Service Manual

SONY
Tektronix

AWG2020
Arbitrary Waveform Generator

070-8658-00

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

Please check for change information at the rear of this manual.

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Instrument Serial Numbers

Each instrument manufactured by Tektronix has a serial number on a panel insert or tag, or stamped on the chassis. The first letter in the serial number designates the country of manufacture. The last five digits of the serial number are assigned sequentially and are unique to each instrument. Those manufactured in the United States have six unique digits. The country of manufacture is identified as follows:

B010000	Tektronix, Inc., Beaverton, Oregon, USA
E200000	Tektronix United Kingdom, Ltd., London
J300000	Sony/Tektronix, Japan
H700000	Tektronix Holland, NV, Heerenveen, The Netherlands

Instruments manufactured for Tektronix by external vendors outside the United States are assigned a two digit alpha code to identify the country of manufacture (e.g., JP for Japan, HK for Hong Kong, IL for Israel, etc.).

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

Printed in U.S.A.

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.

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Preface

This is the service manual for the AWG2020 Arbitrary Waveform Generator. The manual contains information needed to service the AWG2020 to the module level.

Manual Structure

This manual is divided into sections, such as *Specifications* and *Theory of Operation*. Further, some sections are divided into subsections, such as *Product Description* and *Removal and Installation Procedures*.

Sections containing procedures also contain introductions to those procedures. Be sure to read these introductions because they provide information needed to do the service correctly and efficiently. The following contains a brief description of each manual section.

- *Specifications* — contains a description of the AWG2020 and the characteristics that apply to it.
- *Operating Information* — includes general information and operating instructions at the level needed to safely power on and service the AWG2020.
- *Theory of Operation* — contains circuit descriptions that support general service to the module level.
- *Performance Verification* — contains a collection of procedures for confirming that the AWG2020 functions properly and meets warranted limits.
- *Adjustment Procedures* — contains a collection of procedures for adjusting the AWG2020 to meet warranted limits.
- *Maintenance* — contains information and procedures for performing preventive and corrective maintenance of the AWG2020. These instructions include cleaning, module removal and installation, and fault isolation to the module.
- *Options* — contains information on servicing any of the factory-installed options that your AWG2020 includes.
- *Electrical Parts List* — contains a statement referring you to *Mechanical Parts List*, where both electrical and mechanical modules are listed. See below.
- *Diagrams* — contains block diagrams and an interconnection diagram useful in isolating failed modules.
- *Mechanical Parts List* — includes a table of all replaceable modules, their descriptions, and their Tektronix part numbers.

Manual Conventions

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

Some sections of the manual contain procedures for you to perform. To keep those instructions clear and consistent, this manual uses the following conventions:

- Instructions for menu selection follow this format: **FRONT PANEL BUTTON→Main Menu Button→Side Menu Button**. For example, "Press **UTILITY→Misc→Reset to Factory→O.K.**"
- Names of front panel controls and menus appear in the same case (initial capitals, all uppercase, etc.) in the manual as is used on the AWG2020 front panel and menus. Front panel names are all upper-case letters; for example, **MODE MENU, CH 1**, etc.
- Instruction steps are numbered unless there is only one step.

Modules

Throughout this manual, any replaceable component, assembly, or part of the AWG2020 is referred to generically as a module. In general, a module is an assembly (like a circuit board), rather than a component (like a resistor or an integrated circuit). Sometimes a single component is a module; for example, the chassis of the AWG2020 is a module.

Safety

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

Finding Other Information

Other documentation for the AWG2020 Arbitrary Waveform Generator includes:

- The *AWG2020 User Manual* contains a tutorial to quickly describe how to operate the AWG2020. It also includes an in-depth discussion on how to more completely use AWG2020 features.
- The *AWG2020 Programmer Manual* explains how to control the AWG2020 with a computer through the GPIB or RS-232-C interface.

Table of Contents

Specifications

Operating Information

Theory of Operation

Performance Verification

Adjustment Procedures

Maintenance

Options

Electrical Parts List

Diagrams

Mechanical Parts List

List of Figures

List of Tables

List of Tables

Safety Summary

The general safety information in this summary is for both operating and servicing personnel. Specific warnings and cautions are found throughout the manual where they apply, and may not appear in this summary.

Symbols and Terms

These two terms appear in this manual:

- CAUTION statements identify conditions or practices that could result in damage to the equipment or other property.
- WARNING statements identify conditions or practices that could result in personal injury or loss of life.

These three terms appear on equipment:

- *CAUTION* indicates a personal injury hazard not immediately acessible as one reads the marking or a hazard to property, including the equipment itself.
- *DANGER* indicates a personal injury hazard immediately accessible as one reads the marking.

These symbols appear in manuals:

Static-Sensitive Devices

This symbol indicates where applicable cautionary or other information is to be found.

These symbols appear on equipment:

DANGER
High Voltage

Protective ground (earth) terminal

ATTENTION
Refer to manual

Specific Precautions

Observe all of these precautions to ensure your personal safety and to prevent damage to either the AWG2020 or equipment connected to it.

Do Not Perform Service While Alone

Do not perform internal service or adjustment of the AWG2020 unless another person capable of rendering first aid and resuscitation is present.

Use Care When Servicing with Power On

Dangerous voltages exist at several points in the AWG2020. To avoid personal injury, do not touch exposed connections or components while power is on. Disconnect power before removing protective panels, soldering, or replacing components.

Power Source

The AWG2020 is intended to operate from a power source that will not apply more than 250 V_{RMS} between the supply conductors or between either supply conductor and ground. A protective ground connection, through the grounding conductor in the power cord, is essential for safe system operation.

Grounding the AWG2020

The AWG2020 is grounded through the power cord. To avoid electric shock, plug the power cord into a properly wired receptacle where earth ground has been verified by a qualified service person. Do this before making connections to the input or output terminals of the AWG2020.

Without the protective ground connection, all parts of the AWG2020 are potential shock hazards. This includes knobs and controls that may appear to be insulators.

Use the Proper Power Cord

Use only the power cord and connector specified for your AWG2020. Use only a power cord that is in good condition.

Use the Proper Fuse

To avoid fire hazard, use only the fuse specified in the parts list for your AWG2020, and which is identical in type, voltage rating, and current rating.

Do Not Remove Covers or Panels

To avoid personal injury, do not operate the AWG2020 without the panels or covers.

Take Antistatic Precautions

Wear an antistatic grounding wrist strap when working with the input connectors on the AWG2020.

Do Not Operate in Explosive Atmospheres

The AWG2020 provides no explosion protection from static discharges or arcing components. Do not operate the AWG2020 in an atmosphere of explosive gasses.

CRT Handling

Use care when handling a CRT. Breakage of the CRT causes a high-velocity scattering of glass fragments (implosion). 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 it face down in a protected location on a smooth surface with a soft mat under the faceplate.

Introduction

This manual contains information needed to properly service the AWG2020 Arbitrary Waveform Generator, as well as general information critical to safe and effective servicing.

To prevent personal injury or damage to the AWG2020, consider the following before attempting service:

- The procedures in this manual should be performed only by a qualified service person
- Read the *Safety Summary* found at the beginning of this manual
- Read *Preparation for Use* in section 2, *Operating Information*

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

Adjustment Interval

Generally, the manual adjustments described in section 5, *Adjustment Procedures*, should be done every 12 months. In addition, adjustment is recommended after module replacement.

Strategy for Servicing

Throughout this manual, the term, module, refers to any field-replaceable component, assembly, or part of this AWG2020.

This manual contains all the information needed for periodic maintenance of the AWG2020. (Examples of such information are procedures for checking performance and for readjustment.)

Further, it contains all information for corrective maintenance down to the module level. To isolate a failure to a module, use the fault isolation procedures found in *Troubleshooting*, part of section 6, *Maintenance*. To remove and replace any failed module, follow the instructions in *Removal and Installation Procedures*, also part of section 6. After isolating a faulty module, replace it with a fully-tested module obtained from the factory. Section 10, *Mechanical Parts List,* contains part number and ordering information for all replaceable modules.

Tektronix Service Offerings

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

Whether providing warranty repair service or any of the other services listed below, Tektronix service technicians are well equipped to service the AWG2020. Tektronix technicians train on Tektronix products; they have access to the latest information on improvements to the AWG2020 as well as the latest new options.

Warranty Repair Service

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

Repair or Calibration Service

The following services can be purchased to tailor repair and/or calibration of the AWG2020 to fit your requirements.

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

- A single repair and/or adjustment
- Calibrations using equipment and procedures that meet the traceability standards specific to the local area
- Annual maintenance agreements that provide for either calibration and repair or calibration only of the AWG2020

Of these services, the annual maintenance agreement offers a particularly cost-effective approach to service for many owners of the AWG2020.

Self Service

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

Module Exchange — This service reduces down-time for repair by allowing you to exchange most modules for remanufactured ones. Tektronix ships an updated and tested exchange module from the Beaverton, Oregon service center, typically within 24 hours. Each module comes with a 90-day service warranty.

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

Product Description

The AWG2020 is a portable arbitrary waveform generator capable of generating both arbitrary waveforms and standard function waveforms. Key features include:

- Arbitrary waveform generation from waveform data files that you:
  - Create using the graphical waveform editor
  - Generate from equations you create using the equation editor
  - Transfer from GPIB or RS-232-C interfaces
  - Directly transfer from a Tektronix TDS Digitizing Oscilloscope, 2200 Series or 2400 Series Digital Storage Oscilloscope (DSO), RTD710A Transient Digitizer, AFG2020 Arbitrary Function Generator, or from another AWG2020 Arbitrary Waveform Generator
- Continuous generation of arbitrary waveform data files you specify in a sequence file
- Stepped arbitrary waveform generation of waveform data files and/or sequence files you specify in an autostep file (Autostep mode)
- Single- or dual-channel waveform output to 5 V_{p-p} (the second channel is Option 02)
- Point clock rate from 10 Hz to 250 MHz
- Continuous, triggered, gated, or burst trigger modes
- Amplitude modulation
- Output waveform ADD function (CH 2 to CH1)
- Internal waveform memory of 256K × 12 bits for each channel
- Internal catalog memory of 2.2 M
- Waveform file storage in internal nonvolatile memory (512 K) or on external disk
- Two waveform markers (per channel)
- Rear-panel waveform output in digital format (Option 03)
- Editing in frequency domain (floating point processor, Option 09)
- Waveform format conversion utilities, sample waveform library, and sample GPIB programming examples on disk
- Standard function waveforms
- Internal diagnostic/calibration

Performance Characteristics

This subsection describes the conditions required for the AWG2020 to operate to specified characteristics.

Performance Conditions

The electrical characteristics are valid under the following conditions:

1. The instrument must have been calibrated at an ambient temperature from +15° C to +25° C.
2. Allow twenty minutes warm-up time for operation to specified accuracy.
3. The instrument operates at an ambient temperature from +10° C to +40° C, unless otherwise noted.

Any conditions that are unique to a particular characteristic are expressly stated as part of that characteristic.

The electrical and environmental performance limits, together with the related validation procedure, comprise a complete statement of the electrical and environmental performance of a calibrated instrument.

Electrical characteristic limits in the *Performance Requirements* column are verified by completing the test listed in the *Performance Test* column. Items listed in the *Supplemental Information* column are not verified in the manual; they are either explanatory notes or performance characteristics for which no limits are specified.

Characteristics

Table 1-1 through Table 1-3 in this subsection contain the electrical, mechanical, and environmental characteristics of the AWG2020 Arbitrary Waveform Generator.

Electrical Characteristics

Table 1-1: Electrical Characteristics

Characteristic	Performance Requirement	Supplemental Information	Performance Test
	Operating Modes		
Continuous	Generates the waveform continuously.		Check Cont Mode, page 4-11.
Triggered	Output quiescent until triggered by an external, GPIB, or manual trigger; then generates a waveform only one time.		Check Triggered Mode, page 4-13.
Gated	Same as triggered mode, except waveforms are output for the duration of the gated signal.		Check Gated Mode, page 4-17.
Burst	Output quiescent until triggered by an external, GPIB, or manual trigger; then generates a waveform from a predefined burst count.		Check Burst Mode, page 4-15.
Waveform Advance	Continuously generates the first waveform in the predefined sequence. Each successive trigger advances to the next waveform in the sequence.		Check Waveform Advance Mode, page 4-19.
Autostep	Outputs the first waveform in the predefined Autostep File once. The next trigger advances to output the next waveform once and so on, for each successive trigger.		Check Autostep Mode, page 4-21.
	Arithmetic Operation		
Amplitude Modulation (AM) (Multiply)		When Option 02 (second channel) is installed	Check Internal AM Operation, page 4-25.

Table 1-1: Electrical Characteristics (Cont.)

Characteristic	Performance Requirement	Supplemental Information	Performance Test
Arithmetic Operation (Cont.)			
Output	Within 5%	CH2 CH1 Modulation 5 V −100% 0 V 0% −5 V −100%	
Frequency Response	DC to 30 MHz	−3 dB	
External Amplitude Modulation		Input Modulation	Check External AM Operation, page 4-23.
Sensitivity	2 V_{p-p} (±5%) signal causes 100% modulation	1 V, 100% 0 V, 50% −1 V, 0%	
Frequency Response			
CH1	DC to 30 MHz	−3 dB	
Ext Signal	DC to 4 MHz	−3 dB	
Add		When option 02 (second channel) is installed	Check Internal ADD Operation, page 4-26.
Output	Within 5%	CH1 + CH2 (Value indicated at the lower right box in SET-UP menu)	
Frequency Response	DC to 30 MHz	−3 dB	
Arbitrary Waveforms			
Waveform Memory			
Memory Length	256K × 12 bits for waveform data 256K × 1 bits for Marker 1 data 256K × 1 bits for Marker 2 data		
Waveform		64 to 256K in multiple of 8 data points	
Sequence Memory	8K	32 bits/word	
Scan Counter	1 to 64K (16 bits)		
Burst Counter	1 to 64K (16 bits)		

Table 1-1: Electrical Characteristics (Cont.)

Characteristic	Performance Requirement	Supplemental Information	Performance Test
Clock Generator			
Frequency Range	10 Hz to 250 MHz		
Display		4 digit	
Accuracy			Check Clock Frequency Accuracy, page 4-27.
+10° C to +40° C	0.01%		
+15° C to +30° C	0.005%		
Resolution		0.1% to 0.01%	
Skew Between CH1 and CH2	Within 4 ns	Option 02 only	
Reference Oscillator			
Type	TCXO		
Nominal Frequency	12.8 MHz		
Accuracy	±1 ppm		
Stability	±1 ppm/year (20° C to 30° C)		
Filters			
Cut Off			
Frequency		−3 dB	
1 MHz	Within 20%		
5 MHz	Within 20%		
20 MHz	Within 20%		
50 MHz	Within 20%		
Delay			
1 MHz		Typical 390 ns	
5 MHz		Typical 78 ns	
20 MHz		Typical 18 ns	
50 MHz		Typical 11 ns	
Filter Characteristics		Bessel	

Table 1-1: Electrical Characteristics (Cont.)

Characteristic	Performance Requirement	Supplemental Information	Performance Test
Main Outputs			
Amplitude		Except ADD and Multiply operation	
Range	0.05 V to 5 V_{p-p} into 50 Ω		
Resolution	1/4096	12 bits DAC	
DC Accuracy			
0.05 V to 0.5 V	±(0.5% of amplitude + 5 mV)	No offset, at 1 MHz clock	
0.501 V to 5 V	±(1% of amplitude + 25 mV)	No offset, at 1 MHz clock	
Offset			
Range	−100 mA to 100 mA	−2.5 V to 2.5 V into 50 Ω	
Resolution	0.2 mA		
Accuracy	±(1% of offset + 0.2 mA)	Waveform is 0 VDC and amplitude range is 0.05 V	Check Offset Accuracy, page 4-32.
Crosstalk between Channels	<−70 dBc	Option 02, sine (512 points), 250 MHz clock, amplitude 5 V, no offset, no filter	
Noise Floor		Waveform is 0 VDC, normal, no filter, no offset, at a 250 MHz clock	
0.1 V	<−140 dBm/Hz at 10 MHz		
1.0 V	<−130 dBm/Hz at 10 MHz		
5.0 V	<−120 dBm/Hz at 10 MHz		
Pulse Response			Pulse Response Check, page 4-33.
+15° C to +30° C			
Flatness	Within 3%	After 20 ns from rise/fall edges	
Aberrations	Within 7% + 10 mV		
+10° C to +40° C			
Rise/Fall Time	<4.2 ns		
Flatness	Within 5%	After 20 ns from rise/fall edges	
Aberrations	Within 9% + 10 mV		
Impedance		50 Ω	

Table 1-1: Electrical Characteristics (Cont.)

Characteristic	Performance Requirement	Supplemental Information	Performance Test
Main Outputs (Cont.)			
Sinewave Characteristics		F.G. mode, 100 kHz to 2.5 MHz, no offset	
Flatness	Within 4%	Amplitude 1 V, 100 kHz reference	
Total Harmonic Distortion (THD)		Including 4th harmonics	
1.0 V	< −50 dBc		
0.5 V	< −66 dBc		
Spurious			
1 V	< −66 dBc	Excluding clock frequency	
0.5 V	< −66 dBc	Excluding clock frequency	
Harmonic Distortion		At 250 MHz clock, 0.5 V amplitude, 5000 points for sinewave data, no offset, no filter	
Second Harmonics	At least −40 dBc		
Third Harmonics	At least −50 dBc		
Auxiliary Outputs			
Sync		Note: When in Function Generator mode and the frequency is above 250 kHz, the Sync pulse occurs one time per two waveforms	SYNC Out and MARKER Out Amplitude Checks, page 4-35.
Amplitude	1 V into 50 Ω	±0.3 V	
Impedance		50 Ω typical	
Duration	100 ns ±20%		
Sync to Signal Delay	Within 15 ns	Typical 10 ns	
Marker 1			SYNC Out and MARKER Out Amplitude Checks, page 4-35.
Amplitude	1 V into 50 Ω	±0.3 V	
Impedance		50 Ω typical	
Marker to Signal Delay	Within 15 ns	Typical 10 ns	
Marker 2			
Amplitude	1 V into 50 Ω	±0.3 V	
Impedance		50 Ω typical	

Table 1-1: Electrical Characteristics (Cont.)

Characteristic	Performance Requirement	Supplemental Information	Performance Test
Auxiliary Outputs (Cont.)			
Marker to Signal Delay	Within 15 ns	Typical 10 ns	
Clock			
Amplitude	1 V into 50 Ω	±0.3 V	Check Clock Amplitude, page 4-29.
Impedance		50 Ω typical	
Digital Data Out (Option 03 only)			Digital Data Out Check, page 4-41.
Level	ECL compatible		
Output Signals	Data (D0 to D11) Clock	Same wires to DAC	
Skew Between Data	Within 1 ns		
Clock to Data Delay	Within 2 ns		
Connector		68-pin mini-D sub	
Auxiliary Inputs			
Trigger			
Threshold Level	−5 V to 5 V		
Resolution	0.1 V		
Accuracy	±(5% of Level + 0.1 V)		External Trigger Level Accuracy Check, page 4-37.
Pulse Width	15 ns minimum		
Input Swing	0.2 V minimum		
Maximum Input Volts	10 V_{p-p} 5 V_{RMS}	When 1 MΩ selected When 50 Ω selected	
Impedance		1 MΩ with 30 pF (max)	
Trigger to Signal Delay			
Internal Clock	100 ns maximum	Typical 40 ns	
External Clock	100 ns maximum + 1 clock	Typical 40 ns + 1 clock	
Trigger Holdoff	1 S maximum	Excluding Autostep mode	

Table 1-1: Electrical Characteristics (Cont.)

Characteristic	Performance Requirement	Supplemental Information	Performance Test
Auxiliary Inputs (Cont.)			
Amplitude Modulation (AM)			
Range	2 V_{p-p} (−1 V to 1 V) for 100% modulation	±5%	
Maximum Input			
Voltage	±5 V_{p-p}		
Impedance		10 kΩ typical	
Clock			External CLOCK IN Check, page 4-39.
Threshold Level	0.3 V	±0.1 V	
Input Swing	0.8 V minimum		
Pulse Width	2 ns minimum		
Maximum Input Voltage	±2 V_{p-p}		
Impedance		50 Ω typical	
Frequency Range	Up to 250 MHz		
Display			
CRT			
Type		Electro-magnetic deflection	
Phosphor		P31	
Screen Size		17.8 cm (7.0 in.) diagonal, 640 × 480 pixels	
AC Power Source			
Voltage	Selected by internal 115/230 V jumper		
Range	90 VAC to 127 VAC	180 VAC to 250 VAC	
Line Frequency	48 Hz to 63 Hz		
Maximum Power Consumption	300 W		
Maximum Current	5 A		
Fuse Rating	250 V, 6 A, Fast Blow		

Table 1-1: Electrical Characteristics (Cont.)

Characteristic	Performance Requirement	Supplemental Information	Performance Test
	GPIB		
GPIB Requirements	Complies with ANSI/IEEE Std. 488.2-1987		

Mechanical Characteristics

Table 1-2: Mechanical Characteristics

Characteristics	Description
Net Weight	
Standard	9.7 kg (21.39 lb.)
Option 02, 09	10.7 kg (23.59 lb.)
Height (with feet)	164 mm (6.4 in.)
Width (with handle)	362 mm (14.3 in.)
Length	
With Front Cover	491 mm (19.25 in.)
With Handle Extended	576 mm (22.2 in.)

Environmental Characteristics

Table 1-3: Environmental Characteristics

Characteristics	Performance Requirement
Temperature	
Operating	+10° C to +40° C
Non-operating	−20° C to +45° C
Temperature Gradient	
Operating	≤ 15° C per hour (no condensation)
Storage and Transportation	≤ 30° C per hour (no condensation)
Humidity	
Operating and Non-operating	Five cycles (120 hours) with equipment tested at 80% relative humidity. Tested non-operating at 45° C and operating at 40° C.
Altitude	
Operating	To 4.5 km (15,000 feet) Maximum operating temperature decreases 1° C each 0.3 km (1,000) feet above 1.5 km (5,000) feet.
Non-operating	To 15 km (50,000 feet)
Operating and Non-operating	Meets MIL-T-28800C, class 5.
Vibration	
Operating	15 minutes sweep along each of three major axes at a total displacement of 0.003 inch p-p (0.5 G at 55 Hz), with frequency varied from 10 Hz to 55 Hz. Hold 10 minutes at each major resonance, or if no major resonance present, hold 10 minutes at 55 Hz.
Shock	
Non-operating	20 G, half sine, 11 ms duration, three shocks per axis in each direction for a total of 18 shocks
Bench Handling	
Operating	Drop from 10 cm (4 in.) tilt, or 45°, whichever is less. Meets MIL-T-28800C, class 5.
Packaged Product — Vibration and Shock	
Vibration and Bounce	Meets ASTM D999-75, method A, paragraph 3.1g (NSTA Project 1A-B-1).
Drop Test	Meets ASTM D775-61, method 1, paragraph 5 (NSTA Project 1A-B-2).

Table 1-3: Environmental Characteristics (Cont.)

Characteristics	Performance Requirement
Electrostatic Immunity	
No disruption or degradation of performance	Up to 15 kV, 150 pF through 150 Ω
No damage to product	Up to 20 kV, 150 pF through 150 Ω
Electromagnetic Compatibility	
United States	Meets FCC part 15, subpart J, class A
Germany	Meets VDE 0871/6.78 class B
Japan	Meets VCCI
Safety	Conforms with the following safety standards: UL1244 (Std. for Electrical and Electronic Measuring and Testing Equipment) CSA C22.2 No. 231 (Std. for Electrical and Electronic Measuring and Testing Equipment)

Preparation for Use

This subsection describes how to prepare the AWG2020 Arbitrary Waveform Generator for use. The information describes these items:

- Proper operating environment
- Checking power cord and line voltage configurations
- Checking the fuse
- Power-on and power-off cycles

Operating Environment

To ensure proper AWG2020 operation and long life, note these environmental requirements.

Operating Temperature

The AWG2020 operates in an environment with an ambient air temperature between +10° C and +40° C. The AWG2020 storage temperature ranges from −20° C to +45° C. After storage at temperatures outside the operating limits, allow the AWG2020 chassis to stabilize at a safe operating temperature before applying power.

Ventilation Requirements

Air drawn in and exhausted through the cabinet side and bottom panels cools AWG2020 internal circuits. To ensure proper cooling, allow the following clearances:

Top and back	8 cm (3 in.)
Left and right	16 cm (6 in.)

The feet on the bottom of the AWG2020 cabinet provide the required clearance when it is set on a flat surface. The top of the AWG2020 does not require ventilation clearance.

CAUTION

To prevent temporary shutdown of the AWG2020, do not restrict air flow through the chassis. If the AWG2020 shuts down unexpectedly, improve ventilation around the AWG2020 and wait a few minutes to allow it to cool down; then switch the power on again.

Supplying Power

Before installing the AWG2020, note these precautions:

WARNING

To avoid equipment failure and potential fire or personal shock hazards, do not exceed the maximum rated operating voltage of 250 V between the voltage-to-ground (earth) and either pole of the power source. The AWG2020 operates from a single-phase power source and has a three-wire power cord with a two-pole, three-terminal grounding plug. Also, before making connection to the power source, be sure the AWG2020 has a suitable two-pole, three-terminal grounding-type plug.

To avoid personal shock hazard, do not contact conductive parts. All accessible conductive parts are directly connected through the grounding conductor of the power cord to the grounded (earthing) contact of the power plug. The AWG2020 is safety Class 1 equipment (IEC designation).

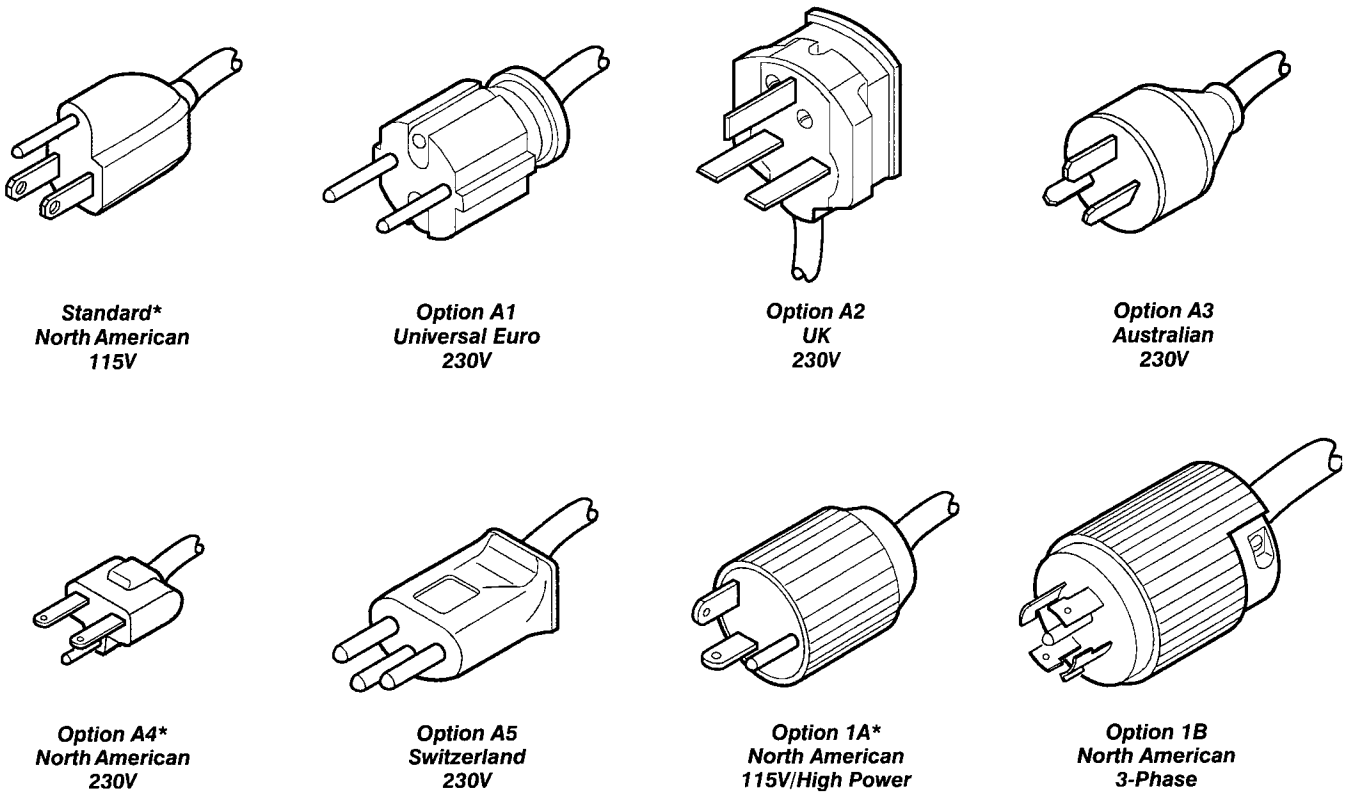
To avoid personal shock hazard, do not defeat the grounding connection. Insert the power input plug only in a mating receptacle with a grounding contact where earth ground has been verified by a qualified service person. Also, for electrical-shock protection, make the grounding connection before making connection to the AWG2020 input or output terminals.

Power Cord Information

The AWG2020 ships with the required power cord as ordered by the customer. Table 2-1 gives the color-coding of the conductors in the power cord. Figure 2-1 shows information on the available power cords.

Table 2-1: Power-cord Conductor Identification

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



Standard
North American
115V

Option A1
Universal Euro
230V

Option A2
UK
230V

Option A3
Australian
230V

Option A4
North American
230V

Option A5
Switzerland
230V

Option 1A
North American
115V/High Power

Option 1B
North American
3-Phase

** Canadian Standards Association certification includes these power plugs for use in the North American power network*

Figure 2-1: Optional Power Cords

Operating Voltage

Section 1, *Specifications*, lists the line voltage and frequency ranges over which the AWG2020 operates.

An arrow on the AWG2020 rear panel indicates the current line voltage setting (see Figure 2-2).

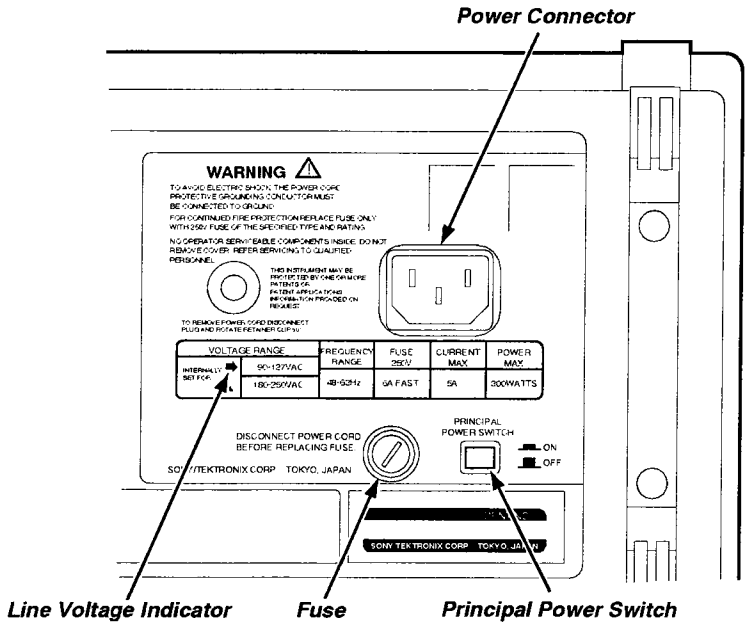


Figure 2-2: Rear Panel Controls

To change the line voltage setting, refer to the subsection, *Procedure for Changing the Line Voltage*, in section 6, *Maintenance*.

Fuse Type and Rating

The AWG2020 uses the same fuse for both line voltage settings. For information about the fuse type and rating, see section 10, *Mechanical Parts List*.

WARNING

To avoid electrical shock, always unplug the power cord from the socket before checking the line fuse.

To check the fuse, remove the fuse holder on the rear panel. Refer to Figure 2-2 for the location of the fuse holder. To remove the fuse holder, turn it counter-clockwise with a screwdriver while pushing it in. Then remove the fuse from the fuse holder.

Applying and Interrupting Power

Consider the following information when you power on or power off the AWG2020 or when external power loss occurs.

Power-on Cycle

At power-on, the start-up diagnostics and calibration check the AWG2020 operation. The start-up diagnostics and calibration take about 40 seconds. If all diagnostic/calibration items complete without error, the AWG2020 displays *Pass* on the screen and then changes to the SETUP menu.

If the diagnostics detect an error, the AWG2020 displays *Fail* and the error code. To exit the diagnostics/calibration menu, press any key; then the system displays the SETUP menu. See section 6, *Maintenance*, for information on diagnostics and fault isolation.

NOTE

If the ambient temperature goes outside the specified operating temperature range, an error occurs during the calibration at power-on. If this happens, power off the AWG2020 and wait until the chassis temperature is appropriate; then switch the power on again.

Power-off Cycle

CAUTION

To prevent loss of internally stored adjustment constants, DO NOT power off the AWG2020 when doing any of the adjustments described in section 5, Adjustment Procedures.

Wait for the AWG2020 to finish the operation when doing internal calibration or adjustments or saving waveform or sequence files. Improper power-off or unexpected loss of power to the AWG2020 can result in the corruption of data stored in nonvolatile memory.

Memory Backup Power

A lithium battery maintains internal nonvolatile memory, allowing the AWG2020 to retain waveform and sequence files if AC power is lost. This battery has a shelf life of about three years. Partial or total loss of stored information at power-on may indicate that the battery needs to be replaced.

WARNING

To avoid risk of fire or explosion, replace the AWG2020 battery with a lithium battery having the part number listed in section 10, Mechanical Parts List. *This battery is a safety-controlled part.*

To avoid risk of fire or explosion, do not recharge, rapidly discharge, or disassemble the battery; and do not incinerate the battery or heat it above 100° C. Also, dispose of used batteries promptly. Small quantities of used batteries can be disposed of in normal refuse. Keep lithium batteries away from children.

Installed Options

Your AWG2020 may include one or more options. To determine which options are installed, power on the AWG2020 and look at the display during the power-on sequence. The AWG2020 lists the installed options after Options, near the top of the display.

Table 2-1 of this subsection gives information about line cord options. Section 7, *Options*, lists other options and optional accessories. For further information and prices of options, see your Tektronix Products catalog or contact a Tektronix Field Office.

Instructions for Operation

Before servicing the AWG2020, read the following operating instructions. These instructions are at the level appropriate for servicing the AWG2020. The user manual contains complete operator instructions.

In addition, section 4, *Performance Verification*, includes instructions for making the front-panel settings required to check AWG2020 characteristics.

How to Power On

To power-on the AWG2020, follow these steps:

1. Set the PRINCIPAL POWER SWITCH (on the back of the AWG2020) to the ON position. This switch is the main power switch; it routes power to the standby circuit in the AWG2020.
2. Then, press the ON/STBY (standby) switch on the front (lower-left corner) of the AWG2020. This switch applies power to the remaining circuits of the AWG2020. Allow at least 20 minutes for the AWG2020 to warm up.

WARNING

To avoid personal shock hazard, turn off both the ON/STBY switch and the PRINCIPAL POWER SWITCH before servicing. The PRINCIPAL POWER SWITCH on the rear panel is the true power disconnect switch. The ON/STBY (standby) switch simply toggles operation on and off. When connected to a power source and when the PRINCIPAL POWER SWITCH is on, the internal power supplies and much of the other circuitry of the AWG2020 remain energized regardless of the setting of the ON/STBY switch.

To avoid personal shock hazard, set the PRINCIPAL POWER SWITCH off before connecting or disconnecting the line cord to or from the power source.

Internal Diagnostics and Calibration Routines

At power-on, the AWG2020 performs internal start-up diagnostics. These diagnostics check internal circuit function and report any failures. In addition, you can initiate internal diagnostics; these diagnostics differ from the start-up diagnostics in that they do more extensive memory checking.

The AWG2020 also contains internal calibration routines, which check internal circuit function and adjust calibration constants. Run these calibration routines at power-on or whenever the AWG2020 undergoes a tempera-

ture change. For instance, run the calibration routines after the AWG2020 warms up at power-on. This warmup period and subsequent calibration assures AWG2020 operation at optimum performance levels.

User Interface

The AWG2020 uses a combination of front-panel buttons, keys, a knob, and on-screen menus to control generator functions. Some front-panel controls select menus and manipulate menu items. Others enter values and units, allow manual triggering, and turn on/off AWG2020 output. On-screen graphics show various aspects of the current AWG2020 configuration.

On-screen menus set all AWG2020 functions except manual triggering and output control. Main menus provide access to lower-level nested submenus. Buttons in the center of the front panel select the main menus.

When you select a menu, the display shows the items controlled by that menu and numeric values currently in effect. Buttons around the display select lower-level menus, change menu selections, modify numeric values and units, and execute functions.

Display

Figure 2-3 contains two examples of AWG2020 displays. To see the first display on the AWG2020, press **Edit** in the MENU column; then press **New Waveform** in the side menu. The second display shows an example of the message area. Text after the illustration describes each display feature.

Status Area — The status of the AWG2020 always appears in the status line. Status information includes the interface status (refer to programmer manual), operating mode status, trigger status (refer to user manual), and busy icon (a clock) which appears while loading or saving waveform or sequence files.

Knob Icon — The knob icon appears next to an item that is selected. To change the value of the item use the general purpose knob or press the numeric and units keys.

Button Operation — This area includes an explanation of front panel operation.

Message Area — This area displays messages for the user.

Error Display Area — If an error occurs during operation, this area displays an error message.

Side Menu Label — This area displays a label that matches the bottom menu that was selected.

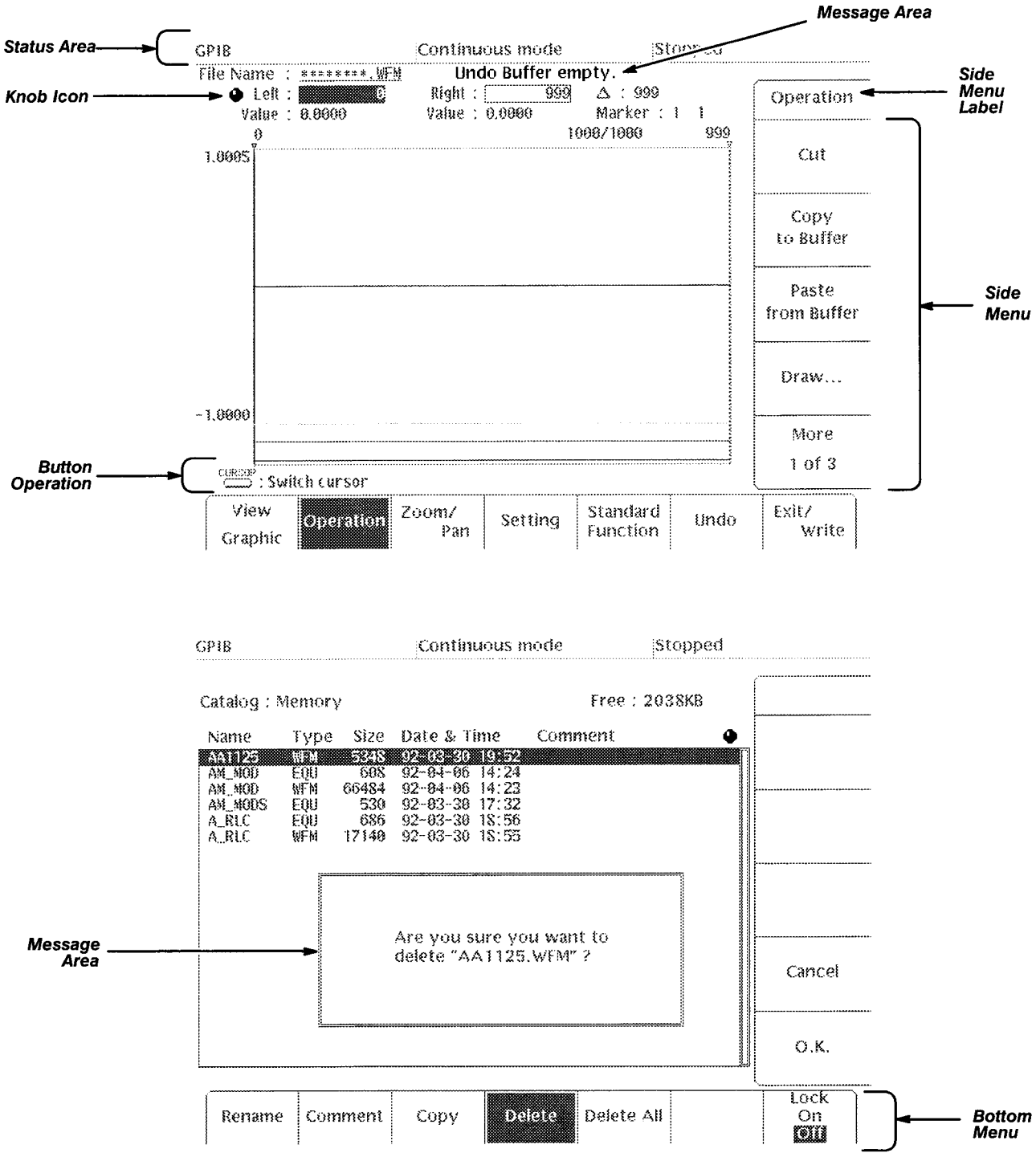


Figure 2-3: Display Features

Side Menu Items — When you select an item from the bottom menu, the corresponding side menu appears on the right side of the screen. To select an item, input numerals, or execute functions, push the soft button corresponding to the side menu item.

Bottom Menus — Pushing any button of the MENU column or the F.G button displays the corresponding bottom menu in the lower part of the screen. To select an item from a bottom menu, push the corresponding soft button.

Menus

The AWG2020 operation is primarily controlled by means of menus that correspond to the SETUP, MODE, EDIT, LOAD/SAVE and UTILITY buttons in the MENU column. To display one of these main menus on the screen, push the corresponding button. The button LED indicates which menu is currently selected. Refer to the User Manual for more details concerning these menus. The F.G button under the MENU column selects function generator operation.

- **SETUP Menu** — The SETUP menu sets the following waveform output parameters for each channel: clock frequency, waveform or sequence file selection, operation, filter, amplitude, and offset.
- **MODE Menu** — This menu sets the operation output mode. The operation modes are the trigger modes (Cont, Triggered, Gated, and Burst) and the modes which display a waveform in sequence for each trigger (Waveform Advance and Auto Step modes). This menu also has an item for setting the timing used to generate synchronization signals.
- **EDIT Menu** — The EDIT menu allows you to edit an existing file saved in internal memory or to create a new file. To modify files in internal memory, use one of the four editors, depending on the waveform file type: waveform edit, sequence edit, equation edit, and autostep edit. With Option 09 installed, use the FFT editor to edit in the frequency domain.
- **LOAD/SAVE Menu** — Here are the functions for this menu:
  - LOAD menu — loads files from the AWG2020 floppy disk drive or nonvolatile internal memory into internal memory.
  - SAVE menu — saves files from the AWG2020 internal memory onto a floppy disk or into nonvolatile internal memory.
- **UTILITY Menu** — Use this menu to rename or delete files saved in the floppy disk or internal nonvolatile memory, to set the parameters of GPIB or RS-232-C, to set AWG2020 date and time, to change display brightness, to check interface status, and to execute internal diagnosis and calibration routines.

Waveform Files

The AWG2020 generates waveform output from four different types of waveform files:

- *Waveform data file (filename.wfm)*. This is the basic waveform data file. It contains the waveform data that the AWG2020 loads into memory and reads when generating waveform output. The data in this kind of file can be created using the waveform editor, generated from equations made using the equation editor, transferred in over an interface, or directly transferred in from certain Tektronix instruments. In addition, the waveform editor displays the data in a waveform data file in three formats: graphical, table, and timing.
- *Waveform equation file (filename.equ)*. The waveform equation file contains equations that express waveform characteristics. Compilation of the waveform equation file generates a waveform data file. The AWG2020 generates the waveform output from this file.
- *Waveform sequence file (filename.seq)*. The waveform sequence file specifies a series of waveform data files. When the AWG2020 executes a waveform sequence file, it sequentially generates waveforms from each waveform data file, in the order specified.
- *Waveform autostep file (filename.ast)*. The waveform autostep file specifies a series of waveform data files and/or waveform sequence files. When the AWG2020 executes a waveform autostep file, it generates the waveform for the first file specified. Then it waits for a trigger before generating from the next specified file. The autostep file includes output conditions for each channel.

Waveform Storage and I/O

The AWG2020 has both internal memory and internal nonvolatile memory (NVRam) for waveform file storage. The AWG2020 generates waveforms from files residing in internal memory. To save a file that is in internal memory, copy it to nonvolatile memory or floppy disk. Only nonvolatile memory retains files at power-off.

The AWG2020 also has a floppy-disk drive for loading files from floppy disk into internal memory or internal nonvolatile memory and for saving files from either memory to floppy disk. The disk drive accepts 3.5-inch MS-DOS-formatted floppy disks.

Loading Files

The following steps explain how to load files from a floppy disk into internal memory.

1. Push the **LOAD/SAVE** button in the MENU column.
2. Turn the disk so the side with the arrow is on top; insert the disk into the AWG2020 floppy disk drive.

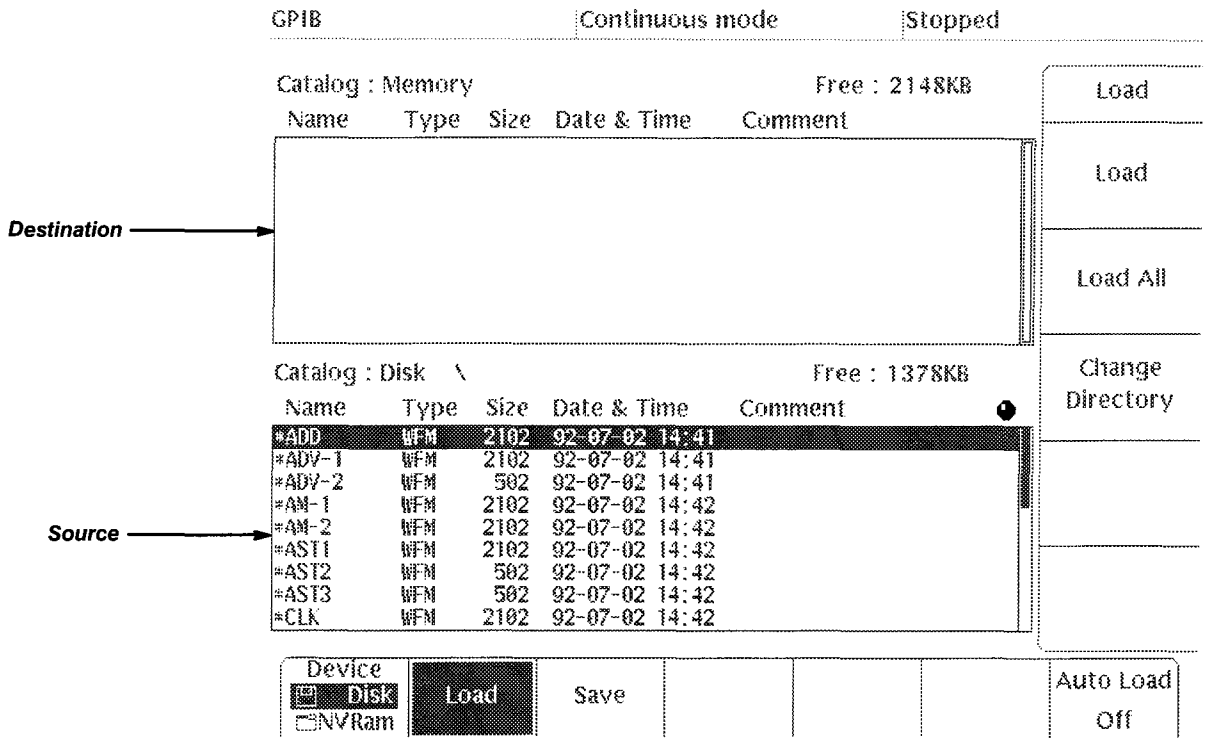


Figure 2-4: LOAD Menu

3. Push the **Device** button along the bottom menu to select **Disk**. The menu in Figure 2-4 appears.
4. Select the **Load All** button along the side menu to load all files in the root directory on the disk into the AWG2020 internal (volatile) memory. Or, turn the general-purpose knob to highlight the file you want to load and select **Load**. The display indicates which file it is loading. When loading is complete, the clock disappears.
5. Push the floppy drive button and remove the disk from the floppy drive.
6. Push any button in the MENU column (other than LOAD/SAVE) to exit the menu.

Setting Output Parameters

The SETUP menu allows you to set various output parameters for outputting a waveform or sequence waveform. To set the output parameters, select a waveform or sequence file (that is already loaded into memory) as the active file.

When you select a file, the AWG2020 changes to the output parameters associated with the file and displays these parameters on the Setup menu. If you modify the displayed output parameters and later save the file, the modified output parameters are saved with the file. (if the file is locked, you cannot modify the file contents.)

The following steps go through the process of selecting a file and modifying individual output parameters.

1. Push the **SETUP** button in the MENU column. The SETUP menu in Figure 2-5 appears.

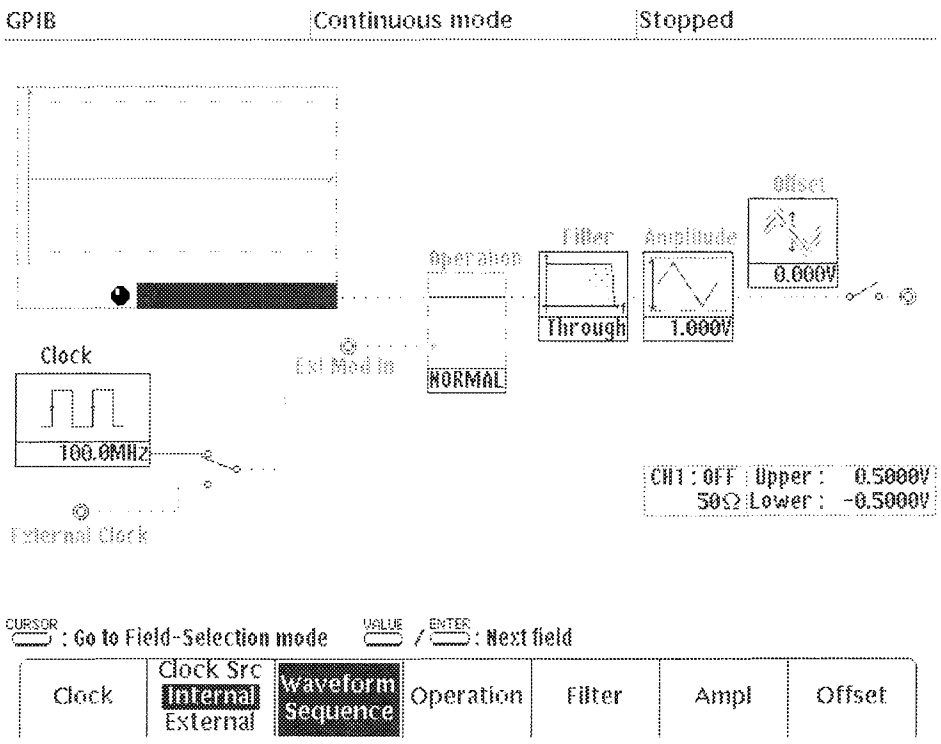


Figure 2-5: SETUP Menu

2. Select **Waveform Sequence** from the bottom menu. Waveform Sequence toggles between the CH1 files (upper list) and the CH2 files (lower list).
3. Turn the general purpose knob to highlight a file in the displayed list of files; these are the files currently in internal memory. Then, push **ENTER** to select the file; the AWG2020 changes to the output parameters associated with the file you selected.
4. After the file is selected, push the front panel **VALUE** button. Now you can modify output waveform parameters.
5. Setting individual parameters:

   Push the **SETUP** button in the MENU column (if the button is not selected). Now select the appropriate item from the bottom menu; then use the numeric keys or general purpose knob to modify the parameter setting.

The following explains each item in the bottom menu.

- **Clock** — This item sets the clock frequency. The product of the clock period and the number of waveform points is the waveform or sequence period. For example, if the clock frequency is 1 MHz (period of 1 μs) and there are 100 waveform points, the waveform period is displayed as 100 μs. With Option 02 (the CH2 output option) installed, the CH2 clock is the CH1 clock frequency divided by any value entered for Clock/Divider.
- **Clock Src** — This item selects the clock source. Select either Internal or External.
- **Operation** — This item performs an arithmetic operation between the CH1 waveform and another waveform and outputs the result at the CH1 output connector. The operations are addition (ADD) and multiplication (AM, EXT AM).

  If the AWG2020 has only a single channel, the items available are EXT AM and NORMAL. With Option 02 (the CH2 output option) installed, the operations available are ADD, AM, EXT AM, and NORMAL.
- **Filter** — This item selects a filter that restricts the frequency band for the output channel. Choose a 50, 20, 5, or 1 MHz filter, or you can select Through (no filter).
- **Ampl** — This selection sets the voltage value for the 12-bit, full-scale, output amplitude on the vertical scale. The amplitude can be set in steps of 1 mV within the range from 0.05 V to 5 V.
- **Offset** — This item sets the offset level of the output waveform. The offset can be set in steps of 5 mV within the range ±2.5 V.

Operation Mode Settings

The MODE menu initiates the waveform output with the output conditions set using the SETUP menu.

1. Push the **MODE** button in the MENU column. The MODE menu in Figure 2-6 appears.
2. Select the operation mode from the bottom menu. The operation modes are Cont, Triggered, Gated, Burst, Waveform Advance, and Autostep.

   In all modes except Cont, the trigger or gate signal source can be the external signal applied to the TRIGGER INPUT connector or can be generated by pushing the front panel TRIGGER MANUAL button. The following text describes the individual modes.

   - **Cont Mode** — When you push the Cont button, the AWG2020 immediately outputs the specified waveform or sequence waveform, continuously.

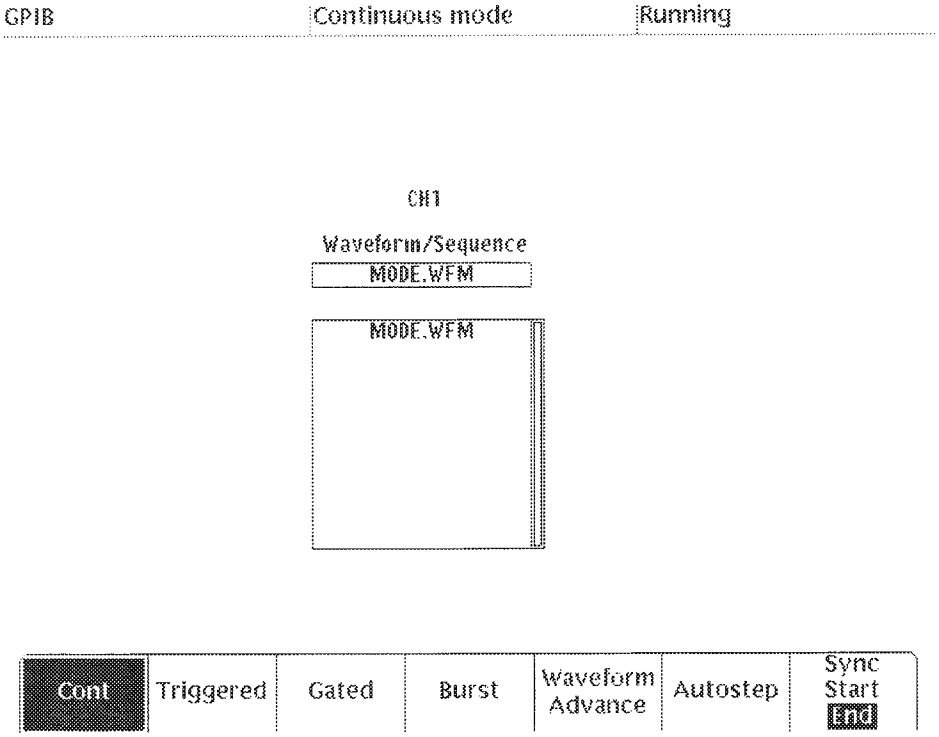


Figure 2-6: MODE Menu

- **Triggered Mode** — In triggered mode, the AWG2020 outputs the specified waveform or sequence waveform once, when a trigger occurs.
- **Gated Mode** — In gated mode, the gate signal controls the waveform or sequence output.

