

Service Manual



THS710A, THS720A, THS730A & THS720P TekScope™

070-9752-01

This document applies to serial number B010100 and above and firmware version 1.00 and above.

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Warning

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



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Company	date or purchase order number
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Phone	Instrument purchase date

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General Safety Summary

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

Only qualified personnel should perform service procedures.

To Avoid Fire or Personal Injury

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

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

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

Replace Batteries Properly. Replace batteries only with the proper type and rating specified.

Recharge Batteries Properly. Recharge batteries for the recommended charge cycle only.

Use Proper AC Adapter. Use only the AC adapter specified for this product.

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

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

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

Do Not Operate in Wet/Damp Conditions.

Do Not Operate in an Explosive Atmosphere.

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:

**Battery Recycling**

This product contains a Nickel Cadmium (NiCd) battery, which must be recycled or disposed of properly. For the location of a local battery recycler in the U.S. or Canada, please contact:

RBRC
Rechargeable Battery Recycling Corp.
P.O. Box 141870
Gainesville, Florida 32614

(800) BATTERY
(800) 227-7379
www.rbrc.com

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.

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 THS710A, THS720A, THS730A, and THS720P TekScope instruments. This manual provides information to troubleshoot and repair the instrument to the module level.

Related Manuals

Additional documentation for the instrument is contained in the related manuals listed below.

Language	User Manual Part Number	Reference Part Number	Programmer Manual Part Number
English	070-9731-XX	070-9741-XX	070-9751-XX
French	070-9732-XX	070-9742-XX	
German	070-9733-XX	070-9743-XX	
Italian	070-9734-XX	070-9744-XX	
Korean	070-9735-XX	070-9745-XX	
Portuguese	070-9736-XX	070-9746-XX	
Spanish	070-9737-XX	070-9747-XX	
Simplified Chinese	070-9738-XX	070-9748-XX	
Traditional Chinese	070-9739-XX	070-9749-XX	
Japanese	070-9740-XX	070-9799-00	

Conventions

In the *Performance Verification*, *Adjustments*, and *Maintenance* chapters of this manual, TekScope instrument setups are shown in tables similar to the one shown below.

The header of each table contains icons that represent the controls and menu items used to set up the instrument. To make a specific setup, read the table from left to right and then from top to bottom as shown below. The table contains the symbol “—” if no action is required.

 METER  SCOPE				TOGGLE 
1. Choose scope mode or meter mode.	2. Press this button on the front panel.	3. Press this bezel button.	4. Press the bezel button again until this selection is highlighted.	5. Use the +/- rocker to set the value for a parameter.
		6.	7.	—
		8.	9.	10.

Specifications

This chapter contains the oscilloscope, DMM, and general specifications for the THS710A, THS720A, THS730A, and THS720P TekScope instruments. All specifications are guaranteed unless noted “typical.” Typical specifications are provided for your convenience but are not guaranteed. Specifications that are marked with the ✓ symbol are checked in the chapter *Performance Verification*.

All specifications apply to all four instruments unless noted otherwise. All specifications assume horizontal MAG is off, unless noted otherwise. To meet specifications, two conditions must first be met:

- The TekScope instrument must have been operating continuously for ten minutes within the operating temperature range specified.
- You must perform the Compensate Signal Path operation, accessible through the utility menu, if the ambient temperature changes by more than 5° C.

Table 1-1: Oscilloscope specifications

Acquisition		
Acquisition Modes	Sample (Normal), Peak detect, Envelope, and Average	
Acquisition Rate, typical	Up to 25 waveforms per second (2 channels, sample acquisition mode, MAG on, no measurements)	
Single Sequence	<i>Acquisition Mode</i>	<i>Acquisition Stops After</i>
	Sample, Peak Detect	Single acquisition, one or two channels simultaneously
	Average, Envelope	N acquisitions, one or two channels simultaneously, N is settable from 2 to 256 or ∞
Inputs		
Input Coupling	DC, AC, or GND	
Input Impedance, DC Coupled	1 MΩ ±1% in parallel with 25 pF ±2 pF	
Maximum Voltage Between Signal and Common at Input BNC	<i>Overvoltage Category</i>	<i>Maximum Voltage</i>
	CAT II Environment (refer to page 1-13)	300 V _{RMS}
	CAT III Environment (refer to page 1-13)	150 V _{RMS}
	For steady-state sinusoidal waveforms, derate at 20 dB/decade above 100 kHz to 13 V _{pk} at 3 MHz and above. Also, refer to Overvoltage Category description on page 1-13.	

Table 1-1: Oscilloscope specifications (Cont.)

Inputs				
Maximum Voltage Between Common and Earth Ground at BNC	600 V _{RMS} (CAT II) or 300 V _{RMS} (CAT III), using rated connectors or accessories			
	30 V _{RMS} , 42.4 V _{pk} , using noninsulated connectors and accessories			
Maximum Voltage, Channel-to-Channel Commons	30 V _{RMS} , 42.4 V _{pk} , using noninsulated connectors and accessories			
Channel-to-Channel Common Mode Rejection, typical	100:1 at frequencies ≤50 MHz, measured on MATH Ch1 – Ch2 waveform, with test signal applied between signal and common of both channels, and with the same VOLTS/DIV and coupling settings on each channel			
Channel-to-Channel Crosstalk, typical	≥100:1 at 50 MHz, measured on one channel, with test signal applied between signal and common of the other channel, and with the same VOLTS/DIV and coupling settings on each channel			
Common to Chassis Capacitance, typical	55 pF			
Vertical				
Number of Channels	2			
Digitizers	8 bit resolution, separate digitizers for each channel sample simultaneously			
VOLTS/DIV Range	5 mV/div to 50 V/div at input BNC			
Polarity	Normal and Invert			
Position Range	±10 divisions			
✓ Analog Bandwidth at BNC, DC Coupled (typical at 5 mV/div, guaranteed at all other settings)	<i>THS710A</i>	<i>THS720A</i>	<i>THS720P</i>	<i>THS730A</i>
	60 MHz at input BNC	100 MHz at input BNC (90 MHz above 35° C)	100 MHz at input BNC (90 MHz above 35° C)	200 MHz at input BNC (180 MHz above 35° C)
Peak Detect or Envelope Bandwidth, typical (25 MS/s or slower)	<i>THS710A</i>	<i>THS720A</i>	<i>THS720P</i>	<i>THS730A</i>
	50 MHz	75 MHz	75 MHz	85 MHz
Analog Bandwidth Limit, typical	Selectable between 20 MHz or full			
Lower Frequency Limit, AC Coupled, typical	≤10 Hz at BNC, reduced by a factor of ten when using a 10X passive probe			
Rise Time at BNC, typical	<i>THS710A</i>	<i>THS720A</i>	<i>THS720P</i>	<i>THS730A</i>
	5.8 ns	3.5 ns	3.5 ns	1.75 ns
Peak Detect or Envelope Pulse Response, typical	Captures 50% or greater amplitude of pulses ≥ 8 ns wide (≥ 20 ns wide at 500 ns/div)			

Table 1-1: Oscilloscope specifications (Cont.)

Vertical				
DC Gain Accuracy	$\pm 2\%$ for Sample or Average acquisition mode			
Position Accuracy	$\pm [0.4\% \times (\text{position} \times \text{volts/div})] + (0.1 \text{ div} \times \text{volts/div})$			
✓ DC Measurement Accuracy, Average Acquisition Mode Using ≥ 16 Waveforms	<i>Measurement Type</i>	<i>Accuracy</i>		
	Absolute voltage measurements	$\pm [2\% \times \text{reading} + (\text{position} \times \text{volts/div})] + (0.1 \text{ div} \times \text{volts/div})$		
	Delta voltage between any two waveforms acquired under same setup	$\pm [2\% \times \text{reading}] + (0.05 \text{ div} \times \text{volts/div})$		
DC Measurement Accuracy, Sample Acq. Mode, typical	$\pm [2\% \times \text{reading} + (\text{position} \times \text{volts/div})] + (0.15 \text{ div} \times \text{volts/div}) + 0.6 \text{ mV}$			
Horizontal				
Sample Rate Range	<i>THS710A</i>	<i>THS720A</i>	<i>THS720P</i>	<i>THS730A</i>
	5 S/s to 250 MS/s, in a 1.25, 2.5, 5 sequence	5 S/s to 500 MS/s, in a 1.25, 2.5, 5 sequence	5 S/s to 500 MS/s, in a 1.25, 2.5, 5 sequence	5 S/s to 1 GS/s, in a 1.25, 2.5, 5 sequence
Record Length	2500 samples for each channel			
SEC/DIV Range (including MAG)	<i>THS710A</i>	<i>THS720A</i>	<i>THS720P</i>	<i>THS730A</i>
	10 ns/div to 50 s/div	5 ns/div to 50 s/div	5 ns/div to 50 s/div	2 ns/div to 50 s/div
✓ Sample Rate and Delay Time Accuracy	± 200 ppm over any ≥ 1 ms time interval			
Delay Time Range	Zero to 50 s			
Internal Trigger				
✓ Trigger Sensitivity, Edge Trigger Type (THS710A, THS720A, and THS720P)	<i>Coupling</i>	<i>Sensitivity</i>		
	DC	0.35 div from DC to 50 MHz, increasing to 1 div at 100 MHz (90 MHz above 35° C)		
✓ Trigger Sensitivity, Edge Trigger Type (THS730A)	<i>Coupling</i>	<i>Sensitivity</i>		
	DC	0.35 div from DC to 50 MHz, increasing to 1.5 div at 200 MHz (180 MHz above 35° C)		

Table 1-1: Oscilloscope specifications (Cont.)

Internal Trigger		
Trigger Sensitivity, Edge Trigger Type, typical	<i>Coupling</i>	<i>Sensitivity</i>
	NOISE REJ	3.5 times the DC-coupled limits
	HF REJ	1.5 times the DC-coupled limit from DC to 30 kHz, attenuates signals above 30 kHz
	LF REJ	1.5 times the DC-coupled limits for frequencies above 1 kHz, attenuates signals below 1 kHz
Trigger Level Range	±4 divisions from center of screen	
Motor Trigger Level Range (THS720P)	0.1 to 5 divisions from center screen, polarity depends on slope selection	
Trigger Level Accuracy, typical	±0.2 divisions, for signals having rise and fall times ≥20 ns	
SET LEVEL TO 50%, typical	Operates with input signals ≥50 Hz	
Width Range, Pulse Trigger Type, typical	99 ns to 1 s, with resolution of 33 ns or approximately 1% of setting (whichever is greater)	
Width Tolerance Range, Pulse Trigger Type, typical	5%, 10%, 15%, or 20%	
Sensitivity, Video Trigger Type, typical	Composite video signal with negative sync pulse amplitude from 0.6 to 2.5 divisions	
Signal Formats and Field Rates, Video Trigger Type	Broadcast systems	Supports NTSC, PAL, and SECAM
	Interlaced	Trigger on selected line of odd field, selected line of even field, or any line
	Non-interlaced	Trigger on selected line or any line
	Line Rates	15 kHz to 65 kHz, in five ranges
Holdoff Range	495 ns to 10 s	
External Trigger		
External Trigger, Maximum Input Voltage	600 V _{RMS} CAT II or 300 V _{RMS} CAT III (refer to page 1-13)	
External Trigger Coupling	DC only	
External Trigger Levels	+0.2 V or +2 V, selectable	
External Trigger Sensitivity	500 mV _{p-p} from DC to 1 MHz, increasing to 1 V _{p-p} at 5 MHz, with signal centered at selected trigger level	

Table 1-1: Oscilloscope specifications (Cont.)

Measurements				
Cursors	Voltage difference between cursors (ΔV) Time difference between cursors (ΔT) Reciprocal of ΔT in Hertz ($1/\Delta T$) Phase difference between cursors (Δ Degrees)			
Automated Measurements	Amplitude, Burst Width, Cycle Mean, Cycle RMS, Fall Time, Frequency, High, Low, Max, Mean, Min, Negative Duty Cycle, Negative Overshoot, Negative Width, Pk - Pk, Period, Positive Duty Cycle, Positive Overshoot, Positive Width, Rise Time, and RMS			
Voltage and Current Harmonics (THS720P)				
Number of Harmonics	First 31 harmonics of signal with fundamental frequency between 30 Hz and 450 Hz			
Harmonics Amplitude Accuracy	Accuracies below are stated as a percent of the fundamental amplitude and are valid only if peak-to-peak amplitude is ≥ 4 divisions and number of averages ≥ 16			
	<i>Fundamental</i>	2 - 11	12 - 21	22 - 31
	$\pm 2.5\%$	$\pm 2.5\%$	$\pm 4\%$	$\pm 4\%$
Harmonics Phase Accuracy	<i>Fundamental</i>	2 - 11	12 - 21	22 - 31
	—	$\pm 4^\circ$	$\pm 8^\circ$	$\pm 8^\circ$
THD-F Measurement	Total harmonic distortion relative to the fundamental amplitude $THD-F = \frac{\sqrt{V_{RMS}^2 - V_f^2}}{V_f} \text{ or } \frac{\sqrt{A_{RMS}^2 - A_f^2}}{A_f}$			
THD-F Accuracy	$\pm 4\%$			
THD-R Measurement	Total harmonic distortion relative to the RMS amplitude $THD-R = \frac{\sqrt{V_{RMS}^2 - V_f^2}}{V_{RMS}} \text{ or } \frac{\sqrt{A_{RMS}^2 - A_f^2}}{A_{RMS}}$			
THD-R Accuracy	$\pm 4\%$			
Frequency Accuracy	$\pm 0.2\%$ of reading			
Power Measurements (THS720P)				
True Power Measurement	$W = \frac{1}{n} \times \sum_n V_n \times A_n$ <i>measured over an integral number of cycles that contain n sample points</i>			
Apparent Power Measurement	$VA = V_{RMS} \times A_{RMS}$			
Reactive Power Measurement	$VAR = \sqrt{(VA)^2 - W^2}$			
Power Measurements Accuracy	$\pm 4\%$ at the BNCs (not including probe uncertainty)			

Table 1-1: Oscilloscope specifications (Cont.)

Power Measurements (THS720P)				
PF Measurement	$\text{Power factor (PF)} = \frac{\text{true power}}{\text{apparent power}} = \frac{W}{VA}$			
θ Measurement	θ is the phase difference between the fundamental components of voltage and current. Positive angle means voltage leads current. Negative angle means voltage lags current.			
DPF Measurement	$\text{Displacement power factor (DPF)} = \cos \theta$			
Power Factor Measurements Accuracy	±0.05			
With P6117 Probe				
Analog Bandwidth, DC Coupled	THS710A	THS720A	THS720P	THS730A
	60 MHz	100 MHz (90 MHz above 35° C)	100 MHz (90 MHz above 35° C)	200 MHz (180 MHz above 35° C)
Probe Attenuation	10X			
Maximum Voltage Between Probe Tip and Reference Lead	Overvoltage Category		Maximum Voltage	
	CAT II Environment (refer to page 1-13)		300 V _{RMS}	
	CAT III Environment (refer to page 1-13)		150 V _{RMS}	
For steady-state sinusoidal waveforms, derate at 20 dB/decade above 900 kHz to 13 V _{pk} at 27 MHz and above. Also, refer to Overvoltage Category description on page 1-13.				
Maximum Voltage Between Reference Lead and Earth Ground Using P6117 Probe	30 V _{RMS} , 42.4 V _{pk}			
Maximum Voltage, Channel-to-Channel Reference Leads Using P6117 Probe	30 V _{RMS} , 42.4 V _{pk}			

Table 1-1: Oscilloscope specifications (Cont.)

With P5102 Probe				
Analog Bandwidth, DC Coupled	<i>THS710A</i>	<i>THS720A</i>	<i>THS720P</i>	<i>THS730A</i>
	60 MHz	100 MHz (90 MHz above 35° C)	100 MHz (90 MHz above 35° C)	100 MHz
Probe Attenuation	10X			
Maximum Voltage Between Probe Tip and Reference Lead, DC Coupled	<i>Overvoltage Category</i>		<i>Maximum Voltage</i>	
	CAT II Environment (refer to page 1-13)		1000 V _{RMS}	
	CAT III Environment (refer to page 1-13)		600 V _{RMS}	
Maximum Voltage Between Probe Tip and Reference Lead, AC Coupled	<i>Overvoltage Category</i>		<i>Maximum Voltage</i>	
	CAT II Environment		±1000 V _{DC}	
	CAT III Environment		±600 V _{DC}	
Maximum Voltage Between Reference Lead and Earth Ground	<i>Overvoltage Category</i>		<i>Maximum Voltage</i>	
	CAT II Environment		600 V _{RMS}	
	CAT III Environment		300 V _{RMS}	

Table 1-2: DMM specifications

General		
Resolution	3 ³ / ₄ digit, 4000 count full scale reading except as noted	
Input Resistance, AC or DC Voltage	10 M Ω \pm 10%	
Input Capacitance, AC or DC Voltage, typical	\leq 100 pF	
Maximum Voltage Between DMM and COM Inputs	<i>Overvoltage Category</i>	<i>Maximum Voltage</i>
	CAT I Environment (refer to page 1-13)	640 V _{RMS} (880 V _{DC})
	CAT II Environment (refer to page 1-13)	600 V _{RMS}
	CAT III Environment (refer to page 1-13)	300 V _{RMS}
Maximum Voltage Between DMM or COM Input and Earth Ground	<i>Overvoltage Category</i>	<i>Maximum Voltage</i>
	CAT I Environment (refer to page 1-13)	640 V _{RMS} (880 V _{DC})
	CAT II Environment (refer to page 1-13)	600 V _{RMS}
	CAT III Environment (refer to page 1-13)	300 V _{RMS}
DC Voltage		
Ranges and Resolution	<i>Range</i>	<i>Resolution</i>
	400.0 mV	0.1 mV
	4.000 V	1 mV
	40.00 V	10 mV
	400.0 V	100 mV
	880 V	1 V
✓ Accuracy	\pm (0.5% of reading + 5 counts)	
Normal Mode Rejection, typical	Rejects AC signals by >60 dB at 50 Hz or 60 Hz (user selectable)	
Common Mode Rejection, typical	Rejects AC signals by >100 dB at 50 Hz or 60 Hz (user selectable)	

Table 1-2: DMM specifications (Cont.)

AC Voltage		
Conversion Type	AC conversions are true RMS. The AC measurement is based on the AC and DC components of the signal as shown below: $AC\ Measurement = RMS(AC+DC) - DC$	
Ranges and Resolution	<i>Range</i>	<i>Resolution</i>
	400.0 mV	0.1 mV
	4.000 V	1 mV
	40.00 V	10 mV
	400.0 V	100 mV
	640 V	1 V
✓ Accuracy (40 Hz to 500 Hz)	<i>Input Waveform</i>	<i>Maximum Error</i>
	Sinusoidal waveforms	±(2% of reading + 5 counts)
	Nonsinusoidal waveforms with crest factor up to 3	±(4% of reading + 5 counts)
Common Mode Rejection, typical	Rejects AC signals by >60 dB at DC, 50 Hz, and 60 Hz	
Ω/Resistance		
Ranges and Resolution	<i>Range</i>	<i>Resolution</i>
	400.0 Ω	0.1 Ω
	4.000 kΩ	1 Ω
	40.00 kΩ	10 Ω
	400.0 kΩ	100 Ω
	4.000 MΩ	1 kΩ
	40.00 MΩ	10 kΩ
✓ Accuracy	<i>Range</i>	<i>Maximum Error</i>
	All ranges except 40 MΩ	±(0.5% of reading + 2 counts)
	40 MΩ	±(2% of reading + 5 counts) for ≤60% relative humidity
Bias Voltage for Full Scale Resistance Measurement, typical	<i>Range</i>	<i>Full Scale Bias Voltage</i>
	400.0 Ω	350 mV
	4.000 kΩ	200 mV
	40.00 kΩ	350 mV
	400.0 kΩ	350 mV
	4.000 MΩ	400 mV
	40.00 MΩ	1.10 V

Table 1-2: DMM specifications (Cont.)

Ω/Resistance		
Open Circuit Voltage, typical	<i>Range</i>	<i>Open Circuit Voltage</i>
	400.0 Ω	4.8 V
	All other ranges	≤1.2 V
Continuity Check		
Indication	An audible tone is generated when measured resistance is below 50 Ω, typical	
Open Circuit Voltage, typical	4 V	
Test Current, typical	1 mA	
Diode Check		
Range	Zero to 2 V, measures forward voltage drop of semiconductor junction	
Voltage Accuracy, typical	±25%	
Open Circuit Voltage, typical	4 V	
Test Current, typical	1 mA	
Data Logger		
Horizontal Scale Range	30 s/div to 24 hours/div (4 minutes to 8 days, full scale)	
Vertical Zoom Range	2X, 5X, or 10X	

Table 1-3: General specifications

Display	
Display Type	4.7 in (120 mm) diagonal liquid crystal
Display Resolution	320 horizontal by 240 vertical pixels
Display Contrast	Adjustable, temperature compensated
Backlight Intensity, typical	35 cd/m ²

Table 1–3: General specifications (Cont.)

RS-232 Interface			
Device Type	DTE. at RJ-45 connector		
Pinout	<i>Signal</i>	<i>Pin Number at 9-pin Null Modem Adapter</i>	<i>Pin Number at RJ-45 Connector</i>
	RTS out	1	8
	TXD out	2	6
	RXD in	3	5
	GND	5	4
	DTR out	6	3
	CTS in	7	7
	RTS out	8	8
	DSR in (not used)	4	2
	DCD in (not used)	7	1
Probe Compensator Output			
Output Voltage, typical	5.0 V into $\geq 1\text{ M}\Omega$ load		
Frequency, typical	1.2 kHz		
Power Source			
Battery	Replaceable Ni-Cd battery pack		
Battery Life, typical	Approximately two hours of continuous use from a full charge		
Low Battery Indication, typical	Low battery message first appears approximately ten minutes before the instrument powers off automatically		
Battery Saver	Standby Time-out and Backlight Time-out extend battery life. Time-out ranges from 1 minute to 15 minutes, or off.		
Battery Charging Time, typical	With TekScope instrument operating	9 hours	
	With TekScope instrument turned off	9 hours	
	In external charger	1.5 hours	
External Power	12 VDC nominal, center positive; Operates with input from 10 VDC to 15 VDC The DC INPUT disconnects itself automatically if >15 VDC is applied. If this occurs, disconnect the overvoltage and then reconnect to a voltage in the proper range.		
Memory Retention, typical	All memory is retained indefinitely with battery removed and without external power applied.		
Fuse	This instrument has no user-replaceable fuses		

Table 1-3: General specifications (Cont.)

Environmental		
Temperature	Operating	-10° C to +50° C
	Nonoperating	-20° C to +60° C
Humidity	+40° C or below	≤95% relative humidity
	+41° C to +50° C	≤75% relative humidity
Altitude	Operating	2,000 m
	Nonoperating	15,000 m
Random Vibration	Operating	2.66 g _{RMS} from 5 Hz to 500 Hz, 10 minutes on each axis
	Nonoperating	3.48 g _{RMS} from 5 Hz to 500 Hz, 10 minutes on each axis
Drop Resistance, typical	Survives a 30 in (76 cm) drop onto concrete with only cosmetic damage	
Moisture Resistance	Meets IEC529, IP43 with DC input hole plug, I/O port hole plug, and battery door installed.	
Mechanical		
Size	Height	8.53 in (217 mm)
	Width	6.95 in (177 mm)
	Depth	2.00 in (50.8 mm)
Weight	With battery installed	3.2 lbs (1.5 kg)
	With all standard accessories in soft carry case	7.5 lbs (3.4 kg)
	When packaged for domestic shipment	9.0 lbs (4.1 kg)
Adjustment Interval		
The recommended adjustment interval is one year		

Table 1-3: General specifications (Cont.)

