

ARTISAN®
TECHNOLOGY GROUP

Your **definitive** source for quality pre-owned equipment.

Artisan Technology Group
(217) 352-9330 | sales@artisantg.com | artisantg.com

Full-service, independent repair center
with experienced engineers and technicians on staff.

We buy your excess, underutilized, and idle equipment
along with credit for buybacks and trade-ins.

Custom engineering
so your equipment works exactly as you specify.

- Critical and expedited services
- In stock / Ready-to-ship
- Leasing / Rentals / Demos
- ITAR-certified secure asset solutions

Expert team | Trust guarantee | 100% satisfaction

All trademarks, brand names, and brands appearing herein are the property of their respective owners.

Visit our website - *Click HERE*

Service Manual

Tektronix

11801C
Digital Sampling Oscilloscope

070-9972-02

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.

CE

Copyright © Tektronix, Inc. All rights reserved.

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

Printed in the U.S.A.

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

TEKTRONIX and TEK are registered trademarks of Tektronix, Inc.

WARRANTY

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

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

This warranty shall not apply to any defect, failure or damage caused by improper use or improper or inadequate maintenance and care. Tektronix shall not be obligated to furnish service under this warranty a) to repair damage resulting from attempts by personnel other than Tektronix representatives to install, repair or service the product; b) to repair damage resulting from improper use or connection to incompatible equipment; or c) to service a product that has been modified or integrated with other products when the effect of such modification or integration increases the time or difficulty of servicing the product.

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

EC Declaration of Conformity

We

Tektronix Holland N.V.
Marktweg 73A
8444 AB Heerenveen
The Netherlands

declare under sole responsibility that the

11801C Digital Sampling Oscilloscope

meets the intent of Directive 89/336/EEC for Electromagnetic Compatibility and Low Voltage Directive 73/23/ECC for Product Safety. Compliance was demonstrated to the following specifications as listed in the Official Journal of the European Communities:

EMC Directive 89/336/EEC:

EN 55011	Class A Radiated and Conducted Emissions

EN 50082-1 Immunity:

IEC 801-2	Electrostatic Discharge Immunity
IEC 801-3	RF Electromagnetic Field Immunity
IEC 801-4	Electrical Fast Transient/Burst Immunity
IEC 801-5	Power Line Surge Immunity

Low Voltage Directive 73/23/EEC:

EN 61010-1	Safety requirements for electrical equipment for measurement, control, and laboratory use

Tektronix, Inc. claims compliance to the EMC Directive 89/336/EEC for the following products when they are used with the above named product:

SD-20
SD-22
SD-24
SD-26
SD-30
SD-32
SD-42
SD-46
SD-51

Declaration of Conformity
with Electromagnetic Compatibility Standards
as Required under the Radiocommunications Act

We

Tektronix, Inc.

of

Tektronix Australia Pty Limited
80 Waterloo Road
North Ryde NSW 2113

Supplier Code: N60

declare under sole responsibility that the

11801C Digital Sampling Oscilloscope

to which this declaration relates is in conformity with the following standards:

AS/NZS 2064.1/2 Industrial, Scientific, and Medical Equipment: 1992

Tektronix, Inc. claims conformity to the standards for the following products when they are used with the above named product:

SD-20
SD-22
SD-24
SD-26
SD-30
SD-32
SD-42
SD-46
SD-51

Contacting Tektronix

Product Support	For application-oriented questions about a Tektronix measurement product, call toll free in North America: 1-800-TEK-WIDE (1-800-835-9433 ext. 2400) 6:00 a.m. – 5:00 p.m. Pacific time Or, contact us by e-mail: tm_app_supp@tek.com For product support outside of North America, contact your local Tektronix distributor or sales office.
Service Support	Contact your local Tektronix distributor or sales office. Or, visit our web site for a listing of worldwide service locations. http://www.tek.com
For other information	In North America: 1-800-TEK-WIDE (1-800-835-9433) An operator will direct your call.
To write us	Tektronix, Inc. P.O. Box 1000 Wilsonville, OR 97070-1000

Table of Contents

Contacting Tektronix ..... **i**

General Safety Summary ..... **xvii**

Service Safety Summary ..... **xix**

Specifications

Operating Information

Sampling Head Installation and Removal **2-2**

Power Information **2-4**

Power Cord Information **2-5**

Memory Backup Power **2-6**

Operating Environment **2-6**

Operating Temperature 2-6

Ventilation Requirements 2-6

Packaging for Shipment **2-7**

Theory of Operation

System Functional Overview **3-3**

Acquisition System Block **3-3**

Strobe Distribution Block **3-3**

Time Base/Controller Block **3-3**

Trigger Select Block **3-3**

Executive Processor Block **3-4**

Memory Management Unit Block **3-4**

Waveform Memory Block **3-4**

Front Panel Controls **3-5**

I/O Block **3-5**

Waveform Compressor and Display Control Block **3-5**

Power Supply **3-6**

Typical Waveform Processing Cycle **3-6**

Block Diagram Descriptions 3-7
A1 M/F Strobe Drive Board 3-7
Data Buffers 3-7
Address Latch 3-7
Function Decoder 3-7
Internal Clock Rate Generator 3-7
Control Buffer 3-8
A3 M/F Power Connect Board 3-8
A4 Regulator Board 3-8
Voltage Fault Detect 3-8
A5 Time Base/Controller Board 3-9
Microprocessor 3-9
RAM/ROM Memory 3-9
Trigger 3-9
Time Base 3-11
Acquisition System Interface 3-11
Memory Management (MMU) Interface 3-11
A7 CRT Socket Board 3-12
Red, Green, and Blue Video Amplifiers 3-12
Red, Green, and Blue Adjustments 3-12
Convergence Adjustment 3-12
A8 CRT Driver Board 3-13
Horizontal Sweep 3-13
Vertical Sweep 3-13
High Voltage and Grid Voltage Generator 3-13
Degauss 3-14
Beam Current Limit 3-14
Grid Bias 3-14
A9, A10, and A11 Front Panel Boards 3-14
Touch Panel, Major Menu Keys, and Menu Status LEDs 3-14
A9 Touch Panel Assembly 3-14
A10 Front Panel Control Board 3-15
A11 Front Panel Button Board 3-15
A12 Rear Panel Assembly 3-15
GPIB Data and Address Bus 3-16
Standard RS-232-C Controller 3-16
Printer Port 3-17
A13 Mother Board 3-17
A14 Input/Output (I/O) Board 3-18
I/O Data Buffer 3-18
I/O Delayed Data Buffer 3-18
Timer Configuration 3-19
Real Time Clock 3-19
Serial Data Interface (SDI) 3-19
Tone Generator 3-19
Temp/Tone Readback Buffer 3-19

A15 Memory Management (MMU) Board 3-20
MMU IC 3-20
Waveform RAM 3-20
Display Interface 3-20
Time Base/Controller Interface 3-21
Executive Processor (EXP) Interface 3-21
Display IC 3-21
Microprocessor 3-21
Bit Map RAM 3-21
Waveform Display RAM 3-22
Video Digital-to-Analog Convertor (DAC) 3-22
A17 Executive Processor Board 3-22
Executive Processor (EXP) 3-22
Numeric Coprocessor 3-23
Bus Controller 3-23
Reset 3-23
Wait State 3-23
Interrupt Controllers 3-23
DMA Controller 3-23
A18 Memory Board 3-24
Address Latches 3-24
Address Decode and Memory Select 3-24
EPROMs, SRAM, and NVRAM 3-25
Memory Data Buffers 3-25
Wait State Generator 3-25
Wait State Diagnostics 3-25
Memory Configuration Readback 3-25
Battery Backup 3-25
A19 Strobe/TDR Buffer Board 3-26
Strobe Sense Select 3-26
Strobe Deskew 3-26
TDR Buffer and Level Shift 3-26
A20-23 Head Interconnect Boards 3-26
A26 M/F Acquisition Interconnect Board 3-27
A24/A27 & A25/A28 Acquisition System Boards 3-27
Programmable Gain Amplifiers 3-27
A/D Convertors 3-28
Measurement Hardware 3-28
Timing and Sampling Head Control 3-28
Shared RAM 3-29
Time Base/Controller Interface 3-29
Microprocessor 3-29

Performance Verification

Test Equipment **4-3**
Test Record 4-6
Using These Procedures **4-11**
Conventions in this Manual 4-11
Menu Selections and Measurement Techniques 4-11
User Manual 4-11
Performance Tests **4-13**
Power-On Diagnostics **4-14**
Setup to Invoke Power-On Diagnostics 4-14
Procedure to Invoke Power-On Diagnostics 4-14
Diagnostics 4-15
Self-Test Diagnostics 4-15
Power-On Diagnostics Complete 4-16
Sampling Heads **4-17**
Setup to Calibrate a Sampling Head 4-17
Procedure to Calibrate a Sampling Head 4-17
Extended Diagnostics **4-19**
Setup to Invoke Extended Diagnostics 4-19
Procedure to Invoke Extended Diagnostics 4-19
Vertical Reference Voltage **4-21**
Specifications 4-21
Setup to Check Vertical Reference Voltage 4-21
Procedure to Check Vertical Reference Voltage 4-21
Horizontal Reference Clock **4-23**
Specifications 4-23
Setup to Check Horizontal Reference Clock 4-23
Procedure to Check Horizontal Reference Clock 4-23
Vertical Accuracy **4-25**
Setup to Check Vertical Gain 4-25
Procedure to Check Vertical Gain 4-25
Setup to Check Offset Accuracy 4-28
Procedure to Check Offset Accuracy 4-28
System Vertical RMS Noise **4-31**
Setup to Examine Vertical RMS Noise 4-31
Procedure to Examine Vertical RMS Noise 4-31
Sweep Rate Accuracy **4-34**
Setup to Examine Sweep Rate Accuracy 4-34
Procedure to Examine Sweep Rate Accuracy 4-34
Sweep Rate Accuracy 2 ns/div 4-35
Sweep Rate Accuracy 1 ns/div 4-36
Sweep Rate Accuracy 100 ps/div 4-36
Sweep Rate Accuracy 10 ps/div 4-36
Sweep Rate Accuracy 1 ps/div 4-37

Triggering, External Direct 4-39
Specifications 4-39
Setup to Check Triggering 4-39
Procedure to Check Triggering 4-39
Prescaler Triggering 4-41
Specifications 4-41
Setup to Check Prescaler Triggering 4-41
Procedure to Check Prescaler Triggering 4-41
Internal Clock 4-43
Measurement Limits 4-43
Setup to Examine Internal Clock 4-43
Procedure to Examine Internal Clock 4-43
Calibrator Output 4-45
Measurement Limits 4-45
Setup to Examine Calibrator Output 4-45
Procedure to Examine Calibrator 4-45

Adjustment

Test Equipment 5-3
Using These Procedures 5-6
Conventions in this Manual 5-6
Menu Selections and Measurement Techniques 5-6
User Manual 5-6
Power Supply 5-7
Measurement Limits 5-7
Setup to Examine Voltage Supply 5-7
Procedure to Examine Voltage Supply 5-7
Setup to Examine/Adjust Voltage Reference 5-9
Procedure to Examine/Adjust Voltage Reference 5-9
Setup to Examine/Adjust Regulator Reference 5-11
Procedure to Examine/Adjust Regulator Reference 5-11
Display 5-13
Measurement Limits 5-13
Setup to Examine/Adjust the Display 5-14
Procedure to Examine/Adjust the Display 5-14
Real Time Clock 5-20
Measurement Limits 5-20
Setup to Examine/Adjust Real Time Clock 5-20
Procedure to Examine/Adjust Real Time Clock 5-20

Maintenance

Preventive Maintenance **6-1**
Removing the Cabinet Panels **6-1**
Cleaning the Instrument **6-2**
Exterior 6-2
CRT 6-2
Interior 6-3
Visual Inspection **6-3**
Periodic Electrical Adjustment **6-3**
Corrective Maintenance **6-5**
Power Supply Voltage Hazard **6-5**
Ordering Parts **6-5**
Static-Sensitive Device Classification **6-6**
Removing and Replacing FRUs **6-8**
Electrical Lock-on of the Front Panel ON/STANDBY Power Switch **6-13**
Power Supply Module Removal/Replacement **6-16**
Fan Motor Removal/Replacement **6-19**
Cathode Ray Tube (CRT) Removal/Replacement **6-20**
Acquisition Unit Removal/Replacement **6-26**
Battery Disposal and First Aid **6-27**
Battery Disposal 6-27
Emergency and First Aid Information 6-28
FRU Board and Assembly Removal **6-29**
A1 M/F Strobe Drive Board 6-31
A3 M/F Power Connect Board 6-32
A4 Regulator Board 6-34
A5 Time Base/Controller Board 6-35
A7 CRT Socket Board and A8 CRT Driver Board 6-37
A9 Touch Panel Assembly 6-40
A10 Front Panel Control Board 6-42
A11 Front Panel Button Board 6-44
A12 Rear Panel Assembly 6-45
A13 Mother Board 6-47
A14 Input/Output (I/O) Board 6-49
A15 Memory Management Unit (MMU) Board 6-51
A17 Executive Processor (EXP) Board 6-53
A18 Memory Board 6-55
A19 Strobe/TDR Buffer Board 6-57
A20−A23 Head Interconnect Boards 6-59
A26 M/F Acquisition Interconnect Board 6-61
A24/A27 Acquisition Analog Boards 6-63
A25/A28 Acquisition MPU Boards 6-64

FRU IC Removal **6-65**
Serial Data Interface Integrated Circuits (“Slam-Pack” ICs) .. 6-65
Firmware Integrated Circuits (“Dual In-Line Package” ICs) .. 6-68
Firmware Upgrade Procedure 6-69
Cables and Connectors **6-75**
Interconnecting Pins **6-75**
Coaxial-type End-Lead Connectors (Peltolas & SMB) 6-75
Multi-Pin Connectors 6-75
Checks After FRU Replacement **6-77**
Diagnostic Troubleshooting **6-79**
Diagnostics Overview **6-79**
Kernel Diagnostics **6-80**
Self-Test/Extended Diagnostics **6-81**
Extended Diagnostics Menu Structure 6-81
Extended Diagnostics Error Index Codes 6-81
Diagnostic Menus **6-84**
Diagnostic Menu Hardcopy 6-85
Diagnostic Terminal Mode (RS-232-C) **6-86**
System Mode (GPIB & RS-232-C) **6-87**
Battery Testing **6-89**
Clearing NVRAM **6-90**
Field Replaceable Unit (FRU) Guide **6-91**
FRU Name Abbreviations 6-92
Component and Module Name Abbreviations 6-93
Executive Subsystem Error Index Codes 6-94
Display Subsystem Error Index Codes 6-98
Time Base Processor Error Index Codes 6-100
Acquisition Processor Error Index Codes 6-102
Other Troubleshooting **6-103**
Power Supply Module **6-103**
Module Troubleshooting 6-103
A4 Regulator Board **6-103**
CRT, A7 CRT Socket Board, or A8 CRT Driver Board **6-104**
Module Troubleshooting 6-104
A13 Mother Board **6-104**
Fuse Testing **6-105**
Time Base Calibration Errors **6-108**
Acquisition Calibration Errors **6-110**

Options

Instrument Options **7-1**
Power Cord Information **7-2**

Electrical Parts List

Electrical Parts **8-1**

Diagrams

Replaceable Parts List

Replaceable Parts **10-1**
Parts Ordering Information **10-1**
Module Replacement 10-1
Firmware Replacement 10-1
Using the Replaceable Parts List **10-2**
Item Names 10-2
Indentation System 10-2
Abbreviations 10-2

List of Figures

Figure 2-1: Sampling Head Compartments in the 11801C Digital Sampling Oscilloscope 2-2
Figure 2-2: Power-Cord Plug Identification 2-5

Figure 3-1: Trigger Edge Slew Rate for High Frequency Selection . . 3-10

Figure 4-1: A26 M/F Acquisition Interconnect Board Test Point Locations 4-22
Figure 4-2: A5 Time Base/Controller Board Test Point Locations . . . 4-24

Figure 5-1: A18 Memory Board Test Point Locations 5-8
Figure 5-2: A2A2 Control Rectifier Board Test Point and Adjustment Locations 5-10
Figure 5-3: A4 Regulator Board Test Point and Adjustment Locations 5-12
Figure 5-4: A8 CRT Driver Board Adjustment Locations 5-18
Figure 5-5: A7 CRT Socket Board Adjustment Locations 5-19
Figure 5-6: A14 I/O Board Test Point and Adjustment Locations 5-22

Figure 6-1: Field Replaceable Units (FRU) Locator 6-14
Figure 6-2: Removing the Power Supply Module, Fan Housing, and Rear Panel Connector Plate 6-16
Figure 6-3: A2A2 Control Rectifier Board Connector Locations 6-17
Figure 6-4: Removing/Replacing the CRT Cover 6-23
Figure 6-5: Removing/Replacing the Cathode Ray Tube 6-24
Figure 6-6: Removing/Replacing the CRT Torx Head Screws 6-25
Figure 6-7: Top View of the Card Cage 6-30
Figure 6-8: Removing/Replacing the A1 M/F Strobe Drive Board . . . 6-31
Figure 6-9: Removing/Replacing the A4 Regulator Board 6-33
Figure 6-10: Removing/Replacing the A5 Time Base/Controller Board 6-36
Figure 6-11: Removing/Replacing the A7 CRT Socket Board 6-38
Figure 6-12: Removing/Replacing the A8 CRT Driver Board 6-39
Figure 6-13: A9 Touch Panel Assembly Torx Head Screws 6-41
Figure 6-14: Removing/Replacing the A9 Touch Panel Assembly . . . 6-41
Figure 6-15: Removing/Replacing the A10 Front Panel Control Board 6-43
Figure 6-16: Removing/Replacing the A11 Front Panel Button Board 6-44
Figure 6-17: Removing/Replacing the A12 Rear Panel Assembly . . . 6-46
Figure 6-18: Removing/Replacing the A13 Mother Board 6-48
Figure 6-19: Removing/Replacing the A14 I/O Board 6-50
Figure 6-20: Removing/Replacing the A15 MMU Board 6-52

Figure 6-21: Removing/Replacing the A17 Executive Processor Board 6-54
Figure 6-22: Removing/Replacing the A18 Memory Board 6-56
Figure 6-23: Removing/Replacing the A19 Strobe/TDR Buffer Board 6-58
Figure 6-24: Removing/Replacing the A20-A23 Head Interconnect Boards 6-59
Figure 6-25: Removing/Replacing the Front Subpanel Assembly . . . 6-60
Figure 6-26: Removing/Replacing the A26 M/F Acquisition Interconnect Board 6-61
Figure 6-27: Top View of the A26 Mainframe Acquisition Interconnect Board 6-62
Figure 6-28: Removing/Replacing the A24/A27 Acquisition Analog Boards 6-63
Figure 6-29: Removing/Replacing the A25/A28 Acquisition MPU Boards 6-64
Figure 6-30: FRU IC Detail 6-67
Figure 6-31: IC Insertion-Extraction Tool 6-69
Figure 6-32: Multi-Pin Connector Orientation and Semiconductor Indexing Diagram 6-74
Figure 6-33: A17 Executive Processor Board Test Point and Status LED Locations 6-95
Figure 6-34: A15 MMU Board Test Point and Status LED Locations 6-99
Figure 6-35: A5 Time Base/Controller Board Status LEDs 6-101
Figure 6-36: A25/A28 Acquisition MPU Board Status LEDs 6-102
Figure 6-37: A14 I/O Board Fuse Locator Diagram 6-107

Figure 7-1: Power-Cord Plug Identification 7-2

Figure 9-1: 11801C-System Functional Block Diagram 9-1
Figure 9-2: A1 M/F Strobe Drive Board Block Diagram 9-1
Figure 9-3: A4 Regulator Board Block Diagram 9-2
Figure 9-4: A5 Time Base/Controller Board Block Diagram 9-2
Figure 9-5: A7 CRT Socket Board Block Diagram 9-2
Figure 9-6: A8 CRT Driver Board Block Diagram 9-3
Figure 9-7: A12 Rear Panel Assembly Block Diagram 9-3
Figure 9-8: A14 I/O Board Block Diagram 9-4
Figure 9-9: A15 MMU Board Block Diagram 9-4
Figure 9-10: A17 Executive Processor Board Block Diagram 9-4
Figure 9-11: A18 Memory Board Block Diagram 9-5
Figure 9-12: A19 Strobe/TDR Buffer Board Block Diagram 9-5
Figure 9-13: A26 M/F Acquisition Interconnect Board Block Diagram 9-5
Figure 9-14: A24/A27 Acquisition Analog Board Block Diagram 9-6
Figure 9-15: A25/A28 Acquisition MPU Board Block Diagram 9-6

Figure 10-1: Cabinet 10-7
Figure 10-2: Front Panel 10-9
Figure 10-3: Chassis, Rear 10-11
Figure 10-4: Circuit Boards 10-13
Figure 10-5: Acquisition Module 10-17
Figure 10-6: Power Supply 10-19
Figure 10-7: Option 1M 10-21
Figure 10-8: Accessories 10-23

List of Tables

Table 1-1: Measurement Limits, Specifications, Adjustments, and Functional Tests 1-1

Table 2-1: Power-Cord Conductor Identification 2-5

Table 4-1: Measurement Limits, Specifications, and Functional Tests 4-1
Table 4-2: Test Equipment 4-3
Table 4-3: Voltage Source Settings 4-27
Table 4-4: Vertical Offset Test Values 4-30
Table 4-5: Sensitivity Settings 4-33
Table 4-6: Prescaler Test Settings 4-42

Table 5-1: Measurement Limits and Adjustments 5-2
Table 5-2: Test Equipment 5-3

Table 6-1: Relative Susceptibility to Damage from Static Discharge . 6-6
Table 6-2: FRU Removal/Replacement Figure Cross Reference 6-8
Table 6-3: Emergency Procedures for Contact with Battery Solvent . 6-28
Table 6-4: Checks Required After FRU Replacement 6-77
Table 6-5: Extended Diagnostics Error Index Code Descriptions . . . 6-82
Table 6-6: System Mode Commands 6-87
Table 6-7: Event Code Descriptions 6-87
Table 6-8: Board FRUs 6-92
Table 6-9: Component Module FRUs 6-93
Table 6-10: Executive Processor Kernel Error Index Codes 6-94
Table 6-11: Executive Processor Status LED Configuration 6-95
Table 6-12: Executive Processor Manual Tests 6-96
Table 6-13: Display Processor Kernel Error Index Codes 6-98
Table 6-14: Display Processor Status LED Configuration 6-98
Table 6-15: Time Base Processor Kernel Error Index Codes 6-100
Table 6-16: Acquisition Processor Kernel Error Index Codes 6-102
Table 6-17: A14 I/O Board Fuse Failures 6-106
Table 6-18: Time Base Calibration Errors 6-109

Table 7-1: Power-Cord Conductor Identification 7-2

Table 10-1: Board FRUs 10-3

General Safety Summary

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

Only qualified personnel should perform service procedures.

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

To Avoid Fire or Personal Injury

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

Use Proper Voltage Setting. Before applying power, ensure that the line selector is in the proper position for the power source being used.

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

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

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

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

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

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

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

Do Not Operate in Wet/Damp Conditions.

Do Not Operate in an Explosive Atmosphere.

Keep Product Surfaces Clean and Dry.

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

Symbols and Terms

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

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

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

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

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

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

CAUTION indicates a hazard to property including the product.

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



WARNING
High Voltage



Protective
Ground (Earth)
Terminal



CAUTION
Refer to Manual



Double
Insulated

Service Safety Summary

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

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

Disconnect Power. To avoid electric shock, disconnect the mains power by means of the power cord or, if provided, the power switch.

Use Caution When Servicing the CRT. To avoid electric shock or injury, use extreme caution when handling the CRT. Only qualified personnel familiar with CRT servicing procedures and precautions should remove or install the CRT.

CRTs retain hazardous voltages for long periods of time after power is turned off. Before attempting any servicing, discharge the CRT by shorting the anode to chassis ground. When discharging the CRT, connect the discharge path to ground and then the anode. Rough handling may cause the CRT to implode. Do not nick or scratch the glass or subject it to undue pressure when removing or installing it. When handling the CRT, wear safety goggles and heavy gloves for protection.

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.

X-Radiation. To avoid x-radiation exposure, do not modify or otherwise alter the high-voltage circuitry or the CRT enclosure. X-ray emissions generated within this product have been sufficiently shielded.

Specifications

This section provides specifications for testing and adjusting your 11801C oscilloscope. Refer to the *11801C User Manual* for a general description of the characteristic, environmental, and user specifications of the oscilloscope. Table 1-1 lists measurement and specification values. Refer to the *Performance Verification* section for Performance test procedures; refer to the *Adjustment* section for Adjustment procedures.

Table 1-1: Measurement Limits, Specifications, Adjustments, and Functional Tests

Part and Description	Measurement Limits *(Examine)*	Specifications *(Check)*	Adjustments *(Adjust)*	Functional Test
Power-On Diagnostics	none	none	none	yes
Sampling Head	none	none	none	yes
Extended Diagnostics	none	none	none	yes
Power Supply				no
Voltage Supply	+4.85 V to +5.25 V	none	none	
Voltage Reference	+5.15 V to +5.25 V	none	R800 +5.2 V Ref for +5.20 V	
Regulator Reference	+9.95 V to +10.05 V	none	R730 +10 V Ref for +10.00 V	
Display				
Cutoff	visible	none	SCREEN, on transformer on A8 CRT Driver board, until display appears	no
Convergence	primary colors are not separated in the white grid	none	CONVERGENCE, R210, for optimum convergence of red, green, and blue	no
Focus	focused grid pattern	none	FOCUS, on transformer on A8 CRT Driver board, for optimum focus on white grid pattern	no

Table 1-1: Measurement Limits, Specifications, Adjustments, and Functional Tests (Cont.)

Part and Description	Measurement Limits *(Examine)*	Specifications *(Check)*	Adjustments *(Adjust)*	Functional Test
Display (Cont.)				
Vertical Size and Position	align with tic marks	none	VERT SIZE, L321; and VERT POS, R311; for optimum alignment	no
Horizontal Size, Linearity and Position	align with tic marks and for optimum appearance	none	H-SIZE, R501; H-LIN, R502; and H-POS, R500; for optimum alignment and linearity	no
Gray Scale	white at the top of the display and gray at the bottom, and the right side of the display is cut off	none	SCREEN, on transformer on A8 CRT Driver board; RED, R200; GREEN, R201; and BLUE, R203; for cutoff and color balance	no
Color Impurity	no severe color impurities in red, green, and blue display	none	cycle power on and off	no
Real Time Clock	1,000,000 µs ±5 µs	none	Real Time Clock for 1,000,000 µs	no
Vertical Reference Voltage	none	5 ±200 µV and −5 ±200 µV	none	no
Horizontal Reference Clock	none	200,000 kHz ±5 kHz	none	no
Vertical Accuracy				
Vertical Gain	none	±1.0% full scale	none	yes
Offset Accuracy	none	±2 mV	none	yes
Vertical Linearity	none	±1%	none	no
System Vertical RMS Noise	200 µV at 2 mV/div 500 µV at 5 mV/div 1 mV at 10 mV/div 632 µV at 20 mV/div 1.58 mV at 500 mV/div 3.16 mV at 100 mV/div 6.32 mV at 200 mV/div	none	none	yes

Table 1-1: Measurement Limits, Specifications, Adjustments, and Functional Tests (Cont.)

Part and Description	Measurement Limits *(Examine)*	Specifications *(Check)*	Adjustments *(Adjust)*	Functional Test
Sweep Rate Accuracy	0.05% at 2 ns/div 0.08% at 1 ns/div 0.8% at 100 ps/div 2.5% at 10 ps/div 10% at 1 ps/div	none	none	yes
Triggering, External Direct, X1 Attenuation				yes
300 MHz Sensitivity	100 mV_{p-p} at 300 MHz	100 mV stable display	none	
1000 MHz Sensitivity	100 mV_{p-p} at 1000 MHz	100 mV stable display	none	
3.0 GHz Sensitivity	100 mV_{p-p} at 3.0 GHz	100 mV stable display	none	
Prescaler Triggering	800 mV_{p-p} at 2 GHz	800 mV stable display	none	yes
	600 mV_{p-p} at 3 GHz	600 mV stable display	none	
	600 mV_{p-p} at 10 GHz	600 mV stable display	none	
Internal Clock				yes
Rise Time	≤2.5 ns	≤2.5 ns	none	
Frequency	100 kHz ±3%	100 kHz ±3%	none	
Duty Cycle	50% ±3%	50% ±3%	none	
Calibrator Output				yes
Rise Time (typical)	250 ps	250 ps	none	
Peak-to-peak Amplitude	250 mV ±10%	250 mV ±10%	none	

Operating Information

The *11801C Digital Sampling Oscilloscope Service Manual* is designed for use by qualified service personnel. It contains information necessary to check, troubleshoot, and maintain the 11801C Digital Sampling Oscilloscope.

Troubleshooting is primarily based upon internal power-on diagnostics. These diagnostics isolate problems to the field replaceable unit (FRU) level. Defective FRUs not detected by diagnostics are isolated using other means. Once the faulty FRU is identified, use the instructions provided in this manual to remove and replace it. The removal and immediate replacement of the faulty FRU allows a minimum of downtime for the user. The *Parts List* section gives a complete list of the FRUs in this instrument.

First-time users are encouraged to read the *11801C Digital Sampling Oscilloscope User Manual*. This will help you to learn the basic functions of the 11801C.

This section contains information about installing and removing a sampling head, applying power, proper environmental conditions, shipping the instrument, and instrument options.

Sampling Head Installation and Removal

To avoid damage to the oscilloscope, set the ON/STANDBY switch to STANDBY before installing or removing sampling heads.

CAUTION

Applying a voltage outside the range printed on the sampling head can result in damage. Static electricity is also a hazard.

The input diodes used in the sampling heads are very susceptible to damage from overdrive signal or DC voltages, and from electrostatic discharge. Never apply a voltage outside the range printed on the front of the sampling head. Operate the 11801C only in a static-controlled environment.

Connect the wrist strap provided with the 11801C to the **ANTISTATIC CONNECTION**, as shown in Figure 2-1. Refer to the *11801C Digital Sampling Oscilloscope User Manual* for more information.

The SD-Series sampling head slides into one of the front panel compartments of the 11801C Digital Sampling Oscilloscope. Figure 2-1 shows the front panel of the 11801C Digital Sampling Oscilloscope and the locations of the sampling head compartments.

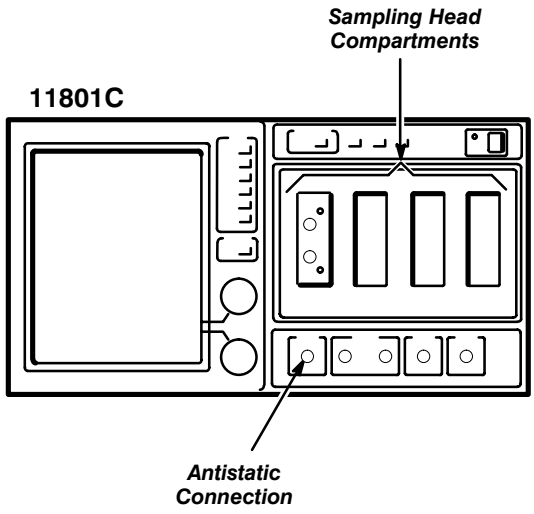


Figure 2-1: Sampling Head Compartments in the 11801C Digital Sampling Oscilloscope

With the ON/STANDBY switch set to STANDBY, place the sampling head in a compartment and slowly push it in with firm pressure. Once the sampling head is seated, turn the lock-down screw to tighten the sampling head in place.

CAUTION

Never install or remove a sampling head when the ON/STANDBY switch is ON. Installing or removing a sampling head when the power is on may damage the oscilliscope.

To remove the sampling head, set the ON/STANDBY switch to STANDBY. Turn the lock-down screw to loosen the sampling head, and then slowly pull out the sampling head.

Power Information

The rear panel LINE VOLTAGE SELECTOR allows you to select either a 115 V or 230 V (48 Hz to 440 Hz) nominal supply source. The 6 A, 250 V line fuse is used for both 115 V and 230 V operation.

WARNING

GROUNDING. *For electric shock protection, make the grounding connection before making any connection to the instrument's input or output terminals. This instrument is safety Class 1 equipment (IEC designation). All accessible conductive parts are directly connected through the grounding conductor of the power cord to the grounded (earth) contact of the power plug.*

Any interruption of the grounding connection can create an electrical shock hazard. The power input plug must be inserted only in a mating receptacle with a grounding contact where earth ground has been verified by a qualified service person. Do not defeat the grounding connection.

WARNING

AC POWER SOURCE AND CONNECTION. *An improper voltage supply can damage the instrument. The instrument operates from a single-phase power source. It has a three-wire power cord and two-pole, three-terminal grounding type plug. The voltage to ground (earth) from either pole of the power source must not exceed the maximum rated operating voltage, 250 V.*

Before making connection to the power source, check that the LINE VOLTAGE SELECTOR is set to match the voltage of the power source and has a suitable two-pole, three-terminal grounding-type plug.

Power Cord Information

A power cord with appropriate plug configuration is supplied with each instrument. Table 2-1, Power-Cord Conductor Identification, gives the color-coding of the conductors in the power cord. If you require a power cord other than the one supplied, refer to Figure 2-2, Power-Cord Plug Identification.

Table 2-1: Power-Cord Conductor Identification

Conductor	Color	Alternate Color
Ungrounded (Line)	Brown	Black
Grounded (Neutral)	Light Blue	White
Grounded (Earth)	Green/Yellow	Green

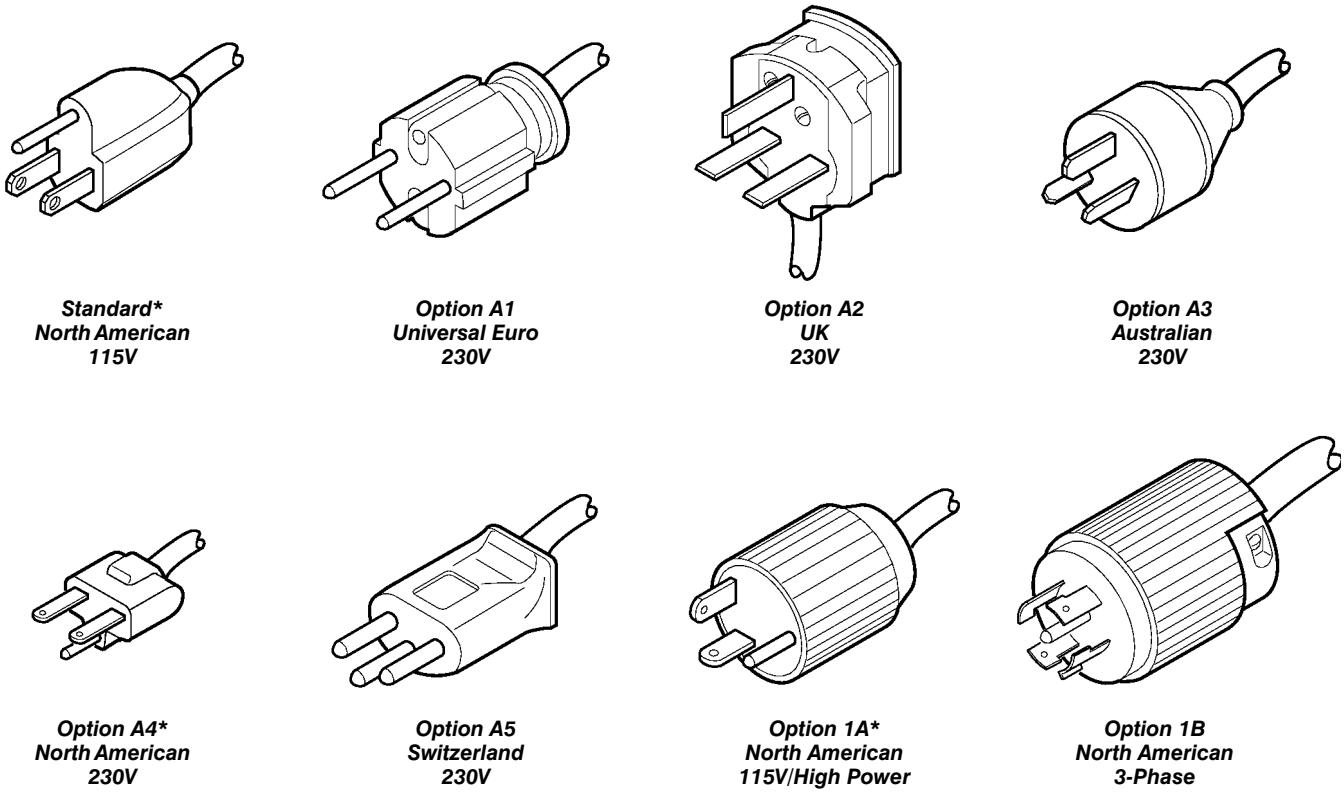


Figure 2-2: Power-Cord Plug Identification

Memory Backup Power

There are four batteries within the instrument that allow the retention of volatile memory upon loss of the AC power source. These self-contained power sources provide memory backup power to retain the following:

- front-panel settings
- stored settings
- stored waveforms
- **Time & Date** parameters
- Time Base Cal Constants (these are regenerated automatically if lost)
- the number of hours of instrument on-time, power-on sequences, and instrument serial number

The batteries have a nominal shelf life of approximately five years.

Operating Environment

The following environmental requirements are provided so that you can ensure proper functioning and extend the operation of the instrument.

Operating Temperature

The instrument can be operated where the ambient air temperature is between 0° C and +50° C and can be stored in ambient temperatures from −40° C to +75° C. After storage at temperatures outside the operating limits, allow the chassis to reach the safe operating temperature before applying power.

Ventilation Requirements

The fan draws air through the side panels of the instrument and blows air out through the rear to cool the instrument. To ensure that this cooling process occurs properly, allow at least two inches clearance on both sides and the rear of the instrument. The top and bottom of the instrument do not require ventilation clearance.



If air flow is restricted, then the instrument's power supply may temporarily shut down.

Packaging for Shipment

If the instrument is to be shipped for long distances by commercial transportation, it should be packaged in the original manner. The carton and packaging material in which your instrument was shipped should be saved and used for this purpose.

Also, if the instrument is to be shipped to a Tektronix service center for service or repair, attach a tag to the instrument showing the following:

- owner of the instrument (with address)
- name of person to contact at your firm
- complete instrument type and serial number
- if possible, furnish complete system firmware versions as displayed in the **Instrument Options** pop-up menu selected from the UTILITY major menu
- a description of the service required

If the original packaging is unfit for use or not available, package the instrument as follows:

- ☐ **Step 1:** Obtain a corrugated cardboard shipping carton with a 375-pound test strength and having inside dimensions at least six inches greater than the instrument dimensions. This allows for cushioning.
- ☐ **Step 2:** Wrap the instrument with polyethylene sheeting or equivalent material to protect the finish.
- ☐ **Step 3:** Cushion the instrument on all sides by tightly packing dunnage or urethane foam between the carton and the instrument, allowing three inches on each side.
- ☐ **Step 4:** Seal the carton with shipping tape or with an industrial stapler.
- ☐ **Step 5:** Mark the address of your local Tektronix service center and your return address on the carton in one or more prominent locations.

Theory of Operation

The Tektronix 11801C is a high-resolution digital sampling oscilloscope accommodating up to eight input channels through the dual-channel sampling heads. With the SD-24 TDR/Sampling Head, eight channels of single-ended TDR or four channels of differential TDR are available as well. Features include the following:

- sweep rates ranging from 5 ms/division to 1 ps/div
- autoset to provide a suitably adjusted display for viewing and further manual adjustment
- windows for viewing expanded sections of a trace
- self-tests to assure continuous accuracy of waveform data and measurements
- digital waveform storage and display
- on-board measurement capabilities
- menu-driven touch-screen operation
- RS-232-C, GPIB, and PRINTER interfaces

This section has two main sub sections:

- **System Functional Overview** describes the major functional blocks of the 11801C and presents a typical waveform processing cycle
- **Block Diagram Descriptions** discusses the individual boards in the 11801C

System Functional Overview

This section describes and illustrates the major functional blocks of the 11801C (see Figure 9-1).

Acquisition System Block

The 11801C contains two identical Acquisition systems. Each Acquisition system supports two dual-channel sampling heads for four overall channels. However, each Acquisition system contains only two physical channels that can be used for data acquisition and measurement.

Since each Acquisition system supports four input channels (two dual-channel heads) but contains only two acquisition/measurement channels, the four input channels are multiplexed into the two acquisition/measurement channels through analog multiplexers. Any one of the four sampling head input channels can be independently connected to either of the two acquisition/measurement channels.

Several calibration signals are also supplied to each multiplexer, although these signals are used only for self-tests and diagnostics.

Strobe Distribution Block

The Strobe Distribution block acts as an interface between the Time Base/Controller and the Acquisition systems.

The Time Base/Controller generates a strobe pulse that is regenerated by the Strobe Distribution block to drive all of the sampling heads in parallel.

Time Base/Controller Block

The Time Base/Controller block is comprised of:

- a microprocessor with local RAM and ROM
- the time base and trigger circuits
- interfaces to the memory management unit (MMU) and Acquisition systems

Trigger Select Block

The Trigger Select block selects the desired trigger signal to be sent to the Time Base/Controller block.

Executive Processor Block

After the user requests an operation (with a front panel control, for instance), the Executive Processor (EXP) directs the oscilloscope to perform this operation. Another primary function of the EXP is to execute diagnostic Self-Tests on the instrument when powering-on or at the user's request. To control operations, the EXP controls and monitors the other circuit boards sharing the executive system bus. Through the executive bus boards, the EXP also indirectly controls all other instrument boards. The EXP generates commands and status signals to control on-board devices and I/O devices, such as GPIB and RS-232-C interfaces, that help process data and help control the rest of the instrument.

Memory Management Unit Block

The memory management unit (MMU) arbitrates requests for access to the Waveform Memory from the following three sources:

- the EXP
- the Time Base/Controller
- the display system

This arbitration allows all three systems transparent access to the Waveform Memory.

Waveform Memory Block

Waveform Memory is shared among the following three processors:

- the EXP
- the Display
- the Time Base/Controller

While the main function of the Waveform Memory is the storage of waveform data and waveform related information, the shared memory is also used to pass messages between the Executive, Display, and Time Base/Controller processors. Eventually, all acquired waveforms are transferred from the Acquisition system memory to the Waveform Memory for display.

Front Panel Controls

User control of the oscilloscope is primarily through the following three front panel controls:

- the front-panel major-menu buttons
- the touch panel
- the multifunction knobs

The major menu buttons are the top level menu selections for the instrument. Touching an icon, menu item, or waveform selects that particular icon, menu item, or waveform, respectively. The multifunction knobs control the function of the particular item that is selected.

I/O Block

The I/O block provides a GPIB port, RS-232-C port, and a PRINTER port for interfacing various I/O devices to the instrument.

Waveform Compressor and Display Control Block

The display subsystem provides all visual output to the user. This includes not only data output such as waveform traces, graticules, axes, and annotation, but displays supporting the human interface as well (which includes menus, labeling for touch panel input, and an interactive output to assist in operating the system; that is, the current mode-setting information).

The oscilloscope uses a custom vertical raster-scan display that provides excellent resolution for both waveform display and text. The display system produces a display by:

1. transferring waveform data from the Waveform Memory
2. compressing it into 512 horizontal pixels
3. converting it to a format compatible with the vertical raster-scan display

The Waveform Compressor takes waveforms with more than 512 data points and compresses these points into 512 groups. For example, for a 1024-point waveform, each group would contain two points; for 2048-point waveforms, each group would contain four points. The Waveform Compressor finds the largest and smallest vertical value in a group of points and then draws a vector between the maximum and minimum — even in “dots” mode. The only difference between dots and vectors is that in vector mode the vectors are extended vertically to meet the vector on the next scan line.

Power Supply

The oscilloscope operates from either a 115 V or 230 V nominal line voltage source at a line frequency between 48 Hz and 440 Hz. The LINE VOLTAGE SELECTOR switch allows selection of AC line inputs of 90 V to 132 V_{RMS} or 180 V to 250 V_{RMS}.

To apply power to the instrument:

1. Turn the rear panel PRINCIPAL POWER switch to ON.
2. Turn the front panel ON/STANDBY switch to ON.

A small green indicator lamp should light, indicating the power is on.

Typical Waveform Processing Cycle

The following is a brief overview of how the oscilloscope acquires, processes, and displays a waveform from the input channels:

1. Analog input signals are connected to the sampling head inputs.
2. The Time Base/Controller block produces precisely timed strobe signals based on the trigger signal.
3. These strobe signals are distributed to the sampling head channels and instruct the sampling heads when to take samples of the input signal.
4. The Acquisition systems take the output of the sampling heads, amplify or attenuate the signals, and apply any offset based on the vertical size and position controls.
5. The output of the amplifiers are applied to analog-to-digital (A/D) converters, which convert the sampled voltages to digital codes and then store these codes in the acquisition system memory.
6. Once all the samples in a waveform have been acquired, the Time Base/Controller then transfers these samples from the Acquisition system memory to the Waveform Memory, through the waveform data direct memory access (DMA).
7. The EXP processes information from the human interfaces (that is; the menus, icons, buttons, and knobs that you interact with to control the oscilloscope).
8. The EXP sends commands to the display system so that the function that the user selected is displayed.
9. When instructed by the EXP, the display system receives the waveform data from waveform memory and converts it to a unique vertical raster-scan format for a display based on the user's settings.

Block Diagram Descriptions

This section describes the 11801C board level block diagrams (see the *Diagrams* section).

A1 M/F Strobe Drive Board

The A1 M/F Strobe Drive board consists of the following circuits:

- Data buffers circuitry
- Address latch circuitry
- Function decoder circuitry
- Internal clock rate generator circuitry
- Control buffers circuitry

See Figure 9-2 for a block diagram of this board.

Data Buffers

This circuit buffers the A5 Time Base/Controller board's address and data buses with bidirectional buffers, and the A5 Time Base/Controller board's control lines with octal buffers.

Address Latch

This circuitry buffers and latches the address for the A5 Time Base/Controller board to use.

Function Decoder

This circuit partially decodes this latched address and enables the data buffers if the address is on this board or on the A24/A27 & A25/A28 Acquisition system boards (controlled through this board). The function decoder also selects the appropriate direction of the data buffers to perform a read or write operation.

Internal Clock Rate Generator

This circuit is a 16-bit programmable counter that is tied to the ÷ 2 flip-flop which produces the square wave output. The overall division ratio of this block can be programmed from 2^2 to 2^{17}. The internal clock rate generator is programmed at power-on to provide a 100 kHz output, given a 4 MHz input on jumper J35.

Control Buffer

This circuit buffers the control signals sent to the A1 M/F Strobe Drive board from the A5 Time Base/Controller board.

A3 M/F Power Connect Board

The A3 M/F Power Connector board consists of built-in connectors that connect the power supply voltages from the A4 Regulator board to the following boards:

- A1 M/F Strobe Drive board
- A5 Time Base/Controller board
- A26 M/F Acquisition Interconnect board

The A3 M/F Power Connect board also supplies ±15 V power to the A14 Input/Output (I/O) board through a 16-pin ribbon cable.

A4 Regulator Board

The regulators convert semi-regulated voltages into stabilized, low-ripple, output voltages. The A4 Regulator board consists of the following regulators and the voltage-fault detect circuitry:

- +50 V
- −15 V
- +5 V
- +15 V
- −50 V

See Figure 9-3 for a block diagram of this board.

The operational amplifiers used for the +50 V, +15 V, +5 V, −50 V, −15 V, and −5 V regulators require that the following special voltages be generated for their operation:

- semi-regulated +54 V supply generates the +20 V supply
- semi-regulated −54 V supply generates the −20 V supply
- semi-regulated +54 V supply generates the +10 V supply
- semi-regulated −54 V supply generates the −10 V supply
- +10.0 REF is used as a reference voltage

Voltage Fault Detect

This circuit consists of two window comparators and associated resistors. This circuitry detects if any regulated supply is over-voltage or under-voltage. The associated resistors set a hysteresis window that is 5% of the regulator sense line voltages.

A5 Time Base/Controller Board

The A5 Time Base Controller board consists of the following circuitry:

- Microprocessor (MPU)
- RAM/ROM
- Trigger circuitry
- Time Base circuitry
- Acquisition system interface
- Memory management unit (MMU) interface

See Figure 9-4 for the block diagram of this board.

Microprocessor

The microprocessor controls the time base and trigger circuitry in response to commands from the Executive Processor, performs local on-line calibration of the time base, schedules waveform acquisitions, and manages the Acquisition system and waveform data transfers.

RAM/ROM Memory

Both RAM and ROM memory reside within the microprocessor's 1 Mbyte of address space. The upper 256 Kbytes is reserved as ROM, the lower 128 Kbytes of static RAM is provided for dynamic data storage and local nonvolatile memory. There are 32 Kbytes of memory-provided communication and waveform storage for the 11801C's eight channels, and another 32 Kbytes for the Strobe Distribution block of the oscilloscope and multiplexers. There are 512 Kbytes of memory assigned as communication and primary waveform storage. Another 32 Kbytes are used to map the communication buffer of the parallel interface with the memory management unit, and the remaining 32 Kbytes are divided into I/O space and time base control.

Trigger

This circuit is comprised of the trigger recognizer and gated voltage control oscillator. The trigger circuits accept trigger signals from the trigger attenuator. The strobe sense signal and internal feedback signals are used in the Self-Tests diagnostic process but are not normally used for data acquisition.

The trigger recognizer sees a valid direct trigger signal and outputs this signal to the voltage controlled oscillator which sets the timing for the strobe signal.

The direct trigger input allows programmed slope, level, AC/DC, and X1/X10 selection.

If auto trigger mode is selected, the timebase will generate its own trigger signal after 20 ms. If normal trigger mode is selected, the 11801C will wait for trigger signals.

The High Frequency On/Off Control selects the state of the trigger hysteresis in the trigger input path.

High Frequency On removes trigger hysteresis and improves sensitivity when the trigger signal edge slew rate is 1 V/ns or greater, typically a 320 mV_{p-p}, 1 GHz sine wave. See Figure 3-1.

High Frequency Off retains trigger hysteresis while improving noise rejection at low frequencies, when the trigger edge slew rate is less than 1 V/ns. It can be used at any frequency if the trigger signal amplitude reliably triggers the 11801C. See Figure 3-1. This is the default setting after initialization.

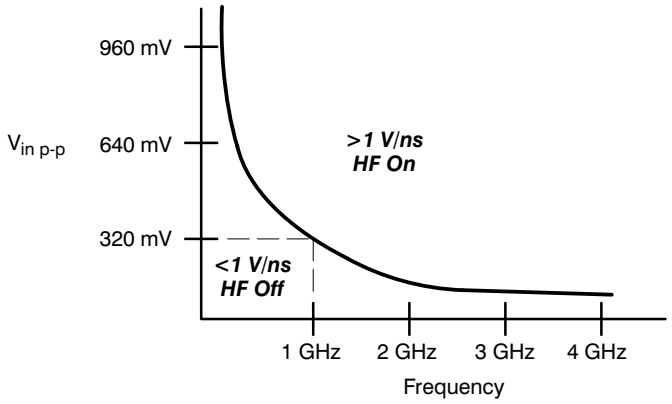


Figure 3-1: Trigger Edge Slew Rate for High Frequency Selection

The Enhanced Triggering ON/Off Control selects the state of the metastable trigger rejection feature in the trigger input path.

Enhanced Triggering On directs the timebase to detect metastable trigger events and reject the acquired data. The data is reacquired at the next trigger event.

Enhanced Triggering Off allows the timebase to acquire and display metastable trigger events.

The Trigger Holdoff Control in the trigger menu programs the trigger holdoff value.

Auto Holdoff is the default mode. This mode automatically programs Actual Holdoff to the minimum possible value. It depends only on the time base settings and is updated when the Main Size and Main Position values change. Triggering is held off to beyond the rightmost point in the Main record. The minimum value is 5 µs. The Actual Holdoff (auto mode) calculation is:

Actual Holdoff (auto mode) = max (5 µs, 5 µs+Main Pos+Duration)

where Duration = Main Size×10 divisions.

Manual Holdoff extends the trigger holdoff to longer periods, up to 2.5 seconds. The Actual Holdoff value depends on the value of Requested Holdoff in addition to the time base settings. The Actual Holdoff (manual mode) calculation is:

Actual Holdoff (manual mode) = max (5 µs, 5 µs+Main Pos+Duration, Requested Holdoff)

Time Base

This circuit is a very precise slewing delay generator. It accepts triggers from the reference oscillator, generates a precise delay, and outputs a strobe-drive pulse.

The time base circuitry consists of a TECL integrated circuit (IC), which contains three six-bit high-speed counters, and a CMOS IC, which contains a 48-bit programmable strobe delay generator.

On the first sample of the waveform, the sample is taken immediately after a starting delay. Subsequent samples are delayed by an small additional amount, called the dot delay. The dot delay is programmed and stored into the strobe delay register. Each sample is delayed by one delay more than the previous sample. The dot delay can vary from 10 fs to 20 ns depending on the horizontal size and the number of points in the waveform record.

The sampling interval (incremental delay between samples) is the total acquisition time (time/division $\times$ 10 divisions) divided by the number of points acquired.

Acquisition System Interface

This circuit contains 16 Kbytes of RAM (physically located on the A25/A28 Acquisition MPU board) that is shared between the Acquisition system and the Time Base/Controller. This RAM is mapped into the microprocessor memory space so that it can be accessed as any other RAM — either by the microprocessor, itself, or by the DMA controller.

This shared memory allows the microprocessor to transfer waveforms from the Acquisition system to the Waveform Memory using DMA. It also provides a mailbox structure for commands and data passed between the two systems.

Memory Management (MMU) Interface

This circuit interfaces the Time Base/Controller to the EXP and the Waveform Memory. This interface allows the EXP to send commands to the microprocessor through the Time Base/Controller and provides the path for waveform transfers from the Acquisition system to the Waveform Memory.

A7 CRT Socket Board

The A7 CRT Socket board is an interface from the A15 MMU board to the CRT. The A7 CRT Socket board consists of the following circuits:

- Red, Green, and Blue video amplifiers
- RED, GREEN, and BLUE cutoff adjustments
- CONVERGENCE adjustment

See Figure 9-5 for a block diagram of this board.

Red, Green, and Blue Video Amplifiers

These three circuits are identical high speed video amplifiers that drive the three cathodes (R, G, and B; red, green, and blue, respectively) of the CRT. Each of the three colors can be programmed to display 64 different levels. This yields a possible 262,144 colors, of which eight can be displayed on the screen at any time.

Red, Green, and Blue Adjustments

These three potentiometers control the cutoff point; that is, the point at which a certain color becomes invisible.

Convergence Adjustment

This potentiometer controls the vertical convergence of the red, green, and blue deflection beams.

A8 CRT Driver Board

The A8 CRT Driver board consists of the following circuits:

- Horizontal sweep circuitry
- Vertical sweep circuitry
- High voltage and grid voltage generator circuitry
- Degauss circuit
- Beam current limit circuit
- Grid bias circuit

The A8 CRT Driver board circuitry drives the raster scan CRT. The VIDEO and SYNC signals from the A15 MMU board generate the Z-axis signal, sweep signals, and grid bias voltages for the CRT.

See Figure 9-6 for a block diagram of this board.

Horizontal Sweep

This circuit generates the sweep current for the horizontal deflection yoke. The horizontal driver includes an oscillator, a voltage ramp generator, a high-gain amplifier, and a flyback generator. These components provide sweep synchronization, horizontal deflection, and linearity.

The horizontal adjustments, H-SIZE, H-POS, and H-LIN, allow you to optimize the appearance of the display.

Vertical Sweep

This circuit produces a deflection current that sweeps the video beam from the bottom to the top of the CRT. This circuit also produces a flyback signal for the flyback transformer that is in parallel with the deflection yoke.

The vertical adjustments, VERT SIZE and VERT POS, set the vertical size and position of the display.

High Voltage and Grid Voltage Generator

This circuit includes the flyback transformer which generates the 16 kV CRT anode potential and other bias voltages. This transformer is coupled and synchronized with the vertical deflection system.

The SCREEN adjustment provides the cutoff point; that is, the point where no information is visible on the display screen. The FOCUS adjustment provides manual focusing of the display image.

Degauss

This circuit removes magnetic fields from the color steel aperture grille. These magnetic fields are induced at each power-on by magnetic sources.

The Degauss circuit produces an exponentially decaying sine wave with a frequency of approximately 3.7 kHz. This waveform is applied to the degauss coils that are located on both sides of the CRT. The decayed oscillation through the coils causes a magnetic field to be induced in the CRT steel aperture grille. This magnetic field saturates the steel, and then forces the stored magnetic field down to zero as the steel is driven around its hysteresis curve.

Beam Current Limit

This circuit limits the average power to the CRT to less than 15 W. An amplifier circuit compares the sum of the anode current and the FOCUS adjustment current to a reference current of 0.72 mA. If the sum of the two currents exceeds the reference current, then the three video amplifiers on the A7 CRT socket board are disabled.

Grid Bias

This circuit provides −40 V of grid bias to the A7 CRT Socket board. At power-off, the grid is supplied with −90 V until the focus circuit discharges a high voltage. This prevents a bright spot from appearing at the center of the screen at power-off.

A9, A10, and A11 Front Panel Boards

The A9, A10, and A11 Front-Panel Circuit boards specifically consist of the:

- A9 Touch Panel assembly
- A10 Front Panel Control board
- A11 Front Panel Button board

Touch Panel, Major Menu Keys, and Menu Status LEDs

These three functions interface to the Executive processor through a general purpose programmable keyboard and display controller IC on the A10 Front Panel Controller board.

The keyboard function of the IC handles the touch matrix and hard keys. The display function drives the menu LED light bars.

A9 Touch Panel Assembly

This circuit is comprised of infrared LEDs that produce a matrix of light beams that are interrupted when the user touches a particular touch zone. The touch panel and hard key matrix are scanned continuously until a shadow or keypress is detected. When a hit is detected, that scan is com-

pleted and the interrupt line is asserted by the display controller. During this time the interrupt is active and no new data is written into the sensor RAM from the touch panel or hard keys even though the hardware continues to scan; therefore, the data will not change in the sensor RAM while the microprocessor is reading it.

Only one infrared LED is turned on at a time and only the phototransistor directly opposite is selected to receive light. This prevents any crosstalk between emitter/detector pairs.

A10 Front Panel Control Board

This circuitry generates the 6-bit address bus that is used to select an infrared LED and its compliment phototransistor on the A9 Touch Panel board.

A11 Front Panel Button Board

This circuitry is comprised of the major menu LED light bars which are driven by the display refresh register output of the A7 Display Controller board. Internally, there is a matrix of display RAM organized in an 8-bit by 8-bit matrix. This display RAM is scanned column by column (automatically); lighting the appropriate LED bar(s) when a high bit is encountered. The coarse/fine LEDs are driven by a latch which is controlled by the EXP. The coarse/fine selections are sensed on the A9 Touch Panel board.

A12 Rear Panel Assembly

The A12 Rear Panel assembly links the oscilloscope to other devices. This assembly contains connectors for the following devices:

- One GPIB Port
- One RS-232-C Port
- One Printer Port (Centronics style)

The A12 Rear Panel assembly is controlled from the A14 Input/Output (I/O) board through a 40-wire cable. This cable carries the following signals:

- Eight-bit bidirectional data bus
- Four-bit address bus
- Four interrupt lines
- GPIB DMA request and grant lines
- Four device control lines
- Assorted power supply and ground lines

See Figure 9-7 for a block diagram of this assembly.

GPIB Data and Address Bus

This bus drives the GPIB controller directly. Control signals DBIN, and WR are used by the GPIB controller to determine if the microprocessor is trying to read from or write to it. The interrupt controllers in the A17 Executive Processor board monitor this interrupt line and will signal the microprocessor to service the GPIB controller. In order to communicate with the microprocessor, the GPIB controller requires that at least one of the following conditions occurs:

- the receiver section of the GPIB controller has a byte of data (Inbyte Register) from the GPIB bus that the microprocessor needs to read
- the transmitter section register (Outbyte Register) is empty and is ready to receive another byte of data
- the status of the GPIB bus or the GPIB controller has changed and the microprocessor has to be notified

On the opposite side of the GPIB controller is another bus system. This other bus system includes an eight-bit data bus which accesses a bidirectional GPIB data buffer and an eight-bit control bus which accesses a GPIB control driver. The GPIB bus is connected to the opposite side of the buffer and control driver. These two devices are specially designed to be TTL signal-level compatible on the bus side of the buffer driver.

The states of three control signals from the GPIB controller, SRQ, NRFD and NDAC, are monitored and displayed on the rear panel of the oscilloscope. These LEDs show the state that the GPIB controller is in, not the state of the GPIB bus.

Two other signals of interest are GPIB RQ and GPIB GR. These signals are used by the DMA Controller on the A17 Executive Processor board to communicate with the GPIB controller. The DMA can be programmed by the microprocessor to service either the Inbyte register or the Outbyte register.

Standard RS-232-C Controller

This communications controller is connected to the same data bus and address bus as the GPIB controller. The RPD7-RPD0 address lines transfer data to and from the microprocessor. The RPA1-RPA4 address lines are used by the microprocessor to select individual registers in the GPIB controller. The STD RS SEL line goes low when the microprocessor wants to communicate with the RS-232-C controller. (This line also drives the Chip Enable.)

The RD and WR signals are driven by the microprocessor to signal if the GPIB controller is to be read from or written into. The controller sets the STD RS INTR (interrupt) line low to request service from the microprocessor. The microprocessor writes a byte into the controller's transmit buffer to transmit data on the RS-232-C bus. The microprocessor reads a byte from the receiver buffer to receive data from the RS-232-C bus. The microprocessor can

also read the status of the controller. The RS-232-C controller translates the parallel data from the microprocessor to serial data from RXD on the RS-232-C bus to parallel data for the microprocessor.

There are transmit and receive buffers which are compatible with the RS-232-C bus. Clear To Send (CTS) and Data Set Ready (DSR) are RS-232-C control signals that can be controlled by the microprocessor. Request To Send (RTS) and Data Terminal Ready (DTR) are signals that can be read by the microprocessor. The Received Signal Detect (RSD) control signal is always high when power is on. This RS-232-C port is a DCE type.

Printer Port

The Centronics-style, J111, printer port is controlled by a programmable peripheral interface IC. This IC has all the control lines necessary to connect to a microprocessor, plus two general purpose eight-bit ports and the control signals to use them. The A12 Rear Panel Assembly Data bus and Address bus connect to the IC and have the same function as described for the GPIB and RS-232-C controllers. The Printer Sel line is set low by the microprocessor when it is communicating with the interface. The RD and WR lines allow the microprocessor to either read or write to the registers in the programmable peripheral interface IC. This IC must be initialized by the microprocessor for Port A to be a strobed input port. Port C provides the control signals.

A13 Mother Board

The A13 Mother board provides the interconnection for the microprocessor signals and the +5 V power among the following boards:

- A14 I/O board
- A15 Memory Management Unit (MMU) board
- A17 Executive Processor board
- A18 Memory board

A14 Input/Output (I/O) Board

The A14 I/O board contains the following circuits:

- Data buffers
- Timer configuration circuitry
- Real time clock
- Serial data interface (SDI)
- Temp/tone readback buffer
- Tone generator
- GPIB control circuitry

See Figure 9-8 for a block diagram of this board.

The A14 I/O board is an interface between the Executive Processor (EXP) and devices on the A9, A10, and A11 Front Panel boards, the A12 Rear Panel assembly, and on-board I/O devices. The EXP reads and writes to these I/O devices at specific I/O addresses. These I/O addresses are decoded to produce device select signals which enable the addressed device. Each I/O device is located on I/O address boundaries of at least 100_{hex}.

The lower eight bits of the Executive data bus transmit data to and from the various I/O devices. Note that only one I/O device can be accessed at a time.

I/O Data Buffer

This circuit buffers the lower eight bits of the Executive data bus from P105. The output of the I/O data bus drives data to the following six on-board devices:

- I/O delayed data buffer
- Rear panel data buffer
- Front panel data buffer
- Tone generator
- Tone/temp readback buffer
- Timer configuration circuitry

I/O Delayed Data Buffer

This circuitry interfaces between the I/O data bus and the Write Delayed data bus.

Timer Configuration

This circuitry is composed of a latch and three two-input data multiplexers built with discrete gates. When a byte of data on the I/O data bus is latched, some of the data bits individually configure counters 1 and 2, allowing the timer to accept different inputs for different system tasks. The operating system uses counter 0 as a real-time clock based on the 2 MHz CLK input from the clock generator, which is always operating at 8 MHz.

Real Time Clock

This clock and its oscillator circuit maintain the current time of day. The EXP sets the real time clock and also interrupts the Executive processor (EXP) every one second to request the EXP to read the time.

Serial Data Interface (SDI)

This circuitry is a custom IC that interfaces the EXP to both front panel knobs. The EXP controls this IC, and this IC interrupts the EXP when a device requires service.

Tone Generator

This circuitry utilizes a DAC and a timer. The timer is equipped with a special current switch and capacitor to set the timer's frequency. The timer outputs a square wave whose frequency is inversely proportional to the digital value written to the temp/tone DAC. Thus, if a zero value is input to the DAC, the tone generator produces the highest tone.

Temp/Tone Readback Buffer

This circuit is an eight-line buffer connected to the I/O data bus. The EXP uses this buffer to monitor the tone generator.

A15 Memory Management (MMU) Board

The A15 MMU board consists of the following circuits:

- MMU IC
- Waveform RAM
- Display interface
- Time Base/Controller interface
- Executive processor (EXP) interface
- Display IC
- Microprocessor
- Bit map RAM
- Waveform display RAM circuitry
- Video DAC

The A15 MMU board coordinates communications among the following three oscilloscope subsystems:

- Display
- Time Base/Controller
- Executive

See Figure 9-9 for a block diagram of this board.

MMU IC

This circuit controls all data transfers to and from waveform RAM. The MMU gate array controls high-speed transfers of waveform data and communication messages between waveform RAM and the three subsystem interfaces: the Display, Time Base/Controller, and Executive processors. A set of handshaking lines designed to the DMA facilities of each particular subsystem coordinates each subsystem interface.

Waveform RAM

This memory consists of 512 Kbytes of RAM. The RAM holds waveform data and messages that are read and written by the Time Base/Controller, Display, and Executive subsystems.

Display Interface

Data is transferred to and from the Display subsystem and to and from the MMU IC through the Display Interface. The data is buffered with the bidirectional display data buffers.

Time Base/Controller Interface

Data is transferred to and from the Time Base/Controller subsystem and to and from the MMU IC through this interface.

Executive Processor (EXP) Interface

This circuit consists of bidirectional buffers, address mapping programmable array logic (PAL), and interface timing control PALs. This circuitry directs data flow to the EXP from the MMU IC and vice versa.

Display IC

This component consists of the following functional circuits:

- CRT controller
- Video output circuitry
- Compressor circuit

The basic function of the CRT Controller is to produce VIDEO and SYNC signals that indicate to the CRT where to position video information. The controller is virtually automatic in operation and invisible to the firmware programmer except for several internal registers that must be initialized at power-on.

The video output circuitry is where the hardware recognizes and displays specific data structures while the raster-scan CRT displays the contents of the bit map.

