-0055 Short
1250-1666 SMA (f-f) adapter feedthru

Ordering Information

Passive probe

54006A	6 GHz passive probe
N1020A	6 GHz TDR probe kit
N1021B	18 GHz Differential TDR Probe Kit
83480AK02	Static Protection Unit
N1024A	TDR Calibration kit

Infiniimax I active probes (1.5 to 7 GHz)

Note: The N1022A probe adapter is required to use these probes with the 86100 DCA

Infiniimax I probe amplifiers

Note: Order one or more Infiniimax I probe head or connectivity kit for each amplifier

1130A	1.5 GHz probe amp
1131A	3.5 GHz probe amp
1132A	5 GHz Iprobe amp
1134A	7 GHz probe amp

Infiniimax I probe heads

E2675A	InfiniiMax differential browser probe head and accessories. Includes 20 replaceable tips and ergonomic handle. Order E2658A for replacement accessories.
E2676A	InfiniiMax single-ended browser probe head and accessories. Includes two ground collar assemblies, 10 replaceable tips, a ground lead socket and ergonomic browser handle. Order E2663A for replacement accessories.
E2677A	InfiniiMax differential solder-in probe head and accessories. Includes 20 full bandwidth and 10 medium bandwidth damping resistors. Order E2670A for replacement accessories.
E2678A	InfiniiMax single-ended/differential socketed probe head and accessories. Includes 48 full bandwidth damping resistors, six damped wire accessories, four square pin sockets and socket heatshrink. Order E2671A for replacement accessories.
E2679A	InfiniiMax single-ended solder-in probe head and accessories. Includes 16 full bandwidth and eight medium bandwidth damping resistors and 24 zero ohm ground resistors. Order E2672A for replacement accessories.

Infiniimax I connectivity kits (popular collections of the above probe heads)

E2669A	InfiniiMax connectivity kit for differential measurements
E2668A	InfiniiMax connectivity kit for single-ended measurements

Infiniimax II active probes (10 to 13 GHz)

Note: The N1022A probe adapter is required to use these probes with the 86100 DCA

Infiniimax II probe amplifiers

Note: Order 1 or more Infiniimax II probe heads for each amplifier. Infiniimax I probe heads and connectivity kits can also be used but will have limited bandwidth.

1168A	10 GHz probe amp
1169A	13 GHz probe amp

Infiniimax II probe heads

N5380A	InfiniiMax II 12 GHz differential SMA adapter
N5381A	InfiniiMax II 12 GHz solder-in probe head
N5382A	InfiniiMax II 12 GHz differential browser

Infiniimax III active probes (16 to 30GHZ)

Note: The N5477A probe adapter is required to use these probes with the 86100 DCA

Infiniimax III probe amplifiers

N2800A	16 GHz probe amp
N2801A	20 GHz probe amp
N2802A	25 GHz probe amp
N2803A	30 GHz probe amp

Infiniimax III probe heads

N5439A	ZIF Probe Head
N5440A	450 Ω ZIF Tip
N5447A	200 Ω ZIF Tip
N5444A	2.92mm/3.5mm/SMA
N5448A	2.92mm Extension Cables
N5441A	Solder-in Probe Head
N5445A	Browser Probe Head

www.agilent.com/find/infiniimax3

Probe adapters

N5477A	Sampling Scope Adapter. Adapts the Infiniimax III system probes to the 86100 Infiniium DCA
N1022A	Adapts 113x/115x,/116x active probes to 86100 Infiniium DCA

The N1022A adapter is powered by connecting it to the built-in probe power connector available on some DCA modules or to an external probe power supply. On modules that do not have a built-in probe power connector, use an 1143A external power supply. It is recommended to order option 001 on the 1143A, which provides a 5-foot power extension cable (01143-61602). The 1143A power supply can power two probes.

