# Service Manual

Tektronix

# CSA7000 Series
# Communication Signal Analyzers
# (CSA7404 & CSA7154)

## 071-7011-00

This document applies to firmware version 2.0.0 and above.

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

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## 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).

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# General Safety Summary

Review the following safety precautions to avoid injury and prevent damage to this product or any products connected to it. To avoid potential hazards, use this product only as specified.

*Only qualified personnel should perform service procedures.*

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

## To Avoid Fire or Personal Injury

**Use Proper Power Cord.** Use only the power cord specified for this product and certified for the country of use.

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

**Ground the Product.** This product 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.

**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 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.*

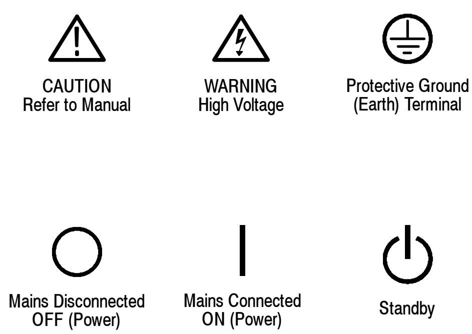
**Terms on the Product.** These terms may appear on the product:

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:



# 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 CSA7000 Communications Signal Analyzer products. 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 using this manual for 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, any replaceable component, assembly, or part is referred to by the term *module.* A module is composed of electrical and mechanical assemblies, circuit cards, interconnecting cables, and user-accessible controls.

### Replaceable Parts

This manual refers to any field-replaceable assembly or mechanical part specifically by its name or generically as a replaceable part. In general, a replaceable part is any circuit board or assembly, such as the hard disk drive, or a mechanical part, such as the I/O port connectors, that is listed in the replaceable parts list of Chapter 10.

### Safety

Symbols and terms related to safety appear in the *General Safety Summary* found at the beginning of this manual.

## Related Documentation

The following related manuals are available for this instrument:

- *CSA7000 User manual.* Tektronix part number 071-0879-XX.
- *CSA7000 Reference manual.* Tektronix part number 071-0880-XX.
- CSA7000, TDS7000, TLA 600 & OTS9000 Series Rackmount Kit (Option 1R) Instructions. Tektronix part number 071-0716-XX.

## Contacting Tektronix

| | |
|---|---|
| **Phone** | 1-800-833-9200* |
| **Address** | Tektronix, Inc.<br>Department or name (if known)<br>14200 SW Karl Braun Drive<br>P.O. Box 500<br>Beaverton, OR 97077<br>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<br>1-800-833-9200, select option 3*<br>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

This chapter contains the specifications for the CSA7000 Series Communications Signal Analyzers. All specifications are guaranteed unless labeled "typical." Typical specifications are provided for your convenience but are not guaranteed. Specifications that are marked with the ✓ symbol are checked in chapter four, *Performance Verification* of the service manual.

All specifications apply to all models unless noted otherwise. To meet specifications, the following conditions must be met:

- The instrument must have been calibrated in an ambient temperature between 20 °C and 30 °C.
- The instrument must be operating within the environmental limits listed in Table 1-12 on page 1-25.
- The instrument must be powered from a source that meets the specifications listed in Table 1-10 on page 1-23.
- The instrument must have been operating continuously for at least 20 minutes within the specified operating temperature range.
- You must perform the Signal Path Compensation procedure after the 20-minute warm-up period, and the ambient temperature must not change more than 5 °C without first repeating the procedure. See *Run the signal path compensation routine* on page 4-6 for instructions to perform this procedure.

## Product and Feature Description

Your instrument is shown in Table 1-1.

**Table 1-1: CSA7000 models**

| Model | Number of channels | Bandwidth | Maximum sample rate (real time) |
|---|---|---|---|
| CSA7404 | 4 | 4 GHz | 20 GS/s |
| CSA7154 | 4 | 1.5 GHz | 20 GS/s |

## Acquisition Features

**Separate Digitizers.** Ensure accurate timing measurements with separate digitizers for each channel. Acquisition on multiple channels is always concurrent. The digitizers can also be combined to yield a higher sample rate on a single channel.

**Fast Acquisition.** Acquire up to 400,000 waveforms per second to see rapidly changing signals or intermittent signal irregularities.

**Long Record Lengths.** Choose record lengths from 500 points up to 100,000 points per channel (up 400,000 points on a single channel). Extend the maximum record length up to a maximum of 32,000,000 points with memory options.

**Peak Detect Acquisition Mode.** See pulses as narrow as 400 ps even at the slower time base settings. Peak detect helps you see noise and glitches in your signal.

**Acquisition Control.** Acquire continuously or set up to capture single shot acquisitions. Enable or disable optional acquisition features such as equivalent time or roll mode. Use Fast Frame acquisition to capture and time stamp many events in a rapid sequence.

**Horizontal Delay.** Use delay when you want to acquire a signal at a significant time interval after the trigger point. Toggle delay on and off to quickly compare the signal at two different points in time.

**Optical-to-Electrical Converter.** Test optical signals using the integrated optical-to-electrical converter and a fully calibrated signal path. Recovered clock and data signals are available. Optical reference receivers are available for selected optical communications standards.

## Signal Processing Features

**Average, Envelope, and Hi Res Acquisition.** Use Average acquisition mode to remove uncorrelated noise from your signal. Use Envelope to capture and display the maximum variation of the signal. Use Hi Res to increase vertical resolution for lower bandwidth signals.

**Waveform Math.** Set up simple math waveforms using the basic arithmetic functions or create more advanced math waveforms using the math expression editor. Waveform expressions can even contain measurement results and other math waveforms.

**Spectral Analysis.** Display spectral magnitude and phase waveforms based on your time-domain acquisitions. Control the instrument using the traditional spectrum analyzer controls such as span and center frequency.

## Display Features

**Color LCD Display.** Identify and differentiate waveforms easily with color coding. Waveforms, readouts, and inputs are color matched to increase productivity and reduce operating errors. Enhance visualization of waveforms with color grading.

**Digital Phosphor.** The instrument can clearly display intensity modulation in your signals. The instrument automatically overlays subsequent acquisitions and then decays them to simulate the writing and decay of the phosphor in an analog instrument CRT. The feature results in an intensity-graded or color-graded waveform display that shows the information in the intensity modulation.

**Fit to Screen.** The Digital Phosphor technology performs the compression required to represent all record points on the screen, even at the maximum record length settings.

**Zoom.** To take advantage of the full resolution of the instrument you can zoom in on a waveform to see the fine details. Both vertical and horizontal zoom functions are available.

## Measurement Features

**Cursors.** Use cursors to take simple voltage, time, and frequency measurements.

**Automatic Measurements.** Choose from a large palette of amplitude, time, and histogram measurements. You can customize the measurements by changing reference levels or by adding measurement gating.

**Mask Testing.** Provides mask testing for verifying compliance to optical and electrical standards. Optical mask testing uses integrated reference receivers.

## Trigger Features

**Simple and Advanced Trigger Types.** Choose simple edge trigger or choose from eight advanced trigger types to help you capture a specific signal fault or event.

**Dual Triggers.** Use the A (main) trigger system alone or add the B trigger to capture more complex events. You can use the A and B triggers together to set up a delay-by-time or delay-by-events trigger condition.

**Comm Triggers.** Use comm triggers to trigger on communication signals.

**Serial Triggers.** Use serial triggers to trigger on serial pattern data.

**Recovered Clock and Data Triggers.** Use recovered clock and data internally to trigger your waveforms. They are also available externally on the CSA7000 Series.

## Convenience Features

**Autoset.** Use Autoset to quickly set up the vertical, horizontal, and trigger controls for a usable display. If a standard mask is active, Autoset adjusts the selected waveform to match the mask, if possible.

**Touch Screen Interface.** You can operate all instrument functions (except the power switch and the touch screen enable/disable switch) from the touch screen interface. If convenient, you can also install a mouse and keyboard to use the interface.

**Toolbar or Menu Bar.** You can choose a toolbar operating mode that is optimized for use with the touch screen, or a PC-style menu-bar operating mode that is optimized for use with a mouse.

**Open Desktop.** The instrument is built on a Microsoft Windows software platform; the instrument application program starts automatically when you apply power to the instrument. You can minimize the instrument application and take full advantage of the built-in PC to run other applications. Moving waveform images and data into other applications is as simple as a copy/paste operation.

**Dedicated Front Panel Controls.** The front panel contains knobs and buttons to provide immediate access to the most common instrument controls. Separate vertical controls are provided for each channel. The same functions are also available through the screen interface.

**Data Storage and I/O.** The instrument has a removeable hard disk drive, a CD-RW drive, and a floppy disk drive that can be used for storage and retrieval of data. The instrument has GPIB, USB, Centronics, and Ethernet ports for input and output to other devices.

**Online Help.** The instrument has a complete online help system that covers all its features. The help system is context sensitive; help for the displayed control window is automatically shown if you touch the help button. Graphical aids in the help windows assist you in getting to the information you need. You can also access the help topics through a table of contents or index.

# Specification Tables

**Table 1-2: Channel input and vertical specifications**

| Characteristic | Description |
|---|---|
| Input channels | Four |
| Input coupling | DC 50 Ω and GND<br><br>Channel input is disconnected from input termination when using GND coupling. |
| ✓Input impedance, DC coupled | 50 Ω ±2.5% at 25 °C, ±0.2% over 0 to 50 °C |
| VSWR, typical | 1.5 for $f_{in}$ <1 GHz<br>1.7 for $f_{in}$ <2.5 GHz<br>2.0 for $f_{in}$ <4 GHz |
| ✓Maximum input voltage | <1 $V_{RMS}$ for <100 mV/division settings and<br><5 $V_{RMS}$ for ≥100 mV settings |
| Number of digitized bits | 8 bits |
| Sensitivity range | 2 mV/div to 1 V/division, in a 1-2-5 sequence |

**Table 1-2: Channel input and vertical specifications (Cont.)**

| Characteristic | | Description | |
|---|---|---|---|
| ✓DC gain accuracy | | 2 mV/div to 3.9 mV/div | ± (2.5% +(6% × net offset)) |
| | | 4 mV/div to 99.5 mV/div | ± (2% +(2% × net offset)) |
| | | ≥ 100 mV/div | ± (2% +(2% × net offset/10)) |
| ✓ DC voltage measurement accuracy | | *Measurement type* | *DC accuracy (in volts)* |
| | Average acquisition mode (≥16 averages) | 2 mV/div to 3.98 mV/div | ±[(2.5% +(6% × net offset)) × \| reading + (position × V/division) - offset \| + offset accuracy + 0.08 division × V/division] |
| | | 4 mV/div to 99.5 mV/div | ±[(2% +(2% × net offset)) × \| reading + (position × V/division) - offset \| + offset accuracy + 0.08 division × V/division] |
| | | ≥ 100 mV/div | ±[(2% +(2% × net offset/10)) × \| reading + (position × V/division) - offset \| + offset accuracy + 0.08 division × V/division] |
| | Delta voltage measurement between any two averages of ≥ 16 waveforms acquired under the same setup and ambient conditions | 2 mV/div to 3.9 mV/div | ±((2.5% +(6% × net offset)) × \| reading \| ) + 0.16 division × V/division setting |
| | | 4 mV/div to 99.5 mV/div | ±((2% +(2% × net offset)) × \| reading \| ) + 0.16 division × V/division setting |
| | | ≥ 100 mV/div | ±((2% +(2% × net offset/10)) × \| reading \| ) + 0.16 division × V/division setting |
| | | *where, net offset = offset - (position × volts/division)* | |
| Nonlinearity, typical | | < 1 digitization level (DL), differential; ≤ 2 DL integral, independently based | |

**Table 1-2: Channel input and vertical specifications (Cont.)**

| Characteristic | Description | |
|---|---|---|
| ✓ Analog bandwidth | DC 50 Ω coupling, Full bandwidth, TCA-SMA or TCA-N adapter, operating ambient 15 °C (0 °C for CSA7154,) to 50 °C, derated by 30 MHz/°C below 15 °C | |
| | *SCALE range* | *Bandwidth* |
| | 2 mV/div to 3.9 mV/div | DC to ≥ 1 GHz |
| | 4 mV/div to 9.9 mV/div | DC to ≥ 1.25 GHz |
| | ≥ 10 mV/div | CSA7404 :<br>DC to 4 GHz<br>CSA7154 :<br>DC to 1.5 GHz |
| Analog bandwidth with P7240 active probe or TCA-BNC adapter, typical | DC 50 Ω coupling, Full bandwidth, operating ambient 15 °C to 30 °C, derated by 20 MHz/°C above 30 °C | |
| | *SCALE range* | *Bandwidth* |
| | 2 mV/div to 3.9 mV/div | DC to 1 GHz |
| | 4 mV/div to 9.9 mV/div | DC to 1.25 GHz |
| | ≥ 10 mV/div | DC to 4 GHz |
| Analog bandwidth with P7330 active probe, typical | DC 50 Ω coupling, Full bandwidth, operating ambient 15 °C to 30 °C, derated by 20 MHz/°C above 30 °C | |
| | *SCALE range* | *Bandwidth* |
| | 2 mV/div to 3.9 mV/div | DC to 1 GHz |
| | 4 mV/div to 9.9 mV/div | DC to 1.25 GHz |
| | ≥ 10 mV/div | DC to 3.5 GHz |
| Calculated rise time, typical[1] | CSA7404: 100 ps<br>CSA7154: 240 ps | |
| Step response settling errors, typical | Full bandwidth | |
| | *SCALE range and step amplitude* | *Settling error at time after step* |
| | 2 mV/div to 99.5 mV/div, with ≤ 1.5 V step | 20 ns: ≤ 2%<br>1 ms: ≤ 0.1% |
| | 100 mV/div to 1 V/div, with ≤ 3 V step | 20 ns: ≤ 2%<br>1 ms: ≤ 0.2% |
| Pulse response, peak detect or envelope mode | Sample rate setting | Minimum pulse width |
| | 2.5 GS/s or less | 400 ps |
| Position range | ± 5 divisions | |

**Table 1-2: Channel input and vertical specifications (Cont.)**

| Characteristic | Description | |
|---|---|---|
| Offset range | *SCALE range* | *Offset range* |
| | 2 mV/div to 50 mV/div | ±0.50 V |
| | 50.5 mV/div to 99.5 mV/div | ±0.25 V |
| | 100 mV/div to 500 mV/div | ±5 V |
| | 505 mV/div to 1 V/div | ±2.5 V |
| Offset accuracy | *SCALE range* | *Offset range* |
| | 2 mV/div to 9.95 mV/div | ±(0.2% × \| net offset \| + 1.5 mV + 0.1 div × V/div setting) |
| | 10 mV/div to 99.5 mV/div | ±(0.35% × \| net offset \| + 1.5 mV + 0.1 div × V/div setting) |
| | 100 mV/div to 1 V/div | ±(0.35% × \| net offset \| + 15 mV + 0.1 div × V/div setting) |
| | *where, net offset = offset - (position × volts/division)* | |
| Effective bits, typical | Nine division sine wave input at the indicated frequency, sampled at 50 mV/division and 20 GS/s | |
| | *Input frequency* | *Effective bits* |
| | 1 MHz | 6.0 bits |
| | 1 GHz | 5.7 bits |
| | 1.5 GHz | 5.5 bits |
| | 2 GHz, CSA7404 only | 5.3 bits |
| | 2.5 GHz, CSA7404 only | 5.2 bits |
| | 3 GHz, CSA7404 only | 5.1 bits |
| | 4 GHz, CSA7404 only | 4.9 bits |
| ✓ Delay between channels | ≤ 30 ps between any two channels with the same scale and coupling settings | |
| ✓ Channel-to-channel crosstalk | ≥15:1 at rated bandwidth (CSA7404 only), and ≥ 80:1 at ≤ 1.5 GHz or the rated bandwidth, whichever is less. Assumes the same scale settings on each channel | |

[1] **Rise time is calculated from the following formula:**

$$RiseTime = \frac{.40}{BW}$$ **where BW is the 3 dB bandwidth in Hz and RiseTime is in seconds.**

**Table 1-3: Horizontal and acquisition system specifications**

| Characteristic | Description | |
|---|---|---|
| Real-time sample rate range | *Number of channels acquired* | *Sample rate range* |
| | 1 | 5 S/s to 20GS/s |
| | 2 | 5 S/s to 10GS/s |
| | 3 or 4 | 5 S/s to 5GS/s |
| Equivalent-time sample rate or interpolated waveform rate range | 10GS/s, 12.5GS/s, 20GS/s, 25GS/s, 40GS/s, 50GS/s, 62.5GS/s, 80GS/s, 100GS/s, 125GS/s, 160GS/s, 200GS/s, 250GS/s, 312.5GS/s, 320GS/s, 400GS/s, 500GS/s, 625GS/s, 800GS/s, 1TS/s | |
| Acquisition modes | Sample, Peak detect, Hi Res, Average, Envelope, and Waveform database | |
| Minimum record length | 500 points | |
| Maximum record length, sample mode | Depends on the number of active channels and the record length options installed. Maximum record length is less in serial trigger mode | |
| Standard | 100,000 points (3 or 4 channels)<br>200,000 points (1 or 2 channels only)<br>400,000 points (1 channel only) | |
| Option 1M installed | 500,000 points (3 or 4 channels)<br>1,000,000 points (1 or 2 channels only)<br>2,000,000 points (1 channel only) | |
| Option 2M installed | 2,000,000 points (3 or 4 channels)<br>4,000,000 points (1 or 2 channels only)<br>8,000,000 points (1 channel only) | |
| Option 3M installed | 4,000,000 points (3 or 4 channels)<br>8,000,000 points (1 or 2 channels only)<br>16,000,000 points (1 channel only) | |
| Option 4M installed | 8,000,000 points (3 or 4 channels)<br>16,000,000 points (1 or 2 channels only)<br>32,000,000 points (1 channel only) | |
| Maximum record length, HiRes mode, sample rate ≤ 1.25 GS/s | 2,000,000 points (1, 2, 3, or 4 channels) | |
| Seconds/division range | 50 ps/div to 10 s/div | |
| Maximum Fast Frame update rate, nominal | 160,000 frames per second | |

**Table 1-3: Horizontal and acquisition system specifications (Cont.)**

| Characteristic | Description | |
|---|---|---|
| Frame length and maximum number of frames | Maximum number of frames for Sample or Peak Detect acquisition mode, depending on memory option installed | |
| | *Frame length* | *Maximum number of frames* |
| | 50 points | Standard: 182<br>Option 1M: 733<br>Option 2M: 3636<br>Option 3M: 7273<br>Option 4M: 7273 |
| | 250 points | Standard: 133<br>Option 1M: 667<br>Option 2M: 2667<br>Option 3M: 5333<br>Option 4M: 6154 |
| | 500 points | Standard: 100<br>Option 1M: 500<br>Option 2M: 2000<br>Option 3M: 4000<br>Option 4M: 5161 |
| | 2500 points | Standard: 33<br>Option 1M: 167<br>Option 2M: 667<br>Option 3M: 1333<br>Option 4M: 2254 |
| | 5000 points | Standard: 18<br>Option 1M: 91<br>Option 2M: 364<br>Option 3M: 727<br>Option 4M: 1322 |
| | 25,000 points | Standard: 4<br>Option 1M: 20<br>Option 2M: 78<br>Option 3M: 157<br>Option 4M: 307 |
| | 50,000 points | Standard: 2<br>Option 1M: 10<br>Option 2M: 40<br>Option 3M: 79<br>Option 4M: 157 |
| | 100,000 points | Standard: 1<br>Option 1M: 5<br>Option 2M: 20<br>Option 3M: 40<br>Option 4M: 79 |

**Table 1-3: Horizontal and acquisition system specifications (Cont.)**

| Characteristic | Description | |
|---|---|---|
| | *Frame length* | *Maximum number of frames* |
| | 250,000 points | Standard: —<br>Option 1M: 2<br>Option 2M: 8<br>Option 3M: 16<br>Option 4M: 32 |
| | 500,000 points | Standard: —<br>Option 1M: 1<br>Option 2M: 4<br>Option 3M: 8<br>Option 4M: 16 |
| | 1 M points | Standard: —<br>Option 1M: —<br>Option 2M: 2<br>Option 3M: 4<br>Option 4M: 8 |
| | 2 M points | Standard: —<br>Option 1M: —<br>Option 2M: 1<br>Option 3M: 2<br>Option 4M: 4 |
| | 4 M points | Standard: —<br>Option 1M: —<br>Option 2M: —<br>Option 3M: 1<br>Option 4M: 2 |
| | 8 M points | Standard: —<br>Option 1M: —<br>Option 2M: —<br>Option 3M: —<br>Option 4M: 1 |
| Update rate, maximum | DPO on: 400,000 waveforms per second<br>DPO off: 130 waveforms per second | |
| ✓ Internal time-base reference frequency | 10 MHz ± 2.5 ppm over any ≥ 100 ms interval. Aging < 1 ppm per year | |
| ✓ Long term sample rate and delay time accuracy | ±2.5 ppm over any ≥100 ms interval. Aging < 1 ppm per year | |
| Aperture uncertainty, typical | Short term:<br>≤ 1.5 ps rms, records having duration ≤ 100 ms.<br>≤ 800 fs rms, records having duration ≤ 10 μs<br><br>Long term:<br>≤ 15 parts per trillion rms, records having duration ≤ 1 minute | |

**Table 1-3: Horizontal and acquisition system specifications (Cont.)**

| Characteristic | Description | |
|---|---|---|
| Time base delay time range | 16 ns to 250 s | |
| ✓ Delta time measurement accuracy | For a single channel, with signal amplitude > 5 divisions, reference level set at 50%, interpolation set to sin(x)/x, volts/division set to ≥ 5 mV/div, with risetime >1.4 $\times T_S$ and <4 $\times T_S$ or 150 ps (whichever is greater) and acquired ≥ 10 mV/Div, where $T_S$ is the sample period. | |
| | *Conditions* | *Accuracy* |
| | Single shot signal, Sample acquisition mode, Full bandwidth | ± (0.06/sample rate +2.5 ppm × \| reading \| ) RMS<br><br>± (0.3/sample rate +2.5 ppm × \| reading \|) peak |
| | Average acquisition mode, >100 averages, Full bandwidth | ± (4 ps +2.5 ppm × \| reading \| ) peak |

**Table 1-4: Trigger specifications**

| Characteristic | Description | |
|---|---|---|
| Trigger jitter, typical | 6 ps rms for low frequency, fast rise time signal | |
| ✓ Edge Trigger Sensitivity | All sources, for vertical scale settings ≥10 mV/div and ≤1 V/div | |
| | *Trigger Source* | *Sensitivity* |
| | Main trigger, DC coupled | ≤ 0.35 div from DC to 50 MHz<br><br>CSA7404:<br>≤ 1.5 div at 3 GHz<br><br>CSA7154:<br>≤ 1 div at 1.5 GHz |
| | Delayed trigger, DC coupled | ≤ 0.35 div from DC to 50 MHz, increasing to 1 div at 1.5 GHz |
| | Auxiliary input, DC coupled | ≤ 250 mV from DC to 50 MHz, increasing to 350 mV at 500 MHz |

**Table 1-4: Trigger specifications (Cont.)**

| Characteristic | Description | |
|---|---|---|
| Edge trigger sensitivity, typical | All sources, for vertical scale settings ≥10 mV/div and ≤1 V/div | |
| | *Trigger coupling* | *Sensitivity* |
| | NOISE REJ | 3 × the DC-coupled limits |
| | AC | Same as DC-coupled limits for frequencies >100 Hz, attenuates signals <100 Hz |
| | HF REJ | Same as DC coupled limits for frequencies <20 kHz, attenuates signals >20 kHz |
| | LF REJ | Same as DC coupled limits for frequencies >200 kHz, attenuates signals <200 kHz |
| Auxiliary trigger input resistance, typical | ≥ 1.5 kΩ | |
| Maximum trigger input voltage, typical | ±20 V (DC + peak AC) | |
| Lowest frequency for Set Level to 50%, typical | 50 Hz | |
| Advanced trigger sensitivity, typical | For vertical scale settings ≥10 mV/div and ≤1 V/div at TekConnect connector<br>Advanced triggers: 1.0 div, from DC to 500 MHz<br>Runt type: 1.0 div | |

**Table 1-4: Trigger specifications (Cont.)**

| Characteristic | Description | |
|---|---|---|
| Advanced trigger timing | For vertical scale settings ≥10 mV/div and ≤1 V/div | |
| | *Minimum recognizable event width or time* | *Minimum re-arm time to recognize next event* |
| Glitch type | Minimum glitch width = 1 ns | 2 ns + (5% of glitch width setting or 25 ns, whichever is smaller) |
| Runt type | Minimum runt width = 2 ns | 2 ns |
| Time-qualified runt type | Minimum runt width = 2 ns | 8.5 ns + (5% of runt width setting or 25 ns, whichever is smaller) |
| Width type | Minimum difference between upper and lower limits = 1 ns | 2 ns + (5% of upper limit setting or 25 ns, whichever is smaller) |
| Transition type | Minimum transition time = 600 ps | 8.5 ns + (5% of transition time setting or 25 ns, whichever is smaller) |
| Timeout type | Minimum timeout time = 1 ns | 2 ns + 5% of timeout set-ting |
| Pattern type, typical | Minimum time the pattern is true = 1 ns | 1 ns |
| State type, typical | Minimum true time before clock edge = 1 ns<br>Minimum true time after clock edge = 1 ns | 1 ns |
| Setup/Hold type, typical | *Minimum clock pulse width from active edge to inactive edge* | *Minimum clock pulse width from inactive edge to active edge* |
| | 2.6 ns + hold time setting | 2 ns |
| | *Setup and Hold parameters* | *Limits* |
| | Setup time (time from data transition to clock edge) | -100 ns minimum<br>+100 ns maximum |
| | Hold time (time from clock edge to data transition) | -1 ns minimum<br>+102 ns maximum |
| | Setup time + Hold time (algebraic sum of the two settings) | +2 ns minimum |

**Table 1-4: Trigger specifications (Cont.)**

| Characteristic | Description | |
|---|---|---|
| Advanced trigger timer ranges | *Limits* | |
| Glitch type | 1 ns to 1 s | |
| Runt type, time qualified | 1 ns to 1 s | |
| Width type | 1 ns to 1 s | |
| Timeout type | 1 ns to 1 s | |
| Transition type | 1 ns to 1 s | |
| Pattern type | 1 ns to 1 s | |
| Setup/Hold type | *Setup and Hold timers* | *Limits* |
| | Setup time (time from data transition to clock edge) | -100 ns to +100 ns |
| | Hold time (time from clock edge to data transition) | -1 ns to +102 ns |
| | Setup time + Hold time (algebraic sum of the two settings) | +2 ns |
| ✓ Advanced trigger timer accuracy | For Glitch, Timeout, or Width types | |
| | *Time range* | *Accuracy* |
| | 1 ns to 500 ns | ±(20% of setting + 0.5 ns) |
| | 520 ns to 1 s | ±(0.01% of setting + 100 ns) |
| Trigger level or threshold range | *Trigger Source* | *Sensitivity* |
| | Any channel | ±12 divisions from center of screen |
| | Auxiliary input | ±8 V |
| | Line | ±0 V, not settable |
| Trigger level or threshold accuracy, typical | Edge trigger, DC coupling, for signals having rise and fall times ≤1 ns | |
| | *Trigger Source* | *Accuracy* |
| | Any channel | ± [(2% × \| setting - net offset \| ) + (0.35 div × volts/div setting) + offset accuracy] (≥ 10 mV/div only) |
| | Auxiliary | Not specified |
| | *where, net offset = offset - (position × volts/division)* | |

**Table 1-4: Trigger specifications (Cont.)**

| Characteristic | | Description | |
|---|---|---|---|
| B Event (Delayed) trigger | | *Trigger After Time* | *Trigger on $n^{th}$ Event* |
| | Range | Delay time = 16 ns to 250 s | Event count = 2 to $10^7$ |
| | Minimum time between arm (A Event) and trigger (B Event), typical | 2 ns from the end of the time period to the B trigger event | 2 ns between the A trigger event and the first B trigger event |
| | Minimum pulse width, typical | — | B event width ≥1 ns |
| | Maximum frequency, typical | — | B event frequency ≤500 MHz |
| Trigger position error, typical | | Edge trigger, DC coupling, for signals having a slew rate at the trigger point of ≥ 0.5 division/ns | |
| | | *Acquisition mode* | *Error* |
| | | Sample, Average | ± (1 waveform interval + 200 ps) |
| | | Peak Detect, Envelope | ± (2 waveform interval + 200 ps) |
| Trigger holdoff range | | 250 ns to 12 s,<br>minimum resolution is 8 ns for settings ≤1.2 µs. A dither of ± 4 ns is added to the holdoff setting | |

**Table 1-5: Serial Trigger specifications**

| Characteristic | Description | |
|---|---|---|
| Serial trigger number of bits | 32 | |
| Serial trigger encoding types | NRZ | |
| ✓Serial trigger baud rate limits | Up to 1.25 GBd | |
| Serial trigger, serial word recognizer position accuracy | Edge trigger, DC coupling, for signals having a slew rate at the trigger point of ≥ 0.5 division/ns | |
| | *Acquisition mode* | *Error* |
| | Sample, Average | ± (1 waveform interval + 200 ps) |
| | Peak Detect, Envelope | ± (2 waveform interval + 200 ps) |
| Clock recovery frequency range | 1.5 MBd to 2.5 GBd. Above 1250 MHz the clock is only available internally as a trigger source. Below 1250 MHz the clock is also available at the Recovered Clock output along with regenerated data. | |

**Table 1-5: Serial Trigger specifications (Cont.)**

| Characteristic | Description |
|---|---|
| Clock recovery jitter, typical | < 0.25% bit period + 9 ps rms for PRBS data patterns.<br>< 0.25% bit period + 8 ps rms for repeating 0011 data patterns. |
| Clock recovery tracking/acquisition range, typical | ± 5% of requested baud |
| Minimum signal amplitude needed for clock recovery, typical | 1 division p-p up to 1.25 GBd<br>1.5 divisions p-p above 1.25 GBd |

**Table 1-6: Display specifications**

| Characteristic | Description |
|---|---|
| Display type | 211.2 mm (W) × 158.4 mm (H), 264 mm (10.4 in) diagonal, liquid crystal active-matrix color display |
| Display resolution | 640 horizontal × 480 vertical pixels |
| Pixel pitch | 0.33 mm horizontal, 0.22 mm vertical |
| Response time, typical | 50 ms, black to white |
| Display refresh rate | 59.94 frames per second |
| Viewing angle, typical | 80 degrees |
| Displayed intensity levels | Supports Windows SVGA high-color mode (16-bit) |

**Table 1-7: Input/output port specifications**

| Characteristic | Description |
|---|---|
| Rear-panel I/O ports | Ports located on the rear panel |
| SVGA video port | Upper video port, DB-15 female connector, connect a second monitor to use dual-monitor display mode, supports Basic requirements of PC99 specifications |
| Scope VGA video port | Lower video port, DB-15 female connector, 31.6 kHz sync, EIA RS-343A compliant, connect to show the instrument display, including live waveforms, on an external monitor |
| Parallel port (IEEE 1284) | DB-25 connector, supports the following modes:<br>-standard (output only)<br>bidirectional (PS-2 compatible)<br>bidirectional enhanced parallel port (IEEE 1284 standard, mode 1 or mode 2, v 1.7)<br>-bidirectional high-speed extended capabilities |
| Serial port | DB-9 COM1 port, uses NS16C550-compatible UARTS, transfer speeds up to 115.2 kb/s |
| Keyboard port | PS-2 compatible, instrument must be powered off to make connection |
| Mouse port | PS-2 compatible, instrument must be powered off to make connection |
| LAN port | RJ-45 connector, supports 10 base-T and 100 base-T |
| Audio ports | Miniature phone jacks for stereo microphone input and stereo line output |
| USB port | Allows connection or disconnection of USB keyboard and/or mouse while instrument power is on |
| GPIB port | IEEE 488.2 standard interface |

**Table 1-7: Input/output port specifications (Cont.)**

<table>
<tr><th>Characteristic</th><th colspan="2">Description</th></tr>
<tr><td rowspan="3">✓ Probe Compensator Output</td><td colspan="2">Front-panel BNC connector, requires Probe Cal Deskew Fixture for probe attachment</td></tr>
<tr><td>Output voltage</td><td>Frequency</td></tr>
<tr><td>200 mV (from base to top) ± 20% into a 50 Ω load (Vol = 0.8 V, Voh = 1 V typical)<br><br>400 mV (from base to top) ± 20% into a ≥ 10 kΩ load (Vol = 1.6 V, Voh = 2 V typical)<br><br>Note: During probe calibration only, a relay switches a DC calibration voltage to this output in place of the 1kHz square wave. This voltage varies from -10 V to +10 V with a source impedance less than 1 W and short circuit current as high as 300 mA.</td><td>1 kHz ± 5%</td></tr>
<tr><td>✓ Analog Signal Output amplitude</td><td colspan="2">BNC connector, provides a buffered version of the signal that is attached to the channel 3 input when channel 3 is the trigger source<br><br>20 mV/div ± 20% into a 1 MΩ load<br>10 mV/div ± 20% into a 50 Ω load<br><br>Offset: between -100 mV and -170 mV into 50 Ω</td></tr>
<tr><td rowspan="3">✓ Auxiliary Output levels</td><td colspan="2">BNC connector, provides a TTL-compatible pulse (polarity selectable) for each A or B trigger (selectable)</td></tr>
<tr><td>$V_{out}$ high</td><td>$V_{out}$ low (true)</td></tr>
<tr><td>≥2.5 V into open circuit,<br>≥1.0 V into 50 Ω load</td><td>≤0.7 V with ≤4 ma sink,<br>≤0.25 V into 50 Ω load</td></tr>
<tr><td>Auxiliary Output pulse width, typical</td><td colspan="2">Pulse width varies, 1 μs minimum</td></tr>
<tr><td>External reference</td><td colspan="2">Run SPC whenever the external reference is more than 2000 ppm different than the internal reference or the reference at which SPC was last run.</td></tr>
<tr><td>Frequency range</td><td colspan="2">9.8 MHz to 10.2 MHz.</td></tr>
<tr><td>Input sensitivity</td><td colspan="2">≥ 200 $mV_{p-p}$</td></tr>
<tr><td>Input voltage, maximum</td><td colspan="2">7 $V_{p-p}$</td></tr>
<tr><td>Input impedance</td><td colspan="2">>1.5 kΩ, $C_{in}$ = 40 pF. measured at >100 kHz</td></tr>
</table>

**Table 1-7: Input/output port specifications (Cont.)**

| Characteristic | Description | |
|---|---|---|
| Internal reference output | | |
| Frequency | 10 MHz ± ≃2.5 ppm over any ≥100 ms interval. Aging <1 ppm per year | |
| Output voltage | *$V_{out}$ high* | *$V_{out}$ low (true)* |
| | ≥2.5 V into open circuit,<br>≥1.0 V into 50 Ω load | ≤0.7 V with ≤4 ma sink,<br>≤0.25 V into 50 Ω load |
| Serial data output baud rate range | Fbaud <1250 MBd. Output swing of 1010 repeating pattern at this baud will be at least 200 mV into 50 Ω. | |
| Serial clock output frequency range | Peak-to-peak output swing at 625 MHz is at least 200 mV p-p into 50 Ω. Higher frequencies are further attenuated by approximately 6 dB per octave above 625 MHz.<br><br>Use AC or DC coupled 50 Ω termination; AC coupling the clock provides about 10% more amplitude. | |
| Serial data and clock output voltages, typical | Voh = -1.0 V<br>Vol = -1.7 V<br>Assumes a load impedance greater than 1 kΩ. (50 Ω source termination.)<br><br>If a 50 Ω or 75 Ω load is used, either use a DC blocking capacitor in series with the signal or reference the termination to about -1.3 V. The signal amplitude will be correspondingly reduced. | |
| Serial data output latency, typical | 11 ns ±4 ns plus 35.5 clock cycles | |

**Table 1-8: O/E converter**

| Characteristic[2] | Description |
|---|---|
| Optical input connector | Rifocs universal connector |
| O/E wavelength range | 700 nm to 1650 nm |
| ✓O/E gain | ≥ 0.27 V/mW (0.35 V/mW typical) at 780 nm ± 20 nm<br>≥ 0.33 V/mW (0.40 V/mW typical) at 850 nm ± 20 nm<br>≥ 0.64 V/mW (0.75 V/mW typical) at 1310 nm ± 20 nm<br>≥ 0.64V/mW (0.75 V/mW typical) at 1550 nm ± 20 nm<br><br>Applies to graded index multimode fiber with core diameter 62.5 µm or smaller at the input and O/E Electrical-to-CH1 Input adapter |
| Optical Channel DC measurement accuracy, typical | ± ((2% +(2% × net offset/1 mW)) × \| reading +(Position × W/div) - Offset \| +0.35% × Net Offset\| +3 µW +0.18 div × W/div) only between 10 µW/div and 50 µW/div inclusive. Average of ≥ 16 waveforms<br><br>The delta between any two averages of ≥ 16 waveforms acquired under the the same setup and ambient conditions:<br>± ((2% +(2% × net offset/1 mW)) × \| reading \|<br>+0.16 div × W/div)<br><br>Excludes normal variations due to fiber connection to the front of the instrument |
| ✓Optical Channel Bandwidth (includes O/E, O/E-to-TekConnect adaptor, and instrument) | 5 °C to 25 °C:<br><br>CSA7404 2.4 GHz<br><br>CSA7154 1.6 GHz |
| DC conversion gain linearity | < 4 mV/div: ± (4.5% + (6% × net offset))<br>4 mV/div to 99.5 mV/div: ± (4% + (2% × net offset))<br>100 mV/div to 1.0 V/div: ± (4% + (2% × net offset/10)) |
| Absolute maximum nondestructive optical input | 5 mW average;<br>10 mW peak at the wavelength with the highest relative responsivity |
| Maximum nonsaturating linear response to transient input, typical | The transient optical signal response is linear (± 6%) for<br>< 170 µW average input (340 µW p) at 850 nm<br>< 120 µW average input (240 µW p) at 1310 and 1550 nm |
| Output zero (Dark level) | ± (1.6 mW +0.1 division × W/div) from 10 µW to 50 µW per division vertical scale setting |

**Table 1-8: O/E converter (Cont.)**

| Characteristic[2] | Description |
|---|---|
| ✓Maximum noise output, rms | CSA7404:<br>1310 nm and 1550 nm<br>≤ 1.1 µW + (6.5% of W/div setting)<br>850 nm<br>≤ 2.1 µW + (6.5% of W/div setting)<br>780 nm<br>≤ 2.6 µW + (6.5% of W/div setting)<br>CSA7154:<br>1310 nm and 1550 nm<br>≤ 0.85 µW + (6.5% of W/div setting)<br>850 nm<br>≤ 1.6 µW + (6.5% of W/div setting)<br>780 nm<br>≤ 2.0 µW + (6.5% of W/div setting)<br>O/E converter alone<br>≤ 0.85 µW |
| Optical return loss, typical | With 50 µm or 62.5 µm core multimode fiber (CPC6):<br>>14 dB for 780 nm ± 20 nm<br>>14 dB for 850 nm ± 20 nm<br><br>With 9 µm core singlemode fiber (SMF-28):<br>>28 dB for 1310 nm ± 20 nm<br>>28 dB for 1550 nm ± 20 nm<br><br>The return loss includes optical reflection contributions from the device under test's SC-SPC connector interface with the user's PC style connector as well as all other optical reflections from that interface up to and including the device under test's final photo diode termination. |
| Peak-to-peak aberrations in response to falling edge, typical | 11% peak-to-peak total aberration (system including O/E-to-CH1 input adapter, and instrument) |
| Maximum falling edge 10% to 2% settling time (ORR disabled), typical | The step response to a fast optical square OFF edge reaches toc within 2% of the final 0% level within 2 ns after the 10% transition point. |
| Smallest average power for mask test (sensitivity), typical | 1310 nm and 1550 nm:<br>40 µW peak-to-peak. 20 µW (-17 dBm) average power assuming 50% average duty cycle<br><br>780 nm and 850 nm:<br>80 µW peak-to-peak. 40 µW (-14 dBm) average power assuming 50% average duty cycle<br><br>Assumes the scale factor is set to minimum µW/div settings and signal is at least 2 divisions peak-to-peak |

**Table 1-8: O/E converter (Cont.)**

| Characteristic[2] | Description |
|---|---|
| Optical scale factor range | 10 μW per division to 500 μW per division<br>Optical reference receiver typically available from the following scale factors:<br>1310 nm and 1550 nm:<br>13.5 μW per division to 66 μW per division<br>850 nm:<br>25 μW per division to 125 μW per division<br>780 nm:<br>28 μW per division to 142 μW per division |

**2 All specifications are with the O/E electrical out-to-CH1 input adapter installed.**

**Table 1-9: Data storage specifications**

| Characteristic | Description |
|---|---|
| Nonvolatile memory retention time, typical | ≥ 5 years |
| Floppy disk | Front-panel 3.5 in floppy disk drive, 1.44 MB capacity |
| Hard disk | Rear-panel, removeable hard disk drive, ≥ 20 GB capacity |
| CD-RW | Rear-panel CD-RW drive |
| Windows memory | 512 MB |

**Table 1-10: Power source specifications**

| Characteristic | Description |
|---|---|
| Power consumption | ≤600 Watts (900 VA) |
| Source voltage and frequency | 100 to 240 V ±10%, 50 Hz to 60 Hz<br>115 V ±10%, 400 Hz<br>CAT II |
| Fuse rating | Either one of the following sizes can be used, each size requires a different fuse cap. Both fuses must be the same type |
| 0.25 in × 1.25 in size | UL198G and CSA C22.2, No. 59, fast acting: 8 A, 250 V (Tektronix part number 159-0046-00, Bussman ABC-8, Littelfuse 314008) |
| 5 mm × 20 mm size | IEC127, sheet 1, fast acting “F”, high breaking capacity: 6.3 A, 250 V (Bussman GDA 6.3, Littelfuse 21606.3) |

**Table 1-11: Mechanical specifications**

| Characteristic | | Description | |
|---|---|---|---|
| Weight | | | |
| | Benchtop configuration | 17.7 kg (39 lbs) instrument only<br>19.1 kg (42 lbs) with fully accessorized pouch<br>38.8 kg (85.5 lbs) when packaged for domestic shipment | |
| | Rackmount kit | 18.6 kg (41 lbs) rackmounted instrument<br>5.6 kg (12.5 lbs) kit packaged for domestic shipment | |
| Dimensions | | | |
| | Benchtop configuration | With front cover | Without front cover |
| | | 278 mm (10.95 in) height,<br>330 mm (13 in) with feet extended<br>455 mm (17.9 in) width<br>435 mm (17.13 in) depth | 277 mm (10.9 in) height,<br>330 mm (13 in) with feet extended<br>455 mm (17.9 in) width<br>426 mm (16.75 in) depth |
| | Rackmount configuration (Option 1R) | With rack handles | Without rack handles |
| | | 267 mm (10.5 in) height<br>502 mm (19.75 in) width<br>486 mm (19.13 in) depth | 267 mm (10.5 in) height<br>482 mm (19 in) width<br>435 mm (17.13 in) depth |
| Cooling | | Fan-forced air circulation with no air filter. | |
| | Required clearances | Top | 0 mm (0 in) |
| | | Bottom | 19 mm (0.75 in) minimum<br>or<br>0 mm (0 in) when standing on feet, flip stands down |
| | | Left side | 76 mm (3 in) |
| | | Right side | 76 mm (3 in) |
| | | Front | 0 mm (0 in) |
| | | Rear | 0 mm (0 in) on rear feet |
| Construction material | | Chassis parts are constructed of aluminum alloy, front panel is constructed of plastic laminate, circuit boards are constructed of glass laminate, and the outer shell is molded and textured from a polycarbonate/ABS blend | |

**Table 1-12: Environmental specifications**

| Characteristic | Description |
|---|---|
| Temperature, operating | 0 °C to +50 °C, excluding floppy disk and compact disk drives<br>+10 °C to +45 °C, including floppy disk and compact disk drives |
| Nonoperating | -22 °C to +60 °C |
| Humidity, operating | 20% to 80% relative humidity with a maximum wet bulb temperature of +29 °C at or below +50 °C, noncondensing<br>Upper limit derated to 25% relative humidity at +50 °C |
| Nonoperating | With no diskette in floppy disk drive<br>5% to 90% relative humidity with a maximum wet bulb temperature of +29 °C at or below +60 °C, noncondensing<br>Upper limit derated to 20% relative humidity at +60 °C |
| Altitude, operating | 3,048 m (10,000 ft.) |
| Nonoperating | 12,190 m (40,000 ft.) |
| Random vibration, operating | 0.24 $g_{RMS}$ from 5 Hz to 500 Hz, 10 minutes on each axis, 3 axis, 30 minutes total, with floppy disk and compact disk installed |
| Nonoperating | 2.28 $g_{RMS}$ from 5 Hz to 500 Hz, 10 minutes on each axis, 30 minutes total, 3 axis |

**Table 1-13: Certifications and compliances**

| Category | Standards or description |
|---|---|
| EC Declaration of Conformity - EMC | Meets intent of Directive 89/336/EEC for Electromagnetic Compatibility. Compliance was demonstrated to the following specifications as listed in the Official Journal of the European Union:<br>EN 61326 Emissions [1, 3] Class A Radiated and Conducted Emissions<br>EN 61326 Immunity [1,2,4]<br>IEC 1000-4-2 Electrostatic Discharge Immunity<br>±4 kV contact discharge, ±8 kV air discharge, performance criterion B<br>IEC 1000-4-3 RF field immunity<br>3 V/m, 80 MHz to 1 GHz,<br>80% amplitude modulated with a 1 kHz sinewave<br>performance criterion A<br>IEC 1000-4-4 Electrical Fast Transient/Burst Immunity<br>1 kV on AC mains, 500 V on !/O cables, performance criterion B<br>IEC 1000-4-5 AC Surge Immunity<br>1 kV differential mode, 2 kV common mode,<br>performance criterion B<br>IEC 1000-4-6 RF Conducted Immunity<br>3 V, 150 kHz to 80 MHz, amplitude modulated with a 1 kHz sinewave, performance criterion A<br>IEC 1000-4-11 AC Mains Voltage Dips and Interruption Immunity<br>100% reduction for one cycle, performance criterion B<br>EN 61000-3-2 Power Harmonic Current Emissions<br>1 If interconnect cables are used, they must be low-EMI shielded cables such as the following Tektronix part numbers or their equivalents: 012-0991-01, 012-0991-02 or 012-0991-03 GPIB Cable; 012-1213-00 (or CA part number 0294-9) RS-232 Cable; 012-1214-00 Centronics Cable; or LCOM part number CTL3VGAMM-5 VGA Cable.<br>2 The performance criteria for when the instrument is subjected to the conditions described above are defined as follows:<br>A — 10 mV/division to 1 V/division: ≤0.4 division waveform displacement or ≤0.8 division increase in peak-to-peak noise<br>5 mV/division and 2 mV/division, typical: ≤8 mV increase in peak-to-peak noise<br>B — temporary, self-recoverable degradation or loss of performance is allowed, but no change of actual operating state or loss of stored data is allowed<br>C — temporary loss of function is allowed provided that the function is self recoverable or can be restored by the operation of the controls<br>3 Radiated emissions may exceed the levels specified in EN 61326 when this instrument is connected to a test object.<br>4 USB mouse and keyboard only, performance criterion C. Normal USB keyboard or mouse operation can be restored by unplugging and reconnecting the USB connector to the instrument. |
| Australia/New Zealand Declaration of Conformity — EMC | Complies with EMC provision of Radiocommunications Act per the following standard(s):<br>AS/NZS 2064.1/2 Industrial, Scientific, and Medical Equipment: 1992, Class A |

**Table 1-13: 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:<br>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 | UL3111-1, First Edition | Standard for electrical measuring and test equipment. |
| Canadian Certification | CAN/CSA C22.2, No. 1010.1-92 | Safety requirements for electrical equipment for measurement, control, and laboratory use. |
| Additional Compliance | IEC61010-1 | Safety requirements for electrical equipment for measurement, control, and laboratory use. |
| Installation (Overvoltage) Category Definition | 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 Definition | 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. |
| Safety Certification Compliance | | |
| Equipment Type | Test and measuring | |
| Safety Class | Class 1 (as defined in IEC 61010-1, Annex H) – grounded product | |
| Pollution Degree | Pollution Degree 2 (as defined in IEC 61010-1). Note: Rated for indoor use only. | |

# Operating Information

This chapter covers installation information and basic operation instructions.

## Installation

The basic operating software is already installed on the hard disk. Refer to *Software Installation* on page 2-6 for instructions on reinstalling the software.

**CAUTION.** *Be sure you have an emergency startup disk. You will need this disk if you ever have to reinstall the Windows operating system. Refer to* Create an Emergency Startup Disk *on page 2-5.*

### Before You Start

Verify that all parts and accessories for the instrument are available. Use the graphical packing list that came with the oscilloscope to determine the necessary parts and accessories. You should also verify that the following items are available:

- the correct power cords
- the product-software CD set that includes installation copies of the software installed on the instrument
- all the accessories necessary to operate the instrument

### Environmental 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 three inches (7.62 cm) of clearance is required on both sides of the instrument, and the bottom requires the clearance provided by the instrument feet.

If you operate the instrument while it is resting on the 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 and sides of the instrument clear of obstructions to ensure proper cooling.*

Tables 1-10 and 1-12 on pages 1-23 and 1-25 list the operating requirements for the instrument. Power source, temperature, humidity, and altitude are listed.

## Connect the Peripherals

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

**Table 2-1: Additional accessory connection information**

| Item | Description |
|---|---|
| Monitor | If you use a non-standard monitor, you may need to change the the 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. For information on printer usage, see *Printing Waveforms* in your user instrument manual. |
| Rackmount | Refer to the CSA7000 Rackmount Installation Instructions for information on installing the rackmount kit. |
| Other | Refer to the Application release notes on your product CD set for possible additional accessory installation information not covered in this manual. |

***WARNING.*** *Before installing accessories to connectors (mouse, keyboard, etc.), power off the instrument. See* Powering Off the Instrument *on page 2-5.*

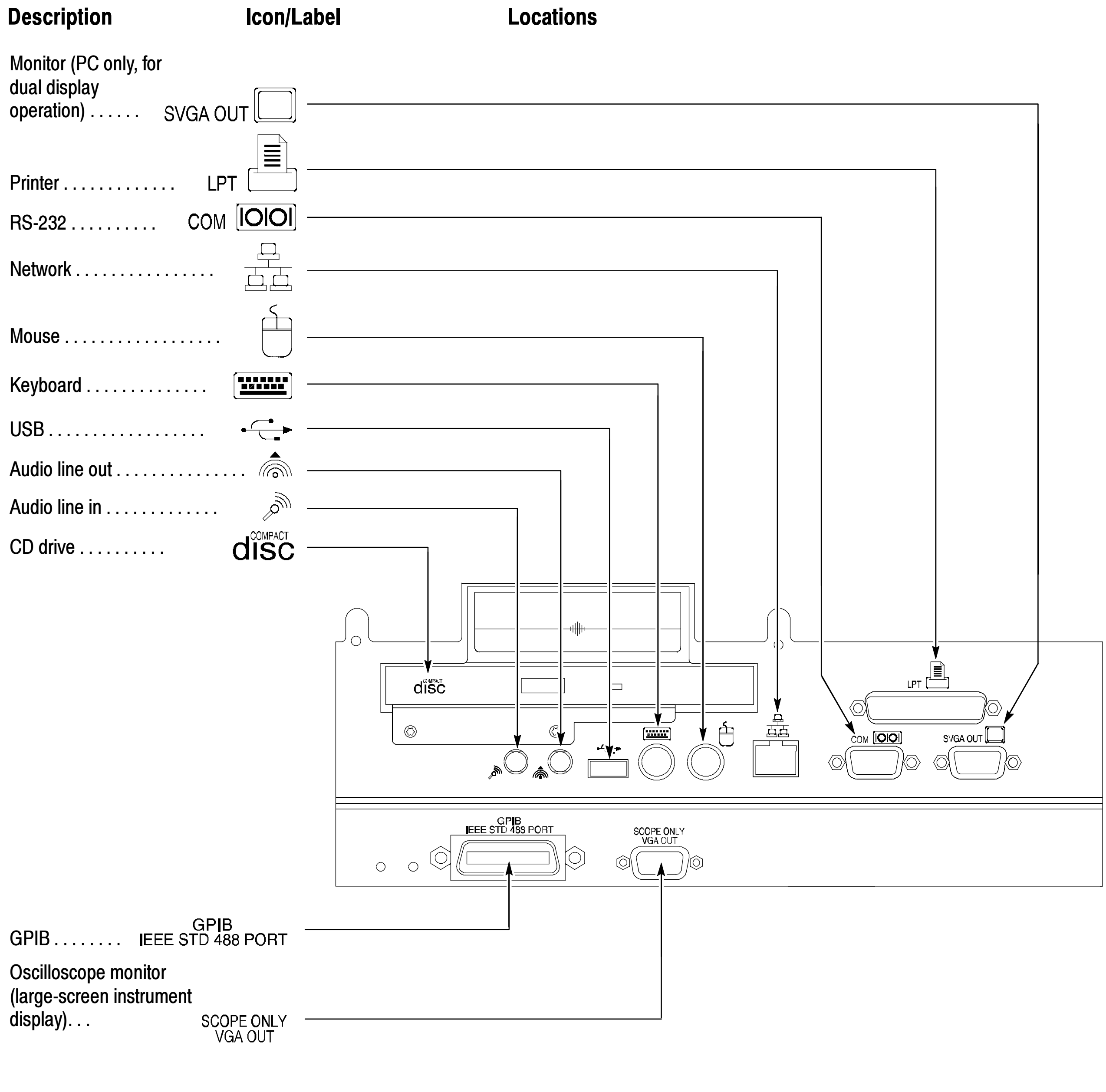



**Figure 2-1: Locations of peripheral connectors on rear panel**

## Power On the Instrument

Follow these steps to power on the instrument.

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

**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 |

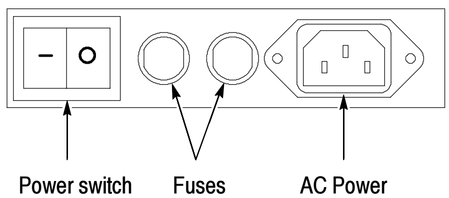



**Figure 2-2: Line fuse and power cord connector locations, rear panel**

***CAUTION.*** *Connect the keyboard, mouse, and other accessories before applying power to the product.*

2. Connect the power cord.
3. If you have an external monitor, connect the power cord and power on the monitor.
4. Turn the Power switch on at the rear panel. (See Figure 2-2 for switch location.)
5. If the instrument does not power on, press the On/Standby switch to power on the instrument (see Figure 2-3 for the switch location).
6. Wait for the boot routine and low-level self test to complete.

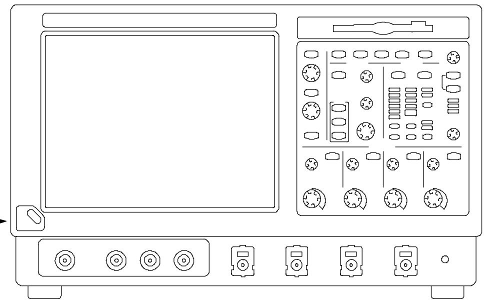



**Figure 2-3: On/Standby switch location**

## Powering Off the Instrument

The instrument has a built-in On/Standby function that removes power from most circuitry in the instrument when you press the On/Standby switch.

To completely remove power to the instrument, perform the shutdown just described, and then set the power switch on the rear panel to off.

## Create an Emergency Startup Disk

Now that you have completed the basic installation process, you should create an emergency startup disk that you can use to restart your instrument in case of a major hardware or software failure. You should create this disk, and then store it in a safe place.

**CAUTION.** *Create this disk and store it in a safe place. It may allow you to recover your Windows installation without rebuilding the entire instrument hard disk.*

The emergency startup disk contains basic files to restart your instrument. It also contains files to check and format the hard disk.

Follow these steps to create the emergency startup disk:

1. Minimize the oscilloscope application by selecting Minimize from the File menu.
2. Select the Windows Start button, point to Settings, and then click Control Panel.
3. In the Control Panel, double-click Add/Remove Programs.
4. Click the Startup Disk tab.
5. Insert a floppy disk into the disk drive and follow the on-screen instructions to create the startup disk.

## Software Installation

This section describes how to install the system software found on the product-software CD that accompanies this product. The instrument ships with the product software installed, so only perform these procedures if reinstallation becomes necessary.

**Software Release Notes.** Read the software release notes README.TXT ASCII file on the product-software CD before performing installation procedures. This file contains additional installation and operation information that supercedes other product documentation.

To view the README.TXT file, open the Notepad Windows accessory and open the file on the product-software CD. After installation, you can also read the copy from a directory on the product:

C:\Program Files\TekScope\ReadMe.txt

**Operating System Restoration.** Use the procedure that accompanies your *Operating System Restore* CD should reinstalling system software become necessary.

The compact disc contains the files necessary to restore the Windows operating system and necessary drivers for the instrument.

The Windows operating system and drivers are factory installed on the instrument hard disk. The compact disc serves as a backup in the event that you have to rebuild the hard drive. You must restore the Windows operating system before you can install the oscilloscope firmware and other product software.

**Application Installation.** Use the procedures that accompany your *Product Software* CD should reinstalling the instrument application software become necessary.

The compact disc contains the files necessary to restore the instrument application and other software for the instrument.

# Operating Information

This section covers basic operation information so that you can operate and prepare to service the instrument.

## Back Up User Files

You should always back up your user files on a regular basis. Use the Microsoft Backup tool to back up files stored on the hard disk. The Backup tool is located in the System Tools folder in the Accessories folder.

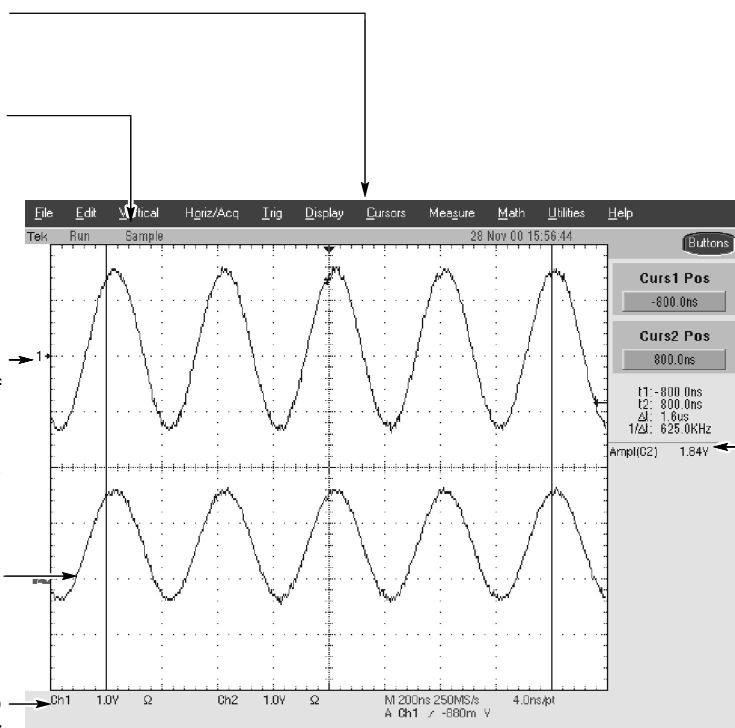
1. Minimize the oscilloscope application by selecting Minimize from the File menu.
2. Select the Windows Start button, point to Programs, Accessories, System Tools, and then click Backup.
3. Use the Microsoft Backup tool to select your backup media and to select the files and folders that you want to back up. Use the online help for information on using the Backup tool. You can back up to the floppy drive, or to a third-party storage device over the printer port (rear panel).

## User Interface Map

This section shows the main parts of the user interface.

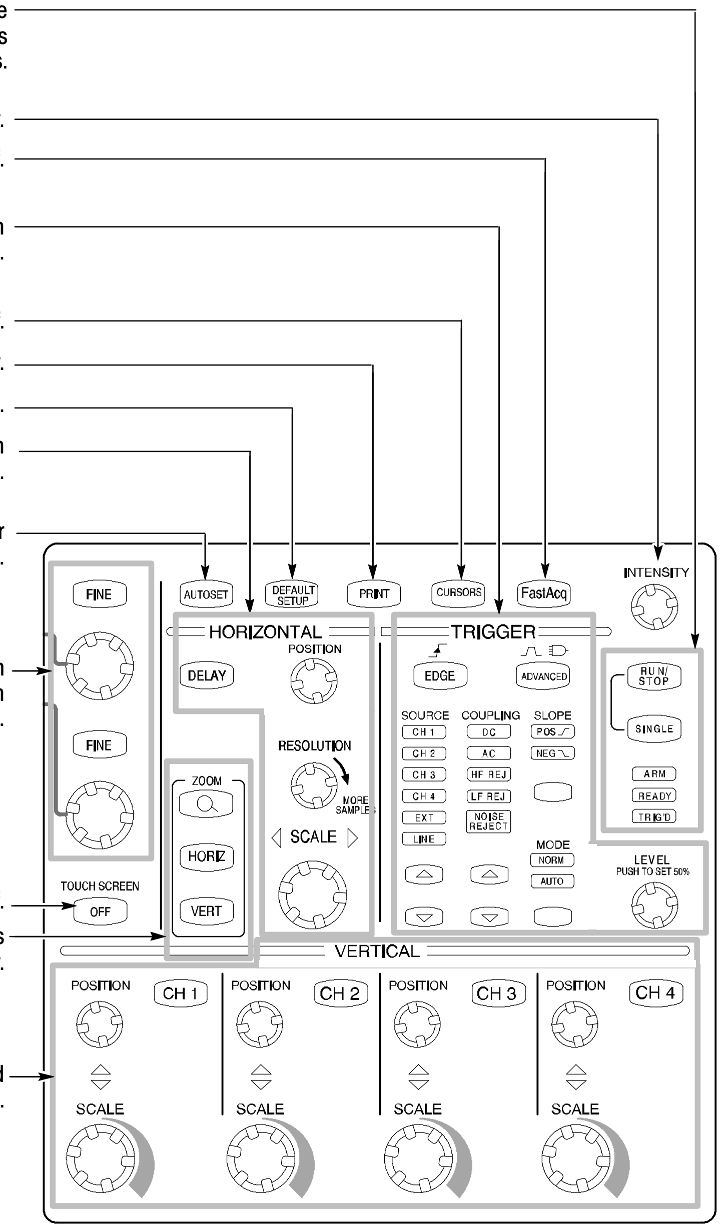
The following illustration shows the instrument in the Menu bar mode. All features of the instrument can be accessed through the menus using a mouse or the touch screen.

When the instrument is in the Tool bar mode, most of the control windows can be accessed by touching buttons at the top of the display.


**Menu Bar:** Access to data I/O, printing, online help system, and oscilloscope functions here
**Status Bar:** Display of acquisition status, mode, and number of acquisitions; trigger status; date; and time
**Waveform Handle:** Touch and drag to change vertical position of waveform. Touch the handle and change the position and scale using the multipurpose knobs
**Display:** Live, reference, & math waveforms display here, along with cursors
**Controls Status:** Quick reference to vertical, horizontal, and trigger selections, scale, and parameters
**Buttons/Menu.** Touch to toggle between tool-bar and menu-bar modes
**Multipurpose Knob Readouts.** Adjust parameters controlled by multipurpose knobs
**Readouts:** Display cursor readouts and measurement readouts in this area, selectable from the menu bar or tool bar
If a control menu is displayed, these readouts move to the graticule area
File
Edit
Vertical
Horiz/Acq
Trig
Display
Cursors
Measure
Math
Utilities
Help
Tek
Run
Sample
28 Nov 00 15:56:44
Buttons
Curs1 Pos
-800.0ns
Curs2 Pos
800.0ns
Ampl(C2) 1.84V

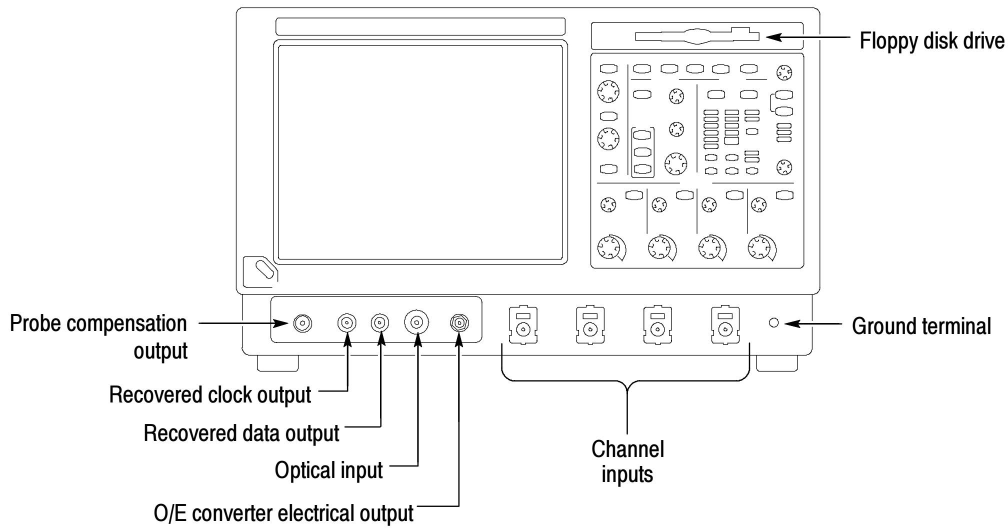
## Front Panel Controls Map

Many of the oscilloscope functions can be controlled directly from the front panel controls or in conjunction with the touch-screen interface.