Certifications and Compliances		
Certifications	Listed UL3111-1 and CAN/CSA-C22.2 No. 1010.1-92, complies with EN61010-1 /A2	
Overvoltage Category	<i>Category</i>	<i>Examples</i>
	CAT III	A typical CAT III environment is the power distribution system within a building or factory. These environments are somewhat protected from lightning strikes, but susceptible to switching transients and other disturbances that may generate high voltage impulses.
	CAT II	A typical CAT II environment is the 120/240 V distribution system within a lab or office. These environments are fairly well protected from external high voltage disturbances.
	CAT I	A typical CAT I environment is circuitry inside electrical or electronic equipment that is powered by a power supply or a battery.
EC Declaration of Conformity	<p>Meets the intent of Directive 89/336/EEC for Electromagnetic Compatibility and Low-Voltage Directive 73/23/ECC for Product Safety as ammended by 93/68/EEC. Compliance was demonstrated to the following specifications as listed in the official Journal of the European Communities:</p> <p>EN 55011 Class A: Radiated and Conducted Emissions^{1 3}</p> <p>EN 50081-1 Emissions: EN 60555-2 Power Harmonics</p> <p>EN 50082-1 Immunity: IEC 801-2 Electrostatic Discharge IEC 801-3 RF Radiated² IEC 801-4 Fast Transients IEC 801-5 Surge³</p> <p>EN 61010-1 Safety</p> <p>¹ Tektronix-supplied ferrite bead required on instrument end of RS-232 cable</p> <p>² Performance criteria: ≤ 5.0 div increase in peak to peak noise (Sample acquisition mode, full bandwidth); otherwise, ≤ 1.0 div increase in peak to peak noise</p> <p>³ Applies to instrument operating with Tektronix-supplied AC adapter</p>	

Operating Information

This chapter provides a quick overview of the following topics:

- Internal and external power sources
- Understanding the front panel
- Connecting and using the probes

For more detailed information about TekScope instrument operation, refer to the *THS710A, THS720A, THS730A, & THS720P User Manual*.

For information about unpacking and inspecting the instrument, refer to *Unpacking and Repacking Instructions* on page 6–40 of this manual.

Internal and External Power Sources

You can power the TekScope instrument from the internal battery pack or from the AC adapter (both are standard accessories).

Using the Battery Pack

Before using the battery for the first time, it must be charged. You can use external power to charge the battery pack while it is in the TekScope instrument. Or you can charge the battery pack with the optional external battery charger. Typical battery charging times are listed below.

Configuration	Typical Charging Time
Battery pack in TekScope instrument	9 hours
Battery pack in external charger	1.5 hours

You can remove and replace the battery pack without losing any saved information. The current setup, saved setups, saved waveforms, and saved data are stored in nonvolatile memory that does not depend on battery power. To prevent loss of saved information, set the ON/STBY switch to STBY before removing the battery pack. See Figure 2–1 for instruction to remove and replace the battery.



WARNING. To avoid shock hazard, the battery door must remain closed in wet or damp conditions.

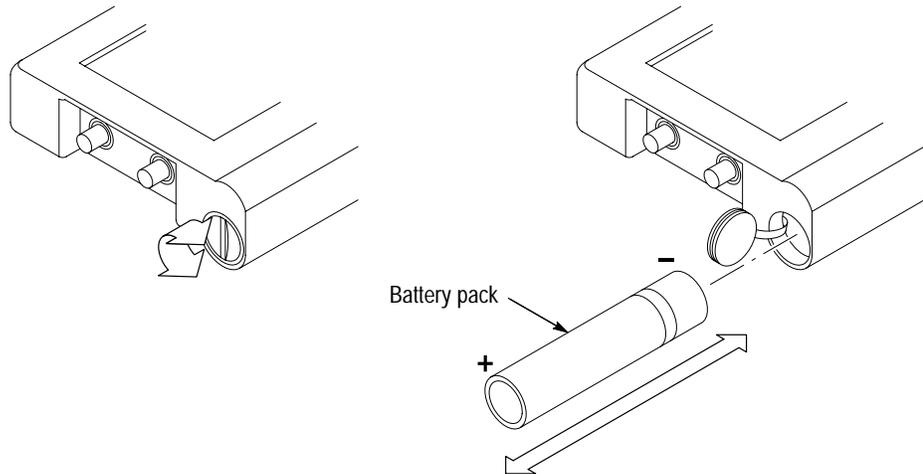


Figure 2-1: Removing and replacing the battery

Using External Power

For benchtop operation, you can use external power. Attach the AC adapter as shown in Figure 2-2. The DC INPUT disconnects itself if an overvoltage is applied. If this occurs, disconnect and then reconnect the AC adapter to resume operation from external power.



WARNING. To avoid shock hazard, the DC input and I/O port hole plugs must remain closed in wet or damp conditions.

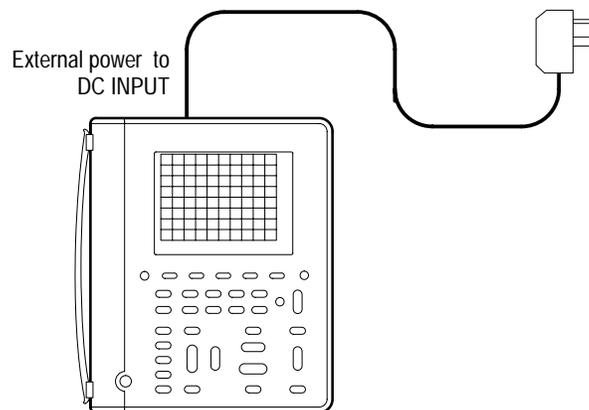


Figure 2-2: AC adapter attachment



CAUTION. To avoid overheating, do not connect external power while the instrument is in a confined space, such as in the soft case.

Understanding the Front Panel

The SCOPE and METER buttons select the operating mode. The front panel has additional buttons for the functions you use most often and menus to access the more specialized functions.

Using Scope Mode

Press the front-panel SCOPE button to enter scope mode. Then, press AUTO-RANGE to set the vertical, horizontal, and trigger automatically for a usable display. A typical scope-mode display is shown in Figure 2–3.

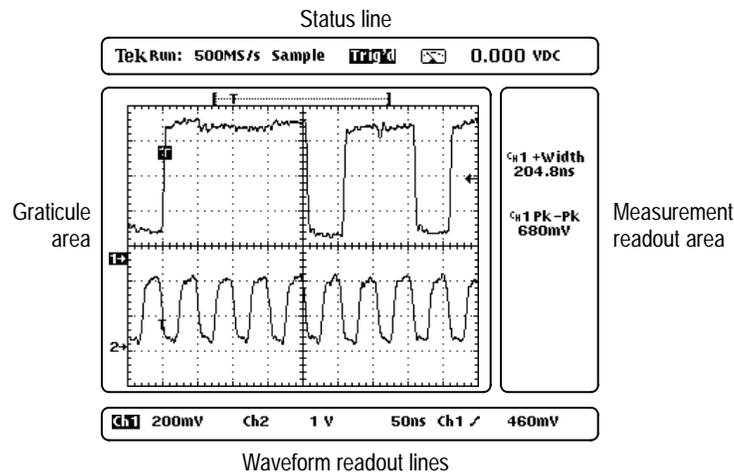


Figure 2–3: Typical scope-mode display

Using Meter Mode

Press the front-panel METER button to enter meter mode. Press one of the bezel buttons to choose a meter function and then press AUTORANGE to set the range automatically. A typical meter-mode display is shown in Figure 2-4.

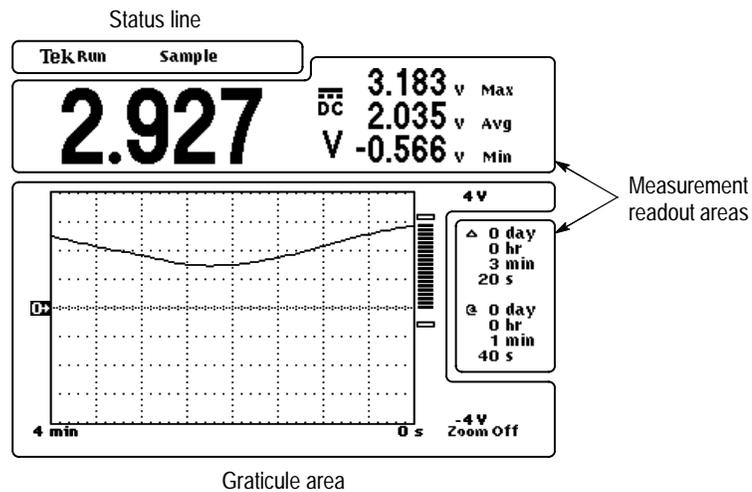
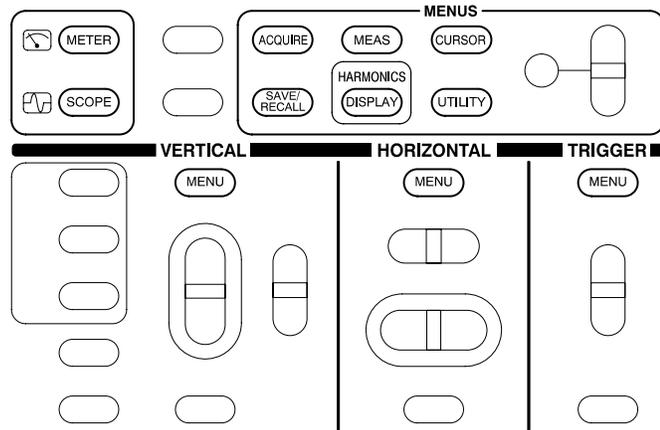


Figure 2-4: Typical meter-mode display

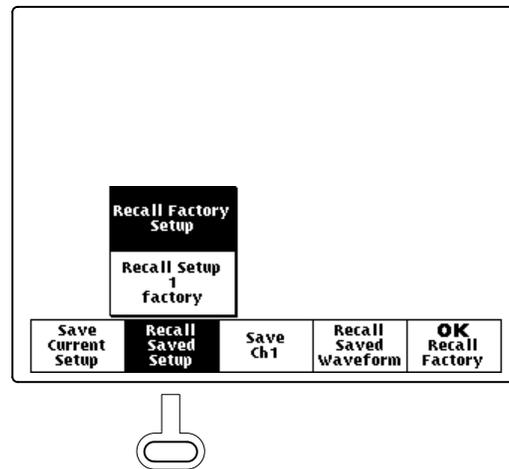
Using the Menu System

To use the menu system, follow the steps below:

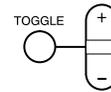
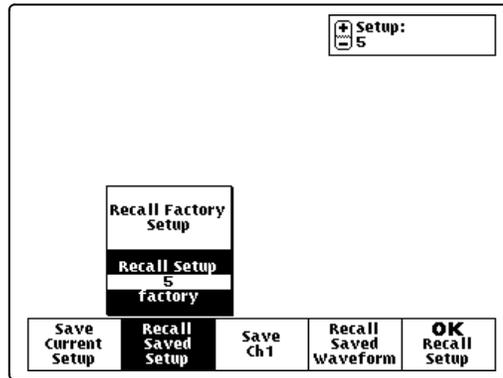
1. Press a front-panel button to display the menu you want to use.



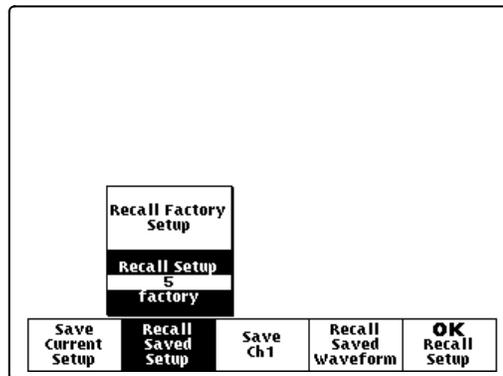
2. Press a bezel button to choose a menu item. If a pop-up menu appears, continue to press the bezel button to choose an item in the pop-up menu. You may need to press the Select Page button to access additional menu items.



- After choosing some menu items, you need to set a numerical parameter to complete the setup. Use the +/- rocker to adjust the parameter or press the TOGGLE button to reset the parameter to its default value.



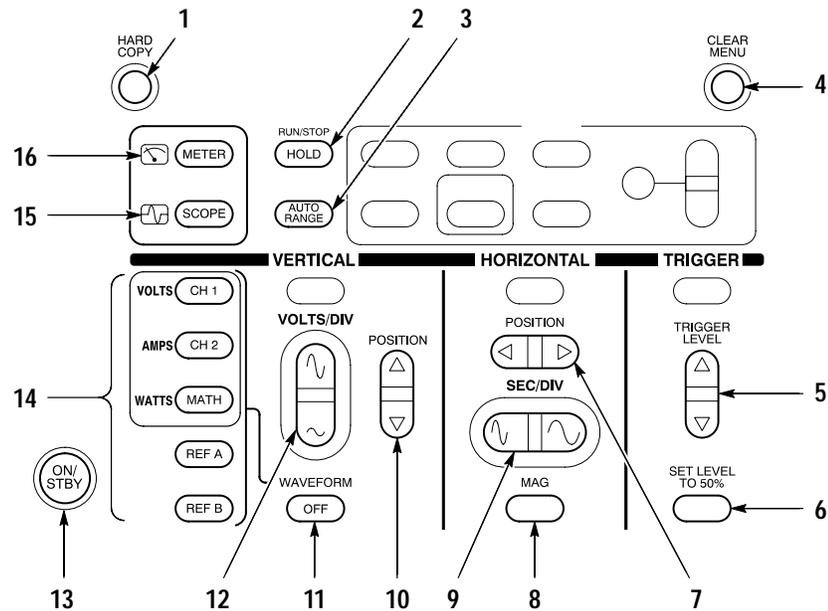
- If the OK bezel button is displayed, press it to confirm your choice.



NOTE. In the Performance Verification, Adjustments, and Maintenance chapters of this manual, TekScope instrument setups are shown in tables. Refer to Conventions on page x for information about reading these tables.

Using the Dedicated Buttons

You can use the dedicated buttons below to take direct actions. These buttons do not require the use of menus.



1. **HARD COPY.** Initiates a hard copy using the RS-232 port.
2. **HOLD.** Stops/restarts oscilloscope acquisition or holds/resets meter readout.
3. **AUTORANGE.** Selects oscilloscope or meter autorange function.
4. **CLEAR MENU.** Clears menu from display.
5. **TRIGGER LEVEL.** Adjusts trigger level.
6. **SET LEVEL TO 50%.** Sets trigger level to midpoint of oscilloscope waveform.
7. **HORIZONTAL POSITION.** Adjusts oscilloscope waveform horizontal position.
8. **MAG.** Turns 10X horizontal magnification on and off.
9. **SEC/DIV.** Adjusts waveform horizontal scale factor for oscilloscope or data logger.
10. **VERTICAL POSITION.** Adjusts oscilloscope waveform vertical position.
11. **WAVEFORM OFF.** Removes selected oscilloscope waveform from display.
12. **VOLTS/DIV.** Adjusts oscilloscope vertical scale factor or meter range.
13. **ON/STBY.** Selects on or standby. Does not disconnect power from the instrument.

14. CH 1, CH 2, MATH, REF A, REF B. Displays waveform and chooses selected waveform. In harmonics mode (THS720P), CH 1 and CH 2 also display harmonics of voltage and current waveforms; MATH displays power measurements.
15. SCOPE. Selects scope mode.
16. METER. Selects meter mode.

Connecting and Using the Probes

The oscilloscope probes and meter leads attach to the connectors located on the top and side panels of the TekScope instrument as shown in Figure 2–5.

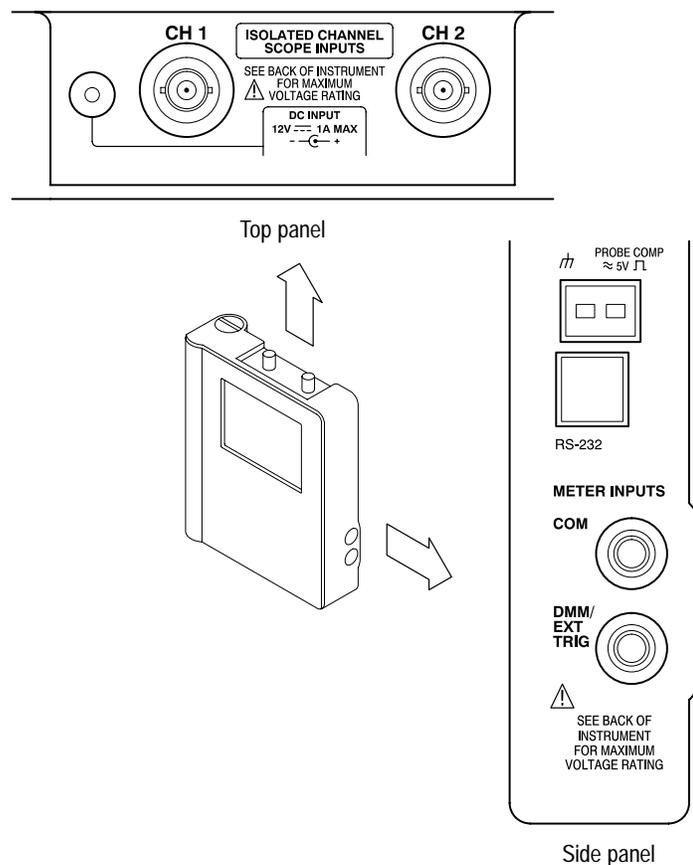
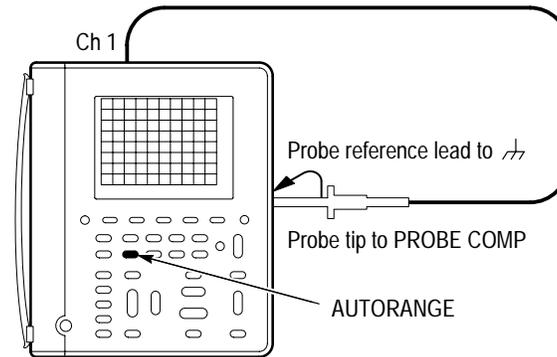


Figure 2-5: Connector locations

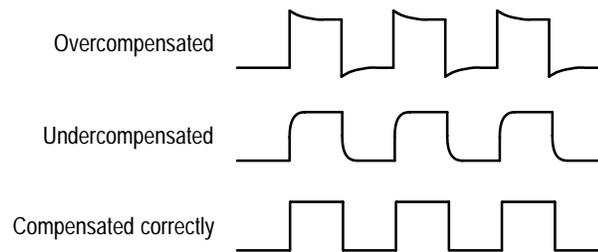
Compensating the Oscilloscope Probes

To maintain signal fidelity, you must compensate each voltage probe for the channel input it is connected to.

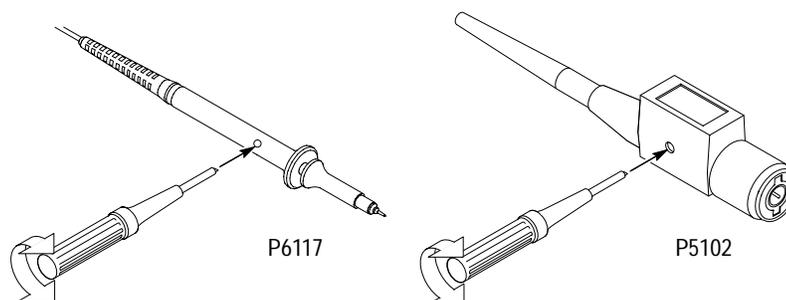
1. Connect the oscilloscope probe and then press **AUTORANGE**.



2. Check the shape of the displayed waveform.



3. If necessary, adjust the probe for correct compensation.



4. Repeat these steps for the other probe and channel.

Attaching the Reference Leads Correctly

If you are using both of the oscilloscope channels, you must attach the probe reference lead for each channel directly to your circuit. These attachments are required because the oscilloscope channels are electrically isolated; they do not share a common chassis connection. If you are also using the DMM, you must also attach the DMM common lead to your circuit for the same reason as above.

Beware of High Voltages

Understand the voltage ratings for the probes you are using and do not exceed those ratings. Two ratings are important to know and understand:

- The maximum measurement voltage from the probe tip to the probe reference lead
- The maximum floating voltage from the probe reference lead to earth ground

These two voltage ratings depend on the probe and your application. Refer to *Specifications* beginning on page 1–1 for more information.



WARNING. *To prevent electrical shock, do not exceed the measurement or floating voltage ratings for the oscilloscope input BNC connector, probe tip, probe reference lead, DMM input connector, or DMM lead.*

Theory of Operation

This chapter describes the electrical operation of the TekScope instrument to the module level. It describes the basic operation of each functional circuit block shown in Figure 3-1.

Main Board

The Main board assembly contains the following oscilloscope and meter functions.

Oscilloscope Signal Path

Each of the two oscilloscope input signals enters the main board and passes through an attenuator and buffer amplifier. Then each signal passes through an isolation interface before reaching the trigger circuitry, a sampler, and a digitizer. The digitized signals are written into system memory for transfer to the display system.

Meter Signal Path

The DMM input enters the Main board and passes through a switching network to select the meter function and range. The DMM signal is then sampled and digitized.

Processor System

The processor system contains a 68331 microprocessor that controls the entire instrument. The processor passes waveforms, meter readings, and text on to the display system. The processor system also contains flash ROM, system RAM, and the RS-232, keyboard, and probe compensation interfaces.

Display System

The display system, consisting of a display controller and video memory, processes text and waveforms to refresh the display.

Power Supply

The power supply provides DC power to circuits on the main board and generates an AC voltage to provide power to the attenuators and buffer amplifiers across the isolation interfaces. It also provides +12 V and -20 V for the display module.

Inverter Board

The inverter board generates an AC voltage for the display backlight.

Display Module

The display module consists of a liquid crystal display (LCD), a display driver, and a fluorescent backlight.

Switch Assembly

The switch assembly is a matrix of switches that form the front-panel buttons. The switch assembly consists of a flex-circuit board and an elastomeric switch mat. Switch closures are read by the processor system.