  As long as the front panel MANUAL button is pushed, (or the gating signal is high) the AWG2020 outputs the specified waveform or sequence. When the MANUAL button is released (or the gating signal goes low), the waveform output stops. When the MANUAL button is pushed again, the output resumes from the level at which the waveform or sequence output stopped.
- **Burst Mode** — With a trigger applied in burst mode, the AWG2020 outputs the number of waveforms or sequences set by the burst count. When completed, the waveform output stops.
- **Waveform Advance Mode** — In Waveform Advance mode, the AWG2020 ignores the waveform repetition counts set up for each waveform file in the sequence file and continuously outputs the waveform until the next trigger event.

When the AWG2020 receives a trigger, it changes to output the next waveform in the sequence (after completion of the current waveform). The next waveform output continues until the next trigger event, and so on. After the final waveform in the sequence, output returns to the first waveform in the sequence file. Use the sequence editor to modify the sequence file.

- **Autostep Mode** — Autostep mode uses the waveform file list and output parameter information in an autostep file. In this mode, the AWG2020 outputs one waveform when a trigger occurs, just as in Waveform Advance mode. The difference is that in this mode, the SETUP output parameters change with the waveform data. Also, the operation mode for each step is triggered; the AWG2020 outputs each waveform or sequence output once. Output then stops until the next trigger event. After the AWG2020 generates each waveform in the autostep file, it does not start over with the first file listed. To generate the waveform files again, you must reselect the autostep file for execution. Use the autostep editor to modify the autostep file.

3. Set the trigger (gate) conditions for the external trigger (gate) source.

   When an operating mode other than Cont is selected, the AWG2020 displays a side menu for selecting the trigger (gate) conditions for the external trigger (gate) source. The following describes each of these items.

   - **Slope** — This item sets the slope for external trigger signals. To select a positive or negative slope, push the side menu Slope button. For a positive slope, the AWG2020 applies the trigger at the rising edge of the external trigger signal; for a negative slope, the trigger is applied at the falling edge of the external trigger signal.
   - **Polarity (Gated Mode)** — This item sets the polarity for the gate that outputs the waveform or sequence based on the level of the external gate signal. To set the polarity, push the side menu Polarity button. For a positive polarity, the AWG2020 outputs the waveform or sequence waveform while the gate signal level is higher than the gate level parameter set with the side menu Level item. For negative polarity, waveform output occurs while the gate signal level is lower.
   - **Level** — This item sets the external trigger (gate) signal level. To set this parameter, push the side menu Level button, then use the numeric keys or the general purpose knob to change the value. The trigger (gate) level can be set in steps of 0.1 V within the range from −5.0 V to 5.0 V.
   - **Impedance** — This item sets the input impedance for the external trigger (gate) source to either 50 Ω or 1 M Ω. To select the value for this parameter, push the side menu Impedance button.

Theory of Operation

This section describes the basic operation of the major circuit blocks or modules in the AWG2020. Section 9, *Diagrams*, includes two block diagrams and an interconnect diagram. Figure 9-1 shows the modules and functional blocks of the AWG2020 with Option 02 and 09 installed. Figure 9-2 is a block diagram of the AWG2020 with Option 03 and 09. Figure 9-3 shows how the modules interconnect.

Module Overview

The module overview describes the basic operation of each functional circuit block.

The AWG2020 Arbitrary Waveform Generator is a portable, single- or dual-channel instrument. For each channel, the AWG2020 reads the digital waveform data loaded into its waveform memory. The point rate clock determines the rate at which the data is read. The AWG2020 converts the data from digital to analog format and outputs the resulting arbitrary waveform.

Clock Synthesizer (A10, Synthesizer Board)

The clock synthesizer circuit is a PLL oscillator that uses a 12.8 MHz reference crystal. It supplies a point rate clock that is adjustable from 250 MHz to 10 Hz for reading data from CH1 waveform memory. The point rate clock is also divided and used for reading data from Option 02 CH2 waveform memory.

When an external clock source is selected, the external clock signal is passed directly through to the Control board and used for reading waveform data in memory. With Option 02 installed, the CH2 clock divider still divides the external clock source based on the selected ratio, thus allowing CH 2 to vary its clock rate.

CH1/CH2 Clock Divider (A21/A31, Control Board)

The clock divider circuit divides the clock signal from the Synthesizer board. The resulting clock is the point rate clock used for reading waveform data from the CH1 or CH2 waveform memory.

Waveform Memory Control (A21, Control Board)

This waveform memory control block controls the waveform memory addresses read out according to the contents of a sequence file.

Waveform Memory (A2, Memory Board)

This functional block contains the memory that holds the waveform digital data. The memory is divided into 8 banks; its output is multiplexed. There are 12 bits for waveform data and two bits for waveform markers (for each channel).

Digital-to-Analog Converter (DAC) (A2, Memory Board)

This functional block is a 12-bit high-speed digital-to-analog converter. It converts the digital data from the waveform memory into analog signals.

Analog Processing (A3, Analog Board)

This analog processing block amplifies the analog signals from the DAC to the necessary amplitude. If an offset is specified, this circuit adds that offset and outputs the result at the output connector for that channel. This circuit also contains a filter, an AM modulator, and other elements that modify waveform output. Its output impedance is 50 Ω.

CPU and Memory (A6, CPU Board)

This functional block directs operation of all internal circuits, based on front panel control operation and commands received over the GPIB or RS-232-C interface. This circuit includes the 68000 CPU, DRAM, EPROM, SRAM. Data in memory is retained by a lithium battery on the A5 Backplane board.

CAUTION

To avoid losing waveform data files stored in NVRam, save the files to a floppy disk before removing the A6 CPU board or A5 Backplane board. Then, restore the files from floppy disk to AWG2020 NVRam after reinstalling the board(s).

GPIB (A6, CPU Board)

This functional block is the General Purpose Interface Bus (GPIB) interface driver, which controls communication with external devices over the parallel interface. The GPIB connector is on the rear panel.

RS-232-C (A6, CPU Board)

This functional block is the RS-232-C interface circuit which controls serial communication with external devices over the RS-232-C interface. The RS-232-C interface connector is on the rear panel.

Display Control (A6, CPU Board)

The display control block processes the test and waveform information based on commands from the processor. The block sends the text and waveform information to the display monitor as video signals, with vertical and horizontal sync control.

Display Monitor

This display monitor takes in the video signals and displays them on a 17.8 cm (7 in.) CRT screen. The display resolution is 480 × 640 pixels.

Front Panel (A12, Keyboard)

The front panel block includes the buttons, keys, knobs, and so on, for entering selections. User selections from the front panel are sent to the processor. The buttons at the bottom and side of the display are also included in this block. Commands from the processor control the LED in the buttons.

Floppy Disk Drive

The 3.5-inch floppy disk drive supports both 2DD and 2HD MS-DOS formats.

Low Voltage Power Supply (A4 Power Board)

This functional block is a switching-type power supply that converts the line voltage into the various voltages required for internal circuit operation. The Power board (A4) is also part of this block; it generates the voltage required for the analog circuits.

The line voltage setting can be switched between 115 VAC and 230 VAC (by an internal jumper).

CAUTION

To prevent possible damage to AWG2020 internal circuits, do not change the selected line voltage without also changing the ID label on the AWG2020 rear panel. The ID label indicates which line voltage is currently selected.

Fan

The fan prevents heat build-up inside the cabinet; it pulls air into the right (floppy-disk) side of the AWG2020 and exhausts it out the left side.

Options

The following three options which modify AWG2020 operation are available.

- **Option 02: Second Output Channel**
  This option adds a second waveform output channel. It includes a Control board and an Analog board for Channel 2.
- **Option 03: Digital Data Out**
  This option directly outputs the digital data in the waveform memory without passing it through the digital-to-analog converter. This option and Option 02 cannot both be installed.
- **Option 09: Floating Point Processor**
  This option is a card dedicated to floating point processing. It provides the capability to edit in the frequency domain and it speeds up internal calculations.

For more information about these and other options, see section 7, *Options*.

Before Verification

This subsection describes the verification procedures in this section, indicates when to use the procedures, and gives conventions used in their structure. The procedures in this section are:

- Self Tests
- Performance Tests

Preparation

These procedures verify the AWG2020 Arbitrary Waveform Generator functionality. Which procedure to do depends on your goal:

- To quickly confirm that the AWG2020 functions correctly and was adjusted properly, do the procedures under *Self Tests*, which begin on page 4-3.

  Advantages: These procedures are short, require no external equipment, and perform extensive functional and accuracy testing. Use them to quickly determine if the AWG2020 is suitable for putting into service, such as when it is first received.

- For a more extensive confirmation of performance, do the *Performance Tests*, beginning on page 4-7 after doing the *Self Tests*.

  Advantages: These procedures involve direct checking of warranted specifications. They require more time and suitable test equipment. (See *Equipment Required* on page 4-8.

Before starting any of these procedures, read *Instructions for Operation* in section 2 of this manual. These instructions briefly describe the AWG2020 front-panel controls and menu system. The user manual contains detailed information on operating the AWG2020.

Conventions

Throughout the procedures in this section, the following conventions apply:

- Each test procedure uses the following general format:
  - Title of Test
  - Equipment Required
  - Prerequisites
  - Procedure

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

    1. First Step
        a. First Substep
            - First Subpart
            - Second Subpart
        b. Second Substep
    2. Second Step

- Instructions for menu selection follow this format: **FRONT PANEL BUTTON→Main Menu Button→Side Menu Button**. For example, "Press **UTILITY→Misc→Reset to Factory→O.K.**"
- Where instructed to use a front-panel button, key, or knob, or select from the MENU column, or from a bottom or side menu, the name of the item appears in boldface type: "push **MODE**, " or "select **Burst** in the bottom menu."

Self Tests

This subsection describes how to use AWG2020 internal self-test routines. No equipment is required to do these procedures. The self tests include these internal routines:

- Diagnostics

  This self-test procedure uses internal routines to verify that the AWG2020 functions, and passes the internal circuit tests.

- Calibration

  The second procedure checks the AWG2020 internal calibration constants and changes them if needed.

Diagnostics

The internal diagnostic routines check AWG2020 characteristics such as amplitude, offset, trigger level, clock, filters, X5 output amplifier, and attenuation.

The AWG2020 automatically performs the internal diagnostics at power-on; you can also run the internal diagnostics using the menu selections described in this procedure. The difference between these two methods of initiating the diagnostics is that the menu method does more detailed memory checking than the power-on method.

Equipment Required: None.

Prerequisites: Power on the AWG2020 and allow a twenty-minute warmup period before doing this procedure.

Procedure:

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

   a. *Display the diagnostics menu and select all tests*: Push **UTILITY→Diag/Cal→Diagnostics xxxx→All**. See the menu in Figure 4-1.

      The list on the left shows the tests available for diagnostics and calibrations. In addition to selecting all of the tests shown for either diagnostics or calibrations, you can select only the test(s) you want to run using the general purpose knob. In Figure 4-1, the symbol to the left of Cpu indicates that test is one of the tests selected. The Interactive Test area is reserved for manufacturing at the factory.

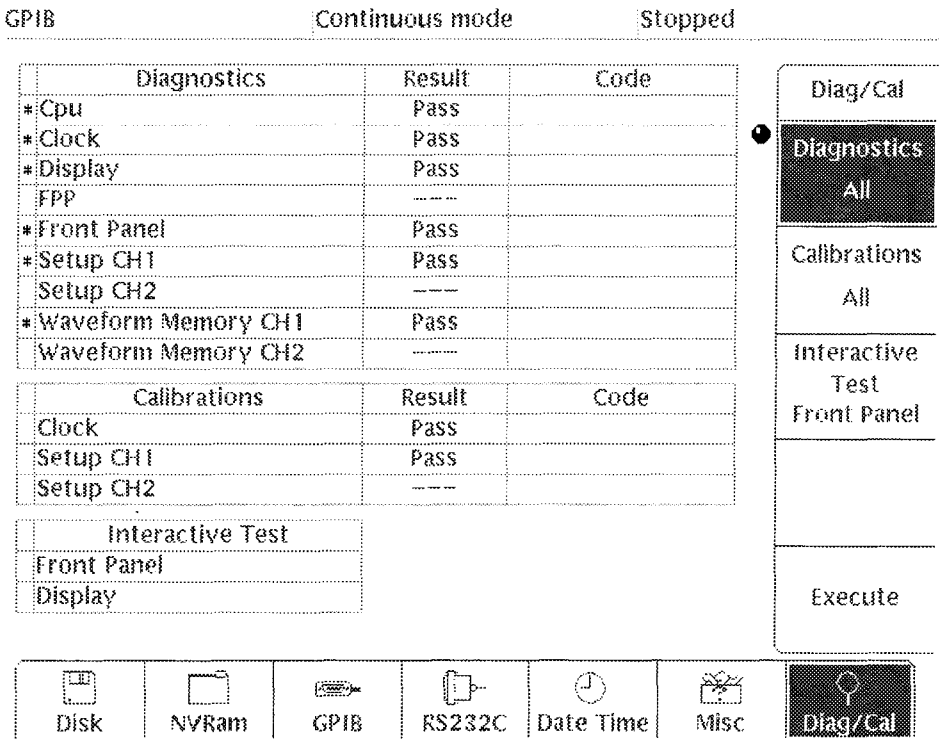


Figure 4-1: Diag/Cal Menu

b. *Run the diagnostics*: Select **Execute** from the side menu. This executes all the AWG2020 diagnostics automatically.

c. *Wait*: The internal diagnostics do an extensive verification of AWG2020 functions. This verification takes about one minute. While it progresses, the screen displays the clock icon. When finished, the resulting status appears on the screen.

d. *Confirm that no failures are found*: Verify that no failures are found and reported on-screen. If the diagnostics displays FAIL as the result of any test, use the instructions in section 6, *Troubleshooting,* to identify the faulty module. If the diagnostics display an error code, contact your nearest representative.

2. *Return to regular service*: Push a button (other than UTILITY) in the MENU column to exit the diagnostic menu.

Calibration

The AWG2020 includes internal calibration routines that check electrical characteristics such as amplitude, offset, trigger level, clock, filters, X5 output amplifier, and attenuation and adjust internal calibration constants as necessary. This procedure describes how to do the internal calibration.

Equipment Required: None.

Prerequisites: Power on the AWG2020 and allow a 20 minute warmup period before doing this procedure.

Procedure:

1. *Verify that internal adjustments pass:* Do the following substeps to verify passing of internal adjustments.
   a. *Display the diagnostics menu and select all tests*: Push **UTILITY→Diag/Cal→Calibrations xxxx→All.** See the menu in Figure 4-1.
   b. *Run the adjustments routine*: Select **Execute** from the side menu. This executes the AWG2020 calibration routines automatically.
   c. *Wait*: The internal calibration does an exhaustive verification of proper AWG2020 function. This verification takes about 12 seconds. While it progresses, the clock icon appears on screen. When finished, the resulting status will appear on the screen.
   d. *Confirm that no failures are found*: Verify that no failures are found and reported on-screen. If the calibration displays FAIL as the result, use the instructions in section 6, *Troubleshooting,* to identify the faulty module. If an error code is displayed, contact our nearest representative.
2. *Return to regular service*: Push any button (other than UTILITY) in the MENU column to exit the diagnostic menu.

NOTE

The interactive tests on the diagnostics screen are for manufacturing use at the factory.

Performance Tests

This subsection contains a series of procedures for checking that the AWG2020 Arbitrary Waveform Generator performs as warranted.

The procedures are arranged in nine logical groupings, presented in the following order:

- Operating Mode Checks
- Arithmetic Operation Checks
- Clock Frequency and Amplitude Checks
- Gain and Offset Accuracy Checks
- Pulse Response Check
- SYNC Out and MARKER Out Amplitude Checks
- External Trigger Level Accuracy Check
- External CLOCK IN Check
- Digital Data Out Check

These procedures extend the confidence level provided by the internal diagnostic and calibration routines described on page 4-3.

Prerequisites

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

- You must have performed and passed the calibration procedure described in *Self Tests*, the previous subsection.
- The AWG2020 must have passed the calibration procedure mentioned above or must have been adjusted using the adjustment procedure in section 5 at an ambient temperature between +20° C and +30° C, must have been operating for a warm-up period of at least 20 minutes, and must be operating at an ambient temperature between 0° C and +50° C.

NOTE

For operation to specified accuracy, allow the AWG2020 to warm up at least 20 minutes before doing the performance tests.

- Load all the files from the Performance Check/Adjustment disk (063-0969-xx) that comes with this manual into AWG2020 internal memory. For instructions on loading files, see *Loading Files* on page 2-11 in the *Instructions for Operation* subsection in section 2.

Related Information

Read *Preparation* and *Conventions* on page 4-1. Also, if you are not familiar with operating the AWG2020, read the subsection, *Instructions for Operation,* in section 2 before doing any of these procedures.

Equipment Required

The following equipment is required to check the performance of the AWG2020.

Table 4-1: Test Equipment

Item Description	Minimum Requirements	Example	Purpose
Precision termination	Impedance: 50 Ω, 0.1% Connectors: BNC	Tektronix Part 011-0129-00	Signal termination.
Adapter	Connectors: BNC female-to-dual banana	Tektronix Part 103-0090-00	Signal interconnection.
Adapter	Connectors: SMA male-to-BNC female	Tektronix Part 015-0554-00	Signal interconnection.
BNC dual input (TEE) adapter	Connectors: BNC	Tektronix Part 103-0030-00	Signal interconnection.
BNC cable (4 required)	Impedance 50 Ω Connectors: BNC Length: 43 inches	Tektronix Part 012-0057-01	Signal interconnection.
Termination board	Must use example equipment	Tektronix Part 671-2957-00	Used to check digital data output (Option 03).
Cable	Must use example equipment	Tektronix Part 012-1408-00	Used to check digital data output (Option 03).
Test leads	Must use example equipment	Tektronix Part 012-1381-00	Used to check digital data output (Option 03).
Test oscilloscope	Bandwidth: >250 MHz	Tektronix TDS500 Series Digitizing Oscilloscope or 2400 Series Digitizing Oscilloscope	Checks output signals. Used in many procedures.
Frequency counter	Frequency range: 10 Hz to 250 MHz	Tektronix DC 5010 Programmable Universal Counter/Timer*	Used to check clock frequency.

Table 4-1: Test Equipment (Cont.)

Item Description	Minimum Requirements	Example	Purpose
Digital multimeter	DC volts range: 0.05 V to 5 V Accuracy: ±0.1%	Fluke 8842A	Used throughout the checks to measure voltage.
Function generator	Output voltage: −5 V to 5 V	Tektronix FG 5010 Programmable Function Generator*	Used to input the trigger signal.
Power supply	Output voltage: −2 V	Tektronix PS 5010 Programmable Power Supply*	Used to check digital data output (Option 03).
Performance Check/ Adjustment disk	Must use example listed	Tektronix Part 063-0969-xx	Used throughout the checks to provide waveform files.

*Requires a TM 5000 Series Power Module Mainframe

Performance Check/Adjustment Files

Table 4-2 lists the waveform files on the Performance Check/Adjustment disk (063-0969-xx) that are used in these performance tests, the AWG2020 front-panel settings that each file sets up, and the performance test that uses each file.

NOTE

*The files on the Performance Check/Adjustment disk are locked (the files names are displayed with *), so the data in these files cannot be changed unless the lock is opened. The file data includes not only waveform data, but also output parameters.*

When you select a file with the Waveform Sequence item, the AWG2020 output parameters change to those specified in the file, and the waveform output reflects waveform data in the file. After selecting a file, do not change an output parameter with the SETUP menu unless a procedure instructs you to do so. During the procedures, if you are unsure that the AWG2020 settings still match the file's settings, select the waveform again using the Waveform Sequence item on the SETUP menu.

Table 4-2: File List for Performance Check/Adjustment Disk

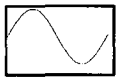
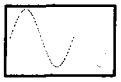
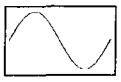
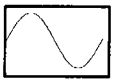
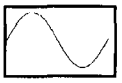
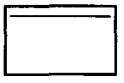
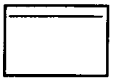
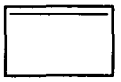
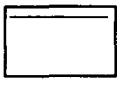
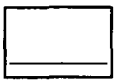
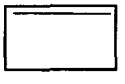
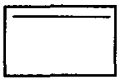
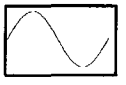
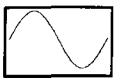
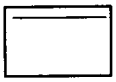
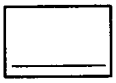
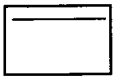
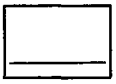
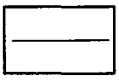
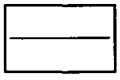
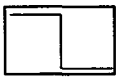
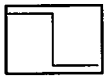
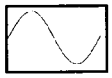
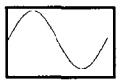
No.	File Name		EDIT Menu		SETUP Menu					Usage
			Wfm Shape	Wfm Point	Clock	Operation	Filter	Ampl	Offset	
1	MODE.WFM			1000	100 MHz	NORMAL	Through	1 V	0 V	Cont Mode, Triggered Mode, Burst Mode, Gated Mode
2	MODE_ADV.SEQ ADV-1.WFM ADV-2.WFM			1200 1000 200	100 MHz	NORMAL	Through	1 V	0 V	Waveform Advance Mode
3	MODE_AST.AST Step: 1 AST-1.WFM			1000	250 MHz	NORMAL	Through	3 V	0 V	
	Step: 2 AST-2.WFM			200	150 MHz	NORMAL	Through	1.5 V	0 V	Autostep Mode
	Step: 3 AST-3.WFM			200	25 MHz	NORMAL	Through	0.5 V	0 V	
4	OPE.AST Step: 1 EXT_AM.WFM	(CH1)		1000	1 MHz	EXT AM	Through	5 V	0 V	External AM Operation
	Step: 2 AM-1.WFM	(CH1)		1000	1 MHz	AM	Through	5 V	0 V	
	AM-2.WFM	(CH2)		1000	1 MHz	– – –	Through	5 V	2.5 V	
	Step: 3 AM-1.WFM	(CH1)		1000	1 MHz	AM	Through	5 V	0 V	Internal AM Operation
	AM-3.WFM	(CH2)		1000	1 MHz	– – –	Through	5 V	−2.5 V	
	Step: 4 ADD.WFM	(CH1)		1000	1 MHz	ADD	Through	5 V	0 V	Internal ADD Operation
	ADD.WFM	(CH2)		1000	1 MHz	– – –	Through	5 V	0 V	
5	CLK_FREQ.WFM			1000	250 MHz	NORMAL	Through	1 V	0 V	Clock Frequency Accuracy
6	CLK_AMPL.WFM			1000	1 MHz	NORMAL	Through	1 V	0 V	Clock Amplitude

Table 4-2: File List for Performance Check/Adjustment Disk (Cont.)

No.	File Name	EDIT Menu		SETUP Menu					Usage
		Wfm Shape	Wfm Point	Clock	Operation	Filter	Ampl	Offset	
7	GAIN_OFF.AST Step: 1 GAIN-1.WFM		1000	1 MHz	NORMAL	Through	0.25 V	0 V	
	Step: 2 GAIN-2.WFM		1000	1 MHz	NORMAL	Through	−0.25 V	0 V	Gain Accuracy
	Step: 3 GAIN-3.WFM		1000	1 MHz	NORMAL	Through	2.5 V	0 V	
	Step: 4 GAIN-4.WFM		1000	1 MHz	NORMAL	Through	−2.5 V	0 V	
	Step: 5 OFFSET-1.WFM		1000	1 MHz	NORMAL	Through	0.05 V	1.25 V	
	Step: 6 OFFSET-2.WFM		1000	1 MHz	NORMAL	Through	0.05 V	−1.25 V	Offset Accuracy
8	PULSE.WFM		64	250 MHz		Through	0.5 V	0 V	Pulse Response
9	SYNC_MKR.WFM		200	1 MHz		Through	1 V	0 V	SYNC Out and MARKER OUT Amplitude
10	TRG_IN.WFM		1000	100 MHz		Through	1 V	0 V	External Trigger Level Accuracy
11	EXT_CLK.WFM		1000	External Clock		Through	1 V	0 V	External Clock In

Operating Mode Checks

These procedures check operation of the Cont, Triggered, Burst, Gated, Waveform Advance, and Autostep modes.

Check Cont Mode

Electrical Characteristic Checked: Operating mode, Continuous, on page 1-5.

Equipment Required: A 50 Ω coaxial cable and an oscilloscope.

Prerequisites: The AWG2020 must meet the prerequisites listed on page 4-7.

Procedure:

1. *Install the test hookup and set test equipment controls:*

   a. *Hook up the oscilloscope:* Connect the AWG2020 CH1 output connector through the coaxial cable to the CH1 vertical input connector on the oscilloscope (see Figure 4-2).

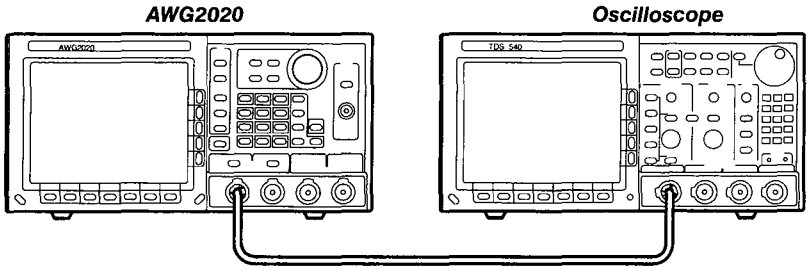


Figure 4-2: Cont Mode Initial Test Hookup

   b. *Set the oscilloscope controls:*

Vertical:	CH1
CH1 coupling:	DC
CH1 scale	0.2 V/div.
CH1 input impedance:	50 Ω
Horizontal	
Sweep	5 µs/div.
Trigger	
Source	CH1
Coupling	DC
Slope	Positive
Level	−100 mV
Mode	Auto

2. *Set the AWG2020 controls and select the waveform file:*

   a. *Initialize AWG2020 controls:* Push **UTILITY→Misc→Reset to Factory→O.K.**

   b. *Select the file:*

   - Push **SETUP→Waveform Sequence**, if necessary, to select a waveform file for CH1. Waveform Sequence toggles between the CH1 files (upper list) and the CH2 files (lower list).
   - Turn the general purpose knob to display the list of waveform files and highlight the **MODE.WFM** file.

- Push **ENTER** to select the file. This button is located to the lower-right of the numeric keypad.

3. *Turn on the AWG2020 CH1 output:* Push the **CH1** button so that the LED above the CH1 output conector is on.
4. *Check against limits*: Check that the amplitude of the sine wave displayed on the oscilloscope is 5 vertical divisions and that 5 cycles of the waveform are displayed.
5. *If Option 02 is installed* (Option 02 adds the CH2 output channel): Repeat this procedure, connecting the oscilloscope to the AWG2020 CH2 output connector, pushing **Waveform Sequence** to select the waveform for CH2, and turning on the CH2 output.
6. *End procedure:* Disconnect the oscilloscope.

Check Triggered Mode

Electrical Characteristic Checked: Operating mode, Triggered, on page 1-5.

Equipment Required: Two 50 Ω coaxial cables, a function generator, and an oscilloscope.

Prerequisites: The AWG2020 meets the prerequisites listed on page 4-7.

Procedure:

1. *Install the test hookup and set test equipment controls:*
   a. *Hook up the oscilloscope:* Connect the AWG2020 CH1 output connector through the coaxial cable to the CH1 vertical input connector on the oscilloscope.
   b. *Hook up the function generator:*
      - Connect the AWG2020 TRIGGER INPUT connector though a coaxial cable to the function generator output connector (see Figure 4-3).

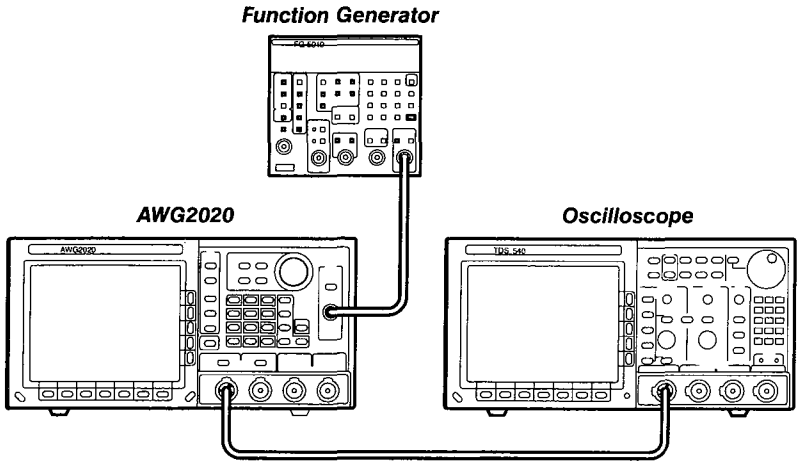


Figure 4-3: Triggered Mode Initial Test Hookup

c. *Set the oscilloscope controls:*

Vertical:	CH1
CH1 coupling:	DC
CH1 scale	0.2 V/div.
CH1 input impedance:	50 Ω
Horizontal	
Sweep	10 µs/div.
Trigger	
Source	CH1
Coupling	DC
Slope	Positive
Level	+100 mV
Mode	Auto

d. *Set the function generator controls:*

Function	Square
Mode	Continuous
Parameter	
Frequency	1 Hz
Amplitude	4 V
Offset	2 V
Output	Off

2. *Set AWG2020 controls and select the waveform file:*

   a. *Initialize AWG2020 controls:* Push **UTILITY→Misc→Reset to Factory→O.K.**

   b. *Modify the AWG2020 default settings:*

   - Push **MODE→Triggered→Slope** to select Positive slope.

- Select **Level** from the side menu and turn the general purpose knob to select a 1 V trigger level.
- Select **Impedance** from the side menu to select 50 Ω impedance.

c. *Select the file:*

- Push **SETUP→Waveform Sequence**, if necessary, to select a waveform file for CH1. Waveform Sequence toggles between the CH1 files (upper list) and the CH2 files (lower list).
- Highlight the **MODE.WFM** file using the general purpose knob.
- Push **ENTER** to select the file.

3. *Turn on the AWG2020 CH1 output:* Push the **CH1** button so that the LED above the CH1 output connector is on.
4. *Check triggered mode with manual triggering*: Push the AWG2020 **MANUAL TRIGGER** button and check that when the button is pushed, the oscilloscope displays a one-cycle sine wave.
5. *Check triggered mode with external triggering:*

   a. *Enable function generator output:* Turn on the function generator output.

   b. *Check triggering:* Check that for each trigger supplied by the function generator, the oscilloscope displays a one-cycle sine wave.
6. *End procedure:* Turn off the function generator output, and disconnect the function generator and oscilloscope.

Check Burst Mode

Electrical Characteristic Checked: Operating mode, Burst, on page 1-5.

Equipment Required: A 50 Ω coaxial cable and an oscilloscope.

Prerequisites: The AWG2020 meets the prerequisites listed on page 4-7.

Procedure:

1. *Install test hookup and set test equipment controls:*

   a. *Hook up the oscilloscope:* Connect the AWG2020 CH1 output connector through the coaxial cable to the CH1 vertical input connector on the oscilloscope (see Figure 4-4).

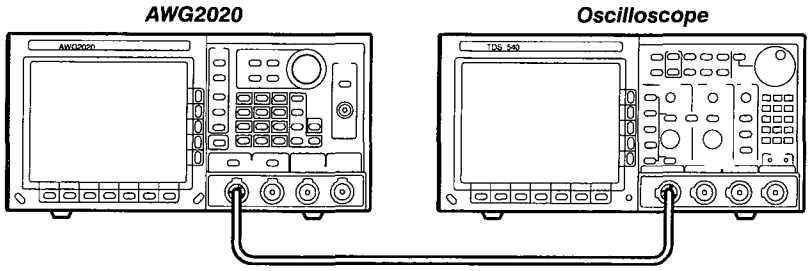


Figure 4-4: Burst Mode Initial Test Hookup

b. *Set the oscilloscope controls:*

Vertical:	CH1
CH1 coupling:	DC
CH1 scale	0.2 V/div.
CH1 input impedance:	50 Ω
Horizontal	
Sweep	10 µs/div.
Trigger	
Source	CH1
Coupling	DC
Slope	Positive
Level	−100 mV
Mode	Auto

2. *Set AWG2020 controls and select the waveform file:*

   a. *Initialize AWG2020 controls:* Push **UTILITY→Misc→Reset to Factory→O.K.**

   b. *Modify the AWG2020 default settings:* Push **MODE→Burst→Burst Count** and turn the general purpose knob to a burst count of 3.

   c. *Select the file:*

   - Push **SETUP→Waveform Sequence**, if necessary, to select a waveform file for CH1. Waveform Sequence toggles between the CH1 files (upper list) and the CH2 files (lower list).
   - Turn the general purpose knob to highlight the **MODE.WFM** file.
   - Push **ENTER** to select the file.

3. *Turn on the AWG2020 CH1 output:* Push the **CH1** button so that the LED above the CH1 output connector is on.

4. *Check burst count*: Push the AWG2020 **MANUAL TRIGGER** button and check that when the button is pushed, the oscilloscope displays three cycles of sine wave.

5. *End procedure:* Disconnect the oscilloscope.

Check Gated Mode

Electrical Characteristic Checked: Operating mode, Gated, on page 1-5.

Equipment Required: Three 50 Ω coaxial cables, a 50 Ω precision termination, a function generator, and an oscilloscope.

Prerequisites: The AWG2020 meets the prerequisites listed on page 4-7.

Procedure:

1. *Install test hookup and set test equipment controls:*

   a. *Hook up the oscilloscope:* Connect the AWG2020 CH1 output connector through the coaxial cable to the CH1 vertical input connector on the oscilloscope.

   b. *Hook up the function generator:* Connect the function generator output to both the AWG2020 TRIGGER INPUT and the oscilloscope CH2 input through a coaxial cable, precision termination, and a dual input coupler (see Figure 4-5).

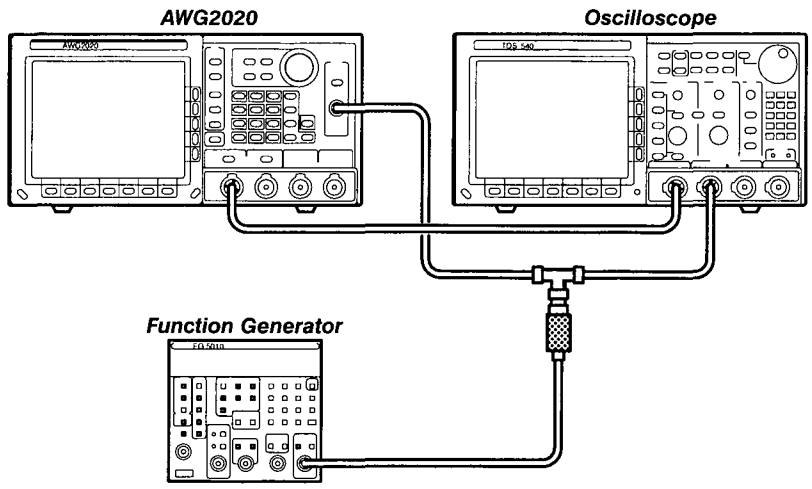


Figure 4-5: Gated Mode Initial Test Hookup

   c. *Set oscilloscope controls:*

Vertical	CH1, CH2
CH1, CH2 coupling	DC
CH1, CH2 scale	0.5 V/div.
CH1 input impedance	50 Ω
CH2 input impedance	1 MΩ
Horizontal	
Sweep	20 µs/div.

Trigger	
Source	CH2
Coupling	DC
Slope	Positive
Level	500 mV
Mode	Auto

d. *Set function generator controls:*

Function	Square
Mode	Continuous
Parameter	
Frequency	1 kHz
Amplitude	4.0 V
Offset	2.0 V
Output	Off

2. *Set the AWG2020 controls and select the waveform file:*

   a. *Initialize AWG2020 controls:* Push **UTILITY→Misc→Reset to Factory→O.K.**

   b. *Modify the AWG2020 default settings:*

   - Push **MODE→Gated→Polarity** to highlight Positive.
   - Select **Impedance** from the side menu to highlight 1 MΩ.

   c. *Select the file:*

   - Push **SETUP→Waveform Sequence**, if necessary, to select a waveform file for CH1. Waveform Sequence toggles between the CH1 files (upper list) and the CH2 files (lower list).
   - Highlight the **MODE.WFM** file, using the general purpose knob.
   - Push **ENTER** to select the file.

3. *Turn on the AWG2020 CH1 output:* Push the **CH1** button so that the LED above the CH1 output connector is on.

4. *Check gated mode with manual trigger:* Push and hold the AWG2020 **MANUAL TRIGGER** button, and check that the oscilloscope continuously displays a sine wave while the MANUAL TRIGGER button is pushed.

5. *Check gated mode with gate signal:*

   a. Change the oscilloscope horizontal sweep setting to 200 µs/div.

   b. *Apply gate signal:* Turn function generator output on.

   c. *Check gated mode with positive gate signal:* Check that the oscilloscope displays a sine wave while the function generator gate signal amplitude is 1 V or greater (see Figure 4-6). Gated level is set to 1.4 V.

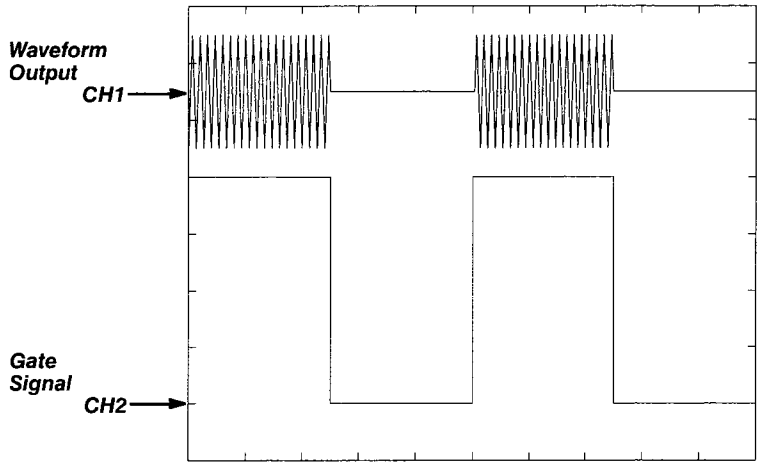


Figure 4-6: Relationship between 1 Volt or Greater Gate Signal and Waveform Output Signal

d. *Change the AWG2020 trigger polarity to negative:* Push **MODE→Polarity** to change the polarity to Negative.

e. *Check gated mode with a negative gate signal:* Check that the oscilloscope displays a sine wave while the function generator gate signal amplitude is 1 V or less.

6. *End procedure:* Turn the function generator output off and disconnect the function generator.

Check Waveform Advance Mode

Electrical Characteristic Checked: Operating mode, Waveform Advance, on page 1-5.

Equipment Required: A 50 Ω coaxial cable and an oscilloscope.

Prerequisites: The AWG2020 meets the prerequisites listed on page 4-7.

Procedure:

1. *Install test hookup and set test equipment controls:*

   a. *Hook up the oscilloscope:* Connect the AWG2020 CH1 output connector through the coaxial cable to the CH1 vertical input connector on the oscilloscope (see Figure 4-7).

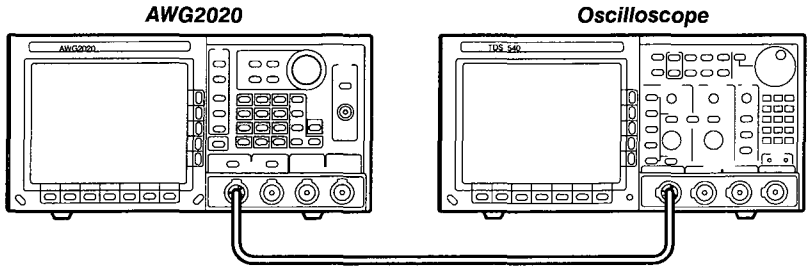


Figure 4-7: Waveform Advance Mode Initial Test Hookup

b. *Set oscilloscope controls:*

Vertical	CH1
CH1 coupling	DC
CH1	0.2 V/div.
CH1 input impedance	50 Ω
Horizontal	
Sweep	5 µs/div.
Trigger	
Source	CH1
Coupling	DC
Slope	Positive
Level	0 V
Mode	Auto

2. *Set the AWG2020 controls and select the waveform file:*

   a. *Initialize AWG2020 controls:* Push **UTILITY→Misc→Reset to Factory→O.K.**

   b. *Set AWG2020 controls:*

   - Push **MODE→Waveform Advance→Slope** to highlight Positive.
   - Select **Level** from the side menu, and turn the general purpose knob to select a 1.0 V level.
   - Select **Impedance** from the side menu to highlight 50 Ω.

   c. *Select waveform file:*

   - Push **SETUP→Waveform Sequence**, if necessary, to select a waveform file for CH1. Waveform Sequence toggles between the CH1 files (upper list) and the CH2 files (lower list).
   - Highlight the **MODE_ADV.SEQ** file using the general purpose knob.
   - Push **ENTER** to select the file.

3. *Turn on the AWG2020 CH1 output:* Push the **CH1** button so that the LED above the CH1 output connector is on.

4. *Check waveform advance:* Repeatedly push the AWG2020 **MANUAL TRIGGER** button, and check that the oscilloscope displays a continuous sine wave that switches between two frequencies at each manual trigger.
5. *End procedure:* Disconnect the oscilloscope.

Check Autostep Mode

Electrical Characteristic Checked: Operating mode, Autostep, on page 1-5.

Equipment Required: Two 50 Ω coaxial cables and an oscilloscope.

Prerequisites: The AWG2020 meets the prerequisites listed on page 4-7.

Procedure:

1. *Install test hookup and set test equipment controls:*
   a. *Hook up the oscilloscope:*
      - Connect the AWG2020 CH1 output through a coaxial cable to the oscilloscope CH1 vertical input.
      - Connect the AWG2020 CH1 SYNC Out output through a coaxial cable to the oscilloscope CH2 vertical input (see Figure 4-8).

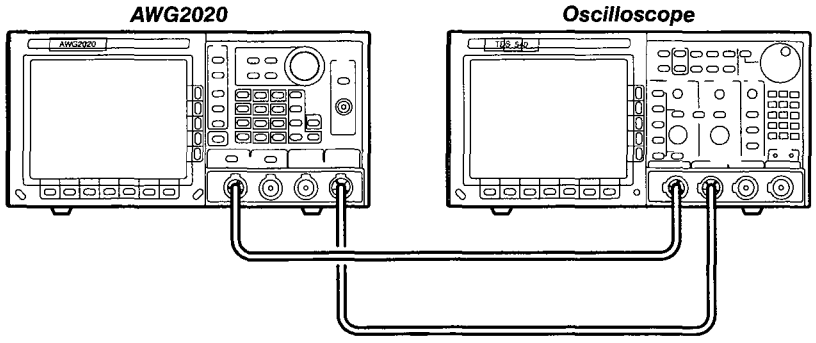


Figure 4-8: Autostep Mode Initial Test Hookup

   b. *Set the oscilloscope controls:*

Vertical	CH1
CH1 coupling	DC
CH1 scale	0.5 V/div.
CH1 input impedance	50 Ω
Horizontal	
Sweep	2 µs/div.

Trigger	
Source	CH2
Coupling	DC
Slope	Positive
Level	100 mV
Mode	Auto

2. *Set the AWG2020 controls and select the waveform file:*
   a. *Initialize AWG2020 controls:* Push **UTILITY→Misc→Reset to Factory→O.K.**
   b. *Modify AWG2020 default settings:*
      - Push **MODE→Autostep→Slope** to highlight Positive.
      - Select **Level** from the side menu, and turn the general purpose knob to select 1 V.
      - Select **Select Autostep File** from the side menu to choose from the file list for CH1.
      - Turn the general purpose knob to highlight the **MODE_AST.AST** file.
      - Push **ENTER**.
      - Select **Start** within the **Sync** frame at the bottom menu.
3. *Turn on the AWG2020 CH1 output:* Push the **CH1** button so that the LED above the CH1 output connector is on.
4. *Check autostep mode:* Push the AWG2020 **MANUAL TRIGGER** button, and check that the oscilloscope momentarily displays a sine wave with a different frequency and amplitude each time you push and release the button.
5. *End procedure:* Disconnect the oscilloscope.

Arithmetic Operation Checks

These procedures check operation of external AM. For an AWG2020 with Option 02, they check internal AM and internal ADD arithmetic functions.

NOTE

The arithmetic operation checks are structured as a continuous series of tests. After Check External AM Operation, *each test uses the control settings from the last test and uses the next step in the sequence file.*

Check External AM Operation

Electrical Characteristic Checked: External amplitude modulation, page 1-6.

Equipment Required: Two 50 Ω coaxial cables, a 50 Ω terminator, a function generator, and a digital multimeter (DMM).

Prerequisites: The AWG2020 meets the prerequisites listed on page 4-7.

Procedure:

1. *Install test hookup and set test equipment controls:*

   a. *Hook up DMM:* Connect the AWG2020 CH1 output through a coaxial cable, the 50 Ω terminator, and BNC-to-dual banana connector to the DMM INPUT connector.

   b. *Hook up function generator:* Connect the AWG2020 rear-panel AM IN input through a coaxial cable to the function generator output (see Figure 4-9).

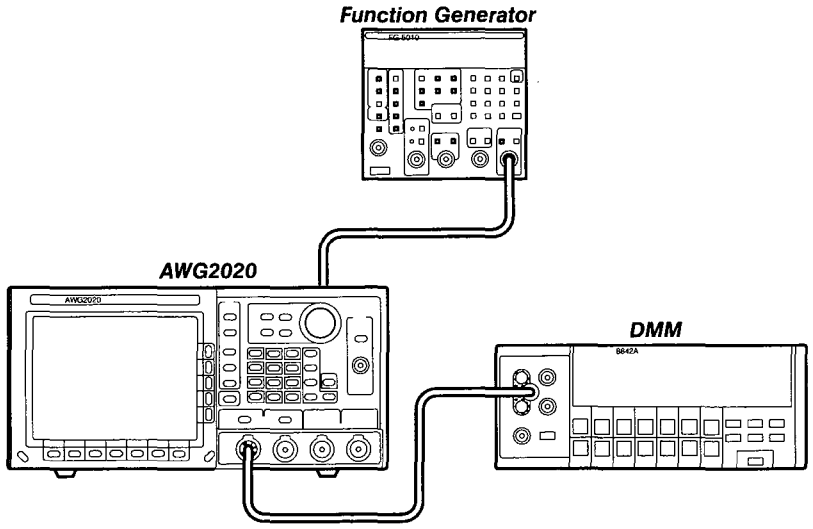


Figure 4-9: External AM Operation Initial Test Hookup

   c. *Set DMM controls*:

Mode	VDC
Range	20
Inputs	Front

   d. *Set function generator controls:*

Function	Square

Mode	Continuous
Parameter	
Frequency	1 kHz
Amplitude	0 V
Offset	1 V
Output	Off

2. *Set the AWG2020 controls and select the waveform file:*

   a. *Initialize AWG2020 controls:* Push **UTILITY→Misc→Reset to Factory→O.K.**

   b. *Modify AWG2020 default settings:*

   - Push **MODE→Autostep.**
   - Select **Impedance** from the side menu to highlight 1 MΩ.

   c. *Select waveform file:*

   - Select **Select Autostep File** from the side menu to choose a waveform file for CH1.
   - Turn the general purpose knob to highlight the **OPE.AST** file.
   - Push **ENTER**.

3. *Turn on the AWG2020 CH1 output:* Push the **CH1** button so that the LED above the CH1 output connector is on.

4. *Enable the function generator output:* Turn on the function generator output.

5. *Check external AM operation:*

   - Check that the step number displayed on the AWG2020 MODE menu is **Step 1** (see Figure 4-10). If it is not, push MANUAL TRIGGER to step though the sequence file steps until Step: 1 is displayed.

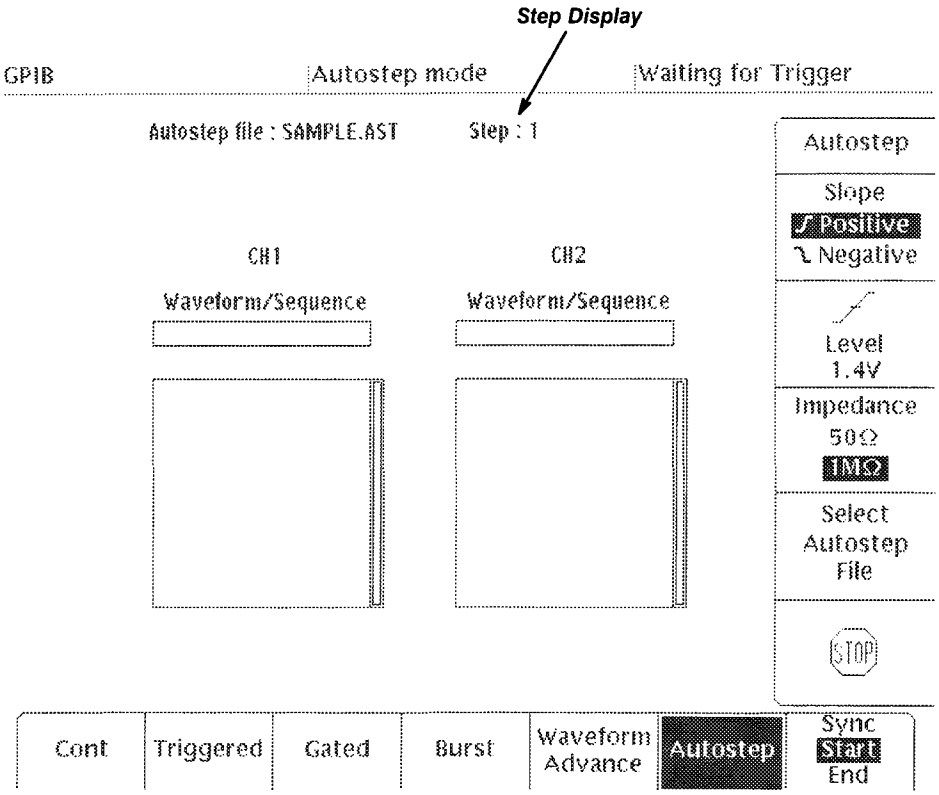


Figure 4-10: MODE Menu Autostep Setting

- Check that the DMM reading is in the range from 2.375 to 2.625 V (100% modulation).
- Set the function generator offset value to 0 V. Check that the DMM reading is in the range from 1.125 to 1.375 V (50% modulation).
- Set the function generator offset value to −1 V. Check that the DMM voltage reading is in the range from −0.125 to 0.125 V (0% modulation).

6. *End procedure:* Keep the test connections and instrument settings for the next check.

Check Internal AM Operation (Option 02 only)

Electrical Characteristic Checked: Arithmetic Operation, Amplitude Modulation, on page 1-5.

Equipment Required: Two 50 Ω coaxial cables, a function generator, and a digital multimeter (DMM).

Prerequisites: The AWG2020 meets the prerequisites listed on page 4-7. It also requires Option 02 (CH2 output channel) in the AWG2020.

Procedure:

1. *Use test hookup and control settings from previous check.*
2. *Check internal AM operation:*
   a. *Check Autostep Step 2:*
      - Push the AWG2020 **MANUAL TRIGGER** button, and check that the step changes to Step 2 on the MODE menu.
      - Check that the DMM reading is in the range from 2.475 VDC to 2.625 VDC.
   b. *Check Autostep Step 3:*
      - Push the AWG2020 **MANUAL TRIGGER** button, and check that the Autostep changes to Step: 3 on the MODE menu.
      - Check that the DMM reading is in the range from −2.625 V to −2.475 V.
3. *End procedure:* Retain the test hookup and settings for the next check.

Check Internal ADD Operation (Option 02 only)

Electrical Characteristic Checked: Arithmetic Operation, Add, on page 1-6.

Equipment Required: Two 50 Ω coaxial cables, a function generator, and a digital multimeter (DMM).

Prerequisites: The AWG2020 meets the prerequisites listed on page 4-7. It also requires Option 02 (CH2 output channel) in the AWG2020.

Procedure:

1. *Use test hookup and control settings from previous check.*
2. *Check internal ADD operation:*
   a. *Check Autostep Step 4:*
      - Push the AWG2020 **MANUAL TRIGGER** button, and check that the step changes to Step 4 on the MODE menu.
      - Check that the DMM reading is in the range from 2.85 V to 3.15 V.

3. *End procedure:*

   a. *Disable function generator output:* Turn the function generator output off.

   b. *Remove equipment:* Disconnect connections to the test equipment.

Clock Frequency and Amplitude Checks

These procedures check the accuracy of the AWG2020 clock frequency and the waveform output amplitude.

Check Clock Frequency Accuracy

Electrical Characteristic Checked: Clock Generator, Accuracy, on page 1-7.

Equipment Required: A 50 Ω coaxial cable, an SMA-BNC adapter, and a frequency counter.

Prerequisites: The AWG2020 meets the prerequisites listed on page 4-7.

Procedure:

1. *Install test hookup and set test equipment controls:*

   a. *Hook up frequency counter:* Connect the AWG2020 rear panel CLOCK OUT connector to the frequency counter input through a coaxial cable and an SMA-BNC adapter (see Figure 4-11).

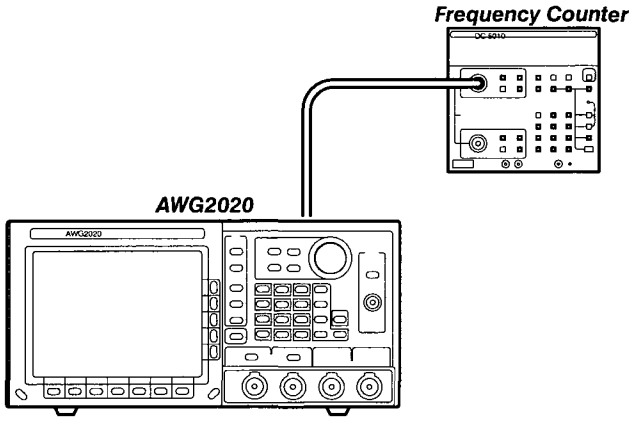


Figure 4-11: Clock Frequency Accuracy Initial Test Hookup

b. *Set frequency counter controls:*

CHANNEL A

Termination	50 Ω
Slope	Negative
Attenuation	X5
Coupling	DC

FREQ A

2. *Set AWG2020 controls and select the waveform:*

   a. *Initialize AWG2020 controls:* Push **UTILITY→Misc→Reset to Factory→O.K.**

   b. *Select the waveform file:*

   - Push **SETUP→Waveform Sequence**, if necessary, to select a waveform file for CH1. Waveform Sequence toggles between the CH1 files (upper list) and the CH2 files (lower list).
   - Turn the general purpose knob to select the **CLK_FREQ.WFM** file.
   - Push **ENTER**.

3. *Check clock frequency accuracy:*

   a. *Check clock frequency accuracy at current clock frequency setting:* Check that the frequency counter reading falls between 249.9875 MHz and 250.025 MHz.

   b. *Check clock frequency accuracy for different clock frequency settings:*

   - Select **Clock/Divider** from the bottom of the SETUP menu, or select **Clock** if the instrument is not equipped with Option 02.
   - Turn the general purpose knob (or press the numeric and units keys, and push ENTER) to select the first clock frequency listed in Table 4-3.
   - Check that the frequency counter reading is within the frequency range listed in the table for the clock frequency setting.
   - Repeat this step for each clock frequency and frequency range listed in Table 4-3.

Table 4-3: Clock Frequency Accuracy

Clock Frequency	Frequency Range
100 MHz	99.995 MHz – 100.005 MHz
1 MHz	0.99995 MHz – 1.00005 MHz
1 kHz	0.99995 kHz – 1.00005 kHz
10 Hz	9.9995 Hz – 10.0005 Hz

4. *End procedure:* Disconnect the frequency counter.

Check Clock Amplitude

Electrical Characteristic Checked: Auxiliary Outputs, Clock, Amplitude, on page 1-10.

Equipment Required: A 50 Ω coaxial cable, an SMA-BNC adapter, and an oscilloscope.

Prerequisites: The AWG2020 meets the prerequisites listed on page 4-7.

Procedure:

1. *Install test hookup and set test equipment controls:*
   a. *Hook up oscilloscope:* Connect the AWG2020 rear-panel CLOCK OUT connector through a coaxial cable and SMA-BNC adapter to the oscilloscope CH1 vertical input (see Figure 4-12).

