

DSA8200 Digital Serial Analyzer Specifications and Performance Verification Technical Reference



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Tektronix

DSA8200 Digital Serial Analyzer Specifications and Performance Verification Technical Reference

Warning

The servicing instructions are for use by qualified personnel only. To avoid personal injury, do not perform any servicing unless you are qualified to do so. Refer to all safety summaries prior to performing service.

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General Safety Summary

Review the following safety precautions to avoid injury and prevent damage to this product or any products connected to it.

To avoid potential hazards, use this product only as specified.

Only qualified personnel should perform service procedures.

While using this product, you may need to access other parts of the system. Read the *General Safety Summary* in other system manuals for warnings and cautions related to operating the system.

To Avoid Fire or Personal Injury

Use Proper Power Cord. Use only the power cord specified for this product and certified for the country of use. Power cord needed only in the mainframe, not modules.

Connect and Disconnect Properly. Do not connect or disconnect probes or test leads while they are connected to a voltage source.

Ground the Product. The mainframe is grounded through the grounding conductor of the power cord. To avoid electric shock, the grounding conductor must be connected to earth ground. Before making connections to the input or output terminals of the product, ensure that the product is properly grounded.

Ground the Product. The modules are indirectly grounded through the grounding conductor of the mainframe power cord. To avoid electric shock, the grounding conductor must be connected to earth ground. Before making connections to the input or output terminals of the product, ensure that the product is properly grounded.

Observe All Terminal Ratings. To avoid fire or shock hazard, observe all ratings and markings on the product. Consult the product manual for further ratings information before making connections to the product.

The inputs are not rated for connection to mains or Category II, III, or IV circuits.

Do not apply a potential to any terminal, including the common terminal, that exceeds the maximum rating of that terminal.

Power Disconnect. The power switch disconnects the product from the power source. See instructions for the location. Do not block the power switch; it must remain accessible to the user at all times.

Do Not Operate Without Covers. Do not operate this product with covers or panels removed.

Use Proper Fuse. Use only the fuse type and rating specified for this product.

Avoid Exposed Circuitry. Do not touch exposed connections and components when power is present.

Wear Eye Protection. Wear eye protection if exposure to high-intensity rays or laser radiation exists.

Do Not Operate With Suspected Failures. If you suspect there is damage to this product, have it inspected by qualified service personnel.

Do Not Operate in Wet/Damp Conditions.

Do Not Operate in an Explosive Atmosphere.

Keep Product Surfaces Clean and Dry.

Provide Proper Ventilation. Refer to the manual's installation instructions for details on installing the product so it has proper ventilation.

Symbols and Terms

Terms in this Manual. These terms may appear in this manual:



WARNING. *Warning statements identify conditions or practices that could result in injury or loss of life.*



CAUTION. *Caution statements identify conditions or practices that could result in damage to this product or other property.*

Terms on the Product. These terms may appear on the product:

DANGER indicates an injury hazard immediately accessible as you read the marking.

WARNING indicates an injury hazard not immediately accessible as you read the marking.

CAUTION indicates a hazard to property including the product.

Symbols on the Product. The following symbols may appear on the product:



CAUTION
Refer to Manual



WARNING
High Voltage


Protective Ground
(Earth) Terminal


Earth Terminal


Chassis Ground


Mains Disconnected
OFF (Power)


Mains Connected
ON (Power)


Standby

Service Safety Summary

Only qualified personnel should perform service procedures. Read this *Service Safety Summary* and the *General Safety Summary* before performing any service procedures.

Do Not Service Alone. Do not perform internal service or adjustments of this product unless another person capable of rendering first aid and resuscitation is present.

Disconnect Power. To avoid electric shock, switch off the instrument power, then disconnect the power cord from the mains power.

Use Care When Servicing With Power On. Dangerous voltages or currents may exist in this product. Disconnect power, remove battery (if applicable), and disconnect test leads before removing protective panels, soldering, or replacing components.

To avoid electric shock, do not touch exposed connections.

Preface

This manual contains the specifications and performance verification procedures for the DSA8200 Digital Serial Analyzer and the modules that can be installed in this instrument (except the 80A03 module).

NOTE. *The 80A03 instruction manual contains its own specifications and servicing information.*

Read this preface to learn how this manual is structured, what conventions it uses, and where you can find other information related to this product.

Manual Structure

This manual is divided into chapters that are made up of related subordinate topics. These topics can be cross referenced as sections.

Be sure to read the introductions to all procedures. These introductions provide important information needed to do the service correctly, safely, and efficiently.

Manual Conventions

This manual uses certain conventions that you should become familiar with before attempting service.

- Modules** Throughout this manual, the term *module* appears. A module is composed of electrical and mechanical assemblies, circuit cards, interconnecting cables, and a user-accessible front panel. References to a module are different than references to products such as “Sampling modules”, “Phase Reference modules”, or “Accessory modules”, which are products installed in the instrument compartments.
- Safety** Symbols and terms related to safety appear in the *General Safety Summary* found at the beginning of this manual.

Related Documentation

The following documents relate to the instrument this manual supports:

- *DSA8200 Digital Serial Analyzer Quick Start User Manual*. Tektronix part number 071-2047-XX.
- *DSA8200 Digital Serial Analyzer Service Manual*. Tektronix part number 071-2049-XX.
- *DSA8200 Digital Serial Analyzer Online Help*. Installed with the application software and accessed from the instrument Help menu.
- *DSA8200 Digital Serial Analyzer Programmer Guide*. An online document accessed from the instrument Help menu.
- *80E01, 80E02, 80E03, 80E04, and 80E06 Electrical Sampling Modules User Manual*. Tektronix part number 071-0434-XX.
- *80E07, 80E08, 80E09, and 80E10 Electrical Sampling Remote Modules User Manual*. Tektronix part number 071-2038-XX.
- *80C00 Series Optical Sampling Modules User Manual*. Tektronix part number 071-0435-XX.
- *80A01 Trigger Prescale Limiting Preamplifier Module User Manual*. Tektronix part number 071-0873-XX.
- *80A02 EOS/ESD Protection Module Instructions*. Tektronix part number 071-1317-XX.
- *80A03 TekConnect Probe Interface Module Instructions*. Tektronix part number 071-1298-XX.
- *80A05 Electrical Clock Recovery Module User Manual*. Tektronix part number 071-1467-XX.
- *80A06 PatternSync Trigger Module Instructions*. Tektronix part number 071-1744-XX.
- *DSA8200, CSA8200, CSA8000, CSA8000B, TDS8200, TDS8000, and TDS8000B Rackmount Kit Instructions*. Tektronix part number 071-0696-XX.
- *TDR Z-Meas Application Online Help*. Ships with this product on a separate CD. Provides information about this TDR Impedance Measuring application that implements the TDR calibration procedures specified by the IPC TM-650 test method.
- *Fast NRZ Application Online Help*. Ships with this product on a separate CD. Provides information about this application that improves throughput for optical eye-pattern mask testing.



Specifications

System Specifications

NOTE. This specification is for the instrument; the specifications for the optical, electrical, and other modules that insert in the module compartments of the instrument front panel are included later in this chapter.

This section contains the specifications for the DSA8200 Digital Serial Analyzer.

The 82A04 Phase Reference module affects the DSA8200 mainframe specifications; therefore, there is no separate specification section for the 82A04 module.

All specifications are guaranteed unless noted as “typical.” Typical specifications are provided for your convenience but are not guaranteed. Specifications that are marked with the ✓ symbol are checked in the *Performance Verification* chapter of this manual.

All specifications apply to the instrument and sampling modules unless noted otherwise. To meet specifications, these conditions must first be met:

- The instrument must have been calibrated/adjusted at an ambient temperature between +10 °C and +40 °C.
- The instrument must have been operating continuously for 20 minutes within the operating temperature range specified.
- The instrument must be in an environment with temperature, altitude, humidity, and vibration within the operating limits described in these specifications.

NOTE. “Sampling Interface” refers to both the small module compartments and the large module compartments, unless otherwise specified.

Table 1-1: System - Signal acquisition

Description	Characteristics
Number of input channels	8 acquisition channels, maximum.
Number of small sampling module compartments	4 compartments, 2 channels per compartment, for a total of 8 channels ¹ .
Number of large sampling module compartments	2 compartments, for a total of 4 channels ¹ .
Small Sampling Module Interface	Tekprobe-Sampling Level 3. Hot switching is not permitted on this interface.
Large Sampling Module Interface	Tekprobe-Sampling Level 3. Hot switching is not permitted on this interface.

Table 1-1: System - Signal acquisition (cont.)

Description	Characteristics
Compartment assignments and conflict resolution	Population of the Ch 1 / Ch 2 large compartment with any module (other than one requiring power only) displaces functionality of the Ch 1 / Ch 2 small compartment. Population of the Ch 3 / Ch 4 large compartment with any module (other than one requiring power only) displaces functionality of the Ch 3 / Ch 4 small compartment.
Compartment utilization	Supports the 80xxx and 82xxx nomenclated modules, including Phase Reference modules.
Real time accessory interface	Small and large slots support TekProbe-SMA, Levels 1 and 2 at front of modules equipped with probe connector. TelConnect probes are supported with 80A03 accessory for all slot small slot modules. Hot switching is permitted on this real time accessory interface.
Vertical sensitivity ranges	10 mV to 1 V full scale at TekProbe-Sampling interface. May be scaled according to sampling module scaling characteristics.
Vertical operating range	Refer to module specifications.
Vertical number of digitized bits	14 bits at TekProbe-Sampling interface.
Offset capabilities	Open loop offset mode is supported at TekProbe-Sampling interface.
Offset range	Refer to module specifications.
Offset resolution	14 bits over ± 1.8 V at TekProbe-Sampling interface.

¹ **Total channels \leq 8.**

Table 1-2: System - Timebase

Description	Characteristics
Horizontal modes	
Mainframe	Short term jitter optimized and Locked to 10 MHz Reference are supported. The 10 MHz reference may be internal or external.
Mainframe with 82A04	Free Run and Triggered Modes are supported.
Sampling rate	
Mainframe (regular modes)	DC - 200 kHz maximum, dictated by trigger rate and actual holdoff setting. If trigger rate is less than the maximum, or the requested holdoff exceeds the minimum, the trigger rate and/or holdoff will dictate the sampling rate.
Mainframe with 82A04 (phase corrected modes)	DC - 50 kHz maximum, one channel. If trigger rate is less than the maximum, or the requested holdoff exceeds the minimum, the trigger rate and / or holdoff will dictate sampling rate.
Record length ¹	20, 50, 100, 250, 500, 1000, 2000 and 4000 samples.

Table 1-2: System - Timebase (cont.)

Description	Characteristics	
Horizontal scale range	100 fs/div to 5 ms/div in 1, 2, 5 steps or 100 fs increments are supported. Maximum record lengths apply at certain ranges per table. For record lengths greater than 1000, the horizontal scale is limited as shown in the table below.	
	<i>Scale set to an integer multiple of:</i>	<i>Maximum record length</i>
	100 fs/div	1000
	200 fs/div	2000
	400 fs/div	4000
Horizontal position range		
Mainframe	50 ms maximum.	
Mainframe with 82A04	Range is determined by the following formula where (f) equals the frequency of the reference clock. $\frac{1}{f} \times 2^{16}$	
Horizontal resolution	1 fs minimum.	
Horizontal position setting resolution	10 fs minimum.	
✓ Time interval accuracy, short term jitter optimized mode	Strobe placement accuracy for a given horizontal interval and position on same strobe line per table below. (Contribution from 80E04 sampling module is included in specification.) 1 ps + 1% of interval, horizontal scale ≤ 20 ps/div, rightmost point of measurement interval <200 ns. 8 ps + 0.1% of interval, horizontal scale ≥ 21 ps/div, rightmost point of measurement interval <200 ns. Guaranteed for all trigger rates.	
✓ Time interval accuracy, locked to internal 10 MHz reference mode ²	Strobe placement accuracy for a given horizontal interval and position on same strobe line per table below. Contribution from 80E04 sampling module is included in specification. 1 ps + 1% of interval, ≤ 20 ps/div. 8 ps + 0.01% of interval, ≥ 21 ps/div. Guaranteed for all trigger rates.	
Timing accuracy, free run phase corrected mode (mainframe with 82A04)	Maximum timing deviation 0.1% of phase reference signal period, typical, relative to phase reference signal. Assumes that phase reference frequency has been correctly entered. Operation of phase reference clock at frequencies requiring extended bandwidth or signal conditioning may require an instrument option.	

Table 1-2: System - Timebase (cont.)

Description	Characteristics
Timing accuracy, triggered phase corrected mode (mainframe with 82A04)	<p>Maximum timing deviation relative to phase reference signal:</p> <p>0.2% of phase reference signal period typical for measurements made > 40 ns after trigger event.</p> <p>0.4% of phase reference signal period typical for measurements made ≤ 40 ns after trigger event.</p> <p>Assumes that phase reference frequency has been correctly entered.</p>
Horizontal deskew range and resolution	
Mainframe	-500 ps to +100 ns on any individual channel in 1 ps increments.
Mainframe with 82A04	<p>Operating in Triggered Phase Corrected modes: -500 ps to +100 ns on any individual channel in 1 ps increments.</p> <p>Operating in Free Run Phase Corrected modes: Deskew range extends over the full clock cycle of the phase reference.</p>

¹ **The total number of samples contained in a single acquired waveform record (memory length in IEEE 1057, 2.2.1).**

² **80E02 sampling module is included in this specification.**

Table 1-3: System - Trigger

Description	Characteristics
Trigger sources	
Mainframe	External Direct Edge Trigger, External Prescaled Trigger, Internal Clock Trigger, and Clock Recovery (with appropriately equipped optical modules).
Mainframe with 82A04	<p>A phase reference signal may be applied to the instrument, when equipped with an 82A04 Phase Reference module, to provide additional phase information for signals being acquired in Triggered Phase Corrected modes and primary phase information for signals being acquired in Free Run Phase Corrected modes.</p> <p>Two bandwidth options are available for the 82A04 and may be required over specific frequency ranges of operation:</p> <p style="padding-left: 40px;">The base product has an 8 GHz - 25 GHz range of operation.</p> <p style="padding-left: 40px;">Option 60G extends the upper frequency range of operation to 60 GHz.</p>
Auto/normal mode	<p>Normal mode: wait for trigger.</p> <p>Auto mode: Trigger automatically generated after 100 ms time-out.</p>
Slope + or - select	<p>Edge + mode: Triggers on positive-slewing edge.</p> <p>Edge - mode: Triggers on negative-slewing edge.</p>

Table 1-3: System - Trigger (cont.)

Description	Characteristics
High frequency on/off select	High Frequency ON mode: Removes trigger hysteresis and improves sensitivity. Should be used when trigger slew rate exceeds 1 V/ns. High Frequency OFF mode: Retains trigger hysteresis and improves noise rejection at low slew rates.
Variable trigger hold off range and resolution	Adjustable 5 μ s to 50 ms in 0.5 ns increments. When External Prescaled Trigger mode is used, hold off period applies to the Prescaled input divided by 16.
External direct trigger capabilities and conditions	Direct edge triggering on signal applied to dedicated front panel connector with Holdoff, Level Adjust, Auto/Normal, High Frequency On/Off, and Enhanced Triggering On/Off controls. External direct trigger specifications apply only under the condition that no other trigger signal is applied to respective connectors, except 82A04 Phase Reference modules. Short term optimized mode and locked to internal 10 MHz reference specifications only apply under the condition that there is no external 10 MHz reference applied to the front panel connector.
External direct trigger input characteristics ¹	50 Ω input resistance, DC coupled only.
External direct trigger input range	± 1.5 V (DC + peak AC) maximum input voltage.
External direct trigger maximum operating trigger signal ²	1 V _{p-p}
External direct trigger level range	Adjustable between ± 1.0 V.
✓ External direct trigger sensitivity ³	100 mV, DC - 3 GHz.
External direct trigger sensitivity	50 mV typical, DC - 4 GHz.
External direct trigger level resolution	1 mV
✓ External direct trigger level accuracy	50 mV + 0.10 x level.
External direct trigger delay jitter, short term optimized mode (typical)	800 fs RMS + 5 ppm of horizontal position.
✓ External direct trigger delay jitter, short term optimized mode	1.2 ps RMS + 10 ppm of horizontal position, or better.
External direct delay jitter, locked to internal 10 MHz reference mode (typical)	1.6 ps RMS + 0.01 ppm of horizontal position.
✓ External direct delay jitter, locked to internal 10 MHz reference mode	2.5 ps RMS + 0.04 ppm of horizontal position, or better.
External direct trigger minimum pulse width (typical)	167 ps
External direct trigger metastability (typical)	Zero
External direct trigger real time accessory interface	Tekprobe-SMA, Levels 1 and 2. Hot switching is permitted on this real time accessory interface.

Table 1-3: System - Trigger (cont.)

Description	Characteristics	
External prescaled trigger capabilities and conditions (typical)	<p>Prescaled triggering on signal applied to dedicated front panel connector with Holdoff, Auto/Normal.</p> <p>External prescaled trigger specifications apply only under the condition that no other trigger source is applied to respective connectors.</p> <p>Short term optimized mode and locked to internal 10 MHz reference specifications only apply under the condition that there is no external 10 MHz reference applied to the front panel connector.</p>	
External prescaled trigger input characteristics (typical)	50 Ω AC coupled input resistance; divide-by-sixteen prescaler ratio, fixed level zero volts.	
External prescaled trigger absolute maximum input (typical)	± 2.5 Vpp	
✓ External prescaled trigger sensitivity and usable range	<i>Frequency range</i>	<i>Sensitivity</i>
	2 GHz - 12.5 GHz	200 mV _{p-p} to 800 mV _{p-p}
External prescaled trigger delay jitter, short term optimized mode (typical)	0.9 ps _{RMS} + 5 ppm of horizontal position.	
✓ External prescaled trigger delay jitter, short term optimized mode	1.3 ps _{RMS} + 10 ppm of horizontal position, or better.	
External prescaled delay jitter, locked to internal 10 MHz reference mode (typical)	1.6 ps _{RMS} + 0.01 ppm of horizontal position.	
✓ External prescaled delay jitter, locked to internal 10 MHz reference mode	2.5 ps _{RMS} + 0.04 ppm of horizontal position, or better.	
External prescaled trigger metastability (typical)	Zero	
Internal clock trigger rates	Rate selectable at 25, 50, 100, and 200 kHz internally and is provided to the trigger, to the TDR stimulus drives in the small sampling module interfaces, and to the Internal Clock Out connector on the front panel.	

¹ **The input resistance at the external direct trigger input and the maximum input voltage.**

² **Maximum signal input for maintaining calibrated time base operation.**

³ **Section 4.10.2 in IEEE standard number 1057. The minimum signal levels required for stable edge triggering of an acquisition.**

Table 1-4: System - Trigger - Phase correction modes (mainframe with 82A04 Phase Reference module)

Description	Characteristics
Phase correction capabilities and conditions	A phase reference signal may be applied to a mainframe equipped with the 82A04 Phase Reference module to provide additional phase information for signals being acquired in Triggered Phase Corrected modes and primary phase information for signals being acquired in Free Run Phase Corrected modes. For Phase Corrected Triggered modes, the phase correction functionality overlays the functionality of the basic trigger operation, although restrictions may be imposed.
Number of phase reference module inputs	One per 82A04 module. Up to three 82A04 modules may be inserted in the small compartments of the mainframe and characterized to operate with one or more vertical sampling module(s); only one phase correction module at a time can be used.
Phase reference input connector	Precision 1.85 mm female connector (V). A 2.4 mm male to 2.92 mm (K) female adapter is provided as a standard accessory to provide connection to 3.5 mm compatible male connectors.
Phase reference module input characteristics (typical)	50 Ω AC coupled through 5 pF
Phase reference module input dynamic range (nonclipping)	2 V _{p-p} (offset \pm 1000 mV)
Phase reference module input maximum nondestruct range	\pm 3 V maximum
Phase reference module input signal level	600 mV _{p-p} to 1.8 V _{p-p} to achieve typical specified jitter performance.
Phase reference mode jitter (typical)	Triggered and Free Run Phase Corrected Modes, 8 GHz - 60 GHz clock, 600 mV - 1.8 V _{p-p} input: 200 fs _{RMS} or better. Triggered and Free Run Phase Corrected Modes, 2 GHz - 8 GHz sine wave clock, 600 mV - 1.8V _{p-p} input: 280 fs _{RMS} or better. The jitter increase between 8 GHz and 2 GHz is roughly inverse proportion to clock frequency. Operation of phase reference clock at frequencies requiring extended bandwidth or signal conditioning may require an optional filter accessory.
Phase reference module compensation temperature range (typical)	\pm 5 °C where compensation was performed. If compartment is changed on mainframe, or if sampling module extender is employed, or length of sampling module extender is changed, the Phase Reference module must be recompensated.
✓ Phase reference module input operating frequency	
With 82A04	8 GHz to 25 GHz
With 82A04-60 G	8 GHz to 60 GHz

Table 1-4: System - Trigger - Phase correction modes (mainframe with 82A04 Phase Reference module) (cont.)

Description	Characteristics
Phase reference module input operating frequency (typical) With 82A04	2 GHz to 25 GHz usable range. Operation below 8 GHz requires the use of external filters, as follows: 2 GHz - 4 GHz: requires 2.2 GHz peaked lowpass filter kit, Tektronix part number 020-2566-00. 4 GHz - 6 GHz: requires 4 GHz lowpass filter kit, Tektronix kit part number 020-2567-00. 6 GHz - 10 GHz: requires 6 GHz filter lowpass filter kit, Tektronix kit part number 020-2568-00. 2 GHz to 25 GHz settable range.
With 82A04-60 G	2 GHz to 60 GHz usable range. Operation below 8 GHz requires the use of external filters as noted for the standard 82A04. 2 GHz to 110 GHz settable range.

Table 1-5: Display

Specifications	Characteristics
Display type	210.4 mm (wide) x 1.578 mm (high), 263 mm (10.4 inch) diagonal, liquid crystal active matrix color display (LCD).
Display resolution	640 horizontal by 480 vertical pixels.
Pixel pitch	Pixels are 0.3288 mm (horizontal) and 0.3288 mm (vertical).

Table 1-6: Ports

Specifications	Characteristics
Video output 1	15-pin D-subminiature connector on the rear panel. Used for a second monitor (DDC28 compliant.)
Video Output 2	15-pin D-subminiature connector on the rear panel. Used for an auxiliary duplicate primary monitor (VGA).
Parallel port (IEEE 1284)	25-pin D-subminiature connector on the rear panel. Supports the following modes: <ul style="list-style-type: none"> ■ Standard mode, output only ■ Bi-directional, PS/2 compatible ■ Bi-directional Enhanced Parallel Port (IEEE 1284 standard, Mode 1 or Mode 2, v1.7) ■ Bi-directional high speed Extended Capabilities Port (ECP)

Table 1-6: Ports (cont.)

Specifications	Characteristics
Serial port	9-pin D-subminiature serial-port connector using NS16C550 compatible UARTs supporting transfer speeds up to 115.2 kbits/sec.
Keyboard and mouse interface	USB and PS/2 compatible connectors.
LAN interface	RJ-45 LAN connector supporting 10BASE-T and 100BASE-T.
External audio connectors	External audio jacks for MIC, LINE OUT, LINE IN, SIDE, REAR, and CTR BASS.
USB interface	Four USB 2.0 high speed connectors (one on the front panel, three on the rear panel).
GPIB interface	Complies with IEEE 488.2.
Internal clock trigger out	<p>Square wave out from 50 Ω. back termination synchronized to the TDR internal clock drive signal. Refer to <i>Trigger System - Internal Clock</i>.</p> <p>Typical performance into 50 Ω termination:</p> <ul style="list-style-type: none"> -0.20 to +0.20 V low level +0.90 to +1.10 V high level
DC calibration output	DC voltage from low impedance drive, programmable to 1 mV over ± 1.25 V range maximum.
DC calibration output accuracy (typical)	0.1 mV + 0.1% into 50 Ω
✓ DC calibration output accuracy	0.2 mV + 0.1% into 50 Ω
External 10 MHz reference input	500 mV _{p-p} to 5 V _{p-p} AC coupled into 1 k Ω , ± 5 V maximum
Gated Trigger Input - Logic Polarity (Option GT equipped mainframes)	<p>A TTL logic 1 enables triggers to be accepted. A TTL logic 0 disables all triggering.</p> <p>Input held high (enable triggers) when no control signal is present.</p>
Gated Trigger Input - Maximum non-destruct input levels (Option GT equipped mainframes)	± 5 V maximum
Gated Trigger Input - Enable-to-Acquire Delay (Option GT equipped mainframes)	<p>3 trigger cycles, where each cycle is defined as (holdoff time + trigger latency). For example: With holdoff set to its minimum 5 μs setting, and a 2.500 GHz clock signal applied to the External Direct Trigger input (a period of 400 ps), the Enable-to-Acquire delay is approximated as $3 \times (5 \mu\text{s} + 0.0004 \mu\text{s}) = 15.0012 \mu\text{s}$.</p> <p>The Enable-to-Acquire delay is the amount of time after the Gated Trigger has been enabled (the level goes from TTL LOW to HIGH) when the first valid sample is retained by the system as the beginning of the waveform record length. When the Gated Trigger is enabled and triggers begin to occur, the system will reject the first three samples to avoid system recovery conditions. Once the first three points have been discarded, then the next valid trigger cycle will be the first point of the record section.</p>
Gated Trigger Input - Maximum Disable Time (Option GT equipped mainframes)	The system checks the status of the gated Trigger approximately once per holdoff and rearm cycle. If the Gated Trigger is disabled immediately after this system check, it will allow nominally a maximum time of (holdoff + trigger period) to elapse before the checking for the status of the Gated Trigger input, recognizing the disable condition, and halting any further sampling of the signal.

Table 1-7: Data storage

Specifications	Characteristics
CD-RW/DVD drive capacity	CD-RW/DVD ROM combo, 644 MB, 16.7 MB/sec, mounted on front panel
Hard disk drive capacity	≥ 40 Gbytes

Table 1-8: Power consumption, fuses, and cooling

Specifications	Characteristics
Source voltage and frequency	<p>Range for the line voltage needed to power the instrument within which the instrument meets its performance requirements.</p> <p>100-240 V RMS ±10%, 50/60 Hz 115 V RMS ±10%, 400 Hz CAT II</p>
Fuse rating	<p>Current and voltage ratings and type of the fuse used to fuse the source line voltage.</p> <p>Two sizes can be used:</p> <p>(0.25 x 1.25 inch size): UL 198G & CSA C22.2, No. 59 Fast acting: 8 Amp, 250 V; Tektronix part number 159-0046-00, BUSSMAN part number ABC-8, LITTLEFUSE part number 314008.</p> <p>(5 x 20 mm size): IEC 127, sheet 1, fast acting “F”, high breaking capacity, 6.3 Amp, 250 V, BUSSMAN part number GDA ±6.3, LITTLEFUSE part number 21606.3.</p>
Power requirements	<p>Maximum: 600 Watts. Fully Loaded: 275 Watts, typical. Mainframe with keyboard and mouse, no modules: 192 Watts, typical.</p> <p>An example of a fully loaded mainframe for these characteristic loads has installed optical modules, electrical modules, and active probes comprised of:</p> <p>one 80C11-CR4 one 80A05-10G three 067-0387-02 one 067-0397-02</p> <p>There is typically a slight 10 W deviation in the dissipation for various line conditions ranging from 48 Hz through 400 Hz as well as operating ambient temperature.</p>
Cooling requirements	<p>Six fans with speed regulated by internal temperature sensors.</p> <p>A 2" (51 mm) clearance must be maintained on the left side and right side of the instrument, and a 0.75" (19 mm) clearance must be maintained on the bottom of the instrument for forced air flow. It should never be operated on a bench with the feet removed, nor have any object placed nearby where it may be drawn against the air vents.</p> <p>No clearance is required on the front, back, and top.</p>

Table 1-9: Mechanical

Specifications	Characteristics
Construction material	Chassis: Aluminum alloy Cosmetic covers: PC/ABS thermoplastic Front panel: Aluminum alloy with PC/thermoplastic overlay Module doors: Nickel plated stainless steel Bottom cover: Vinyl clad sheet metal Circuit boards: Glass-laminate Cabinet: Aluminum
Weight	22.9 kg (50.5 lb) (keyboard, mouse, top pouch, power cord, front shield installed, and no modules installed)
Overall dimensions	Height: 343 mm (13.5 in) Width: 457 mm (18.0 in) Depth: 419 mm (16.5 in) The dimensions do not include feet, rack mount kit, or protruding connectors.
Overall mass, packaged product	36.7 kg (81 lb)
Overall dimensions, packaged product	Height: 613 mm (24.12 in) Width: 695 mm (27.37 in) Depth: 756 mm (29.75 in)

Table 1-10: System - Environmental¹

Description	Characteristics
Dynamics	Random vibration (nonoperating): 2.28 g rms, from 5 to 500 Hz, 10 minutes each axis, (3 axis, 30 minutes total).
Atmospherics	
Temperature:	Operating: 10 °C to +40 °C. 0 °C to +35 °C for 80E0X modules on Tektronix part number 012-1569-02 meter extender. Nonoperating: -22 °C to +60 °C.
Relative humidity:	Operating: 20% to 80%, with a maximum wet bulb temperature of 29 °C at or below +40 °C (upper limits derates to 45% relative humidity at +40 °C, non-condensing). Nonoperating (no floppy disk in floppy drive): 5% to 90%, with a maximum wet bulb temperature of 29 °C at or below +60 °C (upper limits derates to 20% relative humidity at +60 °C, non-condensing).
Altitude:	Operating: 3,000 m (9,842 ft.). Nonoperating: 12,190 m (40,000 ft.).
Electrostatic discharge susceptibility	Up to 8 kV with no change to control settings, or impairment of normal operation. Up to 15 kV with no damage that prevents recovery of normal operation.

¹ **Environmental specifications apply to all properly installed modules unless noted otherwise.**

Table 1-11: Mechanical - 82A04 Phase Reference module

Specifications	Characteristics
Construction material	Chassis: Aluminum alloy Front panel: Plastic laminate Circuit boards: Glass-laminate Cabinet sleeve and end covers: Aluminum
Weight	0.4 kg (13 oz.).
Overall Dimensions	Height 25 mm (1.0 in.) Width 79 mm (3.1 in.) Depth 135 mm (5.3 in.). Does not include connector, adapter, connector cover, or lock down hardware protruding from front or rear panels.

80E00 Electrical Sampling Modules Specifications

This section contains specifications for the following electrical sampling modules:

80E01	80E04	80E08
80E02	80E06	80E09
80E03	80E07	80E10

All specifications are guaranteed unless noted as “typical.” Typical specifications are provided for your convenience but are not guaranteed. Specifications that are marked with the ✓ symbol are checked in the *Performance Verification* chapter.

All specifications apply to all electrical sampling models unless noted otherwise. To meet specifications, these conditions must first be met:

- The instrument must have been calibrated/adjusted at an ambient temperature between +20 °C and +30 °C.
- The instrument must have been operating continuously for 20 minutes within the operating temperature range specified.
- The instrument must be in an environment with temperature, altitude, humidity, and vibration within the operating limits described in these specifications
- A compensation must have been performed. Recompensation is required if a module is moved to another compartment or a module extender is added or removed.

NOTE. For Certifications, refer to the System Specifications section.

Table 1-12: Electrical sampling modules - Signal acquisition

Specifications	Characteristics	
Real time accessory interface	Tekprobe-SMA interface is provided through the electrical sampling-module interface, one per vertical channel.	
Number of input channels	<i>Sampling module</i>	<i>Channels</i>
	80E01, 80E06	1
	80E02, 80E03, 80E04, 80E07, 80E08, 80E09, 80E10	2
Channel input connector	<i>Sampling module</i>	<i>Input connector</i>
	80E02, 80E03, 80E04	3.5 mm female SMA compatible connector
	80E01	2.4 mm female connector
	80E06, 80E09, 80E10	1.85 mm (V) female connector ⁸
	80E07, 80E08	2.92 mm (K) female SMA-compatible connector
✓ Input impedance	<i>Sampling module</i>	<i>Impedance</i>
	80E01, 80E02, 80E03, 80E04, 80E06	50 Ω ± 0.5 Ω
	80E07, 80E08, 80E09, 80E10	50 Ω ± 1 Ω
Vertical dynamic range	1 V _{pp} (offset ± 500 mV)	
Vertical operating range ¹ , maximum	<i>Sampling module</i>	<i>Operating range</i>
	80E01, 80E02, 80E03, 80E04, 80E06	± 1.6 V
	80E07, 80E08, 80E09, 80E10	± 1.1 V
Vertical nondestruct range ² (maximum input voltage)	<i>Sampling module</i>	<i>Maximum input</i>
	80E01, 80E06, 80E07, 80E08, 80E09, 80E10	± 2.0 V (DC+peak AC)
	80E02, 80E03, 80E04	± 3.0 V (DC+peak AC)
Vertical number of digitized bits	14 bits full scale	
Vertical sensitivity range ³	The range of available full scale input settings.	
	<i>Sampling module</i>	<i>Sensitivity range</i>
	80E01, 80E02, 80E03, 80E04, 80E06, 80E07, 80E08, 80E09, 80E10	10 mV to 1 V full scale
Offset range ¹	<i>Sampling module</i>	<i>Offset range</i>
	80E01, 80E02, 80E03, 80E04, 80E06	± 1.6 V
	80E07, 80E08, 80E09, 80E10	± 1.1 V
Compensation temperature range	± 5° C about temperature where compensation was performed. If the module is moved to another compartment on the mainframe, a sampling module extender is employed, or the length of the sampling module extender is changed, the channel(s) must be recompensated.	

Table 1-12: Electrical sampling modules - Signal acquisition (cont.)

Specifications	Characteristics		
✓ DC voltage accuracy, single point, within ± 5 °C of compensated temperature	± 2 mV <system offset offset> ± 0.007 * (assigned offset) ± 0.02 * (vertical value - assigned offset)		
✓ DC vertical voltage deviation from linear least squares fit	± 10 mV		
✓ Analog bandwidth ⁵	<i>Sampling module</i>	<i>Bandwidth</i>	
	80E01	DC to 50 GHz, better than ± 3 dB	
	80E06	DC to 65 GHz, better than ± 3 dB DC to 70 GHz, better than ± 3 dB, typical	
	80E07, 80E08	DC to 30 GHz, better than ± 3 dB	
	80E09	DC to 60 GHz, better than ± 3 dB	
	80E10	DC to 50 GHz, better than ± 3 dB	
Analog bandwidth ⁵	<i>Sampling module</i>	<i>Bandwidth</i>	
	80E02	12.5 GHz, typical	
	80E03 and 80E04	20 GHz, typical	
Analog bandwidth, reduced frequency set points, typical	<i>Sampling module</i>	<i>Bandwidth</i>	
	80E07, 80E08	20 GHz	
	80E09, 80E10	30 GHz, 40 GHz	
Rise time ⁴ , typical	<i>Sampling module</i>	<i>Bandwidth setting</i>	<i>Rise time</i>
	80E01	N/A	≤ 7 ps
	80E02	N/A	≤ 28 ps
	80E03 and 80E04	N/A	≤ 17.5 ps
	80E06	N/A	≤ 5.0 ps
	80E07, 80E08	30 GHz	11.67 ps
		20 GHz	17.5 ps
	80E09	60 GHz	5.83 ps
		40 GHz	8.75 ps
		30 GHz	11.67 ps
	80E10	50 GHz	7 ps
		40 GHz	8.75 ps
30 GHz		11.67 ps	

Table 1-12: Electrical sampling modules - Signal acquisition (cont.)

Specifications	Characteristics		
✓ Random noise, displayed	<i>Sampling module</i>	<i>Bandwidth setting</i>	<i>Noise</i>
	80E01	50 GHz (fixed)	$\leq 2.3 \text{ mV}_{\text{RMS}}$ 1.8 mV _{RMS} , typical
	80E02	12.5 GHz (fixed)	$\leq 800 \mu\text{V}_{\text{RMS}}$ 400 μV_{RMS} , typical
	80E03 and 80E04	20 GHz (fixed)	$\leq 1.2 \text{ mV}_{\text{RMS}}$ 600 μV_{RMS} , typical
	80E06	65 GHz (fixed)	$\leq 2.4 \text{ mV}_{\text{RMS}}$ $\leq 1.8 \text{ mV}_{\text{RMS}}$, typical
	80E07, 80E08	30 GHz	$< 410 \mu\text{V}_{\text{RMS}}$ $< 300 \mu\text{V}_{\text{RMS}}$, typical
		20 GHz	$< 380 \mu\text{V}_{\text{RMS}}$ $< 280 \mu\text{V}_{\text{RMS}}$, typical
	80E09	60 GHz	$< 600 \mu\text{V}_{\text{RMS}}$ $< 450 \mu\text{V}_{\text{RMS}}$, typical
		40 GHz	$< 480 \mu\text{V}_{\text{RMS}}$ $< 330 \mu\text{V}_{\text{RMS}}$, typical
		30 GHz	$< 410 \mu\text{V}_{\text{RMS}}$ $< 300 \mu\text{V}_{\text{RMS}}$, typical
	80E10	50 GHz	$< 700 \mu\text{V}_{\text{RMS}}$ $< 600 \mu\text{V}_{\text{RMS}}$, typical
		40 GHz	$< 480 \mu\text{V}_{\text{RMS}}$ $< 370 \mu\text{V}_{\text{RMS}}$, typical
		30 GHz	$< 410 \mu\text{V}_{\text{RMS}}$ $< 300 \mu\text{V}_{\text{RMS}}$, typical

Table 1-12: Electrical sampling modules - Signal acquisition (cont.)

Specifications	Characteristics	
Step response aberrations ⁷ , typical	<i>Sampling module</i>	<i>Aberrations, step transition⁶</i>
	80E02, 80E03, and 80E04	$\pm 3\%$ 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
	80E01	$\pm 3\%$ 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 $\pm 1\%$ or less over the zone 3 ns to 100 ns following step transition $\pm 0.5\%$ after 100 ns following step transition
	80E06	+ 5% or less for the first 300 ps following step transition
	80E07, 80E08, 80E09, 80E10	At maximum sampler bandwidth setting: $\pm 1\%$ or less over the zone 10 ns to 20 ps before step transition +6%, -10% or less over 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 $\pm 1\%$ or less after 100 ns following step transition
Acquisition delay adjust range, typical	<i>Sampling module</i>	<i>Delay adjust range</i>
	80E07, 80E08, 80E09, 80E10	± 250 ps, each channel

Table 1-12: Electrical sampling modules - Signal acquisition (cont.)

Specifications	Characteristics	
Acquisition delay adjust resolution	<i>Sampling module</i>	<i>Delay adjust resolution</i>
	80E07, 80E08, 80E09, 80E10	135 fs

- 1 **Vertical operating range** defines the maximum range over which the offset plus peak input signal can operate. The offset may be limited as a function of vertical sensitivity and dynamic range, such that no signal exceeding the maximum operating range can be displayed.
- 2 **Vertical nondestruct range** defines the maximum range over which offset plus peak input signal can operate without irreversible damage to the instrument. Operation to instrument specification is not guaranteed outside of the vertical operating range.
- 3 **Input Signal Ranges** in IEEE std 1057, section 2.2.1.
- 4 IEEE std 1057, section 4.8.2, **Transition Duration of Step Response**. The 80E01, 80E07, 80E08, 80E09, and 80E10 rise time is calculated from the 0.35 bandwidth-risetime product. The 80E06 rise time is calculated from the 0.35 typical bandwidth-risetime product.
- 5 IEEE std 1057, section 4.6, **Analog Bandwidth**.
- 6 IEEE std 1057, section 4.8.4, **Overshoot and Precursors**. Step transition occurs at the point of minimum radius of the waveform curvature, after the 50% amplitude point of the step leading edge.
- 7 When tested using a V-connector equipped 50 Ω , ultrafast PIN Photodetector with greater than 50 GHz bandwidth, which is driven by an ultrafast, mode-locked impulse laser (for example, the Calmar FPL-01).
- 8 Because the 2.4 mm connector of this adapter will mechanically interface with the 1.85 mm connector of the 80E06, it serves as a 1.85 mm-to-2.92 mm connector for the 80E06 module.

Table 1-13: Electrical sampling modules (80E04, 80E08, and 80E10 TDR Sampling Modules) - TDR system

Specifications	Characteristics	
Number of TDR channels	2, one per channel	
TDR operation modes	Step output with positive edge polarity, negative edge polarity, and TDR off, independently selectable for each channel.	
TDR maximum input voltage	Specifications are not guaranteed with any DUT applying signal. Do not apply input voltage during TDR operation.	
✓ TDR system reflected rise time ¹	<i>Sampling module</i>	<i>Reflected rise time</i>
	80E04	≤ 35 ps each polarity
	80E08	≤ 22 ps, each polarity ≤ 20 ps, each polarity, typical
	80E10	≤ 16 ps, each polarity ≤ 15 ps, each polarity, typical
TDR incident edge amplitude	± 250 mV step into 50 Ω each polarity, typical	
TDR system incident rise time, typical	<i>Sampling module</i>	<i>Incident rise time</i>
	80E04	≤ 28 ps
	80E08	≤ 18 ps, each polarity
	80E10	≤ 12 ps, each polarity

Table 1-13: Electrical sampling modules (80E04, 80E08, and 80E10 TDR Sampling Modules) - TDR system (cont.)

Specifications	Characteristics	
✓ TDR system step response aberrations, incident edge ²	<i>Sampling module</i>	<i>Step response aberrations</i>
	80E04	<p>±3% or less over the zone 10 ns to 20 ps before step transition</p> <p>+10%, -5% or less typical for the first 400 ps following step transition</p> <p>±3% or less over the zone 400 ps to 5 ns following step transition</p> <p>±1% or less after 5 ns following step transition</p>
	80E08, 80E10	<p>At maximum sampler bandwidth setting, both polarities of TDR:</p> <p>± 1% or less over the zone 10 ns to 20 ps before step transition</p> <p>+20% -2% or less over the zone 14 ps to 150 ps following step transition</p> <p>+12% -2% or less over the zone 150 ps to 400 ps following step transition</p> <p>± 2% or less over the zone 400 ps to 5 ns following step transition</p> <p>+1% -2% or less over the zone 5 ns to 100 ns following step transition</p> <p>± 1% after 100 ns following step transition</p>
TDR incident edge delay adjust range, typical	<i>Sampling module</i>	<i>Incident edge delay adjust</i>
	80E08, 80E10	± 250 ps, each channel and each polarity
TDR incident edge delay adjust resolution, typical	<i>Sampling module</i>	<i>Incident edge delay adjust resolution</i>
	80E08, 80E10	135 fs
TDR step maximum repetition rate	200 kHz	

¹ IEEE std 1057, section 4.8.2, transition duration of step response.

² IEEE std 1057, section 4.8.4, overshoot and precursors.

Table 1-14: Electrical sampling modules - Timebase system

Specifications	Characteristics	
Sampling rate	DC-200 kHz maximum	
Horizontal position range, minimum p.g. (deskew adjust range between channels)	<i>Sampling module</i>	<i>Position range</i>
	80E01, 80E02, 80E03, 80E04, 80E06	19 ns, no extender cable present
	80E07, 80E08, 80E09, 80E10	29 ns

Table 1- 15: Electrical sampling modules - Power consumption

Specifications	Characteristics	
Power dissipation	<i>Sampling module</i>	<i>Power dissipation</i>
	80E01	1.1 W
	80E02, 80E03	1.8 W
	80E04	3.2 W
	80E06	2.4 W
	80E07, 80E09	5.1 W
	80E08, 80E10	6.5 W

Table 1- 16: Electrical sampling modules - Mechanical

Specifications	Characteristics	
Weight (unpacked)	<i>Sampling module</i>	<i>Weight</i>
	80E01, 80E02, 80E03, 80E04, 80E06	0.4 kg (13 oz.)
	80E07, 80E08	861 gm (29.11 oz)
	80E09, 80E10	868 gm (29.35 oz) including two 2.4 mm to 2.92 mm adapters
Overall dimensions	Does not include connectors, connector savers, connector covers, push buttons, or lock-down hardware protruding from the front or rear panels.	
	<i>Sampling module</i>	<i>Dimensions</i>
	80E01, 80E02, 80E03, 80E04, 80E06	Height: 25 mm (1.0 in) Width: 79 mm (3.1 in) Depth: 135 mm (5.3 in)
	80E07, 80E08, 80E09, 80E10 main module	Height: 25 mm (1.0 in) Width: 79 mm (3.1 in) Depth: 135 mm (5.3 in)
	80E07, 80E08, 80E09, 80E10 remote module	Height: 25 mm (1.0 in) Width: 55 mm (2.2 in) Depth: 75 mm (3.0 in) Remote cable length: 2 meters
Construction material	Chassis:	aluminum alloy
	Front panel:	plastic laminate
	Circuit boards:	glass-laminate
	Cabinet:	aluminum

80C00 Optical Sampling Modules Specifications

This section contains specifications for the 80C00 Series Optical Modules. All specifications are guaranteed unless noted as “typical.” Typical specifications are provided for your convenience but are not guaranteed. Except for limits noted “typical,” specifications that are marked with the ✓ symbol are checked in the *Performance Verification* section of the service manual.

All specifications apply to all 80C00 Series Optical Modules unless noted otherwise. To meet specifications, the following conditions must first be met:

- The instrument must have been calibrated/adjusted at an ambient temperature between +20 °C and +30 °C.
- The instrument must have been operating continuously for 20 minutes within the operating temperature range specified.
- Vertical compensation must have been performed with the module installed in the same compartment used when the compensation was performed. Ambient temperature must be within ± 2 °C of the compensation temperature.
- The instrument must be in an environment with temperature, altitude, humidity, and vibration within the operating limits described in these specifications.

NOTE. “*Sampling Interface*” refers to both the electrical sampling module interface and the optical module interface, unless otherwise specified.

NOTE. For Certifications, refer to the System Specifications section.

Table 1-17: Optical modules - Descriptions

Name	Characteristics
80C01	<p>Long wavelength 1100 nm - 1650 nm. Unamplified O/E converter with two user-selectable optical bandwidths:</p> <ul style="list-style-type: none"> 12.5 GHz, > 20 GHz, <p>or three user-selectable reference receiver responses:</p> <ul style="list-style-type: none"> OC-12/STM-4 for 622.08 Mb/s SONET/SDH standards, OC-48/STM-16 for 2.488 Gb/s SONET/SDH standards, and OC-192/STM-64 for 9.953 Gb/s SONET/SDH standards.
80C02	<p>Long wavelength 1100 nm - 1650 nm. Unamplified O/E converter with three user-selectable optical bandwidths:</p> <ul style="list-style-type: none"> 12.5 GHz 20 GHz 30 GHz <p>or one user-selectable reference receiver response:</p> <ul style="list-style-type: none"> OC-192/STM-64 for 9.953 Gb/s Sonet/SDH standards.
80C03	<p>Broad wavelength 700 nm - 1650 nm. Amplified O/E converter with optical bandwidth of 2.5 GHz. The 2.5 Gb/s, OC-48/STM-16, and 2.0 GHz modes all use a physical path that has OC-48/STM-16 reference receiver type response. Two other selectable reference receiver responses:</p> <ul style="list-style-type: none"> FC1063 for the 1.0625 Gb/s fibre channel standard and GBE for the 1.25 Gb/s gigabit ethernet standard.
80C04	<p>Long wavelength 1100 nm - 1650 nm unamplified. Unamplified O/E converter with two user-selectable optical bandwidths:</p> <ul style="list-style-type: none"> 20 GHz 30 GHz <p>or two user-selectable reference receiver responses:</p> <ul style="list-style-type: none"> OC-192/STM-64 for 9.953 Gb/s Sonet/SDH standards 10.664 Gb/s ITU-T Recommendation G.975 standard
80C05	<p>Long wavelength 1520 nm - 1580 nm unamplified. Three user-selectable optical bandwidths:</p> <ul style="list-style-type: none"> 20 GHz 30 GHz 40 GHz <p>or one reference receiver response:</p> <ul style="list-style-type: none"> OC-192/STM-64 for 9.953 Gb/s Sonet/SDH standards
80C06	<p>Long wavelength 1520 nm - 1580 nm. O/E converter unamplified, 55 GHz optical sampler accepts high power optical signals typical for RZ signaling. Particularly well-suited for 40 Gb/s RZ telecom applications, as well as general purpose optical component testing.</p>
80C07	<p>Broad wavelength 700 nm - 1650 nm. Amplified O/E converter with optical bandwidth of 2.5 GHz. The OC-48 and 2.5 GHz modes all use a physical path that has OC-48 reference receiver type response. There are three user-selectable reference receiver responses:</p> <ul style="list-style-type: none"> OC-48/STM-16 OC-3/STM-1 OC-12/STM-4

Table 1-17: Optical modules - Descriptions (cont.)

Name	Characteristics
80C07B	<p>Broad wavelength 700 nm - 1650 nm. Amplified O/E converter with optical bandwidth of 2.5 GHz. The OC-48, 2GBE, INFINIBAND, and 2.5 GHz modes all use a physical path that has OC-48 reference receiver type response. There are eight user-selectable reference receiver responses:</p> <ul style="list-style-type: none"> OC-3 / STM-1 OC-12 / STM-4 OC-48 / STM-16 ENET1250 / GBE ENET2500 / 2GBE INFINIBAND FC1063 / FC FC2125 / 2FC
80C08	<p>Broad wavelength 700 nm-1650 nm. Amplified O/E converter with maximum optical bandwidth (in combination with the internal electrical sampler) of 10 GHz. There are two data rate receiver setups selectable:</p> <ul style="list-style-type: none"> 10GBASE-W for 9.95328 Gb/s 10GBASE-R for 10.3125 Gb/s
80C08B	<p>Broad wavelength 700 nm-1650 nm. Amplified O/E converter with maximum optical bandwidth (in combination with the internal electrical sampler) of 9.5 GHz. There are four user-selectable reference receiver responses:</p> <ul style="list-style-type: none"> 10GBASE-W for 9.95328 Gb/s 10 Gb/s Ethernet standard 10GBASE-R for 10.3125 Gb/s 10 Gb/s Ethernet FEC standard 10GFC for 10.51875 Gb/s 10 Gb/s FibreChannel standard OC-192/STM-64 for 9.953 Gb/s Sonet/SDH standards
80C08C	<p>Broad wavelength 700 nm-1650 nm. Amplified O/E converter with maximum optical bandwidth (in combination with the internal electrical sampler) of > 9.5 GHz. There are six user-selectable reference receiver responses:</p> <ul style="list-style-type: none"> 10GBASE-W for 9.95328 Gb/s 10 Gb/s Ethernet standard 10GBASE-R for 10.3125 Gb/s 10 Gb/s Ethernet FEC standard 10GBE FEC for 11.0957 Gb/s 10GFC FEC for 11.317 Gb/s 10GFC for 10.51875 Gb/s 10 Gb/s FibreChannel standard OC-192/STM-64 for 9.953 Gb/s Sonet/SDH standards <p>or two data filters:</p> <ul style="list-style-type: none"> G.975 FEC 10.66423 Gb/s G.709 FEC 10.709225 Gb/s
80C09	<p>Long wavelength 1100 nm - 1650 nm. Unamplified O/E converter with two user-selectable optical bandwidths:</p> <ul style="list-style-type: none"> 20 GHz, 30 GHz, <p>or two user-selectable reference receiver responses:</p> <ul style="list-style-type: none"> OC-192/STM-64 for 9.953 Gb/s Sonet/SDH standards 10.709 Gb/s ITU-T Recommendation G.709 standard

Table 1-17: Optical modules - Descriptions (cont.)

Name	Characteristics
80C10	<p>Long wavelength 1310 nm and 1550 nm. Unamplified O/E converter with two user-selectable optical bandwidths: 30 GHz, 65 GHz,</p> <p>or two user-selectable reference receiver responses: OC-768/STM-256 for 39.813 Gb/s Sonet/SDH standards 43.018 Gb/s ITU-T G.709 standard</p>
80C10B	<p>Long wavelength 1310 nm and 1550 nm. Unamplified O/E converter with three user-selectable optical bandwidths: 30 GHz (not available with Option F1) 65 GHz 80 GHz (not available with Option F1)</p> <p>or three user-selectable reference receiver responses: OC-768/STM-256 for 39.813 Gb/s Sonet/SDH standards 43.018 Gb/s ITU-T G.709 standard 40GBase-FR for 40 Gb Ethernet at 41.25 Gb/s</p> <p>Option F1 includes the following additional reference receiver filter rates: 100GBase-xR4 25.781 Gb/s 100Gbase-xR4 FEC 27.739 Gb/s</p>
80C11	<p>Long wavelength 1100 nm - 1650 nm. Unamplified O/E converter with two user-selectable optical bandwidths: 20 GHz, 30 GHz,</p> <p>or nine user-selectable reference receiver responses: OC-192/STM-64 for 9.953 Gb/s Sonet/SDH standards 10GBase-W for 10 Gb Ethernet 9.95338 Gb/s 10GBase-R 10.3125 Gb/s 10GBE FEC 11.0957 Gb/s 10GFC FEC for 11.317 Gb/s 10GFC for 10G Fibre Channel 10.51875 16GFC for 16G Fibre Channel 14.025 Gb/s G.975 FEC 10.66423 Gb/s G.709 FEC 10.709225 Gb/s</p>

Table 1-17: Optical modules - Descriptions (cont.)

Name	Characteristics
80C12	<p>Broad wavelength 700 nm - 1650 nm. Amplified O/E converter with maximum optical bandwidth (in combination with the internal electrical sampler) of > 8.5 GHz (> 9.5 GHz in Option 10G).</p> <p>A variety of filter options are available that support 2 to 4 filters from the following list:</p> <ul style="list-style-type: none"> FC1063 for 1.0623 Gb/s FibreChannel FC2125 for 2.125 Gb/s FibreChannel 10GBase-X4 for 3.125 Gb/s 10GFC-X4 for 3.188 Gb/s VSR-5 for 3.318 Gb/s FC4250 for 4.25 Gb/s Fibre Channel <p>Some filter options support a filterless full-bandwidth setting (9 GHz) in place of one hardware filter.</p> <p>Option 10G provides the following reference receiver filter rates:</p> <ul style="list-style-type: none"> SONET/SDH OC-192/STM-64 10GBase-W, 10 Gb Ethernet (9.95338 Gb/s) 10GBase-R (10.3125 Gb/s) 10G Fibre Channel (10.51875 Gb/s) G.975 FEC (10.66 Gb/s) G.709 FEC (10.71 Gb/s) 10GBE FEC (11.0957 Gb/s) 10GFC FEC (11.317 Gb/s) > 9.5 GHz full bandwidth
80C25GBE	<p>Long wavelength 1310 nm and 1550 nm. Unamplified O/E converter with optical bandwidth of 65 GHz. There are two reference receiver filter rates:</p> <ul style="list-style-type: none"> 100GBase-xR4 25.781 Gb/s 100Gbase-xR4 FEC 27.739 Gb/s

Table 1-18: Optical modules - Acquisition

Name	Characteristics
Number of input channels	1 optical
Internal fiber diameter ¹	
80C01, 80C02, 80C04, 80C05, 80C06, 80C09, 80C10, 80C10B, 80C11	9 μm/125 μm single mode
80C03, 80C07, 80C07B, 80C08, 80C08B, 80C08C, 80C12	62.5 μm (Corning 62.5/125 CPC6 specs) multimode (compatible with single-mode fiber) cladding: 125 μm, buffer: 900 μm
Fiber connector	Rifocs UCI (universal connector interface) male connector

Table 1-18: Optical modules - Acquisition (cont.)

Name	Characteristics
Optical return loss	
80C01, 80C02, 80C04, 80C05, 80C06, 80C09, 80C10, 80C10B, 80C11, 80C25GBE	> 30 dB for single-mode fiber
80C03, 80C07, 80C07B, 80C08, 80C08B, 80C08C, 80C12	> 14 dB for multimode fiber > 24 dB for single-mode fiber
Absolute maximum nondestructive optical input ²	
80C01, 80C02, 80C03, 80C04, 80C07, 80C07B, 80C09, 80C11	5 mW average power; 10 mW peak power at wavelength with highest relative responsivity.
80C05, 80C06, 80C10, 80C10B, 80C25GBE	20 mW average power; 60 mW power at wavelength with highest relative responsivity.
80C08, 80C08B, 80C08C, 80C12	1 mW average power; 10 mW peak power at wavelength with highest relative responsivity.
Maximum operating ranges ^{2,11}	
80C01, 80C02, 80C04, 80C09, 80C11	0 to 10 mW displayed limits, not including offset.
80C03, 80C07, 80C07B	0 to 1 mW displayed limits, not including offset.
80C05	0 to 30 mW displayed limits, not including offset. However, signal limit is 10 mW average optical power, 20 mW displayed peak power at wavelength with highest relative responsivity.
80C06	0 to 60 mW displayed limits, including offset, which may be coerced to above 4 mW/div to ensure this is attained, and respecting that the signal limit is 15 mW average optical power, 30 mW displayed peak power at wavelength with highest relative responsivity.
80C08, 80C08B, 80C08C, 80C12	0 to 2 mW displayed limits, not including offset.
80C10, 80C10B	0 to 30 mW displayed limits, not including offset.
80C10B-F1, 80C25GBE	0 to 20 mW displayed limits, not including offset.
Effective wavelength range ³ , typical	
80C01, 80C02, 80C04, 80C09, 80C11	1100 nm to 1650 nm
80C03, 80C07, 80C07B, 80C08, 80C08B, 80C08C, 80C12	700 nm to 1650 nm
80C05, 80C06	1520 nm to 1580 nm
80C10, 80C10B, 80C25GBE	1550 nm: 1520 nm to 1620 nm 1310 nm: 1290 nm to 1330 nm

Table 1-18: Optical modules - Acquisition (cont.)

Name	Characteristics
Calibrated wavelengths	
80C01, 80C02, 80C04, 80C09, 80C10, 80C10B, 80C11	1550 nm and 1310 nm \pm 20 nm
80C03, 80C07, 80C07B, 80C08, 80C08B, 80C08C	1550 nm, 1310 nm, 850 nm, and 780 nm (all \pm 20 nm)
80C05, 80C06	1550 nm \pm 20 nm
80C12	1550 nm, 1310 nm, and 850 nm (all \pm 20 nm)

Table 1-18: Optical modules - Acquisition (cont.)

Name	Characteristics	
✓ Dark level	<p>To achieve these levels, perform a dark level compensation.</p> <p>If any of the following settings or conditions change, you must perform another dark level compensation:</p> <ul style="list-style-type: none"> Trigger rate setting Vertical offset setting Filter or bandwidth setting Ambient temperature change of more than 1 °C ELECTRICAL SIGNAL OUT front panel connection (80C12) 	
80C01	OC-12/STM-4, OC-48/STM-16, OC-192/STM-64, 12.5 GHz	< 10 μ W \pm 2% (vertical offset)
	20 GHz	< 10 μ W \pm 4% (vertical offset)
80C02	OC-192/STM-64, 12.5 GHz	< 10 μ W \pm 2% (vertical offset)
	20 GHz, 30 GHz	< 10 μ W \pm 4% (vertical offset)
80C03, 80C07, 80C07B	All settings	< 500 nW \pm 2% (vertical offset)
80C04	OC-192/STM-64, 10.66 Gb/s	< 10 μ W \pm 2% (vertical offset)
	20 GHz, 30 GHz	< 10 μ W \pm 4% (vertical offset)
80C05	OC-192/STM-64	< 10 μ W \pm 2% (vertical offset)
	20 GHz, 30 GHz, 40 GHz	< 30 μ W \pm 4% (vertical offset)
80C06	50 GHz	< 25 μ W \pm 4% (vertical offset)
80C08, 80C08B, 80C08C, 80C12	All settings	< 1.0 μ W \pm 2% (vertical offset)
80C09	OC-192/STM-64, 10.71 Gb/s	< 10 μ W \pm 2% (vertical offset)
	20 GHz, 30 GHz	< 10 μ W \pm 4% (vertical offset)
80C10, 80C10B, 80C25GBE	1550 nm	\pm [25 μ W + 4% \times vertical offset]
	1310 nm	\pm [35 μ W + 4% \times vertical offset]
80C11	OC-192, 10.71 Gb/s, 10.71 Gb/s, 10GBASE-W, 10GBASE-R, 10GBE FEC, 10GFC, 10GFC FEC	< 10 μ W \pm 2% (vertical offset)
	16GFC	< 10 μ W \pm 3% (vertical offset)
	20 GHz, 30 GHz	< 10 μ W \pm 4% (vertical offset)

Table 1-18: Optical modules - Acquisition (cont.)

Name	Characteristics	
Main-instrument display vertical scale factors	<i>Maximum</i>	<i>Minimum</i>
	80C01, 80C02, 80C04, 80C09, 80C11	1 mW per division
80C03, 80C07, 80C07B	100 μ W per division	1 μ W per division
80C05	3 mW per division	30 μ W per division
80C06	6 mW per division	60 μ W per division
80C08, 80C08B, 80C08C, 80C12	200 μ W per division	2 μ W per division
80C10, 80C10B	3 mW per division	30 μ W per division
80C10B-F1, 80C25GBE	2 mW per division	20 μ W per division
Full scale vertical on the display of the main instrument is 10 divisions. Maximum full scale and minimum full scale are therefore 10 times the values listed above. Vertical scale is adjustable in a 1-2-5 sequence. Between those settings, the scale can be adjusted in smaller increments.		
Vertical offset range		
80C01	\pm 8 mW offset relative to center of waveform display (5 divisions from either top or bottom of waveform display)	
80C02, 80C04, 80C09, 80C11	\pm 6 mW offset relative to center of waveform display (5 divisions from either top or bottom of waveform display)	
80C03	\pm 1 mW offset relative to center of waveform display (5 divisions from either top or bottom of waveform display)	
80C05, 80C10, 80C10B	\pm 15 mW offset relative to center of waveform display (5 divisions from either top or bottom of waveform display)	
80C10B-F1, 80C25GBE	\pm 10 mW offset relative to center of waveform display (5 divisions from either top or bottom of waveform display)	
80C06	\pm 40 mW offset relative to center of waveform display (5 divisions from either top or bottom of waveform display) (typical)	
80C07, 80C07B	\pm 1 mW offset relative to center of waveform display (5 divisions from either top or bottom of waveform display)	
80C08, 80C08B, 80C08C, 80C12	\pm 4 mW offset relative to center of waveform display (5 divisions from either top or bottom of waveform display)	

Table 1-18: Optical modules - Acquisition (cont.)

Name	Characteristics	
DC vertical accuracy ⁴ , typical	<i>Setting</i>	<i>Accuracy</i>
80C01, 80C03, 80C07, 80C07B, 80C08, 80C08B, 80C08C, 80C12	All settings	$\pm 25 \mu\text{W} \pm 2\%$ of [(vertical value) - (vertical offset)]
80C02	12.5 GHz, OC-192/STM-64	$\pm 25 \mu\text{W} \pm 2\%$ of [(vertical value) - (vertical offset)]
	20 GHz	$\pm 25 \mu\text{W} \pm 4\%$ of [(vertical value) - (vertical offset)]
	30 GHz	$\pm 25 \mu\text{W} \pm 6\%$ of [(vertical value) - (vertical offset)]
80C04	10.66 Gb/s, OC-192/STM-64	$\pm 25 \mu\text{W} \pm 2\%$ of [(vertical value) - (vertical offset)]
	20 GHz	$\pm 25 \mu\text{W} \pm 4\%$ of [(vertical value) - (vertical offset)]
	30 GHz	$\pm 25 \mu\text{W} \pm 6\%$ of [(vertical value) - (vertical offset)]
80C05	OC-192/STM-64	$\pm 25 \mu\text{W} \pm 2\%$ of [(vertical value) - (vertical offset)]
	20 GHz	$\pm 25 \mu\text{W} \pm 4\%$ of [(vertical value) - (vertical offset)]
	30 GHz	$\pm 25 \mu\text{W} \pm 6\%$ of [(vertical value) - (vertical offset)]
	40 GHz	$\pm 25 \mu\text{W} \pm 8\%$ of [(vertical value) - (vertical offset)]
80C06	50 GHz	$\pm 120 \mu\text{W} \pm 6\%$ of [(vertical value) - (vertical offset)]
80C09	10.71 Gb/s, OC-192/STM-64	$\pm 25 \mu\text{W} \pm 2\%$ of [(vertical value) - (vertical offset)]
	20 GHz	$\pm 25 \mu\text{W} \pm 4\%$ of [(vertical value) - (vertical offset)]
	30 GHz	$\pm 25 \mu\text{W} \pm 6\%$ of [(vertical value) - (vertical offset)]
80C10	30 GHz	$\pm 25 \mu\text{W} \pm 4\%$ of [(vertical value) - (vertical offset)]
	39.813 Gb/s (OC-768/STM-256), 43.018 Gb/s (G.709 FEC)	$\pm 25 \mu\text{W} \pm 6\%$ of [(vertical value) - (vertical offset)]
	65 GHz setting	$\pm 25 \mu\text{W} \pm 8\%$ of [(vertical value) - (vertical offset)]

Table 1-18: Optical modules - Acquisition (cont.)

Name	Characteristics	
80C10B	30 GHz	$\pm 25 \mu\text{W} \pm 4\%$ of [(vertical value) - (vertical offset)]
	39.813 Gb/s (OC-768/STM-256), 43.018 Gb/s (G.709 FEC), 41.25 Gb/s (40GBase-FR)	$\pm 25 \mu\text{W} \pm 6\%$ of [(vertical value) - (vertical offset)]
	65 GHz setting	$\pm 25 \mu\text{W} \pm 8\%$ of [(vertical value) - (vertical offset)]
	80 GHz setting	$\pm 25 \mu\text{W} \pm 9\%$ of [(vertical value) - (vertical offset)]
80C10B-F1	65 GHz	$\pm 25 \mu\text{W} \pm 8\%$ of [(vertical value) - (vertical offset)]
	39.813 Gb/s (OC-768/STM-256), 43.018 Gb/s (G.709 FEC), 41.25 Gb/s (40GBase-FR)	$\pm 25 \mu\text{W} \pm 6\%$ of [(vertical value) - (vertical offset)]
	25.781 Gb/s (100GBase-xR4), 27.739 Gb/s (100Gbase-xR4 FEC)	$\pm 25 \mu\text{W} \pm 4\%$ of [(vertical value) - (vertical offset)]
80C25GBE	65 GHz	$\pm 25 \mu\text{W} \pm 8\%$ of [(vertical value) - (vertical offset)]
	25.781 Gb/s (100GBase-xR4), 27.739 Gb/s (100Gbase-xR4 FEC)	$\pm 25 \mu\text{W} \pm 4\%$ of [(vertical value) - (vertical offset)]
80C11	OC-192, 10.66Gb/s, 10.71Gb/s, 10Gbase-W, 10Gbase-R, 10GBE FEC, 10GFC, 10GFC FEC	$\pm 25 \text{uW} \pm 2\%$ of [(vertical reading) - (vertical offset)]
	16GFC	$\pm 25 \text{uW} \pm 3\%$ of [(vertical reading) - (vertical offset)]
	20 GHz	$\pm 25 \text{uW} \pm 4\%$ of [(vertical reading) - (vertical offset)]
	30 GHz	$\pm 25 \text{uW} \pm 6\%$ of [(vertical reading) - (vertical offset)]
DC vertical difference accuracy ⁴ , typical	The accuracy of the difference between two cursors in the vertical scale of the same channel.	
	<i>Setting</i>	<i>Accuracy</i>
80C01	12.5 GHz, OC-192/STM-64, OC-48/STM-16, OC-12/STM-4	$\pm 2\%$ of [difference reading]
	20 GHz	$\pm 4\%$ of [difference reading]
80C02	12.5 GHz, OC-192/STM-64	$\pm 2\%$ of [difference reading]
	20 GHz	$\pm 4\%$ of [difference reading]
	30 GHz	$\pm 6\%$ of [difference reading]
80C03, 80C07, 80C07B	All settings	$\pm 2\%$ of [difference reading]
80C04	10.66 Gb/s, OC-192/STM-64	$\pm 2\%$ of [difference reading]
	20 GHz	$\pm 4\%$ of [difference reading]
	30 GHz	$\pm 6\%$ of [difference reading]

Table 1-18: Optical modules - Acquisition (cont.)

Name	Characteristics	
80C05	OC-192/STM-64	± 2% of [difference reading]
	20 GHz	± 4% of [difference reading]
	30 GHz	± 6% of [difference reading]
	40 GHz	± 8% of [difference reading]
80C06, 80C08, 80C08B, 80C08C, 80C12	All settings	± 2% of [difference reading]
80C09	10.71 Gb/s, OC-192/STM-64	± 2% of [difference reading]
	20 GHz	± 4% of [difference reading]
	30 GHz	± 6% of [difference reading]
80C10	30 GHz	± 4% of [difference reading]
	39.813 Gb/s (OC-768/STM-256), 43.018 Gb/s (G.709 FEC)	± 6% of [difference reading]
	65 GHz	± 8% of [difference reading]
80C10B	30 GHz	± 4% of [difference reading]
	39.813 Gb/s (OC-768/STM-256), 43.018 Gb/s (G.709 FEC), 41.25 Gb/s (40GBase-FR)	± 6% of [difference reading]
	65 GHz	± 8% of [difference reading]
	80 GHz	± 9% of [difference reading]
80C10B-F1	65 GHz	± 8% of [difference reading]
	39.813 Gb/s (OC-768/STM-256), 43.018 Gb/s (G.709 FEC), 41.25 Gb/s (40GBase-FR)	± 6% of [difference reading]
	25.781 Gb/s (100GBase-xR4), 27.739 Gb/s (100Gbase-xR4 FEC)	± 4% of [difference reading]
80C25GBE	65 GHz	± 8% of [difference reading]
	25.781 Gb/s (100GBase-xR4), 27.739 Gb/s (100Gbase-xR4 FEC)	± 4% of [difference reading]
80C11	OC-192, 10.66 Gb/s, 10.71 Gb/s, 10Gbase-W, 10Gbase-R, 10GBE FEC, 10GFC, 10GFC FEC	± 2% of [difference reading]
	16GFC	± 3% of [difference reading]
	20 GHz	± 4% of [difference reading]
	30 GHz	± 6% of [difference reading]

Table 1-18: Optical modules - Acquisition (cont.)

Name	Characteristics	
Offset capabilities	Open loop. User assigned, fixed offset value is applied to channel.	
✓ Minimum optical bandwidth ⁵	<i>Setting</i>	<i>Bandwidth</i>
80C01	20 GHz	> 20 GHz
	12.5 GHz	> 12.5 GHz
80C02	30 GHz	> 28 GHz > 30 GHz, typical ⁷
	20 GHz	> 20 GHz
	12.5 GHz	> 12.5 GHz
80C02-CR	30 GHz	> 28 GHz > 29 GHz, typical ⁷
80C03	2.5 GHz	> 2.3 GHz, typical
80C04	30 GHz	> 28 GHz > 30 GHz, typical ⁷
	20 GHz	> 20 GHz
80C04-CR1, 80C04-CR2	30 GHz	> 28 GHz ⁷ > 29 GHz, typical ⁷
80C05	20 GHz	> 20 GHz
	30 GHz	> 30 GHz
	40 GHz	> 40 GHz, typical
80C06	55 GHz ⁶	> 55 GHz, typical
80C07, 80C07B	2.5 GHz	> 2.3 GHz, typical
80C08, 80C08B, 80C08C	10 GHz	> 9 GHz > 10 GHz, typical
80C09	30 GHz	> 30 GHz, typical ⁷
	20 GHz	> 20 GHz
80C09-CR1	30 GHz	> 29 GHz, typical ⁷
80C09, 80C09-CR1	30 GHz	> 28 GHz ⁷
80C10	30 GHz	> 30 GHz
	65 GHz	> 60 GHz > 65 GHz, (typical)
80C10B	30 GHz	> 30 GHz
	80 GHz	> 75 GHz > 80 GHz, (typical)
80C10B, 80C10B-F1	65 GHz	> 60 GHz > 65 GHz, (typical)
80C11, 80C11-CR	20 GHz	> 20 GHz
	30 GHz	> 28 GHz > 30 GHz (typical)

Table 1-18: Optical modules - Acquisition (cont.)