## Front Panel I/O Map

The following illustration shows the input/output connectors and floppy disk drive location.




## Instrument Diagnostics

Do the following steps to verify the instrument passes the internal diagnostics.

1. Display the diagnostics menu:
   - If the oscilloscope is in tool bar mode, touch the **MENU** button to put the instrument into the menu bar mode.
   - Select **Instrument Diagnostics . . .** from the **Utilities** menu.
2. Run the diagnostics.
   - First disconnect any input signals from all four channels.
   - Touch the **Run** button in the diagnostics control window.
3. Wait for the diagnostics to complete.

   The internal diagnostics do an exhaustive verification of proper oscilloscope function. This verification may take several minutes to complete. When the verification is finished, the resulting status will appear in the diagnostics control window.
4. Verify that no failures are found.

## Signal Path Compensation

Run the Signal Path Compensation.

1. Select **Instrument Calibration . . .** from the **Utilities** menu.

2. Verify that the instrument has had a twenty-minute warm-up before continuing.

3. Touch the **Calibrate** button to start the routine.

4. Wait for the test to complete (the test may take several minutes to complete).

5. Verify that the word **Pass** appears under the Status label in the control window.

## Using the Online Help

The user manual represents only part of the assistance available to you — the online help system, integrated as part of the instrument user interface, provides quick-to-access support for operating this instrument.

Two types of online help are available, the instrument online help and the GPIB online programmer's help. The instrument online help provides information on all of the instrument controls and procedures for doing typical tasks. The GPIB online programmer's help is normally installed on a remote PC and provides information for controlling the instrument via the GPIB. This section mainly discusses the online help for the instrument.

**Accessing Help in the Tool Bar Mode.** When the instrument is in the tool bar mode, touch the Help button in the upper right corner of the screen to display help on whatever control window is displayed. From within the Help window, you can access other help through tabs, links, or buttons. You can also touch the Help Topics button to display the standard Windows Contents, Index, and Find tabs.

**Accessing Help in the Menu Bar Mode.** When the instrument is in the menu bar mode, you can access the help system from the drop-down help menu. Select Help on Window to display help on the current control window. Select Contents and Index to display the standard Windows Contents, Index, and Find tabs. You can also select other topics from the Help menu such as information on Technical Support or product specifications.

**Moving the Help Topics to View the Instrument Display.** You may temporarily move any displayed help out of the way while you change control window settings. Touch the Minimize button in the help window to shrink the help window to a button that displays in the upper right corner of the display (with the label Restore Help). Touch the Restore Help button to restore the help window to its normal size.

# Theory of Operation

This section describes the electrical operation of the instrument. Figure 9-1 on page 9-2 shows the module interconnections.

## 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.

## Module Overviews

Module overviews describes the basic operation of each functional circuit block as shown in Figure 9-1 on page 9-2.

### General

A dual-processor system controls the instrument. The instrument features a VGA resolution flat-panel display, a transparent touch screen, and a front-panel with direct access to commonly used instrument functions. You can also use the instrument with a mouse pointing device or keyboard.

### Input Signal Path

A signal enters the instrument through a direct coaxial connection to the input connector, or a probe connected to the front panel.

**Acquisition Board.** The acquisition board 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. Four vertical channels are accommodated. All channels feature a TekConnect interface for additional front-end signal conditioning functions.

**O/E Converter Board.** The optical-to-electrical converter board converts optical signals at its input to electrical signals. The electrical signals are connected to the CH1 input using an adapter.

**Processor System.** The processor system contains two processor boards with microprocessors that control the entire instrument. The basic configuration supports four input channels labeled Ch1 through Ch 4, provides an external trigger input, a trigger output, a Ch 3 signal output, and a probe compensation output.

Each acquisition channel is equipped with a processor that uses its own host interface to interface to the GCS which in turn communicates with the command interface processor over the multiplexed address/data nibble bus.

## Display Panel

Waveforms and menus are displayed on a 10.4 inch, color, active-matrix LCD display with touch panel.

**Display System.** Text and waveforms are processed by different parts of the display circuitry. The display system (display adapter board and inverter board) sends the text and waveform information to the display panel.

**Touch Panel.** The display board sends information from the touch panel to the processor. Any changes in settings are reported to the processor system.

## Front Panel

The NLX board reads the front-panel switches and encoders. Any changes in their settings are reported to the processor system. The NLX board also turns the LEDs on and off.

**Menu Switches.** Front-panel menu switches are also read by the NLX board. The touch screen processor sends any changes in menu selections to the NLX processor system. The **ON/STBY** switch passes through the CPU board to the NLX board. The NLX board creates the signal sent to the power supply to toggle power.

**Floppy Drive.** The floppy drive provides access to stored waveform data and software to customize your instrument.

**CPU Board.** The CPU board provides fast access to the Acquisition board and the display system. The NLX board reads the front-panel switches and encoders and implements any changes requested by their settings. The CPU board provides a GPIB interface through a rear panel connector.

**NLX Board.** The NLX board provides standard Windows functionality and I/O port interfaces to the rear panel.

**NLX Riser Board.** Both processor systems, the floppy drive, CD drive, and hard drive are connected together by, and communicate through, the riser board.

## Rear Panel

The hard drive and CD provide access to stored waveform data and software to customize your instrument with your measurement needs. The GPIB allows for external control of the instrument.

You can make hardcopies on the GPIB, RS-232, and Centronics ports. Another port from the CPU board: cal adjust lock.

The NLX board has one USB port and one serial port on the rear panel. The NLX has 2 USB channels, but one is used internally, routed to the riser board, and is not available for use. The NLX has one serial port, which is routed to the rear panel. A microphone input and earphone output exist on the NLX rear panel. Ethernet connector is RJ-45. Keyboard and mouse are both PS/2.

## 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 standby power supply.

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

Power is distributed throughout the instrument through the front and rear power distribution bus boards.

## Fans

The fan assembly provides forced air cooling for the instrument. The fans are controlled by the CPU and microprocessor.

# Performance Verification

Two types of Performance Verification procedures can be performed on this product: *Brief Procedures* and *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 brief procedures under *Self Tests*, which begin on page 4-5.

  **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 *Self Tests* just mentioned; then do the brief procedures under *Functional Tests* that begin on page 4-6.

  **Advantages:** These procedures require minimal additional time to perform, require no additional equipment other than a BNC cable and BNC-to-SMA adapter or a TCA-BNC adapter, and these procedures 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 4-17, after doing the *Functional* and *Self Tests* mentioned above.

  **Advantages:** These procedures add direct checking of the warranted specifications that are marked with the ✔ symbol. These procedures require specific test equipment. (See *Table 4-1: Test equipment* on page 4-18).

If you are not familiar with operating this instrument, read the instrument reference or user manuals or explore the online help.

## Conventions

Throughout these procedures the following conventions apply:

- Each test procedure uses the following general format:

  Title of Test

  Equipment Required

  Prerequisites

  Procedure

- Each procedure consists of as many steps, substeps, and subparts as required to do the test. Steps, substeps, and subparts are sequenced as follows:

  **1.** First Step

  **a.** First Substep

  - First Subpart
  - Second Subpart

  **b.** Second Substep

  **2.** Second Step

- In steps and substeps, the lead-in statement in italics instructs you what to do, while the instructions that follow tell you how to do it, as in the example step below:

  *Initialize the instrument:* Push the front-panel **DEFAULT SETUP** button.

- Where instructed to use a control in the display or a front-panel button or knob, the name of the control, button, or knob appears in boldface type. Where instructed to make or verify a setting, the value of the setting also appears in boldface type.

---

***STOP**. The **STOP** notation at the left is accompanied by information you must read to do the procedure properly.*

---

- The term "toolbar" refers to a row of buttons at the top of the display. The term "menu bar" refers to a row of menus at the top of the display. You can switch between toolbar and menu bar operating modes by pushing the button near the top right corner of the display. See Figure 4–1.

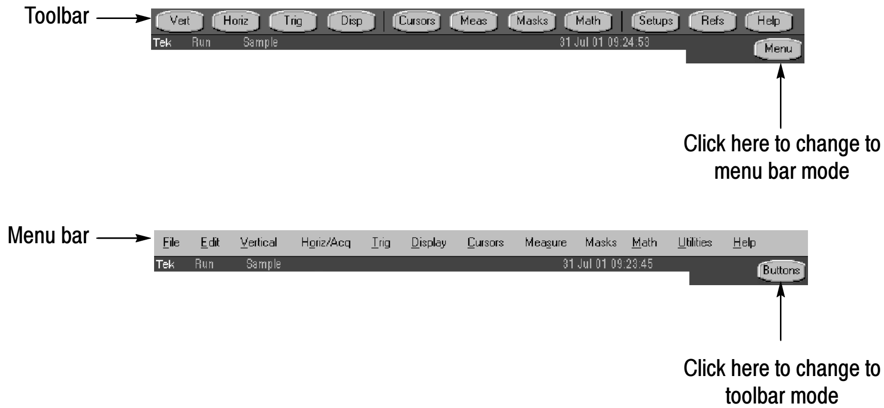



**Figure 4-1: Toolbar and menu bar**

- The procedures assume you have connected a mouse to the instrument so you can click on the screen controls. If you have not connected a mouse, you can use the touch screen to operate all the screen controls.

# Brief Procedures

The *Self Tests* use internal routines to confirm basic functionality and proper adjustment. No test equipment is required to do these test procedures.

The *Functional Tests* utilize the probe-compensation output at the front panel as a test-signal source for further verifying that the instrument functions properly. A BNC cable and a BNC-to-SMA adaptor or a TCA-BNC adapter are required to do these test procedures.

## Self Tests

This procedure uses internal routines to verify that the instrument functions and was adjusted properly. No test equipment or hookups are required.

### Verify Internal Adjustment, Self Compensation, and Diagnostics

| | |
|---|---|
| **Equipment required** | None |
| **Prerequisites** | Power on the instrument and allow a 20 minute warm-up before doing this procedure. |

1. *Verify that internal diagnostics pass:* Do the following substeps to verify passing of internal diagnostics.

   a. *Display the System diagnostics menu:*

      - If the instrument is in toolbar mode, click the **MENU** button to put the instrument into menu bar mode.
      - Pull down the **Utilities** menu and select **Instrument Diagnostics. . . .** This displays the diagnostics control window.

   b. *Run the System Diagnostics:*

      - First disconnect any input signals from all four channels.
      - Click the **Run** button in the diagnostics control window.

   c. *Wait:* The internal diagnostics do an exhaustive verification of proper instrument function. This verification may take several minutes. When the verification is finished, the resulting status will appear in the diagnostics control window.

**NOTE**. *If diagnostic error message 531 is displayed, run signal-path compensation and then rerun Instrument Diagnostics.*

**d.** *Verify that no failures are found and reported on-screen.* All tests should pass.

**e.** *Run the signal-path compensation routine:*

- Pull down the **Utilities** menu and select **Instrument Calibration. . .** . This displays the instrument calibration control window.
- If required because the instrument is in service mode, select the **Signal Path** button under Calibration Area.
- Click the **Calibrate** button to start the routine.

**f.** *Wait:* Signal-path compensation may take five to fifteen minutes to run.

**g.** *Confirm signal-path compensation returns passed status:* Verify that the word ***Pass*** appears in the instrument calibration control window.

**2.** *Return to regular service:* Click the **Close** button to exit the instrument calibration control window.

## Functional Tests

The purpose of these procedures is to confirm that the instrument functions properly. The only equipment required is a P7240 probe, a probe calibration and deskew fixture, a BNC cable, BNC-to-SMA adapter or TCA-BNC adapter, and, to check the file system, a 3.5 inch, 1.44 Mbyte, formatted floppy disk.

**STOP**. *These procedures verify functions; that is, they verify that the instrument features operate. They do not verify that they operate within limits.*

*Therefore, when the instructions in the functional tests that follow call for you to verify that a signal appears on-screen "that is about five divisions in amplitude" or "has a period of about six horizontal divisions," etc., do NOT interpret the quantities given as limits. Operation within limits is checked in* Performance Tests*, which begin on page 4-17.*

***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 certain 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, just redo the procedure from step **1**.*

*When you are instructed to press a front-panel or screen button, the button may already be selected (its label will be highlighted). If this is the case, it is not necessary to press the button.*

## Verify All Input Channels

| | |
|---|---|
| **Equipment required** | One P7240 probe<br>One probe calibration and deskew fixture (067-0405-xx)<br>One BNC cable, such as Tektronix part number 012-0076-xx or the cable that came with the deskew fixture (012-0208-xx) |
| **Prerequisites** | None |

1. *Initialize the instrument:* Push the front-panel **DEFAULT SETUP** button.
2. *Hook up the signal source:* Install a P7240 probe in the channel input you want to test (beginning with CH 1). Connect the BNC cable from the probe compensation output to the A input of the probe calibration and deskew fixture and connect the probe tip to the deskew fixture as shown in Figure 4-2. Remove the jumper from the fixture.

***NOTE**. If a P7240 probe is not available, connect the probe compensation output to the channel input using a BNC cable and adapters.*

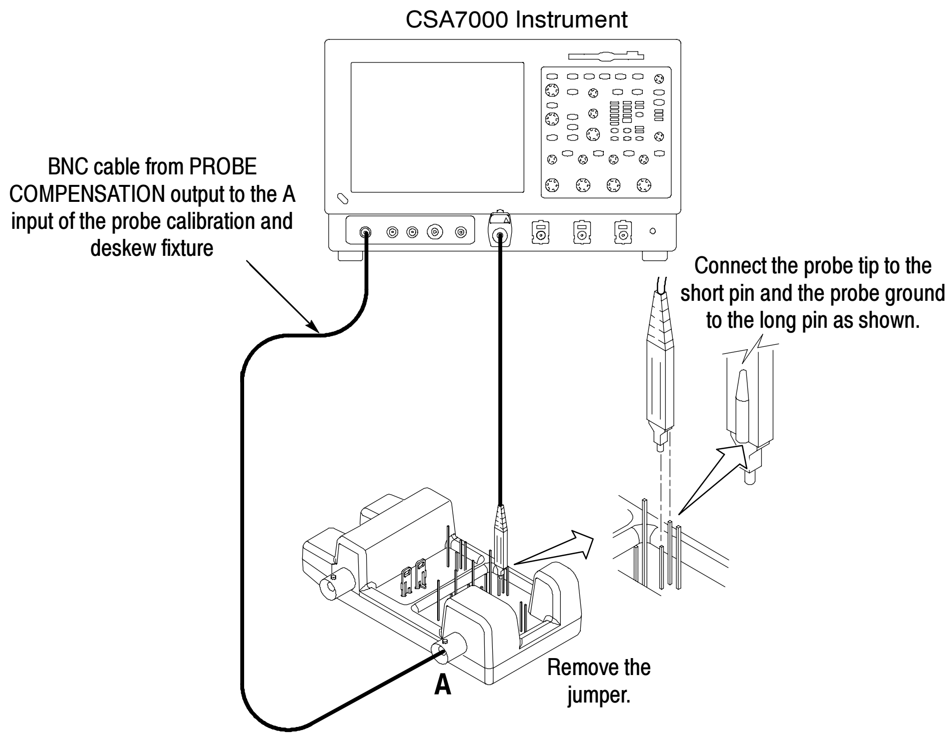



**Figure 4-2: Universal test hookup for functional tests - CH 1 shown**

3. *Turn off all channels:*If any of the front-panel channel buttons are lighted, push those buttons to turn off the displayed channels. See Figure 4-3.

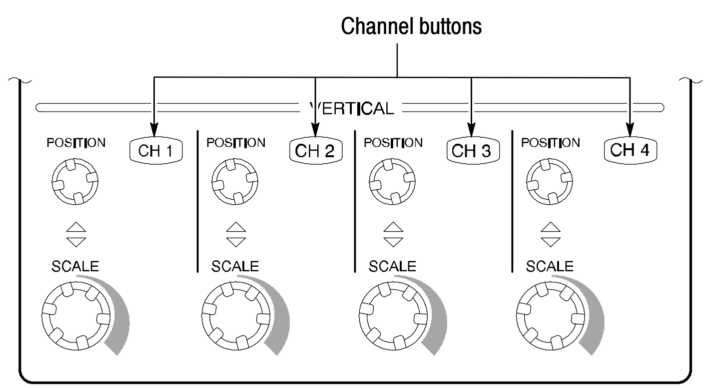



**Figure 4-3: Channel button location**

4. *Select the channel to test:* Push the channel button for the channel you are currently testing. The button lights and the channel display comes on.

5. *Set up the instrument:*

   - Push the front panel **AUTOSET** button. This sets the horizontal and vertical scale and vertical offset for a usable display and sets the trigger source to the channel you are testing.
   - Pull down the **Vert** menu, select Vertical Setup, and then touch **Offset**. Confirm that the Ch1 Offset is about **1.6 V** (0.0 V if not using a P7240 probe).

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 about 100 mV (500 mV if not using a P7240 probe), and a square-wave probe-compensation signal is displayed on-screen.
   - The front-panel vertical **POSITION** knob (for the channel you are testing) moves the signal up and down the screen when rotated.
   - Turning the vertical **SCALE** knob counterclockwise (for the channel you are testing) decreases the amplitude of the waveform on-screen, turning the knob clockwise increases the amplitude, and returning the knob to 100 mV (500 mV if not using a P7240 probe) returns the amplitude to about 4 divisions (0.4 divisions if not using a P7240 probe).

7. *Verify that the channel acquires in all acquisition modes:* Pull down the **Horiz/Acq** menu to select **Horizontal/Acquisition Setup. . . .** Click the **Acquisition** tab in the control window that displays. Click each of the 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 square wave).
   - Peak Detect mode displays an actively acquiring waveform on-screen with the noise present in Sample mode “peak detected.”
   - Hi Res mode displays an actively acquiring waveform on-screen with the noise that was present in Sample mode reduced.
   - Average mode displays an actively acquiring waveform on-screen with the noise reduced.
   - Envelope mode displays an actively acquiring waveform on-screen with the noise displayed.
   - Waveform Database mode displays an actively acquiring waveform on-screen with the noise displayed.

8. *Test all channels:* Repeat steps **2** through **7** until all four input channels are verified.

9. *Remove the test hookup:* Disconnect the BNC cable, fixture, and the probe from the channel input and the probe compensation output. Reinstall the jumper on the calibration and deskew fixture.

## Verify the Time Base

| | |
|---|---|
| **Equipment required** | One BNC cable, such as Tektronix part number 012-0076-00<br>One TCA-BNC adapter |
| **Prerequisites** | None |

1. *Initialize the instrument:*Push the front-panel **DEFAULT SETUP** button.

2. *Hook up the signal source:* Connect the BNC cable from the probe compensation output to the CH 1 input through a TCA-BNC adapter as shown in Figure 4–4.

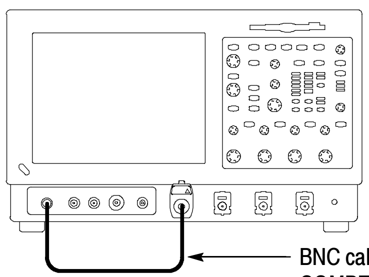



**Figure 4-4: Setup for time base test**

3. *Set up the instrument:* Push the front panel **AUTOSET** button.

4. Pull down the **Vert** menu, select Vertical Setup, and then touch **Offset**. Adjust the Ch1 Offset to **0.8 V** using the multipurpose knob.

5. Set the **Vertical SCALE** to **100 mV** per division.

6. *Set the time base:* Set the horizontal **SCALE** to **200 μs/div**. The time-base readout is displayed at the bottom of the graticule.

7. *Verify that the time base operates:* Confirm the following statements.

   - One period of the square-wave probe-compensation signal is about five horizontal divisions on-screen for the 200 μs/div horizontal scale setting.

   - 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 200 μs/div returns the period to about five divisions.

- The horizontal **POSITION** knob positions the signal left and right on-screen when rotated.

**8.** *Verify horizontal delay:*

**a.** *Center a rising edge on screen:*

- Set the horizontal **POSITION** knob so that the rising edge where the waveform is triggered is lined up with the center horizontal graticule.
- Change the horizontal **SCALE** to **20 μs/div**. The rising edge of the waveform should remain near the center graticule and the falling edge should be off screen.

**b.** *Turn on and set horizontal delay:*

- Pull down the **Horiz/Acq** menu to select **Horizontal/Acquisition Setup. . . .**
- Click the **Horizontal** tab in the control window that displays.
- Click the **Delay Mode** button to turn delay on.
- Double click the **Horiz Delay** control in the control window to display the pop-up keypad. Click the keypad buttons to set the horizontal delay to **500 μs** and then click the **ENTER** key.

**c.** *Verify the waveform:* Verify that a falling edge of the waveform is within a few divisions of center screen.

**d.** *Adjust the horizontal delay:* Rotate the upper multipurpose knob to change the horizontal delay setting. Verify that the falling edge shifts horizontally. Rotate the front-panel horizontal **POSITION** knob. Verify that this knob has the same effect (it also adjusts delay, but only when delay mode is on).

**e.** *Verify the delay toggle function:*

- Rotate the front-panel horizontal **POSITION** knob to center the falling edge horizontally on the screen.
- Change the horizontal **SCALE** to **40 ns/div**. The falling edge of the waveform should remain near the center graticule. If not, readjust the delay setting to center the falling edge.
- Push the front-panel **DELAY** button several times to toggle delay off and on and back off again. Verify that the display switches quickly between two different points in time (the rising and falling edges of this signal).

9. *Remove the test hookup:* Disconnect the BNC cable from the channel input and the probe compensation output.

## Verify the A (Main) and B (Delayed) Trigger Systems

| | |
|---|---|
| **Equipment required** | One BNC cable, such as Tektronix part number 012-0076-00<br>One TCA-BNC adapter |
| **Prerequisites** | None |

1. *Initialize the instrument:* Push the front-panel **DEFAULT SETUP** button.

2. *Hook up the signal source:* Connect the BNC cable from the probe compensation output to the CH 1 input through a TCA-BNC adapter as shown in Figure 4-5.

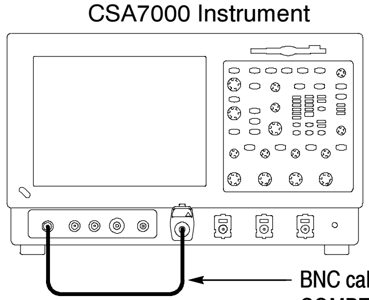



**Figure 4-5: Setup for trigger test**

3. *Set up the instrument:* Push the front-panel **AUTOSET** button.

4. Pull down the **Vert** menu, select Vertical Setup, and then touch **Offset**. Adjust the Ch1 Offset to **0.8 V** using the multipurpose knob.

5. Set the **Vertical SCALE** to **100 mV** per division.

6. *Verify that the main trigger system operates:* Confirm that the following statements are true.

   - The trigger level readout for the A (main) trigger system changes with the trigger-**LEVEL** knob.

   - The trigger-**LEVEL** knob can trigger and untrigger the square-wave signal as you rotate it. (Leave the signal *un*triggered).

   - Pushing the front-panel trigger **LEVEL** knob sets the trigger level to the 50% amplitude point of the signal and triggers the signal that you just left untriggered. (Leave the signal triggered.)

7. *Verify that the delayed trigger system operates:*

   a. *Set up the delayed trigger:*

      - Pull down the **Trig** menu and select **A — B Trigger Sequence. . . .** This displays the A→B Sequence tab of the trigger setup control window.
      - Click the **Trig After Time** button under A Then B.
      - Click the **B Trig Level** control in the control window.

   b. *Confirm that the following statements are tru*e:

      - The trigger-level readout for the B trigger system changes as you turn the lower multipurpose knob.
      - As you rotate the lower multipurpose knob, the square-wave probe-compensation signal can become triggered and untriggered. (Leave the signal triggered.)

   c. *Verify the delayed trigger counter:*

      - Double click the **Trig Delay** control to pop up a numeric keypad for that control.
      - Click the keypad to enter a trigger delay time of **1 second** and then click **Enter**.
      - Verify that the trigger **READY** indicator on the front panel flashes about once every second as the waveform is updated on-screen.

8. *Remove the test hookup:* Disconnect the BNC cable from the channel input and the probe compensation output.

## Verify the File System

| | |
|---|---|
| **Equipment required** | One BNC cable, such as Tektronix part number 012-0076-00<br>One TCA-BNC adapter<br>One 1.44 Mbyte, 3.5 inch DOS-compatible formatted disk. |
| **Prerequisites** | None |

1. *Initialize the instrument:* Push the front-panel **DEFAULT SETUP** button.
2. *Hook up the signal source:* Connect the BNC cable from the probe compensation output to the CH 1 input through a TCA-BNC adapter as shown in Figure 4–6.

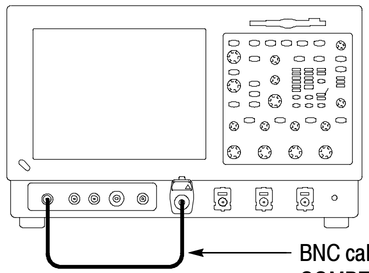



**Figure 4-6: Setup for the file system test**

3. *Insert the test disk:* Insert the floppy disk in the floppy disk drive at the top left of the front panel.
4. *Set up the instrument:* Push the front panel **AUTOSET** button.
5. Pull down the **Vert** menu, select **Vertical Setup**, and then touch **Offset**. Adjust the Ch1 Offset to **0.8 V** using the multipurpose knob.
6. Set the **Vertical SCALE** to **100 mV** per division.
7. *Set the time base:* Set the horizontal **SCALE** to **1 ms/div**. The time-base readout is displayed at the bottom of the graticule.
8. *Save the settings:*
   a. Pull down the **File** menu to select **Instrument Setup. . .** . This displays the instrument setups control window.
   b. Click the **Save** button under Save settings to file in the control window. This displays a familiar Windows dialog box for choosing a destination folder naming the file.
   c. In the Save Instrument Setups As dialog box, select the **3$^1/_2$ Floppy (A:)** icon in the **Save in:** drop-down list to set the save destination to the floppy disk.
   d. Note the default file name and then click the **Save** button to save the setup to the default file name.
9. *Change the settings again:* Set the horizontal **SCALE** to **200 µs/div**.
10. *Verify the file system works:*
    a. Click the **Recall Setups** tab in the control window.

**b.** Click the **Recall** button under Recall settings from file in the control window. This displays a familiar Windows dialog box for locating the settings file that you want to recall.

**c.** In the Recall Save Instrument Setups From dialog box, select the **$3^1/_2$ Floppy (A:)** icon in the **Look in:** drop-down list.

**d.** Locate and then double click in the dialog box on the setup file that you previously stored.

**e.** Verify that the instrument retrieved the saved setup from the disk. Do this by noticing the horizontal **SCALE** is again 1 ms and the waveform shows ten cycles just as it did when you saved the setup.

**11.** *Remove the test hookup:*

**a.** Disconnect the BNC cable and adapter from the channel input and the probe compensation output.

**b.** Remove the floppy disk from the floppy disk drive.

# Performance Tests

This section contains a collection of manual procedures for checking that CSA7000 Series Communications Signal Analyzers perform as warranted.

The procedures are arranged in logical groupings: *Signal Acquisition System Checks, Time Base System Checks, Triggering System Checks*, *Output Ports Checks, Serial Trigger Checks, and Optical-to-Electrical Converter Checks*. They check all the characteristics that are designated as checked in *Specifications.* (The characteristics that are checked appear with a ✓ in *Specifications*).

---

***STOP****. These procedures extend the confidence level provided by the basic procedures described on page 4-5. The basic procedures should be done first, then these procedures performed if desired.*

---

## 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 procedures under *Self Tests,* found on page 4-5, and those under *Functional Tests,* found on page 4-6.
- A signal-path compensation must have been done within the recommended calibration interval and at a temperature within ±5 °C of the present operating temperature. (If at the time you did the prerequisite *Self Tests,* the temperature was within the limits just stated, consider this prerequisite met). A signal-path compensation must have been done at an ambient humidity within 25% of the current ambient humidity and after having been at that humidity for at least 4 hours.
- The instrument must have been last adjusted at an ambient temperature between +20 °C and +30 °C, must have been operating for a warm-up period of at least 20 minutes, and must be operating at an ambient temperature as listed in Table 1-12. (The warm-up requirement is usually met in the course of meeting the Self Tests and Functional Tests prerequisites listed above).

# Equipment Required

Procedures starting on page 4–35, use external, traceable signal sources to directly check warranted characteristics. Table 4–1 lists the required equipment.

**Table 4-1: Test equipment**

| Item number and description | Minimum requirements | Example | Purpose |
|---|---|---|---|
| 1. Attenuator,10X (two required) | Ratio: 10X; impedance 50 Ω; connectors: female BNC input, male BNC output | Tektronix part number 011-0059-02 | Signal Attenuation |
| 2. Attenuator, 5X | Ratio: 5X; impedance 50 Ω; connectors: female BNC input, male BNC output | Tektronix part number 011-0060-02 | Signal Attenuation |
| 3. Terminator, 50 Ω (three required) | Impedance 50 Ω; connectors: female BNC input, male BNC output | Tektronix part number 011-0049-02 | Signal Termination for Channel Delay Test |
| 4. Cable, Precision 50 Ω Coaxial (three required) | 50 Ω, 36 in, male-to-male BNC connectors | Tektronix part number 012-0482-00 | Signal Interconnection |
| 5. Connector, Dual-Banana (two required) | Female BNC-to-dual banana | Tektronix part number 103-0090-00 | Various Accuracy Tests |
| 6. Connector, BNC "T" | Male BNC-to-dual female BNC | Tektronix part number 103-0030-00 | Checking Trigger Sensitivity |
| 7. Coupler, Dual-Input | Female BNC-to-dual male BNC | Tektronix part number 067-0525-02 | Checking Delay Between Channels |
| 8. Probe, 10X | A P7240 probe | Tektronix part number P7240 | Signal Interconnection |
| 9. Floppy disk | 3.5 inch 1.44 Mbyte, DOS-compatible floppy disk | Standard IBM PC-compatible disk | Checking File System Basic Functionality |
| 10. Generator, DC Calibration | Variable amplitude to ±7 V; accuracy to 0.1% | Fluke 9500B[1] | Checking DC Offset, Gain, Measurement Accuracy, and Maximum Input Voltage |
| 11. Generator, Calibration | 500 mV square wave calibrator amplitude; accuracy to 0.25% | Fluke 9500B[1] | To check accuracy of Signal Out |
| 12. Timer-counter | 25 MHz, 1 s gate | Advantest R5360 | Checking long-term sample rate and delay time accuracy |
| 13. Generator, Sine-Wave[3] | 5 kHz to at least 6 GHz. Variable amplitude from 60 mV to 2 $V_{p-p}$ into 50 Ω. Frequency error <2.0% | Rohde & Schwarz SMT06 with options 01 and 02 | Checking Analog Bandwidth, Trigger Sensitivity, Sample-rate, External Clock, and Delay-Time Accuracy |
| 14. Meter, Level and Power Sensor | Frequency range: 10 MHz to the instrument bandwidth. Amplitude range: 6 $mV_{p-p}$ to 2 $V_{p-p}$ | Rohde & Schwarz NRVS and NRV-Z402 | Checking Analog Bandwidth and Trigger Sensitivity |
| 15. Splitter, Power | Frequency range: DC to 4 GHz. Tracking: >2.0% | Tektronix part number 015-0565-00 | Checking Analog Bandwidth |

**Table 4- 1: Test equipment (Cont.)**

| Item number and description | Minimum requirements | Example | Purpose |
|---|---|---|---|
| 16. Adapter (four required) | Male N-to-female BNC | Tektronix part number 103-0045-00 | Checking Analog Bandwidth |
| 17. Adapter | Female N-to-male BNC | Tektronix part number 103-0058-00 | Checking Analog Bandwidth |
| 18. Adapter (three required) | SMA female-to-female | Tektronix part number 015-1012-00 | Checking the delay between channels |
| 19. Adapter (three required) | SMA male-to-female BNC | Tektronix part number 015-1018-00 | Checking the delay between channels |
| 20. Adapter (four required) | SMA male-to-BNC female | TCA-BNC or TCA-SMA and SMA male-to-BNC female adapter (Tektronix part number 015-0554-00 or 015-1018-00) | Signal interconnection |
| 21. Pulse Generator | 2 MHz, $\leq$150 ps rise time, 5 V out | Fluke 9500B[1,2] | Used to Test Delta Time Measurement Accuracy |
| 22. Cable, Coaxial (two required) | 50 Ω, 20 in, male-to-male SMA connectors | Tektronix part number 174-1427-00 | Used to Test Delta Time Measurement Accuracy |
| 23. Adapter | SMA "T", male to 2 SMA female | Tektronix part number 015-1016-00 | Used to Test Delta Time Measurement Accuracy |
| 24. Adapter | SMA female to BNC male | Tektronix part number 015-0572-00 | Used to Test Delta Time Measurement Accuracy |
| 25. Adapter | BNC male to female elbow | Tektronix part number 103-0031-00 | Used to Test Delta Time Measurement Accuracy |
| 26. Terminator (two required) | Short circuit, SMA connector | Tektronix part number 015-1021-00 | Used to Test Delta Time Measurement Accuracy |
| 27. Attenuator, 2X | Ratio: 2X; impedance 50 Ω; connectors: female BNC input, male BNC output | Tektronix part number 011-0069-02 | Used to Test Delta Time Measurement Accuracy |
| 28. Digital Multimeter | Ohms: <60 Ohms | Keithley 2000 | Checking input impedance |
| 29. Optical Impulser | 1550 nm impulse | Calmar FPL-01 Optical Impulser | Calmar FPL-01 Optical Impulser |
| 30. CW laser source | 780 nm, 850 nm, 1310 nm, and 1550 nm | JDS Uniphase 420B laser transmitter and Rifocs 716R with 702RT8.5 controller | Optical tests |
| 31. Optical attenuator, variable | Multimode input and output, 0 to 60 dB | Tektronix OA5022 Optical Attenuator | Optical tests |
| 32. Optical power meter | 780 nm, 850 nm, 1310 nm, and 1550 nm | Agilent 8163A with 81618A optical head interface, 81625B InGaAs optical head and 81000FA FC/PC/SPC/APC connector adapter | Optical tests |

**Table 4-1: Test equipment (Cont.)**

| Item number and description | Minimum requirements | Example | Purpose |
|---|---|---|---|
| 33. Adapter | O/E electrical out to CH1 input | Tektronix part number 013-0327-00 | Used to test O/E converter |
| 34. Adapter | O/E electrical out to SMA | Tektronix part number 013-0326-00 | Used to test O/E converter |
| 35. Cable, fiber-optic (two required) | multimode, 2 m, FC/PC to FC/PC | Tektronix part number 174-2322-00 | Tektronix part number 174-1910-00 |
| 36. Attenuator, optical | 30mm, 10 dB, FC to FC, female to male | Tektronix part number 119-5118-00 | Tektronix part number 119-5118-00 |
| 37. Cable, coaxial | 50 Ω, 39.37 in (1.0m), male-to-male SMA connectors<br>50 Ω, 60 in (1.5m), male-to-male SMA connectors | Tektronix part number 174-1341-00<br><br>Tektronix part number 174-1428-00 | Tektronix part number 174-1341-00<br><br>Tektronix part number 174-1428-00 |
| 38. Terminator | 50 Ω, coaxial terminator, K male | Anritsu-Wiltron 28K50 | Anritsu-Wiltron 28K50 |
| 39. Dust cap | No light transmission | Dust cap provided with optical input | Dark level calibration and optical noise check |

[1] **Fluke 9500B/1100, 9500B/3200, or 9500B/2200 and an output head (9510, 9530, or 9560) appropriate for the bandwidth of the instrument being tested.**

[2] **For Delta Time Measurement Accuracy, use a Fluke 9500B or a pulse generator with a rise time as shown in Table 4-8 on page 4-79.**

[3] **On Instruments with a bandwidth ≤ 3 GHz, items 13, 14, and 15 may be replaced with a Fluke 9500B and an appropriate output head.**

# CSA7000 Test Record

Photocopy this table and use it to record the performance test results for your CSA7000 Series Instrument.

### CSA 7000 Test Record

| | | | |
|---|---|---|---|
| Instrument Serial Number: | ______________ | Certificate Number: | ______________ |
| Temperature: | ______________ | RH %: | ______________ |
| Date of Calibration: | ______________ | Technician: | ______________ |

| CSA7000 performance test | | Minimum | Incoming | Outgoing | Maximum |
|---|---|---|---|---|---|
| DC voltage measurement accuracy (averaged) | | | | | |
| CH1 | 2 mV Vert scale setting, -5 Div position setting, +0.5 V offset | + 512.8 mV | ________ | ________ | + 519.21 mV |
| CH1 | 2 mV Vert scale setting, +5 Div position setting, -0.5 V offset | - 519.21 mV | ________ | ________ | - 512.8 mV |
| CH1 | 50 mV Vert scale setting, -5 Div position setting, +0.5 V offset | + 881.63 mV | ________ | ________ | + 918.38 mV |
| CH1 | 50 mV Vert scale setting, +5 Div position setting, -0.5 V offset | - 918.38 V | ________ | ________ | - 881.63 mV |
| CH1 | 100 mV Vert scale setting, -5 Div position setting, +4.8 V offset | + 4.94 V | ________ | ________ | + 5.06 V |
| CH1 | 100 mV Vert scale setting, +5 Div position setting, -4.8 V offset | - 5.06 V | ________ | ________ | - 4.94 V |
| CH1 | 1.0 V Vert scale setting, -5 Div position setting, +2.5 V offset | + 4.17 V | ________ | ________ | + 4.83 V |
| CH1 | 1.0 V Vert scale setting, +5 Div position setting, -2.5 V offset | - 4.83 V | ________ | ________ | - 4.17 V |
| CH2 | 2 mV Vert scale setting, -5 Div position setting, +0.5 V offset | + 512.8 mV | ________ | ________ | + 519.21 mV |
| CH2 | 2 mV Vert scale setting, +5 Div position setting, -0.5 V offset | - 519.21 mV | ________ | ________ | - 512.8 mV |
| CH2 | 50 mV Vert scale setting, -5 Div position setting, +0.5 V offset | + 881.63 mV | ________ | ________ | + 918.38 mV |
| CH2 | 50 mV Vert scale setting, +5 Div position setting, -0.5 V offset | - 918.38 V | ________ | ________ | - 881.63 mV |
| CH2 | 100 mV Vert scale setting, -5 Div position setting, +4.8 V offset | + 4.94 V | ________ | ________ | + 5.06 V |
| CH2 | 100 mV Vert scale setting, +5 Div position setting, -4.8 V offset | - 5.06 V | ________ | ________ | - 4.94 V |
| CH2 | 1.0 V Vert scale setting, -5 Div position setting, +2.5 V offset | + 4.17 V | ________ | ________ | + 4.83 V |

**CSA 7000 Test Record (cont.)**

| | | | |
|---|---|---|---|
| Instrument Serial Number: | __________ | Certificate Number: | __________ |
| Temperature: | __________ | RH %: | __________ |
| Date of Calibration: | __________ | Technician: | __________ |

| CSA7000 performance test | | Minimum | Incoming | Outgoing | Maximum |
|---|---|---|---|---|---|
| CH2 | 1.0 V Vert scale setting, +5 Div position setting, −2.5 V offset | - 4.83 V | ________ | ________ | - 4.17 V |
| CH3 | 2 mV Vert scale setting, −5 Div position setting, +0.5 V offset | + 512.8 mV | ________ | ________ | + 519.21 mV |
| CH3 | 2 mV Vert scale setting, +5 Div position setting, −0.5 V offset | - 519.21 mV | ________ | ________ | - 512.8 mV |
| CH3 | 50 mV Vert scale setting, −5 Div position setting, +0.5 V offset | + 881.63 mV | ________ | ________ | + 918.38 mV |
| CH3 | 50 mV Vert scale setting, +5 Div position setting, −0.5 V offset | - 916.50 V | ________ | ________ | - 881.63 mV |
| CH3 | 100 mV Vert scale setting, −5 Div position setting, +4.8 V offset | + 4.94 V | ________ | ________ | + 5.06 V |
| CH3 | 100 mV Vert scale setting, +5 Div position setting, −4.8 V offset | - 5.06 V | ________ | ________ | - 4.94 V |
| CH3 | 1.0 V Vert scale setting, −5 Div position setting, +2.5 V offset | + 4.17 V | ________ | ________ | + 4.83 V |
| CH3 | 1.0 V Vert scale setting, +5 Div position setting, −2.5 V offset | - 4.83 V | ________ | ________ | - 4.17 V |
| CH4 | 2 mV Vert scale setting, −5 Div position setting, +0.5 V offset | + 512.8 mV | ________ | ________ | + 519.21 mV |
| CH4 | 2 mV Vert scale setting, +5 Div position setting, −0.5 V offset | - 519.21 mV | ________ | ________ | - 512.8 mV |
| CH4 | 50 mV Vert scale setting, −5 Div position setting, +0.5 V offset | + 881.63 mV | ________ | ________ | + 918.38 mV |
| CH4 | 50 mV Vert scale setting, +5 Div position setting, −0.5 V offset | - 918.38 V | ________ | ________ | - 881.63 mV |
| CH4 | 100 mV Vert scale setting, −5 Div position setting, +4.8 V offset | + 4.94 V | ________ | ________ | + 5.06 V |
| CH4 | 100 mV Vert scale setting, +5 Div position setting, −4.8 V offset | - 5.06 V | ________ | ________ | - 4.94 V |
| CH4 | 1.0 V Vert scale setting, −5 Div position setting, +2.5 V offset | + 4.17 V | ________ | ________ | + 4.83 V |
| CH4 | 1.0 V Vert scale setting, +5 Div position setting, −2.5 V offset | - 4.83 V | ________ | ________ | - 4.17 V |

## CSA 7000 Test Record (cont.)

| | | | |
|---|---|---|---|
| Instrument Serial Number: | __________ | Certificate Number: | __________ |
| Temperature: | __________ | RH %: | __________ |
| Date of Calibration: | __________ | Technician: | __________ |

| CSA7000 performance test | | Minimum | Incoming | Outgoing | Maximum |
|---|---|---|---|---|---|
| DC gain accuracy (averaged) | | | | | |
| CH1 | 2 mV Vert scale setting, | | | | |
| | 0 Div position setting, 0 V offset | + 14.820 mV | ________ | ________ | + 15.580 mV |
| | -5 Div position setting, +0.5 V offset | + 14.355 mV | ________ | ________ | + 16.045 mV |
| | +5 Div position setting, -0.5 V offset | - 14.355 mV | ________ | ________ | - 16.045 mV |
| CH1 | 5 mV Vert scale setting, | | | | |
| | 0 Div position setting, 0 V offset | + 37.240 mV | ________ | ________ | + 38.760 mV |
| | -5 Div position setting, +0.5 V offset | + 36.841 mV | ________ | ________ | + 39.159 mV |
| | +5 Div position setting, -0.5 V offset | - 36.841 mV | ________ | ________ | - 39.159 mV |
| CH1 | 10 mV Vert scale setting, | | | | |
| | 0 Div position setting, 0 V offset | + 74.480 mV | ________ | ________ | + 77.520 mV |
| | -5 Div position setting, +0.5 V offset | + 73.644 mV | ________ | ________ | + 78.356 mV |
| | +5 Div position setting, -0.5 V offset | - 73.644 mV | ________ | ________ | - 78.356 mV |
| CH1 | 20 mV Vert scale setting, | | | | |
| | 0 Div position setting, 0 V offset | + 148.960 mV | ________ | ________ | + 155.040 mV |
| | -5 Div position setting, +0.5 V offset | + 147.136 mV | ________ | ________ | + 156.864 mV |
| | +5 Div position setting, -0.5 V offset | - 147.136 mV | ________ | ________ | - 156.864 mV |
| CH1 | 50 mV Vert scale setting, | | | | |
| | 0 Div position setting, 0 V offset | + 372.400 mV | ________ | ________ | + 387.600 mV |
| | -5 Div position setting, +0.5 V offset | + 366.700 mV | ________ | ________ | + 393.300 mV |
| | +5 Div position setting, -0.5 V offset | - 366.700 mV | ________ | ________ | - 393.300 mV |
| CH1 | 100 mV Vert scale setting, | | | | |
| | 0 Div position setting, 0 V offset | + 744.800 mV | ________ | ________ | + 775.200 mV |
| | 0 Div position setting, +4.5 V offset | + 737.960 mV | ________ | ________ | + 782.040 mV |
| | 0 Div position setting, -4.5 V offset | - 737.960 mV | ________ | ________ | - 782.040 mV |
| CH1 | 200 mV Vert scale setting, | | | | |
| | 0 Div position setting, 0 V offset | + 1.490 mV | ________ | ________ | + 1.550 mV |
| | 2 Div position setting, +4.6 V offset | + 1.477 mV | ________ | ________ | + 1.563 mV |
| | -2 Div position setting, -4.6 V offset | - 1.477 mV | ________ | ________ | - 1.563 mV |
| CH1 | 500 mV Vert scale setting, | | | | |
| | 0 Div position setting, 0 V offset | + 3.724 V | ________ | ________ | + 3.876 V |
| | 4 Div position setting, +5 V offset | + 3.701 V | ________ | ________ | + 3.899 V |
| | -4 Div position setting, -5 V offset | - 3.701 V | ________ | ________ | - 3.899 V |
| CH1 | 1.0 V Vert scale setting, | | | | |
| | 0 Div position setting, 0 V offset | + 7.448 V | ________ | ________ | + 7.752 V |
| | 0 Div position setting, +2.5 V offset | + 5.856 V | ________ | ________ | + 6.144 V |
| | 0 Div position setting, -2.5 V offset | - 5.856 V | ________ | ________ | - 6.144 V |

**CSA 7000 Test Record (cont.)**

| | | | |
|---|---|---|---|
| Instrument Serial Number: | __________ | Certificate Number: | __________ |
| Temperature: | __________ | RH %: | __________ |
| Date of Calibration: | __________ | Technician: | __________ |

| CSA7000 performance test | | Minimum | Incoming | Outgoing | Maximum |
|---|---|---|---|---|---|
| CH2 | 2 mV Vert scale setting, | | | | |
| | 0 Div position setting, 0 V offset | + 14.820 mV | ________ | ________ | + 15.580 mV |
| | -5 Div position setting, +0.5 V offset | + 14.355 mV | ________ | ________ | + 16.045 mV |
| | 5 Div position setting, -0.5 V offset | - 14.355 mV | ________ | ________ | - 16.045 mV |
| CH2 | 5 mV Vert scale setting, | | | | |
| | 0 Div position setting, 0 V offset | + 37.240 mV | ________ | ________ | + 38.760 mV |
| | -5 Div position setting, +0.5 V offset | + 36.841 mV | ________ | ________ | + 39.159 mV |
| | 5 Div position setting, -0.5 V offset | - 36.841 mV | ________ | ________ | - 39.159 mV |
| CH2 | 10 mV Vert scale setting, | | | | |
| | 0 Div position setting, 0 V offset | + 74.480 mV | ________ | ________ | + 77.520 mV |
| | -5 Div position setting, +0.5 V offset | + 73.644 mV | ________ | ________ | + 78.356 mV |
| | 5 Div position setting, -0.5 V offset | - 73.644 mV | ________ | ________ | - 78.356 mV |
| CH2 | 20 mV Vert scale setting, | | | | |
| | 0 Div position setting, 0 V offset | + 148.960 mV | ________ | ________ | + 155.040 mV |
| | -5 Div position setting, +0.5 V offset | + 147.136 mV | ________ | ________ | + 156.864 mV |
| | 5 Div position setting, -0.5 V offset | - 147.136 mV | ________ | ________ | - 156.864 mV |
| CH2 | 50 mV Vert scale setting, | | | | |
| | 0 Div position setting, 0 V offset | + 372.400 mV | ________ | ________ | + 387.600 mV |
| | -5 Div position setting, +0.5 V offset | + 366.700 mV | ________ | ________ | + 393.300 mV |
| | 5 Div position setting, -0.5 V offset | - 366.700 mV | ________ | ________ | - 393.300 mV |
| CH2 | 100 mV Vert scale setting, | | | | |
| | 0 Div position setting, 0 V offset | + 744.800 mV | ________ | ________ | + 775.200 mV |
| | 0 Div position setting, +4.5 V offset | + 737.960 mV | ________ | ________ | + 782.040 mV |
| | 0 Div position setting, -4.5 V offset | - 737.960 mV | ________ | ________ | - 782.040 mV |
| CH2 | 200 mV Vert scale setting, | | | | |
| | 0 Div position setting, 0 V offset | + 1.490 mV | ________ | ________ | + 1.550 mV |
| | 2 Div position setting, +4.6 V offset | + 1.477 mV | ________ | ________ | + 1.563 mV |
| | -2 Div position setting, -4.6 V offset | - 1.477 mV | ________ | ________ | - 1.563 mV |
| CH2 | 500 mV Vert scale setting, | | | | |
| | 0 Div position setting, 0 V offset | + 3.724 V | ________ | ________ | + 3.876 V |
| | 4 Div position setting, +5 V offset | + 3.701 V | ________ | ________ | + 3.899 V |
| | -4 Div position setting, -5 V offset | - 3.701 V | ________ | ________ | - 3.899 V |
| CH2 | 1.0 V Vert scale setting, | | | | |
| | 0 Div position setting, 0 V offset | + 7.448 V | ________ | ________ | + 7.752 V |
| | 0 Div position setting, +2.5 V offset | + 5.856 V | ________ | ________ | + 6.144 V |
| | 0 Div position setting, -2.5 V offset | - 5.856 V | ________ | ________ | - 6.144 V |

**CSA 7000 Test Record (cont.)**

| | |
|---|---|
| Instrument Serial Number: ______ | Certificate Number: ______ |
| Temperature: ______ | RH %: ______ |
| Date of Calibration: ______ | Technician: ______ |

| CSA7000 performance test | | Minimum | Incoming | Outgoing | Maximum |
|---|---|---|---|---|---|
| CH3 | 2 mV Vert scale setting, | | | | |
| | 0 Div position setting, 0 V offset | + 14.820 mV | ______ | ______ | + 15.580 mV |
| | -5 Div position setting, +0.5 V offset | + 14.355 mV | ______ | ______ | + 16.045 mV |
| | 5 Div position setting, -0.5 V offset | - 14.355 mV | ______ | ______ | - 16.045 mV |
| CH3 | 5 mV Vert scale setting, | | | | |
| | 0 Div position setting, 0 V offset | + 37.240 mV | ______ | ______ | + 38.760 mV |
| | -5 Div position setting, +0.5 V offset | + 36.841 mV | ______ | ______ | + 39.159 mV |
| | 5 Div position setting, -0.5 V offset | - 36.841 mV | ______ | ______ | - 39.159 mV |
| CH3 | 10 mV Vert scale setting, | | | | |
| | 0 Div position setting, 0 V offset | + 74.480 mV | ______ | ______ | + 77.520 mV |
| | -5 Div position setting, +0.5 V offset | + 73.644 mV | ______ | ______ | + 78.356 mV |
| | 5 Div position setting, -0.5 V offset | - 73.644 mV | ______ | ______ | - 78.356 mV |
| CH3 | 20 mV Vert scale setting, | | | | |
| | 0 Div position setting, 0 V offset | + 148.960 mV | ______ | ______ | + 155.040 mV |
| | -5 Div position setting, +0.5 V offset | + 147.136 mV | ______ | ______ | + 156.864 mV |
| | 5 Div position setting, -0.5 V offset | - 147.136 mV | ______ | ______ | - 156.864 mV |
| CH3 | 50 mV Vert scale setting, | | | | |
| | 0 Div position setting, 0 V offset | + 372.400 mV | ______ | ______ | + 387.600 mV |
| | -5 Div position setting, +0.5 V offset | + 366.700 mV | ______ | ______ | + 393.300 mV |
| | 5 Div position setting, -0.5 V offset | - 366.700 mV | ______ | ______ | - 393.300 mV |
| CH3 | 100 mV Vert scale setting, | | | | |
| | 0 Div position setting, 0 V offset | + 744.800 mV | ______ | ______ | + 775.200 mV |
| | 0 Div position setting, +4.5 V offset | + 737.960 mV | ______ | ______ | + 782.040 mV |
| | 0 Div position setting, -4.5 V offset | - 737.960 mV | ______ | ______ | - 782.040 mV |
| CH3 | 200 mV Vert scale setting, | | | | |
| | 0 Div position setting, 0 V offset | + 1.490 mV | ______ | ______ | + 1.550 mV |
| | 2 Div position setting, +4.6 V offset | + 1.477 mV | ______ | ______ | + 1.563 mV |
| | -2 Div position setting, -4.6 V offset | - 1.477 mV | ______ | ______ | - 1.563 mV |
| CH3 | 500 mV Vert scale setting, | | | | |
| | 0 Div position setting, 0 V offset | + 3.724 V | ______ | ______ | + 3.876 V |
| | 4 Div position setting, +5 V offset | + 3.701 V | ______ | ______ | + 3.899 V |
| | -4 Div position setting, -5 V offset | - 3.701 V | ______ | ______ | - 3.899 V |
| CH3 | 1.0 V Vert scale setting, | | | | |
| | 0 Div position setting, 0 V offset | + 7.448 V | ______ | ______ | + 7.752 V |
| | 0 Div position setting, +2.5 V offset | + 5.856 V | ______ | ______ | + 6.144 V |
| | 0 Div position setting, -2.5 V offset | - 5.856 V | ______ | ______ | - 6.144 V |

**CSA 7000 Test Record (cont.)**

| | | | |
|---|---|---|---|
| Instrument Serial Number: | ______________ | Certificate Number: | ______________ |
| Temperature: | ______________ | RH %: | ______________ |
| Date of Calibration: | ______________ | Technician: | ______________ |

| CSA7000 performance test | | Minimum | Incoming | Outgoing | Maximum |
|---|---|---|---|---|---|
| CH4 | 2 mV Vert scale setting, | | | | |
| | 0 Div position setting, 0 V offset | + 14.820 mV | ________ | ________ | + 15.580 mV |
| | -5 Div position setting, +0.5 V offset | + 14.355 mV | ________ | ________ | + 16.045 mV |
| | 5 Div position setting, -0.5 V offset | - 14.355 mV | ________ | ________ | - 16.045 mV |
| CH4 | 5 mV Vert scale setting, | | | | |
| | 0 Div position setting, 0 V offset | + 37.240 mV | ________ | ________ | + 38.760 mV |
| | -5 Div position setting, +0.5 V offset | + 36.841 mV | ________ | ________ | + 39.159 mV |
| | 5 Div position setting, -0.5 V offset | - 36.841 mV | ________ | ________ | - 39.159 mV |
| CH4 | 10 mV Vert scale setting, | | | | |
| | 0 Div position setting, 0 V offset | + 74.480 mV | ________ | ________ | + 77.520 mV |
| | -5 Div position setting, +0.5 V offset | + 73.644 mV | ________ | ________ | + 78.356 mV |
| | 5 Div position setting, -0.5 V offset | - 73.644 mV | ________ | ________ | - 78.356 mV |
| CH4 | 20 mV Vert scale setting, | | | | |
| | 0 Div position setting, 0 V offset | + 148.960 mV | ________ | ________ | + 155.040 mV |
| | -5 Div position setting, +0.5 V offset | + 147.136 mV | ________ | ________ | + 156.864 mV |
| | 5 Div position setting, -0.5 V offset | - 147.136 mV | ________ | ________ | - 156.864 mV |
| CH4 | 50 mV Vert scale setting, | | | | |
| | 0 Div position setting, 0 V offset | + 372.400 mV | ________ | ________ | + 387.600 mV |
| | -5 Div position setting, +0.5 V offset | + 366.700 mV | ________ | ________ | + 393.300 mV |
| | 5 Div position setting, -0.5 V offset | - 366.700 mV | ________ | ________ | - 393.300 mV |
| CH4 | 100 mV Vert scale setting, | | | | |
| | 0 Div position setting, 0 V offset | + 744.800 mV | ________ | ________ | + 775.200 mV |
| | 0 Div position setting, +4.5 V offset | + 737.960 mV | ________ | ________ | + 782.040 mV |
| | 0 Div position setting, -4.5 V offset | - 737.960 mV | ________ | ________ | - 782.040 mV |
| CH4 | 200 mV Vert scale setting, | | | | |
| | 0 Div position setting, 0 V offset | + 1.490 mV | ________ | ________ | + 1.550 mV |
| | 2 Div position setting, +4.6 V offset | + 1.477 mV | ________ | ________ | + 1.563 mV |
| | -2 Div position setting, -4.6 V offset | - 1.477 mV | ________ | ________ | - 1.563 mV |
| CH4 | 500 mV Vert scale setting, | | | | |
| | 0 Div position setting, 0 V offset | + 3.724 V | ________ | ________ | + 3.876 V |
| | 4 Div position setting, +5 V offset | + 3.701 V | ________ | ________ | + 3.899 V |
| | -4 Div position setting, -5 V offset | - 3.701 V | ________ | ________ | - 3.899 V |
| CH4 | 1.0 V Vert scale setting, | | | | |
| | 0 Div position setting, 0 V offset | + 7.448 V | ________ | ________ | + 7.752 V |
| | 0 Div position setting, +2.5 V offset | + 5.856 V | ________ | ________ | + 6.144 V |
| | 0 Div position setting, -2.5 V offset | - 5.856 V | ________ | ________ | - 6.144 V |

## CSA 7000 Test Record (cont.)

| | | | |
|---|---|---|---|
| Instrument Serial Number: | ________ | Certificate Number: | ________ |
| Temperature: | ________ | RH %: | ________ |
| Date of Calibration: | ________ | Technician: | ________ |

| CSA7000 performance test | | Minimum | Incoming | Outgoing | Maximum |
|---|---|---|---|---|---|
| Offset accuracy | | | | | |
| CH1 | 2 mV Vert scale setting, | | | | |
| | 0 Div position setting, +0.5 V offset | + 497.3 mV | ________ | ________ | + 502.7 mV |
| | 0 Div position setting, 0 V offset | - 1.7 mV | ________ | ________ | + 1.7 mV |
| | 0 Div position setting, -0.5 V offset | - 502.7 mV | ________ | ________ | - 497.3 mV |
| CH1 | 50 mV Vert scale setting, | | | | |
| | 0 Div position setting, +0.5 V offset | + 491.75 mV | ________ | ________ | + 508.25 mV |
| | 0 Div position setting, 0 V offset | - 6.5 mV | ________ | ________ | + 6.5 mV |
| | 0 Div position setting, -0.5 V offset | - 508.25 mV | ________ | ________ | - 491.75 mV |
| CH1 | 100 mV Vert scale setting, | | | | |
| | 0 Div position setting, +5 V offset | + 4.9575 V | ________ | ________ | + 5.0425 V |
| | 0 Div position setting, 0 V offset | - 25 mV | ________ | ________ | + 25 mV |
| | 0 Div position setting, -5 V offset | - 5.0425 V | ________ | ________ | - 4.9575 V |
| CH1 | 500 mV Vert scale setting, | | | | |
| | 0 Div position setting, +5 V offset | + 4.9175 V | ________ | ________ | + 5.0825 V |
| | 0 Div position setting, 0 V offset | - 65 mV | ________ | ________ | + 65 mV |
| | 0 Div position setting, -5 V offset | - 5.0825 V | ________ | ________ | - 4.9175 V |
| CH1 | 1.0 V Vert scale setting, | | | | |
| | 0 Div position setting, +2.5 V offset | + 2.37625 V | ________ | ________ | + 2.62375 V |
| | 0 Div position setting, 0 V offset | - 115 mV | ________ | ________ | + 115 mV |
| | 0 Div position setting, -2.5 V offset | - 2.62375 V | ________ | ________ | - 2.37625 V |
| CH2 | 2 mV Vert scale setting, | | | | |
| | 0 Div position setting, +0.5 V offset | + 497.3 mV | ________ | ________ | + 502.7 mV |
| | 0 Div position setting, 0 V offset | - 1.7 mV | ________ | ________ | + 1.7 mV |
| | 0 Div position setting, -0.5 V offset | - 502.7 mV | ________ | ________ | - 497.3 mV |
| CH2 | 50 mV Vert scale setting, | | | | |
| | 0 Div position setting, +0.5 V offset | + 491.75 mV | ________ | ________ | + 508.25 mV |
| | 0 Div position setting, 0 V offset | - 6.5 mV | ________ | ________ | + 6.5 mV |
| | 0 Div position setting, -0.5 V offset | - 508.25 mV | ________ | ________ | - 491.75 mV |
| CH2 | 100 mV Vert scale setting, | | | | |
| | 0 Div position setting, +5 V offset | + 4.9575 V | ________ | ________ | + 5.0425 V |
| | 0 Div position setting, 0 V offset | - 25 mV | ________ | ________ | + 25 mV |
| | 0 Div position setting, -5 V offset | - 5.0425 V | ________ | ________ | - 4.9575 V |
| CH2 | 500 mV Vert scale setting, | | | | |
| | 0 Div position setting, +5 V offset | + 4.9175 V | ________ | ________ | + 5.0825 V |
| | 0 Div position setting, 0 V offset | - 65 mV | ________ | ________ | + 65 mV |
| | 0 Div position setting, -5 V offset | - 5.0825 V | ________ | ________ | - 4.9175 V |
| CH2 | 1.0 V Vert scale setting, | | | | |
| | 0 Div position setting, +2.5 V offset | + 2.37625 V | ________ | ________ | + 2.62375 V |
| | 0 Div position setting, 0 V offset | - 115 mV | ________ | ________ | + 115 mV |
| | 0 Div position setting, -2.5 V offset | - 2.62375 V | ________ | ________ | - 2.37625 V |