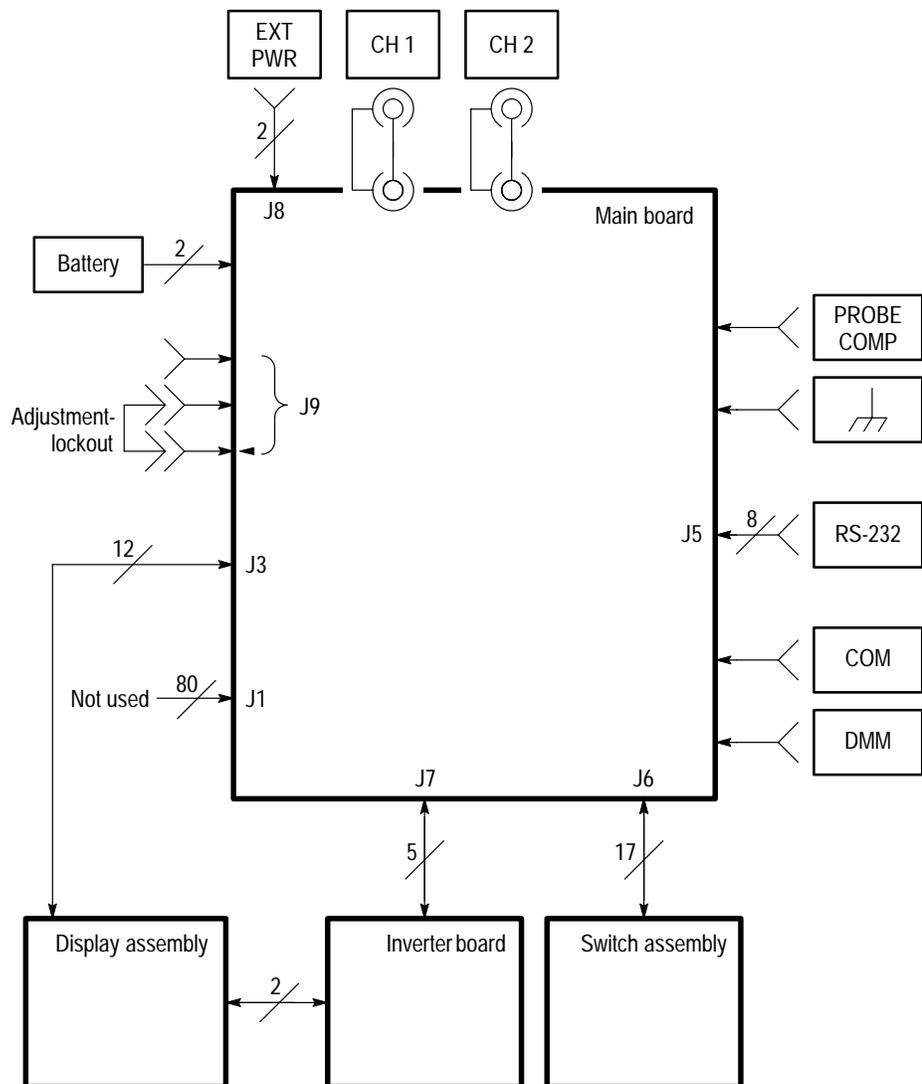


Figure 3-1: Module-level block diagram

Performance Verification

This chapter contains performance verification procedures for the specifications marked with the ✓ symbol. The following equipment, or a suitable equivalent, is required to complete these procedures.

Description	Minimum Requirements	Examples
DC Voltage Source	60 mV to 800 V, $\pm 0.1\%$ accuracy	Wavetek 9100 Universal Calibration System with Oscilloscope Calibration Module (Option 250) Fluke 5500A Multi-product Calibrator with Oscilloscope Calibration Option (Option 5500A-SC)
AC Voltage Source	300 mV to 640 V, $\pm 0.5\%$ accuracy at 500 Hz	
Resistance Standard	360 Ω to 36 M Ω , $\pm 0.1\%$ accuracy	
Leveled Sine Wave Generator	50 kHz and 100 MHz, $\pm 3\%$ amplitude accuracy	
Time Mark Generator	10 ms period, ± 50 ppm accuracy	
Banana to Banana Cable (two required)	Shielded banana jacks on each end	Tektronix Deluxe Meter Lead Set (ATLDX1)
50 Ω BNC Cable	BNC male to BNC male, ≈ 36 in (1 m) long	Tektronix part number 012-0482-00
50 Ω Feedthrough Termination	BNC male and female connectors	Tektronix part number 011-0049-01
Dual Banana to BNC Adapter	Banana plugs to BNC female	Tektronix part number 103-0090-00

Performance Verification

Test Record

Serial Number	Procedure Performed by	Date

Test	Passed	Failed
Self Test		

Oscilloscope Tests		Low Limit	Test Result	High Limit
Channel 1 DC Measurement Accuracy	5 mV/div	34.05 mV		35.95 mV
	500 mV/div	3.405 V		3.595 V
	2 V/div	13.62 V		14.38 V
	10 V/div	68.1 V		71.9 V
Channel 2 DC Measurement Accuracy	5 mV/div	34.05 mV		35.95 mV
	500 mV/div	3.405 V		3.595 V
	2 V/div	13.62 V		14.38 V
	10 V/div	68.1 V		71.9 V
Channel 1 Bandwidth		425 mV		—
Channel 2 Bandwidth		425 mV		—
Sample Rate and Delay Time Accuracy		-4 divs		+4 divs
Channel 1 Edge Trigger Sensitivity		Stable trigger		—
Channel 2 Edge Trigger Sensitivity		Stable trigger		—

DMM Tests		Low Limit	Test Result	High Limit
DC Voltage Accuracy	400 mV range, 60 mV input	59.2 mV		60.8 mV
	400 mV range, 360 mV input	357.7 mV		362.3 mV
	4 V range	3.577 V		3.623 V
	40 V range	35.77 V		36.23 V
	400 V range	357.7 V		362.3 V
	880 V range	783 V		801 V
AC Voltage Accuracy	400 mV range	352.3 mV		367.7 mV
	4 V range, 600 mV input	0.583 V		0.617 V
	4 V range, 3.6 V input	3.523 V		3.677 V
	40 V range	35.23 V		36.77 V
	400 V range	352.3 V		367.7 V
	640 V range	559 V		593 V
Resistance Accuracy	400 Ω range	358.0 Ω		362.0 Ω
	4 k Ω range	3.580 k Ω		3.620 k Ω
	40 k Ω range, 6 k Ω input	5.95 k Ω		6.05 k Ω
	40 k Ω range, 36 k Ω input	35.80 k Ω		36.20 k Ω
	400 k Ω range	358.0 k Ω		362.0 k Ω
	4 M Ω range	3.580 M Ω		3.620 M Ω
	40 M Ω range	35.23 M Ω		36.77 M Ω

Performance Verification Procedures

In these procedures, TekScope instrument setups are shown in tables. Refer to *Conventions* on page x for information about how to use these tables.

Before beginning these procedures, two conditions must first be met:

- The TekScope instrument must have been operating continuously for ten minutes within the operating temperature range specified.
- You must perform the Signal Path Compensation operation described below. If the ambient temperature changes by more than 5° C, you must perform the Signal Path Compensation operation again.

The time required to complete the entire procedure is approximately one hour.



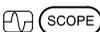
WARNING. Some procedures use hazardous voltages. To prevent electrical shock, always set voltage source outputs to 0 V before making or changing any interconnections.

Signal Path Compensation

Signal path compensation optimizes the oscilloscope accuracy for the current ambient temperature. For maximum accuracy, recompensate the signal path if the ambient temperature changes by 5° C or more.

To compensate the signal path, perform the following steps:

1. Disconnect any probes or cables from the channel 1 and channel 2 input BNC connectors.
2. Execute the signal path compensation with the following steps:

 METER  SCOPE			
SCOPE	UTILITY	System	Cal
		Signal Path	—
		OK Compensate Signal Paths	

3. When the signal path compensation is complete, press **CLEAR MENU** to resume operation of the TekScope instrument.

Execute Self Test This procedure uses internal routines to verify that the TekScope instrument functions and passes its internal self tests. No test equipment or hookups are required. Start the self test with the following setup:

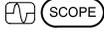
 METER  SCOPE			
SCOPE	UTILITY	System	Diag
		Loop	Once
		Execute	—
		OK Run Test	

A dialog box displays the result when the self test completes. Press the **CLEAR MENU** button to continue operation.

Check Oscilloscope DC Measurement Accuracy

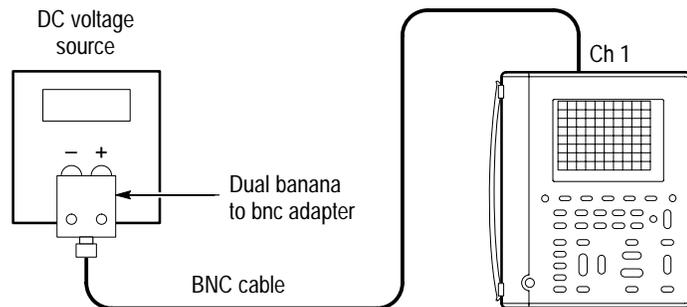
This test checks the DC measurement accuracy of the oscilloscope.

1. Set the DC voltage source output level to **0 V**.
2. Set up the TekScope instrument using the following steps:

 METER  SCOPE				
SCOPE	SAVE/ RECALL	Recall Saved Setup	Recall Factory Setup	—
		OK Recall Factory	—	
	CH 1	—		
	VERTICAL MENU	Probe Type	Voltage Probe	<i>Set to 1X</i>
	ACQUIRE	Mode	Average	<i>Set to 16</i>
	MEAS	Select Measmnt	Mean*	—
	OK Select Measmnt	—		

* You may need to press Select Page to display this selection.

3. Connect the TekScope instrument to the DC voltage source as shown below.



4. For each VOLTS/DIV setting listed below, perform the following steps:
 - a. Set the DC voltage source output level to the positive voltage listed and then record the mean measurement as V_{pos} .
 - b. Reverse the polarity of the DC voltage source and then record the mean measurement as V_{neg} .
 - c. Calculate $V_{\text{diff}} = V_{\text{pos}} - V_{\text{neg}}$ and then compare V_{diff} to the accuracy limits in the table.

VOLTS/DIV Setting	DC Voltage Source Output Levels	Accuracy Limits for V_{diff}
5 mV/div	+17.5 mV, -17.5 mV	34.05 mV to 35.95 mV
500 mV/div	+1.75 V, -1.75 V	3.405 V to 3.595 V
2 V/div	+7.00 V, -7.00 V	13.62 V to 14.38 V
10 V/div	+35.0 V, -35.0 V	68.1 V to 71.9 V

5. Set DC voltage source output level to **0 V**.
6. To check channel 2, repeat step 2 substituting CH 2 for CH 1.
7. Press **CH 1** and **WAVEFORM OFF** to remove the channel 1 waveform from the display.
8. Repeat steps 3 through 5, substituting CH 2 for CH 1, to complete the check of channel 2.

Check Oscilloscope Channel 1 Bandwidth

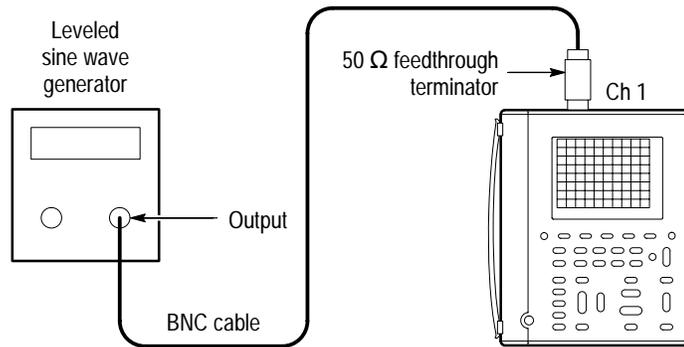
This test checks the bandwidth of channel 1.

1. Set up the TekScope instrument using the following steps:

 METER  SCOPE				
SCOPE	SAVE/ RECALL	Recall Saved Setup	Recall Factory Setup	—
		OK Recall Factory	—	
	ACQUIRE	Mode	Average	<i>Set to 16</i>
	TRIGGER	Coupling	Noise Reject	—
	MEAS	Gating & High-Low Setup	High-Low Method	Min/Max
		Select Measmnt	Pk-Pk*	—
	OK Select Measmnt	—		

* You may need to press Select Page to display this selection.

2. Connect the TekScope instrument to the leveled sine wave generator as shown below.



3. Set the TekScope instrument VOLTS/DIV to **100 mV/div**.
4. Set the TekScope instrument SEC/DIV to **10 μ s/div**.
5. Set the leveled sine wave generator frequency to **50 kHz**.
6. Set the leveled sine wave generator output level so the peak-to-peak measurement is between **599 mV** and **601 mV**.
7. Set the leveled sine wave generator frequency to **200 MHz** if you are checking a THS730A, **100 MHz** if you are checking a THS720A or a THS720P, or **60 MHz** if you are checking a THS710A.
8. Press **MAG**.
9. Set the TekScope instrument SEC/DIV to **10 ns/div**.
10. Check that the peak-to-peak measurement is \geq **425 mV**.
11. Press **MAG**.
12. Proceed to the next test to check the channel 2 bandwidth.

Check Oscilloscope Channel 2 Bandwidth

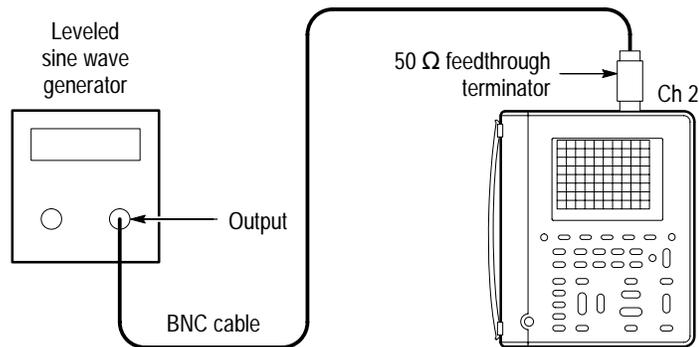
This test checks the bandwidth of channel 2.

1. First check the channel 1 bandwidth using the previous test. Then, perform these additional steps to check the channel 2 bandwidth:

 METER				
 SCOPE	CH 1	—	—	—
	WAVEFORM OFF			
	CH 2			
	TRIGGER	Trigger Source	Ch2	
	MEAS	Gating & High-Low Setup	High-Low Method	Min/Max
		Select Measmnt	Pk-Pk*	—
		OK Select Measmnt	—	

* You may need to press Select Page to display this selection.

2. Connect the TekScope instrument to the leveled sine wave generator as shown below.



3. Set the TekScope instrument VOLTS/DIV to **100 mV/div**.
4. Set the TekScope instrument SEC/DIV to **10 μ s/div**.
5. Set the leveled sine wave generator frequency to **50 kHz**.
6. Set the leveled sine wave generator output level so the peak-to-peak measurement is between **599 mV** and **601 mV**.
7. Set the leveled sine wave generator frequency to **200 MHz** if you are checking a THS730A, **100 MHz** if you are checking a THS720A or a THS720P, or **60 MHz** if you are checking a THS710A.
8. Press **MAG**.
9. Set the TekScope instrument SEC/DIV to **10 ns/div**.
10. Check that the peak-to-peak measurement is \geq **425 mV**.

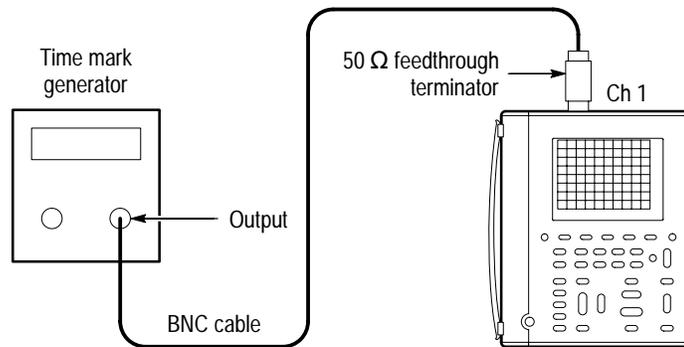
Check Oscilloscope Sample Rate and Delay Time Accuracy

This test checks the oscilloscope time base accuracy.

1. Set up the TekScope instrument using the following steps:

 METER  SCOPE				
SCOPE	SAVE/ RECALL	Recall Saved Setup	Recall Factory Setup	—
		OK Recall Factory	—	
VERTICAL MENU		Probe Type	Voltage Probe	Set to 1X

2. Connect the TekScope instrument to the time mark generator as shown below.

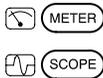


3. Set the time mark generator period to **10 ms**.
4. Set the TekScope instrument VOLTS/DIV to **500 mV/div**.
5. Use the vertical POSITION rocker to center the test signal on screen.

6. Press **SET LEVEL TO 50%**.
7. Press **MAG**.
8. Change the TekScope instrument setup using the following steps:

				
SCOPE	HORIZON-TAL MENU	Time Base	Delayed Runs After Main	—
	CLEAR MENU	—	—	

9. Set the delayed time base SEC/DIV to **50 ms/div**.
10. Change the TekScope instrument setup using the following steps:

				
SCOPE	HORIZON-TAL MENU	Time Base	Delayed Runs After Main	<i>Set delay time to 10 ms</i>
	CLEAR MENU	—	—	—

11. Set the delayed time base SEC/DIV to **500 ns/div**.
12. Check that the rising edge of the marker crosses the center horizontal graticule line within ± 4 divisions of center graticule.

NOTE. One division of displacement from graticule center corresponds to a 50 ppm time base error.

Check Oscilloscope Channel 1 Edge Trigger Sensitivity

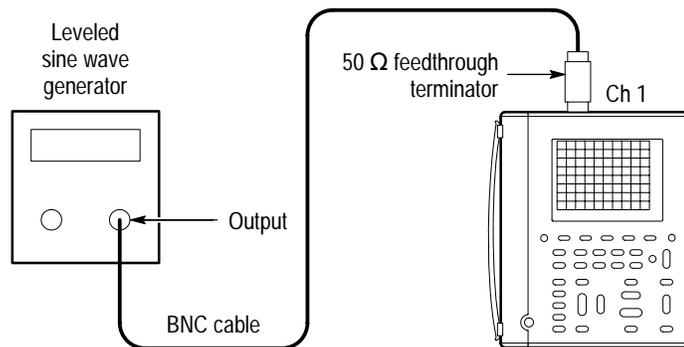
This test checks the edge trigger sensitivity for channel 1.

1. Set up the TekScope instrument using the following steps:

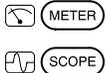
 METER				
 SCOPE	SAVE/RECALL	Recall Saved Setup	Recall Factory Setup	—
		OK Recall Factory	—	
	ACQUIRE	Mode	Average	<i>Set to 16</i>
	TRIGGER	Mode	Normal	—
	MEAS	Gating & High-Low Setup	High-Low Method	Min/Max
		Select Measmnt	Ampl*	—
		OK Select Measmnt	—	

* You may need to press Select Page to display this selection.

2. Connect the TekScope instrument to the leveled sine wave generator as shown below.

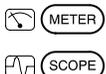


3. Set the leveled sine wave generator frequency to **200 MHz** if you are checking a THS730A or to **100 MHz** if you are checking a THS710A, THS720A or THS720P.
4. Set the TekScope instrument VOLTS/DIV to **500 mV/div**.
5. Press **MAG**.
6. Set the TekScope instrument SEC/DIV to **10 ns/div**.
7. Set the leveled sine wave generator output level to approximately **50 mV_{p-p}** so that the measured amplitude is approximately **500 mV**. (The measured amplitude can fluctuate around 500 mV.)
8. Press **SET LEVEL TO 50%**. Adjust **TRIGGER LEVEL** as necessary and then check that triggering is stable.
9. Change the TekScope instrument setup using the following steps:

			
SCOPE	TRIGGER	Slope	\ (falling edge)

10. Press **SET LEVEL TO 50%**. Adjust **TRIGGER LEVEL** as necessary and then check that triggering is stable.

11. Change the TekScope instrument setup using the following steps:

			
SCOPE	TRIGGER	Slope	(rising edge)

12. Proceed to the next test to check the channel 2 edge trigger sensitivity.

Check Oscilloscope Channel 2 Edge Trigger Sensitivity

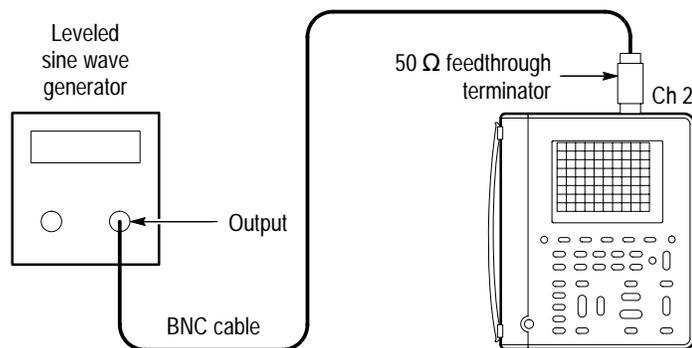
This test checks the edge trigger sensitivity for channel 2.

1. First check the channel 1 edge trigger sensitivity using the previous test. Then, perform these additional steps to check the channel 2 edge trigger sensitivity:

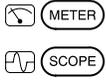
 METER				
SCOPE	CH 1	—	—	—
	WAVEFORM OFF			
	CH 2			
	TRIGGER	Trigger Source	Ch2	
	MEAS	Gating & High-Low Setup	High-Low Method	Min/Max
		Select Measrmt	Ampl*	—
		OK Select Measrmt	—	

* You may need to press Select Page to display this selection.

2. Connect the TekScope instrument to the leveled sine wave generator as shown below.



3. Set the leveled sine wave generator frequency to **200 MHz** if you are checking a THS730A or to **100 MHz** if you are checking a THS710A, THS720A or THS720P.
4. Set the TekScope instrument VOLTS/DIV to **500 mV/div**.
5. Set the leveled sine wave generator output level to approximately **50 mV_{p-p}** so that the measured amplitude is approximately **500 mV**. (The measured amplitude can fluctuate around 500 mV.)
6. Press **SET LEVEL TO 50%**. Adjust **TRIGGER LEVEL** as necessary and then check that triggering is stable.
7. Change the TekScope instrument setup using the following steps:

			
SCOPE	TRIGGER	Slope	\ (falling edge)

8. Press **SET LEVEL TO 50%**. Adjust **TRIGGER LEVEL** as necessary and then check that triggering is stable.

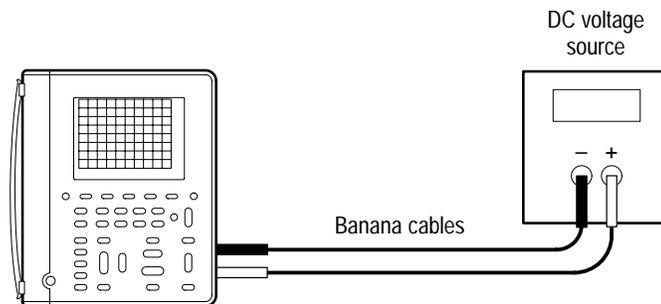
Check Meter DC Voltage Accuracy

This test checks the meter DC voltage accuracy.

1. Set the DC voltage source output level to **0 V**.
2. Set up the TekScope instrument using the following steps:

 METER  SCOPE			
METER	—	VDC	—

3. Connect the TekScope instrument to the DC voltage source as shown below.



4. For each range, set the DC voltage source output to the level listed below, and then compare the meter reading to the accuracy limits.