Name	Characteristics	
80C12	9 GHz (options F2, F3, F5, F6, FC)	> 8.5 GHz > 9 GHz, typical
	10 GHz (option 10G)	> 9.5 GHz > 10 GHz (typical)
80C25GBE	65 GHz	> 60 GHz > 65 GHz, (typical)
Rise time, typical For peak optical signal input which creates < 2 mW _{pp} modulation depth.		
80C01	OC-12/STM-4	750 ps ± 50 ps
	OC-48/STM-16	187 ps ± 15 ps
	OC-192/STM-64	47 ps ± 10 ps
	12.5 GHz	< 40 ps
	20 GHz	< 25 ps
80C02	30 GHz	< 16 ps
	20 GHz	< 25 ps
	12.5 GHz	< 40 ps
	OC-192/STM-64	47 ps ± 10 ps
80C04	30 GHz	< 16 ps
	20 GHz	< 25 ps
	10.66 Gb/s	44 ps ± 10 ps
	OC-192/STM-64	47 ps ± 10 ps
80C05	40 GHz	< 12 ps
	30 GHz	< 16 ps
	20 GHz	< 25 ps
	OC-192/STM-64	47 ps ± 10 ps
80C06	50 GHz	< 9.6 ps
80C09	30 GHz	< 16 ps
	20 GHz	< 25 ps
	10.71 Gb/s, OC-192/STM-64	44 ps ± 10 ps
80C10	65 GHz	7.4 ps
	30 GHz	16 ps
	OC-768/STM-256	12 ps
	G.709 43 Gb/s	11.2 ps

Table 1-18: Optical modules - Acquisition (cont.)

Name	Characteristics	
80C10B	80 GHz	6 ps
	65 GHz	7.4 ps
	30 GHz	16 ps
	OC-768/STM-256	12 ps
	G.709 43 Gb/s	11.2 ps
	40GBase-FR	11.7 ps
80C10B-F1	65 GHz	7.4 ps
	OC-768/STM-256	12 ps
	G.709 43 Gb/s	11.2 ps
	40GBase-FR	11.7 ps
	100GBase-xR4, 100GBase-xR4 FEC	18.6 ps
80C25GBE	65 GHz	7.4 ps
	100GBase-xR4	18.6 ps
	100GBase-xR4 FEC	18.6 ps
80C11	30 GHz	< 16 ps
	20 GHz	< 25 ps
	OC-192, 10Gbase-W, 10Gbase-R, 10GBE FEC, 10GFC, 10GFC FEC	47 ps \pm 10 ps
	16GFC	34 ps \pm 8 ps
	10.66 Gb/s, 10.71 Gb/s	44 ps \pm 10 ps
Rise time, typical For peak optical signal input which creates < 200 μ W _{pp} modulation depth.	<i>Setting</i>	<i>Rise Time</i>
80C03	FC1063	440 ps \pm 35 ps
	ENET 1250 (GBE)	373 ps \pm 30 ps
	OC-48/STM-16	187 ps \pm 15 ps
80C07	OC-3	3.0 ns \pm 170 ps
	OC-12	750 ps \pm 50 ps
	OC-48	187 ps \pm 15 ps

Table 1-18: Optical modules - Acquisition (cont.)

Name	Characteristics	
80C07B	OC-3	3.0 ns \pm 170 ps
	OC-12	750 ps \pm 50 ps
	ENET1250	373 ps \pm 30 ps
	FC1063	440 ps \pm 35 ps
	FC2125	220 ps \pm 18 ps
	OC-48, ENET2500, INFINIBAND, 2.5 GHz	187 ps \pm 15 ps
Rise time, typical For peak optical signal input which creates < 500 μ W _{pp} modulation depth.	<i>Setting</i>	<i>Rise Time</i>
80C08	10 GHz	< 50 ps
	10GBASE-W, 10GBASE-R	47 ps \pm 10 ps
80C08B	10 GHz	< 50 ps
	10GBASE-W, 10GBASE-R, OC-192/STM-64, 10GFC	47 ps \pm 10 ps
80C08C	10 GHz	< 50 ps
	10GBASE-W, 10GBASE-R, OC-192/STM-64, 10GFC, 10GFC FEC, 10GBE FEC, 10.66 Gb/s, 10.71 Gb/s	47 ps \pm 10 ps

Table 1-18: Optical modules - Acquisition (cont.)

Name	Characteristics		
80C12	FC1063	440 ps \pm 35 ps	
	FC2125	220 ps \pm 18 ps	
	10GBase-X4	150 ps \pm 12 ps	
	10GFC-X4	147 ps \pm 12 ps	
	3.318 Gb/s	141 ps \pm 12 ps	
	FC4250	110 ps \pm 9 ps	
	9 GHz	< 56 ps	
	10 GHz	< 50 ps	
	OC-192, 10Gbase-W, 10Gbase-R, 10GBE FEC, 10GFC, 10GFC FEC, 10.66 Gb/s, 10.71 Gb/s		47 ps \pm 10 ps
Time domain vertical response aberrations, typical For peak optical signal input < 5 mW _{p-p} except for 80C03 and 80C07 which creates 200 μ W _{pp} modulation depth.	<i>Setting</i>		<i>Aberrations</i>
80C01	OC-12/STM-4, OC-48/STM-16		< 5%
	OC-192/STM-64, 12.5 GHz		< 10%
	20 GHz		< 15%
80C02	OC-192/STM-64		< 10%
	12.5 GHz		< 15%
	20 GHz		< 20%
	30 GHz		< 30%
80C03	All settings	< 5% _{p-p}	
80C04	OC-192/STM-64, 10.66 Gb/s	< 10%	
	20 GHz	< 20%	
	30 GHz	< 30%	
80C07, 80C07B	All settings	< 5% (typical)	

Table 1-18: Optical modules - Acquisition (cont.)

Name	Characteristics	
80C09	OC-192/STM-64, 10.71 Gb/s	< 10%
	20 GHz	< 20%
	30 GHz	< 30%
80C11	OC-192, 10.66Gb/s, 10.71Gb/s, 10Gbase-W, 10Gbase-R, 10GBE FEC, 10GFC, 10GFC FEC	< 10%
	16GFC	< 14%
	20 GHz	< 20%
	30 GHz	< 30%
Time domain vertical response aberrations, typical For peak optical signal input < 10 mW _{p-p} .	<i>Setting</i>	<i>Aberrations</i>
80C05	OC-192/STM-64	< 5%
	20 GHz, 30 GHz	< 10%
	40 GHz	< 15%
80C06	50 GHz	< 5% (typical) < 10% (maximum)
Time domain vertical response aberrations, typical For peak optical signal input < 2 mW _{p-p} .	<i>Setting</i>	<i>Aberrations</i>
80C08, 80C08B, 80C08C	All settings	< 10% (typical)
80C12	All filter settings (options F1, F2, F3, F4, F5, F6, FC)	< 5% (typical)
	9 GHz setting (options F2, F3, F5, F6, FC)	< 10% (typical)
	All settings (option 10G)	< 10% (typical)
✔ Time domain vertical response aberrations, typical For peak optical signal input < 20 mW _{p-p} .	<i>Setting</i>	<i>Aberrations</i>
80C10	OC-768/STM-256, FEC43.02 Gb/s, 30 GHz	< 5% (maximum) < 3% (typical)
	65 GHz	< 10% (maximum) < 5% (typical)

Table 1-18: Optical modules - Acquisition (cont.)

Name	Characteristics	
80C10B	OC-768/STM-256, FEC43.02 Gb/s, 30 GHz, 40GBase-FR	< 5% (maximum) < 3% (typical)
80C10B	65 GHz	< 10% (maximum) < 5% (typical)
	80 GHz	< 12% (maximum) < 7% (typical)
80C10B-F1	OC-768/STM-256, FEC43.02 Gb/s, 40GBase-FR	< 5% (maximum) < 3% (typical)
	65 GHz	< 10% (maximum) < 5% (typical)
	100GBase-xR4, 100GBase-xR4 FEC	< 5% (maximum) < 3% (typical)
80C25GBE	65 GHz	< 10% (maximum) < 5% (typical)
	100GBase-xR4, 100GBase-xR4 FEC	< 5% (maximum) < 3% (typical)
✓ Vertical equivalent optical noise (maximum and typical) ⁸	<i>Setting</i>	<i>Noise</i>
80C01	OC-12/STM-4, OC-48/STM-16 OC-192/STM-64, 12.5 GHz	< 12 μW_{rms} (maximum) < 8 μW_{rms} (typical)
	20 GHz	< 25 μW_{rms} (maximum) < 15 μW_{rms} (typical)
80C01-CR	OC-12/STM-4, OC-48/STM-16 OC-192/STM-64, 12.5 GHz	< 15 μW_{rms} (maximum) < 10 μW_{rms} (typical)
	20 GHz	< 25 μW_{rms} (maximum) < 15 μW_{rms} (typical)
80C02	OC-192/STM-64, 12.5 GHz	< 10 μW_{rms} (maximum) < 6 μW_{rms} (typical)
	20 GHz	< 15 μW_{rms} (maximum) < 10 μW_{rms} (typical)
	30 GHz	< 30 μW_{rms} ⁷ (maximum) < 20 μW_{rms} (typical)
80C02-CR	OC-192/STM-64, 12.5 GHz	< 12 μW_{rms} (maximum) < 7 μW_{rms} (typical)
	20 GHz	< 20 μW_{rms} (maximum) < 15 μW_{rms} (typical)
	30 GHz	< 40 μW_{rms} ⁷ (maximum) < 30 μW_{rms} (typical)

Table 1-18: Optical modules - Acquisition (cont.)

Name	Characteristics	
80C03, 80C03-CR	FC1063, ENET 1250 (GBE)	< 1 μW_{rms} (maximum) < 0.75 μW_{rms} (typical)
	OC-48/STM-16	< 1.5 μW_{rms} (maximum) < 1 μW_{rms} (typical)
80C04	OC-192/STM-64, FEC 10.66 Gb/s	< 10 μW_{rms} (maximum) < 6 μW_{rms} (typical)
	20 GHz	< 15 μW_{rms} (maximum) < 10 μW_{rms} (typical)
	30 GHz	< 30 μW_{rms} ⁷ (maximum) < 20 μW_{rms} (typical)
80C04-CR1, 80C04-CR2	OC-192/STM-64	< 12 μW_{rms} (maximum) < 7 μW_{rms} (typical)
	20 GHz	< 20 μW_{rms} (maximum) < 15 μW_{rms} (typical)
	30 GHz	< 40 μW_{rms} ⁷ (maximum) < 30 μW_{rms} (typical)
80C05	OC-192/STM-64	< 15 μW_{rms} (maximum) < 10 μW_{rms} (typical)
	20 GHz	< 25 μW_{rms} (maximum) < 15 μW_{rms} (typical)
	30 GHz	< 35 μW_{rms} (maximum) < 25 μW_{rms} (typical)
	40 GHz	< 70 μW_{rms} ⁷ (maximum) < 50 μW_{rms} (typical)
80C06	50 GHz	< 192 μW_{rms} (maximum) < 150 μW_{rms} (typical)
80C07	OC-3/STM-1, OC-12/STM-4	< 1 μW_{rms} (maximum) < 0.50 μW_{rms} (typical)
	OC-48/STM-16	< 1.5 μW_{rms} (maximum) < 0.70 μW_{rms} (typical)
80C07B ¹²	OC-3/STM-1, OC-12/STM-4, ENET1250, FC1063	< 1 μW_{rms} (maximum) < 0.50 μW_{rms} (typical)
	FC2125	< 1.5 μW_{rms} (maximum) < 0.85 μW_{rms} (typical)
	OC-48/STM-4, ENET2500, INFINIBAND, 2.5 GHz	< 1.5 μW_{rms} (maximum) < 0.70 μW_{rms} (typical)
80C08, 80C08B (no clock recovery)	All settings	< 5 μW_{rms} (maximum) < 2.5 μW_{rms} (typical)
80C08-CR1, 80C08B-CR1 80C08B-CR2	All settings	< 5.5 μW_{rms} (maximum) < 3.0 μW_{rms} (typical)

Table 1-18: Optical modules - Acquisition (cont.)

Name	Characteristics		
80C08C (no clock recovery)	All settings	1310 nm, 1550 nm	< 3.0 μW_{rms} (maximum) < 1.7 μW_{rms} (typical)
		850 nm	< 5.0 μW_{rms} (maximum) < 3.0 μW_{rms} (typical)
		780 nm	< 6.0 μW_{rms} (maximum) < 3.5 μW_{rms} (typical)
80C08C-CR1, 80C08C-CR2 80C08C-CR4	All settings	1310 nm, 1550 nm	< 3.5 μW_{rms} (maximum) < 1.9 μW_{rms} (typical)
		850 nm	< 5.5 μW_{rms} (maximum) < 3.3 μW_{rms} (typical)
		780 nm	< 6.6 μW_{rms} (maximum) < 3.9 μW_{rms} (typical)
80C09	OC-192/STM-64, FEC 10.71 Gb/s		< 10 μW_{rms} (maximum) < 6 μW_{rms} (typical)
	20 GHz		< 20 μW_{rms} (maximum) < 15 μW_{rms} (typical)
	30 GHz		< 30 μW_{rms} ⁷ (maximum) < 20 μW_{rms} (typical)
80C09-CR1, 80C09-CR2	OC-192/STM-64, FEC 10.71 Gb/s		< 10 μW_{rms} (maximum) < 7 μW_{rms} (typical)
	20 GHz		< 20 μW_{rms} (maximum) < 15 μW_{rms} (typical)
	30 GHz		< 30 μW_{rms} ⁷ (maximum) < 30 μW_{rms} (typical)
80C10	OC-768/ STM-256 43.02 Gb/s FEC	1310 nm	< 110 μW_{rms} (maximum) < 75 μW_{rms} (typical)
		1550 nm	< 60 μW_{rms} (maximum) < 40 μW_{rms} (typical)
	30 GHz	1310 nm	< 90 μW_{rms} (maximum) < 55 μW_{rms} (typical)
		1550 nm	< 50 μW_{rms} (maximum) < 30 μW_{rms} (typical)
	65 GHz	1310 nm	< 220 μW_{rms} (maximum) < 150 μW_{rms} (typical)
		1550 nm	< 120 μW_{rms} (maximum) < 85 μW_{rms} (typical)

Table 1-18: Optical modules - Acquisition (cont.)

Name	Characteristics			
80C10B	OC-768/ STM-256 43.02 Gb/s FEC	1310 nm	< 50 μW_{rms} (maximum) < 28 μW_{rms} (typical)	
		1550 nm	< 38 μW_{rms} (maximum) < 20 μW_{rms} (typical)	
	40GBase-FR 30 GHz	1310 nm	< 45 μW_{rms} (maximum) < 26 μW_{rms} (typical)	
		1550 nm	< 35 μW_{rms} (maximum) < 19 μW_{rms} (typical)	
	65 GHz	1310 nm	< 75 μW_{rms} (maximum) < 44 μW_{rms} (typical)	
		1550 nm	< 60 μW_{rms} (maximum) < 33 μW_{rms} (typical)	
	80 GHz	1310 nm	< 130 μW_{rms} (maximum) < 72 μW_{rms} (typical)	
		1550 nm	< 105 μW_{rms} (maximum) < 55 μW_{rms} (typical)	
	80C10B Option CRTP	OC-768/ STM-256 43.02 Gb/s FEC	1310 nm	< 58 μW_{rms} (maximum) < 32 μW_{rms} (typical)
			1550 nm	< 44 μW_{rms} (maximum) < 23 μW_{rms} (typical)
		40GBase-FR 30 GHz	1310 nm	< 52 μW_{rms} (maximum) < 30 μW_{rms} (typical)
			1550 nm	< 40 μW_{rms} (maximum) < 22 μW_{rms} (typical)
65 GHz		1310 nm	< 86 μW_{rms} (maximum) < 50 μW_{rms} (typical)	
		1550 nm	< 69 μW_{rms} (maximum) < 37 μW_{rms} (typical)	
80 GHz		1310 nm	< 150 μW_{rms} (maximum) < 81 μW_{rms} (typical)	
		1550 nm	< 121 μW_{rms} (maximum) < 62 μW_{rms} (typical)	

Table 1-18: Optical modules - Acquisition (cont.)

Name	Characteristics			
80C10B-F1	OC-768/ STM-256 43.02 Gb/s FEC 40GBase-FR	1310 nm	< 50 μW_{rms} (maximum) < 28 μW_{rms} (typical)	
		1550 nm	< 38 μW_{rms} (maximum) < 20 μW_{rms} (typical)	
	65 GHz	1310 nm	< 75 μW_{rms} (maximum) < 44 μW_{rms} (typical)	
		1550 nm	< 60 μW_{rms} (maximum) < 33 μW_{rms} (typical)	
	100GBase-xR4 100GBase-xR4 FEC	1310 nm	< 38 μW_{rms} (maximum) < 21 μW_{rms} (typical)	
		1550 nm	< 28 μW_{rms} (maximum) < 15 μW_{rms} (typical)	
	80C10B-F1 Option CRTP	OC-768/ STM-256 43.02 Gb/s FEC 40GBase-FR	1310 nm	< 58 μW_{rms} (maximum) < 32 μW_{rms} (typical)
			1550 nm	< 44 μW_{rms} (maximum) < 23 μW_{rms} (typical)
65 GHz		1310 nm	< 86 μW_{rms} (maximum) < 50 μW_{rms} (typical)	
		1550 nm	< 69 μW_{rms} (maximum) < 37 μW_{rms} (typical)	
100GBase-xR4 100GBase-xR4 FEC		1310 nm	< 44 μW_{rms} (maximum) < 24 μW_{rms} (typical)	
		1550 nm	< 32 μW_{rms} (maximum) < 17 μW_{rms} (typical)	
80C25GBE		65 GHz	1310 nm	< 75 μW_{rms} (maximum) < 44 μW_{rms} (typical)
			1550 nm	< 60 μW_{rms} (maximum) < 33 μW_{rms} (typical)
	100GBase-xR4 100GBase-xR4 FEC	1310 nm	< 38 μW_{rms} (maximum) < 21 μW_{rms} (typical)	
		1550 nm	< 28 μW_{rms} (maximum) < 15 μW_{rms} (typical)	
	80C25GBE Option CRTP	65 GHz	1310 nm	< 86 μW_{rms} (maximum) < 50 μW_{rms} (typical)
			1550 nm	< 69 μW_{rms} (maximum) < 37 μW_{rms} (typical)
100GBase-xR4 100GBase-xR4 FEC		1310 nm	< 44 μW_{rms} (maximum) < 24 μW_{rms} (typical)	
		1550 nm	< 32 μW_{rms} (maximum) < 17 μW_{rms} (typical)	

Table 1-18: Optical modules - Acquisition (cont.)

Name	Characteristics			
80C11 (no clock recovery)	OC-192, 10.66Gb/s, 10.71Gb/s, 10GBase-W, 10GBase-R, 10GBE FEC, 10GFC, 10GFC FEC	< 8 μW_{rms} (maximum) < 5.5 μW_{rms} (typical)		
	16GFC	< 10 μW_{rms} (maximum) < 7 μW_{rms} (typical)		
	20 GHz	< 14 μW_{rms} (maximum) < 10 μW_{rms} (typical)		
	30 GHz (Warranted at ambient temperatures below 30 °C only)	< 30 μW_{rms} (maximum) < 20 μW_{rms} (typical)		
80C11-CR1, 80C11-CR2, 80C11-CR3, 80C11-CR1	OC-192, 10.66Gb/s, 10.71Gb/s, 10Gbase-W, 10Gbase-R, 10GBE FEC, 10GFC, 10GFC FEC	< 9 μW_{rms} (maximum) < 6 μW_{rms} (typical)		
	16GFC	< 11.5 μW_{rms} (maximum) < 8 μW_{rms} (typical)		
	20 GHz	< 15 μW_{rms} (maximum) < 11 μW_{rms} (typical)		
	30 GHz (Warranted at ambient temperatures below 30 °C only)	< 35 μW_{rms} (maximum) < 25 μW_{rms} (typical)		
80C12	FC1063 FC2125 FC4250	1310 nm, 1550 nm	< 2.5 μW_{rms} (maximum) < 1.3 μW_{rms} (typical)	
		850 nm	< 4.0 μW_{rms} (maximum) < 2.1 μW_{rms} (typical)	
	10GBase-X4 10GFC-X4 3.318 Gb/s	9 GHz	1310 nm, 1550 nm	< 5.0 μW_{rms} (maximum) < 2.4 μW_{rms} (typical)
		850 nm	< 8.0 μW_{rms} (maximum) < 3.8 μW_{rms} (typical)	
	All settings option 10G	1310 nm, 1550 nm	< 5.0 μW_{rms} (maximum) < 2.4 μW_{rms} (typical)	
		850 nm	< 8.0 μW_{rms} (maximum) < 3.8 μW_{rms} (typical)	

Table 1-18: Optical modules - Acquisition (cont.)

Name	Characteristics			
✓ OC-3/STM-1 155 Mb/s Reference Receiver setting frequency response ⁷	<p>In the 155.52 Mb/s NRZ setting, the scalar frequency response is verified to fall within fourth-order Bessel-Thompson reference receiver boundary limits.</p> <p>The OC-3/STM-1 nominal scalar frequency response matches the ITU 155.52 Reference Receiver Nominal curve with the following tolerance:</p>			
	(MHz) Frequency	Lower	(dB) Nominal	Upper
	0.000	-0.50	0.00	0.50
	23.33	-0.61	-0.11	0.39
	46.65	-0.95	-0.45	0.05
	69.98	-1.52	-1.02	-0.52
	93.30	-2.36	-1.86	-1.36
	116.7	-3.50	-3.00	-2.50
	140.0	-5.67	-4.51	-3.35
	155.5	-7.25	-5.71	-4.17
	163.3	-8.08	-6.37	-4.66
	186.6	-10.74	-8.54	-6.35
	209.9	-13.55	-10.93	-8.31
	233.3	-16.41	-13.41	-10.41
✓ OC-12/STM-4 622 Mb/s Reference Receiver setting frequency response ⁷	<p>In the 622.08 Mb/s NRZ setting, the scalar frequency response is verified to fall within fourth-order Bessel-Thompson reference receiver boundary limits.</p> <p>The OC-12/STM-4 nominal scalar frequency response matches the ITU 622.08 Reference Receiver Nominal curve with the following tolerance:</p>			
	(MHz) Frequency	Lower	(dB) Nominal	Upper
	0.000	-0.50	0.00	0.50
	93.3	-0.61	-0.11	0.39
	186.6	-0.95	-0.45	0.05
	279.9	-1.52	-1.02	-0.52
	373.2	-2.36	-1.86	-1.36
	466.7	-3.50	-3.00	-2.50
	559.9	-5.67	-4.51	-3.35
	622.1	-7.25	-5.71	-4.17
	653.2	-8.08	-6.37	-4.66
	746.5	-10.74	-8.54	-6.35
	839.8	-13.55	-10.93	-8.31
	933.1	-16.41	-13.41	-10.4

Table 1-18: Optical modules - Acquisition (cont.)

Name	Characteristics			
✓ OC-48/STM-16 2.488 Gb/s Reference Receiver setting frequency response ⁷	Scalar frequency response falls within industry standard, Bessel-Thompson reference receiver boundary limits. SONET OC-48/STM-16 frequency response boundary limits are described in ITU-T G.957 Tables I.1 and I.2. For convenience, the scalar frequency response of the output amplitude (for sinusoidal swept optical input) has been interpreted from the Bessel-Thompson transfer function and listed below:			
	(MHz) Frequency	Lower	(dB) Nominal	Upper
	0.000	-0.50	0.00	0.50
	373.3	-0.61	-0.11	0.39
	746.5	-0.95	-0.45	0.05
	1119.7	-1.52	-1.02	-0.52
	1493.1	-2.36	-1.86	-1.36
	1866.3	-3.50	-3.00	-2.50
	2239.5	-5.67	-4.51	-3.35
	2488.3	-7.25	-5.71	-4.17
	2612.8	-8.08	-6.37	-4.66
	2986.0	-10.74	-8.54	-6.35
	3359.3	-13.55	-10.93	-8.31
	3732.6	-16.41	-13.41	-10.41

Table 1-18: Optical modules - Acquisition (cont.)

Name	Characteristics			
✓ OC-192/STM-64 9.953 Gb/s Reference Receiver setting frequency response ⁷	<p>Scalar frequency response falls within industry standard, Bessel-Thompson reference receiver boundary limits.</p> <p>Tektronix manufactures and tests the 80C01, 80C02, 80C04, 80C05, 80C08¹⁰, 80C09, and 80C11¹⁰ optical modules using 10 Gb reference receivers to have a new superior and tighter tolerance OC-192/STM-64 Reference Receiver response. ITU experts agreed on the minimum performance specifications for 10 Gbit/s (STM-64/OC-192) optical reference receivers (San Antonio ITU Study Group 15 February 2000). These specifications establish system interoperability and test conformance of optical interfaces to ITU-T Recommendation G.691 (see ITU table A.1/G.691 from the WD 16-48 document from Study Group 15 dated February 2000).</p> <p>For convenience, the scalar frequency response of the output amplitude (for sinusoidal swept optical input) has been interpreted from the published Bessel-Thompson transfer function and listed below:</p>			
	(MHz) Frequency	Lower	(dB) Nominal	Upper
	0.000	-0.85	0.00	0.85
	1493.2	-0.96	-0.11	0.74
	2986.0	-1.30	-0.45	0.40
	4478.8	-1.87	-1.02	0.17
	5972.4	-2.71	-1.86	-1.01
	7465.0	-3.86	-3.00	-2.16
	8958.0	-6.19	-4.51	-2.83
	9953.28	-7.87	-5.71	-3.55
	10451.2	-8.75	-6.37	-3.99
	11944.0	-11.53	-8.54	-5.56
	13437.2	-14.45	-10.93	-7.41
	14930.4	-17.41	-13.41	-9.41
✓ OC-768/STM-256 39.813 Gb/s Reference Receiver setting frequency response ⁷	<p>Bessel-Thompson Scalar Frequency Response curve and tolerances at various frequencies; based on ± 1.00 dB DC to $0.75 \times (\text{data rate})$ and ± 5.0 dB at $1.5 \times (\text{data rate})$.</p> <p>NOTE. The table below is a discrete list of some specific values that are commonly listed in ITU standards; curve and tolerances are actually a continuous function.</p>			
	(GHz) Frequency	Lower	(dB) Nominal	Upper
	0	-1.00	0	1.00
	5.97	-1.10	-0.10	0.90
	11.94	-1.45	-0.45	0.55
	17.92	-2.02	-1.02	-0.02
	23.89	-2.86	-1.86	-0.86
	29.86	-4.00	-3.00	-2.00
	35.83	-6.56	-4.51	-2.46
	39.81	-8.37	-5.71	-3.05
	41.80	-9.31	-6.37	-3.43
	47.78	-12.26	-8.54	-4.83
	53.75	-15.32	-10.93	-6.53
	59.72	-18.41	-13.41	-8.41

Table 1-18: Optical modules - Acquisition (cont.)

Name	Characteristics																																																							
✓ 100GBASE-xR4 (25.781 Gb/s, ENET25781) and 100GBASE-xR4 w/ FEC (27.739 Gb/s, ENET27739) Reference Receiver setting frequency response ¹⁰	<p>The published IEEE P802.3ba 100GbE D3.2 standard defines the Optical Reference Receiver specifications for 100GBase-LR4 and -ER4 variants as follows (per section 88.8.8 in P802.3ba D3.2, June 2010): a standard 4th-order Bessel-Thompson Scalar Frequency Response with a reference frequency of 0.75x(data rate), for example 0.75*25.78125 GHz=19.337 GHz. Tolerances are as specified for STM-64 in ITU-T G.691, scaled to 25.78125 GHz in frequency. The following table lists the nominal curve for margin testing and tolerances at various frequencies, based on ± 0.85 dBf DC to 0.75x(nominal data rate) and expanding to ± 4.0 dB at 1.5x(nominal data rate) with logarithmic interpolation for frequency values in between.</p> <p>NOTE. The table below is a discrete list of some specific values that are commonly listed in ITU standards; curve and tolerances are actually a continuous function.</p> <table border="1" data-bbox="513 709 1458 1157"> <thead> <tr> <th data-bbox="513 709 760 785">(MHz) Frequency</th> <th data-bbox="768 709 1015 785">Lower</th> <th data-bbox="1023 709 1205 785">(dB) Nominal</th> <th data-bbox="1213 709 1458 785">Upper</th> </tr> </thead> <tbody> <tr><td>0.00</td><td>-0.85</td><td>0</td><td>0.85</td></tr> <tr><td>3867</td><td>-0.96</td><td>-0.11</td><td>0.74</td></tr> <tr><td>7734</td><td>-1.30</td><td>-0.45</td><td>0.40</td></tr> <tr><td>11602</td><td>-1.87</td><td>-1.02</td><td>-0.17</td></tr> <tr><td>15469</td><td>-2.71</td><td>-1.86</td><td>-1.01</td></tr> <tr><td>19336</td><td>-3.86</td><td>-3.00</td><td>-2.16</td></tr> <tr><td>23203</td><td>-6.19</td><td>-4.51</td><td>-2.83</td></tr> <tr><td>25781</td><td>-7.87</td><td>-5.71</td><td>-3.55</td></tr> <tr><td>27070</td><td>-8.75</td><td>-6.37</td><td>-3.99</td></tr> <tr><td>30938</td><td>-11.53</td><td>-8.54</td><td>-5.56</td></tr> <tr><td>34805</td><td>-14.45</td><td>-10.93</td><td>-7.41</td></tr> <tr><td>38672</td><td>-17.41</td><td>-13.41</td><td>-9.41</td></tr> </tbody> </table>				(MHz) Frequency	Lower	(dB) Nominal	Upper	0.00	-0.85	0	0.85	3867	-0.96	-0.11	0.74	7734	-1.30	-0.45	0.40	11602	-1.87	-1.02	-0.17	15469	-2.71	-1.86	-1.01	19336	-3.86	-3.00	-2.16	23203	-6.19	-4.51	-2.83	25781	-7.87	-5.71	-3.55	27070	-8.75	-6.37	-3.99	30938	-11.53	-8.54	-5.56	34805	-14.45	-10.93	-7.41	38672	-17.41	-13.41	-9.41
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38672	-17.41	-13.41	-9.41																																																					
✓ 40GBase-FR (41.25 Gb/s, ENET41250) Reference Receiver setting frequency response ¹⁰	<p>At the time this document was published the IEEE P802.3bg 40GbE task force has not yet finalized the ORR specifications for the 40GBase-FR serial variant. Preliminary tolerances are chosen to match the first draft proposal D1.0 of IEEE802.3bg released in June 2010 (Sect. 89.7.8). The response follows a standard 4th-order Bessel-Thompson Scalar Frequency Response with a -3 dB reference frequency of 0.75x(data rate), for example, 0.75 x 41.25 GHz = 30.94 GHz. Tolerances are as specified for STM-64 in ITU-T G.691. The following table lists the nominal curve for margin testing and tolerances at various frequencies, based on ± 0.85 dB from DC to 0.75x(data rate) and expanding to ± 4.0 dB at 1.5x(data rate).</p> <table border="1" data-bbox="513 1415 1458 1856"> <thead> <tr> <th data-bbox="513 1415 760 1491">(MHz) Frequency</th> <th data-bbox="768 1415 1015 1491">Lower</th> <th data-bbox="1023 1415 1205 1491">(dB) Nominal</th> <th data-bbox="1213 1415 1458 1491">Upper</th> </tr> </thead> <tbody> <tr><td>0</td><td>-0.85</td><td>0</td><td>0.85</td></tr> <tr><td>6188</td><td>-0.96</td><td>-0.11</td><td>0.74</td></tr> <tr><td>12375</td><td>-1.30</td><td>-0.45</td><td>0.40</td></tr> <tr><td>18563</td><td>-1.87</td><td>-1.02</td><td>-0.17</td></tr> <tr><td>24750</td><td>-2.71</td><td>-1.86</td><td>-1.01</td></tr> <tr><td>30938</td><td>-3.86</td><td>-3.00</td><td>-2.16</td></tr> <tr><td>37125</td><td>-6.19</td><td>-4.51</td><td>-2.83</td></tr> <tr><td>41250</td><td>-7.87</td><td>-5.71</td><td>-3.55</td></tr> <tr><td>43313</td><td>-8.75</td><td>-6.37</td><td>-3.99</td></tr> <tr><td>49500</td><td>-11.53</td><td>-8.54</td><td>-5.56</td></tr> <tr><td>55688</td><td>-14.45</td><td>-10.93</td><td>-7.41</td></tr> <tr><td>61875</td><td>-17.41</td><td>-13.41</td><td>-9.41</td></tr> </tbody> </table>				(MHz) Frequency	Lower	(dB) Nominal	Upper	0	-0.85	0	0.85	6188	-0.96	-0.11	0.74	12375	-1.30	-0.45	0.40	18563	-1.87	-1.02	-0.17	24750	-2.71	-1.86	-1.01	30938	-3.86	-3.00	-2.16	37125	-6.19	-4.51	-2.83	41250	-7.87	-5.71	-3.55	43313	-8.75	-6.37	-3.99	49500	-11.53	-8.54	-5.56	55688	-14.45	-10.93	-7.41	61875	-17.41	-13.41	-9.41
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Table 1-18: Optical modules - Acquisition (cont.)

Name	Characteristics																																																							
✓ 10GBASE-W Reference Receiver setting frequency response ⁷	<p>For convenience, the scalar frequency response of the output amplitude (for sinusoidal swept optical input) has been interpreted from the published Bessel-Thompson transfer function for 10.00000 Gb/s reference receivers (as specified for the 9.95328 Gb/s rate of the 10GBASE-W) and listed below:</p> <table border="1" data-bbox="548 604 1498 1050"> <thead> <tr> <th data-bbox="548 613 799 678"><i>(MHz)</i> <i>Frequency</i></th> <th data-bbox="805 613 1052 678"><i>Lower</i></th> <th data-bbox="1058 613 1243 678"><i>(dB)</i> <i>Nominal</i></th> <th data-bbox="1250 613 1498 678"><i>Upper</i></th> </tr> </thead> <tbody> <tr><td>0</td><td>-0.85</td><td>0.00</td><td>0.85</td></tr> <tr><td>1500</td><td>-0.96</td><td>-0.11</td><td>0.74</td></tr> <tr><td>3000</td><td>-1.30</td><td>-0.45</td><td>0.40</td></tr> <tr><td>4500</td><td>-1.87</td><td>-1.02</td><td>0.17</td></tr> <tr><td>6000</td><td>-2.71</td><td>-1.86</td><td>-1.01</td></tr> <tr><td>7500</td><td>-3.86</td><td>-3.00</td><td>-2.16</td></tr> <tr><td>9000</td><td>-6.19</td><td>-4.51</td><td>-2.83</td></tr> <tr><td>10000</td><td>-7.87</td><td>-5.71</td><td>-3.55</td></tr> <tr><td>10500</td><td>-8.75</td><td>-6.37</td><td>-3.99</td></tr> <tr><td>12000</td><td>-11.53</td><td>-8.54</td><td>-5.56</td></tr> <tr><td>13500</td><td>-14.45</td><td>-10.93</td><td>-7.41</td></tr> <tr><td>15000</td><td>-17.41</td><td>-13.41</td><td>-9.41</td></tr> </tbody> </table>				<i>(MHz)</i> <i>Frequency</i>	<i>Lower</i>	<i>(dB)</i> <i>Nominal</i>	<i>Upper</i>	0	-0.85	0.00	0.85	1500	-0.96	-0.11	0.74	3000	-1.30	-0.45	0.40	4500	-1.87	-1.02	0.17	6000	-2.71	-1.86	-1.01	7500	-3.86	-3.00	-2.16	9000	-6.19	-4.51	-2.83	10000	-7.87	-5.71	-3.55	10500	-8.75	-6.37	-3.99	12000	-11.53	-8.54	-5.56	13500	-14.45	-10.93	-7.41	15000	-17.41	-13.41	-9.41
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✓ 10GBASE-X4 Reference Receiver setting frequency response ⁷	<p>In 10GBase-X4 setting, scalar frequency response falls within industry standard, Bessel-Thompson reference receiver boundary limits.</p> <p>10GBASE-X4 frequency response boundary limits are derived by simply scaling all frequency values by 2.5X as described in IEEE 802.3z section 38.6.5 (this section refers to ITU G.957 for tolerances).</p> <p>For convenience, the scalar frequency response of the output amplitude (for sinusoidal swept optical input) has been interpreted from the Bessel-Thompson transfer function and listed below:</p> <table border="1" data-bbox="548 1339 1498 1780"> <thead> <tr> <th data-bbox="548 1348 799 1413"><i>(MHz)</i> <i>Frequency</i></th> <th data-bbox="805 1348 1052 1413"><i>Lower</i></th> <th data-bbox="1058 1348 1243 1413"><i>(dB)</i> <i>Nominal</i></th> <th data-bbox="1250 1348 1498 1413"><i>Upper</i></th> </tr> </thead> <tbody> <tr><td>0.000</td><td>-0.50</td><td>0.00</td><td>0.50</td></tr> <tr><td>468.8</td><td>-0.61</td><td>-0.11</td><td>0.39</td></tr> <tr><td>937.5</td><td>-0.95</td><td>-0.45</td><td>0.05</td></tr> <tr><td>1406</td><td>-1.52</td><td>-1.02</td><td>-0.52</td></tr> <tr><td>1875</td><td>-2.36</td><td>-1.86</td><td>-1.36</td></tr> <tr><td>2344</td><td>-3.50</td><td>-3.00</td><td>-2.50</td></tr> <tr><td>2813</td><td>-5.67</td><td>-4.51</td><td>-3.35</td></tr> <tr><td>3125</td><td>-7.25</td><td>-5.71</td><td>-4.17</td></tr> <tr><td>3281</td><td>-8.08</td><td>-6.37</td><td>-4.65</td></tr> <tr><td>3750</td><td>-10.74</td><td>-8.54</td><td>-6.35</td></tr> <tr><td>4219</td><td>-13.55</td><td>-10.93</td><td>-8.31</td></tr> <tr><td>4688</td><td>-16.41</td><td>-13.41</td><td>-10.41</td></tr> </tbody> </table>				<i>(MHz)</i> <i>Frequency</i>	<i>Lower</i>	<i>(dB)</i> <i>Nominal</i>	<i>Upper</i>	0.000	-0.50	0.00	0.50	468.8	-0.61	-0.11	0.39	937.5	-0.95	-0.45	0.05	1406	-1.52	-1.02	-0.52	1875	-2.36	-1.86	-1.36	2344	-3.50	-3.00	-2.50	2813	-5.67	-4.51	-3.35	3125	-7.25	-5.71	-4.17	3281	-8.08	-6.37	-4.65	3750	-10.74	-8.54	-6.35	4219	-13.55	-10.93	-8.31	4688	-16.41	-13.41	-10.41
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Table 1-18: Optical modules - Acquisition (cont.)

Name	Characteristics																																																							
✓ 10GFC-X4 (3.188 Gb/s) Reference Receiver setting frequency response ⁷	<p>In 10GFC-X4 setting, scalar frequency response falls within Industry standard, Bessel-Thompson reference receiver boundary limits.</p> <p>10GFC-X4 frequency response boundary limits are described in ANSI FC-PC. The scalar frequency response of the output amplitude (for sinusoidal swept optical input) has been interpreted from the published Bessel-Thompson transfer function and listed below (based on ± 0.5 dB from DC to $0.75 \times (\text{rate})$ and ± 3.0 dB at $1.5 \times (\text{rate})$):</p> <table border="1" data-bbox="505 590 1459 1035"> <thead> <tr> <th data-bbox="505 590 760 663"><i>(MHz)</i> <i>Frequency</i></th> <th data-bbox="760 590 1015 663"><i>Lower</i></th> <th data-bbox="1015 590 1206 663"><i>(dB)</i> <i>Nominal</i></th> <th data-bbox="1206 590 1459 663"><i>Upper</i></th> </tr> </thead> <tbody> <tr><td>0.000</td><td>-0.50</td><td>0.00</td><td>0.50</td></tr> <tr><td>478.1</td><td>-0.61</td><td>-0.11</td><td>0.39</td></tr> <tr><td>956.3</td><td>-0.95</td><td>-0.45</td><td>0.05</td></tr> <tr><td>1434</td><td>-1.52</td><td>-1.02</td><td>-0.52</td></tr> <tr><td>1913</td><td>-2.36</td><td>-1.86</td><td>-1.36</td></tr> <tr><td>2391</td><td>-3.50</td><td>-3.00</td><td>-2.50</td></tr> <tr><td>2869</td><td>-5.67</td><td>-4.51</td><td>-3.35</td></tr> <tr><td>3188</td><td>-7.25</td><td>-5.71</td><td>-4.17</td></tr> <tr><td>3347</td><td>-8.08</td><td>-6.37</td><td>-4.65</td></tr> <tr><td>3825</td><td>-10.74</td><td>-8.54</td><td>-6.35</td></tr> <tr><td>4303</td><td>-13.55</td><td>-10.93</td><td>-8.31</td></tr> <tr><td>4781</td><td>-16.41</td><td>-13.41</td><td>-10.41</td></tr> </tbody> </table>				<i>(MHz)</i> <i>Frequency</i>	<i>Lower</i>	<i>(dB)</i> <i>Nominal</i>	<i>Upper</i>	0.000	-0.50	0.00	0.50	478.1	-0.61	-0.11	0.39	956.3	-0.95	-0.45	0.05	1434	-1.52	-1.02	-0.52	1913	-2.36	-1.86	-1.36	2391	-3.50	-3.00	-2.50	2869	-5.67	-4.51	-3.35	3188	-7.25	-5.71	-4.17	3347	-8.08	-6.37	-4.65	3825	-10.74	-8.54	-6.35	4303	-13.55	-10.93	-8.31	4781	-16.41	-13.41	-10.41
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✓ 10.66 Gb/s Reference Receiver setting frequency response ⁷	<p>This Reference Receiver is essentially identical to the OC-192 9.95328 Gb/s rate with the following changes: the frequency scale for the tolerance curves and nominal -3 dB breakpoints are scaled linearly by the ratio of $(10.664 \text{ Gb/s}) / (9.95328 \text{ Gb/s})$; for example: the 9.953 Gb/s reference receiver has a nominal -3 dB response at $0.75 \times 9.95328 \text{ GHz} = 7.465 \text{ GHz}$. This 10.66 Gb reference receiver has a nominal -3 dB response at $(10.664 / 9.95328) \times 7.465 \text{ GHz} = 7.998 \text{ GHz}$.</p> <p>For convenience, the scalar frequency response of the output amplitude (for sinusoidal swept optical input) has been interpreted from the published Bessel-Thompson transfer function, the frequencies scaled as described above, and then listed below:</p> <table border="1" data-bbox="505 1339 1459 1780"> <thead> <tr> <th data-bbox="505 1339 760 1413"><i>(MHz)</i> <i>Frequency</i></th> <th data-bbox="760 1339 1015 1413"><i>Lower</i></th> <th data-bbox="1015 1339 1206 1413"><i>(dB)</i> <i>Nominal</i></th> <th data-bbox="1206 1339 1459 1413"><i>Upper</i></th> </tr> </thead> <tbody> <tr><td>0</td><td>-0.85</td><td>0</td><td>0.85</td></tr> <tr><td>1599.8</td><td>-0.96</td><td>-0.11</td><td>0.74</td></tr> <tr><td>3199.2</td><td>-1.30</td><td>-0.45</td><td>0.40</td></tr> <tr><td>4798.6</td><td>-1.87</td><td>-1.02</td><td>-0.17</td></tr> <tr><td>6398.9</td><td>-2.71</td><td>-1.86</td><td>-1.01</td></tr> <tr><td>7998.0</td><td>-3.86</td><td>-3.00</td><td>-2.16</td></tr> <tr><td>9597.7</td><td>-6.19</td><td>-4.51</td><td>-2.83</td></tr> <tr><td>10664.0</td><td>-7.87</td><td>-5.71</td><td>-3.55</td></tr> <tr><td>11197.5</td><td>-8.75</td><td>-6.37</td><td>-3.99</td></tr> <tr><td>12796.9</td><td>-11.53</td><td>-8.54</td><td>-5.56</td></tr> <tr><td>14396.7</td><td>-14.45</td><td>-10.93</td><td>-7.41</td></tr> <tr><td>15996.5</td><td>-17.41</td><td>-13.41</td><td>-9.41</td></tr> </tbody> </table>				<i>(MHz)</i> <i>Frequency</i>	<i>Lower</i>	<i>(dB)</i> <i>Nominal</i>	<i>Upper</i>	0	-0.85	0	0.85	1599.8	-0.96	-0.11	0.74	3199.2	-1.30	-0.45	0.40	4798.6	-1.87	-1.02	-0.17	6398.9	-2.71	-1.86	-1.01	7998.0	-3.86	-3.00	-2.16	9597.7	-6.19	-4.51	-2.83	10664.0	-7.87	-5.71	-3.55	11197.5	-8.75	-6.37	-3.99	12796.9	-11.53	-8.54	-5.56	14396.7	-14.45	-10.93	-7.41	15996.5	-17.41	-13.41	-9.41
<i>(MHz)</i> <i>Frequency</i>	<i>Lower</i>	<i>(dB)</i> <i>Nominal</i>	<i>Upper</i>																																																					
0	-0.85	0	0.85																																																					
1599.8	-0.96	-0.11	0.74																																																					
3199.2	-1.30	-0.45	0.40																																																					
4798.6	-1.87	-1.02	-0.17																																																					
6398.9	-2.71	-1.86	-1.01																																																					
7998.0	-3.86	-3.00	-2.16																																																					
9597.7	-6.19	-4.51	-2.83																																																					
10664.0	-7.87	-5.71	-3.55																																																					
11197.5	-8.75	-6.37	-3.99																																																					
12796.9	-11.53	-8.54	-5.56																																																					
14396.7	-14.45	-10.93	-7.41																																																					
15996.5	-17.41	-13.41	-9.41																																																					

Table 1-18: Optical modules - Acquisition (cont.)

Name	Characteristics			
✓ 10.71 Gb/s Reference Receiver setting frequency response ⁷	<p>This Reference Receiver is essentially identical to that for the OC-192 9.95328 Gb/s rate with the following changes: the frequency scale for the tolerance curves and nominal -3 dB breakpoints are scaled linearly by the ratio of (10.709 Gb/s)/(9.95328 Gb/s); for example: the 9.953 Gb/s reference receiver has a nominal -3 dB response at $0.75 \times 9.95328 \text{ GHz} = 7.465 \text{ GHz}$. This 10.71 Gb reference receiver has a nominal -3 dB response at $(10.709/9.95328) \times 7.465 \text{ GHz} = 8.032 \text{ GHz}$.</p> <p>For convenience, the scalar frequency response of the output amplitude (for sinusoidal swept optical input) has been interpreted from the published Bessel-Thompson transfer function, the frequencies scaled as described above, and then listed below:</p>			
	<i>(MHz)</i> <i>Frequency</i>	<i>Lower</i>	<i>(dB)</i> <i>Nominal</i>	<i>Upper</i>
	0	-0.85	0	0.85
	1606.6	-0.96	-0.11	0.74
	3212.8	-1.30	-0.45	0.40
	4819.0	-1.87	-1.02	-0.17
	6426.0	-2.71	-1.86	-1.01
	8032.0	-3.86	-3.00	-2.16
	9638.4	-6.19	-4.51	-2.83
	10709.2	-7.87	-5.71	-3.55
	11245.0	-8.75	-6.37	-3.99
	12851.1	-11.53	-8.54	-5.56
	14457.7	-14.45	-10.93	-7.41
	16064.4	-17.41	-13.41	-9.41

Table 1-18: Optical modules - Acquisition (cont.)

Name	Characteristics			
✓ 16GFC (14.025 Gb/s) Reference Receiver setting frequency response	<p>The 8GFC (ANSI FC-PI-4) and 10GFC standards specify an optical reference receiver with a 7.5 GHz fourth-order ideal Bessel-Thomson frequency response. At the time of writing, reference receiver standards for 16G FibreChannel have not been published in FC-PI-5 (draft rev 0.01). We have anticipated the use of an ideal fourth-order Bessel-Thomson response with a -3 dB bandwidth of 0.75 x data rate (=10.52 GHz) and tolerance limits identical to 8GFC and 10GFC standards.</p> <p>For convenience, the scalar frequency response of the output amplitude (for sinusoidal swept optical input) has been interpreted from the published Bessel-Thompson transfer function, the frequencies scaled as described above, and then listed below.</p> <p>Nominal response curve and tolerance limits (based on ± 0.85 dB from DC to 10.519 GHz and expanding to ± 4.0 dB at 21.038 GHz).</p>			
	<i>(MHz)</i> <i>Frequency</i>	<i>Lower</i>	<i>(dB)</i> <i>Nominal</i>	<i>Upper</i>
	0	-0.85	0	0.85
	2104	-0.96	-0.11	0.74
	4208	-1.30	-0.45	0.40
	6311	-1.87	-1.02	-0.17
	8415	-2.71	-1.86	-1.01
	10519	-3.86	-3.00	-2.16
	12623	-6.19	-4.51	-2.83
	14025	-7.87	-5.71	-3.55
	14726	-8.75	-6.37	-3.99
	16830	-11.53	-8.54	-5.56
	18934	-14.45	-10.93	-7.41
	21038	-17.41	-13.41	-9.41
✓ FEC 43.02 Gb/s Reference Receiver setting frequency response ⁷	<p>The forward error correction method defined in ITU-T standard G.709 creates an additional overhead upon a standard OC-768 (STM256) 40 Gb/s data stream in which the data rate is effectively increased by a ratio of 255/236. Table 7-1 in G.709 standard lists this explicit serial data rate on the physical layer.</p>			
	<i>(GHz)</i> <i>Frequency</i>	<i>Lower</i>	<i>(dB)</i> <i>Nominal</i>	<i>Upper</i>
	0	-1.00	0	1.00
	6.45	-1.10	-0.10	0.90
	12.90	-1.45	-0.45	0.55
	19.36	-2.02	-1.02	-0.02
	25.81	-2.86	-1.86	-0.86
	32.26	-4.00	-3.00	-2.00
	38.71	-6.56	-4.51	-2.46
	43.02	-8.37	-5.71	-3.05
	45.17	-9.31	-6.37	-3.43
	51.63	-12.26	-8.54	-4.83
	58.08	-15.32	-10.93	-6.53
	64.53	-18.41	-13.41	-8.41

Table 1-18: Optical modules - Acquisition (cont.)

Name	Characteristics			
✓ ENET2500 (2 GBE) 2.50 Gb/s Reference Receiver setting frequency response ⁷	<p>Scalar frequency response falls within industry standard, Bessel-Thompson reference receiver boundary limits.</p> <p>2.50 Gb/s frequency response boundary limits are derived by simply scaling all frequency values by 2X as described in IEEE 802.3z section 38.6.5 (this section refers to ITU G.957 for tolerances). For convenience, the scalar frequency response of the output amplitude (for sinusoidal swept optical input) has been interpreted from the Bessel-Thompson transfer function and listed below:</p>			
	(MHz) Frequency	Lower	(dB) Nominal	Upper
	0.000	-0.50	0.00	0.50
	375	-0.61	-0.11	0.39
	750	-0.95	-0.45	0.05
	1125	-1.52	-1.02	-0.52
	1500	-2.36	-1.86	-1.36
	1875	-3.50	-3.00	-2.50
	2250	-5.67	-4.51	-3.35
	2500	-7.25	-5.71	-4.17
	2625	-8.08	-6.37	-4.66
	3000	-10.74	-8.54	-6.35
	3375	-13.55	-10.93	-8.31
	3750	-16.41	-13.41	-10.41
✓ ENET1250 (GBE) 1.25 Gb/s Reference Receiver setting frequency response ⁷	<p>Scalar frequency response falls within industry standard, Bessel-Thompson reference receiver boundary limits.</p> <p>1.250 Gb/s frequency response boundary limits are described in IEEE 802.3z section 38.6.5 (this section refers to ITU G.957 for tolerances).</p> <p>For convenience, the scalar frequency response of the output amplitude (for sinusoidal swept optical input) has been interpreted from the Bessel-Thompson transfer function and listed below:</p>			
	(MHz) Frequency	Lower	(dB) Nominal	Upper
	0.000	-0.50	0.00	0.50
	187.5	-0.61	-0.11	0.39
	375	-0.95	-0.45	0.05
	562.5	-1.52	-1.02	-0.52
	750	-2.36	-1.86	-1.36
	937.5	-3.50	-3.00	-2.50
	1125	-5.67	-4.51	-3.35
	1250	-7.25	-5.71	-4.17
	1312.5	-8.08	-6.37	-4.66
	1500	-10.74	-8.54	-6.35
	1687.5	-13.55	-10.93	-8.31
	1875	-16.41	-13.41	-10.41

Table 1-18: Optical modules - Acquisition (cont.)

Name	Characteristics			
✓ FC1063 (1.0625 Gb/s) Reference Receiver setting frequency response ⁷	In FC1063 setting, scalar frequency response falls within industry standard, Bessel-Thompson reference receiver boundary limits.			
	Fiber Channel frequency response boundary limits are described in ANSI FC-PC. For convenience, the scalar frequency response of the output amplitude (for sinusoidal swept optical input) has been interpreted from the published Bessel-Thompson transfer function and listed below:			
	(MHz) Frequency	Lower	(dB) Nominal	Upper
	0.000	-0.50	0.00	0.50
	159.5	-0.61	-0.11	0.39
	318.9	-0.95	-0.45	0.05
	478.4	-1.52	-1.02	-0.52
	637.9	-2.36	-1.86	-1.36
	797.4	-3.50	-3.00	-2.50
	956.8	-5.67	-4.51	-3.35
	1063	-7.25	-5.71	-4.17
	1116	-8.08	-6.37	-4.66
	1275	-10.74	-8.54	-6.35
	1435	-13.55	-10.93	-8.31
	1595	-16.41	-13.41	-10.41
✓ FC2125 (2.125 Gb/s) Reference Receiver setting frequency response ⁷	In FC2125 setting, scalar frequency response falls within industry standard, Bessel-Thompson reference receiver boundary limits.			
	2G FiberChannel frequency response boundary limits are described in ANSI FC-PC. For convenience, the scalar frequency response of the output amplitude (for sinusoidal swept optical input) has been interpreted from the published Bessel-Thompson transfer function and listed below:			
	(MHz) Frequency	Lower	(dB) Nominal	Upper
	0.000	-0.50	0.00	0.50
	318.8	-0.61	-0.11	0.39
	637.5	-0.95	-0.45	0.05
	956.3	-1.52	-1.02	-0.52
	1275	-2.36	-1.86	-1.36
	1594	-3.50	-3.00	-2.50
	1913	-5.67	-4.51	-3.35
	2125	-7.25	-5.71	-4.17
	2231	-8.08	-6.37	-4.65
	2550	-10.74	-8.54	-6.35
	2869	-13.55	-10.93	-8.31
	3188	-16.41	-13.41	-10.41

Table 1-18: Optical modules - Acquisition (cont.)

Name	Characteristics			
✓ FC4250 (4.25 Gb/s) Reference Receiver setting frequency response ⁷	<p>In FC4250 setting, scalar frequency response falls within industry standard, Bessel-Thompson reference receiver boundary limits.</p> <p>4G FiberChannel frequency response boundary limits are described in ANSI FC-PC. For convenience, the scalar frequency response of the output amplitude (for sinusoidal swept optical input) has been interpreted from the published Bessel-Thompson transfer function and listed below:</p>			
	<i>(MHz)</i> <i>Frequency</i>	<i>Lower</i>	<i>(dB)</i> <i>Nominal</i>	<i>Upper</i>
	0.000	-0.50	0.00	0.50
	637.5	-0.61	-0.11	0.39
	1275	-0.95	-0.45	0.05
	1913	-1.52	-1.02	-0.52
	2550	-2.36	-1.86	-1.36
	3188	-3.50	-3.00	-2.50
	3826	-5.67	-4.51	-3.35
	4250	-7.25	-5.71	-4.17
	4462	-8.08	-6.37	-4.65
	5100	-10.74	-8.54	-6.35
	5738	-13.55	-10.93	-8.31
	6375	-16.41	-13.41	-10.41

Table 1-18: Optical modules - Acquisition (cont.)

Name	Characteristics			
✓ VSR-5 (3.318 Gb/s) Reference Receiver setting frequency response ⁷	<p>In 3.318 Gb/s setting, scalar frequency response falls within industry standard, Bessel-Thompson reference receiver boundary limits.</p> <p>At the time of publishing this document, a standard for VSR-5 frequency response boundary limits has not been defined. The scalar frequency response curve and tolerance boundaries used for 10GBase-X4 scaled to the VSR-5 bit rate will be used for this rate until a standard has been defined.</p> <p>The exact bit rate is given by the formula:</p> $\frac{768 \times 51.84 \text{ Mb/s}}{12} = 3317.76 \text{ Mb/s}$ <p>For convenience, the scalar frequency response of the output amplitude (for sinusoidal swept optical input) has been interpreted from the published Bessel-Thompson transfer function and listed below:</p>			
	<i>(MHz)</i> <i>Frequency</i>	<i>Lower</i>	<i>(dB)</i> <i>Nominal</i>	<i>Upper</i>
	0.000	-0.50	0.00	0.50
	497.7	-0.61	-0.11	0.39
	995.3	-0.95	-0.45	0.05
	1493	-1.52	-1.02	-0.52
	1991	-2.36	-1.86	-1.36
	2488	-3.50	-3.00	-2.50
	2986	-5.67	-4.51	-3.35
	3318	-7.25	-5.71	-4.17
	3484	-8.08	-6.37	-4.65
	3981	-10.74	-8.54	-6.35
	4479	-13.55	-10.93	-8.31
	4977	-16.41	-13.41	-10.41

- 1 Single-mode fiber (Corning SMF-28 specs).
- 2 The optical input powers below nondestructive levels may exceed saturation and compression limits of the module.
- 3 The optical wavelengths that the product accepts and still provides a reasonable (25% of peak optimum) wavelength conversion gain.
- 4 Vertical accuracy specifications are referenced to an internal optical power meter reading for a given optical input, and limited to a temperature range within ±5 °C of previous channel compensation and an ambient temperature within 20 °C to 35 °C.
- 5 Optical bandwidth is the frequency at which the responsivity of the optical to electrical conversion process is reduced by 50% (6 dB).
- 6 Optical bandwidth of the 50 GHz module is defined as (0.48/risetime).
- 7 This specification is limited to the instrument operating in an ambient temperature between +20 °C and +30 °C. Nominal freq response is specified for optical input signals of modulation magnitude such that 2mW_{pp} (200 uW_{pp} for 80C03 and 80C07; 500 uW_{pp} for 80C08 and 80C12) or less signal is applied at the sampler input.
- 8 The optical channel noise with no optical signal input (Dark Level).
- 9 Clock recovery versions reduce the power reaching the vertical channel (splitter to clock recovery produces loss). Therefore, the non-clock recovery modules more closely exhibit the typical noise performance.

- 10 The factory calibration and verification of these tolerances are performed in a stable ambient environment of +25 °C ± 2 °C. The module is specified to perform within these tolerances over an operating temperature range of +20 °C and +30 °C.
- 11 Certain performance characteristics such as reference receiver and filter settings may have more restricted power levels in order to maintain guaranteed performance.
- 12 The 80C07B optical noise specifications given are for the 1310 nm wavelength setting. The noise at wavelength setting 780 nm is typically increased by a factor of 2.0. The noise at 850 nm is typically increased by a factor of 1.6. The noise at 1550 nm is typically the same as at 1310 nm.

Table 1-19: Optical power meter

Name	Characteristics
Optical power meter range	
80C01, 80C02, 80C03, 80C04, 80C07, 80C07B, 80C09, 80C11	+4 dBm to -30 dBm, typical
80C05, 80C06, 80C10, 80C10B, 80C25GBE	+13 dBm to -21 dBm, typical
80C08, 80C08B, 80C08C, 80C12	+0 dBm to -30 dBm, typical
Optical power meter accuracy, typical	5% of reading + connector uncertainty (typical): 780 nm ± 20 nm (80C07B, 80C08C) 850 nm ± 20 nm (80C07B, 80C08C, 80C12) 1310 nm ± 20 nm and 1550 nm ± 20 nm (80C01, 80C02, 80C07B, 80C08C, 80C10, 80C10B, 80C11, 80C12, 80C25GBE)

Table 1-20: Optical modules - Clock recovery options (CR, CR1, CR2, CR3, CR4, and CRTP)

Name	Characteristics
Effective wavelength range (clock recovery path)	
80C01, 80C02, 80C04, 80C09	1270 nm to 1600 nm
80C03, 80C07, 80C07B, 80C08, 80C08B, 80C08C, 80C12	700 nm to 1650 nm
80C11	1270 nm to 1600 nm
80C10B Option CRTP, 80C10B-F1 Option CRTP, and 80C1125GBE Option CRTP	1310 nm: 1280 nm to 1340 nm 1550 nm: 1520 nm to 1620 nm

Table 1-20: Optical modules - Clock recovery options (CR, CR1, CR2, CR3, CR4, and CRTP) (cont.)

Name	Characteristics
Operating data rates ⁵	
80C01-CR	622.08 Mb/s \pm 1000 ppm (OC-12/STM-4)
	2.48832 Gb/s \pm 1000 ppm (OC-48/STM-16)
80C02-CR	9.95328 Gb/s \pm 1000 ppm (OC-192/STM-64)
80C03-CR	1.0625 Gb/s \pm 1000 ppm (FC1063)
	1.2500 Gb/s \pm 1000 ppm (GBE)
	2.48832 Gb/s \pm 1000 ppm (OC-48/STM-16)
	2.5000 Gb/s \pm 1000 ppm (2X GBE)
80C04-CR1	9.95328 Gb/s \pm 1000 ppm (OC-192/STM-64)
80C04-CR2	9.95328 Gb/s \pm 1000 ppm (OC-192/STM-64)
	10.664 Gb/s \pm 1000 ppm (OC-192 FEC)
80C07-CR1	155.52 Mb/s \pm 1000 ppm (OC-3/STM-1)
	622.08 Mb/s \pm 1000 ppm (OC-12/STM-4)
	2488.32 Mb/s \pm 1000 ppm (OC-48/STM-16)
80C07B-CR1	155.52 Mb/s \pm 1000 ppm (OC-3/STM-1)
	622.08 Mb/s \pm 1000 ppm (OC-12/STM-4)
	1062.5 Mb/s \pm 1000 ppm (FC1063/FC)
	1250 Mb/s \pm 1000 ppm (ENET1250/GBE)
	2125 Mb/s \pm 1000 ppm (FC2125/2FC)
	2488.32 Mb/s \pm 1000 ppm (OC-48/STM-16)
	2500 Mb/s \pm 1000 ppm (ENET2500/2GBE)
	2500 Mb/s \pm 1000 ppm (Infiniband)
2666.06 Mb/s \pm 1000 ppm (OC-48-FEC)	
80C08-CR1	9.95328 Gb/s \pm 1000 ppm (10GBASE-W)
	10.3125 Gb/s \pm 1000 ppm (10GBASE-R)
80C08B-CR1	9.95328 Gb/s \pm 1000 ppm (10GBASE-W)
	10.3125 Gb/s \pm 1000 ppm (10GBASE-R)
80C08B-CR2	10.3125 Gb/s \pm 1000 ppm (10GBASE-R)
	10.51875 Gb/s \pm 1000 ppm (10GFC)

Table 1-20: Optical modules - Clock recovery options (CR, CR1, CR2, CR3, CR4, and CRTP) (cont.)

Name	Characteristics
80C08C-CR1	9.95328 Gb/s \pm 1000 ppm (10GBASE-W)
	10.3125 Gb/s \pm 1000 ppm (10GBASE-R)
80C08C-CR2	10.3125 Gb/s \pm 1000 ppm (10GBASE-R)
	10.51875 Gb/s \pm 1000 ppm (10GFC)
80C08C-CR4	Continuous from 9.8 Gb/s to 12.6 Gb/s (User must enter the bit rate into the main instrument with an accuracy better than 1000 ppm)
	Pre-defined selections at 9.95338 Gb/s, 10.3125 Gb/s, 10.51875 Gb/s, 10.66423 Gb/s, 10.709225 Gb/s, 11.0957 Gb/s (The input bit rate must be within 1000 ppm of the selected rate)
80C09-CR1	9.95328 Gb/s \pm 1000 ppm (OC-192/STM-64)
	10.709 Gb/s \pm 1000 ppm (FEC)
80C11-CR1	9.95328 Gb/s \pm 1000 ppm (OC-192/STM-64)
80C11-CR2	9.95328 Gb/s \pm 1000 ppm (OC-192/STM-64)
	10.66423 Gb/s \pm 1000 ppm (10Gb FEC)
80C11-CR3	9.95328 Gb/s \pm 1000 ppm (OC-192/STM-64)
	10.70922 Gb/s \pm 1000 ppm (G.709 FEC)
80C11-CR4	Continuous from 9.8 Gb/s to 12.6 Gb/s (User must enter the bit rate into the main instrument with an accuracy better than 1000 ppm)
	Pre-defined selections at 9.95338 Gb/s, 10.3125 Gb/s, 10.51875 Gb/s, 10.66423 Gb/s, 10.709225 Gb/s, 11.0957 Gb/s (The input bit rate must be within 1000 ppm of the selected rate)
80C10B Option CRTP, 80C10B-F1 Option CRTP, 80C25BGE Option CRTP	Electrical signal outputs continuous from 1 Gb/s to 44.5 Gb/s; provides clock recovery when connected to the Tektronix CR286A Option HS or other compatible external clock recovery device
80C12	Clock recovery provided with the use of the 80A05 or 80A07 Electrical Clock Recovery module.

For the 80C02-CR and 80C04-CR1 modules, the incoming data stream must be of non-return-to-zero format (NRZ) and must have a data sequence content which provides both isolated 1s and multi-consecutive mark sequences (that is 2,3,4 and so forth logical 1s in a consecutive row). NOTE: a fixed pattern of 10101010. . . does not meet the data sequence content. The 80C02-CR and 80C04-CR1 clock recovery functions may not properly lock to such a pattern. The 80C02-CR and 80C04-CR1 will, however, typically lock to a 11001100. . . pattern (this is equivalent to a 2.48832 GHz optical square wave).⁵

✓ Optical sensitivity range, clock recovery (optical input power) ¹	Maximum	Minimum
80C01	+ 5.0 dBm (3.16 mW), typical	-10.0 dBm (100 μ W), typical
80C02	+7.0 dBm (5.0 mW), typical	-10.0 dBm (100 μ W), typical -7.5 dBm, warranted
80C03	-4.0 dBm (400 μ W), warranted	-16.0 dBm (25 μ W), warranted
80C04	+7.0 dBm (5.0 mW), typical	-10.0 dBm (100 μ W), typical -7.5 dBm, warranted
80C07	-4.0 dBm (400 μ W), warranted	-16.0 dBm (25 μ W), warranted

Table 1-20: Optical modules - Clock recovery options (CR, CR1, CR2, CR3, CR4, and CRTP) (cont.)

Name	Characteristics			
80C08-CR1/CR2 80C08B-CR1/ CR2	+0.0 dBm (1.0 mW, all wavelengths), warranted	-13.0 dBm (50 μ W, 1310 nm, 1550 nm), warranted -15.0 dBm (32 μ W, 1310 nm, 1550 nm), typical -12.0 dBm (64 μ W, 780 nm, 850 nm), typical		
80C08C-CR4		+0.0 dBm (1.0 mW), typical	1550 nm, 1310 nm Bit Rate: 9.8 Gb/s to 11.25 Gb/s <i>(AOP @ ER \geq 8.2 dB)⁷</i> <i>(OMA)⁸</i>	
-15 dBm typical -13 dBm warranted ⁶	-12.3 dBm typical -11.3 dBm warranted ⁶			
1550 nm, 1310 nm Bit Rate: 11.25 Gb/s to 12.6 Gb/s <i>(AOP @ ER \geq 8.2 dB)⁷</i> <i>(OMA)⁸</i>	-12.5 dBm typical -11.5 dBm warranted ⁶		-10.8 dBm typical -9.8 dBm warranted ⁶	
850 nm, 780 nm Bit Rate: 9.8 Gb/s to 11.25 Gb/s <i>(AOP @ ER \geq 8.2 dB)⁷</i> <i>(OMA)⁸</i>	-12 dBm typical -10 dBm warranted ⁶		-9.3 dBm typical -8.3 dBm warranted ⁶	
850 nm, 780 nm Bit Rate: 11.25 Gb/s to 12.6 Gb/s <i>(AOP @ ER \geq 8.2 dB)⁷</i> <i>(OMA)⁸</i>	-9.5 dBm typical -8.5 dBm warranted ⁶		-7.8 dBm typical -6.8 dBm warranted ⁶	
80C10B Option CRTP, 80C25GBE Option CRTP (when used with CR286A Option HS)	+10 dBm (10.0 mW), typical		1550 nm Bit Rate: 25 Gb/s to 28 Gb/s <i>(AOP @ ER \geq 8.0 dB)⁷</i> <i>(OMA)⁸</i>	
-4.7 dBm typical -3.0 dBm warranted ⁶			-3.1 dBm typical -1.3 dBm warranted ⁶	
1310 nm Bit Rate: 25 Gb/s to 28 Gb/s <i>(AOP @ ER \geq 8.0 dB)⁷</i> <i>(OMA)⁸</i>			-5.1 dBm typical -3.4 dBm warranted ⁶	-3.5 dBm typical -1.7 dBm warranted ⁶
80C11-CR1/-CR2/-CR3			+7 dBm (5.0 mW), typical	-10.0 dBm (100 μ W), typical -7.5 dBm, warranted ⁶

Table 1-20: Optical modules - Clock recovery options (CR, CR1, CR2, CR3, CR4, and CRTP) (cont.)

Name	Characteristics		
80C11-CR4	+7 dBm (5.0 mW), typical	Bit Rate: 9.8 Gb/s to 11.25 Gb/s	
		<i>AOP @ ER ≥ 8.2 dB</i> ⁷	<i>(OMA)</i> ⁸
		-12 dBm typical -9 dBm warranted ⁶	-10.3 dBm typical -7.3 dBm warranted ⁶
		Bit Rate: 11.25 Gb/s to 12.6 Gb/s	
		<i>(AOP @ ER ≥ 8.2 dB)</i> ⁷	<i>(OMA)</i> ⁸
		-10.5 dBm typical -7.5 dBm warranted ⁶	-8.8 dBm typical -5.8 dBm warranted ⁶
80C12 Clock recovery provided by 80A05 module	0 dBm (1.0 mW), typical	Bit Rate: 150 Mb/s to 2.7 Gb/s 1550 nm, 1310 nm	
		<i>AOP @ ER ≥ 8.2 dB</i> ⁷	<i>(OMA)</i> ⁸
		-13.1 dBm (48.6 μW) warranted ⁶	-11.5 dBm (71.4 μW) warranted ⁶
		Bit Rate: 150 Mb/s to 2.7 Gb/s 850 nm	
		<i>(AOP @ ER ≥ 8.2 dB)</i> ⁷	<i>(OMA)</i> ⁸
		-11.5 dBm (70.7 μW) typical	-9.8 dBm (104 μW) typical
		Bit Rate: 2.7 Gb/s to 11.19 Gb/s 1550 nm, 1310 nm	
		<i>AOP @ ER ≥ 8.2 dB</i> ⁷	<i>(OMA)</i> ⁸
		-11.4 dBm (72.8 μW) warranted ⁶	-9.7 dBm (107 μW) warranted ⁶
		Bit Rate: 2.7 Gb/s to 11.19 Gb/s 850 nm	
		<i>(AOP @ ER ≥ 8.2 dB)</i> ⁷	<i>(OMA)</i> ⁸
		-9.7 dBm (106 μW) typical	-8.1 dBm (156 μW) typical
		Bit Rate: 11.19 Gb/s to 12.5 Gb/s 1550 nm, 1310 nm	
		<i>AOP @ ER ≥ 8.2 dB</i> ⁷	<i>(OMA)</i> ⁸
		-10.1 dBm (97.2 μW) warranted ⁶	-8.5 dBm (143 μW) warranted ⁶
		Bit Rate: 11.19 Gb/s to 12.5 Gb/s 850 nm	
		<i>(AOP @ ER ≥ 8.2 dB)</i> ⁷	<i>(OMA)</i> ⁸
		-8.5 dBm (141 μW) typical	-6.8 dBm (208 μW) typical

Table 1-20: Optical modules - Clock recovery options (CR, CR1, CR2, CR3, CR4, and CRTP) (cont.)