During the refresh of the screen, the hardware acquires bit map data along with waveform display data to yield a final color index.

The compressor circuit receives a waveform composed of several possible numbers of data points and outputs 512 pairs (one minimum and one maximum) to the display.

Microprocessor

The microprocessor transforms the entire Display subsystem into an intelligent peripheral dedicated to operating the display. The firmware that controls the Display subsystem executes from ROM in the microprocessor's address space. The clock for this microprocessor operates at a frequency of 8 MHz.

Bit Map RAM

This memory consists of 256 Kbytes of RAM, divided into 4-bit planes of 65,536 bytes each. Three of the bit planes are for text and the remaining bit plane is for XY, variable persistence, and infinite persistence. Each bit in a plane represents a single pixel of the display. Setting the representative pixel bit in each of the planes controls the color or intensity.

Waveform Display RAM

This memory consists of 65,536 bytes. These bytes contain the minimum/maximum pairs of values, color index, and overrange/underrange information.

Video Digital-to-Analog Convertor (DAC)

This circuitry converts the digital data from the Display IC into analog data for the A7 CRT Socket board.

A17 Executive Processor Board

The A17 Executive Processor board consists of the following circuitry:

- Executive processor (EXP)
- Numeric coprocessor circuitry
- Bus buffer circuitry
- Preset circuitry
- Wait state circuitry
- Interrupt controllers
- DMA Controller

See Figure 9-10 for a block diagram of this board.

Executive Processor (EXP)

This microprocessor executes firmware routines stored in EPROMS that are located on the A18 Memory board to control the operation of the oscilloscope. Along with the numeric coprocessor, the EXP does all data processing not directly related to generating the display or digitizing the waveform. When power is first applied to the oscilloscope, the EXP executes local and system diagnostic tests, which are located in the EPROMs on the A18 Memory board.

The EXP performs these functions with the following three main circuits:

- the clock generator creates the timing signals and synchronized reset signals for the microprocessor
- the microprocessor reads and writes data, generates addresses for I/O and memory devices, and generates status signals for the bus controller
- the bus controller interprets the microprocessor's status signals and generates the necessary bus control signals for the Executive bus

Address decoders, address latches, and data buffers are all support circuits for I/O operations.

Numeric Coprocessor

This coprocessor is a high-speed floating-point processor that executes instructions in parallel with the EXP. The EXP programs and controls the numeric coprocessor as an I/O device at addresses $0F8_{hex}$ to $0FF_{hex}$.

Bus Controller

This circuit consists of a data buffer, an address buffer, and a control buffer that provide command and control signals from the microprocessor to the three Executive buses. The Executive buses consist of the following:

The system data bus — is a bidirectional bus. It allows the microprocessor to fetch instructions from memory, and also to write data to memory and read data from memory. The memory that the microprocessor uses is located on the A18 Memory board.

The system address bus — carries the address of a device when the microprocessor is requesting access to that device. Once the microprocessor has access, the addressed device can then respond to the microprocessor.

The system control bus — carries control signals sent by the microprocessor. These control signals are sent to the devices that the microprocessor addresses so that the devices can respond at the proper moment in the bus cycle.

Reset

This circuitry generates synchronized ready and reset control signals.

Wait State

This circuitry extends the bus cycle so that slower devices have sufficient time to read or write data.

Interrupt Controllers

These circuits constantly monitor the EXP's interrupt lines to ensure that the highest priority interrupt gets serviced first. The Interrupt controllers provide the ability to assign priority levels to all the system's interrupt lines and, conversely, to ignore (mask) any of the interrupt lines as well.

DMA Controller

This circuitry shortens the GPIB transfer time and also the transmission time of waveforms through the GPIB.

A18 Memory Board

The A18 Memory Board provides the Executive processor (EXP) with system RAM (SRAM), Nonvolatile RAM (NVRAM), and EPROM for most operations. Support circuitry for the memories and diagnostic circuitry for troubleshooting are located on-board. All accesses to SRAM, NVRAM, or EPROMs are initiated by the A17 Executive Processor board (specifically by the EXP or the DMA controller). Refer to the discussion of the A17 Executive Processor board, earlier in this section, for bus cycle timing information.

The A18 Memory board consists of the following circuitry:

- Address latches
- Address decode and memory select circuitry
- EPROM and system RAM
- Memory data buffers
- Wait state generator
- Wait state diagnostics
- Memory configuration readback
- Nonvolatile RAM and battery backup

See Figure 9-11 for a block diagram of this board.

Address Latches

This circuitry buffers and holds the address lines for the EPROMs, SRAMs, NVRAMs, and other on-board devices until the end of the bus cycle.

Address Decode and Memory Select

This circuitry consists of a programmable array logic (PAL) device that decodes the address lines to produce five RAM select signals (DCS4-8) and four EPROM select signals (DCS0-3). DCS8 enables the SRAM while DCS4-7 enable the NVRAM. All EPROM and RAM select lines are latched, and the latch outputs are normally enabled. While the latch enable signal is high, the latch outputs are responsive to changes on the inputs; while the latch enable signal is low, the select lines are latched.

The EXP on the A17 Executive Processor board generates the address line inputs, A14-A19. Depending upon the position of a jumper on the A17 Executive Processor board, address lines A20-A23 can be memory bank-select lines or microprocessor address lines.

The memory select circuitry provides latched memory select lines and an enable signal for the memory data buffers.

EPROMs, SRAM, and NVRAM

The memory includes EPROMs, System RAM (SRAM), and Nonvolatile RAM (NVRAM). The EPROMs contain all of the operating system code and diagnostics code for the EXP. All the memories share the latched address bus. The SRAM stores miscellaneous constants that the operating system code uses and produces. The NVRAM contains stored settings, stored traces, and other nonvolatile parameters. The memories are organized into high and low-byte pairs. The address decode PAL generates latched chip-select signals. A separate latched chip-select signal selects each of these pair. The memory data buffers buffer the data lines to the Executive data bus.

Memory Data Buffers

These ICs drive data between the memories and Executive data bus. Both eight-bit buffers are enabled when all of their inputs are high.

Wait State Generator

This circuit allows the EXP to access memory devices when the EXP is operating at faster clock frequencies. When the EXP is operating at frequencies greater than 8 MHz, the bus cycle time is too short to allow reads or writes to the present memory devices. The wait state generator sets the SRDY line (see Figure 9-10) on the Executive bus low to signal the EXP to lengthen the bus cycles.

The wait state generator also contains a circuit to generate control signals (similar to those on the Executive bus). These control signals are early address latch (ELATCH), early memory write control (EMWTC), and early memory read control (EMRDC).

Wait State Diagnostics

This firmware routine measures the time interval that the wait state generator generates when a one (1) is written to I/O address 8020_{hex}. This causes the wait state diagnostics to connect the SRDY signal to the DIAGNSIG line on the Executive bus. A timer on the A14 I/O board can then measure the length of the wait.

Memory Configuration Readback

This circuitry allows the diagnostics to read the position of the memory configuration straps and the bank address lines. One bit of the readback data byte also indicates if the battery is at 2.5 V (an early warning of a low battery). The EXP performs an I/O read at address 8040_{hex} to read this information.

Battery Backup

These batteries provide standby power to the nonvolatile RAM (NVRAM) during the powered-off periods of the oscilloscope.

A19 Strobe/TDR Buffer Board

The A19 Strobe/TDR buffer board is comprised of the following three main circuits:

- Strobe sense select circuitry
- Strobe deskew circuitry
- TDR buffer and level shift circuitry

See Figure 9-12 for a block diagram of this board.

Strobe Sense Select

This circuit consists of five signal diodes (these diodes are normally off). The diodes carry the four sampling signals (J1A, J2A, J3A, J4A) from the four sampling heads, and the reference strobe signal. When a particular diode is biased on, it allows the selected strobe sense signal to continue out of jumper J32.

Strobe Deskew

This circuit corrects the time delay between the sampling strobe signals which may occur from the mismatch in the external cabling or in the internal cables that distribute the strobe. The repositioning is done with the strobe deskew voltages, which are DC control voltages found on jumper J34. (Power is also supplied to this board through this jumper.) The strobe deskew voltages are generated on the A1 M/F Strobe Drive board and are controlled by the microprocessor on the A5 Time Base/Controller board. The sampling strobe alignment is checked by routing the strobe sense signals to the A5 Time Base/Controller board where the microprocessor measures and adjusts the time alignment of each sampling head.

TDR Buffer and Level Shift

This circuitry consists of an ECL buffer and four dual-transistors that level-shift the TDR signal for proper drive of the TDR step generators in the sampling heads.

A20-23 Head Interconnect Boards

The A20-A23 Head Interconnect boards provide the interface between the sampling head connectors (J11, J12, J13, J14), the ribbon cable W150, and the coaxial cables W100 and W200. W150 connects to the A26 M/F Acquisition Interface board and carries the control status and power. W100 and W200 connect to the A24/A27 Acquisition Analog board and carry the signals from the sampling heads.

A26 M/F Acquisition Interconnect Board

The A26 M/F Acquisition Interconnect board provides and distributes the power to the interconnections between the following boards:

- A24/A27 Acquisition Analog board
- A25/A28 Acquisition MPU board
- A20-A23 Head Interconnect boards

See Figure 9-13 for the block diagram of this board.

The A26 M/F Acquisition Interconnect board also has a precision voltage reference (V) to furnish the ±5 V reference required by the A24/A27 Acquisition Analog board.

A24/A27 & A25/A28 Acquisition System Boards

The Acquisition system consists of four boards: the A24/A27 Acquisition Analog boards and the A25/A28 Acquisition MPU boards.

The A24/A27 Acquisition Analog board consists of the following major blocks:

- Programmable gain amplifiers
- A/D converters
- Measurement hardware
- Timing and sampling head control

The A25/A28 Acquisition Analog board consists of the following major blocks:

- Shared RAM
- Tme base/controller interface
- Microprocessor
- Measurement hardware
- Timing and sampling head control

See Figures 9-14 and 9-15 for the block diagrams of these boards.

Programmable Gain Amplifiers

The four sampling head outputs are multiplexed to two amplifier channels through the input multiplexer. The microprocessor selects a sampling head channel to be acquired and connects it to one of the amplifier channels. The programmable gain amplifier then applies offset (Vert Pos) and amplifies or attenuates the signal (Vert Size). The output of the amplifier is applied to the analog to digital (A/D) converter for conversion to digitized data.

A/D Convertors

The output of each programmable gain amplifier is applied to an eight-bit flash A/D converter. The converter compares its analog input to two reference voltages (+1 V REF and −1 V REF) and outputs an eight-bit binary number that indicates the relative value of the analog input signal in relation to the reference voltages. The digital output from the A/D converters is stored in the shared RAM and made available for transfer to the Waveform Memory through the Time Base/Controller.

Measurement Hardware

This circuitry has the selected sampling head output from the input multiplexer applied to a precision strobed voltage comparator. This voltage comparator compares the sampling head output voltage to a reference voltage generated by a 14-bit digital-to-analog converter (DAC). The comparator output is then filtered by a filter and transition counter circuit on the A25/A28 Acquisition MPU board to remove false transitions generated by noise and to count the transitions.

When the processor requests a hardware timing measurement such as a propagation delay measurement, the comparator is programmed for the appropriate measurement level and the transition counter is programmed to locate the selected transition number and slope. The hardware counts the strobe pulses that occur from the beginning of the acquisition to the point where the selected transition occurs. This operation is performed on two channels — one for each crossing point of the timing measurement. When the transition points are found, the Acquisition processor reads the sample number from the hardware and stores it in a specific location in the shared memory for the Time Base/Controller. The Time Base/Controller reads these points (from each channel involved in the measurement), subtracts these points, and then multiplies the result by the sampling interval. The result is a measurement of the time between two threshold points.

Timing and Sampling Head Control

This hardware generates analog control voltages that control several sampling head operation and calibration parameters. For example, the loop gain calibration adjustment is controlled by an analog voltage generated in the oscilloscope for each sampling head channel. In addition, three digital control lines go to each sampling head — two to enable or disable TDR on each channel and one to enable smoothing for both channels in a head.

This circuit block also generates timing signals that control when waveform data is digitized and when the measurement hardware is clocked. The time base sends a strobe pulse to the acquisition system and to the sampling head to initiate a sample. Each acquisition processor can also generate strobe pulses locally for Self-Tests and diagnostic purposes.

Shared RAM

The memory for the A25/A28 Acquisition MPU board contains 16 Kbytes of shared RAM. This memory is arbitrated on the A25/A28 Acquisition MPU boards between the Acquisition system processor, the Time Base/Controller processor, and the A/D converters on the A24/A27 Acquisition Analog board. All waveform data acquired by the Acquisition system, as well as control and data messages passed between the Acquisition system and the Time Base/Controller, pass through this shared memory.

Time Base/Controller Interface

This circuitry handles requests from the Time Base/Controller to access the shared memory on the A25/A28 Acquisition MPU boards. The shared memory is then arbitrated and buffered through the Time Base/Controller interface hardware. This hardware decodes and latches the Time Base/Controller address and generates a wait signal that holds the Time Base/Controller processor in a wait state until a bus cycle can be granted to allow the memory access to complete.

The arbitration logic coordinates requests for access to the shared memory from the A/D converters, the Acquisition system processor, and the Time Base/Controller processor.

Microprocessor

The microprocessor controls the Acquisition system, which has 64 Kbytes of EPROM for code storage, 16 Kbytes of shared RAM and 8 Kbytes of unshared RAM. The microprocessor calibrates and manages the programmable gain amplifiers and measurement hardware. The microprocessor also accepts and executes commands from the Time Base/Controller processor and manages the sampling head digital and analog controls, including scanning the front panel SELECT buttons on the sampling head and driving the front panel LEDs.

Performance Verification

This section contains procedures to check electrical specifications and examine measurement limits listed in Table 4-1. Use these procedures to check the oscilloscope operation following repair. To functionally test the oscilloscope, simply perform the procedures listed in Table 4-1 which have a "yes" indication in the Functional Test column. The Specifications or Measurement Limits are given at the beginning of each procedure. Adjustment procedures are included in the *Adjustment* section. Refer to the *11801C Digital Sampling Oscilloscope User Manual* for more information about oscilloscope specifications and operation. The Setup in each procedure provides information concerning test equipment setup or interconnection. Refer to Table 4-2 for more information concerning test equipment used in the setups.

Most Performance Verification and Adjustment procedures can be run in any order. However, the Sampling Head Calibration must always precede other procedures which use an operational sampling head (i.e., does not apply to parts using the Calibration Head). Also, if a different sampling head is used, then a sampling head calibration is required for each additional sampling head.

Table 4-1: Measurement Limits, Specifications, and Functional Tests

Part and Description	Measurement Limits *(Examine)*	Specifications *(Check)*	Functional Test
Power-On Diagnostics	none	none	yes
Sampling Head	none	none	yes
Extended Diagnostics	none	none	yes
Vertical Reference Voltage	none	+5 V ±200 µV and −5 V ±200 µV	no
Horizontal Reference Clock	none	200,000 kHz ±5 kHz	no
Vertical Accuracy			
Vertical Gain	none	±1.0% full scale	yes
Offset Accuracy	none	±2 mV	yes
Vertical Linearity	none	±1%	no
System Vertical RMS Noise	200 µV at 2 mV/div 500 µV at 5 mV/div 1 mV at 10 mV/div 632 µV at 20 mV/div 1.58 mV at 500 mV/div 3.16 mV at 100 mV/div 6.32 mV at 200 mV/div	none	yes

Table 4-1: Measurement Limits, Specifications, and Functional Tests (Cont.)

Part and Description	Measurement Limits *(Examine)*	Specifications *(Check)*	Functional Test
Sweep Rate Accuracy	0.05% at 2 ns/div 0.08% at 1 ns/div 0.8% at 100 ps/div 2.5% at 10 ps/div 10% at 1 ps/div	none	yes
Triggering			yes
300 MHz Sensitivity	100 mV_{p-p} at 300 MHz	100 mV stable display	
1000 MHz Sensitivity	100 mV_{p-p} at 1000 MHz	100 mV stable display	
3.0 GHz Sensitivity	100 mV_{p-p} at 3.0 GHz	100 mV stable display	
Internal Clock			yes
Rise Time	≤2.5 ns	≤2.5 ns	
Frequency	100 kHz ±3%	100 kHz ±3%	
Duty Cycle	50% ±3%	50% ±3%	
Prescaler	800 mV_{p-p} at 2 GHz 600 mV_{p-p} at 3 GHz 600 mV_{p-p} at 10 GHz	800 mV stable display 600 mV stable display 600 mV stable display	yes
Calibrator Output			yes
Rise Time (typical)	250 ps	250 ps	
Peak-to-peak Amplitude	250 mV ±10%	250 mV ±10%	

Test Equipment

Table 4-2 (Test Equipment), contains suggested test equipment for use in this section. Procedure steps are based on the test equipment examples given, but you may substitute other equipment with similar specifications. The use of different equipment may alter test results, setup information, and related connectors and adapters.

Table 4-2: Test Equipment

Description	Minimum Specification	Examples of Applicable Test Equipment
High Frequency Sine Wave Generator	10 MHz to 10 GHz	WILTRON 6759B Opt 2
Sampling Head	SD-Series	SD-24 and any other Tektronix SD-Series Sampling Head except SD-14
Digital Voltmeter (w/test leads)	≤0.005% Accuracy	FLUKE 8842A Digital Voltmeter
Frequency Counter	One Part in 1,000,000 Accuracy	Tektronix DC 5010 Universal Counter/Timer with a TM 5000-Series Power Module
Calibration Head		Tektronix Calibration Head 067−1413−00
Precision Voltage Source		DATA PRECISION 8200
Test Terminal	any GPIB (IEEE−1978) controller, or ASCII terminal equipped with an RS-232-C port. Requires compatible RS-232-C serial interface cable	IBM compatible PC with terminal emulation software
Coaxial Cable, 50 Ω (3 required)	50 Ω, 36-inch, male BNC connectors	Tektronix Part 012−0482−00
Coaxial Cable, RF	RF cable, 12 in., SMA connectors	Tektronix Part 174−1364−00
	RF cable, 8.5 in., SMA connectors	Tektronix Part 174−1120−00

Table 4-2: Test Equipment (Cont.)

Description	Minimum Specification	Examples of Applicable Test Equipment
Adapters	BNC female-to-male Dual Banana	Tektronix Part 103−0090−00
	BNC male-to-female Dual Banana	Tektronix Part 103−0035−00
	SMA male-to-BNC female (8 required)	Tektronix Part 015−1018−00
	SMA female-to-BNC male	Tektronix Part 013−0126−00
	SMA male-to-N male	Tektronix Part 015−0369−00
Power Divider, 50 Ω	6 dB load isolation, 50 Ω, SMA connectors	Tektronix Part 015−1014−00
Termination, 50 Ω	Impedance, 50 Ω; accuracy within 2%; SMA connectors	Tektronix Part 015−1022−00
Attenuator, 10X	20 dB attenuation, 50 Ω, one male and one female	Tektronix Part 011−0059−02
Attenuator, 2X	50 Ω, SMA, one male and one female	Tektronix Part 015−1001−00
Power Supplies Troubleshooting Fixture		Tektronix 067−1264−00 Extended Diagnostics 11000-Series Power Supplies troubleshooting fixture
Probe, 10X	Attenuation 10X	Tektronix P6106A
Pickoff, 10X		Picosecond Pulse Labs 5520A
Power Meter		HP 436A
Power Sensor		HP 8485A
Alignment Tool	Plastic hex	Tektronix Part 003−0301−00
	Insulated slot	Tektronix Part 003−0675−01
	Square Tip (ceramic)	Tektronix Part 003−1400−00
Magnetic Screw-driver	Holder for Torx head tips	Tektronix Part 003−0293−00

Table 4-2: Test Equipment (Cont.)

Description	Minimum Specification	Examples of Applicable Test Equipment
Torx Head Screwdriver	#10 tip	Tektronix Part 003−0814−00
	#15 tip	Tektronix Part 003−0966−00
	#20 tip	Tektronix Part 003−0866−00
External Loopback Connector	RS-232-C connector	Tektronix Part 013−0198−00
Shorting Strap	two alligator clips on a short pigtail conductor	
Integrated Circuit Extracting Tool	IC Insertion-Extraction Pliers, 28-pin type	General Tool P/N U505BG or equivalent
Board Removal Tools	Straight-slot screwdriver, large	
	Torx-drive screwdriver. T-7, T-8, T-10, T-15, T-20, T-25	
	Allen (hex) Wrench, 1/16-inch	
	Nutdrivers, 3/16-inch, 1/4-inch, 7/16-inch	
	Needle-nose pliers	
Small Ruler	half inch rulings	
Antistatic wrist strap		Tektronix Part 006−3415−04

Test Record

Photocopy the next four pages and use them to record the performance test results for your instrument.

11801C Test Record

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

	Performance Test	Minimum	Incoming	Outgoing	Maximum
	Vertical Accuracy				
Vertical Gain, First Compartment Acquisition Measurement: Channel 1			± 1.2% at checkpoint		
Step 11.	5 mV/div	−20.5 mV	_____	_____	−19.5 mV
	10 mV/div	−41.0 mV	_____	_____	−39.0 mV
	20 mV/div	−82 mV	_____	_____	−78 mV
	50 mV/div	−205 mV	_____	_____	−195 mV
	100 mV/div	−410 mV	_____	_____	−390 mV
	200 mV/div	−820 mV	_____	_____	−780 mV
	5 mV/div	19.5 mV	_____	_____	20.5 mV
	10 mV/div	39.0 mV	_____	_____	41.0 mV
	20 mV/div	78 mV	_____	_____	82 mV
	50 mV/div	195 mV	_____	_____	205 mV
	100 mV/div	390 mV	_____	_____	410 mV
	200 mV/div	780 mV	_____	_____	820 mV

11801C Test Record (Cont.)

	Performance Test	Minimum	Incoming	Outgoing	Maximum
Vertical Gain, First Compartment Acquisition Measurement: Channel 2			±1.2% at checkpoint		
Step 11.	5 mV/div	−20.5 mV	_____	_____	−19.5 mV
	10 mV/div	−41.0 mV	_____	_____	−39.0 mV
	20 mV/div	−82 mV	_____	_____	−78 mV
	50 mV/div	−205 mV	_____	_____	−195 mV
	100 mV/div	−410 mV	_____	_____	−390 mV
	200 mV/div	−820 mV	_____	_____	−780 mV
	5 mV/div	19.5 mV	_____	_____	20.5 mV
	10 mV/div	39.0 mV	_____	_____	41.0 mV
	20 mV/div	78 mV	_____	_____	82 mV
	50 mV/div	195 mV	_____	_____	205 mV
	100 mV/div	390 mV	_____	_____	410 mV
	200 mV/div	780 mV	_____	_____	820 mV
Vertical Offset Accuracy, First Compartment			±2 mV		
Step 10.	400 mV	398 mV	_____	_____	402 mV
Step 11.	1 V	0.998 V	_____	_____	1.002 V
	2 V	1.998 V	_____	_____	2.002 V
	−400 mV	−402 mV	_____	_____	−398 mV
	−1 V	−1.002 V	_____	_____	−0.998 V
	−2 V	−2.002 V	_____	_____	−1.998 V

11801C Test Record (Cont.)

	Performance Test	Minimum	Incoming	Outgoing	Maximum
Vertical Gain, Third Compartment Acquisition Measurement: Channel 1			±1.2% at checkpoint		
Step 11.	5 mV/div	−20.5 mV	_____	_____	−19.5 mV
	10 mV/div	−41.0 mV	_____	_____	−39.0 mV
	20 mV/div	−82 mV	_____	_____	−78 mV
	50 mV/div	−205 mV	_____	_____	−195 mV
	100 mV/div	−410 mV	_____	_____	−390 mV
	200 mV/div	−820 mV	_____	_____	−780 mV
	5 mV/div	19.5 mV	_____	_____	20.5 mV
	10 mV/div	39.0 mV	_____	_____	41.0 mV
	20 mV/div	78 mV	_____	_____	82 mV
	50 mV/div	195 mV	_____	_____	205 mV
	100 mV/div	390 mV	_____	_____	410 mV
	200 mV/div	780 mV	_____	_____	820 mV
Vertical Gain, Third Compartment Acquisition Measurement: Channel 2			±1.2% at checkpoint		
Step 11.	5 mV/div	−20.5 mV	_____	_____	−19.5 mV
	10 mV/div	−41.0 mV	_____	_____	−39.0 mV
	20 mV/div	−82 mV	_____	_____	−78 mV
	50 mV/div	−205 mV	_____	_____	−195 mV
	100 mV/div	−410 mV	_____	_____	−390 mV
	200 mV/div	−820 mV	_____	_____	−780 mV
	5 mV/div	19.5 mV	_____	_____	20.5 mV
	10 mV/div	39.0 mV	_____	_____	41.0 mV
	20 mV/div	78 mV	_____	_____	82 mV
	50 mV/div	195 mV	_____	_____	205 mV
	100 mV/div	390 mV	_____	_____	410 mV
	200 mV/div	780 mV	_____	_____	820 mV

11801C Test Record (Cont.)

	Performance Test	Minimum	Incoming	Outgoing	Maximum
Vertical Offset Accuracy, Third Compartment				±2 mV	
Step 10.	400 mV	398 mV	_____	_____	402 mV
Step 11.	1 V	0.998 V	_____	_____	1.002 V
	2 V	1.998 V	_____	_____	2.002 V
	−400 mV	−402 mV	_____	_____	−398 mV
	−1 V	−1.002 V	_____	_____	−0.998 V
	−2 V	−2.002 V	_____	_____	−1.998 V
Sweep Rate Accuracy					
ns Sweep Rate Accuracy					
Step 10.	2 ns/div (±0.05%)	18.172 ns	_____	_____	18.192 ns
Step 14.	1 ns/div (±0.08%)	9.083 ns	_____	_____	9.098 ns
ps Sweep Rate Accuracy					
Step 18.	100 ps/div (±0.8%)	902 ps	_____	_____	916 ps
Step 28.	10 ps/div (±2.5%)	248.1 mV	_____	_____	260.5 mV
Step 40.	1 ps/div (±10%)	23.1 mV	_____	_____	28.3 mV
Internal Clock					
Step 6.	Rise Time		_____	_____	2.5 ns
Step 8.	Frequency	97 kHz	_____	_____	103 kHz
	Duty Cycle	47%	_____	_____	53%
Calibrator Output					
Step 6.	Rise Time		_____	_____	≈250 ps
	Amplitude	225 mV	_____	_____	275 mV

Using These Procedures

Some procedures begin with a setup illustration that shows what test equipment is needed and how to connect it. The other procedures require only a calibrated SD-Series Sampling Head. Refer to Table 4-2 (Test Equipment), on the preceding pages for an example of the test equipment for each procedure.

Conventions in this Manual

In these procedures, the following conventions are used:

- CAPITAL letters within the body of text identify front panel controls, indicators, and connectors on the oscilloscope (for example, MEASURE) and sampling head.
- **Bold** letters identify menu labels and display messages.
- Initial Capital letters identify connectors, controls, and indicators (for example, On) on associated test equipment.
- In some steps, the first word is italicized to identify a step that contains a performance verification and an adjustment instruction. For example, if *Check* is the first word in the title of a step, an electrical specification is checked. If *Adjust* appears in the title, the step involves an electrical adjustment. If *Examine* is the first word in the title, the step concerns measurement limits that indicate whether the oscilloscope is operating properly; these limits are not to be interpreted as electrical specifications.

Menu Selections and Measurement Techniques

Details on measurement techniques and instructions for making menu selections are generally not included in these procedures. Comprehensive descriptions of menus and oscilloscope features are located in the *11801C Digital Sampling Oscilloscope User Manual*.

User Manual

The *11801C Digital Sampling Oscilloscope User Manual* is strongly recommended to familiarize the first-time user with oscilloscope controls and features.

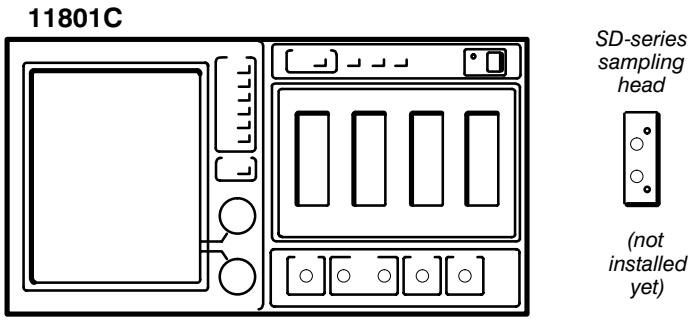
Performance Tests

This section contains the procedures to check the electrical specifications and examine the measurement limits listed in Table 4-1. To functionally test the oscilloscope, simply perform the procedures which have a “yes” indication in the Functional column. The Specifications or Measurement Limits are given at the beginning of each procedure. Adjustment procedures are included in the *Adjustment* section. Refer to the *11801C Digital Oscilloscope User Manual* for more information about oscilloscope operation. The Setup in each procedure provides information concerning test equipment setup or interconnection. Refer to Table 4-2 for more information concerning test equipment used in the setups.

Power-On Diagnostics

This procedure should be performed within the ambient temperature range of +18° C to +28° C (+64° F to +82° F), when a performance check at peak operating conditions is required.

Setup to Invoke Power-On Diagnostics



Procedure to Invoke Power-On Diagnostics

CAUTION

Applying a voltage outside the range printed on the sampling head can result in damage. Static electricity is also a hazard.

The input diodes used in the sampling heads are very susceptible to damage from overdrive signal or DC voltages and from electrostatic discharge. Never apply a voltage outside the range printed on the front of the sampling head. Operate the 11801C only in a static-controlled environment.

Connect the wrist strap provided with the 11801C to the **ANTISTATIC CONNECTION**, as shown in Figure 2-1. Refer to the *11801C Digital Sampling Oscilloscope User Manual* for more information.

☐ **Step 1:** Check that the sampling head is not yet installed, and that the ON/STANDBY switch is in the STANDBY position.

☐ **Step 2:** Remove the top and bottom covers from the oscilloscope (unless you are only performing a functional test).

☐ **Step 3:** Install an SD Series sampling head in the left sampling head compartment marked CH 1/CH 2.

☐ **Step 4:** With the oscilloscope's rear panel PRINCIPAL POWER SWITCH set to OFF, connect the oscilloscope to a suitable power source.

☐ **Step 5:** Set the rear panel PRINCIPAL POWER SWITCH to ON and then set the oscilloscope's front panel ON/STANDBY switch to ON.

When the oscilloscope is first installed, the rear panel PRINCIPAL POWER SWITCH should be set to and left in the ON position. From then on, use the front panel ON/STANDBY switch to perform all subsequent power switching.

☐ **Step 6:** Monitor the following diagnostic run functions, and note the range of possible results.

Diagnostics

Each time the front panel ON/STANDBY switch is set to ON, the oscilloscope performs Kernel diagnostics on its microprocessor subsystems, followed by Self-Test diagnostics on most all of its major circuits. Failures from either of these two sets of diagnostics may cause the oscilloscope to enter the Extended Diagnostics menu as described later in this section.

When Kernel diagnostics begin, the **Diagnostics in Progress** and **Comm Test in Progress** messages are displayed on the screen. If the oscilloscope is being powered-on from a cold condition, then the diagnostics may be completed before the CRT is warmed up and able to display these messages. Diagnostic routines are then performed in parallel on each of the oscilloscope's microprocessor subsystems (Display, Executive, Time Base, and Mainframe Acquisition). Following successful execution of their Kernel diagnostics, Acquisition microprocessors attempt to communicate with the Time Base microprocessor and the Time Base and Display microprocessors attempt to communicate with the Executive microprocessor.

Successful completion of Kernel diagnostics is indicated by the start of Self-Test diagnostics. A failure of Kernel diagnostics will be indicated by the message, **Dsy Kernel Failure**, or **Comm Test in Progress** displaying on the screen (for Display kernel failures) and/or by a single high-low beep and illuminated menu button indicators (for Executive kernel failures).

Self-Test Diagnostics

These begin by displaying Self-Test in Progress (when the Display microprocessor has successfully communicated with the Executive microprocessor). Pattern changes on the display and the flashing of the display indicate a test in progress. The Self-Test diagnostics are successfully completed when the oscilloscope returns to normal operation. Any failures cause the oscilloscope to produce a double high-low beep, and then to display the Extended Diagnostics menu on the screen. Faulty field replaceable units (FRUs) may then be identified by touching the (?)Help label. If any errors occur, record the error codes for the failed circuit block(s), and then refer the oscilloscope to a qualified service person.

Front panel controls are active during the Self-Test diagnostic sequence; however, any disturbance of these controls causes a test failure. If such a failure occurs, the oscilloscope automatically enters the Extended Diagnostics mode and displays the **Extended Diagnostics** menu. Touch the **Exit** label twice to remove this menu. Note that if the diagnostics detect a fatal fault, it may not be possible to exit the menu.

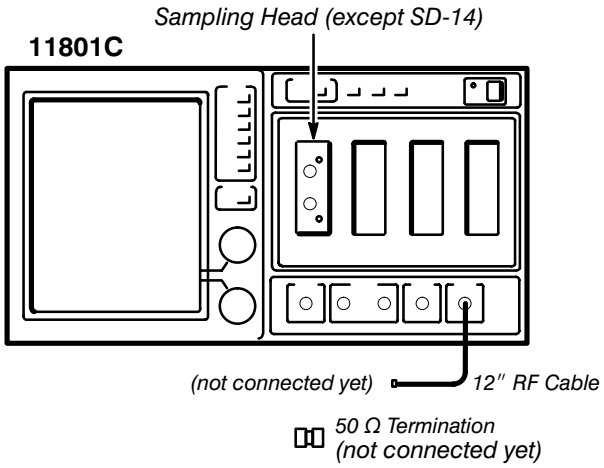
Power-On Diagnostics Complete

This state is signified when the oscilloscope returns to normal operation. If the oscilloscope passes Power-on diagnostics, the front-panel settings that were in effect at the last power-off are restored.

Sampling Heads

This procedure shows the setup and lists the steps for calibrating Loop Gain and Offset Null. Note that this is an optional enhanced accuracy procedure that fine tunes internal channel processing circuitry in conjunction with any operational sampling head type being used (the 067−1413−00 calibration head is a service device and does not require system calibration). This procedure also initiates a built-in 11801C program which causes the mainframe to remember which sampling head type was used in the calibration. In this way, pre-calibrated heads can be interchanged without requiring recalibration.

Setup to Calibrate a Sampling Head



Procedure to Calibrate a Sampling Head

☐ **Step 1:** Power-up and Initialize as follows:

Set the ON/STANDBY switch to ON . . . . . rocker / press
UTILITY button . . . . . press
Initialize (in major menu) . . . . . touch
Initialize (verify) . . . . . touch

☐ **Step 2:** Set up first Automatic Calibration as follows:

Press the UTILITY button . . . . . press
Page to Enhanced Accuracy . . . . . press
Gain (in major menu) . . . . . touch
Identify **Mainframe** . . . . . touch
Identify Channel (**2**) . . . . . touch
Automatic Calibrate (in pop-up menu) . . . . . touch

☐ **Step 3:** Perform the Loop Gain calibration as follows:

Connect the CALIBRATOR output to the sampling head input to be calibrated (**2**).

Select **Proceed** (in the Loop Gain pop-up menu) . . . . . touch
Store Constants (in pop-up menu) . . . . . touch

☐ **Step 4:** Set up second Automatic Calibration as follows:

Disconnect the calibration cable from the sampling head input.

Offset (in major menu) . . . . . touch
Automatic Calibrate (in pop-up menu) . . . . . touch

☐ **Step 5:** Perform the Offset Null calibration as follows:

Connect a 50 Ω termination to the sampling head input.

Select **Proceed** (in pop-up menu) . . . . . touch
Store Constants (in pop-up menu) . . . . . touch
Exit (in pop-up menu) . . . . . touch

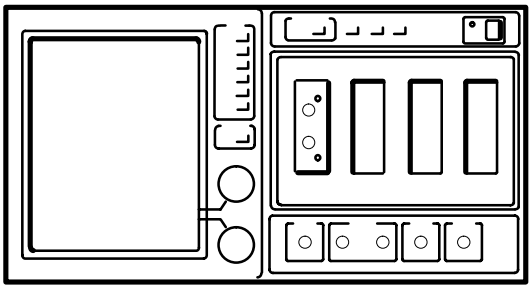
☐ **Step 6:** Repeat Steps 1 through 5 for all sampling head compartments and channels being tested.

Extended Diagnostics

The Extended Diagnostics perform more extensive testing than the Self-Test diagnostics. They can be used to assist troubleshooting, particularly in service environments.

Setup to Invoke Extended Diagnostics

11801C



If the oscilloscope entered the normal operating mode without any diagnostic failures, perform the following steps to enter the Extended Diagnostics mode. No inputs or I/O cables should be attached to the oscilloscope for these tests.

Procedure to Invoke Extended Diagnostics

☐ **Step 1:** With the sampling head installed as illustrated, check initial conditions as follows:

Set the oscilloscope ON/STANDBY switch to ON . . . . . press
Check sampling head Select button is OFF . . visually check indicator

CAUTION

You may lose stored settings, stored traces, or other data stored in NVRAM by turning the power off (that is, setting the ON/STANDBY switch to STANDBY or the PRINCIPAL POWER SWITCH to OFF) during the execution of the Extended Diagnostic tests that deal with the Executive processor's NVRAM tests. However, this does not seriously affect oscilloscope operation.

Select the UTILITY button . . . . . press
Page to Enhanced Accuracy (in major menu) . . . . . touch
Page to Utility2 (in major menu) . . . . . touch
Extended Diagnostic (in major menu) . . . . . touch
Extended Diagnostic (in pop-up menu) . . . . . touch
Select **All,** and then **Run** to start the tests . . . . . touch

☐ **Step 2:** *Check* that all tests have executed and have a Pass status. Then, make the following selections in the order shown:

Executive (if not already highlighted) . . . . . touch
Block (in major menu) . . . . . touch
External I/O (in pop-up menu) . . . . . touch
Area (in major menu) . . . . . touch
GPIB (in major menu) . . . . . touch
Routine (in major menu) . . . . . touch

☐ **Step 3:** Select and run the following tests:

Select **Run** to start the **Intrpt Reset** test . . . . . touch
Select **Reset Status,** and then **Run** to start the test . . . . . touch
Select **Data Lines,** and then **Run** to start the test . . . . . touch
Select **Interrupt,** and then **Run** to start the test . . . . . touch

☐ **Step 4:** Check that all four of the previous tests have executed and passed. Then, exit as follows:

Select **Exit** twice to exit Extended Diagnostics . . . . . touch

Vertical Reference Voltage

This procedure checks that the vertical reference voltage is at ±5 V at J63C on the A26 M/F Acquisition Interconnect board (see Figure 4-1).

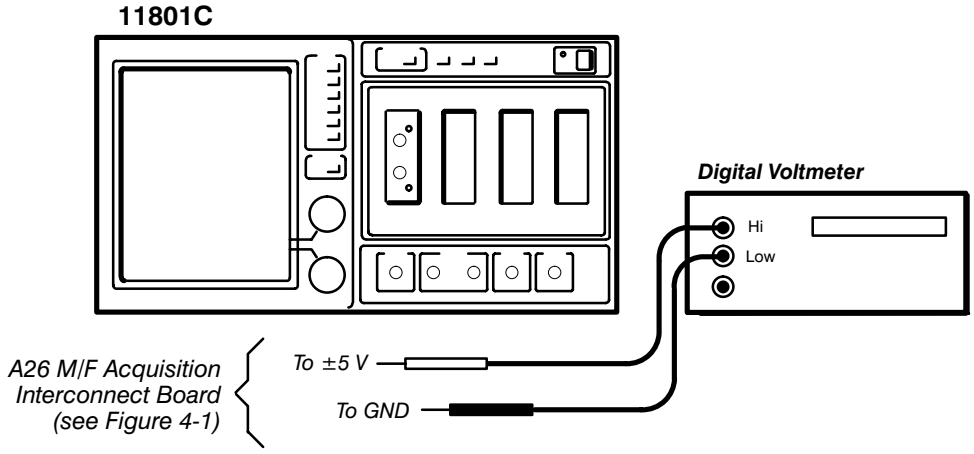
STOP

This procedure should only be performed if maintenance is required. This procedure is not necessary for verifying instrument specifications.

Specifications

The measured voltage must be within the limits of 5 V ±200 µV and −5 V ±200 µV.

Setup to Check Vertical Reference Voltage



Procedure to Check Vertical Reference Voltage

☐ **Step 1:** Initialize the oscilloscope settings as follows:

UTILITY button . . . . . press
Initialize (in major menu) . . . . . touch
Initialize (in verification pop-up menu) . . . . . touch

☐ **Step 2:** Connect the Digital Voltmeter to the +5 V reference point and GND on the A26 Mainframe (M/F) Acquisition Interconnect board. See Figure 4-1.

☐ **Step 3:** Set the Voltmeter for DC Voltage, and *check* for a reading of +5 V, ±200 µV.

☐ **Step 4:** Connect the Digital Voltmeter to the −5 V reference point and GND on the A26 M/F Acquisition Interconnect board.

☐ **Step 5:** Set the Voltmeter for DC Voltage, and *check* for a reading of −5 V, ±200 µV.

STOP If the readings noted in Steps 3 and 5 are outside the stated limits, then servicing of the oscilloscope is required before continuing to the Horizontal Reference Clock procedure.

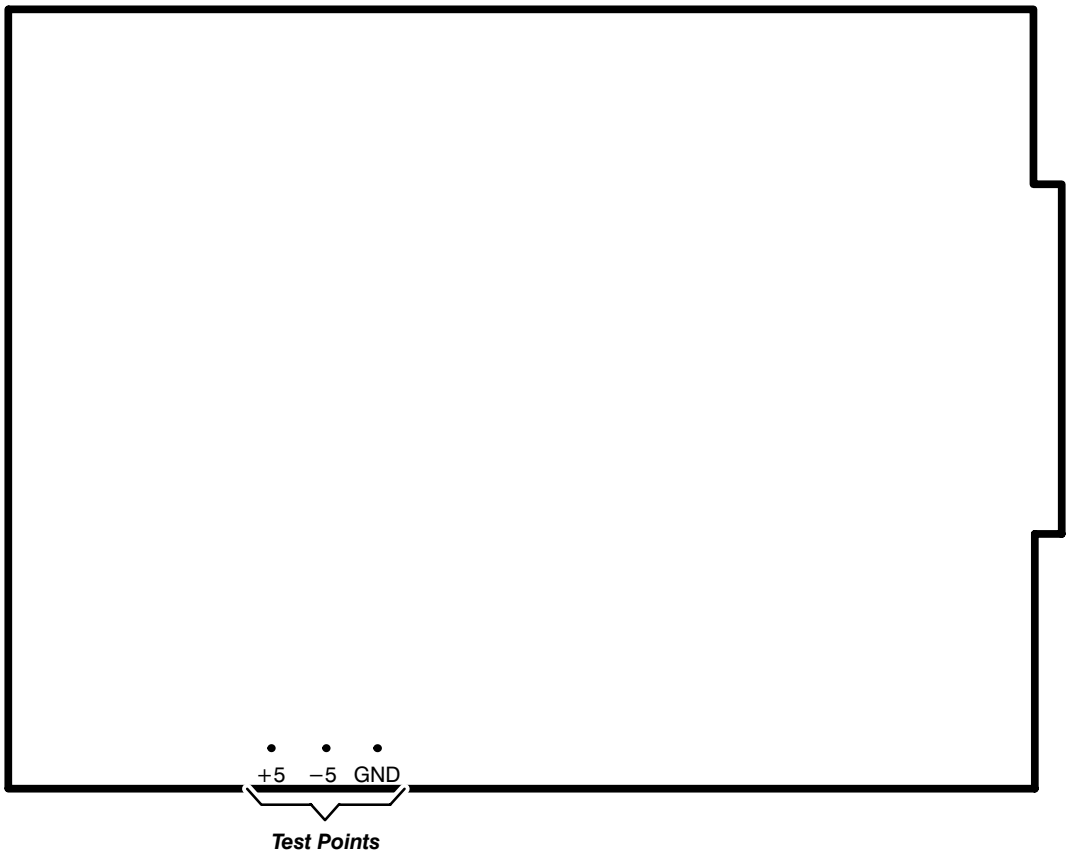


Figure 4-1: A26 M/F Acquisition Interconnect Board Test Point Locations

Horizontal Reference Clock

This procedure verifies the correct operation and accuracy of the oscilloscope's horizontal reference clock (see Figure 4-2).

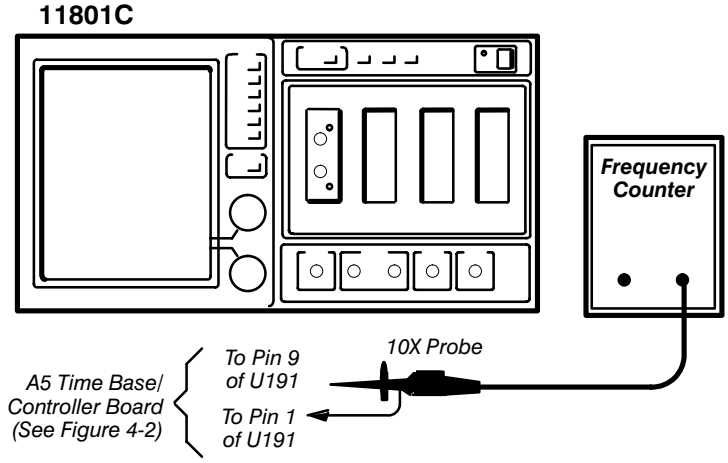


This procedure should only be performed if maintenance is required. This procedure is not necessary for verifying instrument specifications.

Specifications

The operational frequency specification for the horizontal reference clock is 200,000 kHz, ±5 kHz.

Setup to Check Horizontal Reference Clock



Procedure to Check Horizontal Reference Clock

☐ **Step 1:** Initialize the oscilloscope settings as follows:

UTILITY button . . . . . press
Initialize (in major menu) . . . . . touch
Initialize (in verification pop-up menu) . . . . . touch

☐ **Step 2:** Perform the following 11801C operations in the order listed:

- Set the front panel ON/STANDBY switch to STANDBY.
- Set the oscilloscope on its right side (as viewed from facing the front of the oscilloscope).
- Set the oscilloscope front panel ON/STANDBY switch to ON.

☐ **Step 3:** Set the Frequency Counter controls/output as follows:

Frequency counter
- Mode . . . . . Frequency A
- Trigger . . . . . AC
- Slope . . . . . +(positive)
- Attenuation 1X
- Termination . . . . . 1 MΩ

☐ **Step 4:** At U191 on the A5 Time Base/Controller board, touch the 10X Probe to pin 9 and the ground probe to pin 1.

☐ **Step 5:** *Check* that the frequency counter reads within the limits of 199,995 kHz and 200,005 kHz.

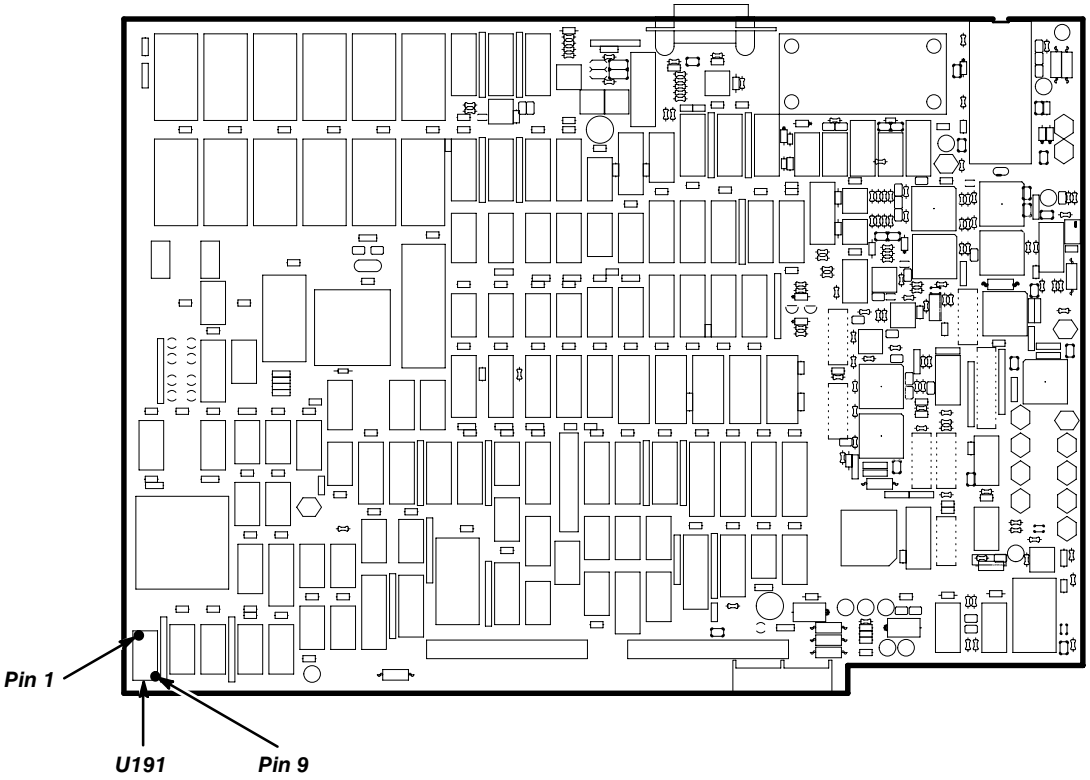
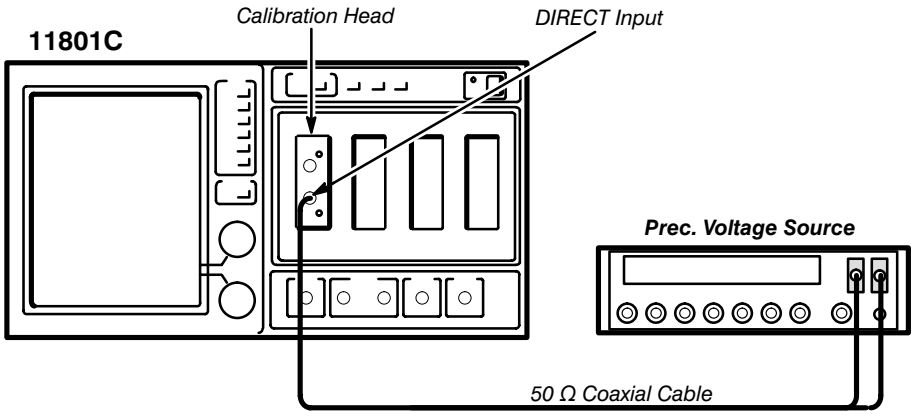


Figure 4-2: A5 Time Base/Controller Board Test Point Locations

Vertical Accuracy

This procedure shows the setups and lists the steps to check the vertical accuracy of the oscilloscope.

Setup to Check Vertical Gain



Procedure to Check Vertical Gain

☐ **Step 1:** Install a Calibration Head (067−1413−00) into the position shown in the setup diagram (CH 1/CH 2 slot). If the unit is in Standby mode, set the power switch to ON. Set the Precision Voltage Source to 0 V and connect it to Channel 2 of the Calibration Head.

NOTE

If powering up from a cold start, the diagnostics will report an error using the Calibration Head. The report will indicate a ***Time Base*** *error. To clear this, exit the diagnostics. Then, ignore the subsequent time base calibration failure notice and continue with the following steps.*

☐ **Step 2:** Initialize the mainframe as follows:

UTILITY button . . . . . press
Initialize (in major menu) . . . . . touch
Initialize (in verification pop-up menu) . . . . . touch

☐ **Step 3:** Trigger the oscilloscope as follows:

TRIGGER button . . . . . press
Source (in major menu) . . . . . touch
Internal Clock (in pop-up menu) . . . . . touch

☐ **Step 4:** Identify the trace as follows:

Def Tra icon . . . . . touch
Identify Channel (**2**) . . . . . touch
Select **Enter Desc** . . . . . touch

☐ **Step 5:** Set the mainframe Vert Offset as follows:

Vert size icon . . . . . touch
Set **Vert Size:M2** to 2 mV/div . . . . . adjust upper knob

☐ **Step 6:** Set Averaging as follows:

Acquire Desc (in major menu) . . . . . touch
Average N (in pop-up menu) . . . . . touch

☐ **Step 7:** Select the Mean Measurement as follows:

MEASURE button . . . . . press
Measurements (in major menu) . . . . . touch
Mean (in the **Measurements** pop-up menu) . . . . . touch
Compare & References (in major menu) . . . . . touch
Save Current Meas Values as References (in pop-up menu) . . . . . touch
Compare off (to **on** in pop-up menu) . . . . . touch

☐ **Step 8:** Set the Voltage source to 8 mV.

Select **Remove**/**Clr Trace** (in major menu) . . . . . touch
Select **Clear Trace** (in pop-up menu) . . . . . touch

☐ **Step 9:** Wait for averaging to complete. Then, *check* that the ΔMean value is to be within 7.8 mV (lower spec) and 8.2 mV (upper spec).

NOTE

Averaging will complete faster if you exit the measurement menu and then return when averaging is complete. Alternatively, use the dial to move the Main Size setting two notches higher than the default setting.

☐ **Step 10:** Change the polarity of the voltage differential coming from the precision voltage Source. *Check* that the ΔMean value is between −7.8 mV and −8.2 mV.

☐ **Step 11:** Refer to Table 4-3 and check actual results against the table specifications for the setting levels indicated.

NOTE

Specifications are one percent of full scale at each volts/div setting. Example: at 5 mV/div full scale for 10 div is 50 mV, which gives an upper and lower spec tolerance of +0.5 mV and −0.5 mV.

Table 4-3: Voltage Source Settings

Sens.	Source V	Lower Spec	Upper Spec
5 mV/div	−20 mV	−20.5 mV	−19.5 mV
10 mV/div	−40 mV	−41.0 mV	−39.0 mV
20 mV/div	−80 mV	−82 mV	−78 mV
50 mV/div	−200 mV	−205 mV	−195 mV
100 mV/div	−400 mV	−410 mV	−390 mV
200 mV/div	−800 mV	−820 mV	−780 mV
5 mV/div	20 mV	19.5 mV	20.5 mV
10 mV/div	40 mV	39.0 mV	41.0 mV
20 mV/div	80 mV	78 mV	82 mV
50 mV/div	200 mV	195 mV	205 mV
100 mV/div	400 mV	390 mV	410 mV
200 mV/div	800 mV	780 mV	820 mV

NOTE

Up to now, you have been working with trace 1 (Channel 2), and internal mainframe acquisition measurement channel 1. Use the following steps to verify the vertical accuracy through internal acquisition measurement channel 2, using trace 2. (Don't remove Voltage Source from Calibration Head Channel 2.)

☐ **Step 12:** Initialize the mainframe as follows:

UTILITY button . . . . . press
Initialize (in major menu) . . . . . touch
Initialize (in verification pop-up menu) . . . . . touch

☐ **Step 13:** Trigger the oscilloscope as follows:

TRIGGER button . . . . . press
Source (in major menu) . . . . . touch
Internal Clock (in pop-up menu) . . . . . touch

☐ **Step 14:** Define the first trace as follows:

Def Tra icon . . . . . touch
Identify Channel (**1**) . . . . . touch
Select **Enter Desc** . . . . . touch

Note that **Trace 1** has been selected at the base of the screen (just above **M1 Main**).

☐ **Step 15:** Define the second trace as follows:

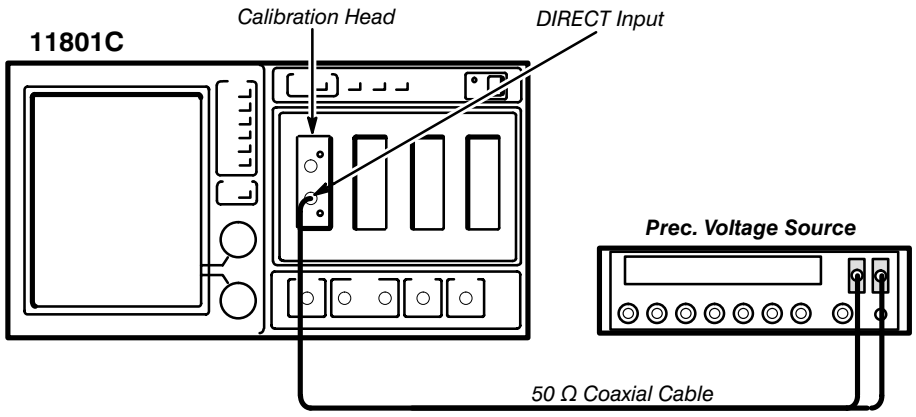
Def Tra icon . . . . . touch
Identify Channel (**2**) . . . . . touch
Select **Enter Desc** . . . . . touch

Note that **Trace 2** has now been selected at the base of the screen (just above **M2 Main**).

☐ **Step 16:** Repeat Steps 5 through 12.

☐ **Step 17:** Power down the oscilloscope. Repeat Steps 1 through 16 for sampling head compartment 3.

Setup to Check Offset Accuracy



Procedure to Check Offset Accuracy

☐ **Step 1:** This second vertical accuracy test uses the same setup preliminaries as the previous test. The Calibration Head/Time Base error will only reappear if you have activated power-up diagnostics. If so, exit diagnostics and, in either case, continue from here.

☐ **Step 2:** Initialize the mainframe as follows:

UTILITY button . . . . . press
Initialize (in major menu) . . . . . touch
Initialize (in verification pop-up menu) . . . . . touch

☐ **Step 3:** Trigger the oscilloscope as follows:

TRIGGER button . . . . . press
Source (in major menu) . . . . . touch
Internal Clock (in pop-up menu) . . . . . touch

☐ **Step 4:** Define the trace as follows:

Def Tra icon . . . . . touch
Identify Channel (**2**) . . . . . touch
Select **Enter Desc** . . . . . touch

☐ **Step 5:** Set Averaging as follows:

Acquire Desc (in major menu) . . . . . touch
Average N (in pop-up menu) . . . . . touch
Select **Exit** . . . . . touch

☐ **Step 6:** Select the Mean Measurement as follows:

MEASURE Button . . . . . press
Measurements (in major menu) . . . . . touch
Mean (in pop-up menu) . . . . . touch
Compare & Reference (in major menu) . . . . . touch
Save Current Meas Values as References (in pop-up menu) . . . . . touch
Compare off (changes to **on** / in pop-up menu) . . . . . touch
Select **Exit** . . . . . touch

☐ **Step 7:** Set the Vertical Size and Offset as follows:

Vertical size icon . . . . . touch
Adjust the **Vert Size: M2** to 10 mV/div . . . . . adjust upper knob
Vert Offset: M2 (in major menu) . . . . . touch
Key in 400 mV (**400m**) on the pop-up display . . . . . touch
Select **Enter** . . . . . touch

Check that **400 mV** has now entered into the display below **Vert Offset: M2**.

☐ **Step 8:** Connect the Voltage Source to the DIRECT input of the Calibration Head.

☐ **Step 9:** *Adjust* the Voltage Source to 400 mV.

☐ **Step 10:** Wait for averaging to complete. Then, *check* that ΔMean value is between −2 mV and +2 mV.

☐ **Step 11:** Repeat Steps 2 through 10 for the offset values shown in Table 4-4.

☐ **Step 12:** Power down the oscilloscope. Repeat Steps 1 through 11 for sampling head compartment 3.

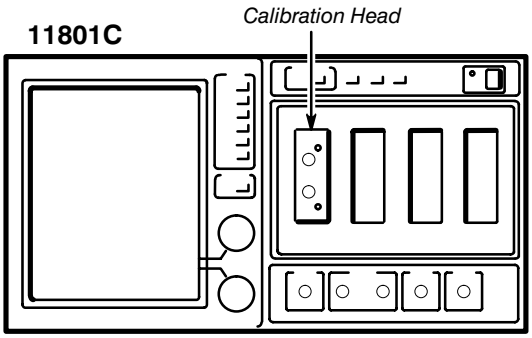
Table 4-4: Vertical Offset Test Values

Sens.	Source V/ Vert Offset	Lower Spec	Upper Spec
10 mV/div	1 V	0.998 V	1.002 V
10 mV/div	2 V	1.998 V	2.002 V
10 mV/div	−400 mV	−402 mV	−398 mV
10 mV/div	−1 V	−1.002 V	−0.998 V
10 mV/div	−2 V	−2.002 V	−1.998 V

System Vertical RMS Noise

This procedure uses the RMS measurement function to measure the noise on the trace from a sampling head compartment.

Setup to Examine Vertical RMS Noise



Procedure to Examine Vertical RMS Noise

☐ **Step 1:** Install the Calibration Head (067−1413−00) into the position shown in the setup diagram. If the unit was in standby mode, set the ON/STANDBY switch to ON.

NOTE

If powering up from a cold start, The diagnostics will report an error using the Calibration Head. The report will indicate a ***Time Base*** *error. To clear this, exit the diagnostics. Then, ignore the subsequent time base calibration failure notice and continue with the following steps.*

☐ **Step 2:** Initialize the mainframe as follows:

UTILITY button . . . . . press
Initialize (in major menu) . . . . . touch
Initialize (in verification pop-up menu) . . . . . touch

☐ **Step 3:** Trigger the oscilloscope as follows:

TRIGGER button . . . . . press
Source (in major menu) . . . . . touch
Internal Clock (in pop-up menu) . . . . . touch

☐ **Step 4:** Identify the trace as follows:

Def Tra icon . . . . . touch
Identify Channel (**1**) . . . . . touch
Select **Enter Desc** . . . . . touch

☐ **Step 5:** Set the mainframe Vert Size as follows:

Vert Size icon . . . . . touch
Set **Vert Size:M1** to 2 mV/div . . . . . adjust upper knob

☐ **Step 6:** Set the record length as follows:

Horizontal Desc (in major menu) . . . . . touch
Main Record Length (in pop-up menu) . . . . . touch
Set **Main Record Len** to 5120 points . . . . . adjust upper knob

☐ **Step 7:** Store the trace as follows:

STORE/RECALL button . . . . . press
Store Trace (in major menu) . . . . . touch
Trace 1 (in pop-up menu) . . . . . touch

Note that you must touch Trace 1 even though it is highlighted in the menu.

Recall Trace (in major menu) . . . . . touch
STO 1 (in pop-up menu) . . . . . touch

☐ **Step 8:** Measure the Mean value as follows:

MEASURE button . . . . . press
Measurements (in major menu) . . . . . touch
Mean (in pop-up menu) . . . . . touch
Exit Menu (in pop-up menu) . . . . . touch

NOTE

Record (write down) the mean value for use in the next step.

☐ **Step 9:** Define the trace to be stored as follows:

Def Tra icon . . . . . touch
Stored Traces (in pop-up menu) . . . . . touch
Stored 1 (in pop-up menu) . . . . . touch
Enter STO1– (mean value) . . . . . touch

Use pop-up key pad to enter STO1– (mean value) recorded (written down) in Step 8.

NOTE

For example, if mean value is 50.2 µV, you would key in "−(50.2 EEX − 6)". STO1 already appears on upper left of display. Exponents are entered by pressing the EEX key, followed by the sign of the exponent (if negative), followed by the exponent value.

Enter Desc (in pop-up menu) . . . . . touch

☐ **Step 10:** Measure the RMS value as follows:

MEASURE button . . . . . press
Measurements (in major menu) . . . . . touch
RMS (in pop-up menu) . . . . . touch
Check that RMS is ≤200 µV.
Exit Menu (to exit) . . . . . touch

☐ **Step 11:** Erase the test traces as follows:

STORE/RECALL button . . . . . press
Delete Trace (in major menu) . . . . . touch
All Traces (in pop-up menu) . . . . . touch
Delete Selected Traces (in pop-up menu) . . . . . touch

☐ **Step 12:** Repeat Steps 4 through 11 at the sensitivities listed in Table 4-5, and check the resulting RMS against the matching specification value in the table.

Table 4-5: Sensitivity Settings

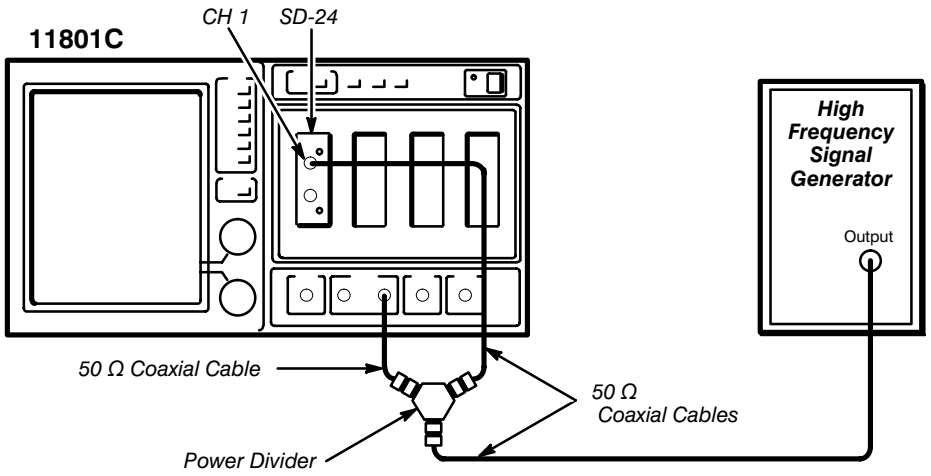
Sensitivity	Specification
5 mV/div	500 µV
10 mV/div	1 mV
20 mV/div	632 µV
50 mV/div	1.58 mV
100 mV/div	3.16 mV
200 mV/div	6.32 mV

☐ **Step 13:** Power down the oscilloscope. Repeat Steps 1 through 12 for all sampling head compartments.

Sweep Rate Accuracy

This procedure shows the setups and lists the steps to check the Sweep Rate Accuracy.

Setup to Examine Sweep Rate Accuracy



Procedure to Examine Sweep Rate Accuracy

☐ **Step 1:** Install the SD-24 Sampling Head into the compartment shown in the setup diagram (CH 1/CH 2 slot). If the unit is in standby mode, set the ON/STANDBY switch to ON.

☐ **Step 2:** Initialize the mainframe as follows:

UTILITY button . . . . . press
Initialize (in major menu) . . . . . touch
Initialize (in verification pop-up menu) . . . . . touch

☐ **Step 3:** Set the horizontal record length as follows:

Horizontal Desc (in major menu) . . . . . touch
Main Record Length (in pop-up menu) . . . . . touch
Set **Main Record Len** to 1024 points . . . . . adjust upper knob

☐ **Step 4:** Identify the trace as follows:

Def Tra icon . . . . . touch
Identify **Mainframe** . . . . . touch
Identify Channel (**1**) . . . . . touch
Select **Enter Desc** . . . . . touch

☐ **Step 5:** Engage high precision calibration mode as follows:

UTILITY button . . . . . press
Page to Enhanced Accuracy . . . . . touch
Time Base Cal Mode (in major menu) . . . . . touch
High Prec (in pop-up menu) . . . . . touch
Exit (in pop-up menu) . . . . . touch

Sweep Rate Accuracy 2 ns/div

☐ **Step 6:** *Adjust* the Sweep Rate to 2 ns/div.

Horizontal icon . . . . . touch
Set **Main Size** to 2 ns/div . . . . . adjust upper knob

☐ **Step 7:** *Adjust* the Signal Generator to the following settings:

Frequency . . . . . 55 MHz
Amplitude . . . . . 1.0 V_{RMS}

NOTE

Check that selected Sampling Head channel (1) indicator is flashing. If not, select channel (1) by pressing select button.

