Service Manual

Tektronix

TVS600 Series
Waveform Analyzers
(TVS621, TVS625, TVS641 & TVS645)

070-9285-00

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 the Safety Summary prior to performing service.

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Tektronix, Inc., P.O. Box 1000, Wilsonville, OR 97070–1000

WARRANTY

Tektronix warrants that the products that it manufactures and sells will be free from defects in materials and workmanship for a period of three (3) years from the date of shipment. If a product proves defective during this warranty period, Tektronix, at its option, either will repair the defective product without charge for parts and labor, or will provide a replacement in exchange for the defective product.

In order to obtain service under this warranty, Customer must notify Tektronix 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, with shipping charges prepaid. Tektronix shall pay for the return of the product to Customer if the shipment is to a location within the country in which the Tektronix service center is located. Customer shall be responsible for paying all shipping charges, duties, taxes, and any other charges for products returned to any other locations.

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 d) to service 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.

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

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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.

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.

Injury Precautions

Avoid Electric Overload. To avoid electric shock or fire hazard, do not apply a voltage to a terminal that is outside the range specified for that terminal.

Avoid Electric Shock. To avoid injury or loss of life, do not connect or disconnect probes or test leads while they are connected to a voltage source.

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

Do Not Operate Without Covers. To avoid electric shock or fire hazard, do not operate this product with covers or panels removed.

Use Proper Fuse. To avoid fire hazard, use only the fuse type and rating specified for this product.

Do Not Operate in Wet/Damp Conditions. To avoid electric shock, do not operate this product in wet or damp conditions.

Do Not Operate in an Explosive Atmosphere. To avoid injury or fire hazard, do not operate this product in an explosive atmosphere.

Product Damage Precautions

Provide Proper Ventilation. To prevent product overheating, provide proper ventilation.

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

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:

DANGER
High Voltage

Protective Ground
(Earth) Terminal

ATTENTION
Refer to Manual

Double
Insulated

Certifications and Compliances

Refer to the specifications section for a listing of certifications and compliances that apply to this 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, disconnect the main power by means of the power cord or, if provided, the power switch.

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 waveform analyzer. Use the information in this manual to service the waveform analyzer to the module level.

Manual Structure

This manual is divided into chapters, such as *Specifications* and *Performance Verification*. Within each chapter, the information is further divided into subsections such as *Product Description* and *Equipment Required*.

Subsections that contain procedures also contain introductions before the procedures. Be sure to read these introductions because they provide information that is needed to do the service correctly and efficiently. The following list provides a brief description of the chapters contained in this manual:

- *Specifications* describes the waveform analyzer and the characteristics that apply to it.
- *Operating Information* includes general information and operating instructions at the level needed to safely power on and service the waveform analyzer.
- *Theory of Operation* contains circuit descriptions that support general service to the module level.
- *Performance Verification* contains procedures to verify that the waveform analyzer functions properly and meets warranted specifications.
- *Adjustment Procedures* contains procedures for adjusting the waveform analyzer to meet warranted specifications.
- *Maintenance* contains information and procedures for performing preventive and corrective maintenance. These instructions include cleaning, module replacement, and fault isolation to the module level.
- *Options* describes standard accessories, optional accessories, and options that may be installed in the waveform analyzer.
- *Electrical Parts List* refers you to *Mechanical Parts List*, where both electrical and mechanical modules are listed. See below.
- *Diagrams* contains a block diagram and an interconnection diagram that are useful when isolating failed modules.
- *Mechanical Parts List* contains an illustration that shows all replaceable modules, and a table that lists the replaceable modules, their descriptions, and their Tektronix part numbers.

Manual Conventions

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

Modules Throughout this manual, any replaceable component, assembly, or part of the waveform analyzer is referred to generically as a "module." In general, a module is an assembly (circuit board), rather than a component (resistor or integrated circuit). Sometimes a single component is a module; for example, each ejector handle is a module.

Safety Symbols and terms related to safety appear in the *General Safety Summary* near the front of this manual.

Related Manuals

The following manuals are related to the use of the waveform analyzer:

- The *TVS600 Series Waveform Analyzers User Manual* (Tektronix part number 070-9283-XX).
- The *TVS600 Series Waveform Analyzers Reference Manual* (Tektronix part number 070-9284-XX) provides a pocket-sized listing of frequently used instrument commands.

Introduction

This manual contains information needed to properly service the waveform analyzer, as well as general information critical to safe and effective servicing.

To prevent personal injury or damage to the waveform analyzer, consider the following before attempting service:

- The procedures in this manual should be performed only by a qualified service person
- Read the *General Safety Summary* and *Service Safety Summary* found at the beginning of this manual
- Read *Operating Information* beginning on page 2–1

When using this manual for servicing, be sure to follow all warnings, cautions, and notes.

Adjustment Interval

Generally, you should perform the adjustments described in the *Adjustment Procedures* once a year. In addition, adjustment is recommended after module replacement.

Strategy for Servicing

Throughout this manual, the term “module” refers to any field-replaceable component, assembly, or part of the waveform analyzer.

This manual contains all the information needed for periodic maintenance of the waveform analyzer. (Examples of such information are procedures for checking performance and for readjustment.)

Further, the manual contains all information for corrective maintenance down to the module level. Refer to the sections indicated to perform the following maintenance procedures:

- Use the fault isolation procedures found in *Troubleshooting* (page 6–27) to isolate a fault to a module
- Follow the instructions in *Removal and Installation Procedures* (page 6–7) to remove and replace any failed module
- After isolating a faulty module, replace it with a fully-tested module obtained from the factory; the *Mechanical Parts List* section contains part number and ordering information for all replaceable modules.

Tektronix Service Offerings

Tektronix provides service to cover repair under warranty as well as other services that may provide a cost-effective answer to your service needs.

Whether providing warranty repair service or any of the other services listed below, Tektronix service technicians are well equipped to service the waveform analyzer. Tektronix technicians train on Tektronix products; they have access to the latest information on improvements to the waveform analyzer as well as the latest new options.

Warranty Repair Service

Tektronix warrants this product for three years from date of purchase. (The warranty appears behind the title page in this manual.) Tektronix technicians provide warranty service at most Tektronix service locations worldwide. The Tektronix product catalog lists all service locations worldwide.

Repair or Calibration Service

The following services can be purchased to tailor repair and/or calibration of the waveform analyzer to fit your requirements.

At-Depot Service. Tektronix offers several standard-priced adjustment (calibration) and repair services:

- A single repair and/or adjustment
- Calibrations using equipment and procedures that meet the traceability standards specific to the local area
- Annual maintenance agreements that provide for either calibration and repair, or calibration only of the waveform analyzer

Of these services, the annual maintenance agreement offers a particularly cost-effective approach to service for many owners of the waveform analyzer.

Self Service

Tektronix supports repair to the module level by providing Module Exchange.

Module Exchange. Use this service to reduce down-time for repair by exchanging modules for remanufactured ones. Tektronix ships an updated and tested exchange module from the Beaverton, Oregon service center, typically within 24 hours. Each module comes with a 90-day service warranty.

For More Information. Contact your local Tektronix service center or sales engineer for more information on any of the repair or adjustment services just described.

Specifications

This chapter provides a complete description of the waveform analyzer specifications. *Product Description* (below) is a general description of the instrument. The *Specification Tables*, which begin on page 1–2, contain the complete specifications for the waveform analyzer.

Product Description

The TVS600 Series Waveform Analyzers are a family of C-size, double-wide VXI modules suitable for use in a variety of test and measurement applications and systems. Many key features are listed below:

- Four standard configurations with full-featured, 1 MΩ/50 Ω inputs: TVS641 and TVS645 have four channels, TVS621 and TVS625 have two channels.
- A maximum realtime digitizing rate up to 5 GSample/second with an analog bandwidth up to 1 GHz. See Table 1–1 for details.

Table 1–1: Comparison of Product Features

Product	Input Channels	Maximum Sample Rate	Analog Bandwidth
TVS645	4	5 GSample/second	1 GHz
TVS641	4	1 GSample/second	250 MHz
TVS625	2	5 GSample/second	1 GHz
TVS621	2	1 GSample/second	250 MHz

- A maximum record length of 30,000 samples with 8-bit vertical resolution.
- Full programmability using a SCPI command set.
- Acquisition modes such as sample, envelope, and average.
- A full complement of internal triggering modes such as edge and pulse, plus VXI backplane and external trigger sources.

Specification Tables

This section contains tables that list the specifications for the waveform analyzer. All specifications are guaranteed unless noted "typical." Specifications that are marked with the ✓ symbol are checked in the *Performance Verification* section.

The performance limits in this specification are valid with these conditions:

- The waveform analyzer must have been calibrated/adjusted at an ambient temperature between +20° C and +30° C.
- The waveform analyzer must be in an environment with temperature, altitude, humidity, and vibration within the operating limits described in these specifications.
- The waveform analyzer must have had a warm-up period of at least 20 minutes.
- The waveform analyzer must have had its signal-path-compensation routine (self cal) last executed after at least a 20 minute warm-up period at an ambient temperature within ±5° C of the current ambient temperature.

Table 1–2: Signal Acquisition System

Name	Description	
✓ Accuracy, DC Gain	±1.5% for full scale ranges from 20 mV to 100 V ±2.0% for full scale ranges <19.9 mV	
✓ Accuracy, DC Voltage Measurement	±(1.5% of input signal + 1% of full scale range) with instrument temperature within 5° C of Setting-Cal temperature for input ranges ≥50 mV full scale	
✓ Accuracy, Delta DC Voltage Measurement	±(1.5% of input signal + 0.1% of full scale range) with instrument temperature within 5° C of Setting-Cal temperature	
✓ Accuracy, Offset[1]	*Full Scale Range Setting*	*Offset Accuracy*
	10 mV – 1 V	±[(0.2% × | offset |) + 1.5 mV + (6% × full scale range)]
	1.01 V – 10 V	±[(0.25% × | offset |) + 15 mV + (6% × full scale range)]
	10.1 V – 100 V	±[(0.25% × | offset |) + 150 mV + (6% × full scale range)]

[1] **Net offset is the nominal voltage level at the waveform analyzer input that corresponds to the center of the A/D Converter dynamic range. Offset accuracy describes the precision of the net offset voltage.**

Table 1–2: Signal Acquisition System (Cont.)

Name	Description		
✓ Analog Bandwidth, DC–50 Ω Coupled or DC–1 MΩ Coupled	*Full Scale Range Setting*	*Bandwidth*[2]	
	10.1 V – 100 V	DC – 500 MHz (TVS625 and TVS645) DC – 250 MHz (TVS621 and TVS641)	
	100 mV – 10 V	DC – 1 GHz (TVS625 and TVS645) DC – 250 MHz (TVS621 and TVS641)	
	50 mV – 99.8 mV	DC – 900 MHz (TVS625 and TVS645) DC – 250 MHz (TVS621 and TVS641)	
	20 mV – 49.8 mV	DC – 600 MHz (TVS625 and TVS645) DC – 250 MHz (TVS621 and TVS641)	
	10 mV – 19.8 mV	DC – 500 MHz (TVS625 and TVS645) DC – 250 MHz (TVS621 and TVS641)	
Bandwidth, Analog, Selections	*Products*	*Bandwidth Selections*	
	TVS625 and TVS645	20 MHz, 250 MHz, and FULL	
	TVS621 and TVS641	20 MHz, 180 MHz, and FULL	
Calculated Rise Time, typical[3]	*Full Scale Range Setting*	*TVS625 and TVS645*	*TVS621 and TVS641*
Typical full-bandwidth rise times are shown in the chart to the right	10.1 V – 100 V	900 ps	1.8 ns
	100 mV – 10 V	450 ps	1.8 ns
	50 mV – 99 mV	500 ps	1.8 ns
	20 mV – 49.9 mV	750 ps	1.8 ns
	10 mV – 19.9 mV	900 ps	1.8 ns
Crosstalk (Channel Isolation)	≥300:1 at 100 MHz and ≥100:1 at the rated bandwidth for the channel's sensitivity (Full Scale Range) setting, for any two channels having equal sensitivity settings		
✓ Delay Between Channels, Full Bandwidth	≤100 ps with equal Full Scale Range and Coupling settings		
Digitized Bits, Number of	8 bits		
Frequency Limit, Upper, 20 MHz Bandwidth Limited, typical	20 MHz		
Frequency Limit, Upper, 250 MHz Bandwidth Limited, typical	*Products*	*Bandwidth*	
	TVS625 and TVS645	250 MHz	
	TVS621 and TVS641	180 MHz	

2 The limits given are for the ambient temperature range of 0° C to +30° C. Reduce the upper bandwidth frequencies by 5 MHz for each °C above +30° C. The bandwidth must be set to FULL.

3 Rise time (rounded to the nearest 50 ps) is calculated from the bandwidth when Full Bandwidth is selected. It is defined by the following formula:

$$\textit{Rise Time (ns)} = 450 \div \textit{BW (MHz)}$$

Table 1–2: Signal Acquisition System (Cont.)

Name	Description	
Input Channels, Number of	*Product*	*Channels*
	TVS645	Four
	TVS641	Four
	TVS625	Two
	TVS621	Two
Input Coupling	DC, AC, or GND[4]	
Input Impedance, DC–1 MΩ Coupled	1 MΩ ±0.5% in parallel with 10 pF ±3 pF	
Input Impedance Selections	1 MΩ or 50 Ω	
Input Resistance, DC–50 Ω Coupled	50 Ω ±1%	
Input VSWR, DC–50 Ω Coupled	≤1.3:1 from DC – 500 MHz, ≤1.5:1 from 500 MHz – 1 GHz	
Input Voltage, Maximum, DC–1 MΩ, AC–1 MΩ, or GND Coupled	The greater of ±300 Vrms or DC, derated at 20 dB/decade above 1 MHz CAT II (see *Overvoltage Category Descriptions* on page 1–13 for more information)	
Input Voltage, Maximum, DC–50 Ω or AC–50 Ω Coupled	5 V_{RMS}, with peaks ≤ ±30 V	
Lower Frequency Limit, AC Coupled, typical	≤10 Hz when AC–1 MΩ Coupled; ≤200 kHz when AC–50 Ω Coupled[5]	
Random Noise	*Bandwidth Selection*	*RMS Noise*
	Full	≤(350 μV + 0.5% of the Full Scale Range setting)
	250 MHz	≤(165 μV + 0.5% of the Full Scale Range setting)
	20 MHz	≤(75 μV + 0.5% of the Full Scale Range setting)
Range, Offset	*Full Scale Range Setting*	*Offset Range*
	10 mV – 1 V	±1 V
	1.01 V – 10 V	±10 V
	10.1 V – 100 V	±100 V
Range, Sensitivity (Full Scale Range), All Channels	10 mV to 100 V[6]	

4 GND input coupling disconnects the input connector from the attenuator and connects a ground reference to the input of the attenuator.

5 The AC Coupled Lower Frequency Limits are reduced by a factor of 10 when 10X passive probes are used.

6 The sensitivity ranges are 10 mV to 100 V full scale, switching in a 1–2–5 sequence of coarse settings. Between these coarse settings, you can adjust the sensitivity with a resolution equal to 1% of the more sensitive coarse setting. For example, between the 500 mV and 1 V ranges, the sensitivity can be set with 5 mV resolution.

Table 1–2: Signal Acquisition System (Cont.)

Name	Description				
Step Response Settling Errors, typical[7]	*Full Scale Range Setting*	*± Step Response*	*Maximum Settling Error (%) at 20 ns*	*100 ns*	*20 ms*
	10 mV – 1 V	≤2 V	0.5%	0.2%	0.1%
	1.01 V – 10 V	≤20 V	1.0%	0.5%	0.2%
	10.1 V – 100 V	≤200 V	1.0%	0.5%	0.2%

Table 1–3: Timebase System

Name	Description	
✓ Accuracy, Long Term Sample Rate and Delay Time	±100 ppm over any interval ≥1 ms	
Range, Extended Realtime Sampling Rate	5 S/s to 10 MS/s in a 1–2.5–5 sequence	
Range, Realtime Sampling Rate	*Products*	*Limits*
	TVS625 and TVS645	20 MS/s to 5 GS/s on all channels simultaneously in a 1–2.5–5 sequence
	TVS621 and TVS641	20 MS/s to 1 GS/s on all channels simultaneously in a 1–2.5–5 sequence
Record Length	256, 512, 1024, 2048, 4096, 8192, 15,000 30,000 (extended realtime sampling mode only)	
Time Stamping	125 ns resolution 0.1% variance	

7 The Full Bandwidth settling errors are typically less than the percentages from the table.

Table 1–4: Trigger System

Name	Description	
✓ Accuracy (Time) for Pulse Glitch or Pulse Width Triggering	*Time Range*	*Accuracy*
	1 ns to 1 μs	±(20% of Setting + 0.5 ns)
	1.02 μs to 1 s	±(204.5 ns + 0.01% of Setting)
✓ Accuracy (DC) for External Trigger Level	±(5% + 150 mV) for signals having rise and fall times ≥20 ns	
✓ Accuracy (DC) for Internal Trigger Level, DC Coupled	±[(2% × | Setting) | + 0.03 of Full Scale Range + Offset Accuracy)] for signals having rise and fall times ≥20 ns	
Holdoff, Variable Main Trigger, typical[1]	For all sampling rates, the minimum holdoff is 250 ns and the maximum holdoff is 12 s; the minimum resolution is 8 ns for settings ≤1.2 μs	
Input, External Trigger, typical	50 Ω input resistance; ±5 V (DC + peak AC) maximum safe input voltage; DC coupled only	
Range, Delayed Trigger Time[2]	16 ns to 250 s	
Range, Events Delay	1 to 10,000,000	
Range (Time) for Pulse Glitch and Pulse Width Triggering	1 ns to 1 s	
Range, Trigger Level	*Source*	*Range*
	Any Channel	±100% of full scale range
	External Input	±1 V
Range, Trigger Point Position	Minimum: 0 Maximum: 30,000	
Resolution, Trigger Level	0.02% of full scale for any Channel source and 2 mV for the External Input source	
Resolution, Trigger Position	One sample interval at all sample rates	
Sensitivities, Pulse-Type Trigger and Events Delay, DC Coupled, typical	10% of full scale, from DC to 500 MHz, for Full Scale Range settings >100 mV and ≤10 V at the BNC input	
Sensitivities, Pulse-Type Trigger Width and Glitch, typical	10% of full scale, for Full Scale Range settings >100 mV and ≤10 V at the BNC input	

1 **Main Trigger is controlled with the TRIGger:A commands.**

2 **Delayed Trigger is controlled with the TRIGger:B commands.**

Table 1–4: Trigger System (Cont.)

Name	Description			
✓ Sensitivity, Edge-Type Trigger, DC Coupled[3]	The minimum signal levels required for stable edge triggering of an acquisition when the source is DC-coupled.			
	Products	*Trigger Source*	*Sensitivity*	
	TVS625 and TVS645	Any Channel	3.5% of Full Scale Range from DC to 50 MHz, increasing to 10% of Full Scale Range at 1 GHz	
	TVS621 and TVS641	Any Channel	3.5% of Full Scale Range from DC to 50 MHz, increasing to 10% of Full Scale Range at 250 MHz	
	TVS621, TVS625, TVS641, and TVS645	External	25 mV from DC to 50 MHz, increasing to 50 mV at 100 MHz	
Sensitivity, Edge-Type Trigger, Not DC Coupled, typical	*Trigger Coupling*	*Typical Signal Level for Stable Triggering*		
	AC	Same as the DC-coupled limits for frequencies above 60 Hz; attenuates signals below 60 Hz		
	High Frequency Reject	One and one-half times the DC-coupled limits from DC to 30 kHz; attenuates signals above 30 kHz		
	Low Frequency Reject	One and one-half times the DC-coupled limits for frequencies above 80 kHz; attenuates signals below 80 kHz		
	Noise Reject	Three times the DC-coupled limits		
Time, Minimum Pulse or Rearm, and Minimum Transition Time, for Pulse-Type Triggering, typical	For Full Scale Range settings >100 mV and ≤10 V at the BNC input			
	Pulse Class	*Minimum Pulse Width*	*Minimum Rearm Width*	
	Glitch	1 ns	2 ns + 5% of Glitch Width Setting	
	Width	1 ns	2 ns + 5% of Width Upper Limit Setting	
Time, Minimum Pulse or Rearm, for Events Delay Triggering, typical	The following chart shows the minimum values for input range settings >100 mV and ≤10 V at the BNC input			
	Triggering Type	*Minimum Pulse Width*	*Minimum Rearm Time*	*Minimum Time Between Channels*[4]
	Events Delay	1 ns (for either + or – pulsewidths)	N/A	2 ns

3 Delayed Trigger has the same specifications as Main Trigger.

4 For Events Delay, the time is the minimum time between a main and delayed event that will be recognized if more than one channel is used.

Table 1–4: Trigger System (Cont.)

Name	Description	
Trigger Position Error, Edge Triggering, typical	*Acquisition Mode*	*Trigger Position Error*[5]
	Sample, Average	±(1 Sample Interval + 1 ns)
	Envelope	±(2 Sample Intervals + 2 ns)

5 The trigger position errors are typically less than the values given here. These values are for triggering signals having a slew rate at the trigger point of ≥5% of full scale/ns.

Table 1–5: Front Panel Connectors

Name	Description		
Arm Input	This input provides external arming capability with a BNC connector		
	Characteristic	*Limits*	
	Arming Threshold Voltage	≤0.8 V	
	Input Voltage Range	0 to 5 V_{pk}, TTL-compatible (arms on a switch closure to ground; internal pull-up resistor to +5 volts is provided)	
	Latency	10 µs	
	Minimum Pulsewidth	10 µs	
Fiducial Input, typical[1]	This input provides fiducial input capability with a BNC connector; the polarity of the signal acquired is inverted with respect to the input		
	Characteristic	*Limits*	
	Fiducial Input/CH 1 HF Gain Ratio	–6 ±25% (CH 1 set to 1 V Full Scale Range)	
	Input Impedance	0.01 µF in series with 50 Ω	
	Input LF Attenuation	Attenuates signals below 100 MHz (highpass time constant of 5 ns)	
	Input Sensitivity	*CH 1 Full Scale Range*	*Fiducial Full Scale Range*
		10 mV to 1 V	6 times the CH 1 Full Scale Range setting
		1.01 V to 10 V	0.6 times the CH 1 Full Scale Range setting
		10.1 V to 100 V	0.06 times the CH 1 Full Scale Range setting
	Input Voltage Range	±1 V	
	Maximum Input	2 V_{RMS}	
	Rise Time	*Products*	*Rise Time*
		TVS625 and TVS645	≤2.5 ns (10% to 90%)
		TVS621 and TVS641	≤3 ns (10% to 90%)

1 **The FIDUCIAL Input is designed for short-duration (≤3 ns) fast rise time (≤2 ns) pulse signals.**

Table 1–5: Front Panel Connectors (Cont.)

Name	Description	
✓ Output, Reference	*Characteristic*	*Limits*
	Output Voltage	8 V ±1%
	Internal Frequency Reference	Frequency is 10 MHz ±0.015% Amplitude is ≥1 V_{p-p} into 50 Ω
Probe Compensation, Output Frequency, typical	1 kHz ±25%	
✓ Probe Compensation, Output Voltage	0.5 V (base-top) ±1% into a ≥50 Ω load	
Serial Interface	This front panel-mounted 9-pin D connector provides a serial interface with the following pin assignments: 1 DCD 2 RXD 3 TXD 4 DTR 5 GND 6 DSR 7 RTS 8 CTS 9 No Connection	

Table 1–6: VXI Interface

Name	Description	
Addressing	Dynamic autoconfigure or set manually	
Inputs, ECLTRG	Either of the two ECLTRG lines may be individually selected to arm or trigger an acquisition	
Inputs, TTLTRG	Any of the eight TTLTRG lines may be individually selected to arm or trigger an acquisition	
Interface Type	Message based (I4)	
Interrupts	Programmable interrupter level 1–7	
Outputs, ECLTRG	Either of the two ECLTRG lines can be driven by the following signals: ARM — The waveform analyzer is armed and waiting for a trigger ATR — Main trigger event has occurred BTR — Delayed trigger event has occurred OPC — Operation pending complete	
Outputs, TTL	Each of the TTLTRG lines (TTLTRG0*–TTLTRG7*) can be driven by the following signals: ARM — The waveform analyzer is armed and waiting for a trigger ATR — Main trigger event has occurred BTR — Delayed trigger event has occurred OPC — Operation pending complete	
Outputs, TTLTRG, Logic Levels	Based on the VXIbus Specification RULE B.6.17	
	Characteristic	*Limits*
	Vout(HI)	Determined by the mainframe termination; the TTL outputs are open collector
	Vout(LO)	≤0.6 V when sinking 48 mA
Outputs, TTLTRG, Logic Polarity	Normal polarity: Negative TRUE; high-to-low transition indicates the event occurred Inverted polarity: Positive TRUE; low-to-high transition indicates the event occurred	
Protocols	Word Serial (WSP) Fast Data Channel FDC TEK V2.1	
VXI Interface	Complies with revision 1.4	

Table 1–7: Power Distribution and Data Handling

Name	Description		
Current Requirements, TVS641 and TVS645, typical	*Voltage*	*DC Current*	*Dynamic Current*
	+12 V	1.3 A	0.45 A
	+5 V	11.0 A	0.8 A
	–5.2 V	4.6 A	0.09 A
	–12 V	1.0 A	0.4 A
Current Requirements, TVS621 and TVS625, typical	*Voltage*	*DC Current*	*Dynamic Current*
	+12 V	1.0 A	0.45 A
	+5 V	8.0 A	0.7 A
	–5.2 V	2.7 A	0.05 A
	–12 V	0.8 A	0.4 A
Nonvolatile Memory Retention Time, typical[1]	Battery life is ≥6 months		
Power Requirements, typical	*Products*	*Power Requirements*	
	TVS641 and TVS645	106.5 Watts	
	TVS621 and TVS625	75.6 Watts	

Table 1–8: Environmental

Name	Description
Airflow Resistance	≤0.178 mm H_2O air pressure with 6.6 l/s airflow
Altitude, Operating and Nonoperating	Operating: to 15,000 feet (4570 m) Nonoperating: to 40,000 feet (12,190 m)
Humidity, Operating and Nonoperating	To 95% relative humidity at or below +30° C; to 45% relative humidity up to +50° C
Temperature, Operating and Nonoperating	Operating: 0° C to +50° C for exterior air when operated in a mainframe with 15° C internal temperature rise, and airflow of 0.75 mm H_2O air pressure @ 2 l/s Nonoperating: –40° C to +71° C

1 **The time that reference waveforms, stored setups, and calibration constants are retained when there is no power to the waveform analyzer.**

Table 1–9: Certifications and Compliances

Name	Description
Certifications	Underwriters Laboratories listed to CAN/CSA-C22.2 No.1010.1-92. Underwriters Laboratories listed to Standard UL3111-1 for Electrical and Electronic Measuring and Testing Equipment.
EC Declaration of Conformity	Meets intent of Directive 89/336/EEC for Electromagnetic Compatibility and Low Voltage Directive 73/23/ECC for Product Safety. Compliance was demonstrated to the following specifications as listed in the Official Journal of the European Communities: EMC Directive 89/336/EEC: EN 50081-1 Emissions: EN 55011 Class A Radiated and Conducted Emissions EN 60555-2 AC Power Line Harmonic Emissions EN 50082-1 Immunity: IEC 801-2 Electrostatic Discharge Immunity IEC 801-3 RF Electromagnetic Field Immunity IEC 801-4 Electrical Fast Transient/Burst Immunity Low Voltage Directive 73/23/EEC: EN 61010-1 Safety requirements for electrical equipment for measurement, control, and laboratory use
FCC Compliance	Emissions comply with FCC Code of Federal Regulations 47, Part 15, Subpart B, Class A Limits
Overvoltage Category Descriptions CAT I: Signal levels in special equipment or parts of equipment, telecommunications, electronics. CAT II: Local-level mains, appliances, portable equipment. CAT III: Distribution-level mains, fixed installation.	CAT II (see *Input Voltage, Maximum, DC–1 MΩ, AC–1 MΩ, or GND Coupled* on page 1–4)
Pollution Degree 2	Do not operate in environments where conductive pollutants may be present.
Safety Certification of Plug-in or VXI Modules	For modules (plug-in or VXI) that are safety certified by Underwriters Laboratories, UL Listing applies only when the module is installed in a UL Listed product. For modules (plug-in or VXI) that have cUL or CSA approval, the approval applies only when the module is installed in a cUL or CSA approved product.

Table 1–10: Mechanical

Name	Description	
Construction Material	Chassis parts constructed of aluminum alloy; front panel constructed of plastic laminate; circuit boards constructed of glass laminate; cabinet is aluminum	
Weight	*Products*	*Weight*
	TVS641 and TVS645	2.6 kg (5 lbs 12 oz)
	TVS621 and TVS625	2.5 kg (5 lbs 8 oz)
Overall Dimensions	Height: 262 mm (10.3 in) Width: 61 mm (2.4 in) Depth: 368 mm (14.5 in)	

Operating Information

This chapter describes how to operate the waveform analyzer when performing maintenance. The operating information is limited to the functions you need to perform the procedures found in this manual. You can find more detailed operating instructions in the *TVS600 Series Waveform Analyzers User Manual* (Tektronix part number 070-9283-XX).

The *Operating Information* is divided into the following sections:

- *Installation* on page 2–1 describes how to install the waveform analyzer into a VXIbus mainframe
- *Operating Information* on page 2–6 describes front panel connectors and indicators, the power-on procedure, self cal, self tests, and instrument commands used for maintenance

Installation

This section describes how to configure and install the waveform analyzer into a VXIbus mainframe. You will learn how to perform the following tasks:

- Set the logical address
- Configure the VXIbus mainframe
- Install the waveform analyzer into a Tektronix VXIbus mainframe
- Remove the waveform analyzer from a Tektronix VXIbus mainframe

Setting the Logical Address

Every module within a VXIbus system must have a unique logical address; no two modules can have the same address. On the waveform analyzer, two rotary switches on the rear panel select the logical address. Refer to Figure 2–1 for the switch locations.

The factory default switch setting (FF) allows the Slot 0 controller to assign a logical address to the waveform analyzer. This is called Dynamic Auto Configuration. You can also select static addresses between 01 and FE hexidecimal (1 to 254 decimal). Read the following descriptions before setting the logical address.

***NOTE**. Do not set the waveform analyzer logical address to 00. Logical address 00 is reserved for the Slot 0 controller.*

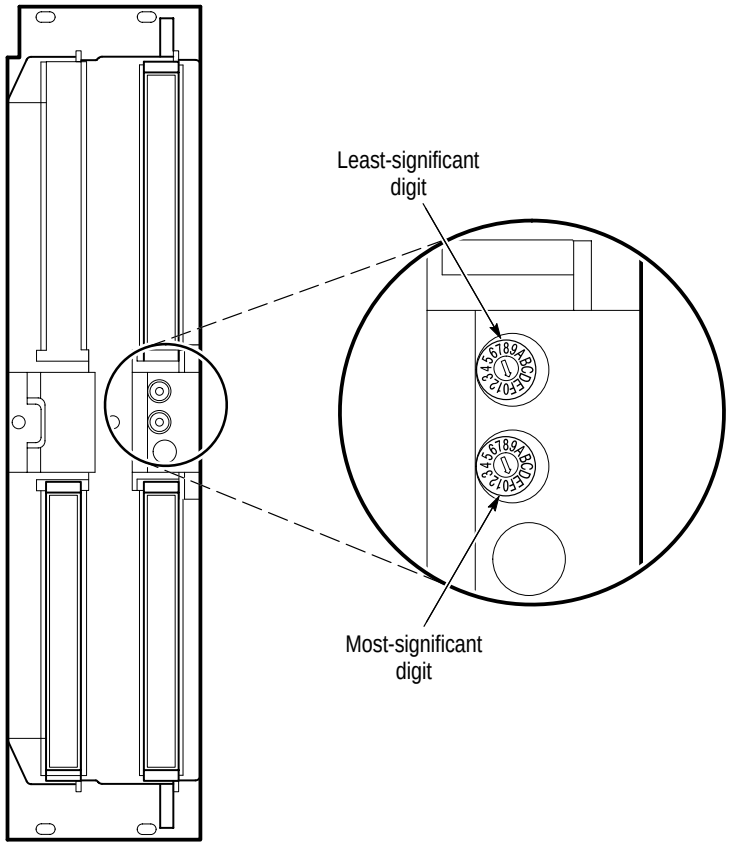


Figure 2–1: Logical address switches

Dynamic Auto Configuration. With Dynamic Auto Configuration selected (hexadecimal FF or decimal 255), the VXIbus system automatically sets the address to an unused value for your system. For example, if there are devices set to addresses 01 and 02 already in your system, the resource manager will automatically assign the waveform analyzer an address other than 01 or 02.

Static Logical Address. Static logical address selections set the address to a fixed value. A static logical address ensures that the waveform analyzer address remains fixed for compatibility with systems that require a specific address value. Remember that each device within your system must have a unique address to avoid communication problems.

Configuring the VXIbus Mainframe

This section describes how to configure a Tektronix VXIbus mainframe before you install the waveform analyzer. If you are installing the waveform analyzer into a different mainframe, refer to the instruction manual for that mainframe for any pertinent installation or capacity information.

Voltage, Current, Power, and Cooling Requirements. Voltage, current, power, and cooling requirements for the waveform analyzer are listed in the *Specifications* section at the following locations:

- Voltage, current, and power requirements; see Table 1–7 on page 1–12
- Cooling requirements; see Table 1–8 on page 1–12

These requirements are also printed on the side of the waveform analyzer. Be sure your mainframe can supply adequate current and cooling to the waveform analyzer and the other modules you plan to install into the same mainframe.

WARNING. *Shock hazards exist due to high voltages within the mainframe compartment. Do not change configuration of the Bus Grant and Interrupt Acknowledge jumpers unless you are qualified to do so. Consult your VXI mainframe manual for safety warnings and configuration information.*

Jumper Settings. Many VXIbus mainframes contain daisy-chain jumper straps that you must configure before installing the waveform analyzer. The jumper straps set up the Bus Grant (BG0-BG3) and Interrupt Acknowledge (IACK) signals. If you are using a Tektronix mainframe, the jumper straps are located beside the P1 connectors. The names of the jumper straps (BG0-BG3 and IACK) are often printed on the circuit board facing the front of the mainframe. Refer to your VXIbus mainframe manual for detailed information about jumper strap locations and requirements.

Some VXIbus mainframes, such as the Tektronix VX1410 Intelliframe™, have an autoconfigurable backplane with electronic jumpering. You do not need to set jumpers on these VXIbus mainframes.

If your VXIbus mainframe has IACK and BG0–BG3 jumper straps, follow the procedure below to set the jumpers for the waveform analyzer:

1. On the mainframe, set the power ON/STANDBY switch to STANDBY.
2. Remove the jumper straps for the left-most slot in which you will install the waveform analyzer (retain the straps for future reconfiguration).
3. Install the jumper straps for the right-most slot in which you will install the waveform analyzer.

For example, if you want to install the waveform analyzer into the third and fourth mainframe slots, remove all jumper straps for the third slot. Install all jumper straps for the fourth slot.

Installation into VXIbus Mainframe

The waveform analyzer may be inserted into any two adjacent slots in the mainframe except Slot 0. Be sure the logical address is set before installation (see *Setting the Logical Address* on page 2–1).

CAUTION. *If you install the waveform analyzer into a D-size mainframe, be sure to connect the P1 and P2 connectors of the module to the P1 and P2 connectors on the mainframe. Electrical damage will result when connecting the P1 and P2 connectors on the module to the P2 and P3 connectors on the mainframe.*

To avoid damage, look for bent pins on P1 and P2 before installation.

Use the following procedure and Figure 2–2 to install the waveform analyzer into the mainframe:

1. On the mainframe, set the power ON/STANDBY switch to STANDBY.
2. Insert the waveform analyzer into the mainframe top and bottom module guides and push it partially into the mainframe (Figure 2–2). Then slide the waveform analyzer into the mainframe as far as it will go without forcing it.
3. Be sure the front panel is flush with the front of the mainframe chassis. If so, use a screwdriver to install the top and bottom retainer screws. Alternate between the screws, applying only a few turns at a time to fully seat the module.

