

Service Manual



**CSA8000 Series
Communications Signal Analyzers
TDS8000 Series
Digital Sampling Oscilloscopes
071-0438-05**

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.

www.tektronix.com

Copyright © Tektronix, Inc. All rights reserved.

Tektronix products are covered by U.S. and foreign patents, issued and pending. Information in this publication supercedes that in all previously published material. Specifications and price change privileges reserved.

Tektronix, Inc., P.O. Box 500, Beaverton, OR 97077

TEKTRONIX and TEK are registered trademarks of Tektronix, Inc.

WARRANTY

Tektronix warrants that the products that it manufactures and sells will be free from defects in materials and workmanship for a period of one (1) year from the date of shipment. If this product proves defective during its warranty period, Tektronix, at its option, will either repair the defective product without charge for parts and labor, or provide a replacement in exchange for the defective product.

This warranty applies only to products returned to the designated Tektronix depot or the Tektronix authorized representative from which the product was originally purchased. For products returned to other locations, Customer will be assessed an applicable service charge. The preceding limitation shall not apply within the European Economic Area, where products may be returned for warranty service to the nearest designated service depot regardless of the place of purchase.

In order to obtain service under this warranty, Customer must provide the applicable office of Tektronix or its authorized representative with notice of the defect before the expiration of the warranty period and make suitable arrangements for the performance of service. Customer shall be responsible for packaging and shipping the defective product to the service center designated by Tektronix or its representative, with shipping charges prepaid. Tektronix or its representative shall pay for the return of the product to Customer. Customer shall be responsible for paying any associated taxes or duties.

This warranty shall not apply to any defect, failure or damage caused by improper use or improper or inadequate maintenance and care. Tektronix shall not be obligated to furnish service under this warranty:

- a) to repair damage resulting from attempts by personnel other than Tektronix representatives to install, repair or service the product;
- b) to repair damage resulting from improper use or connection to incompatible equipment;
- c) to repair any damage or malfunction caused by the use of non-Tektronix supplies or consumables;
- d) to repair a product that has been modified or integrated with other products when the effect of such modification or integration increases the time or difficulty of servicing the product; or
- e) to repair damage or malfunction resulting from failure to perform user maintenance and cleaning at the frequency and as prescribed in the user manual (if applicable).

THE ABOVE WARRANTIES ARE GIVEN BY TEKTRONIX WITH RESPECT TO THIS PRODUCT IN LIEU OF ANY OTHER WARRANTIES, EXPRESS OR IMPLIED. TEKTRONIX AND ITS VENDORS DISCLAIM ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. TEKTRONIX' RESPONSIBILITY TO REPAIR OR REPLACE DEFECTIVE PRODUCTS IS THE SOLE AND EXCLUSIVE REMEDY PROVIDED TO THE CUSTOMER FOR BREACH OF THIS WARRANTY. TEKTRONIX AND ITS VENDORS WILL NOT BE LIABLE FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES IRRESPECTIVE OF WHETHER TEKTRONIX OR THE VENDOR HAS ADVANCE NOTICE OF THE POSSIBILITY OF SUCH DAMAGES.

Table of Contents

General Safety Summary	xiii
Service Safety Summary	xv
Preface	xvii
Manual Structure	xvii
Manual Conventions	xvii
Related Documentation	xviii
Contacting Tektronix	xix

Specifications

System Specifications	1-1
Certifications (CSA/TDS8000, CSA/TDS8000B)	1-16
Certifications (CSA/TDS8200)	1-18
80E00 Electrical Sampling Modules Specifications	1-21
80C00 Optical Sampling Modules Specifications	1-27
80A01 Trigger Prescale Preamplifier Module Specifications	1-67
80A02 EOS/ESD Protection Module Specifications	1-69
80A05 Electrical Clock Recovery Module Specifications	1-71

Operating Information

Installation	2-1
Check the Environmental Requirements	2-1
Site Considerations	2-1
Operating Requirements	2-1
Rackmount Requirements	2-2
Install the Sampling Modules	2-2
Check Your Sampling Module Manual(s)	2-2
Maximum Configuration	2-3
Connect the Peripherals	2-3
Power On the Instrument	2-5
Powering Off the Instrument	2-6
Software Installation	2-7
Description	2-7
Software Release Notes	2-7
Operating System Reinstallation	2-7
System Diagnostics	2-8
Windows Safe Mode	2-8

Theory of Operation

Theory of Operation	3-1
Logic Conventions	3-1

Mainframe Overview	3-1
Input Signal Path	3-1
Display Panel	3-2
Front Panel	3-2
Rear Panel	3-2
Low Voltage Power Supply	3-2
Fans	3-3
Electrical Sampling Modules Overview	3-3
80E04 Electrical TDR/Sampling Module	3-4
Optical Sampling Modules Overview	3-4
80C01 Optical Sampling Module	3-6
80C02 Optical Sampling Module	3-7
80C03 Optical Sampling Module	3-7
80C04 Optical Sampling Module	3-8
80C05 Optical Sampling Module	3-9
80C06 Optical Sampling Module	3-9
80C07 Optical Sampling Module	3-9
80C07B Optical Sampling Module	3-9
80C08 Optical Sampling Module	3-10
80C08B Optical Sampling Module	3-10
80C08C Optical Sampling Module	3-10
80C09 Optical Sampling Module	3-11
80C10 Optical Sampling Module	3-11
80C11 Optical Sampling Module	3-12
80C12 Optical Sampling Module	3-12
80A01 Trigger Prescale Preamplifier Module	3-12
80A02 EOS/ESD Protection Module	3-13
80A05 Electrical Clock Recovery Module	3-13
82A04 Phase Reference Module	3-14

Performance Verification

Performance Verification Procedures	4-1
Brief Procedures	4-3
Perform the Diagnostics	4-3
Perform the Compensation	4-5
Perform the Functional Tests	4-7
Verify Electrical Input Channels	4-7
Verify Optical Input Channels	4-10
Verify the Time Bases Work	4-13
Perform Gated Trigger Test	4-18
Perform the Hardware and Operating System Tests (Microsoft Windows 98 OS Only)	4-24
QA+Win32	4-24
Checking the Cooling Fan Operation	4-25
Checking the Hardware and Operating System	4-26
Performance Tests	4-29
Prerequisites	4-30
Equipment Required	4-31
CSA8000/TDS8000 Series Test Records	4-34
CSA8000/TDS8000 Main-Instrument Test Record	4-35
CSA8000B/TDS8000B Main-Instrument Test Record	4-36

CSA8200/TDS8200 Main-Instrument and 82A04 Module Test Record	4-37
80E00 Electrical Modules Test Record	4-39
80C00 Optical Modules Test Record	4-44
80A01 Electrical Clock Recovery Module Test Record	4-71
80A02 EOS/ESD Protection Module Test Record	4-73
80A05 Electrical Clock Recovery Module Test Record	4-75
Main Instrument	4-77
Prerequisites	4-77
Time Interval Accuracy, Short-Term Optimized and Locked-to-Internal 10-MHz Reference Modes	4-78
External Direct Trigger Level Accuracy	4-81
External Direct Trigger Sensitivity	4-83
External Direct-Trigger Delay Jitter, Short-Term Optimized and Locked-to-Internal 10-MHz Reference Modes	4-86
Trigger Delay Jitter, Free Run Phase Corrected Mode (CSA/TDS8200 with 82A04 Module Only)	4-91
External Prescaled Trigger Delay Jitter, Short-Term Optimized Mode and Locked-to-Internal 10-MHz Reference Mode	4-94
External Prescaled Trigger Sensitivity	4-97
DC Calibration Output	4-100
Electrical Sampling Modules	4-103
Prerequisites	4-103
Input Impedance	4-104
DC Voltage Measurement Accuracy	4-106
Random Noise, Displayed	4-112
Rise Time (80E02, 80E03, & 80E04)	4-114
Analog Bandwidth (80E01)	4-118
50 MHz - 50 GHz Analog Bandwidth (80E06)	4-126
50 GHz - 65 GHz Analog Bandwidth (80E06)	4-136
TDR-System Reflected Rise Time (80E04)	4-148
TDR-System Step Response Aberrations (80E04)	4-150
Optical Sampling Modules	4-157
Prerequisites	4-157
Dark Level & Vertical Equivalent Optical Noise	4-158
Minimum Optical Bandwidth & Reference Receiver Frequency Response	4-167
Integrated Rise Time and Aberrations Check	4-190
Clock Recovery Optical Sensitivity Range and Recovered Clock Timing Jitter	4-196
80A01 Trigger Prescale Limiting Preamplifier Module	4-207
Prerequisites	4-207
System Trigger Sensitivity	4-208
80A02 EOS/ESD Protection Module	4-211
Prerequisites	4-211
Logic Control Threshold	4-211
80A05 Electrical Clock Recovery Module	4-215
Prerequisites	4-215
Clock Recovery Sensitivity Range and Recovered Clock Timing Jitter	4-215

Adjustment Procedures

Adjustment Procedures	5-1
Adjustment Interval	5-1
Adjustment Environment	5-1
Adjustment After Repair	5-1
Required Equipment	5-2
Instrumentation Setup	5-2
Main Instrument Adjustments	5-3
DC Calibrator Adjust	5-3
DC Calibrator Adjust Verification	5-4
Internal 10 MHz Adjust	5-5

Maintenance

Maintenance	6-1
Preventing ESD	6-1
Inspection and Cleaning	6-2
General Care	6-2
Flat Panel Display Cleaning	6-2
Exterior	6-3
Interior	6-4
Removal and Installation Procedures	6-7
Preparation	6-7
Procedures for External Modules	6-9
Front-Panel Knobs	6-9
Trim and Carrying Handle	6-10
Bottom Cover	6-11
Covers	6-13
Line Fuses and AC power cord connector	6-16
Procedures for Modules	6-21
Front Panel Assembly	6-21
Front Panel Board	6-23
Front Panel Keypad	6-24
Display Assembly	6-25
Display Adapter Board	6-27
Standby/On Switch Flex Circuit Removal	6-29
Floppy Disk Drive	6-31
Hard Disk Drive	6-32
CD Drive	6-34
Fan Assembly Removal	6-35
Front and Rear Power Distribution Boards	6-37
Low-Voltage Power Supply	6-38
NLX Board	6-40
Microprocessor	6-43
PC Processor Board	6-45
Acquisition Assembly	6-47
Large Module Interface Circuit Board	6-53
Module Slot Doors	6-55
Electrical Modules	6-64

Exchanging the Electrical Sampling Module	6-65
Replacing the sampling module chassis	6-65
Reinstalling exchange module serial number	6-65
Optical Modules	6-66
80A00 and 82A00 Series Modules	6-67
Troubleshooting	6-69
Check for Common Problems	6-69
Equipment Required	6-72
Isolating Failures between the 80E0X/80C0X Modules or the Mainframe ...	6-72
Isolating to a Board if Power Will Not Come Up	6-73
Checking the Power Supply Voltages	6-74
If the instrument Will Not Boot	6-75
Booting Into Windows	6-76
PPC and NLX PC Diagnostics	6-76
Power-On Diagnostics	6-76
QAPlus/Win	6-76
Diagnostics	6-77
Firmware Updates	6-77
After Repair	6-78
Installing the Instrument Model and Serial Number	6-78
Update/Restore the NLX Board CMOS	6-79
Repackaging Instructions	6-81
Packaging	6-81
Shipping to the Service Center	6-81

Diagrams

Diagrams	7-1
Symbols	7-1
CSA8000 and TDS8000 Series Block Diagram	7-2
Electrical Sampling Modules Block Diagram	7-3
Optical Sampling Modules Block Diagrams	7-4
80A01 Block Diagram	7-25
80A02 Block Diagram	7-26
80A05 Block Diagram	7-27
82A04 Block Diagram	7-28

Replaceable Parts

Replaceable Parts List	8-1
Parts Ordering Information	8-1
Module Servicing	8-1
Using the Replaceable Parts List	8-2

List of Figures

Figure 2-1: Compartments for sampling modules	2-3
Figure 2-2: Locations of peripheral connectors on rear panel	2-4
Figure 2-3: Line fuse and power cord connector locations, rear panel	2-5
Figure 2-4: On/Standby switch location	2-6
Figure 4-1: Compensation dialog box	4-5
Figure 4-2: Hookup for electrical functional tests	4-8
Figure 4-3: Channel button location	4-8
Figure 4-4: Channel button location	4-11
Figure 4-5: Optical channel verification	4-12
Figure 4-6: Hookup for the time base tests	4-13
Figure 4-7: Channel button location	4-14
Figure 4-8: Main time base verification	4-16
Figure 4-9: Mag time base verification	4-17
Figure 4-10: Hookup for the gated trigger tests	4-19
Figure 4-11: Channel button location	4-20
Figure 4-12: Signal triggered	4-21
Figure 4-13: Signal not triggered (signal frozen)	4-22
Figure 4-14: Signal not triggered (no waveform)	4-23
Figure 4-15: Signal triggered	4-24
Figure 4-16: Time interval accuracy test hookup	4-78
Figure 4-17: External direct trigger test hookup	4-81
Figure 4-18: External direct trigger sensitivity test hookup	4-84
Figure 4-19: External direct trigger jitter test hookup	4-86
Figure 4-20: Phase corrected trigger jitter test hookup	4-92
Figure 4-21: External prescaled test hookup	4-95
Figure 4-22: External prescaled trigger sensitivity test hookup	4-97
Figure 4-23: Hookup for DC calibration test	4-101
Figure 4-24: Input impedance test hookup	4-104
Figure 4-25: Vertical DC accuracy test hookup	4-107
Figure 4-26: Rise Time hookup	4-114
Figure 4-27: Power-reference hookup	4-119
Figure 4-28: Adapter characterization hookup	4-120
Figure 4-29: Measure reference signals	4-121

Figure 4-30: 80E01 reference signals hookup	4-123
Figure 4-31: SNA/Autotester Characterization	4-127
Figure 4-32: Power-reference characterization hookup	4-128
Figure 4-33: Hookup to measure Power in	4-129
Figure 4-34: No Adapter hookup	4-130
Figure 4-35: Adapter-loss hookup	4-131
Figure 4-36: 80E06 HF response hookup	4-132
Figure 4-37: SNA/Waveguide Characterization	4-138
Figure 4-38: Power-reference characterization hookup	4-140
Figure 4-39: Hookup to measure Power-in	4-141
Figure 4-40: Adapter-loss hookup	4-143
Figure 4-41: 80E06 HF response hookup	4-144
Figure 4-42: TDR reflected rise time hookup	4-148
Figure 4-43: TDR system step response aberrations hookup	4-150
Figure 4-44: Dark level and vertical equivalent optical noise test hookup	4-158
Figure 4-45: Minimum optical bandwidth and reference receiver frequency response hookup	4-170
Figure 4-46: Proper positioning of the impulse for optimum curve download	4-174
Figure 4-47: Hookup for heterodyne test	4-184
Figure 4-48: Setup used for Heterodyne sweep	4-186
Figure 4-49: Integrated rise time and aberrations hookup	4-191
Figure 4-50: Clock recovery optical sensitivity range and recovered clock timing jitter hookup	4-197
Figure 4-51: Display example (clock signal not synchronized with the data rate input)	4-202
Figure 4-52: Display example (clock signal synchronized with the data rate input)	4-205
Figure 4-53: Display example (zoomed in at the crossing point) ...	4-206
Figure 4-54: 80A01 test hookup	4-209
Figure 4-55: 80A02 test hookup	4-213
Figure 4-56: Clock recovery sensitivity range and recovered clock timing jitter hookup	4-217
Figure 4-57: Display example (clock signal synchronized with the data rate input)	4-220
Figure 4-58: Display example (zoomed in at the crossing point) ...	4-222
Figure 5-1: Adjustment setup using the DMM	5-3
Figure 5-2: Adjustment setup using the signal generator	5-5

Figure 6-1: Knob removal	6-9
Figure 6-2: Trim removal	6-11
Figure 6-3: Bottom cover removal	6-12
Figure 6-4: Cover removal	6-14
Figure 6-5: Cover removal	6-15
Figure 6-6: Line fuses and line cord removal	6-17
Figure 6-7: External modules	6-18
Figure 6-8: Internal modules	6-19
Figure 6-9: Acquisition modules	6-20
Figure 6-10: Front panel assembly removal	6-22
Figure 6-11: J1 flex cable connector removal	6-23
Figure 6-12: Front panel board and keyboard removal	6-24
Figure 6-13: Display removal	6-26
Figure 6-14: Touch panel and LCD assembly removal	6-27
Figure 6-15: Display adaptor board removal	6-28
Figure 6-16: Connector clip assembly	6-28
Figure 6-17: Standby/On switch flex circuit removal	6-30
Figure 6-18: Floppy disk drive removal	6-31
Figure 6-19: Hard drive disk removal	6-33
Figure 6-20: Removing the hard disk drive from the cartridge	6-33
Figure 6-21: CD drive and bracket removal	6-35
Figure 6-22: Fan assembly removal	6-36
Figure 6-23: Front and rear power distribution board removal ...	6-37
Figure 6-24: Low-voltage power supply removal	6-39
Figure 6-25: NLX assembly removal	6-41
Figure 6-26: Riser adapter and NLX board removal	6-42
Figure 6-27: Microprocessor removal	6-44
Figure 6-28: Processor board removal	6-46
Figure 6-29: T-10 screws and threaded posts	6-48
Figure 6-30: Thermal cover removal (8200 only)	6-49
Figure 6-31: Acquisition circuit board assembly removal (8000) ...	6-50
Figure 6-32: Acquisition circuit board assembly removal (8000B) .	6-51
Figure 6-33: Acquisition circuit board assembly removal (8200) ...	6-52
Figure 6-34: Large module interface circuit board removal (8000 and 8000B)	6-54
Figure 6-35: Large module interface circuit board removal (8200) .	6-55
Figure 6-36: Small and Large module chassis removal	6-57
Figure 6-37: Module door spring removal	6-59
Figure 6-38: Module slot door removal	6-60

Figure 6-39: Module ejector handles removal	6-62
Figure 6-40: Spring arm position	6-63
Figure 6-41: Electrical module hardware removal	6-64
Figure 6-42: Optical module cover removal	6-66
Figure 6-43: 80A00 and 8200 series parts removal (80A01 shown) .	6-67
Figure 6-44: Location of power-on and over current LEDs	6-73
Figure 6-45: Location of debug pins	6-74
Figure 6-46: Connectors J1 and J2	6-75
Figure 7-1: Block diagram for CSA8000 and TDS8000 Series Instruments	7-2
Figure 7-2: Block diagram for the 80E00 Series Electrical Sampling Modules	7-3
Figure 7-3: 80C01 Optical sampling block diagram	7-4
Figure 7-4: 80C01 Optical sampling with clock recovery block diagram	7-5
Figure 7-5: 80C02 Optical sampling block diagram	7-6
Figure 7-6: 80C02 Optical sampling with clock recovery block diagram	7-7
Figure 7-7: 80C03 Optical sampling block diagram	7-8
Figure 7-8: 80C03 Optical sampling with clock recovery block diagram	7-9
Figure 7-9: 80C04 Optical sampling block diagram	7-10
Figure 7-10: 80C04 Optical sampling block diagram with clock recovery	7-11
Figure 7-11: 80C05 Optical sampling block diagram	7-12
Figure 7-12: 80C06 Optical sampling block diagram	7-13
Figure 7-13: 80C07 and 80C07B Optical sampling block diagram .	7-14
Figure 7-14: 80C07 and 80C07B Optical sampling with CR1 clock recovery block diagram	7-15
Figure 7-15: 80C08/80C08B/80C08C Optical sampling block diagram	7-16
Figure 7-16: 80C08/80C08B/80C08C Optical sampling with CR1, CR2, & CR4 clock recovery block diagram	7-17
Figure 7-17: 80C09 Optical sampling block diagram	7-18
Figure 7-18: 80C09 Optical sampling with CR1 clock recovery block diagram	7-19
Figure 7-19: 80C10 Optical sampling block diagram	7-20
Figure 7-20: 80C11 Optical sampling block diagram	7-20
Figure 7-21: 80C11 Optical sampling with CR1 clock recovery option block diagram	7-21

Figure 7-22: 80C11 Optical sampling with CR2 and CR3 clock recovery option block diagram	7-22
Figure 7-23: 80C11 Optical sampling with CR4 clock recovery option block diagram	7-23
Figure 7-24: 80C12 Optical sampling block diagram	7-24
Figure 7-25: 80A01 block diagram	7-25
Figure 7-26: 80A02 block diagram	7-26
Figure 7-27: 80A05 block diagram	7-27
Figure 7-28: 82A04 block diagram	7-28
Figure 8-1: External parts	8-7
Figure 8-2: Front panel and drives	8-10
Figure 8-3: Power supply	8-13
Figure 8-4: Acquisition	8-16
Figure 8-5: 8000 and 8000B coaxial cables	8-18
Figure 8-6: 8200 coaxial cables	8-20
Figure 8-7: Electrical modules (80E01, 80E02, 80E03, and 80E04) .	8-22
Figure 8-8: 80E06 module	8-23
Figure 8-9: Optical modules	8-24
Figure 8-10: 80A01 module	8-25
Figure 8-11: Accessories	8-28

List of Tables

Table 1-1: System - Signal acquisition	1-1
Table 1-2: System - Timebase	1-3
Table 1-3: System - Trigger	1-5
Table 1-4: System - Trigger - Phase Correction Modes (CSA/TDS8200 with 82A04 Phase Reference Module)	1-8
Table 1-5: Display	1-10
Table 1-6: Ports	1-10
Table 1-7: Data storage	1-12
Table 1-8: Power consumption, fuses, and cooling	1-12
Table 1-9: Mechanical	1-14
Table 1-10: System - Environmental	1-14
Table 1-11: Mechanical - 82A04 Phase Reference Module	1-15
Table 1-12: Certifications and compliances	1-16
Table 1-13: Certifications and compliances	1-18
Table 1-14: Electrical sampling modules - Descriptions	1-21
Table 1-15: Electrical sampling modules - Signal acquisition	1-22
Table 1-16: Electrical sampling module (80E04) - TDR system ...	1-24
Table 1-17: Electrical sampling modules - Timebase system	1-25
Table 1-18: Electrical sampling modules - Power consumption ...	1-25
Table 1-19: Electrical sampling modules - Mechanical	1-25
Table 1-20: Optical modules - Descriptions	1-28
Table 1-21: Optical modules - Acquisition	1-31
Table 1-22: Optical Power Meter	1-56
Table 1-23: Optical modules - Clock recovery options (CR, CR1, CR2, CR3, and CR4)	1-56
Table 1-24: Optical modules - Mechanical	1-64
Table 1-25: Optical modules - Environmental	1-65
Table 1-26: Module characteristics	1-67
Table 1-27: Environmental specifications	1-68
Table 1-28: Mechanical specifications	1-68
Table 1-29: Electrical	1-69
Table 1-30: Environmental and Mechanical	1-70
Table 1-31: Module characteristics	1-71
Table 1-32: Environmental specifications	1-73
Table 1-33: Mechanical specifications	1-73
Table 1-34: Electromagnetic specifications	1-74

Table 2-1: Additional accessory connection information	2-3
Table 2-2: Line fuses	2-5
Table 3-1: Module optical/electrical split	3-6
Table 4-1: Equipment Required	4-31
Table 4-2: DC Voltage measurement accuracy	4-108
Table 4-3: Data for calculation of gain and linearity	4-111
Table 4-4: Computed rise time	4-117
Table 4-5: Power reference	4-119
Table 4-6: DUT (device under test) reference response	4-122
Table 4-7: 80E06 bandwidth response (50 MHz - 50 GHz)	4-134
Table 4-8: 80E06 bandwidth response (55 GHz - 65 GHz)	4-147
Table 4-9: Application software version required	4-157
Table 4-10: Dark level and vertical equivalent optical noise limits .	4-161
Table 4-11: Minimum optical bandwidth limits	4-175
Table 4-12: Reference receiver frequency response limits	4-176
Table 4-13: Reference receiver frequency response limits	4-189
Table 4-14: Minimum limits	4-194
Table 4-15: Aberrations	4-194
Table 4-16: Clock recovery settings	4-199
Table 4-17: Clock recovery settings & jitter limits	4-203
Table 4-18: Clock recovery settings	4-218
Table 4-19: Clock recovery amplitude & jitter limits	4-221
Table 5-1: Adjustments required for module replaced	5-1
Table 5-2: Required equipment and materials	5-2
Table 6-1: External inspection check list	6-3
Table 6-2: Internal inspection check list	6-4
Table 6-3: Tools required for module removal	6-8
Table 6-4: Failure symptoms and possible causes	6-69
Table 6-5: Power supply voltages	6-75
Table 6-6: Action required for module replaced	6-78

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.

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

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



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 is the service manual for the:

- CSA8000, CSA8000B, and CSA8200 Communications Signal Analyzers
- TDS8000, TDS8000B, and TDS8200 Digital Sampling Oscilloscopes
- modules that install in the instruments (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 servicing this product. Read the *Introduction* following this preface for safety and other important background information needed before servicing this product.

Manual Structure

This manual is divided into chapters, which 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.

Replaceable Parts

This manual refers to any field-replaceable assembly or mechanical part by its name or generically as a replaceable part. In general, a replaceable part is any circuit board or assembly, such as a hard disk drive, or a mechanical part, such as I/O port connectors, that is listed in the replaceable parts list of Chapter 8.

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 instruments this service manual supports:

- *CSA8200 and TDS8200 Quick Start User manual*. Tektronix part number 071-1482-XX. This document also contains specification changes when using the 82A04 Phase Reference module.
- *CSA8000 and TDS8000 Online Help*. Installed with the application software and accessed from the instrument Help menu.
- *CSA8000 & TDS8000 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.
- *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.
- *CSA8000/TDS8000 Rackmount Kit Instructions*. Tektronix part number 071-0696-XX.
- *CSA8000B and TDS8000B User manual*. Tektronix part number 071-1099-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.

Contacting Tektronix

Phone	1-800-833-9200*
Address	Tektronix, Inc. Department or name (if known) 14200 SW Karl Braun Drive P.O. Box 500 Beaverton, OR 97077 USA
Web site	www.tektronix.com
Sales support	1-800-833-9200, select option 1*
Service support	1-800-833-9200, select option 2*
Technical support	Email: techsupport@tektronix.com 1-800-833-9200, select option 3* 6:00 a.m. - 5:00 p.m. Pacific time

* **This phone number is toll free in North America. After office hours, please leave a voice mail message. Outside North America, contact a Tektronix sales office or distributor; see the Tektronix web site for a list of offices.**



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 in this chapter of the manual.*

This section contains the specifications for the CSA8000, CSA8000B, and CSA8200 Communications Signal Analyzers and the TDS8000, TDS8000B, and TDS8200 Digital Sampling Oscilloscopes.

The 82A04 Phase Reference module affects the CSA8200 and TDS8200 mainframe specifications which are documented in the mainframe specifications. 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 *Performance Verification* chapter of this manual.

All specifications apply to the instrument and sampling modules, unless noted otherwise. To meet specifications, three 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 with 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 channel ¹

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

Description	Characteristics
Number of large sampling module compartments	
TDS/CSA8000, TDS/CSA8000B	2 compartments, for a total of 2 channels ¹
TDS/CSA8200	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.
Compartment assignments and conflict resolution	
TDS/CSA8000, TDS/CSA8000B	Population of either Ch 1 or Ch 2 large compartment with any module other than one requiring power only, displaces functionality of the Ch 1 / Ch 2 small compartment.
TDS/CSA8200	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	
TDS/CSA8000, TDS/CSA8000B	Supports the 80xxx nomenclated modules.
TDS/CSA8200	Supports the 80xxx and 82xxx nomenclated modules, including Phase Reference modules.
Real time accessory interface	
TDS/CSA8000, TDS/CSA8000B	The small slot supports TekProbe-SMA, Levels 1 and 2. No accessory support is offered on the large slot. Hot switching is permitted on this real time accessory interface.
TDS/CSA8200	Small and large slots supports TekProbe-SMA, Levels 1 and 2. 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	-1.6 V to +1.6 V at TekProbe-Sampling interface. May be scaled according to sampling module scaling characteristics.
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	±1.6 V at TekProbe-Sampling interface. May be scaled according to sampling module offset and scaling characteristics.
Offset resolution	14 bits over ±1.8 V at TekProbe-Sampling interface.

¹ **Total channels ≤ 8.**

Table 1-2: System - Timebase

Description	Characteristics	
Horizontal modes		
All mainframes	Short term jitter optimized and Locked to 10 MHz Reference are supported. The 10 MHz reference may be internal or external.	
TDS/CSA8200 with 82A04	Free Run and Triggered Modes are supported.	
Sampling rate		
TDS/CSA8000, TDS/CSA8000B, and TDS/CSA8200 (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.	
TDS/CSA8200 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.	
Horizontal scale range		
Software version 1.0 to 2.0	1 ps/div to 5 ms/div in 1, 2, 5 steps or 1 ps increments. Maximum record lengths apply at certain ranges per table. For record lengths greater than 500, 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>
	1 ps/div	1000
	2 ps/div	2000
	4 ps/div	4000
Software version 2.1 and above	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		
All mainframes	50 ms maximum.	
TDS/CSA8200 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		
Software version 1.0 to 2.0	10 fs minimum	
Software version 2.1 and above	1 fs minimum	

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

Description	Characteristics
Horizontal position setting resolution	
Software version 1.0 to 1.2	1 ps minimum
Software version 1.3 to 2.0	100 fs minimum
Software version 2.1 and above	10 fs minimum
✓ Time interval accuracy, short term jitter optimized mode	<p>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.)</p> <p>1 ps + 1%, ≤ 20 ps/div, rightmost point of measurement interval <200 ns</p> <p>8 ps + 0.1% of interval, ≥ 21 ps/div, rightmost point of measurement interval <200 ns</p> <p>Guaranteed for all trigger rates (8200)</p> <p>Guaranteed only for ≤ 100 kHz trigger rate (8000 and 8000B)</p>
Time interval accuracy, short term jitter optimized mode (typical) (8000 and 8000BB)	<p>1 ps + 1% of interval, ≤ 20 ps/div</p> <p>8 ps + 0.1% of interval, ≥ 21 ps/div for ≥ 100 kHz trigger rate</p>
✓ Time interval accuracy, locked to internal 10 MHz reference mode ²	<p>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.</p> <p>1 ps + 1% of interval, ≤ 20 ps/div</p> <p>8 ps + 0.01% of interval, ≥ 21 ps/div</p> <p>Guaranteed only for ≤ 100 kHz trigger rate (8000 and 8000B)</p> <p>Guaranteed for all trigger rates (8200)</p>
Timing accuracy, free run phase corrected mode (Not available for TDS/CSA8000 or TDS/CSA8000B)	
TDS/CSA8200 with 82A04	<p>Maximum timing deviation 0.1% of phase reference signal period, typical, relative to phase reference signal.</p> <p>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.</p>

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

Description	Characteristics
Timing accuracy, triggered phase corrected mode (Not available for TDS/CSA8000 or TDS/CSA8000B)	
TDS/CSA8200 with 82A04	Maximum timing deviation relative to phase reference signal: 0.2% of phase reference signal period typical for measurements made > 40 ns after trigger event. 0.4% of phase reference signal period typical for measurements made ≤ 40 ns after trigger event. Assumes that phase reference frequency has been correctly entered.
Horizontal deskew range and resolution	
All mainframes	-500 ps to +100 ns on any individual channel in 1 ps increments.
TDS/CSA8200 with 82A04	Operating in Triggered Phase Corrected modes: -500 ps to +100 ns on any individual channel in 1 ps increments. Operating in Free Run Phase Corrected modes: Deskew range extends over the full clock cycle of the phase reference.

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	
All mainframes	External Direct Edge Trigger, External Prescaled Trigger, Internal Clock Trigger, and Clock Recovery (with appropriately equipped optical modules)
CSA/TDS8200 with 82A04	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. Two bandwidth options are available for the 82A04 and may be required over specific frequency ranges of operation: The base product has an 8 GHz - 25 GHz range of operation. Option 60G extends the upper frequency range of operation to 60 GHz.
Auto/normal mode	Normal mode: wait for trigger Auto mode: Trigger automatically generated after 100 ms time-out

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

Description	Characteristics
Slope + or - select	Edge + mode: Triggers on positive-slewing edge Edge - mode: Triggers on negative-slewing edge
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.
TDS/CSA8000, TDS/CSA8000B	When External Prescaled Trigger mode is used, holdoff period applies to the Prescaled input divided by 8.
TDS/CSA8200	When External Prescaled Trigger mode is used, holdoff 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)	
CSA/TDS8000	1.0 ps RMS + 5 ppm of horizontal position
CSA/TDS8000B, CSA/TDS8200	800 fs RMS + 5 ppm of horizontal position
✓ External direct trigger delay jitter, short term optimized mode	
CSA/TDS8000	1.5 ps RMS + 10 ppm of horizontal position, or better
CSA/TDS8000B, CSA/TDS8200	1.0 ps RMS + 8 ppm of horizontal position, or better

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

Description	Characteristics	
External direct delay jitter, locked to internal 10 MHz reference mode (typical)		
CSA/TDS8000	1.6 ps RMS + 0.05 ppm of horizontal position	
CSA/TDS8000B, CSA/TDS8200	1.6 ps RMS + 0.01 ppm of horizontal position	
✓ External direct delay jitter, locked to internal 10 MHz reference mode		
CSA/TDS8000	2.5 ps RMS + 0.10 ppm of horizontal position, or better	
CSA/TDS8000B, CSA/TDS8200	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.	
External prescaled trigger capabilities and conditions (typical)	<p>Prescaled triggering on signal applied to dedicated front panel connector with Holdoff, Auto/Normal, Metastability Reject On/Off.</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)		
CSA/TDS8000, CSA/TDS8000B	50 Ω AC coupled input resistance; divide-by-eight prescaler ratio, fixed level zero volts	
CSA/TDS8200	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		
CSA/TDS8000, CSA/TDS8000B	<i>Frequency range</i>	<i>Sensitivity</i>
	2 GHz - 3 GHz	800 mV _{p-p}
	3 GHz - 10 GHz	600 mV _{p-p}
External prescaled trigger sensitivity (typical)		
CSA/TDS8000, CSA/TDS8000B	<i>Frequency range</i>	<i>Sensitivity</i>
	10 GHz - 12.5 GHz	1000 mV _{p-p} ⁴
✓ External prescaled trigger sensitivity and usable range		
CSA/TDS8200	<i>Frequency range</i>	<i>Sensitivity</i>
	2 GHz - 12.5 GHz	200 mV _{p-p} to 800 mV _{p-p}

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

Description	Characteristics
External prescaled trigger delay jitter, short term optimized mode (typical)	
CSA/TDS8000	1.0 pSRMS + 5 ppm of horizontal position
CSA/TDS8000B, CSA/TDS8200	0.9 pSRMS + 5 ppm of horizontal position
✓ External prescaled trigger delay jitter, short term optimized mode	
CSA/TDS8000	1.5 pSRMS + 10 ppm of horizontal position, or better
CSA/TDS8000B, CSA/TDS8200	1.3 pSRMS + 10 ppm of horizontal position, or better
External prescaled delay jitter, locked to internal 10 MHz reference mode (typical)	
CSA/TDS8000	1.6 pSRMS + 0.05 ppm of horizontal position
CSA/TDS8000B, CSA/TDS8200	1.6 pSRMS + 0.01 ppm of horizontal position
✓ External prescaled delay jitter, locked to internal 10 MHz reference mode	
CSA/TDS8000	2.5 pSRMS + 0.1 ppm of horizontal position, or better
CSA/TDS8000B, CSA/TDS8200	2.5 pSRMS + 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.**
- 4 **The 80A01 accessory is designed to allow users to enhance performance.**

Table 1-4: System - Trigger - Phase Correction Modes (CSA/TDS8200 with 82A04 Phase Reference Module)

Description	Characteristics
<i>Note. The specifications in this table apply to a CSA8200 or TDS8200 mainframe equipped with an 82A04 Phase Reference module. The CSA8000, TDS8000, CSA8000B, and TDS8000B mainframes do not support the use of the 82A04 Phase Reference module.</i>	
Phase correction capabilities and conditions	A phase reference signal may be applied to a TDS8200 / CSA8200 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.

Table 1-4: System - Trigger - Phase Correction Modes (CSA/TDS8200 with 82A04 Phase Reference Module) (cont.)

Description	Characteristics
Number of phase reference module inputs	One per 82A04 module. Up to three 82A04 modules may be inserted in the small compartments of the TDS8200 / CSA8200 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 ± 1000 mV)
Phase reference module input maximum nondestruct range	± 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)	± 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
Phase reference module input operating frequency (typical)	

Table 1-4: System - Trigger - Phase Correction Modes (CSA/TDS8200 with 82A04 Phase Reference Module) (cont.)

Description	Characteristics
With 82A04	<p>2 GHz to 25 GHz usable range</p> <p>Operation below 8 GHz requires the use of external filters, as follows:</p> <p>2 GHz - 4 GHz: requires 2.2 GHz peaked lowpass filter kit, Tektronix part number 020-2566-00.</p> <p>4 GHz - 6 GHz: requires 4 GHz lowpass filter kit, Tektronix kit part number 020-2567-00.</p> <p>6 GHz - 10 GHz: requires 6 GHz filter lowpass filter kit, Tektronix kit part number 020-2568-00.</p> <p>2 GHz to 25 GHz settable range.</p>
With 82A04-60 G	<p>2 GHz to 60 GHz usable range. Operation below 8 GHz requires the use of external filters as noted for the standard 82A04.</p> <p>2 GHz to 110 GHz settable range.</p>

Table 1-5: Display

Specifications	Characteristics
Display type	211.2 mm (wide) x 1.58.4 mm (high), 264 mm (10.4 inch) diagonal, liquid crystal active matrix color display (LCD).
Display resolution	640 horizontal by 480 vertical pixels.
Pixel pitch	Pixels are 0.33 mm (horizontal) and 0.22 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. (Supports at least the basic requirements of the PC99 specification.)
Video Output 2	15-pin D-subminiature connector on the rear panel. Used for an auxiliary duplicate primary monitor (VGA).
Parallel port (IEEE 1284)	<p>25-pin D-subminiature connector on the rear panel. Supports the following modes:</p> <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)
Serial port	9-pin D-subminiature serial-port connector using NS16C550 compatible UARTs supporting transfer speeds up to 115.2 kbits/sec.

Table 1-6: Ports (cont.)

Specifications	Characteristics
PS/2 keyboard and mouse interface	PS/2 compatible keyboard and mouse connectors.
LAN interface	RJ-45 LAN connector supporting 10 base-T and 100 base-T
External audio connectors	External audio jacks for MIC IN and LINE OUT
USB interface	One USB connector (the second USB is disabled because of internal use)
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> <p>-0.20 to +0.20 V low level</p> <p>+0.90 to +1.10 V high level</p>
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</p> <p>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:</p> <p>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 re-arm 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
Floppy disk drive capacity	3.5 in floppy disk, 1.44 Mbyte, compatible with DOS 3.3 or later format for storing reference waveforms, image files, and instrument setups.
Hard disk drive capacity	
CSA/TDS8000	≥ 6 Gbytes
CSA/TDS8000B	≥ 20 Gbytes
CSA/TDS8200	≥ 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; Tektronix part number none, BUSSMAN part number GDA ±6.3, LITTLEFUSE part number 21606.3</p>

Table 1-8: Power consumption, fuses, and cooling (cont.)

Specifications	Characteristics
Power requirements	
CSA/TDS8000	Maximum: 600 Watts Fully Loaded Typical: 275 Watts Mainframe alone with no modules: 195 Watts
CSA/TDS8000B	Maximum: 600 Watts Fully Loaded Typical: 240 Watts Mainframe alone with no modules: 160 Watts
CSA/TDS8200	Maximum: 600 Watts Fully Loaded Typical: 275 Watts Mainframe alone with no modules: 150 Watts
	<p>An example of a fully loaded mainframe for these characteristic loads has installed optical modules, electrical modules, and active probes comprised of:</p> <ul style="list-style-type: none"> one 80C11-CR4, one 80A05-10G, three 067-0387-01, one 067-0397-00 <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" (19mm) 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	
CSA/TDS8000	19.73 kg (43.5 lb.) (no keyboard, no mouse, no top pouch, no power cord, and no modules or front shield installed) 22.23 kg (49.0 lb.) (keyboard, mouse, top pouch, power cord, front shield installed, and no modules installed)
CSA/TDS8000B CSA/TDS8200	19.5 kg (43.0 lb.) (no keyboard, no mouse, no top pouch, no power cord, and no modules or front shield installed) 22.0 kg (48.5 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	35.8 kg (79 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 - Environmental

Description	Characteristics
Dynamics	
CSA/TDS8000, CSA/TDS8000B	Random vibration (operating): 0.22 g rms, from 5 to 500 Hz, 10 minutes each axis, (3 axis, 30 minutes total) operating. Random vibration (nonoperating): 2.28 g rms, from 5 to 500 Hz, 10 minutes each axis, (3 axis, 30 minutes total) non-operating.
CSA/TDS8200	Random vibration (operating): 0.141 g rms, from 5 to 200 Hz, 10 minutes each axis, (3 axis, 30 minutes total). Random vibration (nonoperating): 2.28 g rms, from 5 to 500 Hz, 10 minutes each axis, (3 axis, 30 minutes total).

Table 1-10: System - Environmental (cont.)

Description	Characteristics
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: 3,048 m (10,000 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.

Certifications (CSA/TDS8000, CSA/TDS8000B)

NOTE. Certifications apply to all properly installed modules unless noted otherwise.

Table 1-12: Certifications and compliances

Category	Standards or description
EC Declaration of Conformity - EMC	<p>Meets intent of Directive 89/336/EEC for Electromagnetic Compatibility when configured with sampling head modules designed for use with this instrument as identified in this manual. Compliance was demonstrated to the following specifications as listed in the Official Journal of the European Union:</p> <p>EN 61326 EMC Requirements for Electrical Equipment for Measurement, Control and Laboratory use.</p> <p>Class A Radiated and Conducted Emissions</p> <p>IEC 61000-4-2 Performance Criterion B¹</p> <p>IEC 61000-4-3 Performance Criterion A^{1,2}</p> <p>IEC 61000-4-4 Performance Criterion B¹</p> <p>IEC 61000-4-5 Performance Criterion B¹</p> <p>IEC 61000-4-6 Performance Criterion A¹</p> <p>IEC 61000-4-11 Performance Criterion B¹</p> <p>¹ Performance Criteria C for USB keyboard and mouse. Note that operation of the USB keyboard and mouse can be restored by unplugging and then reconnecting the USB connector at the rear panel of the main instrument.</p> <p>² Horizontal timing susceptibility of the optical sampling modules and their internal clock recovery trigger signals usually increase the horizontal timing jitter when external electromagnetic fields are applied. For fields up to 3 V/m, the increase in the horizontal high-frequency RMS jitter is typically less than 3 ps RMS of jitter, added using the square-root-of-the-sum-of-the-squares method. An example follows:</p> <p>If an 80C01-CR operating in clock-recovery trigger mode exhibits 3.5 ps RMS of edge jitter, with no EMC field applied and for an ideal jitterless input, then for applied fields up to 3 V/m the edge jitter, degradation would typically result in a total RMS jitter of:</p> $Jitter \leq \sqrt{3.5ps^2 + 3ps^2} = 4.61ps$ <p>EN 61000-3-2 AC Power Harmonic Current Emissions Radiated emissions may exceed the levels specified in EN 61326 when this instrument is connected to a test object.</p>
Australia/New Zealand Declaration of Conformity - EMC	<p>Complies with EMC Framework per the following standard: AS/NZS 2064.1/2 Class A Radiated and Conducted Emissions</p>
General EMC	<p>To ensure compliance with EMC requirements, only high quality shielded cables having a reliable, continuous outer shield (braid & foil) with full coverage, low impedance connections to shielded connector housings at both ends should be connected to this product.</p>

Table 1-12: Certifications and compliances (cont.)

Category	Standards or description
EC Declaration of Conformity - Low Voltage	Compliance was demonstrated to the following specification as listed in the Official Journal of the European Union: Low Voltage Directive 73/23/EEC, amended by 93/68/EEC EN 61010-1/A2:1995 Safety requirements for electrical equipment for measurement control and laboratory use.
U.S. Nationally Recognized Testing Laboratory Listing, mainframe	UL3111-1 Standard for electrical measuring and test equipment.
Canadian Certification, mainframe	CAN/CSA C22.2 No. 1010.1 Safety requirements for electrical equipment for measurement, control, and laboratory use.
Installation (Overvoltage) Category Description	Terminals on this product may have different installation (overvoltage) category designations. The installation categories are: CAT III Distribution-level mains (usually permanently connected). Equipment at this level is typically in a fixed industrial location. CAT II Local-level mains (wall sockets). Equipment at this level includes appliances, portable tools, and similar products. Equipment is usually cord-connected. CAT I Secondary (signal level) or battery operated circuits of electronic equipment.
Pollution Degree Descriptions	A measure of the contaminates that could occur in the environment around and within a product. Typically the internal environment inside a product is considered to be the same as the external. Products should be used only in the environment for which they are rated. Pollution Degree 2 Normally only dry, nonconductive pollution occurs. Occasionally a temporary conductivity that is caused by condensation must be expected. This location is a typical office/home environment. Temporary condensation occurs only when the product is out of service.
Equipment Type	Test and measuring
Safety Class	Class 1 (as defined in IEC 61010-1, Annex H) - grounded product
Overvoltage Category	Overvoltage Category II (as defined in IEC 61010-1, Annex J)
Pollution Degree	Pollution Degree 2 (as defined in IEC 61010-1). Note: Rated for indoor use only.

Certifications (CSA/TDS8200)

NOTE. Certifications apply to all properly installed modules unless noted otherwise.

Table 1-13: Certifications and compliances

Category	Standards or description																		
EC Declaration of Conformity - EMC	<p>Meets intent of Directive 89/336/EEC for Electromagnetic Compatibility when configured with sampling head modules designed for use with this instrument as identified in this manual. Compliance was demonstrated to the following specifications as listed in the Official Journal of the European Communities:</p> <table> <tr> <td>EN 61326</td> <td>EMC requirements for Class A electrical equipment for measurement, control and laboratory use, Annex D.¹</td> </tr> <tr> <td>IEC 61000-4-2</td> <td>Electrostatic discharge immunity</td> </tr> <tr> <td>IEC 61000-4-3</td> <td>RF electromagnetic field immunity²</td> </tr> <tr> <td>IEC 61000-4-4</td> <td>Electrical fast transient / burst immunity</td> </tr> <tr> <td>IEC 61000-4-5</td> <td>Power line surge immunity</td> </tr> <tr> <td>IEC 61000-4-6</td> <td>Conducted RF immunity</td> </tr> <tr> <td>IEC 61000-4-11</td> <td>Voltage dips and interruptions immunity</td> </tr> </table> <p>¹ Radiated emissions may exceed the levels required by this standard when this equipment is connected to a test object.</p> <p>² Horizontal timing susceptibility of the optical sampling modules and their internal clock recovery trigger signals usually increase the horizontal timing jitter when external electromagnetic fields are applied. For fields up to 3 V/m, the increase in the horizontal high-frequency RMS jitter is typically less than 3 ps RMS of jitter, added using the square-root-of-the-sum-of-the-squares method. An example follows:</p> <p>If an 80C01-CR operating in clock-recovery trigger mode exhibits 3.5 ps RMS of edge jitter, with no EMC field applied and for an ideal jitterless input, then for applied fields up to 3 V/m the edge jitter, degradation would typically result in a total RMS jitter of:</p> $Jitter \leq \sqrt{3.5 ps^2 + 3 ps^2} = 4.61 ps$ <table> <tr> <td>EN 61000-3-2</td> <td>AC Power Harmonic Current Emissions</td> </tr> <tr> <td>EN 61000-3-3</td> <td>Voltage changes, fluctuations, and flicker</td> </tr> </table>	EN 61326	EMC requirements for Class A electrical equipment for measurement, control and laboratory use, Annex D. ¹	IEC 61000-4-2	Electrostatic discharge immunity	IEC 61000-4-3	RF electromagnetic field immunity ²	IEC 61000-4-4	Electrical fast transient / burst immunity	IEC 61000-4-5	Power line surge immunity	IEC 61000-4-6	Conducted RF immunity	IEC 61000-4-11	Voltage dips and interruptions immunity	EN 61000-3-2	AC Power Harmonic Current Emissions	EN 61000-3-3	Voltage changes, fluctuations, and flicker
EN 61326	EMC requirements for Class A electrical equipment for measurement, control and laboratory use, Annex D. ¹																		
IEC 61000-4-2	Electrostatic discharge immunity																		
IEC 61000-4-3	RF electromagnetic field immunity ²																		
IEC 61000-4-4	Electrical fast transient / burst immunity																		
IEC 61000-4-5	Power line surge immunity																		
IEC 61000-4-6	Conducted RF immunity																		
IEC 61000-4-11	Voltage dips and interruptions immunity																		
EN 61000-3-2	AC Power Harmonic Current Emissions																		
EN 61000-3-3	Voltage changes, fluctuations, and flicker																		
Australia / New Zealand Declaration of Conformity - EMC	<p>Complies with EMC provision of Radiocommunications Act per the following standard(s):</p> <table> <tr> <td>AS/NZS 2064.1/2</td> <td>Industrial, Scientific, and Medical Equipment: 1992</td> </tr> </table>	AS/NZS 2064.1/2	Industrial, Scientific, and Medical Equipment: 1992																
AS/NZS 2064.1/2	Industrial, Scientific, and Medical Equipment: 1992																		
EC Declaration of Conformity - Low Voltage	<p>Compliance was demonstrated to the following specification as listed in the Official Journal of the European Communities:</p> <p>Essential requirements of the Low Voltage Directive 73/23/EEC, amended by 93/68/EEC</p>																		

Table 1-13: Certifications and compliances (cont.)

Category	Standards or description
U.S. Nationally Recognized Testing Laboratory Listing, mainframe	UL61010B:2003 Standard for electrical measuring and test equipment.
Canadian Certification, mainframe	CAN/CSA C22.2 No. 1010.1 Safety requirements for electrical equipment for measurement, control, and laboratory use.
Additional Compliance, mainframe	IEC61010-1/A2:1995 Safety requirements for electrical equipment for measurement, control, and laboratory use.
Installation (Overvoltage) Category Description	<p>Terminals on this product may have different installation (overvoltage) category designations. The installation categories are:</p> <p>CAT III Distribution-level mains (usually permanently connected). Equipment at this level is typically in a fixed industrial location.</p> <p>CAT II Local-level mains (wall sockets). Equipment at this level includes appliances, portable tools, and similar products. Equipment is usually cord-connected.</p> <p>CAT I Secondary (signal level) or battery operated circuits of electronic equipment.</p>
Pollution Degree Descriptions	<p>A measure of the contaminants that could occur in the environment around and within a product. Typically the internal environment inside a product is considered to be the same as the external. Products should be used only in the environment for which they are rated.</p> <p>Pollution Degree 2 Normally only dry, nonconductive pollution occurs. Occasionally a temporary conductivity that is caused by condensation must be expected. This location is a typical office/home environment. Temporary condensation occurs only when the product is out of service.</p>
Equipment Type	Test and measuring
Safety Class	Class 1 (as defined in IEC 61010-1, Annex H) - grounded product
Overvoltage Category	Overvoltage Category II (as defined in IEC 61010-1, Annex J)

80E00 Electrical Sampling Modules Specifications

This section contains specifications for the 80E01, 80E02, 80E03, 80E04, and 80E06 Sampling Modules. 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 *Performance Verification* in the service manual.

All specifications apply to all models of sampling module unless noted otherwise. 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

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 1-14: Electrical sampling modules - Descriptions

Sampling module	Description
80E01	1 channel 50 GHz (7 ps risetime) bandwidth, 50 Ω sampling module.
80E02	2 channel 12.5 GHz (28 ps risetime) bandwidth, 50 Ω, low noise sampling module.
80E03	2 channel 20 GHz (17.5 ps risetime) bandwidth, 50 Ω sampling module.
80E04	2 channel 20 GHz (17.5 ps risetime) bandwidth, 50 Ω TDR/sampling module with 35 ps single ended, common mode, and differential TDR capability.
80E06	1 channel 70 GHz (5.0 ps risetime) bandwidth, 50 Ω sampling module.

Table 1-15: 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.	
Channel input connector	<i>Sampling module</i>	<i>Input connector</i>
	80E02, 80E03, 80E04	Precision 3.5 mm female connector.
	80E01	Precision 2.4 mm female connector (2.4 mm male to 2.92 mm (K) female adapter, 015-0703-xx, is supplied).
	80E06	Precision 1.85 mm female connector (V) (2.4 mm male to 2.92 mm (K) female adapter, 015-0703-xx, is supplied).
Number of input channels	<i>Sampling module</i>	<i>Channels</i>
	80E01, 80E06	1
	80E02, 80E03, 80E04:	2
✓ Input impedance	50 Ω \pm 0.5 Ω	
Vertical dynamic range	1 V _{pp} (offset \pm 500 mV)	
Vertical operating range ¹ , maximum	\pm 1.6 V	
Vertical nondestruct range ² (Maximum input voltage)	<i>Sampling module</i>	<i>Maximum input</i>
	80E01, 80E06	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. 10 mV to 1 V full scale	
Compensation temperature range	\pm 5° C about temperature where compensation was performed. If compartment is changed on the mainframe, a sampling module extender is employed, or the length of the sampling module extender is changed, the channel must be recompensated.	
✓ DC voltage accuracy, single point, within \pm 5° C of compensated temperature	\pm 2 mV \pm 0.007 (assigned offset) \pm 0.02 (vertical value - assigned offset)	
✓ DC vertical voltage deviation from linear least squares fit	\pm 10 mV	
✓ Rise time ⁴	<i>Sampling module</i>	<i>Rise time</i>
	80E01	\leq 7 ps, typical
	80E02	\leq 28 ps
	80E03 and 80E04	\leq 17.5 ps
	80E06	\leq 5.0 ps, typical

Table 1-15: Electrical sampling modules - Signal acquisition (cont.)

Specifications	Characteristics	
✓ Analog bandwidth ⁵	<i>Sampling module</i>	<i>Bandwidth</i>
	80A01 Trigger Prescale Preamplifier Module	50 GHz
	80E02	12.5 GHz, typical
	80E03 and 80E04	20 GHz, typical
	80E06	65 GHz 70 GHz, typical
Step response aberrations ⁷ , typical	<i>Sampling module</i>	<i>Aberrations, step transition⁶</i>
	80E02, 80E03 and 80E04	<p>± 3% or less over the zone 10 ns to 20 ps before step transition</p> <p>+10%, -5% or less for the first 300 ps following step transition</p> <p>± 3% or less over the zone 300 ps to 5 ns following step transition</p> <p>± 1% or less over the zone 5 ns to 100 ns following step transition</p> <p>± 0.5% after 100 ns following step transition</p>
	80E01	<p>± 3% or less over the zone 10 ns to 20 ps before step transition</p> <p>+12%, -5% or less for the first 300 ps following step transition</p> <p>+5.5%, -3% or less over the zone 300 ps to 3 ns following step transition</p> <p>± 1% or less over the zone 3 ns to 100 ns following step transition</p> <p>± 0.5% after 100 ns following step transition</p>
Step response overshoot ⁷ , typical	80E06	+ 5% or less for the first 300 ps following step transition
✓ Random noise, displayed	<i>Sampling module</i>	<i>Noise</i>
	80E01	≤ 2.3 mV _{RMS} 1.8 mV _{RMS} , typical
	80E02	≤ 800 mV _{RMS} 400 μV _{RMS} , typical
	80E03 and 80E04	≤ 1.2 mV _{RMS} 600 μV _{RMS} , typical
	80E06	≤ 2.4 mV _{RMS} ≤ 1.8 mV _{RMS} , typical
Offset range ¹	± 1.6 V	

Table 1- 15: Electrical sampling modules - Signal acquisition (cont.)

Specifications	Characteristics
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, <i>Transition Duration of Step Response</i>. The 80E01 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, <i>Analog Bandwidth</i>.
6	IEEE std 1057, section 4.8.4, <i>Overshoot and Precursors</i>. 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-ohm, 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- 16: Electrical sampling module (80E04) - TDR system

Specifications	Characteristics
Number of TDR channels	2, one per channel
TDR polarity and operation mode selections	Positive polarity, negative polarity, and TDR off are independently selectable for each channel.
Maximum input voltage	Do not apply input voltage during TDR operation.
TDR amplitude	250 mV each polarity, typical
✓ TDR system reflected rise time ¹	≤ 35 ps each polarity
TDR system incident rise time	28 ps, typical
TDR step maximum repetition rate	200 kHz
✓ TDR system step response aberrations ²	±3% or less over the zone 10 ns to 20 ps before step transition +10%, -5% or less typical for the first 400 ps following step transition ±3% or less over the zone 400 ps to 5 ns following step transition ±1% or less after 5 ns following step transition

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 1-17: Electrical sampling modules - Timebase system

Specifications	Characteristics
Sampling rate	DC-200 kHz maximum.
Horizontal position range, minimum (deskew adjust range between channels)	≤ 19 ns, no extender cable present, external direct trigger operation.

Table 1-18: 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

Table 1-19: Electrical sampling modules - Mechanical

Specifications	Characteristics
Weight (unpackaged)	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 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

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 listed in unless noted otherwise. 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.
- 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 1-20: Optical modules - Descriptions

Name	Characteristics
80C01	<p>Long wavelength 1100 nm - 1650 nm. Unamplified O/E converter with two user-selectable optical bandwidths: 12.5 GHz, > 20 GHz,</p> <p>or three user-selectable reference receiver responses: 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.</p>
80C02	<p>Long wavelength 1100 nm - 1650 nm. Unamplified O/E converter with three user-selectable optical bandwidths: 12.5 GHz 20 GHz, 30 GHz,</p> <p>or one user-selectable reference receiver response: OC-192/STM-64 for 9.953 Gb/s Sonet/SDH standards.</p>
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: FC1063 for the 1.0625 Gb/s fibre channel standard and GBE for the 1.25 Gb/s gigabit ethernet standard.</p>
80C04	<p>Long wavelength 1100 nm - 1650 nm unamplified. Unamplified O/E converter with two user-selectable optical bandwidths: 20 GHz, 30 GHz,</p> <p>or two user-selectable reference receiver responses: OC-192/STM-64 for 9.953 Gb/s Sonet/SDH standards 10.664 Gb/s ITU-T Recommendation G.975 standard</p>
80C05	<p>Long wavelength 1520 nm - 1580 nm unamplified. Three user-selectable optical bandwidths: 20 GHz 30 GHz 40 GHz,</p> <p>or one reference receiver response: OC-192/STM-64 for 9.953 Gb/s Sonet/SDH standards</p>
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: OC-48/STM-16 OC-3/STM-1 OC-12/STM-4</p>

Table 1-20: 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 five 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 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 1-20: 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 Recommendation G.709 standard</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 with five 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 10GBE FEC 11.0957 10GFC for 10G Fibre Channel 10.51875</p> <p>or two data filters: G.975 FEC 10.66423 Gb/s G.709 FEC 10.709225 Gb/s</p>
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: 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> <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: 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) > 9.5 GHz full bandwidth</p>

Table 1-21: Optical modules - Acquisition

Name	Characteristics
Number of input channels	1 optical
Internal fiber diameter ¹	
80C01, 80C02, 80C04, 80C05, 80C06, 80C09, 80C10, 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
Optical return loss	
80C01, 80C02, 80C04, 80C05, 80C06, 80C09, 80C10, 80C11	> 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, 80C10	20 mW average power; 60 mW power at wavelength with highest relative responsivity.
80C06	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 ¹¹	
80C01, 80C02, 80C04, 80C09	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	0 to 30 mW displayed limits, not including offset.
80C11	5 mW average power; 10mW peak power at wavelength with highest relative responsivity. Optical input powers below non-destruct levels may exceed saturation and compression limits of the particular plug-in.

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

Name	Characteristics
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	1550 nm: 1520 nm to 1580 nm 1310 nm: 1290 nm to 1330 nm
Calibrated wavelengths	
80C01, 80C02, 80C04, 80C09, 80C10, 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 1-21: 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 <p>ELECTRICAL SIGNAL OUT front panel connection (80C12)</p>	
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	65 GHz 1550 nm	\pm [25 μ W + 0.04 \times vertical offset]
	65 GHz 1310 nm	\pm [35 μ W + 0.04 \times vertical offset]
80C11	OC-192, 10.71 Gb/s, 10.71 Gb/s, 10GBASE-W, 10GBASE-R, 10GBE FEC, 10GFC	< 10 μ W \pm 2% (vertical offset)
	20 GHz, 30 GHz	< 10 μ W \pm 4% (vertical offset)

Table 1-21: 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	3 mW per division	30 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	\pm 15 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 1-21: 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 Gb/s, OC-768/STM-256, 43 Gb/s (G.709), FEC43.02 Gb/s	$\pm 25 \mu\text{W} \pm 6\%$ of [(vertical value) - (vertical offset)]
	65 GHz setting	$\pm 25 \mu\text{W} \pm 8\%$ of [(vertical value) - (vertical offset)]

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

Name	Characteristics	
80C11	OC-192, 10.66Gb/s, 10.71Gb/s, 10Gbase-W, 10Gbase-R, 10GBE FEC, 10GFC	$\pm 25 \text{ uW} \pm 2\%$ 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]
80C05	OC-192/STM-64	$\pm 2\%$ of [difference reading]
	20 GHz	$\pm 4\%$ of [difference reading]
	30 GHz	$\pm 6\%$ of [difference reading]
	40 GHz	$\pm 8\%$ of [difference reading]
80C06, 80C08, 80C08B, 80C08C, 80C12	All settings	$\pm 2\%$ of [difference reading]
80C09	10.71 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]]
80C10	30 GHz	$\pm 4\%$ of [difference reading]
	39 Gb/s, OC-768/STM-256, 43 Gb/s, FEC43.02	$\pm 6\%$ of [difference reading]
	65 GHz	$\pm 8\%$ of [difference reading]
80C11	OC-192, 10.66 Gb/s, 10.71 Gb/s, 10Gbase-W, 10Gbase-R, 10GBE FEC, 10GFC	$\pm 2\%$ of [difference reading]
	20 GHz	$\pm 4\%$ of [difference reading]
	30 GHz	$\pm 6\%$ of [difference reading]

Table 1-21: 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	> 65 GHz
80C11, 80C11-CR	20 GHz	> 20 GHz
	30 GHz	> 28 GHz > 30 GHz (typical)
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)

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

Name	Characteristics	
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 1-21: Optical modules - Acquisition (cont.)

Name	Characteristics	
80C11	30 GHz	< 16 ps
	20 GHz	< 25 ps
	OC-192, 10Gbase-W, 10Gbase-R, 10GBE FEC, 10GFC	47 ps ± 10 ps
	10.66 Gb/s, 10.71 Gb/s	44 ps ± 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 ± 35 ps
	GBE	373 ps ± 30 ps
	OC-48/STM-16	187 ps ± 15 ps
80C07	OC-3	3.0 ns ± 170 ps
	OC-12	750 ps ± 50 ps
	OC-48	187 ps ± 15 ps
80C07B	OC-3	3.0 ns ± 170 ps
	OC-12	750 ps ± 50 ps
	ENET1250	373 ps ± 30 ps
	FC1063	440 ps ± 35 ps
	FC2125	220 ps ± 18 ps
	OC-48, ENET2500, INFINIBAND, 2.5 GHz	187 ps ± 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 ± 10 ps
80C08B	10 GHz	< 50 ps
	10GBASE-W, 10GBASE-R, OC-192/STM-64, 10GFC	47 ps ± 10 ps

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

Name	Characteristics	
80C08C	10 GHz	< 50 ps
	10GBASE-W, 10GBASE-R, OC-192/STM-64, 10GFC, 10GBE FEC	47 ps \pm 10 ps
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	47 ps \pm 10 ps
10.66 Gb/s, 10.71 Gb/s	44 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}

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

Name	Characteristics	
80C04	OC-192/STM-64, 10.66 Gb/s	< 10%
	20 GHz	< 20%
	30 GHz	< 30%
80C07, 80C07B	All settings	< 5% (typical)
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	< 10%
	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)

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

Name	Characteristics	
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)
✓ 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)
80C03, 80C03-CR	FC1063, GBE	< 1 μW _{rms} (maximum) < 0.75 μW _{rms} (typical)
	OC-48/STM-16	< 1.5 μW _{rms} (maximum) < 1 μW _{rms} (typical)

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

Name	Characteristics	
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 1-21: 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 1-21: 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		< 8 μW_{rms} (maximum) < 5.5 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-CR4	OC-192, 10.66Gb/s, 10.71Gb/s, 10Gbase-W, 10Gbase-R, 10GBE FEC, 10GFC		< 9 μW_{rms} (maximum) < 6 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 10GBase-X4 10GFC-X4 3.318 Gb/s	1310 nm, 1550 nm	< 3.0 μW_{rms} (maximum) < 1.7 μW_{rms} (typical)
		850 nm	< 4.8 μW_{rms} (maximum) < 2.7 μW_{rms} (typical)
	9 GHz	1310 nm, 1550 nm	< 6.0 μW_{rms} (maximum) < 3.4 μW_{rms} (typical)
		850 nm	< 9.6 μW_{rms} (maximum) < 5.4 μW_{rms} (typical)
	All settings option 10G	1310 nm, 1550 nm	< 6.0 μW_{rms} (maximum) < 3.4 μW_{rms} (typical)
		850 nm	< 9.6 μW_{rms} (maximum) < 5.4 μW_{rms} (typical)

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

Name	Characteristics			
✓ OC-3/STM-1 155 Mb/s Reference Receiver setting frequency response ⁷	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.			
	The OC-3/STM-1 nominal scalar frequency response matches the ITU 155.52 Reference Receiver Nominal curve with the following tolerance:			
	(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	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.			
	The OC-12/STM-4 nominal scalar frequency response matches the ITU 622.08 Reference Receiver Nominal curve with the following tolerance:			
	(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 1-21: 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 1-21: 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 recently 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 are used to establish system interoperability and test conformance of optical interfaces to draft ITU-T Recommendation G.691 which is scheduled to be completed in April 2000 (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 for margin testing and tolerance at various frequencies; based on ± 1.00 DC to $0.75 \times (\text{data rate})$ and $\pm 5.0\text{dB}$ 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	0.50
	5.97	-1.10	-0.10	0.40
	11.94	-1.45	-0.45	0.05
	17.92	-2.02	-1.02	-0.52
	23.89	-2.86	-1.86	-1.36
	29.86	-4.00	-3.00	-2.50
	35.83	-5.96	-4.51	-3.33
	39.81	-7.42	-5.71	-4.15
	41.80	-8.20	-6.37	-4.62
	44.79	-9.42	-7.42	-5.42
	47.78	-11.22	-8.54	-5.87
	53.75	-14.83	-10.93	-7.03
	59.72	-18.41	-13.41	-8.41

Table 1-21: 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>			
✓ 10GBASE-R Reference Receiver setting frequency response ⁷				
✓ 10GBE FEC Reference Receiver setting frequency response ⁷				
✓ 10GFC Reference Receiver setting frequency response ⁷				
✓ 10.66 Data Filter setting frequency response ⁷				
✓ 10.709 Data Filter setting frequency response ⁷				
✓ 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>			
	<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
	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

Table 1-21: 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>			
	<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
✓ 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>			
	<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 1-21: 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> Frequency	Lower	<i>(dB)</i> Nominal	Upper
	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
✓ 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> Frequency	Lower	<i>(dB)</i> Nominal	Upper
	0	-1.00	0	0.50
	6.45	-1.10	-0.10	0.40
	12.90	-1.45	-0.45	0.05
	19.36	-2.02	-1.02	-0.52
	25.81	-2.86	-1.86	-1.36
	32.26	-4.00	-3.00	-2.50
	38.71	-5.96	-4.51	-3.33
	43.02	-7.42	-5.71	-4.15
	45.17	-8.20	-6.37	-4.62
	48.40	-9.42	-7.42	-5.42
	51.63	-11.22	-8.54	-5.87
	58.08	-14.83	-10.93	-7.03
	64.53	-18.41	-13.41	-8.41

Table 1-21: 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 1-21: 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 1-21: 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 1-21: 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> <table border="1"> <thead> <tr> <th>(MHz) Frequency</th> <th>Lower</th> <th>(dB) Nominal</th> <th>Upper</th> </tr> </thead> <tbody> <tr><td>0.000</td><td>-0.50</td><td>0.00</td><td>0.50</td></tr> <tr><td>497.7</td><td>-0.61</td><td>-0.11</td><td>0.39</td></tr> <tr><td>995.3</td><td>-0.95</td><td>-0.45</td><td>0.05</td></tr> <tr><td>1493</td><td>-1.52</td><td>-1.02</td><td>-0.52</td></tr> <tr><td>1991</td><td>-2.36</td><td>-1.86</td><td>-1.36</td></tr> <tr><td>2488</td><td>-3.50</td><td>-3.00</td><td>-2.50</td></tr> <tr><td>2986</td><td>-5.67</td><td>-4.51</td><td>-3.35</td></tr> <tr><td>3318</td><td>-7.25</td><td>-5.71</td><td>-4.17</td></tr> <tr><td>3484</td><td>-8.08</td><td>-6.37</td><td>-4.65</td></tr> <tr><td>3981</td><td>-10.74</td><td>-8.54</td><td>-6.35</td></tr> <tr><td>4479</td><td>-13.55</td><td>-10.93</td><td>-8.31</td></tr> <tr><td>4977</td><td>-16.41</td><td>-13.41</td><td>-10.41</td></tr> </tbody> </table>	(MHz) Frequency	Lower	(dB) Nominal	Upper	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
(MHz) Frequency	Lower	(dB) Nominal	Upper																																																		
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 $\pm 5^\circ\text{C}$ 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 $+20^\circ\text{C}$ and $+30^\circ\text{C}$. Nominal freq response is specified for optical input signals of modulation magnitude such that 2mW_{pp} ($200\text{ uW}_{\text{pp}}$ for 80C03 and 80C07; $500\text{ uW}_{\text{pp}}$ for 80C08) or less signal is applied at the sampler input.
- ⁸ The optical channel noise with no optical noise 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 1-22: 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	+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 ± 20 nm (typical): 780 nm (80C07B, 80C08C) 850 nm (80C07B, 80C08C, 80C12) 1310 nm and 1550 nm (80C01, 80C02, 80C07B, 80C08C, 80C10, 80C11, 80C12)

Table 1-23: Optical modules - Clock recovery options (CR, CR1, CR2, CR3, and CR4)

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

Table 1-23: Optical modules - Clock recovery options (CR, CR1, CR2, CR3, and CR4) (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 1-23: Optical modules - Clock recovery options (CR, CR1, CR2, CR3, and CR4) (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)
80C12	Clock recovery provided with the use of the 80A05 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 1-23: Optical modules - Clock recovery options (CR, CR1, CR2, CR3, and CR4) (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	<table border="1"> <tr> <td colspan="2">1550 nm, 1310 nm Bit Rate: 9.8 Gb/s to 11.25 Gb/s</td> </tr> <tr> <td>$(AOP @ ER \geq 8.2 \text{ dB})^7$</td> <td>$(OMA)^8$</td> </tr> <tr> <td>-15 dBm typical -13 dBm warranted⁶</td> <td>-12.3 dBm typical -11.3 dBm warranted⁶</td> </tr> <tr> <td colspan="2">1550 nm, 1310 nm Bit Rate: 11.25 Gb/s to 12.6 Gb/s</td> </tr> <tr> <td>$(AOP @ ER \geq 8.2 \text{ dB})^7$</td> <td>$(OMA)^8$</td> </tr> <tr> <td>-12.5 dBm typical -11.5 dBm warranted⁶</td> <td>-10.8 dBm typical -9.8 dBm warranted⁶</td> </tr> <tr> <td colspan="2">850 nm, 780 nm Bit Rate: 9.8 Gb/s to 11.25 Gb/s</td> </tr> <tr> <td>$(AOP @ ER \geq 8.2 \text{ dB})^7$</td> <td>$(OMA)^8$</td> </tr> <tr> <td>-12 dBm typical -10 dBm warranted⁶</td> <td>-9.3 dBm typical -8.3 dBm warranted⁶</td> </tr> <tr> <td colspan="2">850 nm, 780 nm Bit Rate: 11.25 Gb/s to 12.6 Gb/s</td> </tr> <tr> <td>$(AOP @ ER \geq 8.2 \text{ dB})^7$</td> <td>$(OMA)^8$</td> </tr> <tr> <td>-9.5 dBm typical -8.5 dBm warranted⁶</td> <td>-7.8 dBm typical -6.8 dBm warranted⁶</td> </tr> </table>	1550 nm, 1310 nm Bit Rate: 9.8 Gb/s to 11.25 Gb/s		$(AOP @ ER \geq 8.2 \text{ dB})^7$	$(OMA)^8$	-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		$(AOP @ ER \geq 8.2 \text{ dB})^7$	$(OMA)^8$	-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		$(AOP @ ER \geq 8.2 \text{ dB})^7$	$(OMA)^8$	-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		$(AOP @ ER \geq 8.2 \text{ dB})^7$	$(OMA)^8$	-9.5 dBm typical -8.5 dBm warranted ⁶	-7.8 dBm typical -6.8 dBm warranted ⁶
1550 nm, 1310 nm Bit Rate: 9.8 Gb/s to 11.25 Gb/s																										
$(AOP @ ER \geq 8.2 \text{ dB})^7$	$(OMA)^8$																									
-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																										
$(AOP @ ER \geq 8.2 \text{ dB})^7$	$(OMA)^8$																									
-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																										
$(AOP @ ER \geq 8.2 \text{ dB})^7$	$(OMA)^8$																									
-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																										
$(AOP @ ER \geq 8.2 \text{ dB})^7$	$(OMA)^8$																									
-9.5 dBm typical -8.5 dBm warranted ⁶	-7.8 dBm typical -6.8 dBm warranted ⁶																									
80C09	+7 dBm (5.0 mW), typical	-10.0 dBm (100 μ W), typical -7.5 dBm, warranted																								
80C11-CR1/-CR2/-CR3	+7 dBm (5.0 mW), typical	-10.0 dBm (100 μ W), typical -7.5 dBm, warranted ⁶																								
80C11-CR4	+7 dBm (5.0 mW), typical	<table border="1"> <tr> <td colspan="2">Bit Rate: 9.8 Gb/s to 11.25 Gb/s</td> </tr> <tr> <td>$(AOP @ ER \geq 8.2 \text{ dB})^7$</td> <td>$(OMA)^8$</td> </tr> <tr> <td>-12 dBm typical -9 dBm warranted⁶</td> <td>-10.3 dBm typical -7.3 dBm warranted⁶</td> </tr> <tr> <td colspan="2">Bit Rate: 11.25 Gb/s to 12.6 Gb/s</td> </tr> <tr> <td>$(AOP @ ER \geq 8.2 \text{ dB})^7$</td> <td>$(OMA)^8$</td> </tr> <tr> <td>-10.5 dBm typical -7.5 dBm warranted⁶</td> <td>-8.8 dBm typical -5.8 dBm warranted⁶</td> </tr> </table>	Bit Rate: 9.8 Gb/s to 11.25 Gb/s		$(AOP @ ER \geq 8.2 \text{ dB})^7$	$(OMA)^8$	-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		$(AOP @ ER \geq 8.2 \text{ dB})^7$	$(OMA)^8$	-10.5 dBm typical -7.5 dBm warranted ⁶	-8.8 dBm typical -5.8 dBm warranted ⁶												
Bit Rate: 9.8 Gb/s to 11.25 Gb/s																										
$(AOP @ ER \geq 8.2 \text{ dB})^7$	$(OMA)^8$																									
-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																										
$(AOP @ ER \geq 8.2 \text{ dB})^7$	$(OMA)^8$																									
-10.5 dBm typical -7.5 dBm warranted ⁶	-8.8 dBm typical -5.8 dBm warranted ⁶																									

Table 1-23: Optical modules - Clock recovery options (CR, CR1, CR2, CR3, and CR4) (cont.)

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

Table 1-23: Optical modules - Clock recovery options (CR, CR1, CR2, CR3, and CR4) (cont.)

Name	Characteristics	
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
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)
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

Table 1-23: Optical modules - Clock recovery options (CR, CR1, CR2, CR3, and CR4) (cont.)

Name	Characteristics	
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	Serial CLOCK output	< 30 ps
80C08B	1/16th CLOCK output	< 300 ps
80C08C		
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 Bandwidth⁵		
80C04-CR2	8 MHz maximum 5 MHz minimum 7 MHz typical	
80C09-CR1		
80C11-CR1		
80C11-CR2		
80C11-CR3		
80C08B-CR1, 80C08B-CR2	4 MHz maximum 2 MHz minimum	
80C08C-CR1, 80C08C-CR2		
80C08C-CR4	4 MHz maximum 1 MHz minimum 2 MHz typical	
80C11-CR4	4 MHz maximum 1 MHz minimum 2 MHz typical	
✓ Recovered clock timing jitter ^{3, 4}		

Table 1-23: Optical modules - Clock recovery options (CR, CR1, CR2, CR3, and CR4) (cont.)

Name	Characteristics	
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 1-24: 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)
80C07B	0.95 kg (2.10 lbs) 1.36 kg (3.0 lbs) (with clock recovery)
80C08	0.95 kg (2.10 lbs)

Table 1-24: Optical modules - Mechanical (cont.)

Name	Characteristics
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	0.95 kg (2.10 lbs)
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)

Table 1-25: 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
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	3,048 m (10,000 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 1-26: 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 1-27: 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 1-28: 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 1-29: Electrical

Characteristic	Specification
Applicable mainframes	TDS8000, CSA8000, TDS8000B, CSA8000B, TDS8200, CSA8200, 11800, and CSA803 instruments
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 1-30: Environmental and Mechanical

Characteristic	Specification
Weight	0.4 kg (0.6 lbs)
Dimensions	
Height	25 mm (1.0 in)
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	3,048 m (10,000 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 1-31: 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 10GHz Data in+, data in-, data out+, data out-: 10dB or better 10GHz to 20GHz
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 1-31: 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 1-31: 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 1-32: 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 1-33: 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 1-34: Electromagnetic specifications

Specification	Characteristic
Emissions	The instrument meets or exceeds the EMC requirements of the following standards: Emissions European Community Requirements (including EN 61326) EN55011 Class A Radiated Emissions EN55011 Class A Conducted Emissions IEC 1000-3-2 Power Harmonic Current Emissions
Susceptibility	The instrument meets or exceeds the EMC requirements of the following standards: EN61326-1 European Community Requirements IEC 1000-4-2 Electrostatic Discharge Immunity 4 kV contact discharge 8 kV air discharge Performance criteria B



Operating Information

Installation

This section covers installation of the instrument, addressing the following topics:

- *Check the Environment Requirements* on page 2-1
- *Install the Sampling Modules* on page 2-2
- *Connect the Peripherals* on page 2-3
- *Power On the Instrument* on page 2-5
- *Powering Off the Instrument* on page 2-6

The basic operating software is already installed on the hard disk. If reinstallation of software becomes needed, see the following topic:

- *Software Installation* on page 2-7

Check the Environmental Requirements

Read this section before attempting any installation procedures. This section describes site considerations, power requirements, and ground connections for your instrument.

Site Considerations

The instrument is designed to operate on a bench or on a cart in the normal position (on the bottom feet). For proper cooling, at least two inches (5.1 cm) of clearance is recommended on the sides of the instrument.

You can also operate the instrument while it rests on its rear feet. Make sure that you properly route any cables coming out of the rear of the instrument to avoid damaging them.



CAUTION. *Keep the bottom of the instrument clear of obstructions to ensure proper cooling.*

Operating Requirements

Specifications in chapter 1 list the operating requirements for the instrument. Power source and temperature, humidity, and altitude are listed.

Rackmount Requirements

If this instrument is rackmounted, see the *TDS8000 & CSA8000 Rackmount Instructions* for additional site considerations or operating requirements. This document ships with the Option 1R (rackmount kit).

Install the Sampling Modules



CAUTION. Do not install or remove any sampling modules while the instrument is powered on.

Always power the instrument down before attempting to remove or insert any sampling module.



WARNING. Sampling modules are inherently vulnerable to static damage. Always observe static-safe procedures and cautions as outlined in your sampling module user manual.

Check Your Sampling Module Manual(s)

Read the sampling-module user manual for instructions on how to install your sampling modules.

NOTE. After first installing a sampling module(s) or after moving a sampling module from one compartment to another, you should run compensation from the Utilities menu to ensure the instrument meets its accuracy specifications. You must run a compensation (accessed from the Utilities menu) whenever the extender configuration is changed from that present at the last compensation. In short, if you install or remove an 80E00 extender, run a compensation. If you exchange a extender for one of a different length, run a compensation. For instructions on running a compensation, see Perform the Compensation on page 4-5.

Figure 2-1 shows compartments for both large and small sampling modules, along with the plug-in connector for the ESD wrist strap that you must use to install and remove these modules.

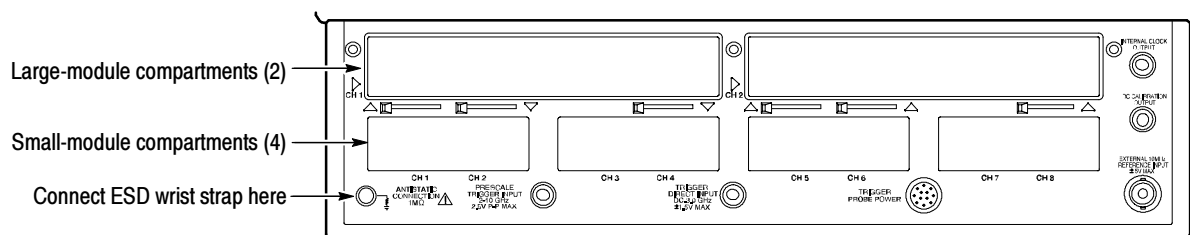


Figure 2-1: Compartments for sampling modules

Maximum Configuration

You can install up to two large sampling modules and four small modules for a maximum of 10 inputs. Of these 10 inputs, only eight inputs can be active at one time. Also, note that installing a large module may disable a small-module compartment. Refer to the user manual for compartment interaction for the various CSA and TDS 8000 Series mainframes.

Install probes, cables, and other connection accessories to your sampling modules as appropriate for your application and sampling module. Again, consult your sampling-module and connection-accessory manuals. Continue with the next section after installing the sampling modules.

Connect the Peripherals

The peripheral connections are mostly the same as those you would make on a personal computer. The connection points are shown in Figure 2-2. See Table 2-1 on page 2-3 for additional connection information.



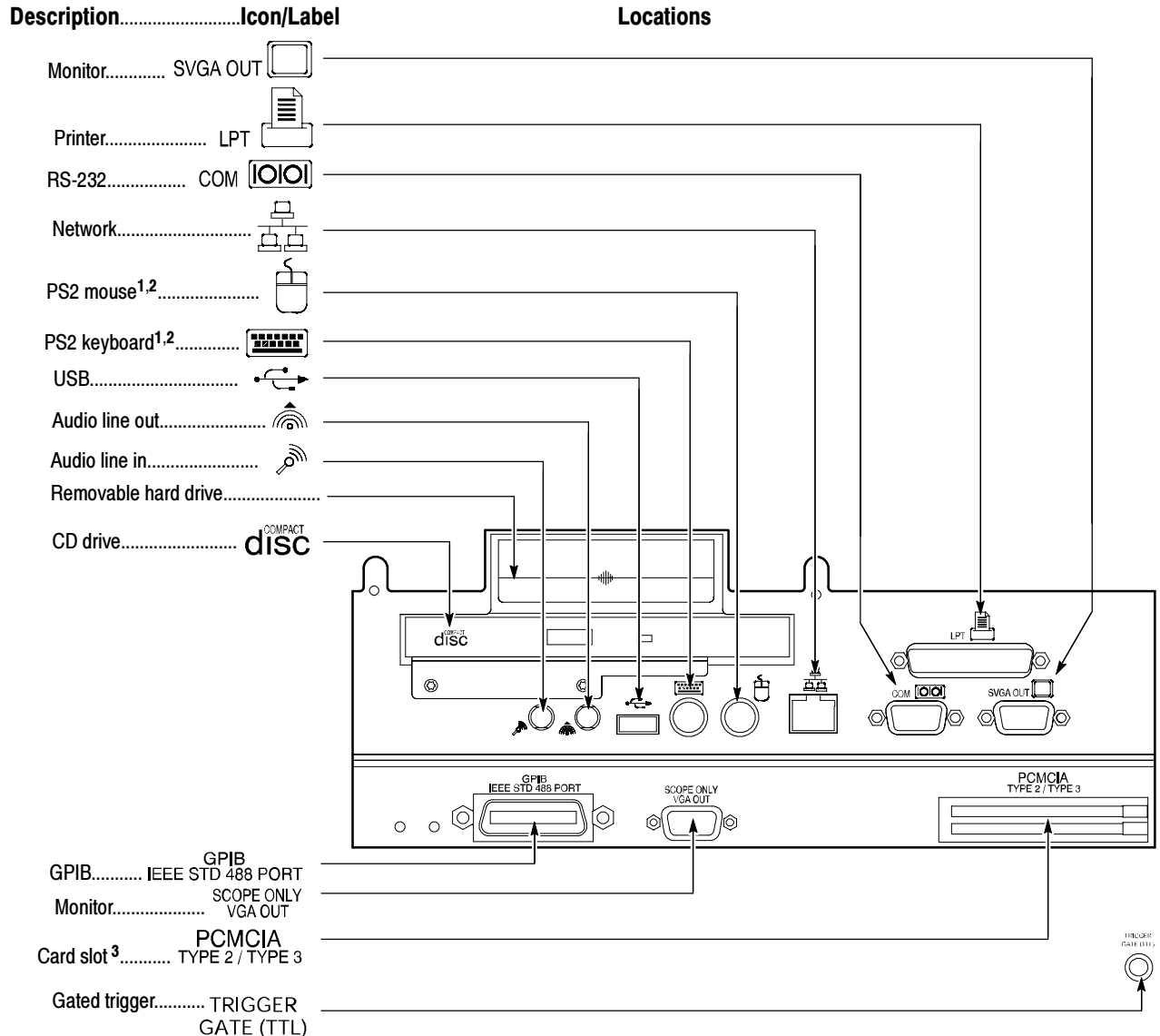
WARNING. Before installing peripheral accessories to connectors (mouse, keyboard, etc.), power down the instrument. See Powering Off the Instrument on page 2-6.

