

Service Manual



AWG615

2.7 GS/s Arbitrary Waveform Generator

071-1516-01

This document applies to firmware version 4.0 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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WARRANTY 2

Tektronix warrants that this product will be free from defects in materials and workmanship for a period of one (1) year from the date of shipment. If any such product proves defective during this warranty period, Tektronix, at its option, either will repair the defective product without charge for parts and labor, or will provide a replacement in exchange for the defective product. Parts, modules and replacement products used by Tektronix for warranty work may be new or reconditioned to like new performance. All replaced parts, modules and products become the property of Tektronix.

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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.

Environmental Considerations

This section provides information about the environmental impact of the product.

Product End-of-Life Handling

Observe the following guidelines when recycling an instrument or component:

Equipment Recycling. Production of this equipment required the extraction and use of natural resources. The equipment may contain substances that could be harmful to the environment or human health if improperly handled at the product's end of life. In order to avoid release of such substances into the environment and to reduce the use of natural resources, we encourage you to recycle this product in an appropriate system that will ensure that most of the materials are reused or recycled appropriately.



The symbol shown to the left indicates that this product complies with the European Union's requirements according to Directive 2002/96/EC on waste electrical and electronic equipment (WEEE). For information about recycling options, check the Support/Service section of the Tektronix Web site (www.tektronix.com).

Mercury Notification. This product uses an LCD backlight lamp that contains mercury. Disposal may be regulated due to environmental considerations. Please contact your local authorities or, within the United States, the Electronics Industries Alliance (www.eiae.org) for disposal or recycling information.

Restriction of Hazardous Substances

This product has been classified as Monitoring and Control equipment, and is outside the scope of the 2002/95/EC RoHS Directive. This product is known to contain lead, cadmium, mercury, and hexavalent chromium.

Preface

The AWG615 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 AWG615 Arbitrary Waveform Generator includes:

- The AWG615 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 AWG615 Arbitrary Waveform Generator Programmer manual explains how to use a GPIB interface to control the waveform generator remotely.

Introduction

This manual provides information and procedures necessary for properly servicing the AWG615 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 ix.
- 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 AWG615 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.



Specifications

Product Overview

Product Description

The AWG615 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 AWG615 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 AWG615 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 AWG615 Arbitrary Waveform Generator contains the following main features:

- 2.7 GS/s sampling rate
- 8-bit DA converter
- 32.4 M-word waveform memory (64.8 M-word optional)
- Two arbitrary marker outputs
- Five waveform editors (see Table 1-1)

Table 1-1: AWG615 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.
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.

- FG mode to generate a standard functional waveform easily.
- Waveform Mixing mode to generate a mixing two-signals digitally.
- Synchronous operation mode to generate 2 channel signals by two AWG615s.

Additional Features

The AWG615 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 AWG615 Arbitrary Waveform Generator User manual for information.
- A GPIB interface that can be used for remotely controlling the AWG615 Arbitrary Waveform Generator and for transferring the waveform data from the external oscilloscopes.

Refer to *Connecting to a GPIB Network* in the AWG615 Arbitrary Waveform Generator user manual for information on setting the GPIB parameters.

Refer to the *AWG615 Arbitrary Waveform Generator Programmer* manual for information on the remote control commands.

Refer to the *Reference: Capturing Waveforms* subsection of the AWG615 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 AWG615 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 AWG615 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 AWG615 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 AWG615 Arbitrary Waveform Generator User manual.

Specifications

This section contains the AWG615 Arbitrary Waveform Generator specifications. All specifications are guaranteed unless labeled “typical”. Typical specifications are provided for your convenience but are not guaranteed.

Specifications that are marked with the ✓ symbol in the column Characteristics are checked in *Appendix B: Performance Verification* and the page number referenced to the corresponding performance verification procedures can be found in the column PV reference page.

The characteristics in the specifications are listed in tables that are divided into categories. In these tables, the subcategories may also appear in boldface under the column Characteristics.

Performance Conditions

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

- The AWG615 Arbitrary Waveform Generator must have been calibrated/adjusted at an ambient temperature between +20° C and +30° C.
- The AWG615 Arbitrary Waveform Generator must be in an environment with temperature, altitude, humidity, and vibration within the operating limits described in these specifications.
- The AWG615 Arbitrary Waveform Generator must have had a warm-up period of at least 20 minutes.
- The AWG615 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 which are warranted.

Electrical Specification

Table 1-1: Run 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, event jump, and so on are neglected 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, event jump, and so on are neglected 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 this functions in this mode. Event jump and Software jump are disabled in Synchronous Operation mode.

Table 1-2: Extended Operation

Characteristics	Description
FG operation	This mode provides user-friendliness like the conventional function generator. The output waveforms are Sine, Triangle, Square, Ramp, Pulse and DC waveform. AWG615 is in AWG mode when this mode is not selected.
Waveform Mixing operation	This mode provides the function for mixing two-signals digitally.
Synchronous Master operation	This mode provides the setup for using as a Master instrument on Synchronous Operation.
Synchronous Slave operation	This mode provides the setup for using as a Slave instrument on Synchronous Operation.

Table 1-3: Arbitrary waveforms

Characteristics	Description
Waveform memory	Memory length: 32 400 000 words (8 bits/1 word)
Op.01	Memory length: 64 800 000 words (8 bits/1 word)
Marker memory	Memory length: 32 400 000 words (2 markers × 1 bit / 1 word)
Op.01	Memory length: 64 800 000 words (2 markers × 1 bit / 1 word)
Sequence memory	1 to 8000 steps
Sequence counter	1 to 65 536 and Infinite

Table 1-3: Arbitrary waveforms

Characteristics	Description
Waveform data points	Multiple of 4 in the range from 960 to 32 400 000 points
Op.01	Multiple of 4 in the range from 960 to 64 800 000 points
Data storage	
Hard disk	≥20 G bytes
Floppy disk	1.44 M bytes

Table 1-4: Clock generator

Characteristics	Description	PV reference page
Sampling frequency	50.000 000 kHz/s to 2.700 000 0 GHz/s	
Resolution	8 digits	
Internal clock ¹		
✓ Frequency accuracy	± 1 ppm (10 °C to 40 °C), during 1 year after calibration	Page 4-51
Phase noise at VCO output, Typical	-58 dBc / Hz (2.7 GS/s with 10 kHz offset) -93 dBc / Hz (2.7 GS/s 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	Complemental; CH1 and $\overline{\text{CH1}}$	

Table 1-6: Main output (cont.)

Characteristics ³	Description	PV reference page
DA converter		
Resolution	8 bits	
Differential nonlinearity	Within $\pm 1/2$ 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 _{p-p} to 2 V _{p-p} , into a 50 Ω load	
Resolution	1 mV	
✓ DC accuracy	$\pm (2.0\% \text{ of amplitude} + 2 \text{ mV})$, offset: 0 V	Page 4-22
Offset		
Range	-0.5 V to 0.5 V, into a 50 Ω load	
Resolution	1 mV	
✓ Accuracy	$\pm 1.5\% \text{ of offset} \pm 10 \text{ mV}$, (20 mV amplitude, waveform data: 0)	Page 4-22
Pulse response (Waveform data: -1 and 1, offset: 0 V, and filter: through, Clock: 1.0 GS/s)		
✓ Rise time (10 % to 90 %)	$\leq 480 \text{ ps}$ (amplitude = 1.0 V _{p-p} , calculated value $\geq 729 \text{ MHz}$)	Page 4-34
✓ Fall time (10 % to 90 %)	$\leq 480 \text{ ps}$ (amplitude = 1.0 V _{p-p} , calculated value $\geq 729 \text{ MHz}$)	
Aberration, Typical	$\pm 10\%$ (amplitude + 1.0 V _{p-p} , using 20 GHz bandwidth oscilloscope)	
Flatness, Typical	$\pm 5\%$ (after 20 ns from rise or fall edges)	
Sinewave characteristics (Clock: 2.7 GS/s, waveform points: 32, Signal frequency: 84.375 MHz, amplitude: 1.0 V, offset: 0 V, filter: through)		
Harmonics	$\leq 40 \text{ dBc}$ (DC to 1000 MHz)	
Noise	$\leq 50 \text{ dBc}$ (DC to 1000 MHz)	
Phase Noise, Typical	$\leq 85 \text{ dBc / Hz}$ (at 10 kHz offset)	
Direct DA out (except option 02)		
Amplitude		
Range	20 mV _{p-p} to 1 V _{p-p} , into a 50 Ω load	
✓ DC Accuracy	$\pm (2\% \text{ of Amplitude} + 2 \text{ mV})$	Page 4-26
Resolution	1 mV	
✓ DC offset accuracy	0 V $\pm 10 \text{ mV}$, (20 mV amplitude, waveform data: 0)	Page 4-26

Table 1-6: Main output (cont.)

Characteristics ³	Description	PV reference page
✓ Pulse response	(Waveform data: -1 and 1, at 0.5 V _{p-p})	Page 4-28
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 _{p-p} to 1 V _{p-p} , into a 50 Ω load	Page 4-30
✓ DC Accuracy	± (2 % of Amplitude + 2 mV)	
Resolution	1 mV	
✓ DC offset accuracy	0 V ± 10 mV, (500 mV amplitude, waveform data: 0)	Page 4-30
✓ Pulse response	(Waveform data: -1 and 1, at 1 V _{p-p})	Page 4-32
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 (174-1427-00) except for DC accuracy.

Table 1-7: Filter (except option 02)

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

Table 1-8: Auxiliary outputs

Characteristics	Description	PV reference page
Marker ⁴		
Number of markers	2 (Complementary). Marker1, <u>Marker1</u> , Marker2, and <u>Marker2</u>	
Connector	Front panel SMA connectors	
High Level (VoH) Range	-1.00 V to +2.45 V, into a 50 Ω load Refer to Figure 1-8 on page 1-18	

Table 1-8: Auxiliary outputs (cont.)

Characteristics	Description	PV reference page
Low Level (VoL) Range	-2.00 V to +2.40 V, into a 50 Ω load Refer to Figure 1-8 on page 1-18	
Amplitude (VoH - VoL) Range	0.05 V _{p-p} , to 1.25 V _{p-p} into a 50 Ω load	
Resolution	50 mV	
✓ DC Accuracy	± 0.1 V ± 5 % of setting, into a 50 Ω load	Page 4-53
Maximum Output Current	± 80 mA	
Rise and fall times (20 % to 80 %), Typical	<130 ps (High: 1.0 V, Lo: 0 V, into a 50 Ω load)	
Period jitter, Typical	Measured by TDS6604 with TDSJIT3. Refer to Table 1-9.	
Cycle to Cycle jitter, Typical	Measured by TDS6604 with TDSJIT3. Refer to Table 1-10.	
Skew, Typical	<20 ps	
Delay between Analog Output and Marker Output, Typical	Maker level: 1 V _{p-p} (High: +1.0 V, Low: 0 V), Analog Output Amplitude: 1 V _{p-p} , Offset: 0 V, Filter: Through, Refer to Figure 1-1 on page 1-11 2.4 ns (Normal Output, Offset: 0 V, Filter: Through) -1.0 ns (Direct Output) 2.0 ns (Option 02)	
VCO output		
Connector	Rear panel SMA connector	
Amplitude	0.4V _{p-p} into a 50 Ω load 0.8 V _{p-p} max. open circuit	
Impedance	50 Ω, AC coupling	
Period jitter, Typical	Measured by TDS6604 with TDSJIT3. Refer to Table 1-11.	
Cycle to Cycle jitter, Typical	Measured by TDS6604 with TDSJIT3. Refer to Table 1-12.	
Connector	Rear panel SMA connector	
10 MHz Reference clock out		
Amplitude, Typical	1.2 V _{p-p} , into a 50 Ω load, Max 2.5 V _{p-p} , open circuit	
Impedance	50 Ω, AC coupling	
Connector	Rear panel BNC connector	
C Out 1, C Out 2 out		
Connector	Rear panel SMA connector	
Input Signal Type	Complementary	

Table 1-8: Auxiliary outputs (cont.)

Characteristics	Description	PV reference page
T Out 1, T Out 2 out	This signal is used for only Synchronous operation between Master and Slave unit.	
Connector	Rear panel SMA connector	
Input Signal Type	Complementary	
Display Monitor out		
Format	VGA	
Connector	15 pin, D-SUB, Rear panel	
Level	ECL	

⁴ The characteristics are specified at the end of the SMA cable (174-1427-00).

Table 1-9: Marker output Period Jitter

Clock frequency	2.7 GS/s		1.35 GS/s		675 MS/s	
	StdDev	Pk-Pk	StdDev	Pk-Pk	StdDev	Pk-Pk
Measurement						
Marker output	2.1 ps	15 ps	2.1 ps	15 ps	2.0 ps	14 ps

Note.Period Jitter is measured with Clock Pattern (01010101.....)

Table 1-10: Marker output Cycle to Cycle Jitter

Clock frequency	2.7 GS/s		1.35 GS/s		675 MS/s	
	StdDev	Pk-Pk	StdDev	Pk-Pk	StdDev	Pk-Pk
Measurement						
Marker output	3.6 ps	26 ps	3.6 ps	26 ps	3.3 ps	23 ps

Note.Cycle to Cycle Jitter is measured with Clock Pattern (01010101.....)

Table 1-11: VCO output Period Jitter

Clock frequency	2.7 GS/s		1.35 GS/s		675 MS/s	
	StdDev	Pk-Pk	StdDev	Pk-Pk	StdDev	Pk-Pk
Measurement						
VCO output	1.7 ps	12 ps	1.6 ps	11 ps	1.6 ps	11 ps

Table 1-12: VCO output Cycle to Cycle Jitter

Clock frequency	2.7 GS/s		1.35 GS/s		675 MS/s	
	StdDev	Pk-Pk	StdDev	Pk-Pk	StdDev	Pk-Pk
VCO output	3.0 ps	22 ps	2.8 ps	20 ps	2.7 ps	19 ps

Table 1-13: 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 to +10 V, into a 1 k Ω load -5 to +5 V, into a 50 Ω load	
Threshold		
Level	-5.0 V to 5.0 V	
Resolution	0.1 V	
Triggered mode	See Figure 1-1 on page 1-11	
Minimum pulse width	10 ns, 0.2 V amplitude ; Triggered mode	
Trigger hold off time	≤ 109.5 clocks + 500 ns ; Single operation ≤ 109.5 clocks + 700 ns ; Synchronous operation	
Delay to analog out, Typical	275.5clocks + 17 ns (Output: Norm, Filter: Through)	
Gated mode	See Figure 1-2 on page 1-12	
Minimum pulse width	1152 clocks + 10 ns, 0.2 V amplitude	
Gate hold off time	≤ 1920 clock + 20 ns (The time interval between the last gate off point and the next gaate on point)	
Delay to analog out, Typical	(1355 to 1563.5) clocks + 9 ns (Output: Norm, Filter: Through)	

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

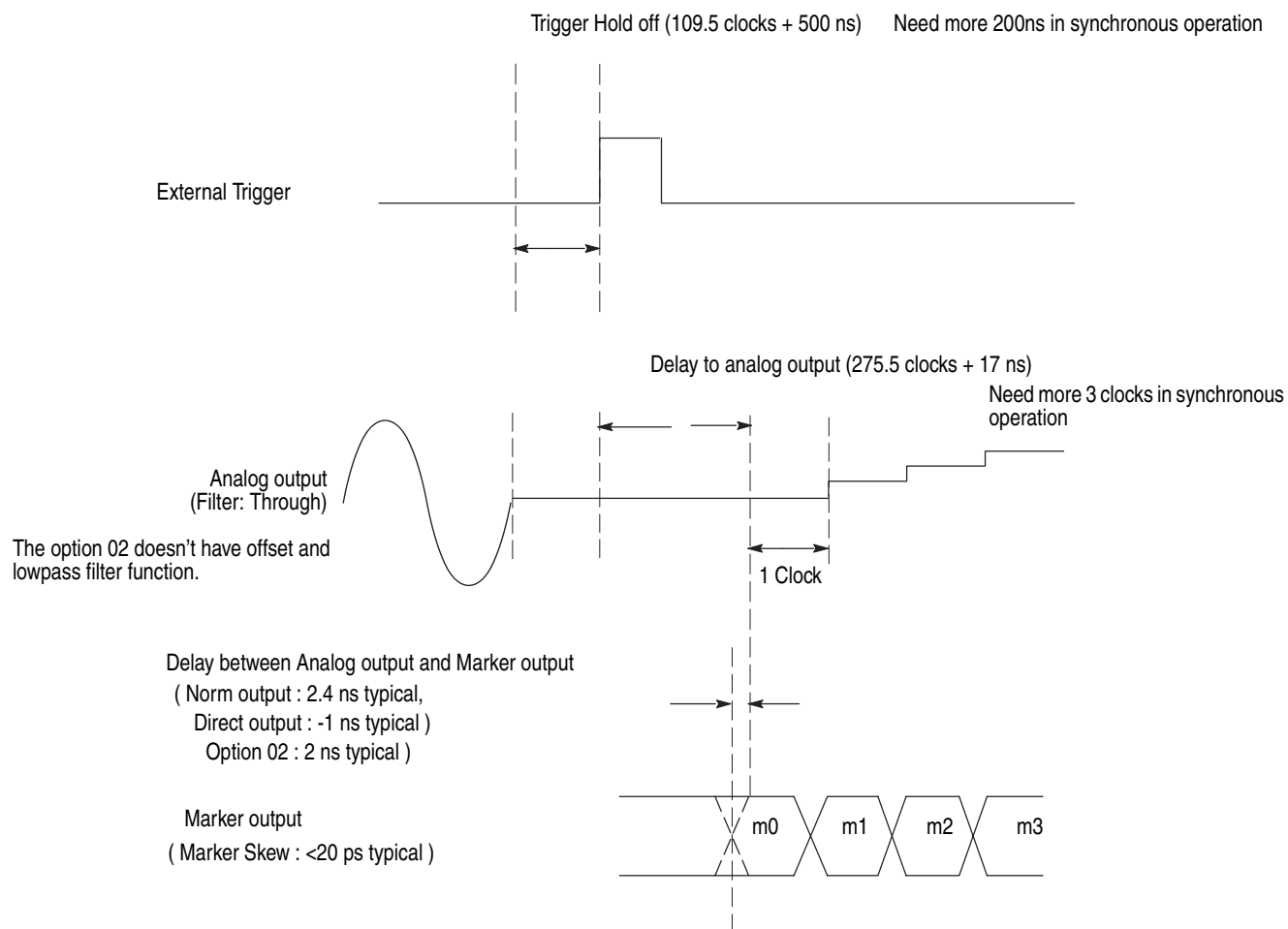
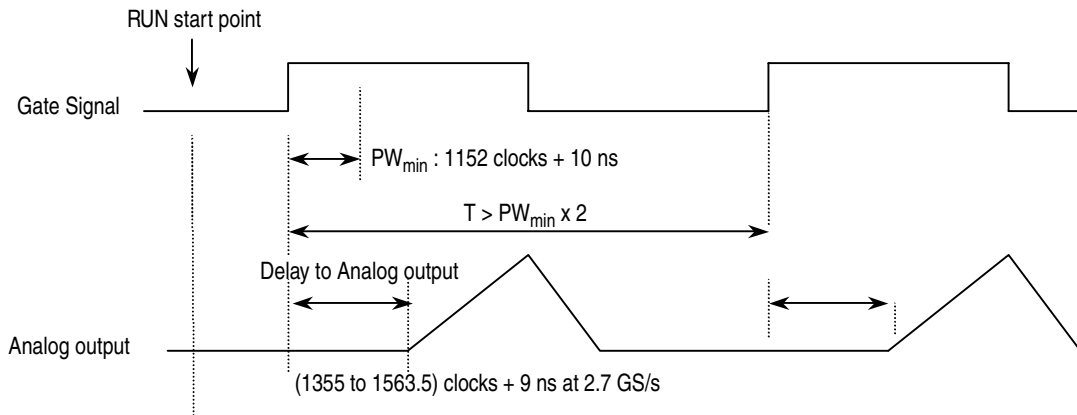


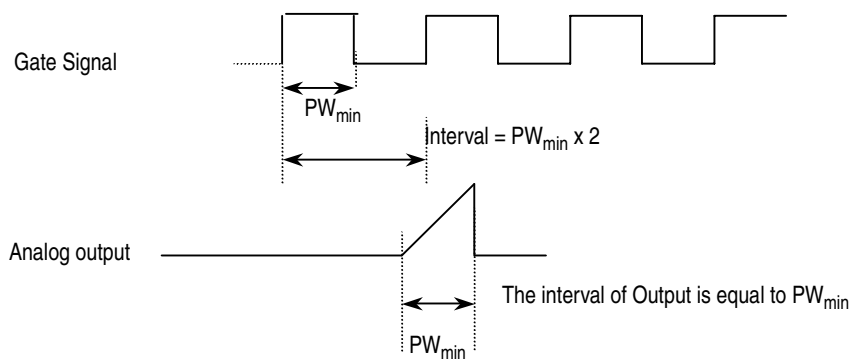
Figure 1-1: Signal Timing

1. After RUN starting, Gate signal is input

1-1. The interval of Gate signal is longer than PW_{min} (Minimum Pulse Width) x 2

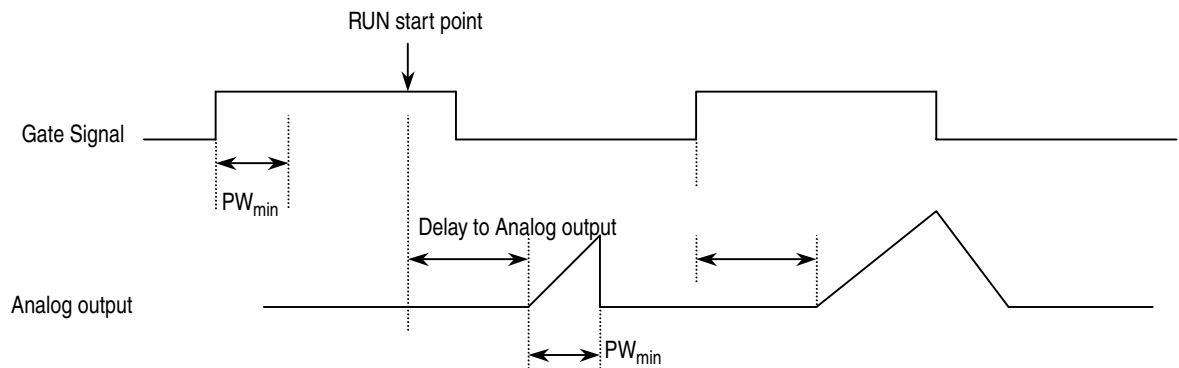


1-2. The interval of Gate signal is equal to PW_{min} (Minimum Pulse Width) x 2



2. Before RUN starting, Gate signal is input

2-1. The interval of Gate signal is longer than PW_{min} (Minimum Pulse Width) x 2



The only interval of 1st Output is equal to PW_{min} and the others are normal.

2-2. The interval of Gate signal is equal to PW_{min} (Minimum Pulse Width) x 2

As above 1-2, the interval of Analog Output is equal to PW_{min} .

Figure 1-2: Gated Mode

1. Sequence 1

Line No.	Waveform Name	Wait for Trigger	Jump to
n:	Waveform1	Off	m (Waveform3)
n+1:	Waveform2	Off	m+1 (Waveform4)
m:	Waveform3	Off	--
m+1:	Waveform4	Off	--

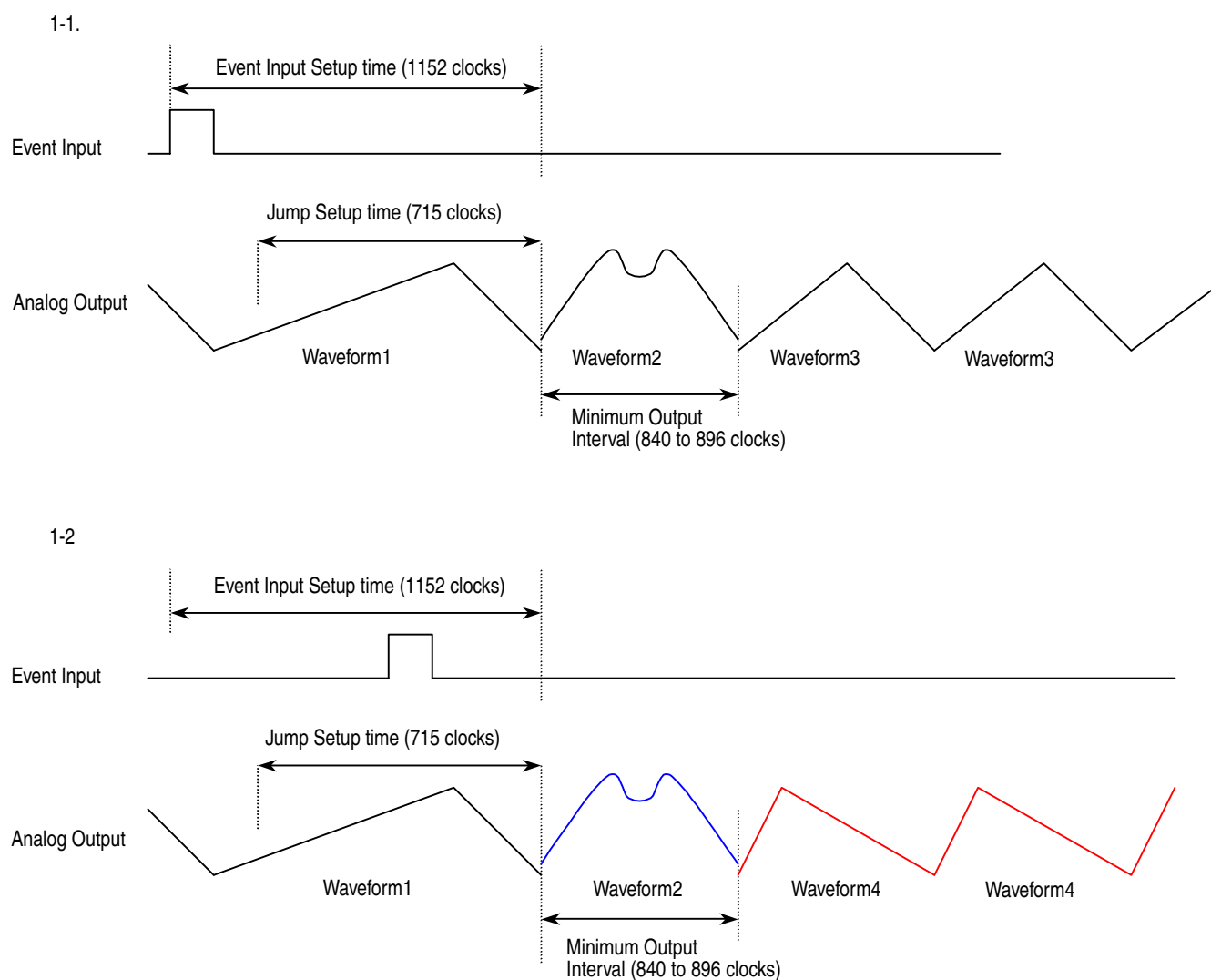


Figure 1-3: Enhanced mode

2. Sequence 2

Line No.	Waveform Name	Wait for Trigger	Jump to
n:	Waveform1	Off	m (Waveform3)
n+1:	Waveform2	Off	m+1 (Waveform4)
m:	Waveform3	On	--
m+1:	Waveform4	On	--

2-1.

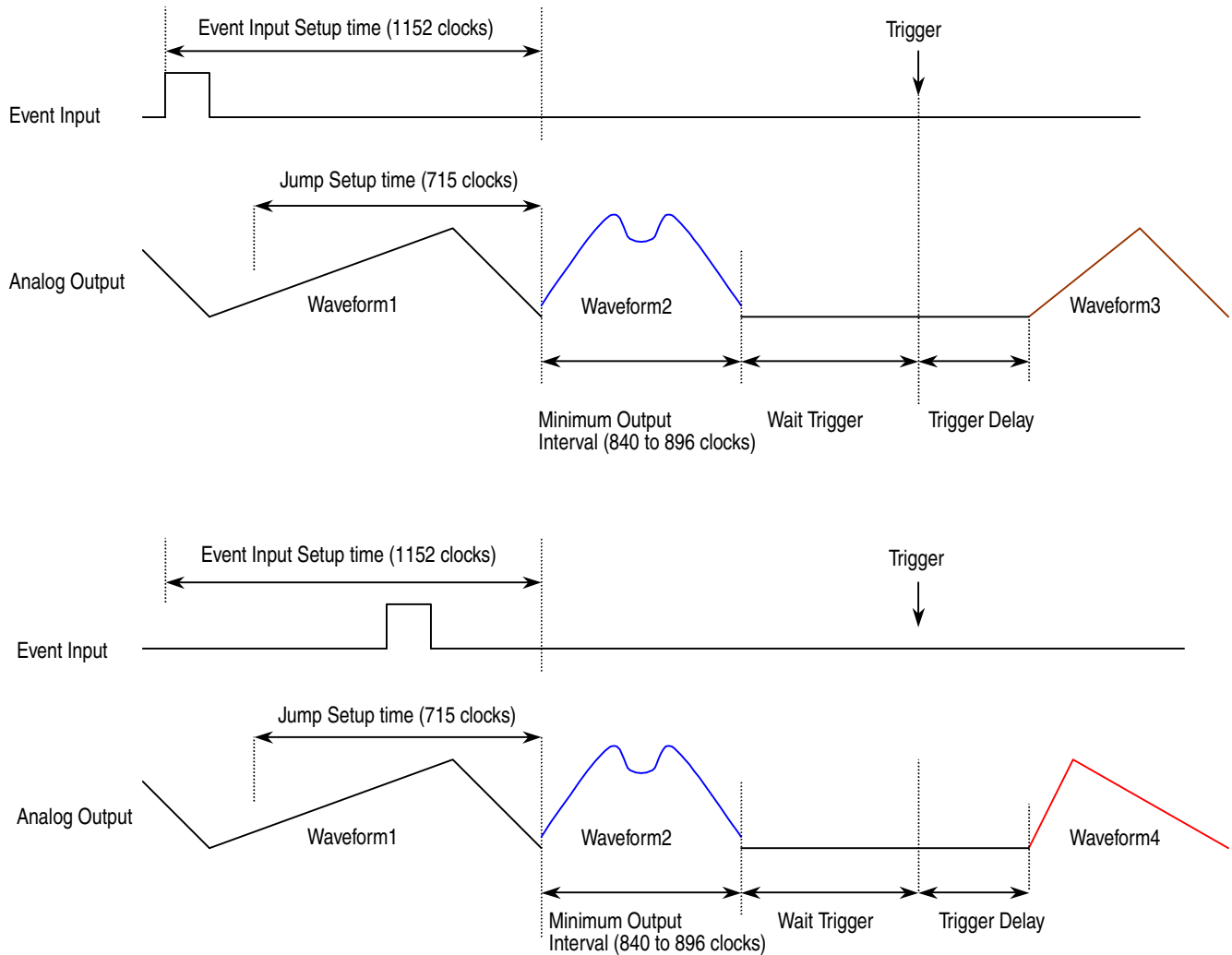


Figure 1-4: Sequence 2

3. Sequence 3

Line No.	Waveform Name	Wait for Trigger	Jump to
n:	Waveform1	Off	m (Waveform3)
n+1:	Waveform2	On	m+1 (Waveform4)
m:	Waveform3	Off	--
m+1:	Waveform4	Off	--

3-1.

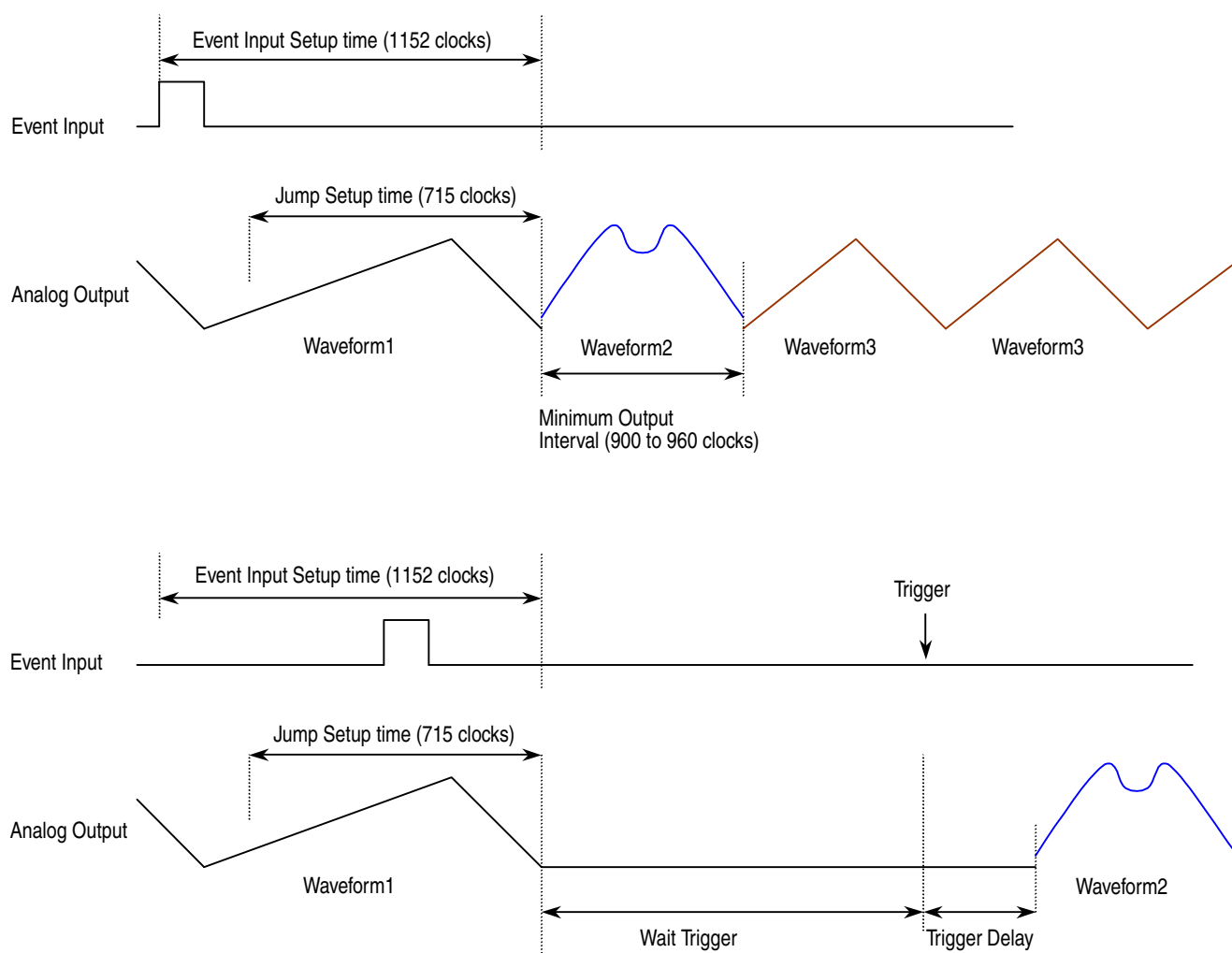


Figure 1-5: Sequence 3

4. Sequence 4

Line No.	Waveform Name	Wait for Trigger	Jump to
n:	Waveform1	Off	m (Waveform3)
n+1:	Waveform2	On	m+1 (Waveform4)
m:	Waveform3	On	--
m+1:	Waveform4	On	--

4-1.

