

Service Manual



AWG710 **4 GS/s Arbitrary Waveform Generator** **070-A830-51**

This document applies to firmware version 3.0 and above.

Warning

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

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General Safety Summary

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

Only qualified personnel should perform service procedures.

To Avoid Fire or Personal Injury

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

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

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

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

The common terminal is at ground potential. Do not connect the common terminal to elevated voltages.

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

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

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

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

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

Do Not Operate in Wet/Damp Conditions.

Do Not Operate in an Explosive Atmosphere.

Keep Product Surfaces Clean and Dry.

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

Symbols and Terms

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



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



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

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

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

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

CAUTION indicates a hazard to property including the product.

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



WARNING
High Voltage



Protective Ground
(Earth) Terminal



CAUTION
Refer to Manual

Service Safety Summary

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

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

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

Use Care When Servicing With Power On. Dangerous voltages or currents may exist in this product. Disconnect power, remove battery (if applicable), and disconnect test leads before removing protective panels, soldering, or replacing components.

To avoid electric shock, do not touch exposed connections.

Calendar (date and time) Backup Battery. This product contains a Lithium:poly-carbon monofluoride battery for calendar backup purposes. This battery is part of the CPU unit and is not replaceable.

Preface

The AWG710 Arbitrary Waveform Generator service manual provides information necessary for servicing the waveform generator to the module level.

Manual Structure

This manual is divided into main sections that address topics 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 as they provide information needed to perform the service correctly and efficiently. The following list provides a brief description of each manual section.

- *Specifications* describes the waveform generator and the characteristics that apply to it.
- *Operating Information* includes general information and operating instructions.
- *Theory of Operation* explains circuit descriptions that support service to the module level.
- *Performance Verification* provides procedures for confirming that the waveform generator functions properly and meets warranted limits.
- *Adjustment Procedures* provides information and procedures to perform waveform generator adjustments.
- *Maintenance* contains information and procedures for performing preventive and corrective maintenance on the waveform generator. These instructions include cleaning, module removal and installation, and fault isolation to the module.
- *Options* contains information on servicing factory-installed options.
- *Electrical Parts List* section refers you to the *Mechanical Parts List* section which contains both the electrical and mechanical information on all module parts.
- *Diagrams* contains illustrations of modules and functional blocks in the waveform generator.
- *Mechanical Parts List* provides a listing of all replaceable modules, their descriptions, and their Tektronix part numbers.

Manual Conventions

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

- Names of front panel controls and menus appear in the same case (such as initial capitals or all uppercase) in the manual as is used on the waveform generator front panel and menus. Front panel names are all uppercase letters; for example, SETUP, UTILITY, HARDCOPY.
- Instruction steps are numbered unless there is only one step.

Modules

Throughout this manual, any replaceable component, assembly, or part of the waveform generator is referred to generically as a module. A module is an assembly (such as a circuit board), as opposed to a component (such as a resistor or integrated circuit). Sometimes a single component is a module; for example, the chassis of the waveform generator.

Safety

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

Finding Other Information

Other documentation for the AWG710 Arbitrary Waveform Generator includes:

- The AWG710 Arbitrary Waveform Generator user manual contains a tutorial that describes how to operate the waveform generator. It also includes a detailed explanation of how to best use the waveform generator features.
- The AWG710 Arbitrary Waveform Generator Programmer manual explains how to use a GPIB interface to control the waveform generator remotely.

Contacting Tektronix

Phone	1-800-833-9200*
Address	Tektronix, Inc. Department or name (if known) 14200 SW Karl Braun Drive P.O. Box 500 Beaverton, OR 97077 USA
Web site	www.tektronix.com
Sales support	1-800-833-9200, select option 1*
Service support	1-800-833-9200, select option 2*
Technical support	Email: techsupport@tektronix.com 1-800-833-9200, select option 3* 6:00 a.m. – 5:00 p.m. Pacific time

* **This phone number is toll free in North America. After office hours, please leave a voice mail message. Outside North America, contact a Tektronix sales office or distributor; see the Tektronix web site for a list of offices.**

Introduction

This manual provides information and procedures necessary for properly servicing the AWG710 Arbitrary Waveform Generator, as well as general information critical to safe and effective servicing.

To prevent personal injury or damage to the waveform generator, review the following information before attempting service:

- The procedures in this manual should be performed only by qualified service personnel.
- Read the *General Safety Summary* and *Service Safety Summary* beginning on page xi.
- Read *Preparation for Use* in the *Operating Information* subsection.

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

Performance Verification Procedures

Complete the performance check described in the *Performance Verification* section every 12 months. In addition, a performance check is recommended after module replacement.

If the waveform generator does not meet performance criteria, repair is necessary.

Strategy for Servicing

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

This manual contains all the information needed for periodic maintenance of the waveform generator. Further, it contains all information for corrective maintenance down to the module level. To isolate a module failure, follow the troubleshooting procedures found in the *Maintenance* section. To remove and replace any failed module, follow the instructions in the *Removal and Installation Procedures* subsection. After isolating a faulty module, replace it with a fully tested module obtained from the factory. The *Replaceable Mechanical Parts* subsection 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 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 trained service professionals. They have access to the latest information on improvements to the AWG710 Arbitrary Waveform Generator as well as new options.

Warranty Repair Service

Tektronix warrants this product for one year from date of purchase. The warranty appears at the front of this manual. Tektronix technicians provide warranty service at most Tektronix service locations. The Tektronix product catalog lists all worldwide service locations.

Self Service

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

Module Exchange. This service reduces downtime for repair by allowing you to exchange most modules for remanufactured ones. 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 Overview

Product Description

The AWG710 Arbitrary Waveform Generator is a waveform generator that can generate simple and arbitrary waveforms, one-channel differential output arbitrary waveforms, and function generator waveforms.

The AWG710 Arbitrary Waveform Generator allows you to create sine, triangle, square, ramp, and complex waves, as well as direct current and noise signals. You can also set waveform attributes such as frequency, amplitude, and offset.

This instrument contains a hard disk drive, a 3.5-inch floppy disk drive, and Ethernet interface for storing and recalling waveform data and instrument settings.

You can control the instrument remotely by sending commands through both the GPIB and 100/10BASE-T interfaces, as well as transfer waveform data directly from a digital storage oscilloscope to the AWG710 Arbitrary Waveform Generator using the GPIB interface. This enables you to use the instrument in combination with other measurement equipment and a computer.

Main Features

The AWG710 Arbitrary Waveform Generator contains the following main features:

- 4.0 GS/s sampling rate
- 8-bit DA converter
- 16 M-word waveform memory (32 M optional)
- Two arbitrary marker outputs
- Five waveform editors (see Table 1–1)

Table 1–1: AWG710 waveform editors

Editor	Description
Waveform	Creates analog waveform data in graphic or tabular form.
Pattern	Creates analog waveform data in timing and table form.
Sequence	Creates sequences of waveforms by combining the waveform files created with the Waveform and/or Pattern Editors.

Table 1-1: AWG710 waveform editors (Cont.)

Editor	Description
Text	Edits plain ASCII format waveform files. For example, you can use the Text editor to edit ASCII format waveform files that are read from an external device.
Equation	Creates files with equations and compiles them into waveform files.

Additional Features

The AWG710 Arbitrary Waveform Generator provides these additional features:

- An Ethernet port for using the NFS (Network File System) and/or FTP link. Refer to *Ethernet Networking* in the AWG710 Arbitrary Waveform Generator User manual for information.
- A GPIB interface that can be used for remotely controlling the AWG710 Arbitrary Waveform Generator and for transferring the waveform data from the external oscilloscopes.

Refer to *Connecting to a GPIB Network* in the AWG710 Arbitrary Waveform Generator user manual for information on setting the GPIB parameters.

Refer to the *AWG710 Arbitrary Waveform Generator Programmer* manual for information on the remote control commands.

Refer to the *Reference: Capturing Waveforms* subsection of the AWG710 Arbitrary Waveform Generator user manual for transferring waveforms from the external oscilloscopes to the waveform generator.

- A port on the rear panel for connecting a 101- or 106- type keyboard to the AWG710 Arbitrary Waveform Generator. You can input values or text using the keyboard instead of the numeric keypad on the front panel. Refer to the *Reference: External Keyboards* section of the AWG710 Arbitrary Waveform Generator user manual.
- An internal clock for setting up the current date and time. Refer to *Internal Clock (Date and Time)* in the AWG710 Arbitrary Waveform Generator user manual. This setup procedure is also described in *Tutorial 1: Instrument Setup*.
- An adjustment of focused color. Focused color allows you to display the system utility screen and set the highlight color. Refer to the *Focused Color* subsection for further information. This setup procedure is also described in *Tutorial 1: Instrument Setup* in the AWG710 Arbitrary Waveform Generator User manual.

Specifications

This section contains the AWG710 Arbitrary Waveform Generator specifications. All specifications are guaranteed unless labeled *Typical*. Typical specifications are provided for your convenience.

Specifications that are marked with the ✓ symbol in the Characteristics column are defined in the *Performance verification* section. The corresponding page of the performance verification procedures can be found in the PV reference page column.

Subcategories of the Characteristics column will appear in boldface font.

See Tables 1–2 through 1–21 for characteristics and descriptions of the electrical specifications. For signal timing, see Figure 1–1 and for mechanical dimensions, see Figure 1–2.

Performance Conditions

Performance limits in this specification are valid under these conditions:

- The AWG710 Arbitrary Waveform Generator must be calibrated/adjusted at an ambient temperature between +20° C and +30° C.
- The AWG710 Arbitrary Waveform Generator must be in an environment with temperature, altitude, humidity, and vibration within the operating limits described in these specifications.
- The AWG710 Arbitrary Waveform Generator must have a warm-up period of at least 20 minutes.
- The AWG710 Arbitrary Waveform Generator must be operating at an ambient temperature between +10° C and +40° C.

Warranted characteristics are described in terms of quantifiable performance limits.

Electrical Specification

Table 1-2: Operation modes

Characteristics	Description
Continuous	Waveform is continuously output in this mode. When a sequence is defined, waveforms are sequentially or repeatedly output in the order defined by the sequence. The extended sequence functions, such as trigger input and event jump, are inactive in this mode.
Triggered	Waveform is output only once when a trigger event is created. A trigger signal is created by the external trigger input signal, GPIB trigger command, and/or pressing the front panel FORCE TRIGGER button. The extended sequence functions such as trigger input and event jump, are inactive in this mode.
Gated	The waveform is output in the same way as in the continuous mode only when the gate is opened. The gate is opened by the gated signal. Note that the output is made from the top of the first waveform for every gate period. The clock signal continuously outputs from the connector outside the gate period.
Enhanced	The waveforms are sequentially or repeatedly output according to the procedures defined in the sequence. All extended functions such as trigger input, event jump, and so on are effective and waveforms are controlled for output by the functions in this mode.

Table 1-3: Arbitrary waveforms

Characteristics	Description
Waveform memory	Memory length: 16 200 000 words (8 bits/1 word)
Op.01	Memory length: 32 400 000 words (8 bits/1 word)
Marker memory	Memory length: 16 200 000 words (2 markers × 1 bit/ 1 word)
Op.01	Memory length: 32 400 000 words (2 markers × 1 bit/ 1 word)
Sequence memory	Maximum 8000 steps
Sequence counter	1 to 65 536 and Infinite
Waveform data points	Multiple of 4 in the range from 960 to 16 200 000 points
Op.01	Multiple of 4 in the range from 960 to 32 400 000 points
Data storage	
Hard disk	10 G bytes
Floppy disk	1.44 M bytes

Table 1-4: Clock generator

Characteristics	Description	PV reference page
Sampling frequency	50 kHz to 4 GHz	
Resolution	8 digits	
Internal clock ¹		
✓ Frequency accuracy	± 1 ppm (10° C to 40° C) (50° F to 104° F) , for one year after calibration	Page 4-48
Phase noise at 1/4 clock output, Typical	(Data Clock is 1/4th of the output sample rate) -80 dBc / Hz (1 GHz with 10 kHz offset) -100 dBc/Hz (1 GHz with 100 kHz offset)	

¹ The internal reference oscillator is used.

Table 1-5: Internal trigger generator

Characteristics	Description	PV reference page
Internal trigger rate ²		
Accuracy	± 0.1%	
Range	1.0 µs to 10.0 s	
Resolution	3 digits, minimum 0.1 µs	

² The internal reference oscillator is used.

Table 1-6: Main output

Characteristics ³	Description	PV reference page
Output connector	Front panel SMA connectors	
Output signal	Complementary; CH1 and $\overline{\text{CH1}}$	
DA converter		
Resolution	8 bits	
Differential nonlinearity	Within ± 1/2 LSB	
Integral nonlinearity	Within ± 1 LSB	
Output impedance	50 Ω	
Normal out (except option 02)		
Output voltage	-1.5 V to +1.5 V, into a 50 Ω load	
Amplitude		
Range	20 mV _{pk-pk} to 2 V _{pk-pk} , into a 50 Ω load	
Resolution	1 mV	
✓ DC accuracy	± (2.0% of amplitude + 2 mV), offset: 0 V	Page 4-22
Offset		
Range	-0.5 V to 0.5 V, into a 50 Ω load	

Table 1-6: Main output (Cont.)

Characteristics ³	Description	PV reference page
Resolution	1 mV	
✓ Accuracy	± 1.5% of offset ± 10 mV, (20 mV amplitude, waveform data: 0)	Page 4-22
Pulse response	(Waveform data: -1 and 1, offset: 0 V, and filter: through)	
✓ Rise time (10% to 90%)	≲ 480 ps (amplitude = 1.0 V _{pk-pk} , calculated value ≳ 729 MHz)	Page 4-35
✓ Fall time (10% to 90%)	≲ 480 ps (amplitude = 1.0 V _{pk-pk} , calculated value ≳ 729 MHz)	
Aberration, Typical	± 6% (amplitude = 1.0 V _{pk-pk} , using 6 GHz bandwidth oscilloscope)	
Flatness, Typical	± 3% (after 20 ns from rise and fall edges)	
Sinewave characteristics	(Clock: 4.0 GS/s, waveform points: 32, Signal frequency: 125 MHz, amplitude: 1.0 V, offset: 0 V, filter: through)	
Harmonics	≲ -40 dBc (DC to 1000 MHz)	
Noise	≲ -50 dBc (DC to 1000 MHz)	
Phase Noise, Typical	≲ -85 dBc / Hz (at 10 kHz offset)	
Direct DA out (except option 02)		
Amplitude		
Range	20 mV _{pk-pk} to 1 V _{pk-pk} , into a 50 Ω load	
✓ DC Accuracy	± (2% of Amplitude + 2 mV)	Page 4-27
Resolution	1 mV	
✓ DC offset accuracy	0 V ± 10 mV, (20 mV amplitude, waveform data: 0)	Page 4-27
✓ Pulse response	(Waveform data: -1 and 1, at 0.5 V _{pk-pk})	Page 4-29
Rise time (10% to 90%)	≲ 280 ps (calculated value ≳ 1.25 GHz)	
Fall time (10% to 90%)	≲ 280 ps (calculated value ≳ 1.25 GHz)	
Extended Bandwidth output (option 02)		
Amplitude		
Range	500 mV _{pk-pk} to 1 V _{pk-pk} , into a 50 Ω load	
✓ DC Accuracy	± (2 % of Amplitude + 2 mV)	Page 4-31
Resolution	1 mV	
✓ DC offset accuracy	0 V ± 10 mV, (500 mV amplitude, waveform data: 0)	Page 4-31
✓ Pulse response	(Waveform data: -1 and 1, at 1 V _{pk-pk})	Page 4-33
Rise time (10 % to 90 %)	≲ 175 ps (calculated value ≳ 2 GHz)	
Fall time (10 % to 90 %)	≲ 175 ps (calculated value ≳ 2 GHz)	

³ The characteristics are specified at the end of the SMA cable (012-1565-00) except for DC accuracy.

Table 1-7: Filter

Characteristics	Description	
Type	Bessel low pass filter, 200 MHz, 100 MHz, 50 MHz, and 20 MHz	
Rise time (10% to 90%), Typical	20 MHz 50 MHz 100 MHz 200 MHz	17 ns 7 ns 3.7 ns 2 ns
Group delay, Typical	20 MHz 50 MHz 100 MHz 200 MHz	18 ns 8 ns 4.7 ns 3 ns

Table 1-8: Auxiliary outputs

Characteristics	Description	PV reference page
Marker ⁴		
Number of markers	2 (Complementary). Marker1 and $\overline{\text{Marker1}}$, Marker2 and $\overline{\text{Marker2}}$	
Level (Hi/Lo)	-1.10 V to +3.00 V, into a 50 Ω load -2.20 V to +6.00 V, into a 1 M Ω load	
Maximum Output	2.5 V _{pk-pk} , into a 50 Ω load	
Resolution	0.05 V	
✓ Accuracy	± 0.1 V ± 5 % of setting, into a 50 Ω load	Page 4-50
Rise and fall times (20% to 80%), Typical	150 ps (2 V _{pk-pk} , Hi: +1 V, Lo: -1 V, into a 50 Ω load)	
Skew, Typical	70 ps	
Period jitter, Typical	Measured by TDS694C-1MHD with TDSJIT1 Refer to Table 1-9.	
Cycle to cycle jitter, Typical	Measured by TDS694C-1MHD with TDSJIT1 Refer to Table 1-10.	
Connector	Front panel SMA connectors	
1/4 Clock output		
Level	ECL 100 K compatible (internally loaded in 50 Ω to -2 V and 47 Ω series terminated)	
Period jitter, Typical	Measured by TDS694C-1MHD with TDSJIT1 Refer to Table 1-9.	
Cycle to cycle jitter, Typical	Measured by TDS694C-1MHD with TDSJIT1 Refer to Table 1-10.	
Connector	Rear panel SMA connector	

Table 1-8: Auxiliary outputs (Cont.)

Characteristics	Description	PV reference page
10 MHz Reference clock out		
Amplitude, Typical	$\geq 1.2 V_{pk-pk}$, into a 50 Ω load, Max 2.5 V_{pk-pk} , open circuit	
Impedance	50 Ω , AC coupling	
Connector	Rear panel BNC connector	

⁴ The characteristics are specified at the end of the SMA cable (012-1565-00).

Table 1-9: Period jitter

Clock frequency	4 GS/s		2 GS/s		1 GS/s	
	StdDev	Pk-Pk	StdDev	Pk-Pk	StdDev	Pk-Pk
Measurement						
Marker output	1.6 ps	11.6 ps	1.9 ps	13.4 ps	2.5 ps	15.1 ps
1/4 Clock output	2.6 ps	20.2 ps	2.4 ps	27.5 ps	1.9 ps	14.0 ps

Table 1-10: Cycle to cycle jitter

Clock frequency	4 GS/s		2 GS/s		1 GS/s	
	StdDev	Pk-Pk	StdDev	Pk-Pk	StdDev	Pk-Pk
Measurement						
Marker output	3.1 ps	21.4 ps	3.2 ps	26.1 ps	3.1 ps	21.9 ps
1/4 Clock output	4.8 ps	44.5 ps	3.7 ps	33.3 ps	3.1 ps	28.7 ps

Table 1-11: Auxiliary inputs

Characteristics	Description	PV reference page
Trigger input ⁵		
Connector	Rear panel BNC connector	
Impedance	1 k Ω or 50 Ω	
Polarity (Trigger mode)/Slope (Gated mode)	POS (positive) or NEG (negative)	
Input voltage range	± 10 V, into a 1 k Ω load ± 5 V, into a 50 Ω load	
Threshold		
Level	-5.0 V to 5.0 V	
✓ Accuracy	$\pm 5\%$ of level ± 0.1 V	Page 4-37
Resolution	0.1 V	
Triggered mode	See Figure 1-1.	
Minimum pulse width	10 ns, 0.2 V amplitude	
Trigger holdoff time	≤ 109.5 clocks + 500 ns	
Delay to analog out, Typical	211.5 clocks + 17 ns (Output: Norm, Filter: Through)	
Gated mode		
Minimum pulse width	1152 clocks + 10 ns, 0.2 V amplitude	
Gate holdoff time	≤ 1920 clock + 20 ns	
Delay to analog out, Typical	(1335 to 1499.5) clocks + 9 ns (Output: Norm, Filter: Through)	

⁵ The characteristics are specified at the end of the BNC cable (012-0482-00).

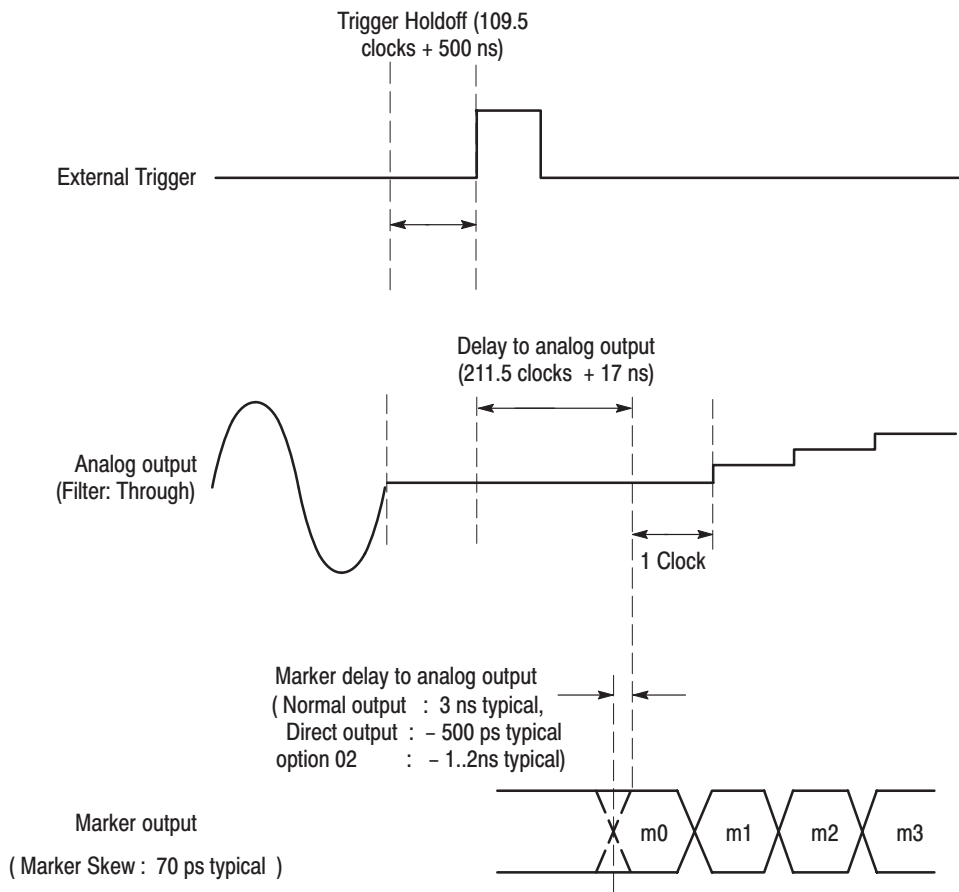


Figure 1-1: Signal timing

Table 1-12: Event Input

Characteristics	Description
Connector	9-pin, D type on the rear panel
Number of events	4 bits
Input signal	4 event bits and Strobe
Threshold	TTL level
Maximum input	0 V to + 5 V (DC + peak AC)
Impedance	1 k Ω , pull-up to +3.3 V
Enhanced mode	
Minimum pulse width	320 clocks + 10 ns
Event holdoff time	\leq 896 clocks + 20 ns
Delay to analog out, Typical (Jump timing: ASYNC)	(Output: Norm, Filter: Through)
Strobe: On	1627.5 clocks + 7 ns
Strobe: Off	1883.5 clocks + 5 ns
Event input to strobe input	
Setup time	192 clocks + 10 ns
Hold time	192 clocks + 10 ns

Table 1-13: 10 MHz reference clock input

Characteristics	Description
Input voltage range	0.2 V to 3.0 V _{pk-pk} (into a 50 Ω load, AC coupling) Maximum \pm 10 V
Impedance	50 Ω , AC coupling
Reference frequency	10 MHz \pm 0.1 MHz
Connector	Rear panel BNC connector

Table 1-14: Function generator (FG)

Characteristics	Description																		
Operation Mode	Continuous mode only																		
Waveform Shape	Sine, Triangle, Square, Ramp, Pulse, DC																		
Frequency	1.000 Hz to 400.0 MHz																		
Amplitude																			
Range	0.020 V _{pk-pk} to 2.000 V _{pk-pk} , into a 50 Ω load																		
Resolution	1 mV																		
Offset (except option 02)																			
Range	-0.500 V to +0.500 V, into a 50 Ω load																		
Resolution	1 mV																		
DC Level (except option 02)	DC waveform only																		
Range	-0.500 V to +0.500 V, into a 50 Ω load																		
Resolution	1 mV																		
Polarity	Normal, Inverted																		
Duty																			
Range	0.1 % to 99.9 %																		
Resolution	<table border="0"> <thead> <tr> <th>Frequency</th> <th>Resolution</th> </tr> </thead> <tbody> <tr> <td>1.000 Hz to 4.000 MHz</td> <td>0.1 %</td> </tr> <tr> <td>4.001 MHz to 20.00 MHz</td> <td>0.5 %</td> </tr> <tr> <td>20.01 MHz to 40.00 MHz</td> <td>1.0 %</td> </tr> <tr> <td>40.01 MHz to 80.00 MHz</td> <td>2.0 %</td> </tr> <tr> <td>80.01 MHz to 100.0 MHz</td> <td>2.5 %</td> </tr> <tr> <td>100.1 MHz to 160.0 MHz</td> <td>4.0 %</td> </tr> <tr> <td>160.1 MHz to 200.0 MHz</td> <td>5.0 %</td> </tr> <tr> <td>200.1 MHz to 400.0 MHz</td> <td>10.0 %</td> </tr> </tbody> </table>	Frequency	Resolution	1.000 Hz to 4.000 MHz	0.1 %	4.001 MHz to 20.00 MHz	0.5 %	20.01 MHz to 40.00 MHz	1.0 %	40.01 MHz to 80.00 MHz	2.0 %	80.01 MHz to 100.0 MHz	2.5 %	100.1 MHz to 160.0 MHz	4.0 %	160.1 MHz to 200.0 MHz	5.0 %	200.1 MHz to 400.0 MHz	10.0 %
Frequency	Resolution																		
1.000 Hz to 4.000 MHz	0.1 %																		
4.001 MHz to 20.00 MHz	0.5 %																		
20.01 MHz to 40.00 MHz	1.0 %																		
40.01 MHz to 80.00 MHz	2.0 %																		
80.01 MHz to 100.0 MHz	2.5 %																		
100.1 MHz to 160.0 MHz	4.0 %																		
160.1 MHz to 200.0 MHz	5.0 %																		
200.1 MHz to 400.0 MHz	10.0 %																		
Marker Out																			
Pulse Width																			
Mrker1	Hi : 0 % to 20 % of 1 waveform period Lo : 20% to 100 % of 1 waveform period																		
Marker2	Hi : 0 % to 50 % of 1 waveform period Lo : 50 % to 100 % of 1 waveform period Hi : 0 % to 52 % of 1 waveform period Lo : 52 % to 100 % of 1 waveform period at frequency range is 100.1MHz to 160.0MHz																		
Level																			
Hi	2.0 V min into a 50 Ω load																		
Lo	0 V max into a 50 Ω load																		

Table 1-15: Display and timer

Characteristics	Description
Display	
Display area	Horizontal: 130.6 mm (5.14 in) Vertical: 97.0 mm (3.81 in)
Resolution	640 (H) × 480 (V) pixels
Size	16 cm (6.4 in) diag. LCD

Table 1-16: AC line power

Characteristics	Description
Rating voltage	100 VAC to 240 VAC, CAT II
Voltage range	90 VAC to 250 VAC
Frequency range	48 Hz to 63 Hz
Maximum power consumption	220 VA
Maximum current	5 A
Fuse rating	10 A fast, 250 V, UL 198G (3 AG) 5 A (T), 250 V, IEC 127

Table 1-17: Timer

Characteristics	Description
Timer	
Operation time	6 years
Type	Lithium battery 3 V, 190 mAh

Table 1-18: Interface connectors

Characteristics	Description
GPIB	24-pin, IEEE 488.1 connector on the rear panel
Ethernet	100/10 BASE-T, RJ-45 connector on the rear panel
Keyboard connector	6-pin, mini-DIN connector on the rear panel

Table 1-19: Installation requirement

Characteristics	Description										
Heat dissipation											
Maximum power	220 VA (maximum line current: 3 A _{rms} , at 50 Hz)										
Surge current	30 A (25° C) peak for equal to or less than 5 line cycles, after the instrument has been turned off for at least 30 seconds										
Cooling clearance	<table border="0"> <tr> <td>Top</td> <td>2 cm (0.8 in)</td> </tr> <tr> <td>Bottom</td> <td>2 cm (0.8 in)</td> </tr> <tr> <td colspan="2"><i>NOTE: The feet on the bottom provide the required clearance when set on a flat surface.</i></td> </tr> <tr> <td>Sides</td> <td>15 cm (6 in)</td> </tr> <tr> <td>Rear</td> <td>7.5 cm (3 in)</td> </tr> </table>	Top	2 cm (0.8 in)	Bottom	2 cm (0.8 in)	<i>NOTE: The feet on the bottom provide the required clearance when set on a flat surface.</i>		Sides	15 cm (6 in)	Rear	7.5 cm (3 in)
Top	2 cm (0.8 in)										
Bottom	2 cm (0.8 in)										
<i>NOTE: The feet on the bottom provide the required clearance when set on a flat surface.</i>											
Sides	15 cm (6 in)										
Rear	7.5 cm (3 in)										

Table 1-20: Environmental

Characteristics	Description
Atmospherics	
Temperature	
Operating	+10° C to +40° C
Nonoperating	-20° C to +60° C
Relative humidity	
Operating	20% to 80% (no condensation) Maximum wet-bulb temperature 29.4° C
Nonoperating	5% to 90% (no condensation) Maximum wet-bulb temperature 40.0° C
Altitude	(Hard disk drive restriction)
Operating	Up to 3 km (10 000 ft) Maximum operating temperature decreases 1° C each 300 m (1 000 ft) above 1.5 km (5 000 ft)
Nonoperating	Up to 12 km (40 000 ft)
Dynamics	
Random vibration	
Operating	2.65 m/s ² rms (0.27Grms), from 5 Hz to 500 Hz, 10 minutes
Nonoperating	22.36 m/s ² rms (2.28Grms), from 5 Hz to 500 Hz, 10 minutes
Shock	
Nonoperating	294 m/s ² (30 G), half-sine, 11 ms duration

Table 1-21: Mechanical

Characteristics	Description
Net weight (without package)	14.1 kg (31.1 lb)
Dimensions (without package)	Height 177 mm (6.97 in) 193 mm (7.60 in) with Feet
	Width 424 mm (16.69 in) 433 mm (17.05 in) with Handle
	Length 470 mm (18.50 in) 508 mm (20.00 in) with Rear Feet
Net weight (with package)	24.5 kg (54.0 lb)
Dimensions (with package)	Height 400 mm (15.75 in)
	Width 550 mm (21.65 in)
	Length 700 mm (27.56 in)

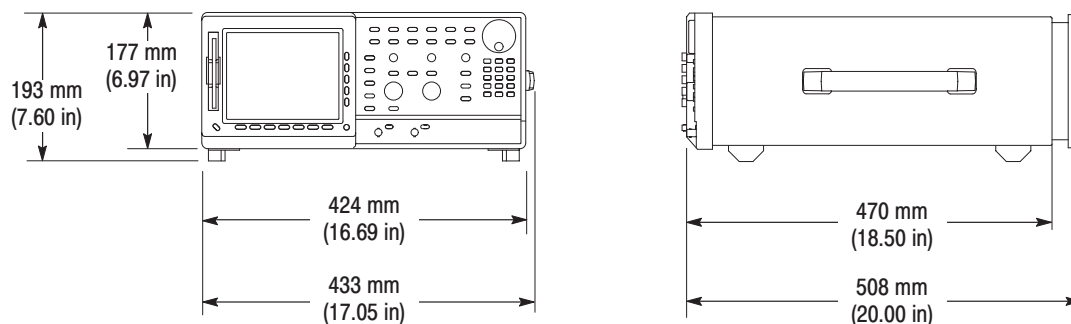


Figure 1-2: Dimensions

Certification and Compliances

The certification and compliances for the AWG710 Arbitrary Waveform Generator are listed in Table 1–22. See Table 1–23 for installation categories and pollution degree descriptions.

Table 1–22: Certifications and compliances

Characteristics	Description																		
EC declaration of conformity	<p>EC council EMC Directive 89/336/EEC, amended by 89/336/EEC; EN61326-1: 1997 Product Family Standard for Electrical Equipment for Measurement, Control, and Laboratory Use–EMC Requirements.</p> <p>Emissions:</p> <table> <tr> <td>EN 61326</td> <td>EMC requirements for class A electrical equipment for measurement control and laboratory use.</td> </tr> <tr> <td>EN 61000-3-2</td> <td>AC power line harmonic emissions</td> </tr> </table> <p>Immunity:</p> <table> <tr> <td>IEC 61000-4-2</td> <td>Electrostatic Discharge Immunity</td> </tr> <tr> <td>IEC 61000-4-3</td> <td>Radiated RF Electromagnetic Field Immunity</td> </tr> <tr> <td>IEC 61000-4-4 ⁶</td> <td>Electrical Fast Transient/Burst Immunity</td> </tr> <tr> <td>IEC 61000-4-5</td> <td>Surge Immunity</td> </tr> <tr> <td>IEC 61000-4-6</td> <td>Conducted Disturbances Induced by RF Field Immunity</td> </tr> <tr> <td>IEC 61000-4-11</td> <td>Power Line Interruption Immunity</td> </tr> </table> <p>Compliance was demonstrated to the following specification as listed in the Official Journal of the European Communities:</p> <p>Low Voltage Directive 73/23/EEC, amended by 93/68/EEC</p> <table> <tr> <td>EN 61010-1/A2:1995</td> <td>Safety requirements for electrical equipment for measurement, control, and laboratory use</td> </tr> </table>	EN 61326	EMC requirements for class A electrical equipment for measurement control and laboratory use.	EN 61000-3-2	AC power line harmonic emissions	IEC 61000-4-2	Electrostatic Discharge Immunity	IEC 61000-4-3	Radiated RF Electromagnetic Field Immunity	IEC 61000-4-4 ⁶	Electrical Fast Transient/Burst Immunity	IEC 61000-4-5	Surge Immunity	IEC 61000-4-6	Conducted Disturbances Induced by RF Field Immunity	IEC 61000-4-11	Power Line Interruption Immunity	EN 61010-1/A2:1995	Safety requirements for electrical equipment for measurement, control, and laboratory use
EN 61326	EMC requirements for class A electrical equipment for measurement control and laboratory use.																		
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IEC 61000-4-3	Radiated RF Electromagnetic Field Immunity																		
IEC 61000-4-4 ⁶	Electrical Fast Transient/Burst Immunity																		
IEC 61000-4-5	Surge Immunity																		
IEC 61000-4-6	Conducted Disturbances Induced by RF Field Immunity																		
IEC 61000-4-11	Power Line Interruption Immunity																		
EN 61010-1/A2:1995	Safety requirements for electrical equipment for measurement, control, and laboratory use																		
Australia/New Zealand declaration of conformity – EMC	<p>Conforms with the following standards in accordance with the Electromagnetic Compatibility Framework:</p> <table> <tr> <td>AS/NZS 2064.1/2</td> <td>Class A radiated and Conducted Emissions</td> </tr> </table>	AS/NZS 2064.1/2	Class A radiated and Conducted Emissions																
AS/NZS 2064.1/2	Class A radiated and Conducted Emissions																		
Safety	UL3111-1 – Standard for electrical measuring and test equipment																		
Third party certification	CAN/CSA C22.2 No. 1010.1 – Safety requirements for electrical equipment for measurement, control and laboratory use																		
Self declaration	IEC 61010-1/A2:1995 – Safety requirements for electrical equipment for measurement, control, and laboratory use																		
Installation category	Power input - Installation Category II (as defined in IEC 61010-1, Annex J)																		
Pollution degree	Pollution Degree 2 (as defined in IEC 61010-1)																		

⁶ Up to 200 mV_{p-p} noise is allowed on the output during this test.

Table 1-23: Installation category and pollution degree descriptions

Characteristics	Description	
Installation category	Terminals on this product may have different installation category designations. The installation categories are:	
	<i>Category</i>	<i>Descriptions</i>
	CAT III	Distribution-level mains (usually permanently connected). Equipment at this level is typically in a fixed industrial location.
	CAT II	Local-level mains (wall sockets). Equipment at this level includes appliances, portable tools, and similar products. Equipment is usually cord-connected.
	CAT I	Secondary (signal level) or battery operated circuits of electronic equipment
Pollution degree	A measure of the contaminants that can occur in the environment around and within a product. Typically, the internal environment inside a product is considered to be the same as the external. Products should be used only in the environment for which they are rated.	
	<i>Category</i>	<i>Descriptions</i>
	Pollution Degree 1	No pollution or only dry, nonconductive pollution occurs. Products in this category are generally encapsulated, hermetically sealed, or located in cleanrooms.
	Pollution Degree 2	Normally only dry, nonconductive pollution occurs. Occasionally a temporary conductivity that is caused by condensation must be expected. This location is a typical office/home environment. Temporary condensation occurs only when the product is out of service.
	Pollution Degree 3	Conductive pollution, or dry, nonconductive pollution that becomes conductive due to condensation. These are sheltered locations where neither temperature nor humidity is controlled. The area is protected from direct sunshine, rain, or direct wind.
	Pollution Degree 4	Pollution that generates persistent conductivity through conductive dust, rain, or snow. Typical outdoor locations.

Preparation for Use

This subsection provides the following information:

- *Supplying Operating Power*
- *Operating Environment*
- *Installation*
- *Repackaging Instructions*

Supplying Operating Power



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 AWG710 Arbitrary Waveform Generator 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 a connection to the power source, be sure the AWG710 Arbitrary Waveform Generator has a suitable two-pole, three-terminal ground-ing-type plug.*

To avoid personal shock, do not touch any conductive parts. All accessible conductive parts are directly connected through the grounding conductor of the power cord to the grounded (earth) contact of the power plug. The AWG710 Arbitrary Waveform Generator is safety Class 1 equipment (IEC designation).

*To prevent electrical shock, remove all power from the instrument, turn the **PRINCIPAL POWER SWITCH** on the back panel to OFF, and disconnect the power cord from the instrument. Some components in the AWG710 Arbitrary Waveform Generator are still connected to line voltage after toggling the instrument to Standby from the front panel **ON/STBY** button.*

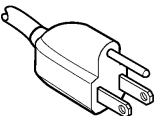
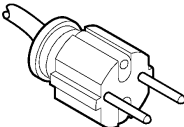
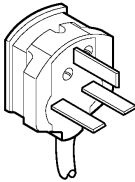
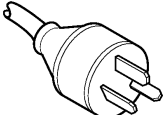
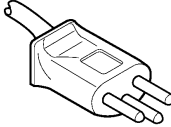
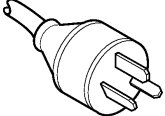
Power Cord Information

A power cord with the appropriate plug configuration is supplied with each AWG710 Arbitrary Waveform Generator. Table 2–1 provides color-coding identification for the power cord conductors. If you require a power cord other than the one supplied, refer to Table 2–2.

Table 2-1: Power-cord conductor identification

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

Table 2-2: Power cord identification

Plug configuration	Normal usage	Option number
	North America 125 V	Standard
	Europe 230 V	A1
	United Kingdom 230 V	A2
	Australia 230 V	A3
	Switzerland 230 V	A5
	China 230 V	AC
	No power cord supplied.	A99

Operating Voltage The AWG710 Arbitrary Waveform Generator operates with any line voltage from 90 to 250 VAC_{RMS} with any line frequency from 48 to 63 Hz. There are two fuses, either of which may be used throughout the line voltage and frequency ranges. The two fuses are not interchangeable as each requires a different fuse cap.

Memory Backup Power Memory modules with on-board batteries allow the AWG710 Arbitrary Waveform Generator to retain only internal clock data upon loss of the AC power source.

To set the date and time in the waveform generator, see the *Reference:Internal Clock (Date and Time)* section of the AWG710 Arbitrary Waveform Generator user manual.

Operating Environment

The following environmental requirements are provided to ensure proper operation and long instrument life.

Operating Temperature Operate the Waveform Generator where the ambient air temperature ranges from 10° C to +40° C (50° F to +104° F). Store the Waveform Generator at ambient temperatures from -20° C to +60° C (-4° F to +140° F). After storage at temperatures outside the operating limits, allow the chassis to stabilize to a safe operating temperature before applying power.

Ventilation Requirements The Waveform Generator is cooled by air drawn in and then exhausted through the cabinet side panels by an internal fan. To ensure proper cooling of the Waveform Generator, allow at least 15 cm (6 in) clearance on both sides, 2.0 cm (0.8 in) on the top and bottom, and 7.5 cm (3 in) at the rear of the Waveform Generator. (The feet on the bottom of the Waveform Generator provide the required clearance when set on flat surfaces.)



CAUTION. When the air flow is restricted and the temperature of the DAC module surface exceeds 80° C, the AWG710 Arbitrary Waveform Generator may temporarily shut down to protect the internal modules. To prevent temporary shutdown of the waveform generator, do not restrict air flow through the chassis.

The AWG710 Arbitrary Waveform Generator displays the message “Power fail or out of temperature limit” before shutting down.

If the AWG710 Arbitrary Waveform Generator shuts down unexpectedly, create more ventilation around the waveform generator. Wait a few minutes to allow cool down and then switch the power on again.

Installation

Before installation, refer to the *Safety Summary* section at the front of this manual for power source, grounding, and other safety information.

Environment

Verify that you have the correct operating environment.



CAUTION. *Damage to the instrument can occur if it is powered on at temperatures outside the specified temperature range.*

The AWG710 Arbitrary Waveform Generator operates correctly in ambient temperatures from +10° C to +40° C (50° F to +104° F) and relative humidity from 20% to 80% with no condensation. If the instrument is stored at temperatures outside this range, do not switch on the power until the chassis is within the operating temperature range. For detailed operating environment information, refer to *Specifications* on page 1–3 and 1–14.

NOTE. *If you are installing the instrument in a rack, refer to the instruction sheet that accompanies the rack-mounting kit for proper installation procedures.*

Verify that there is nothing blocking the flow of air at the fan and air intake holes. The instrument exhausts air using the internal fan. Create open space at the sides of the instrument so that it does not overheat. The following are the minimum space requirements for air flow around the instrument:

Rear	7.5 cm (3 in)
Left and right	15.0 cm (6 in)
Top and bottom	2 cm (0.8 in)

(The feet on the bottom of the instrument provide the required clearance when set on a flat surface.)

NOTE. *If the air flow is restricted and the internal temperature of the AWG710 Arbitrary Waveform Generator exceeds the proper operating temperature range, the instrument temporarily shuts down to protect the internal modules from overheating. To prevent temporary shutdown of the AWG710 Arbitrary Waveform Generator do not restrict air flow through the chassis.*

If the AWG710 Arbitrary Waveform Generator shuts down unexpectedly, improve the ventilation around the waveform generator and wait a few minutes to allow it to cool down; then switch the power on again.

You cannot power on the instrument when the ambient temperature exceeds the instrument temperature operation range. Wait until the instrument cools down, or the ambient temperature decreases to valid operating temperatures, before turning on the instrument again.

Check Fuse

Verify that the fuse is the proper type and rating.

Remove the fuse from the fuse holder on the rear panel and check the fuse. To remove the fuse, turn it counterclockwise with a screwdriver while pressing in. Table 2–3 lists the two fuse types and ratings.



WARNING. *To avoid electrical shock, be sure that the power cord is disconnected from the socket before checking the line fuse.*

Table 2-3: Fuse part numbers

Fuse	Fuse part number
Fuse, cartridge, 3AG, 10A, 250 VAC, FAST, 6.35 mm x 31.75 mm (0.25 in x 1.25 in)	159-0407-XX
Fuse, cartridge, DIN 5 x 20 mm, 5A, 250 V Slow Blow, 5 mm x 20 mm (0.197 in x 0.788 in) (IEC 127)	159-0210-XX

NOTE. *The second fuse listed in the table above is approved under the IEC standards. This fuse is used in equipment sold in the European market.*

Table 2-4: Fuse cap part numbers

Fuse cap	Fuse cap part number
Cap, fuseholder, 3AG fuses	200-2264-XX
Cap, fuseholder, 5x20 mm fuses	200-2265-XX

NOTE. *The second fuse listed in the table on page 2–5 is approved under the IEC standards. This fuse is used in equipment sold in the European market.*

Check Voltage Settings

Check that you have the proper electrical connections. The AWG710 Arbitrary Waveform Generator operates within the following power supply voltage and frequency ranges:

Line voltage range	100 – 240 V
Line frequency	48 – 63 Hz
Maximum power	220 VA

Connect Power Cord

Connect the proper power cord from the rear panel power connector to the power system.

NOTE. The AWG710 Arbitrary Waveform Generator is shipped with a 115 V power cord. If the AWG710 Arbitrary Waveform Generator is to be used with 230 V power, the power cord must be replaced with one appropriate for the power source used. See Table 2–2 for the available power cord types.

Standby Power

Push the **PRINCIPAL POWER SWITCH** (shown in Figure 2–1) on the rear panel of the instrument. Power is now applied to the instrument standby circuitry. Once the instrument is installed, leave the **PRINCIPAL POWER SWITCH** on and use the **ON/STBY** switch, located on the front panel, to toggle the instrument between **ON** and **STBY**.

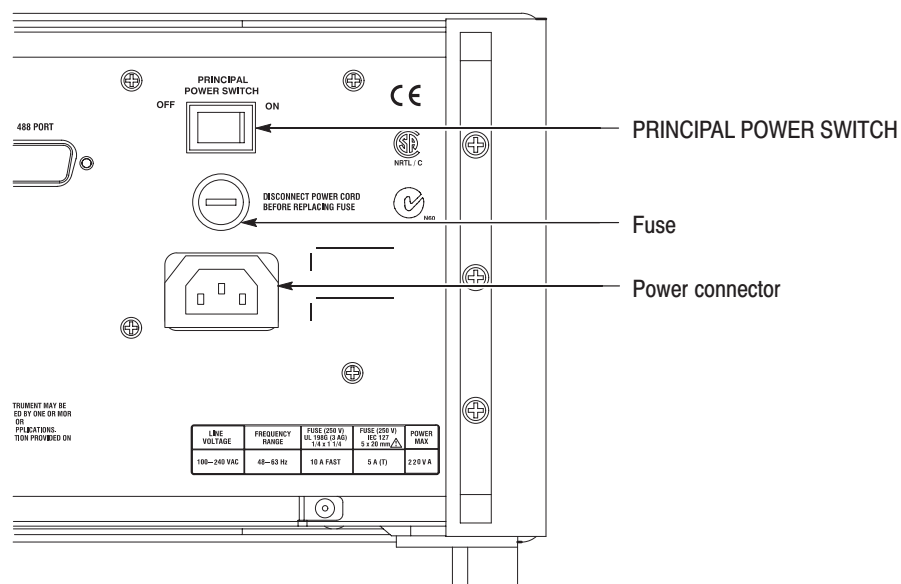


Figure 2–1: Rear panel power switch, fuse holder, and power connector

Power On To power on the instrument, push the **ON/STBY** switch (shown in Figure 2–2) on the lower left side of the front panel. Check that the fan is blowing air out of the instrument.

NOTE. *The instrument must be warmed up for at least 20 minutes and the clock calibrated to operate at its optimum accuracy.*

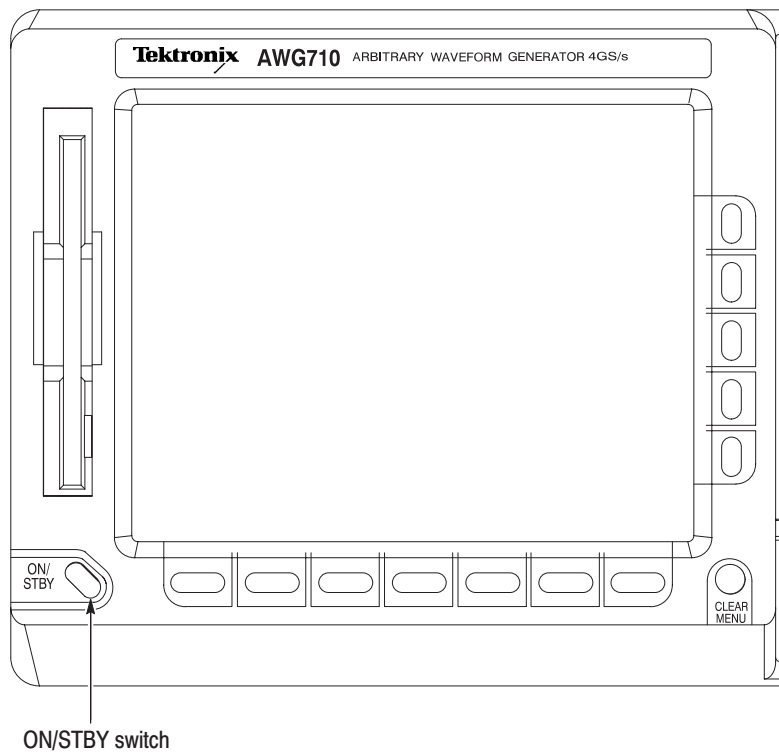


Figure 2-2: Location of the ON/STBY switch

Power-On Diagnostics

The instrument automatically runs power-on self tests to check that the instrument is operating normally.

Check the results of the power-on self tests. If all the diagnostic tests are completed without error, the instrument displays *Pass* and then the SETUP menu screen.

If the system detects an error, the instrument displays *Fail* and the error code number on the screen. You can still operate the instrument if you exit this state, but the wave output accuracy is not guaranteed until the error is corrected. To exit the diagnosis mode, push any button. The system goes to the SETUP menu screen.

NOTE. Contact your local Tektronix Field Office or representative if the instrument displays an error message. Make sure to record the error code number.

Power Off

Power off the AWG710 Arbitrary Waveform Generator by toggling the **ON/STBY** switch to the STBY position and turning the **PRINCIPAL POWER SWITCH** on the rear panel to OFF.



WARNING. To prevent electrical shock, remove all power from the instrument, turn the **PRINCIPAL POWER SWITCH** on the back panel to OFF, and disconnect the power cord from the instrument. Some components in the AWG710 Arbitrary Waveform Generator are still connected to line voltage after turning off the instrument from the front panel **ON/STBY** button.

To prevent loss of data and/or damage to the hard disk, before the power off, confirm that the hard disk LED on the lower right of the front panel does not light or blink.

Repackaging for Shipment

Use the original packaging material to return the instrument. If the original packaging is unfit for use or is not available, repackage the instrument as follows:

1. Obtain a corrugated cardboard shipping carton with dimensions of at least three inches greater than the instrument dimensions and having a carton test strength of at least 125 kg (275 lb).
2. If you are shipping the instrument to a Tektronix Service Center for repair or calibration, attach a tag to the instrument with the following information:
 - Owner of the instrument (with address)
 - Name of a person at your firm who may be contacted if additional information is needed
 - Complete instrument type and serial number
 - A description of the service required
3. Wrap the instrument with polyethylene sheeting or equivalent to protect the outside finish and prevent entry of packing materials into the instrument.
4. Cushion the instrument on all sides by tightly packing urethane foam between the carton and the instrument, allowing for 7.62 cm (3 in) of padding on each side (including top and bottom).
5. Seal the carton with shipping tape or with an industrial stapler.
6. Make sure that the Tektronix Service Center address and your return address are placed on the carton in one or more prominent locations.

NOTE. *To avoid damaging the instrument, do not ship it with a diskette inside the floppy disk drive. When a diskette is inside the drive, the disk release button protrudes and makes the button susceptible to damage.*

Applying and Interrupting Power

Refer to the following information when you power on or power off the instrument, or when power is interrupted due to an external power failure.

Power On Upon power on, the Waveform Generator runs a power-on self check. If it passes, the AWG710 Arbitrary Waveform Generator displays a *Pass* status message and a prompt to press any key to continue. If this fails, the AWG710 Arbitrary Waveform Generator displays a diagnostic log that identifies the area(s) that failed and a prompt to press any key to continue. Refer to the *Maintenance* section for information on diagnostics and fault isolation.

Power Off



CAUTION. *DO NOT power off the Waveform Generator when either running a signal path compensation or when doing any of the adjustments described in the Adjustment Procedures section. To do so might result in the loss of internally stored adjustment constants.*

Do not power off the instrument when doing operations that affect the data stored in the memory. Wait for the instrument to finish the operation when doing adjustments, saving waveforms, or saving setups.

Improper power off, toggling the instrument to STBY improperly, or unexpected loss of power to the AWG710 Arbitrary Waveform Generator can result in calibration data corruptions on the hard disk.

Operating Basics

This section provides an overview of the following topics:

- The *Controls and Connectors* subsection describes the instrument buttons, controls, connectors, and typical screen displays.
- The *Menu Operations* subsection describes how to use menus and enter numeric and text values.
- The *Shortcut Controls* subsection specifies the available shortcut buttons and knobs that control instrument setup parameters.
- The *File Management* subsection provides an overview of all file operations.
- The *Double Windows* subsection explains how to split a file list in the Edit screen. The function enables you to view the file lists of both the hard disk and the floppy disk simultaneously.
- The *Quick View* subsection explains how to view a waveform or pattern file selected from a file list.
- The *Setup Overview* subsection describes the SETUP screen and basic operations.

Controls and Connectors

Front Panel

Figures 2–3 through 2–6 show the locations of the front panel controls and rear-panel connectors.



CAUTION. *To prevent damage to the instrument, do not apply any external voltage to the output connector or marker connector.*

To prevent loss of data, data corruption, and damage to the hard disk, do not push the eject button while the floppy disk or hard disk LED is on or blinking. Doing so can cause data corruption and cause the instrument to hang up. If this happens, toggle to STBY, turn PRINCIPAL POWER SWITCH to OFF, and then turn PRINCIPAL POWER SWITCH back on again.

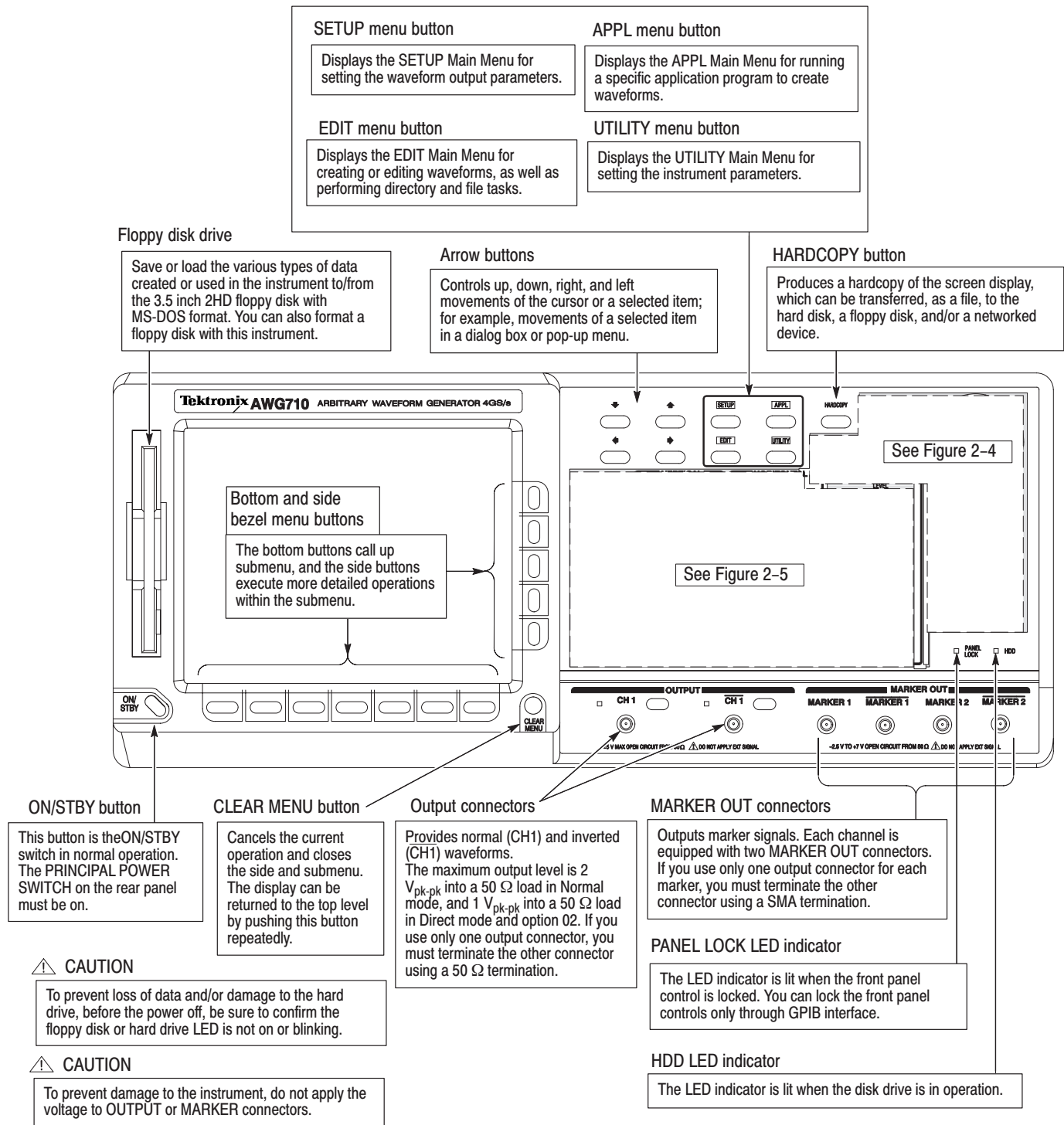


Figure 2-3: Front panel controls

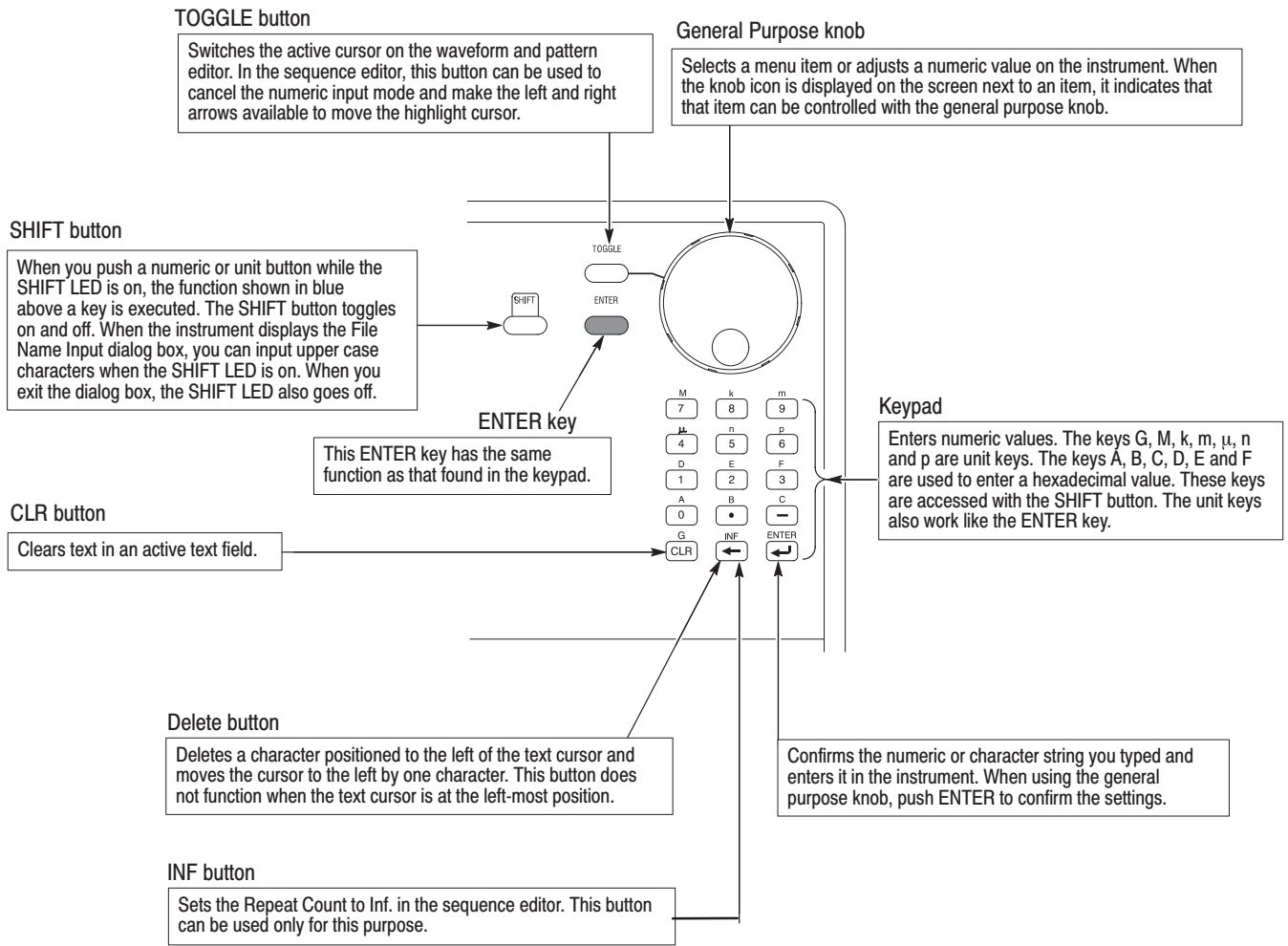


Figure 2-4: Front panel keypad area

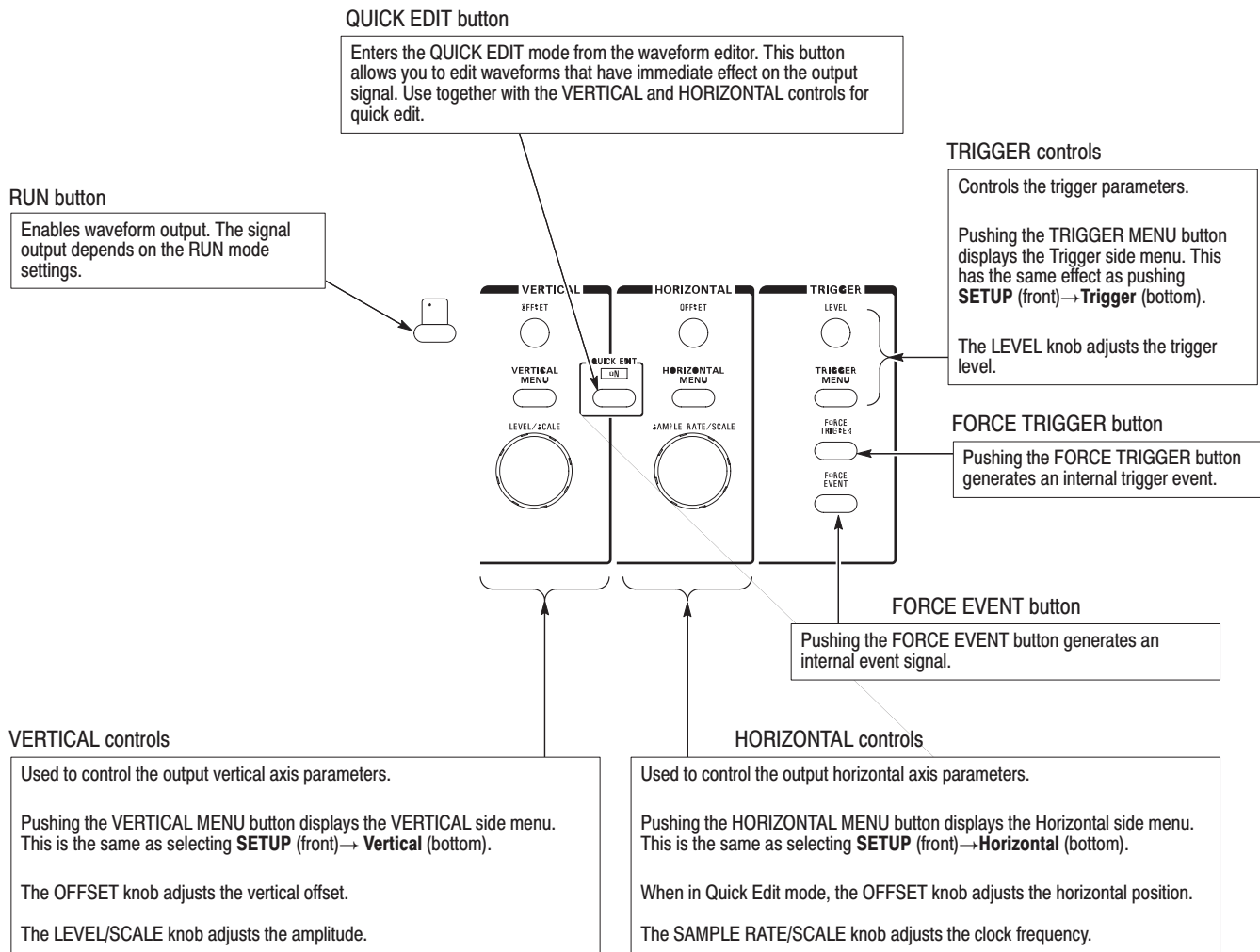


Figure 2-5: Front panel keypad area

Rear Panel

Figure 2-6 shows the rear panel signal and power connectors.