Table 2-1: Additional accessory connection information

Item	Description
Monitor	If you use a non-standard monitor, you may need to change the Windows display settings to achieve the proper resolution for your monitor.
Printer	Connect the printer to the EPP (enhanced parallel port) connector directly. If your printer has a DB-25 connector, use the adapter cable that came with your printer to connect to the EPP connector.
Rackmount	Refer to the <i>CSA8000 & TDS8000 Rackmount Installation Instructions</i> for information on installing the rackmount kit.

Table 2-1: Additional accessory connection information (cont.)

Item	Description
Other	Refer to the Application release notes (readme.txt) in the C:\Program Files\TDSCSA8000\System directory of the instrument for possible additional accessory installation information not covered in this manual.



¹ Product ships with a USB keyboard, that plugs into the USB port, and a USB mouse that plugs into the back of the keyboard

² Some instruments ship with the keyboard and mouse ports reversed.

³ Card slot not available on CSA/TDS8000B or CSA/TDS8200 instruments.

Figure 2-2: Locations of peripheral connectors on rear panel

Power On the Instrument

Follow these steps to power on the instrument for the first time.

1. Check that the line fuses are correct for your application. Both fuses must be the same rating and type. Fuse types require a unique cap and fuseholder. See Table 2-2 and Figure 2-3.

Table 2-2: Line fuses

Fuse type	Rating	Fuse part number	Cap & fuseholder part number
0.25 x 1.250 inch	8 A, fast blow, 250 V	159-0046-00	200-2264-00
5 x 20 mm	6.3 A, fast blow, 250 V	159-0381-00	200-2265-00

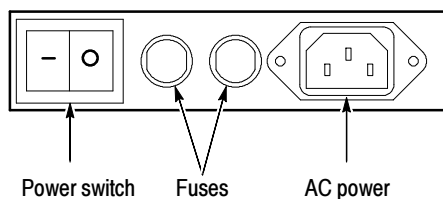


Figure 2-3: Line fuse and power cord connector locations, rear panel



CAUTION. Connect accessories (such as a PS2 keyboard and mouse, and other accessories) before applying power to the product. Some accessories can be damaged if connecting or disconnecting with the instrument power on.

USB devices can be plugged or unplugged without first turning power off.

2. Connect the keyboard and mouse, observing the caution above.

NOTE. Connection of the keyboard and mouse is optional. You can operate most features without them, using the front-panel controls and the touchscreen.

3. Connect the power cord.
4. Turn the Power switch on at the rear panel. (See Figure 2-3 on page 2-5 for switch location.)
5. Push the On/Standby switch to power on the instrument (see Figure 2-4 for the switch location).

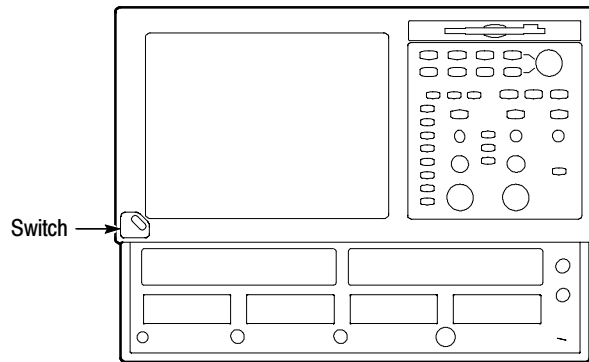


Figure 2- 4: On/Standby switch location

6. Wait for the boot routine and low-level self test to complete.
7. Follow any instructions on the screen.

The internal setup software will automatically configure your instrument and install all required devices, depending on the installed accessories.

Powering Off the Instrument

The instrument has a built-in soft power-down function that safely powers down the instrument when you push the On/Standby button. You do not need to close the UI application or Windows before using the On/Standby button.

To completely remove power to the instrument, first soft power-down the instrument using the On/Standby button, and then set the power switch on the rear panel to off.

You can restore the UI application to the screen by clicking its button in the Windows Task bar.

Software Installation

This section describes how to install the system software found on the 8000 Series OS Restore CDs that accompany this product. The instrument ships with the product software installed, *so only perform these procedures if reinstallation becomes necessary.*

Description

The product software comprises two parts:

- **Microsoft Windows.** The Microsoft Windows operating system comes preinstalled on the instrument. Microsoft Windows is the operating system on which the user-interface application of this product runs. The CDROM(s) included with your instrument contain the Windows operating system which can be used to rebuild the instrument hard drive.

If you need to reinstall Windows, you may be able to do so without rebuilding the instrument hard drive. See *Operating System Reinstallation* on page 2-7 for more information.

- **User Interface (UI) Application.** The UI application complements the hardware controls of the front panel, allowing complete set up of all instrument features. The CDROM(s) included with your instrument contain the UI application for reinstallation if rebuilding the hard drive.

Tektronix provides updates to the user interface application on a regular basis. Updates can be obtained by visiting the Tektronix Web site at www.tektronix.com.

Software Release Notes

Read the software release notes in the Release Notes file (or Readme file for earlier versions), if present, on the CDROM containing the user interface application before performing any installation procedures. This file contains additional installation and operation information that supercedes other product documentation.

After installation, you can also read the copy from a directory on the product:

C:\Programs Files\TDSCSA8000\System

Operating System Reinstallation

If reinstalling Microsoft Windows becomes necessary, use the Windows Operating System restore CD(s) that came with your instrument. Follow the installation procedures provided with the CD(s). The procedures vary between instruments and the version of Microsoft Windows being installed.

NOTE. *Only do the reinstall if the Microsoft Windows operating system is missing or corrupted.*

System Hard Drive Rebuild

If you cannot reboot from the instrument hard drive, you must rebuild the instrument hard drive. This process will return the hard disk to the its original condition present when the instrument shipped.

Data and programs you may have installed will be lost when rebuilding the hard drive.

If you must rebuild the system hard drive, use the System Rebuild CD(s) that shipped with the instrument. Follow the instructions in the booklet found in the CD case.

System Diagnostics

In case of instrument problems, you may wish to run the system diagnostics. If so, see the procedure *Perform the Diagnostics*, on page 4-3.

Windows Safe Mode

If the instrument is turned off before the operating system boots, or if you've installed a third-party product with a driver incompatible with instrument start up, Windows will open in Safe mode. The touchscreen will be inoperable; therefore, you must install the standard-accessory mouse and keyboard to operate the instrument.

When you have finished investigating and removed any barrier to Windows start-up, you can reboot. If the instrument no longer boots to Safe mode, you can remove the keyboard and mouse if desired.



Theory of Operation

Theory of Operation

This chapter describes the electrical operation of the instrument and sampling modules. The diagrams in Chapter 9 show the interconnections of the major circuit blocks.

Logic Conventions

The instrument contains many digital logic circuits. This manual refers to these circuits with standard logic symbols and terms. Unless otherwise stated, all logic functions are described using the positive-logic convention: the more positive of the two logic levels is the high (1) state, and the more negative level is the low (0) state. Signal states may also be described as “true” meaning their active state or “false” meaning their nonactive state. The specific voltages that constitute a high or low state vary among the electronic devices.

Mainframe Overview

This mainframe overview describes the basic operation of each functional circuit block as shown in Figure 7-1 on page 7-2.

General

The instrument control system is a dual Wintel/PowerPC based processor board. The platform features VGA resolution flat-panel display, transparent touch screen and user front-panel with direct access to commonly used scope functions. The instrument is also equipped with a mouse pointing device to facilitate access to more advanced scope functions

Input Signal Path

A signal enters the instrument through a direct coaxial connection to the input connector on a sampling module, or a real time probe connected to the sampling module channel.

Acquisition System. The acquisition system conditions the input signals, samples them, converts them to digital signals, and controls the acquisition process under direction of the processor system. The acquisition system includes the multi-source trigger, acquisition timebase, and acquisition mode generation and control circuitry. The acquisition board is located in the bottom compartment of the instrument and can accommodate four dual-channel sampling Plug-ins, two one-channel optical plug-ins and a trigger/holdoff subsystem. Up to 8 vertical channels are accommodated simultaneously. Channels 1 and 2 are either large or small slots. The presence of an module in one or both large slots displaces the small slot functionality in the leftmost Channel 1 - Channel 2 small slot. The

external trigger and all small slot channels feature a Tekprobe Level 2 probe power connector for additional front end signal conditioning functions like high input-impedance real-time probes.

Processor System. The processor system contains a dual Wintel/PowerPC. The basic instrument configuration supports up to eight channels labeled Ch1 through Ch 8, provides two external trigger inputs for direct and prescaled triggering through built-in prescaler and is able to support two optional internal trigger sources associated with the large slot channels mapped onto electrical channels 1 and 2.

Display Panel Color LCD display Active-matrix touch panel.

Display System. The display system sends the text and waveform information to the display panel.

Touch Panel. The Display board sends information to the processor. Any changes in their settings are reported to the processor system.

Front Panel The front panel board reads the front-panel switches and knob sensors. Any changes in their settings are reported to the processor system. The front panel board also turns the LEDs on and off and generates the bell signal.

Front-panel menu switches are also read by the PPC processor board. The processor sends any changes in menu selections to the processor system. The ON/STBY switch is one of the menu switches. However, it is not read by the front panel board, but passes through the front panel board to the low voltage power supply.

Rear Panel The hard drive and CD Rom provides access to stored waveform data and to load software to customized your instrument with your measurement needs. The GPIB allows for external control of the instrument.

You can make hardcopies on the GPIB and RS-232 ports. Other ports from the front panel board: PC cardbus x 2 and cal adjust lock.

Outputs from the NLX board: SVGA, USB (1), sound, serial, parallel, Ethernet, mouse, keyboard.

Low Voltage Power Supply The low voltage power supply is a switching power converter with active power factor control. It supplies power to all of the circuitry in the instrument.

The principal POWER switch, located on the rear panel, controls all power to the instrument including the Low Voltage Power Supply. The ON/STBY switch,

located on the front panel, also controls all of the power to the instrument except for part of the circuitry in the Low Voltage Power Supply.

The power supply sends a power fail (~PF) warning to the processor system if the power is going down.

Fans The fan assembly provides forced air cooling for the instrument. The fans are controlled by the PPC processor.

Electrical Sampling Modules Overview

The 80E01 and 80E06 are one-channel sampling modules, 50 GHz and 70 GHz, respectively; the 80E02, 80E03, and 80E04 are two-channel modules, 12.5 GHz, 20 GHz, and 20 GHz samplers, respectively. The 80E01 module has a 7 ps rise time, the 80E02 has a 28 ps rise time, the 80E03 and 80E04 modules have a 17.5 ps rise time, and the 80E06 has a 5.0 ps rise time.

For the 80E02 and 80E03, a single strobe delivered from the instrument mainframe to both acquisition channels controls the timing of the strobe assertion to both channels. If channel-to-channel deskew is zero, the sampling coincidence between channels is very close. Acquisition deskew function is carried out by making separate acquisitions over individual acquisition windows.

For the 80E01 and 80E06, an individual strobe delivered from the instrument mainframe to the acquisition channel controls the timing of the strobe assertion to the channel. Acquisition deskew function is carried out by moving the strobe timing for the channel to a unique acquisition window.

Each electrical channel features a Tekprobe Level 2 probe power connector for attachment of a real time probe. The control of this probe is a mainframe function.

All module calibration signals are derived from a 2.5 V precision voltage reference internal to the sampling module. Settings derived from this reference are stored in a non-volatile EEPROM in the sampling module, although the responsibility for the execution of these settings is with the mainframe.

For major functional circuit blocks refer to Figure 7-2 on page 7-3.

80E04 Electrical TDR/Sampling Module

The 80E04 TDR/Sampling module is a two-channel, low noise, 17.5 ps rise time sampler. Each channel is also capable of generating its own Time Domain Reflectometry (TDR) step. The 80E04 sampling module risetime is 17.5 ps.

For the 80E04 a single strobe delivered from the instrument mainframe to both acquisition channels controls the timing of the strobe assertion to both channels. If channel-to-channel deskew is zero, the sampling coincidence between channels is very close. Acquisition deskew function is carried out by making separate acquisitions over acquisition windows.

Each electrical channel features a Tekprobe Level 2 probe power connector for attachment of a real time probe. The control of this probe is a mainframe function.

All module calibration signals are derived from a 2.5 V precision voltage reference internal to the sampling module. Settings derived from this reference are stored in a non-volatile EEPROM in the sampling module, although the responsibility for the execution of these settings is with the mainframe.

When used in the acquisition mode (that is, with the TDR step generator turned off) each channel functions as a normal sampling input. Both channels are strobed simultaneously from a single strobe generator contained within the sampling module, so time coincidence between the two channels is stable.

In the TDR mode, a fast rise time step is generated internally for each channel and applied to the input signal path for that channel. The acquisition portion of the TDR/sampling module remains functional for monitoring the primary step and its reflected components. The sampling module provides two self-contained TDR channels. The polarity of the output step can be selected independently for each channel. This allows differential or common mode testing of two coupled lines as well as independent testing of isolated lines.

For major functional circuit blocks refer to Figure 7-2 on page 7-3.

Optical Sampling Modules Overview

80C0X and 80C0X-CR optical modules share the same mechanical package and are built with a common circuit board. Different functionality within the modules (current and future modules) is achieved by installing different O/E modules, filters and clock recovery boards along with setting the sampler bandwidth as demanded. The key features supported in the module are:

- A one channel, low noise, adjustable bandwidth sampler allowing multiple bandwidth settings for optimizing noise versus bandwidth demands.
- An amplified or non-amplified O/E converter.

- Support for internal RF switches in the signal path with a straight-through path and two hardware-filtered reference receiver paths between the O/E converter and the sampler.
- An average optical power meter.
- Integral clock recovery option with internal coaxial connection to the mainframe trigger, front panel clock and data output (not all have data).
- Communication with the mainframe for identification, control and calibration/compensation storage.

The “system response” depends on all of the components in the signal path from the front panel to the sampler. Bandwidth and reference receiver responses are calibrated at the factory with a sub-picosecond optical impulse applied to the front panel connector or with an optical heterodyne system. This insures that all components are included, but also means that components can not be replaced without performing calibration.

Compensation performs a DC transfer curve characterization for each bandwidth/reference receiver setting. The curve data is stored in the module’s EEPROM and used to generate a look-up table in the mainframe. This data corrects for linearity, gain and offset errors in the sampler.

Reference receivers can be created in any of the following ways:

- A hardware filter inserted between the O/E and the sampler and dominates the response.
- No filter is used, but the sampler’s bandwidth is adjusted.
- The O/E bandwidth is adjusted and dominates the response.

Information about the available bandwidth and reference receiver selections, and the method used to set the bandwidth for the optical modules starts on page 3-6.

The power monitor is a second measure of the photodiode current that is independent of the sampler signal path. Analog circuitry continuously senses the current flowing into the bias side of the photodiode. The signal is amplified by a programmable gain amplifier and input to an 8 bit AD converter. The AD converter and amplifier are controlled through the I²C interface. Compensation performs two functions in the power meter: First, two offset inputs are adjusted in the amplifier so that the signal stays in range for all of the gain settings. Next, offset is measured for all gain settings and stored so it can be subtracted from the raw measured current. Because the measurements are made through independent paths the power monitor is useful in debugging module/mainframe problems.

The main board of the module only provides power and control bits to the clock recovery board. A small fraction of the input signal is split off and applied to the

clock recovery components. The type of splitter for each module is shown in Table 3-1.

Table 3-1: Module optical/electrical split

Module	Optical Split	Electrical Split
C01	✓	
C02	✓	
C03		✓
C04	✓	
C07		✓
C07B		✓
C08		✓
C08B		✓
C08C		✓
C09	✓	
C11	✓	
C12		✓

The recovered clock is routed in coaxial cable through the rear connector of the module to the Optical Front End board in the mainframe. The Optical Front End board has a switch that selects which modules clock will be applied to the trigger. The control signal for that switch comes from the optical module.

80C01 Optical Sampling Module

The 80C01 module supports conformance testing of long wavelength (1100-1650 nm) signals at 622, 2488, and 9953 Mb/s as well as general purpose testing up to 20 GHz optical bandwidth. Bandwidth and reference receiver calibration is performed with a sub-picosecond optical impulse and a fourier transform method.

- OC12: The electrical sampler is adjusted to approximately 7.5 GHz (-3 dB) bandwidth and signal is routed through a hardware filter designed to result in the combined system having an OC12 (STM-4) Reference Receiver response.
- OC48: The electrical sampler is adjusted to 7.5 GHz (-3 dB) bandwidth and signal is routed through a hardware filter designed to result in the combined system having an OC48 (STM-16) Reference Receiver response. These adjustments must be made at the factory.
- OC192: The electrical sampler is adjusted to give the desired response, and signal is not routed through any filter (signal is sent through the straight-

through path). The sampler bandwidth and response is optimized during the calibration such that the combined system will have an OC192 (STM-64) Reference Receiver response.

- 12.5 GHz: The sampler bandwidth and response is set during the calibration such that the combined system will have an Optical Bandwidth (-6 dB) >12.5 GHz.
- 20 GHz: The sampler bandwidth and response is set during the calibration such that the combined system will have an Optical Bandwidth (-6 dB) >20 GHz.

For major functional circuit blocks refer to Figures 7-3 and 7-4 beginning on page 7-4.

80C02 Optical Sampling Module

The 80C02 module is optimized for testing of long-wavelength (1100-1650 nm) signals at (9.953 Gb/s) SONET OC-192 / SDH STM-64 standards. With its high optical bandwidth (>30 GHz) it is also well suited to general purpose high-performance optical component testing.

- OC192: The electrical sampler is adjusted to give the desired response, and signal is not routed through any filter (signal is sent through the straight-through path). The sampler bandwidth and response is optimized during the calibration such that the combined system will have an OC192 (STM-64) Reference Receiver response.
- 12.5 GHz: The sampler bandwidth and response is set during the calibration such that the combined system will have an Optical Bandwidth (-6 dB) >12.5 GHz.
- 20 GHz: The sampler bandwidth and response is set during the calibration such that the combined system will have an Optical Bandwidth (-6 dB) >20 GHz.
- 30 GHz: The sampler bandwidth and response is set during the calibration such that the combined system will have an Optical Bandwidth (-6 dB) >30 GHz.

For major functional circuit blocks refer to Figures 7-5 and 7-6 beginning on page 7-6.

80C03 Optical Sampling Module

The 80C03 module supports conformance testing of both short and long bandwidth (700-1650 nm) signals at 1.063, 1.250, and 2.488 Mb/s as well as general purpose testing with >2.3 GHz optical bandwidth. Its amplified optical to electrical converter design enables the user to examine very low-level optical signals.

- OC48: The electrical sampler is adjusted to approximately 12.5 GHz (-3 dB) bandwidth and signal is not routed through any filter (signal is sent through the straight-through path). The O/E converter is designed by the vendor to match the OC48 reference receiver response curve. The span adjustment provides limited adjustment of the frequency response. It is adjusted at the factory so that the combined system will have an OC48 (STM-64) Reference Receiver response. This mode is synonymous with the 2.3 GHz maximum bandwidth setting.
- FC1063: The electrical sampler is adjusted and O/E converter span voltage are the same values as in the OC48 mode. The signal is routed through a hardware filter designed to result in the combined system having an FC1063 (1.0625 Gb/s Fibre Channel) Reference Receiver response.
- GBE: The electrical sampler is adjusted and O/E converter span voltage are the same values as in the OC48 mode. The signal is routed through a hardware filter designed to result in the combined system having an GBE (1.25 Gb/s Gigabit Ethernet) Reference Receiver response.

The 80C03 module can be configured with clock recovery that supports Fibre Channel 1063 (1.063 Gb/s) and OC-48 / STM-16 (2.488 Gb/s) standards.

For major functional circuit blocks refer to Figure 7-7 and 7-8 beginning on page 7-8.

80C04 Optical Sampling Module

The 80C04 module is optimized for testing of long wavelength (1100-1650 nm) signals at either 9.953 Gb/s or 10.664 Gb/s. With its high optical bandwidth >28 GHz, it is also well suited to general-purpose, high-performance optical component testing.

- OC192 or 10.664 Gb/s: The electrical sampler is adjusted to give the desired response, and signal is not routed through any filter (signal is sent through the straight-through path). The sampler bandwidth and response is optimized during the calibration such that the combined system will have an OC192 (STM-64) or 10.66 Gb Reference Receiver response.
- 20 GHz: The sampler bandwidth and response is set during the calibration such that the combined system will have an Optical Bandwidth (-6 dB) >20 GHz.
- 30 GHz: The sampler bandwidth and response is set during the calibration such that the combined system will have an Optical Bandwidth (-6 dB) >28 GHz.

The 80C04 can be optionally configured with clock recovery (Opt. CR-1) that supports 9.953 Gb/s telecom standards.

For major functional circuit blocks refer to Figures 7-9 and 7-10 beginning on page 7-10.

80C05 Optical Sampling Module

The 80C05 module is designed to test long wavelength (1520–1580 nm) signals. This module is intended to be used as a test and measurement tool for high bandwidth telecommunications with its high optical bandwidth >40 GHz.

- OC192: There is one Reference Receiver setup selectable for 9.95328 Gb/s SONET/SDH standard.
- There is no clock recovery option available.

For major functional circuit blocks refer to Figure 7-11 on page 7-12.

80C06 Optical Sampling Module

The 80C06 module is designed to test long wavelength (1520–1580 nm) signals. This module is intended to be used as a test and measurement tool for high bandwidth telecommunications with its high optical bandwidth >55 GHz.

- 55 GHz: There is only a single bandwidth selection available, no Reference Receiver setups selectable.
- There is no clock recovery option available.

For major functional circuit blocks refer to Figure 7-12 on page 7-13.

80C07 Optical Sampling Module

The 80C07 module is designed to test both long and short wavelength (700–1650 nm) signals. This module is intended to be used as a test and measurement tool for high bandwidth telecommunications with its high optical bandwidth >2.3 GHz.

- Filtered rates are OC-3, OC-12; unfiltered rate is OC-48.
- There is clock recovery option available (155/622/2488 Multi-rate)

For major functional circuit blocks refer to Figures 7-13 and 7-14 on page 7-14.

80C07B Optical Sampling Module

The 80C07B module is designed to test both long and short wavelength (700–1650 nm) signals. This module is intended to be used as a test and measurement tool for high bandwidth telecommunications with its high optical bandwidth >2.3 GHz.

- Supported standards or data filtering rates include OC-3, OC-12, OC-48, ENET2500/2GBE, GBE, FC1063, FC2125, and Infiniband.
- Clock recovery options are available (155/622/1063/1250/2125/2488/2500/2666)

For major functional circuit blocks refer to Figures 7-13 and 7-14 on page 7-14.

80C08 Optical Sampling Module

The 80C08 module is designed to test both long and short wavelength (700–1650 nm) signals. This module is intended to be used as a test and measurement tool for high bandwidth telecommunications with its high optical bandwidth >9.0 GHz.

- 10.0 GHz: No filter is used and the sampler bandwidth is adjusted; the O/E bandwidth is adjusted and dominates the response (9.953/10.3125 Gb/s Multi-rate).
- There is clock recovery option available (9.953/10.3125 Gb/s Multi-rate).

For major functional circuit blocks refer to Figures 7-15 and 7-16 beginning on page 7-16.

80C08B Optical Sampling Module

The 80C08B module is designed to test both long and short wavelength (700–1650 nm) signals. This module is intended to be used as a test and measurement tool for high bandwidth telecommunications with its high optical bandwidth >9.5 GHz.

- 10.0 GHz: No filter is used and the sampler bandwidth is adjusted; the O/E bandwidth is adjusted and dominates the response (9.953/10.3125 Gb/s Multi-rate).
- Clock recovery options are available (9.953/10.3125/10.51875 Gb/s Multi-rate).

For major functional circuit blocks refer to Figures 7-15 and 7-16 beginning on page 7-16.

80C08C Optical Sampling Module

The 80C08C module is designed to test both long and short wavelength (700–1650 nm) signals. This module is intended to be used as a test and measurement tool for high bandwidth telecommunications with its high optical bandwidth >10 GHz.

- 10.0 GHz: No filter is used and the sampler bandwidth is adjusted; the O/E bandwidth is adjusted and dominates the response (9.953/10.3125/10.518/10.66/10.709/11.1 Gb/s).
- Clock recovery options are available (9.953/10.3125/10.518 Gb/s and Continuous-rate from 9.8 Gb/s to 12.6 Gb/s).

For major functional circuit blocks refer to Figures 7-15 and 7-16 beginning on page 7-16.

80C09 Optical Sampling Module

The 80C09 module is designed to test long wavelength (1100-1650 nm) signals. This module is intended to be used as a test and measurement tool for high bandwidth telecommunications with its high optical bandwidth >30 GHz.

- Supported standards or data filtering rates include OC-192 and FEC10.709.
- Clock recovery options are available (OC-192 and FEC10.709)

For major functional circuit blocks refer to Figures 7-17 and 7-18 beginning on page 7-18.

80C10 Optical Sampling Module

The 80C10 module is designed to test long wavelength (1310 and 1550 nm) signals. This module is intended to be used as a test and measurement tool for high bandwidth telecommunications with its high optical bandwidth >65 GHz.

- Supported standards or data filtering rates include OC-768 and FEC43.02 (G.709).
- 30 GHz: The sampler bandwidth and response is set during the calibration such that the combined system will have an Optical Bandwidth (-6 dB) >30 GHz.
- 65 GHz: The sampler bandwidth and response is set during the calibration such that the combined system will have an Optical Bandwidth (-6 dB) >65 GHz.
- There is no clock recovery option available.

For major functional circuit blocks refer to Figure 7-19 on page 7-20.

80C11 Optical Sampling Module

The 80C11 module is designed to test long wavelength (1100–1650 nm) signals. This module is intended to be used as a test and measurement tool for high bandwidth telecommunications with its high optical bandwidth >20 GHz.

- Supported standards or data filtering rates include 9.953/10.31/10.518/10.66/10.71/11.1 Gb/s.
- Clock recovery options are available (9.953/10.66/10.71 Gb/s and Continuous-rate from 9.8 Gb/s to 12.6 Gb/s)

For major functional circuit blocks refer to Figures 7-20, 7-21, 7-22, and 7-23 beginning on page 7-20.

80C12 Optical Sampling Module

The 80C12 module is designed to test both long and short wavelength (700–1650 nm) signals. This module is intended to be used as a test and measurement tool for high bandwidth telecommunications with its high optical bandwidth >10 GHz.

- There are three Reference Receiver filters selectable that are customer specified from the following list of five rates: 1FC (FC1063) for 1.0625Gb/s FibreChannel, 2FC (FC2125) for 2.125Gb/s FibreChannel, 10GBase-X4 for 3.125Gb/s, VSR-5 for 3.31776 Gb/s, and 4FC (FC4250) for 4.25 Gb/s Fibre Channel. A filterless, full-bandwidth setting (9 GHz) is also available.
- In addition, this module offers the option to support 10 Gb/s optical standards as well. This option is mutually exclusive with the sub-10Gb/s filter options. The standard reference receiver filter rates offered with the Option 10G are 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). These filter settings require no hardware filters.
- An electrical clock recovery output signal is provided that can be routed to the Tektronix 80A05 Electrical Clock Recovery module for clock recovery.

For major functional circuit blocks refer to Figure 7-24 on page 7-24.

80A01 Trigger Prescale Preamplifier Module

The 80A01 module is designed to increase the sensitivity of the prescale trigger input of the CSA8000/TDS8000 instruments to $\leq 200 \text{ mV}_{\text{pk-pk}}$.

The major function block of the module is a high sensitivity, high gain RF amplifier. The input and output to this amplifier are routed to two identical SMA, female connectors, labelled Input and Output at the module front panel.

The module receives power from the main instrument through a single connector at the rear of the module. The power LED indicates the module is receiving power through the interface connector.

For major functional circuit blocks refer to Figure 7-25 on page 7-25.

80A02 EOS/ESD Protection Module

The 80A02 EOS/ESD (Electrical Over Stress/Electro-Static Discharge) protection module provides static electricity damage protection to vulnerable sampling head input stages and/or other sensitive elements.

The 80A02 works with any CSA/TDS8000 series instruments or with 11K series sampling instruments (11800 or CSA803 series instruments).

The 80A02 EOS/ESD module has a 26 GHz bandwidth, making it possible to provide static protection to a sensitive single input channel of a sampling oscilloscope with very minimal speed degradation.

The 80A02 EOS/ESD module is designed to work with either the Tektronix P8018 probe for manual test station static protection as well as automated test stations.

For major functional circuit blocks refer to Figure 7-26 on page 7-26.

80A05 Electrical Clock Recovery Module

The electrical clock recovery module is capable of performing clock recovery on the input signal (signal input must meet data rate and format requirements), and provides this signal as a trigger source to the CSA/TDS8000 series instruments.

Front panel connectors provide a replica of the recovered clock signal.

The module uses one of two separate clock recovery circuits dependant on the specified data rate. The single-ended or complementary input signals are split with a 1:2 divider and routed to the two circuits.

The low bandwidth circuit recovers clock and data from input data in the 50 Mb/s to 2.7 Gb/s range. The recovered clock from this circuit is routed directly to the front panel and internal trigger.

The high bandwidth circuit recovers clock and data from input data in the 2.7 Gb/s to 12.6 Gb/s range. The recovered clock to the front panel and internal trigger signals are always clock/16.

With option 10G, the 10G recovered clock is also routed to the front panel.

There is one front panel indicator LED - Clock Recovery Enable. It indicates the clock recovery circuitry is on and programmed to the requested bit rate.

For major functional circuit blocks refer to Figure 7-27 on page 7-27.

82A04 Phase Reference Module

The 82A04 Phase Reference Module is designed to decrease horizontal position uncertainty with data signals, when a reference clock signal synchronized to the data signal, is available. It consumes a small slot, and displaces operation of both channels in that slot.

The Phase Correction modes available are free run, where the module provides unit circle location information for the phase of the data sample, and triggered, where the module, in conjunction with the trigger signal, provides both base positioning, and refined positioning, for the data sample.

The input is precision 1.85 mm. Phase correction works over the range of 2.5 GHz - 25 GHz (82A04), or 2.5 GHz - 60 GHz (82A04-60G). The LED indicates the module is being utilized for phase correction.

For major functional circuit blocks refer to Figure 7-28 on page 7-28.



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 4-3.

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 4-7.

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 4-29, 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 4-31).

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

STOP. *The procedures throughout this chapter contain instructions based on the menus and controls supported by the version 1.3 release and later of the instrument firmware. The procedures will work for earlier versions of software, but some control and menu names will vary slightly.*

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 4-1 for information on when to use these procedures.

NOTE. *The procedures that follow contain instructions based on the menus and controls supported by the version 1.3 release and later of the instrument firmware. The procedures will work for earlier versions of software, but the control and menu names may vary slightly.*

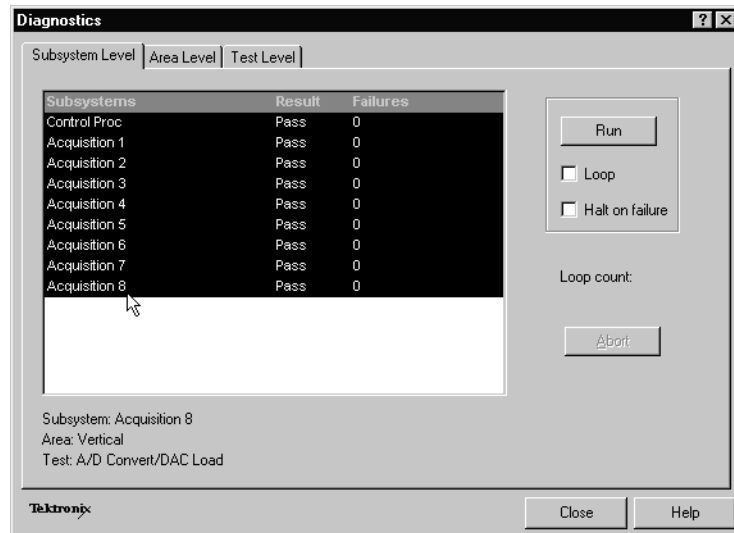
Procedures significantly affected by different software versions and/or instrument type are noted.

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 below.



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.

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.

In the Compensation dialog box, the main instrument (mainframe) and sampling modules are listed. The temperature change from the last compensation is also listed. See Figure 4-1 on page 4-5.

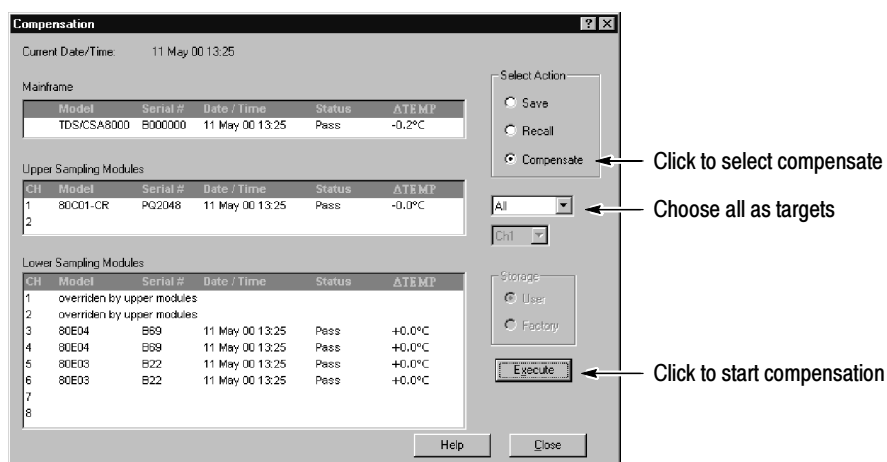


Figure 4-1: Compensation dialog box

- 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 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.

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.*

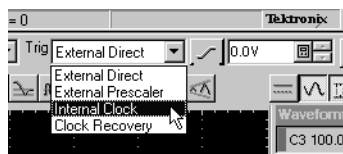
STOP. *DO NOT make changes to the front-panel settings that are not called out in the procedures. Each verification procedure will require you to set the instrument to default settings before verifying functions. If you make changes to these settings, other than those called out in the procedure, you 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	At least one electrical (80E00 series) sampling module must be installed as outlined in its user manual.

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 4-2.

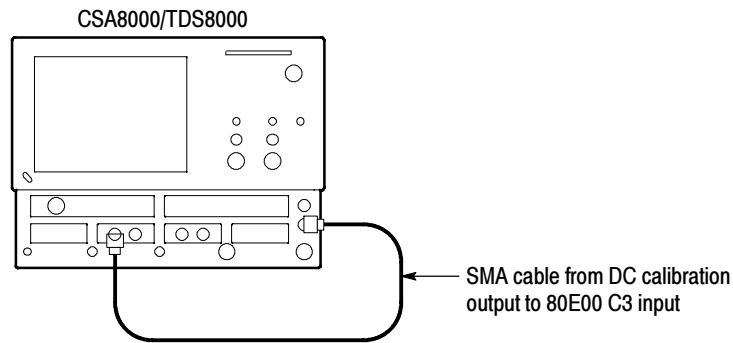


Figure 4-2: Hookup for electrical functional tests

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 4-3.

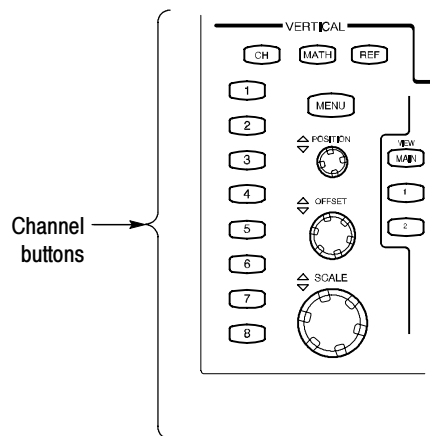


Figure 4-3: Channel button location

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 Measurement 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. In Measurement readout on screen, 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.

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

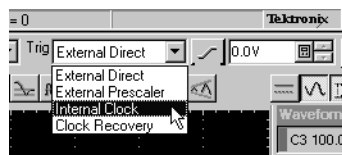
9. *Test all channels:* Repeat steps 3 through 8 until all input channels are verified.
10. *Remove the test hookup:* Disconnect the SMA cable from the channel input and the DC CALIBRATION output.

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 4-4.

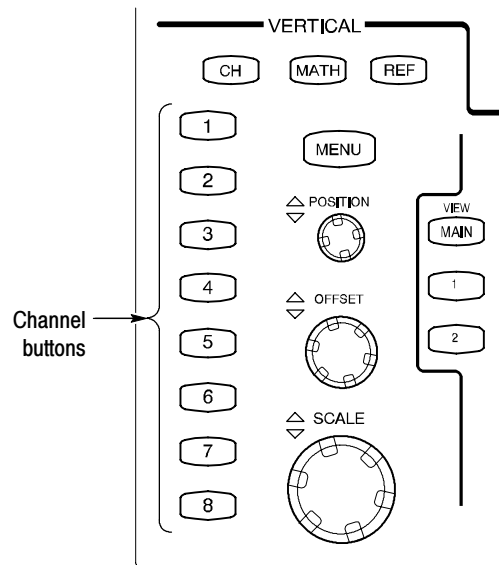


Figure 4-4: Channel button location

4. *Verify that the channel is operational:* Confirm that the following statements are true.
 - A baseline trace displays at about center screen (see Figure 4-5 on page 4-12) 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: 3 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).

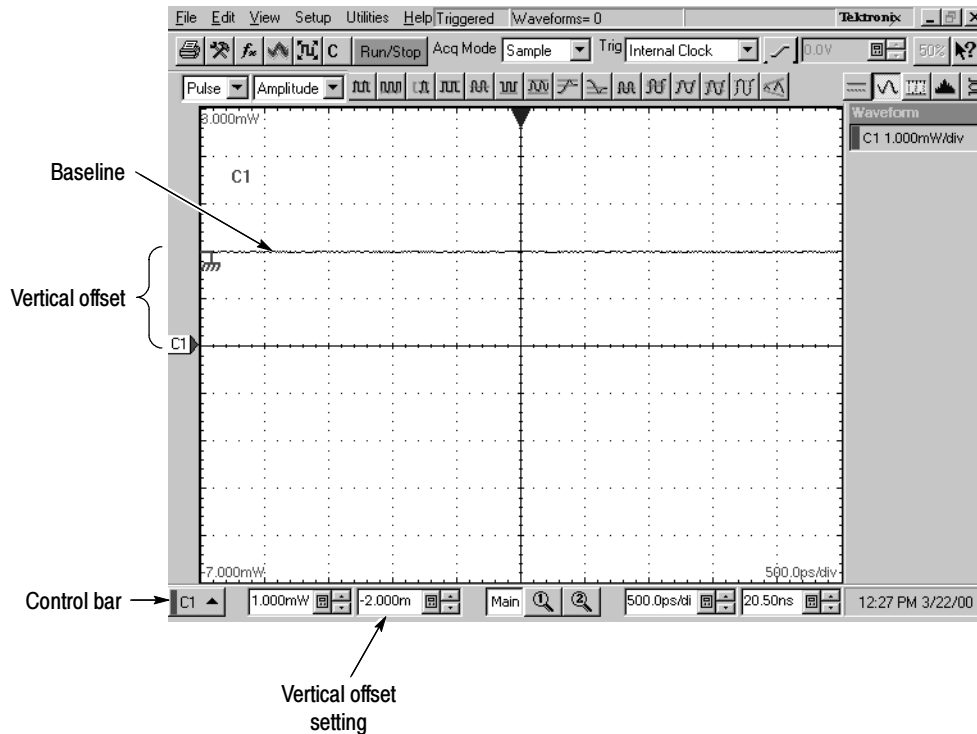


Figure 4-5: Optical channel verification

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 (80E00-series) sampling module
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 4-6.

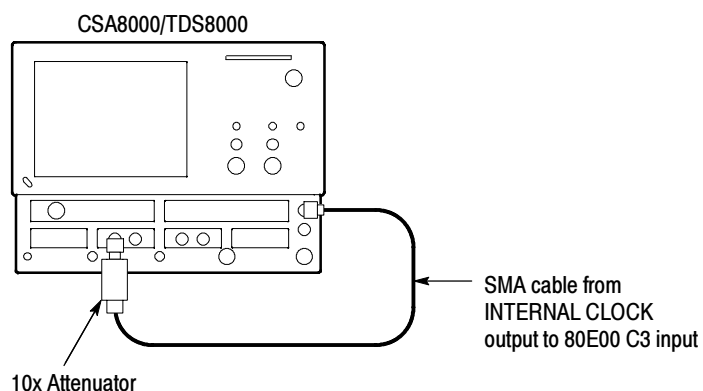


Figure 4-6: Hookup for the time base tests

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 4-7 on page 4-14.

- 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.

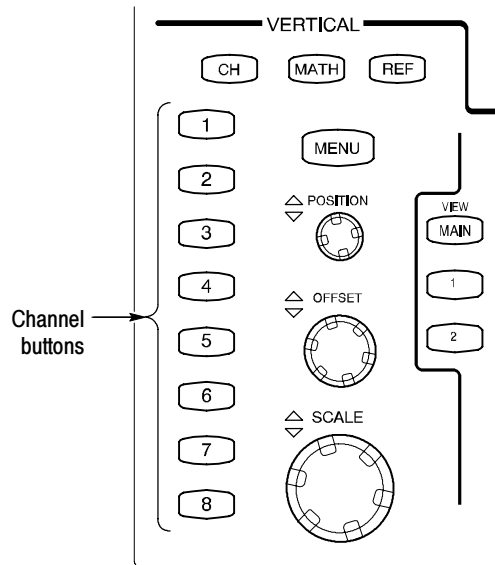


Figure 4-7: Channel button location

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 and set the display for **Normal** and **Show Vectors** (enable) in the Disp Setup dialog box.
 - b. Rotate 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 4-8 on page 4-16.

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.*

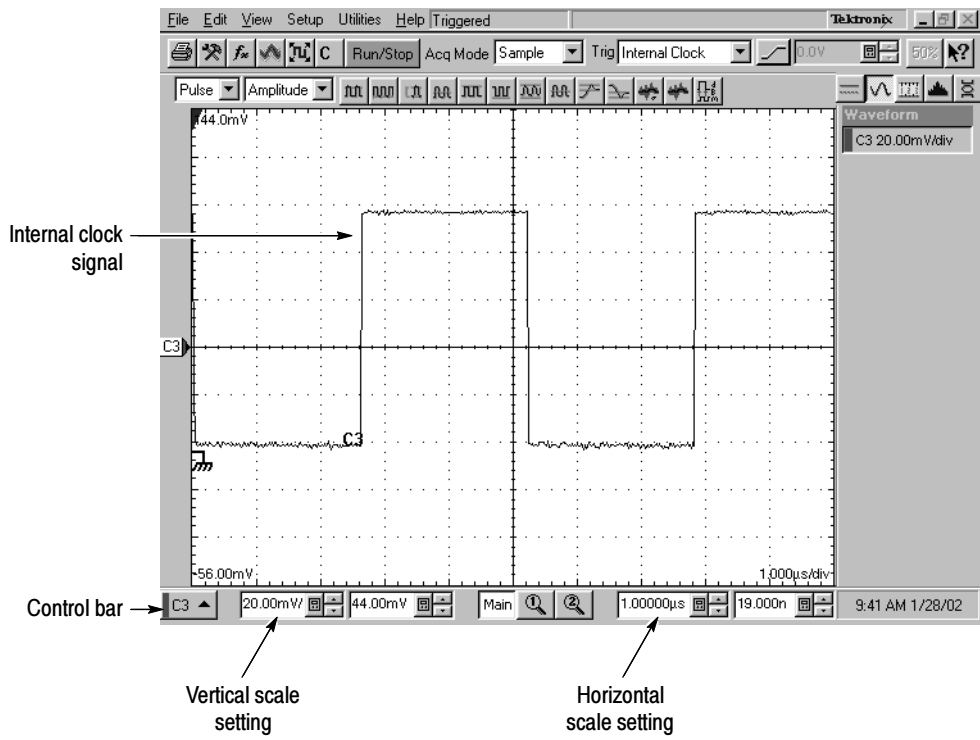


Figure 4-8: Main time base verification

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 4-9 on page the 4-17.
 - 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 4-9.
 - 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 $\mu\text{s}/\text{div}$** .

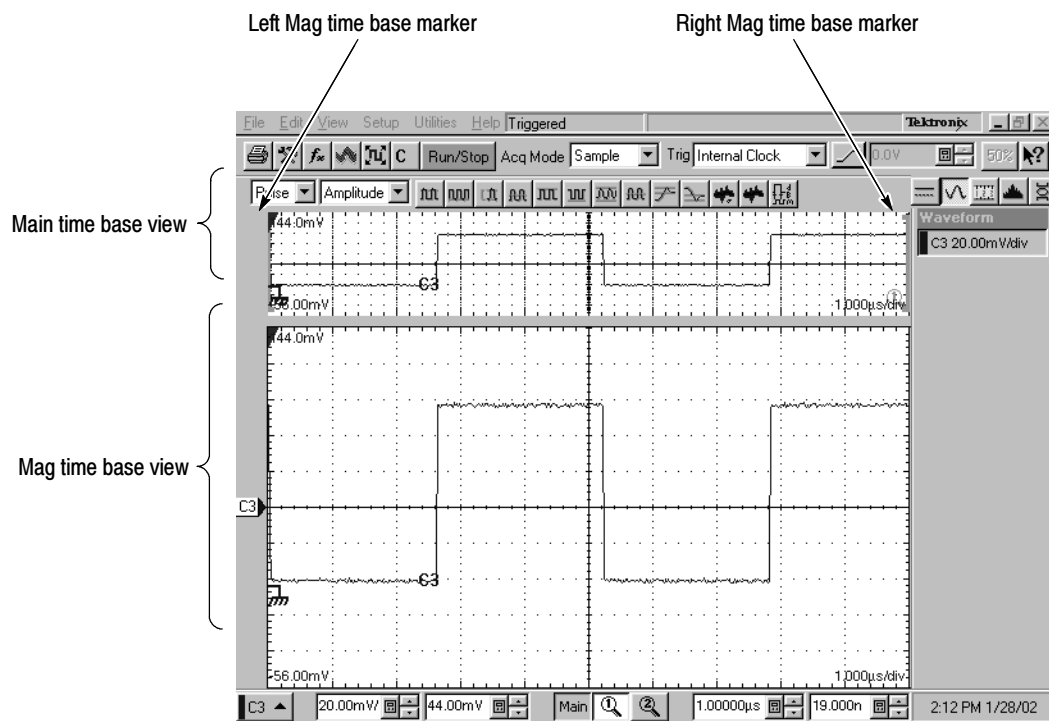


Figure 4-9: Mag time base verification

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	<p>One 50 Ω BNC cable, such as Tektronix part number 174-1341-00</p> <p>One SMA cable, such as Tektronix part number 174-1427-00</p> <p>One 50 Ω terminator cap, such as Tektronix part number 011-0049-00.</p> <p>One SMA 10X attenuator, SMA connector, such as Tektronix part number 015-1003-00</p> <p>Four electrical (80E00-series) sampling modules.</p>
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 4-11 on page 4-20.
3. *Hook up the signal source:* Connect the SMA cable from the Internal Clock output through a 10x attenuator to 80E00 sampling module input channel 3 as shown in Figure 4-10 on page 4-19. Connect BNC cable to External Gate input at rear panel.

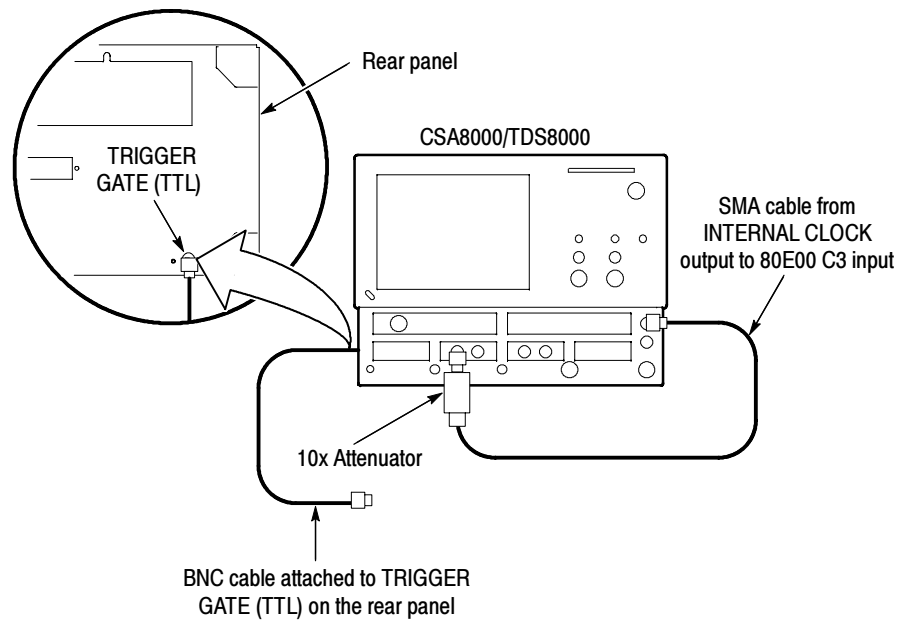


Figure 4-10: Hookup for the gated trigger tests

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 **200kHz**.
- 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.

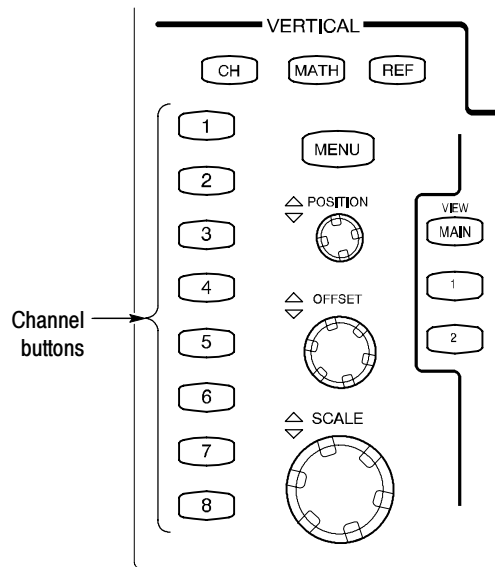


Figure 4- 11: Channel button location

5. *Set the time base:* Set the Horizontal **SCALE** to **2 $\mu\text{s}/\text{div}$** . The horizontal scale readout is displayed in the Control bar at the bottom of the graticule.
6. From the Setup menu, select **Display**. Set the display for **Normal** and **Show Vectors** (enable) in the dialog box.
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 4-12 on page 4-21.

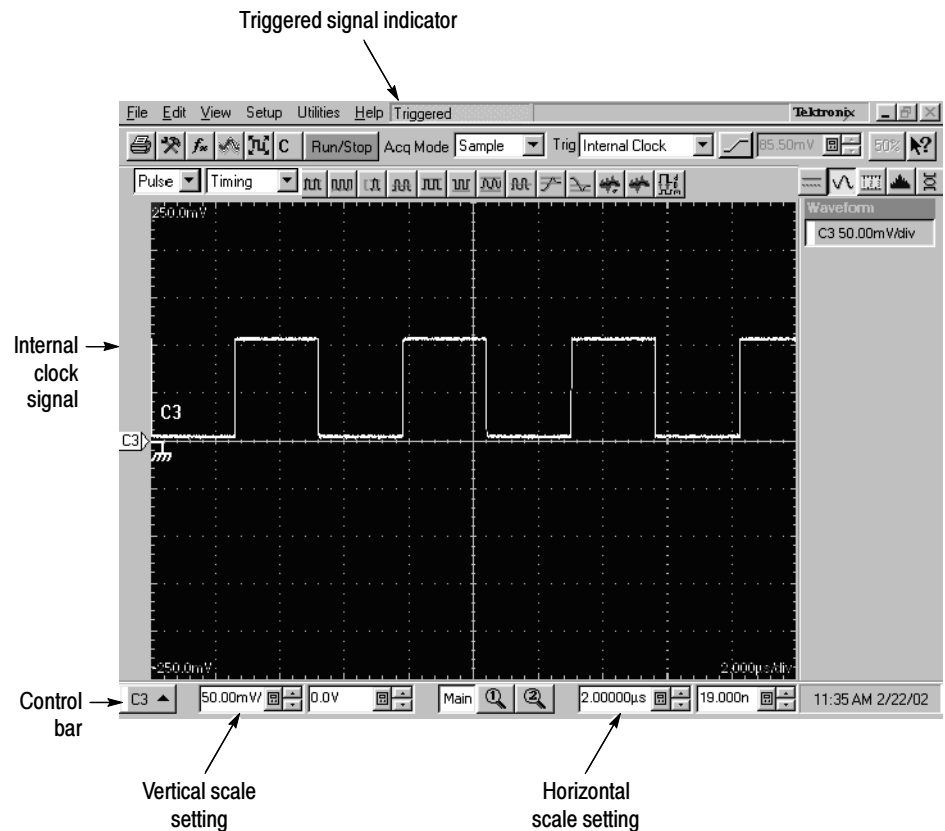


Figure 4-12: Signal triggered

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 4-10 on page 4-19.
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 4-13 on page 4-22. 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 4-14 on page 4-23. Note the Not Trigd indication at the top of the window.

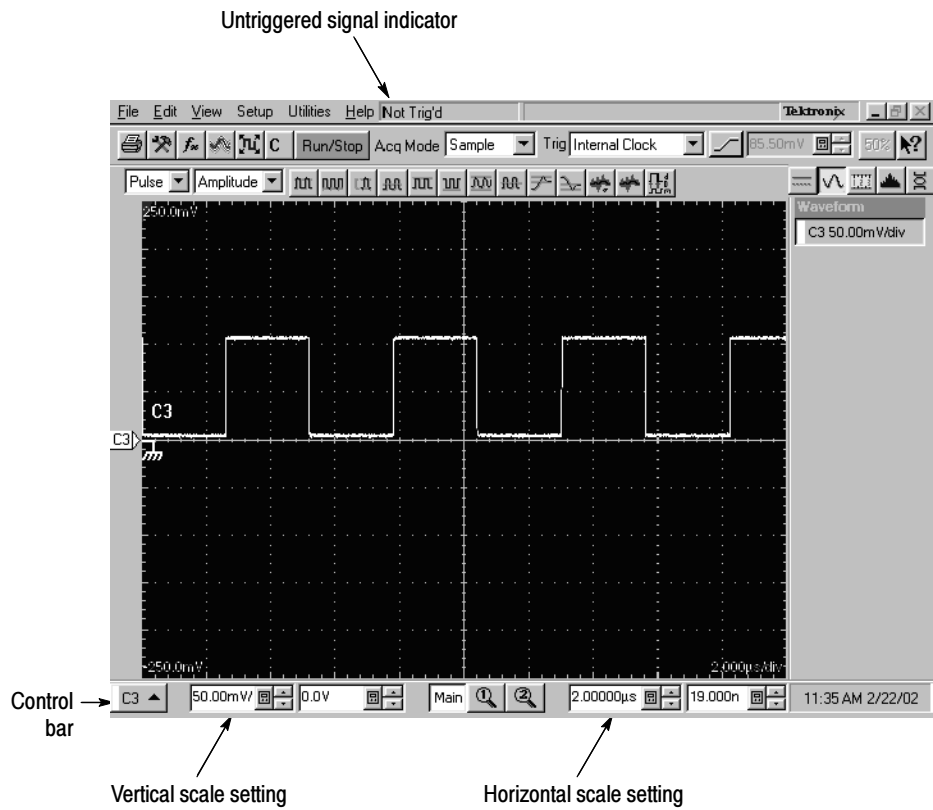


Figure 4- 13: Signal not triggered (signal frozen)

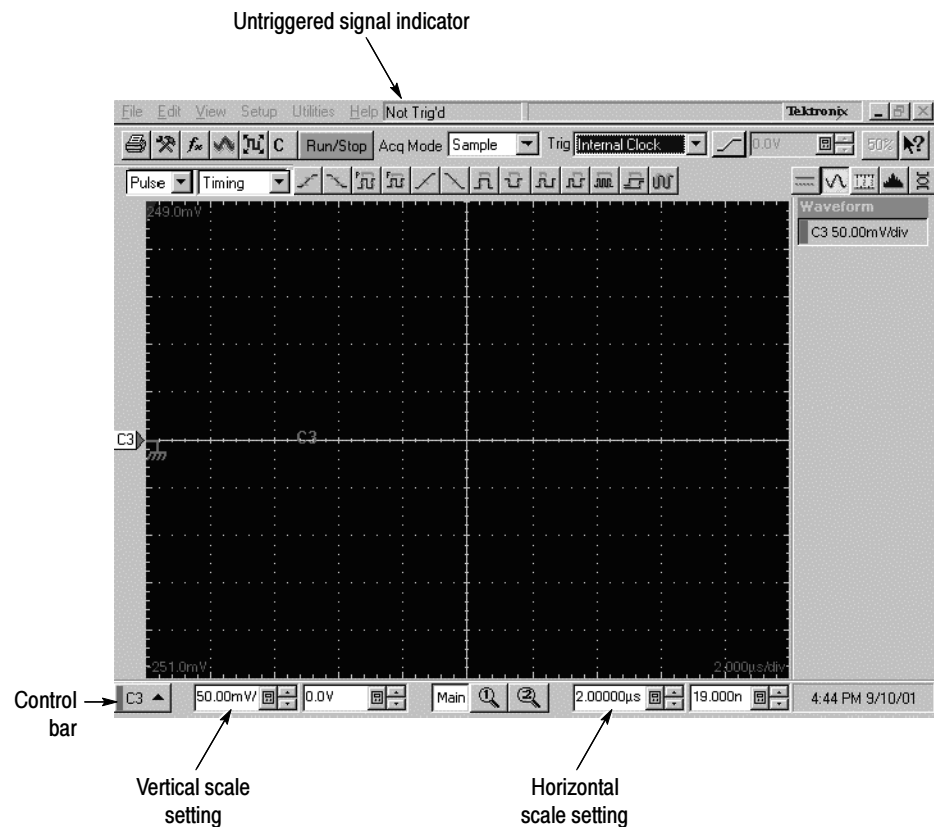


Figure 4-14: Signal not triggered (no waveform)

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 4-15 on page 4-24.
12. Disconnect the test hook up.

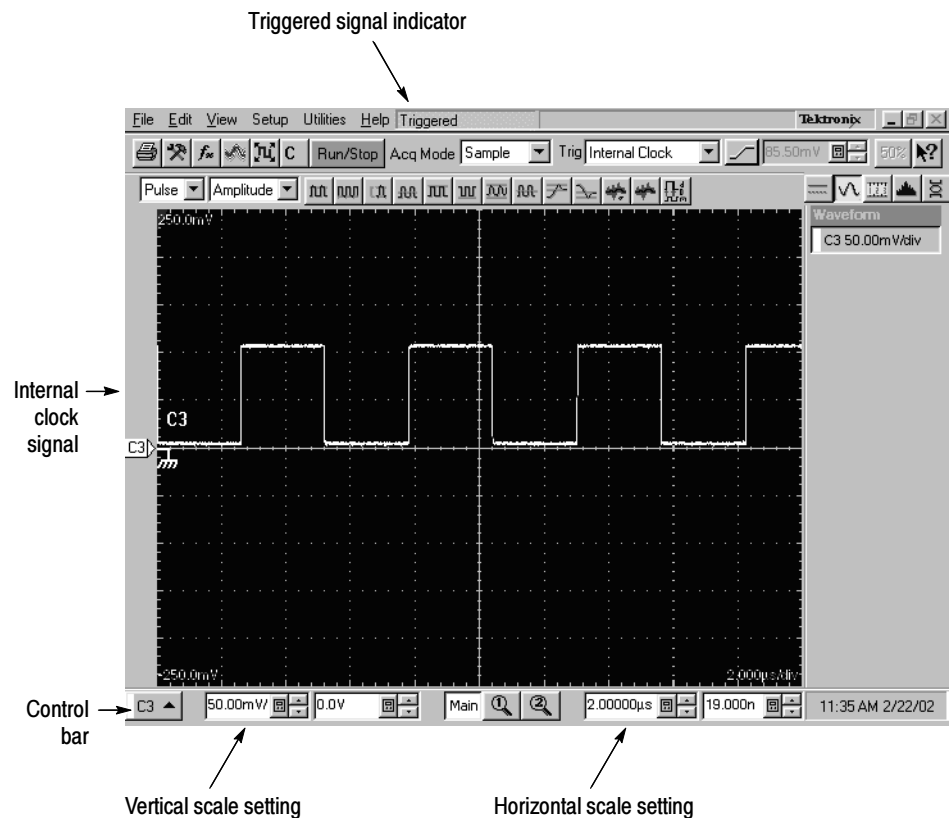


Figure 4- 15: Signal triggered

End of Functional Test Procedures

Perform the Hardware and Operating System Tests (Microsoft Windows 98 OS Only)

STOP. The QA+Win32 program used in these procedures is only available on instruments using the Microsoft Windows 98 operating system.

These procedures verify the instrument hardware functions. A diagnostics program called QA+Win32 is used to make the verifications. No equipment is required.

QA+Win32 QA+Win32 is a comprehensive software application used to check and verify the operation of the PC hardware in the portable mainframe. This procedure uses QA+Win32 to verify the instrument hardware. To run QA+Win32, you must

have either a working keyboard or a working mouse or other pointing device and have Windows 98 running.



CAUTION. Before running the QA+Win32 tests, be aware of the following problems and work-arounds.

- The QA+Win32 discrete memory test fails if the system being tested contains more than 16 megabytes of RAM.

Since your product ships with more than 16 megabytes of RAM, please follow the procedure for *Checking the Hardware and Operating System* on page 4-26.

NOTE. Do not run the memory test from the Memory icon.

- The QA+Win32 hard drive test may report an incorrect number of tracks and cylinders for your hard drive.

This is an internal mapping problem, but has no effect on the results of the test. Bad sectors on your hard drive are still found and marked.

- The QA+Win32 keyboard test does not respond correctly to keys used by Windows 98.

Keyboards made for use with Windows contain two or three keys specific to that operating system. These are usually located on either side of the space bar. QA+Win32 does not trap these keys when performing the keyboard test. Do not press them.

Checking the Cooling Fan Operation

Power on the instrument and visually inspect the left side panel of the instrument to verify that all six cooling fans are rotating.

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

Checking the Hardware and Operating System

To perform a minimal check of the hardware and Windows 98 operating system of this instrument, perform this procedure to run QA+Win32 diagnostics from the Windows 98 Start menu.

Equipment required	None
Prerequisites	A mouse and keyboard must be connected to the instrument and it must be powered on.

1. Push the **RUN/STOP** front-panel button to stop acquisition.
2. Use CTRL-ALT-DEL to close the TDS/CSA8000 application.
3. Click **Start**, then select **Programs**, and then **Sykes Diagnostics** in the Start Menu. Finally, click **QA+Win32**.

NOTE. *You may experience a delay before the program starts.*

4. Click **Tools** on the menu bar, then click **Customize Test...**
5. Click **Default** and exit this dialog by clicking **OK**.
6. Select and execute the following tests individually by clicking on the test buttons (see the illustration on page 4-27) one at a time (see note) and clicking **Start**:
 - a. COM Ports
 - b. LPT Ports
 - c. System Board
 - d. System Info
 - e. USB
 - f. Video

NOTE. *A test button is not highlighted until you select it. As you select the button for each test (tool tip appears when you point to the button), a highlight box appears around the button. When you click Start, the button blinks until the test is complete and the highlight box changes color to indicate the test is complete.*



Follow any instructions appearing on the screen.

7. Check test results in scrollable results listing in the Test Results window of the QAPlus test window. All tests should pass.
8. Close the QA+Win32 diagnostics by selecting **Exit** in the File menu or click the Control Box (X) in upper right corner.
9. You can restart the **TDS/CSA8000** product software application by clicking **Start**, then selecting **Restart** from the Shutdown Windows dialog box.

End of Procedure

Performance Tests

This chapter contains performance verification procedures for the specifications marked with the ✓ symbol. The following equipment, 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*

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 80E00-series module that has passed the tests in *80E00 Electrical Sampling Modules* (page 4-103). When performing the time interval accuracy and trigger delay jitter tests, check each 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 4-106) 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 main instruments and modules as independent products checks both products independently for all measured specifications, except for DC voltage accuracy of main instruments 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 4-3, and the procedure *Perform the Functional Tests*, found on page 4-7.
- 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 4-5) 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 temperatures as follows.
- 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 4-77 use external, traceable signal sources to directly check warranted characteristics. Table 4-1 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 4- 1: Equipment Required

Item number and description	Minimum requirements	Part number or model
1. Adapter (80E01 and 80E06 only)	2.4 mm, male-to-male connectors	HP11900A
2. Adapter (80E01 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. Adapter (Qty. 2)	BNC to dual banana plugs	Tektronix part number 103-0095-00
7. Attenuator (80E01 only)	10 dB, female to male SMA connectors	HP8490D with option 10
8. Attenuator	2X attenuator 50 Ω , SMA connectors	Tektronix part number 015-1001-00
9. Attenuator, optical	30 mm, 10 dB, single-mode, FC to FC, female to male	Tektronix part number 119-5118-00
10. Airline (80E04 only)	50 Ω , airline	Maury Microwave model number 8042D
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
17. Cable, coaxial (Qty. 2)	50 Ω , 20 in (0.5 m), male-to-male SMA connectors	Tektronix part number 174-1427-00

Table 4- 1: Equipment Required (cont.)

Item number and description	Minimum requirements	Part number or model
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. Calibration step generator	Calibration fixture, sampling module cal unit	Tektronix part number 067-1338-0X
21. Digital multimeter	Four wire ohm meter. <0.25% accuracy for volt and ohm measurements	Keithley 2000-20
22. DC power supply	Variable amplitude to ± 104 V; accuracy to 0.1%	Data Precision 8200
23. Laser transmitter	2.5 Gb/s SONET/SDH laser transmitter	JDS Uniphase Model 420B
24. Optical attenuator, variable	Single-mode input and output, 0 to 60 dB	Tektronix part number OA5002
25. Optical Impulser	1550 nm impulse	Calmar FPL-01 Optical Impulser
26. Optical Wavelength Meter	0.001 nm resolution	Advantest Q8326
27. Power meter (80E01 only)	Power meter	Anritsu-Wilton ML2437A
28. Power sensor (80E01 only)	Power sensor w/attached cable	Anritsu-Wilton ML2425A
29. Power divider	50 Ω , 3 SMA female connectors	Tektronix part number 015-0565-00
30. Terminator, cap	Shorting, 34 GHz, precision 3.5 mm, female	Tektronix part number 011-0150-00
31. Terminator	50 Ω , coaxial terminator, K male	Anritsu-Wiltron 28K50
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
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 TDS520 or 540
43. Tunable ECL laser (Qty. 2)	See <i>Tunable Laser Requirements</i> on page 4-183	New Focus tunable ECL lasers (2), Model 6528-HP or 6538-HP

Table 4- 1: Equipment Required (cont.)

Item number and description	Minimum requirements	Part number or model
44. Scalar Network Analyzer (80E06 only)	10 MHz to 50 GHz. Must use specified equipment	Anritsu 54177A
45. SWR Autotester (80E06 only)	10 MHz to 50 GHz. Must use specified equipment	Anritsu 560-98V5
46. Reflectometer (80E06 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 only)	Must use specified equipment	Agilent E4417A Power Meter
48. Power sensor (80E06 only)	50 MHz to 50 GHz. Must use specified equipment	Agilent 8487A Power Sensor, 2002-07-31
49. RF Power Detector (80E06 only)	10 MHz - 50 GHz. Must use specified equipment	Anritsu RF Detector, 560-7VA50
50. Power sensor (80E06 only)	Waveguide Power Sensor. Must use specified equipment	Agilent V8486A
51. Open/Short (80E06 only)	DC to 50 GHz. Must use specified equipment	Anritsu 22V50 Open and Short
52. Adapter (80E06 only)	WR15 (Waveguide)-to-1.85 mm male connectors, 50 GHz to 65 GHz. Must use specified equipment	Anritsu 35WR15V
53. Adapter (80E06 only)	WR15 (Waveguide)-to-1.85 mm female connectors, 50 GHz to 65 GHz. Must use specified equipment	Anritsu 35WR15VF
54. Waveguide section (80E06 only)	Straight section, 50 GHz - 75 GHz, 4 inch length, round flanged. Must use specified equipment	Millitech SRW-15-RO400
55. Attenuator (80E06 only) (Qty. 2)	6 dB attenuator, DC to 50 GHz, 2.4 mm connectors	Agilent 8490D, option 006
56. 80E00 Series Extender (2 meter)	Special extender cable for use with 80E00 Series modules	Tektronix part number 012-1569-00
57. Attenuator (80A05 only) (Qty. 2)	10X (20 dB), female to male SMA connectors	Tektronix part number 015-1003-00
58. Stereo mini phono plug (80A02 only)	Stereo phono mine-plug with exposed connections	Common part, obtain by description

CSA8000/TDS8000 Series Test Records

This section contains test records that you can use to record the outcome of your performance verification checks. Because some of the specifications differ, where applicable, a separate form is provided for the TDS/CSA8000, TDS/CSA8000B, and TDS/CSA8200 instruments. Seven records exist:

- *TDS/CSA8000 Main Instrument*
- *TDS/CSA8000B Main Instrument*
- *TDS/CSA8200 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*

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.

CSA8000/TDS8000 Main-Instrument Test Record

For each channel tested, photocopy this page, and record the performance test results for your CSA8000/TDS8000 main-instrument test record.

CSA8000/TDS8000 Test Record Channel: ____.

Instrument Model: CSA8000 TDS8000
 Instrument 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
1 μ s	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			1.7 ps
100 ns	none			2.5 ps
1 μ s	none			11.5 ps
<i>External direct delay jitter, locked to internal 10 MHz reference mode</i>				
Horizontal Position Set to: 19 ns	none			2.5 ps
100 ns	none			2.5 ps
1 μ s	none			2.6 ps
<i>External prescaled trigger delay jitter, Short term optimized mode</i>				
Horizontal Position Set to: 19 ns	none			1.7 ps
<i>External prescaled delay jitter, locked to internal 10 MHz reference mode</i>				
Horizontal Position Set to: 19 ns	none			2.5 ps
<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

CSA8000B/TDS8000B Main-Instrument Test Record

For each channel tested, photocopy this page, and record the performance test results for CSA8000B/TDS8000B main-instrument test record.

CSA8000B/TDS8000B Test Record Channel: ____.

Instrument Model: CSA8000B TDS8000B
 Instrument 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
	1 μ s	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 delay jitter, locked to internal 10 MHz reference mode</i>				
Horizontal Position Set to:	19 ns	none		2.5 ps
	100 ns	none		2.5 ps
	1 μ s	none		2.5 ps
<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
<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

CSA8200/TDS8200 Main-Instrument and 82A04 Module Test Record

For each channel tested, photocopy this and the next page, and record the performance test results for CSA8200/TDS8200 main-instrument test record.

CSA8200/TDS8200 and 82A04 Test Record Channel: ____.

Instrument Model: CSA8200 TDS8200
 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
1 μ s	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
100 ns	none			2.5 ps
1 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 ps	none			200 fs
<i>External prescaled trigger delay jitter, Short term optimized mode</i>				
Horizontal Position Set to: 19 ns	none			1.5 ps

CSA8200/TDS8200 and 82A04 Test Record Channel: ____ . (cont.)

Performance Test	Minimum	Incoming	Outgoing	Maximum
<i>External prescaled delay jitter, locked to internal 10 MHz reference mode</i>				
Horizontal Position Set to: 19 ns	none			2.5 ps
<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 three pages, and use them to record the performance test results for your 80E00 Test Record.

Note that the designations C1 and C2 (channel 1/channel 2) in the test record may become C3/C4, C5/C6, or C7/CH8, depending on which compartment in the main instrument the module is installed.

80E00 Test Record

Module Model: 80E01 80E02 80E03 80E04 80E06
 Module Serial Number: _____ Certificate Number: _____
 Date of Calibration: _____ Technician: _____

Performance Test		Minimum	Incoming	Outgoing	Maximum
<i>Input Impedance</i>					
C1	Impedance	49.5 Ω			50.5 Ω
	Baseline (80E04 only)	-1 mV			1 mV
C2	Impedance	49.5 Ω			50.5 Ω
	Baseline (80E04 only)	-1 mV			1 mV
<i>DC Voltage accuracy, single point, within $\pm 5^\circ\text{C}$ of compensated temperature</i>					
C1 @ 100 mV/div					
Offset:		Input level:			
-1100 mV		-1550 mV	-18.7 mV		+18.7 mV
-1100 mV		-1350 mV	-14.7 mV		+14.7 mV
-1100 mV		-1100 mV	-9.7 mV		+9.7 mV
-1100 mV		-850 mV	-14.7 mV		+14.7 mV
-1100 mV		-650 mV	-18.7 mV		+18.7 mV
0 mV		-450 mV	-11 mV		+11 mV
0 mV		-250 mV	-7 mV		+7 mV
0 mV		0 mV	-2 mV		+2 mV
0 mV		+250 mV	-7 mV		+7 mV
0 mV		+450 mV	-11 mV		+11 mV
+1100 mV		+650 mV	-18.7 mV		+18.7 mV
+1100 mV		+850 mV	-14.7 mV		+14.7 mV
+1100 mV		+1100 mV	-9.7 mV		+9.7 mV
+1100 mV		+1350 mV	-14.7 mV		+14.7 mV
+1100 mV		+1550 mV	-18.7 mV		+18.7 mV

80E00 Test Record (cont.)

Performance Test		Minimum	Incoming	Outgoing	Maximum
C2 @ 100 mV/diV					
Offset:	Input level:				
-1100 mV	-1550 mV	-18.7 mV			+18.7 mV
-1100 mV	-1350 mV	-14.7 mV			+14.7 mV
-1100 mV	-1100 mV	-9.7 mV			+9.7 mV
-1100 mV	-850 mV	-14.7 mV			+14.7 mV
-1100 mV	-650 mV	-18.7 mV			+18.7 mV
0 mV	-450 mV	-11 mV			+11 mV
0 mV	-250 mV	-7 mV			+7 mV
0 mV	0 mV	-2 mV			+2 mV
0 mV	+250 mV	-7 mV			+7 mV
0 mV	+450 mV	-11 mV			+11 mV
+1100 mV	+650 mV	-18.7 mV			+18.7 mV
+1100 mV	+850 mV	-14.7 mV			+14.7 mV
+1100 mV	+1100 mV	-9.7 mV			+9.7 mV
+1100 mV	+1350 mV	-14.7 mV			+14.7 mV
+1100 mV	+1550 mV	-18.7 mV			+18.7 mV
<i>DC Vertical Voltage deviation from linear least squares fit</i>					
C1	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
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
<i>Rise time</i>					
80E02	C1	none			28 ps
	C2	none			28 ps
80E03	C1	none			17.5 ps
	C2	none			17.5 ps
80E04 ¹	C1	none			17.5 ps
	C2	none			17.5 ps
<i>Analog Bandwidth (80E01)</i>					
C1	to 50 GHz				
	Max power (50 MHz ref)	none			+3 dB
	Min power (50 MHz ref)	-3 dB			
<i>Analog Bandwidth (80E06)</i>					
C1	to 65 GHz				
	Max power (50 MHz ref)	none			+3 dB
	Min power (50 MHz ref)	-3 dB			

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
	C2	Vert scale: 1 mV	none			1.2 mV
80E04	C1	Vert scale: 1 mV	none			1.2 mV
	C2	Vert scale: 1 mV	none			1.2 mV
80E06	C1	Vert scale: 2 mV	none			2.4 mV
<i>TDR system reflected rise time (80E04 models only)</i>						
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
<i>TDR system step response aberrations (80E04 models only)</i>						
C1	positive polarity					
	zone:	from -10 ns to -20 ps ²	-3%			+3%
	zone:	from 400 ps to 5 ns ³	-3%			+3%
	zone:	from 5 ns on ³	-1%			+1%
	negative polarity					
	zone:	from -10 ns to -20 ps ²	-3%			+3%
	zone:	from 400 ps to 5 ns ³	-3%			+3%
zone:	from 5 ns on ³	-1%			+1%	

80E00 Test Record (cont.)

Performance Test		Minimum	Incoming	Outgoing	Maximum
C2	positive polarity				
	zone: from -10 ns to -20 ps ²	-3%			+3%
	zone: from 400 ps to 5 ns ³	-3%			+3%
	zone: from 5 ns on ³	-1%			+1%
	negative polarity				
	zone: from -10 ns to -20 ps ²	-3%			+3%
	zone: from 400 ps to 5 ns ³	-3%			+3%
zone: from 5 ns on ³	-1%			+1%	

- ¹ The rise time of the 80E02, 80E03, 80E04, and 80E06 module is computed from the measured rise time. See the procedure.
- ² Before step transition.
- ³ After step transition.

80C00 Optical Modules Test Record

Photocopy this and the next 26 pages, and use them to record the performance test results for your 80C00 Test Record.

80C00 Test Record

Module Model: 80C01 80C02 80C03 80C04 80C05 80C06 80C07 80C07B
 80C08 80C08B 80C08C 80C09 80C10 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
		FEC10664	-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
80C07	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

80C00 Test Record (cont.)

Performance Test			Minimum	Incoming	Outgoing	Maximum
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
		2.5 GHz	-500 nW			+500 nW
80C08	C1 at 1 μ W	10 GHz	-1.0 μ W			+1.0 μ W
		10GBASE-W	-1.0 μ W			+1.0 μ W
		10GBASE-R	-1.0 μ W			+1.0 μ W
80C08B	C1 at 1 μ W	10 GHz	-1.0 μ W			+1.0 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
80C08C	C1 at 1 μ W	10 GHz	-1.0 μ W			+1.0 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
		10GBE FEC	-1.0 μ W			+1.0 μ W
80C09	C1 at 100 μ W	OC-192/STM-64	-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
80C10 1550 nm	C1 at 25 μ W	OC-768/STM-256	-25 μ W			+25 μ W
		FEC43.02 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 35 μ W	OC-768/STM-256	-35 μ W			+35 μ W
		FEC43.02 Gb/s	-35 μ W			+35 μ W
		30 GHz	-35 μ W			+35 μ W
		65 GHz	-35 μ W			+35 μ W

80C00 Test Record (cont.)

Performance Test			Minimum	Incoming	Outgoing	Maximum
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
		20 GHz	-10 μ W			+10 μ W
		30 GHz	-10 μ W			+10 μ W
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
		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
		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	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
		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 (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
		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

80C00 Test Record (cont.)

Performance Test		Minimum	Incoming	Outgoing	Maximum
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
		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
<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}
		FEC10664	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}
			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}	
		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}	
	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}
			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}
			FEC10712	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 25 μW	1550 nm	OC-768/STM-256	none		60 μW_{rms}
			43.02 Gb/s FEC	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}
			43.02 Gb/s FEC	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
80C11	C1 at 10 μ W		OC-192/STM-64	none		8.0 μ W _{rms}
			Clock Recovery	none		9.0 μ W _{rms}
			10.66 Gb/s	none		8.0 μ W _{rms}
			Clock Recovery	none		9.0 μ W _{rms}
			10.71 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}
			20 GHz	none		14 μ W _{rms}
			Clock Recovery	none		15 μ W _{rms}
			30 GHz	none		30 μ W _{rms}
			Clock Recovery	none		35 μ W _{rms}
80C12	C1 at 5 μ W	1550 nm	FC1063	none		3.0 μ W _{rms}
			FC2125	none		3.0 μ W _{rms}
			FC4250	none		3.0 μ W _{rms}
			10GBase-X4	none		3.0 μ W _{rms}
			10GFC-X4	none		3.0 μ W _{rms}
			3.318 Gb/s	none		3.0 μ W _{rms}
			9 GHz	none		6.0 μ W _{rms}
		1310 nm	FC1063	none		3.0 μ W _{rms}
			FC2125	none		3.0 μ W _{rms}
			FC4250	none		3.0 μ W _{rms}
			10GBase-X4	none		3.0 μ W _{rms}
			10GFC-X4	none		3.0 μ W _{rms}
			3.318 Gb/s	none		3.0 μ W _{rms}
			9 GHz	none		6.0 μ W _{rms}
		850 nm	FC1063	none		4.8 μ W _{rms}
			FC2125	none		4.8 μ W _{rms}
			FC4250	none		4.8 μ W _{rms}
			10GBase-X4	none		4.8 μ W _{rms}
			10GFC-X4	none		4.8 μ W _{rms}
			3.318 Gb/s	none		4.8 μ W _{rms}
			9 GHz	none		9.6 μ W _{rms}

80C00 Test Record (cont.)

Performance Test				Minimum	Incoming	Outgoing	Maximum		
80C12-10G	C1 at 5 μ W	1550 nm	FC1063	none			6.0 μ W _{rms}		
			FC2125	none			6.0 μ W _{rms}		
			FC4250	none			6.0 μ W _{rms}		
			10GBase-X4	none			6.0 μ W _{rms}		
			10GFC-X4	none			6.0 μ W _{rms}		
			3.318 Gb/s	none			6.0 μ W _{rms}		
			9 GHz	none			6.0 μ W _{rms}		
		1310 nm	FC1063	none			6.0 μ W _{rms}		
			FC2125	none			6.0 μ W _{rms}		
			FC4250	none			6.0 μ W _{rms}		
			10GBase-X4	none			6.0 μ W _{rms}		
			10GFC-X4	none			6.0 μ W _{rms}		
			3.318 Gb/s	none			6.0 μ W _{rms}		
			9 GHz	none			6.0 μ W _{rms}		
		850 nm	FC1063	none			9.6 μ W _{rms}		
			FC2125	none			9.6 μ W _{rms}		
			FC4250	none			9.6 μ W _{rms}		
			10GBase-X4	none			9.6 μ W _{rms}		
			10GFC-X4	none			9.6 μ W _{rms}		
			3.318 Gb/s	none			9.6 μ W _{rms}		
			9 GHz	none			9.6 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			

80C00 Test Record (cont.)

Performance Test			Minimum	Incoming	Outgoing	Maximum
80C08C	Bandwidth Setting:	10 GHz	9.5 GHz			none
80C09	Bandwidth Setting:	30 GHz	28 GHz			none
		20 GHz	20 GHz			none
80C010	Bandwidth Setting:	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
80C12-10G	Bandwidth Setting:	10 GHz	9.5 GHz			none
<i>OC-3/STM-1 155 Mb/s Reference Receiver setting frequency response (80C07 and 80C07B modules only)</i>						
Frequency (MHz):	0.000	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

80C00 Test Record (cont.)

Performance Test	Minimum	Incoming	Outgoing	Maximum
<i>OC-12/STM-4 622 Mb/s Reference Receiver setting frequency response (80C01, 80C07 and 80C07B modules only)</i>				
Frequency (MHz): 0.000 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
<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	-0.61			0.39
746.5 -0.45	-0.95			0.05
1119.7 -1.02	-1.52			-0.52
1493.1 -1.86	-2.36			-1.36
1866.3 -3.00	-3.50			-2.50
2239.5 -4.51	-5.67			-3.35
2488.3 -5.71	-7.25			-4.17
2612.8 -6.37	-8.08			-4.66
2986.0 -8.54	-10.74			-6.35
3359.3 -10.93	-13.55			-8.31
3732.6 -13.41	-16.41			-10.41

80C00 Test Record (cont.)

Performance Test	Minimum	Incoming	Outgoing	Maximum
<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	-0.96			+0.74
2986.0 -0.45	-1.30			+0.40
4478.8 -1.02	-1.87			+0.17
5972.4 -1.86	-2.71			-1.01
7465.0 -3.00	-3.86			-2.16
8958.0 -4.51	-6.19			-2.83
9953.28 -5.71	-7.87			-3.55
10451.2 -6.37	-8.75			-3.99
11944.0 -8.54	-11.53			-5.56
13437.2 -10.93	-14.45			-7.41
14930.4 -13.41	-17.41			-9.41
<i>OC768/STM-256 39.813 Gb/s Reference Receiver setting frequency response (80C10 module only)</i>				
Frequency (MHz): 0.000 Nominal response (dB) 0.00	-1.00			+0.50
5.97 -0.10	-1.10			+0.40
11.94 -0.45	-1.45			+0.05
17.92 -1.02	-2.02			-0.52
23.89 -1.86	-2.86			-1.36
29.86 -3.00	-4.00			-2.50
35.83 -4.51	-5.96			-3.33
39.81 -5.71	-7.42			-4.15
41.80 -6.37	-8.20			-4.62
44.79 -7.42	-9.42			-5.42
47.78 -8.54	-11.22			-5.87
53.75 -10.93	-14.83			-7.03
59.72 -13.41	-18.41			-8.41

80C00 Test Record (cont.)