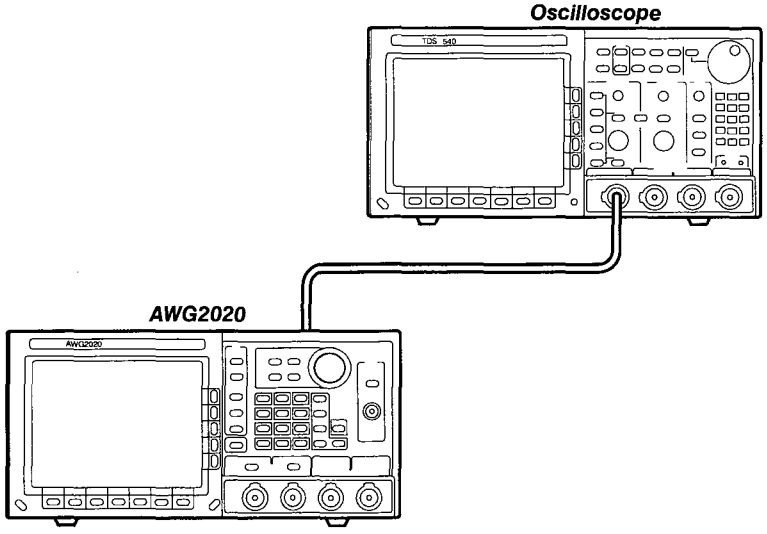


Figure 4-12: Clock Amplitude Initial Test Hookup

b. *Set oscilloscope controls:*

Vertical	CH1
Coupling	DC
Scale	500 mV/div.
Input impedance	50 Ω
Horizontal	
Sweep	400 ns/div.
Trigger	
Source	CH1
Coupling	DC
Slope	Positive
Level	500 mV
Mode	Auto

2. *Set the AWG2020 controls and select the waveform file:*

   a. *Initialize AWG2020 controls:* Push **UTILITY→Misc→Reset to Factory→O.K.**

   b. *Select the waveform file:*

   - Push **SETUP→Waveform Sequence**, if necessary, to select a waveform file for CH1. Waveform Sequence toggles between the CH1 files (upper list) and the CH2 files (lower list).
   - Turn the general purpose knob to select the **CLK_AMPL.WFM** file.
   - Push **ENTER**.

3. *Turn on the AWG2020 CH1 output:* Push the **CH1** button so that the LED above the CH1 output connector is on.

4. *Check clock amplitude accuracy:* Check that the pulse displayed on the oscilloscope has an amplitude of 0.7 V to ~~1.2~~ 1.3 V_{p-p}.

5. *End procedure:* Disconnect the oscilloscope.

Gain and Offset Accuracy Checks

These procedures check the accuracy of the AWG2020 gain and offset.

NOTE

The gain and offset accuracy checks are structured as a continuous test. After Check Gain Accuracy, *the next test uses the control settings from the last test and uses the next step in the sequence file.*

Check Gain Accuracy

Equipment Required: A 50 Ω coaxial cable, a BNC-to-dual banana adapter, and a digital multimeter (DMM).

Prerequisites: The AWG2020 meets the prerequisites listed on page 4-7.

Procedure:

1. *Install test hookup and set controls:*

   a. *Hook up DMM:* Connect the AWG2020 CH1 output through a 50 Ω coaxial cable and a dual banana connector to the DMM INPUT connector (see Figure 4-13).

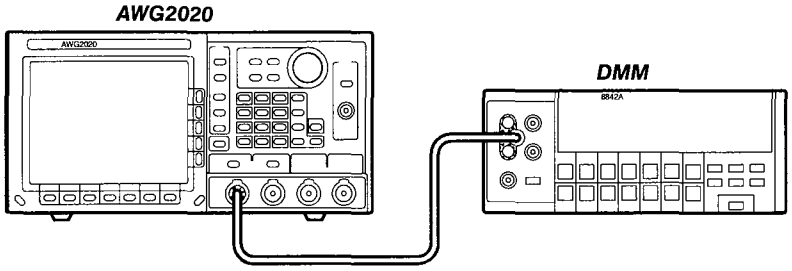


Figure 4-13: Gain Accuracy Initial Test Hookup

   b. *Set DMM controls:*

Mode	VDC
Range	20
Input	Front

2. *Set the AWG2020 controls and select the waveform file:*

   a. *Initialize AWG2020 controls:* Push **UTILITY→Misc→Reset to Factory→O.K.**

   b. *Select the AWG2020 waveform file:*

   - Push **MODE→Autostep→Select Autostep File** to choose a sequence file for CH1.
   - Turn the general purpose knob to select the **GAIN_OFF.AST** file.
   - Push **ENTER**.

3. *Check gain accuracy:*

   - Check that the displayed step is Step 1 on the MODE menu. If it is not, select the side menu STOP button to return to Step 1.
   - Check that the DMM reading is between 0.24375 and 0.25625 VDC.

- Push the AWG2020 **MANUAL TRIGGER** button, and check that the displayed step is Step 2.
- Check that the DMM reading is between −0.24375 and −0.25625 VDC.
- Push the AWG2020 **MANUAL TRIGGER** button, and check that the displayed step is Step 3.
- Check that the DMM reading is between 2.45 and 2.55 VDC.
- Push the AWG2020 **MANUAL TRIGGER** button, and check that the displayed step is Step 4.
- Check that the DMM reading is between −2.45 and −2.55 VDC.

4. *End procedure:* Retain the test hookup and control settings.

Check Offset Accuracy

Electrical Characteristic Checked: Main Outputs, Offset, Accuracy, on page 1-8.

Equipment Required: A 50 Ω coaxial cable, 50 Ω termination, BNC-to-dual banana adapter, and a digital multimeter (DMM).

Prerequisites: The AWG2020 meets the prerequisites listed on page 4-7.

Procedure:

1. *Use the test hookup and test equipment settings from previous check, however, add a 50 Ω termination at the DMM input.*
2. *Check offset accuracy:*
   - Push the AWG2020 **MANUAL TRIGGER** button, and check that the displayed step is Step 5.
   - Check that the DMM voltage reading is in the range from 1.2325 V to 1.2675 V.
   - Push the AWG2020 **MANUAL TRIGGER** button, and check that the displayed step is Step 6.
   - Check that the DMM voltage reading is in the range from −1.2675 V to −1.2325 V.
3. *Check Option 02:* If the AWG2020 has Option 02, repeat the *Gain Accuracy* and *Offset Accuracy Checks* for the AWG2020 channel 2 (CH2).
4. *End procedure:* Disconnect the DMM.

Pulse Response Check

This procedure checks the pulse response characteristics of the AWG2020 output waveforms at amplitudes of 0.5 and 1 V.

Electrical Characteristic Checked: Main Outputs, Pulse Response, on page 1-8.

Equipment Required: A 50 Ω coaxial cable and an oscilloscope.

Prerequisites: The AWG2020 meets the prerequisites listed on page 4-7.

Procedure:

1. *Install test hookup and set test equipment controls:*

   a. *Hook up the oscilloscope:* Connect the AWG2020 CH1 output connector through the coaxial cable to the CH1 vertical input connector on the oscilloscope (see Figure 4-14).

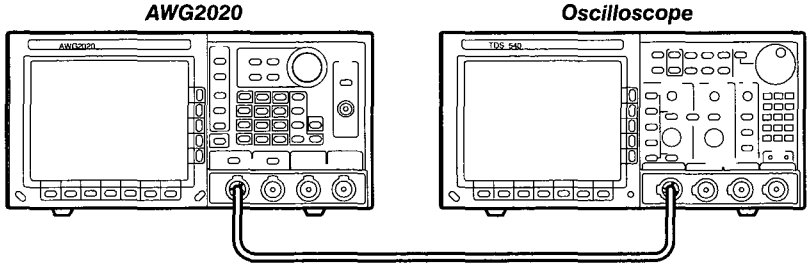


Figure 4-14: Pulse Response Initial Test Hookup

   b. *Set oscilloscope controls:*

Vertical	CH1
Coupling	DC
Scale	0.1 V/div.
Input impedance	50 Ω
Horizontal	
Sweep	2 ns/div.
Trigger	
Source	CH1
Coupling	DC
Slope	Positive
Level	0 V
Mode	Auto

2. *Set the AWG2020 controls and select the waveform file:*

   a. *Initialize AWG2020 controls:* Push **UTILITY→Misc→Reset to Factory→O.K.**

b. *Select waveform file:*

- Push **SETUP→Waveform Sequence**, if necessary, to select a waveform file for CH1. Waveform Sequence toggles between the CH1 files (upper list) and the CH2 files (lower list).
- Turn the general purpose knob to select the **PULSE.WFM** file.
- Push **ENTER**.

3. *Turn on the AWG2020 CH1 output:* Push the **CH1** button so that the LED above the CH1 output connector is on.
4. *Check pulse response at 0.5 V amplitude:*

a. *Check rise time:* Check that the rise time of the waveform displayed on the oscilloscope from the 10% point to the 90% point is 4.2 ns or less.

b. *Check aberrations:* Check that the aberrations of the displayed waveform is within 0.45 div.

c. *Check flatness:* Check that the flatness of the displayed waveform is within 0.15 div. after 20 ns from the rising edge.

d. *Change the oscilloscope controls:*

Horizontal	
Sweep	2 ns/div.
Trigger	
Slope	Negative

e. *Check fall time:* Check that the fall time of the displayed waveform from the 10% point to the 90% point is 4.2 ns or less.

5. *Check pulse response at 1 V amplitude:*

a. *Change the oscilloscope controls:*

Vertical	CH1
CH1 scale	0.2 V/div.
Trigger	
Slope	Positive

b. *Change the AWG2020 controls:*

- Push **SETUP→Ampl** to change the amplitude for CH1.
- Press the numeric key **1**, and press the units key **V** to select an amplitude of 1 V.

c. *Repeat substeps 4a through e, checking to the follow limits:*

Rise time	4.2 ns, maximum
Aberrations	0.4 div., maximum
Flatness	0.15 div., maximum
Fall time	4.2 ns, maximum

6. *Check pulse response for CH2 (Option 02):* If the AWG2020 has a second channel, repeat this *Pulse Response Check* procedure using the AWG2020 CH2 output and selecting the waveform and setting controls for CH2.
7. *End procedure:* Remove the connections.

SYNC Out and MARKER Out Amplitude Checks

These procedures check the amplitude of the SYNC Out and MARKER Out signals.

Electrical Characteristic Checked: Auxiliary Outputs, Sync, Amplitude, on page 1-9; Auxiliary Outputs, Marker 1, Amplitude, on page 1-9.

Equipment Required: A 50 Ω coaxial cable and an oscilloscope.

Prerequisites: The AWG2020 meets the prerequisites listed on page 4-7.

Procedure:

1. *Install test hookup and set test equipment controls:*
   a. *Hook up the oscilloscope:* Connect the AWG2020 CH1 SYNC Out connector through the coaxial cable to the CH1 vertical input connector on the oscilloscope (see Figure 4-15).

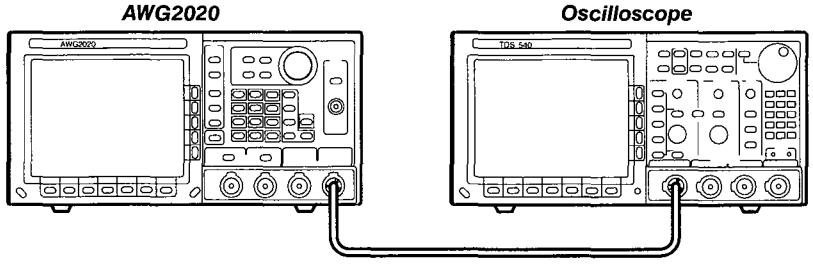


Figure 4-15: Initial Test Hookup

   b. *Set oscilloscope controls:*

Vertical	CH1
CH1 Coupling	DC
CH1 Scale	200 mV/div.
CH1 Input Impedance	50 Ω
Horizontal	
Sweep	50 ns/div.

Trigger	
Source	CH1
Coupling	DC
Slope	Positive
Level	500 mV
Mode	Auto

2. *Set the AWG2020 controls and select the waveform file:*
   a. *Initialize AWG2020 controls:* Push **UTILITY→Misc→Reset to Factory→O.K.**
   b. *Select waveform file:*
      - Push **SETUP→Waveform Sequence**, if necessary, to select a waveform file for CH1. Waveform Sequence toggles between the CH1 files (upper list) and the CH2 files (lower list).
      - Turn the general purpose knob to highlight the **SYNC_MRK.WFM** file.
      - Push **ENTER**.
3. *Check front-panel SYNC Out and MARKER Out amplitude:*
   a. *Check SYNC Out pulse amplitude:* Check that the pulse amplitude of the waveform displayed on the oscilloscope is from 0.7 V_{p-p} to 1.3 V_{p-p}.
   b. *Check MARKER Out pulse amplitude:*
      - Move the coaxial cable from the AWG2020 CH1 SYNC Out connector to the CH1 MARKER 1 connector.
      - Change the oscilloscope sweep to 5 µs/div.
      - Check that the pulse amplitude of the displayed waveform is from 0.7 V_{p-p} to 1.3 V_{p-p}.
4. *Check rear-panel SYNC Out and MARKER Out pulse amplitude:*
   a. *Check CH1 MARKER 2 OUT pulse amplitude:*
      - Move the coaxial cable from the AWG2020 front-panel CH1 MARKER 1 connector and connect it through the SMA-BNC adapter to the rear-panel CH1 MARKER 2 OUT connector.
      - Check that the pulse amplitude of the displayed waveform is from 0.7 V to 1.3 V_{p-p}.
5. *Check Option 02:* If the AWG2020 has a second channel, repeat this entire test, selecting the AWG2020 waveform and setting controls for CH2 and checking:
   - Rear-panel CH2 SYNC Out pulse amplitude
   - Rear-panel CH2 MARKER 1 pulse amplitude
   - Rear-panel CH2 MARKER 2

6. *End procedure:* Disconnect the oscilloscope.

External Trigger Level Accuracy Check

This procedure checks the external trigger level accuracy of the AWG2020.

Electrical Characteristic Checked: Auxiliary Inputs, Trigger, Accuracy, on page 1-10.

Equipment Required: Two 50 Ω coaxial cables, a function generator, and an oscilloscope.

Prerequisites: The AWG2020 meets the prerequisites listed on page 4-7.

Procedure:

1. *Install test hookup and set test equipment controls:*
   a. *Hook up oscilloscope:* Connect the AWG2020 CH1 output through a coaxial cable to the oscilloscope CH1 vertical input.
   b. *Hook up function generator:* Connect the AWG2020 TRIGGER INPUT through a coaxial cable to the function generator output (see Figure 4-16).

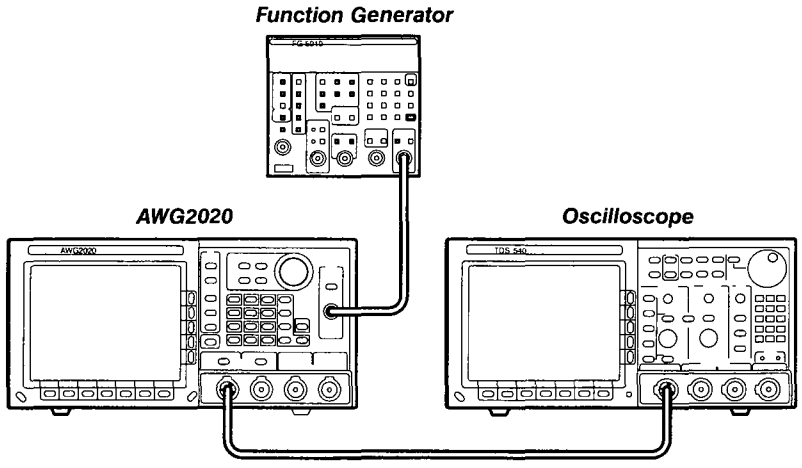


Figure 4-16: External Trigger Level Accuracy Initial Test Hookup

   c. *Set oscilloscope controls:*

Vertical	CH1
CH1 Coupling	DC
CH1 Scale	0.2 V/div.
CH1 Input Impedance	50 Ω

Horizontal	
Sweep	50 µs/div.
Trigger	
Source	CH1
Coupling	DC
Slope	Positive
Level	0 V
Mode	Auto

d. *Set function generator controls:*

Function	Square
Mode	Continuous
Parameter	
Frequency	1 kHz
Amplitude	0 V
Offset	0.6 V
Output	Off

2. *Select the AWG2020 waveform file and set AWG2020 controls:*

   a. *Initialize AWG2020 controls:* Push **UTILITY→Misc→Reset to Factory→O.K.**

   b. *Modify AWG2020 default settings:*

   - Push **MODE→Gated→Polarity** to highlight Positive.
   - Select **Level** from the side menu, and turn the general purpose knob to select 1 V. (You can also use the numeric and units keys to select 1 V; then push ENTER.)
   - Select **Impedance** from the side menu to highlight 1 MΩ.

   c. *Select waveform file:*

   - Push **SETUP→Waveform Sequence**, if necessary, to select a waveform file for CH1. Waveform Sequence toggles between the CH1 files (upper list) and the CH2 files (lower list).
   - Turn the general purpose knob to highlight the **TRG_IN.WFM** file.
   - Push **ENTER**.

3. *Turn on the AWG2020 CH1 output:* Push the **CH1** button so that the LED above the CH1 output connector is on.

4. *Check external trigger high level:*

   a. *Adjust oscilloscope controls:* Press and hold the AWG2020 **MANUAL TRIGGER** button and adjust the oscilloscope vertical and horizontal position to display the waveform from the AWG2020. Release the **MANUAL TRIGGER** button.

b. *Enable function generator output:* Turn on the function generator output.

c. *Check external trigger level accuracy:*

- Gradually increment the function generator offset level until a waveform is displayed on the oscilloscope.
- Check that that the function generator offset level is from 0.85 to 1.15 V, when the waveform is first displayed.

5. *Check external trigger low level:*

a. *Change the function generator controls:*

Parameter	
Offset	−0.6 V

b. *Change the AWG2020 controls:*

- Push **MODE→Polarity** to highlight Negative.
- Select **Level** from the side menu, and turn the general purpose knob to select −1 V. (You can also use the numeric and units keys to select −1 V; then push ENTER.)

c. *Check external trigger level accuracy:*

- Gradually decrement the function generator offset level until a waveform is displayed on the oscilloscope.
- Check that that the function generator offset level is from −1.15 V to −0.85 V, when the waveform is first displayed.

6. *End procedure:* Turn off the function generator output and disconnect the function generator.

External CLOCK IN Check

This procedure checks the AWG2020 response to an external CLOCK IN signal.

Electrical Characteristic Checked: Auxiliary Inputs, Clock, Threshold level, on page 1-11.

Equipment Required: Two 50 Ω coaxial cables, a function generator, and an oscilloscope.

Prerequisites: The AWG2020 meets the prerequisites listed on page 4-7.

Procedure:

1. *Install test hookup and set test equipment controls:*

a. *Hook up oscilloscope:* Connect the AWG2020 CH1 output through a coaxial cable to the oscilloscope CH1 vertical input.

b. *Hook up function generator:* Connect the AWG2020 rear-panel CLOCK IN through a coaxial cable and SMA-BNC adapter to the function generator output (see Figure 4-17).

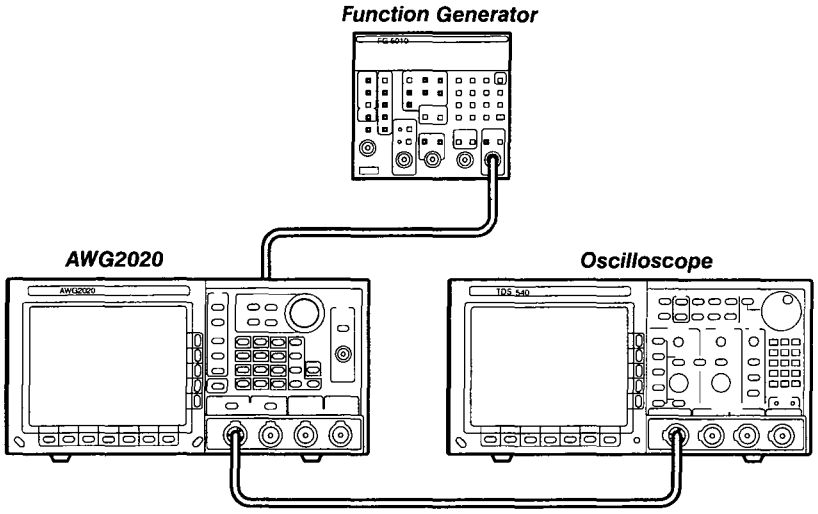


Figure 4-17: External CLOCK IN Initial Test Hookup

c. *Set oscilloscope controls:*

Vertical	CH1
Coupling	DC
Scale	0.2 V/div.
Input Impedance	50 Ω
Horizontal	
Sweep	500 µs/div.
Trigger	
Source	CH1
Coupling	DC
Slope	Positive
Level	0 mV
Mode	Auto

d. *Set function generator controls:*

Function	Square
Mode	Continuous
Parameter	
Frequency	1 MHz
Amplitude	1.6 V
Offset	0.6 V
Output	Off

2. *Select the AWG2020 waveform file and set AWG2020 controls:*
   a. *Initialize AWG2020 controls:* Push **UTILITY→Misc→Reset to Factory→O.K.**
   b. *Select waveform file:*
      - Push **SETUP→Waveform Sequence**, if necessary, to select a waveform file for CH1. Waveform Sequence toggles between the CH1 files (upper list) and the CH2 files (lower list).
      - Turn the general purpose knob to highlight the **EXT_CLK.WFM** file.
      - Push **ENTER**.
3. *Turn on the AWG2020 CH1 output:* Push the **CH1** button so that the LED above the CH1 output connector is on.
4. *Check the external CLOCK IN threshold level:*
   a. *Enable function generator output:* Turn on function generator output.
   b. *Check the level:* Check that the waveform displayed on the oscilloscope has an amplitude of 5 divisions and a stable display of 5 cycles.
5. *Turn off equipment output and disconnect test hookup:*
   a. *Disable function generator output:* Turn off function generator output.
   b. *Remove connections:* Disconnect all connections to the AWG2020.

Digital Data Out Check (Option 03)

This procedure checks the AWG2020 digital data output at the rear panel. This check requires that the AWG2020 has Option 03 installed.

Electrical Characteristic Checked: Auxiliary Outputs, Digital Data Out, Level, on page 1-10.

Equipment Required: Test leads, cable, power supply, termination board, and oscilloscope.

Prerequisites: The AWG2020 meets the prerequisites listed on page 4-7.

Procedure:

1. *Install test hookup and set test equipment controls:*
   a. *Hook up termination board:* Connect the AWG2020 rear digital data output through a digital data output cable to the termination board (see Figure 4-18).

b. *Hook up power supply:* Connect the power supply output through the test leads to the GND TP100 and −2VD TP120 terminals on the termination board.

c. *Hook up oscilloscope:*

- Connect the oscilloscope probe to the CH1 vertical input.
- Connect the probe ground-clip to the GND TP200 terminal on the termination board.

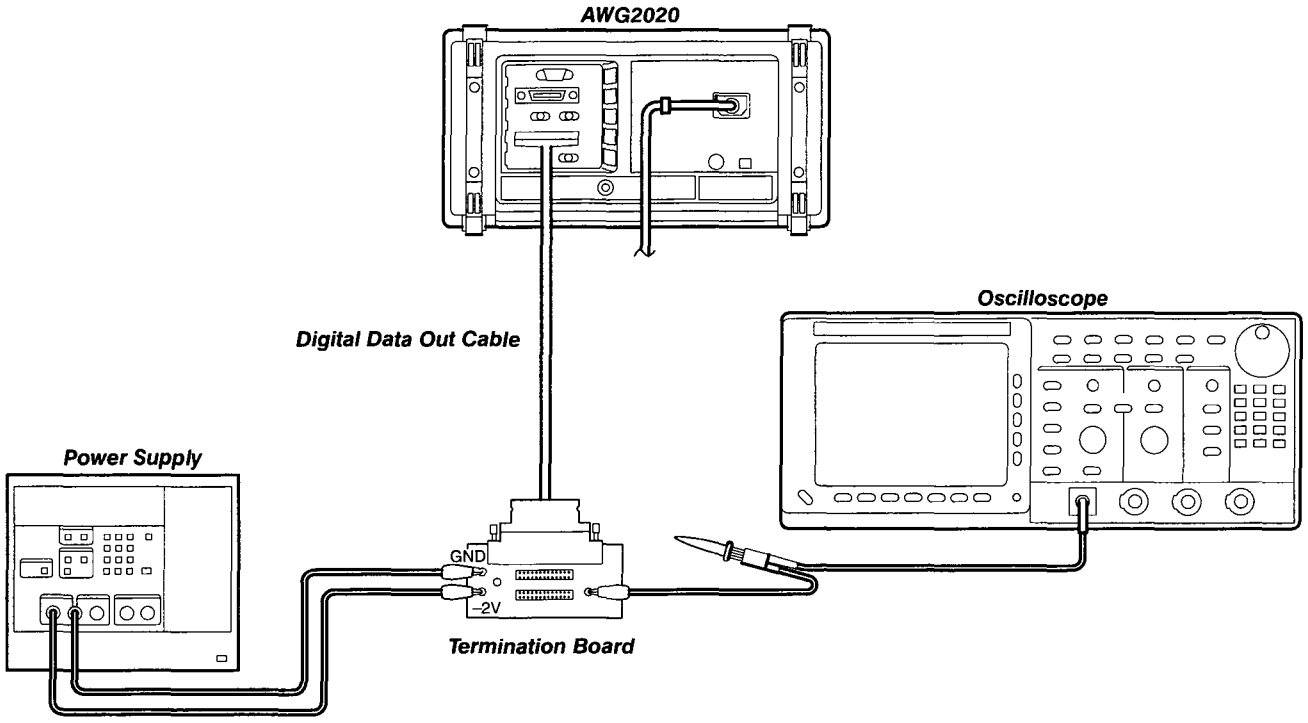


Figure 4-18: Digital Data Out Initial Test Hookup

d. *Set oscilloscope controls:*

Vertical	CH1
Scale	0.1 V/div.
Input Impedance	1 MΩ
Horizontal	
Sweep	Adjust as needed
Trigger	
Mode	Auto

e. *Set power supply controls:*

Parameter	
Supply select	Negative
Voltage	2

2. *Create the AWG2020 waveform file, select waveform file, and set AWG2020 controls:*

   a. *Initialize AWG2020 controls:* Push **UTILITY→Misc→Reset to Factory→O.K.**

   b. *Create waveform file:*

   - Push **EDIT→New Waveform** to enter waveform creation mode.
   - Push **Standard Function→ Func Type→Ramp→Execute** to create the waveform shown in Figure 4-19.

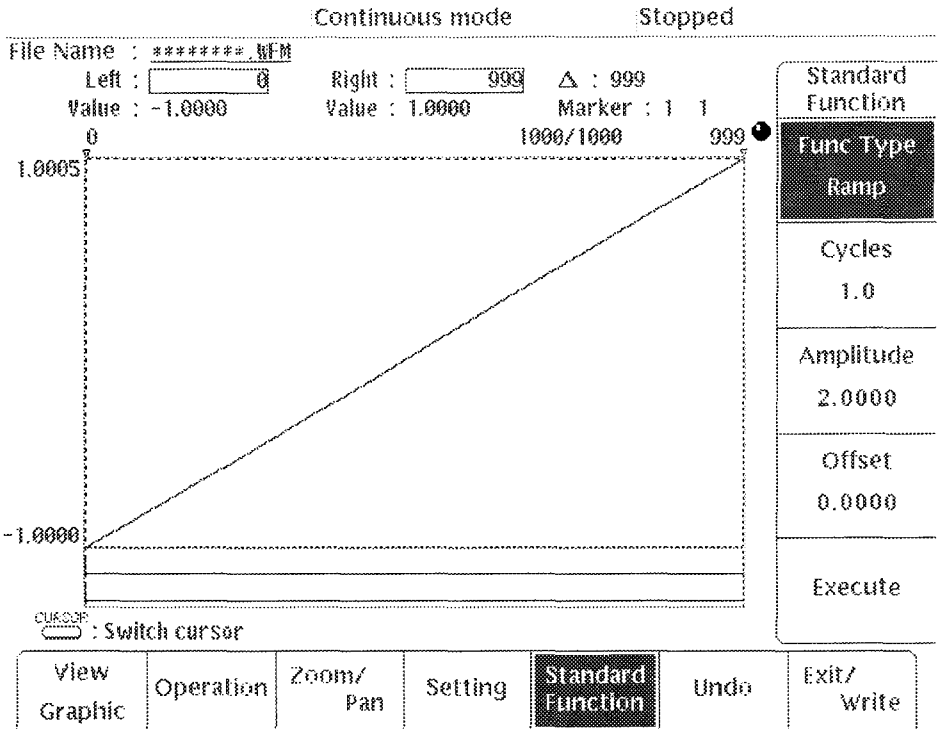


Figure 4-19: Ramp Waveform

   - Push **Exit/Write→Write→Exit** to leave the waveform creation mode.
   - Use the general purpose knob to enter the name, TEST, for the ramp waveform file:
     Select the character, **T**, from the character menu. Then press the VALUE button.
     Repeat this sequence, entering the characters, **E**, **S**, and **T**.
     Then push **ENTER** to create the file name.

   c. *Select waveform file:*

   - Push **SETUP→Waveform Sequence**, if necessary, to select a waveform file for CH1. Waveform Sequence toggles between the CH1 files (upper list) and the CH2 files (lower list).

- Turn the general purpose knob to highlight the **TEST.WFM** file.
- Push **ENTER**.

d. Set AWG2020 controls:

- Select **Clock.**
- Use the general purpose knob or numeric keys to set the clock frequency to 1.000 MHz.
- Push **MODE→Cont.**

3. *Turn on the AWG2020 CH1 output:* Push the **CH1** button so that the LED above the CH1 output connector is on.

4. *Check the digital data output signals:*

a. *Enable power supply output:* Turn on power supply output.

b. *Check the signal levels:*

- Contact the oscilloscope probe to the pins on J200 and J210 (see Figure 4-20). Check that the oscilloscope display shows these signals:
  - Data signals D0–D11, $\overline{D0}$–$\overline{D11}$ are differential ECL output.
  - Clock signals CLK and $\overline{CLK}$ are differential ECL output.
  - All other pins are ground.

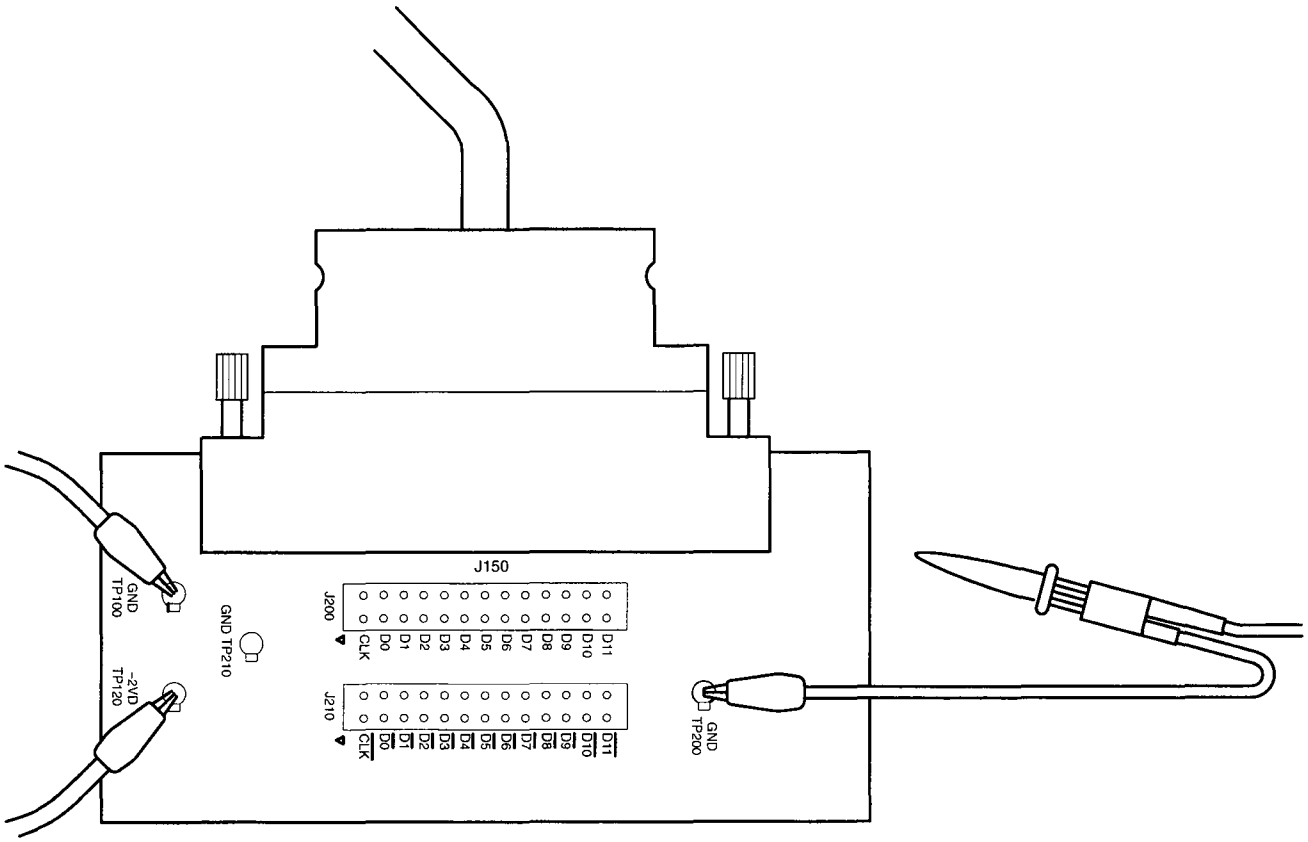


Figure 4-20: Output Pins on the Termination Board

5. *Turn off equipment output and disconnect test hookup:*
   a. *Disable power supply output:* Turn off power supply output.
   b. *Remove connections:* Disconnect all connections to the AWG2020.

Floating Point Processor Check (Option 09)

This procedure checks the AWG2020 floating point processor. This check requires that the AWG2020 has Option 09 installed.

Equipment Required: None.

Prerequisites: The AWG2020 meets the prerequisites listed on page 4-7.

Procedure:

1. *Check that floating point processor test in internal diagnostics passes:*
   a. *Run the AWG2020 internal diagnostics:* Push the AWG2020 **ON/STBY** switch two times so that the AWG2020 runs the power-on diagnostics.

b. *Check the FPP test results:* When the AWG2020 finishes the FPP test, check that the test result is Pass.

This completes the performance tests for the AWG2020.

Before Adjustments

This section contains information needed to manually adjust the AWG2020 Arbitrary Waveform Generator.

The *Adjustment Procedures* section consists of two subsections:

- *Before Adjustments*

  This general information about adjusting the AWG2020 and about the Performance Check/Adjustment disk files.

- *Adjustments*

  Procedures for manually adjusting the AWG2020 assembly.

Use the *Adjustments* subsection to return the AWG2020 to conformance with performance specified in section 1, *Specifications*. This procedure is not required to verify AWG2020 performance; for performance verification procedures see section 4, *Performance Verification*.

Adjustment Interval — Generally, these adjustments should be done every 12 months.

Adjustment After Repair — After the removal and replacement of a module due to electrical failure, do the adjustment procedures in this section.

Requirements for Performance

Before doing the adjustments, note the following requirements.

- Personnel

  Only trained service technicians should perform these procedures.

- Access to Adjustments

  The cabinet must be removed and additional ventilation must be provided when making the adjustments in this procedure. See *Adjustment Instructions* in this subsection for detailed information.

- Warmup Period

  This AWG2020 requires a 20 minute warmup period in a 20° C to 30° C environment before it is adjusted. Adjustments done before the operating temperature has stabilized may cause errors in performance.

- Internal Calibration

  Calibrate the AWG2020 using the internal calibration routine. See the subsection, *Self Tests*, in section 4 for instructions.

- Performance Check/Adjustment Files

  These adjustment procedures require loading a file from the Performance Check/Adjustment disk included with this manual. See *Adjustment Instructions* in this subsection for information about this file.

- Test Equipment

  Table 5-1 lists all test equipment required to adjust the AWG2020.

Equipment Required

Table 5-1 lists the test equipment required to adjust the AWG2020.

Table 5-1: Test Equipment

Item Number and Description	Minimum Requirements	Example	Purpose
BNC cable	Impedance: 50 Ω Connectors: BNC Length: 43 inches	Tektronix Part 012-0057-01	Signal interconnection
PELTOLA cable with BNC connector*	Must use example equipment	Tektronix Part131-1315-01	Signal interconnection
Test oscilloscope	Bandwidth: >250 MHz	Tektronix TDS500 Series Digitizing Oscilloscope or 2400 Series Digitizing Oscilloscope	Used to check output signals
Digital multimeter	DC volts range: 0.05 V to 5 V Accuracy: ±0.1%	Fluke 8842A Digital Multimeter	Used to measure voltage
Fan			Used to cool the AWG2020

***The PELTOLA cable with BNC connector is included in the maintenance kit (Tektronix Part 067-1396-00).**

Adjustment Instructions

The following instructions describe preparing the AWG2020 for adjustment, loading the adjustment file required for these procedures, and making adjustments.

Providing Access

CAUTION

To avoid damaging the eject button, make sure a floppy disk is NOT in the floppy disk drive before removing the cabinet.

Before doing the adjustments, remove the AWG2020 rear cover and cabinet. See section 6, *Maintenance*, for instructions on removing the cabinet and replacing it after adjustment is done.

Cooling

CAUTION

To prevent damage to the AWG2020 due to over-heating, do not do these adjustment procedures without providing additional cooling, as described below.

With the rear cover and cabinet removed, the AWG2020 assembly does not cool properly while power is applied. Preventing heat build-up requires a separate fan to supplement ventilation. Place the fan so it blows air INTO the AWG2020 side near the floppy-disk drive, as shown in Figure 5-1.

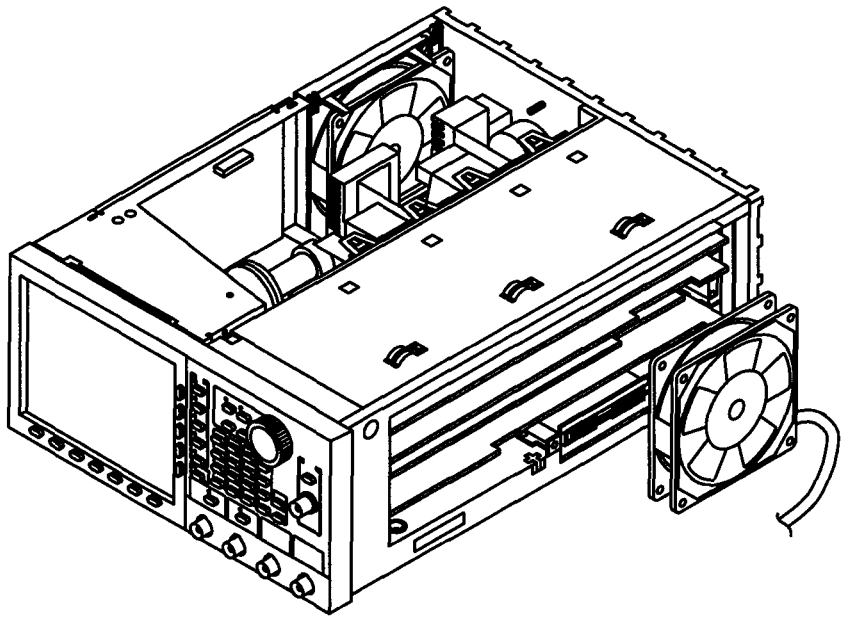


Figure 5-1: Cooling the AWG2020

Performance Check/Adjustment Files

Table 5-2 lists the waveform file on the Performance Check/Adjustment disk that is required to do the adjustments. The table lists the front-panel settings that the file sets up and the adjustment procedures that use the file.

For instructions on loading files, see *Loading Files* on page 2-11 in the *Instructions for Operation* subsection of section 2.

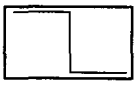
After loading the files, press the button on the floppy disk drive and remove the floppy disk.

NOTE

*The files on the Performance Check/Adjustment disk are locked (the files names are displayed with *), so the data in these files cannot be changed unless the lock is opened. The file data includes not only waveform data, but also output parameters.*

When you select a file with the Waveform Sequence item, the AWG2020 output parameters change to those specified in the file, and the waveform output reflects waveform data in the file. After selecting a file, do not change an output parameter with the SETUP menu unless a procedure instructs you to do so. During the procedures, if you are unsure that the AWG2020 settings still match the file's settings, select the waveform again using the Waveform Sequence item on the SETUP menu.

Table 5-2: File List for Performance Check/Adjustment Disk

No.	File Name	EDIT Menu		SETUP Menu					Usage
		Wfm Shape	Wfm Point	Clock	Operation	Filter	Ampl	Offset	
1	HF_LF.WFM		1000	100 MHz	NORMAL	Through	0.5 V	0 V	All

Adjustments

This subsection describes how to do direct adjustment of AWG2020 circuits. Before doing these adjustments, read *Before Adjustments*, preceding this subsection.

X5 Amplifier HF Compensation

Equipment Required: One 50 Ω coaxial cable and one oscilloscope.

Prerequisites: The AWG2020 must meet the prerequisites listed on page 5-1.

Procedure:

1. *Install the test hookup and set test equipment controls:*

   a. *Hook up the oscilloscope:* Connect the AWG2020 CH1 output connector through the coaxial cable to the CH1 vertical input connector on the oscilloscope (see Figure 5-2).

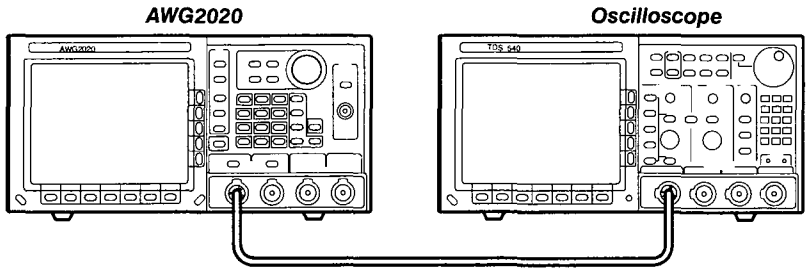


Figure 5-2: Hookup for X5 Amplifier HF Compensation

   b. *Set oscilloscope controls:*

Vertical	CH1
CH1 coupling	DC
CH1 scale	0.1 V/div.
CH1 input impedance	50 Ω
Horizontal	
Sweep	5 ns/div.

Trigger	
Source	CH1
Coupling	DC
Slope	Positive
Level	0 V
Mode	Auto

2. *Set the AWG2020 controls and select the waveform file:*
   a. *Initialize AWG2020 controls:* Push **UTILITY→Misc→Reset to Factory→O.K.**
   b. *Select the waveform file:*
      - Push **SETUP→Waveform Sequence**, if necessary, to select a waveform file for CH1. Waveform Sequence toggles between the CH1 files (upper list) and the CH2 files (lower list).
      - Turn the general purpose knob to highlight the HF_LF.WFM file.
      - Push **ENTER** to select the file.
3. *Enable AWG2020 output:* Push the CH1 output **ON/OFF** button.
4. *Adjust CH1 compensation:*
   a. *Adjust oscilloscope display:* Adjust the horizontal and vertical position to center the waveform on the display.
   b. *Change AWG2020 amplitude:*
      - Push the **SETUP→Ampl.**
      - Press the numeric **.** (decimal point) key, the numeric **5**, **0**, **1** keys, and units **V** key to select 0.501 V.
   c. *Adjustment:* Adjust C201 on the Analog board (A3) for best flatness at 0.500 V. See Figure 5-3 for adjustment location.
5. *If Option 02 is installed, adjust CH2 compensation:*
   a. Move the cable from the AWG2020 CH1 output to the CH2 output.
   b. Repeat steps 2 through 4, selecting the waveform and setting AWG2020 controls for CH2.
   c. Adjust C201 on the Analog board (A23) for best flatness at 0.500 V. See Figure 5-3 for adjustment location.
6. *End procedure:* Disconnect the oscilloscope.

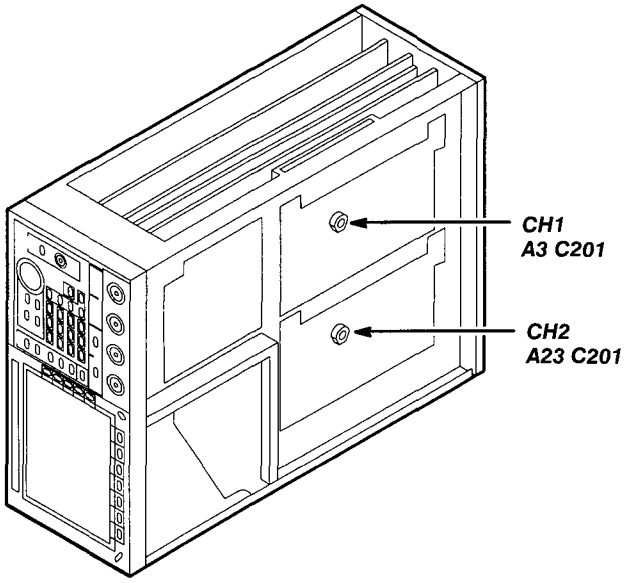


Figure 5-3: C201 Locations for CH1 and CH2

Attenuator LF Compensation

Equipment Required: Two 50 Ω coaxial cables, one PELTOLA cable, and one oscilloscope.

Prerequisites: The AWG2020 must meet the prerequisites listed on page 5-1.

Procedure:

1. *Install the test hookup and set test equipment controls:*
   a. *Hook up the AWG2020:* Connect the AWG2020 CH1 SYNC Out connector through the coaxial cable to the AWG2020 TRIGGER INPUT.
   b. *Hook up the oscilloscope:*
      - Disconnect the J310 cable from the A4 Power board. See Figure 5-4.

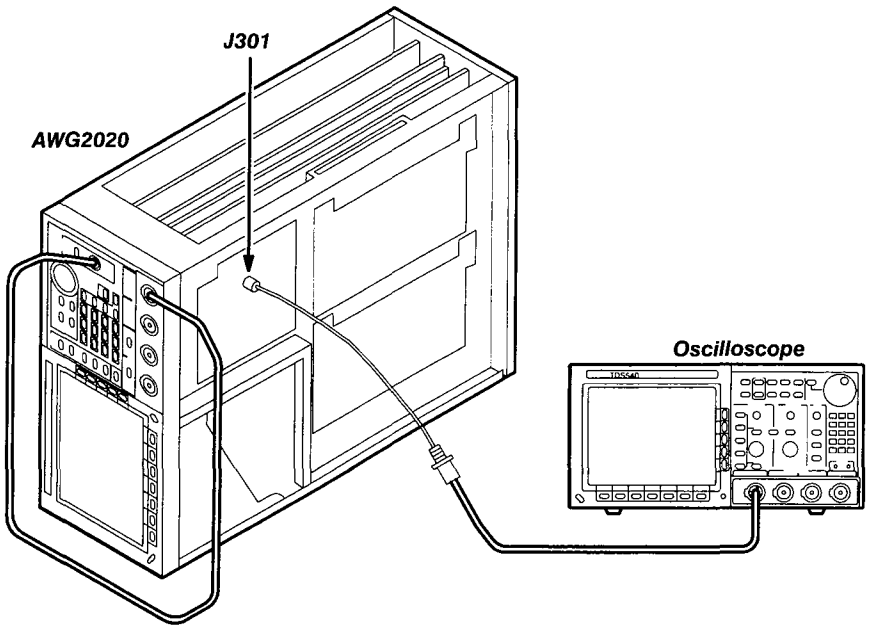


Figure 5-4: Hookup for Attenuator LF Compensation

- Connect the PELTOLA cable with BNC connector in its place. Figure 5-5 shows the cable and BNC details.
- Connect the other end of the PELTOLA cable through a coaxial cable to the oscilloscope CH1 vertical input.

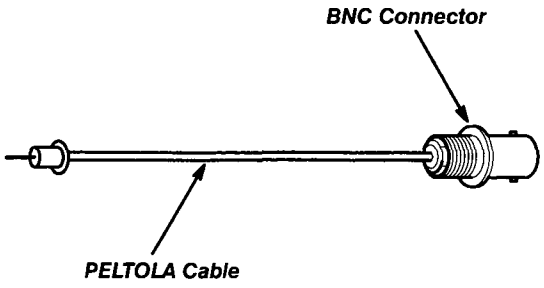


Figure 5-5: PELTOLA Cable with BNC

c. *Set oscilloscope controls:*

Vertical	CH1
CH1 coupling	DC
CH1 scale	50 mV/div.
CH1 input impedance	50 Ω
Horizontal	
Sweep	5 ns/div.

Trigger	
Source	CH1
Coupling	DC
Slope	Positive
Level	0 V
Mode	Auto

2. *Set AWG2020 controls and select the waveform file:*

   a. *Initialize AWG2020 controls:* Push **UTILITY→Misc→Reset to Factory→O.K.**

   b. *Select the waveform file:*

   - Push **SETUP→Waveform Sequence**, if necessary, to select a waveform file for CH1. Waveform Sequence toggles between the CH1 files (upper list) and the CH2 files (lower list).
   - Turn the general purpose knob to highlight the HF_LF.WFM file.
   - Push **ENTER**.

3. *Enable AWG2020 output:* Push the CH1 output **ON/OFF** button.

4. *Adjust compensation:*

   a. *Adjust oscilloscope display:* Adjust the horizontal and vertical position to display the rising edge of the waveform.

   b. *Adjustment:* Adjust C301 on the Power board (A4) so the tip of the waveform is flat. See Figure 5-6 for adjustment location.

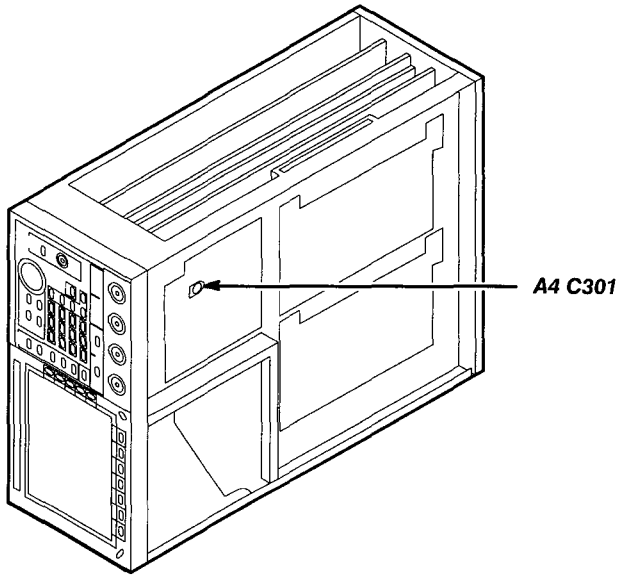


Figure 5-6: C301 Location

5. *End procedure:*
   - Disconnect the coaxial cable between the AWG2020 CH1 and TRIGGER INPUT.
   - Disconnect the PELTOLA cable and coaxial cable between the AWG2020 A4 Power board and oscilloscope.
   - Install cable J310 on the A4 Power board.

End Adjustment Procedures

This is the end of the *Adjustments*. Follow these steps to restore the AWG2020 to service:

1. *Initialize AWG2020 controls:* Push **UTILITY→Misc→Reset to Factory→O.K.**
2. *Equipment power-down:*
   - Turn off oscilloscope power.
   - Push the **OFF/STBY** button on the AWG2020 to toggle off operating power.
   - Push the **PRINCIPAL POWER** switch on the back of the AWG2020 to turn off main power.
   - Unplug the AWG2020 power cord from the line source.
3. *Disk:* Remove Performance Check/Adjustment disk from AWG2020 floppy disk drive.
4. Install the AWG2020 cabinet and rear panel. See section 6, *Maintenance*, for instructions on replacing the cabinet.

Before Maintenance

This section contains the information needed to do periodic and corrective maintenance on the AWG2020 Arbitrary Waveform Generator. Specifically, the following subsections are included:

- *Before Maintenance* — This subsection. It includes this introduction plus general information on preventing damage to internal modules when doing maintenance.
- *Inspection and Cleaning* — Information and procedures for inspecting the AWG2020 and cleaning its external and internal modules.
- *Removal and Installation Procedures* — Procedures for removing defective modules and replacing new or repaired modules.
- *Procedure for Changing the Line Voltage* — Procedure for changing the operation line voltage for the AWG2020.
- *Repackaging* — Information for packaging the AWG2020 properly for shipment.
- *Troubleshooting* — Information for isolating failed modules. Included are instructions for operating the AWG2020 internal diagnostic routines and troubleshooting flowcharts for fault isolation. Most of the flowcharts make use of the internal diagnostic routines to speed fault isolation to a module.

Prerequisites

Before doing any of the procedures in the *Maintenance* section, note the following:

- Only trained service technicians should perform these procedures.
- Read the *Safety Summary* located near the beginning of this manual.
- Read the *Strategy for Servicing* in the front matter introduction before servicing the AWG2020.
- Read section 2, *Operating Information*, before servicing the AWG2020.

Preventing ESD

CAUTION

Static discharge can damage any semiconductor component in the AWG2020.

Precautions

When performing service which requires internal access to the AWG2020, follow these precautions to avoid damaging internal modules and their components due to electrostatic discharge (ESD).

1. Minimize handling of static-sensitive modules.
2. Transport and store static-sensitive modules in their static-protected containers or on a metal rail. Label any package that contains static-sensitive modules.
3. Discharge the static voltage from your body by wearing a grounded antistatic wrist strap while handling these modules. Do service of static-sensitive modules only at a static-free work station.
4. Do not remove the AWG2020 cabinet unless you have met precaution number 3, above. Consider all internal modules static-sensitive.
5. Do not allow anything capable of generating or holding a static charge on the work station surface.
6. Handle circuit boards by the edges when possible.
7. Do not slide the modules over any surface.
8. Avoid handling modules in areas that have a floor or work-surface covering capable of generating a static charge.
9. Do not use high-velocity compressed air when cleaning dust from modules.

Susceptibility to ESD

Table 6-1 lists 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 Static-discharge Damage

Semiconductor Classes	Relative Susceptibility Levels[1]
MOS or CMOS microcircuits or discrete circuits, or linear microcircuits with MOS inputs (most sensitive)	1
ECL	2
Schottky signal diodes	3
Schottky TTL	4
High-frequency bipolar transistors	5
JFET	6
Linear microcircuits	7
Low-power Schottky TTL	8
TTL (least sensitive)	9

[1]Voltage equivalent for levels (voltage discharged from a 100 pF capacitor through resistance of 100 ohms):

1 = 100 to 500 V
2 = 200 to 500 V
3 = 250 V
4 = 500 V
5 = 400 to 600 V
6 = 600 to 800 V
7 = 400 to 1000 V (est.)
8 = 900 V
9 = 1200 V

Inspection and Cleaning

This subsection describes how to determine whether the AWG2020 needs cleaning, and how to do the cleaning. Inspection and cleaning are preventive maintenance procedures. When done regularly, preventive maintenance may prevent AWG2020 malfunction and enhance reliability.

Preventive maintenance consists of visually inspecting and cleaning the AWG2020 and using general care when operating it.

How often to do maintenance depends on the severity of the environment in which the AWG2020 operates. A proper time to perform preventive maintenance is just before direct adjustment.

General Care

The cabinet helps keep dust out of the AWG2020 and is a major component of the instrument cooling system. The cabinet should normally be in place when operating the AWG2020. The AWG2020 front cover (optional accessory) protects the front panel and display from dust and damage. Install it when storing or transporting the instrument.

Inspection and Cleaning Procedures

Inspect and clean the AWG2020 as operating conditions require. The collection of dirt on components inside can cause them to overheat and break down. (Dirt acts as an insulating blanket, preventing efficient heat dissipation.) Dirt also provides an electrical conduction path that can cause an instrument failure, especially under high-humidity conditions.

WARNING

To avoid personal injury or death due to electric shock, unplug the power cord from the line voltage source before cleaning the AWG2020.

CAUTION

To prevent damaging the plastics used in the AWG2020 do not use chemical cleaning agents. Use only deionized water when cleaning the menu buttons or front-panel buttons. Use a 75% isopropyl alcohol solution as a cleaner, and rinse with deionized water. Before using any other type of cleaner, consult your Tektronix Service Center or representative.

To prevent damaging AWG2020 components, do not use high-pressure compressed air when cleaning dust from the interior of the AWG2020. (High pressure air can cause electrostatic discharge.) Instead, use low pressure compressed air (about 9 psi).

Inspection — Exterior

Inspect the outside of the AWG2020 for damage, wear, and missing parts, using Table 6-2 as a guide. If the AWG2020 appears to have been dropped or otherwise abused, check it thoroughly to verify correct operation and performance. Repair any defects that may cause personal injury or lead to further damage to the AWG2020.

Table 6-2: External Inspection Check List

Item	Inspect For	Repair Action
Cabinet, front panel, and cover	Cracks, scratches, deformations, damaged hardware or gaskets.	Replace defective module.
Front-panel knobs	Missing, damaged, or loose knobs.	Repair or replace missing or defective knobs.
Connectors	Broken shells, cracked insulation, and deformed contacts. Dirt in connectors.	Replace defective modules. Clear or wash out dirt.
Carrying handle, cabinet, feet	Correct operation.	Replace defective module.
Accessories	Missing items or parts of items, bent pins, broken or frayed cables, and damaged connectors.	Replace damaged or missing items, frayed cables, and defective modules.