Name	Characteristics	
Clock and data electrical output amplitudes ²		
80C01		> 300 mV _{pp} , typical
80C02	Serial DATA output	> 700 mV _{pp} , typical
	Serial CLOCK output	1.5 V _{pp} , typical
	1/16th CLOCK output	600 mV _{pp} , typical
80C03	Serial DATA output	> 350 mV _{pp} , typical
	Serial CLOCK output	> 350 mV _{pp} , typical
80C04-CR1	Serial DATA output	> 700 mV _{pp} , typical
	Serial CLOCK output	1.5 V _{pp} , typical
	1/16th CLOCK output	600 mV _{pp} , typical
80C04-CR2	Serial CLOCK output	1.5 V _{pp} , typical
	1/16th CLOCK output	600 mV _{pp} , typical
80C07, 80C07B	Serial CLOCK output	450 mV _{pp} , typical
	Serial DATA output	450 mV _{pp} , typical
80C08	Serial CLOCK output	1.0 V _{pp} , typical
	1/16th CLOCK output	600 mV _{pp} , typical
80C08B	Serial CLOCK output	1.0 V _{pp} , typical
	1/16th CLOCK output	600 mV _{pp} , typical
80C08C-CR1/ -CR2	Serial CLOCK output	1.0 V _{pp} , typical
	1/16th CLOCK output	600 mV _{pp} , typical
80C08C-CR4	Serial CLOCK output	800 mV _{pp} , typical
	1/16th CLOCK output	600 mV _{pp} , typical
80C09	Serial CLOCK output	1.5 V _{pp} , typical
	1/16th CLOCK output	600 mV _{pp} , typical
80C10B Option CRTP, 80C25GBE Option CRTP	Electrical DATA signal output	700 mV _{pp} , single-ended, maximum (dependent on optical input amplitude)
80C11-CR1	Serial DATA output	> 700 mV _{pp} , typical
	Serial CLOCK output	900 mV _{pp} , typical
	1/16th CLOCK output	600 mV _{pp} , typical
80C11-CR2/ -CR3	Serial CLOCK output	1.5 V _{pp} , typical
	1/16th CLOCK output	600 mV _{pp} , typical
80C11-CR4	Serial CLOCK output	800 mV _{pp} , typical
	1/16th CLOCK output	600 mV _{pp} , typical
80C12	ELECTRICAL SIGNAL OUT	400 mV _{pp} , maximum (dependent on optical input amplitude)

Table 1-20: Optical modules - Clock recovery options (CR, CR1, CR2, CR3, CR4, and CRTP) (cont.)

Name	Characteristics	
Clock and data rise time and fall times ²		
80C01	Serial DATA output	< 30 ps
	Serial CLOCK output	< 30 ps
80C02	Serial DATA output	< 30 ps
	Serial CLOCK output	< 30 ps
	1/16th CLOCK output	< 300 ps
80C03	Serial DATA output	< 30 ps
	Serial CLOCK output	< 30 ps
80C04	Serial DATA output	< 30 ps
	Serial CLOCK output	< 30 ps
	1/16th CLOCK output	< 300 ps
80C04-CR2	Serial CLOCK output	< 30 ps
	1/16th CLOCK output	< 300 ps
80C07	Serial DATA output	< 30 ps
	Serial CLOCK output	< 30 ps
80C07B	Serial DATA output	< 150 ps
	Serial CLOCK output	< 150 ps
80C08 80C08B 80C08C	Serial CLOCK output	< 30 ps
	1/16th CLOCK output	< 300 ps
80C09	Serial CLOCK output	< 30 ps
	1/16th CLOCK output	< 300 ps
80C11	Serial CLOCK output	< 30 ps
	1/16th CLOCK output	< 300 ps
Jitter Transfer Bandwidth ⁵		
80C04-CR2 80C09-CR1 80C11-CR1 80C11-CR2 80C11-CR3	8 MHz maximum 5 MHz minimum 7 MHz typical	
80C08B-CR1, 80C08B-CR2 80C08C-CR1, 80C08C-CR2	4 MHz maximum 2 MHz minimum	
80C08C-CR4	4 MHz maximum 1 MHz minimum 2 MHz typical	

Table 1-20: Optical modules - Clock recovery options (CR, CR1, CR2, CR3, CR4, and CRTP) (cont.)

Name	Characteristics	
80C11-CR4	4 MHz maximum 1 MHz minimum 2 MHz typical	
✓ Recovered clock timing jitter ^{3, 4}		
80C01	< 8.0 ps _{rms} maximum < 4.0 ps _{rms} typical	
80C02	< 2.0 ps _{rms} maximum < 1.0 ps _{rms} typical ⁵	
80C03	< 8.0 ps _{rms} maximum < 4.0 ps _{rms} typical	
80C04	< 2.0 ps _{rms} maximum < 1.0 ps _{rms} typical ⁵	
80C07	OC-3 setting	< 32.0 ps _{rms} maximum < 12.0 ps _{rms} typical ⁵
	OC-12 setting	< 8.0 ps _{rms} maximum < 4.0 ps _{rms} typical ⁵
	OC-48 setting	< 4.0 ps _{rms} maximum < 2.2 ps _{rms} typical ⁵
80C07B	OC-3 setting	< 32.0 ps _{rms} maximum < 12.0 ps _{rms} typical
	OC-12 setting FC1063 (FC) setting ENET1250 (GBE) setting	< 8.0 ps _{rms} maximum < 4.0 ps _{rms} typical
	FC2125 (2FC) setting	< 6.0 ps _{rms} maximum < 3.0 ps _{rms} typical
	OC-48 setting OC-48-FEC setting ENET2500 (2GBE) setting INFINIBAND setting	< 4.0 ps _{rms} maximum < 2.2 ps _{rms} typical
80C08, 80C08B, 80C08C	< 2.0 ps _{rms} maximum < 1.0 ps _{rms} typical ⁵	
80C09	< 2.0 ps _{rms} maximum < 1.0 ps _{rms} typical ⁵	
80C11	< 2.0 ps _{rms} maximum < 1.0 ps _{rms} typical ⁵	

¹ These powers are the average optical input coupled into the external Optical Sampling Module optical input connector. The range is defined for recovered clock, a 50% duty cycle of the incoming NRZ data (also referred to as 50% mark density), a PRBS pattern of $2^{23}-1$, and an extinction ratio of ≥ 8.2 dB (at eye center).

² Output is 50 Ω AC coupled: specification is for output amplitude at the bulkhead outputs and does not include RF loss of attached cables.

- ³ The clock jitter is applicable to both the external electrical output and the system jitter experienced when the recovered clock is the source of the waveform trigger for the system.
- ⁴ Jitter performance of the system while using the optical module clock recovery as the trigger source is warranted only while no active signal is applied to the main instrument's External Trigger (or Prescaler) input.
- ⁵ Internal use for trigger results in a total system jitter of

$$\geq \sqrt{\text{sum of squares}}$$

therefore, the displayed waveform may normally exhibit :

$$\sqrt{(\text{mainframe jitter}^2 + \text{OCR jitter}^2)}$$

- ⁶ Sensitivity is only warranted for operating ambient temperatures below +30 °C.
- ⁷ The AOP (Average Optical Power) range is defined for recovered clock that has a resulting jitter that is less than the specified maximum, a 50% duty cycle of the incoming data (also referred to as 50% mark density), a PRBS pattern of 2²³ - 1, and an extinction ratio of ≥ 8.2 dB (at eye center).
- ⁸ The OMA (Optical Modulation Amplitude) input level is defined as (P_{HIGH} - P_{LOW}). For an extinction ratio of 8.2, the OMA is 1.47 × AOP or AOP(dBm) + 1.68 dB.
- ⁹ The acceptable signal types and patterns for the specified modules are:

Module	NRZ	RZ	1010 . . .
80C02-CR, 80C04-CR1	Y	N	N
80C03-CR, 80C07-CR, 80C07B-CR1	Y	N	Y
80C04-CR2, 80C08-CR1, 80C08B-CR1, 80C08B-CR2, 80C09-CR1	Y	Y	Y

Table 1-21: Optical modules - Mechanical

Name	Characteristics
Construction material	Chassis parts constructed of aluminum alloy; front panel constructed of plastic laminate; circuit boards constructed of glass-laminate. Cabinet is aluminum.
Weight	
80C01	1.13 kg (2.50 lbs) 1.34 kg (2.95 lbs) (with clock recovery)
80C02	0.95 kg (2.10 lbs) 1.22 kg (2.70 lbs) (with clock recovery)
80C03	1.13 kg (2.50 lbs) 1.34 kg (2.95 lbs) (with clock recovery)
80C04	0.95 kg (2.10 lbs) 1.22 kg (2.70 lbs) (with clock recovery)
80C05	0.95 kg (2.10 lbs)
80C06	0.95 kg (2.10 lbs)
80C07	1.13 kg (2.50 lbs) 1.34 kg (2.95 lbs) (with clock recovery)

Table 1-21: Optical modules - Mechanical (cont.)

Name	Characteristics
80C07B	0.95 kg (2.10 lbs) 1.36 kg (3.0 lbs) (with clock recovery)
80C08	0.95 kg (2.10 lbs)
80C08B	0.95 kg (2.10 lbs) 1.22 kg (2.70 lbs) (with clock recovery)
80C08C	0.95 kg (2.10 lbs) 1.22 kg (2.70 lbs) (with clock recovery)
80C09	0.95 kg (2.10 lbs) 1.22 kg (2.70 lbs) (with clock recovery)
80C10, 80C10B, 80C25GBE	0.85 kg (1.87 lbs) 0.92 kg (2.0 lbs) (with Option CRTP)
80C11	0.95 kg (2.1 lbs) 1.22 kg (2.70 lbs) (with clock recovery)
80C12	1.31 kg (2.89 lbs) (F1, F2, F3, F4, F5, F6, FC) 0.98 kg (2.16 lbs) (option 10G)
Overall dimensions	Height: 25.6 mm (1.0 in) Width: 166.7 mm (6.5 in) Depth: 307.7 mm (12.0 in)

NOTE. For environmental specifications, refer to the documentation for your main instrument.

Table 1-22: Optical modules - Environmental

Name	Characteristics	
Temperature	Installed and operating	+10 °C to +40 °C
	Reference receivers frequency response tolerances, 30 GHz mode, and Optical power meter accuracy	+20 °C to +30 °C
	Installed and non-operating	-22 °C to +60 °C

Table 1-22: Optical modules - Environmental (cont.)

Name	Characteristics	
Humidity	Installed and operating	20% to 80% relative humidity with a maximum wet bulb temperature of 29 °C at or below +40 °C, (upper limit derates to 45% relative humidity at +40 °C) non-condensing.
	Reference receivers frequency response tolerances	+20 °C to +30 °C
	Optical power meter accuracy	+20 °C (80% RH) to +30 °C (80% RH)
	Installed and non-operating	5% to 90% relative humidity with a maximum wet bulb temperature of 29 °C at or below +60 °C, (upper limit derates to 20% relative humidity at +60 °C) non-condensing.
Altitude: installed	Operating	3,000 m (9,842 feet).
	Non-operating	12,190 m (40,000 feet)

80A01 Trigger Prescale Preamplifier Module Specifications

This section contains specifications for the 80A01 Trigger Prescale Preamplifier Module. All specifications are guaranteed unless noted as “typical.” To meet specifications, three conditions must first be met:

- The instrument must have been calibrated/adjusted at an ambient temperature between +20 °C and +30 °C.
- The oscilloscope must have been operating continuously for 20 minutes within the operating temperature range specified.
- The instrument must be in an environment with temperature, altitude, humidity, and vibration within the operating limits described in these specifications.

NOTE. For Certifications, refer to the System Specifications section.

Table 1-23: Module characteristics

Specifications	Characteristics
Mainframe interface	Tekprobe-Sampling, Level 3. Hot switching is not permitted.
Input and output connectors	Female SMA
Input power ¹	-10 dBm to +5 dBm, AC coupled
Output power	+10 dBm maximum saturation
Frequency range	8 GHz to 14 GHz (typical)
80A01 Enhancement to Trigger Sensitivity	≤ 200 mV System Prescale Trigger Sensitivity ²
Output voltage ³	8-12.5 GHz, input voltage 200 mV _{pk-pk} to 1 V _{pk-pk} ; > 800 mV _{pk-pk} 12.5-14 GHz, input voltage 200 mV _{pk-pk} to 1 V _{pk-pk} ; ≥ 1 V _{pk-pk} (typical)
Input/output impedance	50 Ω AC coupled (typical)
Input/output VSWR	2.0:1 maximum from 8-14 GHz (typical)
Power requirements	2.35 W
Maximum input voltage swing	1.1 V _{pk-pk}
Noise figure	5 dB maximum

¹ See Input Voltage Swing specification for more information.

² The minimum level of signal applied to the input of an 80A01 that has its output connected to the Trigger Prescale input of the main instrument. A coaxial cable Tektronix part number 015-0560-00 is recommended for the connection from the 80A01 output to the Trigger Prescale input of the instrument.

³ Amplifier functions to 14 GHz but prescale trigger is nominally limited to 12.5 GHz for 200 mV_{pk-pk} sensitivity.

Table 1-24: Environmental specifications

Specification	Characteristics
Temperature	Operating: +10 °C to +40 °C
Humidity	Non-operating: 5% to 90% relative humidity Operating: 20% to 80% relative humidity

Table 1-25: Mechanical specifications

Specifications	Characteristics
Weight	0.37 kg (13 oz.)
Overall dimensions	Height: 24 mm (0.95 in) Width: 74 mm (2.90 in) Depth: 114 mm (4.95 in) Does not include connectors, connector savers, connector covers, push buttons, or lock-down hardware protruding from the front or rear panels.
Construction material	Chassis: aluminum alloy Front panel: plastic laminate Circuit boards: glass-laminate Cabinet: aluminum

80A02 EOS/ESD Protection Module Specifications

This section contains specifications for the 80A02 EOS/ESD Protection Module. All specifications are guaranteed unless noted as “typical.” To meet specifications, three conditions must first be met:

- The instrument must have been calibrated/adjusted at an ambient temperature between +20 °C and +30 °C.
- The instrument must have been operating continuously for 20 minutes within the operating temperature range specified.
- The instrument must be in an environment with temperature, altitude, humidity, and vibration within the operating limits described in these specifications.

Table 1-26: Electrical

Characteristic	Specification
Number of channels	One
Channel connectors	Precision 26 GHz SMA female connectors
Interface connector	Stereophonic mini plug with the center conductor designated as the manual probe interface and outer conductor as the logic control interface
Input impedance	50 Ω
Absolute maximum input signal level (RF signals)	± 2 V peak
Module analog bandwidth	DC to 26 GHz
Manual control threshold (Auto control terminal unpowered)	Module engaged when manual control input has a resistive path to ground of <100 kΩ, open circuit for stand-by protection mode
✓ Automated logic control threshold (Manual control terminal open)	<0.3 V: stand-by protection mode >1.0 V: Measurement engaged mode
Pilot lights	Power and engaged LED pilot lights indicate the corresponding states
Module switching time	20 ms typical 40 ms maximum

Table 1-27: Environmental and mechanical

Characteristic	Specification
Weight	0.4 kg (0.6 lbs)
Dimensions	
Height	25 mm (1.0 in)

Table 1-27: Environmental and mechanical (Cont.)

Characteristic	Specification
Width	79 mm (3.1 in)
Depth	135 mm (5.3 in)
Environmental conditions	Refer to the host instrument specifications
Temperature	
Operating	+10 °C to + 40 °C Upper rating derates to +35 °C for all sampling modules on 2 meter extender cable
Non-operating	-22 °C to +60 °C
Humidity	
Operating	20% to 80% relative humidity with a maximum wet bulb temperature of +29 °C at or below +40 °C, non-condensing. (Upper limit derates to 45% relative humidity at +40 °C.)
Non-operating	5% to 90% relative humidity with a maximum wet bulb temperature of +29 °C at or below +60 °C, non-condensing. (Upper limit de-rates to 20% relative humidity at +60 °C.)
Altitude	
Operating	3,000 m (9,842 ft)
Non-operating	12,190 m (40,000 ft)
Electromagnetic Compatibility	Refer to the host instrument specifications for modular specifications

80A05 Electrical Clock Recovery Module Specifications

This section contains specifications for the 80A05 Electrical Clock Recovery Module. All specifications are guaranteed unless noted as “typical.” To meet specifications, three conditions must first be met:

- The instrument must have been calibrated/adjusted at an ambient temperature between +20 °C and +30 °C.
- The instrument must have been operating continuously for 20 minutes within the operating temperature range specified.
- The instrument must be in an environment with temperature, altitude, humidity, and vibration within the operating limits described in these specifications.

Table 1-28: Module characteristics

Specifications	Characteristics
Mainframe interface	Tekprobe sampling, level 3. hot switching is not permitted.
Number of inputs	2
Input and output connectors	SMA
Data input/output coupling	DC
Maximum non-destruct range	Either inputs: 2.5 V _{p-p}
Maximum operating range	Single-ended operation: Either input: 2.0 V _{pk-pk}
Maximum operating range	Complementary operation: Each input: 1 V _{p-p}
Maximum DC offset	±2.0 VDC
Electrical Return Loss	Data in+, data in-, data out+, data out-: 15 dB or better DC to 10 GHz
	Data in+, data in-, data out+, data out-: 10dB or better 10 GHz to 20 GHz
Electrical data attenuation	DC to 12.5 GHz: 6.6 dB ±0.6 dB
Propagation delay	Either inputs: 875 ps
Propagation Delay mismatch	Either inputs: <15 ps
Input/output impedance	50 Ω
Step response aberrations	±2% or less over zone 10 ns to 20 ps before step transition ±10% or less for the first 300 ps following step transition +1% -5% or less over zone 300 ps to 3 ns following step transition +1% -3% or less over zone 3 ns to 100 ns following step transition ±0.5% after 100 ns following step transition

Table 1-28: Module characteristics (cont.)

Specifications	Characteristics	
Analog bandwidth	±3 dB, DC to 20 GHz	
Front panel output amplitudes	Trigger clock output:	400 mV _{p-p}
	10G clock output:	500 mV _{p-p}
Front panel rise and fall times	Trigger clock output:	300 ps
	10G clock output:	30 ps
✓ Recovered clock timing jitter	50 Mb/s to 2.7 Gb/s:	< 1.0% of unit interval
	2.7 Gb/s to 6.375 Gb/s:	< 2.5 ps _{RMS}
	9.8 Gb/s to 12.6 Gb/s:	< 2.0 ps _{RMS}
✓ Minimum clock recovery sensitivity	Single-ended operation:	
	150 Mb/s to 2.7 Gb/s:	10 mV _{p-p}
	2.7 Gb/s to 11.19 Gb/s:	15 mV _{p-p}
	11.19 Gb/s to 12.5 Gb/s:	20 mV _{p-p}
	Complementary operation:	
	150 Mb/s to 2.7 Gb/s:	8 mV _{p-p}
	2.7 Gb/s to 11.19 Gb/s:	12 mV _{p-p}
	11.19 Gb/s to 12.5 Gb/s:	15 mV _{p-p}
Supported data rates and formats (without Option 10G)	OC3/SMT1	155.52 Mb/s
	OC12/STM4	622.08 Mb/s
	FibreChannel	1.063 Gb/s
	Gigabit Ethernet	1.25 Gb/s
	Serial ATA	1.5 Gb/s
	2 Gigabit FibreChannel	2.125 Gb/s
	OC48/STM16	2.488 Gb/s
	2 Gigabit Ethernet	2.5 Gb/s
	InfiniBand	2.5 Gb/s
	PCI Express	2.5 Gb/s
	2.5G G.709 FEC	2.666 Gb/s
	Serial ATA	3.0 Gb/s
	XAUI	3.125 Gb/s
	FibreChannel	3.188 Gb/s
	VSR5	3.318 Gb/s
	4 Gigabit FibreChannel	4.25 Gb/s
Supported user selected clock recovery (without Option 10G)	50 Mb/s to 2.7 Gb/s 3.000 Gb/s to 3.188 Gb/s	

Table 1-28: Module characteristics (cont.)

Specifications	Characteristics	
Supported data rates and formats added with Option 10G	Serial ATA	6.0 Gb/s
	XAUI	6.25 Gb/s
	OC192/STM64	9.953 Gb/s
	10GBase-W	9.953 Gb/s
	10GBase-R	10.31 Gb/s
	10G FibreChannel	10.51 Gb/s
	G.975 FEC	10.66 Gb/s
	G.709 FEC	10.71 Gb/s
	10GbE w/FEC	11.10 Gb/s
Super FEC	12.50 Gb/s	
Supported user selected clock recovery with Option 10G	50 Mb/s to 3.188 Mb/s	
	3.267 Gb/s to 4.250 Gb/s	
	4.900 Gb/s to 6.375 Gb/s	
	9.800 Gb/s to 12.60 Gb/s	

Table 1-29: Environmental specifications

Specification	Characteristics
Temperature	Operating: +10 °C to +40 °C
Humidity	Non-operating: 5% to 90% relative humidity Operating: 20% to 80% relative humidity

Table 1-30: Mechanical specifications

Specifications	Characteristics	
Weight	1.22 kg (2.70 lbs.)	
Overall dimensions	Height: 2.5 cm (1.0 in)	
	Width: 16.5 cm (6.5 in)	
	Depth: 30 cm (12 in)	
	Does not include connectors, connector savers, connector covers, push buttons, or lock-down hardware protruding from the front or rear panels.	
Construction material	Chassis	aluminum alloy;
	Front panel	plastic laminate;
	Circuit boards	glass-laminate;
	Cabinet sleeve	aluminum
	Cabinet end covers	aluminum

Table 1-31: Product family electromagnetic compatibility (EMC)

Refer to Mainframe Specification for the modular family specifications

Table 1-32: Product family dynamics

Refer to Mainframe Specification for the modular family specifications

Table 1-33: Product family atmospherics

Refer to Mainframe Specification for the modular family specifications

80A06 PatternSync Trigger Module Specifications

This section contains specifications for the 80A06 PatternSync Trigger Module. All specifications are guaranteed unless noted as “typical.” To meet specifications, three conditions must first be met:

- The instrument must have been calibrated/adjusted at an ambient temperature between +20 °C and +30 °C.
- The instrument must have been operating continuously for 20 minutes within the operating temperature range specified.
- The instrument must be in an environment with temperature, altitude, humidity, and vibration within the operating limits described in these specifications.

Table 1-34: 80A06 PatternSync trigger system

Characteristics	Specifications
Mainframe Interface	Tekprobe sampling, level 3 and Tekprobe SMA when used with the 174-5230-00 SlotSaver adapter on the Trigger Probe Power port. Hot switching is not permitted on this module interface.
Number of Inputs	One
Number of Pattern Sync Channels	One
Front Panel Electrical Connectors	SMA jacks (female)
Front Panel Input/Output Impedance	50 Ω
Maximum Non-Destruct Range (the maximum range over which peak input signal can operate without irreversible damage to the instrument)	2.5 V _{pk-pk}
Maximum Operating Range	2.0 V _{pk-pk}
Maximum DC Offset	±5.0 VDC
Electrical Return Loss	>15 dB 150 MHz to 10 GHz >10 dB 10 GHz to 20 GHz
Input/Output Coupling	CLOCK IN AC CLOCK OUT AC TRIGGER OUT DC (ground referenced)
✓ Supported Clock Rates	Minimum: 150 MHz Maximum: 12.5 GHz Maximum: 12.75 GHz (typical)

Table 1-34: 80A06 PatternSync trigger system (cont.)

Characteristics	Specifications
Prescaler Ratios (lowers the input clock frequency prior to routing to the programmable counter. Set by software based on the input clock frequency and not directly user accessible)	4: for Input clock >150 MHz and ≤3.5 GHz 8: for Input clock >3.5 GHz and ≤7 GHz 16: for Input clock >7 GHz and ≤12.75 GHz
Programmable Pattern Length	Minimum: 2 Maximum: 2^{23} (8,388,608) All pattern lengths between minimum and maximum values are supported. The PatternSync-module overall division ratio will vary based on the user requested or autoselected pattern length and the user requested or autoselected input clock frequency. The programmable counter in the PatternSync module is settable from 30 to 2^{23} so for pattern lengths shorter than 30, the requested value is multiplied by the smallest integer necessary to raise the counter value over 30. The overall division ratio is given by the following product: $\text{division ratio} = \text{prescaler} \times \text{integer multiple} \times \text{programmable counter}$ For example, an 8.5 GHz input clock and requested counter value of 127 will give an overall division ratio of $16 \times 1 \times 127 = 2032$. In this case, the pattern length is longer than 30 so the integer multiple is 1. A 2.5 GHz input clock and requested counter value of 25 will give an overall division ratio of $4 \times 2 \times 25 = 200$.
Front Panel Output Amplitudes	CLOCK OUT (50 Ω, AC coupled): 150 MHz to 8.0 GHz: 500 mV _{pk-pk} (typical) 8.0 GHz to 12.75 GHz: 250 mV _{pk-pk} (typical) TRIGGER OUT (50 Ω, DC coupled, ground referenced): Output High Level: 0 V (Typical) Output Low Level: -550 mV (typical)
Front Panel Output Rise and Fall Times	CLOCK OUT: <60 ps (typical) TRIGGER OUT: <60 ps (typical)
✓ System Trigger Jitter Generation	Applies to mainframe without 82A04: <1.3 ps (rms) input clock >1.2 GHz <3 mUI (rms) input clock ≤1.2 GHz

Table 1-34: 80A06 PatternSync trigger system (cont.)

Characteristics	Specifications
System Trigger Jitter Generation, Typical	Applies to mainframe without 82A04: 850 fs (rms) input clock >1.2 GHz 1.5 mUI (rms) input clock ≤1.2 GHz Applies to mainframe with 82A04: 200 fs (rms)
✓ Minimum Input Sensitivity This voltage is the peak to peak swing of the input clock with a 50% duty cycle from a 50 Ω source. The minimum is defined as the amplitude required to generate a divided trigger output at the correct division ratio with resulting jitter generation that is less than the specified maximum.	150 MHz to 8.0 GHz: 100 mV _{pk-pk} ¹ 8.0 GHz to 12.5 GHz: 200 mV _{pk-pk} ¹
Minimum Input Sensitivity, Typical	50 mV _{pk-pk} typical
Minimum Input Sensitivity, Sinusoidal input This voltage is the peak to peak swing of the input clock with a 50% duty cycle from a 50 Ω source. The minimum is defined as the amplitude required to generate a divided trigger output at the correct division ratio with resulting jitter generation that is less than the specified maximum.	100 mV _{pk-pk} Valid for sinusoidal input clock signals with rise and fall times of 30% of a UI as measured from 10% to 90% of the full amplitude. For instance, a 150 Mb/s (150 MHz clock) data stream would be tested with a clock signal of rise/fall time = 2ns.

¹ Valid for input clock signals with rise and fall times less than 50 ps as measured from 20% to 80% of the full amplitude.

Table 1-35: 80A06 Mechanical characteristics

Characteristics	Specifications
Mass and Dimensions	
Approximate external dimensions	5.5 inches x 3.1 inches x 1 inch (14 cm x 7.9 cm x 2.5 cm)
Mass (module alone with terminators)	0.65 lbs (0.295 kg)

Table 1-36: Product family electromagnetic compatibility (EMC)

Refer to Mainframe Specification for the modular family specifications

Table 1-37: Product family dynamics

Refer to Mainframe Specification for the modular family specifications

Table 1-38: Product family atmospheric

Refer to Mainframe Specification for the modular family specifications



Performance Verification

Performance Verification Procedures

Two types of Performance Verification procedures can be performed on this product: *Brief Procedures* and the more extensive *Performance Tests*. You may not need to perform all of these procedures, depending on what you want to accomplish:

- To rapidly confirm that the instrument functions and was adjusted properly, just do the *Perform the Diagnostics* and *Perform the Compensation* procedures, found under *Brief procedures* beginning on page 2-3.

Advantages: These procedures are quick to do, require no external equipment or signal sources, and perform extensive functional and accuracy testing to provide high confidence that the instrument will perform properly. They can be used as a quick check before making a series of important measurements.

- To further check functionality, first do the procedures just mentioned, and then do the procedure *Perform the Functional Tests*, found under *Brief Procedures* on page 2-7.

Advantages: These procedures require minimal additional time to perform, require no additional equipment other than connection hardware, and more completely test the internal hardware of the instrument. They can be used to quickly determine if the instrument is suitable for putting into service, such as when it is first received.

- If more extensive confirmation of performance is desired, do the *Performance Tests*, beginning on page 2-25, after doing the procedures just referenced.

Advantages: These procedures add direct checking of warranted specifications. They require more time to perform and suitable test equipment is required. (See *Equipment Required* beginning on page 2-27).

If you are not familiar with operating this instrument, refer to the online help or the user information supplied with the instruments.

Brief Procedures

There are three procedures in this section that provide a quick way to confirm basic functionality and proper adjustment:

- *Perform the Diagnostics*
- *Perform the Compensation*
- *Perform the Functional Tests*

These procedures require little or no test equipment. See the description on page 2-1 for information on when to use these procedures.

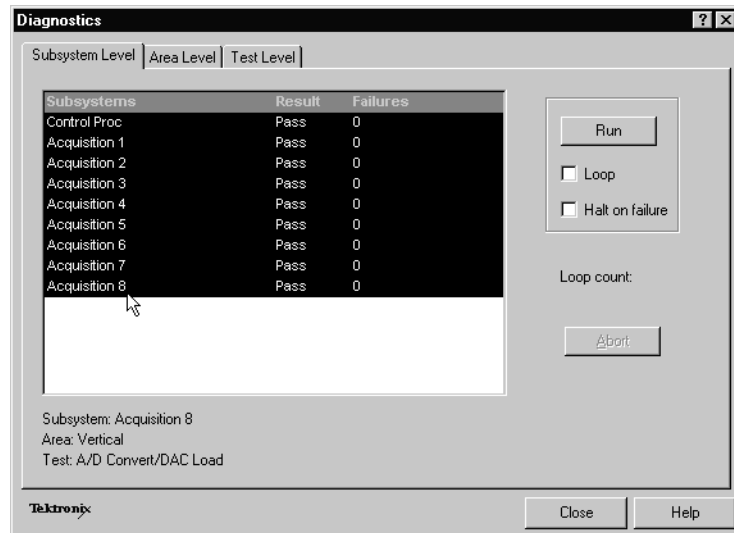
STOP. *The procedures throughout this chapter contain instructions based on the menus and controls from the most updated instrument software available at the time this document was released. These procedures will work for other versions of software, but some control and menu names may vary slightly.*

Perform the Diagnostics

The following steps run the internal routines that confirm basic functionality and proper adjustment.

Equipment required	None
Prerequisites	First, all sampling modules to be diagnosed must be installed as outlined in their user manuals. Second, power on the instrument and allow a 20 minute warm-up before doing this procedure.

1. *Set up the instrument:* From the application menu bar, select Utilities, and then select Diagnostics. The Diagnostics dialog box displays. See the following:



2. Select a diagnostics suite:

- a. In the dialog box, click the Subsystem Level tab.
- b. Select all the entries by clicking the first entry Control Proc and dragging down to select the rest. All entries should be highlighted as shown above.
- c. In the Run box, leave Loop and Halt on Failure unchecked.

3. Verify that the diagnostic suite passes:

- a. Click the Run button to execute the diagnostics.
- b. The diagnostics may take several minutes to complete. Verify that Pass appears as Status in the dialog box when the diagnostics complete.
- c. If instead an error number appears as Status, rerun the diagnostics. If Fail status continues after rerunning compensation and you have allowed warm up to occur, the module or main instrument may need service.
- d. Click the Close button to exit.

End of Procedure

Perform the Compensation

Performing a vertical compensation will maximize the accuracy of the automatic measurements you take. This procedure uses internal routines to optimize the vertical offset, gain, and linearity.

Equipment required	<p>For sampling modules:</p> <ul style="list-style-type: none"> ■ 50 Ω terminations on all electrical module channels (Tektronix part number 015-1022-xx). ■ Dust covers on all optical module channels. <p>The sampling modules ship from Tektronix with the proper terminations and dust covers installed.</p>
Prerequisites	<p>First, all sampling modules to be compensated must be installed as outlined in their user manuals.</p> <p>Second, power on the instrument and allow a 20 minute warm-up before doing this procedure.</p>

1. Run the compensation routines:

- a. From the application menu bar, select Utilities, and then select Compensation.

The Compensation dialog box lists the main instrument and sampling modules. The temperature change from the last compensation is also listed. See Figure 2-1.

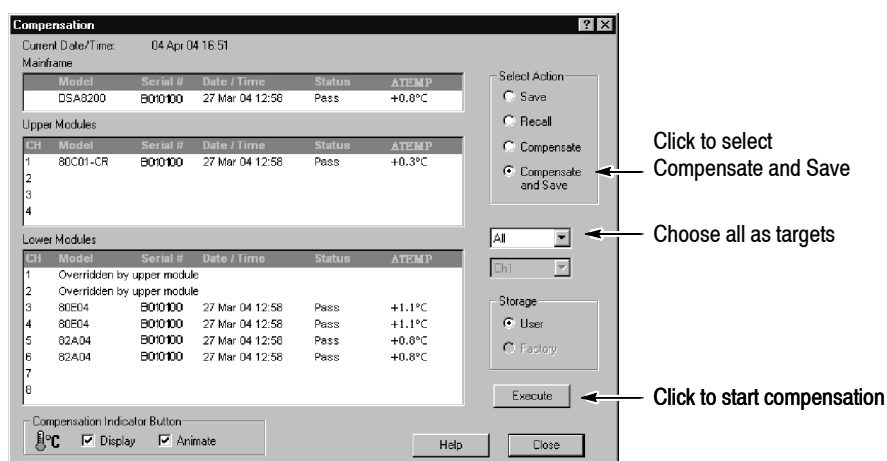


Figure 2-1: Compensation dialog box

- b. Wait until the Status for all items you wish to compensate changes from Warm Up to Pass, Fail, or Comp Req'd.
- c. Under Select Action, click the Compensate and Save option button.
- d. From the top pulldown list, choose All (default selection) to select the main instrument and all its modules as targets to compensate.
- e. Click the Execute button to begin the compensation.
- f. Follow the instructions to disconnect inputs and install terminations that will appear on screen; be sure to follow static precautions (see the user manual for your sampling module) when following these instructions.

NOTE. *Failing to install the 50 Ω terminations on 80E00 sampling-module input connectors can yield erroneous compensation failures or results.*

2. *Verify that the compensation routines pass:*

- a. The compensation may take several minutes to complete. Verify that Pass appears as Status for the main instrument and for all sampling modules listed in the Compensation dialog box when compensation completes.
- b. If instead Fail appears as Status, rerun the compensation. If Fail status continues after rerunning compensation and you have allowed warm-up to occur, the module or main instrument may need service.
- c. If you want to save the compensation constants generated by this compensation, click the Save option button under Select Action. Click the Execute button to save the compensation.
- d. Click the Close button to exit.

End of Procedure

Perform the Functional Tests

These procedures use the DC CALIBRATION OUTPUT and the INTERNAL CLOCK OUTPUT connectors to further verify that the instrument functions properly. An SMA cable is required to do these test procedures.

The purpose of these procedures is to confirm that the instrument functions properly. The equipment required is intentionally kept to a minimum.

STOP. *These procedures verify functions; that is, they verify that the instrument features operate. They do not verify that they operate within limits; therefore, do not interpret any quantities cited (such as “about five horizontal divisions”) as limits.*

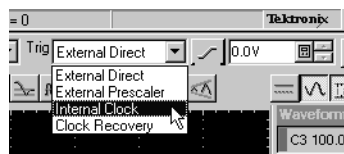
STOP. *DO NOT make changes to the front-panel settings that are not called out in the procedures. Each verification procedure will require you to set the instrument to default settings before verifying functions. If you make changes to these settings, other than those called out in the procedure, you may obtain invalid results. In this case, go back to step 1 and repeat the procedure.*

Verify Electrical Input Channels

Install the test hookup and preset the instrument controls:

Equipment required	One SMA cable, such as Tektronix part number 174-1427-00
Prerequisites	One electrical sampling module (80E01, 80E02, 80E03, 80E04, 80E06, 80E07, 80E08, 80E09, or 80E10)

1. *Initialize the instrument:* Push the front-panel DEFAULT SETUP button and click Yes in the confirmation dialog box.
2. *Set the Trigger System:* In the UI application toolbar, select Internal Clock from the Trig list box as shown below.



3. *Hook up the signal source:* Connect the SMA cable from the DC CALIBRATION output to the channel input that you want to test as shown in Figure 2-2.

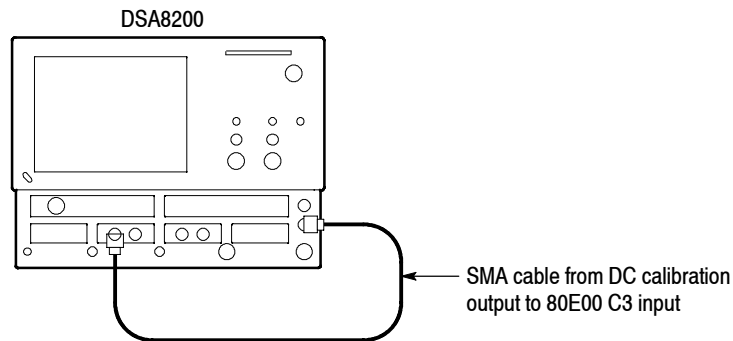


Figure 2-2: Hookup for electrical functional tests

4. Set the DC CALIBRATOR OUTPUT:

- a. Push the Vertical MENU front-panel button. This displays the Vert Setup dialog box.

NOTE. When an optical module is installed, the optical setup dialog box displays by default. Click the Basic button to display the basic dialog box.

- b. Enter a level of 200 mV in the DC CAL box.
- c. Push the Vertical MENU front-panel button again to dismiss the Vert Setup dialog box.

5. Select the channel to test: Push the channel button for the channel you want to test. The button lights and the channel display comes on. See Figure 2-3.

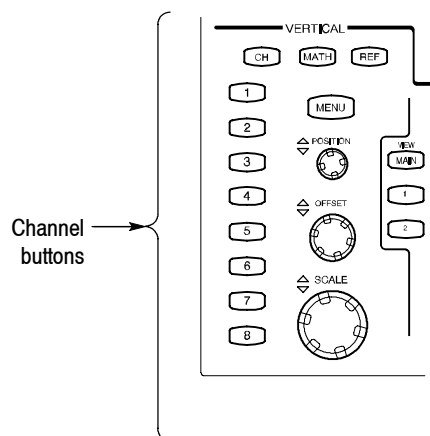


Figure 2-3: Channel button location

6. *Verify that the channel is operational:* Confirm that the following statements are true:
 - The vertical scale readout for the channel under test shows a setting of 100 mV, and a DC level is at about 2 divisions above center screen.
 - The front-panel vertical POSITION knob (for the channel you are testing) moves the DC offset level up and down the screen when rotated. *Return the DC level to 2 divisions above center screen before continuing.*
 - Turning the vertical SCALE knob to 50 mV changes the amplitude of the DC level to about 4 divisions above center screen, and returning the knob to 100 mV returns the amplitude to about 2 divisions above center screen.
7. *Verify that the channel acquires in all acquisition modes:* Push the front-panel button ACQUISITION MENU to display the Acq Setup dialog box. Click each of the three acquisition modes, and confirm that the following statements are true:
 - Sample mode displays an actively acquiring waveform on-screen. (Note that there is a small amount of noise present on the DC level).
 - Average mode displays an actively acquiring waveform on-screen with the noise reduced.
 - Envelope mode displays an actively acquiring waveform on-screen with the upper and lower extremes of the noise displayed.
8. *Verify the DC accuracy compensation:* Do the following substeps:
 - a. Select Meas from the Setup menu. In the Meas Setup dialog box that displays:
 - Select as Source the channel under test. For example, select Main C3 for channel 3.
 - Select Meas1.
 - Set the Select Meas menu to Pulse - Amplitude > Mean.
 - b. Push the Vertical MENU front-panel button. This switches to the Vert Setup dialog box.
 - c. Set the Vertical Scale, Vertical Offset, and DC Calibration Output to the levels shown in the first row of the table that follows.
 - d. Verify that the Mean measurement for the channel under test falls within the limits given in the table.

- e. Repeat steps c and d for each row in the table for your module.

For the 80E01, 80E02, 80E03, 80E04, and 80E06

Vertical Scale (mV/div)	Vertical Offset (mV)	DC CAL Output (mV)	Limits	
			Minimum (mV)	Maximum (mV)
100	-1000.0	-1000.0	-1009.0	-991.0
100	0.0	-450	-461.0	-439.0
100	0.0	0	-2.0	2.0
100	0.0	450	439.0	461.0
100	1000.0	1000.0	991.0	1009.0

For the 80E07, 80E08, 80E09, and 80E10

Vertical Scale (mV/div)	Vertical Offset (mV)	DC CAL Output (mV)	Limits	
			Minimum (mV)	Maximum (mV)
100	-600.0	-600.0	-605.4	-594.6
100	0.0	-450	-461.0	-439.0
100	0.0	0	-2.0	2.0
100	0.0	450	439.0	461.0
100	600.0	600.0	594.6	605.4

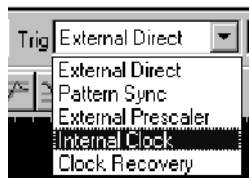
9. *Test all channels:* Repeat steps 3 through 8 until all input channels are verified.
10. *Remove the test hookup:* Disconnect the SMA cable from the channel input and the DC CALIBRATION output.

Verify Optical Input Channels

This verification is done without an input signal.

Equipment required	None
Prerequisites	At least one optical (80C00 series) sampling module must be installed as outlined in its user manual.

1. *Initialize the instrument:* Push the front-panel DEFAULT SETUP button.
2. *Set the Trigger System:* In the UI application toolbar, select Internal Clock from the Trig list box as shown below.



3. *Select the channel to test:* Push the channel button for the channel you want to test. The button lights amber and the channel displays. See Figure 2-4.

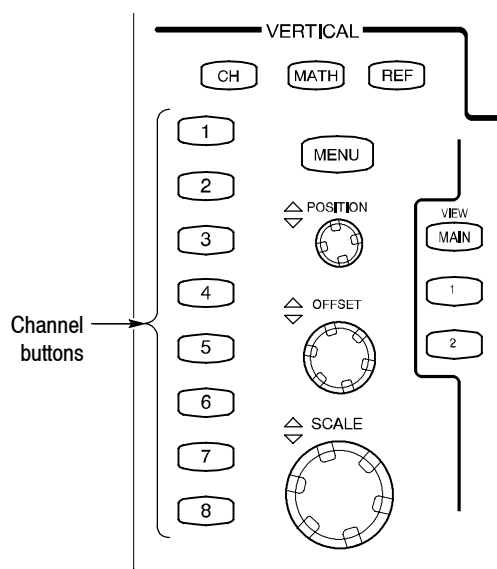


Figure 2-4: Channel button location

4. *Verify that the channel is operational:* Confirm that the following statements are true.
 - A baseline trace displays at about center screen (see Figure 2-5 on page 2-12) and the vertical scale readout for the channel under test shows a setting as follows:
 - 80C01, 80C02, 80C04, 80C09, and 80C11: 1 mW
 - 80C03: 100 μ W
 - 80C05: 3 mW
 - 80C06: 6 mW
 - 80C07, and 80C07B: 100 μ W
 - 80C08, 80C08B, 80C08C and 80C12: 200 μ W
 - 80C10, 80C10B: 3 mW
 - 80C10B-F1, 80C25GBE: 2 mW

- The front-panel Vertical **POSITION** knob (for the channel you are testing) moves the signal up and down the screen when rotated. *Return the baseline trace to center screen before continuing.*
- Turning the Vertical OFFSET front-panel knob counterclockwise offsets the baseline towards the bottom of the screen, turning the knob clockwise offsets the baseline towards the top of the screen, and returning the knob to 0.000 offset returns the baseline to center screen.

NOTE. If the position knob was set to 0.000, you can confirm this in the Vertical menu (use Basic button in the dialog box).

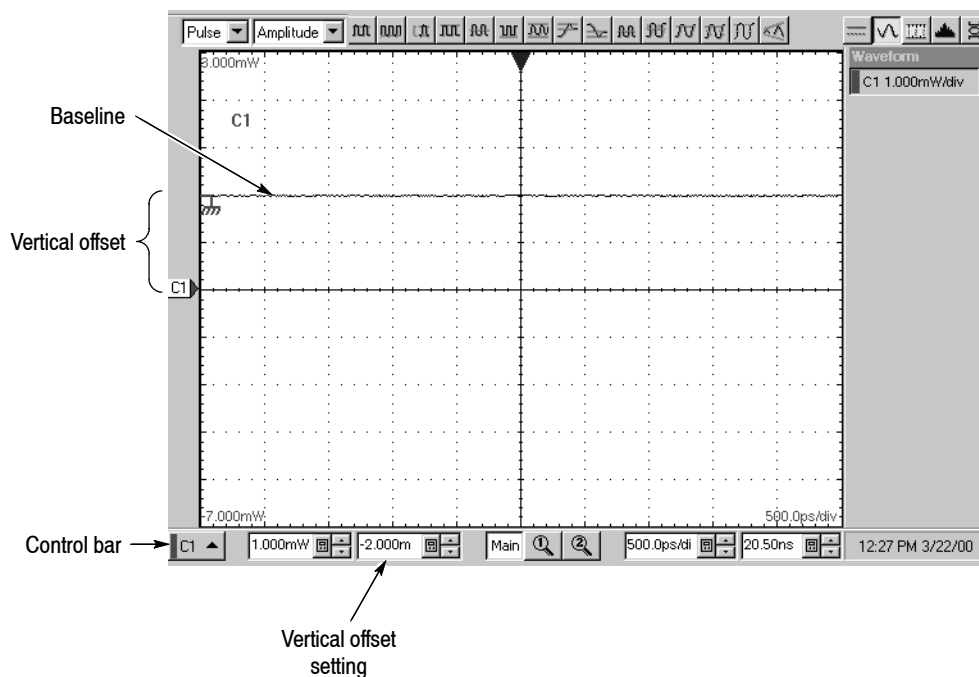


Figure 2-5: Optical channel verification

5. *Verify that the channel acquires in all acquisition modes:* Push the front-panel button Acquisition MENU to display the Acq Setup dialog box. Click each of the three acquisition modes and confirm that the following statements are true:
 - Sample mode displays an actively acquiring waveform on-screen. (Note that there may be a small amount of noise present on the baseline level).

- Average mode displays an actively acquiring waveform on-screen with any noise present reduced.
 - Envelope mode displays an actively acquiring waveform on-screen with the upper and lower extremes of the noise displayed.
6. *Close Acquisition setup dialog box:* Push the Acquisition MENU button to close the Acq setup dialog box.
 7. *Test all channels:* Repeat steps 3 through 5 until all optical input channels are verified.

Verify the Time Bases Work

After verifying the channels, you can now verify that the time bases function. This verification is done using a front-panel signal.

Equipment required	One SMA cable, such as Tektronix part number 174-1427-00 One 10x SMA attenuator, such as Tektronix part number 015-1003-00 One electrical sampling module (80E01, 80E02, 80E03, 80E04, 80E06, 80E07, 80E08, 80E09, or 80E10)
Prerequisites	None

1. *Initialize the instrument:* Push the front-panel DEFAULT SETUP button.
2. *Hook up the signal source:* Connect the SMA cable from the Internal Clock output through a 10x attenuator to any 80E00 sampling module input channel as shown in Figure 2-6.

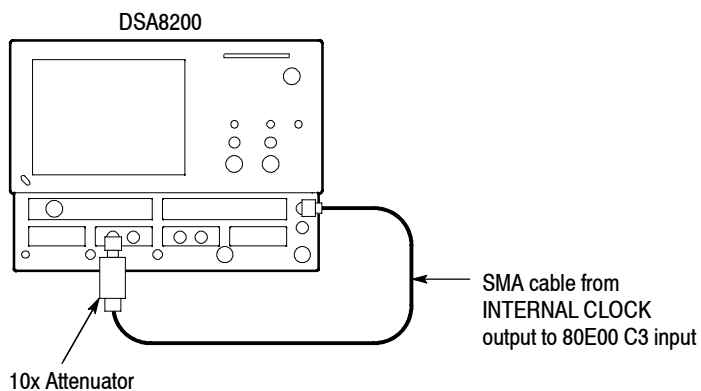


Figure 2-6: Hookup for the time base tests

3. *Set up the instrument:*
 - a. Push the Trigger MENU front-panel button to display the Trig Setup dialog box.

- b. Click **Internal Clock** under **Trigger Source** in the Trig Setup dialog box. The Internal Clock rate should be set to **200 kHz**.
- c. Push the Trigger **MENU** front-panel button again to dismiss the Trig Setup dialog box.
- d. Push the channel button for the channel you connected to in step 2. The button lights and the channel display comes on. See Figure 2-7 on page 2-14.
- e. Turn the Vertical **SCALE** knob to set the vertical scale to **20 mV/div**. The channel scale readout is displayed in the Control bar at the bottom of the graticule.

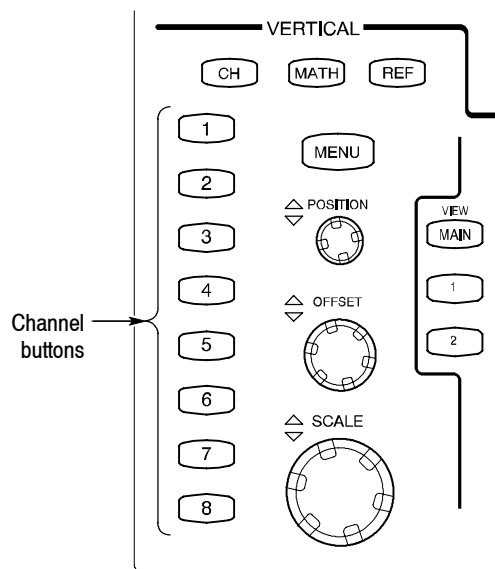


Figure 2-7: Channel button location

4. *Set the time base:* Set the Horizontal **SCALE** to **1 μ s/div**. The horizontal scale readout is displayed in the Control bar at the bottom of the graticule.
 - a. Select Display in the Setup menu. In the Disp Setup dialog box, set the display **Style** to **Normal** and enable (check) **Show Vectors**.
 - b. Close the setup menu.
 - c. Rotate the vertical **OFFSET** knob counterclockwise so that the base of the square wave is about 2 divisions below the center graticule.

NOTE. *Otherwise no vertical trace will be seen for rise and fall.*

5. Verify that the Main time base operates: Confirm the following statements are true:

- One period of the internal clock signal (a square wave) is about five horizontal divisions on-screen. See Figure 2-8 on page 2-16.

NOTE. At some temperatures, there may be extraneous data points beyond the first half cycle when viewing the front-panel Internal Clock output (as is done in this step). This behavior may also occur when viewing multiple cycles in TDR mode. In both cases, this behavior is normal.

- Rotating the Horizontal **SCALE** knob clockwise expands the waveform on-screen (more horizontal divisions per waveform period), counter-clockwise rotation contracts it, and returning the horizontal scale to 1 $\mu\text{s}/\text{div}$ returns the period to about five divisions. Leave the time base set to 1 $\mu\text{s}/\text{div}$.
- The horizontal **POSITION** knob positions the signal left and right on-screen when rotated.

NOTE. The signal will not move past the minimum position setting.

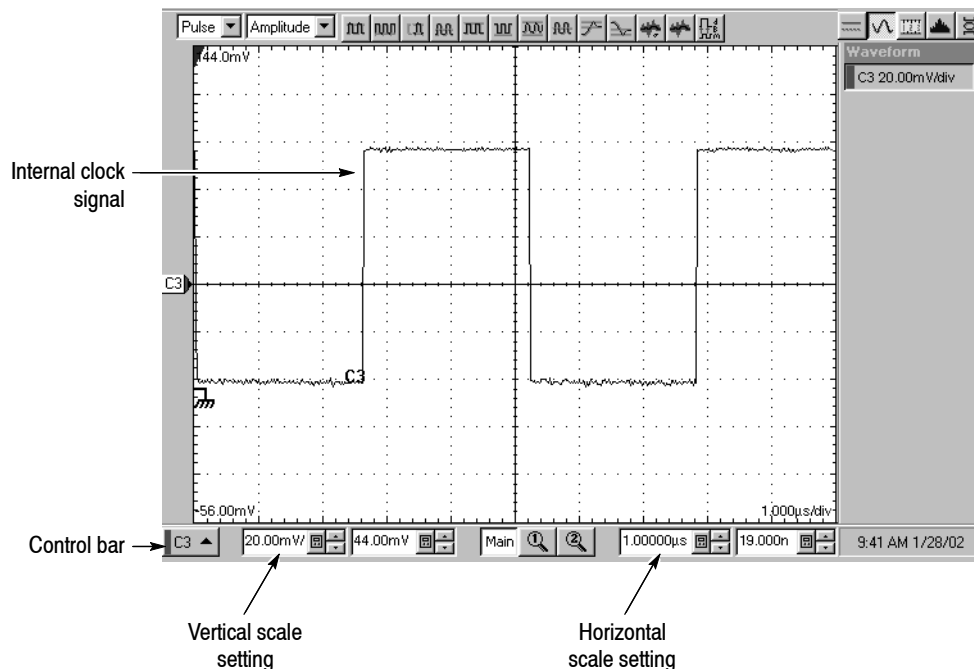


Figure 2-8: Main time base verification

6. Set up the Mag1 time base:
 - a. Push the Horizontal View **MAG1** button on the front panel. The Mag1 time base view will display under the Main time base view.
 - b. Set the Horizontal **SCALE** to **1 $\mu\text{s}/\text{div}$** . The horizontal scale readout is displayed in the Control bar at the bottom of the graticule and is now reading out the scale of the Mag1 time base view.
7. Verify that the Mag1 time base operates: Confirm the following statements.
 - The brackets on the Main View waveform (*top graticule*) are a full-screen width apart (10-divisions). See Figure 2-9 on page 2-17.
 - One period of the internal clock signal (a square wave) in the Mag view (*bottom graticule*) is about five horizontal divisions on-screen. (Matches the waveform in the top graticule.) See Figure 2-9.
 - Rotating the Horizontal **SCALE** knob clockwise to **500 ns/div** expands the waveform *in the bottom graticule* to double the period (about 10-horizontal divisions per waveform period) and returning the Horizontal **SCALE** knob to **1 $\mu\text{s}/\text{div}$** returns the period to about five divisions. Leave the Horizontal Scale set to **1 $\mu\text{s}/\text{div}$** .

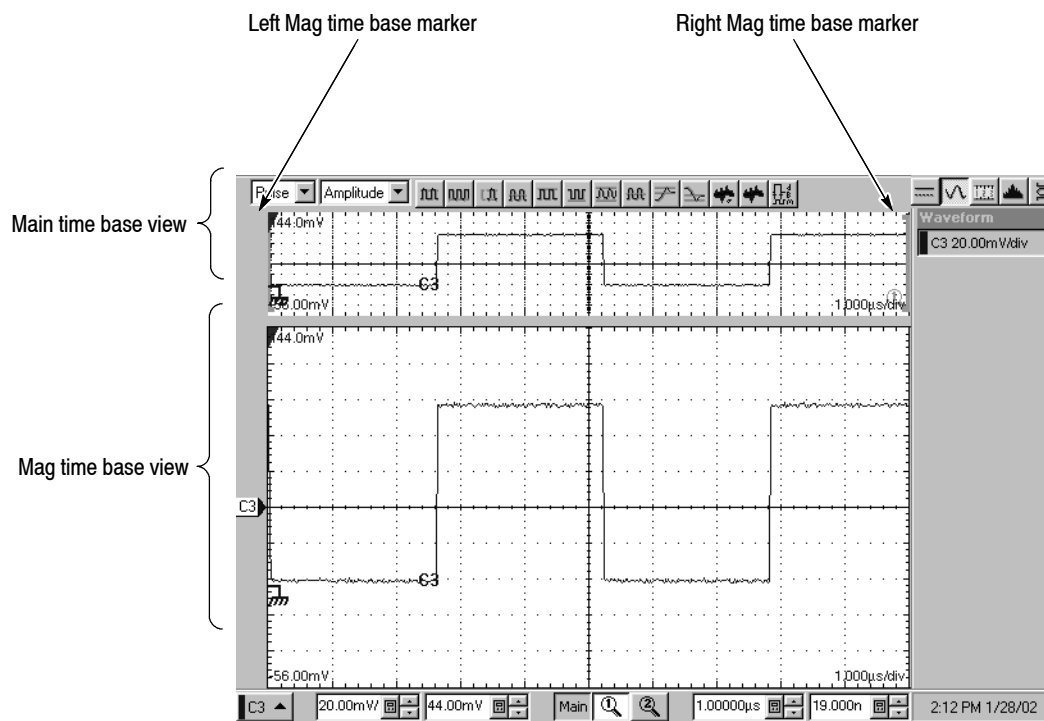


Figure 2-9: Mag time base verification

8. *Verify that the Mag2 time base operates:*

- a. Push the **Mag1** button to remove the display of the Mag1 time base.
- b. Perform steps 6 and 7, but use the Mag2 button instead of the Mag1.

Perform Gated Trigger Test

This test verifies that the Gated Trigger (GT Option) function. This test is done using a front-panel signal and a rear-panel TTL connection.

Equipment required	One short SMA cable, Tektronix part number 174-1427-00 One long SMA cable, Tektronix part number 174-1341-00 One SMA female to BNC male adapter, Tektronix part number 015-0572-00 One 50 Ω terminator cap, Tektronix part number 015-1022-01 One SMA 10X attenuator, SMA connector, Tektronix part number 015-1003-00 One electrical sampling module (80E01, 80E02, 80E03, 80E04, 80E06, 80E07, 80E08, 80E09, or 80E10)
Prerequisites	This test applies only to instruments that include option GT.

1. *Initialize the instrument:* Push the front-panel **DEFAULT SETUP** button.
2. Push the channel 3 button to select it. The button lights and the channel display comes on. See Figure 2-11 on page 2-20.
3. *Hook up the signal source:* Connect the SMA cable from the Internal Clock output through a 10x attenuator to the 80E00 sampling module input channel 3 as shown in Figure 2-10 on page 2-19. Connect SMA cable and SMA female to BNC male adapter to the External Gate input at rear panel.

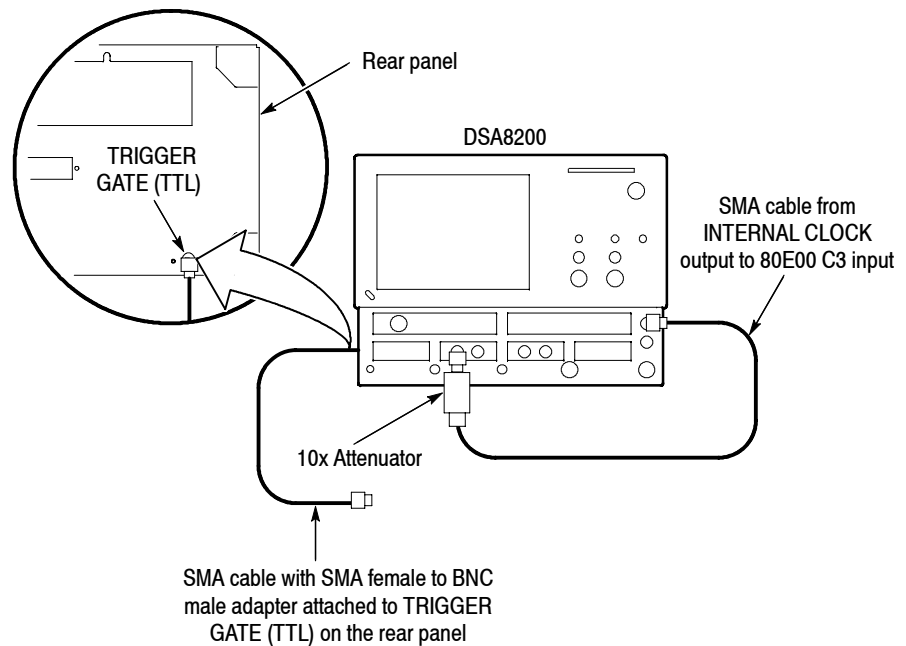


Figure 2-10: Hookup for the gated trigger tests

4. Set up the instrument:

- a. Push the Trigger **MENU** front-panel button to display the Trig Setup dialog box.
- b. Click **Internal Clock** under **Trigger Source** in the Trig Setup dialog box. The Internal Clock rate should be set to **200 kHz**.
- c. Verify that the Gated Trigger option in Enhanced Triggering section is selected (checkbox is checked).
- d. Turn the Vertical **SCALE** knob to set the vertical scale to **50 mV/div**. The channel scale readout is displayed in the Control bar at the bottom of the graticule.

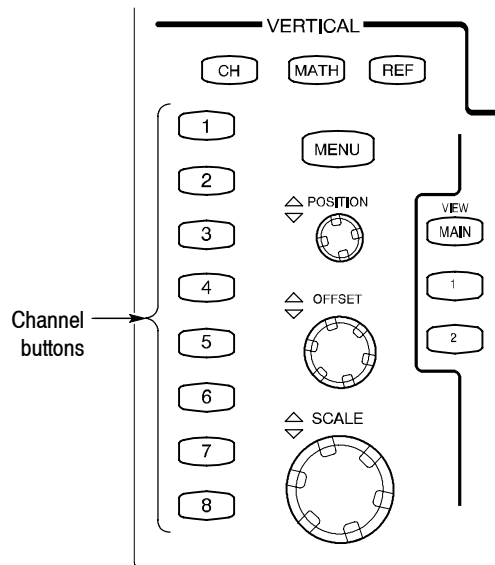


Figure 2- 11: Channel button location

5. *Set the time base:* Set the Horizontal **SCALE** to **2 μ s/div**. The horizontal scale readout is displayed in the Control bar at the bottom of the graticule.
6. Select Display in the Setup menu. In the Disp Setup dialog box, set the display **Style** to **Normal** and enable (check) **Show Vectors**.
7. Push the Horizontal **MENU** button; the Mode in All Timebases must be set to **Lock to Int. 10MHz**.
8. *Verify that Triggering occurs:* Verify signal is triggered with waveform on-screen. See Figure 2-12 on page 2-21.

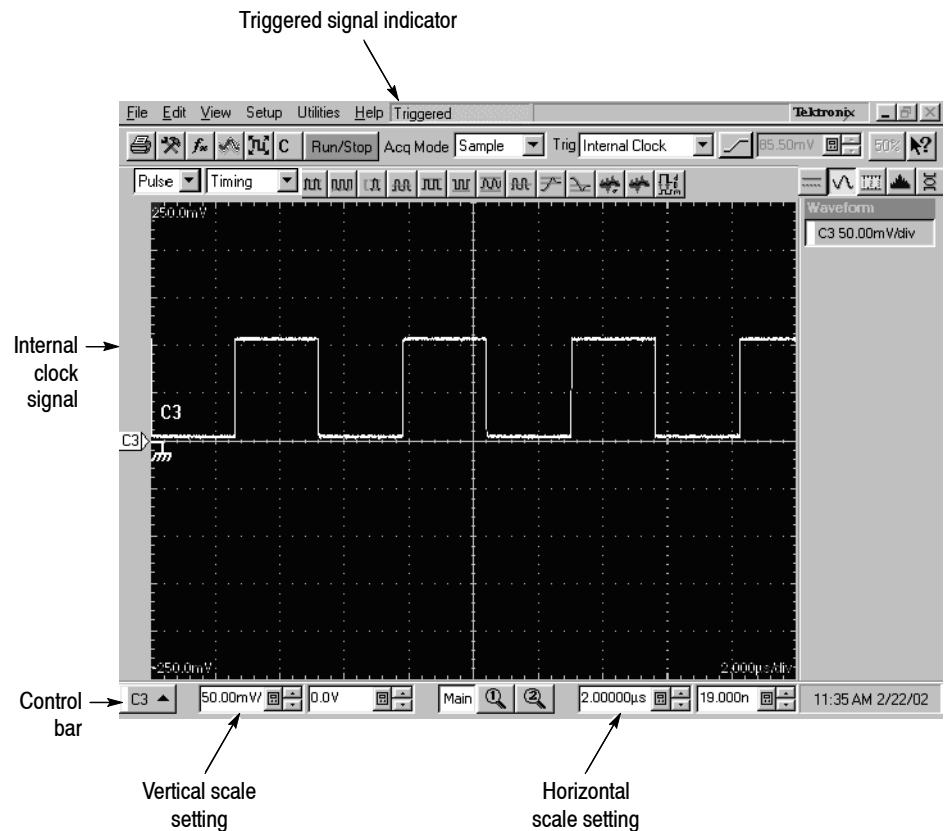


Figure 2-12: Signal triggered

9. *Disable trigger:* Install 50 Ω terminator cap to the end of the cable that is attached to the rear-panel gated trigger BNC. See Figure 2-10 on page 2-19.
10. *Verify that the Gated Trigger functions:* Verify signal is not triggered (gate disabled). Signal freezes on the screen above to indicate triggering has stopped. See Figure 2-13 on page 2-22. Note the Not Trigd indication at the top of the window.
 - a. Push the **CLEAR DATA** button.
 - b. Verify signal is not triggered with no waveform on-screen. See Figure 2-14 on page 2-23. Note the Not Trigd indication at the top of the window.

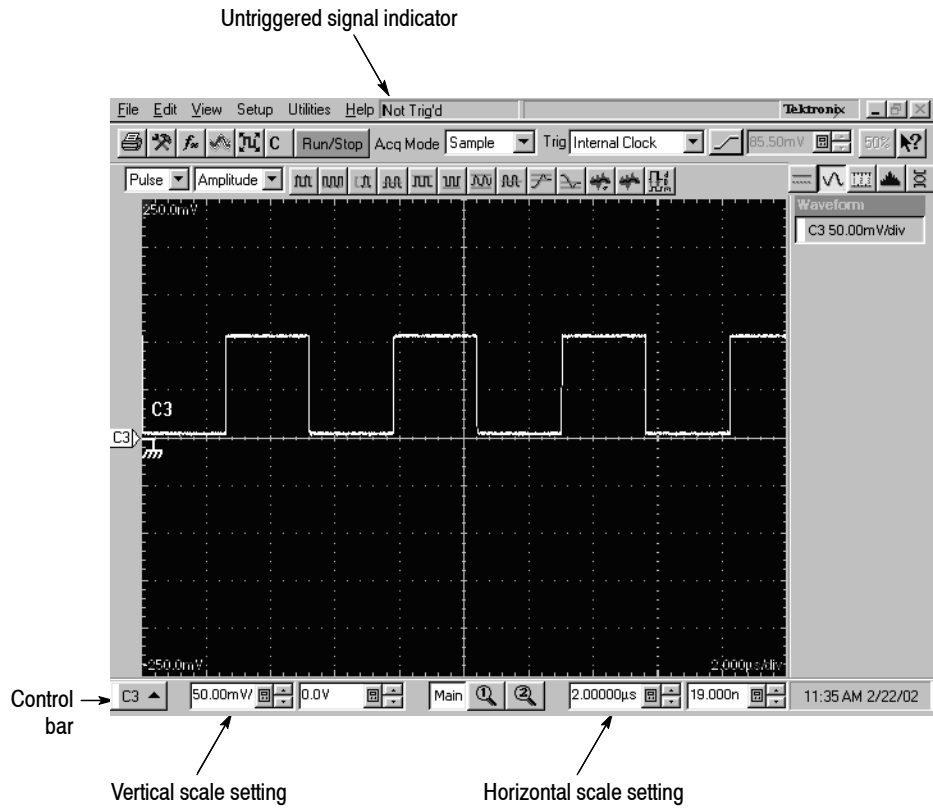


Figure 2- 13: Signal not triggered (signal frozen)

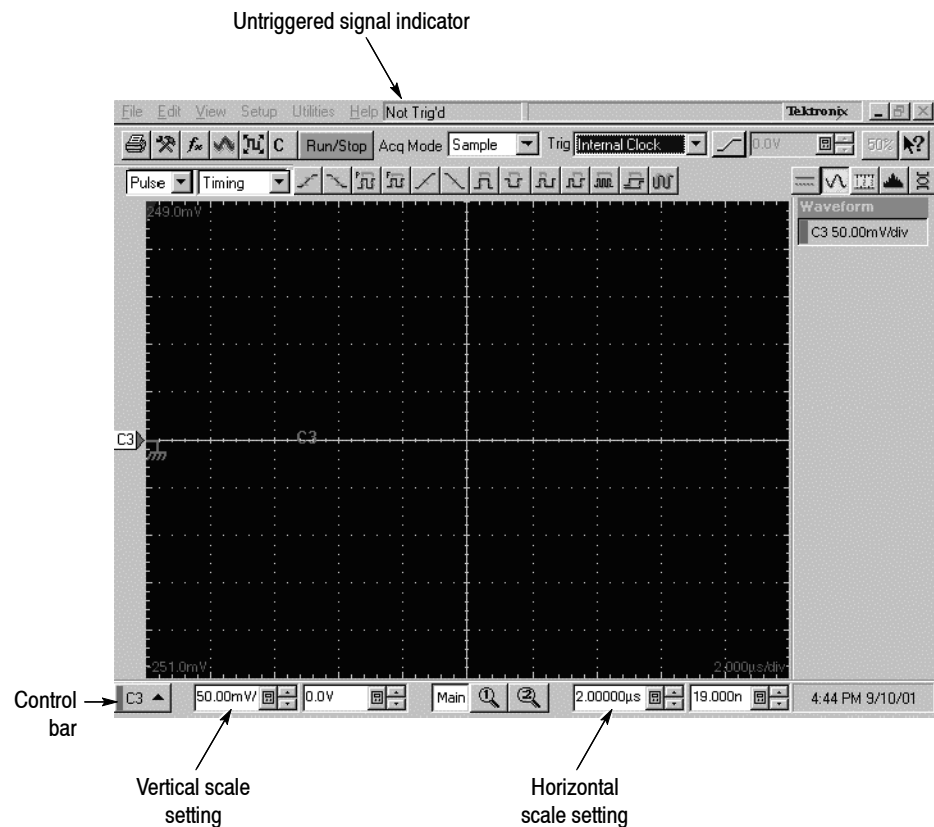


Figure 2-14: Signal not triggered (no waveform)

11. Verify that the Gated Trigger enables triggering: Disconnect 50 Ω terminator cap from the end of the cable. Verify signal is triggered (gate enabled) with waveform on-screen. See Figure 2-15 on page 2-24.
12. Disconnect the test hook up.