**CSA 7000 Test Record (cont.)**

| | | | |
|---|---|---|---|
| Instrument Serial Number: | __________ | Certificate Number: | __________ |
| Temperature: | __________ | RH %: | __________ |
| Date of Calibration: | __________ | Technician: | __________ |

| CSA7000 performance test | | Minimum | Incoming | Outgoing | Maximum |
|---|---|---|---|---|---|
| CH3 | 2 mV Vert scale setting, | | | | |
| | 0 Div position setting, +0.5 V offset | + 497.3 mV | ________ | ________ | + 502.7 mV |
| | 0 Div position setting, 0 V offset | - 1.7 mV | ________ | ________ | + 1.7 mV |
| | 0 Div position setting, -0.5 V offset | - 502.7 mV | ________ | ________ | - 497.3 mV |
| CH3 | 50 mV Vert scale setting, | | | | |
| | 0 Div position setting, +0.5 V offset | + 491.75 mV | ________ | ________ | + 508.25 mV |
| | 0 Div position setting, 0 V offset | - 6.5 mV | ________ | ________ | + 6.5 mV |
| | 0 Div position setting, -0.5 V offset | - 508.25 mV | ________ | ________ | - 491.75 mV |
| CH3 | 100 mV Vert scale setting, | | | | |
| | 0 Div position setting, +5 V offset | + 4.9575 V | ________ | ________ | + 5.0425 V |
| | 0 Div position setting, 0 V offset | - 25 mV | ________ | ________ | + 25 mV |
| | 0 Div position setting, -5 V offset | - 5.0425 V | ________ | ________ | - 4.9575 V |
| CH3 | 500 mV Vert scale setting, | | | | |
| | 0 Div position setting, +5 V offset | + 4.9175 V | ________ | ________ | + 5.0825 V |
| | 0 Div position setting, 0 V offset | - 65 mV | ________ | ________ | + 65 mV |
| | 0 Div position setting, -5 V offset | - 5.0825 V | ________ | ________ | - 4.9175 V |
| CH3 | 1.0 V Vert scale setting, | | | | |
| | 0 Div position setting, +2.5 V offset | + 2.37625 V | ________ | ________ | + 2.62375 V |
| | 0 Div position setting, 0 V offset | - 115 mV | ________ | ________ | + 115 mV |
| | 0 Div position setting, -2.5 V offset | - 2.62375 V | ________ | ________ | - 2.37625 V |
| CH4 | 2 mV Vert scale setting, | | | | |
| | 0 Div position setting, +0.5 V offset | + 497.3 mV | ________ | ________ | + 502.7 mV |
| | 0 Div position setting, 0 V offset | - 1.7 mV | ________ | ________ | + 1.7 mV |
| | 0 Div position setting, -0.5 V offset | - 502.7 mV | ________ | ________ | - 497.3 mV |
| CH4 | 50 mV Vert scale setting, | | | | |
| | 0 Div position setting, +0.5 V offset | + 491.75 mV | ________ | ________ | + 508.25 mV |
| | 0 Div position setting, 0 V offset | - 6.5 mV | ________ | ________ | + 6.5 mV |
| | 0 Div position setting, -0.5 V offset | - 508.25 mV | ________ | ________ | - 491.75 mV |
| CH4 | 100 mV Vert scale setting, | | | | |
| | 0 Div position setting, +5 V offset | + 4.9575 V | ________ | ________ | + 5.0425 V |
| | 0 Div position setting, 0 V offset | - 25 mV | ________ | ________ | + 25 mV |
| | 0 Div position setting, -5 V offset | - 5.0425 V | ________ | ________ | - 4.9575 V |
| CH4 | 500 mV Vert scale setting, | | | | |
| | 0 Div position setting, +5 V offset | + 4.9175 V | ________ | ________ | + 5.0825 V |
| | 0 Div position setting, 0 V offset | - 65 mV | ________ | ________ | + 65 mV |
| | 0 Div position setting, -5 V offset | - 5.0825 V | ________ | ________ | - 4.9175 V |
| CH4 | 1.0 V Vert scale setting, | | | | |
| | 0 Div position setting, +2.5 V offset | + 2.37625 V | ________ | ________ | + 2.62375 V |
| | 0 Div position setting, 0 V offset | - 115 mV | ________ | ________ | + 115 mV |
| | 0 Div position setting, -2.5 V offset | - 2.62375 V | ________ | ________ | - 2.37625 V |

**CSA 7000 Test Record (cont.)**

| | |
|---|---|
| Instrument Serial Number: ______________ | Certificate Number: ______________ |
| Temperature: ______________ | RH %: ______________ |
| Date of Calibration: ______________ | Technician: ______________ |

| CSA7000 performance test | Minimum | Incoming | Outgoing | Maximum |
|---|---|---|---|---|
| Maximum input voltage | | | | |
| CH1 50 mV Vert scale setting, +1 V input | Pass | ________ | ________ | N/A |
| +3 V input | Pass | ________ | ________ | N/A |
| CH1 1 V Vert scale setting, +5 V input | Pass | ________ | ________ | N/A |
| +10 V input | Pass | ________ | ________ | N/A |
| CH2 50 mV Vert scale setting, +1 V input | Pass | ________ | ________ | N/A |
| +3 V input | Pass | ________ | ________ | N/A |
| CH2 1 V Vert scale setting, +5 V input | Pass | ________ | ________ | N/A |
| +10 V input | Pass | ________ | ________ | N/A |
| CH3 50 mV Vert scale setting, +1 V input | Pass | ________ | ________ | N/A |
| +3 V input | Pass | ________ | ________ | N/A |
| CH3 1 V Vert scale setting, +5 V input | Pass | ________ | ________ | N/A |
| +10 V input | Pass | ________ | ________ | N/A |
| CH4 50 mV Vert scale setting, +1 V input | Pass | ________ | ________ | N/A |
| +3 V input | Pass | ________ | ________ | N/A |
| CH4 1 V Vert scale setting, +5 V input | Pass | ________ | ________ | N/A |
| +10 V input | Pass | ________ | ________ | N/A |
| Analog bandwidth | | | | |
| CH1 1 V | 3.535 V | ________ | ________ | N/A |
| 500 mV | 2.12 V | ________ | ________ | N/A |
| 200 mV | 848 mV | ________ | ________ | N/A |
| 100 mV | 424 mV | ________ | ________ | N/A |
| 50 mV | 212 mV | ________ | ________ | N/A |
| 20 mV | 84.8 mV | ________ | ________ | N/A |
| 10 mV | 42.4 mV | ________ | ________ | N/A |
| 5 mV | 21.2 mV | ________ | ________ | N/A |
| 2 mV | 8.48 mV | ________ | ________ | N/A |

**CSA 7000 Test Record (cont.)**

| | | | |
|---|---|---|---|
| Instrument Serial Number: | ______________ | Certificate Number: | ______________ |
| Temperature: | ______________ | RH %: | ______________ |
| Date of Calibration: | ______________ | Technician: | ______________ |

| CSA7000 performance test | | Minimum | Incoming | Outgoing | Maximum |
|---|---|---|---|---|---|
| CH2 | 1 V | 3.535 V | ________ | ________ | N/A |
| | 500 mV | 2.12 V | ________ | ________ | N/A |
| | 200 mV | 848 V | ________ | ________ | N/A |
| | 100 mV | 424 mV | ________ | ________ | N/A |
| | 50 mV | 212 mV | ________ | ________ | N/A |
| | 20 mV | 84.8 mV | ________ | ________ | N/A |
| | 10 mV | 42.4 mV | ________ | ________ | N/A |
| | 5 mV | 21.2 mV | ________ | ________ | N/A |
| | 2 mV | 8.48 mV | ________ | ________ | N/A |
| CH3 | 1 V | 3.535 V | ________ | ________ | N/A |
| | 500 mV | 2.12 V | ________ | ________ | N/A |
| | 200 mV | 848 V | ________ | ________ | N/A |
| | 100 mV | 424 mV | ________ | ________ | N/A |
| | 50 mV | 212 mV | ________ | ________ | N/A |
| | 20 mV | 84.8 mV | ________ | ________ | N/A |
| | 10 mV | 42.4 mV | ________ | ________ | N/A |
| | 5 mV | 21.2 mV | ________ | ________ | N/A |
| | 2 mV | 8.48 mV | ________ | ________ | N/A |
| CH4 | 1 V | 3.535 V | ________ | ________ | N/A |
| | 500 mV | 2.12 V | ________ | ________ | N/A |
| | 200 mV | 848 V | ________ | ________ | N/A |
| | 100 mV | 424 mV | ________ | ________ | N/A |
| | 50 mV | 212 mV | ________ | ________ | N/A |
| | 20 mV | 84.8 mV | ________ | ________ | N/A |
| | 10 mV | 42.4 mV | ________ | ________ | N/A |
| | 5 mW | 21.2 mV | ________ | ________ | N/A |
| | 2 mV | 8.48 mV | ________ | ________ | N/A |

## CSA 7000 Test Record (cont.)

| | |
|---|---|
| Instrument Serial Number: ______ | Certificate Number: ______ |
| Temperature: ______ | RH %: ______ |
| Date of Calibration: ______ | Technician: ______ |

| CSA7000 performance test | Minimum | Incoming | Outgoing | Maximum |
|---|---|---|---|---|
| Delay between channels | N/A | ______ | ______ | 30 ps |
| Channel isolation 1.5 GHz | | | | |
| 100 mV | | | | |
| CH 1 | N/A | ______ | ______ | 0.125 divisions |
| CH 2 | N/A | ______ | ______ | 0.125 divisions |
| CH 3 | N/A | ______ | ______ | 0.125 divisions |
| CH 4 | N/A | ______ | ______ | 0.125 divisions |
| 50 mV | | | | |
| CH 1 | N/A | ______ | ______ | 0.125 divisions |
| CH 2 | N/A | ______ | ______ | 0.125 divisions |
| CH 3 | N/A | ______ | ______ | 0.125 divisions |
| CH 4 | N/A | ______ | ______ | 0.125 divisions |
| 10 mV | | | | |
| CH 1 | N/A | ______ | ______ | 0.125 divisions |
| CH 2 | N/A | ______ | ______ | 0.125 divisions |
| CH 3 | N/A | ______ | ______ | 0.125 divisions |
| CH 4 | N/A | ______ | ______ | 0.125 divisions |
| full bandwidth | | | | |
| 100 mV | | | | |
| CH 1 | N/A | ______ | ______ | 0.67 divisions |
| CH 2 | N/A | ______ | ______ | 0.67 divisions |
| CH 3 | N/A | ______ | ______ | 0.67 divisions |
| CH 4 | N/A | ______ | ______ | 0.67 divisions |
| 50 mV | | | | |
| CH 1 | N/A | ______ | ______ | 0.67 divisions |
| CH 2 | N/A | ______ | ______ | 0.67 divisions |
| CH 3 | N/A | ______ | ______ | 0.67 divisions |
| CH 4 | N/A | ______ | ______ | 0.67 divisions |
| 10 mV | | | | |
| CH 1 | N/A | ______ | ______ | 0.67 divisions |
| CH 2 | N/A | ______ | ______ | 0.67 divisions |
| CH 3 | N/A | ______ | ______ | 0.67 divisions |
| CH 4 | N/A | ______ | ______ | 0.67 divisions |
| Input impedance | | | | |
| CH1 10 mV | 48.75 Ω | ______ | ______ | 51.25 Ω |
| CH1 100 mV | 48.75 Ω | ______ | ______ | 51.25 Ω |
| CH2 10 mV | 48.75 Ω | ______ | ______ | 51.25 Ω |
| CH2 100 mV | 48.75 Ω | ______ | ______ | 51.25 Ω |
| CH3 10 mV | 48.75 Ω | ______ | ______ | 51.25 Ω |
| CH3 100 mV | 48.75 Ω | ______ | ______ | 51.25 Ω |
| CH4 10 mV | 48.75 Ω | ______ | ______ | 51.25 Ω |
| CH4 100 mV | 48.75 Ω | ______ | ______ | 51.25 Ω |

**CSA 7000 Test Record (cont.)**

| | |
|---|---|
| Instrument Serial Number: ____________ | Certificate Number: ____________ |
| Temperature: ____________ | RH %: ____________ |
| Date of Calibration: ____________ | Technician: ____________ |

| CSA7000 performance test | Minimum | Incoming | Outgoing | Maximum |
|---|---|---|---|---|
| Time base system | | | | |
| Long term sample rate, delay time, and internal reference accuracy | 9999.975 kHz | __________ | __________ | 10000.025 kHz |
| Delta time measurement | N/A | __________ | __________ | ≤ 0.015 ns |
| Trigger system accuracy | | | | |
| Time accuracy for pulse, glitch, timeout, and Width, Hor. scale ≤ 1 μs | | | | |
| Lower Limit | 3.5 ns | __________ | __________ | 6.5 ns |
| Upper Limit | 3.5 ns | __________ | __________ | 6.5 ns |
| Time accuracy for pulse, glitch, timeout, and width, Hor. scale > 1 μs | | | | |
| Lower Limit | 1.9 μs | __________ | __________ | 2.1 μs |
| Upper Limit | 1.9 μs | __________ | __________ | 2.1 μs |
| Probe compensation output signal | | | | |
| Frequency | 950 Hz | __________ | __________ | 1.050 kHz |
| Voltage (difference) | 160 mV | __________ | __________ | 240 mV |

## CSA 7000 Test Record (cont.)

| | | | |
|---|---|---|---|
| Instrument Serial Number: | __________ | Certificate Number: | __________ |
| Temperature: | __________ | RH %: | __________ |
| Date of Calibration: | __________ | Technician: | __________ |

| CSA7000 performance test | Minimum | Incoming | Outgoing | Maximum |
|---|---|---|---|---|
| Serial trigger | | | | |
| Baud rate limits | | | | |
| Serial word recognizer | | | | |
| Signal path 0, Pattern matching 1 | | __________ | __________ | |
| Trigger 1 UI before 0 | Pass | __________ | __________ | N/A |
| Trigger on 0 | Pass | __________ | __________ | N/A |
| Trigger 1 UI after 0 | Pass | __________ | __________ | N/A |
| Signal path 1, Pattern matching 1 | | __________ | __________ | |
| Trigger 1 UI before 1 | Pass | __________ | __________ | N/A |
| Trigger on 1 | Pass | __________ | __________ | N/A |
| Trigger 1 UI after 1 | Pass | __________ | __________ | N/A |
| Pattern matching 0 | | __________ | __________ | |
| Position 1 | Pass | __________ | __________ | N/A |
| Position 2 | Pass | __________ | __________ | N/A |
| Position 3 | Pass | __________ | __________ | N/A |
| Position 4 | Pass | __________ | __________ | N/A |
| Position 5 | Pass | __________ | __________ | N/A |
| Position 6 | Pass | __________ | __________ | N/A |
| Position 7 | Pass | __________ | __________ | N/A |
| Position 8 | Pass | __________ | __________ | N/A |
| Position 9 | Pass | __________ | __________ | N/A |
| Position 10 | Pass | __________ | __________ | N/A |
| Position 11 | Pass | __________ | __________ | N/A |
| Position 12 | Pass | __________ | __________ | N/A |
| Position 13 | Pass | __________ | __________ | N/A |
| Position 14 | Pass | __________ | __________ | N/A |
| Position 15 | Pass | __________ | __________ | N/A |
| Position 16 | Pass | __________ | __________ | N/A |
| Position 17 | Pass | __________ | __________ | N/A |
| Position 18 | Pass | __________ | __________ | N/A |
| Position 19 | Pass | __________ | __________ | N/A |
| Position 20 | Pass | __________ | __________ | N/A |
| Position 21 | Pass | __________ | __________ | N/A |
| Position 22 | Pass | __________ | __________ | N/A |
| Position 23 | Pass | __________ | __________ | N/A |
| Position 24 | Pass | __________ | __________ | N/A |
| Position 25 | Pass | __________ | __________ | N/A |
| Position 26 | Pass | __________ | __________ | N/A |
| Position 27 | Pass | __________ | __________ | N/A |
| Position 28 | Pass | __________ | __________ | N/A |
| Position 29 | Pass | __________ | __________ | N/A |
| Position 30 | Pass | __________ | __________ | N/A |
| Position 31 | Pass | __________ | __________ | N/A |
| Position 32 | Pass | __________ | __________ | N/A |
| Clock recovery frequency range | Pass | __________ | __________ | N/A |

**CSA 7000 Test Record (cont.)**

| | | | |
|---|---|---|---|
| Instrument Serial Number: | ________ | Certificate Number: | ________ |
| Temperature: | ________ | RH %: | ________ |
| Date of Calibration: | ________ | Technician: | ________ |

| CSA7000 performance test | Minimum | Incoming | Outgoing | Maximum |
|---|---|---|---|---|
| Optical-to-electrical converter | | | | |
| Dark level, | | | | |
| 10 µW | N/A | ________ | ________ | 2.6 µW |
| 20 µW | N/A | ________ | ________ | 3.6 µW |
| 50 µW | N/A | ________ | ________ | 6.6 µW |
| O/E noise output, maximum | | | | |
| CSA7404 | | | | |
| 1550 and 1310 nm | N/A | ________ | ________ | 4.35 µW |
| 850 nm | N/A | ________ | ________ | 5.35 µW |
| 750 nm | N/A | ________ | ________ | 5.85 µW |
| CSA7154 | | | | |
| 1550 and 1310 nm | N/A | ________ | ________ | 4.1 µW |
| 850 nm | N/A | ________ | ________ | 4.85 µW |
| 750 nm | N/A | ________ | ________ | 5.25 µW |
| O/E gain | | | | |
| 780 nm | 27 mV | ________ | ________ | N/A |
| 850 nm | 33 mV | ________ | ________ | N/A |
| 1310 nm | 64 mV | ________ | ________ | N/A |
| 1550 nm | 64 mV | ________ | ________ | N/A |
| System bandwidth (O/E, O/E-to-CH1 input adaptor, Communications Signal Analyzer) | | | | |
| CSA7404 | | | | |
| 2.4 GHz | 2.4 GHz | ________ | ________ | N/A |
| CSA7154 | | | | |
| 1.6 GHz | 1.6 GHz | ________ | ________ | N/A |

# Signal Acquisition System Checks

These procedures check those characteristics that relate to the signal-acquisition system and are listed as checked under *Warranted Characteristics* in *Specifications.* Refer to Table 4–1 on page 4–18 for test equipment specifications.

## Check DC Voltage Measurement Accuracy

| | |
|---|---|
| **Equipment required** | Two dual-banana connectors (Item 5)<br>One BNC T connector (Item 6)<br>One DC calibration generator (Item 10)<br>One SMA male-to-female BNC adapter (Item 20)<br>Two precision 50 Ω coaxial cables (Item 4) |
| **Prerequisites** | The instrument must meet the prerequisites listed on page 4–17 |

***WARNING.*** *The generator is capable of outputting dangerous voltages. Be sure to set the DC calibration generator to off or 0 volts before connecting, disconnecting, and/or moving the test hookup during the performance of this procedure. Also, check that the calibrator does not have shorting straps installed between the DC output, sense input, or grounds.*

**1.** *Install the test hookup and preset the instrument controls:*

**a.** *Hook up the test-signal source:*

- Set the output of a DC calibration generator to off or 0 volts.
- Connect the output of a DC calibration generator through a dual-banana connector followed by a 50 Ω precision coaxial cable to one side of a BNC T connector. See Figure 4–7.
- Connect the Sense input of the generator through a second dual-banana connector followed by a 50 Ω precision coaxial cable to the other side of the BNC T connector. Now connect the BNC T connector to **CH 1** through an adapter. See Figure 4–7.

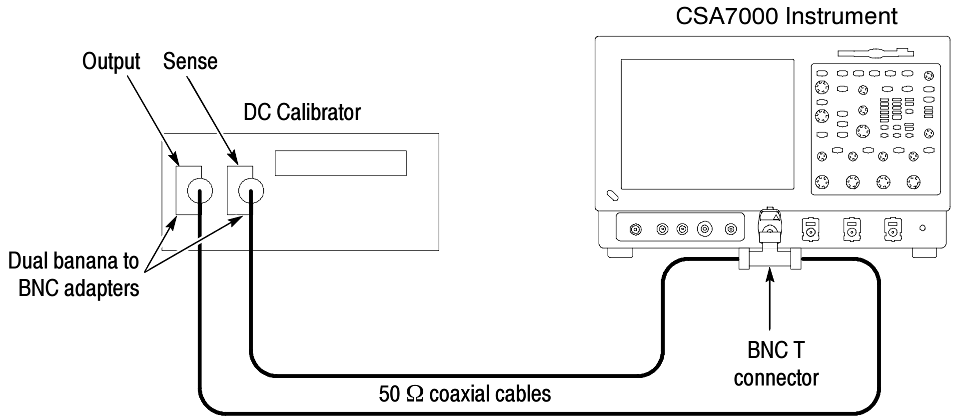



**Figure 4-7: Initial test hookup**

b. *Initialize the instrument:* Press **DEFAULT SETUP**.

c. *Modify the default settings:*

- From the tool bar, touch **Horiz** and select the **Acquisition** tab.
- Touch **Average** and set the number of averages to **16**.

2. *Confirm input channels are within limits for DC accuracy at maximum offset and position:* Do the following substeps — test CH 1 first, *skipping substep 2a since CH 1 is already selected from step 1.*

a. *Select an unchecked channel:*

- From the tool bar, touch **MEAS** and then **Clear** to remove the previous measurement.
- Press the Vertical button of the channel just confirmed to remove the channel from the display.
- Press the front-panel Vertical button that corresponds to the channel you are to confirm.
- Set the generator output to 0 V.
- Move the test hookup to the channel you selected.

b. *Turn on the measurement Mean for the channel:*

- From the tool bar, touch **MEAS** and select the **Ampl** tab, then touch **Mean** to measure the mean of the current channel.
- Touch Setup **Statistics** and touch Measurement Statistics **Mean** to display the measurement statistics of the mean measurement.

- Press **Close**.

**c.** *Set the vertical scale:* Set the vertical **SCALE** to one of the settings listed in Table 4-2 that is not yet checked. (Start with the first setting listed).

**Table 4-2: DC Voltage measurement accuracy**

| Scale setting | Position setting (Divs) | Offset setting | Generator setting | Accuracy limits |
|---|---|---|---|---|
| 2 mV | -5 | +0.5 V | +516 mV | +512.79 mV to +519.21 mV |
| | +5 | -0.5 V | -516 mV | -519.21 mV to -512.79 V |
| 50 mV | -5 | +0.5 V | +900 mV | +881.63 mV to +918.38 mV |
| | +5 | -0.5 V | -900 mV | -918.38 mV to -881.63 mV |
| 100 mV | -5 | +4.8 V | +5.0 V | +4.94 V to 5.06 V |
| | +5 | -4.8 V | -5.0 V | -5.06 V to -4.94 V |
| 1 V | -5 | +2.5 V | +4.5 V | +4.17 V to 4.83 V |
| | +5 | -2.5 V | -4.5 V | -4.83 V to -4.17 V |

**d.** *Display the test signal:*

- From the tool bar touch **VERT** and touch **Position**.
- Use the keypad to set vertical position to -5 divisions (press **CLR**, **5**, **-**, and then **ENTER**, on the keypad). The baseline level will move off screen.
- Touch **Offset**.
- Use the keypad to set vertical offset to the positive-polarity setting listed in the table for the current vertical scale setting. The baseline level will remain off screen.
- Set the generator to the level and polarity indicated in the table for the vertical scale, position, and offset settings you have made. The DC test level should appear on screen. (If it doesn't return, the DC accuracy check has failed for the current vertical scale setting of the current channel).

**e.** *Measure the test signal:* Press **Close**. Read the measurement results at the measurement statistics **μ** measurement readout. See Figure 4-8.

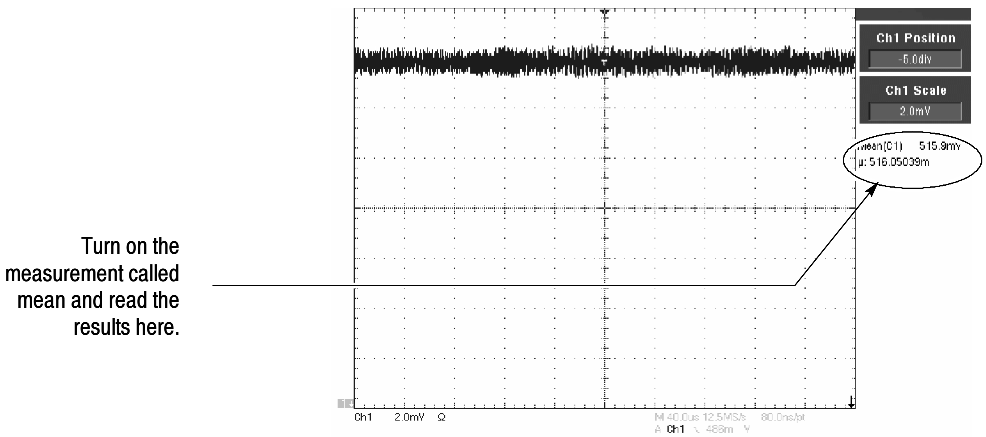



**Figure 4-8: Measurement of DC accuracy at maximum offset and position**

**f.** *Check against limits:*

- CHECK that the readout for the measurement **µ** readout on screen is within the limits listed for the current vertical scale and position/offset/generator settings. Enter value on test record.
- Repeat substep d, reversing the polarity of the position, offset, and generator settings as is listed in the table.
- CHECK that the **µ** measurement readout on screen is within the limits listed for the current vertical scale setting and position/offset/generator settings. Enter value on test record.
- Repeat substeps c through f until all vertical scale settings, listed in Table 4-2, are checked for the channel under test.

**g.** *Test all channels:* Repeat substeps a through f for all four channels.

**3.** *Disconnect the hookup:*

**a.** *Set the generator output to 0 V.*

**b.** Disconnect the cable and adapter from the generator output and the input connector of the channel last tested.

## Check DC Gain Accuracy

| | |
|---|---|
| **Equipment required** | Two dual-banana connectors (Item 5)<br>One BNC T connector (Item 6)<br>One DC calibration generator (Item 10)<br>One SMA male-to-female BNC adapter (Item 20)<br>Two precision 50 Ω coaxial cables (Item 4) |
| **Prerequisites** | The instrument must meet the prerequisites listed on page 4-17 |

***WARNING.*** *The generator is capable of outputting dangerous voltages. Be sure to set the DC calibration generator to off or 0 volts before connecting, disconnecting, and/or moving the test hookup during the performance of this procedure. Also, check that the calibrator does not have shorting straps installed between the DC output, sense input, or grounds.*

**1.** *Install the test hookup and preset the instrument controls:*

**a.** *Hook up the test-signal source:*

- Set the output of a DC calibration generator to off or 0 volts.
- Connect the output of a DC calibration generator through a dual-banana connector followed by a 50 Ω precision coaxial cable to one side of a BNC T connector. See Figure 4-9.
- Connect the Sense input of the generator through a second dual-banana connector followed by a 50 Ω precision coaxial cable to the other side of the BNC T connector. Now connect the BNC T connector to **CH 1** through an adapter. See Figure 4-9.

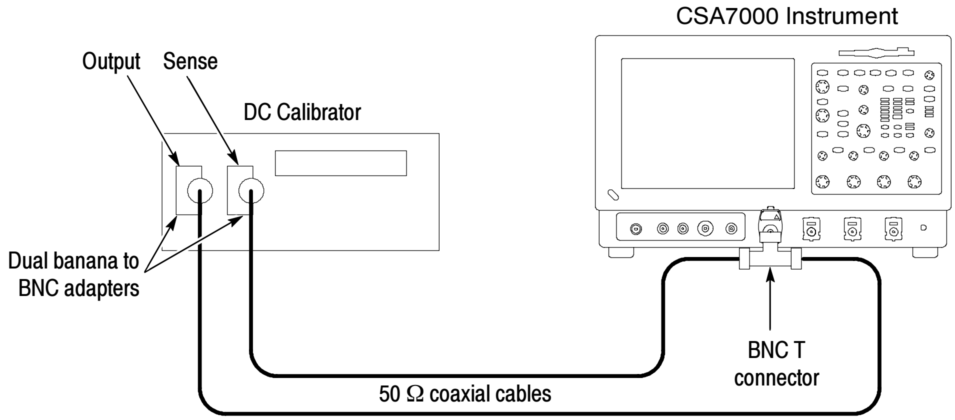



**Figure 4-9: Initial test hookup**

b. *Initialize the instrument:* Press **DEFAULT SETUP**.

c. *Modify the default settings:*

- From the tool bar, touch **Horiz** and select the **Acquisition** tab.
- Touch **Average** and set the number of averages to **16**.

2. *Confirm input channels are within limits for DC gain accuracy.* Do the following substeps — test CH 1 first, *skipping substep 2a since CH 1 is already selected from step 1.*

a. *Select an unchecked channel:*

- From the tool bar, touch **MEAS** and then **Clear** to remove the previous measurement.
- Press the Vertical button of the channel just confirmed to remove the channel from the display.
- Press the front-panel Vertical button that corresponds to the channel you are to confirm.
- *Set the generator output to 0 V.*
- Move the test hookup to the channel you selected.

b. *Turn on the measurement Mean for the channel:*

- From the tool bar, touch **MEAS** and select the **Ampl** tab, then touch **Mean** to measure the mean of the current channel.
- Touch Setup **Statistics** and touch Measurement Statistics **Mean** to display the measurement statistics of the mean measurement.

- Press **Close**.

**c.** *Set the vertical scale:* Set the vertical **SCALE** to one of the settings in Table 4-3 that is not yet checked. (Start with the first setting listed).

**Table 4-3: Gain accuracy**

| Channel | Scale setting | Position setting (Divs) | Offset setting | Generator setting | Measurement mean | Difference of measurement means | Accuracy limits |
|---|---|---|---|---|---|---|---|
| CH1 | 2 mV | 0 | 0 V | +7.6 mV | | | +14.820 mV to +15.580 mV |
| | | | | -7.6 mV | | | |
| | | -5 | +0.5 V | +517.6 mV | | | +14.355 mV to +16.045 mV |
| | | | | +502.4 mV | | | |
| | | 5 | -0.5 V | -517.6 mV | | | -14.355 mV to -16.045 mV |
| | | | | -502.4 mV | | | |
| | 5 mV | 0 | 0 V | +19.0 mV | | | +37.240 mV to +38.760 mV |
| | | | | -19.0 mV | | | |
| | | -5 | +0.5 V | +544.0 mV | | | +36.841 mV to +39.159 mV |
| | | | | +506.0 mV | | | |
| | | 5 | -0.5 V | -544.0 mV | | | -36.841 mV to -39.159 mV |
| | | | | -506.0 mV | | | |
| | 10 mV | 0 | 0 V | +38.0 mV | | | +74.480 mV to +77.520 mV |
| | | | | -38.0 mV | | | |
| | | -5 | +0.5 V | +588.0 mV | | | +73.644 mV to +78.356 mV |
| | | | | +512.0 mV | | | |
| | | 5 | -0.5 V | -588.0 mV | | | -73.644 mV to -78.356 mV |
| | | | | -512.0 mV | | | |
| | 20 mV | 0 | 0 V | +76 mV | | | +148.960 mV to +155.040 mV |
| | | | | -76 mV | | | |
| | | -5 | +0.5 V | +676.0 mV | | | +147.136 mV to +156.864 mV |
| | | | | +524.0 mV | | | |
| | | 5 | -0.5 V | -676.0 mV | | | -147.136 mV to -156.864 mV |
| | | | | -524.0 mV | | | |
| | 50 mV | 0 | 0 V | +190 mV | | | +372.400 mV to +387.600 mV |
| | | | | -190 mV | | | |
| | | -5 | +0.5 V | +940 mV | | | +366.700 mV to +393.300 mV |
| | | | | +560 mV | | | |

**Table 4-3: Gain accuracy (Cont.)**

| Channel | Scale setting | Position setting (Divs) | Offset setting | Generator setting | Measurement mean | Difference of measurement means | Accuracy limits |
|---|---|---|---|---|---|---|---|
| | | 5 | -0.5 V | -940 mV | | | -366.700 mV to -393.300 mV |
| | | | | -560 mV | | | |
| | 100 mV | 0 | 0 V | +380 mV | | | +744.800 mV to +775.200 mV |
| | | | | -380 mV | | | |
| | | 0 | +4.5 V | +4.88 V | | | +737.960 mV to +782.040 mV |
| | | | | +4.12 V | | | |
| | | 0 | -4.5 V | -4.88 V | | | -737.960 mV to -782.040 mV |
| | | | | -4.12 V | | | |
| | 200 mV | 0 | 0 V | +760 mV | | | +1.490 V to +1.550 V |
| | | | | -760 mV | | | |
| | | 2 | +4.6 V | +4.96 V | | | +1.477 V to +1.563 V |
| | | | | +3.44 V | | | |
| | | -2 | -4.6 V | -4.96 V | | | -1.477 V to -1.5643V |
| | | | | -3.44 V | | | |
| | 500 mV | 0 | 0 V | +1.9 V | | | +3.724 V to +3.876 V |
| | | | | -1.9 V | | | |
| | | 4 | +5 V | +4.9 V | | | +3.701 V to +3.899 V |
| | | | | +1.1 V | | | |
| | | -4 | -5 V | -4.9 V | | | -3.701 V to -3.899 V |
| | | | | -1.1 V | | | |
| | 1 V | 0 | 0 V | +3.8 V | | | +7.448 V to +7.752 V |
| | | | | -3.8 V | | | |
| | | 0 | +2.0 V | +5.0 V | | | +5.856 V to +6.144 V |
| | | | | -1.0 V | | | |
| | | 0 | -2.0 V | -5.0 V | | | -5.856 V to -6.144 V |
| | | | | +1.0 V | | | |

**Table 4-3: Gain accuracy (Cont.)**

| Channel | Scale setting | Position setting (Divs) | Offset setting | Generator setting | Measurement mean | Difference of measurement means | Accuracy limits |
|---|---|---|---|---|---|---|---|
| CH2 | 2 mV | 0 | 0 V | +7.6 mV | | | +14.820 mV to +15.580 mV |
| | | | | -7.6 mV | | | |
| | | -5 | +0.5 V | +517.6 mV | | | +14.355 mV to +16.045 mV |
| | | | | +502.4 mV | | | |
| | | 5 | -0.5 V | -517.6 mV | | | -14.355 mV to -16.045 mV |
| | | | | -502.4 mV | | | |
| | 5 mV | 0 | 0 V | +19.0 mV | | | +37.240 mV to +38.760 mV |
| | | | | -19.0 mV | | | |
| | | -5 | +0.5 V | +544.0 mV | | | +36.841 mV to +39.159 mV |
| | | | | +506.0 mV | | | |
| | | 5 | -0.5 V | -544.0 mV | | | -36.841 mV to -39.159 mV |
| | | | | -506.0 mV | | | |
| | 10 mV | 0 | 0 V | +38.0 mV | | | +74.480 mV to +77.520 mV |
| | | | | -38.0 mV | | | |
| | | -5 | +0.5 V | +588.0 mV | | | +73.644 mV to +78.356 mV |
| | | | | +512.0 mV | | | |
| | | 5 | -0.5 V | -588.0 mV | | | -73.644 mV to -78.356 mV |
| | | | | -512.0 mV | | | |
| | 20 mV | 0 | 0 V | +76 mV | | | +148.960 mV to +155.040 mV |
| | | | | -76 mV | | | |
| | | -5 | +0.5 V | +676.0 mV | | | +147.136 mV to +156.864 mV |
| | | | | +524.0 mV | | | |
| | | 5 | -0.5 V | -676.0 mV | | | -147.136 mV to -156.864 mV |
| | | | | -524.0 mV | | | |
| | 50 mV | 0 | 0 V | +190 mV | | | +372.400 mV to +387.600 mV |
| | | | | -190 mV | | | |
| | | -5 | +0.5 V | +940 mV | | | +366.700 mV to +393.300 mV |
| | | | | +560 mV | | | |
| | | 5 | -0.5 V | -940 mV | | | -366.700 mV to -393.300 mV |
| | | | | -560 mV | | | |
| | 100 mV | 0 | 0 V | +380 mV | | | +744.800 mV to +775.200 mV |

**Table 4-3: Gain accuracy (Cont.)**

| Channel | Scale setting | Position setting (Divs) | Offset setting | Generator setting | Measurement mean | Difference of measurement means | Accuracy limits |
|---|---|---|---|---|---|---|---|
| | | | | -380 mV | | | |
| | | 0 | +4.5 V | +4.88 V | | | +737.960 mV to +782.040 mV |
| | | | | +4.12 V | | | |
| | | 0 | -4.5 V | -4.88 V | | | -737.960 mV to -782.040 mV |
| | | | | -4.12 V | | | |
| | 200 mV | 0 | 0 V | +760 mV | | | +1.490 V to +1.550 V |
| | | | | -760 mV | | | |
| | | 2 | +4.6 V | +4.96 V | | | +1.477 V to +1.563 V |
| | | | | +3.44 V | | | |
| | | -2 | -4.6 V | -4.96 V | | | -1.477 V to -1.5643V |
| | | | | -3.44 V | | | |
| | 500 mV | 0 | 0 V | +1.9 V | | | +3.724 V to +3.876 V |
| | | | | -1.9 V | | | |
| | | 4 | +5 V | +4.9 V | | | +3.701 V to +3.899 V |
| | | | | +1.1 V | | | |
| | | -4 | -5 V | -4.9 V | | | -3.701 V to -3.899 V |
| | | | | -1.1 V | | | |
| | 1 V | 0 | 0 V | +3.8 V | | | +7.448 V to +7.752 V |
| | | | | -3.8 V | | | |
| | | 0 | +2.0 V | +5.0 V | | | +5.856 V to +6.144 V |
| | | | | -1.0 V | | | |
| | | 0 | -2.0 V | -5.0 V | | | -5.856 V to -6.144 V |
| | | | | +1.0 V | | | |

**Table 4-3: Gain accuracy (Cont.)**

| Channel | Scale setting | Position setting (Divs) | Offset setting | Generator setting | Measurement mean | Difference of measurement means | Accuracy limits |
|---|---|---|---|---|---|---|---|
| CH3 | 2 mV | 0 | 0 V | +7.6 mV | | | +14.820 mV to +15.580 mV |
| | | | | -7.6 mV | | | |
| | | -5 | +0.5 V | +517.6 mV | | | +14.355 mV to +16.045 mV |
| | | | | +502.4 mV | | | |
| | | 5 | -0.5 V | -517.6 mV | | | -14.355 mV to -16.045 mV |
| | | | | -502.4 mV | | | |
| | 5 mV | 0 | 0 V | +19.0 mV | | | +37.240 mV to +38.760 mV |
| | | | | -19.0 mV | | | |
| | | -5 | +0.5 V | +544.0 mV | | | +36.841 mV to +39.159 mV |
| | | | | +506.0 mV | | | |
| | | 5 | -0.5 V | -544.0 mV | | | -36.841 mV to -39.159 mV |
| | | | | -506.0 mV | | | |
| | 10 mV | 0 | 0 V | +38.0 mV | | | +74.480 mV to +77.520 mV |
| | | | | -38.0 mV | | | |
| | | -5 | +0.5 V | +588.0 mV | | | +73.644 mV to +78.356 mV |
| | | | | +512.0 mV | | | |
| | | 5 | -0.5 V | -588.0 mV | | | -73.644 mV to -78.356 mV |
| | | | | -512.0 mV | | | |
| | 20 mV | 0 | 0 V | +76 mV | | | +148.960 mV to +155.040 mV |
| | | | | -76 mV | | | |
| | | -5 | +0.5 V | +676.0 mV | | | +147.136 mV to +156.864 mV |
| | | | | +524.0 mV | | | |
| | | 5 | -0.5 V | -676.0 mV | | | -147.136 mV to -156.864 mV |
| | | | | -524.0 mV | | | |
| | 50 mV | 0 | 0 V | +190 mV | | | +372.400 mV to +387.600 mV |
| | | | | -190 mV | | | |
| | | -5 | +0.5 V | +940 mV | | | +366.700 mV to +393.300 mV |
| | | | | +560 mV | | | |
| | | 5 | -0.5 V | -940 mV | | | -366.700 mV to -393.300 mV |
| | | | | -560 mV | | | |
| | 100 mV | 0 | 0 V | +380 mV | | | +744.800 mV to +775.200 mV |

**Table 4-3: Gain accuracy (Cont.)**

| Channel | Scale setting | Position setting (Divs) | Offset setting | Generator setting | Measurement mean | Difference of measurement means | Accuracy limits |
|---|---|---|---|---|---|---|---|
| | | | | -380 mV | | | |
| | | 0 | +4.5 V | +4.88 V | | | +737.960 mV to +782.040 mV |
| | | | | +4.12 V | | | |
| | | 0 | -4.5 V | -4.88 V | | | -737.960 mV to -782.040 mV |
| | | | | -4.12 V | | | |
| | 200 mV | 0 | 0 V | +760 mV | | | +1.490 V to +1.550 V |
| | | | | -760 mV | | | |
| | | 2 | +4.6 V | +4.96 V | | | +1.477 V to +1.563 V |
| | | | | +3.44 V | | | |
| | | -2 | -4.6 V | -4.96 V | | | -1.477 V to -1.5643V |
| | | | | -3.44 V | | | |
| | 500 mV | 0 | 0 V | +1.9 V | | | +3.724 V to +3.876 V |
| | | | | -1.9 V | | | |
| | | 4 | +5 V | +4.9 V | | | +3.701 V to +3.899 V |
| | | | | +1.1 V | | | |
| | | -4 | -5 V | -4.9 V | | | -3.701 V to -3.899 V |
| | | | | -1.1 V | | | |
| | 1 V | 0 | 0 V | +3.8 V | | | +7.448 V to +7.752 V |
| | | | | -3.8 V | | | |
| | | 0 | +2.0 V | +5.0 V | | | +5.856 V to +6.144 V |
| | | | | -1.0 V | | | |
| | | 0 | -2.0 V | -5.0 V | | | -5.856 V to -6.144 V |
| | | | | +1.0 V | | | |

**Table 4-3: Gain accuracy (Cont.)**

| Channel | Scale setting | Position setting (Divs) | Offset setting | Generator setting | Measurement mean | Difference of measurement means | Accuracy limits |
|---|---|---|---|---|---|---|---|
| CH4 | 2 mV | 0 | 0 V | +7.6 mV | | | +14.820 mV to +15.580 mV |
| | | | | -7.6 mV | | | |
| | | -5 | +0.5 V | +517.6 mV | | | +14.355 mV to +16.045 mV |
| | | | | +502.4 mV | | | |
| | | 5 | -0.5 V | -517.6 mV | | | -14.355 mV to -16.045 mV |
| | | | | -502.4 mV | | | |
| | 5 mV | 0 | 0 V | +19.0 mV | | | +37.240 mV to +38.760 mV |
| | | | | -19.0 mV | | | |
| | | -5 | +0.5 V | +544.0 mV | | | +36.841 mV to +39.159 mV |
| | | | | +506.0 mV | | | |
| | | 5 | -0.5 V | -544.0 mV | | | -36.841 mV to -39.159 mV |
| | | | | -506.0 mV | | | |
| | 10 mV | 0 | 0 V | +38.0 mV | | | +74.480 mV to +77.520 mV |
| | | | | -38.0 mV | | | |
| | | -5 | +0.5 V | +588.0 mV | | | +73.644 mV to +78.356 mV |
| | | | | +512.0 mV | | | |
| | | 5 | -0.5 V | -588.0 mV | | | -73.644 mV to -78.356 mV |
| | | | | -512.0 mV | | | |
| | 20 mV | 0 | 0 V | +76 mV | | | +148.960 mV to +155.040 mV |
| | | | | -76 mV | | | |
| | | -5 | +0.5 V | +676.0 mV | | | +147.136 mV to +156.864 mV |
| | | | | +524.0 mV | | | |
| | | 5 | -0.5 V | -676.0 mV | | | -147.136 mV to -156.864 mV |
| | | | | -524.0 mV | | | |
| | 50 mV | 0 | 0 V | +190 mV | | | +372.400 mV to +387.600 mV |
| | | | | -190 mV | | | |
| | | -5 | +0.5 V | +940 mV | | | +366.700 mV to +393.300 mV |
| | | | | +560 mV | | | |
| | | 5 | -0.5 V | -940 mV | | | -366.700 mV to -393.300 mV |
| | | | | -560 mV | | | |
| | 100 mV | 0 | 0 V | +380 mV | | | +744.800 mV to +775.200 mV |

**Table 4-3: Gain accuracy (Cont.)**

| Channel | Scale setting | Position setting (Divs) | Offset setting | Generator setting | Measurement mean | Difference of measurement means | Accuracy limits |
|---|---|---|---|---|---|---|---|
| | | | | -380 mV | | | |
| | | 0 | +4.5 V | +4.88 V | | | +737.960 mV to +782.040 mV |
| | | | | +4.12 V | | | |
| | | 0 | -4.5 V | -4.88 V | | | -737.960 mV to -782.040 mV |
| | | | | -4.12 V | | | |
| | 200 mV | 0 | 0 V | +760 mV | | | +1.490 V to +1.550 V |
| | | | | -760 mV | | | |
| | | 2 | +4.6 V | +4.96 V | | | +1.477 V to +1.563 V |
| | | | | +3.44 V | | | |
| | | -2 | -4.6 V | -4.96 V | | | -1.477 V to -1.5643V |
| | | | | -3.44 V | | | |
| | 500 mV | 0 | 0 V | +1.9 V | | | +3.724 V to +3.876 V |
| | | | | -1.9 V | | | |
| | | 4 | +5 V | +4.9 V | | | +3.701 V to +3.899 V |
| | | | | +1.1 V | | | |
| | | -4 | -5 V | -4.9 V | | | -3.701 V to -3.899 V |
| | | | | -1.1 V | | | |
| | 1 V | 0 | 0 V | +3.8 V | | | +7.448 V to +7.752 V |
| | | | | -3.8 V | | | |
| | | 0 | +2.0 V | +5.0 V | | | +5.856 V to +6.144 V |
| | | | | -1.0 V | | | |
| | | 0 | -2.0 V | -5.0 V | | | -5.856 V to -6.144 V |
| | | | | +1.0 V | | | |

**d.** *Display the test signal:*

- From the tool bar touch **VERT** and then touch **Position**.
- Use the keypad to set vertical position to the number of divisions listed in the table for the current vertical scale setting and offset.
- Touch **Offset**.

- Use the keypad to set vertical offset to the setting listed in the table for the current vertical scale and position settings. The baseline level may move off screen.
- Set the generator to the level and polarity indicated in the table for the vertical scale, position, and offset settings you have made. The DC test level should appear on screen. (If it doesn't return, the accuracy check has failed for the current vertical scale, position, and offset settings of the current channel).

**e.** *Measure the test signal:* Press **Close**.

- Read the measurement results at the measurement statistics **µ** measurement readout. See Figure 4-10.
- Record the Mean in the Measurement Mean column of Table 4-3.

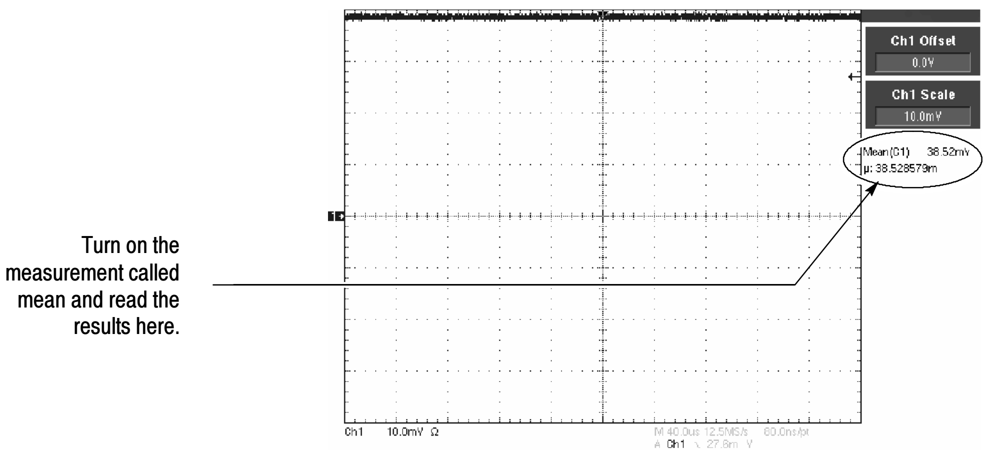



**Figure 4-10: Measurement of DC gain accuracy**

**f.** *Measure second mean:*

- Set the generator to the second level and polarity indicated in the table for the vertical scale, position, and offset settings you have made. The DC test level should appear on screen. (If it doesn't, the accuracy check has failed for the current vertical scale, position, and offset settings of the current channel).
- Repeat substep e using the current vertical scale, position, offset, and new generator setting for the second mean.

**g.** *Check against limits:*

- Subtract the second measurement mean from the first measurement mean for the current vertical scale, position, and offset.

- Record the difference of the two mean measurements in the Difference of Measurement Means column of Table 4–3.
- CHECK that the Difference of Measurement Mean is within the limits listed for the current vertical scale/position/offset/generator settings. Enter measurement mean difference value on test record.

**h.** *Repeat substeps:*

- Repeat substeps d through g, using the next position, offset and generator settings listed in the table for the current vertical scale.
- Repeat substeps d through g, using the next position, offset and generator settings listed in the table for the current vertical scale.

**i.** Repeat substeps c through h until all vertical scale settings, listed in Table 4–3, are checked for the channel under test.

**j.** *Test all channels:* Repeat substeps a through i for all four channels.

**3.** *Disconnect the hookup:*

**a.** *Set the generator output to 0 V.*

**b.** Disconnect the cable and adapter from the generator output and the input connector of the channel last tested.

## Check Offset Accuracy

| | |
|---|---|
| **Equipment required** | Two dual-banana connectors (Item 5)<br>One BNC T connector (Item 6)<br>One DC calibration generator (Item 10)<br>One SMA male-to-female BNC adapter (Item 20)<br>Two precision 50 Ω coaxial cables (Item 4) |
| **Prerequisites** | The instrument must meet the prerequisites listed on page 4-17 |

**WARNING.** *The generator is capable of outputting dangerous voltages. Be sure to set the DC calibration generator to off or 0 volts before connecting, disconnecting, and/or moving the test hookup during the performance of this procedure. Also, check that the calibrator does not have shorting straps installed between the DC output, sense input, or grounds.*

1. *Install the test hookup and preset the instrument controls:*

   a. *Hook up the test-signal source:*

   - Set the output of a DC calibration generator to off or 0 volts.
   - Connect the output of a DC calibration generator through a dual-banana connector followed by a 50 Ω precision coaxial cable to one side of a BNC T connector. See Figure 4-11.
   - Connect the Sense input of the generator through a second dual-banana connector followed by a 50 Ω precision coaxial cable to the other side of the BNC T connector. Now connect the BNC T connector to **CH 1** through an adapter. See Figure 4-11.

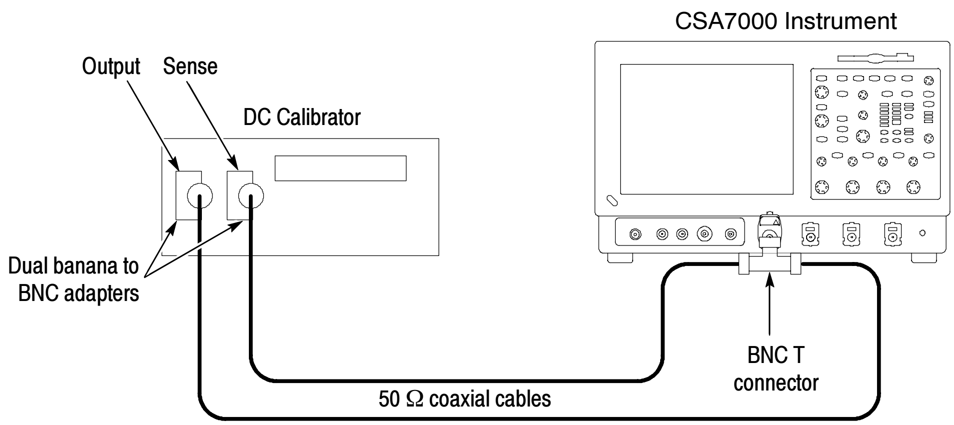



**Figure 4-11: Initial test hookup**

   b. *Initialize the instrument:* Press **DEFAULT SETUP**.

   c. *Modify the default settings:*

   - From the tool bar, touch **Horiz** and select the **Acquisition** tab.
   - Touch **Average** and set the number of averages to **16**.

2. *Confirm input channels are within limits for offset accuracy.* Do the following substeps — test CH 1 first, *skipping substep 2a since CH 1 is already selected from step 1.*

   a. *Select an unchecked channel:*

   - From the tool bar, touch **MEAS** and then **Clear** to remove the previous measurement.
   - Press the Vertical button of the channel just confirmed to remove the channel from the display.

- Press the front-panel Vertical button that corresponds to the channel you are to confirm.
- *Set the generator output to 0 V.*
- Move the test hookup to the channel you selected.

**b.** *Turn on the measurement Mean for the channel:*

- From the tool bar, touch **MEAS** and select the Ampl tab, then touch **Mean** to measure the mean of the current channel.
- Press **Close**.

**c.** *Set the vertical scale:* Set the vertical **SCALE** to one of the settings in Table 4–4 that is not yet checked.

**Table 4-4: Offset accuracy**

| Scale setting | Position setting (Divs) | Offset setting | Generator setting | Accuracy limits |
|---|---|---|---|---|
| 2 mV | 0 | +0.5 V | +500 mV | +497.3 mV to +502.7 mV |
| | | 0 V | 0.0 mV | -1.7 mV to +1.7 mV |
| | | -0.5 V | -500 mV | -502.7 mV to -497.3 mV |
| 50 mV | 0 | +0.5 V | +500 mV | +491.75 mV to +508.25 mV |
| | | 0 V | 0.0 mV | -6.5 mV to +6.5 mV |
| | | -0.5 V | -500 mV | -508.25 mV to -491.75 mV |
| 100 mV | 0 | +5 V | +5.0 V | +4.9575 V to +5.0425 V |
| | | 0 V | 0.0 V | -25 mV to +25 mV |
| | | -5 V | -5.0 V | -5.0425 V to -4.9575 V |
| 500 mV | 0 | +5 V | +5.0 V | +4.9175 V to +5.0825 V |
| | | 0 V | 0.0 V | -65 mV to +65 mV |
| | | -5 V | -5.0 V | -5.0825 V to -4.9175 V |
| 1 V | 0 | +2.5 V | +2.5 V | +2.37625 V to +2.62375 V |
| | | 0 V | 0.0 V | -115 mV to +115 mV |
| | | -2.5 V | -2.5 V | -2.62375 V to -2.37625 V |

**d.** *Display the test signal:*

- From the tool bar touch **VERT** and then touch **Position**.
- Use the keypad to set vertical position to 0.0 divisions (press **CLR** and then **ENTER**, on the keypad).

- Touch **Offset**.
- Use the keypad to set vertical offset to the positive-polarity setting listed in the table for the current vertical scale setting. The baseline level may move off screen.
- Set the generator to the level and polarity indicated in the table for the vertical scale, position, and offset settings you have made. The DC test level should appear on screen. (If it doesn't return, the offset accuracy check has failed for the current vertical scale setting of the current channel).

**e.** *Measure the test signal:* Press **Close**. Read the measurement results at the **Mean** measurement readout. See Figure 4-12.

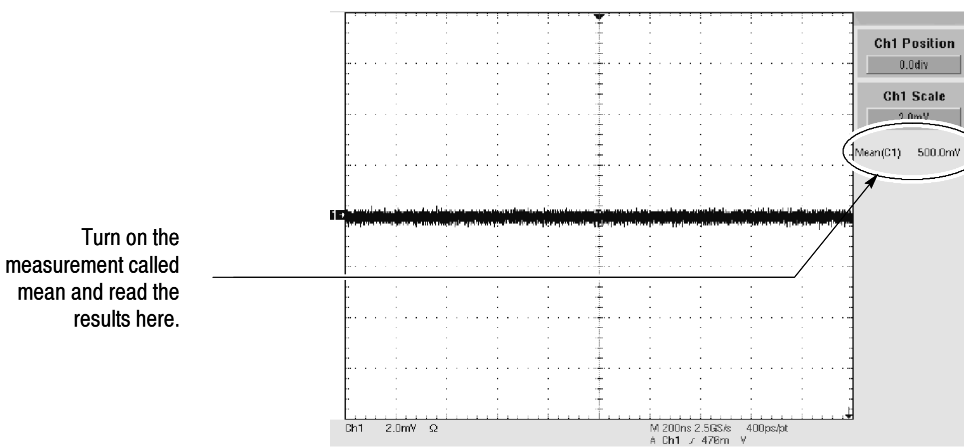



**Figure 4-12: Measurement of offset accuracy**

**f.** *Check against limits:*

- CHECK that the readout for the measurement **Mean** readout on screen is within the limits listed for the current vertical scale and position/offset/generator settings. Enter the value on the test record.
- Repeat substep d, using the zero offset and generator settings as is listed in the table.
- CHECK that the **Mean** measurement readout on screen is within the limits listed for the current vertical scale setting and position/offset/generator settings. Enter the value on the test record.
- Repeat substep d, using the negative-polarity offset and generator settings as is listed in the table.

- CHECK that the **Mean** measurement readout on screen is within the limits listed for the current vertical scale setting and position/offset/generator settings. Enter the value on the test record.
- Repeat substeps c through f until all vertical scale settings, listed in Table 4-4, are checked for the channel under test.

**g.** *Test all channels:* Repeat substeps a through f for all four channels.

**3.** *Disconnect the hookup:*

**a.** *Set the generator output to 0 V.*

**b.** Disconnect the cable and adapter from the generator output and the input connector of the channel last tested.

## Check Maximum Input Voltage

| | |
|---|---|
| **Equipment required** | Two dual-banana connectors (Item 5)<br>One BNC T connector (Item 6)<br>One 10X attenuator (Item 1)<br>One DC calibration generator (Item 10)<br>One SMA male-to-female BNC adapter (Item 20)<br>Two precision 50 Ω coaxial cables (Item 4) |
| **Prerequisites** | The instrument must meet the prerequisites listed on page 4-17 |

***WARNING.*** *The generator is capable of outputting dangerous voltages. Be sure to set the DC calibration generator to off or 0 volts before connecting, disconnecting, and/or moving the test hookup during the performance of this procedure. Also, check that the calibrator does not have shorting straps installed between the DC output, sense input, or grounds.*

**1.** *Install the test hookup and preset the instrument controls:*

**a.** *Hook up the test-signal source:*

- Set the output of a DC calibration generator to off or 0 volts.
- Connect the output of a DC calibration generator through a dual-banana connector followed by a 50 Ω precision coaxial cable to one side of a BNC T connector. See Figure 4-13.

- Connect the Sense input of the generator through a second dual-banana connector followed by a 50 Ω precision coaxial cable to the other side of the BNC T connector. Now connect the BNC T connector to **CH 1** through a 10X attenuator and an adapter. See Figure 4-13.

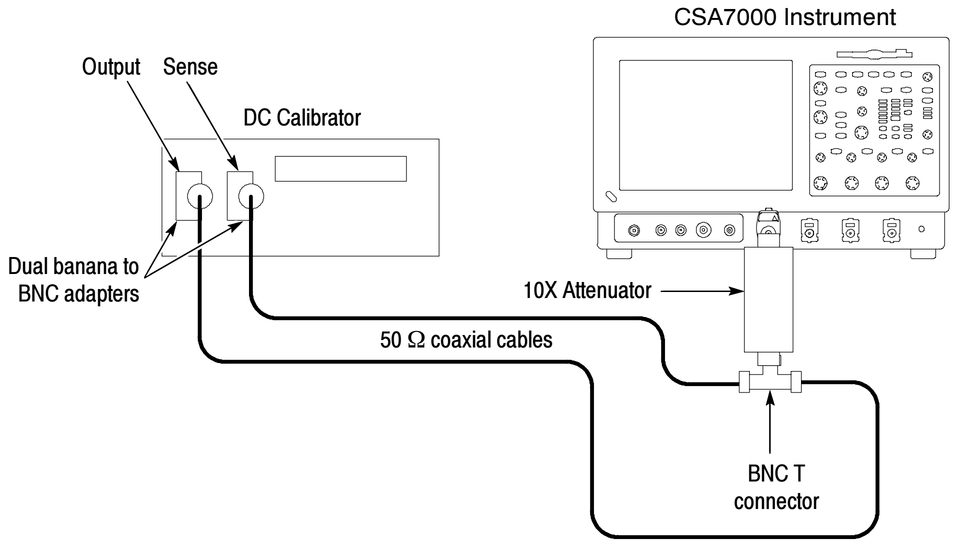



**Figure 4-13: Initial test hookup**

**b.** *Initialize the instrument:* Press **DEFAULT SETUP**.

**c.** *Modify the default settings:*

- From the tool bar, touch **Horiz** and select the **Acquisition** tab.
- Touch **Average** and set the number of averages to **16**.

**2.** *Confirm input channels are within limits for maximum input voltage:* Do the following substeps — test CH 1 first, *skipping substep 2a since CH 1 is already selected from step 1.*

**a.** *Select an unchecked channel:*

- From the tool bar, touch **MEAS** and then **Clear** to remove the previous measurement.
- Press the Vertical button of the channel just confirmed to remove the channel from the display.
- Press the front-panel Vertical button that corresponds to the channel you are to confirm.

- *Set the generator output to 0 V.*
- Move the test hookup to the channel you selected.

**b.** *Turn on the measurement High for the channel:*

- From the tool bar, touch **MEAS** and select the Ampl tab, then touch **High** to measure the high of the current channel.
- Press **Close**.

**c.** *Set the vertical scale:*

- Set the vertical **SCALE** to one of the settings listed in Table 4–5 that is not yet checked. (Start with the first setting listed).
- From the tool bar touch **VERT** and touch **Position**.
- Use the keypad to set vertical position to –3 divisions (press **CLR**, **3**, **–**, and then **ENTER**, on the keypad).
- Set the Coupling to **DC**.
- Touch **Offset**.
- Use the keypad to set vertical offset to 0 V.
- Press **Close**.

**Table 4-5: Maximum input voltage limit**

| Scale setting | Position setting (Divs) | Offset setting | Generator setting | Readout with 10X attenuator | Limits (without 10X attenuator) |
|---|---|---|---|---|---|
| 50 mV | -3 | 0 V | +1 V | +100 mV | Coupling in CH readout stays Ω |
| | | | +3 V | +300 mV | Coupling changes to ground |
| 1 V | -3 | 0 V | +5 V | +500 mV | Coupling in CH readout stays Ω |
| | | | +10 V | +1.0 V | Coupling changes to ground |

**d.** *Display the test signal:* Set the generator to the level and polarity indicated in the table for the vertical scale, position, and offset settings you have made, or set the generator for the readout indicated in the table for the vertical scale, position, and offset settings you have made. See Figure 4–14.

*__NOTE__. When setting the Wavetek to output 10 V, use the following procedure:*
*Press the* ***Aux*** *button*
*Press the fourth soft key down (Selects the pulse with an exclamation point)*
*Set the amplitude to 10 V*
*Press the* **->|** *key to select the pulse energy*
*Set the energy to 50J*
*Press the Output* ***On*** *key*
*Press the* ***Trig Pulse*** *soft key to trigger the pulse (this will generate a 10 V pulse with 25 seconds duration).*

*Use the normal DC output for the 1 V, 3 V, and 5 V generator settings.*

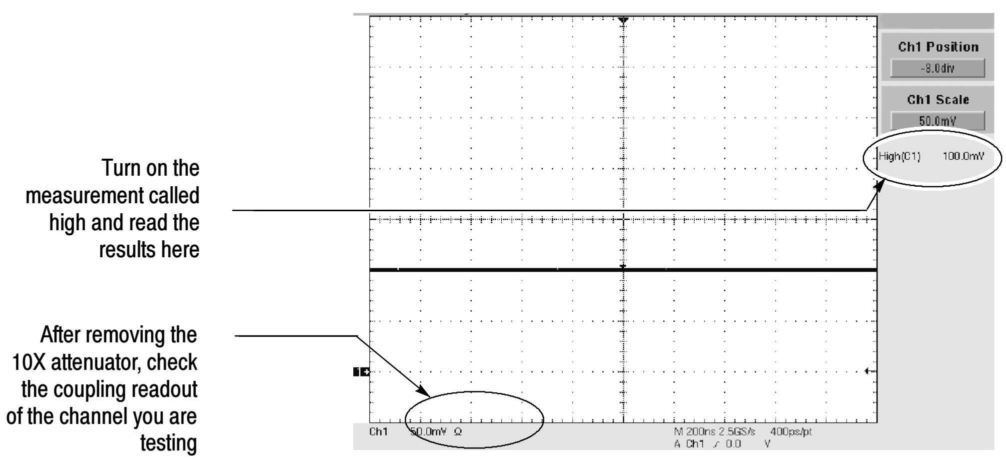



**Figure 4-14: Check of maximum input voltage**

**e.** *Check an unchecked generator setting against limits:*

- Remove the 10X attenuator.
- CHECK that the coupling readout on screen for the selected channel is as listed for the current vertical scale and position/offset/generator settings. Enter result on test record.
- Reinstall the 10X attenuator.

**f.** *Check the next generator setting:* Repeat substeps d and e, using the new generator setting as is listed in the table.

**g.** *Check the remaining vertical scale settings:* Repeat substeps c through f until all vertical scale settings, listed in Table 4–5, are checked for the channel under test.

h. *Test all channels:* Repeat substeps a through g for all vertical channels.

3. *Disconnect the hookup:*

   a. *Set the generator output to 0 V.*

   b. Disconnect the cable, attenuator, and adapter from the generator output and the input connector of the channel last tested.

## Check Analog Bandwidth

| | |
|---|---|
| **Equipment required** | One sine wave generator (Item 13)<br>One level meter and power sensor (Item 14)<br>One power divider (Item 15)<br>One female N to male BNC adapter (Item 17)<br>Four male N to female BNC adapters (Item 16)<br>Two 50 Ω precision cables (Item 4)<br>Attenuators (Items 1 and 2)<br>One SMA male-to-female BNC adapter (Item 20) |
| **Prerequisites** | See page 4-17 |

1. *Install the test hookup and preset the instrument controls:*

   a. *Initialize the instrument:*

   - Press **DEFAULT SETUP**.

   b. *Modify the default settings:*

   - Turn the horizontal **SCALE** knob to 40 ns.
   - From the tool bar, touch **Horiz** and select the **Acquisition** tab.
   - Touch **Average** and set the number of averages to 16.
   - Touch the **Equivalent Time Auto** button.
   - From the tool bar, touch **MEAS**. Touch Setup **Ref Levs**; then touch the Determine Base, Top Form **Min-Max** button.