CAUTION. To prevent damage to the instrument, apply signals only within the stipulated range to the **INPUT** connector.

Do not apply any external voltage to the **OUTPUT** connector.

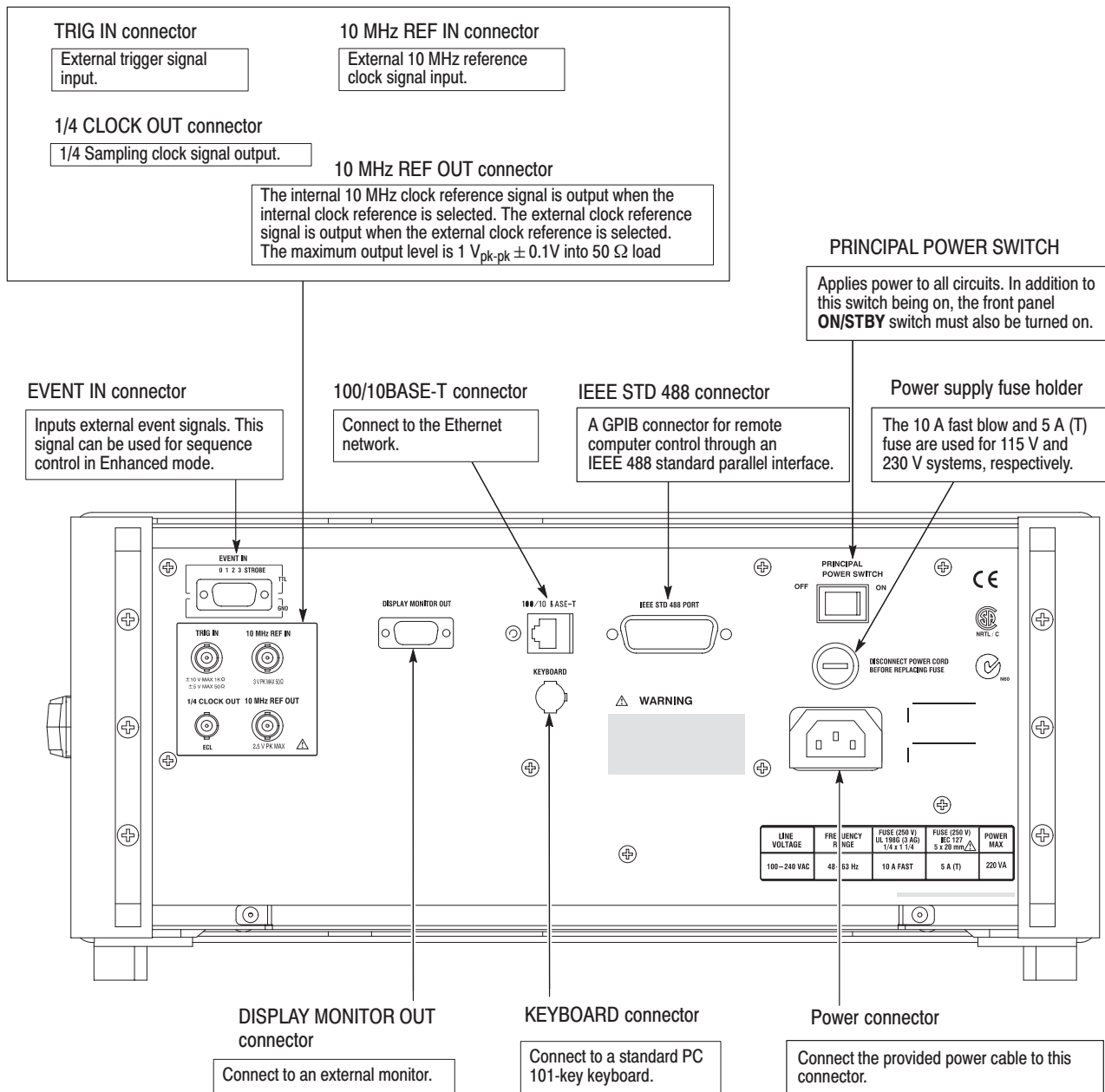


Figure 2-6: Rear panel signal and power connectors

Menu Operations

This section describes the AWG710 Arbitrary Waveform Generator menu system and numeric and text input methods.

Menu System

The AWG710 Arbitrary Waveform Generator uses menus to make selections. There are four menu buttons labeled EDIT, SETUP, APPL, and UTILITY shown in Figure 2–7. Pushing a menu button displays the corresponding screen and menu buttons. These menus let you edit waveforms, initialize instrument settings, define instrument operation, and specify waveform output parameters.

You select items within the displayed menu by pushing the bottom or side bezel button nearest the menu item. These buttons consist of seven bottom buttons and five side buttons as shown in Figure 2–7. These menu bezel buttons are referred to as bottom menu buttons (or bottom buttons) and side menu buttons (or side buttons).

The **CLEAR MENU** button cancels the current menu operation, clears the current menus from the screen, and returns to the previous instrument state.

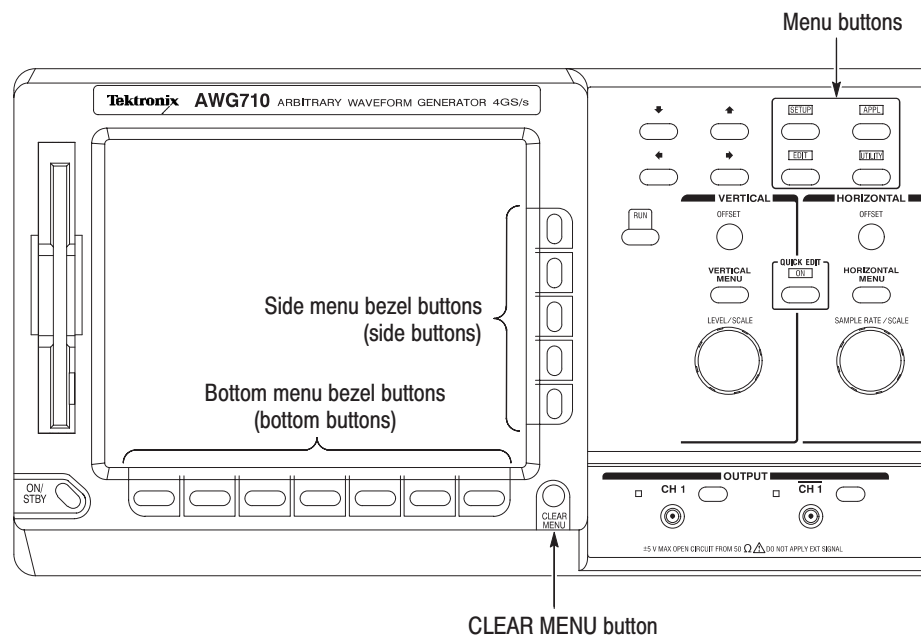


Figure 2–7: Menu buttons, bezel menu buttons, and the CLEAR MENU button

Menu Elements

Pushing a front panel menu button displays the screen and bottom menu items associated with the button. You select a bottom menu item by pushing the button directly below that menu item.

Pushing a bottom button displays a side menu, pop-up menu, list, or dialog box. Figure 2–8 through 2–11 show examples of the side menu, pop-up menu and dialog box, respectively.

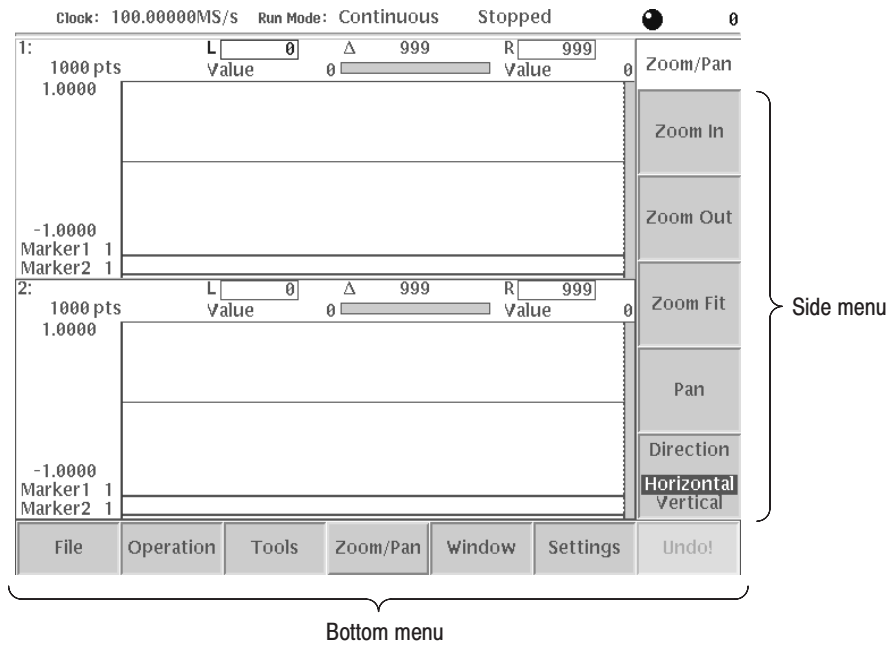


Figure 2–8: Bottom and side menus

Use a side menu button to display a side submenu, set a parameter, perform a task, or cancel an operation. Table 2–5 describes the side menu button types.

Table 2–5: Side menu elements

Menu items	Description	Menu items	Description
External	Executes the displayed function immediately.	Up Level	Cannot be used in the current instrument state (menu item is grayed out).
Output Normal Direct	Switches between two parameters each time the side button is pushed.	Filter 20 MHz	Allows making selections by using the general purpose knob.
Amplitude 1.000Vpp	Allows entering numeric values using the numeric buttons or the general purpose knob.	Add...	Displays submenu. Note that the label on the item is followed by an ellipsis (...).

The pop-up menu example (see Figure 2–9), displays a list of choices. Use the general purpose knob or the front panel arrow buttons to move up or down in the list. Push the **OK** side button or the **ENTER** front-panel button to confirm the selected item.

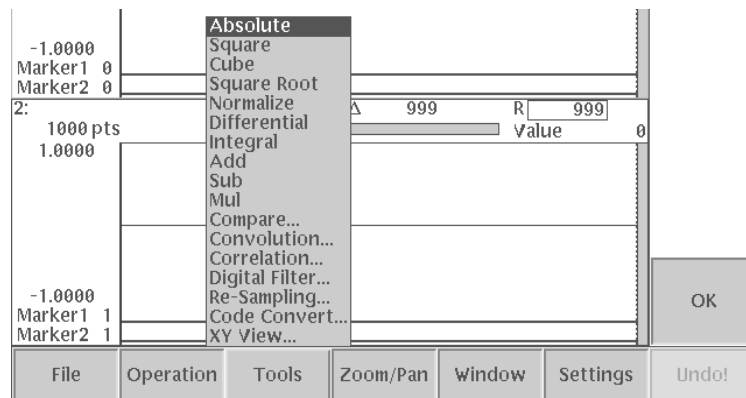


Figure 2–9: Pop-up menu example

The dialog box example as shown Figure 2–10 and the screen menu example shown in Figure 2–11 displays a screen from which you make selections or enter values. Use the front panel arrow buttons to select items or fields. A selected field or item will be highlighted. Use the keypad buttons or the general purpose knob to change values in the selected text/numeric fields or to change 1-of-N

fields. A 1-of-N field contains two or more choices. Only one choice can be selected at a time.

Push the **OK** side button to confirm the dialog box. Push the **Cancel** side button or the **CLEAR MENU** button to exit the dialog box without making any changes.

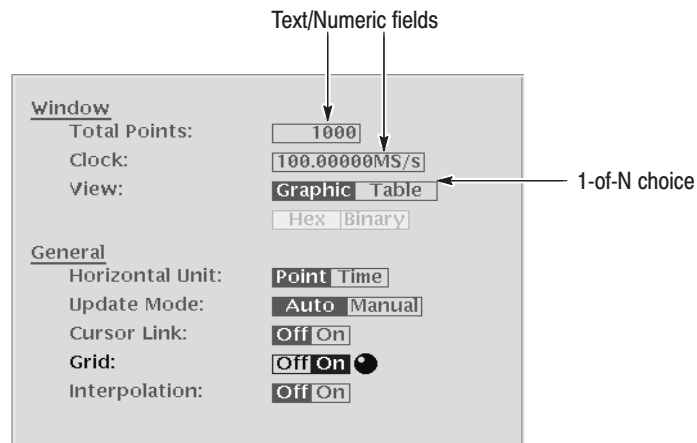


Figure 2-10: Dialog box example

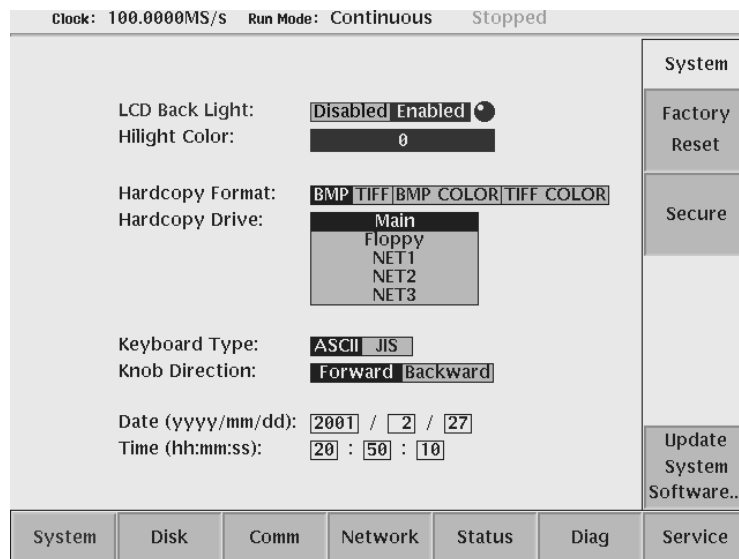
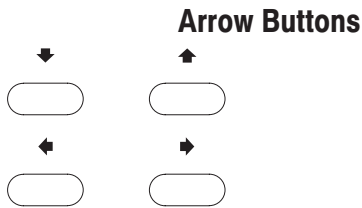


Figure 2-11: Screen menu example



Use the use arrow buttons to move the cursor to a desired position.

Use **▲** and **▼** arrow buttons to move the cursor up or down in a pop-up menu, make a selection in a dialog box, or move a cursor in the Editor menu.

Use **◀** and **▶** arrow buttons to make a selection in a dialog box, move the input caret when you enter numerics with the general purpose knob, or move a cursor in the Editor menu.

CLEAR MENU button

You can use the **CLEAR MENU** button on the front panel to cancel the bottom menu selection or side menu selection just before you selected it.

Numeric Input

You can enter numeric values by using either the numeric keypad or the general purpose knob. If the side menu item displays a value, you can change this value using the general purpose knob or numeric buttons.

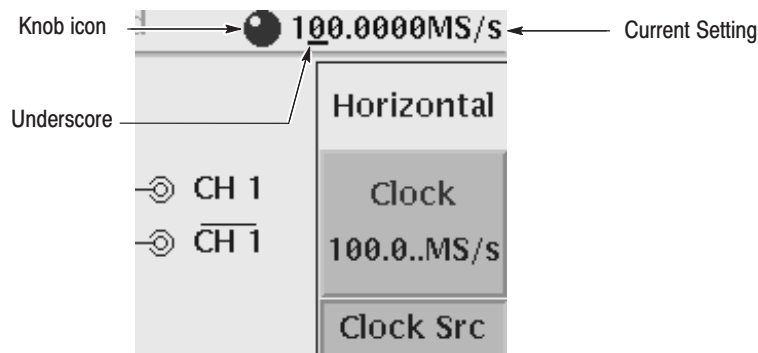


Figure 2-12: Knob icon displayed in Status Display area

General Purpose Knob. A knob icon with a numeric value that includes an underscore character indicates that you can change the value at the underscore location by using the general purpose knob or keypad buttons. By default, the underscore character is positioned beneath the digit specified depending on the parameters. You can only change the value represented by the digits at and to the left of the underscore. Use the **◀** and **▶** arrow buttons to move the underscore to the desired position and then turn the general purpose knob to change the value.

If the numeric value displays the knob icon, but does not show the underscore, then turn the general purpose knob to cycle through the predefined set of values.

When using the general purpose knob, values that you change in side menus and menu screens take effect immediately. Values in pop-up menus are not effective until you push the **OK** side button or the **ENTER** front panel button.

Numeric Keypad. Figure 2–13 shows the numeric keypad and descriptions of the button functions.

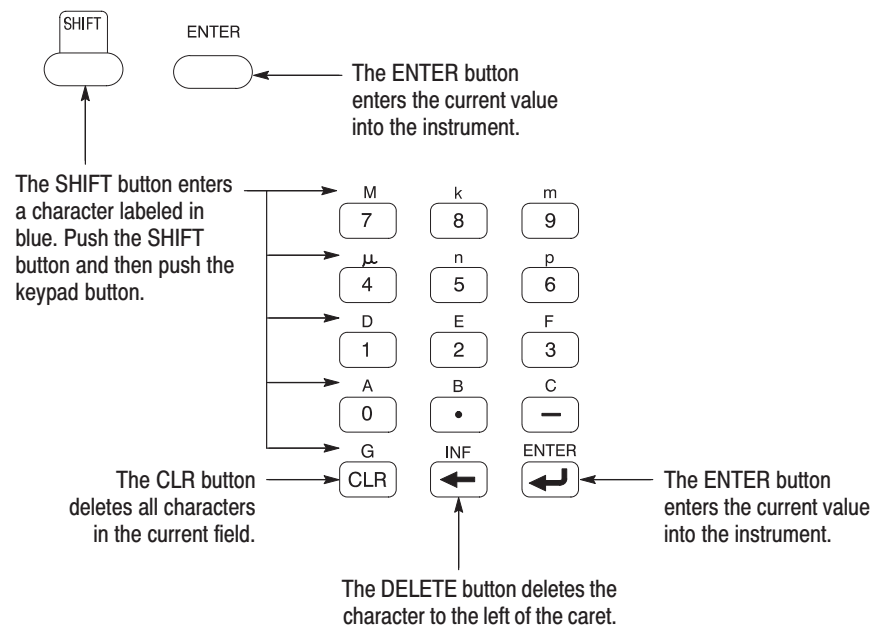


Figure 2–13: Keypad buttons

The **G**, **M**, **k**, **m**, **μ**, **n**, and **p** are unit buttons. The **A**, **B**, **C**, **D**, **E**, and **F** buttons are used for entering hexadecimal values.

To use the numeric keypad to enter a value, position the caret where you want to change a value and then push a keypad button. If you want to enter a unit value labeled in blue just above each numeric button, push or hold down the **SHIFT** button, and then push the corresponding numeric button.

- The current unit remains the same if you do not change the unit. For example, if you want to change from 100 MHz to 200 MHz, you can push **2**, **0**, **0**, and the **ENTER** button.
- Push the numeric buttons and the unit button to enter the specific unit. For example, if you want to change 100 MS/s to 200 kS/s, push **2**, **0**, **0**, and **k** (**SHIFT** + **8**).
- The default time unit, **s**, or the default voltage unit, **v**, is selected if you enter the numeric value, **SHIFT** button and then the **ENTER** button. For example, if you want to change 100 ms to 1 s, push **1**, **SHIFT** button and then the **ENTER** button.

To enter or change more than one character, move the caret to the next position. When you are finished entering values, push the **ENTER** button to confirm and

enter the changes. For example, to enter 200.5 μ s, push **2, 0, 0, ., 5, μ (SHIFT + 4), and ENTER.**

When you enter a value larger than the maximum value in the parameter range, the parameter will be set to the maximum value. When you enter a value smaller than the minimum value, the minimum value will be set in the parameter. To set to the maximum or minimum value, enter a larger value or smaller value. This is useful when you do not know the defined range.

Note that the current unit remains the same when you push the **ENTER** button after entering digits. For example, suppose that the Clock is currently set to 100.0 MS/s. When you press **5, 0** and the **ENTER** button in this order, the Clock will be set to 50.0 MS/s. To set the Clock to 500 kS/s, press **0, ., 5** and the **ENTER** button, or **5, 0, 0, SHIFT,** and **8** button in this order.

Text Input

When you need to assign a name to a waveform file, equation, or IP address, the instrument displays a text dialog box. See Figure 2–14. The text field is where you enter or change an existing character string. The character palette is where you select alphanumeric characters to enter in the text field. You can also select equation or file names from the name list to enter in the text field.

To select a character from the character palette, use the general purpose knob to highlight a character and then push the **ENTER**. Repeat this step until you have entered all characters in the text field. By default, the character palette is selected. To select text from a file name list, use the **▲** and **▼** arrow buttons to move the knob icon to the file name list. Table 2–6 describes all the controls available for entering and editing text.

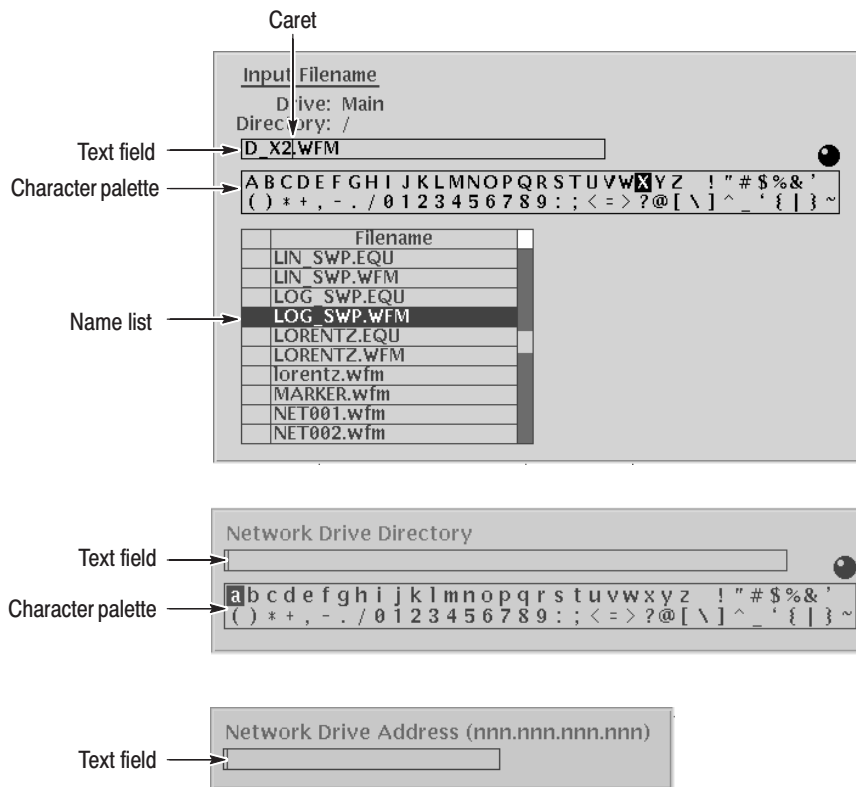


Figure 2-14: Three type of Input text dialog boxes

File Name Input

Verify that the character palette is highlighted and that the general purpose knob is displayed. You cannot select characters if the character palette is not highlighted. Use the ▲ and ▼ arrow buttons to highlight the character palette, if necessary.

Do the following steps to input the file name:

1. Push the ▲ and ▼ arrow buttons to move the caret in the text field.
2. Use the general purpose knob to select the character.
3. Push the **ENTER** button or ↵ button to insert the selected character at the caret position.

Repeat step 1 through step 3 to input the file name.

The current directory file list is displayed in the character palette field. By default, the file is stored in the current directory. If you want to store the file in another directory, use the general purpose knob to move to another directory. If you want to store the file in another drive, push **DRIVE...** (side) to change the drive. You can select the **Up Level**, **Down Level** (side) to move to another directory.

4. Push **DRIVE...** (side) to change the drive. Use the general purpose knob or **↔** arrow buttons to select the drive in the select drive dialog box and push **OK** (side).
5. Push **Up Level** (side) to move up a directory. You cannot move up the directory if you are at the highest level directory.
6. Press **↕** and **↖** arrow button to activate the file list if you want to move down the directory list.
7. Use the general purpose knob to select the directory and push **Down Level** (side).
8. Press **↕** and **↖** arrow button to activate the text field and input the file name.

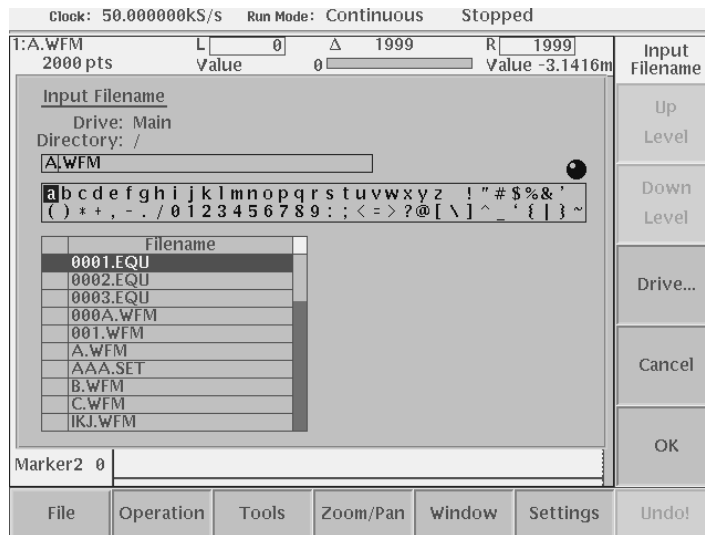


Figure 2-15: Input Filename dialog box

Table 2-6: Text input button functions

Control	Description
General purpose knob	Selects the character to insert into the text field.
↔ and ↔ arrow buttons	Moves the character insertion caret left or right in the text field.
↕ and ↖ arrow buttons	Changes the knob selection area the character palette and the filename list.
ENTER button	Inserts the selected character or character string into the text field.
← button	Deletes one character to the left of the caret.

Table 2-6: Text input button functions (cont.)

Control	Description
CLR button	Clears the entire text field.
Numeric buttons	Enters numeric characters into the text field.
SHIFT button	Enters a selected character in upper case. When you push the SHIFT button, the SHIFT LED lights. When the dialog box disappears, the SHIFT LED light turns off.

Shortcut Controls

Figure 2-16 shows the shortcut buttons and knobs that control specific instrument setup parameters. Using the shortcut controls lets you adjust the output setup parameters even while you are displaying another menu. Table 2-7 describes the shortcut controls.

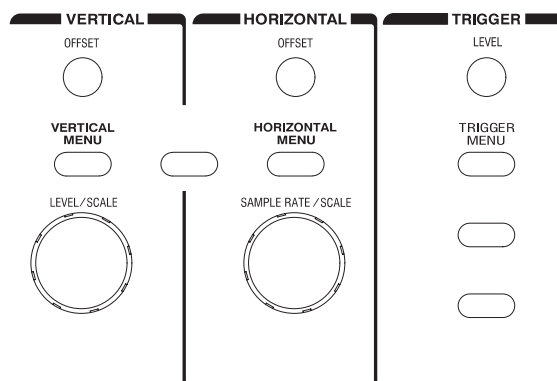


Figure 2-16: Shortcut controls

Table 2-7: Shortcut controls





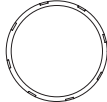


Controls	Description
<p>VERTICAL</p> 	Displays the Vertical side menu. This is the same operation as selecting SETUP (front)→ Vertical (bottom).
	Adjusts the vertical offset parameters. This is the same as selecting SETUP (front)→ Vertical (bottom)→ Offset (side), and then turning the general purpose knob. (except option 02)
	Adjusts the amplitude parameters. This is the same as selecting SETUP (front)→ Vertical (bottom)→ Amplitude (side) and then turning the general purpose knob.

Table 2-7: Shortcut controls (cont.)

Controls	Description
<p>HORIZONTAL</p> 	<p>Displays the Horizontal side menu. This is the same as selecting SETUP (front)→Horizontal (bottom).</p>
<p>SAMPLE RATE / SCALE</p> 	<p>Adjusts the clock setting. This is the same as selecting SETUP (front)→Horizontal (bottom)→Clock (side), and then turning the general purpose knob.</p>
<p>TRIGGER</p> 	<p>Displays the Trigger side menu. This is the same as selecting SETUP (front)→Trigger (bottom).</p>
<p>LEVEL</p> 	<p>Adjusts the trigger level setting. This is the same as selecting SETUP (front)→Trigger (bottom)→Level (side), and then turning the general purpose knob.</p>

File management

This section provides an overview of the file operations for performing file management tasks.

Name and location

File Type Suffixes. The AWG710 Arbitrary Waveform Generator uses numerous file formats to hold different types of data. These file types are listed in Table 2-8. Note that the instrument checks the file format and processes the file based on its content regardless of the file suffix.

Table 2-8: AWG710 Arbitrary Waveform Generator file types

File type	Description
Waveform file	Uses the .wfm or .WFM file suffix. Contains waveform data. All signal data must be in waveform format before it can be output. Created with the waveform editor, by compiling an equation file, or when importing waveforms from external equipment, and created waveform data by application.
Pattern file	Uses the .pat or .PAT file suffix. Contains pattern data. Created with the pattern editor.
Sequence file	Uses the .seq or .SEQ file suffix. Contains waveform sequence and trigger data. Created with the sequence editor.
Equation file	Uses the .equ or .EQU file suffix. Contains equations that describe a waveform. Created with the equation/text editor.

Table 2-8: AWG710 Arbitrary Waveform Generator file types (cont.)

File type	Description
Text file	Uses the .txt or .TXT file suffix. Contains ASCII text. Created with the equation/text editor. And setting parameter file of APPL Digital Modulation.
Setup file	Uses the .set or .SET file suffix. Contains instrument setup and configuration data. Created from the SETUP menu.

Locating Files. There are three locations for storing waveform data on the AWG710 Series Arbitrary Waveform Generator. Data can be stored on the instrument hard disk drive, the floppy disk drive, or a remote storage device accessible through the Ethernet interface. If the file you want to load is not on the current drive, use the SETUP menu main screen **Drive** and **Directory** bottom menu buttons to open the side menus to change the current drive location. Table 2-9 describes the Drive and Directory bottom buttons.

Table 2-9: Drive and directory menus

Bottom menu	Side menu	Description
Drive	Main Floppy Net1 Net2 Net3	Changes the instrument current drive. To select a drive, push the appropriate side menu button. Note that there must be a floppy disk inserted in the instrument floppy disk drive to select the floppy drive. Note that the label Net1, Net2, and Net3 vary depending on the net name settings in the UTILITY menu.
	Up Level Down Level Make Directory Archive Extract	Moves up a directory level. Moves down a directory level. To move down a directory level, select a directory name in the pop-up list, and then push the Down Level side button. The filename list changes to show the contents of the directory. Creates a directory at the current level. To create a directory, push the Make Directory side button to display the Input New Directory Name dialog box. Enter the directory name in the name field, then push the OK side button. The instrument creates the new directory. Creates a new file (.tar format) for archive from selected directory. The archived file keeps hierarchic structure. Restore the archived file (.tar) to the current directory.

NOTE. *In the following procedures, you may have to push the EDIT button twice to exit the editor. When the instrument does not display the file list, push the EDIT button again. If you are prompted, refer to Saving Files on page 2–33.*

Copying Files

You can copy files in from a double window or a single window. In a double window, push the Copy button to copy the selected file in the active window into the desired window.

Copying files in double windows. Do the following steps to copy files selected in the active window:

1. Push **EDIT** (front) button and select the file to copy.
2. Push **Window** (bottom)→**Window** (side) to select **Double**.
Two file windows are displayed.
3. Push **Select** (side) to select the active window.
4. Push **Directory** (bottom)→**Up Level, Down Level, or Make Directory** (side) to select the destination.
5. Push **Select** (side) to activate the window into which you are going to copy the file and then select the file.
6. Push **File** (bottom)→**Copy** (side) to copy the file to the destination as the same file name.

If the directory name is the same as the destination directory name, you will be asked to confirm to overwrite the file.

Copying files in single window. Do the following steps to copy files selected in single window:

1. Push **EDIT** (front) button and select the file to copy.
2. Push **File** (bottom)→**Copy** (side) and select the file name and destination.
3. Push **OK** (side) to copy the file.

The file is copied and renamed.

NOTE. *For additional file copying and file moving procedures, refer to Double Windows on page 2–36.*

Moving Files

To move a file in the double window, do the following steps:

1. Push **EDIT** (front) button and select the file to copy.
2. Push **Window** (bottom)→**Window** (side) to select **Double**.
Two file windows are displayed.
3. Push **Select** (side) to select the active window.
4. Push **Directory** (bottom)→**Up Level, Down Level, or Make Directory** (side) to select the destination.
5. Push **Select** (side) to activate the window into which you are going to move the file and then select the file.
6. Push **File** (bottom)→**Move** (side) to move the file to the destination.

If the directory name is the same as the destination directory name, you will be asked to confirm to overwrite the file.

Renaming Files

The EDIT menu screen allows you to rename files. Do the following steps to rename a file:

1. Push **EDIT** (front).
The instrument displays the file list.
2. Select the file to rename.
3. Push **File** (bottom)→**Rename** (side).
4. Enter the new name for the file in the file name field.
5. Push **OK** (side).

The file is renamed.

Deleting Files

You can delete a file or directory by doing the following steps:

NOTE. *You cannot delete a file or directory if the file or directory is set to 'read only'. Also, you can only delete a directory if the directory is empty.*

1. Push **EDIT** (front).

The instrument displays the file list.

2. Select the file to delete.
3. Push **File** (bottom)→**Delete** (side). The instrument displays a message box asking you to confirm deleting the file.
4. Push **OK** (side) to delete the file or **Cancel** to cancel the operation and keep the file.

You can also delete all files on the current drive and directory by doing the following steps:

1. Push **EDIT** (front)→**File** (bottom)→**Delete All** (side).

The instrument displays a message box asking you to confirm deleting all files.

2. Push **OK** (side) to delete all files or **Cancel** to cancel the operation and keep all files.

Read Only Attribute

To change the read only or read/write attributes on a file, do the following steps:

1. Push **EDIT** (front).

The instrument displays the file list.

2. Select the file to change the attribute.
3. Push **File** (bottom)→**Attribute xxxx** (side).

The **xxxx** is the **Read/Write** or **Read Only** attribute of the selected file. Pushing this side button immediately changes the file attribute.

Files with a read only attribute are identified by  icon, and the directories by  icon. See Figure 2–17.

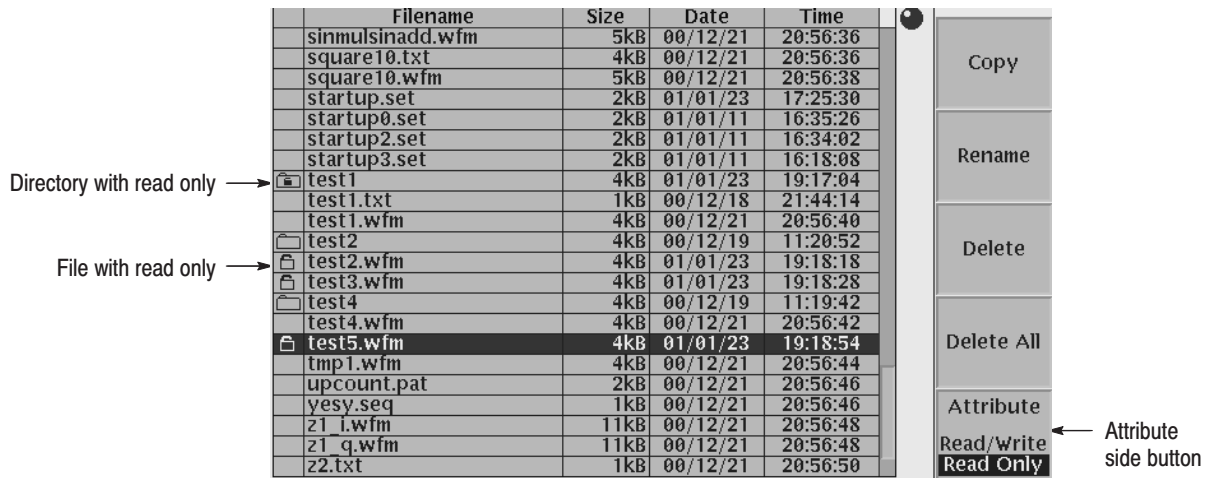


Figure 2-17: Files and directories with read only attribute

Saving Files

Saving files takes place from within each editor screen. You have the choice of saving your waveform data to the current file name or to a new file name. To save a waveform to its current file name, push **File** (bottom)→**Save** (pop-up)→**OK** (side).

If you are saving a waveform for the first time, the instrument opens the Input Filename dialog box as shown in Figure 2-18. Use this dialog box to enter a file name. If necessary, you can select a different storage media or directory by pushing the **Drive...** side menu button. When you are done entering the file name, push the **OK** side button or the front panel **ENTER** button to close the dialog box and save the file.

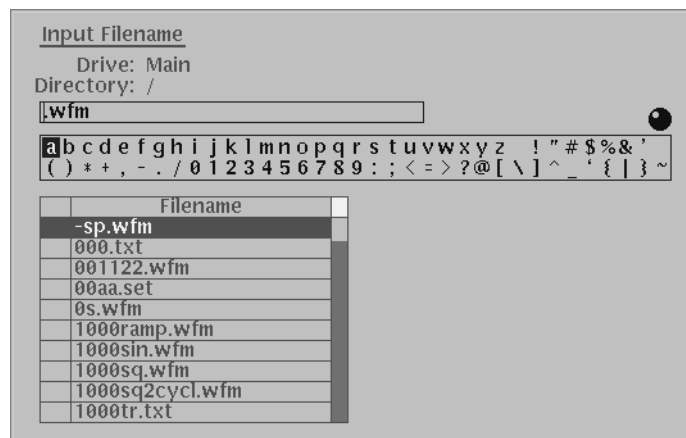


Figure 2-18: Input filename dialog box

NOTE. When you exit an editor without saving edited data, the instrument displays the message *Save the changes you made?* Push the **Yes** side button to save the waveform data.

To save waveform data to a new file name, push **File** (bottom)→**Save As** (pop-up)→**OK** (side). The instrument opens the Input Filename dialog box as shown in Figure 2–18. Use this dialog box to enter a file name. If necessary, you can select a storage media or directory by pushing the **Drive...** side menu button. When you are done entering the file name, push the front panel **ENTER** button to close the dialog box and save the file.

If you are saving a file with a record length larger than 64 data points, the instrument needs to adjust the record length to meet internal memory record length requirements. The instrument displays one of the messages shown in Table 2–10. Select one of the messages and push the **OK** side button to accept the recommended change or cancel the save and then edit the file to satisfy the data record length requirements.

Table 2–10: Waveform record length adjustment messages

Message	Description
Leave it as is	The data is saved, as is, without making changes. The instrument will display an error message if you try to load a file that does not meet the instrument waveform constraints.
Append 0	With Level-0 data added after the data, a file with a data length meeting the requirements is created.
Expand	With the waveform data expanded, a file with a data length meeting the requirements is created.
Expand with Clock	With the waveform data expanded, a file with a data length meeting the requirements is created. In addition, the clock frequency increases without change in scaling factor. The settings are saved in the file.
Repeat	With repetitions of the original data linked, a file with a data length meeting the requirements is created.

Archive, Extract

To archive or extract files, do the following steps.

Archive. When you select Directory in the file list, you can make archives for all the files in the directory and subdirectory.

1. Push **EDIT** (front).

The instrument displays the file list.

2. Select the file to make archive files.

3. Push **Directory** (bottom)→**Archive** (side).

The instrument displays the Input archive name dialog box. By default, the name of <directory name>.tar is automatically assigned. If necessary, you can change the name.

4. Push **OK** button, and the archive file will be created in the current directory.

Extract. The archived file is extracted (restored) to the current directory. If the directory already exists, the existing file will be overwritten.

1. Push **EDIT** (front).

The instrument displays the file list.

2. Select the file to extract.
3. Push **Directory** (bottom)→**Extract** (side).

The instrument extracts the archived files and directories to current directory.

Remote computer archive operation. AWG710 Arbitrary Waveform Generator uses .tar format files. Use the **tar** command when you archive with a remote computer environment. If you are PC user, use **tar** format archive tool.

The following list describes some restrictions on archive and extract operation.

- Blocking factor is 20.
- The file name including the file path in the directory is up to 100.
- The depth of directory hierarchy is up to 16.

Use the following command to make archive file:

```
tar [-] cvf <tar file name> <file name or directory name>
```

Use the following command to extract archive file:

```
tar [-] xvf <tar file name>
```

Double Windows

When the **Window** bottom button is displayed, you can split the file list in the Edit Screen into two lists as shown in Figure 2–19. This function is called Double Windows.

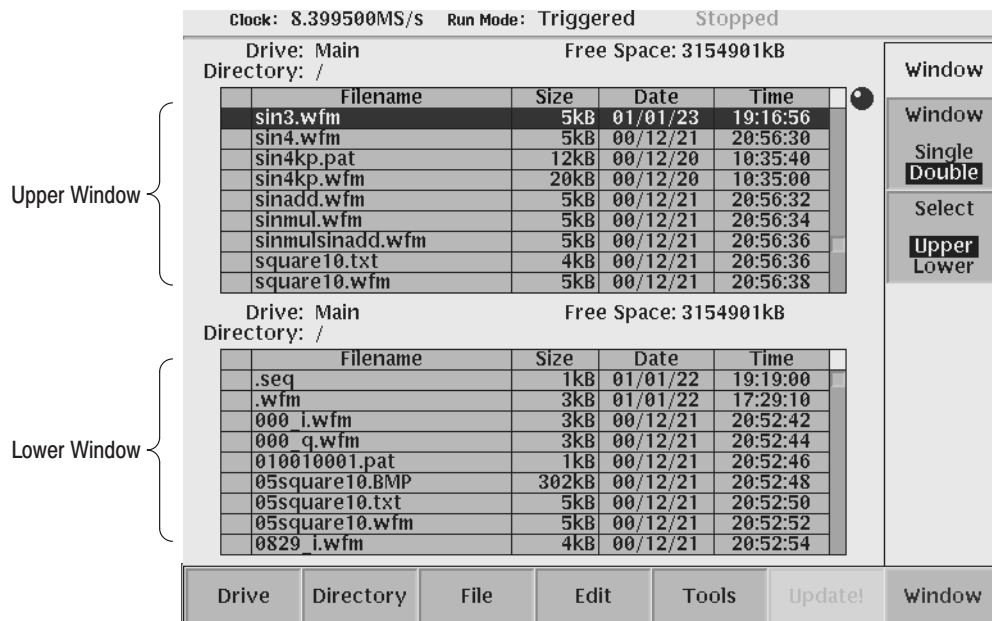


Figure 2–19: Double windows

In Double Windows, for example, you can display the hard disk and floppy disk file lists or the file list of two separate directories. All the functions invoked from the bottom buttons operate the same in single window except for the **File** function.

The two most important functions used in the Double Windows are the Copy and Move file operations. These operations are discussed in *Window Operation* below.

Window Operation

The split windows are named Upper window and Lower window as indicated in Figure 2–19. You must select a window for operation.

When you push **EDIT** (front) → **Window** (bottom), the Window side button appears. Push the **Window** side button to select **Double**. Double windows are displayed. Push the **Window** side button once more to select **Single**. The display returns to the single file list.

When you display the double windows, the **Select** side button will be available. Push the **Select** side button to select **Upper** for file operation in the upper file list

window. Push the **Select** side button once more to select **Lower** for file operation in the lower file list window.

Operation in Double Windows

The most useful functions in the Double Windows may be those invoked from the **File** bottom button. The functions available in the **File** bottom button are described in Table 2–11.

Table 2–11: File operation in double windows

Operation	Description
Copy	Copies a file selected in a selected file list window into the destination specified in the other file list window. You cannot select the directory.
Copy All	Copies all files in a selected file list window into the destination specified in the other file list window. You cannot copy the directory or directory structure.
Move	Moves a file selected in a selected file list window into the destination specified in the other file list window. You cannot select the directory.
Move All	Moves all files in a selected file list window into the destination specified in the other file list window. You cannot move the directory or directory structure.

NOTE. You cannot use the **Rename**, **Delete**, **Delete All**, and **Attribute** side buttons unless you display the single file list window.

When the files with the same file name exist in a destination in a copy or move operation, the message *Overwrite existing file <filename>* appears. At the same time, the **Cancel**, **No**, **Yes to All** and **Yes** side buttons appears. Press any of these side buttons to continue the procedure. See Table 2–12.

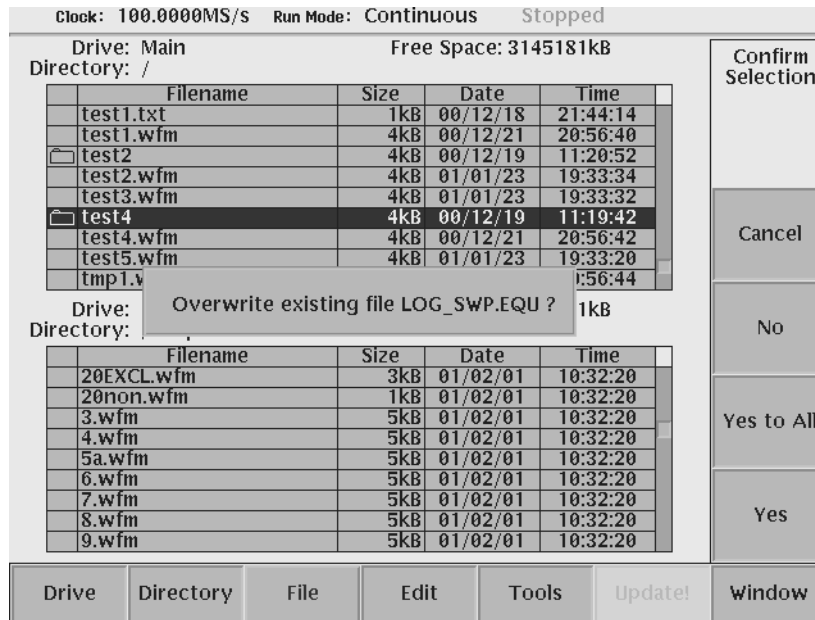


Figure 2-20: Overwrite confirmation

Table 2-12: Confirmation selection for copy-all and move-all operations

Side menu	Description
Cancel	Cancels and stops copy or move operation.
No	Skips the copy or move operation for the file indicated in the message.
Yes to All	Overwrites all the files without displaying any messages until the operation is finished.
Yes	Overwrites the file indicated in the message and proceeds with the operation.

You cannot copy or move the directory. In the copy-all or move-all operations, the message *Directory cannot be copied* appears if you try to move or copy a directory. Press the **OK** side button to confirm and proceed with the operation.

Quick View

Before loading or handling a file, you may want to look at the content of a file to confirm the operation. The Quick View function displays the view window and allows you to view a waveform or pattern file selected in a file list. This function is always available when a file list is displayed on the screen. See Figure 2-21.

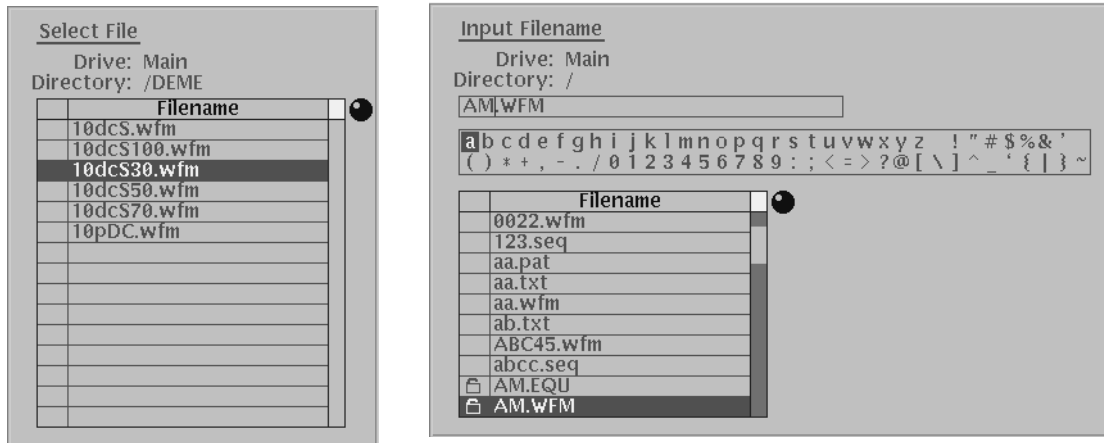


Figure 2-21: File list window examples in which quick view is available

Select a file from the file list window using the general purpose knob. Press the **SHIFT** and **ENTER** front panel buttons simultaneously. The view window displays the waveform or pattern as shown in Figure 2-22.

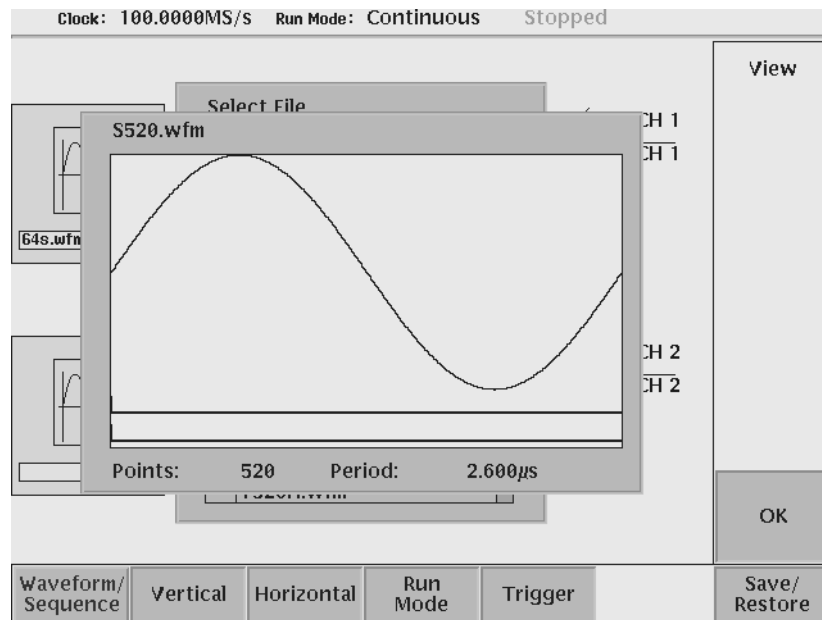


Figure 2-22: Viewing a file by quick view function

Push the **OK** side menu button to close the view window. You cannot view files other than waveform or pattern in this function.

This function is always available when a file list window or file list dialog box is displayed on the screen.

Setup Overview

The Setup screen is where you load and set up the waveform for output. This section gives you an overview of the Setup screen, how to load a file, how to set the signal output parameters, and how to enable signal output. Refer to *The Setup Menu Screen* in the *Reference* section of User manual for more information.

Main Setup Screen

Push the **SETUP** front panel button to display the main Setup screen. See Figure 2–23. Table 2–13 describes the screen waveform parameter icons. Table 2–14 lists the bottom menu functions.

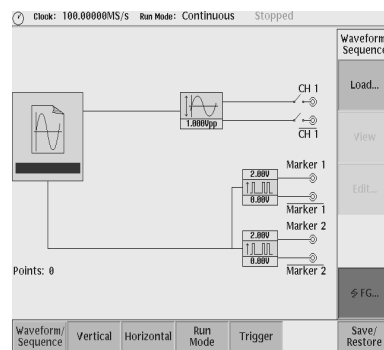
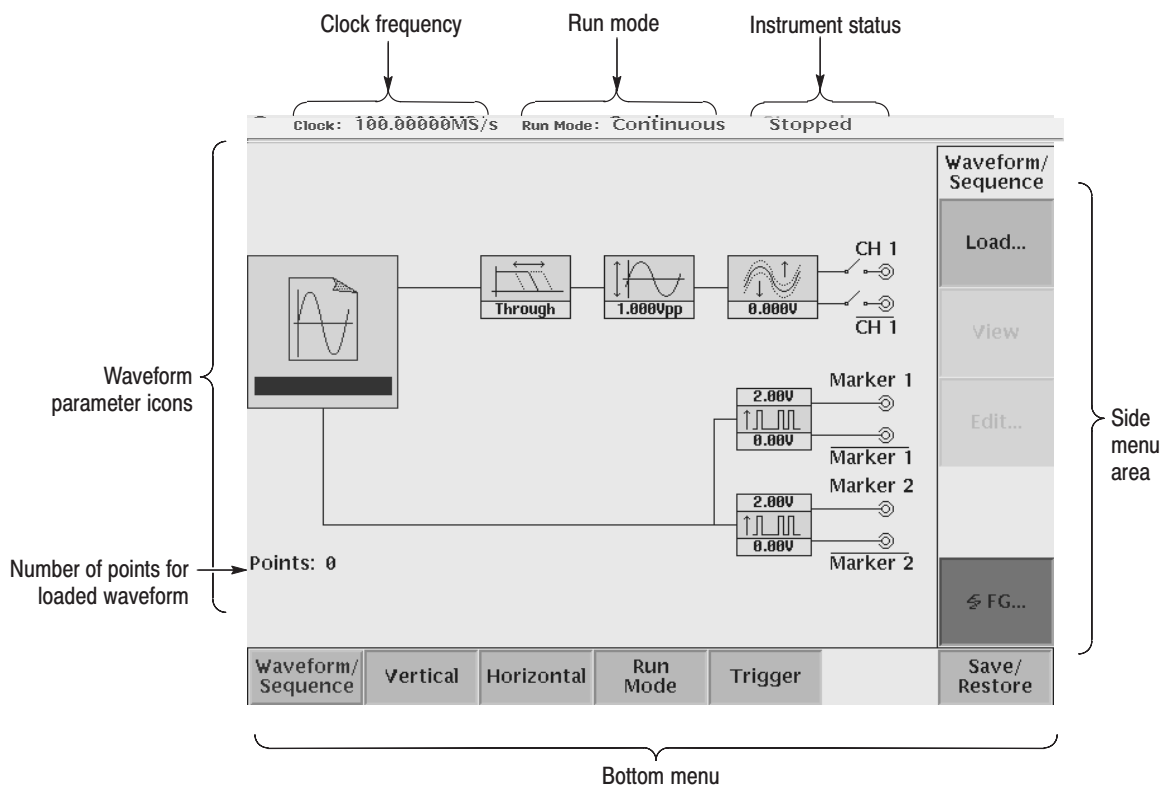


Figure 2–23: Main Setup screen (small figure: option 02)

Table 2-13: Setup screen parameter icons

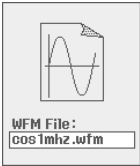
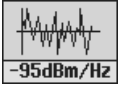
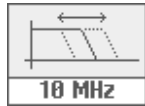
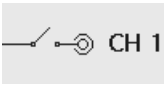
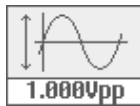

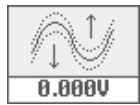
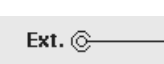
Icon	Description	Icon	Description
	Displays the file name of the waveform, pattern, or sequence file loaded for output. Note: Use the View button to display the loaded waveform.		Displays the noise signal level added.
	Displays the low-pass filter setting through which the waveform is passed. (except option 02)		Indicates that the channel output is enabled or disabled. If the switch is shown open, that channel output is disabled.
	Displays the peak-to-peak signal amplitude setting.		Indicates that the digital output is enabled or disabled. If the switch is shown open, that digital output is disabled.
	Displays the signal offset setting. (except option 02)		Displays the external input added.

Table 2-14: Setup bottom menu buttons

Bottom menu button	Description
Waveform/Sequence	Displays the side menu for loading, viewing, and editing waveform files.
Vertical	Displays the Vertical side menu for setting waveform peak-to-peak amplitude, offset, low-pass filter, and other output parameters. The product which has option 02 doesn't have offset and lowpass filter function.
Horizontal	Displays the Horizontal side menu for setting the clock source, clock frequency, clock reference, and channel skew parameters.
Run Mode	Displays the Run Mode side menu for setting the instrument run mode. Refer to <i>Run Modes</i> for an explanation of the different run modes.
Trigger	Displays the Trigger side menu for setting trigger source, slope, level, external trigger impedance, and interval parameters.
Save/Restore	Displays the Save/Restore side menu to save and restore setup output parameters.

Composition and Setup of Output Channel

Use the Setup menu to set up parameters for each channel as well as the instrument.

Set up the file to load, amplitude, and run mode for each channel. Set up the Horizontal, Run Mode, and Trigger for the instrument.

Loading a Waveform File to Output

Do the following steps to load a waveform file into the Setup screen:

1. Push the **Waveform/Sequence** bottom menu button.

This opens the Waveform/Sequence side menu.