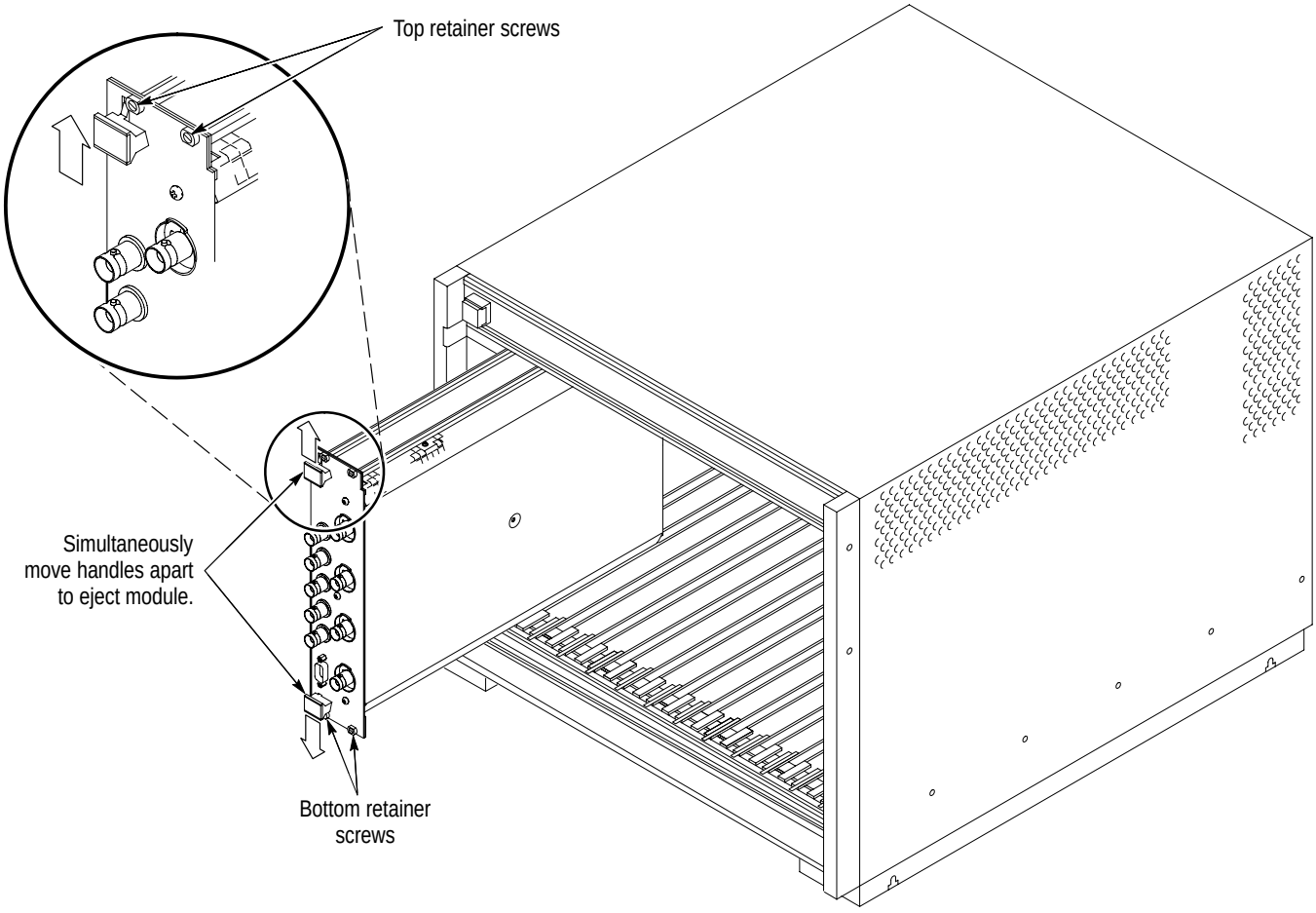


Figure 2–2: Module retainer screws and ejector mechanism

Removal from VXIbus Mainframe

Use the following procedure to remove the waveform analyzer from a Tektronix VXIbus mainframe. If you are using a different mainframe, this procedure may need modification.

1. On the mainframe, set the power ON/STANDBY switch to STANDBY.
2. Using a screwdriver, loosen the top and bottom retainer screws (Figure 2–2).
3. Grasp both handles of the waveform analyzer. At the same time, move the top handle upward and the bottom handle downward to eject the waveform analyzer.
4. Pull the waveform analyzer out of the mainframe.

Operating Information

This section provides the information you will need to operate the waveform analyzer when performing the procedures in this manual. The following operating information is provided:

- Descriptions of each front panel connector and indicator
- Power-on procedure
- Self cal mode
- Self tests
- List of instrument commands used for maintenance

There are two ways to operate the waveform analyzer: send commands over the VXIbus using talk/listen software, or select control settings using menus displayed by the *Tektronix TVS600 Soft Front Panel* software (a standard accessory for the waveform analyzer). You will perform procedures within this manual using talk/listen software.

NOTE. *The procedures in this manual have been written generically so that you can perform them using any talk/listen software installed on your system. An example of talk/listen software that you might use is the* Tektronix TVS600 Soft Front Panel *software talk/listen utility.*

Connectors and Indicators

Figure 2–3 shows the connectors and indicators on the front panel of a four-channel waveform analyzer. The two-channel model looks and operates the same, but without the CH 3 and CH 4 inputs. Descriptions of each connector and indicator follow the illustration.

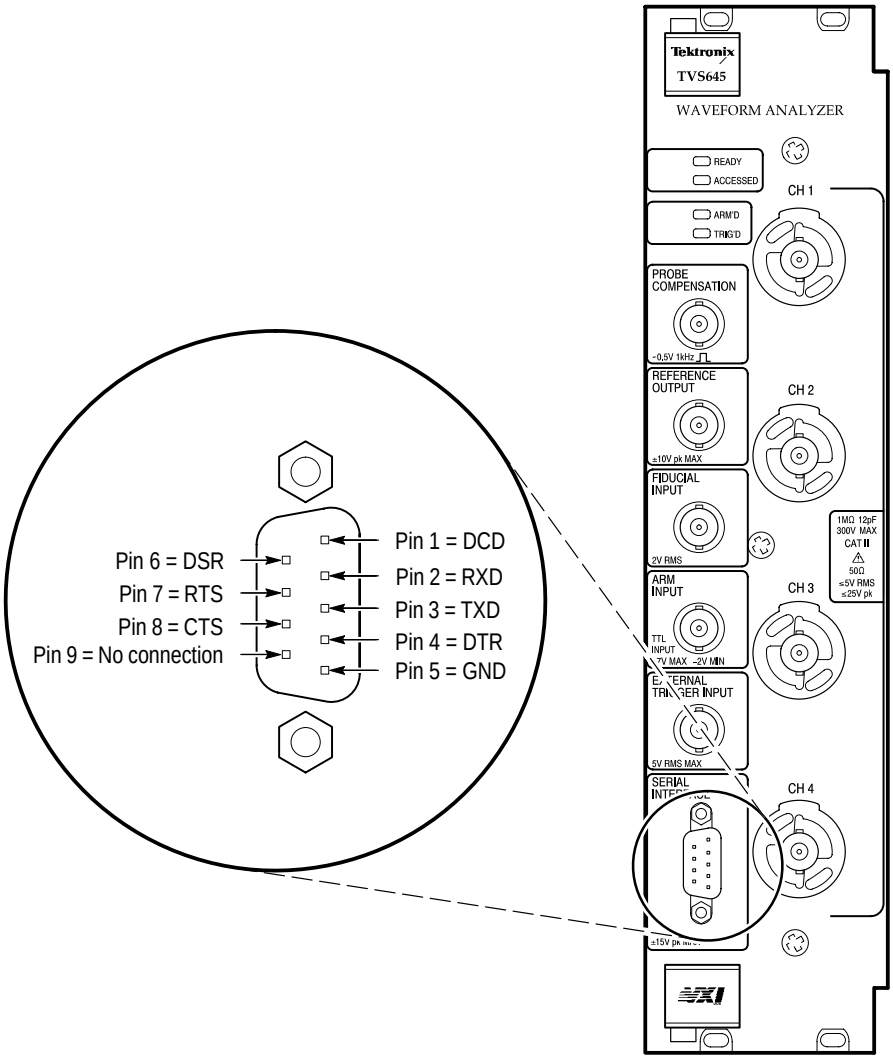


Figure 2–3: Waveform analyzer front panel

CH 1, CH 2, CH 3, and CH 4 Channel Inputs. These BNC input connectors drive the vertical channel amplifiers and their dedicated digitizers. The TVS641 and TVS645 have four input channels as shown in Figure 2–3. The TVS621 and TVS625 have the top two channels.

The channel inputs may be set for 1 MΩ or 50 Ω input impedance. Coupling selections are DC, AC, and Ground. The Ground setting grounds the internal amplifier, but presents a high impedance to the signal.

READY Indicator. The green LED lights continuously after the waveform analyzer completes power-on. During normal operation, READY blinks when an error occurs that generates a message.

ACCESSED Indicator. The yellow LED blinks on and then off under the following conditions:

- Each time communication with the waveform analyzer occurs
- When the Slot 0 controller asserts the Module Identification (MODID) line

ARM'D Indicator. The green LED lights when the waveform analyzer is ready to accept a trigger signal to complete an acquisition.

TRIG'D Indicator. The green LED lights for 300 ms when a trigger is received for the most recent acquisition. If triggers repeat more often than three per second, the indicator lights continuously.

PROBE COMPENSATION. The BNC output provides a signal for adjusting probe compensation. You can select either a square wave (`CLOC`) or a 500 mV DC level (`VOLT`). The square wave frequency is approximately 1 kHz. Amplitude is 500 mV_{p-p} into a $\geq 50\ \Omega$ load. To enable the compensation signal, send the command `OUTP:PCOM ON`.

REFERENCE OUTPUT. The BNC output provides access to two internal references; the DC calibrator reference voltage or the time base clock. The precision calibrator reference voltage (`VOLT`) is +8 V. The time base clock frequency (`CLOC`) is 10 MHz. Signal amplitude is $\geq 1\ V_{p-p}$ into a $\geq 50\ \Omega$ load. Figure 2–4 shows a typical time base clock signal waveform. To enable the selected signal to the REFERENCE OUTPUT connector, send the command `OUTP:REF ON`.

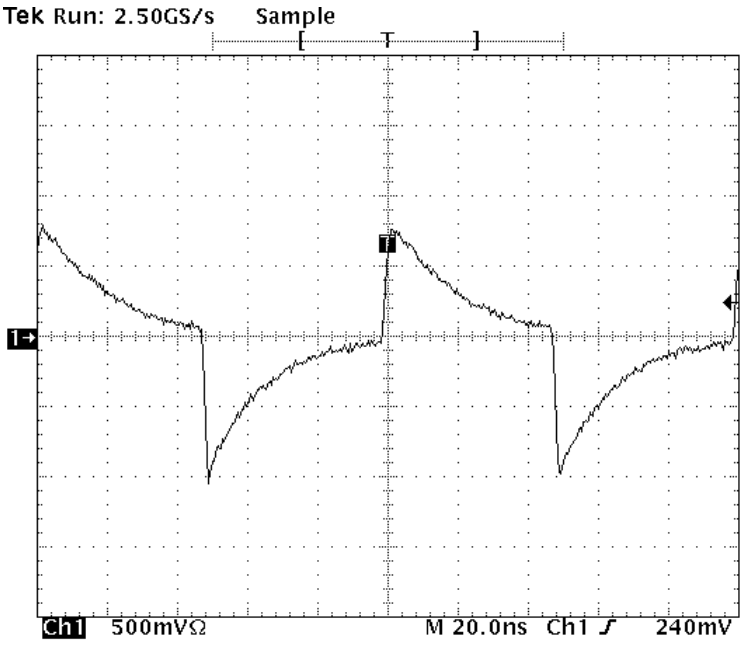


Figure 2–4: Typical time base clock signal waveform (50 Ω impedance)

FIDUCIAL INPUT. The BNC input provides a way to add a signal component to the Channel 1 input signal. The input range is ±1 V. The input impedance is 0.01 μF in series with 50 Ω.

ARM INPUT. The BNC input allows you to arm the acquisition system by grounding the center lead. An internal pull up resistor connected to +5 V maintains a high level until you ground the input. When the center lead is grounded, the waveform analyzer. is armed.

EXTERNAL TRIGGER INPUT. The BNC input provides a way to trigger the time base from an external source. The 50 Ω input is DC coupled. Trigger signals as large as ±5 V (DC + Peak AC) may be applied.

SERIAL INTERFACE. This 9-pin D connector provides a serial interface for controlling the waveform analyzer and reading acquired data. See Figure 2–3 on page 2–7 for the RS-232 pin assignments. You can configure the serial interface with the commands in the SYST:COMM:SER subsystem.

Power-On Procedure

This section describes how to configure and install the waveform analyzer before performing the maintenance procedures in this manual. You will learn about the following topics:

- *Connect the VXIbus Test System* (below) provides instructions for installing the waveform analyzer and Slot 0 controller into a VXIbus mainframe.
- *Power-On Self Tests* on page 2–12 describes the internal self tests the waveform analyzer performs at power-on.
- *Basic Communication* on page 2–12 provides a way to verify the installation. You will query the waveform analyzer identification, and then read the query response.

If the waveform analyzer will not complete the power-on procedure, refer to *Troubleshooting* on page 6–27 for further assistance.

Connect the VXIbus Test System. Perform the following procedure to connect a VXIbus test system similar to the one shown in Figure 2–5. Due to the wide range of possible system configurations, these instructions only provide general guidelines. If necessary, refer to the manual for the system components to determine specific setup and configuration parameters.

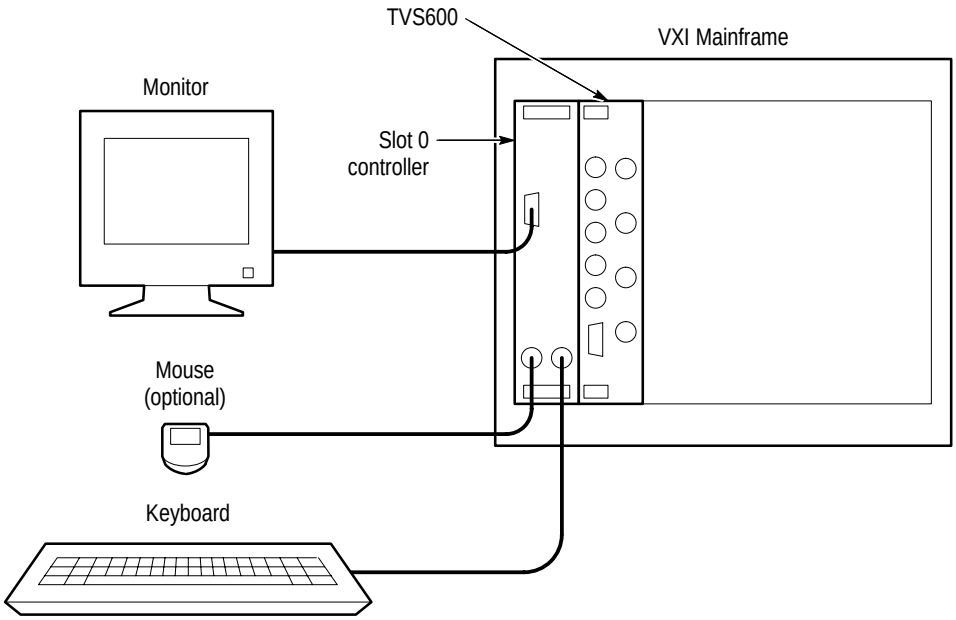


Figure 2–5: Typical VXIbus test system for maintenance procedures

To communicate with the waveform analyzer once power-on is complete, you will need to install a talk/listen software application on your computer. You can use the *Tektronix TVS600 Soft Front Panel*, a standard accessory for the waveform analyzer.

***NOTE**. If you are performing the* Performance Verification Procedure *or* Adjustment Procedures*, use the Slot 0 controller shown in Table 4–3 or Table 5–3, respectively. The Field Adjust/PV software that is used for these procedures only supports the Slot 0 controller listed.*

1. Configure the VXIbus mainframe. Set the jumpers as needed for the Slot 0 controller and waveform analyzer.
   - Refer to the manual for the Slot 0 controller for detailed configuration requirements
   - See *Installation*, beginning on page 2–1, for detailed waveform analyzer configuration requirements
2. Configure and install the Slot 0 controller. Refer to the manual for the Slot 0 controller for detailed instructions.
   a. Set the logical address as required, typically to 00.
   b. Set the interrupt handler as required, typically to 4.
   c. Install the Slot 0 controller into the left-most slot(s) in the VXIbus mainframe.
3. Configure and install the waveform analyzer. See *Installation*, beginning on page 2–1, for detailed instructions.
   a. Set the logical address to one of the following settings:
      - Use 02 to perform the *Performance Verification Procedure* or the *Adjustment Procedures*
      - Use FF (Dynamic Auto Configuration) to perform only the *Incoming Inspection Procedure*
   b. Install the waveform analyzer into the VXIbus mainframe slots that you configured for it in step 1.
4. Connect the monitor, keyboard, and mouse. Refer to the manual for the computer or Slot 0 controller for detailed instructions.
5. Install the talk/listen software. Refer to the manual for the software package for detailed instructions.

Power-On Self Tests. During power-on, the waveform analyzer performs a kernel self test to verify its functionality. Power-on requires approximately five seconds to complete. The front-panel ARM'D and TRIG'D indicators blink during the self test. After testing completes, the front panel indicators have the following states:

- READY — Green (on)
- ACCESSED — off
- ARM'D — off
- TRIG'D — off

***NOTE**. The READY indicator blinks at power-on if the waveform analyzer has an event to report. The indicator does not light if the power-on self test fails.*

Once the power-on self tests are complete, the waveform analyzer recalls settings from nonvolatile memory. Values are equal to the settings that were active when the waveform analyzer was last powered off.

Most parameters have a default value that you can implement by sending the `*RST` command. For more information, see the *TVS600 Series Waveform Analyzers User Manual* (Tektronix part number 070-9283-XX).

Basic Communication. The following procedure helps you to establish communication with your waveform analyzer. At the same time, you will check the firmware version installed in the instrument. To query the waveform analyzer identification, you can use any talk/listen software that allows your Slot 0 controller to communicate over the VXIbus.

1. Power on each component within your VXIbus system (VXIbus mainframe and monitor).
2. Wait for internal self tests to complete. Verify that the front panel indicators have the proper states.
3. Send the following command to query the instrument type and firmware version:

   ```
   *IDN?
   ```

4. Read the waveform analyzer response to the `*IDN?` query.

   The response includes information about the waveform analyzer such as Manufacturer, Model Number, Serial Number, SCPI version, and Firmware Version. A typical response is shown below:

   ```
   TEKTRONIX,TVS641,B010100,SCPI:94.0 FVER:1.0
   ```

Self Cal Mode

The self cal is an internal routine that optimizes instrument performance at the current ambient temperature to maximize measurement accuracy. No external equipment or user actions are needed to complete the procedure. The waveform analyzer saves data generated by the self cal in nonvolatile memory.

***NOTE**. Performing the self cal does not guarantee that all waveform analyzer parameters operate within limits. Operation within limits is achieved by performing the* Adjustment Procedures*, which begin on page 5–1.*

When to Perform Self Cal. You can run a self cal at any time during normal operation. To maintain measurement accuracy, always perform a self cal under the following conditions:

- Operating temperature is not within ±5° C of the temperature when self cal was last performed
- More than 24 hours have elapsed since the last self cal
- You are preparing to make an important series of measurements

If the waveform analyzer loses power during self cal, rerun the self cal following the next power-on. The self cal data generated before power was interrupted must be replaced with a complete set of new data. For best results, always perform the self cal at least 20 minutes after power-on.

Running Self Cal. The waveform analyzer requires approximately 10 minutes to run a self cal. Depending on the results you need, either of the following commands might be used:

- `CAL` runs a complete self cal and saves the resulting data in memory
- `*CAL?` runs a complete self cal, saves the resulting data in memory, and returns a numeric value showing the results

See Table 2–3 on page 2–15 for a more detailed description of the self cal commands.

Self Cal Results. When queried, the waveform analyzer returns a numeric value that shows the self cal results. Use either `CAL:RES?` or `CAL:RES:VERB?` to read the self cal results. Table 2–1 defines the values the waveform analyzer can return. If values between 2000 and 2999 are returned, see *Troubleshooting* on page 6–27 for instructions.

Table 2–1: Self Cal Results

Numeric Value	Definition
–1	Self cal is still in progress
0	Self cal completed successfully
2000 through 2999	Self cal failed; the numeric value identifies the failed self cal function

Self Tests

Self tests are internal tests that check the functionality of circuits within the waveform analyzer. The self tests provide a more complete check of the waveform analyzer than the power-on self test. No external equipment or user actions are needed to complete the self tests.

When to Perform Self Tests. A self test can be performed whenever you need to confirm instrument functionality. These tests, when successfully completed, provide a high level of confidence that the waveform analyzer is functional. You can often use results from failed self tests to isolate faults to a module.

Running Self Tests. The waveform analyzer runs the complete set of self tests in approximately 10 minutes. Depending on the results you need, either of the following commands might be used:

- `TEST` runs all available self tests (1000 to 2999); the resulting self cal data is not saved in memory
- `TEST?` runs all available self tests (1000 to 2999) and returns a numeric value showing the results; the resulting self cal data is not saved in memory

See Table 2–3 on page 2–15 for a summary of all the self test commands.

Self-Test Results. When queried, the waveform analyzer returns a numeric value that shows the self test results. Use either `TEST:RES?` or `TEST:RES:VERB?` to read the self test results. Table 2–2 defines the test values the waveform analyzer can return. If values between 1000 and 2999 are returned, see *Troubleshooting* on page 6–27 for instructions.

Table 2–2: Self Test Results

Numeric Value	Definition
–1	A self test is still in progress
0	Self tests completed successfully
1000 through 2999	A self test failed; the numeric value identifies the failed test

Instrument Commands Used for Maintenance

The waveform analyzer command set contains several commands that execute self tests. You can use the self tests for diagnostic purposes, or for optimizing instrument performance (self cal). Each self test is identified by a number as shown below:

- 1000 to 1999 — functional tests
- 2000 to 2999 — self cal functions

Self tests are initiated using the CAL and TEST command headers. The command header determines whether the waveform analyzer uses the self test results.

CAL Commands. The CAL and *CAL? commands execute a self cal of the waveform analyzer. A self cal runs all self tests within the range 2000 to 2999. Upon successful completion of the self cal, the waveform analyzer stores the resulting data in memory. The self cal data is only replaced when another self cal is successfully completed. See *Self Cal Mode* on page 2–13 for additional information.

TEST Commands. The TEST, TEST?, and *TST? commands execute all self tests within the range of 1000 to 2999. Self tests executed using these commands do not store data in the waveform analyzer memory. For this reason, you can safely execute self tests that perform self cal functions (2000 to 2999) without changing the waveform analyzer performance. See *Self Tests* on page 2–14 for additional information.

Command Summary. Table 2–3 contains an alphabetical listing of the maintenance-related commands. The table provides arguments, syntax examples, and descriptions for each command header. Commands are shown in their abbreviated form. The parenthesized question symbol (?) identifies commands that also have a query form. For a more detailed description of these or any other commands, refer to the *TVS600 Series Waveform Analyzers User Manual* (Tektronix part number 070-9283-XX).

Table 2–3: Service-related Commands

Header	Arguments	Example Syntax	Description
CAL (?)	N/A	CAL CAL?	Executes a self cal of all internal subsystems. Self cal stops if a failure occurs. Query executes a self cal and returns a numeric value showing results. The value 0 indicates no failures. Values between 2000 and 2999 identify unique self cal functions.
CAL:RES?	N/A	CAL:RES?	Returns a numeric value showing results of the last self cal. The value 0 indicates no failures. Values between 2000 and 2999 identify unique self cal functions. The value –1 indicates a self cal is in progress.

Table 2–3: Service-related Commands (Cont.)

Header	Arguments	Example Syntax	Description
CAL:RES:VERB?	N/A	CAL:RES:VERB?	Same as CAL:RES?, but appends the error number with an error-specific message.
OUTP:REF (?)	0 or OFF 1 or ON	OUTP:REF ON OUTP:REF?	Turns the REFERENCE OUTPUT on or off, or returns the on/off status of the REFERENCE OUTPUT. Responses are 0 (off) and 1 (on).
OUTP:REF:FUNC (?)	CLOC VOLT	OUTP:REF:FUNC VOLT OUTP:REF:FUNC?	Selects the signal for output at the REFERENCE OUTPUT connector, or returns signal selection for the REFERENCE OUTPUT. Responses are CLOC and VOLT.
TEST (?)	N/A	TEST TEST?	Executes all internal self tests. If a failure occurs and halt control is enabled, the test will stop immediately. The query executes all internal self tests and returns a numeric value showing results. The value 0 indicates no failures. Values between 1000 and 1999 identify unique test functions. Values between 2000 and 2999 identify unique self cal functions. The data resulting from self cal test execution is not used.
TEST:RES?	N/A	TEST:RES?	Returns the results of the last self test. If a failure occurs, the number returned identifies the first failed test within the sequence. The value 0 indicates no failures. Values between 1000 and 2999 identify unique test functions. The value –1 indicates a test is in progress.
TEST:RES:VERB?	N/A	TEST:RES:VERB?	Same as TEST:RES?, but appends the error number with an error-specific message.
*CAL?	N/A	*CAL?	Executes a self cal of all internal subsystems. Returns a numeric value showing results. The value 0 indicates no failures. Values between 2000 and 2999 identify unique self cal functions.
*IDN?	N/A	*IDN?	Returns identification message in the following format: Manufacturer, Model Number, Options, Serial Number, SCPI and Firmware Version.
*LRN?	N/A	*LRN?	Returns a sequence of program message units that show the current settings. You can return this data to the instrument to place it in a known state.
*RST	N/A	*RST	Returns the instrument settings to the default, (power-on) state.
*TST?	N/A	*TST?	Executes all internal self tests. Returns a numeric value showing results. The value 0 indicates no failures. Values between 1000 and 1999 identify unique diagnostic functions. Values between 2000 and 2999 identify unique self cal functions. The data resulting from self cal test execution is not used.

Theory of Operation

This chapter describes the electrical operation of the waveform analyzer. The information supports fault isolation to the module or circuit board level. It supplements the diagnostic information found in the *Troubleshooting* section that begins on page 6–27.

The following *Block Level Description* describes circuit operation to the functional block level. When reading this description, refer to Figure 9–1 and Figure 9–2 for interconnection and block diagram illustrations, respectively.

Block Level Description

The block level description provides an overview of each functional circuit within the waveform analyzer. Except for the number of channels, the basic operation is the same for each model. The TVS641 and TVS645 models have four input channels. The TVS621 and TVS625 have two input channels.

Input/Output Connectors

Input signals to be measured enter the waveform analyzer through probes or cables connected to BNC connectors on the front panel. A probe interface detects the attenuation factor of each probe. The probe data is routed to the Acquisition Board (A2) where it is used to set the vertical scale.

Five additional front-panel BNCs provide signal connections for functions such as external triggering and probe compensation. A coaxial cable assembly routes the input/output signals between the front panel and the circuit boards.

Acquisition Board (A2)

The Acquisition Board (A2) accepts analog input signals and converts them to digital information. Two 100-pin ribbon cables provide interconnections with the Processor Board (A1) for power supplies, waveform data, and control signals.

The Acquisition Board (A2) consists of the following circuits:

- Attenuators
- Acquisition System
- VCO
- Trigger
- VXI Triggers

Attenuators. Signals applied to each channel input (CH 1, CH 2, CH 3, and CH 4) connect to an attenuator. The Main Processor System, by way of the DSP Processor System, controls the attenuators. The attenuators select input coupling, termination, bandwidth, offset, and full scale range. Outputs from each attenuator drive the Acquisition System and Trigger circuits.

Acquisition System. The Acquisition System amplifies the input signals, samples them, and converts them to digital signals with 8-bit resolution. The system controls the acquisition process under direction of the Main Processor System.

Voltage Controlled Oscillator (VCO). Master clocks for the Acquisition System are generated by the Voltage Controlled Oscillator (VCO). The VCO circuit is a phase locked loop that is referenced to a 10 MHz clock. Signals from an internal 10 MHz clock, or the VXIbus P2 connector, provide a reference for the VCO.

Trigger. The Trigger circuit produces trigger signals to control the Acquisition System timebase. Trigger signals are selected from the following sources:

- Attenuator — internal triggering
- Front-panel EXTERNAL TRIGGER connector — external triggering
- VXI Triggers — triggering from the VXIbus

The front-panel ARM INPUT connector accepts signals from external devices to inhibit triggering.

VXI Triggers. The VXI Triggers circuit routes system-generated TTLTRG and ECLTRG trigger signals to the Trigger circuit. Under control of the Main Processor System, the VXI Triggers circuit selects which TTLTRG and ECLTRG trigger signals are active, and defines the arming and triggering parameters.

Processor Board (A1)

The Processor Board (A1) controls instrument hardware, signal acquisition, and communications functions. Two 100-pin ribbon cables provide interconnections with the Acquisition Board (A2) for power supplies, waveform data, and control signals.

The Processor Board (A1) consists of the following circuits:

- Main Processor System
- DSP Processor System
- VXI Interface
- Serial Interface
- Power Supplies

Main Processor System. The Main Processor System contains a 68330 microprocessor that controls the entire instrument. Commands and data sent to the instrument over the VXIbus pass through the VXI Interface, which resides on the 68330 bus. The 68330 bus also routes data between the Main Processor System, the DSP Processor System, and the Serial Interface.

The Main Processor System includes the instrument firmware. To facilitate upgrades the firmware resides in FlashROM that can be reprogrammed using a Slot 0 controller.

DSP Processor System. The DSP Processor System contains a 320C31 microprocessor that controls signal acquisition, waveform processing, and measurements. Acquisition Memory addressing signals are transferred over the DSP Bus. The DSP Processor System is under control of the Main Processor System.

VXI Interface. The VXI Interface transfers commands and data between the VXIbus and the Main Processor System. Signals pass between the instrument and the VXIbus through the P1 VXIbus connector.

Serial Interface. The Serial Interface transfers data between the Main Processor System and the front-panel SERIAL INTERFACE connector. The connector is RS-232 compatible. Data transfer occurs over the 68330 bus.

Power Supplies. The Power Supplies receive +5 V, –5 V, and ±12 V from the VXIbus mainframe to power the waveform analyzer. Fuses protect the mainframe from over-current conditions. Voltage regulators produce additional ±15 V and ±5 V supplies for use on the Acquisition Board (A2). All power connections to the Acquisition Board (A2) are made through the 100-pin ribbon cables.

Performance Verification

This chapter contains instructions for testing the performance of the waveform analyzer. Two levels of testing are provided:

- *Incoming Inspection Procedure* on page 4–3
- *Performance Verification Procedure* on page 4–13

This section contains an overview of each procedure. You may not need to perform both procedures, depending on the test results you need to obtain.

If you are not familiar with operating the waveform analyzer, read the *Operating Information* that begins on page 2–1 before attempting these procedures. More detailed operating information is available in the *TVS600 Series Waveform Analyzers User Manual* (Tektronix part number 070-9283-XX).

Incoming Inspection Procedure Overview

To rapidly confirm that the waveform analyzer functions and is adjusted properly, perform the *Incoming Inspection Procedure*, which begins on page 4–3. The *Incoming Inspection Procedure* is easy to perform and provides high confidence that the waveform analyzer operates properly. The tests can be used as a quick check before making a series of important measurements. You might use them to determine if the waveform analyzer is suitable for putting into service, such as when it is first received.

Test Equipment Requirements

The *Incoming Inspection Procedure* requires a VXIbus mainframe, Slot 0 controller, computer keyboard, monitor, frequency counter, digital multimeter, and one coaxial cable. Table 4–3 on page 4–16 provides examples of the system components. See *About the System Setup* on page 4–4 for additional information.

Test Summary

The *Incoming Inspection Procedure* tests the functionality of the following parameters:

- Internal self tests
- Time and amplitude references
- Self cal
- FIDUCIAL INPUT connector

Performance Verification Procedure Overview

If more extensive confirmation of performance is desired, perform the *Performance Verification Procedure*. The *Performance Verification Procedure*, which begins on page 4–13, tests each characteristic that is designated as checked (✓) in the *Specifications* section.

Test Equipment Requirements

Table 4–3 on page 4–16 provides a list of test equipment required to perform the *Performance Verification Procedure*. Because software is used to test the waveform analyzer, use the Slot 0 controller shown in Table 4–3. Otherwise the software may not function as described.

Test Record

The test record section on page 4–28 provides instructions for using the Field Adjust/PV software to print a complete summary of the PV test results. Use the test record to document performance before and after adjustment.

Test Summary

The *Performance Verification Procedure* is performed by running the Field Adjust/PV software, provided with this manual. The Field Adjust/PV software provides procedures for testing the following parameters:

- Accuracy, DC Gain
- Accuracy, DC Voltage Measurement
- Accuracy (DC) for Internal Trigger Level, DC Coupled
- Accuracy (DC) for External Trigger Level
- Accuracy, Delta DC Voltage Measurement
- Accuracy, Long Term Sample Rate and Delay Time
- Accuracy (Time) for Pulse Glitch or Pulse Width Triggering
- Accuracy, Offset
- Analog Bandwidth, DC–50 Ω Coupled
- Delay Between Channels, Full Bandwidth
- Output, Reference
- Probe Compensation, Output Voltage
- Random Noise
- Sensitivity, Edge-Type Trigger, DC Coupled

Incoming Inspection Procedure

This section contains instructions for performing the *Incoming Inspection Procedure*. This procedure provides an easy way to check the functionality of the waveform analyzer. For example, you might use the procedure to meet the following test requirements:

- Check the waveform analyzer before making a series of important measurements
- Verify that the waveform analyzer is suitable for putting into service, such as when it is first received

If any test within this section fails, see *Troubleshooting* on page 6–27 for instructions. Failed tests indicate the instrument needs to be serviced.

Description

The *Incoming Inspection Procedure* is divided into four parts:

- *Connect the VXIbus Test System* on page 4–5 provides instructions for setting up the test system needed for these procedures
- *Self Tests* on page 4–6 provides instructions for performing the internal self tests
- *Functional Tests* on page 4–7 measures the time and amplitude reference signals at the REFERENCE OUTPUT connector
- *Self Cal* on page 4–10 provides instructions for performing the self cal

Purpose

This procedure provides a functional check only. If more detailed testing is required, perform the *Performance Verification Procedure*, which begins on page 4–13, after completing this procedure.

Test Interval

Perform these tests whenever you need to gain confidence that the waveform analyzer is operating properly.

Test Equipment

The *Incoming Inspection Procedure* requires the following test equipment:

- VXIbus mainframe
- Slot 0 controller
- Computer peripherals (keyboard and monitor required, mouse is optional)
- Talk/listen software
- One coaxial cable with BNC connectors
- Dual-banana to BNC adapter
- Frequency counter (measures 10 MHz at <0.0025% accuracy)
- Digital multimeter (measures +8 V at 0.25% accuracy)
- Pulse generator; risetime 100 ps, overshoot/undershoot <1.75% (used for *Fiducial Input Check* only)

Table 4–3 on page 4–16 provides examples of the system components.

NOTE. *If you are performing the* Incoming Inspection Procedure *as a prerequisite to the* Performance Verification Procedure*, use the Slot 0 controller shown in Table 4–3. The software that is used for the* Performance Verification Procedure *only supports the Slot 0 controller listed. The Slot 0 controller logical address must be set to 02.*

About the System Setup

The *Incoming Inspection Procedure* is designed for a VXIbus system that contains an embedded Slot 0 controller. During the procedure you will communicate with the waveform analyzer using talk/listen software such as *Tektronix TVS600 Soft Front Panel*, a standard accessory for the waveform analyzer. Figure 4–1 on page 4–5 shows a typical setup.

The procedure can also be performed using other Slot 0 controllers and talk/listen software. If an alternate setup is used, you might need to reformat the commands to work with the talk/listen software.

You may choose to perform the *Incoming Inspection Procedure* using the SERIAL INTERFACE connector on the front panel of the waveform analyzer. You can connect a terminal directly to the SERIAL INTERFACE connector, or run talk/listen software for a PC terminal emulation. The waveform analyzer recalls the last RS-232 settings from memory at power-on. Table 4–1 lists the factory default settings.

Order a 9-pin to 25-pin serial interface cable (Tektronix part number 012-1380-XX) to connect the waveform analyzer SERIAL INTERFACE connector to the terminal.

Table 4–1: Factory Default RS-232 Settings

Parameter	Command Syntax	Default Setting
Baud rate	BAUD	9600
Stop bits	SBIT	1
Parity	PAR	None
DCD	DCD	Off
Echo	ECHO	On
Line buffer	LBUF	On
Pace	PACE	XON
RTS	RTS	On
Error Response	ERES	On

Connect the VXIbus Test System

Perform the following steps to connect a VXIbus test system similar to the one shown in Figure 4–1.