Cleaning Procedure — Exterior

WARNING

To avoid potential electric shock hazard or damage to the AWG2020 circuits, do not allow any moisture inside the AWG2020 during external cleaning; use only enough liquid to dampen the cloth or applicator.

1. Remove loose dust on the outside of the AWG2020 with a lint free cloth.
2. Remove remaining dirt with a lint free cloth dampened in a general purpose detergent-and-water solution. Do not use abrasive cleaners.
3. Clean the light filter protecting the monitor screen with a lint-free cloth dampened with either isopropyl alcohol or, preferably, a gentle, general-purpose detergent-and-water solution.

Inspection — Interior

To access the inside of the AWG2020 for inspection and cleaning, refer to the *Removal and Installation Procedures* in this section.

Inspect the internal portions of the AWG2020 for damage and wear, using Table 6-3 as a guide. Repair any defects immediately.

CAUTION

To prevent damage from electrical arcing, ensure that circuit boards and components are dry before applying power to the AWG2020.

Table 6-3: Internal Inspection Check List

Item	Inspect For	Repair Action
Circuit boards	Loose, broken or corroded solder connections. Burned circuit boards. Burned, broken, or cracked circuit-run plating.	Remove failed modules and replace with a new module.
Resistors	Burned, cracked, broken blistered condition.	Replace failed module and replace with a new module.
Solder connections	Cold solder or rosin joints.	Resolder joint and clean with isopropyl alcohol.

Table 6-3: Internal Inspection Check List (Cont.)

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

Cleaning Procedure — Interior

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

1. Blow off dust with dry, low-pressure, deionized air (approximately 9 psi).
2. Remove any remaining dust with a lint-free cloth dampened in isopropyl alcohol (75% solution), and rinse with a warm deionized water. (A cotton-tipped applicator is useful for cleaning in narrow spaces and on circuit boards.)
3. If steps 1 and 2 do not remove all the dust or dirt, the AWG2020 may be spray washed using a solution of 75% isopropyl alcohol by doing step 4 through 8.
4. Gain access to the parts to be cleaned by removing easily accessible shields and panels (see *Removal and Installation Procedures* in this section).
5. Spray wash dirty parts with the isopropyl alcohol, and wait 60 seconds for the majority of the alcohol to evaporate.
6. Use hot (120° F to 140° F) deionized water to thoroughly rinse them.
7. Dry all parts with low-pressure, deionized air.
8. Dry all components and assemblies in an oven or drying compartment using low-temperature (125° F to 150° F) circulating air.

Lubrication

There is no periodic lubrication required for the AWG2020.

Removal and Installation Procedures

This subsection describes removing and installing the mechanical and electrical modules in the AWG2020 and changing the selected line voltage.

Preparation

This subsection contains the following:

- This preparatory information needed to properly do the procedures that follow
- A list of equipment required in removing modules
- Module locator diagrams for finding each module in the AWG2020
- Procedures for removing and reinstalling electrical and mechanical modules
- A procedure for changing the line voltage selection

WARNING

To avoid possible personal injury or damage to AWG2020 components, read the Preparation for Use *subsection in section 2, and* Preventing ESD *in the subsection,* Before Maintenance. *Before doing this or any other procedure in this manual, read the* Safety Summary *found near the beginning of this manual.*

To avoid possible personal injury or death, disconnect the power cord from the line voltage source before doing any procedures in this section.

List of Mechanical Parts

Section 10, *Mechanical Parts List*, lists all mechanical parts in the AWG2020.

General Instructions

NOTE

Read these general instructions before removing a module.

First read over the *Summary of Procedures* that follows to understand how the procedures are organized. Then read *Equipment Required* to find out the tools needed to remove and install modules.

To remove a module, begin by doing the *Access Procedure* (on page 6-13). By following the instructions in that procedure, you can remove the desired module without unnecessarily removing other modules.

Summary of Procedures

The *Access Procedure* on page 6-13 identifies the procedure for removing each module. These categories separate the procedures based on their location in the AWG2020.

- *Procedures for External Modules* on page 6-16 describes how to remove modules which can be removed without internal access to the AWG2020.
- *Procedures for Internal Modules* on page 6-27 describes how to remove modules which require internal access to the AWG2020.
- *Procedure for Changing the Line Voltage* on page 6-55 describes how to remove the rear cover and cabinet and change the line voltage selection to 230 V.

Equipment Required

The removal of most modules in the AWG2020 requires only a screwdriver handle mounted with a size T-15, Torx screwdriver tip. Use this tool whenever a procedure step instructs you to remove or install a screw, unless a different size screwdriver is specified in that step. The first step of a module procedure lists all equipment required to remove and reinstall the module.

Table 6-4: Equipment Required

Name	Description	Part Number
Screwdriver handle	Accepts Torx-driver bits	003-0524-00
T-9 Torx tip	Torx-driver bit for T-9 size screw heads	003-0965-00
T-15 Torx tip	Torx-driver bit for T-15 size screw heads	003-0966-00
#1 Phillips tip	Phillips-driver bit for #1 size screw heads	003-0335-00
Flat-bladed screwdriver	Screwdriver for removing standard-headed screws	
Hex wrench, 0.050 inch	Standard tool	
Hex wrench, 1/16 inch	Standard tool	
Needle-nose pliers	Standard tool	
Nut driver, 1/2 inch	Standard tool	
Nut driver, 7/32 inch	Standard tool	
Nut driver, 5/16 inch	Standard tool	
Open-end wrench 1/2 inch	Standard tool	
Diagonal cutter	Standard tool	
Soldering iron	Standard tool	

AWG2020 Orientation

In this manual, procedures refer to "front," "back," "top," etc. of the AWG2020. Figure 6-1 shows how the sides are referenced.

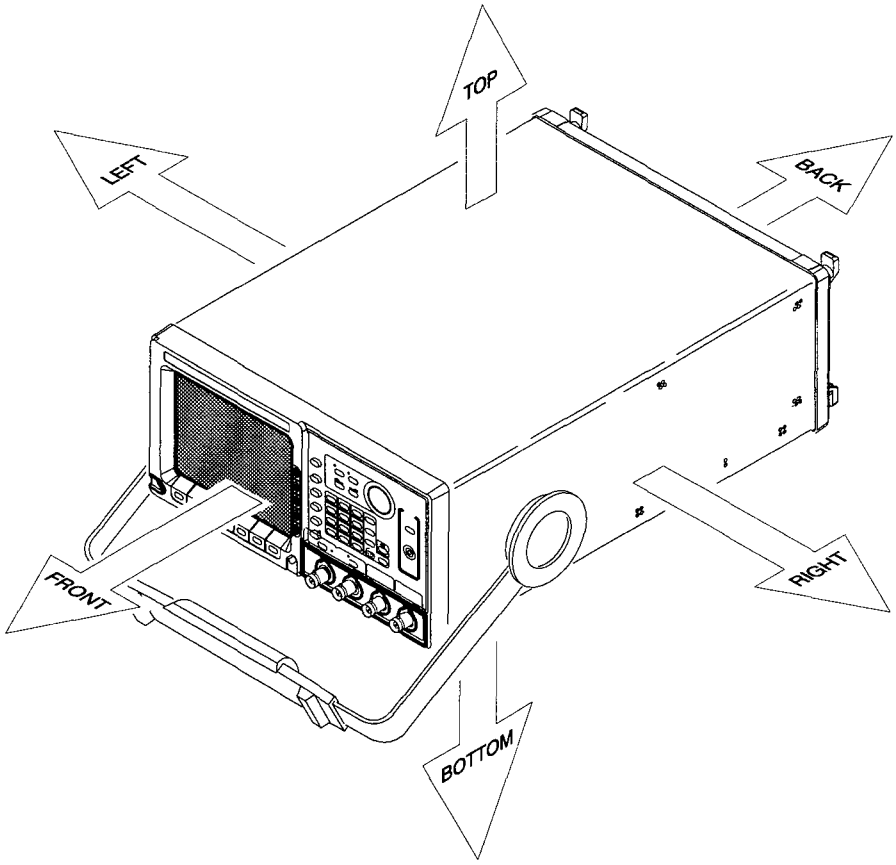
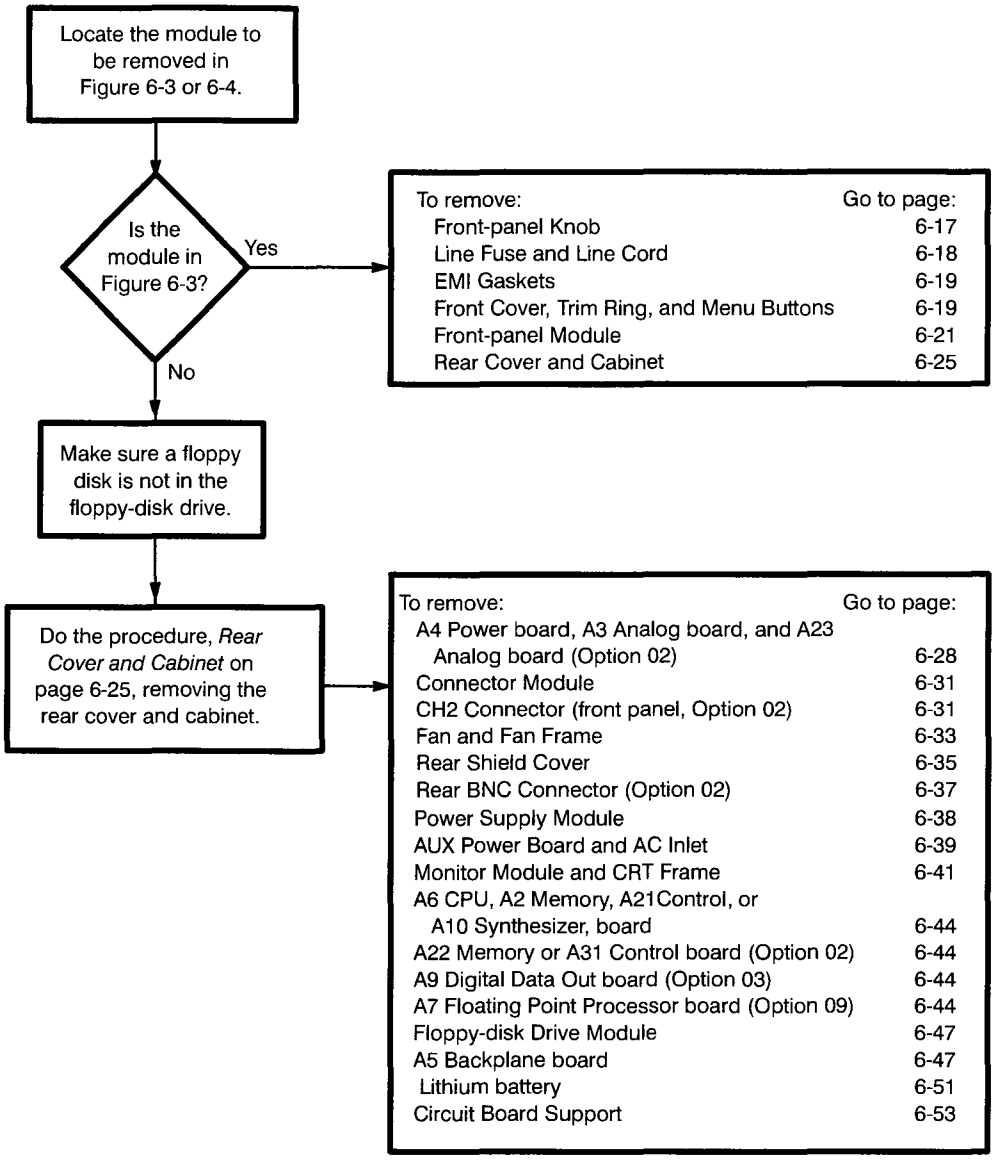


Figure 6-1: AWG2020 Orientation

Access Procedure

When you have identified the module to be removed for service, read *General Instructions* found earlier in this section. Then use the flowchart in Figure 6-2 to determine which procedures to use for removing the module. The removal procedures end with reinstallation instructions.



To remove:	Go to page:
Front-panel Knob	6-17
Line Fuse and Line Cord	6-18
EMI Gaskets	6-19
Front Cover, Trim Ring, and Menu Buttons	6-19
Front-panel Module	6-21
Rear Cover and Cabinet	6-25

To remove:	Go to page:
A4 Power board, A3 Analog board, and A23 Analog board (Option 02)	6-28
Connector Module	6-31
CH2 Connector (front panel, Option 02)	6-31
Fan and Fan Frame	6-33
Rear Shield Cover	6-35
Rear BNC Connector (Option 02)	6-37
Power Supply Module	6-38
AUX Power Board and AC Inlet	6-39
Monitor Module and CRT Frame	6-41
A6 CPU, A2 Memory, A21Control, or A10 Synthesizer, board	6-44
A22 Memory or A31 Control board (Option 02)	6-44
A9 Digital Data Out board (Option 03)	6-44
A7 Floating Point Processor board (Option 09)	6-44
Floppy-disk Drive Module	6-47
A5 Backplane board	6-47
Lithium battery	6-51
Circuit Board Support	6-53

Figure 6-2: Guide to Removal Procedures

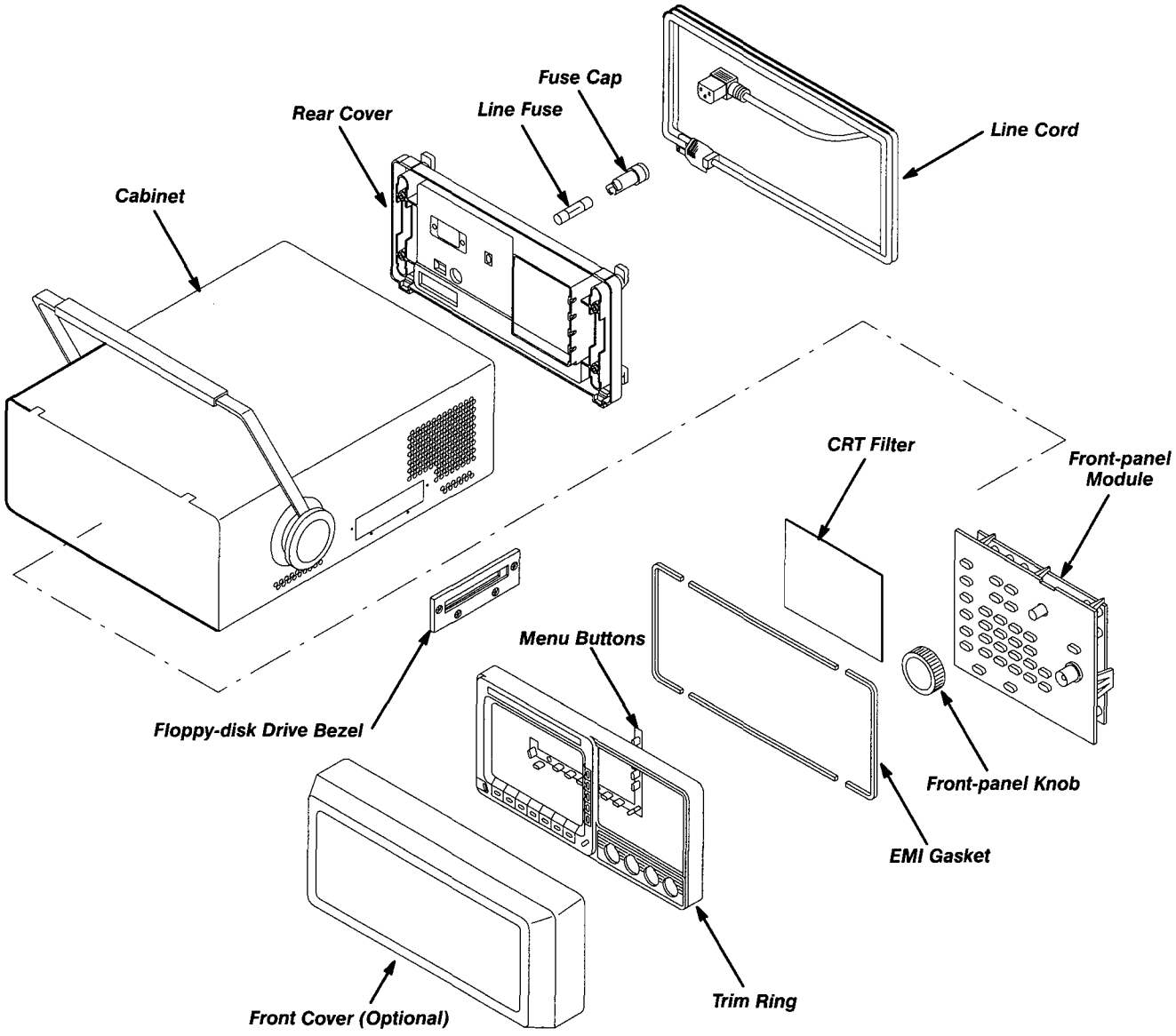


Figure 6-3: External Modules

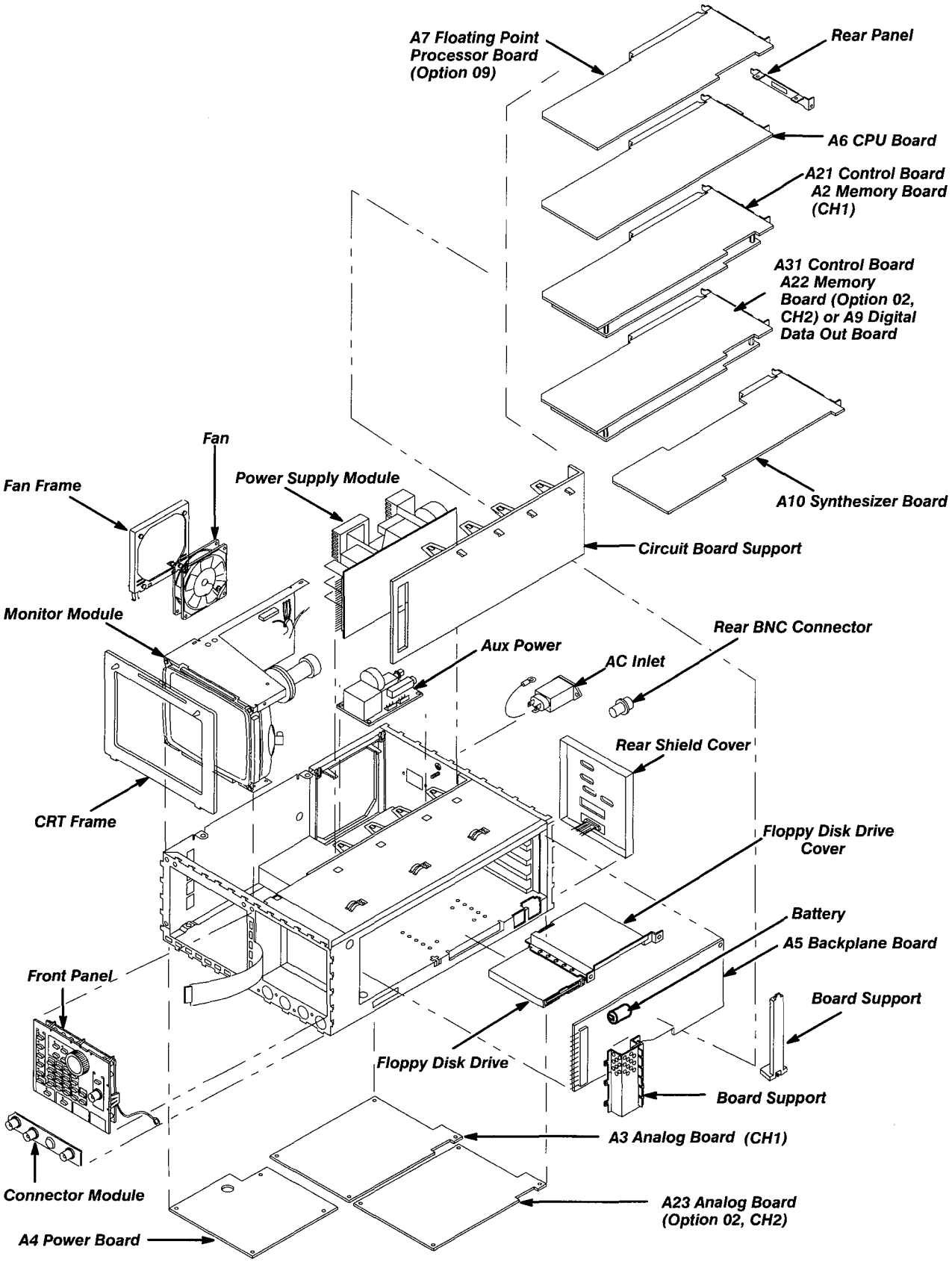


Figure 6-4: Internal Modules

Procedures for External Modules

Do the *Access Procedure* (page 6-13) before doing any procedure in this group.

This group contains the following procedures:

- Front-panel Knob
- Line Fuse and Line Cord
- EMI Gaskets
- Front Cover, Trim Ring, and Menu Buttons
- Front-panel Module
- Rear Cover and Cabinet

Front-panel Knob

1. *Assemble equipment and locate modules to be removed:* You will need a 1/16-inch hex wrench to do this procedure. Find the front-panel knob on the front panel in the locator diagram, *External Modules*, Figure 6-3.
2. *Orient instrument:* Set the AWG2020 with the bottom down on the work surface and the front facing you (see Figure 6-5).
3. *Remove front cover:* If the optional front cover is installed, grasp the front cover by the left and right edges and snap it off of the trim ring. (When reinstalling, align and snap back on.)
4. *Remove knob:* Loosen the setscrew securing the knob using the 1/16-inch hex wrench. Pull the knob toward you to remove it.
5. *Reinstallation:* Place the knob onto the shaft, and tighten the setscrew using the 1/16-inch hex wrench.

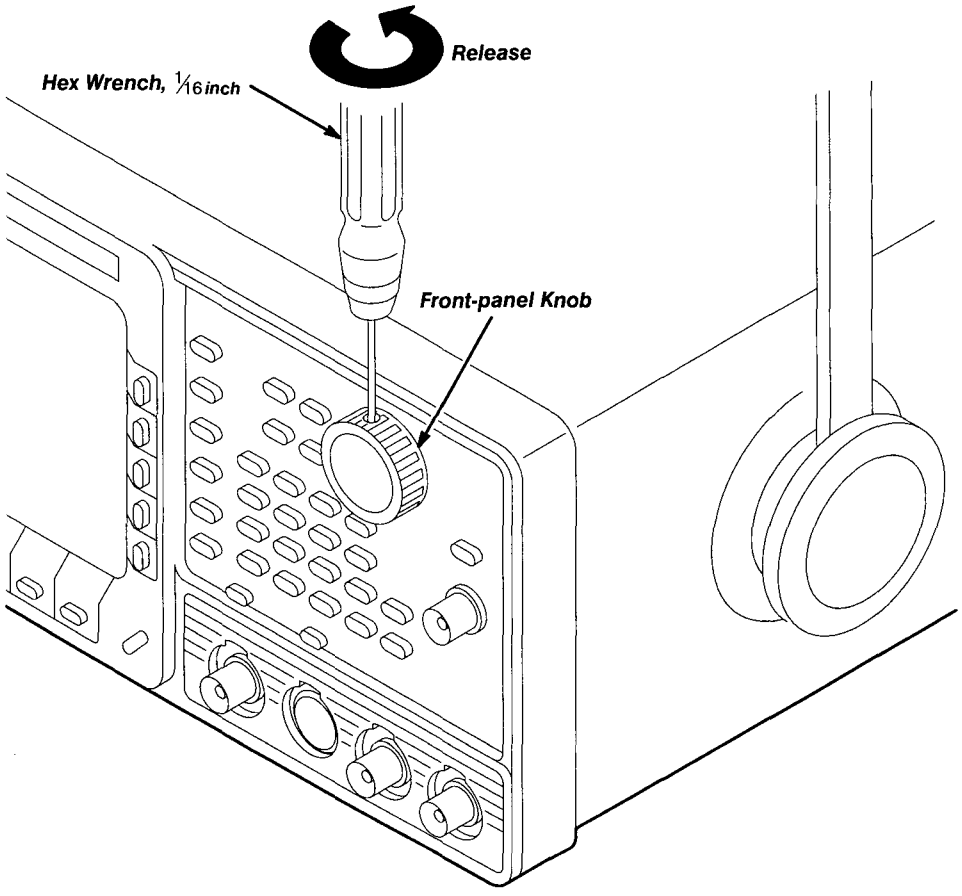


Figure 6-5: Front-panel Knob Removal

Line Fuse and Line Cord

1. *Assemble equipment and locate modules to be removed:* You will need a flat-bladed screwdriver to do this procedure. Locate the line fuse and line cord in the locator diagram, *External Modules*, Figure 6-3.
2. *Orient instrument:* Set the AWG2020 with the bottom down on the work surface and the back facing you. If you are servicing the line fuse, do the next step; if you are servicing the line cord, skip to step 4.
3. *Remove line fuse:* Find the fuse cap on the rear panel. See Figure 6-6. Now, remove the fuse cap by turning it counter-clockwise using a flat-bladed screwdriver, and remove the line fuse. Reverse the procedure to reinstall.
4. *Remove line cord:* Find the line cord on the rear cover. See Figure 6-6. Now, remove the line-cord retaining clamp by first unplugging the line cord from the line cord receptacle (1). Next, grasp both the line cord and the retaining clamp and rotate it 90 degrees, counter-clockwise (2). Pull the line cord and clamp away to complete the removal (3). Reverse the procedure to reinstall.
5. *Reinstallation:* Do steps 3 and 4 in reverse order to reinstall the line cord, and then the line fuse.

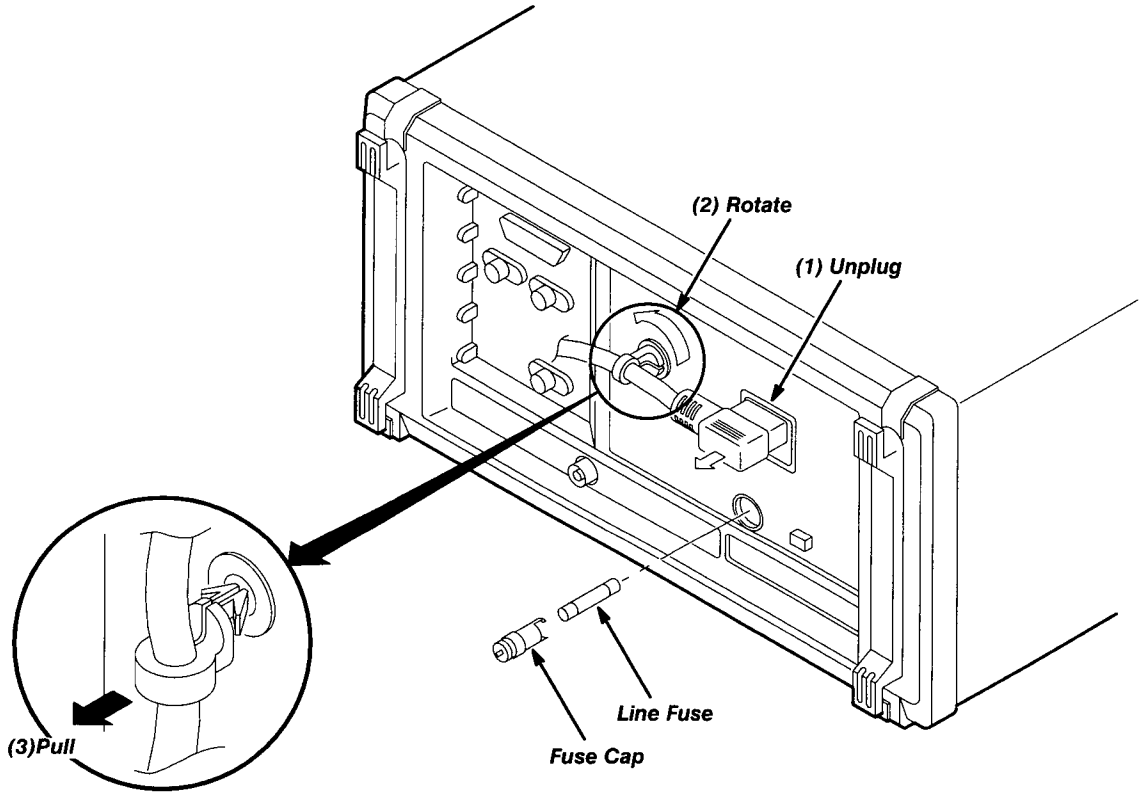


Figure 6-6: Line Fuse and Line Cord Removal

EMI Gaskets

1. *Remove front cover and trim ring:* Do the *Front Cover, Trim Ring, and Menu Buttons* procedure on page 6-19, removing only the front cover and trim ring.

CAUTION

To prevent exceeding the environmental characteristics for EMI, carefully follow the instructions given, when reinstalling the EMI gaskets and/or the AWG2020 cabinet.

2. *Remove EMI gaskets:*
   a. You will need a needle-nose pliers to do this part of the procedure.
   b. Locate the EMI gaskets in the locator diagram, *External Modules*, in Figure 6-3.
   c. Use a pair of needle-nose pliers to remove the four sections of EMI gaskets from the groove in the trim ring.
3. *Reinstall EMI gaskets:* Press the EMI gaskets back into the groove in the trim ring.

Front Cover, Trim Ring, and Menu Buttons

1. *Assemble equipment and locate modules to be removed:* No tools are needed. Locate the modules to be removed in the locator diagram, *External Modules*, in Figure 6-3.
2. *Orient instrument:* Set the AWG2020 with the back down on the work surface and bottom facing you (see Figure 6-7).
3. *Remove front cover:* If the optional front cover is installed, grasp the front cover by the left and right edges and snap it off of the trim ring. (When reinstalling, align and snap back on.)
4. *Remove front-panel knob:* Do the *Front-panel Knob* procedure, on page 6-17.

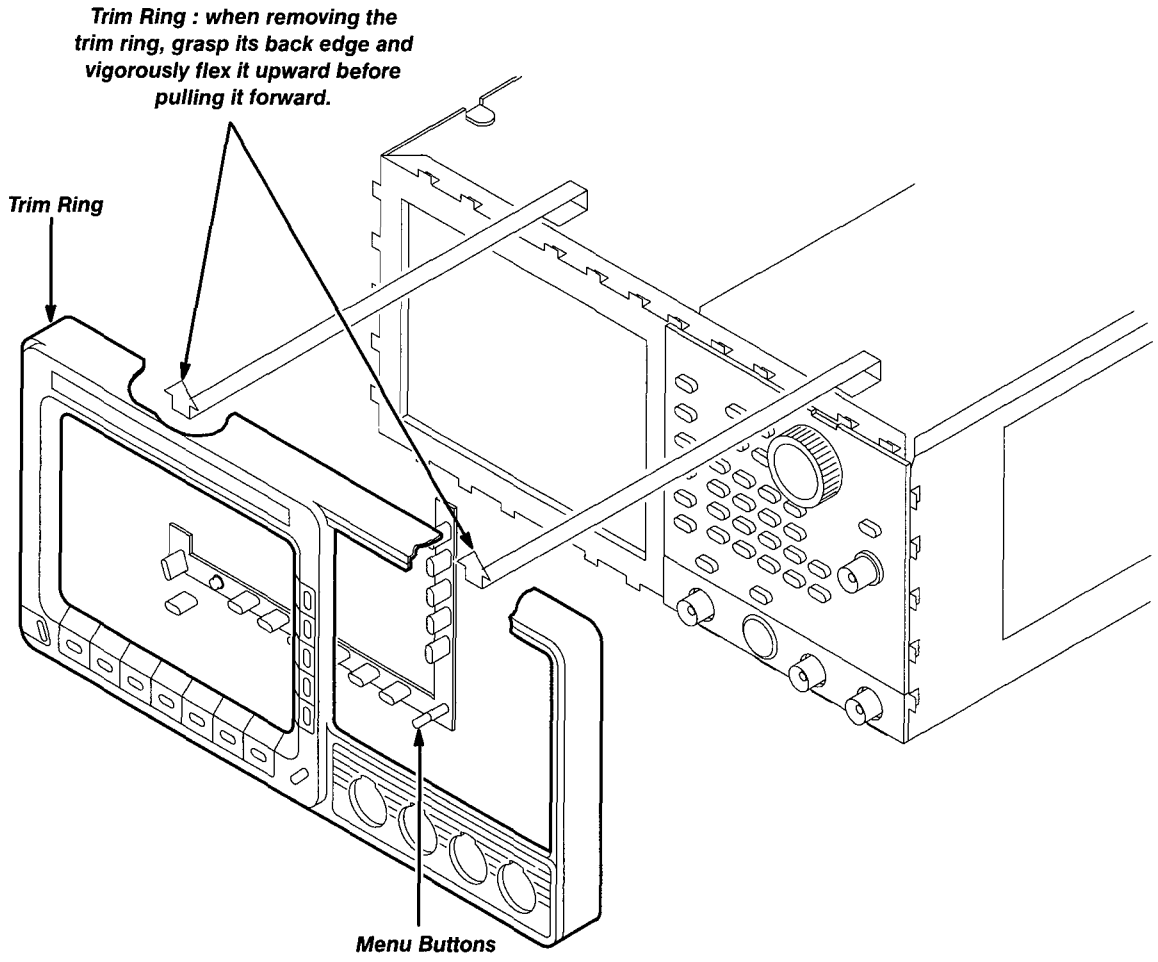


Figure 6-7: Front Cover, Trim Ring, and Menu Button Removal (Front Cover not Shown)

CAUTION

To prevent contaminating AWG2020 parts, do not touch the carbon contact points on the menu buttons installed in the trim ring. Also, do not touch the contacts on the flex circuit exposed when you remove the trim ring.

5. *Remove trim ring:* Grasp the trim ring by the top edge and pry it up and lift it forward to snap it off of the trim ring. If servicing the menu buttons, lift them out of the trim ring. (When reinstalling, reinsert the menu buttons, align the trim ring to the chassis and press it back on.)
6. *Reinstallation:* Do steps 3–5 in reverse order to reinstall the menu buttons, trim ring and the front cover, following the reinstallation instructions found in each step.

Front-panel Module

NOTE

This procedure includes removal and reinstallation instructions for the front-panel module and front-panel buttons. Unless either of those modules are being serviced, do not do step 6, "Further disassembly of Front-panel Module."

1. *Assemble equipment and locate modules to be removed:*
   a. You will need a flat-bladed screwdriver and a 0.05-inch and $\frac{1}{16}$-inch hex wrench to do this procedure.
   b. Locate the modules to be removed in the locator diagram, *External Modules*, in Figure 6-3.
   c. Do the procedure, *Front Cover, Trim Ring, and Menu Buttons*, steps 1–6 (immediately preceding this procedure).
2. *Remove front-panel knob:* Do the *Front-panel Knob* procedure, on page 6-17.
3. *Remove front cover, trim ring, and menu buttons:* Do the *Front Cover, Trim Ring, and Menu Buttons* procedure on page 6-19 removing only the module(s) you want to service.
4. *Orient instrument:* Set the AWG2020 with the bottom down on the work surface and the front facing you.
5. *Remove front-panel module:*
   a. As shown in Figure 6-8, release the snap at the right of the front-panel module using a flat-bladed screwdriver. Lift the front-panel module out of the chassis until you can reach the interconnect cable.
   b. Disconnect the ribbon interconnect cable at J101 and flexible board connector at JP301 on the A12 Keyboard assembly. Disconnect the interconnect cable at the TRIGGER INPUT connector.
   c. Finally, lift the front-panel module out of the chassis to complete the removal.

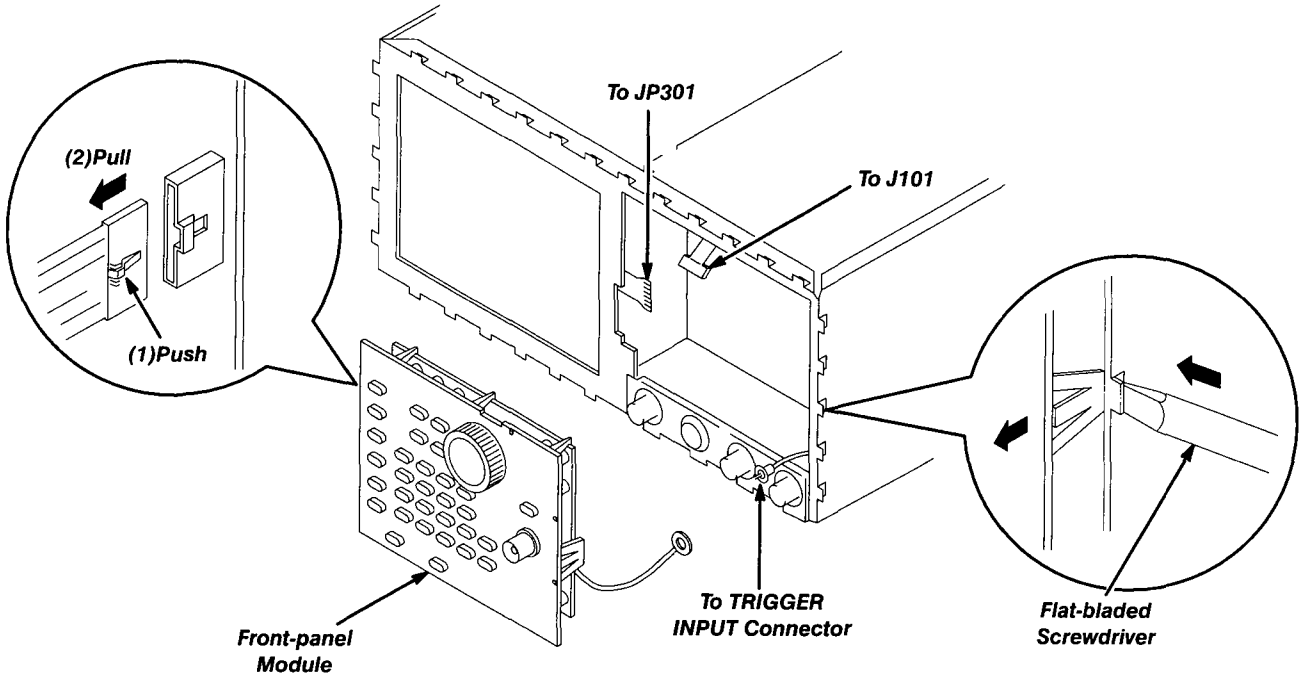


Figure 6-8: Front-panel Module Removal

6. *Further disassembly of front-panel module:* If the front-panel module or the front-panel buttons are to be serviced, do the following substeps:

   a. Remove the front-panel knob from the front-panel module using the method described in the procedure, *Front-panel Knob,* on page 6-17.

   b. Remove the setscrew completely from the extension using the 0.05-inch hex wrench, and then remove the extension from the shaft of the rotary switch.

   c. As shown in Figure 6-9, release the four hooks, and then remove the A12 Keyboard from the chassis.

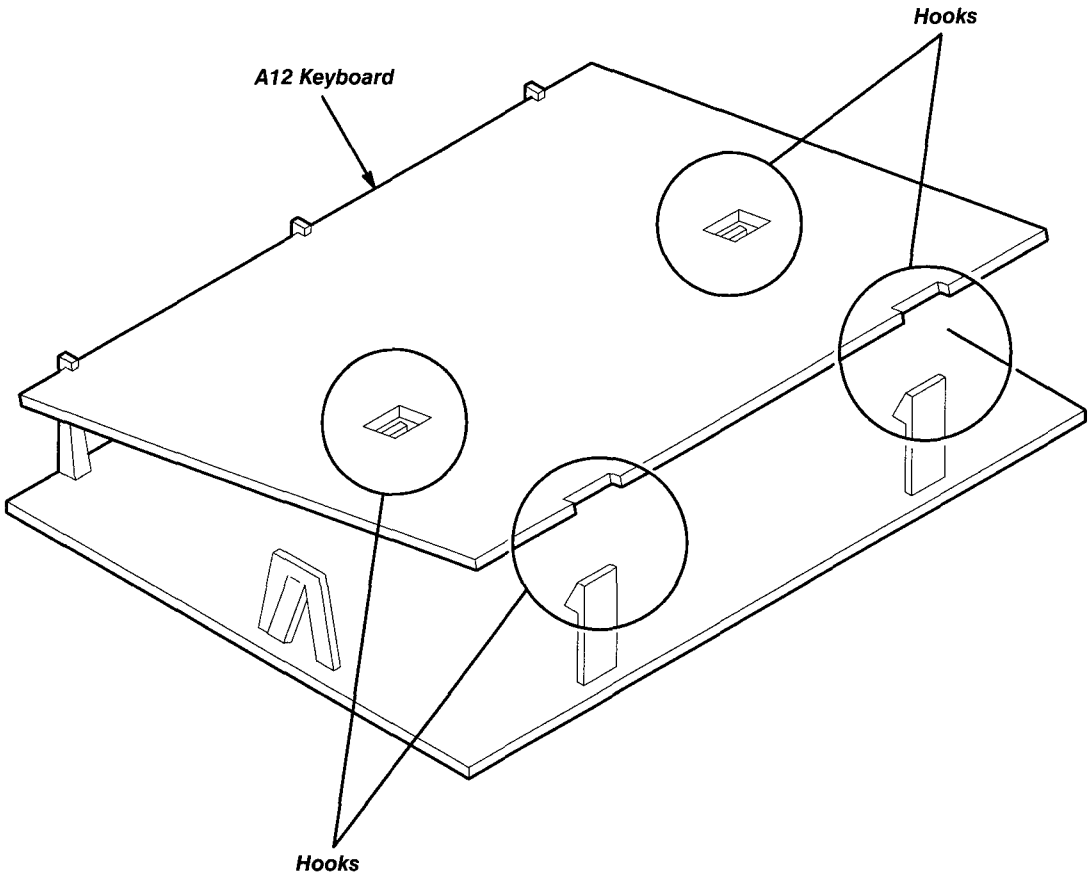


Figure 6-9: A12 Keyboard Removal

d. Now hand disassemble the front-panel module components using Figure 6-10 as a guide. Reverse the procedure to reassemble.

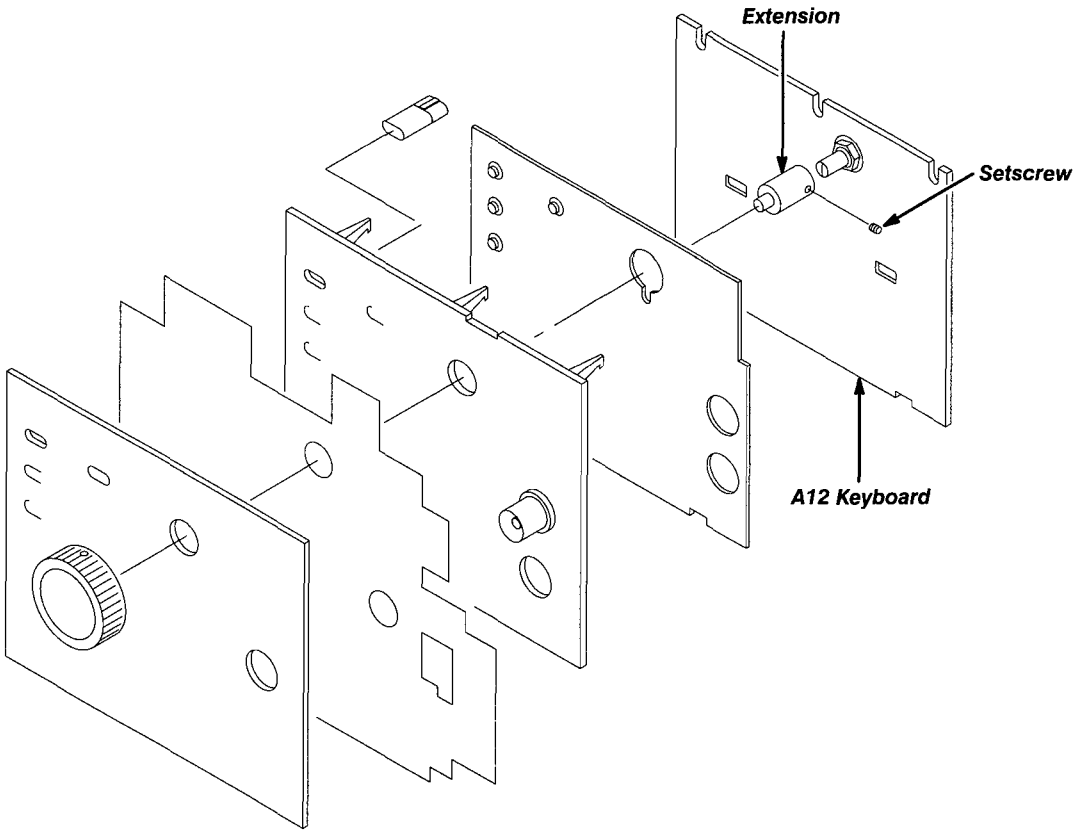


Figure 6-10: Disassembly of Front-panel Module

7. *Reinstallation:* If the front-panel module was further disassembled in step 6, then reverse substeps 6a–6d to reassemble, using Figure 6-10 as a guide. Then do the substeps in step 3 in reverse order, reversing the order of the items in each substep. Last, reinstall the trim ring and, if desired, the front cover, referring to the procedure, *Front Cover, Trim Ring, and Menu Buttons* (page 6-19).

Rear Cover and Cabinet

1. *Assemble equipment and locate modules to be removed:*
   a. You will need a screwdriver with size T-9 and T-15 Torx tips to do this procedure.
   b. Make sure the AWG2020 front cover (optional accessory) is installed. If it is not, install it by snapping the edges of the front cover over the trim ring.
   c. Locate the rear cover and cabinet in the locator diagram, *External Modules*, Figure 6-3.
2. *Orient instrument:* Set the AWG2020 face down, with the front cover on the work surface and the instrument bottom facing you (see Figure 6-11).
3. *Disconnect line cord:* Do the *Line Fuse and Line Cord* procedure on page 6-18, removing only the line cord.
4. *Remove rear cover:* Using a screwdriver with a size T-15 Torx tip, remove the four screws securing the rear cover to the instrument. Lift off the rear cover.
5. *Orient instrument:* Set the AWG2020 face down, with the front cover on the work surface and right side facing you.
6. *Remove floppy disk drive bezel:* Using a screwdriver with a size T-9 Torx tip, remove the four screws securing the floppy-disk drive bezel to the cabinet. Lift off the floppy-disk drive bezel.
7. *Remove cabinet:*

CAUTION

To prevent damaging the eject button, make sure floppy disk is not inserted in the floppy disk drive, before removing the cabinet from the AWG2020.

   a. Using a screwdriver with a size T-15 Torx tip, remove the screw securing the left side of the cabinet to the instrument.
   b. Grasp the right and left edges of the cabinet toward the back.
   c. Pull upward to slide the cabinet off the instrument. Take care not to bind or snag the cabinet on internal cabling as you remove it.
8. *Reinstall cabinet and rear cover:*
   a. Do steps 3 through 7 in reverse order to reinstall the cabinet.
   b. Take care not to bind or snag the cabinet on internal cabling; redress cables as necessary.

c. When sliding the cabinet, be sure that the front edge of the cabinet aligns with the groove containing the four EMI shields on the trim ring.

d. When reinstalling the four screws at the rear panel, tighten them to a torque of 16 kg-cm (6 in-lbs).

e. See the procedure, *Line Fuse and Line Cord,* on page 6-18 to reinstall the line cord. This completes the AWG2020 reassembly.

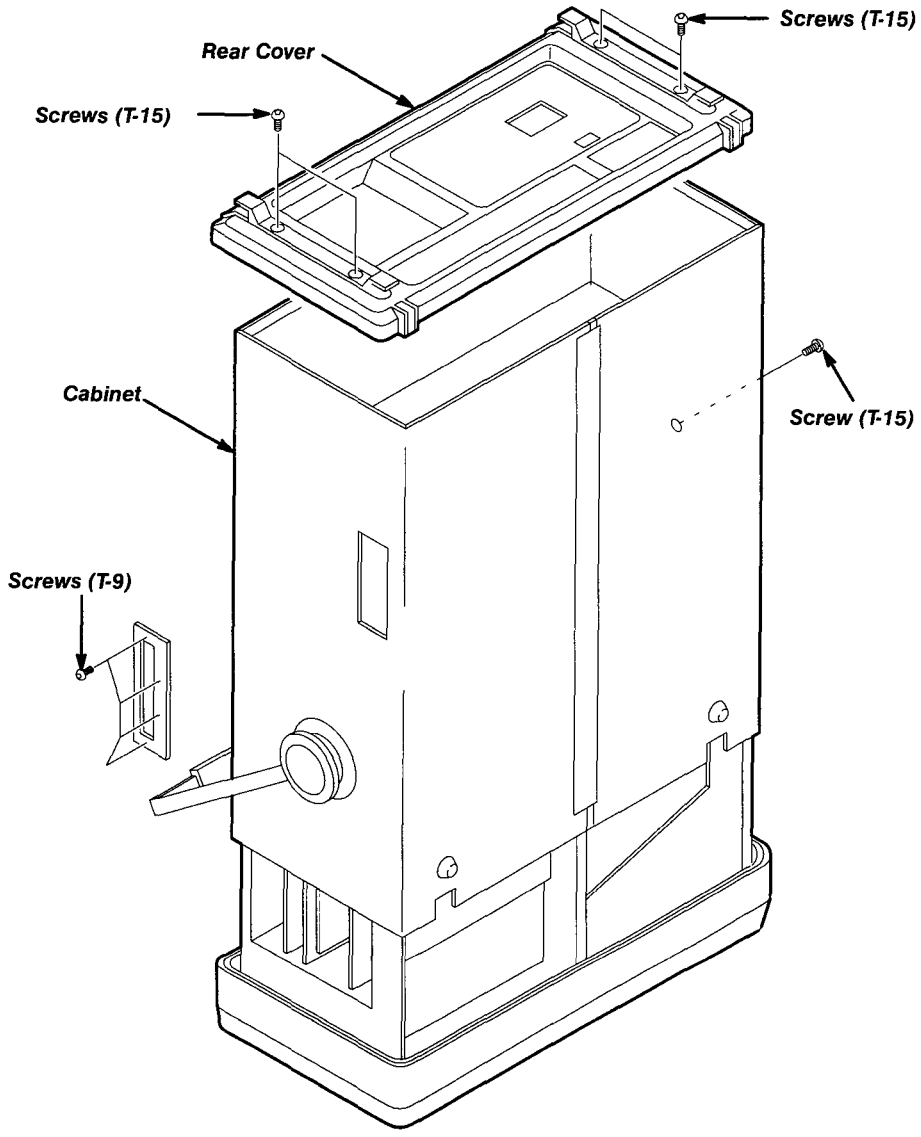


Figure 6-11: Rear Cover and Cabinet Removal

Procedures for Internal Modules

Do the *Access Procedure* (on page 6-13) before doing any procedure in this group.

This part contains the following removal and installation procedures; the procedures are presented in the order listed:

- A4 Power Board, A3 Analog Board, and A23 Analog Board (Option 02)
- Connector Module
- Fan and Fan Frame
- Rear Shield Cover
- Rear BNC Connector
- Power Supply Module
- AUX Power Board and AC Inlet
- Monitor Module and CRT Frame
- Circuit Boards:
  - A6 CPU Board
  - A2 Memory Board
  - A21 Control Board
  - A10 Synthesizer Board
  - For Option 02: A22 Memory Board and A31 Control Board
  - For Option 03: A9 Digital Data Out Board
  - For Option 09: A7 Floating Point Processor Board
- A5 Backplane Board
- Lithium Battery
- Floppy Disk Drive Module
- Circuit Board Support

A4 Power Board, A3 Analog Board, and A23 Analog Board (Option 02)

1. *Assemble equipment and locate modules to be removed:*
   a. You will need a screwdriver with a size T-15 Torx tip to do this procedure.
   b. Locate the modules to be removed in the locator diagram, *Internal Modules*, Figure 6-4.
2. *Orient instrument:* Set the AWG2020 with the top down on the work surface and the right side facing you. If you are not servicing the A4 Power board, skip to step 4.
3. *Remove A4 Power board:*
   a. Disconnect the two interconnect cables at J300 and J310 on the A4 Power board. See Figure 6-12.
   b. Disconnect the three ribbon interconnect cables at J100, J120, and J320 on the A4 Power board. For the AWG2020 with Option 02 installed, disconnect the ribbon interconnect cable at J140 on the A4 Power board.
   c. Using a screwdriver with a size T-15 Torx tip, remove the four screws attaching the A4 Power board to the chassis.
   d. Lift the A4 Power board up and away from the chassis to complete the removal.

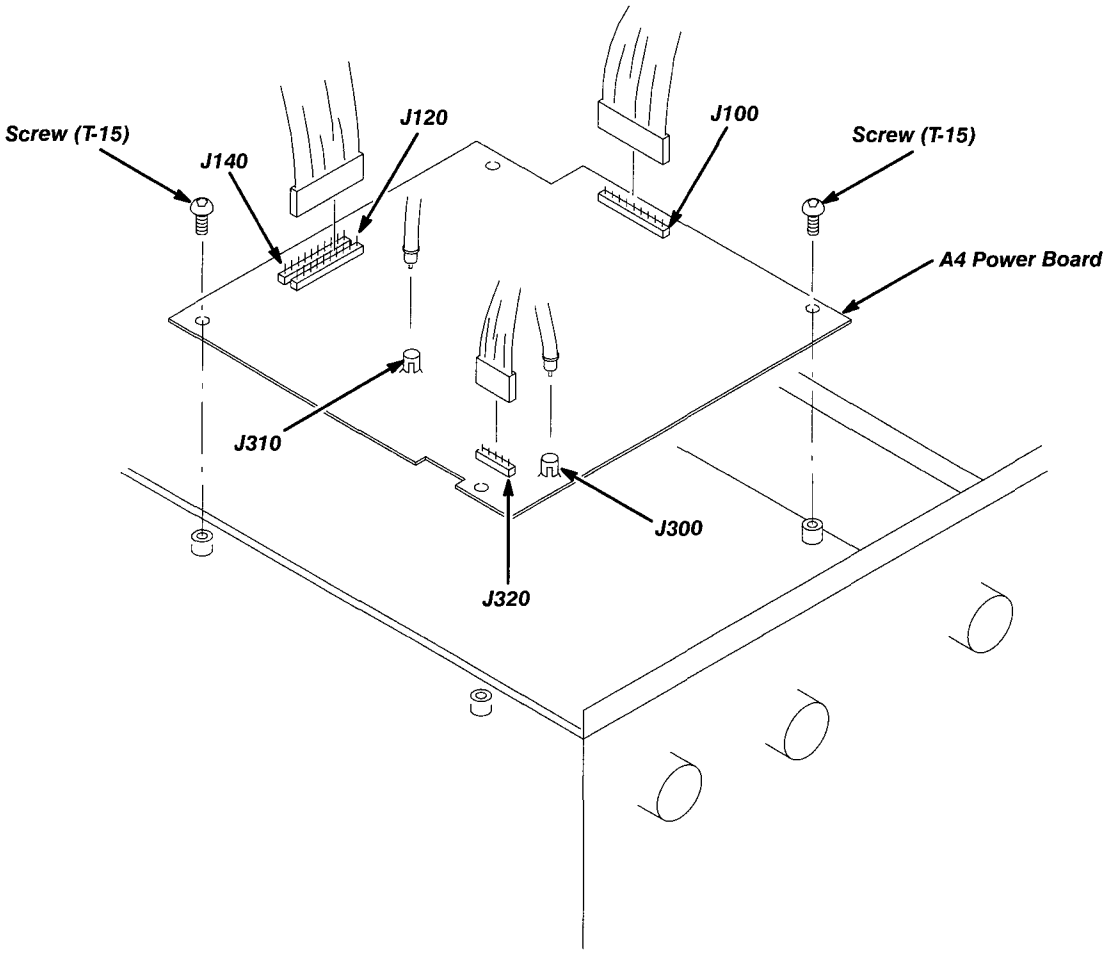


Figure 6-12: A4 Power Board Removal

4. *Remove A3 Analog board:*

   a. Disconnect the four interconnect cables at J100, J150, J160, and J230 of the A3 Analog board. See Figure 6-13.

   b. Disconnect the three ribbon interconnect cables at J300, J400, J410, and J500 of the A3 Analog board.

   c. Using a screwdriver with a size T-15 Torx tip, remove the four screws securing the A3 Analog board to the chassis.

   d. Lift the A3 Analog board up and away from the chassis to complete the removal.