2. Push the **Load...** side button. The instrument opens the Select File list as shown in Figure 2–24.

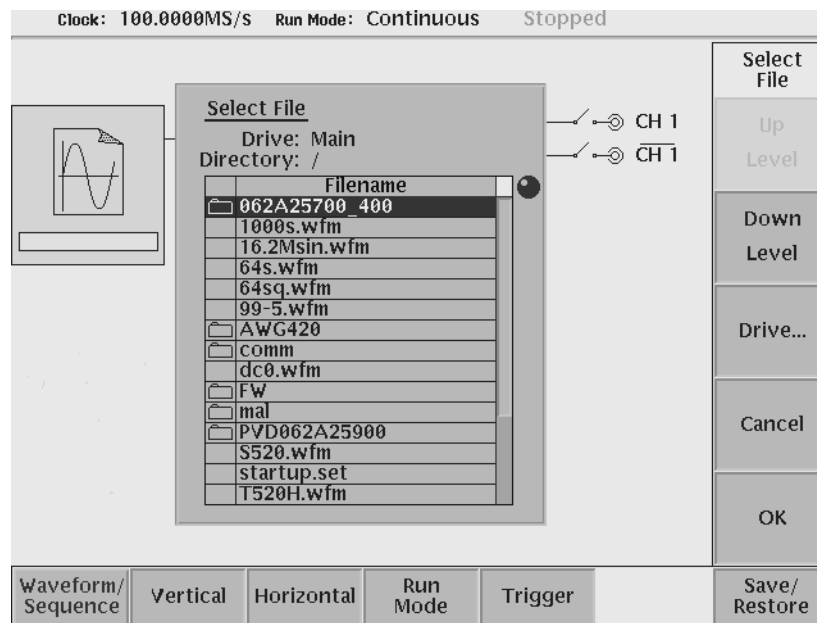


Figure 2–24: Setup waveform/sequence menu

3. Use the general purpose knob or arrow buttons to select the file name to load. If the file you want to load is located in a different drive or directory, use the side menu buttons to change the current drive/directory.
4. Push the **ENTER** front panel button or **OK** side button. The instrument loads the file and displays the file name in the selected channel file icon. Push the **Cancel** side button to exit the file load process.

The procedures above explain how to load a waveform or pattern into the waveform memory, and/or sequence file into the sequence memory, which will be scanned to output. The waveform memory, sequence memory, and the edit

buffer are completely independent. So, you can edit a waveform, pattern, sequence or equation/text while outputting an another waveform or sequence.

However, when you push **SETUP** (front panel)→**Waveform/Sequence** (bottom)→**Edit** (side) to copy the waveform in the waveform memory to the edit buffer, you must save the currently edited waveform, pattern, sequence or equation/text into a file.

You can enter the QUICK EDIT mode only from the waveform editor. When you enter the QUICK EDIT mode, the instrument copies the data from the edit buffer to the undo buffer. All the changes you make immediately reflect the data in the edit buffer and the data in the waveform memory if that data is being loaded to output.

Before loading, you can view a waveform or pattern. Refer to *Quick View* for more detail.

Viewing a Waveform

To view the loaded waveform file, push the **View** side menu button. The instrument opens a window on the screen that displays the waveform, as shown in Figure 2–25. Push the **OK** side menu button or front panel **ENTER** button to close the view window.

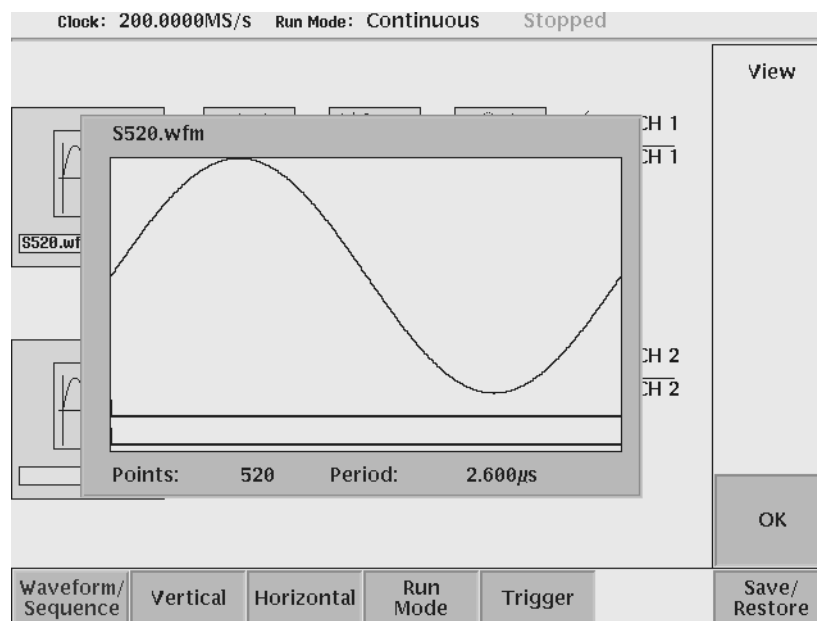


Figure 2–25: Viewing a file in the setup screen

Note that the view function always display the waveform in the file that you specified, but not the waveform in the waveform memory. Even when you change the waveform with the editor and update the waveform memory, the view function still displays the waveform before the update unless you do not save the file.

Setting Waveform Output Parameters

The Setup side menus provide commands for setting and adjusting waveform output parameters. The steps for setting output parameters are discussed in detail in the *Reference* section of the *User manual*. Table 2–15 provides an overview of the Setup side menu operations.

Table 2–15: Setup output parameter operations

Bottom button	Side button	Description
Waveform/ Sequence	Load...	Displays the Select File dialog box that lists files in the current drive and directory. Select a file to load or use the side menu buttons to change drives and/or directories.
	View	Displays the loaded file in a window. Push the OK side menu button to close the view window.
	Edit...	Opens the appropriate editor for the loaded file.
Vertical	Filter	Selects low-pass filter to insert into signal path. Filter values are through (no filter), 1 MHz, 5 MHz, 20 MHz, and 50 MHz. Use the general purpose knob to enter new values. (except option 02)
	Amplitude	Sets the signal peak-to-peak amplitude in increments of 0.001 V. The maximum value is $2 V_{pk-pk}$ ($5 V_{pk-pk}$ with Option 05) in normal mode and $0.5 V_{pk-pk}$ in direct mode. Use the general purpose knob or the keypad to enter new values.
	Offset	Sets the signal offset value in increments of 0.001 V. The offset voltage range is ± 1 V. Use the general purpose knob or the keypad to enter new values. (except option 02)
	Add...	Adds the internal noise signal and/or external input signal to a waveform. You can set the range of the internal noise generator level within the limits of -140 to -95 dBm/Hz (-130 to -95 dBm/Hz with Option 05).
	Output	Selects to connect the DAC output directly to the channel connector. (except option 02)

Table 2-15: Setup output parameter operations (cont.)

Bottom button	Side button	Description
Horizontal	Clock	Sets the clock sample rate from 10 kS/s to 200 MS/s.
	Clock Src	Sets the clock source to either Internal or External. When set to Internal, 10 MHz internal reference clock is used. When set to External, a valid external clock signal is DC to 200 MHz with a voltage level of $0.4 V_{pk-pk}$ and up to $\pm 2 V$.
	Clock Ref	Sets the reference clock source to either Internal or External. A valid external clock signal is 10 MHz ± 0.1 MHz with a voltage level of 0.2 V to $3.0 V_{pk-pk}$.
	Skew...	Sets the skew between Ch1, Ch2 and CH3 within -2.52 ns to 2.52 ns with 70 ps steps.
Run Mode	Continuous Triggered Gated Enhanced	Displays the Run Mode side menu for setting the instrument run mode. Refer to the <i>Run Mode Menu</i> subsection on page 3-4 for an explanation of the different run modes.
Trigger	Source	Sets trigger source to Internal or External. If External is selected, only the interval item is selectable.
	Slope	Sets the trigger slope or gate polarity to Positive or Negative.
	Level	Sets the trigger signal level. The trigger level range is $\pm 5.0 V$ in 0.1 V increments.
	Impedance	Sets the external trigger input line impedance to either 50 Ω or 1 k Ω .
	Interval	Sets trigger interval from 1.0 μs to 10.0 s.
Save/Restore	Save Setup	Save the setup parameters set by SETUP window as a setup file.
	Restore Setup	Restore a setup file.

Outputting a Waveform

To output a loaded waveform, push the **CH (1) OUT** and/or **CH (1) _OUT** front panel button(s), and then the front panel **RUN** button. The LEDs near each button light to indicate they are enabled. The instrument outputs the waveform(s) depending on the Run mode. You can turn either or both channel outputs on or off while the instrument is running by pushing the **CH (1) OUT** or the **CH (1) OUT** buttons. To stop the waveform output, push the **RUN** button so that the LED light turns off.

Saving and Restoring Setup Parameters

The waveform or pattern file contains only waveform and clock information. When you load a waveform or pattern file, the output signal will use the current instrument setup parameters.

To save you from doing a manual setup procedure each time you load a waveform, the AWG710 Arbitrary Waveform Generator lets you save setup parameters in a setup file. You can then restore the saved settings for use with waveforms.

Do the following steps to save the current setup parameters:

1. Push **SETUP** (front)→**Save/Restore** (bottom)→**Save Setup** (side).

The Select Setup Filename dialog box appears.

2. Enter a setup file name.

The suffix .set will appear at the end of the file name.

3. Push the **OK** side button.

The setup information is saved to the designated file.

Do the following steps to restore the setup parameters from a file:

1. Select **SETUP** (front)→**Save/Restore** (bottom)→**Restore Setup** (side).

2. Enter or select the setup file name to load.

3. Push the **OK** side button to load the file and restore the setup parameters, or push the **Cancel** side button to exit the restore process without loading the setup file.

Theory of Operation

This section presents an overview of the AWG710 Arbitrary Waveform Generator hardware, data structures, and operating modes to allow you to take full advantage of the capabilities of the waveform generator.

Interconnect Diagram

Figure 3–1 illustrates the waveform generator circuitry. This section describes the hardware blocks that provide the background knowledge necessary to use the instrument effectively.

CPU. The CPU controls the whole instrument using the GPIB interface, floppy disk connection, 100/10BASE-T Ethernet connection, user interface through the display screen and the front panel, and so on. See Figure 3–1.

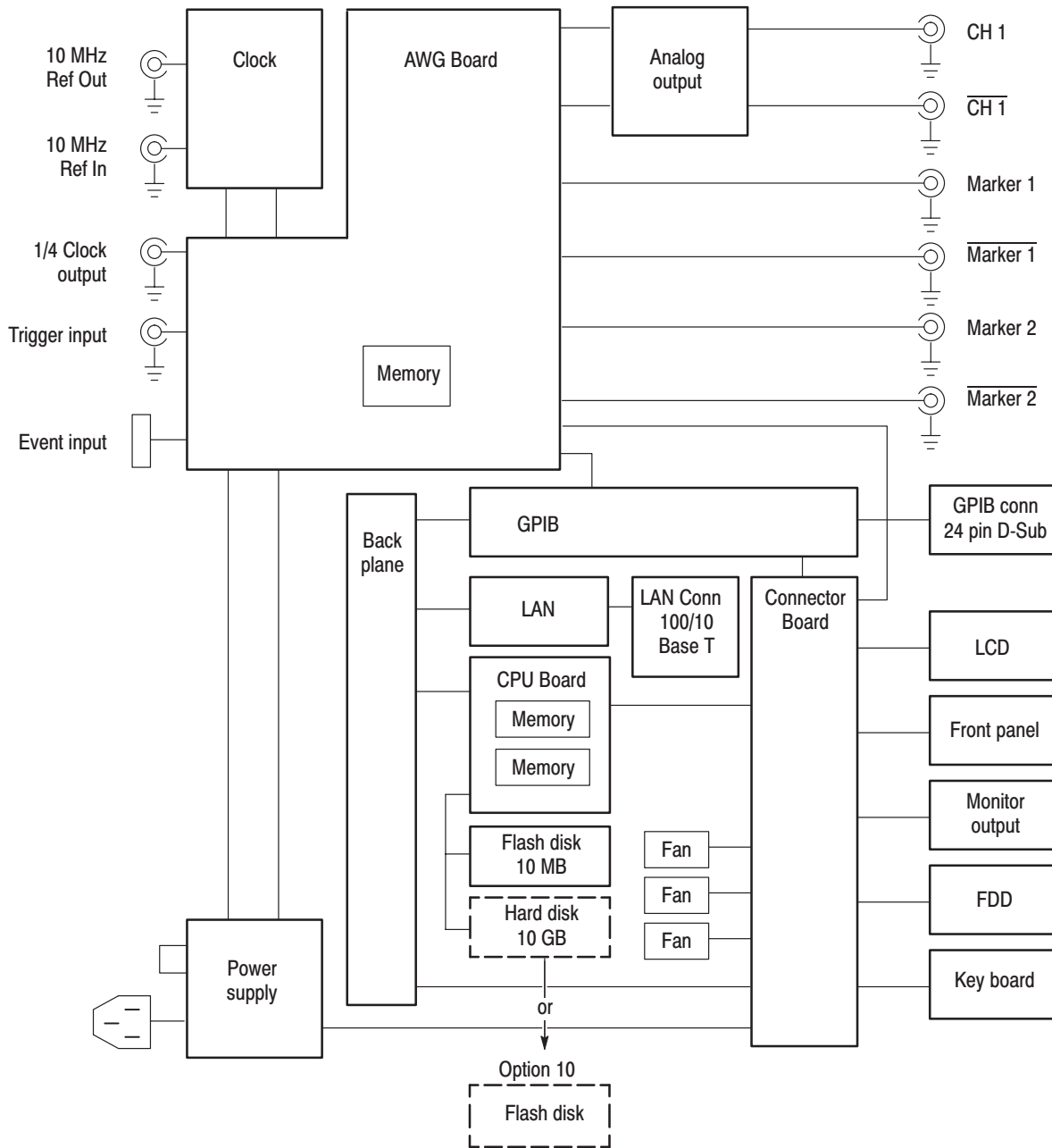


Figure 3-1: AWG710 interconnect diagram

Block Diagram

Figure 3–2 shows the main hardware blocks that comprise the AWG710 Arbitrary Waveform Generator.

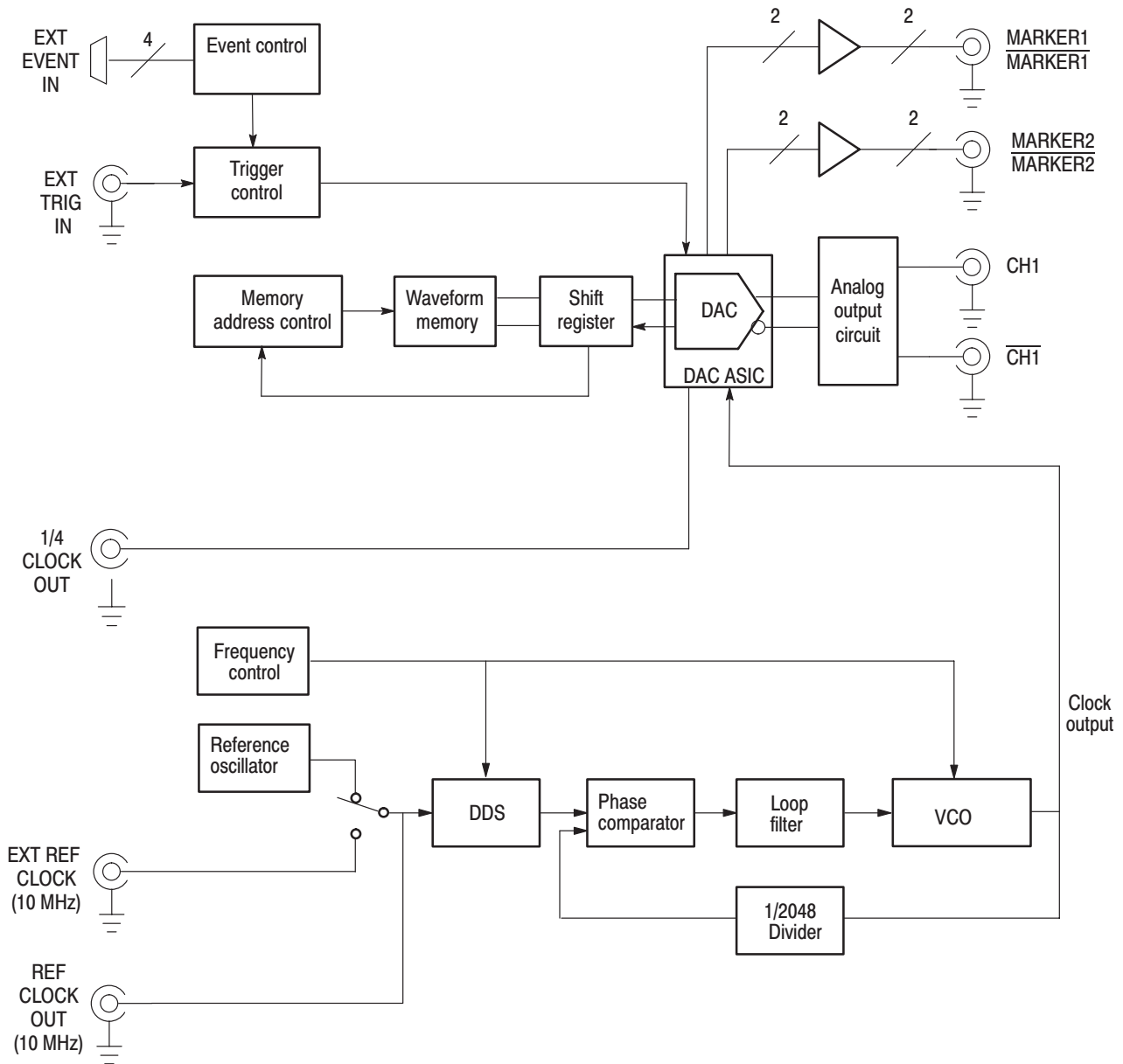


Figure 3–2: AWG710 block diagram

Clock Oscillator. You can select either the internal or external reference clock source by using the SETUP horizontal menu.

If you select the external source, the reference signal connected to the 10 MHz REF In connector on the rear panel will be used.

The internal clock is from the reference clock oscillator, which uses direct digital synthesis (DDS). Figure 3–2 shows the clock oscillator configuration.

Trigger Control. The Trigger Control block controls the Memory Address Control in the operation mode that you specified from the RUN MODE menu.

Waveform Memory and Shift Register. The Waveform Memory block has 8 bits for waveform data and 2 bits per channel for markers, thus a total length of 16 M /32 M (option 01) points. You can set any value from 960 points to 16 M/32 M (option 01) points for the length of the waveform data. It must be in increments of 4.

The Shift Register block provides waveform data from the DAC at a rate of up to 4.0 GS/s.

RUN modes. Selecting a RUN mode from the SETUP menu causes one of the following modes to operate the AWG710 Arbitrary Waveform Generator. Table 3–1 lists the available run modes.

Table 3–1: Run modes

Modes	Descriptions
Continuous	Consecutively output regardless of existence of a trigger signal.
Triggered	The output signal is obtained once only when one of the following is input: <ul style="list-style-type: none"> ■ An external trigger signal from the TRIG IN connector on the rear panel. ■ A trigger signal generated using the FORCE TRIGGER button on the front panel. ■ A trigger command from remote device. ■ If the SEQUENCE has been defined, the TRIGGERED output is obtained once only according to the definition.

Table 3-1: Run modes (Cont.)

Modes	Descriptions
Gated	<p>The waveform is output only while:</p> <ul style="list-style-type: none"> ■ An external trigger signal from the TRIG IN connector on the rear panel. ■ A gate signal through the FORCE TRIGGER button (on the rear panel) is TRUE. ■ A control command such as trigger or event from remote device.
Enhanced	<p>The waveform is obtained, in the order defined with the sequence, based on:</p> <ul style="list-style-type: none"> ■ A trigger signal (for example, an external trigger signal from the TRIG IN connector on the rear panel). ■ An external trigger signal from the TRIG IN connector on the rear panel. ■ An event signal from the EVENT IN connector on the rear panel. ■ An trigger signal from the FORCE TRIGGER button on the front panel. ■ An event signal from the FORCE EVENT button on the front panel. ■ A control command such as trigger, event or jump from remote device.

Analog Circuit. The Analog Circuit block contains the Filter, Attenuator, Output Amplifier, Calibration and Offset Circuits. These circuits are used to process signals generated from the DAC. Option 02 has Calibration Circuits only.

Memory Address Control. The Memory Address Control controls the addresses used to read waveform memory data.

This block loads the first address of the waveform into the Address Counter that was loaded into the waveform memory. It loads the waveform data length to the Length Counter. The Address Counter specifies the point from which the waveform was generated and the Length Counter waveform ending position.

The Address and Length Counters operate with clocks produced by quarter frequency-division for the clocks from the clock oscillator.

If the repeat count value has been loaded in the Repeat Counter, the waveform is generated the specified number of times.

This block controls the sequence to the event signals generated in Enhanced Mode.

Figure 3-3 shows the relationship between the memory address control and the waveform memory.

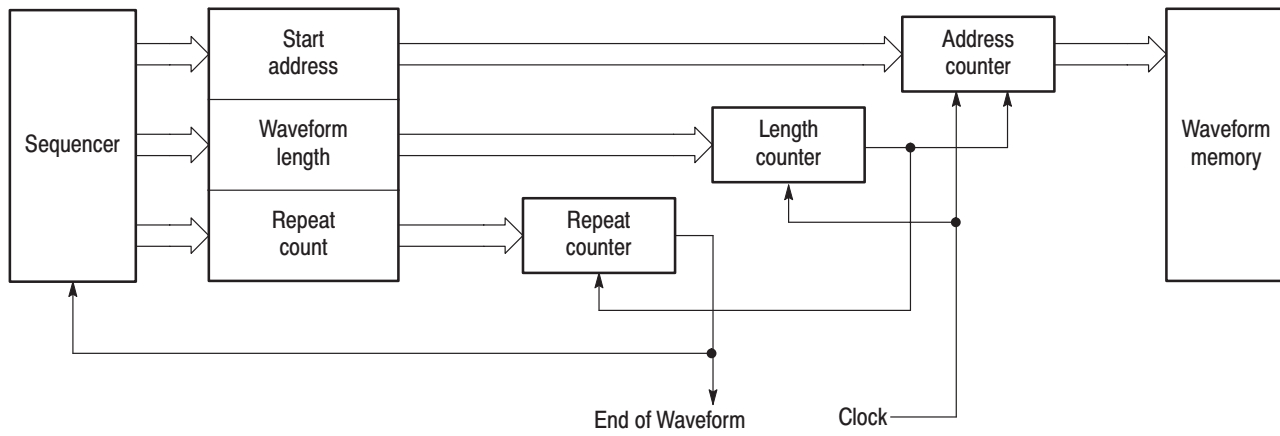


Figure 3-3: Relationship between memory address control and waveform memory

Signal Edit Process

This subsection describes the signal edit process.

Load the desired waveform data to be output into the waveform memory. New waveform data can be created using waveform editors incorporated in the AWG710 Arbitrary Waveform Generator. New data can also be created by combining the following:

- A sample waveform data distributed with floppy disks.
- Previously created waveform data on the built-in hard disk.
- Waveform data measured or created by other equipment, which has been read through the network.

Digital waveform data is loaded to the waveform memory location. The memory address control extracts the waveform data from memory, including the clock speed and the specified order of waveforms relative to the trigger event control.

When the AWG is in the Run mode, the digital output is processed through a high speed digital to analog converter (DAC). The output then goes through the analog output amplifier to the offset and filter circuitry and to the output connector.

Waveform Data Structure

The waveform data structure consists of analog waveform and digital pattern file formats. The waveform file format includes 8-bits of resolution for the DAC output and 2-bits for the digital marker output. The pattern file format includes 10-bits for digital output. (The AWG710 supports two digital marker outputs.) The full scale resolution of the 8-bit DAC is represented by -1.0 to $+1.0$.

Waveform and pattern files use different internal formats and editors. The waveform file format is composed of 4-byte little endian and 1-byte for each data point and markers. The 4-bytes point data is expressed as an IEEE floating point number. The pattern data file is composed of 2-bytes including data and markers.

Waveform files contain floating point numbers that maintain the mathematical data precision necessary for waveform math operations such as multiplying, dividing, adding, and subtracting. Waveform files may be edited, but are much larger for an equivalent record length compared to pattern files.

Pattern files are most useful for minimizing file size and file transfer time between the AWG and a PC.

For more details about file format, refer to the *Data Transfer* subsection in the AWG710 Arbitrary Waveform Generator Programmer manual.

Waveform Edit To edit waveforms, the AWG710 Arbitrary Waveform Generator provides you with Waveform, Pattern, Sequence, Equation, and Text Editors. See Table 3–2 for a description of those editors.

Table 3–2: Editors

Editors	Descriptions
Waveform Editor	<p>The Waveform Editor lets you create or edit a waveform that is displayed on the screen. It enables you to create any waveform by an operation such as cut and paste, partial inversion about the horizontal or vertical axis, shift, or scaling. This operation can be based on a standard waveform, such as a sine or rectangular wave, or the previously created waveform.</p> <p>The Waveform Editor also has a unique feature that edits a waveform with waveform calculation functions (absolute value of waveform, differentiation/integration, convolution, correlation, addition/subtraction/multiplication between waveforms and so on).</p>
Pattern Editor	<p>The Pattern Editor displays a digital signal pattern with a pattern data placed in 8-bit creation waveform memory; it creates a digital signal pattern according to the High/Low settings you made for the individual bits.</p> <p>In addition to the functions supported by the Waveform Editor, the Pattern Editor is capable of generating frequently used digital signals unique to digital signals and pseudo random patterns.</p>
Sequence Editor	<p>The Sequence Editor lets you create a more complex waveform by combining different types of waveform data that you created using the Waveform and/or Pattern Editors. This editor also enables a Waveform listing jump and output stop to take place. They follow the external event information from the EVENT IN connector as well as the number of repetitions and the order for the individual pieces of waveform data.</p>
Text Editor	<p>The Text Editor creates an equation, more exactly, a waveform by a method of equations. When an equation is created using this editor, you must perform a compile.</p> <p>The Text Editor allows you to edit plain ASCII files. It should be used to edit ASCII format waveform data originated from other equipment as well as this instrument itself.</p>

Quick Edit The Quick Editor lets you modify and/or output any part of a waveform you are currently editing with the Waveform Editor. This is done in real time. The data between cursors can be scaled or shifted vertically and/or horizontally (using **Expand/Shift**).

Performance Verification

You can perform two types of Performance Verification procedures with this product: Self Tests and Performance Tests. You may not need to perform all these procedures, depending on what you want to accomplish.

- Verify that the AWG710 Arbitrary Waveform Generator is operating correctly by running the self tests as described in the *Self Tests* subsection.
Advantages: These procedures require minimal time to perform, require no additional equipment, and test the internal hardware of the AWG710 Arbitrary Waveform Generator.
- If a more extensive confirmation of performance is desired, complete the self test, and then do the performance test beginning on page 4–7.
Advantages: These procedures add direct checking of warranted specifications. They require more time to perform and suitable test equipment is required. (Refer to *Equipment Required* on page 4–8).

Conventions

Throughout these procedures the following conventions apply:

- Each test procedure uses the following general format:
 - Title of Test
 - Equipment Required
 - Prerequisites
 - Procedure
- Each procedure consists of as many steps, substeps, and subparts as required to do the test. Steps, substeps, and subparts are sequenced as follows:
 1. First Step
 - a. First Substep
 - First Subpart
 - Second Subpart
 - b. Second Substep
 2. Second Step
- Instructions for menu selection use the following format: **front-panel BUTTON→Main Menu Button→Side Menu Button**. For example, Push **UTILITY→System→Reset to Factory→OK**
- The name of the button or knob appears in boldface type:
Push **EDIT**; then **Drive...**, push **Floppy** side button and use the knob to select **SINE.WFM** from the file list.

Self Tests

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

The self tests include internal diagnostics to verify that the instrument passes the internal circuit tests, and calibration routines to check and adjust the instrument internal calibration constants.

Diagnostics

This procedure uses internal routines to verify that the instrument is operating correctly. No test equipment or hookups are required.

The instrument automatically performs the internal diagnostics when powered 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 performs a more detailed memory check.

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

Confirm that there is no output being performed by verifying that the RUN LED is not on. If the LED is on, push the **RUN** button to turn it off.

Do the following to verify that the instrument passes the internal circuit tests:

Push **UTILITY** (front-panel)→**Diag** (bottom)→**Diagnostic All** (side).

The diagnostic menu is displayed and all tests are selected. Refer to Figure 4–1. If All is not displayed, select All using the general purpose knob.

The list displayed on the screen shows the test items and results in the calibration and diagnostics previously performed. Select all of the test items shown on the screen or use the general purpose knob to select a single test item that you want to run. The results of the diagnostics are shown as error codes. Pass means that the test results occurred without error. If an error is detected, an error code is displayed.

You can also specify how many times to perform the diagnostic tests. Push the **Cycle** side button and then turn the general purpose knob to select the cycle from 1, 3, 10, 100 or Infinite. When you select Infinite, the tests are repeatedly performed and are not be terminated until you push the **Abort Diagnostic** side button.

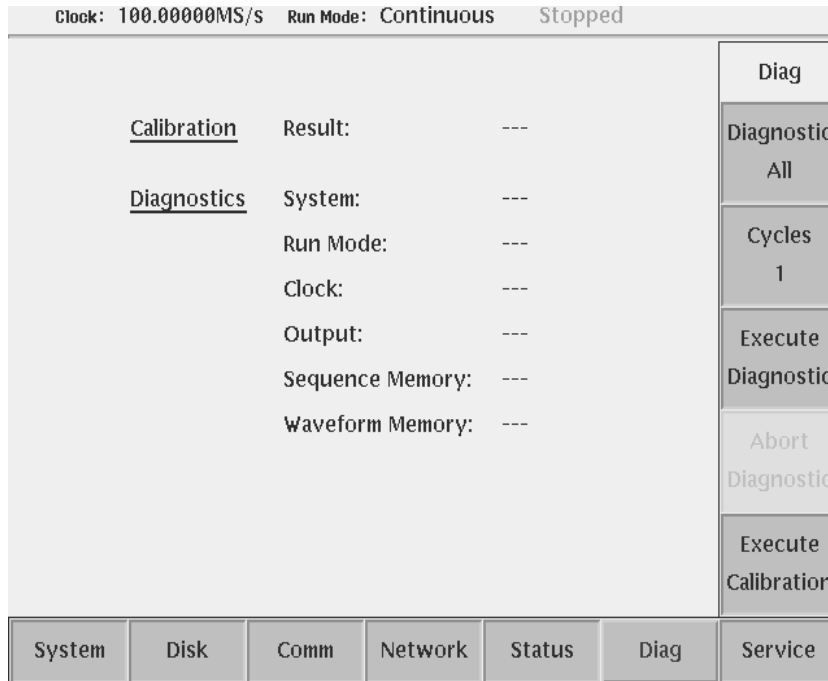


Figure 4-1: Diagnostic menu

Push the **Execute Diagnostic** side button to execute all of the AWG710 Arbitrary Waveform Generator diagnostics automatically.

NOTE. Push the *Abort Diagnostic* button (side menu) to stop a selected diagnostic after it is completed. This button does not stop the diagnostic while it is processing. The *Abort* button stops any further diagnostics from operating.

The internal diagnostics do an extensive verification of AWG710 Arbitrary Waveform Generator functions. While this verification progresses, the screen displays the clock icon. When finished, the resulting status appears on the screen.

Verify that no failures are found and reported on-screen. If the diagnostics terminates without error, Pass is displayed instead of the - - -. If a value is displayed, meaning an error is detected, consult a qualified service technician for further assistance.

Push any bottom or menu button (other than UTILITY) to exit the diagnostic screen.

Calibration

The instrument includes internal calibration routines that check electrical characteristics such as offset, attenuations and filters. Perform calibration to adjust internal calibration constants as necessary. This procedure describes how to do the internal calibration.

Equipment required	None
Prerequisites	Power on the instrument and allow a 20 minute warm-up period at an ambient temperature between +20° C and +30° C before doing this procedure.

Confirm that there is no output being performed by verifying that the RUN LED is not on. If the LED is on, push the **RUN** button to turn it off.

NOTE. *Some calibration items may fail if you start calibration while output is being performed.*

Do the following steps to verify that the internal adjustments have passed:

1. Push **UTILITY** (front-panel)→**Diag** (bottom)→ **Execute Calibration** (side).

This executes the AWG710 Arbitrary Waveform Generator calibration routines automatically.

The internal calibration does an extensive verification of proper AWG710 Arbitrary Waveform Generator functions. While this verification progresses, the message box displaying *Executing Calibration* appears on the screen. When finished, the resulting status will appear in the message box as shown in Figure 4–2.

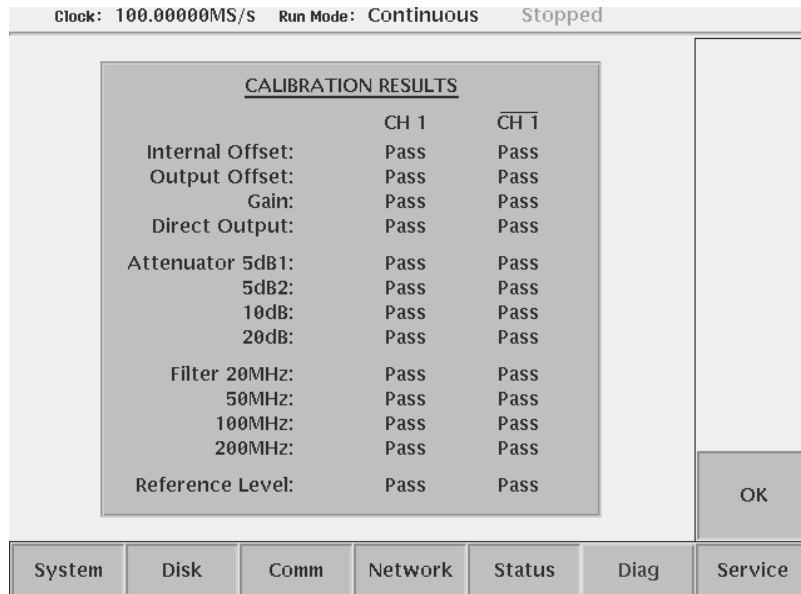


Figure 4-2: Calibration result message box (except option 02)

Verify that no failures are found and reported in the message box. If the calibration displays Fail as the result, consult a qualified service technician for further assistance.

2. Push the **OK** side button and then any bottom or menu button (other than the **UTILITY**) to exit the dialog screen.

NOTE. The calibration data in the memory may be lost if the instrument is powered off while the calibration is executing.

Performance Tests

This subsection contains a collection of procedures for checking that the AWG710 Arbitrary Waveform Generator performs as warranted.

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

Table 4-1: Performance test items

Titles	See (performance verification)	Test items	See (specifications)
Operating mode tests	Page 4-16	Continuous, Triggered, and Gated mode	Page 1-4
Amplitude and offset accuracy tests (normal out)	Page 4-22	Amplitude accuracy, and DC offset accuracy	Page 1-5
Amplitude, DC offset and rise time accuracy tests (direct DA out)	Page 4-27	Amplitude accuracy, DC offset accuracy and Rise time accuracy	Page 1-6
Pulse response tests (normal out)	Page 4-35	Rise time accuracy	Page 1-6
Trigger input tests	Page 4-37	Trigger level accuracy, and Trigger function normality	Page 1-9
Event input and enhanced mode tests	Page 4-41	External event input function normality, and Event mode normality	Page 1-11
1/4 Clock frequency and 10 MHz reference input tests	Page 4-48	1/4 clock output frequency and Reference input normality accuracy	Page 1-5
Marker output tests	Page 4-50	Marker output level accuracy	Page 1-7

The performance tests confirms all the characteristics that are designated as checked in *Appendix A: Specifications*. (The characteristic items that must be checked are listed with the check mark (✓) in *Appendix A: Specifications*).

NOTE. *These procedures extend the confidence level provided by the basic procedures described on page 4-3. The basic procedures should be done first, followed by the Performance Tests, if desired.*

Prerequisites

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

- The cabinet must be installed on the instrument.
- You must have performed and passed the procedures under *Self Tests*, found on page 4–3.
- The waveform generator must have been recently adjusted at an ambient temperature between +20° C and +30° C, must have been operating for a warm-up period of at least 20 minutes, and must be operating at an ambient temperature between +10° C and +40° C.

Refer to *Conventions* on page 4–2 for more information.

Equipment Required

These procedures use external, traceable signal sources to directly check warranted characteristics. Table 4–2 lists the equipment required to complete the performance tests.

Table 4–2: Test equipment

Item number and description	Minimum requirements	Example (recommended)	Purpose
1. Frequency Counter	1 MHz to 100 MHz, Accuracy: < 0.2 ppm	Anritsu MF1603A	Checks reference input.
2. Digital multi meter	DC volts range: 0.05 V to 10 V, Accuracy: ± 0.1 %	Fluke 8842A	Measures voltage. Used in multiple procedures.
3. Oscilloscope	Bandwidth: > 500 MHz, 1 MΩ and 50 Ω inputs	Tektronix 784D	Checks output signals. Used in multiple procedures.
4. Oscilloscope	Bandwidth: > 6 GHz, Rise time: < 58.3 ps, 50 Ω input	Tektronix TDS820	Checks direct DA rise time and normal out pulse response.
5. Function Generator	Output voltage: -5 V to +5 V, Frequency accuracy: < 0.01 %	Tektronix AFG310	Generates external input signals. Used in multiple input signal test procedures.
6. SMA Coaxial Cable (2 required)	50 Ω, male to male SMA connectors	Tektronix part number 174-1427-00	Signal interconnection
7. BNC Coaxial Cable (3 required)	50 Ω, male to male BNC connectors	Tektronix part number 012-0482-00	Signal interconnection
8. Adapter (2 required)	SMA (male) to BNC (female), 50 Ω	Tektronix part number 015-0554-00	Signal interconnection
9. Adapter	SMA (female) to BNC (male), 50 Ω	Tektronix part number 015-0572-00	Signal interconnection

Table 4-2: Test equipment (cont.)

Item number and description	Minimum requirements	Example (recommended)	Purpose
10. BNC-T Connector	BNC (male) to BNC (female) to BNC (female)	Tektronix part number 103-0030-00	Signal interconnection
11. Dual-Banana Connector	BNC (female) to dual banana	Tektronix part number 103-0090-00	Signal interconnection
12. SMA Terminator (2 required)	50 Ω , SMA (male)	Tektronix part number 015-1022-01	Signal termination
13. Precision Terminator	50 Ω , 0.1 %, BNC	Tektronix part number 011-0129-00	Signal termination
14. Performance check disk	Must use example listed	Supplied with the product, Tektronix part number 062-A273-00	To provide waveform files
15. Ground closure (loop-back cable) with 9-pin, D-type connector		Custom, See Figure 4-3.	For event mode test

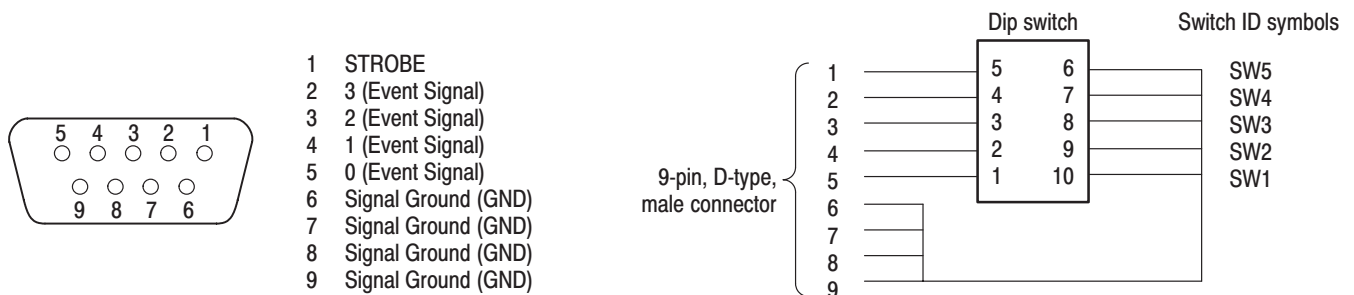


Figure 4-3: EVENT IN connector pins and signals and ground closure connector

Loading Files

The following steps explain how to load files from the Performance Check/Adjustment disk into the waveform memory and/or sequence memory.

1. Insert the disk into the AWG710 Arbitrary Waveform Generator floppy disk drive.
2. Select **SETUP** (front)→**Waveform/Sequence** (bottom)→**Load...** (side)→**Drive...** (side).

The Select Drive dialog box appears as shown in Figure 4-4.

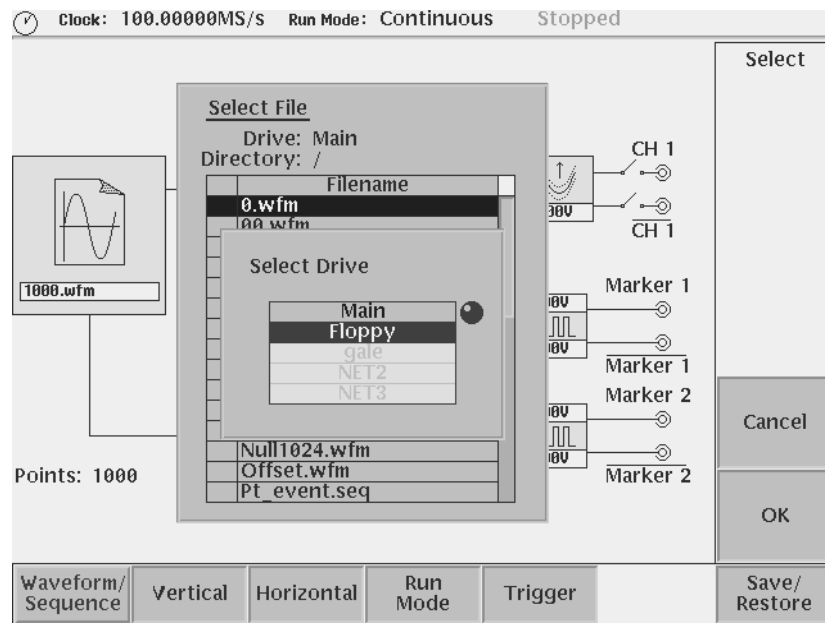


Figure 4-4: Loading file; selecting storage drive

3. Select **Floppy** from the dialog box using the general purpose knob, and then push the **OK** side button.

The Select Drive dialog box disappears and the files in the floppy disk are listed on the Select File dialog box.

4. Use the general purpose knob to select a file to load from the dialog box, and then push the **OK** side button.

The waveform or sequence you selected is loaded into the instrument, and the instrument is also setup with the parameters stored in that file.

5. Remove the floppy disk from the floppy disk drive if the floppy disk is no longer needed.
6. Push any bottom button or menu button to exit the menu.

NOTE. The floppy disk file list displayed on the screen does not automatically update when you replace the diskette with another diskette. To update the file list, reselect the floppy disk drive.

Performance Check/Adjustment Files

Table 4–3 lists the sequence and waveform files on the Performance Check/Adjustment disk that are used in these performance tests, the AWG710 Arbitrary Waveform Generator front panel settings that each file sets up, and the performance test that uses each file.


NOTE. The files on the Performance Check disk are locked (files are marked by the icon  in the file list), so the data in these files cannot be changed unless the lock is opened.

Table 4–3: Waveforms and sequences in performance check disk

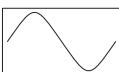
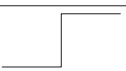
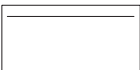


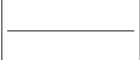
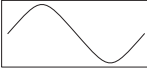


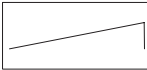
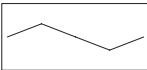
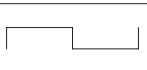
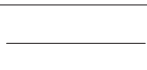
No.	File name	EDIT menu		SETUP menu				Marker setup	Usage
		Form	Points	Clock	Filter	Ampl	Offset		
1	MODE.WFM		1000	4 GHz	Through	1 V	0 V	Marker 1,2: 0 to 499: High, 500 to 999: Low	Run mode, Trigger level, Internal trigger accuracy
2	PULSE.WFM		1000	100 MHz	Through	1 V	0 V		Pulse response
3	AMP1.SEQ								Amplitude accuracy (Normal out), Marker
4	AMP2.SEQ								Amplitude accuracy (Direct out)
5	DC_P.WFM (AMPx.SEQ) ¹		1000	100 MHz	Through	1 V	0 V		Amplitude accuracy
6	DC_M.WFM (AMPx.SEQ) ¹		1000	100 MHz	Through	1 V	0 V		Amplitude accuracy
7	DC0.WFM (AMP2.SEQ)		1000	100 MHz	Through	1 V	0 V		Amplitude accuracy
8	OFFSET.WFM		1000	100 MHz	Through	20 mV	0 V		Offset accuracy

Table 4-3: Waveforms and sequences in performance check disk (cont.)

No.	File name	EDIT menu		SETUP menu				Marker setup	Usage
		Form	Points	Clock	Filter	Ampl	Offset		
9	TRIG.WFM		1000	1 MHz	Through	1 V	0 V		Trigger input
10	PT_EVENT.SEQ								Event input
11	PT_STROB.SEQ								Event input
12	S1024.WFM (PT_XXXX.SEQ) ²		1024	400 MHz	Through	1 V	0 V		Event input
13	S1024H.WFM (PT_XXXX.SEQ) ²		1024	400 MHz	Through	1 V	0 V		Event input
14	R1024H.WFM (PT_XXXX.SEQ) ²		1024	400 MHz	Through	1 V	0 V		Event input
15	T1024H.WFM (PT_XXXX.SEQ) ²		1024	400 MHz	Through	1 V	0 V		Event input
16	Q1024H.WFM (PT_XXXX.SEQ) ²		1024	400 MHz	Through	1 V	0 V		Event input
17	NULL1024H.WFM (PT_XXXX.SEQ) ²		1024	400 MHz	Through	1 V	0 V		Event input

¹ The AMPx.SEQ represents AMP1.SEQ and AMP2.SEQ.

² The PT_XXXX.SEQ represents PT_EVENT.SEQ and PT_STROB.SEQ

AWG710 Test Record

Photocopy this test record and use to record the performance test results for your AWG710 Arbitrary Waveform Generator.

AWG710 Test Record

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

AWG710 Performance Test		Minimum	Incoming	Outgoing	Maximum
Operating Mode					
Check Cont Mode		Pass/Fail	_____	_____	Pass/Fail
Check Triggered Mode (when the FORCE TRIGGER button is pushed)		Pass/Fail	_____	_____	Pass/Fail
Check Triggered Mode (with external triggering)		Pass/Fail	_____	_____	Pass/Fail
Check Gated Mode (when the FORCE TRIGGER button is pushed)		Pass/Fail	_____	_____	Pass/Fail
Check Gated Mode (with the gate signal when the AWG trigger polarity is set to positive)		Pass/Fail	_____	_____	Pass/Fail
Check Gated Mode (with the gate signal when the AWG trigger polarity is set to negative)		Pass/Fail	_____	_____	Pass/Fail
Amplitude and Offset Accuracy (Normal Out), (except option 02)					
CH1 Amplitude	20 mV	17.60 mV	_____	_____	22.40 mV
	200 mV	194.0 mV	_____	_____	206.0 mV
	2 V	1.9580 V	_____	_____	2.0420 V
CH1 Amplitude	20 mV	17.60 mV	_____	_____	22.40 mV
	200 mV	194.0 mV	_____	_____	206.0 mV
	2 V	1.9580 V	_____	_____	2.0420 V
CH1 Offset	0 V	- 10.0 mV	_____	_____	+ 10.0 mV
	+0.5 V	+ 0.4825 V	_____	_____	+ 0.5175 V
	-0.5 V	- 0.4825 V	_____	_____	- 0.5175 V
CH1 Offset	0 V	- 10.0 mV	_____	_____	+ 10.0 mV
	+0.5 V	+ 0.4825 V	_____	_____	+ 0.5175 V
	-0.5 V	- 0.4825 V	_____	_____	- 0.5175 V

AWG710 Test Record (cont.)

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

AWG710 Performance Test		Minimum	Incoming	Outgoing	Maximum
Amplitude, Offset Accuracy and Rise Time (Direct DA Out)					
CH1 Amplitude	20 mV 1 V	17.60 mV 0.9780 V	_____	_____	22.40 mV 1.0220 V
$\overline{\text{CH1}}$ Amplitude	20 mV 1 V	17.60 mV 0.9780 V	_____	_____	22.40 mV 1.0220 V
CH1 Offset	0 V	- 10.0 mV	_____	_____	+ 10.0 mV
$\overline{\text{CH1}}$ Offset	0 V	- 10.0 mV	_____	_____	+ 10.0 mV
CH1 Rise Time	0.5 V Amplitude (10 to 90% point)	N/A	_____	_____	280 ps
$\overline{\text{CH1}}$ Rise Time	0.5 V Amplitude (10 to 90% point)	N/A	_____	_____	280 ps
Amplitude, Offset Accuracy and Rise Time (option 02: Extended bandwidth output)					
CH1 Amplitude	500 mV 1 V	488.0 mV 0.9780 V	_____	_____	512.0 mV 1.0220 V
$\overline{\text{CH1}}$ Amplitude	500 mV 1 V	488.0 mV 0.9780 V	_____	_____	512.0 mV 1.0220 V
CH1 Offset	0 V	- 10.0 mV	_____	_____	+ 10.0 mV
$\overline{\text{CH1}}$ Offset	0 V	- 10.0 mV	_____	_____	+ 10.0 mV
CH1 Rise Time	1.0 V Amplitude (10 to 90 % point)	N/A	_____	_____	175 ps
$\overline{\text{CH1}}$ Rise Time	1.0 V Amplitude (10 to 90 % point)	N/A	_____	_____	175 ps
Pulse Response (Normal Out), (except option 02: Extended bandwidth output)					
CH1 Rise Time	1 V Amplitude (10 to 90% point)	N/A	_____	_____	480 ps
$\overline{\text{CH1}}$ Rise Time	1 V Amplitude (10 to 90% point)	N/A	_____	_____	480 ps
Trigger Input					
Positive Threshold (set the triggering level to 5 V) No trigger when input voltage vary from 0 V to 4.65 V.		Pass/Fail	_____	_____	Pass/Fail
Trigger when input voltage vary from 4.65 V to 5.35 V.		Pass/Fail	_____	_____	Pass/Fail

AWG710 Test Record (cont.)

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

AWG710 Performance Test	Minimum	Incoming	Outgoing	Maximum
Negative Threshold (set the triggering level to -5 V) No trigger when input voltage vary from 0 V to -4.65 V. Trigger when input voltage vary from -5.35 V to -4.65 V.	Pass/Fail Pass/Fail	_____ _____	_____ _____	Pass/Fail Pass/Fail
Event Input and Enhanced Mode				
Check Event Input with Strobe Off pin 0 (when SW1 of the ground closure is closed) pin 1 (when SW2 of the ground closure is closed) pin 2 (when SW3 of the ground closure is closed) pin 3 (when SW4 of the ground closure is closed)	Pass/Fail Pass/Fail Pass/Fail Pass/Fail	_____ _____ _____ _____	_____ _____ _____ _____	Pass/Fail Pass/Fail Pass/Fail Pass/Fail
Check Strobe Input (when SW5 of the ground closure is on and off)	Pass/Fail	_____	_____	Pass/Fail
1/4 Clock Frequency and 10 MHz Reference Input				
Check 1/4 Clock Out Frequency Internal Clock = 200 MS/s	49 999 950 Hz	_____	_____	50 000 050 Hz
Check output with 10 MHz Reference Input 10 MHz Ref In = 10 MHz	49 990 000 Hz	_____	_____	50 010 000 Hz
Check output with 10.1 MHz Reference Input 10 MHz Ref In = 10.1 MHz	50 490 000 Hz	_____	_____	50 510 000 Hz
Marker Output				
MARKER1 Low level (Set the level to -1.1 V.)	-1.2550 V	_____	_____	-0.9450 V
MARKER1 High level (Set the level to 3.0 V.)	2.750 V	_____	_____	3.250 V
MARKER1̄ Low level (Set the level to -1.1 V.)	-1.2550 V	_____	_____	-0.9450 V
MARKER1̄ High level (Set the level to 3.0 V.)	2.750 V	_____	_____	3.250 V
MARKER2 Low level (Set the level to -1.1 V.)	-1.2550 V	_____	_____	-0.9450 V
MARKER2 High level (Set the level to 3.0 V.)	2.750 V	_____	_____	3.250 V
MARKER2̄ Low level (Set the level to -1.1 V.)	-1.2550 V	_____	_____	-0.9450 V
MARKER2̄ High level (Set the level to 3.0 V.)	2.750 V	_____	_____	3.250 V

Operating Mode Tests

The following procedures verify the operation of the Cont, Triggered and Gated modes.

NOTE. When you output signals from the CH1 or $\overline{\text{CH1}}$ OUTPUT, check that the other OUTPUT ($\overline{\text{CH1}}$ or CH1) LED is off. If the other OUTPUT LED is on, push the $\overline{\text{CH1}}$ or CH1 OUT button to turn off the output.

Check Cont Mode

Equipment required	A 50 Ω SMA coaxial cable, a SMA (female)-BNC (male) adapter, and an oscilloscope (TDS784D).
Prerequisites	The AWG710 Arbitrary Waveform Generator must meet the prerequisites listed on page 4–8.

Do the following steps to install the test hookup and set the test equipment controls:

1. Use a 50 Ω SMA coaxial cable to connect the AWG710 Arbitrary Waveform Generator CH1 output connector to the oscilloscope CH1 input connector (see Figure 4–5).

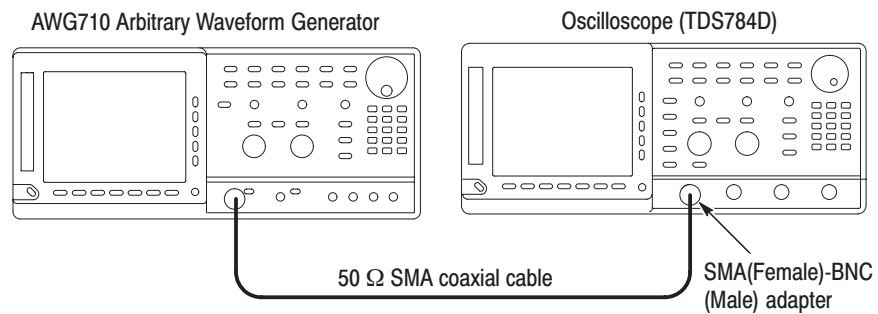


Figure 4–5: Cont mode initial test hookup

2. Set the oscilloscope controls as follows:

Vertical	CH1
CH1 coupling	DC
CH1 scale	200 mV/div
CH1 input impedance	50 Ω
Horizontal	
Sweep	100 ns/div
Trigger	

Source	CH1
Coupling	DC
Slope	Positive
Level	+100 mV
Mode	Auto

Do the following steps to set the AWG710 Arbitrary Waveform Generator controls and to select the waveform file:

1. Push **UTILITY** (front-panel)→**System** (bottom)→**Factory Reset** (side)→**OK** (side).
2. Load the MODE.WFM file.

Refer to *Loading Files* on page 4–10 for file loading procedures.

3. Push the **RUN** and **CH1** output buttons.

The LEDs above the RUN button and CH1 output connectors are on.

4. Check that the amplitude of the sine wave displayed on the oscilloscope is five vertical divisions and that a waveform of approximately one cycle per 2.5 horizontal divisions is displayed.

Check Triggered Mode

The following table lists the equipment and prerequisites required to check the Triggered mode.

Equipment required	Two 50 Ω BNC coaxial cables, a 50 Ω SMA coaxial cable, a SMA(Fe)-BNC(Ma) adapter, a BNC-T (male to 2 females) adapter, a function generator, and an oscilloscope (TDS784D).
Prerequisites	The AWG710 Arbitrary Waveform Generator must meet the prerequisites listed on page 4–8.

Do the following steps to install the test hookup and set the test equipment controls:

1. Use a 50 Ω BNC coaxial cable and a BNC-T adapter to connect the function generator output connector to the AWG710 Arbitrary Waveform Generator TRIG IN connector. Refer to Figure 4–6.
2. Connect a second 50 Ω BNC coaxial cable to the BNC-T adapter. Connect the opposite end of the coaxial cable to the oscilloscope CH2 input.
3. Use a 50 Ω SMA coaxial cable and SMA (female)-BNC (male) adapter to connect the AWG710 Arbitrary Waveform Generator CH1 output connector to the oscilloscope CH1 input connector.

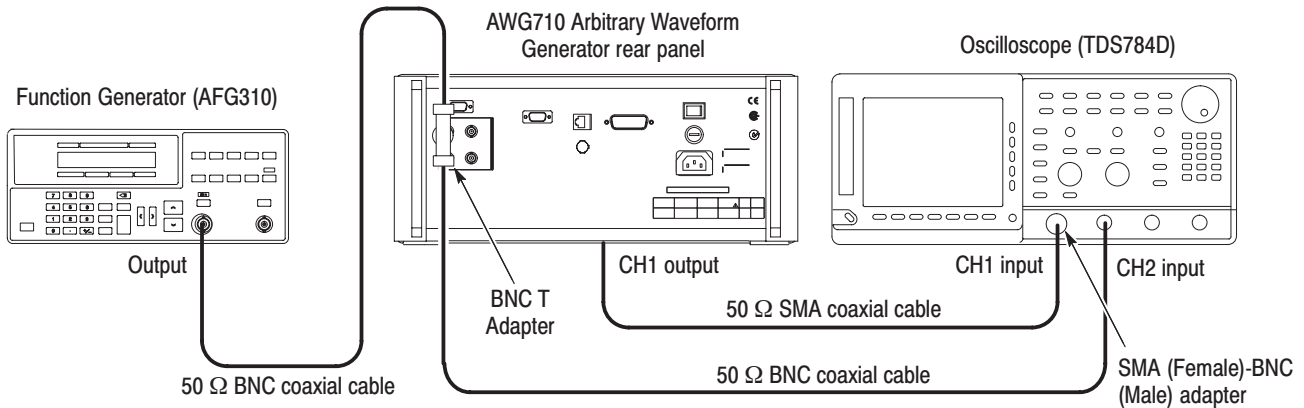


Figure 4-6: Triggered mode initial test hookup

4. Set the oscilloscope controls as follows:

Vertical	CH1 and CH2
CH1 and CH2 coupling	DC
CH1 scale	500 mV/div
CH2 scale	2 V/div
CH1 input impedance	50 Ω
CH2 input impedance	1 MΩ
Horizontal	
Sweep	200 ns/div
Trigger	
Source	CH1
Coupling	DC
Slope	Positive
Level	+100 mV
Mode	NORMAL

5. Set the function generator (AFG310) controls as follows:

Function	Square
Mode	Continuous
Parameters	
Frequency	1 MHz
Amplitude	2.0 V into 50 Ω (4.0 V into 1 MΩ)
Offset	1.0 V into 50 Ω (2.0 V into 1 MΩ)
Output	Off

6. Follow the substeps below to set the AWG710 Arbitrary Waveform Generator controls and to select the waveform file:
 - a. Push **UTILITY** (front-panel)→**System** (bottom)→**Factory Reset** (side)→**OK** (side).
 - b. Push **SETUP** (front-panel)→**Run Mode** (bottom)→**Triggered** (side)
 - c. Load the MODE.WFM file.

Refer to *Loading Files* on page 4–10 for file loading procedures.

- d. Push the **RUN** and **CH1** output buttons.

The LEDs above the RUN button and CH1 output connectors are on.

- e. Push the **FORCE TRIGGER** button.

Verify that the oscilloscope displays a one-cycle sine wave when the FORCE TRIGGER button is pushed. You may need to adjust the horizontal position control to see the signal.

7. Follow the substeps below to check the triggered mode with external triggering:
 - a. Turn on the function generator output.
 - b. Verify that the oscilloscope displays a one-cycle sine wave for each trigger supplied by the function generator. See Figure 4–7.

Retain the test hookup.

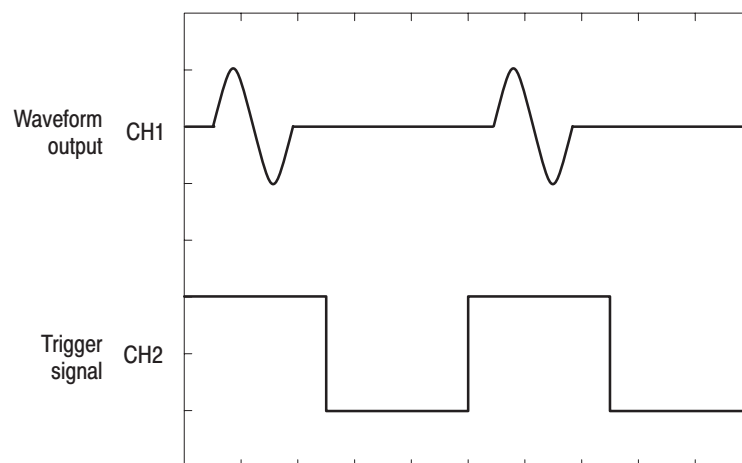


Figure 4–7: Relationship between trigger signal and waveform output

Check Gated Mode

Equipment required	Two 50 Ω BNC coaxial cables, a 50 Ω SMA coaxial cable, a SMA (female)-BNC (male) adapter, a BNC-T (male to 2 females) adapter, a function generator, and an oscilloscope (TDS784D).
Prerequisites	The AWG710 Arbitrary Waveform Generator must meet the prerequisites listed on page 4–8.