Performance Test	Minimum	Incoming	Outgoing	Maximum
<i>FEC43.02 Gb/s G.709 FEC Reference Receiver setting frequency response (80C10 module only)</i>				
Frequency (MHz): 0.000 Nominal response (dB) 0.00	-1.00			+0.50
6.45 -0.10	-1.10			+0.40
12.90 -0.45	-1.45			+0.05
19.36 -1.02	-2.02			-0.52
25.81 -1.86	-2.86			-1.36
32.26 -3.00	-4.00			-2.50
38.71 -4.51	-5.96			-3.33
43.02 -5.71	-7.42			-4.15
45.17 -6.37	-8.20			-4.62
48.40 -7.42	-9.42			-5.42
51.63 -8.54	-11.22			-5.87
58.08 -10.93	-14.83			-7.03
64.53 -13.41	-18.41			-8.41
<i>10.66 Reference Receiver setting frequency response (80C04 and 80C11 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

80C00 Test Record (cont.)

Performance Test	Minimum	Incoming	Outgoing	Maximum
<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	-0.61			0.39
750	-0.95			0.05
1125	-1.52			-0.52
1500	-2.36			-1.36
1875	-3.50			-2.50
2250	-5.67			-3.35
2500	-7.25			-4.17
2625	-8.08			-4.66
3000	-10.74			-6.35
3375	-13.55			-8.31
3750	-16.41			-10.41
<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	-0.61			0.39
375	-0.95			0.05
562.5	-1.52			-0.52
750	-2.36			-1.36
937.5	-3.50			-2.50
1125	-5.67			-3.35
1250	-7.25			-4.17
1312.5	-8.08			-4.66
1500	-10.74			-6.35
1687.5	-13.55			-8.31
1875	-16.41			-10.41

80C00 Test Record (cont.)

Performance Test	Minimum	Incoming	Outgoing	Maximum
<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	-0.61			0.39
318.9	-0.95			0.05
478.4	-1.52			-0.52
637.9	-2.36			-1.36
797.4	-3.50			-2.50
956.8	-5.67			-3.35
1063	-7.25			-4.17
1116	-8.08			-4.66
1275	-10.74			-6.35
1435	-13.55			-8.31
1595	-16.41			-10.41
<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	-0.61			0.39
637.5	-0.95			0.05
956.3	-1.52			-0.52
1275	-2.36			-1.36
1594	-3.50			-2.50
1913	-5.67			-3.35
2125	-7.25			-4.17
2231	-8.08			-4.66
2550	-10.74			-6.35
2869	-13.55			-8.31
3188	-16.41			-10.41

80C00 Test Record (cont.)

Performance Test	Minimum	Incoming	Outgoing	Maximum
<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	-0.96			+0.74
3212.8 -0.45	-1.30			+0.40
4819.0 -1.02	-1.87			+0.17
6426.0 -1.86	-2.71			-1.01
8032.0 -3.00	-3.86			-2.16
9638.4 -4.51	-6.19			-2.83
10709.2 -5.71	-7.87			-3.55
11245.0 -6.37	-8.75			-3.99
12851.1 -8.54	-11.53			-5.56
14457.7 -10.93	-14.45			-7.41
16064.4 -13.41	-17.41			-9.41
<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 -0.11	-0.96			+0.74
3000 -0.45	-1.30			+0.40
4500 -1.02	-1.87			+0.17
6000 -1.86	-2.71			-1.01
7500 -3.00	-3.86			-2.16
9000 -4.51	-6.19			-2.83
10000 -5.71	-7.87			-3.55
10500 -6.37	-8.75			-3.99
12000 -8.54	-11.53			-5.56
13500 -10.93	-14.45			-7.41
15000 -13.41	-17.41			-9.41

80C00 Test Record (cont.)

Performance Test	Minimum	Incoming	Outgoing	Maximum
<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
<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

80C00 Test Record (cont.)

Performance Test	Minimum	Incoming	Outgoing	Maximum
<i>10GFC (10.51875 Gb/s) Reference Receiver setting frequency response (80C08B, 80C08C, and 80C11 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	-0.96			+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>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	-0.61			0.39
937.5	-0.95			0.05
1406	-1.52			-0.52
1875	-2.36			-1.36
2344	-3.50			-2.50
2813	-5.67			-3.35
3125	-7.25			-4.17
3281	-8.08			-4.65
3750	-10.74			-6.35
4219	-13.55			-8.31
4688	-16.41			-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>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	-0.61			0.39
1275	-0.95			0.05
1913	-1.52			-0.52
2550	-2.36			-1.36
3188	-3.50			-2.50
3826	-5.67			-3.35
4250	-7.25			-4.17
4462	-8.08			-4.65
5100	-10.74			-6.35
5738	-13.55			-8.31
6375	-16.41			-10.41

80C00 Test Record (cont.)

Performance Test			Minimum	Incoming	Outgoing	Maximum
<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	-0.61		0.39
	995.3		-0.45	-0.95		0.05
	1493		-1.02	-1.52		-0.52
	1991		-1.86	-2.36		-1.36
	2488		-3.00	-3.50		-2.50
	2986		-4.51	-5.67		-3.35
	3318		-5.71	-7.25		-4.17
	3484		-6.37	-8.08		-4.65
	3981		-8.54	-10.74		-6.35
	4479		-10.93	-13.55		-8.31
	4977		-13.41	-16.41		-10.41
<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}
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}

80C00 Test Record (cont.)

Performance Test			Minimum	Incoming	Outgoing	Maximum
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}
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}
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}
<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%

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

Main Instrument

These procedures check those characteristics that relate to the main instrument (system) that are listed as checked under *System* in *Specifications*. Refer to Table 1-1 on page 1-1.

Prerequisites

Be sure you have performed the *Prerequisites* on page 4-30 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.

NOTE. To perform the External direct trigger delay jitter, short-term optimized and locked to internal 10 MHz reference modes *procedure* you must upgrade to product software version 1.2.43 or higher. (Upgrade 1.2.43 is available as a download). You can determine the software version of the instrument under test by selecting *About TDS/CSA8000* in the *Help* menu on screen. For upgrade information see “*Contacting Tektronix*” on page xix.

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 that follow contain instructions based on the menus and controls supported by the version 1.3 release and later of the instrument firmware. The procedures will work for earlier versions of software, but the 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 29) 80E0X sampling module
Prerequisites	As listed under <i>Prerequisites</i> on page 4-30.

Setup Install the test hookup:

1. Install the 80E0X module into the left-most small module compartment of the instrument (see Figure 4-16 on page 4-78).
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.

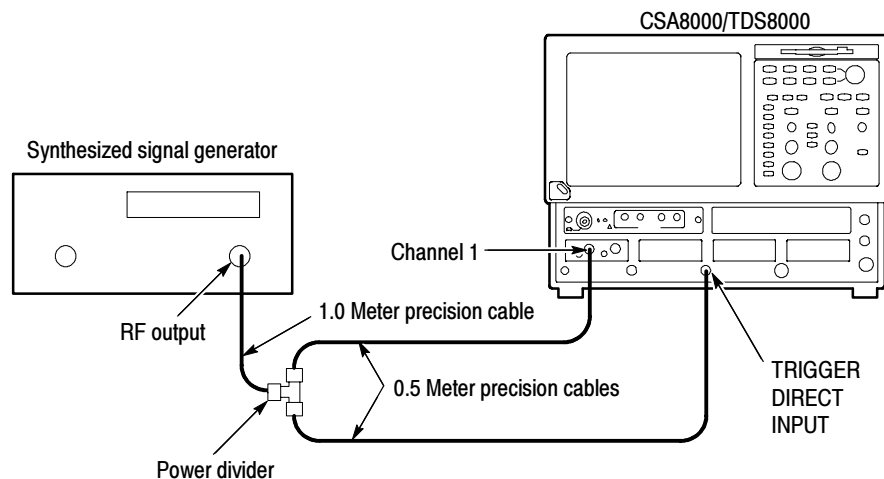


Figure 4- 16: Time interval accuracy test hookup

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.
 - select Metastability Reject.
 - select Auto 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.
 - 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, check On, 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, check On, 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 6.
8. Set the Horizontal Position to $1 \mu\text{s}$, and then repeat steps 3 through 6.
9. Repeat the setup (from step 7e) and the test for all channels for all 80E00 series modules installed.

End of Procedure

External Direct Trigger Level Accuracy

These procedures check those characteristics that relate to the system trigger and are listed as checked under *Warranted Characteristics* in *Specifications*. Refer to Table 1-3 on page 1-5.

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 29) 80E0X sampling module
Prerequisites	As listed under <i>Prerequisites</i> on page 4-30.

Setup

Install the test hookup:

1. Install the 80E0X module into the left-most small module compartment of the TDS8000 or CSA8000 instrument (see Figure 4-17).
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.

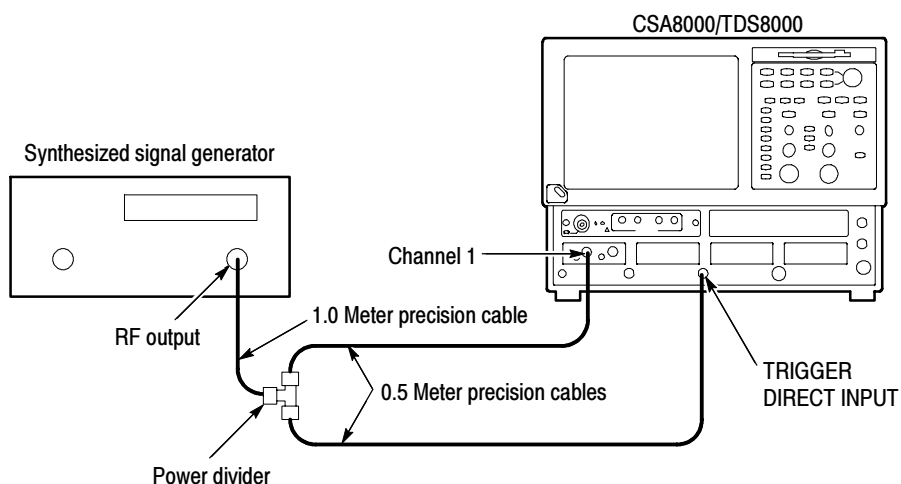


Figure 4-17: External direct trigger test hookup

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.
 - select Metastability Reject.
 - select Auto 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, check On, 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. 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:
 - a. Under Enhanced Triggering, set Metastability Reject to off (unchecked).
Verify that the trigger is operating.
 - b. Under Enhanced Triggering, set Metastability Reject to on (checked), and set High Frequency Triggering to on (checked).
Verify that the trigger is operating.
 - c. 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

These procedures check those characteristics that relate to the system trigger and are listed as checked under *Warranted Characteristics* in *Specifications*. Refer to Table 1-3 on page 1-5.

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 29) 80E0X sampling module
Prerequisites	As listed under <i>Prerequisites</i> on page 4-30.

Setup Install the test hookup:

1. Install the 80E0X module into the left-most small module compartment of the instrument (see Figure 4-18).
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.

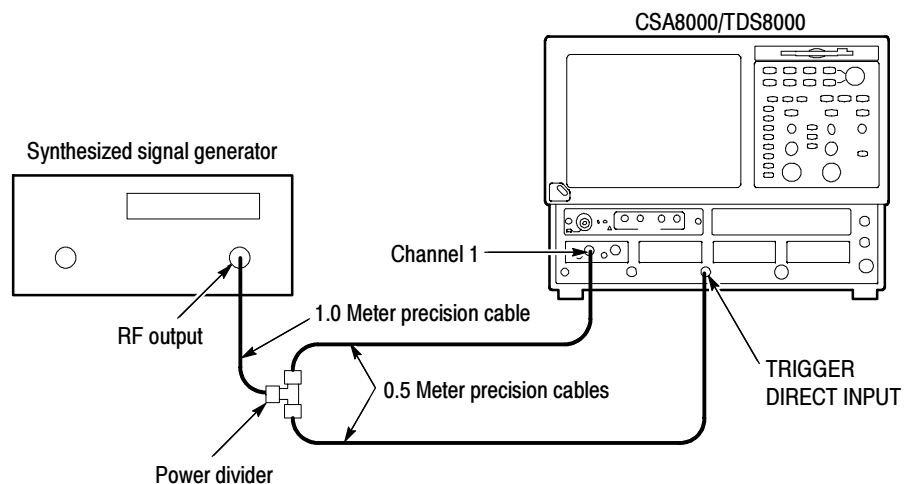


Figure 4-18: External direct trigger sensitivity test hookup

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.
 - select Metastability Reject.
 - select Auto 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.

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

1. In the Meas Setup dialog box:
 - a. Select Meas 1, check On, 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, check On, 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

These procedures check those characteristics that relate to the system trigger and are listed as checked under *Warranted Characteristics* in *Specifications*. Refer to Table 1-3, page 1-5.

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 29) 80E0X sampling module
Prerequisites	As listed under <i>Prerequisites</i> on page 4-30.

Setup Install the test hookup:

1. Install the 80E0X module into the left-most small module compartment of the instrument (see Figure 4-19).
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.

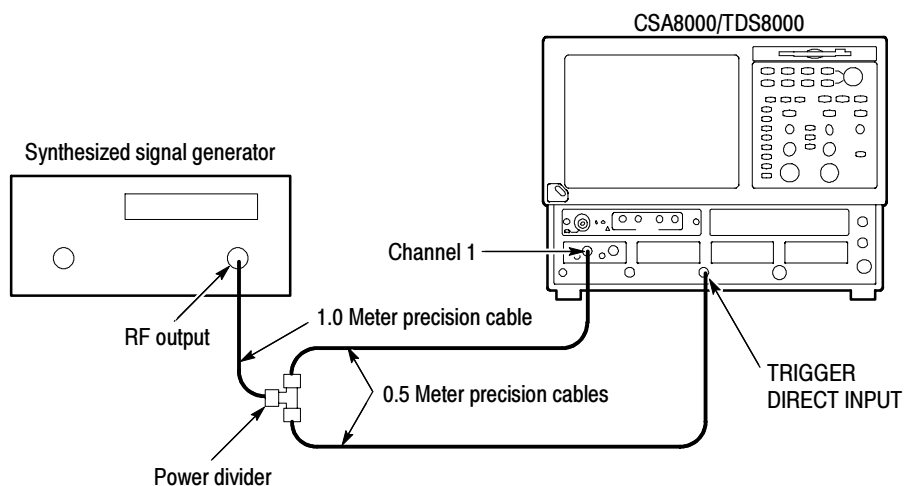


Figure 4-19: External direct trigger jitter test hookup

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.
 - select Metastability Reject.
 - select Auto 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.
 - 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:

NOTE. To use this procedure you must upgrade to product software version 1.2.43 or higher. (Upgrade 1.2.43 is available as a download). You can determine the software version of the instrument under test by selecting About TDS/CSA8000 in the Help menu on screen. For upgrade information see “Contacting Tektronix” on page xix.

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 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 20 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. 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:
 - 8000B and 8200 instruments: 1.4 ps
 - 8000 instrument: 1.7 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 100 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:
 - 8000B and 8200 instrument: 2.2 ps
 - 8000 instrument: 2.5 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 1 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:
 - 8000B and 8200 instrument: 11.2 ps
 - 8000 instrument: 11.5 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:
 - 8000B and 8200 instrument: 2.5 ps
 - 8000 instrument: 2.6 ps
- 28.** Repeat the setup (step 7) and the test for all channels for all 80E00 series modules installed.
- 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 (CSA/TDS8200 with 82A04 Module Only)

These procedures check those characteristics that relate to the CSA/TDS8200 system trigger and 82A04 phase correction and are listed as checked under *Warranted Characteristics* in *Specifications*. Refer to Table 1-3, page 1-5.

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 29) 80E0X sampling module 82A04 Phase Reference module
Prerequisites	As listed under <i>Prerequisites</i> on page 4-30.

Setup Install the test hookup (see Figure 4-19):

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.

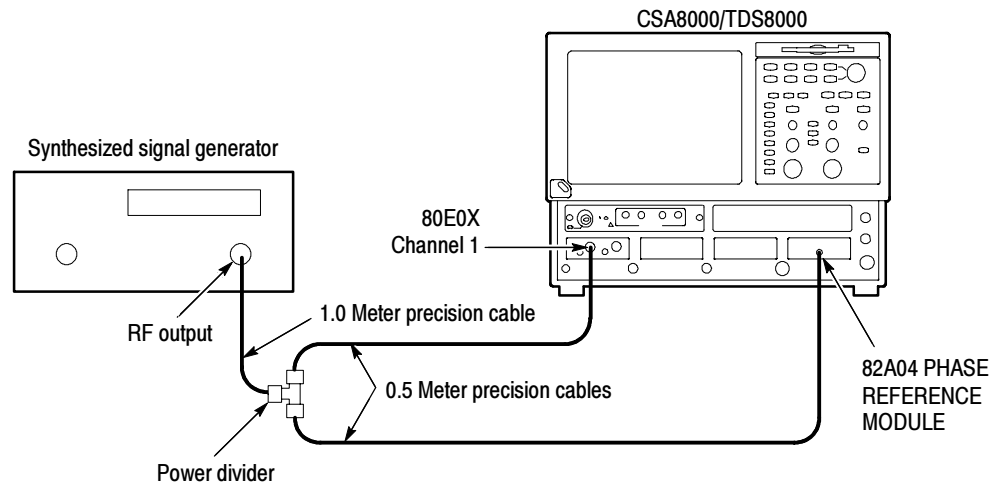


Figure 4-20: Phase corrected trigger jitter test hookup

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 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 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 20 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. 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 200 fs.
8. Disconnect the test setup.

End of Procedure

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

These procedures check those characteristics that relate to the system timebase and are listed as checked under *Warranted Characteristics* in *Specifications*. Refer to Table 1-2, page 1-3.

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 29) 80E0X sampling module
Prerequisites	As listed under <i>Prerequisites</i> on page 4-30.

Setup Install the test hookup:

1. Install the 80E0X module into the left-most small module compartment of the instrument (see Figure 4-21 on page 4-95).
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.

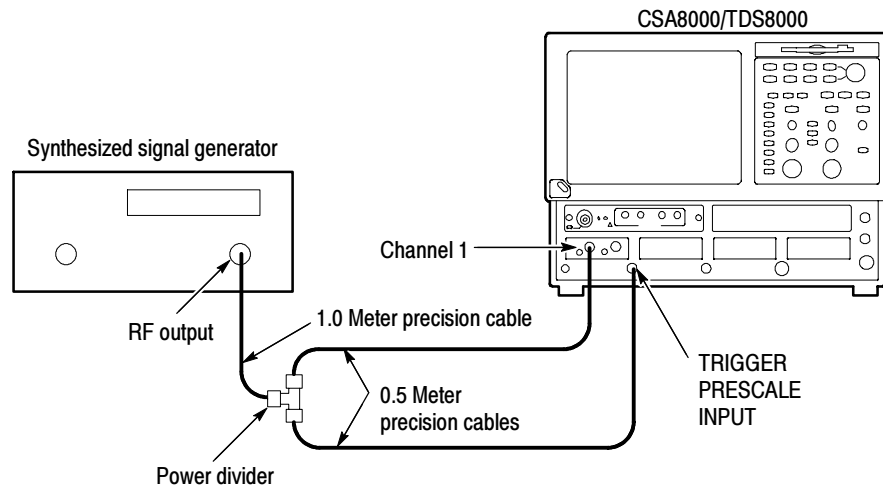


Figure 4-21: External prescaled test hookup

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.
 - select Metastability Reject.
 - select Auto 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.
 - 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, check On, 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, check On, 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 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:

 - 8000B and 8200 instruments: 1.5 ps
 - 8000 instrument: 1.7 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.
5. Repeat the setup (step 7) and test for all channels in all 80E00 series modules installed.

End of Procedure

External Prescaled Trigger Sensitivity

These procedures check those characteristics that relate to the system trigger and are listed as checked under *Warranted Characteristics* in *Specifications*. Refer to Table 1-3 on page 1-5.

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 29) 80E0X sampling module
Prerequisites	As listed under <i>Prerequisites</i> on page 4-30.

Setup Install the test hookup:

1. Install the 80E0X module into the left-most small module compartment of the instrument (see Figure 4-22 on page 4-97).
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.

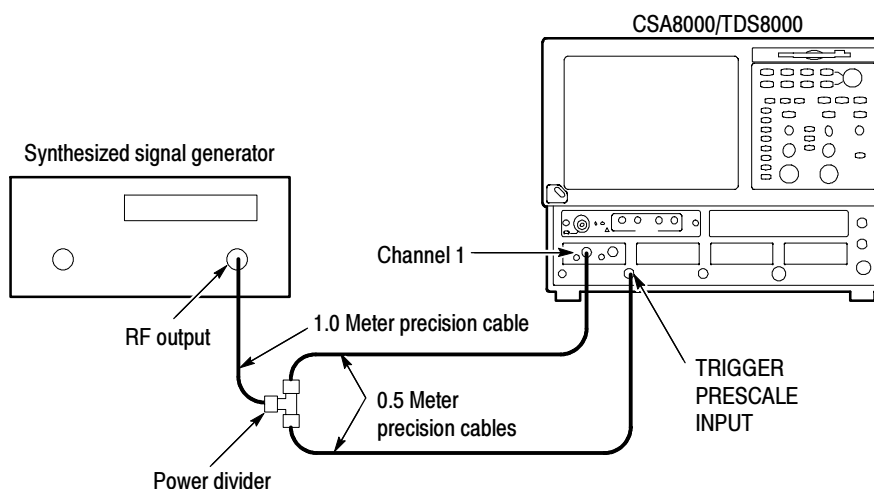


Figure 4-22: External prescaled trigger sensitivity test hookup

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:
 - 8000 and 8000B instruments: 1600 mV_{p-p} (800 mV displayed)
 - 8200 instrument: 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.
 - select Metastability Reject.
 - select Auto Mode.
 - d. In the Vert Setup dialog box:
 - set Scale to:
 - 8000 and 8000B instruments: 100 mV/division
 - 8200 instrument: 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.
 - 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, check On, 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, check On, 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:

- 8000 and 8000B instruments:

Synthesizer signal generator

Frequency	Level (amplitude measurement readout on instrument)
2 GHz	800 mV
3 GHz	600 mV
5 GHz	600 mV
10 GHz	600 mV

- 8200 instrument:

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

These procedures check those characteristics that relate to the DC calibration output and are listed as checked under *Warranted Characteristics* in *Specifications*. Refer to Table 1-6, page 1-10. Refer to Table 4-1 on page 4-31 for the equipment list.

Equipment required	Digital multimeter, such as the Keithley 2000-20 (Item 21) 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 (1.0m), male-to-male SMA connectors (Item 18) SMA female to BNC male connectors (Item 3) BNC to banana plug adapter 103-0095-00 (Item 6)
Prerequisites	At least one electrical (80E00 series) sampling module must be installed as outlined in its user manual.

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 (Item 5) to the DC CALIBRATION output on the front panel as shown in Figure 4-23.
4. Connect the SMA 50 Ω terminator (Item 41) to one of the Female legs of the T-connector.
5. Connect one end of a 50 Ω SMA coax cable (Item 18) to the other leg of the T-connector.
6. Connect the other end of the 50 Ω SMA coax cable (Item 18) to to a digital multimeter (DMM) (Item 21) using a SMA BNC adapter (Item 3) and a BNC to banana plug adapter (Item 6).

7. Set the multimeter to read DC volts.

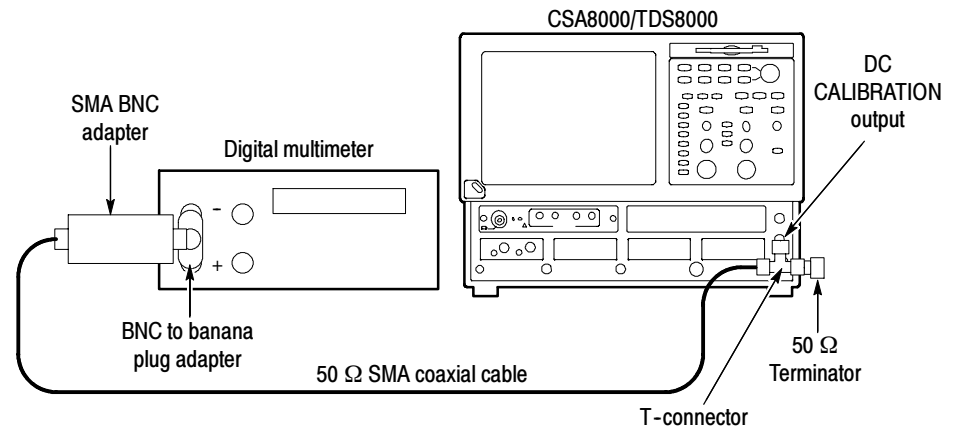


Figure 4-23: Hookup for DC calibration test

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 as checked specifications. Refer to Table 1-14 on page 1-21.

Prerequisites

Be sure you have performed the following prerequisites and the *Prerequisites* on page 4-30 before doing any procedures in this section.

- Install the 80E0X modules in one of the small compartments in the CSA8000 or TDS8000 instrument.
- Check 80E0X module push buttons: Push the select buttons channels 1 and 2 and observe that the yellow indicators lights to Power on. Push them again and observe that the lights turn off.

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. 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 that follow contain instructions based on the menus and controls supported by the version 1.3 release and later of the instrument firmware. The procedures will work for earlier versions of software, but the 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 under *Warranted Characteristics* in *Specifications*. Refer to Table 1-15, page 1-22.

Equipment required	Digital multimeter (Item 21) 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 4-30 and under <i>Prerequisites</i> on page 4-103.

Setup Install the test hookup:

1. Install the 80E0X module into the left-most small module compartment of the TDS8000 or CSA8000 instrument (see Figure 4-24).
2. Connect the Digital multimeter to Channel 1 of the 80E0X module. See Figure 4-24.

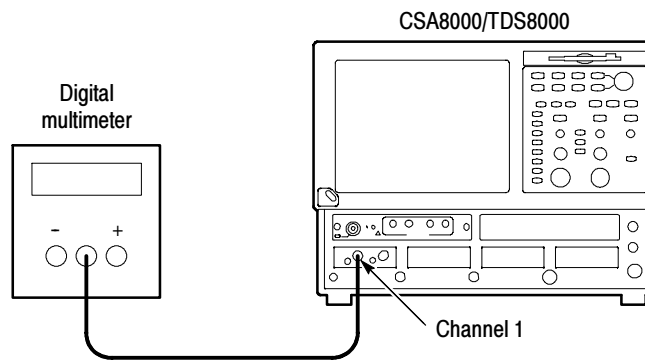


Figure 4-24: Input impedance test hookup

3. Set up the CSA8000/TDS8000 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 *InputR reverse* $\leq 50.5 \Omega$ and $\geq 49.5 \Omega$.
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 under *Warranted Characteristics* in *Specifications*. Refer to Table 1-15, page 1-22.

Equipment required	Digital Multimeter (Item 21) DC Power Supply (Item 22) 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 4-30 and under <i>Prerequisites</i> on page 4-103.



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 4-1.
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 4-25.
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 4-25.

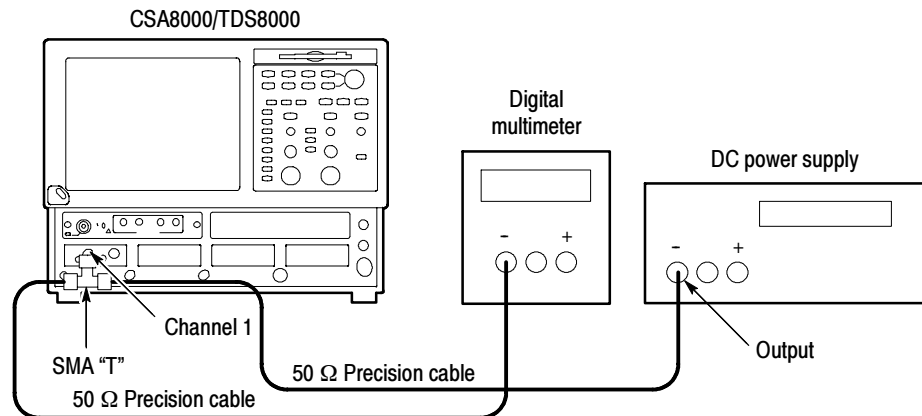


Figure 4-25: Vertical DC accuracy test hookup

6. Set up the CSA8000/TDS8000 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, check On, 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.
 - set Offset to -1100 mV.

Table 4-2: DC Voltage measurement accuracy

DC power supply settings	Offset settings	Accuracy limits
-1550 mV	-1100 mV	± 18.7 mV
-1350 mV	-1100 mV	± 14.7 mV
-1100 mV	-1100 mV	± 9.7 mV
-850 mV	-1100 mV	± 14.7 mV
-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

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

1. Select the DC supply voltage to the settings listed in Table 4-2, page 4-108.
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 CSA8000/TDS8000 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 4-2 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 4-2, 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 4-2, 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 4-3, 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 CSA8000/TDS8000 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, check On, 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 4-3 on page 4-111.
4. Read mean measurement and record it in the *Measured V, mV* and y columns, Table 4-3.
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 4-109)
 - b. Calculate $b =$ (see algorithm on page 4-109)
8. Calculate $Y = ax+b$ for all x .
9. Calculate the deviation of *Measured $V - Y$* for all x .

Table 4-3: 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 4-3 on page 4-111 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 under *Warranted Characteristics* in *Specifications*. Refer to Table 1-15, page 1-22.

Equipment required	No external equipment required
Prerequisites	As listed on page 4-30 and under <i>Prerequisites</i> on page 4-103.

Setup No test equipment hook up is required.

1. Set up the CSA8000/TDS8000 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 (200 kHz).
 - c. In the Acq Setup dialog box:
 - set Acquisition Mode to Sample.
 - under Stop After, check Condition and select Number of Acquisitions from the pull down menu. Enter 96 for the number of acquisitions.
 - d. 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%.
 - e. 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.

Test Follow this procedure to make the Random noise checks:

1. WfmDatabase menu, click Display Database, select C1
2. Histogram menu, select vertical, Enable Histogram.

3. Position 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 tested:
 - $80E01 \leq 2.3 \text{ mV}$.
 - $80E02 \leq 800 \mu\text{V}$.
 - $80E03 \leq 1.2 \text{ mV}$.
 - $80E04 \leq 1.2 \text{ mV}$.
 - $80E06 \leq 2.4 \text{ mV}$.
10. Repeat steps 1 through 7 for channel 2.

End of Procedure

Rise Time (80E02, 80E03, & 80E04)

These procedures check those characteristics that relate to the signal acquisition and are listed as checked under *Warranted Characteristics* in *Specifications*. Refer to Table 1-15, page 1-22.

Equipment required	Step generator (Item 20) One 50 Ω , precision coaxial cable, SMA connectors (Item 17)
Prerequisites	As listed on page 4-30 and under <i>Prerequisites</i> on page 4-103.

Setup Install the test hookup:

1. Install the 80E0X module into the left-most small module compartment of the TDS8000 or CSA8000 instrument. See Figure 4-26.
2. Connect one end of a 50 Ω coaxial cable to the INTERNAL CLOCK OUTPUT of the CSA8000/TDS8000. Connect the remaining end to the TRIGGER INPUT of a step generator.
3. Connect the OUTPUT of the Step generator to Channel 1 of the sampling module. See Figure 4-26. Turn on the step generator.

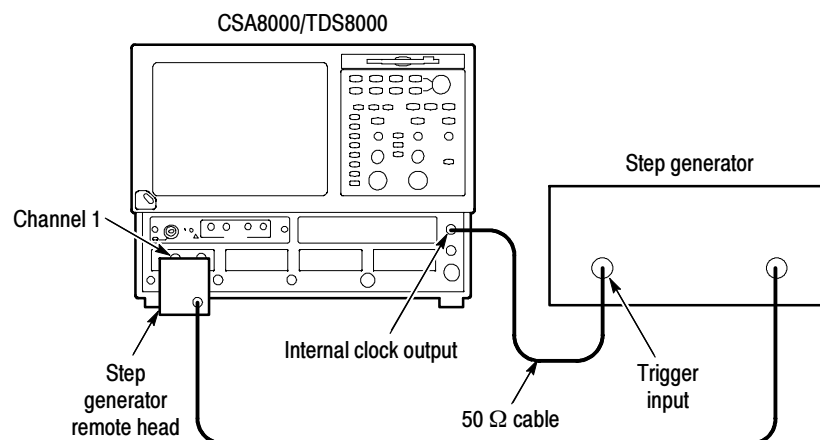


Figure 4-26: Rise Time hookup

4. Set up the CSA8000/TDS8000 as follows:
 - a. Press the DEFAULT Setup button.
 - b. Select C1 from the Waveform Selector menu on the controls bar at the bottom of the display (left corner) or press the Channel 1 push button on the front panel.

- 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 Average, 64 samples.
 - under Stop After, check Condition and select Average Complete from the pull down menu.
- e. In the Horz Setup dialog box:
 - set Record Length to 2000 points.
 - set Scale to 2 μ s/division.
 - set Position to 0 (this will revert to a minimum non-zero value).
 - set Horizontal Reference to 0%.
- f. In the Meas Setup dialog box:
 - select Meas 1, check On, 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 > High.
 - select Meas 2, check On, 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 > Low.
 - select Meas 3, check On, 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 - Timing > Rise Time.
 - with Meas 3 selected, turn on (check) Statistics (check box at bottom of dialog box) and set Weighting to 500.

Test Follow this procedure to make the rise time accuracy checks:

1. Press the CLEAR DATA button on the front panel.
2. Press the RUN/STOP button on the front panel.
3. Several cycles of a pulsed waveform should be displayed.
4. In the Meas Setup dialog box for Meas3 (Rise):
 - a. click the HiLo tab.
 - b. turn off (uncheck) Track High and Track Low.
 - c. set High to measured High value (in the Measurement box at the right of the display).
 - d. set Low to the measured Low value.
 - e. turn on (check) Annotations. There should be four dashed horizontal lines, with the top and bottom lines superimposed on the high and low levels of the waveform, showing that the high and low references are properly set for rise time measurement.
 - f. turn off (uncheck) Annotations.
5. In the Acq Setup dialog box, set Stop After to Run/Stop Button Only.
6. Press the CLEAR DATA button.
7. Press the RUN/STOP button to start acquisition.
8. Use the knobs in the front panel HORIZONTAL section to change the Scale to 10 ps/division, while adjusting the Position to keep the first rising edge of the step waveform centered on the display.
9. Press CLEAR DATA.
10. After about 20 seconds, note the Mean value of the Rise measurement. This is T_{sys} , the system rise time which is a combination of the step generator and the 80E0X module rise times.
11. Calculate T_{mod} , the 80E0X module rise time as follows:

$$T_{mod} = \sqrt{T_{sys}^2 - T_{gen}^2}$$

Where T_{gen} is the step generator rise time.

12. Check that T_{mod} meets the tolerances in Table 4-4.
13. Repeat the Setup and Test sections for Channel 2.

Table 4-4: Computed rise time

Module	T (computed)
80E02	≤ 28 ps
80E03, 80E04	≤ 17.5 ps

14. Disconnect the test setup.

End of Procedure

Analog Bandwidth (80E01)

These procedures check those characteristics that relate to the signal acquisition and are listed as checked under *Warranted Characteristics* in *Specifications*. Refer to Table 1-15, page 1-22. This check has two procedures that characterizes the reference signals. The last procedure characterizes the 80E01 sampling module.

Equipment required	Synthesized signal generator (Item 33) Power meter (Item 27) Power sensor (Item 28) Adapter, 2.4mm male-to-male (Item 1) Adapter, 2.4mm female-to-female (Item 2) Attenuator, 10 dB pad (Item 7) Cable, special, power/phase stability (Item 16)
Prerequisites	As listed on page 4-30 and under <i>Prerequisites</i> on page 4-103.

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. See Figure 4-27 on page 4-119.

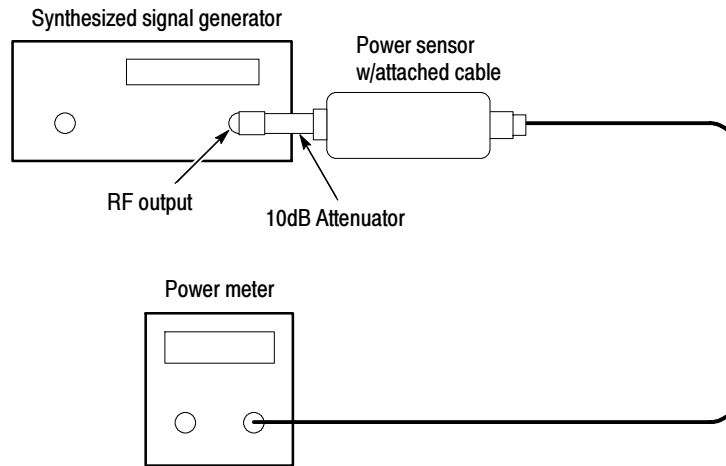


Figure 4-27: Power-reference hookup

Ref.-Characterization Measurements

Follow this procedure to characterize the reference signals:

1. Set the Synthesized signal generator to 0 dBm.

Table 4-5: Power reference

Frequency	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			
32 GHz			
36 GHz			
40 GHz			
44 GHz			
48 GHz			
50 GHz			

2. Set the signal frequency and the power meter frequency to each of the frequencies listed in the *Frequency* column, Table 4-5.
3. Record the readings on the power meter in the *Reference Level dBm* column.

Adapter-Characterization Setup

Install the test hookup to characterize the adapter:

1. Connect the 10 dB attenuator to the Synthesized signal generator. Connect the remaining end of the cable to the 10dB 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 4-28 on page 4-120.

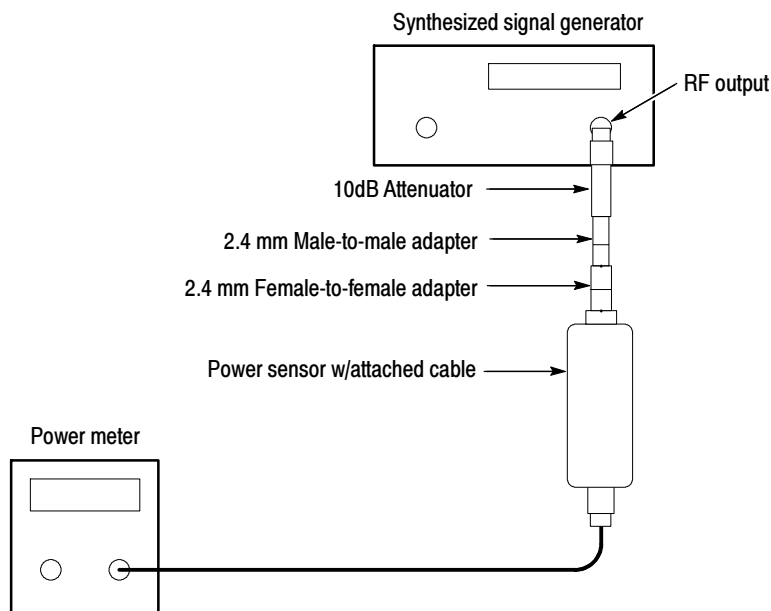


Figure 4-28: Adapter characterization hookup

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 4-5 on page 4-119.
2. Record the readings on the power meter in the *Reference level with the adapters dBm* column, Table 4-5 on page 4-119.
3. Calculate and record the *2.4 mm female-to-female adapter loss dB* in Table 4-5 on page 4-119 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 10dB 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 4-29 on page 4-121.

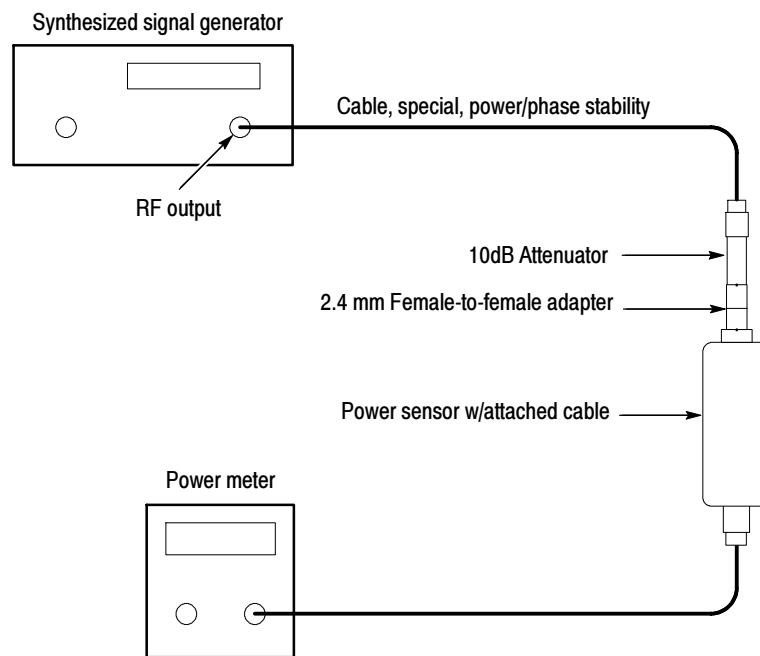


Figure 4-29: Measure reference signals

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 4-6 on page 4-122.
5. Adjust the RF signal level until the reading on the power meter 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 4-6 on page 4-122.

7. Record the Power meter reading in the *Measured RF level dBm* column, Table 4-6 on page 4-122.
8. Calculate and record the *Reference RF level* in Table 4-6 for all frequencies listed as follows:

(Measured RF level) - (2.4mm female-to-female adapter loss dB) column, in Table 4-5 on page 4-119.

Table 4-6: DUT (device under test) reference response

Frequency	Reference set level dBm	Measured RF level dBm	Reference RF level	80E01 measured level	DUT response
50 MHz					
4 GHz					
8 GHz					
12 GHz					
16 GHz					
20 GHz					
24 GHz					
28 GHz					
32 GHz					
36 GHz					
40 GHz					
44 GHz					
48 GHz					
50 GHz					

80E01 Test Setup

Install the test hookup to measure the 80E01 performance:

1. Install the 80E01 module into the left-most small module compartment of the TDS8000 or CSA8000 instrument (see Figure 4-30).
2. Connect one end of the cable to the Synthesized signal generator. Connect the remaining end of the cable to the 10dB attenuator.
3. Connect the remaining end of the 10 dB attenuator to the 80E01 sampling module. See Figure 4-30 on page 4-123.

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

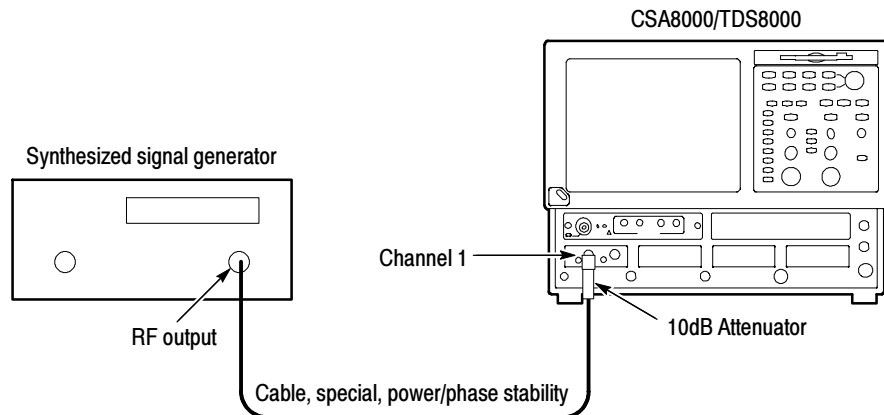


Figure 4-30: 80E01 reference signals hookup

4. Set up the CSA8000/TDS8000 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.
 - under Stop After, check Condition and select Average Complete from the pull down menu.

- 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 80E01 sampling module reference signals:

1. In the Meas Setup dialog box:
 - a. select Meas 1, check On, 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 4-6 on page 4-122.
3. Set the RF signal level listed in the *Reference Set Level dBm* column, Table 4-6.
4. In the Horz Setup dialog box, set the CSA8000/TDS8000 Horizontal Scale to $(1/\text{Frequency})$, where Frequency is the RF signal frequency.
5. Press the CLEAR DATA button on the front panel of the CSA8000/TDS8000.
6. Press the RUN/STOP button on the front panel of the CSA8000/TDS8000.
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 *80E01 Measured level* column, Table 4-6 on page 4-122.

10. Repeat steps 2 through 9 for all frequencies listed in the *Frequency* column, Table 4-6 on page 4-122.
11. Calculate the DUT response as the difference between the *80E01 Measured level* column and the *Reference RF level* column in Table 4-6 as:
$$(80E01 \text{ Measured level}) - (\text{Reference RF level})$$

Record the calculation results in the *DUT Response* column Table 4-6 on page 4-122.
12. Calculate all frequencies listed in the *Frequency* column, Table 4-6 on page 4-122.
13. Find the maximum and minimum power points between the 50 MHz and 50 GHz points in the *DUT Response* column, Table 4-6 on page 4-122.
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. Disconnect the test setup.

End of Procedure

50 MHz - 50 GHz Analog Bandwidth (80E06)

These procedures check those characteristics that relate to the signal acquisition and that are listed as checked under *Warranted Characteristics* in *Specifications*. Refer to Table 1-15, page 1-22.

This check first characterizes and compensates test equipment, and then measures and records the power of the reference and the loss due to the adapters used. At the end, it measures and computes the 80E06 bandwidth response.

NOTE. This procedure checks the lower bandwidth of the 80E06 module. It tests the 50 MHz to 50 GHz frequencies. The procedure *50 GHz - 65 GHz Analog bandwidth* on page 4-136 checks the upper bandwidths.

Equipment required	Scalar network analyzer (SNA) (Item 44) SWR Autotester (Item 45) Power meter (Item 47) Power sensor (Item 48) Power detector (Item 49) Open/Short (Item 51) Adapter, 2.4 mm male-to-male (Item 1) Adapter, 2.4 mm female-to-female (Item 2) Attenuator, 6 dB pad, Qty. 2 (Item 55) Cable, coaxial, Qty. 2 (Item (Item 17) Cable, special, power/phase stability (Item 16) Cable, 80E00 Series Extender (Item 56)
Prerequisites	As listed on page 4-30 and under <i>Prerequisites</i> on page 4-103.

SNA & Autotester Characterization

Do the following steps to store reflected reference levels in the Scalar Network Analyzer (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 4-31 as you perform the following substeps:
 - a. Connect the RF output of the SNA to the input of the Autotester through a 50Ω , cable (Item 21).

- b. Connect the reflected SWR output cable of the Auto Tester to Input B of the SNA.
- c. Connect the open end of the Open/Short directly to the DUT port of the SWR Autotester.

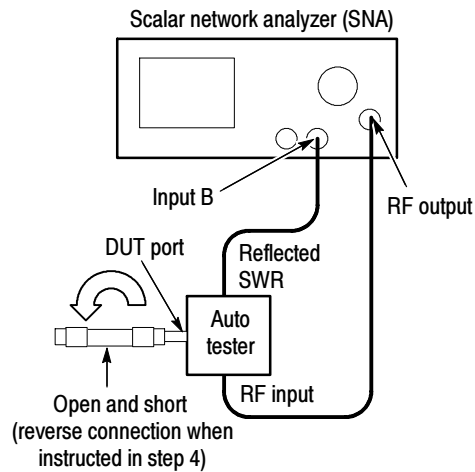


Figure 4-31: SNA/Autotester Characterization

2. Set the SNA as follows:
 - Output level +1 dBm
 - Frequency Multiplier 1 (Default)
 - Frequency Span 10 MHz to 50 GHz
 - No. of Averages 8
 - Channel 1 Off
 - Channel 2 Input B
 - Channel 2 Meas/ Mode Return Loss
3. Press the Calibration key to calibrate the SNA to the Autotester.
4. Follow the instructions on the SNA screen to complete the calibration.
5. Save the Cal/Setup in Memory Location 1.
6. Disconnect the test equipment from the SNA.

Power-Meter/Power Sensor Zero/Cal

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

1. Before turning on the Power meter, connect the Power sensor to the Power Ref output of the Power meter. See Figure 4-32.
2. Connect the attached cable end of the Power sensor to the channel input of the Power meter. See Figure 4-32.
3. Turn on the power meter, and Zero and Cal the Power meter to the Power sensor. See the user manual that came with your Power meter for Zero and Cal instructions.

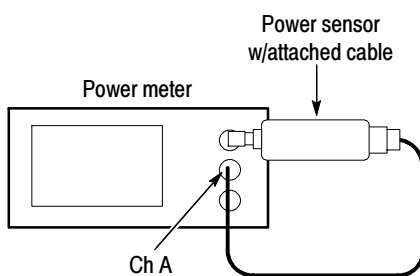


Figure 4-32: Power-reference characterization hookup

Measure the Power In

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

1. Refer to Figure 4-32 as you perform the following substeps:
 - a. Connect the cable end of the Power sensor to the input channel of the power meter.
 - b. Connect the Power sensor to the DUT port of the Autotester.
 - c. Connect the RF output of the SNA to the input of the Autotester through a cable.
 - d. Connect the output of the Autotester to Input B of the SNA through a cable.

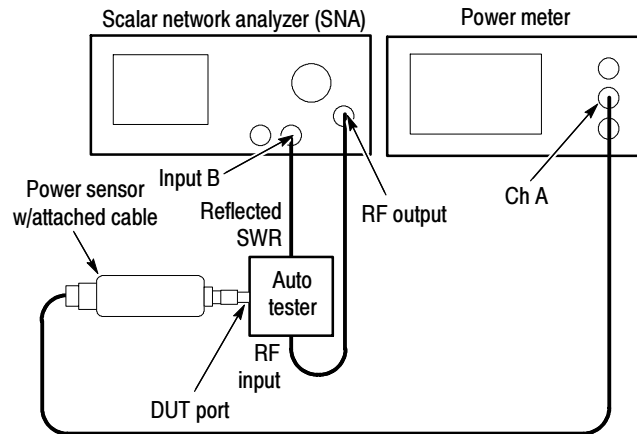


Figure 4-33: Hookup to measure Power in

2. On the SNA, recall the Setup/Cal from Memory Location 1.
3. Set the SNA Frequency Span to 0 Hz to set the SNA to single frequency mode.
4. Do all of the following substeps for each frequency listed in the *Frequency* column, Table 4-7 on page 4-134:
 - a. Set the SNA signal frequency and the Power meter frequency to a frequency listed in the *Frequency* column.
 - b. Turn Trace Hold on the SNA to On.
 - c. Record the reading on the power meter in the *Reference Level* column.
 - d. Turn Trace Hold on the SNA to Off.
5. Disconnect the test hookup.

Adapter Characterization

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

1. Refer to Figure 4-34 as you perform the following substeps:
 - a. Connect two 6 dB attenuators together.
 - b. Connect the Power detector to one end of the attenuators; connect the cable end of the Power detector to input A.
 - c. Connect the remaining end of the attenuators to the RF output of the SNA.

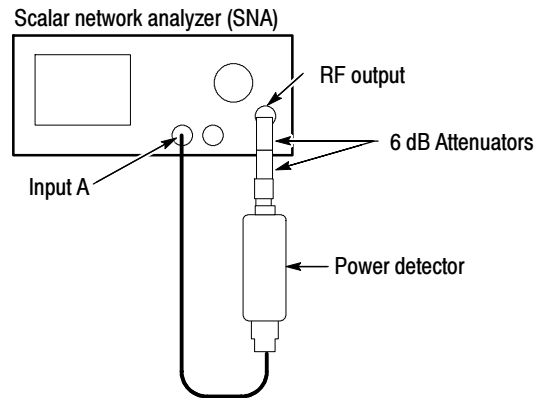


Figure 4-34: No Adapter hookup

2. Set the SNA as follows:
 - Output level +1 dBm
 - Frequency Multiplier 1
 - Frequency Span 0.01 to 50 GHz
 - No. of Averages 8
 - Channel 2 Off
 - Channel 1 Input A
 - Channel 2 Meas/ Mode Transmission
3. Press the Calibration key to calibrate the SNA to the Autotester.
4. Follow the instructions on the SNA screen to complete the calibration.
5. Refer to Figure 4-35 as you perform the following substeps:
 - a. Connect the one end of a 2.4 mm male-to-male adapter to one end of a 2.4 mm female-to-female adapter.
 - b. Install the set of combined adapters between the two 6 dB attenuators.

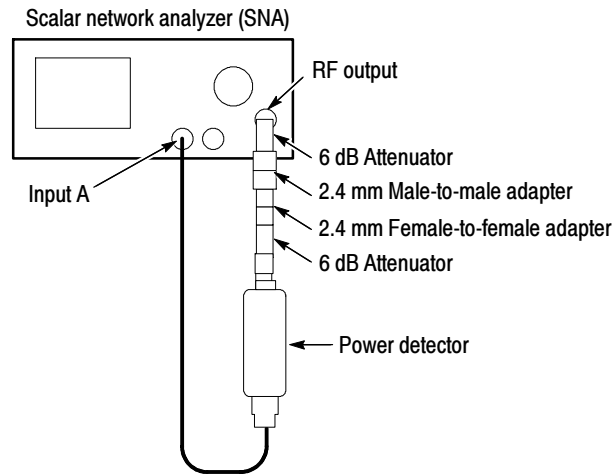


Figure 4-35: Adapter-loss hookup

6. Start the SNA measurement as follows:
 - a. Press select to start measurement
 - b. Press the Cursor On/Off key to turn on the cursor reading.
 - c. Set the Frequency Span to 0 Hz.
7. Set the signal frequency of the SNA to each of the frequencies listed in the *Frequency* column, Table 4-7 on page 4-134.
8. Read the power loss from the SNA screen and record it for each frequency in the *Adapter Loss* column, Table 4-7 on page 4-134.

80E06 HF Setup and Test

Do the following procedure to set up and test the 80E06 HF Response.

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 4-36 as you perform the following substeps:
 - a. Install the Extender into the leftmost slot of the CSA8000/TDS8000 instrument.
 - b. Connect the other end of the Extender to the 80E06 to be tested.
 - c. Connect one end of a 2.4 mm female-to-female adapter to the DUT port on the Autotester.

- d. Connect the remaining end 2.4 mm female-to-female adapter to the input channel of the 80E06.
- e. Connect the RF output of the SNA to the input of the Autotester through a 50 Ω , cable (Item 56).

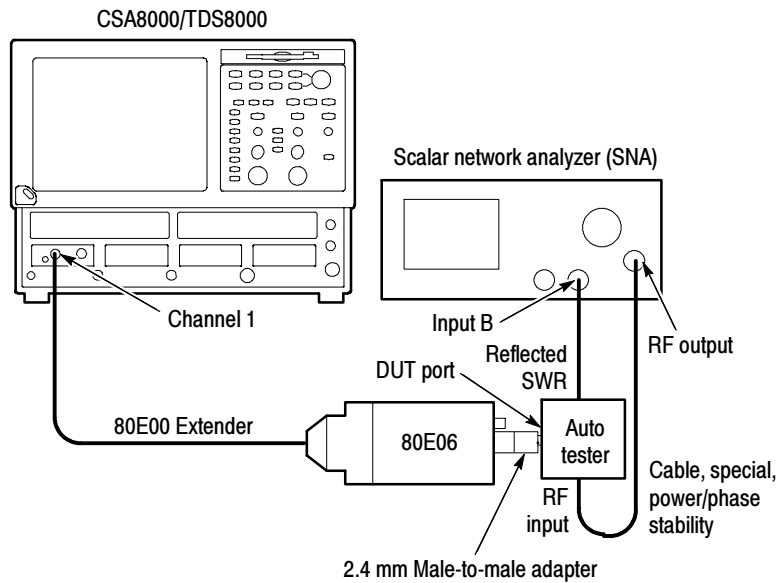


Figure 4- 36: 80E06 HF response hookup

- f. Connect the Reflected SWR output cable of the Autotester to the Input B of the SNA.
2. Set up the CSA8000/TDS8000 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.
 - under Stop After, check Condition and select Number of Acquisitions from the pull down menu.
 - set the Number of Acquisitions count to 64.

- d. 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%.
 - e. In the Vert Setup dialog box:
 - set Scale to 100 mV/division (default)
 - set Offset to 0 mV (default)
 - f. 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.
 - check the On box next to Meas1.
3. Set the SNA as follows:
 - Recall the Setup/Cal stored in Memory Location 1.
 - Output level +1 dBm
 - Frequency Multiplier 1
 - Frequency Span 0 Hz, to put it in single frequency mode
 4. Perform the following substeps for all frequencies listed in the *Frequency* column, Table 4-7 on page 4-134:
 - a. Set the SNA signal frequency to the first of the frequencies listed in the *Frequency* column, Table 4-7 on page 4-134.
 - b. In the Horz Setup dialog box, set the CSA8000/TDS8000 Horizontal Scale to $(1/\text{Frequency})$, where Frequency is the RF signal frequency.
 - c. Turn Trace Hold on the SNA to On.
 - d. Press the CLEAR DATA button on the front panel of the CSA8000/TDS8000.
 - e. Press the RUN/STOP button on the front panel of the CSA8000/TDS8000.

- f. Record amplitude reading readout and use the value as **AMPLITUDE** (Volts) in the substep g. that follows.
 - g. Convert Volts to dBm as follows:

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

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

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

$$dBm = 10 * \log(P1 / 0.001)$$
 - h. Record dBm in the *Measured level* column, Table 4-7 on page 4-134.
 - i. Turn Trace Hold on the SNA to Off.
5. Perform the following substeps for all frequencies listed in the *Frequency* column, Table 4-7 on page 4-134:
- a. Calculate the 80E06 response as the difference between the *Measured level* column and the sum of the *Reference level* column and 1/2 the *Adapter Loss* column in Table 4-6 as:

$$80E06 \text{ resp.} = (\text{Measured level}) - (\text{Reference level} + \text{Adapter Loss}/2)$$
 - b. Record the calculation results in the *80E06 response* column Table 4-7 on page 4-134.
6. Find the maximum and minimum power points between the 50 MHz and 50 GHz points in the *80E06 response* column, Table 4-7 on page 4-134.
7. Check that the following statements are true (the specification is ± 3.0 dB referenced to the 50 MHz):
- The maximum power minus the power at 50 MHz is less than +3.0 dB.
 - The minimum power minus the power at 50 MHz is greater than -3.0 dB.

Table 4-7: 80E06 bandwidth response (50 MHz - 50 GHz)

Frequency ¹	Reference level	Adapter loss	Measured level	80E06 response
50 MHz				
4 GHz				
8 GHz				
12 GHz				
16 GHz				
20 GHz				

Table 4-7: 80E06 bandwidth response (50 MHz - 50 GHz) (cont.)

Frequency ¹	Reference level	Adapter loss	Measured level	80E06 response
24 GHz				
28 GHz				
32 GHz				
36 GHz				
40 GHz				
44 GHz				
48 GHz				
50 GHz				

¹ Frequencies above 50 GHz for the 80E06 module are tested in the next procedure.

8. Disconnect the test setup.

End of Procedure

50 GHz - 65 GHz Analog Bandwidth (80E06)

These procedures check those characteristics that relate to the signal acquisition and are listed as checked under *Warranted Characteristics* in *Specifications*. Refer to Table 1-15, page 1-22.

This procedure checks the upper bandwidth of the 80E06 module. It tests the >50 GHz to 65 GHz frequencies.

NOTE. This procedure checks the upper bandwidth of the 80E06 module. It tests the >50 GHz to 65 GHz frequencies. The procedure *50 MHz - 50 GHz Analog bandwidth* on page 4-126 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 54) Adapter, Wave Guide-to-1.85 mm male (Item 52) Adapter, Wave Guide-to-1.85 mm female (Item 53) 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 4-30 and under <i>Prerequisites</i> on page 4-103. You must have performed the procedure <i>50 MHz - 50 GHz Analog Bandwidth (80E06)</i> on page 4-126.

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 4-37 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.

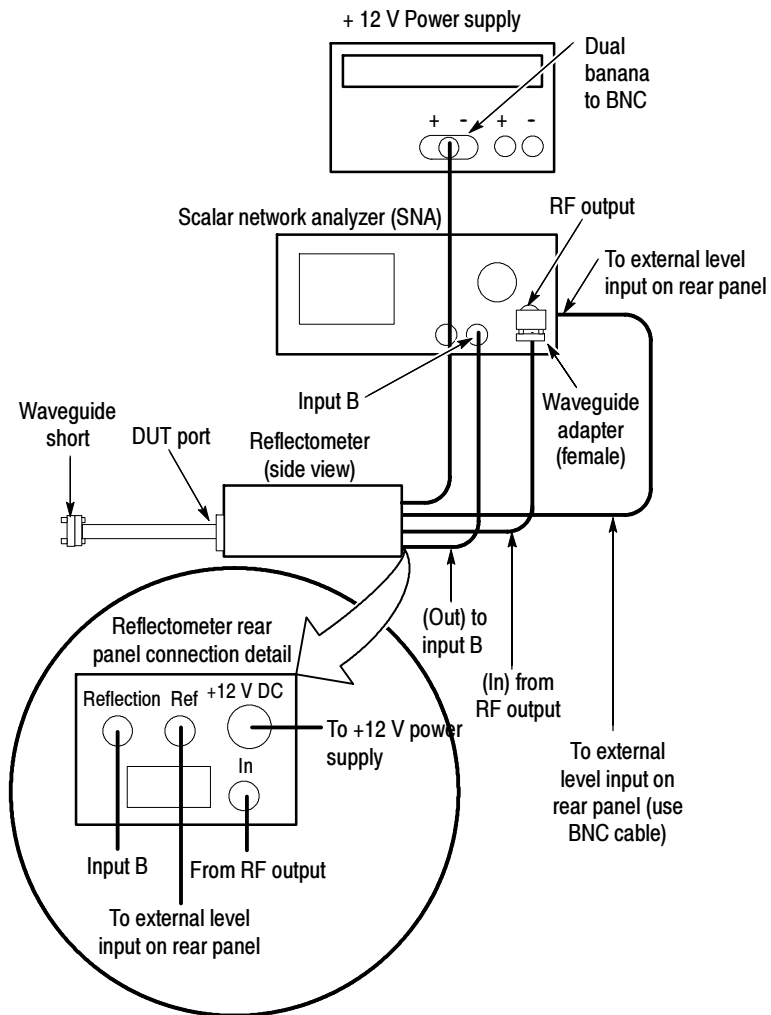


Figure 4- 37: SNA/Waveguide Characterization

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 4-38.
2. Connect the attached cable end of the Waveguide power sensor to the channel input of the Power meter. See Figure 4-38.
3. Zero and Cal the Power meter to the Waveguide power sensor.

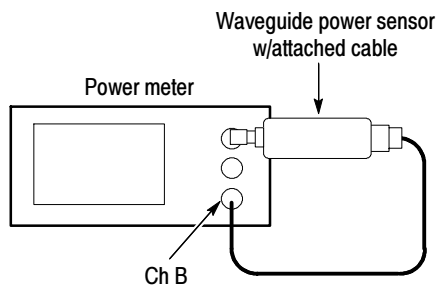


Figure 4-38: Power-reference characterization hookup

Measure the Power In

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

1. Refer to Figure 4-39 as you perform the following substeps:
 - a. Start with the test hookup as was left from step 6 on page 4-139.
 - 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.

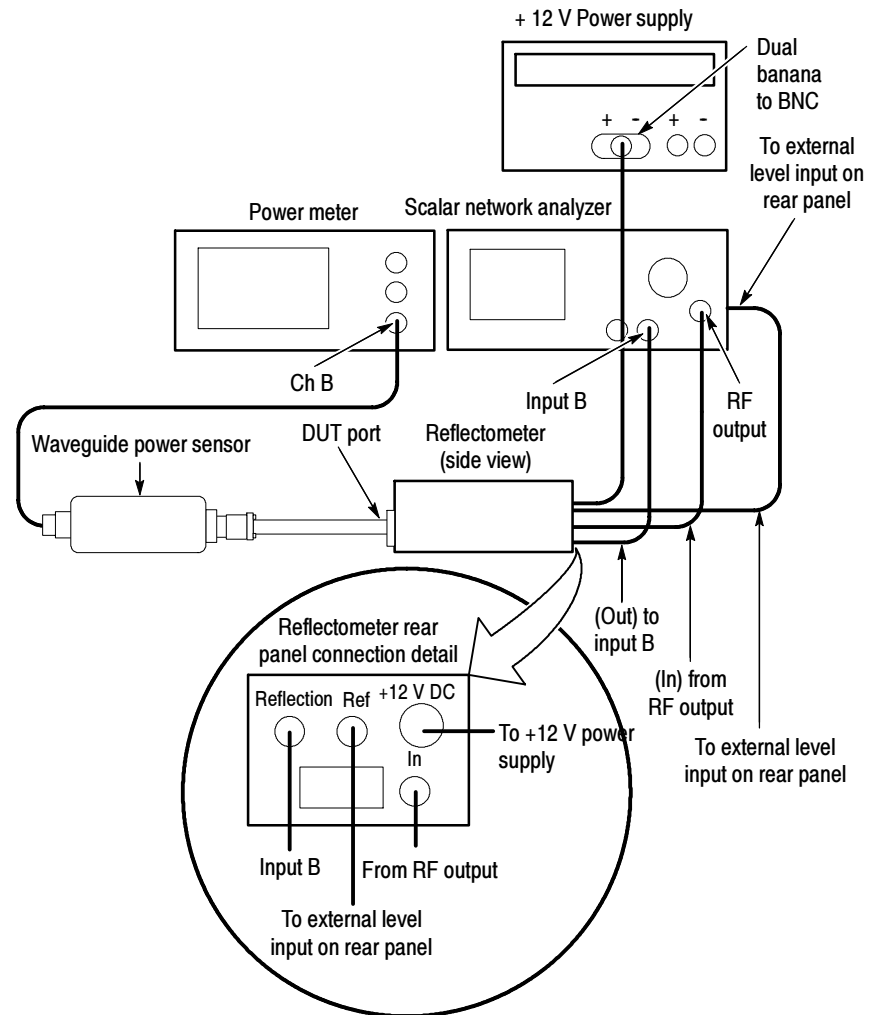


Figure 4-39: Hookup to measure Power-in

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 for all frequencies listed in the *Frequency* column, Table 4-7 on page 4-134.
 - a. Set the SNA signal frequency and the Power meter frequency to each of the frequencies listed in the *Frequency* column, Table 4-8 on page 4-147.
 - b. In the Horz Setup dialog box, set the CSA8000/TDS8000 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 4-40 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 4-40.

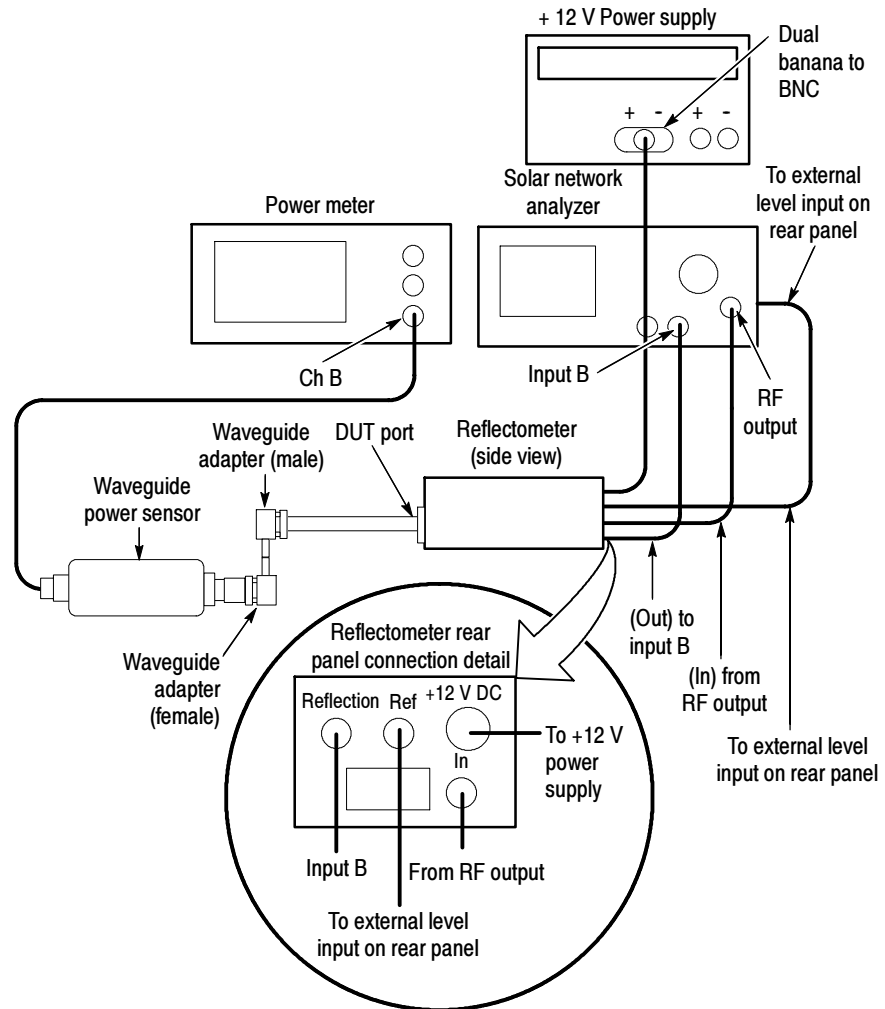


Figure 4-40: Adapter-loss hookup

2. Perform the following substeps for all frequencies listed in the *Frequency* column, Table 4-7 on page 4-134.
 - a. Set the signal frequency and the power meter frequency to each of the frequencies listed in the *Frequency* column, Table 4-8 on page 4-147.
 - 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 4-8 on page 4-147.
 - 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 remaining of the test hookup intact for use in the next procedure.

80E06 HF Setup and Test

Do the following procedure to set up and test the 80E06 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 4-41 as you perform the following substeps:
 - a. Start with the test hookup as left from step 3 in the last procedure.

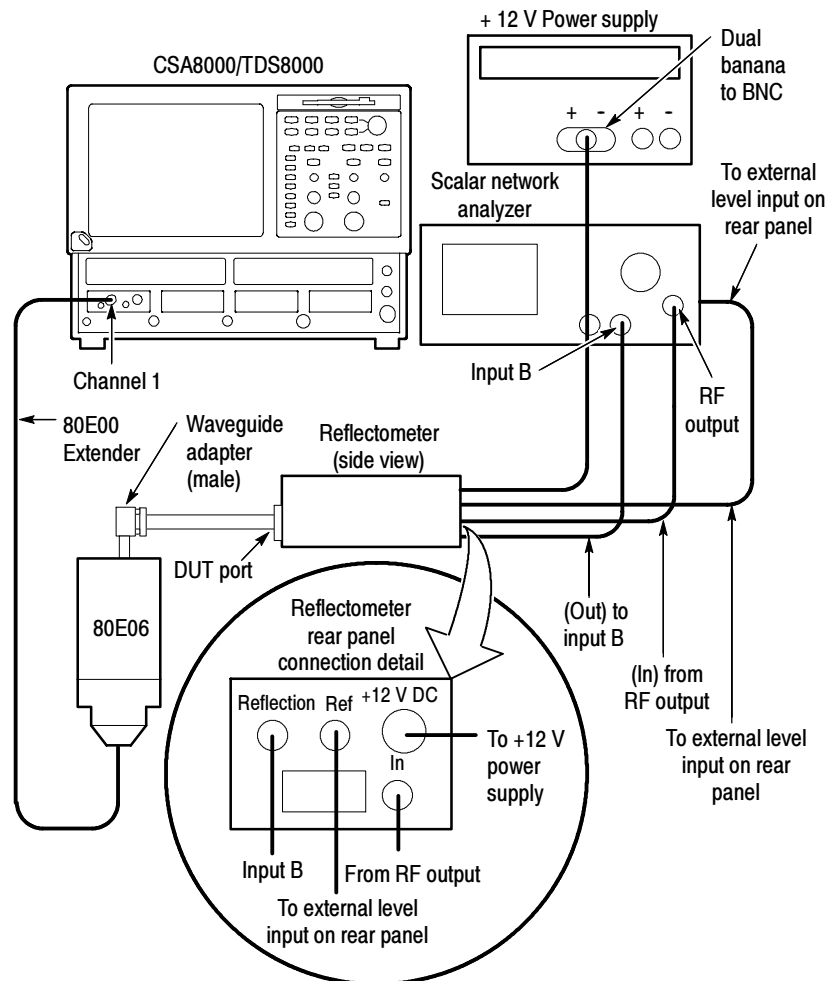


Figure 4-41: 80E06 HF response hookup

- b. Install the 80E00 Extender in the leftmost slot of the CSA8000/TDS8000 instrument.
 - c. Connect the cable end of the 80E00 Extender to the 80E06 to be tested.
 - d. Connect the one end of a Waveguide-to-1.85 mm male adapter to the input channel of the 80E06 to be tested. Connect the other end to the Waveguide section.
2. Set up the CSA8000/TDS8000 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.
 - under Stop After, check Condition and select Number of Acquisitions from the pull down menu.
 - Set the Number of Acquisitions count to 64.
 - d. 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%.
 - e. In the Vert Setup dialog box:
 - set Scale to 100 mV/division (default)
 - set Offset to 0 mV (default)
 - f. 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.
 - check the On box next to Meas1.
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 for all frequencies listed in the *Frequency* column, Table 4-8 on page 4-147.
 - a. Set the SNA signal frequency to the first of the frequencies listed in the *Frequency* column, Table 4-8 on page 4-147.
 - b. Turn Trace Hold on the SNA to On.
 - c. Press the CLEAR DATA button on the front panel of the CSA8000/TDS8000.
 - d. Press the RUN/STOP button on the front panel of the CSA8000/TDS8000.
 - 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:

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

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

$$P_1 = V_{rms} * V_{rms} / 50$$

$$\text{dBm} = 10 * \log(P_1 / 0.001)$$
 - g. Record dBm in the *Measured level* column, Table 4-8 on page 4-147.
 - h. Turn Trace Hold on the SNA to Off.
6. Perform the following substeps for all frequencies listed in the *Frequency* column, Table 4-8 on page 4-147:
 - a. Calculate the Adapter Loss as the difference between the *Reference level (with adapters)* column and the *Reference level (no adapters)* column in Table 4-8:

$$\text{Adapter Loss} = (\text{Ref level with adapters}) - (\text{Ref level no adapters})$$
 - b. Record the calculation results in the *Adapter Loss* column of Table 4-8.

- c. Calculate the 80E06 response using the values in the *Measured level* column and the *Reference level* column in Table 4-8 as:

$$80E06 \text{ Response} = (\text{Measured level}) - (\text{Ref level with no adapters} + \text{Adapter Loss}/2)$$

$$80E06 \text{ Response} = (\text{Measured level}) - (\text{Ref level with adapters} + \text{Adapter Loss}/2) - (\text{Measured level}) + (\text{Ref level with adapters}) + (\text{Adapter Loss}) \div 2$$

- d. Record the calculation results in the *80E06 Response* column Table 4-8 on page 4-147.
7. Find the maximum and minimum power points between the 50 MHz and 65 GHz points in the *90E06 Response* column, Table 4-8 on page 4-147.

Table 4- 8: 80E06 bandwidth response (55 GHz - 65 GHz)

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

8. Note the power at 50 MHz calculated as the 80E06 response recorded in Table 4-7 on page 4-134 of the procedure *50 MHz -50 GHz Analog bandwidth (80E06)*. You will use the 50 MHz power in the next step.
9. Find the maximum power and minimum power in the *80E06 response* column of Table 4-8. 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. Disconnect the test setup.

End of Procedure

TDR-System Reflected Rise Time (80E04)

These procedures check those characteristics that relate to the TDR system (80E04 only) and are listed as checked under *Warranted Characteristics* in *Specifications*. Refer to Table 1-16, page 1-24.

Equipment required	Airline (Item 10) Terminator, cap, shorting (Item 32)
Prerequisites	As listed on page 4-30 and under <i>Prerequisites</i> on page 4-103.

Setup Install the test hookup:

1. Connect a shorting terminator cap to the female connector of the airline. See Figure 4-42.
2. Connect the airline to channel 1 of the module.

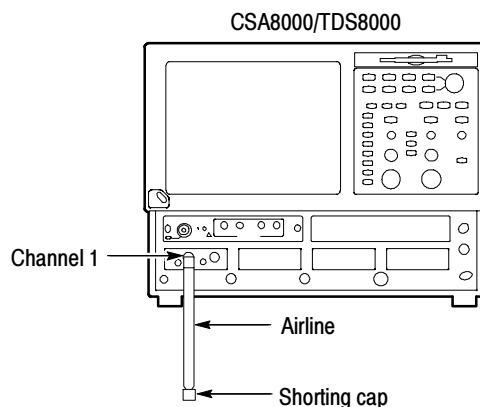


Figure 4-42: TDR reflected rise time hookup

3. Press the DEFAULT SETUP button on the CSA8000/TDS8000 front panel.
4. Set up the CSA8000/TDS8000 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 500 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, check On, 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 CSA8000/TDS8000 front panel.
2. Press the RUN/STOP button on the CSA8000/TDS8000 front panel.
3. Check that the measured fall time (reflected rise time) is ≤ 35 ps, for the positive edge polarity.
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 (ρ), 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) is ≤ 35 ps, for the negative edge polarity.
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 (80E04 only) and are listed as checked under *Warranted Characteristics* in *Specifications*. Refer to Table 1-16, page 1-24.

Equipment required	Terminator, 50 Ω coaxial terminator, K male (Item 31)
Prerequisites	As listed on page 4-30 and under <i>Prerequisites</i> on page 4-103.

Setup Install the test hookup:

1. Install the 80E04 module into the left small module compartment of the CSA8000/TDS8000.
2. Check the aberrations of channel 1, positive TDR polarity as follows:
3. Connect a 50 Ω coaxial terminator to channel 1. See Figure 4-42.

NOTE. To minimize extraneous aberrations, use the recommended terminator listed in the above *Equipment required* table; item 7.

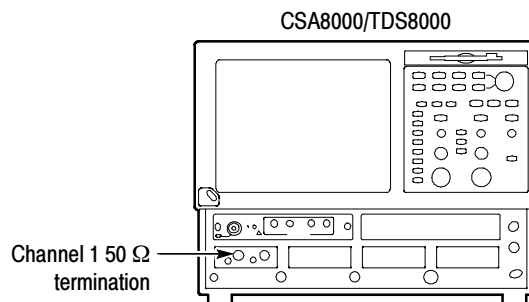


Figure 4-43: TDR system step response aberrations hookup

4. Press the DEFAULT SETUP button on the CSA8000/TDS8000 front panel.
5. Set up the CSA8000/TDS8000 as follows:
 - a. In the TDR Setup dialog box click on C1 Preset.
 - 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, check On, 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 $m\Omega$, making sure to take down the proper sign. This will be used as HiRef, the high reference level for aberration measurements. The low reference level is -1.0 Ω (rho).

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 (minimum).
 - 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 $m\Omega$ /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, check On, 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, check On, 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 m Ω for a 1 Ω step. Since the reference is -1 Ω , the Max and Min values should be within -1.030 to -0.970 Ω 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 m Ω units, not Ω):

- positive aberration (%) = $(1000 + \text{Max}) * 0.1$
- negative aberration (%) = $(1000 + \text{Min}) * 0.1$

For example: if Max = -989 m Ω and Min = -1.003 Ω ,
 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 $m\rho$ 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 mQ for a 1 Q step. The reference level is HiRef, from step 5e on page 4-151 of the setup procedure.
 - i. Calculate the peak aberrations in percent using the formulas (with Max, Min, and HiRef in mQ, not Q):
 - positive aberration (%) = $(\text{Max} - \text{HiRef}) * 0.1$
 - negative aberration (%) = $(\text{Min} - \text{HiRef}) * 0.1$

For example: if Max = +11 mQ and HiRef = -5 mQ,
 positive aberration (%) = $(+11 - (-5)) * 0.1 = +1.6$
 - j. Check that the aberrations calculate 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 mQ for a 1 Q step. The reference level is HiRef, from step 5e on page 4-151 of the setup procedure.

- f.** Calculate the peak aberrations in percent using the formulas (with Max, Min, and HiRef in mQ, not Ω):

 - positive aberration (%) = $(\text{Max} - \text{HiRef}) * 0.1$
 - negative aberration (%) = $(\text{Min} - \text{HiRef}) * 0.1$
- g.** Check that the aberrations calculated in step f for the region >5 ns after the edge are within $\pm 1\%$. If recording data on the Test Record, record the largest (positive or negative) value.
- 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 5a on page 4-150. No other changes to the procedures are needed, since in rho (Ω) 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

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 1-21 and Table 1-23 of the *Optical Modules Specifications* starting on page 1-31.

Prerequisites

Be sure you have performed the appropriate *Prerequisites* on page 4-30 before doing any procedures in this section.

STOP. *The procedures that follow contain instructions based on the menus and controls supported by the release versions 1.3 and later of the instrument firmware. The procedures will work for earlier versions of software, but the control and menu names may vary slightly.*

Proper operation of the optical sampling modules requires that the appropriate TDS8000/CSA8000 application software is installed. The versions according to the specific module are shown in Table 4-9.

Table 4-9: Application software version required

Modules ¹	Software version
80C01, 80C02, 80C03	1.0.0 or greater
80C04, 80C04-CR1	1.1.0 or greater
80C04-CR2, 80C05, 80C06	1.2.0 or greater
80C07, 80C08, 80C09	1.3.0 or greater
80C08B, 80C10	1.4.0 or greater
80C07B, 80C08C, 80C11	1.5.0 or greater
80C12	2.1.0 or greater

¹ **Applies to all clock recovery options unless noted otherwise.**

Dark Level & 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	CSA8000 or TDS8000 Series instrument Terminator, 50 Ω coaxial, SMA male (item 31); used with optical sampling modules with clock recovery (CR)
Prerequisites	As listed on page 4-30 and under <i>Prerequisites</i> on page 4-157.

Setup Install the test hookup and preset the CSA/TDS8000 series instrument controls:

1. Install the 80C0X Optical Sampling Module into Channel 1 of the CSA/TDS8000 series CSA/TDS8000 series instrument (see Figure 4-44).

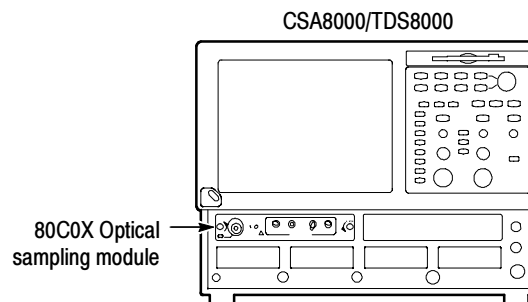


Figure 4-44: Dark level and vertical equivalent optical noise test hookup

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 CSA/TDS8000 series 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 and 80C10 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.
 - 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.
10. Press the CLEAR DATA button on the CSA/TDS8000 series 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.*

11. 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 4-10 for the optical sampling module that you are testing.
12. Repeat steps 9 through 11 for each bandwidth and filter available for the optical sampling module. Refer to Table 4-10.