***NOTE**. The sine wave generator output amplitude must be leveled to within 0.35 db of the reference frequency (10 MHz) through the bandwidth frequency listed in Table 4-6 on page 4-60. The 0.35 db requirement is necessary to ensure a bandwidth that meets Tektronix specifications.*

*You can perform bandwidth PV using an unleveled sine wave generator (with amplitude error > 0.35 db). Under these conditions, the bandwidth PV is subject to the flatness errors associated with the generator used.*

*Refer to the* Sine Wave Generator Leveling Procedure *on page 4-119 if your sine wave generator does not have automatic output amplitude leveling.*

**c.** *Hook up the test-signal source:* Connect the sine wave output of a leveled sine wave generator to **CH 1**. Set the output of the generator to a reference frequency of 10 MHz or less. See Figure 4-15.

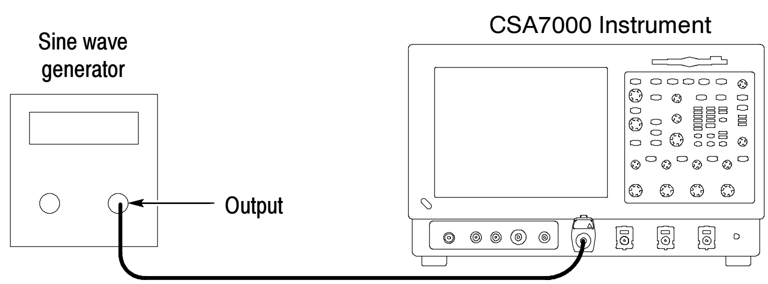



**Figure 4-15: Initial test hookup**

**2.** *Confirm the input channels are within limits for analog bandwidth:* Do the following substeps — test CH 1 first, *skipping substeps* a *and b since CH 1 is already set up for testing from step 1.*

**a.** *Select an unchecked channel:*

- From the tool bar, touch **MEAS** and then **Clear** to remove the previous measurement.
- Press the Vertical button of the channel just confirmed to remove the channel from the display.
- Press the front-panel Vertical button that corresponds to the channel you are to confirm.
- Move the leveled output of the sine wave generator to the channel you selected.

**b.** *Match the trigger source to the channel selected:* Press the Trigger **SOURCE** button until the source that corresponds to the channel you are to confirm is on.

**c.** *Set the vertical scale:* Set the vertical **SCALE** that corresponds to the channel you are to confirm to one of the settings listed in Table 4-6 not yet checked. (Start with the 100 mV setting).

**d.** *Set the triggering coupling:* Touch the Coupling **DC** button.

**Table 4-6: Analog bandwidth**

| Vertical scale | Reference amplitude (6 divisions) | Horizontal scale | Test frequency | Test frequency | Limits |
|---|---|---|---|---|---|
| | | | CSA7404 | CSA7154 | -3 dB Limits |
| 2 mV | 12 mV | 1 ns | 1 GHz | 1 GHz | ≥8.48 mV |
| 5 mV | 30 mV | 1 ns | 1.25 GHz | 1.25 GHz | ≥21.2 mV |
| 10 mV | 60 mV | 1 ns | 4 GHz | 1.5 GHz | ≥42.4 mV |
| 20 mV | 120 mV | 1 ns | 4 GHz | 1.5 GHz | ≥84.8 mV |
| 50 mV | 300 mV | 1 ns | 4 GHz | 1.5 GHz | ≥212 mV |
| 100 mV | 600 mV | 1 ns | 4 GHz | 1.5 GHz | ≥424 mV |
| 200 mV | 1.2 V | 1 ns | 4 GHz | 1.5 GHz | ≥848 mV |
| 500 mV | 3 V[1] | 1 ns | 4 GHz | 1.5 GHz | ≥2.12 V[1] |
| 1 V | 5 V[1] | 1 ns | 4 GHz | 1.5 GHz | ≥3.535 V[1] |

1 If your generator cannot output the required amplitude, determine its maximum output at the Test frequency, and use this for the reference amplitude. The -3 db limit can be calculated as: 0.707 × reference amplitude.

**e.** *Display the test signal:* Do the following subparts to first display the reference signal and then the test signal.

- From the button bar touch **MEAS**; then select the Time tab.
- Touch the **Freq** button to measure the frequency of the current channel.
- Select the Ampl tab. Touch the **Pk-Pk** button.
- Touch **Close** button.
- Set the generator output so the CHx Pk-Pk readout equals the reference amplitude in Table 4-6 that corresponds to the vertical scale set in substep c.

- Press the front-panel **PUSH TO SET 50%** as necessary to trigger a stable display. At full bandwidth, you may also want to make small, manual adjustments to the trigger level. You can use the **Trigger LEVEL** knob to do this.

**f.** *Measure the test signal:*

- Set the frequency of the generator, as shown on screen, to the test frequency in Table 4–6 that corresponds to the vertical scale set in substep c. See Figure 4–16.

- Set the horizontal **SCALE** to the horizontal scale setting in Table 4–6 that corresponds to the vertical scale set in substep c. Press **PUSH TO SET 50%** as necessary to trigger the signal.

- Read the results at the CHx Pk-Pk readout, which will automatically measure the amplitude of the test signal. See Figure 4–16.

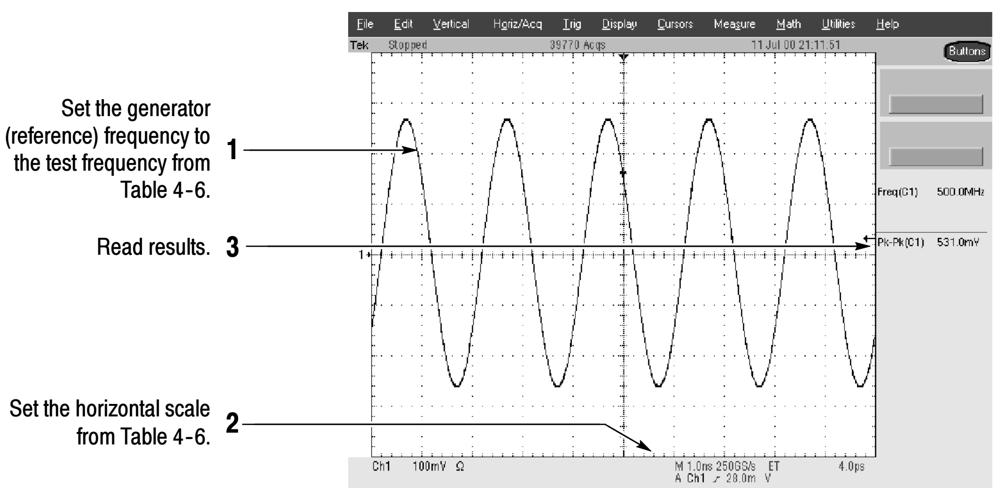



**Figure 4-16: Measurement of analog bandwidth**

**g.** *Check against limits:*

- CHECK that the **Pk-Pk** readout on screen is within the limits listed in Table 4–6 for the current vertical scale setting.

- Enter the voltage on the test record.

- When finished checking, set the horizontal **SCALE** back to the 40 ns setting.

***STOP**. Checking each channel's bandwidth at all vertical scale settings is time consuming and unnecessary. You may skip checking the remaining vertical scale settings in Table 4-6 (that is, skip the following substep, h) if this instrument has performed as follows:*

- Passed the 100 mV vertical scale setting just checked in this procedure.
- Passed the *Verify Internal Adjustment, Self Compensation, and Diagnostics* procedure found under *Self Tests,* on page 4-5.

***NOTE**. Passing the signal path compensation confirms the signal path for all vertical scale settings for all channels. Passing the internal diagnostics ensures that the factory-set adjustment constants that control the bandwidth for each vertical scale setting have not changed.*

**h.** *Check remaining vertical scale settings against limits (optional):*

- If desired, finish checking the remaining vertical scale settings for the channel under test by repeating substeps c through g for each of the remaining scale settings listed in Table 4-6 for the channel under test.
- When doing substep e, skip the subparts that turn on the CHx Pk-Pk measurement until you check a new channel.
- Before doing substep f, touch the **Clear** button to remove the previous channel measurements.
- Install/remove attenuators between the generator leveled output and the channel input as needed to obtain the six division reference signals listed in the table.

**i.** *Test all channels:* Repeat substeps a through g for all four channels.

**3.** *Disconnect the hookup:* Disconnect the test hook up from the input connector of the channel last tested.

## Check Delay Between Channels

| | |
|---|---|
| **Equipment required** | One sine wave generator (Item 13)<br>Three precision 50 Ω coaxial cables (Item 4)<br>One power divider (Item 15) or dual input coupler (item 7)<br>3 SMA female to female adapter connector (Item 18)<br>3 SMA male-to-female BNC adapter connector (Item 19)<br>Two SMA male-to-female BNC adapter (Item 20) |
| **Prerequisites** | See page 4-17 |

***STOP.*** *DO NOT use the vertical position knob to reposition any channel while doing this check. To do so invalidates the test.*

**1.** *Install the test hookup and preset the instrument controls:*

**a.** *Initialize the front panel:*Press the **DEFAULT SETUP** button.

**b.** *Modify the initialized front-panel control settings:*

- Do *not* adjust the vertical position of any channel during this procedure.
- Set the horizontal **SCALE** to 500 ps.
- From the tool bar, touch **Horiz** and select the **Acquisition** tab.
- Touch **Average** and set the number of averages to **16**.

**c.** *Hook up the test-signal source:*

- Connect the sine wave output of a sine wave generator to a 50 Ω precision coaxial cable followed by a power divider.
- Connect the power divider to both **CH 1** and **CH 2**. See Figure 4-17.

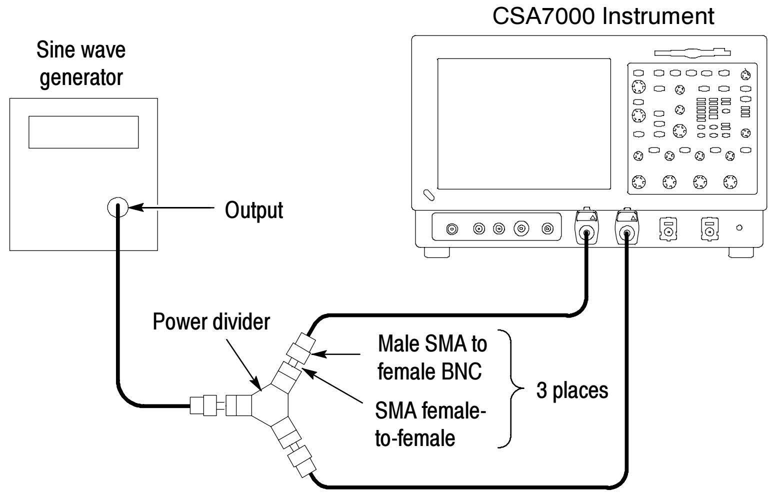



**Figure 4-17: Initial test hookup**

2. *Confirm all four channels are within limits for channel delay:*

   a. *Set up the generator:* Set the generator frequency to 500 MHz and the amplitude for six to eight divisions in CH 1.

      Hint: As you are adjusting the generator amplitude, push **PUSH TO SET 50%** frequently to speed up the updating of the waveform amplitude on screen.

   b. The horizontal **SCALE** should already be set to 500 ps. Now set it to 100 ps.

   c. *Save a CH 2 waveform:* Press the **CH 2** Vertical button. From the button bar, touch the **Refs** button and select the **Ref 2** tab. Touch the Save Wfm to Ref2 **Save** button.

   d. *Save CH 3 waveform:*

      - Move the power divider from **CH 2** to **CH 3**, so that **CH 1** and **CH 3** are driven. Press the Vertical **CH 2** and **CH 3** buttons. Select the **Ref 3** tab and touch the Ch Channel **3** button. Touch the Save Wfm to Ref3 **Save** button.

   e. *Display all test signals:*

      - Press the **CH 3** Vertical button to remove CH 3 from the display.

      - Display the live waveform. Move the power divider from **CH 3** to **CH 4**, so that CH 1 and CH 4 are driven. Press the Vertical **CH 4** button to display. See Figure 4–18 on page 4–65.

- Display the reference waveforms. To do this, touch the Ref 3 Display **Off** button to toggle it to On and display the reference. Select the **Ref 2** tab and touch the Display **Off** button to toggle it to On. You may notice their overlapping waveform handle icons. See Figure 4-18 on page 4-65.

**f.** *Measure the test signal:*

- Locate the time reference points for these waveforms. Do this by first identifying the point where the rising edge of the left-most waveform crosses the center horizontal graticule line. Next, note the corresponding *time reference point* for the right-most waveform. See Figure 4-18 on page 4-65.
- Press **CURSORS** and select the **V Bars** Cursors Type.
- Touch the **Close** button.

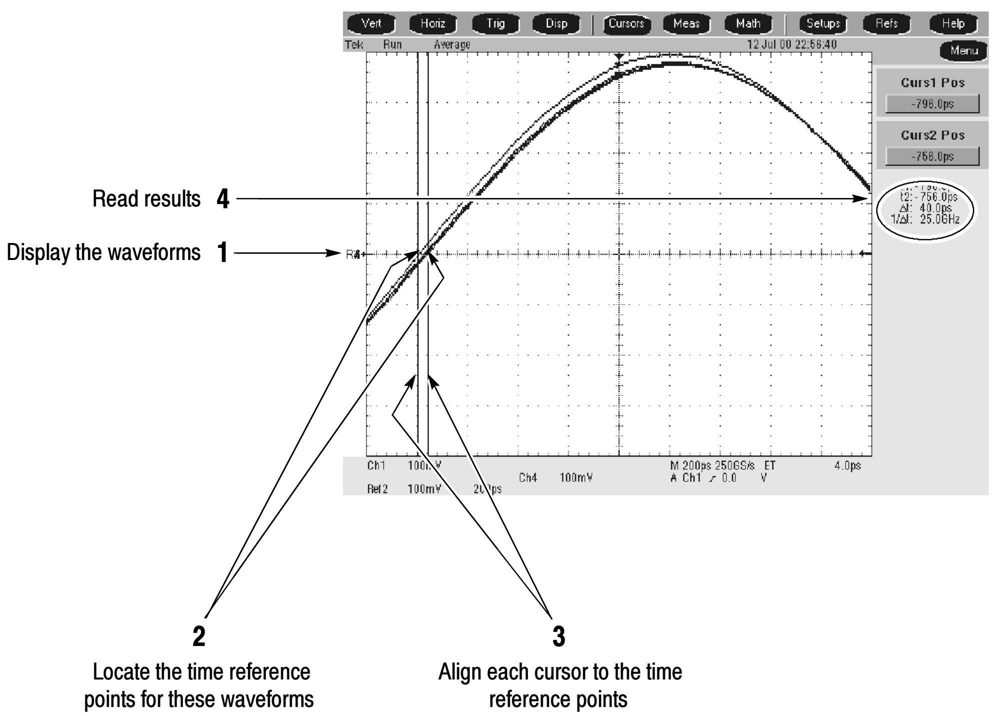



**Figure 4-18: Measurement of channel delay**

**g.** *Check against limits:* Use the cursors to measure the skew from CH 1 to CH 2, CH 1 to CH 3, and CH 1 to CH 4. Write down these three numbers in the first measurement column of Table 4-7. Note that these numbers may be either positive or negative.

**h.** Move the power divider on CH 1 to CH 2. Move the power divider on CH 4 to CH 1.

**i.** Repeat the procedure from step 2.a through 2.e.

**j.** Again use the cursors to measure the skew from CH 1 to CH 2, CH 1 to CH 3, and CH 1 to CH 4. Write down these numbers in the second measurement column of Table 4-7. Note that these numbers may be either positive or negative.

**k.** Add the first CH 1 to CH 2 skew measurement to the second CH 1 to CH 2 skew measurement and divide the result by 2. Use Table 4-7.

**l.** Add the first CH 1 to CH 3 skew measurement to the second CH 1 to CH 3 skew measurement and divide the result by 2. Use Table 4-7.

**m.** Add the first CH 1 to CH 4 skew measurement to the second CH 1 to CH 4 skew measurement and divide the result by 2. Use Table 4-7.

**n.** Check against limits: CHECK that the largest of the three results from steps k, l, and m is between -30 ps and + 30 ps.

**o.** Enter the time on the test record.

**Table 4-7: Delay between channels worksheet**

| Coupling | First measurement | Second measurement | Add first and second measurements | Divide sum by 2 |
|---|---|---|---|---|
| CH 1 to CH 2 skew | | | | |
| CH 1 to CH 3 skew | | | | |
| CH 1 to CH 4 skew | | | | |

**3.** *Disconnect the hookup:* Disconnect the cable from the generator output at the input connectors of the channels.

## Check Channel Isolation (Crosstalk)

| | |
|---|---|
| **Equipment required** | One leveled sine-wave generator (Item 13)<br>One 2X attenuator (Item 27)<br>Four TCA-BNC adapters (Item 20)<br>Three 50 Ω terminators (Item 3)<br>One 50 Ω, precision coaxial cable (Item 4) |
| **Prerequisites** | See page 4-17 |

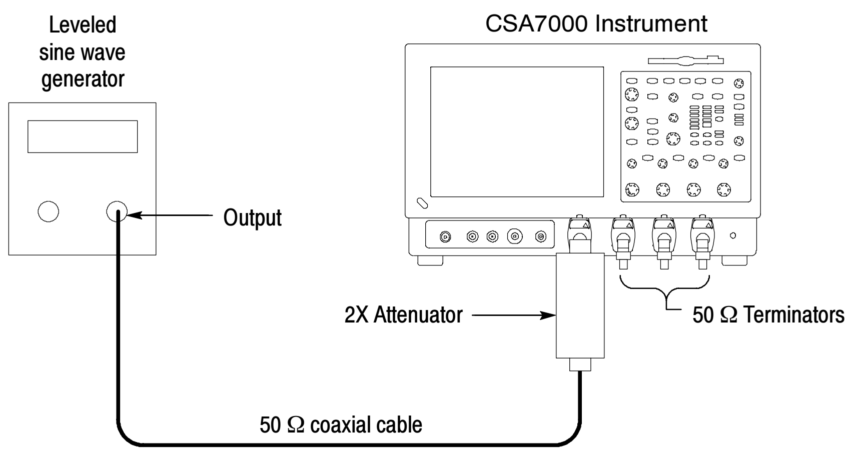



**Figure 4-19: Initial test hookup**

1. *Install the test hookup and preset the instrument controls:*

   a. *Initialize the instrument:* Press the **DEFAULT SETUP** button.

   b. *Modify the initialized control settings:*

      - Turn on all vertical channels (press the Vertical button of any off channels: CH 1, CH 2, CH 3, and CH 4).
      - Set the Horizontal SCALE to **1 ns**.
      - Set the Vertical SCALE of CH 1, CH 2, CH 3, and CH 4 to **100 mV**.
      - From the tool bar, touch **Horiz** and select the **Acquisition** tab.
      - Touch **Average**, set the number of averages to **16**, and touch the **Equivalent Time Auto** button.
      - From the button bar, touch **MEAS**.
      - Touch the Source Channel **1** button.
      - Select the **Ampl** tab; then touch the **Amplitude** button.

- Touch **Close**.
- Set the Trigger SOURCE to **CH 1**.
- Press **PUSH TO SET 50%**.

**c.** *Hook up the test-signal source*:

- Connect, through a 50 Ω precision coaxial cable, a 2X attenuator, and a TCA-BNC adapter, the output of the generator to **CH 1** (see Figure 4-19).
- Connect TCA-BNC adapters to the CH 2, CH 3, and CH 4 inputs.
- Connect 50 Ω terminators to the adapters on the CH 2, CH 3, and CH 4 inputs.

**2.** *Display the test signal:*

- Set the generator to output a sine wave at the bandwidth of your instrument or 1.5 GHz, whichever is less. Set the test signal amplitude for about five divisions on screen. Now fine adjust the generator output until the **CH 1 Amplitude** readout indicates the amplitude is 500 mV. Readout may fluctuate around 500 mV.
- Remove the 2X attenuator.

**3.** Confirm the input channels are within limits for channel isolation:

**a.** Check — Amplitude of each trace other than CH 1 is 0.125 division or less (discount trace width). Enter the largest amplitude on the test record.

**b.** Move the signal to the **CH 2** input connector, change the Trigger SOURCE to **CH 2**, and move the 50 Ω terminator to the CH 1 input.

**c.** Check — Amplitude of each trace other than CH 2 is 0.125 division or less (discount trace width). Enter the largest amplitude on the test record.

**d.** Move the signal to the **CH 3** input connector, change the Trigger SOURCE to **CH 3**, and move the 50 Ω terminator to the CH 2 input.

**e.** Check — Amplitude of each trace other than CH 3 is 0.125 division or less (discount trace width). Enter the largest amplitude on the test record.

**f.** Move the signal to the **CH 4** input connector, change the Trigger SOURCE to **CH 4**, and move the 50 Ω terminator to the CH 3 input.

**g.** Check — Amplitude of each trace other than CH 4 is 0.125 division or less (discount trace width). Enter the largest amplitude on the test record.

**h.** Select an unchecked vertical SCALE:

- Connect the 2X attenuator to the CH 1 input.

- Move the signal to the CH1 input, change the Trigger Source to **CH 1**, and move the 50 Ω terminator to the CH 4 input.
- Press **PUSH TO SET 50%**.
- Set the Vertical SCALE of CH 1, CH 2, CH 3, and CH 4 to **50 mV**
- Set the test signal amplitude for about five divisions on screen. Now fine adjust the generator output until the **CH 1 Amplitude** readout indicates the amplitude is 250 mV. Readout may fluctuate around 250 mV.
- Remove the 2X attenuator.
- Repeat steps a through g.
- Connect the 2X attenuator to CH 1.
- Move the signal to the CH 1 input, change the Trigger Source to **CH 1**, and move the 50 Ω terminator to the CH 4 input.
- Press **PUSH TO SET 50%**.
- Set the Vertical SCALE of CH 1, CH 2, CH 3, and CH 4 to **10 mV**
- Set the test signal amplitude for about five divisions on screen. Now fine adjust the generator output until the **CH 1 Amplitude** readout indicates the amplitude is 50 mV. Readout may fluctuate around 50 mV.
- Remove the 2X attenuator.
- Repeat steps a through g.

**4.** *Display the test signal:* If your instrument bandwidth is ≤ 1.5 GHz, skip to step 6.

- Connect the 2X attenuator to CH 1.
- Move the signal to the CH 1 input, change the Trigger Source to **CH 1**, and move the 50 Ω terminator to the CH 4 input.
- Press **PUSH TO SET 50%**.
- Set the Vertical SCALE of CH 1, CH 2, CH 3, and CH 4 to **100 mV**.
- Set the Horizontal SCALE to display 2 to 5 cycles of the signal.
- Set the generator to output a sine wave at the bandwidth of your instrument. Set the test signal amplitude for about five divisions on screen. Now fine adjust the generator output until the **CH 1 Amplitude** readout indicates the amplitude is 500 mV. Readout may fluctuate around 500 mV.

- Remove the 2X attenuator.

5. Confirm the input channels are within limits for channel isolation:

   a. Check — Amplitude of each trace other than CH 1 is 0.67 division or less (discount trace width). Enter the largest amplitude on the test record.

   b. Move the signal to the CH 2 input connector, change the Trigger SOURCE to CH 2, and move the 50 Ω terminator to the CH 1 input.

   c. Check — Amplitude of each trace other than CH 2 is 0.67 division or less (discount trace width). Enter the largest amplitude on the test record.

   d. Move the signal to the CH 3 input connector, change the Trigger SOURCE to CH 3, and move the 50 Ω terminator to the CH 2 input.

   e. Check — Amplitude of each trace other than CH 3 is 0.67 division or less (discount trace width). Enter the largest amplitude on the test record.

   f. Move the signal to the CH 4 input connector, change the Trigger SOURCE to CH 4, and move the 50 Ω terminator to the CH 3 input.

   g. Check — Amplitude of each trace other than CH 4 is 0.67 division or less (discount trace width). Enter the largest amplitude on the test record.

   h. Select an unchecked Vertical SCALE:

      - Connect the 2X attenuator to CH 1.
      - Move the signal to CH 1, set the Trigger SOURCE to CH 1, and move the 50 Ω terminator to the CH 4 input.
      - Press **PUSH TO SET 50%**.
      - Set the Vertical SCALE of CH 1, CH 2, CH 3, and CH 4 to **50 mV**
      - Set the test signal amplitude for about five divisions on screen. Now fine adjust the generator output until the **CH 1 Amplitude** readout indicates the amplitude is 250 mV. Readout may fluctuate around 250 mV.
      - Remove the 2X attenuator.
      - Repeat steps a through g.
      - Connect the 2X attenuator to CH 1.
      - Move the coaxial cable to CH 1, set the Trigger SOURCE to CH 1, and move the 50 Ω terminator to the CH 4 input.
      - Set the Vertical SCALE of CH 1, CH 2, CH 3, and CH 4 to **10 mV**

- Set the test signal amplitude for about five divisions on screen. Now fine adjust the generator output until the **CH 1 Amplitude** readout indicates the amplitude is 50 mV. Readout may fluctuate around 50 mV.
- Remove the 2X attenuator.
- Repeat steps a through g.

6. *Disconnect the hookup:* Disconnect the cable, terminators, and adapters from the generator output and the input connector of the channel.

## Check Input Impedance

| | |
|---|---|
| **Equipment required** | One Digital Multimeter (Item 28)<br>One Dual-Banana Connector, (Item 5)<br>One precision 50 Ω coaxial cable (Item 4)<br>One SMA male-to-female BNC adapter (Item 20) |
| **Prerequisites** | See page 4-17 |

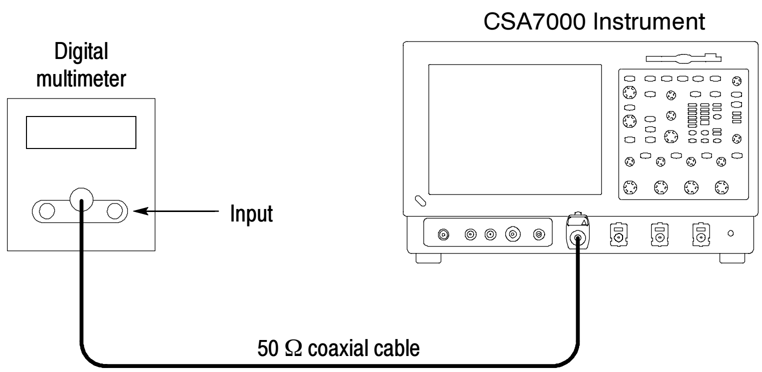



**Figure 4-20: Initial test hookup**

1. *Install the test hookup and preset the instrument controls:*

   a. *Hook up the test-signal source*: Connect, through a 50 Ω precision coaxial cable, the output of the multimeter to **CH 1** through adapters (see Figure 4-20).

   b. Press Default Setup.

   c. Set the Vertical SCALE to 10 mV per division

2. *Check input impedance against limits:*

   a. *Measure the impedance:*Read and record the measured impedance.

   b. Remove the dual banana connector from the digital multimeter (DMM), turn it 180 degrees and reinsert it in the DMM input.

   c. *Measure the impedance:*Read and record the measured impedance.

   d. Add the two measurements and divide the result by 2.

   e. Check — Average of the two measurements is $\geq$48.75 Ohms and $\leq$51.25 Ohms. Enter average on the test record.

3. Set the Vertical SCALE to 100 mV per division and repeat step 2.

4. *Repeat steps 2 through 3 for the remaining input channels:*

   a. Move the test setup to an unchecked input channel.

   b. Set the Vertical SCALE of the channel to 10 mV per division.

   c. Repeat steps 2 *through 3.*

5. *Disconnect the hookup:* Disconnect the equipment from the instrument.

# Time Base System Checks

These procedures check those characteristics that relate to the time base system and are listed as checked under *Warranted Characteristics* in *Specifications.*

## Check Long-Term Sample Rate and Delay Time Accuracy and Reference

| | |
|---|---|
| **Equipment required** | One timer-counter (Item 12)<br>One 50 Ω, precision coaxial cable (Item 4)<br>One SMA male-to-female BNC adapter (Item 20)<br>One sine wave generator (Item 13) |
| **Prerequisites** | See page 4-17 |

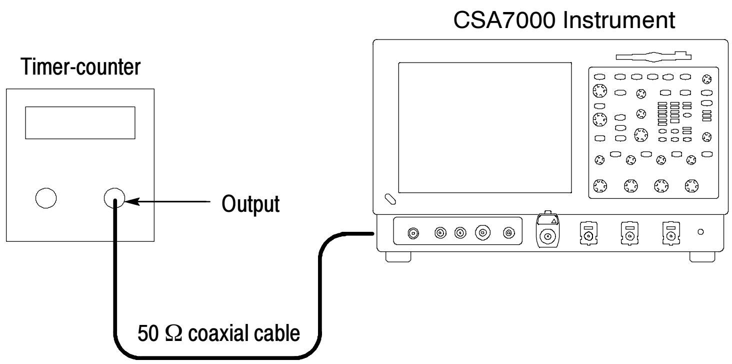



**Figure 4-21: Initial test hookup**

1. *Install the test hookup and preset the instrument controls:*
   a. *Hook up the test-signal source*: Connect, through a 50 Ω precision coaxial cable, the input of the timer-counter to **REF OUT** (see Figure 4–21).
      - Set the timer-counter gate to 1 s.
      - Set the timer-counter to count the reference output.

   b. *Initialize the instrument:* Press the **DEFAULT SETUP** button.
2. *Confirm the time base is within limits for accuracies:*
   a. *Check long-term sample rate and delay time accuracies against limits:*
      - CHECK that the count on the timer-counter is within limits.
      - Enter the count on the test record.

**3.** *Confirm reference is within limits for logic levels:*

**a.** *Display the test signal:*

- Move the cable from the timer-counter to the CH 1 input through an adapter.
- Set the Vertical **SCALE** to 1 V.
- Use the Vertical **POSITION** knob to center the display on screen.

**b.** *Measure logic levels:*

- From the button bar, touch **MEAS** and select the **Ampl** tab.
- Touch the **High** and **Low** buttons.
- Touch the **Close** button.

**c.** *Check REF OUT output against limits:* CHECK that the **CH 1 High** readout is ≥1.0 volt and that the **CH 1 Low** readout ≤0.25 volts.

**4.** *Disconnect the hookup:* Disconnect the cable and adapter from the instrument.

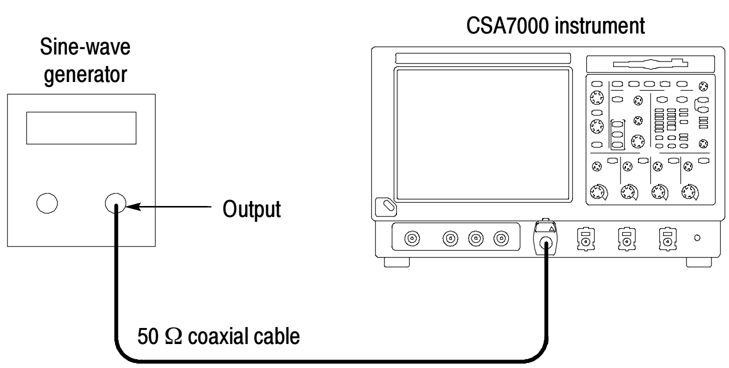



**Figure 4-22: Initial test hookup**

**5.** *Install the test hookup and preset the instrument controls:*

**a.** *Initialize the instrument:* Press the **DEFAULT SETUP** button.

**b.** *Hook up the test-signal source*: Connect, through a 50 Ω precision coaxial cable, the output of the sine wave generator to **CH 1** input through an adapter (see Figure 4–22).

- From the button bar, touch **MEAS** and select the **Ampl** tab.
- Touch the **Pk-Pk** button.

- Touch the **Close** button.
- Set the Vertical **SCALE** to 50 mV.
- Set the generator for a 10.0 MHz sine wave.
- Set the generator to output a 4 division signal. Adjust the output until the Pk-Pk readout displays 200 mV.

**c.** *Set the instrument controls:*

- Move the cable from the **CH 1** input to the rear-panel **Ext Ref** input (see Figure 4-23).
- Touch **Menu** to select menu mode.
- Touch **Utilities** and select **External Signals**.
- Touch the **Internal** button to select the external reference (the button name changes to External).

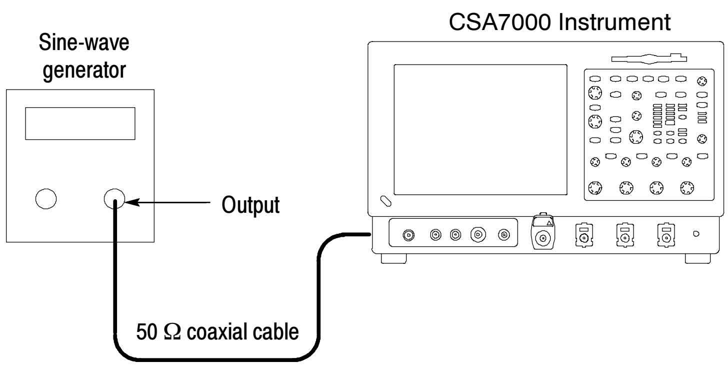



**Figure 4-23: Final test hookup**

**6.** *Confirm external reference:*

**a.** *Perform a signal path compensation:*

- Touch **Utilities** and select **Instrument Calibration**.
- Touch Calibrate and wait for the signal path compensation to finish.

**b.** *Check the completion status:* If the Status is Fail, refer the instrument to qualified service personnel.

**7.** *Disconnect the hookup:*

**a.** Disconnect all test equipment from the instrument.

**b.** *Set the instrument controls:*

- Touch **Menu** to select menu mode.
- Touch **Utilities** and select **External Signals**.
- Touch the **External** button to select the internal reference (the button name changes to Internal).

**c.** *Perform a signal path compensation:*

- Touch **Utilities** and select **Instrument Calibration**.
- Touch **Calibrate** and wait for the signal path compensation to finish.

## Check Delta Time Measurement Accuracy

| | |
|---|---|
| **Equipment required** | One 50 Ω, precision coaxial cable (Item 4)<br>One Connector, BNC "T", male BNC-to-dual female BNC (Item 6)<br>One Pulse Generator, Wavetek 9500 or equivalent (Item 21)<br>Two 50 Ω, coaxial cable, male-to-male SMA connectors (Item 22)<br>One SMA female to BNC male connector (Item 24)<br>One BNC elbow connector (Item 25)<br>One SMA "T", male to two SMA female connectors (Item 23)<br>Two SMA terminator connectors, short circuit, (Item 26)<br>One SMA male-to-female BNC adapter (Item 20)<br>One 2X attenuator, 50 Ω, female BNC-to-male BNC (Item 27) |
| **Prerequisites** | See page 4-17 |

This procedure checks the "sample rate" portion of the Delta Time Measurement Accuracy as listed in *Specifications.* The previous procedure, *Check Accuracy for Long-Term Sample Rate and Delay Time Accuracy and Reference*, see page 4-73, verified the "PPM" portion of the delta time specification.

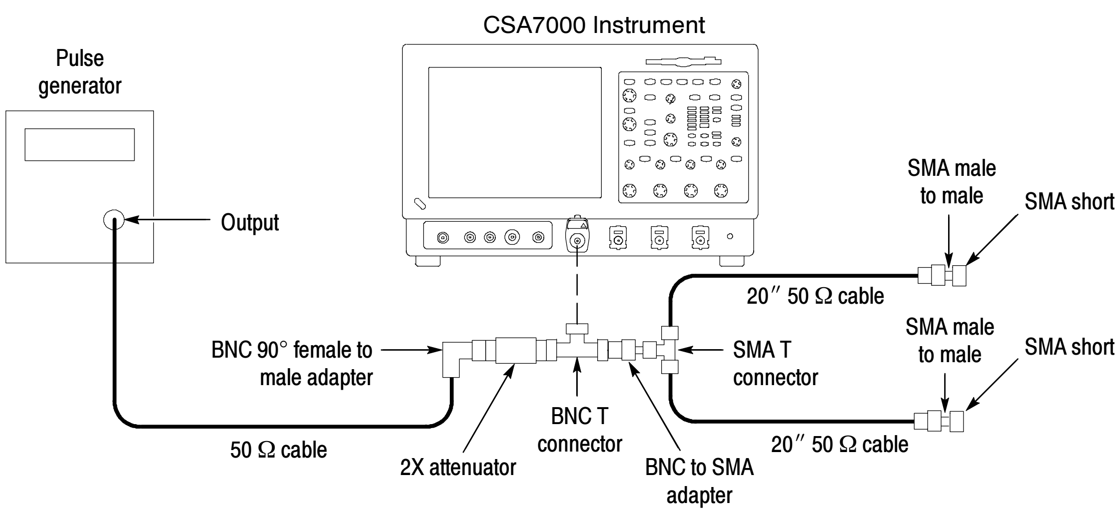



**Figure 4-24: Delta time accuracy test hookup**

1. *Install the test hookup and preset the instrument controls:*

   a. *Initialize the instrument:* Press the **DEFAULT SETUP** button.

**b.** *Hook up the pulse generator (see Figure 4-24 on page 4-77):*

- Connect the pulse generator output to a **50 Ω** precision coaxial cable followed by a 90° right-angle female to male BNC adapter, then a **50 Ω** 2X attenuator. The attenuator is connected to one side of the female BNC T connector. The other side of the BNC T is connected to BNC male to SMA adapter. The SMA side is connected to the male side of the SMA T connector. (Keep the distance between the BNC T and SMA T as short as possible). Connect 20 inch **50 Ω** coaxial cables to each female side of the SMA T connector. Connect a female to female SMA adapter to both male coaxial connectors. Connect the SMA short, to the remaining female SMA adapter. Now connect the male BNC T connector to **CH 1**.
- Set the pulse generator output for a positive-going pulse with a rise-time as shown in Table 4-8 on page 4-79 for your instrument, and for the fastest possible rep rate (at least 1 kHz).
- Set the pulse generator output for about 500 mV. (This amplitude can be adjusted later to get a 5-division pulse on screen.)

**c.** *Modify the initialized front-panel control settings:*

- Power on the pulse generator.
- Press **AUTOSET**. You may see both positive and negative pulses. Adjust the Trigger **LEVEL** knob so the trigger level is about 50% of the rising edge of the positive pulse.
- From the button bar, touch the **Horiz** button and select the Acquisition tab. Press the Equivalent Time **Off** (Real Time Only) button.
- Set the horizontal SCALE to 5 or 10 ns/division. The pulse width should be about **6 ns**.
- Adjust instrument vertical scale and position as necessary to obtain at least **5 divisions** of the **positive** pulse.

---

***NOTE**. If you have followed the procedure, you should have a 250 mV pulse displayed on screen. Later in this procedure you will set the instrument to measure the pulse width at the 150 mV level.*

*If the pulse you supply to the instrument is not a 250 mV pulse, you may need to set the reference level (MidRef) to something other than 150 mV. Set the reference level near the center of the pulse, above any noise, and below any overshoot or ringing on the pulse.*

---

**d.** *Set up for statistics measurements:*

- Press **RUN/STOP** button to freeze the display.
- Touch **MEAS** and select the **Time** tab to bring up the Time Measurements menu.
- Touch the **Positive Width** button.
- Touch Setup **Statistics**. Touch the Measurement Statistics **All** button and then touch **Reset** to reset the statistics.
- Touch **Weight n=**. On the keypad press **1000**, then **ENTER**. Touch **Setup**.
- Touch Setup **Ref Levs** and then touch **Absolute**.
- Touch **MidRef**. Using the keypad or multipurpose knobs, set the mid reference to **150 mV** and press Enter. Touch **Close**.
- Press the **RUN/STOP** button to start the acquisitions.
- Wait about 30 seconds.
- Press **RUN/STOP** button to freeze the display.
- Record the all statistics values.
- Calculate the difference of the Maximum (M) minus the mean (μ).
- Calculate the difference of the mean (μ) minus the Minimum (m).
- Both differences must be less than or equal to the Delta-time accuracy limit shown in Table 4–8 for your instrument.
- Enter the result for delta time on the test record.

**Table 4-8: Delta time measurement**

| Instrument type | Pulse generator rise time range | Delta time accuracy limit |
|---|---|---|
| CSA7404 or CSA7154 | ≤ 150 ps | ≤ 0.015 ns |

**e.** *Repeat for all other channels:*

- Note the vertical scale setting of the channel just confirmed.
- Press the Vertical channel button for the channel just confirmed to remove the channel from display.
- Touch **MEAS** and the **Clear** to remove the measurement.

- Press the front-panel button that corresponds to the channel you are to confirm.
- Set vertical SCALE to the setting noted in step e, first bullet.
- Press the Trigger Source button to toggle the source to the channel selected.
- Move the test hookup to the channel you selected.
- Press **RUN/STOP** button to start the display.
- Repeat step d.

**2.** *Disconnect all test equipment from the instrument.*

## Trigger System Checks

These procedures check those characteristics that relate to the trigger system and are listed as checked in *Specifications.*

### Check Time Accuracy for Pulse, Glitch, Timeout, and Width Triggering

| | |
|---|---|
| **Equipment required** | One sine wave generator (Item 13)<br>One 10X attenuator (Item 1)<br>One 50 Ω, precision coaxial cable (Item 4)<br>One SMA male-to-female BNC adapter (Item 20) |
| **Prerequisites** | See page 4-17 |

**1.** *Install the test hookup and preset the instrument controls:*

**a.** *Initialize the instrument:* Press the **DEFAULT SETUP** button.

**b.** *Modify the default setup:* Set the horizontal **SCALE** to 10 ns.

**c.** *Hook up the test-signal source:* Connect the output of the sine wave generator (Item 13) to CH 1.

Do this through a 50 Ω precision coaxial cable, followed by a 10X attenuator and adapter. See Figure 4-25.

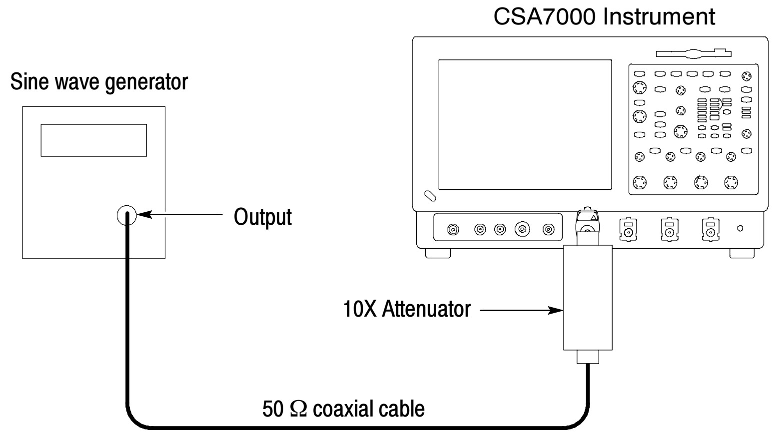



**Figure 4-25: Initial test hookup**

2. *Confirm the trigger system is within time-accuracy limits for pulse-glitch or pulse-width triggering (time range ≤500 n*s*):*

   a. *Display the test signal:* Set the output of the sine wave generator for a 100 MHz, five-division sine wave on screen. Press **PUSH TO SET 50%**.

   b. *Set the trigger mode:* Press the Trigger **MODE** button to toggle it to **NORMAL**.

   c. *Set upper and lower limits that ensure triggering:* See Figure 4-26.

      - Press the front-panel **ADVANCED** button and select the **A Event** tab; then select width triggering by touching the **Width** button.
      - Touch the **Trig When** button and select **Inside** limits.
      - Touch **Upper Limit** and use the keyboard to set the upper limit to 10 ns: press **10**, then **n**, and **ENTER**.
      - Touch **Lower Limit** and use the keypad to set the lower limit to 2 ns.

   d. *Change limits until triggering stops:*

      - Press **PUSH TO SET 50%**.
      - While doing the following subparts, monitor the display (it will stop acquiring) and the front-panel light **TRIG'D** (it will extinguish) to determine when triggering is lost.
      - Use the multipurpose knob to *increase* the **Lower Limit** readout until triggering is lost.

- CHECK that the **Lower Limit** readout, after the instrument loses triggering, is within 3.5 ns to 6.5 ns, inclusive.
- Enter the time on the test record.
- Use the keypad to return the **Lower Limit** to 2 ns and reestablish triggering.
- Touch **Upper Limit**; then use the multipurpose knob to slowly *decrease* the **Upper Limit** readout until triggering is lost.
- CHECK that the **Upper Limit** readout, after the instrument loses triggering, is within 3.5 ns to 6.5 ns, inclusive.
- Enter the time on the test record.

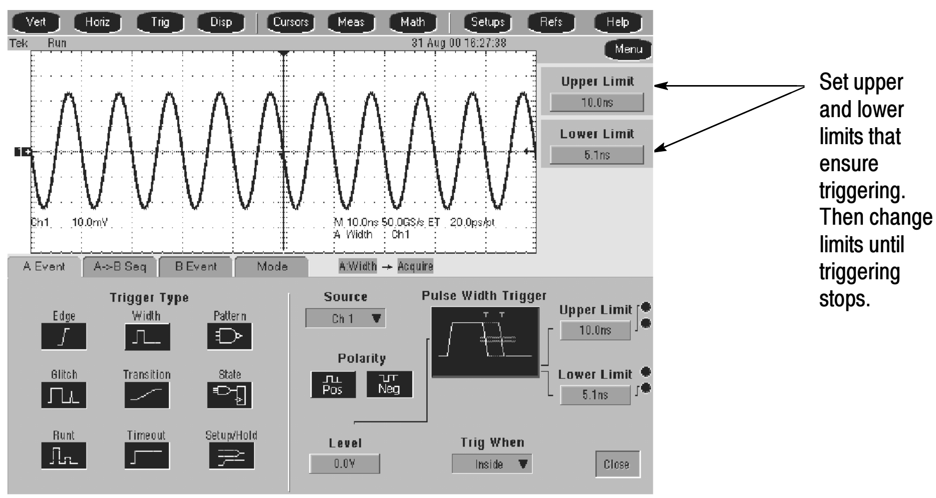



**Figure 4-26: Measurement of time accuracy for pulse and glitch triggering**

**3.** *Confirm the trigger system is within time-accuracy limits for pulse-glitch or pulse-width triggering (time range >520 ns):*

**a.** *Set upper and lower limits that ensure triggering at 250 kHz:*

- Touch **Upper Limit**. Use the keyboard to set the upper limit to 4 μs.
- Touch **Lower Limit**. Use the keypad to set the lower limit to 500 ns.

**b.** *Display the test signal:*

- Set the Horizontal **SCALE** to 4 μs.

- Set the output of the sine wave generator for a 250 kHz, five-division sine wave on screen. Set the Vertical **SCALE** to 20 mV (the waveform will overdrive the display).
- Press **PUSH TO SET LEVEL 50%**.

**c.** *Check against limits:* Do the following subparts in the order listed.

- Use the multipurpose knob to *increase* the **Lower Limit** readout until triggering is lost.
- CHECK that the **Lower Limit** readout, after the instrument stops triggering, is within 1.9 μs to 2.1 μs, inclusive.
- Enter the time on the test record.
- Use the keypad to return the **Lower Limit** to 500 ns and reestablish triggering.
- Touch **Upper Limit**; then use the multipurpose knob to slowly *decrease* the **Upper Limit** readout until triggering stops.
- CHECK that the **Upper Limit** readout, after the instrument loses triggering, is within 1.9 μs to 2.1 μs, inclusive.
- Enter the time on the test record.

**4.** *Disconnect the hookup:* Disconnect the cable and adapter from the generator output and the input connector of **CH 1**.

## Check Sensitivity, Edge Trigger, DC Coupled

| | |
|---|---|
| **Equipment required** | One sine wave generator (Item 13)<br>Two precision 50 Ω coaxial cables (Item 4)<br>One 50 Ω terminator (Item 3)<br>One 10X attenuator (Item 1)<br>One BNC T connector (Item 6)<br>One SMA male-to-female BNC adapter (Item 20)<br>One 5X attenuator (Item 2) |
| **Prerequisites** | See page 4-17. |

**1.** *Install the test hookup and preset the instrument controls:*

**a.** *Initialize the instrument:* Press the **DEFAULT SETUP** button.

**b.** *Modify the initialized front-panel control settings:*

- Set the Horizontal **SCALE** to 20 ns.

- Press the Trigger **MODE** button to toggle it to **Normal**.
- From the tool bar, touch **Horiz** and select the **Acquisition** tab.
- Touch the **Equivalent Time Auto** button.
- Touch **Average** and set the number of averages to **16**.

**c.** *Hook up the test-signal source:*

- Connect the signal output of the generator to a BNC T connector. Connect one output of the T connector to **CH 1** through a 50 Ω precision coaxial cable and an adapter. Connect the other output of the T connector to the **AUX INPUT** through a 50 Ω precision coaxial cable and a 50 Ω terminator. See Figure 4-27.

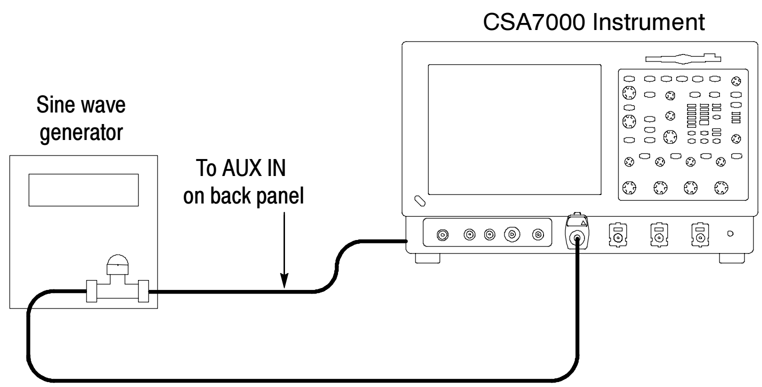



**Figure 4-27: Initial test hookup**

**2.** *Confirm the trigger system is within sensitivity limits (50 MHz):*

**a.** *Display the test signal:*

- Set the generator frequency to 50 MHz.
- From the button bar, touch **MEAS**.
- Touch Setup **Ref Levs**; then touch the **Min-Max** button.
- Touch the **Setup** button and select the **Ampl** tab; then touch the **Amplitude** button.
- Touch **Close**.
- Press **PUSH TO SET 50%**.
- Set the test signal amplitude for about three and a half divisions on screen. Now fine adjust the generator output until the **CH 1**

**Amplitude** readout indicates the amplitude is 350 mV. Readout may fluctuate around 350 mV.

- Disconnect the 50 Ω precision coaxial cable at **CH 1** and reconnect it to **CH 1** through a 10X attenuator.

**b.** *Check the Main trigger system for stable triggering at limits:*

- Read the following definition: 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. At horizontal scale settings of 2 ms/division and faster, **TRIG'D** will remain constantly lighted. It will flash for slower settings.
- Press the Trigger **Slope** button to select the positive slope.
- Adjust the Trigger **LEVEL** knob so that there is a stable trigger. CHECK that the trigger is stable for the test waveform on the positive slope.
- Press the Trigger **Slope** button to select the negative slope. Adjust the Trigger **LEVEL** knob so that there is a stable trigger.
- CHECK that the trigger is stable for the test waveform on the negative slope.
- Leave the trigger system triggered on the positive slope of the waveform before continuing to the next step.

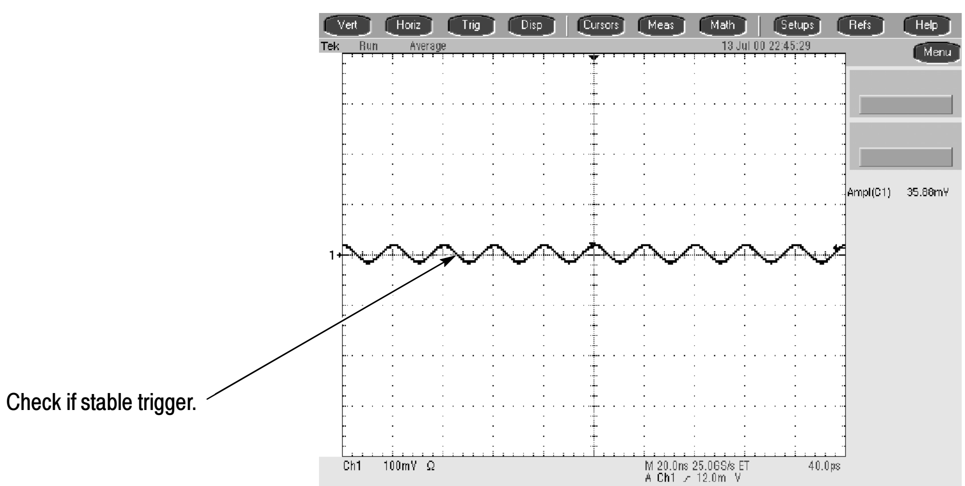



**Figure 4-28: Measurement of trigger sensitivity - 50 MHz results shown**

**c.** *Check Delayed trigger system for stable triggering at limits:* Do the following subparts in the order listed.

- From the button bar touch **Trig**, select the **A Event** tab, and set the **Source** to CH 1.
- Select the **A->B Seq** tab, and touch the A then B **Trig After Time** button.
- Select the B Event tab, and touch the **Set 50%** button.
- CHECK that a stable trigger is obtained for the test waveform for both the positive and negative slopes of the waveform. Use the **TRIGGER LEVEL** knob to stabilize the Main trigger. Touch B Trig Level and use the keypad or the multipurpose knob/FINE button to stabilize the Delayed trigger. Touch one of the Slope buttons to switch between trigger slopes. See Figure 4-28 on page 4-85.
- Leave the Delayed trigger system triggered on the positive slope of the waveform before continuing to the next step. Also, return to the main trigger: select the A->B Seq tab and touch the A->B Sequence **A Only** button. Then select the A Event tab.
- Press **Close**.

**3.** *Confirm the AUX Trigger input:*

**a.** *Display the test signal:*

- Remove the 10X attenuator and reconnect the cable to **CH 1**.
- Set the signal amplitude as follows:

| | |
|---|---|
| CSA7404 & CSA7154 | **2.5 divisions** |

- Now fine adjust the generator output until the **CH 1 Amplitude** readout indicates the amplitude is as follows (Readout may fluctuate):

| | |
|---|---|
| CSA7404 & CSA7154 | **250 mV** |

**b.** *Check the AUX trigger source for stable triggering at limits:* Do the following in the order listed.

- Use the definition for stable trigger from step 2b.
- Press the Trigger **SOURCE** button to toggle it to **EXT**.
- Press **PUSH TO SET 50%**.

- CHECK that a stable trigger is obtained for the test waveform on both the positive and negative slopes. Press the Trigger **SLOPE** button to switch between trigger slopes. Use the Trigger **LEVEL** knob to stabilize the trigger if required.
- Leave the trigger system triggered on the positive slope of the waveform before proceeding to the next check.
- Press the Trigger **SOURCE** button to toggle it to **CH 1**.

**4.** *Confirm that the trigger system is within sensitivity limits (full bandwidth):*

**a.** *Set the Horizontal Scale:* Set the Horizontal **SCALE** to 200 ps.

**b.** *Display the test signal:*

- Set the generator frequency to full bandwidth as follows:

| | |
|---|---|
| CSA7404 | **3 GHz** |
| CSA7154 | **1.5 GHz** |

- Set the generator amplitude on screen as follows:

| | |
|---|---|
| CSA7404 | **7 divisions** |
| CSA7154 | **5 divisions** |

- Now fine adjust the generator output until the **CH 1 Amplitude** readout indicates the amplitude is as follows (Readout may fluctuate):

| | |
|---|---|
| CSA7404 | **750 mV** |
| CSA7154 | **500 mV** |

- Disconnect the cable at **CH 1** and reconnect it to **CH 1** through a 5X attenuator. Check that a stable trigger is obtained.

**c.** Repeat step 2, substep b for the full bandwidth selected.

**d.** *Display the test signal:*

- Set the generator frequency to full bandwidth as follows:

| | |
|---|---|
| CSA7404 & CSA7154 | **1.5 GHz** |

- Disconnect the 5X attenuator. Set the test signal amplitude for about five divisions on screen. Now fine adjust the generator output until the **CH 1 Amplitude** readout indicates the amplitude is 500 mV. (Readout may fluctuate around 500 mV).
- Disconnect the cable at **CH 1** and reconnect it to **CH 1** through a 5X attenuator. Check that a stable trigger is obtained.

**e.** Repeat step 2, substep c only, for the full bandwidth selected.

**f.** *Display the test signal:*

- Set the generator frequency to 500 MHz.
- Set the Horizontal SCALE to 2.5 ns.
- Remove the 5X attenuator and reconnect the cable to **CH 1**.
- Set the generator amplitude on screen as follows:

| | |
|---|---|
| CSA7404 & CSA7154 | **4 divisions** |

- Now fine adjust the generator output until the **CH 1 Amplitude** readout indicates the amplitude is as follows (Readout may fluctuate):

| | |
|---|---|
| CSA7404 & CSA7154 | **350 mV** |

**g.** Repeat step 3, substeps b only, for the full bandwidth selected.

---

***NOTE**. You just checked the trigger sensitivity. If desired, you may repeat steps 1 through 4c for the other channels (CH 2, CH 3, and CH 4).*

---

**5.** *Disconnect the hookup:* Disconnect the cables and adapter from AUX IN and the channel last tested.

## Output Signal Checks

The procedure that follows checks those characteristics of the output signals that are listed as checked under *Warranted Characteristics* in *Specifications.* The instrument outputs these signals at its front and rear panels.

## Check Outputs — CH 3 Signal Out and Aux Trigger Out

| | |
|---|---|
| **Equipment required** | Two precision 50 Ω coaxial cables (Item 4)<br>One calibration generator (Item 11)<br>Two SMA male-to-female BNC adapter (Item 20) |
| **Prerequisites** | See page 4-17. Also, the instrument must have passed *Check DC Voltage Measurement Accuracy* on page 4-35. |

**1.** *Install the test hookup and preset the instrument controls:*

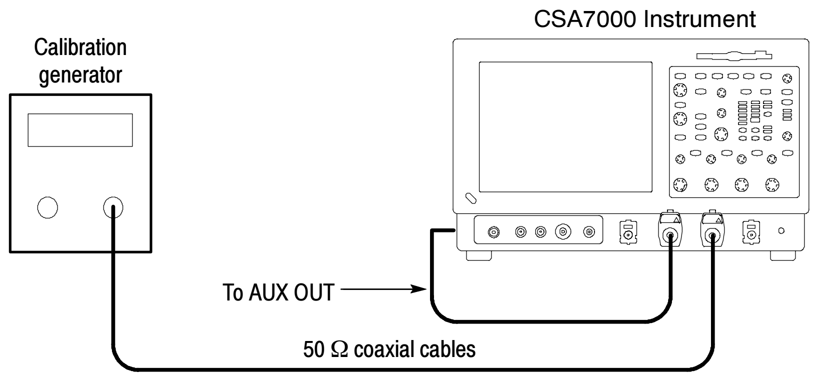



**Figure 4-29: Initial test hookup**

**a.** *Hook up test-signal source 1 (See Figure 4-29):*

- Connect the standard amplitude output of a calibration generator through a 50 Ω precision coaxial cable to **CH 3** through an adapter.
- Set the calibration generator to output a 0.500 V square wave.

**b.** *Hook up test-signal source 2:* Connect the **Aux Out** to **CH 2** through a 50 Ω precision cable and an adapter.

**c.** *Initialize the instrument:* Press the **DEFAULT SETUP** button.

**d.** *Modify the initialized front-panel control settings:*

- Press the Vertical **CH 1** button to toggle it off.
- Press the Vertical **CH 3** button to display that channel.
- Push Trigger **Source** to toggle the source to **CH 3**.
- Set the Horizontal **SCALE** to 200 μs.
- If necessary, adjust the calibration generator output for 5 divisions of amplitude.

- From the tool bar, touch **Horiz** and select the **Acquisition** tab.
- Touch **Average** and set the number of averages to **64**.
- Touch the Close button.

**2.** *Confirm AUX OUT is within limits for logic levels:*

**a.** *Display the test signal:*

- Press the Vertical **CH 3** button to turn off CH 3.
- Press the Vertical **CH 2** button to display that channel.
- Set the Vertical **SCALE** to 500 mV.
- Use the Vertical **POSITION** knob to center the display on screen.

**b.** *Measure logic levels:*

- From the button bar, touch **MEAS** and select the **Ampl** tab.
- Touch the **High** and **Low** buttons.
- Touch the **Close** button.

**c.** *Check AUX OUT output against limits:* CHECK that the **CH 2 High** readout is ≥1.0 volt and that the **CH 2 Low** readout ≤0.25 volts. See Figure 4-30.

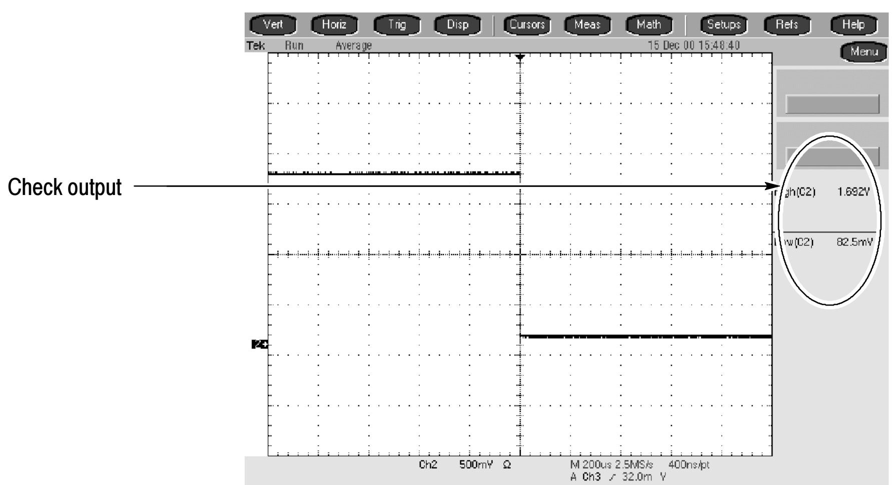



**Figure 4-30: Measurement of trigger out limits**

3. *Confirm SIGNAL OUT is within limits for gain:*

   a. *Measure gain:*

      - Move the precision 50 Ω cable from the **AUX OUT** BNC to the **SIGNAL OUT** BNC.
      - Set Vertical **SCALE** to 50 mV.
      - Press **PUSH TO SET 50%**.
      - From the button bar, touch **MEAS** and select the **Ampl** tab.
      - Touch the **Pk-Pk** button.
      - Touch **Close**.

   b. *Check against limits:* CHECK that the readout **CH 2 Pk-Pk** is between 40 mV and 60 mV, inclusive.

4. *Confirm SIGNAL OUT is within limits for offset:*

   - Disconnect the cable from the CH 3 input.
   - From the button bar, touch **MEAS** and select the **Ampl** tab.
   - Touch the **Low** button.
   - Touch **Close**.

   a. *Check against limits:* CHECK that the Low reading is between –100 mV and –170 mV, inclusive.

5. *Disconnect the hookup:* Disconnect the cables and adapters from the inputs and outputs.

## Check Probe Compensation Output

| | |
|---|---|
| **Equipment required** | Two dual-banana connectors (Item 5)<br>One BNC T connector (Item 6)<br>Two precision 50 Ω coaxial cables (Item 4)<br>One DC calibration generator (Item 10)<br>One SMA-to-BNC adapter (Item 20) |
| **Prerequisites** | See page 4-17. Also, the instrument must have passed *Check Long-Term Sample Rate and Delay Time Accuracy and Reference* on page 4-73. |

1. *Install the test hookup and preset the instrument controls:*

   a. *Hook up test-signal:*

   - Connect one of the 50 Ω cables to **CH 1** through an adapter. See Figure 4-31.
   - Connect the other end of the cable just installed to the **PROBE COMPENSATION** output. See Figure 4-31.

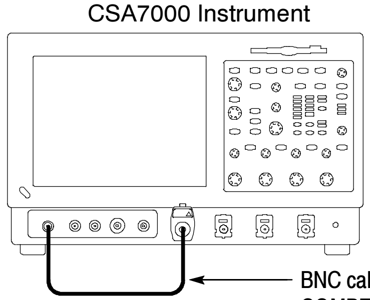



**Figure 4-31: Initial test hookup**

   b. *Initialize the instrument:* Press the **DEFAULT SETUP** button.

   c. *Modify the initialized front-panel control settings:*

   - Set the **Vertical SCALE** to 100 mV.
   - Touch the **Vert** button and then touch **Offset**. Adjust the Ch1 Offset to 0.8 V using the multipurpose knob.
   - Set the Horizontal **SCALE** to 200 μs.
   - Press **PUSH TO SET 50%**.