1. Set the oscilloscope controls as follows:

Vertical	CH1 and CH2
CH1 and CH2 coupling	DC
CH1 scale	500 mV/div
CH2 scale	2 V/div
CH1 input impedance	50 Ω
CH2 input impedance	1 M Ω
Horizontal	
Sweep	20 μ s/div
Trigger	
Source	CH1
Coupling	DC
Slope	Positive
Level	100 mV
Mode	NORMAL

2. Set the function generator (AFG310) controls as follows:

Function	Square
Mode	Continuous
Parameters	
Frequency	10.1 kHz
Amplitude	2.0 V into 50 Ω (4.0 V into 1 M Ω)
Offset	1.0 V into 50 Ω (2.0 V into 1 M Ω)
Output	Off

3. Follow the substeps below to set the AWG710 Arbitrary Waveform Generator controls and to select the waveform file:
 - a. Push **UTILITY** (front-panel)→**System** (bottom)→**Factory Reset** (side)→**OK** (side).
 - b. Push **SETUP** (front-panel)→**Run Mode** (bottom)→**Gated** (side).
 - c. Load the MODE.WFM file.

Refer to *Loading Files* on page 4–10 for file loading procedures.

- d. Push **HORIZONTAL MENU** (front-panel)→ **Clock** (side).

- e. Push **1, 0, 0** and **M** (SHIFT+7) keys in this order or turn the general purpose knob to set the internal clock frequency to 100 MHz.
- f. Push the **RUN** and **CH1** output buttons.

The LEDs above the **RUN** button and **CH1** output connector are on.

- g. Push the **FORCE TRIGGER** button.

Verify that the oscilloscope displays sine waves while the FORCE TRIGGER button is pushed and that the output stops when the Force Trigger button is released.

4. Follow the substeps below to check the gated mode with the gate signal:
 - a. Set the oscilloscope trigger source to CH2 and change the trigger level to 1 V.
 - b. Turn on the function generator output.
 - c. Verify that the oscilloscope displays sine waves while the function generator gate signal amplitude is High level. See Figure 4–8.

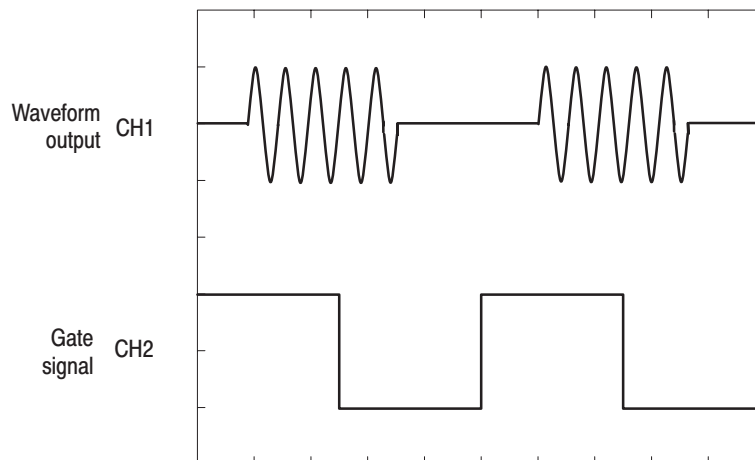


Figure 4–8: Relationship between gate signal and waveform output

- d. Push **SETUP** (front-panel)→**Trigger** (bottom)→**Negative** (side).

This changes the AWG710 Arbitrary Waveform Generator trigger polarity to negative.

5. Verify that the oscilloscope displays sine waves while the function generator gate signal amplitude is Low level.
6. Turn off the function generator output and disconnect from the oscilloscope.

Amplitude and Offset Accuracy Tests (Normal Out), (except option 02)

These procedures check the accuracy of the amplitude and offset outputs of the AWG710 Arbitrary Waveform Generator.

NOTE. *The amplitude and offset accuracy checks are structured as a continuous test. The next test uses the control settings from the previous test and uses the next step in the sequence file.*

NOTE. *When you output signal from the CH1 or $\overline{CH1}$ OUTPUT, check that the other OUTPUT ($\overline{CH1}$ or CH1) LED is off. If the other OUTPUT LED is on, push the $\overline{CH1}$ or CH1 OUT button to turn off the output.*

Check Amplitude Accuracy

Equipment required	A 50 Ω BNC coaxial cable, a 50 Ω precision terminator, a SMA (male)-BNC (female) adapters, BNC (female)-to-dual banana adapter, and a digital multimeter (DMM).
Prerequisites	The AWG710 Arbitrary Waveform Generator must meet the prerequisites listed on page 4–8.

Do the following steps to install the test hookup and set the test equipment controls:

1. Use a 50 Ω BNC coaxial cable, a SMA(Ma)-BNC(Fe) adapter, a 50 Ω precision terminator, and a BNC-to-dual banana adapter to connect the AWG710 Arbitrary Waveform Generator CH1 output to the DMM input connector (see Figure 4–9).

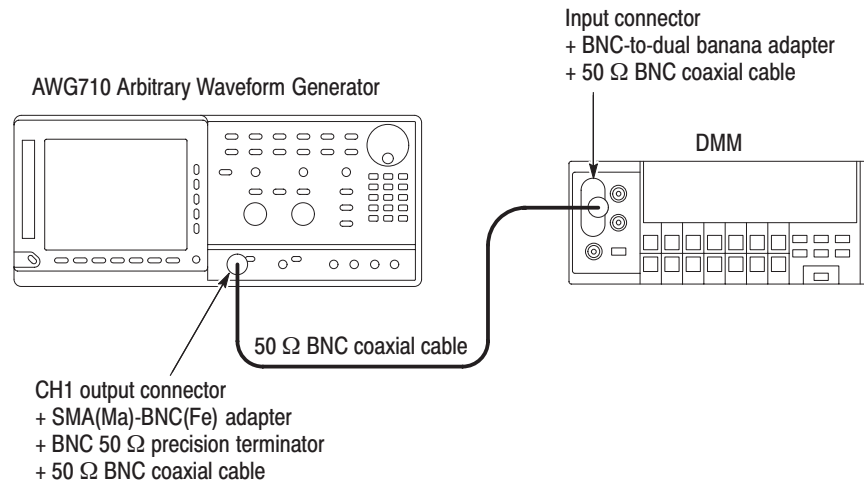


Figure 4–9: Amplitude accuracy initial test hookup

2. Set the DMM controls as follows:

Mode	VDC
Range	Auto
Input	Front

3. Follow the substeps below to set the AWG710 Arbitrary Waveform Generator controls and to select the sequence file:
 - a. Push **UTILITY** (front-panel)→**System** (bottom)→**Factory Reset** (side)→**OK** (side).
 - b. Push **SETUP** (front-panel)→**Run Mode** (bottom)→**Enhanced** (side).

The AWG710 Arbitrary Waveform Generator is set to enhanced mode.

- c. Load the AMP1.SEQ file.

Refer to *Loading Files* on page 4–10 for file loading procedures.

4. Push the **RUN** and **CH1** output buttons.

The LEDs above the RUN button and CH1 output connector are on.

5. Do the following substeps to set the AWG710 Arbitrary Waveform Generator amplitude and confirm the offset setting:
 - a. Push **VERTICAL MENU** (front-panel)→**Amplitude** (side).

- b. Push **0**, **.**, **0**, **2** and **ENTER** keys in this order or turn the general purpose knob to set the amplitude to 0.020 V.
- c. Verify that the offset setting display on the Offset side button is 0.000 V.

If the offset display is not set correctly, push the **Offset** side button, push **0** and then the **ENTER** key.

- 6. Do the following substeps to check the amplitude accuracy of a 20 mV amplitude setting:
 - a. Write the DMM reading as a positive voltage.
 - b. Push the **FORCE EVENT** button.
 - c. Write the DMM reading as a negative voltage.
 - d. Verify that the positive minus negative voltages fall within 20 mV \pm 2.4 mV.
 - e. Push **0**, **.**, **2** and **ENTER** keys in this order or turn the general purpose knob to set the amplitude to 0.200 V.
- 7. Do the following to check the amplitude accuracy of 200 mV amplitude setting:
 - a. Push the **FORCE EVENT** button.
 - b. Write the DMM reading as a positive voltage.
 - c. Push the **FORCE EVENT** button.
 - d. Write the DMM reading as a negative voltage.
 - e. Verify that the positive minus negative voltages fall within 200 mV \pm 6 mV.
 - f. Push the **2** and the **ENTER** keys in this order or turn the general purpose knob to set the amplitude to 2 V.
- 8. Do the following substeps to check the amplitude accuracy of 2 V amplitude setting:
 - a. Push the **FORCE EVENT** button.
 - b. Write the DMM reading as a positive voltage.
 - c. Push the **FORCE EVENT** button.
 - d. Write the DMM reading as a negative voltage.
 - e. Check that the positive minus negative voltages fall within 2 V \pm 0.042 V.

9. Do the following substeps to change the connection to check the $\overline{\text{CH1}}$:
 - a. Push the **CH1** output button.
 - b. Disconnect the adapter, terminator, and cable from the **CH1** output connector.
 - c. Connect the adapter, terminator, and cable (removed in step b) to the $\overline{\text{CH1}}$ output connector.
 - d. Push the $\overline{\text{CH1}}$ output button to turn on the $\overline{\text{CH1}}$ LED.
10. Repeat the *Check Amplitude Accuracy* procedure for the AWG710 Arbitrary Waveform Generator $\overline{\text{CH1}}$ beginning on page 4–22.
11. Reconnect the test hookup on the $\overline{\text{CH1}}$ output to the CH1 output. Retain the control settings.

Check Offset Accuracy

The following procedure checks the Offset Accuracy:

1. Use the test hookup and settings from the Accuracy Test on page 4–22.
2. Follow the substeps below to set the AWG710 Arbitrary Waveform Generator controls and to select the sequence file:
 - a. Push **UTILITY** (front-panel)→**System** (bottom)→**Factory Reset** (side)→**OK** (side).
 - b. Load the OFFSET.WFM file.
Refer to *Loading Files* on page 4–10 for file loading procedures.
 - c. Push **VERTICAL MENU** (front-panel)→**Amplitude** (side).
 - d. Push **0**, **.**, **0**, **2** and **ENTER** keys in this order or turn the general purpose knob to set the amplitude to 0.020 V.
3. Push the **RUN** and **CH1** output buttons.
The LEDs above the RUN button and CH1 output connector are on.
4. Do the following substeps to set the AWG710 Arbitrary Waveform Generator offset:
 - a. Push the **Offset** side button.
 - b. Push **0** and **ENTER** keys in this order.
 - c. Verify that the reading on the DMM falls within $0\text{ V} \pm 10\text{ mV}$.
 - d. Push **0**, **.**, **5** and **ENTER** keys in this order to change the AWG710 Arbitrary Waveform Generator offset to 0.5 V.

- e. Verify that the reading on the DMM falls within $0.5 \text{ V} \pm 0.0175 \text{ V}$.
 - f. Push **-**, **0**, **.**, **5** and **ENTER** keys in this order to change the AWG710 Arbitrary Waveform Generator offset to -0.5 V.
 - g. Check that the reading on the DMM falls within $-0.5 \text{ V} \pm 0.0175 \text{ V}$.
5. Do the following substeps to change the connection to check the $\overline{\text{CH1}}$:
 - a. Push the **CH1** output button.
 - b. Disconnect the adapter, terminator and cable from the **CH1** output connector.
 - c. Connect the adapter, terminator, and cable (removed in step b) to the $\overline{\text{CH1}}$ output connector.
 - d. Push the $\overline{\text{CH1}}$ output button to turn on the $\overline{\text{CH1}}$ LED.
 6. Repeat the *Check Offset Accuracy* procedure for the AWG710 Arbitrary Waveform Generator $\overline{\text{CH1}}$.
 7. Push the $\overline{\text{CH1}}$ output button to turn off the $\overline{\text{CH1}}$ LED.
 8. Disconnect the test hookup from the $\overline{\text{CH1}}$ output connector.

Amplitude, Offset Accuracy and Rise Time Tests (Direct DA Out), (except option 02)

These procedures check the accuracy of the AWG710 Arbitrary Waveform Generator direct waveform outputs; amplitude and offset.

Check Amplitude and DC Offset

Equipment required	A 50 Ω BNC coaxial cable, a 50 Ω precision terminator, an SMA (male)-BNC (female) adapter, BNC (female)-to-dual banana adapter, and a digital multimeter (DMM).
Prerequisites	The AWG710 Arbitrary Waveform Generator must meet the prerequisites listed on page 4–8.

Do the following steps to install the test hookup and set the test equipment controls:

1. Use a 50 Ω BNC coaxial cable, an SMA(Ma)-BNC(Fe) adapter, a 50 Ω precision terminator, and a BNC-to-dual banana adapter to connect the AWG710 Arbitrary Waveform Generator **CH1** output to the DMM input connector (see Figure 4–10).

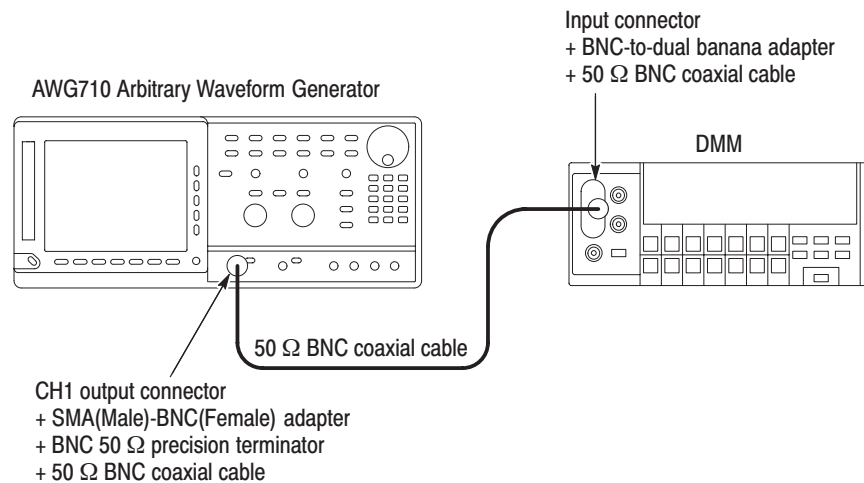


Figure 4–10: Direct DA output amplitude accuracy initial test hookup

2. Set the DMM controls as follows:

Mode	VDC
Range	2 V
Input	Front

3. Push **UTILITY** (front-panel)→**System** (bottom)→**Factory Reset** (side)→**OK** (side).

4. Push **SETUP** (front-panel)→**Run Mode** (bottom)→**Enhanced** (side).
The AWG710 Arbitrary Waveform Generator is set to enhanced mode.
5. Push **VERTICAL MENU** (front-panel)→**Output** (side)→**Direct** (side).
6. Load the AMP2.SEQ file.
Refer to *Loading Files* on page 4–10 for file loading procedures.
7. Push the **RUN** and **CH1** output buttons.
The LEDs above the RUN button and CH1 output connector are on.
8. Do the following substeps to check the direct DA amplitude accuracy of a 1 V amplitude setting:
 - a. Write the DMM reading as a positive voltage.
 - b. Push the **FORCE EVENT** button.
 - c. Write the DMM reading as a negative voltage.
 - d. Verify that the positive minus negative voltages fall within $1.0\text{ V} \pm 0.022\text{ V}$.
 - e. Push **VERTICAL MENU** (front-panel)→**Amplitude** (side).
 - f. Push **0**, **.,0**, **2** and **ENTER** keys in this order or turn the general purpose knob to set the amplitude to 0.020 V.
9. Do the following to check the direct DA amplitude accuracy of 20 mV amplitude setting:
 - a. Push the **FORCE EVENT** button.
 - b. Write the DMM reading as a positive voltage.
 - c. Push the **FORCE EVENT** button.
 - d. Write the DMM reading as a negative voltage.
 - e. Verify that the positive minus negative voltages fall within $20\text{ mV} \pm 2.4\text{ mV}$.
10. Follow the substeps below to check the DC offset:
 - a. Push the **FORCE EVENT** button.
 - b. Check that the reading from the oscilloscope display is about $0\text{ V} \pm 10\text{ mV}$.
11. Do the following substeps to change the connection to check the $\overline{\text{CH1}}$:
 - a. Push the **CH1** output button.

- b. Disconnect the adapter, terminator and cable from the **CH1** output connector.
 - c. Connect the adapter, terminator, and cable (removed in step b) to the **CH1** output connector.
 - d. Push the **CH1** output button to turn on the **CH1** LED.
12. Repeat step 8 through step 10 for the AWG710 Arbitrary Waveform Generator CH1.
 13. Push the **CH1** output button to turn off the **CH1** LED.
 14. Push the **RUN** button to turn off the RUN LED.
 15. Disconnect the DMM.

Check Pulse Rise Time

Equipment required	A 50 Ω SMA coaxial cable and an oscilloscope (TDS820).
Prerequisites	The AWG710 Arbitrary Waveform Generator must meet the prerequisites listed on page 4–8.

Do the following steps to install the test hookup and set the test equipment controls:

1. Use the 50 Ω SMA coaxial cable to connect the AWG710 Arbitrary Waveform Generator CH1 output connector to the oscilloscope CH1 input connector (see Figure 4–11).

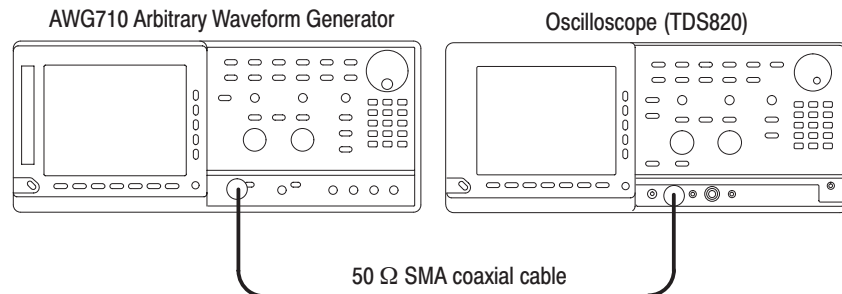



Figure 4–11: Direct DA output pulse rise time initial test hookup

2. Set the oscilloscope controls as follows:

Vertical	CH1
CH1 coupling	DC if applicable
CH1 scale	100 mV/div
Horizontal	
Sweep	500 ps/div

Trigger	
Source	CH1
Slope	
Level	0 V
Mode	Auto

NOTE. The pulse rise time tests use the AWG710 Arbitrary Waveform Generator control settings that have been used in the amplitude and DC offset tests. Do not initialize the AWG710 Arbitrary Waveform Generator controls.

3. Load the PULSE.WFM file.

Refer to *Loading Files* on page 4–10 for file loading procedures.

4. Push **SETUP** (front-panel)→**Run Mode** (bottom)→**Continuous** (side).

The AWG710 Arbitrary Waveform Generator is set to the Continuous mode.

5. Change the AWG710 Arbitrary Waveform Generator controls as follows:

- a. Push **VERTICAL MENU** (bottom)→**Amplitude** (side).
- b. Push **0**, **.**, **5** and **ENTER** keys in this order or turn the general purpose knob to set the amplitude to 0.5 V.
- c. Verify that the Direct DA out is set. If not, push **Output** (side)→**Direct** (side).

6. Push the **RUN** and **CH1** output buttons.

The LEDs above the RUN button and CH1 output connectors are on.

7. Verify that the rise time of the pulse waveform displayed on the oscilloscope is equal to or less than 280 ps.

8. Do the following substeps to change the connection to check the $\overline{\text{CH1}}$:

- a. Push the **CH1** output button.
- b. Disconnect the cable from the CH1 output connector.
- c. Connect the cable to the $\overline{\text{CH1}}$ output connector.
- d. Push the $\overline{\text{CH1}}$ output button to turn on the $\overline{\text{CH1}}$ LED.

9. Repeat step 7 to verify the rise time for the AWG710 Arbitrary Waveform Generator CH1.

10. Push the $\overline{\text{CH1}}$ output button to turn off the $\overline{\text{CH1}}$ LED.

Amplitude, Offset Accuracy and Rise Time Tests (for option 02)

These procedures check the accuracy of the AWG710 Arbitrary Waveform Generator option 02 outputs; amplitude and offset.

Check Amplitude and DC Offset

Equipment required	A 50 Ω BNC coaxial cable, a 50 Ω precision terminator, an SMA(Ma)-BNC(Fe) adapter, BNC (female)-to-dual banana adapter, and a digital multimeter (DMM).
Prerequisites	The AWG710 option 02 Arbitrary Waveform Generator must meet the prerequisites listed on page 4-8.

Do the following steps to install the test hookup and set the test equipment controls:

1. Use a 50 Ω BNC coaxial cable, an SMA(Ma)-BNC(Fe) adapter, a 50 Ω precision terminator, and a BNC-to-dual banana adapter to connect the AWG710 Arbitrary Waveform Generator **CH1** output to the DMM input connector (see Figure 4-12).

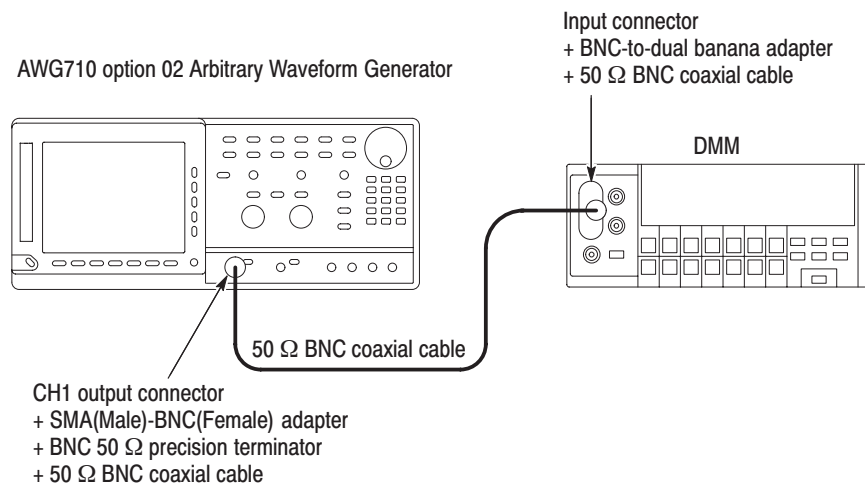


Figure 4-12: Option 02 output amplitude accuracy initial test hookup

2. Set the DMM controls as follows:

Mode	VDC
Range	2 V
Input	Front

3. Push **UTILITY** (front-panel)→**System** (bottom)→**Factory Reset** (side)→**OK** (side).

4. Push **SETUP** (front-panel)→**Run Mode** (bottom)→**Enhanced** (side).

The AWG710 Arbitrary Waveform Generator is set to enhanced mode.

5. Load the AMP2.SEQ file.

Refer to *Loading Files* on page 4–10 for file loading procedures.

6. Push the **RUN** and **CH1** output buttons.

The LEDs above the RUN button and CH1 output connector are on.

7. Do the following substeps to check the option 02 amplitude accuracy of 1 V amplitude setting:

a. Write the DMM reading as a positive voltage.

b. Push the **FORCE EVENT** button.

c. Write the DMM reading as a negative voltage.

d. Verify that the positive minus negative voltages fall within $1.0\text{ V} \pm 0.022\text{ V}$.

e. Push **VERTICAL MENU** (front-panel)→**Amplitude** (side).

f. Push **0**, **.**, **5** and **ENTER** keys in this order or turn the general purpose knob to set the amplitude to 0.500 V.

8. Do the following to check the option 02 amplitude accuracy of 500 mV amplitude setting:

a. Push the **FORCE EVENT** button twice.

b. Write the DMM reading as a positive voltage.

c. Push the **FORCE EVENT** button.

d. Write the DMM reading as a negative voltage.

e. Verify that the positive minus negative voltages fall within $500\text{ mV} \pm 12\text{ mV}$.

9. Follow the substeps below to check the DC offset:

a. Push the **FORCE EVENT** button.

b. Verify that the reading on the DMM falls within $0\text{ V} \pm 10\text{ mV}$.

10. Do the following substeps to change the connection to check the $\overline{\text{CH1}}$:

a. Push the **CH1** output button.

- b. Disconnect the adapter, terminator and cable from the **CH1** output connector.
 - c. Connect the adapter, terminator, and cable (removed in step b) to the **CH1** output connector.
 - d. Push the **CH1** output button to turn on the **CH1** LED.
 - e. Push the **FORCE EVENT** button.
11. Repeat steps 7 through step 9 for the AWG710 Arbitrary Waveform Generator **CH1**.
 12. Push the **CH1** output button to turn off the **CH1** LED.
 13. Push the **RUN** button to turn off the **RUN** LED.
 14. Disconnect the DMM.

Check Pulse Rise Time

Equipment required	A 50 Ω SMA coaxial cable and an oscilloscope (TDS820).
Prerequisites	The AWG710 Arbitrary Waveform Generator must meet the prerequisites listed on page 4-8.

Do the following steps to install the test hookup and set the test equipment controls:

1. Use the 50 Ω SMA coaxial cable to connect the AWG710 Arbitrary Waveform Generator **CH1** output connector to the oscilloscope **CH1** input connector (see Figure 4-13).

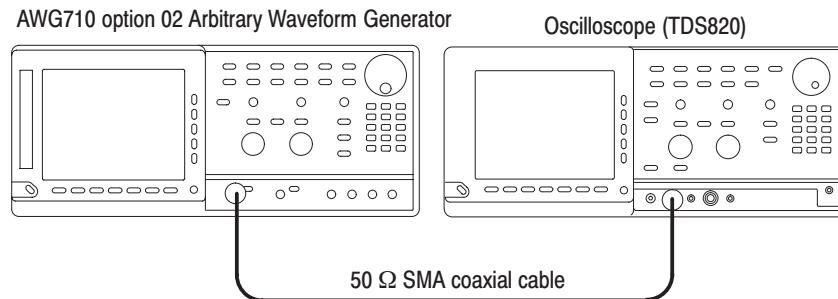



Figure 4-13: Option 02 output pulse rise time initial test hookup

2. Set the oscilloscope controls as follows:

Vertical CH1
 CH1 coupling DC if applicable

CH1 scale	200 mV/div
Horizontal	
Sweep	200 ps/div
Trigger	
Source	CH1
Slope	
Level	0 V
Mode	Auto

NOTE. The pulse rise time tests use the AWG710 Arbitrary Waveform Generator's control settings that have been used in the amplitude and DC offset tests. Do not initialize the AWG710 Arbitrary Waveform Generator controls.

3. Load the PULSE.WFM file.

Refer to *Loading Files* on page 4–10 for file loading procedures.

4. Push **SETUP** (front-panel)→**Run Mode** (bottom)→**Continuous** (side).

The AWG710 Arbitrary Waveform Generator is set to the Continuous mode.

5. Change the AWG710 Arbitrary Waveform Generator controls as follows:

- a. Push **VERTICAL MENU** (bottom)→**Amplitude** (side).
- b. Push **1** and **ENTER** keys in this order or turn the general purpose knob to set the amplitude to 1 V.

6. Push the **RUN** and **CH1** output buttons.

The LEDs above the RUN button and CH1 output connectors are on.

7. Verify that the rise time of the pulse waveform displayed on the oscilloscope is equal to or less than 175 ps.

8. Do the following substeps to change the connection to check the $\overline{\text{CH1}}$:

- a. Push the **CH1** output button.
- b. Disconnect the cable from the CH1 output connector.
- c. Connect the cable to the $\overline{\text{CH1}}$ output connector.
- d. Push the $\overline{\text{CH1}}$ output button to turn on the $\overline{\text{CH1}}$ LED.

9. Repeat step 7 to verify the rise time for the AWG710 Arbitrary Waveform Generator $\overline{\text{CH1}}$.

10. Push the $\overline{\text{CH1}}$ output button to turn off the $\overline{\text{CH1}}$ LED.

Pulse Response Tests (Normal Out), (except option 02)

This procedure checks the pulse response characteristics of the AWG710 Arbitrary Waveform Generator output waveforms at amplitudes of 1 V.

Equipment required	A 50 Ω SMA coaxial cable and an oscilloscope (TDS820).
Prerequisites	The AWG710 Arbitrary Waveform Generator must meet the prerequisites listed on page 4-8.

Do the following steps to install the test hookup and set the test equipment controls:

1. Use the 50 Ω SMA coaxial cable to connect the AWG710 Arbitrary Waveform Generator CH1 output connector to the oscilloscope CH1 input connector (see Figure 4-14).

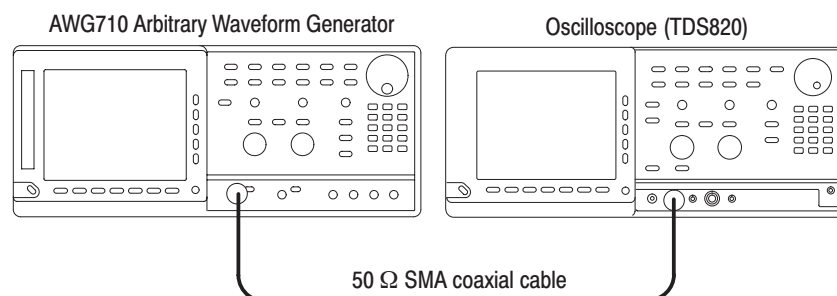


Figure 4-14: Pulse response initial test hookup

2. Set the oscilloscope controls as follows:

Vertical	CH1
CH1 coupling	DC if applicable
CH1 scale	200 mV/div
Horizontal	
Sweep	500 ps/div
Trigger	
Source	CH1
Slope	Positive
Level	0 V
Mode	Auto

3. Push **UTILITY** (front-panel)→**System** (bottom)→**Factory Reset** (side)→**OK** (side).

4. Load the PULSE.WFM file.

Refer to *Loading Files* on page 4–10 for file loading procedures.

5. Push the **RUN** and **CH1** output buttons.

The LEDs above the RUN button and CH1 output connector are on.

6. Verify the pulse response at 1 V amplitude.

- a. Verify that the rise time of the waveform displayed on the oscilloscope from 10% to 90% point is equal to or less than 480 ps.

7. Do the following substeps to change the connection to check the $\overline{\text{CH1}}$:

- a. Push the **CH1** output button.
- b. Disconnect the cable from the CH1 output connector.
- c. Connect the cable to the $\overline{\text{CH1}}$ output connector.
- d. Push the $\overline{\text{CH1}}$ output button to turn on the $\overline{\text{CH1}}$ LED.

8. Repeat the *Check Pulse Response procedure* for the AWG710 Arbitrary Waveform Generator $\overline{\text{CH1}}$.

9. Push the $\overline{\text{CH1}}$ output button to turn off the $\overline{\text{CH1}}$ LED.

10. Disconnect the oscilloscope.

Trigger Input Tests

These procedures check the trigger level accuracy of the AWG710 Arbitrary Waveform Generator.

Equipment required	Two 50 Ω BNC coaxial cables, a 50 Ω SMA coaxial cable, a SMA (female)-BNC (male) adapter, a BNC-T (male to 2 females) adapter, a function generator, and an oscilloscope (TDS784D).
Prerequisites	The AWG710 Arbitrary Waveform Generator must meet the prerequisites listed on page 4–8.

Do the following steps to install the test hookup and set the test equipment controls:

1. Use a 50 Ω SMA coaxial cable and an SMA(Fe)-BNC(Fe) adapter to connect the AWG710 Arbitrary Waveform Generator CH1 output connector to the oscilloscope CH1 input connector.
2. Use a BNC coaxial cable to connect the function generator to the BNC-T adapter which goes to the Trigger Input on the AWG710. Connect a 50 Ω BNC coaxial cable to the BNC-T adapter. Connect the opposite end of the BNC cable to the CH2 input on the oscilloscope. Refer to Figure 4–15.

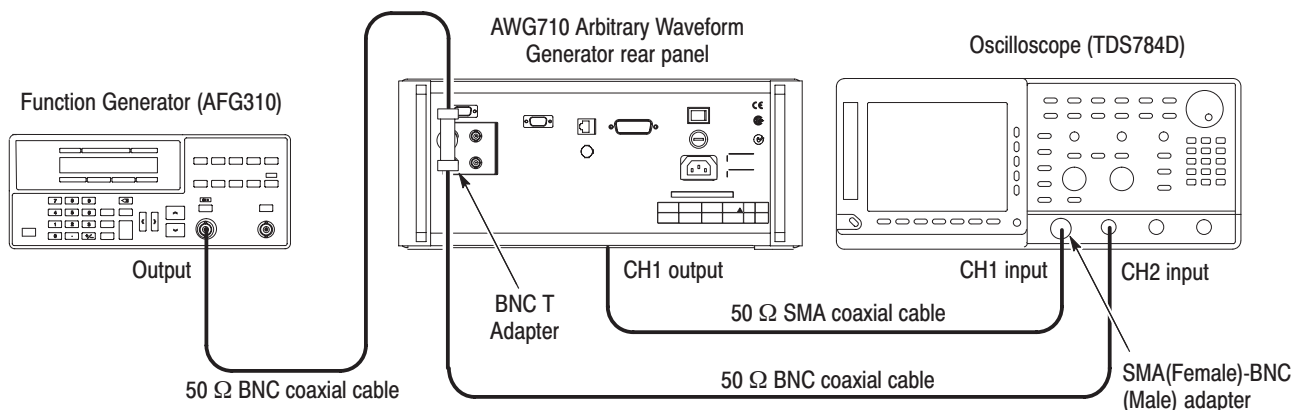


Figure 4–15: Trigger input initial test hookup

3. Set the oscilloscope controls as follows:

Vertical	CH1 and CH2
CH1 and CH2 coupling	DC
CH1 scale	500 mV/div
CH2 scale	2 V/div

CH1 input impedance	50 Ω
CH2 input impedance	1 M Ω
Horizontal	
Sweep	1 ms/div
Trigger	
Source	CH1
Coupling	DC
Slope	Positive
Level	+100 mV
Mode	Auto

- a. Set the function generator controls as follows:

Function	DC
Mode	Continuous
Output	Off

- b. Push **UTILITY** (front-panel)→**System** (bottom)→**Factory Reset** (side)→**OK** (side).
- c. Push **SETUP** (front-panel)→**Run Mode** (bottom)→**Gated** (side).
- d. Load the TRIG.WFM file.

Refer to *Loading Files* on page 4–10 for file loading procedures.

4. Push the **RUN** and **CH1 OUT** buttons.

The LEDs above the RUN button and CH1 output connector are on.

5. Set the trigger level to 5 V by the following substeps:

- a. Push **SETUP** (front-panel)→**Trigger** (bottom)→**Level** (side).
- b. Push **5** and **ENTER** keys in this order.

6. Set the trigger input signal level to 4.65 V by the following substeps below:

- a. Turn on the function generator output.
- b. Select offset by pressing the **OFFSET** button of the function generator.
- c. Set the DC waveform High level to 4.65 V by using the arrow keys.
- d. Check that no waveform is displayed on the oscilloscope as shown in Figure 4–16.

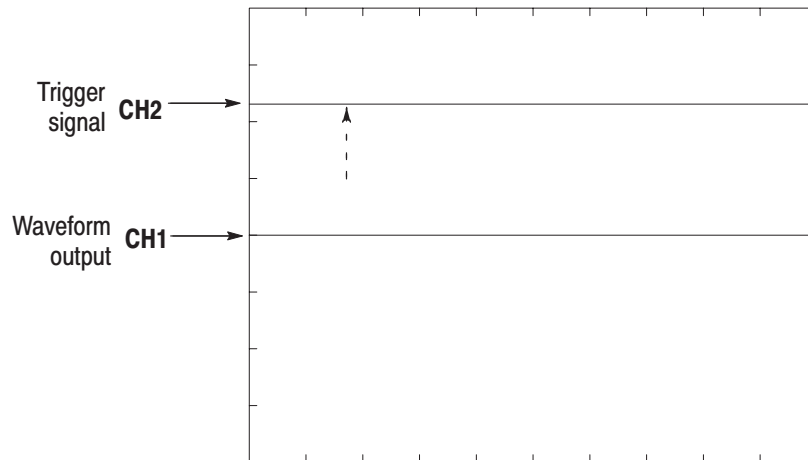


Figure 4-16: Trigger signal and waveform output (+5 V check 1)

- e. Change the pulse waveform high level to 5.35 V by using the arrow keys.
- f. Check that the sine waves are displayed on the oscilloscope as shown in Figure 4-17.

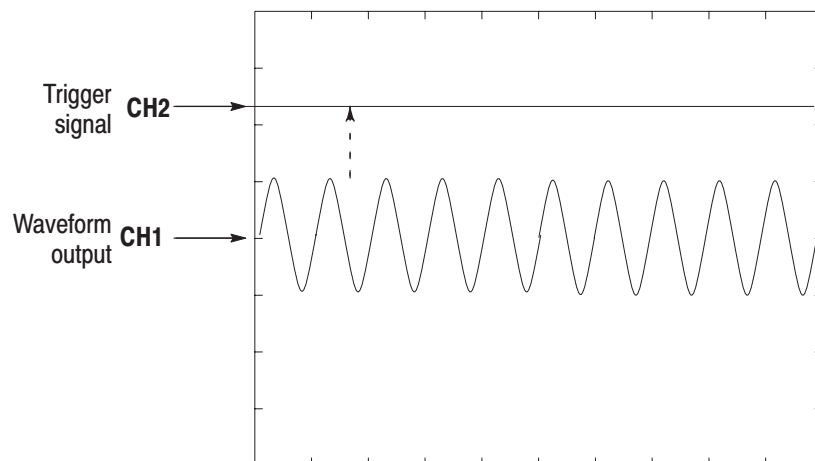


Figure 4-17: Trigger signal and waveform output (+5 V check 2)

7. Follow the substeps below to check the trigger level accuracy at -5 V:
 - a. Push **-**, **5** and **ENTER** keys in this order.
 - b. Set the DC waveform low level of the function generator to -5.35 V by using the arrow keys.

- c. Check that no waveform is displayed on the oscilloscope as shown in Figure 4–18.

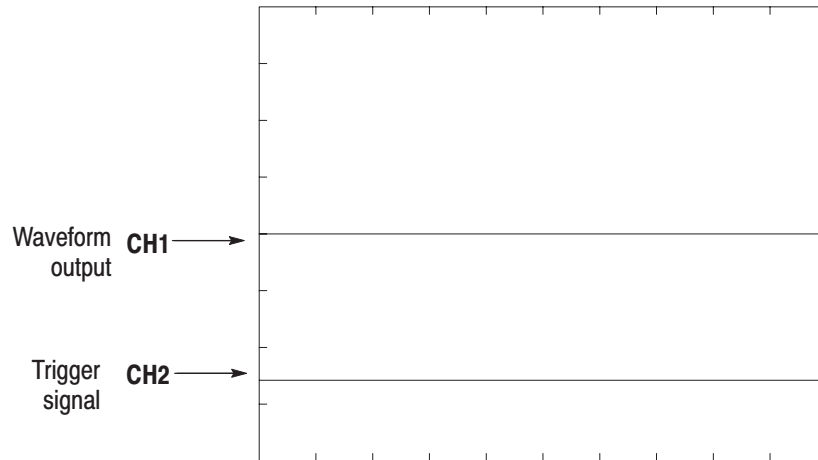


Figure 4–18: Trigger signal and waveform output (-5 V check 1)

- d. Change the pulse waveform low level of function generator to -4.65 V by using cursor keys.
- e. Check that sine waves are displayed on the oscilloscope as shown in Figure 4–19.

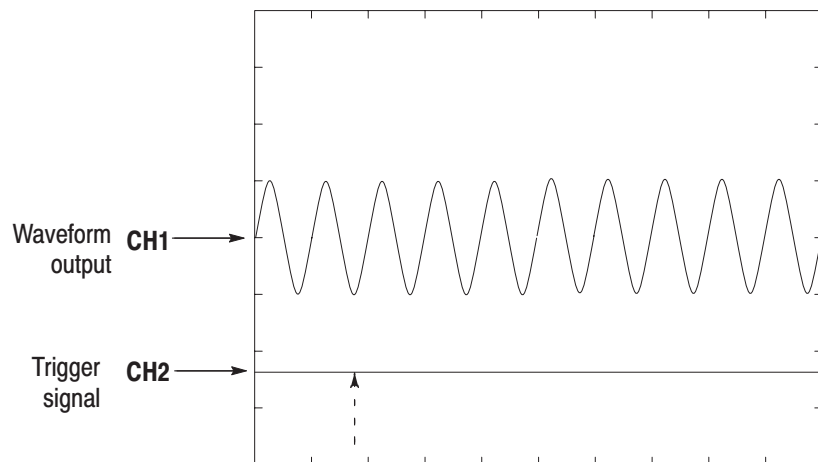


Figure 4–19: Trigger signal and waveform output (-5 V check 2)

- 8. Push the **RUN** button and the CH1 button to turn off the RUN LED.
- 9. Turn off the function generator output to disconnect the function generator.

Event Input and Enhanced Mode Tests

These procedures check the event input signals and enhanced mode operation.

NOTE. The event input check with strobe off and the strobe input check are structured as a continuous test. After the Check Event Input with Strobe Off test is complete, the Check Strobe Input test uses the connections and oscilloscope settings from the Check Event Input with Strobe Off test.

Check Event Input with Strobe Off

Equipment required	A 50 Ω SMA coaxial cable, a SMA (female)-BNC (male) adapter and oscilloscope (TDS784D), and custom-made ground closure. See Figure 4-3 for the connections.
Prerequisites	The AWG710 Arbitrary Waveform Generator must meet the prerequisites listed on page 4-8.

Do the following steps to install the test hookup and set the test equipment controls:

1. Use a 50 Ω SMA coaxial cable and a SMA(Fe)-BNC(Fe) adapter to connect the AWG710 Arbitrary Waveform Generator **CH1** output connector to the oscilloscope CH1 input connector (see Figure 4-20).

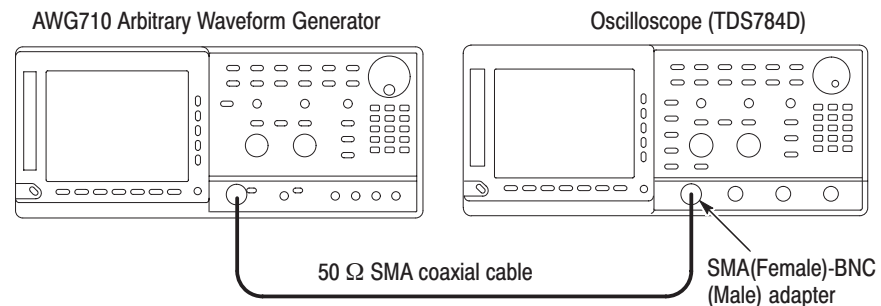


Figure 4-20: Event input and enhanced mode initial test hookup

2. Connect the ground closure to the EVENT IN connector on the AWG710 Arbitrary Waveform Generator rear panel.
3. Set the oscilloscope controls as follows:

Vertical	CH1
CH1 coupling	DC
CH1 scale	200 mV/div
CH1 input impedance	50 Ω
Horizontal	
Sweep	500 ns/div or 400 ns/div

Trigger	
Source	CH1
Coupling	DC
Slope	Positive
Level	+100 mV
Mode	Auto

4. Set all the switches of the ground closure to open.
5. Follow the substeps below to set the AWG710 Arbitrary Waveform Generator controls and select the sequence file:
 - a. Push **UTILITY** (front-panel)→**System** (bottom)→**Factory Reset** (side)→**OK** (side).
 - b. Load the PT_EVENT.SEQ file.
Refer to *Loading Files* on page 4–10 for file loading procedures.
 - c. Push **SETUP** (front-panel)→**Run Mode** (bottom)→**Enhanced** (side) to set the enhanced mode.
6. Push the **RUN** and **CH1 OUT** buttons.
The LEDs above the RUN button and CH1 output connector are on.
7. Check the EVENT IN connector pin 0 input:
 - a. Verify that a waveform displayed on the oscilloscope has the same amplitude as shown in Figure 4–21.

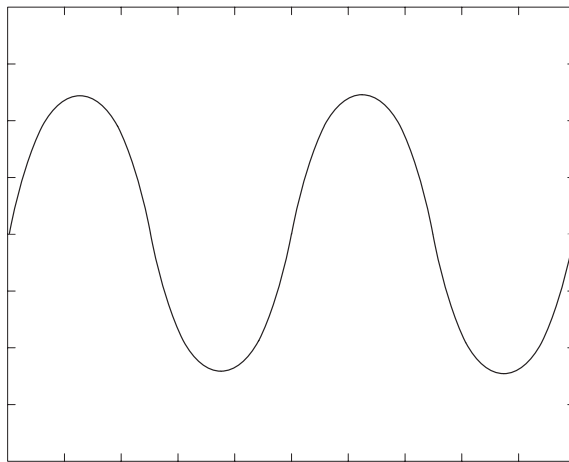


Figure 4-21: Waveform while all ground disclosure switches are open

- b. Close the SW1 of the ground closure to generate an event signal on the EVENT IN connector pin 0.

- c. Verify that the oscilloscope displays the waveform as shown in Figure 4–22 and that the waveform amplitude is the half size of Figure 4–21.

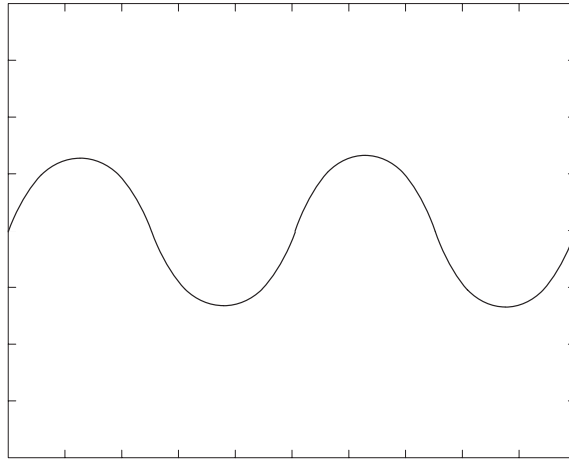


Figure 4–22: Waveform output when the SW1 is closed

- d. Open SW1 of the ground closure to degenerate the event signal.
 - e. Verify that the oscilloscope displays the waveform in Figure 4–21.
8. Check the EVENT IN connector pin 1 input:
 - a. Close SW2 of the ground closure to generate an event signal on the EVENT IN connector pin 1.
 - b. Verify that the oscilloscope displays the waveform as shown in Figure 4–23.

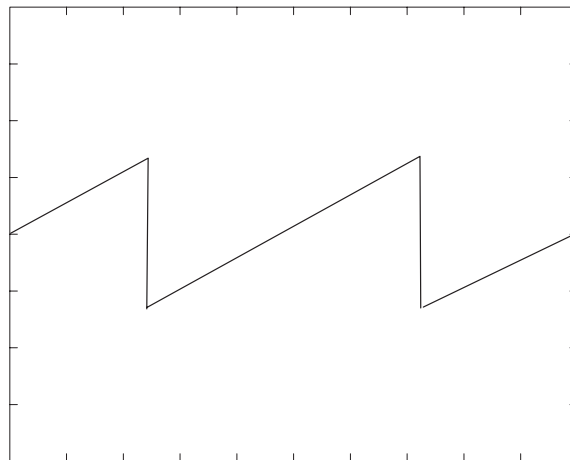


Figure 4–23: Waveform output when SW2 is closed

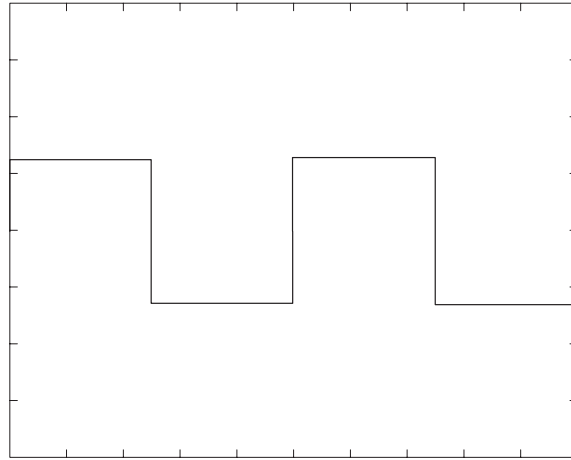


Figure 4-25: Waveform output when SW4 is closed

- c. Open SW4 of the ground closure to degenerate the event signal.
- d. Verify that the oscilloscope displays the waveform in Figure 4-21.

11. Retain the test hookup and control settings.

Check Strobe Input

Use the test hookup and oscilloscope settings from the Check Event Input with Strobe Off test.

- 1.** Follow the substeps below to set the AWG710 Arbitrary Waveform Generator controls and select the sequence file:
 - a. Push **UTILITY** (front-panel)→**System** (bottom)→**Factory Reset** (side)→**OK** (side).
 - b. Load the PT_STROB.SEQ file.

Refer to *Loading Files* on page 4-10 for file loading procedures.

- c. Push **SETUP** (front-panel)→**Run Mode** (bottom)→**Enhanced** (side) to set the run mode to enhanced.
- 2.** Push the **RUN** and **CH1 OUT** buttons.
The LEDs above the RUN button and CH1 output connector are on.
- 3.** Check the EVENT IN connector strobe pin input:
 - a. Verify that the waveform displayed on the oscilloscope has the same amplitude as shown in Figure 4-26.

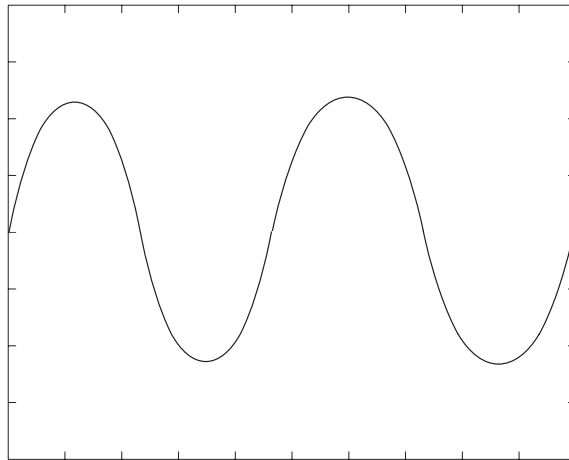


Figure 4-26: Initial waveform output

- b. Close SW5 of the ground closure to generate an event signal on the EVENT IN connector strobe pin.
- c. Verify that the oscilloscope displays the DC waveform as shown in Figure 4-27.

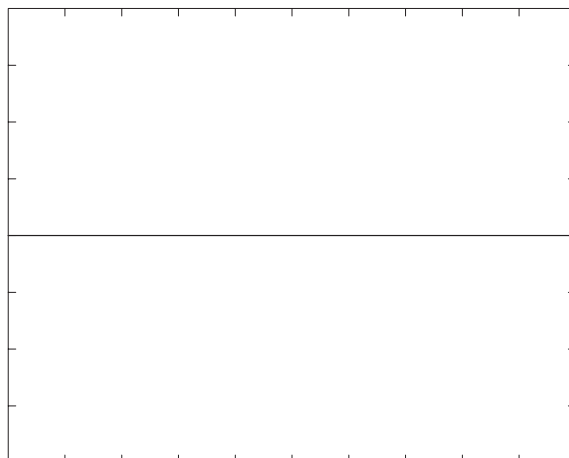


Figure 4-27: DC waveform output when the SW5 is closed

- d. Open SW5 of the ground closure to degenerate the strobe signal on the EVENT IN connector strobe pin.
- e. Verify that the DC waveform is displayed on the oscilloscope.
- f. Close SW5 of the ground closure again.

1/4 Clock Frequency and 10 MHz Reference Input Tests

These procedures check the 10 MHz reference input function of the AWG710 Arbitrary Waveform Generator .

Equipment required	A 50 Ω SMA coaxial cable, A 50 Ω BNC coaxial cable, a SMA(fe- male)-BNC(male) adapter, a frequency counter, and a function generator.
Prerequisites	The AWG710 Arbitrary Waveform Generator must meet the prerequisites listed on page 4–8.

Do the following steps to install the test hookup and set the test equipment controls:

1. Use a 50 Ω SMA coaxial cable and SMA (Fe)-BNC (Ma) adapter to connect the AWG710 Arbitrary Waveform Generator 1/4 CLOCK OUT connector to the input A connector on the frequency counter.
2. Use a 50 Ω BNC coaxial cable to connect the AWG710 Arbitrary Waveform Generator 10 MHz REF IN connector to the function generator output connector (see Figure 4–28).

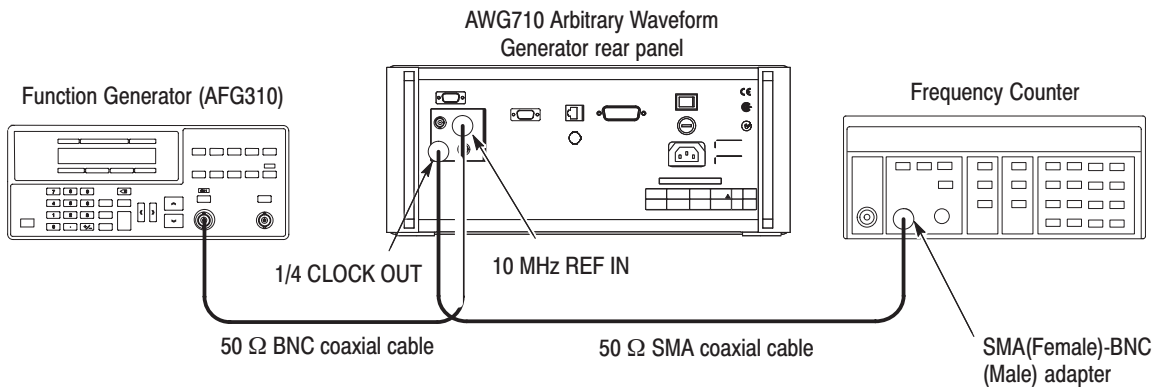


Figure 4–28: 1/4 Clock frequency and 10 MHz reference input initial test hookup

- a. Set the frequency counter controls as follows:

INPUT A	
Coupling	AC
FUNCTION	A FREQ
Gate time	0.2 s
Trigger Level	0 V

- b. Set the function generator (AFG310) controls:

Function	Square
Mode	Continuous
Parameters	
Frequency	10 MHz
Amplitude	2.0 V into 50 Ω (4.0 V into 1 M Ω)
Offset	0 V
Output	On

Check 1/4 Clock frequency

1. Follow the substeps below to set the AWG710 Arbitrary Waveform Generator controls and select the waveform file:
 - a. Push **UTILITY** (front-panel)→**System** (bottom)→**Factory Reset** (side)→**OK** (side).
 - b. Load the MODE.WFM file.
Refer to *Loading Files* on page 4–10 for file loading procedures.
 - c. Push **HORIZONTAL MENU** (front-panel)→**Clock** (side).
 - d. Push **2, 0, 0** and **M** (SHIFT+7) keys in this order or turn the general purpose knob to set the internal clock frequency to 200 MHz.
2. Push the **RUN** button.
The LED above the RUN button is on.
3. Verify that the frequency counter reading is 50 MHz \pm 50 Hz (using the internal reference clock).
4. Retain the test hookup.

Check 10MHz Reference Input

1. Push **HORIZONTAL MENU** (front-panel)→**Clock Ref** (side) so that the AWG710 Arbitrary Waveform Generator reference clock is set to External.
2. Verify that the frequency counter reading is 50.0 MHz \pm 10 kHz (using the external reference clock).
3. Change the function generator controls as follows:

Frequency	10.1 MHz
-----------------	----------
4. Check that the frequency counter reading is 50.5 MHz \pm 10 kHz.
5. Turn the function generator output off and disconnect the function generator and frequency counter.

Marker Output Tests

The following procedures check the accuracy of the AWG710 Arbitrary Waveform Generator marker output level.

NOTE. Connect a 50 Ω SMA terminator to the inverted marker output connector during the marker output tests.

Equipment required	A 50 Ω BNC coaxial cable, a 50 Ω precision terminator, a SMA (male)-BNC (female) adapters, BNC (female)-to-dual banana adapter, and a digital multimeter (DMM).
Prerequisites	The AWG710 Arbitrary Waveform Generator must meet the prerequisites listed on page 4–8.

Do the following steps to install the test hookup and set the test equipment controls:

1. Use a 50 Ω BNC coaxial cable, a SMA(Ma)-BNC(Fe) adapter, a 50 Ω precision terminator, and a BNC-to-dual banana adapter to connect the AWG710 Arbitrary Waveform Generator MARKER 1 OUT to the DMM input connector (see Figure 4–29).

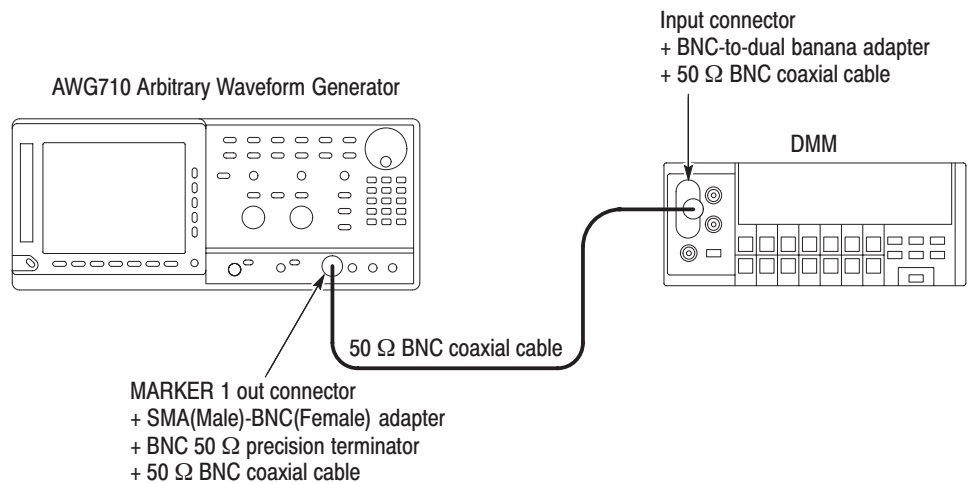


Figure 4–29: Marker output initial test hookup

2. Set the DMM controls as follows:

Mode	VDC
Range	Auto
Input	Front

3. Follow the substeps below to set the AWG710 Arbitrary Waveform Generator controls and to select the sequence file:
 - a. Push **UTILITY** (front-panel)→**System** (bottom)→**Factory Reset** (side)→**OK** (side).
 - b. Push **SETUP** (front-panel)→**Run Mode** (bottom)→**Enhanced** (side).

The AWG710 Arbitrary Waveform Generator is set to enhanced mode.

- c. Load the AMP1.SEQ file.

Refer to *Loading Files* on page 4–10 for file loading procedures.

4. Push the **RUN** button.

The LEDs above the RUN button is on.

5. Do the following substeps to set the AWG710 Arbitrary Waveform Generator marker output high level setting:
 - a. Push **VERTICAL MENU** (front-panel)→**Marker...** (side)→**Marker 1 High Level** (side).
 - b. Push **3**, **.**, **0** and **ENTER** keys in this order or turn the general purpose knob to set the marker level to 3.0 V.
 - c. Verify that the marker 1 high level reading on the DMM screen falls within 2.75 V through 3.25 V.
 - d. Push the **FORCE EVENT** button.
6. Do the following substeps to set the AWG710 Arbitrary Waveform Generator marker output low level setting:
 - a. Push **Marker 1 Low Level** side button.
 - b. Push **–**, **1**, **.**, **1** and **ENTER** keys in this order or turn the general purpose knob to set the marker level to –1.1 V.
 - c. Verify that the marker 1 Low level reading on the DMM screen falls within –1.255 V through –0.945 V.
 - d. Push the **FORCE EVENT** button.

- 7.** Do the following substeps to change the connection to check the MARKER1:
 - a.** Disconnect the 50 Ω precision terminator from the MARKER1 OUT connector.
 - b.** Disconnect the cable with SMA (male)–BNC (female) adapter and BNC 50 Ω terminator) from MARKER 1 OUT connector.
 - c.** Connect the 50 Ω precision terminator to the MARKER 1 OUT (removed in step a).
 - d.** Connect the adapter, terminator, and cable (removed in step b) to the MARKER1 OUT connector.
- 8.** Press FORCE EVENT where needed.
- 9.** Repeat steps 5 and 6 for the AWG710 Arbitrary Waveform Generator MARKER1 OUT.
- 10.** Repeat step 5 through 8 for MARKER 2 OUT and MARKER2 OUT.
- 11.** Disconnect the DMM.

Adjustment Procedures

This section provides the procedures necessary to manually adjust the AWG710 Arbitrary Waveform Generator.

Overview

- Description** This subsection contains the following topics:
- *Overview*. Basic information about adjustment requirements
 - *Before Adjustments*. General information about adjusting the waveform generator and the Performance Check/Adjustment disk files.
 - *Adjustment Instructions*. Procedures for manually adjusting the waveform generator.
- Purpose** Use the *Adjustment Instructions* subsection to return the waveform generator to conformance with the performance specified in the *Specifications* section. This procedure is not required to verify the performance of the waveform generator. To verify the performance of the instrument, refer to the *Performance Verification* section.
- Adjustment Interval** Perform the adjustment procedures every 12 months.
- Adjustment After Repair** After the removal and replacement of a module due to electrical failure, perform the adjustment procedures listed in Table 5–1.

Table 5-1: Adjustments required

Removed and replaced module	Adjustments required
A50 AWG board and Flash disk	Clock Ref. DAC, Calibration and Marker level, Magic Freq.
A71 Output board	Calibration
A77 Attenuator board	Calibration
Other modules	No need to adjust

- Adjustments** There are three adjustment procedures listed in Table 5–2. You can do Calibration and Marker level adjustments without removing the cabinet.

Table 5-2: Adjustments

Adjustments	Refer to
Calibration	Page 4-3
Reference Clock Frequency	Page 5-6
Marker level	Page 5-7
Magic Frequency	Page 5-10

Before doing the adjustments, note the following requirements.

Personnel This procedure is only to be performed by trained service technicians.