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 4-10: 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-16/2.5 Gb	<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}
	10.66	<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}

Table 4- 10: 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
80C07	2 GHz	<500 nW	N/A	N/A
	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}
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}

Table 4-10: 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 (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}
80C08 (1310 nm and 1550 nm)	10GBASE-W	<1 μW	<3.0 μW_{RMS}	<3.5 μW_{RMS}
	10GBASE-R	<1 μW	<3.0 μW_{RMS}	<3.5 μW_{RMS}
	10 GHz	<1 μW	<3.0 μW_{RMS}	<3.5 μW_{RMS}
80C08 (850 nm)	10GBASE-W	<1 μW	<5.0 μW_{RMS}	<5.5 μW_{RMS}
	10GBASE-R	<1 μW	<5.0 μW_{RMS}	<5.5 μW_{RMS}
	10 GHz	<1 μW	<5.0 μW_{RMS}	<5.5 μW_{RMS}
80C08 (780 nm)	10GBASE-W	<1 μW	<6.0 μW_{RMS}	<6.6 μW_{RMS}
	10GBASE-R	<1 μW	<6.0 μW_{RMS}	<6.6 μW_{RMS}
	10 GHz	<1 μW	<6.0 μW_{RMS}	<6.6 μW_{RMS}
80C08B (1310 nm and 1550 nm)	10GBASE-W	<1 μW	<3.0 μW_{RMS}	<3.5 μW_{RMS}
	10GBASE-R	<1 μW	<3.0 μW_{RMS}	<3.5 μW_{RMS}
	10 GHz	<1 μW	<3.0 μW_{RMS}	<3.5 μW_{RMS}
	OC-192/STM-64	<1 μW	<3.0 μW_{RMS}	<3.5 μW_{RMS}
	10GFC	<1 μW	<3.0 μW_{RMS}	<3.5 μW_{RMS}
80C08B (850 nm)	10GBASE-W	<1 μW	<5.0 μW_{RMS}	<5.5 μW_{RMS}
	10GBASE-R	<1 μW	<5.0 μW_{RMS}	<5.5 μW_{RMS}
	10 GHz	<1 μW	<5.0 μW_{RMS}	<5.5 μW_{RMS}
	OC-192/STM-64	<1 μW	<5.0 μW_{RMS}	<5.5 μW_{RMS}
	10GFC	<1 μW	<5.0 μW_{RMS}	<5.5 μW_{RMS}

Table 4- 10: 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
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}
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}
	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}
	10GBE	<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}
	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}
	10GBE	<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}
	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}
	10GBE	<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}

Table 4-10: 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
80C09	OC-192/STM-64	<10 μ W	<10 μ W _{RMS}	<12 μ W _{RMS}
	10.71 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}
80C10 1550 nm	OC-768/STM-256	<25 μ W	<60 μ W _{RMS}	n/a
	FEC43.0184 Gb/s FEC	<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
	FEC43.0184 Gb/s FEC	<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
80C11	OC-192/STM-64	<10 μ W	<8 μ W _{RMS}	<9 μ W _{RMS}
	10.66 Gb/s	<10 μ W	<8 μ W _{RMS}	<9 μ W _{RMS}
	10.71 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}
	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	<3.0 μ W _{RMS}	-
	FC2125	<1 μ W	<3.0 μ W _{RMS}	-
	FC4250	<1 μ W	<3.0 μ W _{RMS}	-
	10GBase-X4	<1 μ W	<3.0 μ W _{RMS}	-
	10GFC-X4	<1 μ W	<3.0 μ W _{RMS}	-
	3.318 Gb/s	<1 μ W	<3.0 μ W _{RMS}	-
	9 GHz	<1 μ W	<6.0 μ W _{RMS}	-

Table 4- 10: 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 (850 nm)	FC1063	<1 μ W	<4.8 μ W _{RMS}	-
	FC2125	<1 μ W	<4.8 μ W _{RMS}	-
	FC4250	<1 μ W	<4.8 μ W _{RMS}	-
	10GBase-X4	<1 μ W	<4.8 μ W _{RMS}	-
	10GFC-X4	<1 μ W	<4.8 μ W _{RMS}	-
	3.318 Gb/s	<1 μ W	<4.8 μ W _{RMS}	-
	9 GHz	<1 μ W	<9.6 μ W _{RMS}	-
80C12 Option 10G (1310 nm and 1550 nm)	FC1063	<1 μ W	<6.0 μ W _{RMS}	-
	FC2125	<1 μ W	<6.0 μ W _{RMS}	-
	FC4250	<1 μ W	<6.0 μ W _{RMS}	-
	10GBase-X4	<1 μ W	<6.0 μ W _{RMS}	-
	10GFC-X4	<1 μ W	<6.0 μ W _{RMS}	-
	3.318 Gb/s	<1 μ W	<6.0 μ W _{RMS}	-
	9 GHz	<1 μ W	<6.0 μ W _{RMS}	-
80C12 Option 10G (850 nm)	FC1063	<1 μ W	<9.6 μ W _{RMS}	-
	FC2125	<1 μ W	<9.6 μ W _{RMS}	-
	FC4250	<1 μ W	<9.6 μ W _{RMS}	-
	10GBase-X4	<1 μ W	<9.6 μ W _{RMS}	-
	10GFC-X4	<1 μ W	<9.6 μ W _{RMS}	-
	3.318 Gb/s	<1 μ W	<9.6 μ W _{RMS}	-
	9 GHz	<1 μ W	<9.6 μ W _{RMS}	-

Minimum Optical Bandwidth & 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 CSA/TDS8000 series instrument, 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. To test the minimum optical bandwidths and the reference receiver frequency response of 80C10 module, skip to *80C10 Procedure* on page 4-183.

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	CSA8000 or TDS8000 Series instrument Calmar FPL-01 optical impulser (item 25) Tektronix OA5002 variable optical attenuator (item 24) Single-mode fiber-optic cable, 2 m, FC to FC connectors (item 13) Optical attenuator, 10 dB, FC-FC, female-male connectors (item 9) Cable, coaxial, 1 m, male to male SMA connectors (item 18)
Prerequisites	As listed on page 4-30 and under <i>Prerequisites</i> on page 4-157.

Before performing this procedure, be sure you have completed the *Dark level & Vertical Equivalent Optical Noise* procedure on page 4-158.

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 4-190.*

Setup

Install the test hookup (see Figure 4-45) and preset the CSA/TDS8000 series instrument controls:

1. Install the 80C0X Optical Sampling Module into Channel 1 of the CSA/TDS8000 series instrument.

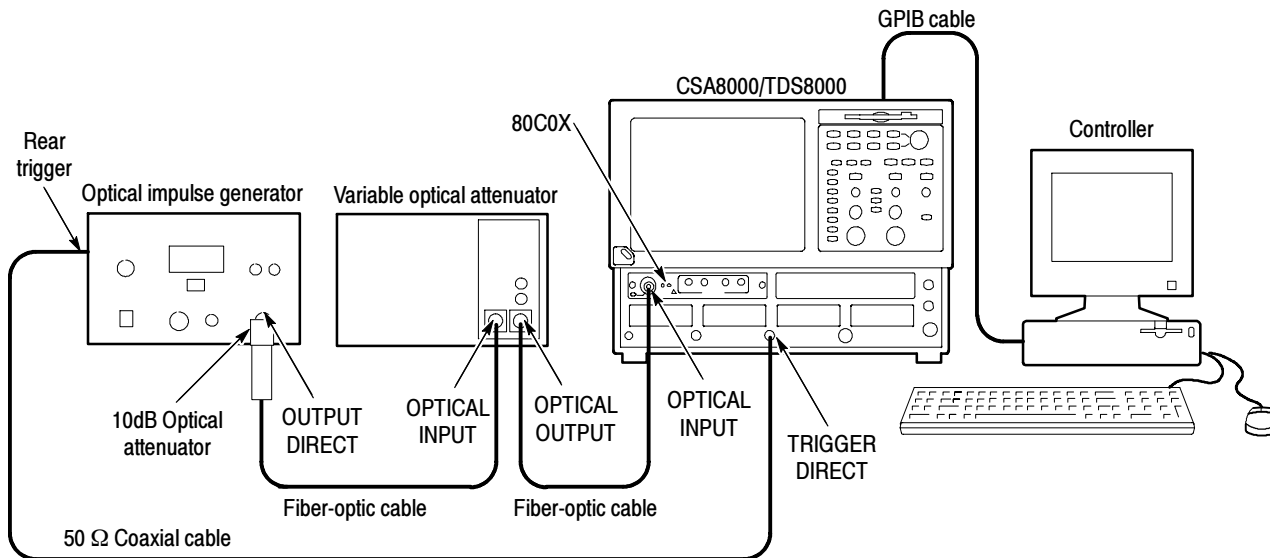


Figure 4- 45: Minimum optical bandwidth and reference receiver frequency response hookup

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 CSA/TDS8000 series 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 4-46.

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 4-46.

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 4-46.

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.*

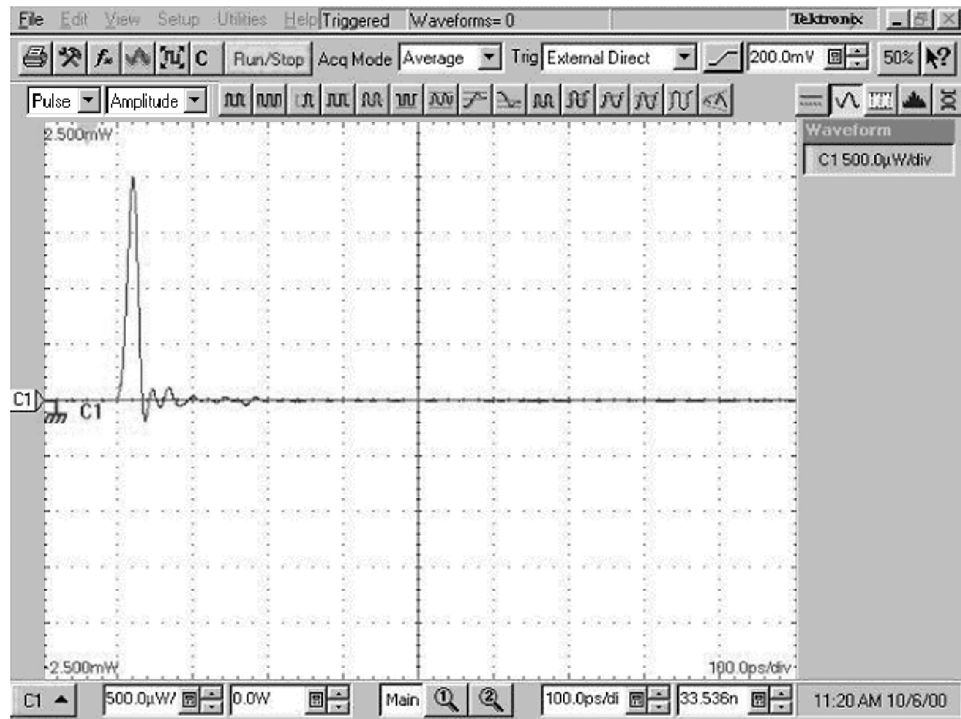


Figure 4-46: Proper positioning of the impulse for optimum curve download

3. Using a controller (such as a PC, Macintosh, or workstation) attached to the CSA/TDS8000 series 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 4-11 for the settings that match the module model).

Table 4-11: 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
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

9. In the Vert Setup dialog box, select a Filter (see the Table 4-12 for filters available for the various optical sampling modules).
10. Do steps 1 through 6.
11. Refer to Table 4-12 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 4- 12: Reference receiver frequency response limits

Optical sampling module	Filter	Limits			
		(MHz)	Lower	Nominal	Upper
80C07, 80C07B	OC-3/STM-1	Frequency			
		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			
		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
80C01, 80C03, 80C07, 80C07B	OC-48/STM-16	Frequency			
		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 4-12: Reference receiver frequency response limits (cont.)

Optical sampling module	Filter	Limits			
		(MHz) Frequency	Lower	(dB) Nominal	Upper
80C01, 80C02, 80C04, 80C05, 80C08B, 80C08C, 80C09, 80C11, 80C12-10G	OC-192/STM-64	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
		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
80C03, 80C07B	ENET2500 (2 GBE) 2.50 Gb/s			0.000	-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

Table 4- 12: Reference receiver frequency response limits (cont.)

Optical sampling module	Filter	Limits			
		(MHz)		(dB)	
80C03, 80C07B	ENET1250 (GBE) 1.25 Gb/s	Frequency	Lower	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	Lower	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
80C07B, 80C12	FC2125	Frequency	Lower	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	-4.66
		2550	-10.74	-8.54	-6.35
		2869	-13.55	-10.93	-8.31
		3188	-16.41	-13.41	-10.41

Table 4-12: Reference receiver frequency response limits (cont.)

Optical sampling module	Filter	Limits			
		(MHz) Frequency	Lower	(dB) Nominal	Upper
80C09, 80C11, 80C12-10G	10.71 Gb/s	0.000	-0.85	0.00	+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
80C08, 80C08B, 80C08C, 80C11, 80C12-10G	10GBASE-R			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 4- 12: Reference receiver frequency response limits (cont.)

Optical sampling module	Filter	Limits			
		(MHz) Frequency	Lower	(dB) Nominal	Upper
80C08C, 80C11, 80C12-10G	10GBE	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
		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
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 4-12: Reference receiver frequency response limits (cont.)

Optical sampling module	Filter	Limits					
		(MHz) Frequency	Lower	(dB) Nominal	Upper		
80C08C	10.709 Data Filter	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	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				
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 4- 12: 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 Test This procedure checks the minimum optical bandwidths and the reference receiver frequency responses of the 80C10 Optical Sampling Module only. To test bandwidths and responses minimum of all other optical sampling modules, skip this procedure and do the *80C01-80C09 and 80C11 Procedure* on page 4-169 instead.

Equipment required	CSA8000 or TDS8000 series instrument Tunable ECL lasers (Qty. 2) (Item 43) See Tunable Laser Requirements, below Wavelength meter (Item 26) 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 4-30 and under <i>Prerequisites</i> on page 4-157.

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 CSA/TDS8000 series instrument controls:

1. Install the 80C10 Optical Sampling Module into Channel 1 of the CSA/TDS8000 series instrument.

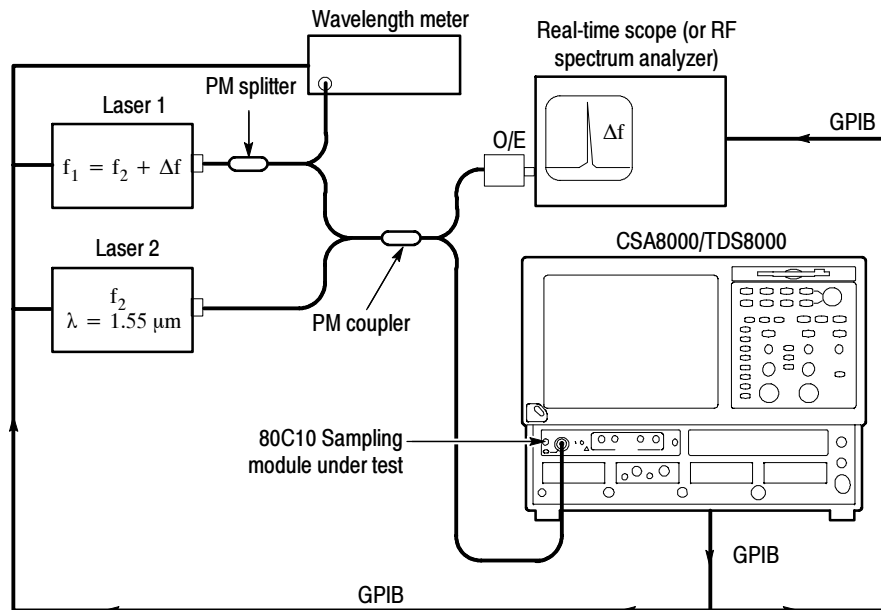


Figure 4- 47: Hookup for heterodyne test

2. Make sure the module under test is properly compensated. See *Perform the Compensation* on page 4-5.

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 module in the CSA/TDS8000 series 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 4-187, 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 4-188):*

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

- 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 (this setting results in a modulation amplitude of 7 - 8 mW).
8. Press the DEFAULT SETUP button on the CSA/TDS8000 series 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 CSA/TDS8000 series 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 4-48 on page 4-186.

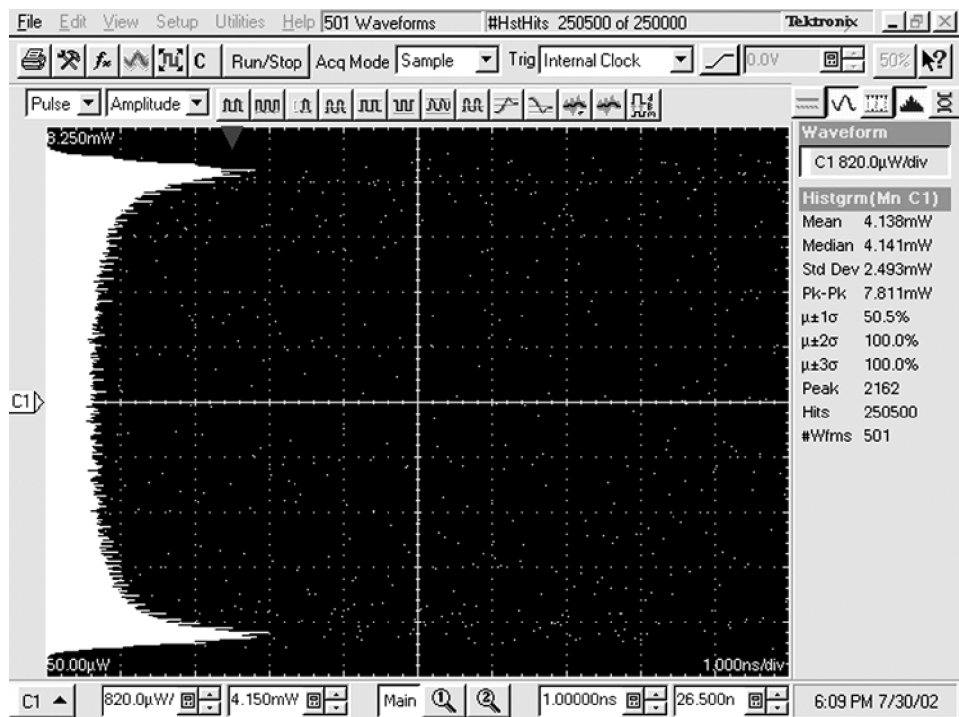


Figure 4- 48: Setup used for Heterodyne sweep

Test Follow this procedure to test the 80C10:

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 4-47 on page 4-184.
 - b. Adjust laser wavelengths until the beat frequency is <65 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 4-185):
 - 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 (\cong 8 pm laser step size). For each frequency point, perform the following steps (see note in the setup on page 4-185):
 - 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 ≥ 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:

Bandwidth setting	Bandwidth limit
30 GHz	>30 GHz
65 GHz	>60 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 4-13 for filters available).
9. Perform steps 1 through 6.

10. Refer to Table 4-13 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 module.

Table 4-13: Reference receiver frequency response limits

Reference receiver	Frequency response limits			
OC768/STM-256 39.813 Gb/s	(MHz)		(dB)	
	Frequency	Lower	Nominal	Upper
	0.000	-1.00	0.00	+0.50
	5.97	-1.10	-0.10	+0.40
	11.94	-1.45	-0.45	+0.05
	17.92	-2.02	-1.02	-0.52
	23.89	-2.86	-1.86	-1.36
	29.86	-4.00	-3.00	-2.50
	35.83	-5.96	-4.51	-3.33
	39.81	-7.42	-5.71	-4.15
	41.80	-8.20	-6.37	-4.62
	44.79	-9.42	-7.42	-5.42
	47.78	-11.22	-8.54	-5.87
53.75	-14.83	-10.93	-7.03	
59.72	-18.41	-13.41	-8.41	
FEC43.02 Gb/s G.709	(MHz)		(dB)	
	Frequency	Lower	Nominal	Upper
	0.000	-1.00	0.00	+0.50
	6.45	-1.10	-0.10	+0.40
	12.90	-1.45	-0.45	+0.05
	19.36	-2.02	-1.02	-0.52
	25.81	-2.86	-1.86	-1.36
	32.26	-4.00	-3.00	-2.50
	38.71	-5.96	-4.51	-3.33
	43.02	-7.42	-5.71	-4.15
	45.17	-8.20	-6.37	-4.62
	48.40	-9.42	-7.42	-5.42
	51.63	-11.22	-8.54	-5.87
58.08	-14.83	-10.93	-7.03	
64.53	-18.41	-13.41	-8.41	

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, or 80C10 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	CSA8000 or TDS8000 series instrument Calmar FPL-01 optical impulser (item 25) Tektronix OA5002 variable optical attenuator (item 24) 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 4-30 and under <i>Prerequisites</i> on page 4-157.

Before performing this procedure, be sure you have completed the *Dark level & Vertical Equivalent Optical Noise* procedure on page 4-158.

Setup

Install the test hookup (see Figure 4-49 on page 4-191) and preset the CSA/TDS8000 series instrument controls:

1. Install the 80C0X Optical Sampling Module into Channel 1 of the CSA/TDS8000 series 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 CSA/TDS8000 series 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.*

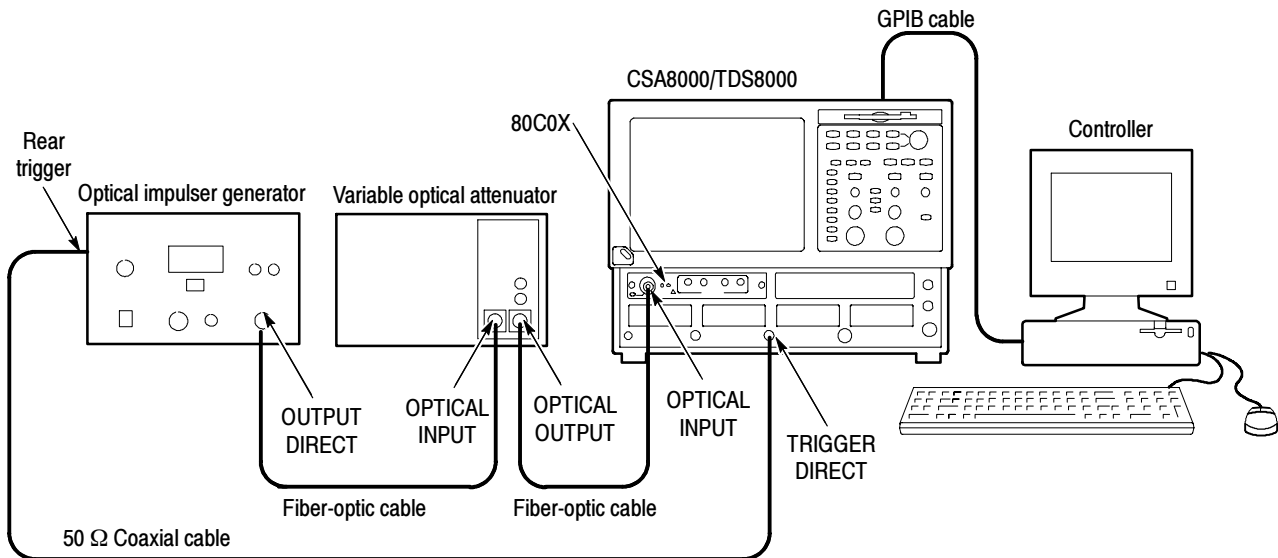


Figure 4-49: Integrated rise time and aberrations hookup

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 $\mu\text{W}/\text{div}$.
 - 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
- 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 or 80C10, 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 or 80C10 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 4-14 for the time difference between G1 and G2 for the different bandwidth and filter settings.
- For 80C10, 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 4-14 for the time difference between G1 and G2 for the different bandwidth and filter settings.

Table 4- 14: 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)

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, and 80C10 modules are listed in Table 4-15.

Table 4- 15: Aberrations

Optical sampling module	Bandwidth/filter setting	Aberrations
80C05	40 GHz	<15%
	30 GHz	<10%
	20 GHz	<10%
	OC192	<5%
80C06	50 GHz	<10%

Table 4- 15: Aberrations (cont.)

Optical sampling module	Bandwidth/filter setting	Aberrations
80C10	65 GHz	<10%
	30 GHz	<5%
	FEC43.02	<5%
	OC768	<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	CSA8000 or TDS8000 series instrument Tektronix 80E02 Sampling Module (item 34) Tektronix OA5002 variable optical attenuator (item 24) Advantest D3186 Pattern Generator (item 40) Optical Transmitter and Receiver (item 23) Single-mode fiber-optic cable, 2 m, FC to FC connectors (item 13) Attenuator, 2X (6 dB pad), 50 Ω , SMA (item 8) Cable, coaxial, 2 ns delay SMA, male connector on each end (item 12)
Prerequisites	As listed on page 4-30 and under <i>Prerequisites</i> on page 4-157.

Before performing this procedure, be sure you have completed the *Dark level & Vertical Equivalent Optical Noise* procedure on page 4-158.

Setup

Install the test hookup (see Figure 4-50) and preset the CSA/TDS8000 series instrument controls:

1. Install the 80C0X Optical Sampling Module into Channel 1 of the CSA/TDS8000 series instrument.
2. Install the 80E02 Sampling Module into Channels 3 and 4 of the CSA/TDS8000 series 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 TDS8000 or CSA8000.
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.

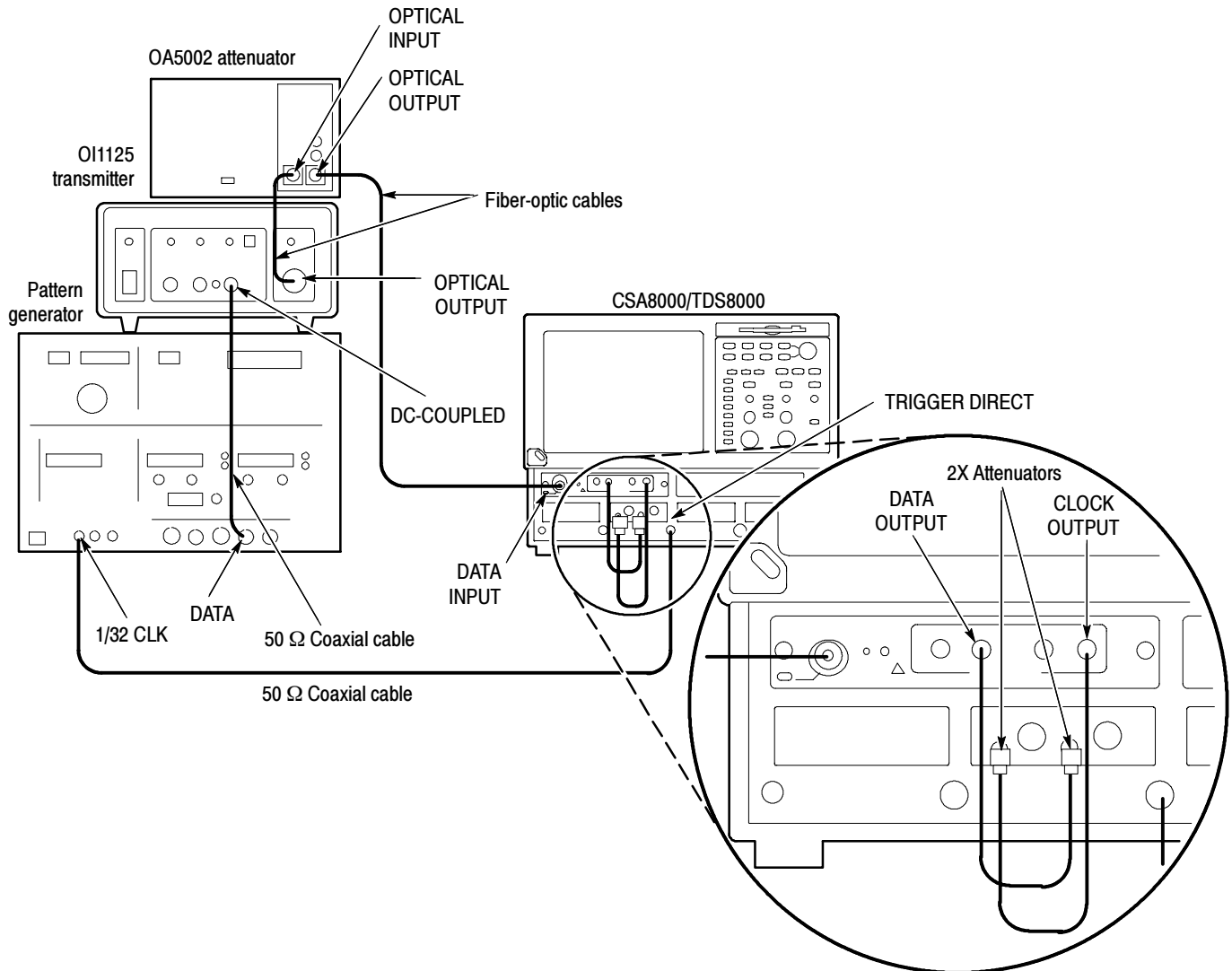


Figure 4-50: Clock recovery optical sensitivity range and recovered clock timing jitter hookup

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 CSA/TDS8000 series 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 CSA/TDS8000 series 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 4-16).

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 TDS/CSA8000 series 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 4-16).
3. Adjust the Horizontal SCALE control on the front panel of the CSA/TDS8000 series instrument to the setting listed in the table for the clock recovery rate that you selected in step 1 (see Table 4-16).

Table 4-16: Clock recovery settings

Optical sampling module	Clock recovery rate	D3186 rate setting	TDS8000 or CSA8000 series 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 4- 16: Clock recovery settings (cont.)

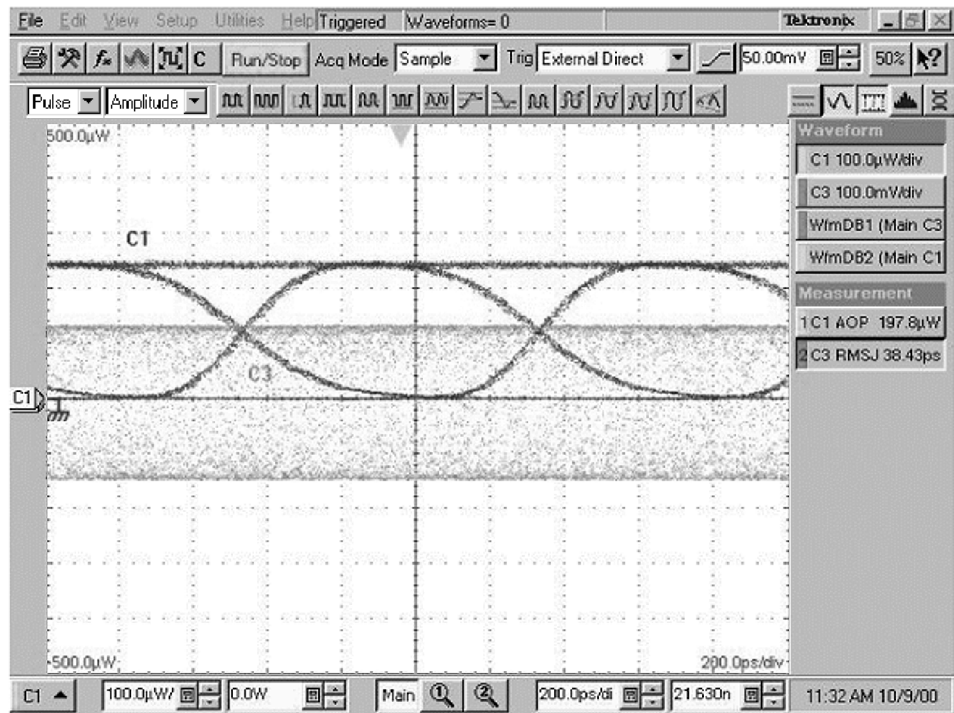
Optical sampling module	Clock recovery rate	D3186 rate setting	TDS8000 or CSA8000 series scale setting
80C03-CR	FC-1063	1.0625 Gb/s	200 ps/div
	GBE	1.2500 Gb/s	200 ps/div
	OC-48	2.48832 Gb/s	100 ps/div
	2.5 Gb/s	2.5000 Gb/s	100 ps/div
80C04-CR1	OC-192	9.95328 Gb/s	50 ps/div
80C04-CR2	OC-192	9.95328 Gb/s	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 4-16: Clock recovery settings (cont.)

Optical sampling module	Clock recovery rate	D3186 rate setting	TDS8000 or CSA8000 series 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
80C011-CR4	Continuous	9.8 Gb/s to 12.6 Gb/s	50 ps/div

At this point in the procedure, the CSA/TDS8000 series instrument is triggered from the 1/32 clock from the D3186 Pulse Pattern Generator. The clock signal from the 80C0X-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 4-52).

If the signals are not synchronous (see Figure 4-51), 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 4-16).



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 4-52, in which the clock signal is synchronized.

Figure 4-51: 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 4-17.
 - 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 4-17: Clock recovery settings & 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			

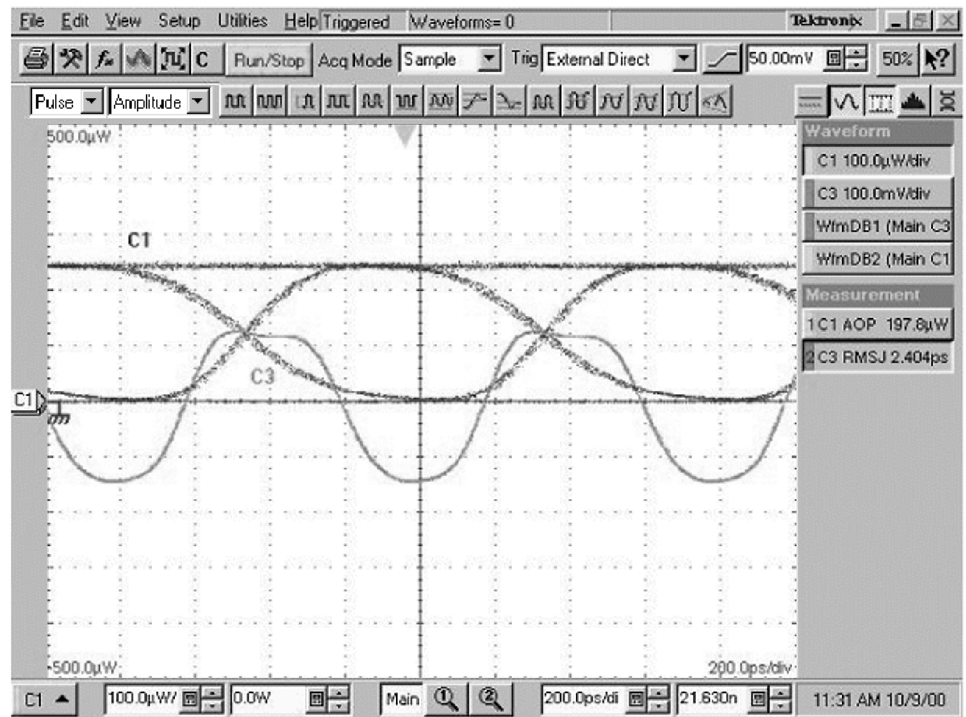
Table 4-17: Clock recovery settings & jitter limits (cont.)

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 was set for step 5d on page 4-202.
 - 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 4-53.

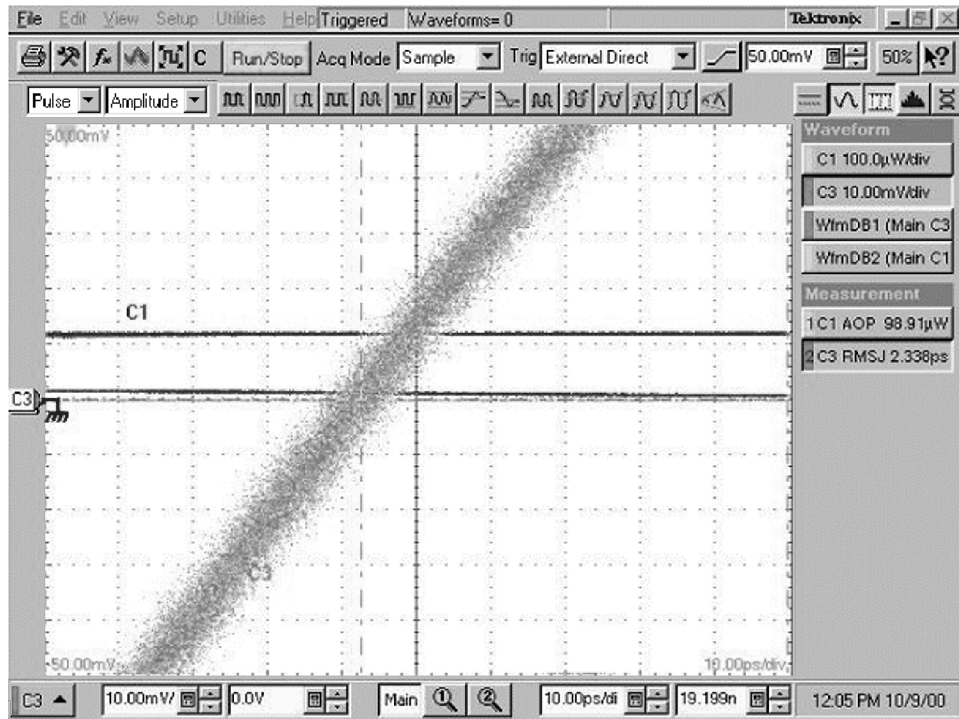
NOTE. You can most easily zoom in on the 50% crossing point by click dragging a rectangle around this edge (using the mouse), and then using the SCALE and FINE control knobs to adjust the settings to 10 mV/div and 10 ps/div.

- 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 4-17.
- 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 4-16.



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 4-51, in which the clock signal is not synchronized.

Figure 4-52: 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 4- 53: 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 1-14 on page 1-21.

STOP. *The procedures that follow contain instructions based on the menus and controls supported by the version 1.3 release of the instrument firmware. The procedures will work for earlier versions of software, but the control and menu names may vary slightly.*

Prerequisites

Be sure you have performed the following prerequisites and the *Prerequisites* on page 4-30 before doing any procedures in this section.

- Install the 80A01 module in left most of the small compartments in the CSA8000 or TDS8000 instrument.
- Install a 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

These procedures check those characteristics that relate to the signal acquisition and are listed as checked under *Warranted Characteristics* in *Specifications*. Refer to Table 1-15, page 1-22.

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 4-30 and under <i>Prerequisites</i> on page 4-207.

Setup

Install the test hookup:

1. Install the 80A01 module into the left-most small module compartment of the instrument (see Figure 4-54).
2. Install an 80E00 module into the small module compartment next to the 80A01 module of the instrument (see Figure 4-54).
3. Connect a coaxial cable to the output of the 80A01 module.
4. Connect the other end of the cable to the 6 dB attenuator (item 22).
5. Connect the 6 db attenuator to Channel 3 of the 80E0x module.
6. In the Vertical Setup menu, set external attenuation to 6dB for Channel 3.
7. Set the signal generator to output a sinewave at 8 GHz and 0 dBm.
8. Connect the RF output of the signal generator (item 13) to Channel 4 of the 80E0x module using a coaxial cable.
9. Set the instrument to trigger on Internal Clock.
10. Set Measurement 1 to measure Amplitude with Channel 4 as the source.
11. Adjust the amplitude of the RF signal generator until Measurement 1 reads 200 mVpp.
12. Disconnect the coaxial cable from the 80E0x Channel 4 input, and move it to the 80A01 input.
13. Change Measurement 1 to measure Amplitude with Channel 3 as the source.

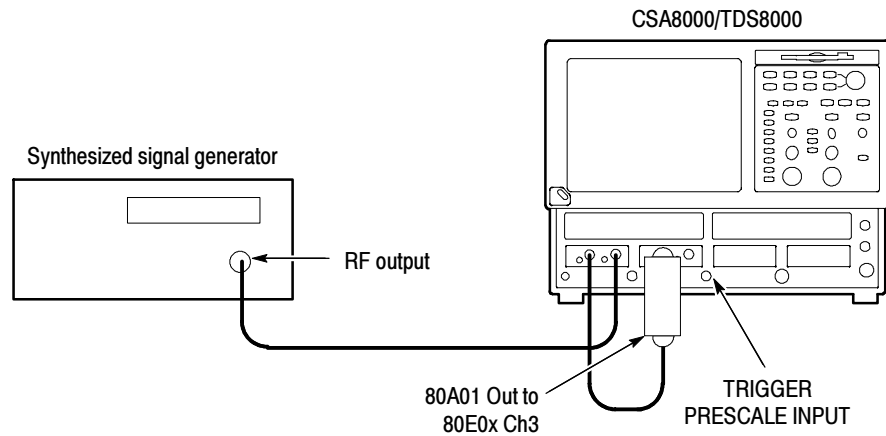


Figure 4-54: 80A01 test hookup

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 1-29 on page 1-69.

STOP. *The procedures that follow contain instructions based on the menus and controls supported by the version 1.3 release of the instrument firmware. The procedures will work for earlier and later 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 4-30 before doing any procedures in this section.

- Install the 80A02 module in one of the small compartments in the CSA8000 or TDS8000 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

This procedure checks those characteristics that relate to the signal acquisition and are listed as checked under *Warranted Characteristics* in *Specifications*. Refer to Table 1-15, page 1-22.

Equipment required	Variable DC power supply (item 22) Stereo mini phone plug (with exposed connections) (item 58)
Prerequisites	As listed on page 4-30 and under <i>Prerequisites</i> on page 4-211.

Setup Install the test hookup (see Figure 4-55):

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 to 5 V.
 - c. Disconnect the voltage supply.
2. Remove the mini phone plug.

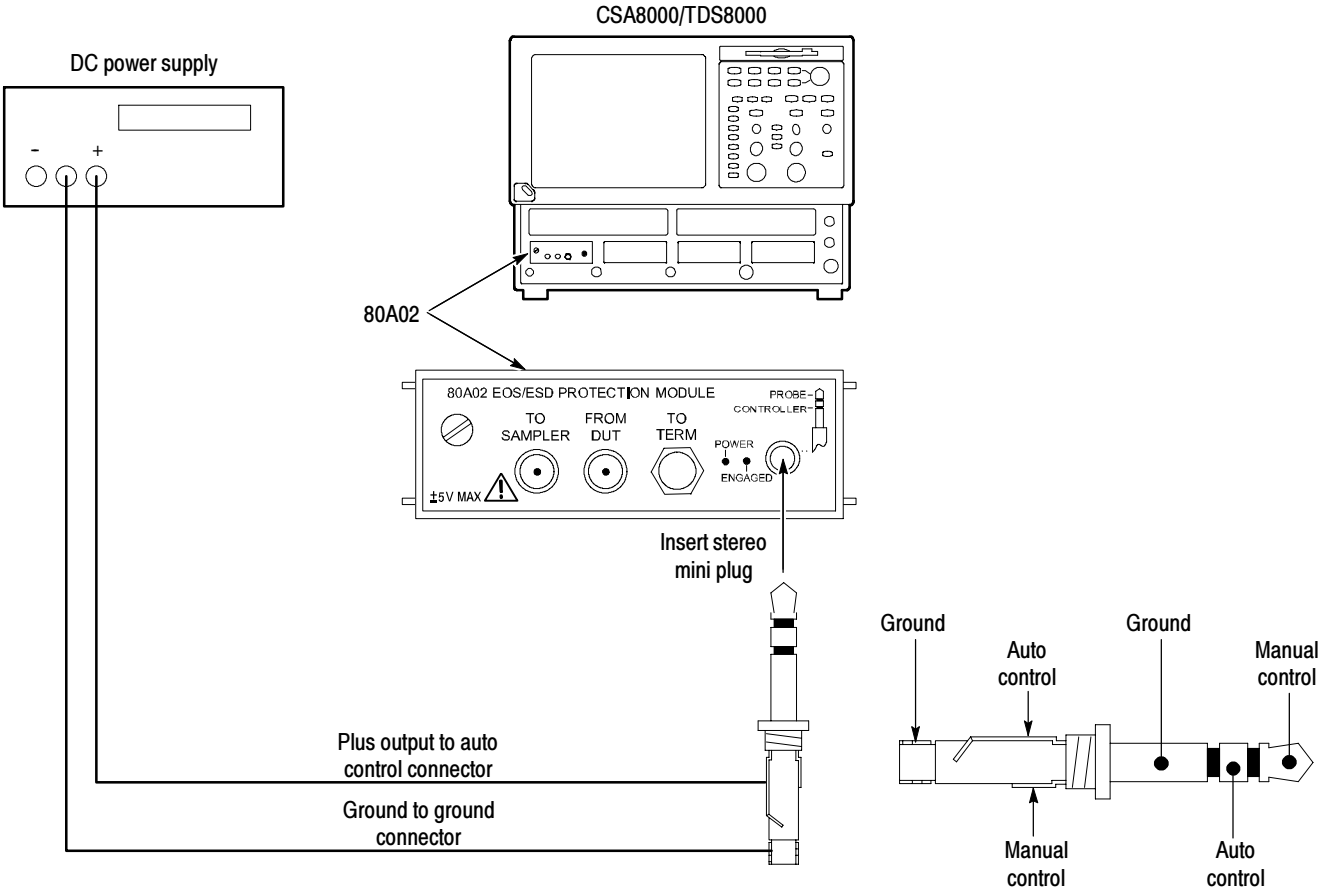


Figure 4-55: 80A02 test hookup

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 1-31 on page 1-71.

STOP. *The procedures that follow contain instructions based on the menus, controls, and data rates supported by the release versions 2.1 and later of the instrument firmware. Version 2.0 has limited data rate support for the 80A05 module. The procedures will not work with versions below 2.0.*

Prerequisites

Be sure you have performed the following prerequisites and the *Prerequisites* on page 4-30 before doing any procedures in this section.

- Install the 80A05 module in one of the small compartments in the CSA8000 or TDS8000 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	CSA8000 or TDS8000 series instrument Tektronix 80E02 Sampling Module (item 34) Advantest D3186 Pattern Generator (item 40) Attenuator, 10X (20 dB pad), 50 Ω , SMA (item57) Cable, coaxial, 2 ns delay SMA, male connector on each end (item 12)
Prerequisites	As listed on page 4-30 and under <i>Prerequisites</i> on page 4-215.

Setup Install the test hookup (see Figure 4-56) and preset the CSA/TDS8000 series instrument controls:

1. Install the 80A05 Clock Recovery Module into Channel 1 of the CSA/TDS8000 series instrument.
2. Install the 80E02 Sampling Module into Channels 3 and 4 of the CSA/TDS8000 series 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 CSA/TDS8000 series 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)

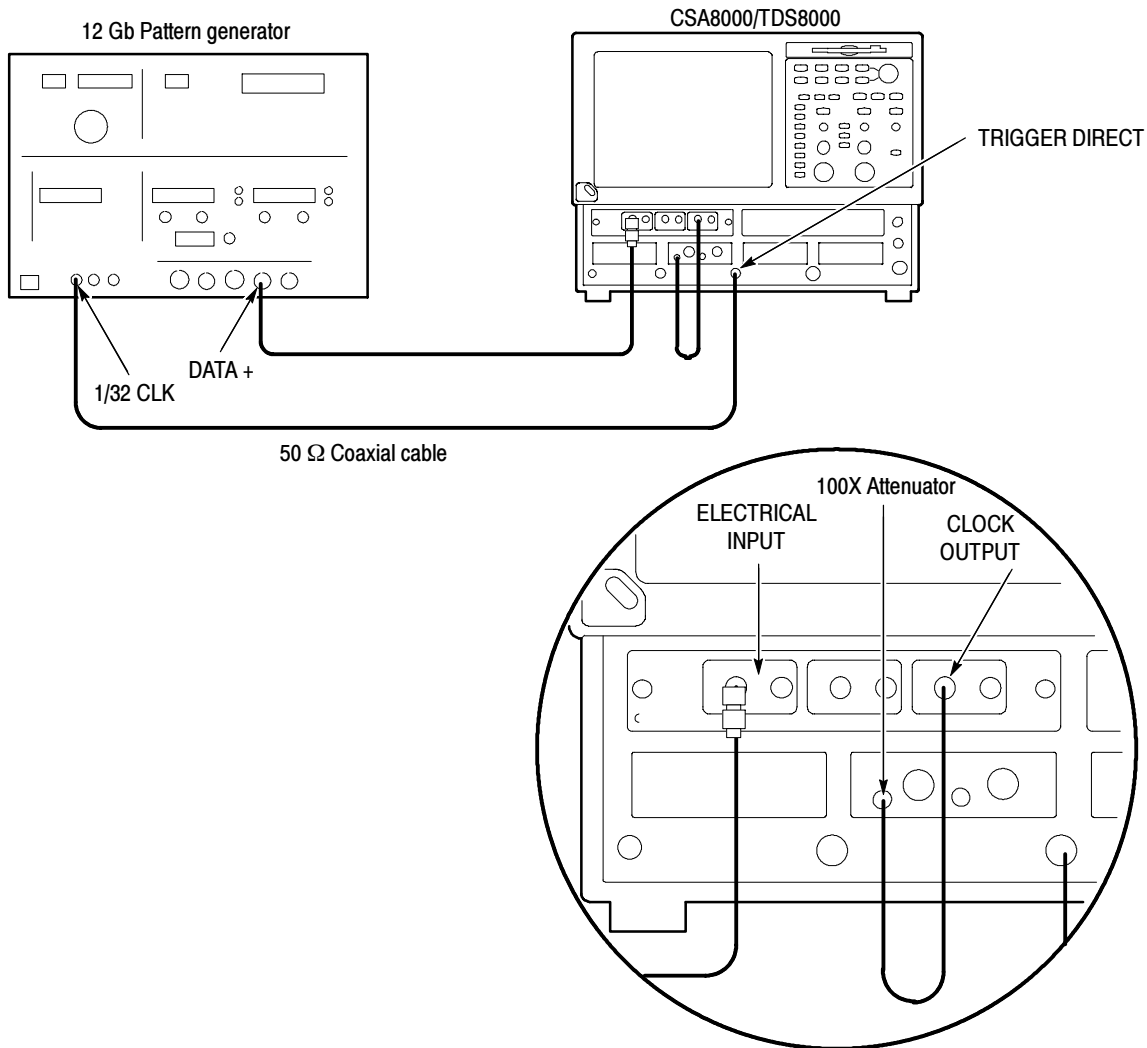


Figure 4-56: Clock recovery sensitivity range and recovered clock timing jitter hookup

8. Allow the CSA/TDS8000 series 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 CSA/TDS8000 series 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 4-18).
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 4-18).
3. Adjust the Horizontal SCALE control on the front panel of the CSA/TDS8000 series instrument to the setting listed in the table for the clock recovery rate that you selected in step 1 (see Table 4-18).

Table 4-18: 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 4-18: 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 CSA/TDS8000 series 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 4-57).

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 4-18).

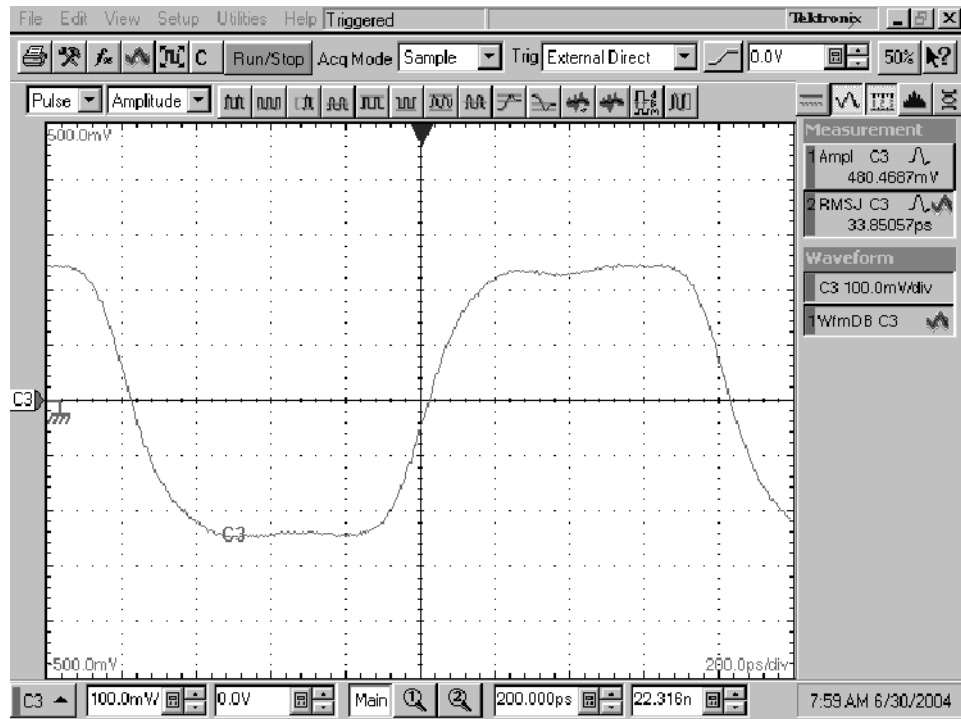


Figure 4-57: Display example (clock signal synchronized with the data rate input)

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 4-19.
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 4-58.

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 4-19.
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 4-19: Clock recovery amplitude & 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.

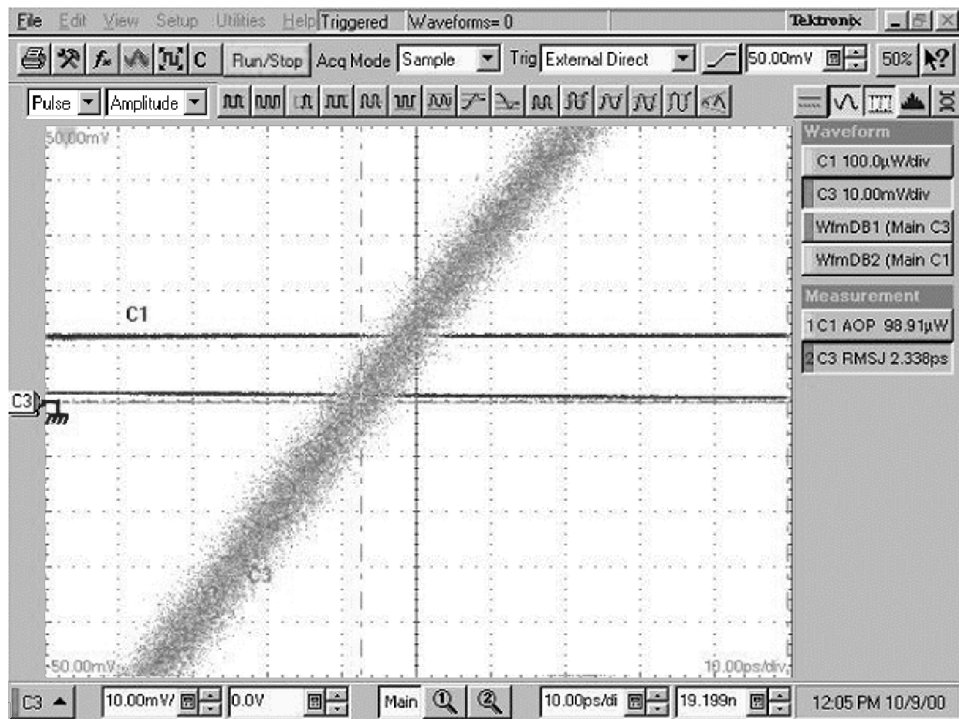


Figure 4- 58: Display example (zoomed in at the crossing point)

8. Disconnect the test setup.

End of Procedure



Adjustment Procedures

Adjustment Procedures

This chapter contains an adjustment procedure for your instrument. The purpose of this procedure is to return the instrument conformance to its specifications.

Adjustment Interval

The voltage and timing references inside the instrument are very stable over time and should not need routine adjustment. The only time you should perform the *Adjustment Procedures* is if the instrument fails any of the Mainframe performance verification checks starting on page 4-77.

Adjustment Environment

The instrument must be adjusted in a 20 °C to 30 °C ambient temperature environment. The instrument and signal source must warm up at least 20 minutes in this environment before you begin the adjustment procedure.

Adjustment After Repair

After removal and replacement of a module due to electrical failure, you must either perform the adjustment procedure or not, depending on the module replaced. See Table 5-1.

Table 5-1: Adjustments required for module replaced

Module replaced	Adjustment required
Front panel assembly	No
Acquisition board	Yes
Processor board	No
NLX processor assembly	No
Display panel or display system	No
Power supply	No
Interconnect boards	No
Fans	No

Required Equipment

The adjustment procedure requires the specific test equipment and materials listed in Table 5-2.

Table 5-2: Required equipment and materials

Category	Specific equipment required	Quantity
Signal source	Signal generator 50 MHz to 1 GHz, ≤ 1 ppm frequency accuracy	1 ea
Meter	Digital Multimeter, with 6.5 plus digits	1 ea
Instrument controller (only one of these configurations required)	PC-compatible computer with National Instruments GPIB Controller card and software, running Windows 95/98 or NT	1 ea
	National Instruments USB GPIB Controller card for Windows 98 and National Instruments NI-488.2 for Windows software (to install in the instrument) ¹	1 ea
Divider	Power, 50 Ω , SMA "T". male Tektronix 015-0565-00	1 ea
Adapter	SMA "T", male to 2 SMA female Tektronix part number 015-1016-00	1 ea
Adapter	SMA male to BNC female, Tektronix part number 015-0554-00	1 ea
Adapter	BNC to dual banana plug, Tektronix part number 103-0095-00	1 ea
Coaxial cables	50 Ω , male-to-male SMA connectors	3 ea
GPIB cables	GPIB cable, 1 m minimum length, Tektronix part number 002-0991-01	1 ea

¹ Depending on other USB devices attached to the instrument, a USB hub may also be required. Consult your National Instruments documentation for more information.

Instrumentation Setup

Set the National Instruments GPIB Interface command software to allow GPIB communications between the PC controller and CSA8000/TDS8000, device under test (DUT).

Before you can execute the adjustment program, you need to set up and configure the instrumentation. Make connections according to the following diagrams. See Figure 5-1.

To perform this procedure you must have the specific equipment listed in Table 5-2.

Main Instrument Adjustments

Once the instrumentation is connected and GPIB configured, allow the instrumentation to warm up for at least 20 minutes before starting the *DC Calibrator Adjust procedures*.

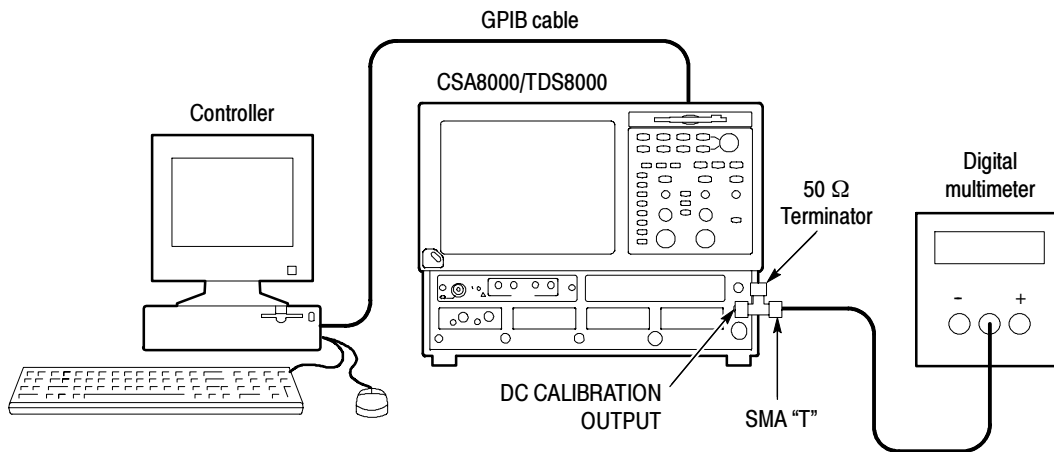


Figure 5-1: Adjustment setup using the DMM

DC Calibrator Adjust

Connect the instrument to a DMM as shown in Figure 5-1.

1. Run the compensation routine, described in *Brief Procedures* section on page 4-5.
2. Enter the following GPIB command to verify communication between the controller and DUT.
*IDN?
Should respond with Tektronix and Firmware Version.
3. Enter the following GPIB command to turn the instrument's cal constant protection off:
SYST:PROT OFF
4. Enter the following GPIB command to set the instrument's DC calibrator offset cal constant to 0:
CALCOMP:DOUBLE "DcCalOffsetAdj",0.0
5. Wait 8 seconds then enter the following GPIB command to set the instrument's DC calibrator Lsb cal constant to 1.0:
CALCOMP:DOUBLE "DcCalLsbAdj",1.0

6. Wait 8 seconds then enter the following GPIB command to set the instrument's DC calibrator output to 0 Volts:
CALIBRATE:DCCALIBRATOR 0.0
Record DMM reading.
7. Enter the following GPIB command to set the instrument's DC calibrator offset cal constant to $-1 * \text{DMM reading}$:
CALCOMP:DOUBLE "DcCalOffsetAdj",(-1.0 * the DMM reading)

Example: CALCOMP:DOUBLE "DcCalOffsetAdj", 3.2e-4
8. Enter the following GPIB command to set the instrument's calibrator to 1.0 V:
CALIBRATE:DCCALIBRATOR 1.0
Record the DMM reading (*reading1*).
9. Enter the following GPIB command to set the instrument's calibrator to -1.0 V:
CALIBRATE:DCCALIBRATOR -1.0
Record the DMM reading (*reading2*).
Calculate cal constant as follows:
$$\frac{(-1.0 * \text{Reading2} + \text{Reading1})}{2}$$
10. Enter the following GPIB command to set the instrument's calibrator Lsb cal constant:
CALCOMP:DOUBLE "DcCalLsbAdj",calculated result from Step 9.
11. Wait 8 seconds then enter the following GPIB command to save the DC adjustments as follows:
CAL:SAVE:FACT:MAI
12. Enter the following GPIB command to turn the instrument's cal constant protection on:
SYST:PROT ON

**DC Calibrator Adjust
Verification**

To verify that the DC calibration adjustment was successful complete the following procedures:

1. Set the instrument's DC calibrator to -1.0 V and verify as follows:
CALIBRATE:DCCALIBRATOR -1.0
2. Verify that the DMM reads $-1.0 \text{ V} \pm 1 \text{ mV}$
3. Set the instrument's DC calibrator to 1.0 V and verify as follows:
CALIBRATE:DCCALIBRATOR 1.0
4. Verify that the DMM reads $1.0 \text{ V} \pm 1 \text{ mV}$

5. Set the instrument's DC calibrator to 0.0 V and verify as follows:
CALIBRATE:DCCALIBRATOR 0.0
6. Verify that the DMM reads 0.0 V \pm 0.1 mV

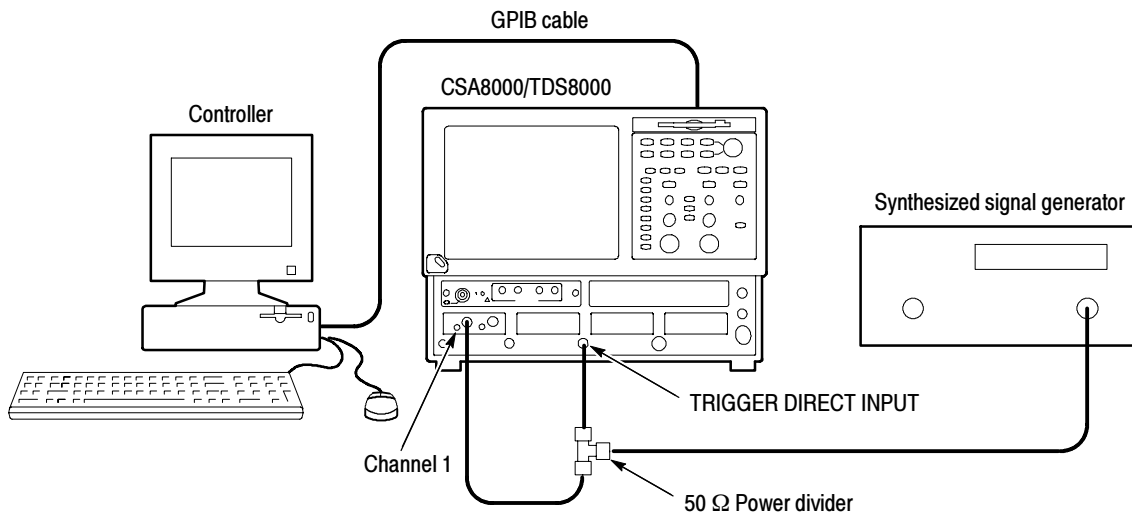


Figure 5-2: Adjustment setup using the signal generator

Internal 10 MHz Adjust Setup

Connect the instrument to a signal generator as shown in Figure 5-2.

Set the signal generator as follows:

- Frequency to 1 GHz
- Amplitude to 1.0 V peak to peak
- Output to on

Preset the CSA8000/TDS8000 controls:

NOTE. CSA8000/TDS8000 settings; Acquisition, Horizontal, Measurement, Trigger, or Vertical menus are located in the Setups dialog, which can be popped up by selecting the Setup Menu.

- Select C1 in the Waveform Selector.
- Acquisition menu, Acquisition to, Average, 64 samples.
- Horizontal menu, Timebase, Scale to 250 ps/division.
- Horizontal menu, All Timebases Mode, Lock to Int 10MHz.
- Measurement menu, Select Meas, Timing, + Cross.
- Measurement menu, select Statistics.

1. Enter the following GPIB command to turn the instrument's cal constant protection off:
SYST:PROT OFF
2. Set the calibration value to default by sending the following GPIB command:
CALCOMP:DOUBLE "Internal10MHzRefFreq",10e6
3. Click Run/Stop (button should be green).
4. Measurement menu, click Show Stats.
5. Record *target value* = (*Mean value* +1 μ s); where *Mean* is from the Statistics window.
6. Horizontal menu, Timebase, Position, enter *target value* recorded in step 5.
7. Click Run/Stop (button should be gray).
8. Measurement menu, click Clear Stats.
9. Click Run/Stop (button should be green), wait 8 seconds then click Run/Stop again (button should be gray).
10. Using the present *Mean* value from the Statistics window, and the *target value* calculated in step 5., Calculate the error and the new cal constant:
$$Error = (mean - target\ value) / 1\ \mu s$$
$$New\ Cal\ Const = Error * 10e6 + 10e6$$
11. Input the new calibration constant into the instrument by sending the following GPIB command:
CALCOMP:DOUBLE "Internal10MHzRefFreq", *New Cal Const* where *New Cal Const* is from Step 10.
12. Wait 8 seconds then save the mainframe factory calibration constants by entering the following GPIB commands:
CAL:SAVE:FACT:MAI
13. Update the mainframe calibration time/date/temperature stamp by entering the following GPIB command:
CAL:UPDATEINFO:MAI
14. Enter the following GPIB command to turn the instrument's cal constant protection on:
SYST:PROT ON

End of Procedure



Maintenance

Maintenance

This section contains the information needed to do periodic and corrective maintenance on the Mainframe, Sampling Heads and Optical modules. The following subsections are included:

- *Preparation.* Introduction plus general information on preventing damage to internal modules when doing maintenance.
- *Inspection and Cleaning.* Information and procedures for inspecting the instrument and cleaning its external and internal modules.
- *Removal and Installation Procedures.* Procedures for the removal of defective modules and replacement of new or repaired modules. Also included is a procedure for disassembly of the instrument for cleaning.
- *Troubleshooting.* Information for isolating and troubleshooting failed modules. Included are instructions for operating the instrument's internal diagnostic routines and troubleshooting trees. Most of the trees make use of these internal diagnostic routines to speed fault isolation to a module.

Preventing ESD

Before servicing this product, read the *Safety Summary* and *Introduction* at the front of the manual and the ESD information below.



CAUTION. *Static discharge can damage any semiconductor component in this instrument.*

When performing any service which requires internal access to the instrument, adhere to the following precautions to avoid damaging internal modules and their components due to electrostatic discharge (ESD).

1. Minimize handling of static-sensitive circuit boards and components.
2. Transport and store static-sensitive modules in their static protected containers or on a metal rail. Label any package that contains static-sensitive boards.
3. Discharge the static voltage from your body by wearing a grounded antistatic wrist strap while handling these modules. Do service of static-sensitive modules only at a static-free work station.
4. Nothing capable of generating or holding a static charge should be allowed on the work station surface.

5. Handle circuit boards by the edges when possible.
6. Do not slide the circuit boards over any surface.
7. Avoid handling circuit boards in areas that have a floor or work-surface covering capable of generating a static charge.

Inspection and Cleaning

Inspection and Cleaning describes how to inspect for dirt and damage. It also describes how to clean the exterior and interior of the instrument. Inspection and cleaning are done as preventive maintenance. Preventive maintenance, when done regularly, may prevent instrument malfunction and enhance its reliability.

Preventive maintenance consists of visually inspecting and cleaning the instrument and using general care when operating it.

How often to do maintenance depends on the severity of the environment in which the instrument is used. A proper time to perform preventive maintenance is just before instrument adjustment.

General Care

The cabinet helps keep dust out of the instrument and should normally be in place when operating the instrument.



WARNING. *Before performing any procedure that follows, power down the instrument and disconnect it from line voltage.*

Flat Panel Display Cleaning

The portable mainframe display is a soft plastic display and must be treated with care during cleaning.



CAUTION. *Improper cleaning agents or methods can damage the flat panel display.*

Avoid using abrasive cleaners or commercial glass cleaners to clean the display surface.

Avoid spraying liquids directly on the display surface.

Avoid scrubbing the display with excessive force.

Clean the flat panel display surface by gently rubbing the display with a clean-room wipe (such as Wypall Medium Duty Wipes, #05701, available from Kimberly-Clark Corporation).

If the display is very dirty, moisten the wipe with distilled water or a 75% isopropyl alcohol solution and gently rub the display surface. Avoid using excess force or you may damage the plastic display surface.



CAUTION. To prevent getting moisture inside the instrument during external cleaning, use only enough liquid to dampen the cloth or applicator.

Exterior Use the following guidelines and methods to inspect and clean the outside of the instrument.

Inspection — Exterior. Inspect the outside of the instrument for damage, wear, and missing parts, using Table 6-1 as a guide. Immediately repair defects that could cause personal injury or lead to further damage to the instrument.

Table 6-1: External inspection check list

Item	Inspect for	Repair action
Cabinet, front panel, and cover	Cracks, scratches, deformations, damaged hardware.	Repair or replace defective module.
Front-panel knobs	Missing, damaged, or loose knobs.	Repair or replace missing or defective knobs.
Connectors	Broken shells, cracked insulation, and deformed contacts. Dirt in connectors.	Repair or replace defective modules. Clear or wash out dirt.
80C0X male fiber connections	Lint or dust on all male fiber connections.	Clean all male fiber connections with a lint-free cleaning cloth.
Carrying handle, and cabinet feet.	Correct operation.	Repair or replace defective module.
Accessories	Missing items or parts of items, bent pins, broken or frayed cables, and damaged connectors.	Repair or replace damaged or missing items, frayed cables, and defective modules.

Cleaning — Exterior. Clean the exterior surfaces of the chassis with a dry lint-free cloth or a soft-bristle brush. If any dirt remains, use a cloth or swab dipped in a 75% isopropyl alcohol solution. Use a swab to clean narrow spaces around controls and connectors. Do not use abrasive compounds on any part of the chassis that may damage the chassis.

Clean the On/Standby switch using a dampened cleaning towel. Do not spray or wet the switch directly.



CAUTION. Avoid the use of chemical cleaning agents which might damage the plastics used in this instrument. Use only deionized water when cleaning the menu buttons or front-panel buttons. Use a 75% isopropyl alcohol solution as a cleaner and rinse with deionized water. Before using any other type of cleaner, consult your Tektronix Service Center or representative.

Interior

Use the following guidelines and methods to inspect and clean the inside of the instrument.

Inspection — Interior. To access the inside of the instrument for inspection and cleaning, refer to the *Removal and Installation Procedures* in this section.

Inspect the internal portions of the instrument for damage and wear, using Table 6-2 as a guide. Defects found should be repaired immediately.

If any circuit board is repaired or replaced, check Table 5-1 on page 5-1, in Chapter 5 to see if it is necessary to adjust the instrument.



CAUTION. To prevent damage from electrical arcing, ensure that circuit boards and components are dry before applying power to the instrument.

Table 6-2: Internal inspection check list

Item	Inspect for	Repair action
Circuit boards	Loose, broken, or corroded solder connections. Burned circuit boards. Burned, broken, or cracked circuit-run plating.	Remove and replace damaged circuit board.
Resistors	Burned, cracked, broken, blistered condition.	Remove and replace damaged circuit board.
Solder connections	Cold solder or rosin joints.	Resolder joint and clean with isopropyl alcohol.
Capacitors	Damaged or leaking cases. Corroded solder on leads or terminals.	Remove and replace damaged circuit board.

Table 6-2: Internal inspection check list (cont.)

Item	Inspect for	Repair action
Semiconductors	Loosely inserted in sockets. Distorted pins.	Firmly seat loose semiconductors. Remove devices that have distorted pins. Carefully straighten pins (as required to fit the socket), using long-nose pliers, and reinsert firmly. Ensure that straightening action does not crack pins, causing them to break off.
Wiring and cables	Loose plugs or connectors. Burned, broken, or frayed wiring.	Firmly seat connectors. Repair or replace modules with defective wires or cables.
Chassis	Dents, deformations, and damaged hardware.	Straighten, repair, or replace defective hardware.

Cleaning Procedure — Interior. To clean the instrument interior, do the following steps:

1. Blow off dust with dry, low-pressure, deionized air (approximately 9 psi).
2. Remove any remaining dust with a lint-free cloth dampened in isopropyl alcohol (75% solution) and rinse with warm deionized water. (A cotton-tipped applicator is useful for cleaning in narrow spaces and on circuit boards.)

STOP. If, after doing steps 1 and 2, a module is clean upon inspection, skip the remaining steps.

3. If steps 1 and 2 do not remove all the dust or dirt, the instrument may be spray washed using a solution of 75% isopropyl alcohol by doing steps 4 through 8.
4. Gain access to the parts to be cleaned by removing easily accessible shields and panels (see *Removal and Installation Procedures*).
5. Spray wash dirty parts with the isopropyl alcohol and wait 60 seconds for the majority of the alcohol to evaporate.
6. Use hot (120 °F to 140 °F) deionized water to thoroughly rinse them.
7. Dry all parts with low-pressure, deionized air.
8. Dry all components and assemblies in an oven or drying compartment using low-temperature (125 °F to 150 °F) circulating air.

Removal and Installation Procedures

This subsection contains procedures for removal and installation of all mechanical and electrical modules.

Preparation



WARNING. Before doing this or any other procedure in this manual, read the Safety Summary found at the beginning of this manual. Also, to prevent possible injury to service personnel or damage to this instrument's components, read Installation in Chapter 2, and Preventing ESD in this section.

This subsection contains the following items:

- Preparatory information that you need to properly do the procedures that follow.
- A list of tools required to remove and disassemble all modules.
- Procedures for removal and reinstallation of the electrical and mechanical modules.
- A disassembly procedure for removal of all the major modules from the instrument at one time and for reassembly of those modules into the instrument. Instructions for doing the actual cleaning are found under *Inspection and Cleaning* at the beginning of this section.
- Module disassembly procedures.



WARNING. Before doing any procedure in this subsection, disconnect the power cord from the line voltage source. Failure to do so could cause serious injury or death.

NOTE. Read Equipment Required for a list of the tools needed to remove and install modules in this instrument. See Table 6-3, page 6-8.

Read the cleaning procedure before disassembling the instrument for cleaning.

Equipment Required. Most modules in this instrument can be removed with a screwdriver handle mounted with a size T-15, Torx® screwdriver tip. *Use this tool whenever a procedure step instructs you to remove or install a screw unless a different size screwdriver is specified in that step.* All equipment required to remove and reinstall each module is listed in the first step of its procedure.

Table 6-3: Tools required for module removal

Item No.	Name	Description	Part number
1	Screwdriver handle	Accepts Torx®-driver bits	General Tool: 620-440
2	Screwdriver handle, extended length, 10.5 to 12 inches	Accepts Torx®-driver bits and $\frac{3}{16}$ socket tip. Used for removing the T-10 screws and $\frac{3}{16}$ inch hex posts from the electrical and optical module slots.	Standard tool or Xcelite 99X10V N/S#48706
3	T-10 Torx tip	Used for removing the electrical or optical module chassis. Torx®-driver bit for T-10 size screw heads.	General Tool: 640-235
4	T-15 Torx tip	Used for removing most the instrument's screws. Torx®-driver bit for T-15 size screw heads.	General Tool: 640-247
5	T-20 Torx tip	Used for removing the handle hardware. Torx®-driver bit for T-20 size screw heads.	General Tool: 640-250
6	$\frac{3}{16}$ inch socket tip	Used for removing the $\frac{3}{16}$ inch hex posts from the electrical and optical module slots.	Standard tool
7	$\frac{1}{8}$ inch flat-bladed screwdriver	Screwdriver for unlocking cable connectors.	Standard tool
8	#0 phillips screwdriver	Screwdriver for removing small phillips screws, CD, floppy & hard drive.	Standard tool
9	Angle-Tip Tweezers	Used to remove front panel knobs	Standard tool
10	$\frac{3}{16}$ inch open-end wrench	Used to remove the rear panel nut posts.	Standard tool
11	$\frac{5}{16}$ inch open-end wrench	Used to remove the rear panel nut posts.	Standard tool
12	Coaxial cable connector tool	Used to remove coaxial connectors from d-subminiature connector housings.	Amp: 58095-1

Procedures for External Modules

The following procedures are found here and are listed in order presented.

- Front Panel Knobs
- Trim (all)
- Bottom cover
- Left and Right covers
- Line Fuse and Line Cord

Front-Panel Knobs

1. *Assemble equipment and locate modules to be removed:* Use an angled-tip tweezers (Item 9) and locate the the front panel see Figure 6-2 on page 6-11.
2. *Orient the instrument:* Set the instrument so its bottom is down on the work surface and its front is facing you.
3. *Remove the knob(s):* Grasp any knob you want to remove and pull it straight out from the front panel about a $\frac{1}{4}$ inch to create some clearance between the base of the knob and the front panel. Insert the tweezers between the knob and front panel and use them to remove the knob. See Figure 6-1.
4. *Reinstallation:* To reinstall, align knob to shaft and push it in until it snaps.



CAUTION. To prevent damage to the encoders located onto the circuit board, apply pressure to the backs of the encoders while pushing the knob on the shaft.

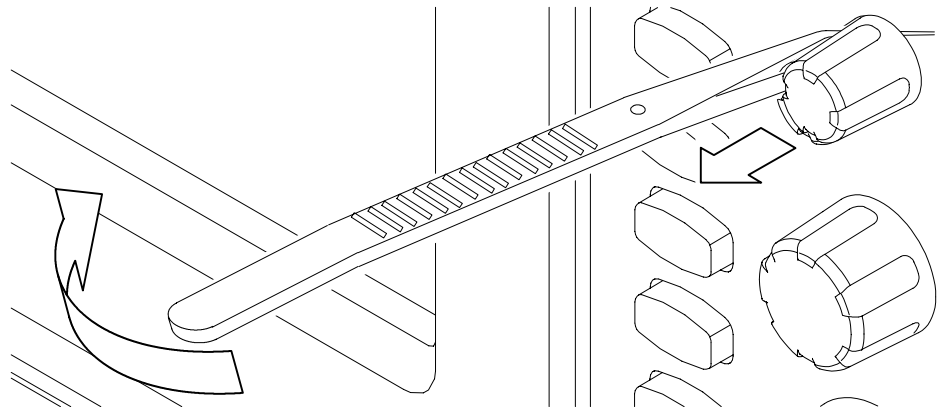


Figure 6-1: Knob removal

Trim and Carrying Handle

1. *Locate module to be removed:* Locate the Trim in the locator diagram, See Figure 6-7, page 6-18.
2. *Remove the front panel trim:* Use Figure 6-2, page 6-11, as a guide.
 - a. Grasp the trim ring by its top edge and pull toward you to detach the three plastic snaps. (Alternatively, you can use a flat-bladed screwdriver or other small prying tool to help you detach the snaps.)
 - b. Swing the bottom of the ring upward and off the front panel.
3. *Remove the acquisition trim:* Use Figure 6-2, page 6-11 as a guide.
 - a. Remove the six T-15 Torxdrive screws that secure the acquisition trim to the instrument.
 - b. Remove the knobs from the electrical and optical ejector levers. Grasp the knobs with your fingers and pull straight out.
 - c. Remove the acquisition trim from the instrument.
4. *Remove the top cover trim:* Use Figure 6-2, page 6-11 as a guide.
 - a. Remove the accessory pouch; it snaps off.
 - b. Remove the four T-15 Torxdrive screws that secure the top cover trim to the instrument. The T-15 Torxdrive screws also secure the snap studs to the top cover.
 - c. Remove the top cover trim from the instrument.
5. *Remove the carrying handle and the right/left side trim panels:* Use Figure 6-2, page 6-11 as a guide.
 - a. Remove the two T-20 Torxdrive screws that secure the handle to the instrument. Remove the handle from the instrument.



CAUTION. *Over-tightening the handle screws may cause the handle to break off from the cabinet. When reinstalling the screws, use a torque wrench to tighten the screws to 8-10 in.lb.*

- b. Slide the side trim panels towards the rear of the instrument allowing the tabs to clear the cover openings, then pull out to remove the panels from the instrument.
6. *Reinstallation:* Do in reverse steps 2 through 5 to reinstall the appropriate trim.

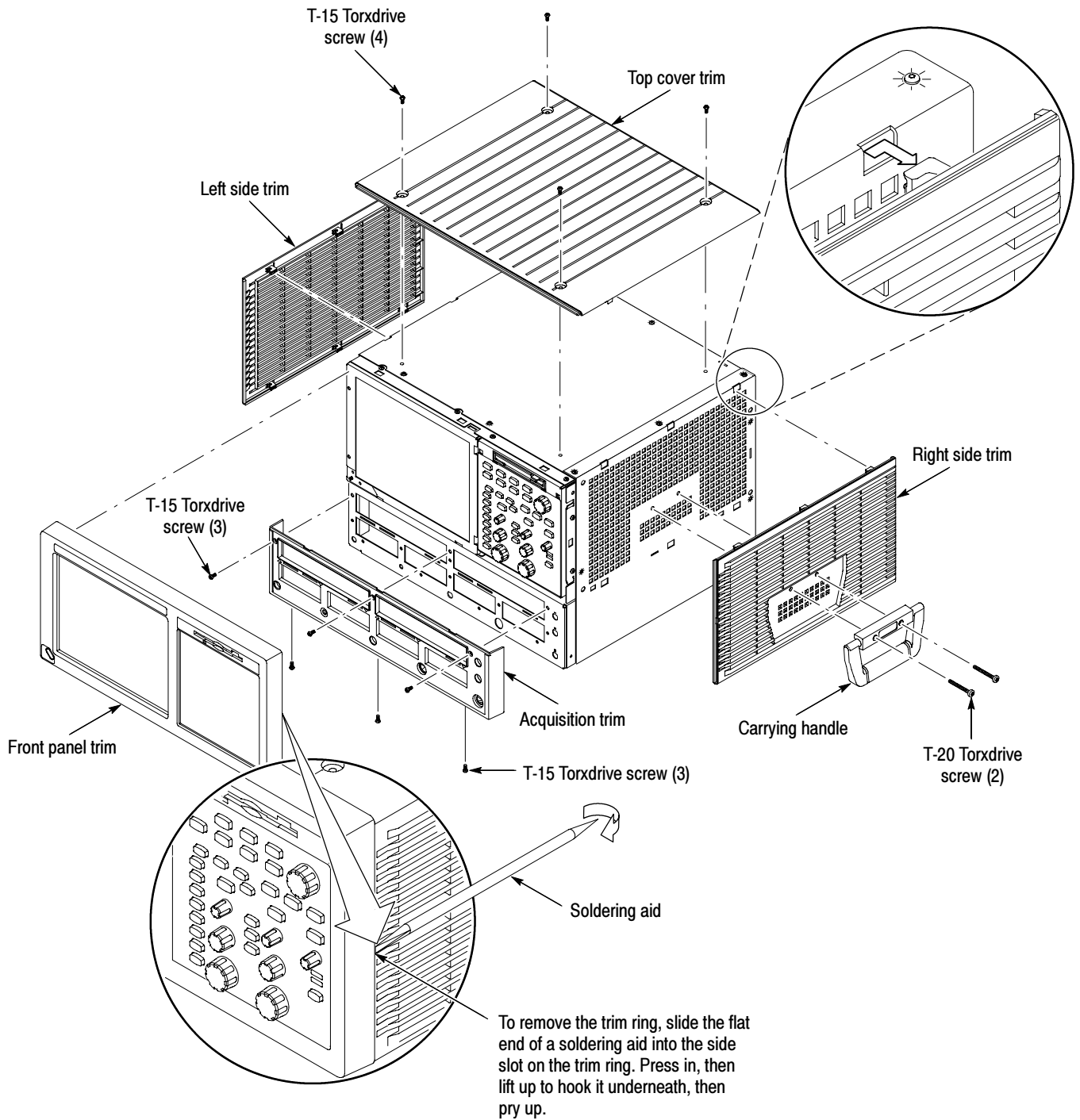


Figure 6-2: Trim removal

Bottom Cover 1. Remove the bottom cover: See Figure 6-3, page 6-12.

2. *Orient the instrument:* Set the instrument so its top is down on the work surface and its bottom is facing you.
 - a. Remove the five T-15 Torxdrive screws that secure the bottom cover to the instrument.
 - b. Remove the bottom cover from the instrument.
3. *Reinstallation:* Do in reverse steps a and b to reinstall the cabinet feet.

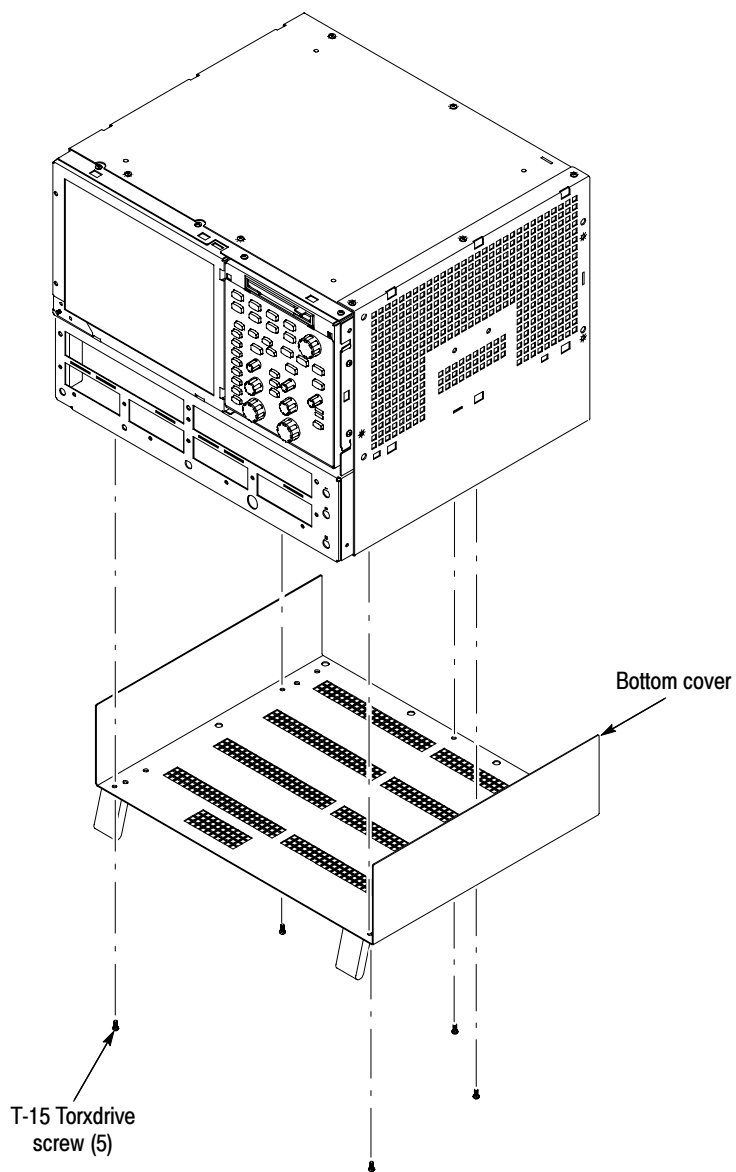


Figure 6-3: Bottom cover removal

- Covers**
1. *Remove the left and right covers:* See Figures 6-4 and 6-5, pages 6-14 and 6-15.
 - Trim (all)
 - Bottom cover
 2. *Orient the instrument:* Set the instrument so its rear is on the work surface and the front of the instrument facing the technician.