☐ **Step 8:** Turn mainframe averaging on.

WAVEFORM button . . . . . press
Acquire Desc (in major menu) . . . . . touch
Average N On (in pop-up menu) . . . . . touch
Select **Exit (**in the pop-up menu**)** . . . . . touch

NOTE

Position the display so the sine wave is centered on the screen. To ensure accurate period measurement, the display must be a full cycle.

☐ **Step 9:** Obtain Period as follows:

MEASURE button . . . . . press
Measurement (in major menu) . . . . . touch
Period (in pop-up menu) . . . . . touch
Exit Menu (in pop-up menu) . . . . . touch

☐ **Step 10:** *Examine* that the period is between 18.172 ns and 18.192 ns, showing that sweep rate accuracy is within 0.05%.

Sweep Rate Accuracy 1 ns/div

☐ **Step 11:** *Adjust* the Sweep Rate to 1 ns/div.

Horizontal (↔) icon . . . . . touch
Set **Main Size** to 1 ns/div . . . . . adjust upper knob

☐ **Step 12:** *Adjust* the Signal Generator to the following settings:

Frequency . . . . . 110 MHz
Amplitude . . . . . 1.0 V_{RMS}

☐ **Step 13:** Press the UTILITY button and adjust the lower knob for a display showing a full waveform.

☐ **Step 14:** Press the MEASURE button and check for a period interval between 9.083 ns and 9.098 ns, showing that sweep rate accuracy is within 0.08%.

Sweep Rate Accuracy 100 ps/div

☐ **Step 15:** Use the upper control knob to adjust the **Main Size** to 100 ps/div.

☐ **Step 16:** *Adjust* the Signal Generator to the following settings:

Frequency . . . . . 1.1 GHz
Amplitude . . . . . 2.0 V_{p-p} (1.4 V_{RMS})
(Set for 1.000 V ±0.004 V_{p-p} on screen.)

☐ **Step 17:** Press the UTILITY button and adjust the lower knob for a display showing a full waveform.

☐ **Step 18:** Press the MEASURE button and check for a period interval between 902 ps and 916 ps, showing that sweep rate accuracy is within 0.8%.

Sweep Rate Accuracy 10 ps/div

☐ **Step 19:** *Adjust* the Signal Generator to the following settings:

Frequency . . . . . 800 MHz
Amplitude . . . . . 2.0 V_{p-p} (1.4 V_{RMS})
(Set for 1.000 V ±0.004 V_{p-p} on screen.)

☐ **Step 20:** Invoke smoothing as follows:

WAVEFORM button . . . . . press
Sampling Head Fnc's (in major menu) . . . . . touch
Smoothing On (in pop-up menu) . . . . . touch
Exit (in pop-up menu) . . . . . touch

☐ **Step 21:** *Adjust* the **Main Size** to 130 ps/div.

☐ **Step 22:** *Adjust* the **Main Pos** to 55 ns.

☐ **Step 23:** Set the **Main Pos** control (lower knob) so that the zero crossing of the waveform occurs on the center graticule.

☐ **Step 24:** Set the horizontal reference point to **Center** as follows, so that the waveform will be expanded about the horizontal center:

WAVEFORM button . . . . . press
Horizontal Desc (in major menu) . . . . . touch
Center (in pop-up menu) . . . . . touch

☐ **Step 25:** *Adjust* the Vertical Size as follows:

Vertical icon . . . . . touch
Set **Vert Size** to 50 mV . . . . . adjust upper knob

☐ **Step 26:** Adjust the Main Size as follows:

Horizontal icon . . . . . touch
Set the **Main Size** to 10 ps/div . . . . . adjust upper knob

☐ **Step 27:** Activate the cursors as follows:

Cursors icon . . . . . touch

☐ **Step 28:** Read the **Δv** located in the major menu. **Δv** should be within −260.5 mV and −248.1 mV or +248.1 mV and +260.5 mV, showing that the sweep rate accuracy is within 2.5%.

☐ **Step 29:** Touch **Exit** (in the major menu).

Sweep Rate Accuracy 1 ps/div

☐ **Step 30:** *Adjust* the Signal Generator to the following settings:

Frequency . . . . . 800 MHz
Amplitude . . . . . 2.0 V_{p-p} (1.4 V_{RMS})
(Set for 1.000 V ±0.004 V_{p-p} on screen.)

☐ **Step 31:** Invoke smoothing as follows:

WAVEFORM button . . . . . press
Sampling Head Fnc's (in major menu) . . . . . touch
Smoothing On (in pop-up menu) . . . . . touch
Exit (in pop-up menu) . . . . . touch

☐ **Step 32:** *Adjust* the **Main Size** to 130 ps/div.

☐ **Step 33:** *Adjust* the **Main Pos** to 55 ns.

☐ **Step 34:** Set the **Main Pos** control (lower knob) so that the zero crossing of the waveform occurs on the center graticule.

☐ **Step 35:** Set the horizontal reference point to **Center** as follows, so that the waveform will be expanded around the horizontal center:

WAVEFORM button . . . . . press
Horizontal Desc (in major menu) . . . . . touch
Center (in pop-up menu) . . . . . touch

☐ **Step 36:** *Adjust* the Vertical Size as follows:

Vertical icon . . . . . touch
Set **Vert Size** to 5 mV . . . . . adjust upper knob

☐ **Step 37:** Set the Main Size as follows:

Horizontal icon . . . . . touch
Set **Main Size** to 1 ps/div . . . . . adjust upper knob

☐ **Step 38:** Turn mainframe averaging on.

WAVEFORM button . . . . . press
Acquire Desc (in major menu) . . . . . touch
Average N (in pop-up menu) . . . . . touch
Select **Exit** (in pop-up menu) . . . . . touch

☐ **Step 39:** Activate the cursors as follows:

Cursors icon . . . . . touch

☐ **Step 40:** Read the **Δv** located in the major menu. **Δv** should be within −28.3 mV and −23.1 mV, or within +32.1 mV and +28.3 mV, showing that the sweep rate accuracy is within 20%.

☐ **Step 41:** Touch **Exit** (in the major menu).

Triggering, External Direct

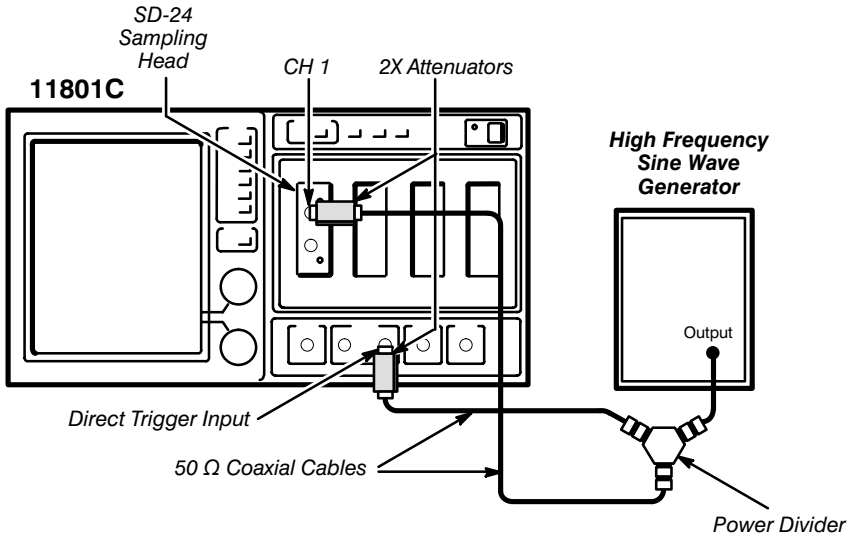
This procedure verifies the correct operation and accuracy of the oscilloscope's trigger system.

Specifications

The specifications for triggering using the external trigger are as follows:

- 100 mV_{p-p} at 300 MHz
- 100 mV_{p-p} at 1000 MHz
- 100 mV_{p-p} at 3.0 GHz

Setup to Check Triggering



Procedure to Check Triggering

☐ **Step 1:** Install the SD-24 Sampling Head into the position shown in the setup diagram (CH 1/CH 2 slot). If the unit was in standby mode, set the ON/STANDBY switch to ON.

☐ **Step 2:** Initialize the mainframe as follows:

UTILITY button . . . . . press
Initialize (in major menu) . . . . . touch
Initialize (in verification pop-up menu) . . . . . touch

☐ **Step 3:** Adjust the high frequency generator as follows:

400 mV_{p-p} at 300 MHz

☐ **Step 4:** On the Sampling Head, press the Channel 1 select button.

☐ **Step 5:** Make the following selections:

AUTOSET button . . . . . press
Slightly adjust the Trigger Level (in TRIGGER major menu) if necessary.
MEASURE button . . . . . press
Measurement (in major menu) . . . . . touch
Peak-Peak (in pop-up menu) . . . . . touch
WAVEFORM button . . . . . press
Sampling Head Fnc's (in major menu) . . . . . touch
Smoothing On (in pop-up menu) . . . . . touch
Exit (in pop-up menu) . . . . . touch

☐ **Step 6:** *Check* waveform for stable triggering. Using AUTOSET, repeat procedure for the following frequency generator settings:

400 mV_{p-p} at 1000 MHz
400 mV_{p-p} at 3.0 GHz

Prescaler Triggering

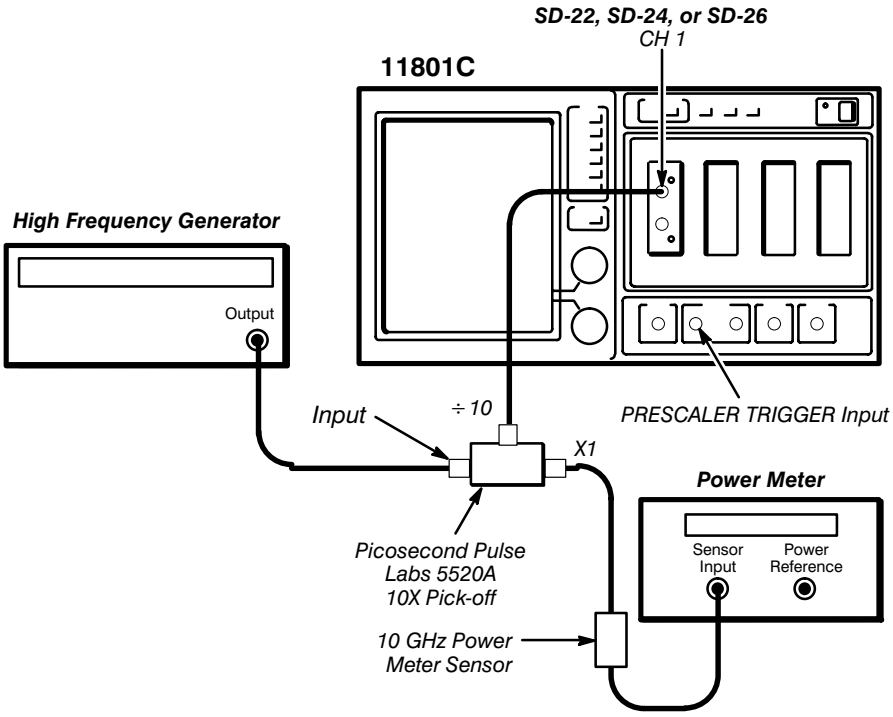
This procedure verifies the correct operation and accuracy of the 11801C's Prescaler trigger system.

Specifications

The specifications for Prescaler triggering are as follows:

- 800 mV_{p-p} at 2 GHz
- 600 mV_{p-p} at 3 GHz
- 600 mV_{p-p} at 10 GHz

Setup to Check Prescaler Triggering



Procedure to Check Prescaler Triggering

☐ **Step 1:** Install the SD-24 Sampling Head into the CH 1/CH 2 slot of the mainframe. Set the ON/STANDBY switch to ON and let the instrument warm up for approximately 15 minutes. Initialize the mainframe settings, then perform the following settings and steps.

☐ **Step 2:** Connect the High Frequency Generator to the Picosecond Pulse Labs (PSPL) 10X Pick-off IN. Connect the PSPL ÷ 10 output to Channel 1 of the Sampling Head.

☐ **Step 3:** Connect the PSPL X1 output to the power meter/sensor (meter/sensor must be calibrated). Set the Generator frequency to 2 GHz.

Adjust the Generator output until the power meter reads:

2.0 dBm (800 mV_{p-p}). Use correction factors for the sensor.

☐ **Step 4:** Connect the PSPL X1 output to the 11801C Prescaler Trigger input.

☐ **Step 5:** 11801C mainframe settings:

DefTra . . . . . touch
Select Channel 1, **M1** . . . . . touch
TRIGGER button . . . . . press
Source . . . . . touch
External Prescaler . . . . . touch
Exit . . . . . touch
Horizontal (↔) icon . . . . . touch
Adjust **Main Size** to 200 ps/div . . . . . adjust upper knob
Vertical (↕) icon . . . . . touch
Adjust **Main Size** to 10 mV/div . . . . . adjust upper knob

☐ **Step 6:** Turn **AVG ON**. *Check* display for stable triggering. Then turn the **AVG OFF**.

☐ **Step 7:** Repeat steps 3, 4, 5 and 6 for the following settings:

Table 4-6: Prescaler Test Settings

Generator Freq	Power Reading	Main Size	Vert Size
3 GHz	−0.458 dBm (600 mV_{p-p})	50 ps/div	10 mV/div
10 GHz	−0.458 dBm (600 mV_{p-p})	50 ps/div	10 mV/div

Internal Clock

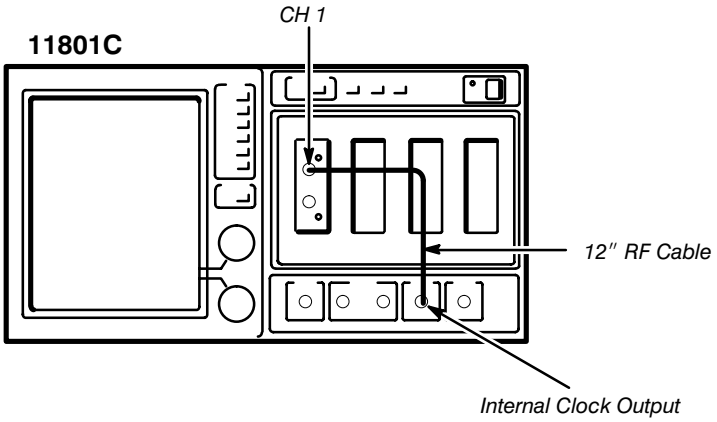
This procedure verifies the correct operation and accuracy of the oscilloscope's Internal Clock signal.

Measurement Limits

The measurement limits of the internal clock pulse are as follows:

- rise time ≤2.5 ns
- frequency of 100 kHz ±3% accuracy
- duty cycle 50% ±3%

Setup to Examine Internal Clock



Procedure to Examine Internal Clock

☐ **Step 1:** Install the SD-24 Sampling Head into the position shown in the setup diagram (CH 1/CH 2 slot). If the unit was in standby mode, set the ON/STANDBY switch to ON.

☐ **Step 2:** Initialize the mainframe as follows:

UTILITY button . . . . . press
Initialize (in major menu) . . . . . touch
Initialize (in verification pop-up menu) . . . . . touch

☐ **Step 3:** Trigger the oscilloscope as follows:

TRIGGER Button . . . . . press
Source (in pop-up menu) . . . . . **Internal Clock**

☐ **Step 4:** On the Sampling Head, press the Channel 1 select button.

☐ **Step 5:** On the oscilloscope, press the AUTOSET button.

☐ **Step 6:** Check the rise time as follows:

MEASURE button . . . . . press
Measurements (in the major menu) . . . . . touch
Rise (in the pop-up menu) . . . . . touch
Check that **Rise** is ≤2.5 ns.
Exit Menu (in pop-up menu) . . . . . touch

☐ **Step 7:** Change the sweep rate as follows:

Horizontal (↔) icon . . . . . touch
Adjust **Main Size** to 5 µs/div. . . . . adjust upper knob

☐ **Step 8:** Check the frequency as follows:

MEASURE button . . . . . press
Measurements (in major menu) . . . . . touch
Frequency (in pop-up menu) . . . . . touch
Duty Cycle (in pop-up menu) . . . . . touch
Check that the frequency is between 97 kHz and 103 kHz.
Check that the Duty Cycle is between 47% and 53%.
Exit Menu (in pop-up menu) . . . . . touch

Calibrator Output

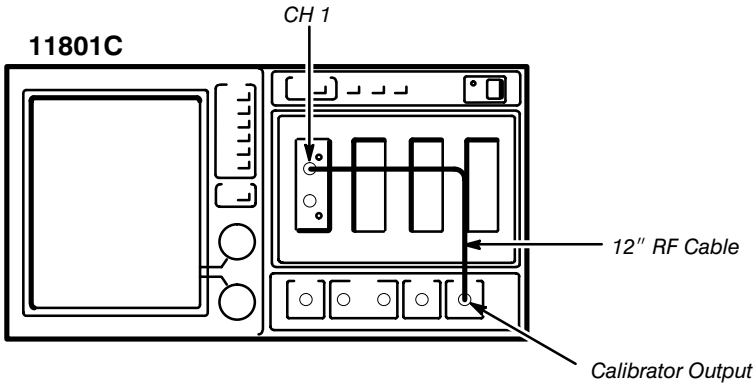
This procedure verifies the correct operation and accuracy of the oscilloscope's calibrator.

Measurement Limits

The measurement limits of the calibrator output are as follows:

- amplitude 250 mV ±15%
- rise time ≈250 ps

Setup to Examine Calibrator Output



Procedure to Examine Calibrator

☐ **Step 1:** Install the SD-24 Sampling Head into the position shown in the setup diagram (CH 1/CH 2 slot). If the unit was in standby mode, set the ON/STANDBY switch to ON.

☐ **Step 2:** Initialize the mainframe as follows:

UTILITY button . . . . . press
Initialize (in major menu) . . . . . touch
Initialize (in verification pop-up menu) . . . . . touch

☐ **Step 3:** Trigger the oscilloscope as follows:

TRIGGER Button . . . . . press
Source (in pop-up menu) . . . . . **Internal Clock**

☐ **Step 4:** On the Sampling Head, press the Channel 1 select button.

☐ **Step 5:** On the oscilloscope, press the AUTOSET button.

☐ **Step 6:** Check the peak-to-peak amplitude as follows:

MEASURE button . . . . . press
Measurements (in the major menu) . . . . . touch
Peak-Peak (in the pop-up menu) . . . . . touch
Rise (in the pop-up menu) . . . . . touch
Rise (in the major menu) . . . . . touch
Proximal (in the pop-up menu) . . . . . touch

Check that **peak-to-peak** amplitude is between 212.5 mV and 287.5 mV (250 mV ±15%).

Adjust **Proximal** for 20% and **Distal** for 80%.

Check that rise time is approximately 250 ps.

Adjustments

This section contains procedures to check electrical specifications, to examine measurement limits, and to manually set all internal adjustments listed in Table 5-1. Use these procedures to return the oscilloscope to specified operation following repair or as part of a comprehensive performance verification procedure to verify that the oscilloscope meets specifications. To adjust the oscilloscope, simply perform the procedures listed in this section. The Specifications or Measurement Limits are given at the beginning of each procedure. Functional tests are included in the *Performance Verification* section. Refer to the *11801C Digital Sampling Oscilloscope User Manual* for more information about specifications and oscilloscope operation. The Setup in each procedure provides information concerning test equipment setup or interconnection. Refer to Table 5-2 for more information concerning test equipment used in the setups.

Most Adjustment and Performance Verification procedures can be run in any order, However, the Sampling Head Calibration must always precede other procedures which use an operational sampling head. Also, if a different sampling head is used, then sampling head calibration is required for each additional sampling head.

Table 5-1: Measurement Limits and Adjustments

Procedure Description	Measurement Limits *(Examine)*	Adjustments *(Adjust)*
Power Supply		
Voltage Supply	+4.85 V to +5.25 V	none
Voltage Reference	+5.15 V to +5.25 V	R800 +5.2 V Ref for +5.20 V
Regulator Reference	+9.95 V to +10.05 V	R730 +10 V Ref for +10.00 V
Display		
Cutoff	visible	SCREEN, on transformer on A8 CRT Driver board, until display appears
Convergence	primary colors are not separated in the white grid	CONVERGENCE, R210, for optimum convergence of red, green, and blue
Focus	focused grid pattern	FOCUS, on transformer on A8 CRT Driver board, for optimum focus on white grid pattern
Vertical Size and Position	align with tic marks	VERT SIZE, L321, and VERT POS, R311, for optimum alignment
Horizontal Size, Linearity and Position	align with tic marks and for optimum appearance	H-SIZE, R501, H-LIN, R502, and H-POS, R500, for optimum alignment and linearity
Gray Scale	white at the top of the display and gray at the bottom, and the right side of the display is cut off	SCREEN, on transformer on A8 CRT Driver board; RED, R200; GREEN, R201,;and BLUE, R203; for cutoff and color balance
Color Impurity	no severe color impurities in red, green, and blue display	cycle power on and off
Real Time Clock	1,000,000 µs ±5 µs	Real Time Clock for 1,000,000 µs

Test Equipment

Table 5-2 (Test Equipment), contains suggested test equipment for use in this manual. Procedure steps are based on the test equipment examples given, but you may substitute other equipment with similar specifications. The use of different equipment may alter test results, setup information, and related connectors and adapters.

Table 5-2: Test Equipment

Description	Minimum Specification	Examples of Applicable Test Equipment
High Frequency Sine Wave Generator	10 MHz to 10 GHz	WILTRON 6759B Opt 2
Sampling Head	SD-Series	SD-24 and any other Tektronix SD-Series Sampling Head except SD-14
Digital Voltmeter (w/test leads)	≤0.005% Accuracy	FLUKE 8842A Digital Voltmeter
Calibration Generator	DC output, 0.25% accuracy 1 V output amplitude	Tektronix PG 506 Calibration Generator with a TM 500-Series Power Module
Frequency Counter	One Part in 1,000,000 Accuracy	Tektronix DC 5010 Universal Counter/Timer with a TM 5000-Series Power Module
Calibration Head		Tektronix Calibration Head 067−1413−00
Precision Voltage Source		DATA PRECISION 8200
Test Terminal	any GPIB (IEEE−1978) controller, or ASCII terminal equipped with an RS-232-C port. Requires compatible RS-232-C serial interface cable	IBM compatible PC with terminal emulation software
Coaxial Cable, 50 Ω (3 required)	50 Ω, 36-inch, male BNC connectors	Tektronix Part 012−0482−00
Coaxial Cable, RF	RF cable, 12 in., SMA connectors	Tektronix Part 174−1364−00
	RF cable, 8.5 in., SMA connectors	Tektronix Part 174−1120−00

Table 5-2: Test Equipment (Cont.)

Description	Minimum Specification	Examples of Applicable Test Equipment
Adapters	BNC female-to-male Dual Banana	Tektronix Part 103−0090−00
	BNC male-to-female Dual Banana	Tektronix Part 103−0035−00
	SMA male-to-BNC female (8 required)	Tektronix Part 015−1018−00
	SMA female-to-BNC male	Tektronix Part 013−0126−00
	SMA male-to-N male	Tektronix Part 015−0369−00
Power Divider, 50 Ω	6 dB load isolation, 50 Ω, SMA connectors	Tektronix Part 015−1014−00
Termination, 50 Ω	Impedance, 50 Ω; accuracy within 2%; SMA connectors	Tektronix Part 015−1022−00
Attenuator, 10X	20 dB attenuation, 50 Ω, one male and one female	Tektronix Part 011−0059−02
Attenuator, 2X	50 Ω, SMA, one male and one female	Tektronix Part 015−1001−00
Power Supplies Troubleshooting Fixture		Tektronix Part 067−1264−00 Extended Diagnostics 11000-Series Power Supplies troubleshooting fixture
Probe, 10X	Attenuation 10X	Tektronix P6106A
Alignment Tool	Plastic hex	Tektronix Part 003−0301−00
	Insulated slot	Tektronix Part 003−0675−01
	Square Tip (ceramic)	Tektronix Part 003−1400−00
Magnetic Screwdriver	Holder for Torx head tips	Tektronix Part 003−0293−00
Torx Head Screwdriver	#10 tip	Tektronix Part 003−0814−00
	#15 tip	Tektronix Part 003−0966−00
	#20 tip	Tektronix Part 003−0866−00

Table 5-2: Test Equipment (Cont.)

Description	Minimum Specification	Examples of Applicable Test Equipment
External Loopback Connector	RS-232-C connector	Tektronix Part 013−0198−00
Shorting Strap	two alligator clips on a short pigtail conductor	
Integrated Circuit Extracting Tool	IC Insertion-Extraction Pliers, 28-pin type	General Tool P/N U505BG or equivalent
Board Removal Tools	Straight-slot screwdriver, large	
	Torx-drive screwdriver, T-7, T-8, T-10, T-15, T-20, T-25	
	Allen (hex) Wrench, 1/16-inch	
	Nutdrivers, 3/16-inch, 1/4-inch, 7/16-inch	
	Needle-nose pliers	
Small Ruler	half inch rulings	
Antistatic wrist strap		Tektronix Part 006−3415−04

Using These Procedures

Some procedures begin with a setup illustration that shows what test equipment is needed and how to connect it. The other procedures require only a calibrated SD-Series Sampling Head. Refer to Table 5-2 (Test Equipment), on the preceding pages for an example of the test equipment for each procedure.

Conventions in this Manual

In these procedures, the following conventions are used:

- CAPITAL letters within the body of text identify front panel controls, indicators, and connectors on the oscilloscope (for example, MEASURE) and sampling head.
- **Bold** letters identify menu labels and display messages.
- Initial Capital letters identify connectors, controls, and indicators (for example, On) on associated test equipment.
- In some steps, the first word is italicized to identify a step that contains a performance verification and an adjustment instruction. For example, if *Check* is the first word in the title of a step, an electrical specification is checked. If *Adjust* appears in the title, the step involves an electrical adjustment. If *Examine* is the first word in the title, the step concerns measurement limits that indicate whether the oscilloscope is operating properly; these limits are not to be interpreted as electrical specifications.

Menu Selections and Measurement Techniques

Details on measurement techniques and instructions for making menu selections are generally not included in these procedures. Comprehensive descriptions of menus and oscilloscope features are located in the *11801C Digital Sampling Oscilloscope User Manual*.

User Manual

A review of the *11801C Digital Sampling Oscilloscope User Manual* is strongly recommended to familiarize the first-time user with oscilloscope controls and features.

Power Supply

This procedure shows the setup and lists the steps to examine the Measured Voltage Supply and to check/adjust the Voltage Reference and the Regulator Reference (see Figures 5-1, 5-2, and 5-3).



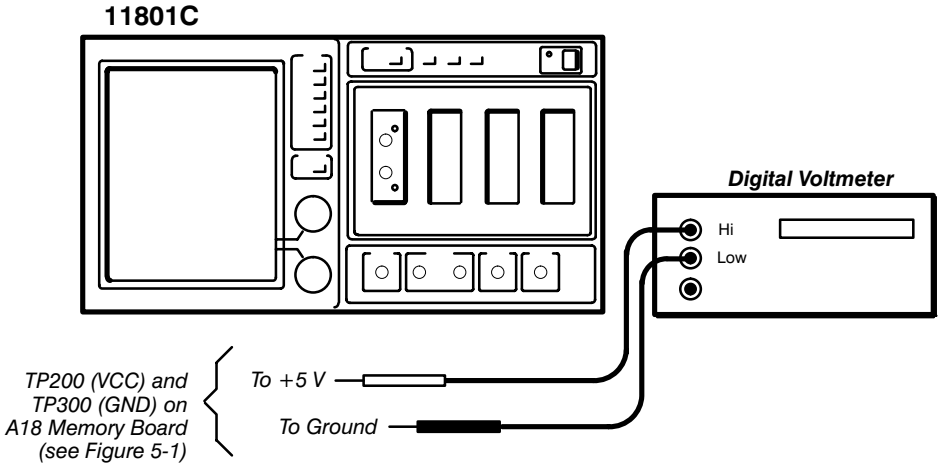
This procedure should only be performed if the instrument is out of measurement limits and maintenance is required. If the oscilloscope is already within limits, proceed to the Display procedure.

Measurement Limits

The measurement limits for this procedure are as follows:

- Measured Voltage Supply limits must be within +4.85 V and +5.25 V
- Voltage Reference must be within +5.15 V and +5.25 V
- Regulator Reference must be within +9.95 V and +10.05 V

Setup to Examine Voltage Supply



Procedure to Examine Voltage Supply

☐ **Step 1:** Set the oscilloscope ON/STANDBY switch to ON, and initialize as follows:

UTILITY button . . . . . press
Initialize (in major menu) . . . . . touch
Initialize (in verification pop-up menu) . . . . . touch

☐ **Step 2:** With the oscilloscope top and bottom covers removed, refer to the *Maintenance* section and locate the A18 Memory board.

☐ **Step 3:** Connect the digital multimeter to TP200 and TP300 as indicated in the setup illustration (see also Figure 5-1).

☐ **Step 4:** *Check* that the Digital Voltmeter reads within the limits of +4.85 V and +5.25 V.

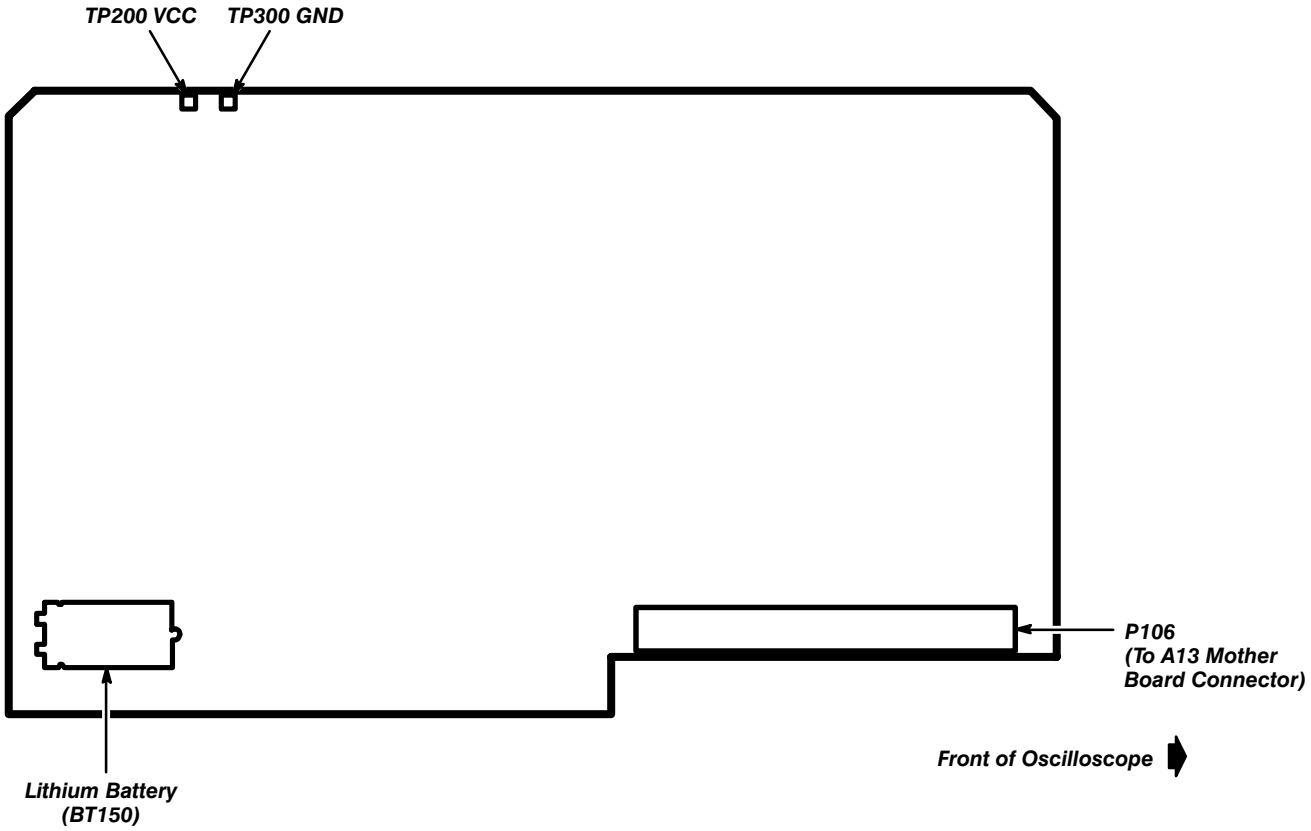
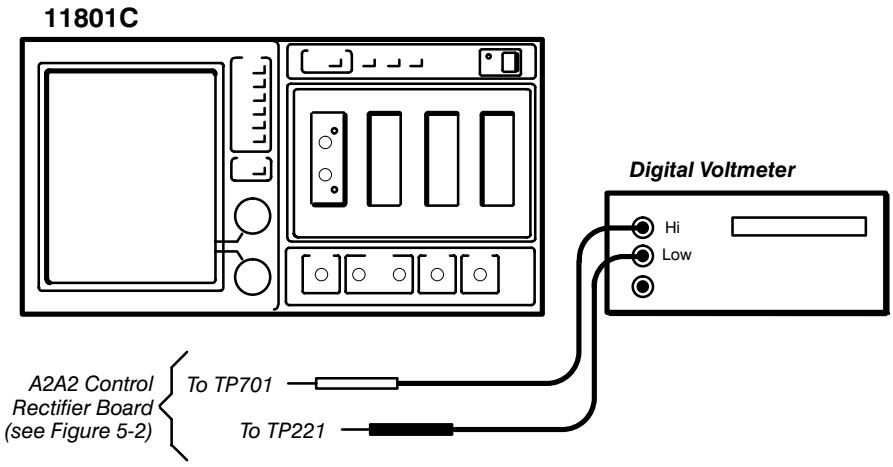


Figure 5-1: A18 Memory Board Test Point Locations

Setup to Examine/Adjust Voltage Reference



STOP This procedure should only be performed if maintenance is required. This is not necessary for verifying instrument specifications.

Procedure to Examine/Adjust Voltage Reference

☐ **Step 1:** Perform the following settings in the order listed:

a. Set the front panel ON/STANDBY switch to STANDBY and the rear panel PRINCIPAL POWER SWITCH to OFF. Disconnect the oscilloscope from the power source.

b. Remove the Power Supply module following the procedure listed under Power Supply Module Removal/Replacement in the *Maintenance* section.

c. Create a short between test points TP830 and TP831 on the A2A2 Control Rectifier board using a shorting strap. See Figure 5-2.

d. Connect the oscilloscope Power Supply module to a suitable line power source.

e. Set the rear panel PRINCIPAL POWER SWITCH to ON.

☐ **Step 2:** With the Digital Voltmeter set to DC Voltage and connected as indicated in the setup diagram, *check* that the multimeter reads within the limits of +5.15 and +5.25 V.

STOP DO NOT attempt to change the following +5.2 V Ref setting if the reading is within the stated limits. Proceed to Step 4.

WARNING

To prevent electric shock, use extreme caution when making the following adjustment.

☐ **Step 3:** *Adjust* the +5.2 V Ref, R800, on the A2A2 Control Rectifier board to +5.20 V.

☐ **Step 4:** Remove the Digital Voltmeter leads from the test points.

☐ **Step 5:** Set the rear panel PRINCIPAL POWER SWITCH to OFF.

☐ **Step 6:** Disconnect the oscilloscope from the power source.

☐ **Step 7:** Remove all test leads and the TP830/831 shorting strap.

☐ **Step 8:** Replace the Power Supply module using the instructions in the *Maintenance* section.

☐ **Step 9:** Set the rear panel PRINCIPAL POWER SWITCH to ON, and the front panel ON/STANDBY switch to ON.

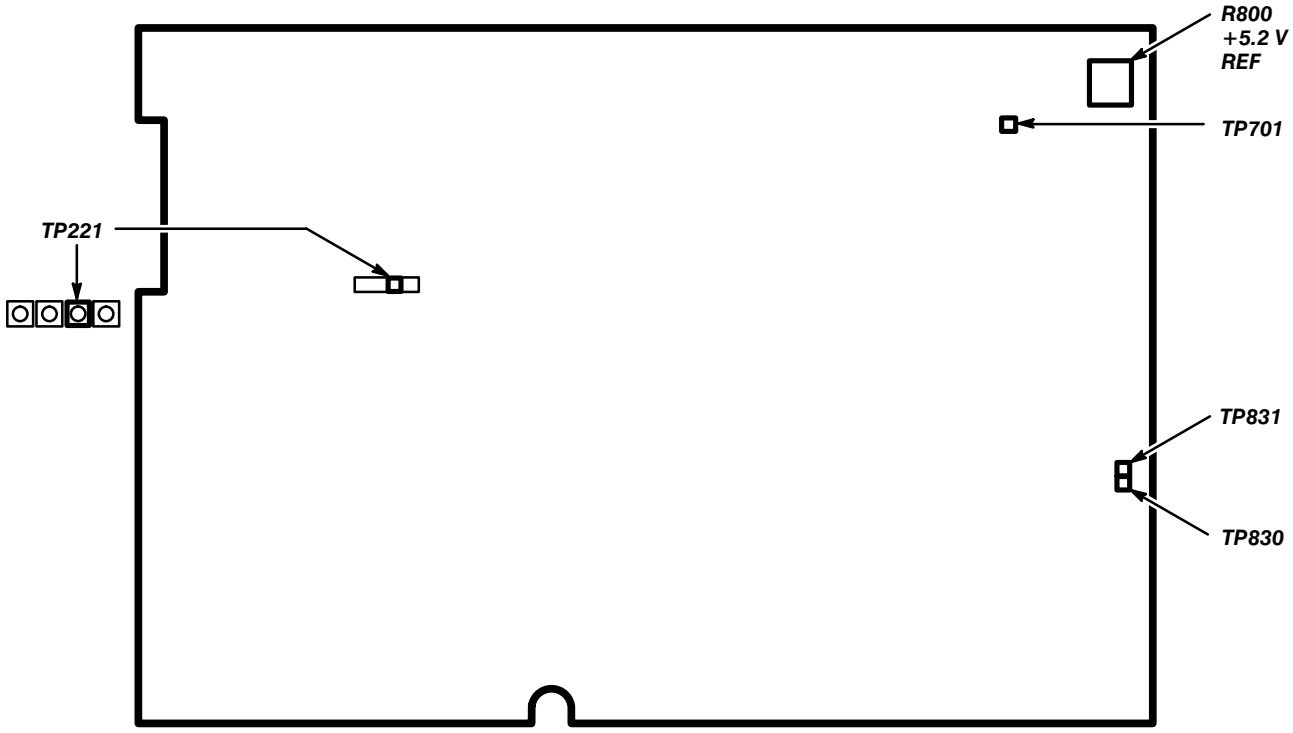
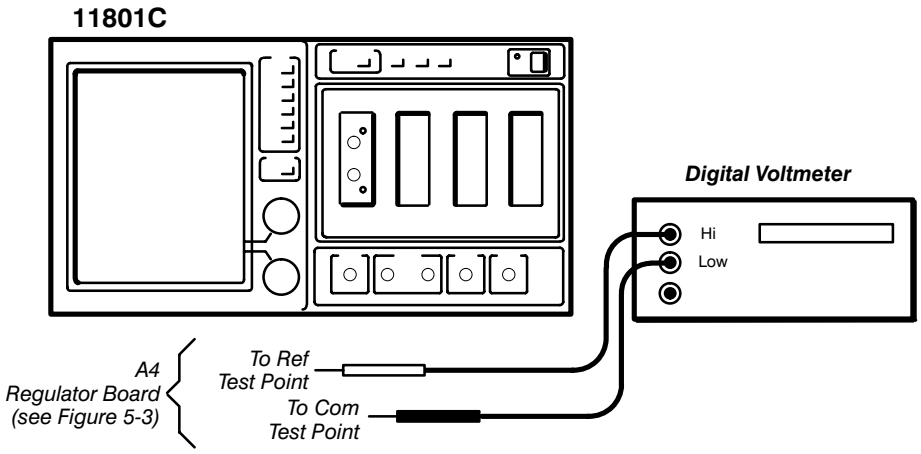


Figure 5-2: A2A2 Control Rectifier Board Test Point and Adjustment Locations

Setup to Examine/Adjust Regulator Reference



Procedure to Examine/Adjust Regulator Reference

☐ **Step 1:** Make the connections shown in the setup and Figure 5-3 diagrams. Check that the oscilloscope power is ON.

☐ **Step 2:** With the Digital Voltmeter in DC Voltage mode, *check* the Voltmeter for a reading within the limits of +9.95 V and +10.05 V.

STOP DO NOT attempt to make the following adjustment to R730 if the reading is within the stated limits. Instead, proceed to Step 4.

WARNING

To prevent electric shock, use extreme caution when making the following adjustment. Access the test points from the right side of the oscilloscope.

☐ **Step 3:** *Adjust* the +10 V Ref, R730, on the A4 Regulator board to +10.00 V.

☐ **Step 4:** Remove the test leads.

☐ **Step 5:** Initiate Power-On Diagnostics (see the *Performance Verification* section).

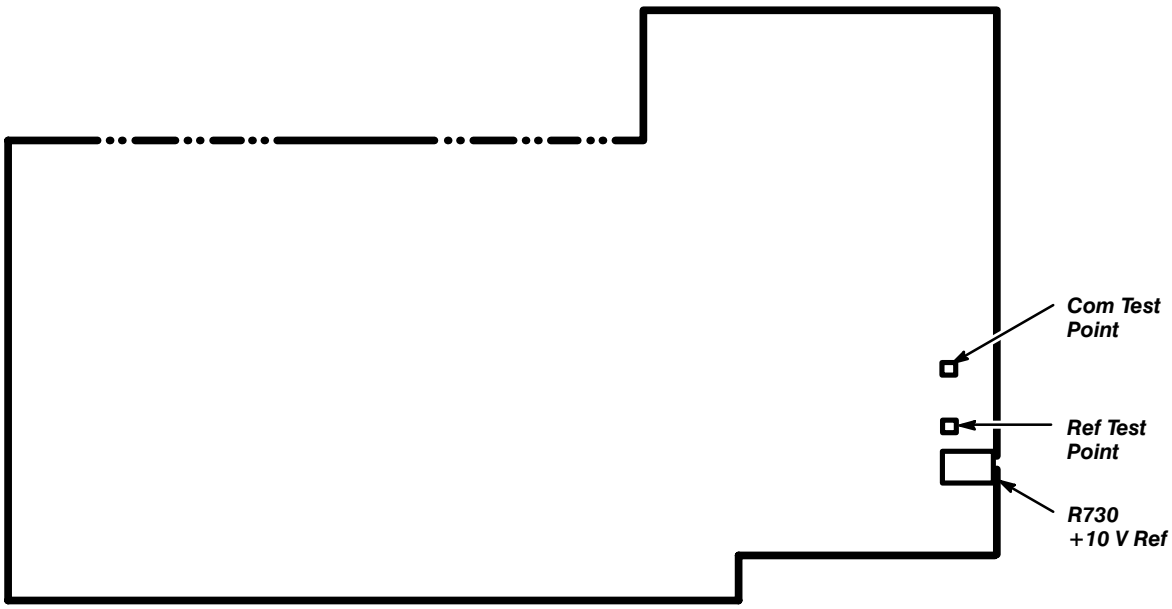


Figure 5-3: A4 Regulator Board Test Point and Adjustment Locations

Display

This procedure shows the setup and lists the steps to examine/adjust the A7 CRT Socket board and the A8 CRT Driver board (see Figures 5-4 and 5-5).



The adjustments in this procedure affect only the visual aspects of the CRT display and you should only perform these adjustments when the CRT, A7 CRT Socket board or A8 CRT Driver board components are replaced. These adjustments do not affect oscilloscope accuracy since all measurements are made on the acquired data, not the displayed data. Unless alignment or brightness difficulties are apparent, proceed to the Real Time Clock procedure.

For all *Examine* steps in this procedure, if the display parameter examined is within the stated limits, then do not perform the *Adjust* step following that *Examine* step. Instead, proceed to the step following the *Adjust* step.

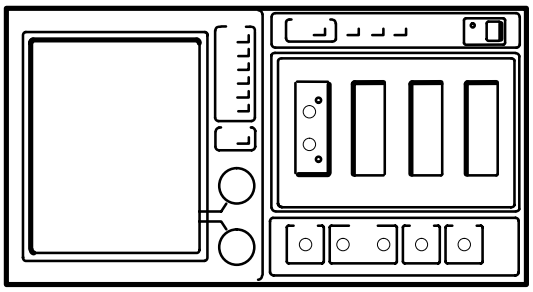
Measurement Limits

The measurement limits are set on the CRT as follows:

- The display must be visible (not cut off).
- The red, green, and blue traces must not be separated.
- Focus is adjusted for minimum line width.
- Vertical size is adjusted to align the corners of the grid pattern with the tic marks on the edges of the front panel bezel.
- Horizontal size is adjusted to align the corners of the grid pattern with the tic marks on the top and bottom edges of the front panel bezel, and the horizontal linearity is adjusted for uniform grid box length.
- Horizontal linearity is adjusted for optimum appearance using an internally generated grid pattern.
- Red, green, and blue colors must have optimum white to gray scale linearity.
- **Red Display**, **Green Disply**, and **Blue Display** in Extended Diagnostics must not contain severe color impurities.

Setup to Examine/Adjust the Display

11801C



Procedure to Examine/Adjust the Display

WARNING

To prevent electric shock, use extreme caution when performing the following adjustment.

☐ **Step 1:** Perform the following settings in the order listed:

11801C
ON/STANDBY . . . . . STANDBY

☐ **Step 2:** Remove the top and bottom cabinet panel covers.

☐ **Step 3:** Remove the three screws that secure the CRT cover, and then remove the cover.

☐ **Step 4:** Remove the two screws that secure the cover that shields the A7 CRT Socket board (CRT Socket board cover).

☐ **Step 5:** Set the ON/STANDBY switch to ON.

☐ **Step 6:** *Examine* that the display is visible.

☐ **Step 7:** *Adjust* SCREEN, located on the transformer mounted to the A8 CRT Driver board, clockwise until the display appears.

☐ **Step 8:** Press the UTILITY button.

☐ **Step 9:** Touch **Extended Diagnostic,** then touch **Extended Diagnostic** in the **Verify Diagnostics** pop-up menu.

☐ **Step 10:** Touch **Block** and then **Front Panel**.

☐ **Step 11:** Touch **Area** and then **Test Pattern**.

☐ **Step 12:** Touch **Routine** and then **White Grid**.

☐ **Step 13:** Touch **Run** in the major menu.

☐ **Step 14:** *Examine* that the primary colors (red, green, and blue) are not separated in the white grid pattern.

WARNING

To prevent electric shock, do not touch the back side of the A7 CRT Socket board. Use extreme caution when performing the following adjustment.

☐ **Step 15:** *Adjust* CONVERGENCE, R210, on the A7 CRT Socket board for the optimum vertical convergence of the red, green, and blue colors.

☐ **Step 16:** *Examine* that the grid pattern is focused.

☐ **Step 17:** *Adjust* FOCUS, located on the transformer mounted on the A8 CRT Driver board, for the optimum focus of the white grid pattern.

☐ **Step 18:** *Examine* that the grid is aligned with the top and bottom tic marks along the inside vertical edge of the front panel bezel. To eliminate any parallax error, look directly ahead at the CRT, and then align the top of the grid with the top vertical tic mark and the bottom of the grid with the bottom tic mark.

☐ **Step 19:** *Adjust* VERT SIZE, L321, and VERT POS, R311, on the A8 CRT Driver board to align the grid with the tic marks along the inside vertical edge of the front panel bezel.

☐ **Step 20:** *Examine* that the grid is aligned with the horizontal tic marks at the top and bottom of the front panel bezel and that the grid boxes are of uniform length throughout the grid pattern.

☐ **Step 21:** *Adjust* H SIZE, R501; H LIN, R502; and H POS, R500, on the A8 CRT Driver board for best overall linearity and position. Use the horizontal tic marks at the top and bottom of the front panel bezel to align the grid.

☐ **Step 22:** H-SIZE, H-LIN, and H-POS potentiometers interact, so you may need to repeat Steps 20 and 21 until they are all correctly adjusted.

☐ **Step 23:** Touch **Exit** to return to the **Routine menu** of the **Extended Diagnostic** menu structure.

☐ **Step 24:** Touch **Gray Scale** in the **Routine** menu.

☐ **Step 25:** Touch **Run** in the major menu.

☐ **Step 26:** *Examine* that the color scale is white at the top, gray at the bottom, and the background on the right side of the display is cut off (that is, the vertical raster lines are not visible on the right side of the display).



If the gray scale meets the previous conditions, do not perform the adjustments in Steps 27, 28, and 30. Proceed to Step 31.

☐ **Step 27:** *Adjust* Red, R200; Green, R201; and Blue, R203, on the A7 CRT Socket board fully counterclockwise.

☐ **Step 28:** *Adjust* SCREEN, located on the transformer that is mounted on the A8 CRT Driver board, so that the bottom block of the gray scale is visible but the background on the right side of the display is still cut off.

☐ **Step 29:** Note which color (red, green, or blue) appears most prominently in the display. DO NOT adjust this color in the following step.

☐ **Step 30:** *Adjust* RED, R200; GREEN, R201; or BLUE, R203, on the A7 CRT Socket board for a pure white to gray scale display. Only adjust the colors that do not appear prominent. For example, if the display appears to be more red, then adjust the GREEN and BLUE potentiometers.

NOTE

SCREEN may have to be adjusted slightly if any of the colors are adjusted. If the vertical raster lines are visible in the background, then adjust SCREEN so that the background is just cut off, but the bottom gray box is still visible.

☐ **Step 31:** Touch **Exit** to return to the **Extended Diagnostic** menu structure.

☐ **Step 32:** Touch **Red Display**, and then touch **Run**.

☐ **Step 33:** *Examine* the red display for any severe color impurities.

☐ **Step 34:** Touch **Exit** to return to the **Extended Diagnostics** menu structure.

☐ **Step 35:** Touch **Green Disply** and then touch **Run**.

☐ **Step 36:** *Examine* the green display for any severe color impurities.

☐ **Step 37:** Touch **Exit** to return to the **Extended Diagnostic** menu structure.

☐ **Step 38:** Touch **Blue Display** and then touch **Run**.

☐ **Step 39:** *Examine* the blue display for any severe color impurities.

☐ **Step 40:** If any of the color displays (that is, the **Red Display**, **Green Disply**, or **Blue Display**) showed severe color impurities, then perform the following to restore the color purity:

- Ensure that the oscilloscope environment is free of all external magnetic fields. For example, a magnetic screwdriver near the oscilloscope could cause color impurities on the screen.
- Set the ON/STANDBY switch to STANDBY.
- Wait 10 seconds, then set the ON/STANDBY switch to ON.
- *Examine* the color displays again, and verify that the color impurities are removed.

NOTE

When the oscilloscope is moved in the earth's magnetic field, color impurities will appear on the display. This is normal. To remove the impurity, repeat Step 40.

☐ **Step 41:** Set the ON/STANDBY switch to STANDBY.

☐ **Step 42:** Replace the CRT Socket board cover and the CRT cover.

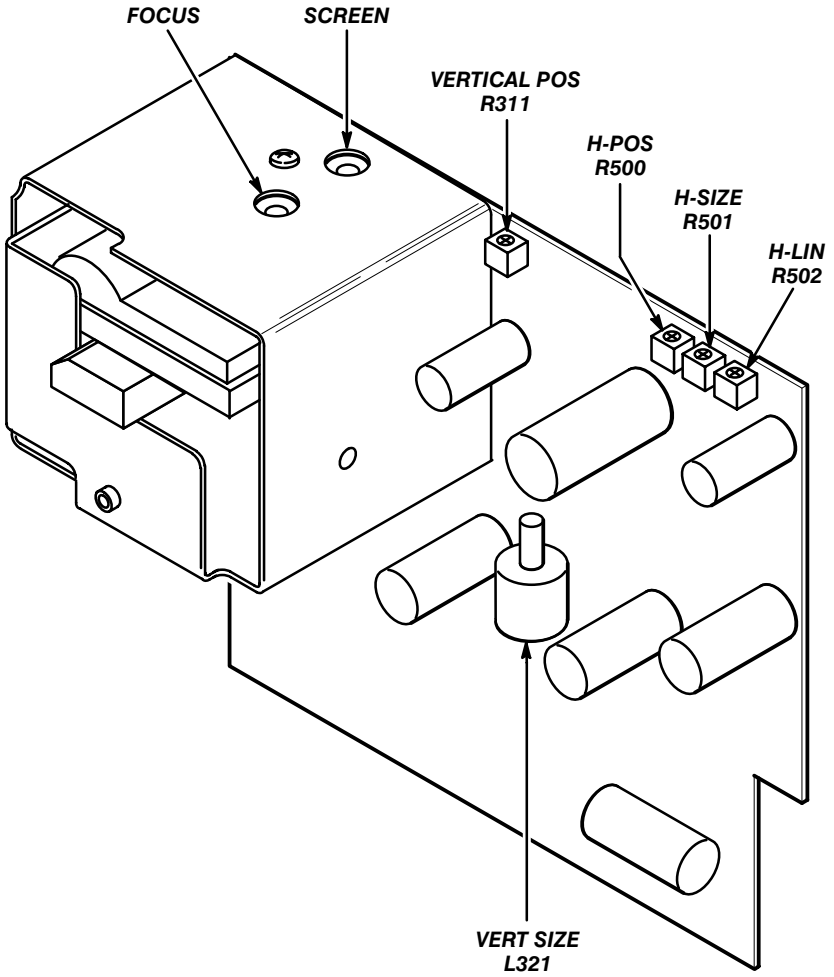


Figure 5-4: A8 CRT Driver Board Adjustment Locations

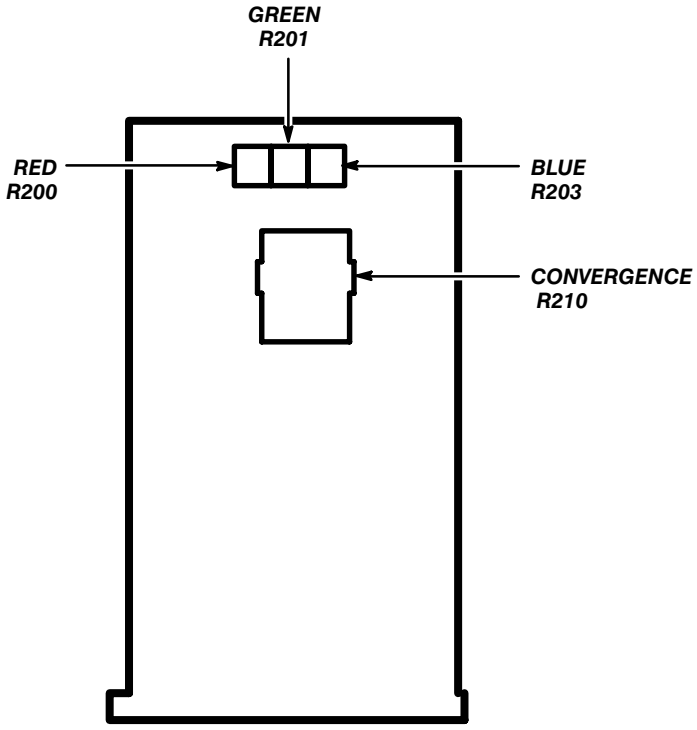


Figure 5-5: A7 CRT Socket Board Adjustment Locations

Real Time Clock

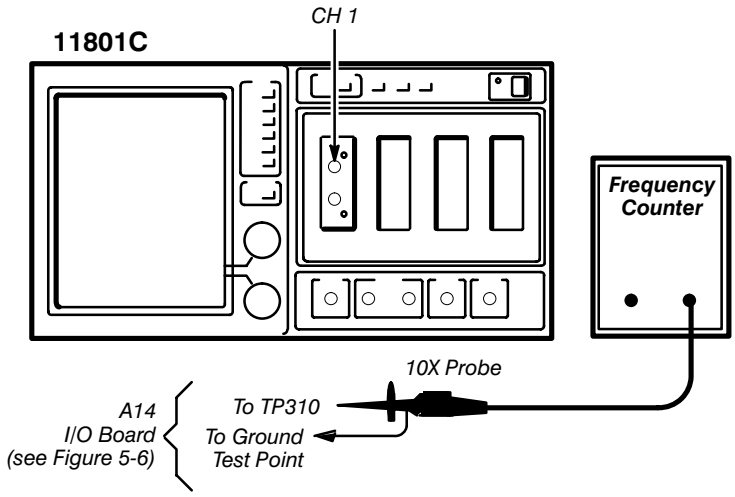
This procedure verifies the correct operation and accuracy of the oscilloscope's input/output systems (see Figure 5-6).

STOP This procedure should be performed only if maintenance is required. Its use is not necessary for verifying instrument specifications.

Measurement Limits

The measurement limit for the real time clock is 1,000,000 µs ±5 µs.

Setup to Examine/Adjust Real Time Clock



Procedure to Examine/Adjust Real Time Clock

☐ **Step 1:** Initialize the oscilloscope settings as follows:

UTILITY button . . . . . press
Initialize (in major menu) . . . . . touch
Initialize (in verification pop-up menu) . . . . . touch

☐ **Step 2:** Perform the following operations in the order given:

- Set the front panel ON/STANDBY switch to STANDBY.
- Remove the L bracket on the front of the card cage.
- Remove both plastic retaining strips from the top of card cage.
- Remove the A17 Main Processor board, and then install it in the fourth slot from the outer edge.
- Remove the A29 Memory Expansion board, and then install it in the third slot.
- Remove the A14 Input/Output (I/O) board, and then install it in second slot.
- Move the A18 Memory board from the first slot to the fifth slot.
- Reconnect all the cables to the A14 I/O board.
- Set the oscilloscope front panel ON/STANDBY switch to ON.

☐ **Step 3:** Connect the Frequency Counter as indicated in the setup diagram (see also Figure 5-6), and set the controls as follows:

Frequency counter
- Mode . . . . . Period
- Trigger . . . . . DC
- Slope . . . . . – (negative)
- Time Base . . . . . 1 MHz

☐ **Step 4:** Make the following oscilloscope selections:

UTILITY button . . . . . press
- **Page to Enhanced Accuracy** (in major menu) . . . . . touch
- **Page to Utility2** (in major menu) . . . . . touch
- **Extended Diagnostics** (in major menu) . . . . . touch
- **Extended Diagnostics** (in pop-up menu) . . . . . touch
- **Block** (in major menu) . . . . . touch
- **Input/Output** (in pop-up menu) . . . . . touch
- **Area** (in major menu) . . . . . touch
- **Real Time Clk** (in pop-up menu) . . . . . touch
- **Routine** (in major menu) . . . . . touch
- **Calibrate** (in pop-up menu) . . . . . touch
- **Run** (in major menu) . . . . . touch

☐ **Step 5:** *Examine* that the frequency counter reads within the limits of 999,995 µs and 1,000,005 µs.



DO NOT attempt to optimize the Real Time Clock setting if the period is within the stated limits. Proceed to Step 7.

☐ **Step 6:** *Adjust* Real Time Clock, C510, for 1,000,000 µs.

☐ **Step 7:** Remove the frequency counter from the power module.

☐ **Step 8:** Set the oscilloscope ON/STANDBY switch to STANDBY.

☐ **Step 9:** Replace the circuit boards (rearranged in Step 1) in their original positions.

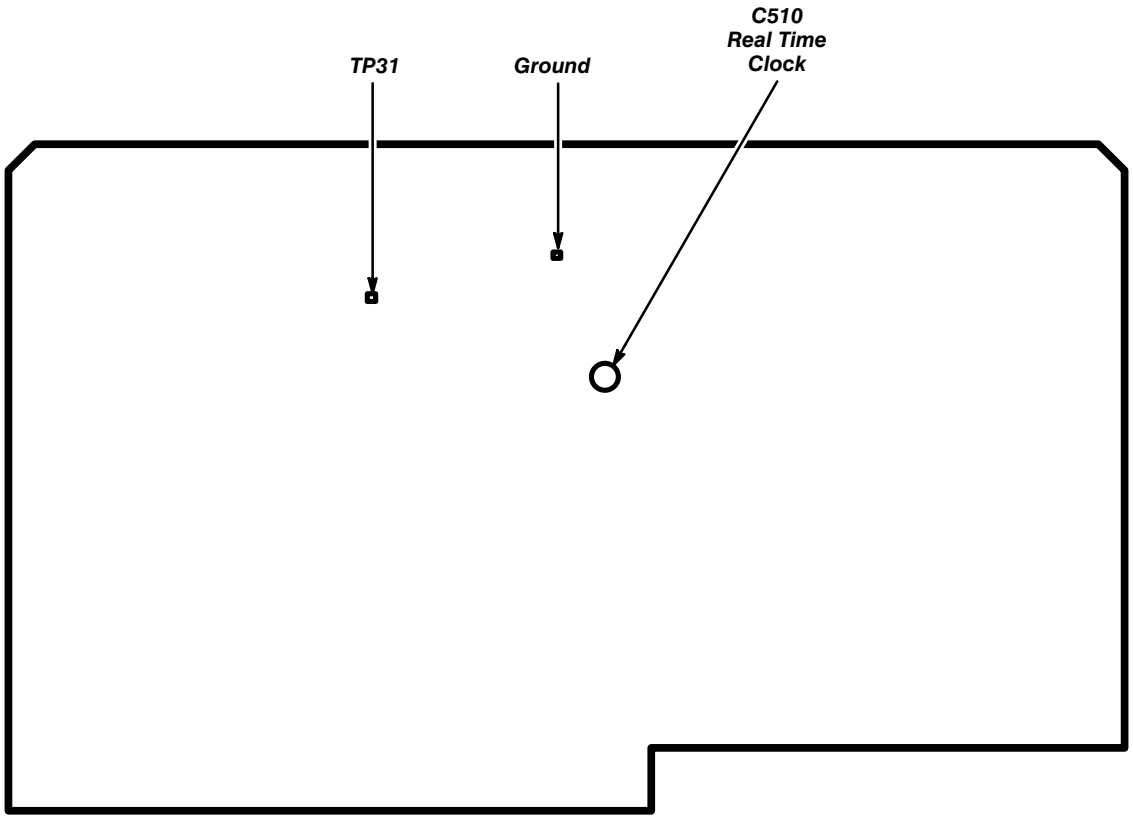


Figure 5-6: A14 I/O Board Test Point and Adjustment Locations

Preventive Maintenance

Regular maintenance can prevent instrument breakdown and may improve the reliability of the instrument. The environment in which the instrument operates will determine the frequency of maintenance. A convenient time for doing preventive maintenance is prior to performing an electrical adjustment.

Removing the Cabinet Panels

WARNING

To prevent electric shock when operating the instrument with the covers removed, do not touch exposed connections or components. Dangerous potentials exist at several points throughout this instrument.

To avoid electric shock, disconnect the power before cleaning the instrument or replacing any parts. Some transistors have voltages present on their cases.

The top and bottom cabinet panels (or covers) protect you from operating potentials present within the instrument. In addition, the panels reduce radiation of electromagnetic interference from the instrument. To remove the panels, loosen the fasteners and lift the panels off. Operate the instrument with the panels in place to protect the interior from dust.

Cleaning the Instrument

The instrument should be cleaned as often as operating conditions require. Dirt in the instrument can cause overheating and component breakdown. Dirt on components acts as an insulating blanket and prevents efficient heat dissipation. Dirt also provides an electrical conduction path which may cause the instrument to fail. The side panels reduce the amount of dust that reaches the interior of the instrument. Keep the side panels in place for safety and cooling.

CAUTION

Avoid the use of chemical cleaning agents which might damage the plastics used in this instrument. Use a nonresidue type of cleaner, preferably isopropyl alcohol or totally denatured ethyl alcohol. Before using any other type of cleaner, consult your local Tektronix service center or representative.

Exterior

Dust on the instrument can be removed with a soft cloth or small brush. The brush is also useful for dislodging dirt on and around the front panel controls. Dirt which remains can be removed with a soft cloth dampened in a mild detergent and water solution. Do not use abrasive cleaners.

CRT

Faceplates are cleaned with a soft, lint-free cloth dampened with denatured alcohol.

Interior

Cleaning should seldom be necessary. To clean the interior, blow off the dust with dry, low-velocity air (approximately 5 lb/in^2). Remove any dirt which remains with a soft brush or a cloth dampened with a mild detergent and water solution. A cotton-tipped applicator is useful for cleaning in narrow spaces, or for cleaning more delicate circuit components. After cleaning, use a washcloth dampened with water to remove any residue.

CAUTION

Circuit boards and components must be dry before applying power, to prevent damage from electrical arcing.

The high-voltage circuits should receive special attention. Excessive dirt in these circuits may cause high-voltage arcing and result in improper instrument operation.

Visual Inspection

The instrument should be inspected occasionally for defects such as broken connections, improperly seated semiconductors, damaged or improperly installed circuit boards, and heat-damaged parts. The corrective procedure for most visible defects is obvious; however, particular care must be taken if heat-damaged parts are found. Since overheating usually indicates other trouble in the instrument, correcting the cause of overheating is important to prevent the damage from reoccurring.

Periodic Electrical Adjustment

To ensure accurate measurements, check the electrical adjustment of this instrument after each 2,000 hours of operation or every 24 months if used infrequently.

Corrective Maintenance

Corrective maintenance consists of module and board replacement procedure for repairing the instrument.

Power Supply Voltage Hazard

Use caution if working near any metal-faced part in the Power Supply module.

WARNING

All metal components, including any metal-faced ones, in the Power Supply module should be considered hazardous because these components may be at the AC line voltage potential.

Always remove the line power cord before attempting any disassembly procedures.

An electric-shock hazard exists when the instrument is not grounded. Do not remove the ground wire (green-yellow) that connects the Power Supply module chassis to the instrument.

Ordering Parts

When ordering replacement parts from Tektronix, Inc., include the following information:

- instrument type
- instrument serial number
- a description of the part
- Tektronix part number

Static-Sensitive Device Classification

CAUTION

Static discharge can damage any semiconductor component in this instrument. Follow the precautions in this section to prevent damage.

This instrument contains electrical components that are susceptible to damage from static discharge. See Table 6-1 for the relative susceptibility of various classes of semiconductors. Static voltages of 1 kV to 30 kV are common in unprotected environments.

Table 6-1: Relative Susceptibility to Damage from Static Discharge

Semiconductor Classes	Relative Susceptibility Levels[1]
MOS or CMOS microcircuits, and discrete or linear microcircuits with MOS inputs (most sensitive)	100 V to 500 V
ECL	200 V to 500 V
Schottky signal diodes	250 V
Schottky TTL	500 V
High-frequency bipolar transistors	400 V to 600 V
JFETs	600 V to 800 V
Linear microcircuits	400 V to 1000 V (est.)
Low-power Schottky TTL	900 V
TTL (least sensitive)	1200 V

[1] **Voltage discharged from a 100 pF capacitor through a resistance of 100 Ω.**

Observe the following precautions to avoid damage:

- Minimize handling of static-sensitive components.
- Transport and store static-sensitive components or assemblies in their original containers, anti-static tube rail, or conductive foam. Label any package that contains static-sensitive assemblies or components.
- Discharge the static voltage from your body by wearing a wrist strap while handling these components. Servicing static-sensitive assemblies or components should be performed only at a static-free work station by qualified service personnel. We recommend using the static control mat; refer to Table 4-2 for the part numbers of this test equipment.
- Keep the work station surface free of anything that can generate or hold a static charge.
- Keep the component leads shorted together whenever possible by storing them in conductive foam or rails.
- Pick up components by the body, never by the leads.
- Do not slide the components over any surface.
- Avoid handling components in areas that have a floor or work-surface covering that can generate a static charge.