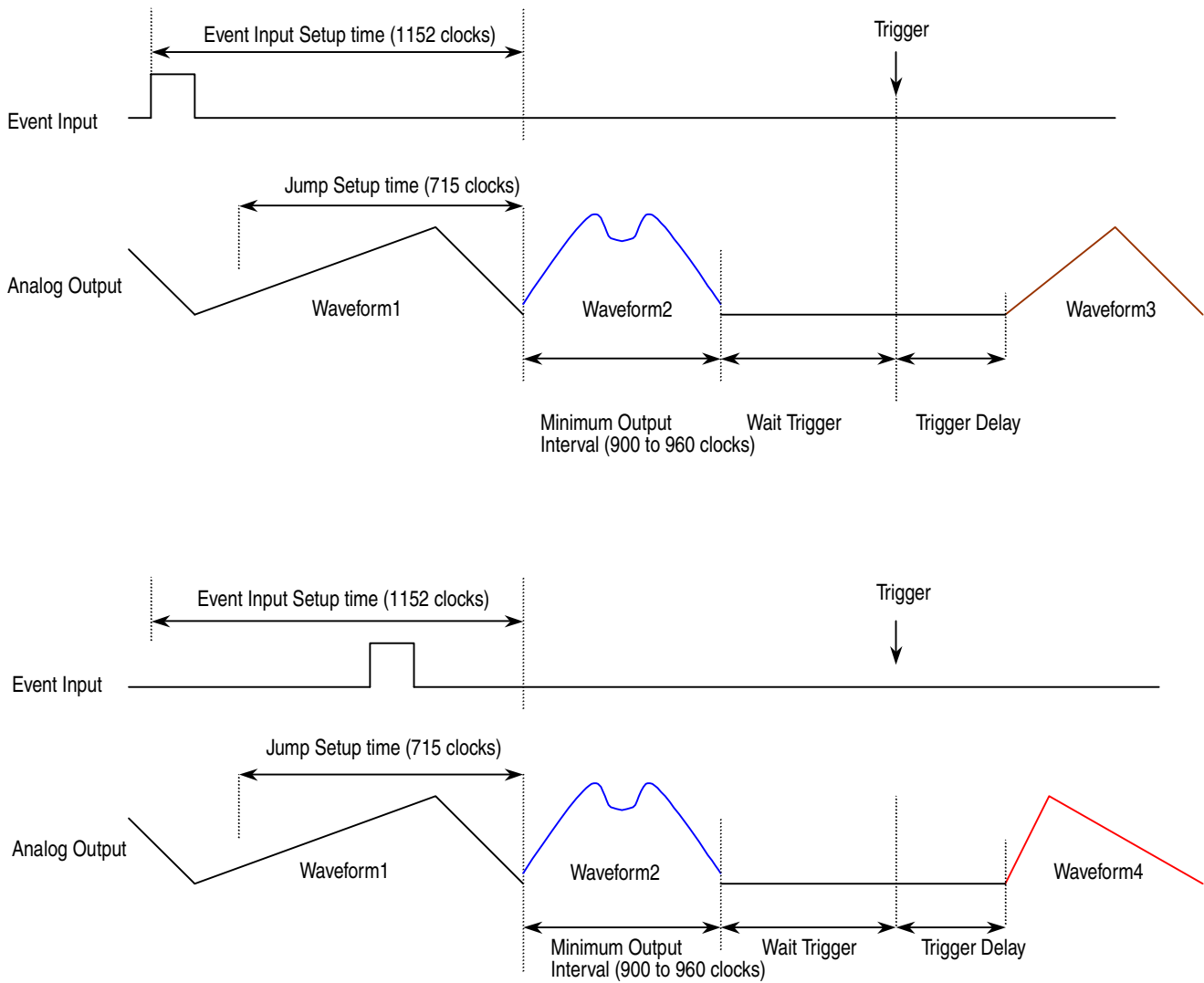


Figure 1-6: Sequence 4

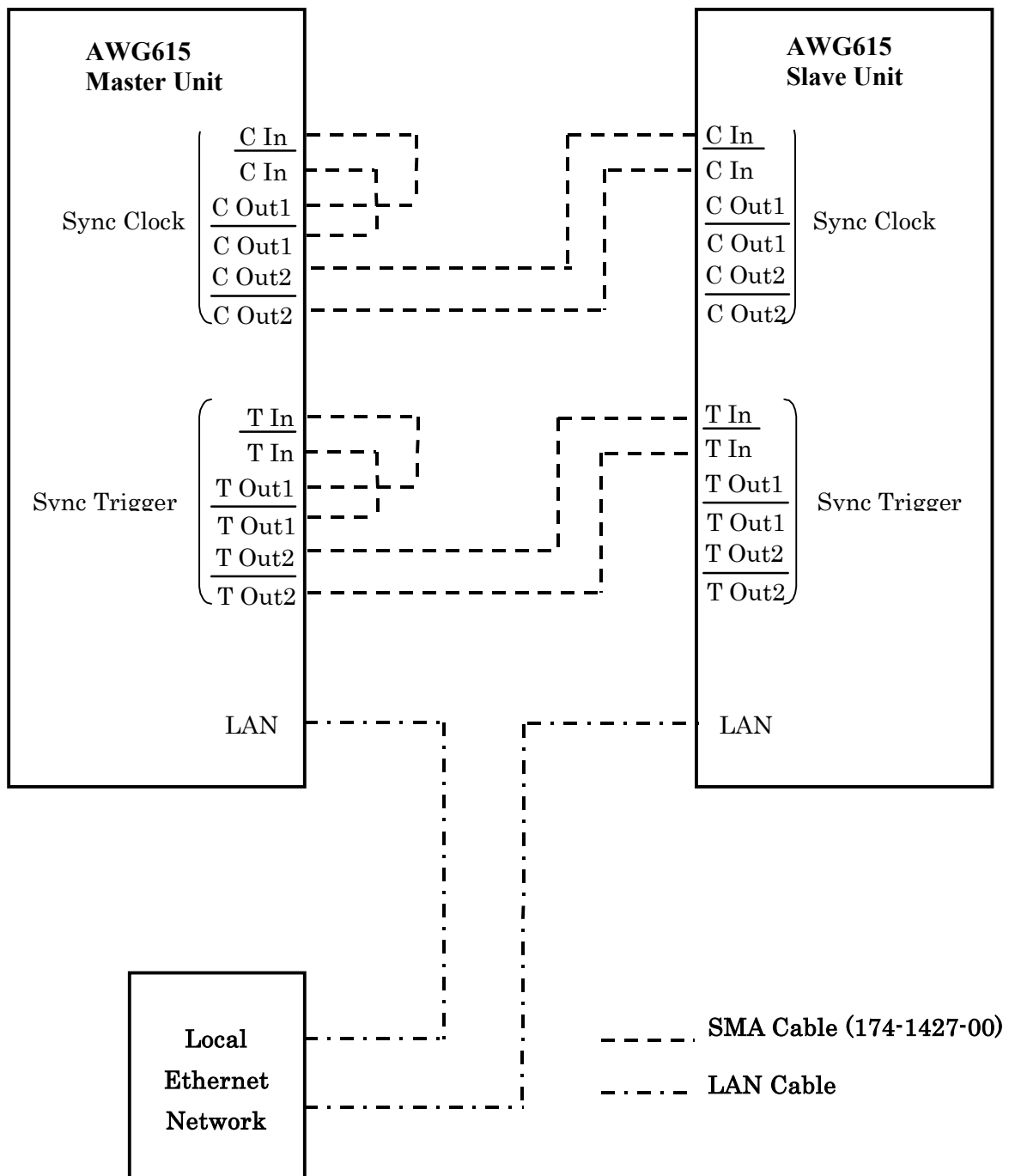


Figure 1-7: The cable connection between units in Synchronous operation

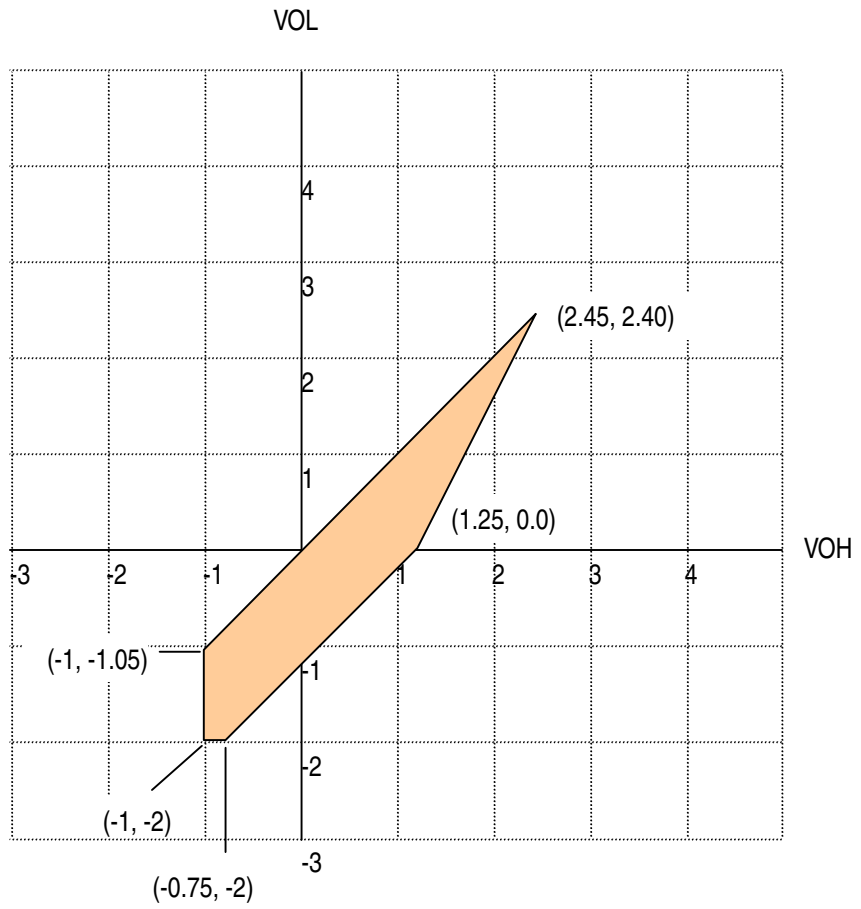
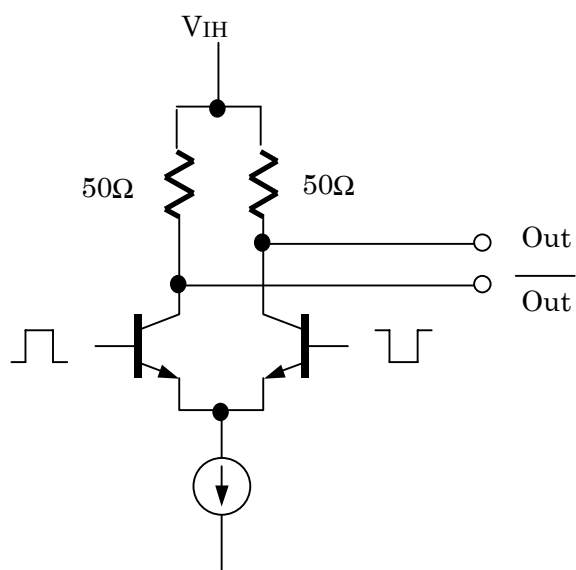


Figure 1-8: Output Voltage Window (into 50Ω to GND) of MARKER



Marker output

Figure 1-9: Output part equivalent circuit of MARKE

Table 1-14: Event Input

Characteristics	Description
Connector	9-pin, D type on the rear panel
Number of events	7 bits
Input signal	7 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 hold off time	(The time interval between the last event input point and the next acceptable event input point) \leq 896 clocks + 20 ns
Delay to analog out, Typical (Jump timing: ASYNC)	(Output: Norm, Filter: Through)
Strobe: On	1691.5 clocks + 10 ns
Strobe: Off	1947.5 clocks + 6 ns
Event input to strobe input	
Setup time	192 clocks + 10 ns
Hold time	192 clocks + 10 ns

Table 1-15: 10 MHz reference clock input

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

Table 1-16: External clock input

Characteristics	Description
Connector	Rear panel SMA connector
Impedance	50 Ω , AC coupling
Required input voltage range swing	0.4 V _{p-p} to 2 V _{p-p} into a 50 Ω load
Required duty cycle	50 \pm 5 %

Table 1-16: External clock input

Characteristics	Description
Frequency range	125 MHz to 2.7 GHz Note: Slew rate should be more than 10 mV/ns.

Table 1-17: C input

Characteristics	Description
Connector	This signal is used for only Synchronous operation between Master and Slave unit. Rear panel SMA connector
Input signal type	Complementary

Table 1-18: T input

Characteristics	Description
Connector	This signal is used for only Synchronous operation between Master and Slave unit. Rear panel SMA connect
Input signal type	Complementary

Table 1-19: Function Generator (FG)

Characteristics	Description																		
Operation Mode	Continuous mode only																		
Waveform Shape	Sine, Triangle, Square, Ramp, Pulse, DC																		
Frequency	1.000 Hz to 270.0 MHz																		
Amplitude																			
Range	0.020 V _{p-p} to 2.000 V _{p-p} , into a 50 Ω load (OPTION02 : 0.5 V _{p-p} to 1.0 V _{p-p} , 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 270.0 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 270.0 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 270.0 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	1.0 V min into a 50 Ω load																		
Lo	0 V max into a 50 Ω load																		

Table 1-20: Display

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

Table 1-21: 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 consumption	240 VA
Maximum current	5 A
Fuse rating	10 A fast, 250 V, UL 198G (3 AG) 5 A (T), 250 V, IEC 127

Table 1-22: Timer

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

Table 1-23: 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 1-24: Installation requirement

Characteristics	Description
Heat dissipation	
Maximum power	220 W max. (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 30s
Cooling clearance	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 1-25: Maintenance requirement

Characteristics	Description
Calibration	The instrument should be fully calibrated at least every 12 months.

Table 1-26: Environmental

Characteristics	Description
Atmospherics	
Temperature	
Operating	+10 °C to +40 °C
Non-operating	-20 °C to +60 °C
Relative humidity	
Operating	20 % to 80 % (no condensation) Maximum wet-bulb temperature 29.4 °C
Non-operating	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)
Non-operating	Up to 12 km (40 000 ft)

Table 1-26: Environmental

Dynamics	
Random vibration	
Operating	2.646 m/s ² rms (0.27Grms), from 5 Hz to 500 Hz, 10 minutes
Non-operating	22.344 m/s ² rms (2.28Grms), from 5 Hz to 500 Hz, 10 minutes
Shock	
Non-operating	294 m/s ² (30 G), half-sine, 11 ms duration

Table 1-27: 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 422 mm (16.61 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)

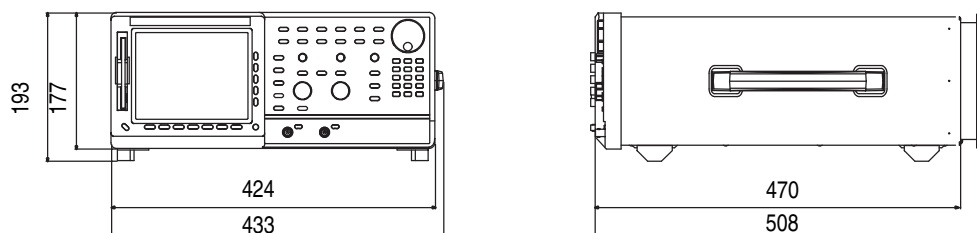


Figure 1-10: Dimensions

Certification and Compliances

The certification and compliances for the AWG615 Arbitrary Waveform Generator are listed in Table 1-28.

Table 1-28: 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 55011 Class A</td> <td>Radiated and Conducted emissions</td> </tr> <tr> <td>EN 61000 - 3 - 2</td> <td>Power Line Harmonic</td> </tr> <tr> <td>EN 61000 - 3 - 3</td> <td>Line voltage alteration and flicker</td> </tr> </table> <p>Immunity:</p> <table> <tr> <td>EN50082 -1</td> <td></td> </tr> <tr> <td>EN 61000 - 4 - 2</td> <td>Electrostatic Discharge Immunity</td> </tr> <tr> <td>EN 61000 - 4 - 3</td> <td>Radiated RF Electromagnetic Field Immunity</td> </tr> <tr> <td>EN 61000 - 4 - 5</td> <td>Surge Immunity</td> </tr> <tr> <td>EN 61000 - 4 - 6</td> <td>Conducted Disturbances Induced by RF Field Immunity</td> </tr> <tr> <td>EN 61000 - 4 - 4⁶</td> <td>Electrical Fast Transient/Burst Immunity</td> </tr> <tr> <td>EN 61000 - 4 - 8</td> <td>Power Frequency Electromagnetic</td> </tr> <tr> <td>EN 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</td> <td>Safety requirements for electrical equipment for measurement, control, and laboratory use</td> </tr> </table>	EN 55011 Class A	Radiated and Conducted emissions	EN 61000 - 3 - 2	Power Line Harmonic	EN 61000 - 3 - 3	Line voltage alteration and flicker	EN50082 -1		EN 61000 - 4 - 2	Electrostatic Discharge Immunity	EN 61000 - 4 - 3	Radiated RF Electromagnetic Field Immunity	EN 61000 - 4 - 5	Surge Immunity	EN 61000 - 4 - 6	Conducted Disturbances Induced by RF Field Immunity	EN 61000 - 4 - 4 ⁶	Electrical Fast Transient/Burst Immunity	EN 61000 - 4 - 8	Power Frequency Electromagnetic	EN 61000 - 4 - 11	Power Line Interruption Immunity	EN 61010 -1	Safety requirements for electrical equipment for measurement, control, and laboratory use
EN 55011 Class A	Radiated and Conducted emissions																								
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EN 61000 - 4 - 8	Power Frequency Electromagnetic																								
EN 61000 - 4 - 11	Power Line Interruption Immunity																								
EN 61010 -1	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> <p>AS/NZS 2064.1/2</p> <p>Class A radiated and Conducted Emissions</p>																								
Safety	<p>UL3111-1 - Standard for electrical measuring and test equipment</p>																								
Third party certification	<p>CAN/CSA C22.2 No. 1010.1 - Safety requirements for electrical equipment for measurement, control and laboratory use</p>																								
Self declaration	<p>IEC 61010 -1:2001 - Safety requirements for electrical equipment for measurement, control, and laboratory use</p>																								
Installation category	<p>Power input — Installation Category II (as defined in IEC 61010-1, Annex J)</p>																								

Table 1-28: Certifications and compliances

Characteristics	Description
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 1-29: 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 IIIe	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 could 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 clean rooms.
	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.



Operating Information

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 AWG615 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 AWG615 Arbitrary Waveform Generator has a suitable two-pole, three-terminal grounding-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 AWG615 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 AWG615 Arbitrary Waveform Generator are still connected to line voltage after toggling the instrument to Standby from the front panel **ON/STBY** button.

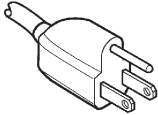
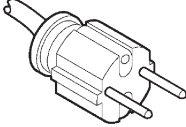
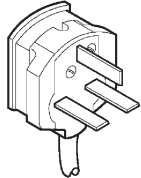
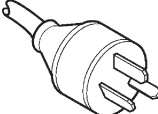
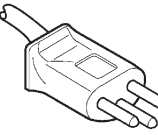
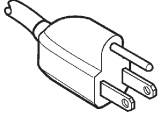
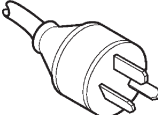
Power Cord Information

A power cord with the appropriate plug configuration is supplied with each AWG615 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	A0
	Europe 230 V	A1
	United Kingdom 230 V	A2
	Australia 230 V	A3
	Switzerland 230 V	A5
	Japan 100 V	A6
	China 230 V	A10
	No power cord supplied.	A99

Operating Voltage The AWG615 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 AWG615 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 AWG615 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 AWG615 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 AWG615 Arbitrary Waveform Generator displays the message “Power fail or out of temperature limit” before shutting down.

If the AWG615 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 AWG615 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, 1-24 and 2-3.

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 AWG615 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 AWG615 Arbitrary Waveform Generator do not restrict air flow through the chassis.

If the AWG615 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 AWG615 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	240 VA

Connect Power Cord

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

NOTE. The AWG615 Arbitrary Waveform Generator is shipped with a 115 V power cord. If the AWG615 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**.

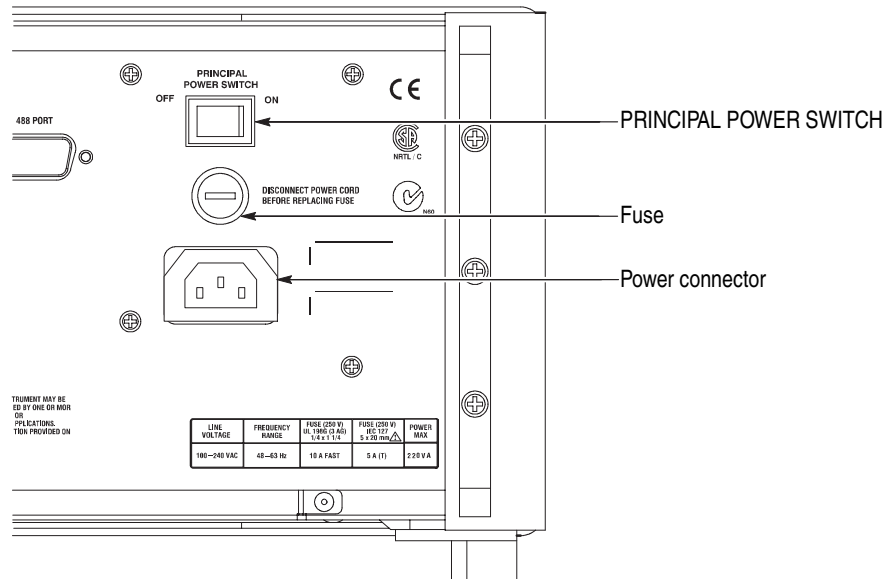


Figure 2-1: Rear panel power switch, fuse holder, and power connector

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.

It will take 1 - several minutes to start up after pushing the ON/STBY switch. The starting time depends on the data length of the waveform file loaded when power Off was executed last time.

In addition, AWG cannot start up when floppy disk other than a system disk is inserted in the floppy disk drive. Please power on after ejecting a disk.

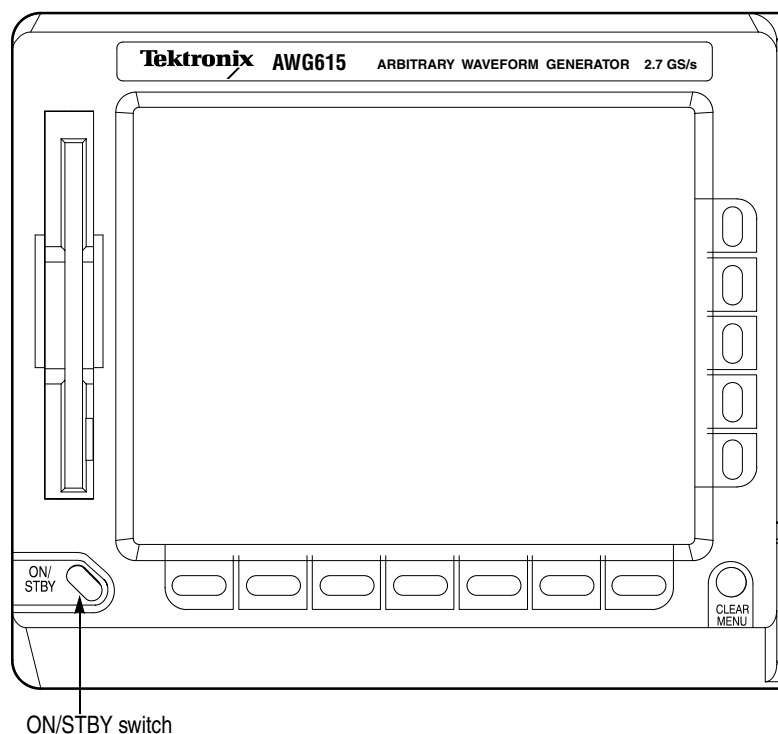


Figure 2-2: Location of the ON/STBY switch

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 AWG615 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 AWG615 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 AWG615 Arbitrary Waveform Generator displays a *Pass* status message and a prompt to press any key to continue. If this fails, the AWG615 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 AWG615 Arbitrary Waveform Generator can result in calibration data corruptions on the hard disk.

Operating Basics

This section provides the following information:

- The *Controls and Connectors* subsection describes the instrument buttons, controls, connectors, and typical screen displays.
- The *Menu Operations* subsection describes how to operate menus and enter numeric and text values.
- The *File Management* subsection describes the overview of the instrument commands and operations for file management tasks.
- The *Editor Overview* subsection introduces the waveform editor functions and operations.
- The *Setup Overview* subsection describes the SETUP screen, and simple operations.
- The *Theory of Operation* subsection describes the electrical operation of the AWG615 Arbitrary Waveform Generator

Controls and Connectors

Front Panel Figures 2-1, 2-2, and 2-3 show the locations of the front-panel controls and connectors.



CAUTION. *To prevent data corruption, do not push the eject button while the LED is on. Doing so can cause data corruption on the floppy disk and cause the instrument to hang up. If this happens, turn power off then back on again.*

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

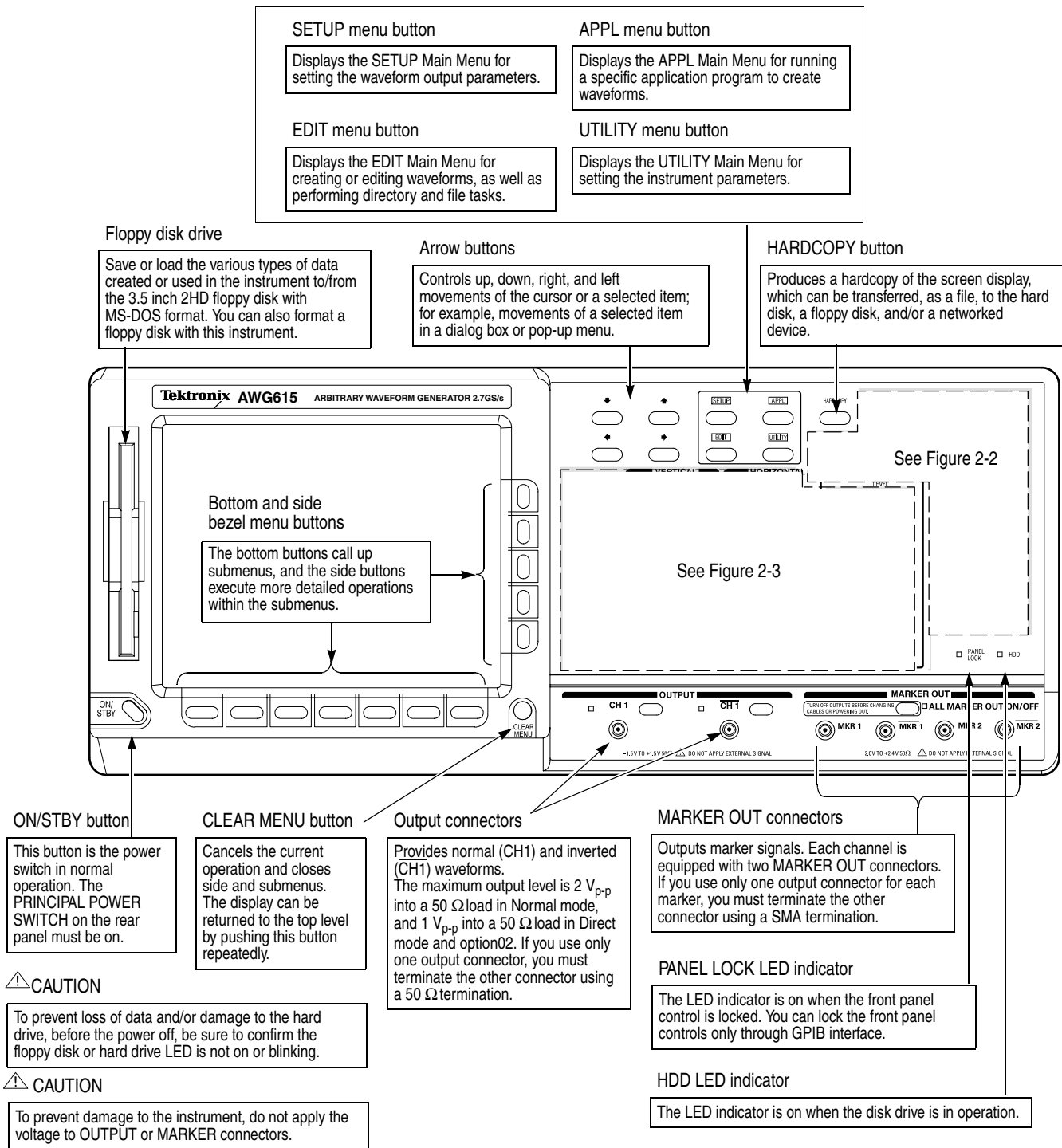


Figure 2-1: Front panel controls

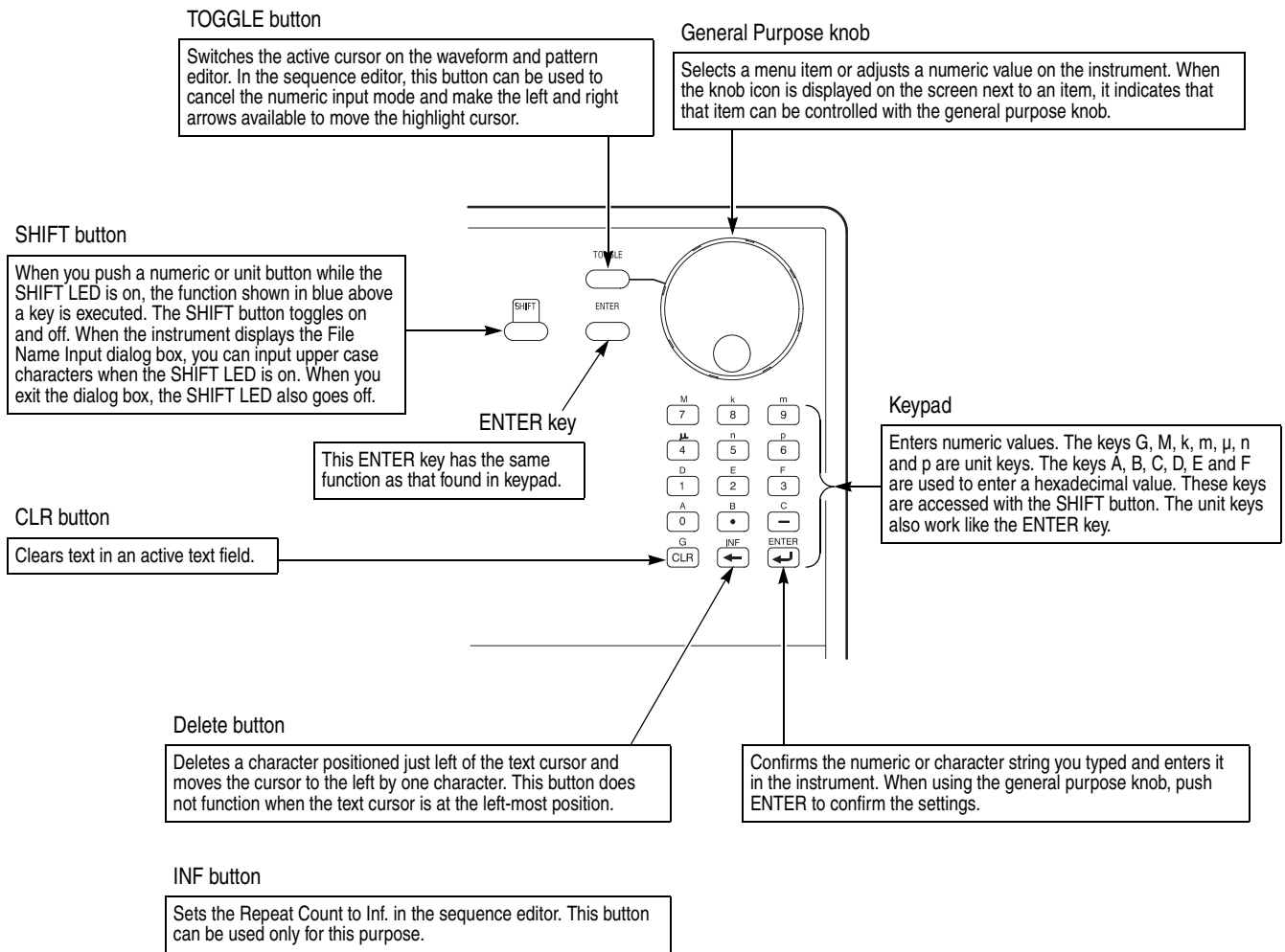


Figure 2-2: Front panel keypad area

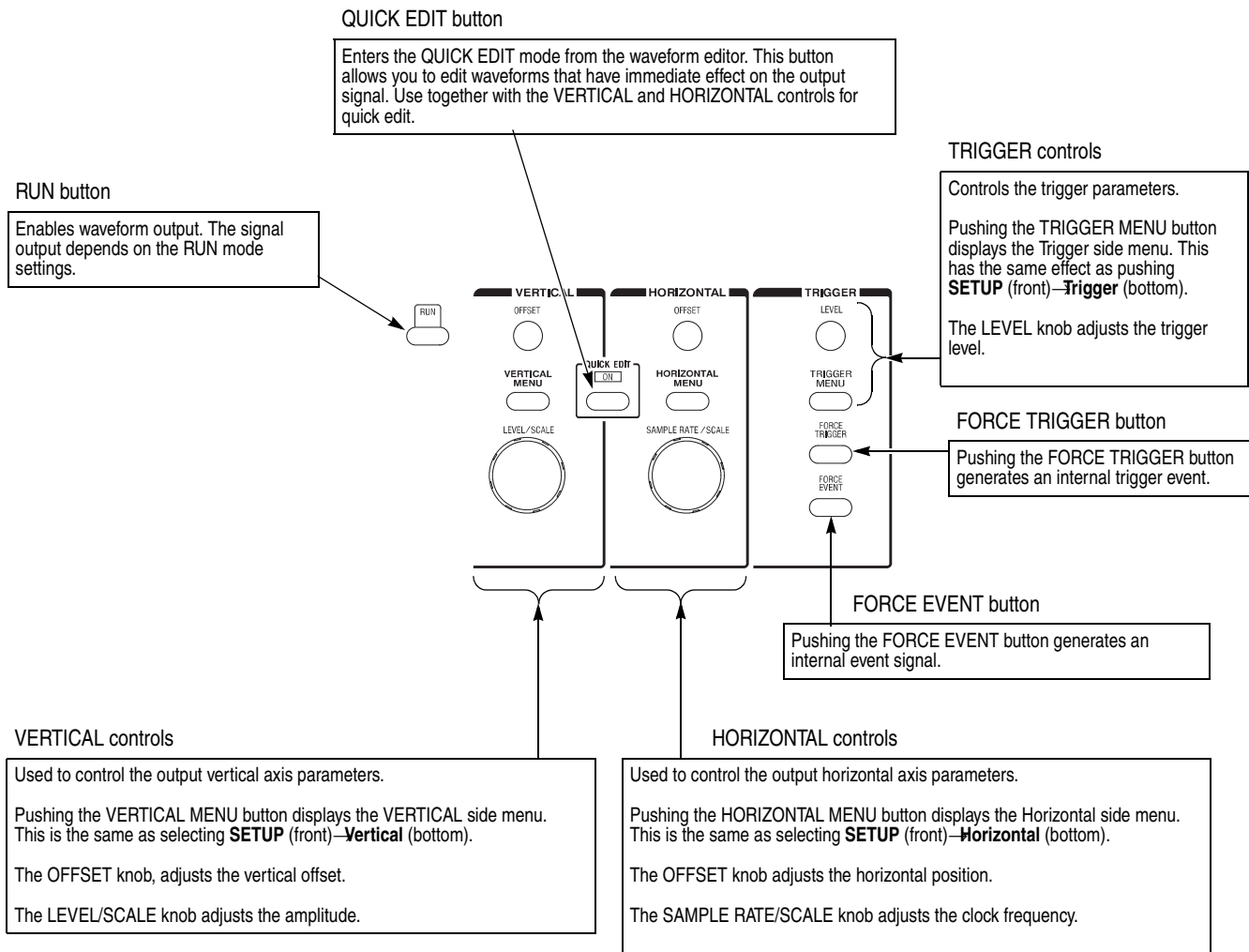


Figure 2-3: Front panel trigger and output controls

Rear Panel Figure 2-4 show the rear panel signal and power connectors.