- Use the Vertical **POSITION** knob to center the display on screen.
- From the tool bar, touch **Horiz** and select the **Acquisition** tab.
- Touch **Average** and set the number of averages to **128**.

**2.** *Confirm that the Probe Compensator signal is within limits for frequency:*

**a.** *Measure the frequency of the probe compensation signal:*

- From the button bar, touch **MEAS** and select the **Time** tab.
- Touch the **Freq** button.

**b.** *Check against limits:*

- CHECK that the **CH 1 Freq** readout is within 950 Hz to 1.050 kHz, inclusive. See Figure 4-32.
- Enter the frequency on the test record.
- Touch **Clear** to remove the measurement.

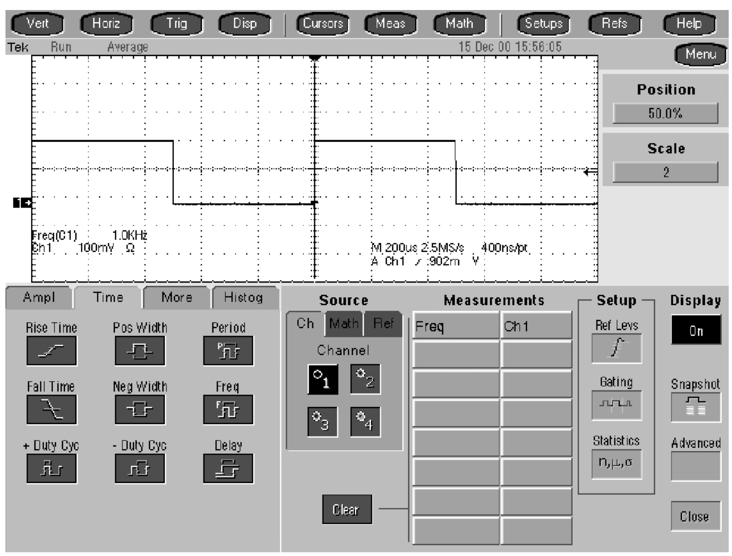



**Figure 4-32: Measurement of probe compensator frequency**

**c.** *Save the probe compensation signal in reference memory:*

- Touch **Refs**; then select the **Ref 1** tab.
- Touch the Save Wfm to Ref1 **Save** button to save the probe compensation signal in reference 1.

- Disconnect the cable from **CH 1** and the probe compensation connector.
- Touch the **Display** button to toggle it to on to displayed the stored signal.

**d.** *Hook up the DC standard source:*

- Set the output of a DC calibration generator to off or 0 volts.
- Connect the output of a DC calibration generator through a dual-banana connector followed by a 50 Ω precision coaxial cable to one side of a BNC T connector. See Figure 4–33.
- Connect the Sense input of the generator through a second dual-banana connector followed by a 50 Ω precision coaxial cable to the other side of the BNC T connector. Now connect the BNC T connector to **CH 1** through a TCA-BNC or BNC-to-SMA adapter. See Figure 4–33.

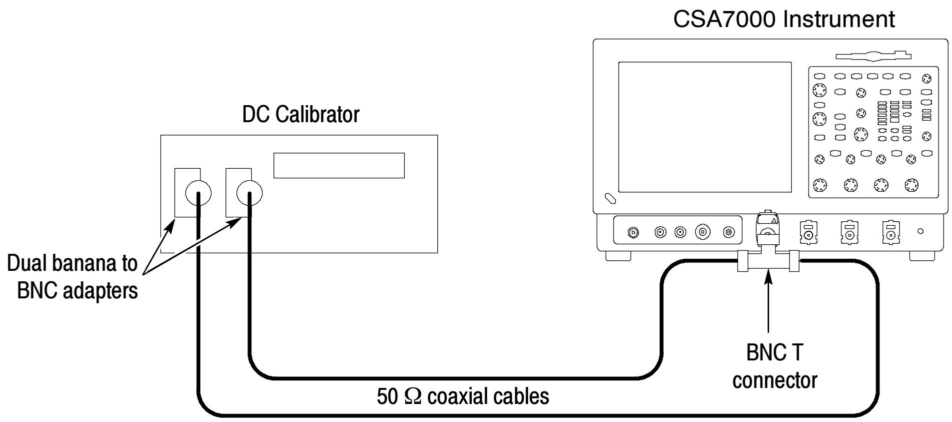



**Figure 4-33: Subsequent test hookup**

**e.** *Measure amplitude of the probe compensation signal:*

- From the tool bar, touch **Horiz** and select the **Acquisition** tab.
- Touch **Average** and set the number of averages to **16** using the keypad or the multipurpose knob.
- Adjust the output of the DC calibration generator until it precisely overlaps the top (upper) level of the stored probe compensation signal. (This value will be near 1.0 V).
- Record the setting of the DC generator.

- Adjust the output of the DC calibration generator until it precisely overlaps the base (lower) level of the stored probe compensation signal. (This value will be near 800 mV).
- Record the setting of the DC generator.

**f.** Press **Close** to remove the menus from the display. See Figure 4-34.

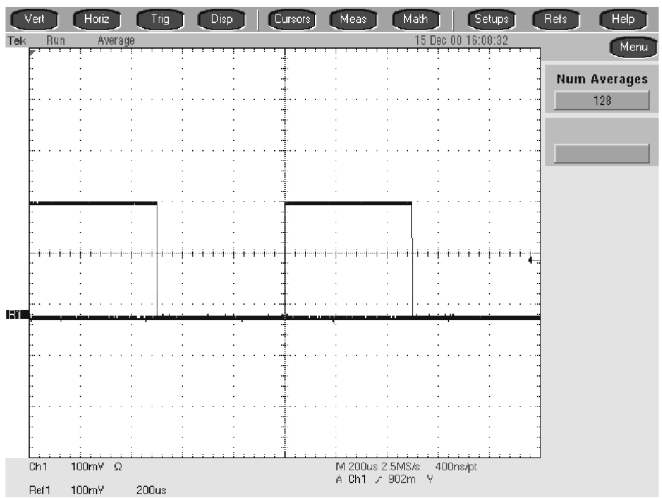



**Figure 4-34: Measurement of probe compensator amplitude**

**g.** *Check against limits:*

- Subtract the value just obtained (base level) from that obtained previously (top level).
- CHECK that the difference obtained is within 160 mV to 240 mV, inclusive.
- Enter voltage difference on test record.

**3.** *Disconnect the hookup:* Disconnect the cable and adapter from **CH 1**.

# Serial Trigger Checks

These procedures check those characteristics that relate to the serial trigger system and are listed as checked in *Specifications.*

## Check Serial Trigger Baud Rate Limits and Word Recognizer Position Accuracy

| | |
|---|---|
| **Equipment required** | One precision 50 Ω coaxial cables (Item 4)<br>One sine-wave generator (Item 13)<br>One or two SMA male-to-female BNC adapter (Item 20)<br>One TCA-BNC or TCA-SMA adapter (item 20) |
| **Prerequisites** | See page 4-17. Also, the instrument must have passed *Check DC Voltage Measurement Accuracy* on page 4-35. |

**1.** *Install the test hookup and preset the instrument controls:*

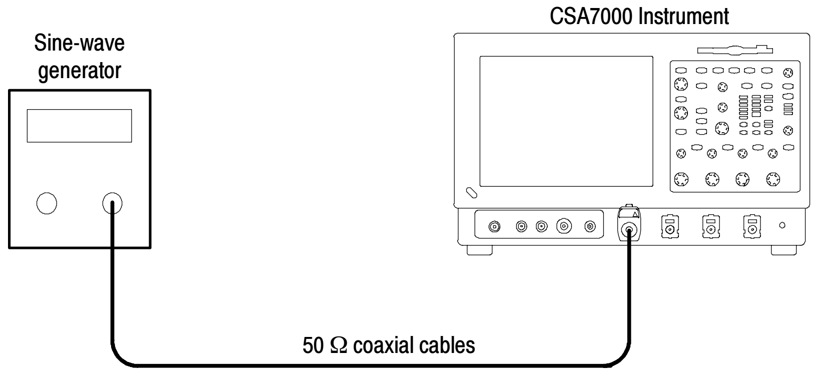



**Figure 4-35: Initial test hookup**

**a.** *Hook Up the test-signal source (see Figure 4-35):*

- Connect the sine wave output of the sine-wave generator through a 50 Ω precision coaxial cable to CH 1 through an adapter.
- Set the sine-wave generator to output a 433 MHz sine wave.

**b.** *Initialize the instrument:* Press the **DEFAULT SETUP** button.

**c.** Modify the initialized front-panel control settings:

- Set the vertical **SCALE** to 50 mV per division.
- Set the horizontal **SCALE** to 2.5 ns per division.
- Adjust the sine-wave generator output for 4 divisions of amplitude centered on the display.

- Adjust the trigger **LEVEL** to trigger at 25% (–1 division) on the sine wave.

**Table 4-9: Serial pattern data**

| Serial pattern data | Trigger location |
|---|---|
| DB6D $B6DB_{16}$ | One UI before the 0 |
| B6DB $6DB6_{16}$ | At the 0 |
| 6DB6 $DB6D_{16}$ | One UI after the 0 |

2. *Verify that the signal path can do isolated 0 and pattern matching circuits can do isolated 1:*

   a. From the button bar, touch **Cursors** and then the **Setup** button.

   b. Set the Tracking Mode to **Tracking**.

   c. Touch the **Close** button.

   d. Adjust the cursors until the Δt readout equals 800 ps (one unit interval). Center the cursors around the center graticule line (see Figure 4–36).

   e. From the button bar, touch **Trig** and select the **A Event** tab.

   f. Touch the **Serial** Trigger Type button and then set the Standard to **GB Ethernet**.

   g. Touch the **Editor** button.

   h. Set the Format to **Hex** and then touch the **Clear** button.

   i. Enter data into the Serial Pattern Data field for one of the settings in Table 4–9 that is not yet checked. (Start with the first setting listed.)

   j. Touch **Apply**.

   k. Verify that the instrument triggers one Unit Interval (UI, one baud divided by the bit period) before the 0 in the input signal (see Figure 4–36). Enter pass or fail in the test record.

   l. Touch the **Clear** button.

   m. Enter data into Serial Pattern Data field for the next setting in Table 4–9 that is not yet checked.

   n. Touch **Apply**.

   o. Verify that the instrument triggers at the 0 in the input signal (see Figure 4–36). Enter pass or fail in the test record.

Triggered 1 UI before a 0

Triggered on a 0

Triggered 1 UI after a 0

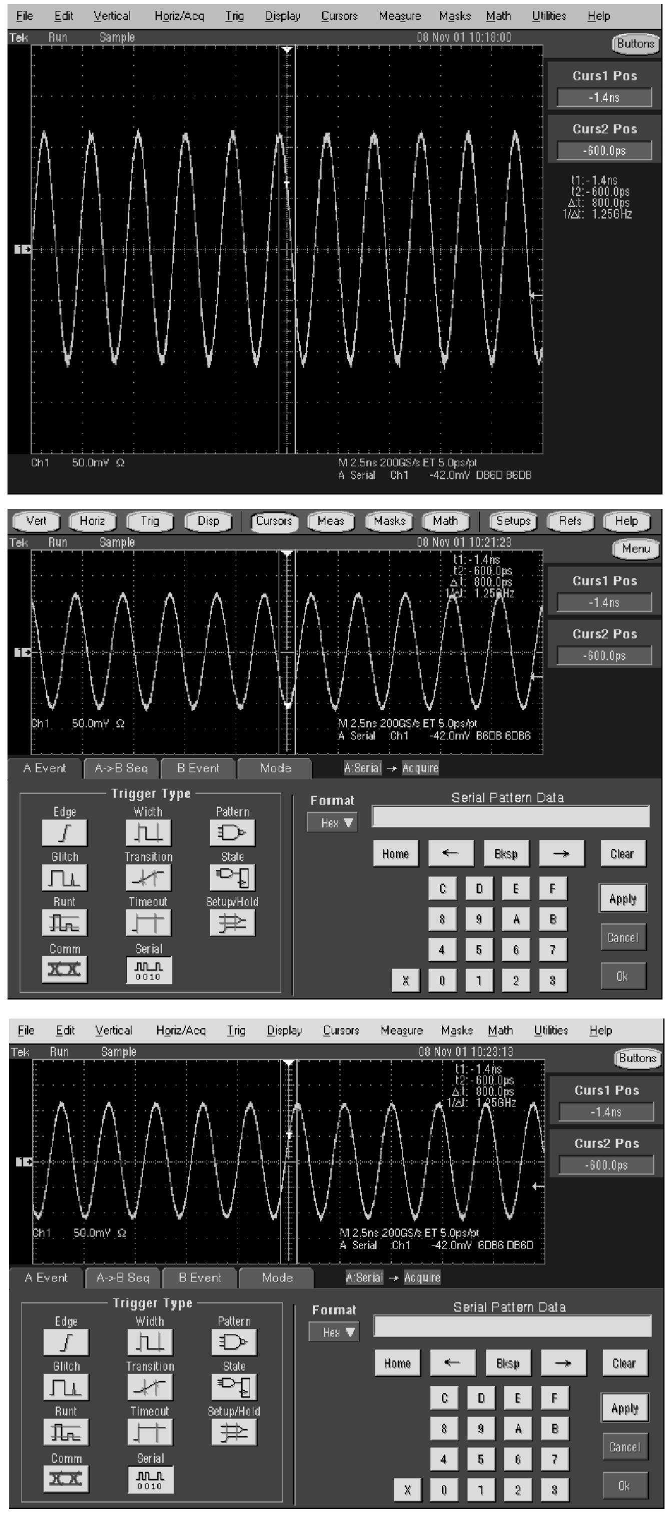



**Figure 4-36: Isolated 0 triggering**

**p.** Touch the **Clear** button.

**q.** Enter data into Serial Pattern Data field for the next setting in Table 4–9 that is not yet checked.

**r.** Touch **Apply**.

**s.** Verify that the instrument triggers one Unit Interval (UI) after the 0 in the input signal (see Figure 4–36). Enter pass or fail in the test record.

**Table 4-10: Word recognizer data**

| Serial pattern data | Trigger location |
|---|---|
| $2492\ 4924_{16}$ | One UI before the 1 |
| $4924\ 9249_{16}$ | At the 1 |
| $9249\ 2492_{16}$ | One UI after the 1 |

**3.** *Verify that the serial path and pattern matching circuits can do isolated 1s:*

**a.** Adjust the trigger **LEVEL** to trigger at 75% (+1 division) on the sine wave.

**b.** Touch the **Clear** button.

**c.** Enter data into the Serial Pattern Data field for one of the settings in Table 4–10 that is not yet checked. (Start with the first setting listed.)

**d.** Touch **Apply**.

**e.** Verify that the instrument triggers one Unit Interval (UI) before the 1 in the input signal (see Figure 4–37). Enter pass or fail in the test record.

**f.** Touch the **Clear** button.

**g.** Enter data into the Serial Pattern Data field for the next setting in Table 4–10 that is not yet checked.

**h.** Touch **Apply**.

**i.** Verify that the instrument triggers at the 1 in the input signal (see Figure 4–37). Enter pass or fail in the test record.

**j.** Touch the **Clear** button.

**k.** Enter data into the Serial Pattern Data field for the next setting in Table 4–10 that is not yet checked.

**l.** Touch **Apply**.

Triggered 1 UI before a 1

Triggered on a 1

Triggered 1 UI after a 1

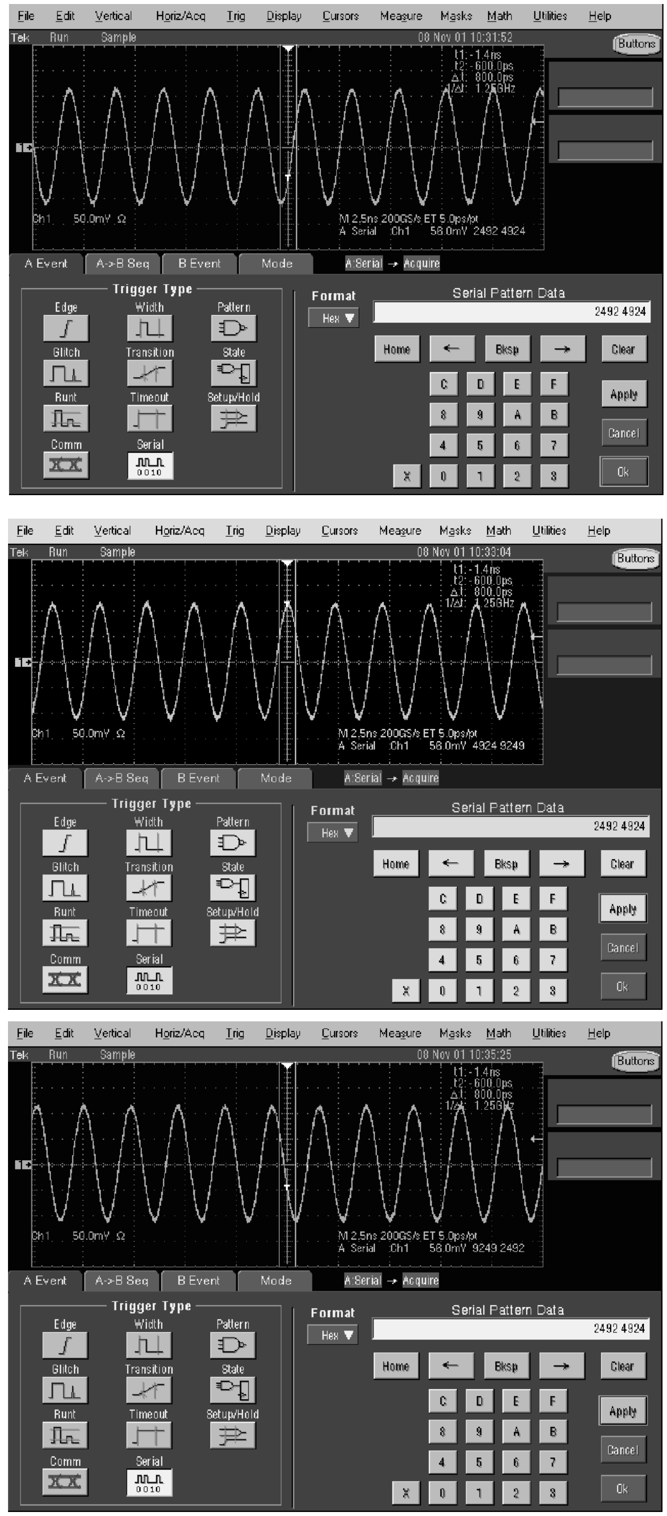



**Figure 4-37: Isolated 1 triggering**

**m.** Verify that the instrument triggers one Unit Interval (UI) after the 1 in the input signal (see Figure 4-37). Enter pass or fail in the test record.

**4.** *Verify that the pattern matching circuits can do isolated 0:*

**a.** Adjust the trigger **LEVEL** to trigger at 75% (+1 division) on the sine wave.

**b.** Set the Format to **Binary** and then touch the **Clear** button.

**c.** Set the Serial Pattern Data pattern bits to XXXX XXXX XXXX XXXX XXXX XXXX XXXX $XXX1_2$.

**d.** Touch **Apply**.

**e.** Verify that the instrument triggers on a 1 (see Figure 4-38). Enter pass or fail in the test record.

**f.** Touch the **Clear** button.

**g.** Set all Serial Pattern Data bits to X except for the nth bit, where n is the step number. For example: if step 4c is step 1 for bit 1, the pattern for step 2, bit 2 is XXXX XXXX XXXX XXXX XXXX XXXX XXXX $XX1X_2$.

**h.** Touch **Apply**.

**i.** Verify that the trigger occurs (n modulo 3) clock cycles after the 1 (see Figure 4-38). Enter pass or fail in the test record.

**j.** Repeat steps g and i until all 32 bits of the Serial Pattern Data have contained a 1.

**5.** *Disconnect the hookup:* Disconnect the cables and adapters from the inputs and outputs.

Triggering on a 1. Step 1, 4, 7, 10, . . .

Triggering 1 clock cycle after a 1. Step 2, 5, 8, 11, . . .

Triggering 2 clock cycles after a 1. Step 3, 6, 9, 12, . . .

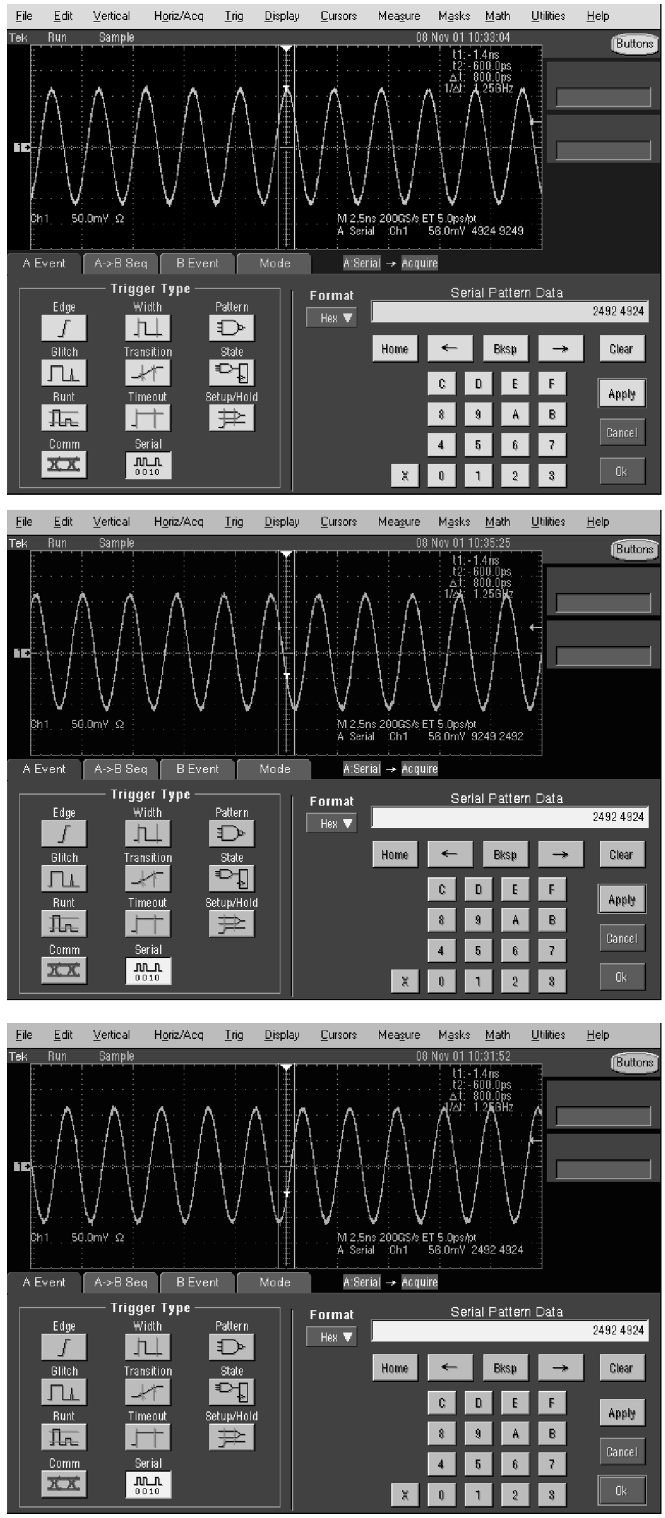



**Figure 4-38: N modulo 3 triggering**

## Check Serial Trigger Clock Recovery Range

| | |
|---|---|
| **Equipment required** | One precision 50 Ω coaxial cables (Item 4)<br>One sine-wave generator (Item 13)<br>One or two SMA male-to-female BNC adapter (Item 20)<br>One TCA-BNC or TCA-SMA adapter (item 20) |
| **Prerequisites** | See page 4-17. Also, the instrument must have passed *Check DC Voltage Measurement Accuracy* on page 4-35. |

1. *Install the test hookup and preset the instrument controls:*

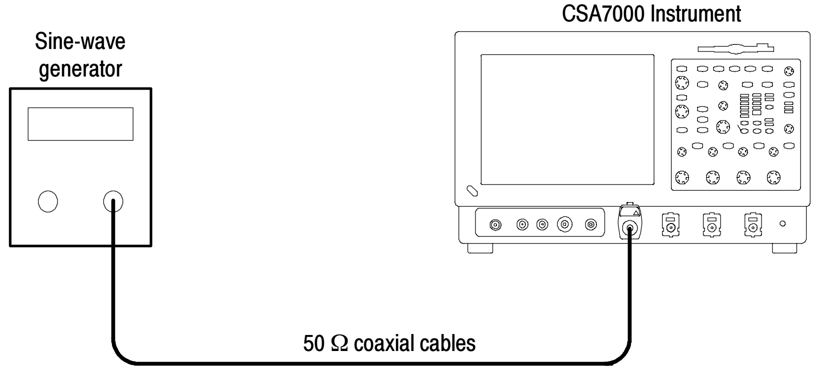



**Figure 4-39: Initial test hookup**

a. *Hook up test-signal source 1 (See Figure 4-39):*

- Connect the sine wave output of the sine-wave generator through a 50 Ω precision coaxial cable to CH 1 through an adapter.
- Set the sine-wave generator to output a 1250 MHz sine wave.

b. *Initialize the instrument:* Press the **DEFAULT SETUP** button.

c. *Modify the initialized front-panel control settings:*

- Press the Vertical **SCALE** to 50 mV per division.
- Set the horizontal **SCALE** to 500 ps per division.
- From the button bar, touch the **Disp** (display) button.
- Set the Display Style to **Dots**.
- Set the Display Persistence to **Variable**, and set the Persist Time to **3.0 s**.
- Touch the **Close** button.

- Adjust the sine-wave generator output for 8 divisions of amplitude.
- From the button bar, touch **Trig** and select the **A Event** tab.
- Touch the **Comm** button. Set **Source** to Ch1, **Type** to R Clk, and **Coding** to NRZ.

**2.** *Verify the clock recovery at frequency:*

**a.** From the button bar, touch **Cursors** and then the **Setup** button.

**b.** Set the Tracking Mode to **Tracking**.

**c.** Touch the **Close** button.

**d.** From the button bar, touch **Trig** and select the **A Event** tab.

**e.** Set the sine-wave generator to output one of the input frequencies in Table 4–11 (on page 4–105) that is not yet checked. (Start with the first setting listed.)

**f.** Set the instrument Bit Rate to the Recovered clock Baud rate listed in the table for the current input frequency.

---

***NOTE**. The instrument will attempt to acquire lock once. If the input data is disrupted, removed, or heavily distorted, the instrument may not acquire lock or may loose lock. If the recovered clock is not locked to the incoming data, the waveform display will not be stable (see Figure 4–40). Once the input data is available, press the PUSH SET TO 50% knob to force the instrument to acquire lock again.*

---

**g.** Press **PUSH TO SET 50%**.

---

***NOTE**. As the input frequency is lowered, adjust the Horizontal SCALE to maintain about 3 to 5 eyes across the display.*

---

**h.** Touch Cursors twice and then touch Close.

**i.** Use cursors to measure the Δt width of the eye (see Figure 4–40 on page 4–106).

**j.** Verify that the eye width Δt is within the minimum and maximum shown in Table 4–11 (on page 4–105) for the selected input frequency.

**k.** Repeat substeps e through j for each input frequency listed in Table 4–11 (on page 4–105).

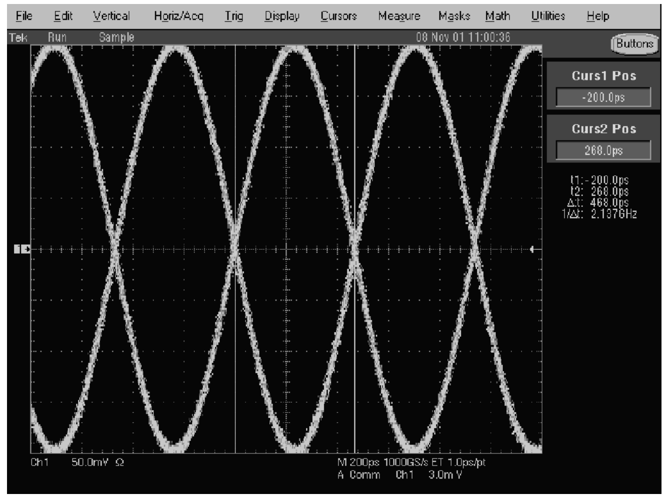
**l.** If all tests pass, enter passed in the test record.

3. *Disconnect the hookup:* Disconnect the cables and adapters from the inputs and outputs.

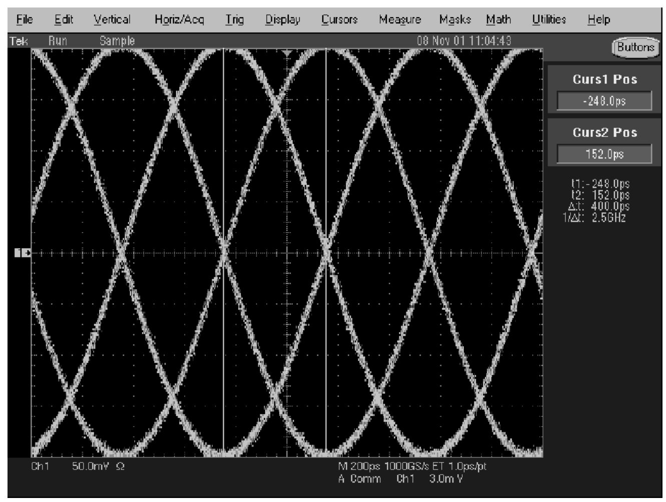
**Table 4-11: Clock recovery input frequencies and baud rates**

| Input frequency | Recovered clock Baud rate | Minimum eye width Δt | Maximum eye width Δt |
|---|---|---|---|
| 1250 MHz | 2500 Mbaud | 388 ps | 412 ps |
| 625 MHz | 2500 Mbaud | 388 ps | 412 ps |
| 625 MHz | 2375 Mbaud | 388 ps | 412 ps |
| 594 MHz | 2500 Mbaud | 408.3 ps | 433.5 ps |
| 477.5 MHz | 1950 Mbaud | 507.9 ps | 539.3 ps |
| 462.5 MHz | 1850 Mbaud | 524.3 ps | 556.7 ps |
| 462.5 MHz | 1757 Mbaud | 524.3 ps | 556.7 ps |
| 439 MHz | 1850 Mbaud | 552.4 ps | 588.6 ps |
| 312.5 MHz | 1250 Mbaud | 776.0 ps | 824.0 ps |
| 310 MHz | 1240 Mbaud | 782.3 ps | 830.6 ps |
| 155 MHz | 620 Mbaud | 1.56 ns | 1.66 ns |
| 155 MHz | 579 Mbaud | 1.56 ns | 1.66 ns |
| 147 MHz | 620 Mbaud | 1.65 ns | 1.75 ns |
| 109 MHz, | 462 Mbaud | 2.22 ns | 2.36 ns |
| 115 MHz | 439 Mbaud | 2.11 ns | 2.24 ns |
| 77.5 MHz | 310 Mbaud | 3.13 ns | 3.32 ns |
| 39 MHz | 156 Mbaud | 6.22 ns | 6.60 ns |
| 19.5 MHz | 78 Mbaud | 12.44 ns | 13.21 ns |
| 9.75 MHz | 39 Mbaud | 24.87 ns | 26.41 ns |
| 4.875 MHz | 19.5 Mbaud | 49.74 ns | 52.82 ns |
| 2.438 MHz | 9.75 Mbaud | 99.47 ns | 105.69 ns |
| 1.219 MHz | 4.876 Mbaud | 198.93 ns | 211.24 ns |
| 609.5 kHz | 2.438 Mbaud | 397.87 ns | 422.48 ns |
| 304.8 kHz | 1.219 Mbaud | 795.60 ns | 844.82 ns |

Recovered clock locked
(1250 MHz)




Recovered clock locked
(625 MHz through 304.8 kHz)




A possible display with the
recovered clock not locked

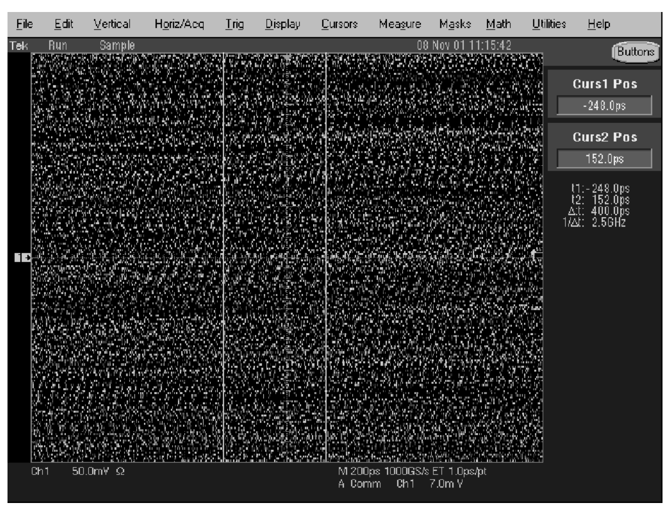



**Figure 4-40: Clock recovery**

# Optical-to-Electrical Converter Checks

The procedure that follows checks those characteristics of the Optical-to-electrical converter that are listed as checked under *Warranted Characteristics* in *Specifications.*

## Check Dark Level Calibration

| | |
|---|---|
| **Equipment required** | Fiber-optic dust cap (Item 39)<br>O/E electrical out-to-CH1 input adapter (Item 33) |
| **Prerequisites** | See page 4-17. Also, the instrument must have passed *Check DC Voltage Measurement Accuracy* on page 4-35. |

1. *Install the test hookup and preset the instrument controls:*

   a. *Hook up test-signal source 1 (See Figure 4-41 on page 4-107):*

      - Install the O/E Electrical Out-to-CH 1 Input adapter on the CSA Instrument.
      - Install the fibre-optic dust cap onto the OPTICAL INPUT connector of the O/E converter.

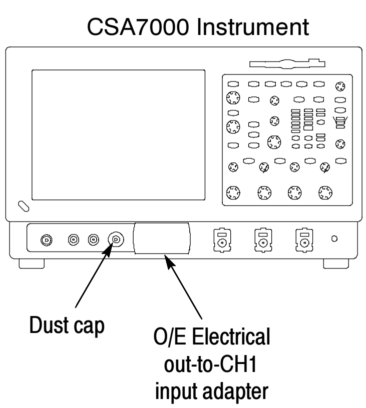



**Figure 4-41: Initial test hookup**

2. Follow this procedure to make the Dark Level checks:

   a. In the Utilities menu, select **Instrument Calibration**. Check that the Status is Pass.

   b. Press the **Calibrate** button.

   c. Wait until the compensation is completed.

   d. Check that the Status is Pass.

e. From the tool bar, touch **Vert** and select the **Chan 1** tab.

f. Select a Calibrated Wavelength.

3. Follow this procedure to calibrate the Dark Level:

   a. Press **Dark Level Compensation** and wait for the compensation to complete.

   b. Press the **Calibrate** button.

   c. Wait until the compensation is completed.

   d. Check that the Status is Pass.

4. *Initialize the instrument:* Press the **DEFAULT SETUP** button.

5. *Modify the initialized front-panel control settings:*

   - From the tool bar, touch **Meas** and select the **Ampl** tab.
   - Touch **Mean**.
   - From the tool bar, touch **Horiz** and select the **Acquisition** tab.
   - Touch **Average** and set the number of averages to **64**.
   - Touch the **Close** button.
   - Set the Vertical **SCALE** to 10 μW.

**Table 4-12: Dark level**

| Scale setting | Accuracy limits |
|---|---|
| 10 μW | ≤ 2.6 μW |
| 20 μW | ≤ 3.6 μW |
| 50 μW | ≤ 6.6 μW |

6. *Confirm Dark Level is within limits:* Do the following substeps — test the scale settings in Table 4-12 first, skipping substep a since 10 μW is already selected from step 1.

   a. Select and unchecked scale setting from Table 4-12.

   b. CHECK that the **CH 1 Mean** readout is within the limits listed for the current scale setting in the table. Record the mean on the test record.

7. Repeat step 6 until all scale settings have been checked.

## Check Maximum Optical-to-Electrical Noise

| | |
|---|---|
| **Equipment required** | Fiber-optic dust cap (Item 39)<br>O/E electrical out-to-CH1 input adapter (Item 33) |
| **Prerequisites** | See page 4-17. Also, the instrument must have passed *Check DC Voltage Measurement Accuracy* on page 4-35. |

This procedure checks the optical-to-electrical noise. The check is made with vertical offset set to zero and no optical signal input (dust cap installed on the OPTICAL INPUT).

1. *Install the test hookup and preset the instrument controls (See Figure 4-42):*

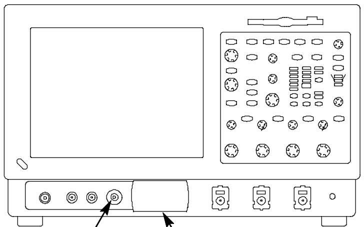



**Figure 4-42: Initial test hookup**

a. Install the fibre-optic dust cap onto the OPTICAL INPUT connector of the O/E converter.

b. Install the O/E Electrical Out-to-CH 1 Input adapter on the CSA Instrument.

c. Press the **DEFAULT SETUP** button.

d. Select **CH1** for the waveform source.

e. From the tool bar, touch the **Vert** button and select the **CH1** tab.

f. Set the **Scale** to 50 μW/div

g. Set **Position** to 0.0div.

h. Set Channel **Offset** to 0.0W.

i. From the tool bar, touch the **Horiz** button and select the **Horizontal** tab.

j. Set the **Scale** to 20 ns/div.

**k.** Set the Record Length to 4000.

**l.** From the tool bar, touch the **Meas** button and select the **Histo** tab.

**m.** Press the **Mean**, **Std Dev**, and **Statistics** buttons.

**n.** Set the Measurement Statistics to **Mean** and press the **Setup** button.

**o.** Press the **Histogram** button, and set the Histogram Mode to **Vert**, the **Display** to On, and set the **Source** to Channel 1,.

**p.** Press the **Advanced** button.

**q.** Press the **Close** button.

**2.** Follow this procedure to make the Optical Noise checks:

**a.** From the tool bar, touch **Vert** and select the **Chan 1** tab.

**b.** Select a Calibrated Wavelength.

**c.** Press the **Close** button.

**d.** Change the Horizontal Scale and then return the **Scale** to 20 ns/div.

**e.** *Confirm Optical Noise is within limits:* After a few seconds, note the Mean and the Std Dev results displayed for the selected wavelength. The mean of the histogram is the dark level value and the standard deviation of the histogram is the maximum RMS optical noise value. Refer to Table 4-13. Enter the value in the test record.

**f.** Repeat steps b through e for each available wavelength.

**Table 4-13: Optical noise limits**

| Instrument | Maximum optical noise, std |
|---|---|
| CSA7404 | |
| 1550 and 1310 nm | 4.35 µW |
| 850 nm | 5.35 µW |
| 780 nm | 5.85 µW |
| CSA7154 | |
| 1550 and 1310 nm | 4.1 µW |
| 850 nm | 4.85 µW |
| 780 nm | 5.25 µW |

**3.** *Disconnect the hookup:* Disconnect the adapters from the inputs and outputs.

## Check Optical-to-Electrical Gain

| | |
|---|---|
| **Equipment required** | Two 62.5 μm multimode fiber-optic cables (Item 35)<br>SMA cable (Item 22)<br>CW laser source (Item 30)<br>Multimode optical attenuator (Item 31)<br>Optical power meter (Item 32)<br>O/E-to-SMA adapter (Item 34)<br>TCA-SMA adapter (item 20) |
| **Prerequisites** | See page 4-17. Also, the instrument must have passed *Check DC Voltage Measurement Accuracy* on page 4-35. |

1. *Install the test hookup and preset the instrument controls:*

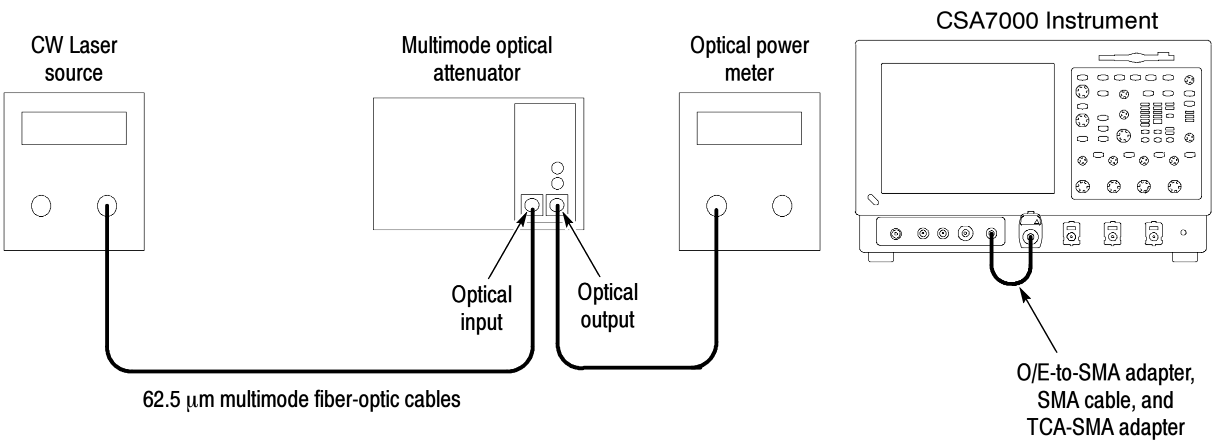



**Figure 4-43: Initial test hookup**

   a. *Hook up test-signal source 1 (See Figure 4-43):*

   - Connect the O/E Electrical Output to the CH 1 Input using an O/E-to-SMA adapter, SMA cable, and TCA-SMA adapter.
   - Connect the output of a CW laser source through a multimode optical-fiber cable to the optical input of a multimode optical attenuator.
   - Connect the output of the optical attenuator to the input of the optical power meter.
   - Set the CW laser source to 780 nm.

- Set the multimode optical attenuator for 0.1 mW (–10 dBm) into the optical power meter.
- Move the optical fiber from the optical power meter to the optical input of the CSA Instrument.

**b.** *Initialize the instrument:* Press the **DEFAULT SETUP** button.

**c.** *Modify the initialized front-panel control settings:*

- From the tool bar, touch **Meas** and select the **Ampl** tab.
- Touch **Mean**.
- From the tool bar, touch **Horiz** and select the **Acquisition** tab.
- Touch **Average** and set the number of averages to **64**.
- Touch the **Close** button.
- Set the Vertical **SCALE** to 20 mV per division.
- Set the Horizontal **SCALE** to 200 μs.

**Table 4-14: O/E gain**

| Wavelength setting | Vertical scale setting | Attenuator output setting | Accuracy limits |
|---|---|---|---|
| 780 nm | 20 mV | 0.1 mW (-10 dBm) | ≥ 27 mV |
| 850 nm | 20 mV | 0.1 mW (-10 dBm) | ≥ 33 mV |
| 1310 nm | 50 mV | 0.1 mW (-10 dBm) | ≥ 64 mV |
| 1550 nm | 50 mV | 0.1 mW (-10 dBm) | ≥ 64 mV |

**2.** *Confirm O/E Gain is within limits:* Do the following substeps — test the first wavelength setting in Table 4–14 first, skipping substep a since 780 nm is already selected from step 1.

**a.** Select and unchecked wavelength from Table 4–14.

- Move the optical fiber from optical input of the the CSA Instrument to the optical power meter.
- Set the CW laser source to wavelength not yet checked from Table 4–14.
- Set the Vertical **SCALE** to the setting in Table 4–14 for the selected wavelength.

- Set the multimode optical attenuator for 0.1 mW out of the optical power meter.
- Move the optical fiber from the optical power meter to the optical input of the CSA Instrument.

**b.** CHECK that the **CH 1 Mean** readout is within the limits listed for the current wavelength setting in the table. Record the mean on the test record.

**c.** Repeat substeps 2.a. and 2.b. until all wavelengths listed in Table 4–14 have been tested.

**3.** *Disconnect the hookup:* Disconnect the cables and adapters from the inputs and outputs.

## Check Optical-to-Electrical System Bandwidth

Before performing the checks for minimum optical bandwidth, 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

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

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

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

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

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:

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

therefore at

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

In some instances, the vertical units displayed for an optical signal are not in voltage, but are in watts, which is a unit of power. The O/E converter 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 O/E converter, then, the bandwidth where the displayed optical power is one half that approaching DC is:

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

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 O/E converter via impulse testing, the resulting impulse waveform is converted to frequency via Fourier transform, and the bandwidth is defined as:

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

This definition is used for 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:

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

This definition is used for reference receiver settings.

This procedure checks the minimum optical bandwidth of the instrument.

***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** | Calmar FPL-01 optical impulser (item 29)<br>Tektronix OA5002 variable optical attenuator (item 31)<br>Multimode fiber-optic cable, 2 m, FC to FC connectors (item 35)<br>Optical attenuator, 10 dB, FC-FC, female-male connectors (item 36)<br>O/E Electrical Out-to-CH 1 Input adapter (Item 33)<br>Cable, coaxial, 1 m, male to male SMA connectors (item 37) |
| **Prerequisites** | See page 4-17 |

Before performing this procedure, be sure you have completed the *Optical Noise* procedure on page 4-109.

**Setup**

Install the test hookup (see Figure 4-44) and preset the controls:

1. Connect a fiber-optic cable between the input of the 10 dB optical attenuator and the output of the optical impulse generator.
2. Connect a fiber-optic cable between the output of the variable optical attenuator and the OPTICAL INPUT of the instrument.
3. 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.*

4. *Initialize the instrument:* Press the **DEFAULT SETUP** button.

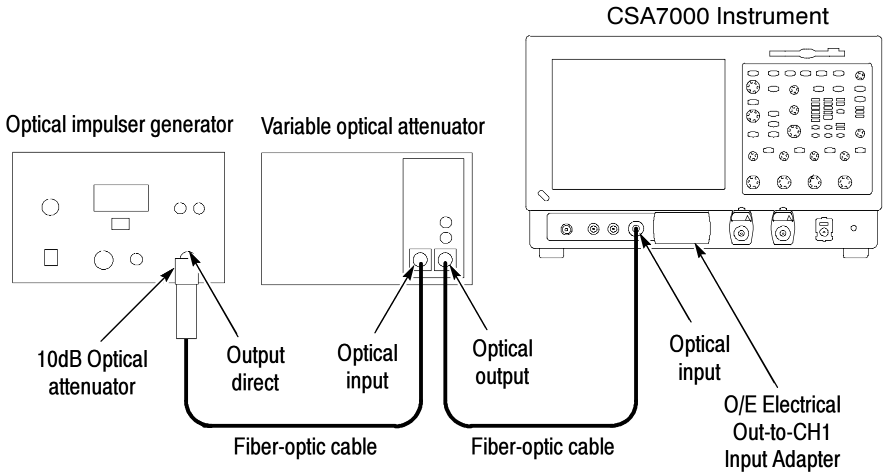



**Figure 4-44: Optical bandwidth hookup**

5. From the tool bar, touch **Horiz** and select the Acquisition tab.
6. Select the **Average** acquisition mode. Set the number of averages to **64**.
7. Press the **PUSH TO SET 50%** button to set the trigger point midway on the rising signal.
8. Select the Horizontal tab, 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 **15.0%**. (This setting will make it easier to locate the first optical pulse later in the procedure.)
   c. Set the **Rec Length** to **2500**.
9. From the tool bar, touch **Vert**, do the the following:
   a. Set the **Scale** to **20.0 µW/div**.
   b. Set **Position** to **–2.0 div**.
   c. Set the Calibrated Wavelength to **1550 nm**.
10. Decrease the amount of attenuation provided by the optical attenuator until a pulse appears.
11. Adjust the attenuation of the variable optical attenuator until it produces an impulse pulse amplitude of 80 $\mu W_{p\text{-}p.}$ See Figure 4–45.

**Procedure**

Follow this procedure to make the optical system bandwidth checks:

**Table 4-15: O/E system bandwidth**

| Instrument | Bandwidth -3 dB (-6 dBm on readout) |
|---|---|
| CSA7404 | 2.4 GHz |
| CSA7154 | 1.6 GHz |

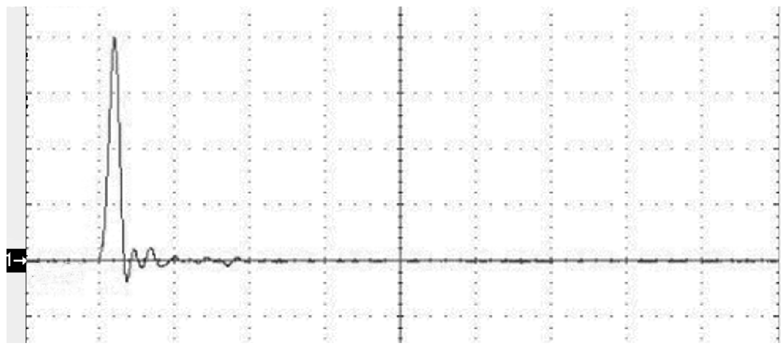


**Figure 4-45: Proper positioning of the impulse**

**12.** *Turn on a magnitude FFT of the optical impulse [the Impulse Response (or Frequency Response) of the system] (Refer to Figure 4-45):*

**a.** From the tool bar, touch **Math** and select the **Math 1** tab.

**b.** Set the Math **Scale** to 3 dBm per division.

**c.** Press the Spectral Analysis **Setup** button and select the **Create** tab.

**d.** Press the **Magnitude** button and then the **Channel 1** button to create a magnitude FFT math waveform.

**e.** From the **Window Type** drop down list, select **Rectangular.**

**f.** Select the **Mag** tab.

**g.** Press the Scale **dBm** button.

**h.** Press **Freq Span** and use the general purpose knobs to adjust the frequency span to 4 GHz. Set the Center Frequency to 2 GHz.

**i.** Set the Ref Level to **–50 dBm** and press **Apply**.

**13.** *Observe the desired response characteristics using the vertical paired cursors (see Figure 4-46):*

**a.** Press the front-panel **CURSOR button.**

b. Select the **Math** tab and press **Math 1.**

c. Press the Cursor Type **Paired** button.

d. Press **Close.**

---

***NOTE**. Pressing the FINE button will change cursor speed.*

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e. Position the first cursor at 400 MHz.

f. Position the second cursor (Δy) to the –6 dBm point (see Table 4–15 and Figure 4–46).

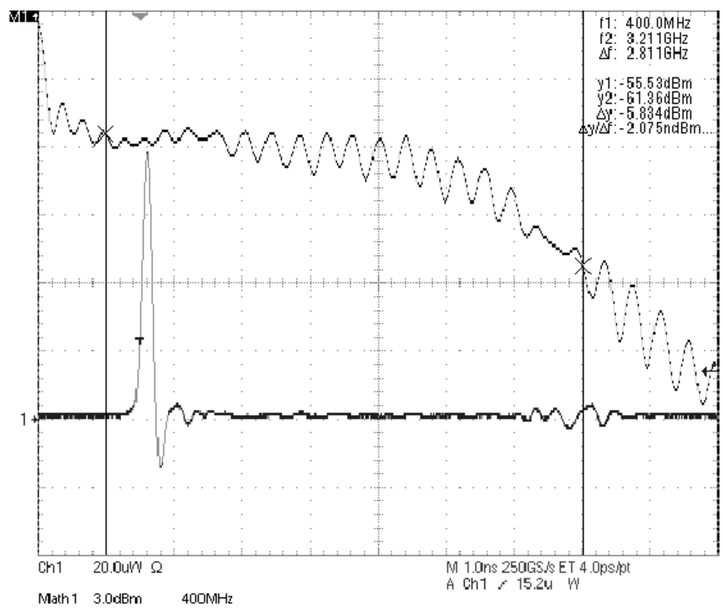


**Figure 4-46: Optical impulse response**

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***NOTE**. In Figure 4–46, the left cursor is at the DC frequency. The right cursor is at the -3 dB frequency.*

---

g. The f2 readout should be at or above the limit shown in Table 4–15.

h. Check that the instrument meets the bandwidth specification at –3 dB (–6 dBm in readout) as listed in Table 4–15. Enter value on test record.

**14.** *Disconnect the hookup:* Disconnect the cables and adapters from the instruments.

# Sine Wave Generator Leveling Procedure

Some procedures in this manual require a sine wave generator to produce the necessary test signals. If you do not have a leveled sine wave generator, use one of the following procedures to level the output amplitude of your sine wave generator.

| | |
|---|---|
| **Equipment required** | Sine wave generator (Item 13)<br>Level meter and power sensor (Item 14)<br>Power divider (Item 15)<br>Two male N to female BNC adapters (Item 16)<br>One precision coaxial cable (Item 4)<br>One SMA-to-BNC adapter (Item 20) |
| **Prerequisites** | See page 4-17 |

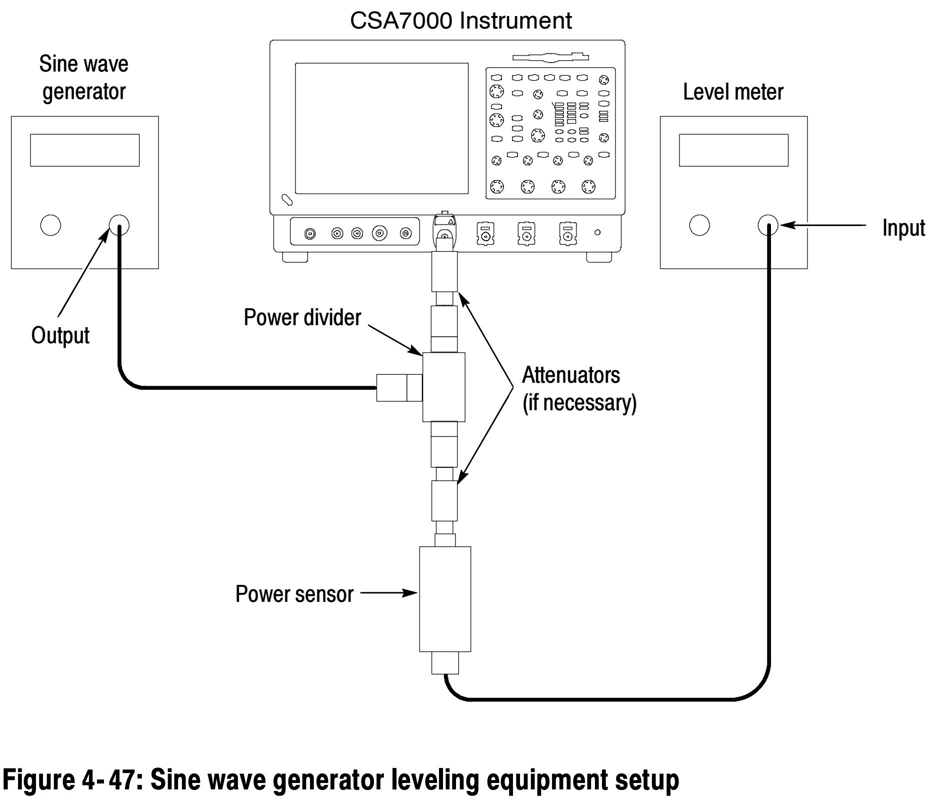


**Figure 4-47: Sine wave generator leveling equipment setup**

1. *Install the test hookup:* Connect the equipment as shown in Figure 4-47.

2. *Set the Generator:*

   - Set the sine wave generator to a reference frequency of 10 MHz.
   - Adjust the sine wave generator amplitude to the required number of divisions as measured by the instrument.

3. *Record the reference level:* Note the reading on the level meter.

4. *Set the generator to the new frequency and reference level:*

   - Change the sine wave generator to the desired new frequency.
   - Input the correction factor and/or the new frequency into the level meter.
   - Adjust the sine wave generator amplitude until the level meter again reads the value noted in step 3. The signal amplitude is now correctly set for the new frequency.

| | |
|---|---|
| **Equipment required** | Sine wave generator (Item 13)<br>Level meter and power sensor (Item 14)<br>Two male N to female BNC adapters (Item 16)<br>One SMA-to-BNC adapter (Item 20)<br>Two precision coaxial cables (Item 4) |
| **Prerequisites** | See page 4-17 |

1. *Install the test hookup:* Connect the equipment as shown in Figure 4-48 (start with the sine wave generator connected to the instrument).

2. *Set the Generator:*

   - Set the sine wave generator to a reference frequency of 10 MHz.
   - Adjust the sine wave generator amplitude to the required number of divisions as measured by the instrument.

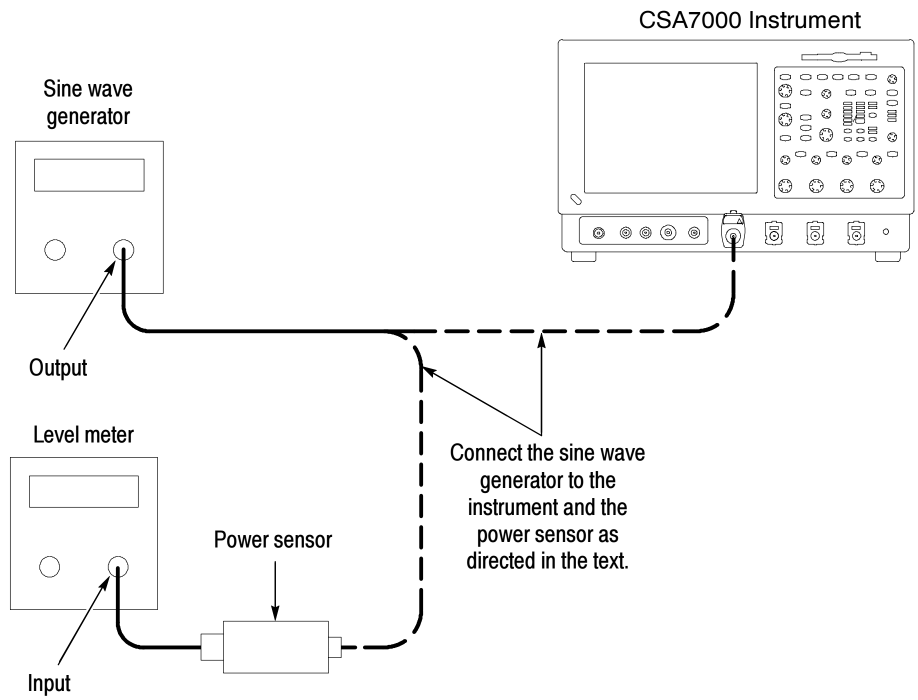


**Figure 4-48: Equipment setup for maximum amplitude**

**3.** *Record the reference level:*

- Disconnect the sine wave generator from the instrument.
- Connect the sine wave generator to the power sensor.
- Note the level meter reading.

**4.** *Set the generator to the new frequency and reference level:*

- Change the sine wave generator to the desired new frequency.
- Input the correction factor and/or the new frequency into the level meter.
- Adjust the sine wave generator amplitude until the level meter again reads the value noted in step 3. The signal amplitude is now correctly set for the new frequency.
- Disconnect the sine wave generator from the power sensor.
- Connect the sine wave generator to the instrument.

# Adjustment Information

This chapter contains adjustment information for your instrument.

## Adjustment Interval

The voltage and timing references inside the instrument are very stable over time and should not need routine adjustment.

If the instrument fails performance tests (refer to *Performance Tests* on page 4-17) then adjustment may be required.

If periodic calibration is one of your requirements, a general rule is to verify performance and make adjustments (only if needed) every 2000 hours of operation or once a year if the instrument is used infrequently.

## Adjustment After Repair

After removal and replacement of a module due to electrical failure, you must either perform an adjustment or not, depending on the module replaced. Modules listed as customer replaceable have adjustment listed if required. Modules not listed as customer replaceable must be installed and adjusted by Tektronix. See Table 6-7 on page 6-67.

## Adjustment

If your instrument requires adjustment, adjustment must be performed by a Tektronix Service Center. See Contacting Tektronix on page xvii for information on contacting Tektronix Service Support.

# Maintenance

This section contains the information needed to do periodic and corrective maintenance on the instrument. The following subsections are included:

- Preventing ESD — General information on preventing damage by electrostatic discharge.
- *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 failed modules. Included are instructions for operating the instrument diagnostic routines and troubleshooting trees. Most of the trees make use of the internal diagnostic routines to speed fault isolation to a module.
- Repackaging Instructions — Information on returning an instrument for service.

## 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.

## Cleaning Optical Connectors

Small dust particles and oils can easily contaminate optical connectors and reduce or block the signal. Take care to preserve the integrity of the connectors by keeping them free of contamination.

**CAUTION.** *To prevent loss of optical power or damage to the optical connectors, keep the connectors clean at all times.*

*When cleaning the connectors with a swab, use gentle circular motions. Use only high quality cleaning supplies that are non-abrasive and leave no residue.*

*To reduce the need for cleaning, immediately replace protective caps on the optical connectors when not in use.*

Use the following items to clean optical connectors:

- Clean, dust-free compressed air
- Fiber-optic cleaning swabs

- Pure, electronics-grade isopropyl alcohol

**NOTE**. *If isopropyl alcohol is used, care must be taken to have a truly clean, pure, electronics-grade isopropyl alcohol source. Bottles of isopropyl alcohol can become contaminated after several uses; it can then leave a residue on optical connectors after drying.*

*Cleaning kits for optical connectors (such as the Tektronix Optical Connector Cleaner kit number 020-2357-00) are available from a number of suppliers.*

To clean optical connectors, follow these steps:

1. Remove the UCI adapter.
2. Hold the can of compressed air upright and spray the can into the air to purge any propellant.
3. Spray the clean compressed air on the connectors to remove any loose particles or moisture.
4. Moisten a clean optical swab with isopropyl alcohol, and then lightly swab the surfaces of the connectors.
5. Spray the clean compressed air on the connectors again to remove any loose particles or isopropyl alcohol.
6. Blow clean compressed air through the UCI adapter before replacing it.

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

## Interior Cleaning

Use a dry, low-velocity stream of air to clean the interior of the chassis. Use a soft-bristle, non-static-producing brush for cleaning around components. If you must use a liquid for minor interior cleaning, use a 75% isopropyl alcohol solution and rinse with deionized water.

## Exterior Cleaning

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.*

**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 |
| 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 |

## Flat Panel Display Cleaning

The 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.*

**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 replaced, check Table 6–2 in Section 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. |
| 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. |

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

| Item | Inspect for | Repair action |
|---|---|---|
| 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.

**Lubrication.** There is no periodic lubrication required for this instrument.

# Removal and Installation Procedures

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

## Preparation

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***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 the instrument components, read* Installation *in Section 2, and* Preventing ESD *in this section.*

---

This subsection contains the following items:

- This preparatory information that you need to properly do the procedures that follow.
- List of tools required to remove 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.