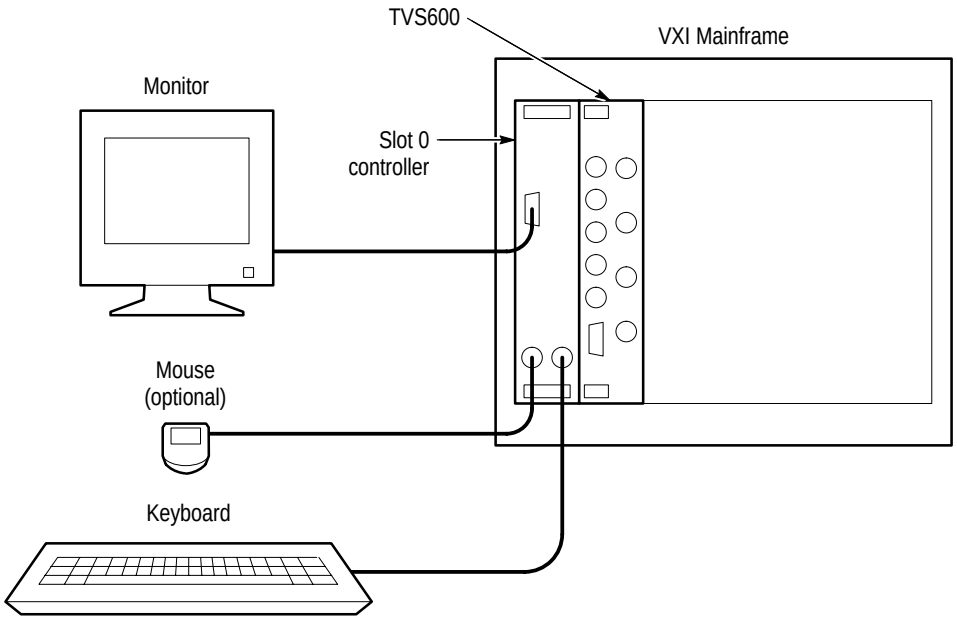


Figure 4–1: Typical VXIbus test system for the Incoming Inspection Procedure

1. Perform the *Power-On Procedure* located on page 2–10. Be sure to set the slot 0 controller logical address to 02.
2. Allow a 20-minute warmup. Then perform the *Self Tests* procedure that begins on page 4–6.

Self Tests

The *Self Tests* use internal routines to verify that the waveform analyzer is functional. No test equipment is required.

***NOTE**. Throughout this procedure, enter the commands as shown. The capitalization of characters is not important; you can use uppercase or lowercase characters.*

1. Send the following command to execute the internal self test routines:

   `TEST`

2. Wait for the self tests to complete.

   - When running self tests, the READY, ACCESSED, ARM'D, and TRIG'D indicators blink
   - These tests take approximately 10 minutes to complete

3. Send the following query to check the self test results:

   `TEST:RES?`

4. Read the self test results.

   - A 0 result indicates all tests passed successfully
   - A –1 result indicates the self tests are still in progress; wait five minutes and send the `TEST:RES?` query again to read the test results
   - A 1000 through 2999 result indicates self test failures; see *Troubleshooting* on page 6–27 for instructions

5. Perform the *Functional Tests* to continue the *Incoming Inspection Procedure*.

Functional Tests

The following procedures test the internal time and voltage references of the waveform analyzer. You will need a frequency counter, digital multimeter, coaxial cable with BNC connectors, and a dual-banana to BNC adapter to perform the *Functional Tests*. See the list on page 4–4 for equipment requirements.

NOTE. *The* Functional Tests *do not verify that all waveform analyzer features operate within limits. Operation within limits is checked in the* Performance Verification Procedure*, which begins on page 4–13.*

Measure Time Reference

This procedure tests the accuracy of the internal time reference (10 MHz ± 1.5 kHz).

1. Use a coaxial cable to connect the frequency counter input to the REFERENCE OUTPUT connector (see Figure 4–2).
2. Send the following command to initialize the waveform analyzer:

   *RST

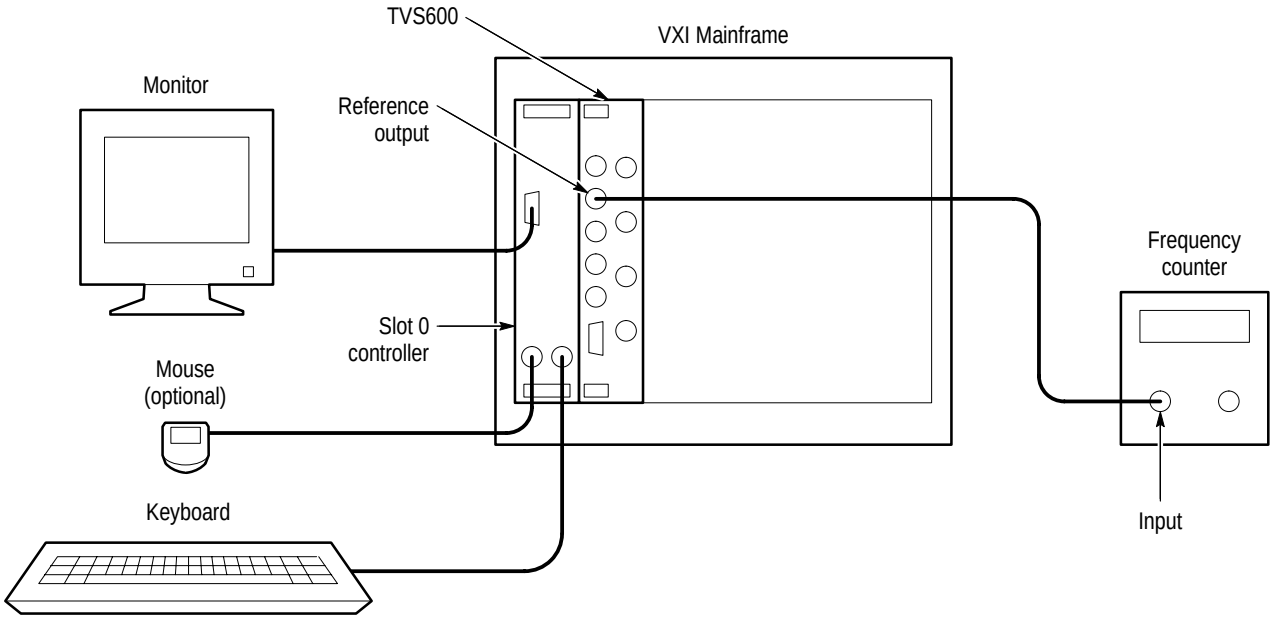


Figure 4–2: Time reference test setup

3. Select the following frequency counter control settings:

Mode	Frequency
Trigger	Internal
Attenuation	X1

4. Send the following command to turn on the time reference:

   ```
   OUTP:REF:FUNC CLOC;:OUTP:REF ON
   ```

5. Adjust the frequency counter trigger control for a stable display. The frequency must be between 9,998,500 Hz and 10,001,500 Hz.

6. Disconnect the frequency counter from the REFERENCE OUTPUT connector.

7. Perform *Measure Voltage Reference* to continue the *Incoming Inspection Procedure*.

Measure Voltage Reference

This procedure tests the accuracy of the internal voltage reference (+8 V ±1%).

1. Use a coaxial cable and dual-banana to BNC adapter to connect the digital multimeter input to the REFERENCE OUTPUT connector (see Figure 4–3).

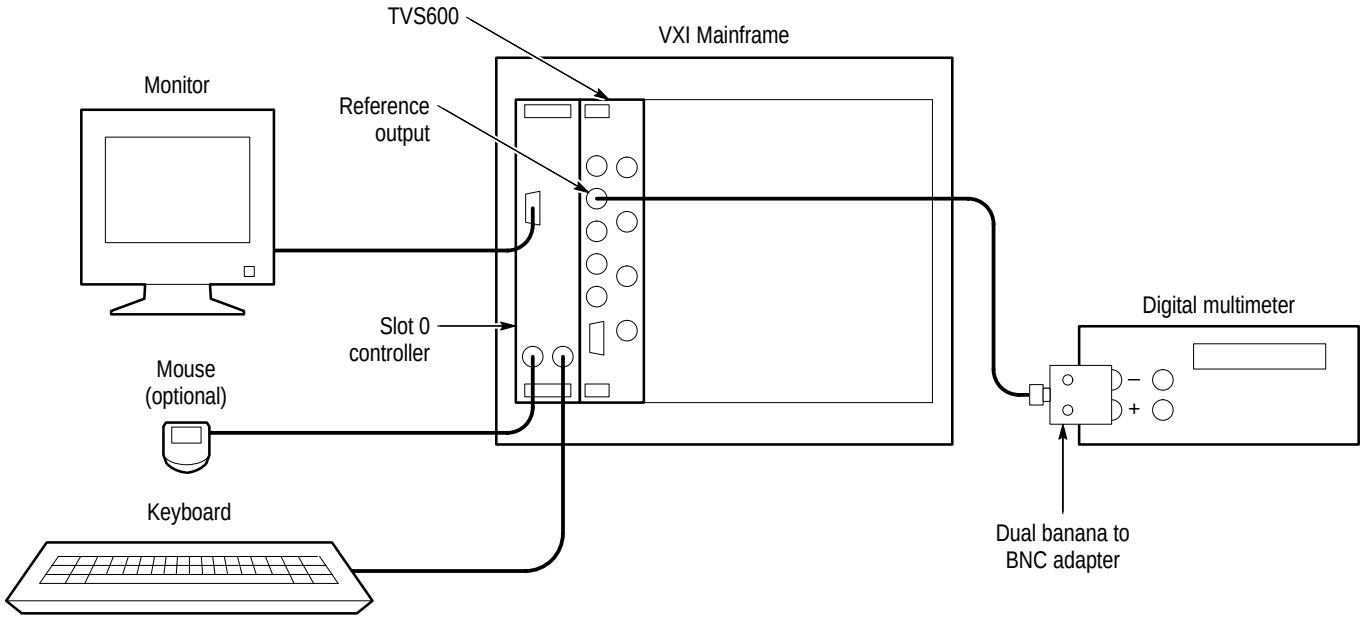


Figure 4–3: Voltage reference test setup

2. Send the following command to initialize the waveform analyzer:

   ```
   *RST
   ```

3. Select the following digital multimeter control settings:

Mode	DC Volts
Scale	20

4. Send the following command to turn on the voltage reference:

   ```
   OUTP:REF:FUNC VOLT;:OUTP:REF ON
   ```

5. Check the digital multimeter display. The voltage must be between +7.92 V and +8.08 V.
6. Disconnect the digital multimeter from the REFERENCE OUTPUT connector.
7. Perform the *Fiducial Input Check* to continue the *Incoming Inspection Procedure*.

Self Cal

The *Self Cal* uses internal routines to generate data such as gain and offset values, to optimize the waveform analyzer performance at the current ambient temperature. The data is stored in memory for use until you perform another self cal. No test equipment is required.

1. Send the following command to execute the internal self cal routines:

   ```
   CAL
   ```

2. Wait for the self cal to complete.

   - When running self cal, the READY, ACCESSED, ARM'D, and TRIG'D indicators blink
   - The self cal takes approximately 10 minutes to complete

3. Send the following query to check the self cal results:

   ```
   CAL:RES?
   ```

4. Read the self cal results.

   - A 0 result indicates all tests passed successfully
   - A –1 result indicates the self cal is still in progress; wait five minutes and send the `CAL:RES?` query again to read the test results
   - A 2000 through 2999 result indicates self cal failures; see *Troubleshooting* on page 6–27 for instructions

This completes the *Incoming Inspection Procedure*. If all tests passed, the waveform analyzer is ready for use. If any test failed, see *Troubleshooting* on page 6–27 for instructions.

FIDUCIAL INPUT Check

This procedure checks the functionality of the FIDUCIAL INPUT on the waveform analyzer front panel. If you do not plan to use the FIDUCIAL input, you may choose to bypass this check and proceed with the *Self Cal*.

During the following procedure a 1 V pulse is applied to the FIDUCIAL INPUT, and no signal is applied to the active CH 1 input. You then measure the resulting AC coupled pulse that appears on the CH 1 acquisition. The 1 V input is AC coupled and reduced by a factor of six. Figure 4–4 shows how the input signal appears on the CH 1 acquisition if you were to graph the data. During the following procedure the waveform analyzer is queried to retrieve the test results (you will not actually see the waveform shown in Figure 4–4).

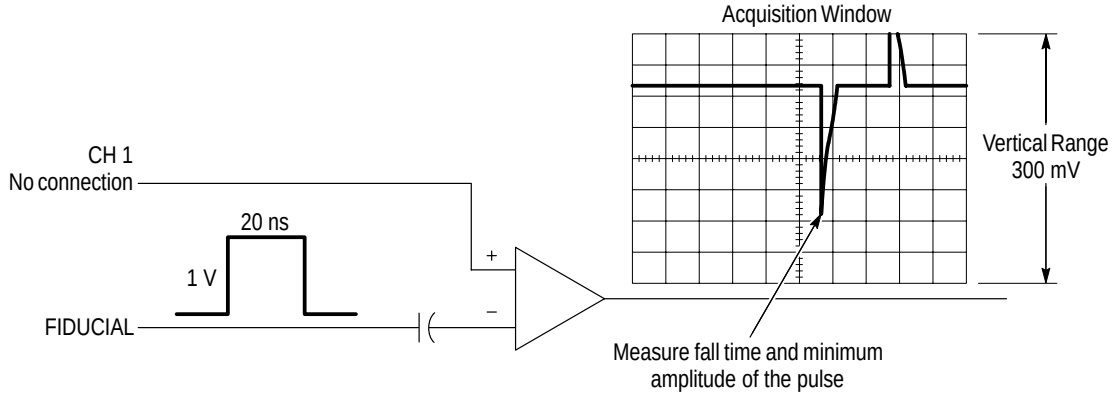


Figure 4–4: Measurement of the FIDUCIAL input functionality

1. Connect the test equipment as shown in Figure 4–5.

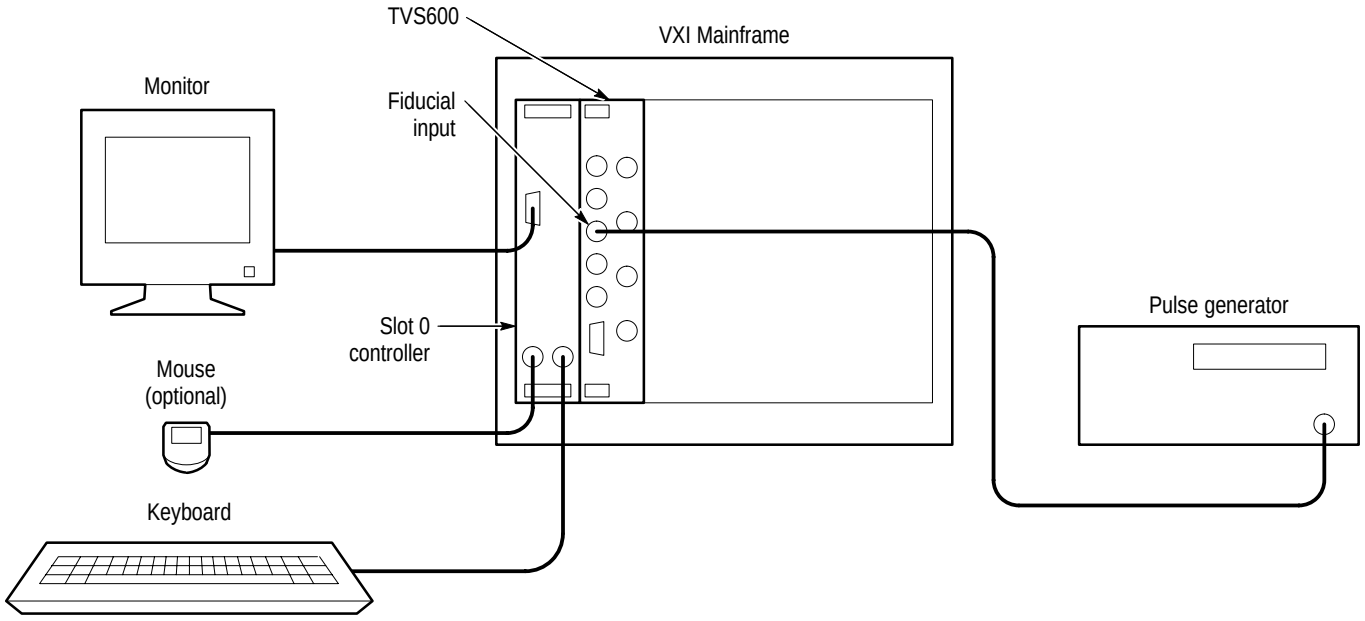


Figure 4–5: FIDUCIAL INPUT check setup

2. Set the pulse generator as follows:

Amplitude	1.0 V
Pulse Duration	20 ns
Duty Cycle	500 ns
Output Enable	ON

3. Send the following commands to the waveform analyzer using the talk/listen software to setup the waveform analyzer:

```
*RST

FUNC CHAN1

VOLT1:RANGE:PTP 300 MV;OFFS -125 MV

TRIG:SLOP NEG;LEV -100 MV

SWE:TINT MIN

SWEEP:OREF:LOC 0.25

AVER ON;:AVER:COUN 8

CALC1:FEED CHAN1;:CALC1:WML FTIM,MIN

CALC1:WML:STAT ON
```

4. Start signal acquisition by sending the command

```
INIT
```

5. Retrieve the results of the fall time and amplitude measurements by sending the command:

```
CALC1:DATA?
```

6. Check that the fall time, the first value, is within the following values:

TVS6X5	approximately 2.5 ns
TVS6X1	approximately 3 ns

7. Verify that the min amplitude, the second value, is approximately 150 mV.

   If the measured values are within the listed specifications, your waveform analyzer FIDUCIAL INPUT is operating correctly.

8. Perform *Self Cal* to continue the *Incoming Inspection Procedure*.

Performance Verification Procedure

NOTE. *These procedures extend the confidence level provided by the* Incoming Inspection Procedure *described on page 4–3. You do not need to perform the* Incoming Inspection Procedure *before doing the* Performance Verification Procedure.

This section contains information needed to test the performance of the waveform analyzer. Testing is performed using the Field Adjust/PV software, provided with this manual.

The Field Adjust/PV software (one disk) contains instructions and control programs for testing each characteristic that is designated as checked (✓) in the *Specifications* section.

Description

The *Performance Verification Procedure* is divided into the following parts:

- *Prerequisites* on page 4–14 describes conditions that must be met before performing this procedure
- *Using the Software* on page 4–14 provides general information about testing the waveform analyzer using the Field Adjust/PV software
- *Equipment Required* on page 4–16 lists the test equipment needed to perform the tests
- *Performance Verification Instructions* on page 4–18 provides written procedures for installing and using the Field Adjust/PV software
- *Test Record* on page 4–28 provides a way to print a record of the test results
- *Help Utility* on page 4–31 provides an overview of the Field Adjust/PV software help system
- *Interrupt Utility* on page 4–33 provides an overview of the Field Adjust/PV software interrupt system

Purpose

This procedure verifies that the waveform analyzer performance is in conformance with the specifications that are designated as checked (✓) in the *Specifications* section.

Test Interval

As a general rule, these tests should be done once a year.

Test Equipment

A VXIbus mainframe, embedded Slot 0 controller, computer peripherals, and external standards are required to test the waveform analyzer. A printer can be used to print a record of the test results. Refer to the equipment list, starting on page 4–16, for a complete list of test equipment requirements.

Prerequisites

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

- A signal-path compensation (self cal) is performed within the recommended calibration interval and at a temperature within ±5° C of the present operating temperature. See *Self Cal Mode* on page 2–13 for details.
- The waveform analyzer must have been last adjusted at an ambient temperature between +20° C and +30° C, must have been operating for a warmup period of at least 20 minutes, and must be operating at an ambient temperature between 0° C and +50° C.
- The side covers are installed on the waveform analyzer.
- The waveform analyzer is in an environment within the limits described in the *Specifications* section (see Table 1–8 on page 1–12).

Using the Software

This section describes how to perform tests using the Field Adjust/PV software. It also provides information about the files located on the Field Adjust/PV software disk.

Performing the Tests

When using the Field Adjust/PV software, you will connect external standards to the waveform analyzer in response to prompts on the computer screen. Your role is to connect the test signals and to instruct the computer to continue. The Field Adjust/PV software automatically selects the waveform analyzer settings and determines the results of each test.

Test Sequences

The Field Adjust/PV software allows you to run groups of tests, or test sequences. A sequence consists of one or more individual tests. The easiest way to test waveform analyzer performance is to run a FULL SEQUENCE, which causes the software to perform all tests in a specified order. However, to obtain partial test information you can also run individual tests or selected groups. The INTERNAL_CAL test must run successfully before the other tests are performed. The remaining tests can then be performed in any order. See *Using the Field Adjust/PV software* on page 4–20 for additional information.

The Field Adjust/PV software contains the tests shown in Table 4–2. Each test verifies one or more parameters that are designated as checked (✓) in the *Specifications* section. By running a FULL SEQUENCE, you will verify the performance of the waveform analyzer.

Table 4–2: Field Adjust/PV Software PV Tests

PV Test Name	Specification Tested
1. INTERNAL_CAL	Runs the internal self cal
2. DC_GAIN_ACCURACY	Accuracy, DC Gain
3. OFFSET_ACCURACY	Accuracy, Offset
4. VERT_DCACCUR	Accuracy, DC Voltage Measurement Accuracy, Delta DC Voltage Measurement
5. VERT_BANDWIDTH	Analog Bandwidth, DC–50 Ω Coupled
6. RANDOM_NOISE	Random Noise
7. DELAY_MATCH	Delay Between Channels, Full Bandwidth
8. TIMEBASE_ACCURACY	Accuracy, Long Term Sample Rate and Delay Time
9. GLITCH_TRIG_ACC	Accuracy (Time) for Pulse Glitch or Pulse Width Triggering
10. TRIG_MAIN_ACC	Accuracy (DC) for Internal and External Trigger Level, DC Coupled
11. TRIG_MAIN_SENS	Sensitivity, Edge-Type Trigger, DC Coupled
12. TRIG_DELAY_ACC	Accuracy (DC) for Internal Trigger Level, DC Coupled
13. TRIG_DELAY_SENS	Sensitivity, Edge-Type Trigger, DC Coupled
14. REFERENCE_OUT	Output, Reference
15. PROBE_COMPENSATION	Probe Compensation, Output Voltage

Equipment Required

These procedures use external, traceable signal sources to directly test characteristics that are designated as checked (✓) in the *Specifications* section. Table 4–3 shows the required equipment list. This equipment list also applies to the *Incoming Inspection Procedure*.

Table 4–3: Test Equipment

Item Number and Description	Minimum Requirements	Example
1. VXIbus Mainframe	Minimum of four plug-in slots	Tektronix VX1410
2. Slot 0 Embedded Controller	National Instruments VXIpc-486 Series Model 566[1]	National Instruments VXIpc-486 Series Model 566[1]
3. Monitor	VGA	Tektronix part number 039–0008–00
4. Keyboard	Standard function, 101 keys	Tektronix part number 119–3772–00
5. Field Adjust/PV software	Shipped with the Service Manual	Part of Tektronix part number 070–9285–XX
6. Frequency Counter	Frequency accuracy: <0.0025% Frequency range: 1 kHz to 10 MHz	Hewlett Packard 5314A
7. Digital Multimeter	DCV error: 0.1% from –10 V to +100 V	Fluke 8842A
8. Connector, Dual-Banana	Female BNC to dual banana	Tektronix part number 103–0090–00
9. Voltage Reference	Amplitude error: <0.001%	Data Precision 8200
10. Capacitor[2]	0.1 μF, 200 V	Tektronix part number 283–0189–00
11. Cable, Dual-Input	Female BNC to dual male BNC	Tektronix part number 067–0525–02
12. Adapter, N to BNC	Male Type N to female BNC	Tektronix part number 103–0045–00
13. Cable, Precision 50 Ω Coaxial	50 Ω, 36 in, male to male BNC connectors	Tektronix part number 012–0482–00
14. Generator, Function	Frequency range: 1 Hz to 20 MHz Frequency accuracy: 0.1% Amplitude range: 10 mV to 20 V_{p-p}	Hewlett Packard 3325B

1 The Field Adjust/PV software runs on the standard configuration. If you will be using other applications, the Slot 0 Controller may need expanded RAM and video RAM capabilities.

2 The capacitor is installed across the Data Precision 8200 output terminals to reduce noise. If your voltage reference produces <4 mVp-p of noise, external noise reduction is not necessary.

Table 4–3: Test Equipment (Cont.)

Item Number and Description	Minimum Requirements	Example
15. Generator, Sine Wave[3]	Frequency range: 100 kHz to 1005 MHz Frequency error: <6 ppm Amplitude: 2 mV to 1.5 V_{RMS} Amplitude error: <0.35 dB	Gigatronics 6061
16. Power Meter with Sensor[3]	Bandwidth: >1.2 GHz Accuracy: 0.2 dB (2%) Sensitivity: 500 pW to 20 mW	Rohde & Schwarz NRVS with Model NRV-Z4 Sensor
17. Adapter, N to BNC (used only with power meter)	Female Type N to male BNC	Tektronix part number 103–0058–00
18. Adapter (used only with power meter)	Male BNC to male BNC	Tektronix part number 103–0029–00
19. 50 Ω Power Divider (used only with power meter)	Provide load isolation between source (Sine Wave Generator), the TVS600 inputs, and the Power Meter Maximum VSWR: 1.50	Tektronix part number 015–0565–00
20. SMA to BNC Adapters (three required, used only with power meter)	For use with the 50 Ω Power Divider	Tektronix part number 015–1018–00
21. Generator, Pulse (optional; used only for *Incoming Inspection Procedure*)	Risetime: <100 ps Overshoot or undershoot: <1.75%	Picoseconds Pulse Labs 4050
22. Printer with cable (optional, used to print test record)	PC-compatible, continuous feed, prints ASCII text, connects to DB-25 female connector	Any general purpose printer

3 If the signal generator output amplitude is not leveled within 0.35 dB over the 10 MHz to 1005 MHz frequency range, refer to *Leveling the Sine Wave Generator with the Power Meter* on page 4–27 for further instructions.

Performance Verification Instructions

NOTE. *Before testing a waveform analyzer that is uncalibrated, you must first complete the adjustment procedure (see page 5–1). An example of an uncalibrated waveform analyzer is one that has been repaired with a new circuit board.*

This section provides instructions for the following test steps:

- Connecting the VXIbus test system
- Installing the Field Adjust/PV software on your system
- Using the Field Adjust/PV software to test the waveform analyzer

Connect the VXIbus Test System

Perform the *Power-On Procedure* located on page 2–10. This procedure describes how to connect the VXIbus test system shown in Figure 4–6.

NOTE. *The VXIbus test system is already configured properly if you performed the* Incoming Inspection Procedure *using the Slot 0 controller listed in Table 4–3. If so, proceed to the* Field Adjust/PV Software Installation *procedure.*

The slot 0 controller logical address must be set to 02.

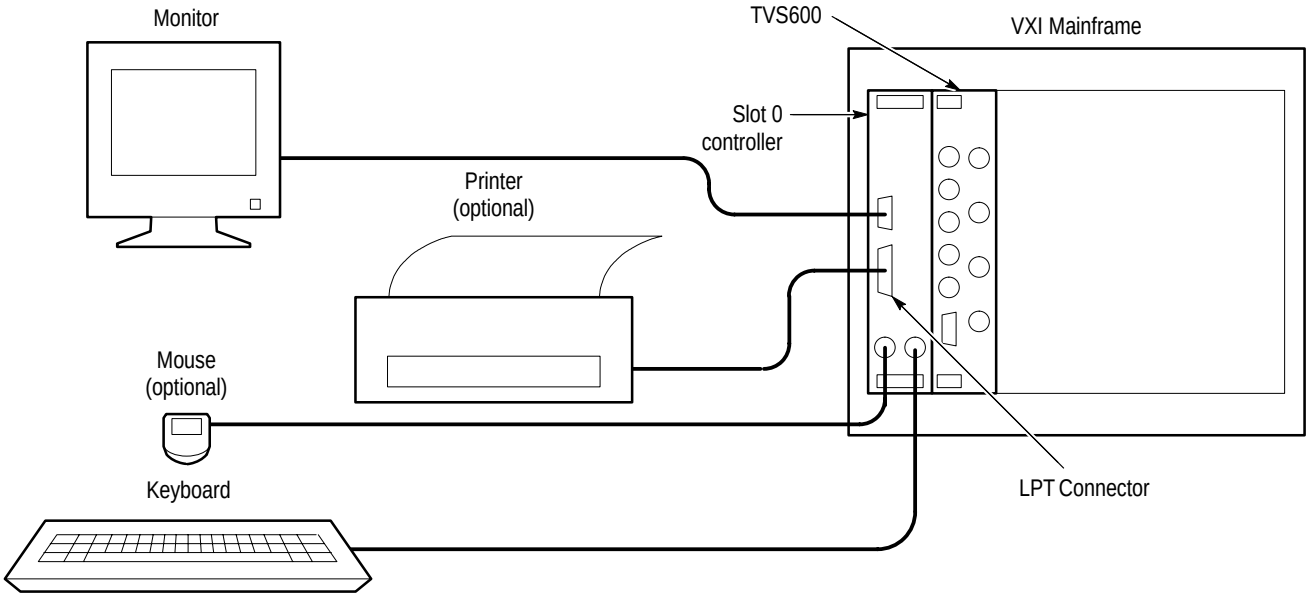


Figure 4–6: VXIbus test system for the Performance Verification Procedure

Field Adjust/PV Software Installation

***NOTE**. ALWAYS use this installation procedure to install the Field Adjust/PV software on a computer. This installation program uses parameters you supply (see step 2, substep d) to create a custom start-up file on your hard disk directory. After installation, the software instructs you to run this start-up batch file whenever you perform the tests. The batch file enables the software to configure your computer properly before it runs the verification program.*

Do not simply copy the software files from one computer to another, because the start-up batch file you copy may not match the computer you copy it to.

If your computer already has a directory named TEKCATS on the hard drive you specify for installation, the software installation cannot be completed.

1. Copy the Field Adjust/PV software disk to a working disk. Use either DOS commands or the Windows File Manager.
2. Install the software onto a hard disk as follows:
   a. Install the working disk into a floppy drive.
   b. To change drives to the floppy drive (either A or B), type `A:` or `B:`.
   c. Type `install`.
   d. When prompted by the on-screen instructions, specify the hard disk on which to install the software.

      Your computer will install the Field Adjust/PV software in a directory named `TEKCATS` on the hard drive you select.
3. Eject the Field Adjust/PV software disk and store in a secure place.

Using the Field Adjust/PV Software

The Field Adjust/PV software contains complete instructions for performing the *Performance Verification Procedure*. After starting the program, entering user identification information, and completing the preliminary set up, you can run full or partial test sequences. While tests are running, you must respond to instructions on the computer screen in the following manner:

- Connect test standards to the waveform analyzer
- Set up the test standards for the output signals described by on-screen instructions
- Press <RETURN> on the computer keyboard to continue the test

When a test passes, the software automatically displays the test results.

Refer to and *Initial Test Setups* on page 4–23 and *Leveling the Sine Wave Generator with the Power Meter* on page 4–27, for descriptions of the test equipment connections you will need when running the PV tests.

Making Menu Selections. A cursor highlights the selected item within a displayed menu. You can move the cursor using the arrow keys on the computer keyboard, or by entering the number next to the desired menu item. Then press the <RETURN> key to execute the selection.

Test Sequence Selections. Choose from the following menu selections to run all or part of the selected test sequence:

- RUN FULL SEQUENCE runs the entire sequence from beginning to end.
- RUN PARTIAL SEQUENCE runs part of the full sequence. The sequence runs from the selected starting point to the end.
- SELECT TEST(S) runs only the selected tests.

RUN FULL SEQUENCE is the most common selection. This sequence tests each parameter to ensure that the waveform analyzer operates within specified limits.

RUN PARTIAL SEQUENCE and SELECT TEST(S) are not intended for normal use. These sequences are useful only when you do not need results for all tests.

If your choice is SELECT TEST(S), you must specify each test to execute. To run a single test, simply enter its number and continue. Use a comma (,) or hyphen (–) to select more than one test. For example, enter 1,3,7 to run tests 1, 3, and 7; enter 10–13 to run tests 10, 11, 12, and 13.

The SELECT TEST(S) sequence activates four function keys for use in this mode. Table 4–4 provides an explanation of each function key.

Table 4–4: Function Keys for SELECT TEST(S) Mode

Function Key	Function	Description
F3	Cancel, End Seq	Stops the test and returns to the SELECT SEQUENCE screen
F4	Clear Input	Erases list of tests to be executed
F7	Save List	Saves list of tests that were executed
F8	Recall List	Recalls a previously saved list of tests

Help and Interrupt Utilities. Help and Interrupt utilities are available to assist you when running the software. You can access these utilities at any time by pressing the <F1> key (Help) or the <F2> key (Interrupt). See pages 4–31 and 4–33 for detailed descriptions of the Help and Interrupt utilities, respectively.

Running Field Adjust/PV Software. Perform the following steps to run the Field Adjust/PV software:

1. Allow the waveform analyzer to warm up for at least 20 minutes before beginning step 2.
2. Start the Field Adjust/PV software as follows:
   - **a.** Change drives to your hard drive (for example, type `C:`).
   - **b.** Type `cd TEKCATS` to change directories to `TEKCATS`.
   - **c.** Type `tvs_test` to start the software.

     After the Field Adjust/PV software starts, the computer will display a user identification screen similar to the one shown in Figure 4–7.

NOTE. *Instructions on the computer screen provide parameters for the information you will enter during steps 3 through 8.*

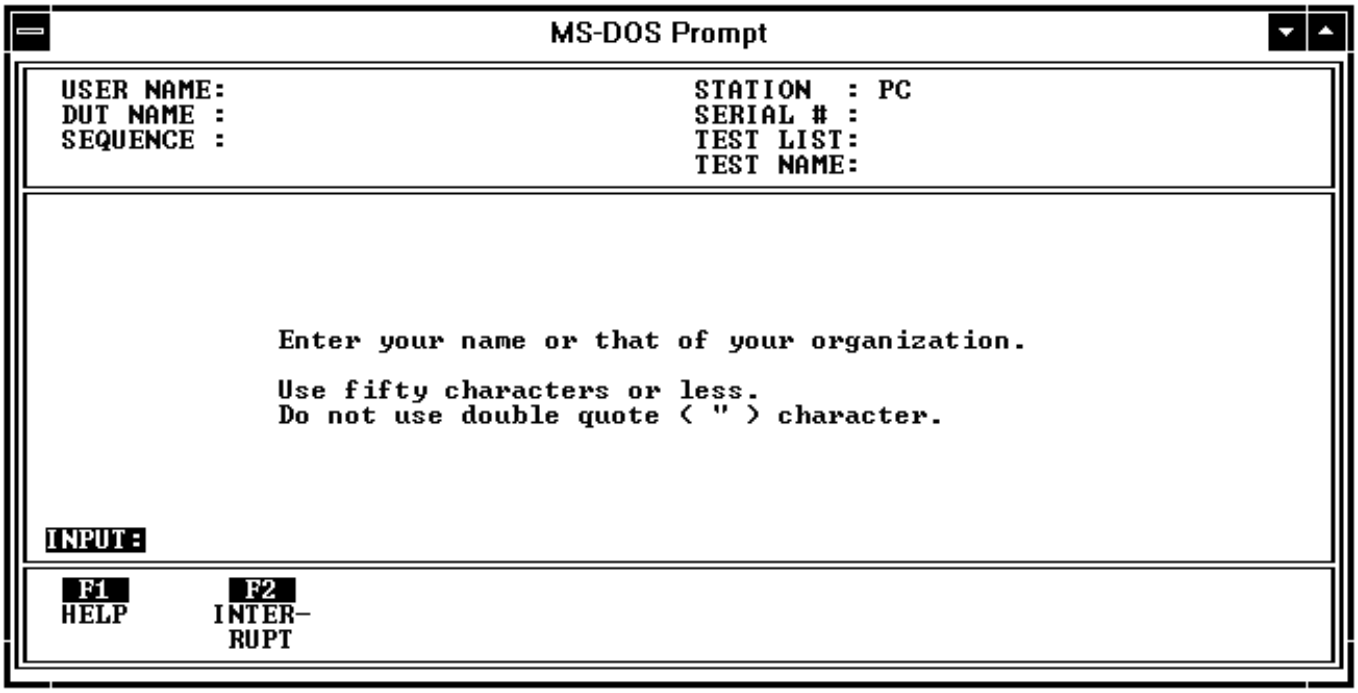


Figure 4–7: The first user identification screen

3. Follow the instructions on your computer screen to enter the name you want to appear in the USER NAME field. Press **<RETURN>** to continue.