Ordering Information

Connectivity solutions

HDMI

N1080A H01 High performance coax based HDMI fixture with plug (TPA-P)

N1080A H02 High performance coax based HDMI fixture with receptacle (TPA-R)

N1080A H03 HDMI low frequency board

SATA

Note: These are available from COMAX Technology, see ***www.comaxtech.com***

iSATA plug to SMA – COMAX P/N H303000104

iSATA receptacle to SMA – COMAX P/N H303000204

ATCA

Note: These are available from F9 Systems, see ***www.f9-systems.com***

Advanced TCA Tx/Rx Signal Blade™

Advanced TCA Tx/Rx Bench Blade™

Call Agilent for connectivity and probing solutions not listed above.

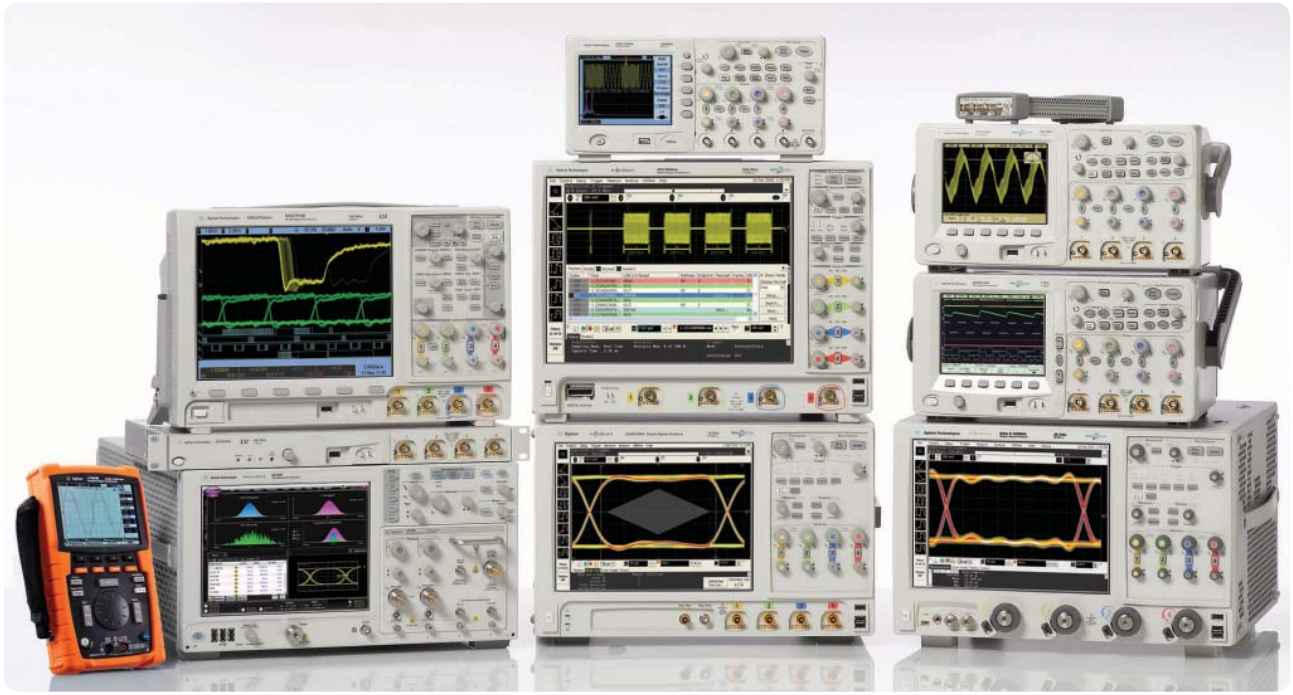
Firmware and software

Firmware and software upgrades are available through the Web or your local sales office. www.agilent.com/find/dcax

N1010A FlexDCA remote access software

86100D DCA-X Brochure

For more information on the features and benefits of the 86100D DCA-X and DCA modules, download the 86100D DCA-X Brochure. Go to: www.agilent.com and search on 5989-5822EN.



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http://www.pxisa.org
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Revised: October 14, 2010

Product specifications and descriptions in this document subject to change without notice.

Printed in USA, November 25, 2010
5990-5824EN

Agilent Technologies