---

***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.*

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

---

**Equipment Required.** Most modules in the CSA7000 Communications Signal Analyzer 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 | General tool number |
|---|---|---|---|
| 1 | Screwdriver handle | Accepts Torx-driver bits | 620-440 |
| 2 | T-10 Torx tip | Used for removing the electrical or optical module chassis. Torx-driver bit for T-10 size screw heads | 640-235 |
| 3 | T-15 Torx tip | Used for removing most instrument screws. Torx-driver bit for T-15 size screw heads | 640-247 |
| 4 | $^{1}/_{8}$ inch flat-bladed screw-driver | Screwdriver for unlocking cable connectors | Standard tool |
| 5 | #0 Phillips screwdriver | Screwdriver for removing small phillips screws, CD, floppy & hard drive | Standard tool |
| 6 | Angle-Tip Tweezers | Used to remove front panel knobs | Standard tool |
| 7 | $^{3}/_{16}$ inch open-end wrench | Used to remove the rear panel nut posts | Standard tool |
| 8 | $^{5}/_{16}$ inch open-end wrench | Used to remove the rear panel nut posts | Standard tool |
| 9 | MA-800G Soldering Aid | Used to remove the front panel trim | Standard tool |

## 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:*
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 $^{1}/_{4}$ inch to create some clearance between the base of the knob and the front panel. Insert the angled-tip 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 on the circuit board, apply pressure to the encoders while pushing the knob on the shaft.*

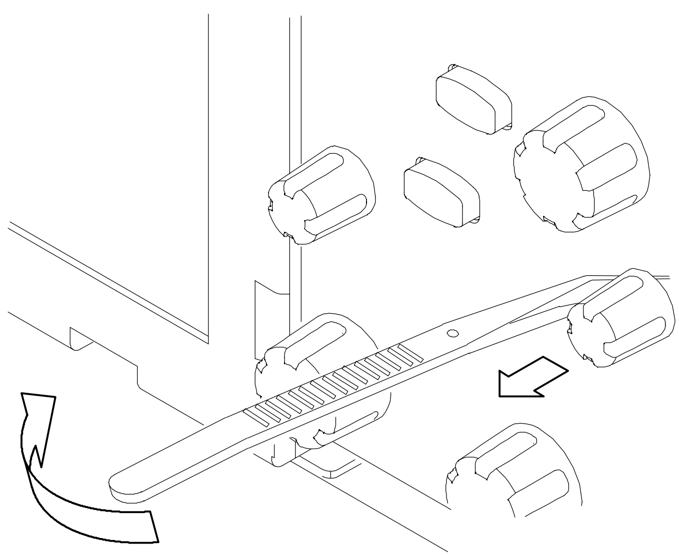

**Figure 6-1: Knob removal**

## Trim and Carrying Handle

1. *Locate module to be removed:* Locate the Trim in the locator diagram. See Figure 6-7, on page 6-18.
2. *Remove the front panel trim:* Use Figure 6-2, on page 6-11, as a guide.
   - **a.** To prevent the power button from falling out of the front panel trim, place a piece of tape over the button.
   - **b.** 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.)
   - **c.** Swing the bottom of the ring upward and off the front panel.
3. *Remove the acquisition trim:* Use Figure 6-2, on page 6-11 as a guide.
   - **a.** Remove the three T-15 Torx screws that secure the acquisition trim to the instrument.
   - **b.** Remove the acquisition trim from the instrument.
4. *Remove the top cover trim:* Use Figure 6-2, on page 6-11 as a guide.
   - **a.** Remove the accessory pouch; it snaps off.
   - **b.** Remove the four T-15 Torx screws that secure the top cover trim to the instrument. The T-15 Torx 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, on page 6-11 as a guide.
   - **a.** Remove the T-15 Torx screws that secure the handle to the instrument. Remove the handle from the instrument.
   - **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.

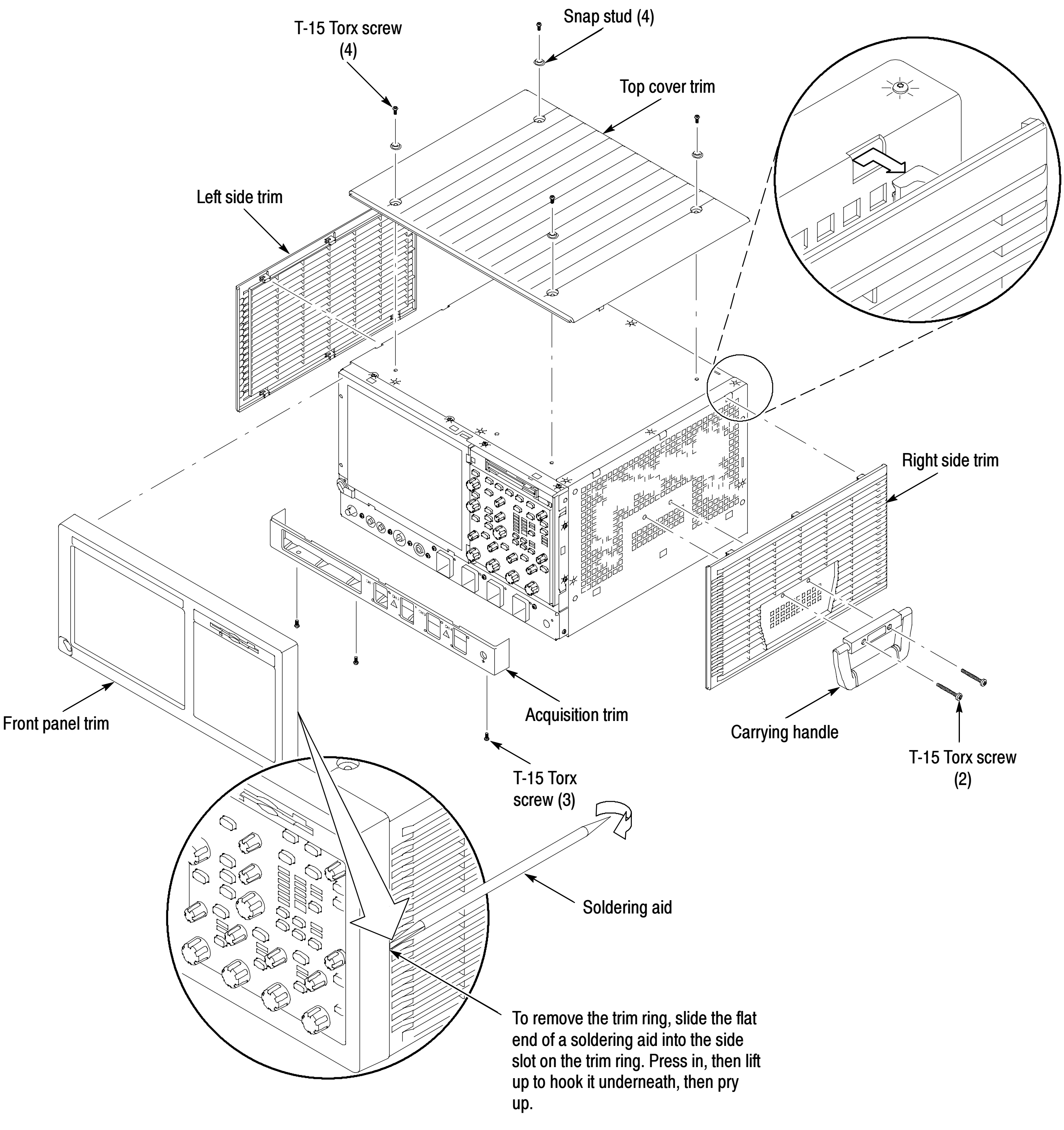


**Figure 6-2: Trim removal**

## Bottom Cover

1. *Remove the bottom cover:* See Figure 6-3, on 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 four T-15 Torx 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 bottom cover.

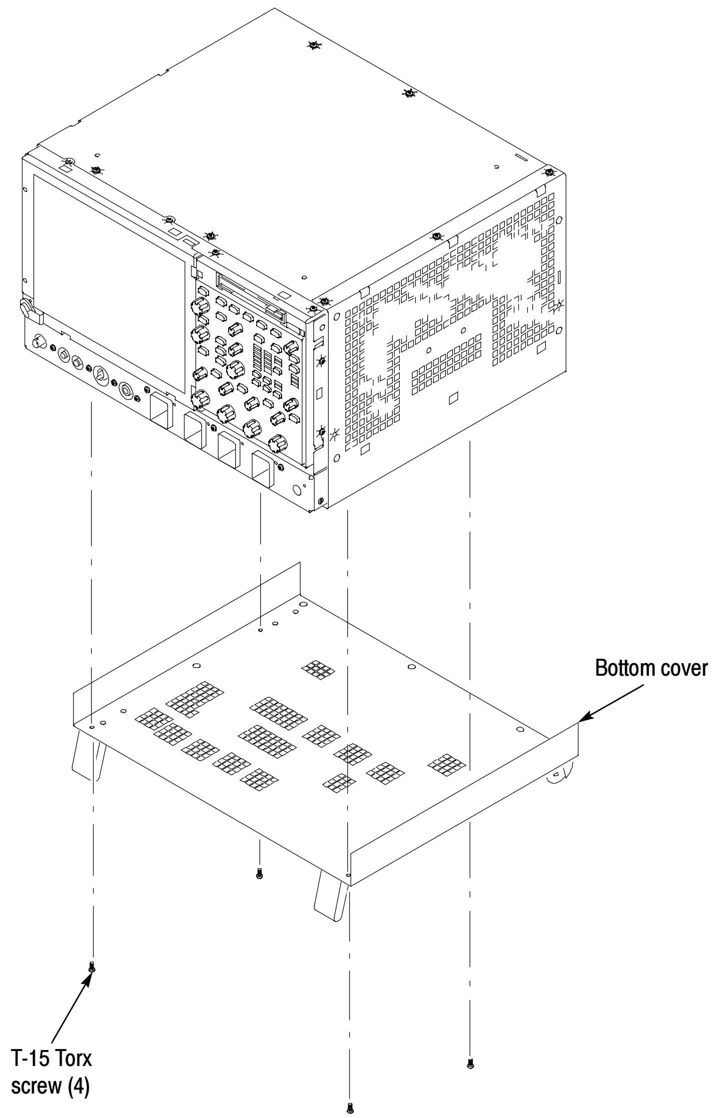


**Figure 6-3: Bottom cover removal**

### Covers

1. *Remove the left and right covers:* See Figures 6–4 and 6–5, on 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 you.

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

   a. Remove the eleven T-15 Torx screws that secure the covers to the top and both sides of the chassis.

   b. Remove the seven T-15 Torx 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 internal cabling as you remove or install.*

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

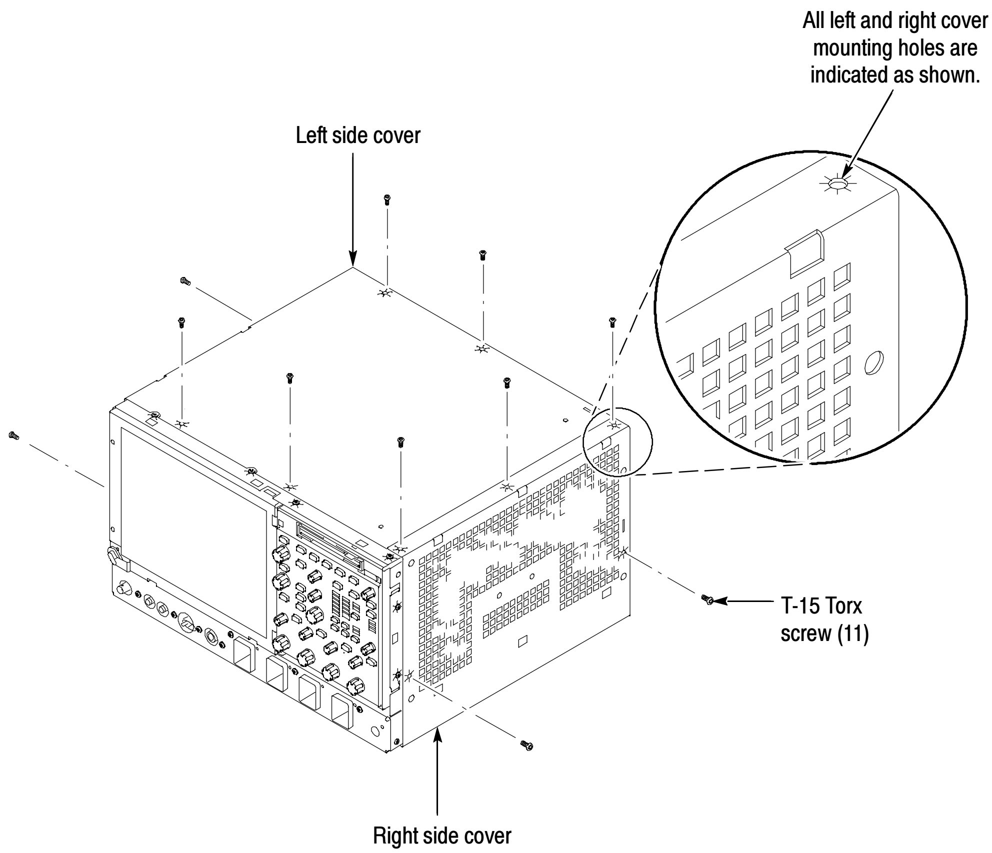


**Figure 6-4: Cover removal**

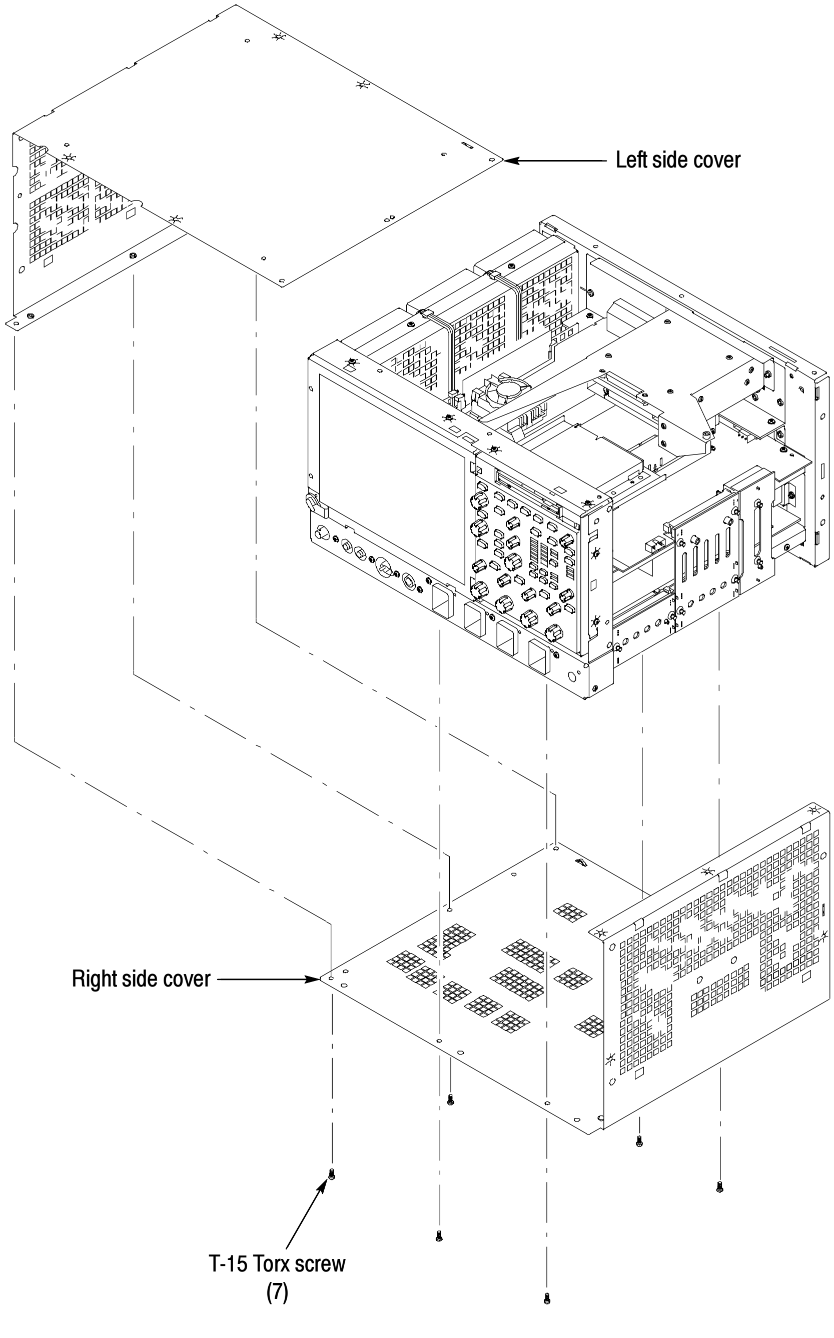


**Figure 6-5: Cover removal**

## 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, on page 6-17.
2. The instrument has a built-in soft power-off function that safely removes power from most of the instrument when you press the On/Standby switch.
3. Power off the rear panel power switch before servicing the line fuse or power cord.
4. *Orient the instrument:* Set the instrument so its bottom is down on the work surface and its rear is facing you.
5. *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.
6. *Remove the line fuse:* Find the fuse caps on the rear panel. Now, remove the fuse cap by turning it counterclockwise using a flat-bladed screwdriver, and remove the line fuse. Reverse procedure to reinstall.
7. *Reinstallation:* Do in reverse steps 6 and 5 to reinstall the line cord and then the line fuse.

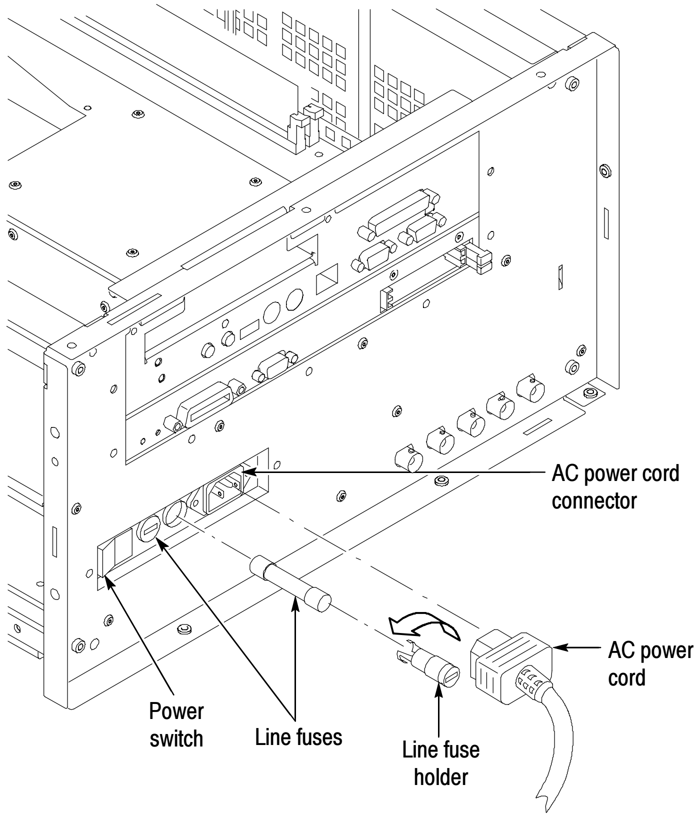


**Figure 6-6: Line fuse and line cord removal**

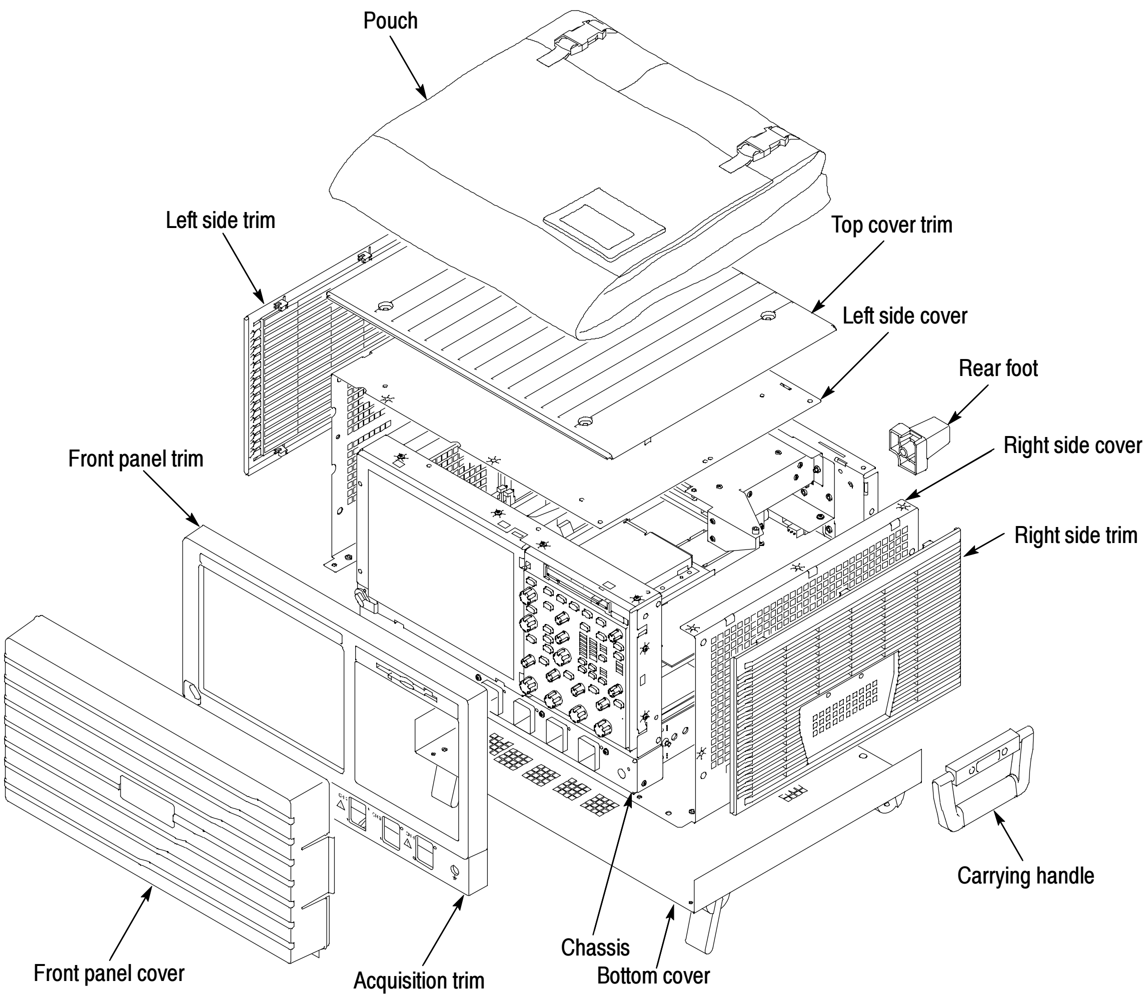


**Figure 6-7: External modules**

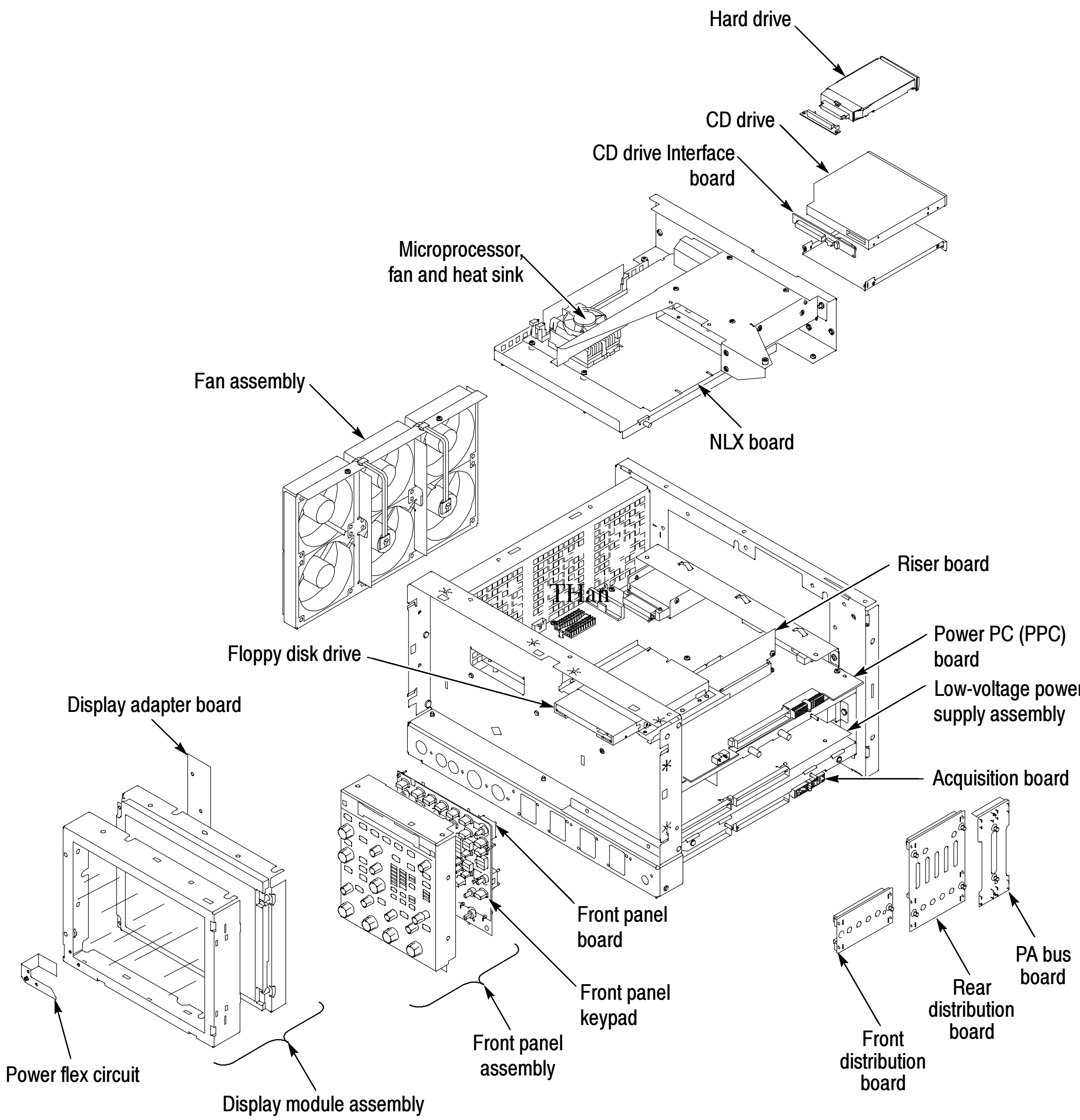


**Figure 6-8: Internal modules**

# 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
- On/Standby Switch Flex Circuit
- Floppy Disk Drive
- Hard Disk Drive
- CD Drive
- Fan Assembly
- Front and Rear Power Distribution Boards (PA Bus Board)
- Low-Voltage Power Supply
- NLX Board
- Microprocessor
- Power PC Board
- Acquisition Board

## Front Panel Assembly

1. *Locate module to be removed:* Locate the Front-panel assembly in Figure 6–9, on page 6–22. Additional modules to be Removed:
   - Trim (Front panel)
2. *Remove the Front-Panel assembly:* See Figure 6–9, on 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 the J1 cable connector lock up to disconnect the J1 flex cable from the display module assembly. See Figure 6-10, on 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.

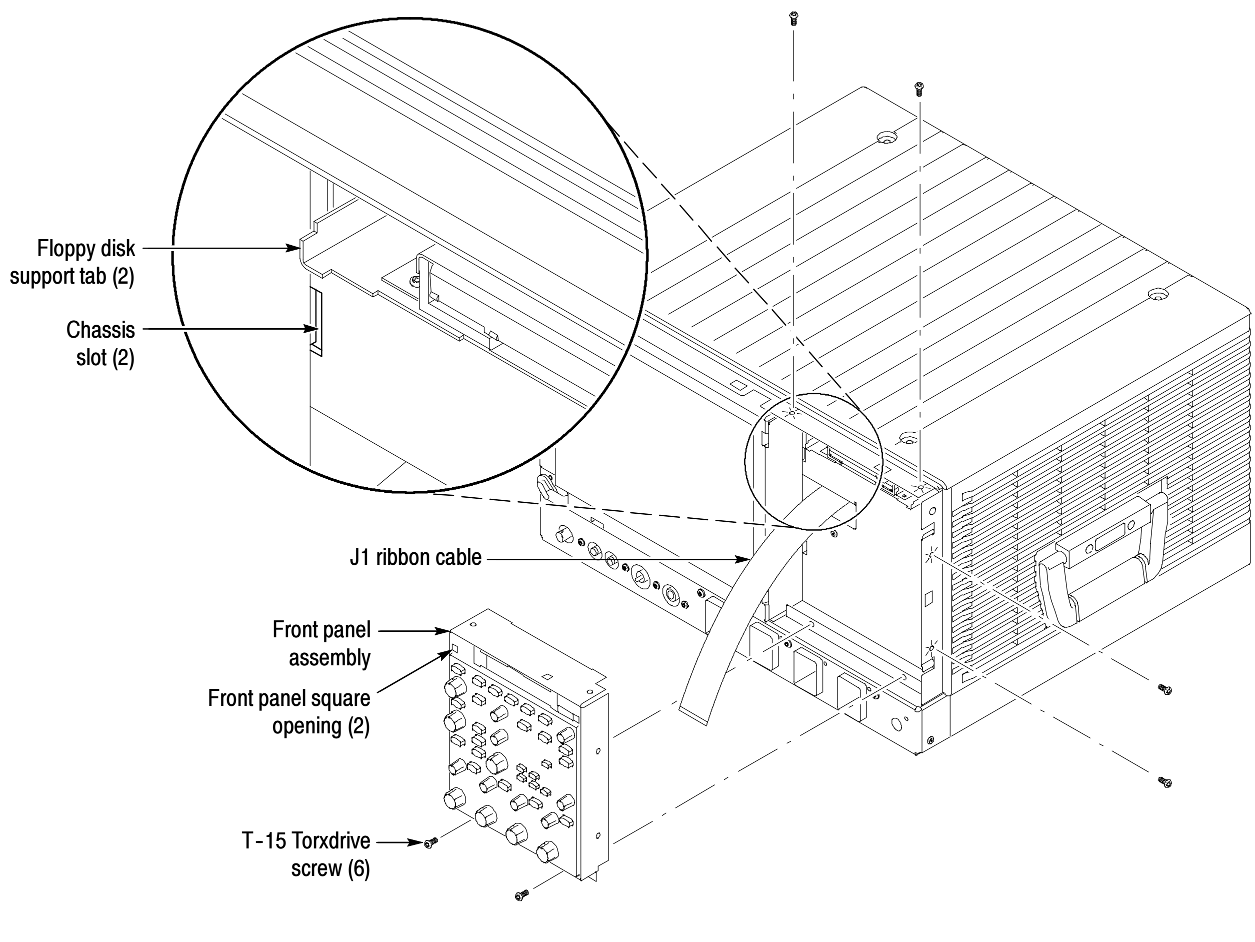


**Figure 6-9: Front-panel assembly removal**

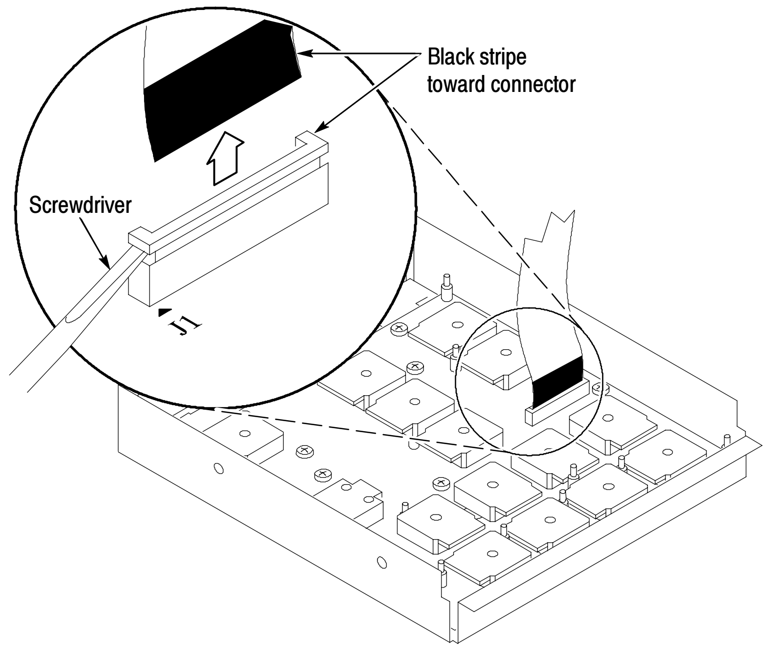


**Figure 6-10: J1 flex cable connector removal**

## Front Panel Board

1. *Locate module to be removed:* Locate the Front Panel assembly Figure 6-9, on 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 6-11, on 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 in Figure 6-9, on 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 6-11.
   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 twelve keypad support guides.
   b. Remove the keypad from the front panel board.

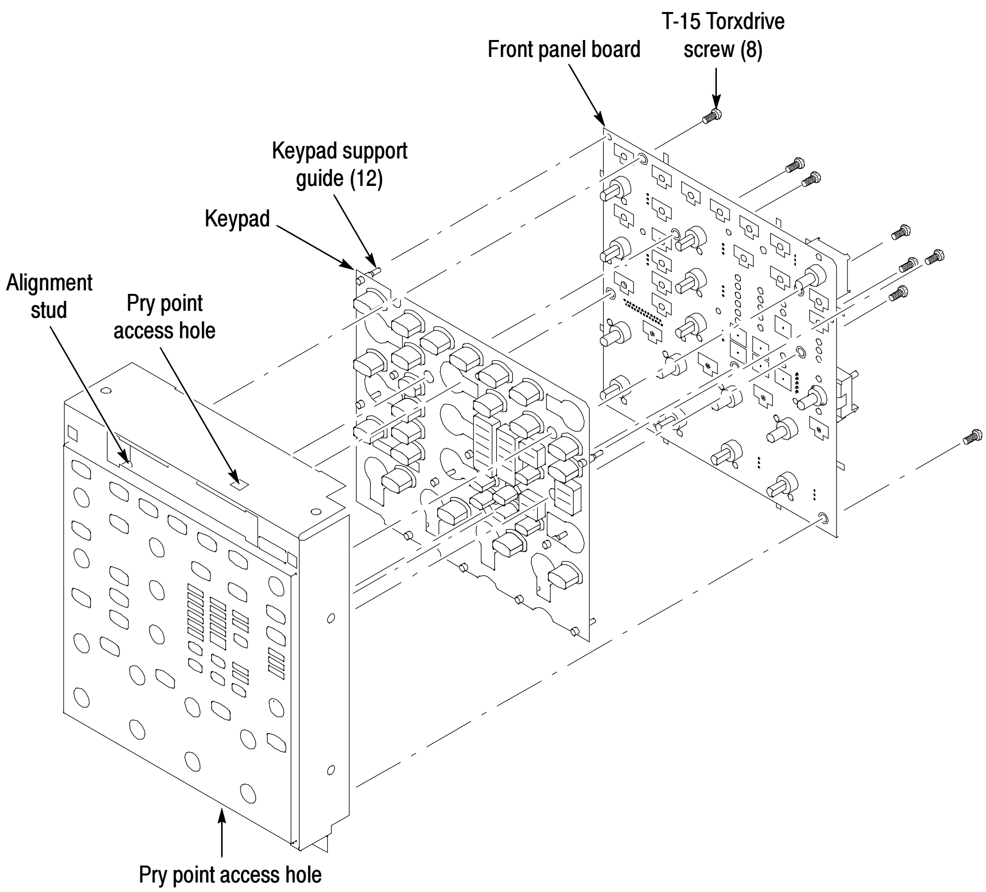


**Figure 6-11: Front panel board and keyboard removal**

**CAUTION.** *When removing or installing the keypad, make sure you do not touch the switch contacts 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 step 2 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 6–9, on page 6–22.

## Display Assembly

1. *Locate module to be removed:* Locate the Display assembly, Figure 6–12, on page 6–26. *Additional modules to be Removed:*

   - Trim (front panel & 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 On/Standby switch assembly.*

3. *Remove the Display assembly:* See Figure 6–12, on page 6–26.

   a. Remove the four T-15 Torxdrive screws that secure the display assembly to the chassis.

   b. Grasp the display assembly at the finger reliefs located at the top-right and bottom-left corners of the display assembly and pull forward far enough to allow access to the flex cable connector.

   c. Disconnect the J5 flex cable from the display assembly. Remove the display module assembly from the instrument. See Figure 6–12, on page 6–26.

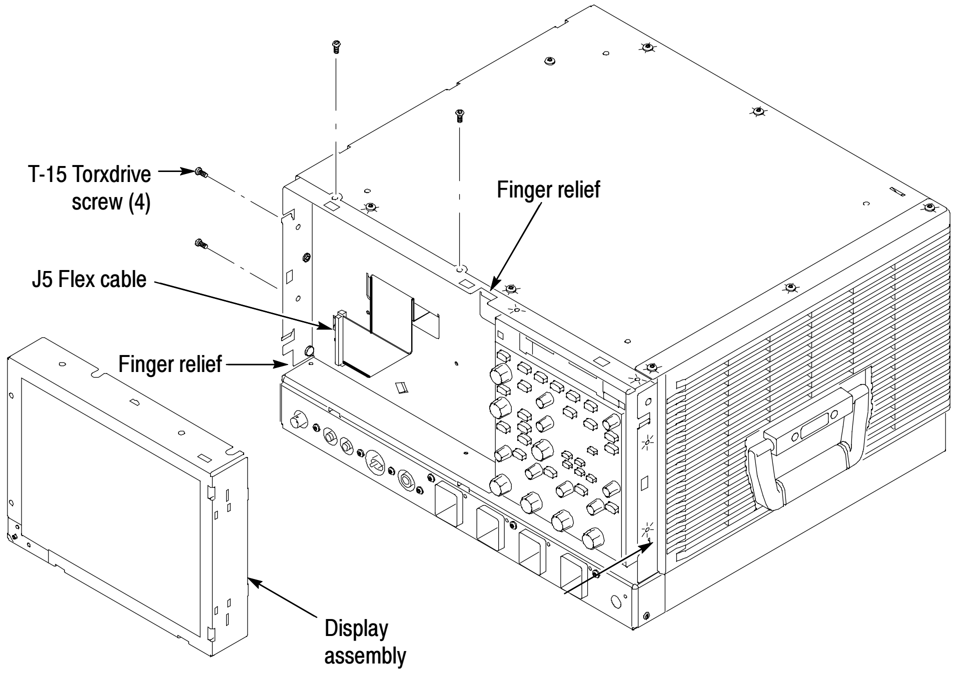


**Figure 6-12: Display removal**

4. *Remove the Touch panel from the Display assembly:* See figures 6-13 and 6-14, on 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 any surfaces of the display glass.*

a. Disconnect cables J1 and J7 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.

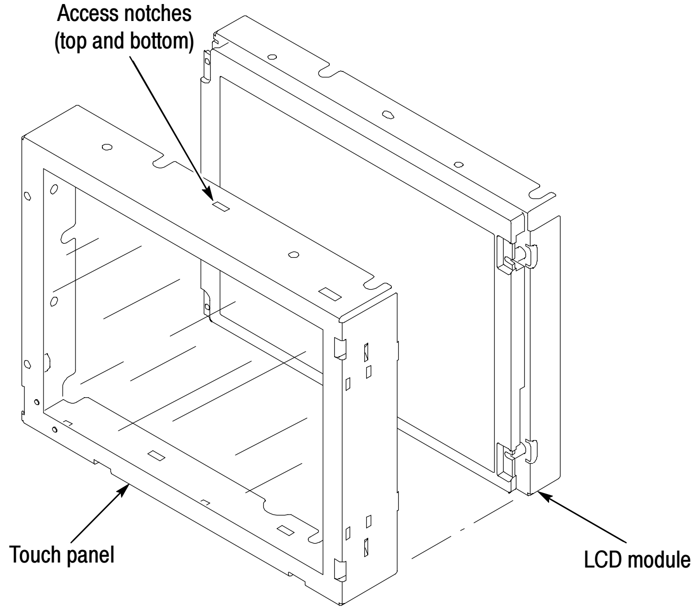


**Figure 6-13: Touch panel and LCD assembly removal**

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 6–8, on page 6–19. Additional modules to be Removed:
   - Trim (front panel & top)
   - Display assembly
2. *Remove the Display Adapter Board:* See Figure 6–14, on page 6–28.
   a. Disconnect cables J1, J4, J6, J5, and J7 and cable clip (see Figure 6–15 on page 6–28) from the Display Adapter board.
   b. Remove the three 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 a and b to reinstall the board.

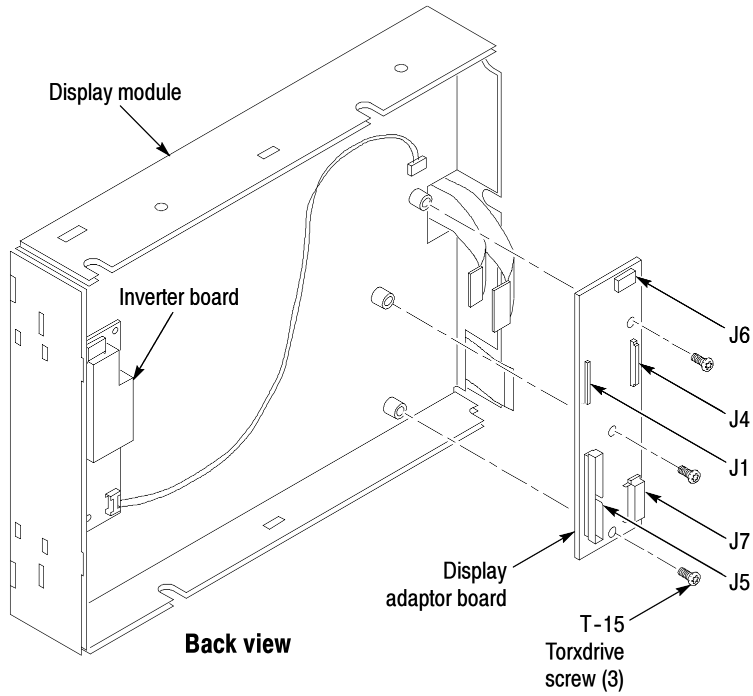


**Figure 6-14: Display adaptor board removal**

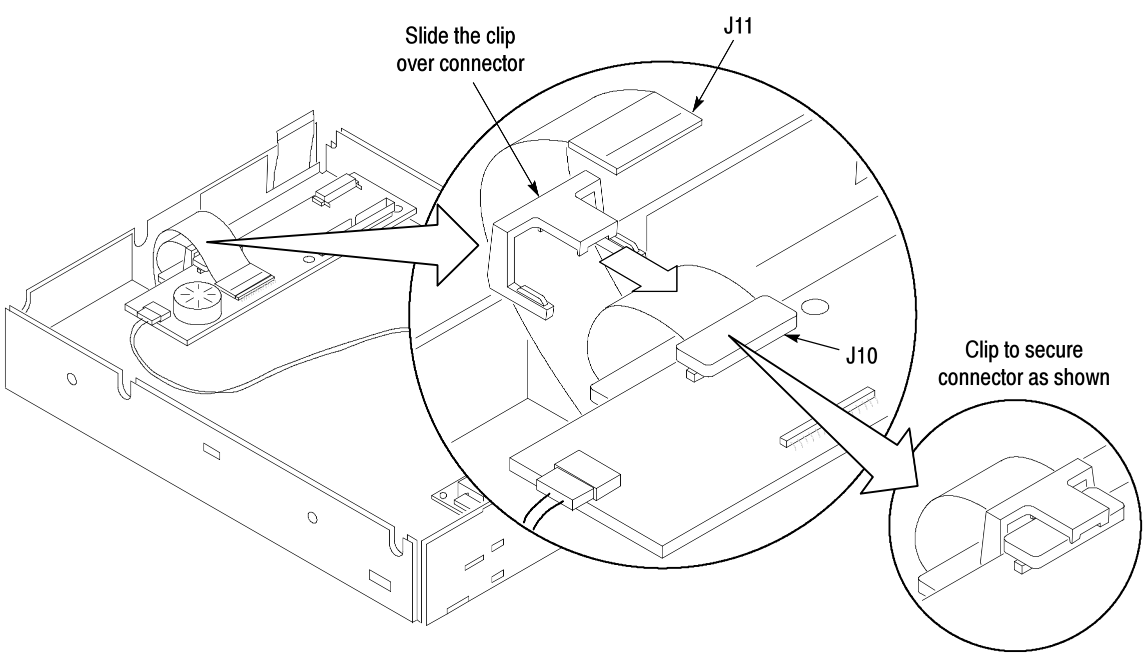


**Figure 6-15: Cable clip removal**

## On/Standby Switch Power Flex Circuit Removal

1. *Locate module to be removed:* Locate the On/Standby Switch power flex circuit in the locator diagram *Internal Modules*, Figure 6-8, on page 6-19. Additional modules to be removed:

   - Trim (front panel)
   - Display assembly

2. *Orient the assembly:* Set the display adapter so its back is down on the work surface and its front is facing you.

3. *Remove the On/Standby Switch power flex circuit:* See Figure 6-16, on page 6-30.

   **a.** Peel the On/Standby switch power flex circuit away from the front of the display assembly.

   **b.** Disconnect the flex circuit from J7 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 On/Standby Switch.

   **a.** Remove the protective backing on the power flex circuit.

   **b.** Slide the connector end of the power flex circuit through the slot in the Display assembly. Make sure the flex circuit connector aligns with J7 on the Display Adapter circuit board.

   **c.** Align the holes in the power 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.

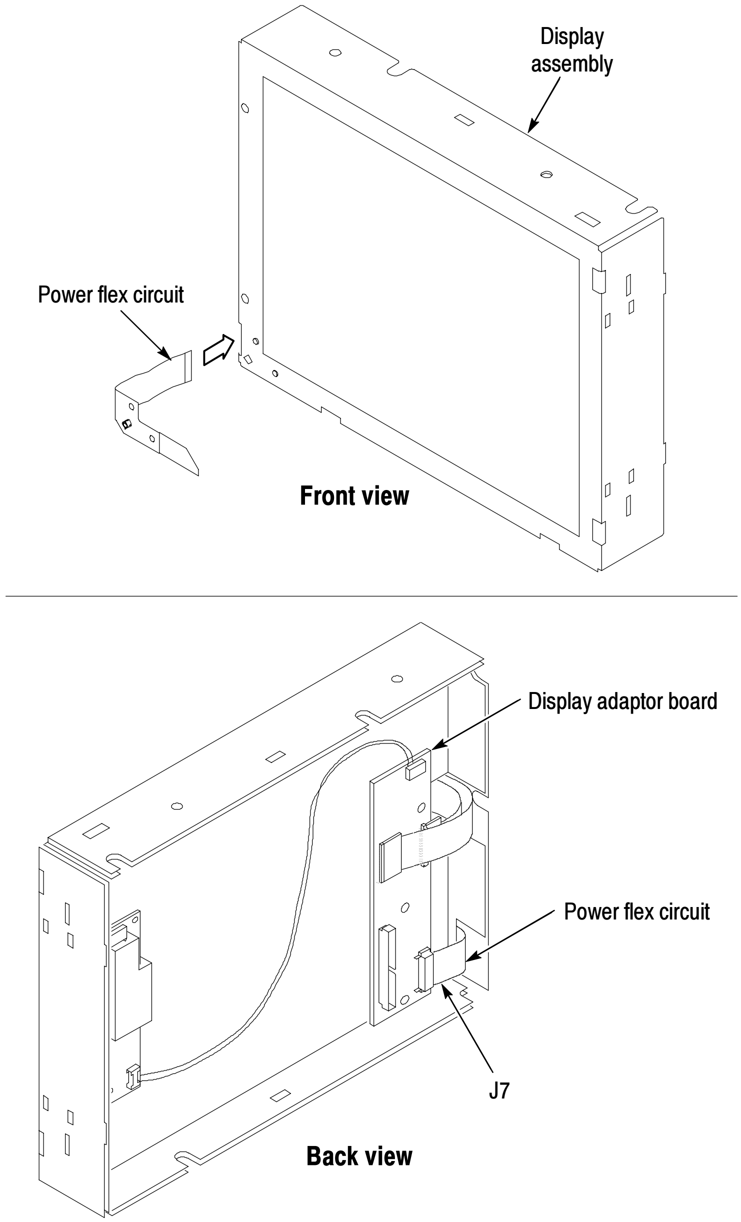


**Figure 6-16: Power flex circuit removal**

## Floppy Disk Drive

1. *Locate modules to be removed:* Locate the Floppy Disk Drive in the locator diagram *Internal Modules*, Figure 6-8, on 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 6-17 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 the 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.

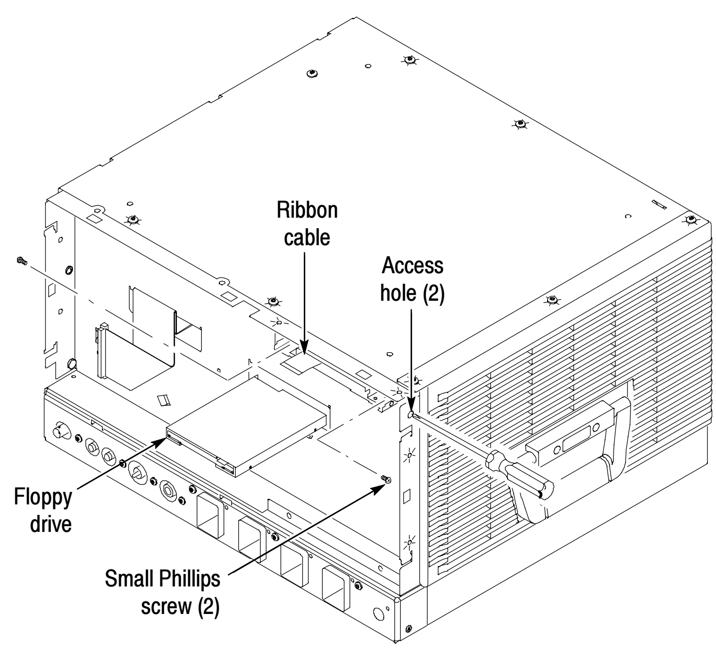


**Figure 6-17: Floppy disk drive removal**

## Hard Disk Drive

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

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

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

*Always power off the instrument 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 6-18, on page 6-33.

   a. Verify that the instrument 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 step 3 to reinstall the hard disk drive assembly. The hard disk drive will push in to lock and push in again to unlock.

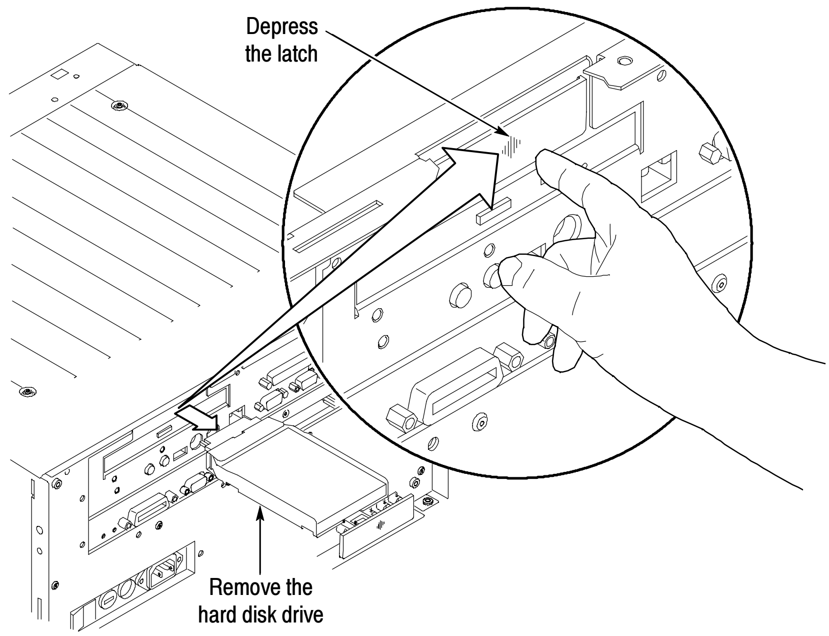


**Figure 6-18: Hard disk drive removal**

5. *Remove the hard disk drive from the cartridge:* See Figure 6–19, on 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.

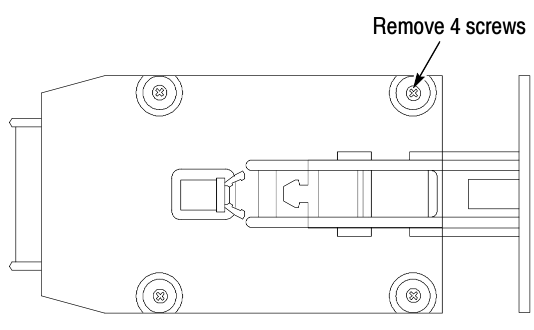


**Figure 6-19: Removing the hard disk drive from the cartridge**

### CD Drive

1. *Locate module to be removed:* Locate the CD Drive in the locator diagram *Internal Modules*, Figure 6-8, on page 6-19. Additional modules to be Removed:
   - Trim (all)
   - Bottom cover
   - Left and Right covers
2. *Remove the CD Drive assembly:* See Figure 6-20, on 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 the CD Drive assembly to the rear chassis.
   - **b.** Disconnect the CD Drive ribbon cable J230 from the Riser board.
   - **c.** Slide the CD Drive assembly (with the ribbon 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 6-20, on 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.

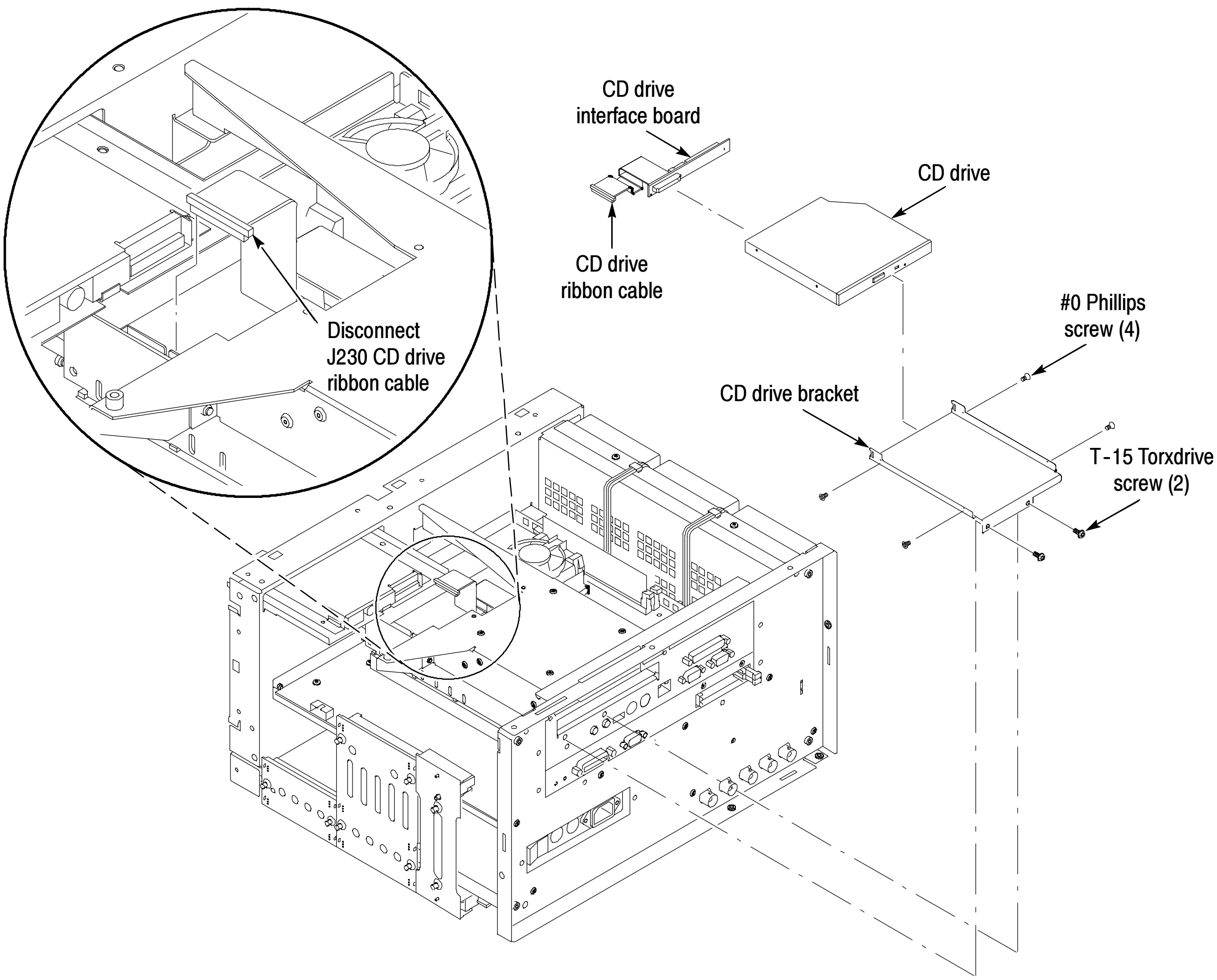


**Figure 6-20: CD drive and bracket removal**

## Fan Assembly Removal

1. *Locate module to be removed:* Locate the Fan assembly in the locator diagram *Internal Modules*, Figure 6–8, on 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:* See Figure 6–21, on page 6–36.

a. *Disconnect the fan from the processor/display board:* Disconnect the two fan 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.

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

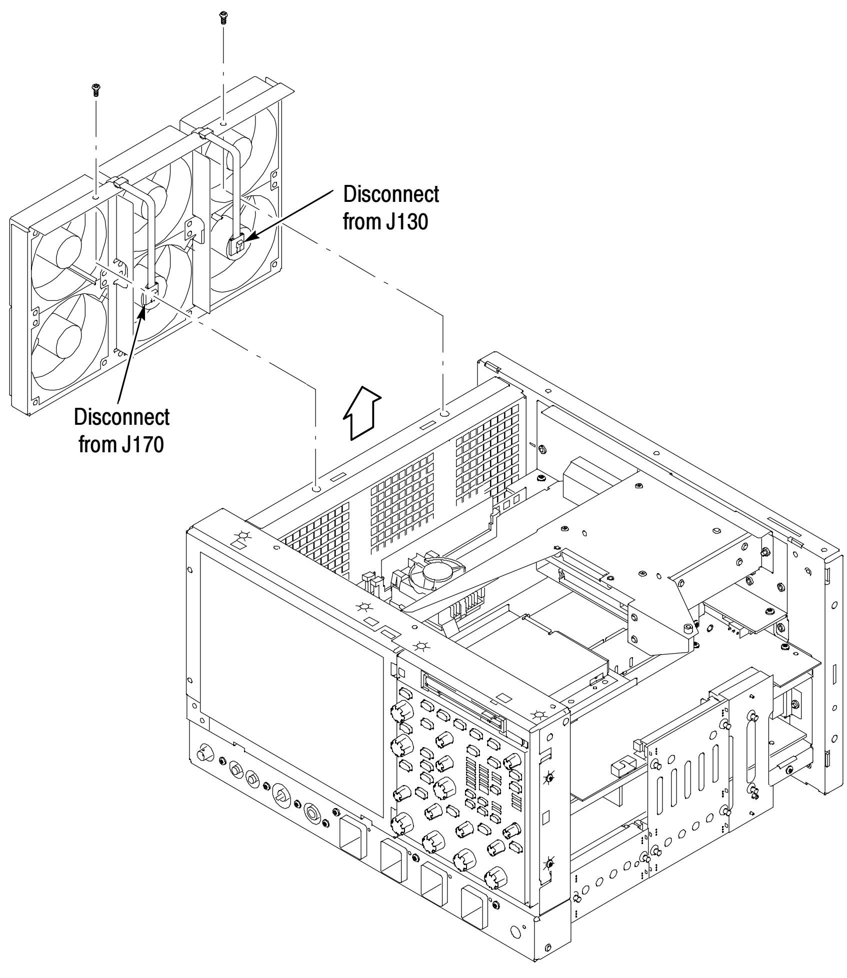


**Figure 6-21: Fan assembly removal**

## Front and Rear Power Distribution Circuit 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, on 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 6-22, on page 6-38.
   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 and J102 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, and J102 Acquisition board.
   c. *Remove the PA Bus Interconnect board:* Grasp the PA Bus Interconnect board and pull it out form the instrument to disconnect it form the following connectors: J930 Processor board and J100 Acquisition board.
4. *Reinstallation:* Do in reverse step 3 to reinstall the front and rear power distribution and the PA bus interconnect boards.

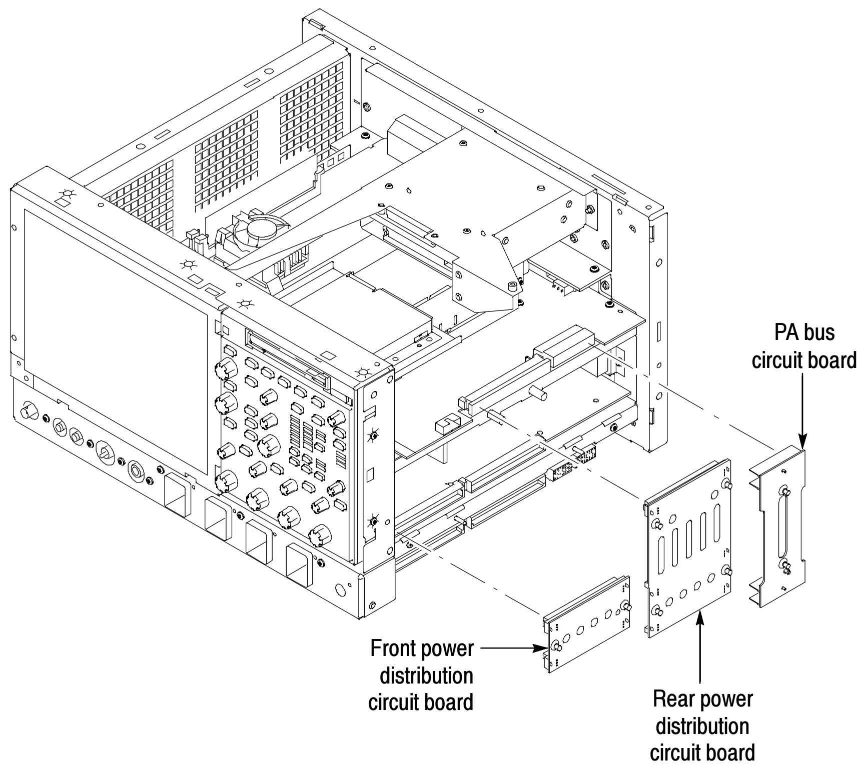


**Figure 6-22: Front and rear power distribution and PA bus boards removal**

### 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, on page 6-19. Additional modules to be Removed:
   - Trim (all)
   - Bottom cover
   - Left and Right covers
   - Front and Rear Distribution Boards and the PA bus interconnect board
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 6-23, on page 6-39.
   - **a.** Remove the two T-15 Torxdrive screws securing the low-voltage power supply to the right-side chassis support.
   - **b.** Remove the three T-15 Torxdrive screws securing the low-voltage power supply to rear chassis.

**c.** Grasp the low-voltage power supply and carefully slide the assembly out of the instrument.

**4.** *Reinstallation:* Do in reverse steps a through c to reinstall the low-voltage power supply.

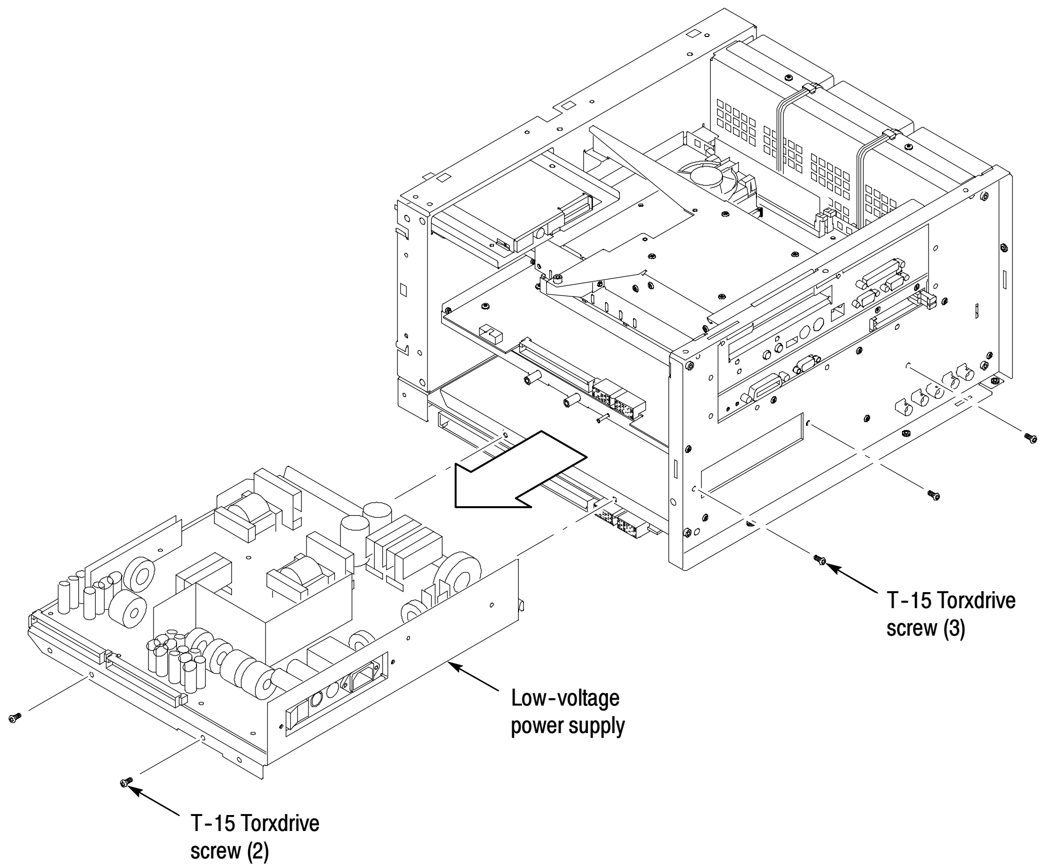


**Figure 6-23: Low-voltage power supply removal**

## NLX Battery

1. *Locate module to be removed:* Locate the NLX battery in the locator diagram *Internal Modules*, Figure 6-8, on page 6-19. Additional modules to be removed:

   - Trim (all)
   - Bottom cover
   - Left and Right covers

2. *Remove the NLX battery:* See Figure 6-26, on page 6-45.