4. Verify the displayed DATE and TIME, or enter new information and press **<RETURN>** to continue.

   Time is expressed in terms of a 24 hour cycle. The values for hours will be 01 through 12 for a.m., and 13 through 24 for p.m.

5. Select a Device Under Test (DUT) from the displayed list. Enter the number next to your choice and press **<RETURN>** to continue.

   The Field Adjust/PV software will list several DUTs. Select the DUT NAME for the waveform analyzer you are testing.

6. Select the PV sequence from the list. Enter the number next to PV and press **<RETURN>** to continue.

   The Field Adjust/PV software lists sequences for PV (Performance Verification) and ADJ (Adjustments).

7. Enter the temperature in degrees Celsius (20 to 30 degree entries are valid). Press **<RETURN>** to continue.

8. Enter the percent humidity (0% to 99% entries are valid). Press **<RETURN>** to continue.

9. Enter the complete serial number of the waveform analyzer (for example, B010100). Press **<RETURN>** to continue.

10. Verify the serial number entry. Enter the number next to your choice and press **<RETURN>** to continue.

    If you select NO, a prompt will ask you to enter the serial number again.

11. Select which part of the sequence to run. Enter the number next to your choice and press **<RETURN>** to continue.

    - RUN FULL SEQUENCE runs the entire sequence from beginning to end.
    - RUN PARTIAL SEQUENCE runs part of the full sequence. The sequence runs from the selected starting point to the end of the sequence.
    - SELECT TEST(S) runs only the selected tests.

12. Follow the on-screen instructions to connect test standards and continue tests. Refer to Figures 4–8 through 4–13 for equipment setup diagrams.

13. When testing is completed, power down and disconnect the test equipment from the waveform analyzer.

Initial Test Setups. As you run the PV tests, on-screen instructions describe the test equipment connections required to perform each test. Figures 4–8 through 4–13 provide detailed connection diagrams for the initial test equipment setups. After the test begins, you will then make changes to test equipment settings and connections when they are requested by the on-screen instructions.

***NOTE**. A 0.1 μF, 200 V capacitor is installed across the voltage reference output terminals to reduce noise during the DC_GAIN_ACCURACY, OFFSET_ACCURACY, and VERT_DCACCUR tests. See* Equipment Required *on page 4–16 for additional information.*

Use the dual input cable when running the DELAY_MATCH and TRIG_DELAY_SENS tests. If separate coaxial cables are used, the tests may fail due to an electrical mismatch between the cables.

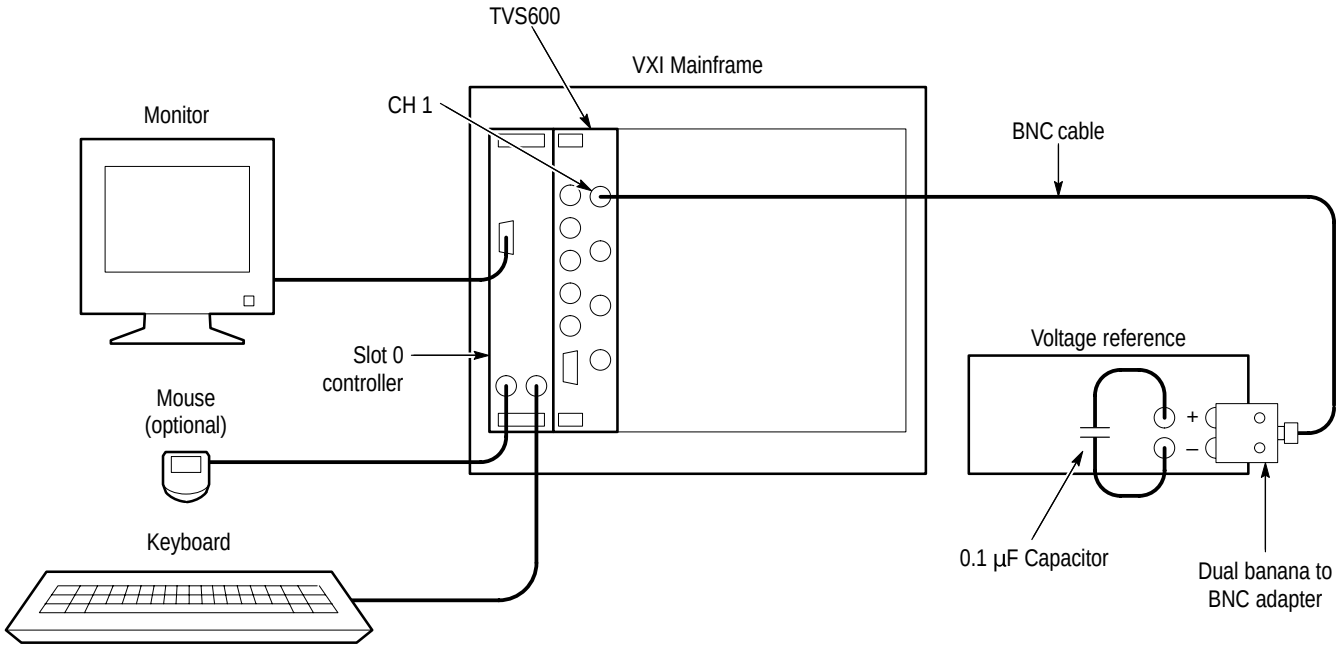


Figure 4–8: Initial setup for the DC_GAIN_ACCURACY, OFFSET_ACCURACY, and VERT_DCACCUR tests

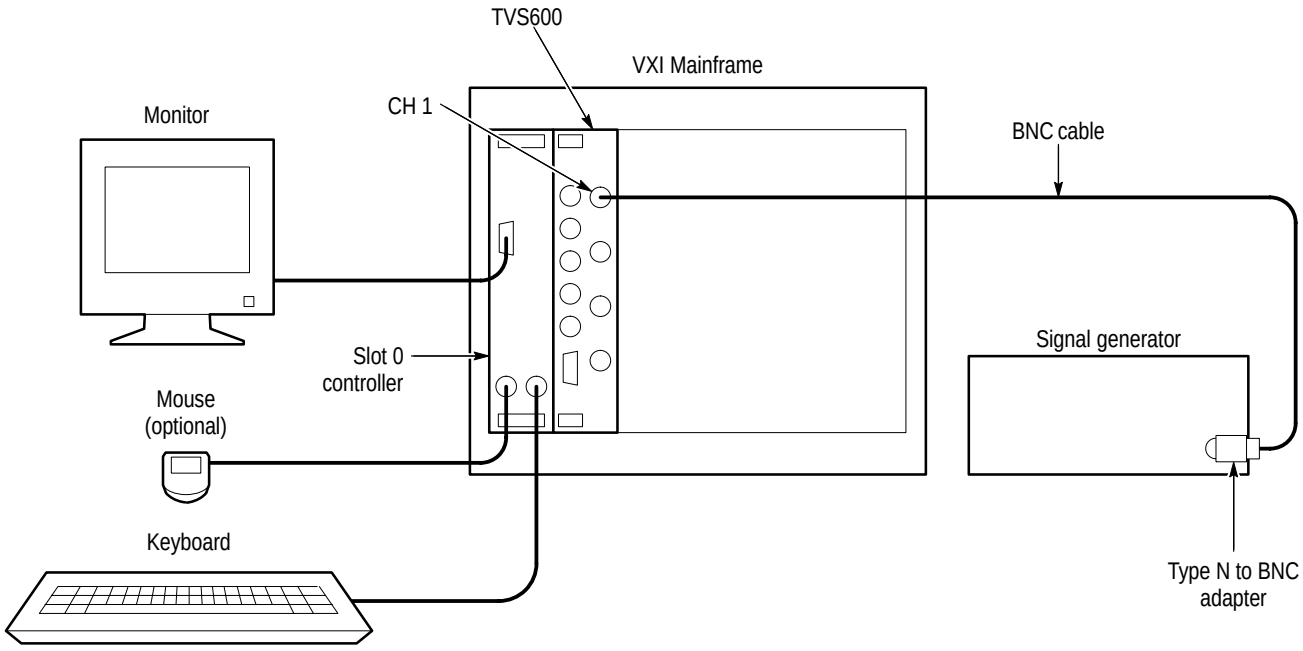


Figure 4–9: Initial setup for the VERT_BANDWIDTH, TIMEBASE_ACCURACY, GLITCH_TRIG_ACC, and TRIG_MAIN_SENS tests

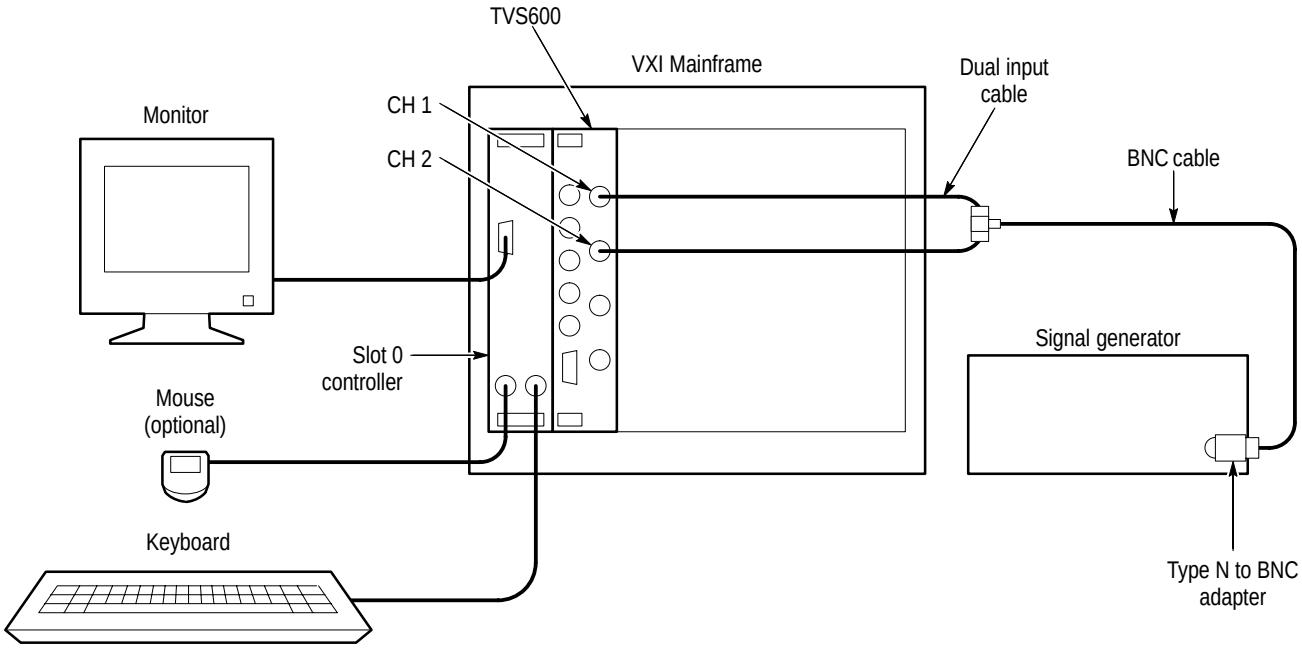


Figure 4–10: Initial setup for the DELAY_MATCH and TRIG_DELAY_SENS tests

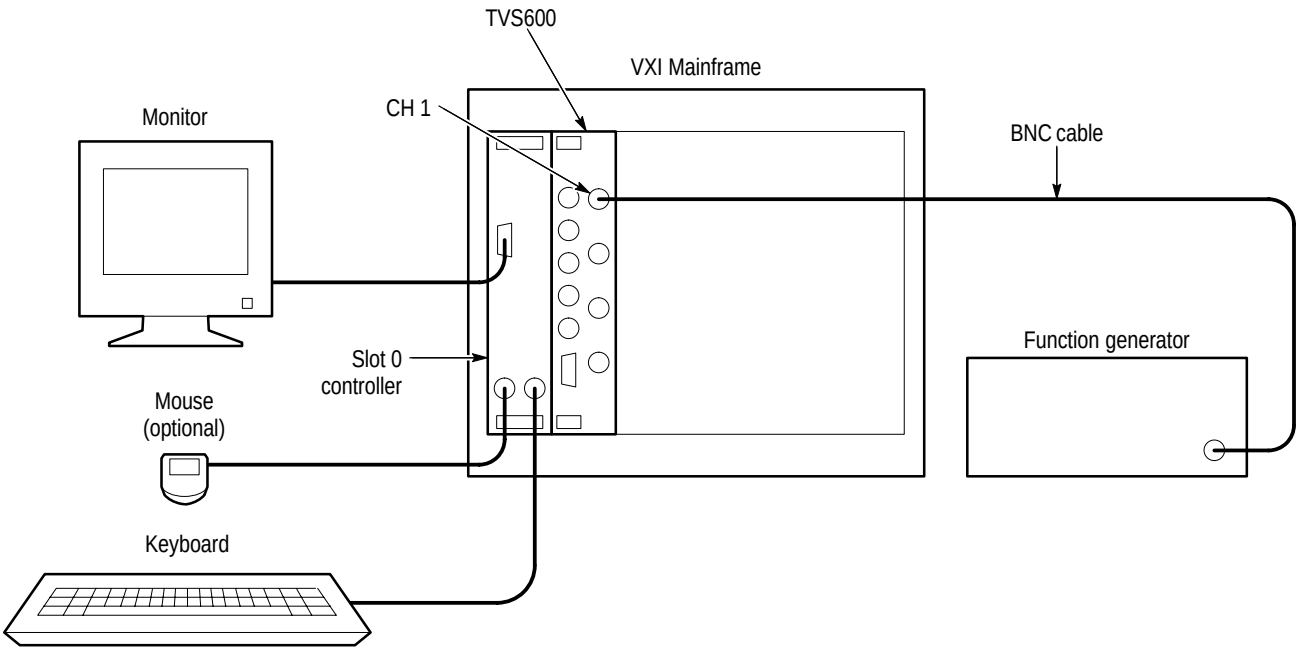


Figure 4–11: Initial setup for the MAIN_TRIG_ACC and TRIG_DELAY_ACC tests

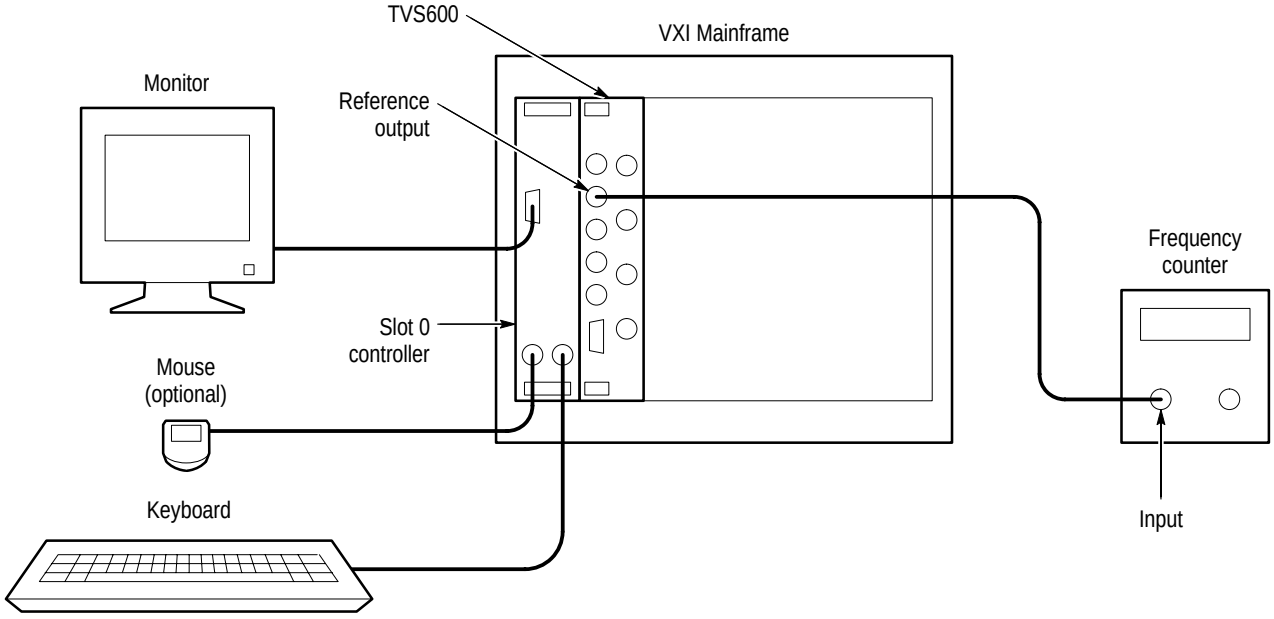


Figure 4–12: Initial setup for the REFERENCE_OUT test

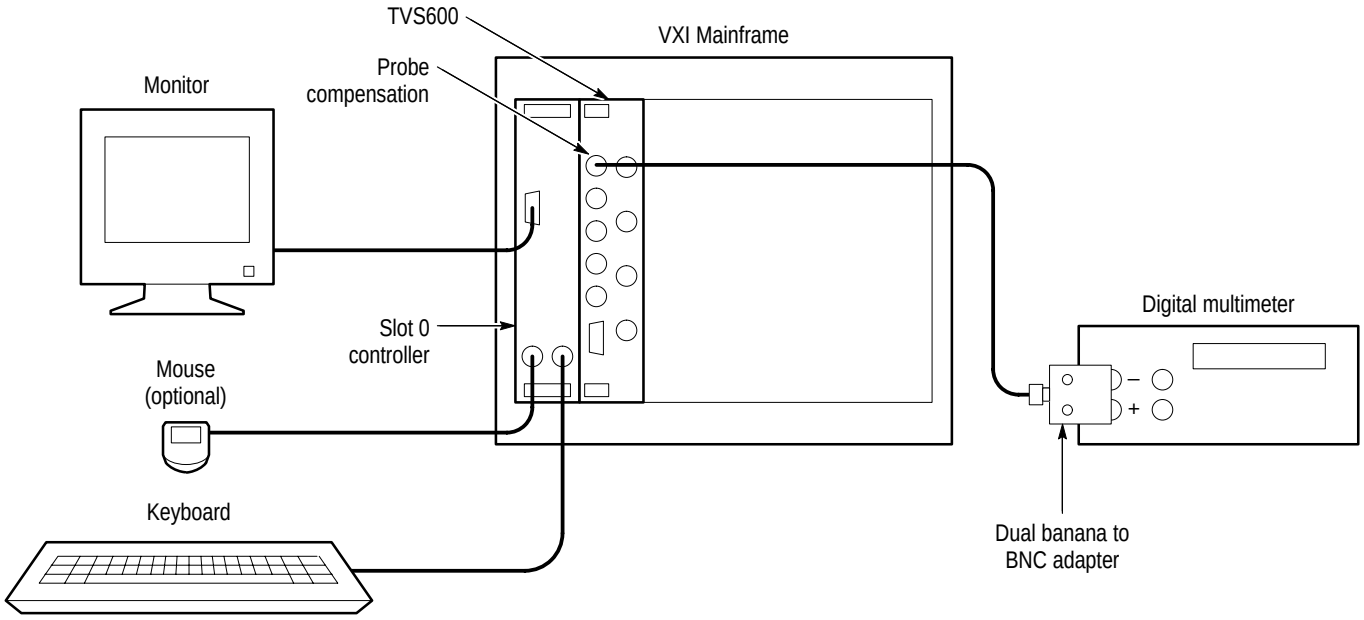


Figure 4–13: Initial setup for the PROBE_COMPENSATION test

Leveling the Sine Wave Generator with the Power Meter. The VERT_BANDWIDTH test requires you to adjust the frequency of the sine wave generator while maintaining a constant output amplitude. If your sine wave generator can produce a constant signal amplitude that is within 0.35 dB over the test frequency range (10 MHz to 1005 MHz for TVS625 and TVS645) then you do not need the power meter. Otherwise the power meter and power divider are necessary to adjust the sine wave generator output amplitude for a constant level. Figure 4–14 shows how to connect the power meter to the system when the signal generator output is not leveled to within 0.35 dB.

You can perform the VERT_BANDWIDTH test using an unleveled sinewave generator (amplitude error >0.35 dB). Under these conditions the bandwidth test is subject to the flatness errors associated with the generator.

***NOTE**. When a power meter is used to monitor the signal generator output, the power meter readout shows the signal amplitude that is applied to the waveform analyzer (DUT). You must adjust the signal generator output for the proper amplitude on the power meter readout.*

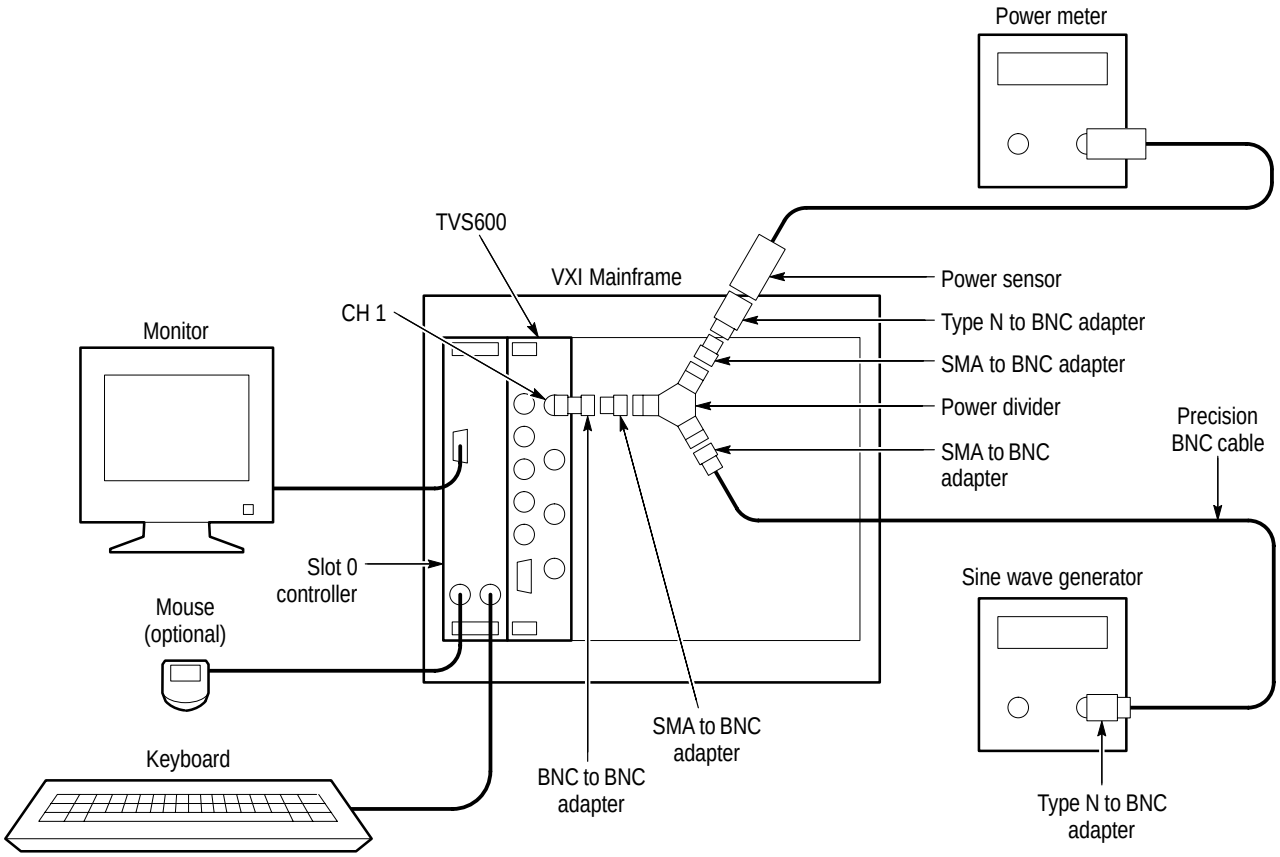


Figure 4–14: Using the power meter to monitor the output amplitude of the sine wave generator

Test Record

You can print a test record that shows the results of the Performance Verification Procedure tests using the Field Adjust/PV software. This convenient feature makes available the actual results of each test; in most cases the test data is not limited to PASS/FAIL indications. You can use the test record to document the waveform analyzer performance over time. For example, you can print the test results before and after the adjustment procedures are performed.

A complete test record contains several pages of test data. For this reason, we recommend using a printer that is capable of printing multiple pages. With the default settings selected (NORMAL results option), a complete record of test results will print as testing occurs. In addition, you can select alternate print results options that determine the test record content and control when printing occurs. See *Selecting Test Record Results Options* on page 4–30 for details.

If a printer is not available, there are two ways to view the test record for the last test sequence completed. Whenever a FULL or PARTIAL sequence completes, or when you exit the Field Adjust/PV software, you will have the option to view the test results on your computer screen. The results option determines the test record content. The software also creates a file that contains the test record from the last sequence. The file location is `TEKCATS/RPT/REPORT`. See *Test Results Files Created by the Field Adjust/PV Software* on page 4–30 for details.

Printing or Viewing the Test Record

You can print a test record as tests are performed when the NORMAL (default) results option is selected. You will have the option to print or view the test record when a FULL or PARTIAL sequence completes. The print menu also appears as you exit the Field Adjust/PV software.

Use the following procedure to print or view the test record:

1. Connect a printer to the Slot 0 Controller as shown in Figure 4–15.

NOTE. *A printer does not need to be connected in order to view the test record on your computer screen.*

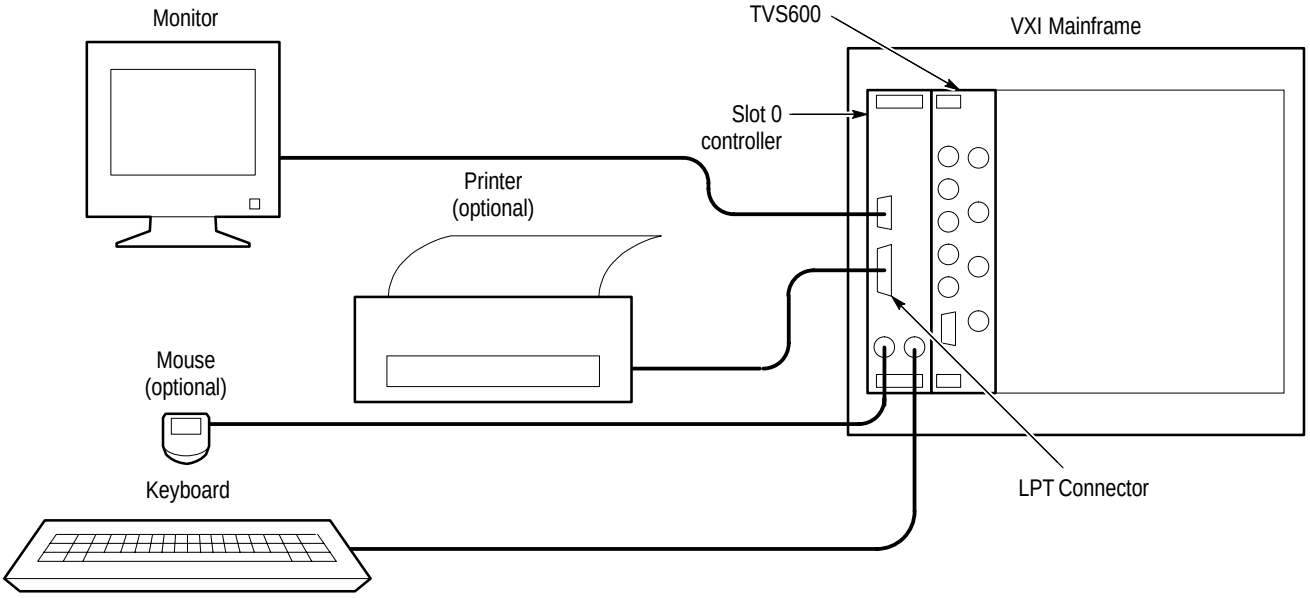


Figure 4–15: Connecting a printer to the VXIbus test system

2. Setup the printer for operation with your Slot 0 Controller. If necessary, refer to the printer manual for instructions.
3. Verify that the printer is ONLINE and is loaded with paper.
4. Run one or more tests using the Field Adjust/PV software.
   - If the NORMAL (default) results option setting is selected, the test record will print as test steps are completed.
   - If you ran a PARTIAL or FULL sequence, select a print or view option from the print menu to print or view the test record.
   - If you ran a SELECT TEST(S) sequence, proceed to step 5.
5. Press the F2 (Interrupt) function key.
6. Select 4 (LEAVE <GOOD BYE>) from the list of choices.
7. Select the print option you want from the list of choices:
   - NONE — The test record is not printed or displayed on the screen
   - PRINT ALL — A complete test record is printed, including the upper and lower test limits
   - PRINT FAIL ONLY — The test record contains only the results of failed tests
   - VIEW — The test record, including the upper and lower test limits, is displayed on the computer screen

Selecting Test Record Results Options

You can setup the Field Adjust/PV software to print two types of test records: NORMAL and FAIL. You can also disable the automatic printing of test results as testing occurs. A description of each results option is shown below:

- NORMAL — The test record prints as testing occurs; it contains the actual test results, including upper and lower test limits
- FAIL — The test record contains only the results of failed tests, including the test name, step that failed, and test results (if any)
- OFF — The test record is not printed as testing occurs

The default results option is NORMAL. Use the following procedure to select a different results option:

1. Before starting a test sequence, press the F2 (Interrupt) function key.
2. Select 6 (DISPLAY/CHANGE CONTROL VARIABLES) from the list of choices.
3. Press the F7 (CHG CONT VARIABLE) function key.
4. Select 3 (CATSHARDCOPY) from the list of choices.
5. Select the results option you want from the list of choices.

Test Results Files Created by the Field Adjust/PV Software

Each time a test sequence completes, the Field Adjust/PV software automatically creates a .DLF file and a REPORT file on your computer hard disk. These files contain the results of the test sequence.

The .DLF File. A new .DLF file is created each time you complete a test sequence. The file size is 25 to 50 KBytes. The file name is based on the serial number you entered for the DUT. For example, the file name will be `B010638.DLF` if you entered the serial number B010638 during the test setup procedure.

The .DLF files are stored in the `TEKCATS/<DUT Type>` directory on your hard drive, where `<DUT Type>` is the product type (TVS621, TVS625, TVS641, or TVS645). You can remove the files using DOS commands as follows:

1. Change drives to your hard drive (for example, type `C:`).
2. Change directories to `TEKCATS/<DUT Type>` where `<DUT Type>` is one of these product types: (TVS621, TVS625, TVS641, or TVS645). For example, type `cd TEKCATS/TVS645` if you are testing a TVS645.
3. Type `del <filename>` to delete one file. To delete a group of files, type `del <*.DLF>`.

The REPORT File. New test data overwrites the REPORT file each time a test sequence is completed, unless NONE was previously selected from the print menu. To access the REPORT file, use the `TEKCATS/RPT/REPORT` path.

Help Utility

The Field Adjust/PV software contains a Help utility that provides detailed information about the tests. You can access Help at any time by pressing the <F1> function key on your computer keyboard.

NOTE. *When you press the <F1> key the test currently running will stop. Once a test stops, it CANNOT be continued. To complete the test you will need to rerun the test.*

Using Help

When you access Help, a description of the current screen appears on your computer. Function keys <F1> through <F8> on your computer keyboard are then used to make selections within the Help utility. Only the function key labels that apply to your Help topic will appear on your computer screen.

Figure 4–16 shows a typical Help screen. A description of each possible function key label follows the illustration. Note that only the function key labels that apply to the help screen (F1, F2, F3, F7, and F8) are shown.

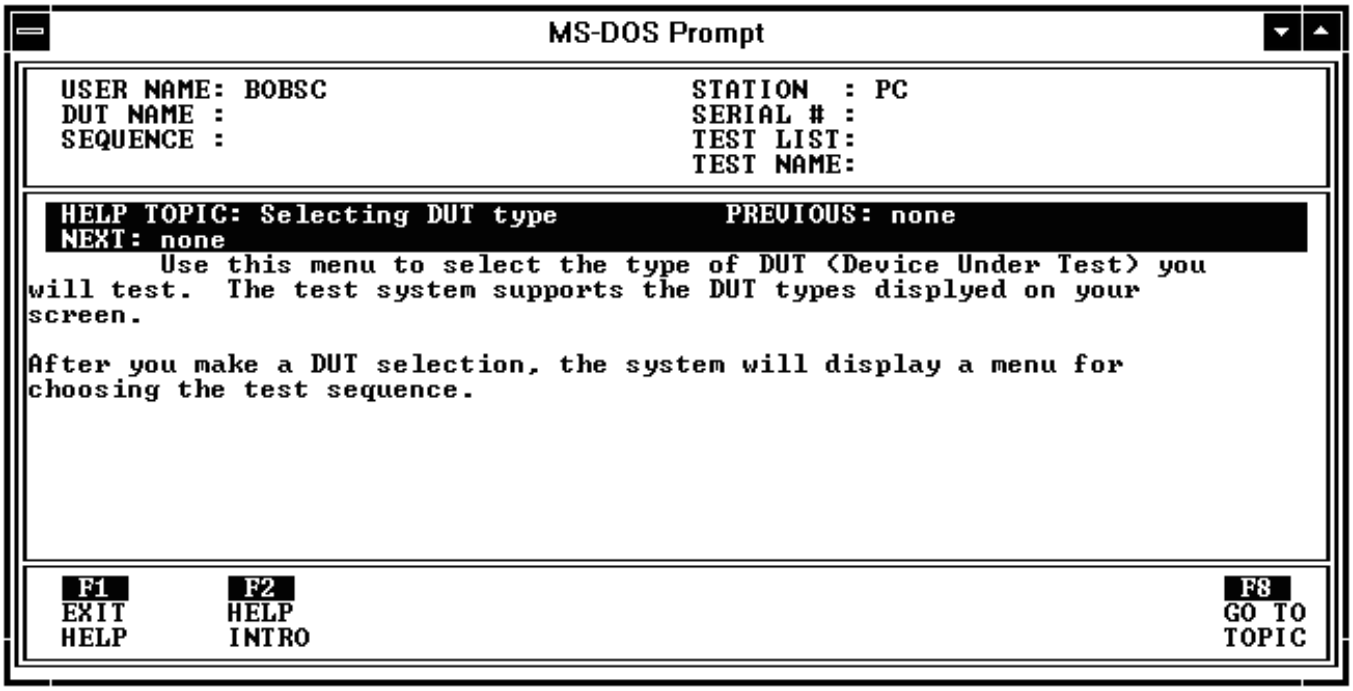


Figure 4–16: Typical help screen

<F1> EXIT HELP	Exit to the most-current system menu screen.
<F2> HELP INTRO	Return to INTRODUCTION TO HELP.
<F3> PREVIOUS TOPIC	Return to the last topic you viewed. The name of the PREVIOUS TOPIC always appears at the top center of your screen.
<F4> NEXT TOPIC	Show information about the next topic. The NEXT TOPIC appears at the top center of your screen.
<F5> RELATED TOPIC	Display a list of topics that are related to the topic currently on your screen. You can select any topic from the displayed list.
<F6> SCROLL UP	Scroll up to view text above the top of the screen.
<F7> SCROLL DOWN	Scroll down to view text below the bottom of the screen.
<F8> GO TO TOPIC	Display a list of all available topics in the help system. You can select any topic from the displayed list.

Interrupt Utility

The Field Adjust/PV software contains an Interrupt utility that stops the current test. You can interrupt a test at any time by pressing the <F2> function key on your computer keyboard.

NOTE. *When you press the <F2> key, the test currently running will stop. Once a test stops, it CANNOT be continued. To complete the test, you will need to rerun the test.*

Using Interrupt

When a test is interrupted, a list of choices appears on your computer screen. To select a choice, enter the number next to your choice and press the <RETURN> key.

Figure 4–17 shows a typical Interrupt screen. A description of the menu choices follows the illustration.