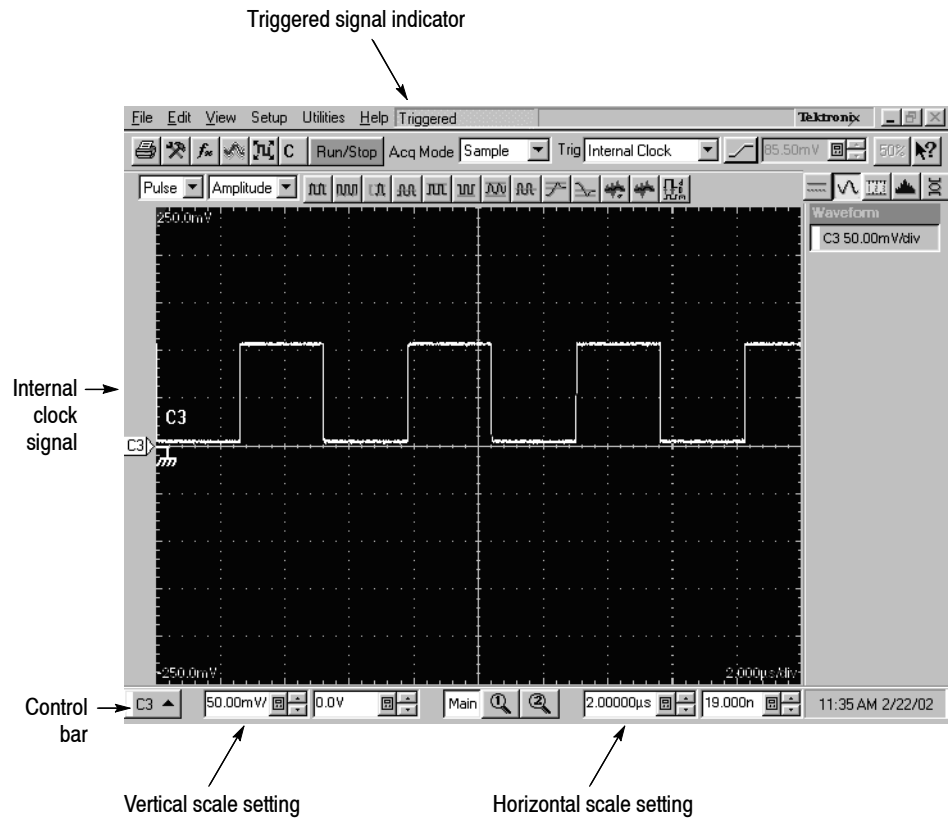


Figure 2- 15: Signal triggered

Checking the Cooling Fan Operation

Power on the instrument and verify that you can feel airflow from all six cooling fans on the left side of the instrument.

Equipment required	None
Prerequisites	The instrument must be powered on and running.

End of Functional Test Procedures

Performance Tests

This chapter contains performance verification procedures for the specifications marked with the ✓ symbol. The equipment listed in Table 2-1, or a suitable equivalent, is required to complete these procedures.

The procedures are arranged in sections:

- *Main Instrument (includes 82A04 Phase Reference Module)*
- *Electrical Sampling Modules*
- *Optical Sampling Modules*
- *80A01 Trigger Prescale Limiting Preamplifier Module*
- *80A02 EOS/ESD Protection Module*
- *80A05 Electrical Clock Recovery Module*
- *80A06 PatternSync Trigger Module*

They check all the characteristics that are designated as checked in *Specifications*.

To check a system consisting of a main instrument and its modules:

- Perform the performance test procedures for the main instrument and then the installed modules.

To check a main instrument as an independent product:

- Do the main instrument tests using a two-channel 80E02, 80E03, 80E04, 80E07, 80E08, 80E09, or 80E10 module that has passed the tests in *80E00 Electrical Sampling Modules* (page 2-109). When performing the time interval accuracy and external direct trigger delay jitter tests, check one channel of each small-module slot.
- In addition, to confirm that a main instrument can properly compensate all channels in all modules in all main instrument slots, do the *DC Voltage Measurement Accuracy* check (page 2-113) using the tested two-channel 80E00-series module. Perform this check for each channel of each small-module slot.
- Be sure to run the instrument compensation routine with the tested module installed each time you move the module to a new slot.

To check a module as an independent product, do the tests for that module type using a main instrument that has passed the process just described for checking a main instrument as an independent product.

NOTE. *Checking the main instrument and modules as independent products verifies each product independently for all measured specifications, except for DC voltage accuracy of the main instrument and of 80E00 modules. The procedures do check that DC compensation is functioning properly, so it is highly probable that any combination of a main instrument and electrical module that passed testing as independent products will meet the system DC voltage accuracy specifications.*

The Brief Procedures section of this manual includes a DC accuracy check to support verification by users that their specific combination of main instrument and electrical module meets system specifications. This test uses the main instrument DC Calibration Output and does not require external test generators.

Prerequisites

The tests in this section comprise an extensive, valid confirmation of performance and functionality when the following requirements are met:

- The cabinet must be installed on the instrument.
- You must have performed and passed the procedure *Perform the Diagnostics*, found on page 2-3, and the procedure *Perform the Functional Tests*, found on page 2-7.
- A compensation must have been done within the recommended calibration interval and at a temperature within $\pm 2^{\circ}$ C of the present operating temperature. (If, at the time you did the procedures *Perform the Diagnostics* and *Perform the Functional Tests*, you also did the *Perform the Compensation procedure* (page 2-5) consider this prerequisite met).
- The instrument must have been last adjusted at an ambient temperature between $+20^{\circ}$ C and $+30^{\circ}$ C, must have been operating for a warm-up period of at least 20 minutes, and must be operating at an ambient temperature.
- Observe all safety rules, especially regarding voltage hazards.

These procedures cover all instrument models. Please disregard checks that do not apply to the specific model you are testing.

Equipment Required

Procedures starting on page 2-83 use external, traceable signal sources to directly check warranted characteristics. Table 2-1 lists the required equipment.



WARNING. *Some of the generator equipment used to complete the performance tests may be capable of producing dangerous output levels.*

Optical generators may cause eye damage. Electrical generators may produce a shock hazard.

Always turn generators to off or 0 before connecting and disconnecting from the test setup.

Observe all the manufacturer's safety information provided with the test equipment.

Table 2- 1: Equipment required

Item number and description	Minimum requirements	Part number or model
1. Adapter (80E01, 80E09, 80E10, and 80E06 only)	2.4 mm, male-to-male connectors	HP11900A
2. Adapter (80E01, 80E09, 80E10, and 80E06 only)	2.4 mm, female-to-female connectors	HP11900B
3. Adapter (Qty. 2)	SMA female to BNC male connectors	Tektronix part number 015-0572-00
4. Adapter (Qty. 2)	BNC to dual banana plugs	Tektronix part number 103-0090-00
5. Adapter	SMA "T" 1 male to 2 SMA female	Tektronix part number 015-1016-00
6. Attenuator (80E01 only)	10 dB, female to male SMA connectors	HP8490D with option 10
7. Attenuator	2X attenuator 50 Ω , SMA connectors	Tektronix part number 015-1001-00
8. Attenuator, optical	30 mm, 10 dB, single-mode, FC to FC, female to male	Tektronix part number 119-5118-00
9. Airline (80E04 and 80E08 only)	50 Ω , airline, 10 cm line	Maury Microwave model number 8042D
10. Airline (80E10 only)	50 Ω , precision airline, 2.4 mm connectors	Maury Microwave model number 7943G
11. Cable, delay, coaxial	Coaxial cable, 50 Ω , 500 ps, with 3.5 mm, male each end, 6.0 inch length	Tektronix part number 015-0564-00
12. Cable, delay, coaxial	Coaxial cable, 50 Ω , 2 ns delay, with SMA male each end	Tektronix part number 015-0560-00
13. Cable, fiber-optic (Qty.2)	Single-mode, 2 m, FC/PC to FC/PC	Tektronix part number 174-1910-00
14. Cable, coaxial (80A01 only)(Qty. 2)	50 Ω , 4 ns delay, with SMA male at each end	Tektronix part number 015-0561-00
15. Cable, coaxial (80A01 only)	50 Ω , 1 ns delay, with SMA male at each end	Tektronix part number 015-0562-00
16. Cable, special (80E01 and 80E06 only)	Phase and power stability	Gore-Tex FE0BM0BM025.0

Table 2- 1: Equipment required (cont.)

Item number and description	Minimum requirements	Part number or model
17. Cable, coaxial (Qty. 2)	50 Ω , 20 in (0.5 m), male-to-male SMA connectors	Tektronix part number 174-1427-00
18. Cable, coaxial	50 Ω , 39.37 in (1.0 m), male-to-male SMA connectors	Tektronix part number 174-1341-00
	50 Ω , 60 in (1.5 m), male-to-male SMA connectors	Tektronix part number 174-1428-00
19. Cable, Precision 50 Ω Coaxial (80E06 only)	50 Ω , 36 in, male-to-male BNC connectors	Tektronix part number 012-0482-00
20. Digital multimeter	Four wire ohm meter. <0.25% accuracy for volt and ohm measurements	Keithley 2000-20
21. DC power supply	Variable amplitude to ± 104 V; accuracy to 0.1%	Data Precision 8200
22. Laser transmitter	2.5 Gb/s SONET/SDH laser transmitter	JDS Uniphase Model 420B
23. Optical attenuator, variable	Single-mode input and output, 0 to 60 dB	Tektronix part number OA5002
24. Optical Impulser	1550 nm impulse	Calmar FPL-01 Optical Impulser
25. Optical Wavelength Meter	0.001 nm resolution	Advantest Q8326
26. Power meter (80E01, 80E06, 80E07, 80E08, 80E09, and 80E10 only)	Power meter	Anritsu-Wilton ML2437A
27. Power sensor (80E01, 80E06, 80E07, 80E08, 80E09, and 80E10 only)	Power sensor w/attached cable	Anritsu-Wilton ML2425A
28. Power divider	50 Ω , 3 SMA female connectors	Tektronix part number 015-0565-00
29. Terminator, cap	Shorting, 34 GHz, precision 3.5 mm, female	Tektronix part number 011-0150-00
30. Terminator	50 Ω , coaxial terminator, K male	Anritsu-Wiltron 28K50
31. Terminator (80E10 only)	50 Ω , coaxial terminator, V male	Anritsu-Wiltron 28V50B
32. Terminator, cap	Cap, short circuit 3.5 mm, SMA male	Tektronix part number 015-1020-00
33. Synthesized signal generator	Signal generator 50 MHz to 50 GHz	Anritsu-Wiltron 69187B
34. Sampling module	Tektronix 80C02 Sampling Module	Tektronix 80C02 Sampling Module
35. Photodetector	>1 GHz bandwidth	Picometrix P-15B
36. Polarization-maintaining fiber coupler	Polarization Isolation <-24 dB	CIRL Model 904P (50/50)
37. Polarization-maintaining fiber coupler	Polarization Isolation <-24 dB	CIRL Model 904PS (5/95)
38. PM fiber jumper cable	FC/APC and FC/PC connector	Tempo-Camarillo part number 2M2L-1P5-1.5
39. SMA fiber jumper cable	FC/APC and FC/PC connector	Fiber Instrument Sales, Inc., part number S3-77AS-1.5-FIS
40. Pulse pattern generator	>12.5 Gb/s pulse pattern generator	Advantest D3186 12 Gb/s Pulse Pattern Generator

Table 2-1: Equipment required (cont.)

Item number and description	Minimum requirements	Part number or model
41. Terminator, cap	Cap, 50 Ω , 0.5 W, SMA male	Tektronix part number 015-1022-01
42. Real-time oscilloscope	500 MHz bandwidth	Tektronix TDS3052 or TDS3054
43. Tunable ECL laser (Qty. 2)	See <i>Tunable Laser Requirements</i> on page 2-190	New Focus tunable ECL lasers (2), Model 6528-HP or 6538-HP
44. Scalar Network Analyzer (80E06, 80E07, 80E08, 80E09, and 80E10 only)	10 MHz to 50 GHz. Must use specified equipment	Anritsu 54177A
45. SWR Autotester (80E06, 80E07, 80E08, 80E09, and 80E10 only)	10 MHz to 50 GHz. Must use specified equipment	Anritsu 560-98V5
46. Reflectometer (80E06 and 80E09 only)	50 GHz to 65 GHz. Must use specified equipment	Oleson R15RFT (specify OML DC power cable to dual banana plug)
47. Power meter (80E06, 80E07, 80E08, 80E09, and 80E10 only)	Must use specified equipment	Agilent E4417A Power Meter
48. Power sensor (80E06 and 80E09 only)	50 MHz to 50 GHz. Must use specified equipment	Agilent 8487A Power Sensor, 2002-07-31
49. RF Power Detector (80E06, 80E07, 80E08, 80E09, and 80E10 only)	10 MHz - 50 GHz. Must use specified equipment	Anritsu RF Detector, 560-7VA50
50. Power sensor (80E06 and 80E09 only)	Waveguide Power Sensor. Must use specified equipment	Agilent V8486A
51. Open/Short (80E06, 80E07, 80E08, 80E09, and 80E10 only)	DC to 50 GHz. Must use specified equipment	Anritsu 22V50 Open and Short
52. Short (80E10 only)	Short	Anritsu 23V50-5.1 V short
53. Adapter (80E06 and 80E09 only)	WR15 (Waveguide)-to-1.85 mm male connectors, 50 GHz to 65 GHz. Must use specified equipment	Anritsu 35WR15V
54. Adapter (80E06 and 80E09 only)	WR15 (Waveguide)-to-1.85 mm female connectors, 50 GHz to 65 GHz. Must use specified equipment	Anritsu 35WR15VF
55. Waveguide section (80E06 and 80E09 only)	Straight section, 50 GHz - 75 GHz, 4 inch length, round flanged. Must use specified equipment	Millitech SRW-15-RO400
56. Attenuator (80E06, 80E07, 80E08, 80E09, and 80E10 only) (Qty. 2)	6 dB attenuator, DC to 50 GHz, 2.4 mm connectors	Agilent 8490D, option 006
57. 80N01 Module Extender (2 meter)	Extender cable for use with certain small compartment modules	Tektronix 80N01 module extender
58. Attenuator (80A05 only) (Qty. 2)	10X (20 dB), female to male SMA connectors	Tektronix part number 015-1003-00
59. Stereo mini phono plug (80A02 only)	Stereo phono mine-plug with exposed connections	Common part, obtain by description
60. Adapter	SMA adapter, female to female	Tektronix part number 015-1012-00

DSA8200 Digital Serial Analyzer Test Records

This section contains test records that you can use to record the outcome of your performance verification checks.

- *DSA8200 Main Instrument (includes 82A04 Phase Reference module)*
- *80E00 Electrical Sampling Modules*
- *80C00 Optical Sampling Modules*
- *80A02 EOS/ESD Protection Module*
- *80A05 Electrical Clock Recovery Module*
- *80A06 Pattern Sync Trigger Module*

Do not enter values into the records contained in this manual; rather, make copies of the records and enter test results on the copies.

The test records provide entries for all checks found in the *Performance Tests* procedures.

DSA8200 Main-Instrument and 82A04 Module Test Record

For each channel tested, photocopy this and the next page, and record the performance test results for the main-instrument test record.

DSA8200 and 82A04 Test Record Channel: ____.

Instrument Serial Number: _____ Certificate Number: _____
Date of Calibration: _____ Technician: _____

Module Model: 82A04
Module Serial Number: _____ Certificate Number: _____
Date of Calibration: _____ Technician: _____

Performance Test	Minimum	Incoming	Outgoing	Maximum
<i>Time interval accuracy, short term optimized mode</i>				
Horizontal Position Set to: 19 ns	0.991 ns			1.009 ns
100 ns	0.991 ns			1.009 ns
<i>Time interval accuracy, locked to internal 10 MHz reference mode</i>				
Horizontal Position Set to: 19 ns	0.9919 ns			1.0081 ns
100 ns	0.9919 ns			1.0081 ns
1 μ s	0.9919 ns			1.0081 ns
<i>External direct trigger delay jitter, short term optimized mode</i>				
Horizontal Position Set to: 19 ns	none			1.4 ps
100 ns	none			2.2 ps
1 μ s	none			11.2 ps
<i>External direct trigger delay jitter, locked to internal 10 MHz reference mode</i>				
Horizontal Position Set to: 19 ns	none			2.5 ps
200 ns	none			2.5 ps
2 μ s	none			2.5 ps
<i>Trigger delay jitter, free run phase corrected mode (with 82A04 module only)</i>				
Horizontal Position Set to: 20 ns	none			none
<i>External prescaled trigger delay jitter, Short term optimized mode</i>				
Horizontal Position Set to: 19 ns	none			1.5 ps
<i>External prescaled delay jitter, locked to internal 10 MHz reference mode</i>				
Horizontal Position Set to: 19 ns	none			2.5 ps

DSA8200 and 82A04 Test Record Channel: ____ . (cont.)

Performance Test		Minimum	Incoming	Outgoing	Maximum
<i>DC Calibration Output</i>					
	Set to:	+1.0 V	+0.9988 V		+1.0012 V
		0.0 V	-0.2 mV		+0.2 mV
		-1.0 V	-1.0012 V		-0.9988 V

80E00 Electrical Modules Test Record

Photocopy this and the next seven pages for each 80E00 module being tested. Use them to record the performance test results for your Test Record.

Note that the C1 and C2 designations (channel 1/channel 2) in the test record may become C3/C4, C5/C6, or C7/C8, depending on which compartment in the main instrument the module is installed in.

80E00 Test Record

Module Model:	<input type="checkbox"/> 80E01	<input type="checkbox"/> 80E02	<input type="checkbox"/> 80E03	<input type="checkbox"/> 80E04	<input type="checkbox"/> 80E06
	<input type="checkbox"/> 80E07	<input type="checkbox"/> 80E08	<input type="checkbox"/> 80E09	<input type="checkbox"/> 80E10	
Module Serial Number:	_____		Certificate Number:	_____	
Date of Calibration:	_____		Technician:	_____	

Performance Test			Minimum	Incoming	Outgoing	Maximum
<i>Input Impedance</i>						
80E01	C1	Impedance	49.5 Ω			50.5 Ω
80E02	Baseline (80E04 only)		-1 mV			1 mV
80E03						
80E04	C2	Impedance	49.5 Ω			50.5 Ω
80E06	Baseline (80E04 only)		-1 mV			1 mV
80E07	C1	Impedance	49 Ω			51 Ω
80E08						
80E09	C2	Impedance	49 Ω			51 Ω
80E10						

80E00 Test Record (cont.)

Performance Test		Minimum	Incoming	Outgoing	Maximum
<i>DC Voltage accuracy, single point, within $\pm 5^{\circ}\text{C}$ of compensated temperature</i>					
80E01	C1 @ 100 mV/div				
80E02	Input level:	Offset:			
80E03	-1550 mV	-1100 mV	-18.7 mV		+18.7 mV
80E04	-1350 mV	-1100 mV	-14.7 mV		+14.7 mV
80E06	-1100 mV	-1100 mV	-9.7 mV		+9.7 mV
	-850 mV	-1100 mV	-14.7 mV		+14.7 mV
	-650 mV	-1100 mV	-18.7 mV		+18.7 mV
	-450 mV	0 mV	-11 mV		+11 mV
	-250 mV	0 mV	-7 mV		+7 mV
	0 mV	0 mV	-2 mV		+2 mV
	+250 mV	0 mV	-7 mV		+7 mV
	+450 mV	0 mV	-11 mV		+11 mV
	+650 mV	+1100 mV	-18.7 mV		+18.7 mV
	+850 mV	+1100 mV	-14.7 mV		+14.7 mV
	+1100 mV	+1100 mV	-9.7 mV		+9.7 mV
	+1350 mV	+1100 mV	-14.7 mV		+14.7 mV
	+1550 mV	+1100 mV	-18.7 mV		+18.7 mV
	C2 @ 100 mV/div				
	Input level:	Offset:			
	-1550 mV	-1100 mV	-18.7 mV		+18.7 mV
	-1350 mV	-1100 mV	-14.7 mV		+14.7 mV
	-1100 mV	-1100 mV	-9.7 mV		+9.7 mV
	-850 mV	-1100 mV	-14.7 mV		+14.7 mV
	-650 mV	-1100 mV	-18.7 mV		+18.7 mV
	-450 mV	0 mV	-11 mV		+11 mV
	-250 mV	0 mV	-7 mV		+7 mV
	0 mV	0 mV	-2 mV		+2 mV
	+250 mV	0 mV	-7 mV		+7 mV
	+450 mV	0 mV	-11 mV		+11 mV
	+650 mV	+1100 mV	-18.7 mV		+18.7 mV
	+850 mV	+1100 mV	-14.7 mV		+14.7 mV
	+1100 mV	+1100 mV	-9.7 mV		+9.7 mV
	+1350 mV	+1100 mV	-14.7 mV		+14.7 mV
	+1550 mV	+1100 mV	-18.7 mV		+18.7 mV

80E00 Test Record (cont.)

Performance Test		Minimum	Incoming	Outgoing	Maximum
80E07	C1 @ 100 mV/div				
80E08	Input level:	Offset:			
80E09	-1050 mV	-600 mV	-15.2 mV		+15.2 mV
80E10	-850 mV	-600 mV	-11.2 mV		+11.2 mV
	-600 mV	-600 mV	-6.2 mV		+6.2 mV
	-350 mV	-600 mV	-11.2 mV		+11.2 mV
	-150 mV	-600 mV	-15.2 mV		+15.2 mV
	-450 mV	0 mV	-11 mV		+11 mV
	-250 mV	0 mV	-7 mV		+7 mV
	0 mV	0 mV	-2 mV		+2 mV
	+250 mV	0 mV	-7 mV		+7 mV
	+450 mV	0 mV	-11 mV		+11 mV
	+150 mV	+600 mV	-15.2 mV		+15.2 mV
	+350 mV	+600 mV	-11.2 mV		+11.2 mV
	+600 mV	+600 mV	-6.2 mV		+6.2 mV
	+850 mV	+600 mV	-11.2 mV		+11.2 mV
	+1050 mV	+600 mV	-15.2 mV		+15.2 mV
	C2 @ 100 mV/div				
	Input level:	Offset:			
	-1050 mV	-600 mV	-15.2 mV		+15.2 mV
	-850 mV	-600 mV	-11.2 mV		+11.2 mV
	-600 mV	-600 mV	-6.2 mV		+6.2 mV
	-350 mV	-600 mV	-11.2 mV		+11.2 mV
	-150 mV	-600 mV	-15.2 mV		+15.2 mV
	-450 mV	0 mV	-11 mV		+11 mV
	-250 mV	0 mV	-7 mV		+7 mV
	0 mV	0 mV	-2 mV		+2 mV
	+250 mV	0 mV	-7 mV		+7 mV
	+450 mV	0 mV	-11 mV		+11 mV
	+150 mV	+600 mV	-15.2 mV		+15.2 mV
	+350 mV	+600 mV	-11.2 mV		+11.2 mV
	+600 mV	+600 mV	-6.2 mV		+6.2 mV
	+850 mV	+600 mV	-11.2 mV		+11.2 mV
	+1050 mV	+600 mV	-15.2 mV		+15.2 mV

80E00 Test Record (cont.)

Performance Test			Minimum	Incoming	Outgoing	Maximum
<i>DC Vertical Voltage deviation from linear least squares fit</i>						
80E01	C1	Set the V_{in} :				
80E02		-450 mV	-10 mV			+10 mV
80E03		-350 mV	-10 mV			+10 mV
80E04		-250 mV	-10 mV			+10 mV
80E06		-150 mV	-10 mV			+10 mV
80E07		-50 mV	-10 mV			+10 mV
80E08		+50 mV	-10 mV			+10 mV
80E09		+150 mV	-10 mV			+10 mV
80E10		+250 mV	-10 mV			+10 mV
			+350 mV	-10 mV		
		+450 mV	-10 mV			+10 mV
	C2	Set the V_{in} :				
		-450 mV	-10 mV			+10 mV
		-350 mV	-10 mV			+10 mV
		-250 mV	-10 mV			+10 mV
		-150 mV	-10 mV			+10 mV
		-50 mV	-10 mV			+10 mV
		+50 mV	-10 mV			+10 mV
		+150 mV	-10 mV			+10 mV
		+250 mV	-10 mV			+10 mV
		+350 mV	-10 mV			+10 mV
		+450 mV	-10 mV			+10 mV

80E00 Test Record (cont.)

Performance Test			Minimum	Incoming	Outgoing	Maximum
<i>Random Noise Displayed</i>						
80E01	C1	Vert scale: 2 mV	none			2.3 mV
80E02	C1	Vert scale: 1 mV	none			800 μ V
	C2	Vert scale: 1 mV	none			800 μ V
80E03	C1	Vert scale: 1 mV	none			1.2 mV
80E04	C2	Vert scale: 1 mV	none			1.2 mV
80E06	C1	Vert scale: 2 mV	none			2.4 mV
80E07	C1 (BW 30 GHz)	Vert scale: 1 mV	none			410 μ V
80E08	C2 (BW 30 GHz)	Vert scale: 1 mV	none			410 μ V
	C1 (BW 20 GHz)	Vert scale: 1 mV	none			380 μ V
	C2 (BW 20 GHz)	Vert scale: 1 mV	none			380 μ V
	C1 (BW 60 GHz)	Vert scale: 1 mV	none			600 μ V
80E09	C2 (BW 60 GHz)	Vert scale: 1 mV	none			600 μ V
	C1 (BW 40 GHz)	Vert scale: 1 mV	none			480 μ V
	C2 (BW 40 GHz)	Vert scale: 1 mV	none			480 μ V
	C1 (BW 30 GHz)	Vert scale: 1 mV	none			410 μ V
	C2 (BW 30 GHz)	Vert scale: 1 mV	none			410 μ V
	80E10	C1 (BW 50 GHz)	Vert scale: 1 mV	none		
C2 (BW 50 GHz)		Vert scale: 1 mV	none			700 μ V
C1 (BW 40 GHz)		Vert scale: 1 mV	none			480 μ V
C2 (BW 40 GHz)		Vert scale: 1 mV	none			480 μ V
C1 (BW 30 GHz)		Vert scale: 1 mV	none			410 μ V
C2 (BW 30 GHz)		Vert scale: 1 mV	none			410 μ V

80E00 Test Record (cont.)

Performance Test			Minimum	Incoming	Outgoing	Maximum
<i>Analog Bandwidth</i>						
80E01	C1 (to 50 GHz)	Max power (50 MHz ref)	none			+3 dB
		Min power (50 MHz ref)	-3 dB			
80E06	C1 (to 65 GHz)	Max power (50 MHz ref)	none			+3 dB
		Min power (50 MHz ref)	-3 dB			
80E07 80E08	C1 (to 30 GHz)	Max power (50 MHz ref)	none			+3 dB
		Min power (50 MHz ref)	-3 dB			
80E09	C1 (to 60 GHz)	Max power (50 MHz ref)	none			+3 dB
		Min power (50 MHz ref)	-3 dB			
	C2 (to 60 GHz)	Max power (50 MHz ref)	none			+3 dB
		Min power (50 MHz ref)	-3 dB			
80E10	C1 (to 50 GHz)	Max power (50 MHz ref)	none			+3 dB
		Min power (50 MHz ref)	-3 dB			
	C2 (to 50 GHz)	Max power (50 MHz ref)	none			+3 dB
		Min power (50 MHz ref)	-3 dB			
<i>TDR system reflected rise time (80E04, 80E08, 80E10 models only)</i>						
80E04	C1	TDR Polarity set to +	none			35 ps
		TDR Polarity set to -	none			35 ps
	C2	TDR Polarity set to +	none			35 ps
		TDR Polarity set to -	none			35 ps
80E08	C1	TDR Polarity set to +	none			22 ps
		TDR Polarity set to -	none			22 ps
	C2	TDR Polarity set to +	none			22 ps
		TDR Polarity set to -	none			22 ps
80E10	C1	TDR Polarity set to +	none			16 ps
		TDR Polarity set to -	none			16 ps
	C2	TDR Polarity set to +	none			16 ps
		TDR Polarity set to -	none			16 ps

80E00 Test Record (cont.)

Performance Test			Minimum	Incoming	Outgoing	Maximum	
<i>TDR system step response aberrations (80E04, 80E08, 80E10 models only)</i>							
80E04	C1 positive polarity	zone: from -10 ns to -20 ps ¹	-3%			+3%	
		zone: from 400 ps to 5 ns ²	-3%			+3%	
		zone: from 5 ns on ²	-1%			+1%	
	C1 negative polarity	zone: from -10 ns to -20 ps ¹	-3%			+3%	
		zone: from 400 ps to 5 ns ²	-3%			+3%	
		zone: from 5 ns on ²	-1%			+1%	
	C2 positive polarity	zone: from -10 ns to -20 ps ¹	-3%			+3%	
		zone: from 400 ps to 5 ns ²	-3%			+3%	
		zone: from 5 ns on ²	-1%			+1%	
	C2 negative polarity	zone: from -10 ns to -20 ps ¹	-3%			+3%	
		zone: from 400 ps to 5 ns ²	-3%			+3%	
		zone: from 5 ns on ²	-1%			+1%	
	80E08	C1 positive polarity	zone: from -10 ns to -20 ps ¹	-1%			+1%
			zone: from 14 ps to 150 ps ²	-2%			+20%
			zone: from 150 ps to 400 ps ²	-2%			+12%
zone: from 400 ps to 5 ns ²			-2%			+2%	
zone: from 5 ns to 100 ns ²			-2%			+1%	
zone: from 100 ns to end ²			-1%			+1%	
C1 negative polarity		zone: from -10 ns to -20 ps ¹	-1%			+1%	
		zone: from 14 ps to 150 ps ²	-2%			+20%	
		zone: from 150 ps to 400 ps ²	-2%			+12%	
		zone: from 400 ps to 5 ns ²	-2%			+2%	
		zone: from 5 ns to 100 ns ²	-2%			+1%	
		zone: from 100 ns to end ²	-1%			+1%	
C2 positive polarity		zone: from -10 ns to -20 ps ¹	-1%			+1%	
		zone: from 14 ps to 150 ps ²	-2%			+20%	
		zone: from 150 ps to 400 ps ²	-2%			+12%	
		zone: from 400 ps to 5 ns ²	-2%			+2%	
		zone: from 5 ns to 100 ns ²	-2%			+1%	
		zone: from 100 ns to end ²	-1%			+1%	

80E00 Test Record (cont.)

Performance Test			Minimum	Incoming	Outgoing	Maximum
80E08	C2 negative polarity	zone: from -10 ns to -20 ps ¹	-1%			+1%
		zone: from 14 ps to 150 ps ²	-2%			+20%
		zone: from 150 ps to 400 ps ²	-2%			+12%
		zone: from 400 ps to 5 ns ²	-2%			+2%
		zone: from 5 ns to 100 ns ²	-2%			+1%
		zone: from 100 ns to end ²	-1%			+1%
80E10	C1 positive polarity	zone: from -10 ns to -20 ps ¹	-1%			+1%
		zone: from 14 ps to 150 ps ²	-2%			+20%
		zone: from 150 ps to 400 ps ²	-2%			+12%
		zone: from 400 ps to 5 ns ²	-2%			+2%
		zone: from 5 ns to 100 ns ²	-2%			+1%
		zone: from 100 ns to end ²	-1%			+1%
	C1 negative polarity	zone: from -10 ns to -20 ps ¹	-1%			+1%
		zone: from 14 ps to 150 ps ²	-2%			+20%
		zone: from 150 ps to 400 ps ²	-2%			+12%
		zone: from 400 ps to 5 ns ²	-2%			+2%
		zone: from 5 ns to 100 ns ²	-2%			+1%
		zone: from 100 ns to end ²	-1%			+1%
	C2 positive polarity	zone: from -10 ns to -20 ps ¹	-1%			+1%
		zone: from 14 ps to 150 ps ²	-2%			+20%
		zone: from 150 ps to 400 ps ²	-2%			+12%
		zone: from 400 ps to 5 ns ²	-2%			+2%
		zone: from 5 ns to 100 ns ²	-2%			+1%
		zone: from 100 ns to end ²	-1%			+1%

¹ Before step transition.

² After step transition.

80C00 Optical Modules Test Record

Photocopy this and the next 26 pages for each 80C00 module being tested. Use them to record the performance test results for your Test Record.

80C00 Test Record

Module Model: 80C01 80C02 80C03 80C04 80C05 80C06 80C07 80C07B
 80C08 80C08B 80C08C 80C09 80C10 80C10B 80C11 80C12
 80C12-10G

Module Serial Number: _____ Certificate Number: _____
 Temperature: _____ RH %: _____
 Date of Calibration: _____ Technician: _____

Performance Test			Minimum	Incoming	Outgoing	Maximum
<i>Dark level</i>						
80C01	C1 at 100 μ W	OC-12/STM-4	-10 μ W			+10 μ W
		OC-48/STM-16	-10 μ W			+10 μ W
		OC-192/STM-64	-10 μ W			+10 μ W
		12.5 GHz	-10 μ W			+10 μ W
		20 GHz	-10 μ W			+10 μ W
80C02	C1 at 100 μ W	OC-192/STM-64	-10 μ W			+10 μ W
		12.5 GHz	-10 μ W			+10 μ W
		20 GHz	-10 μ W			+10 μ W
		30 GHz	-10 μ W			+10 μ W
80C03	C1 at 5 μ W	FC1063	-500 nW			+500 nW
		GBE	-500 nW			+500 nW
		OC-48/STM-16	-500 nW			+500 nW
80C04	C1 at 100 μ W	OC-192/STM-64	-10 μ W			+10 μ W
		10.664 Gb/s	-10 μ W			+10 μ W
		20 GHz	-10 μ W			+10 μ W
		30 GHz	-10 μ W			+10 μ W
80C05	C1 at 100 μ W	OC-12/STM-4	-10 μ W			+10 μ W
		20 GHz	-30 μ W			+30 μ W
		30 GHz	-30 μ W			+30 μ W
		40 GHz	-30 μ W			+30 μ W
80C06	C1 at 200 μ W	50 GHz	-25 μ W			+25 μ W

80C00 Test Record (cont.)

Performance Test		Minimum	Incoming	Outgoing	Maximum
80C07	C1 at 5 μ W	2 GHz	-500 nW		+500 nW
		OC-3/STM-1	-500 nW		+500 nW
		OC-12/STM-4	-500 nW		+500 nW
		OC-48/STM-16	-500 nW		+500 nW
80C07B	C1 at 5 μ W	OC-3/STM-1	-500 nW		+500 nW
		OC-12/STM-4	-500 nW		+500 nW
		OC-48/STM-16	-500 nW		+500 nW
		FC1063	-500 nW		+500 nW
		FC2125	-500 nW		+500 nW
		ENET1250	-500 nW		+500 nW
		ENET2500	-500 nW		+500 nW
		INFINIBAND	-500 nW		+500 nW
80C08	C1 at 1 μ W	2.5 GHz	-500 nW		+500 nW
		10 GHz	-1.0 μ W		+1.0 μ W
		10GBASE-W	-1.0 μ W		+1.0 μ W
80C08B	C1 at 1 μ W	10GBASE-R	-1.0 μ W		+1.0 μ W
		10 GHz	-1.0 μ W		+1.0 μ W
80C08B	C1 at 1 μ W	10GBASE-W	-1.0 μ W		+1.0 μ W
		10GBASE-R	-1.0 μ W		+1.0 μ W
		OC-192/STM-64	-1.0 μ W		+1.0 μ W
		10GFC	-1.0 μ W		+1.0 μ W
		10 GHz	-1.0 μ W		+1.0 μ W
80C08C	C1 at 1 μ W	10GBASE-W	-1.0 μ W		+1.0 μ W
		10GBASE-R	-1.0 μ W		+1.0 μ W
		10 GHz	-1.0 μ W		+1.0 μ W
		OC-192/STM-64	-1.0 μ W		+1.0 μ W
		10GFC	-1.0 μ W		+1.0 μ W
		10GFC FEC	-1.0 μ W		+1.0 μ W
		10GBE FEC	-1.0 μ W		+1.0 μ W
		10.66 Data Filter	-1.0 μ W		+1.0 μ W
		10.709 Data Filter	-1.0 μ W		+1.0 μ W
80C09	C1 at 100 μ W	10GBASE-R	-10 μ W		+10 μ W
		10.71 Gb/s	-10 μ W		+10 μ W
		20 GHz	-10 μ W		+10 μ W
		30 GHz	-10 μ W		+10 μ W

80C00 Test Record (cont.)

Performance Test			Minimum	Incoming	Outgoing	Maximum
80C10 1550 nm	C1 at 50 μ W	OC-768/STM-256	-25 μ W			+25 μ W
		FEC43.0184 Gb/s	-25 μ W			+25 μ W
		30 GHz	-25 μ W			+25 μ W
		65 GHz	-25 μ W			+25 μ W
80C10 1310 nm	C1 at 80 μ W	OC-768/STM-256	-35 μ W			+35 μ W
		FEC43.0184 Gb/s	-35 μ W			+35 μ W
		30 GHz	-35 μ W			+35 μ W
		65 GHz	-35 μ W			+35 μ W
80C10B 1550 nm	C1 at 50 μ W	OC-768/STM-256	-25 μ W			+25 μ W
		FEC43.0184 Gb/s	-25 μ W			+25 μ W
		100GBase-xR4	-25 μ W			+25 μ W
		100GBase-xR4 FEC	-25 μ W			+25 μ W
		40GBase-FR	-25 μ W			+25 μ W
		30 GHz	-25 μ W			+25 μ W
		65 GHz	-25 μ W			+25 μ W
		80 GHz	-25 μ W			+25 μ W
80C10B 1310 nm	C1 at 80 μ W	OC-768/STM-256	-35 μ W			+35 μ W
		FEC43.0184 Gb/s	-35 μ W			+35 μ W
		100GBase-xR4	-35 μ W			+35 μ W
		100GBase-xR4 FEC	-35 μ W			+35 μ W
		40GBase-FR	-35 μ W			+35 μ W
		30 GHz	-35 μ W			+35 μ W
		65 GHz	-35 μ W			+35 μ W
		80 GHz	-35 μ W			+35 μ W
80C11	C1 at at 100 μ W	OC-192/STM-64	-10 μ W			+10 μ W
		10.66 Gb/s	-10 μ W			+10 μ W
		10.71 Gb/s	-10 μ W			+10 μ W
		10Gbase-W	-10 μ W			+10 μ W
		10Gbase-R	-10 μ W			+10 μ W
		10GBE FEC	-10 μ W			+10 μ W
		10GFC	-10 μ W			+10 μ W
		10GFC FEC	-10 μ W			+10 μ W
		16GFC	-10 μ W			+10 μ W
		20 GHz	-10 μ W			+10 μ W
		30 GHz	-10 μ W			+10 μ W

80C00 Test Record (cont.)

Performance Test			Minimum	Incoming	Outgoing	Maximum
80C12 (1310 nm and 1550 nm)	C1 at 1 μ W	FC1063	-1.0 μ W			+1.0 μ W
		FC2125	-1.0 μ W			+1.0 μ W
		FC4250	-1.0 μ W			+1.0 μ W
		FC8500	-1.0 μ W			+1.0 μ W
		10GBase-X4	-1.0 μ W			+1.0 μ W
		10GFC-X4	-1.0 μ W			+1.0 μ W
		3.318 Gb/s	-1.0 μ W			+1.0 μ W
		9 GHz	-1.0 μ W			+1.0 μ W
80C12 (850 nm)	C1 at 1 μ W	FC1063	-1.0 μ W			+1.0 μ W
		FC2125	-1.0 μ W			+1.0 μ W
		FC4250	-1.0 μ W			+1.0 μ W
		FC8500	-1.0 μ W			+1.0 μ W
		10GBase-X4	-1.0 μ W			+1.0 μ W
		10GFC-X4	-1.0 μ W			+1.0 μ W
		3.318 Gb/s	-1.0 μ W			+1.0 μ W
		9 GHz	-1.0 μ W			+1.0 μ W
80C12-10G (1310 nm and 1550 nm)	C1 at 1 μ W	10GBASE-W	-1.0 μ W			+1.0 μ W
		10GBASE-R	-1.0 μ W			+1.0 μ W
		OC-192/STM-64	-1.0 μ W			+1.0 μ W
		FC8500	-1.0 μ W			+1.0 μ W
		10GFC	-1.0 μ W			+1.0 μ W
		10GFC FEC	-1.0 μ W			+1.0 μ W
		10GBE FEC	-1.0 μ W			+1.0 μ W
		10.66 Data Filter	-1.0 μ W			+1.0 μ W
		10.709 Data Filter	-1.0 μ W			+1.0 μ W
80C12-10G (850 nm)	C1 at 1 μ W	10GBASE-W	-1.0 μ W			+1.0 μ W
		10GBASE-R	-1.0 μ W			+1.0 μ W
		OC-192/STM-64	-1.0 μ W			+1.0 μ W
		FC8500	-1.0 μ W			+1.0 μ W
		10GFC	-1.0 μ W			+1.0 μ W
		10GFC FEC	-1.0 μ W			+1.0 μ W
		10GBE FEC	-1.0 μ W			+1.0 μ W
		10.66 Data Filter	-1.0 μ W			+1.0 μ W
		10.709 Data Filter	-1.0 μ W			+1.0 μ W

80C00 Test Record (cont.)

Performance Test			Minimum	Incoming	Outgoing	Maximum
80C25GBE 1550 nm	C1 at 50 μ W	65 GHz	-25 μ W			+25 μ W
		100GBase-xR4	-25 μ W			+25 μ W
		100GBase-xR4 FEC	-25 μ W			+25 μ W
80C25GBE 1310 nm	C1 at 80 μ W	65 GHz	-35 μ W			+35 μ W
		100GBase-xR4	-35 μ W			+35 μ W
		100GBase-xR4 FEC	-35 μ W			+35 μ W
<i>Vertical equivalent optical noise</i>						
80C01	C1 at 100 μ W	OC-12/STM-4	none			12 μ W _{rms}
		Clock Recovery	none			15 μ W _{rms}
		OC-48/STM-16	none			12 μ W _{rms}
		Clock Recovery	none			15 μ W _{rms}
		OC-192/STM-64	none			12 μ W _{rms}
		Clock Recovery	none			15 μ W _{rms}
		12.5 GHz	none			12 μ W _{rms}
		Clock Recovery	none			15 μ W _{rms}
		20 GHz	none			25 μ W _{rms}
	Clock Recovery	none			25 μ W _{rms}	
80C02	C1 at 100 μ W	OC-192/STM-64	none			10 μ W _{rms}
		Clock Recovery	none			12 μ W _{rms}
		12.5 GHz	none			10 μ W _{rms}
		Clock Recovery	none			12 μ W _{rms}
		20 GHz	none			15 μ W _{rms}
		Clock Recovery	none			20 μ W _{rms}
		30 GHz	none			30 μ W _{rms}
	Clock Recovery	none			40 μ W _{rms}	
80C03	C1 at 5 μ W	FC1063	none			1.0 μ W _{rms}
		Clock Recovery	none			1.0 μ W _{rms}
		GBE	none			1.0 μ W _{rms}
		Clock Recovery	none			1.0 μ W _{rms}
		OC-48/STM-16	none			1.5 μ W _{rms}
		Clock Recovery	none			1.5 μ W _{rms}

80C00 Test Record (cont.)

Performance Test			Minimum	Incoming	Outgoing	Maximum
80C04	C1 at 100 μ W	OC-192/STM-64	none			10 μ W _{rms}
		Clock Recovery	none			12 μ W _{rms}
		10.664 Gb/s	none			10 μ W _{rms}
		Clock Recovery	none			12 μ W _{rms}
		20 GHz	none			15 μ W _{rms}
		Clock Recovery	none			20 μ W _{rms}
		30 GHz	none			30 μ W _{rms}
		Clock Recovery	none			40 μ W _{rms}
80C05	C1 at 100 μ W	OC-192/STM-64	none			15 μ W _{rms}
		Clock Recovery	none			15 μ W _{rms}
		20 GHz	none			25 μ W _{rms}
		Clock Recovery	none			25 μ W _{rms}
		30 GHz	none			35 μ W _{rms}
		Clock Recovery	none			35 μ W _{rms}
		40 GHz	none			70 μ W _{rms}
		Clock Recovery	none			70 μ W _{rms}
80C06	C1 at 200 μ W	50 GHz	none			192 μ W _{rms}
		Clock Recovery	none			192 μ W _{rms}
80C07	C1 at 5 μ W	OC-3/STM-1	none			1.0 μ W _{rms}
		Clock Recovery	none			1.0 μ W _{rms}
		OC-12/STM-4	none			1.0 μ W _{rms}
		Clock Recovery	none			1.0 μ W _{rms}
		OC-48/STM-16	none			1.5 μ W _{rms}
		Clock Recovery	none			1.5 μ W _{rms}

80C00 Test Record (cont.)

Performance Test			Minimum	Incoming	Outgoing	Maximum
80C07B	C1 at 5 μ W	1550 nm	OC-3/STM-1	none		1.0 μ W _{rms}
			Clock Recovery	none		1.0 μ W _{rms}
			OC-12/STM-4	none		1.0 μ W _{rms}
			Clock Recovery	none		1.0 μ W _{rms}
			OC-48/STM-16	none		1.5 μ W _{rms}
			Clock Recovery	none		1.5 μ W _{rms}
			FC1063	none		1.0 μ W _{rms}
			Clock Recovery	none		1.0 μ W _{rms}
			FC2125	none		1.5 μ W _{rms}
			Clock Recovery	none		1.5 μ W _{rms}
			ENET1250	none		1.0 μ W _{rms}
			Clock Recovery	none		1.0 μ W _{rms}
			ENET2500	none		1.5 μ W _{rms}
			Clock Recovery	none		1.5 μ W _{rms}
			INFINIBAND	none		1.5 μ W _{rms}
			Clock Recovery	none		1.5 μ W _{rms}
			2.5 GHz	none		1.5 μ W _{rms}
			Clock Recovery	none		1.5 μ W _{rms}
		1310 nm	OC-3/STM-1	none		1.0 μ W _{rms}
			Clock Recovery	none		1.0 μ W _{rms}
			OC-12/STM-4	none		1.0 μ W _{rms}
			Clock Recovery	none		1.0 μ W _{rms}
			OC-48/STM-16	none		1.5 μ W _{rms}
			Clock Recovery	none		1.5 μ W _{rms}
			FC1063	none		1.0 μ W _{rms}
			Clock Recovery	none		1.0 μ W _{rms}
			FC2125	none		1.5 μ W _{rms}
			Clock Recovery	none		1.5 μ W _{rms}
			ENET1250	none		1.0 μ W _{rms}
			Clock Recovery	none		1.0 μ W _{rms}
			ENET2500	none		1.5 μ W _{rms}
			Clock Recovery	none		1.5 μ W _{rms}
			INFINIBAND	none		1.5 μ W _{rms}
			Clock Recovery	none		1.5 μ W _{rms}
			2.5 GHz	none		1.5 μ W _{rms}
			Clock Recovery	none		1.5 μ W _{rms}

80C00 Test Record (cont.)

Performance Test			Minimum	Incoming	Outgoing	Maximum
	850 nm	OC-3/STM-1	none			1.6 μW_{rms}
		Clock Recovery	none			1.6 μW_{rms}
		OC-12/STM-4	none			1.6 μW_{rms}
		Clock Recovery	none			1.6 μW_{rms}
		OC-48/STM-16	none			2.4 μW_{rms}
		Clock Recovery	none			2.4 μW_{rms}
		FC1063	none			1.6 μW_{rms}
		Clock Recovery	none			1.6 μW_{rms}
		FC2125	none			2.4 μW_{rms}
		Clock Recovery	none			2.4 μW_{rms}
		ENET1250	none			1.6 μW_{rms}
		Clock Recovery	none			1.6 μW_{rms}
		ENET2500	none			2.4 μW_{rms}
		Clock Recovery	none			2.4 μW_{rms}
		INFINIBAND	none			2.4 μW_{rms}
		Clock Recovery	none			2.4 μW_{rms}
		2.5 GHz	none			2.4 μW_{rms}
		Clock Recovery	none			2.4 μW_{rms}
	780 nm	OC-3/STM-1	none			2.0 μW_{rms}
		Clock Recovery	none			2.0 μW_{rms}
		OC-12/STM-4	none			2.0 μW_{rms}
		Clock Recovery	none			2.0 μW_{rms}
		OC-48/STM-16	none			3.0 μW_{rms}
		Clock Recovery	none			3.0 μW_{rms}
		FC1063	none			2.0 μW_{rms}
		Clock Recovery	none			2.0 μW_{rms}
		FC2125	none			3.0 μW_{rms}
		Clock Recovery	none			3.0 μW_{rms}
		ENET1250	none			2.0 μW_{rms}
		Clock Recovery	none			2.0 μW_{rms}
		ENET2500	none			3.0 μW_{rms}
		Clock Recovery	none			3.0 μW_{rms}
		INFINIBAND	none			3.0 μW_{rms}
		Clock Recovery	none			3.0 μW_{rms}
2.5 GHz	none			3.0 μW_{rms}		
Clock Recovery	none			3.0 μW_{rms}		

80C00 Test Record (cont.)

Performance Test				Minimum	Incoming	Outgoing	Maximum
80C08	C1 at 5 μ W	1550 nm	10 GHz	none			3.0 μ W _{rms}
			Clock Recovery	none			3.5 μ W _{rms}
			10GBASE-W	none			3.0 μ W _{rms}
			Clock Recovery	none			3.5 μ W _{rms}
			10GBASE-R	none			3.0 μ W _{rms}
			Clock Recovery	none			3.5 μ W _{rms}
		1310 nm	10 GHz	none			3.0 μ W _{rms}
			Clock Recovery	none			3.5 μ W _{rms}
			10GBASE-W	none			3.0 μ W _{rms}
			Clock Recovery	none			3.5 μ W _{rms}
			10GBASE-R	none			3.0 μ W _{rms}
			Clock Recovery	none			3.5 μ W _{rms}
		850 nm	10 GHz	none			5.0 μ W _{rms}
			Clock Recovery	none			5.5 μ W _{rms}
			10GBASE-W	none			5.0 μ W _{rms}
			Clock Recovery	none			5.5 μ W _{rms}
			10GBASE-R	none			5.0 μ W _{rms}
			Clock Recovery	none			5.5 μ W _{rms}
		780 nm	10 GHz	none			6.0 μ W _{rms}
			Clock Recovery	none			6.6 μ W _{rms}
			10GBASE-W	none			6.0 μ W _{rms}
			Clock Recovery	none			6.6 μ W _{rms}
			10GBASE-R	none			6.0 μ W _{rms}
			Clock Recovery	none			6.6 μ W _{rms}

80C00 Test Record (cont.)

Performance Test			Minimum	Incoming	Outgoing	Maximum
80C08B	C1 at 5 μ W	1550 nm	10 GHz	none		3.0 μ W _{rms}
			Clock Recovery	none		3.5 μ W _{rms}
			10GBASE-W	none		3.0 μ W _{rms}
			Clock Recovery	none		3.5 μ W _{rms}
			10GBASE-R	none		3.0 μ W _{rms}
			Clock Recovery	none		3.5 μ W _{rms}
			OC-192/STM-64	none		3.0 μ W _{rms}
			Clock Recovery	none		3.5 μ W _{rms}
			10GFC	none		3.0 μ W _{rms}
			Clock Recovery	none		3.5 μ W _{rms}
		1310 nm	10 GHz	none		3.0 μ W _{rms}
			Clock Recovery	none		3.5 μ W _{rms}
			10GBASE-W	none		3.0 μ W _{rms}
			Clock Recovery	none		3.5 μ W _{rms}
			10GBASE-R	none		3.0 μ W _{rms}
			Clock Recovery	none		3.5 μ W _{rms}
			OC-192/STM-64	none		3.0 μ W _{rms}
			Clock Recovery	none		3.5 μ W _{rms}
			10GFC	none		3.0 μ W _{rms}
			Clock Recovery	none		3.5 μ W _{rms}
		850 nm	10 GHz	none		5.0 μ W _{rms}
			Clock Recovery	none		5.5 μ W _{rms}
			10GBASE-W	none		5.0 μ W _{rms}
			Clock Recovery	none		5.0 μ W _{rms}
			10GBASE-R	none		5.0 μ W _{rms}
			Clock Recovery	none		5.5 μ W _{rms}
			OC-192/STM-64	none		5.5 μ W _{rms}
			Clock Recovery	none		5.5 μ W _{rms}
			10GFC	none		5.0 μ W _{rms}
			Clock Recovery	none		5.5 μ W _{rms}

80C00 Test Record (cont.)

Performance Test			Minimum	Incoming	Outgoing	Maximum
		780 nm	10 GHz	none		6.0 μW_{rms}
			Clock Recovery	none		6.6 μW_{rms}
			10GBASE-W	none		6.0 μW_{rms}
			Clock Recovery	none		6.6 μW_{rms}
			10GBASE-R	none		6.0 μW_{rms}
			Clock Recovery	none		6.6 μW_{rms}
			OC-192/STM-64	none		6.0 μW_{rms}
			Clock Recovery	none		6.6 μW_{rms}
			10GFC	none		6.0 μW_{rms}
			Clock Recovery	none		6.6 μW_{rms}
80C08C	C1 at 5 μW	1310 nm	10 GHz	none		3.0 μW_{rms}
			Clock Recovery	none		3.5 μW_{rms}
			10GBASE-W	none		3.0 μW_{rms}
			Clock Recovery	none		3.5 μW_{rms}
			10GBASE-R	none		3.0 μW_{rms}
			Clock Recovery	none		3.5 μW_{rms}
			OC-192/STM-64	none		3.0 μW_{rms}
			Clock Recovery	none		3.5 μW_{rms}
			10GFC	none		3.0 μW_{rms}
			Clock Recovery	none		3.5 μW_{rms}
			10GFC FEC	none		3.0 μW_{rms}
			Clock Recovery	none		3.5 μW_{rms}
			10GBE FEC	none		3.0 μW_{rms}
			Clock Recovery	none		3.5 μW_{rms}
			10.66 Gb/s	none		3.0 μW_{rms}
			Clock Recovery	none		3.5 μW_{rms}
10.709 Gb/s	none		3.0 μW_{rms}			
Clock Recovery	none		3.5 μW_{rms}			

80C00 Test Record (cont.)

Performance Test			Minimum	Incoming	Outgoing	Maximum
	1550 nm	10 GHz	none			3.0 μW_{rms}
		Clock Recovery	none			3.5 μW_{rms}
		10GBASE-W	none			3.0 μW_{rms}
		Clock Recovery	none			3.5 μW_{rms}
		10GBASE-R	none			3.0 μW_{rms}
		Clock Recovery	none			3.5 μW_{rms}
		OC-192/STM-64	none			3.0 μW_{rms}
		Clock Recovery	none			3.5 μW_{rms}
		10GFC	none			3.0 μW_{rms}
		Clock Recovery	none			3.5 μW_{rms}
		10GFC FEC	none			3.0 μW_{rms}
		Clock Recovery	none			3.5 μW_{rms}
		10GBE FEC	none			3.0 μW_{rms}
		Clock Recovery	none			3.5 μW_{rms}
		10.66 Gb/s	none			3.0 μW_{rms}
		Clock Recovery	none			3.5 μW_{rms}
		10.709 Gb/s	none			3.0 μW_{rms}
		Clock Recovery	none			3.5 μW_{rms}
	850 nm	10 GHz	none			5.0 μW_{rms}
		Clock Recovery	none			5.5 μW_{rms}
		10GBASE-W	none			5.0 μW_{rms}
		Clock Recovery	none			5.0 μW_{rms}
		10GBASE-R	none			5.0 μW_{rms}
		Clock Recovery	none			5.5 μW_{rms}
		OC-192/STM-64	none			5.5 μW_{rms}
		Clock Recovery	none			5.5 μW_{rms}
		10GFC	none			5.0 μW_{rms}
		Clock Recovery	none			5.5 μW_{rms}
		10GFC FEC	none			5.0 μW_{rms}
		Clock Recovery	none			5.5 μW_{rms}
		10GBE FEC	none			5.0 μW_{rms}
		Clock Recovery	none			5.5 μW_{rms}
		10.66 Gb/s	none			5.0 μW_{rms}
		Clock Recovery	none			5.5 μW_{rms}
10.709 Gb/s	none			5.0 μW_{rms}		
Clock Recovery	none			5.5 μW_{rms}		

80C00 Test Record (cont.)

Performance Test			Minimum	Incoming	Outgoing	Maximum
		780 nm	10 GHz	none		6.0 μW_{rms}
			Clock Recovery	none		6.6 μW_{rms}
			10GBASE-W	none		6.0 μW_{rms}
			Clock Recovery	none		6.6 μW_{rms}
			10GBASE-R	none		6.0 μW_{rms}
			Clock Recovery	none		6.6 μW_{rms}
			OC-192/STM-64	none		6.0 μW_{rms}
			Clock Recovery	none		6.6 μW_{rms}
			10GFC	none		6.0 μW_{rms}
			Clock Recovery	none		6.6 μW_{rms}
			10GFC FEC	none		6.0 μW_{rms}
			Clock Recovery	none		6.6 μW_{rms}
			10GBE FEC	none		6.0 μW_{rms}
			Clock Recovery	none		6.6 μW_{rms}
			10.66 Gb/s	none		6.0 μW_{rms}
			Clock Recovery	none		6.6 μW_{rms}
			10.709 Gb/s	none		6.0 μW_{rms}
			Clock Recovery	none		6.6 μW_{rms}
80C09	C1 at 10 μW		OC-192/STM-64	none		10 μW_{rms}
			Clock Recovery	none		12 μW_{rms}
			10.709 Gb/s	none		10 μW_{rms}
			Clock Recovery	none		12 μW_{rms}
			20 GHz	none		15 μW_{rms}
			Clock Recovery	none		20 μW_{rms}
			30 GHz	none		30 μW_{rms}
			Clock Recovery	none		40 μW_{rms}
80C10	C1 at 50 μW	1550 nm	OC-768/STM-256	none		60 μW_{rms}
			43.018 Gb/s	none		60 μW_{rms}
			30 GHz	none		50 μW_{rms}
			65 GHz	none		120 μW_{rms}
		1310 nm	OC-768/STM-256	none		110 μW_{rms}
			43.018 Gb/s	none		110 μW_{rms}
			30 GHz	none		90 μW_{rms}
			65 GHz	none		220 μW_{rms}

80C00 Test Record (cont.)

Performance Test				Minimum	Incoming	Outgoing	Maximum
80C10B	C1 at 50 μ W	1550 nm	OC-768/STM-256	none			38 μ W _{rms}
			43.018 Gb/s	none			38 μ W _{rms}
			40GBase-FR	none			38 μ W _{rms}
			100GBase-xR4	none			28 μ W _{rms}
			100GBase-xR4 FEC	none			28 μ W _{rms}
			30 GHz	none			35 μ W _{rms}
			65 GHz	none			60 μ W _{rms}
			80 GHz	none			105 μ W _{rms}
		1310 nm	OC-768/STM-256	none			50 μ W _{rms}
			43.018 Gb/s	none			50 μ W _{rms}
			40GBase-FR	none			50 μ W _{rms}
			100GBase-xR4	none			38 μ W _{rms}
			100GBase-xR4 FEC	none			38 μ W _{rms}
			30 GHz	none			45 μ W _{rms}
			65 GHz	none			75 μ W _{rms}
			80 GHz	none			130 μ W _{rms}
80C10B Option CRTP	C1 at 50 μ W	1550 nm	OC-768/STM-256	none			44 μ W _{rms}
			43.018 Gb/s	none			44 μ W _{rms}
			40GBase-FR	none			44 μ W _{rms}
			100GBase-xR4	none			32 μ W _{rms}
			100GBase-xR4 FEC	none			32 μ W _{rms}
			30 GHz	none			40 μ W _{rms}
			65 GHz	none			69 μ W _{rms}
			80 GHz	none			121 μ W _{rms}
		1310 nm	OC-768/STM-256	none			58 μ W _{rms}
			43.018 Gb/s	none			58 μ W _{rms}
			40GBase-FR	none			58 μ W _{rms}
			100GBase-xR4	none			44 μ W _{rms}
			100GBase-xR4 FEC	none			44 μ W _{rms}
			30 GHz	none			52 μ W _{rms}
			65 GHz	none			86 μ W _{rms}
			80 GHz	none			150 μ W _{rms}

80C00 Test Record (cont.)

Performance Test		Minimum	Incoming	Outgoing	Maximum
80C11	C1 at 10 μ W	OC-192/STM-64	none		8.0 μ W _{rms}
		Clock Recovery	none		9.0 μ W _{rms}
		10.662 Gb/s	none		8.0 μ W _{rms}
		Clock Recovery	none		9.0 μ W _{rms}
		10.709 Gb/s	none		8.0 μ W _{rms}
		Clock Recovery	none		9.0 μ W _{rms}
		10GBASE-W	none		8.0 μ W _{rms}
		Clock Recovery	none		9.0 μ W _{rms}
		10GBASE-R	none		8.0 μ W _{rms}
		Clock Recovery	none		9.0 μ W _{rms}
		10GBE FEC	none		8.0 μ W _{rms}
		Clock Recovery	none		9.0 μ W _{rms}
		10GFC	none		8.0 μ W _{rms}
		Clock Recovery	none		9.0 μ W _{rms}
		10GFC FEC	none		8.0 μ W _{rms}
		Clock Recovery	none		9.0 μ W _{rms}
		16GFC	none		10.0 μ W _{rms}
		Clock Recovery	none		11.5 μ W _{rms}
				20 GHz	none
		Clock Recovery	none		15 μ W _{rms}
		30 GHz	none		30 μ W _{rms}
		Clock Recovery	none		35 μ W _{rms}

80C00 Test Record (cont.)

Performance Test				Minimum	Incoming	Outgoing	Maximum
80C12	C1 at 5 μ W	1550 nm	FC1063	none			2.5 μ W _{rms}
			FC2125	none			2.5 μ W _{rms}
			FC4250	none			2.5 μ W _{rms}
			FC8500	none			2.5 μ W _{rms}
			10GBase-X4	none			2.5 μ W _{rms}
			10GFC-X4	none			2.5 μ W _{rms}
			3.318 Gb/s	none			2.5 μ W _{rms}
			9 GHz	none			5.0 μ W _{rms}
		1310 nm	FC1063	none			2.5 μ W _{rms}
			FC2125	none			2.5 μ W _{rms}
			FC4250	none			2.5 μ W _{rms}
			FC8500	none			2.5 μ W _{rms}
			10GBase-X4	none			2.5 μ W _{rms}
			10GFC-X4	none			2.5 μ W _{rms}
			3.318 Gb/s	none			2.5 μ W _{rms}
			9 GHz	none			5.0 μ W _{rms}
		850 nm	FC1063	none			4.0 μ W _{rms}
			FC2125	none			4.0 μ W _{rms}
			FC4250	none			4.0 μ W _{rms}
			FC8500	none			4.0 μ W _{rms}
			10GBase-X4	none			4.0 μ W _{rms}
			10GFC-X4	none			4.0 μ W _{rms}
			3.318 Gb/s	none			4.0 μ W _{rms}
			9 GHz	none			8.0 μ W _{rms}

80C00 Test Record (cont.)

Performance Test				Minimum	Incoming	Outgoing	Maximum
80C12-10G	C1 at 5 μ W	1550 nm	10GBASE-W	none			5.0 μ W _{rms}
			10GBASE-R	none			5.0 μ W _{rms}
			OC-192/STM-64	none			5.0 μ W _{rms}
			FC8500	none			5.0 μ W _{rms}
			10GFC	none			5.0 μ W _{rms}
			10GFC FEC	none			5.0 μ W _{rms}
			10GBE FEC	none			5.0 μ W _{rms}
			10.66 Data Filter	none			5.0 μ W _{rms}
			10.66 Data Filter	none			5.0 μ W _{rms}
		1310 nm	10GBASE-W	none			5.0 μ W _{rms}
			10GBASE-R	none			5.0 μ W _{rms}
			OC-192/STM-64	none			5.0 μ W _{rms}
			FC8500	none			5.0 μ W _{rms}
			10GFC	none			5.0 μ W _{rms}
			10GFC FEC	none			5.0 μ W _{rms}
			10GBE FEC	none			5.0 μ W _{rms}
			10.66 Data Filter	none			5.0 μ W _{rms}
			10.66 Data Filter	none			5.0 μ W _{rms}
		850 nm	10GBASE-W	none			8.0 μ W _{rms}
			10GBASE-R	none			8.0 μ W _{rms}
			OC-192/STM-64	none			8.0 μ W _{rms}
			FC8500	none			8.0 μ W _{rms}
			10GFC	none			8.0 μ W _{rms}
			10GFC FEC	none			8.0 μ W _{rms}
			10GBE FEC	none			8.0 μ W _{rms}
			10.66 Data Filter	none			8.0 μ W _{rms}
			10.66 Data Filter	none			8.0 μ W _{rms}
80C25GBE	C1 at 50 μ W	1550 nm	65 GHz	none			60 μ W _{rms}
			100GBase-xR4	none			28 μ W _{rms}
			100GBase-xR4 FEC	none			28 μ W _{rms}
		1310 nm	65 GHz	none			75 μ W _{rms}
			100GBase-xR4	none			38 μ W _{rms}
			100GBase-xR4 FEC	none			38 μ W _{rms}

80C00 Test Record (cont.)

Performance Test				Minimum	Incoming	Outgoing	Maximum
80C25GBE Option CRTP	C1 at 50 μ W	1550 nm	65 GHz	none			69 μ W _{rms}
			100GBase-xR4	none			32 μ W _{rms}
			100GBase-xR4 FEC	none			32 μ W _{rms}
		1310 nm	65 GHz	none			86 μ W _{rms}
			100GBase-xR4	none			44 μ W _{rms}
			100GBase-xR4 FEC	none			44 μ W _{rms}
<i>Minimum Optical bandwidth</i>							
80C01	Bandwidth Setting:	20 GHz	20 GHz			none	
		12.5 GHz	12.5 GHz			none	
80C02	Bandwidth Setting:	30 GHz	28 GHz			none	
		20 GHz	20 GHz			none	
		12.5 GHz	12.5 GHz			none	
80C04	Bandwidth Setting:	30 GHz	28 GHz			none	
		20 GHz	20 GHz			none	
80C05	Bandwidth Setting:	40 GHz	40 GHz			none	
		30 GHz	30 GHz			none	
		20 GHz	20 GHz			none	
80C07	Bandwidth Setting:	2 GHz	2.3 GHz			none	
80C07B	Bandwidth Setting:	2.5 GHz	2.3 GHz			none	
80C08	Bandwidth Setting:	10 GHz	9.5 GHz			none	
80C08B	Bandwidth Setting:	10 GHz	9.5 GHz			none	
80C08C	Bandwidth Setting:	10 GHz	9.5 GHz			none	
80C09	Bandwidth Setting:	30 GHz	28 GHz			none	
		20 GHz	20 GHz			none	
80C10	Bandwidth Setting:	65 GHz	60 GHz			none	
		30 GHz	30 GHz			none	
80C10B	Bandwidth Setting:	80 GHz	75 GHz			none	
		65 GHz	60 GHz			none	
		30 GHz	30 GHz			none	
80C11	Bandwidth Setting:	20 GHz	20 GHz			none	
		30 GHz	28 GHz			none	
80C12 (options F2, F3, F5, F6, FC)	Bandwidth Setting:	9 GHz	8.5 GHz			none	

80C00 Test Record (cont.)

Performance Test			Minimum	Incoming	Outgoing	Maximum
80C12-10G	Bandwidth Setting:	10 GHz	9.5 GHz			none
80C25GBE	Bandwidth Setting:	65 GHz	60 GHz			none
<i>OC-3/STM-1 155 Mb/s Reference Receiver setting frequency response (80C07 and 80C07B modules only)</i>						
Frequency (MHz):	Nominal response (dB)	0.00	-0.50			0.50
23.3		-0.11	-0.61			0.39
46.65		-0.45	-0.95			0.05
69.98		-1.02	-1.52			-0.52
93.3		-1.86	-2.36			-1.36
116.7		-3.00	-3.50			-2.50
140.0		-4.51	-5.67			-3.35
155.5		-5.71	-7.25			-4.17
163.3		-6.37	-8.08			-4.66
186.6		-8.54	-10.74			-6.35
209.9		-10.93	-13.55			-8.31
233.3		-13.41	-16.41			-10.41
<i>OC-12/STM-4 622 Mb/s Reference Receiver setting frequency response (80C01, 80C07 and 80C07B modules only)</i>						
Frequency (MHz):	Nominal response (dB)	0.00	-0.50			0.50
93.3		-0.11	-0.61			0.39
186.6		-0.45	-0.95			0.05
279.9		-1.02	-1.52			-0.52
373.2		-1.86	-2.36			-1.36
466.7		-3.00	-3.50			-2.50
559.9		-4.51	-5.67			-3.35
622.1		-5.71	-7.25			-4.17
653.2		-6.37	-8.08			-4.66
746.5		-8.54	-10.74			-6.35
839.8		-10.93	-13.55			-8.31
933.1		-13.41	-16.41			-10.41

80C00 Test Record (cont.)

Performance Test	Minimum	Incoming	Outgoing	Maximum
<i>OC48/STM-16 2.488 Gb/s Reference Receiver setting frequency response (80C01, 80C03, 80C07, and 80C07B modules only)</i>				
Frequency (MHz): 0.000 Nominal response (dB) 0.00	-0.50			0.50
373.3	-0.11			0.39
746.5	-0.45			0.05
1119.7	-1.02			-0.52
1493.1	-1.86			-1.36
1866.3	-3.00			-2.50
2239.5	-4.51			-3.35
2488.3	-5.71			-4.17
2612.8	-6.37			-4.66
2986.0	-8.54			-6.35
3359.3	-10.93			-8.31
3732.6	-13.41			-10.41
<i>OC192/STM-64 9.953 Gb/s Reference Receiver setting frequency response (80C01, 80C02, 80C04, 80C05, 80C08B, 80C08C, 80C09, 80C11, and 80C12-10G modules only)</i>				
Frequency (MHz): 0.000 Nominal response (dB) 0.00	-0.85			0.85
1493.2	-0.11			+0.74
2986.0	-0.45			+0.40
4478.8	-1.02			+0.17
5972.4	-1.86			-1.01
7465.0	-3.00			-2.16
8958.0	-4.51			-2.83
9953.28	-5.71			-3.55
10451.2	-6.37			-3.99
11944.0	-8.54			-5.56
13437.2	-10.93			-7.41
14930.4	-13.41			-9.41

80C00 Test Record (cont.)

Performance Test	Minimum	Incoming	Outgoing	Maximum
<i>OC768/STM-256 39.813 Gb/s Reference Receiver setting frequency response (80C10 and 80C10B modules only)</i>				
Frequency (GHz): 0.000 Nominal response (dB) 0.00	-1.00			+1.00
5.97	-1.10			+0.90
11.94	-1.45			+0.55
17.92	-2.02			-0.02
23.89	-2.86			-0.86
29.86	-4.00			-2.00
35.83	-6.56			-2.46
39.81	-8.37			-3.05
41.80	-9.31			-3.43
47.78	-12.26			-4.83
53.75	-15.32			-6.53
59.72	-18.41			-8.41
<i>FEC43.02 Gb/s G.709 FEC Reference Receiver setting frequency response (80C10 and 80C10B modules only)</i>				
Frequency (GHz): 0.000 Nominal response (dB) 0.00	-1.00			+1.00
6.45	-1.10			+0.90
12.90	-1.45			+0.55
19.36	-2.02			-0.02
25.81	-2.86			-0.86
32.26	-4.00			-2.00
38.71	-6.56			-2.46
43.02	-8.37			-3.05
45.17	-9.31			-3.43
51.63	-12.26			-4.83
58.08	-15.32			-6.53
64.53	-18.41			-8.41

80C00 Test Record (cont.)