**CAUTION.** *Only perform these steps if you need to replace the NLX battery. Removal of this battery will cause the loss of some BIOS settings.*

   a. Lift the edge of the battery opposite the hold-down spring and slide the battery out of its holder (see Figure 6-24).

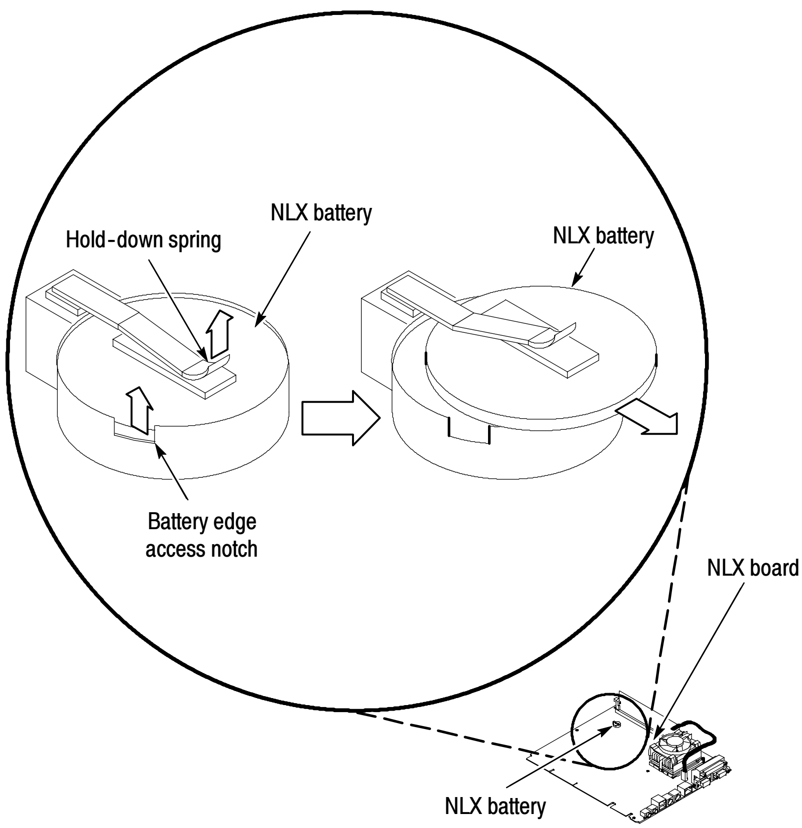


**Figure 6-24: NLX battery removal**

**3.** *Reinstallation:* Reinstall the the NLX battery as follows:

**a.** Do in reverse step 2a to reinstall the NLX battery.

**b.** Power on the instrument.

**c.** After the instrument displays Press <F1> to resume, power off the instrument and then power it on again.

**d.** From the Windows operating system select Start, Programs, and then MS-DOS Prompt.

- If you want your instrument to have access to a network, enter the following command:

  CD ..\TEKTRONIX\CMOS

  CMOS –R NET

- If you want your instrument to not have access to a network, but be able to boot faster, enter the following command:

  CD ..\TEKTRONIX\CMOS

  CMOS –R NONET

**e.** Power off your instrument, and then power on your instrument.

### NLX Board

1. *Locate module to be removed:* Locate the NLX Board in the locator diagram *Internal Modules*, Figure 6–8, on 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, on page 6–43.
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 Processor board edge connector.
   - **f.** Remove the NLX board assembly from the instrument.

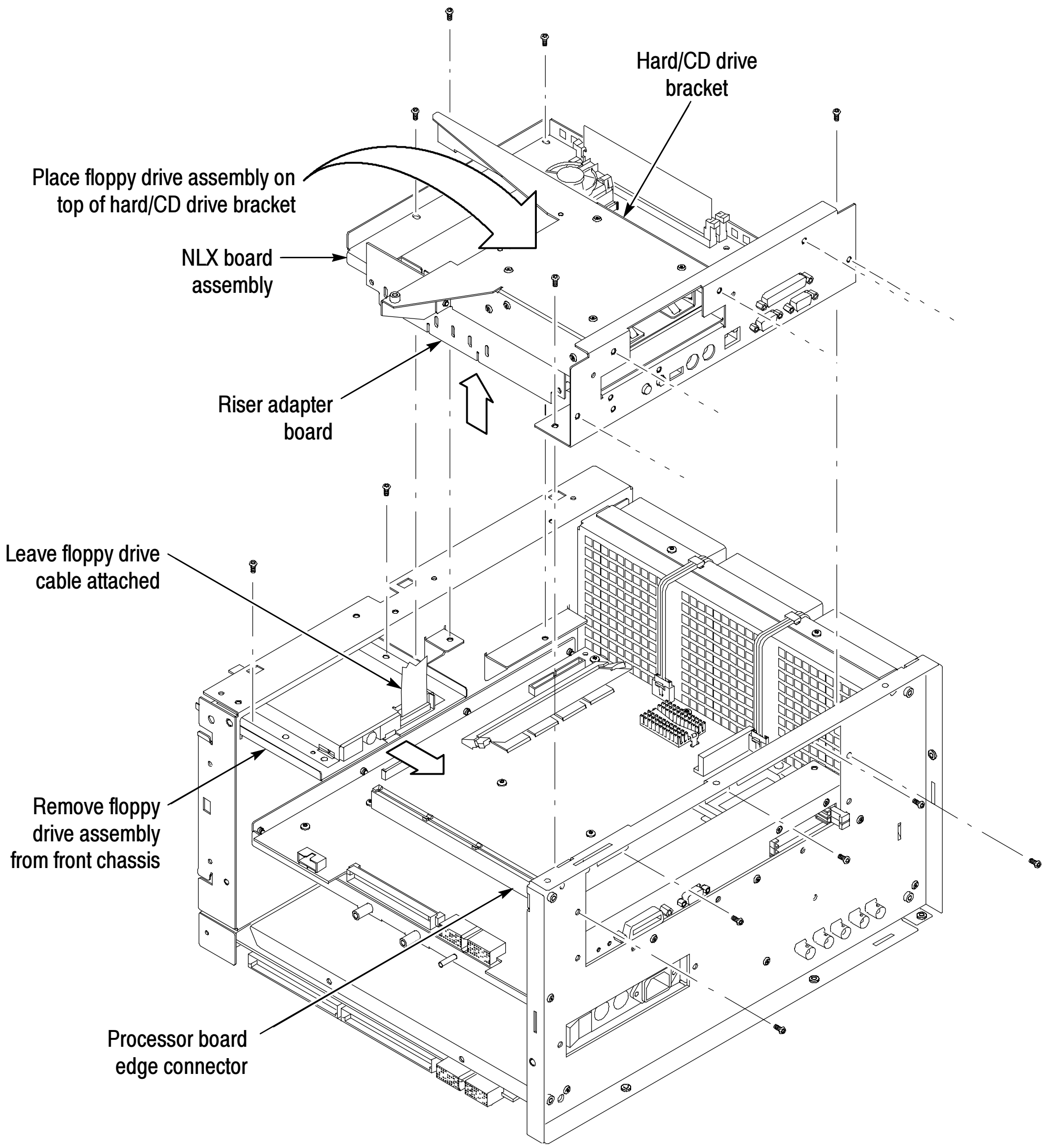


**Figure 6-25: NLX assembly removal**

4. *Remove the Riser Adapter and NLX Boards:* See Figure 6–26, on page 6–45.

   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.

**g.** Remove the NLX board from the support bracket.

**5.** *Reinstallation:* Do in reverse steps 3 and 4 to reinstall the NLX board.

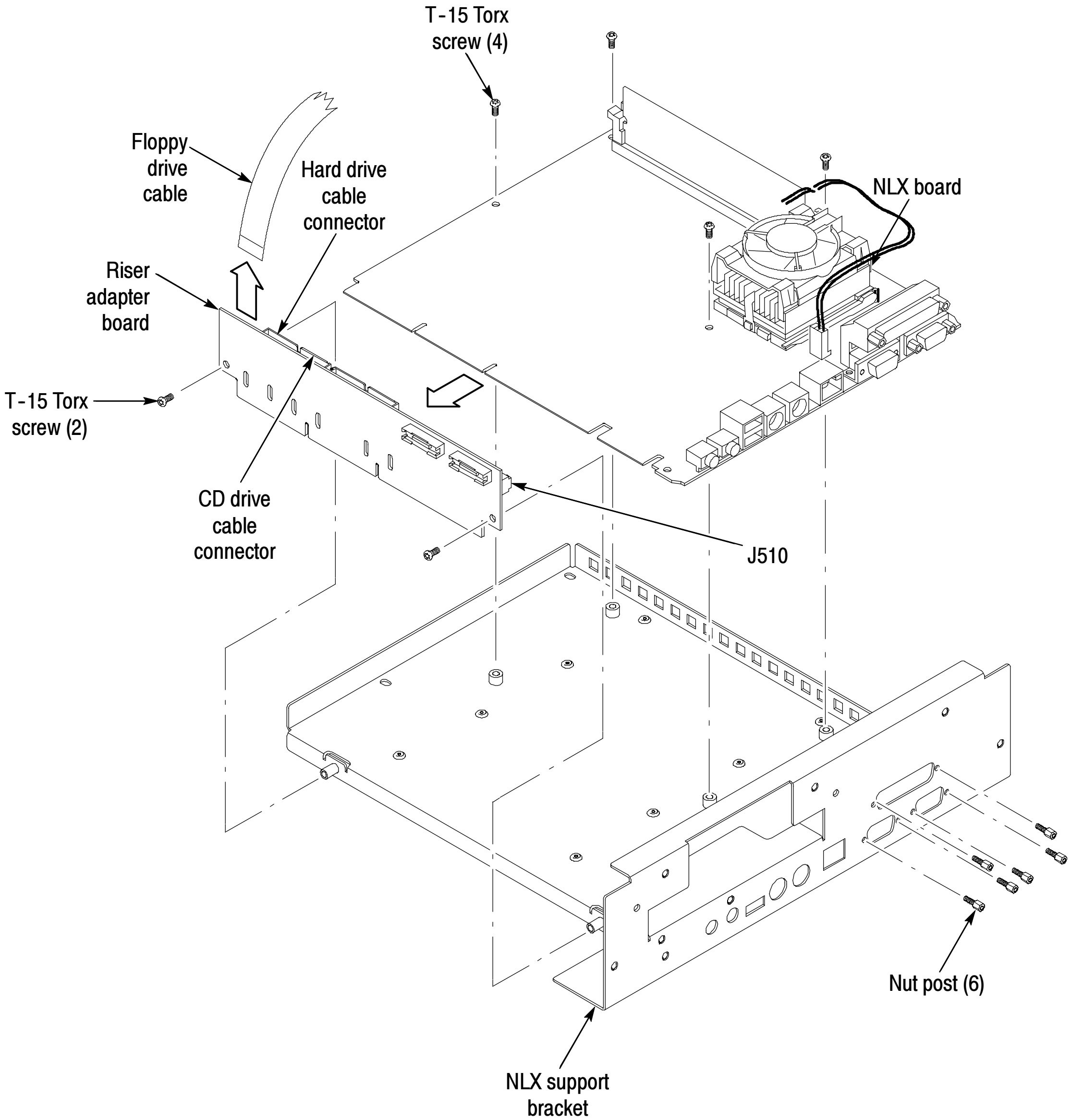


**Figure 6-26: Riser adapter and NLX board removal**

## Microprocessor

1. *Locate module to be removed:* Locate the microprocessor board in the locator diagram *Internal Modules*, Figure 6-8, on 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 instrument. 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 6-47.
   - **a.** Disconnect the fan power cable J14 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.
   - **d.** Lift the microprocessor socket locking lever upward. Remove the microprocessor.
3. *Reinstallation:* 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 center 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 J14 to the NLX board.

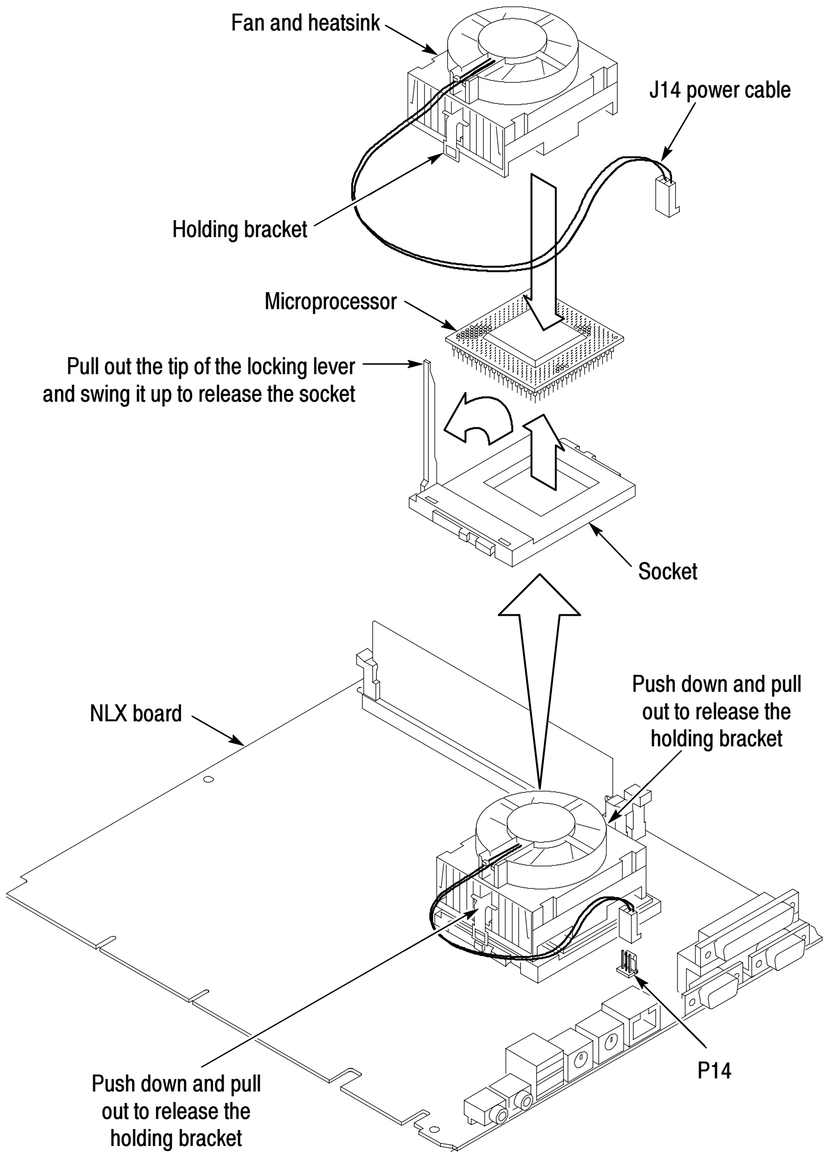


**Figure 6-27: Microprocessor removal**

**PPC Battery**

1. *This battery must be replaced by a Tektronix Service Center*

## PPC Processor Board

1. *Locate module to be removed:* Replacement of this board must be performed by a Tektronix Service Center. Locate the PPC (Power PC) processor board assembly in the locator diagram *Internal Modules*, Figure 6-8, on page 6-19. Additional modules to be removed:

**CAUTION.** *This board should only be replaced by Tektronix.*

- Trim (all)
- Bottom cover
- Left and Right covers
- Hard Disk and CD Drive
- Floppy Disk Drive
- NLX Board
- Front, Rear Power Distribution and PA Bus 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, on page 6-49.

   **a.** Disconnect the J190 and J690 ribbon cables and cables J130 and J170 from the PPC processor board.

   **b.** Remove the nine T-15 Torxdrive screws securing the PPC processor to the chassis support.

   **c.** Remove the five T-15 Torxdrive screws securing the PPC processor board assembly to the rear chassis.

   **d.** Remove the board and bracket.

4. *Remove the PPC processor board bracket:* See Figure 6-28, on page 6-49.

   **a.** Remove the two $^{3}/_{16}$ nut posts that secure the RS-232 connector to the rear of the support bracket.

   **b.** Remove the two $^{5}/_{16}$ 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 and bracket from the PPC processor board.

5. *Reinstallation:* Do in reverse steps 3 and 4 to reinstall the PPC processor board assembly.

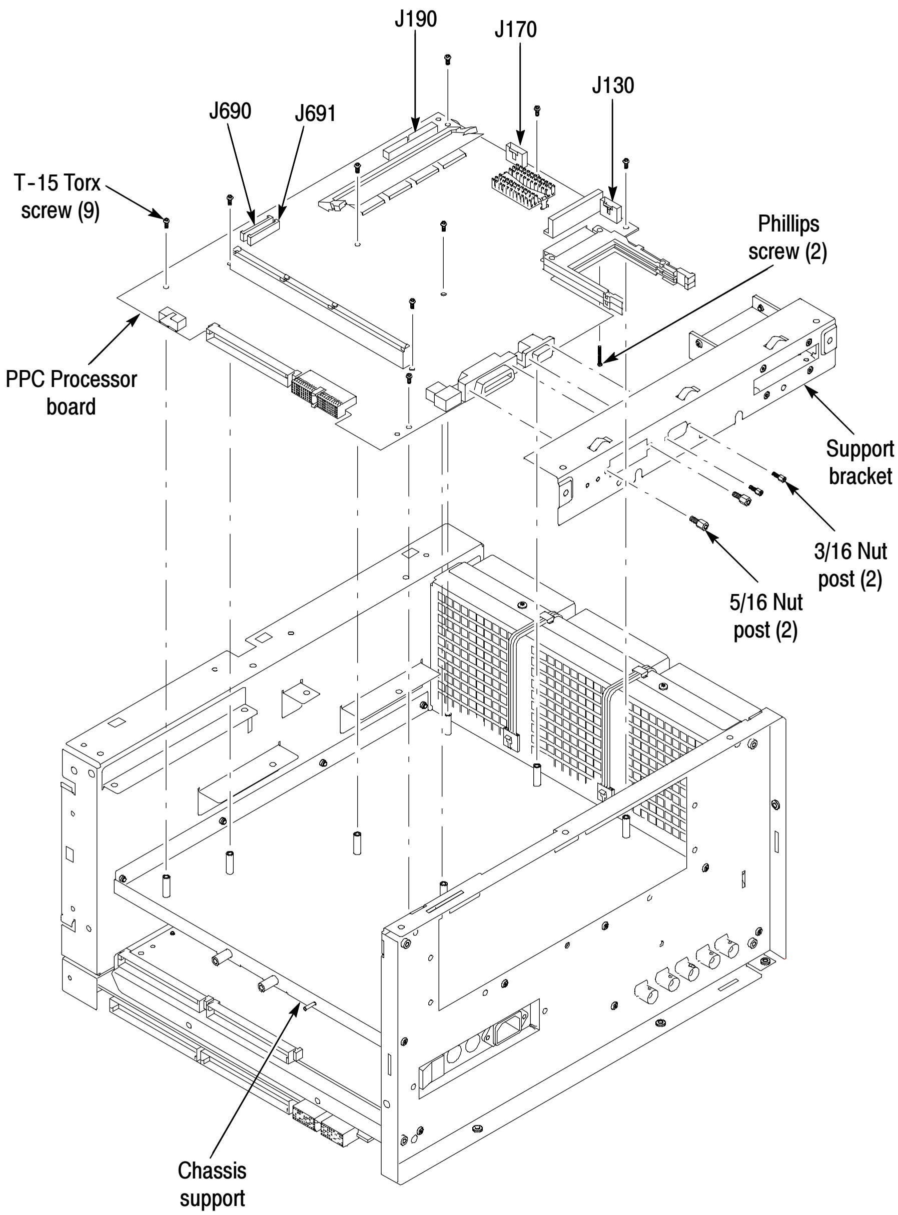


**Figure 6-28: PPC Processor board removal**

## Acquisition Board

1. *Locate module to be removed:* Replacement of this board must be performed by a Tektronix Service Center. Locate the Acquisition board in the locator diagram, Figure 6-8, on page 6-19. Additional modules to be removed:

**CAUTION.** *This board should only be replaced by Tektronix.*

- Trim
- Bottom cover
- Left and Right covers
- Front and Rear Power Distribution Boards (PA Bus board)

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 board:* See Figure 6-29, on page 6-51.

   a. Disconnect EXT REF, REF OUT, SIGNAL OUT, AUX OUT, and AUX IN coaxial cables from the rear panel BNC connectors.

   b. Remove the 13 T-15 Torxdrive screws securing the Acquisition assembly to the front chassis.

   c. Remove the six T-15 Torxdrive screws securing the Acquisition assembly to the chassis.

   d. Slide the Acquisition board toward the rear of the instrument. Then lift the board out of the instrument.

**NOTE**. *If you are replacing the acquisition board assembly, do not remove the remaining parts, they are part of the replaceable assembly.*

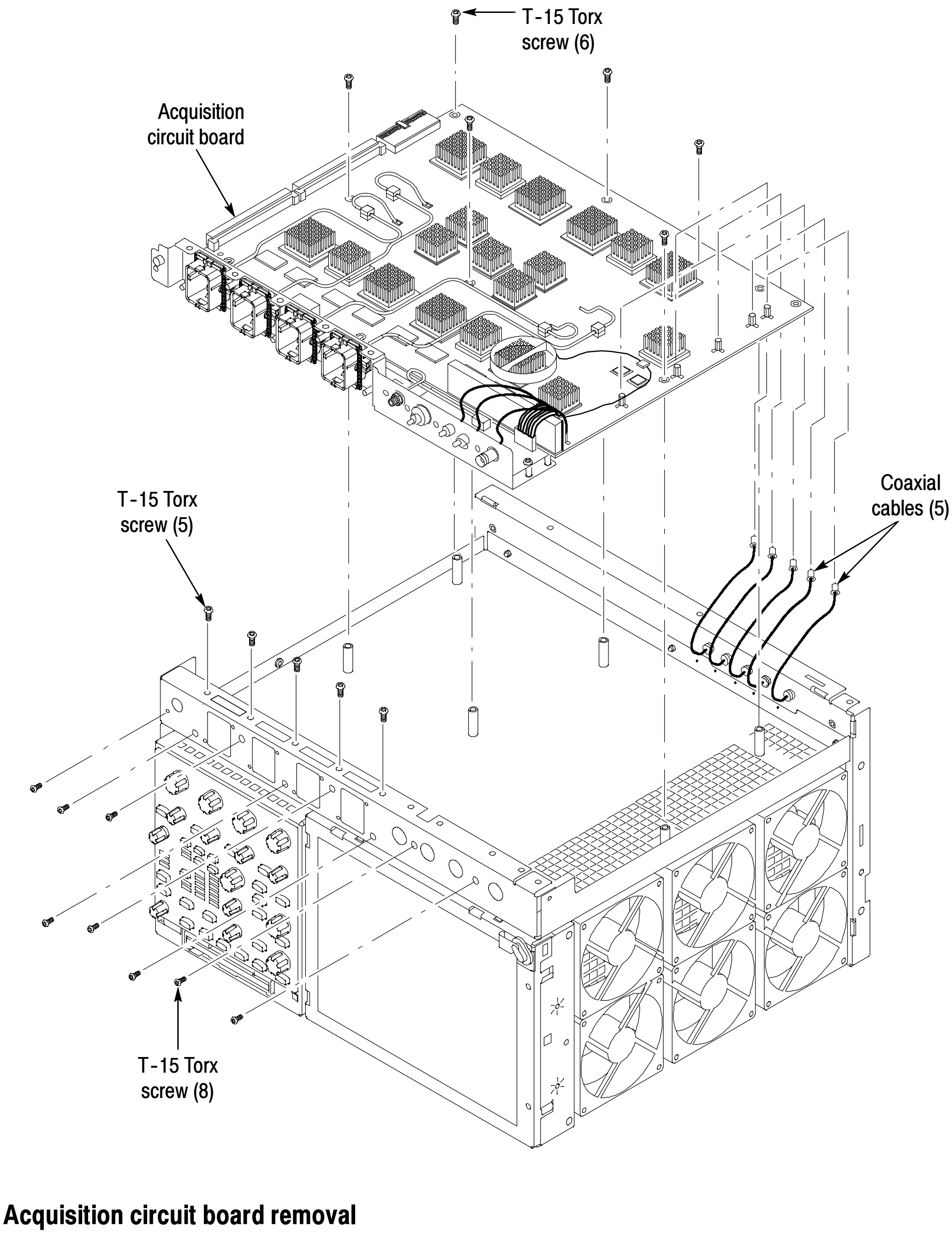


**Figure 6-29: Acquisition circuit board removal**

4. *Access the Front Panel Combination assembly*: See Figure 6-30, on page 6-52.

   a. Remove the TekConnect ribbon cable by grasping the sides of the connector and pulling up.

   b. Remove the 7/16 nut from the inside front of the 4 TekConnect buckets.

c. Remove the three T-15 Torxdrive screws securing the Acquisition board to the Front Panel Combination assembly.

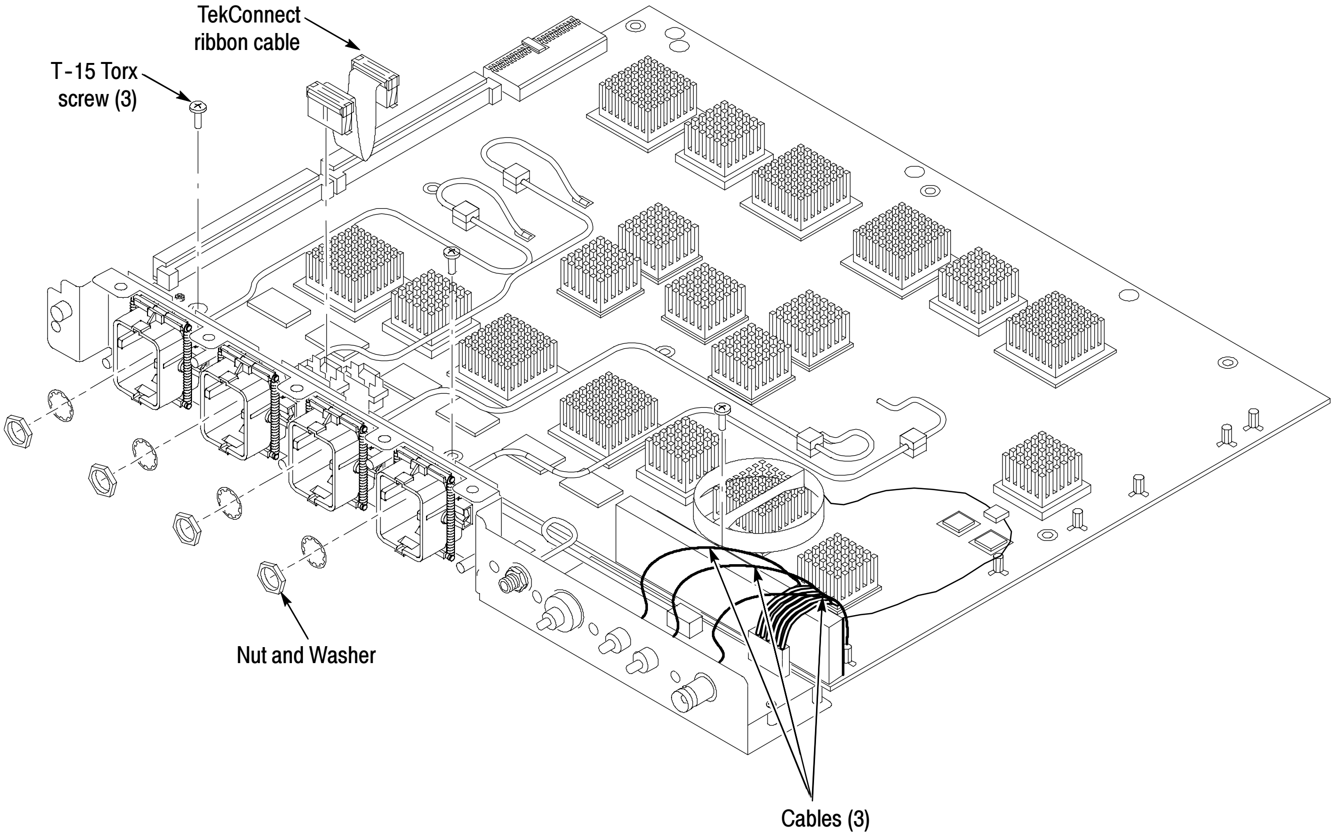


**Figure 6-30: Front panel combination assembly removal**

5. *Remove the TekConnect circuit board:* See Figure 6-31, on page 6-53. Remove the five T-15 Torxdrive screws securing the TekConnect board to the combination assembly.

6. *Remove a TekConnect bucket:* See Figure 6-31, on page 6-53. Remove the three T-15 Torxdrive screws securing the TekConnect bucket to the Front Panel Combination assembly.

***CAUTION.*** *Further disassembly of the Acquisition board and Front-panel combination assembly will damage optical cables and components requiring replacement of the Acquisition board and Front-panel combination assembly. Do not let either the board or assembly hang from, be lifted by, or in some other method stress the cables connected between the Acquisition board and the Front-panel combination assembly.*

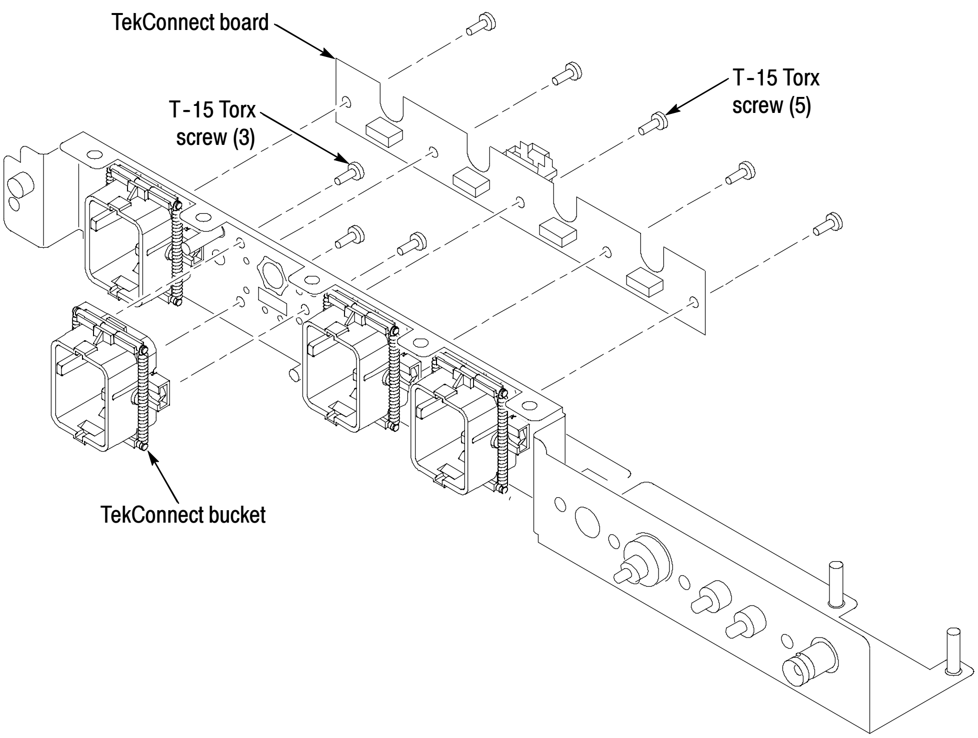


**Figure 6-31: TekConnect board and TekConnect bucket removal**

# Troubleshooting

> ***WARNING.*** *Before performing this or any other procedure in this manual, read the* General Safety Summary *and* Service Safety Summary *found at the beginning of this manual.*
>
> *To prevent possible injury to service personnel or damage to electrical components, please read* Preventing ESD *on page 6-1.*

This section contains information and procedures designed to help you isolate faults to a module.

This section assumes that service personnel have the prerequisite skills required to work on this instrument, including PC troubleshooting and Windows 98 skills. Details of PC and Windows 98 operation and service are not in this manual.

For assistance, contact your local Tektronix Service Center.

## Service Level

This subsection 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 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) |
|---|---|
| Instrument will not power on | ■ Power cord not plugged in<br>■ Failed fuse<br>■ Mains power switch is in off position<br>■ Faulty power supply |
| Front panel light comes on (instrument powers on), but one or more fans will not operate | ■ Faulty fan cable<br>■ Defective fan assembly<br>■ Faulty power supply |

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

| Symptom | Possible cause(s) |
|---|---|
| PPC appears "dead"; power light comes on, but monitor screen(s) is (are) blank, instrument emits no beeps | ■ SO DIMMs incorrectly installed or missing. Missing DIMMs will cause a POST fault and NLX will beep<br>■ Defective Power PC (PPC) board<br>■ Hold down on-standby button on the PPC, if system boots, replace the power supply |
| Hard disk drive related symptoms | ■ Defective hard disk drive<br>■ Incorrect hard disk type selected in the BIOS setup<br>■ Replaceable hard disk drive not installed<br>■ Power supply failure<br>■ Corrupted BIOS module firmware, reinstall firmware<br>■ Hard disk drive not configured as bootable (slave) master hard disk drive<br>■ Loose cable<br>■ Faulty riser board<br>■ Faulty PPC board |
| CD-ROM related symptoms | ■ Defective CD-ROM<br>■ Defective CD-ROM drive cable<br>■ Defective CD-ROM board<br>■ Incorrect CD-ROM configuration in the BIOS setup |
| Flat panel display blank | ■ Display selection jumper set incorrectly on front panel board (there are no jumpers on the board when the instrument is shipped from the factory; this is the correct default setting)<br>■ Video adapter set to AGP (connect monitor to NLX VGA port, enter BIOS, set Video Adapter = PCI)<br>■ BIOS setting not Advance > Video Configuration > Primary Video Adapter = PCI<br>■ Defective cable from front panel board to display adapter board<br>■ Defective cable from inverter board to display adapter board<br>■ Defective cable from inverter board to backlighting display lamp<br>■ Defective backlighting display lamp<br>■ Faulty display<br>■ Faulty controller board<br>■ Faulty inverter board<br>■ Faulty display adapter board |
| BIOS error messages | ■ Refer to the BIOS error message tables starting on page 6-67 |

## Equipment Required

You will need a digital voltmeter to check power supply voltages, as described on page 6-60.

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.

## Fault Isolation Procedure

Follow the primary troubleshooting tree in Figure 6-32 for fault isolation. This tree calls for you to run the diagnostics programs, and check for BIOS errors.

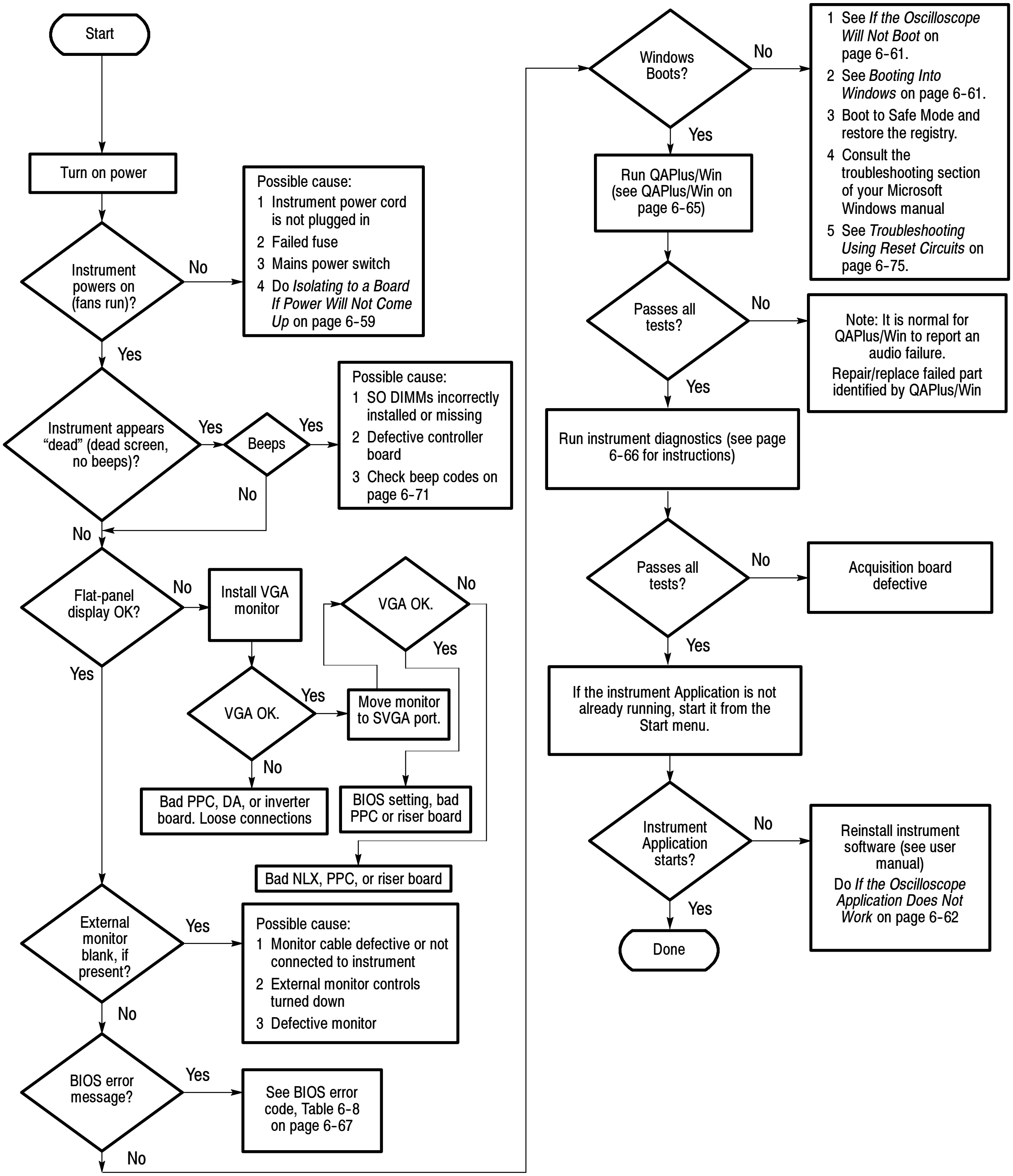


**Figure 6-32: Primary troubleshooting tree**

## Isolating to a Board if Power Will Not Come Up

If the mains power switch is on and the instrument is not on, (power supply is in standby mode), a red light (see Figure 6-33 for its location) is visible through the right side of the instrument. If the instrument is on, the red light is off.

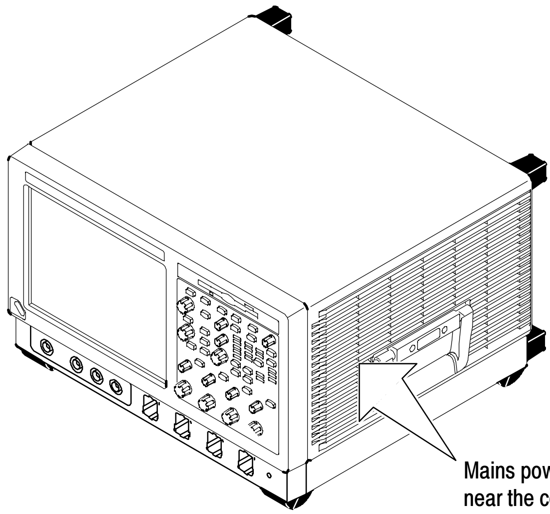


**Figure 6-33: Location of power-on and over current LEDs**

If the instrument thinks power is on, a red light (see Figure 6-33) 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 power distribution board, the NLX board, and the riser board). If you remove the NLX board, you must jumper the debug power-on pins (see Figure 6-34). 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.

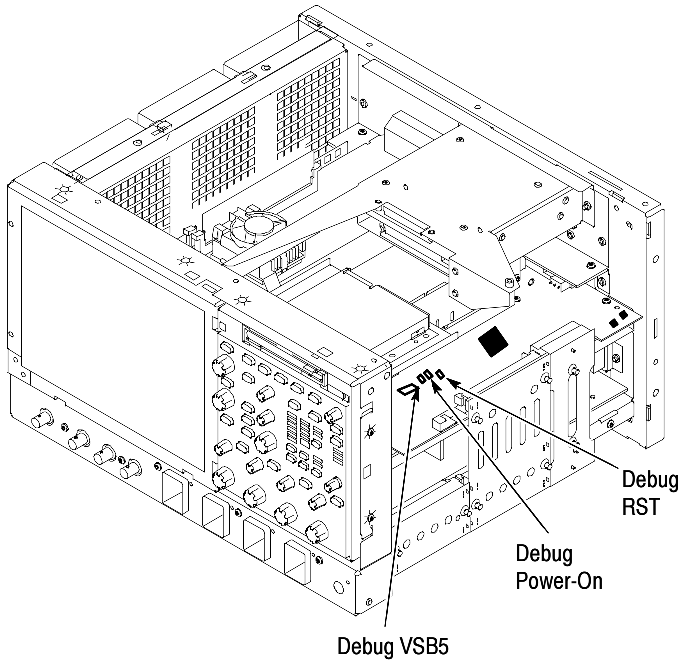


**Figure 6-34: Location of debug pins**

### Checking the Power Supply Voltages

To check the power supply voltages, 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 J1 and J2 connectors is shown in Figure 6-35 on page 6-61.

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.

**Table 6-5: Power supply voltages**

| Front power distribution board (P2) and Power supply (J2) | Voltage | Rear power distribution board (P1) and Power supply (J1) | Voltage | Riser board | Voltage |
|---|---|---|---|---|---|
| Pins A/B/C1, 3, 5, 7, 9, 11 | +3.3 V | Pins A/B/C5, 6 | +12 V | Pin B170 | -5 V |
| Pins A/B/C13 | -15 V | Pins A/B/C8, 9, 11, 12, 14, 15, 17 | +5 V | Pin A1 | -12 V |
| Pins A/B/C15 | +15 V | Pins A/B/C19, 21, 23, 25, 27, 29, 31 | +3.3 V | Pin B2 | +12 V |
| Pins A/B/C17, 18, 20, 21, 22 | -5 V | Pins B/C3 (fan voltage) | +9.8 V | Pin A5 | +3.3 V |
| Pins A/B/C24, 25, 27, 28, 30, 31 | +5 V | | | Pin A57 | +5 V |

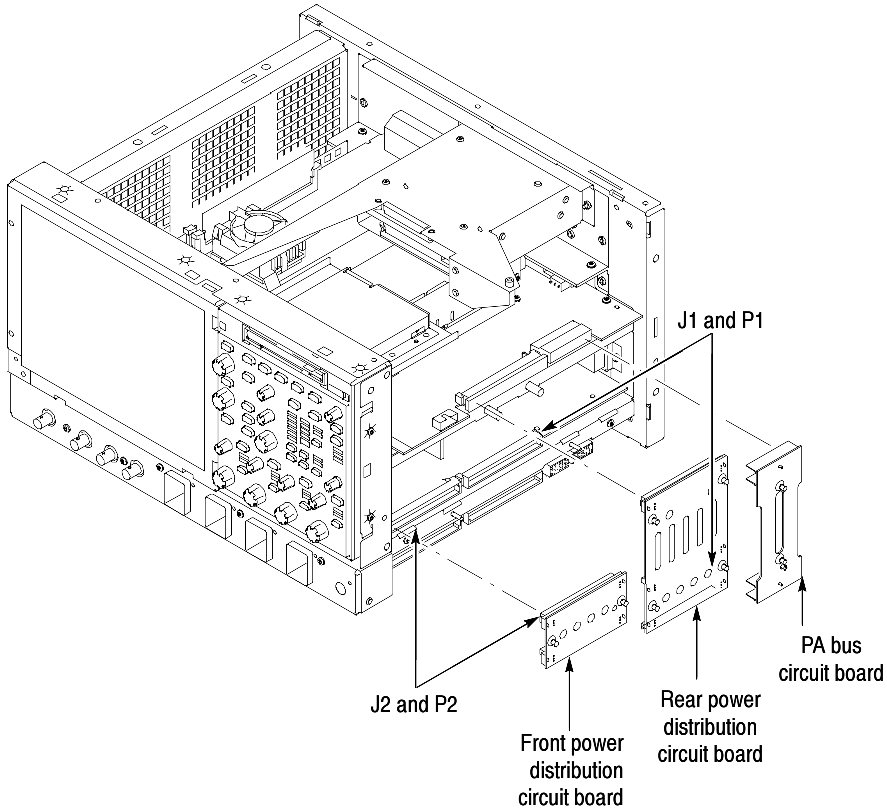


**Figure 6-35: Connectors J1 and J2**

## 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 the display adapter is bad, the BIOS should report it using beep codes (see Table 6–10, on page 6–71).

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).

## 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 6–77).

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.

### If the Instrument Application Does Not Work

If the instrument boots into Windows, but the instrument application does not work (the DPO Man graphic is displayed), check the following:

1. The application software.
2. The Acquisition board.
3. The PPC board.
4. The Riser board (try removing and reinstalling the Riser board).
5. Did someone exit the application using the Task Manager and then try to reenter the application without rebooting?
6. Set Diagnostic Selection DIP switch 2 to off (see *Dip Switch Controls* on page 6–72 for more information), reboot; check the Diagnostic LED (see page 6–73 for more information).
7. If the relays click, the acquisition is running.
8. Check the desktop properties (right click on the desktop and select Properties). On the Settings tab, 16 bit is required. Video merge will not work with other settings. If you change the setting, reboot.
9. On the Settings tab of the desktop properties, select Advanced and then the Performance tab. Hardware Acceleration must be set to Full for video merge to work. If you change the setting, reboot.

## 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 next.

## 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. Table 6-6 lists a subset of the power on tests. Use the results of the tests to help you isolate problems to system modules.

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.

If there are no failures, you can view the results of the tests in the Instrument Diagnostics page under the Utilities menu.

**Table 6-6: Power-on diagnostic tests**

| Component | Group & test | Error codes | Power on | Extended |
|---|---|---|---|---|
| Mainframe | VTC Reset Test | | ✓ | |
| | VTC Walk1 Test | | ✓ | |
| | ADG Register Test | | ✓ | |
| | ADG VXI Addr Test | | ✓ | |
| | ADG VXI Data Test | | ✓ | |
| System | Interrupt Lines | | ✓ | ✓ |
| | Trigger Lines | | ✓ | ✓ |
| Processor | Memory | 111 DRAMWalk1<br>112 DRAMCell<br>113 DRAMMarch<br>114 NVRAM | | ✓ |
| | PCI Bus | 121 Scan Test | | ✓ |
| | Registers | 131 PAI | | ✓ |
| Display | Registers | 211 Display | | ✓ |

**Table 6-6: Power-on diagnostic tests (Cont.)**

| Component | Group & test | Error codes | Power on | Extended |
|---|---|---|---|---|
| Acquisition | Registers | 311 DAC<br>312 Demux<br>313 Atten<br>314 Preamp<br>315 PLL<br>316 ADC | | ✓ |
| | Memory | 321 MemData<br>322 MemAddr<br>323 DataFormat<br>324 MemSpeed | | ✓ |
| | Acq Modes | 331 SubSample<br>332 PeakDetect<br>333 HiRes | | ✓ |
| | Interrupt | 341 Bit Tests | | ✓ |
| | HF Step | 351 PhaseCal | | ✓ |
| | Vertical | 371 50OhmOvld<br>372 ADC Connects | | ✓ |
| | PLL | 381 Clock Freq | | ✓ |
| Trigger | Registers | 411 GTL<br>412 BTL<br>413 DTC<br>414 ExtndTrg<br>415 AuxTrig | | ✓ |
| | TrgLvlComp | 421 LogicComp1<br>422 LogicComp2<br>423 LogicComp3<br>424 LogicComp4 | | ✓ |
| | GTL | 431 TICounters<br>432 GTLBigCntrs | | ✓ |
| | Serial I/O | 441 Atten<br>442 Preamp<br>443 DTC<br>444 ExtendedTrg<br>445 Dacs | | ✓ |
| | BTL | 451 Ch1Edge<br>452 AfterDBE<br>453 AfterDBT<br>454 Slewrate<br>455 LineTrig<br>456 BTL | | ✓ |
| | Extended | 461 Glitch<br>462 PulseWidth<br>463 OptionST_ok | | ✓ |
| | Nibble | 471 Bus | | ✓ |

**Table 6-6: Power-on diagnostic tests (Cont.)**

| Component | Group & test | Error codes | Power on | Extended |
|---|---|---|---|---|
| Misc | GPIB | 511 Interface | | ✓ |
| | Factory Cal Integrity | 521 Factory Cal Data | | ✓ |
| | Cal Integrity (run cal) | 531 Cal Data | | ✓ |
| | Factory Bank2 Integrity | 541 Factory Bank2 | | ✓ |

### 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 TekScope and then touch **End Task**.
   c. Display the Task Manager by pressing CTRL, ALT, and Delete.
   d. Select Windowsscopeservices and then touch **End TAsk**.
   e. Display the Task Manager by pressing CTRL, ALT, and Delete.
   f. Select Servercontrol and then touch **End TAsk**.
   g. Display the Task Manager by pressing CTRL, ALT, and Delete.
   h. Select Vxi11servercontrol 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 has two levels of internal diagnostics that focus on verifying, adjusting, and if need be, isolating faulty modules.

Both levels of internal diagnostics report any bad modules. If a bad module is found, replace the module.

The two levels of diagnostics are the short confidence set and the extended set that tests the instrument circuitry in depth and takes more time. At power on, the instrument automatically executes the short set. The extended set is optional and is executed by using the following procedure:

Prerequisites: Power on the instrument and allow a 20 minute warm-up before doing this procedure.

1. *Display the System diagnostics menu:*
   a. From the menu bar, touch **Utilities** and then select **Instrument Diagnostics**.

## Software Updates

Software 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 software 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 6–7.

**Table 6-7: Action required for module replaced**

| Module replaced | Adjustment required[1] | Software update required |
|---|---|---|
| Front panel assembly | No | None |
| Acquisition board | Yes[2] | None |
| PPC Processor board | No[2] | Installation by Tektronix is required |
| 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 |
| O/E Converter | Yes | None |

1 **Adjustment must be performed by Tektronix.**

2 **Replacement of this board must be performed by Tektronix**

## BIOS Error Messages (Bali NLX)

Table 6-8 lists error messages displayed by the BIOS.

**Table 6-8: BIOS Error messages (Bali)**

| Error message | Explanation |
|---|---|
| GA20 Error | An error occurred with Gate-A20 when switching to protected mode during the memory test. |
| Pri Master HDD Error<br>Pri Slave HDD Error<br>Sec Master HDD Error<br>Sec Slave HDD Error | Could not read sector from corresponding drive. |
| A: Drive Error<br>B: Drive Error | No response from diskette drive. |
| Cache Memory Error | An error occurred while testing L2 cache. Memory may be bad. |
| CMOS Battery Low | Replace the battery soon. |
| CMOS Display Type Wrong | The display type is different than what has been stored in CMOS. Check Setup to make sure type is correct. |
| CMOS Check Sum Bad | The CMOS checksum is incorrect. CMOS memory may have been corrupted. Run Setup to reset values. |
| CMOS Settings Wrong | CMOS values are not the same as the last boot. These values have either been corrupted or the battery has failed. |

**Table 6-8: BIOS Error messages (Bali) (Cont.)**

| Error message | Explanation |
|---|---|
| CMOS Date/Time Not Set | The time and/or date values stored in CMOS are invalid. Run Setup to set correct values. |
| DMA Error | Error during read/write test of DMA controller. |
| FDC Failure | Error while trying to access diskette drive controller. |
| HDC Failure | Error while trying to access hard disk controller. |
| Update Failed | NVRAM was invalid but was unable to be updated. |
| Unlock Keyboard | The system keyboard lock is engaged. The system must be unlocked to continue to boot. |
| Keyboard Error | Error in the keyboard connection. Make sure keyboard is connected properly. |
| KB/Interface Error | Keyboard interface test failed. |
| Timer Error | Timer Test failed. |
| Memory Size Changed | Memory size has changed since the last boot. If no memory was added or removed, then memory may be bad. |
| Serial presence detect (SPD) device data missing or iinconclusive. Do you wish to boot at 100 MHz bus speed? [Y/N] | System memory does not appear to be SPD memory. |
| No Boot Device Available | System did not find a boot device. |
| Off Board Parity Error | A parity error occurred on an off-board card. This error is followed by an address. |
| On Board Parity Error | A parity error occurred in onboard memory. This error is followed by an address. |
| parity Error | A parity error occurred in onboard memory at an unknown address. |
| NVRAM/CMOS/PASSWORD cleared by Jumper | NVRAM, CMOS, and passwords have been cleared. The system should be powered off and the jumper removed. |
| <CTRL_N> Pressed | CMOS is ignored and NVRAM is cleared. User must enter Setup. |

## BIOS Error Messages (Radisys NLX)

When the NLX board powers-on, the BIOS runs power-on-self-tests to check the board. The BIOS writes error codes to location 80h and tries to write the codes to the display. If the error is fatal, then the error code indicates the last successful checkpoint reached. Table 6–9 lists the error messages displayed by the Radisys BIOS.

Once the display is enabled, errors are written to the display as text messages. These messages are always displayed unless the board is configured for silent boot or headless (no keyboard, mouse, or display) operation.

**Table 6-9: BIOS Error messages (Radisys)**

| Displayed error code | Error message | Displayed error code | Error message |
|---|---|---|---|
| 02h | Verify real mode | 6Ch | Display shadow message |
| 03h | Disable NMI | 6Eh | Display non-disposable segments |
| 04h | Get CPU type | 70h | Display error messages |
| 06h | Initialize system hardware | 72h | Check for configuration errors |
| 08h | Initialize chipset registers with initial POST values | 74h | Test real-time clock |
| 09h | Set POST flag | 76h | Check for keyboard errors |
| 0Ah | Initialize CPU registers | 7Ah | Test for key lock on |
| 0Bh | Enable CPU cache | 7Ch | Set up hardware interrupt vectors |
| 0Ch | Initialize cache to initial POST values | 7Eh | Test coprocessor if present |
| 0Eh | Initialize I/O | 80h | Disable on-board I/O ports |
| 0Fh | Initialize local bus IDE | 81h | Late device initialization |
| 10h | Initialize power management | 82h | Detect and install external RS-232 ports |
| 11h | Load alternate registers with initial POST values | 83h | Configure IDE controller |
| 12h | Restore CR0 | 84h | Detect and install external parallel ports |
| 13h | Reset PCI BM | 85h | Initialize PCI PCC devices |
| 14h | Initialize keyboard controller | 86h | Reinitialize on-board I/O ports |
| 16h | BIOS ROM checksum | 87h | Configure MCD devices |
| 17h | Presize DRAM | 88h | Initialize BIOS data area |
| 18h | 8254 timer initialization | 89h | Initialize NMI |
| 1Ah | 8237 DMA controller initialization | 8Ah | Initialize extended BIOS data area |
| 1Ch | Reset programmable interrupt controller | 8Bh | Initialize mouse |
| 20h | Test DRAM refresh | 8Ch | Initialize floppy controller |
| 22h | Test 8742 keyboard controller | 8Eh | Execute auto-typing |
| 24h | Set ES segment register to 4GB | 8Fh | Hard disk controller fast preinitialization |
| 26h | Enable A20 | 90h | Initialize hard disk controller |
| 28h | Auto-size DRAM | 91h | Initialize local bus hard disk controller |
| 29h | Initialize PMM | 92h | Jump to User-Patch2 |
| 2Ah | Clear 512 Kb base RAM | 93h | Build MPTABLE for multiprocessor boards |
| 2Ch | Test 512 Kb base address lines | 95h | Install CD-ROM for boot |
| 2Eh | Test low byte of 512 Kb base memory | 96h | Clear huge ES segment register |
| 2Fh | Pre-system shadow | 97h | Fix up MP table |
| 30h | Test high byte of 512 Kb base memory | 98h | Search for option ROMs (beep for bad checksum) |
| 32h | Test CPU bus-clock frequency | 99h | Check for SMART HDD |
| 33h | Initialize PDM | 9Ah | Shadow option ROMs |

**Table 6-9: BIOS Error messages (Radisys) (Cont.)**

| Displayed error code | Error message | Displayed error code | Error message |
|---|---|---|---|
| 34h | Test CMOS RAM | 9Ch | Set up power management |
| 35h | Initialize alternate chipset registers | 9Dh | Initialize security |
| 36h | Warm start shutdown entry point | 9Eh | Enable hardware interrupts |
| 37h | Re-initialize the chipset | 9Fh | HDD fast initialization (second) |
| 38h | Shadow system BIOS ROM | A0h | Set time of day |
| 39h | Reinitialize the cache | A2h | Check key lock |
| 3Ah | Auto-size cache | A4h | Initialize typematic rate |
| 3Ch | Configure advanced chipset registers | A8h | Erase F2 prompt |
| 3Dh | Load alternate registers with CMOS values | AAh | Scan for F2 keystroke |
| 3Eh | Read HW | ACh | Enter SETUP |
| 40h | Set Initial CPU speed | AEh | Clear in-POST flag |
| 42h | Initialize interrupt vectors | B0h | Check for errors |
| 44h | Initialize BIOS interrupts | B2h | POST done—prepare to boot operating system |
| 45h | Core device initialization | B4h | One beep before boot |
| 46h | Check ROM copyright notice | B5h | Quiet boot end/display MultiBoot menu |
| 48h | Check video configuration against CMOS | B6h | Check password (optional) |
| 49h | Initialize PCI bus and devices | B8h | Clear global descriptor table |
| 4Ah | Initialize all video adapters in system | B9h | Prepare to boot |
| 4Bh | Display Quiet-Boot screen | BAh | DMI |
| 4Ch | Shadow video BIOS ROM | BBh | Initialize BCVS |
| 4Eh | Display copyright notice | BCh | Clear parity checkers |
| 50h | Display CPU type and speed | BDh | Boot Menu |
| 51h | Initialize EISA board | BEh | Clear screen (optional) |
| 52h | Test Keyboard | BFh | Check virus and backup reminders |
| 54h | Set key click if enabled | C0h | Try to boot with INT19 |
| 56h | Enable keyboard | C1h | Initialize PEM |
| 58h | Test for unexpected interrupts | C2h | PEM log |
| 59h | Initialize PDS | C3h | PEM display |
| 5Ah | Display prompt “Press F2 to enter SETUP” | C4h | PEM system error initialization |
| 5Bh | CPU cache off | C5h | Dual CMOS |
| 5Ch | Test RAM between 512 Kb and 640 Kb | C6h | Docking initialization |
| 5Eh | Base address | C7h | Late docking initialization |
| 60h | Test extended memory | D0h | Interrupt handler error |
| 62h | Test extended memory address lines | D2h | Unknown interrupt error |

**Table 6-9: BIOS Error messages (Radisys) (Cont.)**

| Displayed error code | Error message | Displayed error code | Error message |
|---|---|---|---|
| 64h | Jump to User-Patch1 | D4h | Pending interrupt error |
| 66h | Configure advanced cache registers | D6h | Initialize option ROM error |
| 68h | Enable external and CPU caches | D8h | Shutdown error |
| 69h | PM set up SMM | DAh | Extended block move |
| 6Ah | Display external cache size | DCh | Shutdown 10 error |
| 6Bh | Load custom defaults | | |

## BIOS Beep Codes (Bali NLX)

When an error occurs during the power on self test (POST), the BIOS displays an error message describing the problem. The BIOS also issues a beep code (one long tone followed by two short tones) during POST if the video configuration fails (a faulty video card or no card installed) or if an external ROM module does not properly checksum to zero.

An external ROM module (for example, a video BIOS) can also issue audible errors, usually consisting of one long tone followed by a series of short tones. For more information on the beep codes, check the documentation for the device.

There are several POST routines that issue a POST terminal error and shut down the system if they fail. Before shutting down the system, the terminal-error handler issues a beep code (see Table 6-10) signifying the test point error, writes the error to I/O port 80h, attempts to initialize the video, and writes the error in the upper left corner of the screen (using both monochrome and color adapters).

If the POST completes normally, the BIOS issues one short beep before passing control to the operating system.

**Table 6-10: Beep codes (Bali)**

| Beeps | Description |
|---|---|
| 1 | Refresh failure |
| 2 | Parity cannot be reset |
| 3 | First 64 K memory failure |
| 4 | Timer not operational |
| 5 | Processor failure (not used) |
| 6 | 8042 Gate A20 cannot be toggled |
| 7 | Exception interrupt error |

**Table 6-10: Beep codes (Bali) (Cont.)**

| Beeps | Description |
|---|---|
| 8 | Display memory R/W error |
| 9 | ROM checksum error (not used) |
| 10 | CMOS shutdown register test error |
| 11 | Invalid BIOS (for example, POST module not found, etc.) |

## BIOS Beep Codes (Radisys NLX)

When the NLX board powers-on a number of the BIOS checkpoints generate an audible 'beep' code on failure using the standard PC speaker (also routed through the board audio system). The beep codes are made up of up to 4 groups of short beeps and are listed in Table 6–11.

If your instrument does not contain a speaker, attach a speaker to the display-adapter board square pins to hear the codes.

**Table 6-11: Beep codes (Radisys)**

| Check-point code | Error message | Beep code |
|---|---|---|
| 16h | BIOS ROM checksum | 1-2-2-3 |
| 20h | Test DRAM refresh | 1-3-1-1 |
| 22h | Test 8742 keyboard controller | 1-3-1-3 |
| 2Ch | Test 512 Kb base address lines | 1-3-4-1 |
| 2Eh | Test low byte of 512 Kb base memory | 1-3-4-3 |
| 46h | Check ROM copyright notice | 2-1-2-3 |
| 58h | Test for unexpected interrupts | 2-2-3-1 |
| 98h | Search for option ROMs (beep for bad checksum) | 1-2 |
| B4h | One beep before boot | 1 |

## Dip Switch Controls

Dip switches are used to direct program flow during power on self test (POST). A switch set to ON is closed and presents a low state (0 V) to the switch buffer. This is the default switch position. A switch set to OFF is open and presents a high state (3.3 V) to the switch buffer. This is the 'set' position. Table 6–12 describes the switch functions.

**Table 6-12: DIP switch functions**

| Switch | Test option | | |
|---|---|---|---|
| | **Default** | **Set** | **Description** |
| 1 | 1 Meg RAM test | 32 Meg RAM test | POST does not know how much DRAM is installed in the board. |
| 2 | Enable phase 2 POST | Disable phase 2 POST | Use to disable phase 2 of POST. |
| 3 | Do not loop on phase 2 POST | Loop on entire phase 2 POST | This switch is checked at every loop iteration, so it is possible to break out of this loop by moving switch 3 to the default position. You can not loop on a single passing test. |
| 4 | Allow debug output | Suppress debug output | Used by the console. Checked at every write operation. |
| 5 | Loop on failing test | Continue past failing test | If a test fails (except DRAM march test) and switch 6 is set, this switch is checked. You can break out of the loop by moving switch 5 to the set position, removing the fault, or by setting switch 6 to the default position. |
| 6 | Stop on failing test | Continue past failing test | If set and a test fails, the program checks switch 5. If not set, the program will stop on a failure by branching to a loop. To exit the loop, reset the power PC. |
| 7 | Do not cycle application diagnostics | Application diagnostic cycle | If set, the power-on diagnostics cycle, which prevents completion of the boot sequence. |
| 8 | Do not force power-up diagnostics | Forces power-up diagnostics | At power-on this switch is checked, and if set, power-up diagnostics will run. |

## Diagnostic LED

Table 6–13 lists the actions performed at power-up of the power pc (PPC) and the associated display on the diagnostic LED. Until the MPC106 is initialized the LED is not active. RESET forces the display to .8. H, L, P, and a blinking – indicate where the program is in the power-up sequence. As tests occur, the associated number is displayed on the LED. A failing test displays a decimal point and the test number.