Warm-Up Period This waveform generator requires a 20 minute warm-up time in a 20° C to 30° C environment before it is adjusted. Any adjustments done before the operating temperature has stabilized may cause performance errors.

Self Calibration Calibrate the waveform generator using the self calibration routine. Refer to the *Performance Verification* section for instructions.

Performance Check/Adjustments Files These adjustment procedures require you to load a file from the Performance Check/Adjustment disk supplied with the waveform generator. Refer to *Adjustment Instructions* in this subsection for information about this file.

Test Equipment Table 5-3 lists all test equipment required to adjust the waveform generator.

Equipment Required Table 5–3 lists the test equipment required to adjust the waveform generator.

Table 5–3: Test equipment

Item description	Minimum requirements	Example	Purpose
1. Oscilloscope	Bandwidth > 500 MHz	Tektronix TDS784D	Output signal adjustments
2. Frequency counter	1 MHz to 10 MHz Accuracy < 0.2 ppm	Anritsu MF1603A	Output signal adjustment
3. BNC cable	Impedance 50 Ω	Tektronix part number 012-0482-00	Signal interconnection
4. SMA cable	Impedance 50 Ω	Tektronix part number 012-1565-00 or equivalent	Signal interconnection
5. Adapter	SMA (Fe) to BNC (Ma), 50 Ω	Tektronix part number 015-0572-00	Signal interconnection
6. SMA Terminator	50 Ω , SMA male	Tektronix part number 015-1022-01	Signal termination
7. Adjustment Tool	Less than 1/8 inch diameter and over 4 inches long		Enabling service mode
8. Performance check disk	Must use example listed	Tektronix part number 063-A273-00	Used to provide waveform files

Before Adjustments

Use the following instructions to prepare the waveform generator for adjustment, load the adjustment file required for these procedures, and make adjustments.

Cooling

When you do the adjustment procedure with the rear cover and cabinet removed, orient the waveform generator so the bottom is down on the work surface to cool the waveform generator properly.



CAUTION. To prevent damage to the waveform generator when the cabinet and rear cover are removed, always make sure that the work surface is completely clear beneath the waveform generator.

Enabling Service Mode

All the adjustment procedures are obtained through the Service menu which is a submenu of the Utility menu. To enter this menu, you must enable the Service mode using the switch on the A10 Connector board. Perform the following step:

Power on the waveform generator by pushing **ON/STBY** button while pressing the service switch on the A10 Connector board. See Figure 5-1.

If you perform the adjustment procedure without removing the cabinet, you must insert the adjustment tool (Table 5-4, Item 7) in the hole on the left side of the waveform generator to engage the service switch.

Toggle the **ON/STBY** button to **STBY** to disable the Service mode.

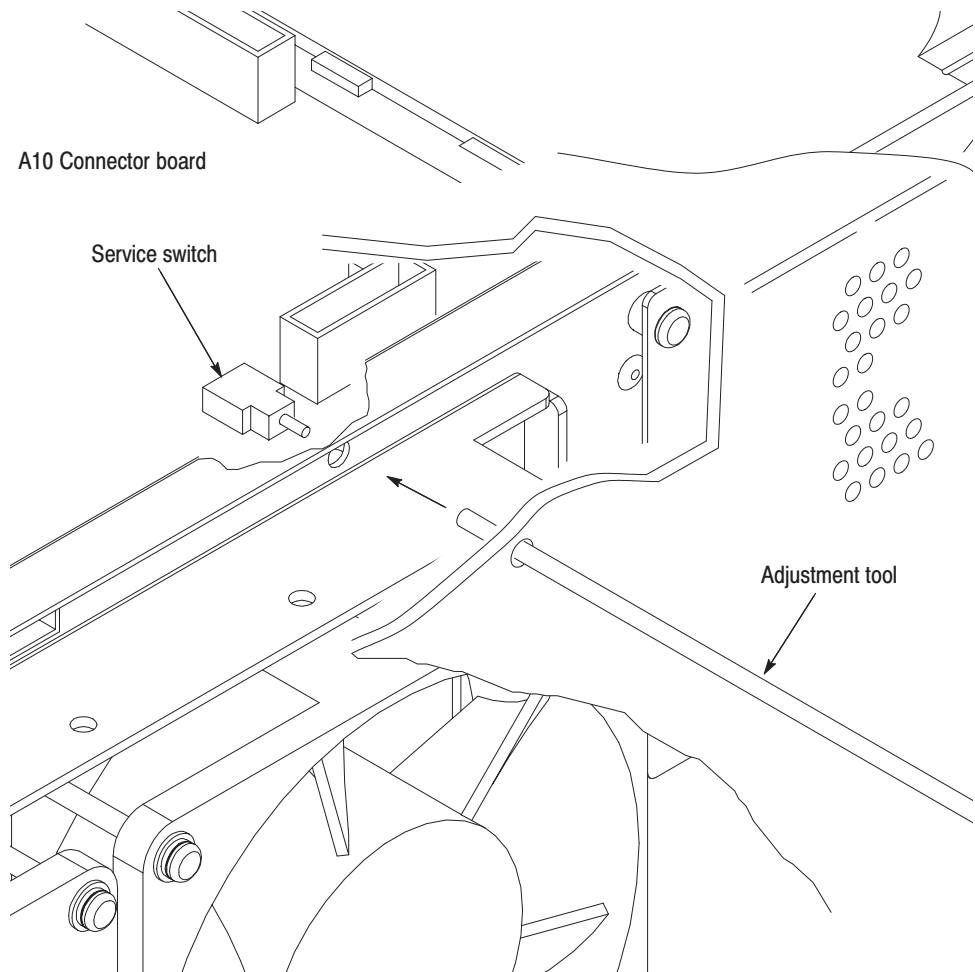


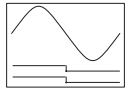
Figure 5-1: Accessing the service switch

Performance Check/Adjustment Files

Table 5–4 lists the waveform file, provided on the Performance Check/Adjustment disk, that is required to do the adjustments.

For instructions on loading files, see *Operating Basics: Loading Files* and the *Reference: Waveform Sequence Menu* section of the User Manual. After loading the files, push the floppy disk drive eject button and remove the floppy disk.

Table 5–4: File list for performance Check/adjustment disk

No.	File name	Wfm shape	Wfm Point	Clock	Usage
1	MODE.WFM		1000	4.0 GHz	Clock frequency adjustment, and Marker Level adjustment

Adjustment Instructions

Reference Clock Frequency

This procedure adjusts Y5200 on the A50 AWG board to set the AWG710 Arbitrary Waveform Generator clock frequency.

Equipment Required	One frequency counter (Item 2) One 50 Ω coaxial cable (Item 3)
---------------------------	--

Do the following steps to connect the test equipment and set the test equipment controls:

1. Use a 50 Ω BNC coaxial cable to connect the waveform generator 10 MHz REF OUT connector to the input A connector on the frequency counter.

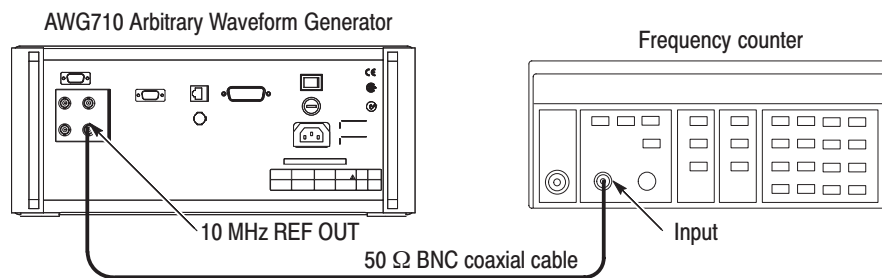


Figure 5-2: Hookup for the reference clock frequency adjustment

2. Set the frequency counter controls as follows:

Input A Coupling	AC
Function	A Frequency
Gate Time	0.2 s
Level	0 V

3. Set the waveform generator controls as follows:
Press **UTILITY** → **System** → **Factory Reset** → **OK**.
4. Follow the substeps below to load the waveform:
 - a. Press **Service** → **Tweak AWG2** (pop-up) → **OK**.
 - b. Press **Clock Ref. DAC**
5. Turn the general purpose knob to adjust the oscillator so that the frequency counter reading is in the range of 10.0 MHz \pm 2 Hz (0.2 ppm).
6. Press **Save** to save the setting.
7. Disconnect the frequency counter.

Marker Level This procedure uses the general purpose knob on the front panel to set the Marker Output level.

Equipment Required	One oscilloscope (Item 1) One SMA 50 Ω coaxial cable (Item 4) SMA (female) to BNC (male) 50 Ω adapter (Item 5) 50 Ω SMA Terminator (Item 6)
---------------------------	---

Do the following steps to connect the test equipment and set test equipment controls:

1. Use a SMA coaxial cable and a SMA (female) to BNC (male) adapter to connect the waveform generator MARKER 1 Output connector to the CH1 input connector on the oscilloscope.
2. Connect a 50 Ω SMA terminator to the waveform generator MARKER 1 Output connector.

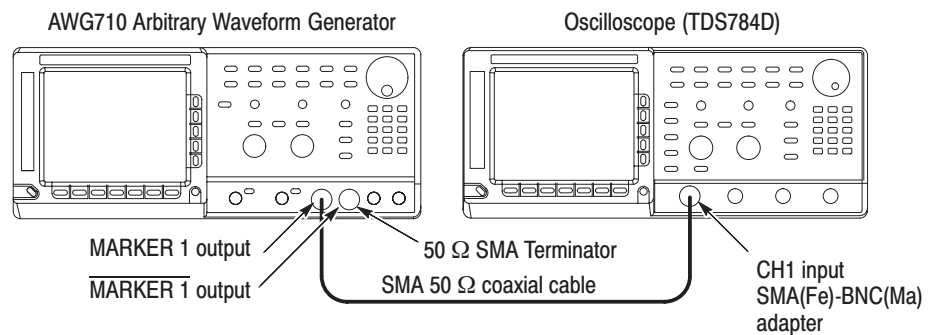


Figure 5-3: Hookup for the marker level adjustment

- a. Set the oscilloscope controls as follows:

Vertical	CH1
CH1 coupling	DC
CH1 scale	100 mV/div
CH1 input impedance	50 Ω
Horizontal	
Sweep	5 μ s/div
Trigger	
Source	CH1
Coupling	DC
Slope	Positive
Level	+500 mV
Mode	Auto

3. Do the following to set the waveform generator controls:
Press **UTILITY** → **System** → **Factory Reset** → **OK**.
4. Follow the substeps below to load the waveform:
 - a. Press **SETUP** → **Waveform/Sequence** → **Load...**
 - b. Turn the general purpose knob to display the list of waveform files and highlight the file **MODE.WFM**.
Press **OK** to select and load the file.
 - c. Press the **RUN** button.
5. Follow the substeps below to setup the Marker:
 - a. Press **Horizontal** → **Clock**.
 - b. Turn the general purpose knob to set the Clock to 100 MS/s.
 - c. Press **Vertical** → **Marker...** → **Marker 1 High Level**
 - d. Turn the general purpose knob to set the voltage to 1.50 V.
 - e. Press **Marker 2 High Level**.
 - f. Turn the general purpose knob to set the voltage to 1.50 V.
 - g. Check that the **Marker 1 low Level** and the **Marker 2 Low Level** are 0.00 V. If there are not, set the voltage to 0.00 V in the same way.
6. Follow the substeps below to adjust Marker 1 level:
 - a. Press **UTILITY** → **Service**
 - b. Turn the general purpose knob to select **Tweak AWG 2**.
 - c. Press **OK**.
 - d. Press **Marker 1 Adj. Level**.
 - e. Set the oscilloscope CH1 input to GND. Note the ground position. Then return the CH1 input to 50 Ω DC.
 - f. Turn the general purpose knob to adjust the waveform of marker low level voltage to 0.00 V within ± 50 mV on the oscilloscope display.
7. Disconnect the SMA coaxial cable from the waveform generator MARKER 1 Output, then reconnect it to the MARKER 2 Output connector.
8. Remove the 50 Ω SMA Terminator from the waveform generator MARKER 1 Output, then reconnect it to the MARKER 2 Output connector.

9. Follow the substeps below to adjust the Marker 2 level:
 - a. Press **Marker 2 Adj. Level**
 - b. Turn the general purpose knob to adjust the waveform of marker low level voltage to 0.00 V within ± 50 mV on the oscilloscope display.
10. Press **Save** to save the setting.
11. Disconnect the oscilloscope.

Magic Frequency

This procedure uses the general purpose knob on the front panel to set the Magic Frequency parameter.

Equipment Required	One oscilloscope (Item 1) One SMA 50 Ω coaxial cable (Item 4) SMA (Fe) to BNC (Ma) 50 Ω adapter (Item 5)
---------------------------	--

Do the following steps to connect the test equipment and set test equipment controls:

1. Use a SMA coaxial cable and a SMA (female) to BNC (male) adapter to connect the waveform generator CH1 Output connector to the CH1 input connector on the oscilloscope.

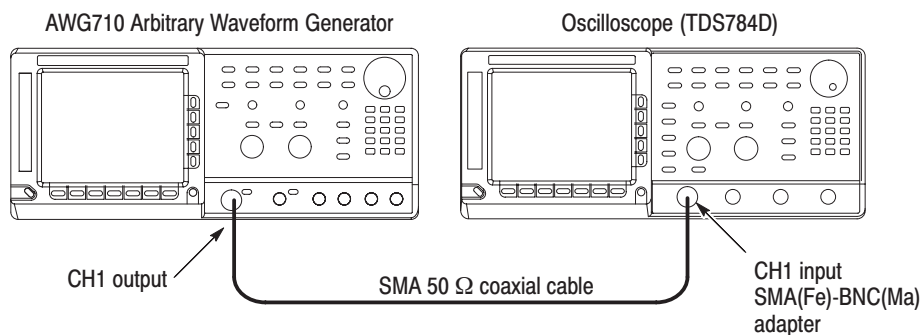


Figure 5-4: Hookup for the marker level adjustment

2. Set the Oscilloscope controls as follows:

Vertical	CH 1
CH 1 coupling	DC
CH 1 scale	200 mV/div
CH 1 input impedance	50 Ω
Horizontal	
Sweep	200 ns/div
Trigger	
Source	CH 1
Coupling	DC
Slope	Positive
Level	0 V
Mode	Auto

3. Do the following to set the waveform generator controls:

Press **UTILITY** → **System** → **Factory Reset** → **OK**.

4. Follow the substeps below to load the waveform:

- a. Press **SETUP** → **Waveform/Sequence** → **Load...**

- b. Turn the general purpose knob to display the list of waveform files and highlight the file **MODE.WFM**.

Press **OK** to select and load the file.

- c. Press the **RUN** button.

- d. Press the **CH1 OUTPUT** button to ON.

5. Adjust Magic Frequency:

- a. Press **UTILITY** → **Service**

- b. Turn the general purpose knob to select **Tweak AWG2**.

- c. Press **OK**.

- d. Press **Magic Freq. .**

- e. Turn the general purpose knob to adjust the waveform on the oscilloscope display so that the corruption of the waveform becomes the maximum.

6. Press **Save** to save the setting.

7. Disconnect the oscilloscope.

Maintenance

This section contains the information needed to perform periodic and corrective maintenance on the AWG710 Arbitrary Waveform Generator.

The following subsections are included:

- **Related Maintenance Procedures.** Provides information relating to various sections discussing maintenance.
- *Preparation.* Introduction plus general information on preventing damage to internal modules when doing maintenance.
- *Inspection and Cleaning.* Information and procedures for inspecting the waveform generator and cleaning the external and internal modules.
- *Removal and Installation Procedures.* Procedures for the removal of defective modules and replacement of new or repaired modules.
- *Troubleshooting.* Information for isolating failed modules. Included are instructions for operating the waveform generator internal diagnostic routines and troubleshooting trees. Most of the trees make use of these internal diagnostic routines to speed fault isolation to a module.

Related Maintenance Procedures

The following subsections contain information and procedures related to maintenance.

- *Operating Information* provides useful troubleshooting instructions when operating the waveform generator. It also details the service strategy and lists options for obtaining maintenance service and replacing failed modules.
- *Theory of Operation* contains a circuit description at the module, or block, level.
- *Performance Verification* provides procedures that may be useful in isolating modules problems by testing the waveform generator performance.
- *Adjustment Procedures* addresses after repair adjustment and the interval between periodic adjustments. It contains a procedure for adjusting the internal circuits of the waveform generator.
- *Diagrams* contains a block diagram using individual modules as blocks and an interconnection diagram showing connections between the modules.
- *Replaceable Mechanical Parts* lists all field replaceable modules by part number.

Preparation

Before servicing this product, read the *Safety Summary* and *Introduction* at the front of the manual and the ESD information below.



CAUTION. *Static discharge can damage any semiconductor component in this generator. If you are removing a module for service, begin by doing the Access Procedure on page 6–16. By following the instructions in that procedure, you remove the module to be serviced while removing the minimum number of additional modules.*

Preventing ESD

When performing any service that requires internal access to the waveform generator, adhere to the following precautions to avoid damaging internal modules and 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 allow anything capable of generating or holding a static charge on the work station surface.
5. Handle circuit boards by the edges when possible.
6. Do not slide the modules over any surface.
7. Avoid handling modules in areas that have a floor or work-surface covering capable of generating a static charge.

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

Inspection and Cleaning

Inspection and Cleaning describes how to inspect for dirt and damage. It also describes how to clean the exterior and interior of the AWG710 Arbitrary Waveform Generators. Inspection and cleaning are done as preventive maintenance. Preventive maintenance, when done regularly, may prevent waveform generator malfunctions and enhance its reliability.

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

How often you perform preventive maintenance depends on the severity of the environment in which the waveform generator is used. It is recommended that you perform preventive maintenance just prior to doing the generator adjustment.

General Care

The cabinet helps keep dust out of the waveform generator and should normally be in place when operating the generator. The generator's front cover protects the front panel and display from dust and damage. Install the front cover when storing or transporting the generator.

Inspection and Cleaning Procedures

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



CAUTION. *Avoid the use of chemical cleaning agents which can damage plastics used in this waveform generator. Use only deionized water when cleaning the menu buttons or front panel buttons. Use an ethyl alcohol solution as a cleaner and rinse with deionized water. Before using any other type of cleaner, consult your Tektronix Service Center or representative.*

Exterior Inspection. Examine the outside of the generator for damage, wear, and missing parts, using Table 6–2 as a guide. Waveform generators that appear to have been dropped or otherwise mishandled should be checked thoroughly to verify correct operation and performance. Immediately repair defects that could cause personal injury or cause further generator damage.

Table 6–2: External Inspection Check List

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

Exterior Cleaning Procedure. Do the following steps to clean the waveform generator exterior:

1. Remove loose dust on the outside of the generator with a lint free cloth.
2. Remove remaining dirt with a lint free cloth dampened with 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 ethyl alcohol or preferably, a mild, general purpose detergent-and-water solution.



CAUTION. To prevent getting moisture inside the generator during external cleaning, use only enough liquid to dampen the cloth or applicator.

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

Inspect the internal portions of the generator for damage and wear, using Table 6–3 as a guide. Defects found should be repaired immediately.



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

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 module and replace with a new module.
Resistors	Burned, cracked, broken, blistered condition.	Remove failed module and replace with a new module.
Solder connections	Cold solder or rosin joints.	Re-solder joint and clean with ethyl alcohol.
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.

Interior Cleaning Procedure. Do the following steps to clean the generator interior:

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 ethyl alcohol and rinse with warm deionized water. (A cotton-tipped applicator is useful for cleaning in narrow spaces and on circuit boards.)

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

3. If step 1 and 2 do not remove all the dust or dirt, the generator may be spray washed using a solution of ethyl alcohol by doing steps 4 through 8.
4. Gain access to the parts to be cleaned by removing easily accessible shields and panels (see *Removal and Installation Procedures*).
5. Spray wash dirty parts with ethyl alcohol and wait 60 seconds for the majority of the alcohol to evaporate.
6. Use hot (48.88° C to 60° C) (120° F to 140° F) deionized water to thoroughly rinse boards and components.
7. Dry all parts with low-pressure, deionized air.
8. Dry all components and assemblies in an oven or drying compartment using low-temperature (51.67° C to 65.56° C) (125° F to 150° F) circulating air.

Lubrication. There is no periodic lubrication required for this generator.

Removal and Installation Procedures

This subsection contains procedures for removal and installation of all mechanical and electrical modules. Any electrical or mechanical module, assembly, or part listed in the *Replaceable Mechanical Parts* section of this manual is a module.

Preparation — Preparation for Use



WARNING. Before doing this or any other procedure in this manual, read the Safety Summary found at the beginning of this manual. Also, to prevent possible injury to service personnel or damage to the generator components, read Operating Information: Installation and Preventing ESD in this section.

This subsection contains the following items:

- Preparatory information that you need to properly do the procedures that follow.
- List of tools required to remove and disassemble all modules.
- Three module locator diagrams for finding the External Modules (see Figure 6–2), Outer-Chassis Modules (see Figure 6–3), and Inner-Chassis Modules (see Figure 6–5).
- Procedures for removal and installation of the electrical and mechanical modules.
- A disassembly procedure for removal of all major modules from the generator at one time and for reassembly of those modules. A complete disassembly is normally only done when completely cleaning the generator. (Instructions for doing the actual cleaning are found under *Inspection and Cleaning* at the beginning of this section.)
- Module disassembly procedures.



WARNING. Before doing any procedure in this subsection, disconnect the power cord from the line voltage source. Failure to do so can cause serious injury or death.

List of Modules

The *Replaceable Mechanical Parts* section lists all modules.

Summary of Procedures

The following procedures are described in the order in which they appear in this section.

- The *Access Procedure* on page 6–16 directs you to the procedure(s) (if any) that are required to access the module to be serviced, then it directs you to the procedure to remove that module.
- *Procedures for External Modules* on page 6–17 explain how to remove modules that do not require internal access to the waveform generator.
- *Procedures for Internal Modules (1)* on page 6–30 are procedures for removing modules which require access to the internal part of the waveform generator but are external to the chassis.
- *Procedures for Internal Modules (2)* on page 6–44 are procedures for removing modules which require access to the internal part of the waveform generator and are internal to the chassis.

Equipment Required. Most modules in this generator can be removed using a screwdriver with a size #2, Phillips tip. Use this tool whenever a procedure step instructs you to remove or install a screw unless a different size screwdriver is specified in that step. All equipment required to remove and install a module are listed in the first step of each procedure.

Table 6–4: Tools required for module removal

Item no.	Name	Description
1	Screwdriver handle	Accepts Phillips-driver bits
2	#1 Phillips tip	Phillips-driver bit for #1 screw size
3	#2 Phillips tip	Phillips-driver bit for #2 screw size
4	Flat-blade screwdriver	Screwdriver for removing standard-headed screws
5	Needle-Nose Pliers	Standard tool
6	Nutdriver, 1/2 inch	Standard tool
7	Nutdriver, 5.5 mm (7/32 inch)	Standard tool
8	Nutdriver, 7 mm (9/32 inch)	Standard tool
9	Retaining Ring Pliers	Standard tool
10	Angle-Tip Tweezers	Standard tool
11	Soldering Iron	Standard tool
12	Pliers	Standard tool
13	Solder Wick	Standard tool

Table 6-4: Tools required for module removal (Cont.)

Item no.	Name	Description
14	Adhesive	TRA-CON: Tra-Bond #BA-2114
15	Wrench, 5/16 inch	Standard tool

Instrument Orientation

Throughout this manual, certain procedures refer to various instrument orientation, such as *front*, *right*, *bottom*, and *top*. See Figure 6-1 for an illustration of how each side is specifically referenced.

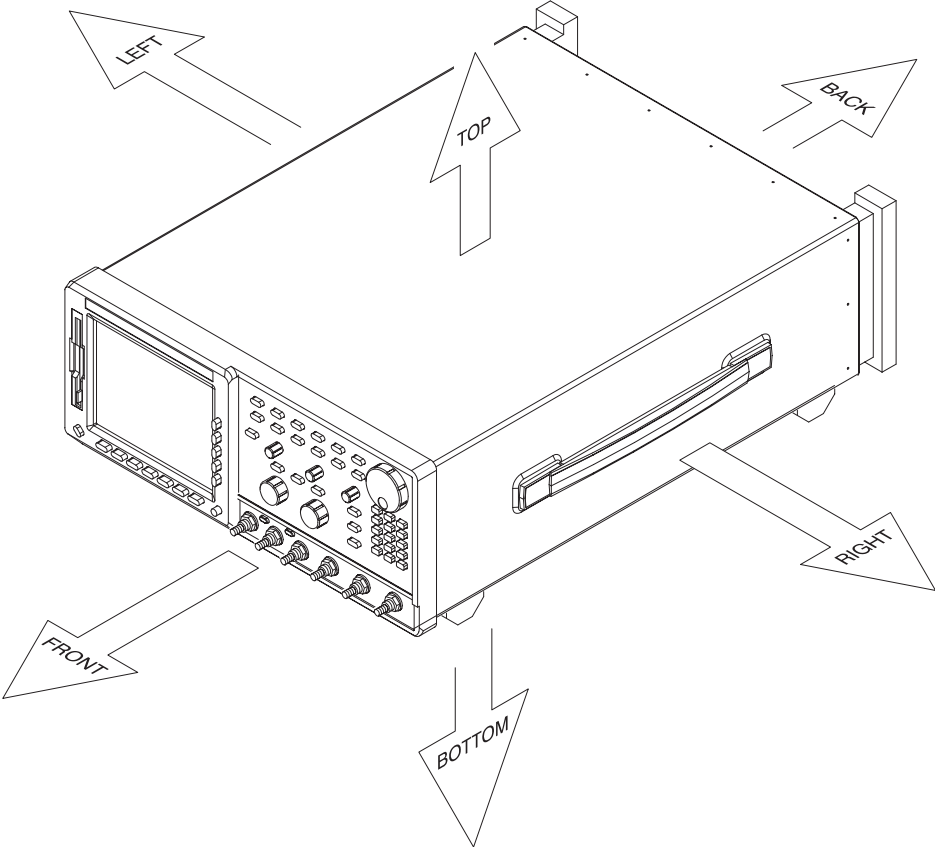


Figure 6-1: Instrument orientation

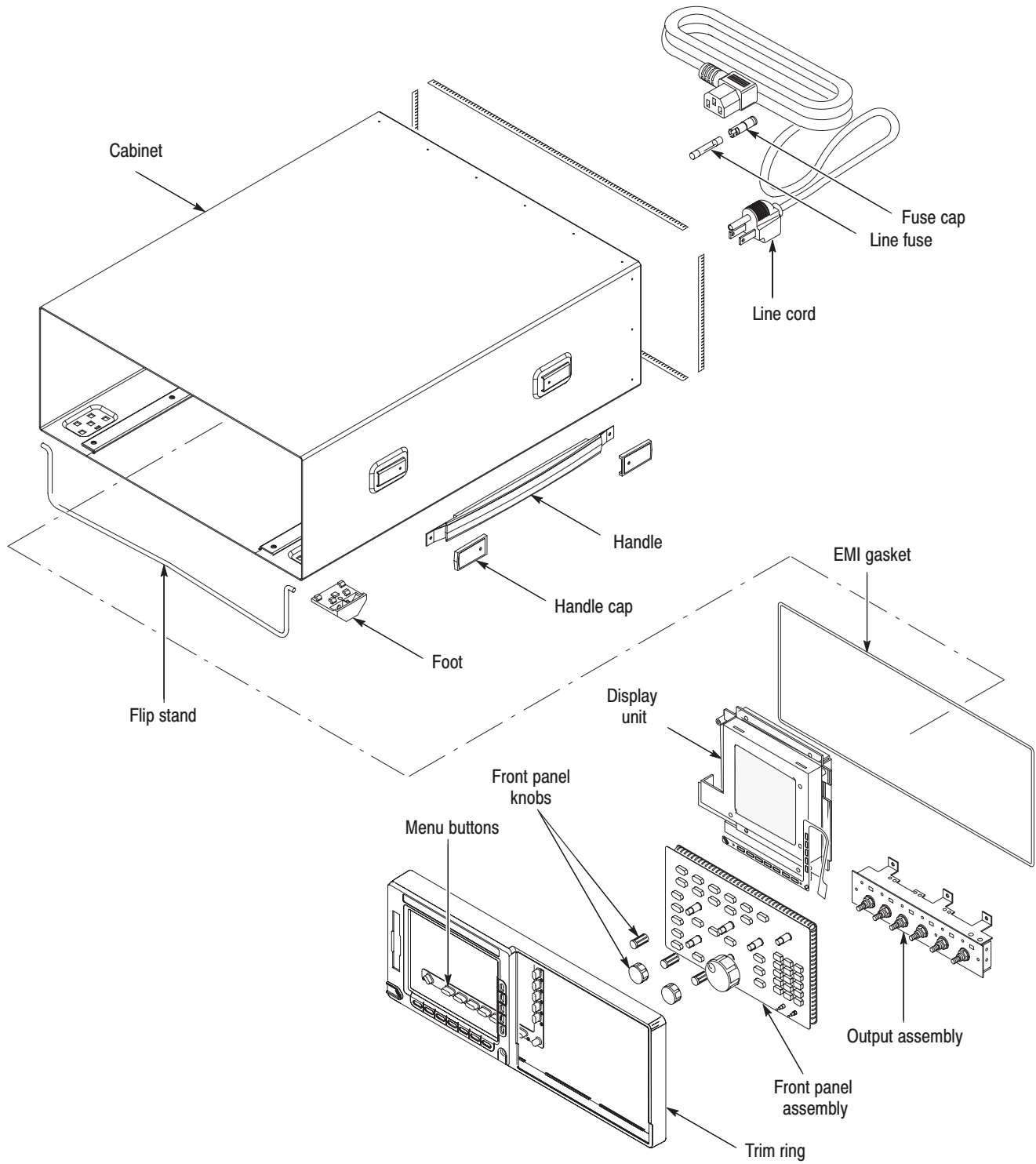


Figure 6-2: External modules

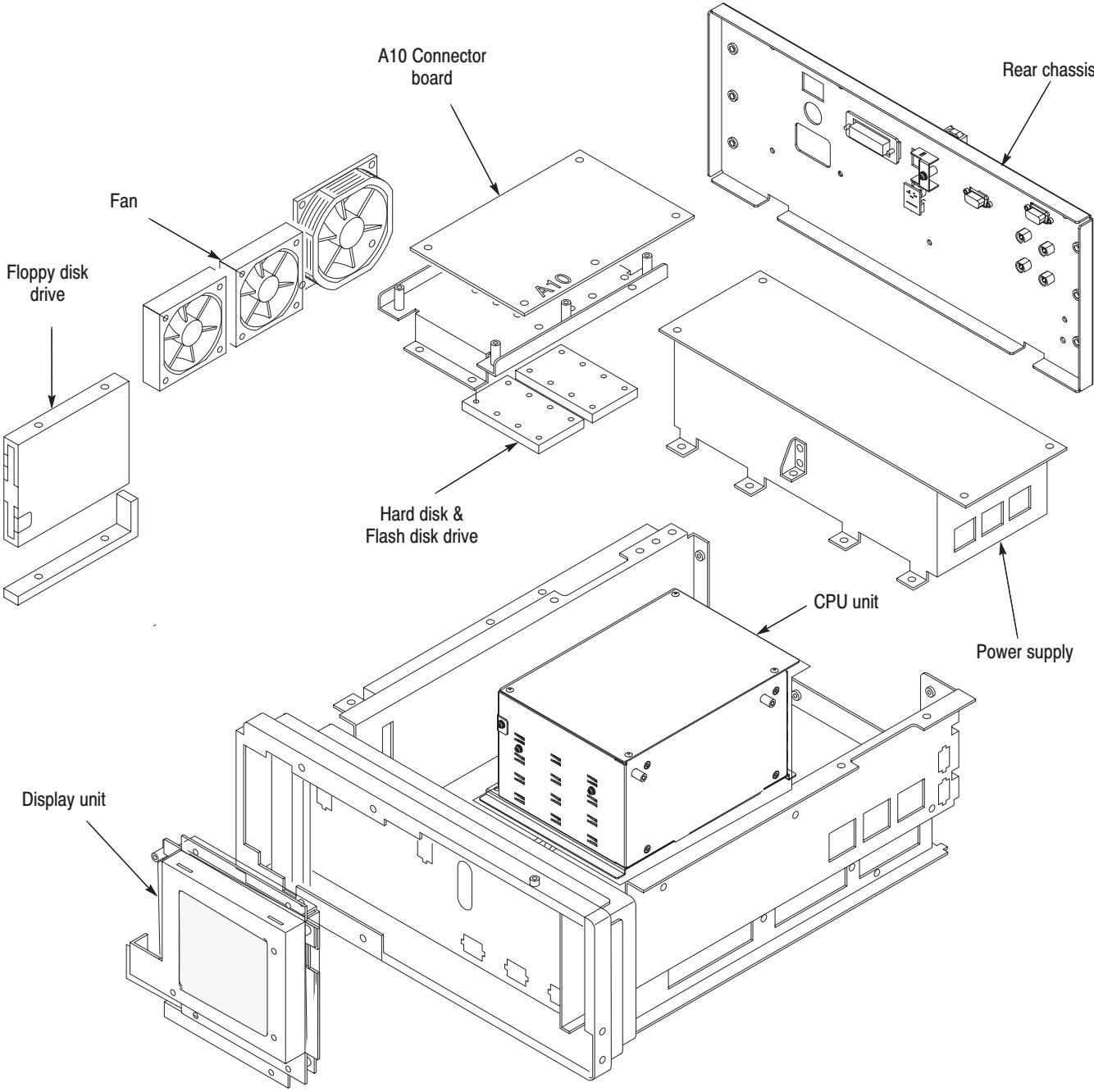


Figure 6-3: Internal modules (1)

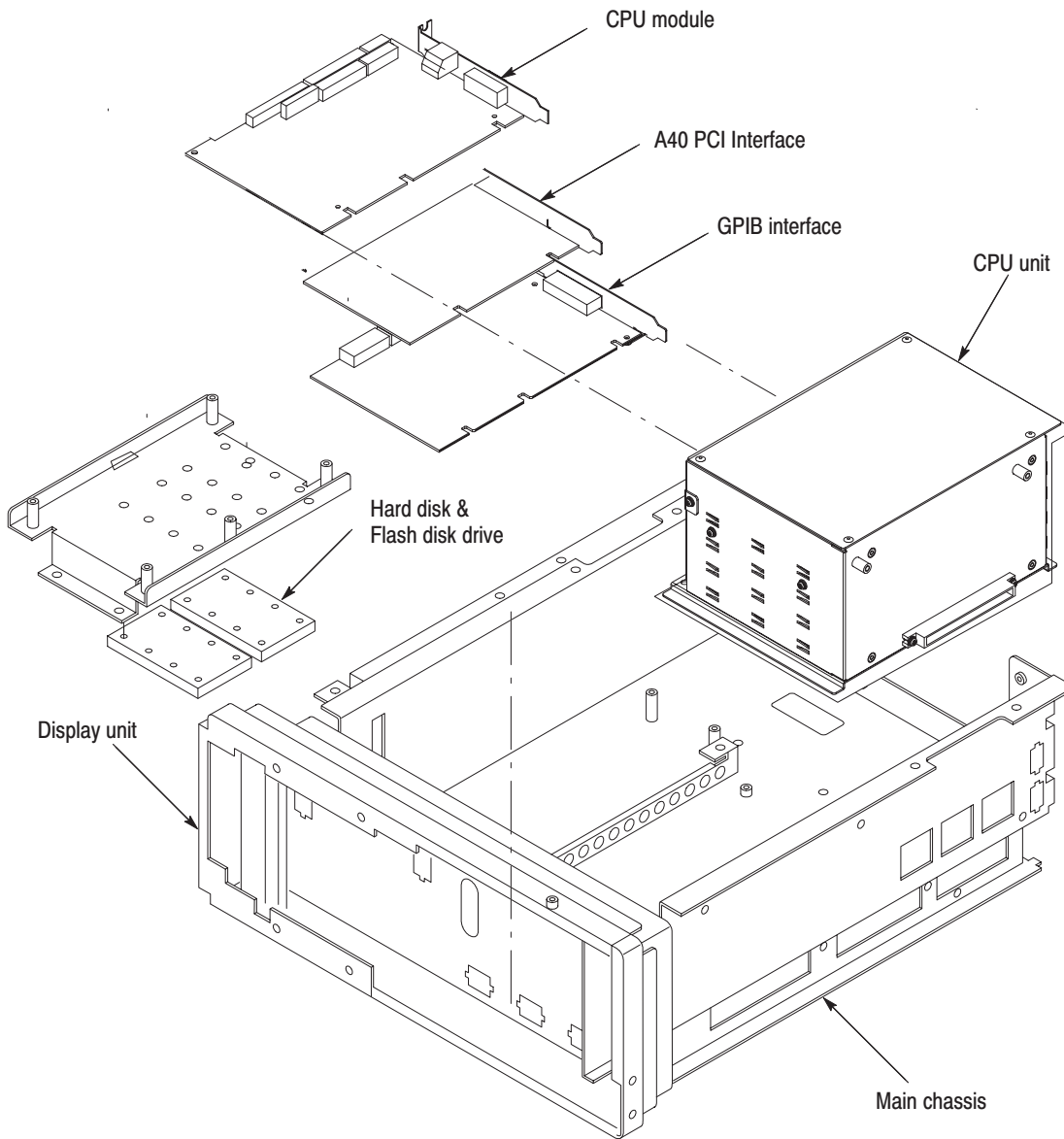


Figure 6-4: Internal modules(1)

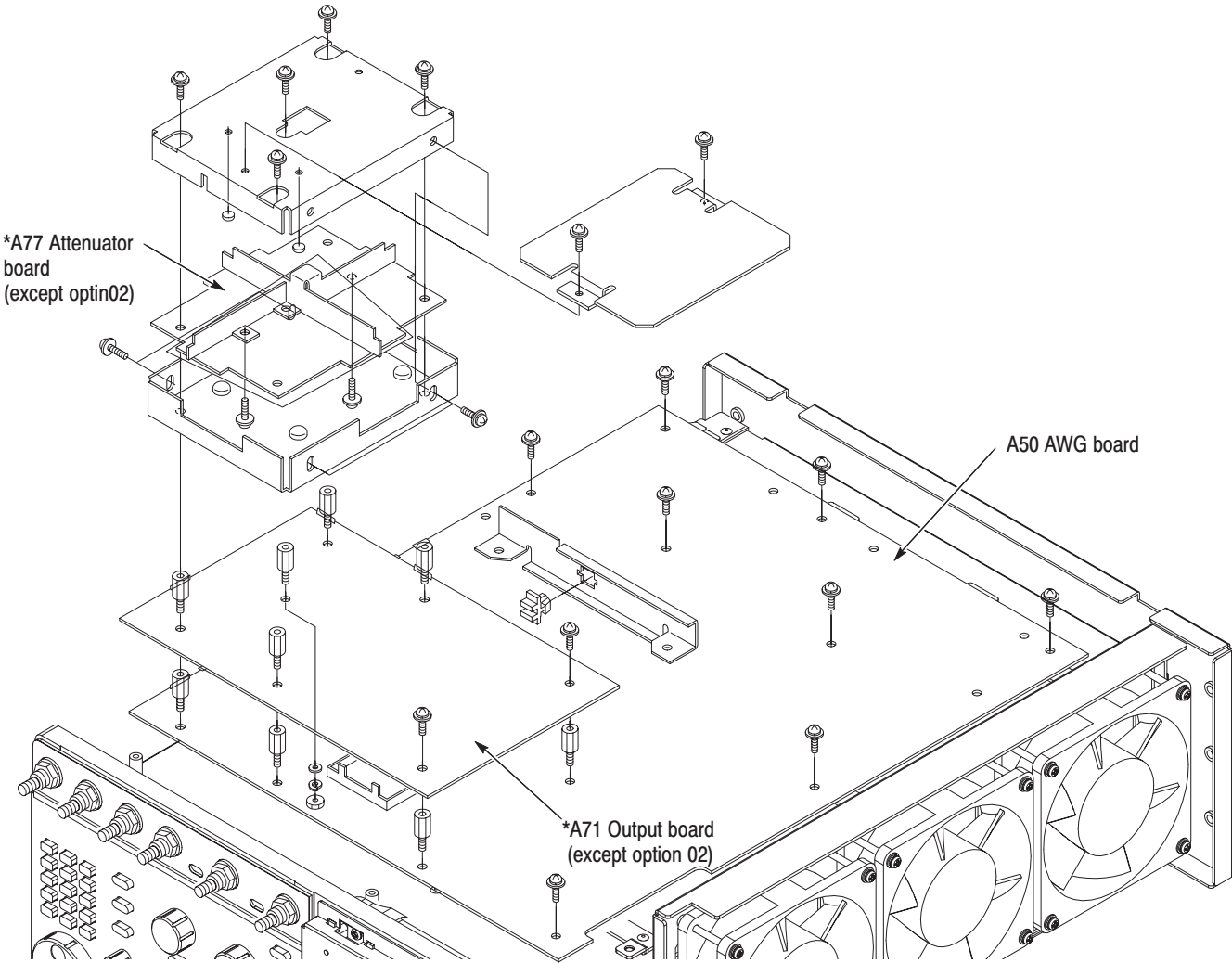


Figure 6-5: Internal modules(2)

*The product which has option 02 doesn't have A77 Attenuator board.

*The product which has option 02 has A72 output board instead of A71 output board.

Access Procedure

Begin with this procedure when you have identified which module to remove for service.

1. Find the module to remove in Figure 6–2 through 6–5.

The title of the figure indicates whether the module is an external, internal module(1), or internal module(2) part.

2. If the module is externally mounted and no internal access is required, remove the module. Follow the steps in *Procedures for External Modules* on page 6–17.

3. If the module is an internal-chassis module and access is required inside of the instrument; do the *Line Fuse and Line Cord* procedure followed by the *Cabinet* procedure. Both procedures are in the *Procedures for External Modules* subsection.

4. After completing those procedures, return to this procedure and continue with step 5.

5. If the module is an internal module(1), access the inner-chassis.

- a. If removing the output assembly or display unit, first do the *Trim Ring* found in *Procedures for External Modules* (page 6–17).

- b. Find and do the procedure for the module to be removed in *Procedures for Internal Modules (1)* on page 6–30.

6. If the module is an internal module(2), access the reverse side of the chassis. Since the module is assembled by three classes, perform the following steps in the order listed.

- a. Find and do the procedure for the module you want to remove in *Procedures for Internal Modules (2)*, page 6–44.

- b. Do the procedure *A10 Connector Board* found in *Procedures for Internal Modules (1)*, page 6–30.

7. Install all modules previously removed. Read the module removal for service instructions found at the end of the procedure. These instructions will guide you in installing all modules previously removed.

Procedures for External Modules

Do the *Access Procedure* on page 6–16 before performing any of the procedures in this subsection.

The following procedures are listed in the order presented.

- *Front Panel Knobs*
- *Line Fuse and Line Cord*
- *EMI Gaskets*
- *Cabinet*
- *Trim Ring*
- *A20 Front Panel Assembly*
- *Output Assembly*
- *Cabinet Modules*

Front Panel Knobs

You will need angled-tip tweezers (Table 6–4, Item 10).

1. Find the knob(s) to be removed on the front panel.
2. Orient the waveform generator so the bottom is on the work surface and the front is facing you.
3. Remove the knob(s) by pulling it straight out from the front panel to create some clearance between the base of the knob and the front panel. Insert the tweezers between the knob and the front panel and remove the knob. See Figure 6–6.
4. To install, align the knob to the shaft and push in until it snaps into place.

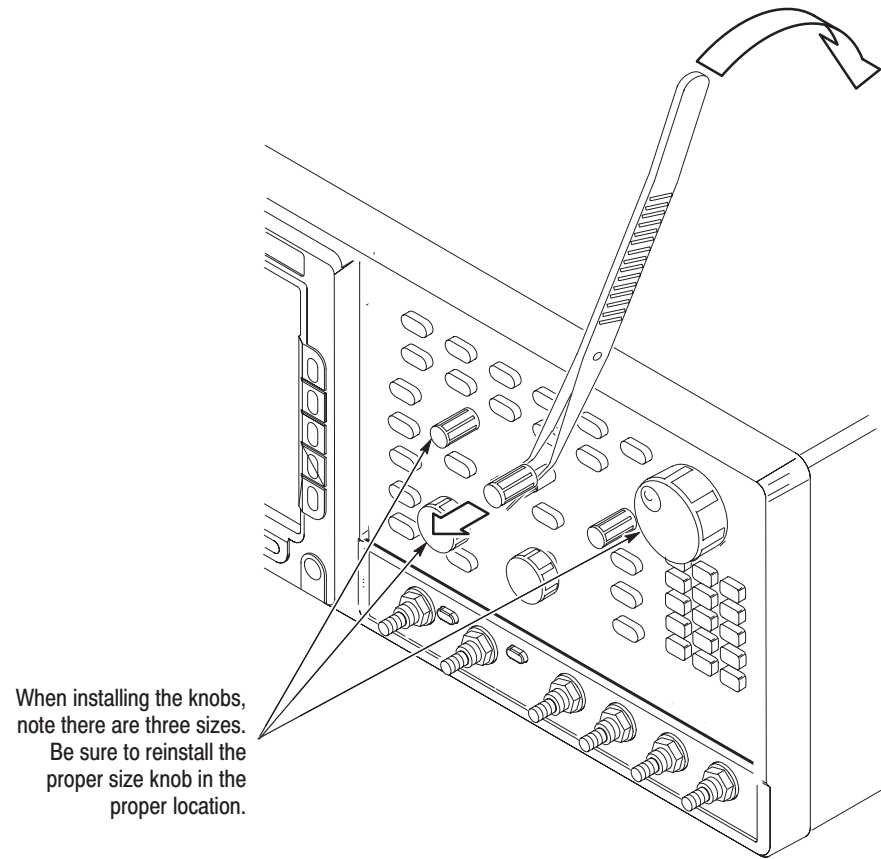


Figure 6-6: Knob removal

Line Fuse and Line Cord

You will need a flat-blade screwdriver (Table 6-4, Item 4). Locate the line fuse and line cord in Figure 6-2.



WARNING. To avoid electrical shock, be sure that the power cord is disconnected from the socket before checking the line fuse.

1. Orient the generator so the bottom is on the work surface and the rear is facing you.
2. Disconnect the line cord from the rear panel connector and main power.
3. If you are servicing the line fuse, do the next step; if you are servicing the line cord, skip to step 5.
4. Find the fuse cap on the rear panel. See Figure 6-7. Remove the fuse cap by turning it counterclockwise using a flat-blade screwdriver and remove the line fuse.
5. Find the line cord on the rear cover. See Figure 6-7. Pull the line cord to complete the removal. Do the procedure in reverse order to install.
6. Do steps 4 and 5 in reverse order to install the line cord and line fuse.

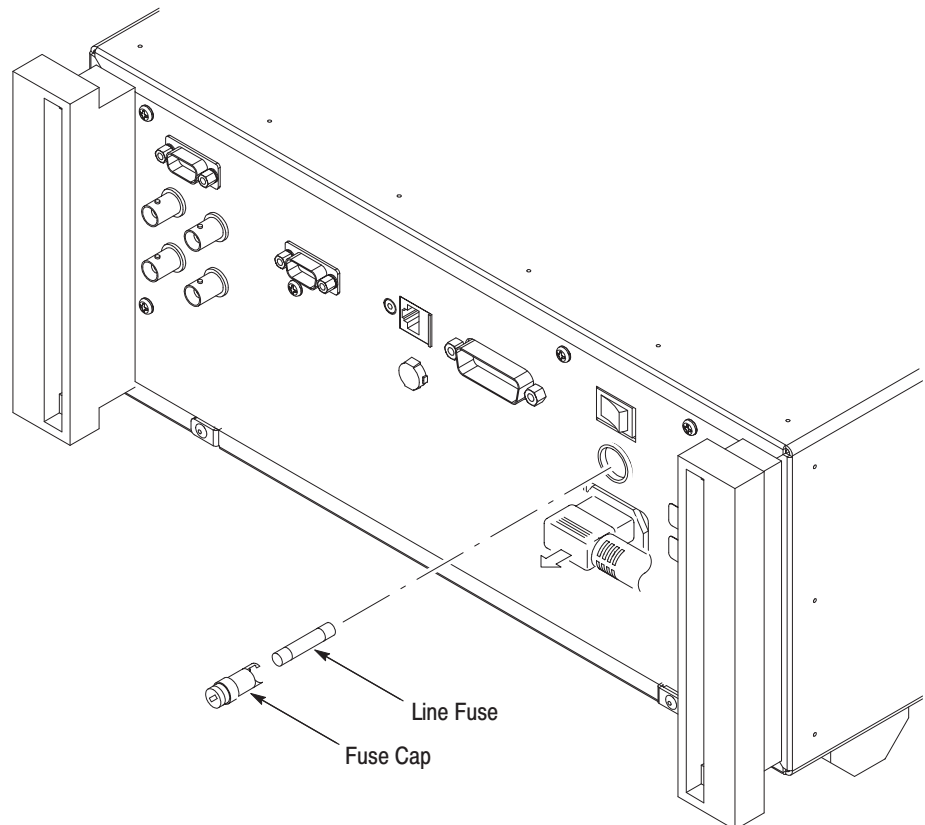


Figure 6-7: Line fuse and line cord removal

EMI Gaskets Do the following cabinet procedure (see Figure 6–8).

Cabinet You will need a screwdriver with a size Phillips #2 tip (Table 6–4, Items 1 and 3).

1. Make sure the front cover (optional accessory) is installed. If it is not, install it by snapping the edges over the trim ring.
2. Locate the cabinet in Figure 6–2, page 6–12.
3. Orient the generator so the front cover is on the work surface and the bottom side is facing you.
4. Unplug the line cord from its receptacle at the rear cover.
5. Remove the six screws at the rear of the cabinet which secure the two feet.
6. Grasp the left and right edges at the rear of the cabinet.
7. Pull upward to slide the cabinet off the generator. Take care not to bind or snag the cabinet on the internal cabling as you remove it.

NOTE. Do not do step 8 through 13 to remove the EMI gasket(s) unless it must be replaced due to damage. If you are not replacing the gasket, skip to step 14.

When installing EMI gaskets and/or the generator cabinet, carefully follow the instructions given. Unless they are performed properly, the generator may not meet its emissions requirements (EMI).

8. Locate the EMI gaskets to be removed in Figure 6–2.
9. You will need a pair of needle-nose pliers (Table 6–4, Item 6). Look for the point where the ends of the gasket touch in the channel at the rear edge of the cabinet.
10. Use a pair of needle-nose pliers to pry up one of the ends.
11. Grasp the EMI gasket and gently pull it out of its channel.
12. Repeat steps 9 through 11 to remove the gasket from its channel on the front casing.
13. To install, press each EMI gasket back into its groove at the rear edge of the cabinet or front casing. Make sure the ends of the gasket touch, but do not overlap, when installing. To prevent overlap, cut off any excess length.
14. To install the cabinet, do steps 3 and 4 in reverse order.
 - a. Take care not to bind or snag the cabinet on internal cabling. Redress the cables if necessary.

- b.** When sliding the cabinet, be sure that the front edge of the cabinet aligns with the groove containing the EMI shield on the front casing.
- c.** Be sure that the ridge around the rear chassis slides into the groove containing a second EMI cable at the rear of the cabinet.
- d.** When installing the four screws at the rear panel, torque to 16 ft-lb.
- e.** See *Line Fuse and Line Cord* to install the line cord.

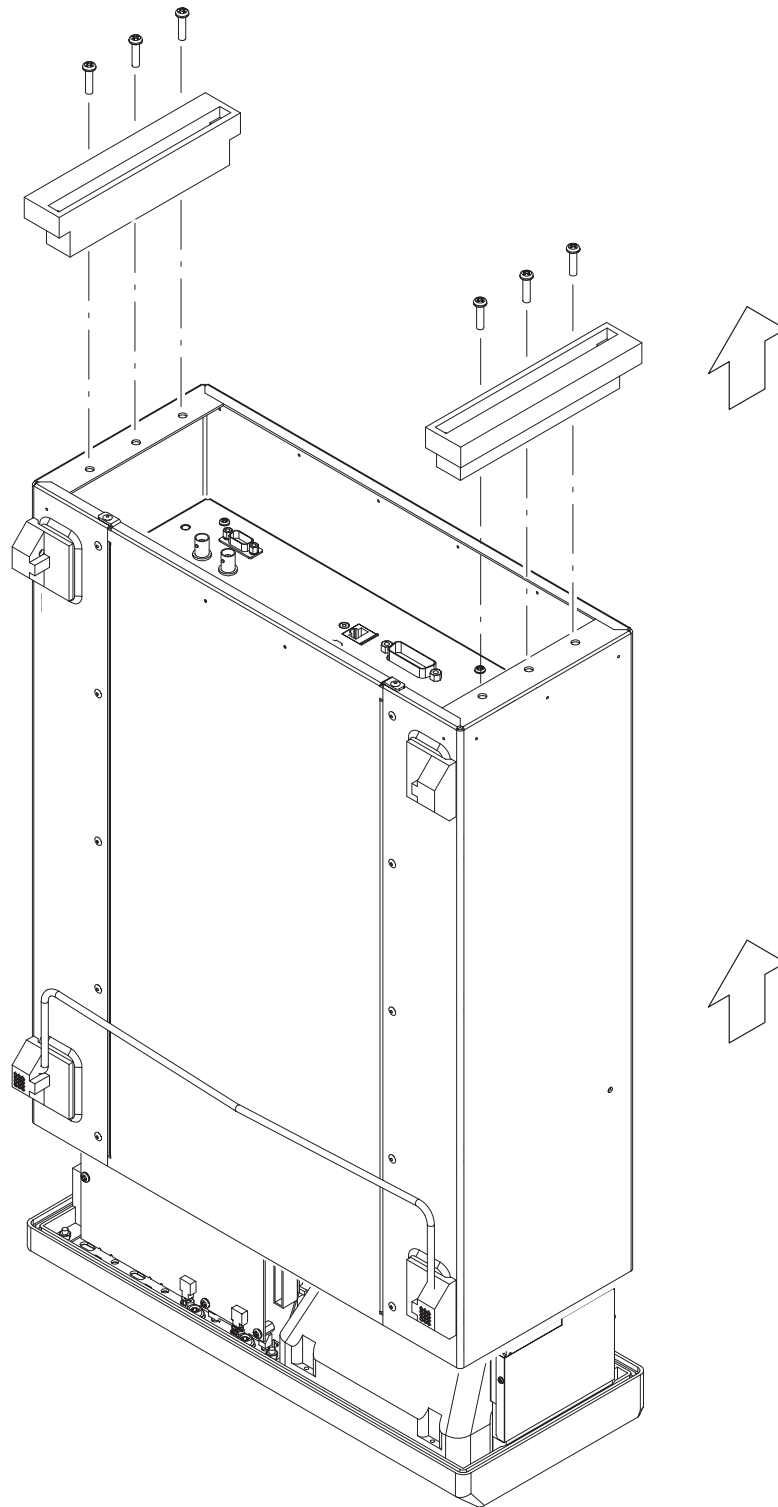


Figure 6-8: Cabinet removal

Trim Ring No tools are needed for this procedure.

1. Locate the modules to be removed in Figure 6–2, page 6–12.
2. Orient the generator so the rear is on the work surface and the bottom is facing you.
3. Remove the front cover by grasping it by the left and right edges and snap it off of the front subpanel. When installing, align and snap back on. See Figure 6–9.

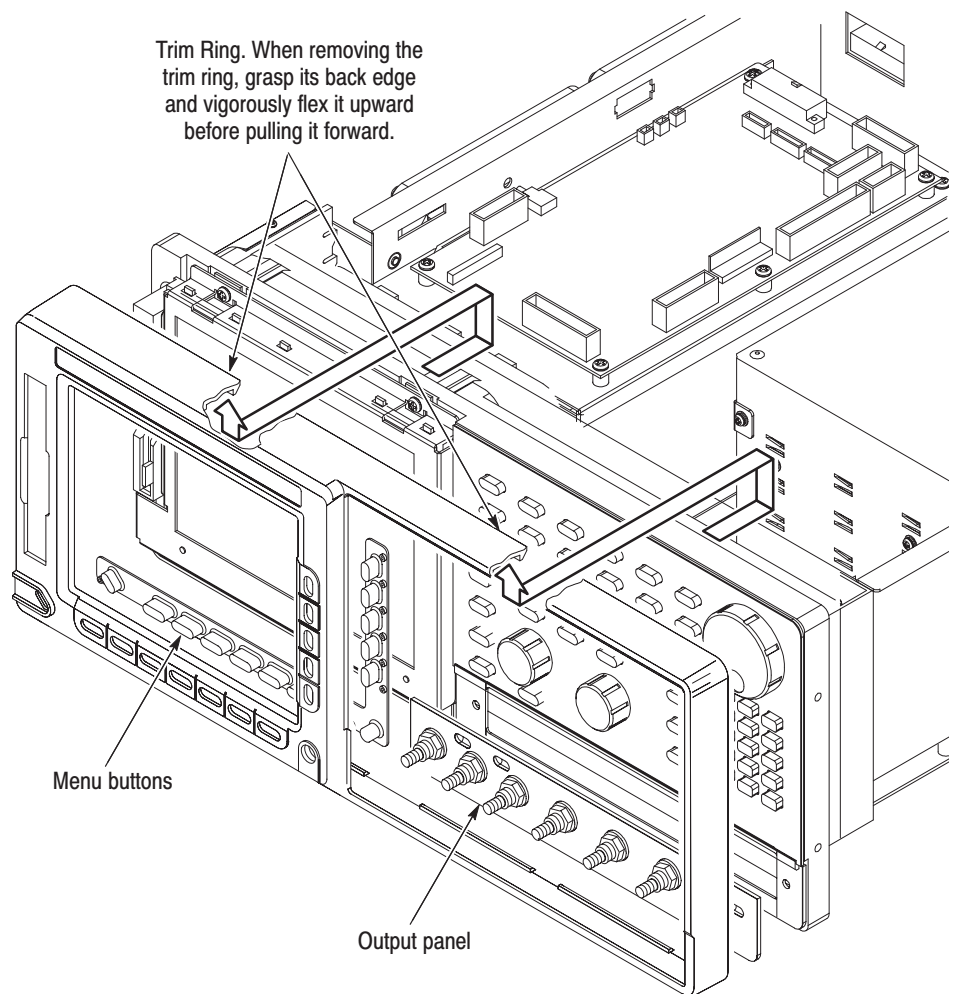


Figure 6–9: Trim ring and menu buttons removal



CAUTION. *To prevent damage to the contacts, do not touch the carbon contact points on the menu buttons installed in the trim ring. Also, do not touch the contacts on the exposed flex circuit when you remove the trim ring.*

4. Remove the trim ring by grasping the top edge and prying it up and lifting it forward to snap it off the front subpanel. If servicing the menu buttons, lift them out of the trim ring. When installing, insert the menu buttons, align the trim ring to the front subpanel and press it back on.
5. To install the output panel, menu buttons, and trim ring, do step 3 and step 4 in reverse order.

A20 Front Panel Assembly

This procedure includes removal and installation instructions for the front panel and front panel buttons. Unless either of those modules are being serviced, do not do step 4.

You will need a screwdriver with a size Phillips #2 tip (Table 6–4, Items 1 and 3).

1. Locate the modules to be removed in Figure 6–2, page 6–12.
2. Do the procedure *Trim Ring* step 1 through step 5, before proceeding to step 3 of this procedure.
3. Orient the waveform generator so the bottom is on the work surface and the front is facing you.
4. Remove the front panel assembly from the front subpanel by lifting the assembly until you can reach the interconnect cable connecting to the Connector board.
5. Disconnect the cable at J154 of the Connector board. Disconnect the flex-board connector at P3 of the front panel assembly. (The flex board is part of the display-frame assembly.) See Figure 6–10.
6. Lift the front panel assembly out of the front subpanel to complete the assembly.