5. *Remove A23 Analog board (Option 02):* If the AWG2020 includes Option 02 which adds a second output channel, then it contains an A23 Analog board.

   a. Disconnect the three interconnect cables at J100, J228, and J230 on the A23 Analog board. See Figure 6-13.

b. Disconnect the two ribbon interconnect cables at J410 and J500 on the A23 Analog board.

c. Using a screwdriver with a size T-15 Torx tip, remove the four screws attaching the A23 Analog board to the chassis.

d. Lift the A23 Analog board up and away from the chassis to complete the removal.

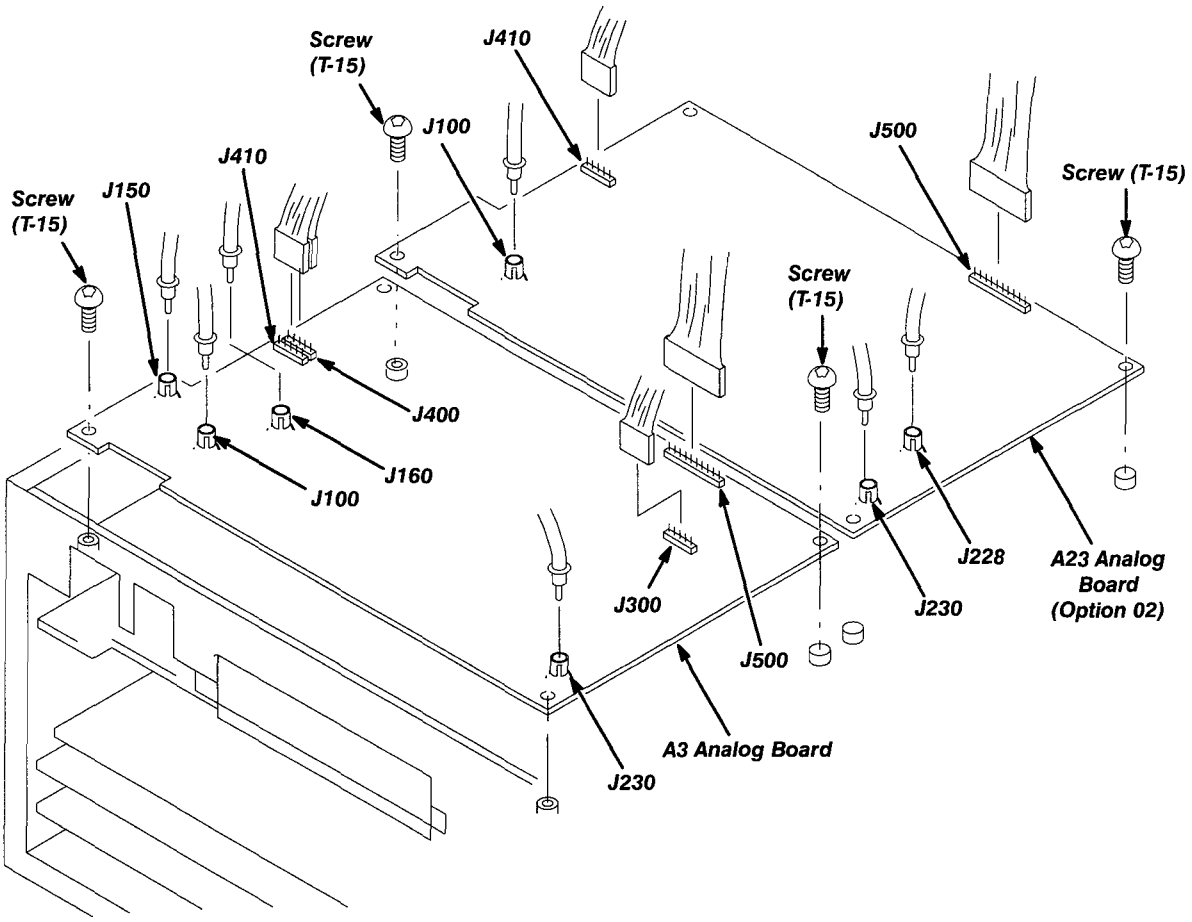


Figure 6-13: A3/A23 Analog Board Removal

6. *Reinstallation:* If the AWG2020 includes Option 02, do substeps 5a–5d to reinstall the A23 Analog board. Do substeps 4a–4d in reverse order to reinstall the A3 Analog board; then, do substeps 3a–3d in reverse order to reinstall the A4 Power board.

Connector Module

1. *Assemble equipment and locate modules to be removed:*
   a. You will need a screwdriver with a size T-9 Torx tip and a ½-inch nut driver to do this procedure.
   b. Locate the modules to be removed in the locator diagram, *Internal Modules*, in Figure 6-4.
2. *Remove front-panel knob:* Do the *Front-panel Knob* procedure, on page 6-17.
3. *Remove front cover, trim ring, and menu buttons:* Do the *Front Cover, Trim Ring, and Menu Buttons* procedure on page 6-19.
4. *Orient instrument:* Set the AWG2020 with the top down on the work surface and the right side facing you.
5. *Remove connector module:*
   a. Disconnect the interconnect cable at the CH1 Waveform Output connector. See Figure 6-14. For an AWG2020 with Option 02, disconnect the interconnect cable at the CH2 Waveform Output connector.
   b. Unsolder the two interconnect cables at the CH1 SYNC, CH1 MARKER 1 connector.
   c. Using the screwdriver with a size T-9 Torx tip, remove the four screws attaching the connector module to the chassis.
6. *Remove BNC connector:*
   a. To remove a BNC connector, remove the nut attaching the BNC connector to the panel using a ½-inch nut driver, and then remove the BNC connector from the panel.
7. *Reinstallation:*
   a. *Install BNC connector:* Do substep 4a, reversing the order of the items in the substep.
   b. *Install connector module:* Install the connector module by doing substeps 5a–5a in reverse order.

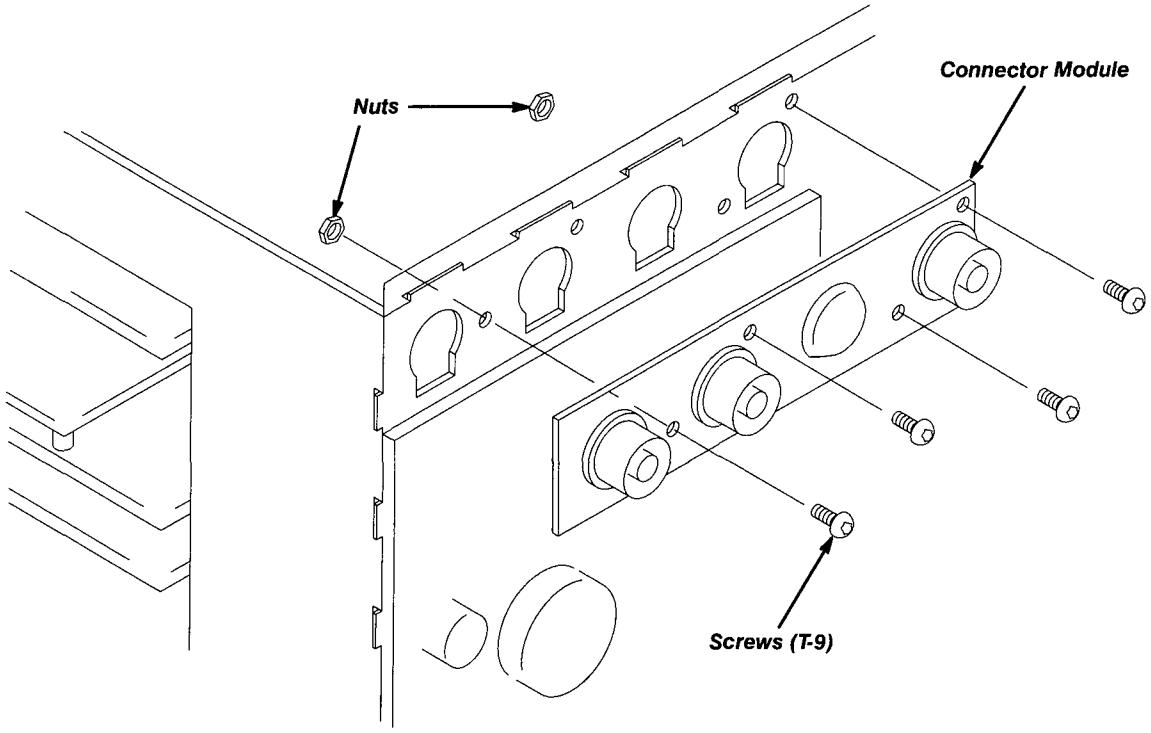


Figure 6-14: Connector Module Removal

Fan and Fan Frame

1. *Assemble equipment and locate modules to be removed:*
   a. You will need a needle-nose pliers and diagonal cutters to do this procedure.
   b. Locate the modules to be removed in the locator diagram, *Internal Modules*, in Figure 6-4.
2. *Orient instrument:* Set the AWG2020 with the bottom down on the work surface and the left side facing you.
3. *Remove fan:*
   a. Using a diagonal cutter, cut the strap tiedown binding the cable that projects from the fan. See Figure 6-15.
   b. Disconnect the ribbon interconnect cable from J3 of the power supply module. See Figure 6-15.
   c. Release the upper hooks securing the fan, lift the fan up, and then take it out.

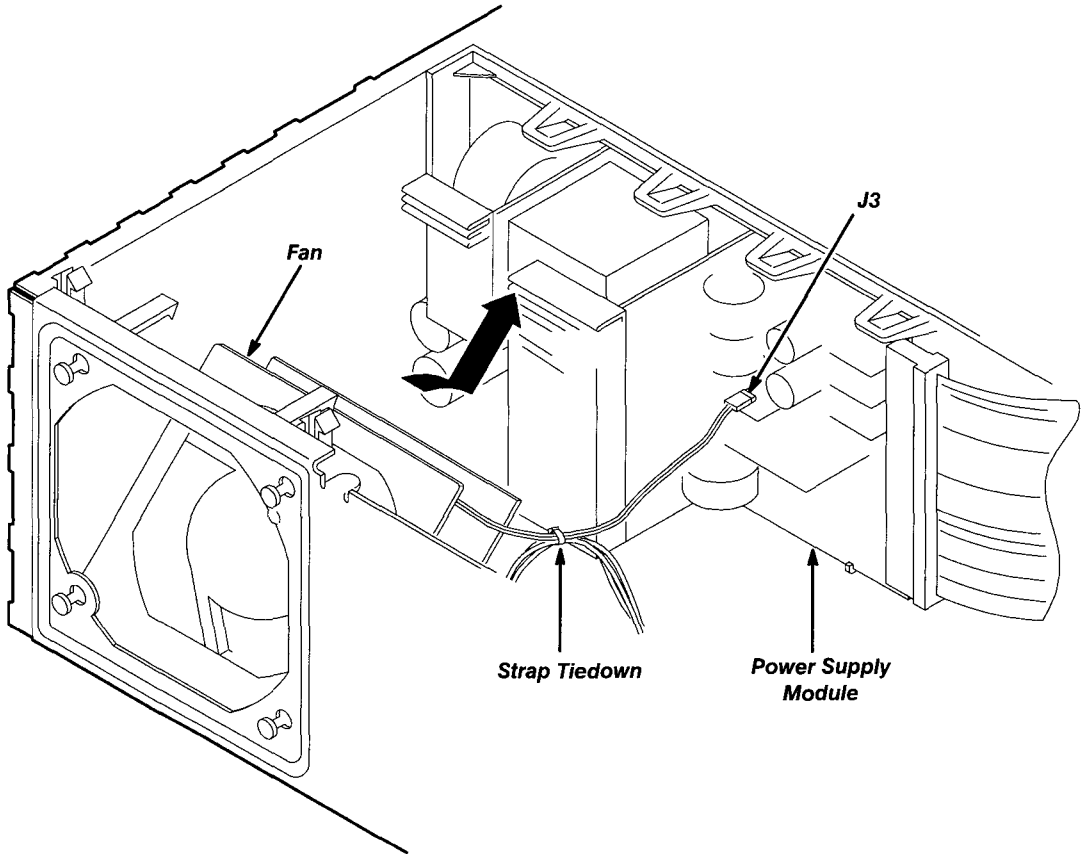


Figure 6-15: Fan Removal

4. *Remove fan frame:* As shown in Figure 6-16, slide (2) in the direction indicated by arrow (1) while pushing it, and then remove the fan frame.

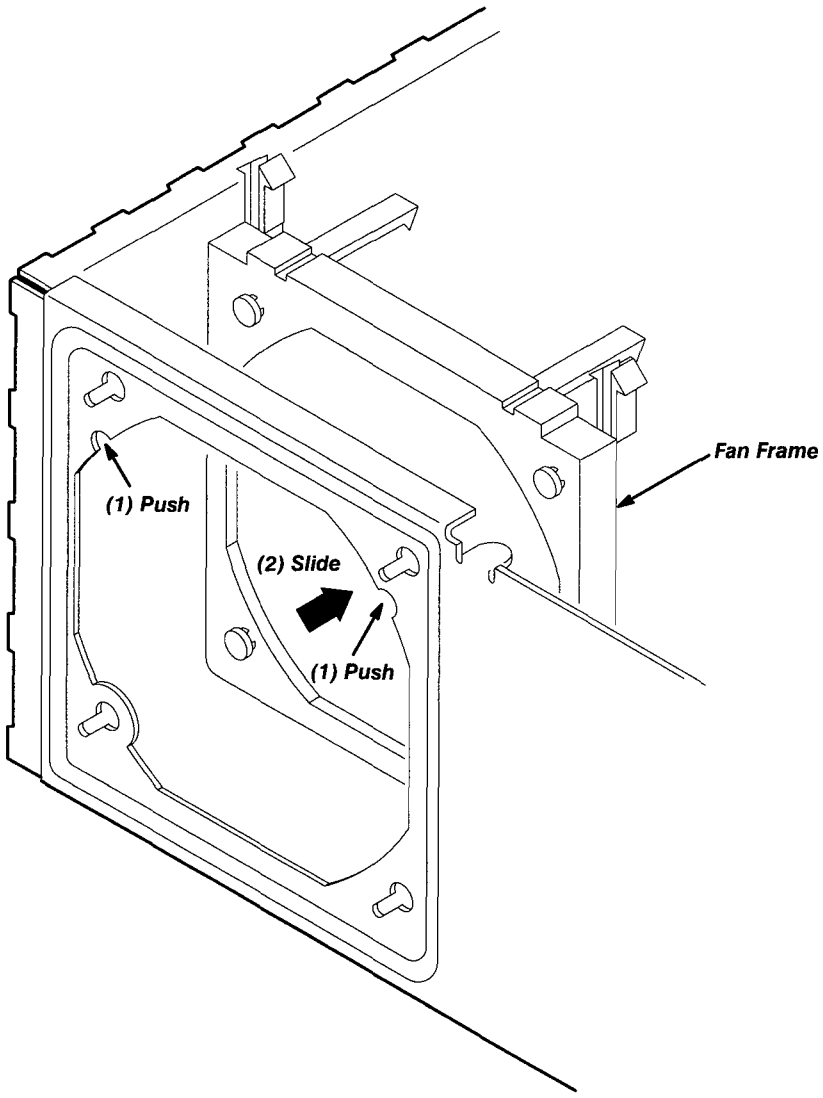


Figure 6-16: Fan Frame Removal

5. *Reinstallation:*

   a. Align the four protrusions of the fan frame with the holes of the chassis, slide the fan to the lower left, and then install it.

   b. Align the fan with the lower guide of the fan frame, pull the fan toward you as far as it will go, and then install it. Connect the cable. Tie the cable using a strap tiedown.

Rear Shield Cover

1. *Assemble equipment and locate modules to be removed:*
   a. You will need a screwdriver with a size T-15 Torx tip and a $\frac{7}{32}$-inch nut driver to do this procedure.
   b. Locate the modules to be removed in the locator diagram, *Internal Modules*, Figure 6-4.
2. *Orient instrument:* Set the AWG2020 with the bottom down on the work surface and the back facing you (see Figure 6-17).
3. *Remove rear shield cover:*
   a. Disconnect the ribbon interconnect cable from J30 on the A6 CPU board. See Figure 6-23.
   b. Using a screwdriver with a size T-15 Torx tip, remove the five screws securing the rear shield cover to the chassis from the back side.
   c. Using a screwdriver with a size T-15 Torx tip, remove the five screws securing the rear shield cover to the chassis from the left side.
   d. Remove the IEEE STD 488 PORT cover by removing the two spacer posts.
   e. Grasp the serial interface connector, pull the rear shield cover toward you taking care not to damage the cable, and then remove the rear shield cover.
   f. You can remove the rear panel of a slot in which no board is mounted.
4. *Remove serial interface connector:* Use a $\frac{7}{32}$-inch nut driver to remove the nut attaching the connector to the rear shield cover; then, remove the connector.
5. *Reinstallation:* Install the serial interface connector if you removed it by reversing the items in step 4; then, install the rear shield cover by doing substeps 3a–3f in reverse order.

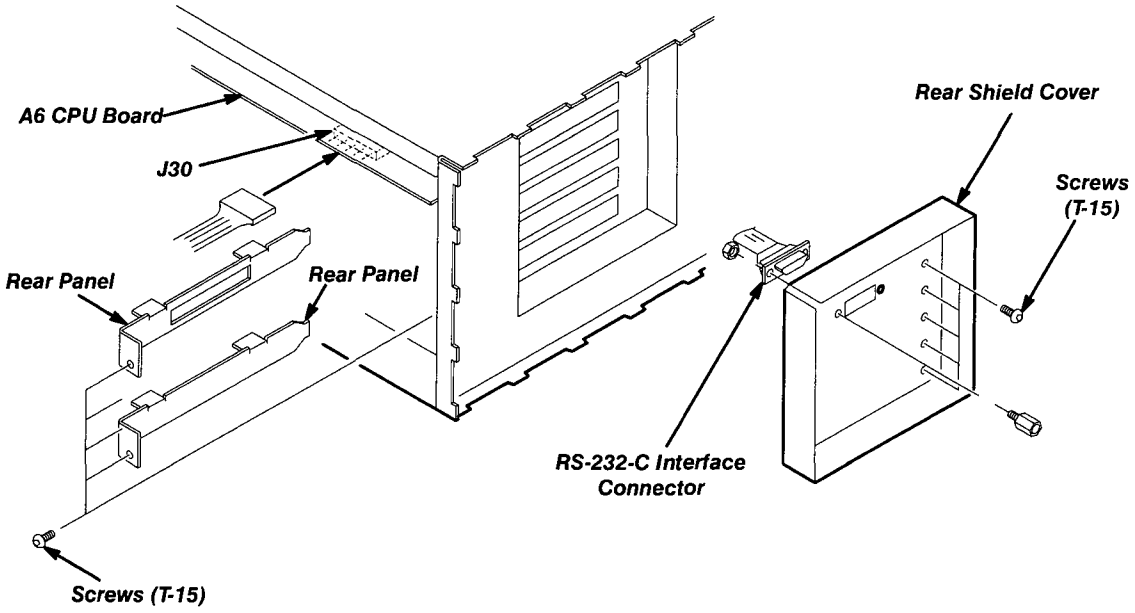


Figure 6-17: Rear Shield Cover Removal

Rear BNC Connector

1. *Assemble equipment and locate modules to be removed:*
   a. You will need a ½-inch open-end wrench to do this procedure.
   b. Locate the modules to be removed in the locator diagram, *Internal Modules*, in Figure 6-4. (An instrument with Option 02 has two additional BNC connectors.)
2. *Orient instrument:* Set the AWG2020 with the top down on the work surface and the left side facing you (see Figure 6-18).
3. *Remove rear BNC connector:*
   a. Disconnect the interconnect cable at the AM IN connector.
   b. Using the open-end wrench, remove the nut securing the BNC connector to the chassis. Then, lift the BNC connector out of the chassis to complete the removal.
   c. For and instrument with Option 02, remove the CH2 MARKER1 OUT and CH2 SYNC OUT connectors using the same procedure.
4. *Reinstallation:* Install the rear BNC connector by doing substeps 3a and 3c in reverse order.

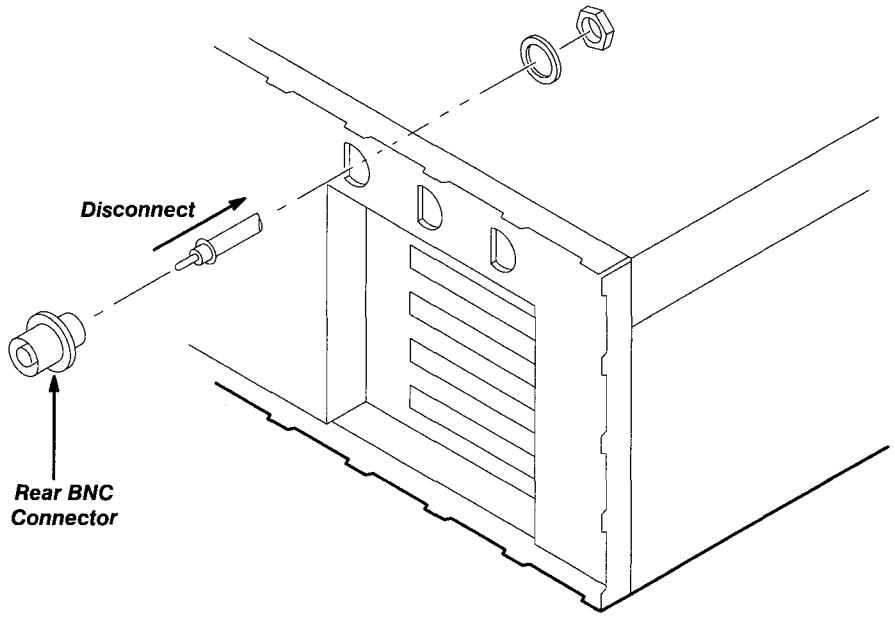


Figure 6-18: Rear BNC Connector Removal

Power Supply Module

1. *Assemble equipment and locate modules to be removed:* You will need a flat-bladed screwdriver to do this procedure. Locate the modules to be removed in the locator diagram, *Internal Modules*, in Figure 6-4.
2. *Remove fan and fan frame:* Do the *Fan and Fan Frame* procedure on page 6-33.
3. *Orient instrument:* Set the AWG2020 with the bottom down on the work surface and the left side facing you.
4. *Remove power supply module:*
   a. Disconnect the ribbon interconnect cable at J1, J3, J4, and J5 on the power supply module. See Figure 6-19.
   b. Disconnect the flat cable at J2 on the power supply module.
   c. Using a flat-bladed screwdriver, push the four hooks, pull the power supply module toward you, and then remove it.

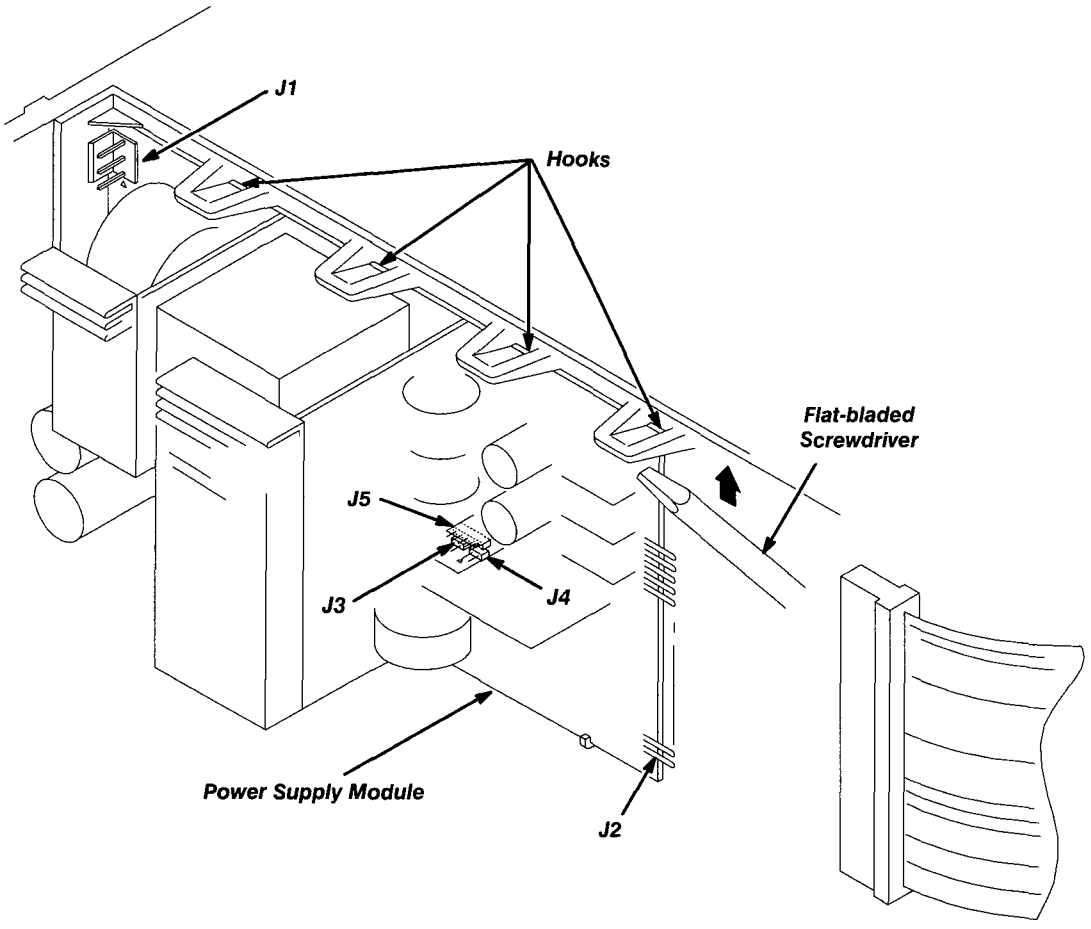


Figure 6-19: Power Supply Module Removal

5. *Reinstallation:* Do substeps 4a–4c in reverse order to reinstall the power supply module.

AUX Power Board and AC Inlet

1. *Assemble equipment and locate modules to be removed:*
   a. You will need a screwdriver with a size T-15 Torx tip and a 5/16-inch nut driver to do this procedure.
   b. Locate the modules to be removed in the locator diagram, *Internal Modules*, in Figure 6-4.
2. *Remove fan and fan frame:* Do the *Fan and Fan Frame* procedure on page 6-33.
3. *Orient instrument:* Set the AWG2020 with the bottom down on the work surface and the back facing you (see Figure 6-20).
4. *Remove the power supply module:* Do the procedure, *Power Supply Module*, on page 6-38.
5. *Remove AUX Power board:*

NOTE

To remove only the AC inlet, skip to step 6.

   a. Disconnect the interconnect cable at CN1 on the AUX Power board.
   b. Remove the three screws attaching the AUX Power board to the chassis.
   c. Lift the AUX Power board up and away from the chassis to complete the removal.
6. *Remove AC inlet:*
   a. Remove the two insulating tubes of cables attached to the AC inlet.
   b. Unsolder the two interconnect cables attached to the AC inlet.
   c. Using a 5/16-inch nut driver, remove the nut attaching the ground wire to the chassis.
   d. Using a screwdriver with a size T-15 Torx tip, remove the two screws securing the AC inlet to the chassis.

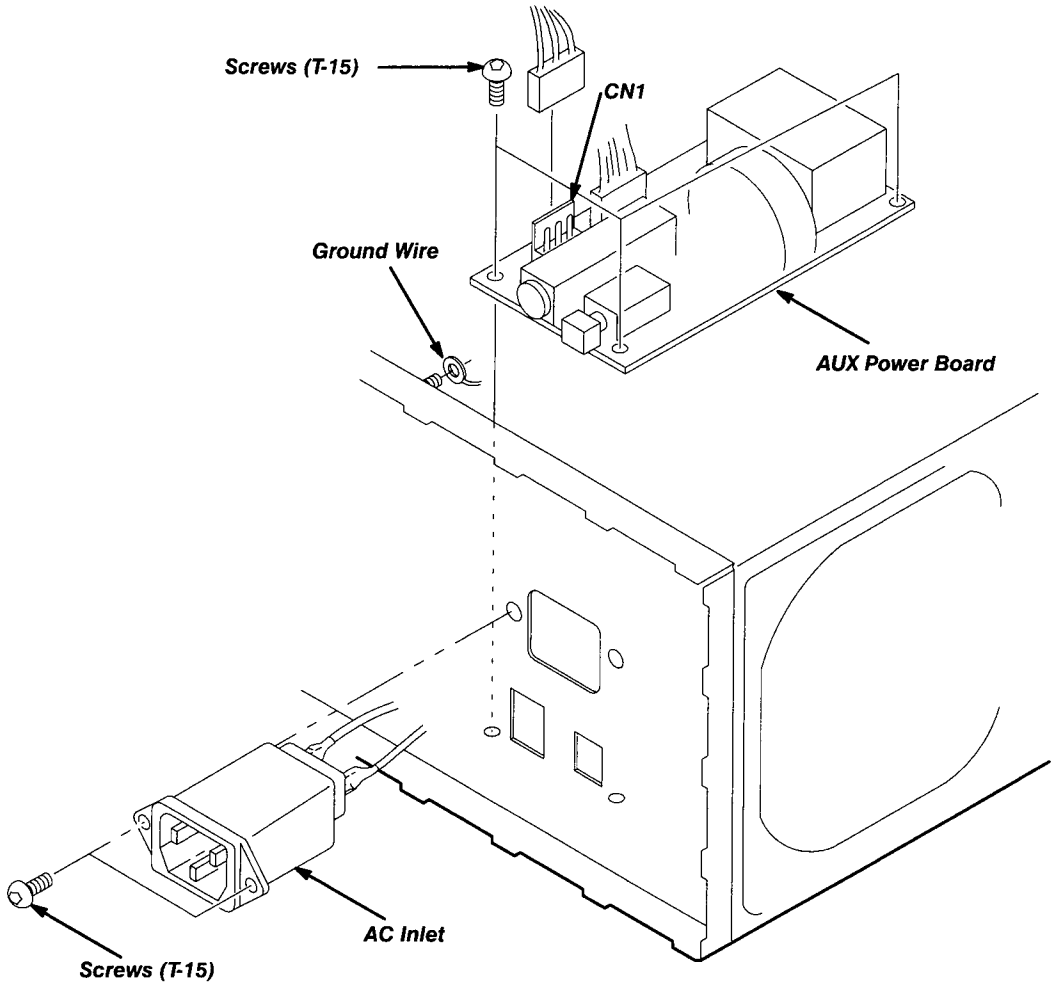


Figure 6-20: AUX Power Board and AC Inlet Removal

7. *Reinstallation:*

   a. Install the AC Inlet by doing substeps 6a–6d in reverse order.

   b. Install the AUX Power board by doing substeps 5a and 5c in reverse order.

Monitor Module and CRT Frame

1. *Assemble equipment and locate modules to be removed:*

   a. You will need a screwdriver with a size T-15 Torx tip and a diagonal cutter to do this procedure.

   b. Locate the modules to be removed in the locator diagram, *Internal Modules*, in Figure 6-4.

2. *Remove front cover, trim ring, and menu buttons:* Do the *Front Cover, Trim Ring, and Menu Buttons* procedure on page 6-19.

3. *Orient instrument:* Set the AWG2020 with the bottom down on the work surface and the left side facing you.

4. *Remove monitor module:*

NOTE

Take care not to damage the CRT surface when installing or removing the monitor module.

   a. Using a diagonal cutter, cut the strap tiedown binding the cable to the monitor module. See Figure 6-21.

   b. Disconnect the ribbon interconnect cable at J901 on the monitor module.

   c. Remove the five screws securing the monitor module top and bottom to the chassis.

   d. Release the snap at the right of the front-panel module and shift the assembly. Insert the screwdriver with a size T-15 Torx tip into the right hole of the chassis, and then remove the screw securing the monitor module.

   e. Lift the monitor module up and away from the chassis to complete the removal.

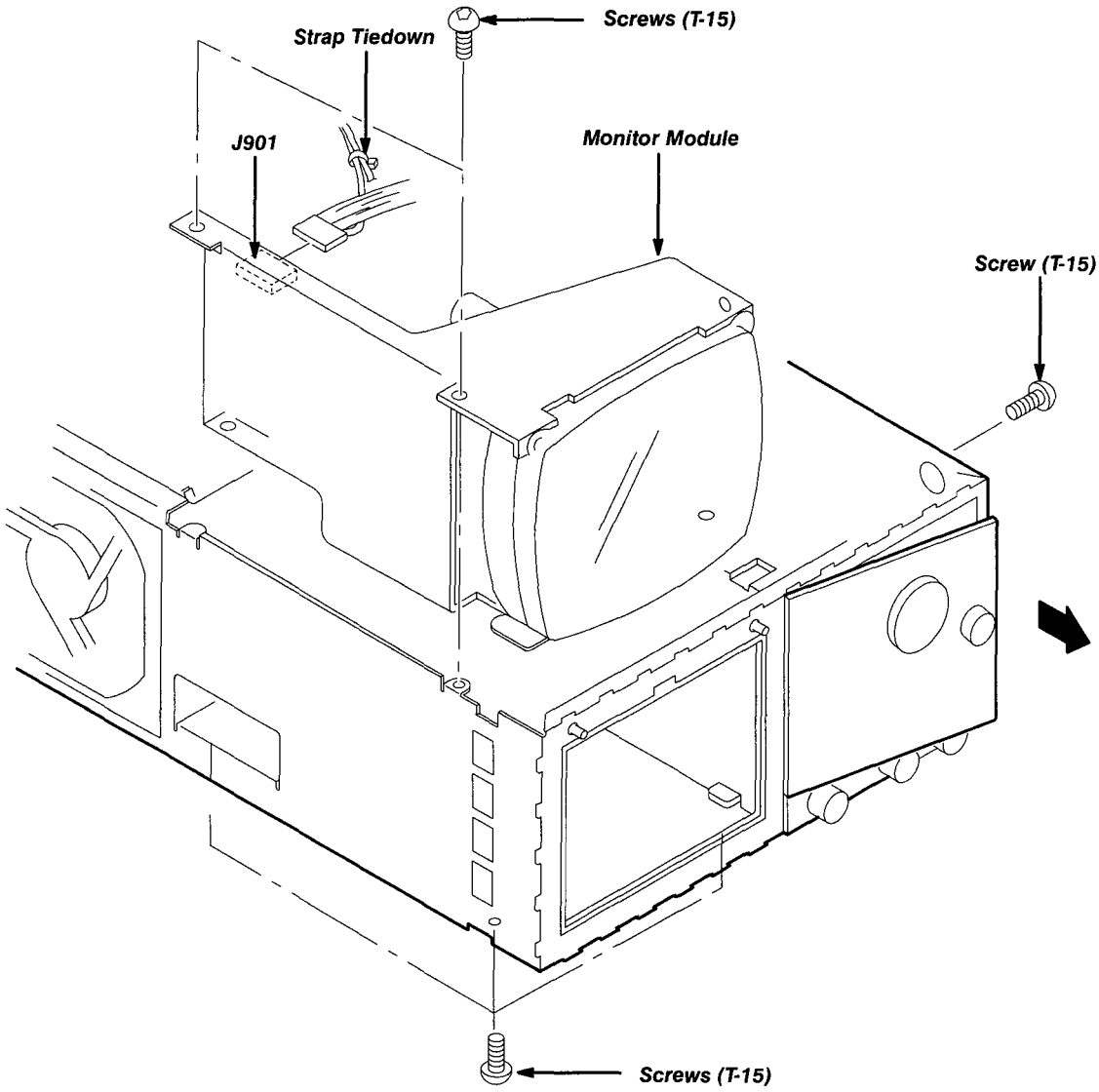


Figure 6-21: Monitor Module Removal

5. *Remove CRT frame:* Grasp the upper part of the CRT frame and take it out as shown in Figure 6-22.

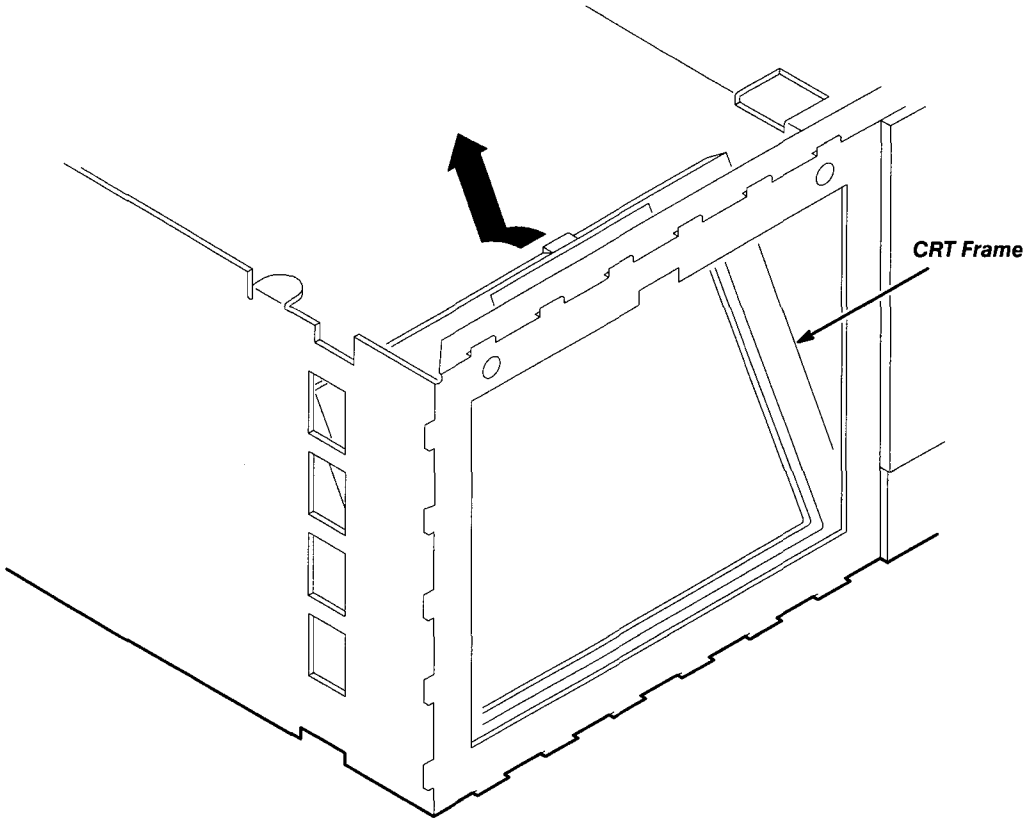


Figure 6-22: CRT Frame Removal

6. *Reinstallation:*

   a. Grasp the upper part of the CRT frame, align the notch of the chassis with the protrusion of the CRT frame, and place the CRT frame in the chassis.

   b. Install the monitor module by doing substeps 4a–4e in reverse order.

Circuit Boards

This procedure describes how to remove these circuit boards:

- A6 CPU Board
- A2 Memory Board
- A21 Control Board
- A10 Synthesizer Board
- For Option 02: A22 Memory Board and A31 Control Board
- For Option 03: A9 Digital Data Out Board
- For Option 09: A7 Floating Point Processor Board

1. *Assemble equipment and locate modules to be removed:* No tools are needed; however, the maintenance kit includes an ejector that is useful in removing circuit boards from the chassis. Locate the modules to be removed in the locator diagram, *Internal Modules*, in Figure 6-4.
2. *Remove the rear shield cover:* Do the procedure, *Rear Shield Cover*, on page 6-35.
3. *Orient instrument:* Set the AWG2020 with the left side down on the work surface and the top facing you.
4. *Remove board support:* Remove the board support upward while pushing its hook to the inside.
5. *Remove A6 CPU board:*

CAUTION

To avoid permanent loss of waveform files, note the following: A lithium battery which maintains the nonvolatile memory during power-off time is located on the A5 Backplane board. The nonvolatile memory that contains the waveforms and their setup parameter data is located on the A6 CPU board. Removing either board will cause the waveform files, sequence files, and autostep files in nonvolatile memory to be permanently lost. Before removing either the A6 CPU board or the A5 Backplane board, save the waveform files, sequence files, and autostep files in the instrument nonvolatile memory to a floppy disk. Then, after reinstalling the board(s), reload the files into nonvolatile memory.

   a. Disconnect the ribbon interconnect cable at J50 and J64 on the A6 CPU board (see Figure 6-23).

b. Disconnect the flat cable at J75 on the A6 CPU board. Remove the flat cable as shown in Figure 6-23.

c. Grasp the upper part of the A6 CPU board, and pull upward to remove it.

6. *Remove A2 Memory board and A21 Control board:*

a. Disconnect the interconnect cable at J121 on the A21 Control board (see Figure 6-23).

b. Disconnect the interconnect cables at J120 and J280 on the A21 Control board.

c. Disconnect the interconnect cable at J100 on the A3 Analog board. See Figure 6-13.

d. For the instrument with Option 03, disconnect the flat cable at J4 on the A2 Memory board.

e. Grasp the upper part of the A2 Memory board and the A21 Control board and pull upward to remove them.

7. *Remove A10 Synthesizer board:*

a. Disconnect the interconnect cables at J280 on the A21 Control board (see Figure 6-23).

b. Disconnect the interconnect cable at J201 and J750 on the A10 Synthesizer board.

c. Disconnect the interconnect cables at J200 on the A10 Synthesizer board.

d. For the instrument with Option 02, disconnect the interconnect cables at J210 and J211 on the A10 Synthesizer board.

e. Grasp the upper part of the A10 Synthesizer board, and pull upward to remove it.

8. *Remove A22 Memory board and A31 Control board (Option 02):* The option adds the A22 Memory board and A31 Control board in the fourth slot from the top.

a. Disconnect the interconnect cables at J120, J121, and J280 on the A21 Control board (see Figure 6-23).

b. Disconnect the interconnect cable at J121 on the A31 Control board.

c. Disconnect the interconnect cables at J120 and J280 on the A31 Control board.

d. Disconnect the interconnect cable at J100 on the A23 Analog board.

e. Grasp the upper part of the A22 Memory board and A31 Control board, and pull it upward to remove it.

9. *Remove A9 Digital Data Out board (Option 03):* The option adds the A9 Digital Data Out board in the fourth slot from the top.
   a. Disconnect the interconnect cables at J120, J121, and J280 on the A21 Control board (see Figure 6-23).
   b. Disconnect the flat cable at J210 on the A9 Digital Data Out board.
   c. Grasp the upper part of the A9 Digital Data Out board, and pull it upward to remove it.
10. *Remove A7 Floating Point Processor board (Option 09):* The option adds the A7 Floating Point Processor board in the first slot from the top.
   a. Grasp the upper part of the A7 Floating Point Processor board and pull it upward to remove it (see Figure 6-23).
11. *Reinstallation:* Do the board removal procedures in reverse order, reversing the order of the items in each procedure.

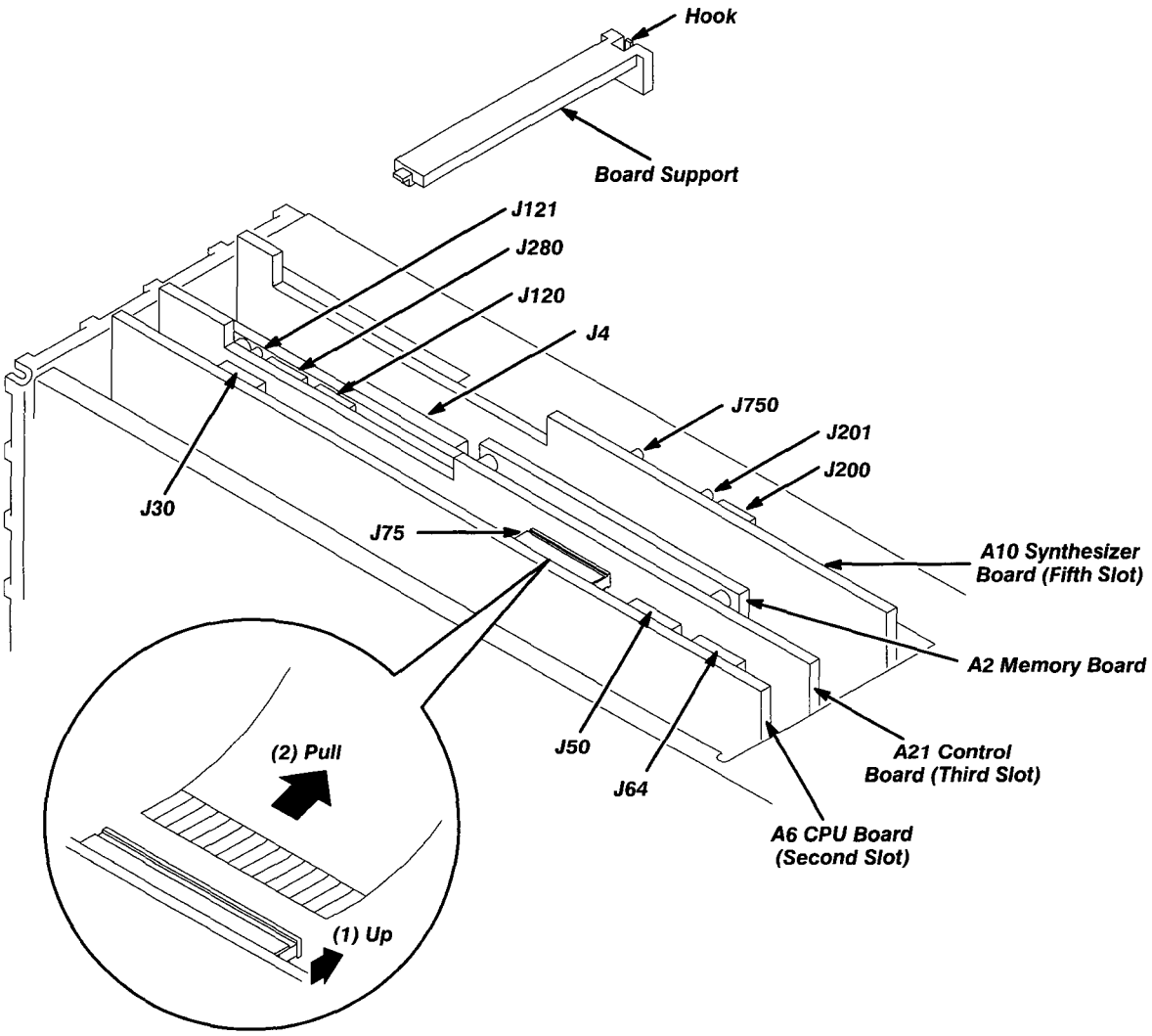


Figure 6-23: Board Removal

A5 Backplane Board

CAUTION

To avoid the permanent loss of waveform files, note the following: A lithium battery which maintains the nonvolatile memory during power-off time is located on the A5 Backplane board. The nonvolatile memory that contains the waveforms and their setup parameter data is located on the A6 CPU board. Removing either board will cause the waveform files, sequence files, and autostep files in nonvolatile memory to be permanently lost. Before removing either the A6 CPU board or the A5 Backplane board, save the waveform files, sequence files, and autostep files in the instrument nonvolatile memory to a floppy disk. Then, after reinstalling the board(s), reload the files into nonvolatile memory.

1. *Assemble equipment and locate modules to be removed:*
   a. You will need a screwdriver with a size T-15 Torx tip and a flat-bladed screwdriver to do this procedure.
   b. Locate the modules to be removed in the locator diagram, *Internal Modules*, in Figure 6-4.
2. *Orient instrument:* Set the AWG2020 with the left side down on the work surface and the top facing you.
3. *Remove all boards:* Do the procedure, *Circuit Boards*, on page 6-44.
4. *Remove A5 Backplane board:*
   a. Remove the five screws and a nut securing the shield cover (see Figure 6-24).
   b. Grasp the shield cover, and take it out.
   c. Disconnect the ribbon interconnect cables at J100 on the A4 Power board and at J410 on the A3 Analog board (see Figure 6-12 and Figure 6-13).
   d. Disconnect the ribbon interconnect cable at J10 on the A5 Backplane board.
   e. Disconnect the flat cable at J6 on the A5 Backplane board.
   f. Remove the remaining four screws securing the A5 Backplane board to the chassis.
   g. Using a flat-bladed screwdriver, release the four hooks of the circuit board support that holds the A5 Backplane board, lift the A5 Backplane board sideways, and then take it out.

5. *Reinstallation:*

   a. *Install the A5 Backplane board:* Do substeps 4a–4g in reverse order to install the board.

   b. *Install the other boards:* Do the procedure, *Circuit Boards*, on page 6-44, in reverse order, reversing the items in each step.

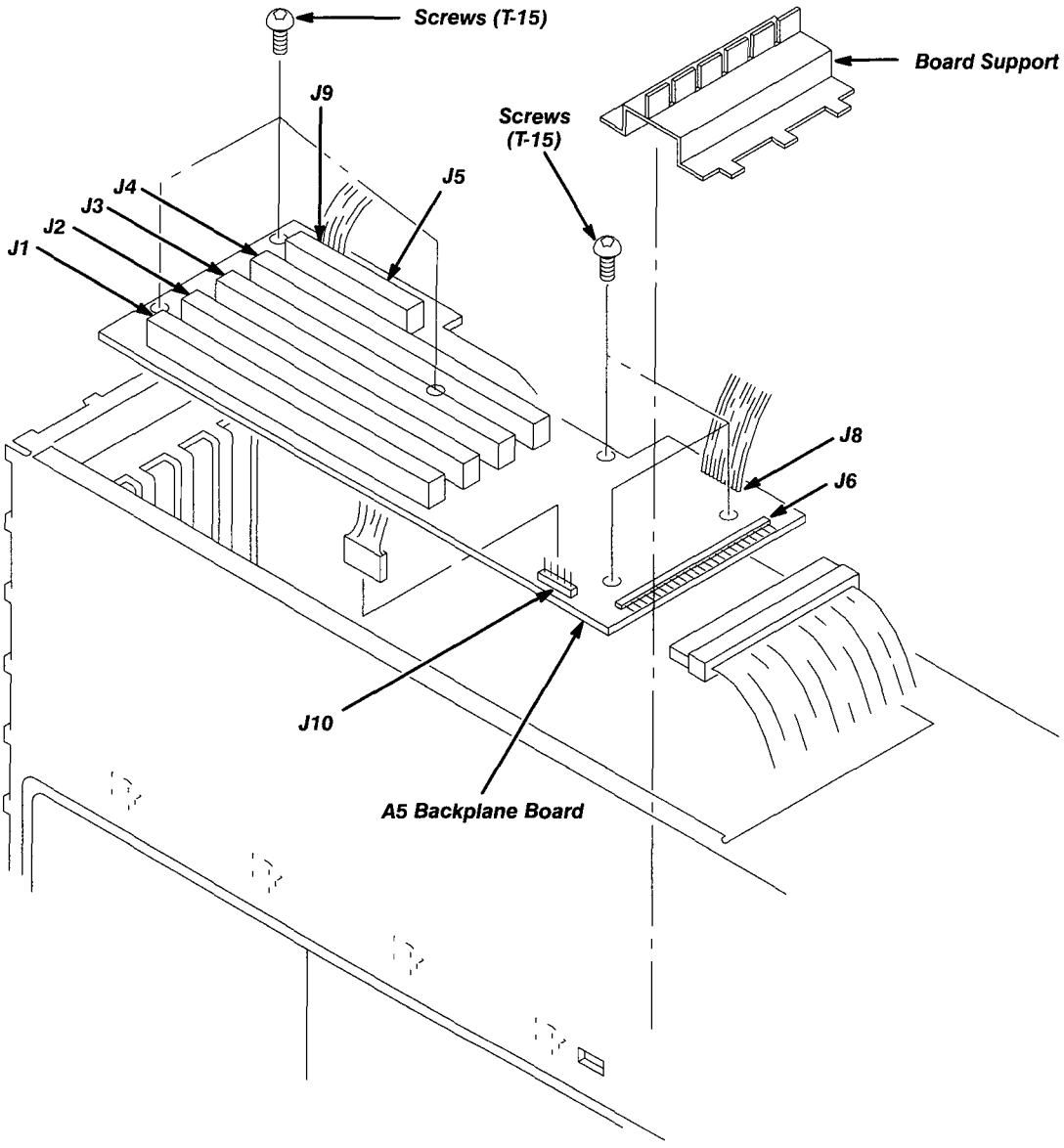


Figure 6-24: A5 Backplane Board Removal

Lithium Battery

WARNING

To avoid the risk of fire or explosion, install a new battery that has the same part number as listed in section 10, Mechanical Parts List, *for a replacement battery.*

To avoid the risk of fire or explosion, do not recharge, rapidly discharge, or disassemble the battery, heat it above 100° C, or incinerate it.

Dispose of used batteries promptly. Small quantities of used batteries may be disposed of in normal refuse. Keep lithium batteries away from children.

1. *Assemble equipment and locate modules to be removed:*
   a. You will need a soldering iron to do this procedure.
   b. You will also need a replacement lithium battery having the part number listed in section 10, *Mechanical Parts List*.
   c. Locate the battery to be removed in the locator diagram, *Internal Modules*, in Figure 6-4.
2. *Remove A5 Backplane board:* Do the *A5 Backplane Board* procedure on page 6-47.
3. *Orient board:* Set the A5 Backplane board on an insulating surface.
4. *Remove used battery:*
   a. Unsolder the tabs at the ends of the battery, taking care not to heat the battery (see Figure 6-25).
   b. Grasp the battery, and lift it away from the board.
5. *Install new battery:*
   a. Place the new battery on the board with the negative tab of the battery closest to the board edge connector.
   b. Solder the tabs to the board.

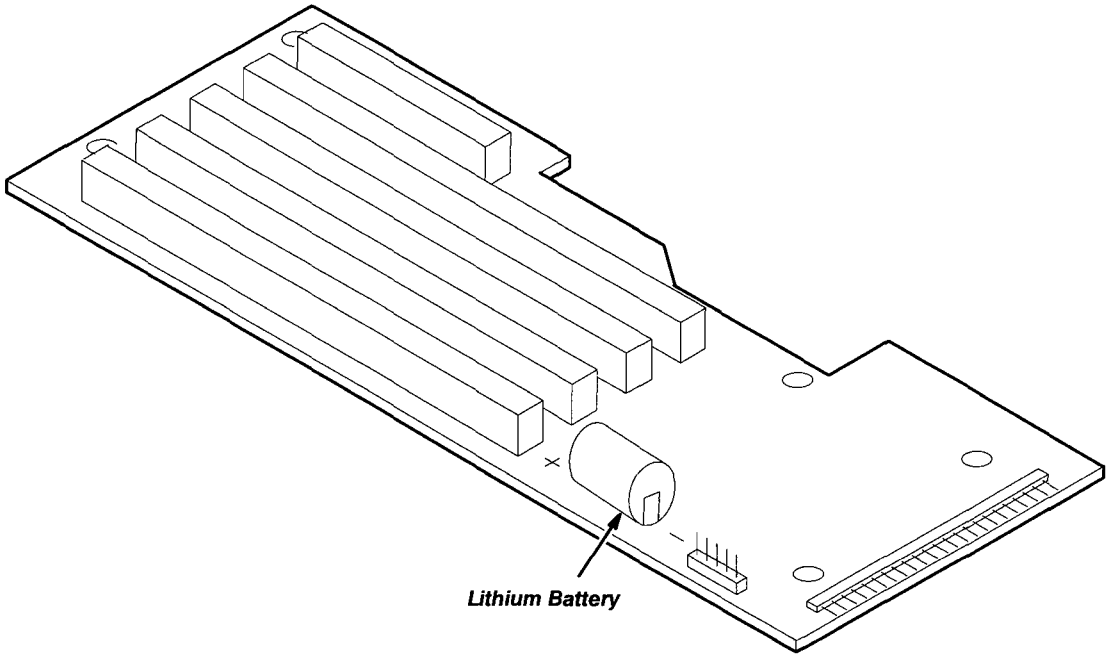


Figure 6-25: Battery Location on the A5 Backplane Board

Floppy-disk Drive Module

1. *Assemble equipment and locate modules to be removed:*
   a. You will need a screwdriver with a size T-9 Torx tip and a size #1 Phillips tip to do this procedure.
   b. Locate the modules to be removed in the locator diagram, *Internal Modules*, in Figure 6-4.
2. *Remove rear shield cover:* Do the *Rear Shield Cover* procedure on page 6-35.
3. *Remove A3 Analog board:* Do the A3 *Analog Board* procedure on page 6-28, removing only the A3 Analog board.
4. *Orient instrument:* Set the AWG2020 with the left side down on the work surface and the bottom facing you.
5. *Remove all circuit boards:* Do the procedure, *Circuit Boards*, on page 6-44.
6. *Remove floppy-disk drive module:*
   a. Using a screwdriver with a size T-9 Torx tip, remove the ten screws securing the floppy-disk drive cover to the chassis (see Figure 6-26).
   b. Using a screwdriver with a size #1 Phillips tip, remove the three screws securing the floppy-disk drive to the chassis.
   c. Grasp the upper part of the floppy-disk, and pull it upward to remove it.
   d. Disconnect the flat cable of the floppy disk drive to complete removal.
7. *Reinstallation:*
   a. *Install floppy-disk drive module:* Do substeps 6a–6d in reverse order.
   b. *Install circuit boards:* Do the procedure, *Circuit Boards*, on page 6-44, in reverse order.
   c. *Install A3 Analog board:* Do the part on removing the A3 Analog board in *A4 Power Board, A3 Analog Board, and A23 Analog Board* on page 6-28 in reverse order. This completes the reinstallation.