Range	DC Voltage Source Output Level	Accuracy Limits
400 mV	60 mV	59.2 mV to 60.8 mV
400 mV	360 mV	357.7 mV to 362.3 mV
4 V	3.6 V	3.577 V to 3.623 V
40 V	36 V	35.77 V to 36.23 V
400 V	360 V	357.7 V to 362.3 V
880 V	792 V	783 V to 801 V

5. Set the DC voltage source output level to **0 V**.

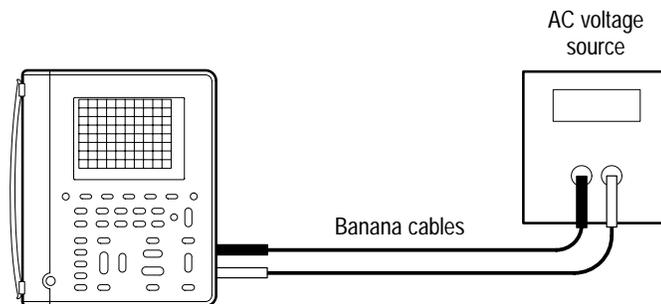
Check Meter AC Voltage Accuracy

This test checks the meter AC voltage accuracy.

1. Set the AC voltage source output level to **0 V**.
2. Set up the TekScope instrument using the following steps:

 METER  SCOPE			
METER	—	VAC	—

3. Connect the TekScope instrument to the AC voltage source as shown below.



4. Set the AC voltage source output frequency to **500 Hz**.
5. For each range, set the AC voltage source output to the level listed below, and then compare the meter reading to the accuracy limits.

Range	AC Voltage Source Output Level	Accuracy Limits
400 mV	360 mV	352.3 mV to 367.7 mV
4 V	600 mV	0.583 V to 0.617 V
4 V	3.6 V	3.523 V to 3.677 V
40 V	36 V	35.23 V to 36.77 V
400 V	360 V	352.3 V to 367.7 V
640 V	576 V	559 V to 593 V

6. Set the AC voltage source output level to **0 V**.

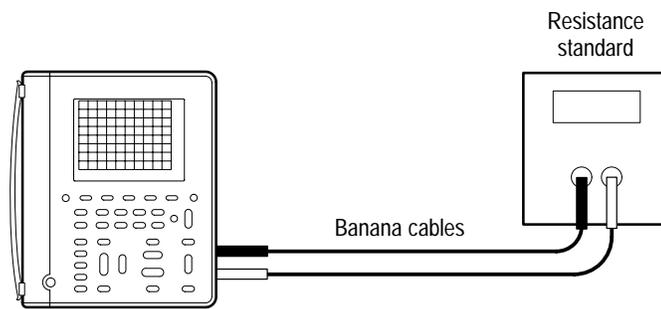
Check Meter Resistance Accuracy

This test checks the meter resistance measurement accuracy.

1. Set up the TekScope instrument using the following steps:

 METER  SCOPE			
METER	—	Ω	—

2. Connect the TekScope instrument to the resistance standard as shown below.



3. For each range, set the resistance standard to the resistance listed below, and then compare the meter reading to the accuracy limits.

Range	Resistance Standard Setting	Accuracy Limits
400 Ω	360 Ω	358.0 Ω to 362.0 Ω
4 k Ω	3.6 k Ω	3.580 k Ω to 3.620 k Ω
40 k Ω	6 k Ω	5.95 k Ω to 6.05 k Ω
40 k Ω	36 k Ω	35.80 k Ω to 36.20 k Ω
400 k Ω	360 k Ω	358.0 k Ω to 362.0 k Ω
4 M Ω	3.6 M Ω	3.580 M Ω to 3.620 M Ω
40 M Ω *	36 M Ω *	35.23 M Ω to 36.77 M Ω

* These limits apply only when the relative humidity is $\leq 60\%$.

This completes the performance verification procedure.

Adjustment Procedures

This chapter contains adjustment procedures for the TekScope instrument.

Only qualified personnel should perform service procedures. Read this *Service Safety Summary* and the *General Safety Summary* before performing any service procedures. Also refer to the chapter *Operating Information* for information about using the TekScope instrument.

NOTE. *The voltage references inside the TekScope instrument are very stable over time and should not require routine adjustment. Before performing any procedure in this chapter, first verify that the instrument does not meet specifications. Refer to the chapter Performance Verification for procedures to verify the specifications.*

Required Equipment

The following equipment, or a suitable equivalent, is required to complete these procedures.

Description	Minimum Requirements	Examples
DC Voltage Source	400 mV to 800 V, $\pm 0.1\%$ accuracy	Wavetek 9100 Universal Calibration System with Oscilloscope Calibration Module (Option 250)
AC Voltage Source	400 mV to 600 V, $\pm 0.5\%$ accuracy at 500 Hz	Fluke 5500A Multi-product Calibrator with Oscilloscope Calibration Option (Option 5500A-SC)
Resistance Standard	100 Ω to 10 M Ω , $\pm 0.1\%$ accuracy	
Fast-Rise Square Wave Generator	300 mV step, ≤ 20 ns risetime, $\leq 0.5\%$ flatness from 500 ns to 200 μ s, 500 Hz or 950 Hz, nominal 50% duty cycle	
Banana to Banana Cable (two required)	Shielded banana jacks on each end	Tektronix Deluxe Meter Lead Set (ATLDX1)
50 Ω BNC Cable	BNC male to BNC male, ≈ 36 in (1 m) long	Tektronix part number 012-0482-00
50 Ω BNC Cable	BNC male to BNC male, ≈ 10 in (25 cm) long	Tektronix part number 012-0208-00
50 Ω Feedthrough Termination	BNC male and female connectors	Tektronix part number 011-0049-01

Description	Minimum Requirements	Examples
Dual Banana to BNC Adapter	Banana plugs to BNC female	Tektronix part number 103-0090-XX
BNC T	One male and two female BNC connectors	Tektronix part number 103-0030-XX

Overview of the Adjustment Process

The TekScope instrument is protected from inadvertent adjustment by an internal adjustment-lockout jumper. Some disassembly is required to access and remove the jumper before you can adjust the instrument. After adjustment is complete, the jumper should be replaced to protect the calibration of the instrument.

Oscilloscope adjustment and meter adjustment are independent procedures. You can choose to adjust either or both. Each procedure consists of a series of steps; as you move through these steps, the TekScope instrument display provides instructions that describe the specific input signal requirements for each step.

NOTE. *During some steps, the instrument may appear to be idle for several minutes while it is processing information internally. Please have patience.*

If all steps in the procedure are completed successfully, a “Pass” message is displayed and the new calibration constants take affect. If any step fails, the procedure is aborted and the current calibration is not affected. You can also choose to abort the procedure at any step.

Before performing adjustment procedures, you must warm up the instrument at least ten minutes in an ambient temperature between 20° C and 30° C. Adjustments performed prior to warm-up or outside this temperature range may result in poor performance.

In this manual, TekScope instrument setups are shown in tables. Refer to *Conventions* on page x for information about how to use these tables.

Accessing the Adjustment-Lockout Jumper

Before adjusting the instrument you must (temporarily) remove the internal adjustment-lockout jumper. You will need a 12 in · lb (1.3 N · m) torque-limiting screwdriver with Torx® T-15 tip and a pair of needle-nose pliers to access and remove the jumper.



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 6–1.

Use this procedure to access and remove the adjustment-lockout jumper.

1. Disconnect all probes, cables, or meter leads from the instrument.
2. Disconnect the AC adapter, open the battery door, and remove the battery.
3. Place the TekScope instrument face down on a soft surface (such as an anti-static mat).
4. Use the torque-limiting Torx® T-15 screwdriver to remove the four screws that hold the case together.
5. Holding the case together, pick it up and place it back side down on a soft surface.
6. As you lift the front cover off the instrument, press the buttons as necessary to prevent the switch mat from coming off with the front cover.
7. To remove the switch mat, lift it off the switch flex-circuit assembly. Place it button-side down on a clean surface.



CAUTION. To avoid contamination of switch contacts, do not touch the carbon contacts on the switch flex-circuit assembly or on the back side of the switch mat.

8. Fold the switch flex-circuit assembly toward you to expose the display module, inverter board, and adjustment-lockout jumper. The jumper location is shown in Figure 5–1.
9. Use the needle nose pliers to remove the adjustment-lockout jumper from the instrument. Set the jumper aside for replacement after the adjustment is complete.
10. To reassemble the instrument, fold the switch flex-circuit assembly back over the display module and inverter board.

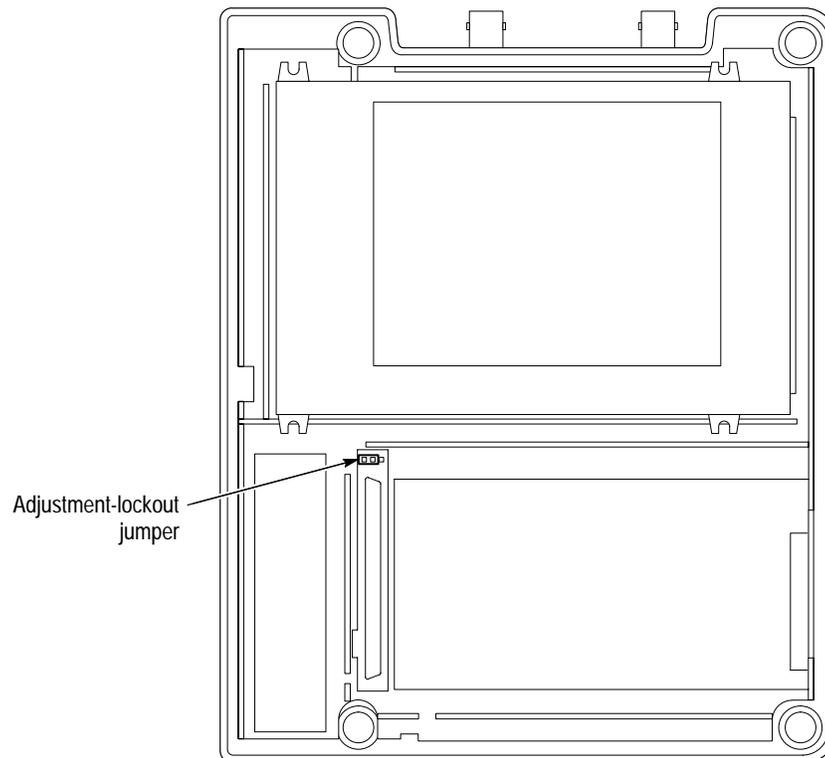


Figure 5-1: Location of adjustment-lockout jumper

- 11.** To install the switch mat, place it (contact side down) on the switch flex-circuit assembly. The five rubber guideposts fit into holes in the circuit board.
- 12.** Place the front cover assembly onto the instrument. Taking care not to pinch the handle, align it into the guides in the front cover. Align the buttons so they all protrude through the holes in the front cover.
- 13.** Holding the case together, pick it up and place it front side down on a soft surface.



CAUTION. To avoid cross-threading or cutting new threads with the screws, carefully follow the procedure in the next step.

- 14.** To install the four screws, follow these steps:
 - a.** Place the screws into their holes in the back cover.
 - b.** Using the torque-limiting Torx® T-15 screwdriver, slowly turn each screw backward (counterclockwise) until you feel the thread drop and then gently tighten the screw (turn clockwise) into the existing thread.

- c. When all four screws are in, hold a corner of the case together firmly to compress the gasket while tightening its screw until snug. Repeat for the other corners. Do not overtighten the screws (14 in · lbs or 1.5 N · m maximum torque).

15. Replace the battery as shown on page 2–2, and then close the battery door.

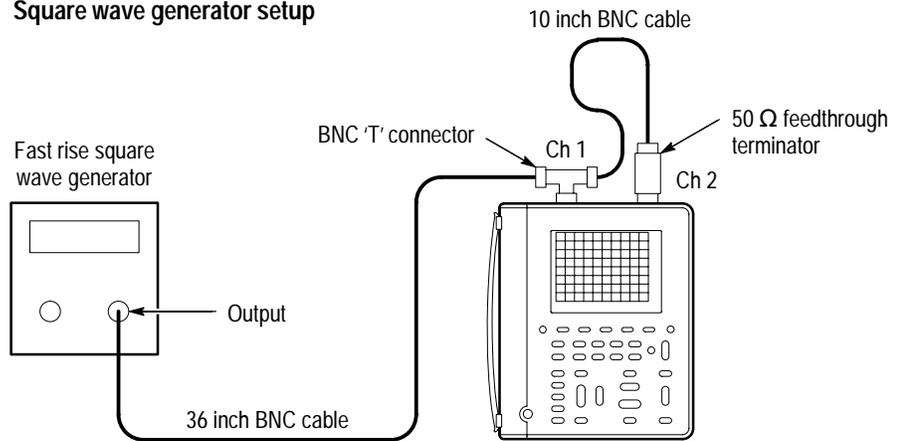
Oscilloscope Adjustment

Three equipment setups, shown in Figure 5–2, are required to complete this adjustment procedure. For each step in the procedure, the specific input signal required by that step is described in the TekScope instrument display. Refer to these diagrams as necessary during the procedure. Table 5–1 summarizes the steps in the procedure and the signal requirement for each step.

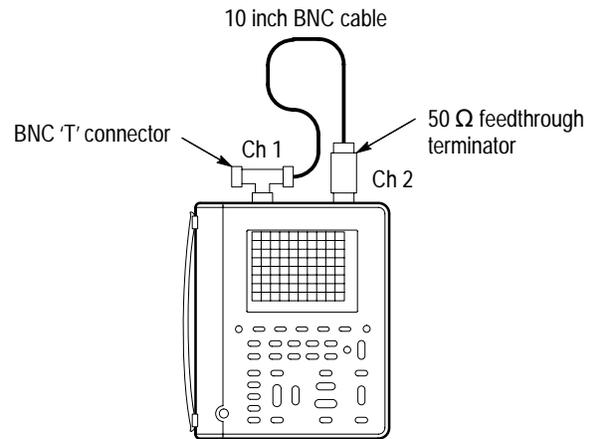
Table 5–1: Summary of oscilloscope adjustment steps

Step	Uses Equipment Setup	Signal Source Setting
1	Square wave generator setup	Fast rise output, 300 mV _{p-p} amplitude, 500 Hz or 950 Hz frequency
2	Zero voltage setup	None
5	DC voltage setup	+7.000 V
6	DC voltage setup	-7.000 V
7	DC voltage setup	+700.0 mV
8	DC voltage setup	-700.0 mV
9	DC voltage setup	+70.00 mV
10	DC voltage setup	-70.00 mV

Square wave generator setup



Zero voltage setup



DC voltage setup

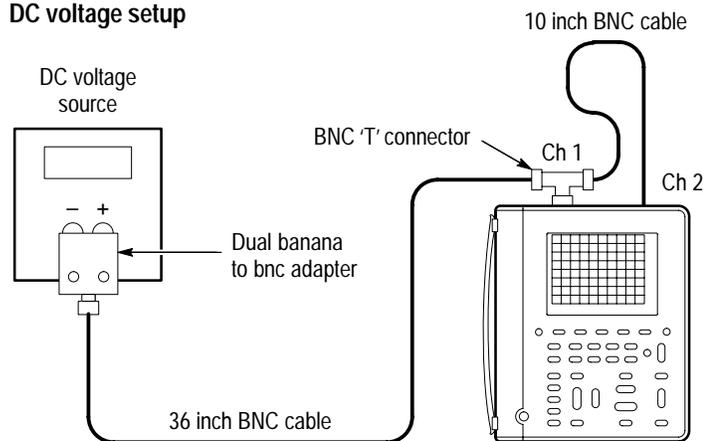


Figure 5-2: Oscilloscope adjustment setups

Oscilloscope Adjustment Procedure

After removing the adjustment-lockout jumper, use this procedure to adjust the oscilloscope voltage references.

1. Turn on the TekScope instrument and let it warm up for at least ten minutes.
2. Connect the fast rise square wave generator to the instrument as shown in the Square wave generator setup of Figure 5–2.
3. Set the fast rise square wave generator to produce an amplitude between **250 mV_{p-p}** and **300 mV_{p-p}**, and frequency between **450 Hz** and **950 Hz** (inclusive).
4. Use the TekScope instrument setup below to start the oscilloscope adjustment process. For each step, follow the specific instructions displayed by the instrument to connect the correct signal source and then confirm that you are ready to proceed to the next step.

 METER			
 SCOPE			
SCOPE	UTILITY	System	Cal
		Factory Scope	—
		OK Factory Cal Scope	

NOTE. During some steps, the instrument may appear to be idle for several minutes while it is processing information internally. Please have patience.

If any step in the procedure fails, the procedure terminates. Failure will result if an incorrect signal source is connected. If this happens, you must start the procedure over from the beginning.

If the procedure completes successfully, a “Pass” message is displayed and the new adjustment takes effect.

Completing the Adjustment Process

After adjusting the oscilloscope, continue with one of the following steps:

- Proceed to *Meter Adjustment* on page 5–8 to adjust the meter voltage references.
- Proceed to *Replacing the Adjustment-Lockout Jumper* on page 5–11 to protect the instrument from inadvertent readjustment.

Meter Adjustment

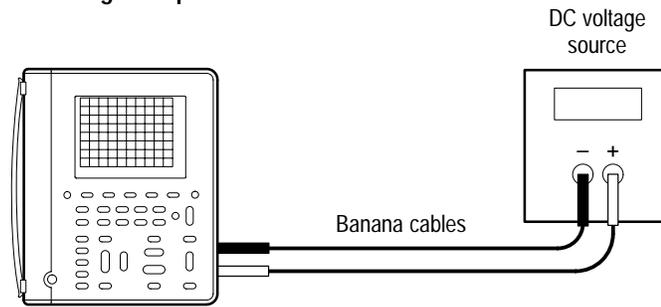
Three equipment setups, shown in Figure 5–3, are required to complete this adjustment procedure. For each step in the procedure, the specific input signal required by that step is described in the TekScope instrument display. Refer to these diagrams as necessary during the procedure. Table 5–2 summarizes the steps in the procedure and the signal requirement for each step.

Table 5–2: Summary of meter adjustment steps

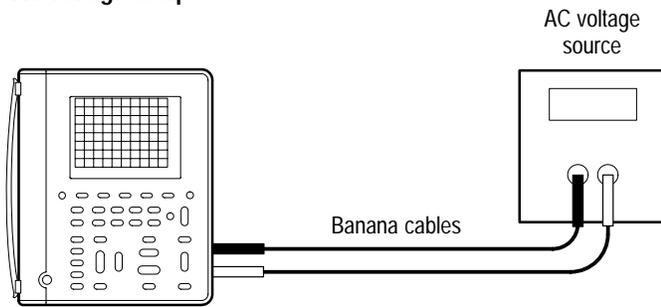
Step	Uses Equipment Setup	Signal or Resistance Source Setting
1	DC voltage setup	+400.0 mV
2	DC voltage setup	4.000 V
3	DC voltage setup	40.00 V
4	DC voltage setup	400.0 V
5	DC voltage setup	850.0 V
6	AC voltage setup	400.0 mV _{RMS} , 500 Hz
7	AC voltage setup	4.000 V _{RMS} , 500 Hz
8	AC voltage setup	40.00 V _{RMS} , 500 Hz
9	AC voltage setup	400.0 V _{RMS} , 500 Hz
10	AC voltage setup	600.0 V _{RMS} , 500 Hz
11	Resistance standard setup	100.0 Ω
12	Resistance standard setup	1.000 k Ω
13	Resistance standard setup	10.00 k Ω
14	Resistance standard setup	100.0 k Ω
15	Resistance standard setup	1.000 M Ω
16	Resistance standard setup	10.00 M Ω
17	DC voltage setup ¹	500.0 mV
18	DC voltage setup ¹	1.000 V

¹ In steps 17 and 18, the DC voltage source must be able to sink approximately 1 mA supplied by the TekScope instrument. You must determine whether or not your DC voltage source is capable of sinking current supplied by a device under test. If the DC voltage source cannot sink current, you can connect a 470 Ω , $\frac{1}{8}$ W shunt resistor across the output of the DC voltage source during steps 17 and 18 only. The shunt resistor will accommodate the current supplied by the TekScope instrument.

DC voltage setup



AC voltage setup



Resistance standard setup

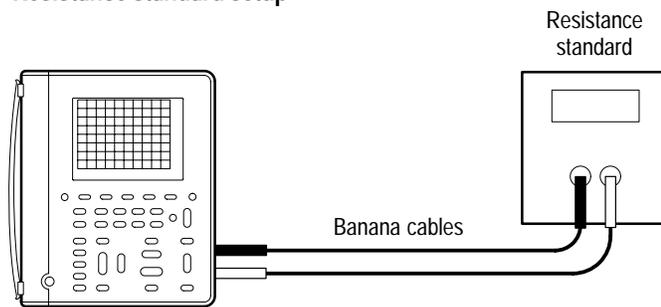


Figure 5-3: Meter adjustment setups

Meter Adjustment Procedure

After removing the adjustment-lockout jumper, use this procedure to adjust the meter voltage references.

1. Turn on the TekScope instrument and let it warm up for at least ten minutes.
2. Connect the DC voltage source to the instrument as shown in the DC voltage setup of Figure 5–3.
3. Set the DC voltage source amplitude to **400 mV**.
4. Use the TekScope instrument setup below to start the meter adjustment process. For each step, follow the specific instructions displayed by the instrument to connect the correct signal source and confirm that you are ready to proceed to the next step.

 METER  SCOPE			
METER	UTILITY	System	Cal
		Factory DMM	—
		OK Factory Cal DMM	

If any step in the procedure fails, the procedure terminates. Failure will result if an incorrect signal source is connected. If this happens, you must start the procedure over from the beginning.

If the procedure completes successfully, a “Pass” message is displayed and the new adjustment takes effect.

Completing the Adjustment Process

After adjusting the meter, continue with one of the following steps:

- Return to *Oscilloscope Adjustment* on page 5–5 to adjust the oscilloscope voltage references.
- Proceed to *Replacing the Adjustment-Lockout Jumper* on page 5–11 to protect the instrument from inadvertent readjustment.

Replacing the Adjustment-Lockout Jumper

After you complete the adjustment process, you should reinstall the adjustment-lockout jumper to prevent inadvertent loss of calibration. To replace the jumper, repeat the procedure *Accessing the Adjustment-Lockout Jumper* on page 5-3. However, in place of step 9, reinstall the jumper onto pins 1 and 2 as shown in Figure 5-4.

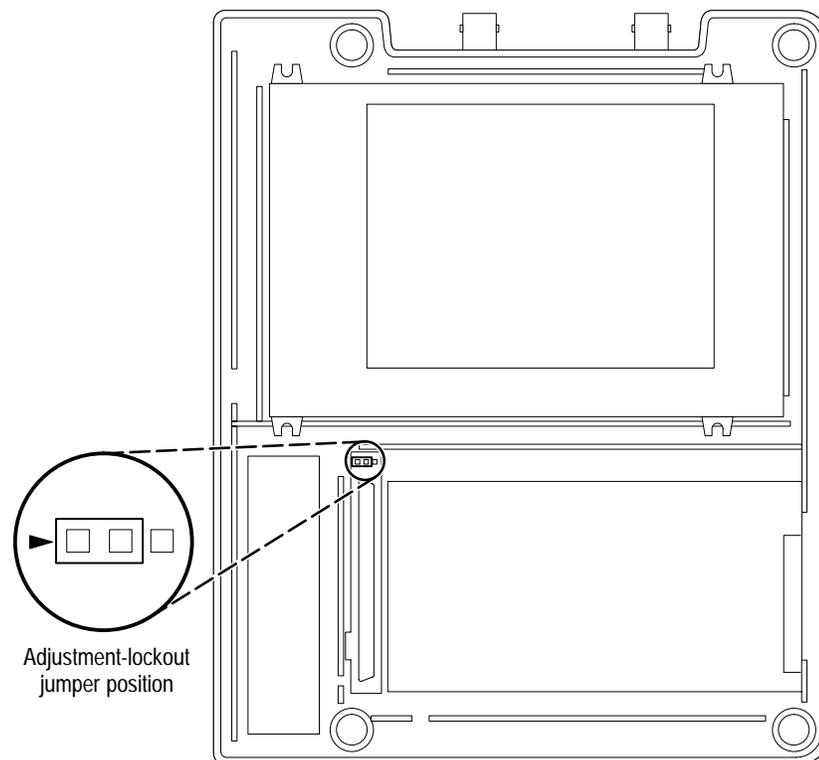


Figure 5-4: Relocating the adjustment-lockout jumper

This completes the adjustment procedure.