Performance Test	Minimum	Incoming	Outgoing	Maximum
<i>10.66 Reference Receiver setting frequency response (80C04, 80C11, and 80C12-10G modules only)</i>				
Frequency (MHz): 0.000 Nominal response (dB) 0.00	-0.85			0.85
1599.8 -0.11	-0.96			+0.74
3199.2 -0.45	-1.30			+0.40
4798.6 -1.02	-1.87			+0.17
6398.9 -1.86	-2.71			-1.01
7998.0 -3.00	-3.86			-2.16
9597.7 -4.51	-6.19			-2.83
10664.0 -5.71	-7.87			-3.55
11197.5 -6.37	-8.75			-3.99
12796.9 -8.54	-11.53			-5.56
14396.7 -10.93	-14.45			-7.41
15996.5 -13.41	-17.41			-9.41
<i>ENET2500 (2 GBE) 2.50 Gb/s Reference Receiver setting frequency response (80C03 and 80C07B modules only)</i>				
Frequency (MHz): 0.000 Nominal response (dB) 0.00	-0.50			0.50
375 -0.11	-0.61			0.39
750 -0.45	-0.95			0.05
1125 -1.02	-1.52			-0.52
1500 -1.86	-2.36			-1.36
1875 -3.00	-3.50			-2.50
2250 -4.51	-5.67			-3.35
2500 -5.71	-7.25			-4.17
2625 -6.37	-8.08			-4.66
3000 -8.54	-10.74			-6.35
3375 -10.93	-13.55			-8.31
3750 -13.41	-16.41			-10.41

80C00 Test Record (cont.)

Performance Test	Minimum	Incoming	Outgoing	Maximum
<i>ENET1250 (GBE) 1.25 Gb/s Reference Receiver setting frequency response (80C03 and 80C07B modules only)</i>				
Frequency (MHz): 0.000 Nominal response (dB) 0.00	-0.50			0.50
187.5	-0.11			0.39
375	-0.45			0.05
562.5	-1.02			-0.52
750	-1.86			-1.36
937.5	-3.00			-2.50
1125	-4.51			-3.35
1250	-5.71			-4.17
1312.5	-6.37			-4.66
1500	-8.54			-6.35
1687.5	-10.93			-8.31
1875	-13.41			-10.41
<i>FC1063 (1.0625 Gb/s) Reference Receiver setting frequency response (80C03, 80C07B, and 80C12 modules only)</i>				
Frequency (MHz): 0.000 Nominal response (dB) 0.00	-0.50			0.50
159.5	-0.11			0.39
318.9	-0.45			0.05
478.4	-1.02			-0.52
637.9	-1.86			-1.36
797.4	-3.00			-2.50
956.8	-4.51			-3.35
1063	-5.71			-4.17
1116	-6.37			-4.66
1275	-8.54			-6.35
1435	-10.93			-8.31
1595	-13.41			-10.41

80C00 Test Record (cont.)

Performance Test	Minimum	Incoming	Outgoing	Maximum
<i>FC2125 (2.125 Gb/s) Reference Receiver setting frequency response (80C07B, and 80C12 modules only)</i>				
Frequency (MHz): 0.000 Nominal response (dB) 0.00	-0.50			0.50
318.8	-0.11			0.39
637.5	-0.45			0.05
956.3	-1.02			-0.52
1275	-1.86			-1.36
1594	-3.00			-2.50
1913	-4.51			-3.35
2125	-5.71			-4.17
2231	-6.37			-4.66
2550	-8.54			-6.35
2869	-10.93			-8.31
3188	-13.41			-10.41
<i>10.71 Gb/s Reference Receiver setting frequency response (80C09, 80C11 and 80C12-10G modules only)</i>				
Frequency (MHz): 0.000 Nominal response (dB) 0.00	-0.85			0.85
1606.6	-0.11			+0.74
3212.8	-0.45			+0.40
4819.0	-1.02			+0.17
6426.0	-1.86			-1.01
8032.0	-3.00			-2.16
9638.4	-4.51			-2.83
10709.2	-5.71			-3.55
11245.0	-6.37			-3.99
12851.1	-8.54			-5.56
14457.7	-10.93			-7.41
16064.4	-13.41			-9.41

80C00 Test Record (cont.)

Performance Test	Minimum	Incoming	Outgoing	Maximum
<i>10BASE-W (9.95328 Gb/s) Reference Receiver setting frequency response (80C08, 80C08B, 80C08C, 80C11, and 80C12-10G modules only)</i>				
Frequency (MHz): 0.000 Nominal response (dB) 0.00	-0.85			0.85
1500	-0.96			+0.74
3000	-1.30			+0.40
4500	-1.87			+0.17
6000	-2.71			-1.01
7500	-3.86			-2.16
9000	-6.19			-2.83
10000	-7.87			-3.55
10500	-8.75			-3.99
12000	-11.53			-5.56
13500	-14.45			-7.41
15000	-17.41			-9.41
<i>10BASE-R (10.3125 Gb/s) Reference Receiver setting frequency response (80C08, 80C08B, 80C08C, 80C11, and 80C12-10G modules only)</i>				
Frequency (MHz): 0.000 Nominal response (dB) 0.00	-0.85			0.85
1500	-0.96			+0.74
3000	-1.30			+0.40
4500	-1.87			+0.17
6000	-2.71			-1.01
7500	-3.86			-2.16
9000	-6.19			-2.83
10000	-7.87			-3.55
10500	-8.75			-3.99
12000	-11.53			-5.56
13500	-14.45			-7.41
15000	-17.41			-9.41

80C00 Test Record (cont.)

Performance Test	Minimum	Incoming	Outgoing	Maximum
<i>10GBE FEC (11.0957 Gb/s) Reference Receiver setting frequency response (80C08C, 80C11, and 80C12-10G modules only)</i>				
Frequency (MHz): 0.000 Nominal response (dB) 0.00	-0.85			0.85
1500	-0.96			+0.74
3000	-1.30			+0.40
4500	-1.87			+0.17
6000	-2.71			-1.01
7500	-3.86			-2.16
9000	-6.19			-2.83
10000	-7.87			-3.55
10500	-8.75			-3.99
12000	-11.53			-5.56
13500	-14.45			-7.41
15000	-17.41			-9.41
<i>10GFC FEC (11.317 Gb/s) Reference Receiver setting frequency response (80C08C, 80C11, and 80C12-10G modules only)</i>				
Frequency (MHz): 0.000 Nominal response (dB) 0.00	-0.85			0.85
1500	-0.96			+0.74
3000	-1.30			+0.40
4500	-1.87			+0.17
6000	-2.71			-1.01
7500	-3.86			-2.16
9000	-6.19			-2.83
10000	-7.87			-3.55
10500	-8.75			-3.99
12000	-11.53			-5.56
13500	-14.45			-7.41
15000	-17.41			-9.41

80C00 Test Record (cont.)

Performance Test	Minimum	Incoming	Outgoing	Maximum
<i>10GFC (10.51875 Gb/s) Reference Receiver setting frequency response (80C08B, 80C08C, 80C11, and 80C12-10G modules only)</i>				
Frequency (MHz): 0.000 Nominal response (dB) 0.00	-0.85			0.85
1500	-0.96			+0.74
3000	-1.30			+0.40
4500	-1.87			+0.17
6000	-2.71			-1.01
7500	-3.86			-2.16
9000	-6.19			-2.83
10000	-7.87			-3.55
10500	-8.75			-3.99
12000	-11.53			-5.56
13500	-14.45			-7.41
15000	-17.41			-9.41
<i>10.66 Gb/s Data Filter (80C08C and 80C12-10G modules only)</i>				
Frequency (MHz): 0.000 Nominal response (dB) 0.00	-0.85			0.85
1500	-0.96			+0.74
3000	-1.30			+0.40
4500	-1.87			+0.17
6000	-2.71			-1.01
7500	-3.86			-2.16
9000	-6.19			-2.83
10000	-7.87			-3.55
10500	-8.75			-3.99
12000	-11.53			-5.56
13500	-14.45			-7.41
15000	-17.41			-9.41

80C00 Test Record (cont.)

Performance Test	Minimum	Incoming	Outgoing	Maximum
<i>10.709 Gb/s Data Filter (80C08C module only)</i>				
Frequency (MHz): 0.000 Nominal response (dB) 0.00	-0.85			0.85
1500	-0.11			+0.74
3000	-0.45			+0.40
4500	-1.02			+0.17
6000	-1.86			-1.01
7500	-3.00			-2.16
9000	-4.51			-2.83
10000	-5.71			-3.55
10500	-6.37			-3.99
12000	-8.54			-5.56
13500	-10.93			-7.41
15000	-13.41			-9.41
<i>10GBASE-X4 (3.125 Gb/s) Reference Receiver setting frequency response (80C12 module only)</i>				
Frequency (MHz): 0.000 Nominal response (dB) 0.00	-0.50			0.50
468.8	-0.11			0.39
937.5	-0.45			0.05
1406	-1.02			-0.52
1875	-1.86			-1.36
2344	-3.00			-2.50
2813	-4.51			-3.35
3125	-5.71			-4.17
3281	-6.37			-4.65
3750	-8.54			-6.35
4219	-10.93			-8.31
4688	-13.41			-10.41

80C00 Test Record (cont.)

Performance Test	Minimum	Incoming	Outgoing	Maximum
<i>10GFC-X4 (3.188 Gb/s) Reference Receiver setting frequency response (80C12 module only)</i>				
Frequency (MHz): 0.000 Nominal response (dB) 0.00	-0.50			0.50
478.1	-0.61			0.39
956.3	-0.95			0.05
1434	-1.52			-0.52
1913	-2.36			-1.36
2391	-3.50			-2.50
2869	-5.67			-3.35
3188	-7.25			-4.17
3347	-8.08			-4.65
3825	-10.74			-6.35
4303	-13.55			-8.31
4781	-16.41			-10.41
<i>16GFC (14.025 Gb/s) Reference Receiver setting frequency response (80C11 module only)</i>				
Frequency (MHz): 0.000 Nominal response (dB) 0.00	-0.85			0.85
2104	-0.96			0.74
4208	-1.30			0.40
6311	-1.87			-0.17
8415	-2.71			-1.01
10519	-3.86			-2.16
12623	-6.19			-2.83
14025	-7.87			-3.55
14726	-8.75			-3.99
16830	-11.53			-5.56
18934	-14.45			-7.41
21038	-17.41			-9.41

80C00 Test Record (cont.)

Performance Test	Minimum	Incoming	Outgoing	Maximum
<i>FC4250 (4.250 Gb/s) Reference Receiver setting frequency response (80C12 module only)</i>				
Frequency (MHz): 0.000 Nominal response (dB) 0.00	-0.50			0.50
637.5	-0.11			0.39
1275	-0.45			0.05
1913	-1.02			-0.52
2550	-1.86			-1.36
3188	-3.00			-2.50
3826	-4.51			-3.35
4250	-5.71			-4.17
4462	-6.37			-4.65
5100	-8.54			-6.35
5738	-10.93			-8.31
6375	-13.41			-10.41
<i>VSR-5 (3.318 Gb/s) Reference Receiver setting frequency response (80C12 module only)</i>				
Frequency (MHz): 0.000 Nominal response (dB) 0.00	-0.50			0.50
497.7	-0.11			0.39
995.3	-0.45			0.05
1493	-1.02			-0.52
1991	-1.86			-1.36
2488	-3.00			-2.50
2986	-4.51			-3.35
3318	-5.71			-4.17
3484	-6.37			-4.65
3981	-8.54			-6.35
4479	-10.93			-8.31
4977	-13.41			-10.41

80C00 Test Record (cont.)

Performance Test			Minimum	Incoming	Outgoing	Maximum
<i>40GBase-FR (41.25 Gb/s, ENET41250) Reference Receiver setting frequency response</i>						
Frequency (MHz):	0.000	Nominal response (dB)	0.00	-0.85		0.85
	6188		-0.11	-0.96		0.74
	12375		-0.45	-1.30		0.40
	18563		-1.02	-1.87		-0.17
	24750		-1.86	-2.71		-1.01
	30938		-3.00	-3.86		-2.16
	37125		-4.51	-6.19		-2.83
	41250		-5.71	-7.87		-3.55
	43313		-6.37	-8.75		-3.99
	49500		-8.54	-11.53		-5.56
	55688		-10.93	-14.45		-7.41
	61875		-13.41	-17.41		-9.41
<i>100GBase-xR4 (25.781 Gb/s, ENET25781 and 100GBase-xR4 w/FEC (27.739 Gb/s, ENET27739) Reference Receiver setting frequency response</i>						
Frequency (MHz):	0.000	Nominal response (dB)	0.00	-0.85		0.85
	3867		-0.11	-0.96		0.74
	7734		-0.45	-1.30		0.40
	11602		-1.02	-1.87		-0.17
	15469		-1.86	-2.71		-1.01
	19336		-3.00	-3.86		-2.16
	23203		-4.51	-6.19		-2.83
	25781		-5.71	-7.87		-3.55
	27070		-6.37	-8.75		-3.99
	30938		-8.54	-11.53		-5.56
	34805		-10.93	-14.45		-7.41
	38672		-13.41	-17.41		-9.41
<i>Recovered clock timing jitter</i>						
80C01-CR	Rate: OC-12	Horz Scale: 500 ps	none			8 ps _{rms}
	Rate: OC-48	Horz Scale: 100 ps	none			8 ps _{rms}
80C02-CR	Rate: OC-192	Horz Scale: 20 ps	none			2 ps _{rms}
80C03-CR	Rate: FC-1063	Horz Scale: 200 ps	none			8 ps _{rms}
	Rate: GBE	Horz Scale: 200 ps	none			8 ps _{rms}
	Rate: OC-48	Horz Scale: 100 ps	none			8 ps _{rms}
	Rate: 2.5 GB/s	Horz Scale: 100 ps	none			8 ps _{rms}
80C04-CR	Rate: OC-192	Horz Scale: 20 ps	none			2 ps _{rms}

80C00 Test Record (cont.)

Performance Test			Minimum	Incoming	Outgoing	Maximum
80C07-CR	Rate: OC-3	Horz Scale: 1 ns	none			32 ps _{rms}
	Rate: OC-12	Horz Scale: 500 ps	none			8 ps _{rms}
	Rate: OC-48	Horz Scale: 100 ps	none			4 ps _{rms}
80C07B-CR	OC-3/STM-1	Horz Scale: 1 ns	none			32 ps _{rms}
	OC-12/STM-4	Horz Scale: 500 ps	none			8 ps _{rms}
	OC-48/STM-16	Horz Scale: 100 ps	none			4 ps _{rms}
	FC1063	Horz Scale: 200 ps	none			8 ps _{rms}
	FC2125	Horz Scale: 100 ps	none			6 ps _{rms}
	ENET1250	Horz Scale: 200 ps	none			8 ps _{rms}
	ENET2500	Horz Scale: 100 ps	none			4 ps _{rms}
	INFINIBAND	Horz Scale: 100 ps	none			4 ps _{rms}
80C08-CR	Rate: OC-192	Horz Scale: 20 ps	none			2 ps _{rms}
	Rate: 10GBASE-W	Horz Scale: 20 ps	none			2 ps _{rms}
	Rate: 10GBASE-R	Horz Scale: 20 ps	none			2 ps _{rms}
80C08B-CR1	Rate: OC-192	Horz Scale: 20 ps	none			2 ps _{rms}
	Rate: 10GBASE-W	Horz Scale: 20 ps	none			2 ps _{rms}
	Rate: 10GBASE-R	Horz Scale: 20 ps	none			2 ps _{rms}
80C08B-CR2	Rate: 10GBASE-R	Horz Scale: 20 ps	none			2 ps _{rms}
	Rate: 10GFC	Horz Scale: 20 ps	none			2 ps _{rms}
80C08C-CR1	Rate: OC-192	Horz Scale: 20 ps	none			2 ps _{rms}
	Rate: 10GBASE-W	Horz Scale: 20 ps	none			2 ps _{rms}
	Rate: 10GBASE-R	Horz Scale: 20 ps	none			2 ps _{rms}
80C08C-CR2	Rate: 10GBASE-R	Horz Scale: 20 ps	none			2 ps _{rms}
	Rate: 10GFC	Horz Scale: 20 ps	none			2 ps _{rms}
80C08C-CR4	Rate: OC-192	Horz Scale: 20 ps	none			2 ps _{rms}
	Rate: 10GBASE-W	Horz Scale: 20 ps	none			2 ps _{rms}
	Rate: 10GBASE-R	Horz Scale: 20 ps	none			2 ps _{rms}
	Rate: 10GFC	Horz Scale: 20 ps	none			2 ps _{rms}
	Rate: G.975 FEC	Horz Scale: 20 ps	none			2 ps _{rms}
	Rate: G.709 FEC	Horz Scale: 20 ps	none			2 ps _{rms}
	Rate: 10GbE FEC	Horz Scale: 20 ps	none			2 ps _{rms}
	Rate: Super FEC	Horz Scale: 20 ps	none			2 ps _{rms}
80C09-CR1	Rate: OC-192	Horz Scale: 20 ps	none			2 ps _{rms}
	Rate: FEC10.71 Gb/s	Horz Scale: 20 ps	none			2 ps _{rms}
80C11-CR1	Rate: OC-192	Horz Scale: 20 ps	none			2 ps _{rms}
80C11-CR2	Rate: OC-192	Horz Scale: 20 ps	none			2 ps _{rms}
	Rate: 10Gb FEC	Horz Scale: 20 ps	none			2 ps _{rms}

80C00 Test Record (cont.)

Performance Test			Minimum	Incoming	Outgoing	Maximum
80C11-CR3	Rate: OC-192	Horz Scale: 20 ps	none			2 ps _{rms}
	Rate: G.709 FEC	Horz Scale: 20 ps	none			2 ps _{rms}
80C11-CR4	Rate: OC-192	Horz Scale: 20 ps	none			2 ps _{rms}
	Rate: 10GBASE-W	Horz Scale: 20 ps	none			2 ps _{rms}
	Rate: 10GBASE-R	Horz Scale: 20 ps	none			2 ps _{rms}
	Rate: 10GFC	Horz Scale: 20 ps	none			2 ps _{rms}
	Rate: G.975 FEC	Horz Scale: 20 ps	none			2 ps _{rms}
	Rate: G.709 FEC	Horz Scale: 20 ps	none			2 ps _{rms}
	Rate: 10GbE FEC	Horz Scale: 20 ps	none			2 ps _{rms}
	Rate: Super FEC	Horz Scale: 20 ps	none			2 ps _{rms}
<i>Aberrations (peak to peak)</i>						
80C05	Filter or Bandwidth	40 GHz	none			15%
		30 GHz	none			10%
		20 GHz	none			10%
		OC-192	none			5%
80C06	Bandwidth	50 GHz	none			10%
80C10	Filter or Bandwidth	OC-768	none			5%
		FEC 43.02 Gb/s	none			5%
		30 GHz	none			5%
		65 GHz	none			10%
80C10B	Filter or Bandwidth	OC-768	none			5%
		FEC 43.02 Gb/s	none			5%
		40GBase-FR	none			5%
		30 GHz	none			5%
		65 GHz	none			10%
		80 GHz	none			12%
		100GBase-xR4	none			5%
		100GBase-xR4 FEC	none			5%
80C25GBE	Filter or Bandwidth	65 GHz	none			10%
		100GBase-xR4	none			5%
		100GBase-xR4 FEC	none			5%

80A01 Electrical Clock Recovery Module Test Record

Photocopy this page and use it to record the performance test results for your 80A01 Test Record.

80A01 Test Record

Module Serial Number: _____ Certificate Number: _____
 Temperature: _____ RH %: _____
 Date of Calibration: _____ Technician: _____

Performance Test	Minimum	Incoming	Outgoing	Maximum
<i>Trigger sensitivity</i>				
8 GHz	800 mV			none
9 GHz	800 mV			none
10 GHz	800 mV			none
11 GHz	800 mV			none
12 GHz	800 mV			none

80A02 EOS/ESD Protection Module Test Record

Photocopy this page and use it to record the performance test results for your 80A02 Test Record.

80A02 Test Record

Module Serial Number: _____	Certificate Number: _____
Temperature: _____	RH %: _____
Date of Calibration: _____	Technician: _____

Performance Test	Minimum	Incoming	Outgoing	Maximum
<i>Logic control threshold level</i>				
Engaged, LED lights	1 V			5 V
Disengaged, LED does not light	0 V			300 mV

80A05 Electrical Clock Recovery Module Test Record

Photocopy this and the next page and use them to record the performance test results for your 80A05 Test Record.

80A05 Test Record

Module Serial Number: _____ Certificate Number: _____
 Temperature: _____ RH %: _____
 Date of Calibration: _____ Technician: _____

Performance Test		Minimum	Incoming	Outgoing	Maximum
<i>Clock recovery sensitivity</i>					
Rate: OC-3	Horz Scale: 1 ns	10 mV			none
Rate: OC-12	Horz Scale: 500 ps	10 mV			none
Rate: FC-1063	Horz Scale: 200 ps	10 mV			none
Rate: GBE	Horz Scale: 200 ps	10 mV			none
Rate: Serial ATA (1.50 Gb/s)	Horz Scale: 200 ps	10 mV			none
Rate: FC2125	Horz Scale: 100 ps	10 mV			none
Rate: OC-48	Horz Scale: 100 ps	10 mV			none
Rate: 2GBE	Horz Scale: 100 ps	10 mV			none
Rate: Infiniband	Horz Scale: 100 ps	10 mV			none
Rate: PCI Express	Horz Scale: 100 ps	10 mV			none
Rate: 2.5 G G.709 FEC	Horz Scale: 100 ps	10 mV			none
Rate: Serial ATA (3.00 Gb/s)	Horz Scale: 100 ps	15 mV			none
Rate: XAUI (3.125 Gb/s)	Horz Scale: 100 ps	15 mV			none
Rate: FibreChannel	Horz Scale: 100 ps	15 mV			none
Rate: VSR5	Horz Scale: 100 ps	15 mV			none
Rate: 4 Gigabit FibreChannel	Horz Scale: 100 ps	15 mV			none
Rate: Serial ATA (6.00 Gb/s) (option 10G)	Horz Scale: 50 ps	15 mV			none
Rate: XAUI (6.25 Gb/s) (option 10G)	Horz Scale: 50 ps	15 mV			none
Rate: OC-192 (option 10G)	Horz Scale: 50 ps	15 mV			none
Rate: 10GBASE-W (option 10G)	Horz Scale: 50 ps	15 mV			none
Rate: 10GBASE-R (option 10G)	Horz Scale: 50 ps	15 mV			none
Rate: 10GFC (option 10G)	Horz Scale: 50 ps	15 mV			none
Rate: G.975 FEC (option 10G)	Horz Scale: 50 ps	15 mV			none
Rate: G.709 FEC (option 10G)	Horz Scale: 50 ps	15 mV			none
Rate: 10GbE w/FEC (option 10G)	Horz Scale: 50 ps	15 mV			none
Rate: Super FEC (option 10G)	Horz Scale: 50 ps	20 mV			none

80A05 Test Record (cont.)

Performance Test		Minimum	Incoming	Outgoing	Maximum
<i>Recovered clock timing jitter</i>					
Rate: OC-3	Horz Scale: 1 ns	none			64 ps
Rate: OC-12	Horz Scale: 500 ps	none			16 ps
Rate: FC-1063	Horz Scale: 200 ps	none			9.4 ps
Rate: GBE	Horz Scale: 200 ps	none			8 ps
Rate: Serial ATA (1.50 Gb/s)	Horz Scale: 200 ps	none			6.7 ps
Rate: FC2125	Horz Scale: 100 ps	none			4.7 ps
Rate: OC-48	Horz Scale: 100 ps	none			4 ps
Rate: 2GBE	Horz Scale: 100 ps	none			4 ps
Rate: Infiniband	Horz Scale: 100 ps	none			4 ps
Rate: PCI Express	Horz Scale: 100 ps	none			4 ps
Rate: 2.5 G G.709 FEC	Horz Scale: 100 ps	none			4 ps
Rate: Serial ATA (3.00 Gb/s)	Horz Scale: 100 ps	none			2.5 ps
Rate: XAUI (3.125 Gb/s)	Horz Scale: 100 ps	none			2.5 ps
Rate: FibreChannel	Horz Scale: 100 ps	none			2.5 ps
Rate: VSR5	Horz Scale: 100 ps	none			2.5 ps
Rate: 4 Gigabit FibreChannel	Horz Scale: 100 ps	none			2.5 ps
Rate: Serial ATA (6.00 Gb/s) (option 10G)	Horz Scale: 50 ps	none			2 ps
Rate: XAUI (6.25 Gb/s) (option 10G)	Horz Scale: 50 ps	none			2 ps
Rate: OC-192 (option 10G)	Horz Scale: 50 ps	none			2 ps
Rate: 10GBASE-W (option 10G)	Horz Scale: 50 ps	none			2 ps
Rate: 10GBASE-R (option 10G)	Horz Scale: 50 ps	none			2 ps
Rate: 10GFC (option 10G)	Horz Scale: 50 ps	none			2 ps
Rate: G.975 FEC (option 10G)	Horz Scale: 50 ps	none			2 ps
Rate: G.709 FEC (option 10G)	Horz Scale: 50 ps	none			2 ps
Rate: 10GbE w/FEC (option 10G)	Horz Scale: 50 ps	none			2 ps
Rate: Super FEC (option 10G)	Horz Scale: 50 ps	none			2 ps

80A06 PatternSync Trigger Module Test Record

Photocopy this page and use it to record the performance test results for your 80A06 Test Record.

80A06 Test RecordNIL

Module Serial Number: _____ Certificate Number: _____
 Temperature: _____ RH %: _____
 Date of Calibration: _____ Technician: _____

Performance Test	Minimum	Incoming	Outgoing	Maximum
<i>Trigger Sensitivity</i>				
150 Mb/s	1.0 V			none
1.2 Gb/s	1.0 V			none
3.0 Gb/s	1.0 V			none
3.05 Gb/s	1.0 V			none
7.0 Gb/s	1.0 V			none
7.05 Gb/s	1.0 V			none
8.0 Gb/s	2.0 V			none
12.5 Gb/s	2.0 V			none
<i>Maximum RMS Trigger Jitter</i>				
150 Mb/s	none			20 ps
1.2 Gb/s	none			1.3 ps
3.0 Gb/s	none			1.3 ps
3.05 Gb/s	none			1.3 ps
7.0 Gb/s	none			1.3 ps
7.05 Gb/s	none			1.3 ps
8.0 Gb/s	none			1.3 ps
12.5 Gb/s	none			1.3 ps

Main Instrument

These procedures check the characteristics that relate to the main instrument that are listed as checked in the *Specifications* chapter. Refer to Tables 1-1 through 1-6 beginning on page 1-1.

Prerequisites

Be sure you have performed the *Prerequisites* on page 2-26 before doing any procedures in this section.

NOTE. Use a torque wrench when connecting the terminators, adapters, attenuator, and power sensor in this setup. Use 8 ± 0.3 inch pounds of torque.

STOP. Throughout these procedures, when steps call for the display of setup dialog boxes, you can display them from the Setup menu in the menu bar at the top of the screen. These procedures assume you will display and dismiss the setup dialog boxes as needed.

STOP. The procedures throughout this chapter contain instructions based on the menus and controls from the most updated instrument software available at the time this document was released. These procedures will work for other versions of software, but some control and menu names may vary slightly.

Time Interval Accuracy, Short-Term Optimized and Locked-to-Internal 10-MHz Reference Modes

Equipment required	Synthesized signal generator (Item 33) 0.5 meter precision SMA cable (Item 17) 1.0 meter precision SMA cable (Item 18) Power divider (Item 28) One electrical sampling module (80E01, 80E02, 80E03, 80E04, 80E06, 80E07, 80E08, 80E09, or 80E10)
Prerequisites	As listed under <i>Prerequisites</i> on page 2-26.

Setup Install the test hookup:

1. Install the 80E0X module into the left-most small module compartment of the instrument (see Figure 2-16 on page 2-84).
2. Connect the synthesized signal generator to a 1.0 meter cable.
3. Connect the remaining end of the 1.0 meter cable to a 50 Ω SMA power divider. Connect two 0.5 meter cables to the two remaining SMA power divider connectors.
4. Connect one of the 0.5 meter cables to Channel 1 of the 80E0X module. Connect the remaining 0.5 meter cable to the TRIGGER DIRECT INPUT.

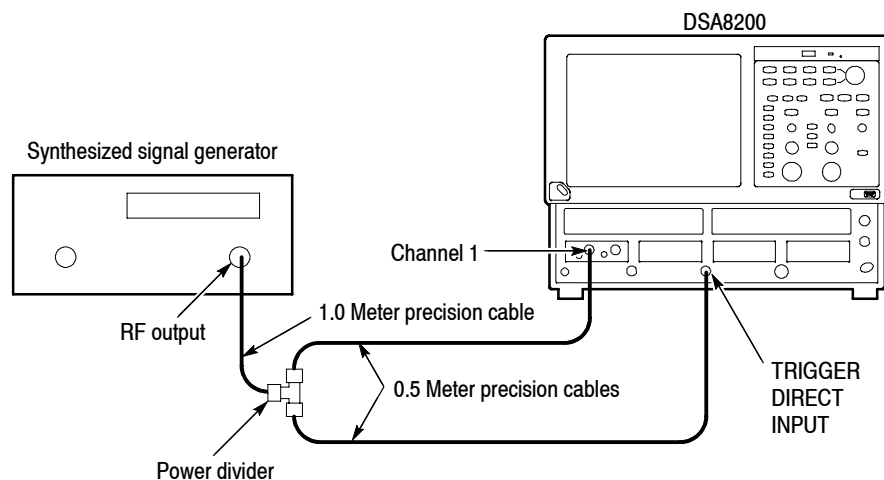


Figure 2- 16: Time interval accuracy test hookup

5. Set the synthesized signal generator frequency to 1 GHz.

6. Set the Synthesized output to 800 mV_{p-p} (400 mV displayed)
7. Set up the instrument as follows:
 - a. Select Default Setup from the Utilities menu on the menu bar at top of display.
 - b. Select C1 from the Waveform Selector menu on the controls bar at the bottom of the display (left corner).
 - c. In the Trig Setup dialog box:
 - Select External Direct for Trigger Source.
 - Select Auto for Mode.
 - d. In the Vert Setup dialog box:
 - Set Scale to 100 mV/division.
 - Set Offset to 0.
 - e. In the Horz Setup dialog box:
 - Set Scale to 200 ps/division.
 - Set Horizontal Reference to 0%.
 - Set Position to 19 ns (29 ns if using 80E07, 80E08, 80E09, 80E10).
 - Set All Timebases Mode to Short Term Jitter.
 - f. In the Acq Setup dialog box, set Acquisition Mode to Average.

Test Follow this procedure to make the time interval accuracy check:

1. In the Meas Setup dialog box:
 - a. Select Meas 1 and make sure the Source 1 button is selected.
 - b. Make sure both the channel under test and Pulse are selected in the Source tab, and then choose Select Meas > Pulse - Amplitude > Amplitude.
 - c. Select Meas 2 and make sure the Source 1 button is selected.
 - d. Make sure both the channel under test and Pulse are selected in the Source tab, and then choose Select Meas > Pulse - Timing > Period.
2. Adjust the synthesizer signal generator level until the amplitude measurement readout on the instrument screen indicates the amplitude is 400 mV.

3. Verify the period measurement readout indicates the period is $1 \text{ ns} \pm 9 \text{ ps}$.
4. In the Horz Setup dialog box, set All Timebases Mode to Lock to Int. 10 MHz.
5. Verify the period measurement readout indicates the period is $1 \text{ ns} \pm 8.1 \text{ ps}$.
6. In the Horz Setup dialog box: set All Timebases Mode to Short Term Jitter.
7. Set the Horizontal Position to 100 ns, and then repeat steps 3 through 5.
8. Set the Horizontal Position to $1 \mu\text{s}$, and then repeat step 5 (checking only Lock to Int. 10 MHz mode).
9. Repeat the setup (from step 7) and the test for all 80E00 series modules installed. Check one input per module.

End of Procedure

External Direct Trigger Level Accuracy

Equipment required	Synthesized signal generator (Item 33) 0.5 meter precision SMA cable (Item 17) 1.0 meter precision SMA cable (Item 18) Power divider (Item 28) One electrical sampling module (80E01, 80E02, 80E03, 80E04, 80E06, 80E07, 80E08, 80E09, or 80E10)
Prerequisites	As listed under <i>Prerequisites</i> on page 2-26.

Setup Install the test hookup:

1. Install the 80E0X module into the left-most small module compartment of the main instrument (see Figure 2-17).
2. Connect the synthesized signal generator to a 1.0 meter cable.
3. Connect the remaining end of the 1.0 meter cable to a 50 Ω SMA power divider. Connect two 0.5 meter cables to the two remaining SMA power divider connectors.

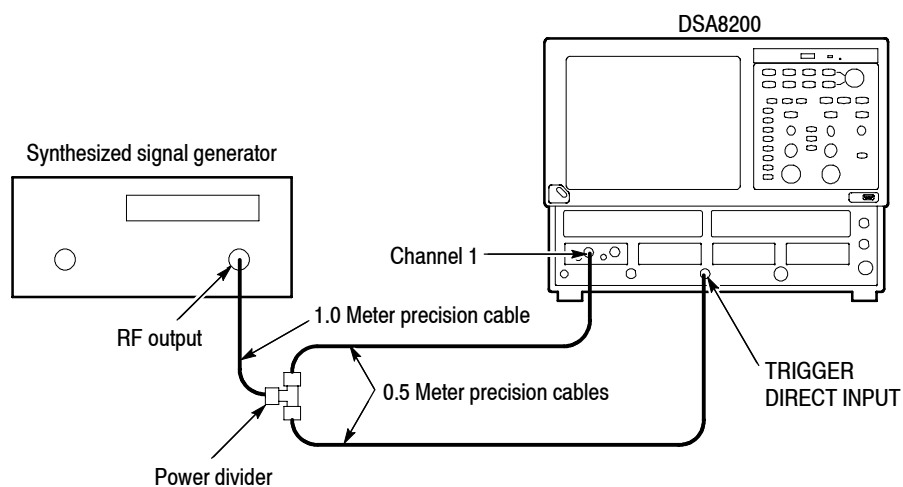


Figure 2-17: External direct trigger test hookup

4. Connect one of the 0.5 meter cables to Channel 1 of the 80E0X module. Connect the remaining 0.5 meter cable to the TRIGGER DIRECT INPUT.
5. Set the synthesized signal generator frequency to 100 MHz (10 ns period).

6. Set the synthesized output to 1600 mV_{p-p} (800 mV displayed).
7. Set up the instrument as follows:
 - a. Select Default Setup from the Utilities menu on the menu bar at top of display.
 - b. Select C1 from the Waveform Selector menu on the controls bar at the bottom of the display (left corner).
 - c. In the Trig Setup dialog box:
 - Select External Direct for Trigger Source.
 - Select Auto for Mode.
 - d. In the Vert Setup dialog box:
 - Set Scale to 100 mV/division.
 - Set Offset to 0.
 - e. In the Horz Setup dialog box:
 - Set Scale to 5 ns/division.
 - Set Horizontal Reference to 0%.
 - Set Position to minimum.
 - Set All Timebases Mode to Short Term Jitter.

Test Follow this procedure to make the direct trigger level accuracy check:

1. In the Meas Setup dialog box:
 - a. Select Meas 1 and make sure the Source 1 button is selected.
 - b. Make sure both the channel under test and Pulse are selected in the Source tab.
 - c. Choose Select Meas > Pulse - Amplitude > Amplitude.
2. Adjust the synthesizer signal generator level until the amplitude measurement readout on the instrument screen indicates the amplitude is 800 mV.

NOTE. *A stable trigger is one that is consistent; that is, one that results in a uniform, regular display triggered on the selected slope (positive or negative). This display should not have its trigger point switching between opposite slopes, nor should it roll across the screen. The following step represents approximately 180° phase shift. Verify that the trigger is operating (stable).*

3. In the Trig Setup dialog box, set the slope to negative and verify the trigger is operating and that the waveform position changes by 4.6 ns to 5.4 ns.
4. Set the slope back to positive.
5. In the Trig Setup dialog box, under Level, adjust the trigger level between -100 mV to +100 mV.

Verify the waveform position changes between 625 ps and 1 ns as the level is changed between +100 mV to -100 mV. (With positive slope, the waveform shifts to the right.)

End of Procedure

External Direct Trigger Sensitivity

Equipment required	Synthesized signal generator (Item 33) 0.5 meter precision SMA cable (Item 17) 1.0 meter precision SMA cable (Item 18) Power divider (Item 28) One electrical sampling module (80E01, 80E02, 80E03, 80E04, 80E06, 80E07, 80E08, 80E09, or 80E10)
Prerequisites	As listed under <i>Prerequisites</i> on page 2-26.

Setup Install the test hookup:

1. Install the 80E0X module into the left-most small module compartment of the instrument (see Figure 2-18).
2. Connect the synthesized signal generator to a 1.0 meter cable.
3. Connect the remaining end of the 1.0 meter cable to a 50 Ω SMA power divider. Connect two 0.5 meter cables to the two remaining SMA power divider connectors.
4. Connect one of the 0.5 meter cables to Channel 1 of the 80E0X module. Connect the remaining 0.5 meter cable to the TRIGGER DIRECT INPUT.

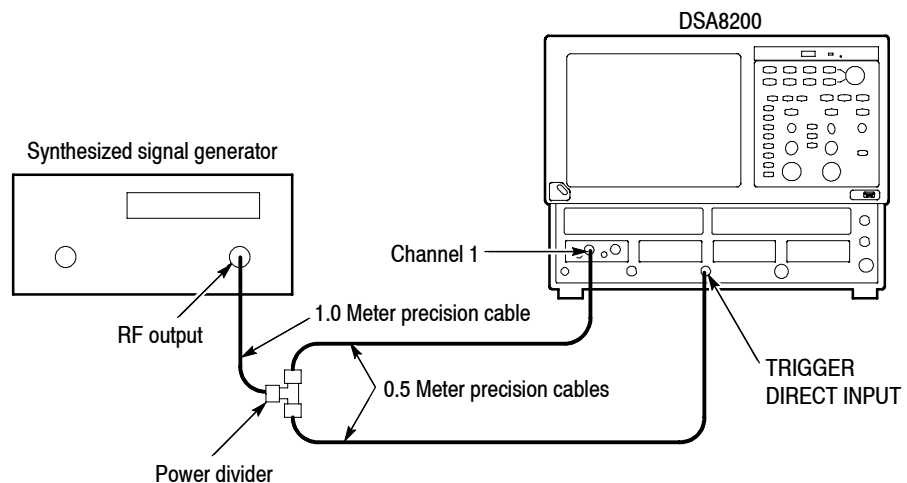


Figure 2- 18: External direct trigger sensitivity test hookup

5. Set the synthesized signal generator frequency to 2.5 GHz (400 ps period).

6. Set the synthesized output to 400 mV_{p-p} (200 mV displayed).
7. Make the following settings to the instrument:
 - a. Select Default Setup from the Utilities menu on the menu bar at top of display.
 - b. Select C1 from the Waveform Selector menu on the controls bar at the bottom of the display (left corner).
 - c. In the Trig Setup dialog box:
 - Select External Direct for Trigger Source.
 - Select Auto for Mode.
 - d. In the Vert Setup dialog box:
 - Set Scale to 20 mV/division.
 - Set Offset to 0.
 - e. In the Horz Setup dialog box:
 - Set Scale to 200 ps/division.
 - Set Horizontal Reference to 0%.
 - Set Position to 19 ns (29 ns if using 80E07, 80E08, 80E09, 80E10).

Test Follow this procedure to make the direct trigger sensitivity check:

1. In the Meas Setup dialog box:
 - a. Select Meas 1 and make sure the Source 1 button is selected.
 - b. Make sure both the channel under test and Pulse are selected in the Source tab, and then choose Select Meas > Pulse - Amplitude > Amplitude.
 - c. Select Meas 2 and make sure the Source 1 button is selected.
 - d. Make sure both the channel under test and Pulse are selected in the Source tab, and then choose Select Meas > Pulse - Timing > Frequency.
2. Adjust the synthesizer signal generator level until the amplitude measurement readout on the instrument screen indicates the amplitude is 100 mV.
3. Set the signal generator frequency to 100 MHz.
4. Adjust the Horizontal Scale to allow at least two full periods to be displayed.

5. Verify that the frequency read out on the instrument screen is within 10% from the true value.
6. Set the signal generator frequency to each of the following values, adjust the horizontal scale to the corresponding sec/div setting, and repeat steps 4 and 5:
 - 800 MHz at 500 ps/division
 - 1 GHz at 500 ps/division
 - 2 GHz at 200 ps/division
 - 3 GHz at 100 ps/division

End of Procedure

External Direct-Trigger Delay Jitter, Short-Term Optimized and Locked-to-Internal 10-MHz Reference Modes

Equipment required	Synthesized signal generator (Item 33) 0.5 meter precision SMA cable (Item 17) 1.0 meter precision SMA cable (Item 18) Power divider (Item 28) One electrical sampling module (80E01, 80E02, 80E03, 80E04, 80E06, 80E07, 80E08, 80E09, or 80E10)
Prerequisites	As listed under <i>Prerequisites</i> on page 2-26.

Setup Install the test hookup:

1. Install the 80E0X module into the left-most small module compartment of the instrument (see Figure 2-19).
2. Connect the synthesized signal generator to a 1.0 meter cable.
3. Connect the remaining end of the 1.0 meter cable to a 50 Ω SMA power divider. Connect two 0.5 meter cables to the two remaining SMA power divider connectors.

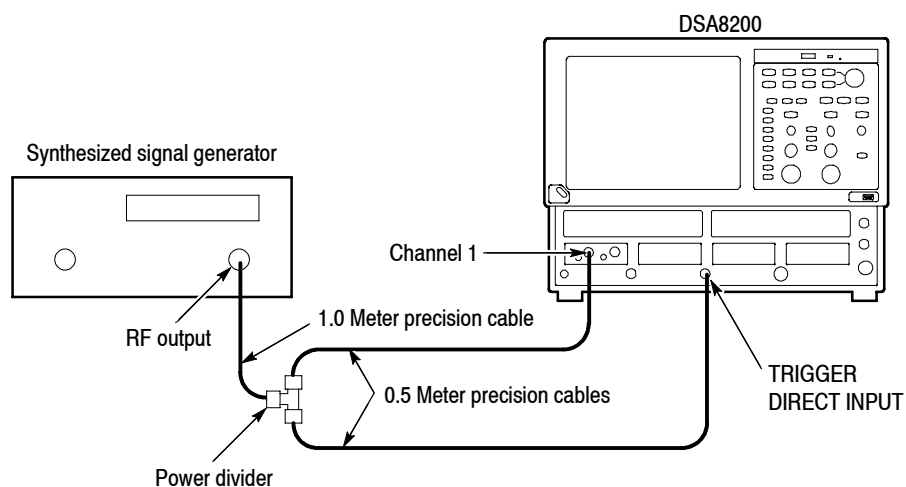


Figure 2-19: External direct trigger jitter test hookup

4. Connect one of the 0.5 meter cables to Channel 1 of the 80E0X module. Connect the remaining 0.5 meter cable to the TRIGGER DIRECT INPUT.

5. Set the synthesized signal generator frequency to 2.5 GHz.
6. Set the Synthesized output to 1.6 V_{p-p} (800 mV_{p-p} displayed).
7. Make the following settings to the instrument:
 - a. Select Default Setup from the Utilities menu on the menu bar at top of display.
 - b. Select C1 from the Waveform Selector menu on the controls bar at the bottom of the display (left corner).
 - c. In the Trig Setup dialog box:
 - Select External Direct for Trigger Source.
 - Select Auto for Mode.
 - d. In the Vert Setup dialog box:
 - Set Scale to 100 mV/division.
 - Set Offset to 0.
 - e. In the Horz Setup dialog box:
 - Set Scale to 200 ps/division.
 - Set Horizontal Reference to 0%.
 - Set Position to 19 ns (29 ns if using 80E07, 80E08, 80E09, 80E10).
 - Set Record Length to 2000.
 - Set All Timebase Mode to Short Term Jitter.

Test Follow this procedure to make the direct trigger delay jitter check:

1. In the Meas Setup dialog box:
 - a. Select Meas 1 and make sure the Source 1 button is selected.
 - b. Make sure both the channel under test and Pulse are selected in the Source tab, and then choose Select Meas > Pulse - Amplitude > Amplitude.
 - c. Select Meas 2 and make sure the Source 1 button is selected.
 - d. Make sure both the channel under test and Pulse are selected in the Source tab, and then choose Select Meas > Pulse - Timing > RMS Jitter. Dismiss any database notification that pops up.
 - e. Check the Use Wfm Database box in the Source tab.

2. In the Wfm Database dialog box, check Display in the Database.

NOTE. *The instrument will select whichever of the two databases that is not in use. Turn on Display Database for the database that shows the current channel in the Source box. Deselect Database On for the other database.*

3. Set the Horizontal Scale to 5 ps/division, and position the rising edge until it goes through the center of the display (where the center horizontal and vertical graticules cross).
4. Set the Vertical Scale to 10 mV/division.
5. In the Acq Setup dialog box, set Stop After to Condition and set the Number of Acquisitions to 400. See the *online help* for information on setting acquisition modes.
6. Press CLEAR DATA, and then press the RUN/STOP button. The instrument will acquire 400 acquisitions and stop. This takes a couple of seconds.
7. Verify that the RMS Jitter read out on the instrument screen is less than 1.4 ps.
8. In the Horiz dialog box, set All Timebases Mode to Lock Int. 10 MHz.
9. In the Acq Setup dialog box:
 - a. Set Stop After to Run/Stop Button Only.
 - b. Press RUN/STOP until it toggles to green in color. Position the rising edge until it goes through the center of the display.
 - c. Set Stop After to Condition.
10. Press CLEAR DATA, press RUN/STOP, and wait for it to stop.
11. Verify that the RMS Jitter read out is less than 2.5 ps.
12. In the Horizontal Setup dialog box:
 - a. Set Timebase > Position to 200 ns.
 - b. Set All Timebases Mode to Short Term Jitter.
13. In the Acq Setup dialog box:
 - a. Set Stop After to Run/Stop Button Only.
 - b. Press RUN/STOP until it toggles to green in color. Position the rising edge until it goes through the center of the display.
 - c. Set Stop After to Condition.

14. Press CLEAR DATA, press RUN/STOP, and wait for it to stop.
15. Verify that the the RMS Jitter read out is less than 2.2 ps.
16. In the Horizontal Setup dialog box, set All Timebases Mode to Lock Int. 10 MHz.
17. In the Acq Setup dialog box:
 - a. Set Stop After to Run/Stop Button Only.
 - b. Press RUN/STOP until it toggles to green in color. Position the rising edge until it goes through the center of the display.
 - c. Set Stop After to Condition.
18. Press CLEAR DATA, press RUN/STOP, and wait for it to stop.
19. Verify that the the RMS Jitter read out is less than 2.5 ps.
20. In the Horizontal Setup dialog box:
 - a. Set Timebase > Position to 2 μ s.
 - b. Set All Timebases Mode to Short Term Jitter.
21. In the Acq Setup dialog box:
 - a. Set Stop After to Run/Stop Button Only.
 - b. Press RUN/STOP until it toggles to green in color. Position the rising edge until it goes through the center of the display.
 - c. Set Stop After to Condition.
22. Press CLEAR DATA, press RUN/STOP, and wait for it to stop.
23. Verify that the the RMS Jitter read out is less than 11.2 ps.
24. In the Horizontal Setup dialog box, set All Timebases Mode to Lock Int. 10 MHz.
25. In the Acq Setup dialog box:
 - a. Set Stop After to Run/Stop Button Only.
 - b. Press RUN/STOP until it toggles to green in color. Position the rising edge until it goes through the center of the display.
 - c. Set Stop After to Condition.
26. Press CLEAR DATA, press RUN/STOP, and wait for it to stop.
27. Verify that the the RMS Jitter read out is less than 2.5 ps.

- 28.** Repeat the setup (from step 7) and the test for all 80E00 series modules installed. Check one input per module (e.g. channels 1, 3, 5, and 7).
- 29.** In Acq Setup dialog box, set Stop After to Run/Stop Button Only when finished.

End of Procedure

Trigger Delay Jitter, Free Run Phase Corrected Mode

Equipment required	Synthesized signal generator (Item 33) 0.5 meter precision SMA cable (Item 17) 1.0 meter precision SMA cable (Item 18) Power divider (Item 28) One electrical sampling module (80E01, 80E02, 80E03, 80E04, 80E06, 80E07, 80E08, 80E09, or 80E10) 82A04 Phase Reference module
Prerequisites	As listed under <i>Prerequisites</i> on page 2-26.

Setup Install the test hookup (see Figure 2-20):

1. Install the 82A04 Phase Reference module into the right-most small module compartment of the instrument.
2. Install the 80E0X module into the left-most small module compartment of the instrument.
3. Connect the synthesized signal generator to a 1.0 meter cable.
4. Connect the remaining end of the 1.0 meter cable to a 50 Ω SMA power divider. Connect two 0.5 meter cables to the two remaining SMA power divider connectors.

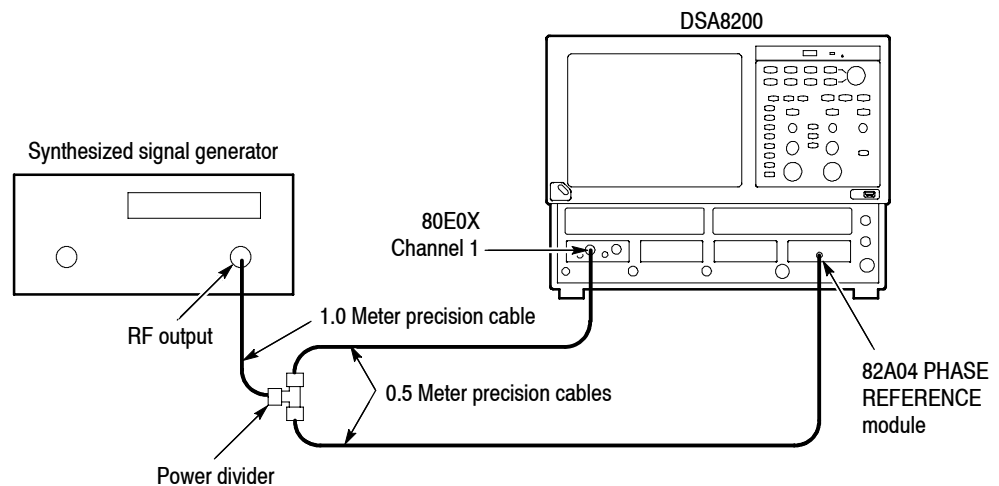


Figure 2-20: Phase corrected trigger jitter test hookup

5. Connect one of the 0.5 meter cables to Channel 1 of the 80E0X module.
6. Connect the remaining 0.5 meter cable to the 82A04 Phase Reference module. Use the cable adapter supplied with the 82A04 module.
7. Set the synthesized signal generator frequency to 10.0 GHz.
8. Set the Synthesized output to 1.6 V_{p-p} (800 mV_{p-p} displayed).
9. Make the following settings to the instrument:
 - a. Select Default Setup from the Utilities menu on the menu bar at top of display.
 - b. Select C1 from the Waveform Selector menu on the controls bar at the bottom of the display (left corner).
 - c. In the Phase Ref Setup dialog box:
 - Set phase correction to Free Run.
 - Set source to C7_C8.
 - Set input freq to 10.00 GHz.
 - Press the Characterize button and follow the onscreen instructions.
 - d. In the Vert Setup dialog box:
 - Set Scale to 1 mV/division.
 - Set Offset to 0.
 - e. In the Horz Setup dialog box:
 - Set Scale to 200 fs/division.
 - Set Horizontal Reference to 0%.
 - Set Position to 20 ns (set to 29 ns for 80E07, 80E08, 80E09, and 80E10).
 - Set Record Length to 2000.

Test Follow this procedure to make the phase corrected jitter check:

1. In the Meas Setup dialog box:
 - a. Select Meas 1 and make sure the Source 1 button is selected.
 - b. Make sure the channel under test and Pulse are selected in the Source tab, and then choose Select Meas > Pulse - Amplitude > Amplitude.
 - c. Select Meas 2 and make sure the Source 1 button is selected.

- d. Make sure both the channel under test and Pulse are selected in the Source tab, and then choose Select Meas > Pulse - Timing > RMS Jitter. Dismiss any database notification that pops up.
 - e. Check the Use Wfm Database box in the Source tab.
2. In the Wfm Database dialog box, check Display in the Database.

NOTE. *The instrument will select whichever of the two databases that is not in use. Turn on Display Database for the database that shows the current channel in the Source box. Deselect Database On for the other database.*

3. Set the Horizontal Scale to 2 ps/division, and position the rising edge until it goes through the center of the display (where the center horizontal and vertical graticules cross).
4. Set the Vertical Scale to 5 mV/division.
5. In the Acq Setup dialog box, set Stop After to Condition and set the Number of Acquisitions to 400.
6. Press CLEAR DATA, and then press the RUN/STOP button. The instrument will acquire 400 acquisitions and stop. This takes a couple of seconds.
7. Take several RMS Jitter readings and enter the average value on the Test Record. Typically this value will be 200 fs or less. Jitter in free run phase corrected mode does not have a guaranteed specification.
8. Repeat the setup (from step 9 under Setup) and the test for all 80E00 series modules installed. Check one input per module (e.g. channels 1, 3, and 5).
9. Disconnect the test setup.

End of Procedure

External Prescaled Trigger Delay Jitter, Short-Term Optimized Mode and Locked-to-Internal 10-MHz Reference Mode

Equipment required	Synthesized signal generator (Item 33) 0.5 meter precision SMA cable (Item 17) 1.0 meter precision SMA cable (Item 18) Power divider (Item 28) One electrical sampling module (80E01, 80E02, 80E03, 80E04, 80E06, 80E07, 80E08, 80E09, and 80E10)
Prerequisites	As listed under <i>Prerequisites</i> on page 2-26.

Setup

Install the test hookup:

1. Install the 80E0X module into the left-most small module compartment of the instrument (see Figure 2-21 on page 2-101).
2. Connect the synthesized signal generator to a 1.0 meter cable.
3. Connect the remaining end of the 1.0 meter cable to a 50 Ω SMA power divider. Connect two 0.5 meter cables to the two remaining SMA power divider connectors.
4. Connect one of the 0.5 meter cables to Channel 1 of the 80E0X module. Connect the remaining 0.5 meter cable to the TRIGGER PRESCALE INPUT.

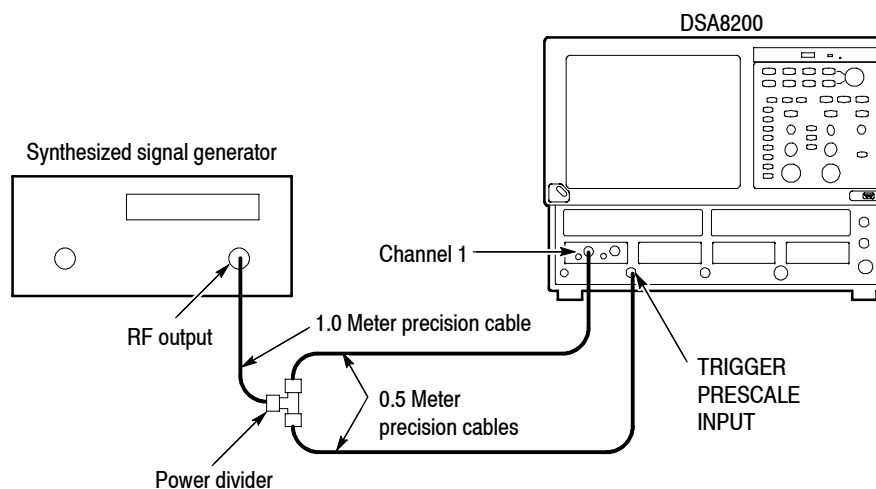


Figure 2-21: External prescaled test hookup

5. Set the synthesized signal generator frequency to 2.5 GHz.

6. Set the Synthesized output to 1600 mV_{p-p} (800 mV displayed)
7. Set up the instrument as follows:
 - a. Select Default Setup from the Utilities menu on the menu bar at top of display.
 - b. Select C1 from the Waveform Selector menu on the controls bar at the bottom of the display (left corner).
 - c. In the Trig Setup dialog box, select External Prescaler for Trigger Source.
 - d. In the Vert Setup dialog box:
 - Set Scale to 100 mV/division.
 - Set Offset to 0.
 - e. In the Horz Setup dialog box:
 - Set Scale to 200 ps/division.
 - Set Horizontal Reference to 0%.
 - Set Position to 19 ns (29 ns if using 80E07, 80E08, 80E09, 80E10).
 - Set All Timebases Mode to Short Term Jitter.

Test Follow this procedure to make the external prescale check:

1. In the Meas Setup dialog box:
 - a. Select Meas 1 and make sure the Source 1 button is selected.
 - b. Make sure both the channel under test and Pulse are selected in the Source tab, and then choose Select Meas > Pulse - Amplitude > Amplitude.
 - c. Check the Use Wfm Database box in the Source tab.
 - d. Select Meas 2 and make sure the Source 1 button is selected.
 - e. Make sure both the channel under test and Pulse are selected in the Source tab, and then choose Select Meas > Pulse - Timing > RMS Jitter. Dismiss any database notification that pops up.
 - f. Check the Use Wfm Database box in the Source tab.
2. In the Wfm Database dialog box, check Display in the Database.
3. Adjust the synthesizer signal generator level until the amplitude measurement readout on the instrument screen indicates the amplitude is 800 mV.

- 4.** In the Horiz dialog box:
 - a.** Set the Horizontal Scale to 20 ps/division and position the rising edge until it goes through the center line of the display.

Verify that the the RMS Jitter read out on the instrument screen is less than 1.5 ps.
 - b.** Under All Timebases, set Mode to Lock Int. 10 MHz and position the rising edge until it goes through the center of the display (crossing of the center horizontal and vertical graticule).

Verify that the RMS Jitter is less than 2.5 ps.

End of Procedure

External Prescaled Trigger Sensitivity

Equipment required	Synthesized signal generator (Item 33) 0.5 meter precision SMA cable (Item 17) 1.0 meter precision SMA cable (Item 18) Power divider (Item 28) One electrical sampling module (80E01, 80E02, 80E03, 80E04, 80E06, 80E07, 80E08, 80E09, and 80E10)
Prerequisites	As listed under <i>Prerequisites</i> on page 2-26.

Setup Install the test hookup:

1. Install the 80E0X module into the left-most small module compartment of the instrument (see Figure 2-22 on page 2-104).
2. Connect the synthesized signal generator to a 1.0 meter cable.
3. Connect the remaining end of the 1.0 meter cable to a 50 Ω SMA power divider. Connect two 0.5 meter cables to the two remaining SMA power divider connectors.

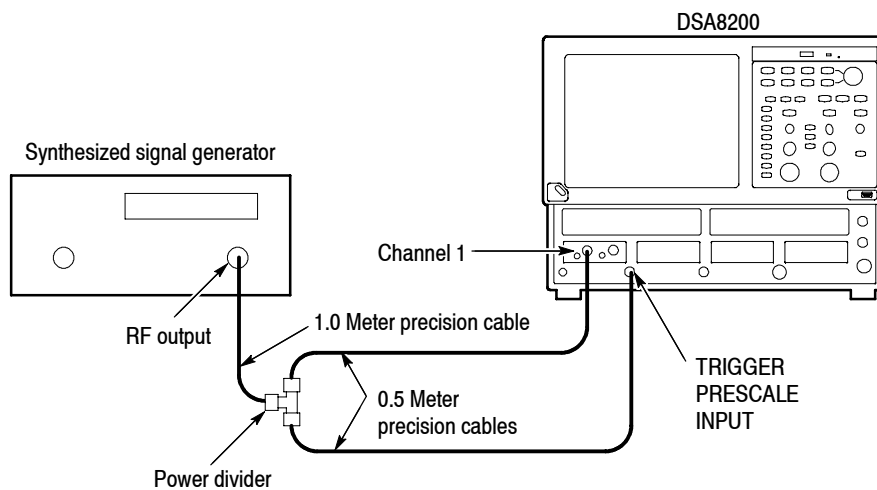


Figure 2-22: External prescaled trigger sensitivity test hookup

4. Connect one of the 0.5 meter cables to Channel 1 of the 80E0X module. Connect the remaining 0.5 meter cable to the TRIGGER PRESCALE INPUT.
5. Set the synthesized signal generator frequency to 2 GHz (500 ps period).

6. Set the synthesized output to 400 mV_{p-p} (200 mV displayed).
7. Make the following settings to the instrument:
 - a. Select Default Setup from the Utilities menu on the menu bar at top of display.
 - b. Select C1 from the Waveform Selector menu on the controls bar at the bottom of the display (left corner).
 - c. In the Trig Setup dialog box, select External Prescaler for Trigger Source.
 - d. In the Vert Setup dialog box:
 - Set Scale to 50 mV/division.
 - Set Offset to 0.
 - e. In the Horz Setup dialog box:
 - Set Scale to 200 ps/division.
 - Set Position to 19 ns (29 ns if using 80E07, 80E08, 80E09, 80E10).
 - Set Horizontal Reference to 0%.
 - Set All Timebases Mode to Short Term Jitter.

Test Follow this procedure to make the prescaled trigger sensitivity check:

1. In the Meas Setup dialog box:
 - a. Select Meas 1 and make sure the Source 1 button is selected.
 - b. Make sure both the channel under test and Pulse are selected in the Source tab, and then choose Select Meas > Pulse - Amplitude > Amplitude.
 - c. Select Meas 2 and make sure the Source 1 button is selected.
 - d. Make sure both the channel under test and Pulse are selected in the Source tab, and then choose Select Meas > Pulse - Timing > Frequency.

2. Adjust the synthesizer signal generator frequency and level to the following:

Synthesizer signal generator

Frequency	Level (amplitude measurement readout on instrument)
2 GHz to 12 GHz in 1 GHz increments	200 mV
2 GHz to 12 GHz in 1 GHz increments	800 mV

3. Adjust the Horizontal Scale to allow two full periods to be displayed.
4. Verify that the frequency read out on the instrument screen is within 10% from the true value.
5. Repeat steps 2 through 4 for each frequency setting.
6. Disconnect the test setup.

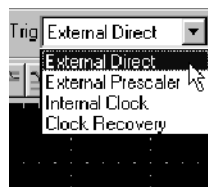
End of Procedure

DC Calibration Output

Equipment required	Digital multimeter, such as the Keithley 2000-20 (Item 20) SMA "T" 1 male to 2 SMA female (Item 5) Cap, 50 Ω , 0.5 W, SMA male (Item 41) 50 Ω , 39.37 in (1.0 m), male-to-male SMA connectors (Item 18) SMA female to BNC male connectors (Item 3) BNC to banana plug adapter 103-0090-00 (Item 4)
Prerequisites	One electrical sampling module (80E01, 80E02, 80E03, 80E04, 80E06, 80E07, 80E08, 80E09, and 80E10)

Setup Install the test hookup:

1. Push the front-panel DEFAULT SETUP button and click Yes in the confirmation dialog box.
2. In the UI application toolbar, select External Direct from the Trig list box as shown below.



3. Connect the SMA male connector of the T-connector to the DC CALIBRATION output on the front panel as shown in Figure 2-23.
4. Connect the SMA 50 Ω terminator to one of the Female legs of the T-connector.
5. Connect one end of a 50 Ω SMA coax cable to the other leg of the T-connector.
6. Connect the other end of the 50 Ω SMA coax cable to a digital multimeter (DMM) using a SMA BNC adapter and a BNC to banana plug adapter.
7. Set the multimeter to read DC volts.

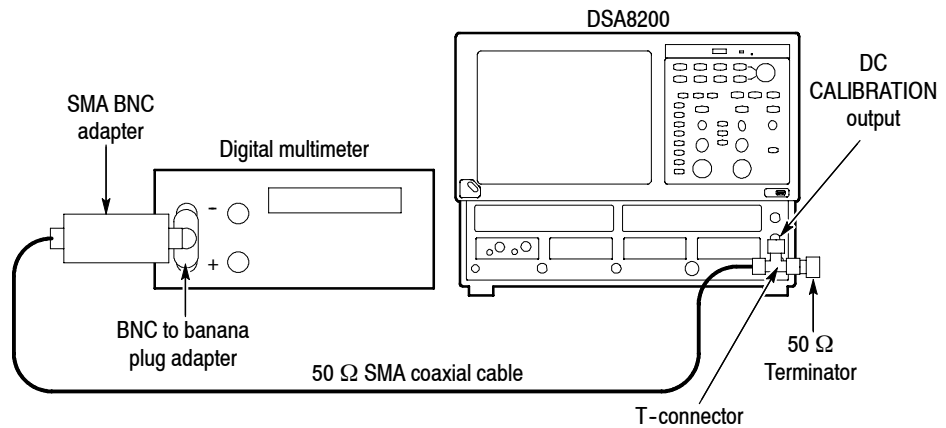


Figure 2-23: DC calibration test hookup

Test Follow this procedure to make the DC calibration output check:

1. Set the DC CALIBRATOR OUTPUT:
 - a. Push the Vertical MENU front-panel button. This displays the Vert Setup dialog box.
 - b. Set the amplitude in the DC CAL box to each of the following settings and record the DMM readings in the test record.
 - +1.0 V
 - 0.0 V
 - -1.0 V
2. Check the readings against the limits in the test records.
3. Push the Vertical MENU front-panel button again to dismiss the Vert Setup dialog box.
4. Disconnect the test setup.

Electrical Sampling Modules

These procedures check those characteristics that relate to the electrical sampling modules and are listed and checked in the *Specifications* chapter. Refer to Table 1-12 on page 1-14.

NOTE. *The test hookups in the procedures illustrate an electrical module installed into a small compartment. The 80E07, 80E08, 80E09, and 80E10 Electrical Sampling Remote modules functionally operate the same as the non-remote modules, using a similar hookup.*

Prerequisites

Be sure you have performed the following prerequisites and the *Prerequisites* on page 2-26 before doing any procedures in this section.

- Install the 80E0X modules in one of the small compartments in the instrument.
- Check 80E0X module push-buttons: Push the channel 1 and channel 2 buttons and observe that the yellow indicator lights turn on. Push them again and observe that the lights turn off. Note that there are two push-buttons per channel on the 80E07, 80E08, 80E09, and 80E10: one on the main module and one on the remote head. Check both of these.

NOTE. *Use a calibrated torque wrench when connecting the terminators, adapters, attenuator, and power sensor in this setup. Use 8 ± 0.3 inch pounds of torque.*

STOP. *When a procedure calls for the display of setup dialog boxes, you can display them from the Setup menu in the menu bar at the top of the screen. These procedures assume you will display and dismiss them as needed.*

STOP. *The procedures throughout this chapter contain instructions based on the menus and controls from the most updated instrument software available at the time this document was released. These procedures will work for other versions of software, but some control and menu names may vary slightly.*

Input Impedance

These procedures check those characteristics that relate to the signal acquisition and are listed as checked in the *Specifications* chapter. Refer to Table 1-12, page 1-14.

Equipment required	Digital multimeter (Item 20) Cable, coaxial 50 Ω , 20 in (0.5m), male-to-male SMA (Item 17) Adapter, SMA female to BNC male connectors (Item 3) Adapter, BNC to dual banana plugs (Item 4)
Prerequisites	As listed on page 2-26 and under <i>Prerequisites</i> on page 2-109.

Setup Install the test hookup:

1. Install the 80E0X module into the left-most small module compartment of the main instrument (see Figure 2-24).
2. Connect the Digital multimeter to Channel 1 of the 80E0X module. See Figure 2-24.

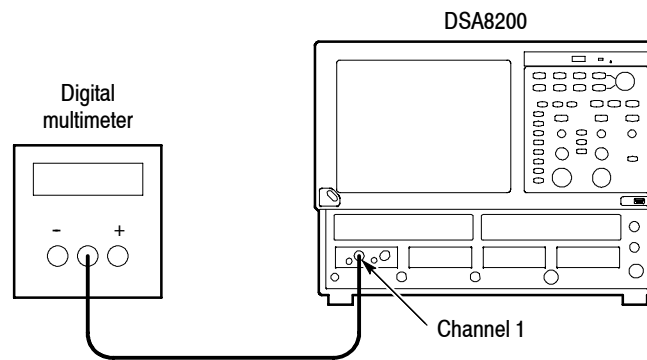


Figure 2-24: Input impedance test hookup

3. Set up the main instrument as follows:
 - a. Select C1 from the Waveform Selector menu on the controls bar at the bottom of the display (left corner).
 - b. In the Trig Setup dialog box, select Internal Clock (200 kHz).
 - c. In the Vert Setup dialog box, set Offset to 0.0 V.

- d. In the Horz Setup dialog box:
 - Set Scale to 2 ns/division.
 - Set Position to 0 (this will revert to a minimum non-zero value).
 - Set Horizontal Reference to 0%.
- e. In the Acq Setup dialog box, set Acquisition Mode to Sample.

Test Follow this procedure to make the input impedance check:

1. Set the Digital multimeter to the ohm mode.
2. Record InputR reading on the Digital multimeter.
3. Reverse polarity and record InputR reading on the Digital multimeter.
4. Check average of *InputR* and *reverse-InputR*:
 - 80E01, 80E02, 80E03, 80E04, 80E06 $\leq 50.5 \Omega$ and $\geq 49.5 \Omega$
 - 80E07, 80E08, 80E09, 80E10 $\leq 51 \Omega$ and $\geq 49 \Omega$
5. *80E04 Only*: Set the Digital multimeter to volt mode at the minimum range (≤ 100 mV).
6. *80E04 Only*: Record reading on the Digital multimeter as baseline voltage.
7. *80E04 Only*: Check baseline voltage for $\leq \pm 1$ mV. Enter value on test record.
8. Make the following settings, and then repeat steps 1 through 7 to check channel 2.
 - a. Select the next channel to test (if any) from the Waveform Selector menu on the controls bar at the bottom of the display (left corner).
 - b. In the Vert Setup dialog box, set Offset to 0.0 V.
9. Disconnect the test setup.

End of Procedure

DC Voltage Measurement Accuracy

These procedures check those characteristics that relate to the signal acquisition and are listed as checked in the *Specifications* chapter. Refer to Table 1-12, page 1-14.

Equipment required	Digital Multimeter (Item 20) DC Power Supply (Item 21) SMA "T", male to 2 SMA female (Item 5) Two 50 Ω , precision coaxial cables, SMA connectors (Item 17) Adapter, SMA female to BNC male connectors (Item 3) Adapter, BNC to dual banana plugs (Item 4)
Prerequisites	As listed on page 2-26 and under <i>Prerequisites</i> on page 2-109.



WARNING. *Improper operation of the DC Power Supply may create a shock hazard.*



CAUTION. *To avoid damage to the electrical module, do not exceed 2 volts input.*

Setup

Install the test hookup:

1. Perform instrument and module compensation, see *Perform the Compensation* on page 2-5.
2. Set the output of a DC power supply to off or 0 volts.
3. Connect a SMA T to Channel 1 of the sampling module.
4. Connect a 50 Ω precision coaxial cable to one side of the SMA T. Connect a 50 Ω precision coaxial cable to the remaining side of the SMA T. See Figure 2-25.
5. Connect one 50 Ω precision coaxial cable to the output of a DC power supply through a dual-banana connector. Connect the remaining 50 Ω precision coaxial cable to a digital multimeter. See Figure 2-25.

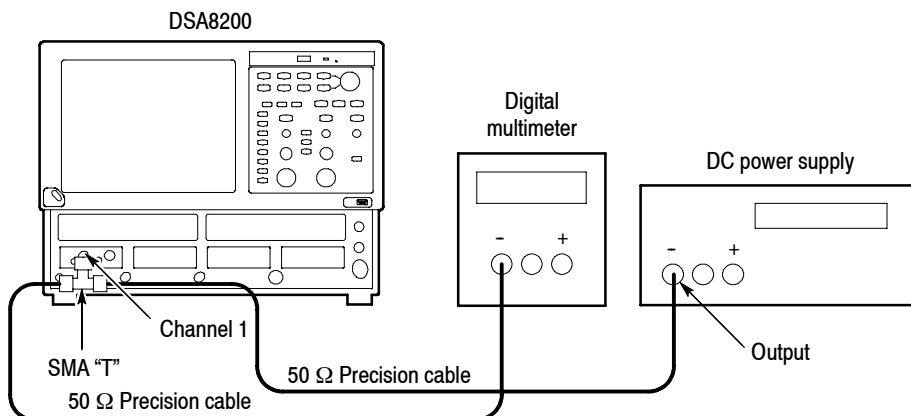


Figure 2-25: Vertical DC accuracy test hookup

6. Set up the main instrument as follows:
 - a. Select C1 from the Waveform Selector menu on the controls bar at the bottom of the display (left corner).
 - b. In the Trig Setup dialog box, set Trigger Source to Internal Clock.
 - c. In the Acq Setup dialog box:
 - Set Acquisition Mode to Average, 32 samples.
 - Under Stop After, check the Condition box, and select Average Complete from the pull-down menu.
 - d. In the Horz Setup dialog box:
 - Set Scale to 2 ns/division.
 - Set Position to 0 (this will revert to a minimum non-zero value).
 - Set Horizontal Reference to 0%.