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

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

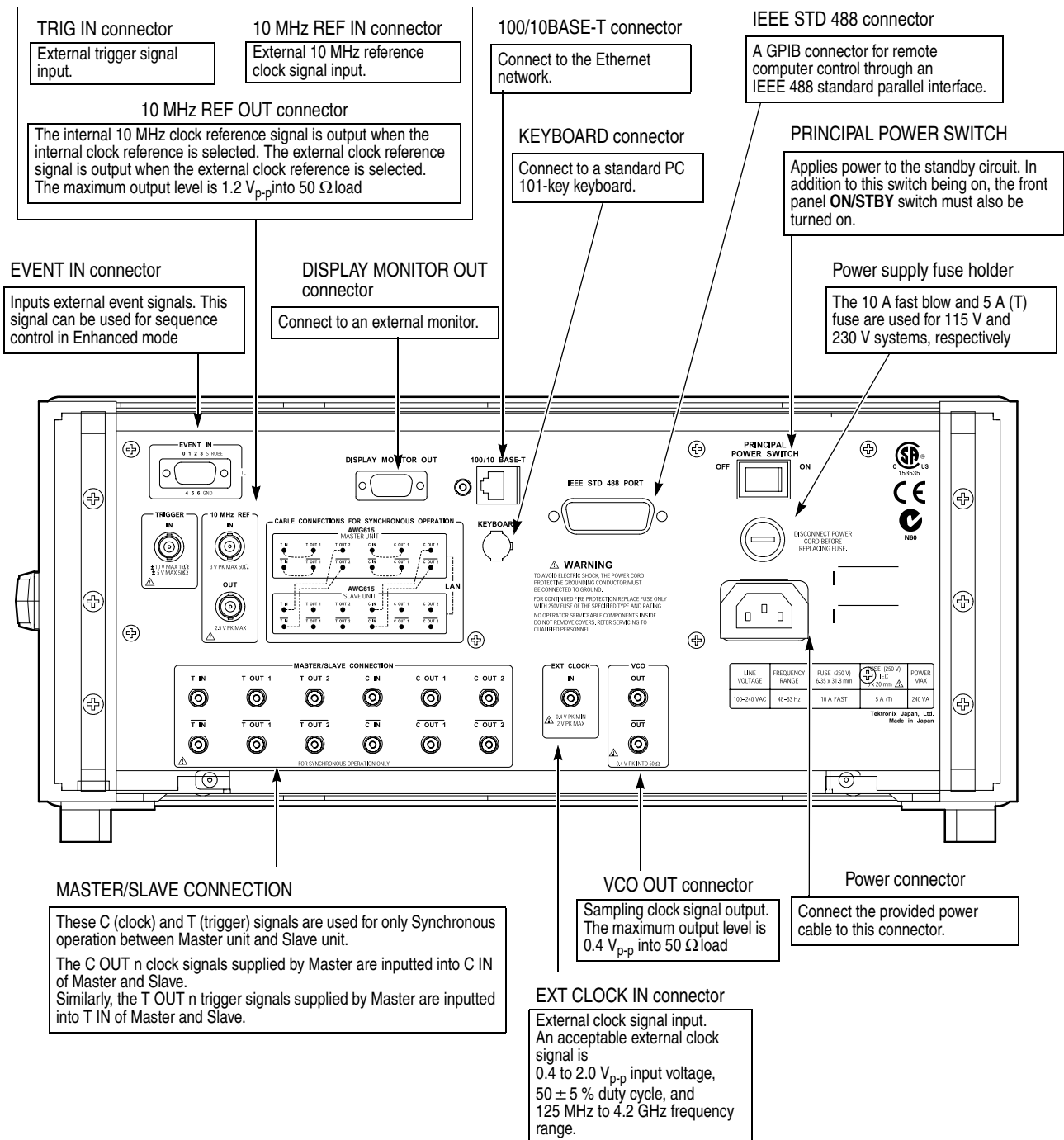


Figure 2-4: Rear panel signal and power connectors

Menu Operations

This section describes the AWG615 Arbitrary Waveform Generator menu system and numeric and text input methods.

Menu System

The AWG615 Arbitrary Waveform Generator uses menus to make selections. There are four menu buttons, labeled EDIT, SETUP, APPL, and UTILITY, as shown in Figure 2-5. 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 to the menu item. These buttons consist of seven bottom buttons and five side buttons, as shown in Figure 2-5. 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 exits to the previous instrument state.

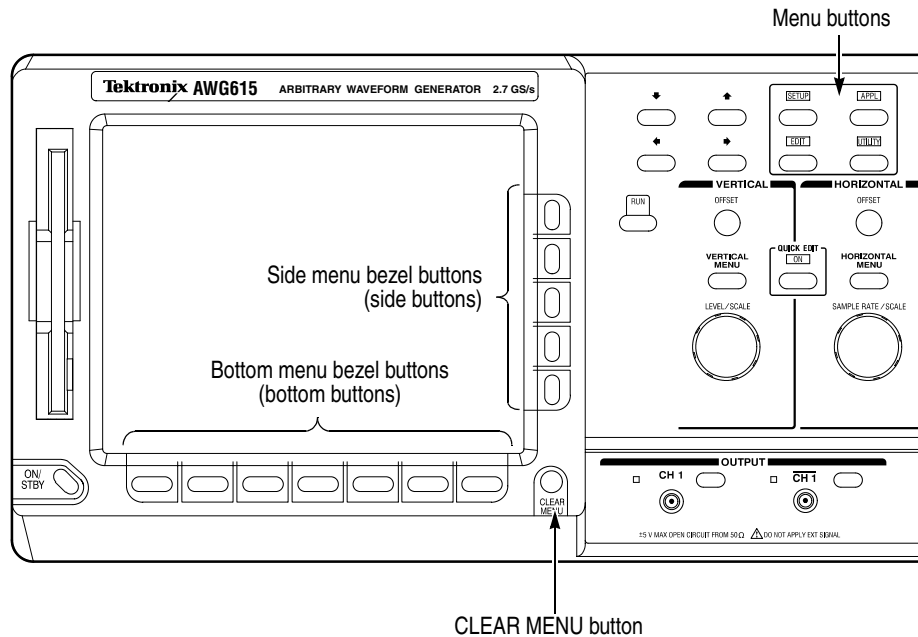


Figure 2-5: Menu buttons, bezel menu buttons, and the CLEAR MENU button

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. Figures 2-6 through 2-8 show examples of the side menu, pop-up menu and dialog box, respectively.

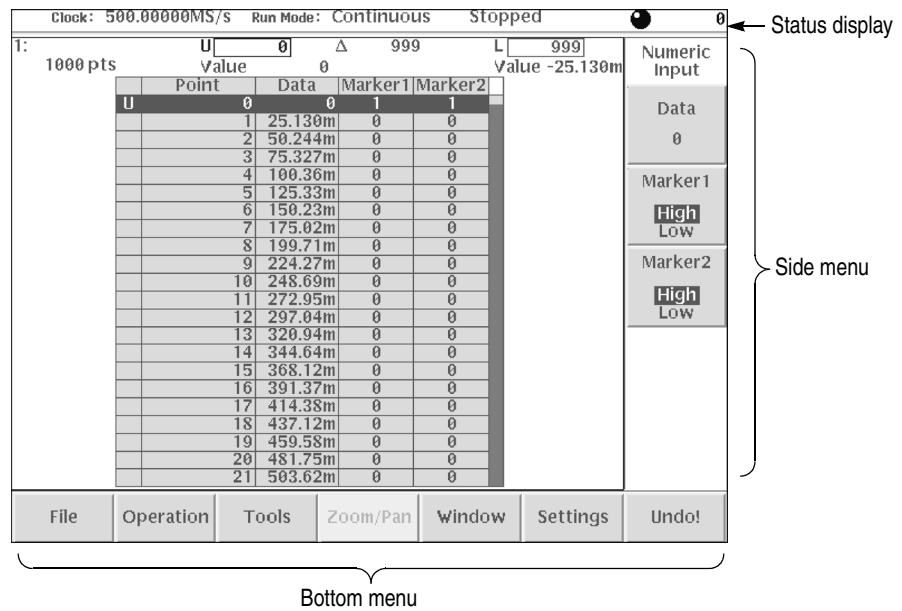


Figure 2-6: Bottom and side menus

You use a side menu button to display a side submenu, set a parameter, perform a task, or cancel an operation. Table 2-1 describes the side menu button types.

Table 2-1: 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.	Marker...	Displays submenus. Note that the label on the item is followed by an ellipsis (...).

The pop-up menu example, shown in Figure 2-7, displays a list of choices from which you make a selection. 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.

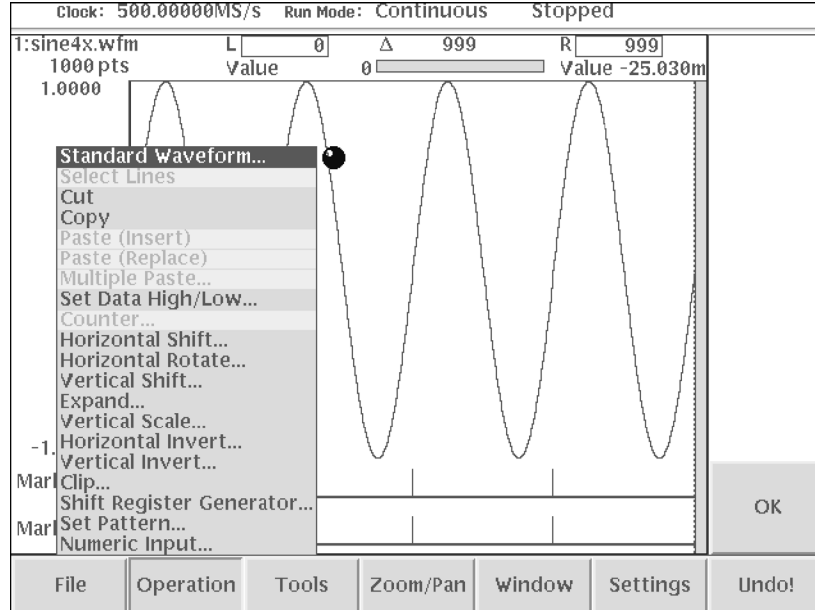


Figure 2-7: Pop-up menu example

The dialog box example, shown in Figure 2-8, displays a form in which you make selections or enter values. Use the front-panel arrow buttons to select items or fields. A selected field or item is highlighted. Use the keypad buttons or the general purpose knob to change values in selected text/numeric fields or change 1-of-N fields. A 1-of-N field contains two or more choices of which only one 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.

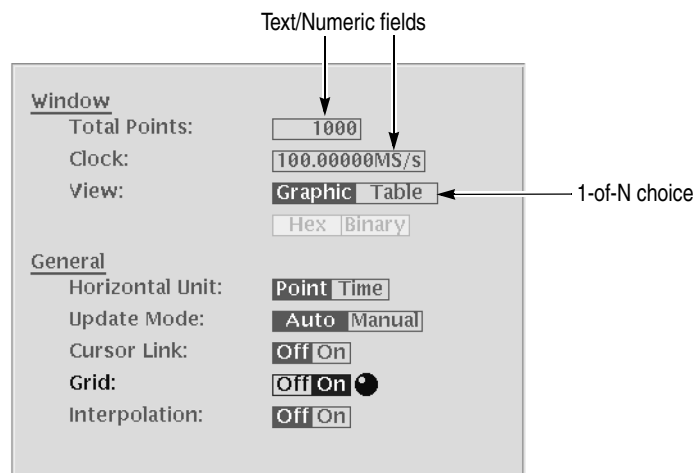


Figure 2-8: Dialog box example

Refer to *Numeric Input* on page 2-20 and *Text Input* on page 2-22 for more information on selecting and entering values in menus and dialog boxes.

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 alter this value using the general purpose knob or numeric buttons.

Pushing the type of side menu button or selecting a parameter in a pop-up menu causes the current setting to appear on the right end of the Status Display area as shown in Figure 2-9.

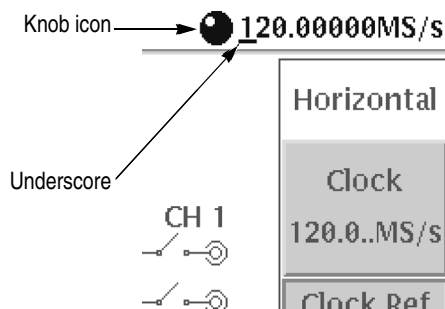


Figure 2-9: Knob icon displayed in Status Display area

The 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 under 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 has the knob icon, but does not have the underscore, then turning the general purpose knob cycles through a predefined set of values.

When using the general purpose knob, values 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.

The Numeric Keypad

Figure 2-10 shows the numeric keypad, with descriptions of the button operations.

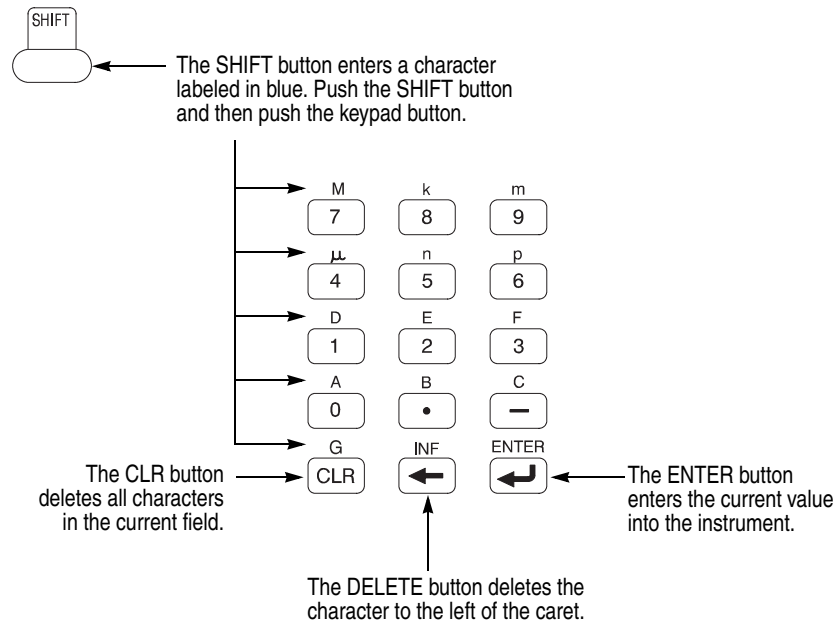


Figure 2-10: Keypad buttons

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 to 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.

To enter or change more than one character, move the caret to the next position to change. When you are done entering values, push the **ENTER** button to confirm the changes and enter them into the instrument. For example, to enter 200.5 μs, push **2, 0, 0, ., 5, SHIFT** and **4 (μ)** buttons in this order.

When you enter a value larger than the maximum value in the range for the parameter, 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 range that can be set.

Note that the current unit is always kept when you just use the **ENTER** after entering digits. For example, suppose that the Clock is currently set to 100.0 MS/s. When you press the **5, 0** and **ENTER** buttons 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 **ENTER** buttons, or **5, 0, 0, SHIFT**, and **8 (k)** buttons in this order.

Text Input

When you need to assign a name to a waveform file or equation, or a IP address to the instrument, the instrument displays a text dialog box. See Figure 2-11. The text field is where you enter or change an existing character string. The character palette is where you select alphanumeric characters to insert into the text field. You can also select equation or file names from the name list to insert into the text field.

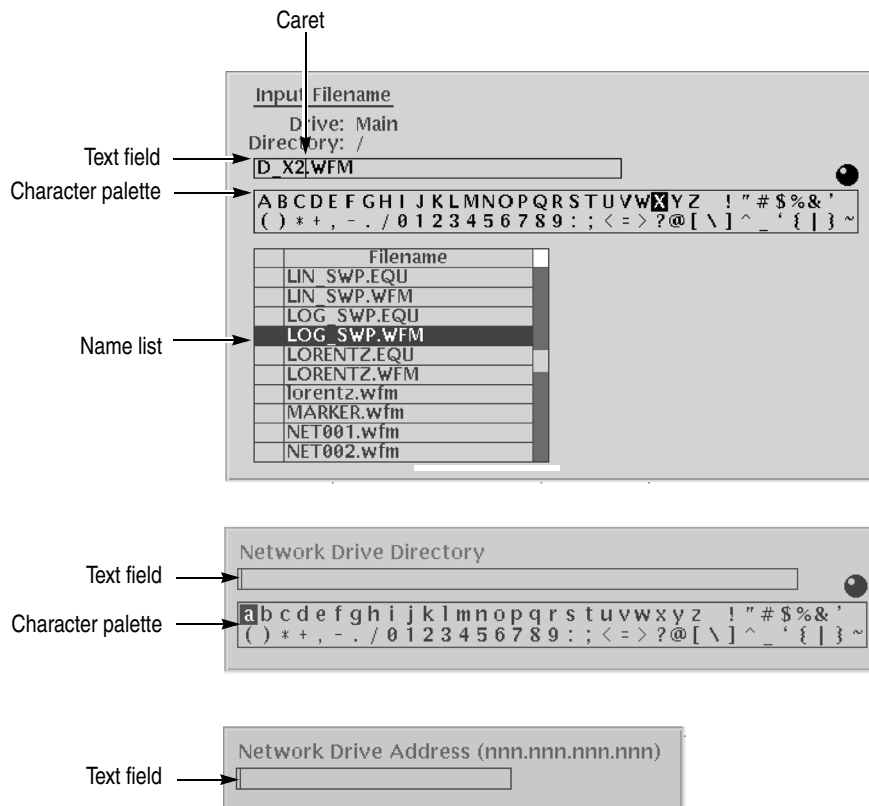


Figure 2-11: Three type of Input text dialog boxes

To select a character from the character palette, use the general purpose knob to highlight a character, and then push the **ENTER** to insert the character into the text field. 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 2-2 describes all the controls you can use for entering and editing text.

Table 2-2: 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.
ENTER button	Inserts the selected character or character string into the text field.
← button	Deletes one character to the left of the caret.
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 also goes off.

Shortcut Controls

Figure 2-12 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 2-3 describes the shortcut controls.

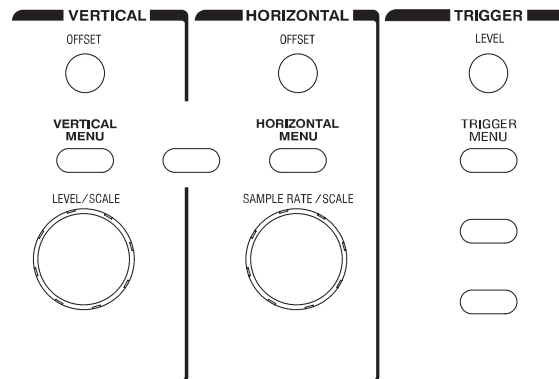


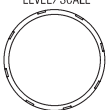






Figure 2-12: Shortcut controls

Table 2-3: Shortcut controls

Controls	Description
<p>VERTICAL</p> 	<p>Displays the Vertical side menu. This is the same operation as selecting SETUP (front)→Vertical (bottom).</p>
	<p>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)</p>
	<p>Adjusts the amplitude parameters. This is the same as selecting SETUP (front)→Vertical (bottom)→Amplitude (side), and then turning the general purpose knob.</p>
<p>HORIZONTAL</p> 	<p>Displays the Horizontal side menu. This is the same as selecting SETUP (front)→Horizontal (bottom).</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>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 is an overview of the instrument commands and operations for doing file management tasks.

File Type Extensions

The AWG615 Arbitrary Waveform Generator uses numerous file formats to hold different types of data. These file types are listed in Table 2-4. Note that the instrument checks the file format and processes the file based on its content, regardless of the file extension.

Table 2-4: AWG615 Arbitrary Waveform Generator file types

Files	Description
Waveform file	Use .wfm or .WFM suffix for identification. 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 by converting to waveform format when importing waveforms from external equipment.
Pattern file	Use .pat or .PAT suffix for identification. Contains pattern data. Created with the pattern editor.
Sequence file	Use .seq or .SEQ suffix for identification. Contains waveform sequence and trigger data. Created with the sequence editor.
Equation file	Use .equ or .EQU suffix for identification. Contains equations or functions that describe a waveform. Created with the equation/text editor. Both text editor and equation editor assign .txt suffix by default, but use .equ suffix to avoid confusion with normal text file.
Text file	Use .txt or .TXT suffix for identification. Contains ASCII text. Created with the equation/text editor.
Setup file	Use .set or .SET suffix for identification. Contains instrument setup and configuration data of both AWG and FG mode. Created from the SETUP menu.

Locating Files

There are three locations for storing waveform data on the AWG615 Arbitrary Waveform Generator. Data can be stored on the instrument hard disk drive, the instrument 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 EDIT menu main screen **Drive** and **Directory** bottom menu buttons to open side menus that let you change the current drive location. Table 2-5 describes the Drive and Directory bottom buttons.

Table 2-5: Drive and Directory menus

Bottom menu	Side menu	Description	
Drive	Main	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.	
	Floppy		
	Net1		
	Net2		
Directory	Net3	Moves up a directory level.	
	Up Level		
	Down 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.
	Make 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.
	Archive		Creates a new file (.tar format) for archive from selected directory. The archived file keeps hierarchic structure.
	Extract	Restore the archived file (.tar) to the current directory.	

NOTE. In the following procedures, you may have to push the **EDIT** button twice to quit the editor. When the instrument does not display the file list, push the **EDIT** button again. Refer to Saving Files on page 2-29.

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 2-32.

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 Renaming files is similar to Copying files, but the original files are deleted. 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 Do the following steps to delete a file:

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 You can change the read only or read/write attributes on a file. Do the following steps to change the file attribute:

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.

The file with a read only attribute is marked by  , and the directory by  . See Figure 2-13.

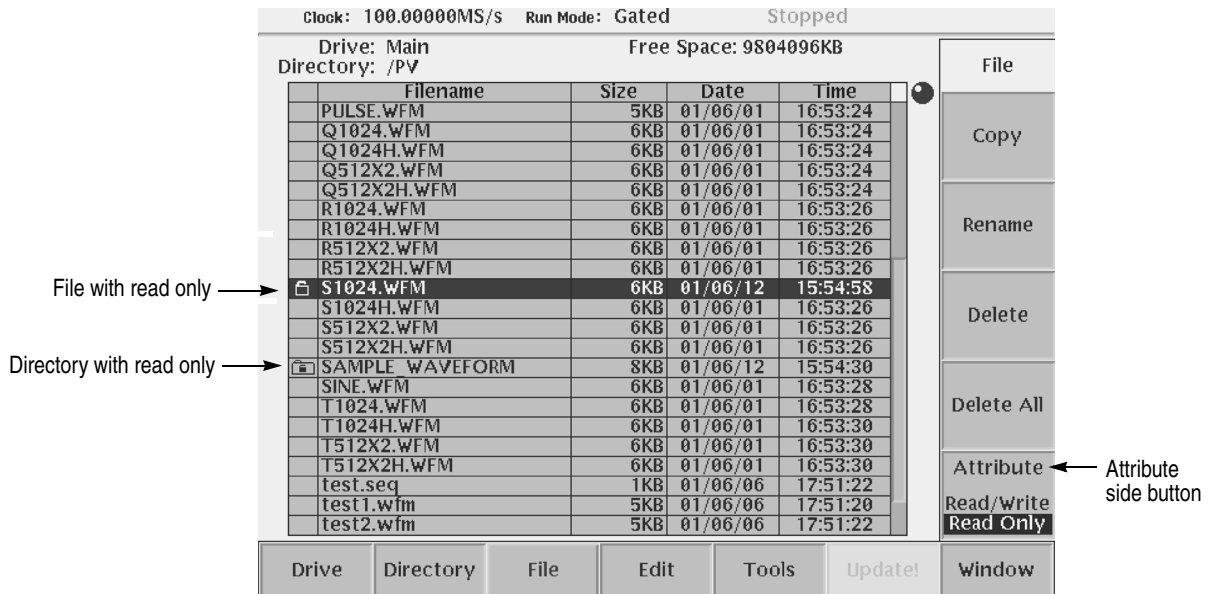


Figure 2-13: Files and directories with read only attribute

Saving Files

You can save files from 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, shown in Figure 2-14. 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. Enter the file name, then push the **OK** side button or the **ENTER** front-panel button to close the dialog box and save the file.

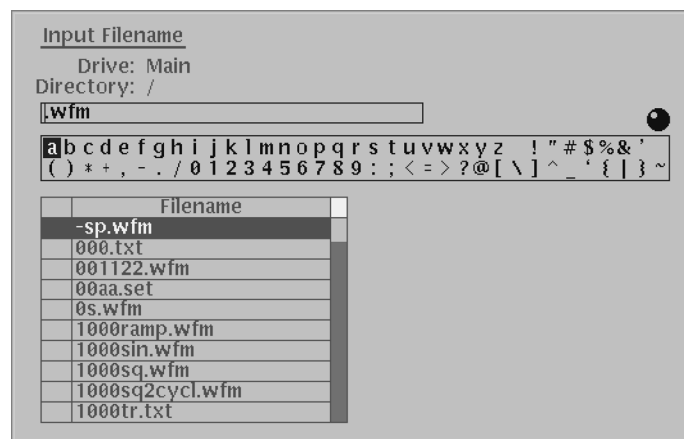


Figure 2-14: Input Filename dialog box

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, shown in Figure 2-14. 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. Enter the file name, then push the **ENTER** front-panel button to close the dialog box and save the file.

If you are saving a file with a record length larger than 960 data points and the record is not evenly divisible by four, 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 2-6. You can 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 2-6: Waveform record length adjustment messages

Message	Description
Leave as it is	The data is saved, as it 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. If the total length of the linked data exceeds 32.4M/64.8M (option 01) points, this will cause an error.

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. AWG615 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 2-15. This function is called Double Windows.



Figure 2-15: 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 2-15. 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 Window

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 2-7.

Table 2-7: 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 2-8.

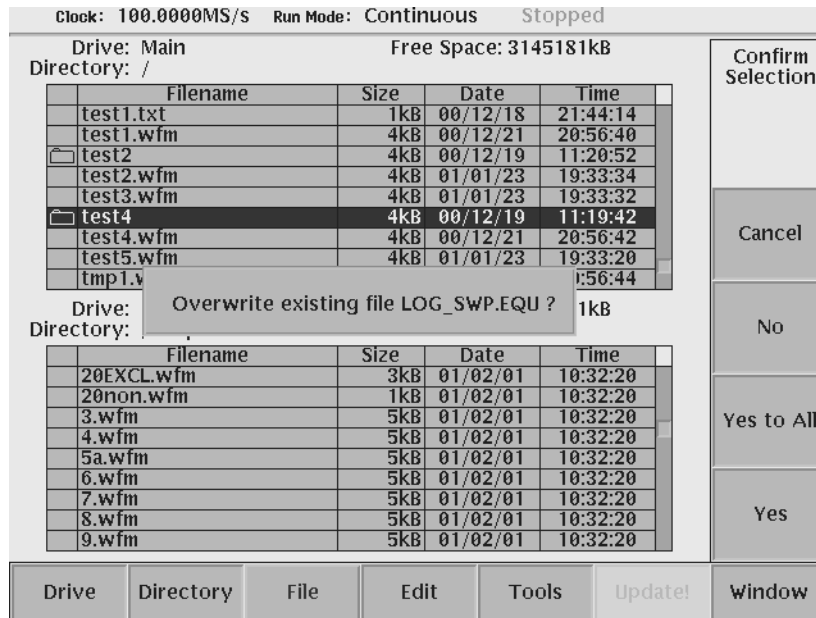


Figure 2-16: Overwrite confirmation

Table 2-8: 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 sometimes 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 2-17.

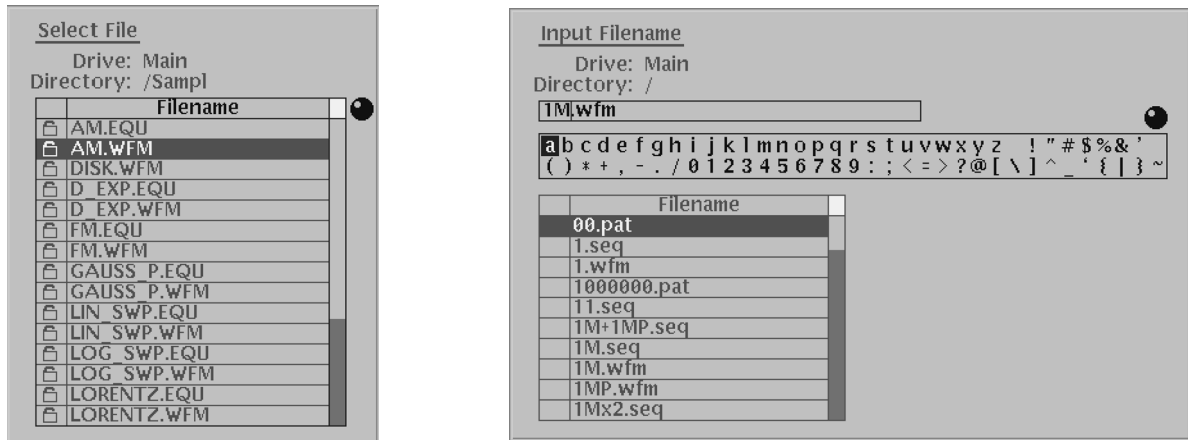


Figure 2-17: File list window examples in which Quick View is available

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 displaying the waveform or pattern appears as shown in Figure 2-18.

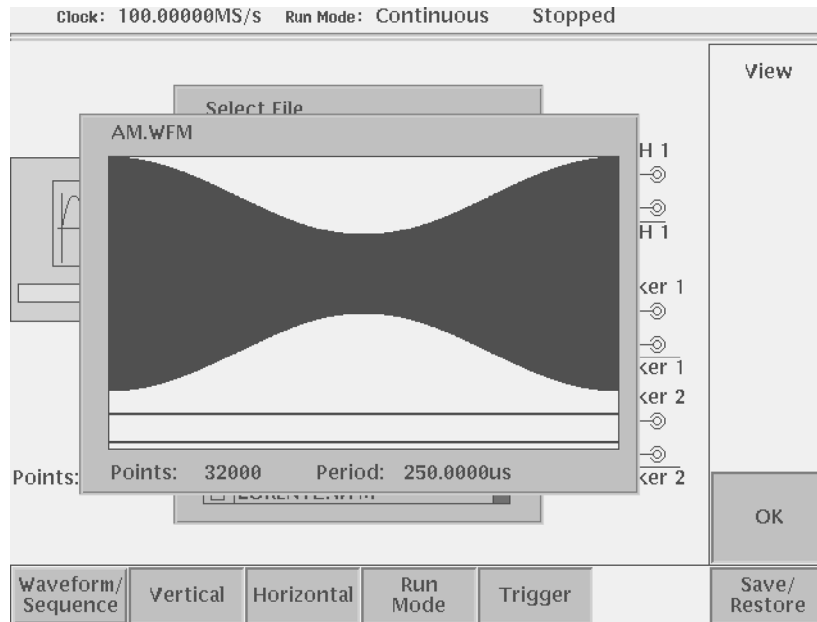


Figure 2-18: Viewing a file by Quick View function

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.

Main Setup Screen

To display the main Setup screen, push the **SETUP** front-panel button. The instrument displays the main Setup screen as shown in Figure 2-19. Table 2-9 describes the screen waveform parameter icons. Table 2-10 lists the bottom menu functions.

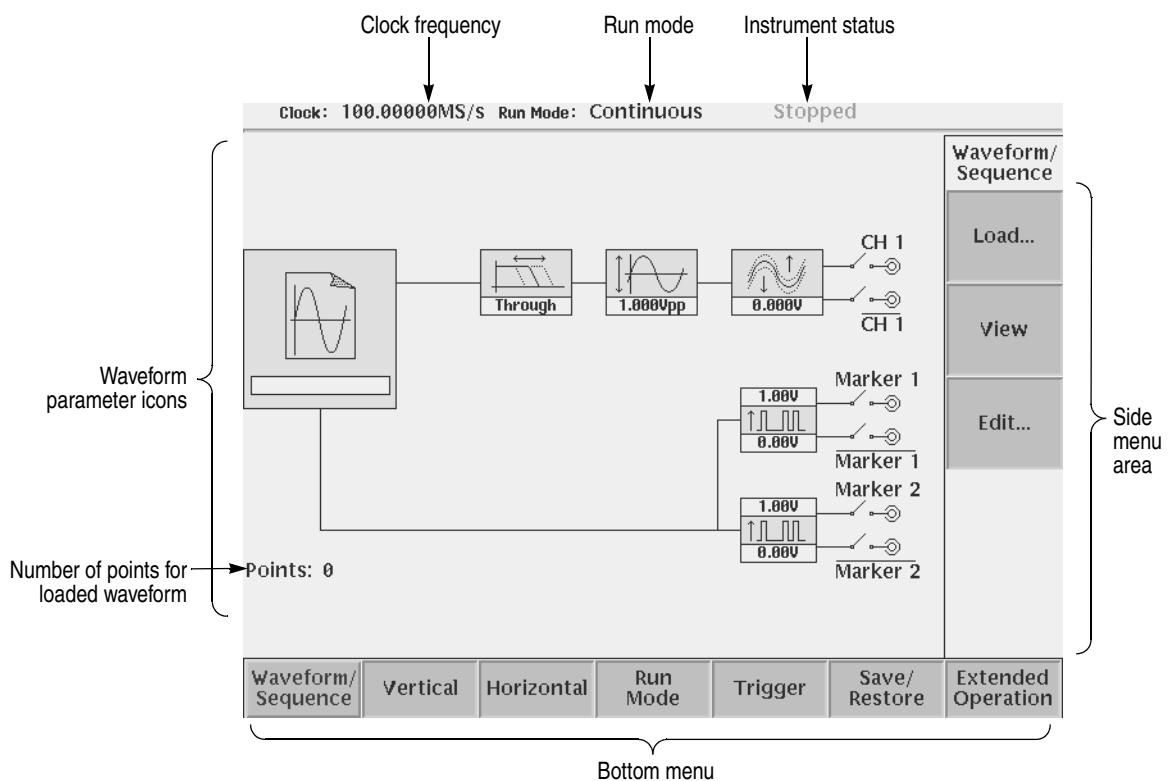


Figure 2-19: Main Setup screen (except option02)

Table 2-9: Setup screen parameter icons

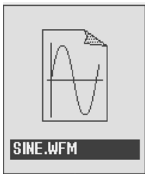
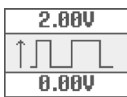
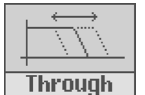
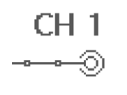
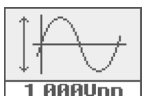


Icon	Description	Icon	Description
	Displays the file name of the waveform, pattern, or sequence file loaded for output. Note: use the View button to display the loaded waveform.		Displays the digital output and marker signal minimum and maximum voltage settings.
	Displays the lowpass filter setting through 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 marker output is enabled or disabled. All Marker outputs are controlled by the ALL MARKER OUT ON/OFF button.
	Displays the signal offset setting. (except option 02)		

Table 2-10: Setup bottom menu buttons

Bottom menu button	Description
Waveform/Sequence	Displays the side menu for loading, viewing, editing waveform files, and for entering the FG mode main screen.
Vertical	Displays the Vertical side menu for setting waveform peak-to-peak amplitude, offset, lowpass filter, marker, 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, and marker signal delay parameters.
Run Mode	Displays the Run Mode side menu for setting the instrument run mode. Refer to <i>Run Modes</i> in the <i>Reference</i> section 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.
Extended Operation	Displays the Extended Operation side menu to change the operation mode such as FG mode, Waveform Mixing mode and Synchronous Operation mode.