Maintenance

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

- *Preparation* refers you to important information contained elsewhere in this manual.
- *Preventing ESD* provides general information on preventing damage to internal modules when doing maintenance.
- *Inspection and Cleaning* provides procedures for inspecting the TekScope instrument and cleaning its external and internal modules.
- *Removal and Installation Procedures* provide procedures for the removal and installation of modules.
- *Troubleshooting* provides information for isolating failed modules.
- *Unpacking and Repacking Instructions* provides packaging information for shipment or storage.

Preparation

Only qualified personnel should perform service procedures. Read the *Service Safety Summary* and the *General Safety Summary* before performing any service procedures. Also refer to the chapter *Operating Information* for information about using the TekScope instrument.

Preventing ESD

When performing any service which requires internal access to the TekScope instrument, 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 instrument.*

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.

Inspection and Cleaning

This section describes how to inspect for dirt and damage, and how to clean the TekScope instrument. 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 TekScope instrument, and using general care when operating it. How often to do maintenance depends on the severity of the environment in which the instrument is used. A proper time to perform preventive maintenance is just before adjustment of the instrument.

General Care

Protect the TekScope instrument from adverse weather conditions. The instrument is not waterproof.

Do not store or leave the instrument where the LCD display will be exposed to direct sunlight for long periods of time.

The front and back covers help keep dust out of the TekScope instrument and must be in place during normal operation.



CAUTION. To avoid damage to the TekScope instrument, do not expose it to any sprays, liquids, or solvents.

Inspection and Cleaning Procedures

Inspect and clean the TekScope instrument 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 an instrument failure, especially under high-humidity conditions.

Inspection — Exterior. Inspect the outside of the TekScope instrument for damage, wear, and missing parts. 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 instrument.

Cleaning Procedure — Exterior. To clean the TekScope instrument exterior, perform the following steps:

1. Remove loose dust on the outside of the instrument with a lint free cloth. Use care to avoid scratching the clear plastic display filter.
2. Use a soft cloth or paper towel dampened with water to clean the instrument. You can use a 75% isopropyl alcohol solution for more efficient cleaning.



CAUTION. To avoid damage to the surface of the TekScope instrument, do not use any abrasive or chemical cleaning agents.

Inspection — Interior. During normal use, the TekScope instrument case seals the internal components against common dust and dirt. However, if it appears that the instrument may have been damaged or has been exposed to an unusually dirty or wet environment, you should inspect and clean the interior.

To inspect and clean the interior, disassemble the instrument according to the procedure *Complete Disassembly* on page 6–23.

Inspect the internal portions of the instrument for damage and wear using Table 6–1 as a guide. Defects found should be repaired immediately.

Table 6–1: Internal inspection check list

Item	Inspect For	Repair Action
Front and Back Cover	Cracks or deformations. Scratched lettering or display filter. Loose connectors or labels.	Repair or replace defective hardware.
Hole Plugs, Gasket and Foam Pads	Misplaced or missing pieces.	Relocate or replace defective pieces.
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.

Table 6–1: Internal inspection check list (Cont.)

Item	Inspect For	Repair Action
Solder connections	Cold solder or rosin joints.	Resolder joint and clean with isopropyl alcohol.
Wiring and cables	Loose plugs or connectors. Burned, broken, or frayed wiring.	Firmly seat connectors. Repair or replace modules with defective wires or cables.

Cleaning Procedure — Interior. To clean the TekScope instrument 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.)

STOP. If, after performing steps 1 and 2, a module is clean upon inspection, skip steps 3 and 4. Proceed with step 5.

If steps 1 and 2 do not remove all the dust or dirt, all modules in the instrument except the Display Module may be spray washed using a solution of 75% isopropyl alcohol. Proceed with step 3.

3. Spray wash dirty parts with the 75% isopropyl alcohol solution and wait 60 seconds for the majority of the alcohol to evaporate.
4. Use hot (49° C to 60° C / 120° F to 140° F) deionized water to thoroughly rinse the parts.
5. Dry all parts with low-pressure, deionized air.
6. Dry all components and assemblies in an oven or drying compartment using low-temperature (52° C to 66° C / 125° F to 150° F) circulating air.

Lubrication. There is no periodic lubrication required for the TekScope instrument.

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 6–5 describes where to locate a list of replaceable modules.
- *Summary of Procedures* on page 6–6 lists the procedures for removal and installation of modules.
- *Tools Required* on page 6–7 describes the tools needed to perform the procedures.
- *Tilt Stand*, on page 6–8, begins a series of procedures that describe the removal and installation of modules.

Preparation

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



WARNING. Only qualified personnel should perform service procedures. 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 6–1.

1. Read the *Summary of Procedures* on page 6–6 to understand which procedure to use to access a given module. Then read *Tools Required* on page 6–7 for a list of tools needed to remove and install modules in the TekScope instrument.
2. If you are disassembling the TekScope instrument for cleaning, refer to the *Inspection and Cleaning* procedure on page 6–2 for cleaning instructions.

List of Modules

The *Mechanical Parts List* chapter 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

Table 6–2 lists the removal and installation procedures in order of increasing complexity.

Table 6–2: Removal and installation procedures

Procedure	Modules Accessed	Begins on Page
Tilt Stand	Tilt stand	6–8
Front-Panel Label	Front-panel label	6–10
Front Cover	Front cover Display shield Switch mat Gasket Handle Battery door Screws	6–11
Display Module	Display module Inverter board	6–16
Back Cover	DC power hole plug I/O port hole plug Back cover / back label / battery contact assembly	6–19
Complete Disassembly	Chassis / BNC connectors / banana jacks Main board Switch flex-circuit assembly Display cable Inverter board cable Foam pad set ²	6–23

² Some pieces in the foam pad set are accessed by the Front Cover and Back Cover procedures.

Tools Required

You will need the following tools to remove and replace all the modules in the TekScope instrument.

- Torque-limiting screwdriver, 12 in · lb (1.3 N · m) range with Torx® T-15 tip
- Screwdriver with $\frac{1}{4}$ inch flat blade
- Screwdriver with $\frac{1}{8}$ inch flat blade
- Needle-nose pliers
- Sharp knife (X-ACTO® knife or equivalent)

Tilt Stand You will need a $\frac{1}{4}$ inch flat-bladed screwdriver to remove the tilt stand.

STOP. You do not have to remove the tilt stand to access internal modules. In most cases, you do not have to remove the tilt stand to clean the TekScope instrument exterior.

Removal. Use this procedure to remove a defective tilt stand.

1. Place the TekScope instrument face down on a soft surface (such as an anti-static mat).
2. Insert the $\frac{1}{4}$ inch flat-bladed screwdriver into the gap between the tilt stand and instrument case as shown in Figure 6-1.
3. Twist the screwdriver gently to release one side of the tilt stand from the instrument case. Take care not to damage the case.

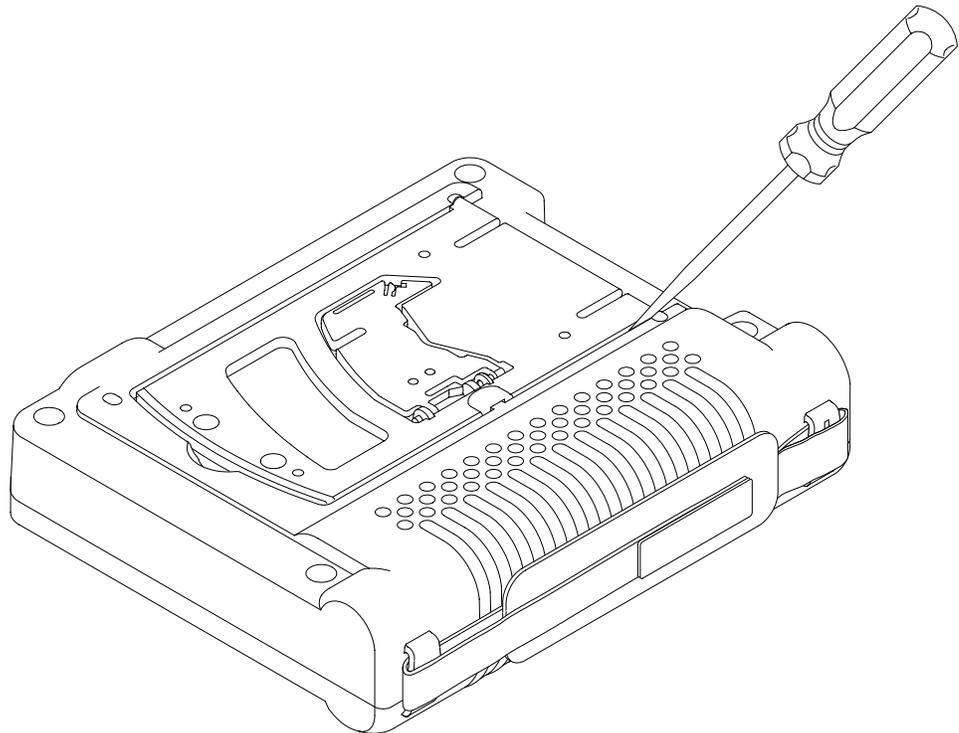


Figure 6-1: Removing the tilt stand

Installation. Use this procedure to install a new tilt stand.

1. Orient the tilt stand to the back of the instrument case with the hinge pins toward the top and the side bump toward the handle.
2. Insert one hinge pin into its socket and place the other into the cavity in the back of the instrument case as shown in Figure 6–2.
3. Rotate the tilt stand to slide the second hinge pin upward and into its socket.

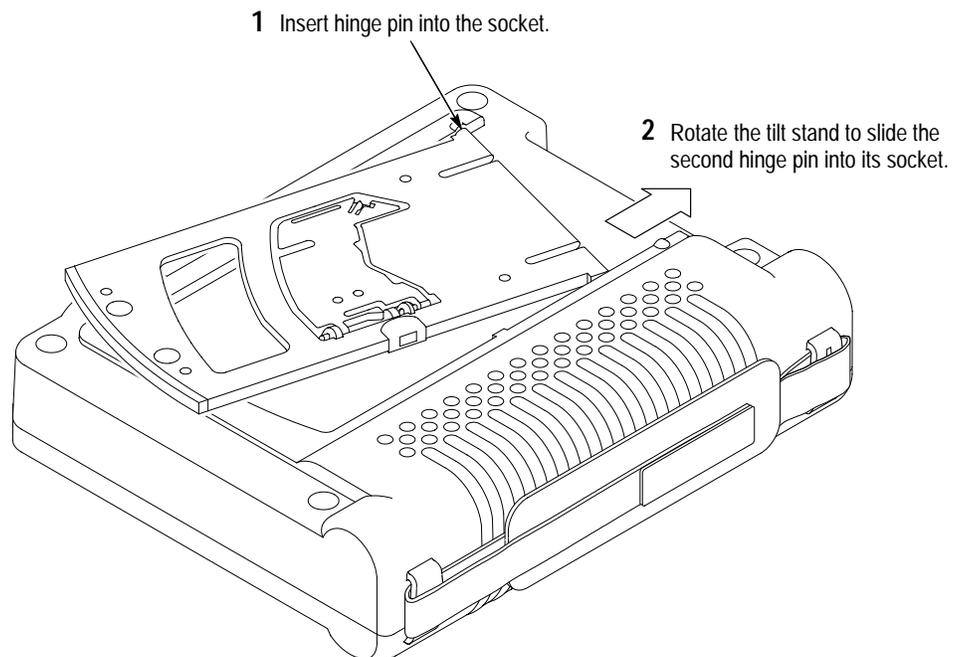


Figure 6–2: Installing the tilt stand

Front-Panel Label

You will need a sharp knife and needle-nose pliers to remove a defective front-panel label.



CAUTION. Removal of a front-panel label will destroy it. Do not remove it unless it is defective and needs to be replaced.

Removal. Use this procedure to remove a defective front-panel label.

1. Use the sharp knife to pry up a corner of the label.
2. Use the needle-nose pliers to peel the label off.

Installation. Use this procedure to install a new front-panel label in either a new or the existing front cover.

1. Peel the paper off the back side of the new label.
2. Handling the label by its edges only, align it with the recess in the front cover as shown in Figure 6–3.
3. When properly aligned, press the new label into place.

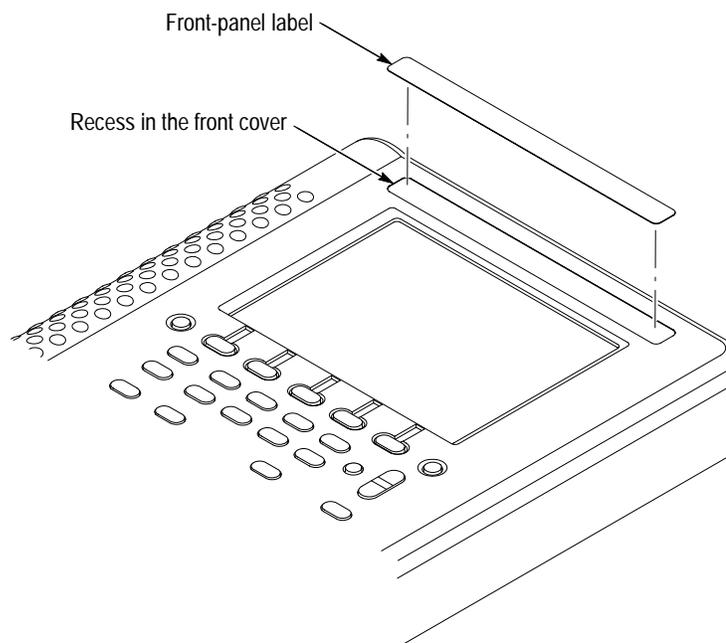


Figure 6–3: Installing a new front-panel label

Front Cover

You will need a torque-limiting Torx® T-15 screwdriver, needle-nose pliers, and sharp knife to remove the front cover and other immediately accessible modules.



CAUTION. Attempting to remove the display shield from the front cover will likely destroy both pieces. If one or the other are defective, both must be replaced.

Removal. Use this procedure to remove the front cover and access the handle, switch mat, battery door, and gasket.

1. Disconnect all probes, cables, or meter leads from the instrument.
2. Disconnect the AC adapter, open the battery door, and remove the battery.
3. Place the TekScope instrument face down on a soft surface (such as an anti-static mat).
4. Use the Torx® T-15 screwdriver to remove the four screws that hold the case together.
5. Holding the case together, pick it up and place it back side down on a soft surface.
6. As you lift the front cover off the instrument, press the buttons as necessary to prevent the switch mat from coming off with the front cover.
7. To remove the handle, slip it off its guides.
8. To remove the switch mat, lift it off the switch flex-circuit assembly. Place it button-side down on a clean surface.



CAUTION. To avoid contamination of switch contacts, do not touch the carbon contacts on the switch flex-circuit assembly or on the back side of the switch mat.

9. To remove the battery door, use the needle-nose pliers to slip the retaining tether off of the post inside the instrument case as shown in Figure 6-4.

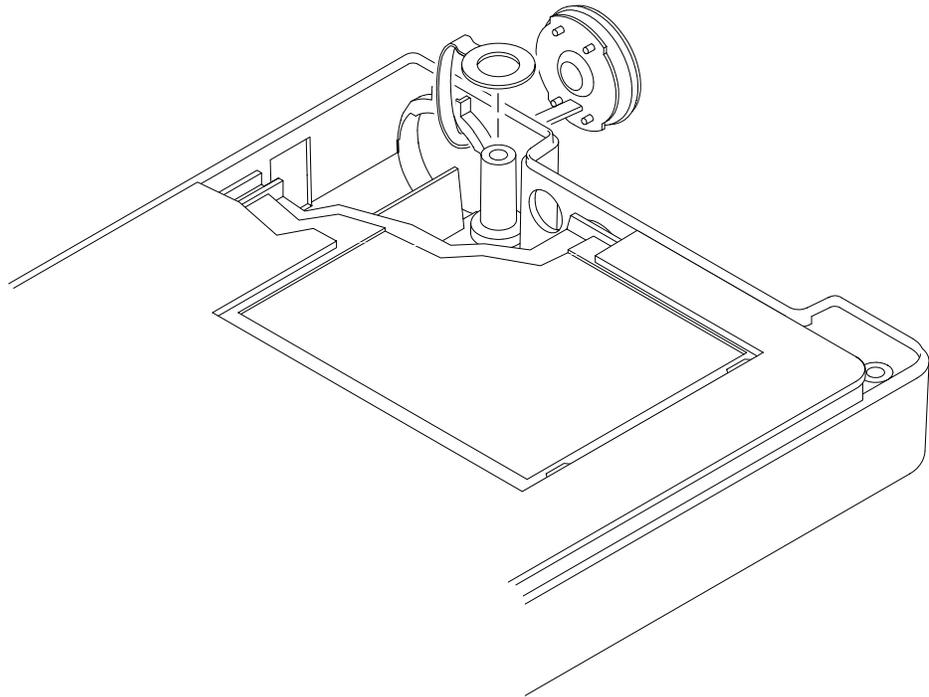


Figure 6-4: Removing the battery door

NOTE. In most cases, the gasket does not have to be removed from the front cover for interior cleaning.

- 10.** To remove the gasket from the front cover, use the needle-nose pliers to lift it out of the groove in the front cover, starting with the accessible tail at the bottom of the front cover.

Installation. Use this procedure to install the battery door, switch mat, handle, gasket, and front cover.

- 1.** Place the TekScope instrument back side down on a soft surface (such as an anti-static mat).
- 2.** To install the battery door, pass the retaining tether through the battery opening from the outside and then use the needle-nose pliers to slip the retaining strap onto the post (see Figure 6-4).
- 3.** To install the switch mat, place it (contact side down) on the switch flex-circuit assembly. The five rubber guideposts fit into holes in the circuit board.

4. If you are installing a new front cover, follow these steps to assemble it before installation. Refer to Figure 6-5.
 - a. Install a new label using the procedure on page 6-10.
 - b. Install a new display shield into the inside of the new front cover. Remove the backing paper from the adhesive on the display shield, align it over the two diagonal posts, and then press it into place. The blue border should be even when viewed from the face of the front cover.
 - c. Install new foam pad as shown in Figure 6-5.

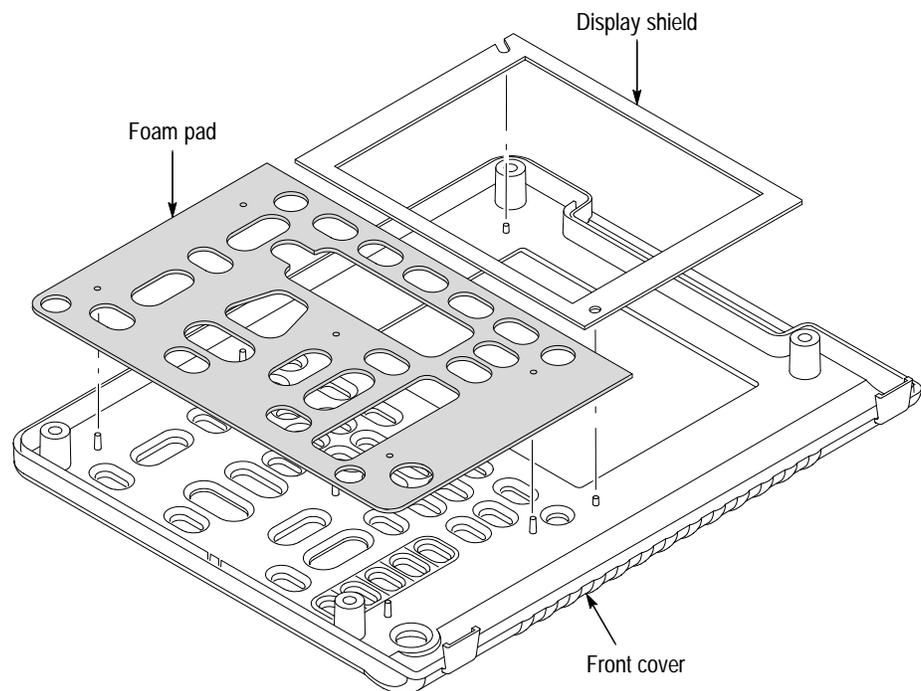


Figure 6-5: Assembling a new front cover

- d. Install a new gasket into the groove around the edge of the front cover. As shown in Figure 6-6, start the gasket at the bottom of the cover leaving a short ($\frac{1}{8}$ inch) tail through the slot. Carefully press the gasket into place around the rim with the $\frac{1}{8}$ inch flat-bladed screwdriver. To finish the installation, overlap the starting point and then pass the end of the gasket through the remaining slot. Trim the ending tail to $\frac{1}{8}$ inch length with the sharp knife.