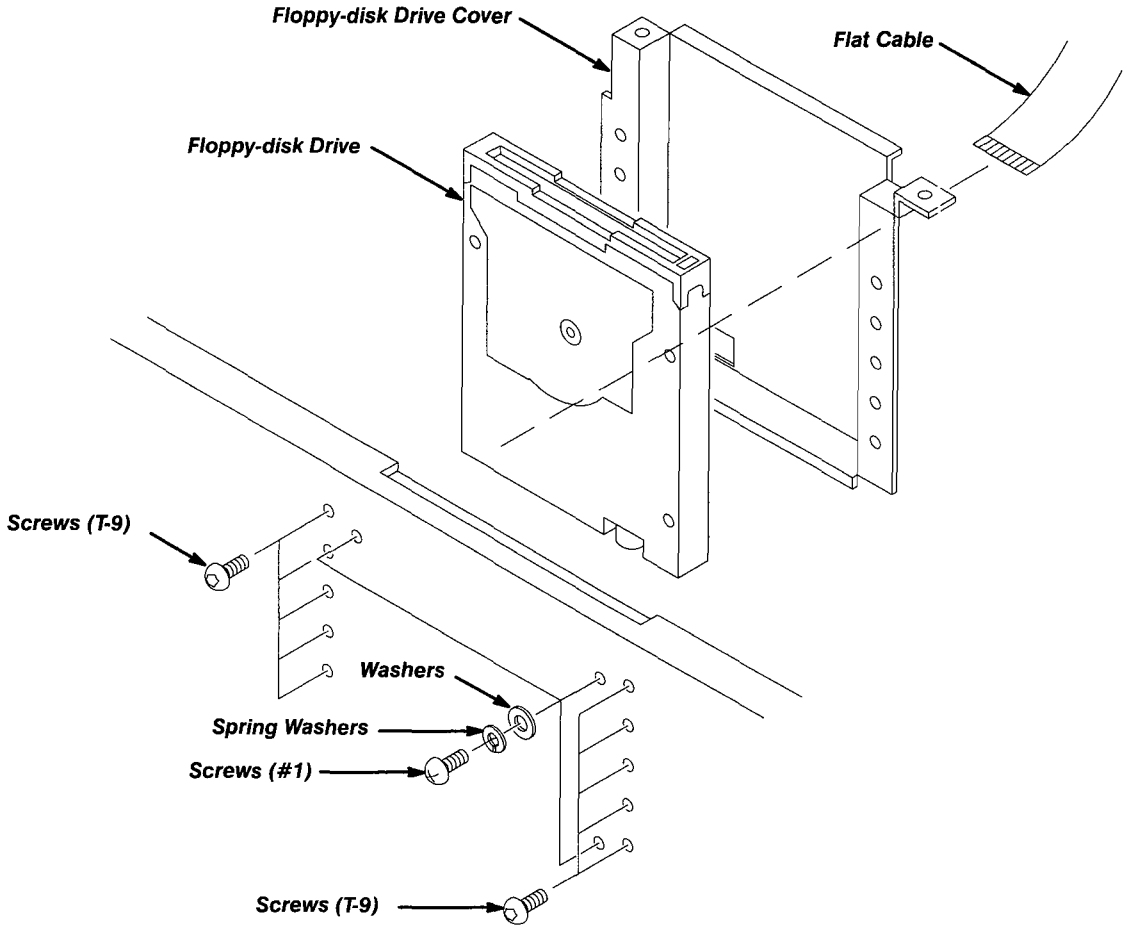


Figure 6-26: Floppy-disk Drive Module Removal

Circuit Board Support

1. *Assemble equipment and locate modules to be removed:* No tools are needed. Locate the modules to be removed in the locator diagram, *Internal Modules*, on Figure 6-4.
2. *Orient instrument:* Set the AWG2020 with the bottom down on the work surface and the left side facing you.
3. *Remove all circuit boards:* Do the procedure, *Circuit Boards*, on page 6-44, removing all boards.
4. *Remove A5 Backplane board:* Do the procedure, *A5 Backplane Board*, on page 6-47 to remove the Backplane board.
5. *Remove power supply module:* Do the procedure, *Power Supply Module*, on page 6-38 to remove the power supply module.
6. *Remove circuit board support:* As shown in Figure 6-27, push the two points indicated to slide the circuit board support upward, and then remove it.

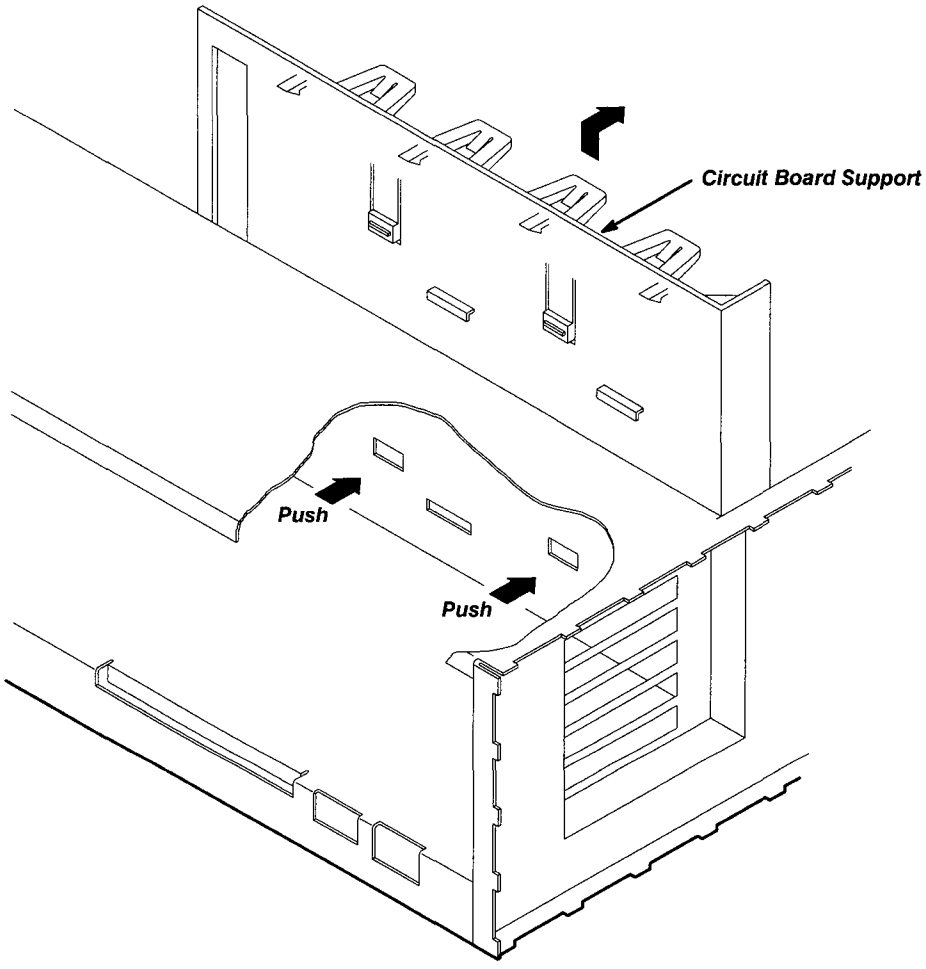


Figure 6-27: Circuit Board Support Removal

7. *Reinstallation:*

   a. *Install circuit board support:* Align the protrusion of the circuit board support with the groove of the chassis.

   b. *Install power supply module:* Do the procedure, *Power Supply Module* (on page 6-38) in reverse order to install the power supply module.

   c. *Install A5 Backplane board:* Do the procedure, *A5 Backplane Board* (on page 6-47) in reverse order to install the Backplane board.

   d. *Install all circuit boards:* Do the procedure, *Circuit Boards*, on page 6-44, installing the boards in reverse order.

Procedure for Changing the Line Voltage

This part of the subsection explains the procedure for changing the operation line voltage for the AWG2020 Arbitrary Waveform Generator from 115 V to 230 V.

The line voltage change procedure consists of three parts:

- Removing the Rear Cover and Cabinet
- Moving the Interconnect Cable
- Reinstalling the Cabinet and Rear Cover

This procedure requires the tools listed in Table 6-5.

Table 6-5: Tools Required

Item No.	Name	Description	Part Number
1	Screwdriver handle	Accepts Torx-driver bits	003-0524-00
2	T-9 Torx tip	Torx-driver bit for T-9 size screw heads	003-0965-00
3	T-15 Torx tip	Torx-driver bit for T-15 size screw heads	003-0966-00
4	Needle-nose pliers	Standard tool	

Here are the parts of the procedure:

WARNING

To avoid risk of shock hazard or death, always disconnect the AWG2020 power cord before using this procedure. When the power cord is connected to the AC power source, dangerous voltages are generated within the AWG2020, even if the PRINCIPAL POWER SWITCH on the rear panel is off.

Remove the Rear Cover and Cabinet

1. *Assemble equipment and install front cover:*
   a. You will need a screwdriver with a size T-15 Torx tip and a size T-9 Torx tip to do this procedure.
   b. Make sure the AWG2020 front cover (optional accessory) is installed if it is not, install it by snapping the edges of the cover over the trim ring.
   c. Obtain a 230 V ID label (optional accessory).
2. *Orient instrument:* Set the AWG2020 with the face down on the work surface and the back facing you.

3. *Remove line cord:* Unplug the line cord from the receptacle at the rear cover.
4. *Remove rear cover:* Using a screwdriver with a size T-15 Torx tip, remove the four screws securing the rear cover to the instrument. Lift off the rear cover.
5. *Remove cabinet:*

CAUTION

To prevent damaging the eject button, make sure a floppy disk is not inserted in the floppy disk drive before removing the cabinet.

a. Using a screwdriver with a size T-15 Torx tip, remove the screw securing the left side of the cabinet to the instrument. See Figure 6-28.

b. Turn the AWG2020 so the right side faces you.

c. Using a screwdriver with a size T-9 Torx tip, remove the four screws securing the floppy-disk drive bezel to the cabinet.

d. Pull upward to slide the cabinet off the instrument.

CAUTION

To prevent damaging cables and cable connections, take care not to bind or snag the cabinet on the internal cabling as you remove the cabinet.

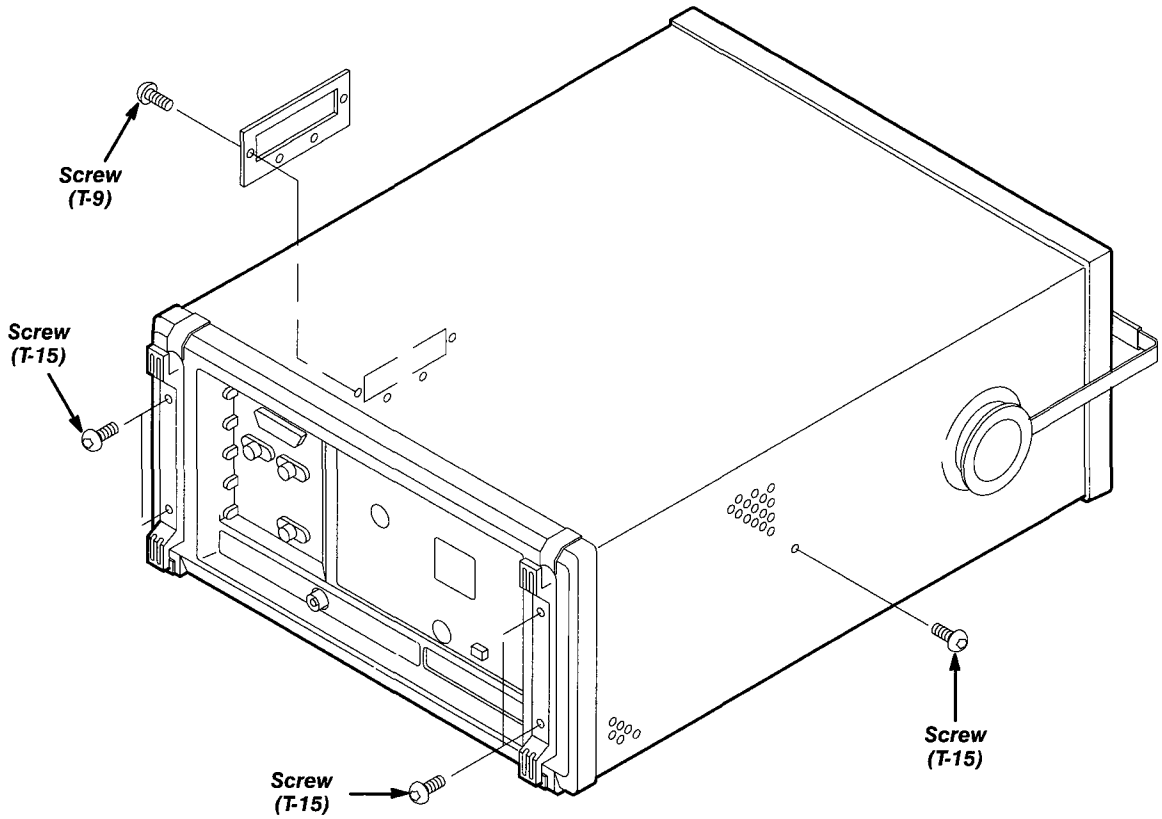


Figure 6-28: Rear Cover and Cabinet Removal

Moving the Interconnect Cable

Here is the procedure for moving the interconnect cable from the 115 V to 230 V position.

1. *Orient instrument:* Set the AWG2020 with the bottom down on the work surface and the left side facing you.
2. *Move the interconnect cable:*
   a. Disconnect the interconnect cable at J1 of the power supply module.
   b. Using a pair of needle-nose pliers, move the W1 cable from TP1 (115V) to TP2 (230V). Figure 6-29 shows the locations of TP1 and TP2.
   c. Connect the cable removed in Step 2a to its original position.

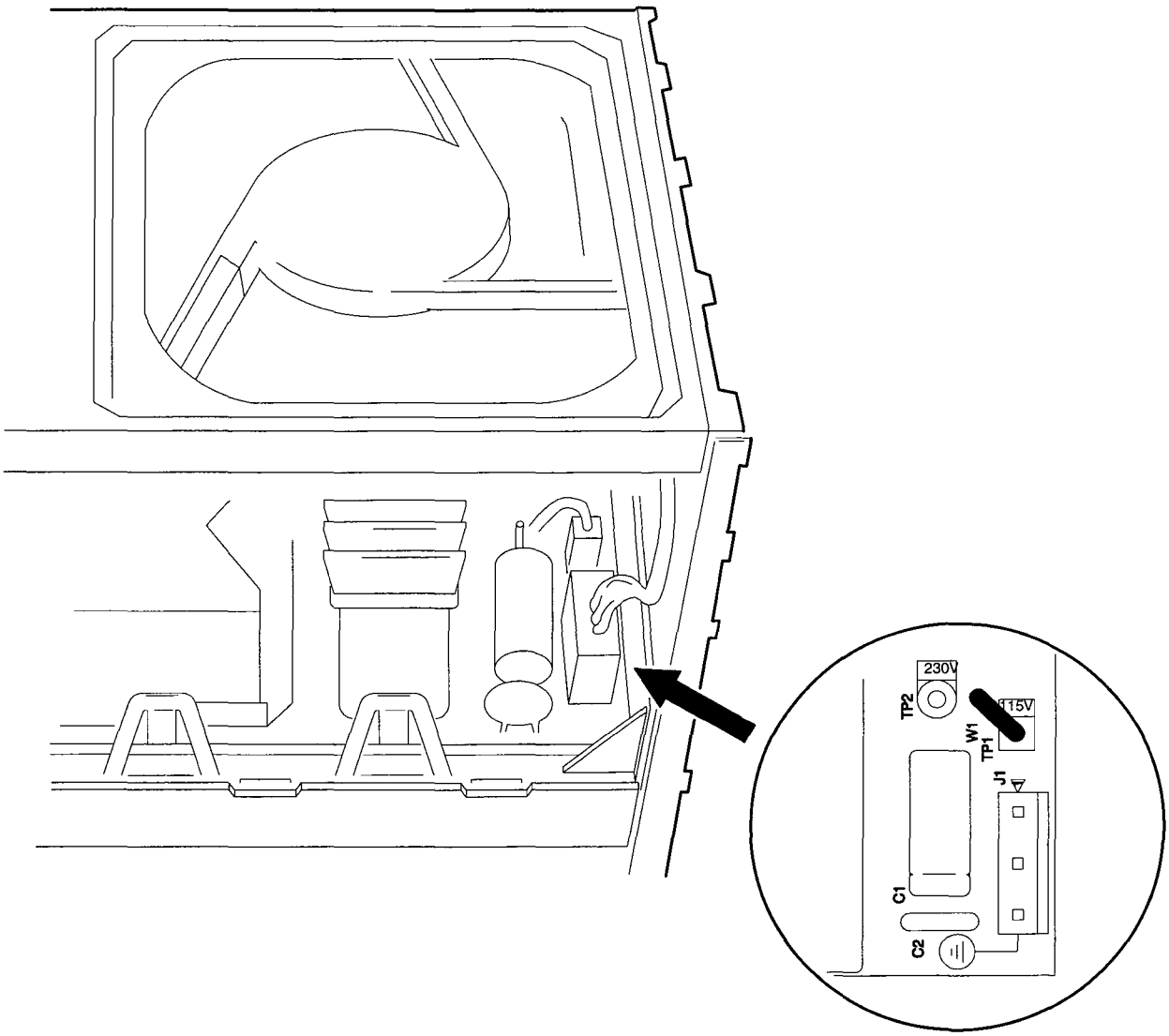


Figure 6-29: Locations of TP1 and TP2

Reinstalling the Cabinet and Rear Cover

1. *Orient instrument:* Set the AWG2020 with the bottom down on the work surface and the left side facing you.
2. *Install rear cover and cabinet:* Install the rear cover and cabinet, reversing the rear cover and cabinet removal procedure.
3. *Install new label:*
   a. Set the instrument with the bottom down on the work surface and the back facing you.
   b. Apply the 230 V ID label to the rear panel at the location shown in Figure 6-30.

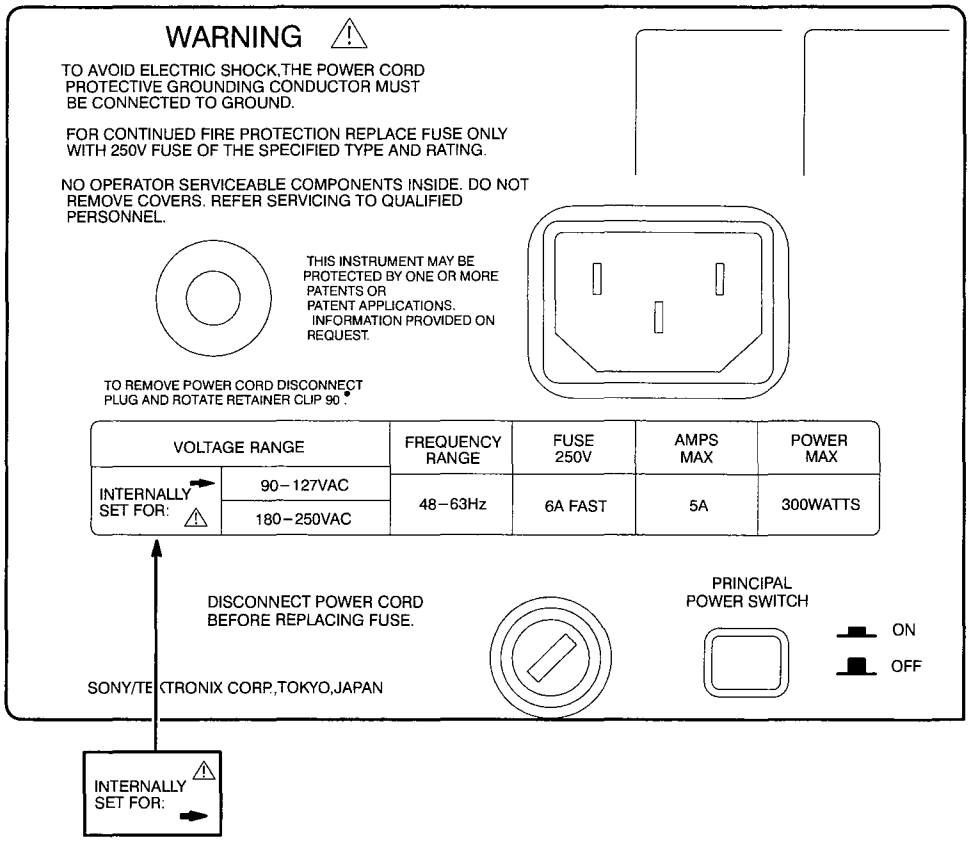


Figure 6-30: Location for Applying the 230 V ID Label

This completes the procedure for changing the line voltage from 115 V to 230 V.

Repackaging

This subsection contains information about repackaging the AWG2020 for shipment.

Repackaging Instructions

Use a corrugated cardboard shipping carton having a test strength of at least 275 pounds and with an inside dimension at least six inches greater than the AWG2020 dimensions. (If available, use the original shipping carton, which meets these requirements.)

If the AWG2020 is shipped to a Tektronix Service Center, enclose the following information:

- The owner's address
- Name and phone number of a contact person
- Type and serial number of the AWG2020
- Reason for returning
- A complete description of the service required

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

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

Troubleshooting

This subsection contains information and procedures designed to isolate faulty modules in the AWG2020 Arbitrary Waveform Generator. If these procedures indicate a module needs to be replaced, follow the *Removal and Installation Procedures* in the preceding subsection.

After Repair Adjustment

After replacing a module, do the adjustments in section 5, *Adjustment Procedures* (page 5-1).

Troubleshooting Procedures

The troubleshooting procedures in this subsection consist of these flowcharts.

- Figure 6-31: Primary Troubleshooting Procedure
- Figure 6-33: Troubleshooting Procedure 1 — Power Supply Module
- Figure 6-36: Troubleshooting Procedure 2 — A6 CPU Board or Front-panel Module
- Figure 6-38: Troubleshooting Procedure 3 — Monitor Module
- Figure 6-42: Troubleshooting Procedure 4 — Module Isolation

To use these procedures, begin with the Primary Troubleshooting Procedure. It prompts you to check various indications of AWG2020 functionality and directs you to the other troubleshooting procedures.

AWG2020 Diagnostics

The AWG2020 has internal diagnostics that verify circuit functionality. The AWG2020 automatically executes the internal diagnostics at power-on. You can also run the internal diagnostics by using the UTILITY menu. See *Checking Diagnostics Tests* below. The difference between the two methods of running the internal diagnostics routine is that the power-on method does not do as much memory checking.

If the internal diagnostics indicate a test in the internal diagnostics failed, use the troubleshooting procedures in this subsection to determine which module to replace.

Checking Diagnostics Tests

Prerequisites — Power on the AWG2020 and allow a 20 minute warmup before doing this procedure.

1. Push the **UTILITY→Diag/Cal→Diagnostics**
2. Select **All** with the general purpose knob.
3. Select **Execute** from the side menu. This executes all the diagnostics automatically. As each test finishes, the result is displayed on the screen.
4. Check the diagnostic test results. If any test failed, go to *Troubleshooting Procedure 4 — Module Isolation* on page 6-74. The table in the flowchart shows which module is related to each diagnostic test. If the tests pass but there is still a problem, go to the *Primary Troubleshooting Procedure* on page 6-65.

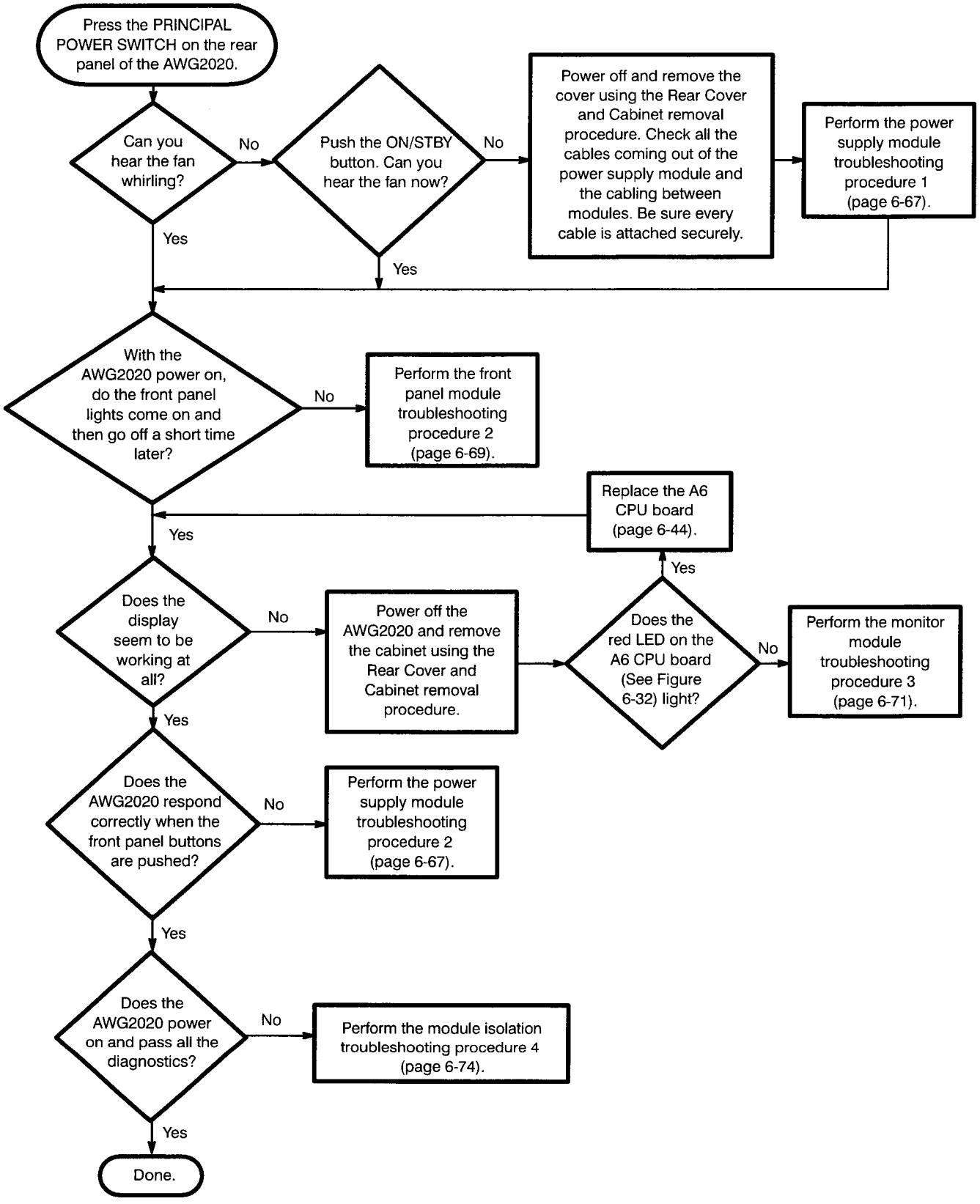


Figure 6-31: Primary Troubleshooting Procedure

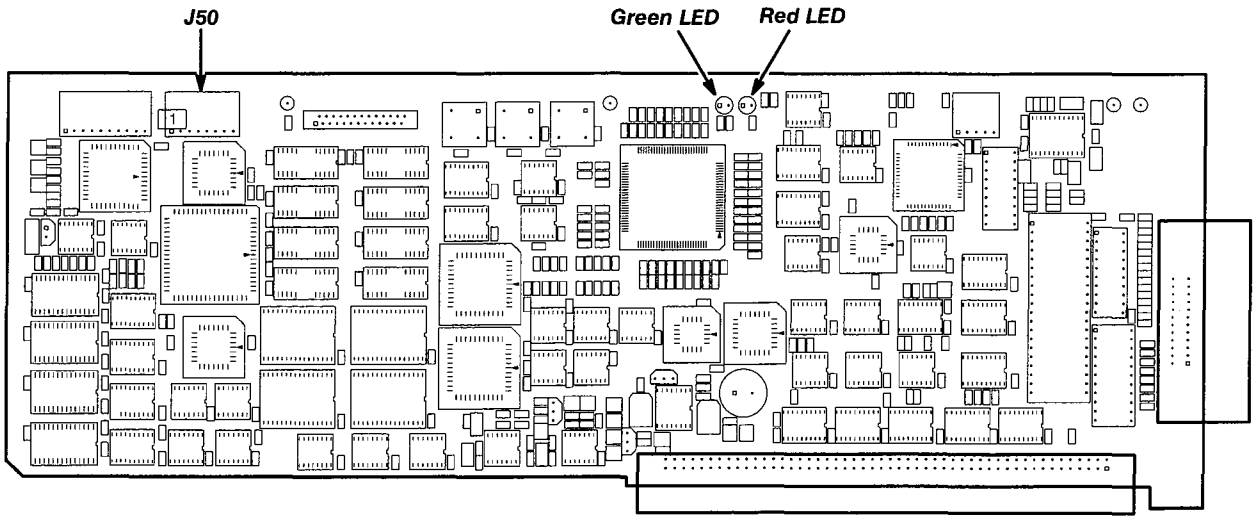


Figure 6-32: CPU Board

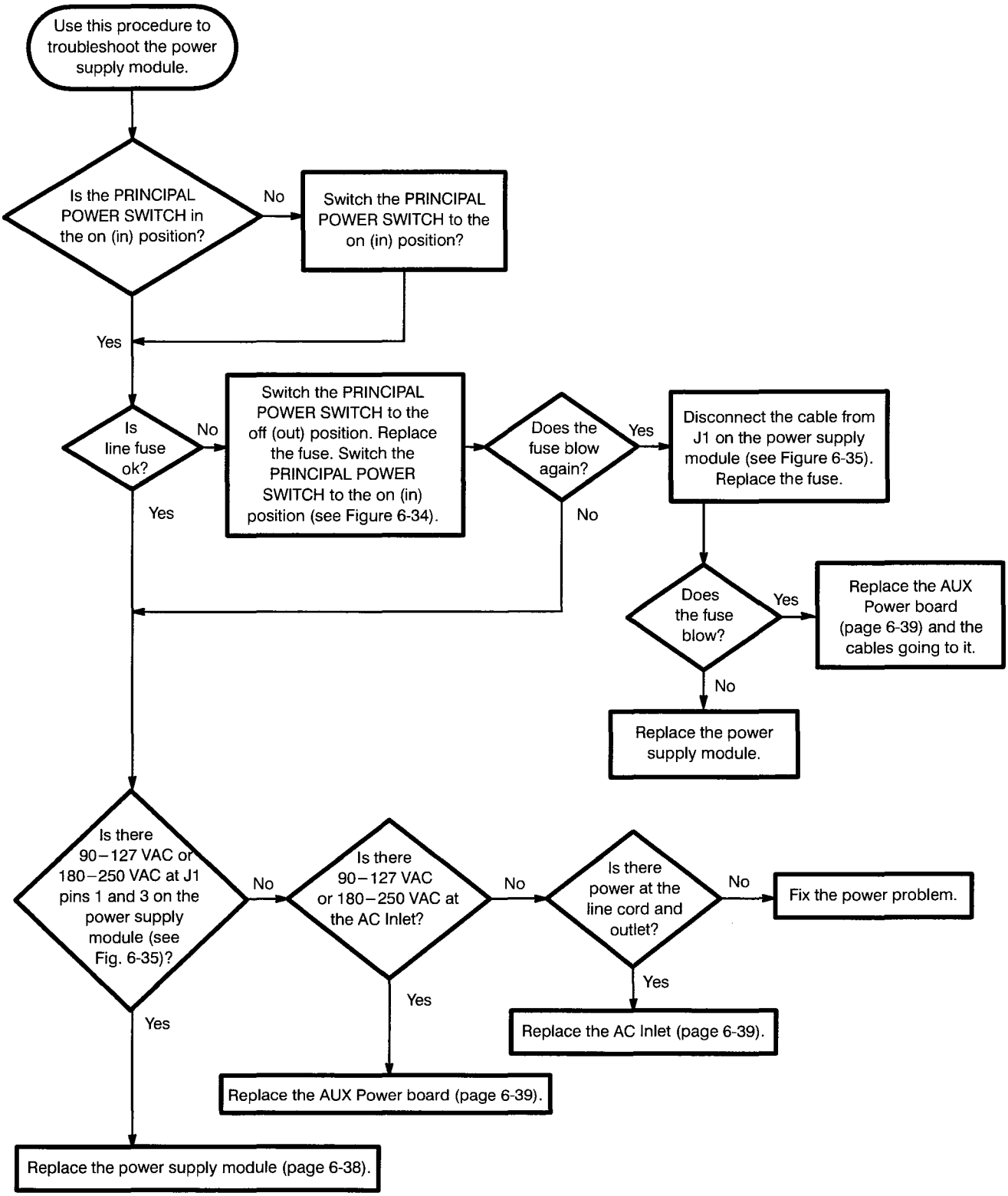


Figure 6-33: Troubleshooting Procedure 1 — Power Supply Module

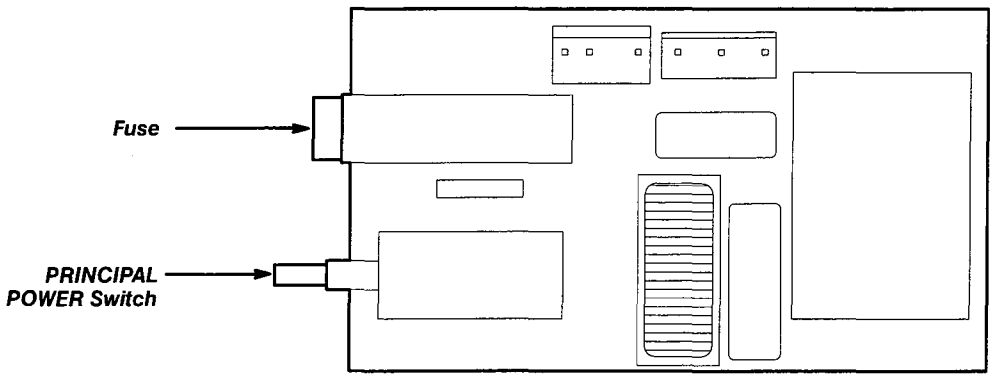


Figure 6-34: AUX Power Board

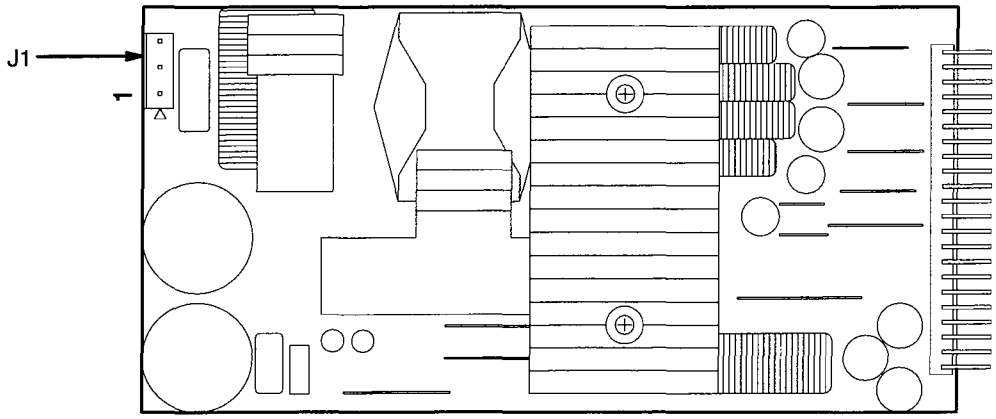


Figure 6-35: Power Supply Module

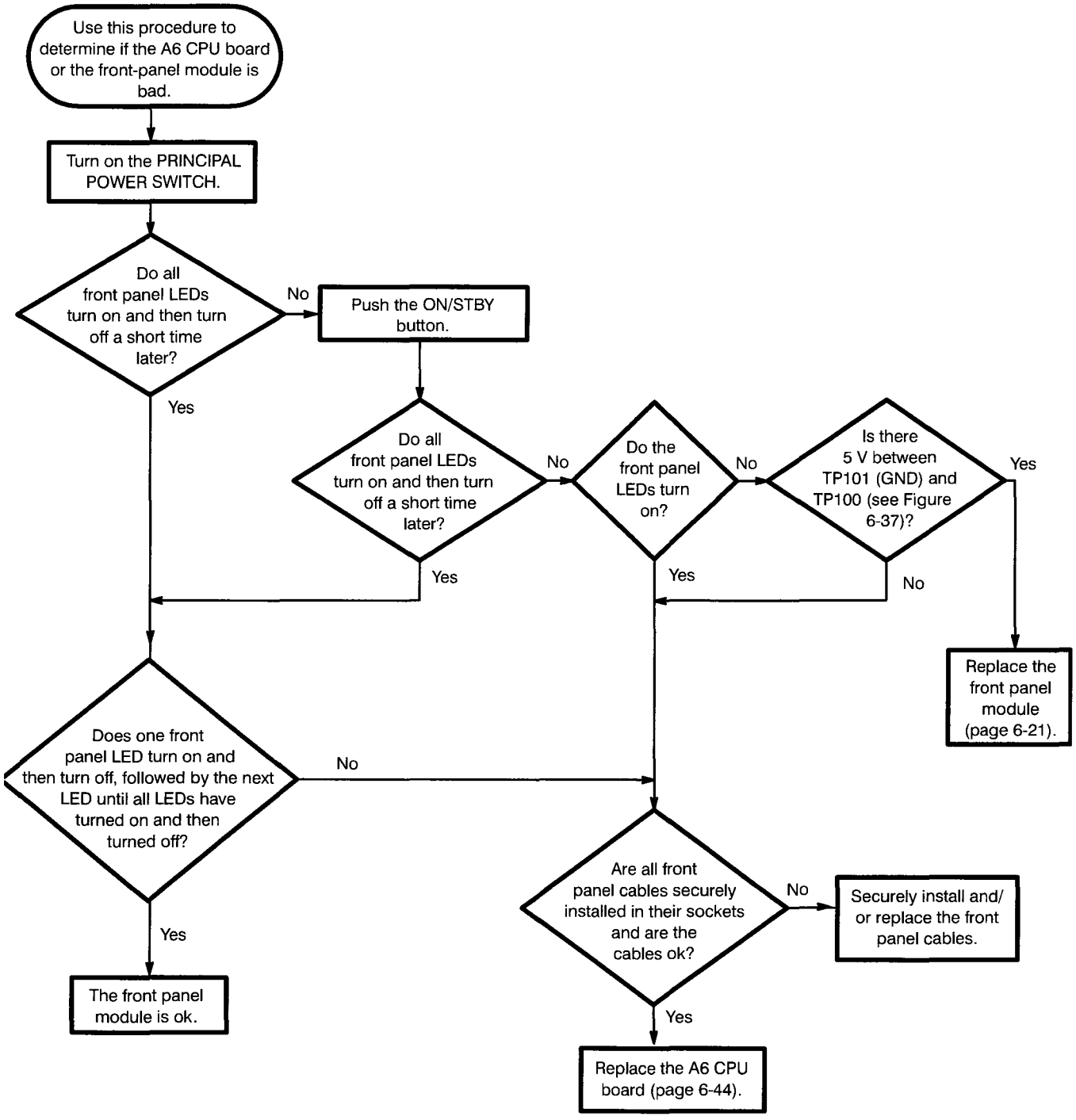


Figure 6-36: Troubleshooting Procedure 2 — A6 CPU Board or Front-panel Module

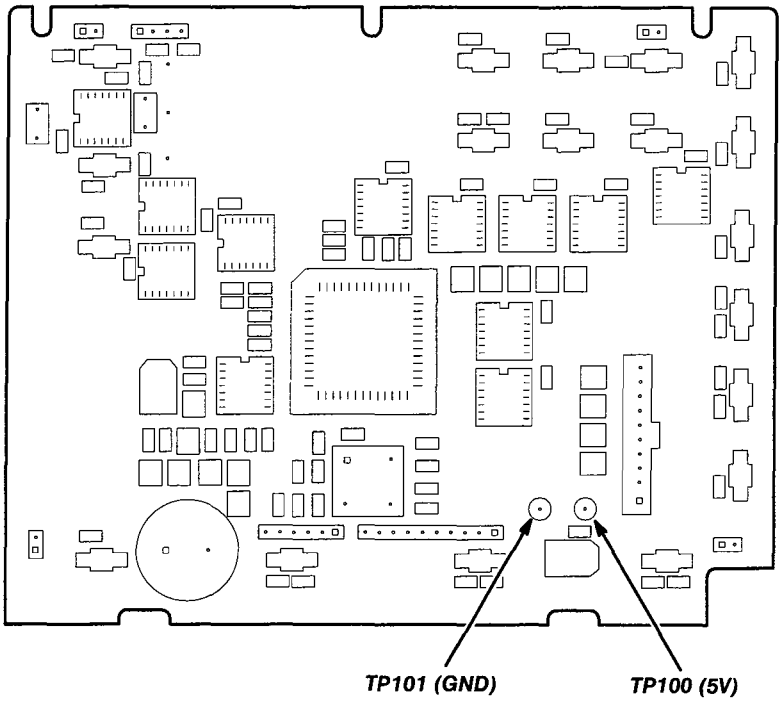


Figure 6-37: Key Board

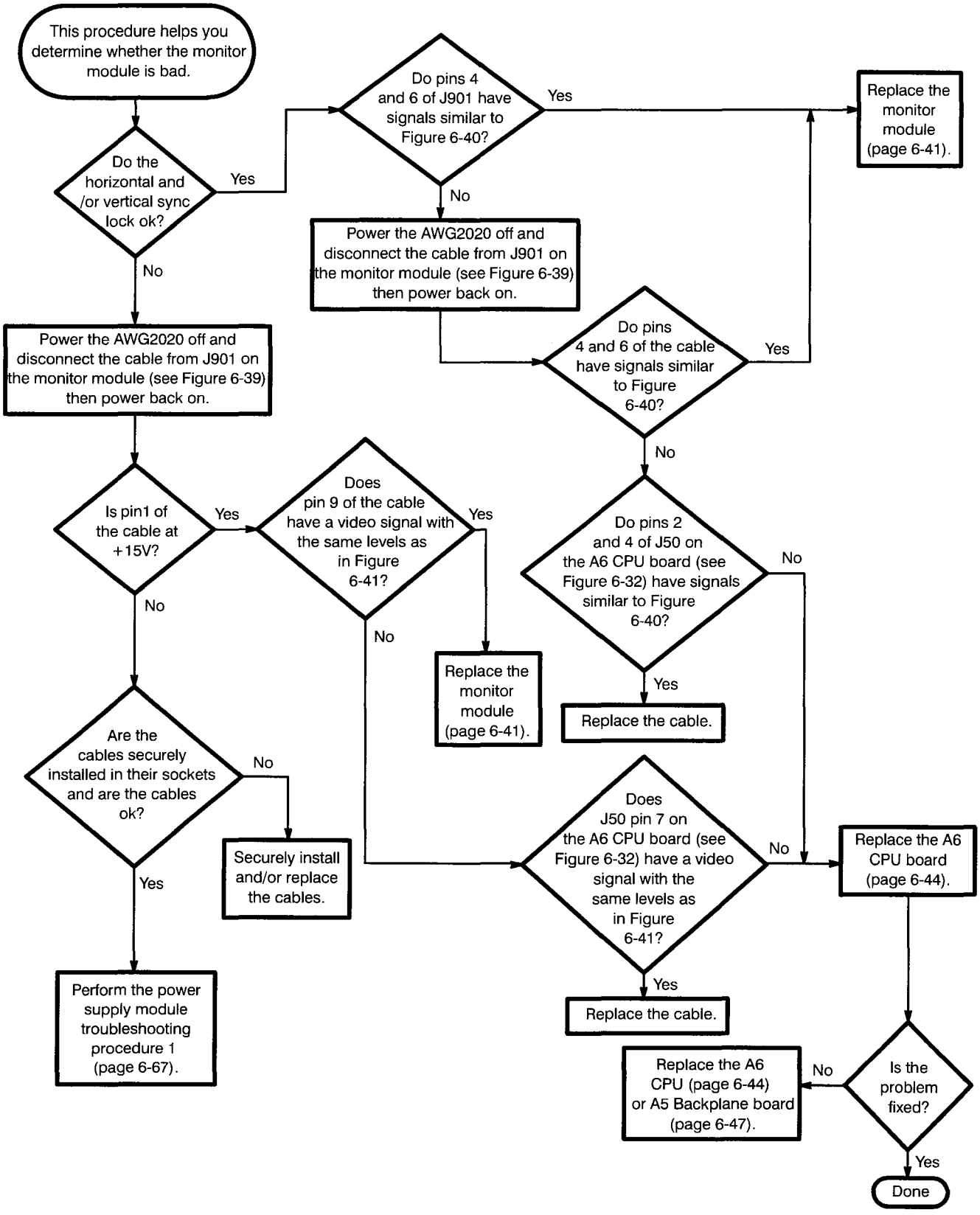


Figure 6-38: Troubleshooting Procedure 3 — Monitor Module

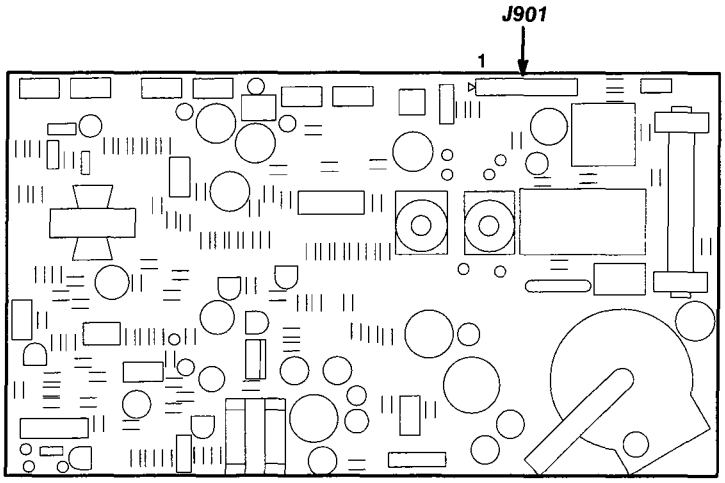


Figure 6-39: Monitor Module

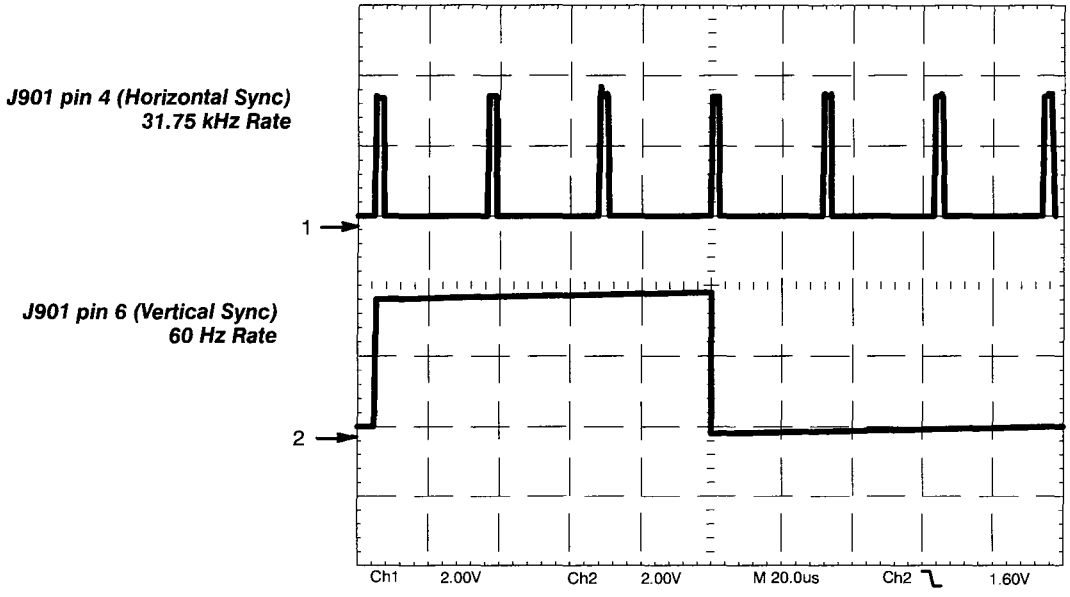


Figure 6-40: Horizontal and Vertical Sync Signals

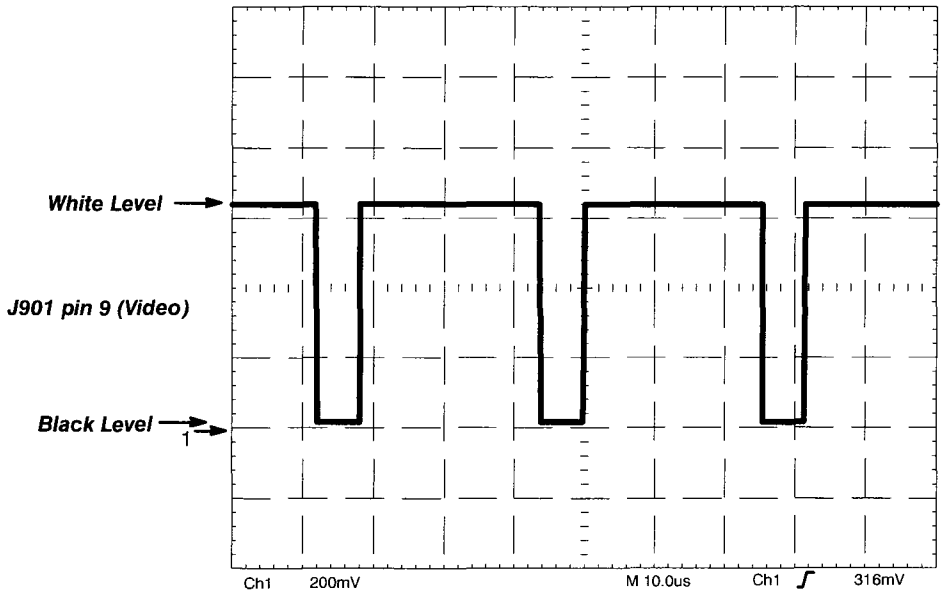
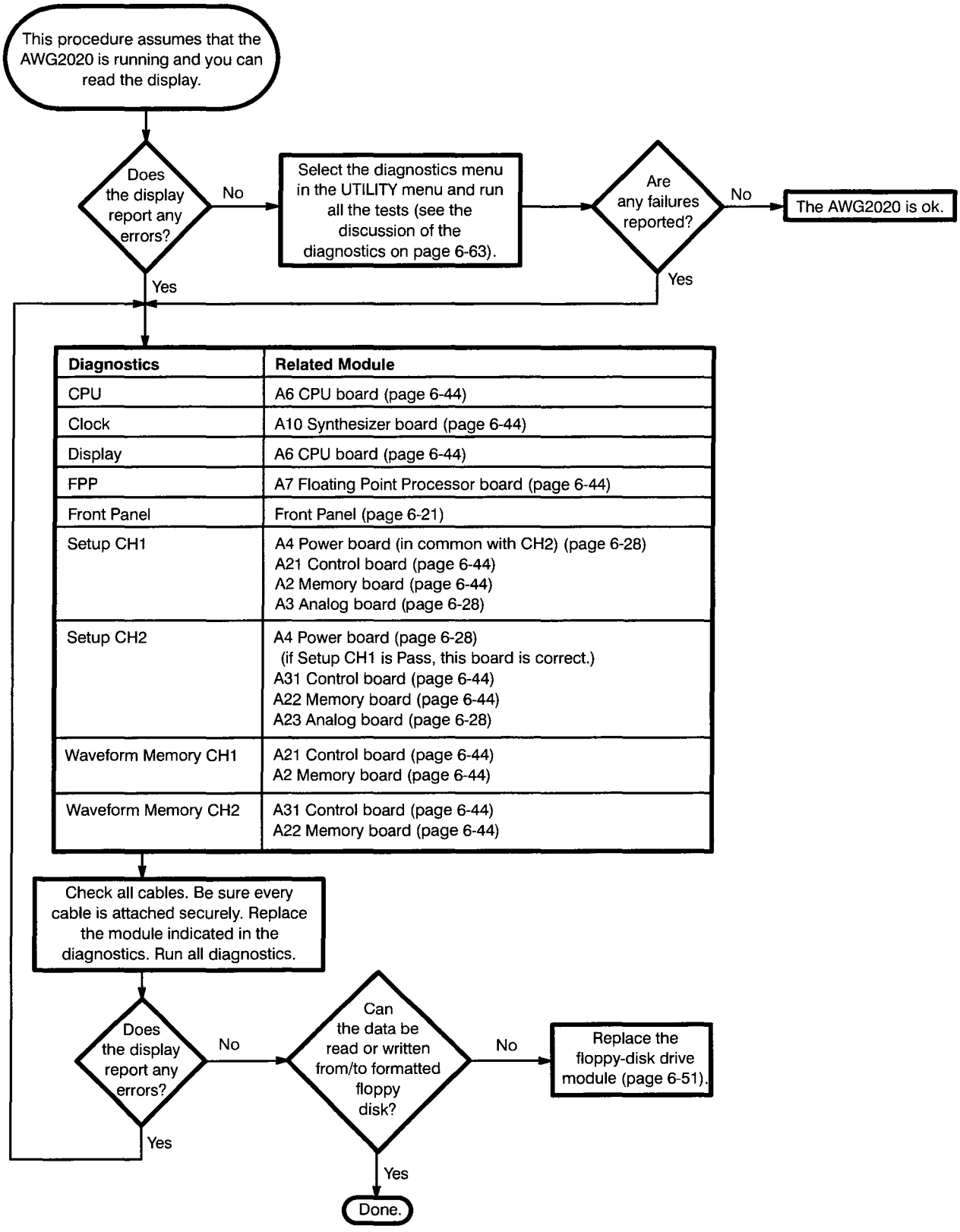


Figure 6-41: A Video Signal with White and Black Levels



Diagnostics	Related Module
CPU	A6 CPU board (page 6-44)
Clock	A10 Synthesizer board (page 6-44)
Display	A6 CPU board (page 6-44)
FPP	A7 Floating Point Processor board (page 6-44)
Front Panel	Front Panel (page 6-21)
Setup CH1	A4 Power board (in common with CH2) (page 6-28) A21 Control board (page 6-44) A2 Memory board (page 6-44) A3 Analog board (page 6-28)
Setup CH2	A4 Power board (page 6-28) (if Setup CH1 is Pass, this board is correct.) A31 Control board (page 6-44) A22 Memory board (page 6-44) A23 Analog board (page 6-28)
Waveform Memory CH1	A21 Control board (page 6-44) A2 Memory board (page 6-44)
Waveform Memory CH2	A31 Control board (page 6-44) A22 Memory board (page 6-44)

Figure 6-42: Troubleshooting Procedure 4 — Module Isolation

Options and Accessories

This section describes the various options as well as the standard and optional accessories that are available for the AWG2020 Arbitrary Waveform Generator.

List of Options

Options include:

- **Option 02** — adds a CH2 output. See note, below.
- **Option 03** — makes digital waveform data available at the rear panel. See note, below.
- **Option 09** — adds a board dedicated to floating-point processing.
- **Option 1R** — ships the waveform generator configured for installation in an instrument rack.
- **Option A1–A5** — changes the standard power cord to one of five alternate power cord configurations.
- **Option B1** — adds the service manual and the Performance Check/Adjustment disk.

NOTE

Options 02 and 03 are mutually exclusive.

Each option is described more fully in the following pages.

Options A1–A5

In place of the standard North American, 110 V, 60 Hz power cord, Tektronix ships any of five alternate power cord configurations with the waveform generator, as ordered by the customer.

Table 7-1: International Power Cords

Option	Power Cord
Option A1	Universal European — 220 V, 50 Hz
Option A2	United Kingdom — 240 V, 50 Hz
Option A3	Australian — 240 V, 50 Hz
Option A4	North American — 240 V, 60 Hz
Option A5	Switzerland — 220 V, 50 Hz

Option 02

Option 02 adds a second output channel. The second output channel allows you to simultaneously output two different waveforms and to use arithmetic functions. This option and Option 03 cannot both be installed.