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 2-20.

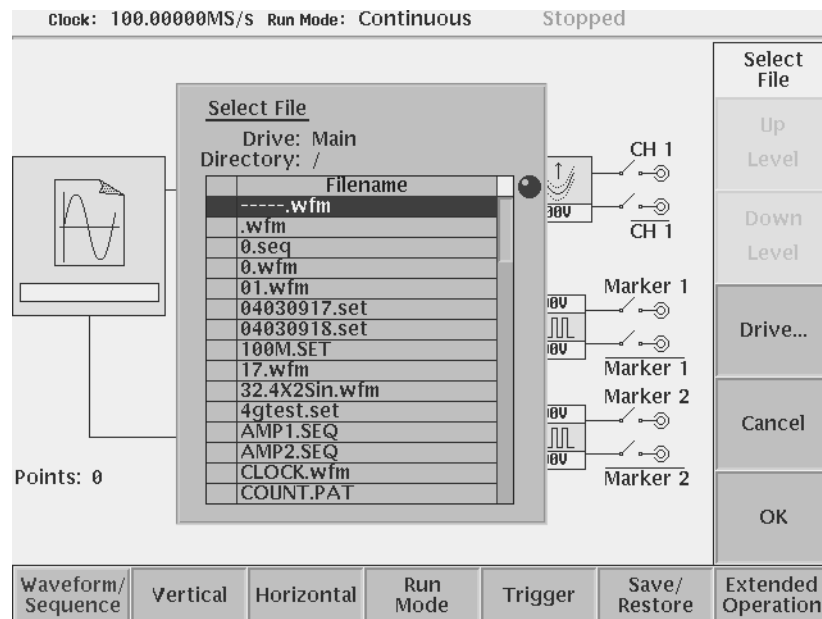


Figure 2-20: Select File dialog on the Load menu

3. Use the general purpose knob or ▲ and ▼ 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.
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 explains 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 into the QUICK EDIT mode only from the waveform editor. When you enter into the quick edit mode, the instrument copies the data in the edit buffer into the undo buffer. All the changes you make immediately reflect to the data in the edit buffer, and also to 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* on page 2-35 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 2-21. Push the **OK** side menu button or **ENTER** front-panel button to close the view window.

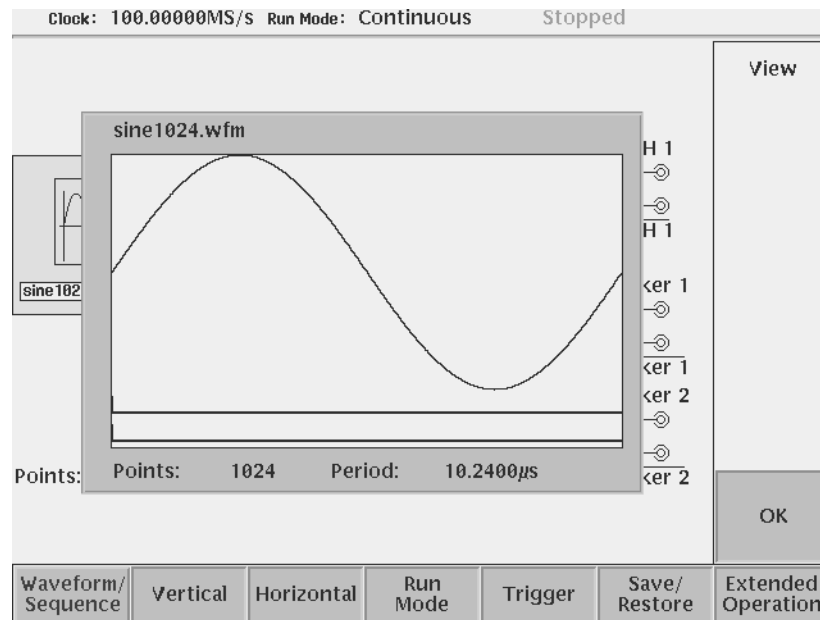


Figure 2-21: Viewing a file in the Setup screen

Note that the View function does not display the waveform in the waveform memory, but displays the waveform in the file that you specified. Even though you change the waveform with the editor and update the waveform memory, the View function still displays the waveform before the update unless you save the file.

Editing a Waveform

To edit the loaded waveform file, push the **Edit...** side menu button. The instrument opens the appropriate edit window for the previously loaded file type.

If you have not loaded a file in the Setup screen, the instrument displays the message *No output data*, and you cannot enter into the editor.

The editors are described in more detail in the *Reference* section of the User manual.

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 2-11 provides an overview of the Setup side menu operations.

Table 2-11: 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 lowpass filter to insert into signal path. Filter values are Through (no filter), 20 MHz, 50 MHz, 100 MHz, and 200 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 _{p-p} in normal mode and 1 V _{p-p} 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 ±0.5 V. Use the general purpose knob or the keypad to enter new values.(except option 02)
	Marker...	Displays a side menu to set Marker 1 and Marker 2 signal high and low values. The marker signal voltage range is -2.0 V to 2.45 V and maximum amplitude is 1.25 V _{p-p} into 50 Ω . Use the general purpose knob or the keypad to enter new values.
	Output...	Toggles normal output to direct output.(except option 02)

Table 2-11: Setup output parameter operations (cont.)

Bottom button	Side button	Description
Horizontal	Clock	Sets the clock sample rate from 50 kS/s to 2.7 GS/s.
	Clock Ref	Sets the reference clock source to either Internal or External. A valid external clock signal is 10 MHz \pm 0.1 MHz with a voltage level of 0.2 to 3.0 V _{p-p} .
	Clock Src	Sets the clock source to either Internal or External. A valid external clock signal is 125 MHz to 2.7 GHz with a voltage level of 0.4 to 2.0 V _{p-p} .
Run Mode	Continuous Triggered Gated Enhanced	Displays the Run Mode side menu for setting the instrument run mode. Refer to <i>The Run Mode Menu</i> section on page 3-3 for an explanation of the different run modes.
Trigger	Source	Sets trigger source to Internal or External. If External selected, all other side menu items are not selectable except Interval.
	Slope (or Polarity)	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 μ s to 10.0 s.
Save/Restore	Save Setup	Save the setup parameters set by SETUP window and Extended Operation mode window as a setup file.
	Restore Setup	Restore a setup file.
Extended Operation	FG...	Enters the FG mode for easy generate of standard functional waveform.
	Waveform Mixing...	Enter the Waveform Mixing mode.
	Sync Master...	Enter the Sync-Master of the Synchronous Operation mode.
	Sync Slave...	Enter the Sync-Slave of the Synchronous Operation mode.

Outputting a Waveform

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

Saving and Restoring Setup Parameters

The waveform or pattern file contains only the 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 AWG615 Arbitrary Waveform Generator lets you save setup parameters into a setup file. You can then restore the saved settings for use with waveforms.

The setup parameters of the AWG mode and the Extended Operation mode are saved in a setup file. When a setup file is restored, settings in both AWG mode and Extended Operation mode will replace the contents of a setup file.

Do the following steps to save the current setup parameters:

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

The Input Filename dialog box appears.

2. Enter a setup file name.

The setup file name must have the extension .set.

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

The setup information is saved to the designated file.

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

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

The message box displaying *Restoring setup destroys current settings.* appears. The instrument then opens the Select Setup Filename dialog box.

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

Theory of Operation

This section presents an overview of the AWG615 Arbitrary Waveform Generator hardware, data structures, and operating modes to allow you to take full advantage of the capabilities of the waveform generator.

Block Diagram

Figure 3-1 show the main hardware blocks that make up the AWG615 Arbitrary Waveform Generator.

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.

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 3-1 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 32.4 M /64.8 M (option 01) points. You can set any value from 960 points to 32.4 M/64.8 M (option 01) points for the length of waveform data. It must be in increments of 4.

The Shift Register block is used to provide waveform data from the DAC at a rate up to 2.7 GS/s.

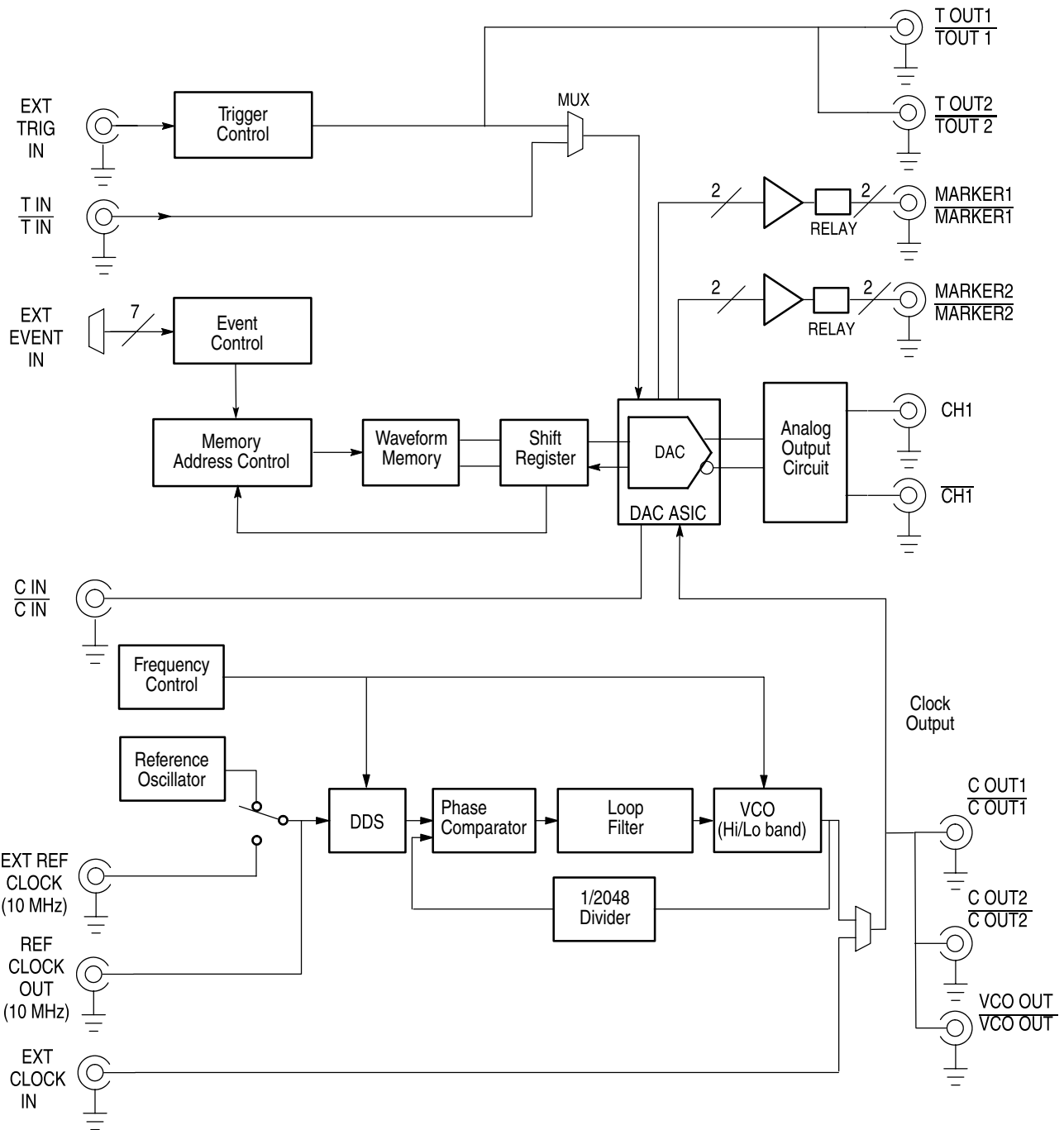


Figure 3-1: AWG615 block diagram

RUN modes. Selecting a RUN mode from the SETUP menu causes one of the following to operate the AWG615 Arbitrary Waveform Generator:

Table 3-1: Run modes

Modes	Descriptions
Continuous	Consecutively output regardless of existence of a trigger signal.
Triggered	The output signal is obtained only once when one of the following is input: <ul style="list-style-type: none"> ■ An external trigger signal from the rear panel's TRIG IN connector. ■ A trigger signal generated with the front-panel's FORCE TRIGGER button. ■ A trigger command from remote device.
Gated	The waveform is output only while: <ul style="list-style-type: none"> ■ An external trigger signal from the rear panel's TRIG IN connector. ■ A gate signal through the front-panel's FORCE TRIGGER button is TRUE. ■ A control command such as trigger or event from remote device. (Except the Synchronous operation mode)
Enhanced	The waveform is obtained, in the order defined with the sequence, based on: <ul style="list-style-type: none"> ■ A trigger signal (for example, an external trigger signal from the rear panel's TRIG IN connector). ■ An event signal from the rear panel's EVENT IN connector. ■ An trigger signal from the front panel's FORCE TRIGGER button. ■ An event signal from the front panel's FORCE EVENT button. ■ A control command such as trigger, event or jump from remote device. (Except the Synchronous operation mode)

Extended operation. Selecting a Extended operation from the Extended Operation menu causes one of the following to operate the AWG615 Arbitrary Waveform Generator:

Table 3-2: Extended operation

Modes	Descriptions
FG	Enter the FG mode for easy generate of a standard functional waveform.
Waveform Mixing	Create and output a mixed waveform. Waveform mixing generates the waveform which added the value for every point of two waveforms, A and B, at a rate of a mixing ratio.

Table 3-2: Extended operation (cont.)

Modes	Descriptions
Synchronous Operation	<p data-bbox="688 394 1442 552">Synchronous Operation is a feature that outputs synchronized two channels of signal using two units of AWG615. A word synchronous called here means that two units of the AWG615 operate with the same clock and that start and stop of output signals of two units are corresponding.</p> <p data-bbox="688 583 1442 667">In the Synchronous Operation mode, the Clock and the Trigger signals of two units are provided directly from the master unit. For other signals, the master controls the slave through a LAN.</p>

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. Option02 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.

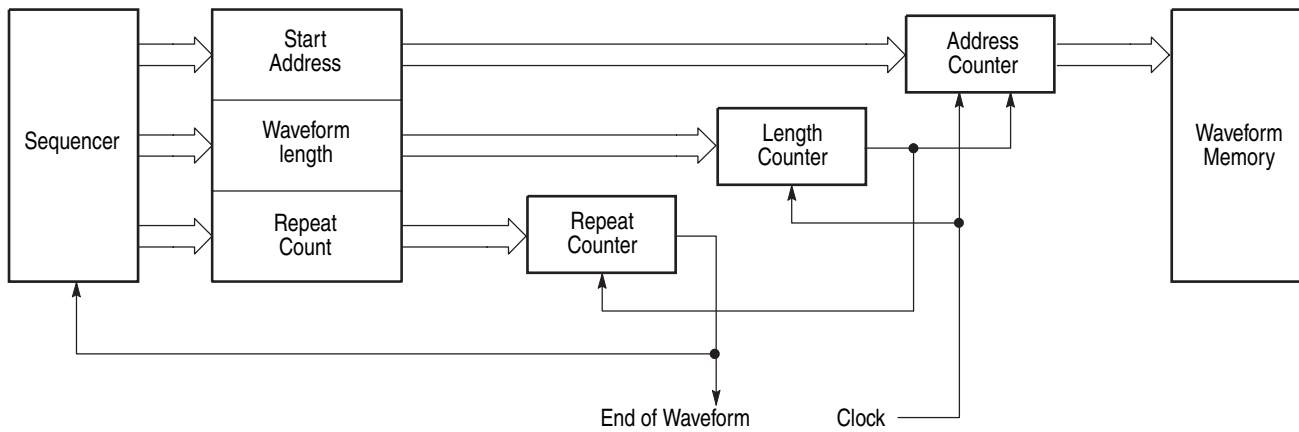


Figure 3-2: Relationship between memory address control and waveform memory

Figure 3-2 shows the relationship between the memory address control and the 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 AWG615 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 Running 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 AWG615 supports 2 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, subtracting and so forth. 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 Data Transfer section in AWG615 Arbitrary Waveform Generator Programmer Manual.

Waveform Edit To enable editing, the AWG615 Arbitrary Waveform Generator provides you with Waveform, Pattern, Sequence, Equation, and Text Editors. See Table 3-3 for the explanations of those editors.

Table 3-3: Editors

Editors	Descriptions
Waveform Editor	<p>The Waveform Editor lets you create or edit a waveform that is being 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 is capable of editing 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 a few types of the waveform data that you have created using 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 has been created using this editor, you need to perform compiling.</p> <p>The Text Editor also enables you to edit a plain ASCII file. It should be used to edit ASCII-format waveform data created with another 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 (Expand/Shift).



Performance Verification

Performance Verification

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

- Verify that the AWG615 Arbitrary Waveform Generator is operating correctly by running the self tests which begin on page 4-2.

Advantages: These procedures require minimal time to perform, require no additional equipment, and test the internal hardware of the AWG615 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 4-6.

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 4-7).

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

The *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 does a more detailed memory check than the power-on method.

Equipment required	None
Prerequisites	Power on the instrument and allow a twenty-minute warmup 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 on the screen shows the test items and results in the calibration and diagnostics previously made. 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 result of the diagnostics are shown as error code. Pass means that the tests have been made without error. If an error is detected, an error code is displayed.

You can also specify how many times the diagnostic tests are performed. 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.

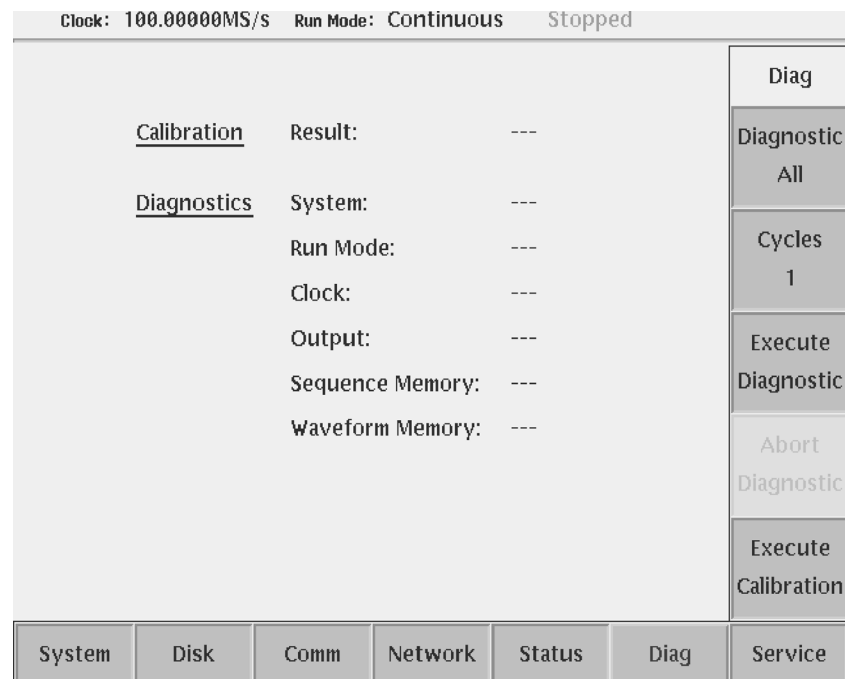


Figure 4-1: Diagnostic menu

Do the following to execute all of the AWG615 Arbitrary Waveform Generator diagnostics automatically:

Push the **Execute Diagnostic** side button.

The internal diagnostics do an extensive verification of AWG615 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 warmup 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 AWG615 Arbitrary Waveform Generator calibration routines automatically.

The internal calibration does an extensive verification of proper AWG615 Arbitrary Waveform Generator functions. While this verification progresses, the message box displaying *Executing Calibration* appear on screen. When finished, the resulting status will appear in the message box as shown in Figure 4-2.

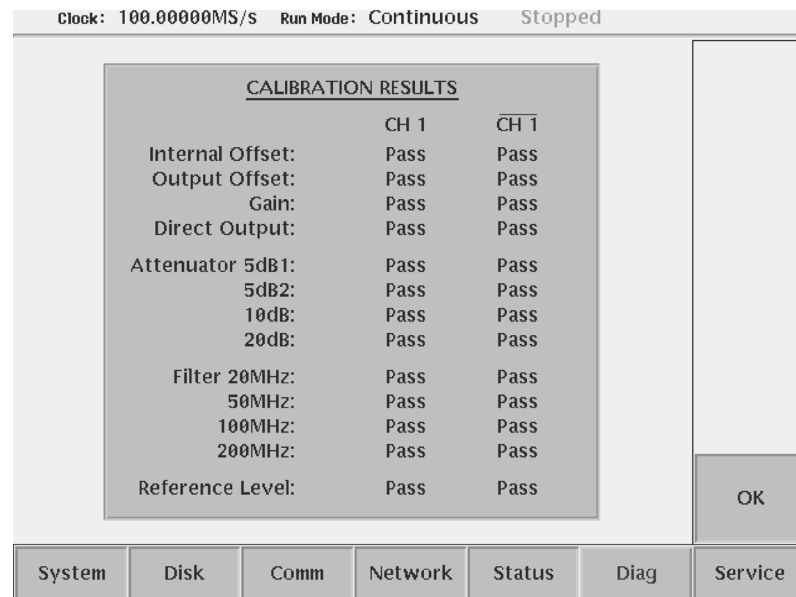


Figure 4-2: Calibration result message box (except option 02)

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 executed,

Performance Tests

This section contains a collection of procedures for checking that the AWG615 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 normality	Page 1-4
Amplitude and offset accuracy tests (normal out)	Page 4-22	Amplitude accuracy, and DC offset accuracy	Page 1-6
Amplitude, DC offset and rise time accuracy tests (direct DA out)	Page 4-26	Amplitude accuracy, DC offset accuracy and Rise time accuracy	Page 1-6
Amplitude, DC offset and Rise time accuracy test (Option2)	Page 4-30	Amplitude accuracy, DC offset accuracy and Rise time accuracy	Page 1-7
Pulse response tests (normal out)	Page 4-34	Rise time accuracy	Page 1-7
Trigger input tests	Page 4-36	Trigger level accuracy, and Trigger function normality	
Event input and enhanced mode tests	Page 4-40	External event input function normality, and Event mode normality	
External Clock input and VCO Out tests	Page 4-40	External Clock input function normality, and VCO Out normality	Page 1-8, 1-20
VCO			

The performance tests check all of 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*).

Prerequisites The tests in this section comprise 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 4-2.
- 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 4-1 for more information.

Equipment Required These procedures use external, traceable signal sources to directly check warranted characteristics. Table 4-2 lists the required equipment used 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 3 GHz, Accuracy: < 0.2 ppm	Anritsu MF1603A	Checks reference input. VCO Out test
2. Digital multi meter	DC volts range: 0.05 V to 10 V, Accuracy: $\pm 0.1\%$	Fluke 8842A	Measures voltage. Used in multiple procedures.
3. Oscilloscope	Bandwidth: > 500 MHz, 1 M Ω and 50 Ω inputs	Tektronix TDS784D	Checks output signals. Used in multiple procedures.
4. Oscilloscope	Bandwidth: > 6 GHz, Rise time: < 58.3 ps, 50 Ω input	Tektronix TDS820	Checks 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.
5. Signal Generator	Output voltage: -5 V to +5 V, Frequency accuracy: < 0.01 %	Agilent 8648B	Generates external input signals. Used in multiple input signal test procedures.
6. SMA Coaxial Cable (4 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. Adapter	SMA (female) to N (male), 50 Ω	Tektronix part number SMA(fe) -SMA(fe) 015-1012-00+SMA(ma)-N (ma) 015-0369-00	Signal interconnection
11. BNC-T Connector	BNC (male) to BNC (female) to BNC (female)	Tektronix part number 103-0030-00	Signal interconnection
12. Dual-Banana Connector	BNC (female) to dual banana	Tektronix part number 103-0090-00	Signal interconnection
13. SMA Terminator (2 required)	50 Ω SMA (male)	Tektronix part number 015-1022-01	Signal termination
14. Precision Terminator	50 Ω 0.1 %, BNC	Tektronix part number 011-0129-00	Signal termination
15. Performance check disks	Must use example listed	Supplied with the product, Tektronix part number 063-3721-00 for AWG615	Used to provide waveform files.
16. Ground closure (loopback cable) with 9-pin, D-type connector		Custom, See Figure 4-3.	Used for event mode test.

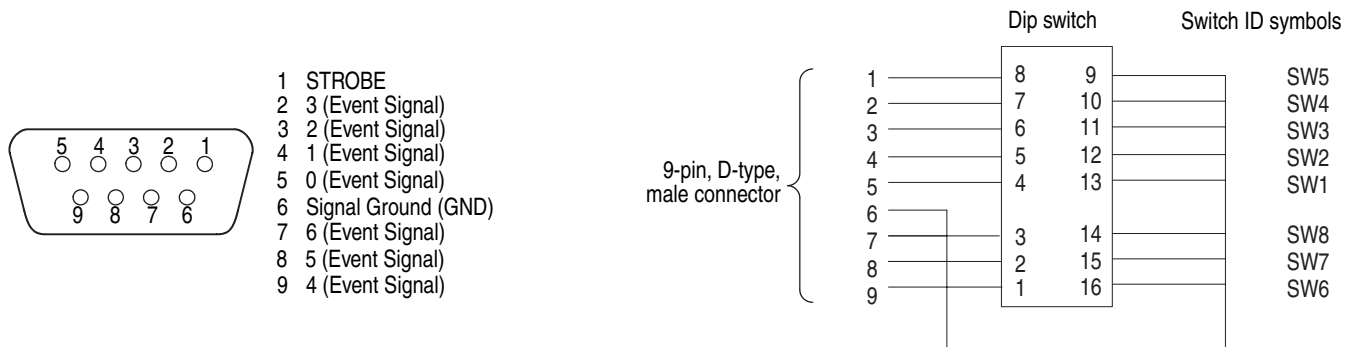


Figure 4-3: EVENT IN connector pins and signals and ground closure connector

Loading Files

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

1. Insert the disk into the AWG615 Arbitrary Waveform Generator floppy disk drive.
2. Select **SETUP** (front)→**Waveform/Sequence** (bottom)→**Load...** (side)→**Drive...** (side).

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

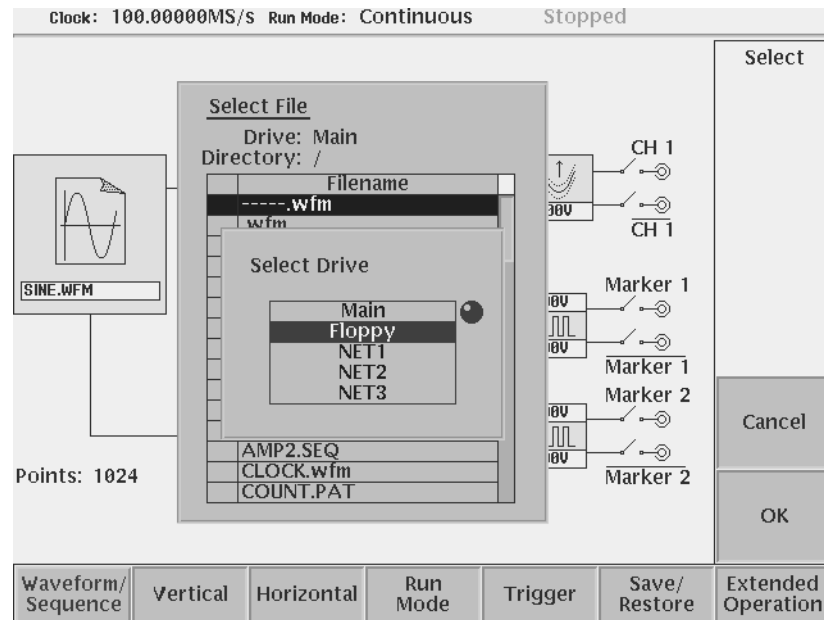


Figure 4-4: Loading file; selecting storage drive

3. Select **Floppy** from the dialog box with 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 be loaded 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 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 AWG615 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 (the 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

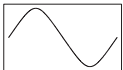
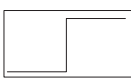


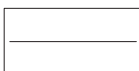
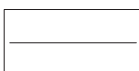

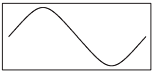
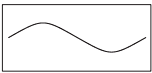
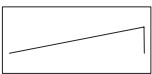
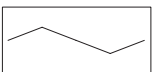
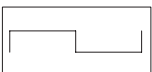
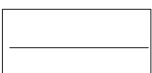
No.	File name	EDIT menu		SETUP menu				Marker setup	Usage
		Form	Points	Clock	Filter	Ampl	Offset		
1	MODE.WFM		1000	4 GHz	Through	1 V	0 V	Marker 1,2: 0 to 499: High, 500 to 999: Low	Run mode, Trigger level, Internal trigger accuracy
2	PULSE.WFM		1000	100 MHz	Through	1 V	0 V		Pulse response
3	AMP1.SEQ								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
9	TRIG.WFM		1000	1 MHz	Through	1 V	0 V		Trigger input
10	PT_EVENT7.SEQ								Event input
11	PT_STROB7.SEQ								Event input

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		
12	S1024.WFM (PT_XXXXX.SEQ) ²		1024	400 MHz	Through	1 V	0 V		Event input
13	S1024H.WFM (PT_XXXXX.SEQ) ²		1024	400 MHz	Through	1 V	0 V		Event input
14	R1024H.WFM (PT_XXXXX.SEQ) ²		1024	400 MHz	Through	1 V	0 V		Event input
15	T1024H.WFM (PT_XXXXX.SEQ) ²		1024	400 MHz	Through	1 V	0 V		Event input
16	Q1024H.WFM (PT_XXXXX.SEQ) ²		1024	400 MHz	Through	1 V	0 V		Event input
17	NULL1024.WFM (PT_XXXXX.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_XXXXX.SEQ represents PT_EVENT7.SEQ and PT_STROB7.SEQ

AWG615 Test Record

Photocopy this test record and use to record the performance test results for your AWG615 Arbitrary Waveform Generator.

AWG615 Test Record

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

AWG615 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 200 mV 2 V	17.60 mV 194.0 mV 1.9580 V	_____	_____	22.40 mV 206.0 mV 2.0420 V
$\overline{\text{CH1}}$ Amplitude	20 mV 200 mV 2 V	17.60 mV 194.0 mV 1.9580 V	_____	_____	22.40 mV 206.0 mV 2.0420 V
CH1 Offset	0 V +0.5 V -0.5 V	- 10.0 mV + 0.4825 V - 0.4825 V	_____	_____	+ 10.0 mV + 0.5175 V - 0.5175 V
$\overline{\text{CH1}}$ Offset	0 V +0.5 V -0.5 V	- 10.0 mV + 0.4825 V - 0.4825 V	_____	_____	+ 10.0 mV + 0.5175 V - 0.5175 V

AWG615 Test Record (cont.)

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

AWG615 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

Performance Verification

AWG615 Test Record (cont.)

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

AWG615 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)	Pass/Fail	_____	_____	Pass/Fail
pin 1 (when SW2 of the ground closure is closed)	Pass/Fail	_____	_____	Pass/Fail
pin 2 (when SW3 of the ground closure is closed)	Pass/Fail	_____	_____	Pass/Fail
pin 3 (when SW4 of the ground closure is closed)	Pass/Fail	_____	_____	Pass/Fail
pin 4 (when SW5 of the ground closure is closed)	Pass/Fail	_____	_____	Pass/Fail
pin 5 (when SW6 of the ground closure is closed)	Pass/Fail	_____	_____	Pass/Fail
pin 6 (when SW7 of the ground closure is closed)	Pass/Fail	_____	_____	Pass/Fail
Check Strobe Input (when SW5 of the ground closure is on and off)	Pass/Fail	_____	_____	Pass/Fail

External Clock Input and VCO Output

External Clock Input Frequency External Clock = 200 MHz	displayed approximately 200.00 MS/s	_____		
VCO Output: amplitude	approximately 400 mV _{p-p}	_____		
VCO Output: period	approximately 5 ns	_____		
$\overline{\text{VCO}}$ Output: period	approximately 5 ns	_____		
CH1 Output: period	approximately 5 μ s	_____		

VCO Output frequency and 10 MHz Reference Input

Check VCO Out Frequency Internal Clock = 2.5 GS/s	2 499 997.5 kHz	_____	_____	2 500 002.5 kHz
Check output with 10 MHz Reference Input 10 MHz Ref In = 10 MHz	approximately 2 500 000 kHz	_____		
Check output with 10.1 MHz Reference Input 10 MHz Ref In = 9.9 MHz	approximately 2 475 000 kHz	_____		

AWG615 Test Record (cont.)

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

AWG615 Performance Test	Minimum	Incoming	Outgoing	Maximum
Marker Output				
MARKER1 High level (Set the level to 2.45 V.)	2.2275 V	_____	_____	2.6725 V
MARKER1 Low level (Set the level to -2.0 V.)	-2.2 V	_____	_____	-1.8 V
$\overline{\text{MARKER1}}$ High level (Set the level to 2.45 V.)	2.2275 V	_____	_____	2.6725 V
$\overline{\text{MARKER1}}$ Low level (Set the level to -2.0 V.)	-2.2 V	_____	_____	-1.8 V
MARKER2 High level (Set the level to 2.45V.)	2.2275 V	_____	_____	2.6725 V
MARKER2 Low level (Set the level to -2.0 V.)	-2.2 V	_____	_____	-1.8 V
$\overline{\text{MARKER2}}$ High level (Set the level to 2.45 V.)	2.2275 V	_____	_____	2.6725 V
$\overline{\text{MARKER2}}$ Low level (Set the level to -2.0 V.)	-2.2 V	_____	_____	-1.8 V
Synchronous Operation				
C1 Out - C In, T1 Out - T In $\overline{\text{C1 Out}} - \overline{\text{C In}}, \overline{\text{T1 Out}} - \overline{\text{T In}}$	Pass/Fail	_____	_____	Pass/Fail
C2 Out - C In, T2 Out - T In $\overline{\text{C2 Out}} - \overline{\text{C In}}, \overline{\text{T2 Out}} - \overline{\text{T In}}$	Pass/Fail	_____	_____	Pass/Fail

Operating Mode Tests

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

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 Cont Mode

Equipment required	A 50 Ω SMA coaxial cable, a SMA(Female)-BNC(Male) adapter and an oscilloscope (TDS700).
Prerequisites	The AWG615 Arbitrary Waveform Generator must meet the prerequisites listed on page 4-7.

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 AWG615 Arbitrary Waveform Generator CH1 output connector to the oscilloscope CH1 input connector (see Figure 4-5).

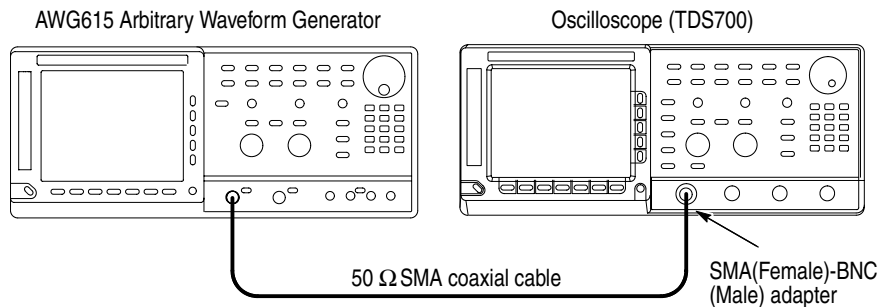


Figure 4-5: Cont mode initial test hookup

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 AWG615 Arbitrary Waveform Generator controls and to select the waveform file:

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

4. Load the MODE.WFM file.

Refer to *Loading Files* on page 4-8 for file loading procedures.