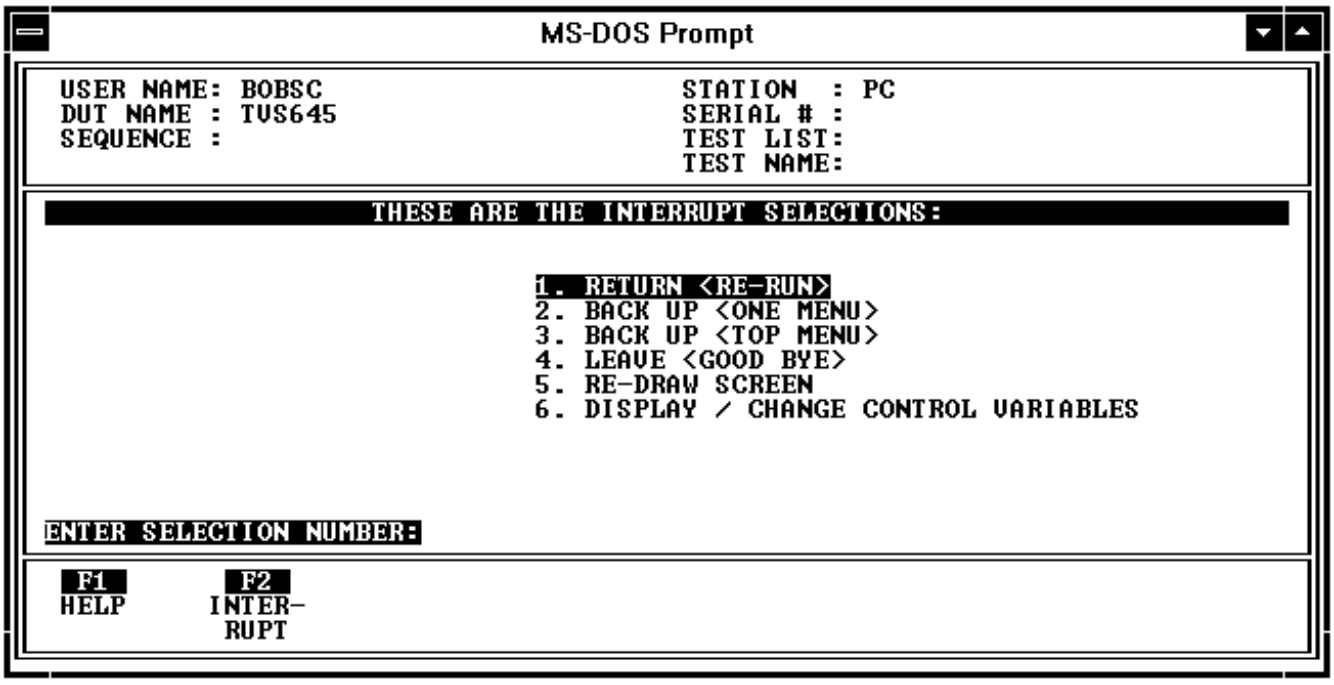


Figure 4–17: Typical Interrupt Screen

<1> RETURN (RE-RUN)	Return to the menu or test that was active when you pressed the Interrupt key (F1). If a test was running, the system returns to the beginning of that test.
<2> BACK UP (ONE MENU)	Move to the next higher level in the menu system. If the currently displayed menu is the highest-level menu, that menu will continue to be displayed.
<3> BACK UP (TOP MENU)	Move to the top-level menu. If your system contains more than one DUT, you will move to the SELECT DUT menu. If your system contains one DUT, you will move to the SELECT SEQUENCE menu. If there is only one sequence for the selected DUT, you will move to the SEQUENCE MODE menu.
<4> LEAVE (GOOD BYE)	Stops the software and returns to the DOS prompt. You cannot return to the point at which Leave was selected; restarting the Field Adjust/PV software executes the program from the beginning. The DUT returns to its default settings.
<5> REDRAW SCREEN	Clear and redraw the screen. Use this feature to remove unwanted information from the screen.
<6> DISPLAY / CHANGE CONTROL VARIABLES	Display the values of the important test system parameters. You can use this menu to change many of the parameter settings.

Adjustment Procedures

This chapter contains information needed to adjust the waveform analyzer. Adjustments are performed using the Field Adjust/PV software, provided with this manual.

The Field Adjust/PV software (one disk) contains instructions and control programs for adjusting the waveform analyzer. The software describes test equipment connections and settings, selects waveform analyzer parameters, and loads calibration constants into waveform analyzer memory.

Description

The *Adjustment Procedures* are divided into the following sections:

- *Requirements for Performance* (below) and *Using the Software* on page 5–2 provide general information about adjusting the waveform analyzer
- *Equipment Required* on page 5–3 provides a list of equipment required to perform the adjustments
- *Adjustment Instructions* on page 5–5 provides written procedures for installing and using the Field Adjust/PV software
- *Help Utility* on page 5–13 provides an overview of the Field Adjust/PV software help system
- *Interrupt Utility* on page 5–14 provides an overview of the Field Adjust/PV software interrupt system

Read each section listed above before using the Field Adjust/PV software.

Purpose

This procedure returns the waveform analyzer to conformance with the warranted characteristics listed in the *Specifications* section. The procedure can also be used to optimize the performance of the waveform analyzer.

Adjustment Interval

As a general rule, these adjustments should be done once a year.

Requirements for Performance

Before performing this procedure, you need to meet the following requirements.

Personnel

Only trained service technicians should perform this procedure.

Warmup Period

The waveform analyzer requires a 20-minute warmup time in a +20° C to +30° C environment before it is adjusted. Adjustments performed before the operating temperature has stabilized may cause errors in performance.

Access

You do not remove the side covers to perform this procedure.

Test Equipment

A VXIbus mainframe, embedded Slot 0 controller, computer peripherals, and external standards are required to adjust the waveform analyzer. Refer to the equipment list, starting on page 5–3, for a complete list of test equipment requirements.

Using the Software

This section describes how to perform adjustments using the Field Adjust/PV software. It provides information about the files located on the Field Adjust/PV software disk, and indicates when you should perform the adjustments.

Performing the Adjustments

When using the Field Adjust/PV software, you will not manually adjust any circuits. Instead, the software adjusts the instrument hardware using external standards you provide in response to prompts on the computer screen. Your role is to connect the test signals and to instruct the computer to continue. Upon successful completion of each adjustment, the Field Adjust/PV software automatically loads the new calibration data into the waveform analyzer memory .

Adjustment Sequences and Dependencies

The Field Adjust/PV software allows you to run groups of adjustments, or sequences. A sequence consists of one or more individual adjustments. Normally you will perform a RUN FULL SEQUENCE, which executes each adjustment in the proper order. The Field Adjust/PV software also provides instructions for running each adjustment individually. However, you should only perform individual adjustments while troubleshooting the waveform analyzer. See *Using the Field Adjust/PV software* on page 5–6 for additional information.

Some adjustments depend on successful prior completion of other adjustments. For example, all the tests associated with the Base Calibration must be passed before any other adjustments can be successfully completed. Table 5–1 lists the tests and dependencies for each adjustment.

Table 5–1: Adjustments and Dependencies

Adjustment	Tests	Prior Completion Requirements
Base Calibration Adjustment	EXTERNAL_CAL INTERNAL_CAL	None
Frequency Response Adjustment (TVS625 and TVS645 only)	BANDWIDTH_CAL	Base Calibration
Pulse Trigger Adjustment	GLITCH_TRIG_CAL PNP_LATENCY_CAL	Base Calibration
Channel to Channel Skew Adjustment	CHAN_SKEW_CAL	Base Calibration

Adjustment After Repair

After the removal or replacement of a module, you must either perform a Full Sequence or self cal, depending on the module serviced. See Table 5–2 for details.

Table 5–2: Adjustments After Repair

Module Replaced	Adjustments Required
A1 Processor Board	Self cal
A2 Acquisition Board	Full Sequence

Equipment Required

Table 5–3 lists the test equipment required to adjust the waveform analyzer.

Table 5–3: Test Equipment

Item Number and Description	Minimum Requirements	Example
1. VXIbus Mainframe	Minimum of four plug-in slots	Tektronix VX1410
2. Slot 0 Embedded Controller	National Instruments VXIpc-486 Series Model 566[1]	National Instruments VXIpc-486 Series Model 566[1]
3. Monitor	VGA	Tektronix part number 039–0008–00
4. Keyboard	Standard function, 101 keys	Tektronix part number 119–3772–00
5. Field Adjust/PV software	Shipped with the Service Manual	Part of Tektronix part number 070–9285–XX

1 The Field Adjust/PV software runs on the standard configuration. If you will be using other applications, the Slot 0 Controller may need expanded RAM and video RAM capabilities.

Table 5–3: Test Equipment (Cont.)

Item Number and Description	Minimum Requirements	Example
6. Frequency Counter	Frequency accuracy: <0.0025% Frequency range: 1 kHz to 10 MHz	Hewlett Packard 5314A
7. Digital Multimeter	DCV error: 0.1% from –10 V to +100 V	Fluke 8842A
8. Connector, Dual-Banana (two required)	Female BNC to dual banana	Tektronix part number 103–0090–00
9. Voltage Reference	Amplitude error: <0.001%	Data Precision 8200
10. Capacitor[2]	0.1 μF, 200 V	Tektronix part number 283–0189–00
11. Cable, Dual-Input	Female BNC to dual male BNC	Tektronix part number 067–0525–02
12. Adapter, N to BNC	Male Type N to female BNC	Tektronix part number 103–0045–00
13. Cable, Precision 50 Ω Coaxial	50 Ω, 36 in, male to male BNC connectors	Tektronix part number 012–0482–00
14. Generator, Sine Wave[3]	Frequency range: 100 kHz to 1005 MHz Frequency error: <6 ppm Amplitude: 2 mV to 1.5 V_{RMS} Amplitude error: <0.35 dB	Gigatronics 6061
15. Power Meter with Sensor[3]	Bandwidth: >1.2 GHz Accuracy: 0.2 dB (2%) Sensitivity: 500 pW to 20 mW	Rohde & Schwarz NRVS with Model NRV-Z4 Sensor
16. Adapter, N to BNC (used only with power meter)	Female Type N to male BNC	Tektronix part number 103–0058–00
17. Adapter (used only with power meter)	Male BNC to male BNC	Tektronix part number 103–0029–00
18. 50 Ω Power Divider (used only with power meter)	Provide load isolation between source (Sine Wave Generator), the TVS600 inputs, and the Power Meter Maximum VSWR: 1.50	Tektronix part number 015–0565–00
19. SMA to BNC Adapters (three required, used only with power meter)	For use with the 50 Ω Power Divider	Tektronix part number 015–1018–00

2 The capacitor is installed across the Data Precision 8200 output terminals to reduce noise. If your voltage reference produces <4 mVp-p of noise, external noise reduction is not necessary.

3 If the signal generator output amplitude is not leveled within 0.35 dB over the 10 MHz to 1005 MHz frequency range, refer to *Leveling the Sine Wave Generator with the Power Meter* on page 5–12 for further instructions.

Adjustment Instructions

This section provides instructions for the following adjustment steps:

- Connecting the VXIbus test system
- Installing the Field Adjust/PV software on your system
- Using the Field Adjust/PV software to adjust the waveform analyzer

Connect the VXIbus Test System

Perform the *Power-On Procedure* located on page 2–10. This procedure describes how to connect the VXIbus test system shown in Figure 5–1.

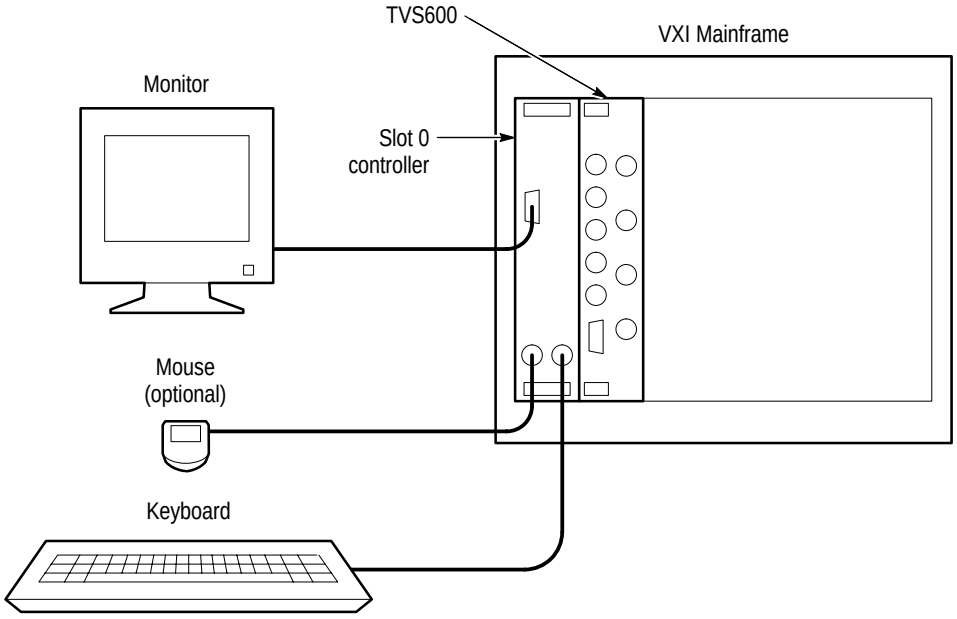


Figure 5–1: Test system configuration

Field Adjust/PV Software Installation

NOTE. *ALWAYS use this installation procedure to install the Field Adjust/PV software on a computer. This installation program uses parameters you supply (see step 2, substep d) to create a custom start-up file on your hard disk directory. After installation, the software instructs you to run this start-up batch file whenever you perform the adjustments. The batch file enables the software to configure your computer properly before it runs the adjustment program.*

Do not simply copy the software files from one computer to another, because the start-up batch file you copy may not match the computer you copy it to.

If your computer already has a directory named TEKCATS on the hard drive you specify for installation, the software installation cannot be completed.

1. Copy the Field Adjust/PV software disk to a working disk. Use either DOS commands or utilities such as the Windows Program Manager.
2. Install the software onto the hard disk as follows:
   a. Install your working disk into a floppy drive.
   b. To change drives to the floppy drive (either A or B), type `A:` or `B:`.
   c. Type `install`.
   d. When prompted by the on-screen instructions, specify the hard disk on which to install the software.

      Your computer will install the Field Adjust/PV software in a directory named `TEKCATS` on the hard drive you select.
3. Eject the Field Adjust/PV software disk and store in a secure place.

Using the Field Adjust/PV Software

The Field Adjust/PV software contains complete instructions for performing the adjustments. After starting the program, entering user identification information, and completing the preliminary setup, you can run full or partial test sequences. While tests are running, you must respond to instructions on the computer screen in the following manner:

- Connect test standards to the waveform analyzer
- Set up the test standards for the output signals described by on-screen instructions
- Press <RETURN> on your computer keyboard to continue the test

When a test passes, the software automatically loads new calibration data into the waveform analyzer memory.

Refer to *Initial Test Setups* on page 5–9 and *Leveling the Sine Wave Generator with the Power Meter* on page 5–12, for descriptions of the test equipment connections you will need when running the Adjustment procedures.

Making Menu Selections. A cursor highlights the selected item within a displayed menu. You can move the cursor using the arrow keys on your computer keyboard, or by entering the number next to the desired menu item. Then press the <RETURN> key to execute the selection.

Test Sequence Selections. Choose from the following menu selections to run all or part of the selected test sequence:

- RUN FULL SEQUENCE runs the entire sequence from beginning to end.
- RUN PARTIAL SEQUENCE runs part of the full sequence. The sequence runs from the selected starting point to the end.
- SELECT TEST(S) runs only the selected tests.

RUN FULL SEQUENCE is the most common selection. This sequence runs each available adjustment in the proper order.

RUN PARTIAL SEQUENCE and SELECT TEST(S) are not intended for normal use. These sequences are useful only when you are troubleshooting the waveform analyzer.

If your choice is SELECT TEST(S), you must specify each test to execute. To run a single test, simply enter its number and continue. Use a comma (,) or hyphen (–) to select more than one test. For example, enter 1,3, to run tests 1 and 3; enter 2–4 to run tests 2, 3, and 4.

The SELECT TEST(S) sequence activates four function keys for use in this mode. Table 5–4 provides an explanation of each function key.

Table 5–4: Function Keys for SELECT TEST(S) Mode

Function Key	Function	Description
F3	Cancel, End Seq	Stops the test and returns to the SELECT SEQUENCE screen
F4	Clear Input	Erases list of tests to be executed
F7	Save List	Saves list of tests that were executed
F8	Recall List	Recalls a previously saved list of tests

Help and Interrupt Utilities. Help and Interrupt utilities are available to assist you when running the software. You can access these utilities at any time by pressing the <F1> key (Help) or the <F2> key (Interrupt). See pages 5–13 and 5–14 for detailed descriptions of the Help and Interrupt utilities, respectively.

Running Field Adjust/PV Software. Perform the following steps to run the Field Adjust/PV software:

1. Allow the waveform analyzer to warm up for at least 20 minutes before beginning step 2.
2. Start the Field Adjust/PV software as follows:
   - **a.** Change drives to your hard drive (for example, type `C:`).
   - **b.** Type `cd TEKCATS` to change directories to `TEKCATS`.
   - **c.** Type `tvs_test` to start the software.

     After the Field Adjust/PV software starts, the computer will display a user identification screen similar to the one shown in Figure 5–2.

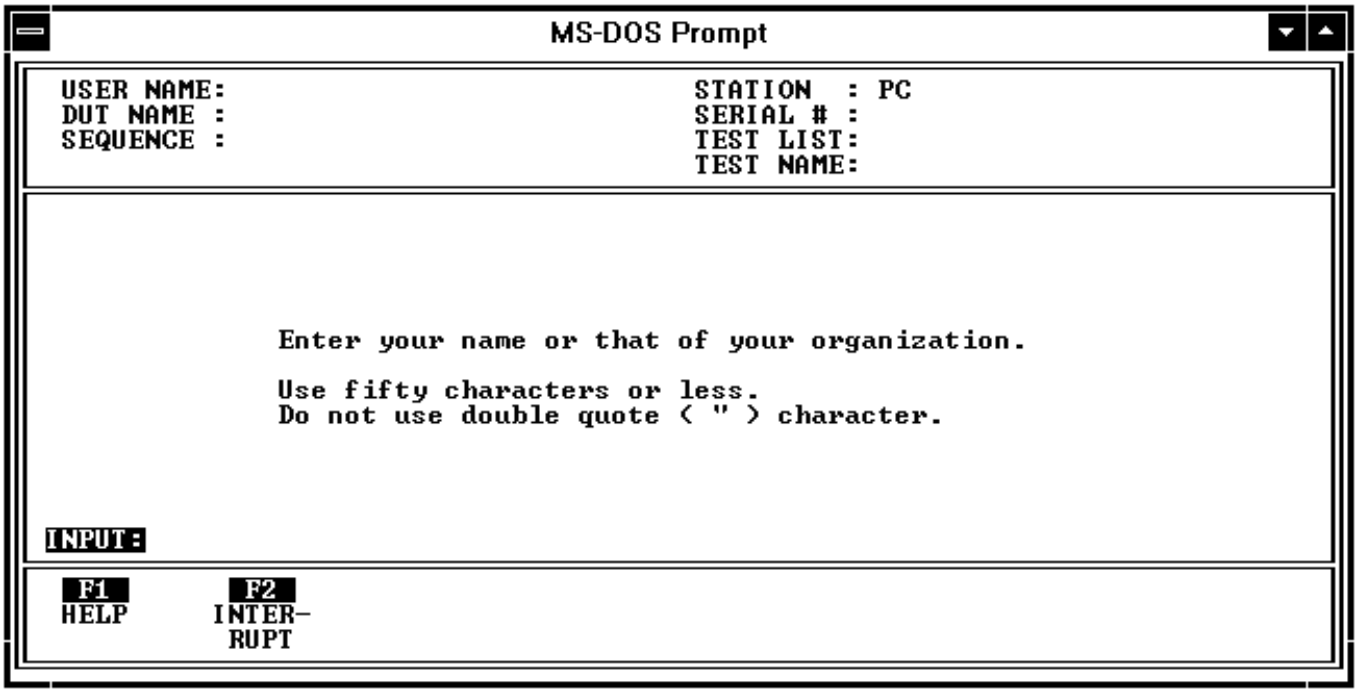


Figure 5–2: The first user identification screen

NOTE. *Instructions on the computer screen provide parameters for the information you will enter during steps 3 through 8.*

3. Follow the instructions on your computer screen to enter the name you want to appear in the USER NAME field. Press **<RETURN>** to continue.
4. Verify the displayed DATE and TIME, or enter new information and press **<RETURN>** to continue.

   Time is expressed in terms of a 24 hour cycle. The values for hours will be 01 through 12 for a.m., and 13 through 24 for p.m.
5. Select a Device Under Test (DUT) from the displayed list. Enter the number next to your choice and press **<RETURN>** to continue.

   The Field Adjust/PV software will list several DUTs. Select the DUT NAME for the waveform analyzer you are testing.
6. Select the ADJ sequence from the list. Enter the number next to ADJ and press **<RETURN>** to continue.

   The Field Adjust/PV software lists sequences for PV (Performance Verification) and ADJ (Adjustments).

7. Enter the temperature in degrees Celsius (20 to 30 degree entries are valid). Press **<RETURN>** to continue.
8. Enter the percent humidity (0% to 99% entries are valid). Press **<RETURN>** to continue.
9. Enter the complete serial number of the waveform analyzer (for example, B010100). Press **<RETURN>** to continue.
10. Verify the serial number entry. Enter the number next to your choice and press **<RETURN>** to continue.

    If you select NO, a prompt will ask you to enter the serial number again.
11. Select which part of the sequence to run. Enter the number next to your choice and press **<RETURN>** to continue.
    - RUN FULL SEQUENCE runs the entire sequence from beginning to end.
    - RUN PARTIAL SEQUENCE runs part of the full sequence. The sequence runs from the selected starting point to the end of the sequence.
    - SELECT TEST(S) runs only the selected tests.
12. Follow the on-screen instructions to connect test standards and continue tests. Refer to Figures 5–3 through 5–6 for equipment setup diagrams.
13. When adjustment is completed, disconnect the test equipment from the waveform analyzer.

Initial Test Setups. As you run the adjustment procedures, on-screen instructions describe the test equipment connections required to perform each adjustment. Figures 5–3 through 5–6 provide detailed connection diagrams for the initial test equipment setups. After the adjustment begins, you will then make changes to test equipment settings and connections when they are requested by the on-screen instructions.

NOTE. *A 0.1 μF, 200 V capacitor is installed across the voltage reference output terminals to reduce noise during the EXTERNAL_CAL adjustment. See* Equipment Required *on page 5–3 for additional information.*

Use the dual input cable when running the CHAN_SKEW_CAL test. If separate coaxial cables are used, the adjustment may fail due to an electrical mismatch between the cables.

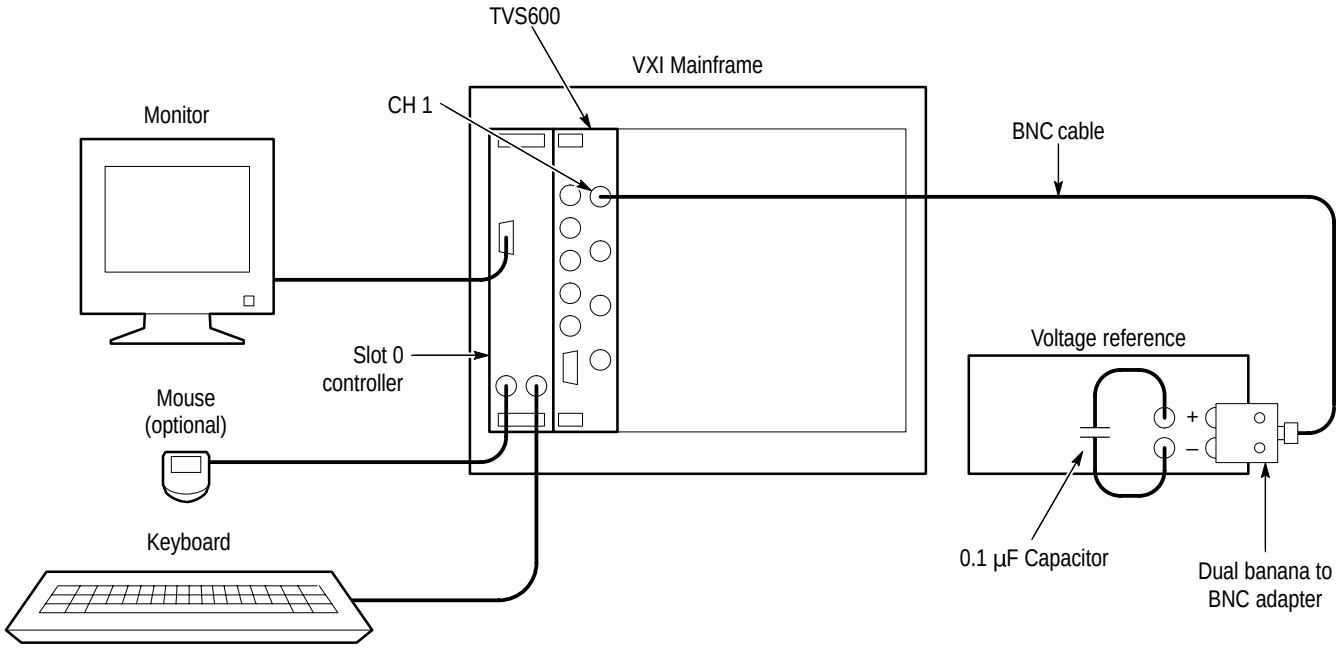


Figure 5–3: Initial setup for the EXTERNAL_CAL adjustment (CVR cal section)

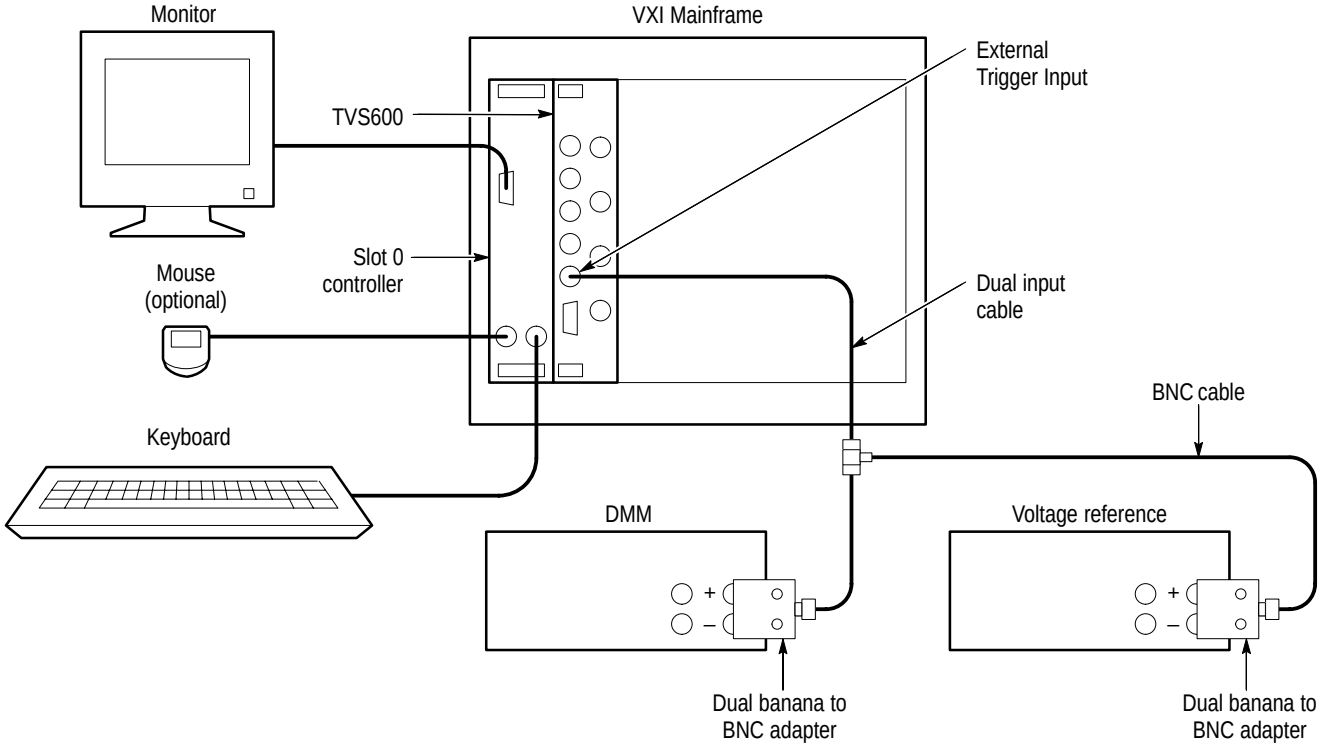


Figure 5–4: Initial setup for the EXTERNAL_CAL adjustment (EXT TRIG cal section)

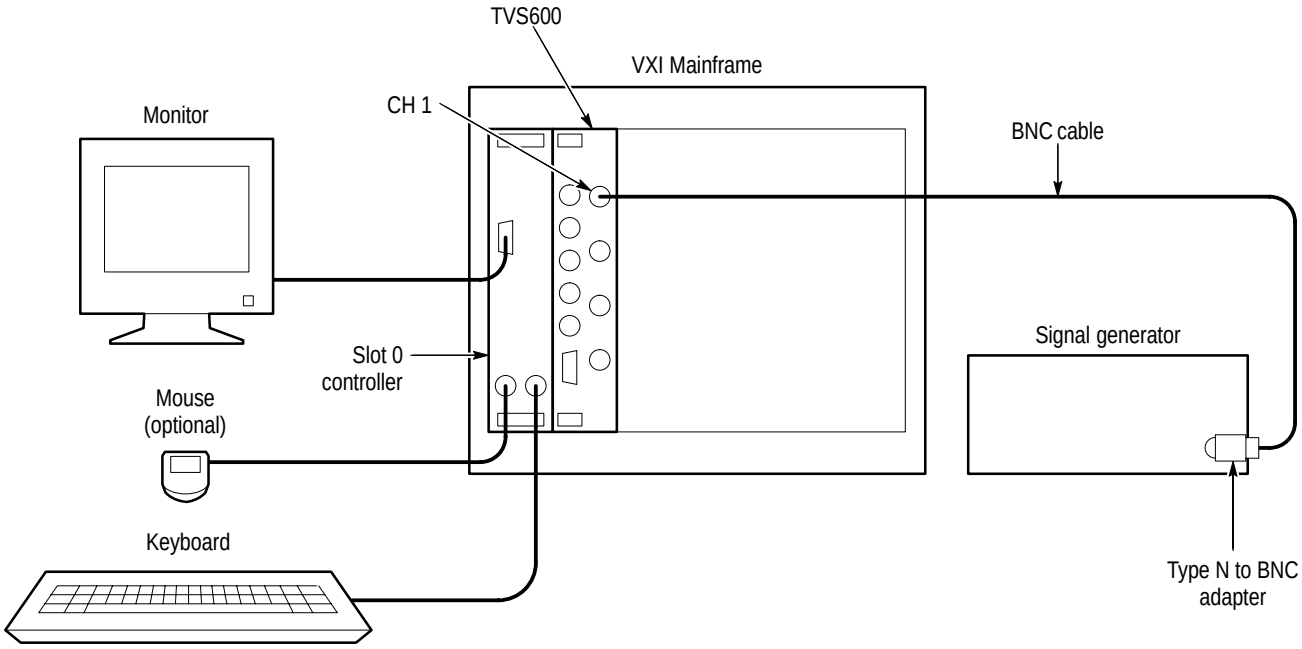


Figure 5–5: Initial setup for the BANDWIDTH_CAL, GLITCH_TRIG_CAL, and PNP_LATENCY_CAL adjustments

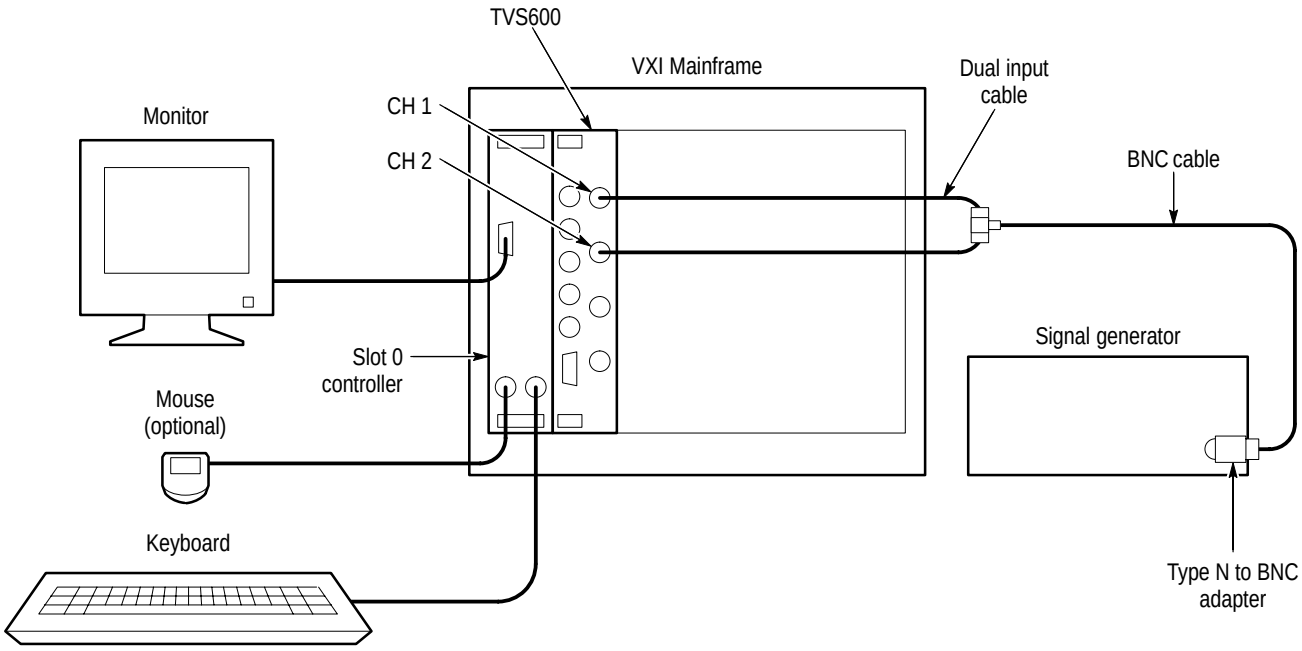


Figure 5–6: Initial setup for the CHAN_SKEW_CAL adjustment

Leveling the Sine Wave Generator with the Power Meter. The BANDWIDTH_CAL adjustment requires you to adjust the frequency of the sine wave generator while maintaining a constant output amplitude. If your sine wave generator can produce a constant signal amplitude that is within 0.35 dB over the test frequency range (10 MHz to 1005 MHz for TVS625 and TVS645) then you do not need the power meter. Otherwise the power meter and power divider are necessary to adjust the sine wave generator output amplitude for a constant level. Figure 5–7 shows how to connect the power meter to the system when the signal generator output is not leveled to within 0.35 dB.

You can perform the BANDWIDTH_CAL adjustment using an unleveled sinewave generator (amplitude error >0.35 dB). Under these conditions the adjustment is subject to the flatness errors associated with the generator.