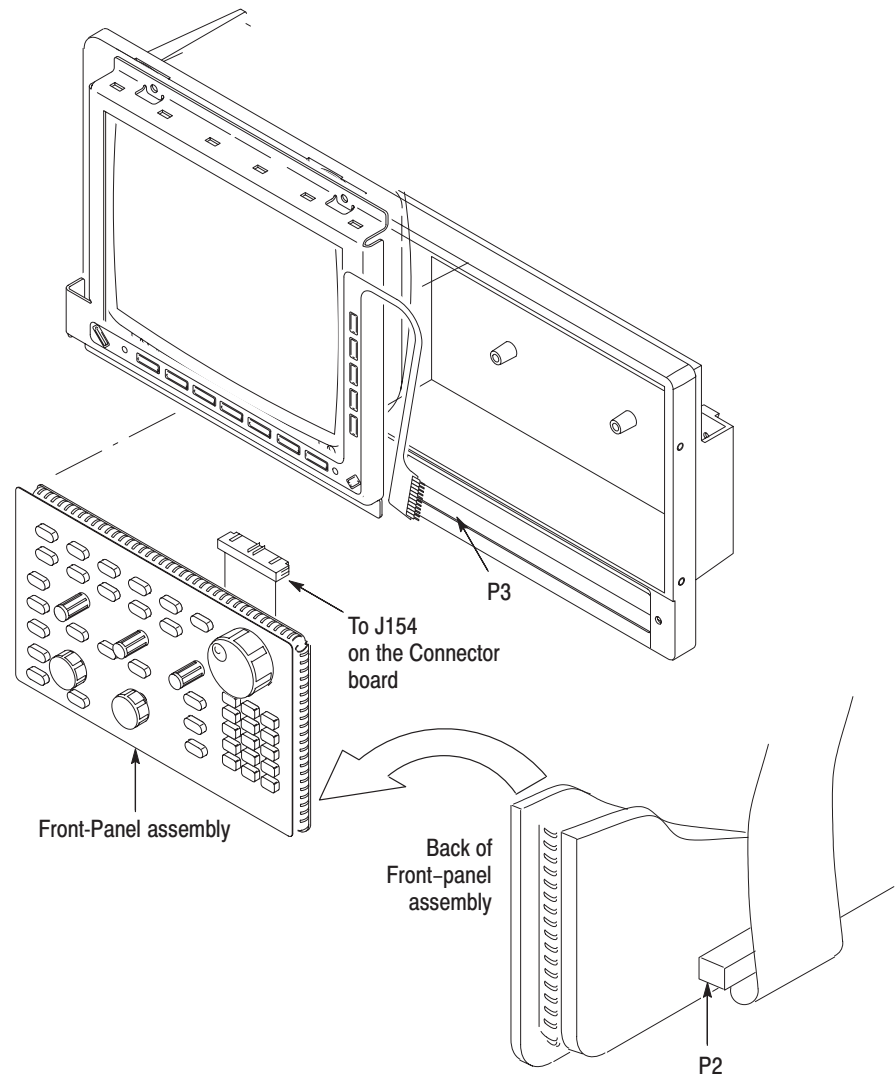


Figure 6-10: A20 Front panel assembly removal

If the front panel or the front panel buttons need service, do the following steps:

7. Remove the front panel control knobs from the front panel assembly using the method described in *Front Panel Knobs* on page 6-17.
8. Remove the eight screws that mount the front panel board to the front panel.
9. Hand disassemble the front panel assembly components using Figure 6-11 as a guide. Do this procedure in reverse order to reassemble using Figure 6-11 as a guide.
10. To install, reverse this procedure.

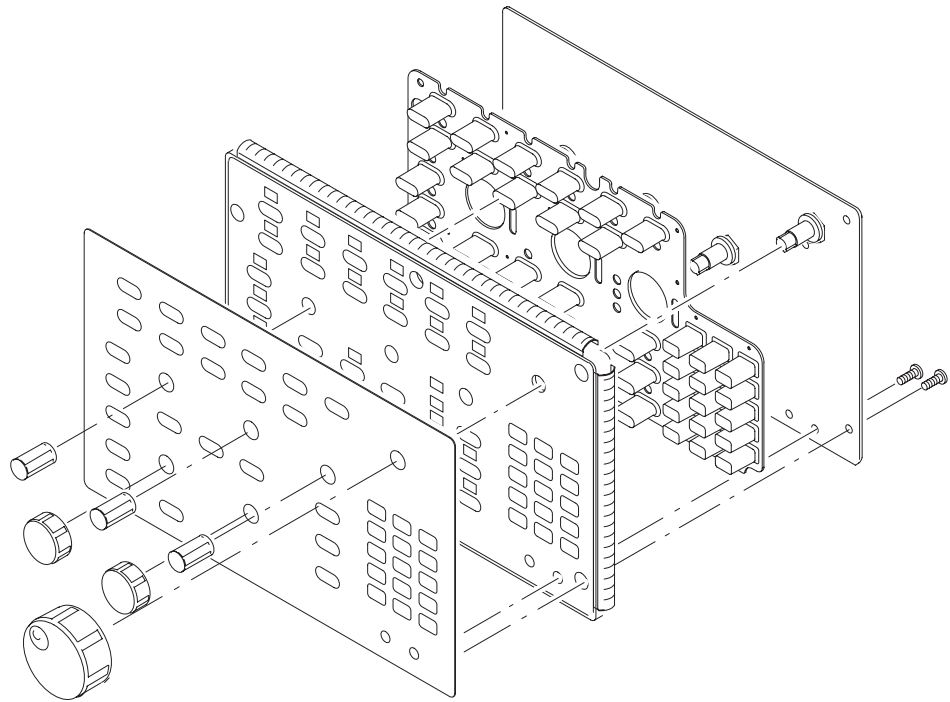


Figure 6-11: Disassembly of front panel assembly

Output Assembly

You will need a screwdriver with a size Phillips #2 tip (Table 6-4, Items 1 and 3).

1. Locate the modules to be removed in Figure 6-2, page 6-12.
2. Do the *Trim Ring* and *A20 Front panel assembly* procedures immediately preceding this procedure.
3. Orient the waveform generator so the bottom is on the work surface and the front is facing you.
4. To remove the output panel, disconnect the on/off cable at J200 of the A50 AWG board and all the Analog output cables at J190 and J290 of each A70/A72 Output boards.
5. Remove the three screws at the front side of the chassis, the two screws on the bottom of the chassis and the two screws at the right side of chassis attaching the Output assembly to the main chassis.
6. Pull out the Output assembly from the main chassis.
7. To install, reverse this procedure.

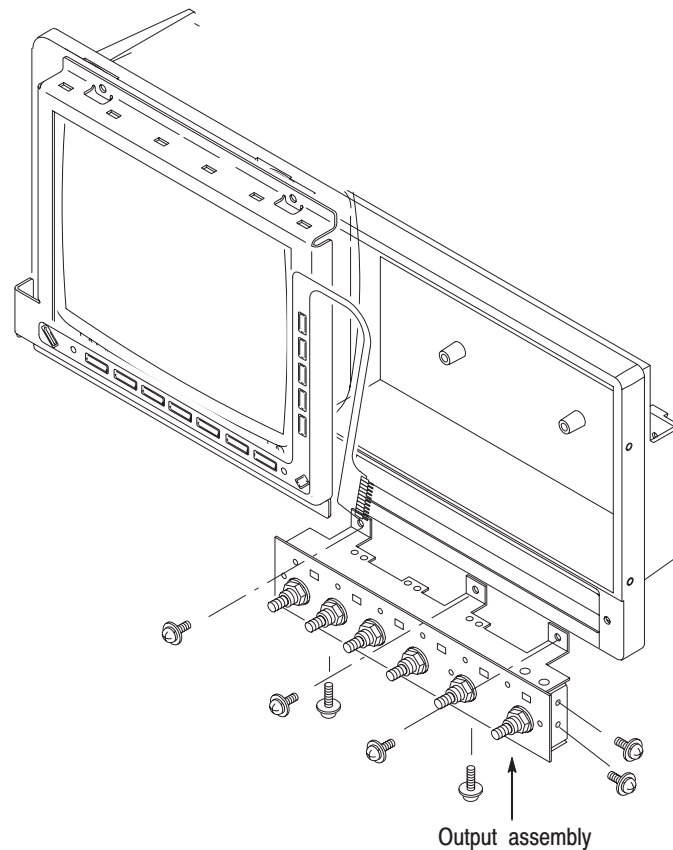


Figure 6-12: Output assembly removal

Cabinet Modules

You will need a pair of needle-nose pliers (Table 6-4, Item 5).

1. Locate the modules to be removed in Figure 6-2, page 6-12.
2. Orient the waveform generator so the left side is on the work surface and the handle is facing upward (see Figure 6-13).
3. Remove the handle by inserting the tips of a pair of needle-nose pliers (Table 6-4, Item 5) into the hole of either handle cap. Push and hold to depress the handle release.
4. While holding the handle release, pull it out of the slot in the handle cap. Repeat the procedure to remove the handle from the other handle cap.
5. To install, reverse this procedure.
6. Remove the handle caps by inserting the retaining ring pliers (Table 6-4, Item 9) into the opening created in the handle cap by removing the handle.

- 7.** While using the pliers to expand the handle cap outward, grasp it and snap it off.
- 8.** Repeat the procedure to remove the remaining cap as needed; push the cap(s) back on to install.
- 9.** Remove the flip stand by grasping it on both sides where it joins each flip stand foot. Now compress the flip stand until the flip stand ends clear the flip stand feet to complete the removal.
- 10.** To remove the flip stand foot or feet, do the *Cabinet* procedure (page 6–20) to gain access to the inside of the cabinet.
- 11.** Working from inside the cabinet, push the two retainers to release the flip stand foot you wish to remove and lift it away from the outside of the cabinet.
- 12.** Repeat this procedure to remove as many of the remaining feet as needed. Insert the two retainers back into their slots in the cabinet and snap any flip stand foot, previously removed, into place.
- 13.** To install, reverse this procedure.

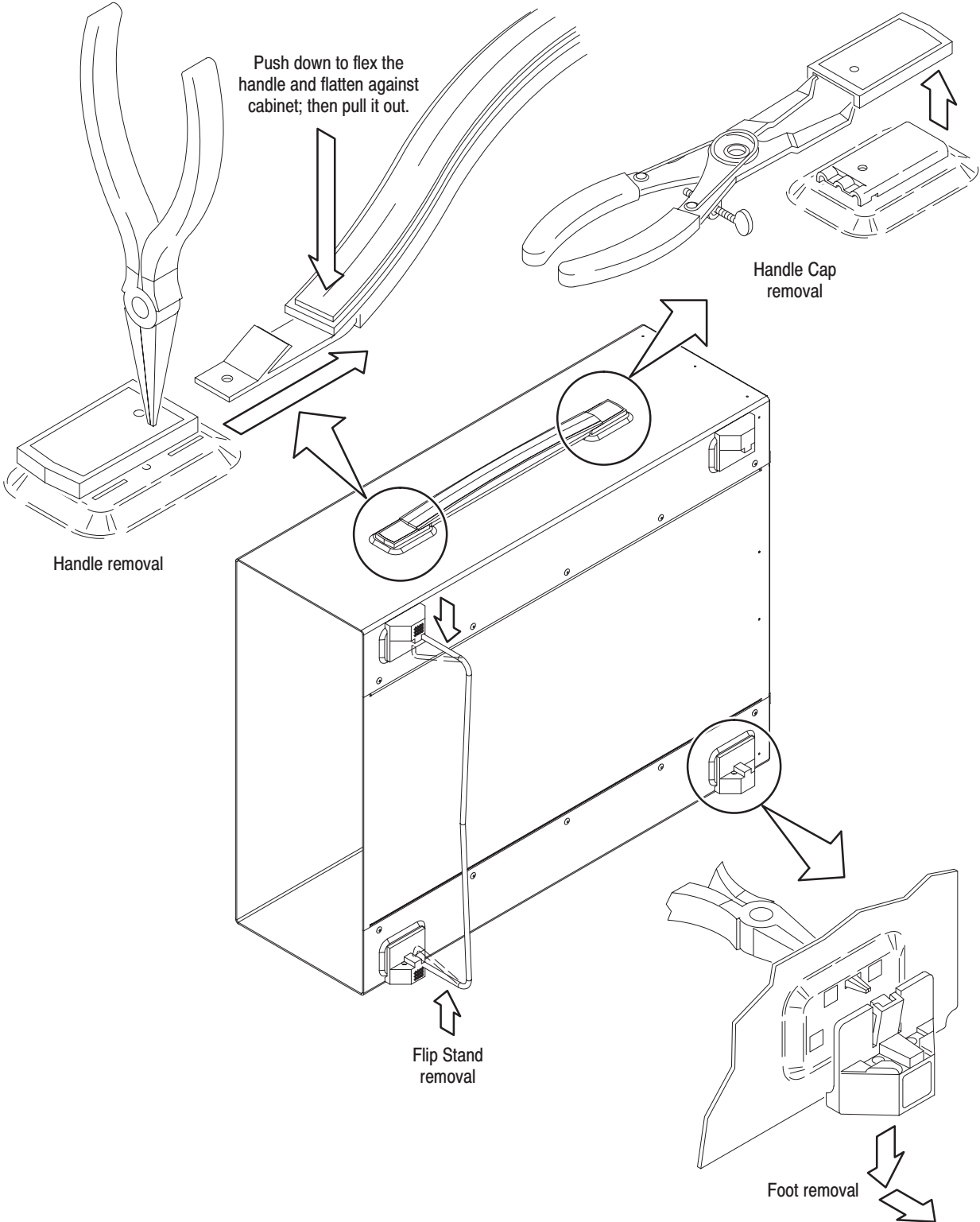


Figure 6-13: Cabinet modules removal

Procedures for Internal Modules(1)

You must complete the *Access Procedure* before doing any of the procedures described in this subsection. This subsection describes removal/installation procedures for the following modules:

- *Fan*
- *Floppy disk drive*
- *Display Assembly*
- *PS100 Low Voltage Power Supply*
- *A10 Connector board*
- *CPU unit*
 - *CPU Board*
 - *A40 PCI Interface Board*
 - *GPIB Board*
 - *Back Plane Board*
- *Hard Disk and Flash Disk*
- *Rear chassis*

- Fan** You will need a screwdriver with a size #2 Phillips tip (Table 6-4, Items 1 and 3).
1. Locate the fan in Figure 6-3 on page 6-13.
 2. Orient the waveform generator so the bottom is on the work surface and the left side is facing you (see Figure 6-14).
 3. Slide the cable connector at the fan to unplug the cable from the Connector board at J310.
 4. Remove the four screws that secure it to the main chassis and lift the fan out. The large fan uses spacer posts.
 5. To install, do the steps in reverse order. Refer to the *Cabinet* procedure, on page 6-20, to complete the generator assembly.

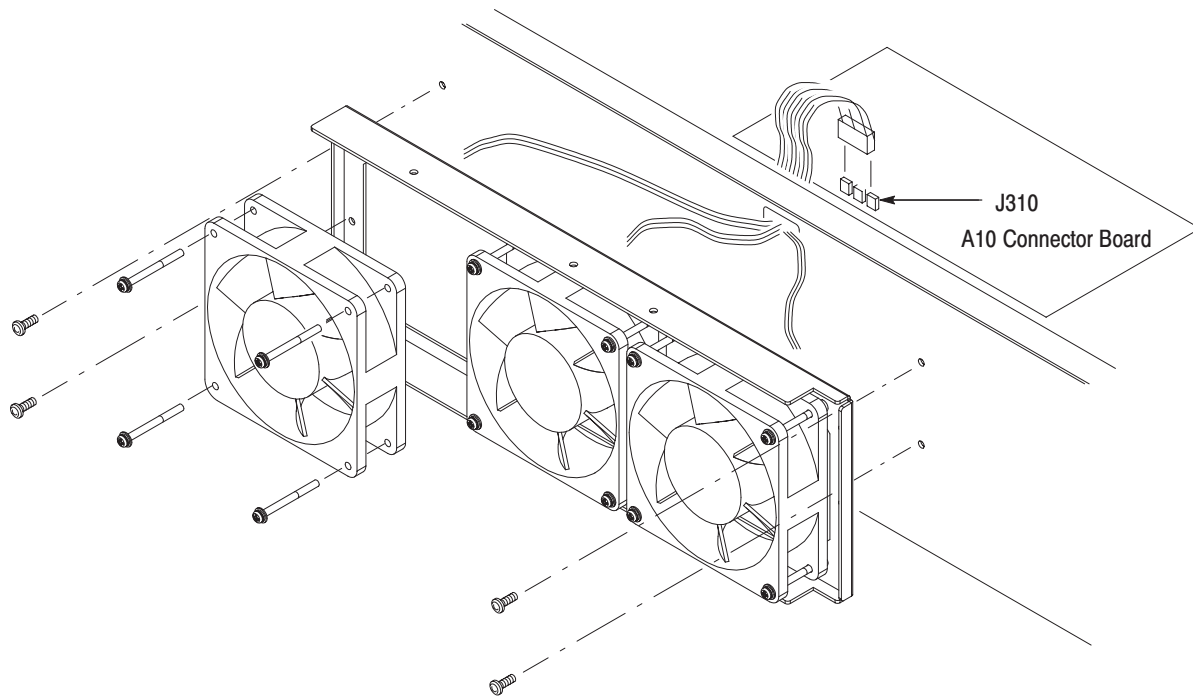


Figure 6-14: Fan removal

Floppy disk drive

You will need a screwdriver with a size #1 Phillips tip (Table 6-4, Items 1 and 2).

1. Locate the modules to be removed, including those listed under *Additional Modules Removed* in Figure 6-3, page 6-13.
2. Orient the waveform generator so the top is on the work surface and the left side is facing you.
3. Unplug the J102 floppy driver connector (ribbon interconnect cable) that connects the disk drive to the A10 Connector board.
4. Use the screwdriver with a #1 Phillips tip to remove the two screws that secure the floppy disk drive with bracket to the main chassis, and lift it out from the chassis using Figure 6-15 as a guide. When removing the disk drive main body from the bracket, remove the screw that secures the drive to the bracket, then pull out the disk drive.
5. To install, do this procedure in reverse order. Refer to the *Cabinet* procedure on page 6-20 to complete the generator assembly.

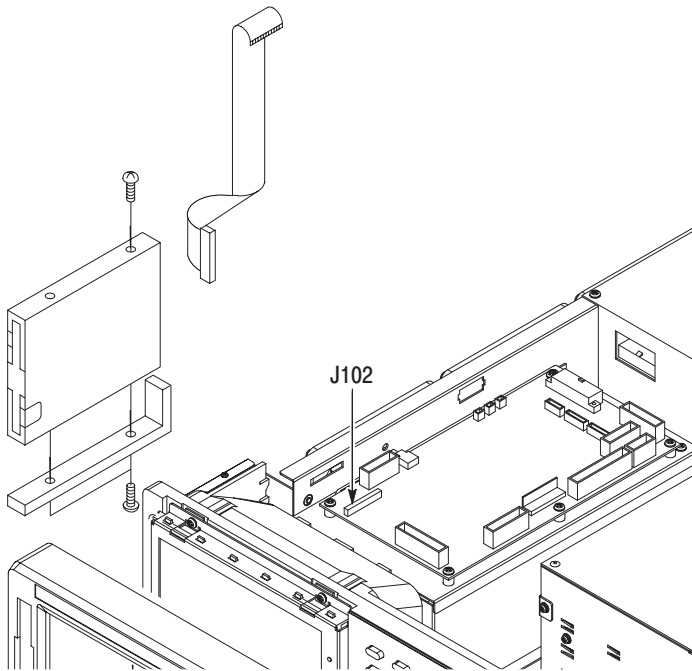


Figure 6-15: Floppy disk drive removal

Display Assembly

You will need a screwdriver with a size #2 Phillips tip (Table 6–4, Items 1 and 3).

1. Locate the modules to be removed in Figure 6–3, on page 6–13.
2. Do the *Trim Ring, Menu Button* and *A20 Front Panel Assembly* procedures immediately preceding this procedure.
3. Orient the waveform generator so the bottom is on the work surface and the front panel is facing you (see Figure 6–16).
4. Unplug the LCD and Back Light connectors J225 and J245 on the A10 Connector board.
5. Unplug the LCD connector on the right side of the LCD display by pushing toward the rear panel.
6. Remove the four screws on the top and bottom of the display frame that mount the display assembly to the chassis.
7. Remove the display frame, filter, and filter retainer.
8. Remove the LCD display and bracket by pulling it out from left side.

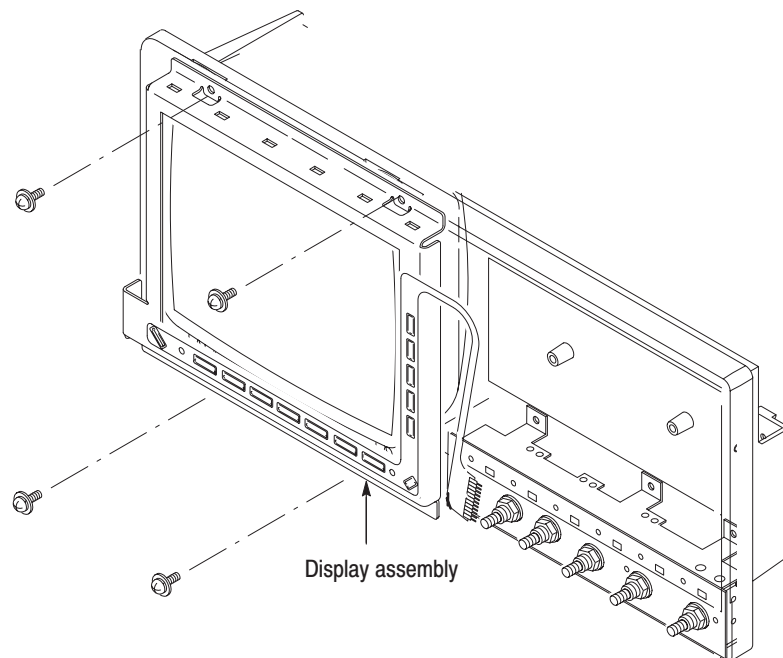


Figure 6–16: Display assembly removal

9. To install, do this procedure in the reverse order.

10. See the following procedures, in the order shown, to complete the reassembly of the waveform generator:
 - *A20 Front Panel Assembly* (page 6–24)
 - *Trim Ring, Menu Buttons* (page 6–23)
 - *Cabinet* (page 6–20) (completes reassembly)

PS100 Low Voltage Power Supply

You will need a screwdriver with a size #2 Phillips tip (Table 6–4, Items 1 and 3).

1. Locate the Power Supply in Figure 6–3, page 6–13.
2. Orient the waveform generator so the bottom is on the work surface and the right side is facing you.
3. To remove the low-voltage power supply, unplug four power cables from J3 on the A10 Connector board and J1, J2, and J4 on the A50 Sequence board. See Figure 6–17.
4. Remove the two screws on the left side of the rear Principal Power switch and the power cable connector of the generator that mount the low-voltage power supply to the rear chassis.
5. Remove the four screws from the top of the supply, the five screws at the bottom, and the one screw from the side that mounts the supply to the main chassis. Then remove the screw securing the ground lead to the main chassis.
6. Lift the module up and out of the generator to complete the removal.
7. To install, do this procedure in reverse order then refer to the *Cabinet* procedure, on page 6–20 to complete assembly of the generator.

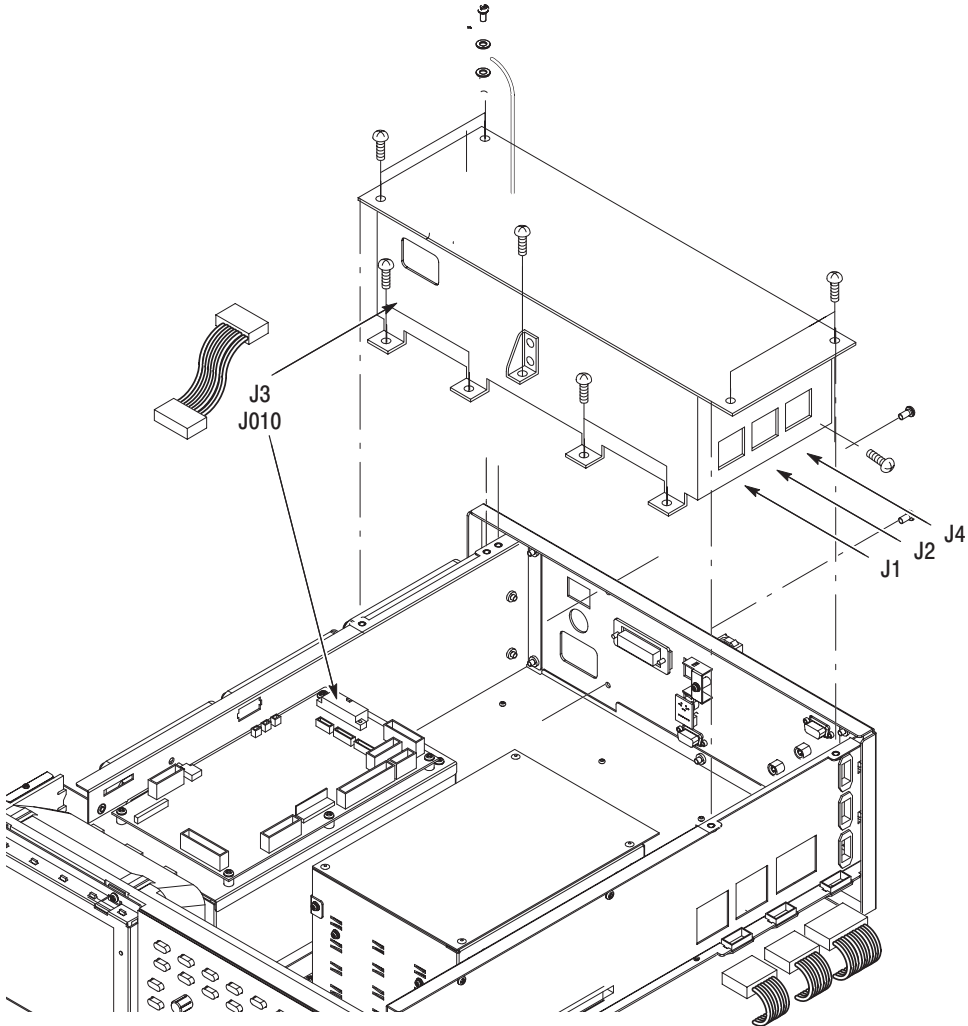


Figure 6-17: Power supply module removal

A10 Connector Board

You will need a screwdriver with a size #2 Phillips tip (Table 6–4, Items 1 and 3).

1. Locate the modules to be removed in Figure 6–3, page 6–13.
2. Orient the waveform generator so the bottom is on the work surface and the front is facing you.
3. To disconnect the A10 Connector board, disconnect the following cables and connectors. See Figure 6–18 as a guide.
 - Fan power cable at J310
 - Cable from the low-voltage power supply at J010
 - Cable to the PCI Backplane power supply at J320
 - J245 LCD Backlight, J225 TFT LCD and J102 Floppy disk driver connector
 - Interconnect cables from CPU board at J100 CPU FDD, J110 CPU MISC, J150 CPU VGA & COM1 and J220 CPU LCD
 - Interconnect cables to the Monitor Out at J152 and the A90 Key board at J112
 - Interconnect cable from the PCI Interface at 200
 - Cables from the A20 Front Panel board at J154
4. Use a screwdriver with a size #2 Phillips tip to remove the five screws that attach the A11 Connector board to the HDD bracket.
5. Lift the board up and out from the HDD bracket to complete the removal.
6. To install, do this procedure in reverse order. Refer to the *Cabinet* procedure on page 6–20 to complete the assembly of the generator.

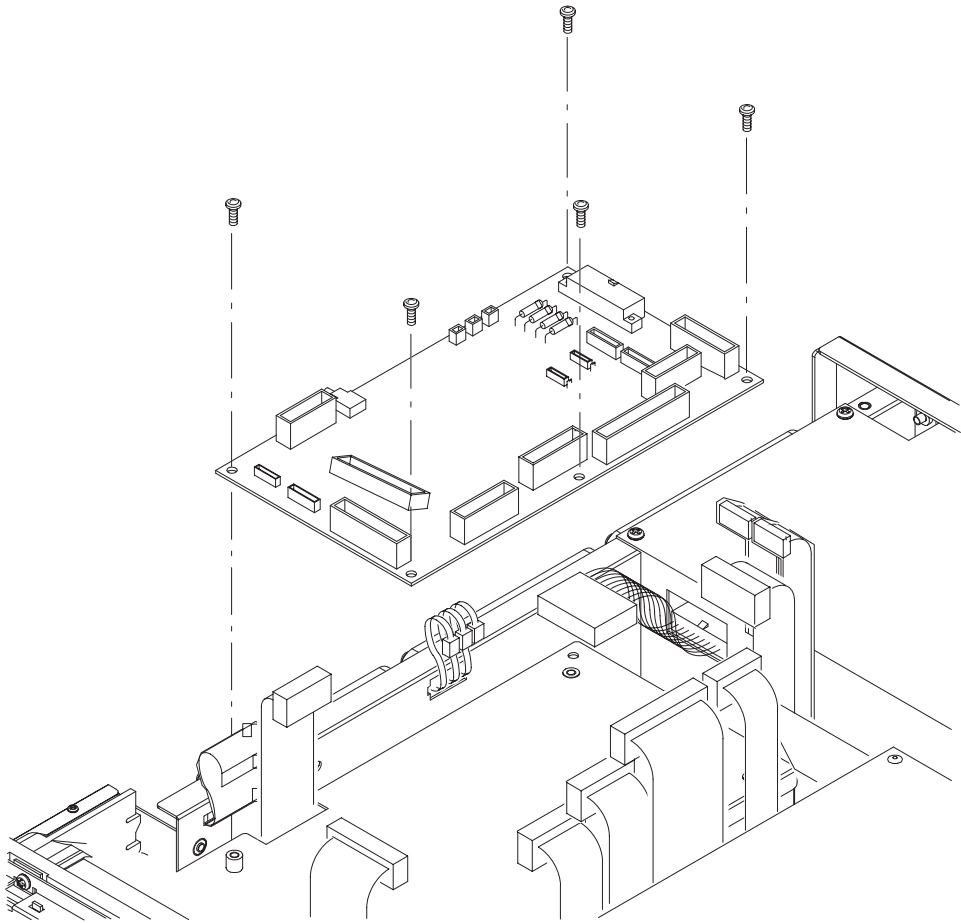


Figure 6-18: A10 connector board removal

CPU unit This procedure describes how to remove the following circuit boards that are contained in the CPU unit:

- CPU board
- Hard Disk and Flash Disk
- A40 PCI Interface Board
- GPIB Board
- Back Plane

NOTE. *The Lithium polycarbon monofluoride battery on the CPU board is not user-replaceable. Removing the battery erases calendar backup data. Replace the CPU board as a unit. Dispose of the used battery in the proper environmental manner.*

You will need a screwdriver with a size #2 Phillips tip (Table 6–4, Items 1 and 3).

1. Locate the modules to be removed in Figure 6–4, page 6–14.
2. Orient the waveform generator so the bottom is on the work surface and the right side is facing you.
3. Remove the *CPU unit* using Figure 6–19 as a guide while doing the following substeps:
 - a. Unplug the GPIB interconnect cable at the GPIB board and the LAN interconnect cable and the VGA and COM1 interconnect cable at the CPU board.
 - b. Unplug the LCD flat cable, FDD flat cable, HDD IDE flat cable, and the MISC flat cable at the CPU board.
 - c. Unplug the two flat cables from the A50 Sequence board and the flat cable from the A10 Connector board at the A40 PCI Interface board.
 - d. Remove the two screws on the bottom and the two screws on the right side.
 - e. Lift the CPU Unit up and out from the main chassis.

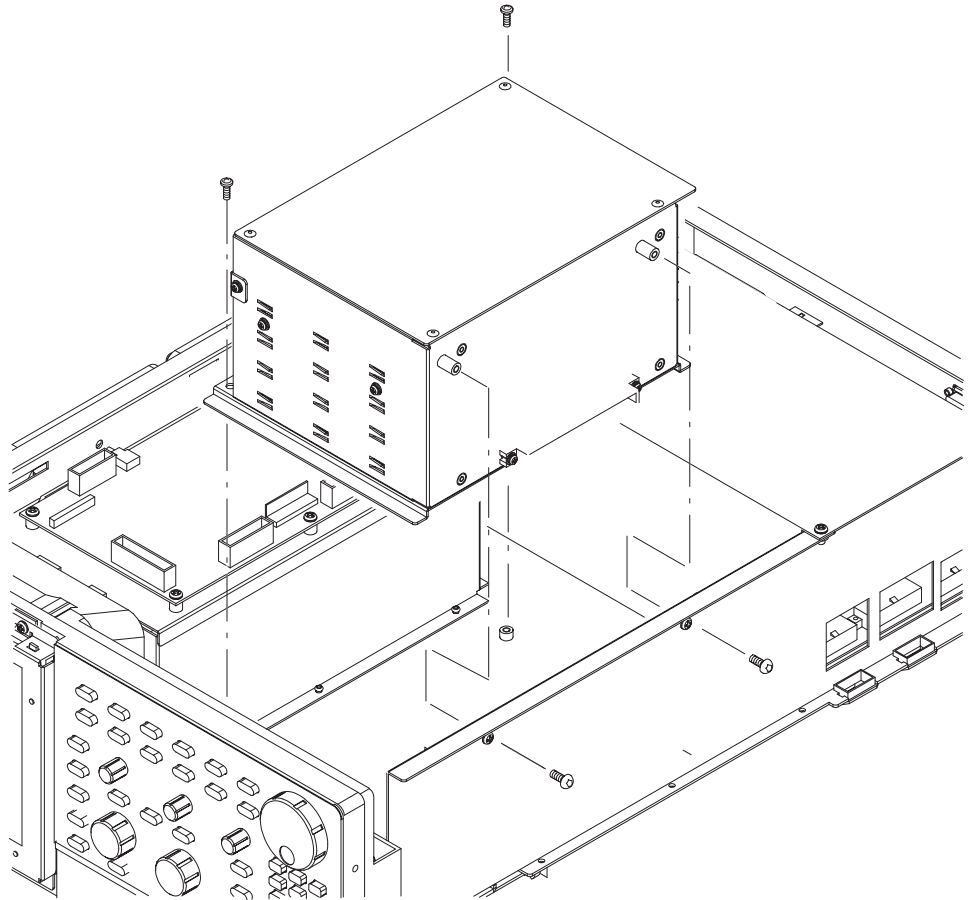


Figure 6-19: CPU unit removal

4. Remove the **CPU board** using Figure 6-20 as a guide while doing the following substeps:
 - a. Use a screwdriver with a size #2 Phillips tip to remove the screw that secures the CPU board to the frame with a retainer on the the right side of the unit.
 - b. Remove the screw on the left side of the CPU board.
 - c. Grasp the board and slide it out of the unit.

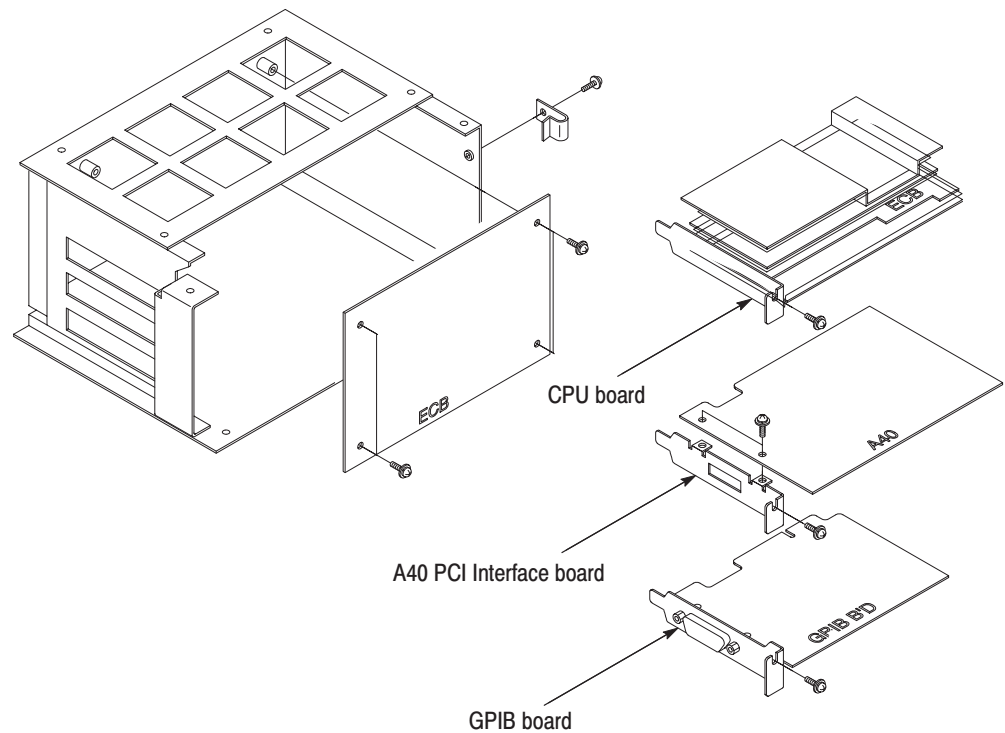


Figure 6-20: CPU, A40 PCI Interface, and GPIB boards removal

5. Remove the A40 PCI Interface board (using a screwdriver with a size #2 Phillips tip) by removing the screw on the left side of the board. See Figure 6-20.
6. Grasp the board and slide it out.
7. Remove the GPIB board (using a screwdriver with a size #2 Phillips tip) by removing the screw on the left side of the GPIB board. See Figure 6-20.
8. Grasp the board and slide it out.
9. Remove the Back Plane (using a screwdriver with a size #2 Phillips tip) by removing the four screws securing the board to the frame. See Figure 6-20.
10. Grasp the board and slide it out.
11. To install, do this procedure in reverse order.
12. Refer to the *Cabinet* procedure on page 6-20 to complete the assembly of the waveform generator.

Hard disk and Flash disk

This procedure describes how to remove the Hard Disk and Flash Disk unit.

You will need a screwdriver with a size Phillips #2 tip (Table 6-4, Items 1 and 3).

1. Locate the modules to be removed in Figure 6-4, page 6-14.
2. Orient the waveform generator so the bottom is on the work surface and the front is facing you.
3. The hard disk unit is beneath the A10 board. Do the *A10 Connector board removal procedure (page 6-24)* before continuing this procedure.
4. Unplug the IDE interface cable from the IDE interface connector on the disk drive.
5. Use a screwdriver with a size Phillips #2 tip to remove the four screws that secure the hard disk and flash disk bracket to the chassis. See Figure 6-21.
6. Remove the four screws that secure the hard disk drive and the flash disk drive to the bracket.

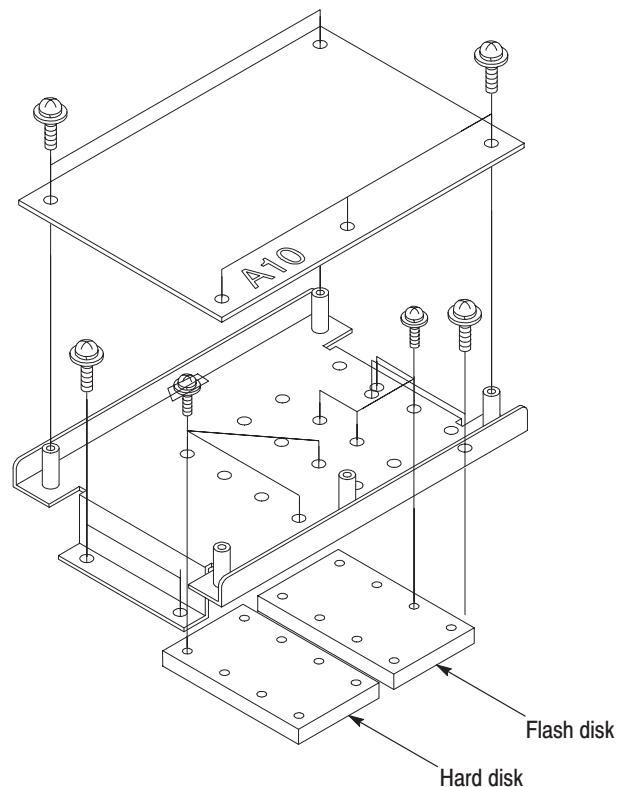


Figure 6-21: Hard disk and flash disk removal

Rear Chassis

You will need a screwdriver with a size #2 Phillips tip (Table 6–4, Items 1 and 3).

1. Locate the modules to be removed in Figure 6–3, page 6–13.
2. Do the *PS100 Low Voltage Power Supply* procedure (page 6–34) to remove the power supply module.
3. Install the front cover (optional accessory) if it is not already installed.
4. Orient the waveform generator so the bottom is on the work surface and the rear is facing you.
5. Remove the rear chassis using Figure 6–22 as a guide when doing the following substeps:
 - a. Unplug these cables:
 - GPIB interconnect cable at GPIB card in the CPU Unit
 - LAN interconnect cable and the Option port interconnect cable at the connector on the CPU board
 - Cable to DISPLAY MONITOR OUT at J152 and KEYBOARD at J112 on the A10 Connector board
 - Event In cable at J1000 on the A5– Sequence board
 - Clock In at J210, Clock Out at J700, 10MHz Ref In at J500, 10MHz Ref Out at J530, and Trig In at J300 coax cables on the A50 Sequence board
 - CHx Add In at J300 coax cable on the A70/A72 Output board
 - CHx Marker1 at J1004 and Marker2 at J1006 coax cables on the A52 AWG board
 - b. Remove the five screws that secure the rear chassis to the main chassis.

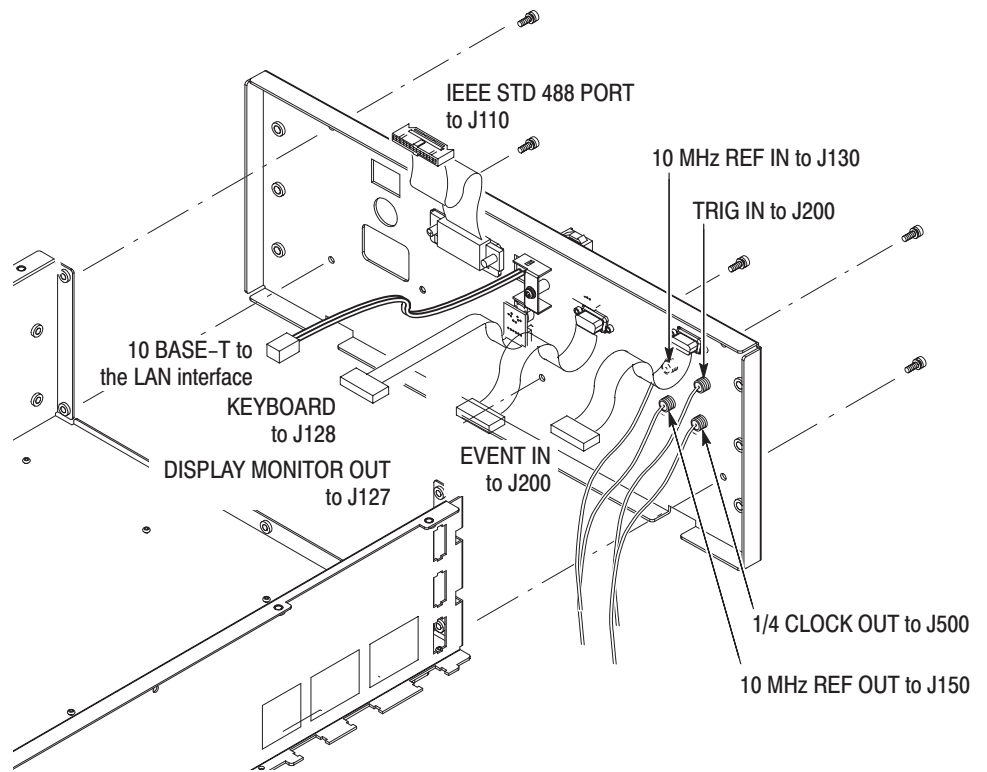


Figure 6-22: Rear chassis removal

6. To install, do this procedure in the reverse order. Complete the assembly in the order listed.
 - *PS100 Low Voltage Power Supply* (page 6-34)
 - *Cabinet* (page 6-20)

Procedures for Internal Modules(2),

You must complete the *Access Procedure* on page 6–16 before doing any of the procedures for the Internal modules(2). The procedures are presented in the following order:

- *A77 Attenuator Board* (except option 02)
- *A72 Output Board* (except option 02)
- A50 AWG board
- *A72 Output Board* (for option 02)

The option 02 model doesn't have *A77 attenuator board*, and it has *A72 output board* instead of *A71 output board*.

A77 Attenuator Board (except option 02)

You will need a screwdriver with a size #2 Phillips tip (Table 6–4, Items 1 and 3). The *A77 Attenuator board* is contained in the aluminum shield case.

1. Locate the modules to be removed in Figure 6–5, page 6–15.
2. Orient the waveform generator so the top is on the work surface and the rear is facing you.
3. Remove the *A77 Attenuator Board* with the shield case using Figure 6–23 on page 6–45 as a guide.
 - a. Unplug these cables:
 - Output cables to CH1 and $\overline{\text{CH1}}$ Output connector
 - Two cables from the A50 AWG board
 - Eight cables from the *A71 Output board*
 - b. Remove the five screws on the upper surface attaching the shield case to the *A72 Output Board*.
4. Lift the shield case including the *A77 Attenuator Board* up perpendicularly from the *A72 Output Board* to complete the removal.

NOTE. *The A77 Attenuator board has two connectors on the front and rear panels and is connected to the A71 Output board. If the post spacer(s) is removed with the output board, remove the spacer(s) and screw it back into its mounting hole.*

5. To open a shield case, remove the four screws on both sides of it.
6. To install, do the procedure in the reverse order.

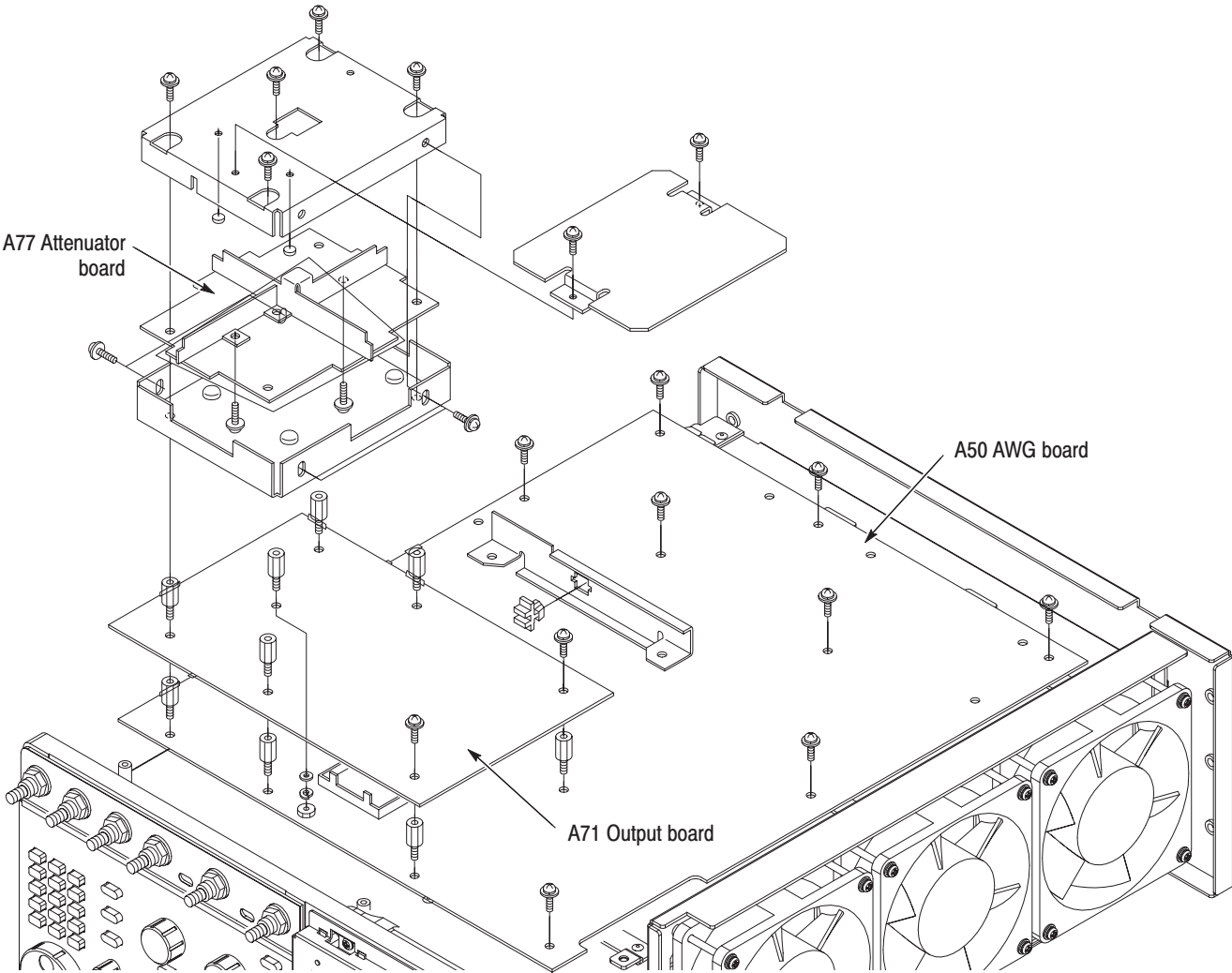


Figure 6-23: Removal of the A77, A71 and A50 boards (except option 02)

**A71 Output Board
(except option 02)**

You will need a screwdriver with a size #2 Phillips tip (Table 6–4, Items 1 and 3).

1. Locate the modules to be removed in Figure 6–5, page 6–15.
2. Orient the waveform generator so its top is down on the work surface and its front is facing you.
3. Perform the *A77 Attenuator Board* procedure that precedes this procedure to remove the interconnect cables.
4. Remove the *A72 Output Board* using Figure 6–23 on page 6–45 as a guide.
5. Unplug the eight cables from the *A77 Attenuator Board*.
6. Remove the six screws on the front panel and rear panel sides that attach the *A72 Output Board* to the A50 AWG board.
7. Lift the Output board up perpendicularly from the A50 AWG board to complete the removal.

NOTE. *A72 Output Board has a connector on the front panel side, and is connected with A50 AWG board. In case you remove A72 Output Board, raise perpendicularly. If the post spacer(s) is removed with the output board, remove the spacer(s) and screw it back into its mounting hole.*

8. To install, do this procedure in the reverse order and proceed to the *Cabinet* procedure (page 6–20) to complete the assembly.

**A50 AWG Board
(A common circuit board)**

You will need a screwdriver with a size #2 Phillips tip (Table 6–4, Items 1 and 3) and a nutdriver 5.5 mm (Table 6–4, Item 7).

1. Locate the modules to be removed in Figure 6–5, page 6–15.
2. Orient the waveform generator so the top is on the work surface and the rear is facing you.
3. Perform the *A77 Attenuator Board* and *A72 Output Board* procedures prior to this procedure to remove the Sequence board.
4. Unplug the following cables and connectors:
 - Three power supply cables J610, J630 and J670
 - Flat cable from Event Input at J560
 - Flat cable from A22 On/Off board at J600
 - Two flat cables from PCI Interface board at J100 and J110
 - Coax cables from 10MHz Ref Out at J5230, 10MHz Ref In at J5210, 1/4 Clock Out at J5450 and Trigger In at J5100
 - Four coax cables from Marker Out at J5510, J5511, J5610 and J5611
5. Remove the *A50 AWG board* using Figure 6–23 on page 6–45 as a guide.
 - a. Remove the six spacer posts.
 - b. Remove the eight screws that attach the Sequencer board to the main chassis.
6. To install, do the procedure in the reverse order.

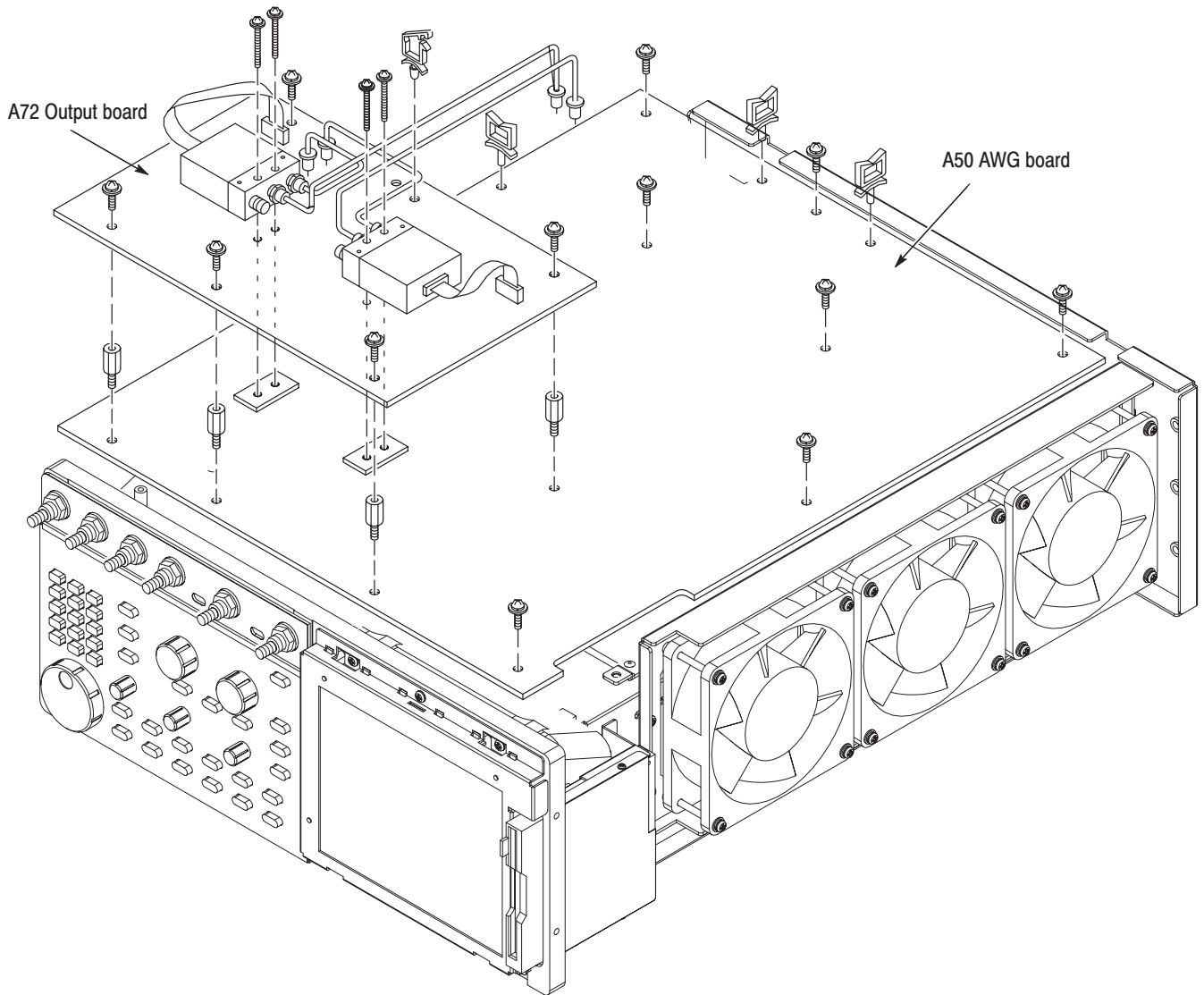


Figure 6-24: Removal of the A77, A72 and A50 boards (for option 02)

**A72 Output Board
(option 02 only)**

You will need a screwdriver with a size #2 Phillips tip (Table 6–4 of page 6–10, Items 1, 3 and 15).

1. Locate the modules to be removed in Figure 6–5, page 6–15.
2. Orient the waveform generator so its top is down on the work surface and its front is facing you.
3. Unplug the analog output cables with SMA connectors of K100 and K200.
4. Unplug the MKD1 cable with J5400 of the A50 AWG board, the MKD2 cable with J5401.
The MKDx is mentioned in the tip of each cable.
5. Remove the A72 Output board on the post spacer with six-screws(211–0751–00).
6. Remove the *A72 Output Board* using Figure 6–24 on page 6–48 as a guide.
7. Lift the A72 Output board up perpendicularly from the A50 AWG board to complete the removal.
8. To install, do this procedure in the reverse order and proceed to the *Cabinet* procedure (page 6–20) to complete the assembly.

Troubleshooting

This subsection contains information and procedures designed to help you isolate faulty modules in the waveform generator. If a module needs to be replaced, follow the *Removal and Installation Procedures* in this section.

This subsection consists of the following flowcharts:

- Figure 6–25: Primary Troubleshooting Procedure on page 6–52.
- Figure 6–26: Troubleshooting Procedure 1 - Power Supply Module on page 6–53.
- Figure 6–28: Troubleshooting Procedure 2 - CPU or Front-panel Module on page 6–55.
- Figure 6–29: Troubleshooting Procedure 3 - LCD and backlight on page 6–56.
- Figure 6–31: Troubleshooting Procedure 4 - Module Isolation on page 6–58.

See Figure 6–27 for power supply connectors and Figure 6–30 for the A10 connector board.

Diagnostics

The waveform generator has two levels of internal diagnostics that focus on verifying, adjusting, and if necessary, isolating faulty modules.

Both levels of the internal diagnostics report any bad modules and/or interfaces. If a bad module and/or interface is found, use the troubleshooting procedures in this section to determine which module needs to be replaced.

The two levels of diagnostics are the short confidence set and the extended set that tests the oscilloscope circuitry in depth and takes more time. Upon powering on, the waveform generator automatically executes the short set. The extended set is optional and is executed by using the following procedure:

Prerequisites: Power on the waveform generator and allow a 20 minute warm-up before doing this procedure:

1. Display the diagnostics menu: Press **UTILITY** → **Diag**.
2. Select the menu: Select **ALL** using the general purpose knob.
3. Run the diagnostics: Press **Execute Diagnostic**.
4. Wait: The internal diagnostics do an exhaustive verification of proper function. This verification will take several minutes. When finished, the waveform generator will display a report listing any bad modules and/or interfaces.