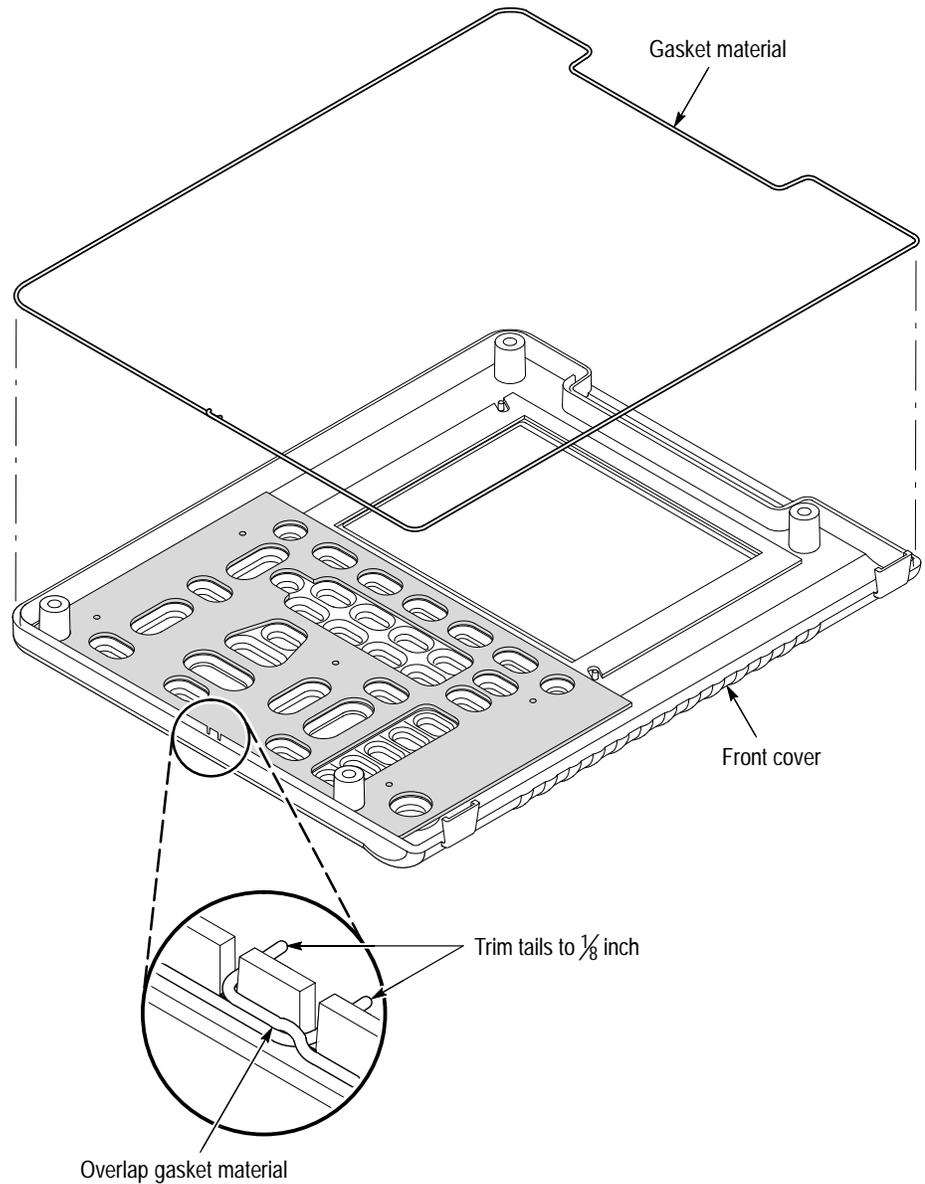


Figure 6-6: Installing the gasket

5. Slip the handle into the guides of the back cover as shown in Figure 6-7.
6. Place the front cover assembly onto the instrument. Taking care not to pinch the handle, align it into the guides in the front cover. Align the buttons so they all protrude through the holes in the front cover.
7. Holding the case together, pick it up and place it front side down on a soft surface.

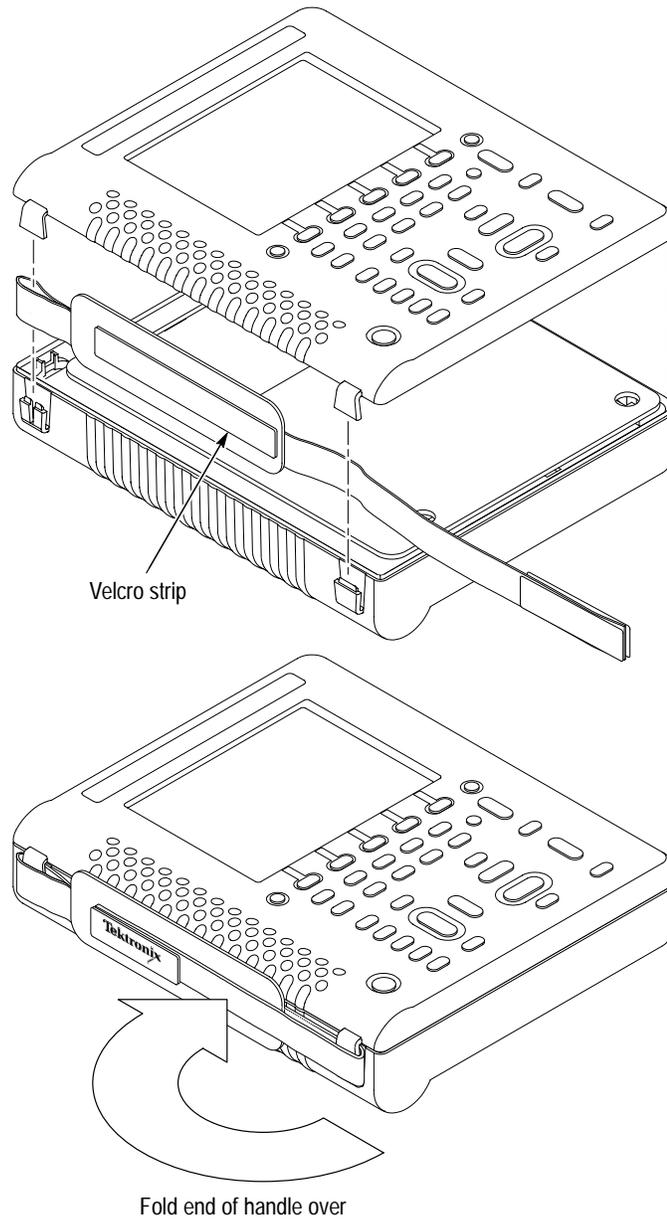


Figure 6-7: Installing the handle



CAUTION. To avoid cross-threading or cutting new threads with the screws, carefully follow the procedure in the next step.

8. To install the four screws, follow these steps:
 - a. Place the screws into their holes in the back cover.
 - b. Using the torque-limiting Torx® T-15 screwdriver, slowly turn each screw backward (counterclockwise) until you feel the thread drop and then gently tighten the screw (turn clockwise) into the existing thread.
 - c. When all four all screws are in, hold a corner of the case together firmly to compress the gasket while tightening its screw until snug. Repeat for the other corners. Do not overtighten the screws (12 in · lbs or 1.m N · m maximum torque).
9. Replace the battery as shown on page 2–2, and then close the battery door.

Display Module

You will need a $\frac{1}{8}$ inch flat-bladed screwdriver to remove the display module and inverter board.

Removal. First remove the front cover and switch mat using the procedure on page 6–11. Then, use the following procedure to remove the display module and inverter board.

1. Fold the switch flex-circuit assembly toward you to expose the display module and inverter board.



CAUTION. To avoid scratching the surface of the display module, do not let it touch any hard object.

The display module surface may scratch easily. To clean it, first try pressurized air. If a soft cloth is required to clean it, use very light pressure.

2. To remove the inverter board, unplug the input and output connectors and then lift the inverter board off the two guideposts. You may want to use the $\frac{1}{8}$ inch flat-bladed screwdriver to help release the connectors from their sockets.
3. To remove the display module, follow these steps:
 - a. Disconnect the cable from the display module to the inverter board, if it is not already disconnected.
 - b. Lift the right side of the display module out of the chassis and fold the display module to the left, as shown in Figure 6–8.

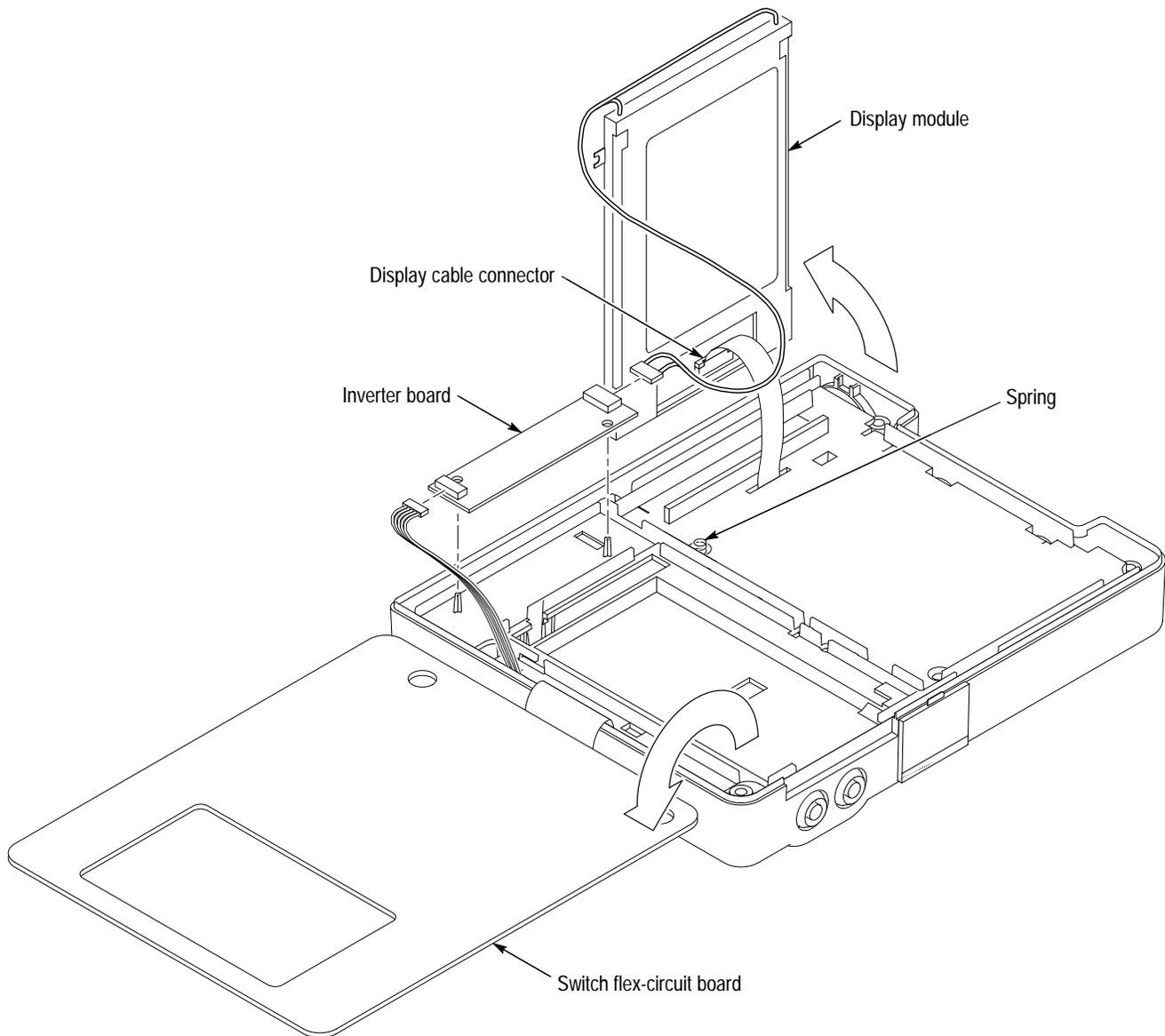


Figure 6–8: Removing the display module

- c. Using the $\frac{1}{8}$ inch flat-bladed screwdriver, carefully open the display-cable connector as shown in Figure 6–9.
- d. When the connector is open, slip the display cable out of the connector to free the display module.

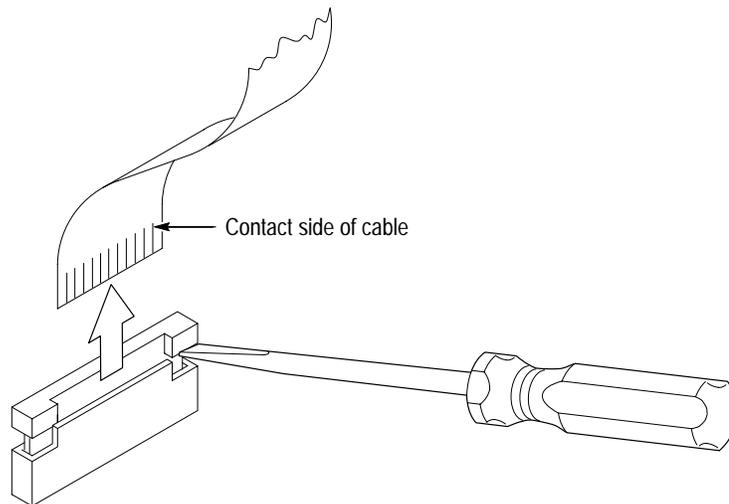


Figure 6-9: Opening the display cable connector

Installation. Use this procedure to install the display module and inverter board.

1. Open the display-cable connector on the back of the display module.
2. Hold the display module upright as shown in Figure 6-8.
3. Insert the display cable into its connector and then use the $\frac{1}{8}$ inch flat-bladed screwdriver to close the connector. Check that the display cable is fully inserted into the connector.
4. Fold the display module back into the chassis and seat it between the foam pads.
5. Plug the cable from the display module into the inverter board and then route the cable in the channels as shown in Figure 6-10.
6. Place the inverter board into its cavity over the guideposts in the chassis.
7. Reconnect the connector to the bottom of the inverter board and route the wires as shown in Figure 6-10.
8. If you just installed a new display module, peel off the protective plastic sheet.
9. Fold the switch flex-circuit assembly back over the display module and inverter board.
10. Install the switch mat and front cover using the procedure on page 6-12.

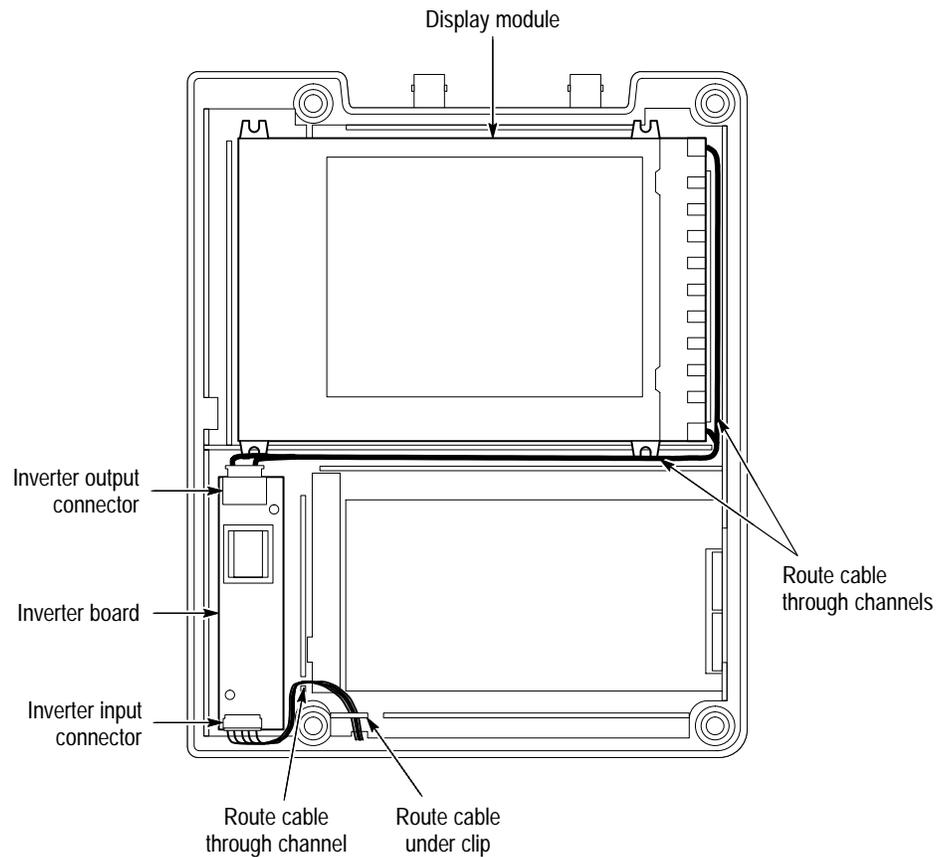


Figure 6–10: Routing cables to the inverter board

Back Cover

You will need a $\frac{1}{8}$ inch flat-bladed screwdriver and needle-nose pliers to remove the chassis assembly and hole plugs from the back cover.

NOTE. The back labels and battery contacts are an integral part of the back cover. If any of these parts are defective, the back cover must be replaced.

Removal. First remove the front cover and switch mat using the procedure on page 6–11. Then, use the following procedure to remove the chassis assembly.

1. Place the instrument back-side down on a soft surface.
2. Lift the battery connector, located on the handle-side of the chassis, off its retaining pins and disconnect the connector.
3. Insert the $\frac{1}{8}$ inch flat-bladed screwdriver between the back cover and chassis at the location shown in Figure 6–11.

4. Carefully lift the bottom of the chassis out of the back cover. As the chassis assembly comes out, pull it toward you to back the BNC connectors out of their holes in the back cover.

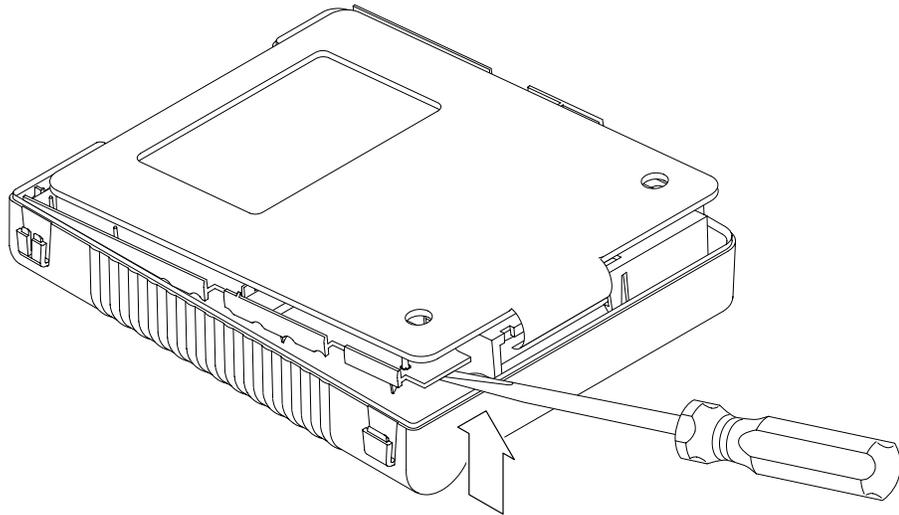


Figure 6–11: Lifting the chassis

5. When the chassis is free from the back cover, set it aside with the main board facing down on a soft, static-free surface.
6. To remove a defective DC power hole plug or I/O port hole plug, follow these steps:
 - a. From the outside of the back cover, pull on the hole plug.
 - b. From the inside of the back cover, use the $\frac{1}{8}$ inch flat-bladed screwdriver to work each retaining tab out of its hole in the back cover.

Installation. Use this procedure to install the hole plugs and chassis assembly into the back cover.

1. To install a new hole plug, insert the retaining tabs into their holes in the back cover. While pushing on the plug from the outside, pull gently on the tabs from the inside with the needle-nose pliers until they lock into place.
2. To install the chassis assembly into the back cover, follow these steps:
 - a. If the instrument was completely disassembled, check that the chassis is properly assembled.
 - b. Check that all foam pads inside the back cover are correctly installed. Refer to Figure 6–12 for the correct locations.

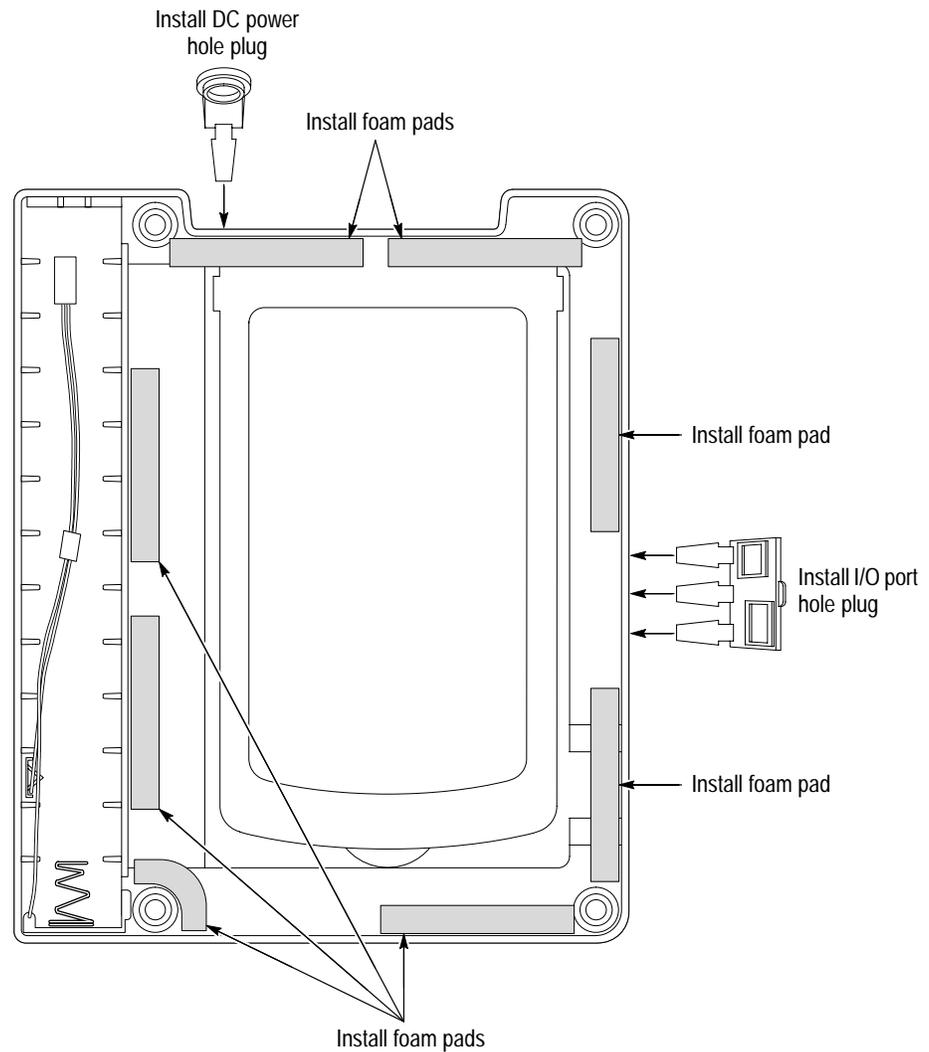


Figure 6-12: Foam pad and hole plug locations on the back cover

- c.** Place the back cover on a soft surface with the BNC connector openings facing away from you.
 - d.** Dress the battery wires to the left side of the back cover to provide clearance for the chassis.
 - e.** While inserting the BNC connectors into their openings, lower the chassis into the back cover.
 - f.** Reconnect the battery wire connector and press it onto its retaining pins. Check that the polarity of the connector is correct. Dress the wires into the channel on the chassis as shown in Figure 6-13.
- 3.** Install the switch mat and front cover using the procedure on page 6-12.