Option 03

With Option 03, the waveform generator can provide the following digital signals at the rear panel output connector. This option and Option 02 cannot both be installed.

Data Output

The data (D0–D11) going to the internal D/A converter is buffered and routed to the output connector at the rear panel. When generating an analog waveform at the front panel, the waveform generator simultaneously outputs digital data at the rear panel connector. The output is differential ECL.

Clock Output

The same clock that goes to the internal D/A converter is buffered and routed to the rear panel connector. The clock output is also differential ECL.

Figure 7-1 shows a block diagram of the Option 03 circuit.

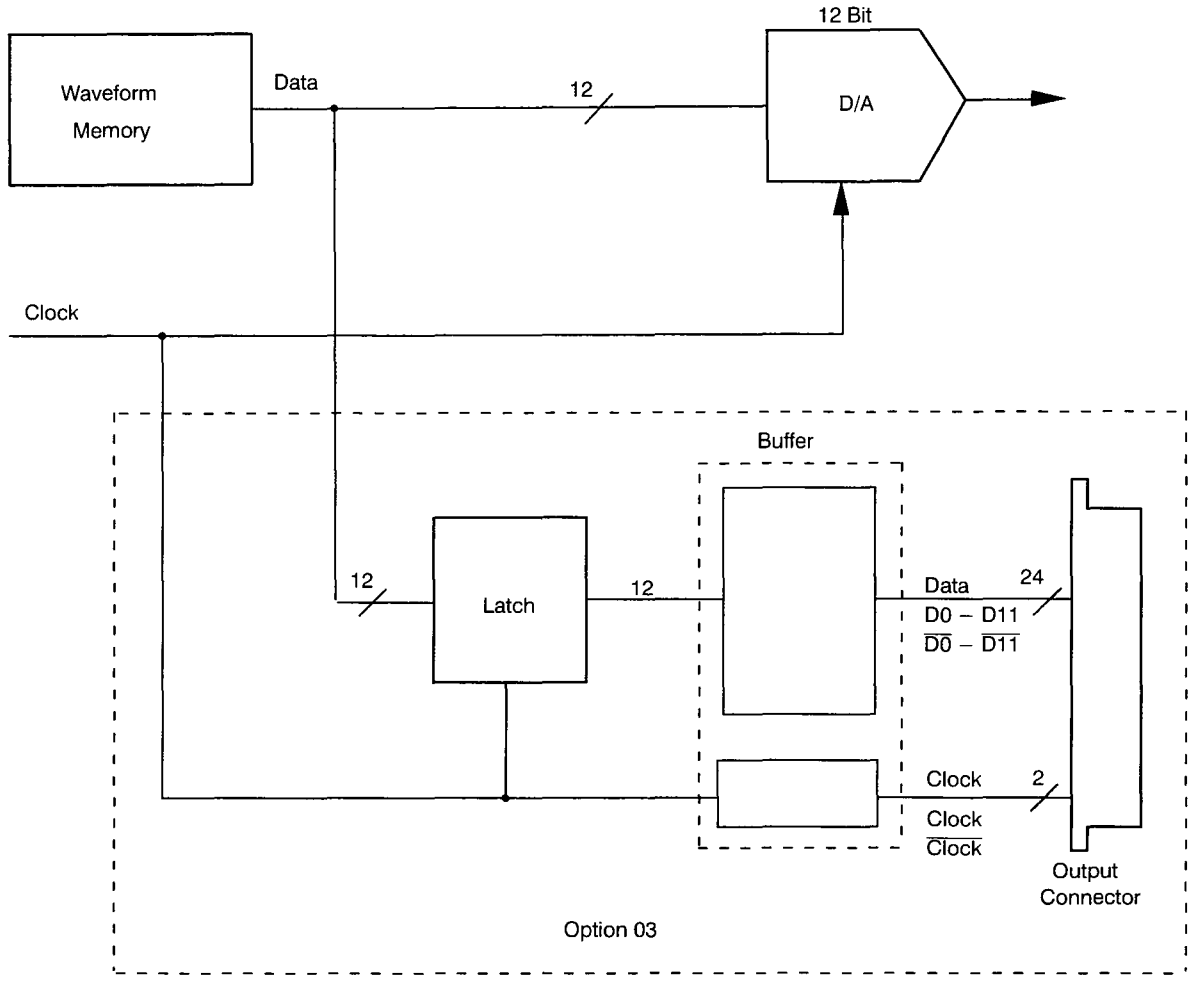


Figure 7-1: Option 03 Block Diagram

Output Connector Configuration

Figure 7-2 shows the shape of the output connector and its pin locations. Table 7-2 lists the output signal for each pin.

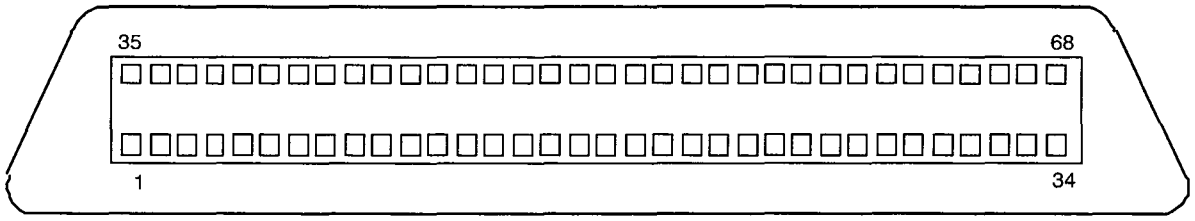


Figure 7-2: Option 03 Output Connector

Table 7-2: Option 03 Digital Output Signals

Pin Number	Signal	Pin Number	Signal
6	~CLOCK	39	CLOCK
14	~Data bit 0	47	Data bit 0
12	~Data bit 1	45	Data bit 1
10	~Data bit 2	43	Data bit 2
8	~Data bit 3	41	Data bit 3
16	~Data bit 4	49	Data bit 4
20	~Data bit 5	53	Data bit 5
22	~Data bit 6	55	Data bit 6
18	~Data bit 7	51	Data bit 7
30	~Data bit 8	63	Data bit 8
28	~Data bit 9	61	Data bit 9
26	~Data bit 10	59	Data bit 10
24	~Data bit 11	57	Data bit 11

Pins 4, 33, 34, 37, 67, and 68 have no internal connection.
All other pins are connected to chassis ground.
~ = active low signal.

Operation

Basically, Option 03 operation is the same as for the AWG2020 itself. When a waveform is not being output, the waveform initial data can be output to the connector. At this time, the clock is not generated.

When waveform output begins, the clock is generated and the data is updated.

NOTE

During the hold-off period, when loading a new waveform into waveform memory and resetting the waveform memory, excess output is generated in the data clock (see Figure 7-3).

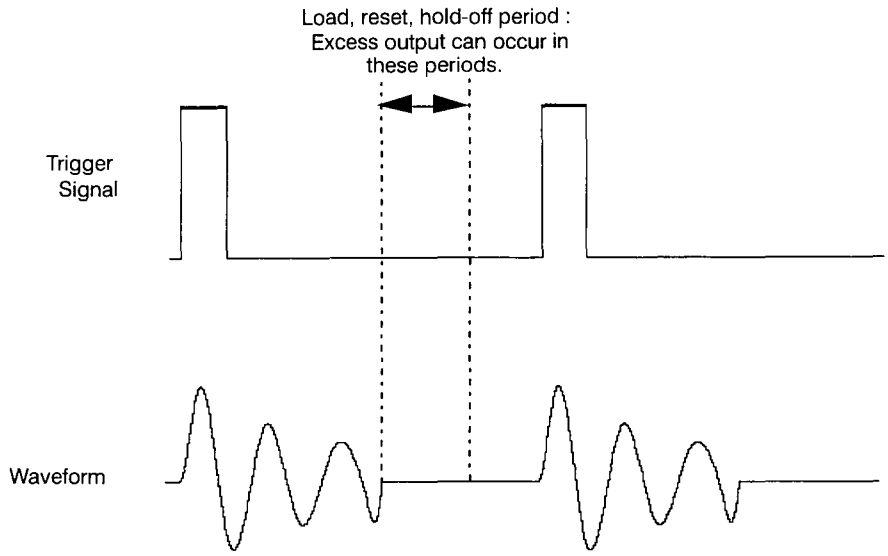


Figure 7-3: Generation of Excess Output

Output Circuit and Output Waveform

The ECL buffer (10E116) output is connected to the output connector. It must be terminated with a 50 Ω resistor at the receiving side (user side). If this termination resistor is missing, the signals do not appear at the output connector. The same is true for the clock output. See Figure 7-4.

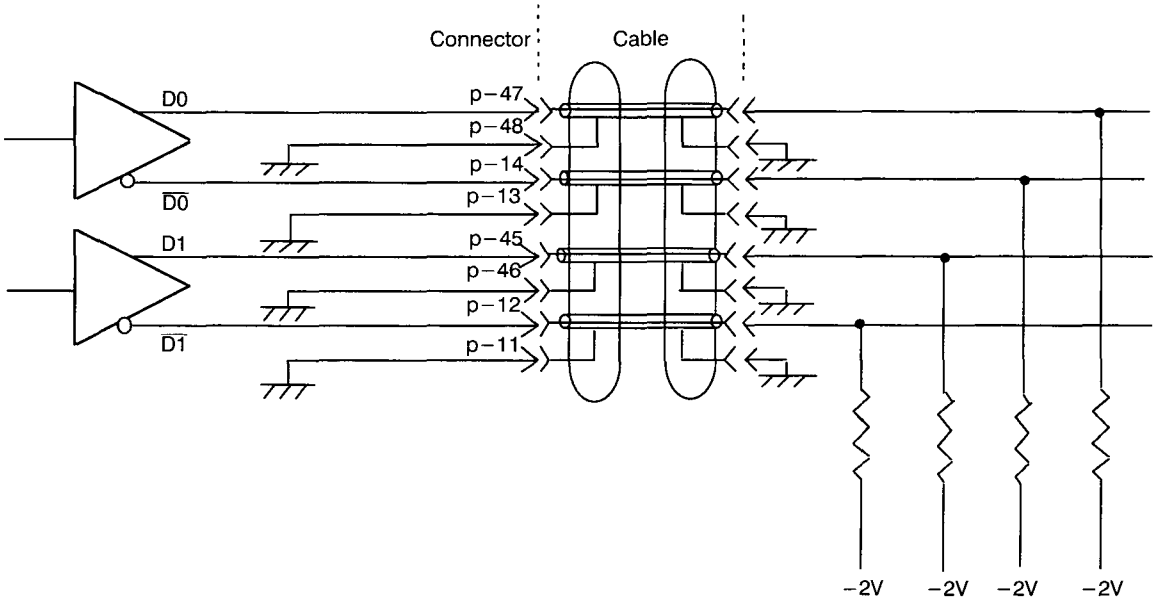


Figure 7-4: Output Circuit

The data output signal skew is held to 1 ns, maximum. The rise and fall times depend on characteristics of the buffer IC, but neither is greater than 1 ns. See Figure 7-5. Both of these maximum levels are the values without using cables. If a cable is used, these waveforms have transmission distortion.

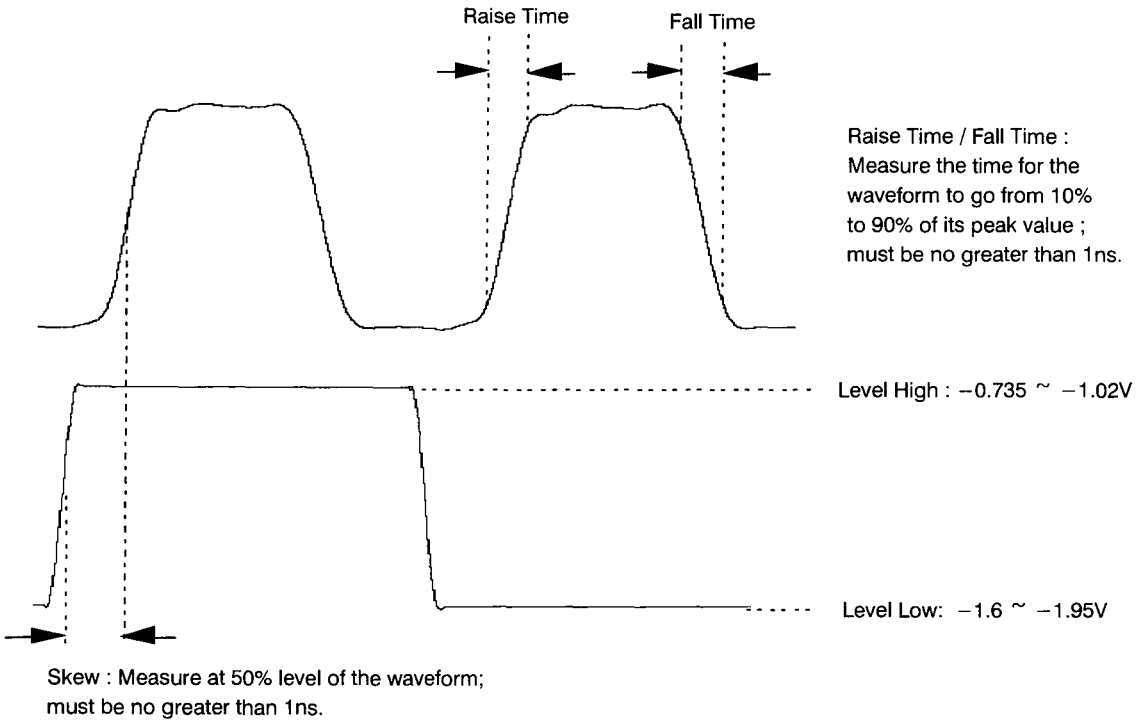


Figure 7-5: Output Waveform

Latch the data with a clock before using the waveform. Delay the clock appropriately with a delay line in order to reproduce the data reliably. See Figure 7-6.

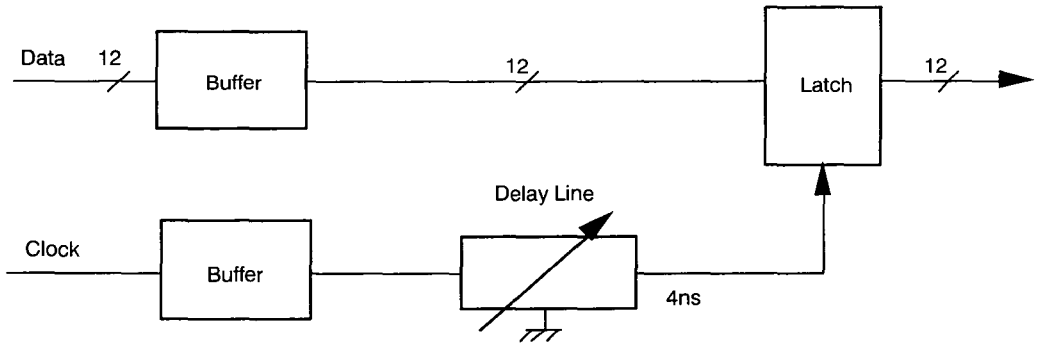


Figure 7-6: Data Latching

Application Suggestions

Cables — The cable connecting the AWG2020 rear panel output connectors and the user circuit is extremely critical for operation at the maximum clock frequency. Thus, follow these recommendations to obtain optimum performance:

- Use coaxial cable with a characteristic impedance of 50 Ω for all DATA and CLOCK lines.
- Keep cables as short as possible. The acceptable length depends on the characteristics of the coaxial cable used, but lengths under 1 meter are desirable.
- In order to minimize signal reflection, carefully dress the ends of the cables:
  - *Make the section stripped of its outer covering as short as possible. Figure 7-7 shows the strip length of the coaxial cable.*
  - *Connect the external covering of the cable to the ground for the signals corresponding to each connector.*

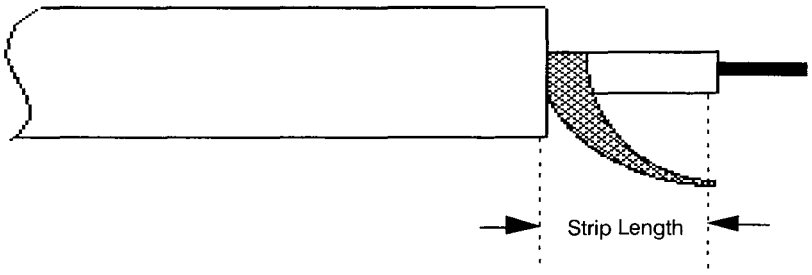


Figure 7-7: Coaxial Cable End Processing

Cable Examples — Tektronix has 1-meter long cables available as optional accessories. Figure 7-8 shows an example of the option cable and a receiving connector.

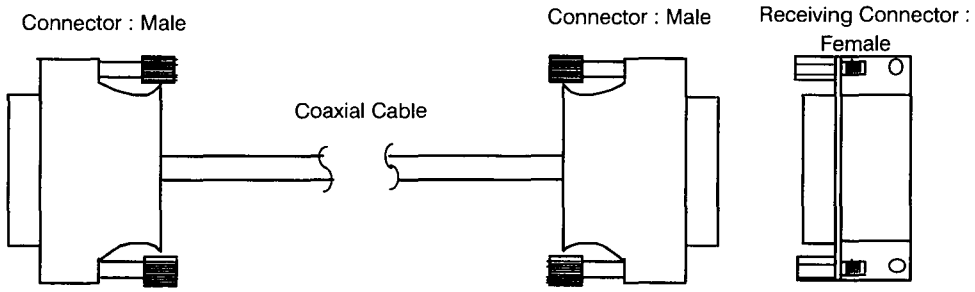


Figure 7-8: Cable Examples

Digital Data Latch Example — Figure 7-9 shows an example of an external circuit for latching the digital data.

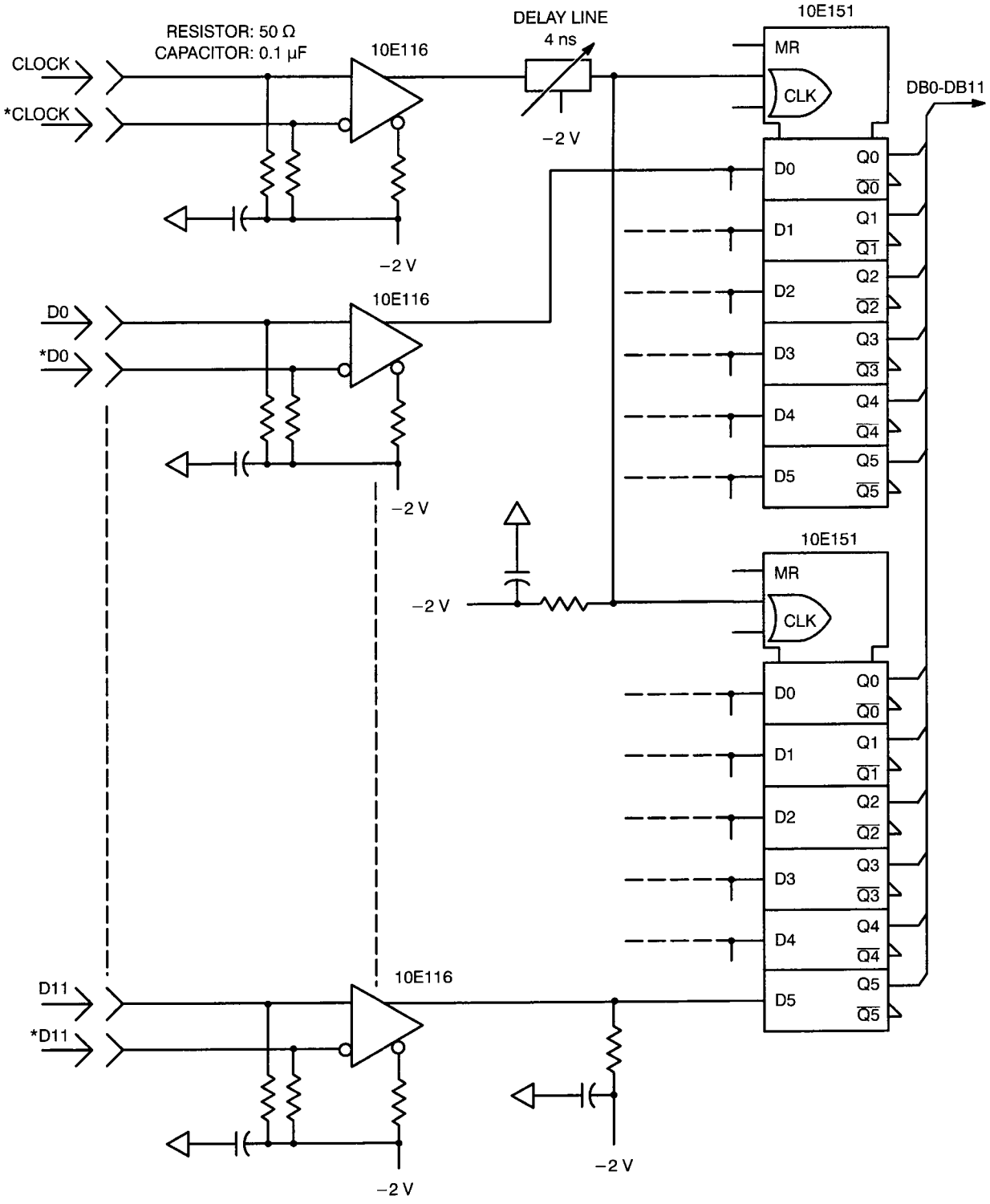


Figure 7-9: Digital Data Latch Example

NOTE

Tektronix cannot be responsible for the infringement of any third-party industrial proprietary rights, copyrights, or other rights arising from the use of these circuits.

Option 09 Description

This option is a board dedicated to floating point processing. It speeds up internal calculations and provides frequency domain editing of waveforms.

Option 1R Description

For Option 1R, the waveform generator is configured for installation in a 19-inch wide instrument rack. In this configuration, the floppy disk drive is mounted on the front panel. To change an AWG2020 into a rackmount version, you can order a rackmount kit. See *Accessories* in this section for more information.

Accessories

Standard Accessories

The following standard accessories are provided with each instrument:

Table 7-3: Standard Accessories List

Qty	Description	Part Number
1	User manual	070-8656-01
1	Programmer manual	070-8657-01
1	GPIB Programming Examples Disk, 3.5-inch media	063-1380-00
1	Waveform Data Format Conversion Software Disk, 3.5-inch media	063-0968-00
1	Sample Waveform Library Disk, 3.5-inch media	063-0970-00
1	Power cable	161-0230-01
1	Fuse (6 A, 250 V, fast-blow)	159-0239-00

Optional Accessories

The following optional accessories are recommended for use with the instrument:

Table 7-4: Optional Accessories List

Qty	Description	Part Number
1	Service manual	070-8658-00
1	Performance Check/Adjustment Disk	063-0969-00
1	Front cover	200-3232-00
1	Accessory pouch	016-1159-00
1	C9 camera adapter	016-1154-00
1	GPIB cable	012-0991-00
1	Digital Data Out cable (for Option 03)	012-1408-00
1	Termination board (for Option 03)	671-2957-00
1	50 Ω BNC cable	012-1342-00
1	50 Ω BNC cable, double-shielded	012-1256-00
1	SMA(μA)-BNC(Fe) cable	015-0554-00
1	50 Ω BNC terminator	011-0049-01
1	ID label (for 230 V)	334-8409-00
1	Maintenance kit (see Table 7-5)	067-1396-00
1	Rackmount kit (see description later)	016-1189-00

Table 7-5: Maintenance Kit Contents

Qty	Description	Part Number
1	Extender-A board (for slot 1, 2, 3, 4)	671-2331-00
1	Extender-B board (for slot 5)	671-2487-00
1	Cable kit	198-5802-00
1	Ejector	003-1315-00
1	Header	131-5537-00
1	Connector (PELTOLA-to-BNC)	131-1315-01

Rackmount Kit — You can also order a rackmount kit for reconfiguring the AWG2020 for installation in a rack. The kit is Tektronix part no. 016-1189-00 (for field conversions).

Electrical Parts List

The modules that make up this instrument are often a combination of mechanical and electrical subparts. Therefore, all replaceable modules are listed in section 10, *Mechanical Parts List.* Refer to that section for part numbers when using this manual.

Diagrams

This section contains two block diagrams and an interconnect diagram. The first block diagram shows the modules and functional blocks in an AWG2020 with Option 02, the second channel, and Option 09, Floating Point Processor. The second block diagram shows the AWG2020 with Option 03, Digital Data Out, an d Option 09, Floating Point Processor. The interconnect diagram shows how the modules in the AWG2020 connect.

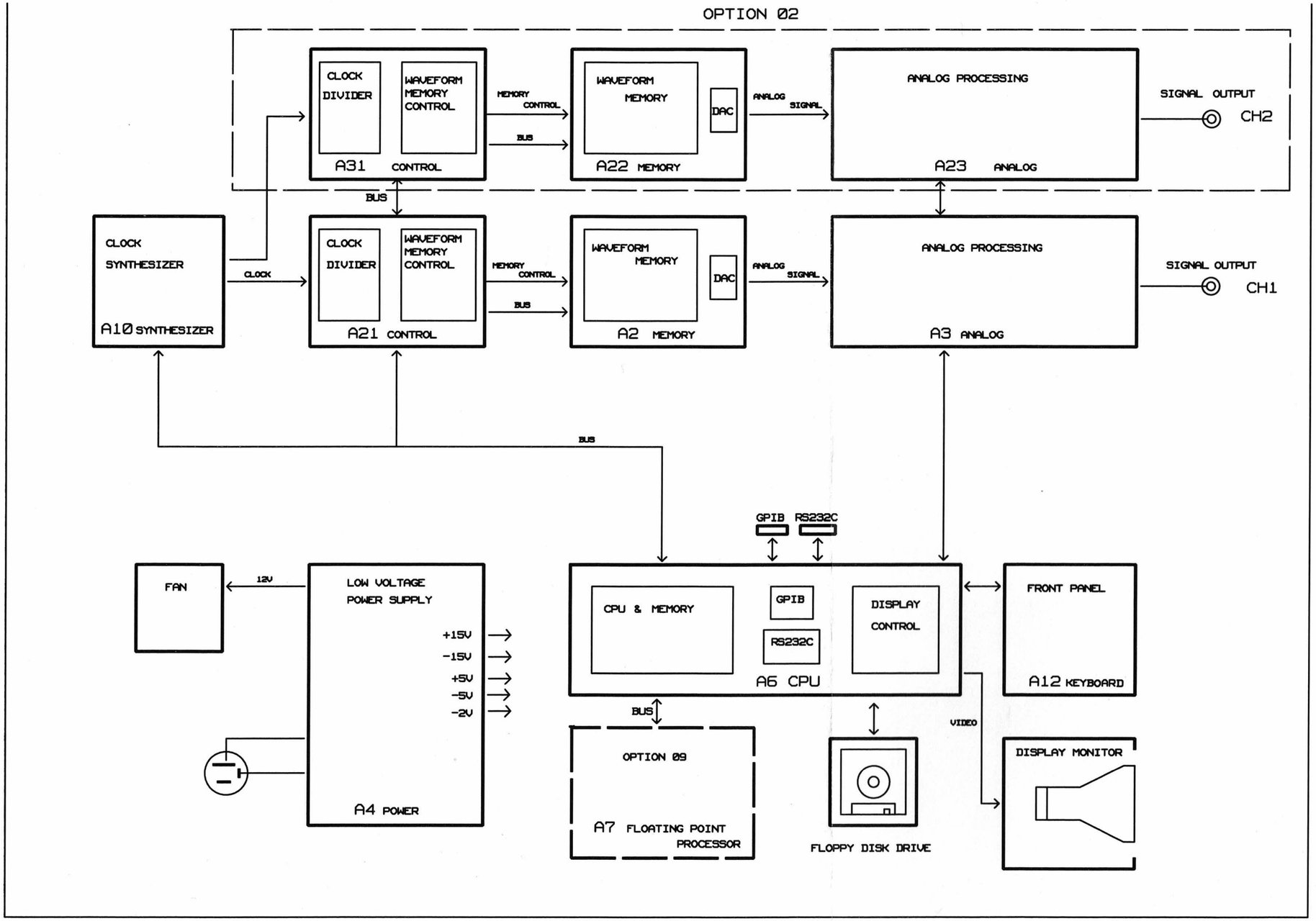


Figure 9-1: Block Diagram of AWG2020 With Options 02 and 09

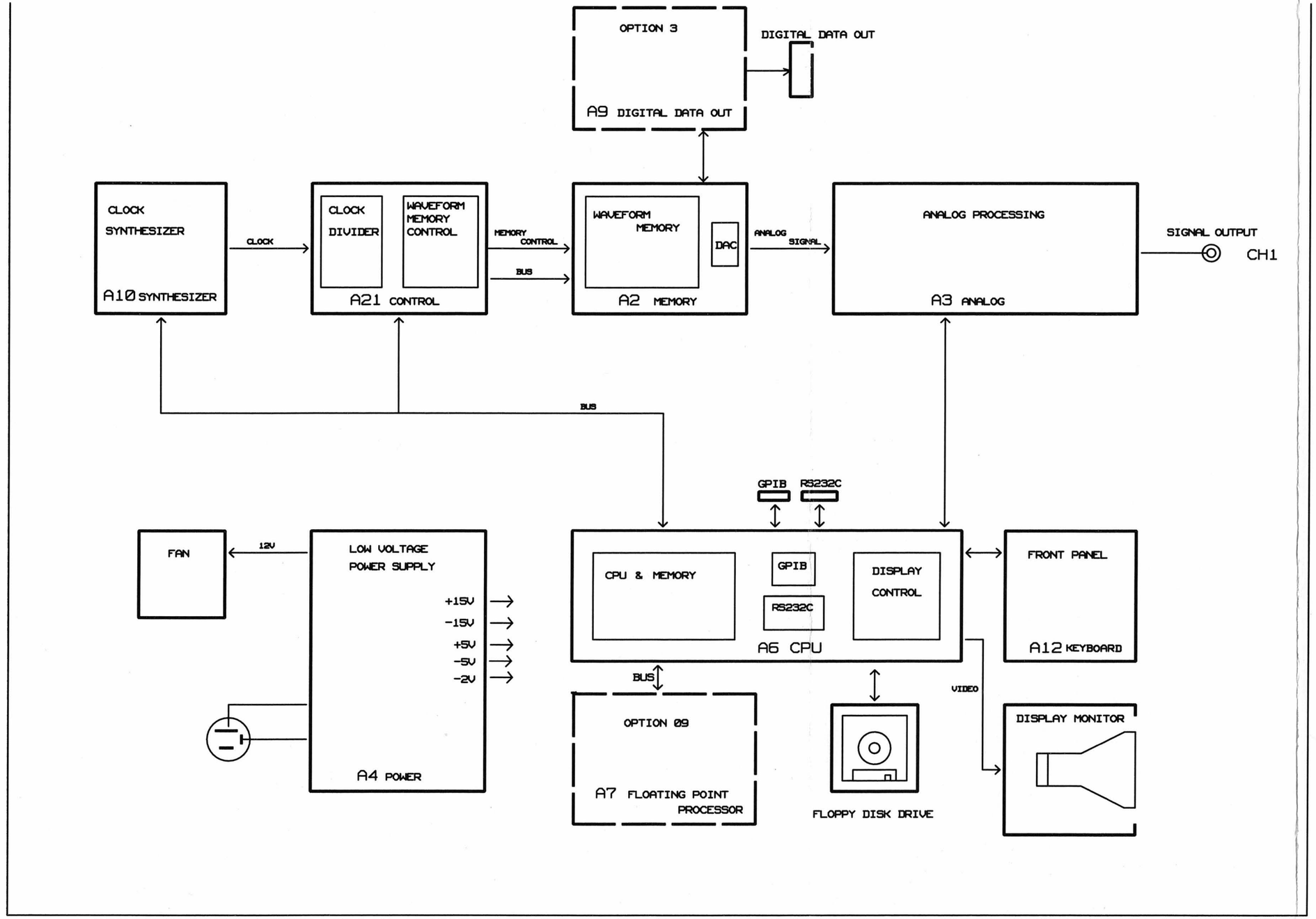


Figure 9-2: Block Diagram of AWG2020 With Options KEYBOARD 03 and 09

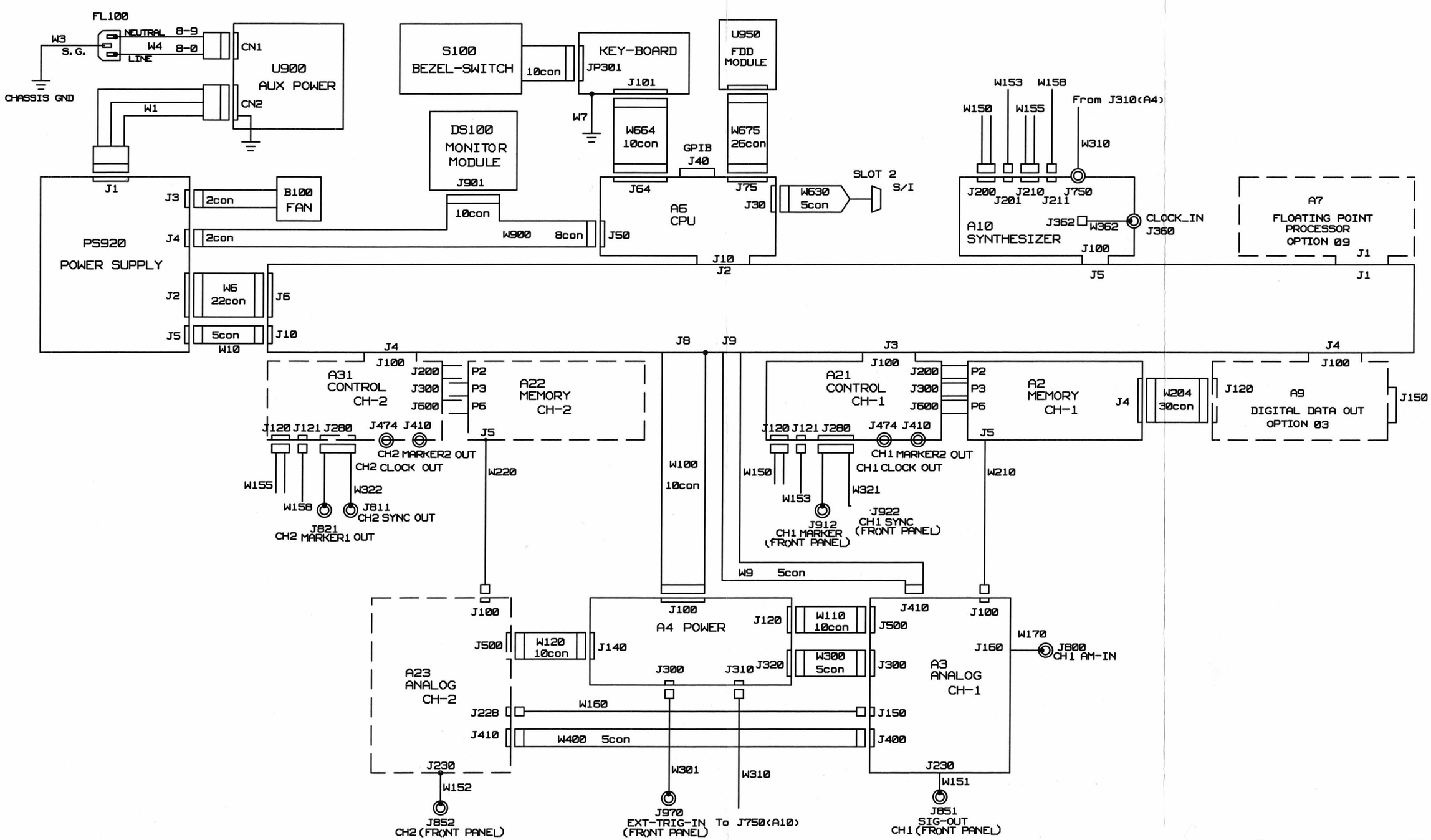


Figure 9-3: Interconnect Diagram

Mechanical Parts List

This section contains a list of the modules that are replaceable for the AWG2020. 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 AWG2020 is serviced by module replacement so there are two options to 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. 6630.
- **New Modules.** You may purchase new replacement modules in the same way as other replacement parts.

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.

Abbreviations

Abbreviations conform to American National Standards Institute (ANSI) standard Y1.1

CROSS INDEX – MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip Code
TK0BD	TAISHO ELECTRIC IND CO LTD	5–28–16 OKUSAWA SETAGAYA–KU	TOKYO JAPAN
TK0392	NORTHWEST FASTENER SALES INC	7923 SW CIRRUS DRIVE	BEAVERTON OR 97005–6448
TK0435	LEWIS SCREW CO	4300 S RACINE AVE	CHICAGO IL 60609–3320
TK1163	POLYCAST INC	9898 SW TIGARD ST	TIGARD OR 97223
TK1287	ENOCH MFG CO	14242 SE 82ND DR PO BOX 98	CLACKAMAS OR 97015
TK1499	AMLAN INC	97 THORNWOOD RD	STAMFORD CT 06903–2617
TK1572	RAN–ROB INC	631 85TH AVE	OAKLAND CA 94621–1254
TK1725	GREENPAR CONNECTORS LTD	PO BOX 15 HARLOW	ESSEX CM20 2ER ENGLAND
TK1908	PLASTIC MOLDED PRODUCTS	4336 SO ADAMS	TACOMA WA 98409
TK1918	SHIN–ETSU POLYMER AMERICA INC	1181 NORTH 4TH ST	SAN JOSE CA 95112
TK2432	UNION ELECTRIC	15/F #1, FU–SHING N. ROAD	TAIPEI, TAIWAN ROC
0JR05	TRIQUEST CORP	3000 LEWIS AND CLARK HWY	VANCOUVER WA 98661–2999
0KB01	STAUFFER SUPPLY	810 SE SHERMAN	PORTLAND OR 97214
00779	AMP INC	2800 FULLING MILL PO BOX 3608	HARRISBURG PA 17105
04713	MOTOROLA INC SEMICONDUCTOR PRODUCTS SECTOR	5005 E MCDOWELL RD	PHOENIX AZ 85008–4229
07416	NELSON NAME PLATE CO	3191 CASITAS	LOS ANGELES CA 90039–2410
12327	FREEWAY CORP	9301 ALLEN DR	CLEVELAND OH 44125–4632
24931	SPECIALTY CONNECTOR CO INC	2100 EARLYWOOD DR PO BOX 547	FRANKLIN IN 46131
61058	MATSUSHITA ELECTRIC CORP OF AMERICA PANASONIC INDUSTRIAL CO DIV	ONE PANASONIC WAY PO BOX 1502	SECAUCUS NJ 07094–2917
65374	DOTRONIX	160 1ST STREET SE	NEW BRIGHTON MN 55112
73743	FISCHER SPECIAL MFG CO	111 INDUSTRIAL RD	COLD SPRING KY 41076–9749
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
83486	ELCO INDUSTRIES INC	1101 SAMUELSON RD	ROCKFORD IL 61101
86928	SEASTROM MFG CO INC	701 SONORA AVE	GLENDALE CA 91201–2431

Fig. & Index No.	Tektronix Part No.	Serial No. Effective	Serial No. Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
10-1-1	343-1213-00			1	CLAMP,PWR CORD:POLYMIDE	TK1163	ORDER BY DESC
-2	161-0230-01			1	CABLE ASSY,PWR,:3,18 AWG,92 L,SVT,TAN (STANDARD ACCESSORY)	TK2432	ORDER BY DESC
-3	337-3891-00			1	SHIELD,ELEC:TRANSFORMER,PERMALLOY	80009	337389100
-4	342-0976-00			1	INSULATOR,PLATE:190MM X 380MM	80009	342097600
-5	334-8235-00			1	MARKER,IDENT:MKD WARNING/FUSE DATA	80009	334823500
-6	334-3388-01			1	MARKER,IDENT:MKD,SONY/TEKTRONIX CORP	80009	334338801
-7	334-8410-00			1	MARKER,IDENT:BLANK,POLYESTER	80009	334841000
-8	334-8236-00			1	MARKER,IDENT:MKD SIGNAL CH1	80009	334823600
-9	211-0691-00			4	SCREW,MACHINE:6-32 X 0.625,PNH,STL	0KB01	ORDER BY DESC
-10	200-3991-00	J300101	J300233	1	COVER,REAR:HARD,POLYCARBONATE,LEXAN	TK1163	ORDER BY DESC
	200-3991-01	J300234		1	COVER,REAR:HARD,POLYCARBONATE,LEXAN	TK1163	ORDER BY DESC
-11	390-1117-00			1	CABINET,SCOPE:EMI VERSION,W/HANDLE	80009	390111700
-12	211-0378-00			4	SCR,ASSEM WSHR:4-40 X 0.375.PNH,STL,CD PL	0KB01	ORDER BY DESC
-13	200-3983-00			1	BEZEL:FDD,AL	80009	200398300
-14	348-1276-00			1	GASKET,SHIELD:CONDUCTIVE FORM STRIP	80009	348127600
-15	334-8234-00	J300101	J300184	1	MARKER,IDENT:MKD AWG2020,HANDLE	80009	334823400
	334-8234-01	J300185		1	MARKER,IDENT:MKD AWG2020,HANDLE	80009	334823401
-16	260-2539-00			1	SWITCH SET:BEZEL	TK1918	260-2539-00
-17	366-2164-00			14	PUSH BUTTON:SMOKE TAN	80009	366216400
-18	354-0709-00			1	RING,TRIM:LEXAN 940	80009	354070900
-19	334-8233-00			1	MARKER,IDENT:MKD AWG2020	80009	334823300
-20	378-0404-00			1	FILTER,LT,CRT:BLUE SMOKE,112MM X 145MM	80009	378040400
-21	348-1289-00			1	SHLD GSKT,ELEK:MESH TYPE,3.2MM X 4.7MM	80009	348128900
-22	211-0722-00			1	SCREW,MACHINE:6-32 X 0.25,PNH,STL	0KB01	ORDER BY DESC

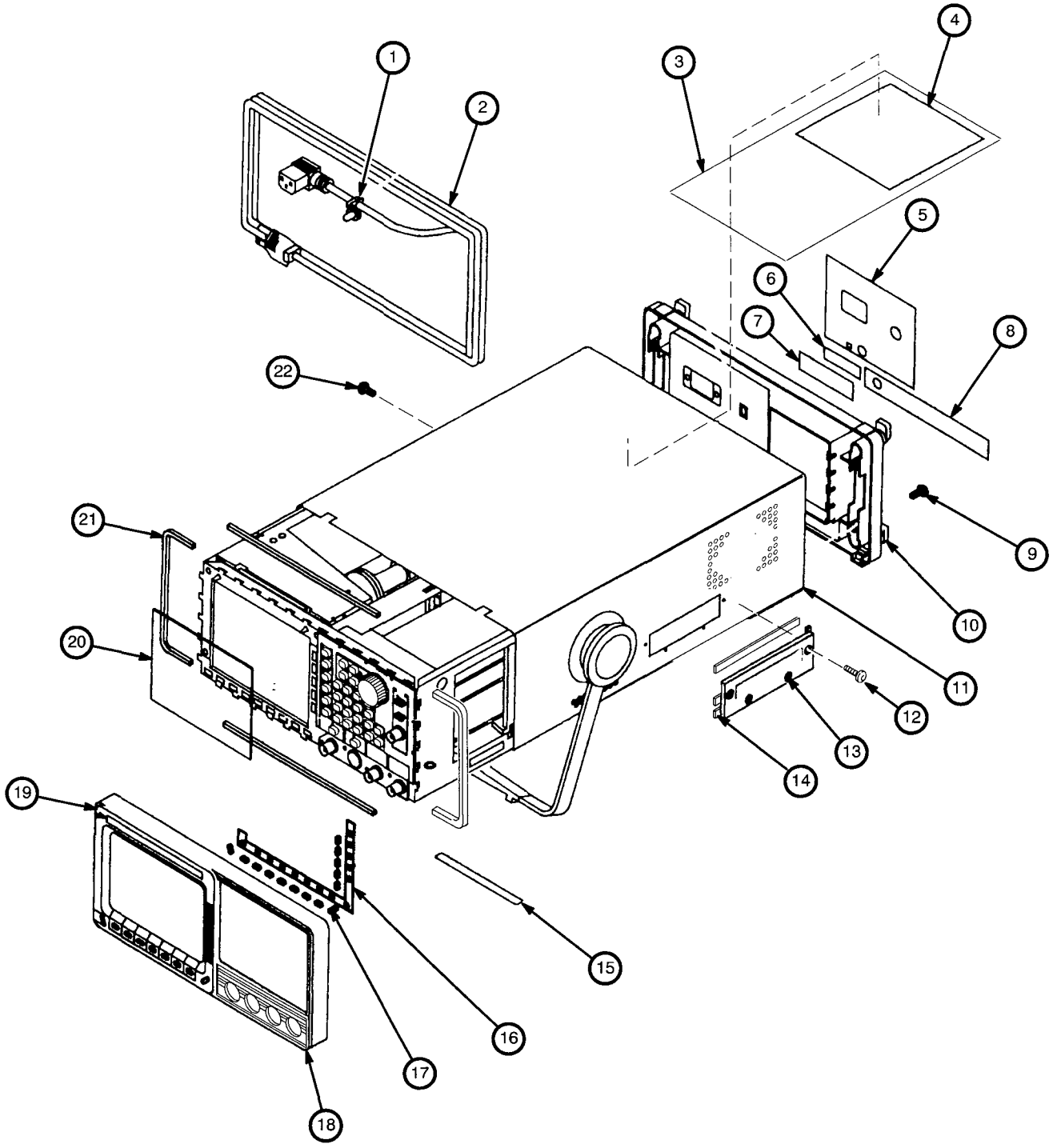


Figure 10-1: Cabinet

Fig. & Index No.	Tektronix Part No.	Serial No. Effective	Serial No. Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
10-2-1	213-0882-00			11	SCREW,TPG,TR:6-32 X 0.437 TAPTITE,PNH,STL	0KB01	ORDER BY DESC
-2	343-0549-00			2	STRAP,TIEDOWN,E:0.098 W X 4.0 L,ZYTEL	TK1499	HW-047
-3	119-4322-01			1	FAN,TUBAXIAL:12VDC,2.4M/M,5.8MM HZO,6W (B100)	80009	119432201
-4	620-0050-00	J300101	J300240	1	POWER SUPPLY:PRI 250VAC,48-440HZ,SEC 15V (U920)	80009	620005000
	620-0050-01	J300241		1	POWER SUPPLY:PRI 250VAC,48-440HZ,SEC 15V (U920)	80009	620005001
-5	366-1480-04			1	PUSH BUTTON:BLK,0.328 X 0.253 X 0.43	0JR05	ORDER BY DESC
-6	--------			1	CAP,FUSEHOLDER: (P/O FIGURE 2-3)		
-7	159-0205-01			1	FUSE,WIRE LEAD:1A,125V,FAST (F150)	80009	159020501
-8	119-4315-01			1	CIRCUIT BD ASSY:AUX,POWER SUPPLY (U900)	80009	119431501
-9	119-4465-00			1	FILTER,RFI:8A,250VAC,50/60HZ,FLANGE MT (FL100)	80009	119446500
-10	426-2426-00			1	FRAME,FAN MTG:POLYCARBONATE	80009	426242600
-11	210-0457-00			1	NUT,PL,ASSEM WA:6-32 X 0.312,STL CD PL	TK0435	ORDER BY DESC
-12	334-3379-00			1	MARKER,IDENT:MARKED GROUND SYMBOL	07416	ORDER BY DESC
-13	386-6159-00			1	SUPPORT,CKT BD:BACK PLANE & PWR SPLY	80009	386615900
-14	441-1930-00	J300101	J300271	1	CHASSIS ASSY:AL	80009	441193000
	441-1930-01	J300272		1	CHASSIS ASSY:AL	80009	441193001
-15	210-0586-00			2	NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL	TK0435	ORDER BY DESC
-16	131-0955-00			2	CONN,RF JACK:BNC,50 OHM,FEMALE (J912,922)	TK1725	G35152BN
-17	210-0255-00			2	TERMINAL,LUG:0.391 ID,LOCKING,BRS CD PL	TK1572	ORDER BY DESC
-18	407-4087-00			1	BRKT,CMPNT,BNC:ALUMINUM,5.250 X 1.050	80009	407408700
-19	211-0325-00			4	SCR,ASSEM WSHR:4-40 X 0.25,PNH,STL	0KB01	ORDER BY DESC
-20	134-0218-00			1	BUTTON,PLUG:0.625 DIA,PLASTIC,TAN	80009	134021800
-21	210-0005-00			1	WASHER,LOCK:#6 EXT,0.02 THK,STL	78189	1106-00
-22	211-0722-00			1	SCREW,MACHINE:6-32 X 0.25,PNH,STL	0KB01	ORDER BY DESC
-23	131-1315-01			1	CONN,RF JACK:BNC/PNL,;50 OHM,FEMALE (J851)	24931	28JR306-1
-24	259-0086-00			1	FLEX CIRCUIT:BEZEL BUTTON (S100)	07416	ORDER BY DESC
-25	426-2436-00			1	FRAME,CRT FLTR:POLYCARBONATE	TK1163	ORDER BY DESC
-26	348-1313-00			1	GASKET,SHIELD:CONDUCTIVE URETHANE FORM	80009	348131300
-27	348-1302-00			1	GASKET,SHIELD:CONDUCTIVE URETHANE FORM	80009	348130200
-28	119-3917-00	J300101	J300289	1	MONITOR:7 INCH MONOCHROME (DS100)	65374	BCX-2070
	640-0079-01	J300290		1	DISPLAY MONITOR:7INCH,480 X 640 PIXEL (DS100)	80009	640-0079-01

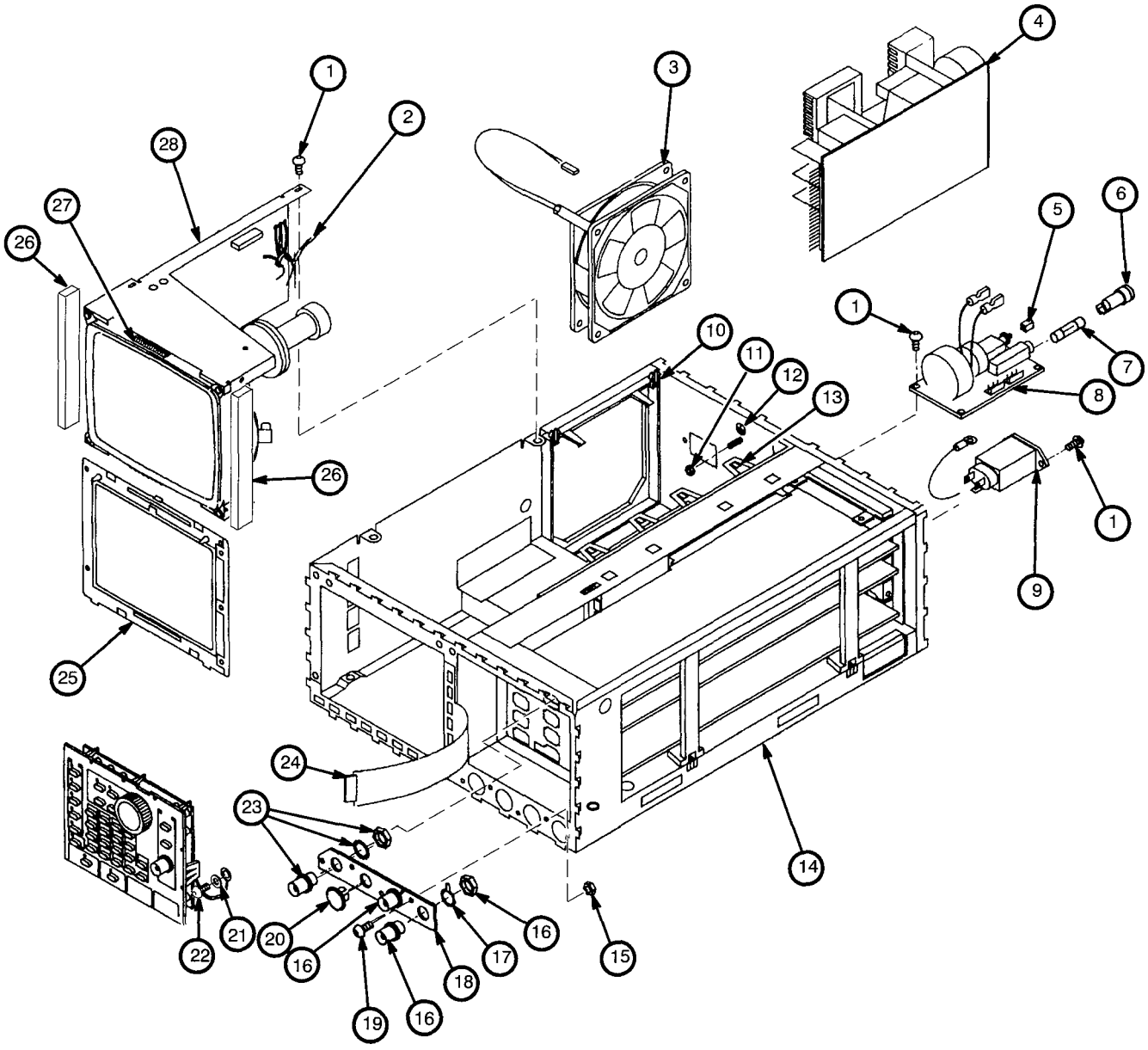


Figure 10-2: Main Chassis and CRT

Fig. & Index No.	Tektronix Part No.	Serial No. Effective	Serial No. Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
10-3-1	131-1315-01			1	CONN,RF JACK:BNC/PNL,;50 OHM,FEMALE (J800)	24931	28JR306-1
-2	337-3875-00			1	SHIELD,ELEC:REAR,CH1,BRS NI PL,AWG2020	80009	337387500
-3	211-0722-00			22	SCREW,MACHINE:6-32 X 0.25,PNH,STL	0KB01	ORDER BY DESC
-4	129-1051-00			2	SPACER,POST:12.5 MM L,W/4-40 INT THD	80009	129105100
-5	334-8313-00	J300101	J300187	1	MARKER,IDENT:MKD CH1 & CH2	80009	334831300
	334-8313-01	J300188		1	MARKER,IDENT:MKD CH1 & CH2	80009	334831301
-6	129-1107-00			2	SPACER,POST:0.98 L,6-32 EXT & M3.5 INT THD	TK1287	129-1107-00
-7	348-1314-00			1	GASKET,SHIELD:FINGER TYPE,BE-CU,609.6MM	80009	348131400
-8	344-0472-00			3	CLIP,CABLE:NYLON,GRAY	80009	344047200
-9	252-0571-33			1	PLASTIC SHEET:EXTR CHAN,5MM X 3.3MM	80009	252057133
-10	342-0302-00			1	INSULATOR,FILM:CHASSIS,MYLAR	80009	342030200
-11	337-3874-00			1	SHIELD,ELEC:FDD,AL	80009	337387400
-12	119-4404-00			1	DISK DRIVE:FLOPPY,3.5 INCH W/INTERFACE (U950)	80009	119440400
-13	348-1276-00			2	GASKET,SHIELD:CONDUCTIVE FORM STRIP	80009	348127600
-14	343-1084-00			1	CLAMP,CABLE:NYLON	80009	343108400
-15	348-0948-00			2	GROMMET,PLASTIC:BLACK,RING,9.5MM ID	80009	348094800
-16	211-0373-00			10	SCREW,MACHINE:4-40 X 0.25,PNH,STL	83486	ORDER BY DESC
-17	210-0994-00			3	WASHER,FLAT:0.125 ID X 0.25 OD X 0.022,STL	12327	ORDER BY DESC
-18	210-0054-00			3	WASHER,LOCK:#4 SPLIT,0.025 THK STL	86928	ORDER BY DESC
-19	211-0823-00			3	SCREW,MACHINE:M2.6 X 5MM L,PNH,STL	80009	211082300
-20	351-0927-00	J300101	J300271	5	GUIDE,CKT BD:SPRING TYPE	80009	351092700
-21	211-0827-00	J300101	J300271	25	SCREW,MACHINE:M2 X 4MM L,PNH,STL	80009	211082700
-22	671-2329-01			1	CIRCUIT BD ASSY:BACKPLANE (A5)	80009	671232901
-23	146-0055-00			1	BATTERY,DRY:3.0V,1200 MAH,LITHIUM (A5BT001)	61058	BR-2/3A-E2P
-24	252-0571-33	J300101	J300187	1	PLASTIC SHEET:EXTR CHAN,5MM X 3.3MM	80009	252057133
-25	337-3877-00			1	SHIELD,ELEC:CENTER,AL,AWG2020	80009	337387700
-26	210-0586-00			1	NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL	TK0435	ORDER BY DESC
-27	671-2327-02	J300101	J300187	1	CIRCUIT BD ASSY:ANALOG (A3)	80009	671232702
	671-2327-03	J300188		1	CIRCUIT BD ASSY:ANALOG (A3)	80009	671232703
-28	671-2328-00			1	CIRCUIT BD ASSY:POWER (A4)	80009	671232800