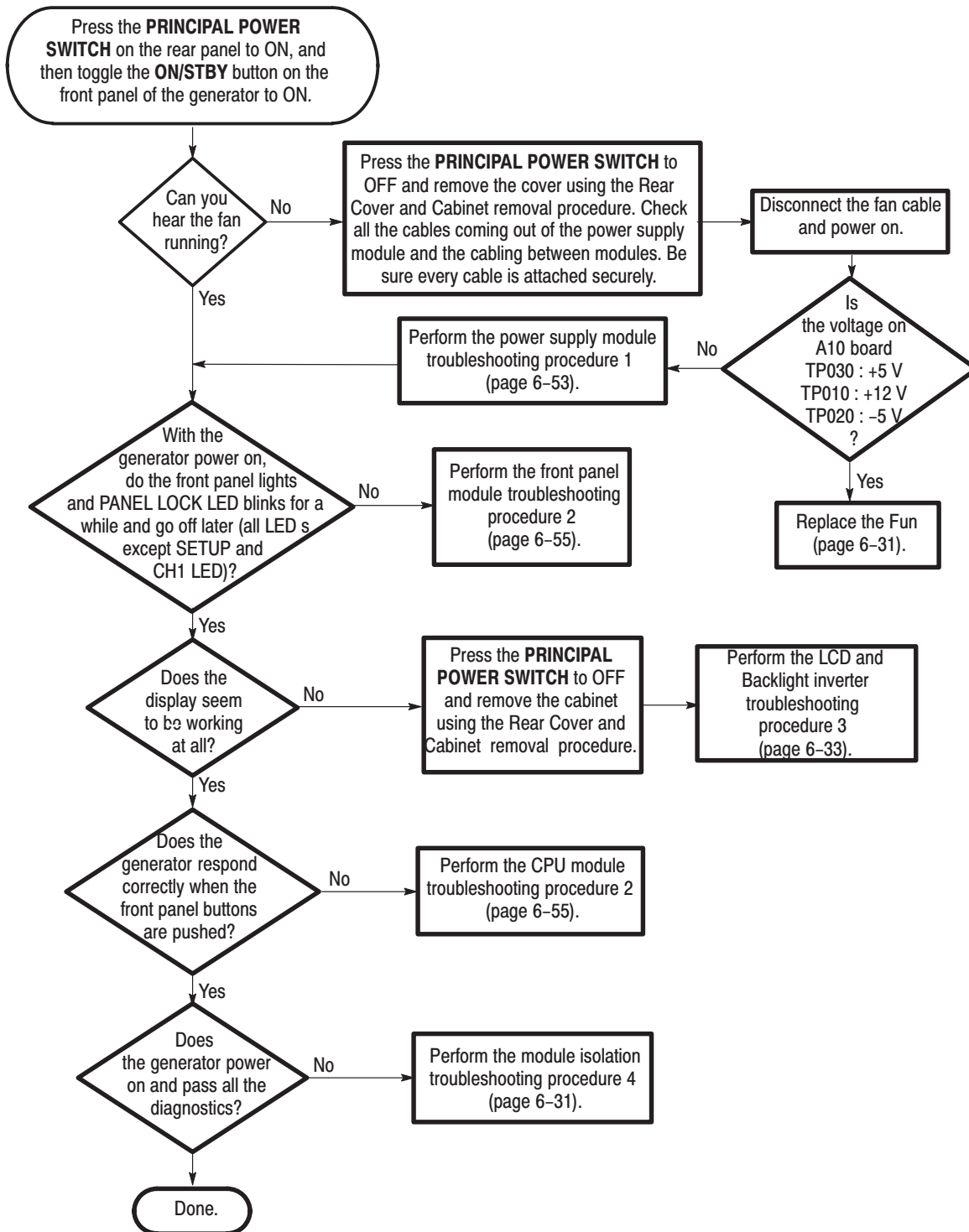


Figure 6-25: Primary troubleshooting procedure

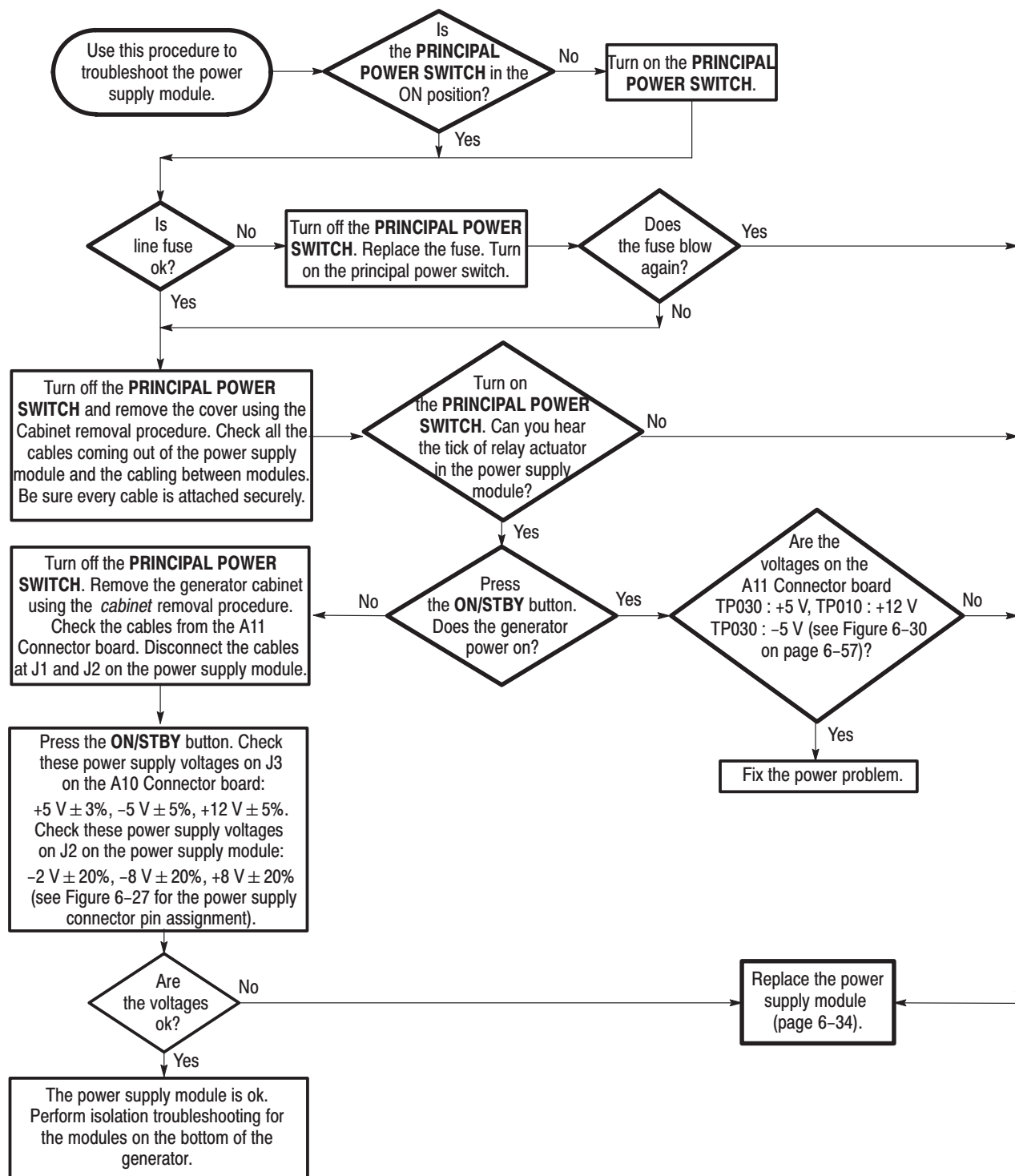
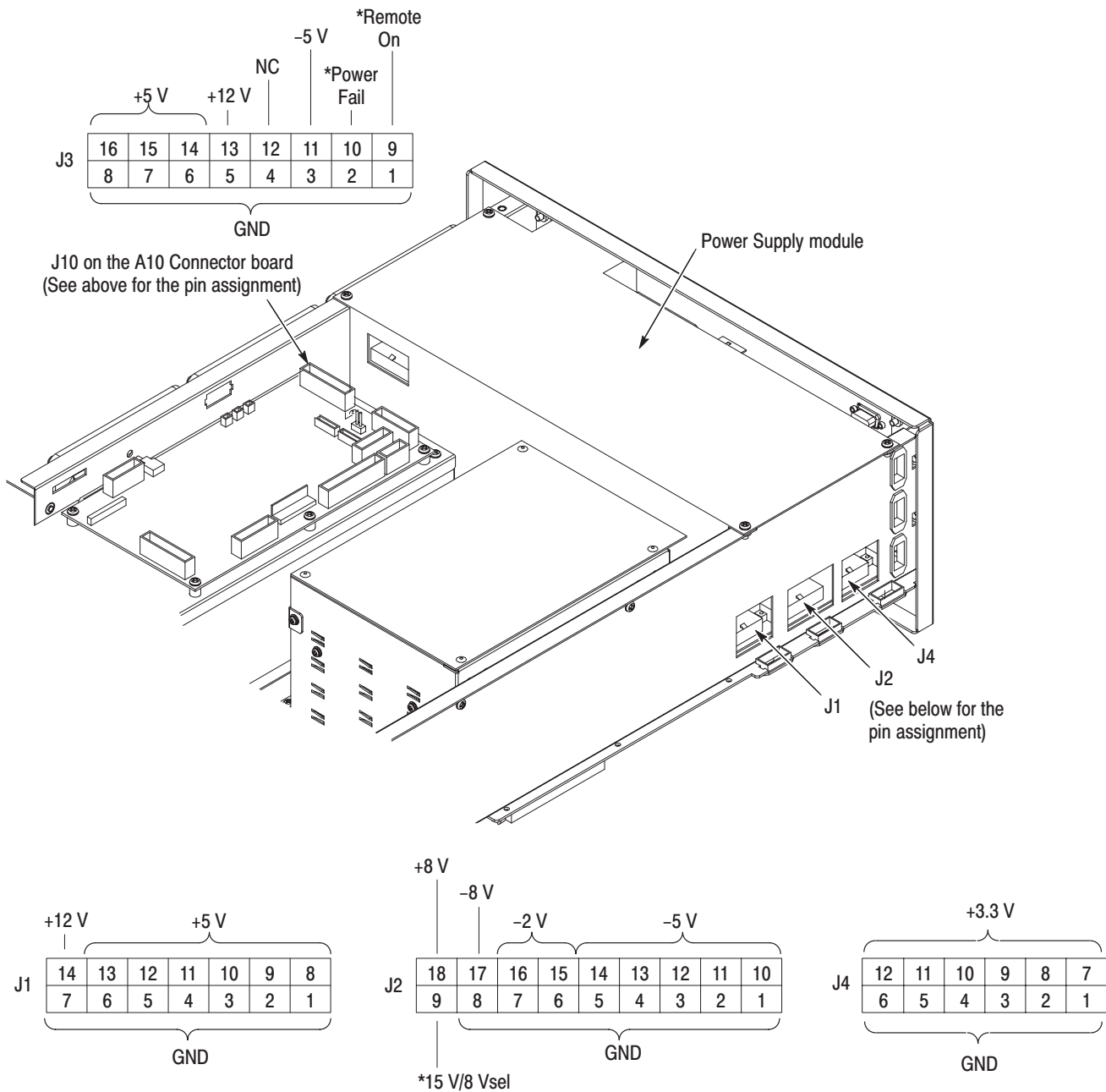


Figure 6-26: Troubleshooting procedure 1 — Power Supply module



CAUTION. NEVER connect the pin *15 V/8 Vsel to anywhere. It must always be open to avoid damage to the power supply module.

Figure 6-27: Power supply connectors

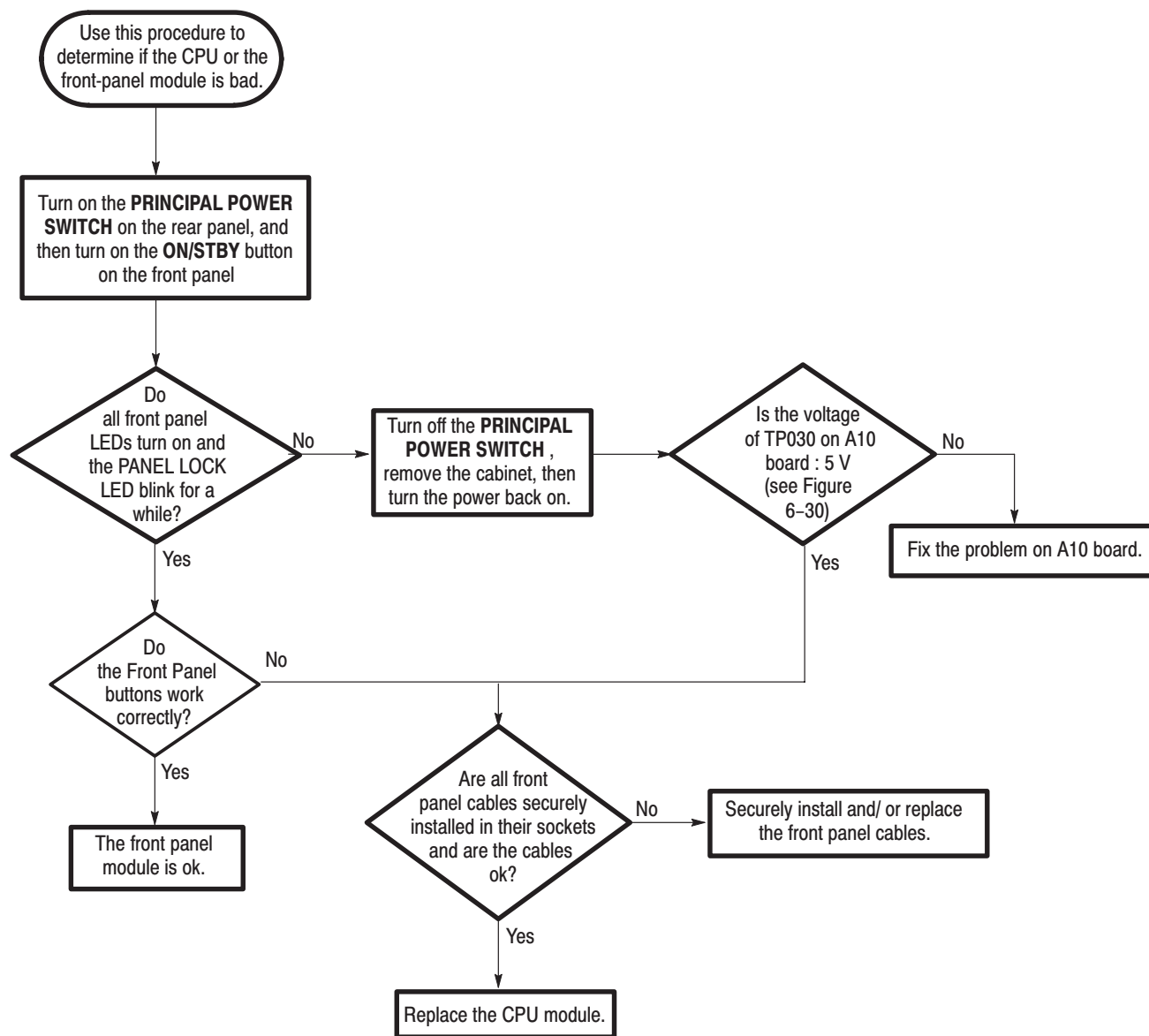


Figure 6-28: Troubleshooting procedure 2 — CPU or front panel module

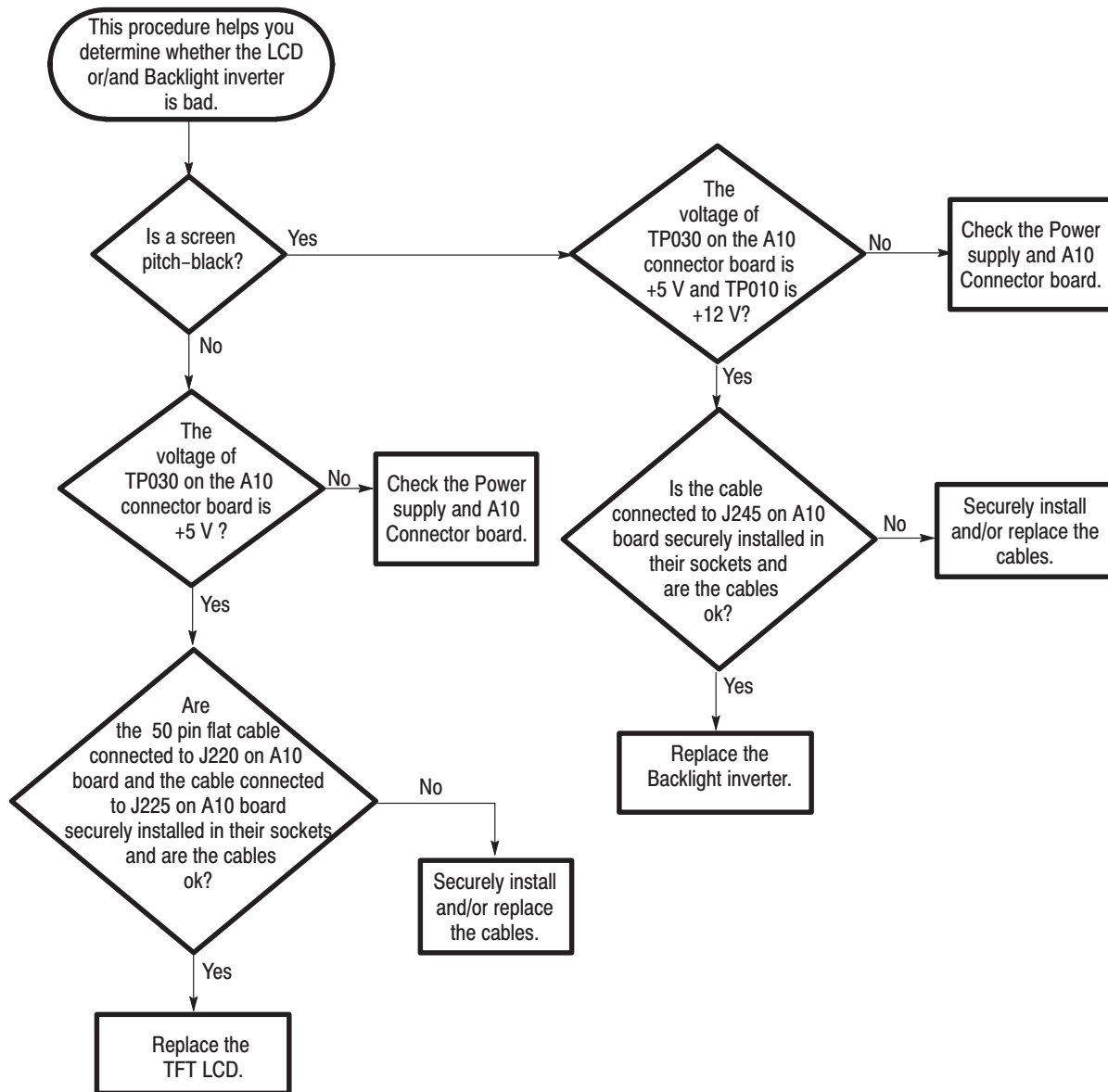


Figure 6-29: Troubleshooting procedure 3 — LCD module

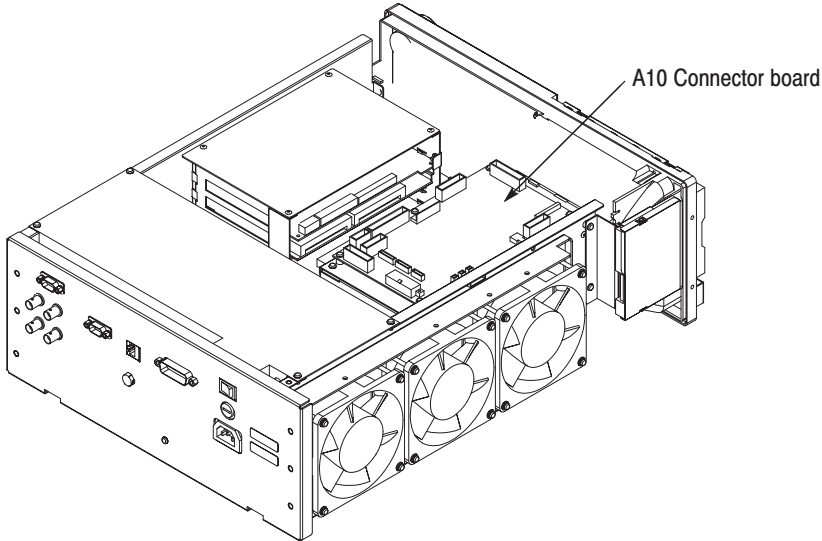
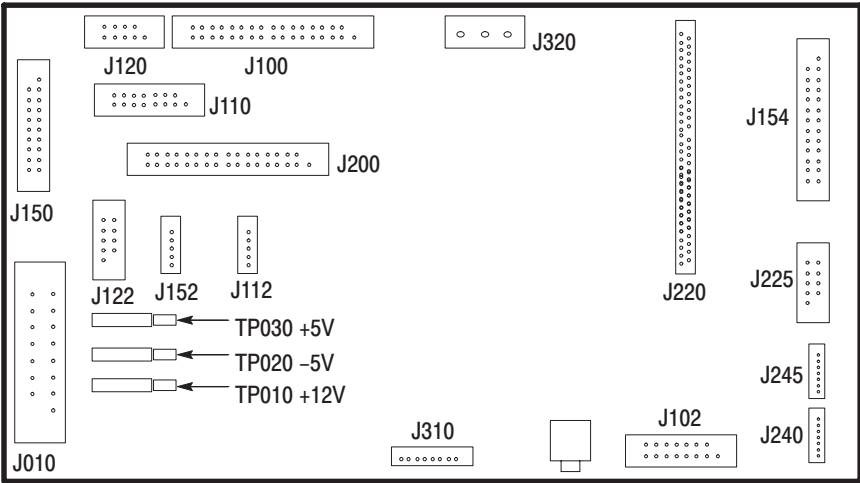


Figure 6-30: A10 connector board

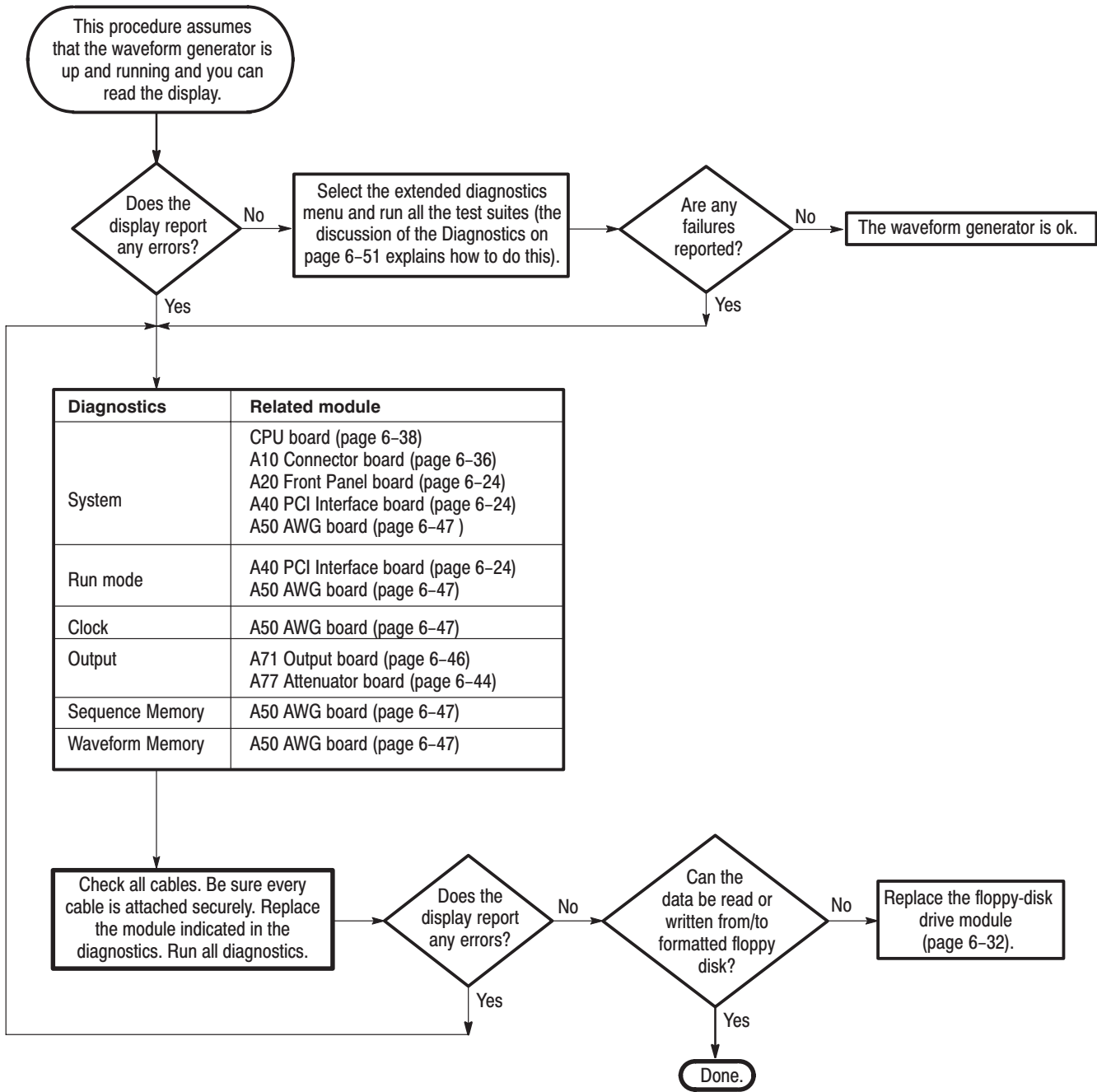


Figure 6-31: Troubleshooting procedure 4 — Module isolation

Messages and Codes

Error and event codes with negative values are SCPI standard codes. Error and event codes with positive values are unique to the waveform generator series number.

Table 6–5 lists event code definitions. When an error occurs, you can find its error class by checking for its the code range in Tables 6–6 through 6–14. Events in these tables are organized by event class.

Table 6–5: Definition of event codes

Event class	Code range	Description
No error	0	No event or status
Command errors	–100 to –199	Command syntax errors
Execution errors	–200 to –299	Command execution errors
Device-specific errors	–300 to –399	Internal device errors
Query errors	–400 to –499	System event and query errors
Power-on events	–500 to –599	Power-on events
User request events	–600 to –699	User request events
Request control events	–700 to –799	Request control events
Operation complete events	–800 to –899	Operation complete events
Extended device-specific errors	1 to 32767	Device dependent device errors
Reserved	other than above	not used

Command Errors

Command errors are returned when there is a syntax error in the command.

Table 6-6: Command errors

Error code	Error message
-100	Command error
-101	Invalid character
-102	Syntax error
-103	Invalid separator
-104	Data type error
-105	GET not allowed
-108	Parameter not allowed
-109	Missing parameter
-110	Command header error
-111	Header separator error
-112	Program mnemonic too long
-113	Undefined header
-114	Header suffix out of range
-115	Unexpected number of parameters
-120	Numeric data error
-121	Invalid character in number
-123	Exponent too large
-124	Too many digits
-128	Numeric data not allowed

Table 6-6: Command errors (Cont.)

Error code	Error message
-130	Suffix error
-131	Invalid suffix
-134	Suffix too long
-138	Suffix not allowed
-140	Character data error
-141	Invalid character data
-144	Character data too long
-148	Character data not allowed
-150	String data error
-151	Invalid string data
-158	String data not allowed
-160	Block data error
-161	Invalid block data
-168	Block data not allowed
-170	Expression error
-171	Invalid expression
-178	Expression data not allowed
-180	Macro error
-181	Invalid outside macro definition
-183	Invalid inside macro definition
-184	Macro parameter error

Execution Errors

These error codes are returned when an error is detected during command execution.

Table 6-7: Execution errors

Error code	Error message
-200	Execution error
-201	Invalid while in local
-202	Settings lost due to RTL
-203	Command protected
-210	Trigger error
-211	Trigger ignored
-212	Arm ignored
-213	Init ignored
-214	Trigger deadlock
-215	Arm deadlock
-220	Parameter error
-221	Settings conflict
-222	Data out of range
-223	Too much data
-224	Illegal parameter value
-225	Out of memory
-226	Lists not same length
-230	Data corrupt or stale
-231	Data questionable
-232	Invalid format
-233	Invalid version
-240	Hardware error
-241	Hardware missing
-250	Mass storage error
-251	Missing mass storage
-252	Missing media

Table 6-7: Execution errors (Cont.)

Error code	Error message
-253	Corrupt media
-254	Media full
-255	Directory full
-256	File name not found
-257	File name error
-258	Media protected
-260	Expression error
-261	Math error in expression
-270	Macro error
-271	Macro syntax error
-272	Macro execution error
-273	Illegal macro label
-274	Macro parameter error
-275	Macro definition too long
-276	Macro recursion error
-277	Macro rejuvenation not allowed
-278	Macro header not found
-280	Program error
-281	Cannot create program
-282	Illegal program name
-283	Illegal variable name
-284	Program currently running
-285	Program syntax error
-286	Program runtime error
-290	Memory use error
-291	Out of memory
-292	Referenced name does not exist
-293	Referenced name already exists
-294	Incompatible type

Device Specific Errors

These error codes are returned when an internal instrument error is detected. This type of error can indicate a hardware problem.

Table 6-8: Device specific errors

Error code	Error message
-300	Device specific error
-310	System error
-311	Memory error
-312	PUD memory lost
-313	Calibration memory lost
-314	Save/recall memory lost
-315	Configuration memory lost
-320	Storage fault
-321	Out of memory
-330	Self-test failed
-340	Calibration failed
-350	Queue overflow
-360	Communication error
-361	Parity error in program message
-362	Framing error in program message
-363	Input buffer overrun
-365	Time out error

Query Errors

These error codes are returned in response to an unanswered query.

Table 6-9: Query errors

Error code	Error message
-400	query error
-410	query INTERRUPTED
-420	query UNTERMINATED
-430	query DEADLOCKED
-440	query UNTERMINATED after indefinite response

Power-On Events

These events occur when the instrument detects an off to on transition in its power supply.

Table 6-10: Power-on events

Event code	Event message
-500	Power on

User Request Events

These events are unused in the AWG710 Waveform Generator.

Table 6-11: User request events

Event code	Event message
-600	User request

Request Control Events

This event is unused in the AWG710 Waveform Generator.

Table 6-12: Request control events

Event code	Event message
-700	Request control

Operation Complete Events

This event occurs when the synchronization protocol, having been enabled by an *OPC command, completes all selected pending operations.

Table 6-13: Operation complete events

Event code	Event message
-800	Operation complete

Device Errors

Table 6–14 lists AWG400 series error code and their meaning.

Table 6–14: Messages and codes

Er- ror code	Error message	Related module	Supplementary Information
/* ---- Calibration ---- */			
1101	CH1 internal offset calibration failure	A71 (Output)/A77 (ATT)	Check A71 (Output), A77 (ATT) and connection.
1104	$\overline{\text{CH1}}$ internal offset calibration failure	A71 (Output)/A77 (ATT)	Check A71 (Output), A77 (ATT) and connection.
1201	CH1 output offset calibration failure	A71 (Output)/A77 (ATT)	Check A71 (Output), A77 (ATT) and connection.
1204	$\overline{\text{CH1}}$ output offset calibration failure	A71 (Output)/A77 (ATT)	Check A71 (Output), A77 (ATT) and connection.
1301	CH1 Gain calibration failure	A71 (Output)/A77 (ATT)	Check A71 (Output), A77 (ATT) and connection.
1304	$\overline{\text{CH1}}$ Gain calibration failure	A71 (Output)/A77 (ATT)	Check A71 (Output), A77 (ATT) and connection.
1401	CH1 Gain difference calibration failure	A71 (Output)/A77 (ATT)	Check A71 (Output), A77 (ATT) and connection.
1404	$\overline{\text{CH1}}$ Gain difference calibration failure	A71 (Output)/A77 (ATT)	Check A71 (Output), A77 (ATT) and connection.
1501	CH1 Direct output Gain calibration failure	A71 (Output)/A77 (ATT)	Check A71 (Output), A77 (ATT) and connection.
1504	$\overline{\text{CH1}}$ Direct output Gain calibration failure	A71 (Output)/A77 (ATT)	Check A71 (Output), A77 (ATT) and connection.
1601	CH1 Attenuator calibration failure	A71 (Output)/A77 (ATT)	Check A71 (Output), A77 (ATT) and connection.
1604	$\overline{\text{CH1}}$ Attenuator calibration failure	A71 (Output)/A77 (ATT)	Check A71 (Output), A77 (ATT) and connection.
1611	CH1 x5dB attenuator calibration failure	A71 (Output)/A77 (ATT)	Check A71 (Output), A77 (ATT) and connection.
1614	$\overline{\text{CH1}}$ x5dB attenuator calibration failure	A71 (Output)/A77 (ATT)	Check A71 (Output), A77 (ATT) and connection.
1621	CH1 x5dB 2 attenuator calibration failure	A71 (Output)/A77 (ATT)	Check A71 (Output), A77 (ATT) and connection.
1624	$\overline{\text{CH1}}$ x5dB 2 attenuator calibration failure	A71 (Output)/A77 (ATT)	Check A71 (Output), A77 (ATT) and connection.
1631	CH1 x10dB attenuator calibration failure	A71 (Output)/A77 (ATT)	Check A71 (Output), A77 (ATT) and connection.
1634	$\overline{\text{CH1}}$ x10dB attenuator calibration failure	A71 (Output)/A77 (ATT)	Check A71 (Output), A77 (ATT) and connection.
1641	CH1 x20dB attenuator calibration failure	A71 (Output)/A77 (ATT)	Check A71 (Output), A77 (ATT) and connection.
1644	$\overline{\text{CH1}}$ x20dB attenuator calibration failure	A71 (Output)/A77 (ATT)	Check A71 (Output), A77 (ATT) and connection.
1701	CH1 Filter calibration failure	A71 (Output)/A77 (ATT)	Check A71 (Output), A77 (ATT) and connection.
1704	$\overline{\text{CH1}}$ Filter calibration failure	A71 (Output)/A77 (ATT)	Check A71 (Output), A77 (ATT) and connection.
1711	CH1 20MHz Filter calibration failure	A71 (Output)/A77 (ATT)	Check A71 (Output), A77 (ATT) and connection.
1714	$\overline{\text{CH1}}$ 20MHz Filter calibration failure	A71 (Output)/A77 (ATT)	Check A71 (Output), A77 (ATT) and connection.
1721	CH1 50MHz Filter calibration failure	A71 (Output)/A77 (ATT)	Check A71 (Output), A77 (ATT) and connection.
1724	$\overline{\text{CH1}}$ 50MHz Filter calibration failure	A71 (Output)/A77 (ATT)	Check A71 (Output), A77 (ATT) and connection.
1731	CH1 100MHz Filter calibration failure	A71 (Output)/A77 (ATT)	Check A71 (Output), A77 (ATT) and connection.
1734	$\overline{\text{CH1}}$ 100MHz Filter calibration failure	A71 (Output)/A77 (ATT)	Check A71 (Output), A77 (ATT) and connection.
1741	CH1 200MHz Filter calibration failure	A71 (Output)/A77 (ATT)	Check A71 (Output), A77 (ATT) and connection.

Table 6-14: Messages and codes (Cont.)

Er- ror code	Error message	Related module	Supplementary Information
1744	CH1 200MHz Filter calibration failure	A71 (Output)/A77 (ATT)	Check A71 (Output), A77 (ATT) and connection.
1801	CH1 Reference level calibration failure	A71 (Output)	Check A71 (Output), A77 (ATT) and connection.
1804	CH1 Reference level calibration failure	A71 (Output)	Check A71 (Output), A77 (ATT) and connection.
/* ---- System Diagnostics ---- */			
2100	System failure	CPU/Flash Disk/HDD	Check CPU/Flash Disk/HDD and connection.
2101	Realtime clock power	CPU/Flash Disk/HDD	Check CPU/Flash Disk/HDD and connection.
2102	Configuration record and Check-sum status	CPU/Flash Disk/HDD	Check CPU/Flash Disk/HDD and connection.
2103	Incorrect configuration	CPU/Flash Disk/HDD	Check CPU/Flash Disk/HDD and connection.
2104	Memory size miscompare	CPU/Flash Disk/HDD	Check CPU/Flash Disk/HDD and connection.
2105	Fixed-disk drive initialization status	CPU/Flash Disk/HDD	Check CPU/Flash Disk/HDD and connection.
2106	Time status	CPU/Flash Disk/HDD	Check CPU/Flash Disk/HDD and connection.
2110	Front panel failure	A20 (Front Panel)	Check A20 And connection.
2111	Front panel configuration	A20 (Front Panel)	Check A20 and connection.
2112	Front panel communication	A20 (Front Panel)	Check A20 and connection.
2113	Front panel RAM	A20 (Front Panel)	Check A20 and connection.
2114	Front panel ROM	A20 (Front Panel)	Check A20 and connection.
2115	Front panel A/D	A20 (Front Panel)	Check A20 and connection.
2116	Front panel timer	A20 (Front Panel)	Check A20 and connection.
2700	Calibration data failure	Flash Disk	Check Flash Disk. Also possible no calibration after A50/A70 were exchanged.
2701	Calibration data not found	Flash Disk	Check Flash Disk. Also possible no calibration after A50/A70 were exchanged.
2702	Calibration data checksum	Flash Disk	Check Flash Disk. Also possible no calibration after A50/A70 were exchanged.
2703	Calibration data invalid	Flash Disk	Check Flash Disk. Also possible no calibration after A50/A70 were exchanged.
/* ---- Run Mode Diagnostics ---- */			
3000	Run mode failure	A50 (AWG)	Check A50 (AWG).
3100	Run mode Control register0 failure	A50 (AWG)	Check A50 (AWG).
3101-3108	Run mode control register0 bit0 to bit7	A50 (AWG)	Check A50 (AWG).
3200	Run mode control register1 failure	A50 (AWG)	Check A50 (AWG).
3201	Run mode control register1 reg0	A50 (AWG)	Check A50 (AWG).
3211	Run mode control register1 reg10	A50 (AWG)	Check A50 (AWG).
/* ---- Clock Diagnostics ---- */			
4000	Clock failure	A50 (AWG)	Check A50 (AWG).

Table 6-14: Messages and codes (Cont.)

Er- ror code	Error message	Related module	Supplementary Information
4100	PLL lock/unlock failure	A50 (AWG)	Check A50 (AWG).
/* ---- Sequence Memory Diagnostics ---- */			
5000	Sequence memory failure	A50 (AWG)	Check A50 (AWG).
5100	Sequence memory data bus failure	A50 (AWG)	Check A50 (AWG).
5101-5132	Sequence memory data bus bit0 to bit31	A50 (AWG)	Check A50 (AWG).
5200	Sequence memory address bus failure	A50 (AWG)	Check A50 (AWG).
5201-5216	Sequence memory address bus bit0 to bit15	A50 (AWG)	Check A50 (AWG).
5300	Sequence memory chip cell failure	A50 (AWG)	Check A50 (AWG).
5301-5302	Sequence memory chip 0 to chip 1	A50 (AWG)	Check A50 (AWG).
5350	Sequence memory chip select failure	A50 (AWG)	Check A50 (AWG).
5351-5352	Sequence memory chip select 0 to select 1	A50 (AWG)	Check A50 (AWG).
/* ---- Waveform Memory Diagnostics ---- */			
6000	Waveform memory failure	A50 (AWG)	Check A50 (AWG).
6100	CH1 Waveform memory data bus failure	A50 (AWG)	Check A50 (AWG).
6101-6132	CH1 Waveform memory data bus bit0 to bit31	A50 (AWG)	Check A50 (AWG).
6150	CH1 Waveform memory chip data bus failure	A50 (AWG)	Check A50 (AWG).
6151-6186	CH1 Waveform memory chip data bus bit0 to bit35	A50 (AWG)	Check A50 (AWG).
6200	CH1 Waveform memory address bus failure	A50 (AWG)	Check A50 (AWG).
6201-6219	CH1 Waveform memory address bus bit0 to bit18	A50 (AWG)	Check A50 (AWG).
6300	CH1 Waveform memory chip cell failure	A50 (AWG)	Check A50 (AWG).
6301-6336	CH1 Waveform memory chip0 to chip35	A50 (AWG)	Check A50 (AWG).
6350	CH1 Waveform memory chip select failure	A50 (AWG)	Check A50 (AWG).
6351-6386	CH1 Waveform memory chip select 0 to select 35	A50 (AWG)	Check A50 (AWG).
/* ---- Output Diagnostics ---- */			
7000	Output failure	A70 (Output)	Also possible D/A converter and so forth on A52.
7100	Internal offset failure	A70 (Output)	Also possible D/A converter and so forth on A52.
7101	CH1 internal offset	A70 (Output)	Also possible D/A converter and so forth on A52.
7104	CH1 internal offset	A70 (Output)	Also possible D/A converter and so forth on A52.
7200	Output offset failure	A71 (Output)/A77 (ATT)	Check A71 (Output), A77 (ATT) and connection.

Table 6-14: Messages and codes (Cont.)

Er- ror code	Error message	Related module	Supplementary Information
7201	CH1 output offset failure	A71 (Output)/A77 (ATT)	Check A71 (Output), A77 (ATT) and connection.
7204	$\overline{\text{CH1}}$ output offset failure	A71 (Output)/A77 (ATT)	Check A71 (Output), A77 (ATT) and connection.
7300	Arb gain failure	A71 (Output)/A77 (ATT)	Check A71 (Output), A77 (ATT) and connection.
7301	CH1 Arb gain	A71 (Output)/A77 (ATT)	Check A71 (Output), A77 (ATT) and connection.
7304	$\overline{\text{CH1}}$ Arb gain	A71 (Output)/A77 (ATT)	Check A71 (Output), A77 (ATT) and connection.
7400	Direct Gain failure	A71 (Output)/A77 (ATT)	Check A71 (Output), A77 (ATT) and connection.
7401	CH1 Direct Gain	A71 (Output)/A77 (ATT)	Check A71 (Output), A77 (ATT) and connection.
7404	$\overline{\text{CH1}}$ Direct Gain	A71 (Output)/A77 (ATT)	Check A71 (Output), A77 (ATT) and connection.
7510	5dB 1 attenuator failure	A71 (Output)/A77 (ATT)	Check A71 (Output), A77 (ATT) and connection.
7511	CH1 5dB 1 attenuator	A71 (Output)/A77 (ATT)	Check A71 (Output), A77 (ATT) and connection.
7514	$\overline{\text{CH1}}$ 5dB 1 attenuator	A71 (Output)/A77 (ATT)	Check A71 (Output), A77 (ATT) and connection.
7520	5dB 2 attenuator 1 failure	A71 (Output)/A77 (ATT)	Check A71 (Output), A77 (ATT) and connection.
7521	CH1 5dB 2 attenuator	A71 (Output)/A77 (ATT)	Check A71 (Output), A77 (ATT) and connection.
7524	$\overline{\text{CH1}}$ 5dB 2 attenuator	A71 (Output)/A77 (ATT)	Check A71 (Output), A77 (ATT) and connection.
7530	10dB attenuator 2 failure	A71 (Output)/A77 (ATT)	Check A71 (Output), A77 (ATT) and connection.
7531	CH1 10dB attenuator	A71 (Output)/A77 (ATT)	Check A71 (Output), A77 (ATT) and connection.
7534	$\overline{\text{CH1}}$ 10dB attenuator	A71 (Output)/A77 (ATT)	Check A71 (Output), A77 (ATT) and connection.
7540	20dB attenuator failure	A71 (Output)/A77 (ATT)	Check A71 (Output), A77 (ATT) and connection.
7541	CH1 20dB attenuator	A71 (Output)/A77 (ATT)	Check A71 (Output), A77 (ATT) and connection.
7544	$\overline{\text{CH1}}$ 20dB attenuator	A71 (Output)/A77 (ATT)	Check A71 (Output), A77 (ATT) and connection.
7610	20MHz filter failure	A71 (Output)/A77 (ATT)	Check A71 (Output), A77 (ATT) and connection.
7611	CH1 1MHz filter	A71 (Output)/A77 (ATT)	Check A71 (Output), A77 (ATT) and connection.
7614	$\overline{\text{CH1}}$ 20MHz filter	A71 (Output)/A77 (ATT)	Check A71 (Output), A77 (ATT) and connection.
7620	50MHz filter failure	A71 (Output)/A77 (ATT)	Check A71 (Output), A77 (ATT) and connection.
7621	CH1 50MHz filter	A71 (Output)/A77 (ATT)	Check A71 (Output), A77 (ATT) and connection.
7624	$\overline{\text{CH1}}$ 50MHz filter	A71 (Output)/A77 (ATT)	Check A71 (Output), A77 (ATT) and connection.
7630	100MHz filter failure	A71 (Output)/A77 (ATT)	Check A71 (Output), A77 (ATT) and connection.
7631	CH1 100MHz filter	A71 (Output)/A77 (ATT)	Check A71 (Output), A77 (ATT) and connection.
7634	$\overline{\text{CH1}}$ 100MHz filter	A71 (Output)/A77 (ATT)	Check A71 (Output), A77 (ATT) and connection.
7640	200MHz filter failure	A71 (Output)/A77 (ATT)	Check A71 (Output), A77 (ATT) and connection.
7641	CH1 200MHz filter	A71 (Output)/A77 (ATT)	Check A71 (Output), A77 (ATT) and connection.
7644	$\overline{\text{CH1}}$ 200MHz filter	A71 (Output)/A77 (ATT)	Check A71 (Output), A77 (ATT) and connection.
7700	Reference level failure	A71 (Output)/A77 (ATT)	Check A71 (Output), A77 (ATT) and connection.
7701	Reference level failure	A71 (Output)/A77 (ATT)	Check A71 (Output), A77 (ATT) and connection.

Table 6-14: Messages and codes (Cont.)

Er- ror code	Error message	Related module	Supplementary Information
7704	Reference level failure	A71 (Output)/A77 (ATT)	Check A71 (Output), A77 (ATT) and connection.
9111	Waveform/Sequence load error: waveform memory full	-	
9112	Waveform/Sequence load error: invalid waveform length	-	
9113	Waveform/Sequence load error: waveform length too short	-	
9114	Waveform/Sequence load error: waveform length changed	-	
9121	Sequence load error: missing file name in sequence	-	
9122	Sequence load error: too many nesting levels	-	
9123	Sequence load error: infinite loop in sub-sequence	-	
9124	Sequence load error: infinite sub-sequence loop	-	
9125	Sequence load error: max sequence elements exceeded	-	
9126	Sequence load error: invalid jump address	-	
9127	Sequence load error: sequence memory full	-	
9128	Sequence load error: infinite loop and Goto One not allowed	-	
9129	Sequence load error: infinite loop and Goto <N> not allowed	-	
9151	Waveform load warning: output disabled in some channels	-	
9152	Waveform/Sequence output warning: output disabled	-	

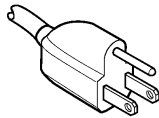
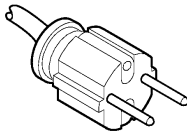
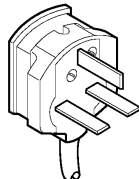
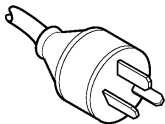
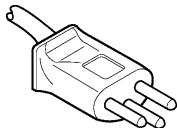
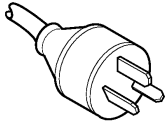
Options and Accessories

This subsection describes the various options as well as the standard and optional accessories that are available for the AWG710 Arbitrary Waveform Generator.

Power Cord Options

Table 7-1 lists the power cords available with the AWG710 Arbitrary Waveform Generator.

Table 7-1: Power cord options

Plug configuration	Normal usage	Option number
	North America 125 V	Standard
	Europe 230 V	A1
	United Kingdom 230 V	A2
	Australia 230 V	A3
	Switzerland 230 V	A5
	China 230 V	AC
	No power cord supplied.	A99

Options

This subsection describes the following options available with the AWG710 Arbitrary Waveform Generator Arbitrary Waveform Generator:

Option 1R (Rack Mounting)

AWG710 Arbitrary Waveform Generator. comes configured for installation in a 19-inch wide instrument rack. For later field conversions, order Rack Mount Kit (020–A045–00) or contact your local Tektronix sales office or representative.

Option D1 (Test Result Report)

A calibration data test result report will be provided with the AWG710 Arbitrary Waveform Generator when this option is specified.

Option 01 (32 MB Words Memory)

Increase memory length up to 32 MB (32400000 points).

Option 02 (High Bandwidth Output)

Expand output bandwidth
The product which has option 02 doesn't have offset and lowpass filter function, also, main output amplitude of 20mVpk-pk to 2Vpk-pk is changed to 500mVpk-pk to 1Vpk-pk into a 50 Ohm load.

Option 10 (Flash Disk)

Flash disk addition. The hard disk is deleted when this option is ordered. This option allows 24 hour continuous operation. The number of points used in the Waveform Editor is restricted because of the reduced disk space.

The AWG710 Arbitrary Waveform Generator retains the state of the front panel ON/STB switch. The ON/STB switch must be left in the on position to be able to power on and power off the instrument using the principal power switch.

NOTE. *If the **ON/STBY** switch is left in the **STBY** position, you will not be able to power on/off the instrument using the **PRINCIPAL POWER SWITCH** or an external power switch unit.*

Accessories

Standard Accessories The AWG710 Arbitrary Waveform Generator includes the standard accessories listed in Table 7–2.

Table 7–2: Standard accessories

Accessory	Part number
User Manual	070-A828-50
Programmer Manual	070-A829-50
Sample waveform floppy disk, 3.5 inch	062-A271-XX
Sample program floppy disk, 3.5 inch	062-A258-XX
Performance check/adjustment floppy disk, 3.5 inch	062-A273-XX
Arb-Link Software (pkg of 3 floppy disks)	062-A270-XX
SMA 50 Ω terminator, Male (2 installed on the instrument)	015-1022-01
Power Cord (except A99)	(see Table 7–1)

Optional Accessories The optional accessories listed in Table 7–3 are recommended for use with the instrument.

Table 7–3: Optional accessories

Accessory	Part number
Service Manual	070-A830-51
Front cover	200-3696-01
Rack Mount Kit (for field conversion)	020-A045-00
GPIB cable	012-0991-00
BNC cable, 50 Ω , 0.6 m (2 ft)	012-1342-00
BNC cable, 50 Ω , 2.5 m (8.2 ft), double-shield	012-1256-00
SMA cable, 50 Ω , 0.5 m, (1.64 ft), Male-Male	174-1427-00
SMA cable, 50 Ω , 1.0 m, (3.28 ft), Male-Male	174-1341-00
SMA cable, 50 Ω , 1.2 m, (3.94 ft), Male-Male	174-1428-00
SMA cable, 50 Ω , 1.5 m (4.92 ft), Male-Male	012-1565-00
SMA delay cable, 1 ns, Male-Male	015-0562-00
SMA delay cable, 2 ns, Male-Male	015-0560-00
SMA delay cable, 5 ns, Male-Male	015-0561-00
SMA T-connector, Male-Female & Female	015-1016-00

Table 7-3: Optional accessories (cont.)

Accessory	Part number
SMA 50 Ω divider, Male	015-1014-00
SMA delay cable, 1 ns, Male-Male	015-0562-00
SMA-BNC adapter, Male-Female	015-0554-00
SMA-BNC adapter, Female-Male	015-0572-00
SMA adapter kit	020-1693-00
BNC terminator, 50 Ω	011-0049-02
BNC power divider, 50 Ω , DC to 300 MHz, VSWR: 1.2 max.	015-0660-00
BNC low pass filter, 400 MHz	015-0659-00
BNC low pass filter, 200 MHz	015-0658-00
BNC low pass filter, 100 MHz	015-0657-00
Transformer	CT1
Transformer	CT2
Transformer	CT6
Cart	K475



Electrical Parts List

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

Diagrams

This section contains the Block & Interconnect Diagram for the AWG710 Arbitrary Waveform Generator.

This diagram shows the modules and functional blocks in the waveform generator. In addition, it illustrates how the modules in the waveform generator are connected (see Figure 9-1).

Cable Assembling Parts List

Tektronix part number	Connection point. A	Connection point. B
174-B938-00	A50 AWG Board:J5230	10MHz REF OUT
174-B939-00	A50 AWG Board:J5210	10MHz REF IN
174-B643-00	A50 AWG Board:J5450	1/4 CLOCK OUT
174-B940-00	A50 AWG Board:J5100	TRIG IN
174-3878-00	A50 AWG Board:J1000	EVENT INPUT
174-B929-00	A50 AWG Board:	PS100 Power Supply:J1
174-B930-00	A50 AWG Board:	PS100 Power Supply:J2
174-B931-00	A50 AWG Board:	PS100 Power Supply:J4
174-B883-00	A50 AWG Board:J100	A40 PCI Interface Board J220
174-4315-00	A50 AWG Board:J110	A40 PCI Interface Board J220
174-B882-00	A50 AWG Board:J200	A22 ON/OFF Board
174-B933-00	A50 AWG Board:J5400	A71 OUTPUT Board J100
174-B933-00	A50 AWG Board:J5401	A71 OUTPUT Board J200
174-B932-00	(A71 OUTPUT Board J140	A71 OUTPUT Board J142
:	A71 OUTPUT Board J240	A71 OUTPUT Board J242
:	A71 OUTPUT Board J170	A71 OUTPUT Board J146
:	A71 OUTPUT Board J270	A71 OUTPUT Board J144
:	A71 OUTPUT Board J310	A71 OUTPUT Board J246
:	A71 OUTPUT Board J311	A71 OUTPUT Board J244
:	A71 OUTPUT Board J320	A71 OUTPUT Board J155
:	A71 OUTPUT Board J321)	A71 OUTPUT Board J255
174-B649-00	A71 OUTPUT Board J180	CH1 ANALOG OUT
174-B650-00	A71 OUTPUT Board J280	$\overline{\text{CH1}}$ ANALOG OUT
174-B934-00	A50 AWG Board:J5510	MARKER1 OUT
174-B935-00	A50 AWG Board:J5511	$\overline{\text{MARKER1}}$ OUT
174-B936-00	A50 AWG Board:J5610	MARKER2 OUT
174-B937-00	A50 AWG Board:J5611	$\overline{\text{MARKER2}}$ OUT
174-B884-00	GPIB Card	GPIB Connector
174-B941-00	GPIB Board:LAN	LAN Connector
174-4302-00	CPU Board :LCD	A10 CONNECTOR Board J220
174-B335-00	CPU Board :MICS	A10 CONNECTOR Board J110
174-B334-00	CPU Board :FDD	A10 CONNECTOR Board J100
174-4298-00	CPU Board:VGA,COM1	A10 CONNECTOR Board J150
174-B892-00	A10 CONNECTOR Board J310	FAN
174-B891-00	CPU Board :IDE	FLASH DISK,HDD
174-B887-00	A10 CONNECTOR Board J320	PCI Backplane
174-B356-00	A10 CONNECTOR Board:J010	PS100 Power supply J3

Cable Assembling Parts List (Cont.)

Tektronix part number	Connection point. A	Connection point. B
174-B338-00	A10 CONNECTOR Board:J112	A90 Key Board
174-B329-01	A10 CONNECTOR Board:J102	FLOPPY DISK DRIVE
174-B926-00	A10 CONNECTOR Board:J225	TFT LCD
174-3879-00	A10 CONNECTOR Board:J152	MONITOR OUT(15pin,D-Sub)
174-B337-00	A10 CONNECTOR Board:J154	A20 FRONT PANEL Board
174-B889-00	A10 CONNECTOR Board:J245	Back Light
174-B886-00	A10 CONNECTOR Board:J200	A40 PCI Interface Board J200

Replaceable Mechanical Parts

This section contains a list of the replaceable modules for the AWG710 Arbitrary Waveform Generator. Use this list to identify and order replacement parts.

Parts Ordering Information

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

Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available and to give you the benefit of the latest circuit improvements. Therefore, when ordering parts, it is important to include the following information in your order.

- Part number
- Instrument type or model number
- Instrument serial number
- Instrument modification number, if applicable

If you order a part that has been replaced with a different or improved part, your local Tektronix field office or representative will contact you concerning any change in part number.

Part Number Revision Level

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



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

Module Servicing

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

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

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

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

Using the Replaceable Parts List

This section contains a list of the mechanical and/or electrical components that are replaceable for the generator. Use this list to identify and order replacement parts. The following table describes each column in the parts list.

Parts List Column Descriptions

Column	Column name	Description
1	Figure & Index Number	Items in this section are referenced by component number.
2	Tektronix Part Number	Use this part number when ordering replacement parts from Tektronix.
3 and 4	Serial Number	Column three indicates the serial number at which the part was first effective. Column four indicates the serial number at which the part was discontinued. No entries indicates the part is good for all serial numbers.
5	Qty	This indicates the quantity of parts used.
6	Name & Description	An item name is separated from the description by a colon (:). Because of space limitations, an item name may sometimes appear as incomplete. Use the U.S. Federal Catalog handbook H6-1 for further item name identification.
7	Mfr. Code	This indicates the code of the actual manufacturer of the part. (Code to name and address cross reference is located after this page.)
8	Mfr. Part Number	This indicates the actual manufacturer's or vendor's part number.

Abbreviations

Abbreviations conform to American National Standard ANSI Y1.1-1972.

Mfr. Code to Manufacturer Cross Index

The following table cross indexes codes, names, and addresses of manufacturers or vendors of components listed in the parts list.