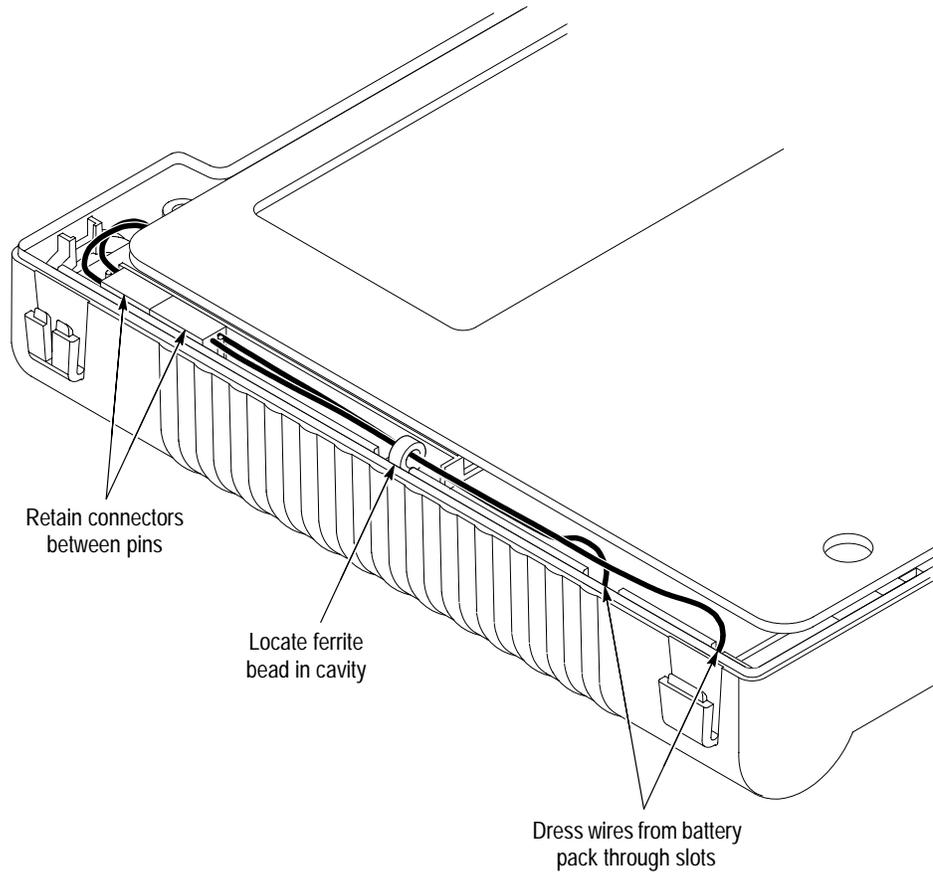


Figure 6-13: Routing the battery wires

Complete Disassembly

You will need a $\frac{1}{8}$ inch flat-bladed screwdriver and needle-nose pliers to remove modules mounted to the the chassis.

Removal. First, remove the front cover and switch mat using the procedure on page 6–11. Next, remove the chassis assembly using the procedure on page 6–19. Then, use the following procedure to disassemble the chassis.

STOP. *If you are disassembling only for cleaning, inspect the chassis assembly to determine whether further disassembly is required to perform internal cleaning. If so, then proceed.*

1. Remove the display module and inverter board using the procedure on page 6–16.
2. With the switch flex-circuit assembly folded toward you, place the chassis assembly on a soft, static-free surface with the main board side facing up.
3. To remove the main board and switch flex-circuit assembly from the chassis, follow these steps:
 - a. Use the needle-nose pliers to remove both coaxial connectors from the back side of the BNC connectors. Be careful not to crush the cable.
 - b. Use the $\frac{1}{8}$ inch flat-bladed screwdriver to open the display cable connector on the main board and then disconnect the display cable. Refer to Figure 6–9 on page 6–18 if necessary.
 - c. Dress the battery cable outward to free it from obstructions.
 - d. Following the sequence (circled numbers) shown in Figure 6–14, lift gently on the edges of the main board while releasing the board-retaining snaps.



CAUTION. *To prevent damage to the flex circuit, take care not to twist the flex circuit at its connection to the main board.*

- e. When all six snaps are released, lift the main board and switch flex-circuit assembly out of the chassis enough to access the back side of the banana jacks.
- f. Use the needle-nose pliers to remove both wires from the back side of the banana jacks. Be careful not to deform the connectors attached to the wires.
- g. Complete the removal of the main board and switch flex-circuit assembly and then place it on a soft, static-free surface with the two metal shields facing up.

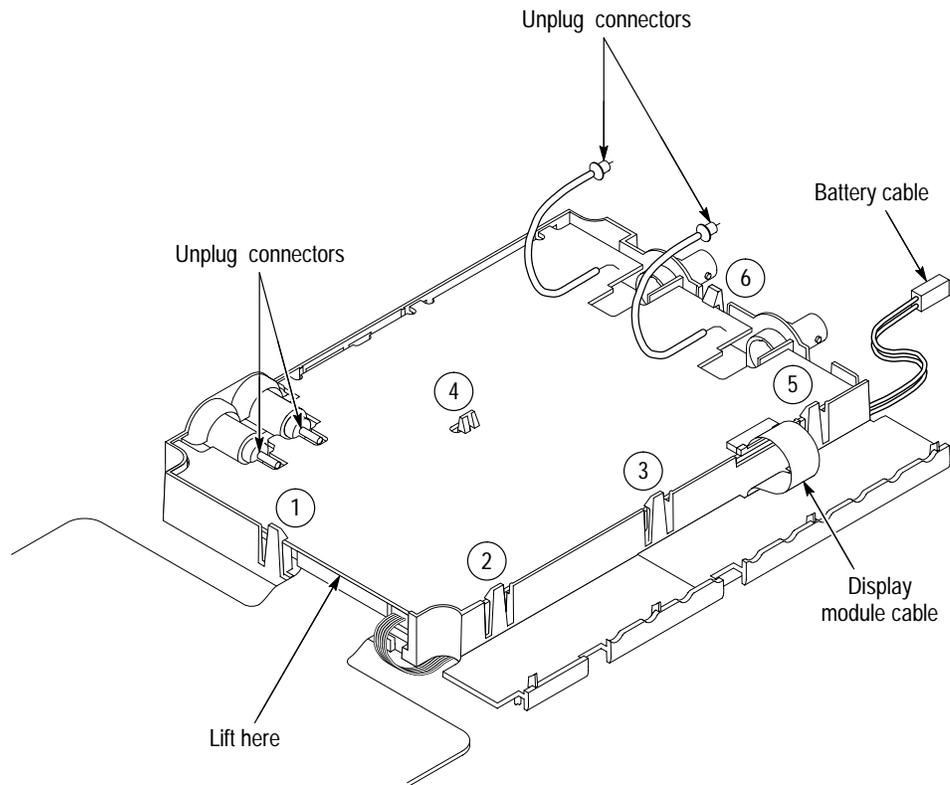


Figure 6-14: Removing the main board and switch flex-circuit assembly

4. To remove the switch flex-circuit assembly from the main board, follow these steps:
 - a. With the main board laying flat from the previous step, raise the switch flex-circuit assembly to an upright position.
 - b. While holding the flex-circuit assembly upright, use both thumbs and forefingers to grasp the left and right sides of the connector.
 - c. Carefully, alternate pulling on the left and right sides of the connector to work it out of its socket. Do not pull one side out much farther than the other or bent pins may result.
5. To remove the inverter board cable from the main board, unplug it.

NOTE. The BNC connectors and banana jacks are an integral part of the chassis. If any of these connectors are defective, the chassis must be replaced.

Installation. Use this procedure to reassemble the entire instrument.

1. Check that the ten foam pads on the chassis are correctly installed. The foam pads that surround the display module should be aligned to locating marks in the chassis. Refer to Figure 6–15 for the locations of all the foam pads.

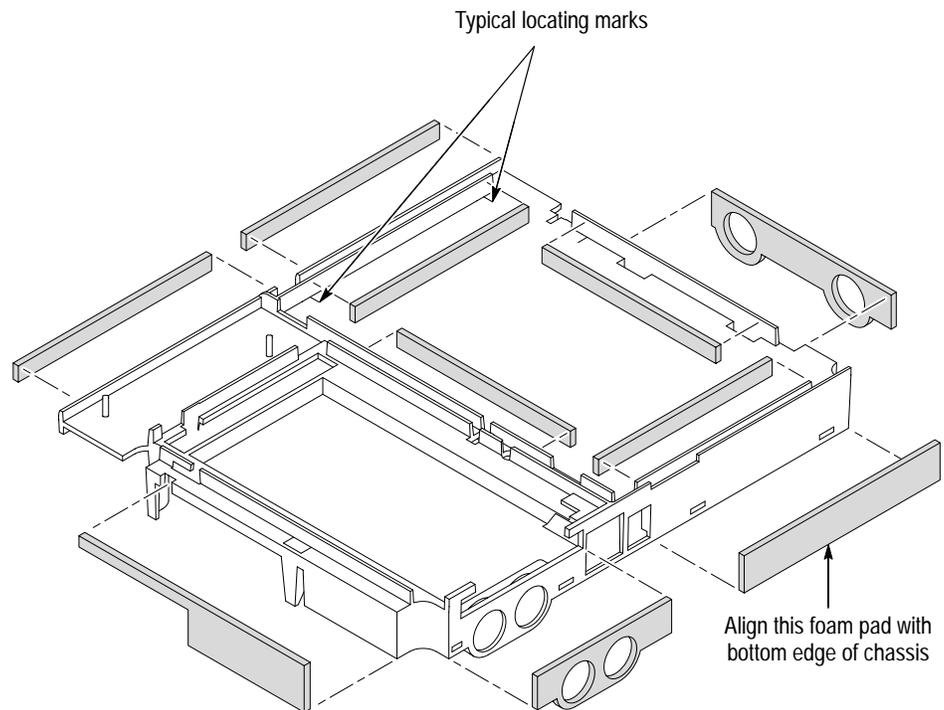


Figure 6–15: Foam pad locations on the chassis

2. Place the main board on a soft, static-free surface with the two metal shields facing up and away from you.
3. Install the inverter board cable (either end) into its connector (J7) on the main board.
4. To reconnect the switch flex-circuit assembly to the main board, follow these steps:
 - a. Hold the switch flex-circuit assembly upright with the carbon contacts facing you.
 - b. Use both thumbs and forefingers to grasp the left and right sides of the connector.
 - c. From both sides, push the connector into its socket. You may need to alternate pushing on the left and right sides to insert the connector.

5. To prepare the main board and switch flex circuit board for installation into the chassis, follow these steps:
 - a. Fold the switch flex-circuit assembly toward you.
 - b. Dress the battery wires away from you.
 - c. Dress the two coaxial cables that will connect to the BNC connectors to a position under the main board.
 - d. Dress the two wires that will connect to the banana jacks to a position under the main board.
6. To install the main board and switch flex-circuit assembly into the chassis, follow these steps:
 - a. Place the chassis on a soft, static-free surface with the BNC connectors facing away from you and the banana jacks facing left.
 - b. Lift the main board and switch flex-circuit assembly together and turn them over keeping the switch flex-circuit assembly facing you.
 - c. Place the main board and switch flex-circuit assembly on the chassis so that you can attach the two wires to the back of the banana jacks.
 - d. Use the needle-nose pliers to attach both wires to the back side of the banana jacks. Be careful not to deform the connectors attached to the wires. Dress the wires so that they will fit between the main board and the chassis.
 - e. Insert the four tabs on the left side of the main board into their rectangular holes in the chassis as shown in Figure 6-16.
 - f. While lowering the right side of the main board, dress the battery wires into the slot in the chassis.
 - g. When the main board is lowered in place, snap it into the six retaining snaps of the chassis.
 - h. Use the needle-nose pliers to insert both coaxial connectors into the back side of the BNC connectors. Be careful not to crush the cable or bend the center conductor.

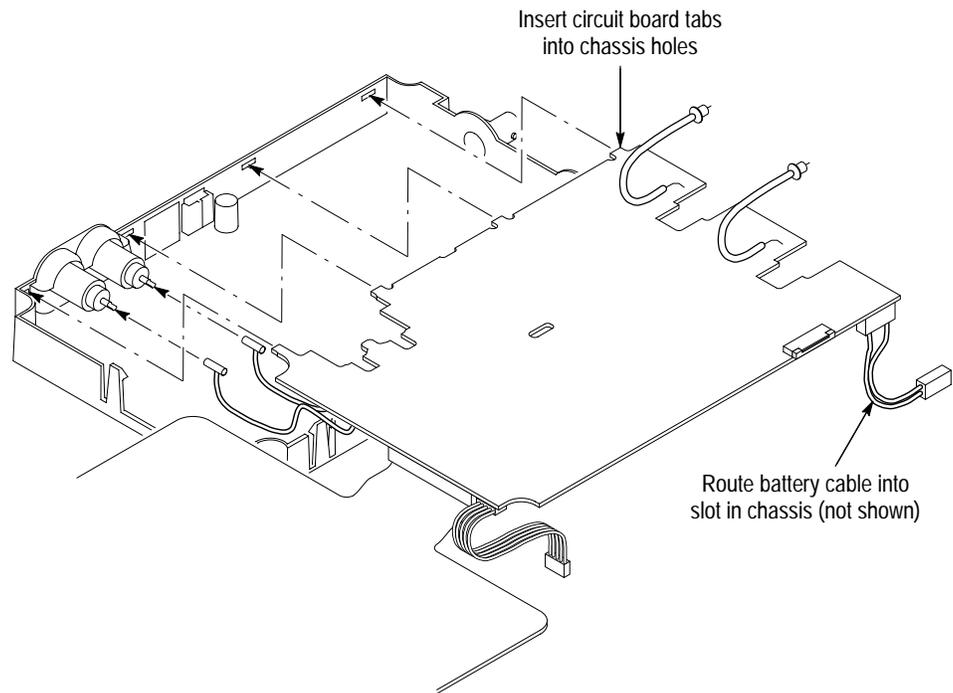


Figure 6-16: Reassembling the chassis

7. To install the display cable, follow these steps:
 - a. Use the $\frac{1}{8}$ inch flat-bladed screwdriver to open the connector on the main board.
 - b. With the conductive contacts facing away from the main board, insert the display cable into its connector.
 - c. Use the $\frac{1}{8}$ inch flat-bladed screwdriver to close the connector and then check that the display cable is fully inserted into the connector.
 - d. Dress the display cable down through the slot in the chassis.
8. Turn the chassis assembly over so that the main board is facing down.
9. Install the display module and inverter board using steps 1 through 9 of the procedure on page 6-18.
10. Install the chassis assembly into the back cover using steps 1 and 2 of the procedure on page 6-20.
11. Install the switch mat and front cover using the procedure on page 6-12.
12. If detached, install the tilt stand using the procedure on page 6-9.

This completes the reassembly of the instrument.

Troubleshooting

This section contains information and procedures to help you isolate a defective module in the TekScope instrument.



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 6–1.

Adjustment After Repair

If you replace the main board, you must adjust the instrument after repair. Refer to the chapter *Adjustment Procedures* for information about adjustment.

Required Tools and Equipment

You may need the the following tools and equipment to troubleshoot the instrument.

Tools and Equipment	Example
AC adapter	Standard accessory to TekScope instrument
Battery pack, fully charged	Standard accessory to TekScope instrument
Oscilloscope with 10X probe	Tektronix TDS 300- or TDS 400-series with standard accessory probe
DMM	Tektronix DMM200- or DMM300-series handheld multimeter
1/8 inch flat-bladed screwdriver	Hunter 30312
Metal paper clip	Common office accessory

Begin Here

Begin with these steps to isolate a defective module. Some steps direct you to other procedures in this section.

1. Install a charged battery, connect the AC adapter, and then turn on the TekScope instrument. If (after a short wait) the display backlight turns on and the display appears to operate normally, then skip to *Executing Diagnostics* on page 6–35.
2. If (after a short wait) the display backlight turns on but the display shows any of the following symptoms, turn off the instrument immediately. Skip to *Display* on page 6–33.
 - Display color is dark blue or violet when viewed straight on
 - Display color is abnormal (green or orange) when viewed straight on

- Displayed information is interrupted by static horizontal or vertical lines or stripes
3. If (after a short wait) you can see that the display operates normally but the display backlight does not turn on, then skip to *Backlight* on page 6–32.
 4. If the instrument does not appear to turn on (no display backlight, no sound of relay clicks, no displayed information), then continue with step 5.
 5. Disconnect the AC adapter from the instrument. Remove the front cover using the procedure *Front Cover* on page 6–11.
 6. Reinstall the battery (removed in the *Front Cover* procedure).
 7. Verify that the battery connector is properly connected. See Figure 6–17.



CAUTION. To avoid damage to the battery or battery contacts, be careful not to short the conductors at the battery connector.

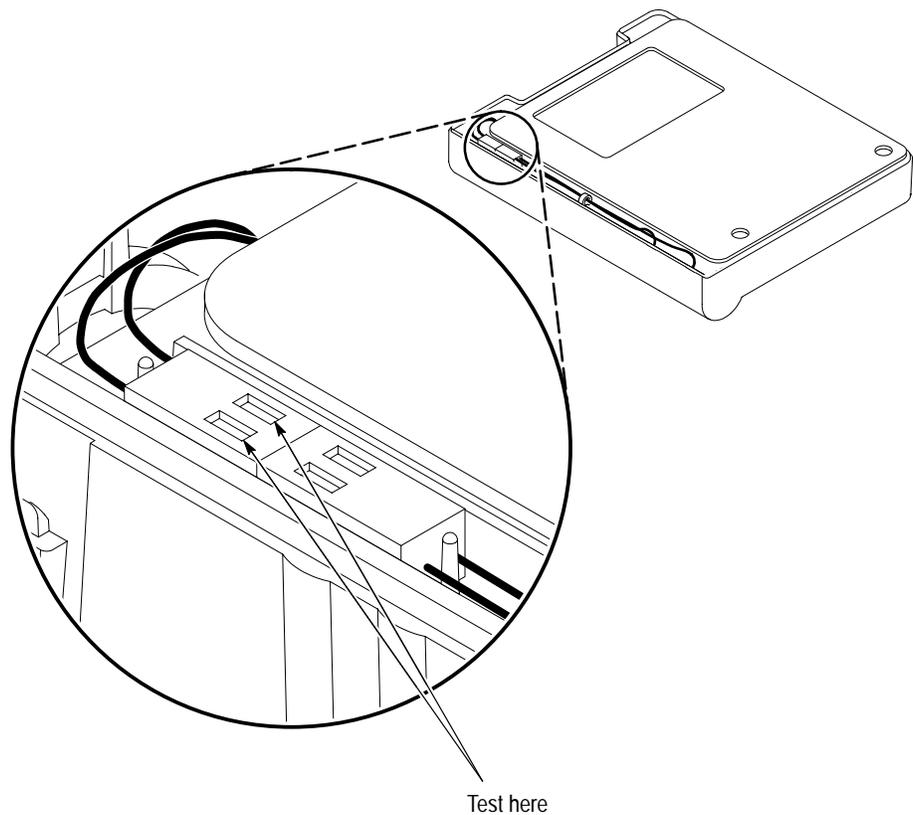


Figure 6–17: Battery connector location

8. With the AC adapter still disconnected, use a DMM to measure the DC voltage at the battery connector. Follow the instructions in the table below.

Voltage Measurement at Battery Connector	Instructions
Approximately 0 V _{DC}	<p>Check that the battery is installed correctly.</p> <p>Remove the battery and measure its voltage. You should measure an open-circuit voltage >4.8 V_{DC} across a fully charged battery.</p> <p>If the battery is charged, the battery contacts inside the back cover are probably defective. Replace the back cover assembly.</p>
Greater than 0 V _{DC} but less than 4 V _{DC}	<p>Remove the battery and measure its voltage. The open-circuit voltage across a good battery should measure >4 V_{DC}, even if not fully charged. If it remains <4 V_{DC}, the battery may be defective. Replace it.</p> <p>If the battery is fully charged (open-circuit voltage >4.8 V_{DC}) but the voltage under load is <4 V_{DC}, the main board is drawing excessive current. Replace the main board.</p>
Greater than 4 V _{DC} (check both mating connectors)	Remove the battery and then proceed with step 9.

9. With the battery removed from the instrument, reattach the AC adapter to the instrument. Measure the DC voltage at the battery connector. Follow the instructions in the table below.

Voltage Measurement at Battery Connector	Instructions
Less than 1 V _{DC}	<p>Check that the AC adapter is connected correctly.</p> <p>Disconnect the AC adapter and measure its output voltage. If the voltage is less than 12 V_{DC}, the AC adapter is probably defective. Replace it.</p>
Greater than 1 V _{DC}	Proceed with step 10.

10. Reinstall the battery. Leave the AC adapter connected to the instrument.
11. Use a 1/8 inch flat-bladed screwdriver to lift the lower edge of the chassis assembly out of the back cover just until the connector from the flex-circuit assembly to the main board is accessible.

12. Using a bent paper clip, momentarily short pins 15 and 17 of the connector to bypass the ON/STBY switch as shown in Figure 6–18. Follow the instructions in the table below.

Instrument Behavior	Instructions
Instrument turns on	Inspect and/or clean the switch flex-circuit assembly and the switch mat. If cleaning does not solve the problem, one or the other are defective. Replace them both.
Instrument does not turn on	The main board is probably defective. Replace it.

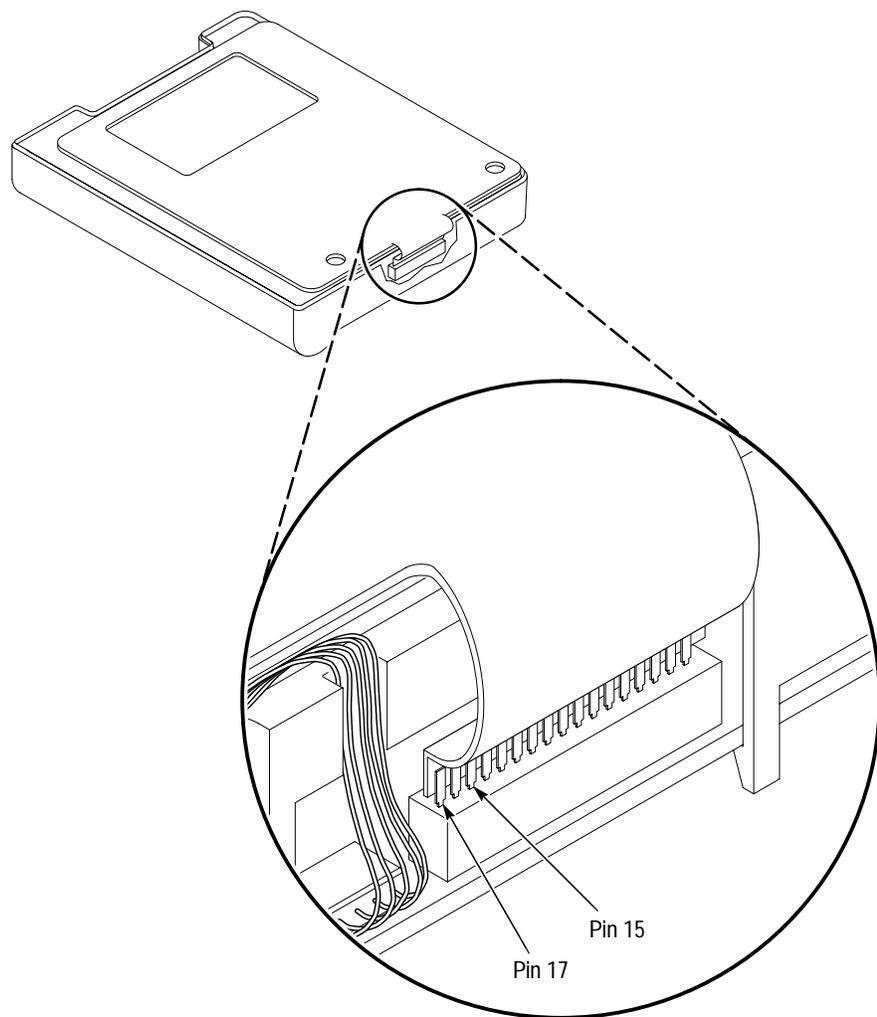


Figure 6–18: Bypassing the ON/STBY switch

Backlight Follow these steps to troubleshoot a nonfunctional backlight.

1. Remove the front cover using the procedure *Front Cover* on page 6–11.
2. Turn the instrument on, remove the switch mat, and then fold the switch flex-circuit assembly toward you to access the inverter board.



WARNING. To avoid electrical shock, do not touch the two-wire output connector of the inverter board. The output connector is the one closest to the display module.