NOTE. *All mounting screw holes are indicated by a star etched around the mounting hole.*

- a. Remove the thirteen T-15 Torxdrive screws that secure the covers to the top and both sides of the chassis.
- b. Remove the nine T-15 Torxdrive screws that secure the covers to the bottom of the chassis.
- c. Pull the bottom-right cover down and slide to the right to remove from the instrument. Pull the top-left cover upward and slide to the left to remove from the instrument.



CAUTION. *Take care not to bind or snag the covers on the instrument's internal cabling as you remove or install.*

3. *Reinstallation:* Do in reverse steps a through c to reinstall the cabinet.

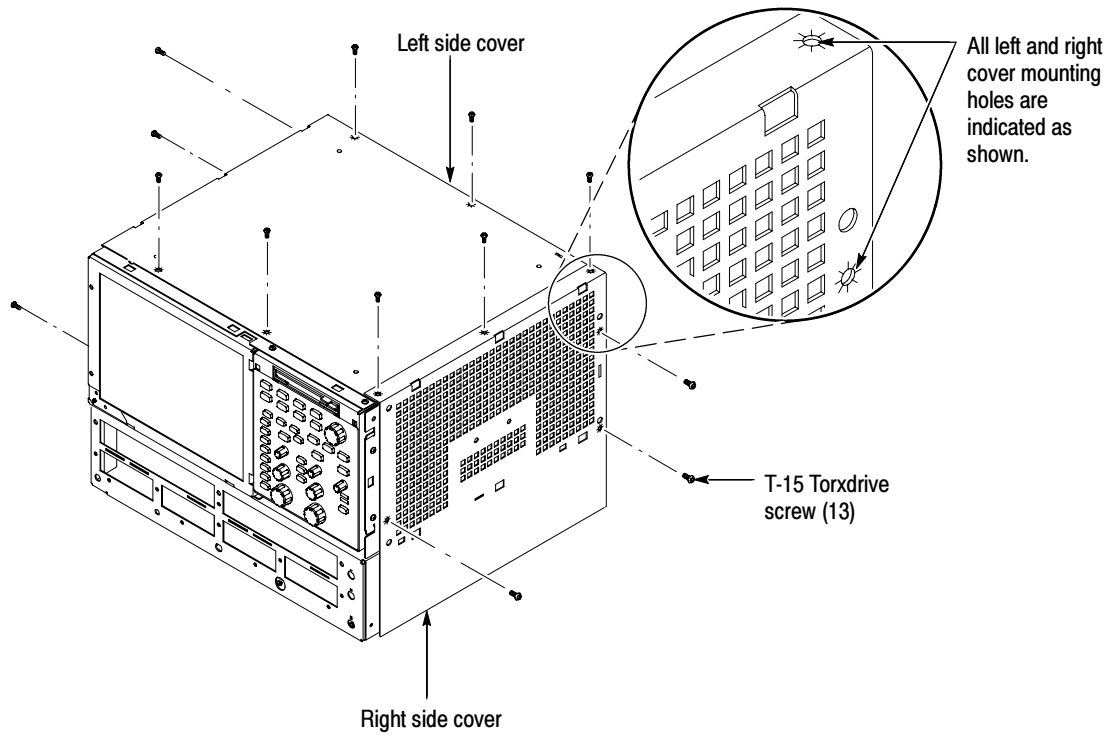


Figure 6-4: Cover removal

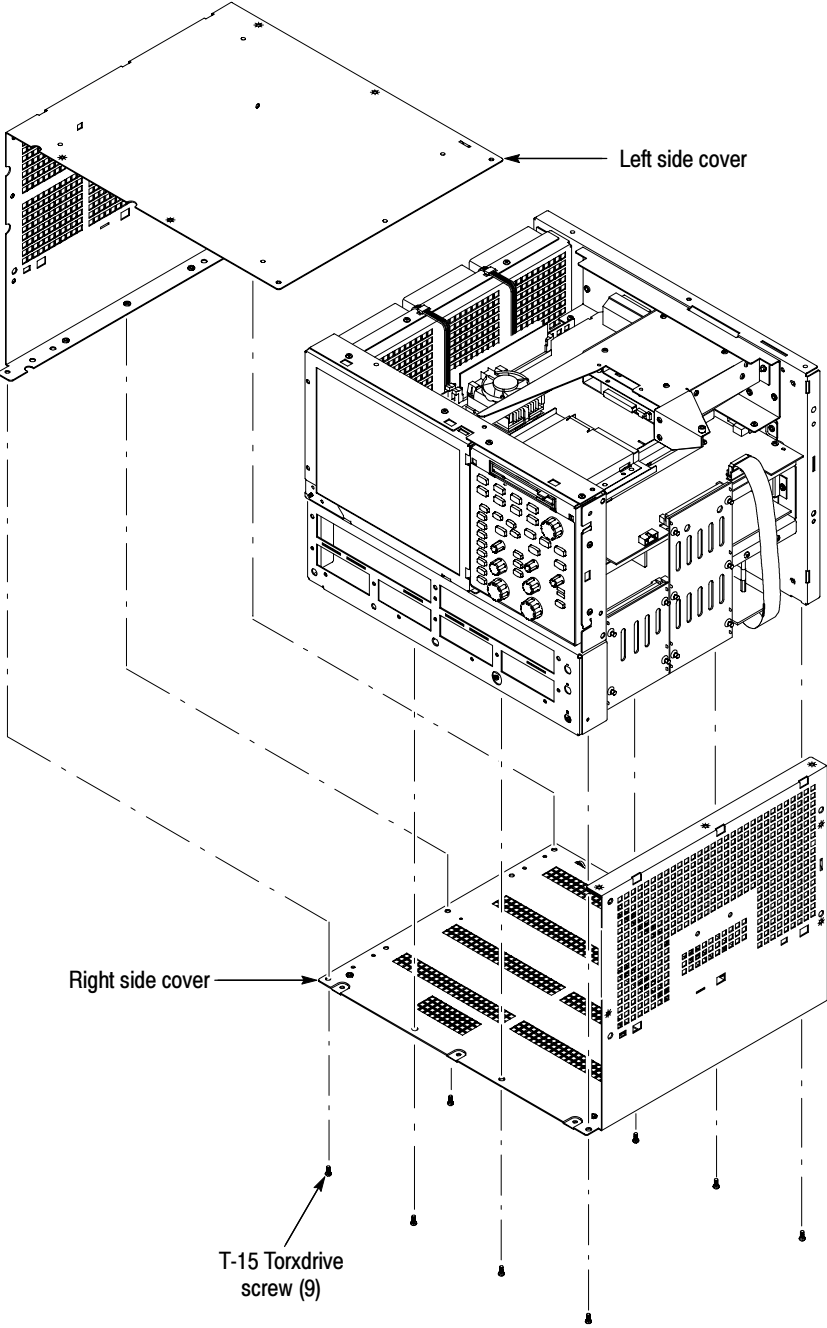


Figure 6-5: Cover removal

Line Fuses and AC power cord connector

1. *Assemble equipment and locate modules to be removed:* Locate the power switch, line fuses and AC power cord connector in Figure 6-6, page 6-17.
2. The instrument has a built-in soft power-off function that safely powers off the instrument when you press the On/Standby switch. You must power off the instrument using the Windows 98 shutdown process before depressing the front panel On/Standby switch.
3. Power off the rear panel power switch before servicing the line fuses or power cord.



CAUTION. *When powering off the instrument, use the Windows 98 shut down procedure. (Choose Shutdown from the Start menu.)*

Powering down the instrument without using the Windows 98 shut down procedure can corrupt the software on the hard disk.

4. *Orient the instrument:* Set the instrument so its bottom is down on the work surface and its rear is facing you. If you are servicing the line fuses, do the next step; if you are servicing the line cord, skip to step 6.
5. *Remove line fuses:* Find the fuse caps on the rear panel. Now, remove both fuse caps by turning them counterclockwise using a flat-bladed screwdriver, and remove the line fuses. Reverse procedure to reinstall.
6. *Remove line cord:* Find the line cord on the rear cover. Pull the line cord away to remove from the AC power connector. Reverse procedure to reinstall.
7. *Reinstallation:* Do in reverse steps 5 and 6 to reinstall the line cord and then the line fuse.

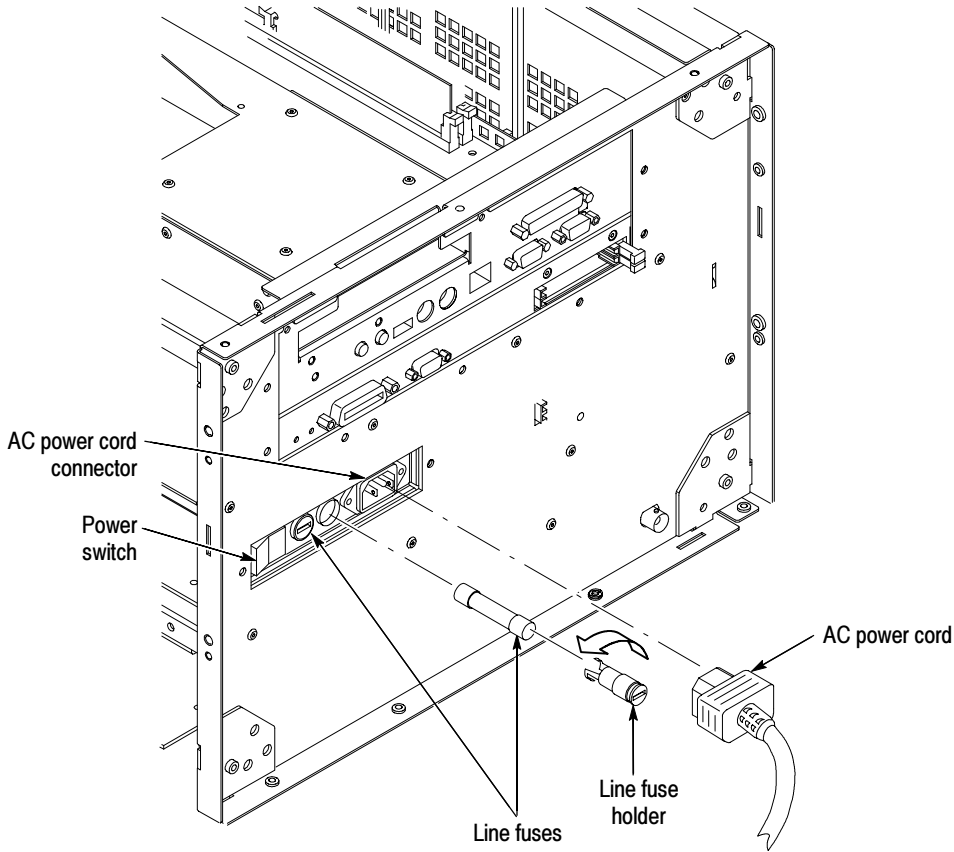


Figure 6-6: Line fuses and line cord removal

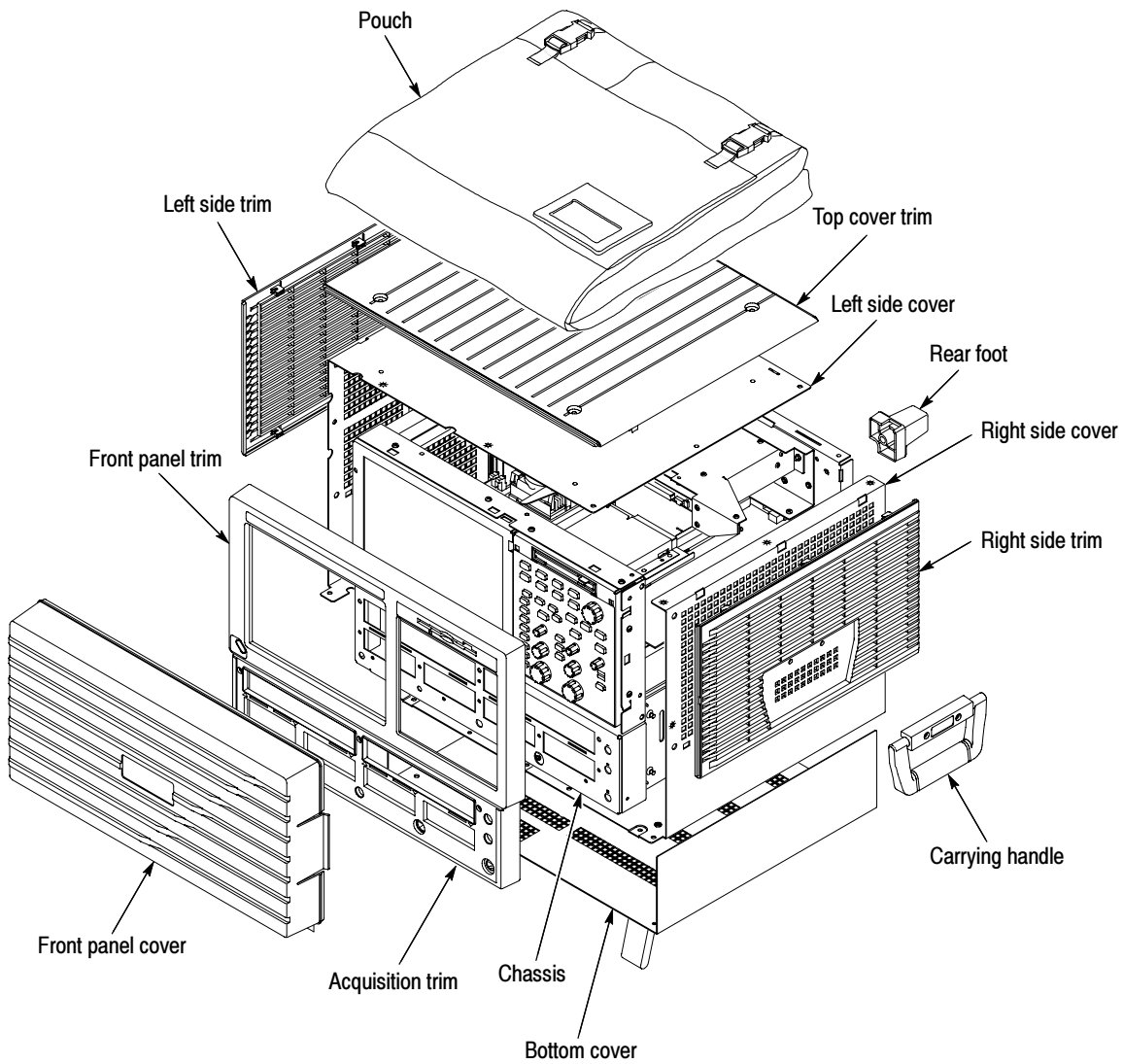


Figure 6-7: External modules

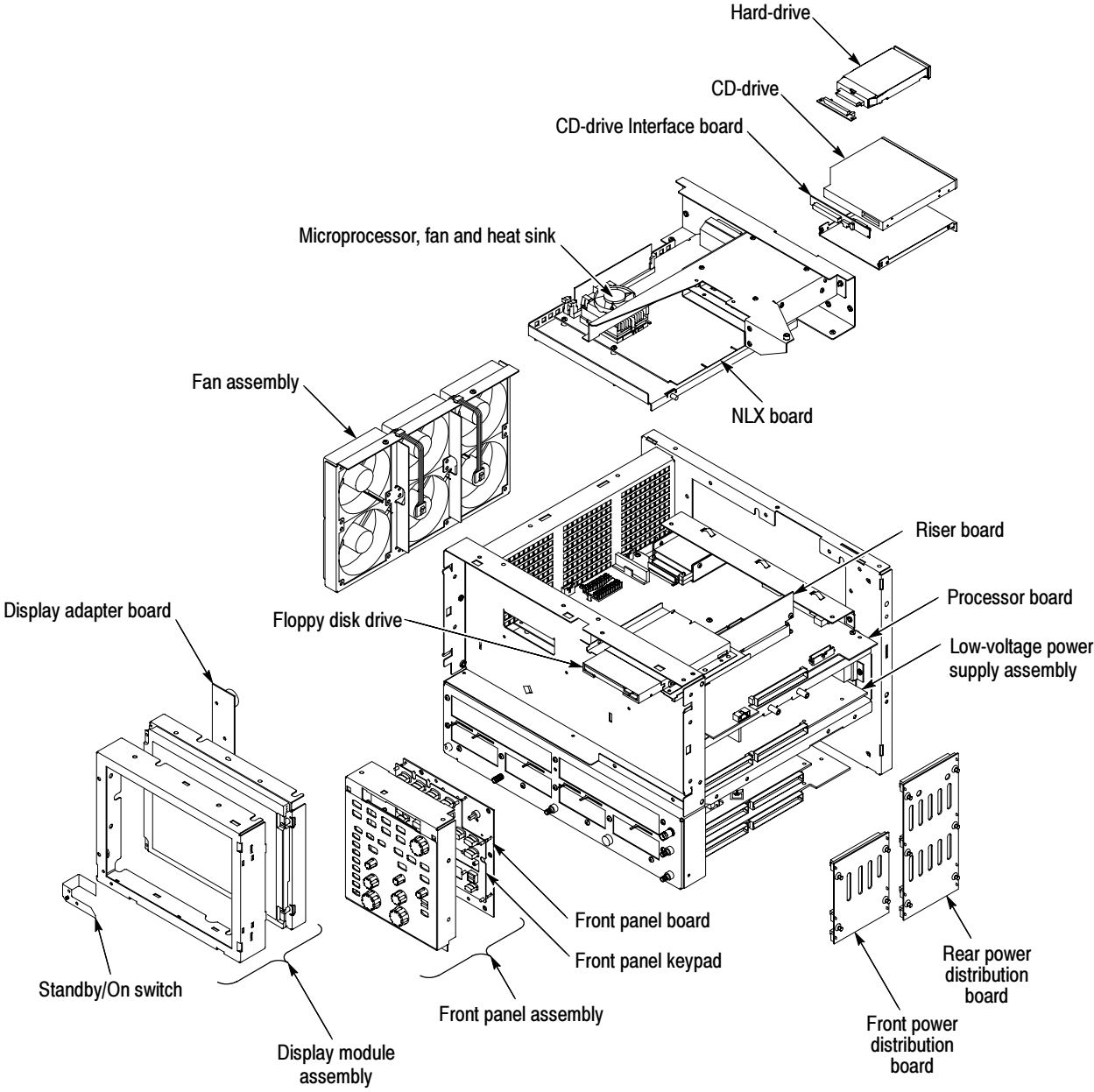


Figure 6-8: Internal modules

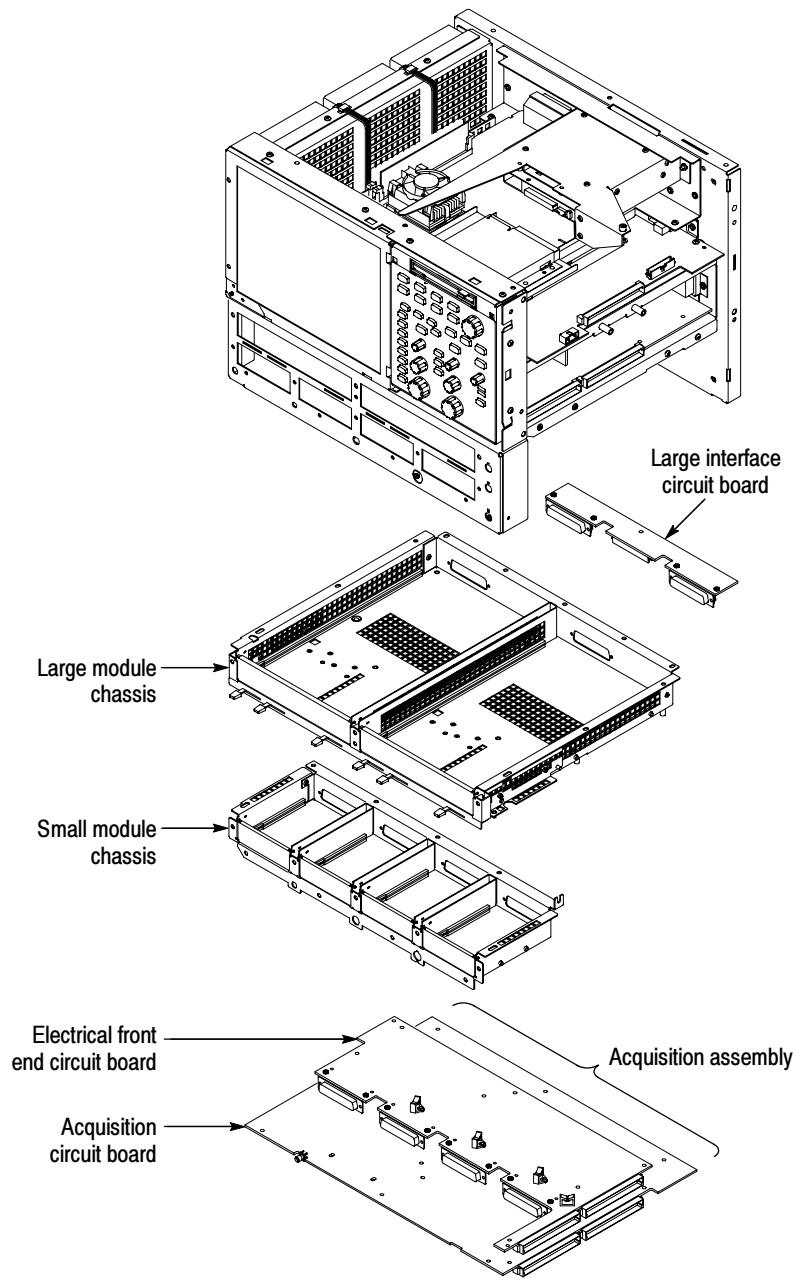


Figure 6-9: Acquisition modules

Procedures for Modules

You should have completed the Procedures for external modules before doing many of the procedures in this collection. The procedures found here are listed in disassembly order:

- Front Panel assembly
- Front Panel Board
- Front Panel Keypad
- Display assembly
- Display Adapter Board
- Standby/On Switch Flex Circuit
- Floppy Disk Drive
- Hard Disk Drive
- CD Drive
- Front and Rear Power Distribution Boards
- Low-Voltage Power Supply
- NLX Board
- Microprocessor
- PC Processor Board
- Fan assembly
- Acquisition assembly
- Large Module Interface Board
- Module Slot Doors
- Electrical Modules
- Optical Modules
- 80A00 and 82A00 Series Modules

Front Panel Assembly

1. *Locate module to be removed:* Locate the Front Panel assembly Figure 6-10, page 6-22. Additional modules to be removed:
 - Trim (Front panel)

2. *Remove the Front Panel assembly:* See Figure 6-10, page 6-22.
3. *Orient the instrument:* Set the instrument so its bottom is down on the work surface and its front panel is facing you.
 - a. Remove the six T-15 Torxdrive screws that secure the Front panel assembly to the front chassis.
 - b. Grasp the top of Front Panel assembly and pull forward to allow access to the ribbon cable connector on the front panel board.
 - c. Use the $\frac{1}{8}$ inch flat-bladed screwdriver to carefully lift J1 cable connector lock up to disconnect J1 flex cable from the display module assembly. See Figure 6-11, page 6-23. Note the connector's pin 1 index mark and the black stripe on the cable for later reassembly.
 - d. Pull the Front Panel assembly forward and remove from the instrument.
4. *Reinstallation:* Do in reverse steps a through d to reinstall the front panel assembly.

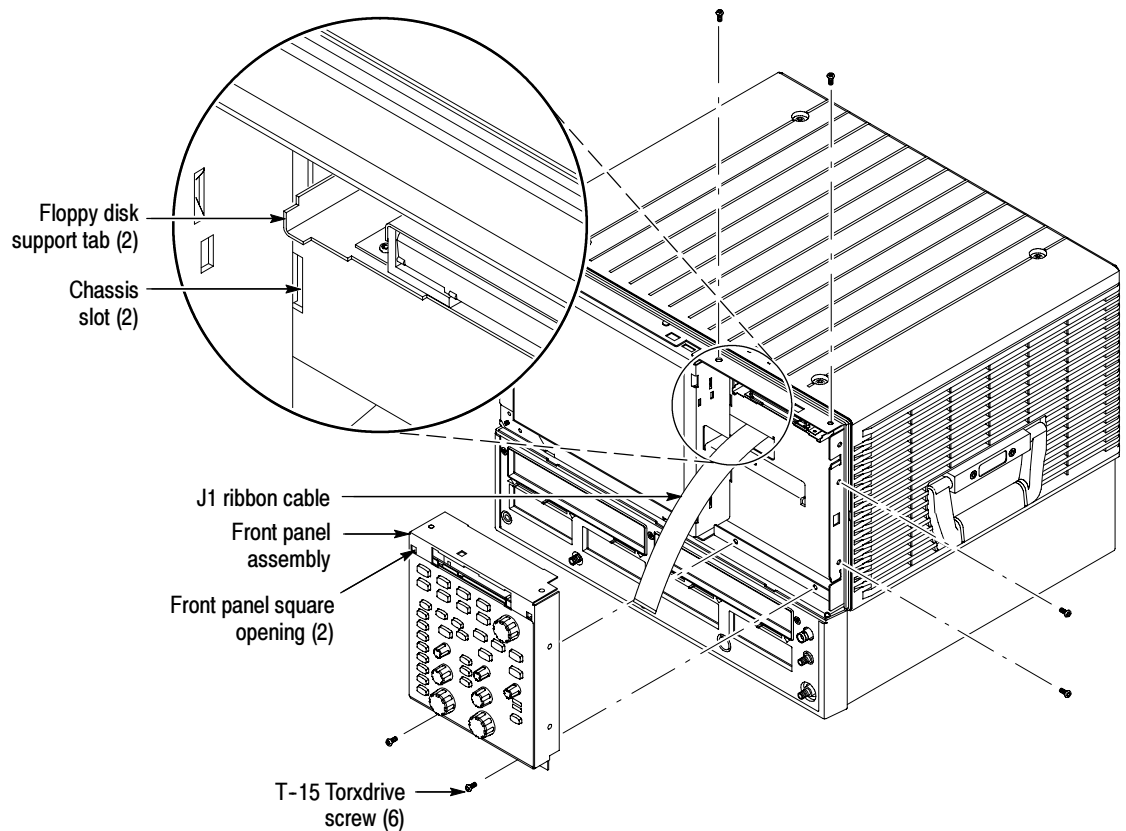


Figure 6-10: Front panel assembly removal

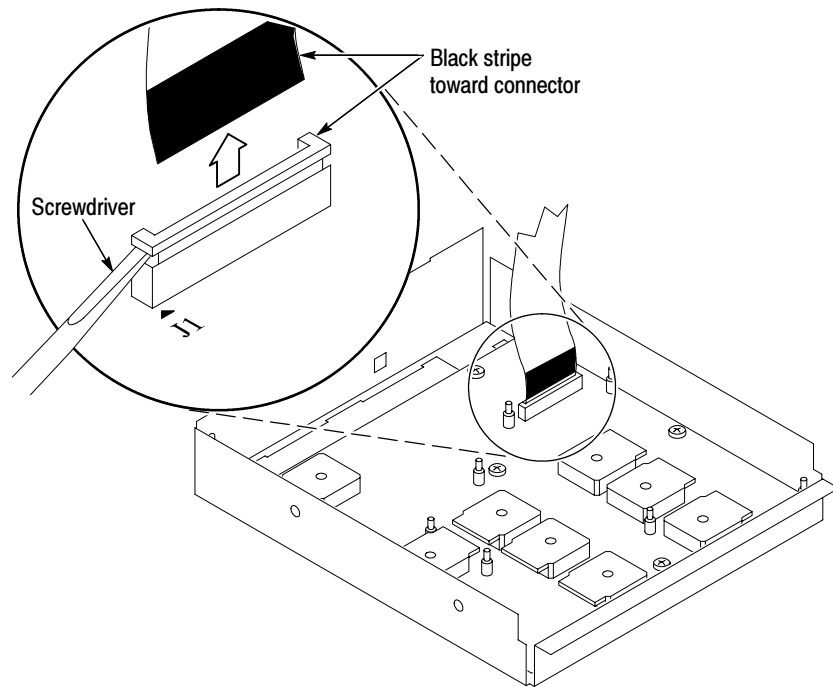


Figure 6-11: J1 flex cable connector removal

Front Panel Board

1. *Locate module to be removed:* Locate the Front Panel assembly Figure 6-10, page 6-22. Additional modules to be removed:
 - Front Panel Knobs
 - Trim (front panel)
 - Front Panel assembly
2. *Remove the Front Panel board:* See Figure 6-12, page 6-24.
 - a. Remove the eight T-15 Torxdrive screws that secure the Front panel board to the Front panel assembly.
 - b. Pry the board up off the alignment studs. Place a flat bladed screwdriver in the pry point access holes to pry the board up from the assembly.
 - c. Remove the board from the assembly.
3. *Reinstallation:* Do in reverse steps a through c to reinstall the front panel board.

Front Panel Keypad

1. *Locate module to be removed:* Locate the Front Panel assembly Figure 6-10, page 6-22. Additional modules to be removed:
 - Front Panel Knobs
 - Trim (front panel)
 - Front Panel assembly
 - Front Panel Board
2. *Remove the Front Panel keypad:* See Figure 6-12, page 6-24.
 - a. Pull on each of the keypad support guides to separate the keypad from the Front panel board. Use a pair of tweezers or equivalent tool to pull the keypad support guides.
 - b. Remove the keypad from the front panel board.

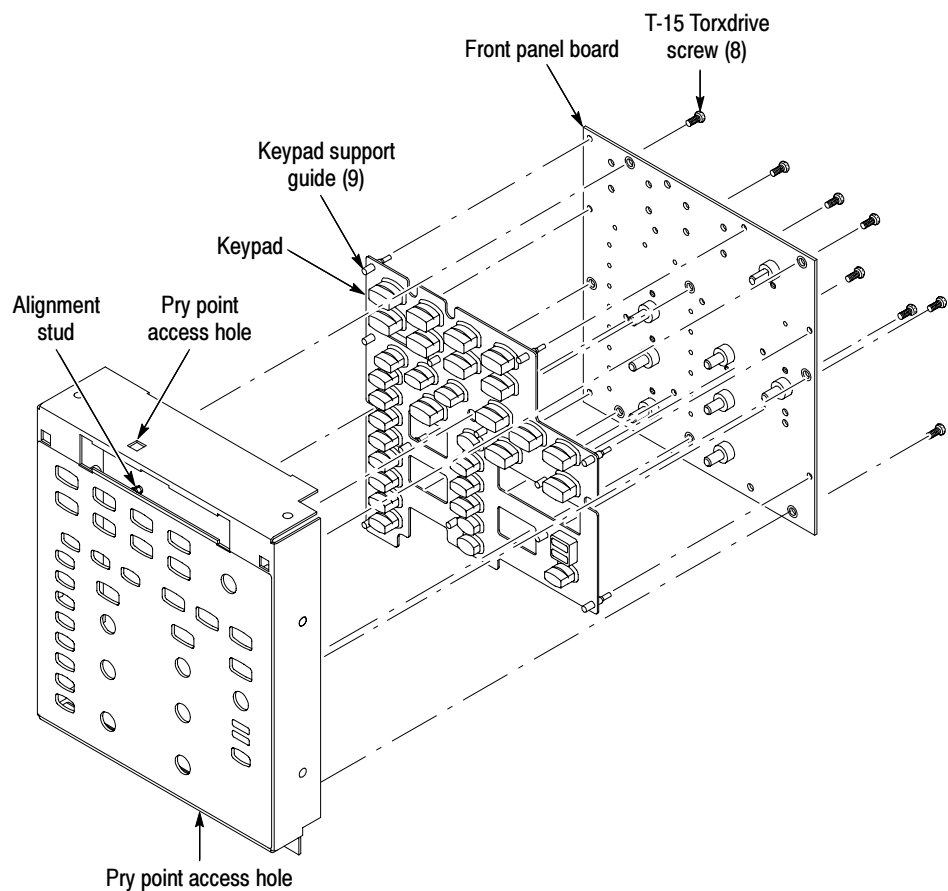


Figure 6-12: Front panel board and keyboard removal



CAUTION. When removing or installing the keypad, make sure you do not touch the switch contact with your fingers. The oils in your fingers will degrade or damage the switch contacts. To help prevent damage to the keypad use cotton gloves when removing or installing the keyboard pad.

3. *Reinstallation:* Do in reverse steps to reinstall the Keypad, front panel board, and the front panel assembly. Then see the following instructions:
 - a. Make sure the keypad is aligned properly on the Front Panel board.
 - b. Make sure the ribbon cable is routed correctly when installing the Front Panel into the chassis.
 - c. Insert the two floppy disk support tabs into the front panel square openings. Both left front panel tabs must go into the chassis slots. See Figure 6-10, page 6-22.

Display Assembly

1. *Locate module to be removed:* Locate the Display assembly, Figure 6-13, page 6-26. Additional modules to be removed:
 - Trim (front panel and top)
2. *Orient the instrument:* Set the instrument so its bottom is down on the work surface and its front panel is facing you.



CAUTION. To avoid damage to the front panel Standby/On switch assembly, do not set the Display module assembly on a work surface. Sliding the instrument over the edge of the work surface could break off the Standby/On switch assembly.

3. *Remove the Display assembly:* See Figure 6-13, page 6-26.
 - a. Remove the four T-15 Torxdrive screws that secure the Display assembly to the chassis.
 - b. Grasp the top edge of the Display assembly and pull forward far enough to allow access to the flex cable connector.
 - c. Disconnect J8 flex cable from the display assembly. Remove the display module assembly from the instrument. See Figure 6-13, page 6-26.

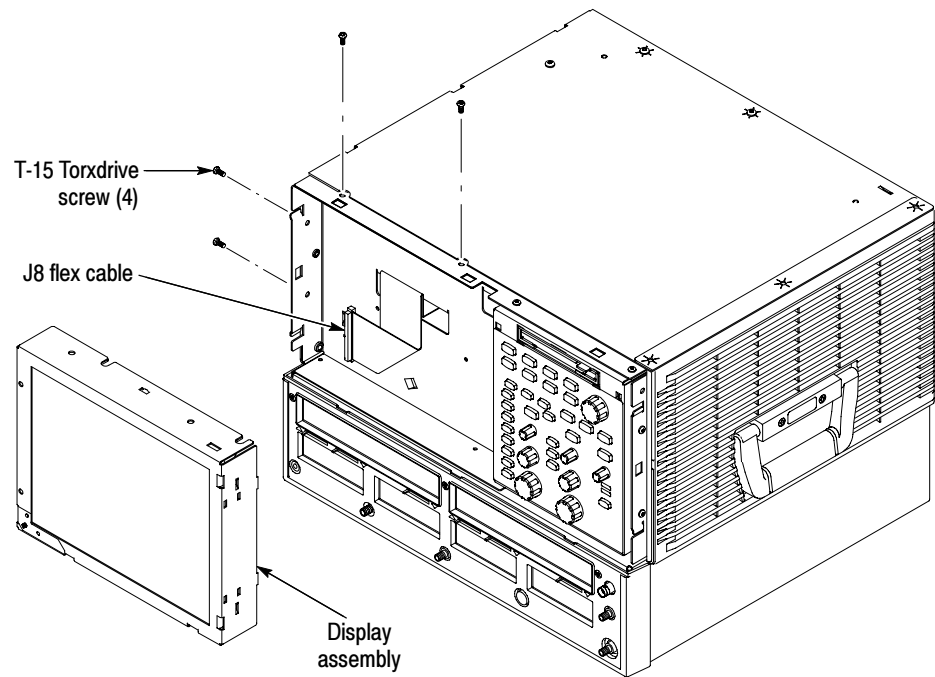


Figure 6-13: Display removal

4. *Remove the Touch panel from the Display assembly:* See Figures 6-14 and 6-15, pages 6-27 and 6-28.



CAUTION. *To prevent degradation of the display sharpness, this procedure must be performed in a dust free environment. The service technician should wear cotton gloves to prevent finger oils from contaminating all surfaces of the display glass.*

- a. Disconnect J1, J9 and J10 cables from the Display Adapter circuit board.
- b. Separate the assembly by carefully prying the Touch panel (outer) assembly from the Display (inner) assembly. Insert a flat-bladed screwdriver in the access notches to push out on the Touch panel assembly.

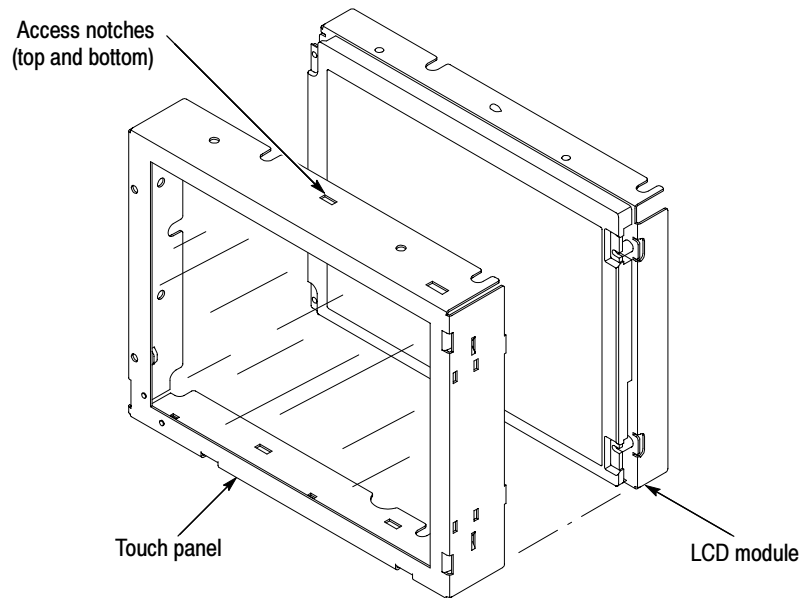


Figure 6-14: Touch panel and LCD assembly removal

5. *Reinstallation:* Do in reverse steps 1 through 5 to reinstall the Display assembly.

Display Adapter Board

1. *Locate module to be removed:* Locate the display adapter board in the locator diagram *Internal Modules*, Figure 6-7, page 6-18. Additional modules to be removed:
 - Trim (front panel and top)
 - Display assembly
2. *Remove the Display Adapter Board:* See Figures 6-15 and 6-16, page 6-28.
 - a. Disconnect J11, J1, J7, J8, and J9 cables from the Display Adapter board.
 - b. Slide the clip off the connector (at J10).
 - c. Disconnect J10 cable from the Display Adapter board.
 - d. Remove the two T-15 Torxdrive screws that secure the Display Adapter circuit board to the Display assembly. Remove the Display Adapter from the assembly.
3. *Reinstallation:* Do in reverse steps 2a through 2d to reinstall the board.

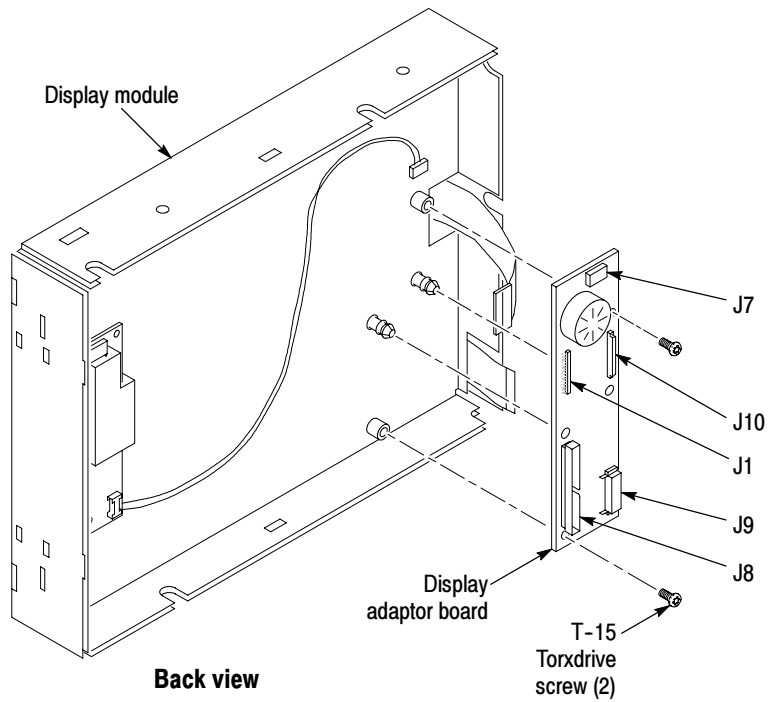


Figure 6-15: Display adaptor board removal

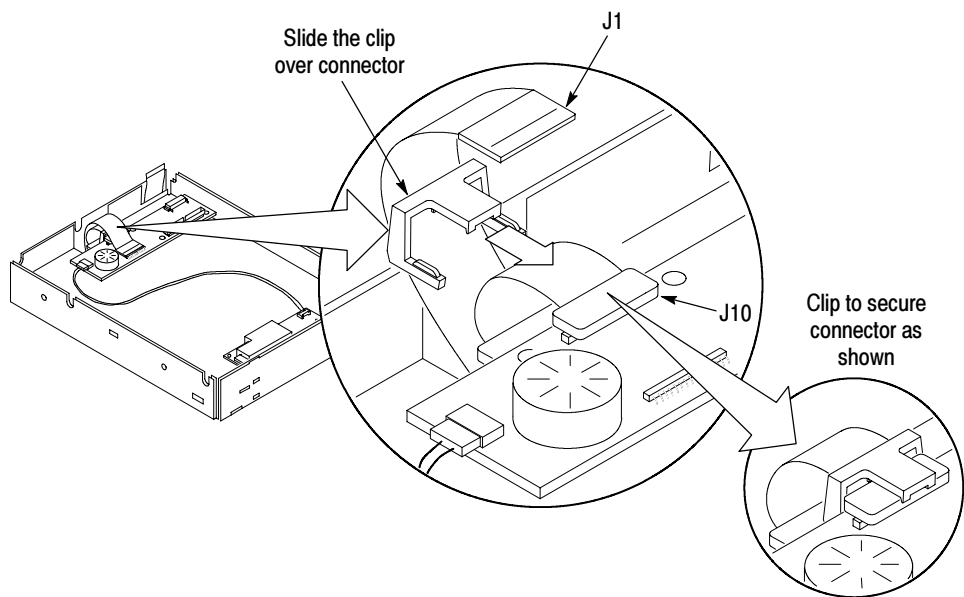


Figure 6-16: Connector clip assembly

**Standby/On Switch Flex
Circuit Removal**

1. *Locate module to be removed:* Locate the Standby/On Switch flex circuit in the locator diagram *Internal Modules*, Figure 6-8, page 6-19. Additional modules to be removed:
 - Trim (front panel and top)
 - Display assembly
2. *Orient the oscilloscope:* Set the oscilloscope so its bottom is down on the work surface and its front is facing you.
3. *Remove the Standby/On Switch flex circuit:* See Figure 6-17, page 6-30.
 - a. Peel the Standby/On switch flex circuit away from the front of the display assembly.
 - b. Disconnect the flex circuit from J9 on the Display Adapter circuit board.
 - c. Grasp the flex circuit and pull it out of the Display assembly.
4. *Reinstallation:* Do following procedure to reinstall the Standby/On Switch.
 - a. Remove the protective backing on the Standby/On switch flex circuit.
 - b. Slide the connector end of the Standby/On switch flex circuit through the slot in the Display assembly. Make sure the flex circuit connector aligns with J9 on the Display Adapter circuit board.
 - c. Align the holes in the flex circuit to the two index posts on the front side of the Display assembly.
 - d. Firmly press the flex circuit to the Display assembly chassis surface.

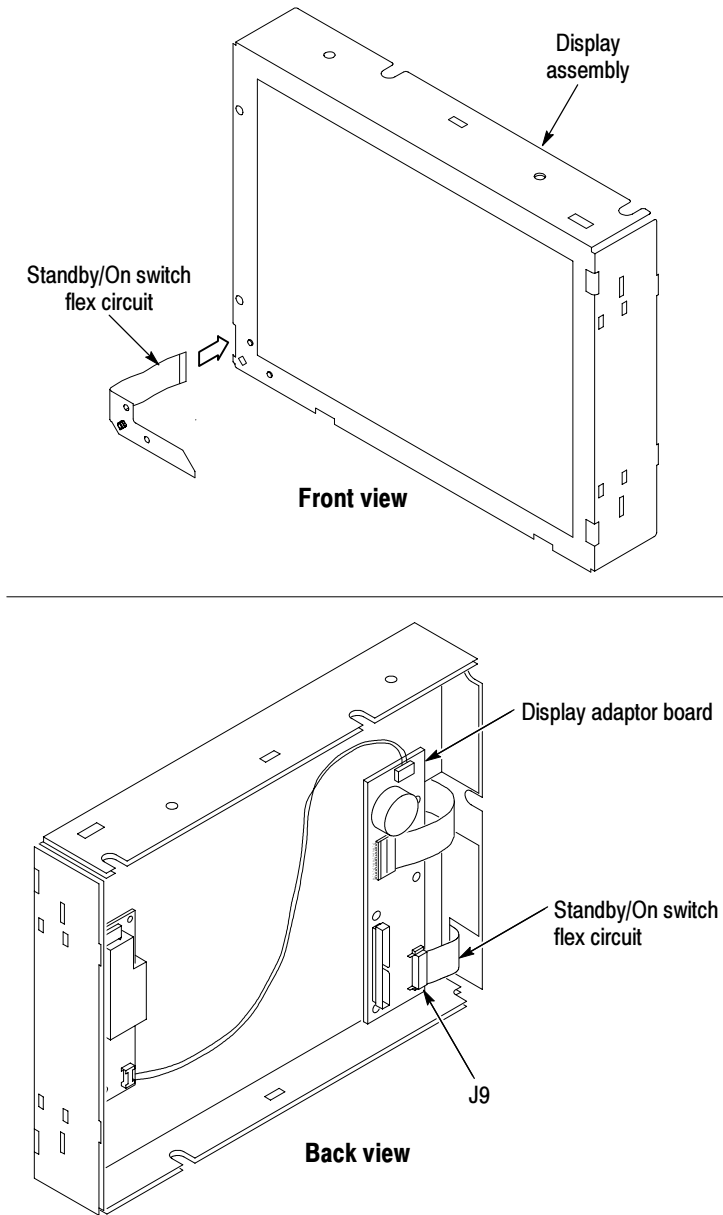
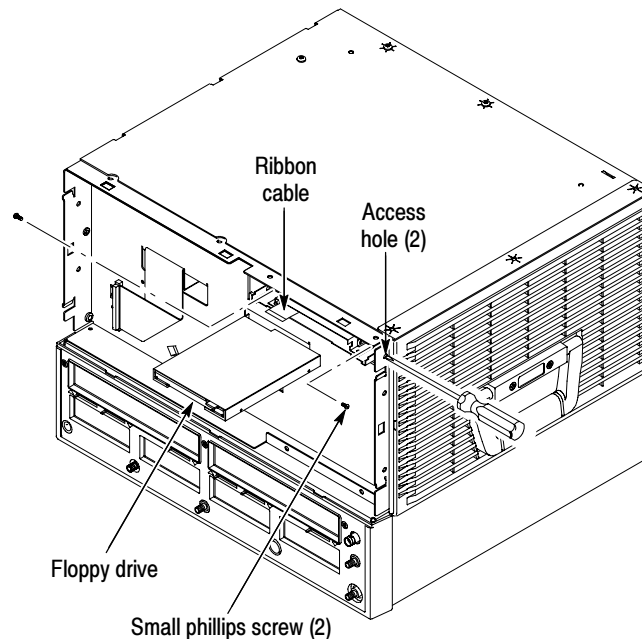


Figure 6-17: Standby/On switch flex circuit removal

Floppy Disk Drive

1. *Locate modules to be removed:* Locate the Floppy Disk Drive in the locator diagram *Internal Modules*, Figure 6-8, page 6-19. Additional modules to be removed:
 - Trim (front panel and top)
 - Front Panel assembly
 - Display assembly
2. *Remove the floppy disk drive:* Use Figure 6-18, page 6-31 as a guide. A #0 phillips screwdriver is required for this procedure.
3. *Orient the instrument:* Set the instrument so its bottom is down on the work surface and its front panel is facing you.
 - a. Remove the two small phillips screws that secure floppy disk drive assembly to the bracket. Use the access hole located on the outer chassis to remove one of the small phillips screws.
 - b. Slide the floppy drive out toward the front of the instrument far enough to allow you to disconnect the ribbon cable connector.
 - c. Remove the floppy drive from the instrument.
4. *Reinstallation:* Do in reverse steps a through c to reinstall the floppy disk drive.

**Figure 6-18: Floppy disk drive removal**

Hard Disk Drive

1. *Locate module to be removed:* Locate the Hard Disk Drive in the locator diagram *Internal Modules*, Figure 6-8, page 6-19.



CAUTION. *Do not remove the replaceable hard disk drive when the mainframe is powered on.*

The replaceable hard disk drive may be permanently damaged if it is removed while the mainframe is powered on.

Always power down the mainframe before removing the replaceable hard disk drive.

2. *Orient the instrument:* Set the instrument so its bottom is down on the work surface and its rear panel is facing you.
3. *Remove the hard disk drive:* See Figure 6-19, page 6-33.
 - a. Verify that the chassis is powered down.
 - b. Push the hard disk drive cover in and the hard drive will disconnect from the latch.
 - c. Grasp the hard disk drive assembly and slide it out of the instrument.
4. *Reinstallation:* Do in reverse steps a and b to reinstall the hard disk drive assembly. The hard disk drive will push in to lock and push in again to unlock.

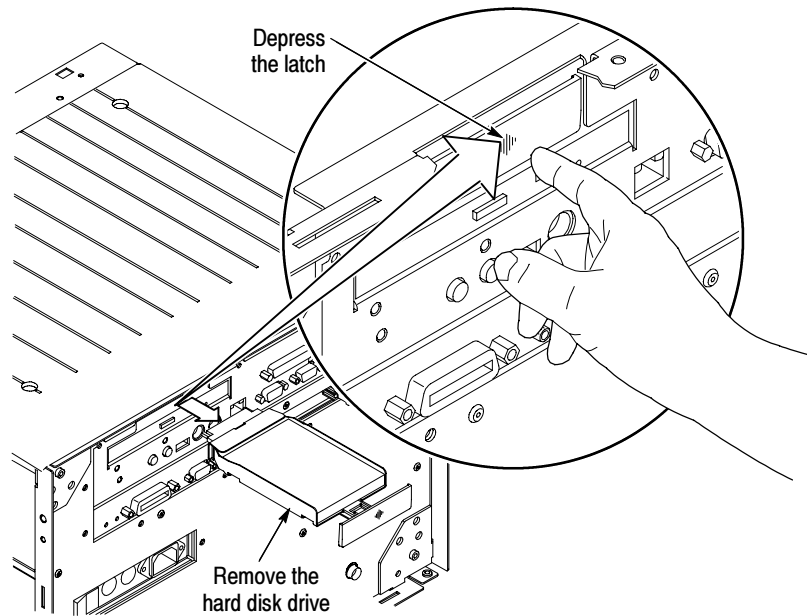


Figure 6-19: Hard drive disk removal

5. *Remove the hard disk drive from the cartridge:* See Figure 6-20, page 6-33.
 - a. Remove the four #0 phillips screws that fasten the hard disk drive to the cartridge.
 - b. Carefully remove the hard disk drive from the cartridge, and remove the cable assembly from the connector on the hard disk drive.

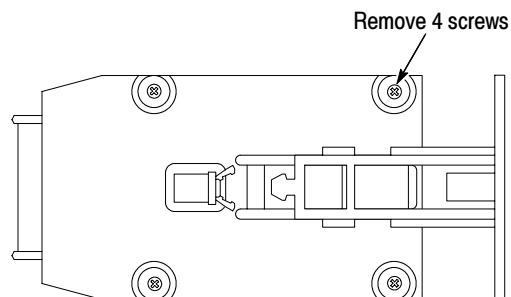


Figure 6-20: Removing the hard disk drive from the cartridge

- CD Drive**
1. *Locate module to be removed:* Locate the CD Drive in the locator diagram *Internal Modules*, Figure 6-8, page 6-19. Additional modules to be removed:
 - Trim (all)
 - Bottom cover
 - Left and Right covers
 2. *Remove the CD Drive assembly:* See Figure 6-21, page 6-35.
 3. *Orient the instrument:* Set the instrument so its bottom is down on the work surface and its rear panel is facing you.
 - a. Remove the two T-15 Torxdrive screws that secure CD Drive assembly to the rear chassis.
 - b. Disconnect the CD Drive ribbon cable J230, from Riser board.
 - c. Slide the CD Drive assembly (with the cable attached) toward the rear of the chassis and remove it from the instrument.
 4. *Remove the CD Drive bracket and Rom interface board:* See Figure 6-21, page 6-35.
 - a. Remove the four #0 phillips screws that secure the bracket to the CD Drive. Remove the CD Drive from the bracket.
 - b. Remove the Interface board from the CD Drive by pulling the Interface board straight back until they separate.
 5. *Reinstallation:* Do in reverse steps 3 and 4 to reinstall the CD Drive assembly.

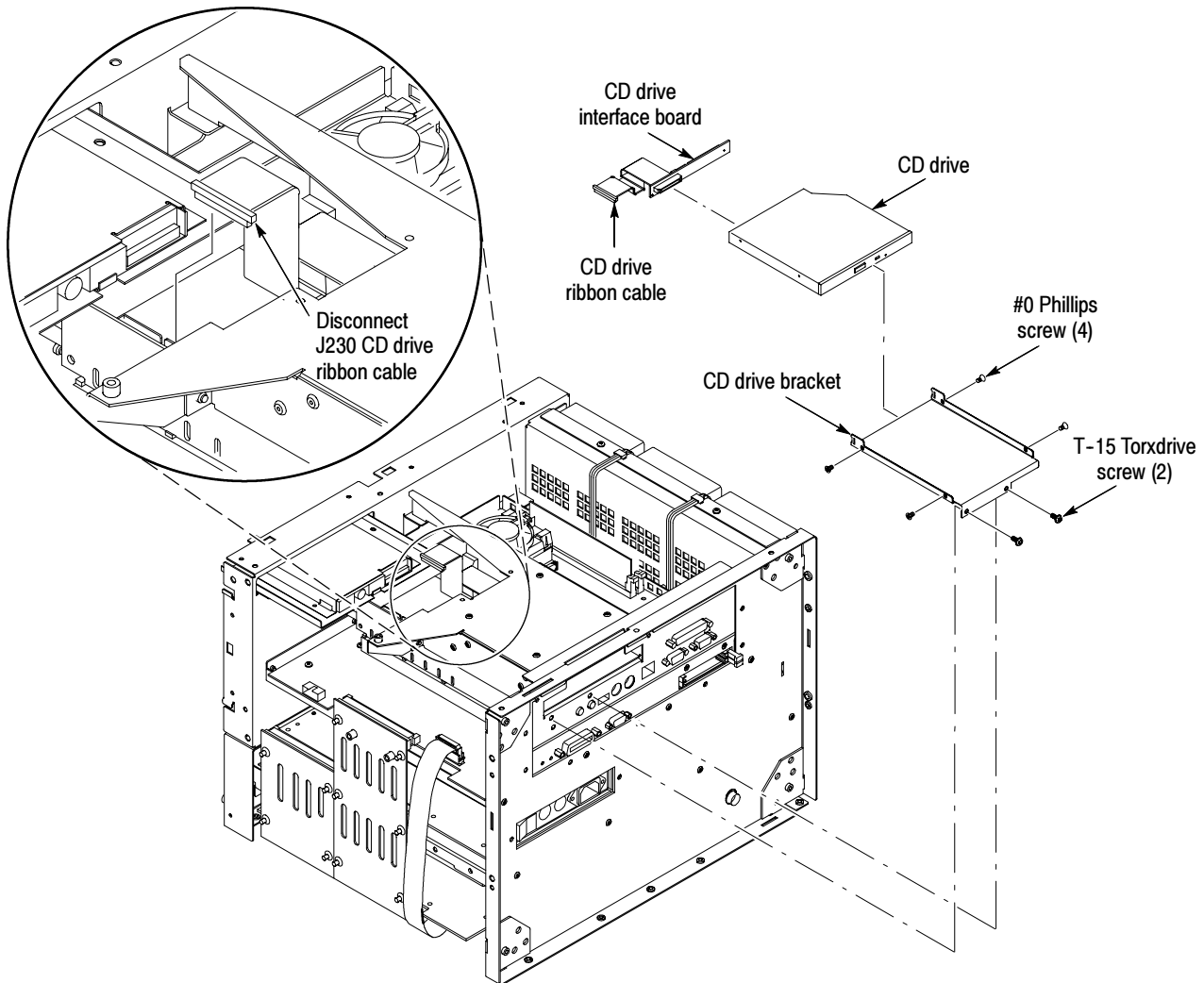


Figure 6-21: CD drive and bracket removal

Fan Assembly Removal

1. *Locate module to be removed:* Locate the Fan assembly in the locator diagram *Internal Modules*, Figure 6-8, page 6-19. Additional modules to be removed:
 - Trim (all)
 - Bottom cover
 - Left and Right covers
2. *Orient the instrument:* Set the instrument so its bottom is down on the work surface and its left side is facing you.

3. *Remove the fan assembly:* See Figure 6-22, page 6-36.



CAUTION. Take care when handling the fan assembly, the fan blades are brittle and can be easily damaged.

- a. *Disconnect the fan from processor/display board:* Disconnect the fan's two power cables J130 and J170 located on the processor board.
 - b. Remove the two T-15 Torxdrive screws securing the fan assembly to the top main chassis.
 - c. Lift the fan assembly up and out from the chassis.
4. *Reinstallation:* Do in reverse steps a through c to reinstall the fan assembly.

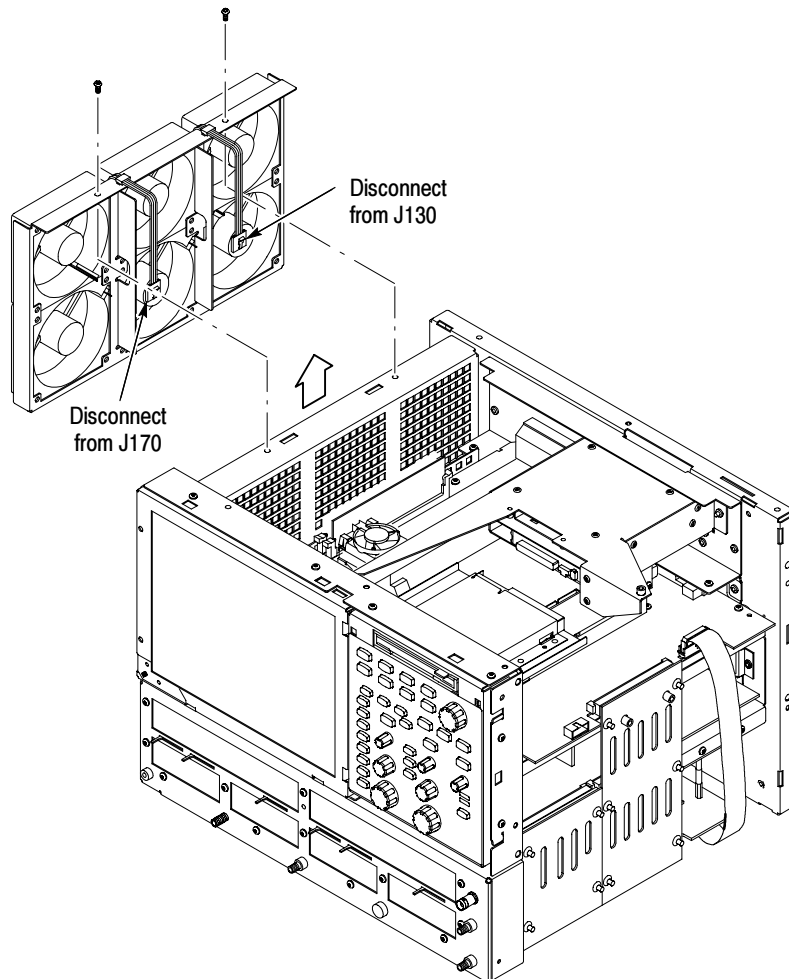


Figure 6-22: Fan assembly removal

Front and Rear Power Distribution Boards

1. *Assemble equipment and locate modules to be removed:* Find the modules to be removed in the locator diagram *Internal Modules*, Figure 6-8, page 6-19. Additional modules to be removed:
 - Trim (all)
 - Bottom cover
 - Left and Right covers
2. *Orient the instrument:* Set the instrument so its left side is down on the work surface and its right side is facing you.
3. *Remove the Front power distribution board:* See Figure 6-23, page 6-37.
 - a. Grasp the Front power distribution board and pull it out from the instrument to disconnect it from the following connectors; J2 Power supply board, J102 Electrical front-end board, and J202 Acquisition board.
 - b. *Remove the Rear power distribution board:* Grasp the Rear Power Distribution board and pull it out from the instrument to disconnect it from the following connectors; J201 Processor board, J1 Power supply board, J301 Electrical front-end board, and J102 Acquisition board.
4. *Reinstallation:* Do in reverse steps a and b to reinstall the front and rear power distribution circuit boards.

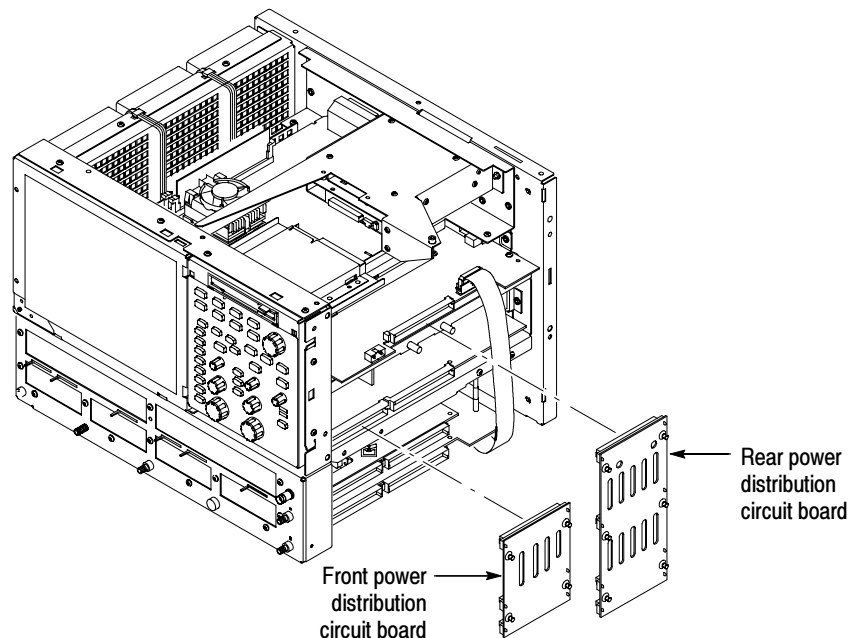


Figure 6-23: Front and rear power distribution board removal

Low-Voltage Power Supply

1. *Assemble equipment and locate modules to be removed:* Locate the modules to be removed in the locator diagram *Internal Modules*, Figure 6-8, page 6-19. Additional modules to be removed:

NOTE. *In addition to this topic, see Checking the Power Supply Voltages on page 6-74 in the Troubleshooting section.*

- Trim (all)
 - Bottom cover
 - Left and Right covers
 - Front and Power rear distribution boards
2. *Orient the instrument:* Set the instrument so its bottom is down on the work surface and its right-side is facing you.
 3. *Remove the low-voltage power supply:* See Figure 6-24, page 6-39.
 - a. Disconnect J930 ribbon cable connector from the PC processor board.
 - b. Remove the two T-15 Torxdrive screws securing the low-voltage power supply to the right-side chassis support.
 - c. Remove the three T-15 Torxdrive screws securing the low-voltage power supply to rear chassis.
 - d. Grasp the low-voltage power supply and carefully slide the assembly out of the mainframe.
 4. *Reinstallation:* Do in reverse steps a through c to reinstall the low-voltage power supply.

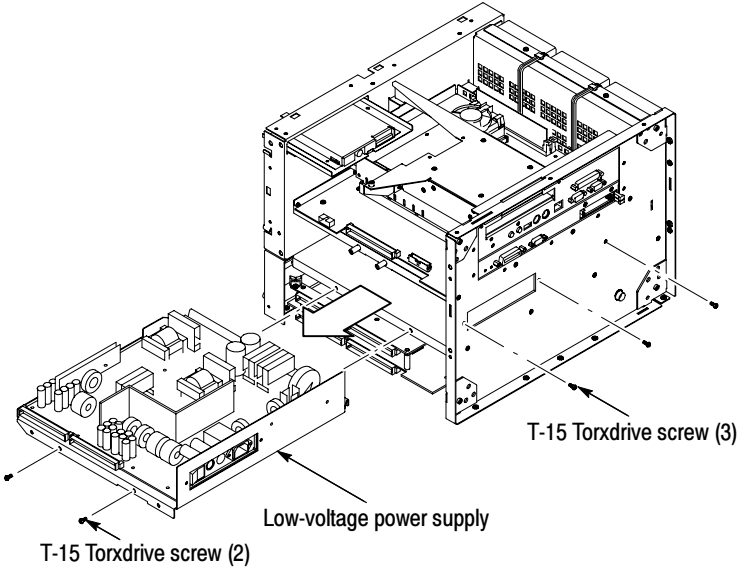


Figure 6-24: Low-voltage power supply removal

- NLX Board**
1. *Locate module to be removed:* Locate the NLX Board in the locator diagram *Internal Modules*, Figure 6-8, page 6-19. Additional modules to be removed:
 - Trim (all)
 - Bottom cover
 - Left and Right covers
 2. *Remove the NLX Board assembly:* See Figure 6-25, page 6-41.
 3. *Orient the instrument:* Set the instrument so its bottom is down on the work surface and its top panel is facing you.
 - a. Remove the two T-15 Torxdrive screws that secure the floppy disk drive assembly into the front chassis.
 - b. Slide the floppy drive assembly, with cable attached, out toward the rear of the instrument. Place floppy drive assembly on top of the hard/CD drive bracket.
 - c. Remove the five T-15 Torxdrive screws that secure NLX board assembly to the chassis.
 - d. Remove the five T-15 Torxdrive screws that secure NLX board assembly to the rear chassis.
 - e. Grasp the front edge of the NLX board assembly and pull up on the assembly to disconnect the Riser Adapter from the PC Processor board's edge connector.
 - f. Remove the NLX board assembly from the instrument.

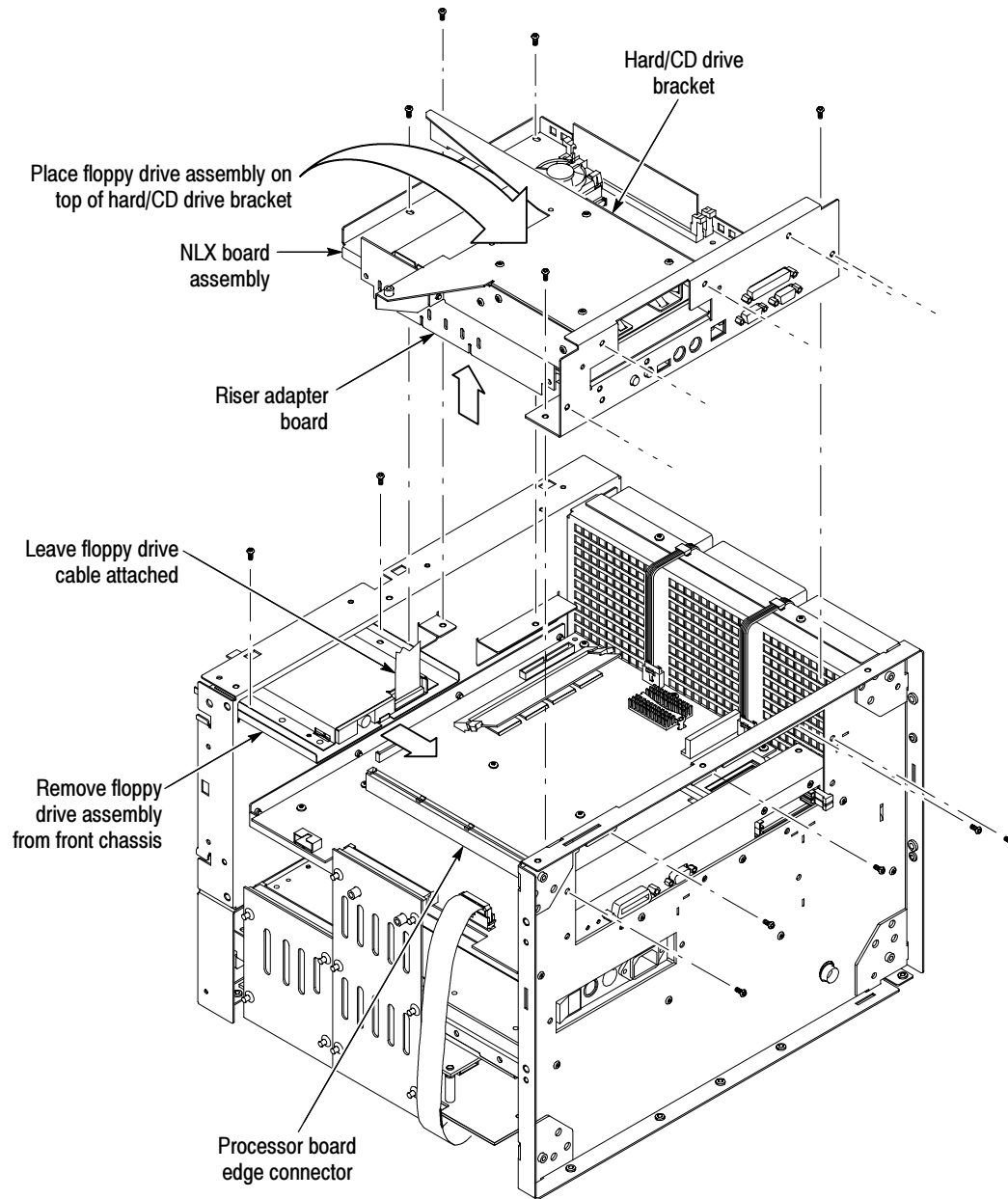


Figure 6-25: NLX assembly removal

4. *Remove the Riser Adapter and NLX boards:* See Figure 6-26, page 6-42.
 - a. Remove the two T-15 Torxdrive screws that secure Riser Adapter board to the NLX support bracket.
 - b. Disconnect the ribbon cable connectors from the floppy drive, hard drive and CD drive.

- c. Remove the floppy drive assembly from the NLX board assembly.
 - d. Grasp the Riser board and pull it straight out to disconnect J510 edge card connector from the NLX board. Remove the Riser Adapter board from the NLX board assembly.
 - e. Remove the four T-15 Torxdrive screws that secure NLX board to the NLX support bracket.
 - f. Remove the six 3/16 nut posts that secure the three connectors to the rear of the support bracket. Then remove the NLX board from the support bracket.
 - g. Remove the NLX board from the support bracket.
5. *Reinstallation:* Do in reverse steps 3 and 4 to reinstall the NLX board.

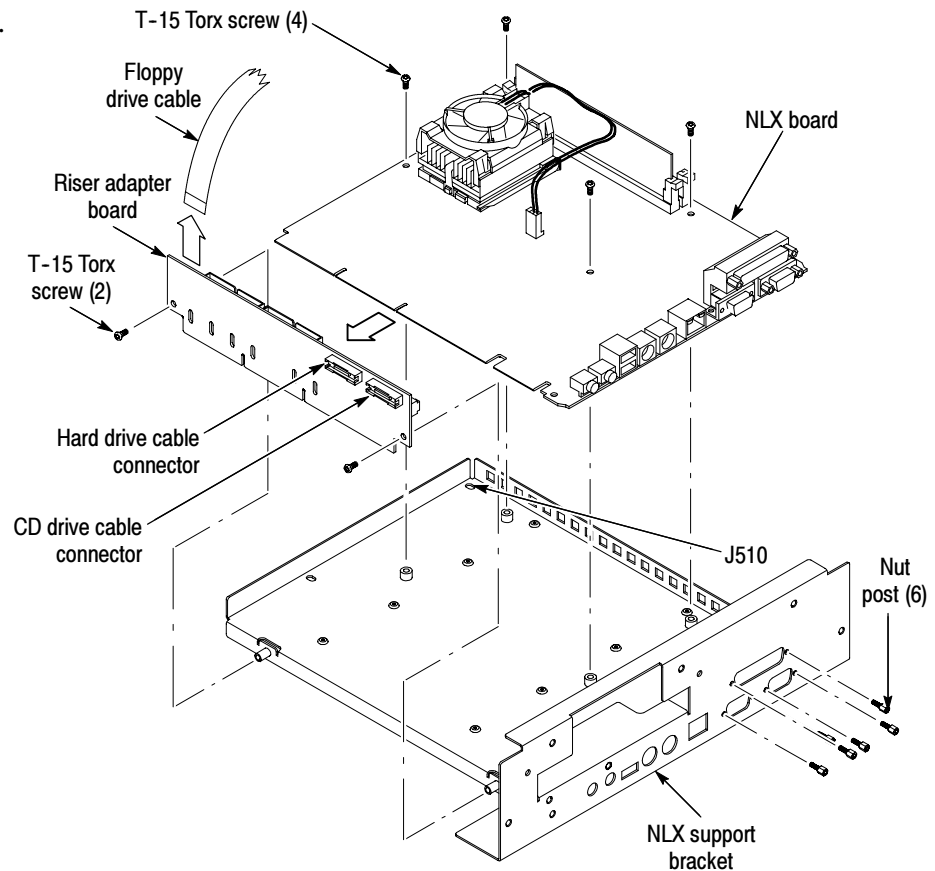


Figure 6-26: Riser adapter and NLX board removal

Microprocessor

1. *Locate module to be removed:* Locate the Front Panel board in the locator diagram *Internal Modules*, Figure 6-8, page 6-19. Additional modules to be removed:
 - Trim
 - Bottom cover
 - Left and Right covers



CAUTION. *The microprocessor is susceptible to static-discharge damage. Service this component only in a static-free environment. Observe standard handling precautions for static-sensitive devices while servicing the chassis. Always wear a grounded wrist and foot straps while servicing the microprocessor, NLX or processor boards.*

2. *Remove the microprocessor:* See Figure 6-27, page 6-44.
 - a. Disconnect the fan power cable J401 from the NLX board.
 - b. Push down and pull out on the holding bracket located nearest to the outer edge of the circuit board.
 - c. Pull out and unlatch the remaining bracket. Lift the fan/heatsink assembly out from the microprocessor.
 - d. Lift the microprocessor socket locking lever upward. Remove the microprocessor.
3. *Reinstallation:* To reinstall the microprocessor to the NLX board as follows:
 - a. Install the microprocessor in the socket.
 - b. Lower the socket locking lever.
 - c. Make sure the fan/heatsink assembly is positioned with the fan cable toward the outer edge of the circuit board.
 - d. Place the fan/heatsink assembly on the microprocessor to allow you to latch the bracket to the tab that is nearest to the center of the circuit board.
 - e. Set the remaining edge of the fan/heatsink down on the microprocessor and fasten the remaining bracket to the assembly.
 - f. Connect the fan power cable J401 from the NLX board.

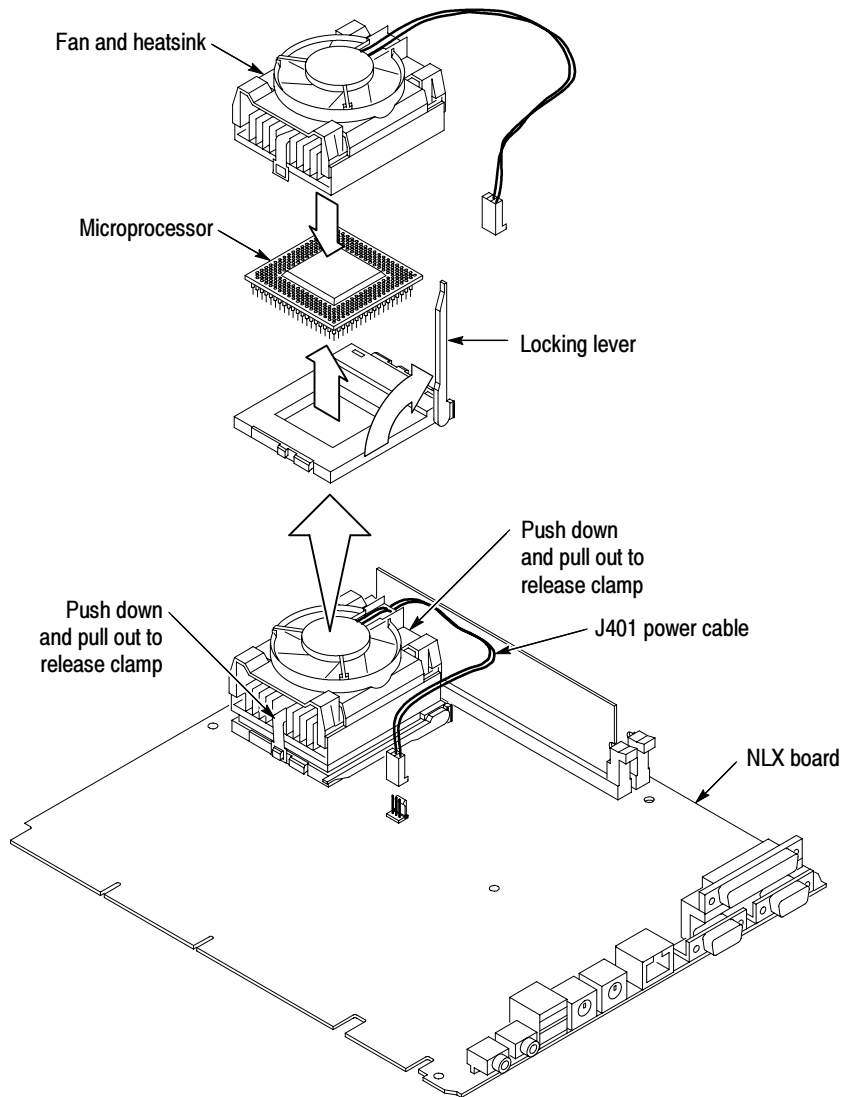


Figure 6-27: Microprocessor removal

PC Processor Board

1. *Locate module to be removed:* Locate the PC Processor Board assembly in the locator diagram *Internal Modules*, Figure 6-8, page 6-19. Remove the following in this order:
 - Trim (all)
 - Bottom cover
 - Left and Right covers
 - Hard Disk and CD Drive
 - Floppy Disk Drive
 - NLX Board
 - Front and Rear Power Distribution Boards
2. *Orient the instrument:* Set the instrument so its bottom is down on the work surface and its top panel is facing you.
3. *Remove the PC Processor board assembly:* See Figure 6-28, page 6-46.
 - a. Disconnect J190 and J691 ribbon cables from the PC processor board.
 - b. Remove the nine T-15 Torxdrive screws securing the PC processor board to the chassis support.
 - c. Remove the five T-15 Torxdrive screws securing the PC processor board assembly to the rear chassis.
4. *Remove the PC Processor Board:* See Figure 6-28, page 6-46.
 - a. Remove the two $\frac{3}{16}$ nut posts that secure the RS-232 connector to the rear of the support bracket.
 - b. Remove the two $\frac{5}{16}$ nut posts that secure the sub-D connector to the rear of the support bracket.
 - c. Remove the two phillips screws that secure the PCMCIA (Personal card, memory card interface adapter) to the pc processor board. Remove the PCMCIA from the PC processor board.
 - d. Disconnect J930 ribbon cable connector from the PC processor board.
 - e. Then remove the PC processor board from the instrument.
5. *Reinstallation:* Do in reverse steps 3 and 4 to reinstall the PC processor assembly.

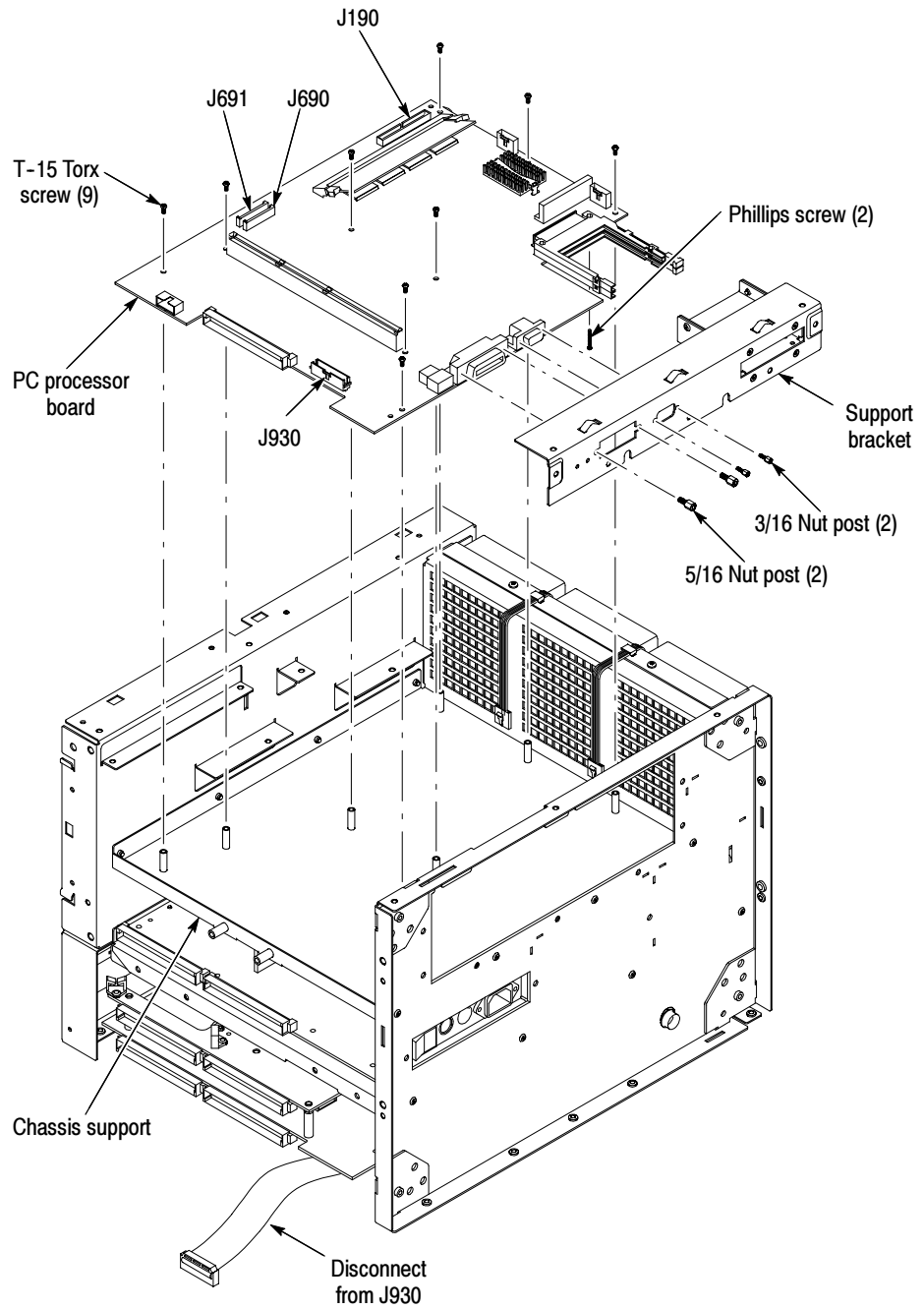


Figure 6-28: Processor board removal

Acquisition Assembly

1. *Locate module to be removed:* Locate the Acquisition assembly in the locator diagram, Figure 6-9, page 6-20. Remove the Acquisition assembly following in this order:
 - Trim
 - Bottom cover
 - Left and Right covers
 - Front and Rear Power Distribution Boards
2. *Orient the instrument:* Set the instrument so its top is down on the work surface and its bottom is facing you.
3. *Remove the Acquisition assembly:* The Acquisition assembly includes, the Acquisition board and Electrical Front End board. See Figure 6-31, page 6-50 (8000 instrument), Figure 6-32, page 6-51 (8000B instrument), or Figure 6-33, page 6-52 (8200 instrument).
 - a. Remove the $\frac{5}{16}$ inch nut that secures the TRIGGER PRESCALE SMA cable to the front panel.
 - b. Remove the ten T-15 Torxdrive screws securing the Acquisition assembly to the chassis.