Manufacturers Cross Index

Mfr. Code	Manufacturer	Address	City, state, zip code
S3109	FELLER	72 VERONICA AVE UNIT 4	SUMMERSET NJ 08873
TK0392	NORTHWEST FASTENER SALES INC	8058 SW NIMBUS AVENUE	BEAVERTON OR 97008
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
TK1908	PLASTIC MOLDED PRODUCTS	4336 SO ADAMS	TACOMA WA 98409
TK1918	SHIN-ETSU POLYMER AMERICA INC	1181 NORTH 4TH ST	SAN JOSE CA 95112
TK2058	TDK CORPORATION OF AMERICA	1600 FEEHANVILLE DRIVE	MOUNT PROSPECT, IL 60056
TK2432	UNION ELECTRIC	15/F #1, FU-SHING N. ROAD	TAIPEI, TAIWAN ROC
TK2548	XEROX BUSINESS SERVICES DIV OF XEROX CORPORATION	14181 SW MILLIKAN WAY	BEAVERTON OR 97077
OJR05	TRIQUEST CORP	3000 LEWIS AND CLARK HWY	VANCOUVER WA 98661-2999
OKB01	STAUFFER SUPPLY	810 SE SHERMAN	PORTLAND OR 97214
00779	AMP INC	2800 FULLING MILL PO BOX 3608	HARRISBURG PA 17105
07416	NELSON NAME PLATE CO	3191 CASITAS	LOS ANGELES CA 90039-2410
2W733	BELDEN CORPORATION	2200 US HIGHWAY 27 SOUTH PO BOX 1980	RICHMOND IN 47375-0010
24931	SPECIALTY CONNECTOR CO INC	2100 EARLYWOOD DR PO BOX 547	FRANKLIN IN 46131
6D224	HARBOR TRI-TEC A BERG ELECTRONICS COMPANY	14500 SOUTH BROADWAY	GARDENA, CA 90248
61058	MATSUSHITA ELECTRIC CORP OF AMERICA PANASONIC INDUSTRIAL CO DIV	TWO PANASONIC WAY	SECAUCUS NJ 07094
61857	SAN-0 INDUSTRIAL CORP	91-3 COLIN DRIVE	HOLBROOK NY 11741
61935	SCHURTER INC	1016 CLEGG COURT	PETALUMA CA 94952-1152
64537	KDI/TRIANGLE ELECTRONICS	60 S JEFFERSON ROAD	WHIPPANY, NJ 07981
73743	FISCHER SPECIAL MFG CO	111 INDUSTRIAL RD	COLD SPRING KY 41076-9749
75915	LITTELFUSE TRACOR INC SUB OF TRACOR INC	800 E NORTHWEST HWY	DES PLAINES IL 60016-3049
78189	ILLINOIS TOOL WORKS INC SHAKEPROOF DIV	ST CHARLES ROAD	ELGIN IL 60120
80009	TEKTRONIX INC	14150 SW KARL BRAUN DR PO BOX 500	BEAVERTON OR 97077-0001
86928	SEASTROM MFG CO INC	701 SONORA AVE	GLENDALE CA 91201-2431
98291	SEAELECTRO CORP BICC ELECTRONICS	40 LINDEMAN DR	TURNBULL CT 06611-4739

Replaceable Parts List

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description	Mfr. code	Mfr. part number
1-1	334-A580-01			1	MARKER, IDENT:MKD AWG710, POLYCARBONATE		334-A580-01
-2	101-0142-01			1	TRIM,DECORATIVE:FRONT,RACK MOUNT		101-0142-00
-3	260-2715-00			1	ACTUATOR:ELASTOMER MAT,FRONT PANEL,RUBBER		260-2715-00
-4	259-A001-00			1	FLEX CIRCUIT BEZEL BUTTONS		259-A001-00
-5	348-1276-00			11C M	GASKET,SHIELD: CONDUCTIVE FORM STRIP,3.3MM X 4.8MM,W/ADHESIVE TAPE,1M L		426-A188-00
-6	426-A188-00			1	FRAME, DISPLAY:MAIN FILTER, AL		426-A188-00
-7	378-0466-00			1	FILTER,LT,CRT SMOKE GRAY,ACRILIC,WITH AR FILM		378-0466-00
-8	343-A344-00			1	RETAINER, FILTER, SST		343-A344-00
-9	426-A189-00			1	FRAME, LCD:PC, BLACK		426-A189-00
-10	119-B086-00			1	DISPLAY MONITOR: 6.4 INCH, COLOR-TFT, 640X480, VGA	SHARP	LQ64D343
-11	344-0472-00			1	BUSHING:BUSHING,NYLON,GRAY		344-0472-00
-12	407-A645-00			1	BRACKET, LCD:AL		407-A645-00
-13	119-B087-00			1	INVERTER UNIT: IN 9.6-14.4V, FOR DUAL BULB	TDK	CXA-0214
-14	211-1036-00			2	SCREW,MACHINE M2 X 6MM L,PNH,STL,MFZN-C,CROSS REC,W/FALT&LOCK WASHERS		211-1036-00
-15	174-B926-00			1	CA, ASSY, SP ELEC 31, 28AWG, 15CM L, FD9M-31S-1R BOTH ENDS		174-B926-00
-16	174-B889-00			1	CA, ASSY, SP, ELEC:6, 26AWG, 15CM L, W/HOLDER, 1MM CTR		174-B889-00
-17	343-0778-00			1	CLAMP,LOOP:5.4MM ID,66NYLON		343-0778-00
-18	211-1036-00			4	SCREW,MACHINE M2 X 6MM L,PNH,STL,MFZN-C,CROSS REC,W/FALT&LOCK WASHERS		211-1036-00
-19	211-0751-00			4	SCREW,MACHINE:M3X8MM L,PNH,STL,ZN-C,CROSS REC W/FLAT&LOCK WASHERS		211-0751-00

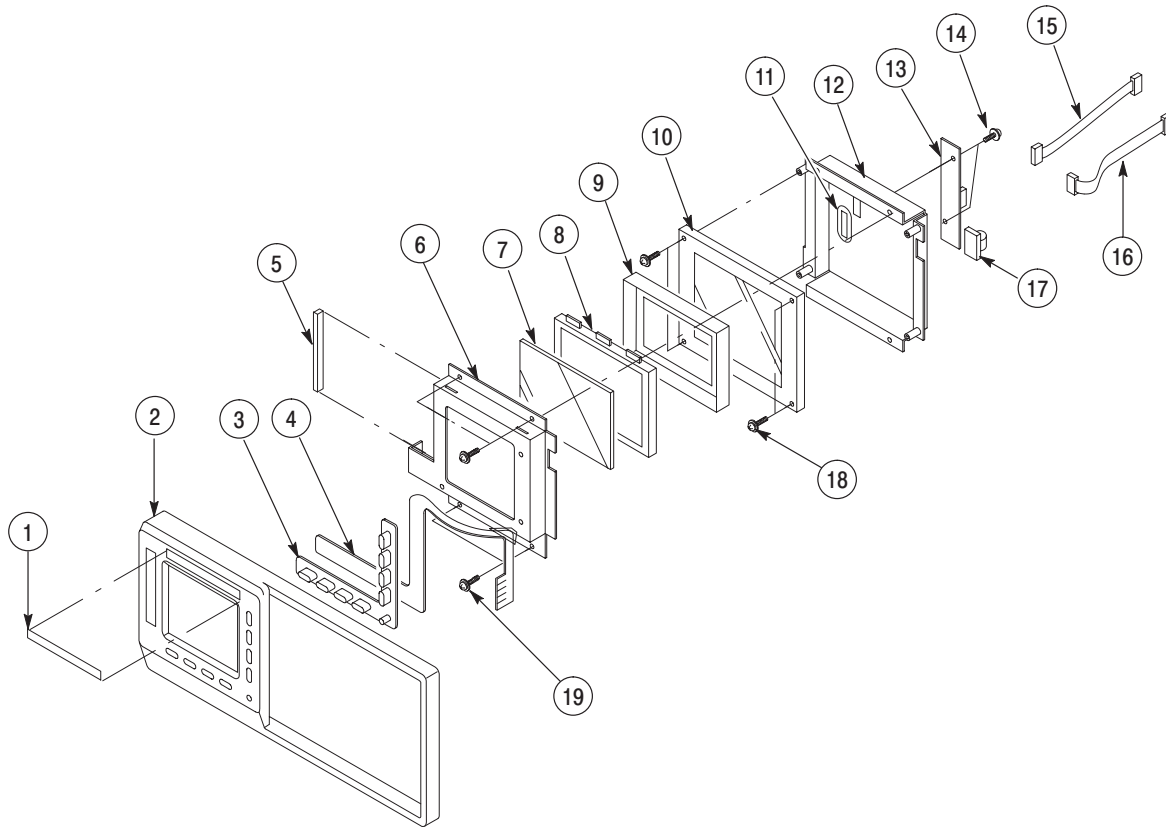


Figure 10-1: Front and Display unit

Replaceable Parts List

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description	Mfr. code	Mfr. part number
2-1	333-A414-00			1	PANEL, FRONT: KEYBOARD, AWG710, POLYCARBONATE		333-A414-00
-2	386-A838-00			1	SUBPANEL, FRONT:KEYBOARD, AL, AWG710		386-A838-00
-3	380-0927-01			1	HOLDER,SWITCH		380-0927-01
-4	260-2715-00			1	ACTUATOR:ELASTOMER MAT,FRONT PANEL,RUBBER		260-2715-00
-5	348-1159-00			2	SHIELD,ELEC:SST,W/CHEVRONS,0.4 PITCH,8.0L		348-1159-00
-6	671-B081-01			1	CIRCUIT BD ASSY:A20,FRONT PANEL,389-A689-00 WIRED		671-B081-01
-7	211-0751-00			6	SCREW,MACHINE: M3X8MM L,PNH,STL,ZN-C,CROSS REC W/FLAT&LOCK WASHERS		211-0751-00
-8	377-0579-00			5	INSERT,KNOB:PLASTIC		337-0579-00
-9	348-1160-00			1	SHIELD,ELEC:SST,W/CHEVRONS,0.4 PITCH,5.0L		348-1160-00
-10	124-0469-00			1	STRIP,TRIM:FRONT PANEL,AL		124-0469-00
-11	210-A084-00			1	WASHER,PLAIN:M3,NYLON,3.1 X 6.0 X 0.5		210-A084-00
-12	366-2170-00			1	KNOB:1.700DIA		366-2170-00
-13	366-2114-00			2	KNOB:IVORY GRAY,SCROLL,1.243 IDX 1.4 OD X 0.4 H		366-2114-00
-14	366-2111-00			3	KNOB:IVORY GRAY,SCROLL,1.243 IDX 1.4 OD X 0.4 H		366-2111-00

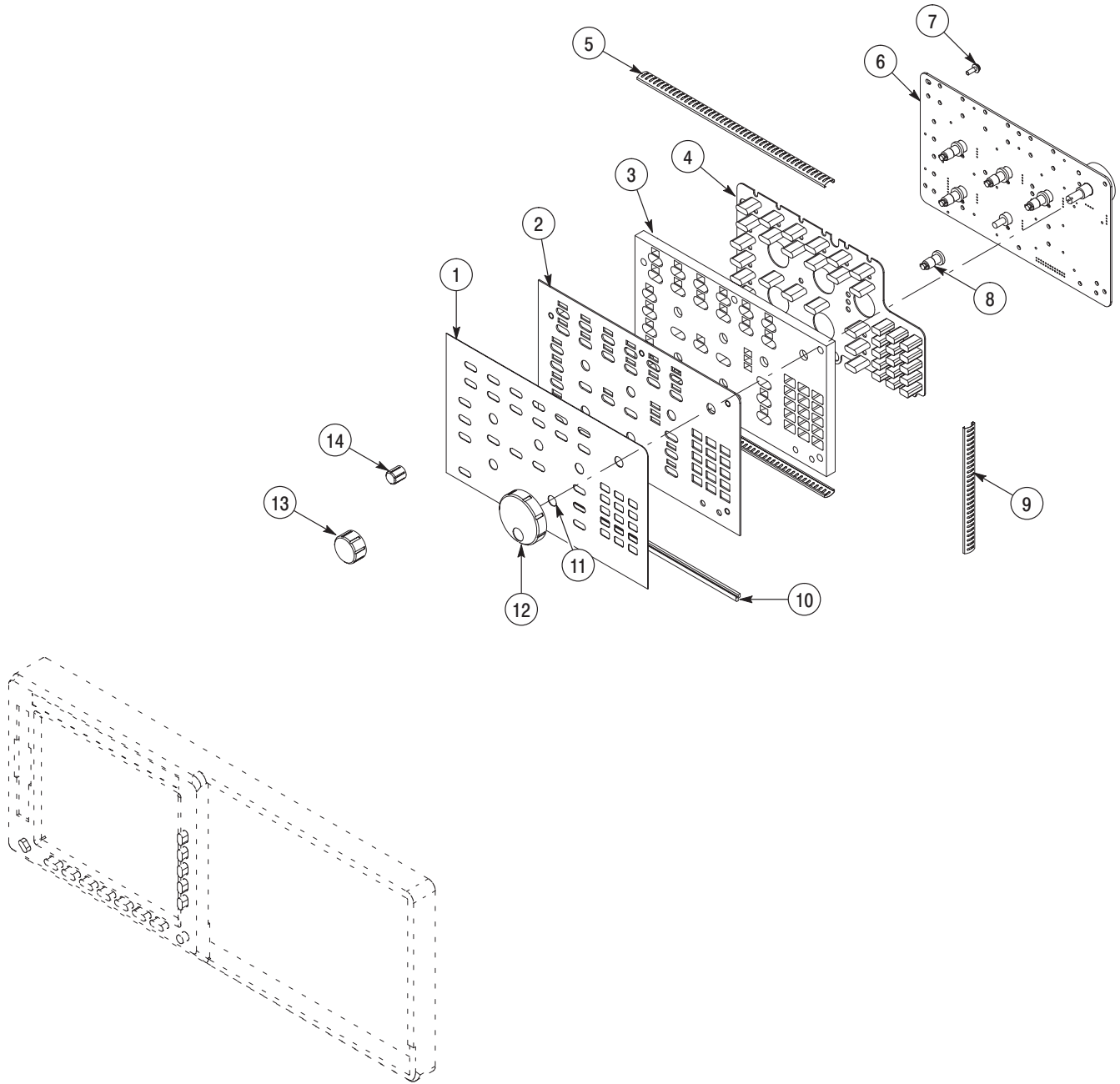


Figure 10-2: Front panel

Replaceable Parts List (except option 02)

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description	Mfr. code	Mfr. part number
3-1	174-B649-00			1	CA ASSY,RF:50 OHM COAX,15CM L,9-1,SMA TO PELTORA, SST SHELL		174-B649-00
-2	174-B650-00			1	CA ASSY,RF:50 OHM COAX,15CM L,9-2,SMA TO PELTORA, SST SHELL		174-B650-00
-3	174-B643-00			1	CA ASSY,RF:50 OHM COAX,50CM L,9-1,SMA TO PELTORA, SST SHELL		174-B643-00
-4	174-B644-00			1	CA ASSY,RF:50 OHM COAX,50CM L,9-2,SMA TO PELTORA, SST SHELL		174-B644-00
-5	174-B645-00			1	CA ASSY,RF:50 OHM COAX,50CM L,9-3,SMA TO PELTORA, SST SHELL		174-B645-00
-6	174-B646-00			1	CA ASSY,RF:50 OHM COAX,50CM L,9-4,SMA TO PELTORA, SST SHELL		174-B646-00
-7	671-B152-00			1	CIRCUIT BOARD ASSY: A22 KEY ON/OFF,389-B153-00, WIRED		671-B152-00
-8	211-0871-00			3	SCREW,MACHINE:M3X6MM L,PNH,STL,ZN-C,CROSS REC W/FLAT(7MM OD)&LOCK WASHERS		211-0871-00
-9	366-A054-00			2	PUSH BUTTON:TEK TAN, ABS		366-A054-00
-10	343-0549-00			2	STRAP,TIEDOWN:1.6-19MM DIA,66NYLON		
-11	211-0751-00			5	SCREW,MACHINE:M3X8MM L,PNH,STL,ZN-C,CROSS REC W/FLAT&LOCK WASHERS		211-0751-00
-12	333-A463-00			1	PANEL,FRONT:KEYBOARD,MTX100,POLYCARBONATE,T0.2		333-A463-00
-13	407-A655-00			1	BRACKET, ASSY:OUTPUT CONNECTOR, AL		407-A656-00

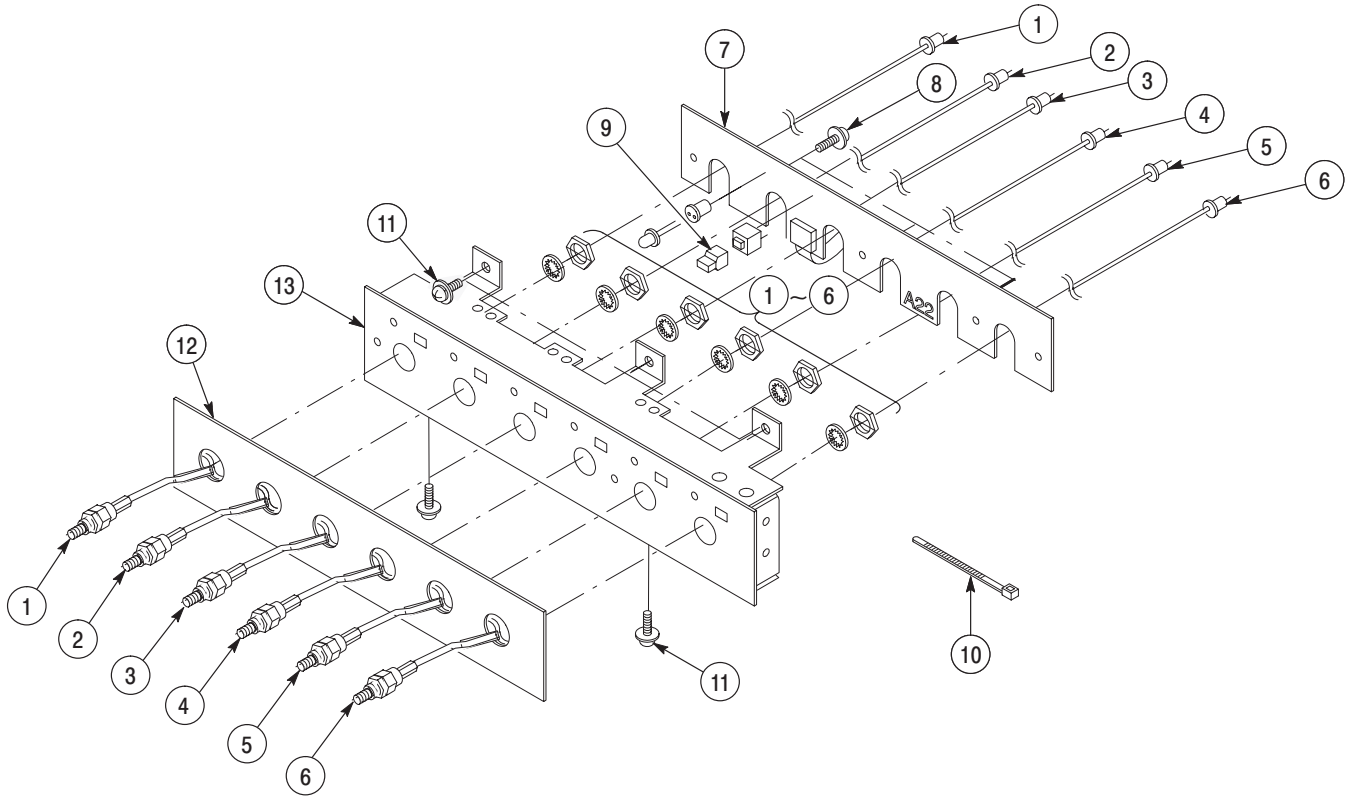


Figure 10-3: Front Output unit (except option 02)

Replaceable Parts List (for option 02)

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description	Mfr. code	Mfr. part number
4-1	174-B934-00			1	W5510, 45CM L, MKD 1, SMA TO PELTRA		174-B934-00
-2	174-B935-00			1	W5511, 45CM L, MKD 2, SMA TO PELTRA		174-B935-00
-3	174-B936-00			1	W5610, 45CM L, MKD 3, SMA TO PELTRA		174-B936-00
-4	174-B937-00			1	W5611, 45CM L, MKD 4, SMA TO PELTRA		174-B937-00
-5	174-C046-00			1	W701, 15CM L.,MKD 1, SMA-SMA, (CH1 TO K100)		174-C046-00
-6	174-C047-00			1	W702, 15CM L, MKD 2, SMA-SMA, (CH1 TO K200)		174-C046-00
-7	671-B152-00			1	CIRCUIT BOARD ASSY: A22 KEY ON/OFF, 389-B153-00, WIRED		671-B152-00
-8	211-0871-00			3	SCREW,MACHINE:M3X8MM L, PNH, STL,ZN-C, CROSS REC W/FLAT (7MM OD)&LOCK WASHERS		211-0871-00
-9	366-0753-00			2	PUSH BUTTON:TEK TAN, ABS		366-0753-00
-10	343-0549-00			2	STRAP, TIEDOWN:1.6-19MM DIA, 66NYLON		343-0549-00
-11	211-0751-00			5	SCREW,MACHINE:M3X8MM L, PNH, STL, ZN-C, CROSS REC W/FLAT&LOCK WASHERS		211-0751-00
-12	333-A463-00			1	PANEL, FRONT:SMA, AWG710 option 02, POLYCARBONATE,		333-A463-00
-13	407-A655-00			1	BRACKET, ASSY:OUTPUT CONNECTOR, AL		407-A656-00
	614-A027-00			1	PANEL, ASSY KIT THIS KIT CONTAINS ALL ABOVE PARTS.		614-A027-00

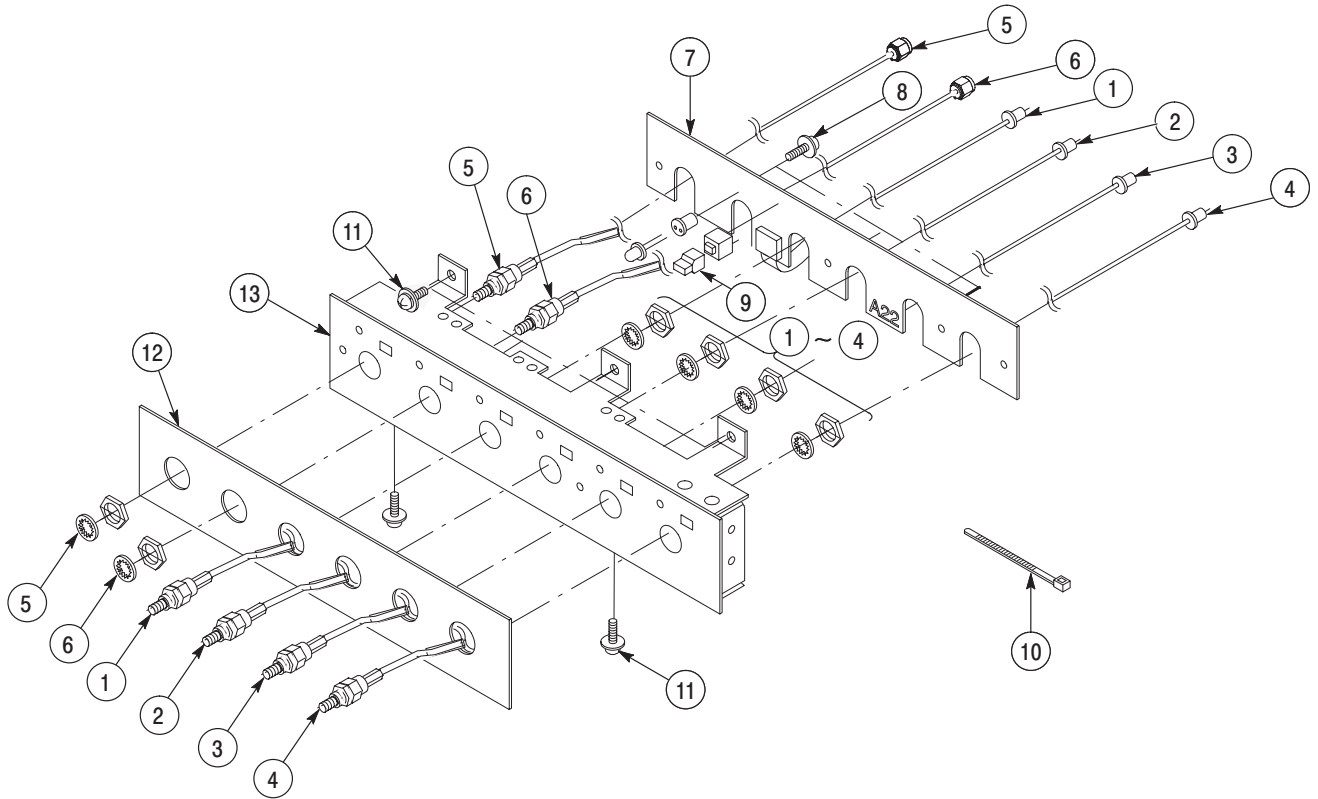


Figure 10-4: Front Output unit (for option 02)

Replaceable Parts List

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description	Mfr. code	Mfr. part number
5-1	441-A282-00			1	CHASSIS, ASSY:CPU, AL, See Fig 10-5		441-A282-00
-2	211-0945-00				SCREW, MACHINE:M4X8MM L,STL,ZN-C,CROSS REC		211-0945-00
-3	211-0871-00			5	SCREW,MACHINE:M3X6MM L,PNH,STL,ZN PL,CROSS REC,W/FLAT(7MM OD)& LOCK WASHER		211-0871-00
-4	671-B130-00			1	CIRCUIT BD ASSY: A10 CONNECTOR, 389-B099-XX WIRED		671-B130-00
-5	407-A648-00			1	BRACKET:HDD, CONNECTOR BD, AL, AWG710		407-A648-00
-6	211-0871-00			7	SCREW,MACHINE:M3X6MM L,PNH,STL,ZN PL,CROSS REC, W/FLAT(7MM OD)& LOCK WASHER		211-0871-00
-7	119-B090-00			1	HDD UNIT:"2.5", "10.06HB, IDE I/F", FORMATTED	IBM	119-B090-00
-7	119-B138-00			1	MEMORY MODULE:"2.5",FLASH DISK,256MB		119-B138-00
-8	131-A609-00			1	BUS,CONDUCTOR:SHORT BAR,2MM PITCH		131-A609-00
-9	620-A006-00			1	POWER SUPPLY:IN 90-250V, 47-63HZ, OUT +5V/20A, -2V/10A, -5V/18A, +12V/4.7A, 3.3V/20A, +15OR8V/3A, -	FUJI DENKI	FH0410
-10	174-B931-00			1	CA, ASSY, SP, ELEC:12, 22AWG, 6CM L		174-B881-00
-11	174-B930-00			1	CA, ASSY, SP, ELEC:18, 22AWG, 6CM L		174-B880-00
-12	174-B929-00			1	CA, ASSY, SP, ELEC:14, 22AWG, 6CM L		174-B879-00
-13	119-B149-00			1	MEMORY MODULE:SOLID STATE DRIVE, 16MB, IDE-I/F F/W INSTALLED		119-B149-00
-14	174-B891-00			1	CA, ASSY, SP, ELEC:44, 28AWG, FLAT, 23CM L, 2MM CTR		174-B891-00
-15	344-0472-00			3	BUSHING:BUSHING,NYLON,GRAY		344-0472-00
-16	174-B356-00			1	CABLE, ASSY, SP:PS, 16CON, A10, 7CM, 5557-16R		174-B356-00
-17	344-A019-00			2	CLIP, CABLE:WIRE SADDLE, 16 MM X 15.5 MM, 66 NYLON		WS-2WS
-18	343-1644-00			2	CLIP, CABLE:WIRE SADDLE,		UAMS-07-0
-19	343-0549-00			8	STRAP,TIEDOWN:1.6-19MM DIA,66NYLON		343-0549-00
-20	211-A044-00			2	SCREW,MACHINE:M3X10MML,FLH,STLZNPL,CROSSREC		211-A044-00
-21	650-A878-00			1	CHASSIS,ASSY:AL,FRONT&REARPNL,BUILDONMAIN		650-A878-00
-22	220-A177-00			1	NUT, PLATE:STL, ZN PL		220-A177-00
-23	344-0472-00			5	BUSHING:BUSHING,NYLON,GRAY		344-0472-00
-24	255-0732-00			CM	PLASTICCHANNEL:1.7MMX3.7MMX4.0MM,NATURAL,NYLON		255-0732-00
-25	211-1082-00			1	SCREW,MACHINE: M2.6X10MM L,PNH,STL,ZN-C,CROSS REC,W/FLAT & LOCK WASHER		211-1082-00
-26	211-1033-00			1	SCREW,MACHINE:M2.6X3MM L,PNH,BRS NI PL CROSS REC		211-1033-00
-27	105-1081-03			1	BRACKET,FDD ADAPTOR		105-1081-03
-28	119-5953-00			1	FD DRIVE		119-5953-00
-29	211-A218-00			1	SCREW,MACHINE:M2.6X6MML,PNH,STL,ZN-C,CROSSREC W/LOCK&FLAT		211-A218-00
-30	174-B329-01			1	CA ASSY,SP,ELEC:26 COND,150MM,FFC		174-B329-01
-31	344-0472-00			3	BUSHING,NYLON,GRAY		344-0472-00
-32	119-B103-00			2	FAN, TUBEAXIAL:12V, 225MA, 2.7W, 2950RPM, 56.8CFM, 42.1PA, FBA09A12HZ, W/O LEAD	MATSU SHITA	FBA09A12HZ

Replaceable Parts List (Cont.)

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description	Mfr. code	Mfr. part number
-33	129-A229-00			4	SPACER,POST:20.0MML,M4INT/EXTTHD,7MMHEX,STL ZN-CPL		UN237-P4
-34	210-0008-00			1	WASHER,LOCK:#8 INTL,0.02 THK,STL CD PL		210-0008-00
-35	174-B892-00			1	CA, ASSY, SP, ELEC:6, 26AWG, 26CM L, FOR FAN MOTOR		174-B892-00
-36	212-A049-00			8	SCREW, MACHINE:M4X30MM L, BDGH, STL ZN-C PL, CROSS REC		212-A049-00
-37	211-1042-00			4	SCREW,MACHINE:M4X10MM L,BDGH,STL,ZN PL		211-1042-00
-38	119-B104-00			1	FAN, TUBEAXIAL: 12V, 370MA, 4.44W, 2500RPM, 103.8CFM, 66.7PA, FBL12G12H, W/O LEAD	MATSU SHITA	FBL12G12H

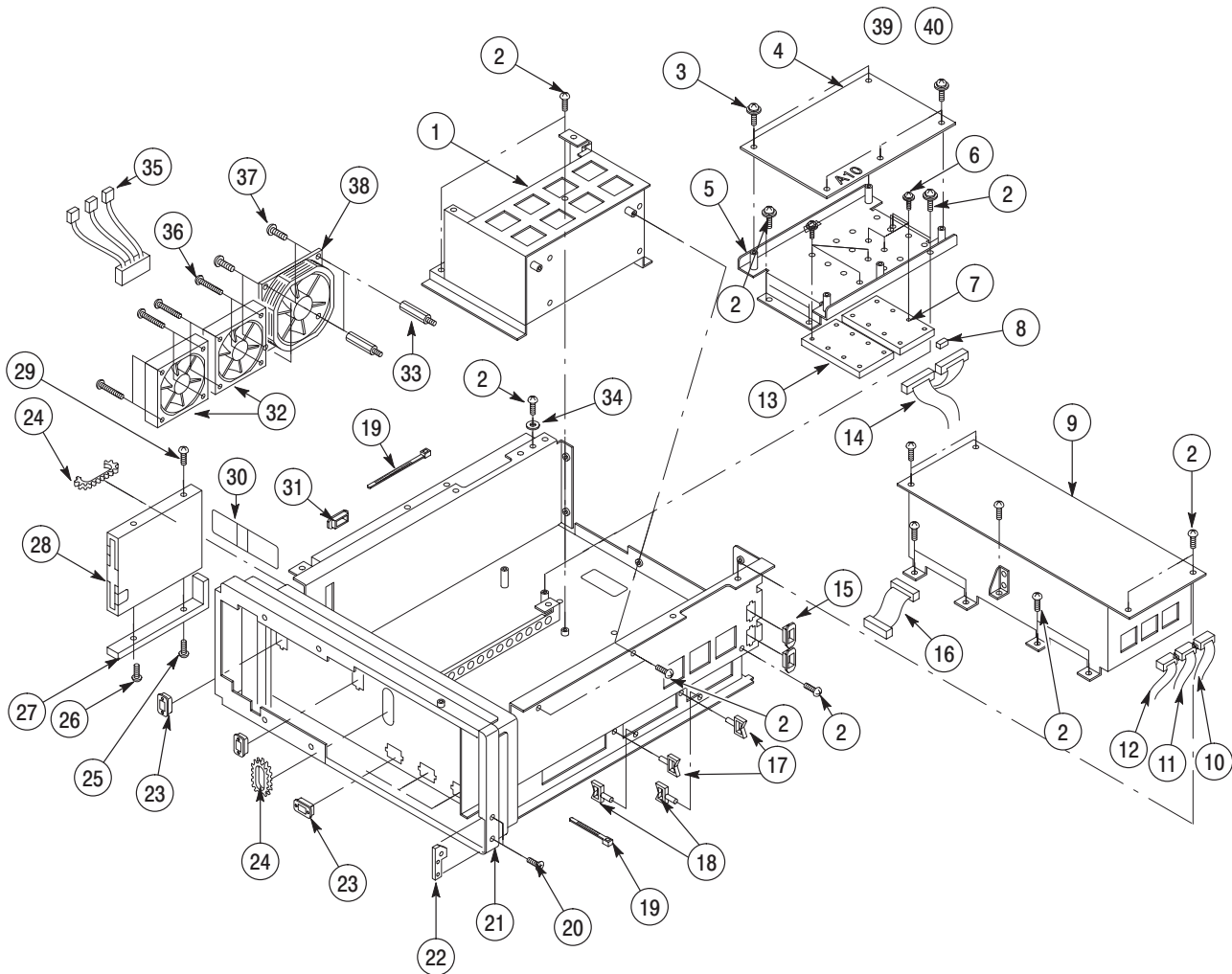


Figure 10-5: Chassis

Replaceable Parts List

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description	Mfr. code	Mfr. part number
6-1	441-A282-00			1	CHASSIS, ASSY:CPU, AL, AWG710		441-A282-00
-2	343-A345-00			1	RETAINER,CKT BD:CPU,AL,AWG710		343-A345-00
-3	211-0871-00			10	SCREW,MACHINE:M3X6MM L,PNH,STL,ZN PL,CROSS REC,W/FLAT(7MM OD)& LOCK WASHER		211-0871-00
-4	119-6139-00			1	COMPUTER KIT:BACK PLANE BD,3SLOT,PCI BUS		119-6139-00
-5	119-B136-00			1	CPU, UNIT:PENTIUM 133MHZ, W/64MB DIMM, 100BT, HALF-SIZE WITH DIMM AND SET UP		HPU5810ADA-133
-6	671-B129-00			1	CIRCUIT BD ASSY:A40 PCI I/F, 389-B102-XX WIRED		671-B129-00
-7	119-A849-00			1	INTERFACE BOARD: PCI-GPIB CARD		777440-01
-8	407-A647-00			1	BRACKET, BOARD:PCI I/F, AL, AWG710		407-A647-00
-9	174-B334-00			1	CA ASSY, SP, ELEC:34, 28AWG, 9CM L, FLAT		174-B334-00
	174-B335-00			1	CA ASSY, SP, ELEC:16, 28AWG, 11CM L, FLAT, DISPLAY		174-B336-00
	174-4298-00			1	CA ASSY,SP,ELEC:20CON/9CON/15CON,AWG26,23CM L		174-4298-00
	174-B886-00			1	CA, ASSY, SP, ELEC:26, 28AWG, FLAT, 25CM L		174-B886-00
	174-4302-00			1	CA ASSY,SP,ELEC:50,AWG28,20CM L,FLAT, 1MM		174-4302-00
	174-B883-00			1	CA, ASSY, SP, ELEC:80, 30AWG, FLAT, 27CM L, 0.65CTR		174-B883-00
	174-4315-00			1	CA ASSY,SP,ELEC: 100,AWG32,30CM L,FLAT		174-4315-00
	174-B887-00			1	CA, ASSY, SP, ELEC:3, 18AWG, 30CM L		174-B887-00
-10	343-1644-00				CLAMP,CABLE:CLIP LOCKING WIRE,NYLON		343-1644-00

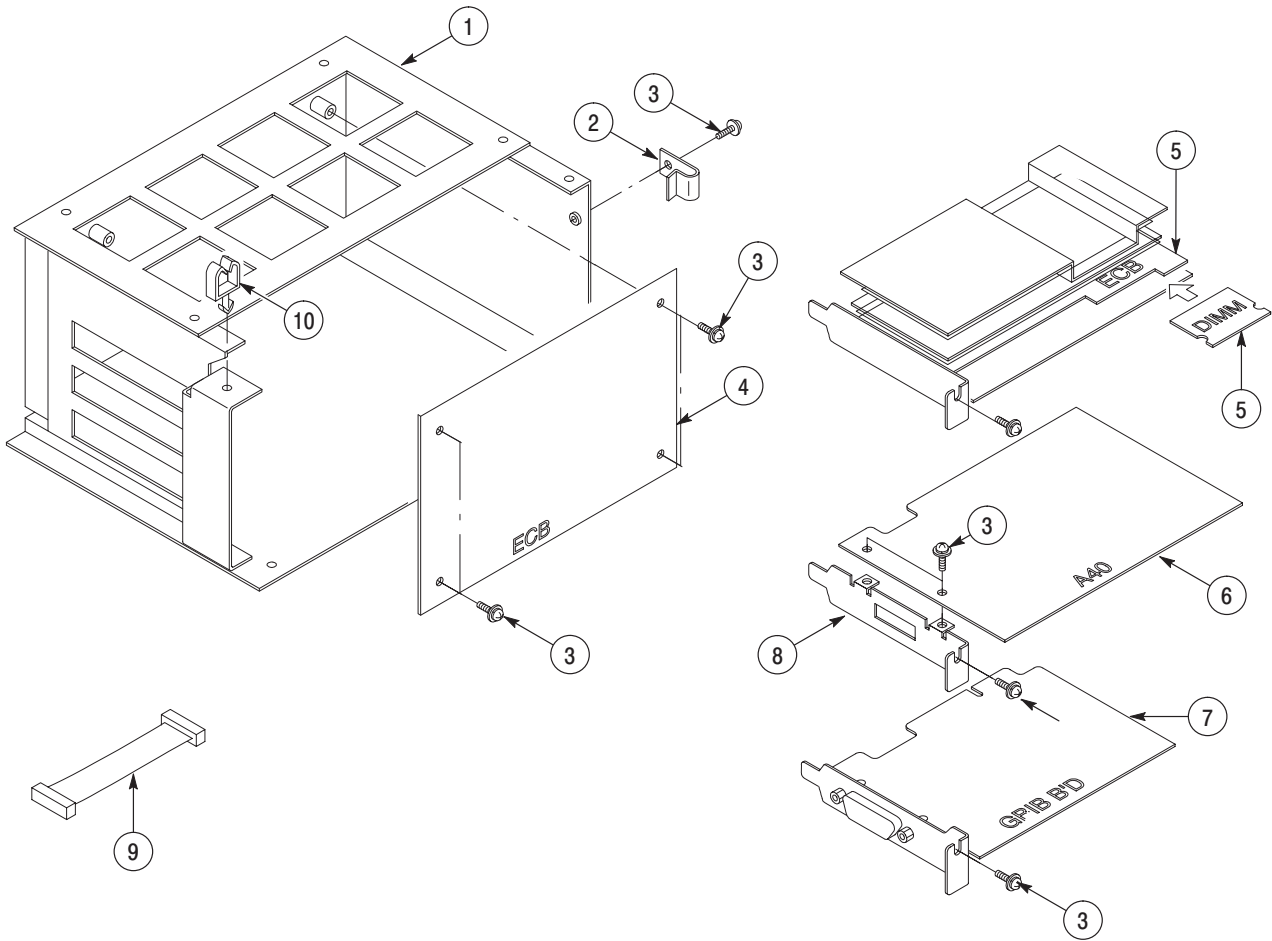


Figure 10-6: CPU unit

Replaceable Parts List (except option 02)

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description	Mfr. code	Mfr. part number
7-1	337-A211-00			1	SHIELD, ELEC:ATT, TOP		337-A211-00
-2	211-0751-00			2	SCREW,MACHINE:M3X8MM L,PNH, STL, ZN-C, CROSS REC W/FLAT&LOCK WASHERS		211-0751-00
-3	200-A522-00			1	COVER, CABLE, AL		200-A522-00
-4	174-B932-00			8	CA, ASSY, RF:500HM COAX, 15CM L, PELTRA		174-B932-00
-5	174-B933-00			2	CA, ASSY, RF:500HM COAX, 21CM L, PELTRA		174-B933-00
-6	344-0557-00			3	CLIP, CABLE:WIRE SADDLE, 11.1 MM X 14.7 MM, 66-NYLON		344-0557-00
-7	338-A855-00			1	STIFFENER:OUTPUT BOARD		338-A855-00
-8	351-A165-00			1	GUIDE, CKT BOARD, NYLON		351-A165-00
-9	129-A558-00			2	SPACER, POST:9.0MM L, M3, INT/EXT THD, 5.5 MM HEX, BRS NI PL		129-A558-00
-10	211-0751-00			2	SCREW,MACHINE:M3X8MM L,PNH, STL, ZN-C, CROSS REC W/FLAT&LOCK WASHERS		211-0751-00
-11	671-B147-01			1	CIRCUIT BD ASSY:A71 OUTPUT, 389-B150-01 WIRED		671-B147-01
-12	671-B207-00			1	CIRCUIT BD ASSY:A50, STD, 389-B115-02 WIRED		671-B207-00
-12	671-B208-00			1	CIRCUIT BD ASSY:A50, OP-01, 32M, 389-B115-02 WIRED		671-B208-00
-13	211-0751-00			8	SCREW,MACHINE:M3X8MM L,PNH, STL, ZN-C, CROSS REC W/FLAT&LOCK WASHERS		211-0751-00
-14	337-A212-00			1	SHIELD, ELEC:OUTPUT BOARD		337-A212-00
-15	220-0212-00			1	NUT, PLAIN, HEX:M3 X 5.5 MM HEX, STL, ZN-C, 1-SHU		220-0212-00
-16	210-A015-00			1	WASHER, LOCK:#3, SPLIT, STL MFZN-C		210-A015-00
-17	210-A007-00			1	WASHER, PLAIN:#3, 6 MM OD, STL MFZN-C		210-A007-00
-18	129-A061-00			4	SPACER, POST:10.0MM L, M3, INT/EXT THD, 5.5 MM HEX, BRS NI PL		SQ-24
-19	129-A592-00			5	SPACER, POST:7.0MM L, M3 INT/EXT THD, BRS, 5.5MM HEX, BRS NIPL		SQ-15
-20	348-1371-00			4	FOOT, CABINET:CLEAR POLYURETHANE W/ADHESIVE		348-1371-00
-21	211-0751-00			5	SCREW,MACHINE:M3X8MM L,PNH, STL, ZN-C, CROSS REC W/FLAT&LOCK WASHERS		211-0751-00
-22	337-A210-00			1	SHIELD, ELEC, ATT:BOTTOM		337-A210-00
-23	211-0751-00			4	SCREW,MACHINE:M3X8MM L,PNH, STL, ZN-C, CROSS REC W/FLAT&LOCK WASHERS		211-0751-00
-24	671-B148-01			1	CIRCUIT BD ASSY:A77 ATT, 389-B113-01 WIRED		671-B148-01
-25	386-A848-01			1	STIFFNER, CKT BD:ATT		386-A848-01
-26	348-1203-00			2	FOOT, CABINET:CLEAR POLYURETHANE W/ADHESIVE		348-1203-00
-27	211-0751-00			5	SCREW,MACHINE:M3X8MM L,PNH, STL, ZN-C, CROSS REC W/FLAT&LOCK WASHERS		211-0751-00

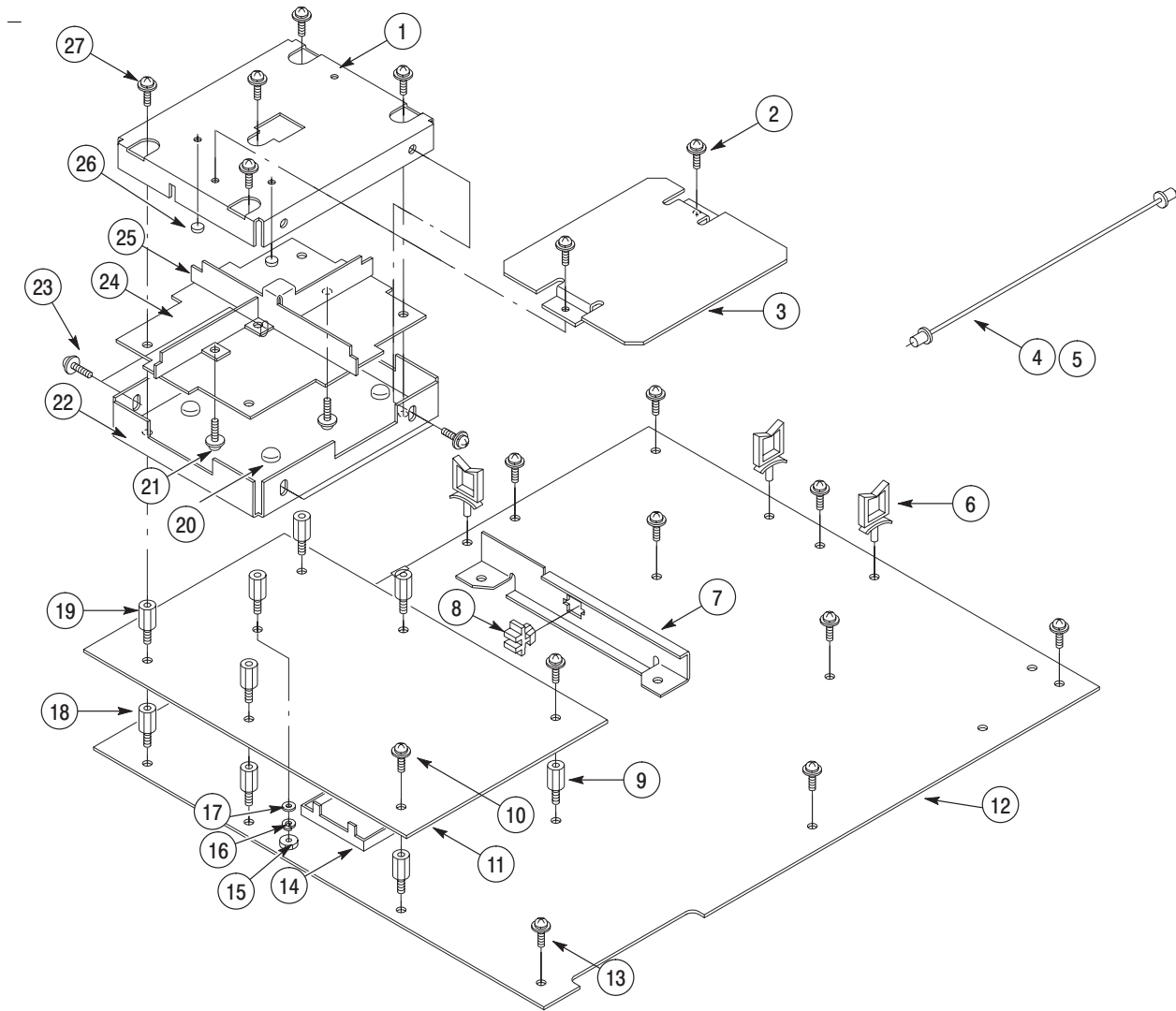


Figure 10-7: Circuit boards(except option 02)

Replaceable Parts List (for option 02)

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description	Mfr. code	Mfr. part number
8-1	129-A061-00			6	SPACER, POST:10.0MM L, M3, INT/EXT THD, 5.5 MM HEX, BRS NI PL		129-A061-00
-2	211-0751-00			6	SCREW, MACHINE: M3X 8MM L, PNH, STL, N-C, CROSS REC W/FLAT&LOCK WASHERS		211-0751-00
-3	148-A079-00			2	RELAY (K100, K200)		148-A079-00
-4	174-C052-00			2	W710, W720, 10CM 4CON, RIBON		174-C052-00
-5	211-A240-00			4	SCREW MACHINE: M3X20MM L, PNH, STL ZN PL, CROSS		211-A240-00
-6	174-C049-00			1	W5401, 25CM L MKD 2, SMA-PELTRA (K200 - A50:J5401)		174-C049-00
-7	174-C048-00			1	W5400, 25CM L MKD 1, SMA-PELTRA (K100 - A50:J5400)		174-C048-00
-8	343-A360-00			1	CLAMP, CABLE: LOCKING WIRE SADDLE 11MM X 7.2MM, 66NYLON		343-A360-00
-9	174-C051-00			1	W520, 10CM L, MKD 2, SMA-PELTRA (K200 - A72:J520)		174-C051-00
-10	174-C050-00			1	W510, 10CM L, MKD 1, SMA-PELTRA (K100 - A72:J510)		351-A165-00
-11	671-B271-50			1	CIRCUIT BD ASSY:A72 OUTPUT		671-B271-50
-12	220-A184-00			2	NUT, PLAT: AL		220-A184-00
	650-A910-00			1	MODULER KIT, THIS KIT CONTAINS PARTS No. 3 THROUGH No. 12.		650-A910-00

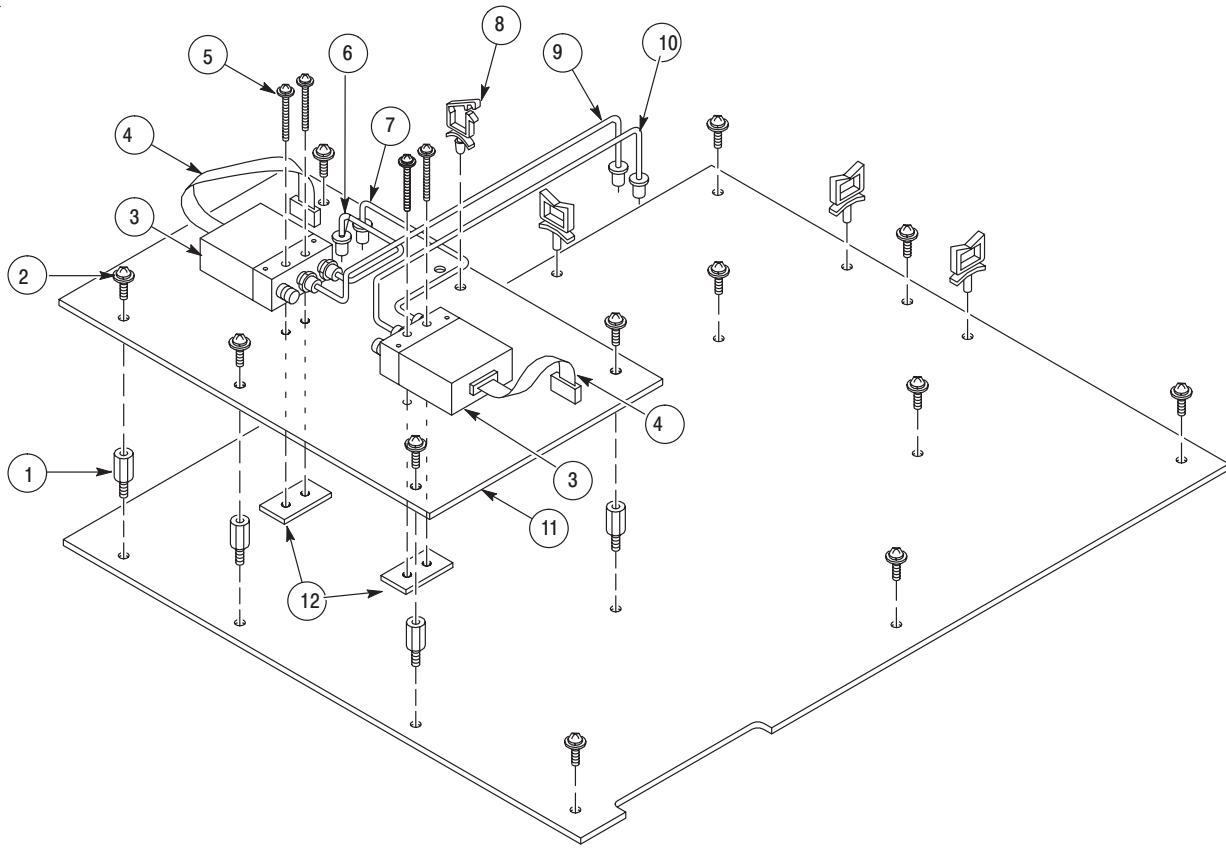


Figure 10-8: Circuit boards (for option 02)

Replaceable Mechanical Parts

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description	Mfr. code	Mfr. part number
Replaceable Parts List							
Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description	Mfr. code	Mfr. part number
9-1	333-A435-00			1	PANEL, REAR:AWG710, AL		333-A435-00
-2	174-3878-00			1	CA, ASSY, SP, ELEC:10CON/9PIN, 26AWG, 27CM L		174-3878-00
-3	276-0324-00			3	CORE [ZCAT1518-0730]		276-0324-00
-4	131-1315-01			3	CONN,RF,JACK:BNC,50OHM,FEMALE,STR,PELTORA,PANEL MOUNT		131-1315-01
-5	174-B643-00			1	CA ASSY,SP,ELEC:50OHM COAX,50CM L,9-1,SMA-PELTRA,SST SHELL		174-B643-00
-6	174-B941-00			1	CA, ASSY, SP, ELEC:8, LAN, 100BASE-T, 35CM L, TWISTED		174-B885-00
-7	174-B942-00			2	CA, ASSY, SP ELEC:1, 22AWG, 4.5CM L, 0-N, W/LUG M3		174-B942-00
-8	407-4554-00			1	BRACKET, CONN:MODULAR CONN		
-9	211-0871-00			1	SCREW,MACHINE:M3X6MM L,PNH,STL,ZN PL,CROSS REC,W/FLAT(7MM OD)& LOCK WASHER		211-0871-00
-10	671-4326-00			1	CIRCUIT BD ASSY:A90 KEYBOARD; 389-A695-00 WIRED		671-4326-00
-11	174-B338-00			1	CA ASSY, SP, ELEC:6, 26AWG, 43CM L, RIBBON, W/HOLDER, 2MM PITCH		174-B338-00
-12	174-B940-00			1	CA, ASSY, RF:50OHM COAX, 50CM L, MKD T1, PELTRA		174-B940-00
-12	174-B939-00			1	CA, ASSY, RF:50OHM COAX, 55CM L, MKD R0, PELTRA		174-B939-00
-12	174-B938-00			1	CA, ASSY, RF:50OHM COAX, 55CM L, MKD R1, PELTRA		174-B938-00
-12	174-B643-00			1	CA, ASSY, SP, ELEC:50OHM COAX, 55CM L, 9-1, SMA-PELTRA, SST SHELL		174-B643-00
-13	220-A176-00			1	NUT, PLATE:STL		220-A176-00
-14	174-B884-00				CA, ASSY, SP, ELEC: 24, 28AWG, FLAT, 40CM, GPIB		174-B884-00
-15	211-0945-00			7	SCREW, MACHINE:M4X8MM L,STL,ZN-C,CROSS REC		
-16	174-3879-00			1	CA ASSY, SP, ELEC:8, 26AWG, 43CM L, RIBBON W/ HOLDER, 2MM PITCH		174-3879-00
-17	214-3903-01			4	SCREW,JACK:4-40 X 0.312 EXT THD,4-40 INT THD,0.188 HEX,STEEL,CAD PLATE		214-3903-01
-18	210-A015-00			4	WASHER, LOCK:#3, SPLIT, STL MFZN-C		210-A015-00
-19	210-A007-00			4	WASHER, PLAIN:#3, 6MM OD, STL MFZn-C, KOGATAMARU		210-A007-00
	159-0407-XX			1	FUSE, CARTRIDGE, 3AG, 10A, 350VAC, FAST, 6.35MM X 31.75 MM (0.25 IN X 1.25 IN)		159-0407-XX
	159-0210-XX			1	FUSE, CARTRIDGE, DIN 5 X 20MM, 5A, 250V SLOW BLOW, 5MM X 20MM (.197 IN X .788 IN)		159-0210-XX
	200-2264-XX			1	CAP, FUSEHOLDER, 3AG FUSES		200-2264-XX
	200-2265-XX			1	CAP, FUSEHOLDER, 5 X 20MM FUSES		200-2265-XX

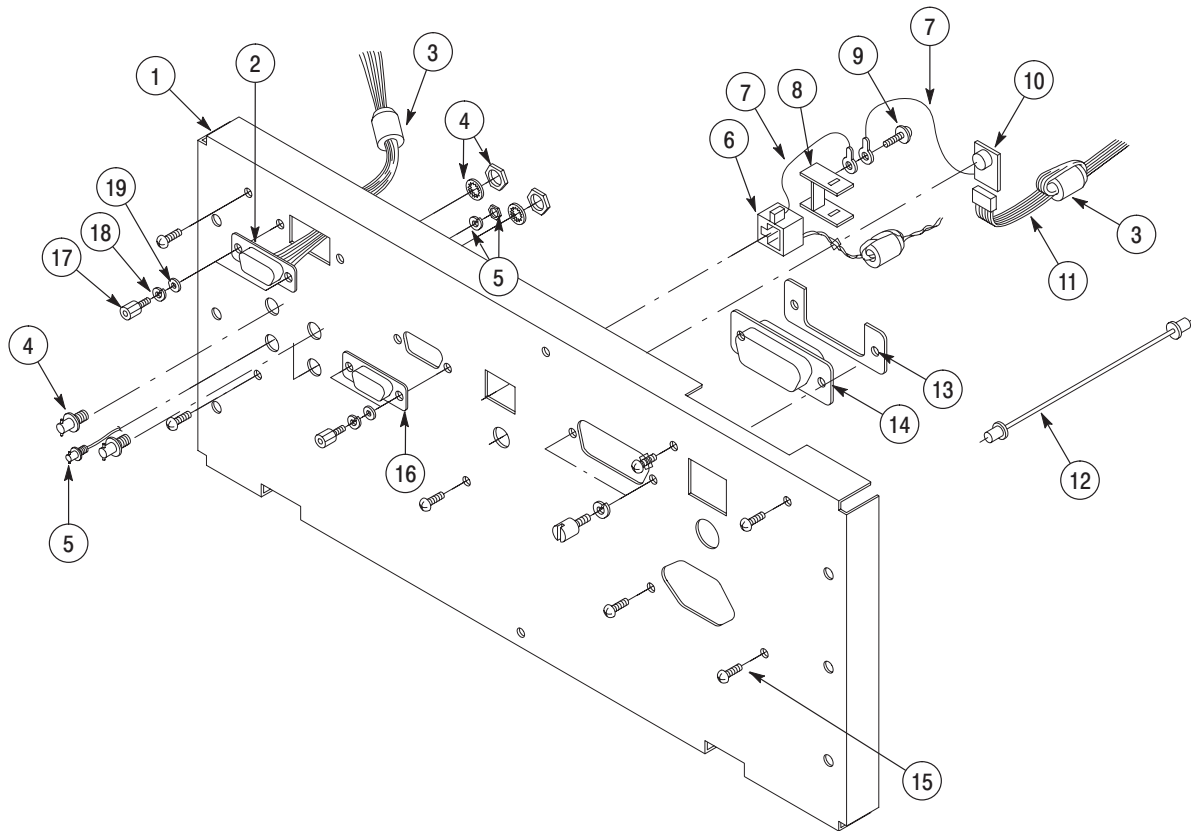


Figure 10-9: Rear Panel

Replaceable Parts List

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description	Mfr. code	Mfr. part number
10-1	390-A088-00			1	CABINET ASSY:AL		390-A088-00
-2	348-1314-00			122 CM	GASKET,SHIELD:FINGER TYPE,BE-CU,609.6MM L,W/ADHESIVE		348-1314-00
-3	211-0945-00			2	SCREW, MACHINE:M4X8MM L,STL,ZN-C,CROSS REC		211-0945-00
-4	212-0210-00			6	SCREW, MACHINE:M5X20MM L,PNH,STL,ZN-C,CROSS REC JIS B111		212-0210-00
-5	348-1115-00			2	FOOT,CABINET:SLATE GRAY,PLASTIC		348-1115-00
-6	437-A011-00			1	CABINET ASSY:FOOT STAND & CARRING HANDLE, BUILT ON CABINET(390-A088-XX)		437-A011-00
-7	101-0142-00			1	TRIM,DECORATIVE:FRONT		101-0142-00
-8	348-1569-00			114 CM	SHILD GASKET, ELEC:MESH TYPE, 3.2MM OD, SI SPONG CORE		348-1569-00

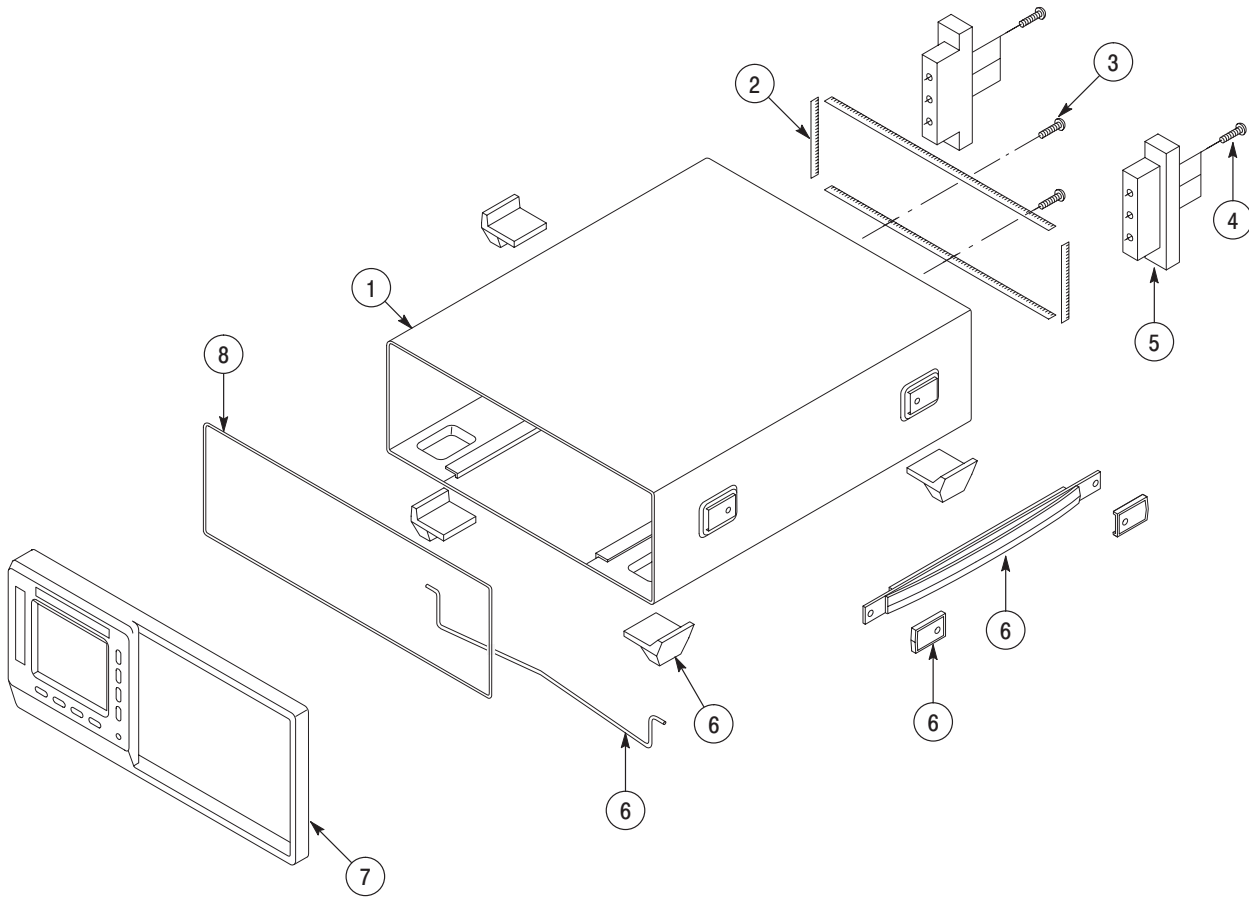


Figure 10-10: Cabinet

Replaceable Parts List

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description	Mfr. code	Mfr. part number
11-1	101-0142-01			1	TRIM,DECORATIVE:FRONT,RACK MOUNT		101-0142-01
-2	348-1569-00			114 CM	SHILD GASKET, ELEC:MESH TYPE, 3.2MM OD, SI SPONG CORE		348-1569-00
-3	367-0022-00			2	HANDLE,BOW:4.579 L,BRS CRPL		367-0022-00
-4	212-0507-00			4	SCREW,MACHINE:10-32 X 0.375,PNH,STL ZN-CM1,POZIDRIV		212-0507-00
-5	390-A088-00			1	CABINET ASSY:AL, AWG710		390-A088-00
-6	407-A651-01			2	BRACKET: SUPPORT, SIDE, RACK MOUNT, AL		407-A651-00
-7	211-0945-00			2	SCREW, MACHINE:M4X8MM L,STL,ZN-C,CROSS REC		211-0945-00
-8	348-1314-00			122 CM	GASKET,SHIELD:FINGER TYPE,BE-CU,609.6MM L,W/ADHESIVE		348-1314-00
-9	212-0214-00			6	SCREW,MACHINE:M5X12MM L,PNH,STL,ZN-C,CROSS REC,W/FLAT & LOCK WASHER		212-0214-00
-10	351-0313-00			1	GUIDE,RACKMOUNT:19.218 L,PAIR		351-0313-00
-11	351-0623-00			1	SLIDE,DWR,EXT:22.0 X 1.54,STEELSAFFTY CONTROLLED		351-0623-00
-12	212-0507-00			4	SCREW,MACHINE:10-32 X 0.375,PNH,STL ZN-CM1,POZIDRIV		212-0507-00
-13	212-0215-00			4	SCREW,MACHINE:M4X12MM L,PNH,STL,ZN-PL,CROSS REC,W/FLAT & LOCK WASHER		212-0215-00
-14	407-4020-00			2	BRACKET,SUPPORT:FRONT,ALUMINUM		407-4020-00

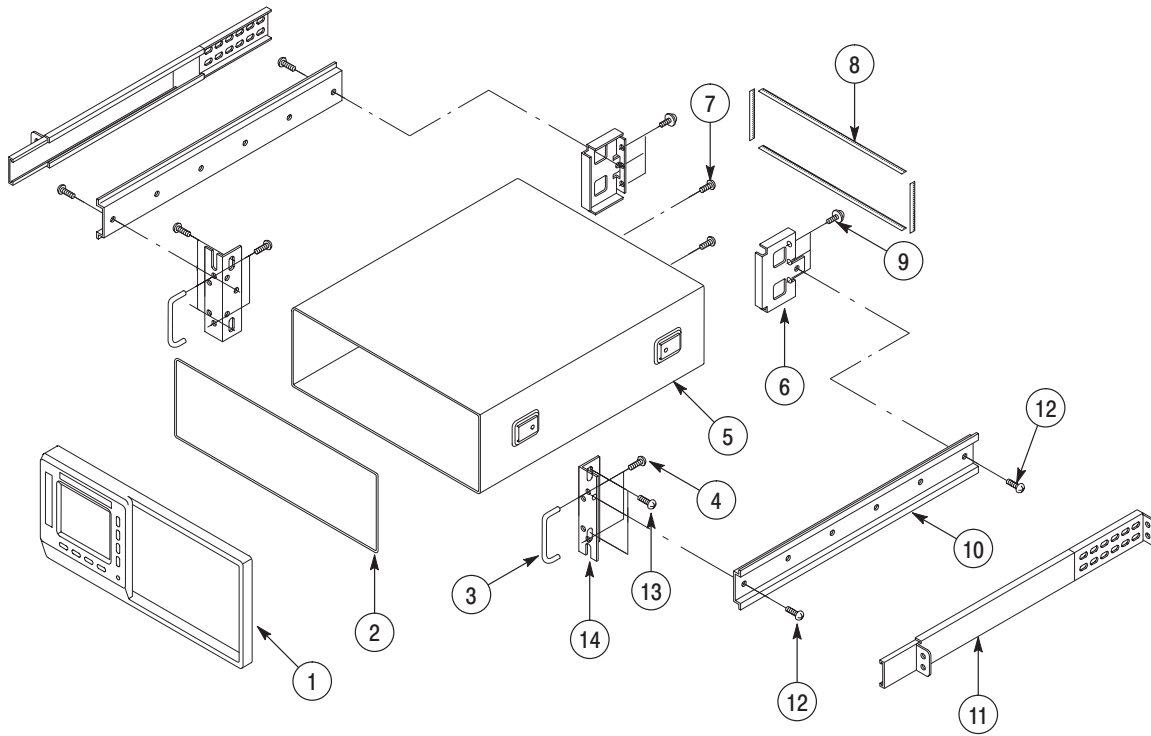


Figure 10-11: Rack mount