- e. In the Meas Setup dialog box:
- Select Meas 1 and make sure the Source 1 button is selected.
 - Make sure both the channel under test and Pulse are selected in the Source tab, and then choose Select Meas > Pulse - Amplitude > Mean.
- f. In the Vert Setup dialog box, set Scale to 100 mV/division.

Table 2-2: DC voltage measurement accuracy

Module	DC power supply settings	Offset settings	Accuracy limits
80E01	-1550 mV	-1100 mV	± 18.7 mV
80E02	-1350 mV	-1100 mV	± 14.7 mV
80E03	-1100 mV	-1100 mV	± 9.7 mV
80E04	-850 mV	-1100 mV	± 14.7 mV
80E06	-650 mV	-1100 mV	± 18.7 mV
	-450 mV	0 mV	± 11 mV
	-250 mV	0 mV	± 7 mV
	0 mV	0 mV	± 2 mV
	+250 mV	0 mV	± 7 mV
	+450 mV	0 mV	± 11 mV
	+650 mV	+1100 mV	± 18.7 mV
	+850 mV	+1100 mV	± 14.7 mV
	+1100 mV	+1100 mV	± 9.7 mV
	+1350 mV	+1100 mV	± 14.7 mV
	+1550 mV	+1100 mV	± 18.7 mV

Table 2-2: DC voltage measurement accuracy (cont.)

Module	DC power supply settings	Offset settings	Accuracy limits
80E07	-1050 mV	-600 mV	± 15.2 mV
80E08	-850 mV	-600 mV	± 11.2 mV
80E09	-600 mV	-600 mV	± 6.2 mV
80E10	-350 mV	-600 mV	± 11.2 mV
	-150 mV	-600 mV	± 15.2 mV
	-450 mV	0 mV	± 11 mV
	-250 mV	0 mV	± 7 mV
	0 mV	0 mV	± 2 mV
	+250 mV	0 mV	± 7 mV
	+450 mV	0 mV	± 11 mV
	+150 mV	+600 mV	± 15.2 mV
	+350 mV	+600 mV	± 11.2 mV
	+600 mV	+600 mV	± 6.2 mV
	+850 mV	+600 mV	± 11.2 mV
	+1050 mV	+600 mV	± 15.2 mV

Test Follow this procedure to make the Vertical DC accuracy checks:

1. Select the DC supply voltage to the settings listed in Table 2-2 based on the module being tested.
2. Press the CLEAR DATA button on the front panel.
3. Press the RUN/STOP button on the front panel.
4. Record input voltage reading on the digital multimeter.
5. Record the voltage for the Mean measurement displayed on the main instrument screen.
6. Calculate DC voltage accuracy: $error = input\ V - meas\ V$.
7. CHECK that the error calculated in step 6 is within the limits listed Table 2-2 for the associated vertical scale and offset and DC voltage settings. Enter the value on test record.
8. Repeat steps 1 through 7 until all DC voltage and offset settings, listed in Table 2-2, are checked for the channel under test.

9. Change all settings in the setup to Channel 2, and then repeat steps 1 through 7 until all DC voltage settings and offset settings, listed in Table 2-2, are checked.

End of Procedure

Test Follow this procedure to make the DC vertical voltage accuracy, single point, compensated checks:

The gain of the 80E00 is equal to the slope of a regression line of the paired measurement readings in Table 2-3, with the V_{in} values plotted along the x axis, and the measured values plotted along the Y axis.

Linear least squares fit algorithm:

$y = ax + b$ where

$$a = (nS_{xy} - S_x S_y) / (nS_{xx} - S_x^2)$$

$$b = (S_{xx} S_y - S_{xy} S_x) / (nS_{xx} - S_x^2)$$

$x = \text{abscissa (controlled value)}$

$y = \text{ordinate (measured value)}$

$$S_x = \text{Sum}(x)$$

$$S_{xx} = \text{Sum}(x^2)$$

$$S_{xy} = \text{Sum}(xy)$$

$$S_y = \text{Sum}(y)$$

$n = \text{number of points}$

1. Set up the main instrument as follows:
 - a. Select C1 from the Waveform Selector menu on the controls bar at the bottom of the display (left corner).
 - b. In the Acq Setup dialog box:
 - Set Acquisition Mode to Average, 16 samples.
 - c. In the Vert Setup dialog box:
 - Set Scale to 100 mV/division.
 - Set Offset to 0 mV.
 - d. In the Meas Setup dialog box:
 - Select Meas 1 and make sure the Source 1 button is selected.
 - Make sure both the channel under test and Pulse are selected in the Source tab, and then choose Select Meas > Pulse - Amplitude > Mean.
2. Set the $V_{in} = -450$ mV.

3. Read DVM measurement and record it in the *Input V_{in}* and the *x* columns, Table 2-3 on page 2-119.
4. Read mean measurement and record it in the *Measured V, mV* and *y* columns, Table 2-3.
5. Repeat steps 2-3 for all other V_{in} .
6. Calculate S_x , S_{xx} , S_y , and S_{xy} , for each setting:
 - a. Copy the *Input V_{in}* value to *x* column.
 - b. Copy the *Measured V, mV* value to *y* column.
 - c. Calculate x^2 and record in x^2 column.
 - d. Calculate xy and record in xy column.
 - e. Add the up the *x*, x^2 , *y* and xy columns and record the sums in the S_x , S_{xx} , S_y and S_{xy} columns.
7. Calculate a, b.
 - a. Calculate a = (see algorithm on page 2-117)
 - b. Calculate b = (see algorithm on page 2-117)
8. Calculate $Y = ax+b$ for all *x*.
9. Calculate the deviation of *Measured $V - Y$* for all *x*.

Table 2-3: Data for calculation of gain and linearity

V_{in} mV	Input V_{in}	Measured V, mV	x	x^2	y	xy	$Y = ax+b$	Deviation	lower limit	upper limit
-450									-10	+10
-350									-10	+10
-250									-10	+10
-150									-10	+10
-50									-10	+10
50									-10	+10
150									-10	+10
250									-10	+10
350									-10	+10
450									-10	+10
									-10	+10
n			S_x	S_{xx}	S_y	S_{xy}				

10. Change all settings in the setup to Channel 2, and then repeat steps 1 through 9 until all DC vertical voltage accuracy, single point, compensated calculations listed in Table 2-3 on page 2-119 are checked.

11. Disconnect the test setup.

End of Procedure

Random Noise, Displayed

These procedures check those characteristics that relate to the signal acquisition and are listed as checked in the *Specifications* chapter. Refer to Table 1-12, page 1-14.

Equipment required	No external equipment required
Prerequisites	As listed on page 2-26 and under <i>Prerequisites</i> on page 2-109.

Setup No test equipment hook up is required.

1. Set up the main instrument as follows:
 - a. Press the DEFAULT SETUP button on the main instrument front panel.
 - b. Select C1 from the Waveform Selector menu on the controls bar at the bottom of the display (left corner).
 - c. In the Trig Setup dialog box, set Trigger Source to Internal Clock (200 kHz).
 - d. In the Acq Setup dialog box:
 - Set Acquisition Mode to Sample.
 - Under Stop After, select Number of Acquisitions from the pull down menu. Enter 96 for the number of acquisitions and check Condition.
 - e. In the Horz Setup dialog box:
 - Set Record length to 1000 points.
 - Set Scale to 1 ps/division.
 - Set Position to 0 (this will revert to a minimum non-zero value).
 - Set Horizontal Reference to 0%.
 - f. In the Vert Setup dialog box:
 - Set Scale to 2 mV/division if testing with an 80E01 or 80E06 module; set to 1 mV/division for all other modules.
 - Set Offset to 0 mV.
 - Set Bandwidth to the maximum setting (module dependant).

Test Follow this procedure to make the Random noise checks:

1. Wfm Database Setup dialog box, click Display in the Database and set Source to C1.

2. In the Hist Setup dialog box, select Vertical and Enable Histogram in the Source.
3. Adjust the right and left side histogram window to the cover all the horizontal divisions.
4. Position the top histogram window three divisions above the center line.
5. Position the bottom histogram window three divisions below the center line.
6. Press the CLEAR DATA button on the front panel.
7. Press the RUN/STOP button on the front panel.
8. Record the noise V STD DEV reading.
9. Check noise V for the module tested in Table 2-4.

Table 2-4: Random noise limits

Module	Bandwidth setting	Noise limit
80E01		$\leq 2.3 \text{ mV}$
80E02		$\leq 800 \mu\text{V}$
80E03, 80E04		$\leq 1.2 \text{ mV}$
80E06		$\leq 2.4 \text{ mV}$
80E07, 80E08	30 GHz BW setting	$\leq 410 \mu\text{V}$
	20 GHz BW setting	$\leq 380 \mu\text{V}$
80E09	60 GHz BW setting	$\leq 600 \mu\text{V}$
	40 GHz BW setting	$\leq 480 \mu\text{V}$
	30 GHz BW setting	$\leq 410 \mu\text{V}$
80E10	50 GHz BW setting	$\leq 700 \mu\text{V}$
	40 GHz BW setting	$\leq 480 \mu\text{V}$
	30 GHz BW setting	$\leq 410 \mu\text{V}$

10. Repeat steps 1 through 8 for each bandwidth setting.
11. Repeat steps 1 through 8 for channel 2.

End of Procedure

Analog Bandwidth up to 50 GHz (80E01, 80E06, 80E07, 80E08, 80E09, 80E10)

These procedures check those characteristics that relate to the signal acquisition and are listed as checked in the *Specifications* chapter. Refer to Table 1-12, page 1-14. This check has two procedures that characterizes the reference signals. The last procedure characterizes the sampling module.

NOTE. *This test setup is limited to 50 GHz. To test modules with a bandwidth above this, you will also need to perform the Analog Bandwidth to 60 GHz procedure.*

Equipment required	Synthesized signal generator (Item 33) Power meter (Item 26) Power sensor (Item 27) Adapter, 2.4 mm male-to-male (Item 1) Adapter, 2.4 mm female-to-female (Item 2) Attenuator, 10 dB pad (Item 6) Cable, special, power/phase stability (Item 16)
Prerequisites	As listed on page 2-26 and under <i>Prerequisites</i> on page 2-109.

Power-Reference Characterization Setup

Install the test hookup to measure the power reference:

NOTE. *Use a torque wrench when connecting the terminators, adapters, attenuator, and power sensor in this setup. Use 8 ± 0.3 inch pounds of torque.*

1. Connect the 10 dB attenuator to the Synthesized signal generator. Connect the remaining end to the power sensor. Connect the power sensor to the power meter.

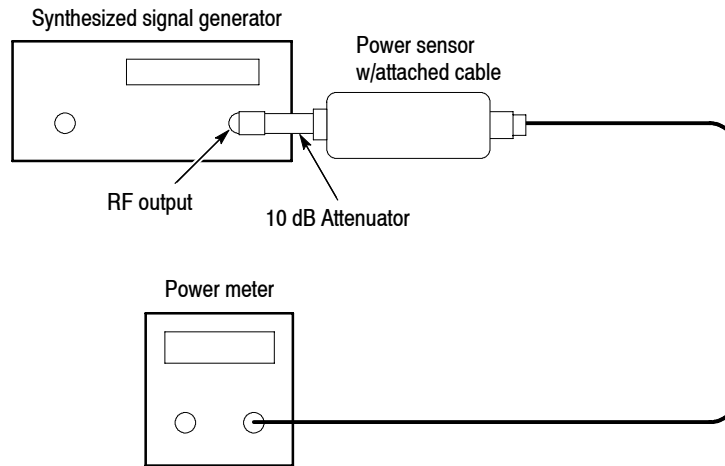


Figure 2-26: Power-reference hookup

Ref.-Characterization Measurements

Follow this procedure to characterize the reference signals:

1. Set the Synthesized signal generator to 0 dBm.
2. Set the signal frequency and the power meter frequency to each of the frequencies listed in the *Frequency* column of Table 2-5.

Table 2-5: Power reference

Frequency ¹	Reference Level dBm	Reference level with adapters dBm	2.4 mm female to female adapter loss dB
50 MHz			
4 GHz			
8 GHz			
12 GHz			
16 GHz			
20 GHz			
24 GHz			
28 GHz			
30 GHz			
32 GHz			
36 GHz			
40 GHz			

Table 2-5: Power reference (cont.)

Frequency ¹	Reference Level dBm	Reference level with adapters dBm	2.4 mm female to female adapter loss dB
44 GHz			
48 GHz			
50 GHz			

¹ You only need to characterize the frequency up to the maximum bandwidth of the module under test.

- Record the readings on the power meter in the *Reference Level dBm* column.

Adapter-Characterization Setup

Install the test hookup to characterize the adapter:

- Connect the 10 dB attenuator to the Synthesized signal generator. Connect the remaining end of the cable to the 10 dB attenuator. Connect the remaining end of the 10 dB attenuator to a 2.4 mm female-to-female adapter. Connect the remaining end of the 2.4 mm female-to-female adapter to the power sensor. Connect the remaining end of the power sensor to the power meter. See Figure 2-27 on page 2-124.

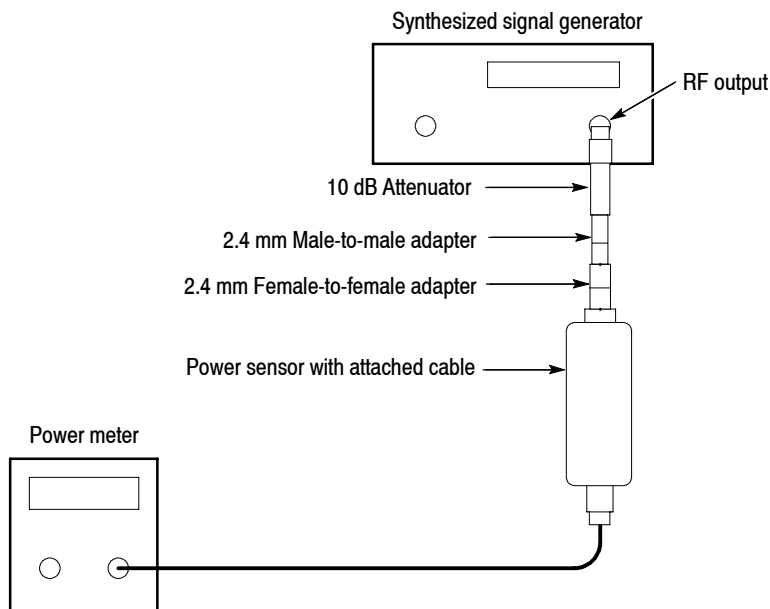


Figure 2-27: Adapter characterization hookup

**Adapter-Characterization
Measurements**

Follow this procedure to characterize the reference level with the adapters:

1. Set the signal frequency and the power meter frequency to each of the frequencies listed in the *Frequency* column, Table 2-5 on page 2-123.

NOTE. *You only need to characterize the reference level up to the maximum bandwidth of the module under test.*

2. Record the readings on the power meter in the *Reference level with the adapters dBm* column, Table 2-5 on page 2-123.
3. Calculate and record the *2.4 mm female-to-female adapter loss dB* in Table 2-5 on page 2-123 for all frequencies listed as follows:

$$((\text{Reference level with adapters dBm}) - (\text{Reference level dBm})) / 2$$

Setup

Install the test hookup to measure reference signals:

NOTE. *Use a torque wrench while connecting the adapters, power sensor in this setup. Use 8 ± 0.3 inch pounds of torque.*

1. Connect the cable to the Synthesized signal generator. Connect the remaining end of the cable to the 10 dB attenuator.
2. Connect the remaining end of the 10 dB attenuator to a 2.4 mm female-to-female adapter. Connect the remaining end of the 2.4 mm female-to-female adapter to the power sensor. Connect the remaining end of the power sensor to the power meter. See Figure 2-28 on page 2-126.

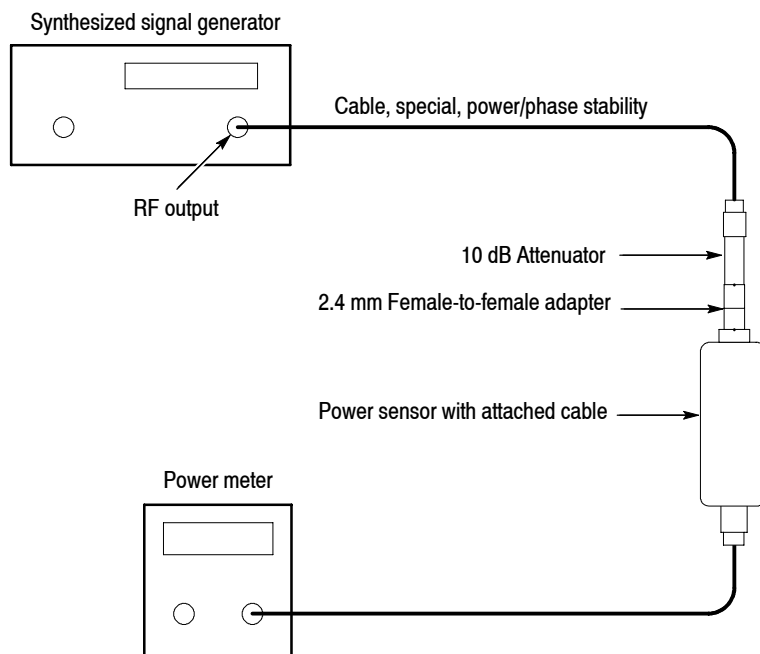


Figure 2-28: Measure reference signals

3. Set the synthesized signal generator to +3 dBm.
4. Set the signal frequency and the power meter frequency to each of the frequencies listed in the *Frequency* column, Table 2-6 on page 2-127.

NOTE. Only perform checks up to the maximum bandwidth of the module under test.

5. Adjust the RF signal level until the reading on the power meter is as close to -9 dBm as possible.
6. Record the Synthesized signal generator set level reading in the *Reference RF set level dBm* column, Table 2-6 on page 2-127.
7. Record the Power meter reading in the *Measured RF level dBm* column, Table 2-6 on page 2-127.
8. Calculate and record the *Reference RF level* in Table 2-6 for all frequencies listed as follows:

(Measured RF level) - (2.4mm female-to-female adapter loss dB) column, in Table 2-5 on page 2-123.

Table 2-6: DUT (device under test) reference response ¹

Frequency	Reference set level dBm	Measured RF level dBm	Reference RF level	Measured level											DUT response	
				80E01	80E06	80E07		80E08		80E09			80E10			
						20	30	20	30	30	40	60	30	40		50
50 MHz																
4 GHz																
8 GHz																
12 GHz																
16 GHz																
20 GHz																
24 GHz																
28 GHz																
30 GHz																
32 GHz																
36 GHz																
40 GHz																
44 GHz																
48 GHz																
50 GHz																

¹ Only perform checks up to the maximum bandwidth of the module under test.

Test Setup

Install the test hookup to measure the performance:

1. Install the module into the left-most small module compartment of the main instrument (see Figure 2-29).
2. Connect one end of the cable to the Synthesized signal generator. Connect the remaining end of the cable to the 10 dB attenuator.
3. Connect the remaining end of the 10 dB attenuator to the sampling module. See Figure 2-29 on page 2-128.

NOTE. Use a torque wrench while connecting the adapters, power sensor in this setup. Use 8 ± 0.3 inch pounds of torque.

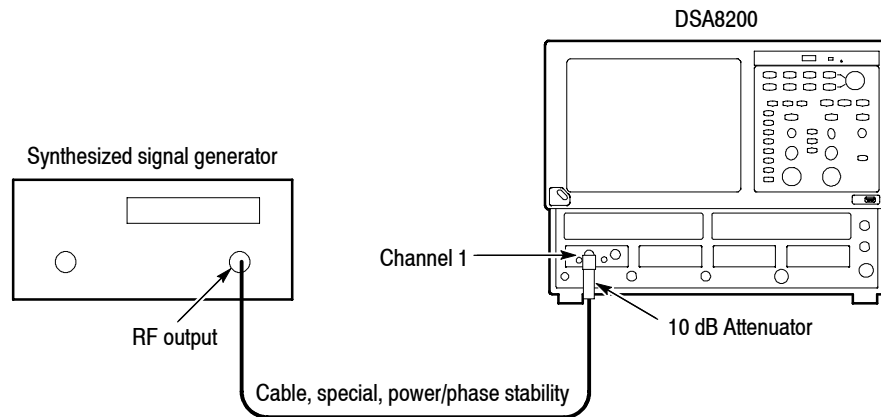


Figure 2-29: Reference signals hookup

4. Set up the main instrument as follows:
 - a. Select C1 from the Waveform Selector menu on the controls bar at the bottom of the display (left corner).
 - b. In the Trig Setup dialog box set Source to Internal Clock (200 kHz).
 - c. In the Acq Setup dialog box, set Acquisition Mode to Envelope.

- d. In the Horz Setup dialog box:
 - Set Record Length to 2000 points.
 - Set Position to 0 (this will revert to a minimum non-zero value).
 - Set Horizontal Reference to 0%.
- e. In the Vert Setup dialog box:
 - Set Scale to 35 mV/division.
 - Set Offset to 0.

Test Follow this procedure for the sampling module reference signals:

1. In the Meas Setup dialog box:
 - a. Select Meas 1 and make sure the Source 1 button is selected.
 - b. Make sure both the channel under test and Pulse are selected in the Source tab, and then choose Select Meas > Pulse - Amplitude > Amplitude.
2. Set the RF signal frequency listed in the *Frequency* column, Table 2-6 on page 2-127.
3. Set the RF signal level listed in the *Reference Set Level dBm* column, Table 2-6.
4. In the Horz Setup dialog box, set the main instrument Horizontal Scale to $(1/\text{Frequency})$, where Frequency is the RF signal frequency.
5. Press the CLEAR DATA button on the main instrument front panel.
6. Press the RUN/STOP button on the main instrument front panel.
7. Record amplitude reading readout and use the value as AMPLITUDE (Volts) in the step that follows.
8. Convert Volts to dBm as follows:

$$V_p = (\text{AMPLITUDE}/2)$$

$$V_{rms} = V_p / \text{SQRT}(2)$$

$$P1 = V_{rms} * V_{rms} / 50$$

$$\text{dBm} = 10 * \log(P1/0.001)$$
9. Record dBm in the *Measured level* column, Table 2-6 on page 2-127.

10. Repeat steps 2 through 9 for all frequencies listed in the *Frequency* column, Table 2-6 on page 2-127.

11. Calculate the DUT response as the difference between the *Measured level* column and the *Reference RF level* column in Table 2-6 as:

$$(Measured\ level) - (Reference\ RF\ level)$$

Record the calculation results in the *DUT Response* column Table 2-6 on page 2-127.

12. Calculate all frequencies listed in the *Frequency* column, Table 2-6 on page 2-127.

13. Find the maximum and minimum power points in the *DUT Response* column, Table 2-6 on page 2-127.

14. The maximum power minus the power at 50 MHz should be less than +3.0 dB. The minimum power minus the power at 50 MHz should be greater than -3.0 dB. The specification is ± 3.0 dB referenced to the 50 MHz.

15. Repeat the Setup and Test sections for all bandwidth settings.

16. Repeat the Setup and Test sections for channel 2.

17. Disconnect the test setup.

End of Procedure

Analog Bandwidth above 50 GHz (80E06 and 80E09)

These procedures check those characteristics that relate to the signal acquisition and are listed as checked in the *Specifications* chapter. Refer to Table 1-12, page 1-14.

This procedure checks the upper bandwidth of the 80E06 and 80E09 modules.

NOTE. This procedure checks tests the >50 GHz to 65 GHz frequencies. The procedure *Analog Bandwidth to 50 GHz* on page 2-122 checks the lower bandwidths.

Equipment required	Scalar network analyzer (SNA) (Item 44) Reflectometer, with OML DC power cable to dual banana plug (Item 46) Power meter (Item 47) Waveguide power sensor (Item 48) Waveguide section (Item 55) Adapter, Wave Guide-to-1.85 mm male (Item 53) Adapter, Wave Guide-to-1.85 mm female (Item 54) Cable, coaxial (Item 17) Cable, special, power/phase stability (Item 16) Cable, BNC (Item 19) Cable, 80E00 Series Extender (Item 56) BNC to banana adapter (Item 4)
Prerequisites	As listed on page 2-26 and under <i>Prerequisites</i> on page 2-109. You must have performed the procedure <i>Analog Bandwidth to 50 GHz</i> on page 2-122.

SNA & Reflectometer Characterization

Do the following steps to store reflected reference levels in the SNA:

NOTE. Use a torque wrench when connecting the terminators, adapters, attenuator, and power sensor in this setup. Use 8 ± 0.3 inch pounds of torque.

1. Refer to Figure 2-30 as you perform the following steps:
 - a. Connect the output of a +12 V power supply to the dual-banana plug end of the OLM DC power cable.

- b.** Connect the remaining end of the OLM DC power cable to the +12 V input of the Reflectometer.
- c.** Connect the RF output of the SNA to a Wave Guide-to-1.85 mm female adapter. Connect a 50 Ω , cable from the adapter to the the RF input of the Reflectometer.
- d.** Connect the Reflection output of the Reflectometer to Input B of the SNA through an Aritsu 560-10BX-2 cable.
- e.** Connect the Ref output of the Reflectometer to External Level input of the SNA the through a 50 Ω , BNC cable.
- f.** Connect one end of a Waveguide section to the DUT port of the Reflectometer.
- g.** Connect the Waveguide short directly to the remaining end of the Waveguide.

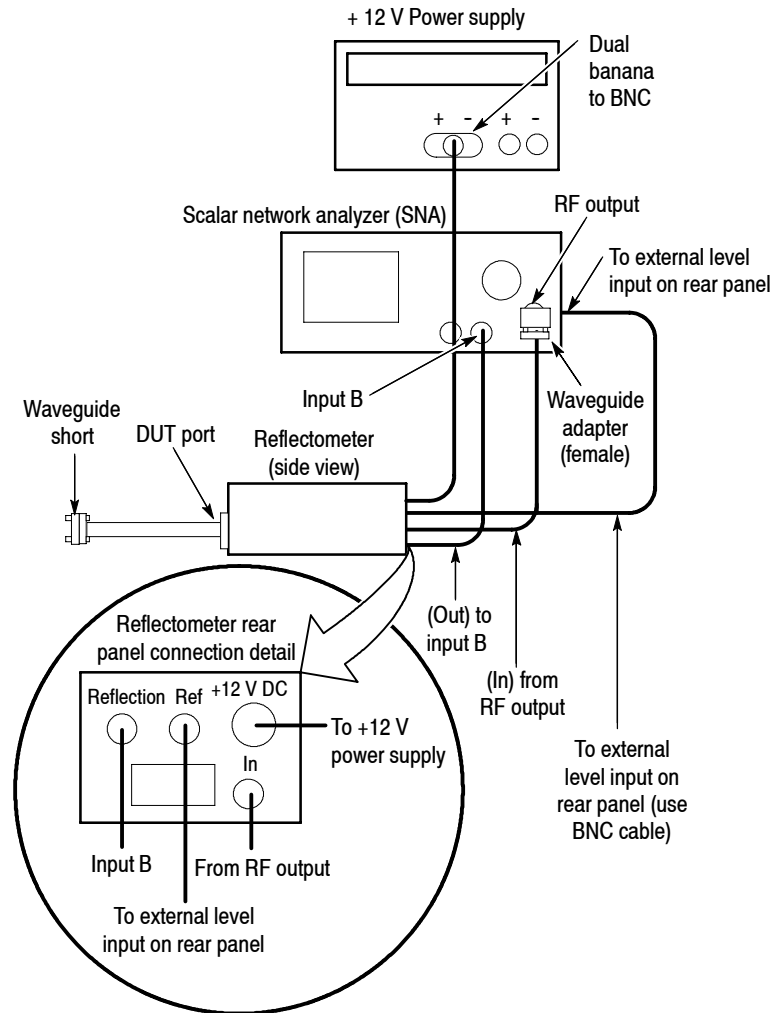


Figure 2-30: SNA/Waveguide characterization

2. Set the SNA as follows:
 - Output level +9 dBm
 - Frequency Multiplier 4
 - Frequency Span 50 GHz to 65 GHz
 - No. of Averages 8
 - Leveling External
 - Channel 1 Off
 - Channel 2 Input B
 - Channel 2 Meas/ Mode Return Loss
3. Press the Calibration key to start calibrating the SNA to the Reflectometer.
4. Follow the instructions on the SNA screen to complete the calibration, with the following exception: leave the Waveguide short connected to the Waveguide section throughout calibration. Ignore the instruction on screen to connect a Waveguide open.
5. Save the Cal/Setup in Memory Location 2.
6. Leave the test equipment hooked up for use in later steps. You will use it when you do the steps under *Measure the Power In*.

**Power-Meter/Power
Sensor Zero/Cal**

Follow this procedure to zero and calibrate the Waveguide power sensor to the Power meter:

1. Connect the Waveguide power sensor to the Power Ref output of the Power meter. See Figure 2-31.
2. Connect the attached cable end of the Waveguide power sensor to the channel input of the Power meter. See Figure 2-31.
3. Zero and Cal the Power meter to the Waveguide power sensor.

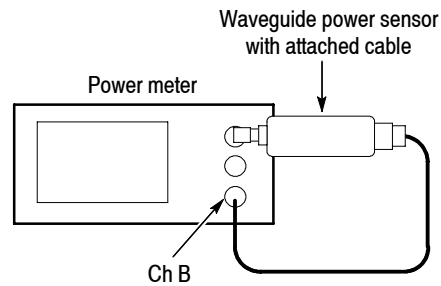


Figure 2-31: Power-reference characterization hookup

Measure the Power In

Follow this procedure to measure the power in of each SNA reference signal at each frequency.

1. Refer to Figure 2-32 as you perform the following substeps:
 - a. Start with the test hookup as was left from step 6 on page 2-134.
 - b. Remove the Waveguide short from the Waveguide section.
 - c. Connect the Waveguide power sensor directly to the Waveguide section.
 - d. Connect the attached cable of the Waveguide power sensor to the Ch B input of the Power meter.

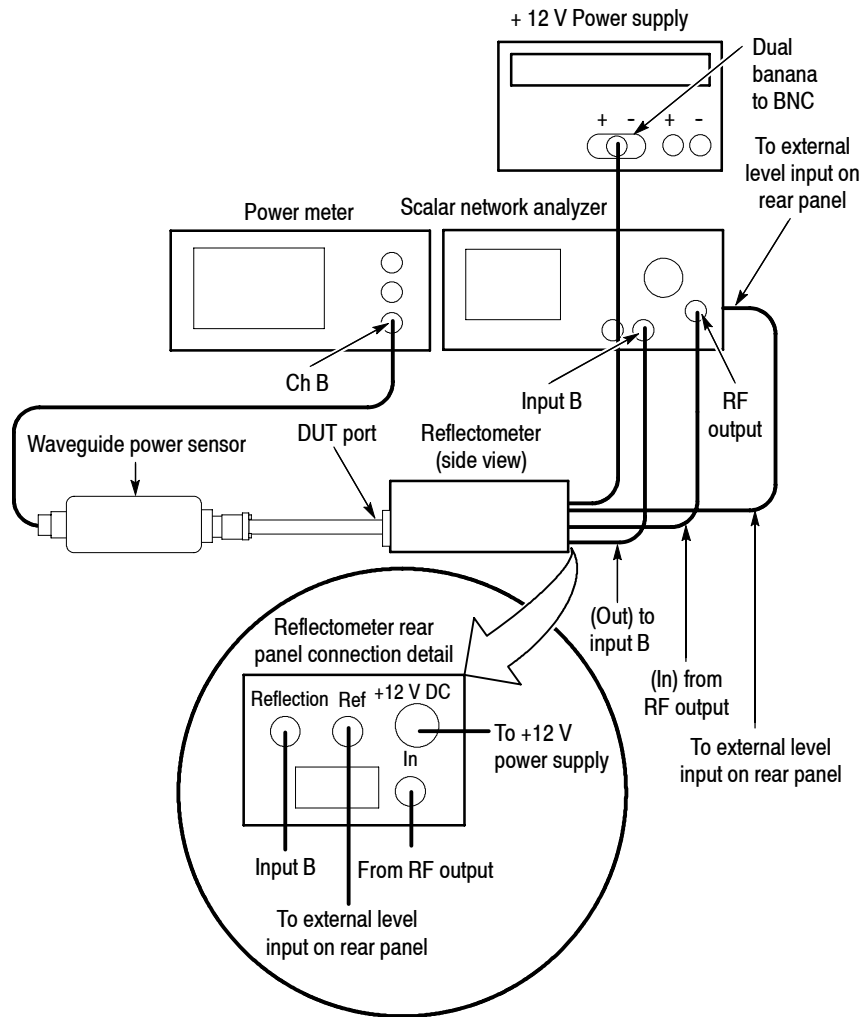


Figure 2-32: Hookup to measure Power-in

2. On the SNA, recall the Setup/Cal from Memory Location 2.
3. Set the SNA Frequency Span to 0 Hz to set the SNA to single frequency mode.
4. Perform the following substeps:
 - a. Set the SNA signal frequency and the Power meter frequency to each of the frequencies listed in the *Frequency* column, Table 2-7 on page 2-142.
 - b. In the Horz Setup dialog box, set the main instrument Horizontal Scale to $(1/\text{Frequency})$, where Frequency is the RF signal frequency.
 - c. Turn Trace Hold on the SNA to On.

- d. Record the reading on the power meter in the *Reference Level* column.
 - e. Turn Trace Hold on the SNA to Off.
5. Leave the test equipment hooked up for use in the steps under *Adapter Characterization*.

Adapter Characterization

Do the following procedure to derive the power loss of the adapters:

- 1. Refer to Figure 2-33 as you perform the following substeps:
 - a. Start with the test hookup as left from step 5 in the last procedure.
 - b. Disconnect the Waveguide power sensor from the Waveguide section.
 - c. Connect the 1.85 mm end of a Waveguide-to-1.85 mm female adapter to the 1.85 mm end of a Waveguide-to-1, 85 mm male adapter.
 - d. Install the set of combined adapters between the Waveguide power sensor and the Waveguide section as is shown in Figure 2-33.

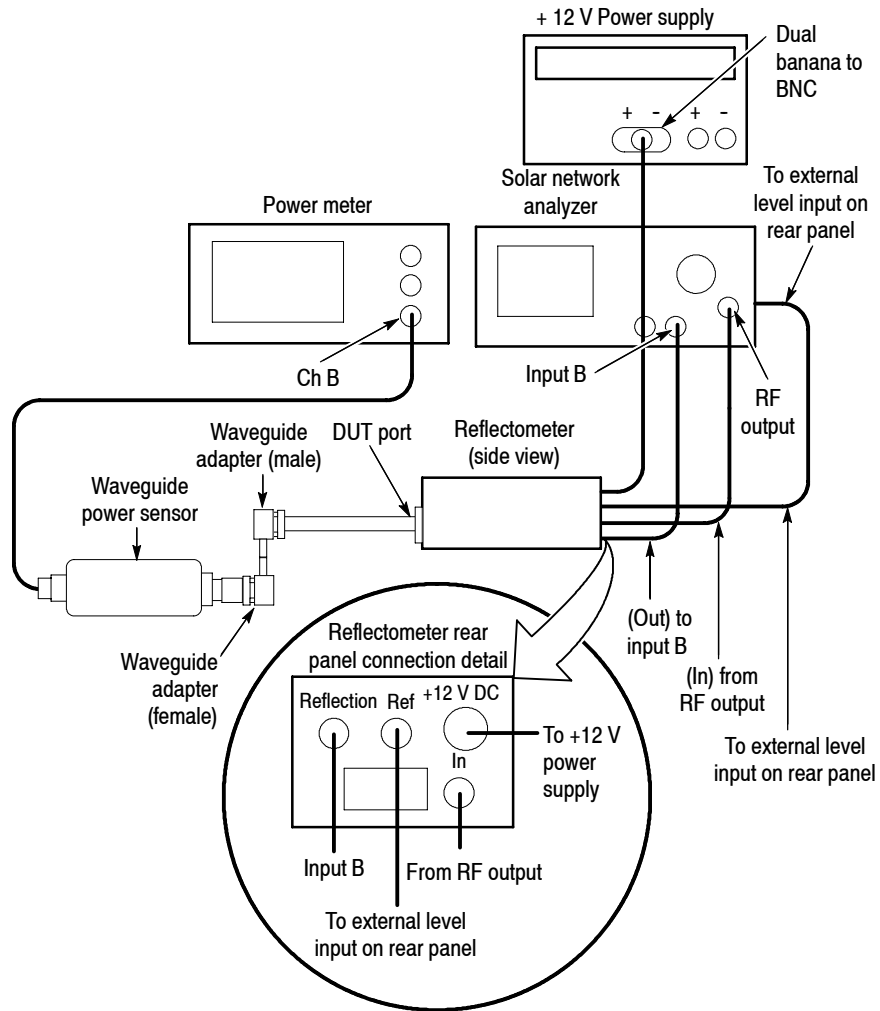


Figure 2-33: Adapter-loss hookup

2. Perform the following substeps:

- a. Set the signal frequency and the power meter frequency to each of the frequencies listed in the *Frequency* column, Table 2-7 on page 2-142.

NOTE. Only perform checks up to the maximum bandwidth of the module under test.

- b. Turn Trace Hold on the SNA to On.
- c. Read the power loss from the SNA screen, and record it for each frequency in the *Adapter Loss* column, Table 2-7 on page 2-142.

- d. Turn Trace Hold on the SNA to Off.
3. Disconnect the Waveguide adapters (separating them from each other), the Waveguide power sensor, and the Power meter from the test hookup. Leave the remainder of the test hookup intact for use in the next procedure.

HF Setup and Test

Do the following procedure to set up and test the HF Response.

NOTE. Use a torque wrench when connecting the terminators, adapters, attenuator, and Waveguide power sensor in this setup. Use 8 ± 0.3 inch pounds of torque.

1. Refer to Figure 2-34 as you perform the following substeps:
 - a. Start with the remainder of the test hookup from step 3 in the last procedure.
 - b. If testing an 80E06, install the 80N01 Extender Cable in the leftmost slot of the main instrument and connect the cable end of the Extender to the 80E06. If testing an 80E09, install the module in the leftmost slot.
 - c. Connect the one end of a Waveguide-to-1.85 mm male adapter to the input channel of the module to be tested. Connect the other end to the Waveguide section.

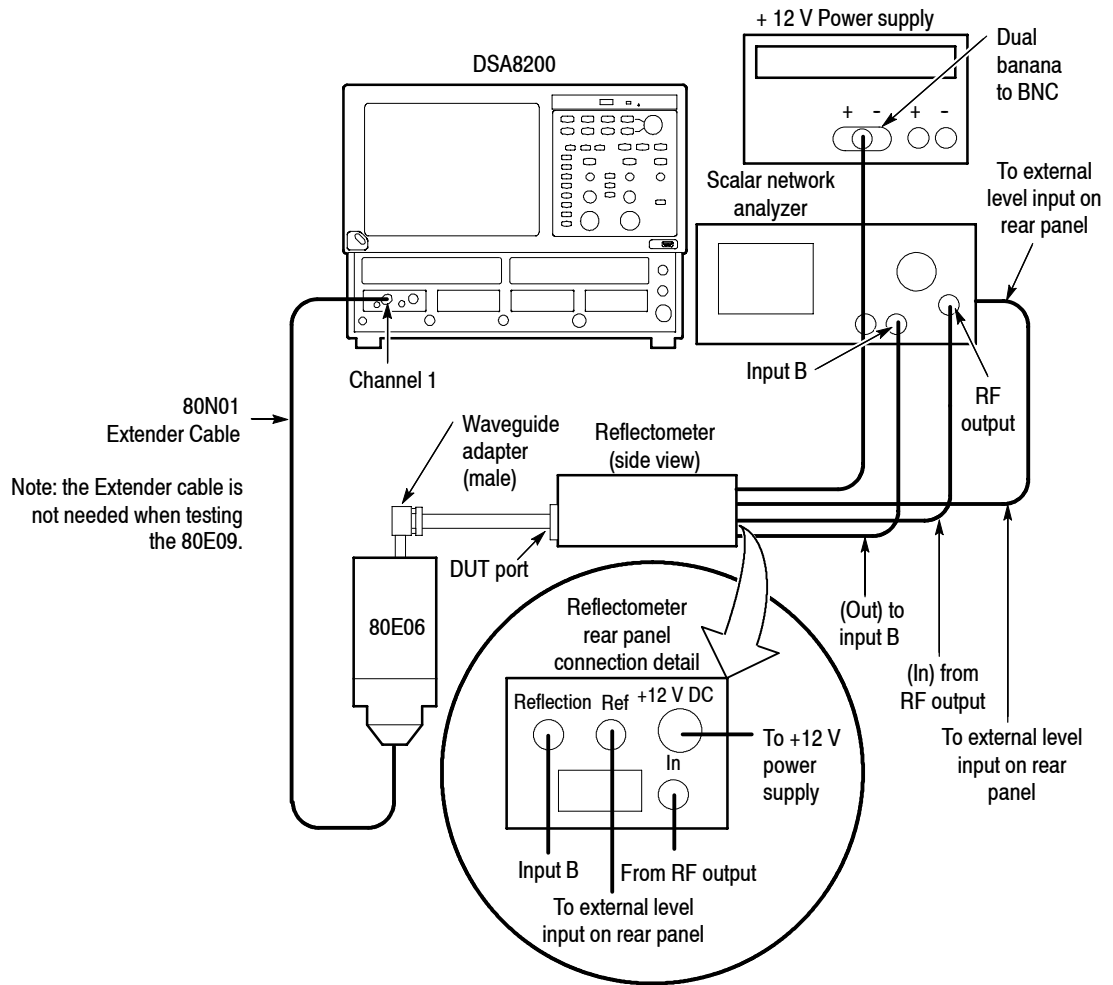


Figure 2-34: HF response hookup

2. Set up the main instrument as follows:
 - a. Press the DEFAULT SETUP button on the main instrument front panel.
 - b. Select C1 from the Waveform Selector menu on the controls bar at the bottom of the display (left corner).
 - c. In the Trig Setup dialog box, set Source to Internal Clock (200 kHz).
 - d. In the Acq Setup dialog box:
 - Set Acquisition Mode to Envelope.
 - Under Stop After, check Condition and select Number of Acquisitions from the pull down menu.

- Set the Number of Acquisitions count to 64.
 - e. In the Horz Setup dialog box:
 - Set set scale to 100 ps/div.
 - Set Record Length to 1000 points.
 - Set Position to 0 (this will revert to a minimum non-zero value).
 - Set Horizontal Reference to 0%.
 - f. In the Vert Setup dialog box:
 - Set Scale to 100 mV/division (default).
 - Set Offset to 0 mV (default).
 - g. In the Measurements Setup dialog box:
 - Select Meas1.
 - in the Source tab, select Main C1, and select Pulse under Signal Type.
 - Click Select Meas, and select Pulse-Amplitude, and then Amplitude, in the menus that display.
3. On the SNA, recall the Setup/Cal from Memory Location 2.
 4. Set the SNA Frequency Span to 0 Hz to set the SNA to single frequency mode.
 5. Perform the following substeps:
 - a. Set the SNA signal frequency to the first of the frequencies listed in the *Frequency* column, Table 2-7 on page 2-142.
 - b. Turn Trace Hold on the SNA to On.
 - c. Press the CLEAR DATA button on the front panel of the main instrument.
 - d. Press the RUN/STOP button on the front panel of the main instrument.
 - e. Record amplitude reading readout and use the value as AMPLITUDE (Volts) in the substep g. that follows.

- f. Convert Volts to dBm as follows:

$$V_p = (\text{AMPLITUDE}/2)$$

$$V_{rms} = V_p / \text{SQRT}(2)$$

$$P1 = V_{rms} * V_{rms} / 50$$

$$\text{dBm} = 10 * \log(P1 / 0.001)$$
 - g. Record dBm in the *Measured level* column, Table 2-7 on page 2-142.
 - h. Turn Trace Hold on the SNA to Off.
6. Perform the following substeps for all frequencies listed in the *Frequency* column, Table 2-7 on page 2-142:
- a. Calculate the Adapter Loss as the difference between the *Reference level (with adapters)* column and the *Reference level (no adapters)* column in Table 2-7:

$$\text{Adapter Loss} = (\text{Ref level with adapters}) - (\text{Ref level no adapters})$$
 - b. Record the calculation results in the *Adapter Loss* column of Table 2-7.
 - c. Calculate the module response using the values in the *Measured level* column and the *Reference level* column in Table 2-7 as:

$$\text{Module Response} = (\text{Measured level}) - (\text{Ref level with no adapters} + \text{Adapter Loss}/2)$$

$$\text{Module Response} = (\text{Measured level}) - (\text{Ref level with adapters} + \text{Adapter Loss}/2) - (\text{Measured level}) - (\text{Ref level with adapters}) + (\text{Adapter Loss}) \div 2$$
 - d. Record the calculation results in the *Response* column Table 2-7.
7. Find the maximum and minimum power points between the 50 MHz and 65 GHz points in the *Response* column, Table 2-7.

Table 2-7: Bandwidth response (55 GHz - 65 GHz)

Frequency ¹	Reference level (no adapters)	Reference level (with adapters)	Adapter loss	Measured level	80E06 response	80E09 response		
						30	40	60
55 GHz								
60 GHz								
65 GHz								

¹ Only perform checks up to the maximum bandwidth of the module under test.

8. Note the power at 50 MHz calculated as the module response recorded in Table 2-6 on page 2-127 of the procedure *Analog Bandwidth to 50 GHz*. You will use the 50 MHz power in the next step.
9. Find the maximum power and minimum power in the *Response* column of Table 2-7. Check that the following statements are true (the specification is ± 3.0 dB referenced to the 50 MHz):
 - The maximum power minus the 50 MHz power is less than +3.0 dB.
 - The minimum power minus the 50 MHz power is greater than -3.0 dB.
10. Repeat the Setup and Test sections for all bandwidth settings.
11. Repeat the Setup and Test sections for channel 2.
12. Disconnect the test setup.

End of Procedure

TDR-System Reflected Rise Time (80E04, 80E08, 80E10)

These procedures check those characteristics that relate to the TDR system and are listed as checked in the *Specifications* chapter. Refer to Table 1-13, page 1-18.

Equipment required	Airline (Item 9), 80E04 and 80E08 only 2.4 mm airline (Item 10), 80E10 only Short (Item 52), 80E10 only Terminator, cap, shorting (Item 32), 80E04 and 80E08 only
Prerequisites	As listed on page 2-26 and under <i>Prerequisites</i> on page 2-109.

Setup Install the test hookup:

1. Connect a shorting terminator cap to the female connector of the airline. See Figure 2-35.
2. Connect the airline to channel 1 of the module.

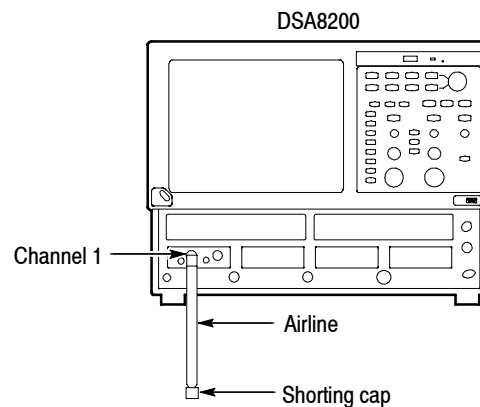


Figure 2-35: TDR reflected rise time hookup

3. Press the DEFAULT SETUP button on the main instrument front panel.
4. Set up the main instrument as follows:
 - a. In the TDR Setup dialog box, click on C1 Preset.
 - b. There should be a positive pulse, about 1 ns long for a 10 cm airline. The reflection from the short is located at the falling edge of the pulse. This is the edge to be measured. Adjust the horizontal position knob to bring the falling edge to the center vertical graticule.

- c. In the Horz Setup dialog box:
 - Set Record Length to 2000 points.
 - Set Horizontal Reference to 50%.
 - Set Scale to 50 ps/division, while using the horizontal position knob to keep the falling edge centered.
- d. In the Acq Setup dialog box:
 - Set Acquisition Mode to Average, 128 samples.
 - Under Stop After, check Condition and select Average Complete from the pull down menu.
- e. In the Meas Setup dialog box:
 - Select Meas 1 and make sure Source 1 button is selected.
 - Make sure the channel under test and Pulse are selected in the Source tab, and then choose Select Meas > Pulse - Timing > Fall Time.

Test Follow this procedure to make the fall time checks:

1. Press the CLEAR DATA button on the main instrument front panel.
2. Press the RUN/STOP button on the main instrument front panel.
3. Check that the measured fall time (reflected rise time) for the positive edge polarity is as follows:
 - 80E04 ≤ 35 ps
 - 80E08 ≤ 22 ps
 - 80E10 ≤ 16 ps
4. In the TDR Setup dialog box change C1 polarity to negative edge (pictured as a falling slope).

NOTE. *Since this display is in units of rho, the waveform will not invert when the edge polarity is changed, so the waveform will not appear to change significantly.*

5. Press the CLEAR DATA button.
6. Press the RUN/STOP button.

7. Check that the measured fall time (reflected rise time) for the negative edge polarity is as follows:
 - 80E04 ≤ 35 ps
 - 80E08 ≤ 22 ps
 - 80E10 ≤ 16 ps
8. Repeat the Setup and Test sections for channel 2.
9. Disconnect the test setup.

End of Procedure

TDR-System Step Response Aberrations (80E04)

These procedures check those characteristics that relate to the TDR system and are listed as checked in the *Specifications* chapter. Refer to Table 1-13, page 1-18.

Equipment required	Terminator, 50 Ω coaxial terminator, K male (Item 30)
Prerequisites	As listed on page 2-26 and under <i>Prerequisites</i> on page 2-109.

Setup Install the test hookup:

1. Install the module into the left small module compartment of the main instrument.
2. Connect a 50 Ω coaxial terminator to channel 1. See Figure 2-36.

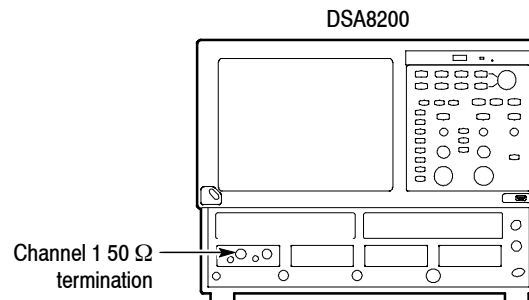


Figure 2-36: TDR system step response aberrations hookup

3. Press the DEFAULT SETUP button on the main instrument front panel.
4. Set up the main instrument as follows:
 - a. In the TDR Setup dialog box, click on C1 Preset. This sets up Channel 1 (C1) positive polarity by default; it will later be manually switched to select negative polarity and for channel 2, during the test sequence.
 - b. In the Acq Setup dialog box set the Acquisition Mode to Average, 128 samples.

- c. In the Horz Setup dialog box:
 - Set Record Length to 2000 points.
 - Set Position to 1 μ s.
 - Set Scale to 100 ns/division.
- d. In the Meas Setup dialog box:
 - Select Meas 1 and make sure the Source 1 button is selected.
 - Make sure both the channel under test and Pulse are selected in the Source tab, and then choose Select Meas > Pulse - Amplitude> Mean.
- e. Record for later use the High measurement value in mp, making sure to take down the proper sign. This will be used as HiRef, the high reference level for aberration measurements.

Test Follow this procedure to make the aberration checks:

1. Check aberrations in the range of 10 ns to 20 ps before the edge (aberrations within $\pm 3\%$).
 - a. Set the Horizontal Position to 0 (or to the minimum value possible).
 - b. Change the Horizontal Scale to 50 ps/division while adjusting Horizontal Position to keep the rising edge of the first step waveform on screen.
 - c. Press the front panel FINE button to turn it on.
 - d. Adjust the Horizontal Position knob so the waveform crosses the center vertical graticule at the 10% (amplitude) point of the rising edge. Since the waveform is 2 major divisions high at 500 mp/div, the waveform should be crossing the center vertical graticule at 9 minor divisions below the center horizontal graticule. This defines the ending reference point for pre-transition aberration measurements.
 - e. Press the FINE button to turn it off.

- f. In the Meas Setup dialog box:
- Select Meas 1 and make sure the Source 1 button is selected.
 - Make sure both the channel under test and Pulse are selected in the Source tab, and then choose Select Meas > Pulse - Amplitude > Max.
 - Select the Region tab.
 - Set Gate G2 to 46%.
 - Turn Gates on (check).
- g. In the Meas Setup dialog box:
- Select Meas 2 and make sure the Source 1 button is selected.
 - Make sure both the channel under test and Pulse are selected in the Source tab, and then choose Select Meas > Pulse - Amplitude > Min.
 - Select the Region tab.
 - Set Gate G2 to 46%.
 - Set Gates on (check).
- h. The Max and Min measurements are now set to include the region of 250 ps to 20 ps before the edge. The aberration specification over this region is $\pm 3\%$, which is ± 30 mQ for a 1 ρ step. Since the reference is -1 ρ , the Max and Min values should be within -1.030 to -0.970 ρ to meet the $\pm 3\%$ specification.
- i. Calculate and take down for later use the peak aberrations in percent using the formulas (with Max and Min in mQ units, not Q):
- Positive aberration (%) = $(1000 + \text{Max}) * 0.1$
 - Negative aberration (%) = $(1000 + \text{Min}) * 0.1$
- For example: if Max = -989 mQ and Min = -1.003 ρ ,
positive aberration (%) = $(1000 + (-989)) * 0.1 = +1.1$
negative aberration (%) = $(1000 + (-1003)) * 0.1 = -0.3$

NOTE. *The aberration can have either a positive or negative sign. Both aberrations could have the same sign when the waveform does not cross the reference line in the region being checked.*

- j.** In the Horz Setup dialog box:
 - Set Horizontal Reference to 50%.
 - Set Horizontal Scale to 2 ns/division.
- k.** In the Meas Setup dialog box for Meas2 (Region tab selected), set Gate G2 to 49%.
- l.** Select Meas1, set Gate G2 to 49%.
- m.** The Max and Min measurements are now set to include the region of 10 ns to 200 ps before the edge. As before, the aberration specification over this region is $\pm 3\%$, so the Max and Min values should be within -1.030 to -0.970 ρ .
- n.** Calculate the peak aberrations in percent using the formulas (with Max and Min in mp units, not ρ):
 - Positive aberration (%) = $(1000 + \text{Max}) * 0.1$.
 - Negative aberration (%) = $(1000 + \text{Min}) * 0.1$.
- o.** Check that the aberrations for the entire 10 ns to 20 ps region before the edge (from steps i and n) are within $\pm 3\%$. If recording data on the Test Record, enter the largest (positive or negative) value.
- 2.** Check aberrations in the range of 400 ps to 5 ns after the edge (aberrations within $\pm 3\%$).
 - a.** Change the Horizontal Scale to 50 ps/division while adjusting Horizontal Position to keep the rising edge of the step waveform centered on the display.
 - b.** Press the front panel FINE button to turn it on.
 - c.** Adjust the Horizontal Position knob so the waveform crosses the center vertical graticule at the 90% (amplitude) point of the rising edge. The waveform should be crossing the center vertical graticule at 1 minor division below the center horizontal graticule. This defines the beginning reference for post-transition aberration measurements.
 - d.** Press the front panel FINE button to turn it off.
 - e.** In the Horz Setup dialog box:
 - Set Horizontal Reference to 50%.
 - Set Horizontal Scale to 1 ns/division.

- f. In the Meas Setup dialog box, for Meas1:
- Set G1 to 54%.
 - Set G2 to 100%.
- g. In the Meas Setup dialog box, for Meas2:
- Set G1 to 54%.
 - Set G2 to 100%.
- h. The Max and Min measurements are now set to include the region of 400 ps to 5 ns after the edge. The aberration specification over this region is $\pm 3\%$, which is ± 30 mp for a 1 ρ step. The reference level is HiRef, from step 4e on page 2-154 of the setup procedure.
- i. Calculate the peak aberrations in percent using the formulas (with Max, Min, and HiRef in mp, not ρ):
- Positive aberration (%) = (Max - HiRef) * 0.1.
 - Negative aberration (%) = (Min - HiRef) * 0.1.
- For example: if Max = +11 mp and HiRef = -5 mp,
positive aberration (%) = (+11 - (-5)) * 0.1 = +1.6
- j. Check that the aberrations calculated in step i for the 400 ps to 5 ns region after the edge are within $\pm 3\%$. If recording data on the Test Record, enter the largest (positive or negative) value.
3. Check the range >5 ns after the edge (aberrations within $\pm 1\%$).
- a. Change the Horizontal Scale to 10 ns/division.
 - b. Adjust Horizontal Position so waveform rising edge is at the second vertical graticule (assuming that first graticule is the left edge of display).
 - c. In the Meas Setup dialog box for Meas2, set Gate G1 to 15%.
 - d. In the Meas Setup dialog box for Meas1, set Gate G1 to 15%.
 - e. The Max and Min measurements are now set to include the region of 5 ns to 90 ns after the edge. The aberration specification over this region is $\pm 1\%$, which is ± 10 mp for a 1 ρ step. The reference level is HiRef, from step 4e on page 2-154 of the setup procedure.
 - f. The Max and Min measurements are now set to include the region of 250 ps to 20 ps before the edge. The aberration specification over this region is $\pm 1\%$, which is ± 10 mp for a 1 ρ step. Since the reference is

-1 ρ , the Max and Min values should be within -1.010 to -0.990 ρ to meet the $\pm 1\%$ specification.

- g. Calculate and take down for later use the peak aberrations in percent using the formulas (with Max and Min in mQ units, not Ω):
- Positive aberration (%) = $(1000 + \text{Max}) * 0.1$.
 - Negative aberration (%) = $(1000 + \text{Min}) * 0.1$.

For example: if Max = -989 mQ and Min = -1.003 ρ ,
positive aberration (%) = $(1000 + (-989)) * 0.1 = +1.1$
negative aberration (%) = $(1000 + (-1003)) * 0.1 = -0.3$

4. Repeat the Setup and Test procedures for the TDR negative edge polarity. To do this check, select negative edge polarity after selecting TDR Preset in Setup step 4a on page 2-147. No other changes to the procedures are needed, since in rho (ρ) mode the display does not invert when the TDR edge polarity is changed.
5. Repeat the Setup and Test procedures for channel 2, both polarities.

End of Procedure

TDR-System Step Response Aberrations (80E08 and 80E10)

These procedures check those characteristics that relate to the TDR system and are listed as checked in the *Specifications* chapter. Refer to Table 1-13, page 1-18.

Equipment required	Terminator, 50 Ω coaxial terminator, K male (Item 30), 80E08 only Terminator, 50 Ω coaxial terminator, V male (Item 31), 80E10 only
Prerequisites	As listed on page 2-26 and under <i>Prerequisites</i> on page 2-109.

Setup Install the test hookup:

1. Install the module into the left small module compartment of the main instrument.
2. Connect a 50 Ω coaxial terminator to channel 1. See Figure 2-37.

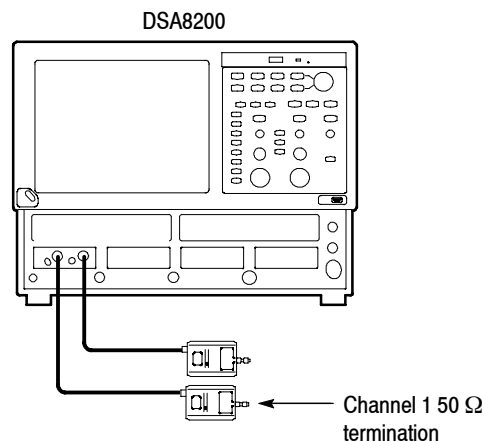


Figure 2-37: TDR system step response aberrations hookup

3. Press the DEFAULT SETUP button on the main instrument front panel.
4. Set up the main instrument as follows:
 - a. In the TDR Setup dialog box click on C1 Preset. This sets up Channel 1 (C1) positive polarity by default; it will later be manually switched to select negative polarity and for channel 2, during the test sequence.
 - b. In the Acq Setup dialog box set the Acquisition Mode to Average, 128 samples.

- c. In the Horz Setup dialog box:
 - Set Record Length to 2000 points.
 - Set Position to 1 μ s.
 - Set Scale to 50 μ s/division.
- d. In the Meas Setup dialog box:
 - Select Meas 1 and make sure the Source 1 button is selected.
 - Make sure both the channel under test and Pulse are selected in the Source tab, choose Select Meas > Pulse - Amplitude> Amplitude, and then check the On box.
 - Select the HiLow tab and uncheck Track High and Track Low in the Tracking Method.
- e. Record for later use the High reference and Low reference measurement values in mp, making sure to take down the proper sign. This will be used as HiRef and LoRef (the high and low reference levels for aberration measurements).

Test Follow this procedure to make the aberration checks:

1. Check aberrations in the range of 10 ns to 20 ps before the edge (aberrations within $\pm 1\%$).
 - a. Set the Horizontal Position to its minimum setting using the Horizontal position knob.
 - b. Change the Horizontal Scale to 50 ps/division while adjusting Horizontal Position, keeping the rising edge of the first step waveform on screen.
 - c. Press the front panel FINE button to turn it on.
 - d. Adjust the Horizontal Position knob so the waveform crosses the center vertical graticule at the 10% (amplitude) point of the rising edge. Since the waveform is 2 major divisions high at 500 mp/div, the waveform should be crossing the center vertical graticule at 9 minor divisions below the center horizontal graticule. This defines the ending reference point for pre-transition aberration measurements.
 - e. Press the FINE button to turn it off.

f. In the Meas Setup dialog box:

- Select Meas 1 and make sure the Source 1 button is selected.
- Make sure both the channel under test and Pulse are selected in the Source tab, choose Select Meas > Pulse - Amplitude> Max, and then check the On box.
- Select the Region tab.
- Set Gate G1 to 0%.
- Set Gate G2 to 46%.
- Turn Gates on (check).

g. In the Meas Setup dialog box:

- Select Meas 2 and make sure the Source 1 button is selected.
- Make sure both the channel under test and Pulse are selected in the Source tab, choose Select Meas > Pulse - Amplitude> Min, and then check the On box.
- Select the Region tab.
- Set Gate G1 to 0%.
- Set Gate G2 to 46%.
- Set Gates on (check).

h. Calculate and take down for later use the peak aberrations in percent using the formulas (with Max, Min, and LoRef in mp units, not ρ):

- Positive aberration (%) = $(\text{Max}-\text{LoRef}) * 0.1/(\text{HiRef}-\text{LoRef})$.
- Negative aberration (%) = $(\text{Min}-\text{LoRef}) * 0.1/(\text{HiRef}-\text{LoRef})$.

For example: if Max=-1.019 ρ , Min=-1.033 ρ , LoRef=-1030 mp, and HiRef=0

positive aberration (%) = $(-1019-(-1030)) * (0.1/(0-(-1030))) = +1.1$

negative aberration (%) = $(-1033-(-1030)) * (0.1/(0-(-1030))) = -0.3$

NOTE. *The aberration can have either a positive or negative sign. Both aberrations could have the same sign when the waveform does not cross the reference line in the region being checked.*

2. Check aberrations in the range of 14 ps to 150 ps after the edge (aberrations within +20% and -2%).

- a. Press the Default Setup button on the front panel.
- b. Open the Trigger Menu dialog box from the instrument front panel, select Internal Clock, and set the Internal Clock rate to 50 kHz using the drop down menu.
- c. Select the TDR tab in the menu dialog box. In the Preset column, select C1 (or whichever channel your module is on).
- d. Select the Measurement tab. Set up Meas1, Meas2, and Meas3 as follows:
 - **Meas1.** Choose Select Meas>Pulse-Amplitude>+ Overshoot.
 - **Meas2.** Choose Select Meas>Pulse-Amplitude>Pk-Pk.
 - **Meas3.** Choose Select Meas>Pulse-Amplitude>Amplitude.
- e. Press the math function button on the icon bar at the top of your screen (*fx*). Create a math trace (M1) to calculate the lower aberration extreme (undershoot) by pressing the following keys in the popup dialog box:
 - Meas1
 - -
 - (
 - 100
 - *
 - (
 - Meas2
 - /
 - Meas3
 -)
 -)
 - Confirm that the final expression is $\text{Meas1} - (100 * (\text{Meas2} / \text{Meas3}))$
 - Check the On box and click OK.
- f. Select the Measurement tab in the Setup dialog box menu. Set up Meas4 as follows:
 - Choose Select Meas>Pulse-Amplitude>Mean.
 - Choose Source1 and select M1 in the Source.

- g. Set the time/div to 20 $\mu\text{s}/\text{div}$ (use the Horizontal Scale knobs).
- h. Select Meas3 from the Measurement tab in the setup dialog box menu, select the HiLow tab, and uncheck the Track Hi and Track Low boxes.
- i. Repeat step h for Meas1.
- j. Change the Horizontal Scale to 50 ps/division while adjusting Horizontal Position, keeping the rising edge of the first step waveform on screen.
- k. Press the front panel FINE button to turn it on.
- l. Adjust the horizontal position such that the incident edge 50% crossing occurs one division in from the left edge of the screen.
- m. Press the front panel FINE button to turn it off.
- n. In the Horizontal Setup dialog box, set Horizontal Reference to 10%.
- o. Select the following measurements from the Setup dialog box menu and set them up as follows:
 - **Meas1.** Select the Region tab and set G1 to 10% (approximately 50% edge crossing threshold), G2 to 40% (150 ps), and check the Gates On box.
 - **Meas2.** Select the Region tab, check the Gates On box, set G1 to slightly before the observed location of the maximum overshoot, and set G2 to 40% (150 ps).

NOTE. *Meas1 now reads overshoot directly on-screen. Meas4 now reads undershoot directly on-screen.*

- p. Check that the TDR incident edge aberrations in the range of 14 ps to 150 ps after the edge are within specification:
 - Aberration Upper Spec limit (USL): $\text{Meas1} + \text{Overshoot}(C1) \leq 20\%$.
 - Aberration Lower Spec limit (LSL): $\text{Meas4 Mean}(M1) \geq -2\%$.
3. Check aberrations in the range of 150 ps to 400 ps after the edge (aberrations within +12% to -2%).
 - a. Set Meas1 and Meas2 as follows:
 - **Meas1.** Select the Region tab and set G1 to 40% (150 ps) and G2 to 90% 400 ps).
 - **Meas2.** Select the Region tab and set G1 to 40% (150 ps) and G2 to 90% 400 ps).

Optical Sampling Modules

The following performance verification procedures for the optical sampling modules check the characteristics that are shown as checked specifications (✓ symbol) in Table 1-18 and Table 1-20 of the *Optical Modules Specifications* starting on page 1-25.

Prerequisites

Be sure you have performed the appropriate *Prerequisites* on page 2-26 before doing any procedures in this section.

STOP. *The procedures throughout this chapter contain instructions based on the menus and controls from the most updated instrument software available at the time this document was released. These procedures will work for other versions of software, but some control and menu names may vary slightly.*

Dark Level and Vertical Equivalent Optical Noise

This procedure checks the dark level, which is the offset in the optical channel caused by thermal variations or finite leakage current. This procedure also checks the vertical equivalent optical noise. The checks are made with vertical offset set to zero and no optical signal input to the optical sampling module (dustcap installed on the OPTICAL INPUT).

Equipment required	DSA8200 Digital Serial Analyzer Terminator, 50 Ω coaxial, SMA male (item 30); used with optical sampling modules with clock recovery (CR)
Prerequisites	As listed on page 2-26 and under <i>Prerequisites</i> on page 2-161.

Setup Install the test hookup and preset the instrument controls:

1. Install the 80CXX Optical Sampling Module into Channel 1 of the main instrument (see Figure 2-38).

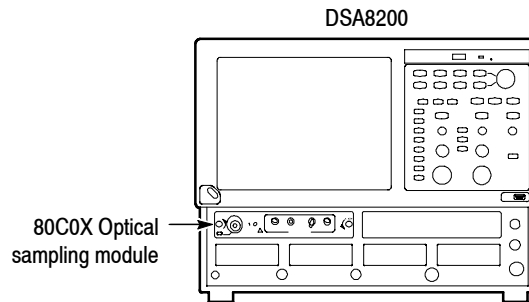


Figure 2-38: Dark level and vertical equivalent optical noise test hookup

2. Install the black, fibre-optic dustcap onto the OPTICAL INPUT connector of the optical sampling module.
3. If the optical sampling module has clock recovery, install 50 Ω terminations on the outputs.
4. Press the DEFAULT SETUP button on the instrument front panel. Click Yes in the dialog box that appears.
5. Select C1 for the waveform source (use the waveform selector button in the lower left corner of the application display).
6. In the Trig Setup dialog box, select Internal Clock for the Trigger Source.

NOTE. If the Scale, Position, and Channel Offset control boxes are not displayed in the following step, click the Basic button in the lower left part of the Vert Setup dialog box.

7. In the Vert Setup dialog box, do the following:
 - a. Set the Scale to one of the following values:
 - 100 μ W/div for an 80C01, 80C02, 80C04, 80C05, 80C09, and 80C11 Optical Sampling Module.
 - 5 μ W/div for an 80C03, 80C07, and 80C07B Optical Sampling Module.
 - 200 μ W/div for an 80C06, 80C10, 80C10B, or 80C25GBE Optical Sampling Module.

- 1 μ W/div for an 80C08, 80C08B, 80C08C, and 80C12 Optical Sampling Module
 - b. Set Position to 0.0div.
 - c. Set Channel Offset to 0.0W.
8. In the Horiz Setup dialog box do the following:
 - a. Set Scale to 1.000 ns/div.
 - b. Set Record Length to 500.
 9. In the Hist Setup dialog box, do the following:
 - a. Select Main C1 as the Source.
 - b. Check Enable Histogram.
 - c. Select Vertical.
 - d. Close the Hist Setup dialog box.

Test Follow this procedure to make the Dark Level and Vertical Equivalent Optical Noise checks:

1. In the Utilities menu, select System Properties. Check that the Mainframe Current On-Time is greater than 0.33 hours (20 minutes).

NOTE. *The values in System Properties dialog box do not update while the dialog box is open. Close the dialog box and reopen it to get updated values.*

2. Close the System Properties dialog box.
3. In the Utilities menu, select Compensation.
4. Make the following selections in the Compensation dialog box:
 - a. Under Select Action, select Compensate.
 - b. Select Module in the pull-down menu.
 - c. Select Ch1.
5. Click Execute, and then click OK to the message box that appears.
6. Wait until the compensation is completed (hour glass cursor reverts back to arrow cursor). It is recommended that you store this compensation result in

the module as the Stored User values. To store the compensation results in the module, do the following procedure:

- a. In the Select Action section of the Compensation dialog box, select Save.
 - b. In the Storage section, make sure User is selected.
 - c. Click the Execute button. This saves the compensation results in the module.
7. Click Close to close the Compensation dialog box.
 8. In the Vert Setup dialog box, click the Optical>> button. This displays fields for setting up the vertical optical parameters.
 9. Select a bandwidth or filter in the Vert Setup dialog box. Refer to Table 2-8 for available settings.
 10. Disconnect the optical fiber from the module input. In the Vert Setup dialog box, click the Dark Level compensate button. When the compensation has completed, reconnect the optical fiber to the input.
 11. Press the CLEAR DATA button on the instrument front panel.