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

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

6. Check that the amplitude of the sine wave displayed on the oscilloscope is 5 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 (TDS700).
Prerequisites	The AWG615 Arbitrary Waveform Generator must meet the prerequisites listed on page 4-7.

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 AWG615 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(Fe)–BNC(Ma) adapter to connect the AWG615 Arbitrary Waveform Generator CH1 output connector to the oscilloscope CH1 input connector.

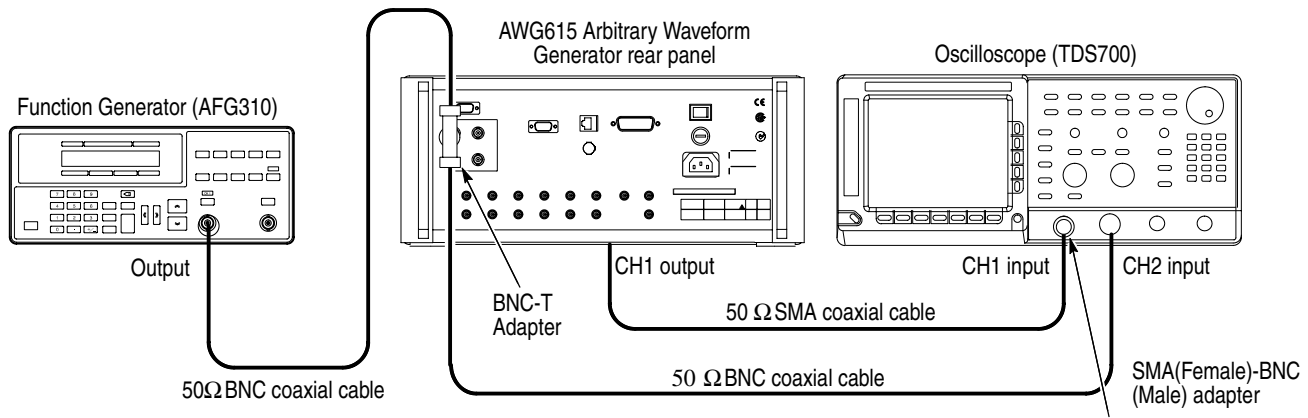


Figure 4-6: Triggered mode initial test hookup

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 AWG615 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 4-8 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.

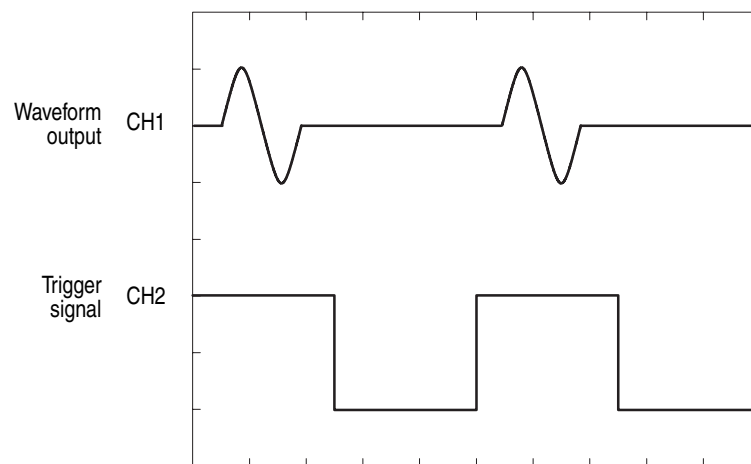


Figure 4-7: Relationship between trigger signal and waveform output

Check Gated Mode

Equipment required	Two 50 Ω BNC coaxial cables, a 50 Ω SMA coaxial cable, a SMA(Fe)–BNC(Ma) adapter, a BNC–T (male to 2 females) adapter, a function generator, and an oscilloscope (TDS700).
Prerequisites	The AWG615 Arbitrary Waveform Generator must meet the prerequisites listed on page 4-7.

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 AWG615 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 4-8 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.

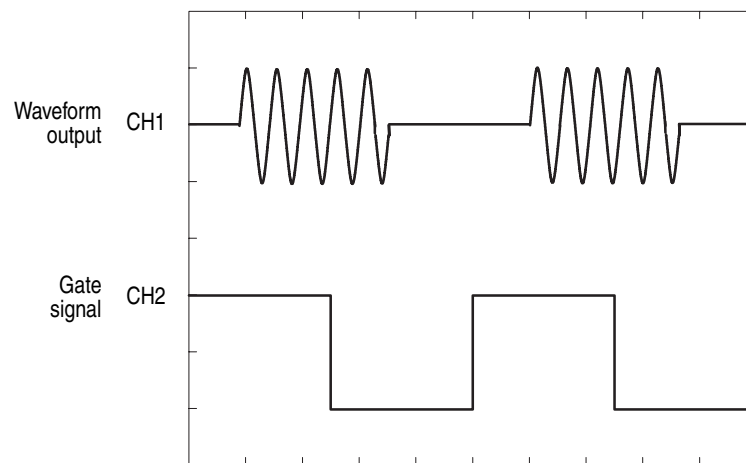


Figure 4-8: Relationship between gate signal and waveform output

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

This changes the AWG615 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 AWG615 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 $\overline{CH1}$ or 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(Ma)–BNC(Fe) adapters, BNC (female)–to–dual banana adapter, and a digital multimeter (DMM).
Prerequisites	The AWG615 Arbitrary Waveform Generator must meet the prerequisites listed on page 4-7.

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 AWG615 Arbitrary Waveform Generator CH1 output to the DMM input connector (see Figure 4-9).

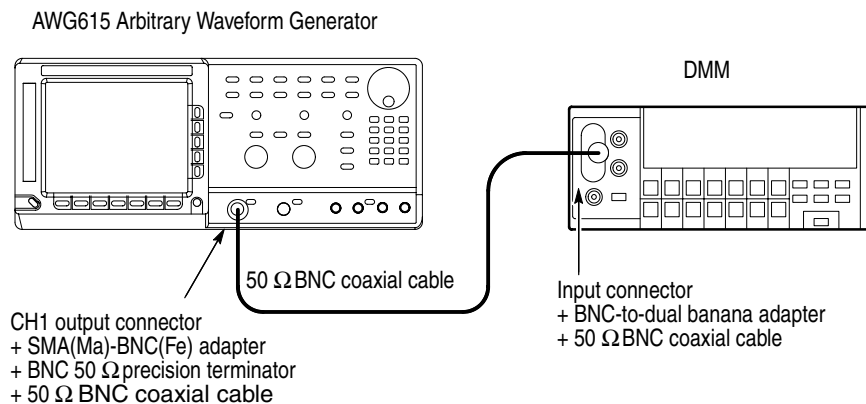


Figure 4-9: Amplitude accuracy initial test hookup

2. Set the DMM controls as follows:

Mode	VDC
Range	Auto
Input	Front

3. Follow the substeps below to set the AWG615 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 AWG615 Arbitrary Waveform Generator is set to enhanced mode.

- c. Load the AMP1.SEQ file.

Refer to *Loading Files* on page 4-8 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 AWG615 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, and push **0** and then **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 $200\text{ mV} \pm 6\text{ mV}$.
 - 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 $2\text{ V} \pm 0.042\text{ V}$.
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 the 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 AWG615 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 previous check on page 4-22.
- 2. Follow the substeps below to set the AWG615 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 4-8 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 AWG615 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 AWG615 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 AWG615 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 AWG615 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 AWG615 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(Ma)–BNC(Fe) adapter, BNC (female)–to–dual banana adapter, and a digital multimeter (DMM).
Prerequisites	The AWG615 Arbitrary Waveform Generator must meet the prerequisites listed on page 4-7.

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 AWG615 Arbitrary Waveform Generator **CH1** output to the DMM input connector (see Figure 4-10).

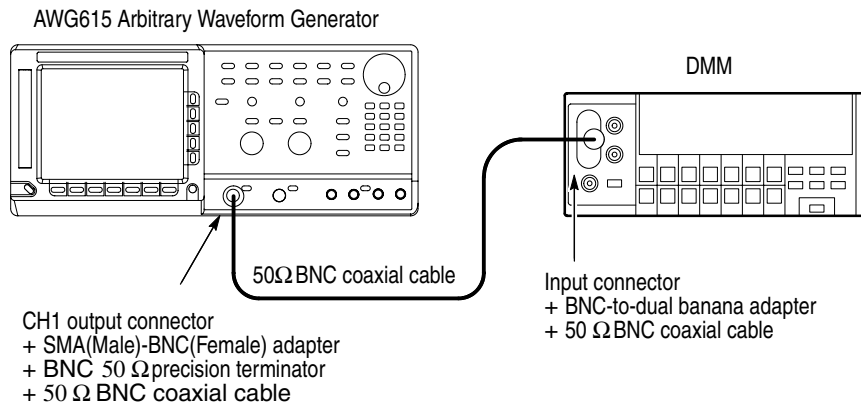


Figure 4-10: Direct DA output amplitude accuracy initial test hookup

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 AWG615 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 4-8 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 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 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 $20\text{ mV} \pm 2.4\text{ mV}$.
10. Follow the substeps below to check the DC offset:
 - a. Push the **FORCE EVENT** button.
 - b. Verify that the reading on the DMM falls within $0\text{ V} \pm 10\text{ mV}$.
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 $\overline{\text{CH1}}$ output connector.

- d. Push the **CH1** output button to turn on the **CH1** LED.
- e. Push the **FORCE EVENT** button.
- 12. Repeat steps 8 through step 10 for the AWG615 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 AWG615 Arbitrary Waveform Generator must meet the prerequisites listed on page 4-7.

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 AWG615 Arbitrary Waveform Generator CH1 output connector to the oscilloscope CH1 input connector (see Figure 4-11).

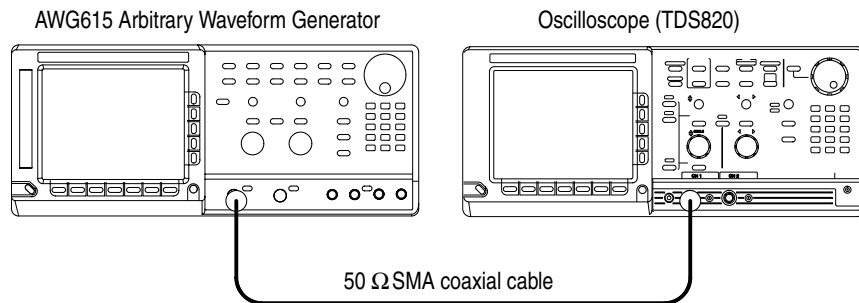



Figure 4-11: Direct DA output pulse rise time initial test hookup

- 2. Set the oscilloscope controls as follows:

- Vertical CH1
- CH1 coupling..... DC if applicable
- CH1 scale 100 mV/div
- CH1 input impedance 50 Ω
- Horizontal CH1
- Sweep..... 500 ps/div

Trigger	
Source.....	CH1
Slope.....	
Level.....	0 V
Mode.....	Auto

NOTE. The pulse rise time tests use the AWG615 Arbitrary Waveform Generators control settings that have been used in the amplitude and DC offset tests. Do not initialize the AWG615 Arbitrary Waveform Generator controls.

3. Load the PULSE.WFM file.
Refer to *Loading Files* on page 4-8 for file loading procedures.
4. Push **SETUP** (front-panel)→**Run Mode** (bottom)→**Continuous** (side).
The AWG615 Arbitrary Waveform Generator is set to the Continuous mode.
5. Change the AWG615 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 AWG615 Arbitrary Waveform Generator $\overline{\text{CH1}}$.
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 AWG615 Arbitrary Waveform Generator option02 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 AWG615 option 02 Arbitrary Waveform Generator must meet the prerequisites listed on page 4-7.

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 AWG615 Arbitrary Waveform Generator **CH1** output to the DMM input connector (see Figure 4-12).

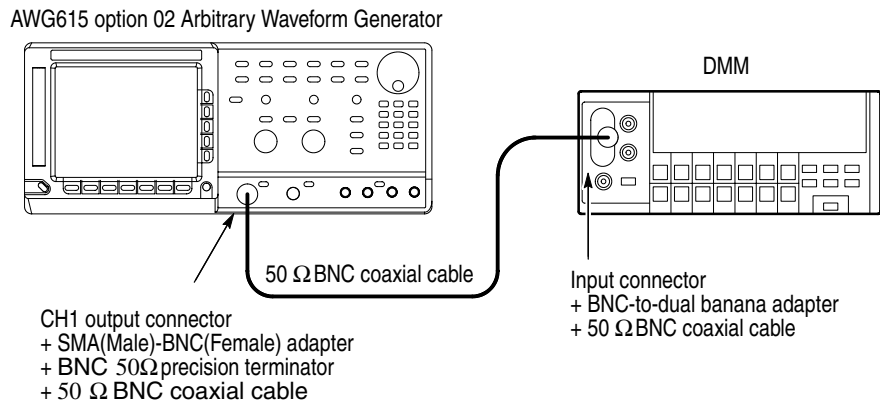


Figure 4-12: Option02 output amplitude accuracy initial test hookup

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 AWG615 Arbitrary Waveform Generator is set to enhanced mode.
5. Load the AMP2.SEQ file.
Refer to *Loading Files* on page 4-8 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 option02 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 option02 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 $\overline{\text{CH1}}$ output connector.
 - d. Push the $\overline{\text{CH1}}$ output button to turn on the $\overline{\text{CH1}}$ LED.

- e. Push the **FORCE EVENT** button.
- 11. Repeat steps 7 through step 9 for the AWG615 Arbitrary Waveform Generator $\overline{\text{CH1}}$.
- 12. Push the $\overline{\text{CH1}}$ output button to turn off the $\overline{\text{CH1}}$ 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 AWG615 Arbitrary Waveform Generator must meet the prerequisites listed on page 4-7.

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 AWG615 Arbitrary Waveform Generator CH1 output connector to the oscilloscope CH1 input connector (see Figure 4-13).

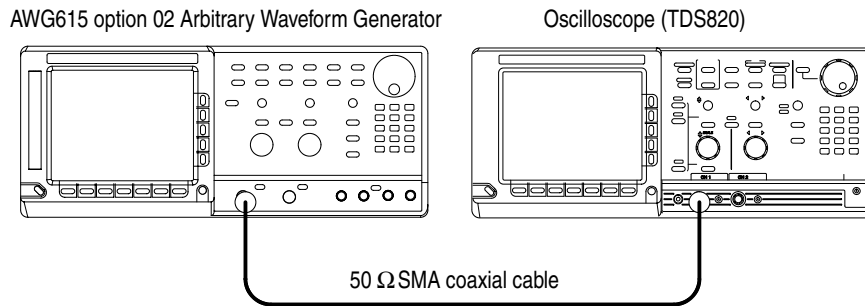



Figure 4-13: Option02 output pulse rise time initial test hookup

- 2. Set the oscilloscope controls as follows:

- Vertical CH1
- CH1 coupling DC if applicable
- CH1 scale 200 mV/div
- CH1 input impedance 50 Ω
- Horizontal
- Sweep 200 ps/div

Trigger	
Source.....	CH1
Slope.....	
Level.....	0 V
Mode.....	Auto

NOTE. The pulse rise time tests use the AWG615 Arbitrary Waveform Generators control settings that have been used in the amplitude and DC offset tests. Do not initialize the AWG615 Arbitrary Waveform Generator controls.

3. Load the PULSE.WFM file.
Refer to *Loading Files* on page 4-8 for file loading procedures.
4. Push **SETUP** (front-panel)→**Run Mode** (bottom)→**Continuous** (side).
The AWG615 Arbitrary Waveform Generator is set to the Continuous mode.
5. Change the AWG615 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 AWG615 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 AWG615 Arbitrary Waveform Generator output waveforms at amplitudes of 1 V.

Equipment required	A 50 Ω SMA coaxial cable and an oscilloscope (TDS820).
Prerequisites	The AWG615 Arbitrary Waveform Generator must meet the prerequisites listed on page 4-7.

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 AWG615 Arbitrary Waveform Generator CH1 output connector to the oscilloscope CH1 input connector (see Figure 4-14).

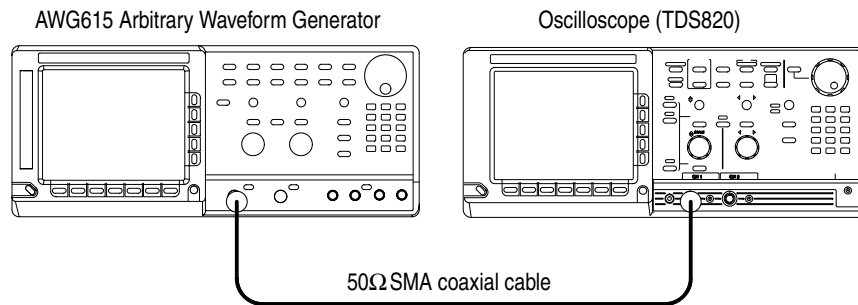


Figure 4-14: Pulse response initial test hookup

2. Set the oscilloscope controls as follows:

VerticalCH1	
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 4-8 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 AWG615 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 AWG615 Arbitrary Waveform Generator.

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 (TDS700).
Prerequisites	The AWG615 Arbitrary Waveform Generator must meet the prerequisites listed on page 4-7.

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 AWG615 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 AWG615. 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.

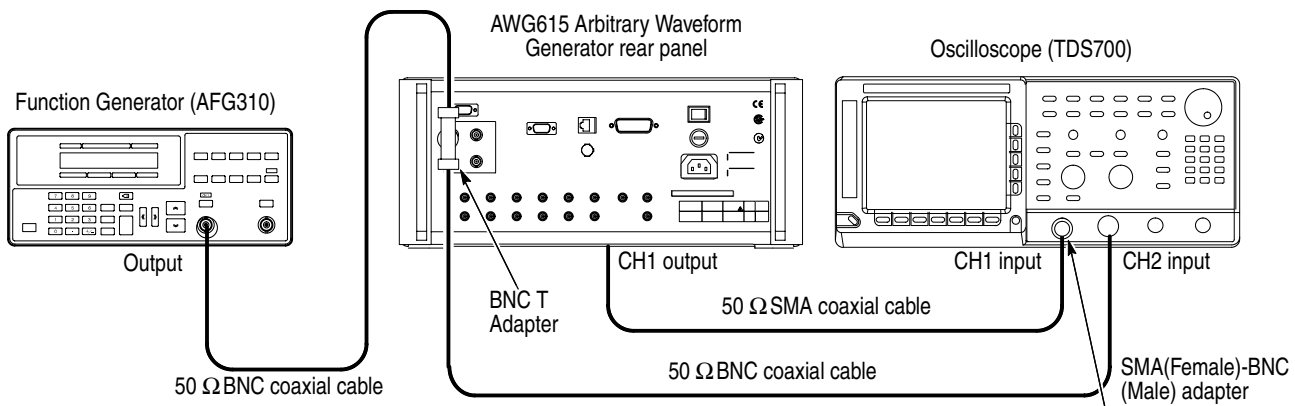


Figure 4-15: Trigger input initial test hookup

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 4-8 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 below:
- Push **SETUP** (front-panel)→**Trigger** (bottom)→**Level** (side).
 - Push **5** and **ENTER** keys in this order.
6. Set the trigger input signal level to 4.65 V by the following substeps below:
- Turn on the function generator output.
 - Select offset by pressing the **OFFSET** button of function generator.
 - Set the DC waveform high level to 4.65 V by using cursor keys.
 - Check that no waveform is displayed on the oscilloscope as shown in Figure 4-16.

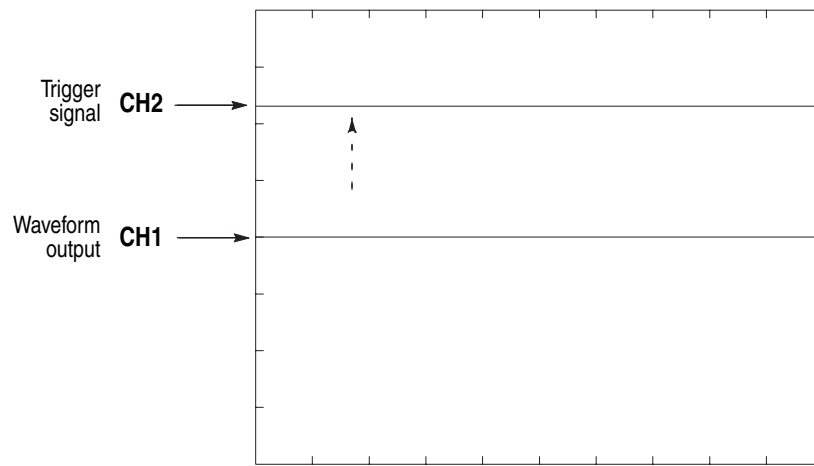


Figure 4-16: Trigger signal and waveform output (+5 V check 1)

- e. Change the pulse waveform high level to 5.35 V by using cursor keys.
- f. Check that sine waves are displayed on the oscilloscope as shown in Figure 4-7.

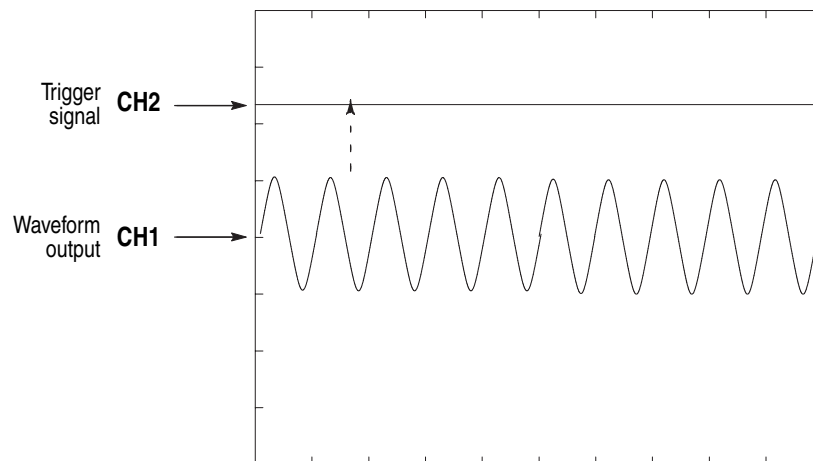


Figure 4-17: Trigger signal and waveform output (+5 V check 2)

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

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

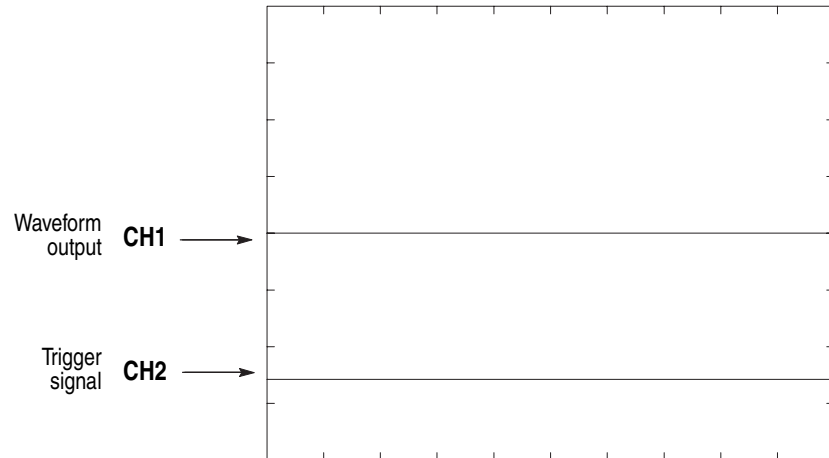


Figure 4-18: Trigger signal and waveform output (-5 V check 1)

- 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.

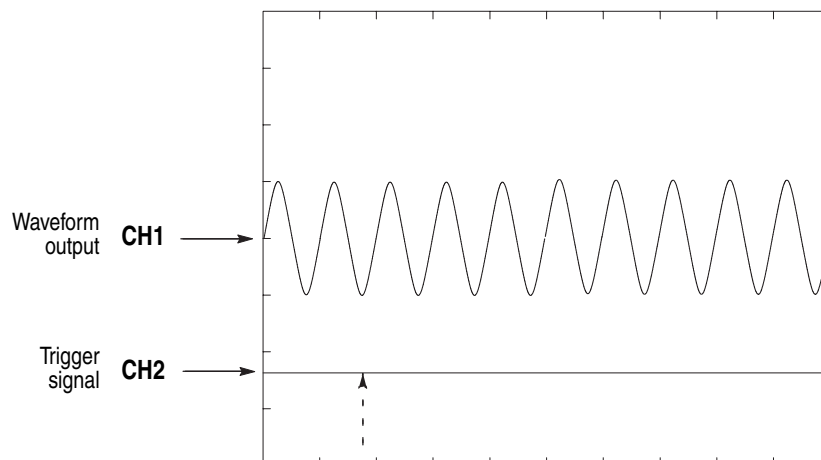


Figure 4-19: Trigger signal and waveform output (-5 V check 2)

8. Push the **RUN** button and the **CH1** button to turn off the **RUN LED**.
9. Turn off the function generator output, 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 Check Event Input with Strobe Off, the next test uses the connections and oscilloscope settings from the previous test.

Check Event Input with Strobe Off

Equipment required	A 50 Ω SMA coaxial cable, a SMA(Female)-BNC(Male) adapter and an oscilloscope (TDS700), and custom-made ground closure. See Figure 4-3 for the connections.
Prerequisites	The AWG615 Arbitrary Waveform Generator must meet the prerequisites listed on page 4-7.

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(Female)-BNC(Female) adapter to connect the AWG615 Arbitrary Waveform Generator **CH1** output connector to the oscilloscope CH1 input connector (see Figure 4-20).

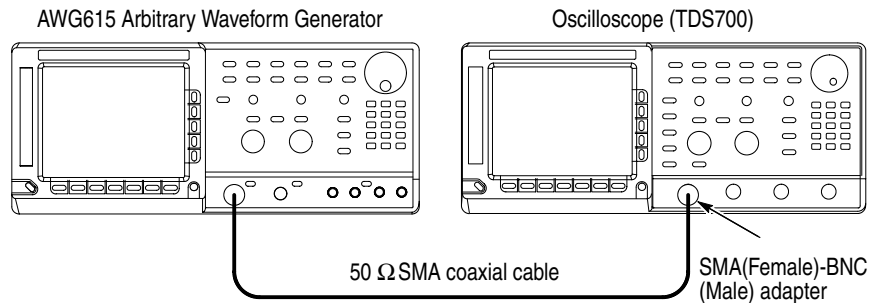


Figure 4-20: Event input and enhanced mode initial test hookup

2. Connect the ground closure to the EVENT IN connector on the AWG615 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 AWG615 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_EVENT7.SEQ file.

Refer to *Loading Files* on page 4-8 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.

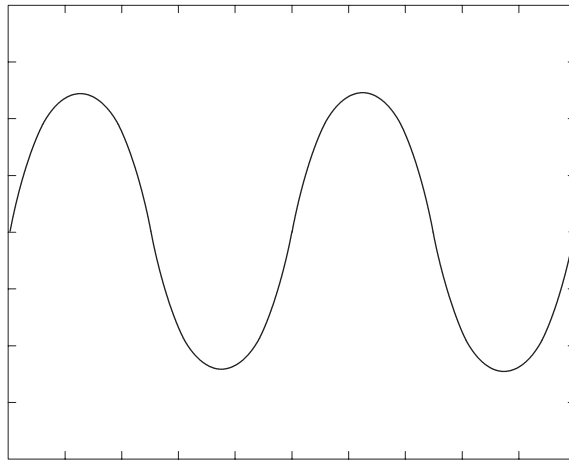


Figure 4-21: Waveform while all ground disclosure switches are open

- 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.

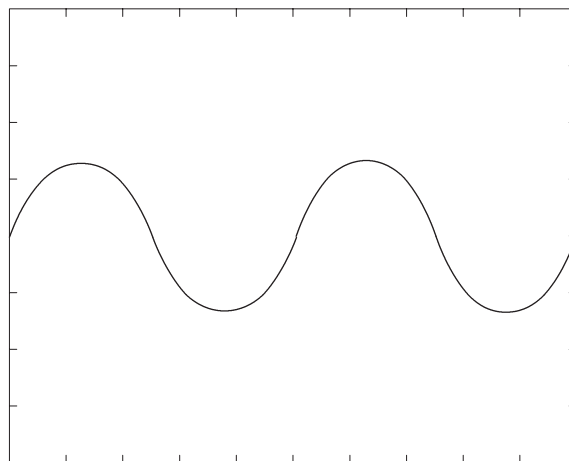


Figure 4-22: Waveform output when the SW1 is closed

- 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.

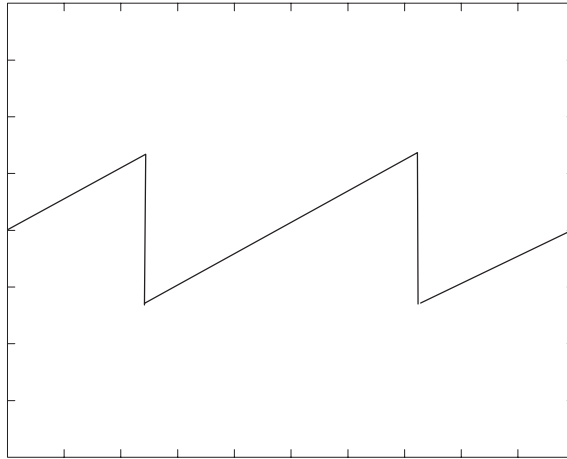


Figure 4-23: Waveform output when SW2 is closed

- c. Open the SW2 of the ground closure to degenerate the event signal.
 - d. Verify that the oscilloscope displays the waveform shown in Figure 4-21.
- 9. Check the EVENT IN connector pin 2 input:**
- a. Close SW3 of the ground closure to generate an event signal on the EVENT IN connector pin 2.
 - b. Verify that the oscilloscope displays the waveform shown in Figure 4-24.

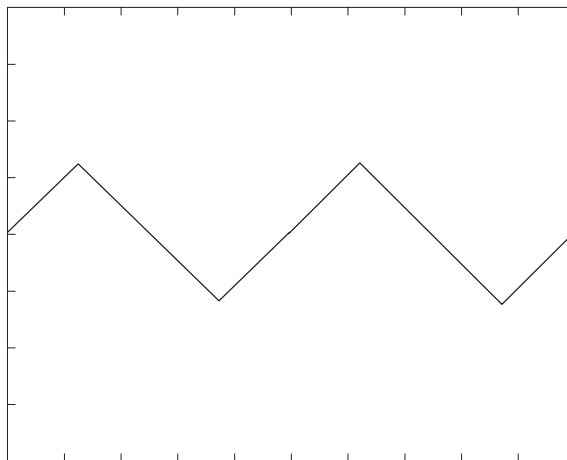


Figure 4-24: Waveform output when the SW3 is closed

- c. Open SW3 of the ground closure to degenerate the event signal.
 - d. Verify that the oscilloscope displays the waveform in Figure 4-21.
- 10.** Check the EVENT IN connector pin 3 input:
- a. Close the SW4 of the ground closure to generate an event signal on the EVENT IN connector pin 3.
 - b. Verify that the oscilloscope displays the waveform shown in Figure 4-25.

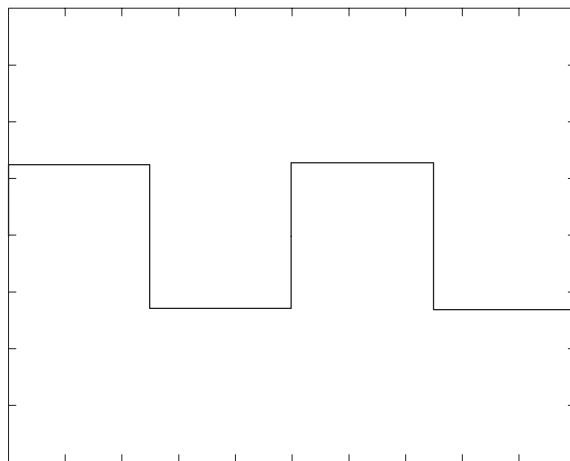


Figure 4-25: Waveform output when SW4 is closed

- 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.** Check the EVENT IN connector pin 4 input:
- a. Close the SW6 of the ground closure to generate an event signal on the EVENT IN connector pin 4.

- b. Verify that the oscilloscope displays the waveform shown in Figure 4-26 and that the waveform cycle is the half of Figure 4-21.

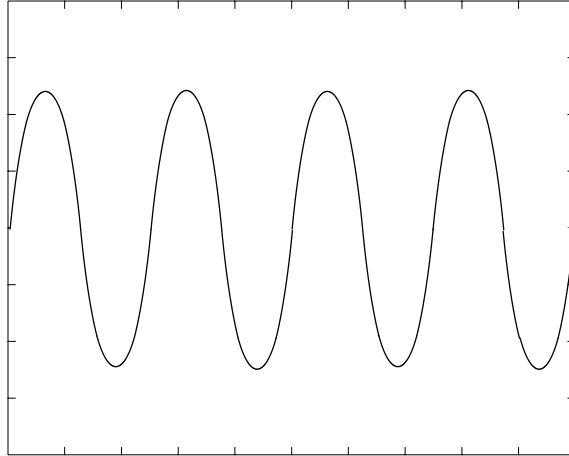


Figure 4-26: Waveform output when SW6 is closed

- c. Open SW6 of the ground closure to degenerate the event signal.
 - d. Verify that the oscilloscope displays the waveform in Figure 4-21.
- 12. Check the EVENT IN connector pin 5 input:**
- a. Close the SW7 of the ground closure to generate an event signal on the EVENT IN connector pin 5.
 - b. Verify that the oscilloscope displays the waveform shown in Figure 4-27.

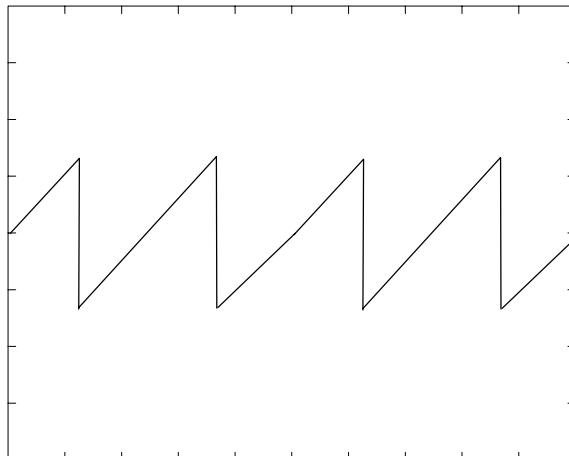


Figure 4-27: Waveform output when SW7 is closed

- c. Open SW7 of the ground closure to degenerate the event signal.

- d. Verify that the oscilloscope displays the waveform in Figure 4-21.
- 13. Check the EVENT IN connector pin 6 input:
 - a. Close the SW8 of the ground closure to generate an event signal on the EVENT IN connector pin 6.
 - b. Verify that the oscilloscope displays the waveform shown in Figure 4-27.

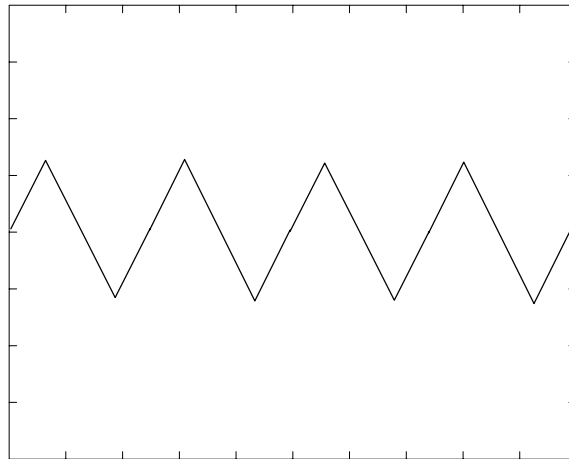


Figure 4-28: Waveform output when SW8 is closed

- c. Open SW8 of the ground closure to degenerate the event signal.
- d. Verify that the oscilloscope displays the waveform in Figure 4-21.
- 14. Retain the test hookup and control settings.