3. Using a DMM, measure the DC voltage across pins 1 and 2 of the input connector on the inverter board. Follow the instructions in the table below.

Voltage Measurement at Inverter Input Connector	Instructions
Approximately 0 V _{DC}	<p>Check that the inverter input cable is properly connected at both ends.</p> <p>Fold the switch flex-circuit assembly back over the instrument. Use a 1/8 inch flat-bladed screwdriver to lift the lower edge of the chassis assembly out of the back cover until you access the edge of the main board.</p> <p>Remove the inverter input cable from the main board. Measure the DC voltage on pins 1 and 2 of the connector on the main board.</p> <p>If the measured voltage is approximately 12 V_{DC}, the inverter input cable is defective. Replace it.</p> <p>If the measured voltage is approximately 0 V_{DC}, the main board is probably defective. Replace it.</p>
Approximately 12 V _{DC}	Proceed with step 4.

4. Using an oscilloscope and 10X probe, attach the probe ground lead to the ground terminal on the right side of the instrument. Set the oscilloscope time base to 1 ms/div and vertical sensitivity to 1 V/div.

NOTE. The inverter output voltage is approximately a 250 V_{RMS}, 40 kHz sine wave. Capacitive coupling to the oscilloscope probe tip is sufficient to determine if the inverter output voltage is present.

5. Hold the probe tip above the output connector of the inverter board. Do not touch the probe tip to either of the conductors in the connector. Follow the instructions in the table below.

Oscilloscope Display	Instructions
No signal displayed	The inverter board is probably defective. Replace it.
Approximately 40 kHz sinewave displayed	The display module is probably defective. Replace it.

Display Follow these steps to troubleshoot a nonfunctional display.

1. Remove the front cover using the procedure *Front Cover* on page 6–11.
2. Remove the display module and inverter board using the procedure *Display Module* on page 6–16.
3. Fold the switch flex-circuit board back over the instrument and reinstall the switch mat.
4. Connect the AC adapter to the instrument
5. Turn the instrument on, remove the switch mat, and then fold the switch flex-circuit assembly toward you to access display cable.

NOTE. Without the display module installed, the simplest way to verify that the instrument is on is to probe the PROBE COMP output with an oscilloscope. If the instrument is on, the PROBE COMP output generates approximately a 5 V, 1.2 kHz squarewave.

6. Use an oscilloscope and 10X probe to probe the contacts on the loose end of the display cable. The table below describes the signals you should expect to see. If some or all of the signals are not present, then skip to step 9.

Signal at Loose End of Display Cable	Description
Pin 1 (closest to bottom of instrument)	No signal, might appear noisy
Pin 2	No signal, might appear noisy
Pin 3	Digital data, high = 5 V, low = 0 V
Pin 4	Digital data, high = 5 V, low = 0 V
Pin 5	Digital data, high = 5 V, low = 0 V
Pin 6	Digital data, high = 5 V, low = 0 V

Signal at Loose End of Display Cable	Description
Pin 7	-10 V _{DC} to -22 V _{DC}
Pin 8	0 V (ground)
Pin 9	+5 V _{DC}
Pin 10	1.89 MHz clock (528 ns period), ≈ 50% duty cycle, appears in bursts, high = 5 V, low = 0 V
Pin 11	19.3 kHz clock (51.7 μs period), ≈ 16% duty cycle, high = 5 V, low = 0 V
Pin 12 (closest to BNC end of instrument)	75.5 Hz clock (13.2 ms period), ≈ 0.4% duty cycle, high = 5 V, low = 0 V

7. If all the signals are present on the loose end of the connector, turn the instrument off and then reinstall the display module using the procedure on page 6–18.
8. Turn the instrument on. If the problem persists, the display module is probably defective. Replace it.
9. Remove the chassis assembly from the back cover using the procedure *Back Cover* on page 6–19.
10. Place the chassis assembly on a soft, static-free surface with the main board facing up and the switch flex-circuit assembly folded out toward you. Install the switch mat on the switch flex-circuit assembly.
11. Check, and if necessary, reconnect the display cable connection to the main board. Inspect the display cable for any sign of damage; if damage is evident, replace it.
12. Connect the AC adapter to the instrument and turn it on. Verify that the instrument is on by probing the PROBE COMP output.
13. Probe the display signals at the display connector of the main board as was done in step 6.
14. If some or all of the signals are not present at the main board display connector, the main board is probably defective. Replace it.

Executing Diagnostics

Follow these steps to troubleshoot using diagnostics.

1. To execute the internal diagnostic tests, remove all input signals from the instrument and then perform the following steps:

 METER  SCOPE			
SCOPE	UTILITY	System	Diag
		Loop	Once
		Execute	—
		OK Run Test	

2. A dialog box displays the result when the diagnostic tests completes. If any test fails, the main board is probably defective. Replace it.
3. If all tests pass, press the **CLEAR MENU** button to continue operation.
4. You should be able to compensate the signal path of a functioning instrument. To execute Signal Path Compensation, remove all input signals from the instrument and then perform the following steps:

 METER  SCOPE			
SCOPE	UTILITY	System	Cal
		Signal Path	—
		OK Compensate Signal Paths	

5. If Signal Path Compensation does not complete successfully, perform the Factory Cal Scope adjustment on page 5–5 and then repeat step 4.
6. If all tests pass, press the **CLEAR MENU** button to continue operation.
7. If trouble persists, proceed to *Input Connections*.

Input Connections

Follow these steps to troubleshoot the input connections only if the following condition is true: the instrument appears to function normally in every way except you have determined that the channel 1, channel 2, or DMM signal is not getting into the instrument as expected.

1. Remove the front cover using the procedure *Front Cover* on page 6–11.
2. Remove the chassis assembly from the back cover using the procedure *Back Cover* on page 6–19.
3. Check that the coaxial connections to the back side of the channel 1 and channel 2 BNC connectors are intact. Use the DMM to measure continuity from the BNC connector to the end of the coaxial cable where it attaches to the main board.
4. Check that the wire connections to the back side of the DMM and COM banana jacks are intact. Use the DMM to measure continuity from the banana jacks to the end of the wire where it attaches to the main board.
5. If no problem is found and the trouble persists, the main board is probably defective in some way that the internal diagnostics cannot detect. Replace it.

Other Troubleshooting Use these techniques to troubleshoot other parts of the instrument.

Buttons. Press each of the front-panel buttons to verify that it operates properly. The table below lists the buttons that depend on a particular instrument state for you to see an effect when the button is pressed. Unless noted otherwise, the instrument should be in scope mode for this test.

Button	Precondition	Expected Behavior
HARD COPY	None	With no connection to the RS-232 port, a message will appear approximately 10 seconds after HARD COPY is pressed
Any bezel button	Press DISPLAY first	Displays pop-up menu
CLEAR MENU	Press DISPLAY first	Removes menu
SCOPE	Press METER first	Changes to scope mode
+/- Rocker	Press CURSOR and then choose Function V Bars first	Cursor moves
TOGGLE	Press CURSOR and then choose Function V Bars first	Changes active cursor
WAVEFORM OFF	Press CH 1 first	Removes waveform
VERTICAL MENU	Press CH 1 first	Displays menu
VOLTS/DIV	Press CH 1 first	Changes sensitivity
VERTICAL POSITION	Press CH 1 first	Repositions waveform
TRIGGER LEVEL	Press CH 1 first	Changes trigger level
SET LEVEL TO 50%	Adjust TRIGGER LEVEL first	Resets trigger level

If any button fails to operate, inspect and/or clean the switch flex-circuit assembly and the switch mat. If cleaning does not solve the problem, the switch flex-circuit assembly, switch mat, or main board may be defective. Use the procedure below to isolate the problem:

1. Replace the switch flex-circuit assembly and then retest the buttons. If the problem persists, proceed to step 2.
2. Replace the switchmat and then retest the buttons. If the problem persists, proceed to step 3.
3. Replace the main board.

PROBE COMP Output. When the instrument is on, the PROBE COMP output should generate a square wave, approximately 5 V in amplitude, at a 1.2 kHz frequency. Use the oscilloscope and a 10X probe to probe this output. If the signal is not present, the main board is probably defective. Replace it.

RS-232 Port. Verify that the RS-232 port operates properly. The easiest way to test the port is to make a hard copy with a compatible printer and RS-232 cable. To prepare to make a hard copy, verify the following statements:

- The printer is compatible with one of the supported formats: Deskjet, DPU 411/II, DPU 412, Epson 9-pin, Epson 24-pin, Laserjet, or Thinkjet.
- The printer is equipped with a serial (RS-232) port.
- The printer is connected to the instrument through a known good RS-232 cable and adapter (if needed).
- The printer is powered on and paper is loaded.
- The printer baud rate setting is known.

Set up the instrument and start the hard copy with the following steps:

 METER  SCOPE				
SCOPE	UTILITY	System	RS-232	—
		Set RS232 Parameters To Defaults	—	
		Baud rate	—	<i>Set baud rate to match printer baud rate</i>
		System	Hard Copy	—
		Format	<i>Choose format to match printer¹</i>	
		OK Select Format	—	
HARD COPY	—			

¹ You may need to press Select Page to display additional printer formats.

If the RS-232 port is defective, replace the main board.

Battery and External Power. Verify the battery and external power with the following procedure:

***NOTE.** If the instrument runs normally under battery power but only for a short time, the battery may have lost its capacity to hold a charge. You may be able to recover some of its capacity by repeatedly charging and then completely discharging the battery several times. If several charge/discharge cycles do not improve the battery life, it should be replaced.*

1. Install a fully charged battery and connect the AC adapter to the instrument.
2. Turn the instrument on.
3. Disconnect the AC adapter plug from the instrument. If the instrument turns off, then battery power is not working. Go back to step 5 on page 6–29 to troubleshoot the problem.
4. While the instrument is running, reconnect the AC adapter and then remove the battery. If the instrument turns off then external power is not working. Disconnect the AC power adapter from the instrument and use a DMM to measure its DC output voltage. Follow the instructions in the table below.

AC Adapter Voltage Measurement	Instructions
Less than 12 V _{DC}	The AC adapter is probably defective. Replace it.
Greater than 12 V _{DC}	The main board is probably defective. Replace it.

Unpacking and Repacking Instructions

This section contains the information needed to unpack the TekScope instrument and repack it for shipment or storage.

Unpacking The TekScope instrument and its standard accessories are carefully packed at the factory in a padded case, which is enclosed in a shipping carton. If, upon receipt, damage to the shipping carton is evident, notify the shipper. Tektronix, Inc. is not responsible for damage caused during shipping.

If you have not already done so, carefully remove the TekScope instrument and its accessories from the padded case and inspect them for damage. Save the shipping carton for repacking or storage.

Repacking 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 TekScope instrument should be stored in a clean, dry environment. The following environmental characteristics apply for both shipping and storage (instrument not operating):

- Temperature range: -20°C to $+60^{\circ}\text{C}$
- Altitude: To 15,000 m

See the chapter *Specifications* for a complete listing of the environmental characteristics.

Options

The TekScope instrument options provide AC adapters, User Manuals, and Reference Manuals for international customers. Table 7-1 describes these options.

Table 7-1: TekScope instrument options

Option	Description
A1	Universal European AC adapter, 220 V
A2	United Kingdom AC adapter, 240 V
A6	Japan AC adapter, 100 V
L1	French-language User and Reference Manuals
L2	Italian-language User and Reference Manuals
L3	German-language User and Reference Manuals
L4	Spanish-language User and Reference Manuals
L5	Japanese-language User Manual, English-language Reference
L6	Portuguese-language User and Reference Manuals
L7	Simple Chinese-language User and Reference Manuals
L8	Standard Chinese-language User and Reference Manuals
L9	Korean-language User and Reference Manuals
LR	Russian-language User Manual
1B	Includes THS7BAT and THS7CHG for European 220 V
2B	Includes THS7BAT and THS7CHG for United Kingdom 240V
3B	Includes THS7BAT and THS7CHG for North American 120V

Electrical Parts List

Refer to the *Mechanical Parts List* chapter for a complete listing and description of replaceable parts for the TekScope instrument.

Diagrams

See Figure 3-1 on page 3-2 for a block/interconnect diagram of the TekScope instrument. There are no additional diagrams in this chapter.

Mechanical Parts List

This section contains a list of the replaceable modules for the TekScope instrument. Use this list to identify and order replacement parts.

Parts Ordering Information

Replacement parts are available through your local Tektronix field office or representative.

Changes to Tektronix 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.

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 TekScope instrument. Use this list to identify and order replacement parts. The following table describes each column in the parts list.

Parts List Column Descriptions

Column	Column Name	Description
1	Figure & Index Number	Items in this section are referenced by 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
0BL82	CRT SCIENTIFIC	14746 RAYMER ST	VAN NUYS, CA 91405
0KB01	STAUFFER SUPPLY CO.	810 SE SHERMAN	PORTLAND, OR 97214-4657
1DM20	PARLEX CORP.	7 INDUSTRIAL WAY	SALEM, NH 03079
22670	GM NAMEPLATE, INC.	2040 15TH AVENUE WEST	SEATTLE, WA 98119-2783
53279	XENTEK, INC	1770 LA COSTA MEADOW DR.	SAN MARCOS, CA 92069
80009	TEKTRONIX, INC.	P.O. BOX 500	BEAVERTON, OR, 97077-0001
85471	BOYD CORP.	6136 NE 87TH AVENUE	PORTLAND, OR 97220
8X345	NORTHWEST SPRING AND MFG., INC.	5858 SW WILLOW LANE	LAKE OSWEGO, OR 97035
TK1163	POLY-CAST, INC.	9898 SW TIGARD ST.	TIGARD, OR 97223
TK2469	UNITREK CORP.	3000 LEWIS AND CLARK HWY., SUITE #2	VANCOUVER, WA 98661
TK2539	ROYAL CASE COMPANY, INC.	315 S. MONTGOMERY, P.O. BOX 2231	SHERMAN, TX 75070-5070

Mechanical Parts List

Replaceable Parts List

Fig. & Index Number	Tektronix Part Number	Serial No. Effective	Serial No. Discont'd	Qty	Name & Description	Mfr. Code	Mfr. Part Number
10-1	334-9310-00	B010100		1	LABEL: FRONT PANEL (THS710A)	22670	334-9310-00
-1	334-9310-10	B010100		1	LABEL: FRONT PANEL (THS720A)	22670	334-9310-10
-1	334-9310-20	B010100		1	LABEL: FRONT PANEL (THS730A)	22670	334-9310-20
-1	334-9310-30	B010100		1	LABEL: FRONT PANEL (THS720P)	22670	334-9310-30
-2	437-0451-10	B010100		1	FRONT COVER (THS710A, THS720A, THS730A)	TK1163	437-0451-10
-2	437-0451-20	B010100		1	FRONT COVER (THS720P)	TK1163	437-0451-20
-3	337-4010-00	B010100		1	DISPLAY SHIELD: CLEAR LEXAN	85471	337-4010-00
-4	348-1475-00	B010100		1	GASKET: NEOPRENE, 35.0 X 0.045 OD	OKB01	348-1475-00
-5	260-2615-00	B010100		1	SWITCH MAT: ELASTOMERIC	OBL82	260-2615-00
-6	259-0098-00	B010100		1	SWITCH FLEX CIRCUIT ASSY	22670	259-0098-00
-7	119-4985-11	B010100		1	DISPLAY MODULE: LCD W/ BACKLIGHT	80009	119-4985-11
-8	214-4706-00	B010100		1	SPRING: 0.74 X 0.185 OD	8X345	214-4706-00
-9	348-1441-00	B010100		1	FOAM PAD SET	85471	348-1441-00
-10	671-3923-0X	B010100		1	CIRCUIT BD ASSY: MAIN (THS710A)	80009	671-3923-0X
-10	671-3923-1X	B010100		1	CIRCUIT BD ASSY: MAIN (THS720A)	80009	671-3923-1X
-10	671-4010-0X	B010100		1	CIRCUIT BD ASSY: MAIN (THS730A)	80009	671-4010-0X
-10	671-3923-2X	B010100		1	CIRCUIT BD ASSY: MAIN (THS720P)	80009	671-3923-2X
-11	200-4214-00	B010100		1	BATTERY DOOR	TK1163	200-4214-00
-12	200-4267-00	B010100		1	HOLE PLUG SET: DC POWER AND I/O PORT	TK1163	200-4267-00
-13	213-1099-00	B010100		4	SCREW: THREAD FORMING, 1.79 X 31 MM, T-15 TORX	OKB01	213-1099-00
-14	334-8998-00	B010100		1	LABEL: BACK COVER, MARKED UL AND CE	22670	334-8998-00
-15	348-1426-00	B010100		1	TILT STAND ASSY	TK1163	348-1426-00
-16	437-0453-10	B010100		1	BACK COVER	TK1163	437-0453-10
-17	174-3487-01	B010100		1	CONTACT ASSY: BATTERY	TK2469	174-3487-01
-18	174-3366-01	B010100		1	CABLE ASSY: INVERTER TO MAIN BD, 5-CONDUCTOR	TK2469	174-3366-01
-19	174-3367-00	B010100		1	CABLE ASSY: DISPLAY TO MAIN BD, 12-CONDUCTOR	1DM20	1.00MM-12-3.5-B
-20	441-2066-01	B010100		1	CHASSIS ASSY: INCLUDES BNC CONNECTORS AND BANANA JACKS	TK1163	441-2066-01
-21	671-3673-XX	B010100		1	CIRCUIT BD ASSY: INVERTER	80009	671-3673-XX
-22	346-0280-00	B010100		1	HANDLE: BLACK WEBBING (THS710A, THS720A, THS730A)	TK2539	346-0280-00
-22	346-0280-20	B010100		1	HANDLE: YELLOW WEBBING (THS720P)	TK2539	346-0280-20

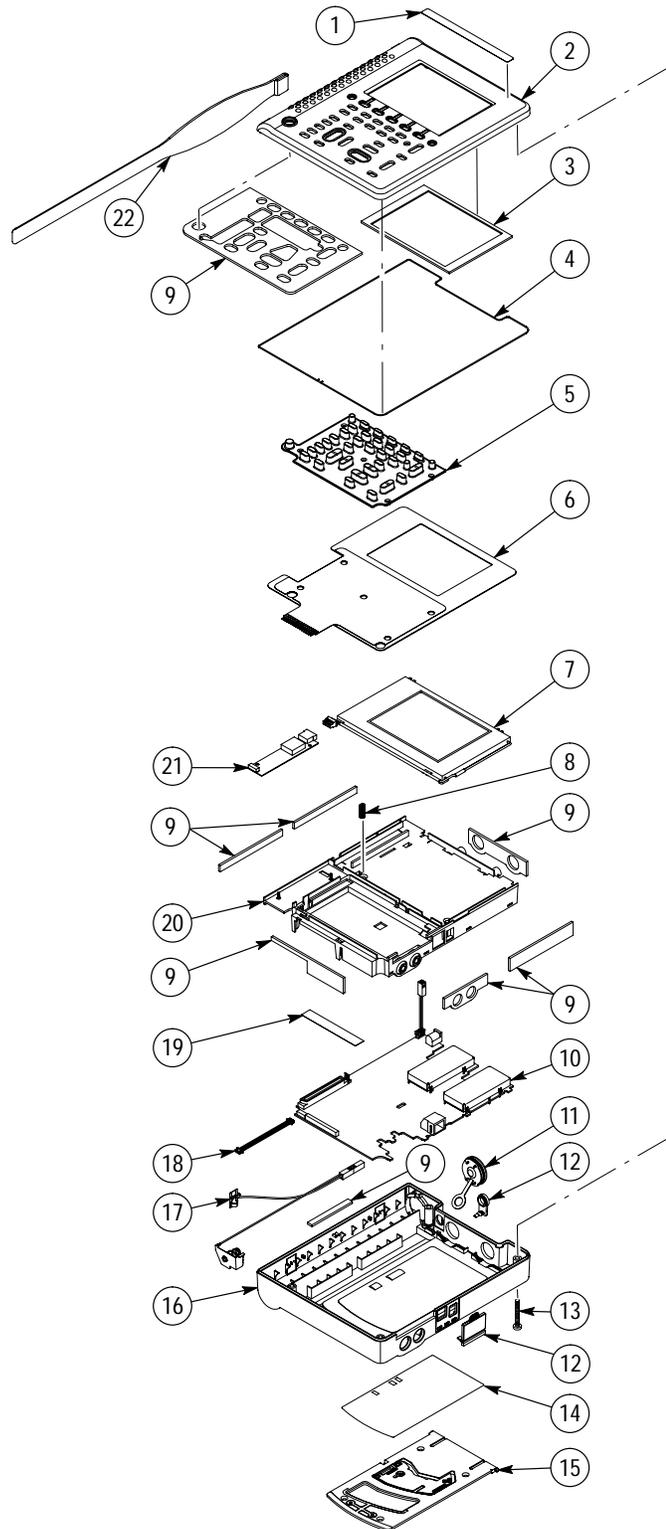


Figure 10-1: Exploded diagram

Table 10–1 lists the replaceable standard accessories for the TekScope instrument and the instrument options that included them in the original shipment. These accessories are not shown in Figure 10–1.

Table 10–1: Replaceable standard accessories

Tektronix Part Number or Nomenclature	Description of Accessory	Instrument Options That Include the Accessory
P6117	Passive 10X probes	All
012-1482-00	Meter lead set	All
THS7BAT	Battery pack	All
119-4812-01	AC adapter (North American)	All except A1, A2, and A6
119-4813-01	AC adapter (Universal Euro- pean)	A1 only
119-4922-01	AC adapter (UK)	A2 only
119-4923-01	AC adapter (Japan)	A6 only
012-1364-00	2 m RS-232 cable	All
103-0403-00	RJ-45 to 9-pin female adapter	All
016-1399-01	Soft case	All
070-9731-XX	User and Reference Manuals (English)	All except L1 through L9
070-9732-XX	User and Reference Manuals (French)	L1
070-9733-XX	User and Reference Manuals (German)	L3
070-9734-XX	User and Reference Manuals (Italian)	L2
070-9735-XX	User and Reference Manuals (Korean)	L9
070-9736-XX	User and Reference Manuals (Portuguese)	L6
070-9737-XX	User and Reference Manuals (Spanish)	L4
070-9738-XX	User and Reference Manuals (Simplified Chinese)	L7
070-9739-XX	User and Reference Manuals (Traditional Chinese)	L8
070-9740-XX	User and Reference Manuals (Japanese)	L5
071-0011-XX	User Manual (Russian)	LR

Table 10–1: Replaceable standard accessories (Cont.)

Tektronix Part Number or Nomenclature	Description of Accessory	Instrument Options That Include the Accessory
070-9741-XX	Replacement Reference Manual only (English)	None
070-9742-XX	Replacement Reference Manual only (French)	None
070-9743-XX	Replacement Reference Manual only (German)	None
070-9744-XX	Replacement Reference Manual only (Italian)	None
070-9745-XX	Replacement Reference Manual only (Korean)	None
070-9746-XX	Replacement Reference Manual only (Portuguese)	None
070-9747-XX	Replacement Reference Manual only (Spanish)	None
070-9748-XX	Replacement Reference Manual only (Simplified Chinese)	None
070-9749-XX	Replacement Reference Manual only (Traditional Chinese)	None
070-9799-XX	Replacement Reference Manual only (Japanese)	None