NOTE. *When a power meter is used to monitor the signal generator output, the power meter readout shows the signal amplitude that is applied to the waveform analyzer (DUT). You must adjust the signal generator output for the proper amplitude on the power meter readout.*

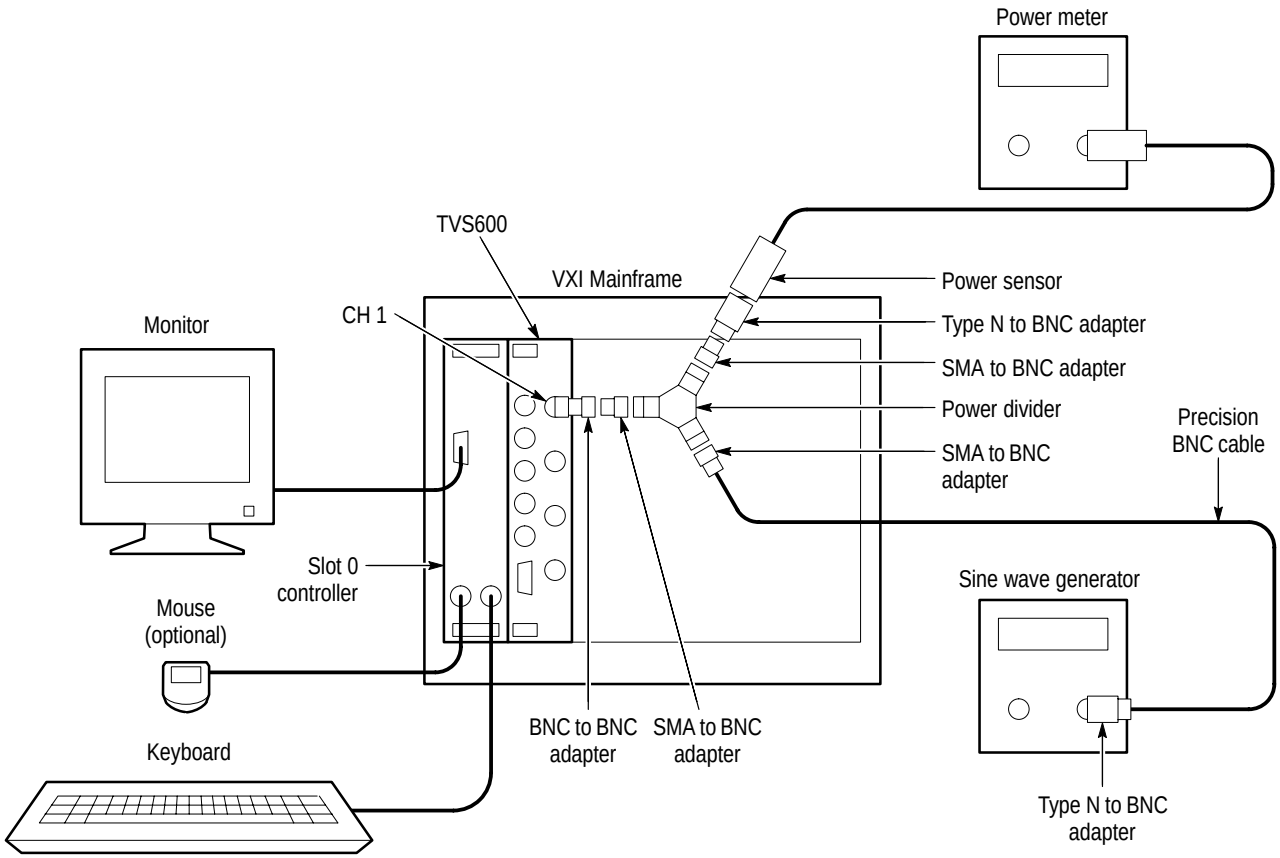


Figure 5–7: Using the power meter to monitor the output amplitude of the sine wave generator

Help Utility

The Field Adjust/PV software contains a Help utility that provides detailed information about the tests. You can access Help at any time by pressing the <F1> function key on your computer keyboard.

NOTE. *When you press the <F1> key, the test currently running will stop. Once a test stops, it CANNOT be continued. To complete the test, you will need to rerun the test.*

Using Help

When you access Help, a description of the current screen appears on your computer. Function keys <F1> through <F8> on your computer keyboard are then used to make selections within the Help utility. Only the function key labels that apply to your Help topic will appear on your computer screen.

Figure 5–8 shows a typical Help screen. A description of each possible function key label follows the illustration. Note that only the function key labels that apply to the help screen (F1, F2, F3, F7, and F8) are shown.

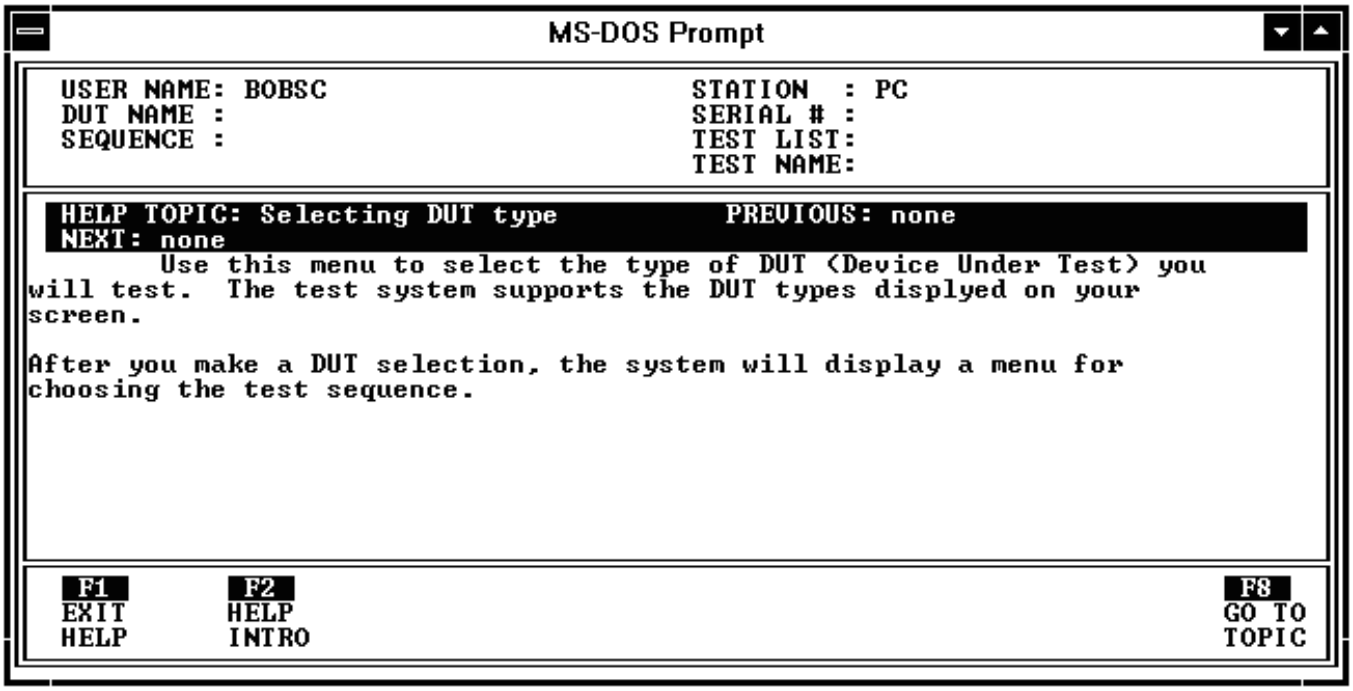


Figure 5–8: Typical help screen

<F1> EXIT HELP Exit to the most-current system menu screen.

<F2> HELP INTRO Return to INTRODUCTION TO HELP.

<F3> PREVIOUS TOPIC Return to the last topic you viewed. The name of the PREVIOUS TOPIC always appears at the top center of your screen.

<F4> NEXT TOPIC Show information about the next topic. The NEXT TOPIC appears at the top center of your screen.

<F5> RELATED TOPIC Display a list of topics that are related to the topic currently on your screen. You can select any topic from the displayed list.

<F6> SCROLL UP Scroll up to view text above the top of the screen.

<F7> SCROLL DOWN Scroll down to view text below the bottom of the screen.

<F8> GO TO TOPIC Display a list of all available topics in the help system. You can select any topic from the displayed list.

Interrupt Utility

The Field Adjust/PV software contains an Interrupt utility that stops the current test. You can interrupt a test at any time by pressing the <F2> function key on your computer keyboard.

***NOTE**. When you press the <F2> key, the test currently running will stop. Once a test stops, it CANNOT be continued. To complete the test you will need to rerun the test.*

Using Interrupt

When a test is interrupted, a list of choices appears on your computer screen. To select a choice, enter the number next to your choice and press the <RETURN> key.

Figure 5–9 shows a typical Interrupt screen. A description of the menu choices follows the illustration.

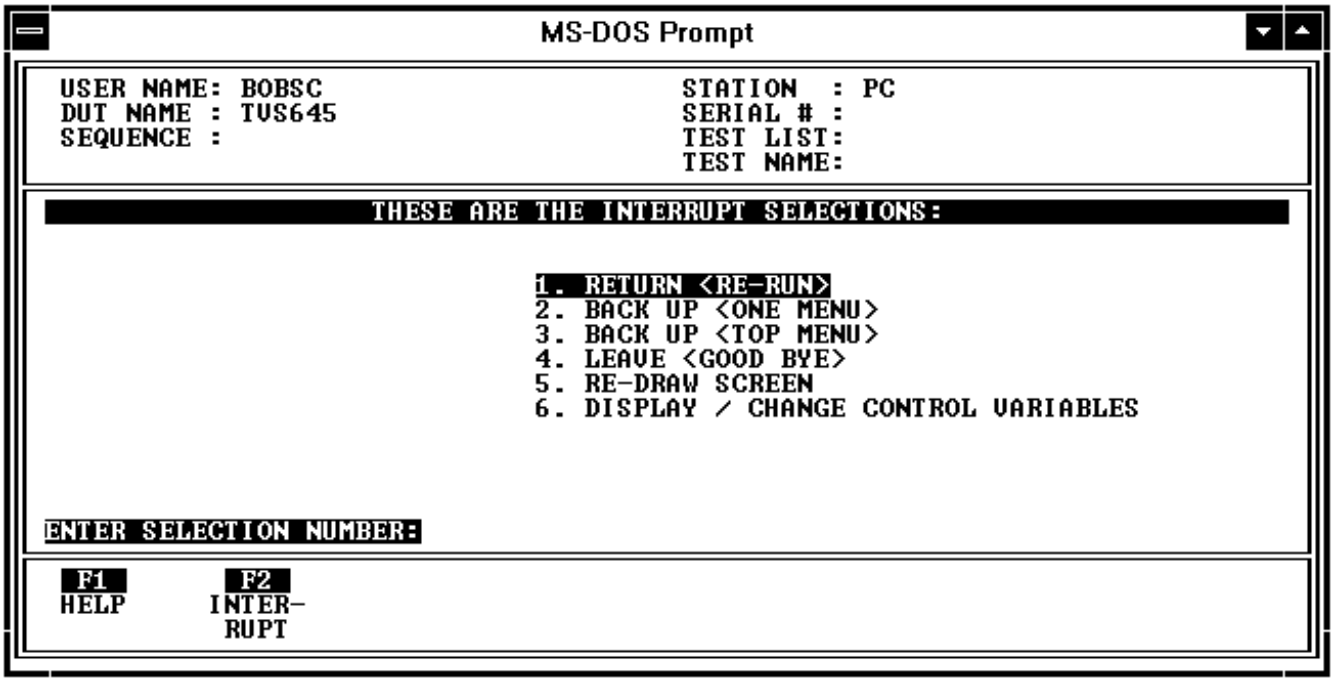


Figure 5–9: Typical interrupt screen

<1> RETURN (RE-RUN) Return to the menu or test that was active when you pressed the Interrupt key (F1). If a test was running, the system returns to the beginning of that test.

<2> BACK UP (ONE MENU) Move to the next higher level in the menu system. If the currently displayed menu is the highest-level menu, that menu will continue to be displayed.

<3> BACK UP (TOP MENU) Move to the top-level menu. If your system contains more than one DUT, you will move to the SELECT DUT menu. If your system contains one DUT, you will move to the SELECT SEQUENCE menu. If there is only one sequence for the selected DUT, you will move to the SEQUENCE MODE menu.

<4> LEAVE (GOOD BYE) Stops the software and returns to the DOS prompt. You cannot return to the point at which Leave was selected; restarting the Field Adjust/PV software executes the program from the beginning. The DUT returns to its default settings.

<5> REDRAW SCREEN Clear and redraw the screen. Use this feature to remove unwanted information from the screen.

<6> DISPLAY / CHANGE CONTROL VARIABLES Display the values of the important test system parameters. You can use this menu to change many of the parameter settings.

Maintenance

This chapter contains the information needed to do periodic and corrective maintenance on the waveform analyzer. The following sections are included:

- The *Maintenance* section provides general information on preventing damage to internal modules when doing maintenance, lithium battery warnings and disposal instructions, and procedures for inspecting the waveform analyzer and cleaning its external and internal modules.
- The *Removal and Installation Procedures* (page 6–7) provide procedures for the removal and installation of modules.
- *Troubleshooting* (page 6–27) provides information for isolating failed modules. Included are system-level instructions that isolate faults within your system, and troubleshooting trees that use the internal self tests and DC voltage measurements to locate faults within the waveform analyzer.
- *Repackaging Instructions* (page 6–37) provides packaging information for shipment or storage.

Related Maintenance Procedures

The following chapters contain information/procedures related to maintenance.

- The *Operating Information* section provides instructions for operating the waveform analyzer in order to perform the maintenance procedures within this manual.
- The *Theory of Operation* section contains a circuit description to the module, or block, level.
- The *Performance Verification* section contains tests that may be useful in isolating problems to modules by testing waveform analyzer performance.
- The *Adjustment Procedures* section contains a procedure for adjusting the internal circuits of the waveform analyzer. The procedure may be used after repairs are made, or for periodic adjustments.
- The *Diagrams* section contains a block diagram using individual modules as blocks and an interconnection diagram showing connections between the modules.
- The *Mechanical Parts List* section lists all field replaceable modules by part number.

Preventing ESD

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

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

1. Minimize handling of static-sensitive modules.
2. Transport and store static-sensitive modules in their static protected containers or on a metal rail. Label any package that contains static-sensitive modules.
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 modules over any surface.
7. Avoid handling modules in areas that have a floor or work-surface covering capable of generating a static charge.

Battery Disposal

WARNING. *To avoid personal injury, observe the proper procedures for handling lithium batteries. Improper handling can cause fire, explosion, or severe burns. Do not recharge, crush, disassemble, heat above 100° C (212° F), incinerate, or expose the battery to water.*

The waveform analyzer contains one lithium battery, A1U70, located on the Processor Board (A1). Battery replacement is accomplished by installing a new Processor Board (A1). Read the following information before replacing the battery. See *Processor Board* on page 6–12 for replacement instructions.

Dispose of lithium batteries according to local, state, and federal regulations.

In the United States, you can typically dispose of small quantities (less than 20) of batteries with ordinary garbage in a sanitary landfill. You must send larger quantities by surface transport to a hazardous waste disposal facility. Package the batteries individually to prevent shorting. Then, pack them in a sturdy container that is clearly labelled: Lithium Batteries — DO NOT OPEN.

Inspection and Cleaning

This section describes how to inspect for dirt and damage, and how to clean the waveform analyzer. Inspection and cleaning are done as preventive maintenance. Preventive maintenance, when done regularly, may prevent malfunctions and enhance reliability.

Preventive maintenance consists of visually inspecting and cleaning the waveform analyzer, and using general care when operating it. How often to do maintenance depends on the severity of the environment in which the waveform analyzer is used. A proper time to perform preventive maintenance is just before adjustment of the waveform analyzer.

General Care

The side cover keeps dust out of the waveform analyzer and should be in place during normal operation.

Inspection and Cleaning Procedures

Inspect and clean the waveform analyzer as often as operating conditions require. The collection of dirt on internal components can cause them to overheat and breakdown. Dirt acts as an insulating blanket, preventing efficient heat dissipation. Dirt also provides an electrical conduction path that could cause a waveform analyzer failure, especially under high-humidity conditions.

CAUTION. *Avoid the use of chemical cleaning agents that might damage the plastics and external labels used in the waveform analyzer. Use a cloth dampended with water to clean external surfaces. To clean internal surfaces, 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 waveform analyzer for damage, wear, and missing parts. Use Table 6–1 as a guide. Instruments that appear to have been dropped or otherwise abused should be checked thoroughly to verify correct operation and performance. Immediately repair defects that could cause personal injury or lead to further damage to the waveform analyzer.

Table 6–1: External Inspection Check List

Item	Inspect For	Repair Action
Front panel and side cover	Cracks, scratches, deformations, missing or damaged retainer screws, ejector handles, or gaskets.	Replace defective or missing modules.
Front panel connectors	Broken shells, cracked insulation, and deformed contacts. Dirt in connectors.	Replace defective modules. Clear or wash out dirt.
Rear connectors	Cracked or broken shells, damaged or missing contacts. Dirt in connectors.	Replace defective modules. Clear or wash out dirt.
Accessories	Missing items or parts of items, bent pins, broken or frayed cables, and damaged connectors.	Replace damaged or missing items, frayed cables, and defective modules.

CAUTION. *To prevent damage to electrical components from moisture during external cleaning, use only enough liquid to dampen the cloth or applicator.*

Cleaning Procedure — Exterior. To clean the waveform analyzer exterior, perform the following steps:

1. Remove loose dust on the outside of the waveform analyzer with a lint free cloth.
2. Remove remaining dirt with a lint free cloth dampened with water. Do not use abrasive cleaners.

Inspection — Interior. Remove the module cover (see page 6–10) to access the inside of the waveform analyzer for inspection and cleaning.

Inspect the internal portions of the waveform analyzer for damage and wear using Table 6–2 as a guide. Defects found should be repaired immediately. If any electrical module is replaced, check Table 5–2 on page 5–3 to determine if you need to adjust the waveform analyzer.

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 failed module and replace with a new module.
Resistors	Burned, cracked, broken, blistered condition.	Remove failed module and replace with a new module.
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 failed module and replace with a new module.
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), and reinsert firmly. Ensure that straightening action does not crack pins, causing them to break off.
Wiring and cables	Loose plugs or connectors. Burned, broken, or frayed wiring.	Firmly seat connectors. Repair or replace modules with defective wires or cables.
Chassis	Dents, deformations, and damaged hardware.	Straighten, repair, or replace defective hardware.

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

Cleaning Procedure — Interior. To clean the waveform analyzer interior, perform 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.)

***NOTE**. If, after performing steps 1 and 2, a module is clean upon inspection, skip the remaining steps.*

If steps 1 and 2 do not remove all the dust or dirt, the waveform analyzer may be spray washed using a solution of 75% isopropyl alcohol (see steps 3 through 7).

3. Gain access to the parts to be cleaned by removing easily accessible shields and panels (see *Removal and Installation Procedures* on page 6–7).
4. Spray wash dirty parts with the isopropyl alcohol and wait 60 seconds for the majority of the alcohol to evaporate.
5. Use hot (48.9° C to 60° C/120° F to 140° F) deionized water to thoroughly rinse the parts.
6. Dry all parts with low-pressure, deionized air.
7. Dry all components and assemblies in an oven or drying compartment using low-temperature (51.7° C to 65.6° C/125° F to 150° F) circulating air.

Lubrication. There is no periodic lubrication required for the waveform analyzer.

Removal and Installation Procedures

This section describes how to remove and install the major mechanical and electrical modules. It provides the following information:

- *List of Modules* on page 6–7 describes where to locate a list of replaceable modules
- *Summary of Procedures* on page 6–8 lists the procedures for removal and installation of modules
- *Tools Required* on page 6–8 describes the tools needed to perform the procedures
- Beginning with *Ejector Handles* on page 6–9, detailed procedures describe the removal and installation of modules

Preparation — Please Read

Please read the following warning statement. Then read the following general instructions before removing a module.

WARNING. *Before doing this or any other procedure in this manual, read the* General Safety Summary *and* Service Safety Summary *found at the beginning of this manual. Also, to prevent possible injury to service personnel or damage to electrical components, read* Preventing ESD *on page 6–2.*

1. Read the *Summary of Procedures* on page 6–8 to understand how the procedures are grouped. Then read *Tools Required* on page 6–8 for a list of tools needed to remove and install modules in the waveform analyzer.
2. If you are disassembling the waveform analyzer for cleaning, refer to the *Inspection and Cleaning* procedure on page 6–3 for cleaning instructions.

List of Modules

The *Mechanical Parts List* section provides a list of all replaceable modules. Any electrical or mechanical module, assembly, or part listed in the parts list is referred to as a module.

Summary of Procedures

The procedures are listed below in the order in which they appear in this section:

- *Ejector Handles* on page 6–9 describes how to replace the module ejector handles
- *Module Cover* on page 6–10 describes how to replace the module cover
- *Processor Board* on page 6–12 describes how to replace the Processor Board (A1)
- *Serial Interface Cable Assembly* on page 6–15 describes how to replace the front panel SERIAL INTERFACE connector
- *BNC Connectors* on page 6–17 describes how to replace the five front panel BNC connectors (not channel input connectors)
- *Fuses* on page 6–18 describes how to replace the BNC connector fuses, and fuses related to power supplies
- *Coaxial Cable Assembly* on page 6–20 describes how to replace the coaxial cable assembly
- *Probe Interface* on page 6–22 describes how to replace the probe interface flex circuit
- *Acquisition Board* on page 6–25 describes how to replace the Acquisition Board (A2)

Tools Required

Most modules in the waveform analyzer can be removed using a screwdriver handle mounted with size T-10 and T-15 Torx® screwdriver bits. Table 6–3 lists the tools needed to replace modules in the waveform analyzer. All tools required to remove and install each module are listed before the procedure.

Table 6–3: Tools Required for Module Replacement

Item Number	Name	Description
1	Screwdriver handle	Accepts Torx® driver bits
2	T-10 Torx tip	Torx® driver bit for T-10 size screw heads
3	T-15 Torx tip	Torx® driver bit for T-15 size screw heads
4	One-half inch (1/2) nut driver	Standard tool
5	One-quarter (1/4) inch nut driver	Standard tool
6	Soldering iron	Standard tool
7	Solder wick	Standard tool
8	Three-sixteenth (3/16) inch nut driver	Standard tool

Ejector Handles

You will need a screwdriver with a size T-10 Torx® tip (Table 6–3, items 1 and 2) to replace the ejector handles.

Removal

Use the following procedure and Figure 6–1 to remove the ejector handles.

NOTE. *The ejector labels can be replaced without removing the ejector handles.*

1. Place the instrument on its right side (power requirements label facing down).
2. Remove the screw and flat washer that secure the ejector handle to the chassis.
3. Lift up on the ejector handle until it clears the mounting post.
4. Remove the ejector handle from the waveform analyzer.

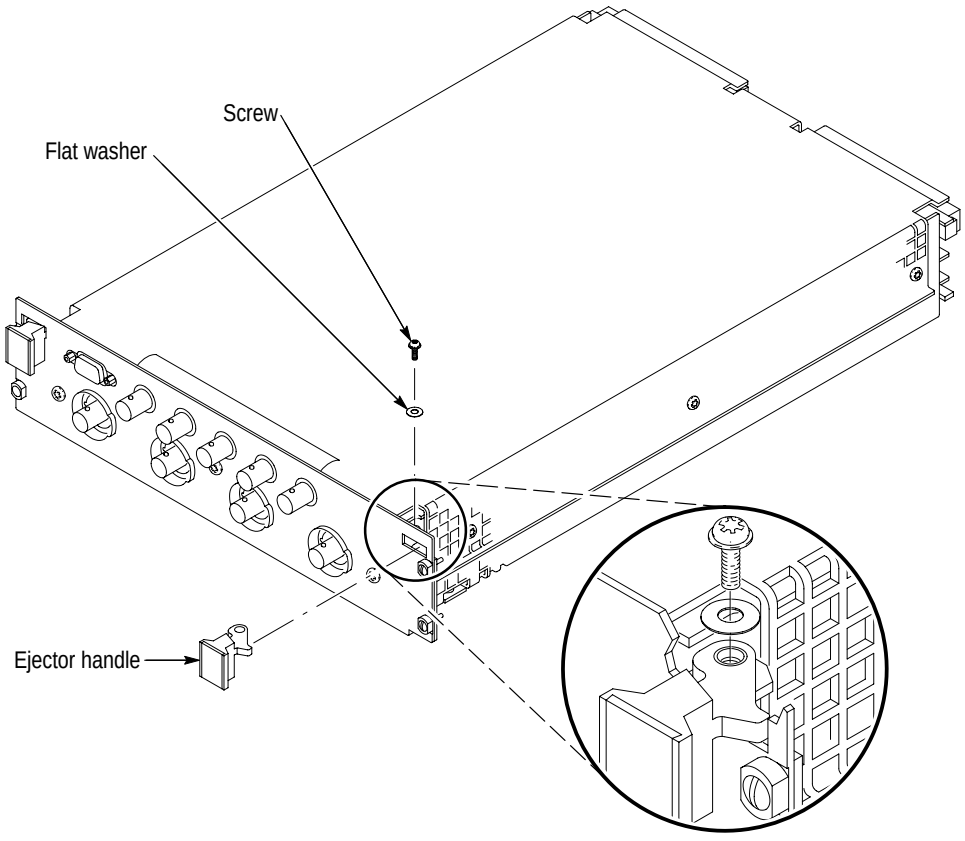


Figure 6–1: Ejector handle replacement

Installation

Use the following procedure and Figure 6–1 to install the ejector handles.

NOTE. *The top and bottom ejector handles are not interchangeable.*

1. Install the ejector handle through the front panel cutout onto the mounting post.
2. Install the screw and flat washer to secure the ejector handle to the chassis.

Module Cover

You will need a screwdriver with a size T-10 Torx® tip (Table 6–3, items 1 and 2) to replace the module cover.

Removal

Use the following procedure and Figure 6–2 to remove the module cover.

1. Place the instrument on its right side (power requirements label facing down).
2. Remove four (4) screws that secure the rear panel to the chassis (Figure 6–2). Set the rear panel aside.
3. Remove four (4) screws that secure the module cover to the chassis.
4. Lift the module cover from the chassis.

Installation

Use the following procedure and Figure 6–2 to install the module cover.

NOTE. *The module cover must be installed tightly against the chassis. This will ensure that the waveform analyzer fits into any two adjacent slots in the maniframe.*

1. Place the instrument on its right side.
2. Place the module cover onto the chassis.
3. Push forward on the module cover so the front edge of the module cover is next to the rear of the front subpanel.
4. While holding the module cover in place, install the four (4) screws nearest the front of the module, to secure the module cover to the chassis.
5. Install four (4) screws that secure the rear panel to the chassis.

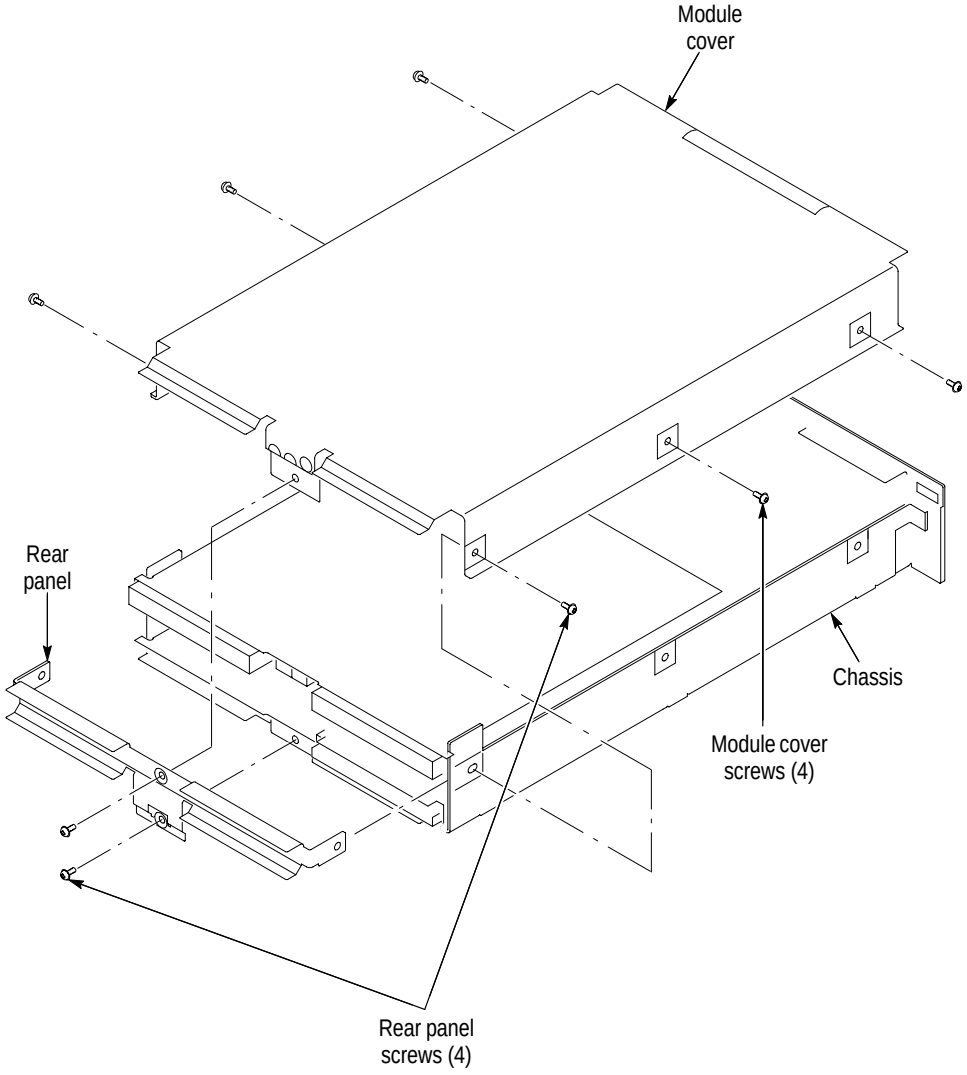


Figure 6–2: Module cover removal

Processor Board

You will need a screwdriver with a size T-10 Torx® tip (Table 6–3, items 1 and 2) to replace the Processor Board.

Removal

Use the following procedure and Figure 6–3 to remove the Processor Board.

NOTE. *After replacing the Processor Board, you must reprogram the FlashROM and self cal the waveform analyzer. To restore the self cal settings, refer to* Self Cal Mode *on page 2–13.*

1. Perform the *Module Cover* removal procedure (see page 6–10).
2. Unplug two 100-pin ribbon cables from J6 and J9.
3. Unplug one 9-pin ribbon cable from J5.
4. Remove six (6) screws that secure the Processor Board to the chassis.
5. Carefully move the Processor Board away from the front panel until the tab (Figure 6–3) clears the front subpanel.
6. Lift the board above the chassis. Then unplug the yellow/white coaxial cable from J3.

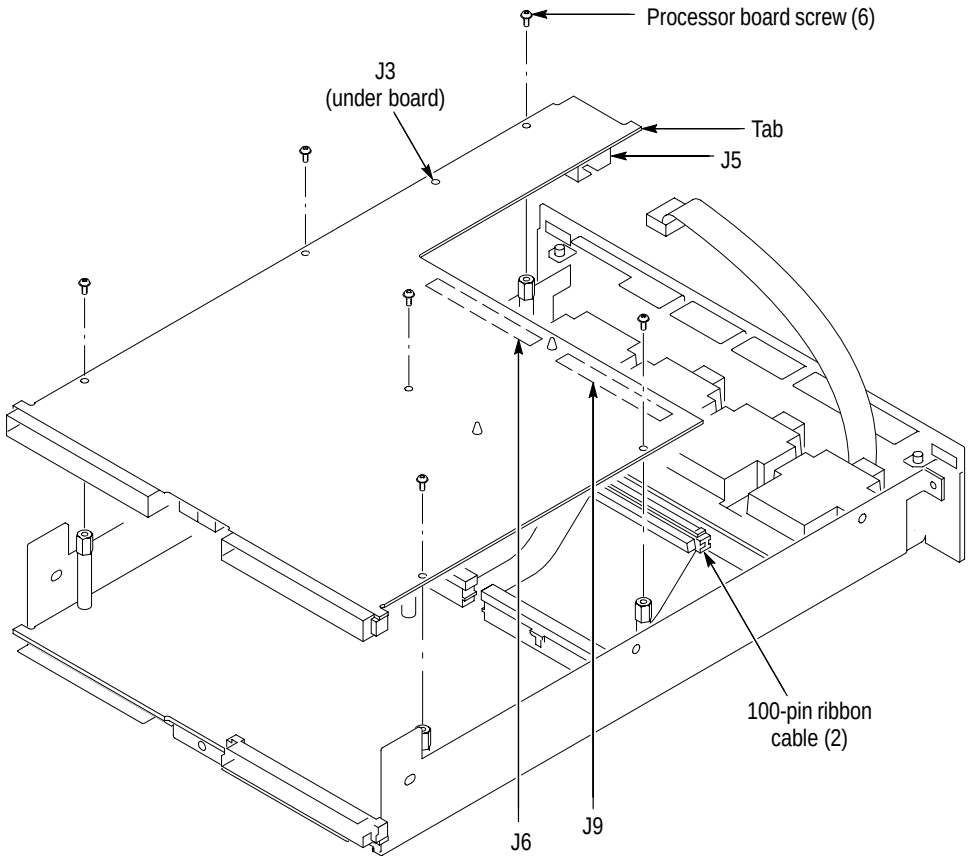


Figure 6–3: Processor board removal

Installation

Use the following procedure and Figure 6–3 to install the Processor Board.

***NOTE**. After replacing the Processor Board, you must reprogram the FlashROM and self cal the waveform analyzer. To restore the self cal settings, refer to* Self Cal Mode *on page 2–13.*

1. Hold the Processor Board above the chassis and install the yellow/white coaxial cable at J3.
2. Insert the tab on the Processor Board into the front subpanel as shown in Figure 6–4. Then set the Processor Board in place on the chassis.

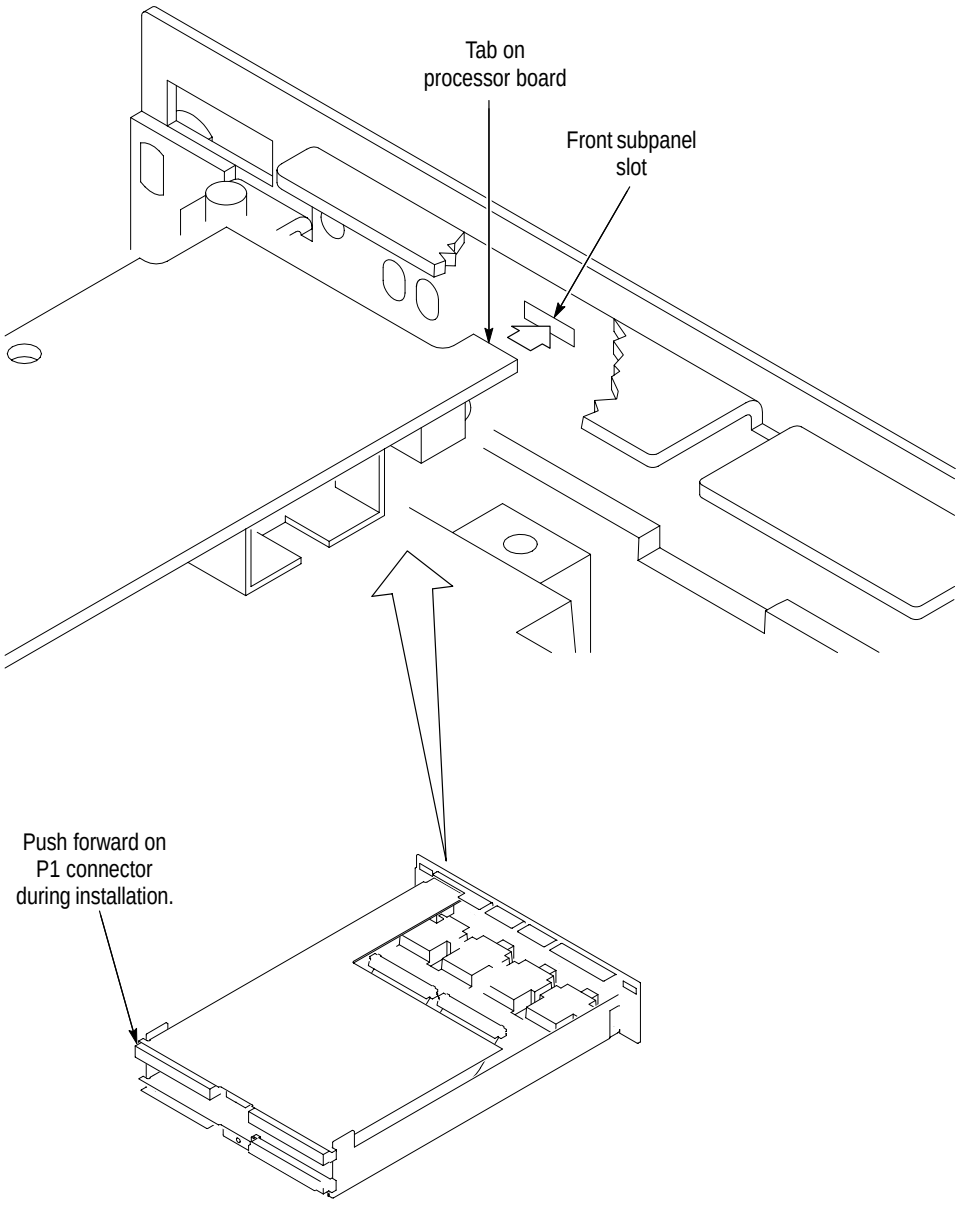


Figure 6–4: Inserting processor board tab into front subpanel

3. Push forward on the Processor Board P1 connector. To ensure proper alignment, the tab must be fully inserted into the front subpanel slot.
4. While holding the Processor Board in place, install the six (6) screws that secure the Processor Board to the chassis.
5. Install the 9-pin ribbon cable at J5.
6. Install the two 100-pin ribbon cables at J6 and J9.
7. Perform the *Module Cover* installation procedure (see page 6–10).