Removing and Replacing FRUs

Use Table 6-2 as a convenient reference for finding connector and screw locations when removing and replacing field replaceable units (FRUs). The first column in the table lists the FRU to be removed or replaced, and the second column lists the figures that you should reference for the location of connector and screw locations discussed in the procedure to remove/replace this FRU.

Table 6-2: FRU Removal/Replacement Figure Cross Reference

FRU to be Removed/ Replaced	Figures to Reference During Removal		Page
Power Supply Module	Figure 6-2	Removing the Power Supply Rear Plate, Fan Housing, and Rear Panel Connector Plate	6-16
	Figure 6-3	A2A2 Control Rectifier Board Connectors Locations	6-17
Fan Motor	Figure 6-2	Removing the Power Supply Rear Plate, Fan Housing, and Rear Panel Connector Plate	6-16
Cathode Ray Tube (CRT)	Figure 6-5	Removing/Replacing the Cathode Ray Tube	6-24
	Figure 6-12	Removing/Replacing the A8 CRT Driver Board	6-39
	Figure 6-15	Removing/Replacing the A10 Front Panel Button Board	6-43
	Figure 6-32	Multi-Pin Connector Orientation and Semiconductor Indexing Diagram	6-74
Acquisition Unit	Figure 6-23	Removing/Replacing the A19 Strobe/TDR Buffer Board	6-58
	Figure 6-26	Removing/Replacing the A26 M/F Acquisition Interconnect Board	6-61
	Figure 6-32	Multi-Pin Connector Orientation and Semiconductor Indexing Diagram	6-74
Batteries	Figure 6-10	Removing/Replacing the A5 Time Base/ Controller Board	6-36
	Figure 6-19	Removing/Replacing the A14 I/O Board	6-50
	Figure 6-22	Removing/Replacing the A18 Memory Board	6-56
A1 Mainframe (M/F) Strobe Drive Board	Figure 6-8	Removing/Replacing the A1 M/F Strobe Drive Board	6-31
	Figure 6-32	Multi-Pin Connector Orientation and Semiconductor Indexing Diagram	6-74
A3 Mainframe (M/F) Power Connect Board	Figure 6-2	Removing the Power Supply Rear Plate, Fan Housing, and Rear Panel Connector Plate	6-16
	Figure 6-3	A2A2 Control Rectifier Board Connectors Locations	6-17
	Figure 6-9	Removing/Replacing the A4 Regulator Board	6-33
	Figure 6-10	Removing/Replacing the A5 Time Base/ Controller Board	6-36
	Figure 6-19	Removing/Replacing the A14 I/O Board	6-50
	Figure 6-23	Removing/Replacing the A19 Strobe/TDR Buffer Board	6-58

Table 6-2: FRU Removal/Replacement Figure Cross Reference (Cont.)

FRU to be Removed/ Replaced	Figures to Reference During Removal		Page
A4 Regulator Board	Figure 6-2	Removing the Power Supply Rear Plate, Fan Housing, and Rear Panel Connector Plate	6-16
	Figure 6-3	A2A2 Control Rectifier Board Connectors Locations	6-17
	Figure 6-9	Removing/Replacing the A4 Regulator Board	6-33
	Figure 6-32	Multi-Pin Connector Orientation and Semiconductor Indexing Diagram	6-74
A5 Time Base/Controller Board	Figure 6-10	Removing/Replacing the A5 Time Base/Controller Board and A6 Calibrator Board	6-36
	Figure 6-32	Multi-Pin Connector Orientation and Semiconductor Indexing Diagram	6-74
A6 Calibrator Board	Figure 6-10	Removing/Replacing the A5 Time Base/Controller Board and A6 Calibrator Board (Steps 1 and 2 only)	6-36
A7 CRT Socket Board	Figure 6-11	Removing/Replacing the A7 CRT Driver Board	6-38
	Figure 6-32	Multi-Pin Connector Orientation and Semiconductor Indexing Diagram	6-74
A8 CRT Driver Board	Figure 6-5	Removing/Replacing the Cathode Ray Tube	6-24
	Figure 6-12	Removing/Replacing the A8 CRT Driver Board	6-39
	Figure 6-15	Removing/Replacing the A10 Front Panel Button Board	6-43
	Figure 6-32	Multi-Pin Connector Orientation and Semiconductor Indexing Diagram	6-74
A9 Touch Panel Assembly	Figure 6-5	Removing/Replacing the Cathode Ray Tube	6-24
	Figure 6-15	Removing/Replacing the A10 Front Panel Button Board	6-43
	Figure 6-32	Multi-Pin Connector Orientation and Semiconductor Indexing Diagram	6-74
A10 Front Panel Control Board	Figure 6-5	Removing/Replacing the Cathode Ray Tube	6-24
	Figure 6-15	Removing/Replacing the A10 Front Panel Button Board	6-43
	Figure 6-32	Multi-Pin Connector Orientation and Semiconductor Indexing Diagram	6-74
A11 Front Panel Button Board	Figure 6-5	Removing/Replacing the Cathode Ray Tube	6-24
	Figure 6-15	Removing/Replacing the A10 Front Panel Button Board	6-43
	Figure 6-16	Removing/Replacing the A11 Front Panel Button Board	6-44
	Figure 6-32	Multi-Pin Connector Orientation and Semiconductor Indexing Diagram	6-74
A12 Rear Panel Assembly	Figure 6-5	Removing/Replacing the Cathode Ray Tube	6-24
	Figure 6-17	Removing/Replacing the A12 Rear Panel Assembly	6-46
	Figure 6-32	Multi-Pin Connector Orientation and Semiconductor Indexing Diagram	6-74

Table 6-2: FRU Removal/Replacement Figure Cross Reference (Cont.)

FRU to be Removed/ Replaced	Figures to Reference During Removal		Page
A13 Mother Board	Figure 6-7	Top View of the Card Cage	6-30
	Figure 6-18	Removing/Replacing the A13 Mother Board	6-48
	Figure 6-19	Removing/Replacing the A14 I/O Board	6-50
	Figure 6-32	Multi-Pin Connector Orientation and Semiconductor Indexing Diagram	6-74
A14 Input/Output (I/O) Board	Figure 6-7	Top View of the Card Cage	6-30
	Figure 6-19	Removing/Replacing the A14 I/O Board	6-50
	Figure 6-32	Multi-Pin Connector Orientation and Semiconductor Indexing Diagram	6-74
A15 Memory Manager Unit (MMU) Board	Figure 6-7	Top View of the Card Cage	6-30
	Figure 6-20	Removing/Replacing the A15 MMU Board	6-52
	Figure 6-32	Multi-Pin Connector Orientation and Semiconductor Indexing Diagram	6-74
A17 Main Processor Board	Figure 6-7	Top View of the Card Cage	6-30
	Figure 6-21	Removing/Replacing the A17 Main Processor Board	6-54
	Figure 6-32	Multi-Pin Connector Orientation and Semiconductor Indexing Diagram	6-74
A18 Memory Board	Figure 6-7	Top View of the Card Cage	6-30
	Figure 6-22	Removing/Replacing the A18 Memory Board	6-56
A19 Strobe/TDR Buffer Board	Figure 6-23	Removing/Replacing the A19 Strobe/TDR Buffer Board	6-58
	Figure 6-26	Removing/Replacing the A26 M/F Acquisition Interconnect Board	6-61
	Figure 6-32	Multi-Pin Connector Orientation and Semiconductor Indexing Diagram	6-74
A20-A23 Head Interconnect Boards	Figure 6-23	Removing/Replacing the A19 Strobe/TDR Buffer Board	6-58
	Figure 6-24	Removing/Replacing the A20-A23 Head Interconnect Boards	6-59
	Figure 6-25	Removing/Replacing the Front Subpanel Assembly	6-60
	Figure 6-26	Removing/Replacing the A26 M/F Acquisition Interconnect Board	6-61
	Figure 6-28	Removing/Replacing the A24/A27 Acquisition Analog Boards	6-63
	Figure 6-29	Removing/Replacing the A25/A28 Acquisition MPU Boards	6-64
	Figure 6-32	Multi-Pin Connector Orientation and Semiconductor Indexing Diagram	6-74

Table 6-2: FRU Removal/Replacement Figure Cross Reference (Cont.)

FRU to be Removed/ Replaced	Figures to Reference During Removal		Page
A26 Mainframe (M/F) Acquisition Interconnect Board	Figure 6-23	Removing/Replacing the A19 Strobe/TDR Buffer Board	6-58
	Figure 6-25	Removing/Replacing the Front Subpanel Assembly	6-60
	Figure 6-26	Removing/Replacing the A26 M/F Acquisition Interconnect Board	6-61
	Figure 6-27	Top View of the A26 M/F Acquisition Interconnect Board	6-62
	Figure 6-28	Removing/Replacing the A24/A27 Acquisition Analog Boards	6-63
	Figure 6-29	Removing/Replacing the A25/A28 Acquisition MPU Boards	6-64
	Figure 6-32	Multi-Pin Connector Orientation and Semiconductor Indexing Diagram	6-74
A24/A27 Acquisition Analog Boards	Figure 6-23	Removing/Replacing the A19 Strobe/TDR Buffer Board	6-58
	Figure 6-26	Removing/Replacing the A26 M/F Acquisition Interconnect Board	6-61
	Figure 6-28	Removing/Replacing the A24/A27 Acquisition Analog Boards	6-63
	Figure 6-32	Multi-Pin Connector Orientation and Semiconductor Indexing Diagram	6-74
A25/A28 Acquisition MPU Boards	Figure 6-23	Removing/Replacing the A19 Strobe/TDR Buffer Board	6-58
	Figure 6-26	Removing/Replacing the A26 M/F Acquisition Interconnect Board	6-61
	Figure 6-29	Removing/Replacing the A25/A28 Acquisition MPU Boards	6-64
	Figure 6-32	Multi-Pin Connector Orientation and Semiconductor Indexing Diagram	6-74
Firmware ICs	Figure 6-30	FRU IC Detail	6-67
	Figure 6-32	Multi-Pin Connector Orientation and Semiconductor Indexing Diagram	6-74
Serial Data Interface (SDI) IC	Figure 6-19	Removing/Replacing the A14 I/O Board	6-50
	Figure 6-32	Multi-Pin Connector Orientation and Semiconductor Indexing Diagram	6-74
	Figure 6-31	IC Insertion-Extraction Tool	6-69
Fuses	Figure 6-37	Fuse Locations	6-107

NOTE

In addition to the figures listed in Table 6-2, the exploded-view drawings in the Parts List *section may be helpful in removing or disassembling individual FRUs or subassemblies. Also, Figures 6-1 and 6-30 are useful for determining the location of FRUs and FRU ICs.*

The top and/or bottom covers will need to be removed for most repairs. To loosen the cover fasteners, use a coin or a straight-slot screwdriver with a large-sized tip and rotate the cover fasteners a quarter turn counter-clockwise.

Whenever a specific area is mentioned (such as the right side), it will usually be in reference to the front of the instrument. If another reference is intended, it will be indicated (for example, viewing from the left side or viewing from the rear of the instrument).

All connector names are labeled on the circuit board and/or on the connectors themselves.

WARNING

To avoid electric-shock hazard and instrument damage, always disconnect the oscilloscope from its power source before removing or replacing FRUs. For sampling head removal or replacement, switch the front panel ON/STANDBY switch to STANDBY.

Electrical Lock-on of the Front Panel ON/STANDBY Power Switch

Some applications of the oscilloscope may require that the power remain on. To electrically lock the power on, use the following procedure:

- ☐ **Step 1:** Switch the rear panel PRINCIPAL POWER SWITCH to OFF.
- ☐ **Step 2:** Remove the AC power cable.
- ☐ **Step 3:** Position the instrument on its left (handle) side, as viewed from the front.
- ☐ **Step 4:** Remove the bottom cover.
- ☐ **Step 5:** Locate the A4 Regulator board.
- ☐ **Step 6:** Locate the J820 jumper on the A4 Regulator board.
- ☐ **Step 7:** Reposition the J820 jumper from its two outer (right side) pins to its two inner (left side) pins, without dropping the jumper.
- ☐ **Step 8:** Replace the bottom cover. Turn the instrument in the upright position.
- ☐ **Step 9:** Reconnect the AC power cable and switch the PRINCIPAL POWER SWITCH to ON.

  The power will now remain on regardless of the setting of the ON/STANDBY power switch.

CAUTION

To prevent damage to the instrument and/or sampling head, do not install or remove a sampling head while the power is on.

- ☐ **Step 10:** To turn the power off while the ON/STANDBY power switch is disabled, use the rear panel PRINCIPAL POWER SWITCH.

To return to normal operation of the ON/STANDBY Power Switch, follow the preceding steps in reverse order.

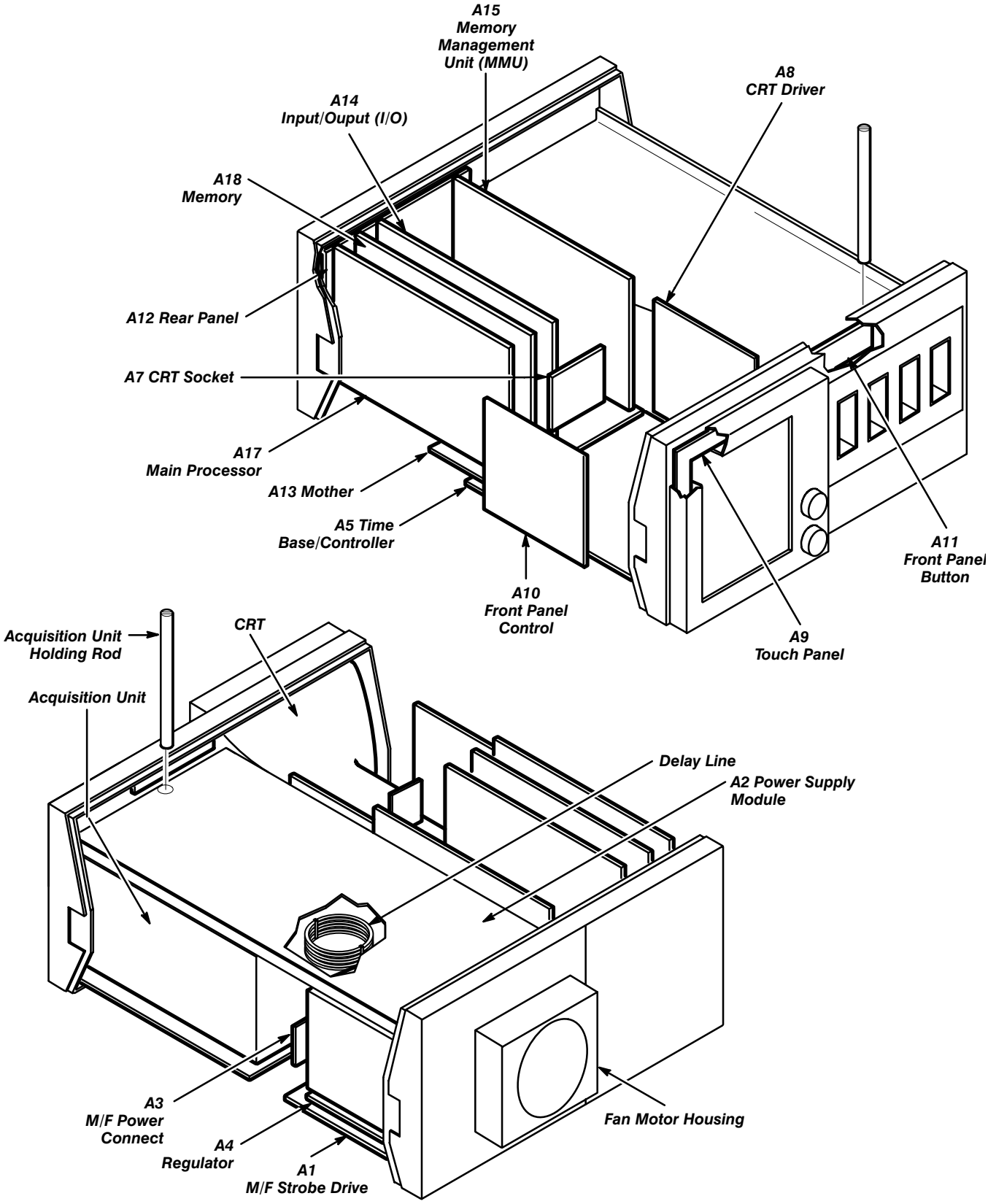


Figure 6-1: Field Replaceable Units (FRU) Locator

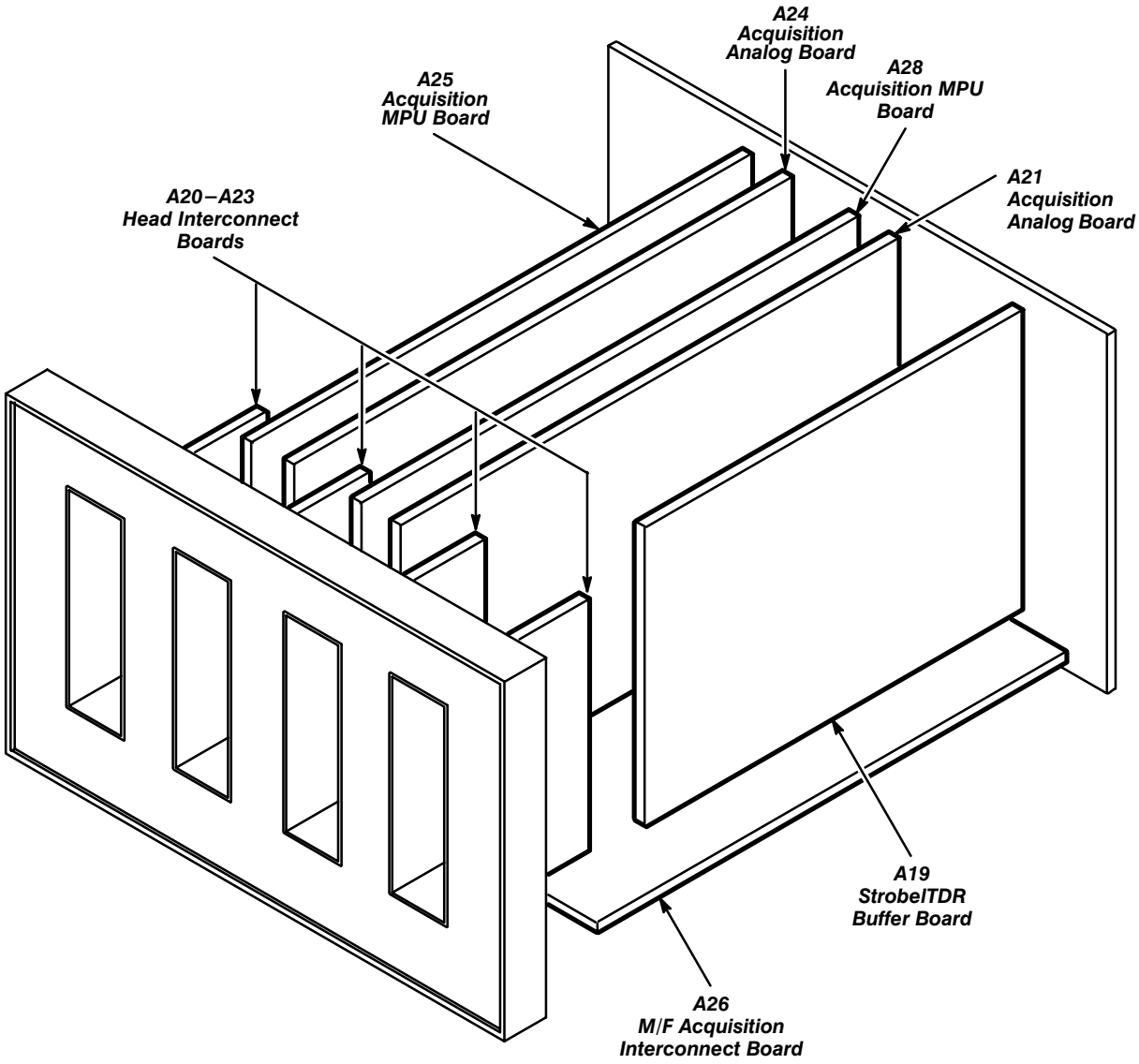


Figure 6-1: Field Replaceable Unit (FRU) Locator (Cont.)

Power Supply Module Removal/ Replacement

The Power Supply module slides out of the rear of the oscilloscope for maintenance and troubleshooting. It may also be removed to gain better access to the A3 M/F Power Connect board or the A4 Regulator board.

See Figure 6-2 and Figure 6-3 for connector and screw locations.

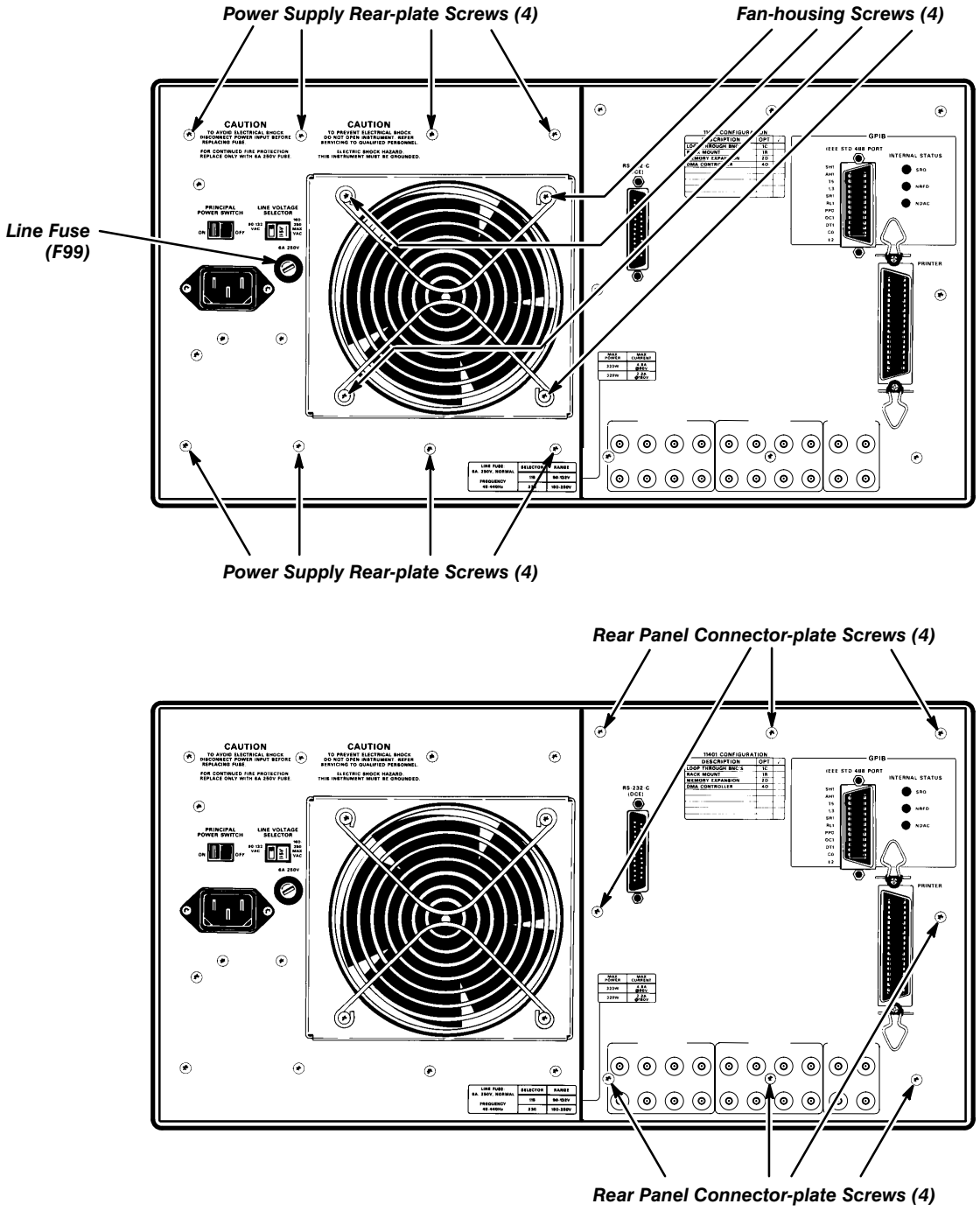


Figure 6-2: Removing the Power Supply Module, Fan Housing, and Rear Panel Connector Plate

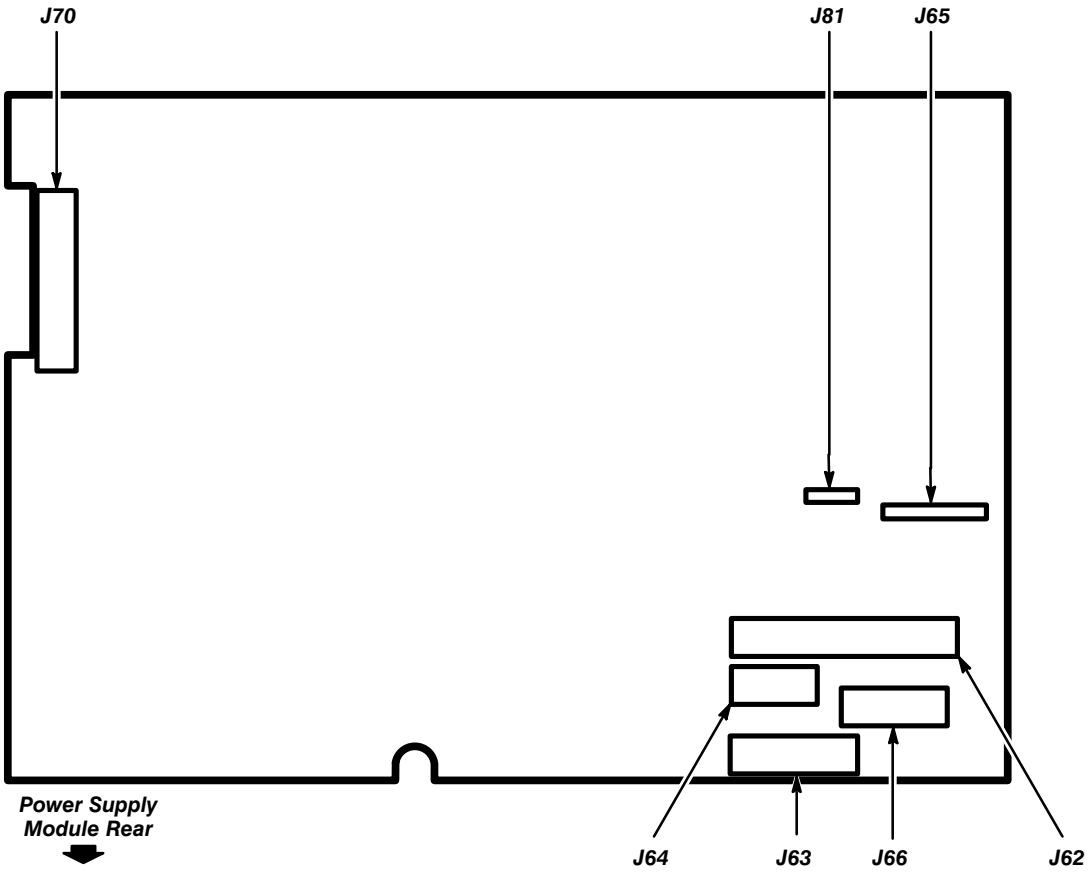


Figure 6-3: A2A2 Control Rectifier Board Connector Locations

To remove the Power Supply module from the oscilloscope, proceed as follows:

- ☐ **Step 1:** Turn the instrument on its left side (as viewed facing the rear panel). The Power Supply module will now be at the bottom of the instrument.
- ☐ **Step 2:** Remove the eight Torx head screws that secure the power supply module.
- ☐ **Step 3:** Carefully pull the Power Supply module partially out of the instrument. Do not stretch taut or bind the wires attached to the A2A2 Control Rectifier board connectors.

CAUTION

To prevent damage to the connector pins, pull the Power Supply module only partially out of the instrument.

☐ **Step 4:** Remove the wire connectors from the pins on the A2A2 Control Rectifier board.

☐ **Step 5:** Remove the chassis ground (green-yellow) wire that is connected to the Power Supply module from the chassis of the instrument.

☐ **Step 6:** Remove the Power Supply module.

To replace the Power Supply module, perform the previous steps in the reverse order.

NOTE

Align the metal guides on the top of the Power Supply module with the grooves inside the upper part of the opening in the instrument.

Be careful not to pinch any wires or interconnecting cables while installing the Power Supply module.

Fan Motor Removal/ Replacement

See Figure 6-2 for connector and screw locations.

Remove and replace the fan motor as follows:

☐ **Step 1:** Using a pencil or tape, mark the top of the fan motor housing for later use in determining the position of the motor. Remove the four screws securing the housing to the rear of the instrument mainframe. Hold the housing as you remove the last screws.

☐ **Step 2:** Separate the grill and the housing from the motor.

☐ **Step 3:** Remove the two wires at their motor connections. Note that the red wire is (+) and the brown wire is (−).

☐ **Step 4:** Remove the fan motor.

NOTE

Observe the position in which the motor was mounted to ensure that the motor is remounted in its original positioning, or the fan wires may not reach.

To replace the fan motor, perform the previous steps in the reverse order, noting the following additional points while replacing the motor:

- use the mark from Step 1 to determine the original position of the motor
- tighten the screws securely
- remove the mark from the top of the housing
- check that no wires contact the fan blades

CAUTION

To prevent damage to the fan connection, be careful not to pinch the wires under the fan housing.

Cathode Ray Tube (CRT) Removal/ Replacement

WARNING

The cathode ray tube (CRT) may retain a dangerous electrical (16 kV) charge. To prevent electric shock, fully discharge the anode before removing the CRT. Short the anode lead from the CRT to the chassis. Wait approximately ten minutes and again firmly short the anode lead to the chassis. Then, remove the CRT.

If the CRT breaks, the glass fragments scatter at a high velocity (implosion). Use extreme care when handling the CRT. Protective clothing and safety glasses should be worn. Avoid striking the CRT on any object which might cause it to crack or implode. When storing a CRT, place it in a protective carton or set the CRT face down in a protected location with smooth surface and with the CRT faceplate on a soft mat.

See Figures 6-1, 6-4, 6-5, 6-6, 6-7, 6-13, and 6-32 for module, connector, screw, and index locations.

Remove the CRT as follows:

- ☐ **Step 1:** Remove the three Torx head screws that secure the CRT cover, and then the CRT cover.
- ☐ **Step 2:** Set the instrument in the inverted position.
- ☐ **Step 3:** Use a 1/16-inch Allen wrench to loosen the two small screws that secure the two control knobs. Carefully remove the control so knobs that you do not lose the small Allen screws inside the knobs.

CAUTION

When replacing the two control knobs, do not overtighten the two Allen screws.

- ☐ **Step 4:** Remove the two Torx head screws on the bottom of the A9 Touch Panel Assembly.
- ☐ **Step 5:** Lift up on the bottom of the A9 Touch Panel Assembly and swing the assembly outward. The top of the A9 Touch Panel Assembly is held in place with two tabs that hook under the top of the chassis. Pull the assembly out until you can access the black ground wire that connects the A9 Touch Panel Assembly to the instrument chassis.
- ☐ **Step 6:** Remove the quick-disconnect ground connector that connects the black ground wire to the instrument chassis.

☐ **Step 7:** Set the A9 Touch Panel Assembly aside. To avoid stressing the ribbon cable that is still connected to the A9 Touch Panel Assembly and to keep the assembly from cluttering your work space, place the A9 Touch Panel Assembly on top of the sampling head compartments. Do not damage the A9 Touch Panel Assembly when placing it on top of the sampling head plug-in compartments.

☐ **Step 8:** Carefully set the instrument on its left side.

☐ **Step 9:** Remove the two plastic circuit board guides from the top of the card cage.

☐ **Step 10:** Remove the two Torx head screws that secure the A7 CRT Socket board cover. Use a short Torx head screwdriver to remove the rear-most Torx head screw.

☐ **Step 11:** Remove the A7 CRT Socket board cover.

☐ **Step 12:** Slowly pull the A7 CRT Socket board towards the rear of the instrument to unplug the A7 CRT Socket board from the CRT.

NOTE

When reattaching the A7 CRT Socket board to the CRT, align the pins of the CRT to the receptacles on the A7 CRT Socket board. Then, slowly push the pins into the receptacles.

Do not force the connection into place; doing so can bend or break some of the pins. If the pins do not slide easily into the receptacles, then pull the A7 CRT Socket board away from the CRT, and realign the A7 CRT Socket board to the CRT.

WARNING

The CRT anode voltage is 16 kV. To avoid electric shock, ground the anode lead from the CRT to the chassis to remove any stored charge remaining in the CRT. Wait approximately ten minutes. Then, ground the anode load to the chassis again.

☐ **Step 13:** Remove connector J54 from the A8 CRT Driver board. Note the position of the multi-pin connector's index triangle to ensure that you can correctly replace the connector.

☐ **Step 14:** Remove the four Torx head screws that secure the CRT to the top of the instrument chassis. Two of the screws are removed from the front of the front panel chassis and two of the screws are removed from behind the front panel casting.

☐ **Step 15:** Remove the top CRT support bar from the instrument. The CRT support bar is not attached once the four Torx head screws securing the top of the CRT are removed.

☐ **Step 16:** Remove the four Torx head screws that secure the CRT to the bottom of the instrument chassis. Two of the screws are removed from the front of the front panel chassis, and two of the screws are removed from behind the front panel casting.

☐ **Step 17:** Remove the bottom CRT support bar from the instrument.

CAUTION

Once the four Torx head screws are removed from the bottom of the CRT, the CRT is not attached to the instrument. Use care to not damage the CRT while it is loose in the instrument.

☐ **Step 18:** Slowly pull the CRT out of the front panel chassis.

To replace the CRT, perform the previous steps in reverse order.

NOTE

Replacing the CRT will require that the instrument be readjusted.

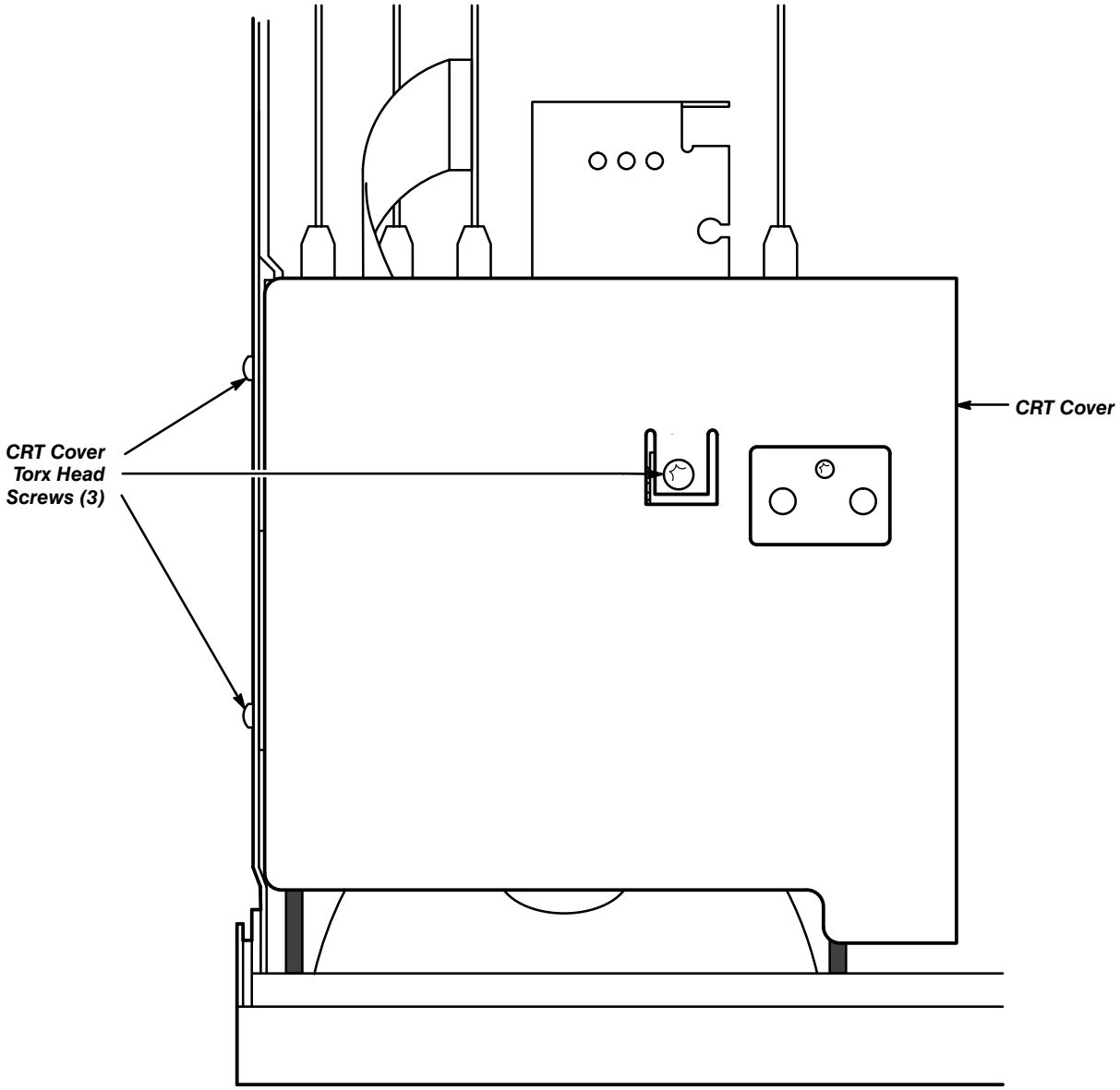


Figure 6-4: Removing/Replacing the CRT Cover

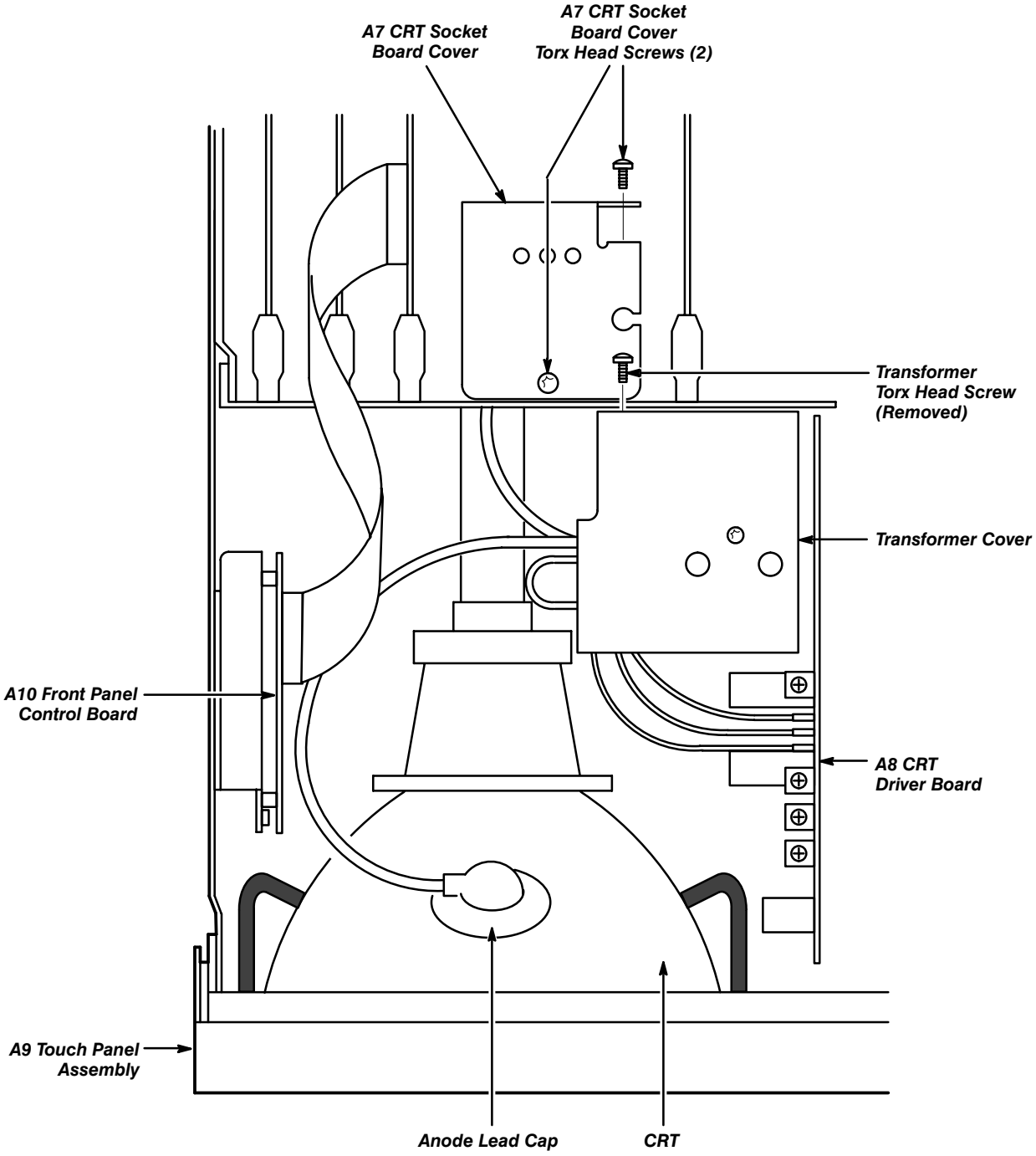


Figure 6-5: Removing/Replacing the Cathode Ray Tube

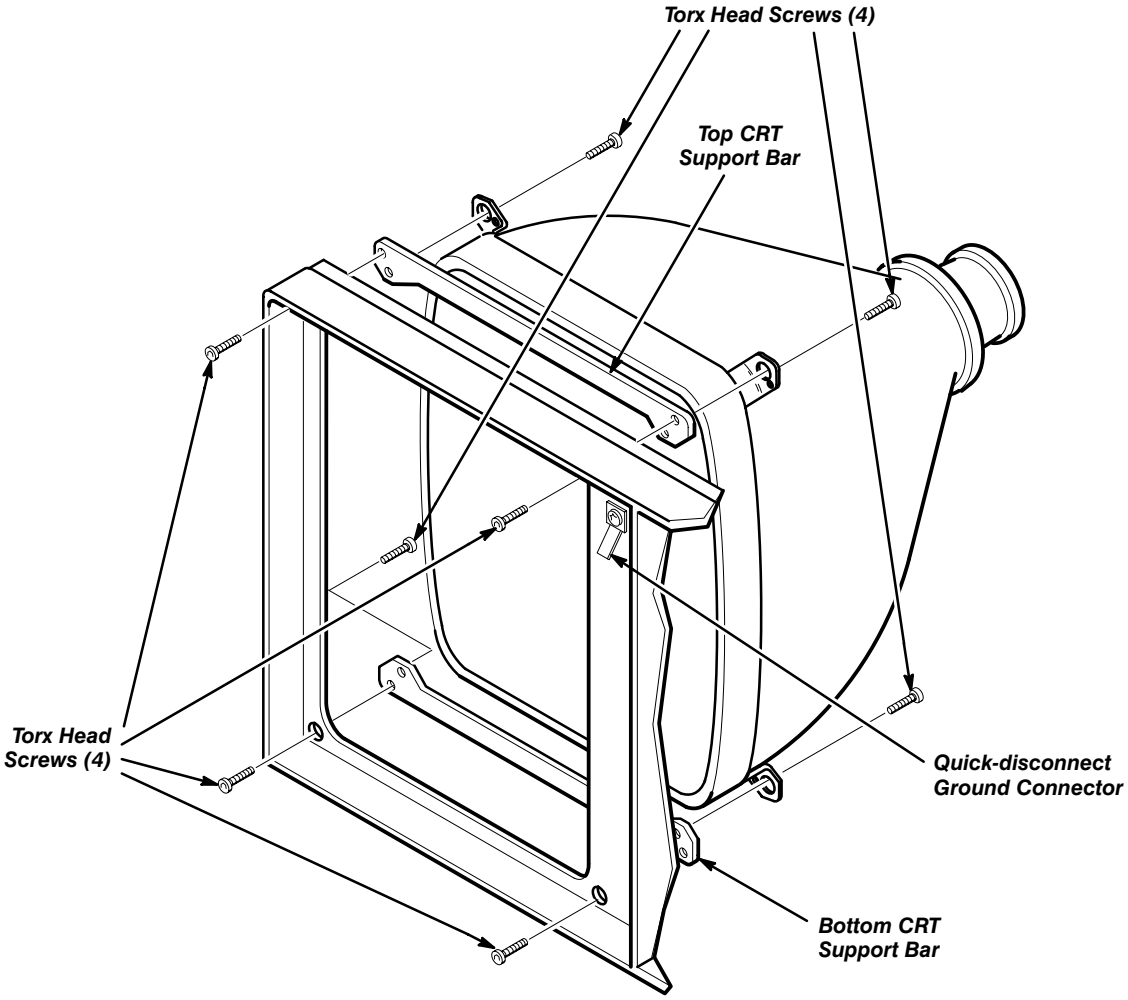


Figure 6-6: Removing/Replacing the CRT Torx Head Screws

Acquisition Unit Removal/ Replacement

See Figures 6-23, 6-26, and 6-32 for connector, screw, and index locations.

Remove and replace the Acquisition unit as follows (the Acquisition unit can be removed with the instrument in the normal upright position for all steps):

CAUTION

Lifting the trim covers to remove them will break the trim covers. There is a clip on the inside of the trim cover which slides over the end of the side frame section. To remove the trim covers, move each cover toward the end of the instrument where it is located. (The front cover moves forward and the rear cover moves backward.) Moving the clip about 1/8-inch will release the cover. Then, the cover can be removed from the instrument.

- ☐ **Step 1:** Remove the bolt from the top of the chassis, just behind the front casting.
- ☐ **Step 2:** Remove the trim covers from the right side (as viewed from the front of the instrument).
- ☐ **Step 3:** Remove the two Torx head screws that hold the frame section and remove the frame section.
- ☐ **Step 4:** Remove connectors J10 on the A26 M/F Acquisition Interconnect board and J34 on the A19 Strobe/TDR Buffer board. Note the position of the connector's index triangles to ensure that the multi-pin connectors can be correctly replaced.
- ☐ **Step 5:** Remove connectors J29A, J30A, J32, J33A, and J33B on the A19 Strobe/TDR Buffer board.
- ☐ **Step 6:** Grab between the two sampling head slots and gently pull out the Acquisition unit a few inches.
- ☐ **Step 7:** Remove the gray ground wire from the rear of the Acquisition unit.
- ☐ **Step 8:** Remove the Acquisition unit.

CAUTION

To prevent damage to interconnecting wires, be careful not to pinch any interconnecting wires when replacing this unit.

To replace the Acquisition unit, perform the previous steps in the reverse order.

Battery Disposal and First Aid

The instrument contains the following number of batteries on the following boards:

- two batteries (in the U500 and U511 RAM sockets) on the A5 Time Base/Controller board
- one battery (BT130) on the A14 I/O board
- one battery (BT150) on the A18 Memory board

See Figures 6-10, 6-19, and 6-22 respectively, for the location of these batteries.

WARNING

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

Battery Disposal

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

NOTE

Typically, small quantities (less than 20) can be safely disposed of with ordinary garbage in a sanitary landfill.

Larger quantities must be sent by surface transport to a hazardous waste disposal facility. The batteries should be individually packaged to prevent shorting. Then, pack them into a sturdy container that is clearly labeled, ***Lithium Batteries — DO NOT OPEN.***

Emergency and First Aid Information

In case of accidental contact with the lithium batteries, give your emergency care provider the following information:

- **Manufacturer:** Panasonic
- **Battery Type:** Lithium Poly-Carbon monoflouride, BR 2/3 A
- **Solvent** (electrolyte): Gama Butyrlactone is of low toxicity. It can cause some eye and respiratory irritation. According to the manufacturer, the solvent may be released during venting. (Venting is an out gassing of battery material.) This is usually caused by short circuiting (for more than a few seconds) or by overheating.
- **Solute:** LIBF4

Table 6-3 lists the emergency procedures to follow should you come in contact with battery solvent.

Table 6-3: Emergency Procedures for Contact with Battery Solvent

Contact	Do This:
Skin	Wash promptly with plenty of water.
Eyes	Flush immediately with plenty of water and use an emergency eye wash, if available. Report to a medical professional for treatment.
Inhalation	Leave the area and get fresh air. Report to a medical professional for treatment.
Ingestion	Non-toxic according to laboratory testing. However, report to a medical professional for advice.

In case of venting, clear the immediate area. Venting will usually last only a few seconds.

FRU Board and Assembly Removal

Pin connectors are for electrical interconnection with chassis-mounted components and other boards. Most boards/assemblies in the instrument are mounted on the chassis. The following four boards plug onto the top of the A13 Mother board (see Figure 6-7 for the location of these boards in the card cage):

- A14 Input/Output (I/O)
- A15 Memory Management Unit (MMU)
- A17 Executive Processor (EXP)
- A18 Memory

The following two boards plug onto the A26 M/F Acquisition Interconnect board (See Figure 6-1 for the locations of these boards in the Acquisition unit):

- A24/A27 Acquisition Analog
- A25/A28 Acquisition MPU

Feed-through connectors join the plug-on boards to the A13 Mother board and the A26 M/F Acquisition Interconnect board.

CAUTION

To minimize the chance of static charge damage to the integrated circuits and/or related circuitry, after removing a board from the instrument, place it on a grounded, antistatic surface.

Some components that are mounted on a board must be retained for use with the new assembly. These components would include interconnecting plugs, support posts, and some wiring.

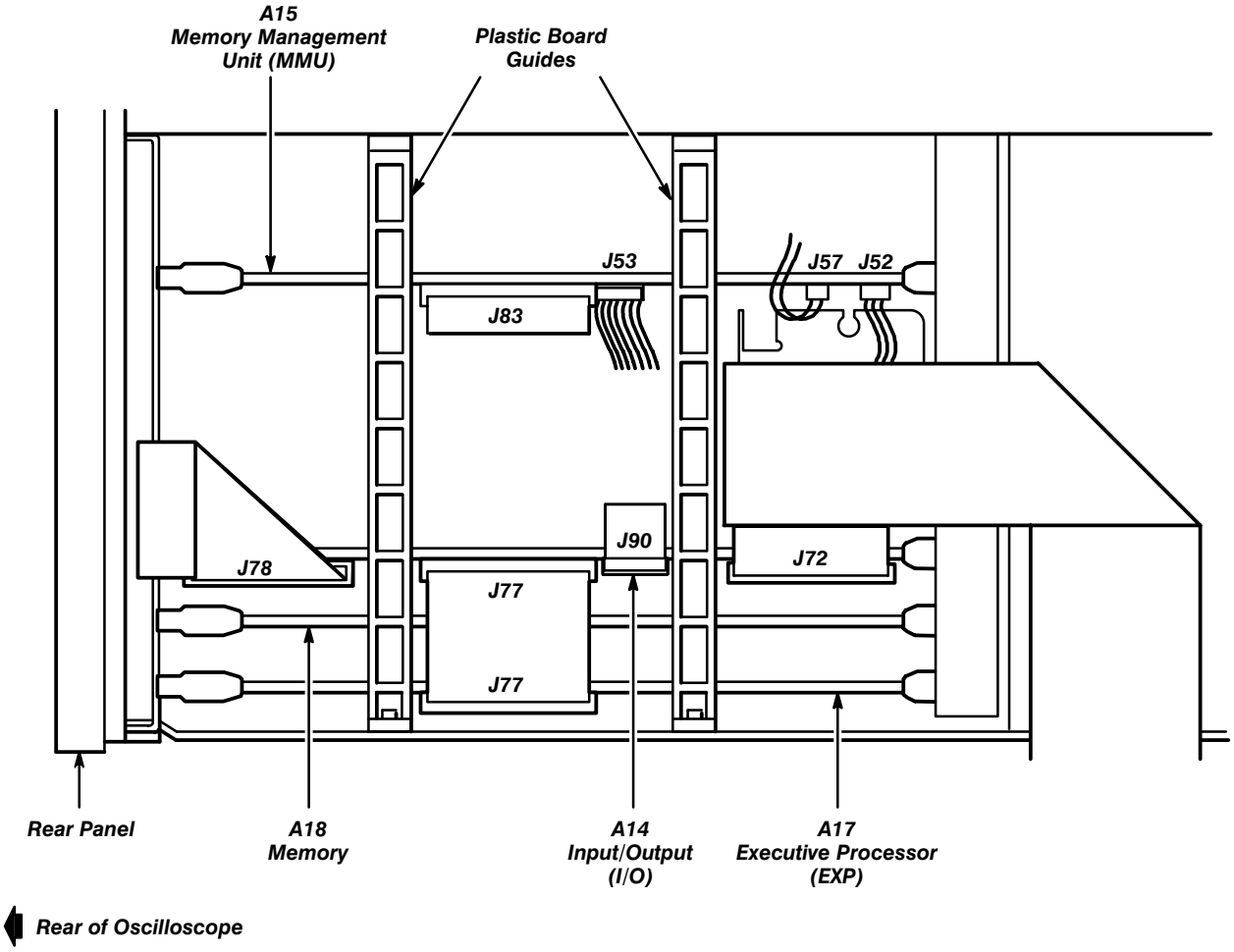


Figure 6-7: Top View of the Card Cage

A1 M/F Strobe Drive Board

Removal and replacement steps are listed below. See Figures 6-8 and 6-32 for connector, screw, and index locations.

☐ **Step 1:** Place the instrument in the inverted position and remove the bottom panel.

☐ **Step 2:** Remove connectors J16, J27, J28, J33A, J33B, J35, J36, J37, J38, and J39 from the A1 M/F Strobe Drive board. Then remove connectors J10, J18, and J34 from the A1 M/F Strobe Drive board. Note the position of connectors from the A1 M/F Strobe Drive board index triangle to ensure that the connectors can be correctly replaced.

NOTE

Record the positions of the connectors to ensure that the connectors can be correctly replaced.

☐ **Step 3:** Remove the five Torx head screws and carefully lift the board, unplugging it from the J19 connector on the A1 M/F Strobe Drive board.

To replace the A1 M/F Strobe Drive board, perform the previous steps in reverse order.

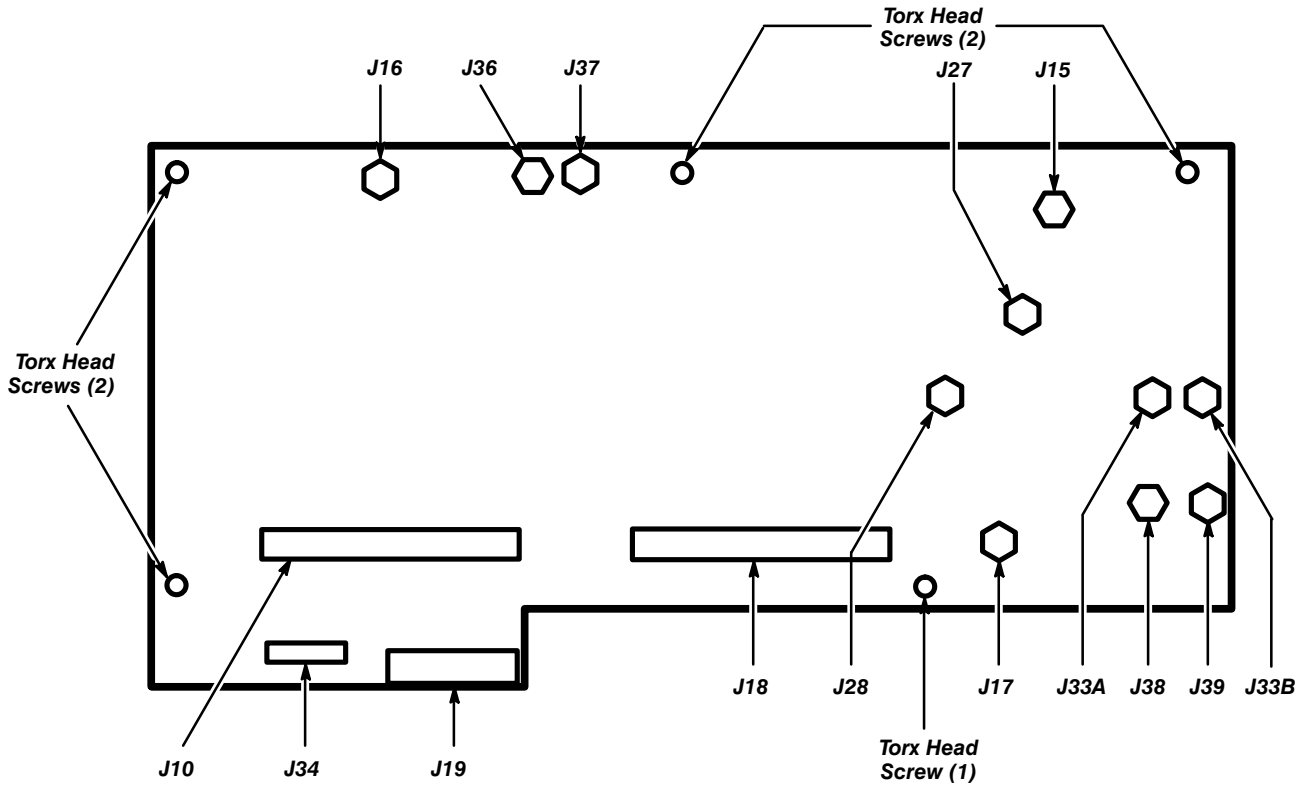


Figure 6-8: Removing/Replacing the A1 M/F Strobe Drive Board

A3 M/F Power Connect Board

Removal and replacement steps are listed below. See Figures 6-2, 6-3, 6-9, and 6-19 for connector, screw, and index locations.

☐ **Step 1:** Remove the Power Supply module as described earlier in this section.

NOTE

The chasis ground wire (green-yellow) wire may be removed from the Power Supply module for this operation only.

Record the positions of all connectors to ensure that the connectors can be correctly replaced.

☐ **Step 2:** Remove the A1 M/F Strobe Drive board.

☐ **Step 3:** Remove the A5 Time Base/Controller board.

☐ **Step 4:** Remove the A4 Regulator board.

☐ **Step 5:** Remove J90 from the A14 Input/Output board.

To replace the A3 M/F Power Connect board, perform the previous steps in reverse order.

WARNING

To prevent electric shock or damage to the instrument, check that the chassis ground wire is replaced on the Power Supply module.

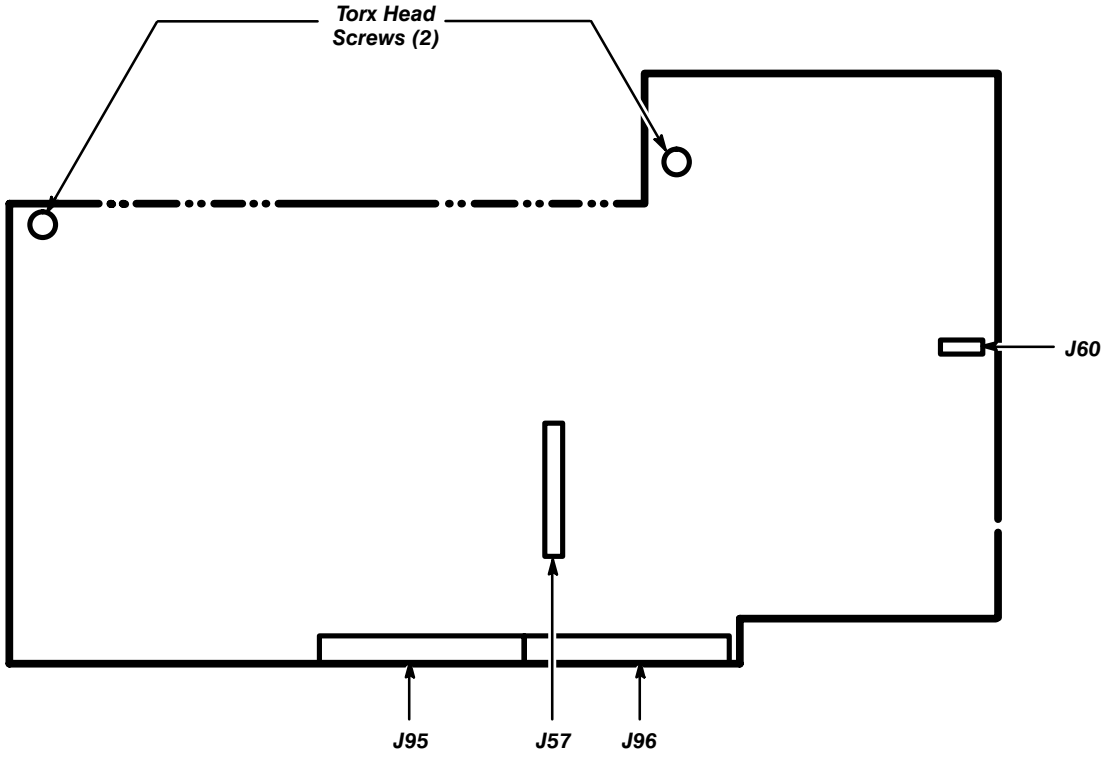


Figure 6-9: Removing/Replacing the A4 Regulator Board

A4 Regulator Board

Removal and replacement steps are listed below. See Figures 6-2, 6-3, 6-9, and 6-32 procedures for removal for connector, screw, and index locations.

☐ **Step 1:** Remove the Power Supply module. (See the Power Supply Module Removal procedure in this section.)

☐ **Step 2:** Set the instrument upright position (if not already in this position).

☐ **Step 3:** Remove connectors J57 and J60 from the A4 Regulator board. Note the position of the multi-pin connector's index triangles to ensure that the connectors can be correctly replaced.

☐ **Step 4:** Remove the two Torx head screws from the metal heat sink attached to the rear of this board.

NOTE

Now, the A4 Regulator board is not attached to the chassis. However, it remains connected to the A3 M/F Power Connect board through interconnecting pins.

☐ **Step 5:** Carefully unplug the J95 and J96 pins from the A4 Regulator board by pulling the A4 Regulator board toward the rear.

☐ **Step 6:** Remove the A4 Regulator board.

To replace the A4 Regulator board, perform the previous steps in reverse order.

NOTE

Match the index triangle on the multi-pin connectors with the corresponding square pad on the circuit board.

A5 Time Base/Controller Board
A6 Calibrator Board

Removal and replacement steps are listed below. See Figures 6-10 and 6-32 for connector, screw, and index locations.

☐ **Step 1:** Place the instrument in the inverted position.

☐ **Step 2:** To remove the A6 Calibrator Board, remove connectors J1 and J17 from the A6 Calibrator Board. Remove the Torx head screw securing the board in place. Lift the board from J91 on the A5 Time Base/Controller Board. Perform this process in reverse to replace the Calibrator Board.

☐ **Step 3:** To remove the A5 Time Base/Controller Board, remove connectors J16, J29A, J30A, J32, J35, J91, Ext Att, and Presc from the A5 Time Base/Controller board. Use exteme care to prevent damage to the cable center connector that was attached to Presc. Then, remove connectors J18 and J83 from the A5 Time Base/Controller board. Note the position of the multi-pin connector's index triangles to ensure that the connectors can be correctly replaced.

NOTE

Record the positions of the connectors and the receptacles to ensure that these connectors and receptacles will be positioned correctly when reinstalled.

☐ **Step 4:** Remove the six Torx head screws holding the board in place.

☐ **Step 5:** Remove the A5 Time Base/Controller board.

To replace the board, perform the previous steps in reverse order.

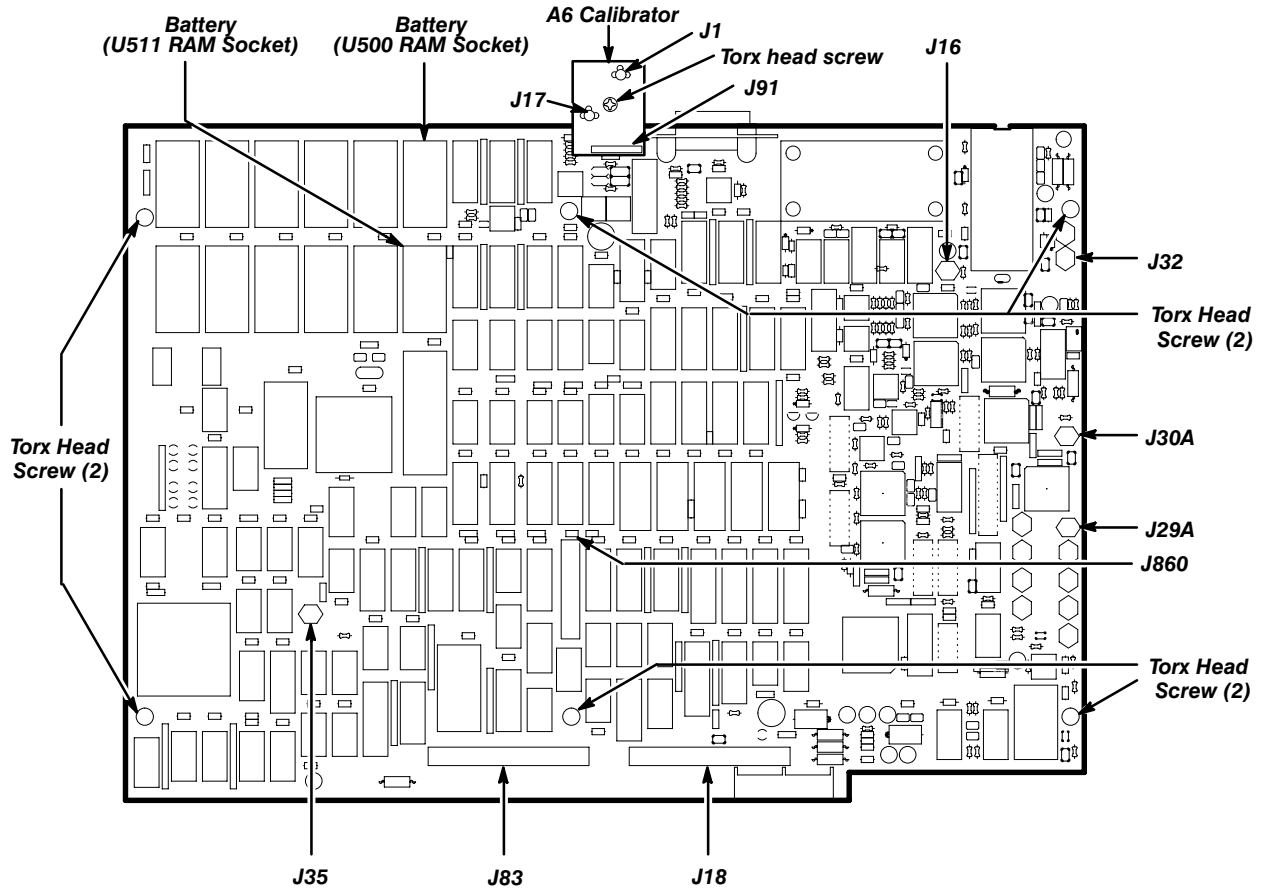


Figure 6-10: Removing/Replacing the A5 Time Base/Controller Board and A6 Calibrator Board

A7 CRT Socket Board and A8 CRT Driver Board

See Figures 6-1, 6-4, 6-5, 6-7, 6-11, 6-12, 6-13, 6-15, and 6-32 for board, connector, screw, and index locations.