**Table 6-13: Diagnostic LED**

| LED | Diagnostic status | | |
|---|---|---|---|
| | **Passed test** | **Testing** | **Test method** |
| .8 | | MPC740 initialization, MPC106 walking one test, or<br><br>MPC106 configuration test | Walk a one through configuration register. Use addresses FEC00000 and FEE00000. A one is walked through the lower data bus.<br>Requests the vendor identifier. Use addresses FEC00000 and FEE00000. Vendor identifier data is presented on the lower data bus. Data 0x0face106 is written to the MPC740 register gpr2 if the correct vendor identifier is returned. If the incorrect identifier is returned, data 0x01bad106 is written to the register. |
| 0 | MPC740 initialization, MPC106 walking one test, or<br><br>MPC106 configuration test | First PCI access test and UART initialize | This is not a pass/fail test, only an attempt to read the PCI bus. Read the configuration space of the SIO. The SIO should return the vendor/device identifier (0x00021057), within MPC740 gpr2 register. No data comparison or fault determination occurs. DIP switches are not checked.<br>Set UART to 9600, n, 8, 1. No testing or fault reporting is performed. Once completed, console is usable. Dip switches are not checked. |
| 1 | First PCI access test and UART initialize | PC87560 walking-one | Walk a one through the configuration register. Walk a one through the AD bus. |
| 2 | PC87560 walking-one | PC87560 configuration | Request vendor/device identifier. Data 0x0face560 is written to MPC740 register gpr6 if correct identifier is returned. If incorrect identifier is returned, data 0x01bad560 is written to MPC740 register gpr6. |
| 3 | PC87560 configuration | DEC21554 configuration | Request vendor/device identifier. Data 0x0face215 is written to MPC740 register gpr6 if correct identifier is returned. If incorrect identifier is returned, data 0x01bad215 is written to MPC740 register gpr6. |
| 4 | DEC21554 configuration | RS232 interface test | Send UUUUUUUU (55hex, 1010101 binary) to console. |
| 5 | RS232 interface test | ROM checksum | Calculate device checksum and compare with checksum in ROM. |
| 6 | ROM checksum | DRAM cell test with cache | Test address lines. Write patterns to address range set by switch 1. From start address (000000000) to end address, write hex pattern aaaaaaaa. Repeat for hex patterns cccccccc and f0f0f0f0. |
| 7 | DRAM cell test with cache | DRAM march test with out cache | DRAM march test. Test data lines. Write to address range set by switch 1. Cache is disabled. |
| 8 | DRAM march test with out cache | DRAM march test with cache | Test data lines. Write to address range set by switch 1. |
| 9 | DRAM march test with cache | DRAM walking one | Test data lines. Walk a one through DRAM memory location. Cache is disabled. Walk a one through buss MEM_DL. |
| A | DRAM walking one | NVRAM walking one | Walk a one through NVRAM memory location. Cache is disabled. Walk a one through bus XPC_ISA_D. |
| H | POST passed | | |

**Table 6-13: Diagnostic LED (Cont.)**

| LED | Diagnostic status | | |
|---|---|---|---|
| | Passed test | Testing | Test method |
| L | | Boot parameters loaded and waiting for host | Program has loaded boot parameters and is waiting to connect to host. |
| P | | Loading files from host | Program has connected to host and is loading instrument files. |
| — | Load process complete | | Files have completed loading. |

## Troubleshooting Using Reset Circuits

The Power PC (PPC) board uses a combination of removable jumpers and surface mount resistors to manipulate circuit reset for troubleshooting.

There are three PCI busses on the PPC board, the NLX primary PCI bus, L2 PCI bus, and the embedded PPC PCI bus. A hardware fault on any of these busses can prevent Windows from starting properly.

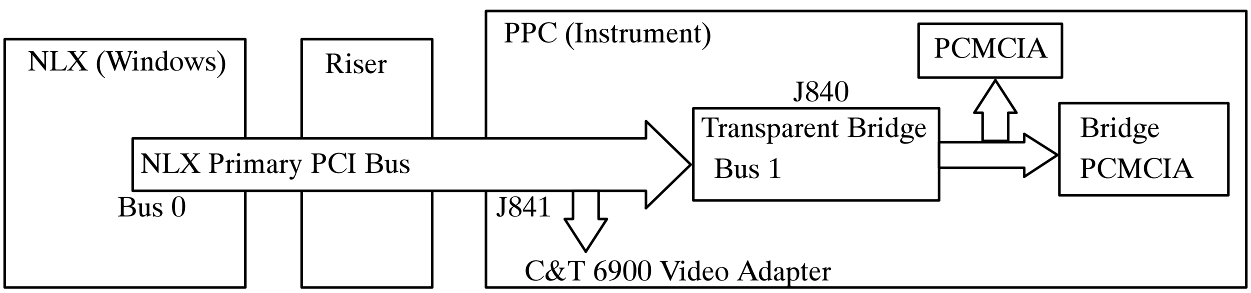


**Figure 6-36: The three PCI busses**

Using jumpers J840 and J841 (see Figure 6–38 on page 6–77) you can selectively remove components from the NLX primary PCI bus. This is useful when Windows will not start. The PPC board components on the NLX primary PCI bus are the DIGITAL 21150 transparent bridge, and the C&T 6900 video adapter.

Installing J840 forces the transparent bridge, all components on the L2 PCI bus, and all components on the PPC PCI bus into reset. If this allows Windows to start, you will need to eliminate the PPC PCI bus. The easiest way to force the PPC PCI bus into reset is to press and hold the PPC reset button, S900. So, remove J840, and holding the reset button, determine if the instrument will boot to Windows.

Installing J841 removes the C&T 6900 from the Windows side. Note, neither the PPC ECB VGA port or the LCD will function if J841 is installed. Use the NLX SVGA port (see Figure 6-37).

**NOTE**. *The C&T 6900 video adapter located on the Tektronix PPC board is the primary video adapter. A second video adapter, the RAGE 2C, is located on the NLX board. The RAGE is an AGP video adapter and the C&T 6900 is a PCI bus video adapter. The C&T 6900 is made the primary video adapter because it can drive LCD panels. Tektronix forces the C&T 6900 to be the primary video adapter via BIOS setting Advance→ Video Configuration→ Primary Video Adapter = PCI.*

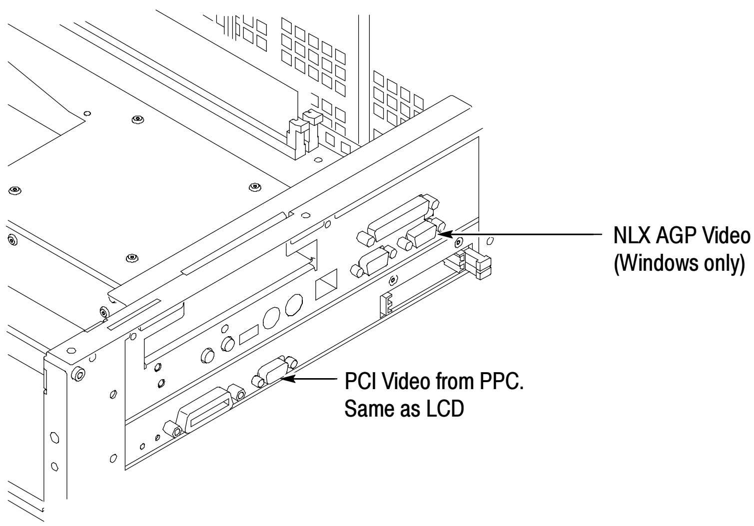


**Figure 6-37: PCI and NLX video connectors**

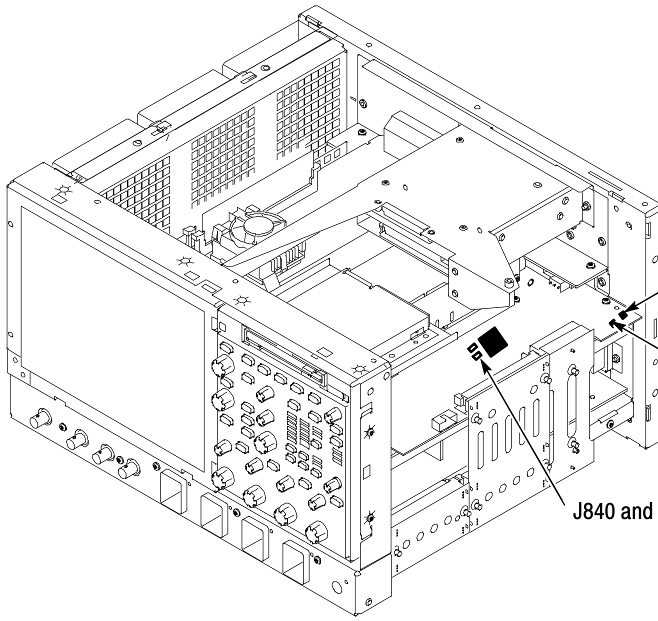


**Figure 6-38: Location of jumpers and reset button**

## Update/Restore the NLX Board CMOS

If the CMOS parameters become corrupted, restore the CMOS memory using the following procedure:

***CAUTION.*** *Only install CMOS parameters from Tektronix. CMOS parameters from other manufactures may make your instrument inoperable.*

1. Edit the autoexec.bat file.
2. Remove comments CMOS restore parameters.
3. Boot the instrument.
4. Edit the autoexec.bat file to recomment the CMOS restore parameters.

If you cannot restore the CMOS memory, replace the battery.

## Installing an Authorization Key

If you replace your PPC board or add a new option, you must install a new authorization key. Install the authorization key using the following procedure:

1. From the instrument menu bar, touch the **Utilities** menu, select **Option Installation**, and then touch **Continue**.
2. Enter the new key using an attached keyboard.
3. Touch **Continue**.

## Hard Disk Drive Maintenance

Use the same procedures to maintain the instrument hard disk drive that you use to maintain a hard disk drive in a personal computer.

Using ScanDisk, attempt to fix the disk without destroying data on the disk. To use ScanDisk, perform the following steps:

1. Remove the hard disk drive from the instrument.
2. Install the hard disk drive into personal computer.
3. Power up the computer and run ScanDisk. Set Scandisk to perform a thorough surface scan and to automatically fix errors.
   - Using Microsoft Windows 98: select Start\Programs\Accessories\System Tools\ScanDisk
   - Using Microsoft MSDOS: enter SCANDISK *drive*: /SURFACE /AUTOFIX
4. If ScanDisk will not repair the disk, format the hard disk drive using the File Utilities Format command. Format will destroy all data currently on the disk.
5. If reformatting the hard disk and reloading the software will not repair the disk, install a new hard disk drive.

# Repackaging Instructions

This section contains the information needed to repackage the instrument for shipment or storage.

## Packaging

When repacking the instrument for shipment, use the original packaging. If the packaging is unavailable or unfit for use, contact your local Tektronix representative to obtain new packaging.

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.

# Options

This section lists the standard and optional accessories available for the instrument, as well as the product options.

## Options

The following options can be ordered for the instrument:

- Option 1K: K4000 Instrument Cart
- Option 1R: Rack Mount Kit (includes: hardware and instructions for converting to rackmount configuration)
- Option 1M: Long record length: 500 ksamples per channel, 2 Msamples maximum
- Option 2M: Long record length: 2 Msamples per channel, 8 Msamples maximum
- Option 3M: Long record length: 4 Msamples per channel, 16 Msamples maximum
- Option 4M: Long record length: 8 Msamples per channel, 32 Msamples maximum
- Option 37: Add one P6245, 1 GHz Active Probe (CSA7154 only)
- Option 39: Add one P6248, 1.7 GHz Differential Probe (CSA7154 only)
- Option 51: Add one P7240, 4 GHz, active probe (CSA7404 only)
- Option 52: Add one P7330, 3 GHz, differential probe (CSA7404 only)
- International Power Cords Options:
  - Option A1 – Universal European 230 V, 50 Hz
  - Option A2 – United Kingdom 230 V, 50 Hz
  - Option A3 – Australian 230 V, 50 Hz
  - Option A5 – Switzerland 230 V, 50 Hz
  - Option AC – China 230 V, 50 Hz
  - Option A99 – No power cord
- Option J1: TDSJIT2 Jitter Analysis application

- Option J2: TDSDDM2 Disk Drive Measurements application
- Option JT3: TDSJIT3 Advanced Jitter Analysis application with random and deterministic jitter analysis
- Option CP2: TDSCPM2 Compliance Testing for ITU-T G.703 and ANSI T1.102 communications standards (Requires Option SM)
- Option USB: USB2 Compliance Testing Software for USB1.0/USB2.0 standards (requires TDSUSBF USB test fixture)
- Option CSA7UP: Field upgrade options. Many are available. Contact Tektronix (see page xvii) for a complete list of available options
- Service offerings:
  - Opt. C3: Calibration services extended to cover three years
  - Opt. C5: Calibration services extended to cover five years
  - Opt. D1: Calibration data report
  - Opt. D3: Test Data for calibration services in Opt. C3
  - Opt. D5: Test Data for calibration services in Opt. C5
  - Opt. R3: Repair warranty extended to cover three years
  - Opt. R5: Repair warranty extended to cover five years

## Accessories

This section lists the standard and optional accessories available for this instrument.

### Standard

The following accessories are shipped with the instrument:

**Table 7-1: Standard accessories**

| Accessory | Part number |
|---|---|
| Graphical Packing List | 071-1045-xx |
| User Manual | 071-7010-xx |
| Reference Kit | 020-2404-xx |
| Product Software CD | 063-3461-xx |
| Operating System Restore CD | 020-2437-xx |
| Optional Applications Software CD and Documentation Kit | 020-2450-xx |

**Table 7-1: Standard accessories (Cont.)**

| Accessory | Part number |
|---|---|
| Oscilloscope Analysis and Connectivity Made Easy Kit | 020-2449-xx |
| Option SM and ST User Manual | 071-1035-xx |
| Online Help (part of the application software) | —— |
| Performance Verification (a pdf file on the Product Software CD) | —— |
| Programmer Online Guide (files on the Product Software CD) | —— |
| NIST, Z540-1, and ISO9000 Calibration Certificate | —— |
| Four TekConnect-to-SMA adapters, CSA7404 | TCA-SMA |
| Four TekConnect-to-BNC adapters, CSA7154 | TCA-BNC |
| Adapters:<br>O/E Electrical Out-to-CH1 Input adapter (013-0327-xx)<br>O/E-to-SMA adapter (013-0326-xx) | 020-2423-xx |
| U.S. Power Cord | 161-0104-00 |
| Mouse | 119-6298-xx |
| Front Cover | 200-4653-xx |
| Accessory Pouch | 016-1441-xx |
| Probe Calibration and Deskew Fixture, with instructions and BNC cable | 067-0405-xx |
| Fiber cleaning kit | 020-2357-xx |
| FC/PC UCI adapter, installed | 119-4516-xx |

## Optional

The accessories in Table 7-2 are orderable for use with the instrument at the time this manual was originally published. Consult a current Tektronix catalog for additions, changes, and details.

**Table 7-2: Optional accessories**

| Accessory | Part number |
|---|---|
| Service Manual | 071-7011-xx |
| Transit Case | 016-1522-xx |
| Scope Cart | K4000 (Option 1K) |
| P6158 20x 1 kΩ low capacitance voltage divider probe[1] | P6158 |
| P6245 1.5 GHz high speed active probe[1] | P6245 |
| P6248 1.5 GHz differential probe[1] | P6248 |

**Table 7-2: Optional accessories (Cont.)**

| Accessory | Part number |
|---|---|
| P7240 4 GHz active probe | P7240 |
| P7260 6 GHz 5X/25X active probe | P7260 |
| P7330 differential 3.5 GHz probe | P7330 |
| CT6 high frequency current probe[1] | CT6 |
| AM503S DC/AC current measurement system[1] | AM503S |
| P6150 9 GHz/3 GHz low capacitance divider probe[1] | P6150 |
| P6701B optical/electrical converter (500 to 950 nm)[1] | P6701A/B |
| P6703B optical/electrical converter (1100 to 1650 nm)[1] | P6703A/B |
| AFTDS Telecomm differential electrical interface adapter (for line rates <8 Mb/s; requires TCA-BNC adapter) | AFTDS |
| TDSUSBF USB test fixture; used with Option USB | TDSUBF |
| AMT75 1 GHz 75-ohm adapter[1] | AMT75 |
| One turn current loop probe calibration adapter | 015-0601-50 |
| TekConnect-to-SMA adapter | TCA-SMA |
| TekConnect-to-BNC adapter | TCA-BNC |
| TekConnect-to-N adapter | TCA-N |
| TekConnect high impedance buffer amplifier, 500 MHz 1 MΩ BNC-to-TekConnect adapter (includes one P6139A probe) | TCA-1MEG |
| VocalLink Pro Voice Controlled Software | VCLNKP |
| VocalLink Basic Voice Controlled Software | VCLNKB |
| Wavewriter: AWG and waveform creation software | S3FT400 |
| WSTRO WaveStar Software | WSTRO |
| GPIB cable (1 m) | 012-0991-01 |
| GPIB cable (2 m) | 012-0991-00 |
| RS-232 cable | 012-1298-xx |
| PS-2 keyboard | 118-9402-00 |
| USB Keyboard | 119-6633-xx |
| Centronics cable | 012-1214-xx |
| Replacement hard disk | 650-4271-xx |

**Table 7-2: Optional accessories (Cont.)**

| Accessory | Part number |
|---|---|
| Optical Connector Adapters | |
| FC/PC | 119-5115-00 |
| SC/PC | 119-5116-00 |
| ST/PC | 119-4513-00 |
| DIN/PC 47256 | 119-4546-00 |
| Diamond 2.5 | 119-4556-00 |
| Diamond 3.5 | 119-4558-00 |
| SMA 2.5 | 119-4517-00 |
| SMA | 119-4557-00 |
| Dust cap, optical | 200-4104-00 |

[1] Requires TCA-BNC TekConnect BNC adapter

**NOTE**. *The P6339A probe is not supported by this instrument.*

# Electrical Parts List

The modules that make up this instrument are often a combination of mechanical and electrical subparts. Therefore, all replaceable modules are listed in Section 10, *Mechanical Parts List.* Refer to that section for part numbers when using this manual.

# Diagrams

This section describes the electrical operation of the CSA7000 Communications Signal Analyzer and modules using the major circuit blocks or modules. Figure 9-1 on page 9-2 shows the instrument module interconnections.

## 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

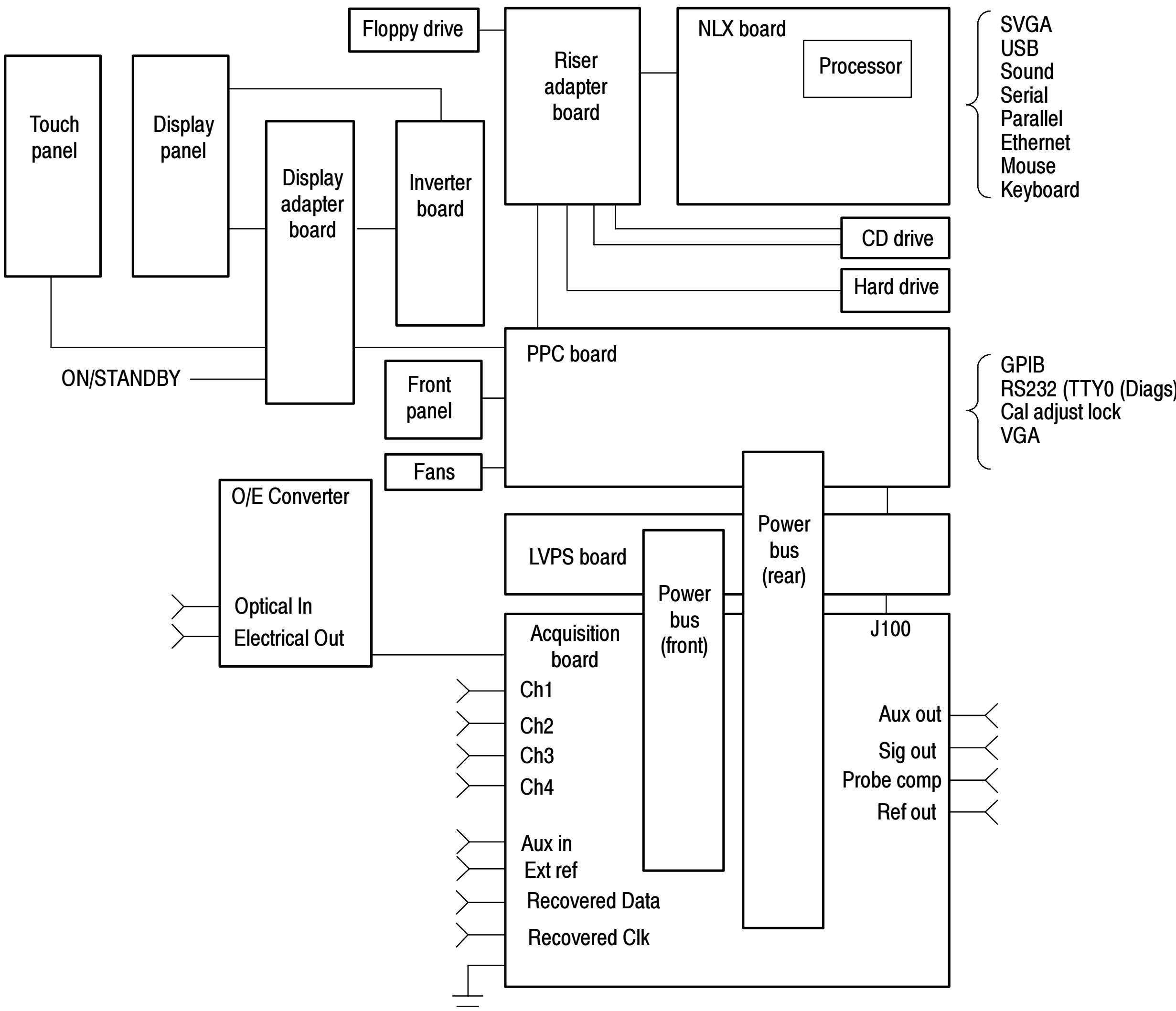


**Figure 9-1: CSA7000 series block diagram**

# Mechanical Parts List

This section 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 1-800-833-9200, select option 2.

**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.

**Manufacturers cross index**

| Mfr. code | Manufacturer | Address | City, state, zip code |
|---|---|---|---|
| 00779 | TYCO ELECTRONICS CORPORATION | CUSTOMER SERVICE DEPT<br>PO BOX 3608 | HARRISBURG, PA 17105-3608 |
| 049S6 | FUJITSU COMPUTER PRODUCTS OF AMERICA INC | 2904 ORCHARD PARKWAY | SAN JOSE, CA 95134-2009 |
| 05791 | LYN-TRON, INC | 6001 S THOMAS MALLEN RD | SPOKANE, WA 99224-9406 |
| 060D9 | TENSOLITE COMPANY | PRECISION HARNESS AND ASSEMBLY<br>3000 COLUMBIA HOUSE BLVD #120 | VANCOUVER, WA 98661 |
| 06915 | RICHCO | 5825 N TRIPP AVE<br>P.O. BOX 804238 | CHICAGO, IL 60646 |
| 09922 | FCI USA INC | 825 OLD TRAIL ROAD | ETTERS, PA 17319-9769 |
| 0B0A9 | DALLAS SEMICONDUCTOR | 4350 BELTWOOD PKWY S | DALLAS, TX 75244 |
| 0J9P9 | GEROME MFG CO INC | PO BOX 737<br>403 NORTH MAIN | NEWBERG, OR 97132 |

## Manufacturers cross index (cont.)

| Mfr. code | Manufacturer | Address | City, state, zip code |
|---|---|---|---|
| 0JR05 | TRIQUEST-PUGET PLASTICS LLC | 3000 COLUMBIA HOUSE BLVD<br>SUITE 101 | VANCOUVER, WA 98661 |
| 0KB01 | STAUFFER SUPPLY CO | 810 SE SHERMAN | PORTLAND, OR 97214-4657 |
| 0KB05 | NORTH STAR NAMEPLATE INC | LABEL PRODUCTS<br>5750 NE MOORE COURT | HILLSBORO, OR 97124-6474 |
| 0KBZ5 | Q & D PLASTICS INC | 1812 - 16TH AVENUE<br>PO BOX 487 | FOREST GROVE, OR 97116-0487 |
| 0L0L7 | RADISYS CORPORATION | 5445 NE DAWSON CREEK DRIVE | HILLSBORO, OR 97124 |
| 12136 | PHC INDUSTRIES INC | 1643 HADDON AVE | CAMDEN, NJ 08103 |
| 1DM20 | PARLEX CORP | 7 INDUSTRIAL WAY | SALEM, NH 03079 |
| 22670 | GM NAMEPLATE INCORPORATED | 2040 15TH AVE WEST | SEATTLE, WA 98119-2783 |
| 24931 | FCI USA INC | RF/COAXIAL DIV<br>2100 EARLYWOOD DR<br>PO BOX 547 | FRANKLIN, IN 46131 |
| 26003 | MARTEK POWER MDI | 4115 SPENCER STREET | TORRANCE, CA 90503-2489 |
| 2K262 | BOYD CORPORATION | 6136 NE 87TH AVENUE | PORTLAND, OR 97220 |
| 34649 | INTEL CORPORATION | 3065 BOWERS<br>PO BOX 58130 | SANTA CLARA, CA 95051-8130 |
| 46628 | LOGITECH INC | 6505 KAISER DR | FREMONT, CA 94555 |
| 50356 | TEAC AMERICA INC | 7733 TELEGRAPH RD<br>PO BOX 750 | MONTEBELLO, CA 90640-6537 |
| 52833 | KEY TRONIC CORPORATION | N 4424 SULLIVAN RD<br>PO BOX 14687 | SPOKANE, WA 99214-0687 |
| 57924 | BOURNS INC | INTEGRATED TECHNOLOGY DIV.<br>1400 NORTH 1000 WEST | LOGAN, UT 84321 |
| 5Y400 | TRIAX METAL PRODUCTS INC | 1880 SW MERLO DRIVE | BEAVERTON, OR 97006 |
| 61058 | PANASONIC INDUSTRIAL CO ECG | M/S 7H-4<br>TWO PANASONIC WAY | SECAUCUS, NJ 07094 |
| 61935 | SCHURTER INC | 1016 CLEGG CT<br>PO BOX 750158 | PETALUMA, CA 94975-0158 |
| 71400 | BUSSMANN | DIVISION COOPER INDUSTRIES INC<br>PO BOX 14460 | ST LOUIS, MO 63178 |
| 75915 | LITTELFUSE INC | 800 E NORTHWEST HWY | DES PLAINES, IL 60016-3049 |
| 76096 | ELMA ELECTRONICS INC | 41440 CHRISTY ST | FREMONT, CA 94538 |
| 78189 | SHAKEPROOF | DIVISION OF ILLINOIS TOOL WORK<br>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<br>PO BOX 500 | BEAVERTON, OR 97077-0001 |
| 9F560 | IBM CORPORATION | 420 E SOUTH TEMPLE ST | SALT LAKE CITY, UT 84145 |
| S3109 | FELLER U.S. CORPORATION | 68 VERONICA AVE, UNIT #5 | SOMERSET, NJ 08873 |
| S4091 | SANYO DENKI | C/O TJBO LIAISON<br>M/S 78-210 | BEAVERTON, OR 97077-7077 |

## Manufacturers cross index (cont.)

| Mfr. code | Manufacturer | Address | City, state, zip code |
|---|---|---|---|
| TK0588 | UNIVERSAL PRECISION PRODUCT | 1775 NW CORNELIUS PASS RD | HILLSBORO, OR 97124 |
| TK0JL | CHROMA ATE INC | 43 WU-CHUAN ROAD<br>WU-KU INDUSTRIAL PARK | WU-KU, TAIPEI HSIEN, TAIWAN CN |
| TK1373 | PATELEC-CEM | 10156 TORINO<br>VAICENTALLO<br>62/456 | ITALY, |
| TK1943 | NEILSEN MANUFACTURING INC | 3501 PORTLAND RD NE | SALEM, OR 97303 |
| TK2250 | ARROW ELECTRONICS INC. | 9500 SW NIMBUS AVE, BLDG E | BEAVERTON, OR 97008-7163 |
| TK2338 | ACC MATERIALS | ED SNYDER<br>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 |
| TK2541 | AMERICOR ELECTRONICS LTD | UNIT-H<br>2682 W COYLE AVE | ELK GROVE VILLAGE, IL 60007 |
| TK2548 | XEROX CORPORATION | 14181 SW MILLIKAN WAY | BEAVERTON, OR 97005 |
| TK2565 | VISION PLASTICS INC | 26000 SW PARKWAY CENTER DRIVE | WILSONVILLE, OR 97070 |
| TK2582 | TUFF CAT USA LLC | 814 N HAYDEN MEADOWS DRIVE | PORTLAND, OR 97217 |
| TK6253 | VOLEX INC | 646 CARRIBEAN DR | SUNNYVALE, CA 94089-1108 |

## 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 | ACCESSORY POUCH:BLACK CORDURA | TK2582 | TK1441 BLACK CORDURA |
| -2 | 211-1050-00 | | | 12 | SCREW,MACHINE:6-32 X 0.312 L,PNH,STL CAD PLT,T15 | 0KB01 | 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,THERMO PLASTIC | 7X318 | 348-1648-00 |
| -5 | 211-0720-00 | | | 4 | SCR,ASSEM WSHR:6-32 X 0.500,PNH,STL,CDPL,T-15 TORX | 0KB01 | ORDER BY DESCRIPTION |
| -6 | 161-0104-00 | | | 1 | CABLE ASSEMBLY:3,18 AWG,98 L (STANDARD ACCESSORY) | S3109 | ORDER BY DESCRIPTION |
| -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 | 61935 | FEK 031 1666 |
| | 200-2265-00 | | | 2 | CAP,FUSEHOLDER:5 X 20MM FUSES | 61935 | 031.1663 |
| -9 | 200-4522-00 | | | 1 | COVER,RIGHT:PC ABS,13.645L X 8.250W,TEK BLUE, | 7X318 | 2TEK1633 |
| -10 | 212-0232-00 | | | 2 | SCREW,MACHINE:8-32 X 1.125L, PNH,STL,BLACK OXIDE,T-20 | 0KB01 | OBD |
| -11 | 367-0477-00 | B010100 | B029999 | 1 | HANDLE,CARRYING:POLYPROPYLENE VINYL GRIP | 12136 | PT 3170 |
| -12 | 367-0528-00 | B010100 | | 1 | HANDLE,CARRYING:DUAL DUROMETER MOLDED,POLYPROPYLENE,VINYL GRIP SECTION, | 12136 | 367-0528-00 |
| -13 | 407-4887-00 | B010100 | | 1 | BRACKET:HANDLE BASE,PC/ABS ALLOY,BAYER BAYBLEND FR-110,TEK BLUE, | TK2565 | 407-4887-00 |
| -14 | 200-4699-00 | | | 1 | COVER,BOTTOM:RIGHT | TK1943 | 200-4699-00 |
| -15 | 200-4698-00 | | | 1 | COVER ASSEM:BOTTOM,W/FEET,0.040 AL,VINYL CLAD (ITEMS 13 & 14) | 0J9P9 | 200-4698-00 |
| -16 | 348-1515-00 | | | 1 | FEET,CABINET:CABINET FEET,BLACK,GLASS-FIBRE REINFORCED PLASTIC,SET OF 4 FEET,W/SCREWS | 76096 | 63-526 |
| -17 | 101-0159-00 | | | 1 | TRIM,INPUT:PLASTIC,BLACK,ABS | 7X318 | 101-0159-00 |
| -18 | 200-4653-00 | | | 1 | COVER,FRONT:PROTECTIVE | 7X318 | 200-4653-00 |
| -19 | 335-0545-00 | | | 1 | MARKER,IDENT:INTERCONNECT OVERLAY,W/ADHESIVE | 0KB05 | 335-0545-00 |
| -20 | 101-0151-01 | | | 1 | TRIM,FRONT:PC ABS,17.200W X 8.450H,TEK SILVER GRAY | 7X318 | 2TEK1648 |
| -21 | 260-2719-00 | | | 1 | SWITCH,KEYPAD:ELASTOMERIC MAT,POWER BUTTON | TK2376 | 260-2719-00 |
| -22 | 335-0544-00 | | | 1 | MARKER,IDENT:FRONT LABEL,MKD CSA7404 | 0KB05 | 335-0544-00 |
| | 335-0670-00 | | | 1 | MARKER,IDENT:FRONT LABEL,MKD CSA7154 | 0KB05 | 335-0670-00 |
| -23 | 200-4510-01 | | | 1 | COVER:TOP,LEFT,0.050 AL, | TK1943 | 200-4510-01 |
| -24 | 200-4521-00 | | | 1 | COVER,LEFT:PC ABS,13.654L X 8.250W,TEK BLUE, | 7X318 | 2TEK1632 |
| -25 | 200-4520-00 | | | 1 | COVER,TOP:PC ABS,17.200L X 13.550W,TEK BLUE, | 7X318 | 2TEK1637 |

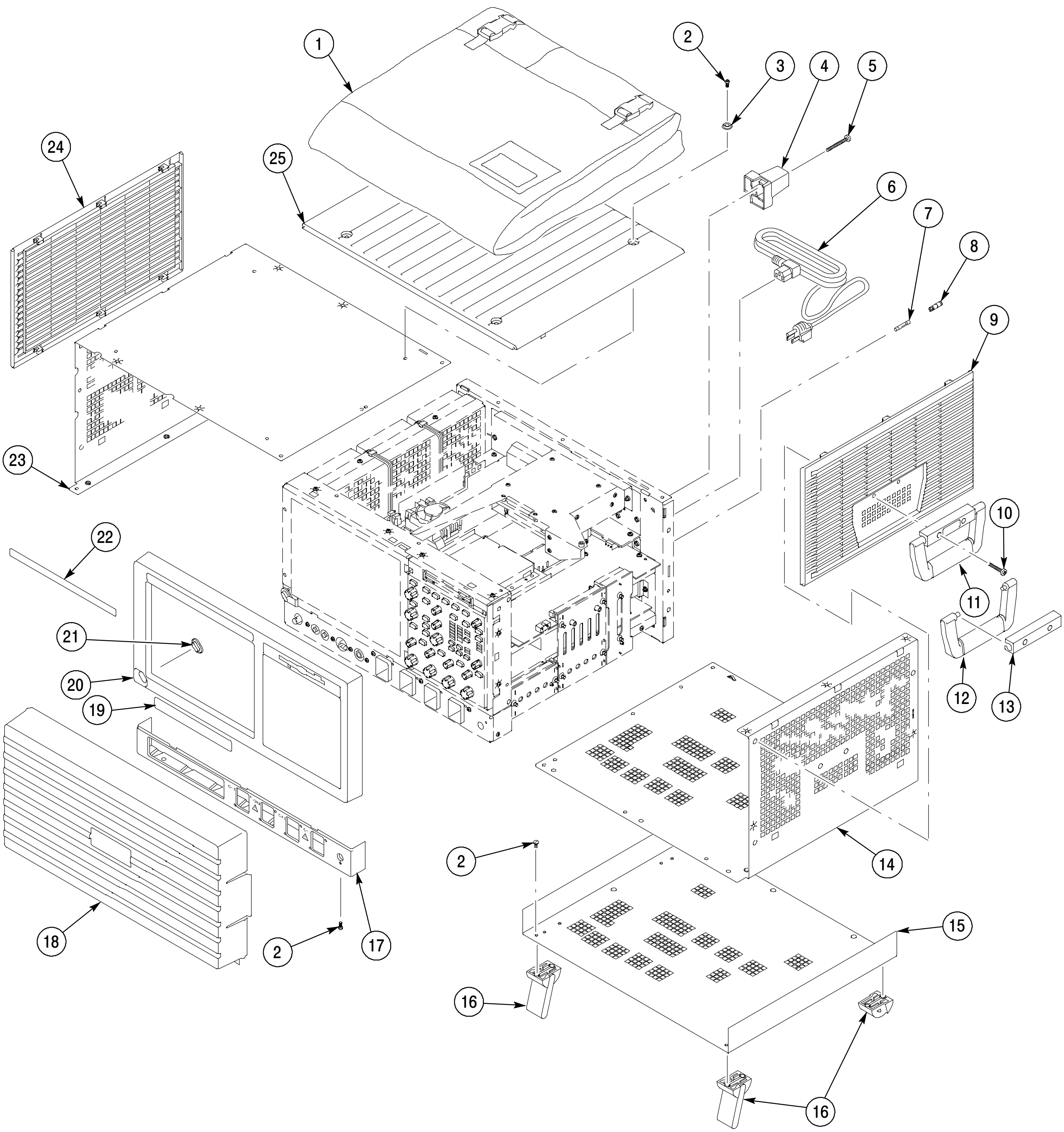


**Figure 10-1: External parts**

## 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 PLT,T15 | 0KB01 | OBD |
| -2 | 650-4271-00 | | | 1 | ASSEM:RHDD,W/O SW (ITEMS 3 THROUGH 7) | 80009 | 650-4271-00 |
| -3 | 119-6733-00 | | | 1 | DISK DRIVE:WINCHESTER,2.5 IN,20.0GB,SINGLE PLATTER | 9F560 | 07N8325 |
| -4 | 437-0494-00 | | | 1 | CABINET ASSY:PLASTIC,RHDD HOLDER | 7X318 | 437-0494-00 |
| -5 | 211-1081-00 | | | 4 | SCREW,MACHINE:M3 X 0.5 X 3.5MM, | 0KB01 | 211-1081-00 |
| -6 | 174-3925-00 | | | 1 | CA ASSY,SP:RIBBON,44,28 AWG,1MM,1.0 L,2 X 22 | 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 | CABLE ASSY:FLAT FLEX,26 POS, 9.753L,FLOPPY & FNT PNL | 060D9 | 174-4320-00 |
| -9 | Not Replaceable[1] | | | 1 | CIRCUIT BD ASSY:PROCESSOR | 80009 | 671-4659-02 |
| -10 | 407-4706-00 | | | 1 | BRACKET:FLOPPY DRIVE,6.064 X 5.075,AL | TK1943 | 407-4706-00 |
| -11 | 211-1079-00 | | | 2 | SCREW,MACHINE:2.6 X 0.45 MM,3.0L,PNH,STL,PHILLIPS | 0KB01 | 10310188-0 |
| -12 | 119-6106-00 | | | 1 | DISK DRIVE:FLOPPY,3.5INCH,1.44 MB,0.5 IN,DDDS | TK2250 | FD-05HF5630 |
| -13 | 679-4840-00 | | | 1 | CKT BD SUBASSY:PRODUCTION PA BUS | 80009 | 679-4840-00 |
| -14 | 679-4477-00 | | | 1 | CKT BD SUBASSY:REAR POWER DISTRIBUTION | 80009 | 679-4477-00 |
| -15 | 361-1762-00 | | | 1 | SPACER,SUPPORT:0.250 X 0.171 X 0.375,CKT BD,NYLON | 06915 | CPST-4-01 |
| -16 | 679-4476-00 | | | 1 | CKT BD SUBASSY:FRONT POWER DISTRIBUTION | 80009 | 679-4476-00 |
| -17 | 614-1013-00 | | | 1 | PANEL ASSEMBLY:FRONT (ITEMS 18 THROUGH 23) | 80009 | 614-1013-00 |
| -18 | 679-5366-00 | | | 1 | CKT BD SUBASSY:FRONT PANEL | 57924 | 679-5366-00 |
| -19 | 260-2762-00 | | | 1 | SWITCH,KEYPAD:ELASTOMERIC,FRONT PANEL | | 260-2762-00 |
| -20 | 366-0821-00 | | | 7 | KNOB,CAP:0.650 D,SILVER GRAY | 22670 | 366-0821-00 |
| -21 | 366-0819-00 | | | 1 | KNOB,EPS:PUSH BUTTON,SILVER GRAY | 22670 | 366-0819-00 |
| -22 | 366-0820-00 | | | 7 | KNOB,CAP:SILVER GRAY | 22670 | 366-0820-00 |
| -23 | 333-4420-00 | | | 1 | SUBPANEL ASSY:OFFSET,BRACKET ASSY,W/LABEL | 7X318 | 333-4420-00 |
| -24 | 650-4186-01 | | | 1 | MODULE ASSEMBLY:TOUCH PANEL | 80009 | 650-4186-01 |
| -25 | 259-0155-01 | | | 1 | FLEX CIRCUIT:POWER SWITCH,W/LED | 22670 | 259-0155-01 |
| -26 | 650-4189-01 | | | 1 | MODULE ASSY:LCD (INCLUDES ITEMS 27 THROUGH 29) | 80009 | 650-4189-01 |
| -27 | 174-4189-00 | | | 1 | CABLE ASSEMBLY:FLAT FLEX,DISPLAY ADAPTER | 1DM20 | 174-4189-00 |
| -28 | 679-5244-00 | | | 1 | CKT BD:DISPLAY ADAPTER | 80009 | 679-5244-00 |
| -29 | 174-3618-00 | | | 1 | CABLE ASSY SP:RIBBON,CPR,28 AWG,9.5 L,1X5,0.049CTR | 060D9 | OBD |
| -30 | 343-1676-00 | | | 1 | CONN,RCPT,ELEC:MATES W/(8) 36 CONT | 80009 | 343-1676-00 |
| -31 | 437-0486-01 | | | 1 | FAN ASSEMBLY:6 FANS | TK0JL | 437-0486-01 |
| -32 | 174-4188-00 | | | 1 | CA ASSY:RIBBON,DISPLAY PROCESSOR | 060D9 | 174-4188-00 |
| -33 | 159-5017-00 | | | 1 | FUSE:7.0A,125V,FAST BLOW,FUSE IN HOLDER,0.383L X 0.198W X 0.15H,16MM T&R, | 75915 | 154 007 |
| -34 | 679-4379-00 | | | 1 | CKT BD SUBASSY:CONNECTOR CONVERSION | 80009 | 679-4379-00 |
| -35 | 174-4321-00 | | | 1 | CABLE ASSY:FLAT FLEX,26POS,HARD DRIVE | 060D9 | 174-4321-00 |

1 **Replacement of this part must be performed by Tektronix**

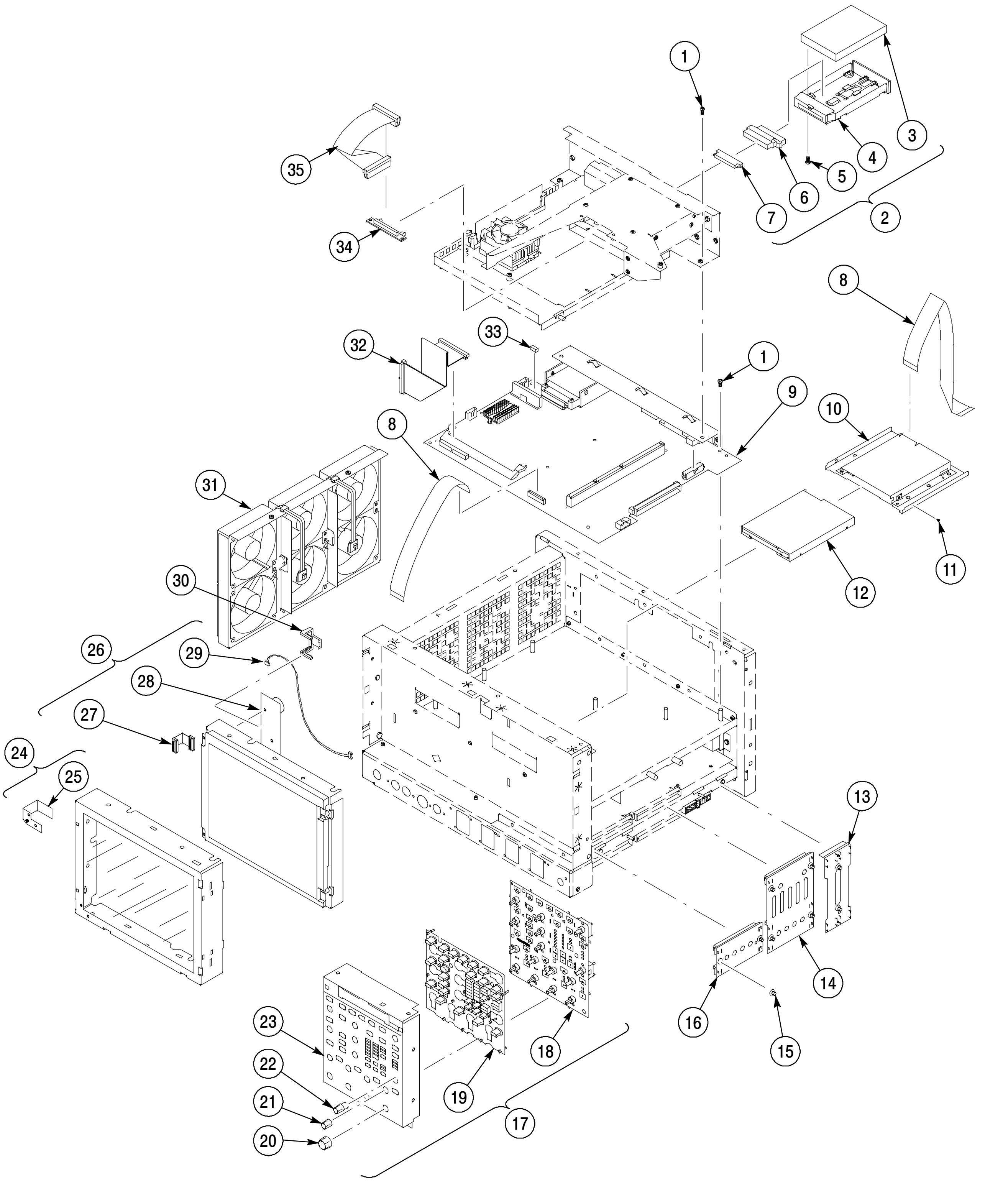


**Figure 10-2: Front panel and drives**

## 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,SOCKET 370 COMPATIB | 34649 | BX80526F566128 |
| -1A | 119-6459-00 | | | 1 | FAN,CHIP COOLER:12VDC,90MA,4800RPM,35DBA,64MM X 51MM X 45MM,W/HEATSINK & CLIP FOR CELERON | S4091 | 109X6512A1116 |
| -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 | 146-0096-00 | | | 1 | BATTERY,DRY:3.0V,LITHIUM MANGANESE DIOXIDE,210MAH,20 X 3.2MM COINCELL,CR2032 | 61058 | CR2032 |
| -4 | 039-0117-00 | | | 1 | NLX BOARD:RADISYS,W/OUT PROCESSOR & MEMORY | 0L0L7 | 039-0117-00 |
| -5 | 211-1050-00 | | | 8 | SCREW,MACHINE:6-32 X 0.312 L,PNH,STL CAD PLT,T15 | 0KB01 | OBD |
| -6 | 679-4667-00 | | | 1 | CKT BD SUBASSY:RISER | 80009 | 679-4667-00 |
| -7 | 211-1050-00 | | | 4 | SCREW,MACHINE:6-32 X 0.312 L,PNH,STL CAD PLT,T15 | 0KB01 | OBD |
| -8 | 213-1061-00 | | | 2 | JACKSCREW:6-32 X 0.320 EXT THD,M3.5 X 0.6-6 INT THD X 0.215L,GPIB,BLACK | 00779 | 554043-3 |
| -9 | 386-7147-00 | | | 1 | PANEL,I/O:POWER PC PROCESSOR,AL, | TK1943 | 386-7147-00 |
| -10 | 131-6680-00 | | | 1 | CONN HDR:SMD,MALE,RTANG,2 X 34 | 09922 | 61555-200CA |
| -11 | 211-0887-00 | | | 4 | SCREW,METRIC:M2 X 0.4 X 16 MM L,PH,PHILLIPS DRIVE | 0KB01 | 211-0887-00 |
| -12 | 131-1315-01 | | | 2 | CONN,RF JACK:BNC,PNL,50 OHM,FEMALE,STR,PELTOLA PNL MNT,SILVER ALLOY,0.576 MLG X 0.366 TERMN | 24931 | 28JR306-1 |
| -13 | 441-2271-00 | | | 1 | CHASSIS ASSY:MAIN | TK1943 | 441-2271-00 |
| -14 | 119-5806-05 | | | 1 | POWER SUPPLY:CUSTOM,AC-DC,375W,85-275VAC | 26003 | 119-5806-05 |
| -15 | 210-0465-00 | | | 1 | NUT,PLAIN,HEX:0.25-32 X 0.375,BRS CD PL | 0KB01 | ORDER BY DESCRIPTION |
| -16 | 210-0046-00 | | | 1 | WASHER,LOCK:0.261 ID,INTL,0.018 THK,STL CD PL | 78189 | 1214-05-00-0541C |
| -17 | 136-0140-00 | | | 1 | JACK,TIP:BANANA,CHARCOAL GRAY | 0KBZ5 | N/A |
| -18 | 146-0124-00 | | | 1 | BATTERY:3V,130MAHR,POWER CAP FOR DALLAS DS1245YP-XXX NVRAM,HDTV-7000, | 0B0A9 | DS9034PC |
| -19 | 156-9074-00 | | | 3 | IC,MEMORY:CMOS,DRAM,32MEG X 64, 256MEG, SDRAM, PC100, MT16LSDT3264AG-10E,DIMM168 | | MT16LSDT3264AG-10E |
| -20 | 441-2183-02 | | | 1 | CHASSIS ASSY:REAR DRIVE BAY,0.050 AL | TK1943 | 441-2183-02 |
| -21 | 407-4880-01 | | | 1 | BRACKET:CD-ROM,REAR DRIVE BAY CHASSIS,0.035 CRS | TK1943 | 407-4880-01 |
| -22 | 174-4231-00 | | | 1 | CABLE ASSY (HARD DRIVE & CD-ROM) | 060D9 | 174-4231-00 |
| -23 | 671-4377-00 | | | 1 | CIRCUIT BD ASSY:CD ROM INTERFACE | 80009 | 671-4377-00 |
| -24 | 119-6691-00 | | | 1 | DISK DRIVE:644MEG,CD-RW,16.6 MB/SEC,IDE/ATAPI | 50356 | CD-W28E-93 |
| -25 | 211-1070-00 | | | 4 | SCREW:M2 X 2MM,PNH,PHL, STL NI PLT | 0KB01 | 211-1070-00 |
| -26 | 441-2279-00 | | | 1 | CHASSIS:NLX,FINISHED,AL, | TK1943 | 441-2279-00 |
| -27 | 211-0720-00 | | | 5 | SCR,ASSEM WSHR:6-32 X 0.500,PNH,STL,CDPL,T-15 | 0KB01 | ORDER BY DESCRIPTION |

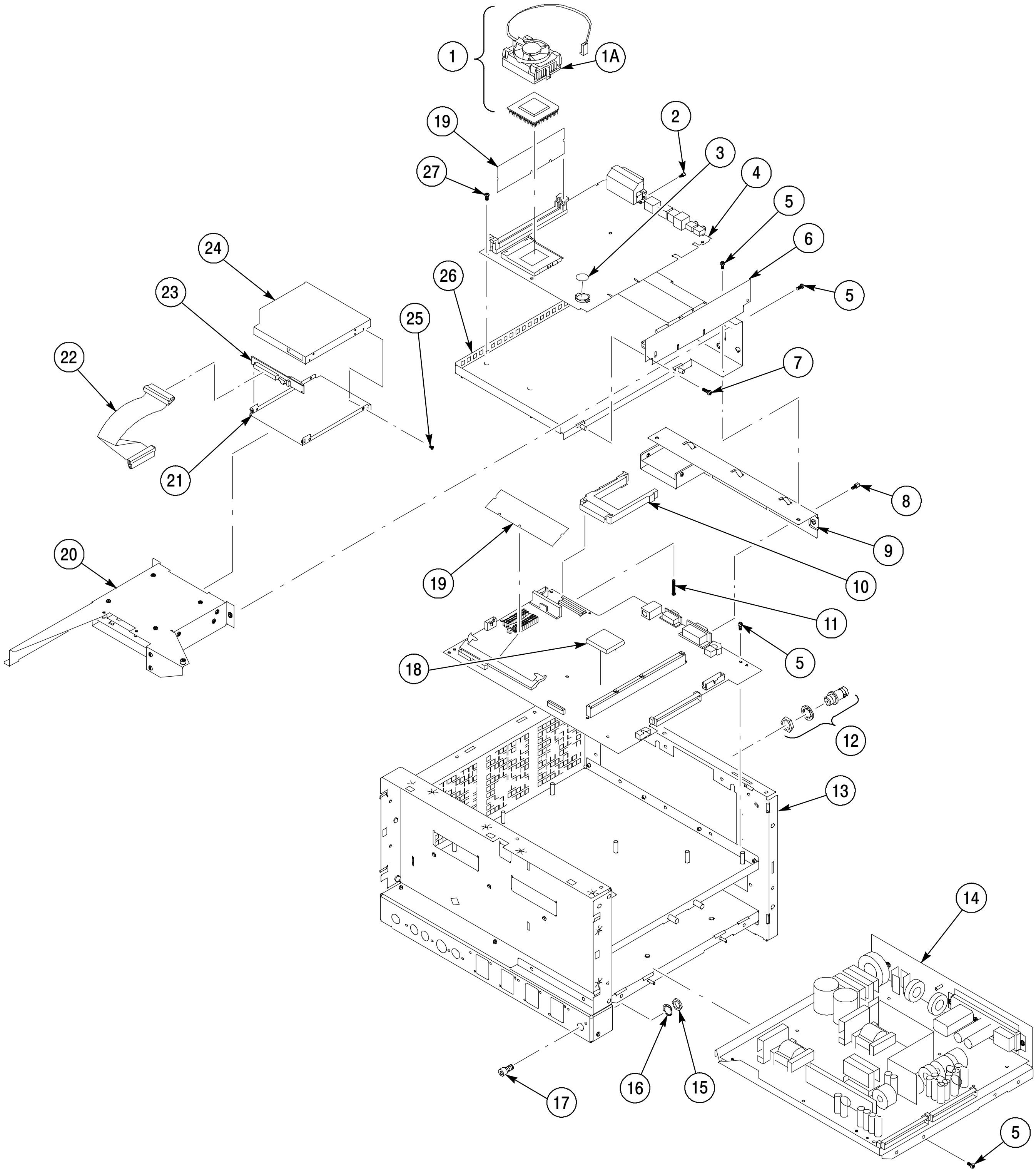


**Figure 10-3: Power supply**

## 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 | Not Replaceable[1] | | | 1 | CIRCUIT BD ASSY:ACQUISITION & PROBE INTERFACE,CSA7404 | 80009 | 672-1695-50 |
| | Not Replaceable[1] | | | 1 | CIRCUIT BD ASSY:ACQUISITION & PROBE INTERFACE,CSA7154 | 80009 | 672-1668-51 |
| -2 | 174-4502-00 | | | 1 | CABLE ASSY:RIBBON 24 PIN,POGO TO ACQ BD | | 174-4502-00 |
| -3 | 174-0206-00 | | | 2 | CABLE ASSY,RF:50 OHM COAX,11.25 L,PELTOLA X PELTOLA,(210-0800-00),RFP | 060D9 | ORDER BY DESCRIPTION |
| -4 | 174-2031-00 | | | 3 | CABLE ASSY:COAX,RFP,50 OHM,6.5L,PELTOLA BOTH ENDS,210-0775-00 & 210-0800-00 | TK2338 | 174-2031-00 |
| -5 | 174-4634-00 | | | 1 | CA ASSY, SP:RIBBON,IDC,8,26 AWG,3.5 L,DUAL ENDED,FEMALE,STR,1X8,0.100 CTR,30 GOLD | 060D9 | 174-4634-00 |
| -6 | 348-1719-00 | | | 1 | GASKET,SHIELD:5.250 X 1.0,URETHANE FOAM,W/ACRYLIC ADHESIVE,ECCOSORB LS26/SS-3 | 2K262 | 348-1719-00 |
| -7 | 131-1315-01 | | | 4 | CONN,RF JACK:BNC,PNL,50 OHM,FEMALE,STR,PELTOLA PNL MNT,SILVER ALLOY,0.576 MLG X 0.366 TERMN | 24931 | 28JR306-1 |
| -8 | 426-2609-00 | | | 4 | RECEPTACLE:PROBE ASSEMBLY | 0JR05 | 426-2609-00 |
| -9 | 679-5236-00 | | | 1 | CIRCUIT BD ASSY:PROBE INTERFACE POGO | 80009 | 679-5236-00 |

1 **Replacement of this part must be performed by Tektronix**

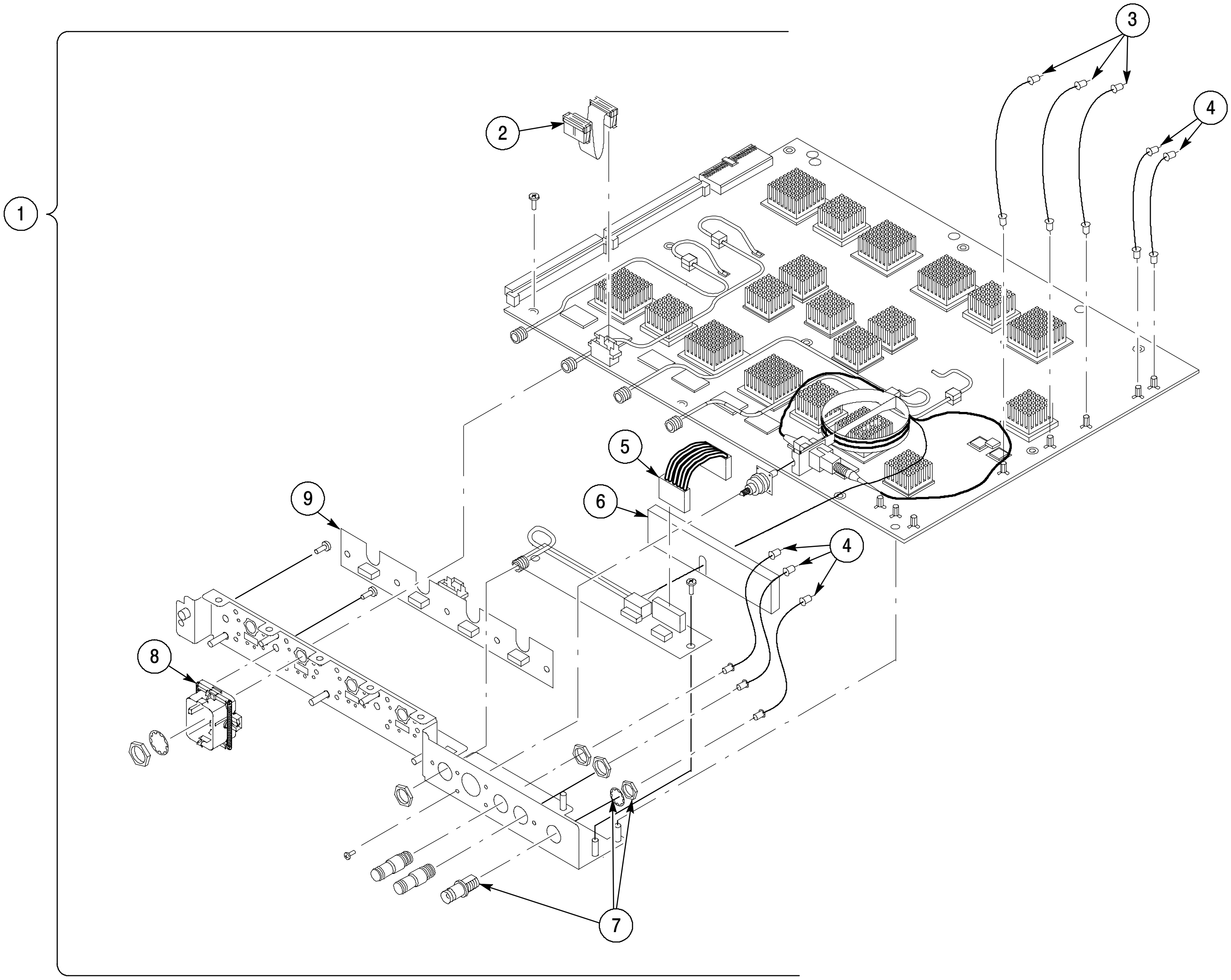


**Figure 10-4: Acquisition assembly**

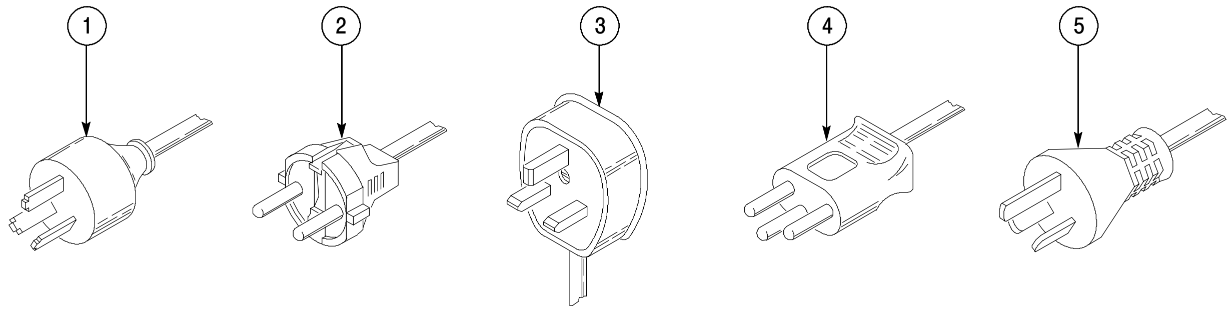


**Figure 10-5: Accessories**

## Replaceable Parts List

| Fig. & index number | Tektronix part number | Serial no. effective | Serial no. discont'd | Qty | Name & description | Mfr. code | Mfr. part number |
|---|---|---|---|---|---|---|---|
| | | | | | **STANDARD ACCESSORIES** | | |
| 5-1 | 161-0104-05 | | | 1 | CA ASSY,PWR:3,1.0MM SQ,250V/10A,2.5 METER (OPTION A3 - AUSTRALIA) | TK1373 | 161-0104-05 |
| -2 | 161-0104-06 | | | 1 | CA ASSY,PWR:3,1.0MM SQ,250V/10A,2.5 METER (OPTION A1 - EUROPEAN) | TK1373 | ORDER BY DESCRIPTION |
| -3 | 161-0104-07 | | | 1 | CA ASSY,PWR:3,1.0MM SQ,240V/10A,2.5 METER,FUSED (OPTION A2 - UNITED KINGDOM) | TK2541 | ORDER BY DESCRIPTION |
| -4 | 161-0167-00 | | | 1 | CA ASSY,PWR:3,0.75MM SQ,250V/10A,2.5 METER (OPTION A5 - SWITZERLAND) | S3109 | ORDER BY DESCRIPTION |
| -5 | 161-0306-00 | | | 1 | CA ASSY,PWR:3,1.0MM SQ,250V/10A,2.5 METER (OPTION AC - CHINA) | TK6253 | 92-2637-250BKH |
| | -------- | | | 1 | CABLE ASSY,PWER,:3,18 AWG,92 L (STANDARD CABLE - SEE FIG 10-1-6) | | |
| | -------- | | | 1 | POUCH, PLASTIC:POUCH (STANDARD CABLE - SEE FIG 10-1-1) | TK2582 | TK1441 BLACK CORDURA |
| | 020-2437-03 | | | 1 | SW KIT:OS RESTORE,WIN98 RESTORE CD | 80009 | 020-2437-00 |
| | 020-2404-00 | | | 1 | MANUAL SET:REFERENCES,ALL LANGUAGES | 80009 | 020-2404-00 |
| | 071-7010-00 | | | 1 | MANUAL,TECH:USER | TK2548 | 071-7010-00 |
| | 071-7000-00 | | | 1 | MANUAL,TECH:REFERENCE,ENGLISH | TK2548 | 071-7000-00 |
| | 119-6298-00 | | | 1 | MOUSE:LOGITECCH WHEEL MOUSE | 46628 | A147722 |
| | 067-0405-00 | | | 1 | FIXTURE,CAL:PROBE CAL DESKEW | 80009 | 067-0405-00 |
| | 020-2449-00 | | | 1 | ACCESSORY KIT:OSCILLOSCOPE ANALYSIS & CONNETIVITY MADE EASY MANUAL W/SW | TK2548 | 020-2449-00 |
| | 063-3461-05 | | | 1 | SOFTWARE PKG:PRODUCT SOFTWARE,V2.0.0,CD | TK2548 | 063-3461-05 |
| | 200-4104-00 | | | 1 | CAP,DUST:BLACK | TK2491 | UT11-01 |
| | 020-2357-00 | | | 1 | CLEANING KIT:FIBER OPTIC | 80009 | 020-2357-00 |
| | | | | | **OPTIONAL ACCESSORIES** | | |
| | 119-6633-00 | | | 1 | KEYBOARD:USB,W/2 USB PORTS,104 KEY,KEYTRONIC | 52833 | E06101USB-C |

## 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 |
|---|---|---|---|---|---|---|---|
| | 071-7011-00 | | | 1 | MANUAL TECH:SERVICE,CSA7000 SERIES | TK2548 | 071-7011-00 |
| | 016-1790-00 | | | 1 | RACKMOUNT KIT | 5Y400 | 016-1790-00 |