NOTE. *If the Vert Setup dialog box covers the Histogram statistics readout at the right side of the display, click in the Setups title bar and drag the dialog box to the left until you can see the Histogram statistics.*

12. After a few seconds, note the Mean and the Std Dev results displayed on the right side of the display for the selected bandwidth or filter. The mean of the histogram is the dark level value and the standard deviation of the histogram is the maximum RMS vertical equivalent optical noise value. Compare these values to the bandwidth or filter, mean, and standard deviation listed in Table 2-8 for the optical sampling module that you are testing.
13. Repeat steps 9 through 12 for each bandwidth and filter available for the optical sampling module. Refer to Table 2-8.

NOTE. *The filter and bandwidth settings for the optical sampling module you are testing are selected from the Filter or Bandwidth control boxes in the Vert Setup dialog box.*

End of Procedure

Table 2-8: Dark level and vertical equivalent optical noise limits

Optical sampling module	Bandwidth or filter	Dark level	Vertical equivalent optical noise	
			Without CR	With CR
80C01	OC-12/STM-4	<10 μ W	<12 μ W _{RMS}	<15 μ W _{RMS}
	OC-48/STM-16	<10 μ W	<12 μ W _{RMS}	<15 μ W _{RMS}
	OC-192/STM-64	<10 μ W	<12 μ W _{RMS}	<15 μ W _{RMS}
	12.5 GHz	<10 μ W	<12 μ W _{RMS}	<15 μ W _{RMS}
	20 GHz	<10 μ W	<25 μ W _{RMS}	<25 μ W _{RMS}
80C02	OC-192/STM-64	<10 μ W	<10 μ W _{RMS}	<12 μ W _{RMS}
	12.5 GHz	<10 μ W	<10 μ W _{RMS}	<12 μ W _{RMS}
	20 GHz	<10 μ W	<15 μ W _{RMS}	<20 μ W _{RMS}
	30 GHz	<10 μ W	<30 μ W _{RMS}	<40 μ W _{RMS}
80C03	FC1063	<500 nW	<1 μ W _{RMS}	<1 μ W _{RMS}
	GBE	<500 nW	<1 μ W _{RMS}	<1 μ W _{RMS}
	OC-48/STM-16	<500 nW	<1.5 μ W _{RMS}	<1.5 μ W _{RMS}
80C04	OC-192/STM-64	<10 μ W	<10 μ W _{RMS}	<12 μ W _{RMS}
	10.664 Gb/s	<10 μ W	<10 μ W _{RMS}	<12 μ W _{RMS}
	20 GHz	<10 μ W	<15 μ W _{RMS}	<20 μ W _{RMS}
	30 GHz	<10 μ W	<30 μ W _{RMS}	<40 μ W _{RMS}
80C05	OC-192/STM-64	<10 μ W	<15 μ W _{RMS}	<15 μ W _{RMS}
	20 GHz	<30 μ W	<25 μ W _{RMS}	<25 μ W _{RMS}
	30 GHz	<30 μ W	<35 μ W _{RMS}	<35 μ W _{RMS}
	40 GHz	<30 μ W	<70 μ W _{RMS}	<70 μ W _{RMS}
80C06	50 GHz	<25 μ W	<192 μ W _{RMS}	<192 μ W _{RMS}
80C07	2 GHz	<500 nW	N/A	N/A
	OC-3/STM-1	<500 nW	<1 μ W _{RMS}	<1 μ W _{RMS}
	OC-12/STM-4	<500 nW	<1 μ W _{RMS}	<1 μ W _{RMS}
	OC-48/STM-16	<500 nW	<1.5 μ W _{RMS}	<1.5 μ W _{RMS}

Table 2-8: Dark level and vertical equivalent optical noise limits (cont.)

Optical sampling module	Bandwidth or filter	Dark level	Vertical equivalent optical noise	
			Without CR	With CR
80C07B (1310 nm and 1550 nm)	OC-3/STM-1	<500 nW	<1 μW_{RMS}	<1 μW_{RMS}
	OC-12/STM-4	<500 nW	<1 μW_{RMS}	<1 μW_{RMS}
	OC-48/STM-16	<500 nW	<1.5 μW_{RMS}	<1.5 μW_{RMS}
	FC1063	<500 nW	<1 μW_{RMS}	<1 μW_{RMS}
	FC2125	<500 nW	<1.5 μW_{RMS}	<1.5 μW_{RMS}
	ENET1250	<500 nW	<1 μW_{RMS}	<1 μW_{RMS}
	ENET2500	<500 nW	<1.5 μW_{RMS}	<1.5 μW_{RMS}
	INFINIBAND	<500 nW	<1.5 μW_{RMS}	<1.5 μW_{RMS}
	2.5 GHz	<500 nW	<1.5 μW_{RMS}	<1.5 μW_{RMS}
80C07B (850 nm)	OC-3/STM-1	<500 nW	<1.6 μW_{RMS}	<1.6 μW_{RMS}
	OC-12/STM-4	<500 nW	<1.6 μW_{RMS}	<1.6 μW_{RMS}
	OC-48/STM-16	<500 nW	<2.4 μW_{RMS}	<2.4 μW_{RMS}
	FC1063	<500 nW	<1.6 μW_{RMS}	<1.6 μW_{RMS}
	FC2125	<500 nW	<2.4 μW_{RMS}	<2.4 μW_{RMS}
	ENET1250	<500 nW	<1.6 μW_{RMS}	<1.6 μW_{RMS}
	ENET2500	<500 nW	<2.4 μW_{RMS}	<2.4 μW_{RMS}
	INFINIBAND	<500 nW	<2.4 μW_{RMS}	<2.4 μW_{RMS}
	2.5 GHz	<500 nW	<2.4 μW_{RMS}	<2.4 μW_{RMS}
80C07B (780 nm)	OC-3/STM-1	<500 nW	<2.0 μW_{RMS}	<2.0 μW_{RMS}
	OC-12/STM-4	<500 nW	<2.0 μW_{RMS}	<2.0 μW_{RMS}
	OC-48/STM-16	<500 nW	<3.0 μW_{RMS}	<3.0 μW_{RMS}
	FC1063	<500 nW	<2.0 μW_{RMS}	<2.0 μW_{RMS}
	FC2125	<500 nW	<3.0 μW_{RMS}	<3.0 μW_{RMS}
	ENET1250	<500 nW	<2.0 μW_{RMS}	<2.0 μW_{RMS}
	ENET2500	<500 nW	<3.0 μW_{RMS}	<3.0 μW_{RMS}
	INFINIBAND	<500 nW	<3.0 μW_{RMS}	<3.0 μW_{RMS}
	2.5 GHz	<500 nW	<3.0 μW_{RMS}	<3.0 μW_{RMS}

Table 2-8: Dark level and vertical equivalent optical noise limits (cont.)

Optical sampling module	Bandwidth or filter	Dark level	Vertical equivalent optical noise	
			Without CR	With CR
80C08 (1310 nm and 1550 nm)	10GBASE-W	<1 μ W	<3.0 μ W _{RMS}	<3.5 μ W _{RMS}
	10GBASE-R	<1 μ W	<3.0 μ W _{RMS}	<3.5 μ W _{RMS}
	10 GHz	<1 μ W	<3.0 μ W _{RMS}	<3.5 μ W _{RMS}
80C08 (850 nm)	10GBASE-W	<1 μ W	<5.0 μ W _{RMS}	<5.5 μ W _{RMS}
	10GBASE-R	<1 μ W	<5.0 μ W _{RMS}	<5.5 μ W _{RMS}
	10 GHz	<1 μ W	<5.0 μ W _{RMS}	<5.5 μ W _{RMS}
80C08 (780 nm)	10GBASE-W	<1 μ W	<6.0 μ W _{RMS}	<6.6 μ W _{RMS}
	10GBASE-R	<1 μ W	<6.0 μ W _{RMS}	<6.6 μ W _{RMS}
	10 GHz	<1 μ W	<6.0 μ W _{RMS}	<6.6 μ W _{RMS}
80C08B (1310 nm and 1550 nm)	10GBASE-W	<1 μ W	<3.0 μ W _{RMS}	<3.5 μ W _{RMS}
	10GBASE-R	<1 μ W	<3.0 μ W _{RMS}	<3.5 μ W _{RMS}
	10 GHz	<1 μ W	<3.0 μ W _{RMS}	<3.5 μ W _{RMS}
	OC-192/STM-64	<1 μ W	<3.0 μ W _{RMS}	<3.5 μ W _{RMS}
	10GFC	<1 μ W	<3.0 μ W _{RMS}	<3.5 μ W _{RMS}
80C08B (850 nm)	10GBASE-W	<1 μ W	<5.0 μ W _{RMS}	<5.5 μ W _{RMS}
	10GBASE-R	<1 μ W	<5.0 μ W _{RMS}	<5.5 μ W _{RMS}
	10 GHz	<1 μ W	<5.0 μ W _{RMS}	<5.5 μ W _{RMS}
	OC-192/STM-64	<1 μ W	<5.0 μ W _{RMS}	<5.5 μ W _{RMS}
	10GFC	<1 μ W	<5.0 μ W _{RMS}	<5.5 μ W _{RMS}
80C08B (780 nm)	10GBASE-W	<1 μ W	<6.0 μ W _{RMS}	<6.6 μ W _{RMS}
	10GBASE-R	<1 μ W	<6.0 μ W _{RMS}	<6.6 μ W _{RMS}
	10 GHz	<1 μ W	<6.0 μ W _{RMS}	<6.6 μ W _{RMS}
	OC-192/STM-64	<1 μ W	<6.0 μ W _{RMS}	<6.6 μ W _{RMS}
	10GFC	<1 μ W	<6.0 μ W _{RMS}	<6.6 μ W _{RMS}

Table 2-8: Dark level and vertical equivalent optical noise limits (cont.)

Optical sampling module	Bandwidth or filter	Dark level	Vertical equivalent optical noise	
			Without CR	With CR
80C08C (1310 nm and 1550 nm)	10GBASE-W	<1 μ W	<3.0 μ W _{RMS}	<3.5 μ W _{RMS}
	10GBASE-R	<1 μ W	<3.0 μ W _{RMS}	<3.5 μ W _{RMS}
	OC-192/STM-64	<1 μ W	<3.0 μ W _{RMS}	<3.5 μ W _{RMS}
	10GFC	<1 μ W	<3.0 μ W _{RMS}	<3.5 μ W _{RMS}
	10GFC FEC	<1 μ W	<3.0 μ W _{RMS}	<3.5 μ W _{RMS}
	10GBE FEC	<1 μ W	<3.0 μ W _{RMS}	<3.5 μ W _{RMS}
	10.66 Data Filter	<1 μ W	<3.0 μ W _{RMS}	<3.5 μ W _{RMS}
	10.709 Data Filter	<1 μ W	<3.0 μ W _{RMS}	<3.5 μ W _{RMS}
80C08C (850 nm)	10GBASE-W	<1 μ W	<5.0 μ W _{RMS}	<5.5 μ W _{RMS}
	10GBASE-R	<1 μ W	<5.0 μ W _{RMS}	<5.5 μ W _{RMS}
	OC-192/STM-64	<1 μ W	<5.0 μ W _{RMS}	<5.5 μ W _{RMS}
	10GFC	<1 μ W	<5.0 μ W _{RMS}	<5.5 μ W _{RMS}
	10GFC FEC	<1 μ W	<5.0 μ W _{RMS}	<5.5 μ W _{RMS}
	10GBE FEC	<1 μ W	<5.0 μ W _{RMS}	<5.5 μ W _{RMS}
	10.66 Data Filter	<1 μ W	<5.0 μ W _{RMS}	<5.5 μ W _{RMS}
	10.709 Data Filter	<1 μ W	<5.0 μ W _{RMS}	<5.5 μ W _{RMS}
80C08C (780 nm)	10GBASE-W	<1 μ W	<6.0 μ W _{RMS}	<6.6 μ W _{RMS}
	10GBASE-R	<1 μ W	<6.0 μ W _{RMS}	<6.6 μ W _{RMS}
	OC-192/STM-64	<1 μ W	<6.0 μ W _{RMS}	<6.6 μ W _{RMS}
	10GFC	<1 μ W	<6.0 μ W _{RMS}	<6.6 μ W _{RMS}
	10GFC FEC	<1 μ W	<6.0 μ W _{RMS}	<6.6 μ W _{RMS}
	10GBE FEC	<1 μ W	<6.0 μ W _{RMS}	<6.6 μ W _{RMS}
	10.66 Data Filter	<1 μ W	<6.0 μ W _{RMS}	<6.6 μ W _{RMS}
	10.709 Data Filter	<1 μ W	<6.0 μ W _{RMS}	<6.6 μ W _{RMS}
80C09	OC-192/STM-64	<10 μ W	<10 μ W _{RMS}	<12 μ W _{RMS}
	10.709 Gb/s	<10 μ W	<10 μ W _{RMS}	<12 μ W _{RMS}
	20 GHz	<10 μ W	<15 μ W _{RMS}	<20 μ W _{RMS}
	30 GHz	<10 μ W	<30 μ W _{RMS}	<40 μ W _{RMS}

Table 2-8: Dark level and vertical equivalent optical noise limits (cont.)

Optical sampling module	Bandwidth or filter	Dark level	Vertical equivalent optical noise	
			Without CR	With CR
80C10 1550 nm	OC-768/STM-256	<25 μ W	<60 μ W _{RMS}	n/a
	43.018 Gb/s	<25 μ W	<60 μ W _{RMS}	n/a
	30 GHz	<25 μ W	<50 μ W _{RMS}	n/a
	65 GHz	<25 μ W	<120 μ W _{RMS}	n/a
80C10 1310 nm	OC-768/STM-256	<35 μ W	<110 μ W _{RMS}	n/a
	43.018 Gb/s	<35 μ W	<110 μ W _{RMS}	n/a
	30 GHz	<35 μ W	<90 μ W _{RMS}	n/a
	65 GHz	<35 μ W	<220 μ W _{RMS}	n/a
80C10B 1550 nm			Without CRTP	With CRTP
	OC-768/STM-256	<25 μ W	<38 μ W _{RMS}	<44 μ W _{RMS}
	43.018 Gb/s	<25 μ W	<38 μ W _{RMS}	<44 μ W _{RMS}
	41.25 Gb/s	<25 μ W	<38 μ W _{RMS}	<44 μ W _{RMS}
	30 GHz	<25 μ W	<35 μ W _{RMS}	<40 μ W _{RMS}
	65 GHz	<25 μ W	<60 μ W _{RMS}	<69 μ W _{RMS}
	80 GHz	<25 μ W	<105 μ W _{RMS}	<121 μ W _{RMS}
80C10B 1310 nm			Without CRTP	With CRTP
	OC-768/STM-256	<35 μ W	<50 μ W _{RMS}	<58 μ W _{RMS}
	43.018 Gb/s	<35 μ W	<50 μ W _{RMS}	<58 μ W _{RMS}
	41.25 Gb/s	<35 μ W	<50 μ W _{RMS}	<58 μ W _{RMS}
	30 GHz	<35 μ W	<45 μ W _{RMS}	<52 μ W _{RMS}
	65 GHz	<35 μ W	<75 μ W _{RMS}	<86 μ W _{RMS}
	80 GHz	<35 μ W	<130 μ W _{RMS}	<150 μ W _{RMS}

Table 2-8: Dark level and vertical equivalent optical noise limits (cont.)

Optical sampling module	Bandwidth or filter	Dark level	Vertical equivalent optical noise	
			Without CR	With CR
80C10B-F1 1550 nm			Without CRTP	With CRTP
	OC-768/STM-256	<25 μ W	<38 μ W _{RMS}	<44 μ W _{RMS}
	43.018 Gb/s	<25 μ W	<38 μ W _{RMS}	<44 μ W _{RMS}
	41.25 Gb/s	<25 μ W	<38 μ W _{RMS}	<44 μ W _{RMS}
	65 GHz	<25 μ W	<60 μ W _{RMS}	<69 μ W _{RMS}
	25.871 GHz	<25 μ W	<28 μ W _{RMS}	<32 μ W _{RMS}
	27.739 GHz	<25 μ W	<28 μ W _{RMS}	<32 μ W _{RMS}
80C10B-F1 1310 nm			Without CRTP	With CRTP
	OC-768/STM-256	<35 μ W	<50 μ W _{RMS}	<58 μ W _{RMS}
	43.018 Gb/s	<35 μ W	<50 μ W _{RMS}	<58 μ W _{RMS}
	41.25 Gb/s	<35 μ W	<50 μ W _{RMS}	<58 μ W _{RMS}
	65 GHz	<35 μ W	<75 μ W _{RMS}	<86 μ W _{RMS}
	25.871 Gb/s	<35 μ W	<38 μ W _{RMS}	<44 μ W _{RMS}
	27.739 Gb/s	<35 μ W	<38 μ W _{RMS}	<44 μ W _{RMS}
80C25GBE 1550 nm			Without CRTP	With CRTP
	65 GHz	<25 μ W	<60 μ W _{RMS}	<69 μ W _{RMS}
	25.871 Gb/s	<25 μ W	<28 μ W _{RMS}	<32 μ W _{RMS}
	27.739 Gb/s	<25 μ W	<28 μ W _{RMS}	<32 μ W _{RMS}
80C25GBE 1310 nm			Without CRTP	With CRTP
	65 GHz	<35 μ W	<75 μ W _{RMS}	<86 μ W _{RMS}
	25.871 Gb/s	<35 μ W	<38 μ W _{RMS}	<44 μ W _{RMS}
	27.739 Gb/s	<35 μ W	<38 μ W _{RMS}	<44 μ W _{RMS}

Table 2-8: Dark level and vertical equivalent optical noise limits (cont.)

Optical sampling module	Bandwidth or filter	Dark level	Vertical equivalent optical noise	
			Without CR	With CR
80C11	OC-192/STM-64	<10 μ W	<8 μ W _{RMS}	<9 μ W _{RMS}
	10.662 Gb/s	<10 μ W	<8 μ W _{RMS}	<9 μ W _{RMS}
	10.709 Gb/s	<10 μ W	<8 μ W _{RMS}	<9 μ W _{RMS}
	10GBASE-W	<10 μ W	<8 μ W _{RMS}	<9 μ W _{RMS}
	10GBASE-R	<10 μ W	<8 μ W _{RMS}	<9 μ W _{RMS}
	10GBE FEC	<10 μ W	<8 μ W _{RMS}	<9 μ W _{RMS}
	10GFC	<10 μ W	<8 μ W _{RMS}	<9 μ W _{RMS}
	10GFC FEC	<10 μ W	<8 μ W _{RMS}	<9 μ W _{RMS}
	16GFC	<10 μ W	<10 μ W _{RMS}	<11.5 μ W _{RMS}
	20 GHz	<10 μ W	<14 μ W _{RMS}	<15 μ W _{RMS}
	30 GHz	<10 μ W	<30 μ W _{RMS}	<35 μ W _{RMS}
80C12 (1310 nm and 1550 nm)	FC1063	<1 μ W	<2.5 μ W _{RMS}	-
	FC2125	<1 μ W	<2.5 μ W _{RMS}	-
	FC4250	<1 μ W	<2.5 μ W _{RMS}	-
	FC8500	<1 μ W	<2.5 μ W _{RMS}	-
	10GBase-X4	<1 μ W	<2.5 μ W _{RMS}	-
	10GFC-X4	<1 μ W	<2.5 μ W _{RMS}	-
	3.318 Gb/s	<1 μ W	<2.5 μ W _{RMS}	-
	9 GHz	<1 μ W	<5 μ W _{RMS}	-
80C12 (850 nm)	FC1063	<1 μ W	<4.0 μ W _{RMS}	-
	FC2125	<1 μ W	<4.0 μ W _{RMS}	-
	FC4250	<1 μ W	<4.0 μ W _{RMS}	-
	FC8500	<1 μ W	<4.0 μ W _{RMS}	-
	10GBase-X4	<1 μ W	<4.0 μ W _{RMS}	-
	10GFC-X4	<1 μ W	<4.0 μ W _{RMS}	-
	3.318 Gb/s	<1 μ W	<4.0 μ W _{RMS}	-
	9 GHz	<1 μ W	<8.0 μ W _{RMS}	-

Table 2-8: Dark level and vertical equivalent optical noise limits (cont.)

Optical sampling module	Bandwidth or filter	Dark level	Vertical equivalent optical noise	
			Without CR	With CR
80C12-10G (1310 nm and 1550 nm)	10GBASE-W	<1 μ W	<5.0 μ W _{RMS}	-
	10GBASE-R	<1 μ W	<5.0 μ W _{RMS}	-
	OC-192/STM-64	<1 μ W	<5.0 μ W _{RMS}	-
	FC8500	<1 μ W	<5.0 μ W _{RMS}	-
	10GFC	<1 μ W	<5.0 μ W _{RMS}	-
	10GFC FEC	<1 μ W	<5.0 μ W _{RMS}	-
	10GBE FEC	<1 μ W	<5.0 μ W _{RMS}	-
	10.66 Data Filter	<1 μ W	<5.0 μ W _{RMS}	-
	10.709 Data Filter	<1 μ W	<5.0 μ W _{RMS}	-
80C12-10G (850 nm)	10GBASE-W	<1 μ W	<8 μ W _{RMS}	-
	10GBASE-R	<1 μ W	<8 μ W _{RMS}	-
	OC-192/STM-64	<1 μ W	<8 μ W _{RMS}	-
	FC8500	<1 μ W	<8 μ W _{RMS}	-
	10GFC	<1 μ W	<8 μ W _{RMS}	-
	10GFC FEC	<1 μ W	<8 μ W _{RMS}	-
	10GBE FEC	<1 μ W	<8 μ W _{RMS}	-
	10.66 Data Filter	<1 μ W	<8 μ W _{RMS}	-
	10.709 Data Filter	<1 μ W	<8 μ W _{RMS}	-

Minimum Optical Bandwidth and Reference Receiver Frequency Response

Before performing the checks for minimum optical bandwidth and reference receiver frequency response, you need to have an understanding of what optical bandwidth is and how it is measured.

Traditionally, the bandwidth of a device or system is defined as the frequency at which the power out of the same device or system is one half as compared with a frequency near DC. In the voltage domain, the power dissipated into a resistive load (for example, a 50 Ω termination of a sampler) is the V_{RMS}^2/R where V_{RMS} is the RMS of the voltage swing seen at the resistive load, and R is the resistance value. A logarithmic scale using decibels is typically used to describe a frequency dependent response of a system.

A value expressed in terms of a decibel relative to a reference is defined as:

$$dB = 10 \times \log \left(\frac{value}{reference} \right)$$

For electrical bandwidths, the power ratio is used so:

$$dB = 10 \times \log \left(\frac{Power_f}{Power_{DC}} \right)$$

when

$$\frac{Power_f}{Power_{DC}} = \frac{1}{2}$$

$$10 \times \log \left(\frac{1}{2} \right) = -3 \text{ dB}$$

In terms of voltage, and resistance, the bandwidth is expressed as:

$$-3 \text{ dB} = 10 \times \log \left(\frac{\frac{V_f^2}{R}}{\frac{V_{DC}^2}{R}} \right)$$

where V_f is the RMS of the voltage swing response at the bandwidth frequency and V_{DC} is the RMS voltage swing response at a frequency approaching DC. Further math yields that $V_f = 0.707 \times V_{DC}$. The expression is simplified by the cancellation of the R and the movement of the squared term inside the log expression to a multiple outside the log expression:

$$\log \left(\frac{\frac{V_f^2}{R}}{\frac{V_{DC}^2}{R}} \right) = 2 \times 10 \times \log \left(\frac{V_f}{V_{DC}} \right) = 20 \times \log \left(\frac{V_f}{V_{DC}} \right)$$

therefore at

$$-3 \text{ dB} \frac{V_f}{V_{DC}} = 0.707$$

In the DSA8200, the vertical units displayed for an optical module are not in voltage, but are in watts, which is a unit of power. The O/E converter inside the module outputs a voltage swing whose amplitude is linearly dependent on the incoming optical power swing. In this condition the voltage applied at the electrical sampler already represents Optical Power in its linear form (as opposed to having to square the voltage and divide by R). For the optical sampling modules, then, the bandwidth where the displayed optical power is one half that approaching DC is:

$$dB = 10 \times \log \left(\frac{Power_f}{Power_{DC}} \right) = -3 \text{ dB}$$

The V_f in such a system is one half (0.5) the V_{DC} as opposed to 0.707. The optical bandwidth, therefore, corresponds to the traditional electrical bandwidth at -6 dB. During testing of optical modules via impulse testing, the resulting impulse waveform is converted to frequency via Fourier transform, and the bandwidth is defined as:

$$-3 \text{ dB} = 10 \times \log \left(\frac{\text{vertical swing @ frequency}}{\text{vertical swing @ DC}} \right)$$

This definition is used for 2.3 GHz, 2.5 GHz, 12.5 GHz, 20 GHz, 30 GHz, 40 GHz, 50 GHz and 65 GHz bandwidth settings.

During reference receiver curve calculation, however, the definition is changed to match the industry standard definition, which was authored assuming electrical bandwidths where:

$$-3 \text{ dB} = 20 \times \log \left(\frac{\text{vertical swing @ frequency}}{\text{vertical swing @ DC}} \right)$$

This definition is used for all NRZ reference receiver settings in all the modules.

**80C01-80C09, 80C11, and
80C12 Procedure**

This procedure checks the minimum optical bandwidths and the reference receiver frequency responses of all 80C0X Optical Sampling Module except the 80C10, 80C10B, and 80C25GBE. To test the minimum optical bandwidths and the reference receiver frequency response of 80C10, 80C10B, and 80C25GBE modules, skip to *80C10 and 80C10B Test* on page 2-190.

NOTE. *To optimize performance, make sure that all connections are clean and secure and that all components of the system are in good condition. Optical fiber can gradually degrade the system performance as it is repeatedly flexed over time.*

Equipment required	DSA8200 Digital Serial Analyzer Calmar FPL-01 optical impulser (item 24) Tektronix OA5002 variable optical attenuator (item 23) Single-mode fiber-optic cable, 2 m, FC to FC connectors (item 13) Optical attenuator, 10 dB, FC-FC, female-male connectors (item 8) Cable, coaxial, 1 m, male to male SMA connectors (item 18)
Prerequisites	As listed on page 2-26 and under <i>Prerequisites</i> on page 2-161.

Before performing this procedure, be sure you have completed the *Dark level and Vertical Equivalent Optical Noise* procedure on page 2-161.

NOTE. *Because of interpolation errors in the FFT calculation of the impulse response, the 80C06 module is not tested like the other modules in this section. Instead, we integrate the impulse response to generate a step and then measure the 10% to 90% risetime of this step response. For the 80C06, go to the Integrated Rise Time and Aberrations Check on page 2-198.*

Setup

Install the test hookup (see Figure 2-39) and preset the instrument controls:

1. Install the 80C0X Optical Sampling Module into Channel 1 of the instrument.

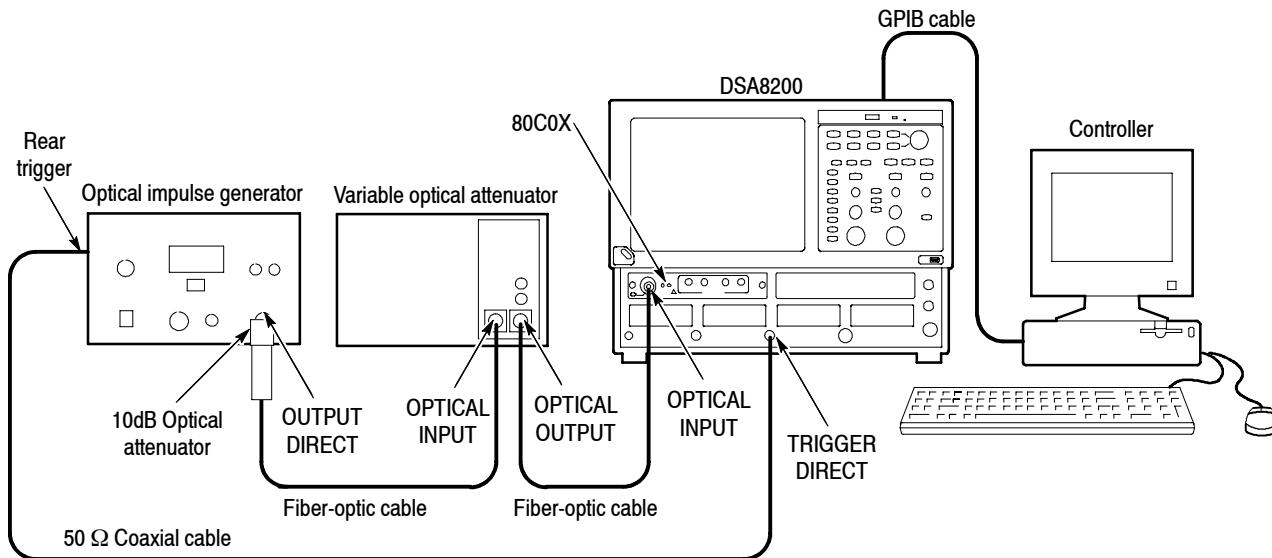


Figure 2-39: Minimum optical bandwidth and reference receiver frequency response hookup

2. Connect the 10 dB optical attenuator to the output of the optical impulse generator.
3. Connect a fiber-optic cable between the 10 dB optical attenuator and the input of the OA5002 variable optical attenuator.
4. Connect a fiber-optic cable between the output of the variable optical attenuator and the OPTICAL INPUT of the optical sampling module.
5. Connect a 50 Ω coaxial cable from the rear trigger (SYN) on the optical impulse generator to the TRIGGER DIRECT input on the instrument.
6. Start with about 30 dB of attenuation on the variable attenuator.

NOTE. To avoid dispersing the narrow optical impulse signal, keep all fiber lengths as short as possible. Lengths that are 2 to 3 meters long are acceptable.

7. Press the SELECT ON/OFF button on the 80C0X Optical Sampling Module so that the adjacent indicator lights. This turns on Channel 1 (C1) on the 80C0X-CR Optical Sampling Module.
8. In the Setup menu, select Acquire and make the following changes in the Acq Setup dialog box:
 - a. Select Average as the acquisition mode.
 - b. Set the number of samples to 64 Samples.

9. In the Trig Setup dialog box, do the following:
 - a. Select External Direct for the trigger source.
 - b. Select Auto for Mode.
 - c. Select the rising edge for Slope.
 - d. Click the Set to 50% button to set the trigger point midway on the rising signal.
10. In the Horiz Setup dialog box, do the following;
 - a. Set the Scale to 1.000 ns/div. (This setting will make it easier to initially locate the optical pulse later in the procedure.)
 - b. Set the Position to 18.000 ns. (This setting will make it easier to locate the first optical pulse later in the procedure.)
 - c. Set the Record Length to 2000.
11. In the Disp Setup dialog box, do the following:
 - a. In the Style section, select Normal.
 - b. Check Show Vectors.

NOTE. *If the Scale, Position, and Channel Offset control boxes are not displayed in the following step, click the Basic>> button in the lower left part of the Vert Setup dialog box.*

12. In the Vert Setup dialog box, do the the following:
 - a. Set the Scale to 500.0 μ W/div or a lower setting if 500.0 μ W is not available.
 - b. Set Position to 0.0 div.
 - c. Set Channel Offset to 0.0 W.
 - d. Click the Optical>> button in the lower left part of the Vert Setup dialog box.
 - e. Set Wavelength to 1550 nm.
 - f. Set the Bandwidth or Filter to the highest bandwidth setting available for the optical sampling module that you are testing:

■ 80C01	Filter to None	Bandwidth to 20.000 GHz
■ 80C02	Filter to None	Bandwidth to 30.000 GHz

■ 80C03	Filter to None	Bandwidth 2 GHz
■ 80C04	Filter to None	Bandwidth to 30.000 GHz
■ 80C05	Filter to None	Bandwidth to 40.000 GHz
■ 80C07	Filter to None	Bandwidth to 2.0 GHz
■ 80C07B	Filter to None	Bandwidth to 2.5 GHz
■ 80C08	Filter to None	Bandwidth to 10.000 GHz
■ 80C08B	Filter to None	Bandwidth to 10.000 GHz
■ 80C08C	Filter to None	Bandwidth to 10.000 GHz
■ 80C09	Filter to None	Bandwidth to 30.000 GHz
■ 80C11	Filter to None	Bandwidth to 30.000 GHz
■ 80C12	Filter to None	Bandwidth to 9 GHz
■ 80C12-10G	Filter to None	Bandwidth to 10 GHz

- g. Position the cursor in the title bar of the Setups dialog box and drag the box to the right side of the display.

13. Use the Horizontal POSITION control to position the impulse at the first horizontal division. (This ensures that post-impulse aberrations are included in the record.) See Figure 2-40.

14. Adjust the attenuation of the variable optical attenuator as follows:

- If you are testing an 80C01, 80C02, 80C04, 80C09, or 80C11 Optical Sampling Module, adjust it until it produces an impulse pulse amplitude of $1.5 \text{ mW}_{\text{p-p}}$ to $2.5 \text{ mW}_{\text{p-p}}$.
- If you are testing an 80C03, 80C07, 80C07B, 80C08, 80C08B, 80C08C or 80C12 Optical Sampling Module, adjust the attenuator until a $200 \mu\text{W}_{\text{p-p}}$ pulse amplitude is achieved.
- If you are testing an 80C05 optical sampling module, adjust the attenuator until a $10 \text{ mW}_{\text{p-p}}$ pulse amplitude is achieved.

Test Follow this procedure to make the minimum optical bandwidth and reference receiver frequency response checks:

NOTE. *The minimum optical bandwidth is not checked for the 80C03 Optical Sampling Module. If testing this module, go to step 10 in this procedure and continue with this procedure to check the reference receiver frequency responses.*

1. Use the Horizontal POSITION control to position the impulse at the first horizontal division. (This ensures that post-impulse aberrations are included in the record.) See Figure 2-40.

You may experience signal jitter if you try to display a signal that is not the first impulse and is late in relation to time zero.

2. Adjust the Horizontal SCALE control so that the width of the impulse at its base is approximately 1/4 to 3/4 of a horizontal division on the display. See Figure 2-40.

NOTE. *If the width of the impulse is much greater than 3/4 of a horizontal division, the resulting Fourier transform will not have enough frequency resolution; if the width is much smaller than 1/4 of a horizontal division, the amount of samples that fall on the impulse may be too coarse, resulting in quantum errors in the resulting Fourier transform.*

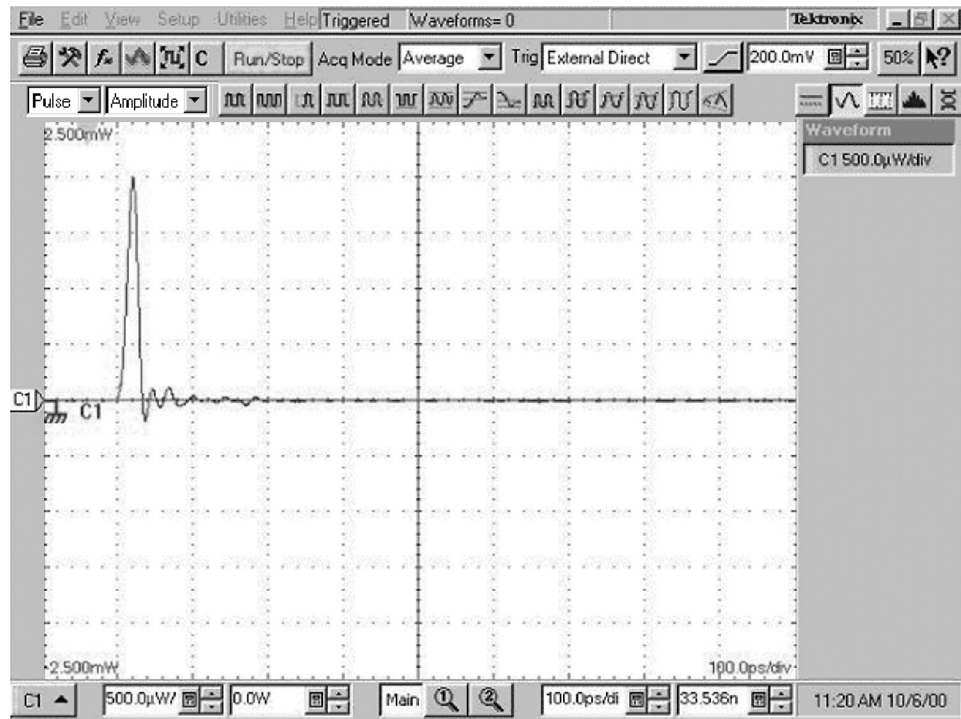


Figure 2-40: Proper positioning of the impulse for optimum curve download

3. Using a controller (such as a PC, Macintosh, or workstation) attached to the main instrument via GPIB, download the waveform.

NOTE. Alternatively, you can use the *Save Waveform*, *Copy Waveform*, or a network connection to transfer a waveform curve to a spreadsheet, ASCII file, or other application.

4. Using the available controller software, such as Labview, perform a Fourier Transform on the waveform; this transforms the time-domain impulse response to a scalar frequency response.
5. Normalize the Fourier Transform result such that DC or low frequency is 0 dB.
6. Plot the frequency response.
7. Check that the optical sampling module meets the performance requirements for the bandwidth setting chosen.
8. Repeat steps 1 through 7 for the remaining bandwidth settings for the optical module under test (refer to Table 2-9 for the settings that match the module model).

Table 2-9: Minimum optical bandwidth limits

Optical sampling module	Bandwidth setting	Bandwidth limit
80C01	20 GHz	>20 GHz
	12.5 GHz	>12.5 GHz
80C02	30 GHz	>28 GHz
	20 GHz	>20 GHz
	12.5 GHz	>12.5 GHz
80C04	30 GHz	>28 GHz
	20 GHz	>20 GHz
80C05	40 GHz	>40 GHz
	30 GHz	>30 GHz
	20 GHz	>20 GHz
80C07	2.0 GHz	>2.3 GHz
80C07B	2.5 GHz	>2.3 GHz
80C08	10.0 GHz	>9.5 GHz
80C08B	10.0 GHz	>9.5 GHz
80C08C	10.0 GHz	>9.5 GHz
80C09	30 GHz	>28 GHz
	20 GHz	>20 GHz
80C10	65 GHz	>60 GHz
	30 GHz	>30 GHz
80C10B	80 GHz (not included in Option F1)	>75 GHz
	65 GHz	>60 GHz
	30 GHz (not included in Option F1)	>30 GHz
80C11	30 GHz	>28 GHz
	20 GHz	>20 GHz
80C12	9 GHz (options F2, F3, F5, F6, FC)	>8.5 GHz
80C12-10G	10 GHz	>9.5 GHz
80C25GBE	65 GHz	>60 GHz

9. In the Vert Setup dialog box, select a Filter (see the Table 2-10 for filters available for the various optical sampling modules).

10. Do steps 1 through 6.

11. Refer to Table 2-10 and check that the optical sampling module meets the limits listed for the tested filter.
12. Repeat steps 9 through 11 for each of the filters available for the optical sampling module that you are testing.

Table 2- 10: Reference receiver frequency response limits

Optical sampling module	Filter	Limits			
		(MHz)	Lower	(dB)	Upper
80C07, 80C07B	OC-3/STM-1	Frequency		Nominal	
		0.000	-0.50	0.00	0.50
		23.33	-0.61	-0.11	0.39
		46.65	-0.95	-0.45	0.05
		69.98	-1.52	-1.02	-0.52
		93.30	-2.36	-1.86	-1.36
		116.7	-3.50	-3.00	-2.50
		140.0	-5.67	-4.51	-3.35
		155.5	-7.25	-5.71	-4.17
		163.3	-8.08	-6.37	-4.66
		186.6	-10.74	-8.54	-6.35
		209.9	-13.55	-10.93	-8.31
233.3	-16.41	-13.41	-10.41		
80C01, 80C07, 80C07B	OC-12/STM-4	Frequency		Nominal	
		0.000	-0.50	0.00	+0.50
		93.3	-0.61	-0.11	+0.39
		186.6	-0.95	-0.45	+0.05
		279.9	-1.52	-1.02	-0.52
		373.2	-2.36	-1.86	-1.36
		466.7	-3.50	-3.00	-2.50
		559.9	-5.67	-4.51	-3.35
		622.1	-7.25	-5.71	-4.17
		653.2	-8.08	-6.37	-4.66
		746.5	-10.74	-8.54	-6.35
		839.8	-13.55	-10.93	-8.31
933.1	-16.41	-13.41	-10.41		

Table 2-10: Reference receiver frequency response limits (cont.)

Optical sampling module	Filter	Limits			
		(MHz) Frequency	Lower	(dB) Nominal	Upper
80C01, 80C03, 80C07, 80C07B	OC-48/STM-16	0.000	-0.50	0.00	+0.50
		373.3	-0.61	-0.11	+0.39
		746.5	-0.95	-0.45	+0.05
		1119.7	-1.52	-1.02	-0.52
		1493.1	-2.36	-1.86	-1.36
		1866.3	-3.50	-3.00	-2.50
		2239.5	-5.67	-4.51	-3.35
		2488.3	-7.25	-5.71	-4.17
		2612.8	-8.08	-6.37	-4.66
		2986.0	-10.74	-8.54	-6.35
		3359.3	-13.55	-10.93	-8.31
		3732.6	-16.41	-13.41	-10.41
		80C01, 80C02, 80C04, 80C05, 80C08B, 80C08C, 80C09, 80C11, 80C12-10G	OC-192/STM-64	0.000	-0.85
1493.2	-0.96			-0.11	+0.74
2986.0	-1.30			-0.45	+0.40
4478.8	-1.87			-1.02	-0.17
5972.4	-2.71			-1.86	-1.01
7465.0	-3.86			-3.00	-2.16
8958.0	-6.19			-4.51	-2.83
9953.28	-7.87			-5.71	-3.55
10451.2	-8.75			-6.37	-3.99
11944.0	-11.53			-8.54	-5.56
13437.2	-14.45			-10.93	-7.41
14930.4	-17.41			-13.41	-9.41
80C04, 80C11, 80C12-10G	10.66			0.000	-0.85
		1599.8	-0.96	-0.11	+0.74
		3199.2	-1.30	-0.45	+0.40
		4798.6	-1.87	-1.02	+0.17
		6398.9	-2.71	-1.86	-1.01
		7998.0	-3.86	-3.00	-2.16
		9597.7	-6.19	-4.51	-2.83
		10664.0	-7.87	-5.71	-3.55
		11197.5	-8.75	-6.37	-3.99
		12796.9	-11.53	-8.54	-5.56
		14396.7	-14.45	-10.93	-7.41
		15996.5	-17.41	-13.41	-9.41

Table 2- 10: Reference receiver frequency response limits (cont.)

Optical sampling module	Filter	Limits			
		(MHz)	Lower	(dB)	Upper
80C03, 80C07B	ENET2500 (2 GBE) 2.50 Gb/s	Frequency		Nominal	
		0.000	-0.50	0.00	+0.50
		375	-0.61	-0.11	+0.39
		750	-0.95	-0.45	+0.05
		1125	-1.52	-1.02	-0.52
		1500	-2.36	-1.86	-1.36
		1875	-3.50	-3.00	-2.50
		2250	-5.67	-4.51	-3.35
		2500	-7.25	-5.71	-4.17
		2625	-8.08	-6.37	-4.66
		3000	-10.74	-8.54	-6.35
		3375	-13.55	-10.93	-8.31
		3750	-16.41	-13.41	-10.41
80C03, 80C07B	ENET1250 (GBE) 1.25 Gb/s	Frequency		Nominal	Upper
		0.000	-0.50	0.00	+0.50
		187.5	-0.61	-0.11	+0.39
		375	-0.95	-0.45	+0.05
		562.5	-1.52	-1.02	-0.52
		750	-2.36	-1.86	-1.36
		937.5	-3.50	-3.00	-2.50
		1125	-5.67	-4.51	-3.35
		1250	-7.25	-5.71	-4.17
		1312.5	-8.08	-6.37	-4.66
		1500	-10.74	-8.54	-6.35
		1687.5	-13.55	-10.93	-8.31
		1875	-16.41	-13.41	-10.41
80C03, 80C07B, 80C12	FC1063	Frequency		Nominal	Upper
		0.000	-0.50	0.00	+0.50
		159.5	-0.61	-0.11	+0.39
		318.9	-0.95	-0.45	+0.05
		478.4	-1.52	-1.02	-0.52
		637.9	-2.36	-1.86	-1.36
		797.4	-3.50	-3.00	-2.50
		956.8	-5.67	-4.51	-3.35
		1063	-7.25	-5.71	-4.17
		1116	-8.08	-6.37	-4.66
		1275	-10.74	-8.54	-6.35
		1435	-13.55	-10.93	-8.31
		1595	-16.41	-13.41	-10.41

Table 2-10: Reference receiver frequency response limits (cont.)

Optical sampling module	Filter	Limits			
		(MHz) Frequency	Lower	(dB) Nominal	Upper
80C07B, 80C12	FC2125	0.000	-0.50	0.00	0.50
		318.8	-0.61	-0.11	0.39
		637.5	-0.95	-0.45	0.05
		956.3	-1.52	-1.02	-0.52
		1275	-2.36	-1.86	-1.36
		1594	-3.50	-3.00	-2.50
		1913	-5.67	-4.51	-3.35
		2125	-7.25	-5.71	-4.17
		2231	-8.08	-6.37	-4.66
		2550	-10.74	-8.54	-6.35
		2869	-13.55	-10.93	-8.31
		3188	-16.41	-13.41	-10.41
		80C09, 80C11, 80C12-10G	10.71 Gb/s	0.000	-0.85
1606.6	-0.96			-0.11	+0.74
3212.8	-1.30			-0.45	+0.40
4819.0	-1.87			-1.02	-0.17
6426.0	-2.71			-1.86	-1.01
8032.0	-3.86			-3.00	-2.16
9638.4	-6.19			-4.51	-2.83
10709.2	-7.87			-5.71	-3.55
11245.0	-8.75			-6.37	-3.99
12851.1	-11.53			-8.54	-5.56
14457.7	-14.45			-10.93	-7.41
16064.4	-17.41			-13.41	-9.41
80C08, 80C08B, 80C08C, 80C11, 80C12-10G	10GBASE-W			0.000	-0.85
		1500	-0.96	-0.11	+0.74
		3000	-1.30	-0.45	+0.40
		4500	-1.87	-1.02	-0.17
		6000	-2.71	-1.86	-1.01
		7500	-3.86	-3.00	-2.16
		9000	-6.19	-4.51	-2.83
		10000	-7.87	-5.71	-3.55
		10500	-8.75	-6.37	-3.99
		12000	-11.53	-8.54	-5.56
		13500	-14.45	-10.93	-7.41
		15000	-17.41	-13.41	-9.41

Table 2- 10: Reference receiver frequency response limits (cont.)

Optical sampling module	Filter	Limits			
		(MHz) Frequency	Lower	(dB) Nominal	Upper
80C08, 80C08B, 80C08C, 80C11, 80C12-10G	10GBASE-R	0.000	-0.85	0.00	+0.85
		1500	-0.96	-0.11	+0.74
		3000	-1.30	-0.45	+0.40
		4500	-1.87	-1.02	-0.17
		6000	-2.71	-1.86	-1.01
		7500	-3.86	-3.00	-2.16
		9000	-6.19	-4.51	-2.83
		10000	-7.87	-5.71	-3.55
		10500	-8.75	-6.37	-3.99
		12000	-11.53	-8.54	-5.56
		13500	-14.45	-10.93	-7.41
		15000	-17.41	-13.41	-9.41
		80C08C, 80C11, 80C12-10G	10GBE FEC	0.000	-0.85
1500	-0.96			-0.11	+0.74
3000	-1.30			-0.45	+0.40
4500	-1.87			-1.02	-0.17
6000	-2.71			-1.86	-1.01
7500	-3.86			-3.00	-2.16
9000	-6.19			-4.51	-2.83
10000	-7.87			-5.71	-3.55
10500	-8.75			-6.37	-3.99
12000	-11.53			-8.54	-5.56
13500	-14.45			-10.93	-7.41
15000	-17.41			-13.41	-9.41
80C08B, 80C08C, 80C11, 80C12-10G	10GFC			0.000	-0.85
		1500	-0.96	-0.11	+0.74
		3000	-1.30	-0.45	+0.40
		4500	-1.87	-1.02	-0.17
		6000	-2.71	-1.86	-1.01
		7500	-3.86	-3.00	-2.16
		9000	-6.19	-4.51	-2.83
		10000	-7.87	-5.71	-3.55
		10500	-8.75	-6.37	-3.99
		12000	-11.53	-8.54	-5.56
		13500	-14.45	-10.93	-7.41
		15000	-17.41	-13.41	-9.41

Table 2- 10: Reference receiver frequency response limits (cont.)

Optical sampling module	Filter	Limits			
		(MHz) Frequency	Lower	(dB) Nominal	Upper
80C08C, 80C11, 80C12-10G	10GFC FEC	0.000	-0.85	0.00	+0.85
		1500	-0.96	-0.11	+0.74
		3000	-1.30	-0.45	+0.40
		4500	-1.87	-1.02	-0.17
		6000	-2.71	-1.86	-1.01
		7500	-3.86	-3.00	-2.16
		9000	-6.19	-4.51	-2.83
		10000	-7.87	-5.71	-3.55
		10500	-8.75	-6.37	-3.99
		12000	-11.53	-8.54	-5.56
		13500	-14.45	-10.93	-7.41
		15000	-17.41	-13.41	-9.41
		80C11	16GFC, 14.03GHz	0.000	-0.85
2104	-0.96			-0.11	+0.74
4208	-1.30			-0.45	+0.40
6311	-1.87			-1.02	-0.17
8415	-2.71			-1.86	-1.01
10519	-3.86			-3.00	-2.16
12623	-6.19			-4.51	-2.83
14025	-7.87			-5.71	-3.55
14726	-8.75			-6.37	-3.99
16830	-11.53			-8.54	-5.56
18934	-14.45			-10.93	-7.41
21038	-17.41			-13.41	-9.41
80C08C	10.66 Data Filter			0.000	-0.85
		1500	-0.96	-0.11	+0.74
		3000	-1.30	-0.45	+0.40
		4500	-1.87	-1.02	-0.17
		6000	-2.71	-1.86	-1.01
		7500	-3.86	-3.00	-2.16
		9000	-6.19	-4.51	-2.83
		10000	-7.87	-5.71	-3.55
		10500	-8.75	-6.37	-3.99
		12000	-11.53	-8.54	-5.56
		13500	-14.45	-10.93	-7.41
		15000	-17.41	-13.41	-9.41

Table 2- 10: Reference receiver frequency response limits (cont.)

Optical sampling module	Filter	Limits			
		(MHz)		(dB)	
80C08C	10.709 Data Filter	Frequency	Lower	Nominal	Upper
		0.000	-0.85	0.00	+0.85
		1500	-0.96	-0.11	+0.74
		3000	-1.30	-0.45	+0.40
		4500	-1.87	-1.02	-0.17
		6000	-2.71	-1.86	-1.01
		7500	-3.86	-3.00	-2.16
		9000	-6.19	-4.51	-2.83
		10000	-7.87	-5.71	-3.55
		10500	-8.75	-6.37	-3.99
		12000	-11.53	-8.54	-5.56
		13500	-14.45	-10.93	-7.41
		15000	-17.41	-13.41	-9.41
		80C12	10GBASE-X4	0.000	-0.50
468.8	-0.61			-0.11	0.39
937.5	-0.95			-0.45	0.05
1406	-1.52			-1.02	-0.52
1875	-2.36			-1.86	-1.36
2344	-3.50			-3.00	-2.50
2813	-5.67			-4.51	-3.35
3125	-7.25			-5.71	-4.17
3281	-8.08			-6.37	-4.65
3750	-10.74			-8.54	-6.35
4219	-13.55			-10.93	-8.31
4688	-16.41	-13.41	-10.41		
80C12	10GFC-X4	0.000	-0.50	0.00	0.50
		478.1	-0.61	-0.11	0.39
		956.3	-0.95	-0.45	0.05
		1434	-1.52	-1.02	-0.52
		1913	-2.36	-1.86	-1.36
		2391	-3.50	-3.00	-2.50
		2869	-5.67	-4.51	-3.35
		3188	-7.25	-5.71	-4.17
		3347	-8.08	-6.37	-4.65
		3825	-10.74	-8.54	-6.35
		4303	-13.55	-10.93	-8.31
4781	-16.41	-13.41	-10.41		

Table 2-10: Reference receiver frequency response limits (cont.)

Optical sampling module	Filter	Limits			
80C12	FC4250	0.000	-0.50	0.00	0.50
		637.5	-0.61	-0.11	0.39
		1275	-0.95	-0.45	0.05
		1913	-1.52	-1.02	-0.52
		2550	-2.36	-1.86	-1.36
		3188	-3.50	-3.00	-2.50
		3826	-5.67	-4.51	-3.35
		4250	-7.25	-5.71	-4.17
		4462	-8.08	-6.37	-4.65
		5100	-10.74	-8.54	-6.35
		5738	-13.55	-10.93	-8.31
		6375	-16.41	-13.41	-10.41
		80C12	VSR-5	0.000	-0.50
497.7	-0.61			-0.11	0.39
995.3	-0.95			-0.45	0.05
1493	-1.52			-1.02	-0.52
1991	-2.36			-1.86	-1.36
2488	-3.50			-3.00	-2.50
2986	-5.67			-4.51	-3.35
3318	-7.25			-5.71	-4.17
3484	-8.08			-6.37	-4.65
3981	-10.74			-8.54	-6.35
4479	-13.55			-10.93	-8.31
4977	-16.41			-13.41	-10.41

80C10, 80C10B, and 80C25GBE Test

This procedure checks the minimum optical bandwidths and the reference receiver frequency responses of the 80C10, 80C10B, and 80C25GBE Optical Sampling Modules only. To test bandwidths and responses minimum of all other optical sampling modules, skip this procedure and do the *80C01-80C09, 80C11, and 80C12 Procedure* on page 2-175 instead.

Equipment required	DSA8200 Digital Serial Analyzer Tunable ECL lasers (Qty. 2) (Item 43) See Tunable Laser Requirements, below Wavelength meter (Item 25) Polarization Maintaining fiber coupler (50/50) (Item 36) Polarization Maintaining tap coupler (90/10) (Item 37) PM fiber jumper cable (FC/APC and FC/PC connector) (Item 38) SMA fiber jumper cable (FC/APC and FC/PC connector) (Item 39) Tektronix 500 MHz real-time scope (Item 42) Photodetector, >1GHz bandwidth (Item 35)
Prerequisites	As listed on page 2-26 and under <i>Prerequisites</i> on page 2-161.

Tunable Laser Requirements

The lasers used for this test meet the following requirements:

- The lasers must be a tunable External Cavity Laser (ECLs), which has a narrow linewidth and high side-mode suppression ratio (>50 dB) that result in single frequency emission.
- The lasers must have an absolute wavelength accuracy of <1 pm, where the wavelength of the sweep laser is measured during the sweep using a high precision optical wavelength meter¹. The sweep laser must be mode-hop free over the sweep range.
- The lasers must be matched to each other for polarization and power, in order to achieve near 100% modulation. For example:
 - Align the axis of polarization of the two lasers at the input to the module under test with an extinction ratio of > 20 dB. To do so, use lasers with Polarization-Maintaining (PM) output fibers and use PM fibers and PM components in the entire setup.
 - Adjust the power of the lasers to be equal at the input to the module under test. See step 7.

¹ For the optical wavelength meter, the relative accuracy and display resolution must be 1 pm (wavelengths are vacuum values).

Setup Install the test hookups, and preset the main instrument controls:

1. Install the 80C10, 80C10B, or 80C25GBE Optical Sampling Module into Channel 1 of the main instrument.

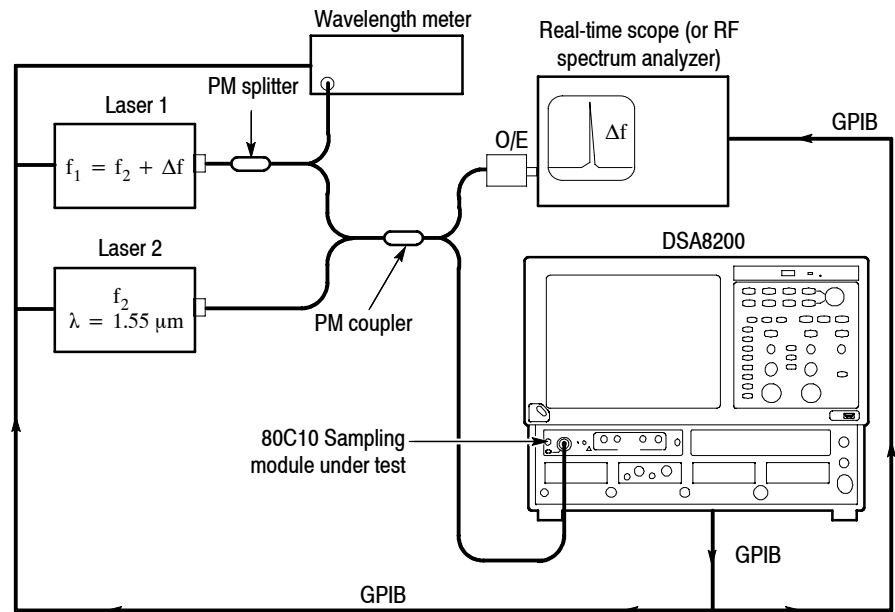


Figure 2-41: Hookup for heterodyne test

2. Make sure the module under test is properly compensated. See *Perform the Compensation* on page 2-5.

NOTE. To optimize performance, make sure that all connections are clean and secure and that all components of the system are in good condition. Optical fiber can gradually degrade the system performance as it is repeatedly flexed over time.

3. Connect a PM fiber-optic cable between the OPTICAL output of the Laser 1 and the PM splitter. Connect the input of the PM splitter to the OPTICAL output of laser 1.
4. Connect the 5% output of the PM splitter to the wavelength meter; connect the other output of the PM splitter to the PM coupler.
5. Connect a PM fiber-optic cable between the OPTICAL output of the Laser 2 and the PM coupler. Connect the second input of the PM coupler to the OPTICAL output of laser 2.

6. Connect one output of the PM coupler to the O/E converter on the real-time scope or RF spectrum analyzer; connect the other output of the PM coupler to the 80C10, 80C10B, or 80C25GBE module in the main instrument.
7. Verify the following settings on both Laser 1 and Laser 2:
 - Instantaneous Laser linewidth: < 300 kHz.
 - Side-mode suppression ratio: > 50 dB.
 - Power stability is $\leq \pm 0.025$ dB during the duration of sweep and over wavelength range of sweep. This needs to be verified before continuing this procedure. If the lasers do not meet this specification, apply correction values (see note).

NOTE. *If lasers do not meet power stability or sweep flatness requirement:*

- *In performing steps 3 and 4 on page 2-194, at each frequency point (including the DC reference point) record the mean value from the histogram statistics: m_i*
- *The corrected normalized response values (dB) are calculated using (also see the equation in step 6b on page 2-195):*

$$R(f_i) = 10 \cdot \log \left(\sqrt{\frac{\sigma_i^2 - \sigma_b^2}{\sigma_0^2 - \sigma_b^2}} \cdot \frac{m_0}{m_i} \right)$$

- Adjust the power of each laser so that the powers are equal and so that average input to the module under test is 1.75 - 2 mW each (this setting results in a modulation amplitude of 7 - 8 mW).
8. Press the DEFAULT SETUP button on the instrument front panel. Click Yes in the dialog box that appears.
 9. Select C1 for the waveform source (use the waveform selector button in the lower left corner of the application display).
 10. In the Trig Setup dialog box, select Internal Clock for the Trigger Source. Use the default 200 kHz setting.
 11. Set the Acq Mode to Sample in the instrument tool bar.

NOTE. *If the Scale, Position, and Channel Offset control boxes are not displayed in the following step, click the Basic button in the lower left corner of the Vert Setup dialog box.*

12. In the Vert Setup dialog box, use the default settings.
13. In the Horiz Setup dialog box, set the Scale to 1.000 ns/div.
14. In the Hist Setup dialog box, do the following steps:
 - a. Select Main C1 as the Source.
 - b. Check Enable Histogram.
 - c. Select Vertical (limits are 0-100%).
 - d. Close the Hist Setup dialog box.
 - e. See the setup illustration in Figure 2-42.

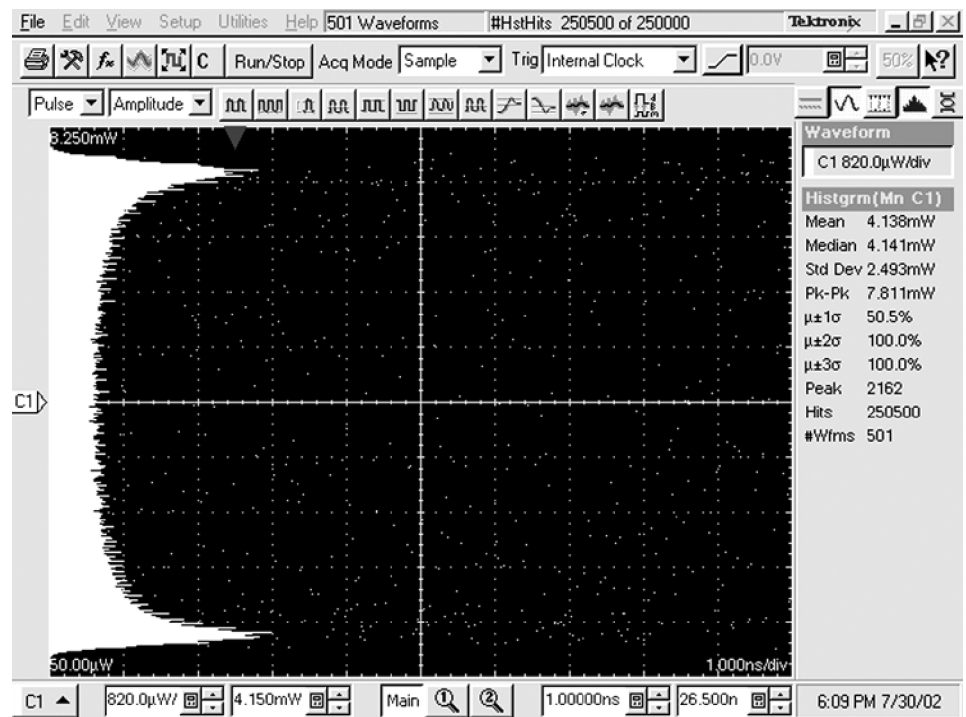


Figure 2-42: Setup used for heterodyne sweep

Test Follow this procedure to test the 80C10, 80C10B, or 80C25GBE:

NOTE. The values in System Properties dialog box do not update while the dialog box is open. Close the dialog box and reopen it to get updated values.

1. Set lasers to the DC starting point at (1550 nm):
 - a. Adjust laser wavelengths to within 0.5 pm of each other by monitoring the beat note directly on the real-time scope. See Figure 2-41 on page 2-191.
 - b. Adjust laser wavelengths until the beat frequency is <150 MHz, and record the frequency f_{DC} . This is the DC reference point.
2. For Vertical scale:
 - a. Set the vertical position to zero.
 - b. Record the mean and peak-to-peak value from the histogram statistics.
 - c. Set vertical offset to the mean value.
 - d. Adjust the vertical scale so that the peak-to-peak amplitude covers about 95% of the vertical range.
3. Record DC reference values (see note in the setup on page 2-192):
 - a. Press Clear Data.
 - b. Acquire a histogram with 250,000 hits.
 - c. Record the standard deviation from the histogram statistics: σ_0 .
 - d. Record the wavelength of the sweep laser: λ_0 .
4. Perform the frequency sweep to at least 1.5 x bandwidth. The recommended frequency step size is 1 GHz (\approx 8 pm laser step size). For each frequency point, perform the following steps (see note in the setup on page 2-192):
 - a. Step to and park sweep laser at next wavelength.
 - b. Allow the laser to stabilize.
 - c. Press Clear Data.
 - d. Acquire a histogram with 250,000 hits.
 - e. Record the standard deviation from the histogram statistics: σ_i
 - f. Record the wavelength of the sweep laser: λ_i
5. Record background standard deviation (due to laser and sampling module noise).
 - a. Set laser detuning to \geq 750 GHz.
 - b. Clear the data.

- c. Acquire a histogram with 250,000 hits.
 - d. Record the standard deviation from the histogram statistics: σ_b
6. Calculate the normalized frequency response curve:

- a. The frequency values are given by:

$$f_i = c \cdot \left(\frac{1}{\lambda_i} - \frac{1}{\lambda_0} \right) + f_{DC}$$

where $c=2.9979 \times 10^8$ m/s (vacuum speed of light)

- b. The corresponding response values (dB) normalized to the lowest frequency point (=“DC”) are given by:

$$R(f_i) = 10 \cdot \log \left(\sqrt{\frac{\sigma_i^2 - \sigma_b^2}{\sigma_0^2 - \sigma_b^2}} \right)$$

7. Check that the optical bandwidth is greater than or equal to that stated below for each bandwidth setting.
- a. The optical bandwidth is determined by the frequency point where the response curve crosses the -3 dB line. The limits follow:

Module	Bandwidth setting	Bandwidth limit
80C10, 80C10B	30 GHz	>30 GHz
80C10, 80C10B, 80C25GBE	65 GHz	>60 GHz
80C10B	80 GHz	>75 GHz

You select the bandwidth settings for the module under test from the Bandwidth control box in the Vert Setup dialog box.

- b. For Optical Reference Receivers the frequency response curves and Bessel-Thompson tolerances are plotted on an electrical power scale (20log) by convention. In this case, the response values given in 6b) have to be multiplied by a factor of 2.
8. In the Vert Setup dialog box, select a Filter using the Filter control (see Table 2-11 for filters available).
9. Perform steps 1 through 6.

10. Refer to Table 2-11 and check that the optical sampling module meets the limits listed for the tested filter.
11. Repeat steps 9 through 11 for each of the filters available for the 80C10 or 80C10B module.

Table 2- 11: Reference receiver frequency response limits

Reference receiver	Frequency response limits			
	(GHz) Frequency	Lower	(dB) Nominal	Upper
OC768/STM-256 39.813 Gb/s	0.00	-1.00	0.00	+1.00
	5.97	-1.10	-0.10	+0.90
	11.94	-1.45	-0.45	+0.55
	17.92	-2.02	-1.02	-0.02
	23.89	-2.86	-1.86	-0.86
	29.86	-4.00	-3.00	-2.00
	35.83	-6.56	-4.51	-2.46
	39.81	-8.37	-5.71	-3.05
	41.80	-9.31	-6.37	-3.43
	47.78	-12.26	-8.54	-4.83
	53.75	-15.32	-10.93	-6.53
	59.72	-18.41	-13.41	-8.41
	FEC43.02 Gb/s G.709	0.00	-1.00	0.00
6.45		-1.10	-0.10	+0.90
12.90		-1.45	-0.45	+0.55
19.36		-2.02	-1.02	-0.02
25.81		-2.86	-1.86	-0.86
32.26		-4.00	-3.00	-2.00
38.71		-6.56	-4.51	-2.46
43.02		-8.37	-5.71	-3.05
45.17		-9.31	-6.37	-3.43
51.63		-12.26	-8.54	-4.83
58.08		-15.32	-10.93	-6.53
64.53		-18.41	-13.41	-8.41

Table 2- 11: Reference receiver frequency response limits (Cont.)

Reference receiver	Frequency response limits				
	(MHz) Frequency	Lower	(dB) Nominal	Upper	
100GBase-xR4 (25.781 Gb/s, ENET25781) and 100GBase-xR4 w/FEC (27.739 Gb/s, ENET27739)	0.00	-0.85	0.00	+0.85	
	3867	-0.96	-0.11	+0.74	
	7734	-1.30	-0.45	+0.40	
	11602	-1.87	-1.02	-0.17	
	15469	-2.71	-1.86	-1.01	
	19336	-3.86	-3.00	-2.16	
	23203	-6.19	-4.51	-2.83	
	25781	-7.87	-5.71	-3.55	
	27070	-8.75	-6.37	-3.99	
	30938	-11.53	-8.54	-5.56	
	34805	-14.45	-10.93	-7.41	
	38672	-17.41	-13.41	-9.41	
	40GBase-FR (41.25 Gb/s, ENET41250)	At the time this document was published, the IEEE P802.3bg 40GbE task force has not yet finalized the optical reference receiver specifications for the 40GBase-FR serial variant. Preliminary tolerances are chosen to match the first draft proposal D1.0 of IEEE802.3bg released in June 2010 (Sect. 89.7.8).			
		(MHz) Frequency	Lower	(dB) Nominal	Upper
0.00		-0.85	0.00	+0.85	
6188		-0.96	-0.11	+0.74	
12375		-1.30	-0.45	+0.40	
18563		-1.87	-1.02	-0.17	
24750		-2.71	-1.86	-1.01	
30938		-3.86	-3.00	-2.16	
37125		-6.19	-4.51	-2.83	
41250		-7.87	-5.71	-3.55	
43313		-8.75	-6.37	-3.99	
49500		-11.53	-8.54	-5.56	
55688		-14.45	-10.93	-7.41	
61875		-17.41	-13.41	-9.41	

End of Procedure

Integrated Rise Time and Aberrations Check

This procedure checks the integrated rise time of an 80C06 Optical Sampling Module and the aberrations of an 80C05, 80C06, 80C10, 80C10B, or 80C25GBE Optical Sampling Module.

NOTE. *To optimize performance, make sure that all connections are clean and secure and that all components of the system are in good condition. Optical fiber can gradually degrade the system performance as it is repeatedly flexed over time.*

Equipment required	DSA8200 Digital Serial Analyzer Calmar FPL-01 optical impulser (item 24) Tektronix OA5002 variable optical attenuator (item 23) Single-mode fiber-optic cable, 2 m, FC to FC connectors (item 13) Cable, coaxial, 1 m, male to male SMA connectors (item 18)
Prerequisites	As listed on page 2-26 and under <i>Prerequisites</i> on page 2-161.

Before performing this procedure, be sure you have completed the *Dark level and Vertical Equivalent Optical Noise* procedure on page 2-161.

Setup

Install the test hookup (see Figure 2-43 on page 2-199) and preset the main instrument controls:

1. Install the 80C0X Optical Sampling Module into Channel 1 of the instrument.
2. Connect a fiber-optic cable between the output of the optical impulse generator and the input of the OA5002 variable optical attenuator.
3. Connect a fiber-optic cable between the output of the OA5002 variable optical attenuator and the optical input of the optical sampling module.
4. Connect a 50 Ω coaxial cable from the rear trigger (SYN) on the optical impulse generator to the TRIGGER DIRECT input on the instrument.
5. Start with about 30 dB of attenuation on the variable attenuator.