Serial Interface Cable Assembly

You will need a screwdriver with a size T-10 Torx® tip, and a 3/16 inch nut driver (Table 6–3, items 1, 2, and 8) to replace the serial interface cable assembly.

Removal

Use the following procedure and Figure 6–5 to remove the serial interface cable assembly.

1. Perform the *Module Cover* removal procedure (see page 6–10).
2. Unplug the serial interface cable from J5 on the Processor Board.

CAUTION. *To avoid damage to the SERIAL INTERFACE connector shell, do not force the nut driver between the jack screws and the connector.*

3. Using a 3/16 inch nut driver, remove two (2) jack screws that secure the SERIAL INTERFACE connector to the front panel.
4. Lift the serial interface cable assembly from the chassis.

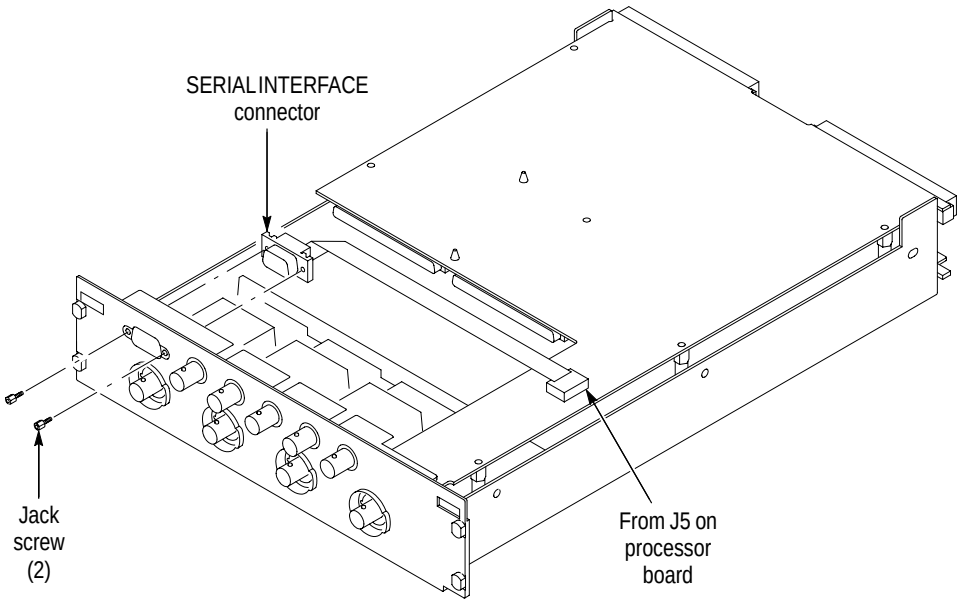


Figure 6–5: Serial interface connector removal

Installation

Use the following procedure and Figure 6–5 to install the serial interface cable assembly.

1. Insert the SERIAL INTERFACE connector, from the rear of the front panel, into the front panel cutout.

CAUTION. *To avoid damage to the SERIAL INTERFACE connector shell, do not force the nut driver between the jack screws and the connector shell.*

2. Using a 3/16 inch nut driver, install two (2) jack screws that secure the connector to the front panel.
3. Plug the serial interface cable connector into J5 on the Processor Board. When installing a new cable, fold it as shown in Figure 6–5 to ensure proper polarity of the connector.
4. Perform the *Module Cover* installation procedure (see page 6–10).

BNC Connectors

You will need a screwdriver with a size T-10 Torx® tip and a 1/2 inch nut driver (Table 6–3, items 1, 2, and 4) to replace the following BNC connectors:

- PROBE COMPENSATION
- REFERENCE OUTPUT
- FIDUCIAL INPUT
- ARM INPUT
- EXTERNAL TRIGGER INPUT

Removal

Use the following procedure and Figure 6–6 to remove the BNC connectors.

1. Perform the *Processor Board* removal procedure (see page 6–12).
2. Unplug the coaxial cable from the rear of the BNC that is being replaced.
3. Using a 1/2 inch nut driver, remove the securing nut and washer from the rear of the connector.
4. Remove the BNC from the front panel.

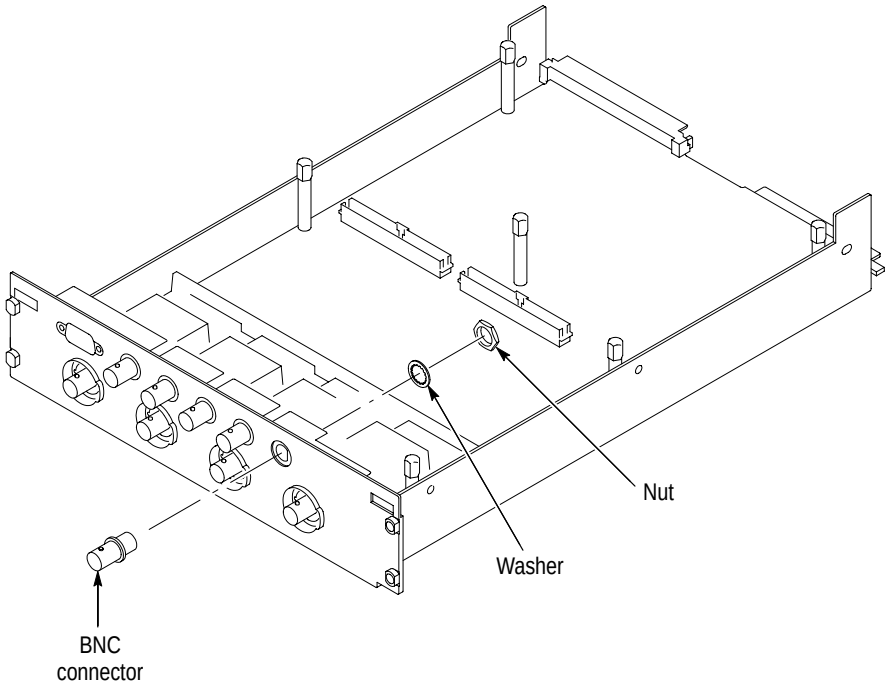


Figure 6–6: BNC replacement

Installation

Use the following procedure and Figure 6–6 to install BNC connectors.

1. Insert the BNC through the hole in the front panel.
2. Slide the washer onto the BNC, next to the back side of the front panel.
3. Using a 1/2 inch nut driver, install the securing nut onto the rear of the connector.
4. Plug the coaxial cable into the rear of the BNC (see Figure 6–8 on page 6–20 for a detailed description of the cable connections).
5. Perform the *Processor Board* installation procedure (see page 6–13).

Fuses

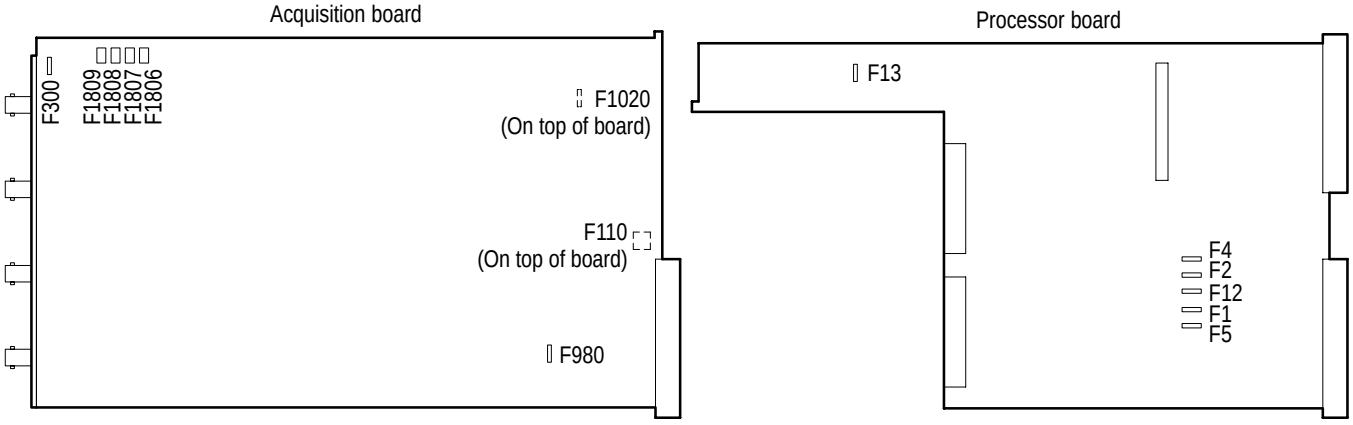
CAUTION. *To avoid damage to the waveform analyzer, use only replacement fuses that match the type, voltage, and current rating of the original fuse. See the* Mechanical Parts List *section for the part number of replacement fuses.*

You will need a screwdriver with a size T-10 Torx® tip, a soldering iron, and solder wick (Table 6–3, items 1, 2, 6, and 7) to replace the fuses.

Removal

Use the following procedure and Figure 6–7 to remove the fuses.

1. Perform the *Processor Board* removal procedure (see page 6–12).
2. Use Figure 6–7 to locate the fuse to be replaced. If the fuse is mounted on the back side of the Acquisition board (A2), perform the *Probe Interface* removal procedure (see page 6–22). If you can already access the fuse, proceed to step 3.
3. Using a soldering iron and solder wick, unsolder and discard the fuse.



Circuit Number	Circuit Board	Purpose
F110	Acquisition Board	+5 V
F300	Acquisition Board	Fiducial input
F980	Acquisition Board	Reference output
F1020	Acquisition Board	External trigger input
F1806	Acquisition Board	+5 V to probe interface
F1807	Acquisition Board	–5 V to probe interface
F1808	Acquisition Board	+15 V to probe interface
F1809	Acquisition Board	–15 V to probe interface

Circuit Number	Circuit Board	Purpose
F1	Processor Board	+12 V
F2	Processor Board	+5 VD
F4	Processor Board	–5.2 V
F5	Processor Board	–12 V
F12	Processor Board	+5V
F13	Processor Board	Calibrator output

Figure 6–7: Fuse replacement

Installation

Use the following procedure and Figure 6–7 to install the fuses.

CAUTION. *To avoid damage to the waveform analyzer, use only replacement fuses that match the type, voltage, and current rating of the original fuse. See the* Mechanical Parts List *section for the part number of replacement fuses.*

1. Using a soldering iron, solder the new fuse into place.
2. If the Acquisition Board (A2) was removed, perform the *Probe Interface* installation procedure (page 6–24).
3. Perform the *Processor Board* installation procedure (see page 6–13).

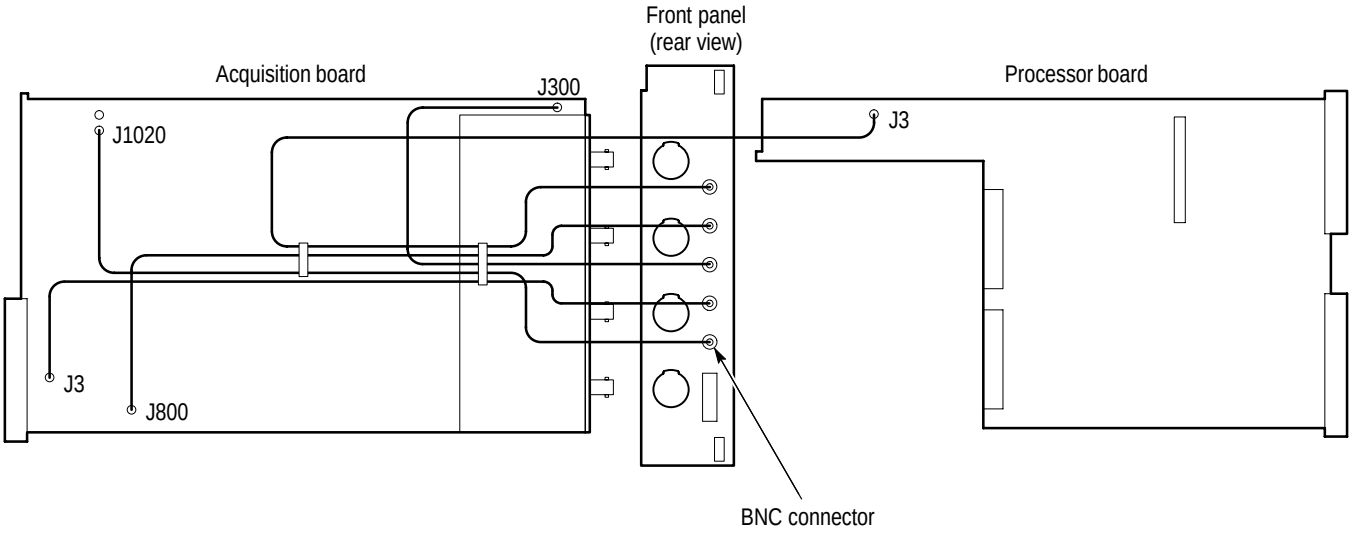
Coaxial Cable Assembly

You will need a screwdriver with a size T-10 Torx® tip (Table 6–3, items 1 and 2) to replace the coaxial cable assembly.

Removal

Use the following procedure and Figure 6–8 to remove the coaxial cable assembly.

1. Perform the *Processor Board* removal procedure (see page 6–12).
2. Unplug the five (5) coaxial cables from the front panel BNC connectors.
3. Unplug the four (4) coaxial cables from the Acquisition Board connectors.



Connector	Color Code	Circuit Board	Circuit Number
Probe Compensation	Yellow/white	Processor Board	J3
Reference Output	Green/white	Acquisition Board	J980
Fiducial Input	Red/white	Acquisition Board	J300
Arm Input	Purple/white	Acquisition Board	J800
External Trigger Input	Blue/white	Acquisition Board	J1020

Figure 6–8: Coaxial cable assembly replacement

Installation

Use the following procedure and Figure 6–8 to install the coaxial cable assembly.

1. Install the five (5) coaxial cables into the front panel BNC connectors as shown in Figure 6–8.
2. Install the four (4) coaxial cables into connectors on the Acquisition Board as shown in Figure 6–8. The yellow/white coaxial cable will be installed later.

CAUTION. *To avoid damage to the coaxial cable assembly during Processor Board installation, be sure the cables lay as shown in Figure 6–9.*

3. Dress the coaxial cable assembly as shown in Figure 6–9. Route it between the center post and the top side of the instrument.

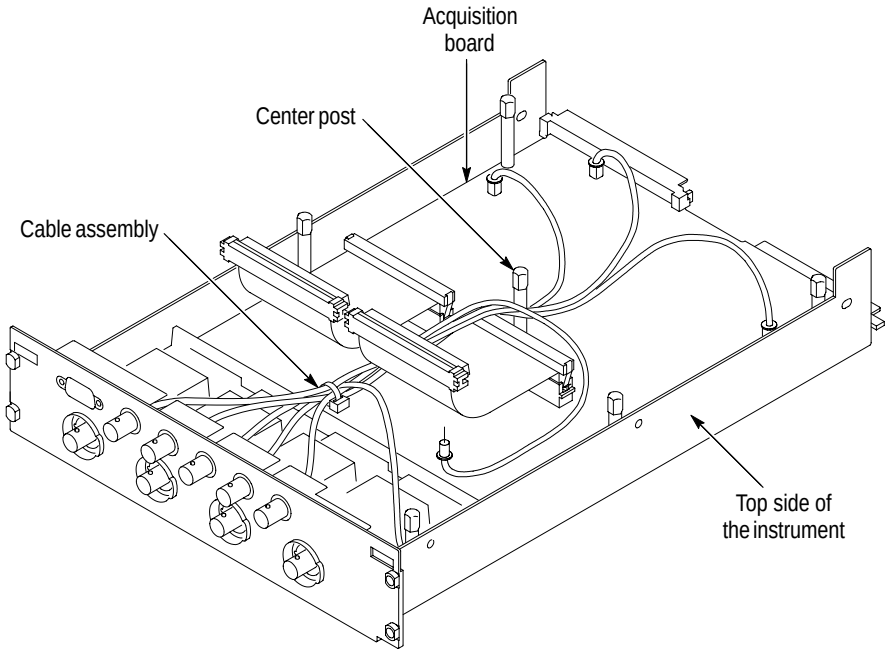


Figure 6–9: Dress of coaxial cable assembly

4. Perform the *Processor Board* installation procedure (see page 6–13).

Probe Interface

You will need a screwdriver with size T-10 and T-15 Torx® tips and a 1/4 inch nut driver (Table 6–3, items 1, 2, 3, and 5) to replace the probe interface.

Removal

Use the following procedure and Figure 6–10 to remove the probe interface.

1. Perform the *Module Cover* removal procedure (see page 6–10).
2. Perform the *Coaxial Cable Assembly* removal procedure (see page 6–20).
3. Using a 1/4 inch nut driver, remove six (6) spacer posts that secure the Acquisition Board to the chassis.
4. Using a screwdriver with a T-15 Torx® tip, remove three (3) screws that secure the Acquisition Board to the front panel.

CAUTION. *To avoid damage to the plastic probe adapter rings during Acquisition Board removal, be sure the BNC connectors do not get caught on the probe adapter rings during removal..*

5. Carefully slide the Acquisition Board away from the front panel until the BNC connectors clear the front subpanel. Then lift the module from the chassis.
6. If necessary, remove the plastic probe adapter rings from the BNC connectors on the attenuator housing. The plastic rings often remain in the front panel during Acquisition Board removal.
7. Unlock socket J1163 (slide the lock tabs away from the attenuator housing).
8. Remove the probe interface from J1163. Then carefully slide the probe interface from around each BNC connector on the Acquisition Board.

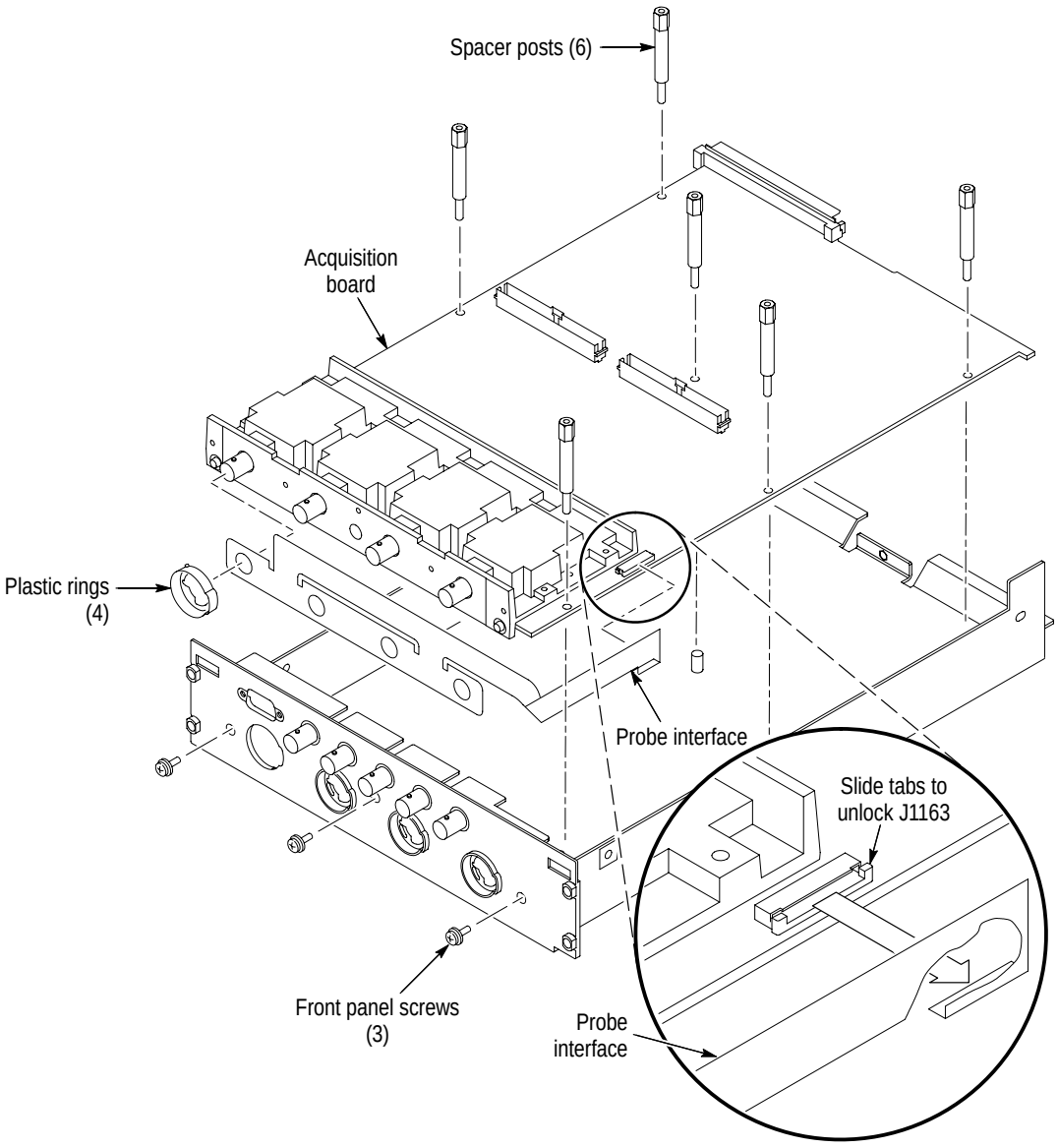


Figure 6–10: Probe interface replacement

Installation

Use the following procedure and Figure 6–10 to install the probe interface.

NOTE. *Be sure the RF shielding gasket is installed on the BNC connectors before installing the probe interface.*

1. Install the probe interface over the BNC connectors on the Acquisition Board.
2. Carefully bend the probe interface cable as shown in Figure 6–10. Then install the probe interface into socket J1163 on the Acquisition Board.
3. Lock J1163 (slide the lock tabs toward the attenuator housing).
4. If necessary, turn the front panel face down and insert the plastic rings into holes in the front panel. The plastic rings may already be installed if they stayed in the front panel during Acquisition Board removal.
5. Turn the front panel face down and carefully slide the Acquisition Board into the front panel until the BNC connectors clear the front subpanel. Then lay the module onto the chassis. Be sure the attenuator housing is flush with the back side of the front panel.
6. Using a screwdriver with a T-15 Torx® tip, install three (3) screws that secure the Acquisition Board to the front panel.
7. Using a 1/4 inch nut driver, install six (6) spacer posts that secure the Acquisition Board to the chassis.
8. Perform the *Coaxial Cable Assembly* installation procedure (see page 6–21).

Acquisition Board

You will need a screwdriver with size T-10 and T-15 Torx® tips and a 1/4 inch nut driver (Table 6–3, items 1, 2, 3, and 5) to replace the Acquisition Board.

Removal

Use the following procedure and Figure 6–11 to remove the Acquisition Board.

NOTE. *After replacing the Acquisition Board, you must adjust the waveform analyzer. See the* Adjustment Procedures *section for detailed instructions.*

1. Perform the *Probe Interface* removal procedure (see page 6–22).
2. Remove the RF shielding gasket from the BNC connectors. Set the shield aside.
3. Unplug two (2) 100-pin ribbon cables from J100 and J101 as follows:
   a. Grasp and squeeze the metal cable retainers (Figure 6–11) to unlock the cable from its connector.
   b. Unplug the cable from the Acquisition Board. Set the cable aside.

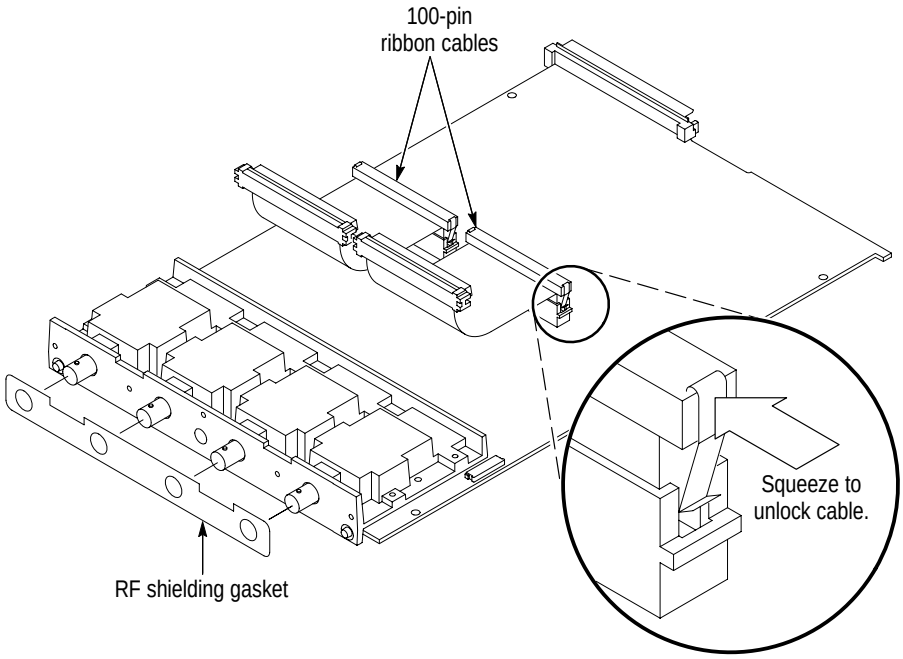


Figure 6–11: Acquisition board replacement

Installation

Use the following procedure and Figure 6–11 to install the Acquisition Board.

NOTE. *After replacing the Acquisition Board, you must adjust the waveform analyzer. See the* Adjustment Procedures *section for detailed instructions.*

1. Plug two (2) 100-pin ribbon cables onto J100 and J101. Be sure to firmly seat the cables into their sockets so the cable retainers snap into place.
2. Install the RF shielding gasket onto the BNC connectors.
3. Perform the *Probe Interface* installation procedure (page 6–24).

Troubleshooting

WARNING. *Before doing this or any other procedure in this manual, read the* General Safety Summary *and* Service Safety Summary *found at the beginning of this manual. Also, to prevent possible injury to service personnel or damage to electrical components, read* Preventing ESD *on page 6–2.*

This section contains information and procedures designed to help you isolate faults within your system. There are two levels of troubleshooting instructions:

- *System Diagnostics* on page 6–28 helps to isolate faults to a system component
- *TVS600 Diagnostics* on page 6–30 helps to isolate faults to a module within the waveform analyzer

The troubleshooting instructions in the *TVS600 Diagnostics* section isolate faults to one of the following waveform analyzer modules:

- Processor Board (A1)
- Acquisition Board (A2)
- Power supply fuses
- Probe interface flex cable

Other sections in this manual contain instructions you will need to complete repairs after locating the faulty module. Refer to the following sections:

- Use the *Removal and Installation Procedures* that begin on page 6–7 for module replacement instructions
- Refer to Table 5–2 on page 5–3 after module replacement to determine if adjustments are required
- Complete the procedures found in the *Performance Verification* section to verify instrument functionality following repairs or adjustment

System Diagnostics

Table 6–4 provides a list of common problems that will cause your VXIbus system to malfunction. The list is not exhaustive; other conditions may exist that prevent your system from operating properly. If you are not able to complete the *Power-On Procedure* (page 2–10), try to repair your system using the suggestions found in the **Possible Cause(s)** column of Table 6–4.

It is possible that you will not identify which system component is faulty after checking for the symptoms in Table 6–4. You should use a working VXIbus module to quickly determine if the waveform analyzer is at fault. Perform the following steps:

1. Remove the waveform analyzer from the VXIbus mainframe.
2. Configure the VXIbus mainframe for the working VXIbus module. Be sure to use the plug-in slots where you want to install the waveform analyzer.
3. Install the working VXI module.
4. Power-on the system and check for normal operation of the working VXIbus module.

If your system operates normally with the working VXIbus module installed, the waveform analyzer needs to be repaired. The *TVS600 Diagnostics* section on page 6–30 provides the troubleshooting procedures you need to locate faults within the waveform analyzer.

Table 6–4: Failure Symptoms and Possible Causes

Symptom	Possible Cause(s)
Computer does not power on	■ Power connection faulty; check or substitute power cord ■ Line voltage setting incorrect; check setting and line fuse ■ Hardware failure; consult manufacturer or product literature
Mainframe does not power on	■ Power connection faulty; check or substitute power cord ■ Fuse blown; check line fuse ■ Mainframe power supply failure; contact local Tektronix service center
Monitor does not power on	■ Power connection faulty; check or substitute cord ■ Fuse blown; check line fuse ■ Monitor power supply failure; contact local Tektronix service center
Monitor display is blank	■ Adjust monitor controls for brightness and contrast ■ VGA cable connection faulty; check or substitute VGA cable ■ Monitor failure; contact local Tektronix service center
Computer does not boot	■ Non-system diskette or floppy in external drive; make sure computer is booting from hard drive ■ Hard drive failure or corrupted files on hard drive; consult manufacturer or product literature for service information
TVS600 *and* Slot 0 controller do not power on	■ Modules not fully inserted; make sure front of module is flush with front panel ■ Mainframe not configured properly; consult manufacturer or product literature for information ■ Mainframe power supply failure; contact local Tektronix service center
Slot 0 controller does not power on	■ Module not fully inserted; make sure front of module is flush with front panel ■ Mainframe not configured properly; consult manufacturer or product literature for information ■ Module failure; contact local Tektronix service center
TVS600 does not power on (READY indicator not green)	■ Module not fully inserted; make sure front of module is flush with front panel ■ Mainframe not configured properly; consult manufacturer or product literature for information ■ Module failure; see *TVS600 Diagnostics* on page 6–30, or contact local Tektronix service center
TVS600 or Slot 0 controller does not respond to *IDN? query	■ Module not fully inserted; make sure front of module is flush with front panel ■ Incorrect address for TVS600; set logical address to expected address of the TVS600; refer to page 2–1 for instructions ■ TVS600 failure; see *TVS600 Diagnostics* on page 6–30, or contact local Tektronix service center
TVS600 loses settings when power is turned off	■ TVS600 failure; see *TVS600 Diagnostics* on page 6–30, or contact local Tektronix service center ■ TVS600 battery failure; refer to page 6–12 for Processor Board (A1) replacement instructions

TVS600 Diagnostics

This section provides troubleshooting charts that help you identify faulty modules within the waveform analyzer. The procedures require that your system is functional; it operates normally when modules other than the waveform analyzer are installed. If you have not determined that the waveform analyzer needs repair, refer to *System Diagnostics* on page 6–28 before troubleshooting the waveform analyzer.

Equipment Required

The test equipment needed to troubleshoot the waveform analyzer depends on the type of failure. Many faults can be detected using a digital multimeter. However, waveform analyzer testing and adjustments might be required to correct some faults. Under those circumstances, you will need the test equipment listed in the *Performance Verification* and *Adjustment Procedures* sections.

You will be required to install a new Processor Board (A1) and fuses to isolate certain faults. See the *Mechanical Parts List* section to locate the Tektronix part number for replacement parts.

Front Panel Indicators

The READY, ARM'D, and TRIG'D front panel indicators provide information about the waveform analyzer at power-on. You will use these indicators to determine which troubleshooting chart to use.

Under normal conditions, the ARM'D and TRIG'D indicators light for a short time after power is turned on. Approximately five seconds after power-on, the READY indicator turns on and the remaining indicators turn off.

The READY indicator blinks at power-on if the waveform analyzer has an event to report. The event could help you locate a fault. To read the event, send the following query:

```
SYST:ERR?
```

The returned event message contains the event number and a text description of the event. When you read an event, the event is removed from the queue. If the READY indicator continues to blink, send the query again to retrieve additional event numbers and descriptions.

Troubleshooting Procedure

This section contains two troubleshooting charts that will help you locate faulty waveform analyzer modules:

- The *Primary Troubleshooting Procedure* chart on page 6–32 provides troubleshooting steps that test the waveform analyzer modules
- The *Power Supply Troubleshooting Procedure* chart on page 6–34 locates power supply faults within the waveform analyzer

To begin the procedure, perform the following steps:

NOTE. *Install the waveform analyzer into the VXIbus mainframe so that you have access to the left side of the instrument. The troubleshooting procedures require voltage measurements on the Processor Board (A1).*

1. Install the waveform analyzer into a functional VXIbus mainframe that is configured for the waveform analyzer. See the *Operating Information* section for installation instructions.
2. Before you power on the VXIbus mainframe power, look at the READY, ARM'D, and TRIG'D front panel indicators.
3. Power on the VXIbus mainframe power and note how the front panel indicators respond.
4. Use the *Primary Troubleshooting Procedure* chart on page 6–32 to determine how to proceed.

NOTE. *Before replacing modules, be sure to inspect all associated cables and connectors for damage and proper installation.*

5. Use the *Removal and Installation Procedures* that begin on page 6–7 to replace the faulty module.
6. Refer to Table 5–2 on page 5–3 after module replacement to determine if adjustments are required.
7. Complete the procedures found in the *Performance Verification* section.