Remove and replace the A7 CRT Socket board and the A8 CRT Driver board as follows:

☐ **Step 1:** Remove the three Torx head screws that secure the CRT cover, and then remove the CRT cover.

☐ **Step 2:** Remove the two plastic circuit board guides on top of the card cage.

☐ **Step 3:** Remove the two Torx head screws that secure the A7 CRT Socket board cover, and then remove the A7 CRT Socket board cover.

☐ **Step 4:** Slowly pull the A7 CRT Socket board toward the rear of the instrument to unplug the A7 CRT Socket board from the CRT.

☐ **Step 5:** Remove connectors J53 and J56 on the A7 CRT Socket board. Note the positions of the multi-pin connector's index triangles to ensure that you can correctly replace these connectors.

WARNING

The CRT anode voltage is 16 kV. To avoid electric shock, ground the anode lead from the CRT to the chassis to short any stored charge remaining in the CRT. Wait approximately ten minutes, then ground the anode lead to the chassis again (refer to Step 6).

☐ **Step 6:** Use a non-conducting tool to pry up the anode lead cap. This rubber cap is located on the upper part of the CRT, behind the front casting. Using a non-conducting tool, release the spring clip inside the cap and remove the anode. Insert one blade of a pair of needle-nose pliers against the anode, and touch the other blade to the top of the front casting to ground the anode to the chassis.

☐ **Step 7:** Remove the single Torx head screw that secures the A8 CRT Driver board to the instrument chassis. Use either of the following methods to remove the Torx head screw:

- Remove the Torx head screw with a very short handled T-15 Torx head screwdriver. Ensure that you do not strike the CRT while removing the screw.
- Remove the A10 Front Panel Control board. Then, use a Torx head screwdriver that has an extension length inserted in it to remove the Torx head screw. Access the screw from the hole in the left side of the instrument chassis. Ensure that you do not strike the CRT while removing the screw.

☐ **Step 8:** Remove the single Torx head screw that secures the transformer on the A8 CRT Driver board to the instrument chasis. This screw is located at the rear of the transformer. The A8 CRT Driver board is now not attached to the instrument chassis.

☐ **Step 9:** Remove connectors J52, J56, and J57 from the A8 CRT Driver board. Note the position of the multi-pin connector's index triangles to ensure that you can correctly replace these connectors.

☐ **Step 10:** Lift the A8 CRT Driver board partially out of the instrument chassis.

☐ **Step 11:** Remove connectors J54 and J55 from the A8 CRT Driver board. Note the position of the multi-pin connector's index triangles to ensure that you can correctly replace these connectors.

☐ **Step 12:** Remove the A8 CRT Driver board and the A7 CRT Socket board.

☐ **Step 13:** Unsolder the two wires that connect the A8 CRT Driver board to the A7 CRT Socket board (the two boards are now separated).

To replace the A8 CRT Driver board and the A7 CRT Socket board, perform the previous steps in reverse order.

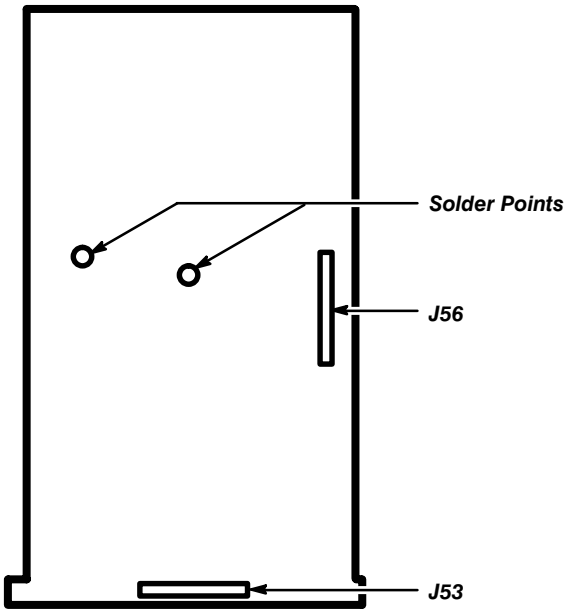


Figure 6-11: Removing/Replacing the A7 CRT Socket Board

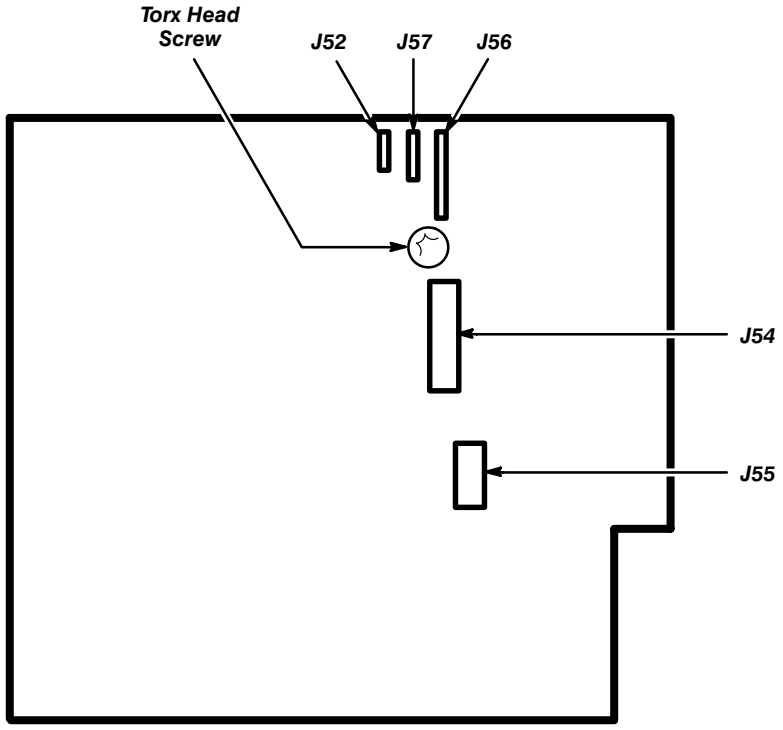


Figure 6-12: Removing/Replacing the A8 CRT Driver Board

A9 Touch Panel Assembly

Removal and replacement steps are listed below. See Figures 6-5, 6-15, and 6-32 for connector, screw, and index locations.

Remove and replace the A9 Touch Panel assembly as follows:

- ☐ **Step 1:** Set the instrument on its right side. (The CRT will now be at the top.)
- ☐ **Step 2:** Use a 1/16-inch Allen wrench to loosen the small Allen screws in each of the two control knobs.
- ☐ **Step 3:** Slowly remove the two control knobs so that you do not lose the small Allen screws inside the knobs.
- ☐ **Step 4:** Remove the two Torx head screws at the bottom of the A9 Touch Panel Assembly.
- ☐ **Step 5:** Lift up on the bottom of the A9 Touch Panel Assembly and swing the assembly outward.

NOTE

The top of the A9 Front Panel Assembly is held by two tabs. These tabs fit into two slots in the front-panel chassis.

- ☐ **Step 6:** Remove the black ground wire from the quick-disconnect ground connector on the front panel casting.
- ☐ **Step 7:** Remove connector J73 from the A10 Front Panel Control board. Note the position of multi-pin connector's index triangles to ensure that you can correctly replace this connector. Carefully remove the wire cable through the slot provided in the front casting.

  Cover the A9 Touch Panel Assembly with protective material once it is removed since the plastic exterior may scratch.

To replace the A9 Touch Panel Assembly board, perform the previous steps using the reverse process.

NOTE

Feed any slack cable from connector J73 to inside the chassis (near the A10 Front Panel Control board). Be careful to not pinch the interconnecting cable while replacing the front panel bezel.

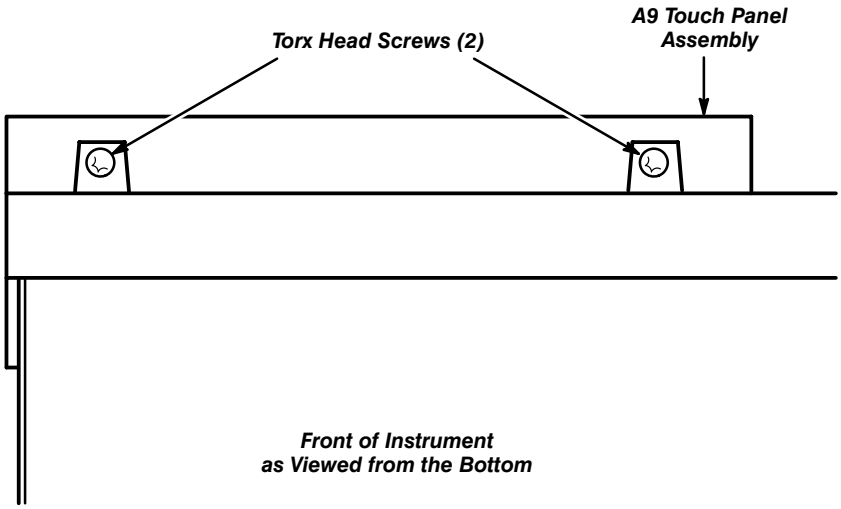


Figure 6-13: A9 Touch Panel Assembly Torx Head Screws

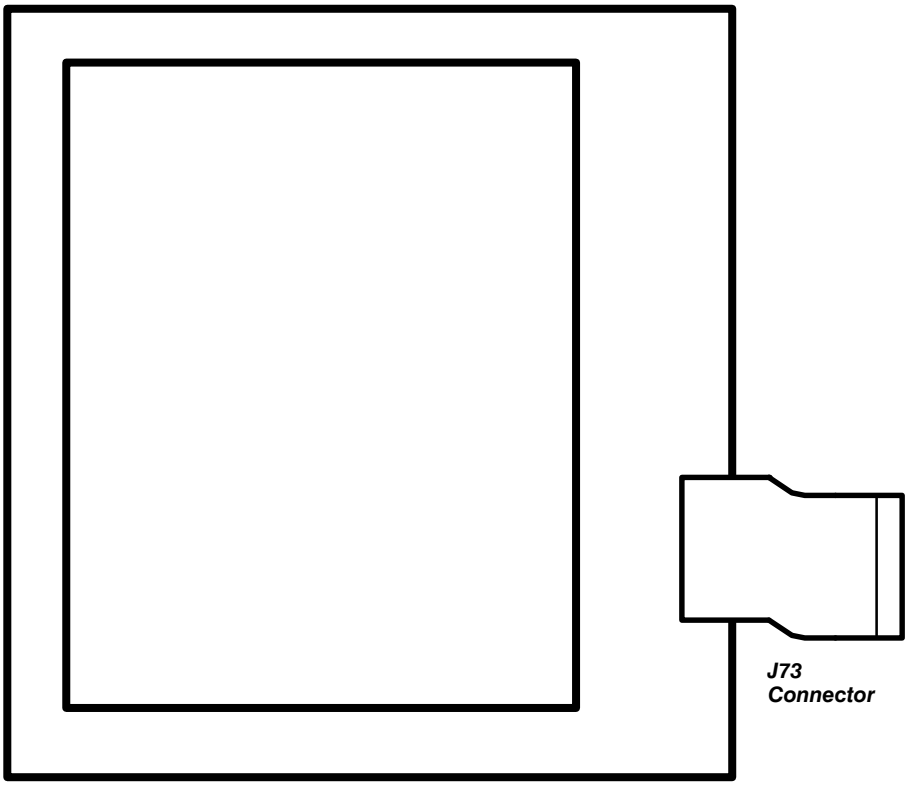


Figure 6-14: Removing/Replacing the A9 Touch Panel Assembly

A10 Front Panel Control Board

Removal and replacement steps are listed below. See Figures 6-5, 6-11, 6-15, and 6-32 for connector, screw, and index locations.

- ☐ **Step 1:** Remove the CRT shield. (Refer to the Cathode Ray Tube Removal procedure in this section, starting at Step 3.)
- ☐ **Step 2:** Remove connectors J72, J73, J74, and J75 from the A10 Front Panel Button board. Note the position of the multi-pin connector's index triangles to ensure that the connectors can be correctly replaced.
- ☐ **Step 3:** Remove the two Torx head screws at the upper edge of the board.
- ☐ **Step 4:** Lift the board away from the guides at its bottom and remove it.

To replace the A10 Front Panel Control board, perform the previous steps in reverse order.

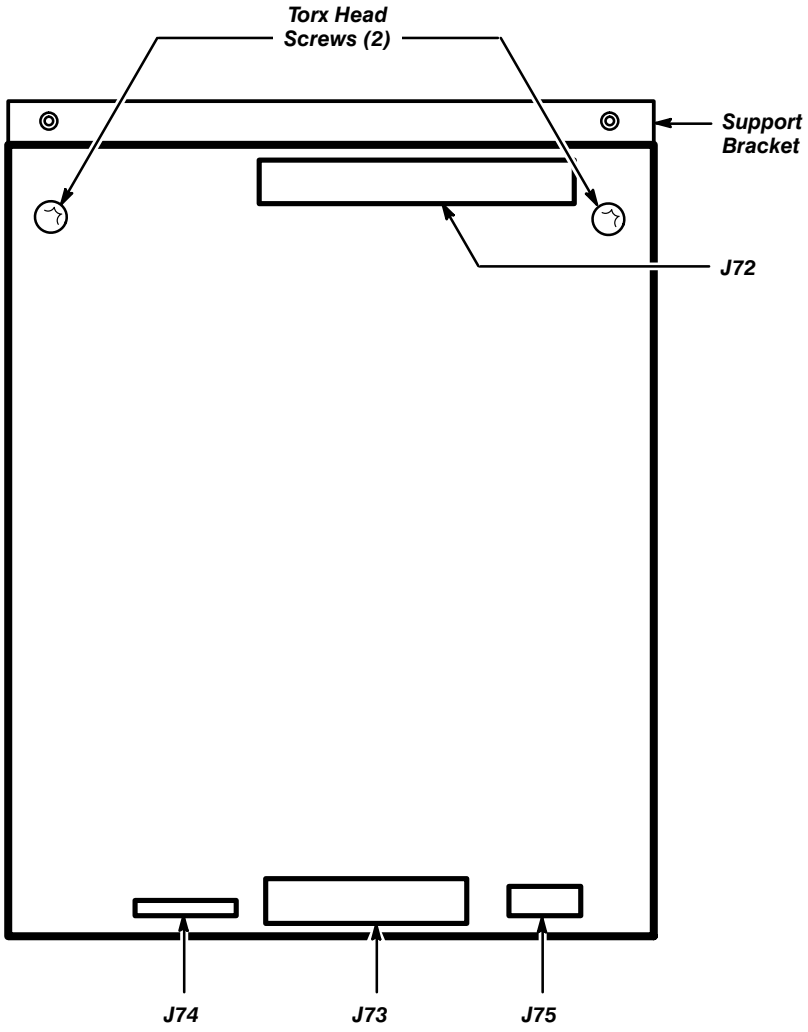


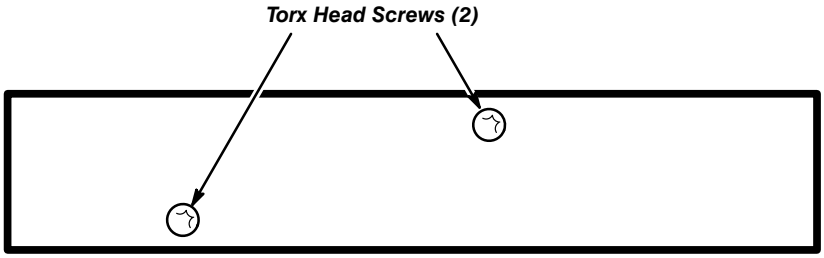
Figure 6-15: Removing/Replacing the A10 Front Panel Control Board

A11 Front Panel Button Board

Removal and replacement steps are listed below. See Figures 6-5, 6-11, 6-15, 6-16, and 6-32 for connector, screw, and index locations.

- ☐ **Step 1:** Remove the CRT shield. (Refer to the removal instructions in the Cathode Ray Tube Removal/Replacement procedure earlier in this section, starting at Step 3.)
- ☐ **Step 2:** Remove connector J75 from the A10 Front Panel Control board. Note the position of connector index triangles for correct replacement.
- ☐ **Step 3:** Remove the two Torx head screws from the A11 Front Panel Button board, which is located at the top and near the inside center of the front casting.
- ☐ **Step 4:** Remove the A11 Front Panel Button board.

To replace the A11 Front Panel Button board, perform the previous steps in reverse order.



Rear View of the A11 Front Panel Button Board

Figure 6-16: Removing/Replacing the A11 Front Panel Button Board

A12 Rear Panel Assembly

Removal and replacement steps are listed below. See Figures 6-2, 6-17, and 6-32 for connector, screw, and index locations.

☐ **Step 1:** Remove the connectors from the RS-232-C, the GPIB, and the PRINTER connector holders.

☐ **Step 2:** Remove the eight Torx head screws from the outer edges of the rear panel connector plate.

☐ **Step 3:** Tilt the plate back from the instrument. Remove connector J78 from the top of the A12 Rear Panel assembly. Remove the grounding wire. Note the position of the connector's index triangles to ensure that the connectors can be correctly replaced.

☐ **Step 4:** Remove the rear panel connector plate and the attached A12 Rear Panel Assembly.

☐ **Step 5:** Remove the following items from the rear panel plate:

- two bail brackets, screws, and washers from the PRINTER connector
- two posts from the GPIB connector
- posts, lockwashers, and flat washers from the RS-232-C connector(s)
- Torx head screw and washer (at lower left, if present)

☐ **Step 6:** Remove the A12 Rear Panel Assembly from the rear panel connector plate.

CAUTION

The metal covers on the PRINTER and on the GPIB connectors are loose. If the board is inverted, these covers will fall off.

To replace the A12 Rear Panel assembly, perform the previous steps in reverse order.

NOTE

Replacement of connector J78 will be simplified if you replace the connector before reinstalling the rear panel connector plate on the rear of the chassis.

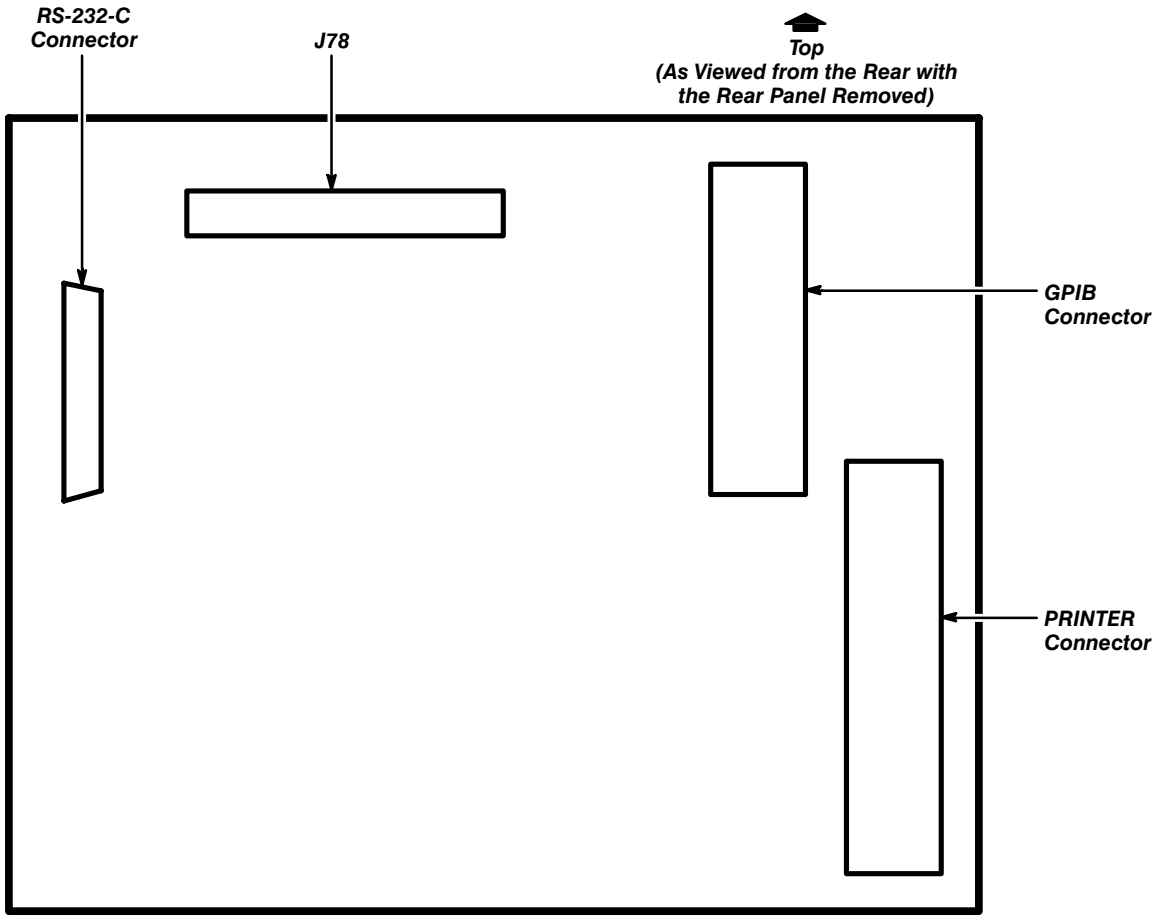


Figure 6-17: Removing/Replacing the A12 Rear Panel Assembly

A13 Mother Board

Removal and replacement steps are listed below. See Figures 6-7, 6-18, and 6-32 for connector, screw, and index locations.

☐ **Step 1:** Remove the three Torx head screws that secure the CRT cover, and then remove the CRT cover. Remove the card cage retainer from the top front of the card cage by removing the card cage's two screws. Remove both circuit board guides from the top of the card cage. The other ends of the guides contain slots which attach to the edge of a metal bracket. Both ends of the guides can be pried loose.

☐ **Step 2:** Remove the A14 I/O, A15 MMU, A17 Executive Processor, and A18 Memory boards. Note the position of the multi-pin connector's index triangles to ensure that the connectors can be correctly replaced.

NOTE

Tag the interconnecting plugs and mark the board locations to ensure that the plugs can be correctly replaced as well.

☐ **Step 3:** Remove connector J63A from the A13 Mother board.

☐ **Step 4:** Remove the six Torx head screws.

☐ **Step 5:** Remove the A13 Mother board.

To replace the A13 Mother board perform, perform the previous steps in reverse order.

CAUTION

To prevent damage to the interconnecting wires, be careful not to pinch the wires along the inside edge while replacing this board.

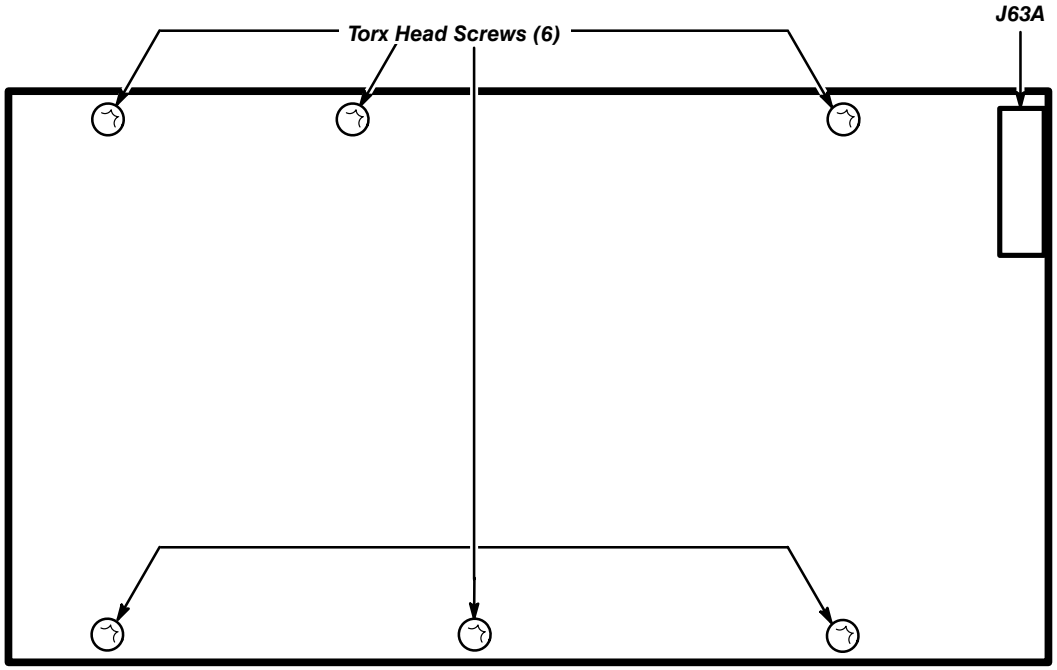


Figure 6-18: Removing/Replacing the A13 Mother Board

A14 Input/Output (I/O) Board

See Figures 6-4, 6-7, 6-19, and 6-32 for board, connector, screw, and index locations.

Remove and replace the A14 I/O board as follows:

- ☐ **Step 1:** Remove the three Torx head screws that secure the CRT cover, and then remove the CRT cover.
- ☐ **Step 2:** Remove both of the plastic board guides from the top of the card cage. These guides are retained by two small catches located in two holes in the left bracket of the card cage. The other ends of the guides contain slots which attach to the edge of a metal bracket. Both ends of the guides can be pried loose.
- ☐ **Step 3:** Remove connectors J72, J77, J78, and J90 from the A14 I/O board. Note the position of multi-pin connector's index triangles to ensure that you can be correctly replace these connectors.
- ☐ **Step 4:** Lift the white, hinged tab at the upper, front edge of the board. Pull the tab upward until the A14 I/O board separates from the A13 Mother board.
- ☐ **Step 5:** Remove the A14 I/O board.

To replace the A14 I/O board, perform the previous steps in reverse order.

NOTE

Insert the board edges into the plastic guides at each end of the card cage. Lower the board into position.

Ensure that connector P105 is seated on the A13 Mother board connector. Push down firmly on the A14 I/O board to seat this connector on the A13 Mother board.

WARNING

A lithium battery (BT130) is mounted on the A14 I/O board. Be careful when placing the A14 I/O board on metal surfaces. If some IC or battery leads are shorted, the battery may discharge or overheat and vent. (You can use plastic standoffs to prevent short circuits.) ***This battery requires special handling for disposal.*** *Refer to the instructions on Lithium Battery Disposal and First Aid earlier in this section.*

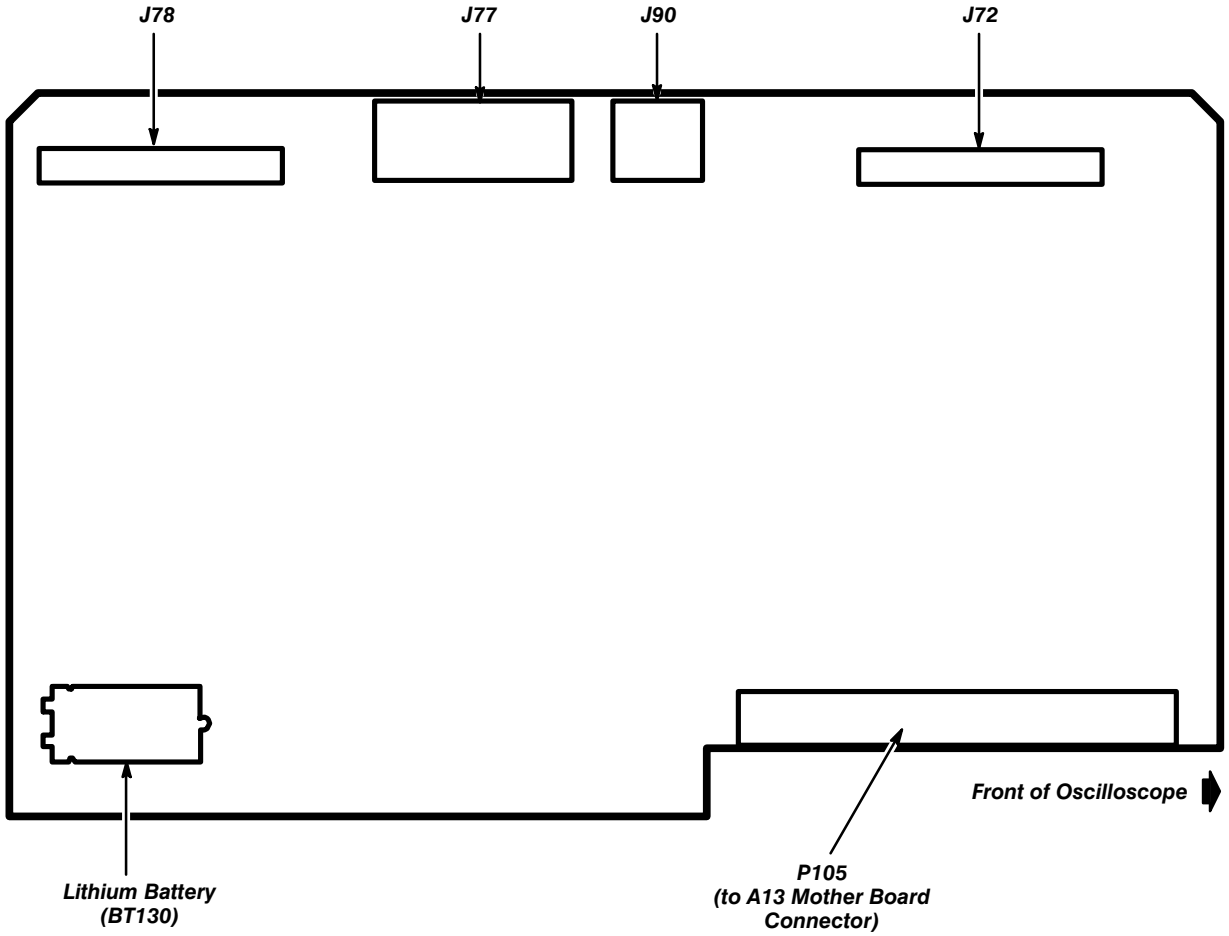


Figure 6-19: Removing/Replacing the A14 I/O Board

A15 Memory Management Unit (MMU) Board

See Figures 6-4, 6-7, 6-20, and 6-32 for board, connector, screw, and index locations.

Remove and replace the A15 MMU board as follows:

- ☐ **Step 1:** Remove the three Torx head screws that secure the CRT cover, and then remove the CRT cover.
- ☐ **Step 2:** Remove both of the plastic board guides from the top of the card cage. The guides are retained by two small catches located in two holes in the left bracket of the card cage. The other ends of the guides contain slots which attach to the edge of a metal bracket. Both ends of the guides can be pried loose.
- ☐ **Step 3:** Remove connectors J52, J53, J57, and J83 from the A15 MMU board. Note the position of the multi-pin connector's index triangles to ensure that you can correctly replace these connectors.
- ☐ **Step 4:** Lift the white, hinged tabs at the front and rear edges of the A15 MMU board. Pull the tabs upward until the A15 MMU board separates from the A13 Mother board.
- ☐ **Step 5:** Remove the A15 MMU board.

To replace the A15 MMU board, perform the previous steps in the reverse order.

NOTE

Insert the board edges into the plastic guides at each end of the card cage. Lower the board into position.

Ensure that connector P101 is seated onto the A13 Mother board connector. Push down firmly on the A15 MMU board to seat this connector on the A13 Mother board.

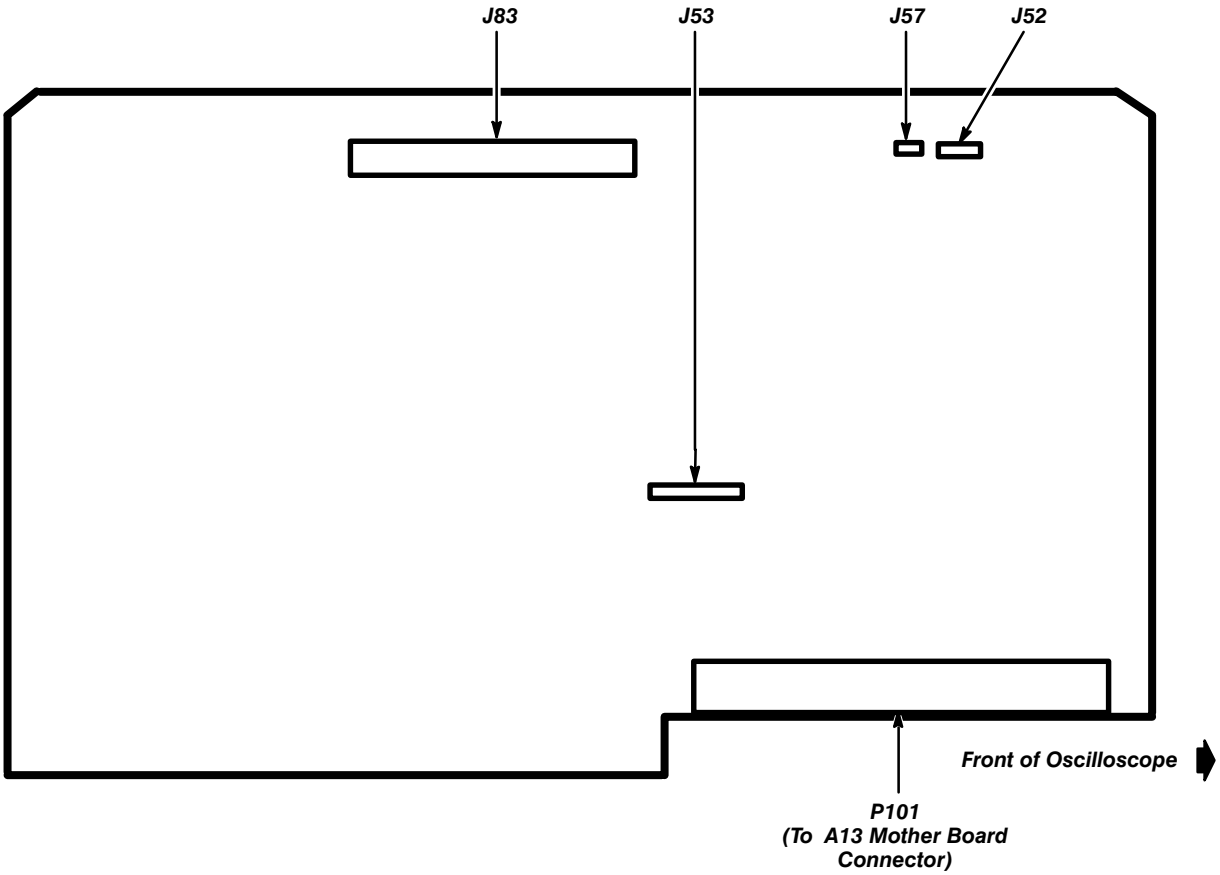


Figure 6-20: Removing/Replacing the A15 MMU Board

A17 Executive Processor (EXP) Board

See Figures 6-4, 6-7, 6-21, and 6-32 for board, connector, screw, and index locations.

Remove and replace the A17 Executive Processor board as follows:

- ☐ **Step 1:** Remove the three Torx head screws that secure the CRT cover, and then remove the CRT cover.
- ☐ **Step 2:** Remove both of the plastic board guides from the top of the card cage. The guides are retained by two small catches located in two holes in the left bracket of the card cage. The other ends of the guides contain slots which attach to the edge of a metal bracket. Both ends of the guides can be pried loose.
- ☐ **Step 3:** Remove connector J77 from the A17 Executive Processor board. Note the position of the multi-pin connector's index triangle to ensure that you can correctly replace this connector.
- ☐ **Step 4:** Lift the white, hinged tabs at the front and rear edges of the board. Pull the tabs upward until the A17 Executive Processor board separates from the A13 Mother board.
- ☐ **Step 5:** Remove the A17 Executive Processor board.

To replace the A17 Executive Processor board, perform the previous steps in reverse order.

NOTE

Insert the board edges into the plastic guides at each end of the card cage. Lower the board into position.

Ensure that connector P104 on the A17 Executive Processor board is seated onto the of A13 Mother board connector. Push down firmly on the A17 Executive Processor board to seat this connector on the A13 Mother board.

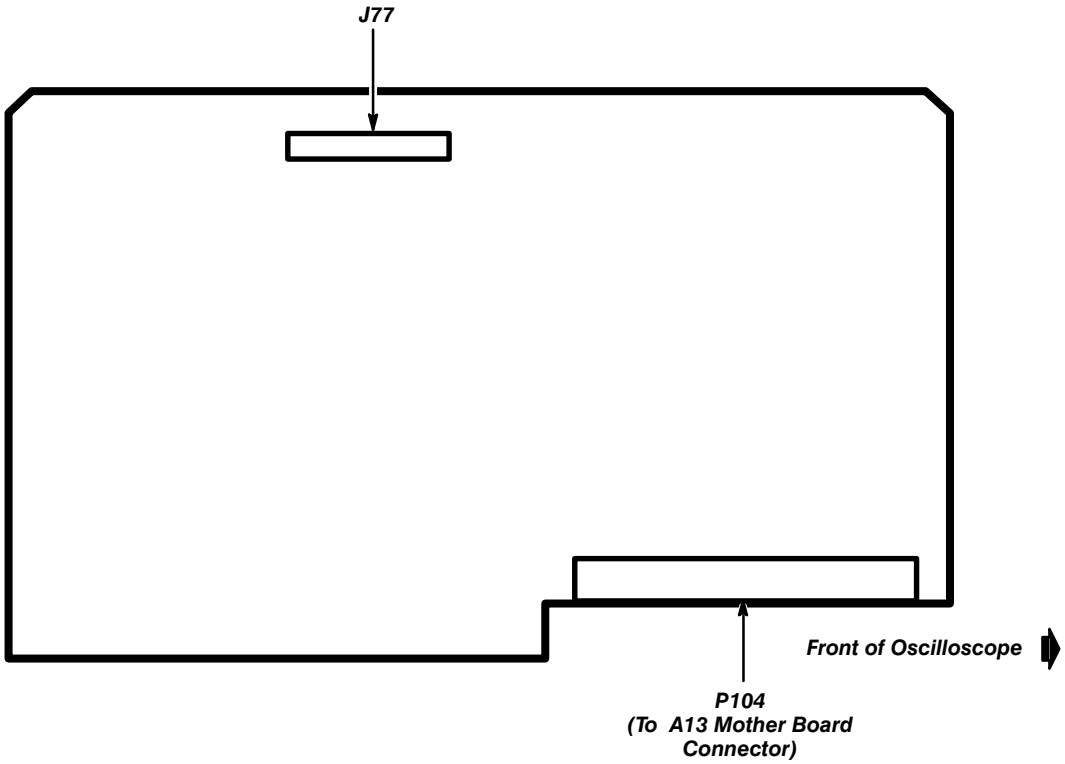


Figure 6-21: Removing/Replacing the A17 Executive Processor Board

A18 Memory Board

See Figures 6-4, 6-7, 6-21, 6-22, and 6-32 for board, connector, screw, and index locations.

Remove and replace the A18 Memory board as follows:

☐ **Step 1:** Remove the three Torx head screws that secure the CRT cover, and then remove the CRT cover.

☐ **Step 2:** Remove both of the plastic board guides from the top of the card cage. The guides are retained by two small catches located in two holes in the left bracket of the card cage. The other ends of the guides contain slots which attach to the edge of a metal bracket. Both ends of the guides can be pried loose.

☐ **Step 3:** Remove connector J77 from the A17 Executive Processor board. Note the position of the multi-pin connector's index triangle to ensure that you can correctly replace this connectors.

☐ **Step 4:** Lift the white, hinged tabs at the front and rear edges of the board. Pull the tabs upward until the A18 Memory board separates from the A13 Mother board.

☐ **Step 5:** Remove the A18 Memory board.

To replace the A18 Memory board, perform the previous steps in reverse order.

NOTE

Insert the edges of the board into the plastic guides at each end of the card cage. Lower the board into position.

Ensure that connector P106 is seated onto the A13 Mother board connector. Push down firmly on the A18 Memory board to seat this connector on the A13 Mother board.

WARNING

A lithium battery (BT130) is mounted on the A18 Memory board. Be careful when placing the A18 Memory board on metal surfaces. If some IC or battery leads are shorted, the battery may discharge or overheat and vent. (You can use plastic standoffs to prevent short circuits.) ***This battery requires special handling for disposal.*** *Refer to the instructions on Lithium Battery Disposal and First Aid earlier in this section.*

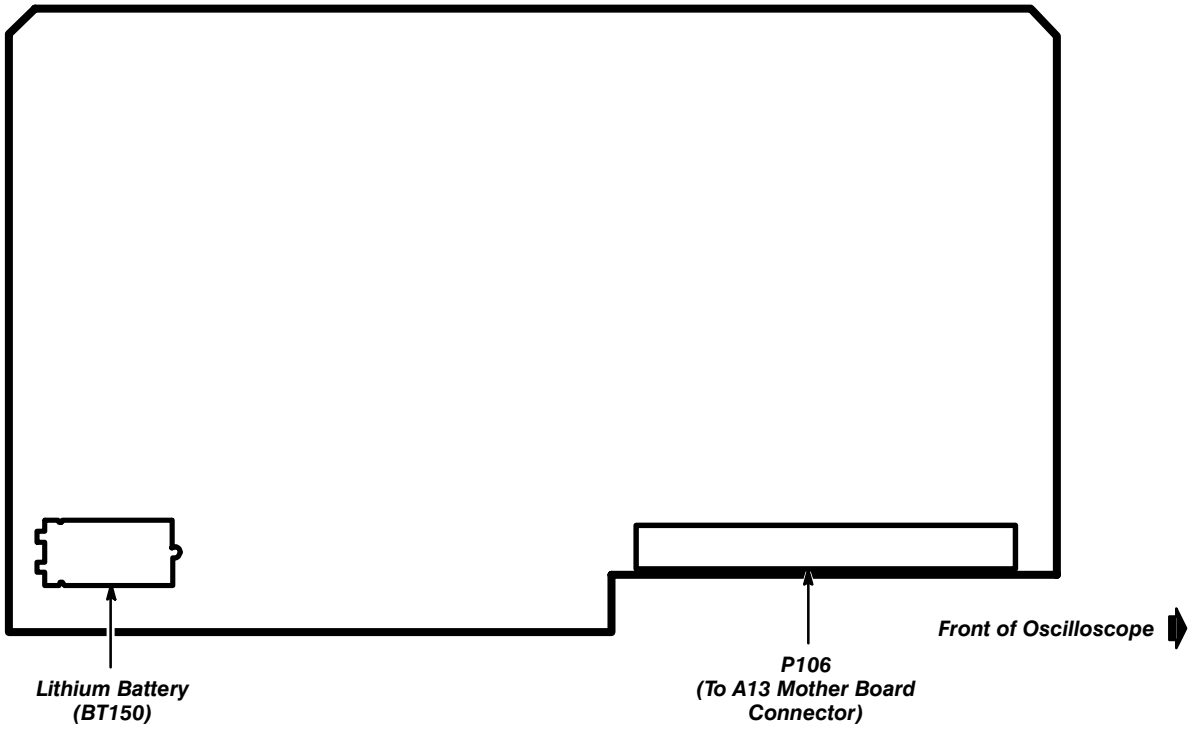


Figure 6-22: Removing/Replacing the A18 Memory Board

A19 Strobe/TDR Buffer Board

Removal and replacement steps are listed below. See Figures 6-23, 6-26, and 6-32 for connector, screw, and index locations.

☐ **Step 1:** Remove the Acquisition unit and position the Acquisition unit in the upright position.

☐ **Step 2:** Remove the two Torx head screws on each black retaining brace located at the top of the Acquisition unit to remove these braces.

☐ **Step 3:** Remove connectors J1A, J2A, J3A, J4A, J1B, J2B, J3B, J4B, J1C, J2C, J3C, J4C, J29A, J30A, J32, J33A, J33B, and J34 from the A19 Strobe/TDR Buffer board.

NOTE

Record the positions of the connectors and the receptacles to ensure that the connectors can be correctly replaced.

☐ **Step 4:** Remove J10 from the A26 M/F Acquisition Interconnect board.

☐ **Step 5:** Remove the two Torx head screws on the bottom of the A19 Strobe/TDR Buffer board, and gently pull out the board.

To replace the A19 Strobe/TDR board, perform the previous steps in reverse order.

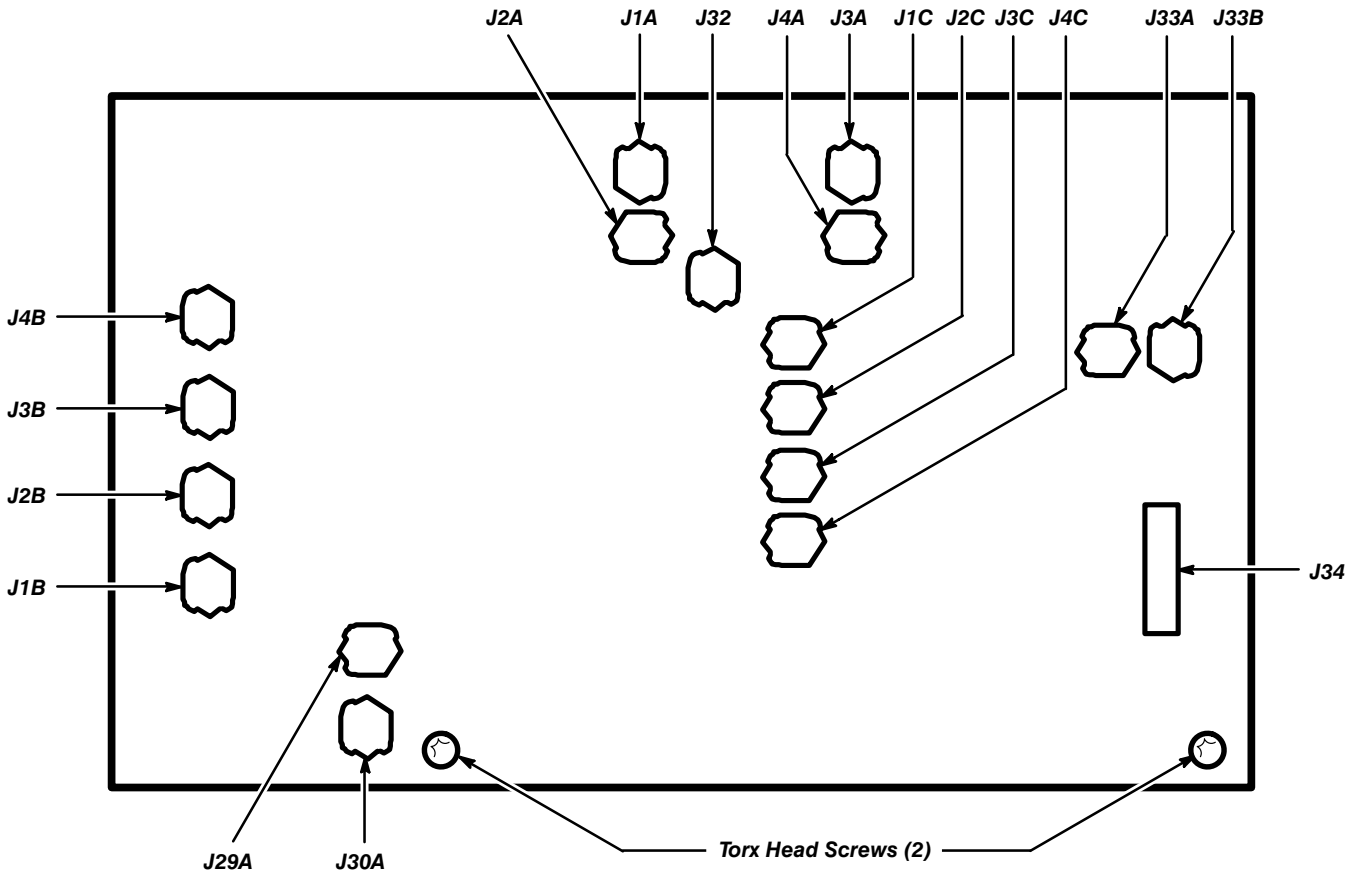


Figure 6-23: Removing/Replacing the A19 Strobe/TDR Buffer Board

A20−A23 Head Interconnect Boards

Removal and replacement steps are listed below. See Figures 6-23, 6-24, 6-25, 6-26, 6-28, 6-29, and 6-32 for connector and screw locations.

- ☐ **Step 1:** Remove the Acquisition unit and place the Acquisition unit in the upright position.
- ☐ **Step 2:** Remove the two Torx head screws on each black retaining brace located at the top of the Acquisition unit.
- ☐ **Step 3:** Remove the A24/A27 Acquisition Analog boards, the A25/A28 Acquisition MPU boards, and the A19 Strobe/TDR Buffer board.
- ☐ **Step 4:** Remove the four screws holding the top of the front subpanel of the Acquisition unit.
- ☐ **Step 5:** Remove the four screws on the gold-colored locking bar located on the top front of the Acquisition unit.
- ☐ **Step 6:** Turn the Acquisition unit in the inverted position and repeat Steps 4 and 5 on the bottom of the Acquisition unit.
- ☐ **Step 7:** Remove the connectors from the A26 M/F Acquisition Interconnect board connector. Note the position of the multi-pin connector's index triangle to ensure that the connector can be correctly replaced.
- ☐ **Step 8:** Remove the Front Subpanel assembly with the A20−A23 Head Interconnect boards intact.
- ☐ **Step 9:** Remove the bottom Torx head screw from within the sampling head compartment that contains the head interconnect board you are removing.
- ☐ **Step 10:** Turn the Front Subpanel assembly around so that the open compartments face away from you.
- ☐ **Step 11:** Remove the top nut that fastens the sampling head compartment to the head interconnect board you are removing.

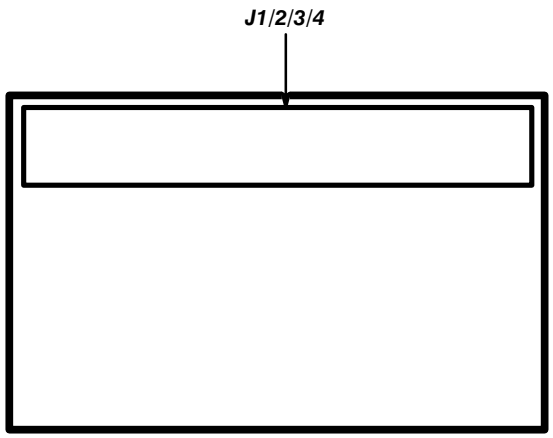


Figure 6-24: Removing/Replacing the A20-A23 Head Interconnect Boards

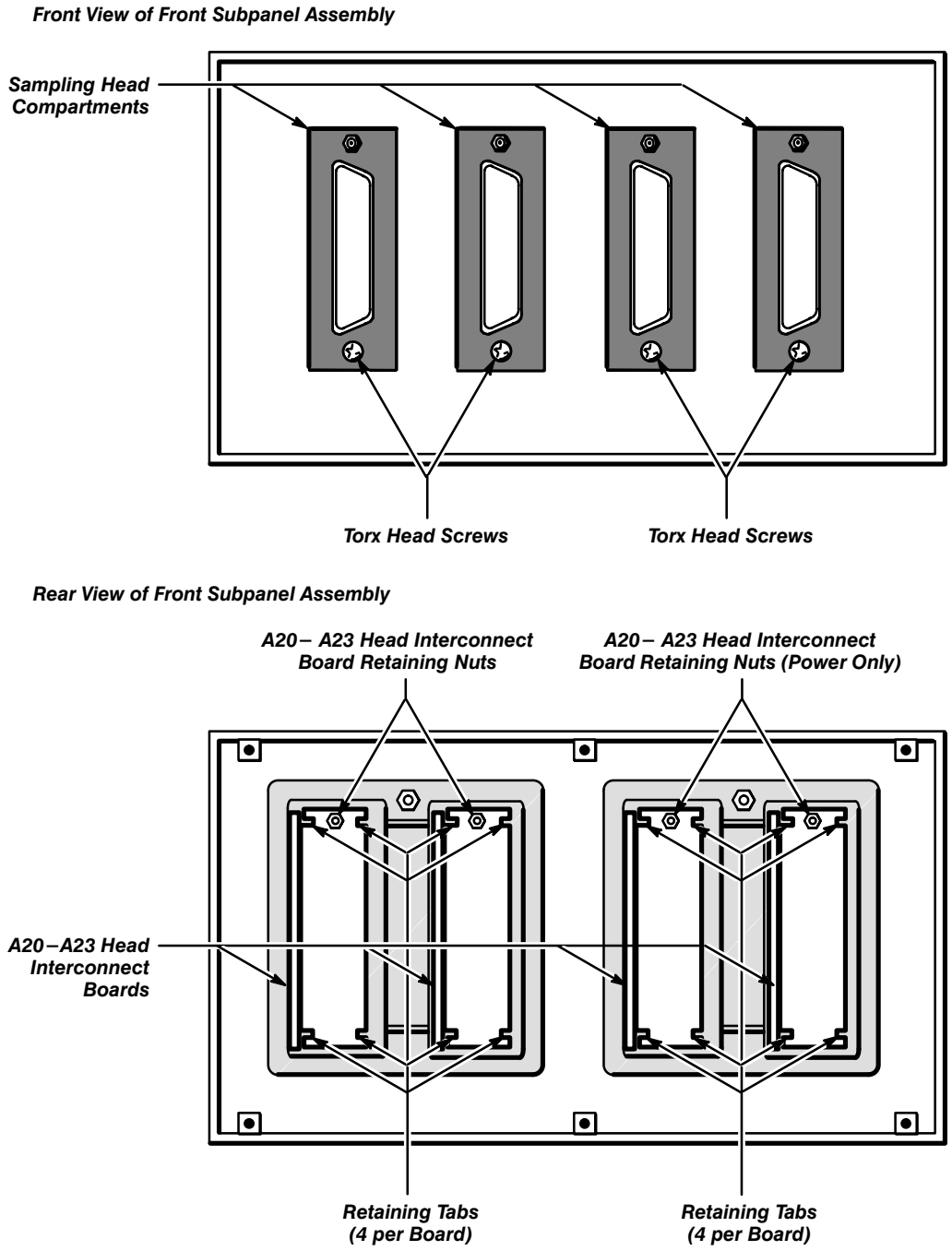


Figure 6-25: Removing/Replacing the Front Subpanel Assembly

☐ **Step 12:** Remove the head interconnect board by slightly prying up on the tabs that are keeping it in place, and slowly remove the board(s) from the J1/2/3/4 connector.

To replace the A20-A23 Head Interconnect boards, perform the previous steps in reverse order.

A26 M/F Acquisition Interconnect Board

Removal and replacement steps are listed below. See Figures 6-23, 6-25, 6-26, 6-27, 6-28, 6-29, and 6-32 for connector, screw, and index locations.

- ☐ **Step 1:** Remove the Acquisition unit as and place the Acquisition unit in the upright position.
- ☐ **Step 2:** Remove the A24/A27 Acquisition Analog board, the A25/A28 Acquisition MPU board and the A19 Strobe/TDR Buffer board.
- ☐ **Step 3:** Remove the four screws on the gold colored retaining brace holding the top of the Front Subpanel assembly of the Acquisition unit.
- ☐ **Step 4:** Remove the four screws on the gold colored locking bar located on the top front of the Acquisition unit.
- ☐ **Step 5:** Turn the Acquisition unit in the inverted position and repeat Steps 3 and 4 on the bottom of the Acquisition unit.
- ☐ **Step 6:** Remove connectors J11, J12, J13, and J14 on the A26 M/F Acquisition Interconnect board. Note the position of the multi-pin connector's index triangle to ensure that the connector can be correctly replaced.

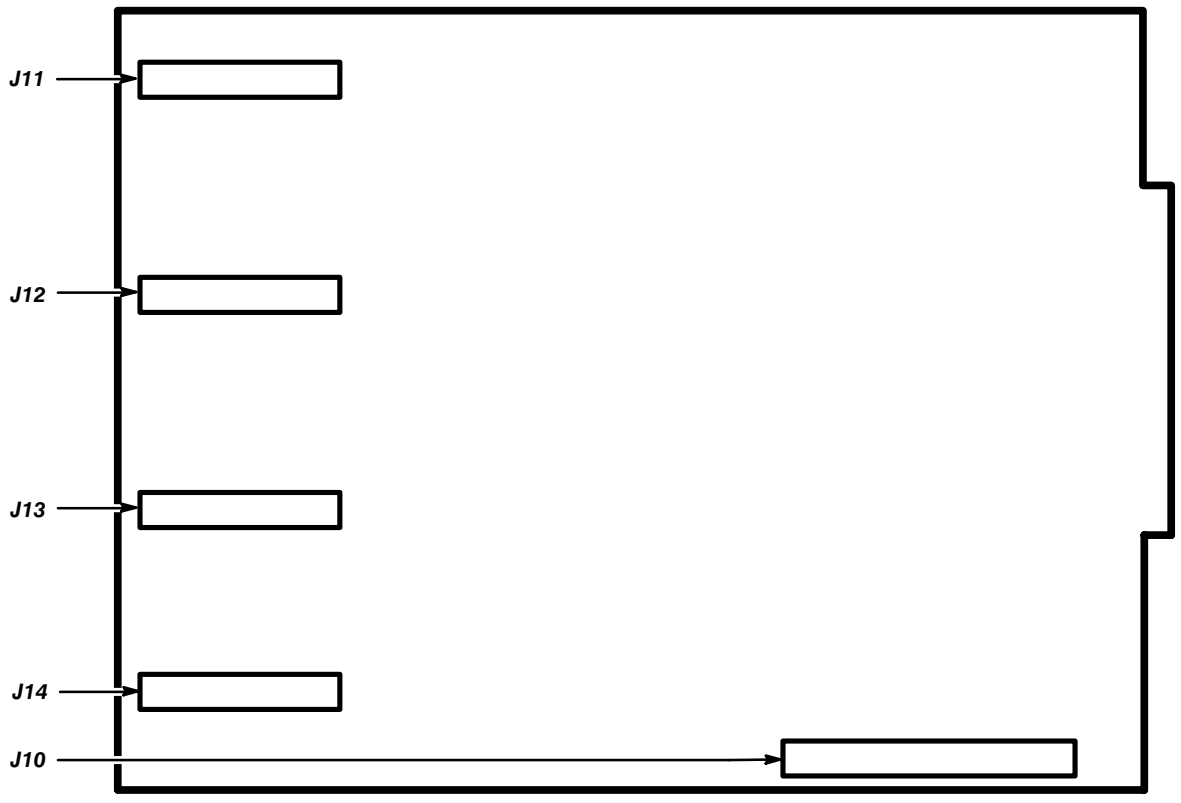


Figure 6-26: Removing/Replacing the A26 M/F Acquisition Interconnect Board

☐ **Step 7:** Remove the Front Subpanel assembly with the head interconnect boards intact.

☐ **Step 8:** Remove the six Torx head screws to remove the A26 M/F Acquisition Interconnect board.

To replace the A26 M/F Acquisition Interconnect board, perform the previous steps in reverse order.

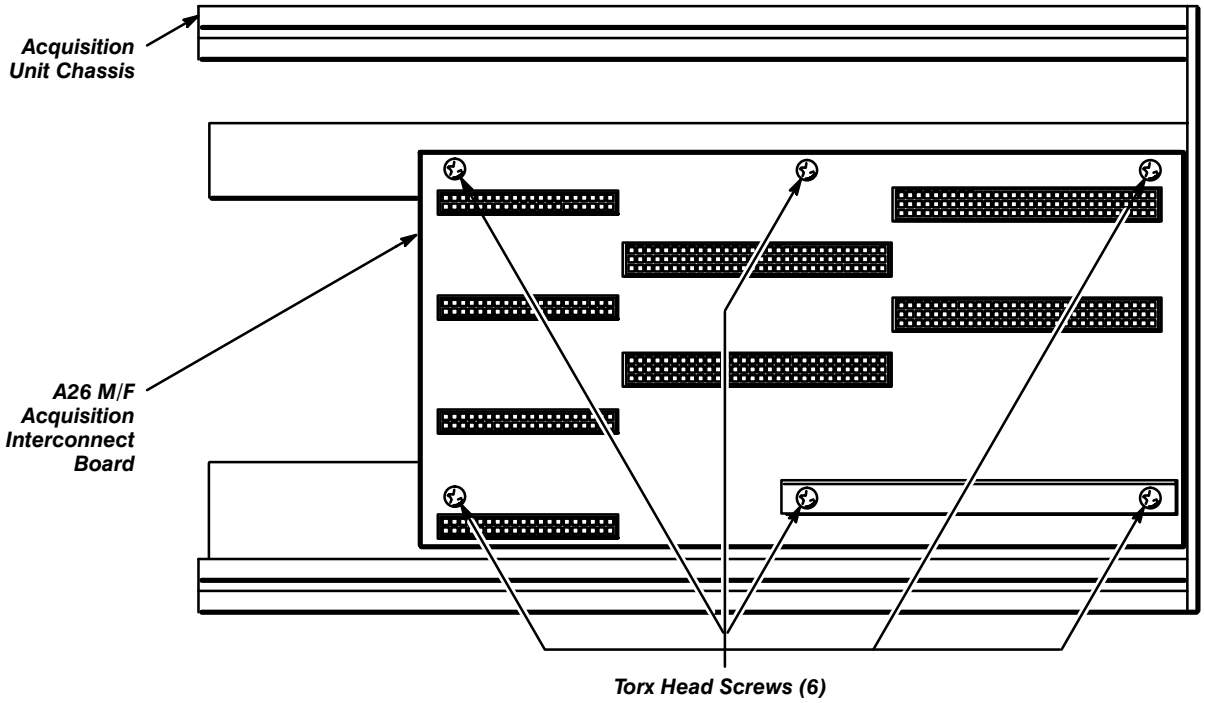


Figure 6-27: Top View of the A26 Mainframe Acquisition Interconnect Board

A24/A27 Acquisition Analog Boards

Removal and replacement steps are listed below. See Figures 6-23, 6-26, 6-28, and 6-32 for board guide, screw, and index locations.

- ☐ **Step 1:** Remove the Acquisition unit and place the Acquisition unit in the upright position.
- ☐ **Step 2:** Remove the two Torx head screws on each black retaining brace located at the top of the Acquisition unit; remove these braces.
- ☐ **Step 3:** Remove connectors J41, J42, J43, and J44 from the A24/A27 Acquisition Analog board.
- ☐ **Step 4:** Pull up on the hinged white tabs until the board separates from connector P6.

To replace the A24/A27 Acquisition Analog board, perform the previous steps in reverse order.

NOTE

Insert the edges of the board into the plastic guides. Lower the board into position.

Check that connector is seated onto the A26 M/F Acquisition Interconnect board connector. Push down firmly on the A24/A27 Acquisition Analog board to seat this connector on the A26 M/F Acquisition Interconnect board.

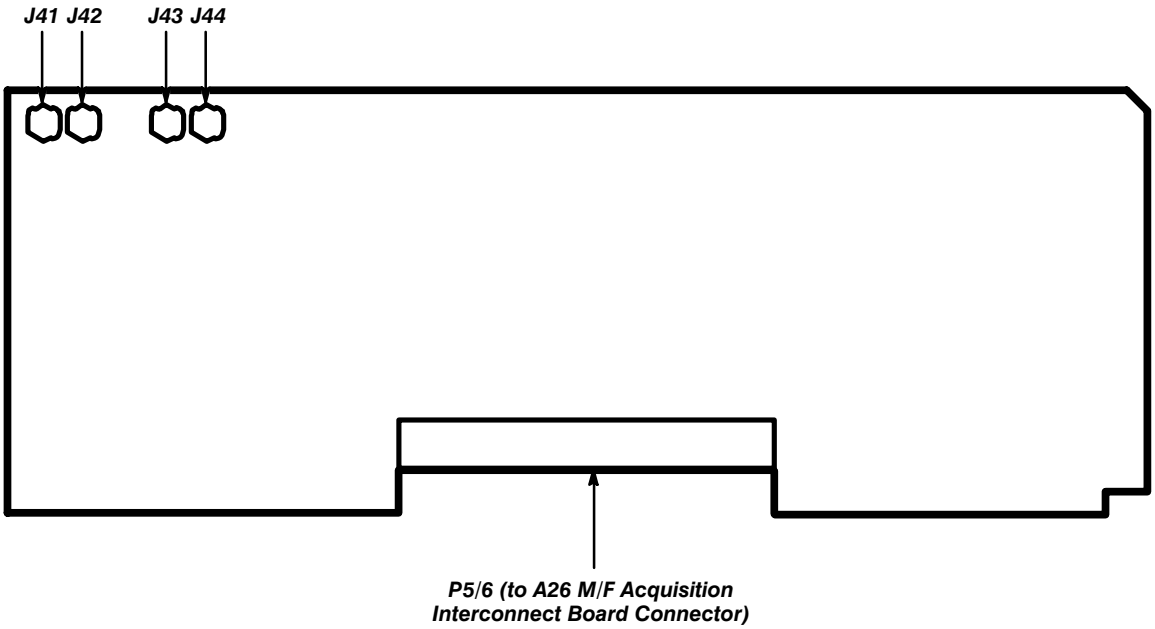


Figure 6-28: Removing/Replacing the A24/A27 Acquisition Analog Boards

A25/A28 Acquisition MPU Boards

Removal and replacement steps are listed below. See Figures 6-23, 6-26, 6-29, and 6-32 for board guide, screw, and index locations.

☐ **Step 1:** Remove the Acquisition unit and place it in the upright position.

☐ **Step 2:** Remove the two Torx head screws on each black retaining brace located at the top of the Acquisition unit; remove these braces.

☐ **Step 3:** Pull up on the hinged white tabs until the board separates from connector P8 on the A26 M/F Acquisition Interconnect board.

To replace the A25/A28 Acquisition MPU board, perform the previous steps in reverse order.

NOTE

Insert the edges of the board into the plastic guides. Lower the board into position.

Check that the connector is seated onto the A26 M/F Acquisition Interconnect board connector. Push down firmly on the A25/A28 Acquisition MPU board to seat this connector on the A26 M/F Acquisition Interconnect board.

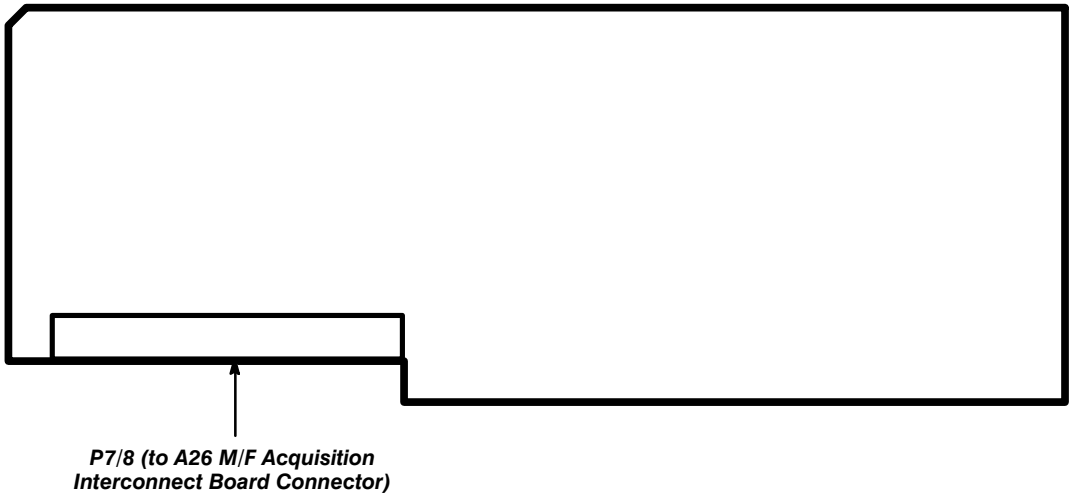


Figure 6-29: Removing/Replacing the A25/A28 Acquisition MPU Boards

FRU IC Removal

The procedures for removing and replacing the FRU ICs in the oscilloscope are outlined in this section.