Check Strobe Input

Use the test hookup and oscilloscope settings from previous check.

- 1. Follow the substeps below to set the AWG615 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_STROB7.SEQ file.
Refer to *Loading Files* on page 4-8 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 4-29.

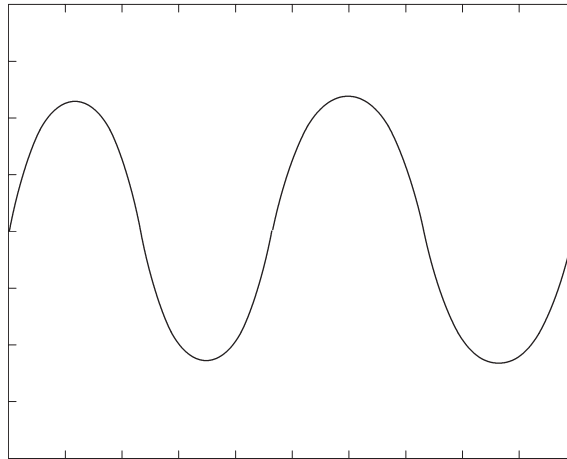


Figure 4-29: Initial waveform output

- 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 4-30.

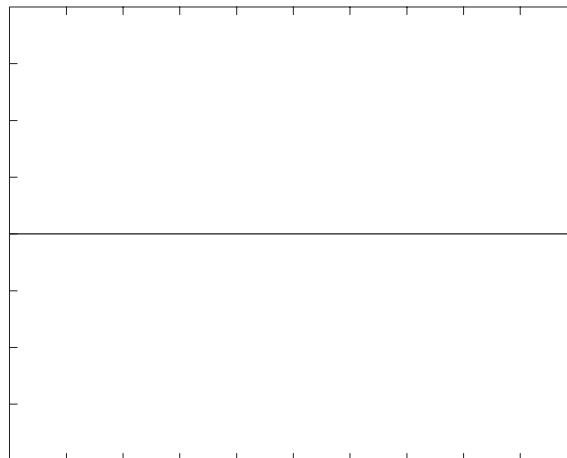


Figure 4-30: DC waveform output when the SW5 is closed

- 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.
 - g. Verify that the oscilloscope displays the waveform as shown in Figure 4-29.
4. Push the **CH1 OUT** button to turn off the CH1 LED.
 5. Disconnect the oscilloscope and ground closure.

External Clock Input and VCO Out Output Tests

These procedures check the external clock input function and the VCO output function of the AWG615 Arbitrary Waveform Generator.

Equipment required	Two 50 Ω SMA coaxial cables, a SMA(Female)-BNC(Ma) adapter, a signal generator, and an oscilloscope (TDS700).
Prerequisites	The AWG615 Arbitrary Waveform Generator must meet the prerequisites listed on page 4-7.

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(Female)-BNC(Fe) adapter to connect the AWG615 Arbitrary Waveform Generator VCO OUT output connector to the oscilloscope CH1 input connector.
2. Use a 50 Ω SMA coaxial cable to connect the AWG615 Arbitrary Waveform Generator EXT CLOCK IN input connector to the signal generator output connector.

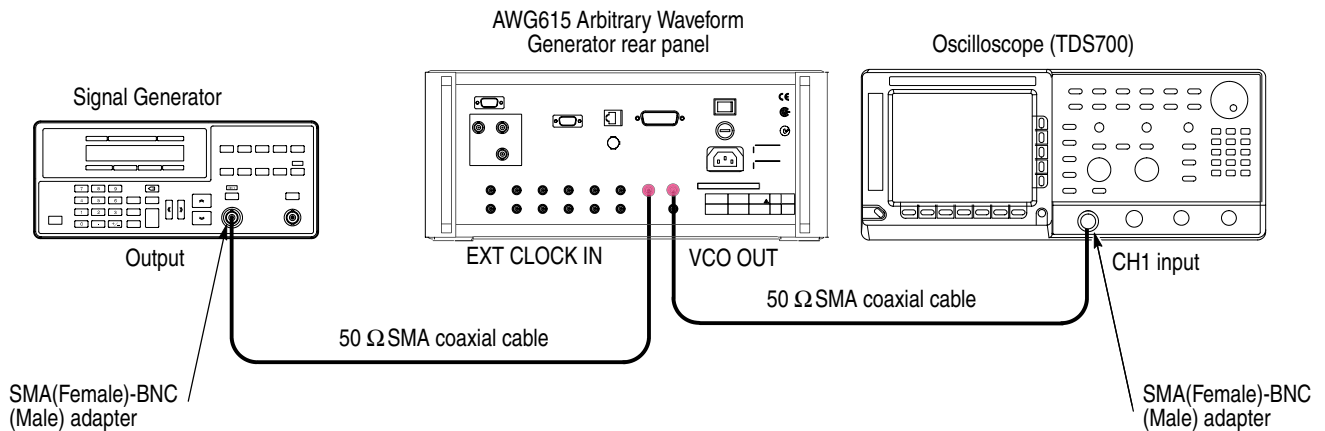


Figure 4-31: Trigger input initial test hookup

3. Set the oscilloscope controls as follows:

Vertical	CH1
CH1 coupling.....	DC
CH1 scale	200 mV/div
CH1 input impedance	50 Ω
Horizontal	
Sweep	2 ns/div

Trigger

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

- a. Set the signal generator controls as follows:

Parameter

Frequency.....	200 MHz
Amplitude.....	1.0 V (50 Ω)
Output.....	On

- b. Push **UTILITY** (front-panel)→**System** (bottom)→**Factory Reset** (side)→**OK** (side).
- c. Load the MODE.WFM file.
- d. Push **SETUP** (front-panel)→**Horizontal** (bottom)→**Clock Src** (side)→**External**.

Refer to *Loading Files* on page 4-8 for file loading procedures.

4. Push the **RUN** and **CH1 OUT** buttons.
5. Check that the LEDs above the RUN button and CH1 output connector are on.
6. Check that about 200.00 MS/s is displayed on the Clock field on the left-hand side of the AWG615 display top end.
7. Check that the amplitude of the square wave displayed on the oscilloscope is approximately 400 mV_{p-p} and the period is approximately 5 ns.
8. Disconnect the cable from the VCO OUT connector and connect the cable to the $\overline{\text{VCO OUT}}$ connector.
9. Check that the amplitude of the square wave displayed on the oscilloscope is approximately 400 mV_{p-p} and the period is approximately 5 ns.
10. Disconnect the cable from the $\overline{\text{VCO OUT}}$ connector and connect the cable to the CH1 OUTPUT connector of the AWG615.
11. Set the Horizontal sweep of the oscilloscope to 2 μs/
12. Check that the period of the sine wave displayed on the oscilloscope is approximately 5 μs.
13. Push the **RUN** button and the CH1 button to turn off the RUN LED.
14. Turn off the function generator output, disconnect the function generator.

VCO OUT Output Frequency and 10 MHz Reference Input Tests

These procedures check the VCO OUT output frequency and the 10 MHz reference input function of the AWG615 Arbitrary Waveform Generator.

Equipment required	A 50 Ω SMA coaxial cable, A 50 Ω BNC coaxial cable, a SMA(Female)-BNC(Male) adapter, a frequency counter, and a function generator.
Prerequisites	The AWG615 Arbitrary Waveform Generator must meet the prerequisites listed on page 4-7.

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(Female)-BNC(Male) adapter to connect the AWG615 Arbitrary Waveform Generator VCO OUT connector to the input B connector on the frequency counter.
2. Use a 50 Ω BNC coaxial cable to connect the AWG615 Arbitrary Waveform Generator 10 MHz REF IN connector to the function generator output connector (see Figure 4-32).

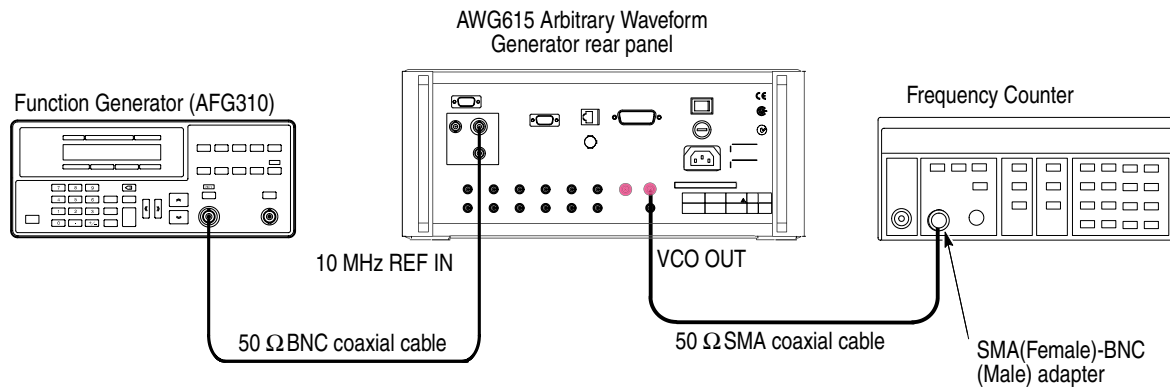


Figure 4-32: VCO OUT output frequency and 10 MHz reference input initial test hookup

- a. Set the frequency counter controls as follows:

INPUT A	
Coupling	AC
FUNCTION	B 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 MΩ)
Offset	0 V
Output	On

**Check VCO OUT
frequency**

1. Follow the substeps below to set the AWG615 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 4-8 for file loading procedures.
 - c. Push **HORIZONTAL MENU** (front-panel)→**Clock** (side).
 - d. Push **2**, **.**, **5** and **G** (SHIFT+CLR) keys in this order or turn the general purpose knob to set the internal clock frequency to 2.5 GHz.
2. Push the **RUN** button.
The LED above the RUN button is on.
3. Verify that the frequency counter reading is 2.5 GHz ± 2.5 kHz (using internal reference clock).
4. Retain the test hookup.

**Check 10MHz Reference
Input**

5. Push **HORIZONTAL MENU** (front-panel)→**Clock Ref** (side) so that the AWG615 Arbitrary Waveform Generator reference clock is set to External.
6. Verify that the frequency counter reading is approximately 2.50 GHz (using external reference clock).
7. Change the function generator controls as follows:

Frequency	9.9 MHz
-----------------	---------
8. Check that the frequency counter reading is approximately 2.475 GHz.
9. Turn the function generator output off and disconnect the function generator and frequency counter.

Marker Output Tests

These procedures check the accuracy of the AWG615 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(Ma)–BNC(Fe) adapters, BNC (female)–to–dual banana adapter, and a digital multimeter (DMM).
Prerequisites	The AWG615 Arbitrary Waveform Generator must meet the prerequisites listed on page 4-7.

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 AWG615 Arbitrary Waveform Generator MARKER 1 OUT to the DMM input connector (see Figure 4-33).

AWG615 Arbitrary Waveform Generator

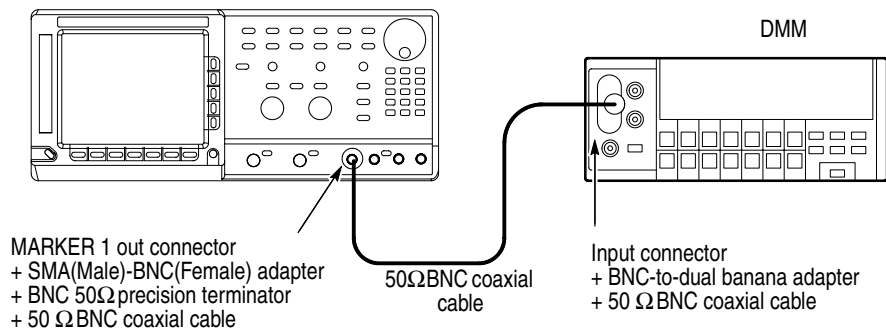


Figure 4-33: Marker output initial test hookup

2. Set the DMM controls as follows:

Mode VDC
Range Auto
Input Front

3. Follow the substeps below to set the AWG615 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 AWG615 Arbitrary Waveform Generator is set to enhanced mode.

c. Load the AMP1.SEQ file.

Refer to *Loading Files* on page 4-8 for file loading procedures.

4. Push the **RUN** button and **ALL MARKER OUT ON/OFF** button.

The LEDs above the RUN button and ALL MARKER OUT ON/OFF is on.

5. Do the following substeps to set the AWG615 Arbitrary Waveform Generator marker output high level setting:

a. Push **VERTICAL MENU** (front-panel)→**Marker...** (side)→**Marker 1 High Level** (side).

b. Push **2**, **.**, **4**, **5** and **ENTER** keys in this order or turn the general purpose knob to set the marker level to 2.45 V.

c. Verify that the marker 1 high level reading on the DMM screen falls within 2.2275 V through 2.6725 V.

d. Push the **FORCE EVENT** button.

6. Do the following substeps to set the AWG615 Arbitrary Waveform Generator marker output low level setting:

a. Push **Marker 1 Low Level** side button.

b. Push **-**, **2**, **.**, **0** and **ENTER** keys in this order or turn the general purpose knob to set the marker level to -2.0 V.

c. Verify that the marker 1 low level reading on the DMM screen falls within -2.2 V through -1.8 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(Ma)-BNC(Fe) 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 the cable (removed in step b) to the MARKER1 OUT connector.

8. Press Force Event where needed.

9. Repeat steps 5 and 6 for the AWG615 Arbitrary Waveform Generator MARKER1 OUT.
10. Repeat steps 5 through 8 for MARKER 2 OUT and MARKER2 OUT.
11. Disconnect the DMM.

Synchronous Operation Tests

These procedures check the signal path for the Synchronous Operation of the AWG615 Arbitrary Waveform Generator.

Equipment required	Four 50 Ω SMA C coaxial cables (P/N: 174-1427-00).
Prerequisites	The AWG615 Arbitrary Waveform Generator must meet the prerequisites listed on page 4-7.

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

NOTE. To perform this test, it is necessary to operate the AWG615 in Service mode.

1. Operate the AWG615 in Service mode (Refer to *Enabling Service Mode* on page 5-4);
 - a. Power off the AWG615.
 - b. Pushing the service switch by the adjustment tool, push the **ON/STBY** button.
2. Use four 50 Ω SMA coaxial cables to connect the T IN connector to the T OUT1 connector, the T IN connector to the T OUT1 connector, the C IN connector to the C OUT1 connector, and the C IN connector to the C OUT1 connector (see Figure 4-34).

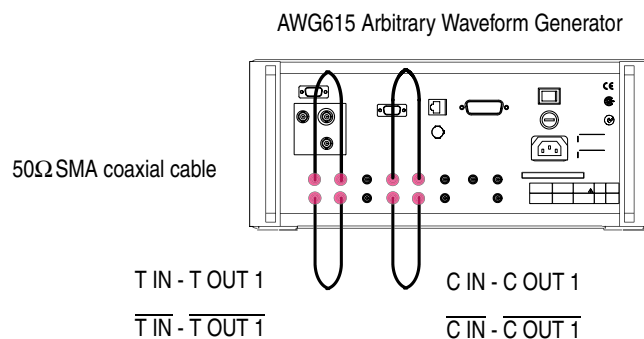


Figure 4-34: Synchronous operation test hookup

3. Follow the substeps below to set the AWG615 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)→**Extended Operation** (bottom)→**Sync - Master** (side).
 - c. Push **Connect** (bottom)→**Execute Trig Timing Calibration** (side).
4. Check that Pass is displayed being displayed on the Trigger Timing Cal. field at the lower left of the AWG615 screen.
5. Change the cable connection.
 - a. Disconnect the cable from the T OUT1 connector and connect it to the T OUT2 connector.
 - b. Disconnect the cable from the $\overline{\text{T OUT1}}$ connector and connect it to the $\overline{\text{T OUT2}}$ connector.
 - c. Disconnect the cable from the C OUT1 connector and connect it to the T OUT2 connector.
 - d. Disconnect the cable from the $\overline{\text{C OUT1}}$ connector and connect it to the $\overline{\text{T OUT2}}$ connector.
6. Push **Execute Trig Timing Calibration** (side).
7. Check that Pass is displayed being displayed on the Trigger Timing Cal. field at the lower left of the AWG615 screen.
8. Disconnect the four SMA cables.



Adjustment Procedures

Adjustment Procedures

This section provides the procedures necessary to manually adjust the AWG615 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, A60 Clock&Sync board and Flash disk	Clock Ref. DAC, Calibration and 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 adjustments without removing the cabinet.

Table 5-2: Adjustments

Adjustments	Refer to
Calibration	page 4-4
Reference Clock Frequency	page 5-6
Magic Frequency	page 5-7

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.

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. Adjustment Tool	Less than 1/8 inch diameter and over 4 inches long		Enabling service mode
7. 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 5-3, Item 6) 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.

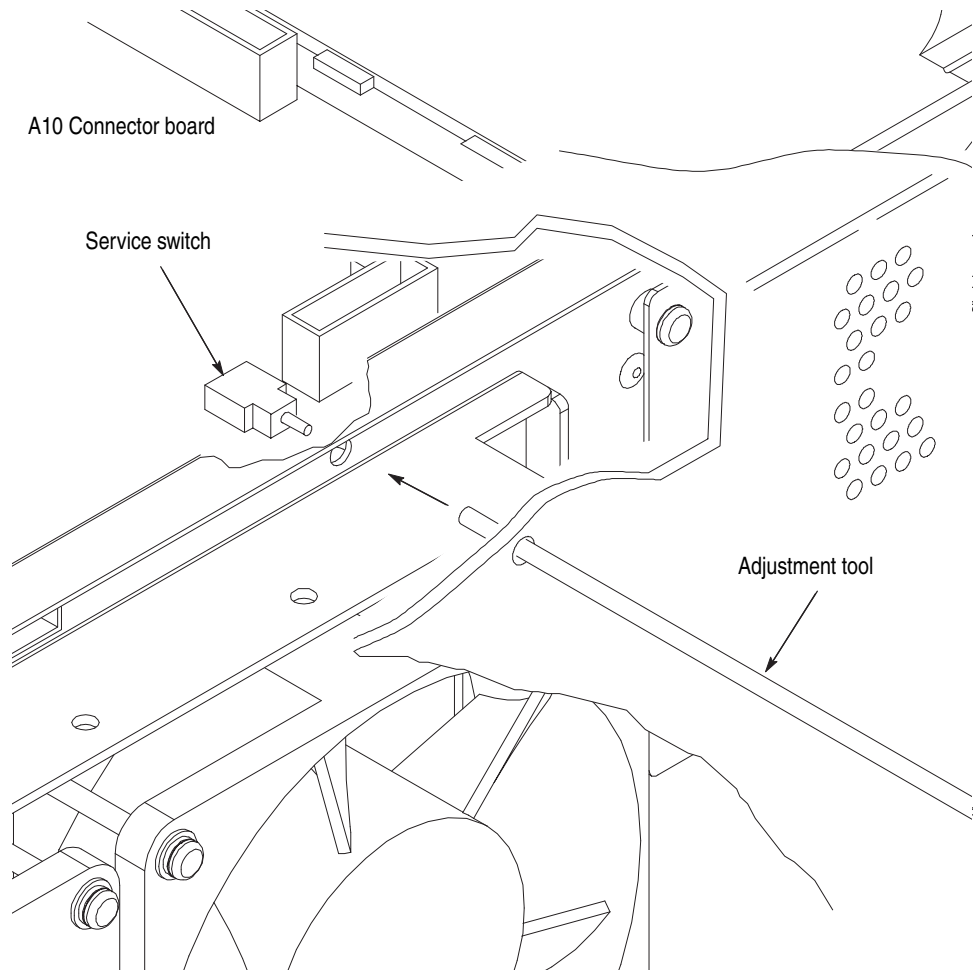


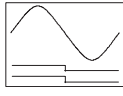
Figure 5-1: Accessing the service switch

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 A60 Sync&Clock board to set the AWG615 Arbitrary Waveform Generator clock frequency.

Equipment Required	One frequency counter (Item 2)
	One 50 Ω BNC 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.

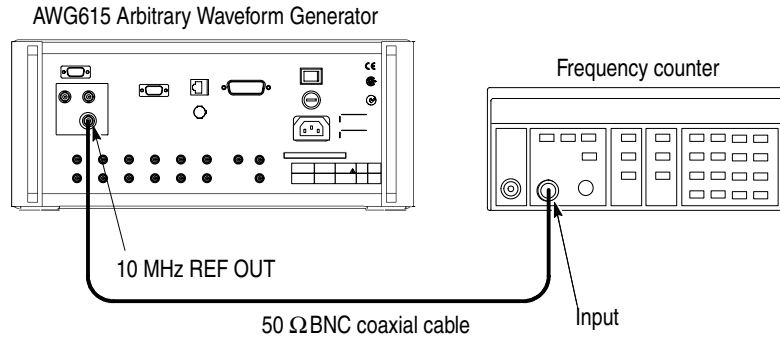


Figure 5-2: Hookup for the reference clock frequency adjustment

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.

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.

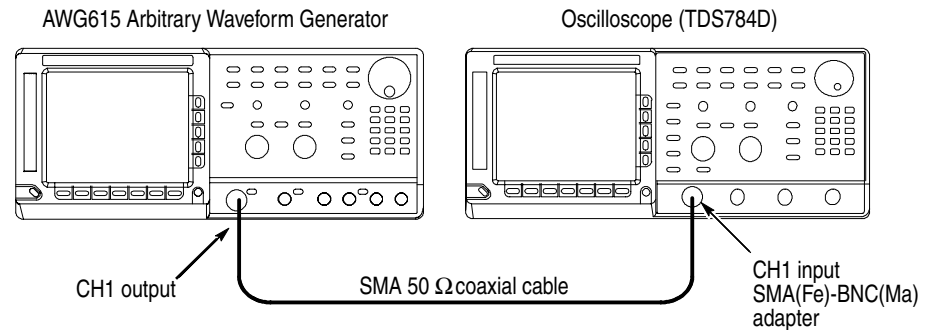


Figure 5-3: Hookup for the magic frequency adjustment

2. Set the Oscilloscope controls as follows:

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

Maintenance

This section contains the information needed to perform periodic and corrective maintenance on the AWG615 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

2 = 200 to 500 V

3 = 250 V

4 = 500 V

5 = 400 to 600 V

6 = 600 to 800 V

7 = 400 to 1000 V (est.)

8 = 900 V

9 = 1200 V

Inspection and Cleaning

Inspection and Cleaning describes how to inspect for dirt and damage. It also describes how to clean the exterior and interior of the AWG615 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

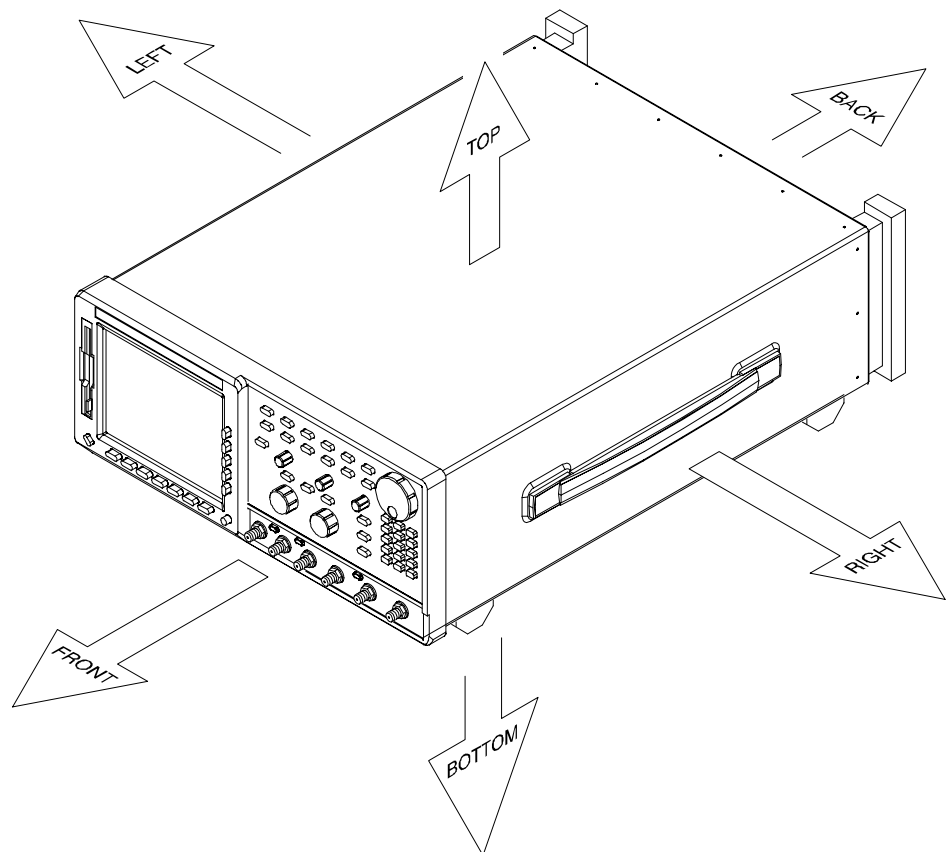
Item no.	Name	Description
1	Screwdriver handle	Accepts Phillips–driver bits
2	#1 Phillips tip	Phillips–driver bit for #1 screw size
3	#2 Phillips tip	Phillips–driver bit for #2 screw size
4	Flat–blade screwdriver	Screwdriver for removing standard-headed screws
5	Needle–Nose Pliers	Standard tool
6	Nutdriver, 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**

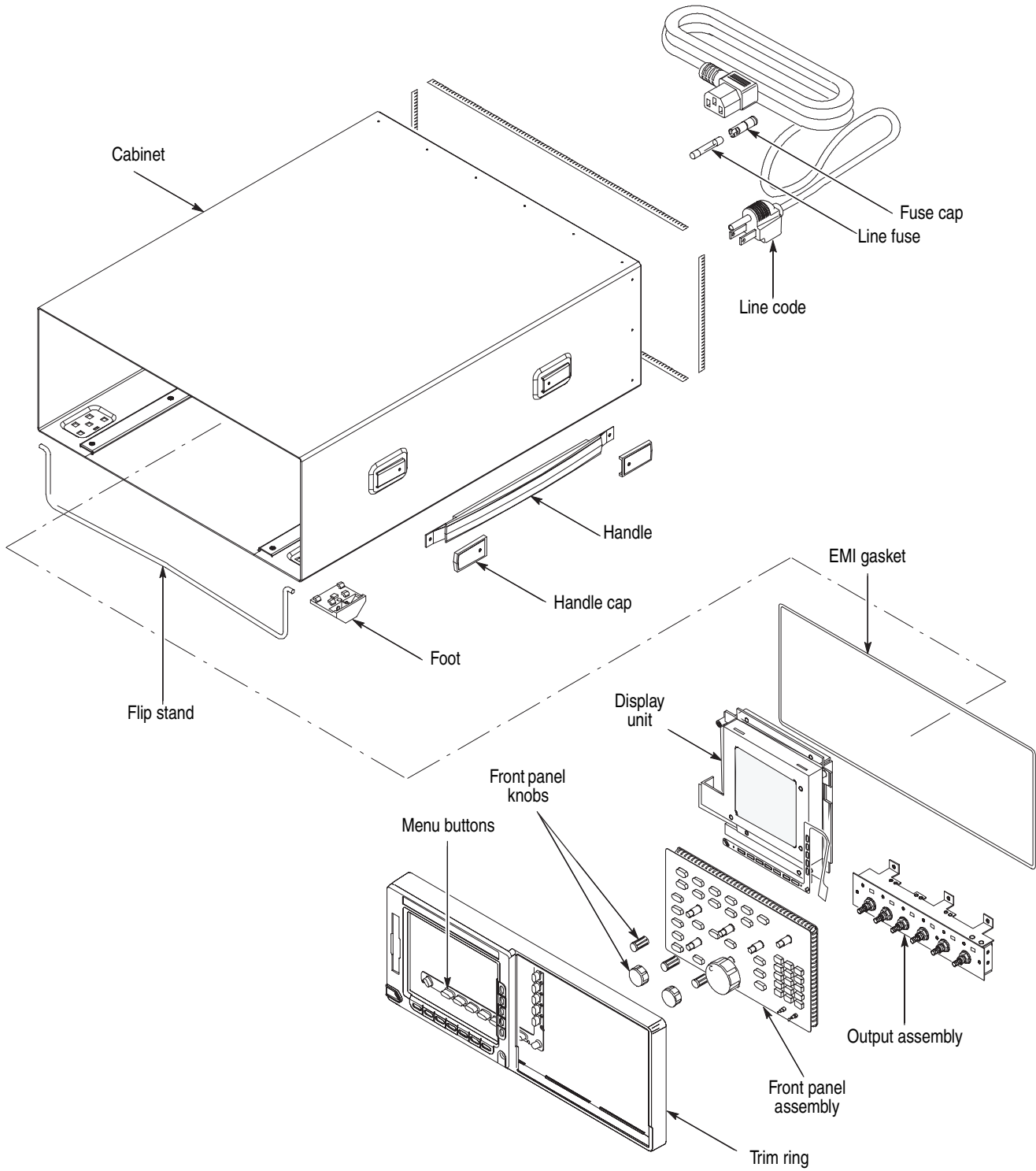


Figure 6-2: External modules

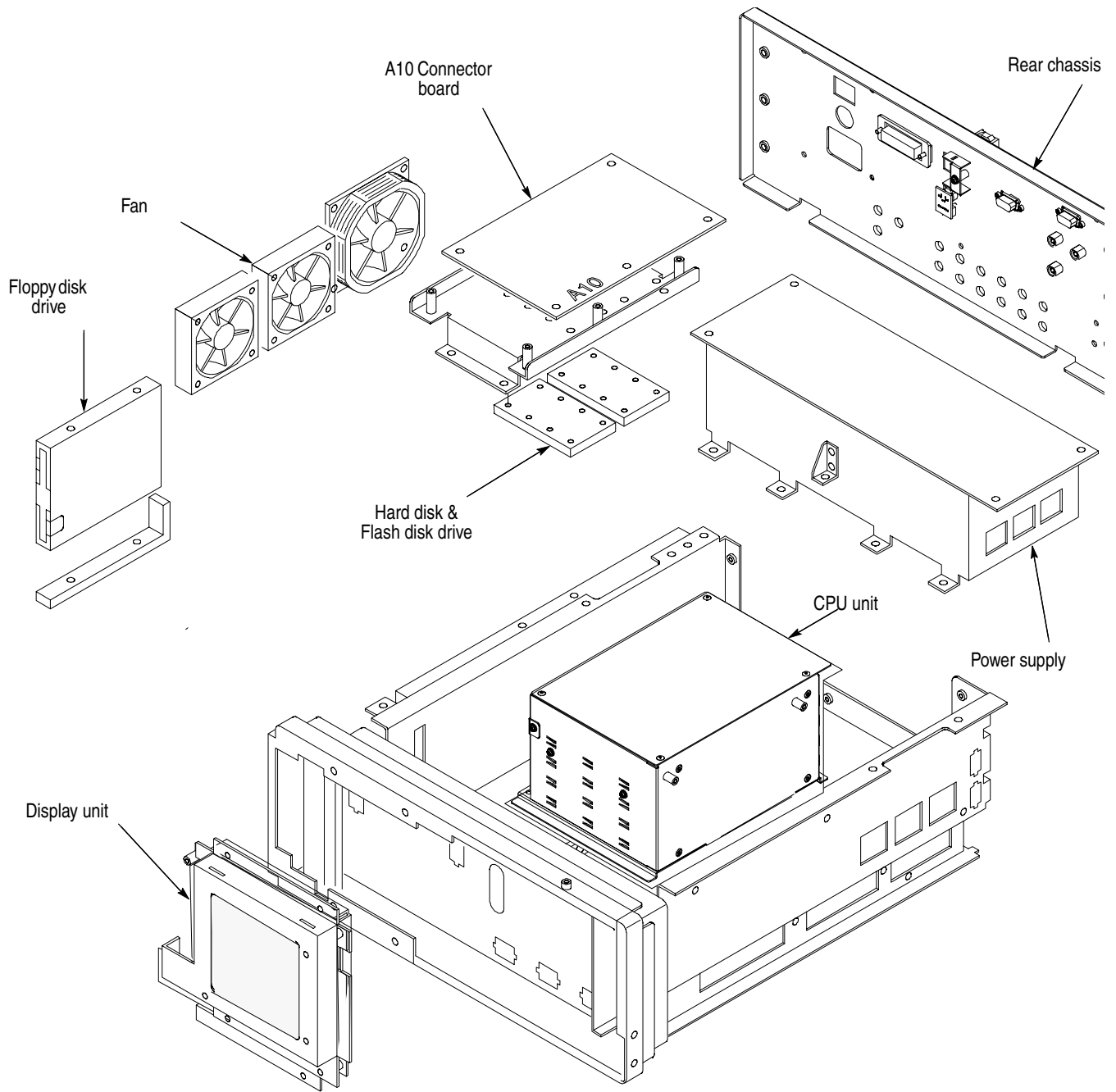


Figure 6-3: Internal modules (1)

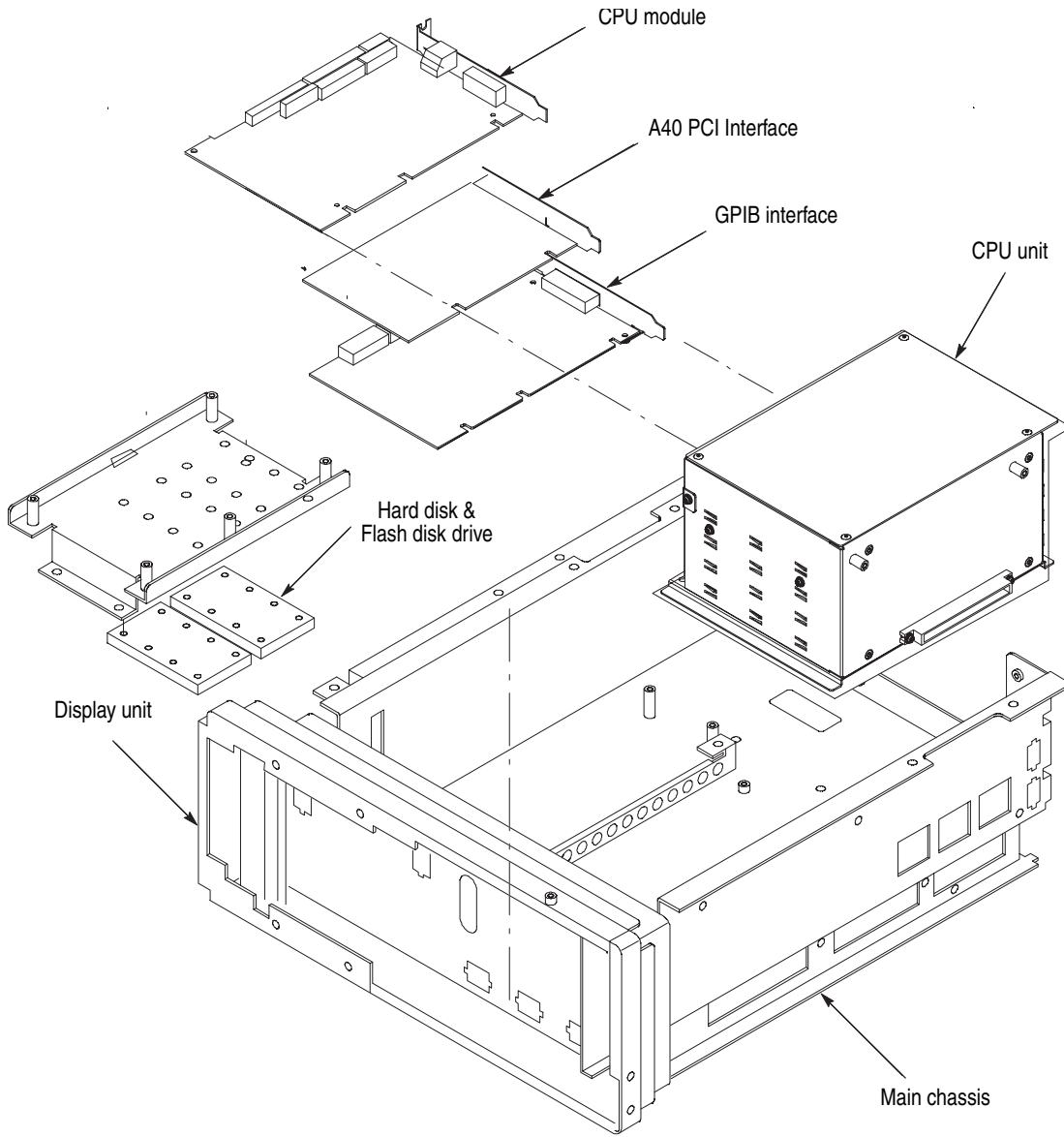


Figure 6-4: Internal modules(1)

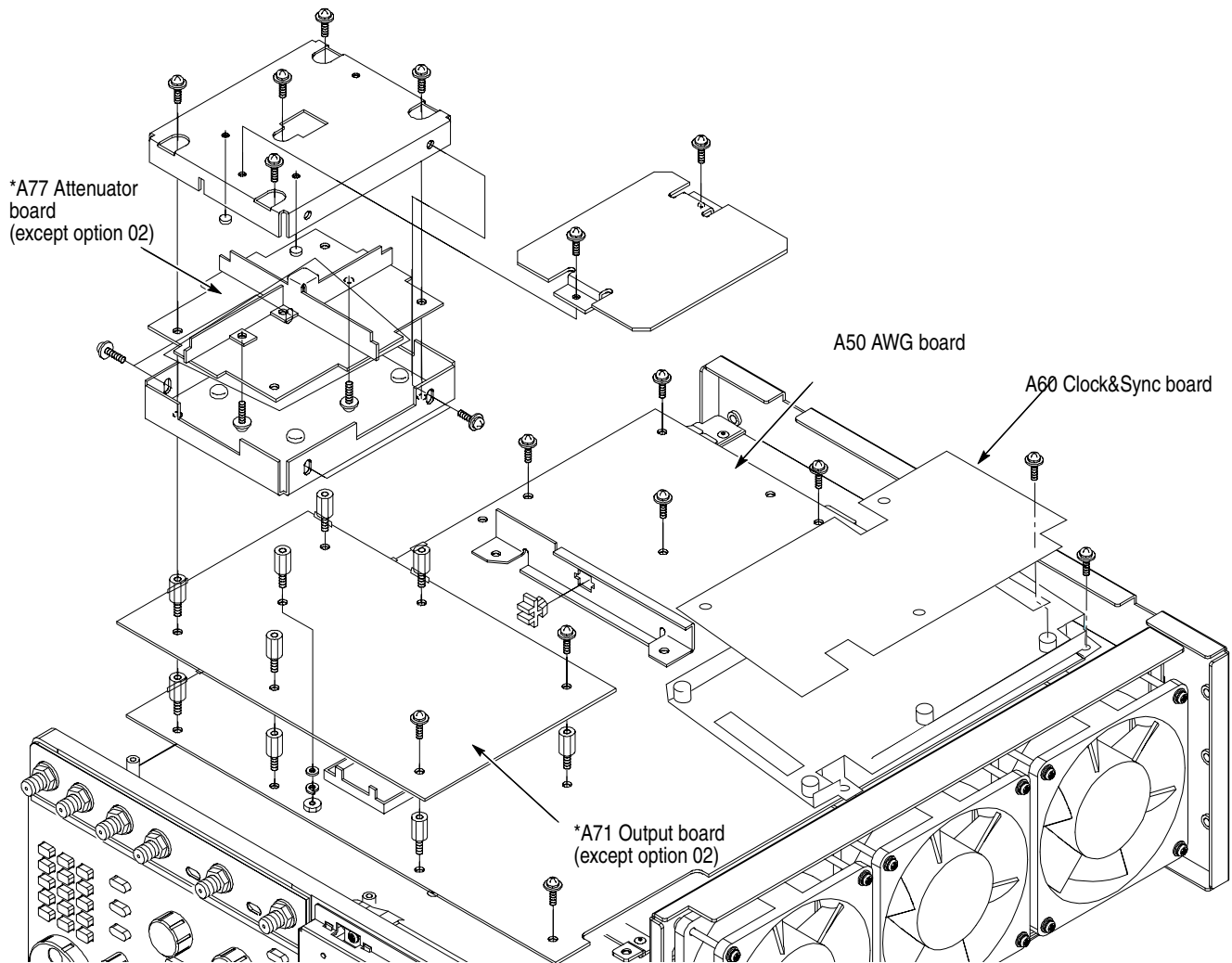


Figure 6-5: Internal modules(2)

*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.