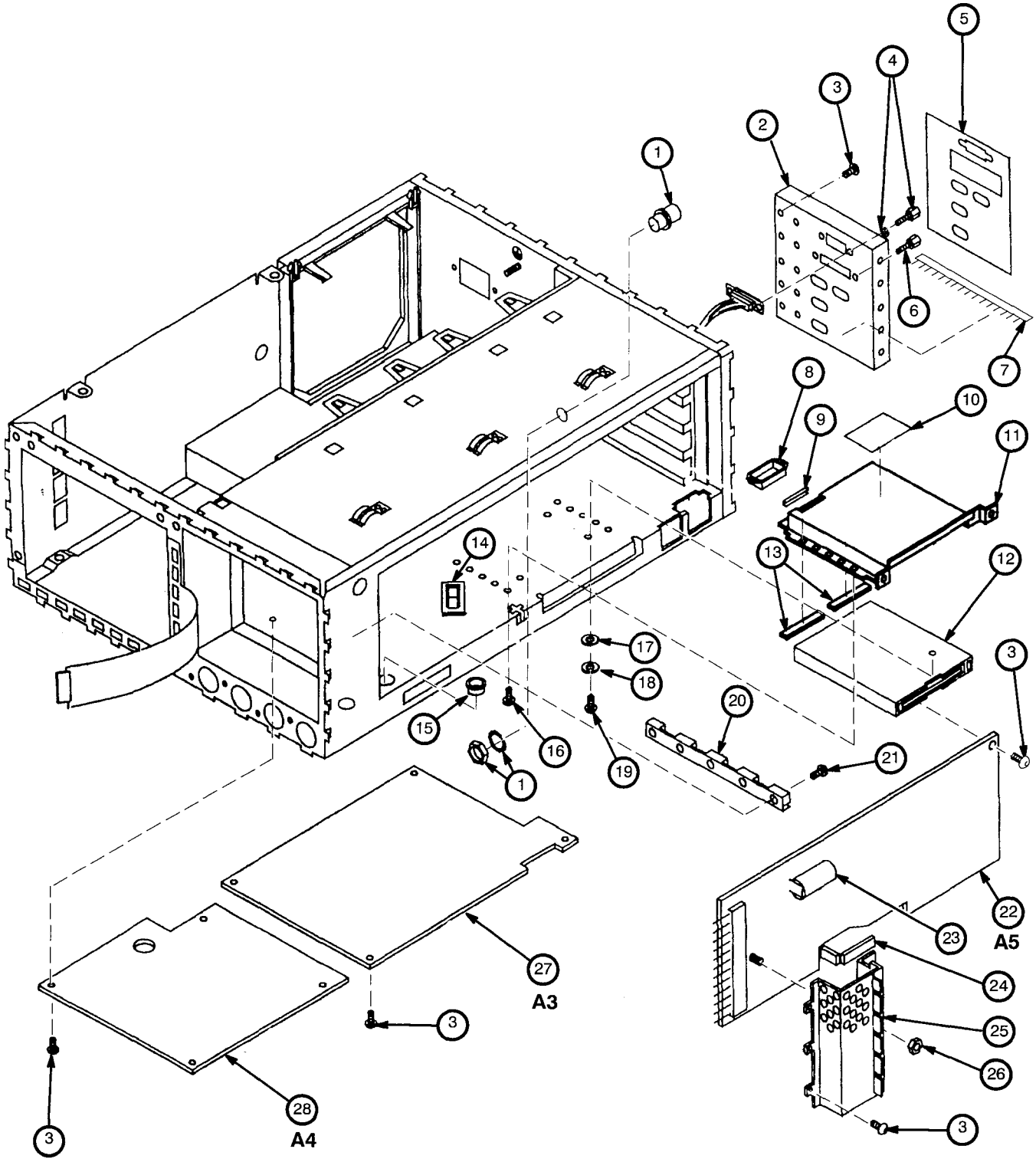


Figure 10-3: Main Chassis and Circuit Boards

Fig. & Index No.	Tektronix Part No.	Serial No. Effective	Serial No. Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
10-4-1	160-6551-00	J300101	J300132	1	IC,MEMORY:EPROM;CMOS,256K X 16,100NS (A6U305)	80009	160655100
	160-6551-01	J300133	J300154	1	IC,MEMORY:EPROM;CMOS,256K X 16,100NS (A6U305)	80009	160655101
	160-6551-02	J300155		1	IC,MEMORY:EPROM;CMOS,256K X 16,100NS (A6U305)	80009	160655102
-2	160-8676-00	J300101	J300132	1	IC,DIGITAL:CMOS,262144 X 16 BIT EPROM,PRGM (A6U300)	80009	160867600
	160-8676-01	J300133	J300154	1	IC,MEMORY ITEM:CMOS,EPROM;256K X 16 (A6U300)	80009	160867601
	160-8676-02	J300155		1	IC,MEMORY ITEM:CMOS,EPROM;256K X 16 (A6U300)	80009	160867602
-3	671-2330-01	J300101	J300132	1	CIRCUIT BD ASSY:CPU (A6)	80009	671233001
	671-2330-02	J300133	J300154	1	CIRCUIT BD ASSY:CPU (A6)	80009	671233002
	671-2330-03	J300155	J300155	1	CIRCUIT BD ASSY:CPU (A6)	80009	671233003
	671-2330-04	J300156	J300183		CIRCUIT BD ASSY:CPU (A6)	80009	671233004
	671-2330-05	J300184			CIRCUIT BD ASSY:CPU (A6)	80009	671233005
-4	131-5165-00			1	CONN,RIBBON:PCB,;FEMALE,RTANG,24 POS (A6J40)	00779	555139-1
-5	333-4011-00			1	PANEL,REAR:FLOATING POINT PROCESSOR BD	80009	333401100
-6	211-0722-00			5	SCREW,MACHINE:6-32 X 0.25,PNH,STL	0KB01	ORDER BY DESC
-7	211-0001-00			6	SCREW,MACHINE:2-56 X 0.25,PNH,STL	TK0435	ORDER BY DESC
-8	131-5524-00			3	CONN,RF JACK:SMA,;50 OHM,FEMALE (A10J360, A21J410, A21J474)	80009	131552400
-9	348-1324-00			1	GSKT,SHLD,ELEK:3.0MM DIA,SILICON,RUBBER	80009	348132400
-10	337-3890-00			3	SHIELD,ELEC:EMI,SMA,COPPER,AWG2020	80009	337389000
-11	386-6158-00			1	SUPPORT,CKT BD:MAT MATERIAL	80009	386615800
-12	671-2206-01	J300101	J300176	1	CIRCUIT BD ASSY:CONTROL,CH 1 (A21)	80009	671220601
	671-2206-02	J300177		1	CIRCUIT BD ASSY:CONTROL,CH 1 (A21)	80009	671220602
-13	671-2326-01			1	CIRCUIT BD ASSY:MEMORY (A2)	80009	671232601
-14	333-3976-00			1	PANEL,REAR:EXT ENDER BOARD,AL	80009	333397600
-15	671-2205-02	J300101	J300132	1	CIRCUIT BD ASSY:SYNTHESIZER (A10)	80009	671220502
	671-2205-03	J300133		1	CIRCUIT BD ASSY:SYNTHESIZER (A10)	80009	671220503
-16	343-1535-00			2	CABLE CLAMP:POLYVINYL	80009	343153500
-17	210-0001-00			2	WASHER,LOCK:#2 INTL,0.013 THK,STL	78189	1202-00-00-0541
-18	210-0405-00			6	NUT,PLAIN,HEX:2-56 X 0.188,BRS CD PL	73743	12157-50
-19	211-0325-00			12	SCR,ASSEM WSHR:4-40 X 0.25,PNH,STL	0KB01	ORDER BY DESC
-20	129-1409-00			6	SPACER,POST:10.0MM L,4-40 INT THD	80009	129140900

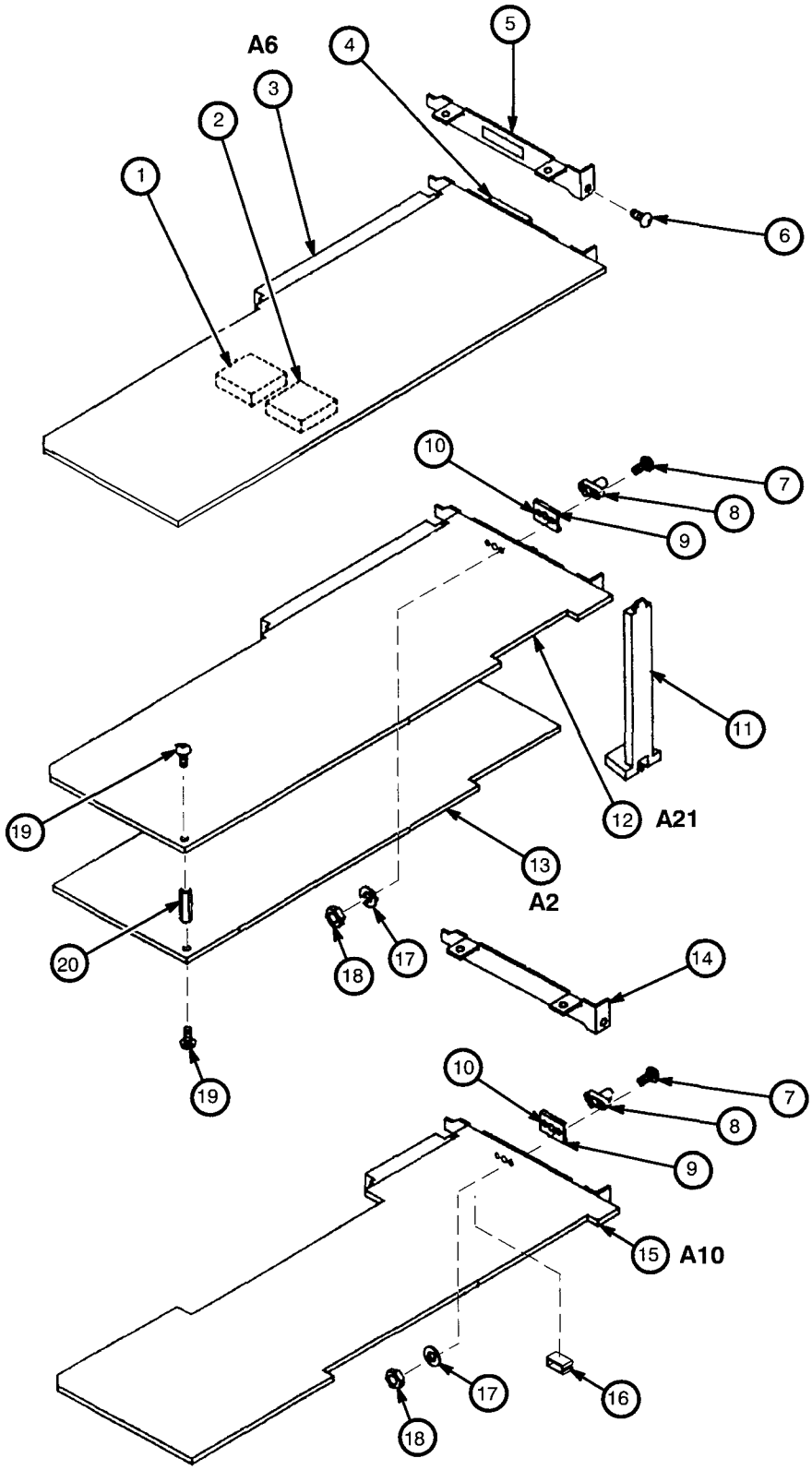


Figure 10-4: Circuit Boards

Fig. & Index No.	Tektronix Part No.	Serial No. Effective	Serial No. Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
10-5-1	671-2520-00	J300101	J300132	1	CIRCUIT BD ASSY:KEYBOARD (A12)	80009	671252000
	671-2520-01	J300133	J300152	1	CIRCUIT BD ASSY:KEYBOARD (A12)	80009	671252001
	671-2520-02	J300153	J300157	1	CIRCUIT BD ASSY:KEYBOARD (A12)	80009	671252002
	671-2520-03	J300158		1	CIRCUIT BD ASSY:KEYBOARD (A12)	80009	671252003
-2	213-0153-00			1	SETSCREW:5-40 X 0.125,STL	TK0392	ORDER BY DESCP
-3	260-2497-01			1	SWITCH,ROTARY:ENCODER (A12S103)	80009	260249701
-4	384-1686-00			1	EXTENSION SHAFT:0.790 L X 0.500 DIA,PLASTIC	80009	384168600
-5	160-7853-06			1	IC,PROCESSOR:CMOS,MICROCOMPUTER;8-BIT (A12U101)	04713	MC68HC705B5FN
-6	210-0413-00			2	NUT,PLAIN,HEX:0.375-32 X 0.5,BRS CD PL	73743	3145-402
-7	210-0840-00			1	WASHER,FLAT:0.39 ID X 0.562 OD X 0.02,STL	86928	ORDER BY DESC
-8	348-1276-00			1	GASKET,SHIELD:CONDUCTIVE FORM STRIP	80009	348127600
-9	131-1315-01			1	CONN,RF JACK:BNC/PNL,;50 OHM,FEMALE (J970)	24931	28JR306-1
-10	366-2159-00			1	KNOB:IVORY GRAY,SCROLL,1.243 IDX 1.4 OD	TK1163	ORDER BY DESC
-11	213-0048-00			1	SETSCREW:4-40 X 0.125,STL	TK0392	ORDER BY DESC
-12	333-3974-01			1	PANEL,FRONT:AWG2020	80009	333397401
-13	337-3878-00			1	SHIELD,ELEC:FRONT PANEL,EMI,AL FOIL	80009	337387800
-14	380-1060-00			1	HOUSING,SWITCH:POLYCARBONATE,AFG2020	80009	380106000
-15	260-2552-00			1	SWITCH,PUSH:50 BUTTON,SP/ST	80009	260255200
-16	366-2163-00			31	PUSH BUTTON:IVORY GRAY,OVAL	80009	366216300

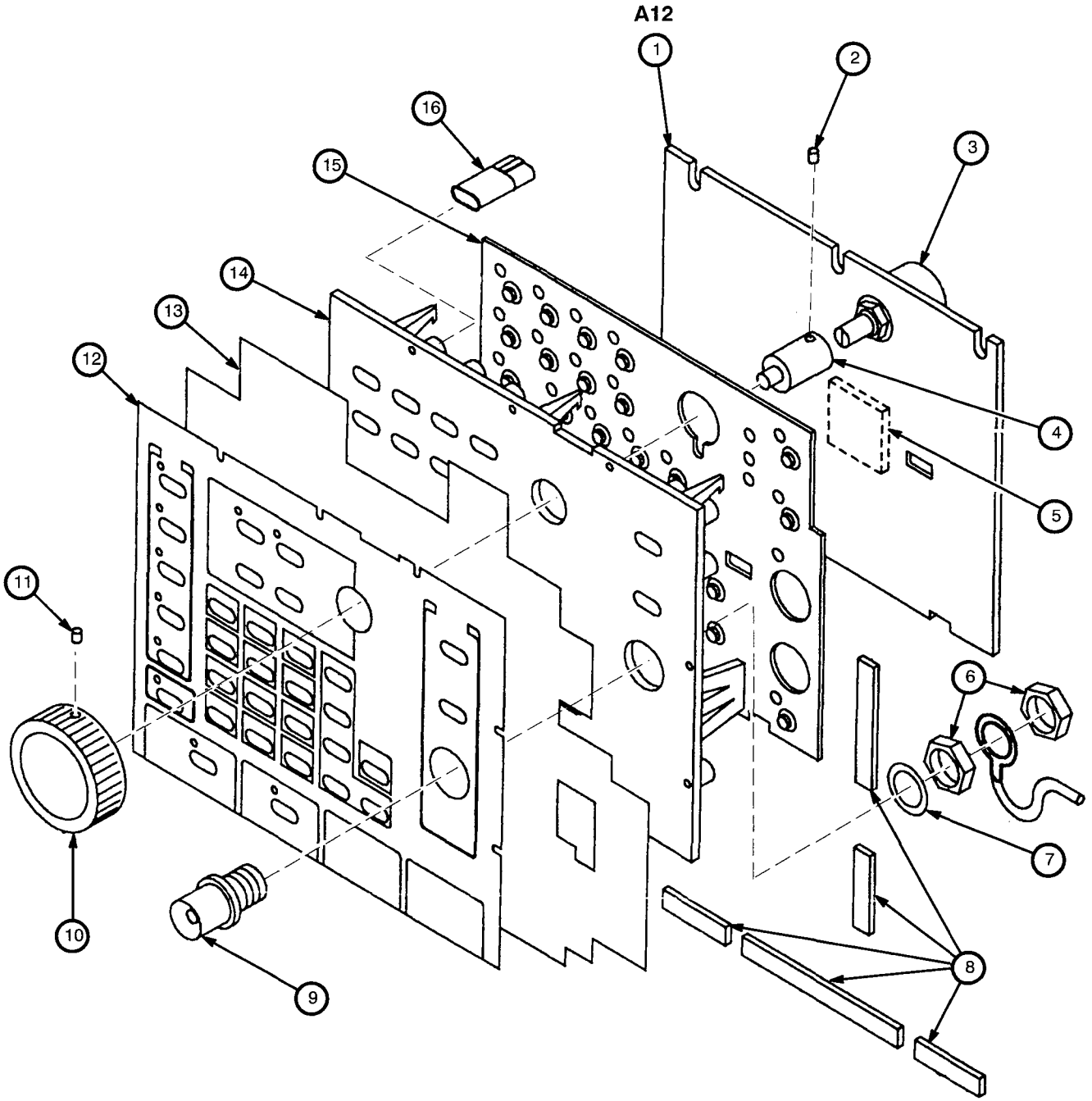


Figure 10-5: Front Panel Assembly

Fig. & Index No.	Tektronix Part No.	Serial No. Effective	Serial No. Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
					OPTION 02		
10-6-1	334-8316-00			1	MARKER,IDENT:MKD I/O SIGNALS CH1 & CH2 (OPTION 02 ONLY)	80009	334831600
-2	131-0955-00			2	CONN,RF JACK:BNC,;50 OHM,FEMALE (J811,821--OPTION 02 ONLY)	TK1725	G35152BN
-3	211-0001-00			2	SCREW,MACHINE:2-56 X 0.25,PNH,STL (OPTION 02 ONLY)	TK0435	ORDER BY DESC
-4	131-5524-00			1	CONN,RF JACK:SMA,;50 OHM,FEMALE (A31J410--OPTION 02 ONLY)	80009	131552400
-5	337-3890-00			1	SHIELD,ELEC:EMI,SMA,COPPER,AWG2020 (OPTION 02 ONLY)	80009	337389000
-6	348-1324-00			1	GSKT,SHLD,ELEK:3.0MM DIA,SILICON,RUBBER (OPTION 02 ONLY)	80009	348132400
-7	671-2677-00	J300101	J300187	1	CIRCUIT BD ASSY:CONTROL CH2 (A31--OPTION 02 ONLY)	80009	671267700
	671-2677-01	J300188		1	CIRCUIT BD ASSY:CONTROL,CH2 (A31--OPTION 02 ONLY)	80009	671267701
-8	671-2747-00			1	CIRCUIT BD ASSY:MEMORY CH2 (A22--OPTION 02 ONLY)	80009	671274700
-9	210-0001-00			1	WASHER,LOCK:#2 INTL,0.013 THK,STL (OPTION 02 ONLY)	78189	1202-00-00-0541
-10	210-0405-00			2	NUT,PLAIN,HEX:2-56 X 0.188,BRS CD PL (OPTION 02 ONLY)	73743	12157-50
-11	129-1409-00			6	SPACER,POST:10.0MM L,4-40 INT THD (OPTION 02 ONLY)	80009	129140900
-12	211-0325-00			12	SCR,ASSEM WSHR:4-40 X 0.25,PNH,STL (OPTION 02 ONLY)	0KB01	ORDER BY DESC
-13	671-2661-01	J300101	J300200	1	CIRCUIT BD ASSY:ANALOG (A23--OPTION 02 ONLY)	80009	671266101
	671-2661-02	J300201		1	CIRCUIT BD ASSY:ANALOG (A23--OPTION 02 ONLY)	80009	671266102
-14	211-0722-00			4	SCREW,MACHINE:6-32 X 0.25,PNH,STL (OPTION 02 ONLY)	0KB01	ORDER BY DESC
-15	210-0255-00			2	TERMINAL,LUG:0.391 ID,LOCKING,BRS CD PL (OPTION 02 ONLY)	TK1572	ORDER BY DESC
-16	131-1315-01			1	CONN,RF JACK:BNC/PNL,;50 OHM,FEMALE (J852--OPTION 02 ONLY)	24931	28JR306-1

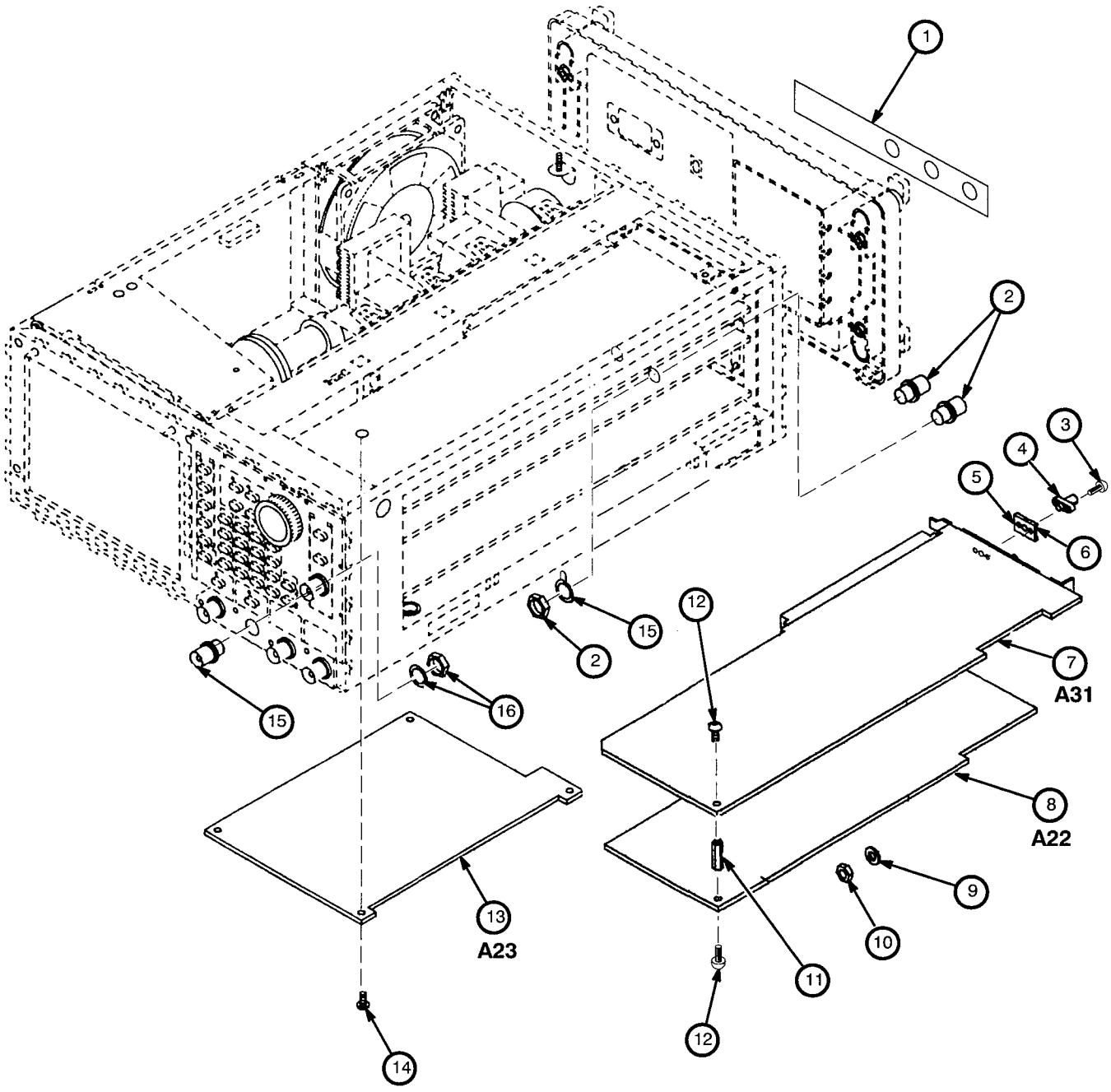


Figure 10-6: Option 02

Fig. & Index No.	Tektronix Part No.	Serial No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
					OPTION 03		
10-7-1	337-3876-01			1	SHIELD,ELEC:REAR,DIGITAL DATA OUT (OPTION 03 ONLY)	80009	337387601
-2	334-8314-01			1	MARKER,IDENT:MKD DIGITAL DATA OUT (OPTION 03 ONLY)	80009	334831401
-3	348-1368-00			2	GASKET,SHIELD:FINGER TYPE, W/ADHESIVE (OPTION 03 ONLY)	80009	348136800
-4	131-5566-00			1	CONN,RIBBON:PCB,FEMALE,RTANG,68 POS (A9J150--OPTION 03 ONLY)	80009	131556600
-5	671-2497-01			1	CIRCUIT BD ASSY:DIGITAL DATA OUT (A9--OPTION 03 ONLY)	80009	671249701

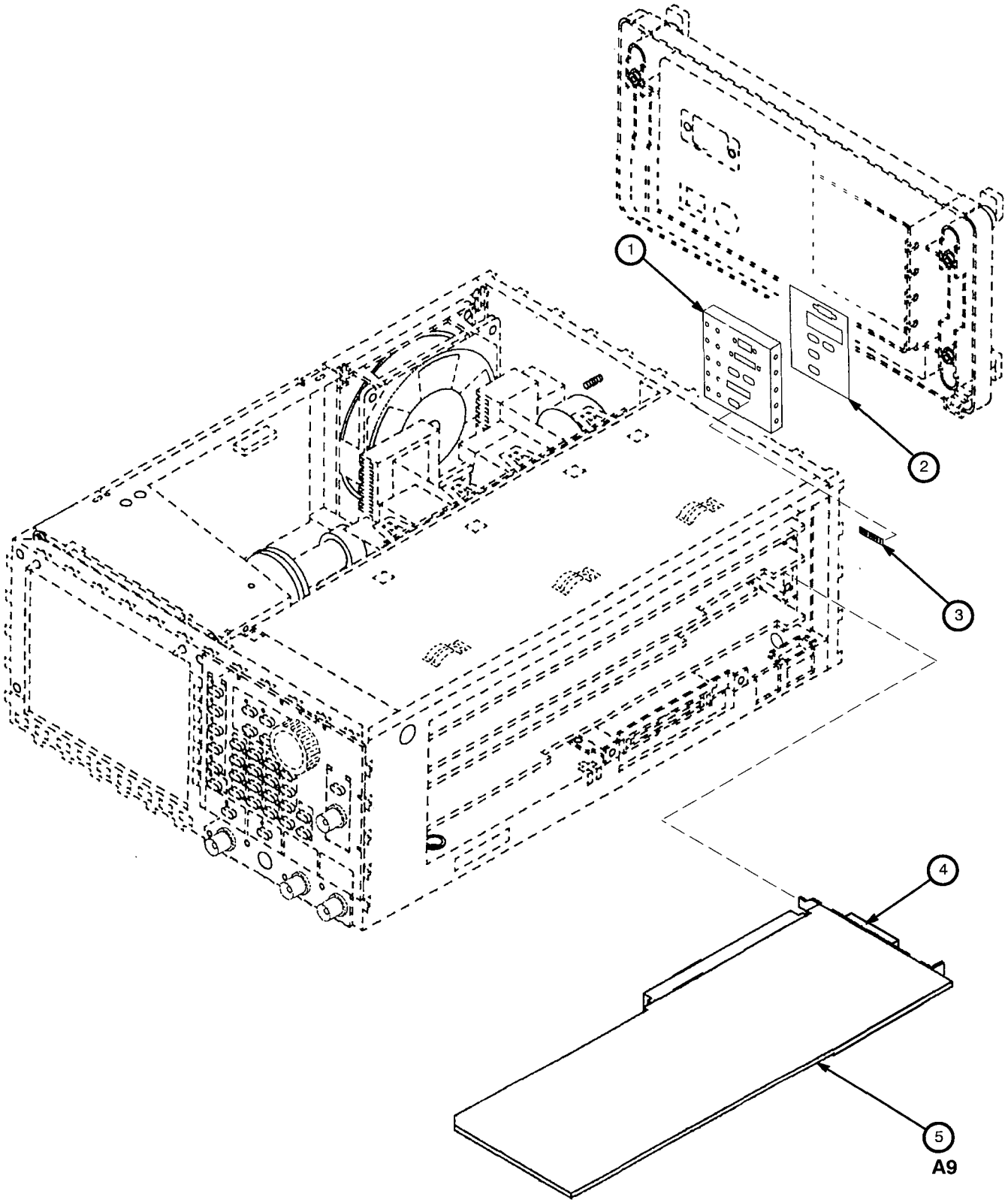


Figure 10-7: Option 03

Fig. & Index No.	Tektronix Part No.	Serial No. Effective	Serial No. Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
					OPTION 09		
10-8-1	671-2496-01			1	CIRCUIT BD ASSY:FLOATING POINT PROC (A7--OPTION 09 ONLY)	80009	671249601

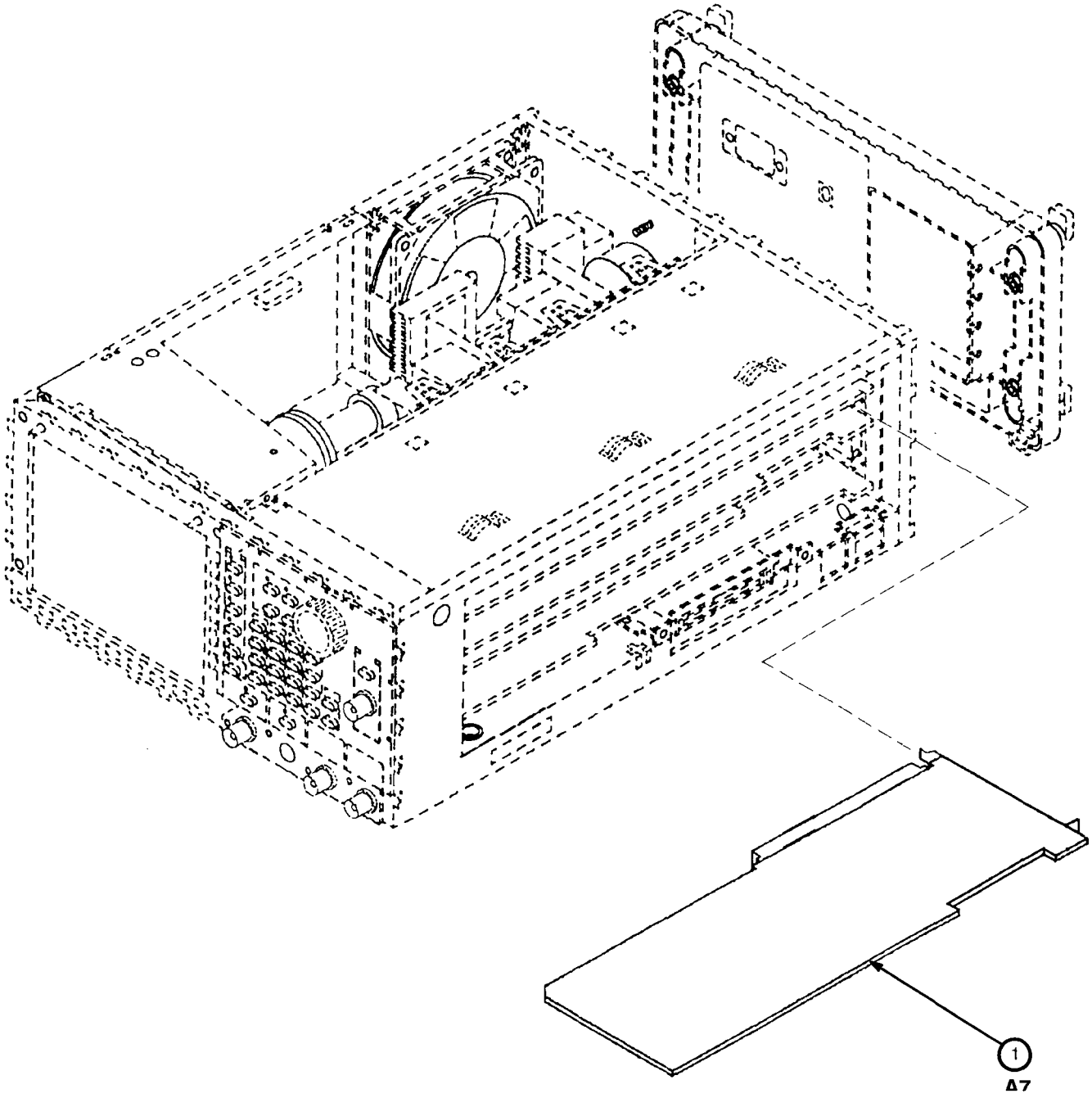


Figure 10-8: Option 09

Component Number	Tektronix Part No.	Serial No. Effective	Serial No. Dscont	Name & Description	Mfr. Code	Mfr. Part No.
				CABLE ASSEMBLIES		
W1	174-2934-00			CA ASSY,SP,ELEC:3,18 AWG,18CM L,AWG2020	80009	174293400
W3	196-3388-00			LEAS,ELECTRICAL:18 AWG,12CM L,5-4,W/TERM	80009	196338800
W4	174-2935-00			CA ASSY,SP,ELEC:2.18 AWG,12CM L,W/CONN	80009	174293500
W6	174-2285-00	J300101	J300143	CA ASSY,SP,ELEC:22,18 AWG,10CM L	80009	174228500
W6	174-2971-00	J300144		CA ASSY,SP,ELEC:22,18 AWG,10CM L	80009	174297100
W7	196-3389-00			LEAS,ELECTRICAL:18 AWG,15CM L,5-4,W/TERM	80009	196338900
W9	174-2953-00			CA ASSY,SP,ELEC:5,26 AWG,24CM L,RIBBON	80009	174295300
W10	174-2936-00			CA ASSY,SP,ELEC:5,26 AWG,26CM L,RIBBON	80009	174293600
W100	174-2931-00			CA ASSY,SP,ELEC:10,26 AWG,11CM L,RIBBON	80009	174293100
W110	174-2932-00			CA ASSY,SP,ELEC:10,26 AWG,22CM L,RIBBON	80009	174293200
W120	174-2946-00			CA ASSY,SP,ELEC:10,26 AWG,33CM L,RIBBON (OPTION 02 ONLY)	80009	174294600
W150	174-2937-00			CABLE ASSY,RF:50 OHM COAX,32CM L,9-1	80009	174293700
W151	174-2938-00			CABLE ASSY,RF:50 OHM COAX,42CM L,9-1	80009	174293800
W152	174-2947-00			CABLE ASSY,RF:50 OHM COAX,42CM L,9-2 (OPTION 02 ONLY)	80009	174294700
W153	174-2955-00			CABLE ASSY,RF:50 OHM COAX,32CM L,9-1	80009	174295500
W155	174-2948-00			CABLE ASSY,RF:2 EACH 50 OHM COAX,32CM L (OPTION 02 ONLY)	80009	174294800
W158	174-2956-00			CABLE ASSY,RF:50 OHM COAX,32CM L,9-2 (OPTION 02 ONLY)	80009	174295600
W160	174-2949-00	J300101	J300307	CABLE ASSY,RF:50 OHM COAX,41CM L,9-2 (OPTION 02 ONLY)	80009	174294900
W160	174-2947-00	J300308		CABLE ASSY,RF:50 OHM COAX,42CM L,9-2 (OPTION 02 ONLY)	80009	174294700
W170	174-2939-00			CABLE ASSY,RF:50 OHM COAX,12CM L,9-1	80009	174293900
W204	174-2776-00			CA ASSY,SP,ELEC:30,28 AWG,40MM L,FLAT (OPTION 03 ONLY)	80009	174277600
W210	174-2940-00			CABLE ASSY,RF:50 OHM COAX,37CM L,9-1	80009	174294000
W220	174-2950-00			CABLE ASSY,RF:50 OHM COAX,37CM L,9-2 (OPTION 02 ONLY)	80009	174295000
W300	174-2952-00			CA ASSY,SP,ELEC:5,26 AWG,30CM L,RIBBON	80009	174295200
W301	174-2941-00			CABLE ASSY,RF:50 OHM COAX,17CM L,9-1	80009	174294100
W310	174-2942-00			CABLE ASSY,RF:50 OHM COAX,23CM L,9-0	80009	174294200
W321	174-2943-00			CABLE ASSY,RF:50 OHM COAX,46CM L,9-1	80009	174294300
W322	174-2951-00			CABLE ASSY,RF:50 OHM COAX,17CM L,9-3 (OPTION 02 ONLY)	80009	174295100
W362	174-2944-00			CABLE ASSY,RF:50 OHM COAX,32CM L,9-1	80009	174294400
W400	174-2954-00			CA ASSY,SP,ELEC:5,26 AWG,15CM L,RIBBON (OPTION 02 ONLY)	80009	174295400
W630	174-2933-00			CA ASSY,SP,ELEC:5,26 AWG,15CM L,RIBBON	80009	174293300
W664	174-2945-00			CA ASSY,SP,ELEC:10,26 AWG,23CM L,RIBBON	80009	174294500
W675	174-2775-00			CA ASSY,SP,ELEC:26,350MM L,FLAT FLEX	80009	174277500
W900	174-2770-00			CA ASSY,SP,ELEC:10,26 AWG,390MM L,RIBBON	80009	174277000

Fig. & Index No.	Tektronix Part No.	Serial No. Effective	Serial No. Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
					STANDARD ACCESSORIES		
	063-0968-00	J300101	J300132	1	SOFTWARE PKG:DATA FORMAT CONV,3.5IN	80009	063096800
	063-0968-01	J300133	J300152	1	SOFTWARE PKG:DATA FORMAT CONV,3.5IN	80009	063096801
	063-0968-03	J300153		1	SOFTWARE PKG:DATA FORMAT CONV,3.5IN	80009	063096803
	063-0970-00			1	SOFTWARE PKG:APPLICATION,3.5 IN	80009	063097000
	070-8656-01			1	MANUAL,TECH:USERS	80009	070865601
	070-8657-01			1	MANUAL,TECH:PROGRAMMER	80009	070865701
	159-0239-00			1	FUSE,CARTRIDGE:3AG,6A,250V,MEDIUM	80009	159023900
	--------			1	CABLE ASSY,PWR,:3,18 AWG,92 L,SVT,TAN (SEE FIGURE 1-2)		
	161-0104-05			1	CABLE ASSY,PWR,:3,18 AWG,240V,98.0 L (OPTION A3-AUSTRALIAN)	S3109	SAA/3-OD3CCFC3X
	161-0104-06			1	CABLE ASSY,PWR,:3 X 0.75MM SQ,220V,98.0 L (OPTION A1-EUROPEAN)	S3109	VIIGSOPO-HO5VVF
	161-0104-07			1	CABLE ASSY,PWR,:3,1.0MM SQ,240 VOLT,2.5 M (OPTION A2-UNITED KINGDOM)	S3109	ORDER BY DESC
	161-0104-08			1	CABLE ASSY,PWR,:3,18 AWG,98 L,SVT,GREY/BLK (OPTION A4-NORTH AMERICAN)	70903	ORDER BY DESC
	161-0167-00			1	CABLE ASSY,PWR,:3.0 X 0.75,6A,240V,2.5M L (OPTION A5-SWITZERLAND)	S3109	ORDER BY DESC
					OPTIONAL ACCESSORIES		
	011-0049-01			1	TERMN,COAXIAL:50 OHM,5W,BNC	80009	011004901
	012-0991-00			1	CABLE,COMPOSITE:IDC,GPIB:2 METER	00779	553577-3
	012-1256-00			1	CABLE,INTCON:50 OHM COAX,98.0 L	TK0BD	7220369010
	012-1342-00			1	CABLE ASSY,RF:50 OHM COAX,24.0 L	80009	012134200
	012-1408-00			1	CABLE,INTCON:1M L,36 PIN CONN EACH END (OPTION 03 ONLY)	80009	012140800
	015-0554-00			1	ADPTR,SMA,ELEC:FEMALE BNC TO MALE SMA	24931	29JP170-1
	016-1154-00			1	HOOD ASSEMBLY:2KDSO	80009	016115400
	016-1159-00			1	POUCH:POUCH & PLATE,GPS SIZE	80009	016115900
	016-1189-00			1	ADAPTER,RACK:AWG2020	80009	016118900
	063-0969-00			1	SOFTWARE PKG:ADJUSTMENT/PERFORMANCE	80009	063096900
	067-1396-00			1	FIXTURE,CAL:MAINTENANCE	80009	067139600
	070-8658-00			1	MANUAL,TECH:SERVICE	80009	070865800
	200-3232-00			1	COVER,FRONT:ABS	TK1908	ORDER BY DESC
	334-8409-00			1	MARKER,IDENT:MKD LINE VOLTAGE,POLYESTER	80009	334840900

To: smtp@netsrv1@servers[<m_fieldsvc@tekgen.BV.TEK.COM>]
From: @bangate.TEK.COM>
Cc:
Bcc: @Service
Subject: TWINS: AWG2020/2021 Error Codes
Attachment:
Date: 1997-08-28 20.31

==========

August 28, 1997

TWINS: AWG2020/2021 Error Codes

SonyTek has provided the error codes for the AWG2020 and AWG2021:

==========

The reference table is as follows :

Diagnostics	Related Module	Error Code Range
CPU	A6 CPU board	110 through 140
Clock	A10 Synthesizer board	210 through 222
Display	A6 CPU board	310 through 313
FPP	A7 Floating Point Processor board	410 through 433
Front Panel	Front Panel	510 through 560
Setup CH1	A4 Power board (in common with CH2)	810 and 811
	A21 Control board	710 through 715
	A2 Memory board	720 through 735
	A3 Analog board	610 through 682
Setup CH2	A4 Power board (if setup CH1 is Pass, this board is correct.)	810 and 811
	A31 Control board	710 through 715
	A22 Memory board	720 through 735
	A23 Analog board	610 through 682
Waveform Memory CH1	A21 Control board	710 through 715
	A2 Memory board	720 through 735
Waveform Memory CH2	A31 Control board	710 through 715
	A22 Memory board	720 through 735

DESCRIPTION:
Description of module's usage, data structures, and other information of general value.

```
#ifndef DIAGERROR_H
#define DIAGERROR_H

bit assignment used in DB routines
```

```
#define DIAG_ER_DSP_MASK        (1<<4)
#define DIAG_ER_FP_MASK         (1<<5)
#define DIAG_ER_TRIGGER_MASK    (1<<6)
#define DIAG_ER_SETUP_MASK      (1<<7)
#define DIAG_ER_WMEM_MASK       (1<<8)

#define CAL_ER_CLOCK_MASK       (1<<2)
#define CAL_ER_TRIGGER_MASK     (1<<6)
#define CAL_ER_SETUP_MASK       (1<<7)

Cpu diagnostic errors
100   #define   DIAG_ER_CPU
110   #define ERROR_DIAG_CPU_ROM0
111   #define ERROR_DIAG_CPU_ROM1
112   #define ERROR_DIAG_CPU_ROM2

120   #define ERROR_DIAG_CPU_SRAM_DATA_LINE
121   #define ERROR_DIAG_CPU_SRAM_ADRSS_LINE
122   #define ERROR_DIAG_CPU_SRAM1
123   #define ERROR_DIAG_CPU_SRAM2
124   #define ERROR_DIAG_CPU_SRAM3
125   #define ERROR_DIAG_CPU_SRAM4

130   #define ERROR_DIAG_CPU_DRAM_DATA_LINE
131   #define ERROR_DIAG_CPU_DRAM_ADRSS_LINE
132   #define ERROR_DIAG_CPU_DRAM1
133   #define ERROR_DIAG_CPU_DRAM2
134   #define ERROR_DIAG_CPU_DRAM3
135   #define ERROR_DIAG_CPU_DRAM4
136   #define ERROR_DIAG_CPU_DRAM5
137   #define ERROR_DIAG_CPU_DRAM6
138   #define ERROR_DIAG_CPU_DRAM7
139   #define ERROR_DIAG_CPU_DRAM8

140   #define ERROR_IIC

Clock diagnostic/calibration errors
200   #define   DIAG_ER_CLOCK
      #define   CAL_ER_CLOCK
      #if   defined(AWG2005)
210   #define ER_PLL_REGISTER       A1 register latch etc.

220   #define ER_PLL1_RANGE_MAX     A1 PLL1 fail at max freq
221   #define ER_PLL1_RANGE_MID     A1 PLL1 fail at mid freq
222   #define ER_PLL1_RANGE_MIN     A1 PLL1 fail at min freq

230   #define ER_PLL2_RANGE_MAX     A1 PLL2 fail at max freq
231   #define ER_PLL2_RANGE_MID     A1 PLL2 fail at mid freq
232   #define ER_PLL2_RANGE_MIN     A1 PLL2 fail at min freq

240   #define ER_SWEEP_MEMORY       A31 sweep memory error

      #elif defined(AWG2020/AWG2021/AWG2010/AWG2011)
210   #define ER_HIGH_PLL_RANGE_MAX /* High-PLL fail at max freq
211   #define ER_HIGH_PLL_RANGE_MID /* High-PLL fail at mid freq
212   #define ER_HIGH_PLL_RANGE_MIN /* High-PLL fail at min freq
```

```
      #elif defined(AWG2040)
210   #define   ER_PLL_REGISTER     /* A1 register latch etc.
220   #define ER_PLL1_RANGE_MAX     /* A1 PLL1 fail at max freq
221   #define ER_PLL1_RANGE_MID     /* A1 PLL1 fail at mid freq
222   #define ER_PLL1_RANGE_MIN     /* A1 PLL1 fail at min freq

230   #define ER_PLL2_RANGE_MAX     /* A1 PLL2 fail at max freq
231   #define ER_PLL2_RANGE_MID     /* A1 PLL2 fail at mid freq
232   #define ER_PLL2_RANGE_MIN     /* A1 PLL2 fail at min freq

240   #define   ER_SWEEP_MEMORY     /* A31 sweep memory error
      #endif

Display diagnostic errors

300   #define   DIAG_ER_DISPLAY

310   #define ER_VRAM1  /* Video ram 1 fail (A6U530)
311   #define ER_VRAM2  /* Video ram 2 fail (A6U532)
312   #define ER_VRAM3  /* Video ram 3 fail (A6U534)
313   #define ER_VRAM4  /* Video ram 4 fail (A6U536)

 DSP diagnostic errors

400   #define   DIAG_ER_DSP

410   #define DSP_ERROR_DMA

420   #define DSP_ERROR_RAM0
421   #define DSP_ERROR_RAM1
422   #define DSP_ERROR_RAM2

430   #define DSP_ERROR_BANK0
431   #define DSP_ERROR_BANK1
432   #define DSP_ERROR_BANK2
433   #define DSP_ERROR_BANK3


 Front Panel diagnostic errors

500   #define   DIAG_ER_FP

510   #define ER_FP_ROM     /* FPP ROM fail
520   #define ER_FP_RAM     /* FPP RAM fail
530   #define ER_FP_TIMER   /* FPP timer fail
540   #define ER_FP_AD      /* FPP A-D fail
550   #define ER_FP_TIMEOUT /* unable to putc(), getc()
560   #define ER_FP_OTHER   /* other error in key.c

 Setup diagnostic/calibration errors

600   #define   DIAG_ER_SETUP
      #define   CAL_ER_SETUP        DIAG_ER_SETUP

      #if   defined(AWG2005)
```

```
621   #define   ERROR_CAL_AJ_POST        /* post-amp offst adjust fail

640   #define   ERROR_CAL_AJ_AM_PRE      /* in-mult offst adjust fail
641   #define   ERROR_CAL_AJ_AM_POST     /* out-mult offst adjust fail
642   #define   ERROR_CAL_AJ_AM_INTH     /* intAM in-mult offset adjust
fail
643   #define   ERROR_CAL_AJ_AM_INTL     /* intAM in-mult offset adjust
fail
644   #define   ERROR_CAL_AJ_ADD_CH1     /* ADD Ch1 DA offst adjust fail
645   #define   ERROR_CAL_AJ_ADD_CH2     /* ADD Ch2 DA offst adjust fail

650   #define   ERROR_CAL_GAIN_THROUGH   /* through DA gain fail
651   #define   ERROR_CAL_GAIN_FILTER1   /* filter 0.5M DA gain fail
652   #define   ERROR_CAL_GAIN_FILTER2   /* filter 1M DA gain fail
653   #define   ERROR_CAL_GAIN_FILTER3   /* filter 2M DA gain fail
654   #define   ERROR_CAL_GAIN_FILTER4   /* filter 5M DA gail fail

660   #define   ERROR_CAL_GAIN_VAR       /* Variable amp gain fail
661   #define   ERROR_CAL_GAIN_ATT_PRE   /* Front Att gain fail
662   #define   ERROR_CAL_GAIN_ATT_POST  /* Rear Att gain fail

670   #define   ERROR_CAL_GAIN_AM   /* AM gain fail
671   #define   ERROR_CAL_GAIN_EXTAM     /* External AM  gain fail
672   #define   ERROR_CAL_GAIN_CH1_ADD   /* Ch1 ADD gain fail
673   #define   ERROR_CAL_GAIN_CH2_ADD   /* Ch2 ADD gain fail

680   #define ERROR_CAL_OFFSET_0    /* offset cal error at 0V
681   #define ERROR_CAL_OFFSET_5    /* offset cal error at 0V

      #elif defined(AWG2020/AWG2021/AWG2010/AWG2011)

610   #define ERROR_CAL_AD_0V          /* AD cal fail at 0V read
611   #define ERROR_CAL_AD_5V          /* AD cal fail at 5V Reference read

620   #define ERROR_CAL_AJ_THROUGH     /* through DA offst adjust fail
621   #define ERROR_CAL_AJ_FILTER1M    /* filter 1M DA offst adjust fail
622   #define ERROR_CAL_AJ_FILTER5M    /* filter 5M DA offst adjust fail
623   #define ERROR_CAL_AJ_FILTER20M   /* filter 20M DA offst adjust fail
624   #define ERROR_CAL_AJ_FILTER50M   /* filter 50M DA offst adjust fail

630   #define ERROR_CAL_AJ_MAG         /* 5 X mag DA offst adjust fail
631   #define ERROR_CAL_AJ_ATT_3_1     /* Att 3db-1 DA offst adjust fail
632   #define ERROR_CAL_AJ_ATT_3_2     /* Att 3db-2 DA offst adjust fail
633   #define ERROR_CAL_AJ_ATT_10      /* Att 10db DA offst adjust fail
634   #define ERROR_CAL_AJ_ATT_20      /* Att 20db DA offst adjust fail
640   #define ERROR_CAL_AJ_AM          /* AM  offst adjust fail
641   #define ERROR_CAL_AJ_AM_PRE      /* input mult offst adjust fail
642   #define ERROR_CAL_AJ_AM_POST     /* output mult offst adjust fail

650   #define ERROR_CAL_GAIN_THROUGH   /* through DA gain fail
651   #define ERROR_CAL_GAIN_FILTER1M  /* filter 1M DA gain fail
652   #define ERROR_CAL_GAIN_FILTER5M  /* filter 5M DA gain fail
653   #define ERROR_CAL_GAIN_FILTER20M /* filter 20M DA gain fail
654   #define ERROR_CAL_GAIN_FILTER50M /* filter 50M DA gail fail

660   #define ERROR_CAL_GAIN_MAG       /* 5 X mag DA gain fail
```

```
670   #define ERROR_CAL_GAIN_AM          /* Att 20db DA gain fail

680   #define ERROR_CAL_OFFSET_0         /* offset cal error at 0V
681   #define ERROR_CAL_OFFSET_DA1V      /* offset cal error at 1V
682   #define ERROR_CAL_OFFSET_DAN1V     /* offset cal error at -1V

      #elif defined(AWG2040)
610   #define ERROR_CAL_OFFSET_ZERO
620   #define ERROR_CAL_OFFSET_GAIN
630   #define ERROR_CAL_AMPL_MIN
640   #define ERROR_CAL_AMPL_MAX
      #endif

Waveform Memory diagnostic errors

700   #define   DIAG_ER_WMEM

      #if   defined(AWG2005)
710   #define ER_SEQRAM1  /* sequence ram1 fail (A2U162)
711   #define ER_SEQRAM2  /* sequence ram2 fail (A2U164)
712   #define ER_SEQRAM3  /* sequence ram3 fail (A2U262)
713   #define ER_SEQRAM4  /* sequence ram4 fail (A2U264)

720   #define ER_WFMRAM1  /* segment ram1 fail  (A2U198)
721   #define ER_WFMRAM2  /* segment ram2 fail  (A2U200)
722   #define ER_WFMRAM3  /* segment ram3 fail  (A2U206)
723   #define ER_WFMRAM4  /* segment ram4 fail  (A2U208)
724   #define ER_WFMRAM5  /* segment ram5 fail  (A2U298)
725   #define ER_WFMRAM6  /* segment ram6 fail  (A2U300)
726   #define ER_WFMRAM7  /* segment ram7 fail  (A2U306)
727   #define ER_WFMRAM8  /* segment ram8 fail  (A2U308)

      #elif defined(AWG2020/AWG2021/AWG2010/AWG2011)
710   #define ER_SEQRAM1  /* sequence ram1 fail (A21U546)
711   #define ER_SEQRAM2  /* sequence ram2 fail (A21U548)
712   #define ER_SEQRAM3  /* sequence ram3 fail (A21U550)
713   #define ER_SEQRAM4  /* sequence ram4 fail (A21U552)
714   #define ER_SEQRAM5  /* sequence ram5 fail (A21U566)
715   #define ER_SEQRAM6  /* sequence ram6 fail (A21U568)
721   #define ER_WFMRAM2  /* segment ram2 fail  (A2U206)
722   #define ER_WFMRAM3  /* segment ram3 fail  (A2U214)
723   #define ER_WFMRAM4  /* segment ram4 fail  (A2U216)
724   #define ER_WFMRAM5  /* segment ram5 fail  (A2U224)
725   #define ER_WFMRAM6  /* segment ram6 fail  (A2U226)
726   #define ER_WFMRAM7  /* segment ram7 fail  (A2U234)
727   #define ER_WFMRAM8  /* segment ram8 fail  (A2U236)
728   #define ER_WFMRAM9  /* segment ram9 fail  (A2U244)
729   #define ER_WFMRAM10 /* segment ram10 fail (A2U246)
730   #define ER_WFMRAM11 /* segment ram11 fail (A2U254)
731   #define ER_WFMRAM12 /* segment ram12 fail (A2U256)
732   #define ER_WFMRAM13 /* segment ram13 fail (A2U264)
733   #define ER_WFMRAM14 /* segment ram14 fail (A2U266)
734   #define ER_WFMRAM15 /* segment ram15 fail (A2U274)
735   #define ER_WFMRAM16 /* segment ram16 fail (A2U276)
```

```
713   #define ER_SEQRAM4  /* sequence ram4 fail (A2U264)

720   #define ER_WFMRAM1  /* segment ram1 fail  (A2U198)
721   #define ER_WFMRAM2  /* segment ram2 fail  (A2U200)
722   #define ER_WFMRAM3  /* segment ram3 fail  (A2U206)
723   #define ER_WFMRAM4  /* segment ram4 fail  (A2U208)
724   #define ER_WFMRAM5  /* segment ram5 fail  (A2U298)
725   #define ER_WFMRAM6  /* segment ram6 fail  (A2U300)
726   #define ER_WFMRAM7  /* segment ram7 fail  (A2U306)
727   #define ER_WFMRAM8  /* segment ram8 fail  (A2U308)
      #endif

Trigger diagnostic/calibration errors
800   #define   DIAG_ER_TRIGGER     800
800   #define   CAL_ER_TRIGGER      800

810   #define ERROR_TRIG_0VOLT  810 /* trig diag 0V fail
811   #define ERROR_TRIG_5VOLT  811 /* trig diag 5V fail


      #endif    /* ifndef DIAGERROR_H

<< End of list >>
```

==========

My thanks to Keizo Kimura, SOTK Customer Service for providing this information.

Tektronix Customer Sales Support Center
email: _ @tek.com
Phone: (503) 627-3714 or 1-800-835-9433, ext. 3714
Fax: 503 627-5695
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