NOTE. *To avoid dispersing the narrow optical impulse signal, keep all fiber lengths as short as possible. Lengths that are 2 to 3 meters long are acceptable.*

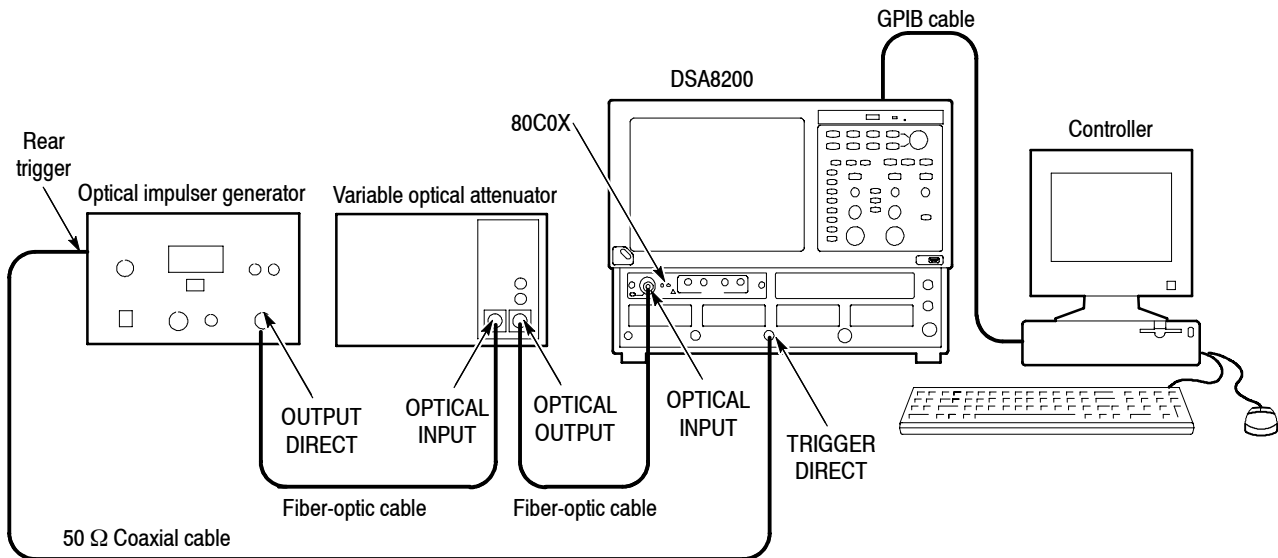


Figure 2-43: Integrated rise time and aberrations hookup

6. Press the SELECT ON/OFF button on the optical sampling module so that the adjacent indicator lights. This turns on Channel 1 (C1) on the module.
7. In the Setup menu, select Acquire and make the following changes in the Acq Setup dialog box:
 - a. Select Sample as the acquisition mode.
8. In the Trig Setup dialog box, do the following:
 - a. Select External Direct for the trigger source.
 - b. Select Normal for Mode.
 - c. Select the rising edge for Slope.
 - d. Click the Set to 50% button to set the trigger point midway on the rising signal.
9. In the Horiz Setup dialog box, do the following:
 - a. Set the Scale to 1.000 ns/div. (This setting will make it easier to initially locate the optical pulse later in the procedure.)
 - b. Set the Position to 30.000 ns. (This setting will make it easier to locate the first optical pulse later in the procedure.)
 - c. Set the Record Length to 2000.
 - d. Set the timebase to short term jitter.

- 10.** In the Disp Setup dialog box, do the following:
 - a.** In the Style section, select Normal.
 - b.** Check Show Vectors.
- 11.** In the Vert Setup dialog box, do the the following:
 - a.** Set the Scale to 500.0 μ W/div.
 - b.** Set Position to 0.0 div.
 - c.** Set Channel Offset to 0.0 W.
 - d.** Click the Optical>> button in the lower left part of the Vert Setup dialog box.
 - e.** Set Wavelength to 1550 nm.
 - f.** Set the Bandwidth to:
 - 40 GHz for 80C05
 - 50 GHz for 80C06
 - 65 GHz for 80C10, 80C10B-F1, or 80C25GBE
 - 80 GHz for 80C10B
- 12.** Use the Horizontal POSITION control to position the impulse at the second horizontal division.
- 13.** Use the Horizontal POSITION and SCALE controls to:
 - For 80C05, 80C10, 80C10B, or 80C25GBE decrease the Horizontal SCALE to 40 ps/div
 - For 80C06, decrease the Horizontal SCALE to 20 ps/div
 - Position the impulse at the second horizontal division.
- 14.** Use the Vertical SCALE control to increase the vertical scale to 2 mW/div.
- 15.** Adjust the attenuation of the variable optical attenuator to an impulse amplitude of 14 mW p-p to 16 mW p-p.
- 16.** Select Meas Dialog box and make the following changes:
 - a.** Select Meas 1, check On, and make sure the Source 1 button is selected.
 - b.** Make sure both Main C1 and Pulse are selected in the Source tab, and then choose Select Meas > Pulse - Amplitude > Mean.
 - c.** Click the Region tab.

- d. Enter 0% for G1 and 5% for G2. Check the On box to turn Gates on.
17. Press the MATH button on the front panel. (This will bring up the menu to define math functions on the waveforms.)
18. Using the supplied symbols in the menu, enter the following formula:
 $100 * \text{Avg}(\text{Intg}(C1 - \text{Meas1}))$
19. In the Num Avgs field enter 100.
20. Check the box M1 On.
21. Click OK at the bottom of the menu.

NOTE. For an 80C05, 80C10, 80C10B, or 80C25GBE module skip steps 22 and 23.

22. Select Meas Dialog box and make the following changes:
 - a. Select Meas 2, check On, and make sure the Source 1 button is selected.
 - b. Select Main M1 (Math 1) as the source and Pulse as signal type in the Source tab, and then choose Select Meas > Pulse - Timing > Rise Time.

NOTE. The Main M1 rise-time measurement displayed in the right-hand margin.

23. Set the bandwidth and note the risetime measurement displayed in the right-hand margin according to the following:
 - 80C06 Bandwidth 50 GHz Rise Time 9.6 ps (typical)
24. Adjust the attenuator until the displayed amplitude of the impulse is 4 mW. Adjust the Horizontal position until the impulse peak is at the second division.
25. Select the Meas Dialog box and make the following changes:
 - a. Select Meas 3, check On, and make sure the Source 1 button is selected.
 - b. Select Main M1 (Math 1) as the source and Pulse as signal type in the Source tab, and then choose Select Meas > Pulse - Amplitude > Pk-Pk.
 - c. Select Meas 4, check On, and make sure the Source 1 button is selected.
 - d. Select Main M1 (Math 1) as the source and Pulse as signal type in the Source tab, and then choose Select Meas > Pulse - Amplitude > Pk-Pk.
 - e. Click the Region tab. Turn the gates on by checking the box next to On.

f. Adjust G1 and G2 as follows:

- For 80C05 or 80C06, increase G1 until it is immediately to the left of the peak of the first rising edge, which should be approximately at the second division. Move G2 until the time difference between G1 and G2 is 5 times the rise time from the rising edge. See Table 2-12 for the time difference between G1 and G2 for the different bandwidth and filter settings.
- For 80C10, 80C10B, or 80C25GBE increase G1 until it is 15 ps after the 50% point of the rising edge. Move G2 until the time difference between G1 and G2 is 10 times the rise time from the rising edge. See Table 2-12 for the time difference between G1 and G2 for the different bandwidth and filter settings.

Table 2- 12: Minimum limits

Optical sampling module	Bandwidth/filter setting	Time difference
80C05	40 GHz	G2-G1 = 65 ps (5 x 13 ps)
	30 GHz	G2-G1 = 85 ps (5 x 17 ps)
	20 GHz	G2-G1 = 125 ps (5 x 25 ps)
	OC192	G2-G1 = 235 ps (5 x 47 ps)
80C06	50 GHz	G2-G1 = 48 ps (5 x 9.6 ps)
80C10	65 GHz	G2-G1 = 74 ps (10 x 7.4 ps)
	30 GHz	G2-G1 = 160 ps (10 x 16 ps)
	OC768	G2-G1 = 120 ps (10 x 12 ps)
	FEC43.02	G2-G1 = 112 ps (10 x 11.2 ps)
80C10B	80 GHz	G2-G1 = 60 ps (10 x 6.0 ps)
	65 GHz	G2-G1 = 74 ps (10 x 7.4 ps)
	30 GHz	G2-G1 = 160 ps (10 x 16 ps)
	OC768	G2-G1 = 120 ps (10 x 12 ps)
	FEC43.02	G2-G1 = 112 ps (10 x 11.2 ps)
	40GBase-FR	G2-G1 = 119 ps (10 x 11.9 ps)

Table 2-12: Minimum limits (cont.)

Optical sampling module	Bandwidth/filter setting	Time difference
80C10B-F1	65 GHz	G2-G1 = 74 ps (10 x 7.4 ps)
	OC768	G2-G1 = 120 ps (10 x 12 ps)
	FEC43.02	G2-G1 = 112 ps (10 x 11.2 ps)
	40GBase-FR	G2-G1 = 119 ps (10 x 11.9 ps)
	100GBase-xR4 FEC	G2-G1 = 192 ps (10 x 19.2 ps)
	100GBase-xR4	G2-G1 = 192 ps (10 x 19.2 ps)
80C25GBE	65 GHz	G2-G1 = 74 ps (10 x 7.4 ps)
	100GBase-xR4 FEC	G2-G1 = 192 ps (10 x 19.2 ps)
	100GBase-xR4	G2-G1 = 192 ps (10 x 19.2 ps)

26. To calculate the Time Domain Vertical Response Aberrations, divide Measurement 4 by Measurement 3 and multiply by 100. The aberration limits for the 80C05, 80C06, 80C10, 80C10B and 80C25GBE modules are listed in Table 2-13.

Table 2-13: Aberrations

Optical sampling module	Bandwidth/filter setting	Aberrations
80C05	40 GHz	<15%
	30 GHz	<10%
	20 GHz	<10%
	OC192	<5%
80C06	50 GHz	<10%
80C10	65 GHz	<10%
	30 GHz	<5%
	FEC43.02	<5%
	OC768	<5%

Table 2- 13: Aberrations (cont.)

Optical sampling module	Bandwidth/filter setting	Aberrations
80C10B	80 GHz	<12%
	65 GHz	<10%
	30 GHz	<5%
	FEC43.02	<5%
	OC768	<5%
	40GBase-FR	<5%
80C10B-F1	65 GHz	<10%
	OC768	<5%
	FEC43.02	<5%
	40GBase-FR	<5%
	100GBase-xR4 FEC	<5%
	100GBase-xR4	<5%
80C25GBE	65 GHz	<10%
	100GBase-xR4 FEC	<5%
	100GBase-xR4	<5%

Clock Recovery Optical Sensitivity Range and Recovered Clock Timing Jitter

This procedure checks the clock recovery optical sensitivity range and the recovered clock timing jitter on Optical Sampling Modules that are equipped with clock recovery options.

Equipment required	DSA8200 Digital Serial Analyzer Tektronix 80E02 Sampling Module (item 34) Tektronix OA5002 variable optical attenuator (item 23) Advantest D3186 Pattern Generator (item 40) Optical Transmitter and Receiver (item 22) Single-mode fiber-optic cable, 2 m, FC to FC connectors (item 13) Attenuator, 2X (6 dB pad), 50 Ω , SMA (item 7) Cable, coaxial, 2 ns delay SMA, male connector on each end (item 12)
Prerequisites	As listed on page 2-26 and under <i>Prerequisites</i> on page 2-161.

Before performing this procedure, be sure you have completed the *Dark level & Vertical Equivalent Optical Noise* procedure on page 2-161.

Setup Install the test hookup (see Figure 2-44) and preset the main instrument controls:

1. Install the 80C0X Optical Sampling Module into Channel 1 of the instrument.
2. Install the 80E02 Sampling Module into Channels 3 and 4 of the instrument. (Channel 1 and Channel 2 are disabled when an optical sampling module is installed in the upper Channel 1.)
3. Install 2X SMA electrical attenuators on the inputs of the 80E02 Sampling Module (to prevent saturation).
4. Connect a less than 2 ns delay, 50 Ω coaxial cable between the 1/32 CLK signal output of the pattern generator and the TRIGGER DIRECT connector on the instrument.
5. Connect a less than 2 ns delay, 50 Ω coaxial cable between the DATA output of the pattern generator and the DIGITAL IN DC-COUPLED input on the laser transmitter.
6. Connect a single-mode fiber-optic cable between the OPTICAL output of the laser transmitter and the OPTICAL INPUT on the variable optical attenuator.

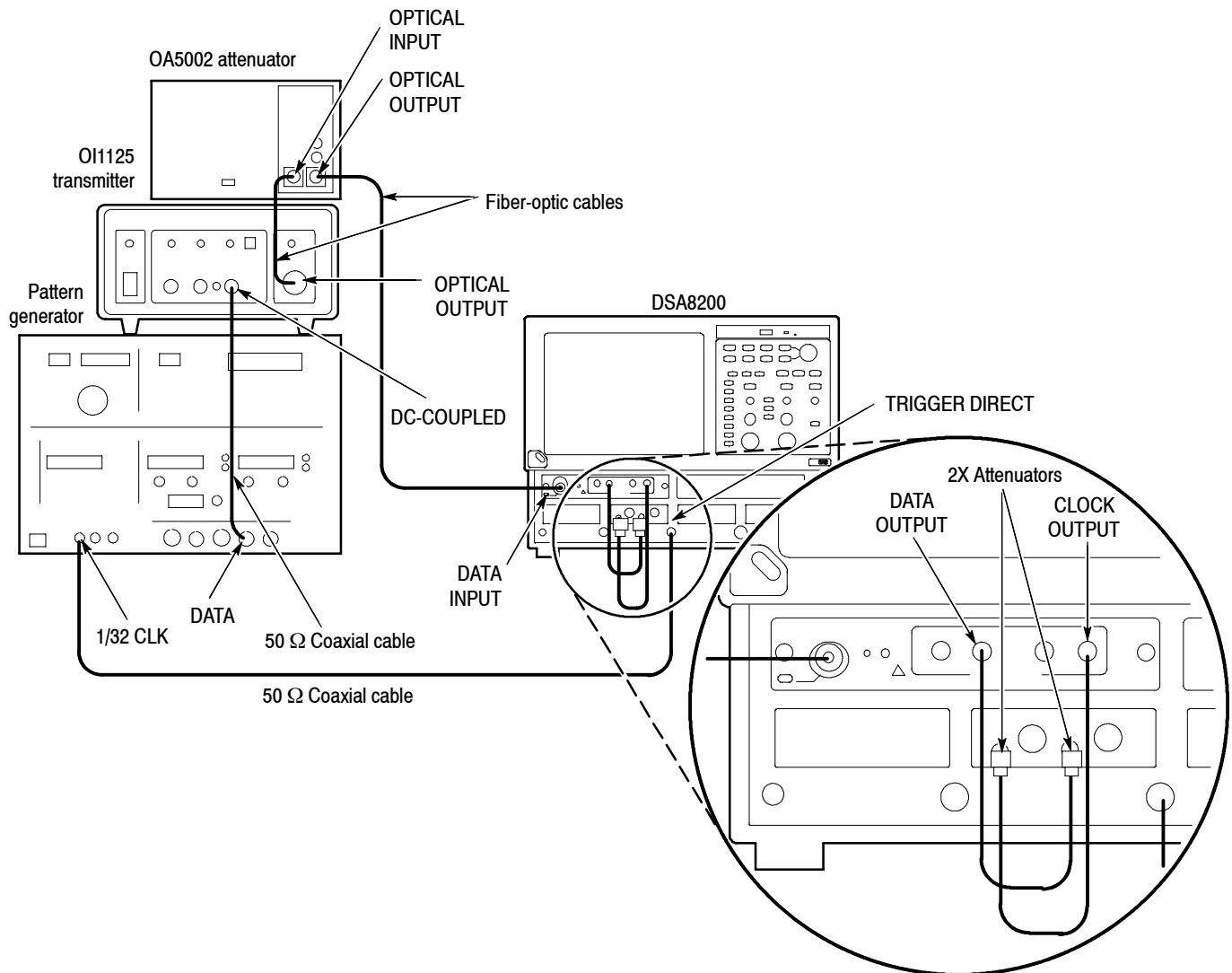


Figure 2-44: Clock recovery optical sensitivity range and recovered clock timing jitter hookup

7. Connect a single-mode fiber-optic cable between the OPTICAL OUTPUT of the variable optical attenuator and the OPTICAL INPUT of the 80C0X-CR Optical Sampling Module.
8. Connect a less than 2 ns delay, 50 Ω coaxial cable between the CLOCK OUTPUT of the 80C0X-CR Optical Sampling Module and the Channel 3 input on the 80E02 Sampling Module.
9. Connect a less than 2 ns delay, 50 Ω coaxial cable between the DATA OUTPUT of the 80C0X-CR Optical Sampling Module and the Channel 4 input on the 80E02 Sampling Module.

10. The D3186 Pulse Pattern Generator must use its own reference clock. Set the following data signal parameters on the pattern generator:
 - AC coupled
 - DATA output mode -2 V
 - Amplitude 0.700 V
 - Offset -1.00 V
 - PRBS23 pattern
 - NRZ data format
 - Balanced duty cycle (crossing set to the default 50% level)
 - Data rate to 2.48832 Gb/s (the data rate will be changed, depending on each specific data rate to be tested later in the procedure)
11. Set the variable optical attenuator for minimum attenuation.
12. Allow the instrument and its modules to warm up for at least 20 minutes in an environment that has had less than 1 °C variation throughout the warm-up cycle.
13. Press the DEFAULT SETUP button on the instrument.
14. Press the SELECT ON/OFF button on the 80C0X Optical Sampling Module so that the adjacent indicator lights. This turns on Channel 1 (C1) on the 80C0X-CR Optical Sampling Module.
15. Press the SELECT ON/OFF button on the 80E02 Sampling Module so that the adjacent indicator lights. This turns on Channel 3 (C3), which displays the CLOCK signal.
16. From the Setup Menu, select the Trig Setup dialog box. Make the following changes:
 - a. Select External Direct as the Trigger Source.
 - b. In the Level section, click the Set to 50% button.
 - c. Select positive edge for the Slope.
17. Select the Meas Setup dialog box. Make the following changes:
 - a. Select Meas 1, check On, and make sure the Source 1 button is selected.
 - b. Make sure both Main C1 and NRZ are selected in the Source tab, and then choose Select Meas > NRZ - Amplitude > Average Optical Power.

18. Select the Vert Setup dialog box and make the following changes:
 - a. Select C1 for Waveform.
 - b. Set the Wavelength to match the wavelength of the laser transmitter.
19. Select the Wfm Database Setup dialog box.
 - a. In the Database1 section, select Main C3 as the Source.
 - b. Check On for Database1.
20. Select the Meas Setup dialog box and make the following changes:
 - a. Select Meas 2, check On, and make sure the Source 1 button is selected.
 - b. Select both Main C3 and NRZ in the Source tab, and then choose Select Meas > NRZ - Timing > RMS Jitter.
 - c. Check the Use Wfm Database selection.

Test Follow this procedure to make the clock recovery optical sensitivity range and recovered clock timing jitter checks:

1. In the Trig Setup dialog box, select the clock recovery rate for C1 that you want to test (see Table 2-14).

NOTE. Leave External Direct selected as the Trigger Source, even though you are selecting a rate other than None. In this preliminary setup, the clock recovery circuitry is enabled for the 80C0X-CR Optical Sampling Module, but the main instrument timebase receives its trigger events from the TRIGGER DIRECT input signal and not the actual recovered clock.

2. Set the data rate of the D3186 Pulse Pattern Generator to the rate setting for the clock recovery rate that you selected in step 1 (see Table 2-14).
3. Adjust the Horizontal SCALE control on the front panel of the instrument to the setting listed in the table for the clock recovery rate that you selected in step 1 (see Table 2-14).

Table 2-14: Clock recovery settings

Optical sampling module	Clock recovery rate	D3186 rate setting	DSA8200 scale setting
80C01-CR	OC-12	0.62208 Gb/s	500 ps/div
	OC-48	2.48832 Gb/s	100 ps/div
80C02-CR	OC-192	9.95328 Gb/s	50 ps/div

Table 2- 14: Clock recovery settings (cont.)

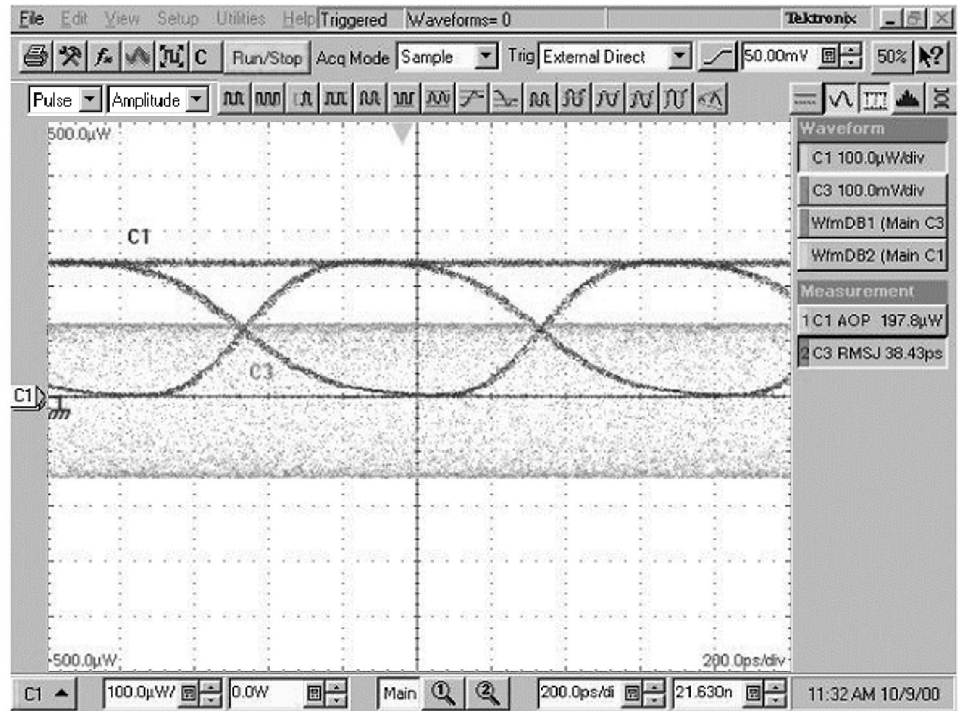
Optical sampling module	Clock recovery rate	D3186 rate setting	DSA8200 scale setting
80C03-CR	FC-1063	1.0625 Gb/s	200 ps/div
	GBE	1.2500 Gb/s	200 ps/div
	OC-48	2.48832 Gb/s	100 ps/div
	2.5 Gb/s	2.5000 Gb/s	100 ps/div
80C04-CR1	OC-192	9.95328 Gb/s	50 ps/div
80C04-CR2	OC-192	9.95328 Gb/s	50 ps/div
	FEC10.6646	10.6646 Gb/s	50 ps/div
80C07-CR	OC-3	0.15552 Gb/s	1 ns
	OC-12	0.62208 Gb/s	500 ps/div
	OC-48	2.48832 Gb/s	100 ps/div
80C07B-CR	OC-3	0.15552 Gb/s	1 ns
	OC-12	0.62208 Gb/s	500 ps/div
	OC-48	2.48832 Gb/s	100 ps/div
	FC1063	1.0625 Gb/s	200 ps/div
	GBE	1.25 Gb/s	200 ps/div
	FC2125	2.125 Gb/s	100 ps/div
	2GBE	2.5 Gb/s	100 ps/div
	Infiniband	2.5 Gb/s	100 ps/div
80C08-CR	10GBASE-W	9.95328 Gb/s	50 ps/div
	10GBASE-R	10.3125 Gb/s	50 ps/div
80C08B-CR1	10GBASE-W	9.95328 Gb/s	50 ps/div
	10GBASE-R	10.3125 Gb/s	50 ps/div
80C08B-CR2	10GFC	10.51875 Gb/s	50 ps/div
	10GBASE-R	10.3125 Gb/s	50 ps/div
80C08C-CR1	10GBASE-W	9.95328 Gb/s	50 ps/div
	10GBASE-R	10.3125 Gb/s	50 ps/div
80C08C-CR2	10GFC	10.51875 Gb/s	50 ps/div
	10GBASE-R	10.3125 Gb/s	50 ps/div
80C08C-CR4	Continuous	9.8 Gb/s to 12.6 Gb/s	50 ps/div

Table 2- 14: Clock recovery settings (cont.)

Optical sampling module	Clock recovery rate	D3186 rate setting	DSA8200 scale setting
80C09-CR1	FEC10.71	10.799225 Gb/s	50 ps/div
	OC-192	9.95328 Gb/s	50 ps/div
80C11-CR1	OC-192	9.95328 Gb/s	50 ps/div
80C11-CR2	OC-192	9.95328 Gb/s	50 ps/div
	10.66 FEC	10.66423 Gb/s	50 ps/div
80C11-CR3	OC-192	9.95328 Gb/s	50 ps/div
	FEC10.71	10.709225 Gb/s	50 ps/div
80C11-CR4	Continuous	9.8 Gb/s to 12.6 Gb/s	50 ps/div

At this point in the procedure, the main instrument is triggered from the 1/32 clock from the D3186 Pulse Pattern Generator. The clock signal from the 80Cxx-CR Optical Sampling Module that is connected to C3 on the 80E02 Sampling Module should be synchronous with the signal from the pulse pattern generator (see Figure 2-46).

If the signals are not synchronous (see Figure 2-45), check that the D3186 data rate is set to a data rate that matches the clock recovery rate set for the 80C0X-CR Optical Sampling Module (see Table 2-14).



Example of the display when the clock signal from the Optical Sampling Module is not synchronous with the data rate input. Note the unstable (“washed out”) clock signal. Compare this with Figure 2-46, in which the clock signal is synchronized.

Figure 2-45: Display example (clock signal not synchronized with the data rate input)

4. Once you have verified that the recovered clock signal (C3) is locked with the incoming data, select the Trig Setup dialog box, and select Clock Recovery as the Trigger Source.
5. Do the following substeps to check the clock recovery optical sensitivity range:
 - a. Find the module under test listed in Table 2-15.
 - b. Adjust the variable optical attenuator until the Average Optical Power (AOP) measurement for C1 matches the value given in the AOP Meas. Max column for the module under test.
 - c. Check that the clock signal remains stable.
 - d. Adjust the variable optical attenuator until the Average Optical Power (AOP) measurement for C1 matches the value given in the AOP Meas. Min column for the module under test.
 - e. Check that the clock signal remains stable.

Table 2- 15: Clock recovery settings and jitter limits

Module & clock recovery rate		Max optical power	Min optical power	Max RMS Jitter
80C01-CR	OC-12	Not specified, set to -9.0 dBm (125 μ W)	Not specified, set to -9.0 dBm (125 μ W)	8 ps
	OC-48			
80C02-CR	OC-192	Not specified, set to -7.5 dBm (178 μ W)	-7.5 dBm (178 μ W)	2 ps
80C03-CR	FC-1063	-4 dBm (400 μ W)	-16.0 dBm (100 μ W)	8 ps
	GBE			
	OC-48			
	2.5 Gb/s			
80C04-CR1	OC-192	+7.0 dBm (5 mW)	-10.0 dBm (100 μ W)	2.0 ps
80C04-CR2	OC-192	+7.0 dBm (5 mW)	-10.0 dBm (100 μ W)	2.0 ps
	FEC10.6646			
80C07-CR	OC-3	-4 dBm (400 μ W)	-16.0 dBm (25 μ W)	32.0 ps
	OC-12			8.0 ps
	OC-48			4.0 ps
80C07B-CR	OC-3	-4 dBm (400 μ W) (All wavelengths)	-16.0 dBm (25 μ W) (1550 nm and 1310 nm)	32.0 ps
	OC-12			8.0 ps
	OC-48			4.0 ps
	FC1063			8.0 ps
	FC2125			3.0 ps
	ENET1250			8.0 ps
	ENET2500			4.0 ps
	INFINIBAND			4.0 ps
80C08-CR	OC-192	+0.0 dBm (1 mW)	-15 dBm (32 μ W)	2.0 ps
	10GBASE-W			
	10GBASE-R			
80C08B-CR1	OC-192	+0.0 dBm (1 mW)	-15 dBm (32 μ W)	2.0 ps
	10GBASE-W			
	10GBASE-R			
80C08B-CR2	10GFC	+0.0 dBm (1 mW)	-15 dBm (32 μ W)	2.0 ps
	10GBASE-R			

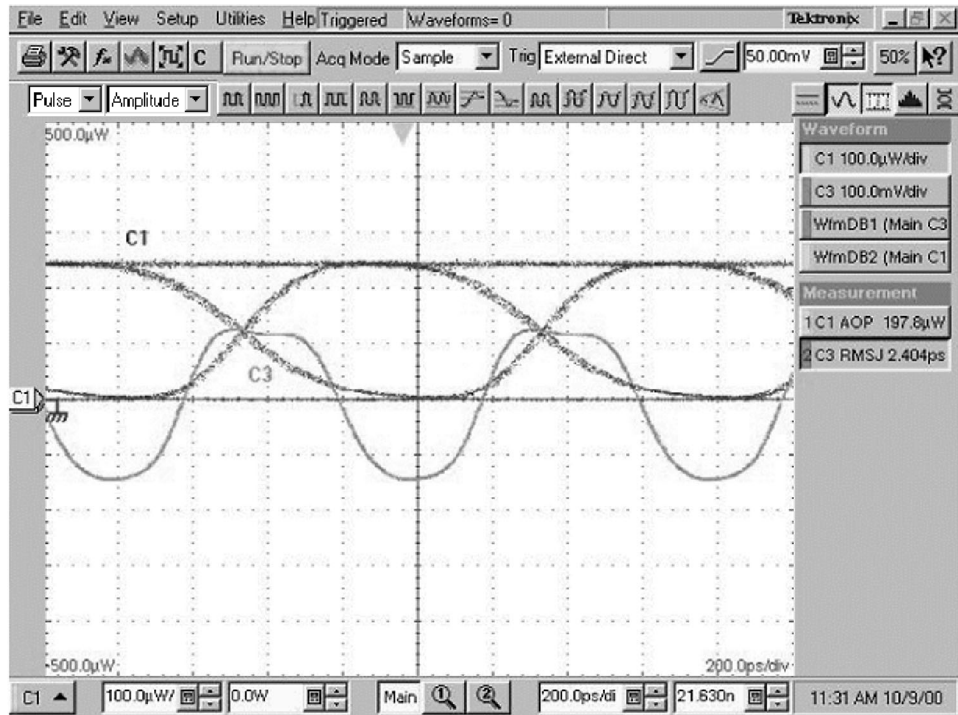
Table 2-15: Clock recovery settings and jitter limits (cont.)

Module & clock recovery rate		Max optical power	Min optical power	Max RMS Jitter
80C08C-CR1	OC-192	+0.0 dBm (1 mW)	-15 dBm (32 μ W)	2.0 ps
	10GBASE-W			
	10GBASE-R			
80C08C-CR2	10GFC	+0.0 dBm (1 mW)	-15 dBm (32 μ W)	2.0 ps
	10GBASE-R			
80C09-CR1	FEC10.799225	Not specified, set to -7.5 dBm (178 μ W)	-7.5 dBm (178 μ W)	2.0 ps
80C11-CR1	OC-192	+7.0 dBm (5 mW)	-10.0 dBm (100 μ W)	2.0 ps
80C11-CR2	OC-192	+7.0 dBm (5 mW)	-10.0 dBm (100 μ W)	2.0 ps
	10Gb FEC			
80C11-CR3	OC-192	+7.0 dBm (5 mW)	-10.0 dBm (100 μ W)	2.0 ps
	G.709 FEC			

6. Do the following substeps to check recovered clock timing jitter:
- a. If you are checking an 80C01 or an 80C03 module, set the Average Optical Power (AOP) to 125 μ W (-9.0 dBm); otherwise, leave the AOP set as it was set for step 5d on page 2-211.
 - b. Zoom into the 50% crossing point of the first rising edge on the C3 clock signal until the Horizontal SCALE is 10 ps/div and the Vertical SCALE is 10 mV/div. See Figure 2-47.

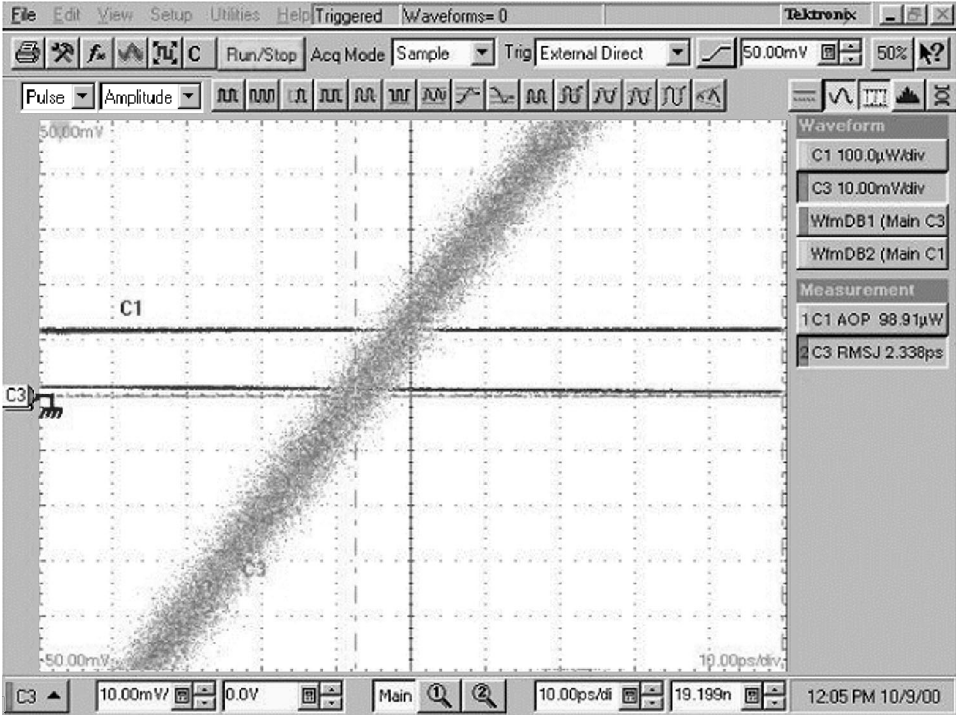
NOTE. You can most easily zoom in on the 50% crossing point by clicking and dragging a rectangle around this edge, and then using the SCALE and FINE control knobs to adjust the settings to 10 mV/div and 10 ps/div.

- c. Check that the RMS jitter measurement for C3 is less than or equal to the value given in the maximum RMS jitter column of Table 2-15.
- d. Repeat this procedure from step 1 to check the recovered clock optical sensitivity and timing jitter for each of the clock recovery rates of the optical sampling module you are testing. See Table 2-14.



Example of the display when the clock signal from the Optical Sampling Module is synchronous with the data rate input from the pulse pattern generator. Note the stable clock signal waveform. Compare this with Figure 2-45, in which the clock signal is not synchronized.

Figure 2-46: Display example (clock signal synchronized with the data rate input)



Example of the display zoomed in to 10 mV/div and 10 ps/div at the crossing point (50%) on the recovered clock signal (C3)

Figure 2-47: Display example (zoomed in at the crossing point)

End of Procedure

80A01 Trigger Prescale Limiting Preamplifier Module

These procedures check those characteristics that relate to 80A01 module and are listed as checked specifications. Refer to Table 1-23 on page 1-68.

STOP. *The procedures throughout this chapter contain instructions based on the menus and controls from the most updated instrument software available at the time this document was released. These procedures will work for other versions of software, but some control and menu names may vary slightly.*

Prerequisites

Be sure you have performed the following prerequisites and the *Prerequisites* on page 2-26 before doing any procedures in this section.

- Install the 80A01 module in left most of the small compartments in the main instrument.
- Install an 80E0X module in the small module compartment immediately to the right of the installed 80A01 module.

NOTE. *Use a calibrated torque wrench when making connections to a module's connectors. Use 8 ± 0.3 inch pounds of torque.*

STOP. *Throughout these procedures, when steps call for the display of setup dialog boxes, you can display them from the Setup menu in the menu bar at the top of the screen. These procedures assume you will display and dismiss the setup dialog boxes as needed.*

System Trigger Sensitivity

Equipment required	Cable, coaxial 50 Ω , 20 in (0.5m), male-to-male SMA (Item 14) Cable, coaxial 50 Ω , male-to-male SMA (Item 15) Attenuator, 6 dB, female to male SMA connectors (item 8) Generator, sinewave (Item 33)
Prerequisites	As listed on page 2-26 and under <i>Prerequisites</i> on page 2-217.

Setup Install the test hookup:

1. Connect a coaxial cable to the output of the 80A01 module.
2. Connect the other end of the cable to the 6 dB attenuator.
3. Connect the 6 db attenuator to Channel 3 of the 80E0x module.
4. In the Vertical Setup menu, set external attenuation to 6 dB for Channel 3.
5. Set the signal generator to output a sinewave at 8 GHz and 0 dBm.
6. Connect the RF output of the signal generator to Channel 4 of the 80E0x module using a coaxial cable.
7. Set the instrument to trigger on Internal Clock.
8. Set Meas1 to measure Amplitude with Channel 4 as the source.
9. Adjust the amplitude of the RF signal generator until Measurement 1 reads 200 mV_{pp}.
10. Disconnect the coaxial cable from the 80E0x Channel 4 input, and move it to the 80A01 input.
11. Change Meas1 to measure Amplitude with Channel 3 as the source.

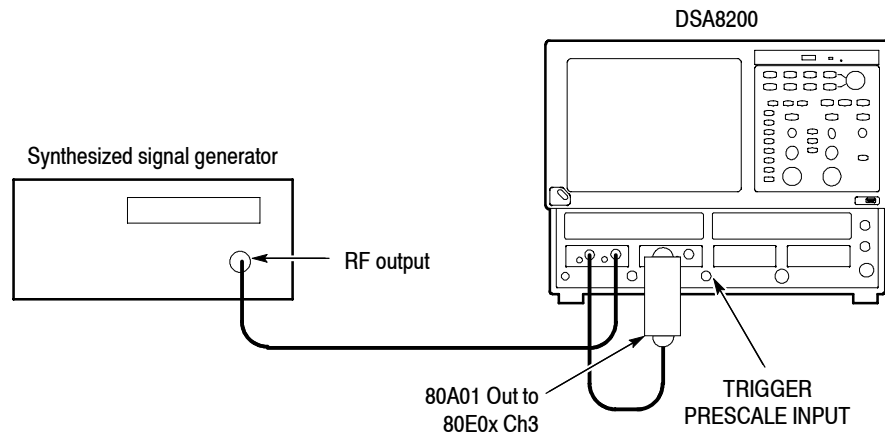


Figure 2-48: 80A01 test hookup

Test Follow this procedure to make the enhanced trigger sensitivity check:

1. Repeat the sinewave amplitude adjustment and 80A01 output amplitude measurement at each frequency in the list that follows.
2. For each frequency in the list that follows, check that the amplitude readout is as listed.

Frequency setting	Meas. amp. readout
8 GHz	≥ 800 mV
9 GHz	≥ 800 mV
10 GHz	≥ 800 mV
11 GHz	≥ 800 mV
12 GHz	≥ 800 mV

3. Disconnect test setup.

End of Procedure

80A02 EOS/ESD Protection Module

These procedures check those characteristics that relate to 80A02 module and are listed as checked specifications. Refer to Table 1-26 on page 1-70.

STOP. *The procedures throughout this chapter contain instructions based on the menus and controls from the most updated instrument software available at the time this document was released. These procedures will work for other versions of software, but some control and menu names may vary slightly.*

Prerequisites

Be sure you have performed the following prerequisites and the *Prerequisites* on page 2-26 before doing any procedures in this section.

- Install the 80A02 module in one of the small compartments in the main instrument.

NOTE. *Use a calibrated torque wrench when making connections to a module's connectors. Use 8 ± 0.3 inch pounds of torque.*

Logic Control Threshold

Equipment required	Variable DC power supply (item 21) Stereo mini phone plug (with exposed connections) (item 59)
Prerequisites	As listed on page 2-26 and under <i>Prerequisites</i> on page 2-221.

Setup Install the test hookup (see Figure 2-49):

1. Insert the stereo mini phone plug into the PROBE CONTROLLER connector of the 80A02.
2. Connect the voltage source to the stereo mini phone plug as follows:
 - a. Identify the connection of the phone plug that is the auto control portion of the phone plug.
 - b. Set the voltage supply to 0 V and connect the plus supply to the auto control connection. Connect the voltage supply ground to the ground portion of the phone plug.

Test Follow this procedure to make the control threshold check:

1. Check the auto control operation of the 80A02 module:
 - a. Check that the relay in the 80A02 module does not activate (no click sound) and that the ENGAGED LED does not light while adjusting the DC supply from 0 to 300 mV.
 - b. Check that the relay in the 80A02 module activates (click sound) and that the ENGAGED LED lights while adjusting the DC supply from 1 V to 5 V.
 - c. Disconnect the voltage supply.
2. Remove the mini phone plug.

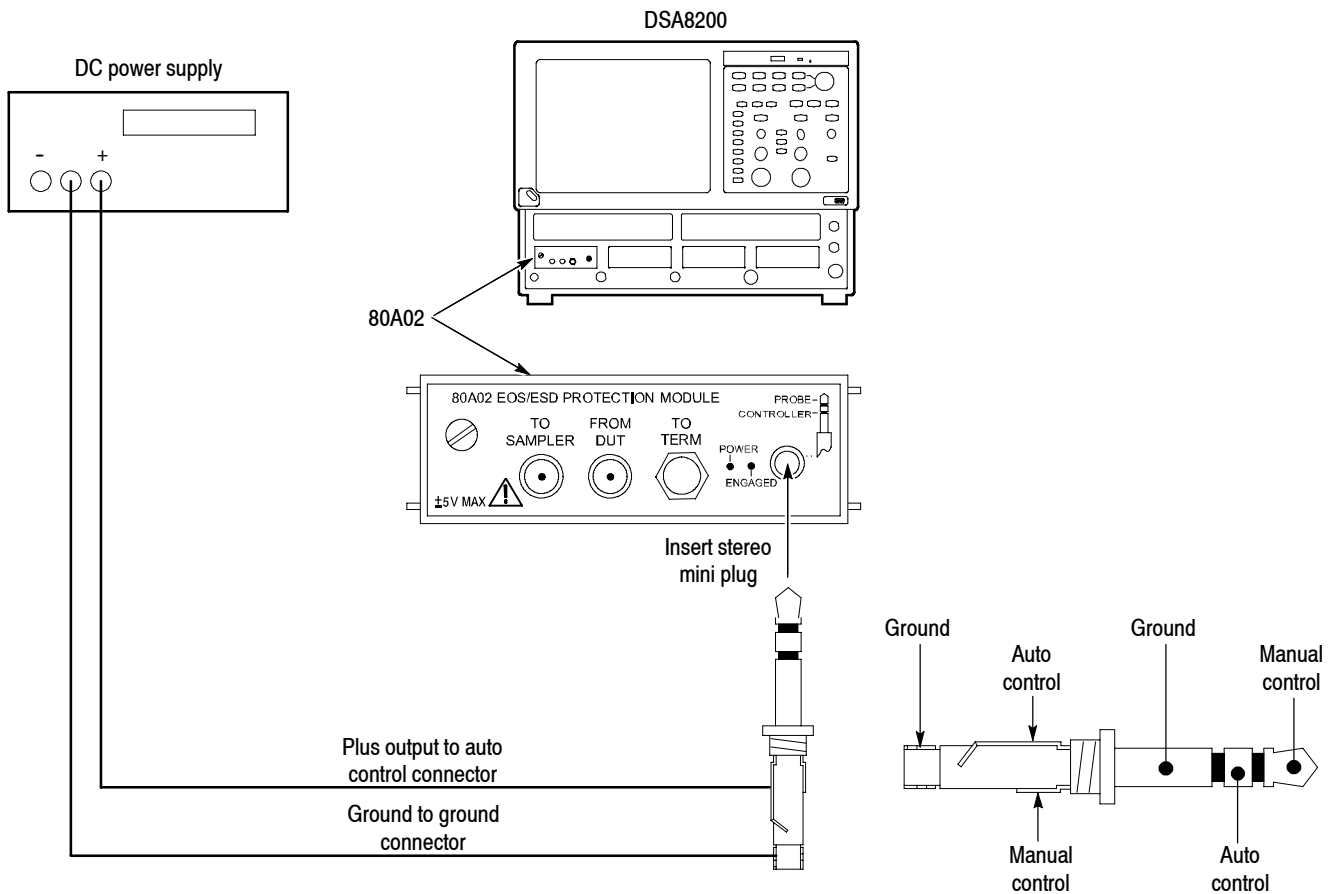


Figure 2-49: 80A02 test hookup

End of Procedure

80A05 Electrical Clock Recovery Module

These procedures check those characteristics that relate to 80A05 module and are listed as checked specifications. Refer to Table 1-28 on page 1-72.

STOP. *The procedures throughout this chapter contain instructions based on the menus and controls from the most updated instrument software available at the time this document was released. These procedures will work for other versions of software, but some control and menu names may vary slightly.*

Prerequisites

Be sure you have performed the following prerequisites and the *Prerequisites* on page 2-26 before doing any procedures in this section.

- Install the 80A05 module in one of the small compartments in the main instrument.

NOTE. *Use a calibrated torque wrench when making connections to a module's connectors. Use 8 ± 0.3 inch pounds of torque.*

Clock Recovery Sensitivity Range and Recovered Clock Timing Jitter

This procedure checks the clock recovery sensitivity range and the recovered clock timing jitter on the 80A05 module.

Equipment required	DSA8200 Digital Serial Analyzer Tektronix 80E02 Sampling Module (item 34) Advantest D3186 Pattern Generator (item 40) Attenuator, 10X (20 dB pad), 50 Ω , SMA (item58) Cable, coaxial, 2 ns delay SMA, male connector on each end (item 12)
Prerequisites	As listed on page 2-26 and under <i>Prerequisites</i> on page 2-223.

Setup Install the test hookup (see Figure 2-50) and preset the main instrument controls:

1. Install the 80A05 Clock Recovery Module into Channel 1 of the instrument.
2. Install the 80E02 Sampling Module into Channels 3 and 4 of the instrument.
3. Connect a less than 2 ns delay, 50 Ω coaxial cable between the 1/32 CLK signal output of the pattern generator and the TRIGGER DIRECT connector on the instrument.
4. Install 2 10X (20 dB) SMA electrical attenuators (in series, creating 100X attenuation) on the ELECTRICAL INPUT IN+ of the 80A05 Module.
5. Connect a less than 2 ns delay, 50 Ω coaxial cable between the DATA + OUTPUT of the pattern generator and the ELECTRICAL INPUT IN+ of the 80A05.
6. Connect a less than 2 ns delay, 50 Ω coaxial cable between the TRIGGER CLOCK OUTPUT of the 80A05 Module and the Channel 3 input on the 80E02 Sampling Module.
7. The D3186 Pulse Pattern Generator must use its own reference clock. Set the following data signal parameters on the pattern generator:
 - AC coupled
 - Amplitude 0.700 V
 - PRBS23 pattern
 - NRZ data format
 - Balanced duty cycle (crossing set to the default 50% level)
 - Data rate to 0.15552 Gb/s (the data rate will be changed, depending on each specific data rate to be tested later in the procedure)

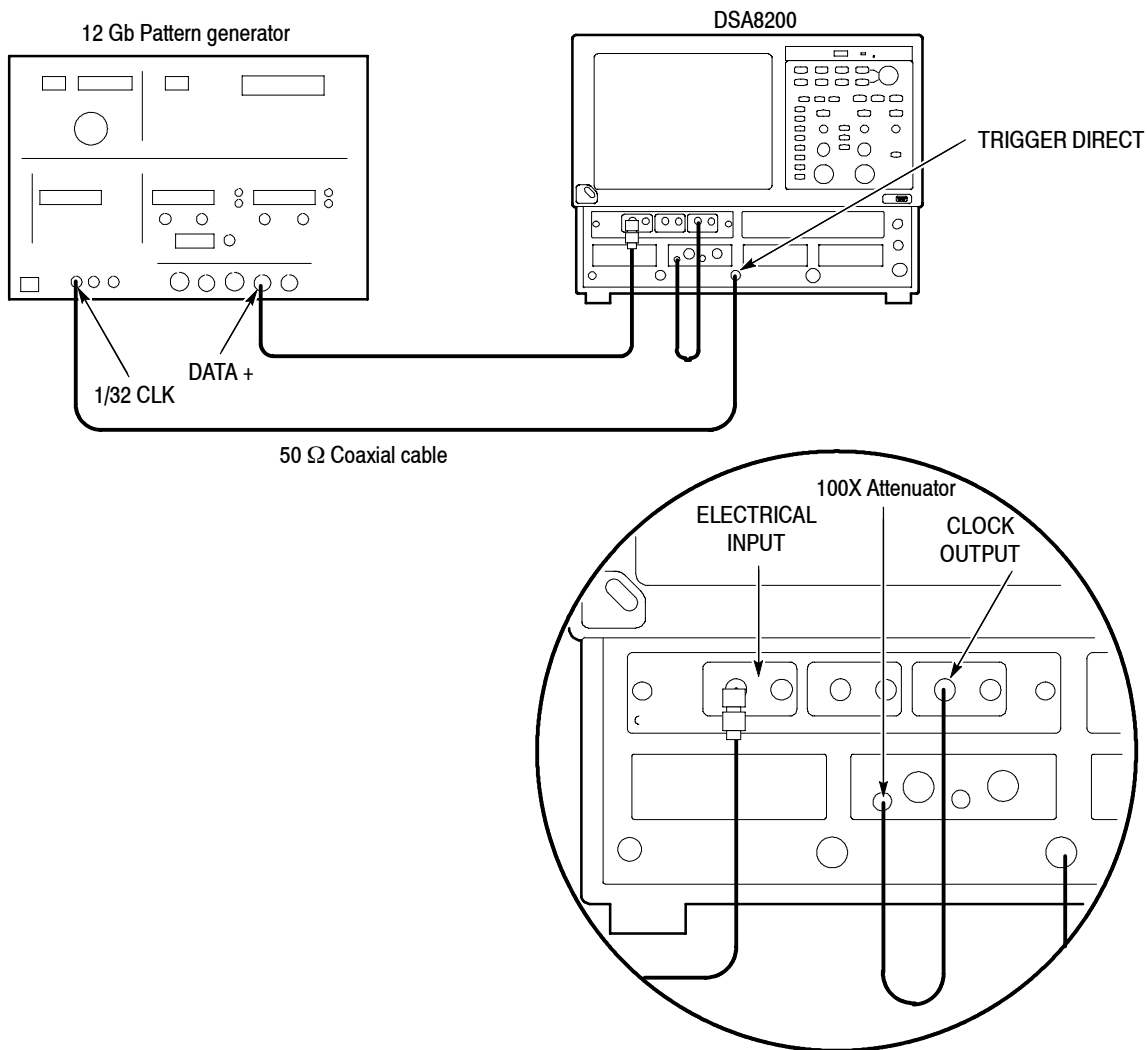


Figure 2-50: Clock recovery sensitivity range and recovered clock timing jitter hookup

8. Allow the instrument and its modules to warm up for at least 20 minutes in an environment that has had less than 1 °C variation throughout the warm-up cycle.
9. Press the DEFAULT SETUP button on the instrument.
10. Press the SELECT ON/OFF button on the 80E02 Sampling Module so that the adjacent indicator lights. This turns on Channel 3 (C3), which displays the TRIGGER CLOCK signal.

11. From the Setup Menu, select the Trig Setup dialog box. Make the following changes:
 - a. Select External Direct as the Trigger Source.
 - b. In the Level section, click the Set to 50% button.
 - c. Select positive edge for the Slope.
12. Select the Meas Setup dialog box. Make the following changes:
 - a. Select Meas 1, check On, and make sure the Source 1 button is selected.
 - b. Make sure both Main C1 and Pulse are selected in the Source tab, and then choose Select Meas > Pulse - Amplitude > Amplitude.
13. Select the Meas Setup dialog box and make the following changes:
 - a. Select Meas 2, check On, and make sure the Source 1 button is selected.
 - b. Select both Main C3 and Pulse in the Source tab, and then choose Select Meas > Pulse - Timing > RMS Jitter.
 - c. Check that the Use Wfm Database selection is selected.

Test Follow this procedure to make the clock recovery sensitivity and clock timing jitter checks:

1. In the Trig Setup dialog box, select the clock recovery rate for C1 that you want to test (see Table 2-16).
2. Set the D3186 Pulse Pattern Generator to the rate setting and amplitude for the clock recovery rate that you selected in step 1 (see Table 2-16).
3. Adjust the Horizontal SCALE control on the front panel of the instrument to the setting listed in the table for the clock recovery rate that you selected in step 1 (see Table 2-16).

Table 2-16: Clock recovery settings

Clock recovery rate	D3186		TDS/CSA8000 series scale setting
	Rate setting	Amplitude	
OC-3	0.15552 Gb/s	1.0 V	1 ns/div
OC-12	0.62208 Gb/s	1.0 V	500 ps/div
FC-1063	1.0625 Gb/s	1.0 V	200 ps/div
GBE	1.25 Gb/s	1.0 V	200 ps/div
Serial ATA	1.50 Gb/s	1.0 V	200 ps/div

Table 2-16: Clock recovery settings (cont.)

Clock recovery rate	D3186		TDS/CSA8000 series scale setting
	Rate setting	Amplitude	
FC2125	2.125 Gb/s	1.0 V	100 ps/div
OC-48	2.48832 Gb/s	1.0 V	100 ps/div
2GBE	2.5 Gb/s	1.0 V	100 ps/div
Infiniband	2.5 Gb/s	1.0 V	100 ps/div
PCI Express	2.5 Gb/s	1.0 V	100 ps/div
2.5 G G.709 FEC	2.666 Gb/s	1.0 V	100 ps/div
Serial ATA	3.0 Gb/s	1.5 V	100 ps/div
XAUI	3.125 Gb/s	1.5 V	100 ps/div
FibreChannel	3.188 Gb/s	1.5 V	100 ps/div
VSR5	3.318 Gb/s	1.5 V	100 ps/div
4 Gigabit FibreChannel	4.25 Gb/s	1.5 V	100 ps/div
Serial ATA ¹	6.0 Gb/s	1.5 V	200 ps/div
XAUI ¹	6.25 Gb/s	1.5 V	100 ps/div
OC-192 ¹	9.95328 Gb/s	1.5 V	50 ps/div
10GBASE-W ¹	9.95328 Gb/s	1.5 V	50 ps/div
10GBASE-R ¹	10.3125 Gb/s	1.5 V	50 ps/div
10GFC ¹	10.51875 Gb/s	1.5 V	50 ps/div
G.975 FEC ¹	10.66 Gb/s	1.5 V	50 ps/div
G.709 FEC ¹	10.71 Gb/s	1.5 V	50 ps/div
10GbE w/FEC ¹	11.10 Gb/s	1.5 V	50 ps/div
Super FEC ¹	12.50 Gb/s	2.0 V	50 ps/div

¹ Only available with Option 10G.

At this point in the procedure, the instrument is triggered from the 1/32 clock from the D3186 Pulse Pattern Generator. The clock signal from the 80A05 Module that is connected to C3 on the 80E02 Sampling Module should be synchronous with the signal from the pulse pattern generator (see Figure 2-51).

If the signals are not synchronous, check that the D3186 data rate is set to a data rate that matches the clock recovery rate set for the 80A05 Module (see Table 2-16).

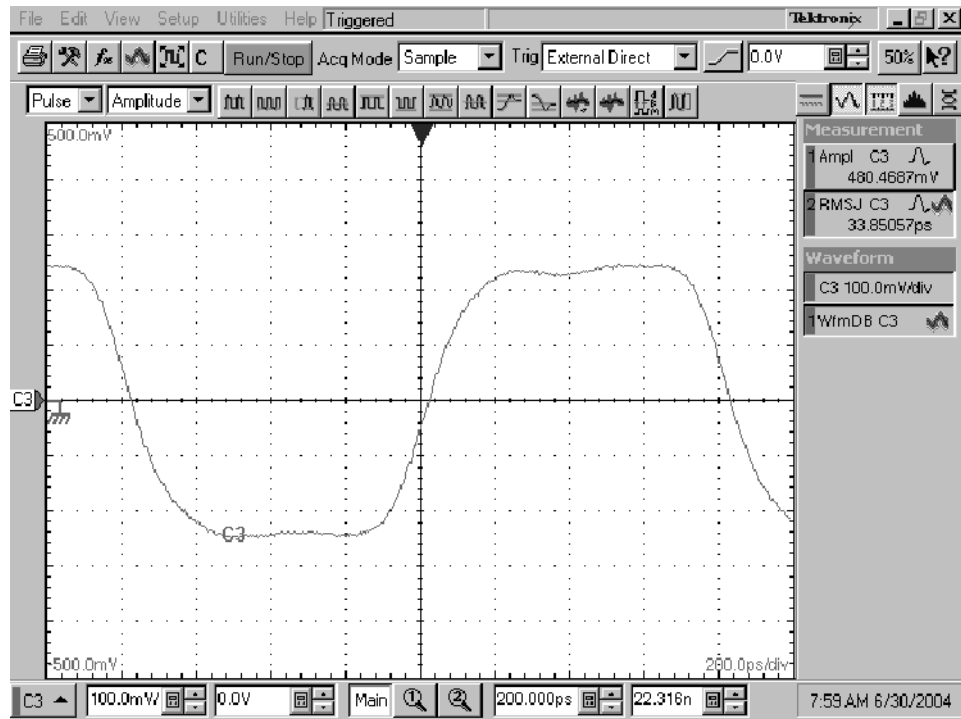


Figure 2-51: Display example (clock signal synchronized with the data rate input)

4. Check that the Minimum amplitude measurement for C3 is greater than or equal to the value given in the Minimum amplitude column of Table 2-17.
5. Do the following substeps to check recovered clock timing jitter:
 - a. Remove the two 10X attenuators from the 80A05 module and reconnect the 50 Ω coaxial cable from the pattern generator to the 80A05.
 - b. Set the D3186 Pulse Pattern Generator amplitude to 0.50 V.
 - c. Zoom into the 50% crossing point of the first rising edge on the C3 clock signal until the Horizontal SCALE is 20 ps/div and the Vertical SCALE is 10 mV/div. See Figure 2-52.

NOTE. You can most easily zoom in on the 50% crossing point by click dragging a rectangle around this edge (using the mouse), and then using the SCALE and FINE control knobs to adjust the settings to 10 mV/div and 20 ps/div.

- d. Check that the RMS jitter measurement for C3 is less than or equal to the value given in the maximum RMS jitter column of Table 2-17.
6. Repeat this procedure from step 1 to check the recovered clock sensitivity and recovered clock timing jitter for each of the clock recovery rates.

Table 2-17: Clock recovery amplitude and jitter limits

Clock recovery rate	Minimum pk-pk amplitude	Max RMS jitter
OC-3	>200 mV	64 ps
OC-12	>200 mV	16 ps
FC-1063	>200 mV	9.4 ps
GBE	>200 mV	8 ps
Serial ATA (1.50 Gb/s)	>200 mV	6.7 ps
FC2125	>200 mV	4.7 ps
OC-48	>200 mV	4 ps
2GBE	>200 mV	4 ps
Infiniband	>200 mV	4 ps
PCI Express	>200 mV	4 ps
2.5 G G.709 FEC	>200 mV	4 ps
Serial ATA (3.00 Gb/s)	>200 mV	2.5 ps
XAUI (3.125 Gb/s)	>200 mV	2.5 ps
FibreChannel	>200 mV	2.5 ps
VSR5	>200 mV	2.5 ps
4 Gigabit FibreChannel	>200 mV	2.5 ps
Serial ATA (6.00 Gb/s) ¹	>200 mV	2 ps
XAUI (6.25 Gb/s) ¹	>200 mV	2 ps
OC-192 ¹	>200 mV	2 ps
10GBASE-W ¹	>200 mV	2 ps
10GBASE-R ¹	>200 mV	2 ps
10GFC ¹	>200 mV	2 ps
G.975 FEC ¹	>200 mV	2 ps
G.709 FEC ¹	>200 mV	2 ps
10GbE w/FEC ¹	>200 mV	2 ps
Super FEC ¹	>200 mV	2 ps

¹ **Only available with Option 10G.**

7. Move the test setup from the 80A05 ELECTRICAL INPUT IN+ connector to the IN- connector and repeat this procedure from step 1.

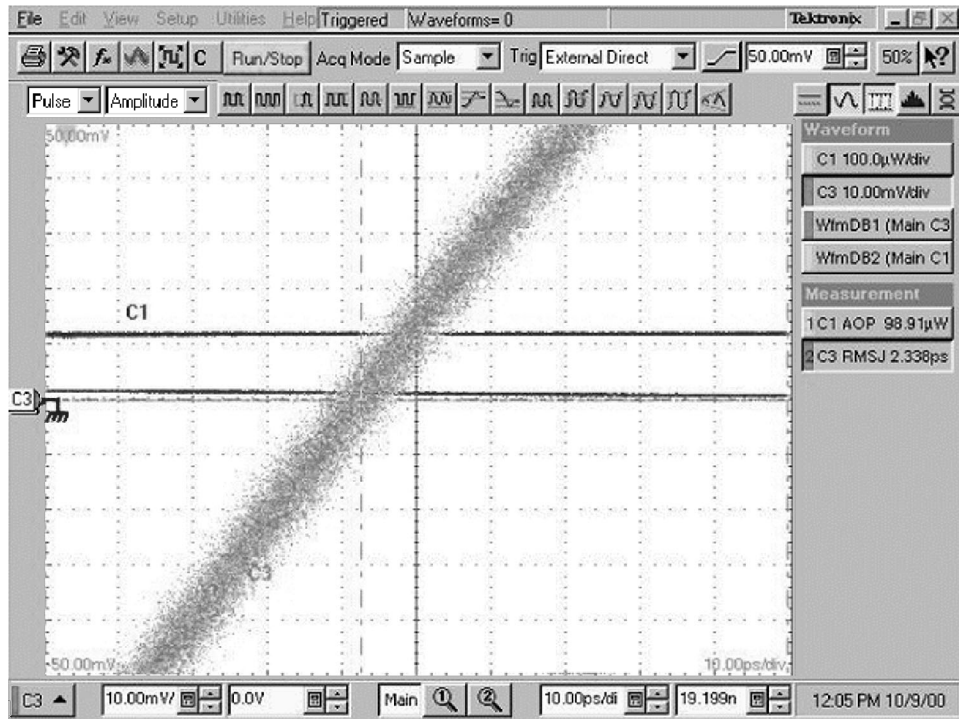


Figure 2- 52: Display example (zoomed in at the crossing point)

8. Disconnect the test setup.

End of Procedure

80A06 PatternSync Trigger Module

These procedures check those characteristics that relate to 80A06 module and are listed as checked specifications. Refer to Table 1-34 on page 1-76.

STOP. *The procedures throughout this chapter contain instructions based on the menus and controls from the most updated instrument software available at the time this document was released. These procedures will work for other versions of software, but some control and menu names may vary slightly.*

Prerequisites

Be sure you have performed the following prerequisites and the *Prerequisites* on page 2-26 before doing any procedures in this section.

NOTE. *Use a calibrated torque wrench when making connections to module connectors. Use 8 ± 0.3 inch pounds of torque.*

Supported Clock Rates, Minimum Input Sensitivity, and Maximum Jitter Checks

This procedure checks that the 80A06 locks onto the input clock at the supported rates and at the Minimum Voltage level specified, and produces a trigger with jitter that is less than the maximum specified.

Equipment required	DSA8200 Digital Serial Analyzer Tektronix 80E04 Sampling Module (item 34) Advantest D3186 Pattern Generator (item 40) Attenuator, 10X (20 dB pad), 50 Ω , SMA (item 58) Cable, coaxial, 2 ns delay SMA, male connector on each end (item 12)
Prerequisites	As listed on page 2-26 and under <i>Prerequisites</i> on page 2-231.

Setup

Install the test hookup (see Figure 2-53), preset the main instrument controls, and preset the pattern generator:

1. Install the 80A06 PatternSync Module to be tested into Channel compartment 7 and 8 of the instrument.
2. Install an 80E04 Electrical Sampling Module into Channel compartment 3 and 4 of the instrument.
3. Connect a less than 2 ns delay, 50 Ω coaxial cable between the TRIGGER OUT of the 80A06 module and the TRIGGER DIRECT connector of the instrument.
4. Connect a less than 2ns delay, 50 Ω coaxial cable between the DATA OUT+ signal output of the pattern generator and Channel 3.
5. Connect a less than 2ns delay, 50 Ω coaxial cable between the CLOCK OUT of the 80A06 module and Channel 4.
6. Connect a less than 2ns delay, 50 Ω coaxial cable between the CLOCK signal output of the pattern generator and a 20dB attenuator.
7. Connect the other end of the 20 dB attenuator directly to the CLOCK IN input of the 80A06 module.
8. The D3186 Pulse Pattern Generator must use its own reference clock. Set the following data signal parameters on the pattern generator:
 - a. AC coupled
 - b. Clock amplitude 1.0 V
 - c. Data amplitude 0.8 V
 - d. PRBS7 pattern
 - e. NRZ data format
 - f. Balanced duty cycle (crossing set to the default 50% level)
 - g. Data rate to 150 Mb/s (the data rate will be changed, depending on each specific data rate to be tested later in the procedure).
9. Allow the instrument and its modules to warm up for at least 20 minutes in an environment that has had less than 1 °C variation throughout the warm-up cycle.

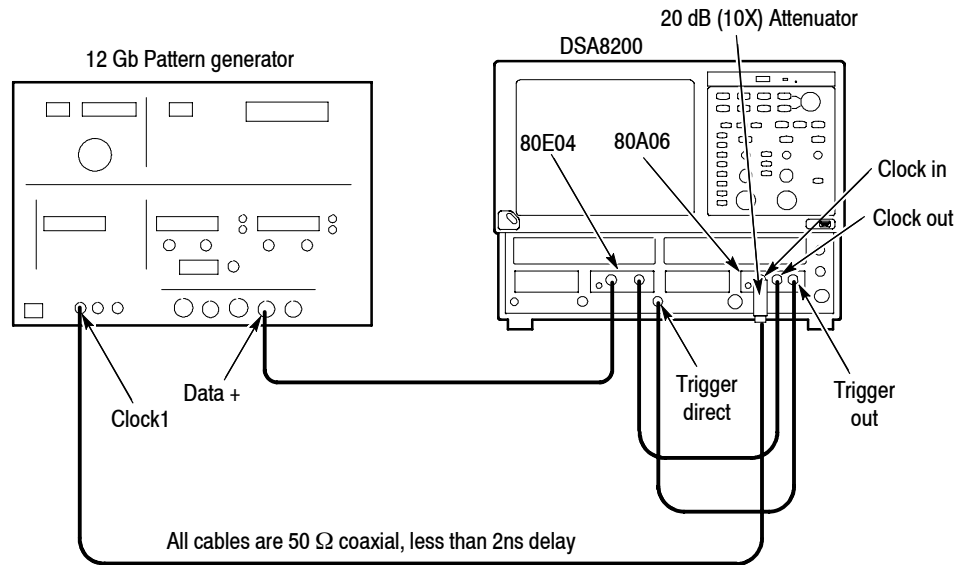


Figure 2-53: Hookup for Clock Rates, Input Sensitivity, and Jitter Checks

10. Press the DEFAULT SETUP button on the instrument.
11. Press the SELECT ON/OFF buttons on the 80E04 Sampling Module so that the adjacent indicator lights come on. This turns on Channel 3 (C3) and Channel 4 (C4), which display the BERT data and the buffered clock signals.
12. From the Setup Menu, select the Trig Setup dialog box. Make the following changes:
 - a. Select PatternSync as the Trigger Source.
 - b. Click the PatternSync Setup button to open the PatternSync Setup menu.
 - Ensure Source is set to C7.
 - Set Data Rate to 150 Mb/s.
 - Set Pattern Length to 127 bits.
 - Ensure Data to Clock Ratio is 1:1.
13. Select the Meas Setup dialog box. Make the following changes to Meas 1:
 - a. Select Meas > Pulse – Timing > RMS jitter.
 - b. Ensure the Use Wfm Database box is checked.
 - c. Ensure that Main C3 is the source for the measurement.
 - d. Ensure that Meas 1 is checked On.

Test Follow this procedure to check PatternSync Sensitivity and Timing Jitter at the Supported Clock Rates:

1. In the PatternSync Setup dialog box, select the data rate for C7 that you want to test (see Table 2-18 on page 2-235).
2. Set the D3186 Pulse Pattern Generator to the rate setting and amplitude for the data rate that you selected in step 1 (see Table 2-18 on page 2-235).
3. Adjust the Horizontal POSITION control on the front panel of the instrument to position the first rising edge of the data stream acquired on C3 at the center of the display.
4. Check that the waveform is triggered on screen at the data (clock) rate and amplitude set in step 2.
5. Adjust the Horizontal SCALE control on the front panel of the instrument to the setting listed in the table for the data rate that you selected in step 1 (see Table 2-18 on page 2-235).

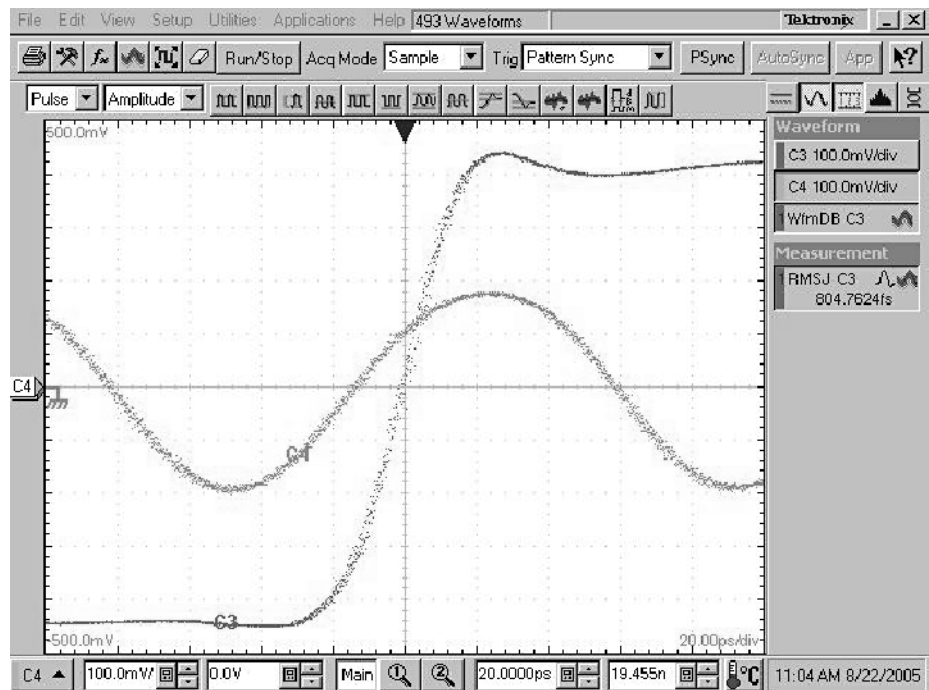


Figure 2-54: Example display for Supported Clock Rates, Minimum Input Sensitivity, and Maximum Jitter Checks

6. Check that the RMS jitter measurement for C3 is less than or equal to the value given in the maximum RMS jitter column of Table 2-18.

7. Repeat steps 1 through step 7 to check the Minimum PatternSync Sensitivity and Maximum Jitter for each of the data rates (Supported Clock Rates) listed in Table 2-18.
8. Change the BERT pattern length to PRBS10.
9. In the PatternSync Setup dialog box, set Pattern Length to 1023 bits.
10. Repeat steps 1 through step 7 to test 80A06 Supported Clock Rates, Minimum Sensitivity, and Maximum Jitter at PRBS10.
11. Change the BERT pattern length to PRBS15.
12. In the PatternSync Setup dialog box, set Pattern Length to 32767 bits.
13. Repeat steps 1 through step 7 to test 80A06 Supported Clock Rates, Minimum Sensitivity, and Maximum Jitter at PRBS15.

Table 2-18: PatternSync settings and jitter limits

Data rate	D3186 Generator		DSA8200 scale	Max RMS jitter
	Rate setting	Clock amplitude		
150 Mb/s	150 Mb/s	1.0 V	50 ps/div	20 ps
1.2 Gb/s	1.2 Gb/s	1.0 V	20 ps/div	1.3 ps
3.0 Gb/s	3.0 Gb/s	1.0 V	20 ps/div	1.3 ps
3.05 Gb/s	3.05 Gb/s	1.0 V	20 ps/div	1.3 ps
7.0 Gb/s	7.0 Gb/s	1.0 V	20 ps/div	1.3 ps
7.05 Gb/s	7.05 Gb/s	1.0 V	20 ps/div	1.3 ps
8.0 Gb/s	8.0 Gb/s	2.0 V	20 ps/div	1.3 ps
12.5 Gb/s	12.5 Gb/s	2.0 V	20 ps/div	1.3 ps

End of Procedure