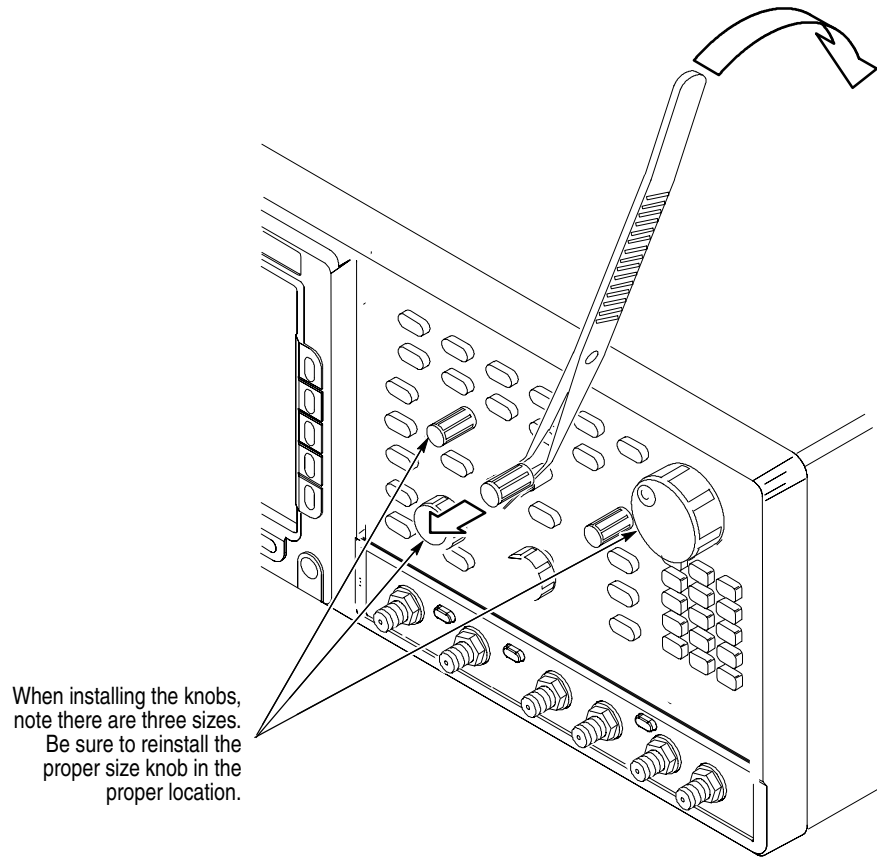


Figure 6-6: Knob removal

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.

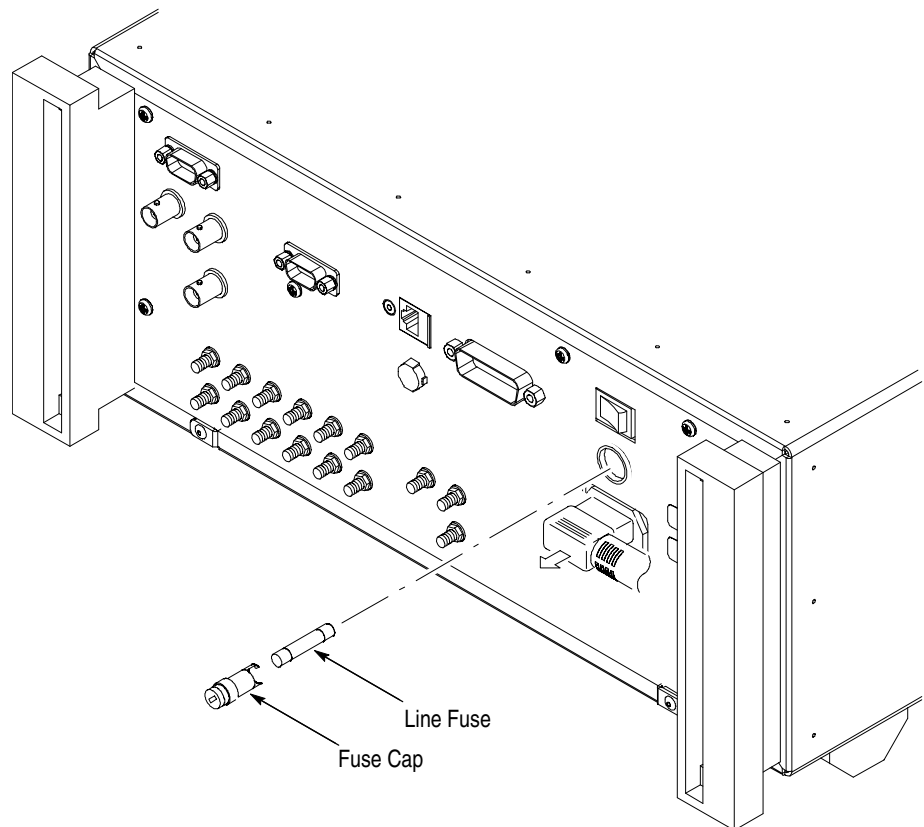


Figure 6-7: Line fuse and line cord removal

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. Unplug the line cord from its receptacle at the rear cover.
3. Locate the cabinet in Figure 6-2, page 6-12.
4. Orient the generator so the front cover is on the work surface and the bottom side is facing you.
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 5 and 12 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.

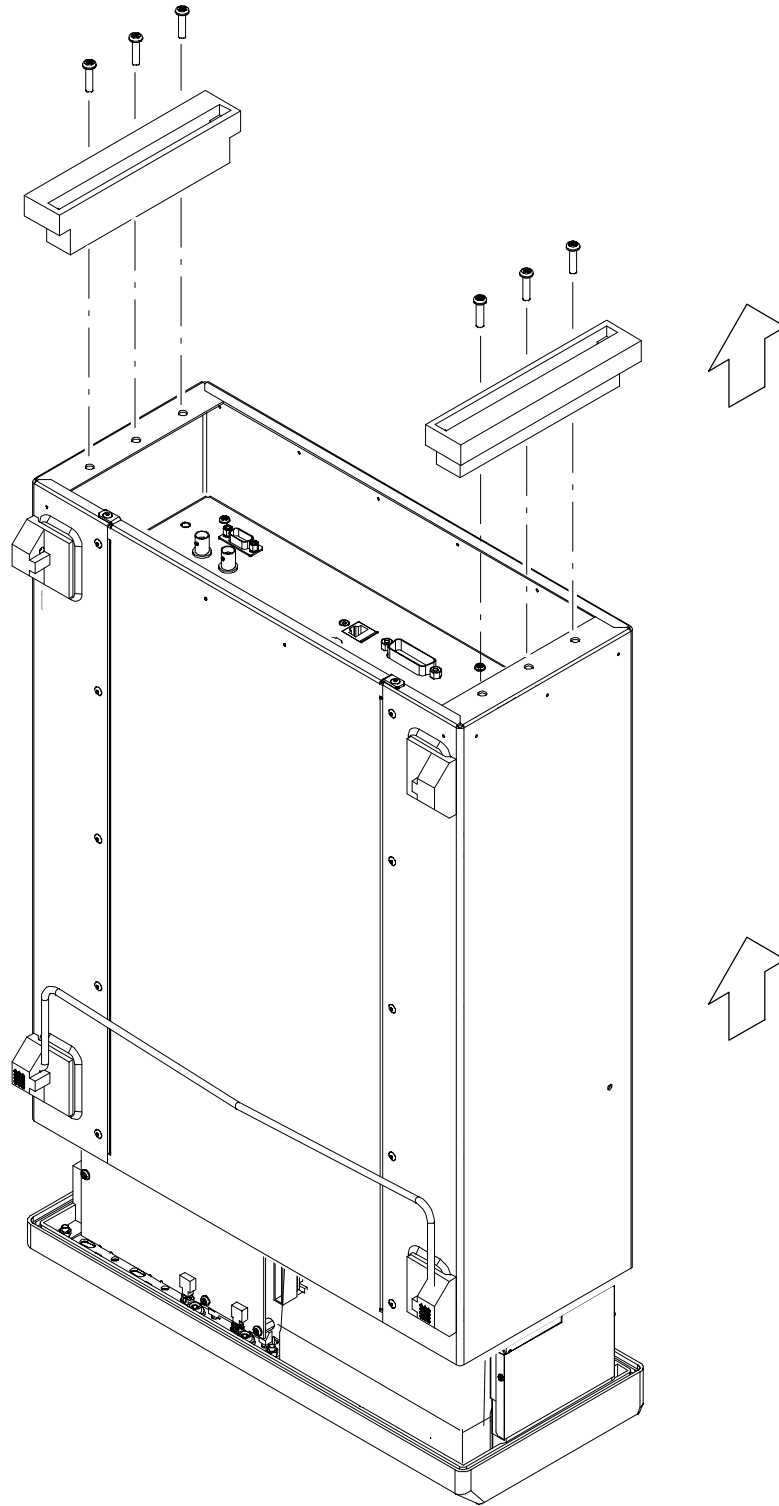


Figure 6-8: Cabinet removal

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.

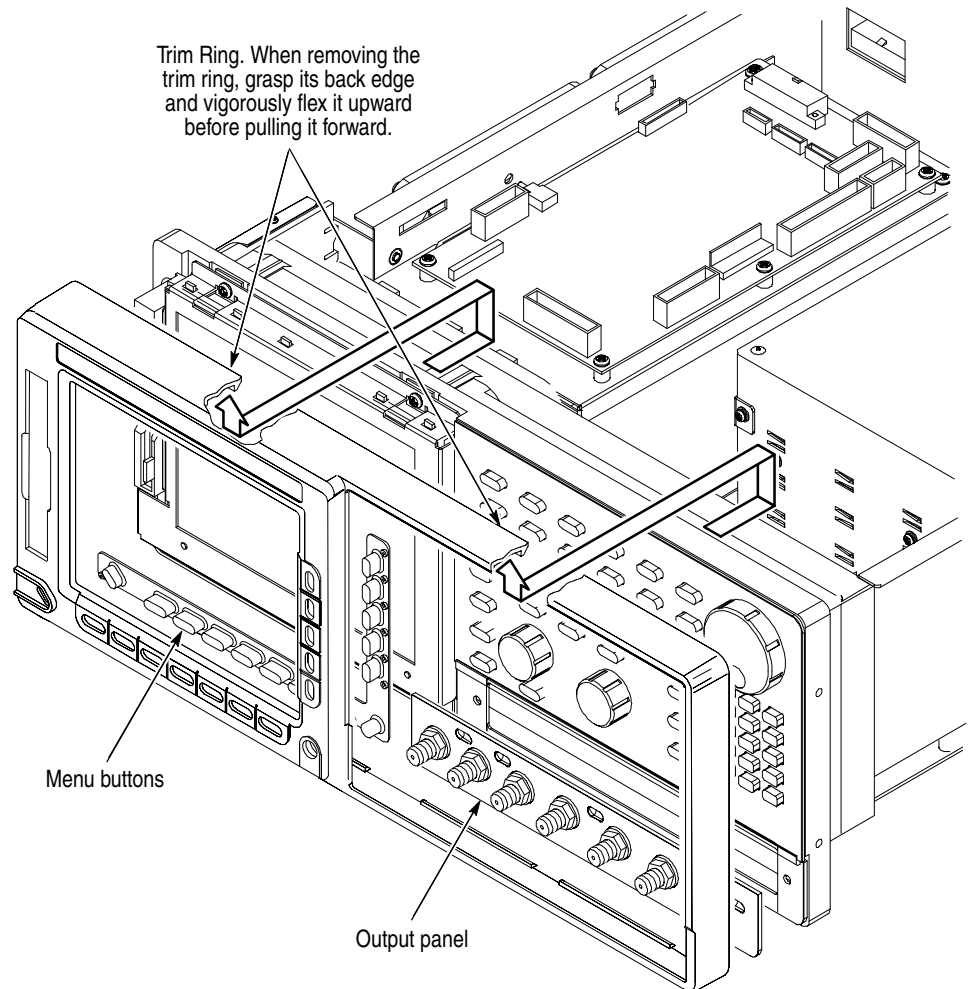


Figure 6-9: Trim ring and menu buttons removal



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.

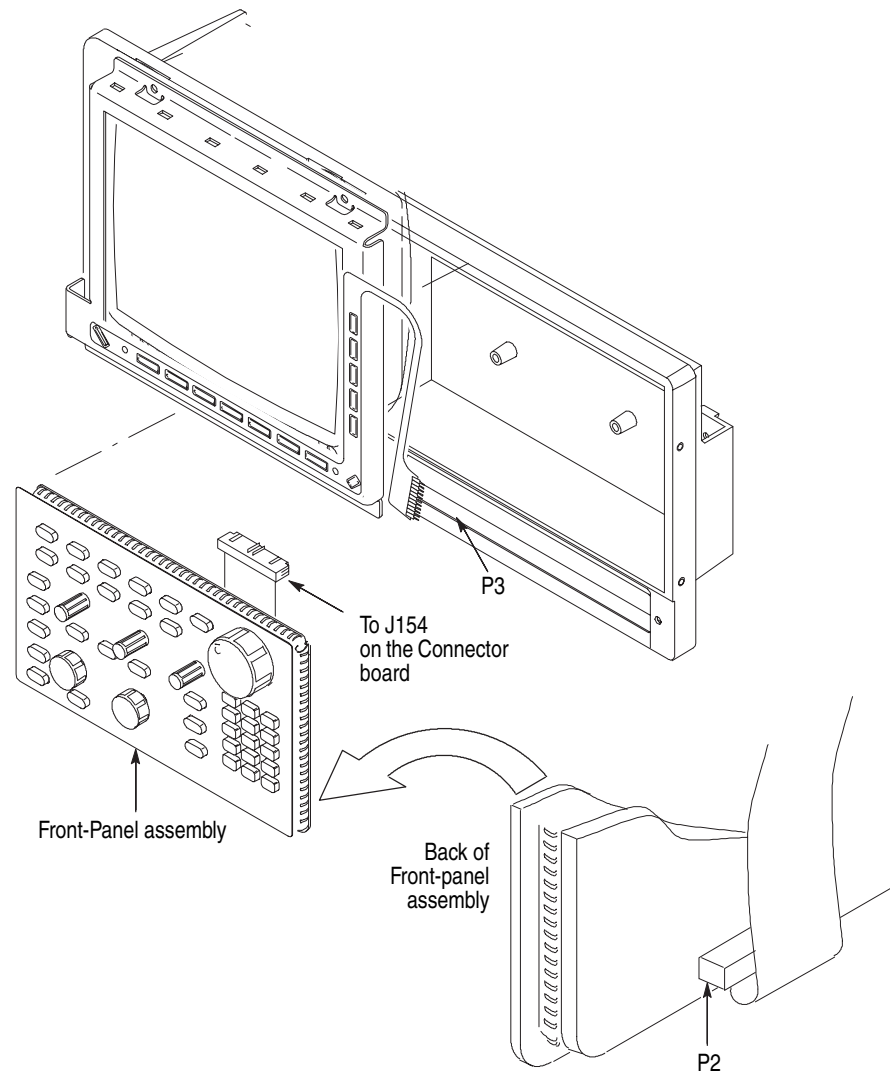


Figure 6-10: A20 Front panel assembly removal

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.

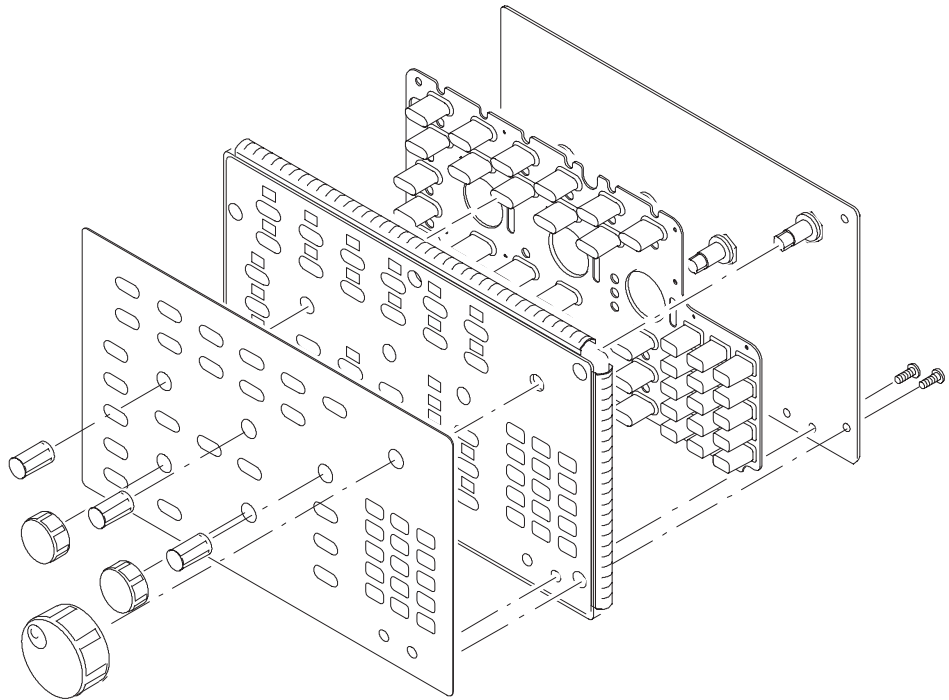


Figure 6-11: Disassembly of front panel assembly

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 Marker Out cables at J6301, J6302, J7301, J7302 of the A50 AWG board and all the Analog output cables at J180 and J280 of each A77/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.

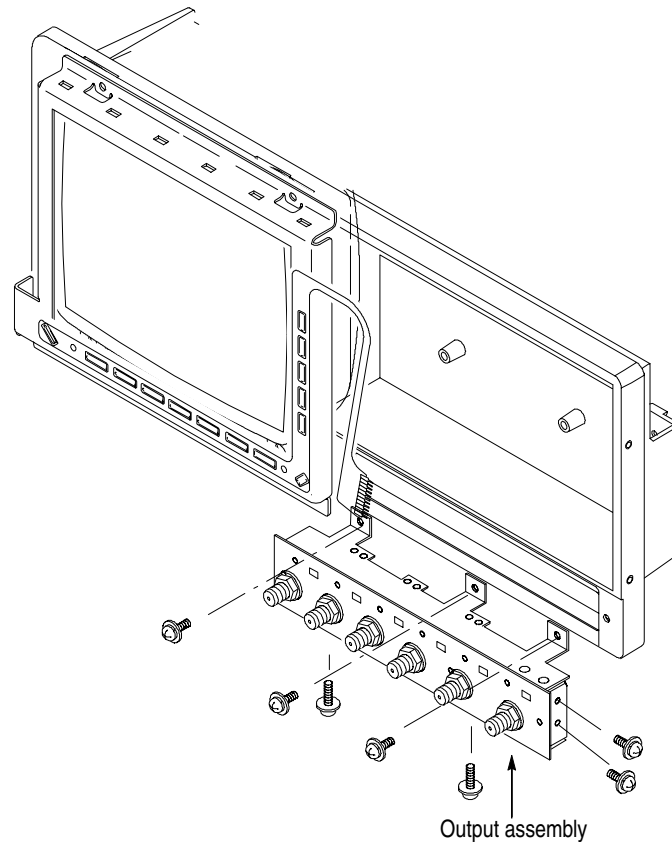


Figure 6-12: Output assembly removal

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.

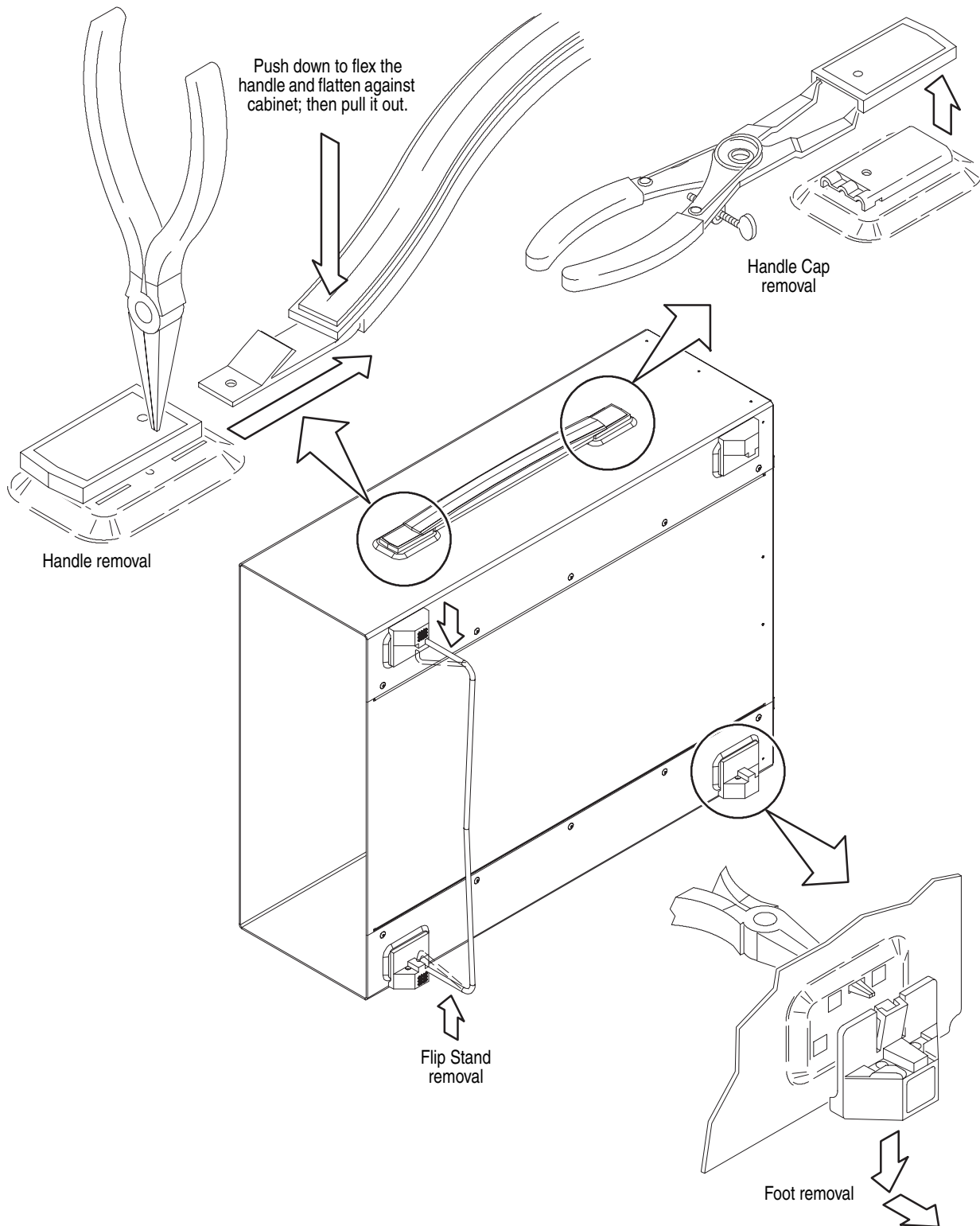


Figure 6-13: Cabinet modules removal

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.

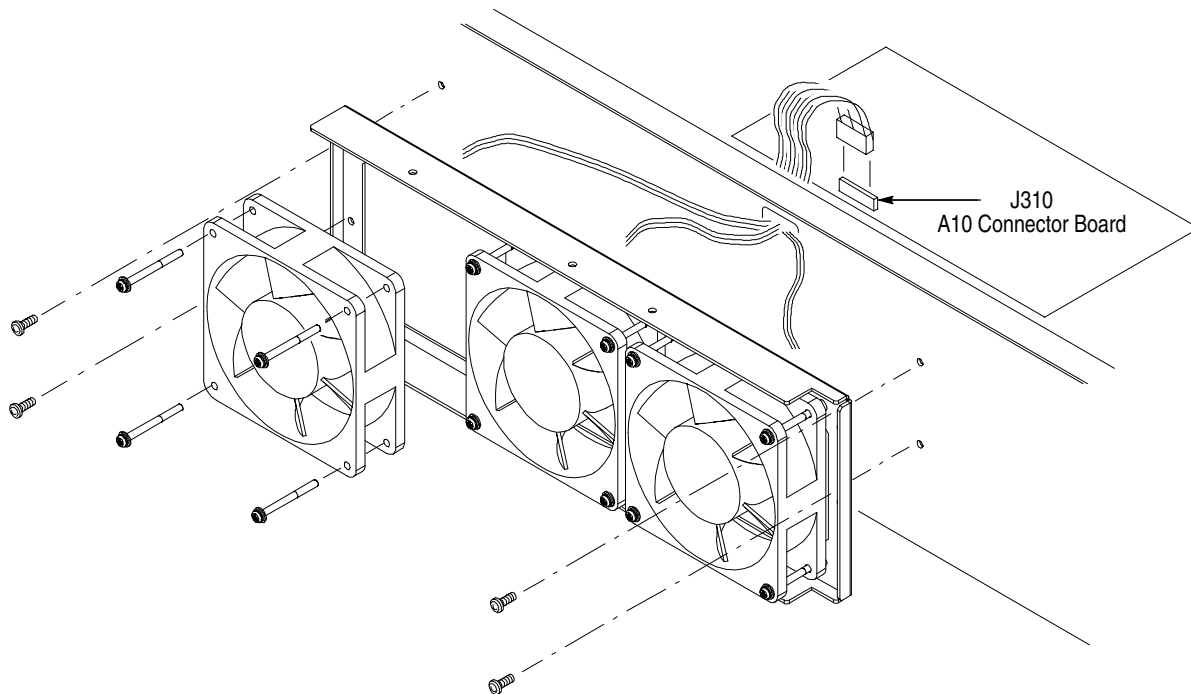


Figure 6-14: Fan removal

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.

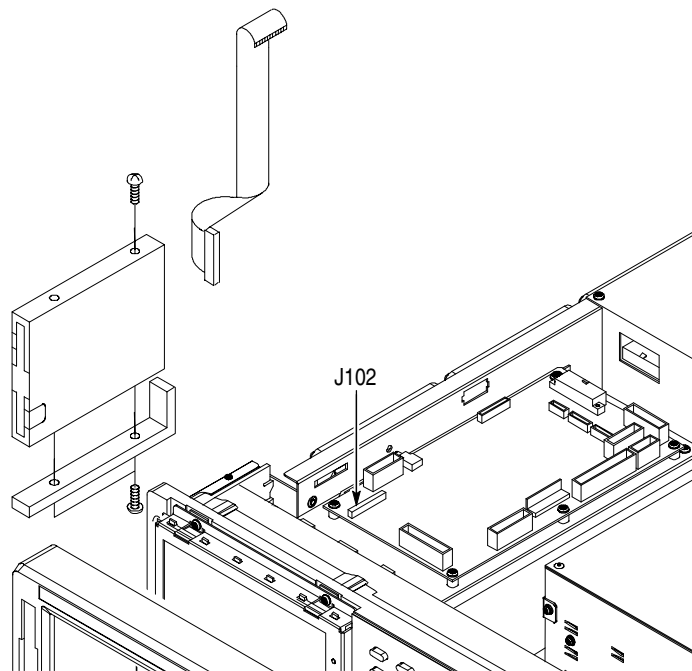


Figure 6-15: Floppy disk drive removal

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.

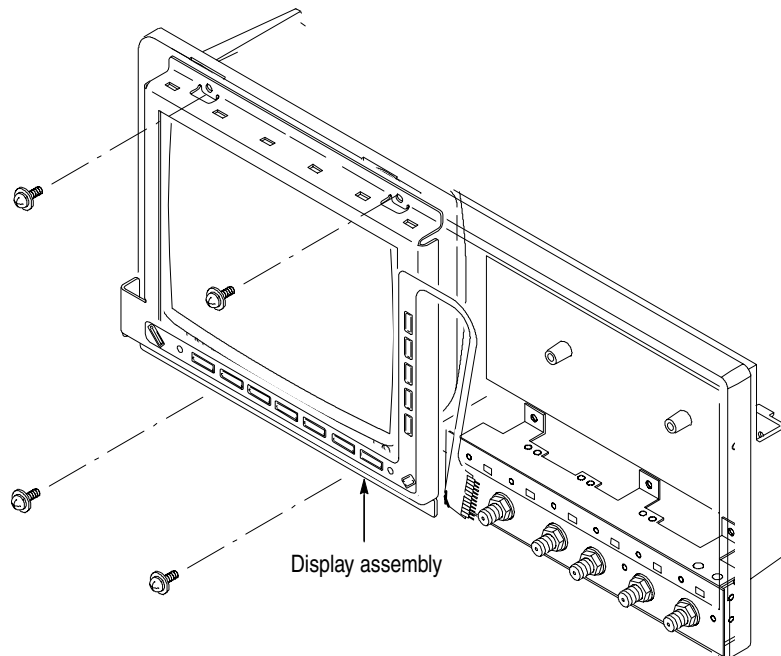


Figure 6-16: Display assembly removal

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 AWG 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.

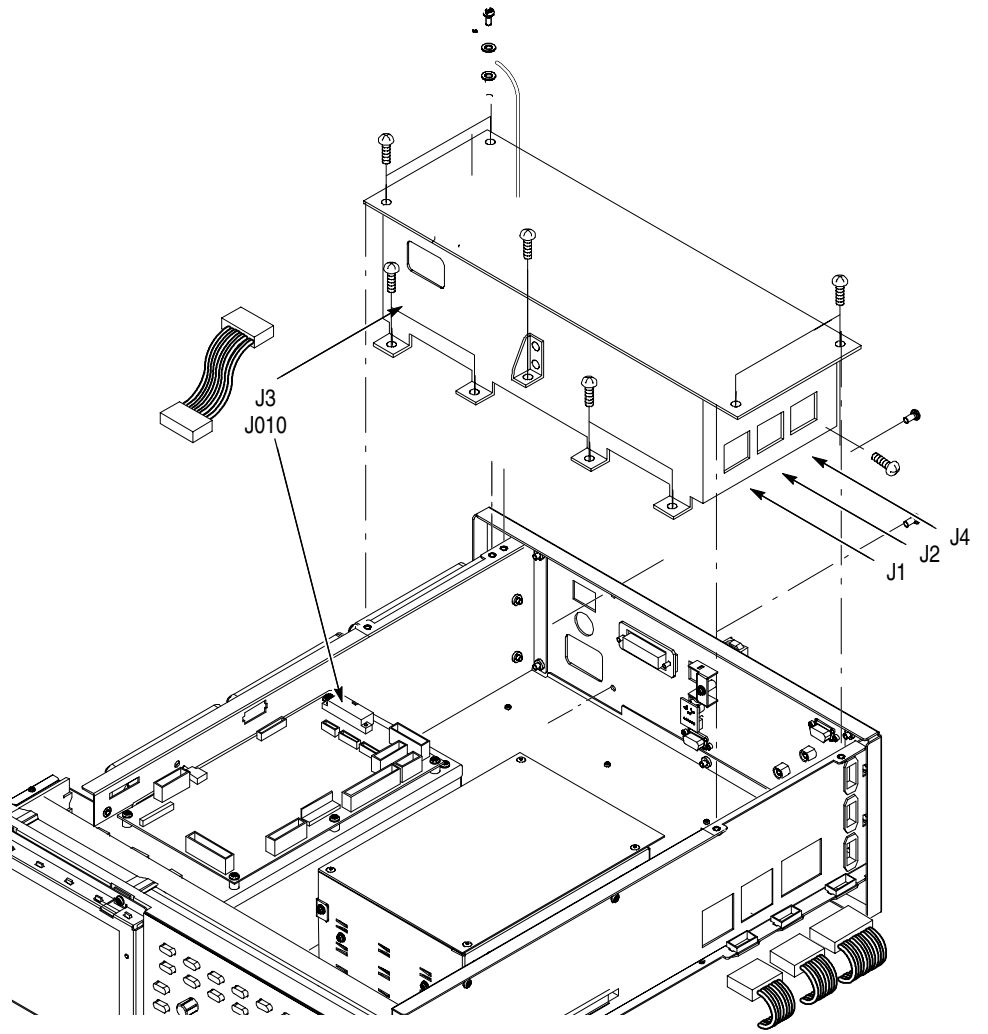


Figure 6-17: Power supply module removal

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 J200
 - 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.