Serial Data Interface Integrated Circuits ("Slam-Pack" ICs)

U330 is mounted on the A14 I/O board. See Figure 6-30 for the location of this IC. It has a raised, ridged, heat sink cover. The IC is oriented to its socket by a beveled corner. The other corners are notched to fit the edges of the socket. The beveled corner aligns with a spring (small metal tab) at one corner of the socket. An example of the IC is shown in Figure 6-32.

To remove the Serial Data Interface IC, proceed as follows:

☐ **Step 1:** Remove the A14 I/O board.

☐ **Step 2:** Hold the heat sink cover in place and unfasten the retaining clip by moving the retaining clip across the tabs while pushing down slightly on the cover.

CAUTION

To prevent static damage to the instrument or components, observe all the special precautions mentioned under Static-Sensitive Classification in this section.

☐ **Step 3:** Remove the cover slowly to prevent the IC from falling out. Note the position of the index of the IC for later use before removing the IC.

☐ **Step 4:** Remove the IC with tweezers.

CAUTION

Finger oils can degrade reliability of components. Avoid touching the IC or its socket contacts with your fingers.

Replace the Serial Data Interface IC as follows:

☐ **Step 1:** Using tweezers, place the beveled corner of the replacement IC against the index spring (the original positioning of this index was noted earlier).

CAUTION

Do not damage the spring by improperly seating the beveled corner because shorting of the two corner contacts could result.

☐ **Step 2:** Arrange the other corners with the tweezers to fit evenly at the edges of the socket.

☐ **Step 3:** Set the cover flat on the IC with the cover's end tabs properly aligned with, but not in, the mating recesses in the socket.

☐ **Step 4:** Push down on the cover, keeping it flat on the IC. Slide the cover end tabs into place. Hold it there while moving the retaining clip over the tabs at the other end of the cover.

☐ **Step 5:** Slightly pull on the cover to check that the cover is secure.

☐ **Step 6:** Replace the A14 I/O board.

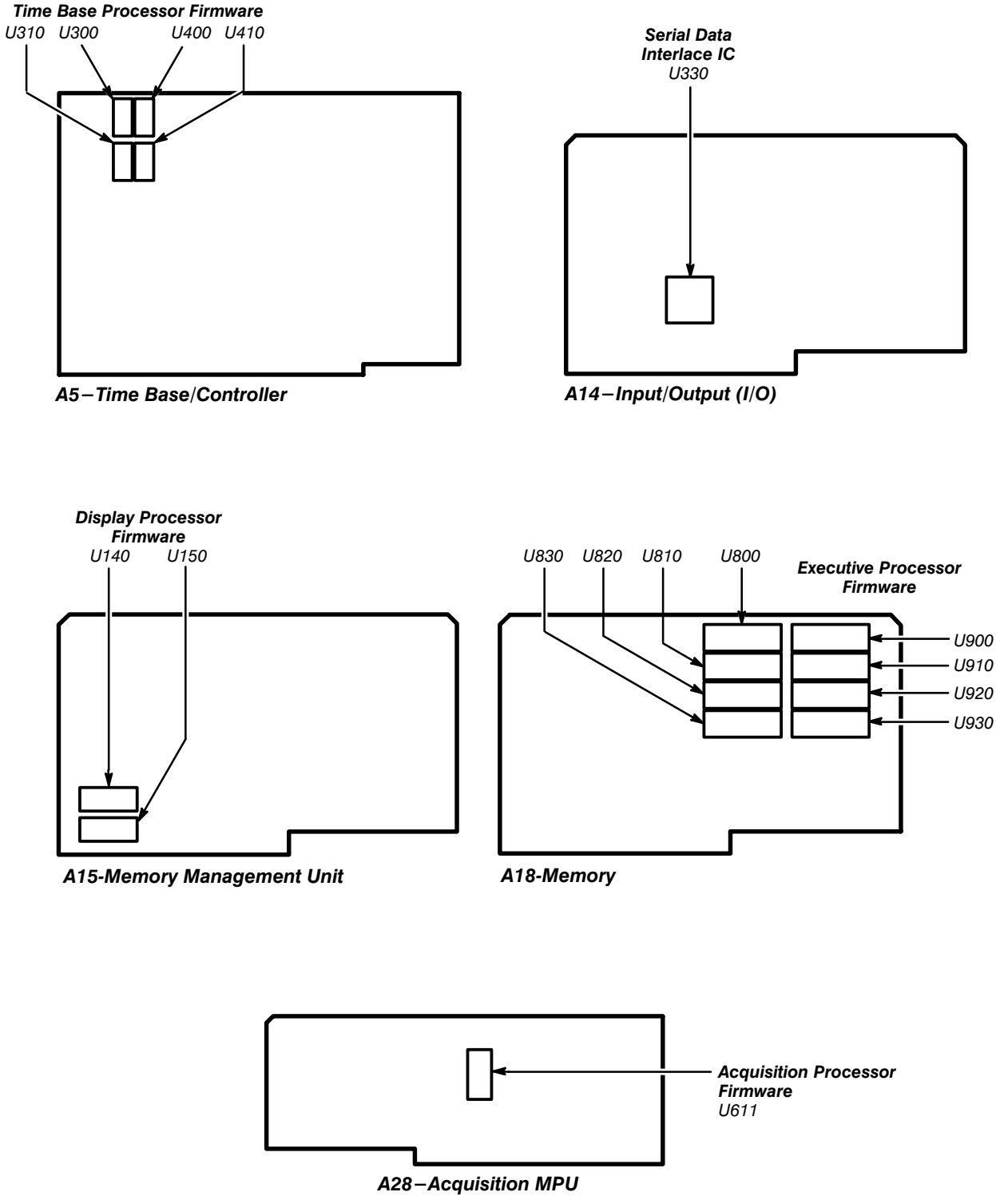


Figure 6-30: FRU IC Detail

Firmware Integrated Circuits ("Dual In-Line Package" ICs)

The firmware ICs are located on five separate boards (see Figure 6-30 for the IC locations on each circuit board). The boards and their respective firmware (FW) are:

- **A5 Time Base/Controller board** — Time Base Processor FW (U300, U310, U400 and U410)
- **A15 MMU board** — Display Processor FW (U140 and U150)
- **A18 Memory board** — Main Processor FW (U800, U810, U820, U830, U900, U910, U920 and U930)
- **A25 and A28 Acquisition MPU boards** — Acquisition Processor FW (U611)

All of the ICs listed above are ordered by a single Tektronix part number, as a single firmware kit. (**Each IC cannot be ordered separately**.) For the 11801C, the firmware kit number is 020-1889-XX.

To remove and replace the firmware ICs in your oscilloscope, follow these procedures:

WARNING

Dangerous shock hazards may be exposed when the instrument covers are removed. Before proceeding, ensure that the oscilloscope PRINCIPAL POWER SWITCH is in the OFF position. Then, disconnect the instrument from the power source. Disassembly should only be attempted by qualified service personnel.

CAUTION

To prevent static damage to the instrument, observe all the special precautions mentioned under Static-Sensitive Classification in this section.

Firmware Upgrade Procedure

To upgrade or replace your firmware ICs, complete the following steps:

☐ **Step 1:** Prepare the instrument for the firmware upgrade procedure as follows:

- Set the PRINCIPAL POWER SWITCH to OFF, and remove the power cord.
- Place the instrument on its right side (if not already in this position) to provide access to the boards upgraded in the firmware upgrade procedure that follows.

☐ **Step 2:** Access boards within the card cage as follows:

- Ensure that the PRINCIPAL POWER SWITCH is set to OFF and the power cord is unplugged.
- Remove the instrument's top panel cover.
- Remove the two plastic board guides from the top of the card cage (at the left rear of the instrument).
- Remove the three Torx head screws that secure the CRT cover, and then remove the CRT cover (see Figure 6-4).

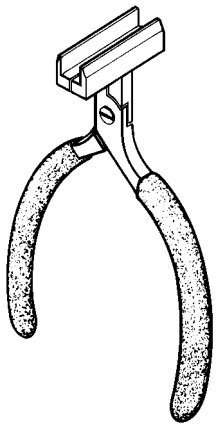


Figure 6-31: IC Insertion-Extraction Tool

☐ **Step 3:** Upgrade the A15 MMU board firmware as follows:

- Remove the A15 MMU board from the card cage. The A15 MMU board is typically located farthest from the outside (left side) of the instrument.
- Locate the two firmware ICs, U140 and U150.

CAUTION

To prevent damage to the firmware ICs or the board, ensure pin 1 is positioned correctly when replacing components.

NOTE

Use the IC Insertion-Extraction Pliers shown in Figure 6-31 for removing and replacing the ICs. (Refer to Table 4-2, Test Equipment for the part number of these pliers.)

Do not use the label on the IC for an index because it may be applied incorrectly. See Figure 6-32 for the correct location of the index on the IC.

- Remove U140 and replace it with the upgraded IC. The last two-digit portion of the part number on the replacement IC should be the same as, or higher than, that on the removed IC. Ensure that pin 1 is oriented correctly.
- Similarly replace U150 with the upgraded IC.

☐ **Step 4:** Upgrade the A18 Memory board firmware as follows:

- Remove the A18 Memory board from the card cage. The A18 Memory board is typically located one slot from the outside (left side) of the instrument.
- On the A18 Memory board, replace the following ICs:

U800	U900
U812	U910
U820	U920
U830	U930

  In each case, the last two-digits of the part number on the replacement IC should be the same as, or higher than, that on the removed IC. Again, ensure that pin 1 is oriented correctly.
- Return the A18 Memory board to its former location in the card cage.

☐ **Step 5:** Upgrade the A5 Time Base/Controller board firmware as follows:

- Locate U300, U310, U400, and U410 on the A5 Time Base/Controller board (see Figure 6-30). These components are found near the bottom front of the instrument with the instrument positioned on its right side.
- Replace U300, U310, U400, and U410 on the A5 Time Base/Controller board.

  The last two-digit portion of the part number on the replacement IC should be the same as, or higher than, that on the removed IC. Again, ensure that pin 1 is oriented correctly.

☐ **Step 6:** Upgrade the A25/A28 Acquisition MPU board firmware as follows:

- Remove the Acquisition unit from the instrument.
- Remove the A25/A28 Acquisition MPU board from the Acquisition unit (see Figure 6-1 for the exact location of these boards in the Acquisition unit).
- Locate U611 on the A25/A28 Acquisition MPU board (see Figure 6-28). This board is located in the card cage.
- Replace U611 on the A25/A28 Acquisition MPU board.

  The last two-digit portion of the part number on the replacement IC should be the same as, or higher than, that on the removed IC. Ensure that pin 1 is oriented correctly.

☐ **Step 7:** Verify the instrument serial number as follows:

- Locate the manufacturing jumper, J860, on the A5 Time Base/Controller board (see Figure 6-10), and install the terminal connector link.
- Connect a power cord to the instrument.
- Connect a terminal or controller to the oscilloscope. Refer to the *11801C User Manual* for more information on this connection.
- Set the PRINCIPAL POWER SWITCH and ON/STANDBY switch to ON.
- Set necessary communication parameters; for example, baud rate.
- After the instrument is powered-on, to establish communication from the terminal or controller, enter the following commands (<CR> is the return key):

  e<CR>
  v<CR>

- Verify that the serial number on the instrument's front panel matches the mainframe ID number in the **Identify** pop-up menu in the UTILITY major menu.
- If the numbers do not match, then enter the command:

  uid main:"**BXXXXXX**"<CR>

  where **XXXX** corresponds to the serial number digits found on the front panel serial number marker.
- Verify that the proper ID is now displayed in the **Identify** pop-up menu, in the Utility major menu.

☐ **Step 8:** Remove the procedure setup as follows:

- Set the PRINCIPAL POWER SWITCH to OFF.
- Remove the J860 manufacturing jumper from the A5 Time Base/Controller board.
- Replace the bottom instrument cover, and set the instrument upright.

☐ **Step 9:** Perform the final power-on and verification as follows:

NOTE

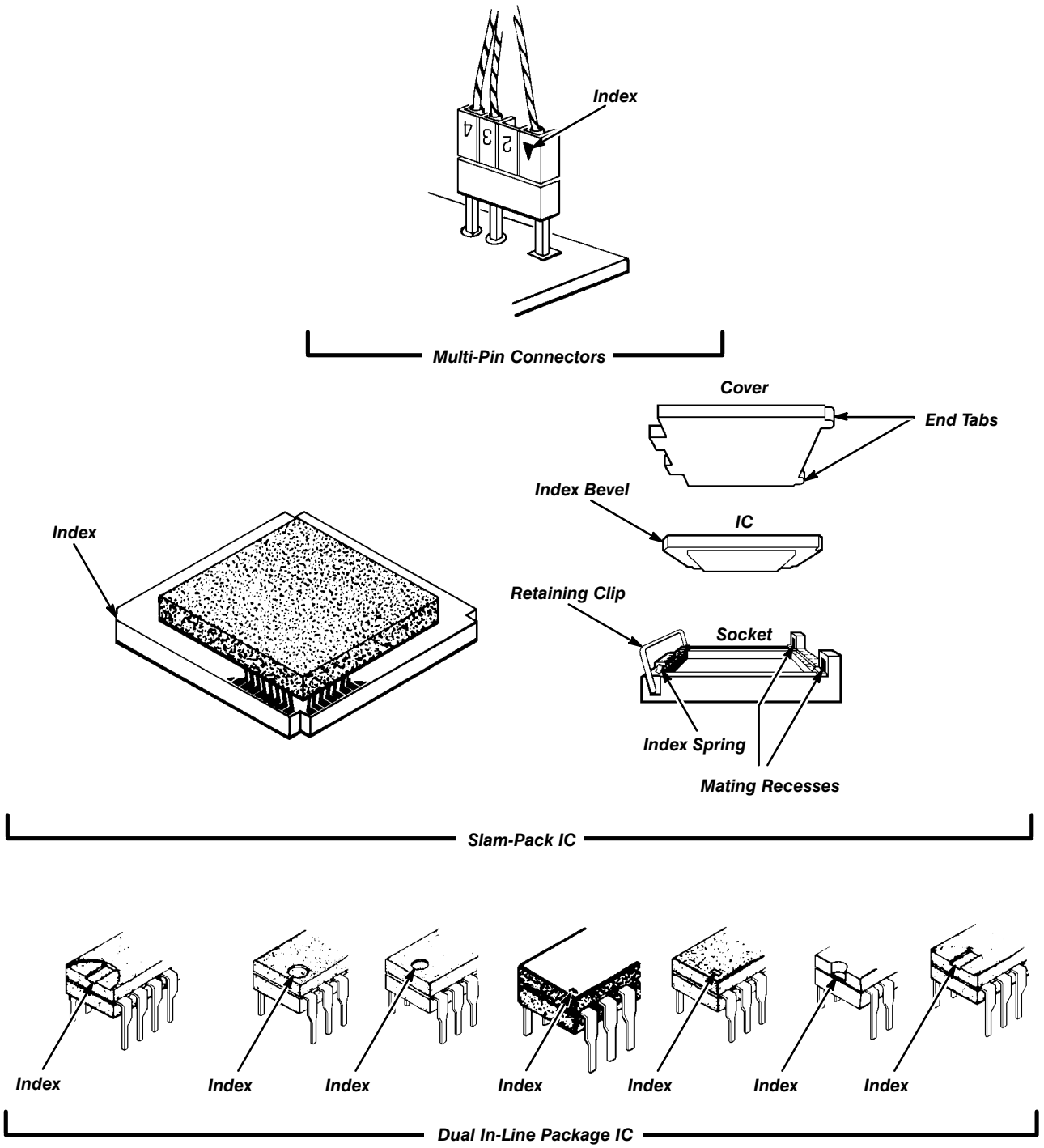
You must now perform the power-on sequence again for the instrument to recognize the new manufacturing jumper configuration.

- Set the PRINCIPAL POWER SWITCH and ON/STANDBY switch to ON.
- Verify that the instrument powers-on and successfully completes the Self-Test diagnostics.

NOTE

If problems are encountered, then check for the following:

- *all components are properly oriented in the sockets*
- *all component pins are properly seated*
- *components are installed in the correct location*



Note: *Match the index triangle on the multi-pin connectors with the corresponding square pad on the circuit board.*

Figure 6-32: Multi-Pin Connector Orientation and Semiconductor Indexing Diagram

Cables and Connectors

Cabling diagrams are provided in the *Diagrams* section to show the interconnecting cables between the various circuit boards, modules, and assemblies. Use these diagrams as a reference when you are removing and/or replacing cables between these units.

Interconnecting Pins

Two methods of interconnection are used to electrically connect circuit boards with other boards and components. When the interconnection is made with a coaxial cable, a special end-lead connector plugs into a socket on the board. Other interconnections are made with a pin soldered into the board.

Two types of connectors are used for these interconnecting pins. If the connector is mounted on a plug-on board, a special socket is soldered into the board. If the connector is on the end of a lead, an end-lead pin connector is used which mates with the interconnecting pin. The following information provides the removal and replacement procedure for the various types of interconnecting methods.

Coaxial-type End-Lead Connectors (Peltolas & SMB)

These connectors use color coding of wires, which may be helpful to correlate a Peltola connector to its socket on a circuit board. The wire insulation's color, or its colored stripe, is the same as the color represented by the last digit of the JXX component number. (EXAMPLE: a green wire would connect to a J05 socket.) Other Peltola connectors may have labels which designate their JXX component number.

Multi-Pin Connectors

These connectors are arranged so that the pin connectors used to connect the wires to the interconnecting pins are clamped to the ends of the associated leads.

Some of the pin connectors are grouped together and mounted in a plastic holder. The overall result is that these connectors are installed and removed as a multi-pin connector.

Pin 1 on multi-pin connectors is designated with a triangle (or arrowhead). A triangle, dot, or square printed on circuit boards denotes pin 1. When a connection is made to a circuit board, the position or orientation of the

triangle on the multi-pin holder is determined by the index (triangle, dot or square) printed on the circuit board. Most board-mounted connectors have a square pad for pin 1. (See Figure 6-32.)

NOTE

Match the index triangle on the multi-pin connectors with the corresponding square pad on the circuit board.

Some multi-pin connectors are keyed by a gap between the pin 1 and 3 positions in the holder. (A small plastic plug covers the pin 2 position on the end of the holder.) There is a corresponding gap between pins 1 and 3 on the circuit board.

Align the plug in the multi-pin holder with the gap between the circuit board pins. The connector is then ready to be installed.

Many of the larger, multi-pin ribbon connectors have a red, blue, or other contrasting color line along one side of their attached wire cables. This line indicates the location of pins 1 and 2 and also the location of the corresponding triangle index mark on the connector.

Some of the gray-colored ribbon cables may have the number of their connectors stamped on them.

The ribbon connectors have the following two functions:

- to provide a strain relief for the wire connections. The wire ribbon is wrapped around a bar between the wire connections and the top of the connector. Strain is then felt between the wires and the top of the connector. This relieves most of the strain which would otherwise be felt on the wire connections.
- to provide a pull-tab to ease disconnection. The pull-tab is attached inside the connector. When the tab is pulled, even pressure is applied across the connector. The connector then separates easily from its holder.

NOTE

To remove these ribbon connectors, grasp the pull-tab (fastened into the connector, if there) and pull it loose from the holder.

If there isn't a pull-tab present in the connector, grasp the ends of the connector instead. Pull it straight out from the connector socket.

Checks After FRU Replacement

After any FRU has been replaced, that particular unit should be checked. Table 6-4 lists the required checks (and the respective procedure name) to perform.

Table 6-4: Checks Required After FRU Replacement

FRU Replacement	Checks Required
A1 Strobe Drive Board	Power-On Diagnostics Extended Diagnostics Internal Clock
A3 M/F Power Connect Board	Power-On Diagnostics Extended Diagnostics
A4 Regulator Board	Power-On Diagnostics Extended Diagnostics Power Supply Vertical Reference Voltage Vertical Accuracy System Vertical RMS Noise Sweep Rate Accuracy Triggering
A5 Time Base/Controller Board	Power-On Diagnostics Extended Diagnostics
A8 CRT Driver Board	Display
A9 Touch Panel Assembly	Power-On Diagnostics Extended Diagnostics
A10 Front Panel Control Board	Power-On Diagnostics Extended Diagnostics
A11 Front Panel Button Board	Power-On Diagnostics Extended Diagnostics
A12 Rear Panel Board	Power-On Diagnostics Extended Diagnostics
A13 Mother Board	Power-On Diagnostics Extended Diagnostics
A14 Input/Output Board	Power-On Diagnostics Extended Diagnostics Real Time Clock
A15 MMU Board	Power-On Diagnostics Extended Diagnostics
A17 Executive Processor Board	Power-On Diagnostics Extended Diagnostics
A18 Memory Board	Power-On Diagnostics Extended Diagnostics

Table 6-4: Checks Required After FRU Replacement (Cont.)

FRU Replacement	Checks Required
A19 Strobe/TDR Buffer Board	Power-On Diagnostics Extended Diagnostics Sweep Rate Accuracy Internal Clock
A20-A23 Head Interconnect Boards	Power-On Diagnostics Vertical Accuracy System Vertical RMS Noise
A26 M/F Acquisition Interconnect Board	Power-On Diagnostics Extended Diagnostics Vertical Reference Voltage
A24/A27 Acquisition Analog Boards	Power-On Diagnostics Extended Diagnostics Vertical Accuracy System Vertical RMS Noise
A25/A28 Acquisition MPU Boards	Power-On Diagnostics Extended Diagnostics
Firmware ICs	Power-On Diagnostics Extended Diagnostics
Cathode Ray Tube (CRT)	Display
Power Supply Module	Power-On Diagnostics Extended Diagnostics Power Supply Vertical Reference Voltage Vertical Accuracy System Vertical RMS Noise Sweep Rate Accuracy

Diagnostic Troubleshooting

This section provides the information necessary to troubleshoot a faulty oscilloscope to the field replaceable unit (FRU) level. In most cases, an FRU is a circuit board. The primary means for troubleshooting is to use the error index code output from the Kernel diagnostics and cross-reference them to the suspect circuit boards in the following tables, or to use the built-in FRU help function available in Extended Diagnostics. In addition, conventional troubleshooting techniques are described at the end of this section to help identify a faulty A4 Regulator board, CRT, Power Supply module, A13 Mother board, or A8 CRT Driver board.

Diagnostics Overview

All subsystem processors (Executive, Display, Time Base, and Acquisition) execute a set of Kernel diagnostics prior to the Self-Test diagnostics. After the Acquisition processor has verified its support circuitry, it tries to establish communication with the Time Base processor. After the Time Base processor has verified its critical support circuitry and after it has attempted to communicate with the Acquisition processor, the Time Base processor attempts to communicate with the Executive processor. Likewise, the Display processor attempts to communicate with the Executive processor after successfully executing its Kernel diagnostics.

After a processor has successfully completed its Kernel diagnostics and established communications with the next order processor (for example, Acquisition-to-Time Base and Time Base-to-Executive), then the Self-Test diagnostics execute to verify the more global functionality of the processor's hardware system. After all the Self-Test diagnostics are executed, any failures cause the oscilloscope to enter Extended Diagnostics and to display the error index codes in a diagnostic menu. Extended diagnostics contains tests which are a superset of the Self-Test.

The Kernel diagnostics (low-level Self-Test diagnostics) and Self-Test/Extended Diagnostics produce and format error index codes differently, so they are covered separately. Kernel diagnostics error index codes for each subsystem are produced and read quite differently from each other.

Note that some of these tests that may indicate faulty FRU(s) are not executed automatically during the Self-Test diagnostics (that is, some errors codes are only generated by manually selecting tests or Extended Diagnostics).

Kernel Diagnostics

Kernel diagnostics are executed each time the front panel ON/STANDBY switch is set to ON. The oscilloscope performs power-on diagnostics on its microprocessor subsystems and Self-Test diagnostics on all of its major circuits.

When Kernel diagnostics begin, the messages **Diagnostics in Progress** and **Comm Test in Progress** are displayed. If the oscilloscope is being powered-on from a cold condition, then the diagnostics may complete before the CRT is warmed up and able to display these messages.

Diagnostic routines are performed in parallel on each of the instrument's processor subsystems: Display, Executive, Time Base, and Acquisition. Following successful execution of their Kernel diagnostics, the Acquisition processor attempts to communicate with the Time Base processor and the Time Base and Display processors attempt to communicate with the Executive processor.

The Executive processor will continue Self-Test diagnostics even if it is the only processor that has successfully completed its Kernel diagnostics.

In the case where the Display processor has not communicated successfully with the Executive processor, the message indicating that Self-Test diagnostics are beginning will not appear on the screen. Kernel diagnostic failures may be indicated by the message, **Dsy Kernel Failure**, or **Comm Test in Progress** on the screen and/or a single high-low beep and illuminated menu buttons.

If either the Display, Time Base, or Acquisition processors do not successfully pass their communications stage, then the oscilloscope automatically enters Extended Diagnostics at the end of the Self-Test diagnostics. If the Display processor is at fault, then the Extended Diagnostic menu will not appear on the screen.

The Kernel diagnostic tests execute concurrently in all three subsystem processor circuits at power-on. Hardware critical to diagnostic operation is verified, such as ROM, RAM, DMAs, timers, and interrupt control circuitry. For the Executive Processor, this requires checking basic operation for most boards in the card cage (that is, those boards plugged in to the A13 Mother board). The last step of Kernel diagnostics for the Display, Time Base, and Acquisition processors is to verify communication. Within each processor, all Kernel diagnostics must execute without failures before the Self-Test diagnostics can execute. However, the Executive processor continues with its Self-Test diagnostics despite a communication failure encountered with the Display and/or Time Base processors; and the Time Base processor does not halt when it has a communication failure with the Acquisition processor.

Since the condition of the instrument is unknown at power-on, when a kernel failure occurs, Kernel diagnostics in the Executive, Time Base, and Acquisition processors do not attempt to display error index codes. Instead, these processors generate hexidecimal (hex) numbers that are read as a series of binary bits, such as XXX1 0101 (hex error code 15_{hex}) for the Executive processor; 0100 (hex error code 4_{hex}) for the Time Base processor; or

10 (hex error code 2_{hex}) for the Acquisition processor, from either internal test points or LEDs. Refer to Tables 6-10, 6-15, and 6-16 for more information and examples of these hex error codes.

The Display kernel diagnostics display an error message on the screen giving the name of the test that failed. For example, the following message indicates that the DMA 0 test failed:

Dsy Kernel Failure
DMA 0

If the error message does not appear on the screen, the error index code can be obtained from the status LEDs and pins on the A15 Memory Management Unit board (see Figure 6-34).

Self-Test/Extended Diagnostics

Refer to the Power-On Diagnostics procedure in the *Performance Verification* section for information about Self-Test/Extended Diagnostics.

Extended Diagnostics Menu Structure

The menu structure determines the format of the error index codes. The Extended Diagnostics menus are a four-level hierarchy with the Subsys (that is, the Subsystem) menu at the highest level. This four-level Subsystem, Block, Area and Routine menu hierarchy generates the error index codes. Each subsystem in the Subsystem menu can be selected and tested if there are functional processor(s) and communication paths. Each subsystem is broken into a number of parts, or circuit blocks, in the Block menu for the selected subsystem. In a similar manner, each block is broken into a number of circuit areas in the Area menu, the third level. The fourth and lowest menu level is the Routine menu, which contains the smallest test unit that can be selected and executed.

Extended Diagnostics Error Index Codes

The error index codes for the Extended Diagnostics are five-digit codes whose first character indicates the subsystem tested. The last four digits are hexadecimal ($_{hex}$) numbers that indicate the Block, Area, Routine, and specific failure mode. For example, E2321 is decoded as follows:

E Subsystem — Executive

2 Block name — Front Panel

3 Area name — Soft Keys

2 Routine name — Column Open

1 Failure Identity — specific failure mode

Table 6-5 lists the subsystem character for the Extended Diagnostic error index codes.

Table 6-5: Extended Diagnostics Error Index Code Descriptions

Description	Meaning
E	Executive
D	Display
T	Time Base
m	Mainframe Acquisitions
a	SM-11 multi-channel unit A Acquisition
b	SM-11 multi-channel unit B Acquisition
c	SM-11 multi-channel unit C Acquisition
d	SM-11 multi-channel unit D Acquisition

Front panel controls are active during the Self-Test diagnostics sequence and any disturbance may cause a test failure, forcing the oscilloscope into the Extended Diagnostics mode. Touch the **(E)Exit** label twice in succession to remove the Extended Diagnostics menu and resume normal operation. In situations where the Display, Time Base, or Acquisition processors have failed their kernel diagnostics, exiting diagnostics to normal operation will not be possible.

After the Self-Test/Extended Diagnostic programs have executed, any resultant error index codes appear on the display next to the associated subsystem name in the Extended Diagnostics menu. Each subsystem that had a failure gives the first error encountered and the number of failures in the subsystem.

To get a more complete list of the error index codes in a subsystem, touch the selector of a failed subsystem (if the failed subsystem is not already selected) and then touch the Block selector. Touching the Area and then Routine selectors shows the lowest level test routines in the selected Block. The currently selected Subsystem, Block, Area, and Routine are shown below their labels at the bottom of the Extended Diagnostics menu. Several function and operating mode selectors are also available at the bottom of the screen. When certain test routines are selected, some of these operating modes are non-selectable. Additionally, when some of the operating modes are set to certain states, some of the test routines may become non-selectable.

The function and mode operators are listed below:

- **(?)Help** — displays a list of FRUs for the currently selected routine. If the routine had a failure, then the error index code for that routine is also displayed. The FRUs are normally listed as the most-to-least probable cause for errors in the routine. In some cases, the FRUs are listed according to their ease-of-replaceability in order to minimize the time required to identify the faulty FRU.

Within this menu, you can scan forward to the next routine or the next failure by touching the appropriate selectors in the lower portion of the screen (which functions like a simple keypad). Scanning continues in a circular fashion through all available subsystems.

Upon exiting this menu, the instrument returns to the same menu level (that is, Subsystem, Block, Area and Routine) that it was at before the help function was invoked. However, the displayed menu may be different if any scanning was performed.

- **(−)Delete** — places an execution mark on the currently selected menu name (in the upper menu area) and all items beneath it, down to the Routine level. This inhibits the actual execution of these routines, when **(r)Run** is invoked.

  Visually, execution marks are displayed on the screen as an asterisk (*****) immediately to the left of the menu name (in the upper menu area). If one, but not all, menu names in a menu are marked with an asterisk, then the name of the menu at the next highest level (that is, from Area to Block) is preceded by an execution mark of a minus (−).

- **(+)Add** — removes the execution mark, if present, on the currently selected menu name and all execution mark*s* on items (that is, blocks, areas, or routines) below the currently selected menu name (down to the Routine level). The execution mark, if present, will change from an asterisk (*****) or minus (−) to a space.

- **(D)Debugger** — normally cannot be selected and is used by qualified service personnel only.

- **E(Exit)** — terminates Extended Diagnostics and returns the instrument to normal operating mode, but only if this selector is touched twice in succession. The first touch causes a confirmation prompt to appear at the top of the screen; the second touch causes the actual termination of the Extended Diagnostics.

- **(p)Loop** — toggles On and Off. When On, the selected test(s) is executed continuously with the number of iterations displayed.

- **(t)Terse** — toggles On and Off. When On, tests in the loop mode execute at the fastest rate, but the iteration (i.e. Loop) readout is not updated until the test is stopped (by touching the screen or a button).

- **(x)All** — toggles On and Off. When On, all tests in the current menu are selected to execute when started.

- **(s)Stop on Err** — toggles On and Off. When On, testing stops after the first failed test completes.

- **(r)Run**/**(q)Quit** — starts or stops the currently selected tests.

Diagnostic Menus

The upper portion of the display screen is used to display diagnostic menus. Menus are comprised of menu items and menu fields. Menu items are rows of items that can be selected, while menu fields are columns of status information.

There are four tiers of menus which may appear in the menu area (only one is present at any given time), the Subsystem, Block, Area and Routine menus. Upon entry into any menu, there is always one menu item which is selected. Additionally, only one menu item can be selected at any given time.

The following field descriptions apply for Subsystem, Block, Area and Routine menus.

Subsystem, Block and Area menus are divided into the following four fields: Execution Mark, Title, Error Index Code, and Failure Count. The Routine menu has these and three additional test result fields.

- **Execution Mark** — is a one character field preceding the Title field and succeeding the keystroke selector identification. The three values of this field and their meanings are as follows:

  ‘ ’ All routines in this Subsystem, Block, or Area are available for execution

  ‘*’ No routines in the Subsystem, Block, or Area are available for execution

  ‘–’ One or more routines in the Subsystem, Block, or Area are available for execution

  Refer to the Delete and Add descriptions for further information.

- **Title field** — contains the name of individual hardware Subsystems, Blocks, Areas, or Routines.

- **Error Index Code field** — contains an index code. The index field may contain one of five types of status (indicating one of four types of tests), providing the following information:

  “**pass**” An automatic test has executed and did not fail.

  “**Yxxxx**” A test has failed and the failure encountered in subsystem **Y** is **xxxx**. This index code contains one digit each for Subsystem identification, Block identification, Area identification, Routine identification, and a Test identifier that gives some specific information about the failure.

  “********” An automatic test has not yet been executed. When the test does execute, the test will provide either **pass** or **Yxxxx** failure status.

  “**– – – –**” The test requires you to perform some type of test set-up using the RS-232-C loopback connector. When executed, this status provides **pass** or **Yxxxx** failure status. To execute this test, you must select it.

" " (blank) This status indicates that the test requires action from the user (such as the front panel verification tests), or that the test is for stimulus only (such as the manual calibration tests). This status does not provide failure status. To execute this test, select it individually.

"**????**" This status indicates that an option was found that was not present in the current instrument configuration or that a subsystem was found that did not have a working communication path.

- **Failure Count field** — indicates the total number of routine failures (one per routine) currently encountered in the Subsystem, Block or Area. Thus, the Failure Count will never be more than the total number of routines in the subsystem. If no tests have been executed or no failures have occurred, this field is blank. Since the failure count field is an indication of all routines that have failures, it is possible to have a failure field count greater than the loop count (for example, there may be five routine failures after the first loop).

  A field display of **65535+** indicates that the Failure Count field has gone beyond 65534 and that an overflow condition has occurred.

The following field descriptions apply only to Routine menus.

- **Test Results fields** — contain information useful for troubleshooting. One of the following formats is used:
  - test address, expected data, and actual data
  - expected data lower bound (minimum), expected data upper bound (maximum) and actual data

Diagnostic Menu Hardcopy

Press the hardcopy button on the front panel to make hardcopy of the diagnostic menu. The hardcopy is sent to a printer attached to the PRINTER port. Screen hardcopies can also be obtained from other menus (for example, help menus, interactive test menus, and hardware debugger menus).

After a hardcopy is output, a Form Feed is issued to the printer. If no printer is attached or the printer can not print (for example, if the printer is off line or if the printer is out of paper), then the following warning is shown in the Input/Prompt area:

Hardcopy absent or off line.

The hardcopy function is unavailable for some tests requiring human interaction, such as touch panel interactive tests, various display tests, and CRT/touch panel calibration patterns.

The knobs control the screen intensity during the four main diagnostics menu levels. The TOUCH PANEL ON/OFF button enables/disables the touch panel response to user touches.

Diagnostic Terminal Mode (RS-232-C)

The RS-232-C port drives a terminal which conforms to the ANSI 3.64 standard. In this mode, the terminal provides a screen-driven, interactive human interface.

This mode is useful when either the display or touch panel is not functioning properly, or when it is desired to remotely use the diagnostics with a modem and phone link.

There are several single terminal keystroke commands which are equivalent to front panel buttons or are terminal-only commands, all of which do not appear on any of the display screens. The following terminal keystrokes do appear on the screen and are shown in quotes:

- **'B'<baud rate><cr>** — this keystroke, followed by the baud rate and carriage return) allows you to change the default baud rate to any one of the allowable product baud rates (300, 1200, 9600, 19200). The default power-up baud rate is determined from the position of two internal jumpers located on the A14 I/O board. (The Default setting is for 9600 baud.)
- **'T'** — this keystroke toggles the screen output between the current screen display and an ANSI compatible terminal. The terminal should initially be set in its ANSI mode.
- **'K'** — this keystroke toggles the screen output between the current screen display and a Tektronix 4x05 terminal (4105, 4205).
- **'L'** — this keystroke toggles the screen output between the current screen display and a Tektronix 4x07 terminal (4107, 4207).
- **'H'** — this keystroke produces a hardcopy of the current diagnostic menu as described earlier.
- **'O'** — this keystroke disables/enables the touch panel response to the user's touches. It is equivalent to the TOUCH PANEL ON/OFF button.
- **'Q'** — this keystroke, when used in interactive test menus, stops and starts the display information in the keypad prompt area. This keystroke is equivalent to the ACQUISITION RUN/STOP button in those menus.

To gain access to the terminal mode diagnostics, the instrument must be in the Extended Diagnostic mode.

To exit the terminal mode, either recycle the power, enter the (Exit) keystroke twice to begin normal operation, or enter the appropriate 'L', 'T', or 'K' keystroke to transfer the screen output back to the instrument display.

System Mode (GPIB & RS-232-C)

The Self-Test diagnostics and Extended Diagnostics are accessible using the two commands listed in Table 6-6.

Table 6-6: System Mode Commands

Header	Argument	Notes
TEST		Set-only
TEST	**[XTND]**	Set-only
TEST	**[MAN]**	Set-only
DIAG?		Query-only

The **TEST** command invokes Self-Test diagnostics or Extended Diagnostic execution. The **TEST** command without arguments initiates Self-Test diagnostics. The **TEST** command with argument **XTND** initiates Extended Diagnostics.

Refer to the *CSA 803C and 11801C Digital Sampling Oscilloscope Programmer Manual* for more information on TEST and DIAG command syntax and usage.

The return of one of two event codes listed in Table 6-7 to the GPIB and RS-232-C ports signals that diagnostic testing is complete.

Table 6-7: Event Code Descriptions

Event Code	Explanation
460	Self-Test or Extended Diagnostics were completed successfully
394	Self-Test or Extended Diagnostics were completed and failed

In either case, a GPIB/RS-232-C controller may obtain pass/fail information through the **DIAG?** query.

The **TEST** command with argument **MAN** initiates the Extended Diagnostics similarly to entering Extended Diagnostics through the front panel UTILITY menu. The primary use of this command is to provide the remote operator a convenient way of accessing the diagnostics through the normal RS-232-C interface so that the operator can use the Diagnostic Terminal Mode to do remote testing.

CAUTION

*The **TEST** command with argument **MAN** violates normal GPIB protocols in that, when used, the instrument becomes non-responsive to further GPIB commands until normal operation is resumed.*

The **DIAG?** query returns pass/fail information from the most recent invocation of Self-Test diagnostics or Extended Diagnostics. Examples of possible responses and explanations are as follows:

DIAG PASSED: NONE

This response indicates that the Self-Test diagnostics or Extended Diagnostic operation did not detect any test faults.

DIAG FAILED: E1311, E1711, E1721, E1731

This response indicates that the Extended Diagnostic operation detected test faults.

DIAG FAILED: E1311, D1211, T1431

This response indicates that the Self-Test diagnostics or Extended Diagnostic operation detected test faults.

DIAG BYPASSED

This response indicates that a power-on has occurred and that Self-Test diagnostics were bypassed through a jumper on the A14 I/O board.

Battery Testing

The oscilloscope holds four lithium batteries to provide power when the instrument is turned off. The following discussions provide criteria for determining if a battery has exceeded its lifetime and is thus causing incorrect instrument operation. (A battery's lifetime will typically exceed five years.) If the battery voltage measures (at 20° C) equal to or greater than the voltages given, then the circuit should operate correctly from 0° C to 50° C. (These voltage measurements are taken with the instrument power off.)

Battery BT130 provides power for the real time clock on the A14 I/O board. If the clock begins to lose time rapidly when the instrument is turned off or the diagnostics report that the **Real Time Clk (E42XX)** has failed, the battery should be tested. If the battery voltage measures less than 2.7 V, then the most likely source of the problem is the battery and you should follow the instructions for battery replacement and disposal earlier in this section.

Battery BT150 provides power for the nonvolatile RAM (NVRAM) on the A18 Memory board. If the diagnostics consistently report an **NVRAM Battery (E141X)** failure over multiple power-ons, then the battery should be tested. If the battery voltage measures less than 2.7 V, then the most likely source of the problem is the battery and you should follow the instructions for battery replacement and disposal earlier in this section.

Sockets for devices U500 and U511 provide power for the NVRAM on the A5 Time Base/Controller board. If the diagnostics consistently report a **Static RAM Battery (T1331)** failure over multiple power-ons, then the batteries should be tested. If either one of the battery voltages measures less than 2.1 V, as measured on pin 28 (Vcc), follow the instructions for battery replacement and disposal earlier in this section. (It is recommended that both batteries be replaced at the same time.)

NOTE

Turning the instrument off while Extended Diagnostics is executing one of the NVRAM memory tests may cause failure of the NVRAM battery test. If the diagnostics report an NVRAM battery failure, then exit the diagnostics. This will rewrite the confidence words into the NVRAM. Turn the instrument off for at least one hour. Then, turn the instrument back on. If the diagnostics still indicate an NVRAM battery failure, then the battery should be tested.

Clearing NVRAM

Before a power-up Self-Test begins — but just after the Executive processor has run its Kernel Diagnostics — the front panel buttons are scanned by the Executive processor. If the Executive processor senses that the WAVEFORM and TRIGGER buttons, and only these two buttons, are pressed (i.e., closed) during this time, then the Executive processor resets its NVRAM to a default state, the Teksecure Erase Memory function. This essentially destroys all stored settings, stored traces, and saved trace descriptions. When this occurs, the NVRAM is initialized by filling all but a few locations with a default value. The following items are left intact after the NVRAM is reset:

Number of instrument power-ons (POWERON?)
Instrument power-on time (UPTIME?)
Mainframe serial number (UID? MAIN)

Field Replaceable Unit (FRU) Guide

This section correlates Kernel Diagnostic error index codes with the components or boards suspected of causing each error. The suspect FRU(s) for Self-Test/Extended Diagnostics error index codes are identified by using the built-in FRU help function, **(?)Help**, described under Self-Test/Extended Diagnostics.

The FRU(s) in the Suspect board category in the following error index tables are listed in most-to-least probable cause order. If any diagnostic errors occur, inspect the suspect FRU for loose connections and components. Then, repeat the Diagnostic test. If any diagnostic errors occur again, replace the suspect FRU(s) with a known good FRU or FRUs. Check that the new FRU is configured exactly like the old one and that any installed firmware matches the version in the old FRU.

The error index codes and tests are divided into four groups based on the four processor subsystems: Executive, Display, Time Base, and Acquisition. Each subsystem group has a table of kernel diagnostic error index codes. In addition, the Executive has a table of manual test error index codes which help extend the confidence level of instrument functionality.

If necessary, kernel error index codes for the Executive and Display subsystems can be read, using a logic probe, as TTL logic levels on circuit board pins.

FRU Name Abbreviations

Abbreviations of FRU names are listed in Table 6-8.

Table 6-8: Board FRUs

FRU	Board	Board No
STROBEDR	M/F Strobe Driver board	(A1)
MFPOWERR	M/F Power Connect board	(A3)
REG	Regulator board	(A4)
TBC	Time Base/Controller board	(A5)
CRTSOC	CRT Socket board	(A7)
CRTDR	CRT Driver board	(A8)
TOUCH	Touch Panel assembly	(A9)
FPCTRL	Front Panel Control board	(A10)
FPBUT	Front Panel Button board	(A11)
REAR	Rear Panel assembly	(A12)
MOTHER	Mother board	(A13)
IO	Input/Output board	(A14)
MMU	Memory Management Unit board	(A15)
EXP	Executive Processor board	(A17)
MEM	Memory board	(A18)
STROBEBUF	Strobe/TDR Buffer board	(A19)
HEAD	Head Interconnect board	(A20-A23)
ACQANALOG	Acquisition Analog board	(A24/A27)
ACQMPU	Acquisition MPU board	(A25/A28)
MFACQCON	M/F Acquisition Interconnect board	(A26)

Component and Module Name Abbreviations

Abbreviations of component and module names are listed in Table 6-9.

Table 6-9: Component Module FRUs

FRU	Board
CRT	Cathode Ray Tube
FW	Executive, Display, Time Base, or Acquisition Firmware
SDI	Serial Data Interface IC
BATTERY	Lithium Battery
PS	Power Supply Module

NOTE

The Executive, Display, Time Base, and Acquisition firmware is packaged in a single firmware (FW) kit; the individual parts are not available as separate components.

Executive Subsystem Error Index Codes

Error index codes for the Executive subsystem are listed in Table 6-10 along with the suspected FRUs.

Bit patterns for these hexadecimal error index codes are displayed with the front panel MENUS LEDs in bottom-to-top bit order. The STORE/RECALL label represents the MSB (most significant bit) and the WAVEFORM label represents the LSB (least significant bit). When lit, the LEDs represent a one.

For example, error index code 12_{hex} causes the STORE/RECALL and TRIGGER LEDs to light.

Table 6-10: Executive Processor Kernel Error Index Codes

Error Index$_{hex}$	Hybrid/IC FRUs	Suspect Board FRUs
1F – 1D		MEM, EXP
1C – 19	FW	MEM
18 – 16		IO, EXP
15		EXP
14		EXP, MEM
13		FPCTRL, IO, MPU
12		IO, EXP
11		IO, EXP
10 – 0E		REAR, IO, MPU
0D		MMU, EXP
0C		EXP, MEM
0B		REAR, IO, EXP

The status LEDs (DS306 and DS307) on the A17 Executive Processor board will flash while the Kernel diagnostic tests are executing. If a kernel failure is detected, then one or both LEDs will remain on. Table 6-11 lists the various LED configurations and their significance.

Reading the Executive processor subsystem error bits from the A17 Executive Processor board test points, TP201 (MSB) to TP205 (LSB), is also possible. See Figure 6-33 for the location of these test points and status LEDs. The bits are high (+5 V) true.

Table 6-11: Executive Processor Status LED Configuration

DS307	DS306	Significance
ON	ON	Power-On
ON	OFF	Kernel Tests Executing
OFF	ON	Kernel Tests Failed
OFF	OFF	Kernel Tests Finished

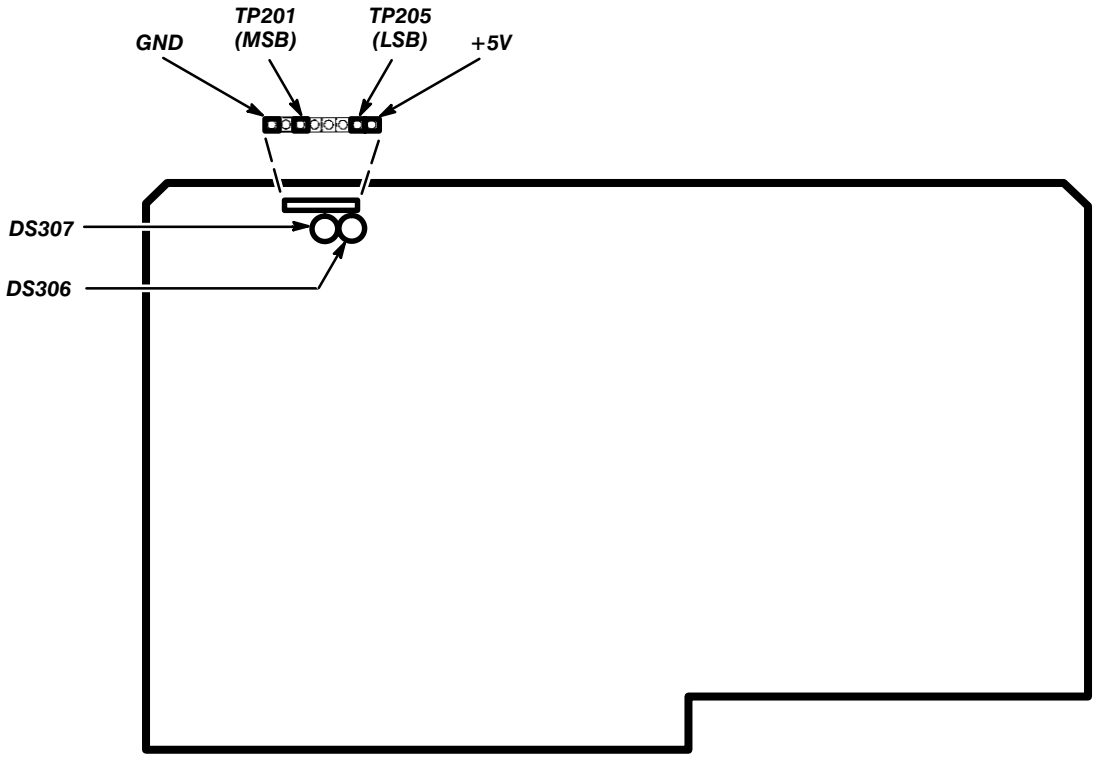


Figure 6-33: A17 Executive Processor Board Test Point and Status LED Locations

Table 6-12 lists the Executive processor manual tests and verification procedures. If the conditions specified in the verification procedure listed are not met, then the suspect FRUs can be found by using the **(?) Help** function.

These tests are performed manually and produce no error index code displays. They are included to help you locate faulty boards that the Kernel or Self-Test diagnostics possibly did not locate. Interconnections such as the A13 Mother board cables and the power supply boards are not listed; however, these interconnections are considered as possible problem sources.

Table 6-12: Executive Processor Manual Tests

Test	Verification Procedure
Front Panel	
Verify	
Hard Keys	This test allows you to interactively press the hard keys to verify their operation. This test verifies the operation of a key with both visual and audio feedback. This test requires operator interaction and can be executed only in the **Routine** pop-up menu with the **All** and **Loop** modes set to **Off**. Once this test is invoked, you can press any of the hard keys on the instrument and verify that the corresponding image of the key on the screen is highlighted, that the associated LED is turned on, and that an audio click is generated.
Soft Keys	This test allows you to interactively touch any of the soft keys and verify their operation. This test verifies the operation of a key with both visual and audio feedback. This test requires operator interaction and can be executed only in the **Routine** pop-up menu with the **All** and **Loop** modes set to **Off**. Once this test is invoked, you can touch any of the soft keys in the instrument and verify that a touch box is drawn around the soft key on the screen and that an audio click is generated.
Knobs	This test allows you to turn either of the knobs and verify their operation. This test verifies knob movement with visual feedback. This test requires operator interaction and can be executed only in the **Routine** pop-up menu with the **All** and **Loop** modes set to **Off**. Once this test is invoked, you can turn either of the knobs on the instrument and verify that the corresponding knob pointer on the screen rotates and that the associated counter value changes.
Test Pattern	
Gray Scale Green Grid White Grid Red Display Green Display Blue Display HV Reg Dsply	These tests allow you to examine and adjust the CRT adjustments pertaining to color. These tests require operator interaction and are only executable in the **Routine** pop-up menu with the **All** and **Loop** modes set to **Off**. Once one of the tests is invoked, the operator can examine/adjust the CRT by following the procedure outlined in the *Adjustments* section.

Table 6-12: Executive Processor Manual Tests (Cont.)

Test	Verification Procedure
Internal I/O	
Tone Gen	
Ramp Tone	This test verifies the capability of the instrument to generate tones through its internal speaker. This test requires operator interaction and can be executed only in the **Routine** pop-up menu with the **Loop** mode set to **On** and the **Terse** and **All** mode set to **Off**. After invoking this test, you should verify that a high-speed clicking sound occurs.
Real Time Clk	
Calibrate	This test allows you to check and adjust the Real Time Clock period. This test requires operator interaction and can be executed only in the **Routine** pop-up menu with the **All** and **Loop** modes set to **Off**. Once this test is invoked, you can examine/adjust the real time clock period following the procedure outlined in the Real Time Clock procedure in the *Adjustments* section.
External I/O	
Printer	
Pattern	This test prints a set of patterns (all printable ASCII characters) to help you verify the external printer interface. This test requires operator interaction and can be executed only in the **Routine** pop-up menu with the **All** mode set to **Off**. Before executing this test, you should connect a Centronics-compatible printer to the PRINTER port on the rear panel of the instrument.
RS-232	
Extern Loop	This test verifies parts of the external RS-232-C interface. This test requires operator interaction and can be executed only in the **Routine** pop-up menu with the **All** mode set to **Off**. Before executing this test, you should plug an external loopback connector on the RS-232-C connector on the rear panel of the instrument.
GPIB	
Inrpt Reset Reset Status Data Lines Interrupt	These tests verify the Executive processor interface to the internal GPIB circuitry. The major external GPIB functions are not tested. This test requires operator interaction and can be executed only in the **Routine** pop-up menu with the **All** and **Loop** modes set to **Off**. Before executing this test, you should unplug the GPIB connector from the instrument.

Display Subsystem Error Index Codes

The Display subsystem error index codes and suspect FRUs are listed in Table 6-13.

Table 6-13: Display Processor Kernel Error Index Codes

Error Index$_{hex}$	Suspect Hybrid/ IC FRUs	Suspect Board FRUs
1 – 4	FW	MMU
5 – 7		MMU

The name of the first Display kernel test that fails is displayed on the screen. The Display processor error index code is read from the A15 MMU board test points DIAG0 (LSB) to DIAG2 (MSB). The bits are high (+5 V) true.

The status LEDs (DS201 and DS200) on the A15 MMU board will flash while the Kernel diagnostic tests are executing. If a kernel failure is detected, then one or both LEDs will remain on. Table 6-14 lists the various LED configurations and their significance. See Figure 6-34 for the location of these test points and status LEDs.

Table 6-14: Display Processor Status LED Configuration

DS200	DS201	Significance
ON	ON	Power-On
ON	OFF	Kernel Tests Executing
OFF	ON	Kernel Tests Failed
OFF	OFF	Kernel Tests Finished

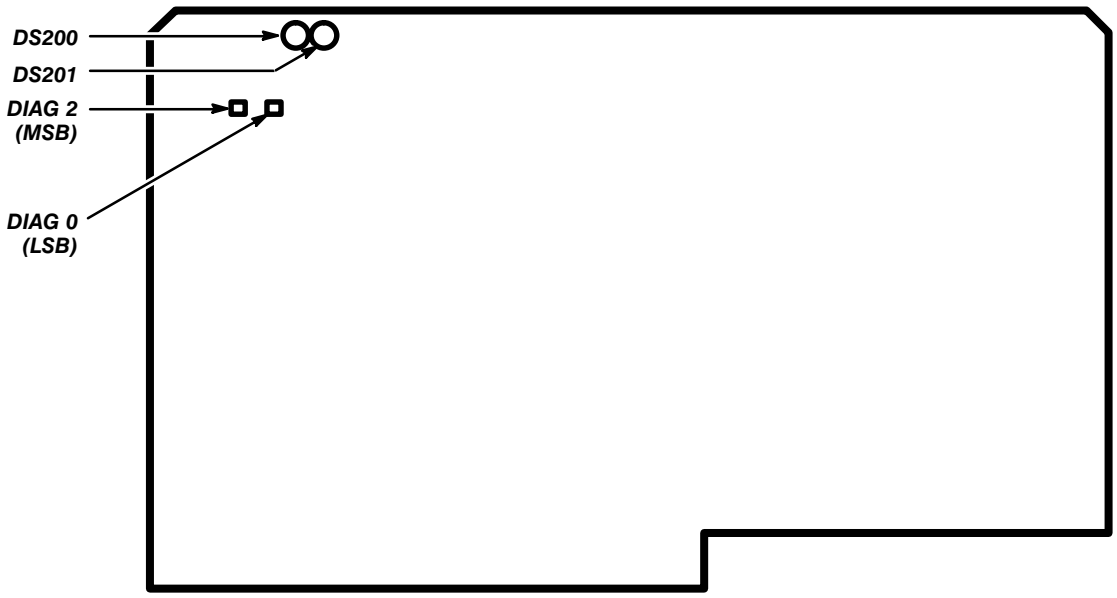


Figure 6-34: A15 MMU Board Test Point and Status LED Locations

Time Base Processor Error Index Codes

Error index codes for the Time Base Processor are listed in Table 6-15.

Table 6-15: Time Base Processor Kernel Error Index Codes

Error Index$_{hex}$	Suspect Hybrid/ IC FRUs	Suspect Board FRUs
1		TBC
2 – 3	FW	TBC
4 – 7		TBC
8 – A		TBC, MMU
B		TBC
C		TBC, MMU

The error index code bits of the first Time Base kernel test that fails are read from the A5 Time Base/Controller board status LEDs ST4 (MSB), ST3, ST2, and ST1 (LSB). The bits are true (one) when the LED is on. Also, status LEDs ST5 and ST6 indicate when the test is executing and when the test has failed, respectively. See Figure 6-35 for the location of these status LEDs.

The patterns from the status LEDs are applicable only when the Time Base is executing or stopped in Kernel diagnostics.

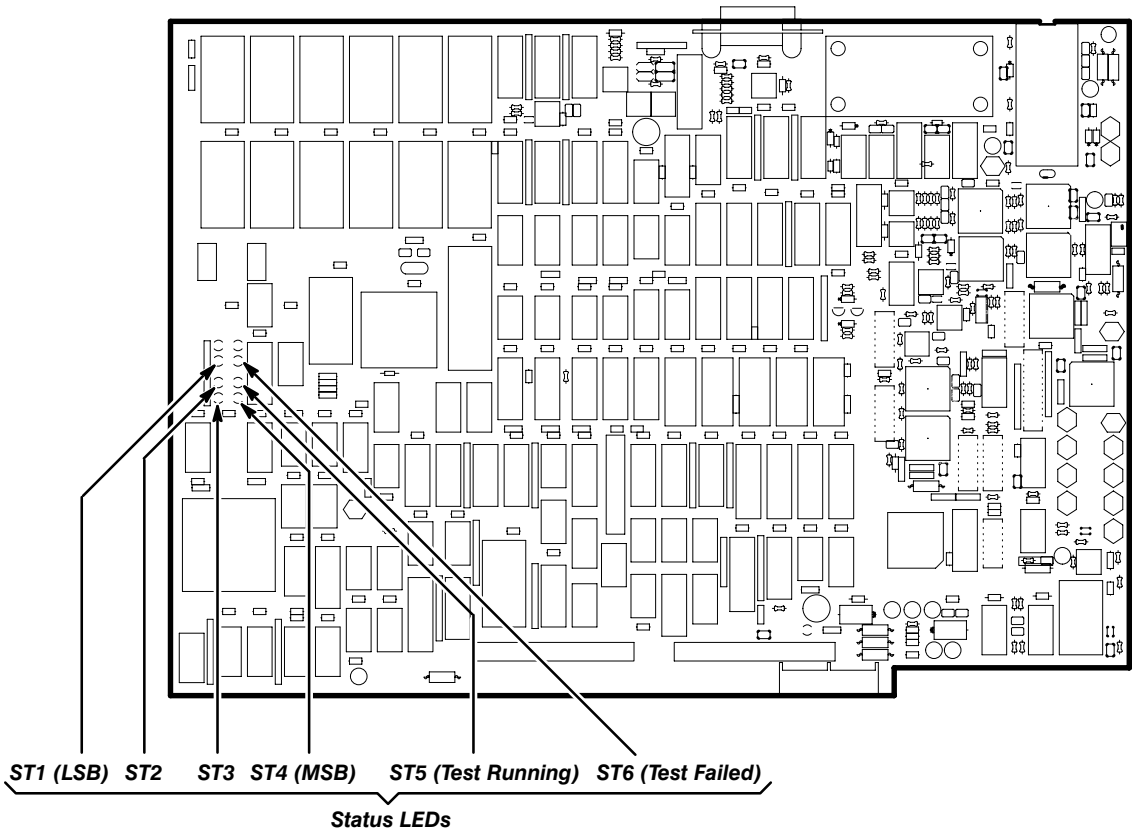


Figure 6-35: A5 Time Base/Controller Board Status LEDs

Acquisition Processor Error Index Codes

Error codes for the Acquisition Processor are listed in Table 6-16.

The error index code bits of the first Acquisition kernel test that fails are read from the A25/A28 Acquisition MPU board status LEDs, DS101 (MSB) and DS100 (LSB). See Figure 6-36 for the location of these status LEDs.

The patterns from the status LEDs are applicable only when the Acquisition is executing or stopped in Kernel diagnostics.

Table 6-16: Acquisition Processor Kernel Error Index Codes

Error Index$_{hex}$	Suspect Hybrid/ IC FRUs	Suspect Board FRUs
1	FW	ACQMPU
2		ACQMPU
3		ACQMPU, TBC, STRO-BEDR, MFACQCON

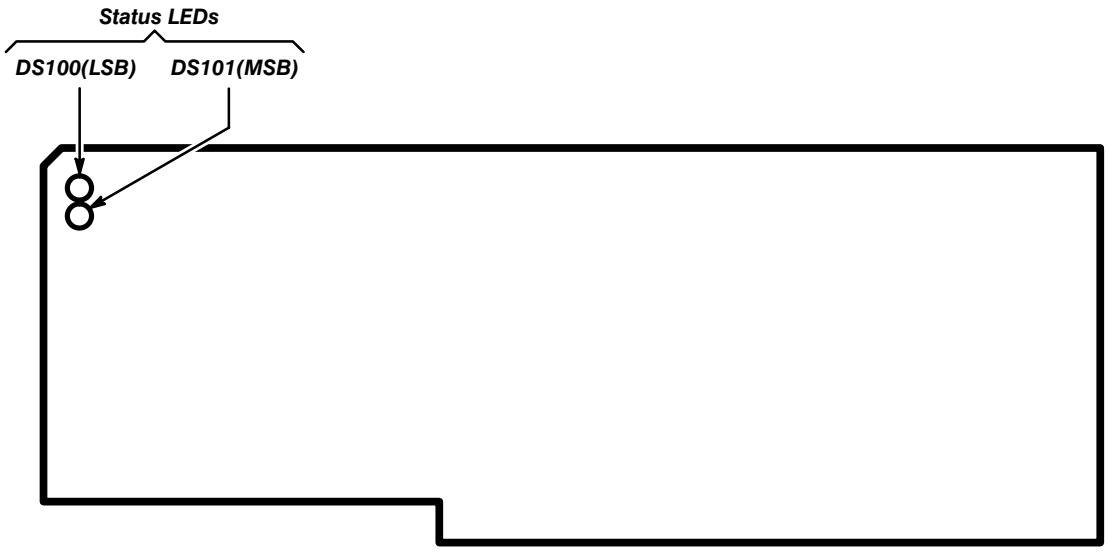


Figure 6-36: A25/A28 Acquisition MPU Board Status LEDs

Other Troubleshooting

This section provides additional information and procedures for troubleshooting a faulty oscilloscope to the FRU level.

Power Supply Module

This procedure requires an Extended Diagnostics power supplies troubleshooting fixture. Refer to Table 4-2 for a complete description of the equipment required.

Module Troubleshooting

If any Power Supply module problems are present, they appear when the ON/STANDBY switch is set to ON. If the green indicator beside the ON label fails to light, then check for the following conditions:

- The PRINCIPAL POWER SWITCH located on the back panel is in the ON position.
- The line cord is connected to a functional power source with the same output voltage as set at the LINE VOLTAGE SELECTOR on the back panel.
- The fuse is good. If the fuse is blown, then replace the fuse.
- The fan is exhausting air from the instrument when the ON/STANDBY switch is ON. A defective fan causes an over-temperature shutdown in the power supply.

If these checks fail to correct the problem, connect the Extended Diagnostics 11000-Series Power Supplies Test Fixture to the Power Supply module (refer to the documentation accompanying the test fixture for troubleshooting techniques). The test fixture indicates which power supply voltage source is at fault. To help isolate the source of the problem, set the instrument's ON/STANDBY switch to STANDBY, and disconnect the suspected faulty power supply voltage source from the Power Supply module. Set the ON/STANDBY switch to ON. If the test fixture does not record a fault, then you have verified the suspected faulty power source. This procedure is only effective for externally shorted power supplies. Once again, refer to the documentation accompanying the test fixture for more troubleshooting information.

A4 Regulator Board

This board is implicitly verified; that is, if all the other FRUs pass diagnostic testing, then you can assume that the A4 Regulator board is operating correctly as well.

CRT, A7 CRT Socket Board, or A8 CRT Driver Board

This procedure requires a test terminal and a compatible RS-232-C serial interface cable. Refer to Table 4-2 for a complete description of the equipment required.

Module Troubleshooting

If the oscilloscope powers on (the ON/STANDBY light is on), but the display gives either scrambled information or none at all, then the CRT and A8 CRT Driver board are suspect. The following two procedures help you determine whether the A15 MMU board or one of the CRT units, (either the CRT, the A7 CRT Socket board, or the A8 CRT Driver board) is at fault.

- With the power off (ON/STANDBY switch to STANDBY), remove the top cover, then turn the power on. Observe the two LEDs on the A15 MMU board and those on the A17 Executive Processor board in the card cage. These LEDs should flicker on and off until the diagnostic tests are complete and then all turn off. If any of these LEDs remain lit, it indicates a problem with the board on which the LED resides. If all LEDs turn off, then the CRT, A7 CRT Socket board, or the A8 CRT Driver board is suspect.
- With the power off, connect a test terminal (ANSI 3.64-compatible) to the oscilloscope with an RS-232-C cable. Touch the screen through the full power-on cycle to force a diagnostic error so that the instrument enters Extended Diagnostics. On the test terminal, type **T** to display the **EXTENDED DIAGNOSTICS** menu on the terminal display. If the displayed errors are only for the front panel touch screen, then the CRT, the A7 CRT Socket board or the A8 CRT Driver board is at fault. Note any other errors and use Table 6-5, earlier in this section, to identify the suspect subsystem.

A13 Mother Board

This board is implicitly verified; that is, if all the other FRUs pass diagnostic testing, then you can assume that the A13 Mother board is operating correctly as well.

Fuse Testing

The A14 I/O board has four fuses (see Figure 6-37). F200 supplies +5 V to the A12 Rear Panel board. F800 supplies +5 V to the A10 Front Panel Control board and the A9 Touch Panel board. F600 supplies +15 V to the A14 I/O board, card cage, A10 Front Panel Control board, A9 Touch Panel board, A11 Front Panel Button board, and A12 Rear Panel board (reduced to +12 V). F602 supplies −15 V to the A14 I/O board, card cage, A10 Front Panel Control board (reduced to −5 V), and A12 Rear Panel board (reduced to −12 V).