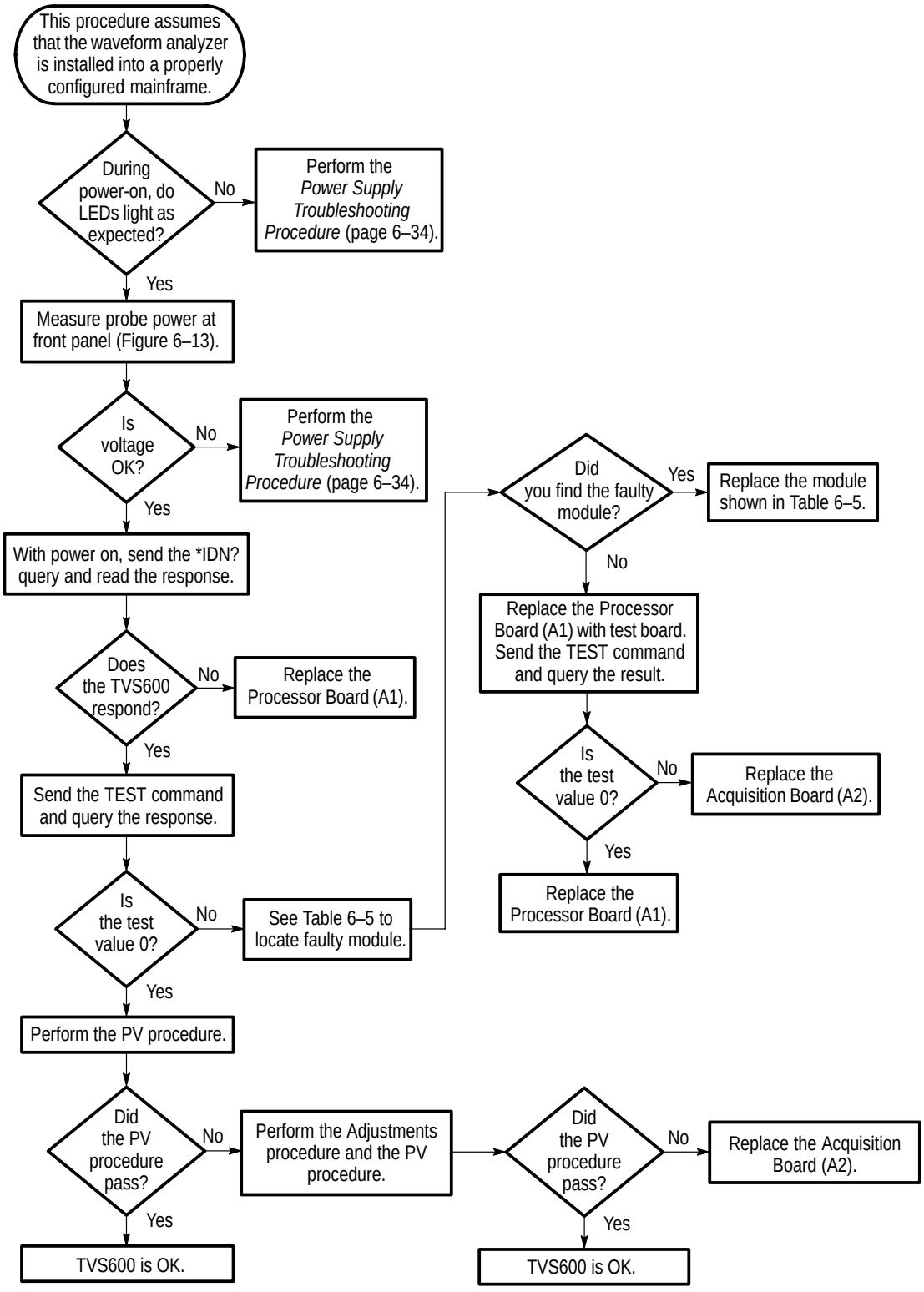
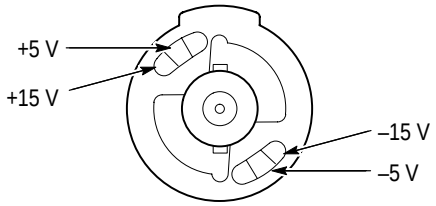


Figure 6–12: Primary troubleshooting procedure



Power Supply	Limits
+5 V	+4.85 V to +5.15 V
+15 V	+14.55 V to +15.45 V
–15 V	–14.55 V to –15.45 V
–5 V	–4.85 V to –5.15 V

Figure 6–13: Probe power voltage check

Table 6–5: Primary Fault Location Table

Test Code	Faulty Module
1000	Processor Board (A1)
1307, 1313, 1316, 1317, 2000, 2001, 2002, 2003, 2011, 2020	Acquisition Board (A2)
All other codes	Cannot identify faulty module

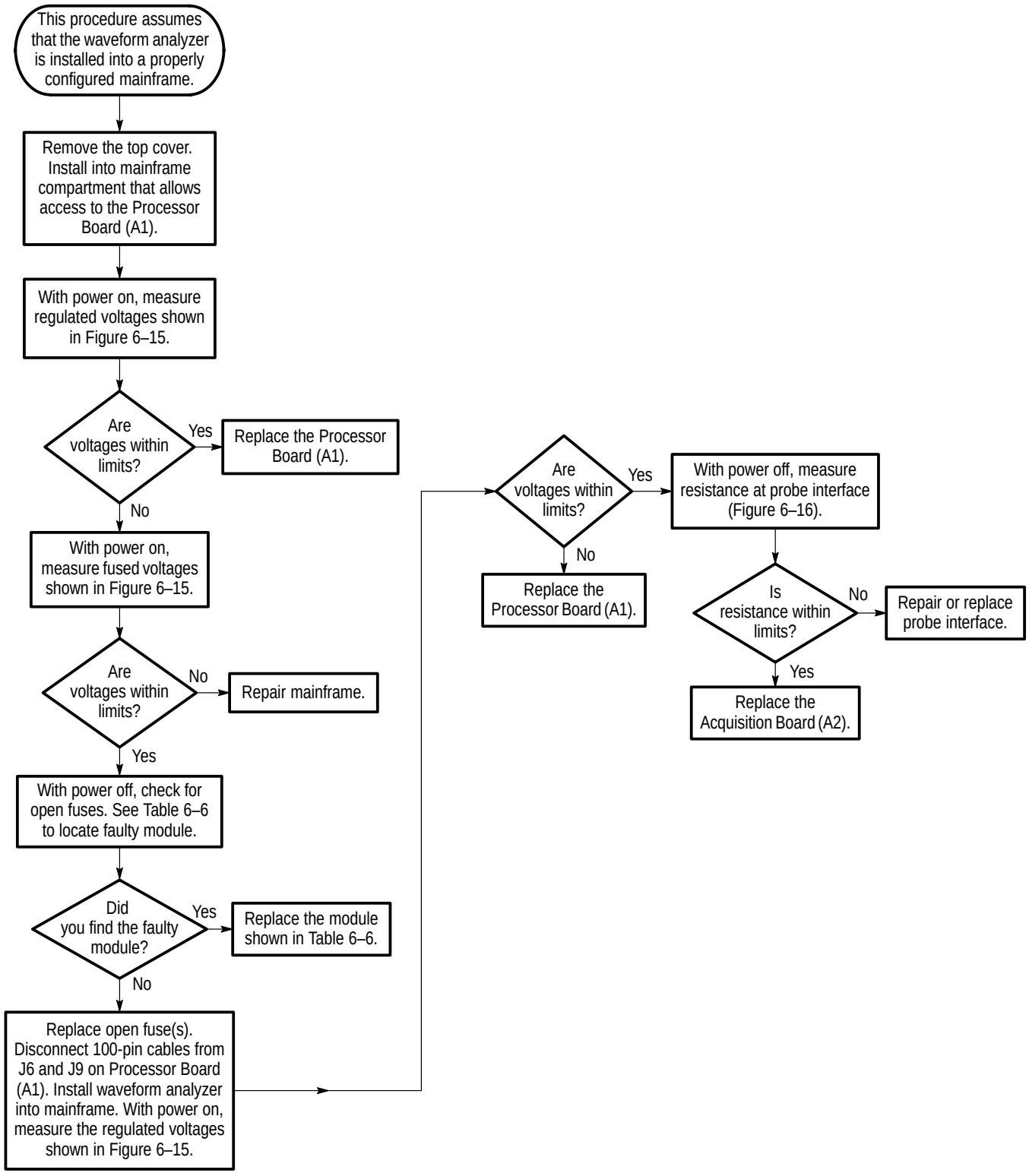
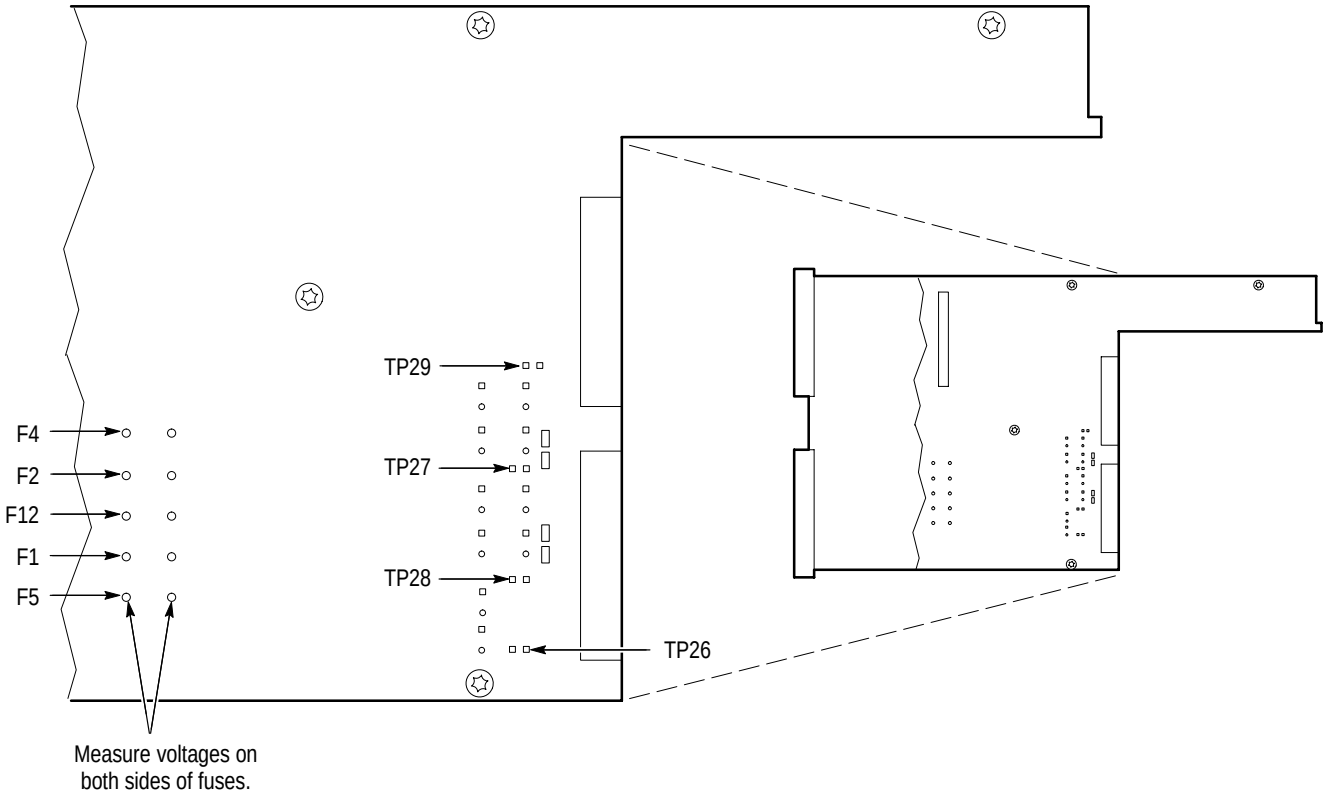


Figure 6–14: Power supply troubleshooting procedure



Fused Voltages From VXIbus Mainframe

Test Point	Power Supply	Limits
F4	–5.2 V	–4.85 V to –5.46 V
F2	+5 VD	4.65 V to +5.25 V
F12	+5 V	+4.65 V to +5.25 V
F1	+12 V	+10.8 V to +13.2 V
F5	–12 V	–10.8 V to –13.2 V

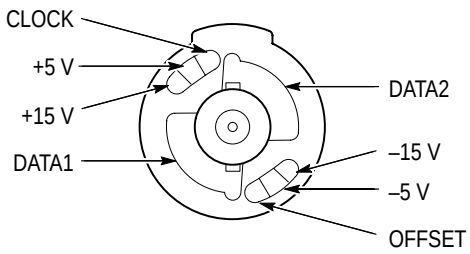
Regulated Voltages From Processor Board (A1)

Test Point	Power Supply	Limits
TP29	–5 V	–4.9 V to –5.25 V
TP27	+5 V	+4.9 V to +5.25 V
TP28	+15 V	+14.85 V to +15.3 V
TP26	–15 V	–14.85 V to –15.3 V

Figure 6–15: DC voltages for troubleshooting

Table 6–6: Power Supply Fault Location Table

Open Fuse	Faulty Module
No open fuses	Cannot identify faulty module
F1 (+12 V power supply)	Cannot identify faulty module
F2 (+5 VD power supply)	Processor Board (A1)
F4 (–5.2 V power supply)	Cannot identify faulty module
F5 (–12 V power supply)	Cannot identify faulty module
F12 (+5 V power supply)	Acquisition Board (A2)



Signal	Approximate Resistance to Ground
Clock	1 kΩ
+5 V	20 Ω
+15 V	590 Ω
Data1	950 Ω
Data2	950 Ω
–15 V	150 Ω
–5 V	30 Ω
Offset	870 Ω

Values shown are typical when using a Fluke 8842A DMM on the 2K scale. Allow the meter to stabilize for 10 seconds before reading the measured value.

Figure 6–16: Probe interface resistance

Repackaging Instructions

This section contains the information needed to repackage the waveform analyzer for shipment or storage.

Packaging

Use a corrugated cardboard shipping carton having a test strength of at least 275 pounds (125 kg) and with an inside dimension at least six inches (15.25 cm) greater than the instrument dimensions.

If the instrument is being shipped to a Tektronix Service Center, enclose the following information:

- 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

Seal the shipping carton with an industrial stapler or strapping tape.

Mark the address of the Tektronix Service Center and also your own return address on the shipping carton in two prominent locations.

Storage

The waveform analyzer should be stored in a clean, dry environment. The following environmental characteristics apply for both shipping and storage:

- Temperature range: –40° F to +159.8° F (–40° C to +71° C)
- Altitude: To 40,000 feet (12,190 meters)

See Table 1–8 on page 1–12 for a complete listing of the environmental charactertistics.

Options

This chapter describes the accessories and options that are available for the waveform analyzer.

Tektronix offers maintenance options that cover calibration and repair services. Contact your local Tektronix representative for details.

Standard Accessories

The following accessories are shipped with the waveform analyzer:

- *TVS600 Series Waveform Analyzers User Manual* (Tektronix part number 070-9283-XX)
- *TVS600 Series Waveform Analyzers Reference Manual* (Tektronix part number 070-9284-XX)
- *TVS600 Series VXIplug&play Instrument Drivers* (part of Tektronix part number 070-9283–XX)

Optional Accessories

The following accessories can be ordered for use with the waveform analyzer:

- *TVS600 Series Waveform Analyzers Service Manual* (Tektronix part number 070-9285-XX)
- *Field Adjust/PV SW* (part of Tektronix part number 070–9285–XX)

Options

There are no options available at this time.

Electrical Parts List

Refer to the *Mechanical Parts List* section for a complete listing and description of replaceable parts for the waveform analyzer.

Diagrams

This chapter contains the block diagram and the interconnection diagram for the waveform analyzer.

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 (when used) 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.

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

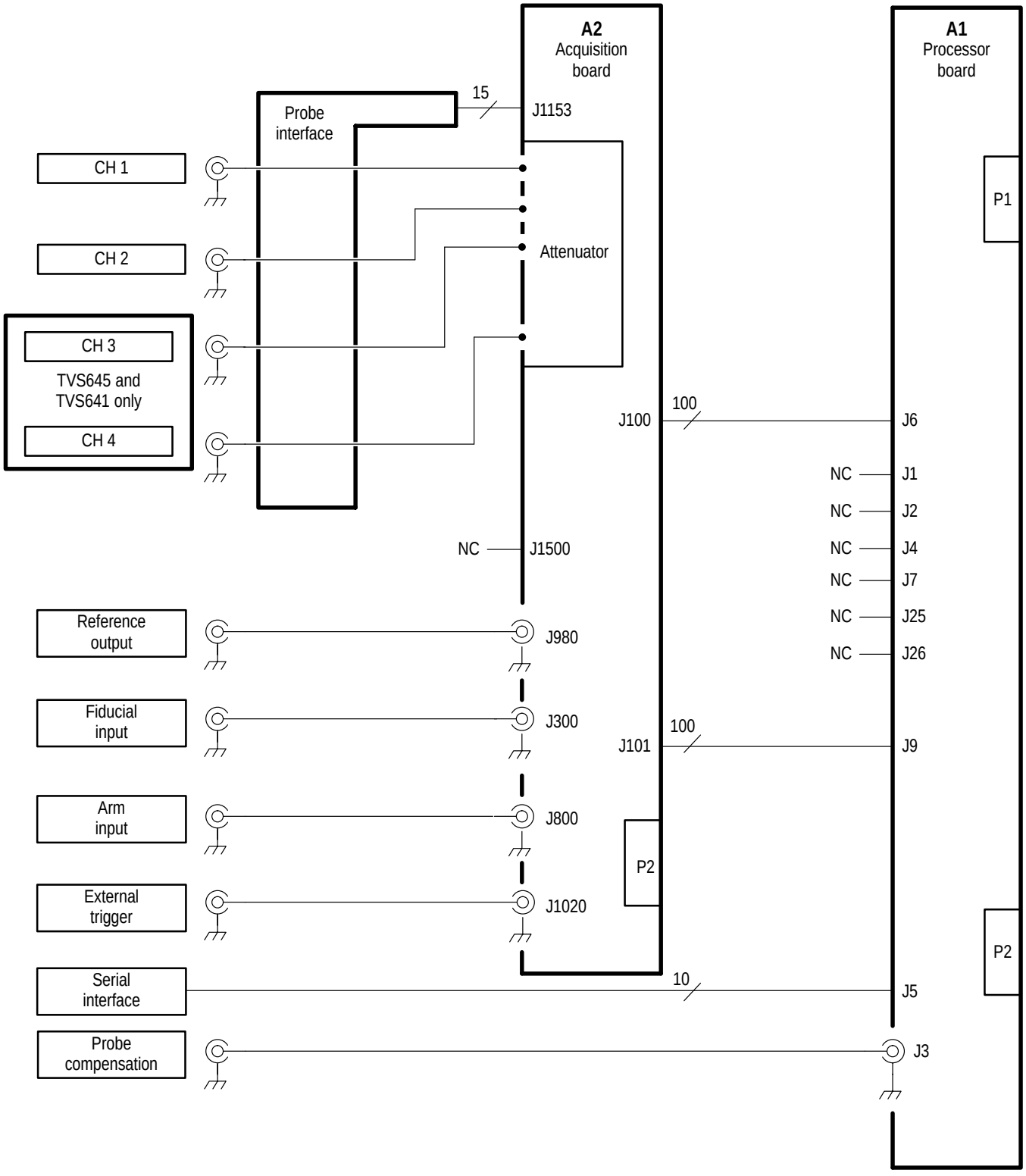


Figure 9–1: Interconnections

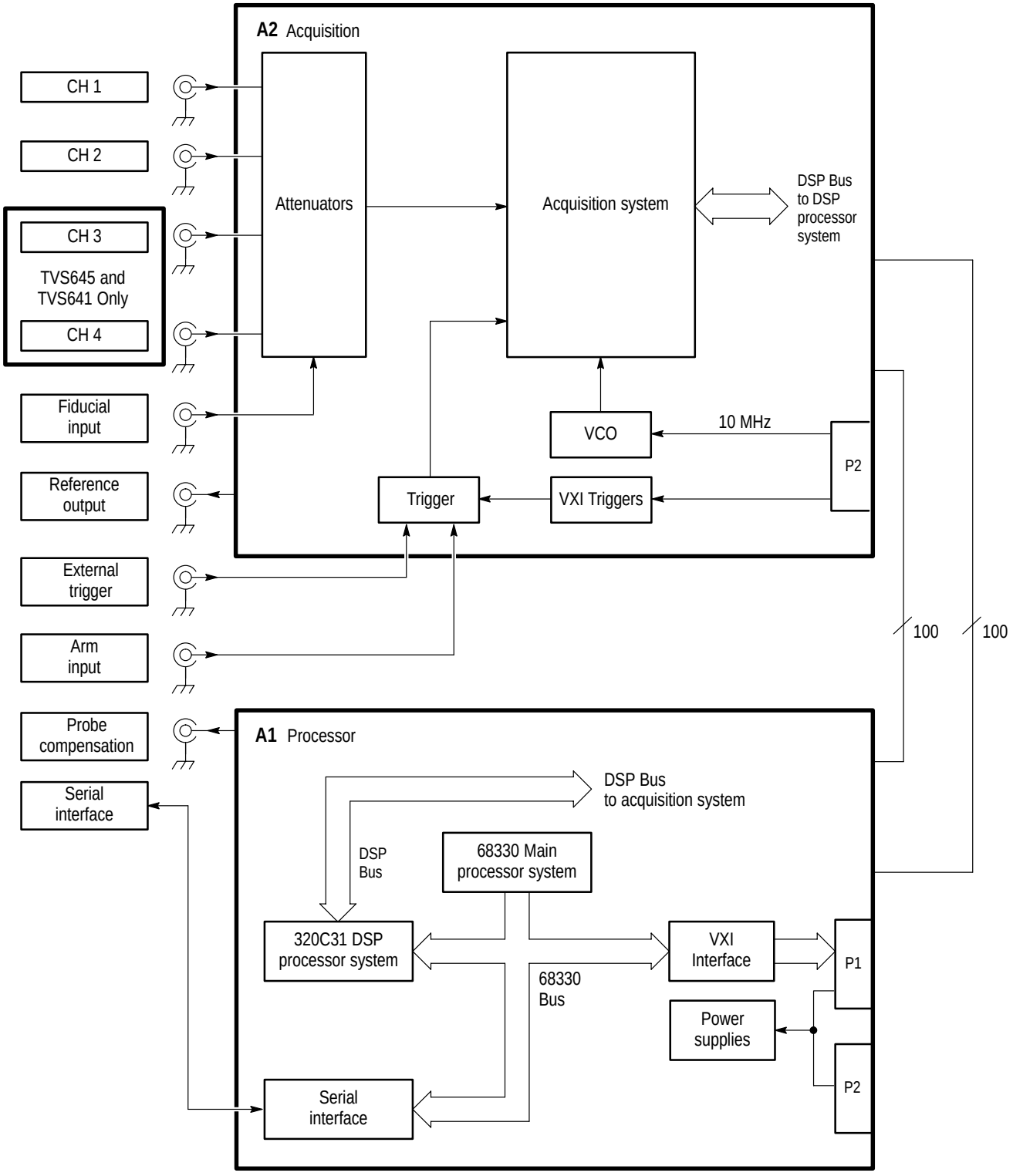


Figure 9–2: Block diagram

Mechanical Parts List

This chapter contains a list of the replaceable modules for the waveform analyzer. 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 products are sometimes made to accommodate improved components as they become available and to give you the benefit of the latest improvements. Therefore, when ordering parts, it is important to include the following information in your order.

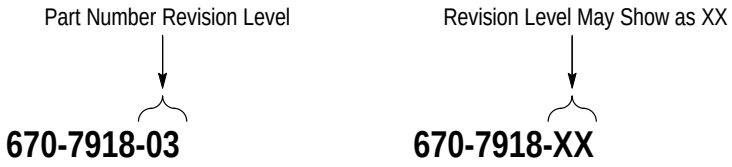
- Part number (see Part Number Revision Level below)
- Instrument type or model number
- Instrument serial number
- Instrument modification number, if applicable

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.

Change information, if any, is located at the rear of this manual.

Part Number Revision Level

Tektronix part numbers contain two digits that show the revision level of the part. For most parts in this manual, you will find the letters XX in place of the revision level number.



When you order parts, Tektronix will provide you with the most current part for your product type, serial number, and modification (if applicable). At the time of your order, Tektronix will determine the part number revision level needed for your product, based on the information you provide.

Module Servicing

Modules can be serviced by selecting one of the following three options. Contact your local Tektronix service center or representative for repair assistance.

Module Exchange. In some cases you may exchange your module for a remanufactured module. These modules cost significantly less than new modules and meet the same factory specifications. For more information about the module exchange program, call 1-800-TEK-WIDE, extension 6630.

Module Repair and Return. You may ship your module to us for repair, after which we will return it to you.

New Modules. You may purchase replacement modules in the same way as other replacement parts.

Using the Replaceable Parts List

This section contains a list of the mechanical and/or electrical components that are replaceable for the waveform analyzer. 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 figure and index numbers to the exploded view illustrations that follow.
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.
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 table titled Manufacturers Cross Index shows codes, names, and addresses of manufacturers or vendors of components listed in the parts list.

Manufacturers Cross Index

Mfr. Code	Manufacturer	Address	City, State, Zip Code
00779	AMP INC.	CUSTOMER SERVICE DEPT PO BOX 3608	HARRISBURG, PA 17105–3608
0J9P9	GEROME MFG CO INC	PO BOX 737 403 NORTH MAIN	NEWBERG, OR 97132
0JR05	TRIQUEST PRECISION PLASTICS	3000 LEWIS & CLARK HWY PO BOX 66008	VANCOUVER, WA 98666–6008
0KB01	STAUFFER SUPPLY CO	810 SE SHERMAN	PORTLAND, OR 97214–4657
0KB05	NORTH STAR NAMEPLATE INC	5750 NE MOORE COURT	HILLSBORO, OR 97124–6474
24931	SPECIALTY CONNECTOR CO	2100 EARLYWOOD DR P O BOX 547	FRANKLIN, IN 46131
30817	INSTRUMENT SPECIALTIES CO INC	EXIT 53, RT 80 BOX A	DELAWARE WATER GAP, PA 18327
80009	TEKTRONIX INC	14150 SW KARL BRAUN DR PO BOX 500	BEAVERTON, OR 97077–0001
86928	SEASTROM MFG CO INC	456 SEASTROM STREET	TWIN FALLS, ID 83301
TK2469	UNITREK CORPORATION	3000 LEWIS & CLARK HWY SUITE 2	VANCOUVER, WA 98661
TK2597	MERIX CORP	1521 POPLAR LANE	FOREST GROVE, OR 97116
TK2647	INSTRUMENT SPECIALITIES INC	C/O TEMCO NW 1336 SE 51ST STREET	HILLSBORO, OR 97123

Replaceable Parts List

Fig. & Index Number	Tektronix Part Number	Serial No. Effective	Serial No. Discont'd	Qty	Name & Description	Mfr. Code	Mfr. Part Number
10–1–1	200–4242–00			1	COVER,VXI:VXI APPLICATION,TWO–WIDE,COVER	80009	200–4242–00
–2	211–0408–00			6	SCR,ASSEM WSHR:4–40 X 0.250,PNH,STL,ZINC,T–10	0KB01	211–0408–00
–3	348–1434–00			4	GASKET,EMI:2.912 L,CLIP ON,BE CU EMI GASKET,TIN PLD	30817	97–613–17–029
–4	211–0408–00			6	SCR,ASSEM WSHR:4–40 X 0.250,PNH,STL,ZINC,T–10	0KB01	211–0408–00
–5	671–3233–XX			1	CIRCUIT BD ASSY:PROCESSOR (A1)	80009	671–3233–XX
	159–5009–00			1	FUSE,SMD:1.5A,125V,FAST BLOW,0.1 X 0.1 X 0.24 (F13)	80009	159–5009–00
	159–5014–00			2	FUSE,SMD:2.0A,125V,FAST BLOW,0.1 X 0.1 X 0.24 (F1, F5)	80009	159–5014–00
	159–5015–00			2	FUSE,SMD:10.0A,125V,FAST BLOW,0.1 X0.1 X 0.24 (F4, F12)	80009	159–5015–00
	159–5018–00			1	FUSE,SMD:3.0A,125V,FAST BLOW,0.1 X 0.1 X 0.24 (F2)	80009	159–5018–00
–6	129–1474–00			6	POST SPACER:0.250 HEX,1.508 L,4–40 INT,THD X 0.5 L, 6–32 EXT THD,STEEL	80009	129–1474–00
–7	671–3232–XX			1	CIRCUIT BD ASSY:ACQUISITION,TVS645 (A2)	80009	671–3232–XX
	159–5000–00			1	FUSE,THERMAL:2.5A,125V,FAST,2816,SMD (F110)	80009	159–5000–00
	159–5003–00			4	FUSE,THRM,CHIP:SELF RESETTING FUSE,1.1A HOLD,2.2A TRIP AT 20 DEG C,20V MAX (F1806, F1807, F1808, F1809)	80009	159–5003–00
	159–5009–00			3	FUSE,SMD:1.5A,125V,FAST BLOW,0.1 X 0.1 X 0.24 (F300, F980, F1020)	80009	159–5009–00
–7	671–3569–XX			1	CKT BD ASSY:ACQUISITION,TVS641 (A2)	80009	671–3569–XX
	159–5000–00			1	FUSE,THERMAL:2.5A,125V,FAST,2816,SMD (F110)	80009	159–5000–00
	159–5003–00			4	FUSE,THRM,CHIP:SELF RESETTING FUSE,1.1A HOLD,2.2A TRIP AT 20 DEG C,20V MAX (F1806, F1807, F1808, F1809)	80009	159–5003–00
	159–5009–00			3	FUSE,SMD:1.5A,125V,FAST BLOW,0.1 X 0.1 X 0.24 (F300, F980, F1020)	80009	159–5009–00
–7	671–3570–XX			1	CKT BD ASSY:ACQUISITION,TVS625 (A2)	80009	671–3570–XX
	159–5000–00			1	FUSE,THERMAL:2.5A,125V,FAST,2816,SMD (F110)	80009	159–5000–00
	159–5003–00			4	FUSE,THRM,CHIP:SELF RESETTING FUSE,1.1A HOLD,2.2A TRIP AT 20 DEG C,20V MAX (F1806, F1807, F1808, F1809)	80009	159–5003–00
	159–5009–00			3	FUSE,SMD:1.5A,125V,FAST BLOW,0.1 X 0.1 X 0.24 (F300, F980, F1020)	80009	159–5009–00

Replaceable Parts List (Cont.)

Fig. & Index Number	Tektronix Part Number	Serial No. Effective	Serial No. Discont'd	Qty	Name & Description	Mfr. Code	Mfr. Part Number
–7	671–3571–XX			1	CKT BD ASSY:ACQUISITION,TVS621 (A2)	80009	671–3571–XX
	159–5000–00			1	FUSE,THERMAL:2.5A,125V,FAST,2816,SMD (F110)	80009	159–5000–00
	159–5003–00			4	FUSE,THRM,CHIP:SELF RESETTING FUSE,1.1A HOLD,2.2A TRIP AT 20 DEG C,20V MAX (F1806, F1807, F1808, F1809)	80009	159–5003–00
	159–5009–00			3	FUSE,SMD:1.5A,125V,FAST BLOW,0.1 X 0.1 X 0.24 (F300, F980, F1020)	80009	159–5009–00
–8	211–0408–00			1	SCR,ASSEM WSHR:4–40 X 0.250,PNH,STL,ZINC,T–10	0KB01	211–0408–00
–9	210–0870–00			1	WASHER,FLAT:0.141 ID X 0.312 OD X 0.05,STL CD PL	86928	ORDER BY DESCR
–10	334–9142–00			1	LABEL–ROLL STOC:TVS621,SUPERLABEL,S/N,UL,CE	80009	334–9142–00
–10	334–9144–00			1	LABEL–ROLL STOC:TVS625,SUPERLABEL,S/N,UL,CE	80009	334–9144–00
–10	334–9145–00			1	LABEL–ROLL STOC:TVS641,SUPERLABEL,S/N,UL,CE	80009	334–9145–00
–10	334–9147–00			1	LABEL–ROLL STOC:TVS645,SUPERLABEL,S/N,UL,CE	80009	334–9147–00
–11	441–2080–00			1	CHASSIS,VXI:TWO–WIDE,BOTTOM CHASSISW/SUB FRONT PANEL ATTACHED,TVS641 /TVS645	80009	441–2080–00
–11	441–2081–00			1	CHASSIS:VXI TWO–WIDE, BOTTOM CHASSISW/SUB FRONT PANEL ATTACHED,TVS621/TVS625	80009	441–2081–00
–12	386–6868–00			1	PANEL,VXI:TWO–WIDE,BACK PANEL	80009	386–6868–00
–13	211–0408–00			2	SCR,ASSEM WSHR:4–40 X 0.250,PNH,STL,ZINC,T–10	0KB01	211–0408–00
–14	211–0911–00			4	SCREW,MACHINE:M2.5, PITCH 0.45MM, LENGTH 11MM, HEAD DIA 5MM, HEAD HEIGHT 2MM, BRIGHT NICKEL FI	80009	211–0911–00
–15	211–0730–00			3	SCR,ASSEM WSHR:6–32 X 0.375,PNH,STL,CDPL,T–15	0KB01	ORDER BY DESCR
–16	367–0410–00			1	HANDLE,EJECTOR:BOTTOM,SINGLE WIDE MODULE	80009	367–0410–00
–17	334–7519–00			1	MARKER,IDENT:MKD VXIBUS HANDLE,EJECTOR	0KB05	334–7519–00
–18	131–0890–01			2	CONN,HARDWARE:DSUB,JACK SCREW,4–40 X 0.312 L HEX HD,STL CD PL	00779	205818–2
–19	210–0870–00			1	WASHER,FLAT:0.141 ID X 0.312 OD X 0.05,STL CD PL	86928	ORDER BY DESCR
–20	211–0408–00			1	SCR,ASSEM WSHR:4–40 X 0.250,PNH,STL,ZINC,T–10	0KB01	211–0408–00
–21	354–0654–01			4/2	RING,CONN:BNC (TVS641 and TVS645 use 4, TVS621 and TVS625 use 2)	0JR05	ORDER BY DESCR
–22	131–1315–01			5	CONN,RF JACK:BNC/PNL,50 OHM,FEMALE,STR	24931	28JR306–1
–23	367–0411–00			1	HANDLE,EJECTOR:TOP,SINGLE WIDE	80009	367–0411–00
–24	334–9022–00			1	MARKER IDENT:VXI EJECTOR LABEL,TVS645	80009	334–9022–00
–24	334–9023–00			1	MARKER IDENT:VXI EJECTOR LABEL,TVS641	80009	334–9023–00
–24	334–9024–00			1	MARKER IDENT:VXI EJECTOR LABEL,TVS625	80009	334–9024–00
–24	334–9025–00			1	MARKER IDENT:VXI EJECTOR LABEL,TVS621	80009	334–9025–00
–25	174–2693–00			1	CA ASSY,SP,ELEC:RIBBON,IDC,9 COND,28 AWG,8.0 L,MALE DB9 X 2X5	TK2469	174–2693–00
–26	348–1422–00			1	GASKET,RF:SHIELDING,0.005 BERYLLIUM COPPER ALLOY C17200 1/2 HARD,0.0003 MIN BRIGHT NICKEL	0J9P9	348–1422–00
–27	259–0101–01			1	FLEX CIRCUIT:TEK PROBE INTERFACE	TK2597	259010101

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
–28	196–3417–00			1	CA ASSY,SP:COAXIAL,RFP,5,50 OHM,2,10.25 L,3,15.25 L	TK2469	196–3417–00
–29	174–3458–00			2	CA ASSY,SP:RIBBON,IDC,30AWG,0.025 CTR,3.325 L,100 POS	80009	174–3458–00
–30	348–1365–01			1	SHLD GSKT,ELEC:SYMETRICAL SLOTTED FINGER, 0.350 W X 7.5 L	TK2647	348–1365–01

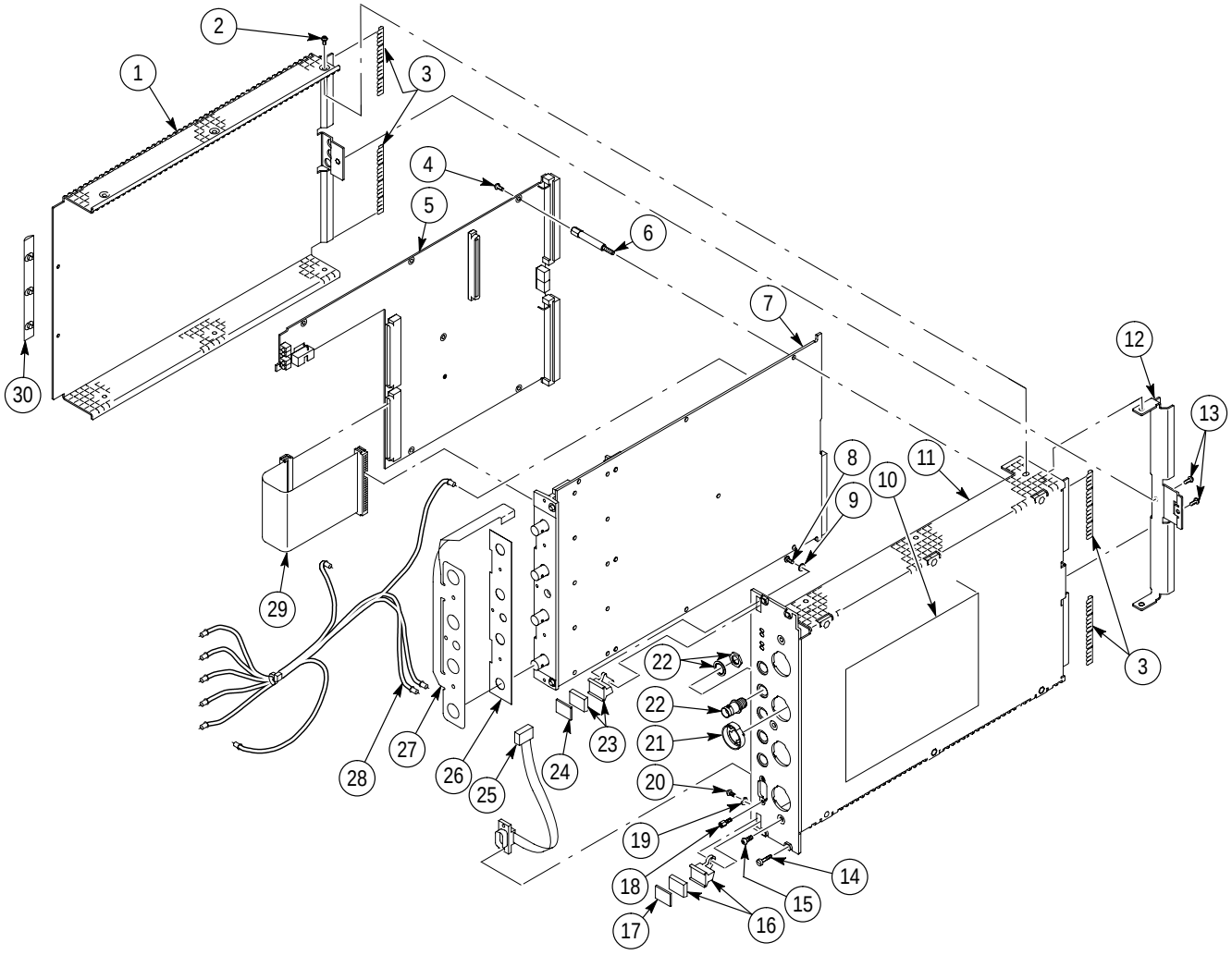


Figure 10–1: Waveform analyzer exploded view

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		
	070–9283–XX			1	MANUAL,TECH:VXI BUS USER MANUAL	80009	070–9283–XX
	070–9284–XX			1	MANUAL,TECH:VXI BUS REFERENCE MANUAL	80009	070–9284–XX
					OPTIONAL ACCESSORIES		
	070–9285–XX			1	MANUAL,TECH:VXI BUS SERVICE MANAUL	80009	070–9285–XX