NOTE. Six (seven on the 8000B and 8200) Acquisition assembly screws are 0.312 inch long. Three Acquisition assembly screws are 1.750 inch long. The 1.750 inch screw locations are marked on the circuit board.

- c. Disconnect the one SMB connector that is connected to the trigger hybrid, located on the front edge of the Acquisition circuit board.
- d. Disconnect two coaxial cables from J8 and J16, located on the Acquisition circuit board.
- e. Disconnect coaxial cable from J5, located on the Acquisition circuit board (8000B only). See Figure 6-32, page 6-51.
- f. Disconnect J10 ribbon cable connector from the J930 processor board.
- g. *Orient the instrument:* Set the instrument so its front panel surface is facing you. Push the module slot covers in to access the slot connectors and attaching hardware.



CAUTION. Note the locations of the T-10 Torxdrive screws and the $\frac{3}{16}$ inch hex threaded posts for later reassembly. Make sure you reinstall the Torxdrive screw and threaded posts in the correct position. The $\frac{3}{16}$ inch hex threaded posts have etched lines around their mounting holes. Interchanging the threaded posts with the Torxdrive screws could cause damage to your module connector. See Figure 6-29 for hardware locations.



CAUTION. Do not interchange the small and large sampling module threaded posts. The large slot sampling module threaded posts are single threaded posts and the small slot sampling module posts are double threaded posts. Installing the double threaded posts into the large module slot could damage the large module connector.

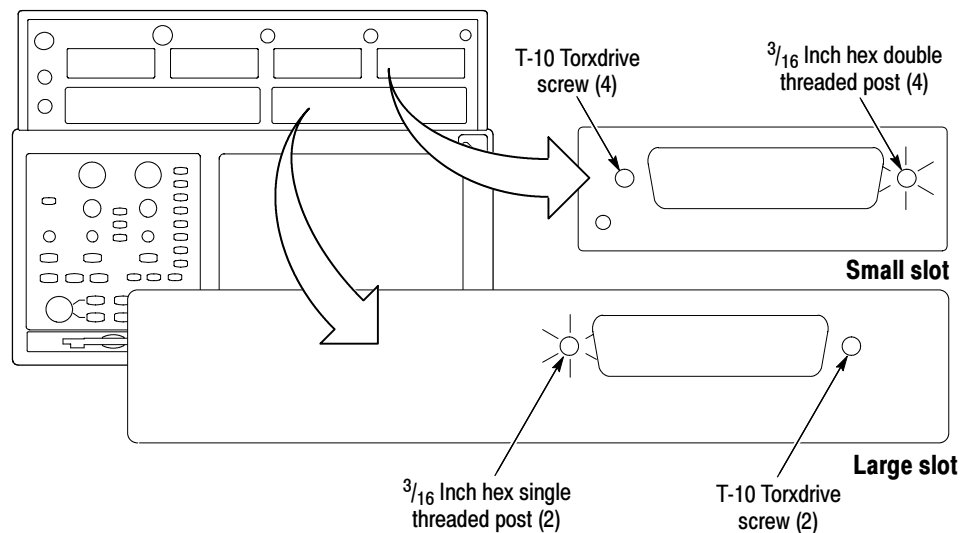


Figure 6-29: T-10 screws and threaded posts

- h.** Remove the four $\frac{3}{16}$ inch hex threaded post from each small module slot.
- i.** Remove the four T-10 Torxdrive screws from each small module slot.
- j.** Remove the Torxdrive screw retaining the circuitry thermal cover. Lift the cover off and remove the $\frac{3}{16}$ inch hex threaded post (8200 only). See Figure 6-30, page 6-49.

NOTE. When reinstalling the thermal cover, make sure that the cover sits in the holding clips.

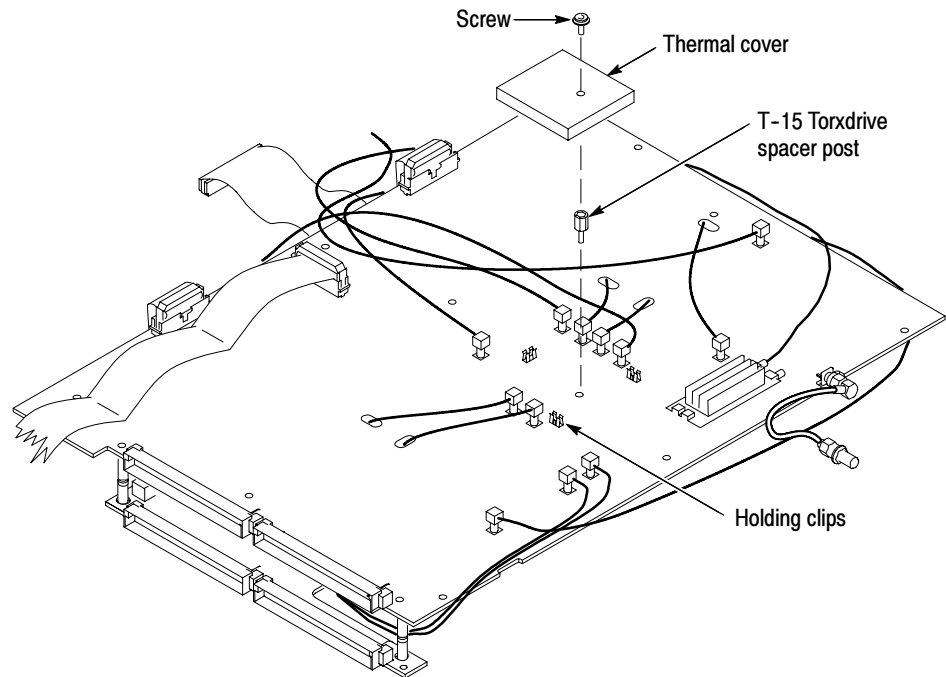


Figure 6-30: Thermal cover removal (8200 only)

- k. Disconnect J6 ribbon cable connector from the large module circuit board.
 - l. Disconnect J5 coaxial cable connector from the large module circuit board.
 - m. Disconnect the three coaxial cables connected to the front panel; INTERNAL CLOCK OUTPUT, DC CALIBRATION OUTPUT, AND EXTERNAL 10 MHz REFERENCE INPUT.
 - n. Disconnect the TRIGGER PROBE POWER ribbon connector from J25 on the Electrical front end board.
 - o. Slide the Acquisition assembly back toward the rear of the instrument then lift up and out of the instrument.
4. *Reinstallation:* Do, in reverse order, substeps h through o.

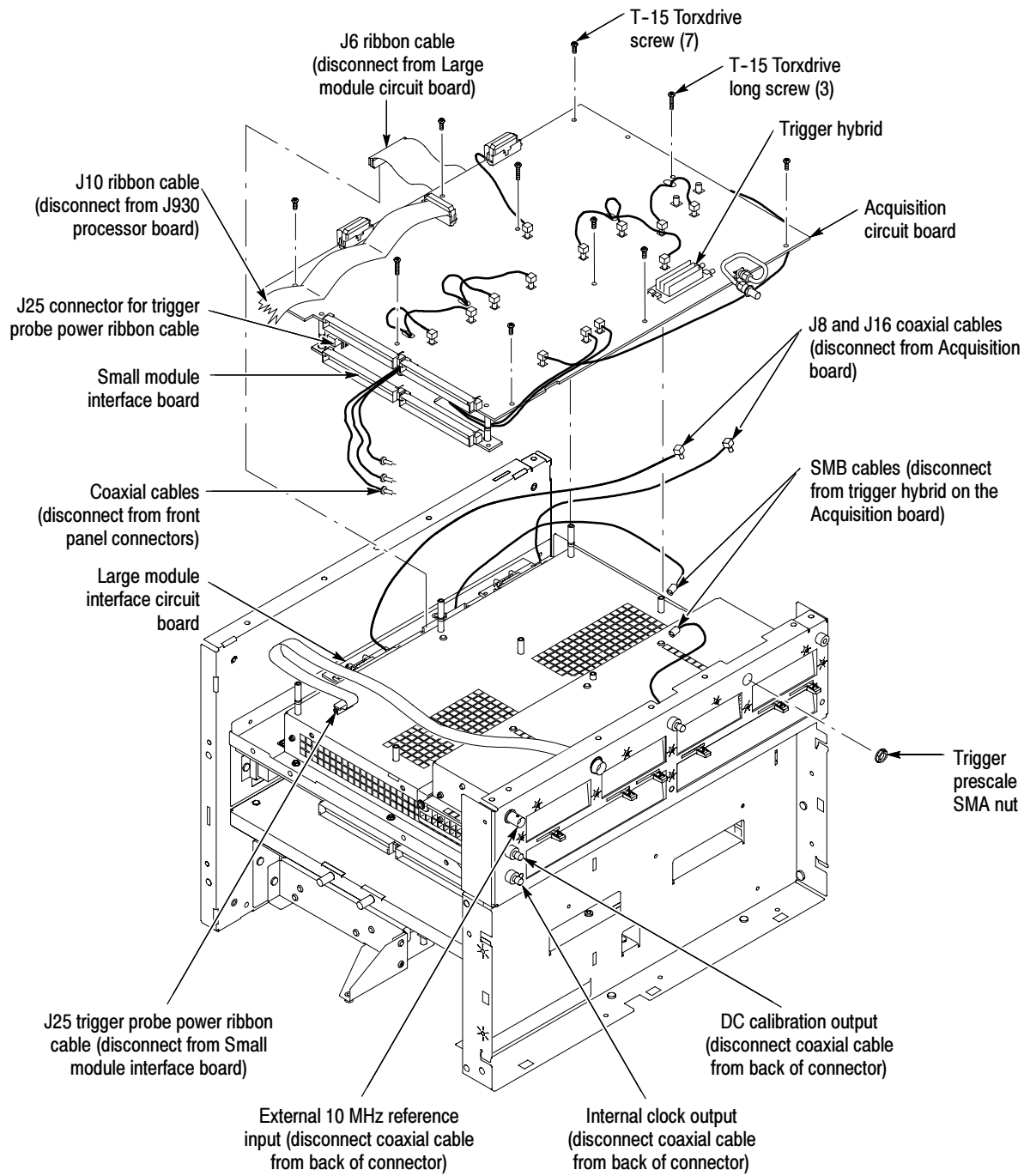


Figure 6-31: Acquisition circuit board assembly removal (8000)

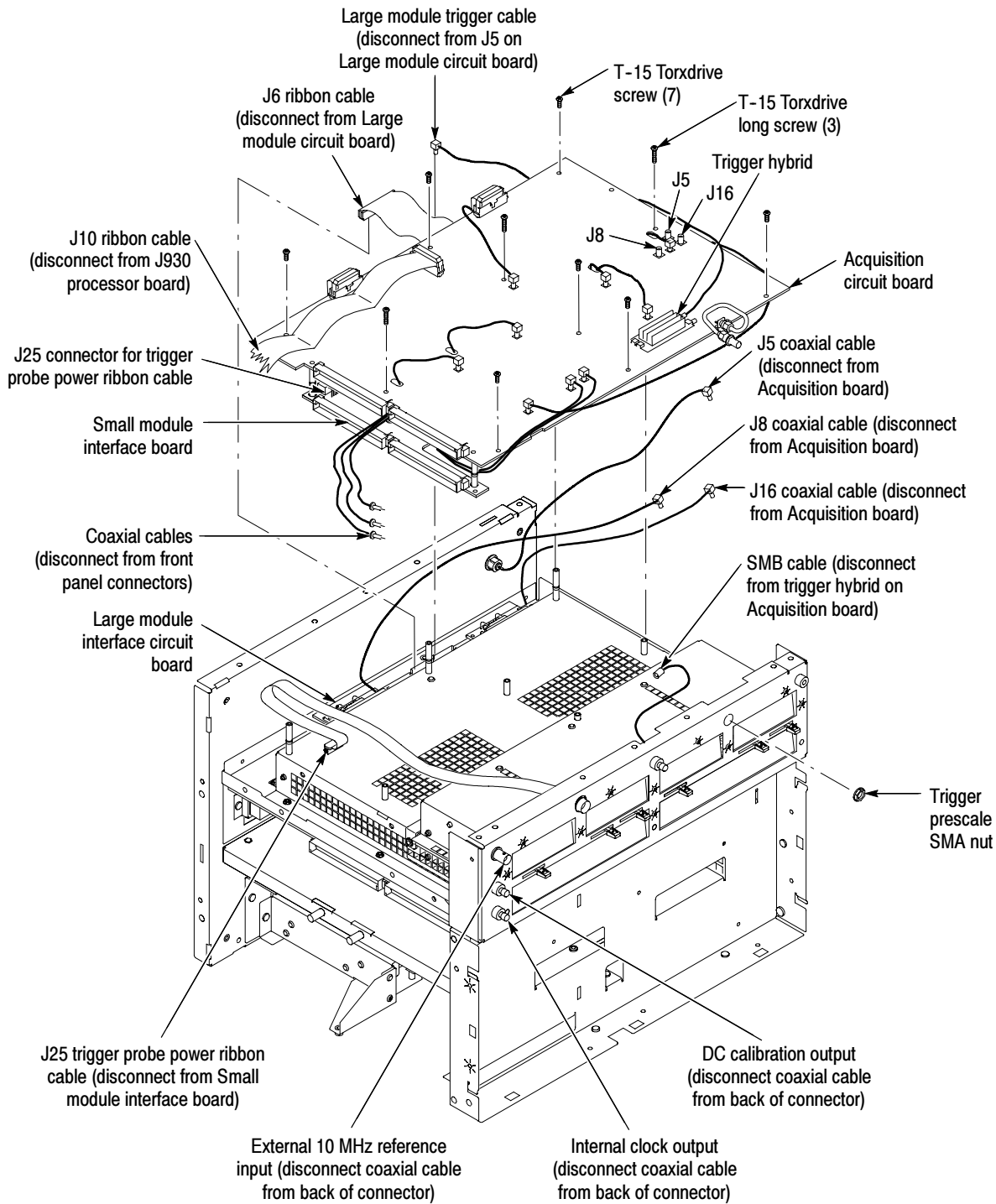


Figure 6-32: Acquisition circuit board assembly removal (8000B)

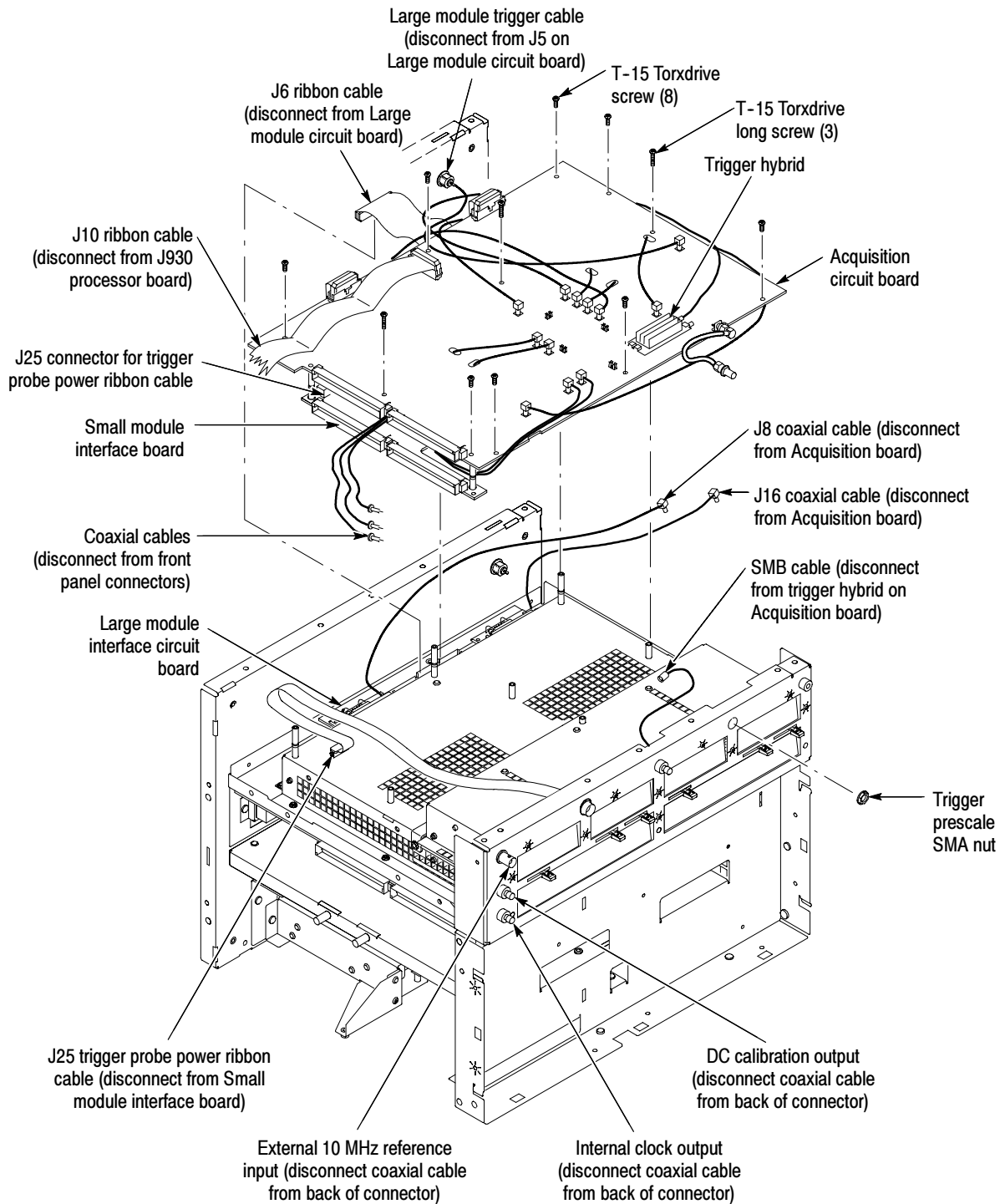


Figure 6-33: Acquisition circuit board assembly removal (8200)

**Large Module Interface
Circuit Board**

1. *Locate module to be removed:* Locate the Large module Interface circuit board in the locator diagram, Figure 6-9, page 6-20. Remove the Large Module Interface circuit board following in this order:
 - Trim
 - Bottom cover
 - Left and Right covers
 - Front and Rear Power Distribution boards
 - Acquisition assembly
2. *Orient the instrument:* Set the instrument so its top is down on the work surface and its bottom is facing you.
3. *Remove the Large Module Interface circuit board:*
 - a. Remove the two $\frac{3}{16}$ inch hex threaded post from each optical module slot. See Figure 6-29, page 6-48
 - b. Remove the two T-10 Torxdrive screws from each optical module slot.
 - c. Remove the T-15 Torxdrive screw located on the Large Module Interface circuit board. See Figure 6-34, page 6-54 (8000 and 8000B) or Figure 6-35, page 6-55 (8200).
 - d. Lift up on the rear of the Large Module Interface circuit board and lift the board out of the instrument.
4. *Reinstallation:* Do, in reverse order, substeps a through d.

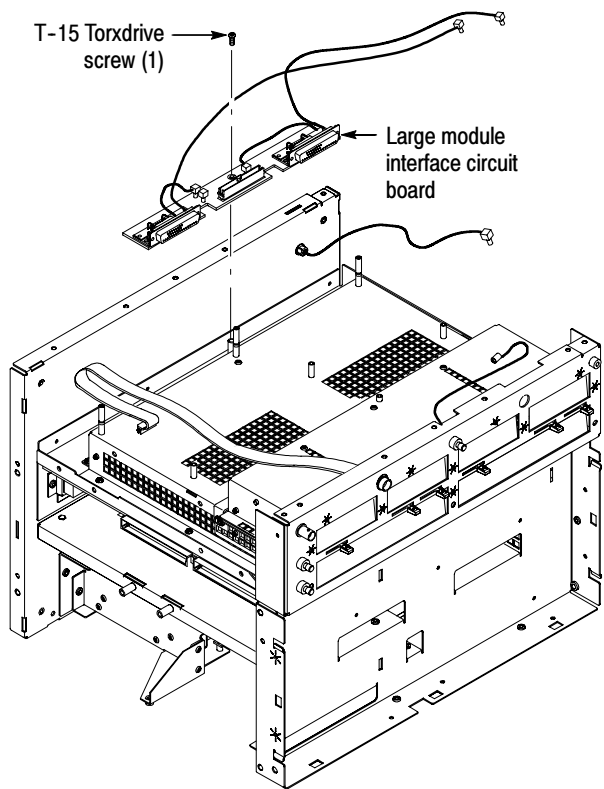


Figure 6-34: Large module interface circuit board removal (8000 and 8000B)

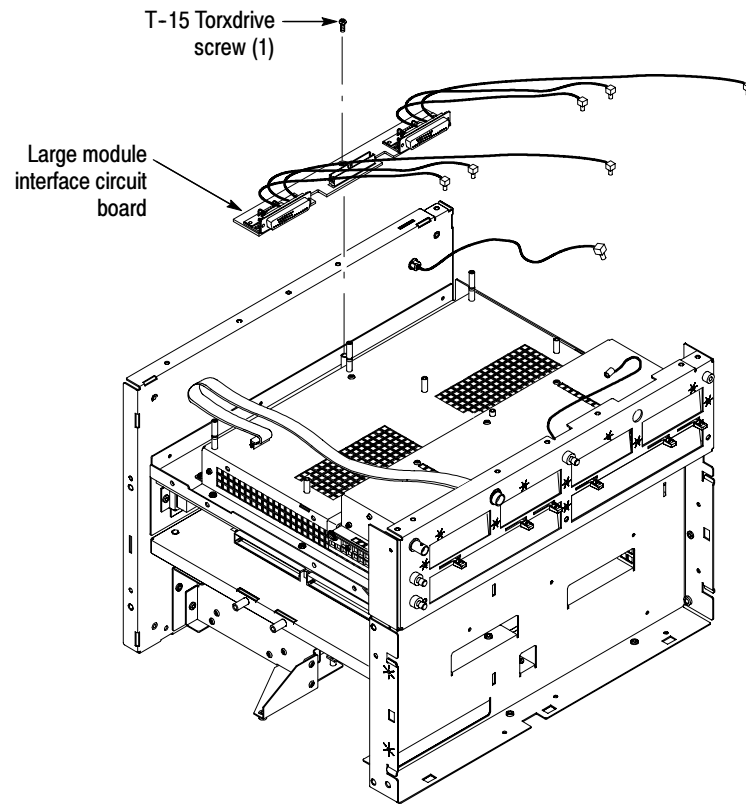


Figure 6-35: Large module interface circuit board removal (8200)

Module Slot Doors

1. *Assemble equipment and locate modules to be removed:* Locate the Module Slot Doors in the locator diagram. Figure 6-9, page 6-20. Additional modules to be removed:
 - Trim
 - Bottom cover
 - Left and Right covers
 - Front and Rear Power Distribution boards
 - Acquisition assembly
2. *Orient the instrument:* Set the instrument so its top is down on the work surface and its front is facing you.

3. *Remove the small module chassis:* See Figure 6-36, page 6-57.
 - a. Remove the nine T-10 Torxdrive screws from front panel.



CAUTION. *One of these Torxdrive screws secures a $\frac{5}{16}$ inch hex nut and grounding lug to the inside chassis. When removing the top right T-10 Torxdrive screw, make sure this ground nut is retained for later reassembly. See Figure 6-36, page 6-57.*

- b. Remove the seven $\frac{5}{16}$ inch hex nuts that secures the small module chassis to the instrument.
 - c. Lift the chassis up and out of the instrument.
4. *Remove the large module chassis:* See Figure 6-36, page 6-57.
 - a. Remove the four T-10 Torxdrive screws from the front panel.
 - b. Remove the eleven $\frac{5}{16}$ inch hex nuts that secure the optical module chassis to the instrument.
 - c. Remove all the snap-on ejector lever handles.
 - d. Lift the back of the chassis up over the studs, then slide the chassis to the rear and out of the instrument.

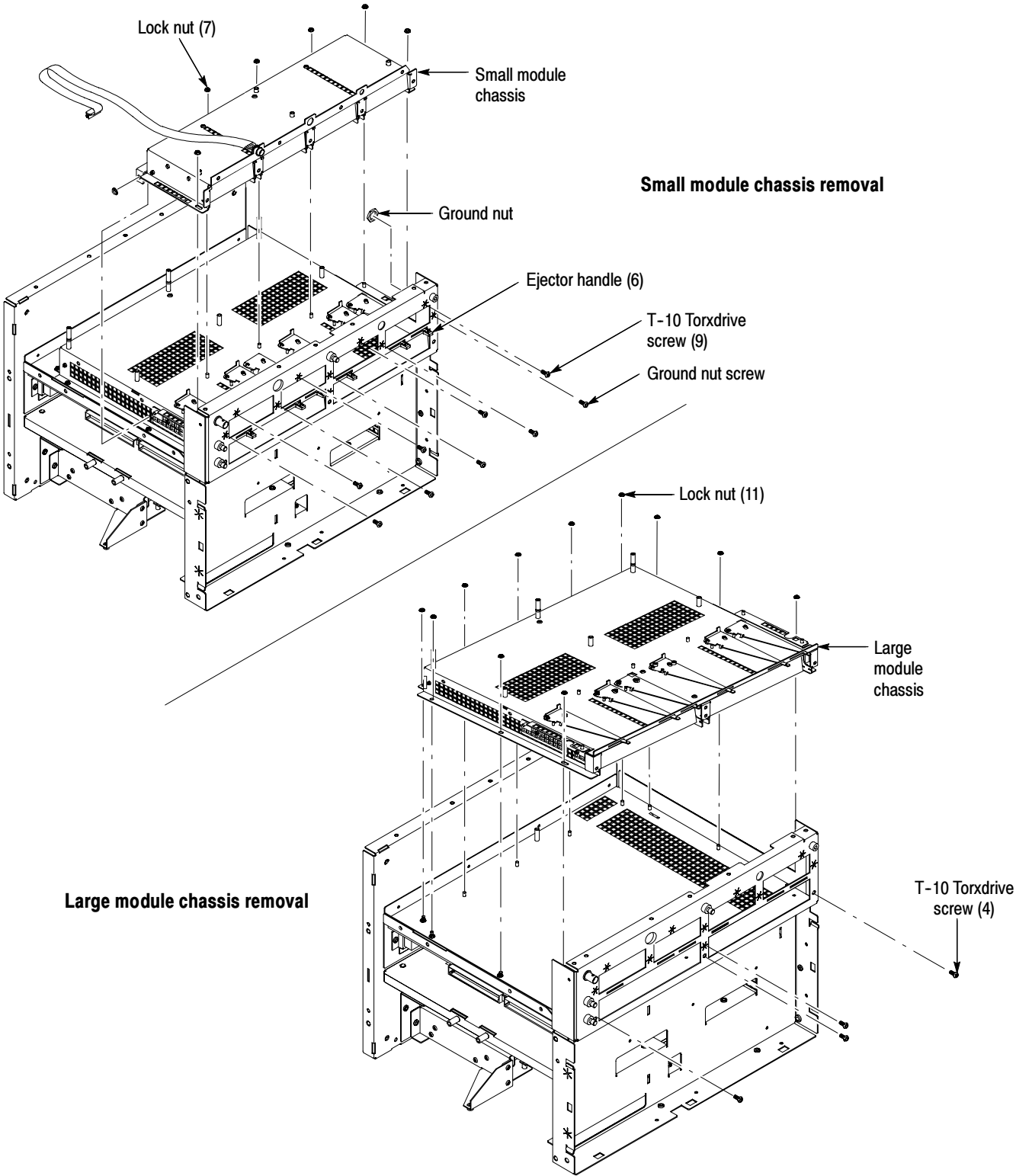


Figure 6-36: Small and Large module chassis removal

5. *Remove the module slot doors:* See Figures 6-37 and 6-38, pages 6-59 and 6-60.
6. *Orient the small or large module chassis:* Set the chassis so the module slot cavities with springs and slot guides are facing you.
 - a. Remove both slot door springs by prying the spring arm from the small slots located on the sides of the module slot. Use a pair of tweezers to pull the spring arms out from the slot.

NOTE. *There is a right and left spring, note locations of the springs for later reassembly.*

- b. Push the module slot door slightly in while lifting the door out of the chassis.

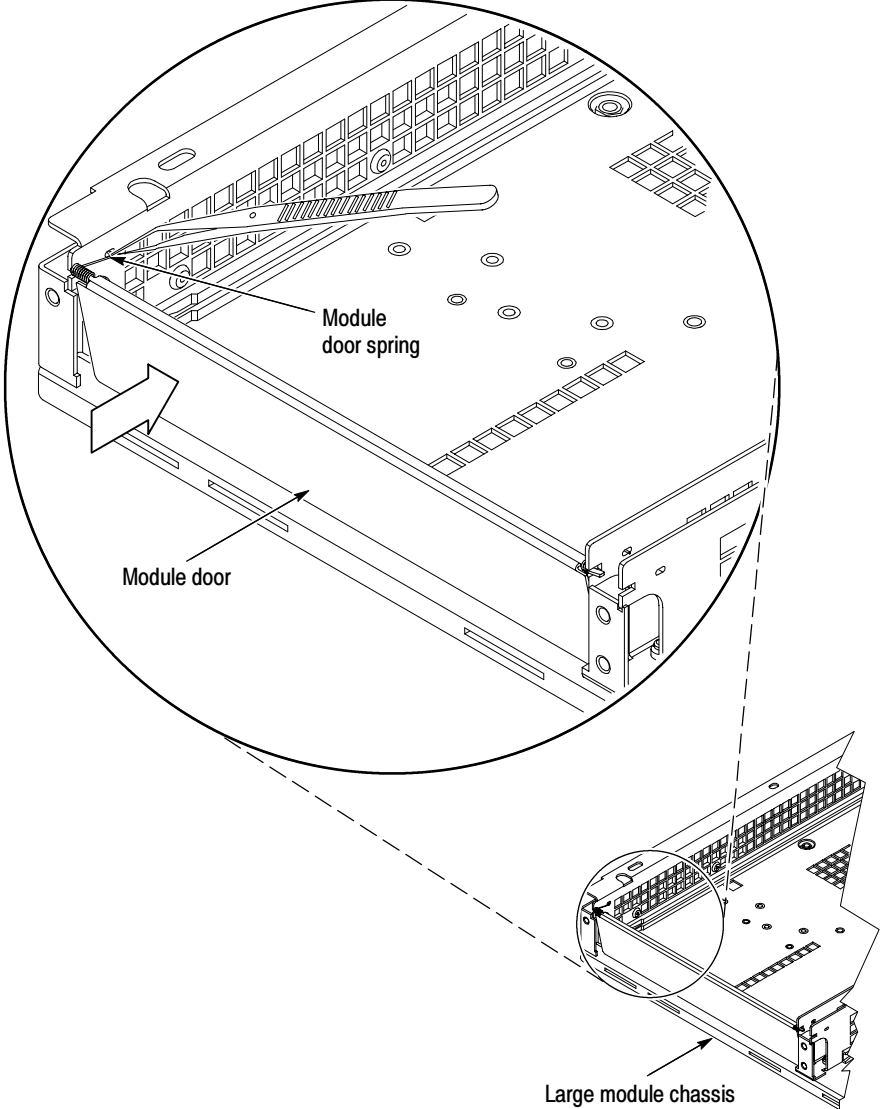


Figure 6-37: Module door spring removal

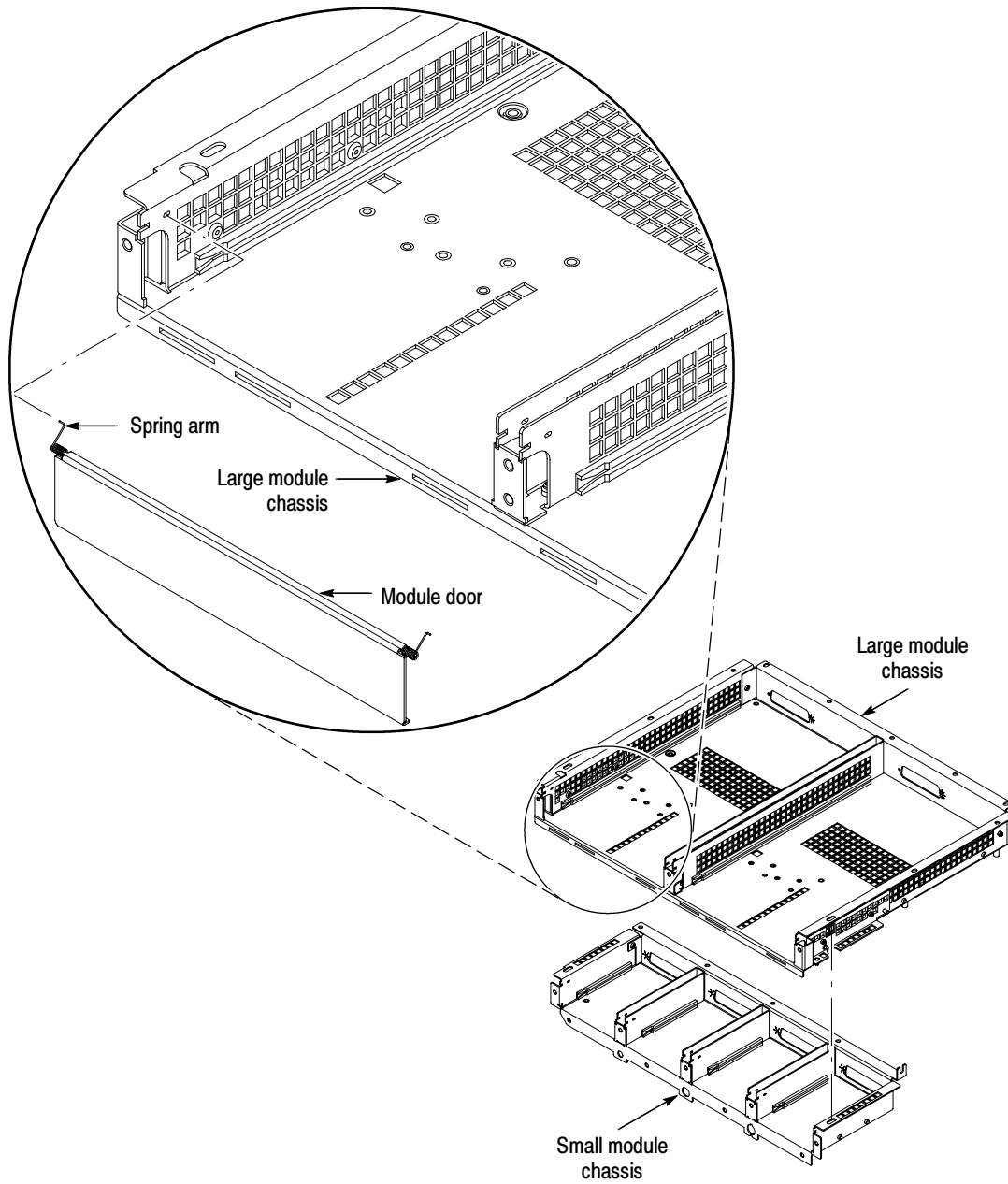


Figure 6-38: Module slot door removal

7. *Remove the module ejector levers:* See Figures 6-39 and 6-40, pages 6-62 and 6-63.
8. *Orient the small or large module chassis:* Set the optical chassis so the module ejector levers are facing you.
 - a. Remove both T-10 Torxdrive screws that secure the ejector lever to the optical chassis.
 - b. Remove both brass washers, ejector lever and ejector spring.
9. *Reinstallation:* Perform the following procedure to reinstall the ejector levers and module slot doors.
 - a. Place the ejector spring over the pem nut standoffs (pivot and slider). One spring arm is positioned next to the ejector lever spring tab. The other spring arm is positioned to the left-side of the stud post.
 - b. Place the ejector lever over the ejector spring and pem nut standoffs (pivot and slider).

NOTE. *Make sure the ejector lever is positioned correctly. The ejector lever has a dimple protruding to accommodate the snap-on handle. When installing the ejector lever this dimple must be facing up from the optical chassis. See Figure 6-39, page 6-62.*

- c. Place brass shoulder washers over both pivot and slider mounting positions.
- d. Install both T-10 and Torxdrive screws to secure the pivot and slider mounting positions.
- e. Move the left spring arm to the right-side of the stud post. The right spring arm must be on the left of the lever tab. See Figure 6-40, page 6-63.

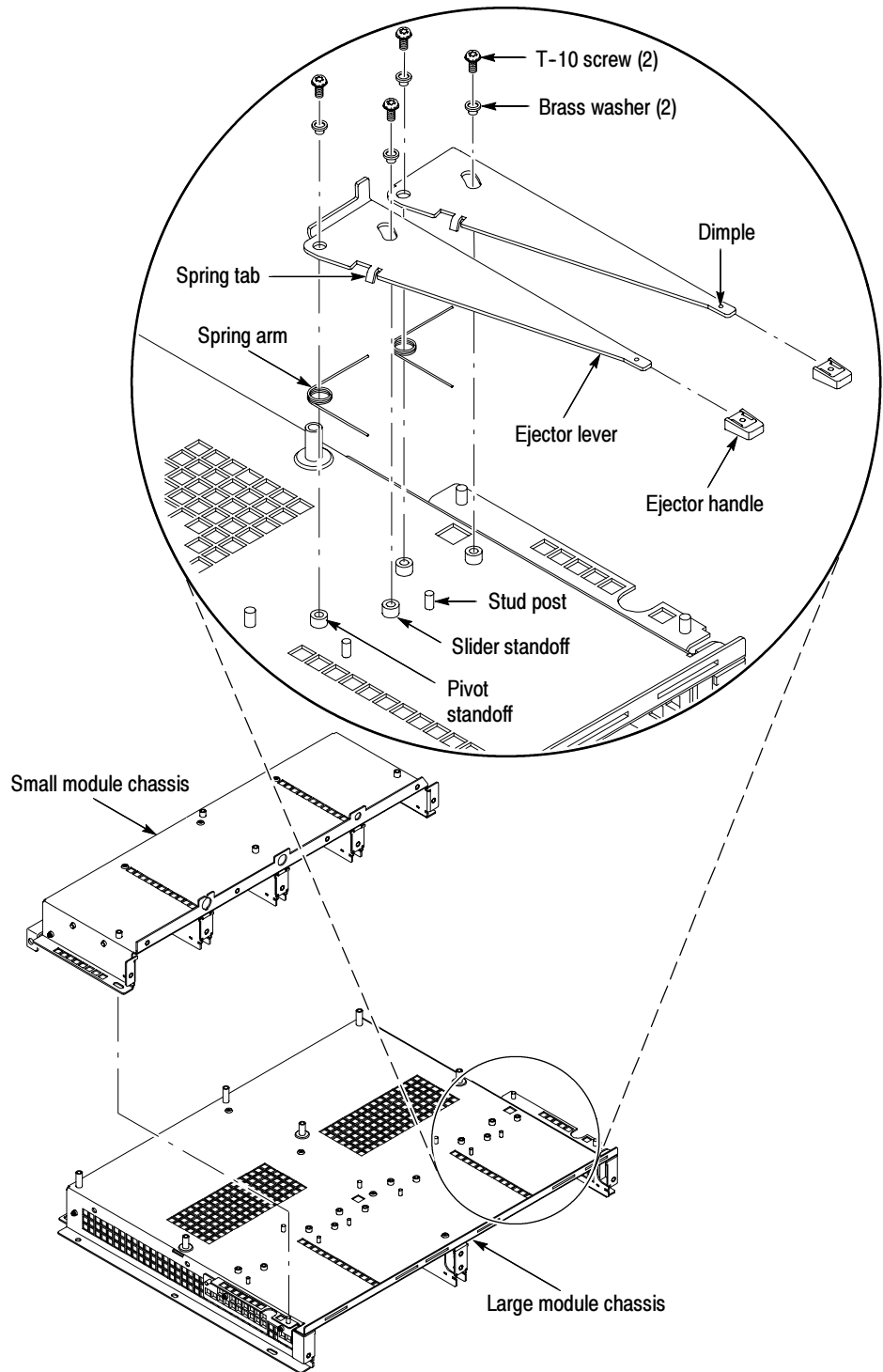


Figure 6-39: Module ejector handles removal

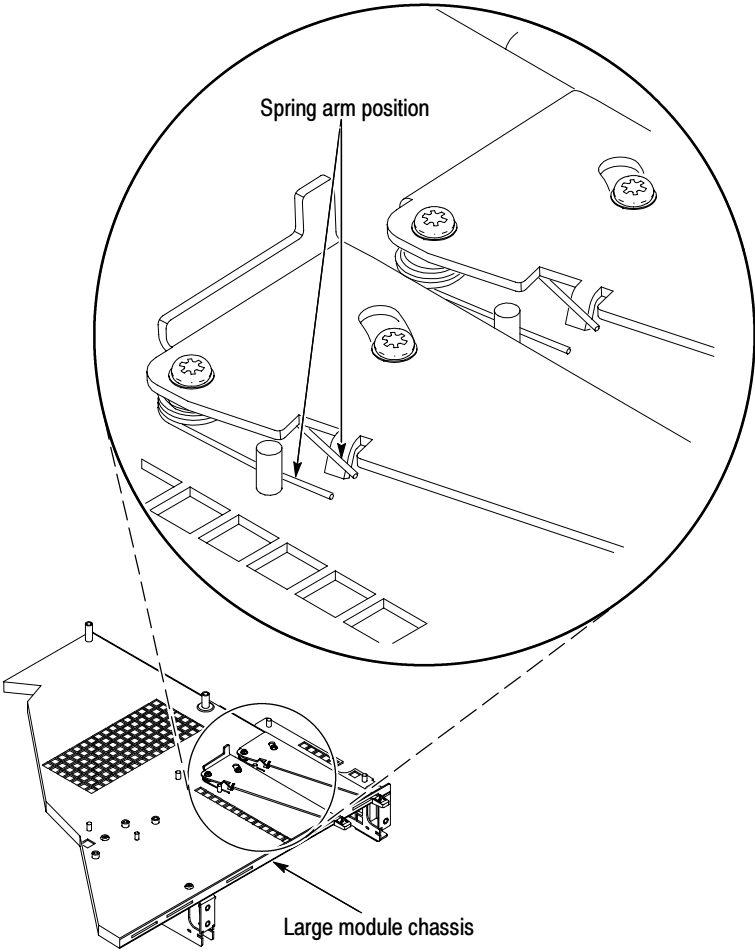


Figure 6-40: Spring arm position

Electrical Modules

1. *Orient the sampling module:* Set the sampling module so its left side is down on the work surface and its right side is facing you.



CAUTION. *Static discharge can damage any semiconductor in the instrument or sampling module. To prevent damage from static discharge wear wrist and foot grounding straps while handling sampling module chassis. Service should be performed in a static-free work station by a qualified service technician. Minimize handling of static-sensitive components.*

2. *Remove the cover:* See Figure 6-41, page 6-64.
 - a. Remove two phillips screws that secure the front panel to the cover. Remove the front panel.
 - b. Remove the four phillips screws that secure the cover to the chassis.
 - c. Slide the chassis out toward the rear of the cover.

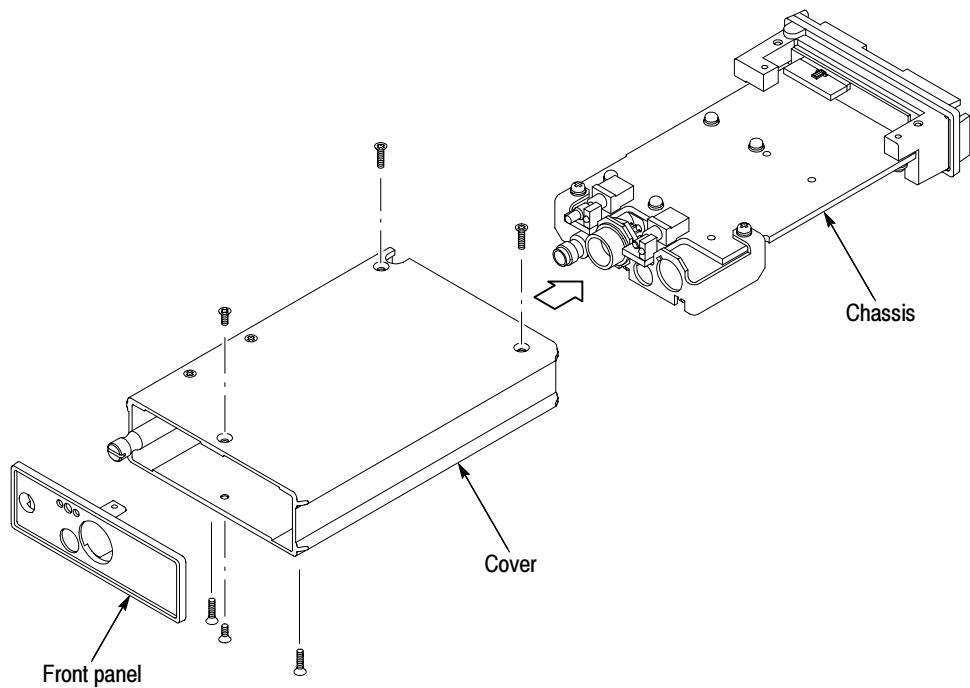


Figure 6-41: Electrical module hardware removal

Exchanging the Electrical Sampling Module

Replacing the sampling module chassis

If it is determined that a sampling module failure is caused by an internal part, you must exchange the complete sampling module chassis to Tektronix. The customer will keep the cover and attaching hardware. Sampling module exchange can be made with either your local Tektronix service center or central Tektronix exchange in Beaverton, Oregon.

1. Transport the chassis sampling modules with terminations on the inputs.
2. Transport the chassis sampling modules in their original containers and store the sampling modules on a metal or conductive surface.
3. When handling the exposed chassis sampling module only, do not touch any exposed component on the circuit board. Grasp the exposed module by the edges of the circuit board or the rear or front housings.

Reinstalling exchange module serial number

Program the serial number (printed on the sampling module cover) into the new replacement sampling module chassis.

1. Reinstall the chassis into the cover following the procedure on page 6-64.
2. Install the electrical sampling module into one of the instrument's slots.
3. Connect a GPIB cable to the GPIB port of the instrument connect the remaining end to the GPIB port of a PC.



CAUTION. Do not have any user interface dialogs active. Dialogs such as Compensation, System properties will prevent the instrument from responding to GPIB commands.

4. Enter the following GPIB commands:
 - a. SYSTem:PROTect OFF
 - b. SYSTem:PROPerties:CH(1-8):SERialnum <serialNum_string>

Example: SYST:PROP:CH3:SER "B010123"

NOTE. For a 2 channel sampling module either channel can be specified in step b. For an 80E01 sampling module use only the lower numbered channel number such as CH1 or CH3.

- c. SYSTem:PROTect ON

5. Verify the serial number change: Pull down the **Utility** menu and then select **System Properties, Sampling Modules**. Click on the channel you want to verify, such as **C3** or **C4**. This display will confirm the sampling module serial number.

Optical Modules

1. *Orient the optical sampling module:* Set the optical sampling module so its left side is down on the work surface and its right side is facing you.
2. *Remove the cover:* See Figure 6-42.
 - a. Remove the seven T-10 Torxdrive screws (80C02 has eleven T-10 Torxdrive screws, four T-10 Torxdrive screws on the top cover) that secure the cover to the module chassis.
 - b. Lift the rear of the cover up and slide back about $\frac{1}{2}$ inch, then lift the non-optical connector side up toward the optical connector side.
 - c. Remove the cover from the chassis.
3. *Reinstallation:* Do in reverse steps a through d to reinstall the front panel assembly.

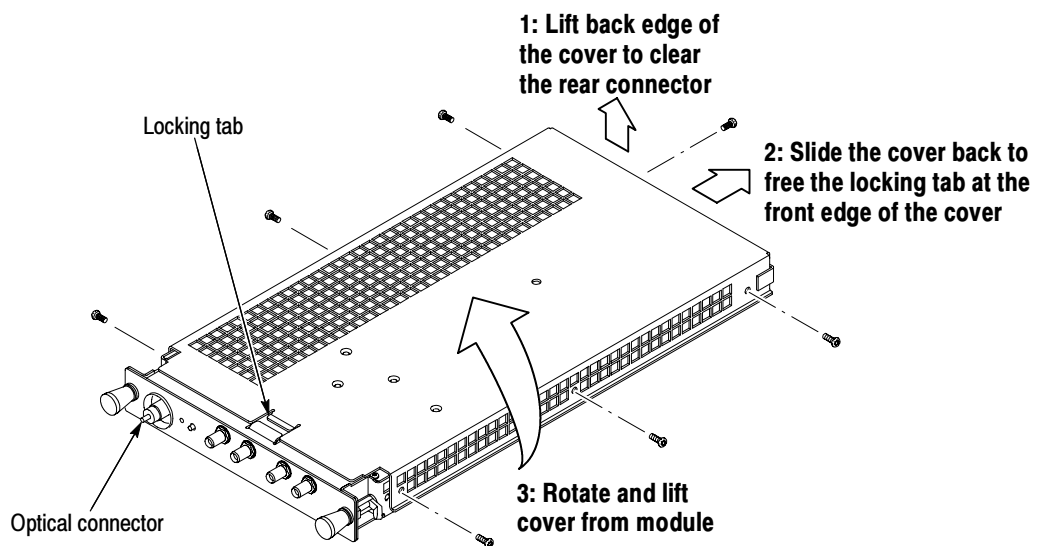


Figure 6-42: Optical module cover removal

80A00 and 82A00 Series Modules



1. *Orient the module:* Set the module so that its left side is down on the work surface and its right side is facing you.

CAUTION. *Static discharge can damage any semiconductor in the instrument or sampling module. To prevent damage from static discharge wear wrist and foot grounding straps while handling the module chassis. Service should be performed in a static-free work station by a qualified service technician. Minimize handling of static-sensitive components.*

2. *Remove the front panel:* See Figure 6-43, page 6-67.
 - a. Remove two coaxial terminators on the front panel connectors.
 - b. Remove two phillips screws that secure the front panel to the cover. Remove the front panel.

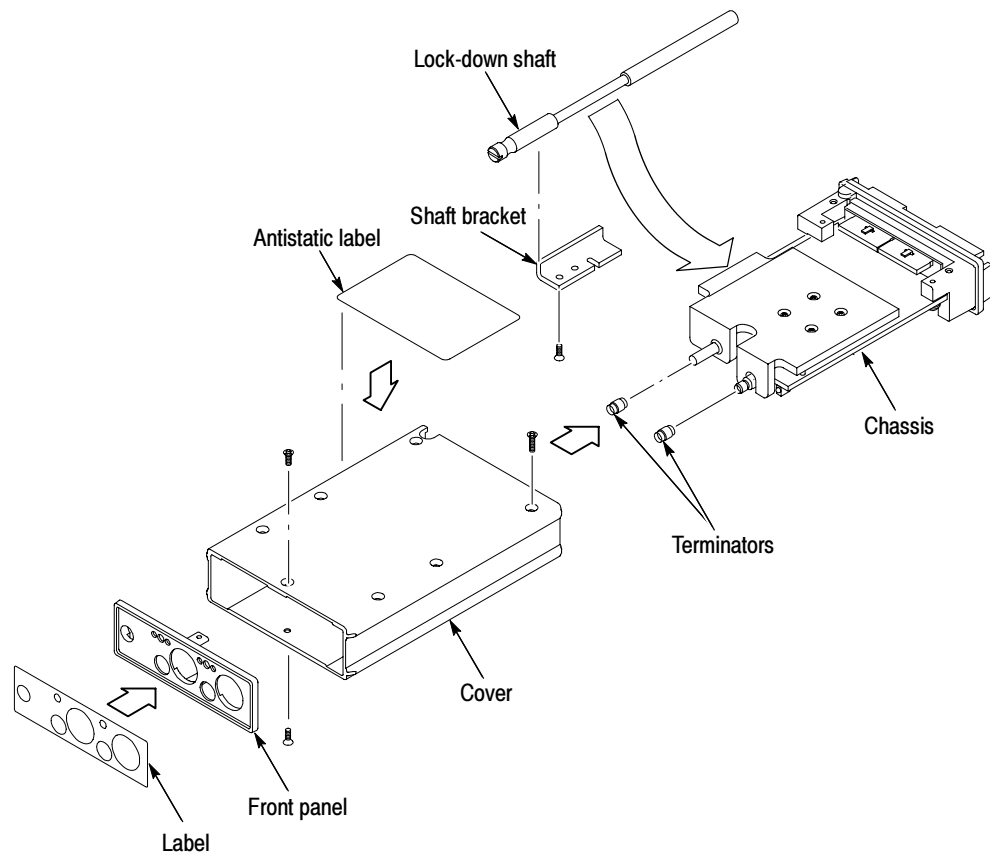


Figure 6-43: 80A00 and 8200 series parts removal (80A01 shown)

3. *Remove the cover:* See Figure 6-43, page 6-67.
 - a. Remove the six phillips screws that secure the cover to the chassis.
 - b. Slide the chassis out toward the rear of the cover.
4. *Remove the lock-down shaft and bracket:* See Figure 6-43, page 6-67.
 - a. Remove the two phillips screws that secure the bracket to its mount. Remove it.
 - b. Lift out the lock-down shaft.
5. *Reinstallation: Perform steps 2 through 4 in reverse to reassemble the module.*
 - a. If installing a replacement the front panel, do the following steps before performing step 2:
 - Remove the backing from the front panel label.
 - Align the holes and attach to the front panel.
 - b. If installing a replacement cover, do the following steps before performing step 3:
 - Remove the backing from the antistatic label.
 - Install the antistatic label to the replacement cover.

Troubleshooting

This section contains information and procedures designed to help you isolate faulty modules in the instrument. If a module needs to be replaced, follow the *Removal and Installation Procedures* located in this section.

Check for Common Problems

Use Table 6-4 to quickly isolate possible failures. The table lists problems related to the instrument and possible causes. The list is not exhaustive, but it may help you eliminate a problem that is quick to fix, such as a blown fuse or loose cable.

Table 6-4: Failure symptoms and possible causes

Symptom	Possible cause(s)
Mainframe will not power on	<ul style="list-style-type: none">■ Power cord not plugged in.■ Failed fuse.■ Faulty power supply.■ Faulty modules.■ Main power switch (rear panel) not on.■ Front panel power switch not on.■ Monitor not connected properly.
Front panel light comes on (mainframe powers on), but one or more fans will not operate	<ul style="list-style-type: none">■ Faulty fan cable.■ Defective fan assembly.■ Faulty power supply.
Mainframe powers on but no signal displayed	<ul style="list-style-type: none">■ Wrong channel is selected, Waveform Selector and Setup menus.■ Module not fully installed into the slot.■ Signal cable not connected properly.■ Wrong trigger input, check signal cable and Setup menus are Direct or Prescale.
Controller appears “dead”; power light comes on, but monitor screen(s) is (are) blank	<ul style="list-style-type: none">■ SO DIMMs incorrectly installed or missing.■ Defective NLX board

Table 6-4: Failure symptoms and possible causes (cont.)

Symptom	Possible cause(s)
Flat LCD panel display blank	<ul style="list-style-type: none"> ■ External monitor plugged in but not powered on. ■ External monitor plugged in (look on external monitor for display). ■ Connect an external monitor cable to the SCOPE ONLY VGA OUT rear panel connector. If monitor has a display, replace the LCD panel assembly. ■ Connect an external monitor cable to the SVGA OUT rear panel connector, if monitor has a display the BIOS may need to be setup. ■ If the BIOS is OK then, replace the Power PC circuit board assembly. ■ Connect an external monitor cable to the SVGA OUT rear panel connector. If the monitor has no display, replace the NLX circuit board assembly. ■ If the monitor has no display when connected to the SVGA OUT rear panel connector, replace the NLX circuit board assembly. ■ Defective cable from front panel board to riser board. ■ Defective cable from Power PC board to front panel board.
Front panel LEDs do not light.	<ul style="list-style-type: none"> ■ Replace the front panel board.
Hard disk drive related symptoms	<ul style="list-style-type: none"> ■ Defective hard disk drive. ■ Incorrect hard disk type selected in the BIOS setup. ■ Replaceable hard disk drive not installed. ■ Power supply failure. ■ Corrupted controller BIOS module firmware, reinstall firmware. ■ Controller BIOS setup problem. See BIOS Settings. ■ Replaceable hard disk drive or optionally field installed fixed hard disk drive not configured as bootable (slave) master hard disk drive. ■ Faulty benchtop controller.
CD-ROM related symptoms	<ul style="list-style-type: none"> ■ Defective CD-ROM. ■ Defective CD-ROM drive cable. ■ Defective CD-ROM board. ■ Incorrect CD-ROM configuration in the BIOS setup.

Table 6-4: Failure symptoms and possible causes (cont.)

Symptom	Possible cause(s)
Diagnostic errors	<ul style="list-style-type: none"> ■ Remove all electrical and optical modules from the instrument, then diagnostics again. If the instrument passes diagnostics, check for the electrical and optical module that is causing the failures. Then run diagnostics again. ■ If the instrument fails the diagnostics without the installed modules replace the Acquisition assembly. The run diagnostics again.
Compensation errors	<ul style="list-style-type: none"> ■ Remove all electrical and optical modules from the instrument, then run compensation again. If the instrument passes compensation, check for the electrical and optical module that is causing the failure. ■ Verify that each module is completely installed into the slot. If the instrument still fails compensation, replace the Acquisition assembly.
Modules not recognized	<ul style="list-style-type: none"> ■ Module firmware incompatible with mainframe software version. ■ Faulty module. Refer to appropriate module service manual for further troubleshooting information. ■ Module not fully installed into the slot.
80C0X modules have no signals displayed	<ul style="list-style-type: none"> ■ Module not fully installed into the slot. ■ Wrong channel is selected, Waveform Selector and Setup menus. ■ Signal cable not connected properly. ■ Replace optical cables. ■ Replace Optical assembly or Acquisition assembly.
80C0X modules; poor noise performance	<ul style="list-style-type: none"> ■ Male fiber-fiber connections need to be cleaned. Refer to Table 6-1 on page 6-3.
80C0X modules; frequency response exhibits a steep negative “droop” in its plot.	<ul style="list-style-type: none"> ■ Bad internal O/E RF amplifier de-coupling. Check tightness of all rigid cable interconnect.
BIOS error messages	<ul style="list-style-type: none"> ■ Refer to the BIOS error message table.
Instrument locks up	<ul style="list-style-type: none"> ■ Power down the instrument, then restart. ■ Replace the NLX assembly. ■ Replace the Power PC circuit board assembly.

Equipment Required

You will need a digital voltmeter to check power supply voltages, as described on page 6-74.

Testing might also be required to correct some faults. Under those circumstances, you will need the test equipment listed in the *Performance Verification and Adjustment Procedures* in this manual.

Isolating Failures between the 80E0X/80C0X Modules or the Mainframe

To determine if the sampling module has failed or the mainframe failed, perform the following:

1. Perform the module compensation. Refer to *Perform the Compensation* on page 4-5.
2. Perform the measurement procedures you require to make your test.
3. If the the measurement fails, Remove the sampling module and install it into another slot.
4. Perform steps 1 and 2, then take the following action:
 - If the measurement successfully functions, there is a good chance the mainframe channel has failed. Perform other mainframe diagnostics in this section.
 - If the measurement fails, there is a good chance the sampling module has failed. Return to Tektronix, Inc. for repair.

Isolating to a Board if Power Will Not Come Up

If the mains power is on, a red light (see Figure 6-44 for its location) is visible through the right side of the instrument.

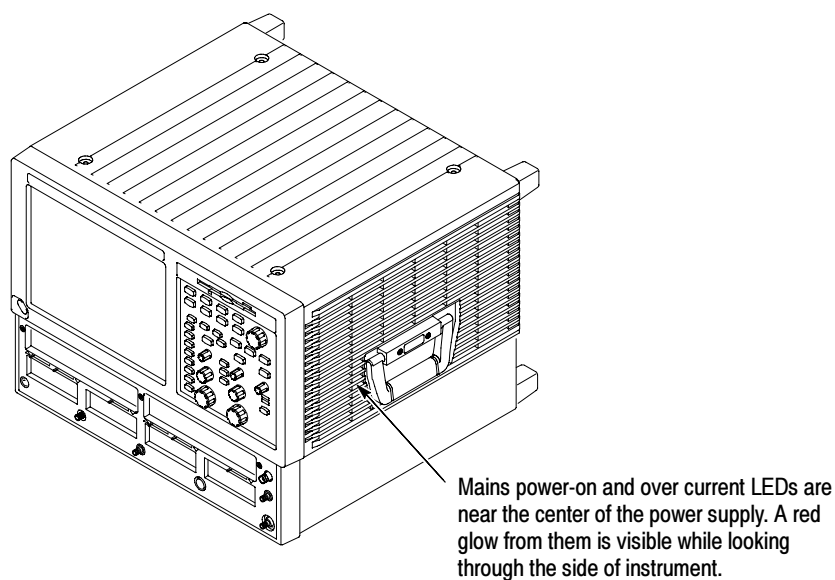


Figure 6-44: Location of power-on and over current LEDs

If the instrument thinks power is on, a red light (see Figure 6-44) means that there is an over current condition.

If the on/standby pin (pin C1 of P201 on the rear power distribution board or pin B162 on the riser board) is low, the instrument thinks power is on.

Remove boards one at a time to locate a fault (the display, floppy, acquisition board, front [analog supply to acquisition board] and rear power distribution boards, the NLX board, and the riser board). If you remove the NLX board, you must jumper the debug power-on pins (see Figure 6-45). The PPC board and the rear power distribution board are required for power to come up.

If removing the boards did not find the problem, replace the power supply.

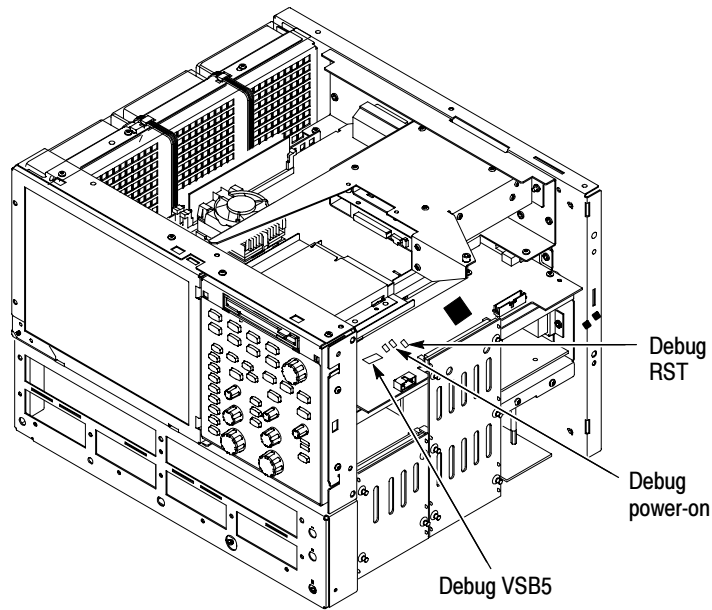


Figure 6-45: Location of debug pins

Checking the Power Supply Voltages

Power off the mainframe and remove any modules installed in it. Power on the instrument and connect the reference lead of a digital voltmeter to chassis ground, such as the top of the power supply.

Attach a 0.025 inch square pin to the probe tip of the other lead and insert it into a pin on one of the connectors. The pins that should be carrying voltages are listed in Table 6-5. The location of the P1 and P2 connectors is shown in Figure 6-46 on page 6-75.

Measure the power supply voltages with the voltmeter and compare each reading to the values listed in the tables. If the voltages are within about 5% of the nominal voltages, your power supply is functional.

Also see *Low-Voltage Power Supply* on page 6-38.

Table 6-5: Power supply voltages

Front power distribution board (P2)	Voltage	Rear power distribution board (P1)	Voltage
Pins A1, B1, C1	+3.3 V	Pins A5, B5, C5	+12 V
Pins A13, B13, C13	-15 V	Pins A8, B8, C8	+5 V
Pins A15, B15, C15	+15 V	Pins A19, B19, C19	+3.3 V
Pins A17, B17, C17 (8000 series only)	-5 V		
Pins A24, B24, C24 (8000 series only)	+5 V		
Pins A17, B17, C17 (8000B series only)	-5.2 V		
Pins A24, B24, C24 (8000B series only)	+5.2 V		

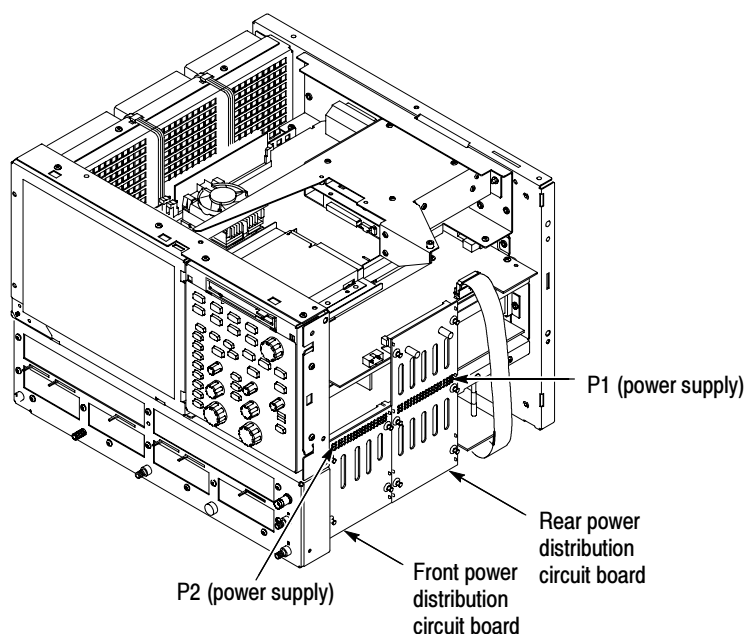


Figure 6-46: Connectors J1 and J2

If the instrument Will Not Boot

If there is a display on the VGA port, but not on the LCD, replace the display assembly (LCD, lamps, and cable).

If nothing is displayed, is the display turned on? At boot time and while using an external monitor connected to the NLX external video port, press F2 to enter the BIOS setup. The Advanced Video Configuration menu lets you select PCI (LCD) or AGP (the NLX port on the rear panel). The lower VGA port on the rear panel is the PCI video port (driven by the same video controller as the LCD).

If none of the above is true, the display adapter may be bad.

Booting Into Windows

If the instrument will not boot, press F8 to enter the start up menu, and boot to the command prompt. If you can boot to the command prompt, use the MSDOS Edit program to edit the autoexec.bat file to run the CMOS restore utility (see *Update/Restore the NLX Board CMOS* on page 6-79).

If booting starts, finds the hard disk, but hangs displaying the Windows splash screen:

1. Select the AGP video port using the setup menu.
2. Disable the busses and disconnect the PPC board by installing J840 and J841.
3. If the system boots (it will only boot to Windows, the instrument application will not run) to the external NLX video port, replace the PPC board.

PPC and NLX PC Diagnostics

The primary diagnostics for the instrument are the power-on diagnostics, the QA+Win32 diagnostics, and the instrument diagnostics. Procedures for running these diagnostics are described below.

Power-On Diagnostics

The power-on diagnostics check the basic functionality of the instrument at every power on. If any failures occur at power on, the screen displays the calibration and diagnostics property page.

The power on tests ensure that hardware is installed and can be accessed by the software. The tests provide limited diagnostic information, but do not provide any performance information. The instrument diagnostics provide more extensive tests than the power-on diagnostics.

The power on tests check the generic hardware including the keyboard, mouse, memory, CPU, and associated peripherals. The interrupt lines and trigger lines are also checked.

QAPlus/Win

If the instrument passes all the BIOS tests and Windows boots, the primary tree calls for you to run QAPlus/Win diagnostics software.

QAPlus/Win is a comprehensive diagnostic software application to check and verify the operation of the PC hardware in the instrument.

To run QAPlus/Win, you must have a working keyboard (a working mouse or other pointing device is optional) and have the Windows operating system running. Repair or replace any failed component identified by QAPlus/Win.

NOTE. To run QAPlus/Win you must have either a working keyboard or a working mouse (or other pointing device) and Windows running.

To run the QAPlus/Win diagnostic software, do the following steps:

1. Exit the instrument application.
 - a. Display the Task Manager by pressing CTRL, ALT, and Delete.
 - b. Select TDS7000 and then touch **End Task**.
 - c. Display the Task Manager by pressing CTRL, ALT, and Delete.
 - d. Select Windowsscopeservices and then touch **End Task**.
2. Exit all other applications and exit all windows.
3. Click Start → Programs → QAPlus_Win → QAPlus_Win.
4. Touch **OK** and select the tests you want to perform.
5. To restore the instrument to normal operating condition, reboot the instrument after QAPlus/Win diagnostic tests are complete.

instrument Diagnostics. If the instrument passes all the QAPlus/Win tests, the primary tree calls for you to run the instrument Diagnostics. The instrument Diagnostics are a comprehensive software test that checks the functionality of the instrument. If the instrument Diagnostics test fails, the instrument is defective.

To run the instrument Diagnostics, do the following steps:

1. Turn off all other applications.
2. From the menu bar, touch **Utilities** and then select **Instrument Diagnostics**.

Diagnostics

The instrument executes a set of internal diagnostics at every power-up. The results can be viewed from the Utilities > Diagnostics dialog. To execute diagnostics Refer to Perform Diagnostics on page to 4-3.

Firmware Updates

Firmware updates are easy to do. Simply install the firmware CD in your instrument and follow the displayed instructions or the instructions that accompany the CD.

If you want to order a firmware update, contact your Tektronix service center.

After Repair

After removal and replacement of a module due to electrical failure, you must perform the adjustment or software update as indicated in Table 6-6.

Table 6-6: Action required for module replaced

Module replaced	Adjustment required	Software update required
Front panel assembly	No	None
Acquisition board	Yes	Boot ROM and authorization code
PPC processor board	Yes	Boot ROM and authorization code
NLX processor assembly	No	Windows, instrument application
Display panel or display system	No	None
Power supply	Yes	None
Interconnect boards	No	None
Fans	No	None

Installing the Instrument Model and Serial Number

To install a model or serial number into the instrument do the following steps:

1. Connect a PC with a GPIB interface to the GPIB interface of the instrument.



WARNING. Make sure the unique identifier does not end in all zeros before generating or setting the key.

2. Enter the following GPIB commands, if necessary install a new instrument's model number:
 SYST:PROT OFF
 SYST:PROP:MAI:MODE "TDS8000B" or SYST:PROP:MAI:MODE
 "CSA8200"
 SYST:PROT ON

NOTE. Use the correct model number for your instrument, such as TDS8000B or CSA8000.

3. Enter the following GPIB commands, if necessary install a new instrument's serial number:
SYST:PROT OFF
SYST:PROP:MAI:SER <serial number string>, e.g. "B010100"
SYST:PROT ON
4. These commands take effect immediately and can be verified by viewing the mainframe properties: Utilities>System Properties.

Update/Restore the NLX Board CMOS

If the CMOS parameters become corrupted, restore the CMOS memory using the following procedures:



CAUTION. Only install CMOS parameters from Tektronix. CMOS parameters from other manufactures may make your instrument inoperable.

This procedure will allow you to restore the CMOS settings with or without LAN (local area network). Resnet command will restore the CMOS with the LAN disabled. Resnet command will restore the CMOS with the LAN enabled.

If the instrument is running normally or in safe mode:

1. Select Run from the Start menu.
2. From the Run dialog box type one of the following commands:
C:resnet (to enable the network)
C:resnet (to disable the network)
3. Restart the computer, and hold down F2 while it reboots to get into the BIOS Setup Utility menu.
4. In the Bios Setup Utility menu:
 - a. select Advanced, using the right arrow.
 - b. select Peripheral Configuration, using the down arrow.
 - c. press Enter.
5. Confirm the LAN Device configurations:
 - Enabled if resnet was run.
 - Disable if resnet was run.
6. Press CTRL-ALT-DEL to reboot the computer.

Repackaging Instructions

This section contains the information needed to repack the portable main-frame for shipment or storage.

Packaging

When repacking the instrument or sampling modules for shipment, use the original packaging. If the packaging is unavailable or unfit for use, contact your local Tektronix representative to obtain new packaging. Refer to *Contacting Tektronix* on page xix for the address, the email address, and phone number.

Seal the shipping carton with an industrial stapler or strapping tape.

Shipping to the Service Center

Contact the Service Center to get an RMA (return material authorization) number, and any return or shipping information you may need.

If the instrument is being shipped to a Tektronix Service Center, enclose the following information:

- The RMA number.
- The owner's address.
- Name and phone number of a contact person.
- Type and serial number of the instrument.
- Reason for returning.
- A complete description of the service required.

Mark the address of the Tektronix Service Center and the return address on the shipping carton in two prominent locations.



Diagrams

Diagrams

This chapter illustrates the electrical operation of the CSA8000 and TDS8000 series instruments and modules using the major circuit blocks.

Symbols

Graphic symbols and class designation letters are based on ANSI Standard Y32.2-1975. Abbreviations are based on ANSI Y1.1-1972.

Logic symbology is based on ANSI/IEEE Std 91-1984 in terms of positive logic. Logic symbols depict the logic function performed and can differ from the manufacturer's data.

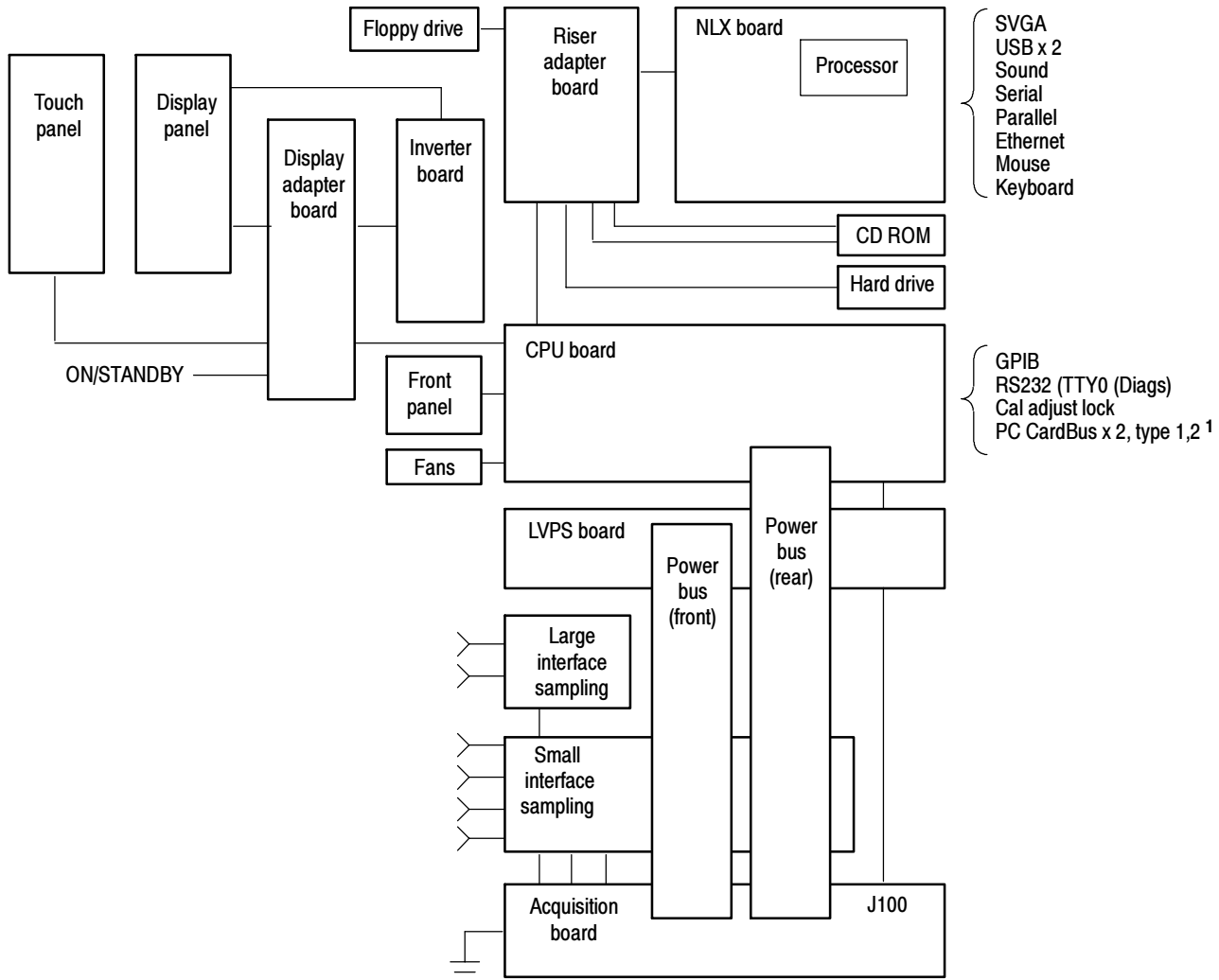
The tilde (~) preceding a signal name indicates that the signal performs its intended function when in the low state.

Other standards used in the preparation of diagrams by Tektronix, Inc. are:

- Tektronix Standard 062-2476 Symbols and Practices for Schematic Drafting
- ANSI Y14.159-1971 Interconnection Diagrams
- ANSI Y32.16-1975 Reference Designations for Electronic Equipment
- MIL-HDBK-63038-1A Military Standard Technical Manual Writing Handbook

CSA8000 and TDS8000 Series Block Diagram

Figure 7-1 shows the instrument interconnections between major circuit blocks.



¹ The PC CardBus is not available on the CSA/TDS8000B or CSA/TDS8200 instruments.

Figure 7-1: Block diagram for CSA8000 and TDS8000 Series Instruments

Electrical Sampling Modules Block Diagram

Figure 7-2 shows the interconnections between major circuit blocks of all electrical sampling modules.

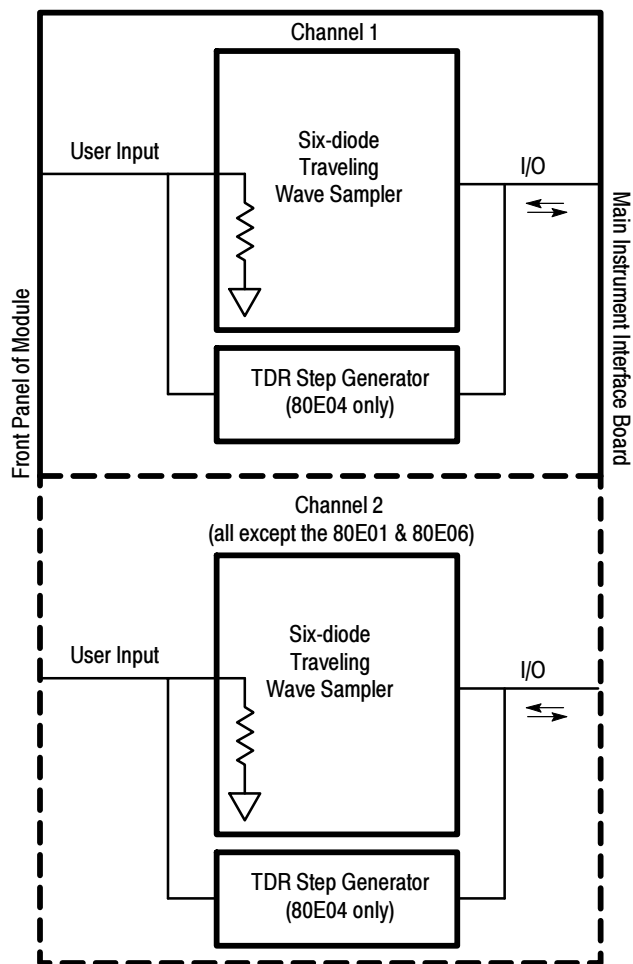


Figure 7-2: Block diagram for the 80E00 Series Electrical Sampling Modules

Optical Sampling Modules Block Diagrams

Figures 7-3 through 7-24 show the interconnections between major circuit blocks of each optical sampling module.