- F200 supplies +5 V to the A12 Rear Panel board. If diagnostics report failure of all three ports (RS-232-C, GPIB, and PRINTER), then this fuse is the probable suspect (assuming that the ribbon cable to the A12 Rear Panel board is connected). When tested with a multimeter, this fuse should measure less than 1.5 Ω.
- F800 supplies +5 V to the A10 Front Panel Control board and the A11 Front Panel board. If the diagnostics report both an A9 Touch Panel board failure and knob failures, then this fuse is one possible source of this problem. When tested with an multimeter, this fuse should measure less than 1 Ω.
- F600 supplies +15 V to the A14 I/O board temperature sensor and tone generator, the lights of the A11 Front Panel Button board, the A9 Touch Panel board, the A12 Rear Panel board's RS-232-C output line drivers, the card cage, and the A17 Executive Processor board's NVRAM. If the NVRAM battery test and the **RS-232-C External Loop Back** test fail (but the **Internal Loop Back** test passes) and the A11 Front Panel Button board's lights, temperature sensor, and tone generator are all off, then this fuse is the probable suspect. When tested with an multimeter, this fuse should measure less than 1 Ω.
- F602 supplies −15 V to the A14 I/O board temperature sensor and tone generator, A12 Rear Panel board's RS-232-C output line drivers, the A9 Touch Panel board, and the card cage. If the temperature sensor, tone generator, and **RS-232-C External Loop Back** test fail (but the **Internal Loop Back** test passes), then this fuse is the probable suspect. When tested with an multimeter, this fuse should measure less than 1 Ω.

The A14 I/O board uses the +15 V and −15 V supplies on board to operate the temperature sensor and the tone generator. Of the other card cage boards, the A18 Memory board uses the +15 V supply to operate the NVRAM circuitry. The information above and Table 6-17 will help you to identify a failure of one of these fuses. If a test fails, then check the fuses.

WARNING

Using a replacement fuse with an incorrect current rating may cause the ribbon cables to melt and create fire danger during a component fault.

See Figures 6-2 and 6-37 for the location of the line fuse and the A14 I/O board fuses, respectively.

When a fuse must be replaced, unsolder the fuse from the board. Be careful not to damage the solder pads on the board. (It may be helpful to straighten the fuse leads on the rear of the board before removing the leads from their holes in the circuit board.) Refer to the *Parts List* section for the correct value and part number of each fuse.

Table 6-17: A14 I/O Board Fuse Failures

Fuse	Executive Kernel Test Failure (refer to Table 6-10, Executive Subsystem Error Index Codes)	Self-Test/Extended Test Failure
F200 open	10_{hex} (GPIB Interrupt)	
F800 open	13_{hex} (Front Panel Inter) **Note:** *The front panel lights do not work, so the code must be read from the error status test points (TP200-TP205) on the A17 Executive Processor board.*	
F600 open	Passes the Kernel diagnostic tests, but the front panel lights are not lit.	Exec Control E1411 3 NVRAM E1411 3 Battery E1411 1 *Data Lines E1421 1 *Addr/Data E1431 1 Internal I/O E3111 1 Temp Sensor E3111 1 Comparator E3111 1 *Tone Gen —— *Ramp Tone (works) **Note:** *The front panel lights, soft keys, and hard keys do not work.*
F602 open	13_{hex} (Front Panel Inter) **Note:** *The tone generator has a very different tone.*	

***indicates a Manual Test forced by the operator. The test is not automatically executed by Self-Test diagnostics.**

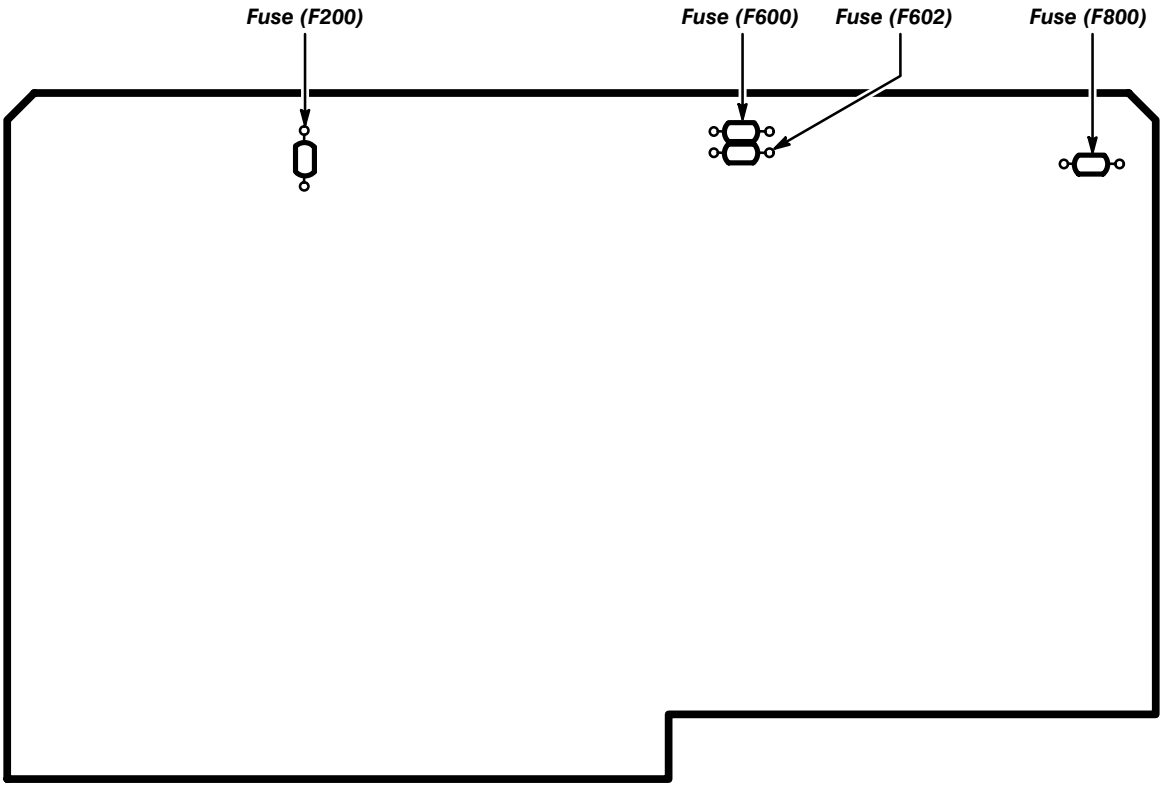


Figure 6-37: A14 I/O Board Fuse Locator Diagram

Time Base Calibration Errors

Table 6-18 lists the time base calibration errors that can appear on the oscilloscope screen and the suspected faulty FRUs that cause the error. The FRUs are listed in the order of most to least likely source of the error.

Time base calibration error messages with error codes greater than 100 have two different forms, depending on when the error occurs. If the error occurs during power-on, then the message will say:

Time base calibration failed at power up: 2XX

where 2XX is the error code.

If the error occurs at any other time, then the message will say:

Time base calibration failed: 1XX

where 1XX is the error code.

Calibration data to enhance the time interpolator linearity is stored in NVRAM on the Time Base/Controller board. If this NVRAM fails, a T1331 error occurs during power-up diagnostics. The values are written at the factory with the GPIB command `CALCORRECTION`.

`CALCORRECTION<ui>:N`

where <*ui*> = 0. . .32 and `N` = −128. . .+127

CAUTION

The calibration enhancement values are set at time of manufacture. There is no query form of this command. Do NOT reset these values. If a T1331 failure occurs during extended power-up diagnostics or you suspect a time interpolator error, contact Tektronix factory service.

A T1331 failure causes all N values in the 33 ui locations to be reset to zero. The oscilloscope will still run, but with decreased accuracy in the time interpolator linearity. Resetting NVRAM with the Teksecure feature does not affect the Time Base/Controller board NVRAM.

Table 6-18: Time Base Calibration Errors

Error Message	Error Code	Suspect FRU
Minor time base calibration problem:	12	TBC
	14	TBC
	16	TBC
	18	TBC
	24	TBC
	33	TBC
Time base calibration failed (at power-on);	101 (201)	TBC
	102 (202)	TBC
	103 (203)	TBC
	111 (211)	TBC
	113 (213)	TBC
	115 (215)	TBC
	117 (217)	TBC
	121 (221)	TBC
	122 (222)	TBC
	123 (223)	TBC
	125 (225)	TBC
	126 (226)	TBC
	131 (231)	TBC STROBEBUF STROBEDR
	132 (232)	TBC
	134 (234)	TBC
	135 (235)	TBC STROBEBUF STROBEDR
	136 (236)	TBC
	137 (237)	TBC
	138 (238)	TBC STROBEBUF STROBEDR, or Sampling Head

Acquisition Calibration Errors

When acquisition calibration errors occur, a message will appear on the oscilloscope screen, followed by a number that indicates which Acquisition system the error was detected in. Following this number, there will be a string of eight, four-digit error codes that are used to identify possible faulty FRUs. The following example shows the form that the error message will appear:

Error detected in acquisition system AA: BBBB, CCCC, DDDD, EEEE, FFFF, GGGG, HHHH, IIII

where the **A** digits represent the number of the Acquisition system, and the **B**, **C**, **D**, **E**, **F**, **G**, **H**, and **I** digits represent the four-digit error codes.

The **B** and **I** digits can be ignored. If any of the **C** or **D** digits are non-zero, then the possible faulty FRUs, from most to least likely, are:

ACQMPU
MFACQCON
ACQANALOG
TBC

If any of the **E**, **F**, **G**, or **H** digits are non-zero, then the possible fault FRUs, from most to least likely, are:

ACQANALOG
ACQMPU
MFACQCON

Options

This section contains information on instrument and power cord options available for your 11801C digital oscilloscope.

Instrument Options

Your instrument may be equipped with one or more options. A brief description of each available option is given in the following discussion. Option information is incorporated into the appropriate sections of the manual set. Refer to the Table of Contents for the location of option information. For further information and prices of instrument options, see your *Tektronix Products Catalog* or contact your local Tektronix service center.

Option 1M — adds connectors for SM−11 instrumentation, providing up to 128 additional channels for a total of 136 acquisition channels.

Option 1R — adds slide rails and rackmounting hardware to convert the benchtop instrument to a standard 19-inch rackmount version. This option can be added at any time.

Option 1T — adds the Predefined Telecommunications Mask firmware. This feature is standard after serial number B020000, though it still appears as Option 1T in the **Identify** (System Identification) pop-up menu. This option can be added to pre-B020000 instruments.

Option A1 — replaces the standard power cord with the Universal European 220 V type power cord.

Option A2 — replaces the standard power cord with the United Kingdom 240 V type power cord.

Option A3 — replaces the standard power cord with the Australian 240 V type power cord.

Option A4 — replaces the standard power cord with the North American 250 V type power cord.

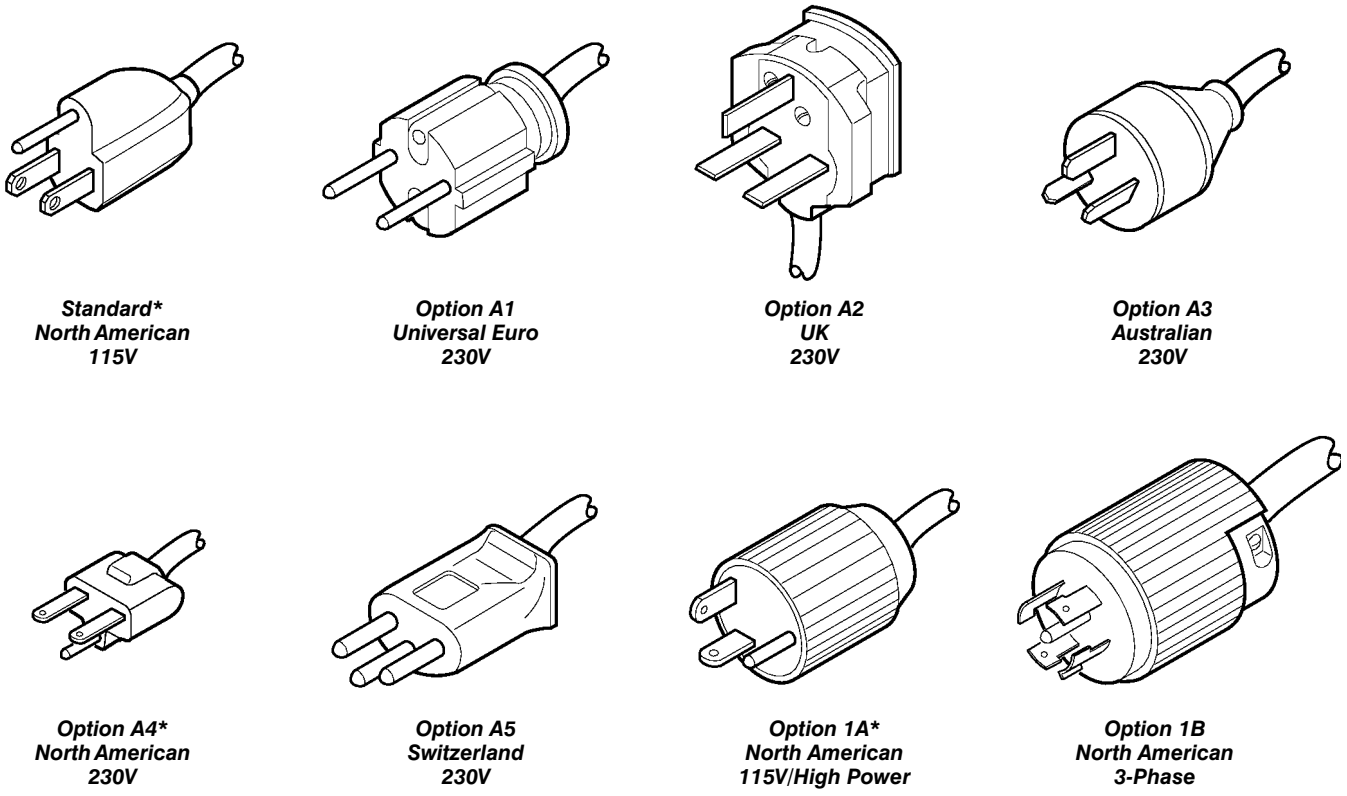
Option A5 — replaces the standard power cord with the Switzerland 240 V type power cord.

Power Cord Information

A power cord with appropriate plug configuration is supplied with each instrument. Table 7-1, Power-Cord Conductor Identification, gives the color-coding of the conductors in the power cord. If you require a power cord other than the one supplied, refer to Figure 7-1, Power-Cord Plug Identification.

Table 7-1: Power-Cord Conductor Identification

Conductor	Color	Alternate Color
Ungrounded (Line)	Brown	Black
Grounded (Neutral)	Light Blue	White
Grounded (Earth)	Green/Yellow	Green



** Canadian Standards Association certification includes these power plugs for use in the North American power network*

Figure 7-1: Power-Cord Plug Identification

Electrical Parts

The modules that make up this instrument are often a combination of mechanical and electrical subparts. Therefore, all replaceable modules are listed in the *Parts List* section. Refer to that section for part numbers when using this manual.

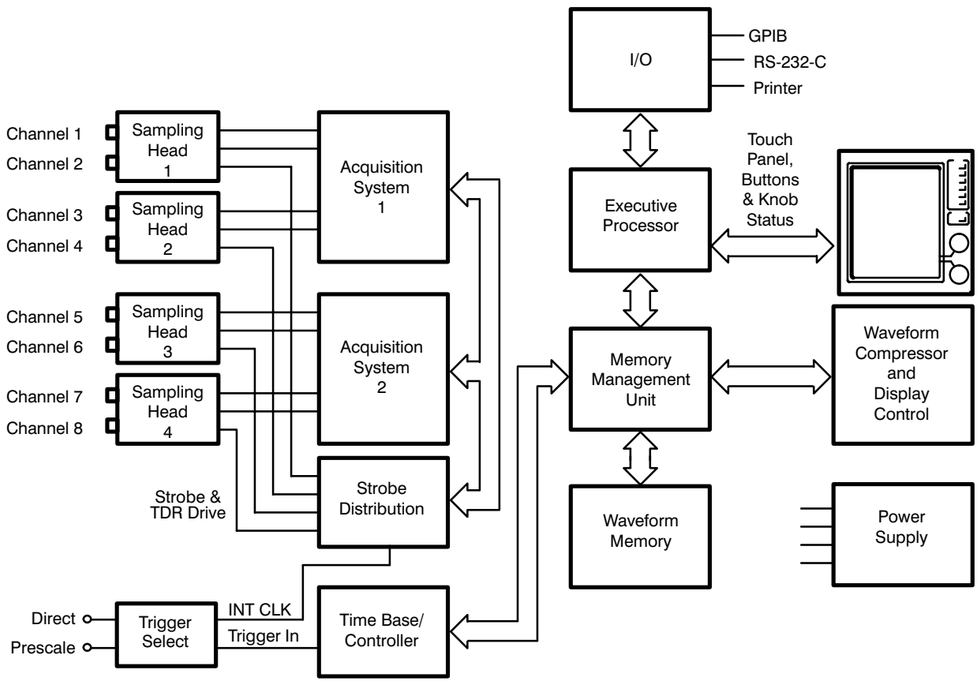


Figure 9-1: 11801C-System Functional Block Diagram

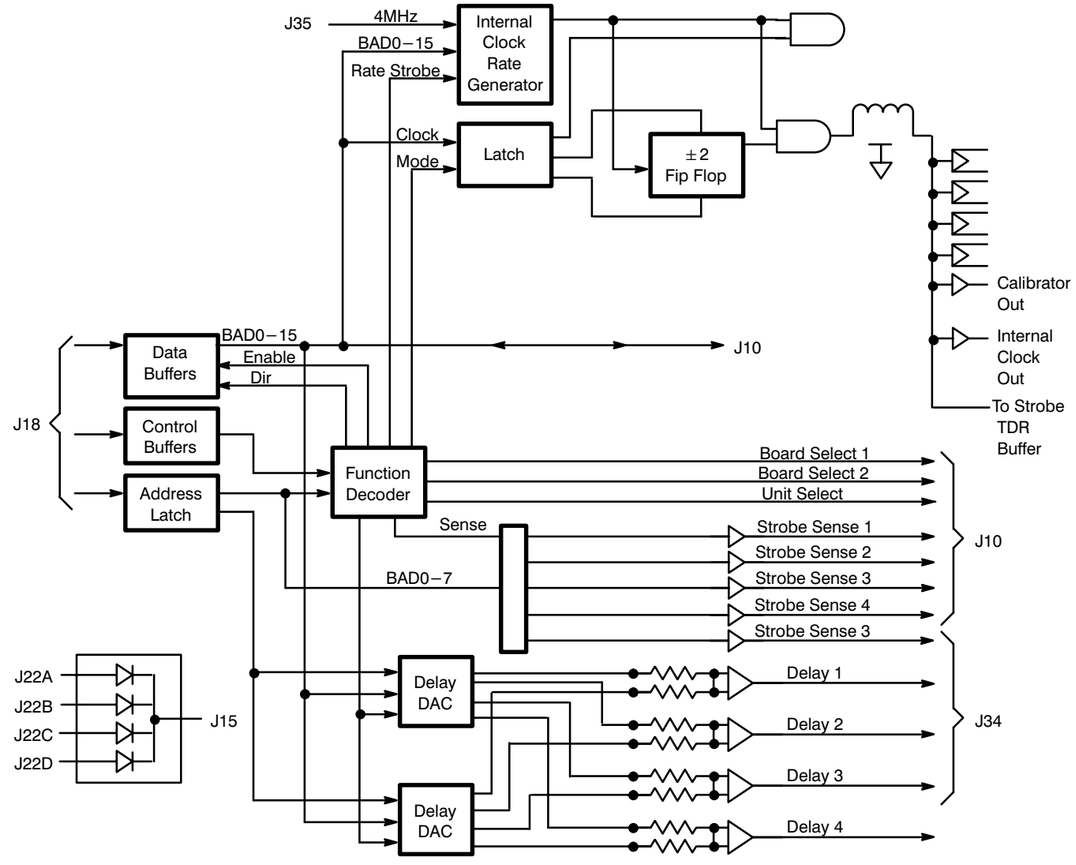


Figure 9-2: A1 M/F Strobe Drive Board Block Diagram

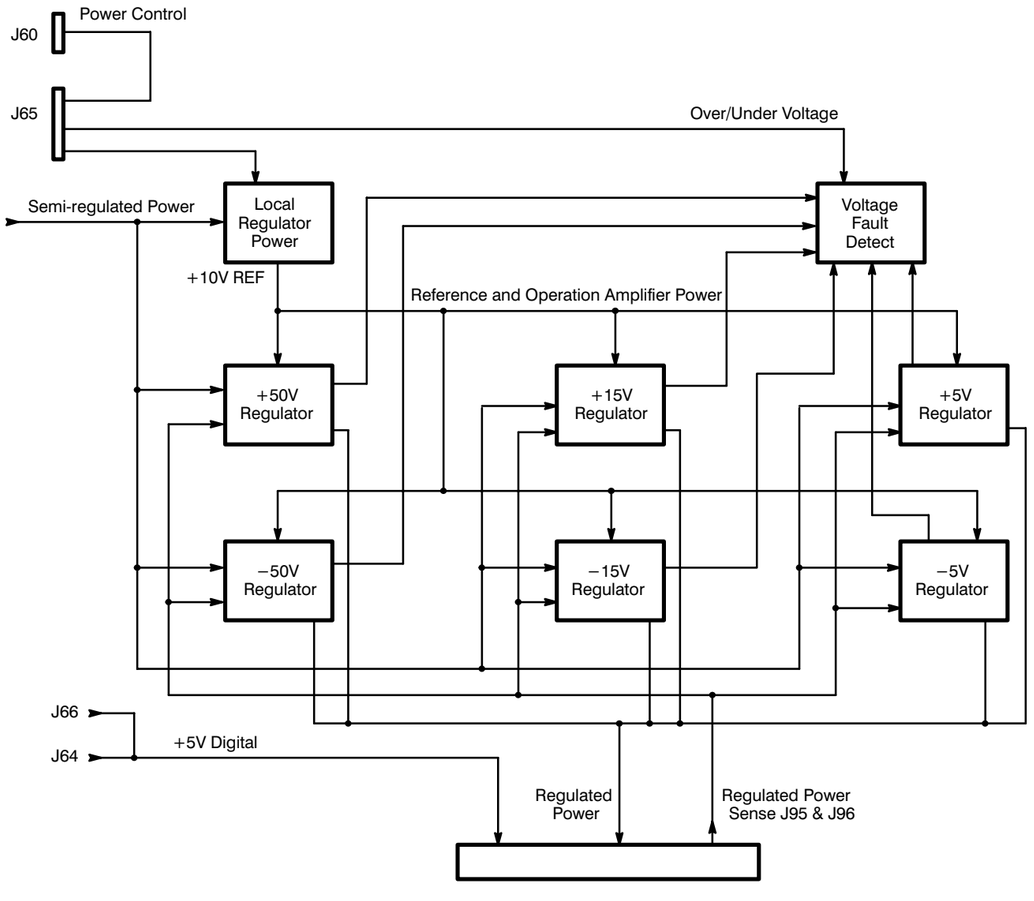


Figure 9-3: A4 Regulator Board Block Diagram

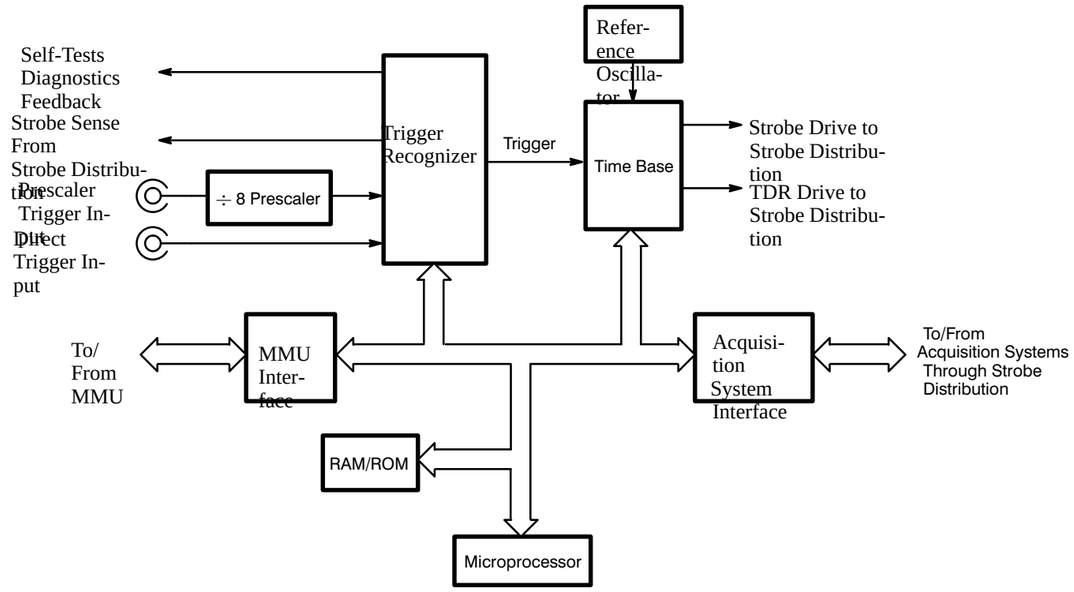


Figure 9-4: A5 Time Base/Controller Board Block Diagram

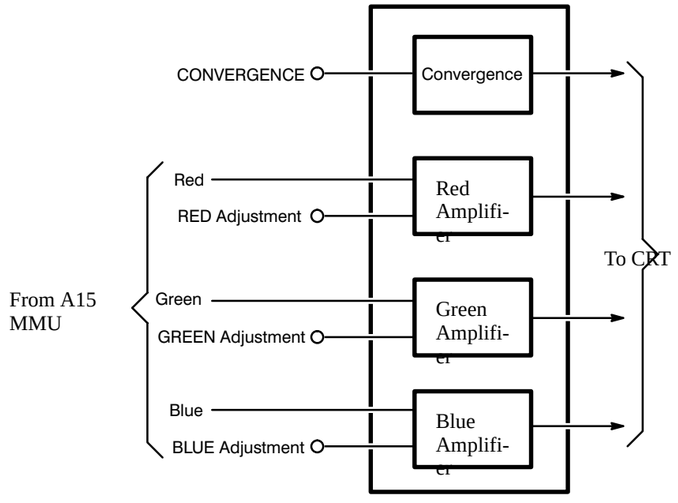


Figure 9-5: A7 CRT Socket Board Block Diagram

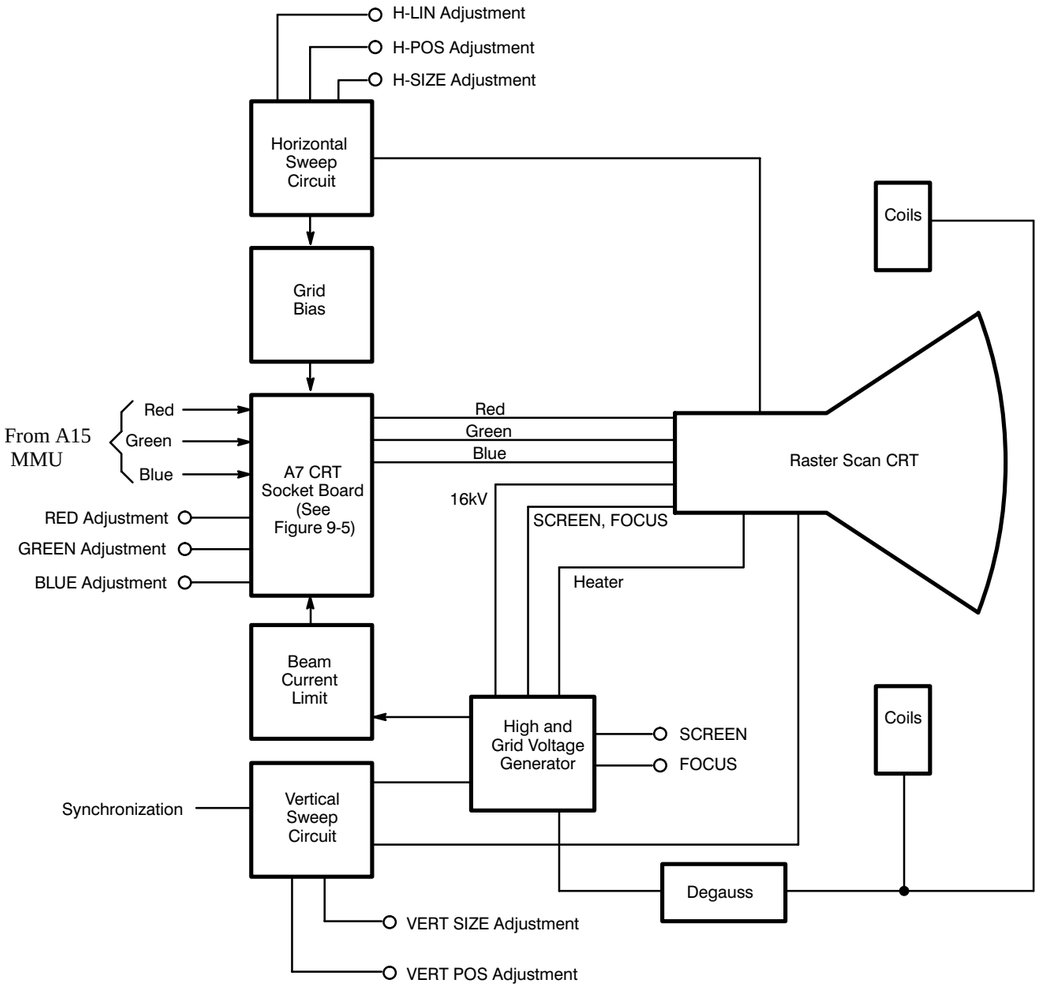


Figure 9-6: A8 CRT Driver Board Block Diagram

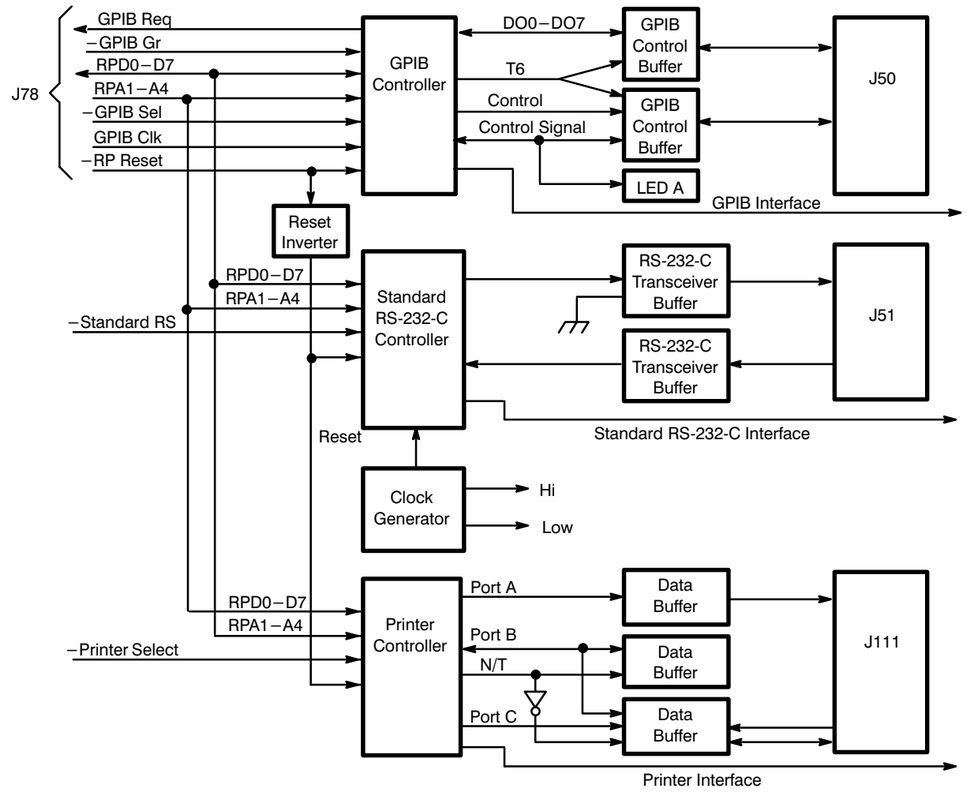


Figure 9-7: A12 Rear Panel Assembly Block Diagram

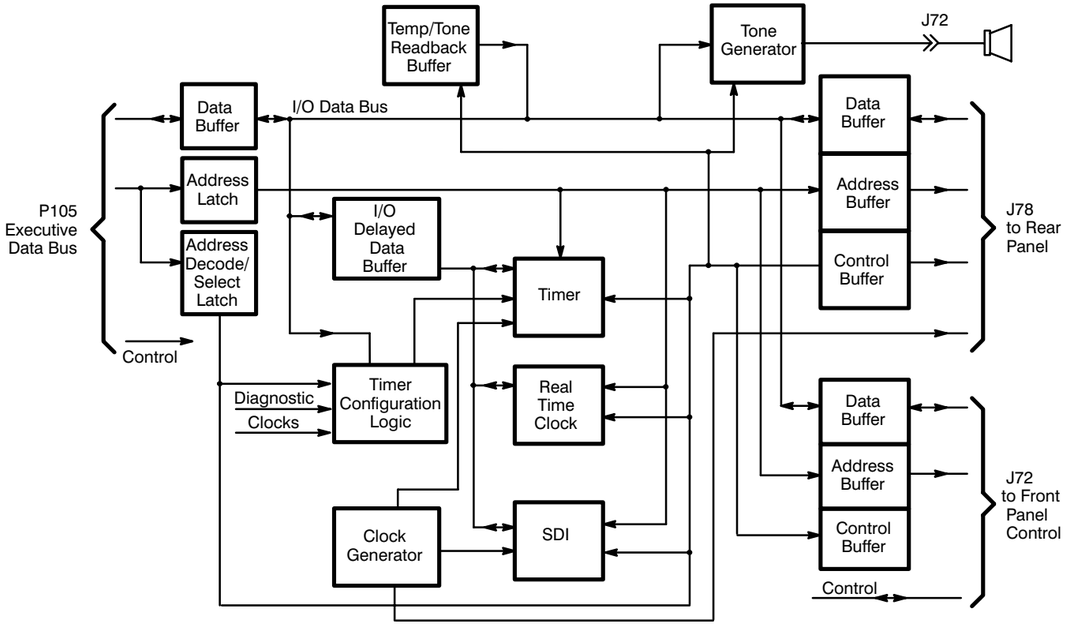


Figure 9-8: A14 I/O Board Block Diagram

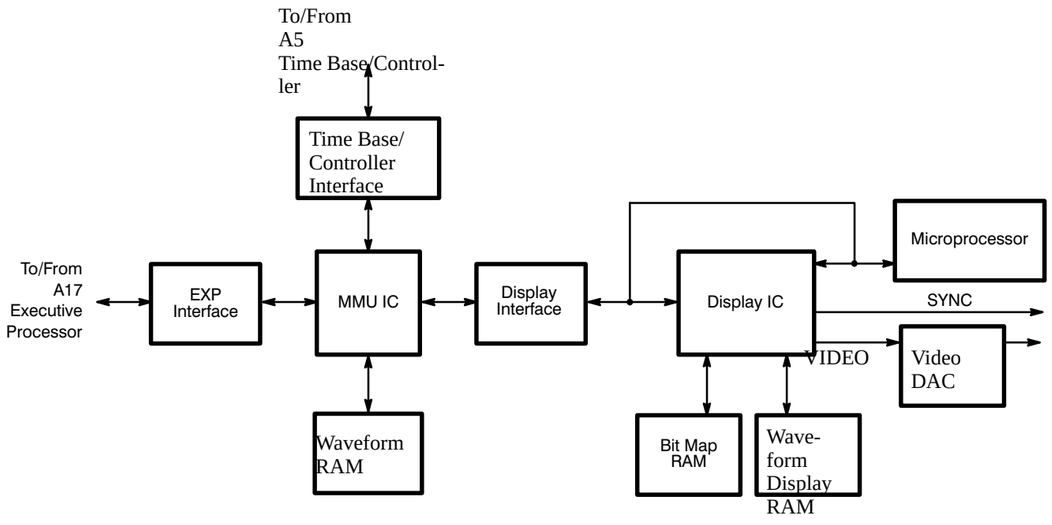


Figure 9-9: A15 MMU Board Block Diagram

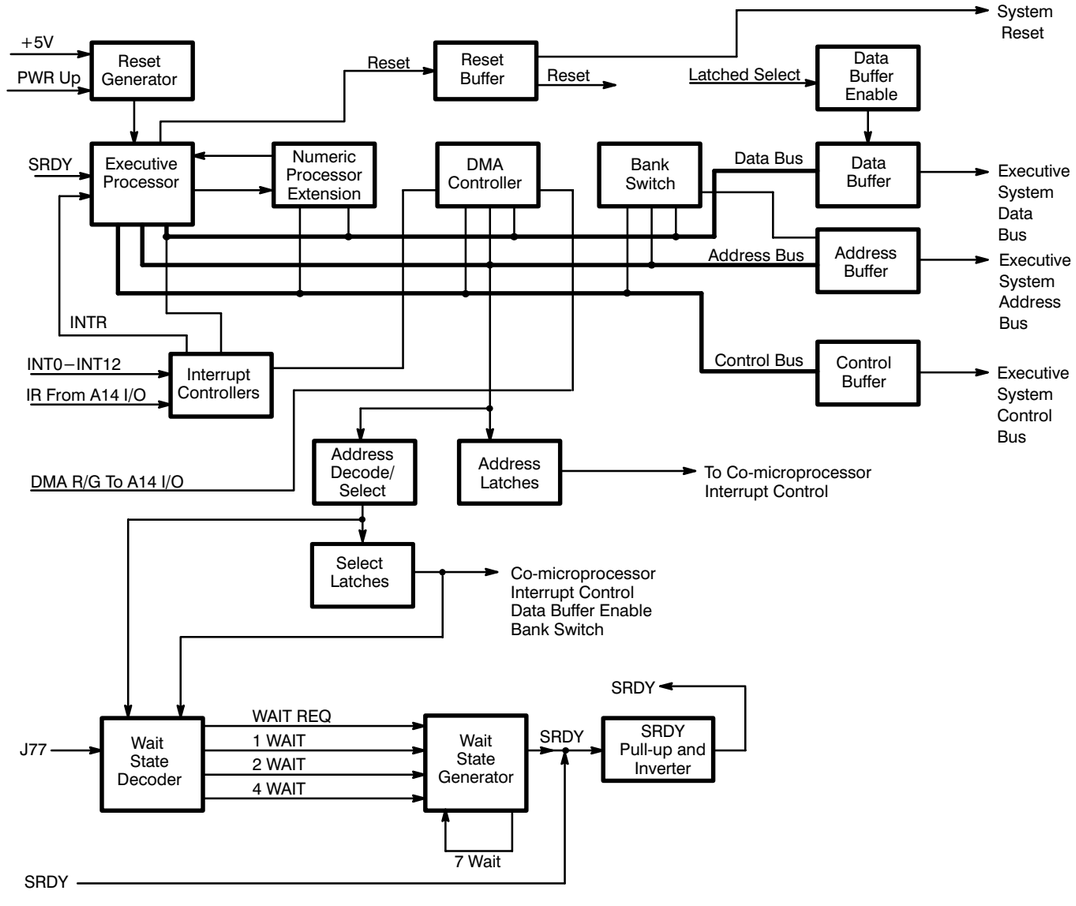


Figure 9-10: A17 Executive Processor Board Block Diagram

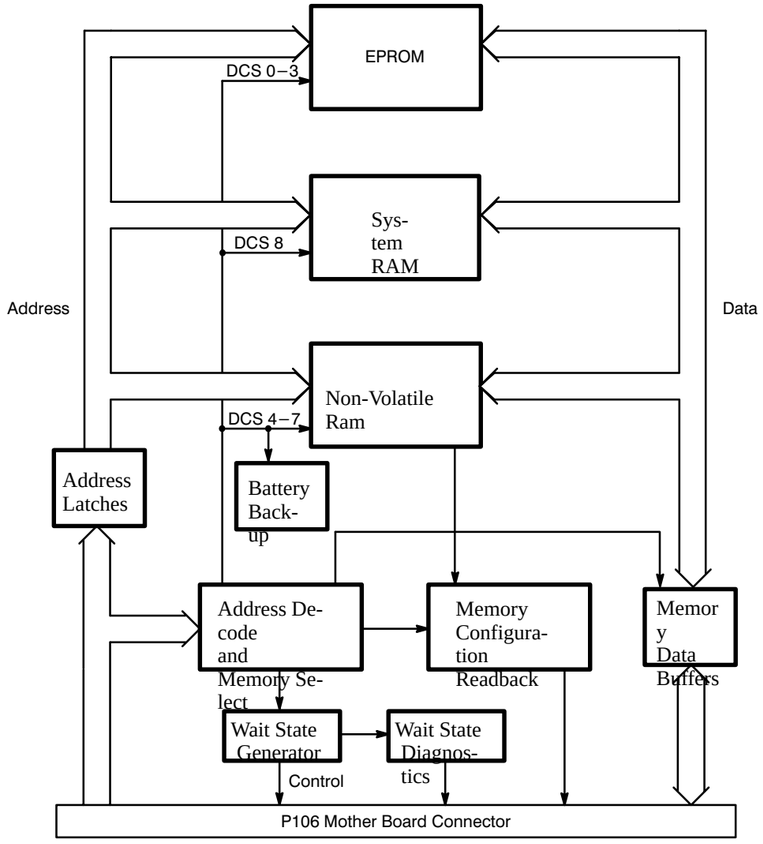


Figure 9-11: A18 Memory Board Block Diagram

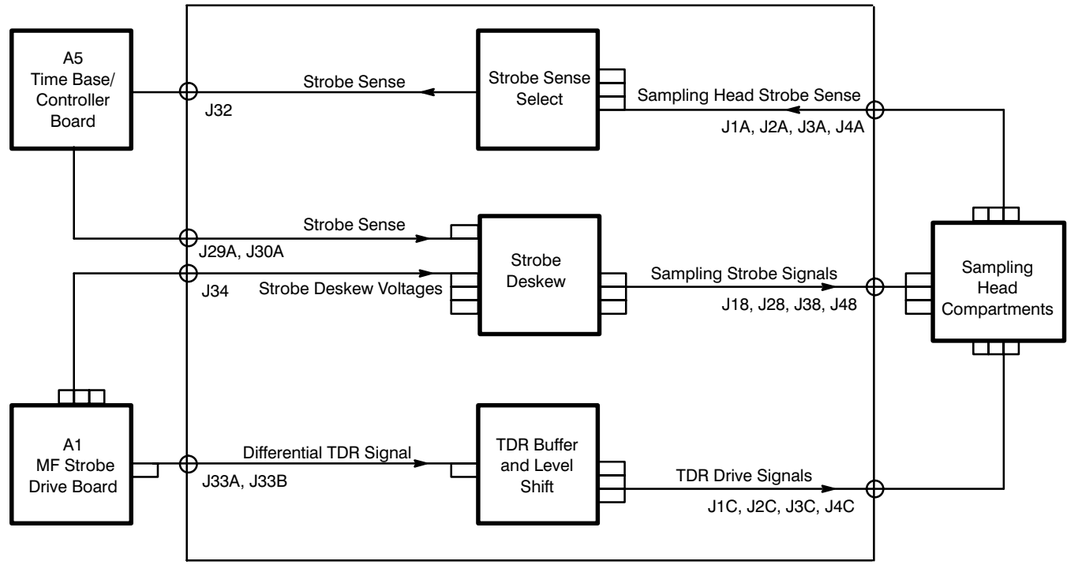


Figure 9-12: A19 Strobe/TDR Buffer Board Block Diagram

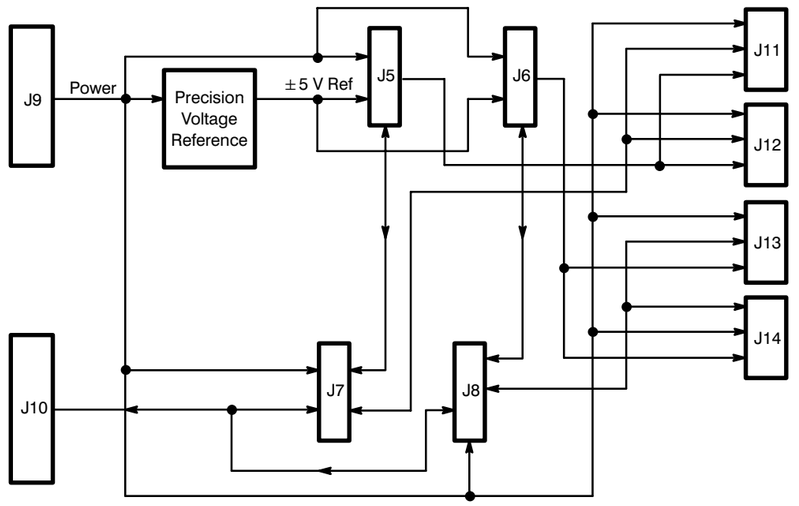


Figure 9-13: A26 M/F Acquisition Interconnect Board Block Diagram

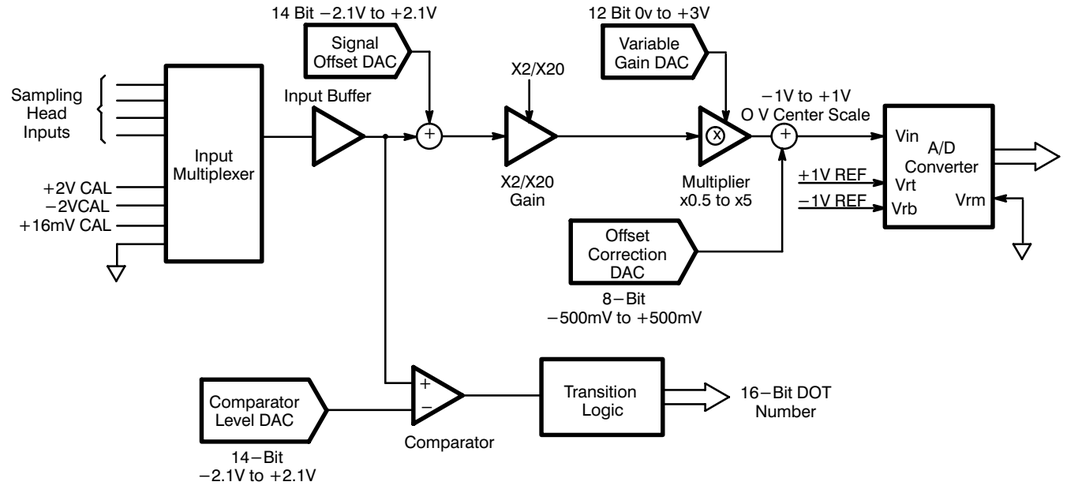


Figure 9-14: A24/A27 Acquisition Analog Board Block Diagram

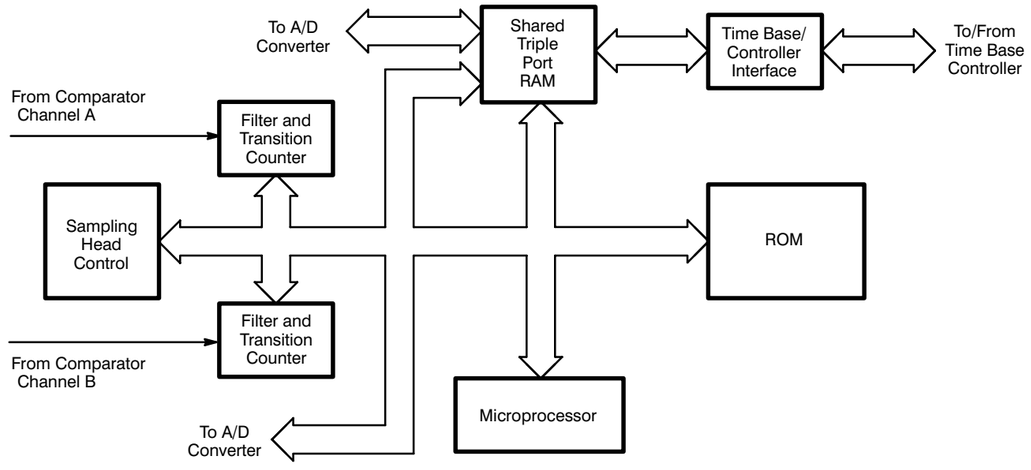
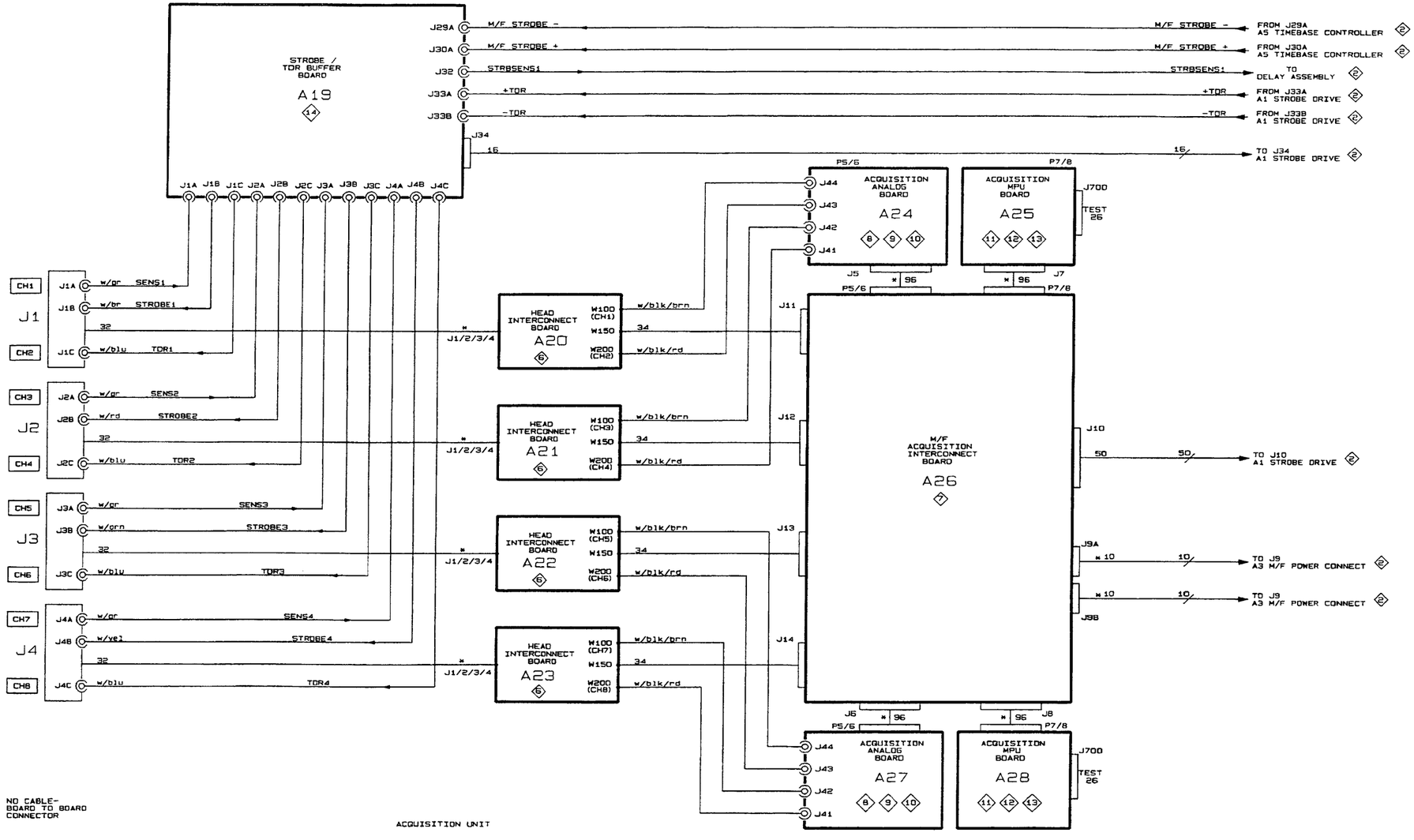
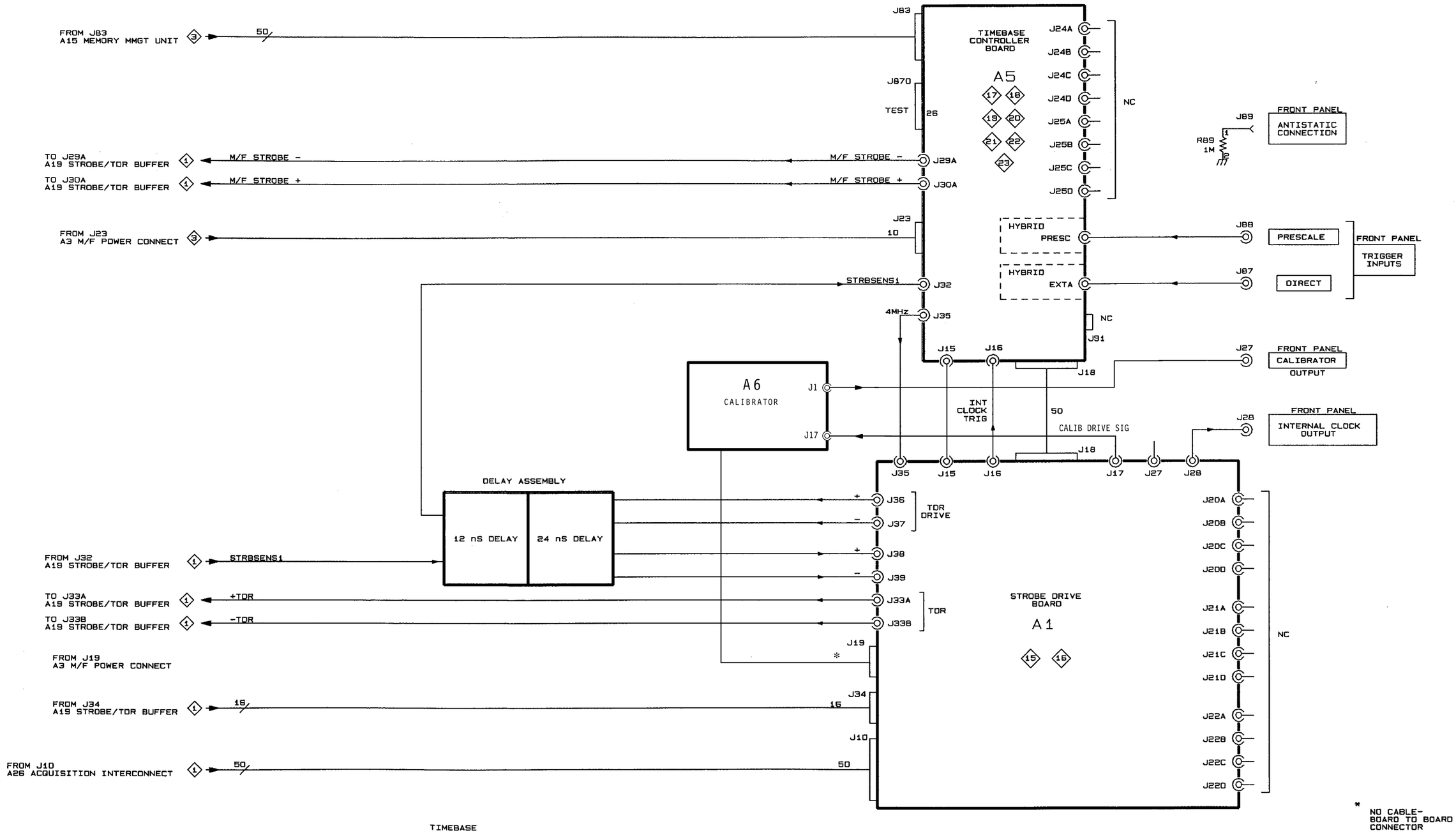


Figure 9-15: A25/A28 Acquisition MPU Board Block Diagram

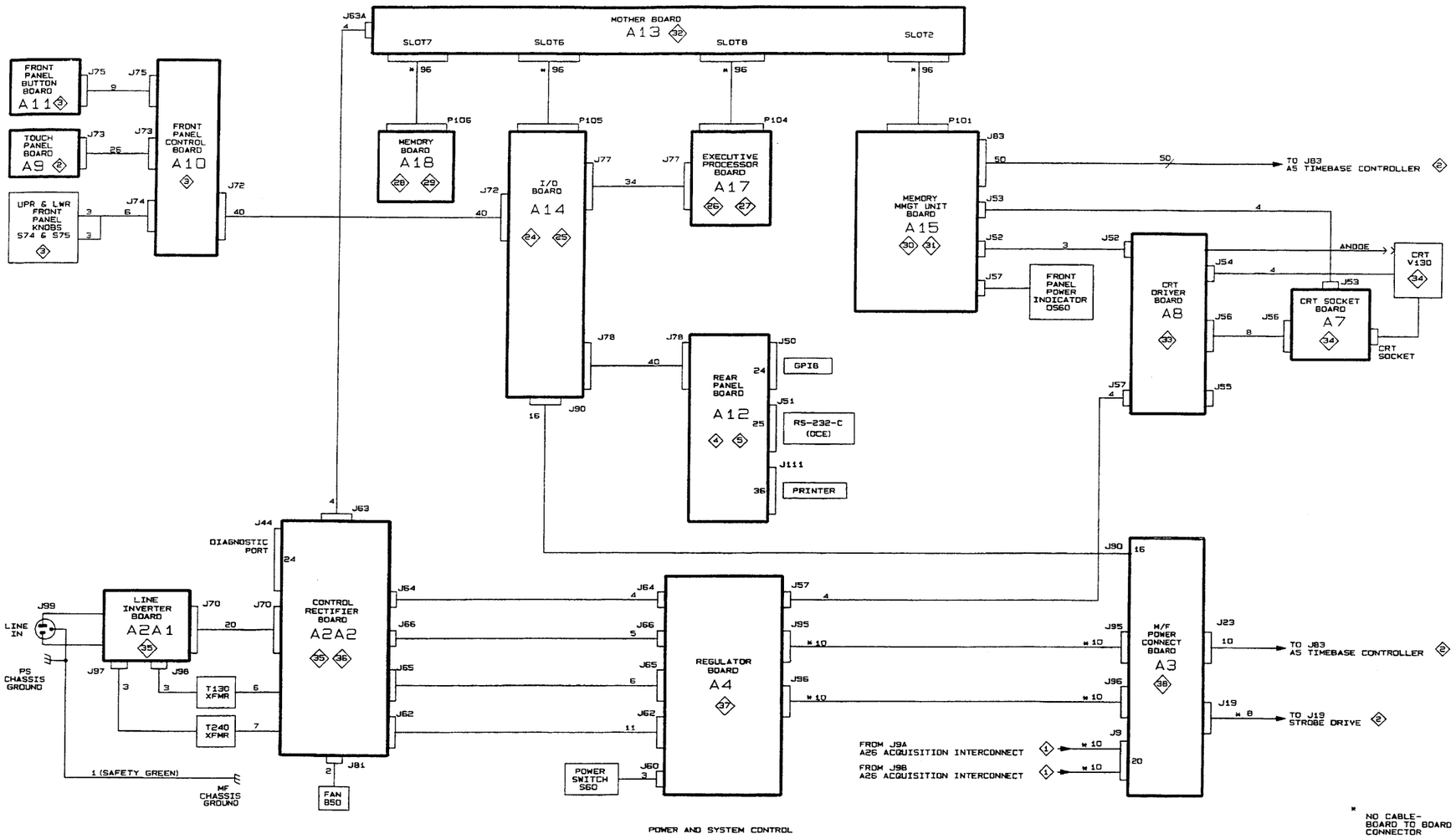


11801C Detailed Block (Cabling) Diagram ◇1



TIMEBASE

CSA803C Detailed Block (Cabling) Diagram 2



11801C Detailed Block (Cabling) Diagram (Cont.) ◇3

Replaceable Parts

This section contains a list of the replaceable components for the 11801C. As described below, use this list to identify and order replacement parts.

Parts Ordering Information

Replacement parts are available from or through your local Tektronix, Inc. service center or representative.

Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available and to give you the benefit of the latest circuit improvements. Therefore, when ordering parts, it is important to include the following information in your order:

- part number
- instrument type or model number
- instrument serial number
- instrument modification number, if applicable

If a part you order has been replaced with a different or improved part, your local Tektronix service center or representative will contact you concerning any change in the part number.

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

Module Replacement

The 11801C is serviced by module replacement, so there are three options you should consider:

- **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−TEKWIDE, ext. BV 5799.
- **Module Repair.** You may ship your module to us for repair, after which we will return it to you.
- **New Modules.** You may purchase new replacement modules in the same way as other replacement parts.

Firmware Replacement

To replace firmware in this product, order the firmware by the part number printed on the component label. Firmware is not listed in the replaceable parts lists.

Using the Replaceable Parts List

The tabular information in the Replaceable Parts List is arranged for quick retrieval. Understanding the structure and features of the list will help you find the all the information you need for ordering replacement parts.

Item Names

In the Replaceable Parts List, an Item Name is separated from the description by a colon (:). Because of space limitations, an Item Name may sometimes appear as incomplete. For further Item Name identification, U.S. Federal Cataloging Handbook H6-1 can be used where possible.

Indentation System

This parts list is indented to show the relationship between items. The following example is of the indentation system used in the Description column:

1 2 3 4 5 Name & Description
Assembly and/or Component
Attaching parts for Assembly and/or Component
(END ATTACHING PARTS)
Detail Part of Assembly and/or Component
Attaching parts for Detail Part
(END ATTACHING PARTS)
Parts of Detail Part
Attaching parts for Parts of Detail Part
(END ATTACHING PARTS)

Attaching parts always appear at the same indentation as the item they mount, while the detail parts are indented to the right. Indented items are part of, and included with, the next higher indentation. Attaching parts must be purchased separately, unless otherwise specified.