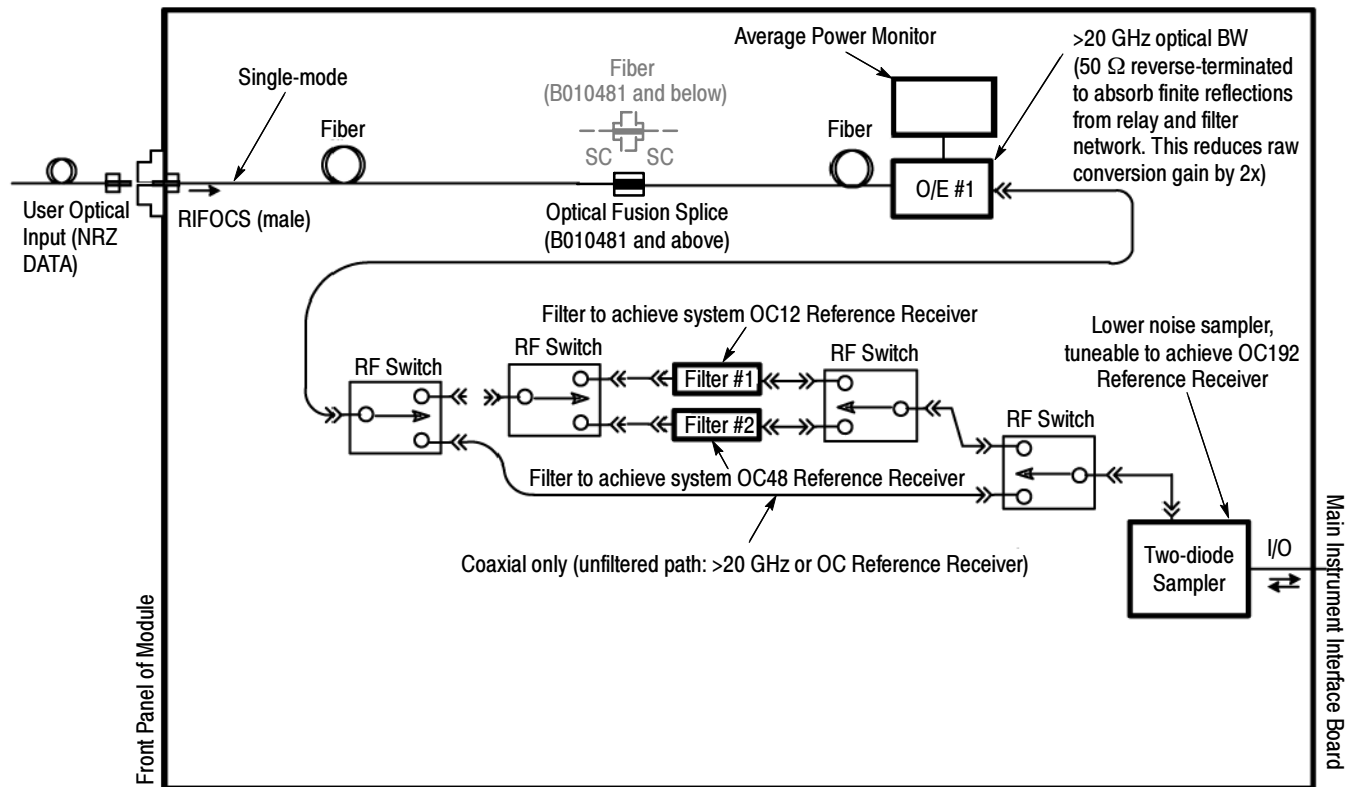


Figure 7-3: 80C01 Optical sampling block diagram

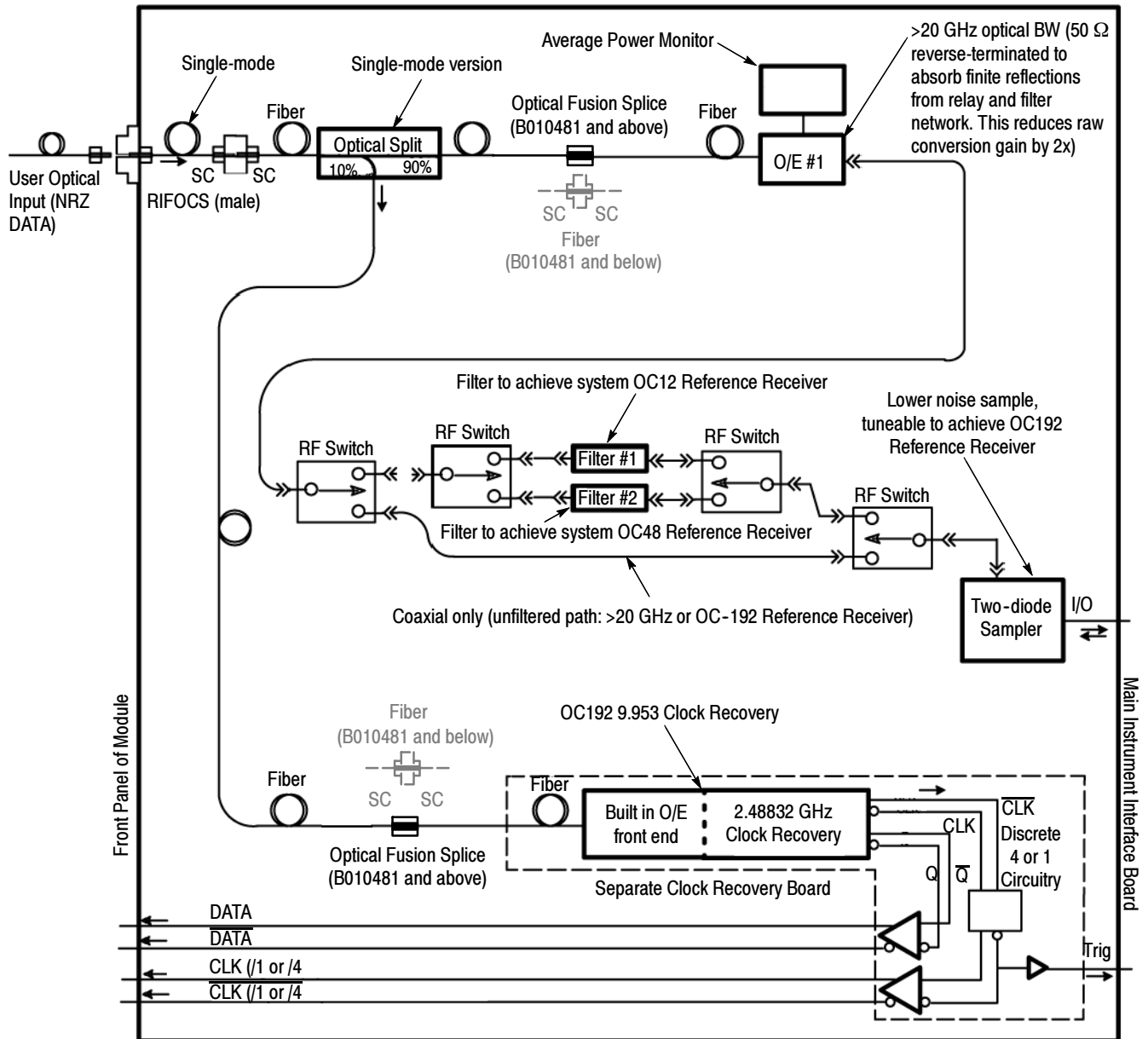


Figure 7-4: 80C01 Optical sampling with clock recovery block diagram

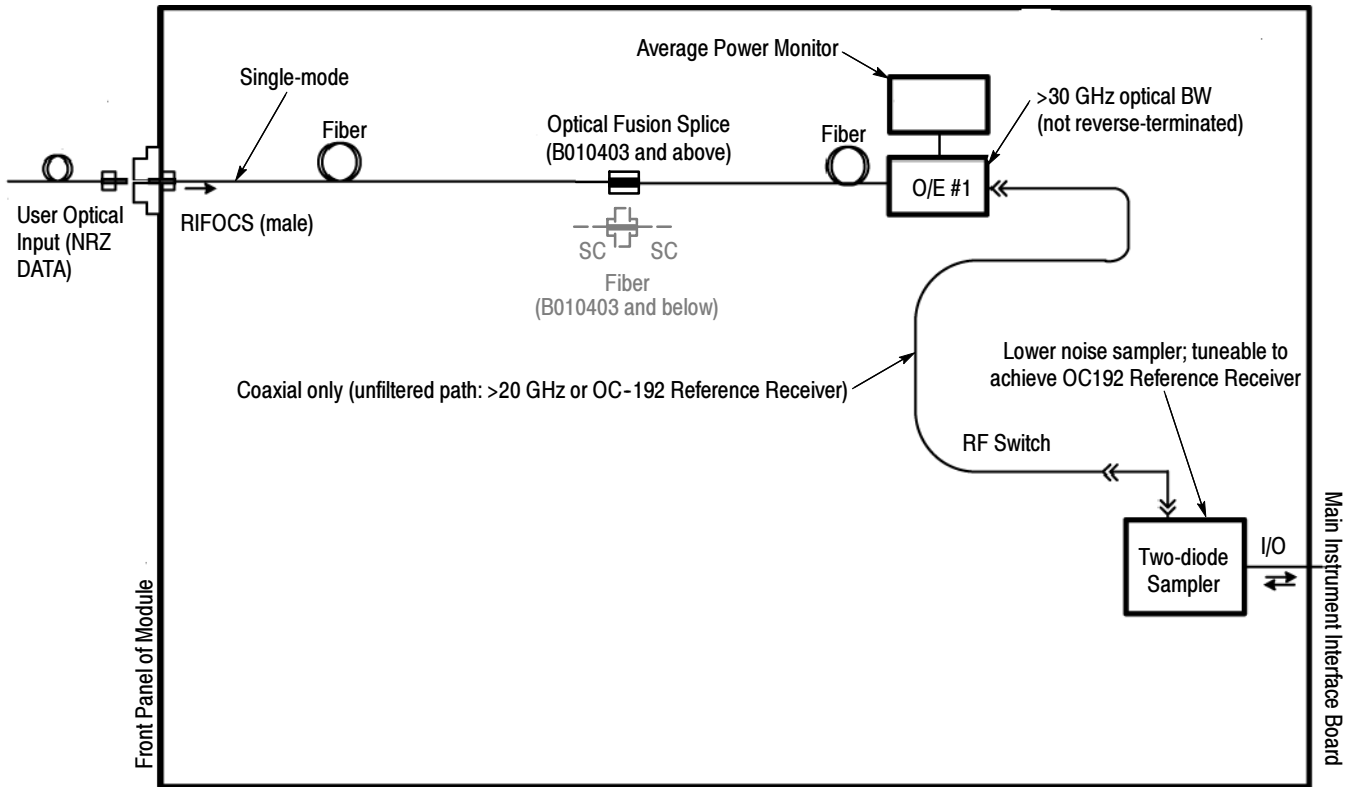


Figure 7-5: 80C02 Optical sampling block diagram

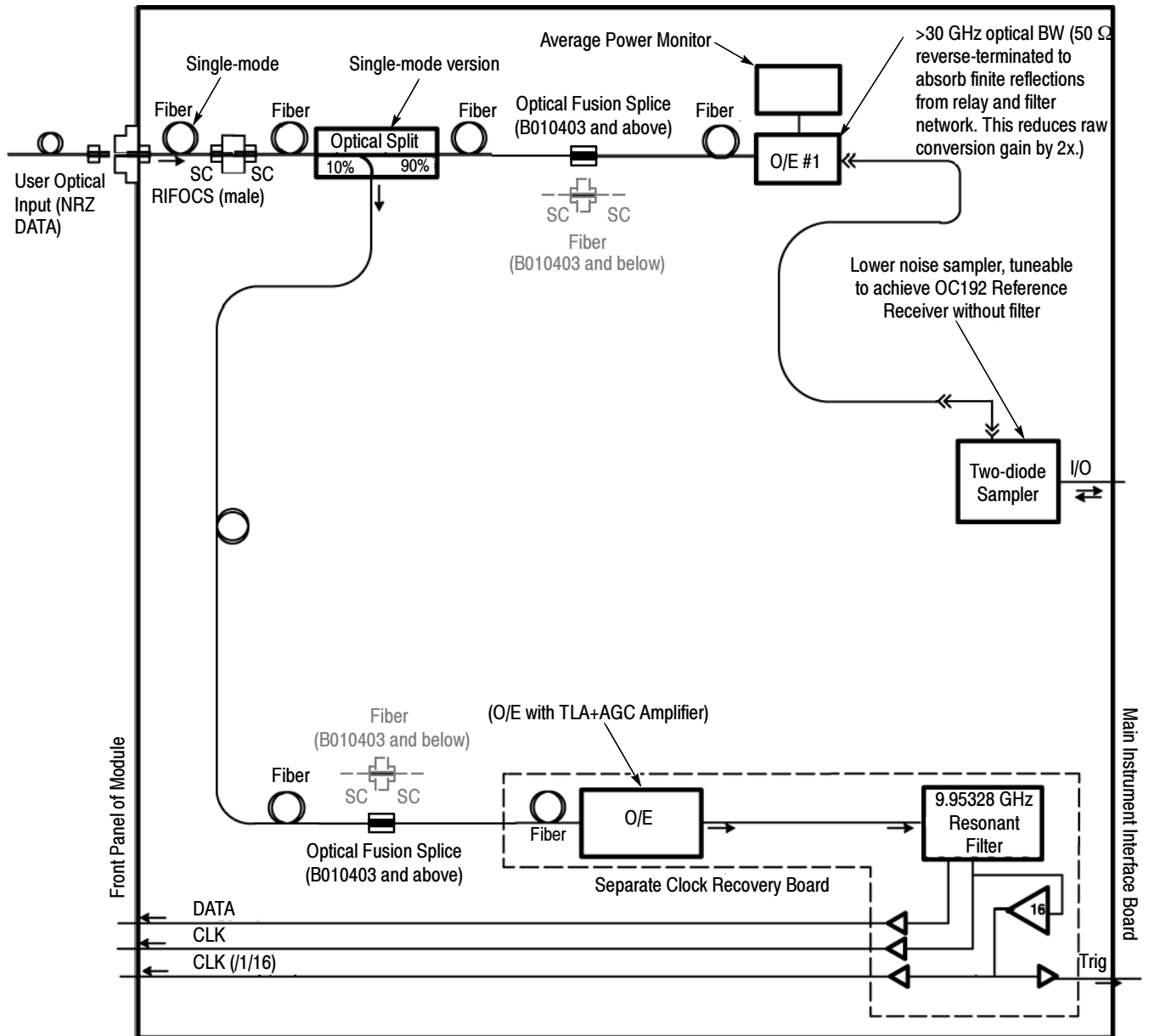


Figure 7-6: 80C02 Optical sampling with clock recovery block diagram

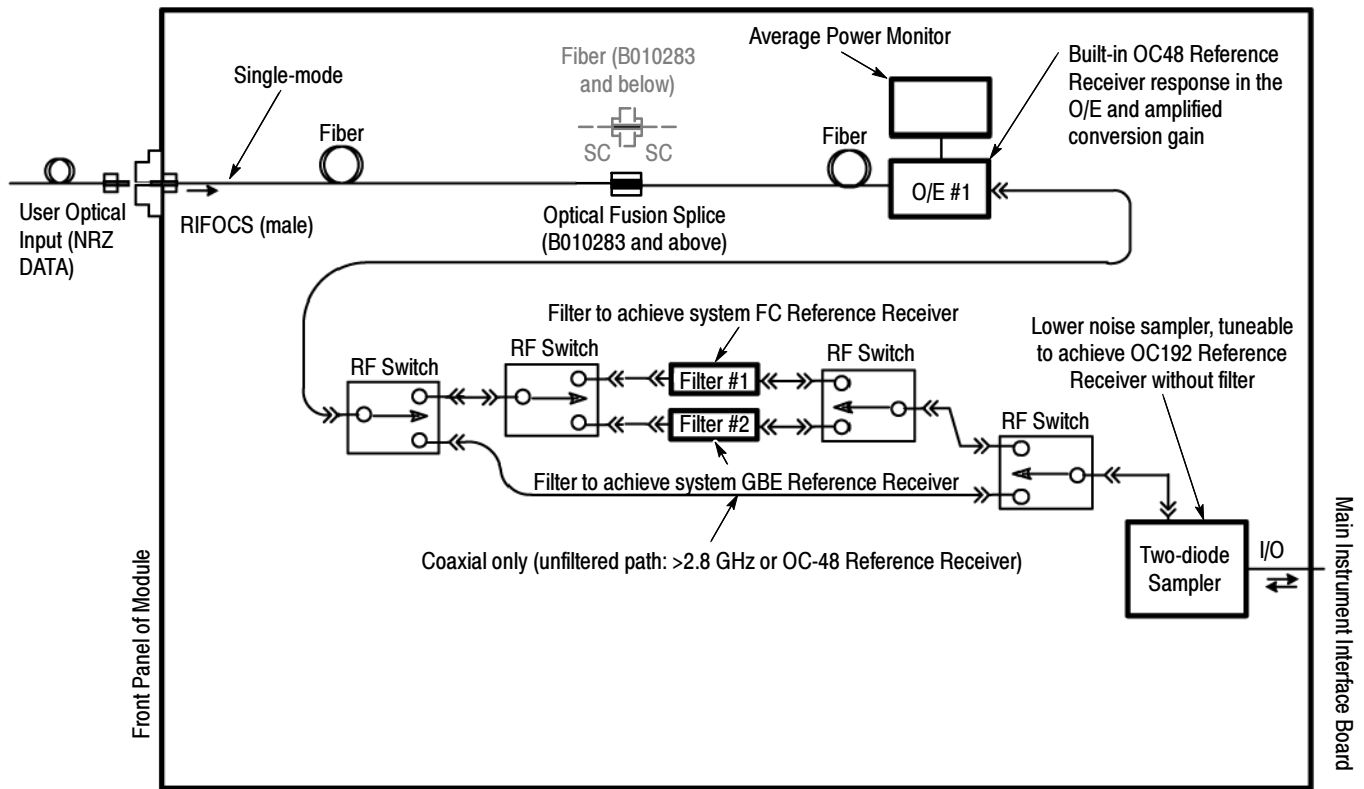


Figure 7-7: 80C03 Optical sampling block diagram

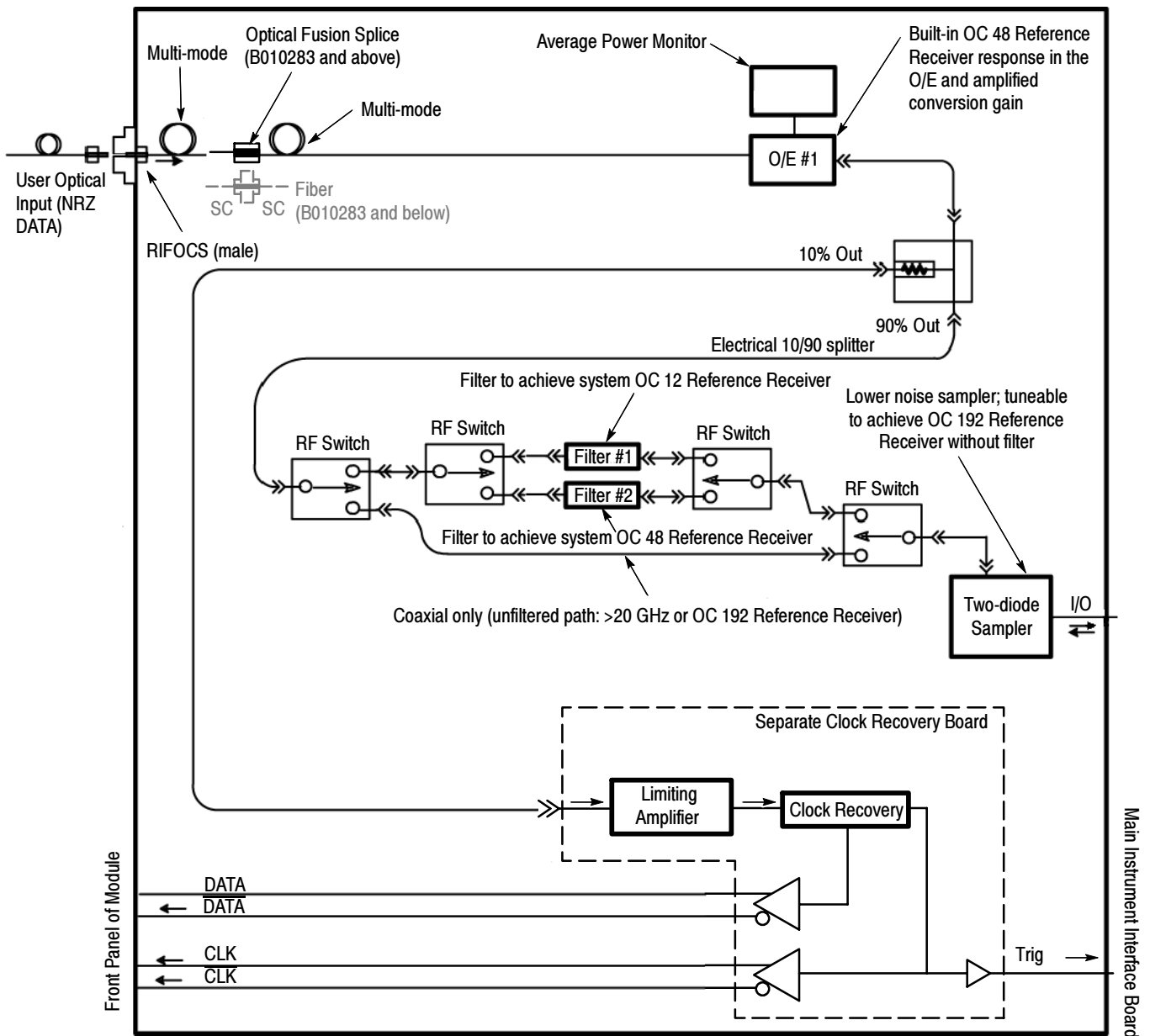


Figure 7-8: 80C03 Optical sampling with clock recovery block diagram

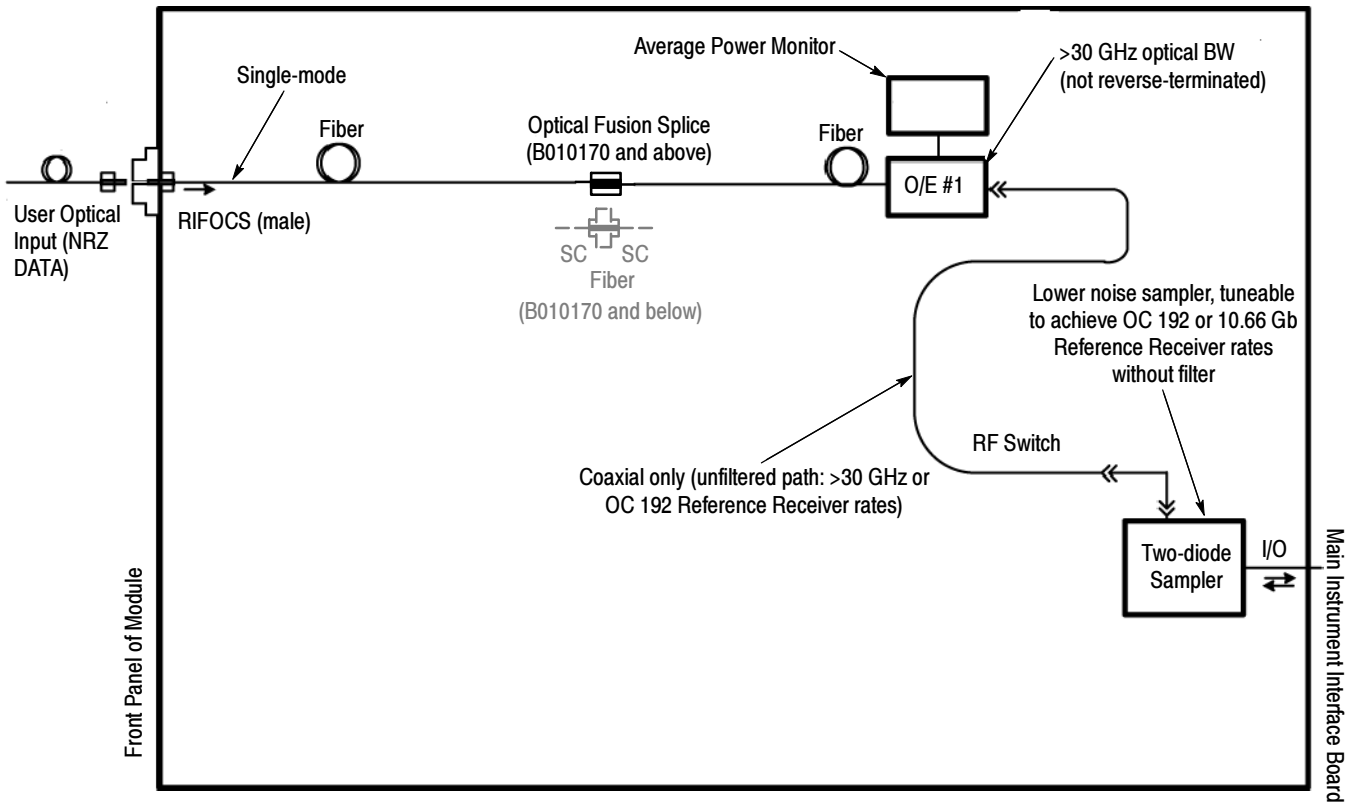


Figure 7-9: 80C04 Optical sampling block diagram

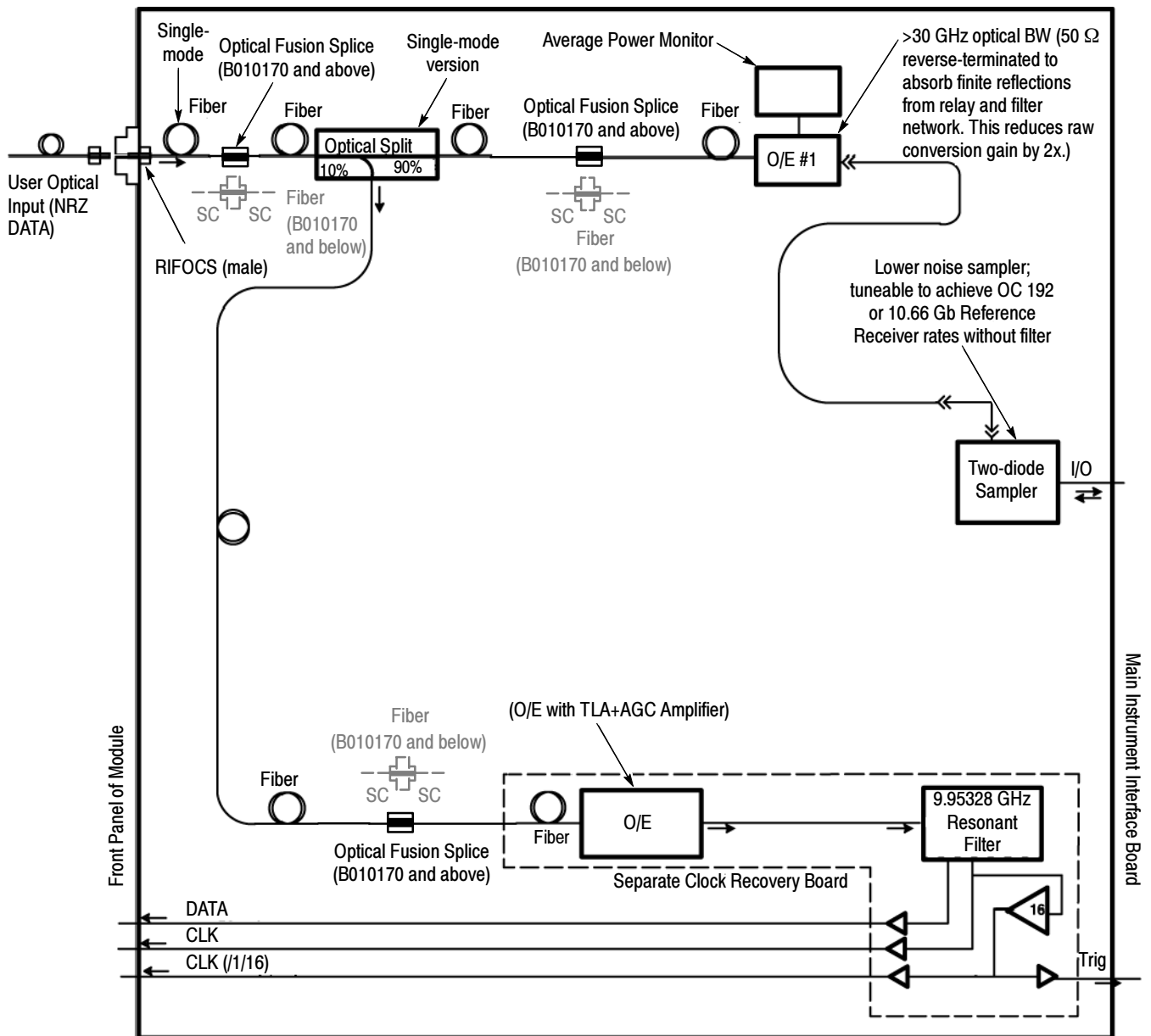


Figure 7-10: 80C04 Optical sampling block diagram with clock recovery

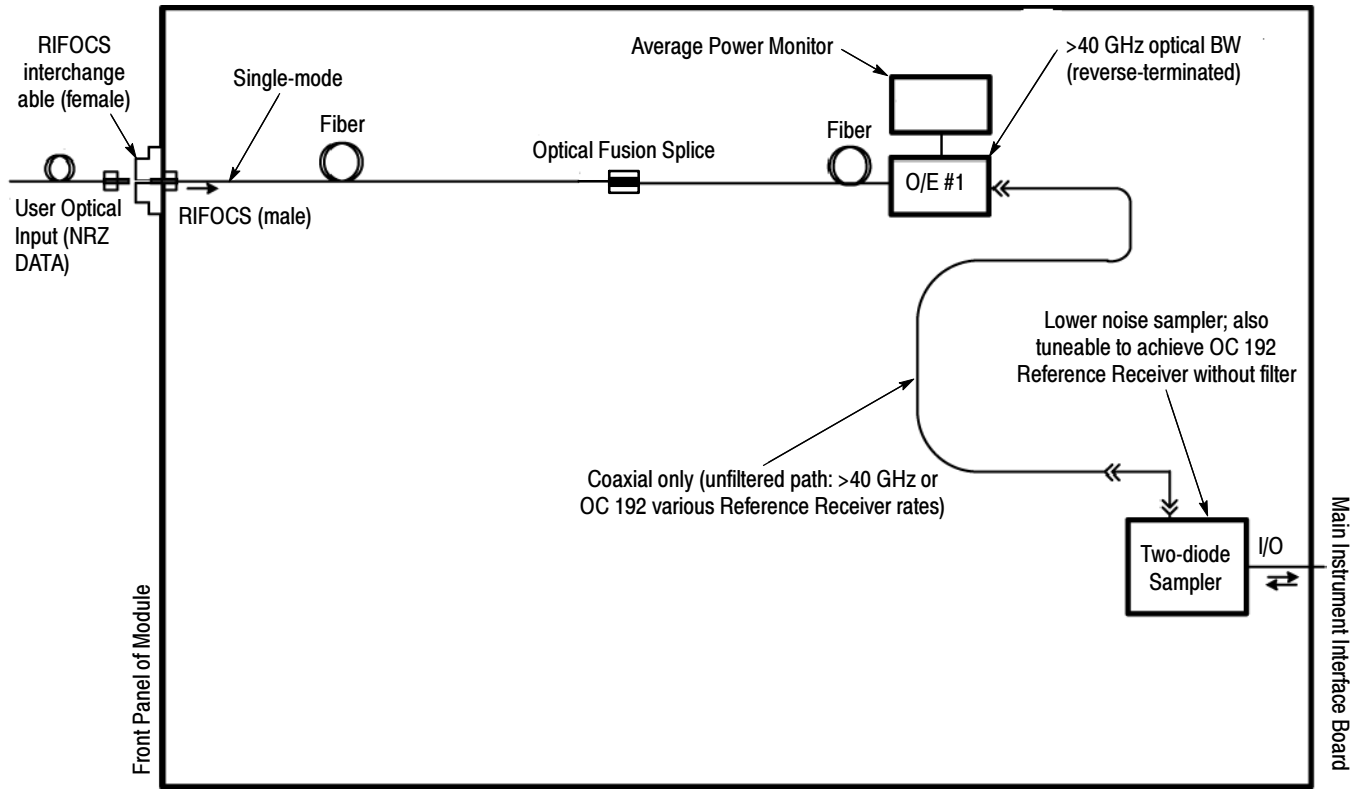


Figure 7- 11: 80C05 Optical sampling block diagram

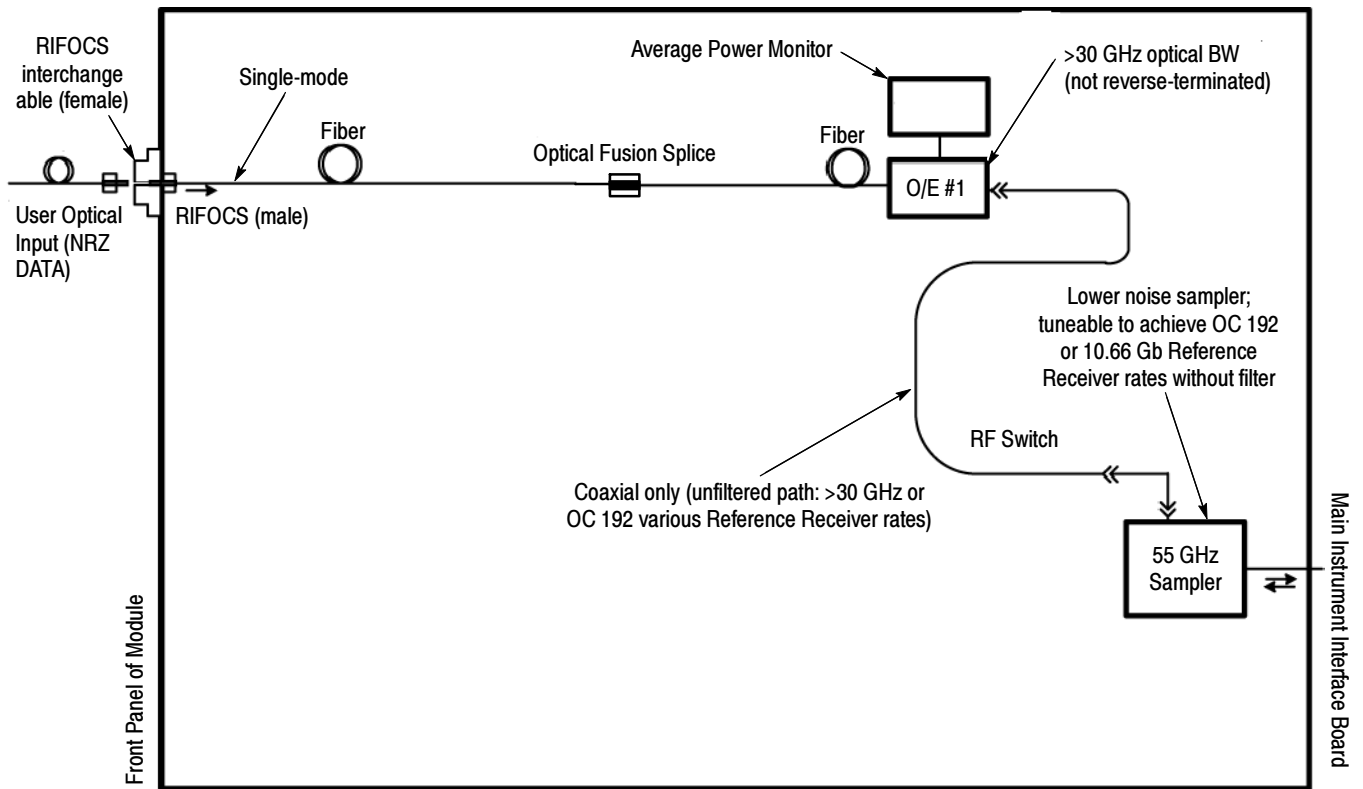


Figure 7-12: 80C06 Optical sampling block diagram

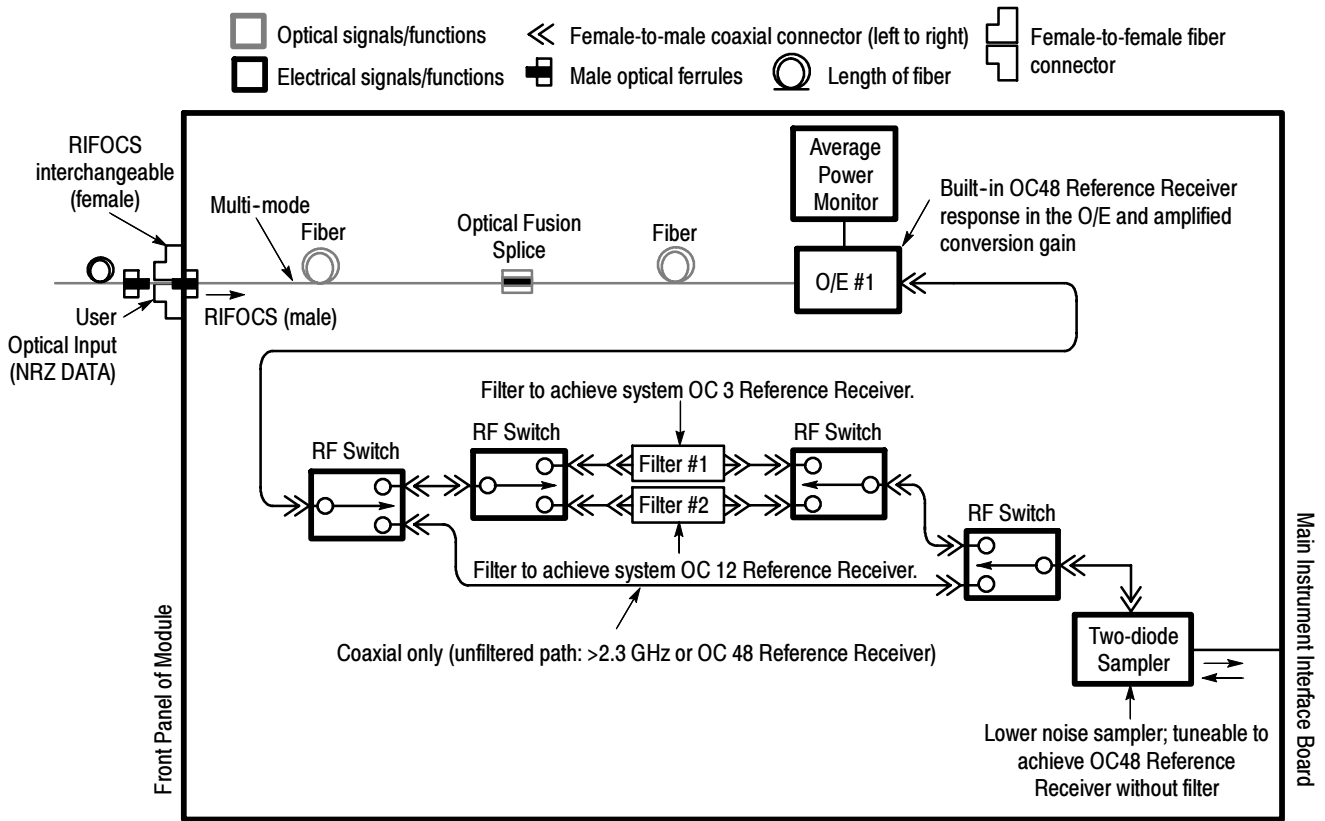


Figure 7-13: 80C07 and 80C07B Optical sampling block diagram

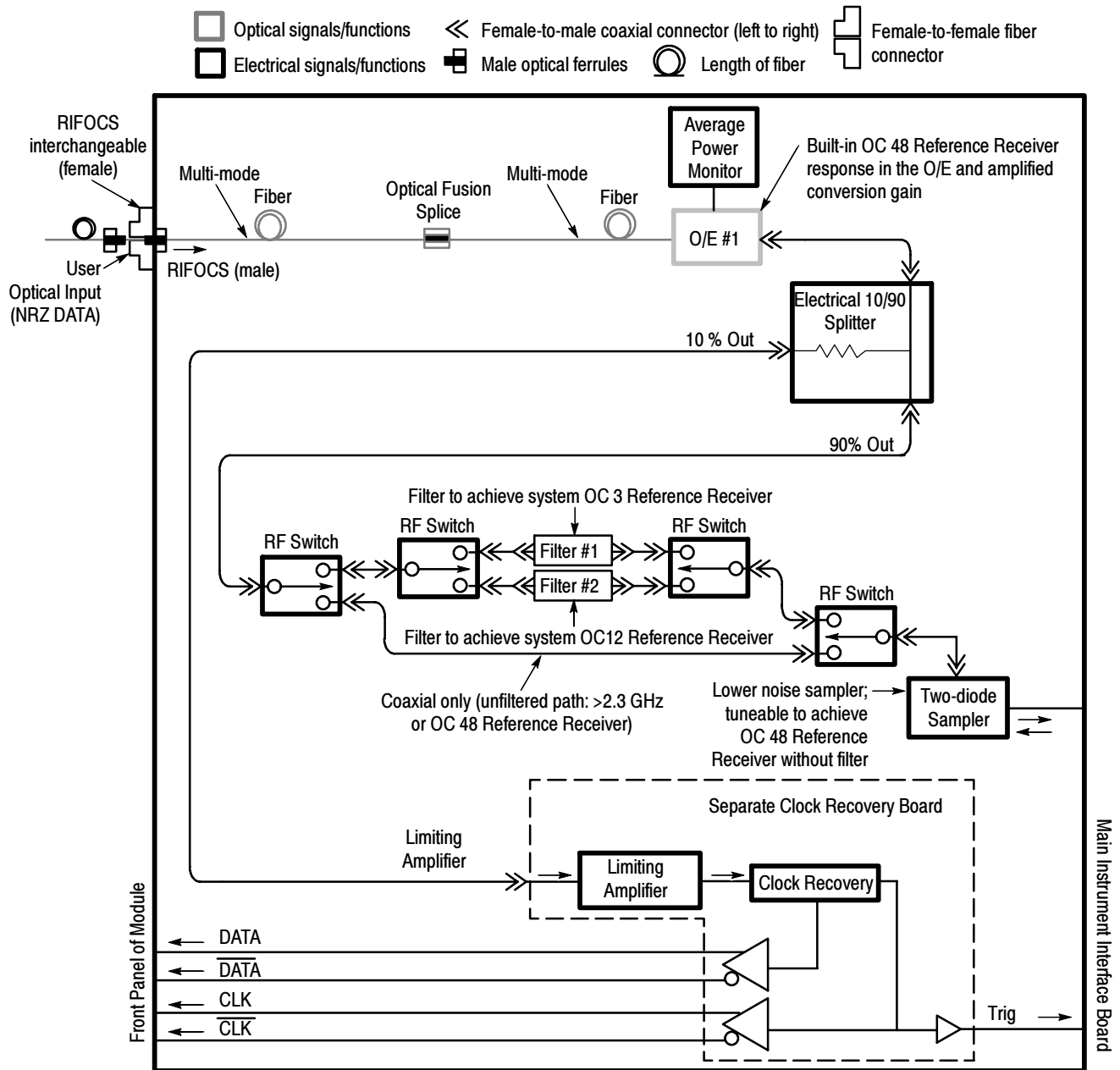


Figure 7-14: 80C07 and 80C07B Optical sampling with CR1 clock recovery block diagram

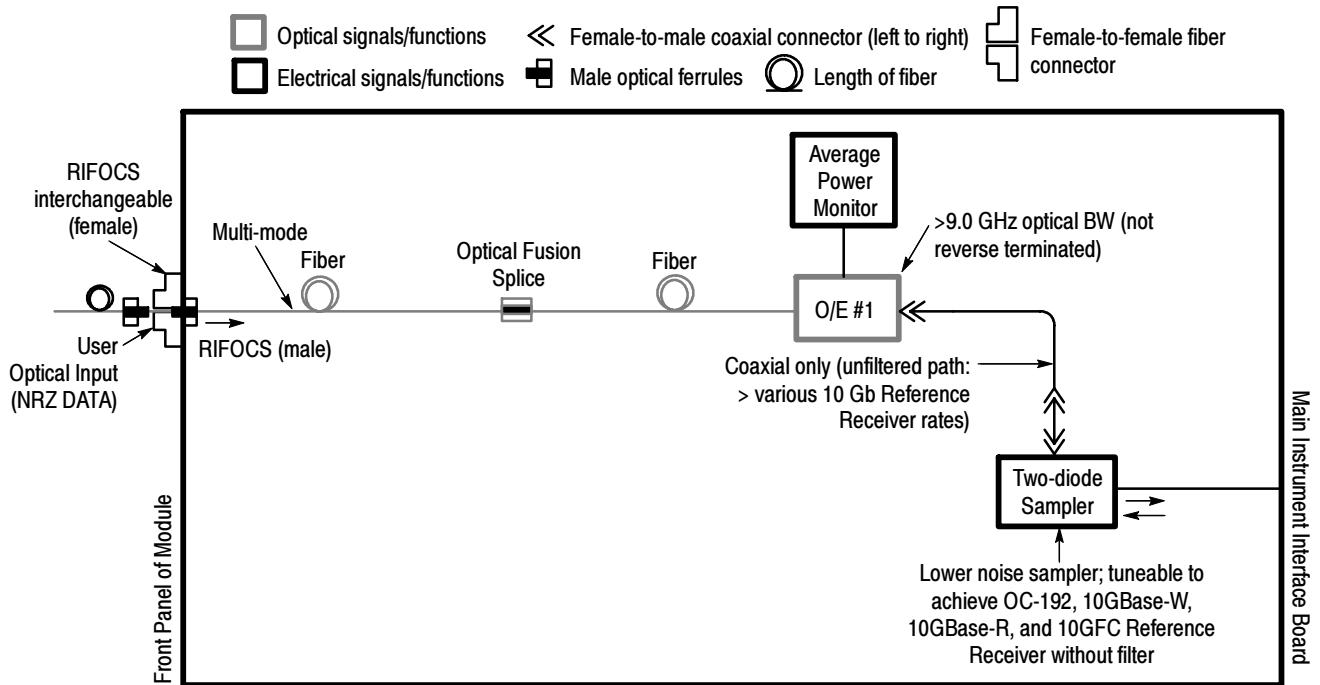


Figure 7- 15: 80C08/80C08B/80C08C Optical sampling block diagram

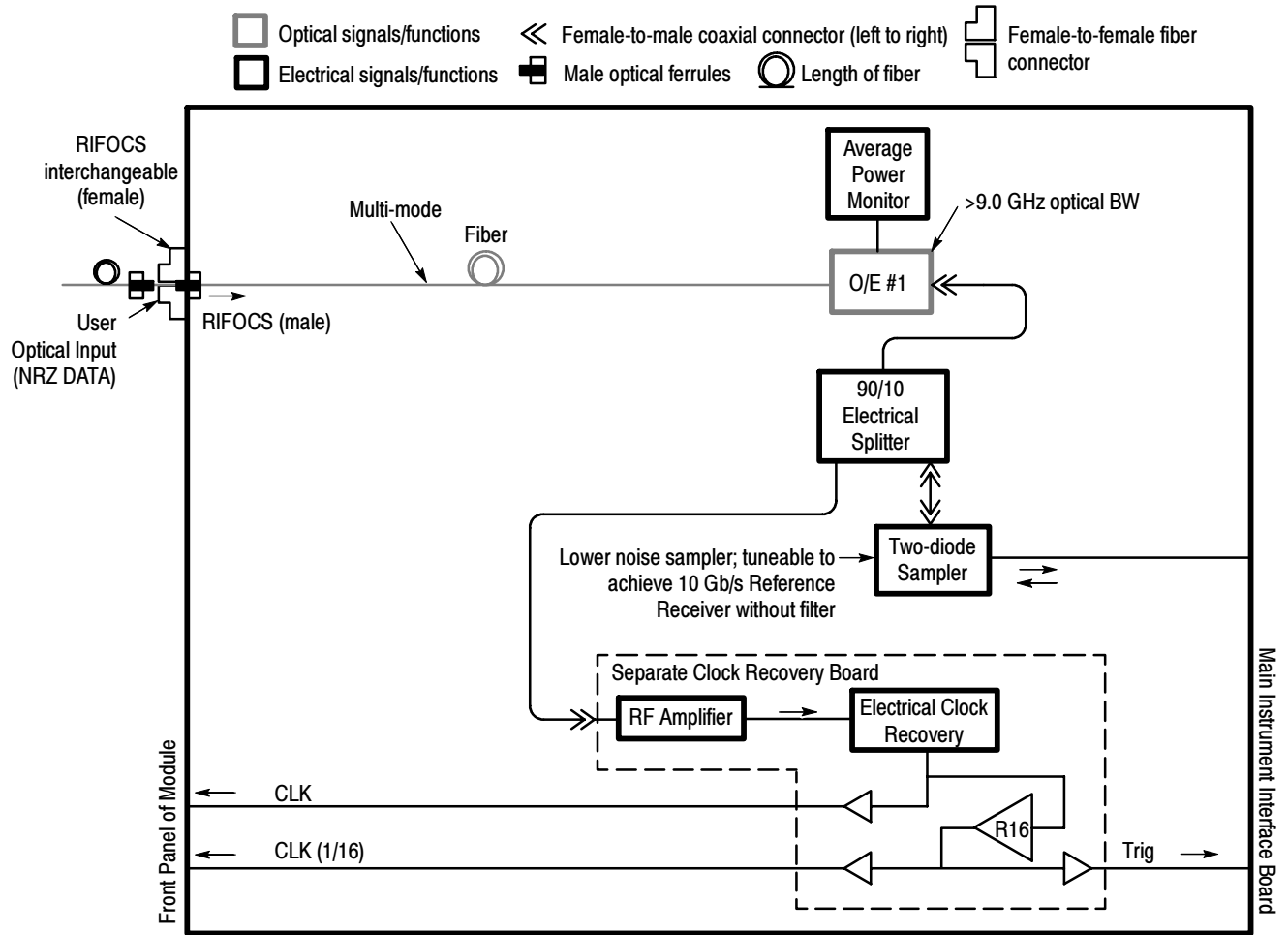


Figure 7- 16: 80C08/80C08B/80C08C Optical sampling with CR1, CR2, & CR4 clock recovery block diagram

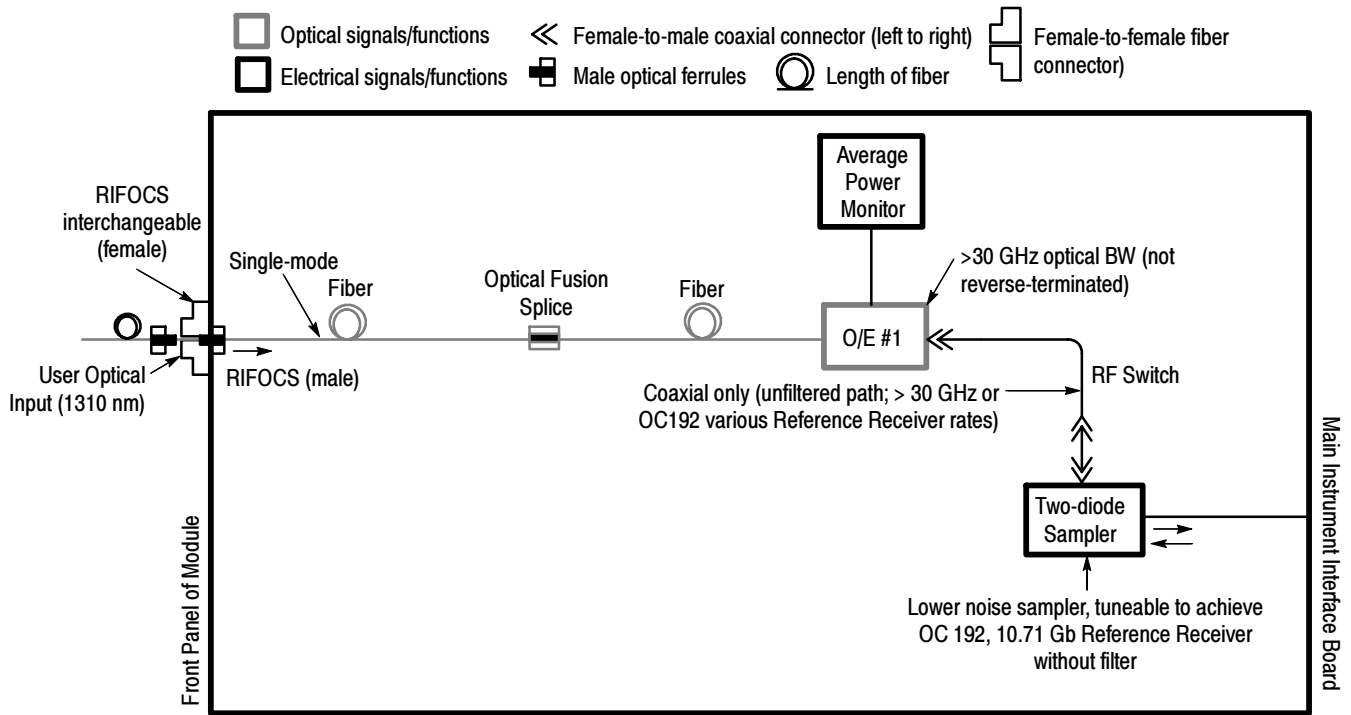


Figure 7- 17: 80C09 Optical sampling block diagram

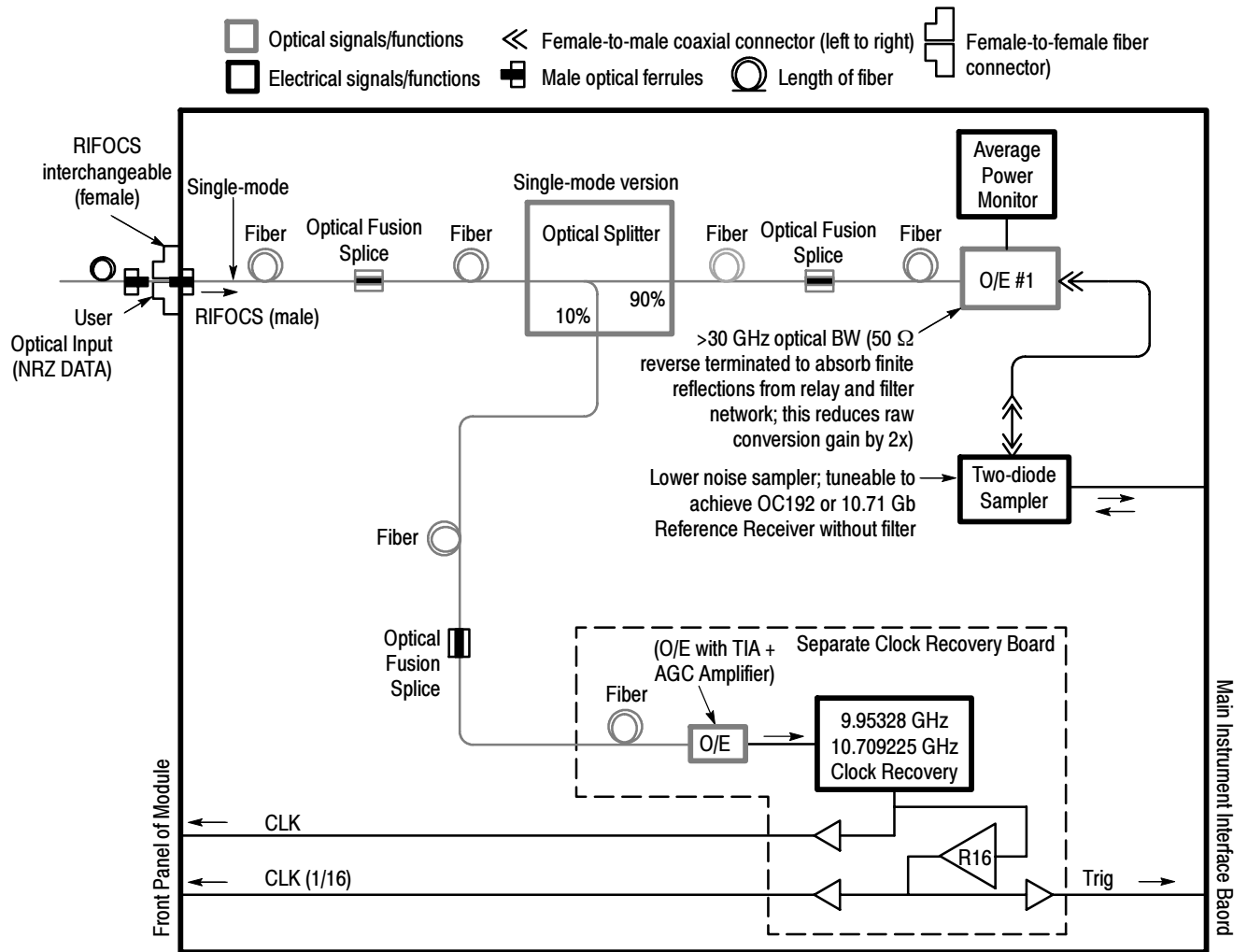


Figure 7- 18: 80C09 Optical sampling with CR1 clock recovery block diagram

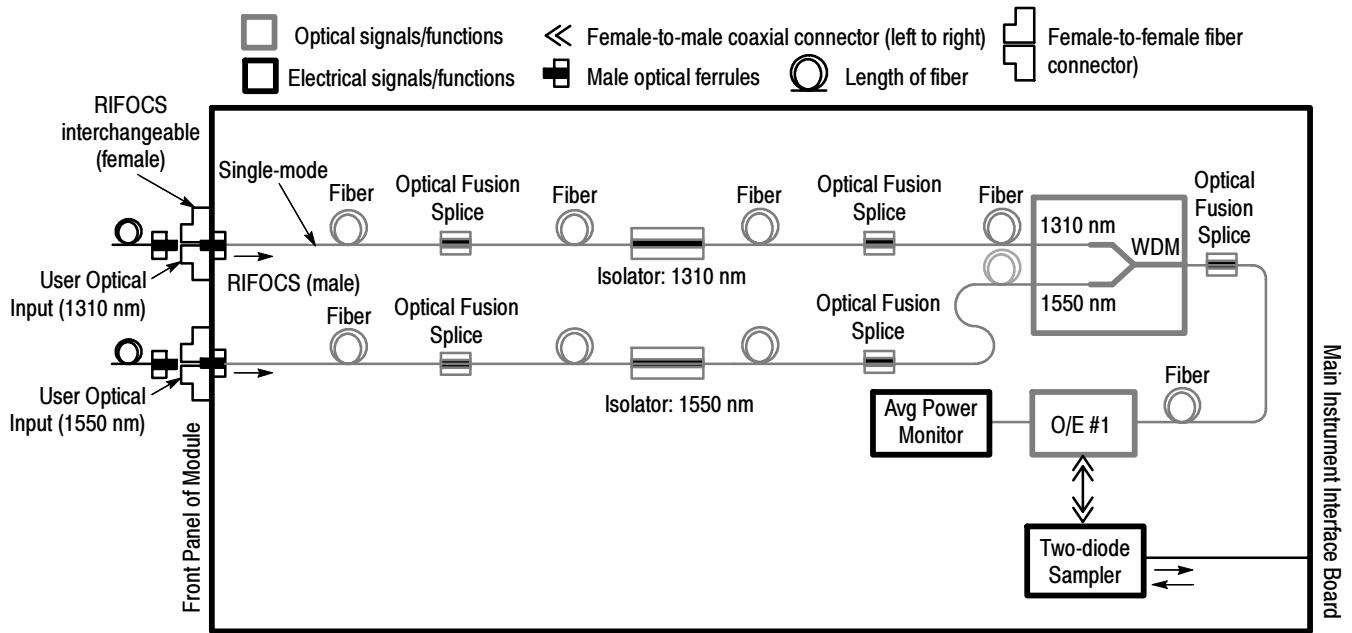


Figure 7-19: 80C10 Optical sampling block diagram

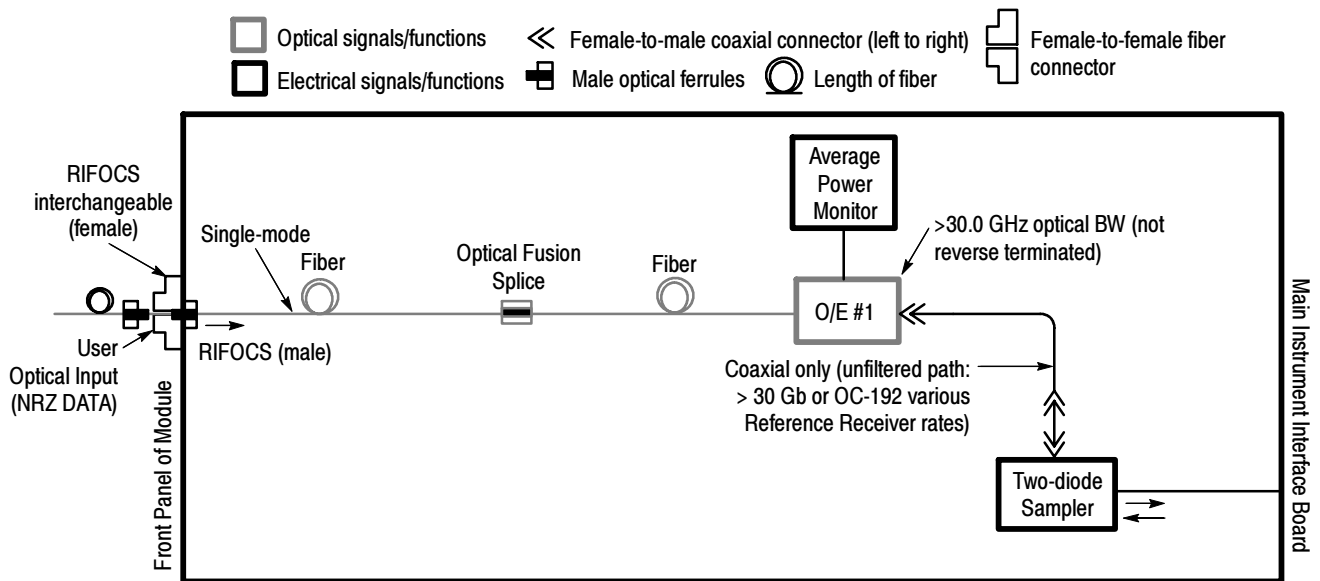


Figure 7-20: 80C11 Optical sampling block diagram

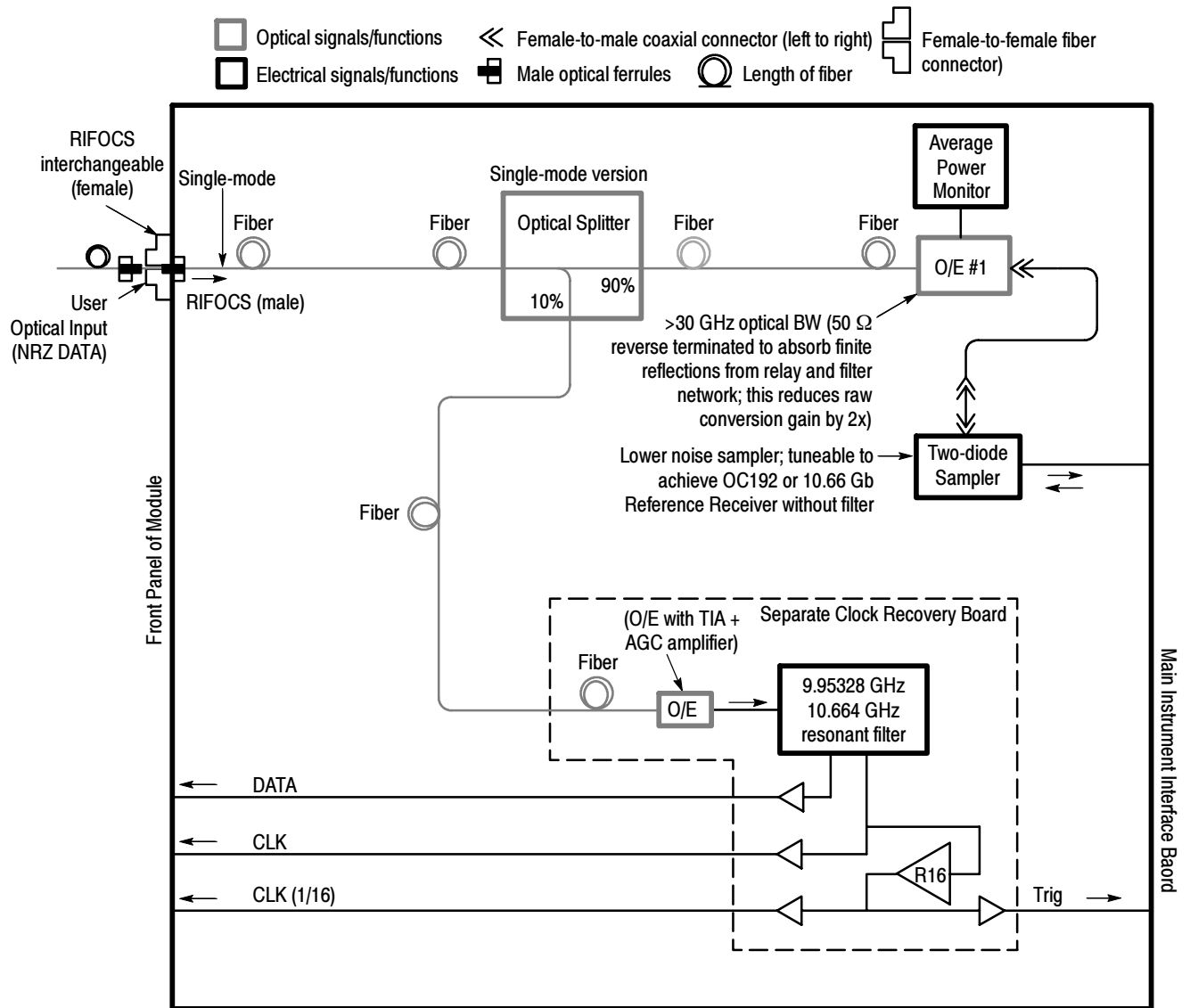


Figure 7-21: 80C11 Optical sampling with CR1 clock recovery option block diagram

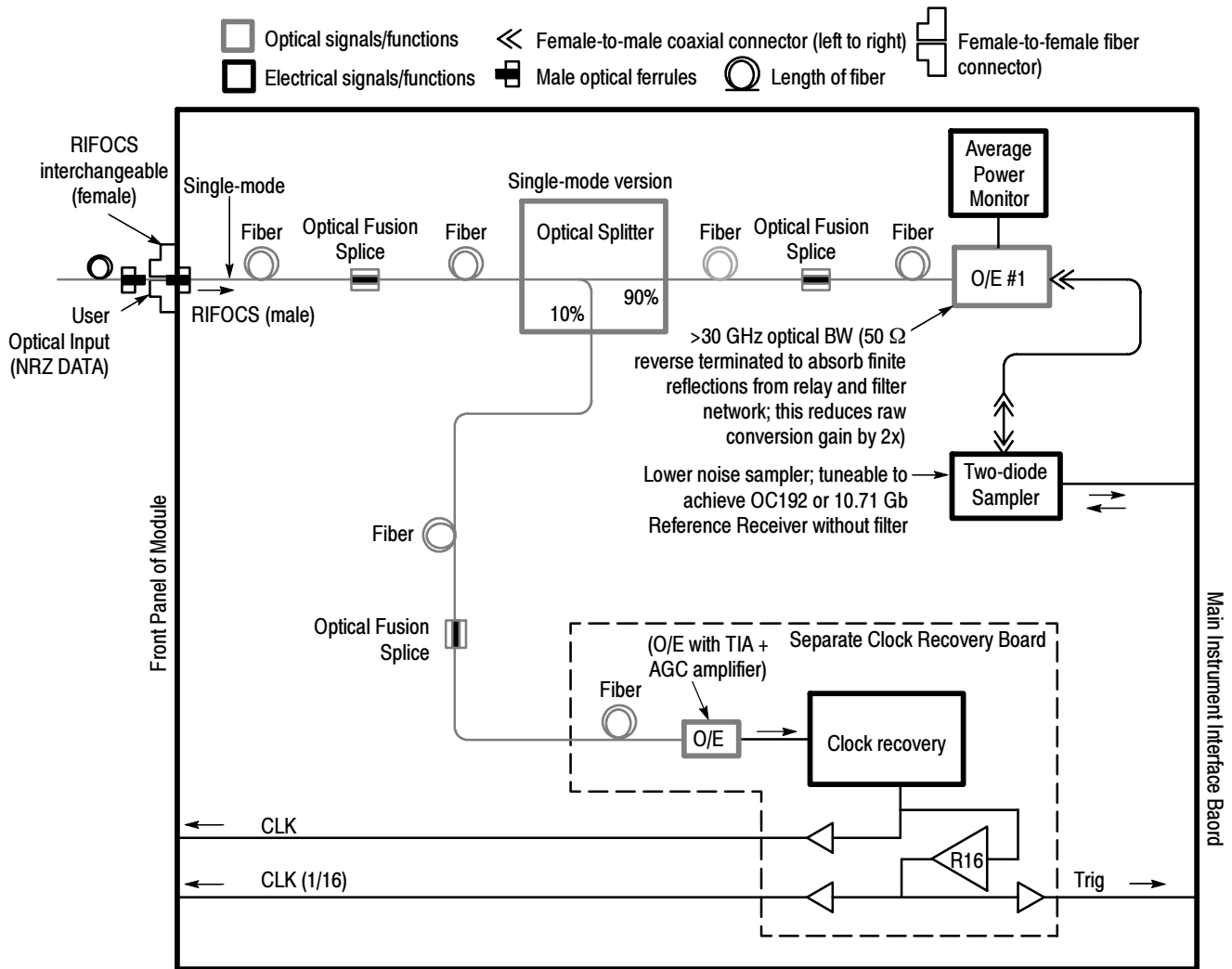


Figure 7-22: 80C11 Optical sampling with CR2 and CR3 clock recovery option block diagram

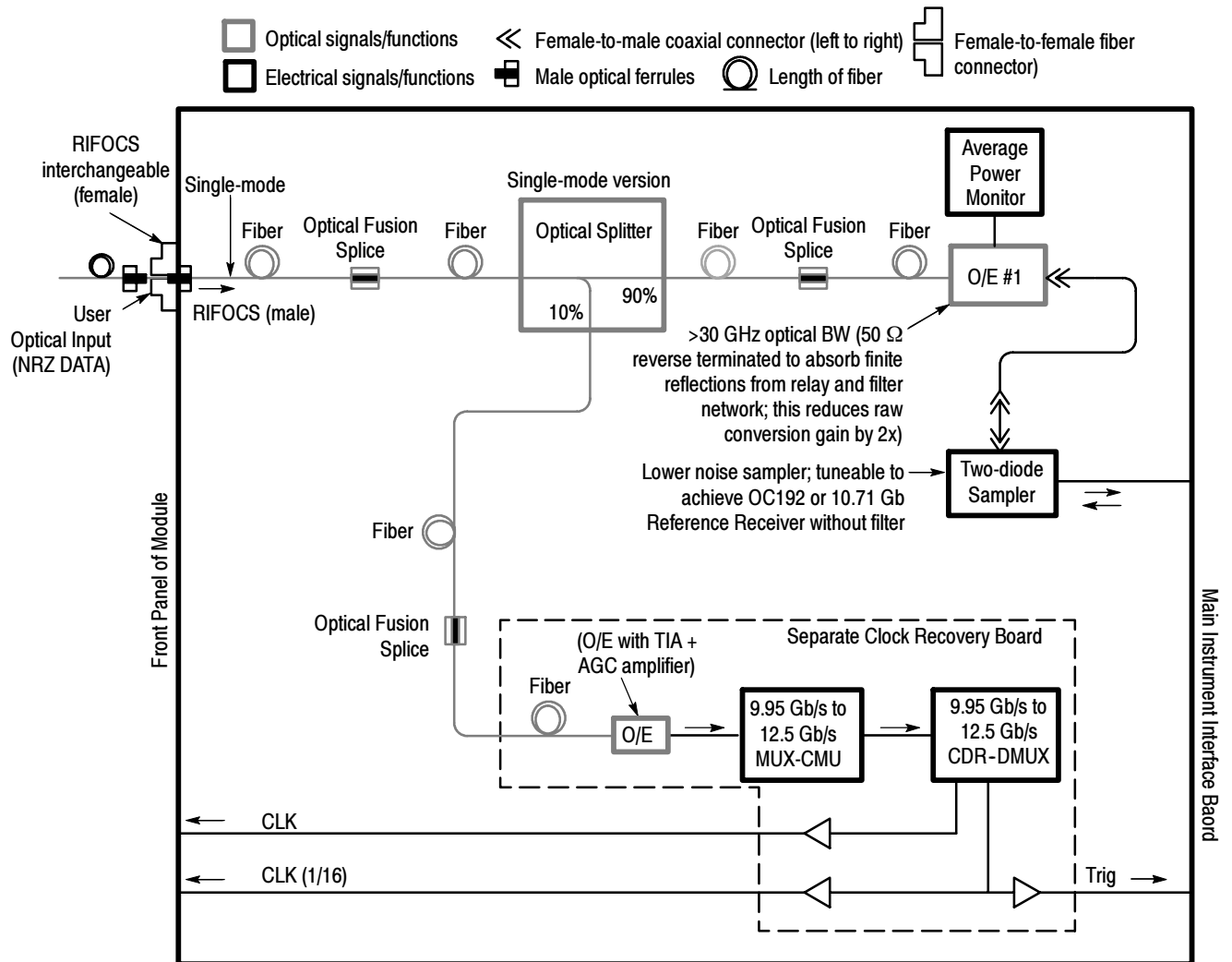


Figure 7-23: 80C11 Optical sampling with CR4 clock recovery option block diagram

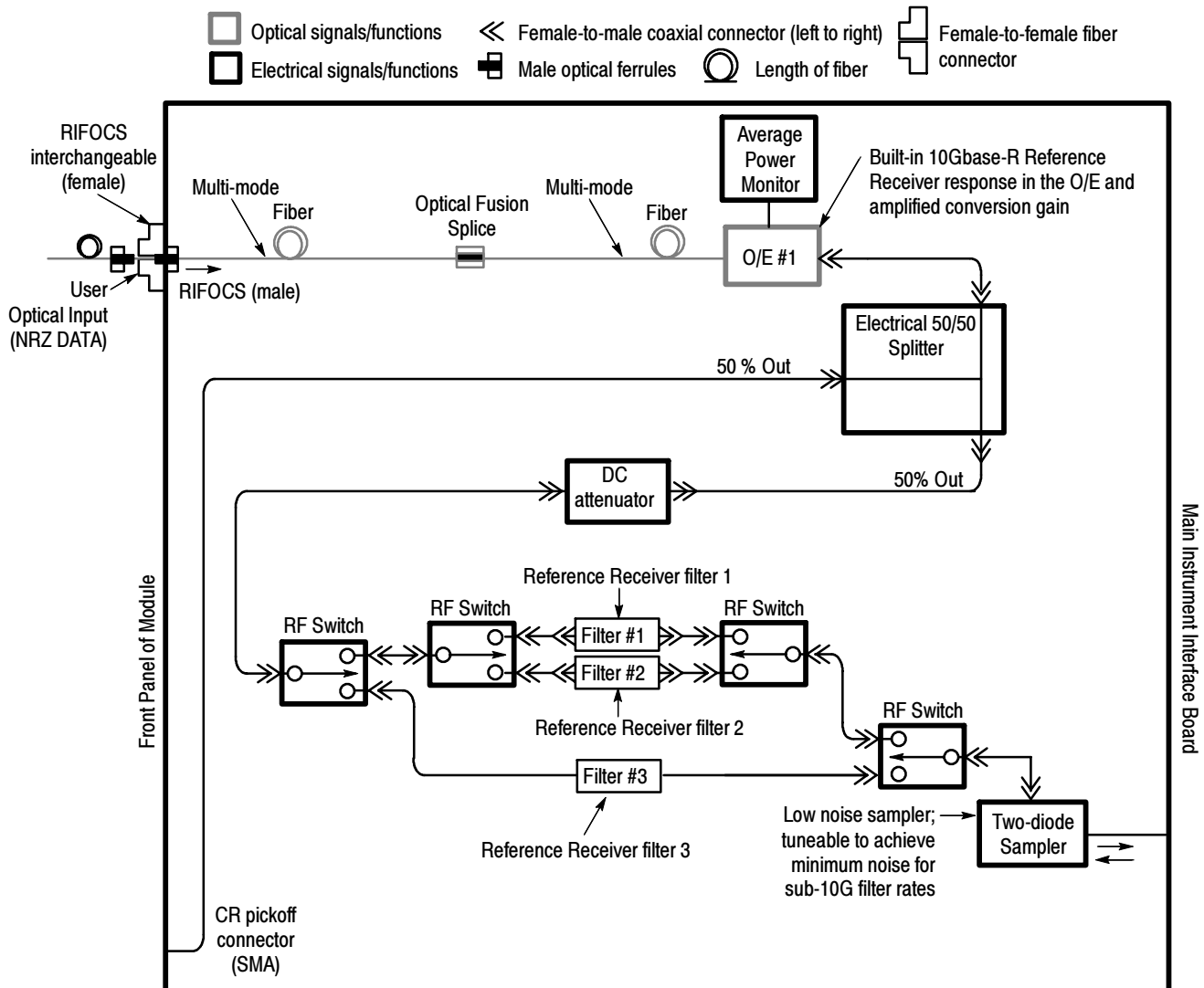


Figure 7-24: 80C12 Optical sampling block diagram

80A01 Block Diagram

Figure 7-25 show the interconnections between major circuit blocks of the 80A01 module.

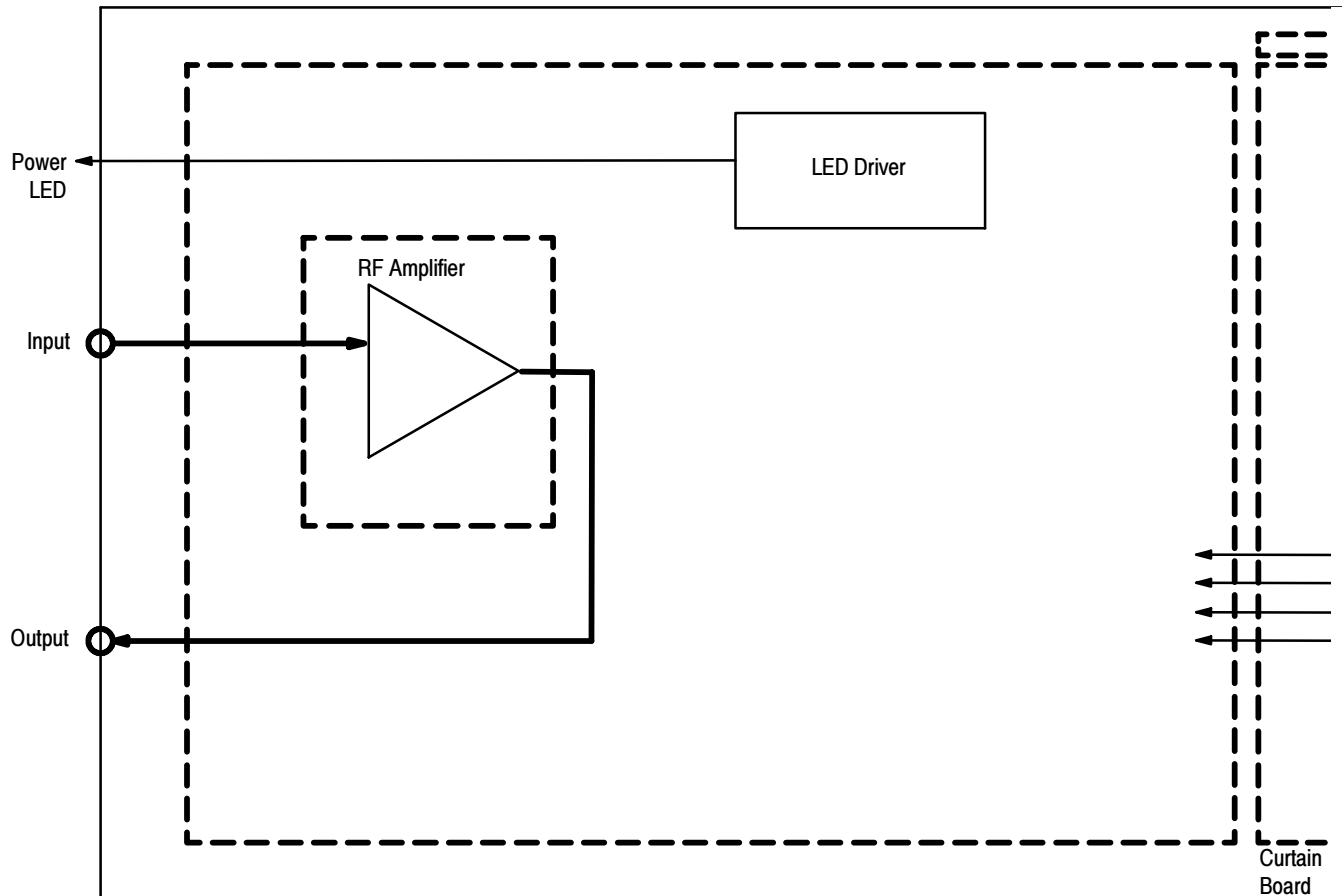


Figure 7-25: 80A01 block diagram

80A02 Block Diagram

Figure 7-26 shows the interconnections between major circuit blocks of the 80A02 module.

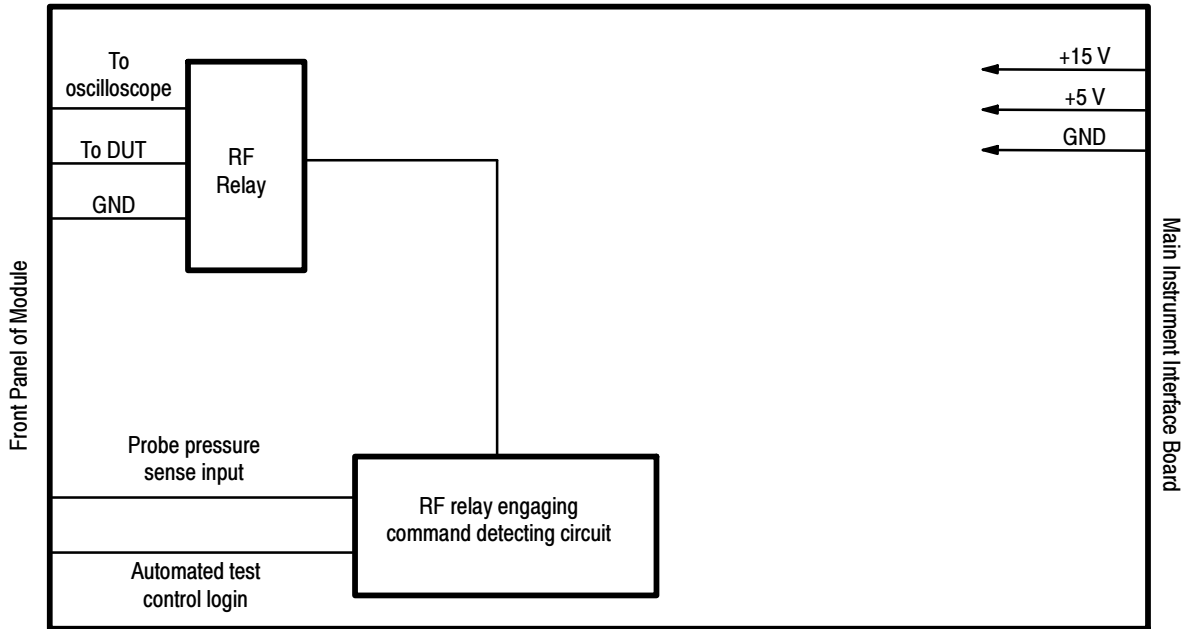


Figure 7-26: 80A02 block diagram

80A05 Block Diagram

Figure 7-27 shows the interconnections between major circuit blocks of the 80A05 module.

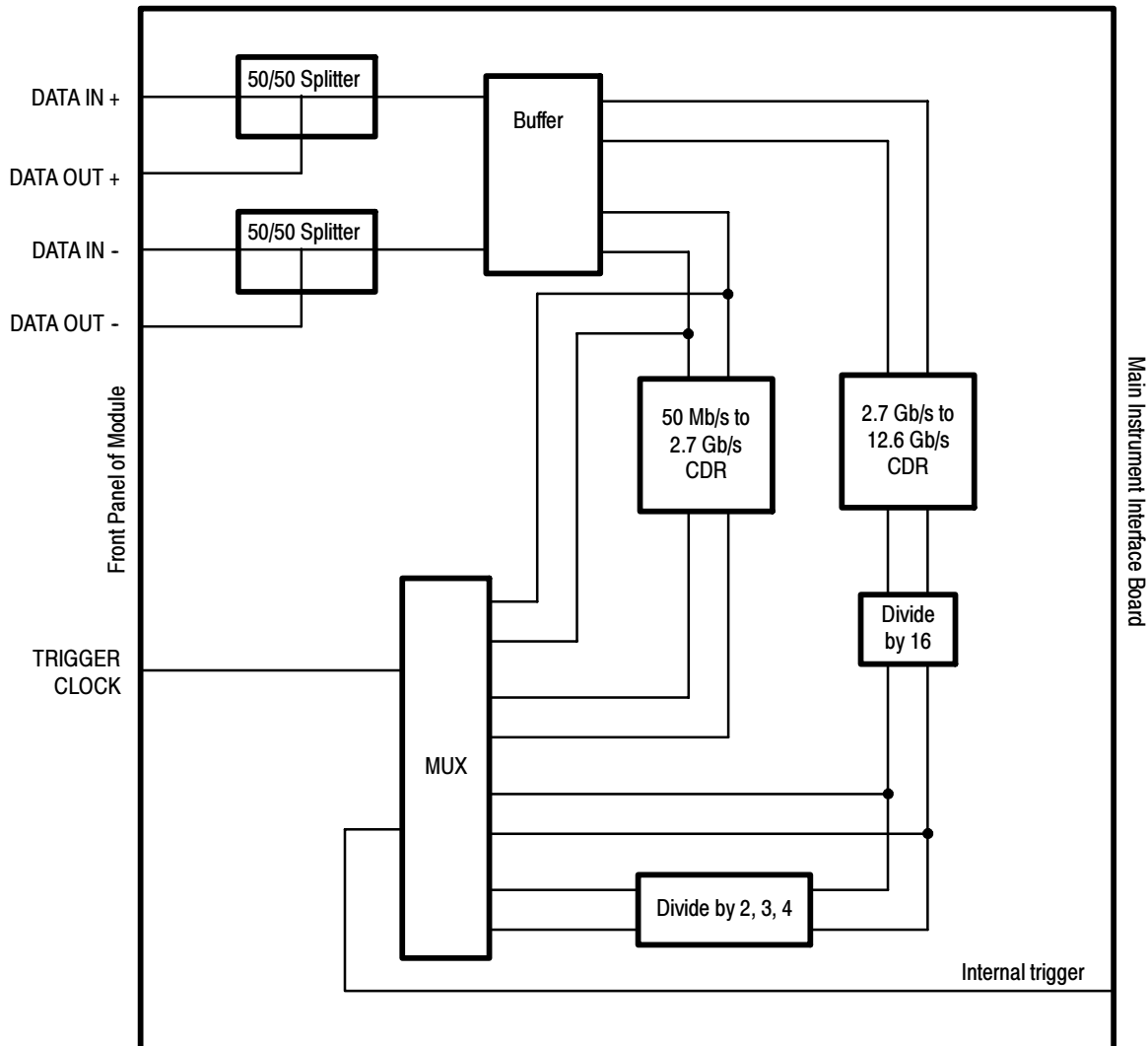


Figure 7-27: 80A05 block diagram

82A04 Block Diagram

Figure 7-28 shows the interconnections between major circuit blocks of the 82A04 module.

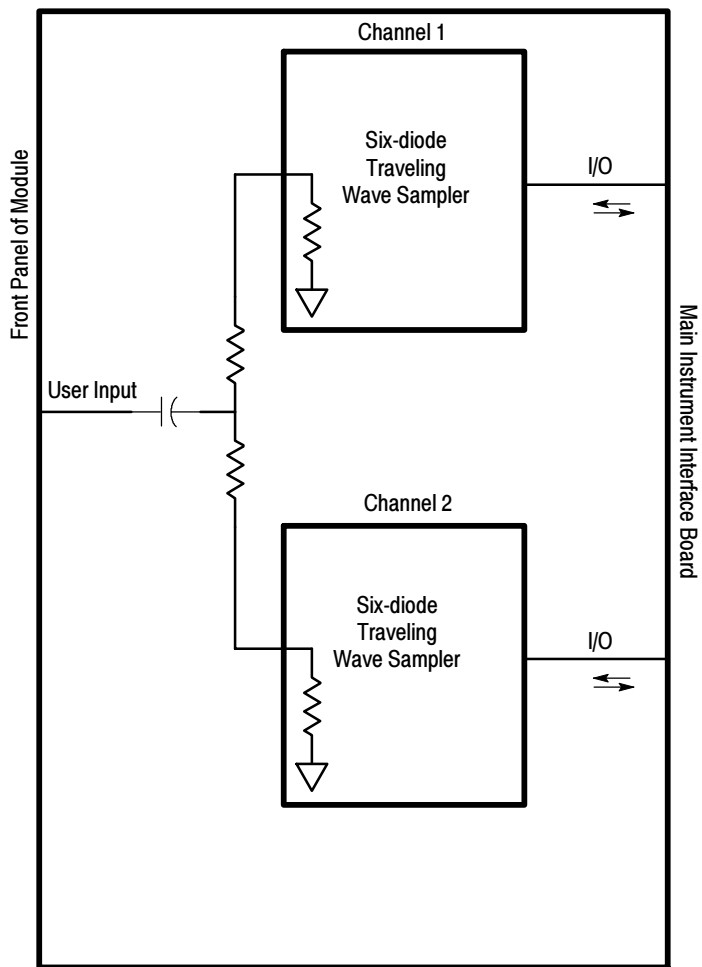


Figure 7-28: 82A04 block diagram



Replaceable Parts

Replaceable Parts List

This chapter contains a list of the replaceable modules for the instrument. Use this list to identify and order replacement parts.

Parts Ordering Information

Replacement parts are available through your local Tektronix field office or representative.

Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available and to give you the benefit of the latest circuit improvements. Therefore, when ordering parts, it is important to include the following information in your order.

- Part number
- Instrument type or model number
- Instrument serial number
- Instrument modification number, if applicable

If you order a part that has been replaced with a different or improved part, your local Tektronix field office or representative will contact you concerning any change in part number.

Module Servicing

Modules can be serviced by selecting one of the following three options. Contact your local Tektronix service center or representative for repair assistance.

Module Exchange. In some cases you may exchange your module for a remanufactured module. These modules cost significantly less than new modules and meet the same factory specifications. For more information about the module exchange program, call 1-800-TEK-WIDE, extension 6630.

Module Repair and Return. You may ship your module to us for repair, after which we will return it to you.

New Modules. You may purchase replacement modules in the same way as other replacement parts.

Using the Replaceable Parts List

This section contains a list of the mechanical and/or electrical components that are replaceable for the instrument. Use this list to identify and order replacement parts. The following table describes each column in the parts list.

Parts list column descriptions

Column	Column name	Description
1	Figure & Index Number	Items in this section are referenced by component number.
2	Tektronix Part Number	Use this part number when ordering replacement parts from Tektronix.
3 and 4	Serial Number	Column three indicates the serial number at which the part was first effective. Column four indicates the serial number at which the part was discontinued. No entries indicates the part is good for all serial numbers.
5	Qty	This indicates the quantity of parts used.
6	Name & Description	An item name is separated from the description by a colon (:). Because of space limitations, an item name may sometimes appear as incomplete. Use the U.S. Federal Catalog handbook H6-1 for further item name identification.
7	Mfr. Code	This indicates the code of the actual manufacturer of the part. (Code to name and address cross reference is located after this page.)
8	Mfr. Part Number	This indicates the actual manufacturer's or vendor's part number.

Abbreviations Abbreviations conform to American National Standard ANSI Y1.1-1972.

Mfr. Code to Manufacturer Cross Index The following table cross indexes codes, names, and addresses of manufacturers or vendors of components listed in the parts list.

**Mfr. Code to Manufacturer
Cross Index**

The table titled Manufacturers Cross Index shows codes, names, and addresses of manufacturers or vendors of components listed in the parts list.

Manufacturers cross index

Mfr. code	Manufacturer	Address	City, state, zip code
00779	AMP INC.	CUSTOMER SERVICE DEPT PO BOX 3608	HARRISBURG, PA 17105-3608
01295	TEXAS INSTRUMENTS INC	SEMICONDUCTOR GROUP 13500 N CENTRAL EXPRESSWAY PO BOX 655303	DALLAS, TX 75272-5303
01963	CHERRY ELECTRICAL PRODUCTS CO	3600 SUNSET AVENUE	WAUKEGAN, IL 60087-3214
02660	AMPHENOL CORP	720 SHERMAN AVE	HAMDEN, CT 06514-6514
03ZT7	MOBILE PLANET	9175 DEERING AVE	CHATSWORTH, CA 91311
04713	MOTOROLA INC	SEMICONDUCTOR PRODUCTS SECTOR 5005 E MCDOWELL ROAD	PHOENIX, AZ 85008-4229
049S6	FUJITSU COMPUTER PRODUCTS OF AMERICA INC	2904 ORCHARD PARKWAY	SAN JOSE, CA 95134-2009
05791	LYN-TRON INC	SOUTH 6001 THOMAS MALLEEN RD	SPOKANE, WA 99204
060D9	UNITREK CORPORATION	3000 COLUMBIA HOUSE BLVD, SUITE 120	VANCOUVER, WA 98661
06666	GENERAL DEVICES	PO BOX 39100	INDIANAPOLIS, IN 46239
06915	RICHCO	5825 N TRIPP AVE P.O. BOX 804238	CHICAGO, IL 60646
07416	NELSON NAME PLATE COMPANY	3191 CASITAS AVENUE	LOS ANGELES, CA 90039-2410
0ADN8	DELTA PRODUCTS CORP-DPZ	4405 CUSHING PARKWAY	FREMONT, CA 94538
0GZV8	HUBER & SUHNER INC	19 THOMPSON DRIVE	ESSEX JUNCTION, VT 05452-3408
0J9P9	GEROME MFG CO INC	PO BOX 737 403 NORTH MAIN	NEWBERG, OR 97132
0KB01	STAUFFER SUPPLY CO	810 SE SHERMAN	PORTLAND, OR 97214-4657
0KB05	NORTH STAR NAMEPLATE INC	5750 NE MOORE COURT	HILLSBORO, OR 97124-6474
0KBZ5	Q & D PLASTICS INC	1812 - 16TH AVENUE PO BOX 487	FOREST GROVE, OR 97116-0487
12136	PHC INDUSTRIES INC	1643 HADDON AVE PO BOX 1448	CAMDEN, NJ 08103
16179	M/A COM INC	1011 PAWTUCKER BLVD. PO BOX 3295	LOWELL, MA 01853-3295
1AW87	LEWIS SCREW CO.	4300 SOUTH RACINE AVENUE	CHICAGO, IL 60609
1DM20	PARLEX CORP	7 INDUSTRIAL WAY	SALEM, NH 03079
20944	ANRITSU COMPANY	685 JARVIS DRIVE	MORGAN HILLS, CA 95037
22526	FCI/BERG ELECTRONICS INC	825 OLD TRAIL ROAD	ETTERS, PA 17319-9769
22670	GM NAMEPLATE INCORPORATED	2040 15TH AVE WEST	SEATTLE, WA 98119-2783
24931	FCI/BERG ELECTRONICS INC	RF/COAXIAL DIV 2100 EARLYWOOD DR PO BOX 547	FRANKLIN, IN 46131
26003	MARTEK POWER MDI	4115 SPENCER STREET	TORRANCE, CA 90503-2489

Replaceable Parts List

Manufacturers cross index (cont.)

Mfr. code	Manufacturer	Address	City, state, zip code
26805	M/A COM OMNI SPECTRA INC	MICROWAVE CONNECTOR DIV 140 4TH AVE	WALTHAM, MA 02254
2K262	BOYD CORPORATION	6136 NE 87TH AVENUE	PORTLAND, OR 97220
2W733	BELDEN WIRE & CABLE COMPANY	2200 US HWY 27 SOUTH PO BOX 1980	RICHMOND, IN 47374
32559	BIVAR INC	4 THOMAS ST	IRVINE, CA 92718
34649	INTEL CORPORATION	3065 BOWERS PO BOX 58130	SANTA CLARA, CA 95051-8130
3M099	PORTLAND SCREW COMPANY	6520 N BASIN AVE	PORTLAND, OR 97217
46628	LOGITECH INC	6505 KAISER DR	FREMONT, CA 94555
50356	TEAC AMERICA INC	7733 TELEGRAPH RD PO BOX 750	MONTEBELLO, CA 90640-6537
5Y400	TRIAx METAL PRODUCTS INC	1880 SW MERLO DRIVE	BEAVERTON, OR 97006
64537	KDI/TRIANGLE CORPORATION	60 S JEFFERSON RD	WHIPPANY, NJ 07981
6Y440	MICRON SEMICONDUCTOR PRODUCTS INC	8000 S FEDERAL WAY PO BOX 6	BOISE, ID 83707-0006
61058	MATSUSHITA ELECTRIC CORP OF AMERICA	PANASONIC INDUSTRIAL CO DIV TWO PANASONIC WAY	SECAUCUS, NJ 07094
64537	KDI/TRIANGLE CORPORATION	60 S JEFFERSON RD	WHIPPANY, NJ 07981
71400	BUSSMANN	DIVISION COOPER INDUSTRIES INC PO BOX 14460	ST LOUIS, MO 63178
74594	COMPONENT RESOURCES INC	BUSSMAN PARTS C/O CASEY LAKEY 14525 SW WALKER ROAD	BEAVERTON, OR 97006
76096	ELMA ELECTRONICS INC	41440 CHRISTY ST	FREMONT, CA 94538
78189	SHAKEPROOF	DIVISION OF ILLINOIS TOOL WORK ST. CHARLES ROAD	ELGIN, IL 60120
7X318	KASO PLASTICS INC	5720-C NE 121ST AVE, STE 110	VANCOUVER, WA 98682
80009	TEKTRONIX INC	14150 SW KARL BRAUN DR PO BOX 500	BEAVERTON, OR 97077-0001
86928	SEASTROM MFG CO INC	456 SEASTROM STREET	TWIN FALLS, ID 83301
8X345	NORTHWEST SPRING MFG CO	5858 WILLOW LANE	LAKE OSWEGO, OR 97035
93907	CAMCAR DIV OF TEXTRON INC	ATTN: ALICIA SANFORD 516 18TH AVE	ROCKFORD, IL 611045181
94222	SOUTHCO, INC.	210 N BRINTON LAKE RD	CONCORDVILLE, PA 19331
98291	ITT CANNON RF PRODUCTS	585 EAST MAIN STREET	NEW BRITAIN, CT 06051
S4091	SANYO DENKI	C/O TJBO LIAISON M/S 78-210	BEAVERTON, OR 97077-7077
S5769	NEC CORPORATION	NEC BUILDING 7-1, SHIBA 5 CHOME MINATO-KU	TOKYO, JP 108
TK0588	UNIVERSAL PRECISION PRODUCT	1775 NW CORNELIUS PASS RD	HILLSBORO, OR 97124
TK1163	POLYCAST INC	14140 SW 72ND AVE SUITE 100	TIGARD, OR 97224
TK1916	SKS DIE CASTING & MACHINING INC.	1849 OAK ST	ALAMEDA, CA 94501

Manufacturers cross index (cont.)

Mfr. code	Manufacturer	Address	City, state, zip code
TK1943	NEILSEN MANUFACTURING INC	3501 PORTLAND RD NE	SALEM, OR 97303
TK2172	WYLE ELECTRONICS INC	10300 SW NIMBUS AVE BLDG P, SUITE B	PORTLAND, OR 97223
TK2250	ARROW ELECTRONICS INC.	9500 SW NIMBUS AVE, BLDG E	BEAVERTON, OR 97008-7163
TK2338	ACC MATERIALS	ED SNYDER BLDG 38-302	BEAVERTON, OR 97077
TK2376	CONDUCTIVE RUBBER TECH	22125 17TH AVE SE, SUITE 117	BOTHELL, WA 98021
TK2491	RIFOCS CORPORATION	1340 FLYNN RD	CAMARILLO, CA 93012
TK2539	ROYAL CASE COMPANY INC	315 S MONTGOMERY PO BOX 2231	SHERMAN, TX 75070
TK2548	XEROX CORPORATION	14181 SW MILLIKAN WAY	BEAVERTON, OR 97005
TK2563	REVTEK INC	4288 SE INTERNATIONAL WAY	PORTLAND, OR 97222
TK2565	VISION PLASTICS INC	26000 SW PARKWAY DRIVE	WILSONVILLE, OR 97070
TK2582	TUFF CAT USA LLC	814 N HAYDEN MEADOWS DRIVE	PORTLAND, OR 97217
TK2601	MAXTEK COMPONENTS CORPORATION	13335 SW TERMAN RD PO BOX 428	BEAVERTON, OR 97075-0428
TK2647	INSTRUMENT SPECIALTIES CO INC.	C/O TEMCO NW 1336 SE 51ST STREET	HILLSBORO, OR 97123
TK6173	MULTI-FINELINE ELECTRONIX INC (MFLEX)	DBA: MFLEX 1301 N DYNAMICS STREET	ANAHEIM, CA 92806
TK6181	IMC PLASTICS INC	19400 SW TETON AVE	TUALATIN, OR 97062
TK6253	VOLEX INTERCONNECT INC	646 CARRIBEAN DR	SUNNYVALE, CA 94089-1108

Replaceable Parts List

Replaceable Parts List

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description	Mfr. code	Mfr. part number
1-1	016-1441-00			1	POUCH, PLASTIC: PLASTIC POUCH	80009	016-1441-00
-2	211-1050-00			12	SCREW,MACHINE:6-32 X 0.312 L,PNH,STL CAD,T15	OKB01	OBD
-3	355-0298-00			4	STUD.SNAP:0.570 DIA,0.165 THK,STAINLESS STEEL	TK0588	355-0298-00
-4	348-1648-00			4	FOOT:REAR W/CORD WRAP,THERMOPLASTIC	TK6181	348-1648-00
-5	211-0720-00			4	SCR,ASSEM WSHR:6-32 X 0.500,PNH,STL,CDPL,T-15	OKB01	ORDER BY DESCRIPTION
-6	161-0230-01			1	CABLE ASSY,PWR,;3,18 AWG,92 L,SVT, (STANDARD ACCESSORY)	TK2432	ORDER BY DESC
-7	159-0046-00			2	FUSE,CARTRIDGE:3AG,8A,250V,15SEC,CER	71400	ABC 8
	159-0381-00			2	FUSE,CARTRIDGE:5 X 20 MM,6.3A,250V,FAST BLOW,HIGH BREAKING CAPACITY,UL REC,SEMKO,	71400	GDA-6.3
-8	200-2264-00			2	CAP,FUSEHOLDER:3AG FUSES (AMERICAN)	61935	FEK 031 1666
	200-2265-00			2	CAP,FUSEHOLDER:5 X 20MM FUSES (EUROPEAN)	61935	FEK 031.1663
-9	200-4522-00			1	COVER,RIGHT:PCABS,13.645L X 8.250W, BLUE	TK6181	200-4522-00
-10	212-0232-00			2	SCREW,MACHINE:8-32 X 1.125L, PNH,STL,BLACK OXIDE,T-20	OKB01	OBD
-11	367-0528-00			1	HANDLE,CARRYING:POLYPROPYLENE VINYL GRIP	12136	PT 3170
-12	200-4556-00			1	COVER, BOTTOM RIGHT:0.050 ALUMINUM	OJ9P9	200-4556-00
-13	200-4625-00			1	COVER,BOTTOM:0.060 AL,VINYL CLAD, INCLUDING FEET (ITEMS 13 & 14)	OJ9P9	200-4625-00
-14	348-1648-00			1	FEET,CABINET:CABINET FEET,BLACK,GLASS-FIBRE REINFORCED PLASTIC,SET OF 4 FEET, W/SCREWS	76096	63-526
-15	101-0150-00			1	TRIM:ACQUISITION, PCABS (CSA8000, TDS8000, CSA8000B, TDS8000B)	TK6181	101-0150-00
	101-0167-00			1	TRIM:ACQUISITION, PCABS (CSA8200, TDS8200)	TK6181	101-0167-00
-16	200-4519-00			1	COVER,FRONT:PCABS,17.420L X 8.670W X 2.000	TK6181	200-4519-00
-17	101-0151-01			1	TRIM,FRONT:PCABS,17.200W X 8.450H, SILVER GRAY	TK6181	101-0151-01
-18	260-2719-00			1	SWITCH,KEYPAD:ELASTOMERIC,FRONT PANEL,ON/OFF	TK2376	260-2719-00
-19	335-0660-00			1	MARKER,IDENT:LABEL,MAIN FRAME,0.500 X 8.510,LEXAN,W/ADHESIVE,CSA8000,	OKB05	335-0660-00
-19	335-0659-00			1	MARKER,IDENT:0.500 X 8.510,LEXAN W/ADHESIVE,MAIN FRAME,TDS8000,	OKB05	335-0656-00
-20	200-4555-00			1	COVER, TOP LEFT:0.050 ALUMINUM	OJ9P9	200-4555-00
-21	200-4521-00			1	COVER,LEFT:PCABS,13.654L X 8.250W,BLUE	TK6181	200-4521-00
-22	200-4520-00			1	COVER, TOP:PCABS,17.200L X 13.550W,BLUE	TK6181	200-4520-00

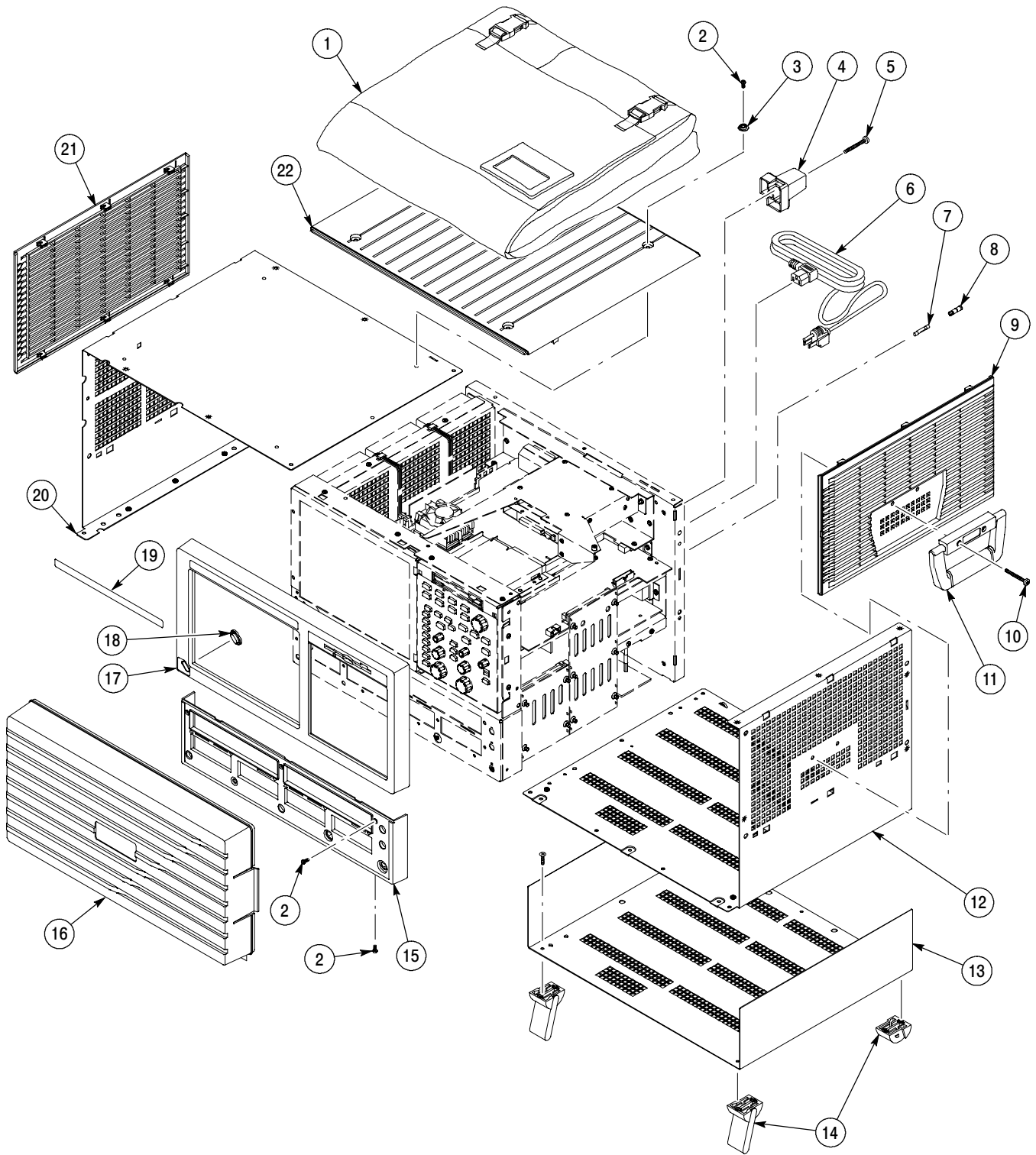


Figure 8-1: External parts

Replaceable Parts List

Replaceable Parts List

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description	Mfr. code	Mfr. part number
2-1	211-1050-00			8	SCREW,MACHINE:6-32 X 0.312 L,PNH,STL CAD,T15	OKB01	OBD
-2	650-4271-01			1	RHDD ASSEMBLY:W/O SW (ITEMS 3 THROUGH 7)	80009	650-4412-00
-3	119-6733-00			1	DISK DRIVE:WINCHESTER,2.5 IN, 20.0GB,SINGLE PLATTER	049S6	MHK2060AT
-4	437-0494-00			1	CABINET ASSY:REMOVEABLE HARD DISK DRIVE HOLDER	TK1943	437-0494-00
-5	211-1081-00			4	SCREW,MACHINE:M3 X 0.5 X 3.5MM	OKB01	211-1081-00
-6	174-3925-00			1	CA ASSY,SP:RIBBON,,28 AWG,1.0 L,2 X 22 (HARD DRIVE)	060D9	174-3925-00
-7	679-4378-00			1	CKT BD SUBASSY:HARD DISK DRIVE INTERFACE	80009	679-4378-00
-8	174-4320-00			2	CA ASSY:FLAT FLEX, 9.753L (FLOPPY DRIVE CABLE & FRONT PANEL)	060D9	174-4320-00
-9	671-4657-01			1	CIRCUIT BD ASSY:PROCESSOR (CSA8000, TDS8000, CSA8000B, TDS8000B)	80009	671-4657-01
	644-1045-01			1	NLX BOARD ASSY; RADISYS,SF810-L-C850 PCI/ISA MOTHER BOARD,W/ INTEL 850MHZ CELERON PROCESSOR,W/O MEMORY (CSA8200, TDS8200)	80009	644-1045-01
-10	407-4706-00			1	BRACKET:FLOPPY DRIVE,6.064 X 5.075,ALUMINUM	TK1943	407-4706-00
-11	211-1079-00			2	SCREW,MACHINE:2.6 X 0.45 MM,3.0L,PNH,STL,PHILLIPS	OKB01	10310188-0
-12	119-6106-00			1	DISK DRIVE:FLOPPY,3.5INCH,1.44 MB, 0.5 IN,DDDS	TK2250	FD-05HF5630
-13	174-4241-01			1	CA,ASSY:RIBBON,BUS,IDC,32 AWG,17.00L,60POS (PROCESSOR TO ACQ)	060D9	174-4241-01
-14	361-1762-00			1	SPACER,SUPPORT:0.250 X 0.171 X 0.375,CKT BD,NYLON	06915	CPST-4-01
-15	679-4761-00			1	CKT BD SUBASSY:POWER REAR	80009	679-4761-00
-16	679-4760-00			1	CKT BD SUBASSY:POWER FRONT	80009	679-4760-00
-17	614-0968-00			1	PANEL MODULE:FRONT,W/HARDWARE (ITEMS 18 THROUGH 23)	80009	614-0968-00
-18	679-4689-00			1	CKT BD SUBASSY:FRONT PANEL CONTROL BD	80009	679-4689-00
-19	260-2724-00			1	SWITCH,KEYPAD:ELASTOMERIC,FRONT PANEL	TK2376	260-2724-00
-20	366-0770-00			3	KNOB,CAP:0.925 DIA	TK1163	366077000
-21	366-0771-00			2	KNOB,CAP:SILVER GRAY,0.650 DIA X 0.520 H	TK1163	366-0771-00
-22	366-0772-00			3	KNOB,CAP:SIVER GRAY,0.425 DIA X 0.520 H	TK1163	366-0772-00
-23	333-4339-00			1	SUBPANEL,FRONT:6.380 X 7.700,ALUMINUM,LEXAN LABEL	TK1943	333-4339-00
-24	650-3938-00			1	COMPONENT KIT:DISPLAY MODULE (ITEMS 25 THROUGH 30)	80009	650-3938-00
-25	259-0155-01			1	FLEX CIRCUIT:POWER FLEX CIRCUIT SILVER INK	07416	259-0155-01
-26	650-4186-00			1	MODULE ASSY:TOUCH PANEL (ITEMS 25 & 26)	80009	650-4186-00
-27	174-4189-00			1	CABLE ASSEMBLY:FLAT FLEX (DISPLAY ADAPTER)	1DM20	174-4189-00
-28	650-4187-01			1	MODULE ASSY:LCD, DISPLAY (ITEMS 27 THROUGH 30)	80009	650-4187-01

Replaceable Parts List (cont.)

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description	Mfr. code	Mfr. part number
-29	679-4479-01			1	CKT BD SUBASSY:DISPLAY ADAPTER, W/HARDWARE (CSA8000 AND TDS8000)	80009	679-4479-01
	679-4479-01	B010100	B020346	1	CKT BD SUBASSY:DISPLAY ADAPTER, W/HARDWARE (CSA8000B)	80009	679-4479-01
	679-5244-00	B020347		1	CKT BD SUBASSY:DISPLAY ADAPTER, W/HARDWARE (CSA8000B)	80009	679-5244-00
	679-4479-01	B010100	B020362	1	CKT BD SUBASSY:DISPLAY ADAPTER, W/HARDWARE (TDS8000B)	80009	679-4479-01
	679-5244-00	B020363		1	CKT BD SUBASSY:DISPLAY ADAPTER, W/HARDWARE (TDS8000B)	80009	679-5244-00
	679-5244-00			1	CKT BD SUBASSY:DISPLAY ADAPTER, W/HARDWARE (CSA8200 AND TDS8200)	80009	679-5244-00
-30	174-3618-00			1	CA,ASSY SP:RIBBON,CPR,28 AWG,9.5 L,1X5,0.049CTR	060D9	OBD
-31	343-1676-00			1	CABLE CLAMP,PC/ABS,BAYER,BAYBLEND FR-110,SILVER GREY	TK2565	343-1676-00
-32	437-0486-01			1	ASSY,FAN:SIX FANS ASSEMBLY	0J9P9	437-0486-01
-33	174-4188-00			1	CA ASSY:RIBBON, (DISPLAY)	060D9	174-4188-00
-34	679-4379-00			1	CKT BD SUBASSY:CONNECTOR CONVERSION	80009	679-4379-00
-35	174-4231-00			1	CABLE ASSY:IDE CABLE ASSEMBY (HARD DRIVE)	060D9	174-4231-00

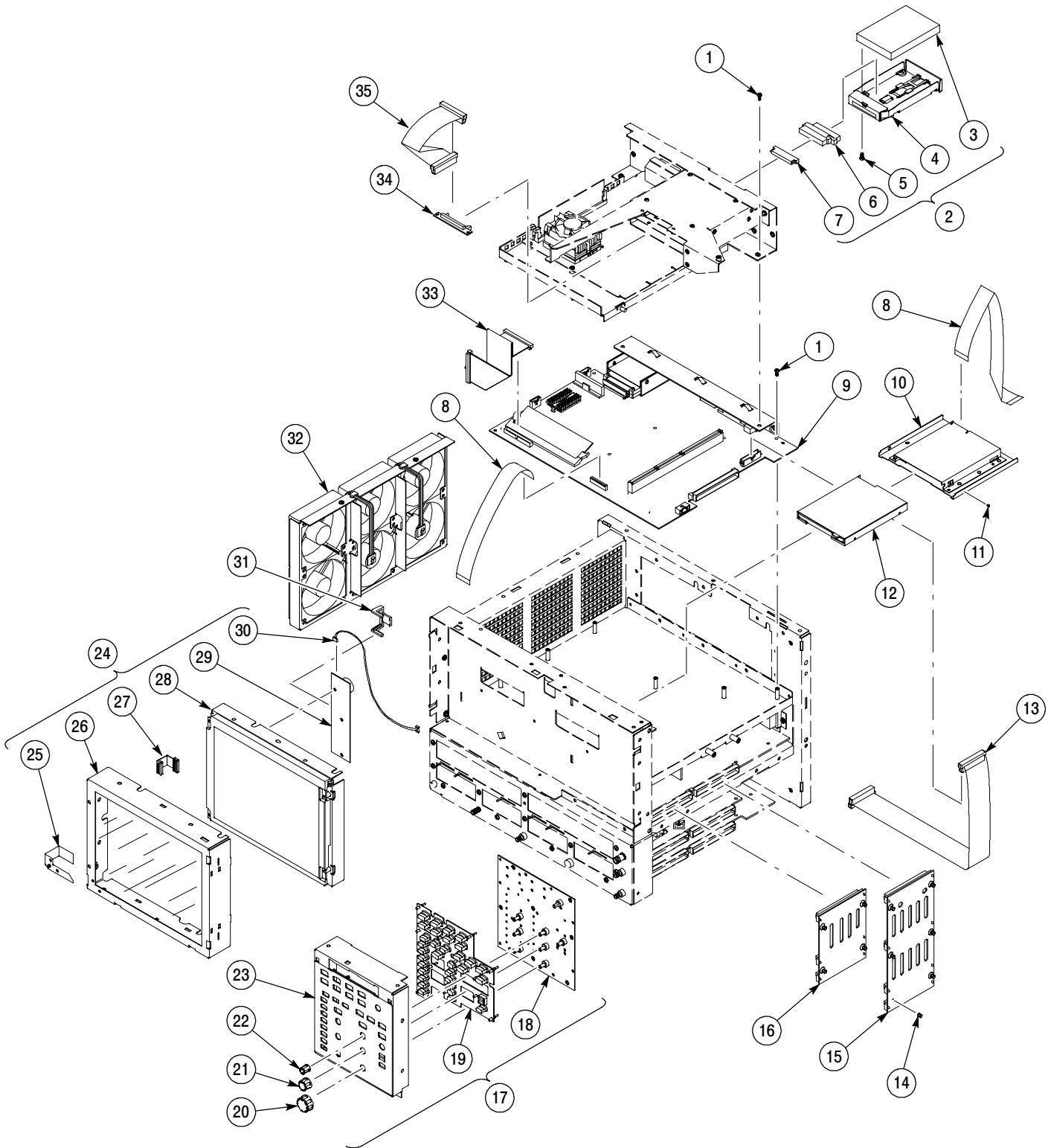


Figure 8-2: Front panel and drives

Replaceable Parts List

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description	Mfr. code	Mfr. part number
3-1	119-6511-00			1	IC,PROCESSOR:CMOS,MICROPROCESSOR,CELERON,566 MHZ,66MHZ BUS,SOCKET 370 COMPATIB	34649	BX80524P500128
-1A	119-6459-00			1	FAN,CHIP COOLER:12VDC,80MA,4400RPM,30DBA,64MM X 51MM X 31MM,W/HEATSINK & CLIP FOR CELERON	80009	119-6459-00
-2	214-3903-00			8	SCREW,JACK:4-40 X 0.312 LONG,0.188 H HEX HEAD STAND OFF,4-40 INT THD, X 0.312 THD EXT 4-40	05791	LT4276
-3	050-3506-00			1	NLX BOARD:MODIFY MOTHER BOARD NLX PROCESSOR	80009	039-0117-00
-4	211-1050-00			8	SCREW,MACHINE:6-32 X 0.312 L,PNH,STL CAD PLT,T15	0KB01	OBD
-5	679-4667-00			1	CKT BD SUBBASSY:RISER	80009	679-4667-00
-6	211-1050-00			4	SCREW,MACHINE:6-32 X 0.312 L,PNH,STL CAD PLT,T15	0KB01	OBD
-7	213-1061-00			2	JACKSCREW:6-32 X 0.320 EXT THD,M3.5 X 0.6-6 INT THD X 0.215L,GPIB	00779	554043-3
-8	386-7147-00			1	PANEL,I/O:ALUMINUM,POWER PC PROCESSOR	TK1943	386-7147-00
-9	131-6680-00			1	CONN HDR:CARDBUS HDR,SMD,MALE,RTANG,2 X 34	22526	61555-200CA
-10	211-0887-00			4	SCREW,METRIC:M2 X 0.4 X 16 MM L,PH,PHILLIPS DRIVE	0KB01	211-0887-00
-11	441-2172-00			1	CHASSIS ASSY:0.05 ALUM,13.65 X 16.50 X 3.55 (8000 ONLY)	0J9P9	441-2172-00
-11	441-2283-00			1	CHASSIS ASSY:MAIN,CENTER,FRONT,REAR & ACQUISITION CHASSIS,TDS8000B,CSA8000B	TK1943	441-2283-00
-12	119-5806-05			1	5.0V POWER SUPPLY:CUSTOM,AC-DC,375W,85-275VAC TDS8000, CSA8000	26003	119-5806-00
-12	119-6697-01			1	5.2V POWER SUPPLY:CUSTOM,AC-DC,375W,85-275VAC, TDS8000B, CSA8000B	26003	119-6697-01
-13	131-1315-01			1	CONN,RF JACK:BNC/PNL,50 OHM,FEMALE,STR,PELTOLA	24931	28JR306-1
-14	103-0269-00			3	ADAPTER,CONN:SMA TO PELTOLA,FEMALE TO FEMALE,STR,PNL,D/FLAT,0.385 MTG HOLE,GOLD/NICKEL	80009	103-0269-00
-15	131-0850-00			1	CONN,JACK,RF:SMA,FEEDTHRU,DUAL FEMALE,STR,50 OHM,0.25 MTG W/ 0.375HEX,0.59 X 0.24 MLG,GOLD/SS	26805	2084-0000-02
-16	210-0457-00			1	NUT,PL,ASSEM WA:6-32 X 0.312,STL CD PL,W/LOCKWASHER	0KB01	ORDER BY DESCRIPTION
-17	210-0465-00			1	NUT,PLAIN,HEX:0.25-32 X 0.375,BRS CD PL	0KB01	ORDER BY DESCRIPTION
-18	650-4086-00			1	CABLE ASSEMBLY:ELECT,ANTI STATIC CONNECTION	060D9	650-4086-00
-19	210-1443-00			1	WASHER,FLAT:0.25 ID X 0.375 OD X 0.265,NYLON	74594	5610-120-062
-20	136-0140-00			1	JACK,TIP:BANANA,CHARCOAL GRAY	0KBZ5	N/A
-21	156-4827-00			1	IC,MEMORY:CMOS,SDRAM,8MEG X 64,MC-458CB646-A10,DIMM168	6Y440	MT8LSDT864AG-10 EC7
-22	441-2183-01			1	CHASSIS:REAR DRIVE BAY (HDD & CD-ROM) AL & STEEL	TK1943	441-2183-01
-23	407-4880-01			1	BRACKET,CD-ROM:STEEL	TK1943	407-4880-01
-24	174-4231-00			1	CABLE ASSY:CABLE ASSEMBY (CD-ROM)	060D9	174-4231-00
-25	671-4377-00			1	CIRCUIT BD ASSY:CD ROM INTERFACE	80009	671-4377-00

Replaceable Parts List

Replaceable Parts List (cont.)

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description	Mfr. code	Mfr. part number
-26	119-5728-00			1	DISK DRIVE:OPTICAL,644MB,CD-ROM,16.7 MB/SEC	50356	CD-224E-903
-27	211-1070-00			4	SCREW:M2 X 2MM,PNH,PHL, STL NI PLT	0KB01	211-1070-00
-28	441-2279-00			1	CHASSIS,NLX:ALUMINUM,W/HARDWARE	TK1943	441-2279-00
-29	211-0720-00			5	SCR,ASSEM WSHR:6-32,0.500,PNH,STL,CDPL,T-15	0KB01	ORDER BY DESCRIPTION
-30	156-9074-00			1	IC,MEMORY:CMOS,SDRAM,16MEG X 64, SYNC, UNBUFFERED,3.3V,MC-4516CD646-A10,DIMM168		MT16LSDT3264AG-10E

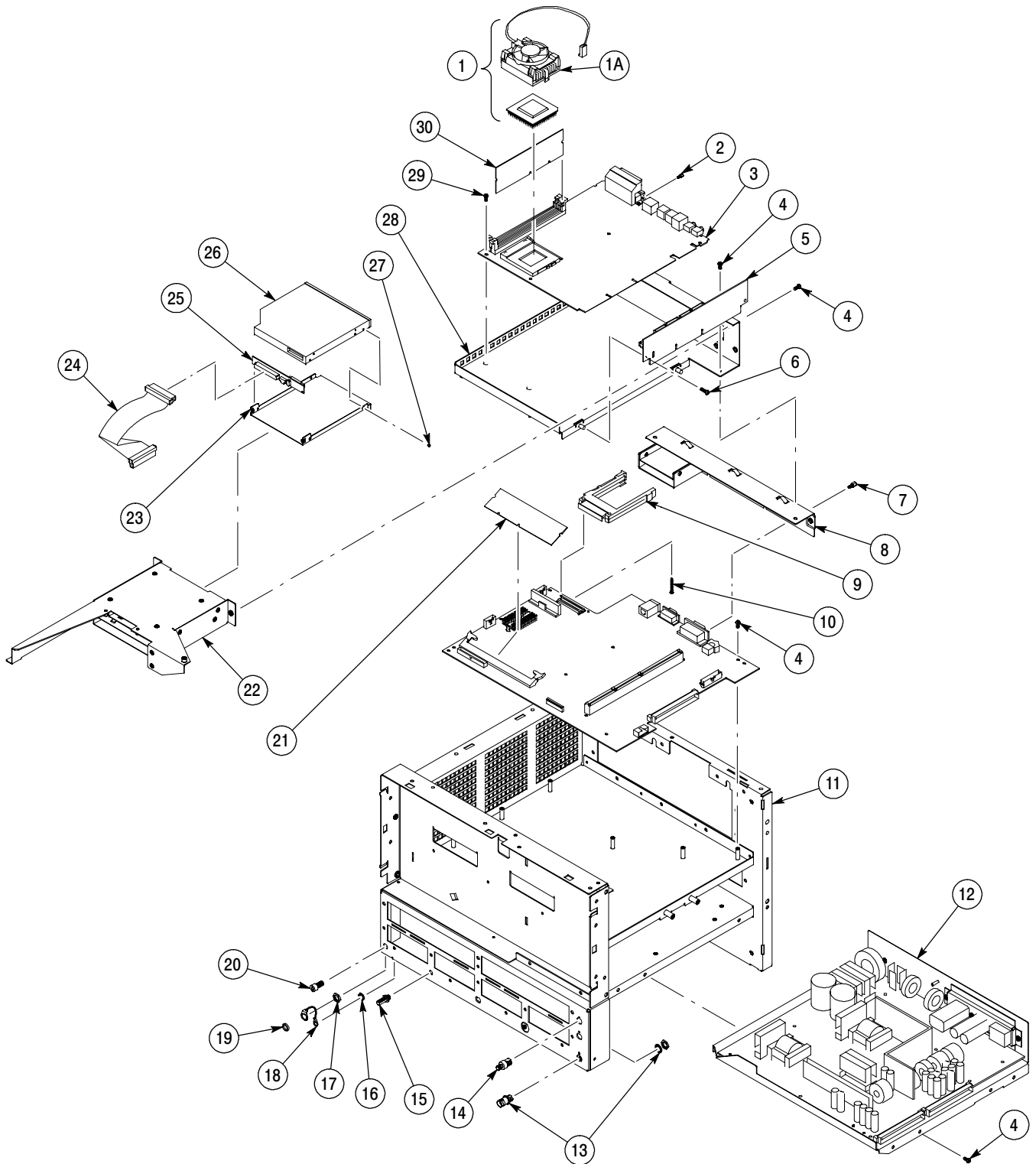


Figure 8-3: Power supply

Replaceable Parts List

Replaceable Parts List

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description	Mfr. code	Mfr. part number
4-1	441-2176-00			1	CHASSIS ASSY:LARGE MODULE,0.050 AL	OJ9P9	441-2176-00
-2	211-1050-00			21	SCREW,MACHINE:6-32 X 0.312 L,PNH,STL CAD PLT,T15	OKB01	OBD
-3	671-4483-00			1	CIRCUIT BD ASSY:OPTICAL FRONT END	80009	671-4483-00
-4	174-4046-00			1	CA ASSY,SP:RIBBON,BUS PROCESSOR,IDC,32 AWG	060D9	174-4046-00
-5	351-1068-00			4	GUIDE:CARD GUIDE	32559	E-1000
-6	129-1516-00			3	SPACER, POST:ECB-1.077,0.250 HEX 12L 14 STEEL	TK0588	129-1516-00
-7	210-0457-00			20	NUT,PL,ASSEM WA:6-32 X 0.312,STL CD PL,W/LOCKWASHER	OKB01	ORDER BY DESCRIPTION
-8	174-4045-01			2	CA ASSY,SP:RIBBON,BUS ACQUISITION,IDC,32 AWG	060D9	174-4045-01
-9	Order 4-11			1	CIRCUIT BD ASSY:SMALL MODULE INTERFACE Part of item 4-11: COMBO ASSEMBLY:ACQP/EFE		NA
-10	Order 4-11			1	CKT BD SUBASSY:ACQ BOARD Part of item 4-11: COMBO ASSEMBLY:ACQP/EFE		NA
-11	650-4418-01			1	COMBO ASSEMBLY:ACQP/EFE (8000 AND 8000B)	80009	650-4418-01
	650-4608-00			1	COMBO ASSEMBLY:ACQP/EFE (8200)	80009	650-4608-00
-12	351-1067-00			8	GUIDE:CARD GUIDE,E-300	32559	E-300
-13	174-4043-00			1	CA ASSY,SP,ELEC:DISCRETE,TRIGGER PROBE POWER	060D9	174-4043-00
-14	211-0815-00			3	SCREW,MACHINE:6-32 X 1.750,PNH,STL,ZINC,T-15	3M099	211-0815-00
-15	174-4322-00			1	CA ASSY,RF:RFS,0.141OD,50 OHM,SMA,JACK, X SMA,JACK (8000 AND 8000B only)	060D9	174-4322-00
	174-4902-00			1	CA ASSY,RF:RFS,0.141OD,50 OHM,SMA,JACK, X SMA,JACK (8200 only)	060D9	174-4902-00
-16	441-2175-01			1	CHASSIS ASSY:SMALL MODULE,0.050 AL	OJ9P9	441-2175-01
-17	211-0373-00			18	SCREW,MACHINE:4-40 X 0.250,PNH,STL CD PLT,T10	93907	ORDER BY DESCRIPTION
-18	355-0259-00			4	STUD,LOCKING:0.850 X 0.188 HEX,SST	TK0588	ORDER BY DESCRIPTION
-19	214-4893-00			6	SPRING,TORSION:0.126OD X 0.094ID,DOOR,RIGHT,0.018DIA	8X345	R07SPRG4
-20	200-4560-00			4	COVER:SMALL MODULES,0.036 SST	TK1943	200-4560-00
-21	214-4892-00			6	SPRING,TORSION:0.126OD,0.094ID.DOOR,LEFT,0.018DIA	8X345	R07SPRG3
-22	105-1132-00			4	LEVER,EJECT:0.048 THK SSTL,SMALL MODULE	TK1943	105-1132-00
-23	210-0185-00			12	WASHER,SHLDR:0.375 OD X 0.115 ID X 0.093 THK	TK0588	210-0185-00
-24	366-0815-00			6	KNOB:EJECTOR LEVER,PC/ABS,SILVER GRAY	TK6181	366-0815-00
-25	105-1131-00			2	LEVER,EJECT:0.048 THK SSTL,LARGE MODULE	TK1943	105-1131-00
-26	214-4891-00			6	SPRING,TORSION:0.304 X 0.256 X 1.152	8X345	R07SPRG1
-27	355-0297-00			2	STUD,SHOULDERED:4-40 X 1.050L,SST	TK0588	355-0297-00
-28	200-4561-00			2	COVER:0.036 SST,LARGE MODULES	TK1943	200-4561-00
-29	200-4876-00			1	COVER, THERMAL, STOBE CIRCUITRY (8200 only)	OKB05	200-4876-00

Replaceable Parts List (cont.)

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description	Mfr. code	Mfr. part number
-30	211-0967-00			1	SCREW; 6-32X 0.25,PNH,STL,ZI PLT,T-15,W/CAPTIVE FLAT WASHER (8200 only)	0KB01	211-0967-00
-31	129-0208-00			1	SPACER,POST; 0.312 L,6-32 STUD,BRS,ELECTROLESS NICKEL,0.25 HEX (8200 only)	0KB01	129-0208-00

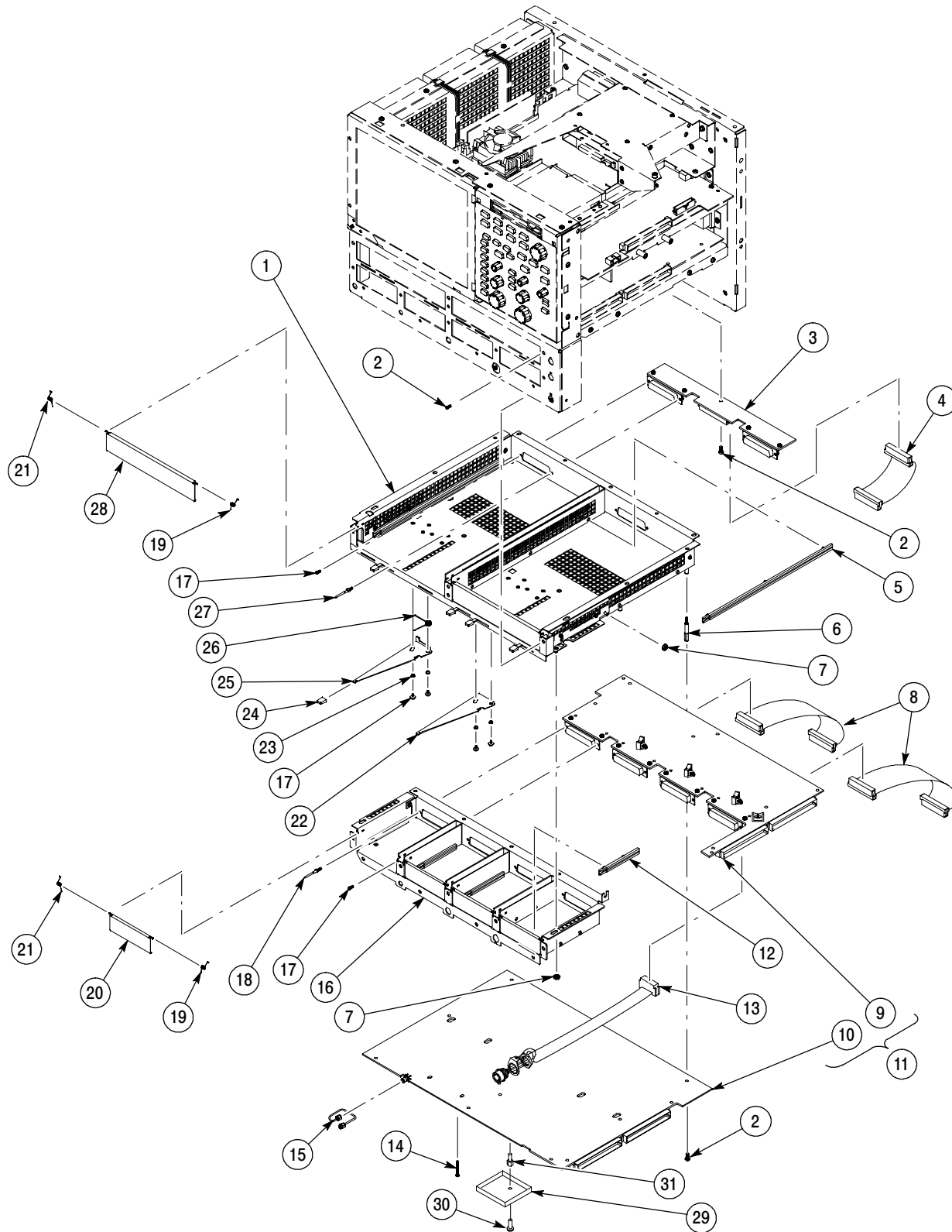


Figure 8-4: Acquisition

Replaceable Parts List

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description	Mfr. code	Mfr. part number
5-1	174-4348-00			2	CA ASSY, RF:COAXIAL,50 OHM,RG-316,12.00L,MCX RTANG PLUG 50 OHM TO MCX RTANG PLUG	060D9	174-4348-00
-2	174-4233-00			4	CA ASSY,RF:COAXIAL,50 OHM, DSUB TO MCX-B,R07CABL1	060D9	174-4233-00
-3	174-4347-00			10	CA ASSY,RF:COAXIAL,50 OHM,RG-316,7.500L,X D-SUB	060D9	174-4347-00
-4	174-4138-00			3	CABLE ASSY,RF:COAXIAL,50 OHM,OPTICAL BD TO ACQ BD	060D9	174-4138-00
-5	174-4132-00			1	CABLE ASSY,RF:COAXIAL,50 OHM,7.5 L,SMB TO PELTOLA	060D9	174-4132-00
-6	174-4133-00			4	CABLE ASSY,RF:COAXIAL,50 OHM,14.0 L,MCX TO PELTOLA	060D9	174-4133-00
-7	174-4137-00			2	CABLE ASSY,RF:COAXIAL,50 OHM,D-SUB TO ACQ BD	060D9	174-4137-00
-8	174-4234-01			1	CA ASSY,RF:COAXIAL,50 OHM, SMB TO MCX,R07CABL2	060D9	174-4234-01
	343-0459-00			1	STRAP,TIEDOWN,E:0.098 W X 4.0 L,ZYTEL (not shown on drawing)	74594	343-0459-00

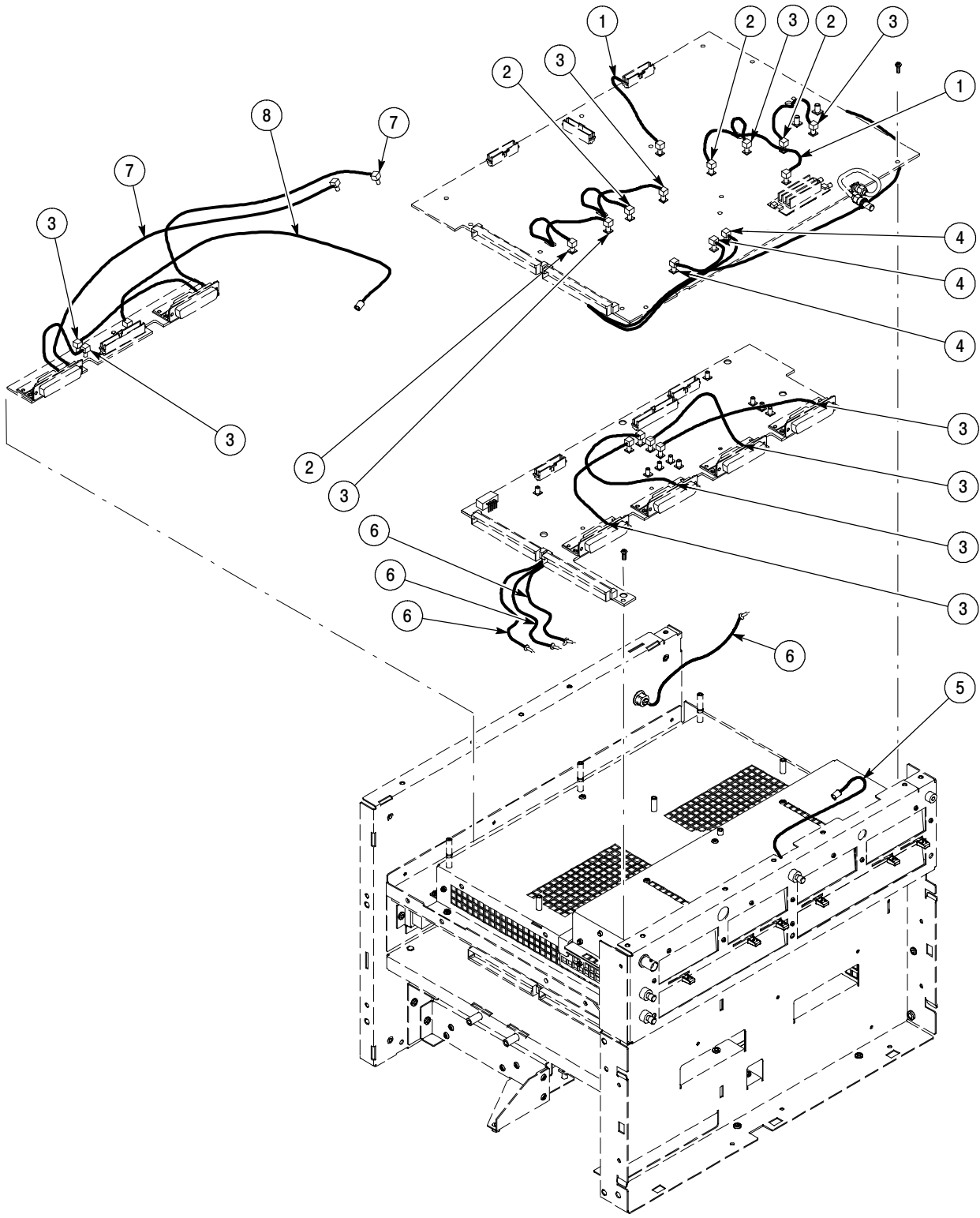


Figure 8-5: 8000 and 8000B coaxial cables

Replaceable Parts List

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discontinued	Qty	Name & description	Mfr. code	Mfr. part number
6-1	174-4348-00			2	CA ASSY, RF:COAXIAL,50 OHM,RG-316,12.00L,MCX RTANG PLUG 50 OHM TO MCX RTANG PLUG	060D9	174-4348-00
-2	174-4902-00			1	CABLE ASSEMBLY, RF TRIGGER PRESCALE	060D9	174-4902-00
-3	174-4347-00			4	CA ASSY,RF:COAXIAL,50 OHM,RG-316,7.500L,X D-SUB	060D9	174-4347-00
-4	174-4138-00			3	CABLE ASSY,RF:COAXIAL,50 OHM,OPTICAL BD TO ACQ BD	060D9	174-4138-00
-5	174-4132-00			1	CABLE ASSY,RF:COAXIAL,50 OHM,7.5 L,SMB TO PELTOLA	060D9	174-4132-00
-6	174-4133-00			1	CABLE ASSY,RF:COAXIAL,50 OHM,14.0 L,MCX TO PELTOLA	060D9	174-4133-00
-7	174-4137-00			2	CABLE ASSY,RF:COAXIAL,50 OHM,D-SUB TO ACQ BD	060D9	174-4137-00
-8	174-4234-01			1	CA ASSY,RF:COAXIAL,50 OHM, SMB TO MCX,R07CABL2	060D9	174-4234-01
-9	174-4882-00			2	CABLE ASSY,RF:COAXIAL,50 OHM,D-SUB TO ACQ BD	060D9	174-4882-00
	343-0459-00			1	STRAP,TIEDOWN,E:0.098 W X 4.0 L,ZYTEL (not shown on drawing)	74594	343-0459-00

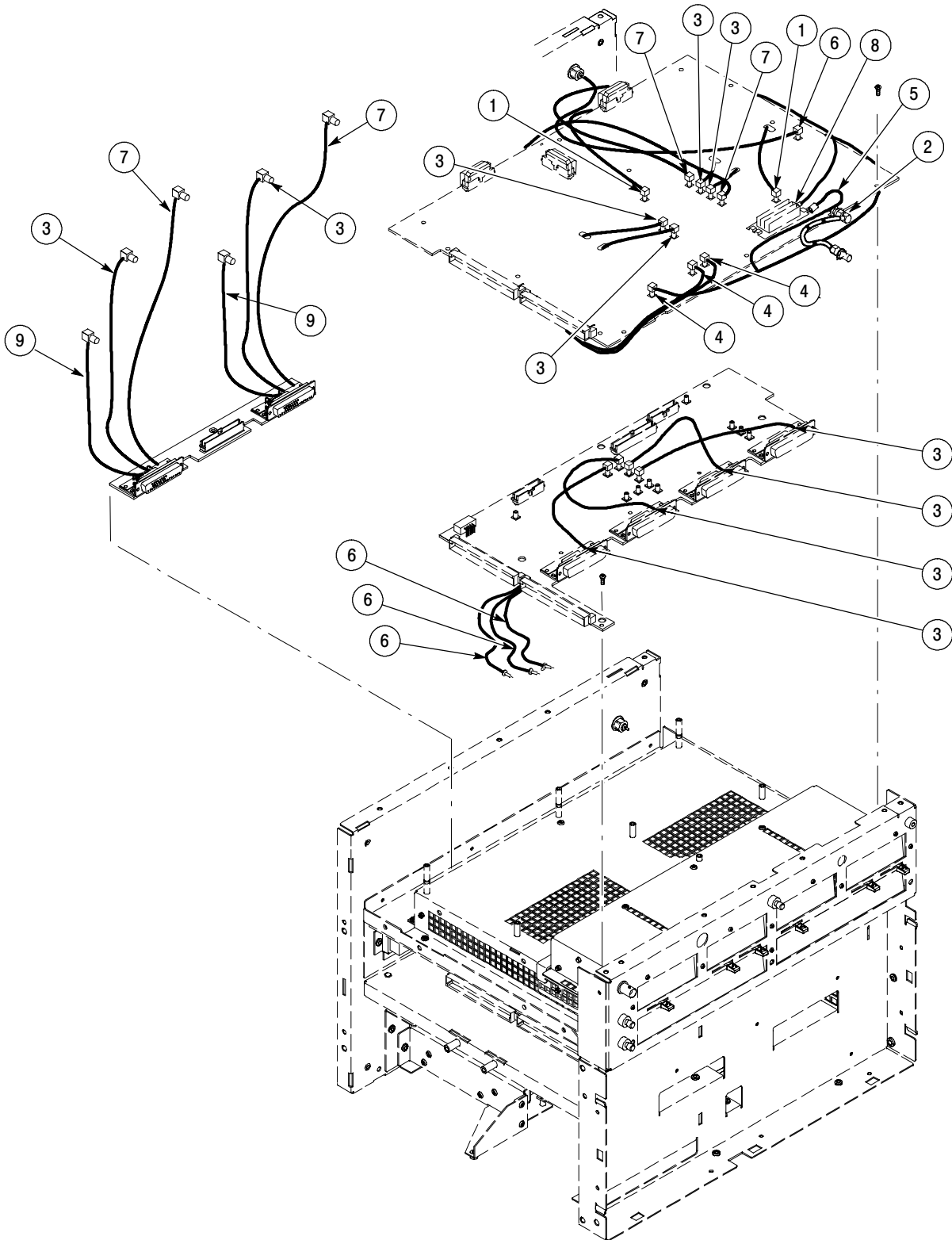


Figure 8-6: 8200 coaxial cables

Replaceable Parts List

Fig. & Index number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description	Mfr. code	Mfr. part number
7-1	211-0088-00			3	SCREW,MACHINE:2-56 X 0.281,FLH,82 DEG,STL BK OXD,POZ	0KB01	ORDER BY DESCRIPTION
-2	386-7293-00			1	PLATE,FRICTION	TK2601	386-7293-00
-3	384-1838-00			1	SHAFT; SCREW LOCKDOWN, 303 SST, R05HDSCR	TK2563	ORDER BY DESCRIPTION
-4	391-0239-00			1	LOCK SCREW:MOUNTING BLOCK	TK2601	391-0239-00
-5	211-0088-00			4	SCREW,MACHINE:2-56 X 0.281,FLH,82 DEG,STL BK OXD,POZ	0KB01	ORDER BY DESCRIPTION
-6	366-0804-00			1	KNOB:PUSH BUTTON, 0.11 OD, 0.33L, DELRIN, GRAY, 80E01	TK1163	366-0804-00 (R05PBKNB)
	366-0804-00			2	KNOB:PUSH BUTTON, 0.11 OD, 0.33L, DELRIN, GRAY, 80E02, 80E03, 80E04	TK1163	366-0804-00 (R05PBKNB)
-7	211-0087-00			2	SCREW,MACHINE:2-56 X 0.188,FLH,82 DEG SST,POZ	1AW87	ORDER BY DESCRIPTION
-8	214-4081-00			1	MTG,SCR LOCKDWN:ALUMINUM	5Y400	ORDER BY DESCRIPTION
-9	380-1132-00			1	HOUSING:SAMPLING HEAD,AL, 80E02	5Y400	380-1132-00
-10	333-4340-00			1	PANEL,FRONT:ALUMINUM,CHROMATE,W/TEK SILVERGRAY	5Y400	333-4340-00
-11	335-0151-00			1	MARKER,IDENT:LABEL,0.010 POLY,W/ADHESIVE,80E02	0KB05	335-0151-00
	335-0152-00			1	MARKER,IDENT:LABEL,,0.010 POLY,W/ADHESIVE,80E03	0KB05	335-0152-00
	335-0153-00			1	MARKER,IDENT:LABEL,0.010 POLY,W/ADHESIVE,80E04	0KB05	335-0153-00
-12	380-1138-00			1	HOUSING:ALUMINUM,SAMPLING HEAD 80E01	5Y400	380-1138-00
-13	333-4371-00			1	PANEL,FRONT:ALUMINUM,CHROMATE,W/TEK SILVERGRAY	5Y400	333-4371-00
-14	335-0339-00			1	MARKER,IDENT:LABEL,0.010 POLY,W/ADHESIVE, 80E01	0KB05	335-0339-00

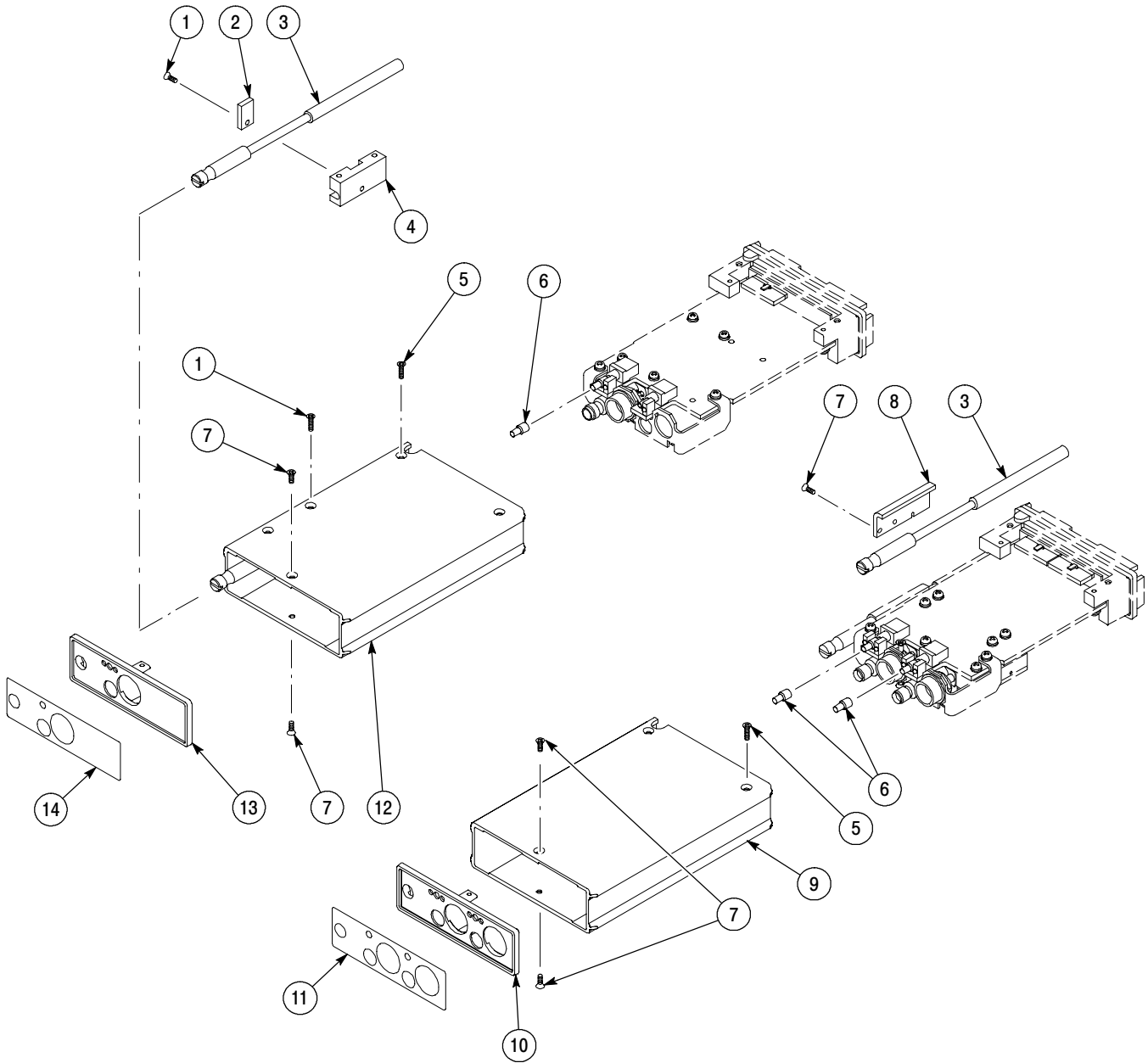


Figure 8- 7: Electrical modules (80E01, 80E02, 80E03, and 80E04)

Replaceable Parts List

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description	Mfr. code	Mfr. part number
8-1	380-1159-00			1	HOUSING:SAMPLING HEAD,ALUMINUM,80E06, SAFETY CONTROLLED	5Y400	380-1159-00
-2	211-0087-00			2	SCREW,MACHINE:2-56 X 0.188,FLH,82 DEG SST,POZ	1AW87	ORDER BY DESCRIPTION
-3	333-4436-00			1	PANEL, FRONT:NSD HEADS,BLANK,386-5603-00,80E06	OJ4C1	333-4436-00
-4	335-0863-00			1	MARKER,IDENT:SAMPLING HEAD,2.760 X 0.810,0.010 POLY,W/ADHESIVE,80E06,SAFETY CONTROLLED	OKB05	335-0863-00
-5	211-0088-00			4	SCREW,MACHINE:2-56 X 0.281,FLH,82 DEG,STL BK OXD,POZ	OKB01	ORDER BY DESCRIPTION

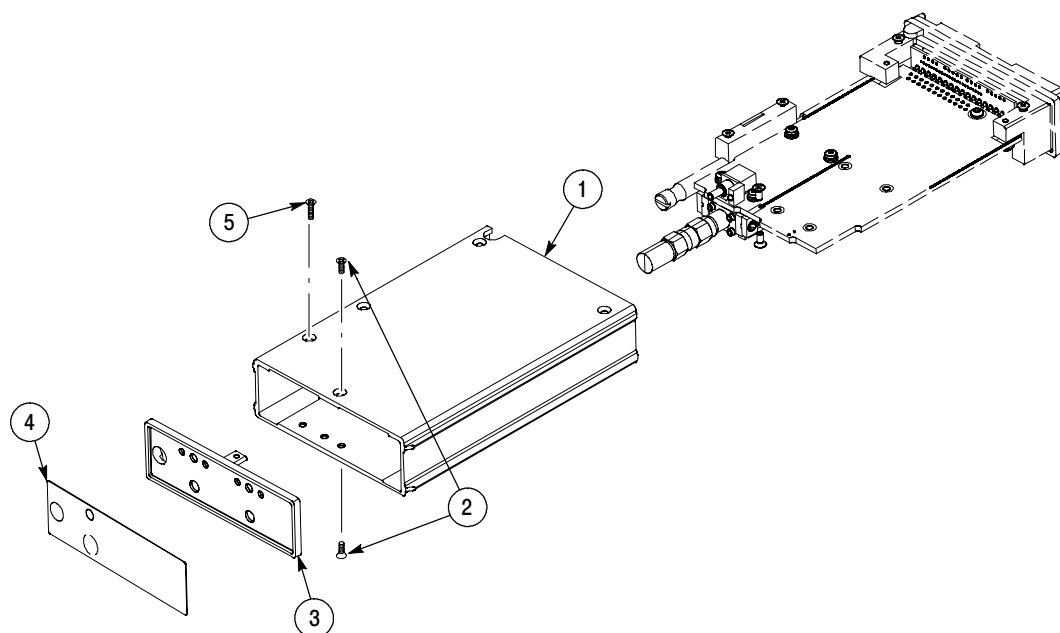


Figure 8-8: 80E06 module

Replaceable Parts List

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description	Mfr. code	Mfr. part number
9-1	200-4568-00			1	COVER:OPTICAL MODULE,0.050 AL	TK1943	200-4568-00
-2	335-0370-00			1	MARKER,IDENT:ANTI-STATIC LABEL,0.005 POLY	OKB05	335-0102-00
-3	211-0373-00			7	SCREW,MACHINE:4-40 X 0.250,PNH,STL CD PLT,T10	93907	ORDER BY DESCRIPTION
-4	105-1115-00			2	LATCH:ADJUSTABLE GRIP,16-10-511-16	94222	16-10-511-16
-5	200-4104-00			1	CAP,DUST:ELAY M75-M80 SHORE,BLACK MATT TEXTURED	TK2491	UT11-01

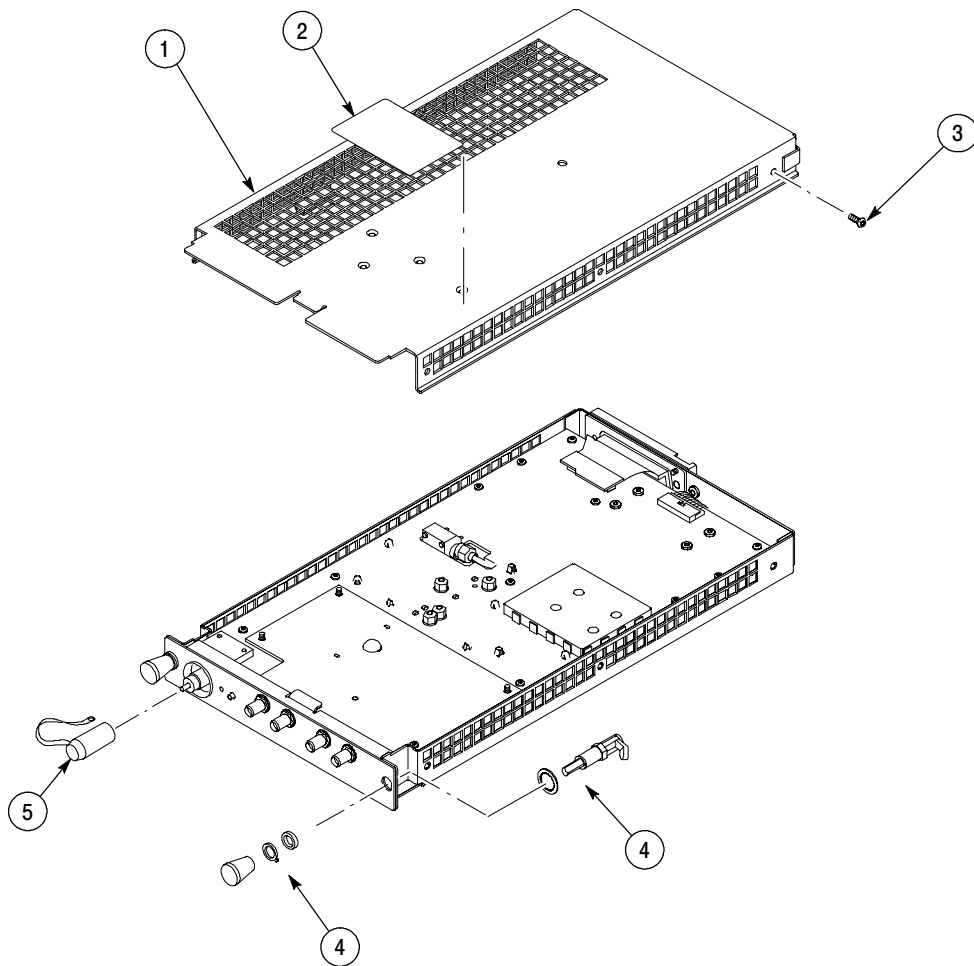


Figure 8-9: Optical modules

Replaceable Parts List

Fig. & Index number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description	Mfr. code	Mfr. part number
10-1	384-1838-00			1	SHAFT:SCREW LOCKDOWN,303 SST,R05HDSCR	TK0588	384-1838-00
-2	214-4081-00			1	LOCKDOWN:SCREW MOUNT,0.080 AL	5Y400	214-4081-00
-3	211-3008-00			2	SCREW,MACHINE:2-56 X 0.281,PNH,SST,PASS,POZI DR	0KB01	211-3008-00
-4	015-1022-01			1	TERMINATOR:COAXIAL, 50 OHM, 0.5W, SMA	61162	50T-320 SMA M
-5	335-0370-00			1	MARKER,IDENT:ANTI-STATIC LABEL,0.005 POLY	0KB05	335-0102-00
-6	211-0088-00			8	SCREW,MACHINE:2-56 X 0.281,FLH,82 DEG,STL BK OXD,POZ	0KB01	ORDER BY DESCRIPTION
-7	380-1151-00			1	HOUSING:SAMPLING MODULE,TRIGGER PRESCALE LIMITING PREAMP	5Y400	380-1151-00
-8	211-0087-00			2	SCREW,MACHINE:2-56 X 0.188,FLH,82 DEG SST,POZ	1AW87	ORDER BY DESCRIPTION
-9	333-4392-00			1	PANEL,FRONT:TRIGGER PRESCALE LIMITING PREAMP,AL ALLOY	5Y400	333-4392-00
-10	335-0485-00			1	MARKER,IDENT:LABEL,MKD 80A01 PRESCALE MODULE,2.760 X .810,LEXAN,	0KB05	335-0485-00

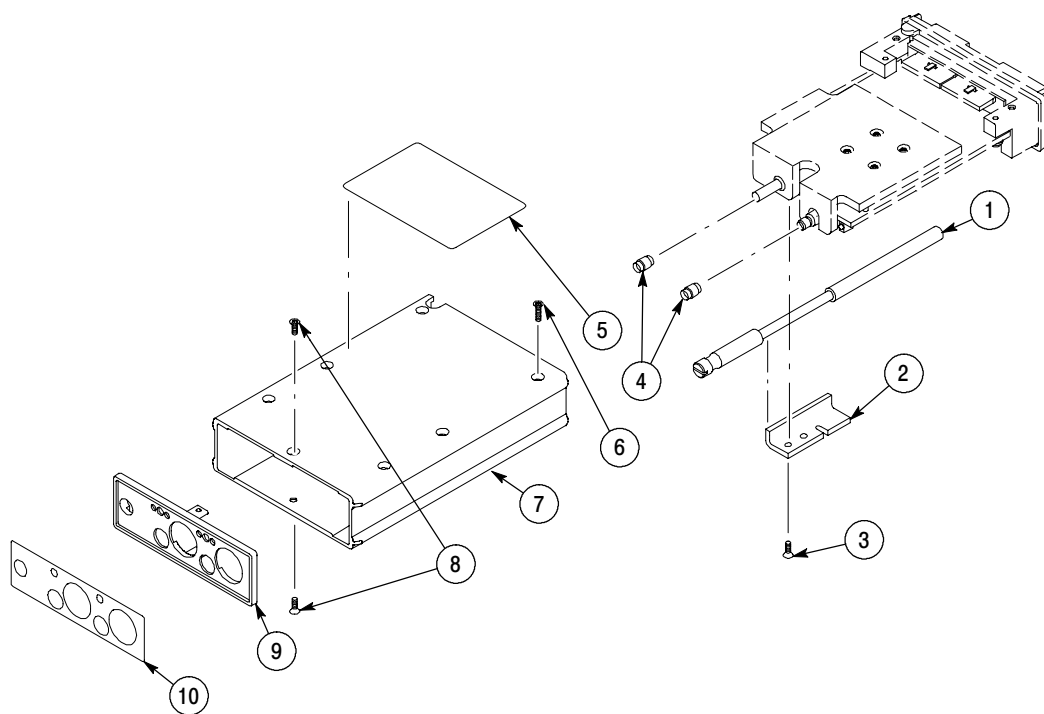


Figure 8-10: 80A01 module

Replaceable Parts List

Replaceable Parts List

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description	Mfr. code	Mfr. part number
MAINFRAME STANDARD ACCESSORIES							
11-1	161-0104-05			1	CA ASSY,PWR:3,1.0MM SQ,250V/10A,2.5 M (OPTION A3 - AUSTRALIAN)	S3109	198-010
-2	161-0104-06			1	CA ASSY,PWR:3,1.0MM SQ,250V/10A,2.5 M (OPTION A1 - EUROPEAN)	S3109	198-010
-3	161-0104-07			1	CA ASSY,PWR:3,1.0MM SQ,240V/10A,2.5 M (OPTION A2 - UNITED KINGDOM)	S3109	209010
-4	161-0167-00			1	CA ASSY,PWR:3,0.75MM SQ,250V/10A,2.5 M (OPTION A5 - SWITZERLAND)	S3109	ORDER BY DESC
-5	161-0306-00			1	CA ASSY,PWR:3,1.0MM SQ,250V/10A,2.5 M (OPTION AC - CHINA)	TK6253	92-2637-250BKH
	-----			1	CABLE ASSY,PWER:3,18 AWG,92 L (STANDARD CABLE - SEE FIG 10-1-6)		
	016-1268-00			1	POUCH, PLASTIC:POUCH (STANDARD CABLE - SEE FIG 10-1-1)	TK2539	2122
	020-2370-XX			1	ACCESSORY KIT:SOFTWARE PACKAGING KIT, CSA8000, TDS8000, CSA8000B, TDS8000B	TK2548	020-2370-XX
	020-2526-XX			1	ACCESSORY KIT; PRODUCT SOFTWARE KIT,V2.0; 8000 SERIES	TK2548	020-2526-XX
	020-2436-XX			1	ACCESSORY KIT:WINDOWS OPERATING SYSTEM RESTORE SOFTWARE,W/TEK ENVELOPES & CD BOOKLET CSA8000, TDS8000, CSA8000B, TDS8000B	TK2548	020-2436-XX
	020-2527-XX			1	ACCESSORY KIT; WINDOWS OPERATING SYSTEM RESTORE SOFTWARE,WIN2K, W/TEK ENVELOPES & CD BOOKLET 8000 SERIES	TK2548	020-2527-XX
	020-2543-XX			1	ACCESSORY KIT; PRODUCT DOCUMENTATION CD,W/ BOOKLET,CSA8000 & TDS8000 SERIES	TK2548	020-2543-XX
	071-0433-XX			1	MANUAL,TECH:USER, CSA8000, TDS8000, CSA8000B, TDS8000B	TK2548	071-0433-XX
	071-1096-XX			1	MANUAL,TECH:REFERENCE, CSA8000B, TDS8000B	TK2548	071-1096-XX
	071-1099-XX			1	MANUAL,TECH:USER, CSA8000B, TDS8000B	TK2548	071-1099-XX
					MANUAL,TECH:QUICK START USER, CSA8200, TDS8200		
	119-6633-00			1	KEYBOARD:USB KEYBOARD CSA8000, TDS8000, CSA8000B, TDS8000B	52833	E06101 USB-C
	119-B146-00			1	KEYBOARD:USB; MTX100 CSA8200, TDS8200	SH216	119-B146-00
	119-6298-00			1	MOUSE:LOGITECCH WHEEL MOUSE CSA8000, TDS8000, CSA8000B, TDS8000B	46628	830306-001
	119-6936-00			1	POINTER ASSY,MOUSE; USB,WHITE,OPTICAL THREE BUTTON WHEELED,W/USB TO PS2 ADAPTER,ABS,SAFETY CONTROLLED		D66-00029
	119-6107-00			1	STYLUS:STYLUS FOR TOUCH SCREEN	03ZT7	T1100
MAINFRAME OPTIONAL ACCESSORIES							
	012-1568-00			1	CA ASSY:SSP,ELEC,1 METER LONG, EXTENDER	060D9	012-1568-00
	012-1569-00			1	CA ASSY:SSP,ELEC,2 METER LONG, EXTENDER	060D9	012-1569-00

Replaceable Parts List (cont.)

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discontinued	Qty	Name & description	Mfr. code	Mfr. part number
	015-0552-00			1	ADPTR,APC,ELEC:3.5MM,MALE TO FEMALE	02660	131-7053
	015-0553-00			1	ADPTR,SMA,ELEC:MALE TO FEMALE,SLIDE ON MALE	98291	50-674-6324-990
	015-1001-01			1	ATTENUATOR, FIX:2:1 ATTENUATION, 50 OHM, SMA SERIES CONNECTORS	16179	2082-4573-06
	015-1002-01			1	ATTENUATOR, FIX:5:1 ATTENUATION, 50 OHM, SERIES SMA CONNECTORS	16179	2082-4573-14
	015-0565-00			1	POWER DIVIDER:50 OHM, 3 SMA FEMALE CONNECTORS	64537	D293S
	016-1791-01			1	RACKMOUNT KIT: OPTION 1R, CSA/TDS8000 SERIES	80009	016-1791-01
	067-1338-00			1	FIXTURE,CAL:,SAMPLING HEAD CAL UNIT	TK2601	067-1338-00
	071-0438-XX			1	MANUAL,TECH:SERVICE, CSA8000, TDS8000, CSA8000B, TDS8000B, CSA8200, TDS8200	TK2548	071-0438-XX
	650-4271-00			1	DISK DRIVE:WINCHESTER,2.5 IN,10.0 GB SINGLE PLATTER,9.5 MM,IDE,MHH2064AT,	80009	650-4271-00
	-----			1	DUAL DELAY LINE: DL-11	80009	DL-11
	-----			1	PROBE: P6209, 4.0 GHz ACTIVE FET PROBE	80009	P6202
	-----			1	EOS/ESD PROTECTION MODULE:ELECTRICAL STATIC ISOLATION OF TEKTRONIX ELECTRICAL SAMPLING MODULES	80009	80A02
80E0X STANDARD ACCESSORIES							
	015-1022-00			1	TERMINATOR, COA:SHORT CIRCUIT, SMA MALE (80E01)	0GZV8	64SMA-50-0-1
	015-1022-00			2	TERMINATOR, COA:SHORT CIRCUIT, SMA MALE (80E02, 80E03 AND 80E04)	0GZV8	64SMA-50-0-1
	015-0703-xx			1	ADPTR,RF,PRCN:2.4MM OR 1.85MM MALE TO 2.92MM FEMALE (80E01 and 80E06 only)	20944	26-925-0000-90
80E0X OPTIONAL ACCESSORIES							
	071-0434-XX			1	MANUAL,TECH:SAMPLING MODULE USER	TK2548	071-0434-XX
	012-1568-00			1	CA ASSY:SSP,ELEC,1 METER LONG, EXTENDER	060D9	012-1568-00
	012-1569-00			1	CA ASSY:SSP,ELEC,2 METER LONG, EXTENDER	060D9	012-1569-00
	015-1001-00			1	ATTENUATOR, FIX:2:1 ATTENUATION, 50 OHM, SERIES SMA CONNECTORS	16179	2082-4573-06
	015-1002-01			1	ATTENUATOR, FIX:5:1 ATTENUATION, 50 OHM, SERIES SMA CONNECTORS	16179	2082-4573-14
80C0X OPTIONAL ACCESSORIES							
	071-0435-XX			1	MANUAL,TECH:OPTICAL MODULE USER	TK2548	071-0435-XX
	119-4514-00			1	ADAPTER,D4:TFS3030,AD4-20	TK2491	AD4-20
	119-4515-00			1	ADAPTER,BICONIC:TFS3030,AB1-25	TK2491	ABI-25
	119-4516-00			1	CONNECTOR, OPTO:ADAPTER, FC-PC, ATTEN 0.6DB, RTN LOSS 35DB, RPTB+/-0.2DB, RIFOCS, APC-10	TK2491	APC-10
	119-4517-00			1	ADAPTER,SMA:TFS3030,2.5MM,AMT-10	TK2491	AMT-10
	119-4518-00			1	ADAPTER,SC:TFS3030,ASC-10	TK2491	ASC-10
	119-4546-00			1	ADAPTER,DIN:47256,AD-234	TK2491	AD-234

Replaceable Parts List (cont.)

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description	Mfr. code	Mfr. part number
	119-4556-00			1	ADAPTER,HP-PC:OPTICAL CONNECTOR, UNIVERSAL CONNECTOR INTERFACE, AHP-10	TK2491	PROPRIETARY INFORMATION (AHP-10)
	119-4557-00			1	ADAPTER,UNIV:SMA 905/906,ASM-90	TK2491	PROPRIETARY INFORMATION (ASM-90)
	119-4558-00			1	ADAPTER,UNIV:DIAMOND 3.5MM,AMS-00	TK2491	PROPRIETARY INFORMATION (AMS-00)
	119-4513-00			1	CONNECTOR, OPTO:ADAPTER, ST, ATTEN 0.6DB, RTN LOSS 35DB, RPTB +/-0.2DBRIFOCSS, ATS-16	TK2491	ATS-16

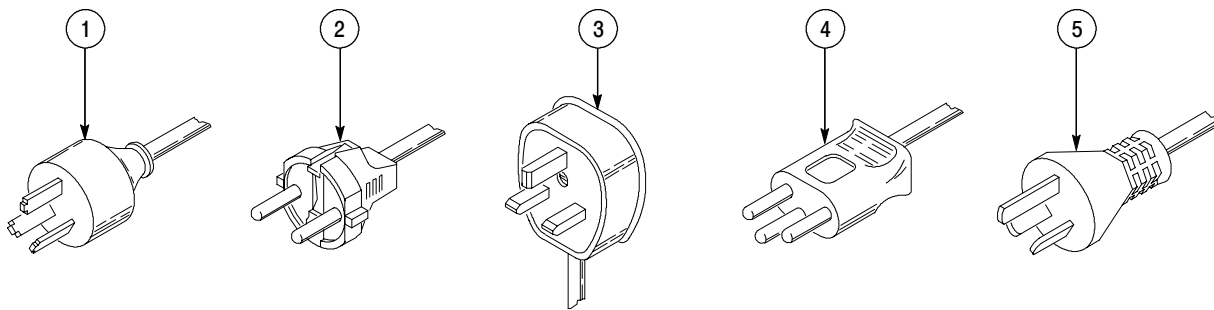


Figure 8- 11: Accessories