Abbreviations

Abbreviations conform to American National Standards Institute (ANSI) standard Y1.1

Table 10-1: Board FRUs

FRU	Part Number	Description
A1	670−9365−06	M/F Strobe Drive
A2	620−0022−09	Power Supply Assembly
A3	670−9640−00	M/F Power Connect
A4	670−9655−01	Regulator
A5	672−0386−00	Time Base/Controller (Standard)
A5	672−0385−00	Time Base/Controller (w/Option 1M)
A6	671−4471−00	Calibrator
No A#	657−0081−01	Trigger Prescaler Hybrid
A8	672−1372−01	CRT Driver
A9	614−0940−00	Touch Panel Assembly
A10	670−8847−01	Front Panel Control
A11	671−1130−00	Front Panel Button
A12	671−0013−00	Rear Panel
A13	671−1129−00	Mother
A14	670−8854−04	Input/Output
A15	671−1023−02	Memory Management Unit
A17	671−2888−00	Executive Processor
A18	672−0382−XX	Memory
A19	671−2909−00	Strobe TDR Buffer (P/O 657−)
No A#	657−0090−00	Acquisition Module
A20	670−9366−02	Head Interconnect (P/O 657−)
A21	670−9366−02	Head Interconnect (P/O 657−)
A22	670−9366−02	Head Interconnect (P/O 657−)
A23	670−9366−02	Head Interconnect (P/O 657−)
A24	670−9364−05	Acquisition Analog (P/O 657−)
A25	670−9363−01	Acquisition MPU (P/O 657−)
A26	670−9361−00	M/F Acquisition Interconnect
A27	670−9364−05	Acquisition Analog (P/O 657−)
A28	670−9363−01	Acquisition MPU (P/O 657−)

CROSS INDEX – MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip Code
S0482	SONY CONSUMER ELECTRONICS		TOKYO JAPAN
S3109	FELLER	72 VERONICA AVE UNIT 4	SUMMERSET NJ 08873
S3629	SCHURTER AG H C/O PANEL COMPONENTS CORP	2015 SECOND STREET	BERKELEY CA 94170
TK0435	LEWIS SCREW CO	4300 S RACINE AVE	CHICAGO IL 60609–3320
TK0488	CURRAN COIL SPRING INC	635 NW 16TH	PORTLAND OR 97209–2206
TK0588	UNIVERSAL PRECISION PRODUCTS	1775 NW 216TH	HILLSBORO OR 97123
TK1159	IMPROVED PRODUCTS	3400 OLYMPIC STREET	SPRINGFIELD OR 97477
TK1163	POLYCAST INC	9898 SW TIGARD ST	TIGARD OR 97223
TK1262	MURPHY ELECTRONICS INC (DIST)		
TK1302	MOUNTAIN MOLDING	606 SECOND STREET	BERTHOUD CO 80513
TK1416	SHARP CORP	22–22 NAGAIKE–CHO ABENO–KU	OSAKA JAPAN
TK1465	BEAVERTON PARTS MFG CO	1800 NW 216TH AVE	HILLSBORO OR 97124–6629
TK1499	AMLAN INC	97 THORNWOOD RD	STAMFORD CT 06903–2617
TK1547	MOORE ELECTRONICS INC (DIST)	19500 SW 90TH COURT PO BOX 1030	TUALATIN OR 97062
TK1572	RAN–ROB INC	631 85TH AVE	OAKLAND CA 94621–1254
TK1617	CRAFT FACTORY PLASTICS	17145 SW ALEXANDER	ALOHA OR 97007
TK1719	NEDELCO BV (THOMAS & BETTS)	POSTBUS 6431	3002 AK ROTTERDAM THE NETHERLANDS
TK1727	PHILIPS NEDERLAND BV AFD ELONCO	POSTBUS 90050	5600 PB EINDHOVEN THE NETHERLANDS
TK1869	ALPS	100 N CNTRE AVE	ROCKVILLE CENTRE NY 11570
TK1905	PUGET CORP OF OREGON	7440 S W BONITA	TIGARD OR 97223
TK1916	SKS DIE CASTING CO	2200 4TH	BERKELEY CA 94710–2215
TK1943	NEILSEN MANUFACTURING INC	3501 PORTLAND ROAD NE	SALEM OR 97303
TK1967	SYNDETEK	3915 E MAIN	SPOKANE WA 99202
TK2072	PRECISION DECORATORS INC HAWTHORNE BUSINESS CENTER	5289 NE ELAM YOUNG PARKWAY SUITE G400	HILLSBORO OR 97124
TK2105	QUALTEK ELECTRONICS CORP FAN–S DIV	7158 INDUSTRIAL PARK BLVD	MENTOR OH 44060
TK2122	INDUSTRIAL GASKET INC	1623 SE 6TH AVE	PORTLAND OR 97214–3502
TK2338	ACC MATERIALS	ED SNYDER BLDG 38–302	BEAVERTON OR 97077
TK2435	MEC IMEX INCORPORATED	6TH FLOOR 162 CHANG AN E ROAD SEC 2	TAIPEI, TAIWAN ROC
TK2469	UNITREK CORPORATION	3000 LEWIS & CLARK WAY SUITE #2	VANCOUVER WA 98601
0B445	ELECTRI–CORD MFG CO INC	312 EAST MAIN ST	WESTFIELD PA 16950
0JR05	TRIQUEST CORP	3000 LEWIS AND CLARK HWY	VANCOUVER WA 98661–2999
0J260	COMTEK MANUFACTURING OF OREGON (METALS)	PO BOX 4200	BEAVERTON OR 97076–4200
0J9P9	GEROME MFG CO INC	PO BOX 737	NEWBERG OR 97132

CROSS INDEX – MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip Code
0KB01	STAUFFER SUPPLY	810 SE SHERMAN	PORTLAND OR 97214
0KB05	NORTH STAR NAMEPLATE	1281–S NE 25TH	HILLSBORO OR 97124
00779	AMP INC	2800 FULLING MILL PO BOX 3608	HARRISBURG PA 17105
06915	RICHCO PLASTIC CO	5825 N TRIPP AVE	CHICAGO IL 60646–6013
11897	PLASTIGLIDE MFG CORP	2701 W EL SEGUNDO BLVD	HAWTHORNE CA 90250–3318
18677	SCANBE MFG CO DIV OF ZERO CORP	3445 FLETCHER AVE	EL MONTE CA 91731
2W944	PAPST MECHATRONIC CORP	AQUIDNECK INDUSTRIAL PK	NEWPORT RI 02840
24931	SPECIALTY CONNECTOR CO INC	2100 EARLYWOOD DR PO BOX 547	FRANKLIN IN 46131
28520	HEYCO MOLDED PRODUCTS	750 BOULEVARD P O BOX 160	KENILWORTH NJ 07033–1721
29870	VICTOR CORP	618 MAIN STREET	WEST WARWICK RI 02893
30010	BICC–VERO ELECTRONICS INC	40 LINDEMAN DR	TRUMBULL CT 06611–4739
34649	INTEL CORP SALES OFFICE /ST4–2/	3065 BOWERS AVE	SANTA CLARA CA 95051
5Y400	TRIAX METAL PRODUCTS INC DIV OF BEAVERTON PARTS MFG CO	1800 216TH AVE NW	HILLSBORO OR 97124–6629
50579	SIEMENS COMPONENTS INC OPTOELECTRONICS DIV	19000 HOMESTEAD RD	CUPERTINO CA 95014–0712
52814	TECH–ETCH INC	45 ALDRIN RD	PLYMOUTH MA 02360
53387	MINNESOTA MINING MFG CO	PO BOX 2963	AUSTIN TX 78769–2963
61058	MATSUSHITA ELECTRIC CORP OF AMERICA PANASONIC INDUSTRIAL CO DIV	ONE PANASONIC WAY PO BOX 1502	SECAUCUS NJ 07094–2917
61857	SAN–0 INDUSTRIAL CORP	85 ORVILLE DR PO BOX 511	BOHEMIA LONG ISLAND NY 11716–2501
66302	VLSI TECHNOLOGY INC	1109 MCKAY DR	SAN JOSE CA 95131–1706
71400	BUSSMANN DIV OF COOPER INDUSTRIES INC	114 OLD STATE RD PO BOX 14460	ST LOUIS MO 63178
75915	LITTELFUSE INC SUB TRACOR INC	800 E NORTHWEST HWY	DES PLAINES IL 60016–3049
78189	ILLINOIS TOOL WORKS INC SHAKEPROOF DIV	ST CHARLES ROAD	ELGIN IL 60120
80009	TEKTRONIX INC	14150 SW KARL BRAUN DR PO BOX 500	BEAVERTON OR 97077–0001
83385	MICRODOT MFG INC GREER–CENTRAL DIV	3221 W BIG BEAVER RD	TROY MI 48098
83486	ELCO INDUSTRIES INC	1101 SAMUELSON RD	ROCKFORD IL 61101
83553	ASSOCIATED SPRING BARNES GROUP INC	15001 S BROADWAY P O BOX 231	GARDENA CA 90248–1819
85480	BRADY W H CO CORP H Q INDUSTRIAL PRODUCTS DIV	2221 W CAMDEN RD PO BOX 2131	MILWAUKEE WI 53209
93907	TEXTRON INC CAMCAR DIV	600 18TH AVE	ROCKFORD IL 61108–5181

Fig. & Index No.	Tektronix Part No.	Serial No. Effective	Serial No. Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
					CABINET		
10−1−1	200−2191−00			2	CAP,RETAINER:PLASTIC	0JR05	ORDER BY DESC
−2	367−0248−01			1	HANDLE,CARRYING:16.341 L,W/CLIP	TK1465	ORDER BY DESC
−3	211−0718−00			2	SCREW,MACHINE:6−32 X 0.312,FLH,STL	0KB01	ORDER BY DESC
−4	212−0681−00			4	SCREW,MACHINE:10−32 X 0.25,PNH,STL	83486	MACHINE SCREW:
−5	426−2098−01			1	FRAME SECT,CAB.:LEFT SIDE	TK1465	ORDER BY DESC
−6	211−0721−00			8	SCREW,MACHINE:6−32 X 0.375,PNH,STL	0KB01	ORDER BY DESC
−7	101−0106−00			4	TRIM,DECORATIVE:LEFT SIDE,FRONT CASTING	TK1163	ORDER BY DESC
−8	426−2099−01			1	FRAME SECT,CAB.:RIGHT SIDE	TK1465	ORDER BY DESC
−9	348−0886−00			4	SHLD GSKT,ELEK:FINGER TYPE,18.310 L	TK1159	ORDER BY DESC
−10	348−0879−00			4	FOOT,CABINET:BOTTOM,BLUE,POLYCARB	TK1163	ORDER BY DESC
−11	348−0596−00			4	PAD,CAB.FOOT:0.69 X 0.255 X 0.06,PU	TK2122	348−0596−00
−12	348−0875−00			1	FLIPSTAND,CAB.:	TK0488	ORDER BY DESC
−13	211−0711−00			4	SCR,ASSEM WSHR:6−32 X 0.25,PNH,STL,T15	0KB01	ORDER BY DESC
−14	214−0603−02			8	PIN ASSY,SECRG:W/SPRING WASHER	0J260	ORDER BY DESC
−15	386−0227−00			8	STOP,CLP,RIM CL:ACETAL	0JR05	386−0227−00
−16	386−1151−00			8	CLAMP,RIM CLENC:SPG STL	83553	ORDER BY DESC
−17	200−3415−00			1	COV,CAB LIFTOFF:LOWER,AL,BLUE PAINT	80009	200341500
−18	200−3759−00			1	COVER,CABINET:TOP,LIFT OFF	0J260	ORDER BY DESC

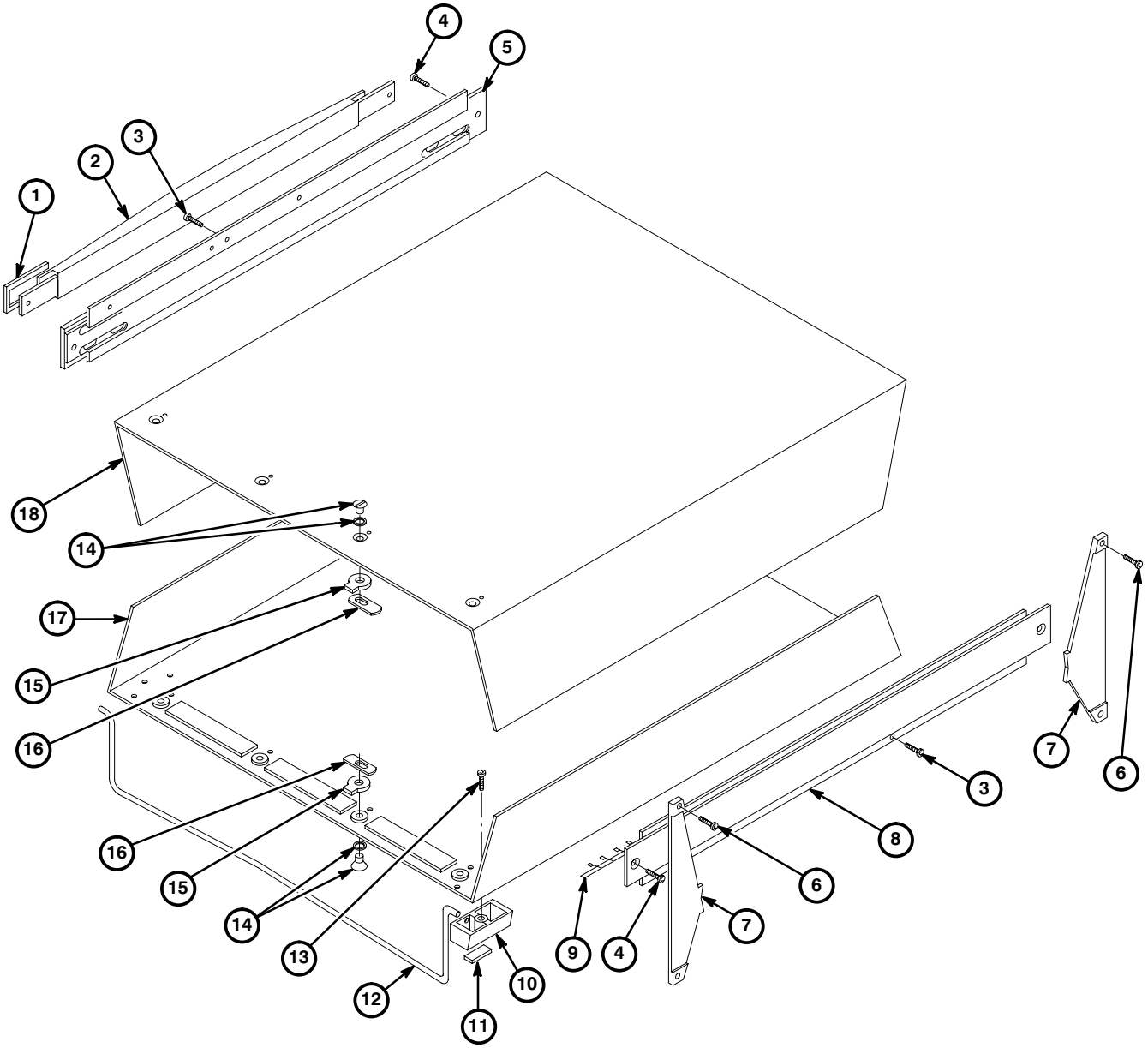


Figure 10-1: Cabinet

Fig. & Index No.	Tektronix Part No.	Serial No. Effective	Serial No. Dscont	Qty	12345	Name & Description	Mfr. Code	Mfr. Part No.
						FRONT PANEL		
10−2−1	614−0940−00			1		SUBPANEL ASSY:11801C (SEE A9, EXCHANGE ITEM)	80009	614094000
−2	386−5806−00			1		FRAME,LENS:TOUCH PANEL	0JR05	ORDER BY DESC
−3	−−−−−−−−			1		CIRCUIT BD ASSY:TOUCH PANEL (NOT REPLACEABLE, ORDER 614−0916−XX)		
−4	366−0600−01			7		PUSH BUTTON:0.269 X 0.409 ABS	TK1163	ORDER BY DESC
−5	211−0372−00			4		SCREW,MACHINE:4−40 X 0.312,PNH,STL	93907	B80−00020−003
−6	211−0722−00			4		SCREW,MACHINE:6−32 X 0.25,PNH,STL	0KB01	ORDER BY DESC
−7	386−5268−07			1		SUBPANEL,FRONT:FINISHED	TK1916	386−5268−07
−8	211−0721−00			1		SCREW,MACHINE:6−32 X 0.375,PNH,STL	0KB01	ORDER BY DESC
−9	381−0469−00			2		BAR,SUPPORT:CRT	5Y400	ORDER BY DESC
−10	211−0711−00			4		SCR,ASSEM WSHR:6−32 X 0.25,PNH,STL,T15	0KB01	ORDER BY DESC
−11	131−1688−00			1		TERM,QIK DISC.:0.250 SPADE,STUD MT;MALE	00779	42822−4
−12	154−0946−00			1		ELECTRON TUBE:CRT,COLOR (V130)	S0482	09FXES−C1
−13	210−0006−00			1		WASHER,LOCK:#6 INTL,0.018 THK,STL	78189	1206−00−00−0541
−14	211−0718−00			5		SCREW,MACHINE:6−32 X 0.312,FLH,STL	0KB01	ORDER BY DESC
−15	311−2320−00			2		ENCODER,DIGITAL:INCREMENTAL,50PPR	TK1869	EC24B50000FB
−16	671−1130−00			1		CIRCUIT BD ASSY:FRONT PANEL BUTTON (SEE A11, EXCHANGE ITEM)	80009	671113000
−17	348−1075−00			2		SHLD GSKT,ELEK:SOLID TYPE,1.66 L	52814	ORDER BY DESC
−18	211−0410−00			2		SCR,ASSEM WSHR:4−40 X 0.437,PNH,STL,T10	93907	829−07510−024
−19	260−2275−00 343−0549−00			1 1		SWITCH,ROCKER:SPST,30MA,12V STRAP,TIEDOWN,E:0.098 W X 4.0 L,ZYTEL	TK1262 TK1499	MEO1O−D HW−047
−20	333−3418−00			1		PANEL,FRONT:UPPER	TK2072	ORDER BY DESC
−21	150−0121−13 174−0616−00			1 1		LIGHT,INDICATOR:5V,GREEN,INCANDECENT CABLE ASSY,RF:50 OHM COAX,30.0 L,9−8	TK1967 TK2469	ORDER BY DESC ORDER BY DESC
−22	210−0586−00			10		NUT,PL,ASSEM WA:4−40 X 0.25,STL	TK0435	ORDER BY DESC
−23	348−1076−00			1		SHLD GSKT,ELEK:SOLID TYPE,2.28 L	52814	ORDER BY DESC
−24	210−0465−00			1		NUT,PLAIN,HEX:0.25−32 X 0.375,BRS	0KB01	ORDER BY DESC
−25	210−0223−01 315−0105−00			1		TERMINAL,LUG:0.26 ID,LOCKING,BRS TINNED RES,FXD,FILM:1M OHM,5%,0.25W (R89)	0KB01 TK1727	ORDER BY DESC SFR25 2322−181
−26	348−0878−00			1		SHLD GSKT,ELEK:SOLID TYPE,7.646 L	52814	ORDER BY DESC
−27	103−0269−00 131−6337−00			3 1		ADAPTER,CONN:SMA TO PELTOLA ADAPTER,CONN:PRESCALER	24931 24931	39JR198−1 39AS1100
−28	333−3908−02			1		PANEL,FRONT:11801C,LOWER	0KB05	333−3908−01
−29	210−0895−00			1		WASHER,SHLDR:0.255 X 0.375 X 0.105 THK,NYL	TK1617	NA
−30	136−0140−00			1		JACK,TIP:BANANA,CHARCOAL GRAY	TK1617	136−0140−00
−31	220−0052−00			2		NUT,PLAIN,HEX:M9 X 0.75	0KB01	ORDER BY DESC
−32	384−1682−02			2		SHAFT,EXTENSION:1.833 L,ALUMINUM	80009	384168202
−33	366−0600−00			4		PUSH BUTTON:0.269 X 0.409,ABS	TK1163	ORDER BY DESC
−34	131−4763−00			1		CONTACT,ELEC:GROUND,CU BE	TK2469	ORDER BY DESC
−35	211−0711−00			1		SCR,ASSEM WSHR:6−32 X 0.25,PNH,STL,T15	0KB01	ORDER BY DESC

Fig. & Index No.	Tektronix Part No.	Serial No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
10−2−36	211−0378−00			1	SCR,ASSEM WSHR:4−40 X 0.375.PNH,STL,T9	0KB01	ORDER BY DESC
−37	211−0373−00			2	SCREW,MACHINE:4−40 X 0.25,PNH,STL	83486	ORDER BY DESC
−38	200−3143−01			1	COVER,CRT SCALE:BEZEL	TK1163	ORDER BY DESC
−39	213−0022−00			2	SETSCREW:4−40 X 0.188,STL	0KB01	ORDER BY DESC
−40	366−0582−00			2	KNOB:ENCODER	TK1163	ORDER BY DESC
−41	334−9520−00			1	PANEL,FRONT:11801C	0KB05	334952000

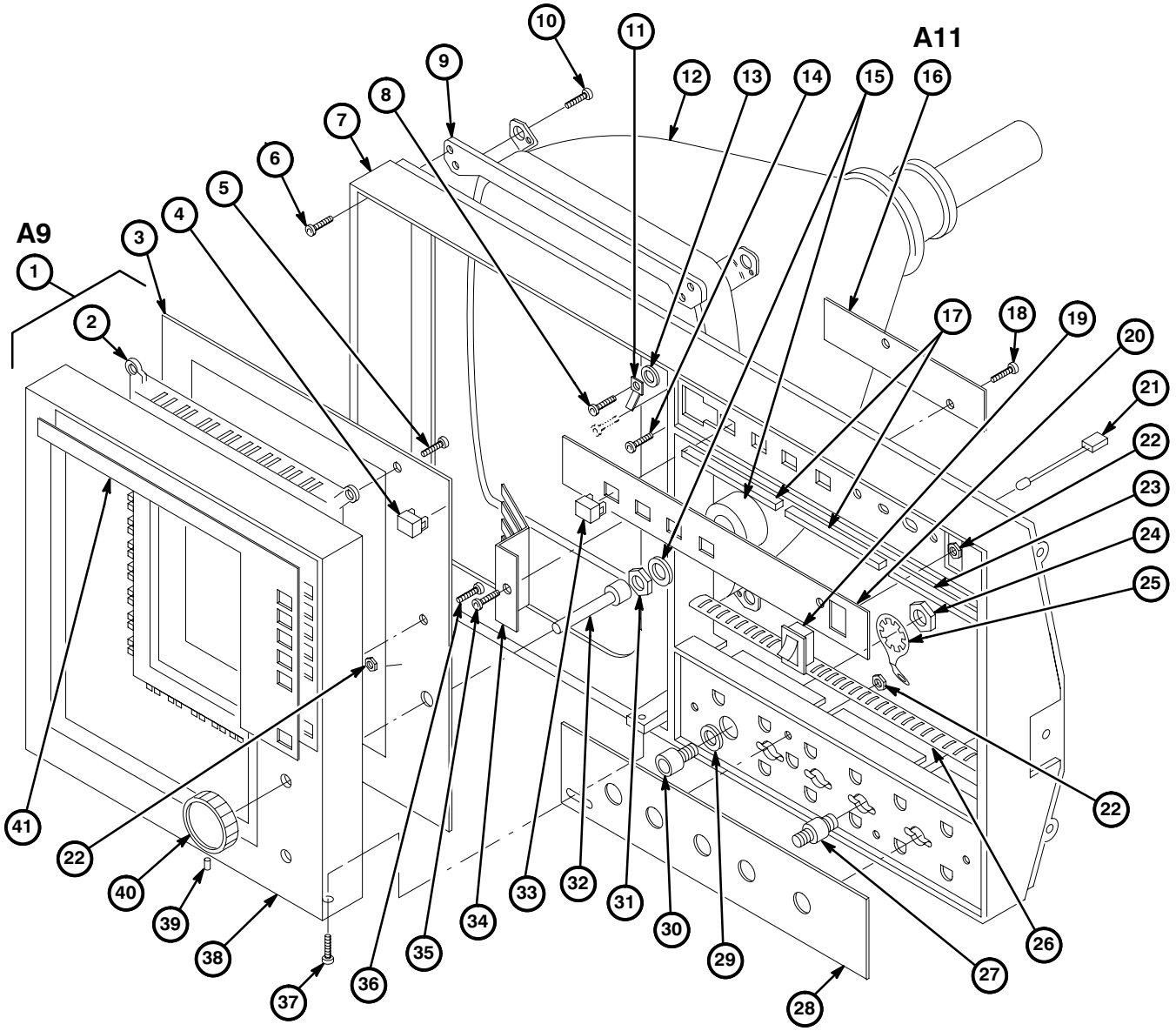


Figure 10-2: Front Panel

Fig. & Index No.	Tektronix Part No.	Serial No. Effective	Serial No. Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
					CHASSIS, REAR		
10−3−1	200−3690−01			1	COVER,HIGH VOLT:ALUMINUM	80009	200369001
−2	211−0722−00			8	SCREW,MACHINE:6−32 X 0.25,PNH,STL	0KB01	ORDER BY DESC
−3	407−3438−02			1	BRACKET,CHASSIS:ALUMINUM	TK1943	ORDER BY DESC
−4	351−0746−00			2	GUIDE,CKT BOARD:NYLON 6.803 L	0JR05	ORDER BY DESC
−5	211−0718−00			14	SCREW,MACHINE:6−32 X 0.312,FLH,STL	0KB01	ORDER BY DESC
−6	351−0746−00			1	GUIDE,CKT BOARD:NYLON 6.803 L	0JR05	ORDER BY DESC
−7	671−0013−00			1	CIRCUIT BD ASSY:REAR PANEL (SEE A12, EXCHANGE ITEM)	80009	671001300
−8	211−0721−00			8	SCREW,MACHINE:6−32 X 0.375,PNH,STL	0KB01	ORDER BY DESC
−9	129−1085−00			2	SPACER,POST:0.25 L,4−40,BRS,0.25 HEX	TK0588	129−1085−00
−10	211−0410−00			2	SCR,ASSEM WSHR:4−40 X 0.437,PNH,STL,T10	93907	829−07510−024
−11	214−2476−01			2	HDW ASSY KIT:BAIL LOCK,ELEC CONN RCPT	53387	3475−4
−12	214−3106−00			2	HARDWARE KIT:JACK SOCKET	53387	3341−1S
−13	211−0411−00			1	SCR,ASSEM WSHR:4−40 X 0.5,PNH,STL,T10	93907	ORDER BY DESC
−14	386−5369−03			1	PLATE,CONNECTOR:STD,ALUMINUM	TK1465	386−5369−03
−15	255−0334−00			1	PLASTIC CHANNEL:12.75 X 0.175 X 0.155,NYLON	11897	122−NN−2500−060
−16	211−0711−00			5	SCR,ASSEM WSHR:6−32 X 0.25,PNH,STL,T15	0KB01	ORDER BY DESC
−17	386−5269−02			1	SUBPANEL,REAR:PLATED	TK1916	ORDER BY DESC
−18	386−5283−00			2	SUPPORT,CHASSIS:POWER SUPPLY,POLYCARB	0JR05	ORDER BY DESC
−19	343−0081−00			1	STRAP,RETAINING:0.125 DIA,NYLON	85480	CPNY−172BK
−20	210−0007−00			1	WASHER,LOCK:#8 EXT,0.02 THK,STL	0KB01	ORDER BY DESC
	174−1406−00			1	CA ASSY,SP,ELEC:18,AWG,6.0 L	TK2469	ORDER BY DESC
−21	214−4082−00			2	PIN,GUIDE:0.850 L,METAL	TK0588	214−4082−00
−22	351−0744−00			2	GUIDE,PLUG−IN:POLYAMIDE	TK1163	ORDER BY DESC
−23	610−0750−00			1	CHASSIS ASSY:	TK1943	ORDER BY DESC
	407−4028−00			1	BRACKET,SUPPORT:	0J9P9	ORDER BY DESC
−24	119−4589−00			1	DELAY LINE,ELEC:COAXIAL,;24NS MTCHD PAIR	80009	119458900
−25	348−0532−00			1	GROMMET,PLASTIC:BLACK,ROUND,0.625 ID	28520	2096
−26	348−0253−00			1	GROMMET,PLASTIC:BLACK,OBLONG	0JR05	ORDER BY DESC
−27	210−0457−00			3	NUT,PL,ASSEM WA:6−32 X 0.312,STL	TK0435	ORDER BY DESC
−28	343−0040−00			1	CLAMP,COIL:	80009	343004000
−29	211−0720−00			3	SCR,ASSEM WSHR:6−32 X 0.50,PNH,STL,T15	0KB01	ORDER BY DESC
−30	346−0143−00			1	STRAP,TIEDOWN,E:14.5 X 0.14,PLASTIC	TK1719	TY244M
−31	108−1462−00			2	COIL,RF:FXD	TK1967	ORDER BY DESC
−32	343−0085−00			2	CLAMP,LOOP:0.312 DIA,NYLON	06915	N5−01
−33	351−0765−00			12	GUIDE,CKT BOARD:NYLON	30010	29−0124D
−34	386−1559−00			1	SPACER,CKT BD:0.47 H,ACETAL	80009	386155900
−35	−−−−−−−−			1	CIRCUIT BD ASSY:CRT SOCKET (NOT REPLACEABLE, ORDER 672−1372−XX)		
−36	200−3708−00			1	COVER,CKT BOARD:1	TK1943	ORDER BY DESC
−37	670−8847−01			1	CIRCUIT BD ASSY:FRONT PANEL CONTROL (SEE A10, EXCHANGE ITEM)	80009	670884701
−38	407−3840−00			1	BRACKET,SUPPORT:	TK1943	ORDER BY DESC

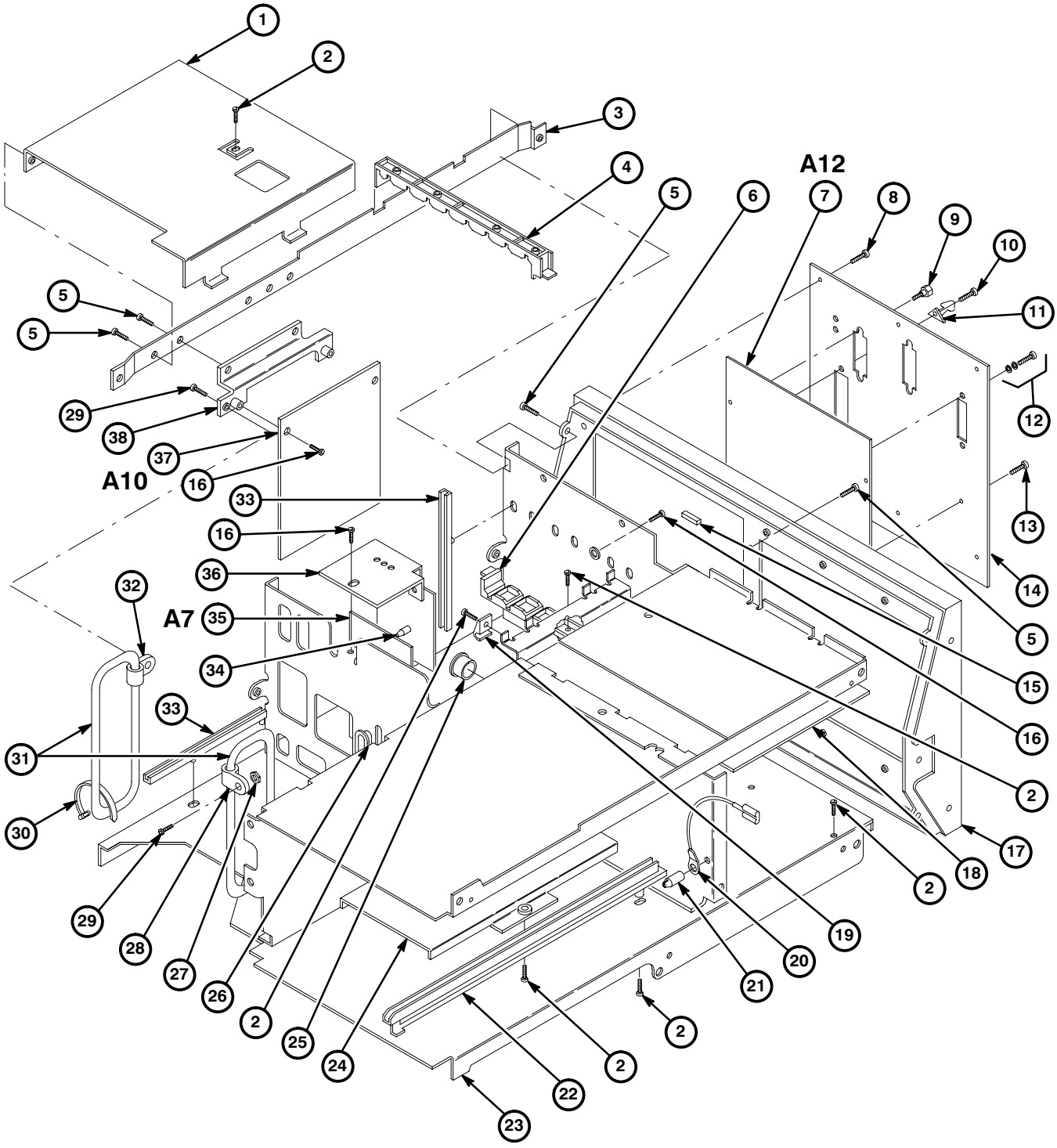


Figure 10-3: Chassis, Rear

Fig. & Index No.	Tektronix Part No.	Serial No. Effective	Serial No. Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
					CIRCUIT BOARDS		
10−4−1	146−0055−00			2	BATTERY,DRY:3.0V,1200 MAH,LITHIUM (BT130, BT150)	61058	BR−2/3A−E2P
−2	159−0245−00			4	FUSE,WIRE LEAD:1A,125V,FAST (F200, F600, F602, F800)	71400	TR/MCR−1
−3	156−3812−00			1	IC,PROCESSOR:HMOS,MICROPROCESSOR (U830)	34649	R80286−10
	156−3821−00			1	IC,PROCESSOR:NMOS,PERIPHERAL (U800)	50579	SAB82258A−1N
−4	156−2622−00			1	IC,ASIC:HMOS,SEMI CUSTOM,STD CELL (U330)	66302	VF4157RC CC0001
−5	671−1129−00			1	CIRCUIT BD ASSY:MOTHER (SEE A13, EXCHANGE ITEM)	80009	671112900
−6	211−0722−00			1	SCREW,MACHINE:6−32 X 0.25,PNH,STL	0KB01	ORDER BY DESC
−7	670−9655−01			1	CIRCUIT BD ASSY:REGULATOR (SEE A4, EXCHANGE ITEM)	80009	670965501
−8	159−0220−00			1	FUSE,WIRE LEAD:3A,125V,FAST (F430)	61857	SP5−3A
−9	211−0721−00			2	SCREW,MACHINE:6−32 X 0.375,PNH,STL	0KB01	ORDER BY DESC
−10	211−0408−00			5	SCR,ASSEM WSHR:4−40 X 0.250,PNH,STL,T10	93907	829−06815−024
−11	670−9640−00			1	CIRCUIT BOARD:M/F POWER CONNECT (SEE A3, EXCHANGE ITEM)	80009	670964000
−12	211−0711−00			19	SCR,ASSEM WSHR:6−32 X 0.25,PNH,STL,T15	0KB01	ORDER BY DESC
−13	670−9365−06			1	CIRCUIT BD ASSY:M/F STROBE DRIVER (SEE A1, EXCHANGE ITEM)	80009	670936506
−14	672−0385−00			1	CIRCUIT BD ASSY:TIMEBASE IM OPT (SEE A5 OPT. 10, EXCHANGE ITEM)	80009	672038500
	671−4209−00			1	MODULAR ASSY:TRIGGER PRESCALER	80009	671420901
−15	671−4471−00			1	CIRCUIT BD ASSY:CALIBRATOR (SEE A6, EXCHANGE ITEM)	80009	671447100
−16	672−1372−01			1	CIRCUIT BD ASSY:CRT DRIVER (SEE A8, EXCHANGE ITEM)	80009	672137201
−17	159−0235−00			1	FUSE,WIRE LEAD:0.75A,125V,FAST (F330)	71400	TR/MCR 3/4
−18	407−3824−00			1	BRACKET,SUPPORT:HV XFMR,0.062 AL	5Y400	ORDER BY DESC
−19	213−0992−00			1	SCREW,TPG,TF:4−24 X 0.375,PNH,STL	93907	B80−70000−003
−20	671−1023−02			1	CIRCUIT BD ASSY:MEMORY MANAGEMENT UNIT (SEE A15, EXCHANGE ITEM)	80009	671102302
−21	670−8854−04			1	CIRCUIT BD ASSY:INPUT/OUTPUT (SEE 14, EXCHANGE ITEM)	80009	670885404
−22	671−1890−00			1	CIRCUIT BD ASSY:MEMORY (SEE A18, EXCHANGE ITEM)	80009	671189000
−23	671−2888−00			1	CIRCUIT BD ASSY:EXECUTIVE PROCESSOR (SEE A17, EXCHANGE ITEM)	80009	671288800

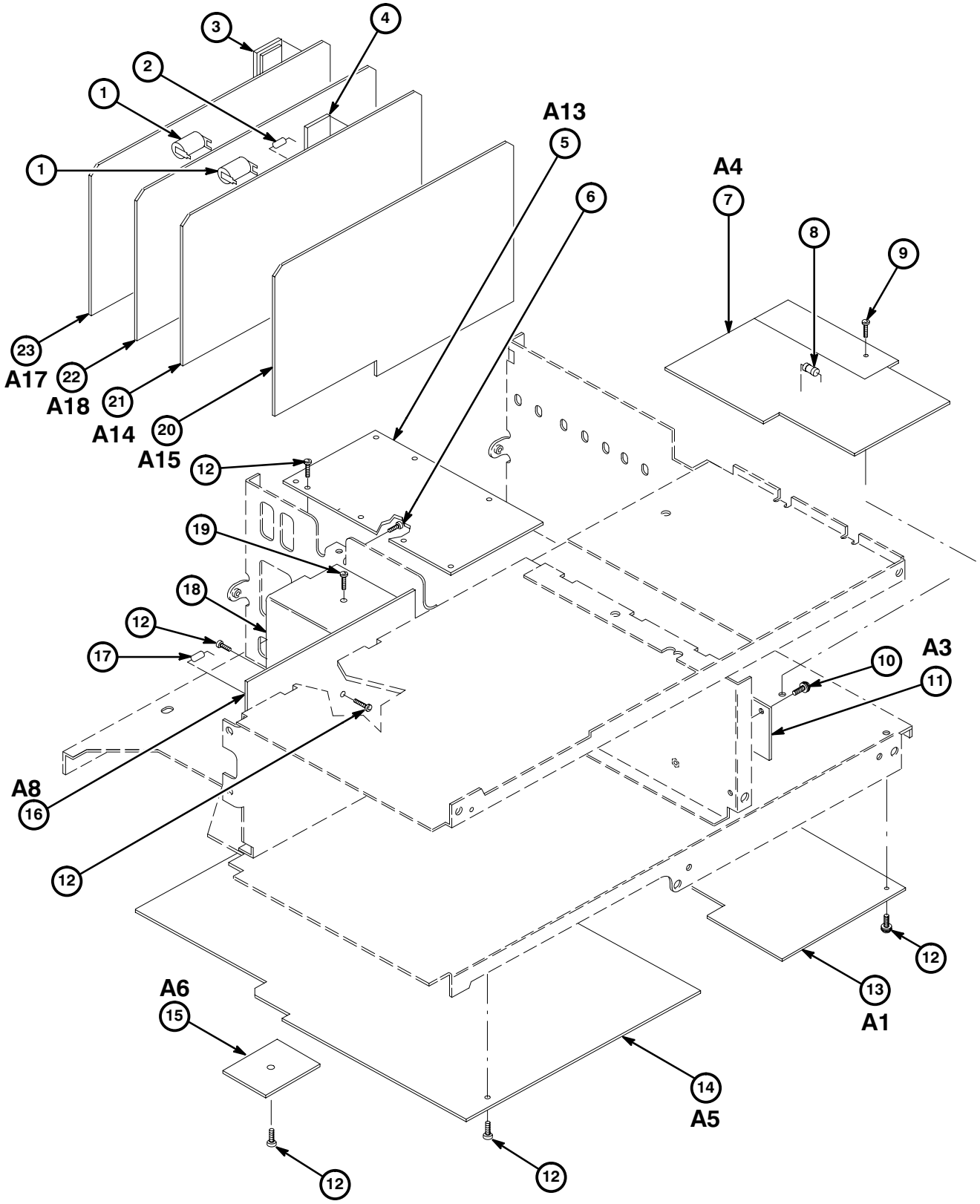


Figure 10-4: Circuit Boards

Fig. & Index No.	Tektronix Part No.	Serial No. Effective	Serial No. Dscont	Qty	12345	Name & Description	Mfr. Code	Mfr. Part No.
						WIRE ASSEMBLIES		
						(SEE MAINT SECTION FOR CABLING DIAGRAM)		
	174−3076−00			1		CA ASSY,RF:COAXIAL,RFD,50 OHM,0.10 D,6.5 L (FROM A4J66 TO A2A2J66)	80009	174307600
	174−0563−00			1		CA ASSY,SP,ELEC:8,18 AWG,8.0 L (FROM A4J64 TO A2A2J64)	TK1967	ORDER BY DESC
	174−0576−00			1		CA ASSY,SP,ELEC:50,28 AWG,10.3 L,RIBBON (FROM A26J10 TO A1J10)	TK1547	ORDER BY DESC
	174−0577−00			1		CA ASSY,SP,ELEC:16,28 AWG,7.5 L,RIBBON (FROM A19J34 TO A1J34)	TK1547	ORDER BY DESC
	174−0580−00			1		CA ASSY,SP,ELEC:50,28 AWG,14.0 L,RIBBON (FROM A18J83 TO A5J83)	TK1547	ORDER BY DESC
	174−0609−00			1		CABLE ASSY,RF:50 OHM COAX,11.0 L,9−0−5 (FROM A1J35 TO A5J35)	TK2469	ORDER BY DESC
	174−3076−00			1		CA ASSY,RF:COAXIAL,RFD,50 OHM,0.10 D,6.5 L (FROM A5J32 TO A19J32)	80009	174307600
	174−0623−00			1		CABLE ASSY,RF:50 OHM COAX,6.0 L,9−0 (FROM A19J30A TO A5J30B)	TK2469	ORDER BY DESC
	174−0624−00			1		CABLE ASSY,RF:50 OHM COAX,6.0 L,9−N (FROM A19J29A TO A5J29B)	TK2469	ORDER BY DESC
	174−0625−00			1		CABLE ASSY,RF:50 OHM COAX,17.5 L,9−3 (FROM A19J33B TP A1J33B)	TK2469	ORDER BY DESC
	174−0751−00			1		CABLE ASSY,RF:50 OHM COAX,34.0 L,9−7 (FROM A1J17 TO A6J17)	TK2469	ORDER BY DESC
	174−0827−00			1		CABLE ASSY,RF:50 OHM COAX,17.5 L,9−03 (FROM A1J33A TO A19J33A)	TK2469	ORDER BY DESC
	174−1557−00			1		CA ASSY,SP,ELEC:8,22 AWG,(4)12.5 L,(4)11.125 L (FROM A10J74 TO ENCODERS S74 AND S75)	TK1967	ORDER BY DESC
	174−1559−00			1		CA ASSY,SP,ELEC:8,26 AWG,12.0 L (FROM A7J56 TO A8J56)	TK1967	ORDER BY DESC
	174−1560−00			1		CA ASSY,SP,ELEC:4,26 AWG,21.0 L,RIBBON (FROM A4J57 TO A8J57)	TK1967	ORDER BY DESC
	174−1561−00			1		CA ASSY,SP:RIBBON,;CPR,3,26 AWG,9.0 L (FROM A8J52 TO A15J52)	TK1967	ORDER BY DESC
	174−1743−00			1		CA ASSY,PWR:DESCRETE,;PSC,4,18 AWG,18.5 L (FROM A2A2J63 TO A13J63A)	TK1967	ORDER BY DESC
	174−1744−00			1		CA ASSY,SP,ELEC:50,28 AWG (FROM A10J72 TO A14J72)	TK1547	ORDER BY DESC
	174−2030−02			1		CABLE ASSY,RF:50 OHM COAX,5.O L,W/BL JKT (FROM A5J88 TO FRONT PANEL J88)	TK2338	174−2030−02
	174−3781−00			1		CABLE ASSY,RF:50 OHM COAX,8.76 L,SEMI-RIGID (FROM A4J87 TO FRONT PANEL J87)	TK2338	174−3781−00
	174−1426−00			1		CA ASSY,SP,ELEC:34,26 AWG,8.0 L (FROM A5J18 TO A1J18)	80009	174142600
	175−9803−00			3		CA ASSY,SP:RIBBON,;CPR,7,26 AWG,7.5 L (FROM A2A2J65 TO A4J65) (FROM A7J53 TO A15J53) (FROM A5J16 TO A1J16)	TK1967	ORDER BY DESC

Fig. & Index No.	Tektronix Part No.	Serial No. Effective	Serial No. Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
	175−9814−00			1	CA ASSY,SP,ELEC:34,3.0 L (FROM A14J77 TO A17J77)	TK1547	ORDER BY DESC
	175−9857−00			1	CA ASSY,SP,ELEC:11,18 AWG,7.25 L,RIBBON (FROM A4J62 TO A2A2J62)	TK1967	ORDER BY DESC

Fig. & Index No.	Tektronix Part No.	Serial No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
					ACQUISITION MODULE		
	657−0090−00			1	MODULAR ASSY:ACQUISITION MODULE,11801C (EXCHANGE ITEM)	80009	657009000
10−5−1	670−9363−01			1	CIRCUIT BD ASSY:ACQUISITION MPU (SEE A25. EXHANGE ITEM)	80009	670936301
−2	670−9364−05			1	CIRCUIT BD ASSY:ACQUISITION ANALOG (SEE A24. EXHANGE ITEM)	80009	670936405
−3	670−9363−01			1	CIRCUIT BD ASSY:ACQUISITION MPU (SEE A28, EXCHANGE ITEM)	80009	670936301
−4	670−9364−05			1	CIRCUIT BD ASSY:ACQUISITION ANALOG (SEE A27, EXCHANGE ITEM)	80009	670936405
−5	426−2167−00			1	FRAME SECT,CAB.:MODULE	TK1465	426−2167−00
−6	351−0784−00			3	GUIDE,CKT BD:UPPER,PP,7.0 L	TK1905	ORDER BY DESC
−7	211−0392−00			6	SCREW,MACHINE:4−40 X 0.25,FLH,STL,T−8	93907	ORDER BY DESC
−8	426−2168−00			1	FRAME SECT,CAB.:MODULE	TK1465	426−2168−00
−9	131−1247−00			1	TERM,QIK DISC.:0.187 X 0.02 BLADE,45 DEG	00779	61664−1
−10	213−0904−00			8	SCREW,TPG,TR:6−32 X 0.5,PNH,STL	83385	ORDER BY DESC
−11	351−0761−00			2	GUIDE,CKT BD:PLASTIC,2.5 L	18677	11633−1
−12	386−5535−00			1	PLATE,REAR:ALUMINUM	TK1943	ORDER BY DESC
−13	671−2909−00			1	CIRCUIT BD ASSY:STROBE TDR BUFFER (SEE A19, EXCHANGE ITEM)	80009	671290900
−14	211−0409−00			10	SCR,ASSEM WSHR:4−40 X 0.312,PNH,STL,T10	93907	829−06888−024
−15	670−9361−00			1	CIRCUIT BD ASSY:M/F ACQUISITION INTCON (SEE A26, EXCHANGE ITEM)	80009	670936100
−16	407−3562−00			1	BRACKET,CKT BD:MODULE DISCONNECT,AL	TK1943	ORDER BY DESC
−17	426−2166−00			1	FRAME SECT,CAB.:MODULE	80009	426216600
−18	386−5687−00			2	SUPPORT,CKT BD:PLASTIC	TK1163	ORDER BY DESC
−19	211−0718−00			12	SCREW,MACHINE:6−32 X 0.312,FLH,STL	0KB01	ORDER BY DESC
−20	381−0452−00			2	BAR,LOCKING MDL:	5Y400	ORDER BY DESC
−21	426−2165−00			1	FRAME SECT,CAB.:MODULE	TK1465	426−2165−00
−22	384−1756−00			1	ROD,LOCKING:0.25,SST	TK0588	384−1756−00
−23	670−9366−02			4	CIRCUIT BD ASSY:HEAD INTERCONNECT (SEE A20,A21,A22,A23, EXCHANGE ITEMS)	80009	670936602
−24	210−0458−00			4	NUT,PL,ASSEM WA:8−32 X 0.344,STL	0KB01	210−0458−00
−25	136−0894−00			2	SKT,PL−IN ELEK:3.5 X 3.5 X 1.86,ALUMINUM	TK1916	ORDER BY DESC
−26	211−0372−00			4	SCREW,MACHINE:4−40 X 0.312,PNH,STL	93907	B80−00020−003
−27	348−0235−00			2	SHLD GSKT,ELEK:FINGER TYPE,4.734 L	TK1465	348−0235−00
−28	355−0259−00			4	STUD,LOCKING:0.850 X 0.188 HEX,SST	TK0588	ORDER BY DESC
−29	333−3421−00			1	PANEL,FRONT:	TK2072	ORDER BY DESC
−30	351−0786−00			4	GUIDE,PLUG−IN:PC,3.167 L	TK1302	ORDER BY DESC
−31	386−5475−00			1	SUBPANEL,FRONT:7.94 X 4.988,AL	TK1943	386−5475−00

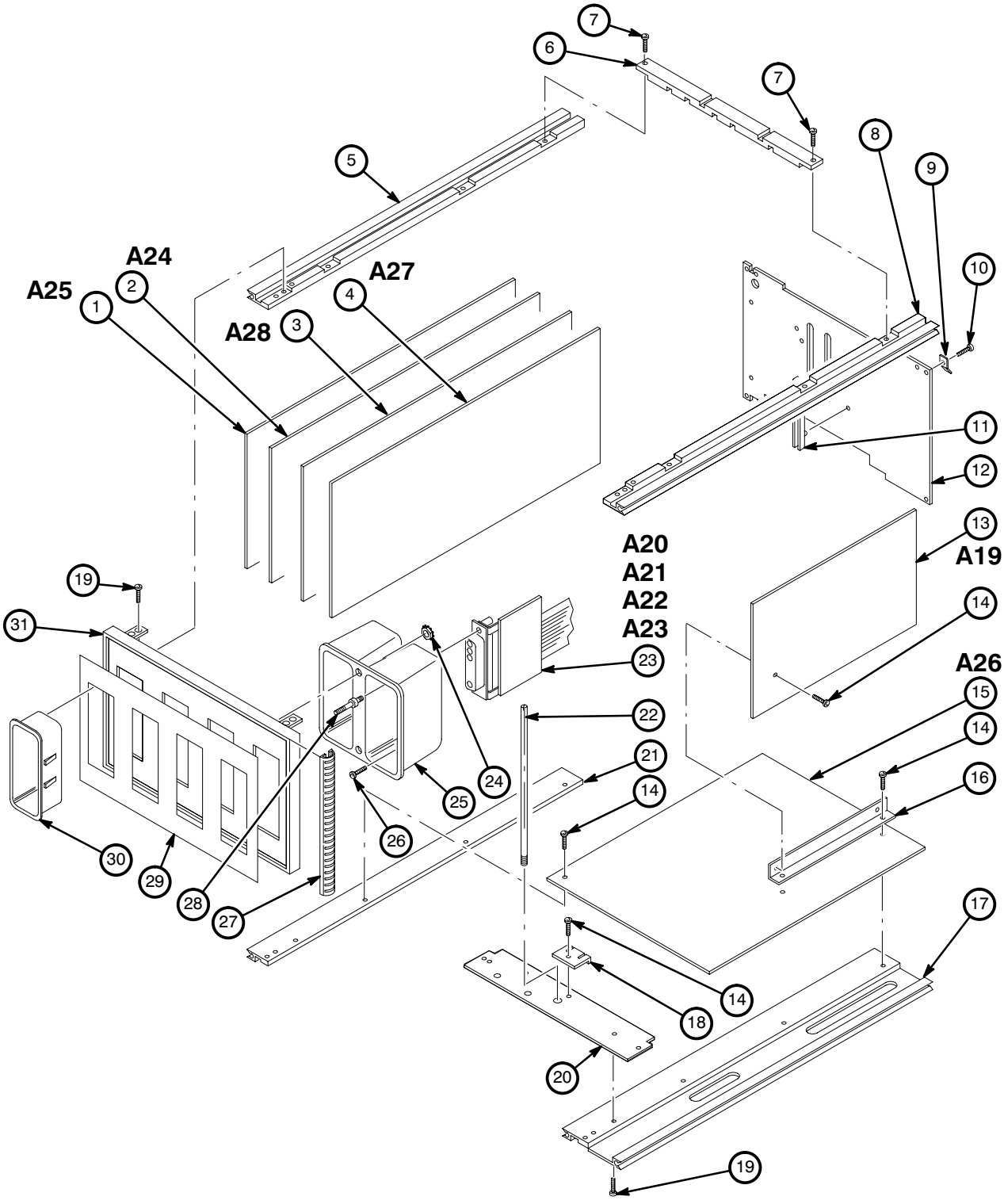


Figure 10-5: Acquisition Module

Fig. & Index No.	Tektronix Part No.	Serial No. Effective	Serial No. Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
					WIRE ASSEMBLIES		
					(SEE MAINT SECTION FOR CABLING DIAGRAM)		
	174−0626−01			4	CABLE ASSY,RF:50 OHM COAX,16.5 L,9−6 (FROM A19J1C TO A20J1C) (FROM A19J2C TO A21J2C) (FROM A19J3C TO A22J3C) (FROM A19J4C TO A23J4C)	TK2338	174−0626−01
	174−0627−01			4	CABLE ASSY,RF:50 OHM COAX,15.0 L,9−5 (FROM A19J1A TO A20J1A) (FROM A19J2A TO A21J2A) (FAROM A19J3A TO A22J3A) (FROM A19J4A TO A23J4A)	TK2338	174−0627−01
	174−0628−01			1	CABLE ASSY,RF:50 OHM COAX,13.0 L,9−1 (FROM A18J1B TO A20J1B)	TK2338	174−0628−01
	174−0629−01			1	CABLE ASSY,RF:50 OHM COAX,10.6 L,9−2 (FROM A18J1B TO A21J1B)	TK2338	174−0629−01
	174−0630−01			1	CABLE ASSY,RF:50 OHM COAX,8.2 L,9−3 (FROM A19J3B TO A22J3B)	TK2338	174−0630−01
	174−0631−01			1	CABLE ASSY,RF:50 OHM COAX,5.8 L,9−4 (FROM A19J4B TO A32J3B)	TK2338	174−0631−01
	343−0549−00			4	STRAP,TIEDOWN,E:0.098 W X 4.0 L,ZYTEL	TK1499	HW−047

Fig. & Index No.	Tektronix Part No.	Serial No. Effective	Serial No. Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
					POWER SUPPLY		
10−6−1	620−0022−09			1	POWER SUPPLY: (SEE A2, EXCHANGE ITEM)	80009	620002209
−2	200−2222−00			1	GUARD,FAN:	TK2105	08213
−3	211−0744−00			4	SCREW,MACHINE:6−32 X 2.0,PNH,TORX,STL	TK0435	ORDER BY DESC
−4	200−2264−00			1	CAP,FUSEHOLDER:3AG FUSES	S3629	FEK 031 1666
−5	159−0013−00			1	FUSE,CARTRIDGE:3AG,6A,250V,FAST BLOW (F99, USED IN FUSE HOLDER)	75915	312006
	159−0021−00			1	FUSE,CARTRIDGE:3AG,2A,250V,FAST BLOW (F410, PART OF LINE INVERTER BOARD)	71400	AGC−2
	159−0248−00			1	FUSE,WIRE LEAD:1.5 A (F650, PART OF LINE INVERTER BOARD)	71400	TR/MCR−1 1/2
	159−0220−00			1	FUSE,WIRE LEAD:3A,125V,FAST (F740, PART OF CONTROL RECTIFIER BOARD)	61857	SP5−3A
−6	407−3362−00			1	BRACKET,FAN:0.050 5005 H−34	5Y400	ORDER BY DESC
−7	204−0832−00			1	BODY,FUSEHOLDER:3AG & 5 X 20MM FUSES	S3629	031 1673
−8	119−1725−01			1	FAN,TUBEAXIAL:8 14.5VDC,6W,3200RPM,106CFM	2W944	4112 KX
−9	211−0722−00			8	SCREW,MACHINE:6−32 X 0.25,PNH,STL	0KB01	ORDER BY DESC

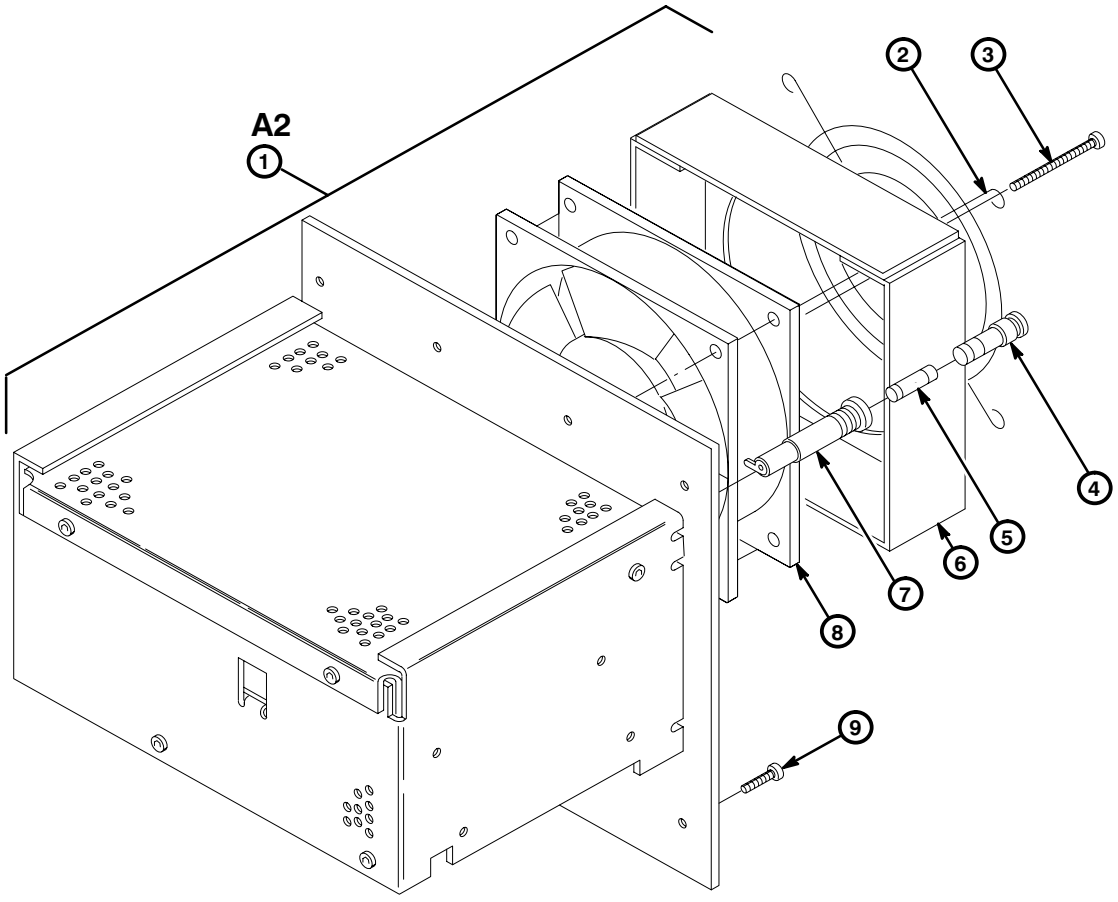


Figure 10-6: Power Supply

Fig. & Index No.	Tektronix Part No.	Serial No. Effective	Serial No. Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
					OPTION 1M		
10−7−1	614−0940−00			1	SUBPANEL ASSY: (EXCHANGE ITEM)	80009	614094000
−2	211−0721−00			11	SCREW,MACHINE:6−32 X 0.375,PNH,STL	0KB01	ORDER BY DESC
−3	103−0269−00			20	ADAPTER,CONN:SMA TO PELTOLA	24931	39JR198−1
−4	386−5472−00			1	PLATE,CONN MTG:ALUMINUM	TK1943	ORDER BY DESC
−5	386−5471−00			1	SUBPANEL,REAR:	TK1916	ORDER BY DESC
					WIRE ASSEMBLIES (SEE MAINT SECTION FOR CABLING DIAGRAM)		
	174−0608−00			1	CABLE ASSY,RF:50 OHM COAX,167.0L,9−2, 167.0L,9−2,179.0L,9−3,179.0L,9−3 (TO A19J23A,J30A,J33A,J33B) (TO A5J29B,J30B) (TO A1J33A,J33B)	TK2469	ORDER BY DESC
	174−0613−00			12	CABLE ASSY,RF:50 OHM COAX,7.0 L,9−N (FROM A1+1,+2,+3,+4 TO REAR PNL MCU TDR DRIVE +1,+2,+3,+4) (FROM A1−1,−2,−3,−4 TO REAR PNL MCU TDR DRIVE −1,−2,−3,−4) (FROM A1 1,2,3,4 TO REAR PANEL MCU STROBE SENSE 1,2,3,4)	TK2469	ORDER BY DESC
	174−0618−00			8	CABLE ASSY,RF:50 OHM COAX,15.0 L,9−N (FROM A5+1,+2,+3,+4 TO REAR PANEL MCU STROBE DRIVE +1,+2,+3,+4) (FROM A5−1,−2,−3,−4 REAR PANEL MCU STROBE DRIVE −1,−2,−3,−4)	TK2469	ORDER BY DESC
	174−1093−00			1	CABLE ASSY,RF:50 OHM COAX,30.0 L,9−2 (FROM A1J15 TO A5J15)	TK2469	ORDER BY DESC

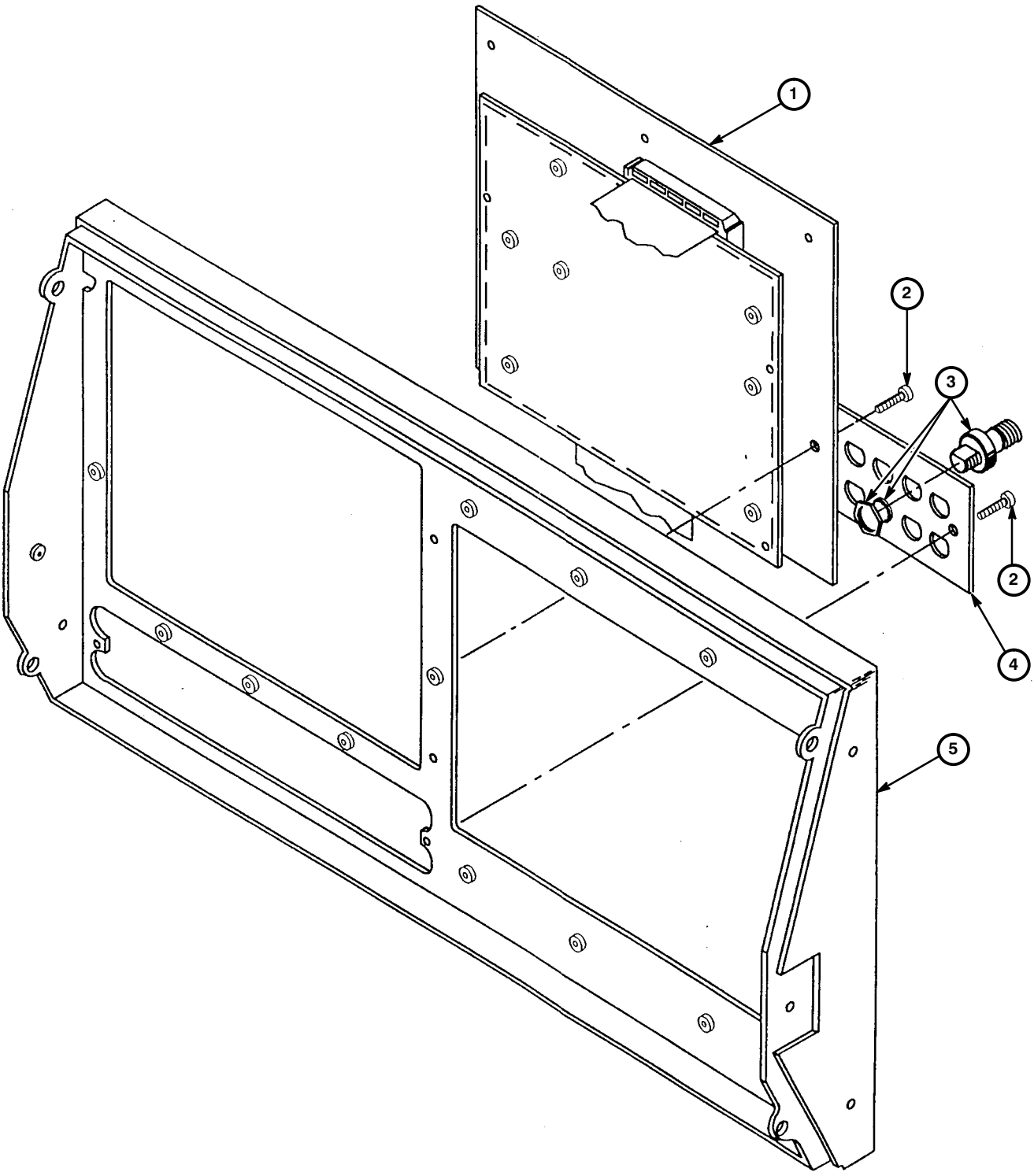


Figure 10-7: Option 1M

Fig. & Index No.	Tektronix Part No.	Serial No. Effective	Serial No. Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
					STANDARD ACCESSORIES		
10−8−1	161−0066−00			1	CABLE ASSY,PWR,:3,18AWG,98 L	0B445	ECM−161−0066−00
−2	161−0154−00			1	CABLE ASSY,PWR,:3,1.00MM SQ,250V,10A,2.5M (OPTION A5 ONLY)	S3109	12−H05VVF3G 00
−3	161−0066−12			1	CABLE ASSY,PWR,:3,18 AWG,98 L (OPTION A4 ONLY)	29870	ORDER BY DESC
−4	161−0066−11			1	CABLE ASSY,PWR,:3,1.00MM SQ,250V,10A,2.5M (OPTION A3 ONLY)	S3109	198−000
−5	161−0066−10			1	CABLE ASSY,PWR,:3,0.1MM SQ,250V,2.5 M (OPTION A2 ONLY)	S3109	BS/13−H05VVF3G0
−6	161−0066−09			1	CABLE ASSY,PWR,:3,0.75MM SQ,220V,99.0 L (OPTION A1 ONLY)	S3109	86511000
	174−1120−00			2	CA ASSY,RF:COAXIAL,;RFD,50 OHM,8.0 L	TK2469	ORDER BY DESC
	174−1364−00			1	CABLE ASSY,RF:12.0 L,0−N	TK2469	ORDER BY DESC
	070−9970−xx			1	MANUAL,TECH:PROGRAMMER,11801C/CSA803C	80009	0709970xx
	070−9971−xx			1	MANUAL,TECH:USER,11801C	80009	0709971xx
	070−9972−xx			1	MANUAL,TECH:SERVICE,11801C	80009	0709972xx
					OPTIONAL ACCESSORIES		
	012−0555−00			1	CABLE,INTCON:CENTRONIX,3 METERS LONG	TK1416	DKIT−0034HCZZ
	012−0911−00			1	CABLE,INTCON:MOLDED,RS232;10 FT	TK2435	ORDER BY DESC
	012−0991−00			1	CABLE,COMPOSITE:IDC,GPIB:2 METER	00779	553577−3
	012−0991−01			1	CABLE,GPIB:LOW EMI,1 METER	00779	553577−2
	012−1220−00			1	CA ASSY,SP,ELEC:1 METER LONG	TK2469	ORDER BY DESC
	012−1221−00			1	CA ASSY,SP,ELEC:2 METER LONG	TK2469	ORDER BY DESC
	200−3395−00			1	COV,SMPLG HEAD:SNAP−IN	TK1163	ORDER BY DESC

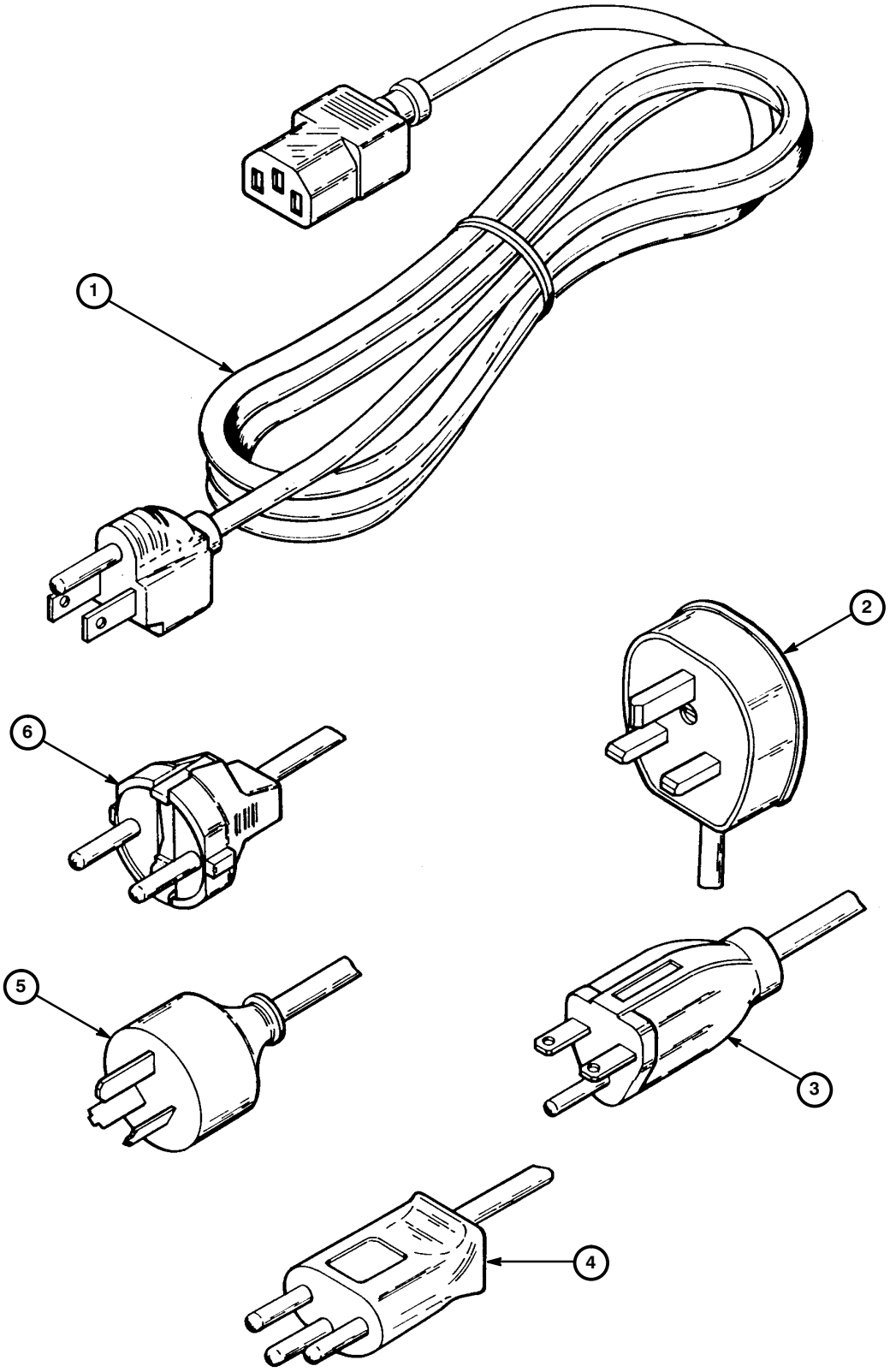


Figure 10-8: Accessories

Artisan Technology Group is an independent supplier of quality pre-owned equipment

Gold-standard solutions

Extend the life of your critical industrial, commercial, and military systems with our superior service and support.

We buy equipment

Planning to upgrade your current equipment? Have surplus equipment taking up shelf space? We'll give it a new home.

Learn more!

Visit us at **artisantg.com** for more info on price quotes, drivers, technical specifications, manuals, and documentation.

Artisan Scientific Corporation dba Artisan Technology Group is not an affiliate, representative, or authorized distributor for any manufacturer listed herein.

We're here to make your life easier. How can we help you today?

(217) 352-9330 | sales@artisantg.com | artisantg.com

ARTISAN® TECHNOLOGY GROUP