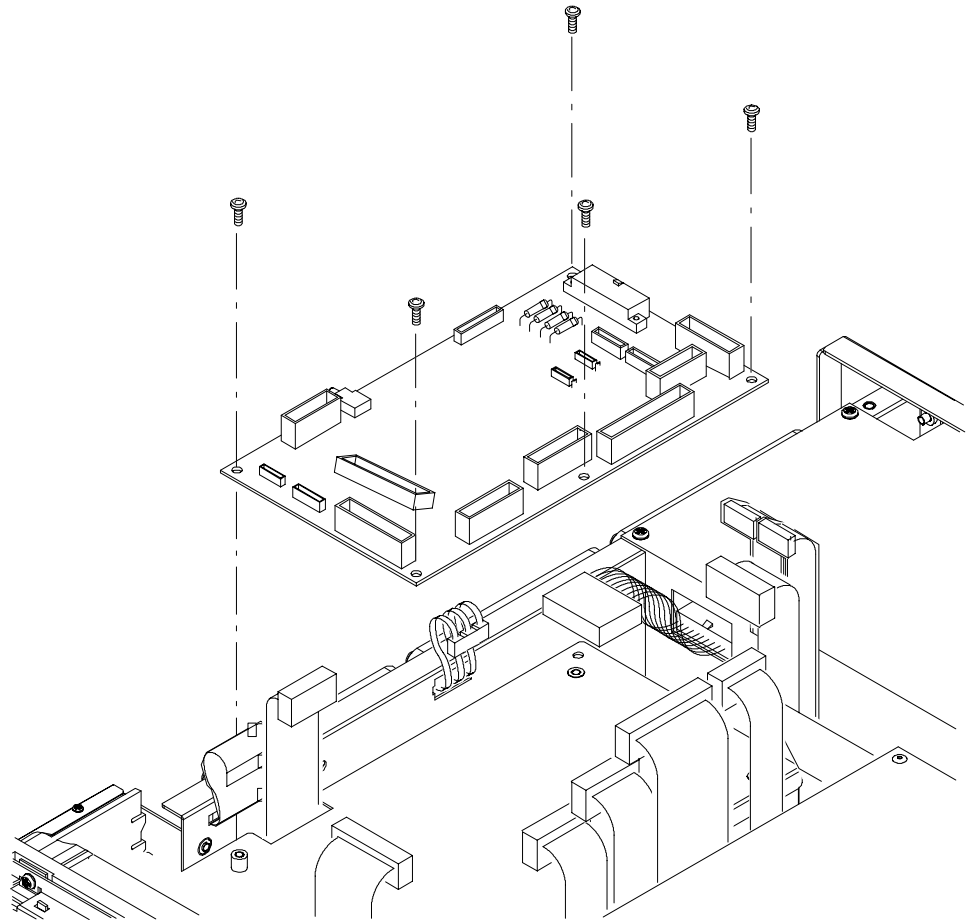


Figure 6-18: A10 connector board removal

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 poly carbon mono fluoride 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 AWG 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.

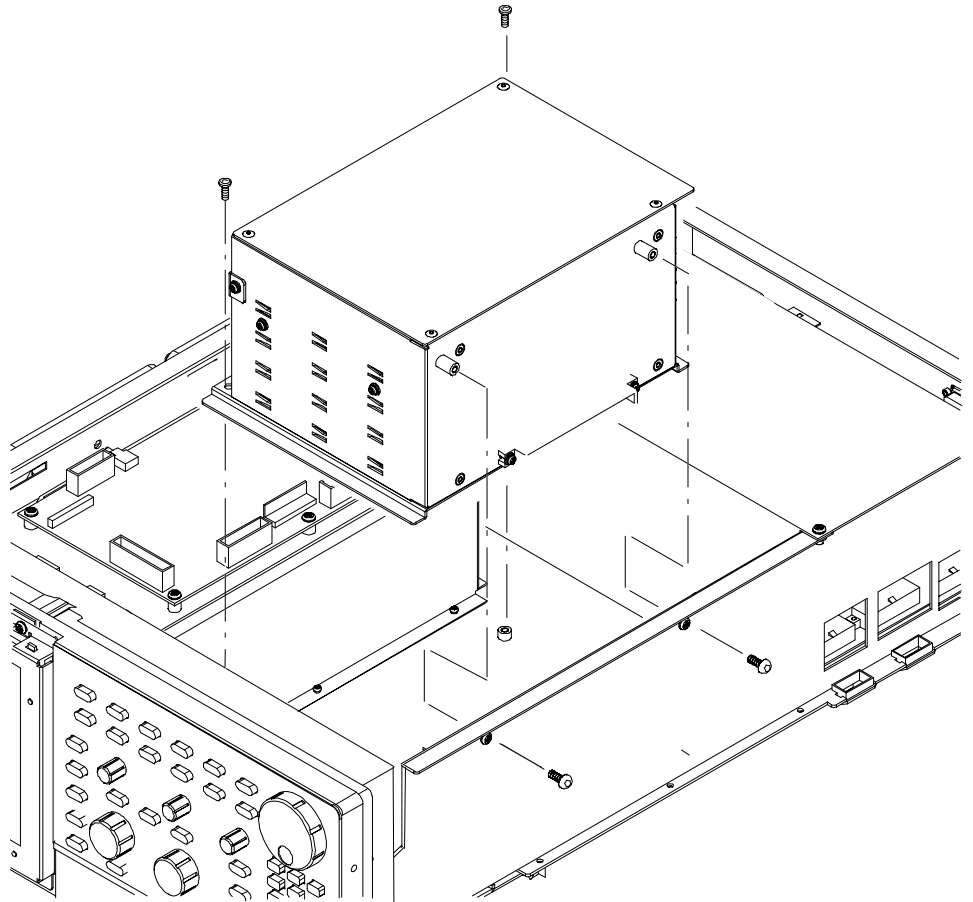


Figure 6-19: CPU unit removal

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 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.

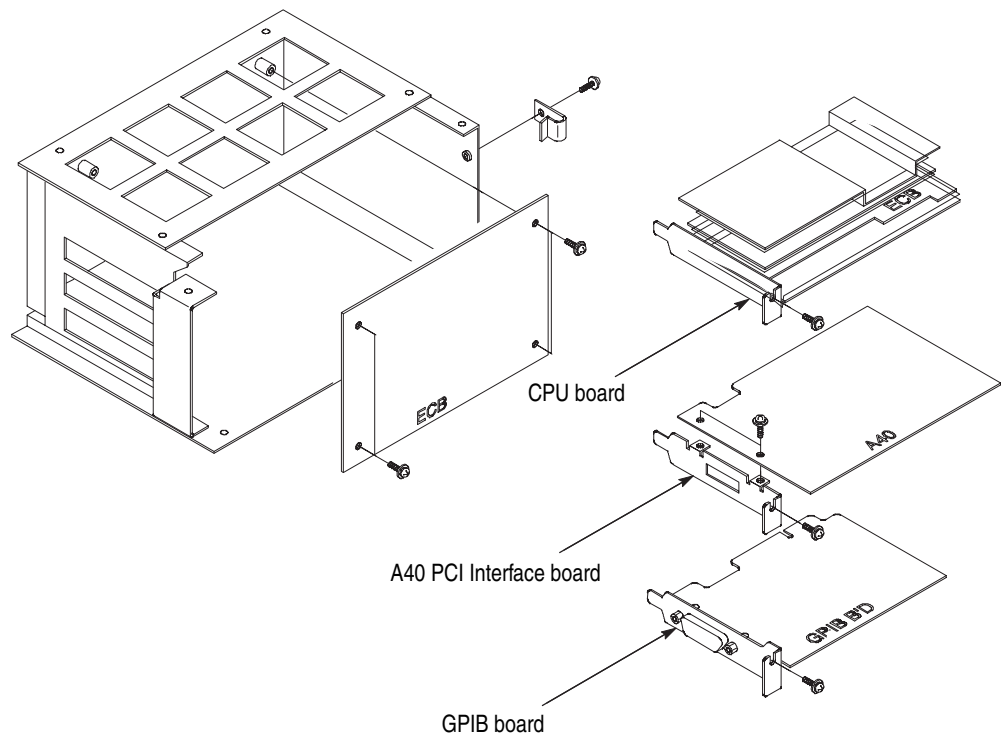


Figure 6-20: CPU, A40 PCI Interface, and GPIB boards removal

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 6-36) 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.

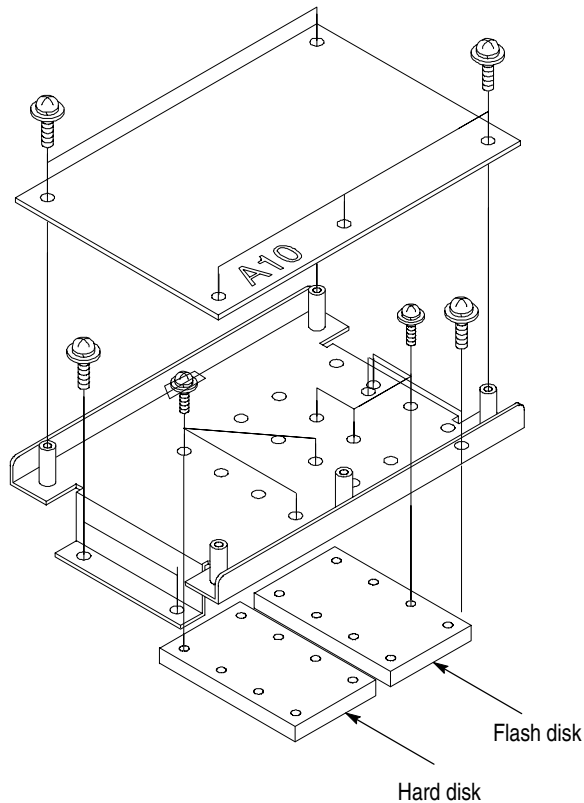


Figure 6-21: Hard disk and flash disk removal

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 J560 on the A50 AWG board
 - C IN at R11(J5420), $\overline{C\ IN}$ at R12(J5421) on the A 50 AWG board.
 - T IN at R5(J8080), $\overline{T\ IN}$ at R6(J8081), T OUT1 at R7(J8060), $\overline{T\ OUT1}$ at R8(J8061), T OUT2 at R9(J8062), $\overline{T\ OUT2}$ at R10(J8063), C OUT1 at R13(J8204), $\overline{C\ OUT1}$ at R14(J8205), C OUT2 at R15(J8206), $\overline{C\ OUT2}$ at R16(J8207), EXT CLOCK IN at R17(J6290), VCO OUT at R18(J8210), $\overline{VCO\ OUT}$ at R19(J8211) on the A60 CLOCK & SYNC board.
 - b. Remove the five screws that secure the rear chassis to the main chassis.

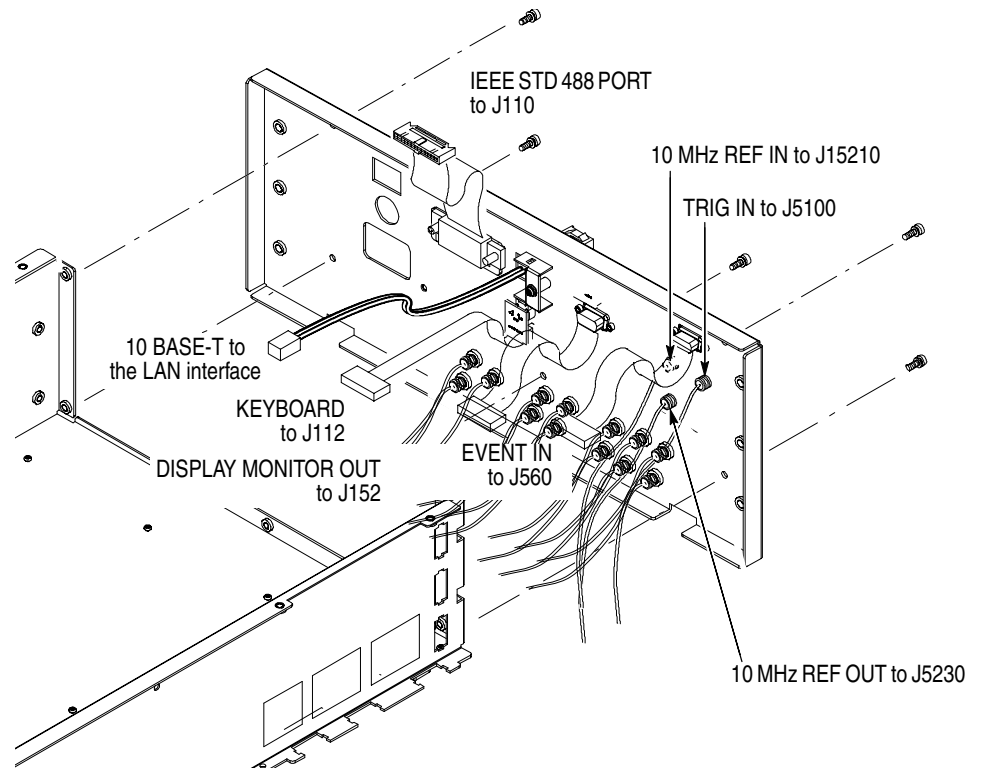


Figure 6-22: Rear chassis removal

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)
- *A71 Output Board* (except option 02)
- *A60 Clock&Sync Board*
- *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 at J5400 and J5401 on 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 *A71 Output Board*.
4. Lift the shield case including the *A77 Attenuator Board* up perpendicularly from the *A71 Output Board* to complete the removal.

NOTE. *The A77 Attenuator board has two connectors on both the front and rear panel side 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.

- To install, do the procedure in the reverse order.

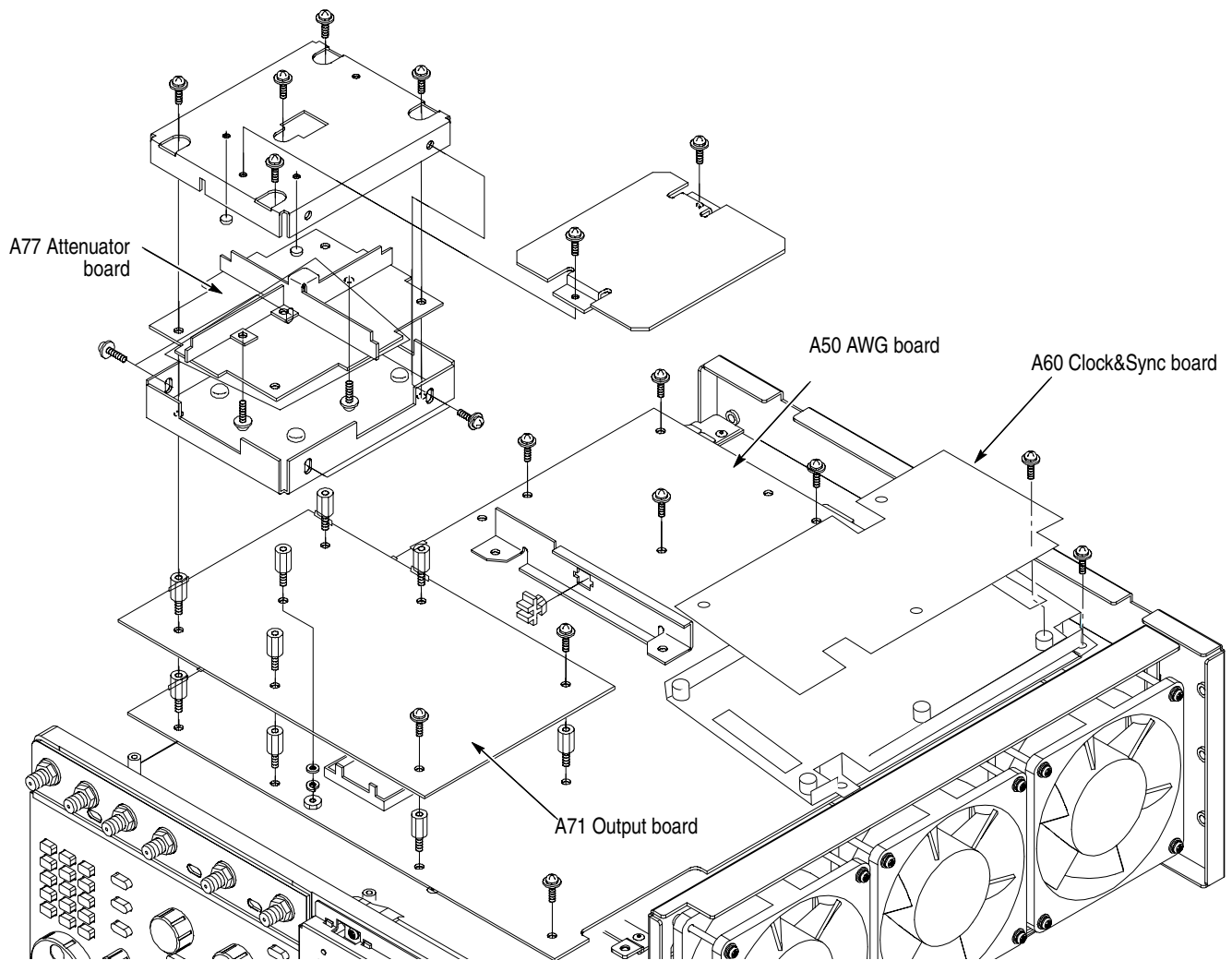


Figure 6-23: Removal of the A77, A71, A60 and A50 boards (except option 02)

**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 *A71 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 *A71 Output Board* to the *A50 AWG board*.
7. Lift the Output board up perpendicularly from the *A50 AWG board* to complete the removal.

NOTE. *A71 Output board has a connector on the front panel side, and is connected with A50 AWG board. In case you remove A71 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.

A60 Clock&Sync 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. Remove the *A60 Clock&Sync Board* with the bracket using Figure 6-23 on page 6-45 as a guide.
 - a. Unplug these cables:
 - Three cables from TRIG IN, 10MHz REF IN and to 10MHz REF OUT connector
 - Four cables from the A50 AWG board
 - Thirteen cables from the Rear panel
 - b. Remove the three screws on the upper surface attaching the shield case to the *A50 AWG Board*.
4. Lift the bracket including the *A60 Clock&Sync Board* up perpendicularly from the *A50 AWG Board* to complete the removal.

NOTE. *The A60 Clock&Sync Board has two connectors on both the front and rear panel side and is connected to the A50 AWG board. In case you remove the A60 Clock&Sync Board, raise perpendicularly.*

5. To remove from the bracket, remove the six screws.
6. To install, do the procedure in the reverse order.

**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 *A71 Output Board* and *A60 Clock&Sync Board* procedures prior to this procedure to remove the AWG 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
 - Two cables from C IN at J5420 and $\overline{\text{C IN}}$ at J5421
 - Four cables from Marker Out at J6301, J6302, J7301 and J7302
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 AWG board to the main chassis.
6. To install, do the procedure in the reverse order.

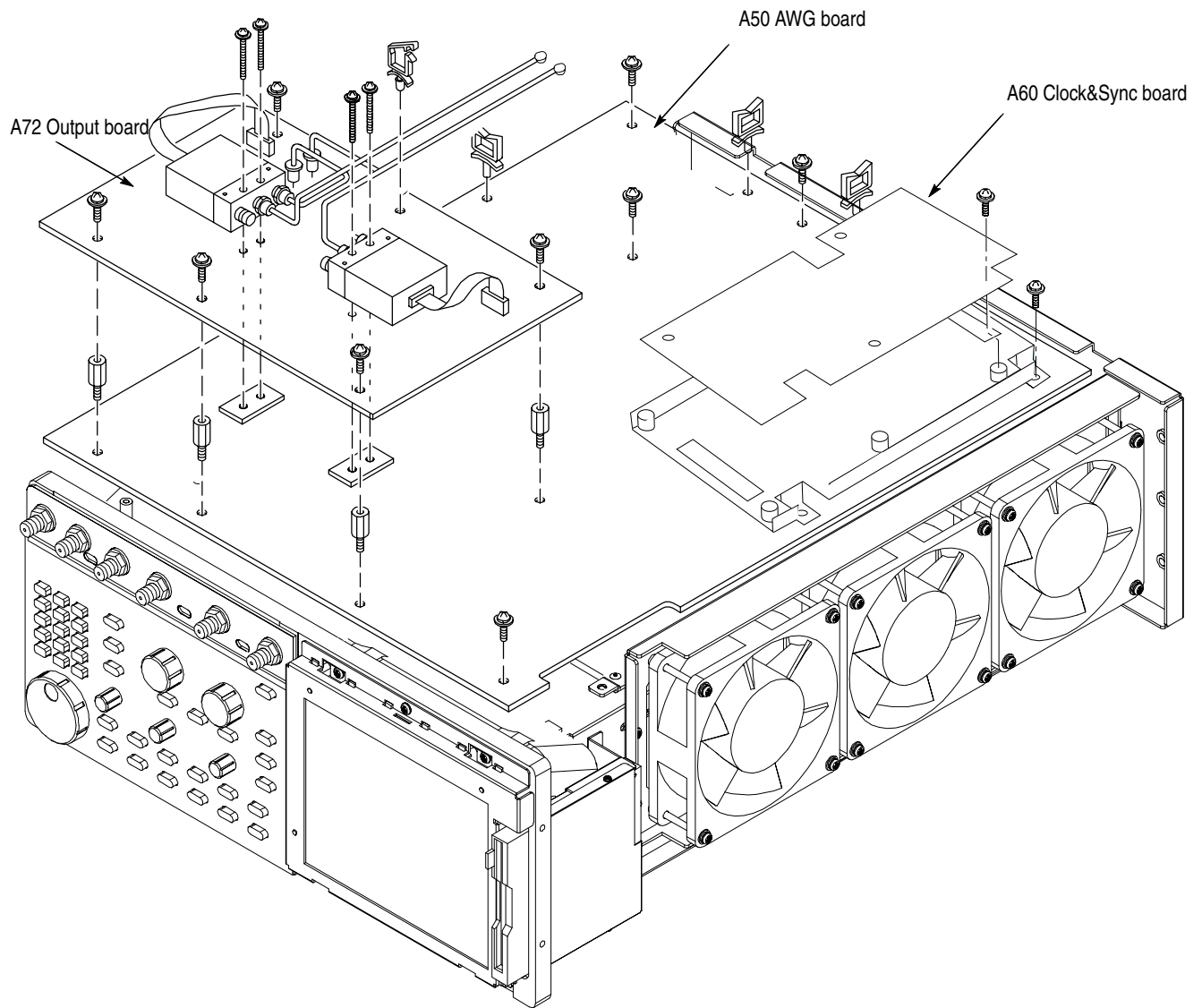


Figure 6-24: Removal of the A72, A60 and A50 boards (for option 02)

**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 6-49 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.
- Figure 6-32: Troubleshooting Procedure 5– Synchronous operation on page 6-59.

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.

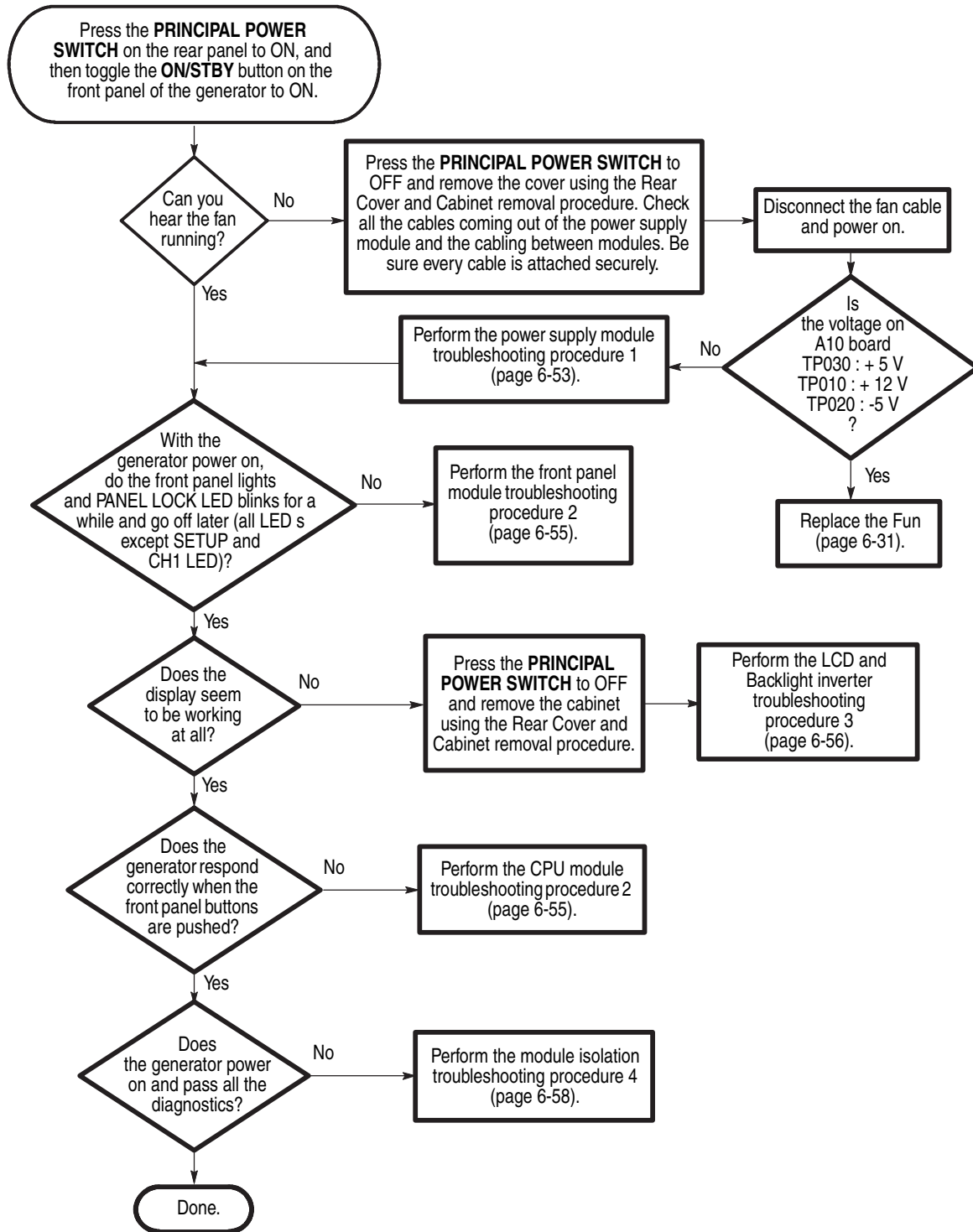


Figure 6-25: Primary troubleshooting procedure

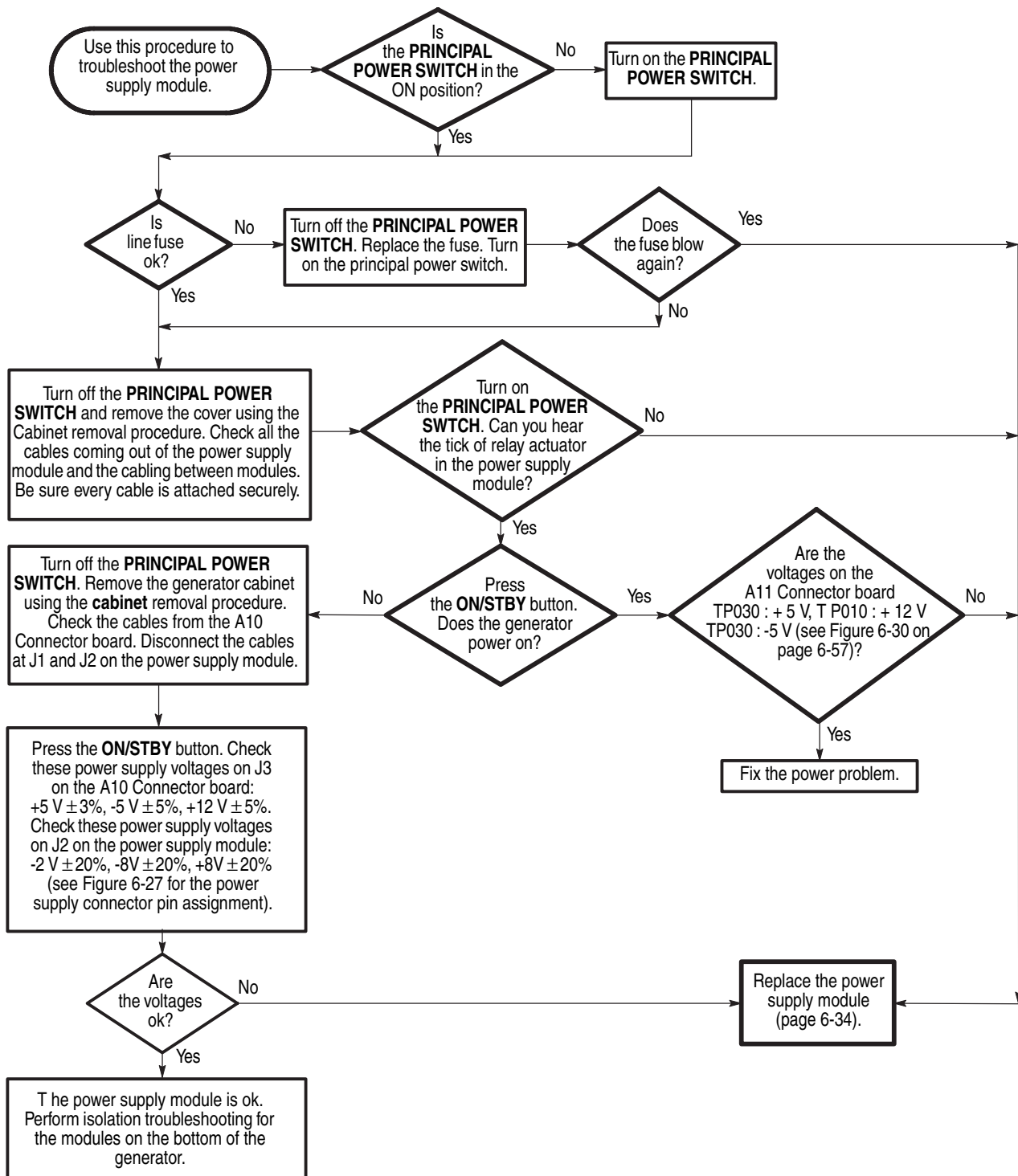
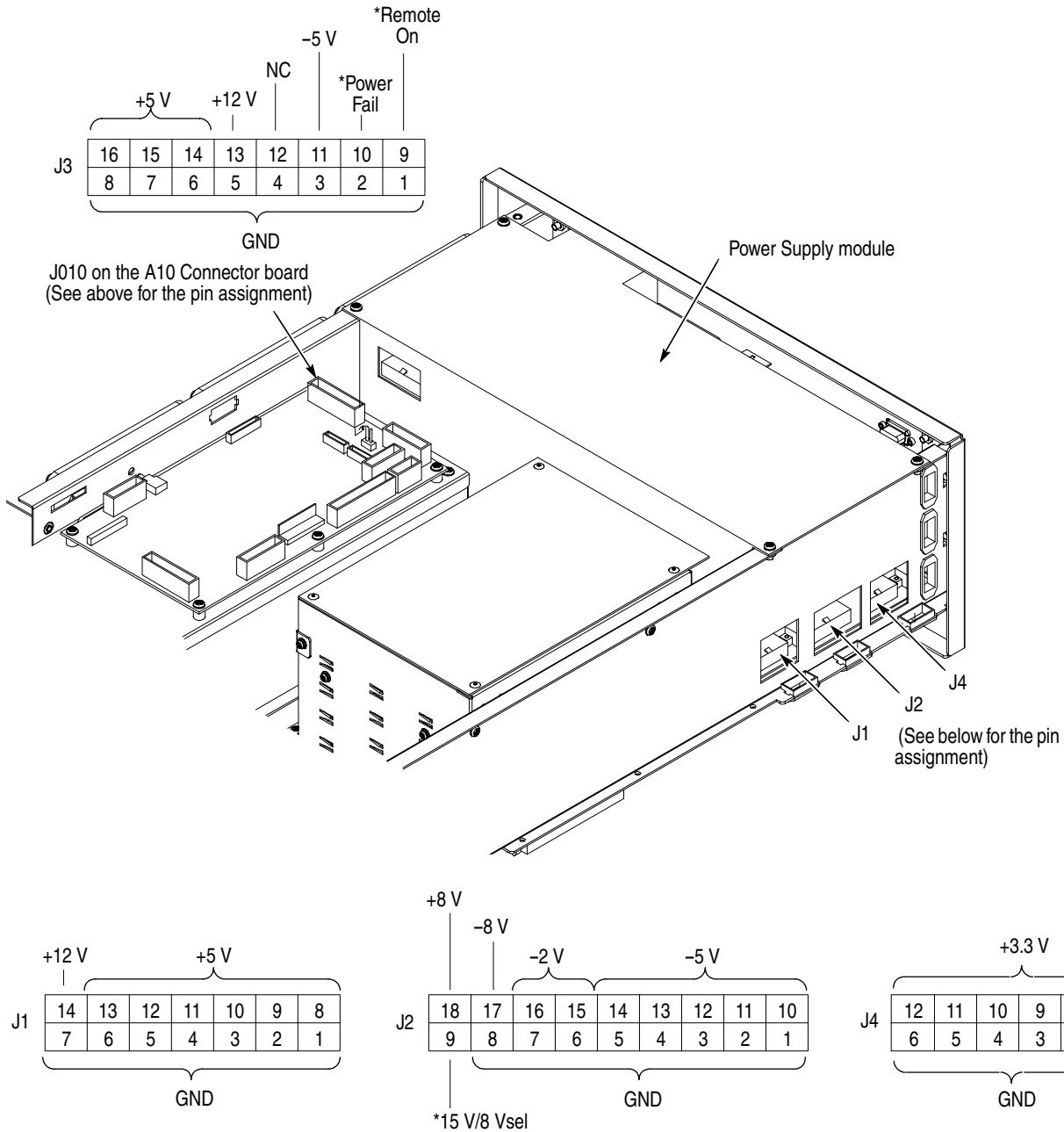


Figure 6-26: Troubleshooting procedure 1 — Power Supply module



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

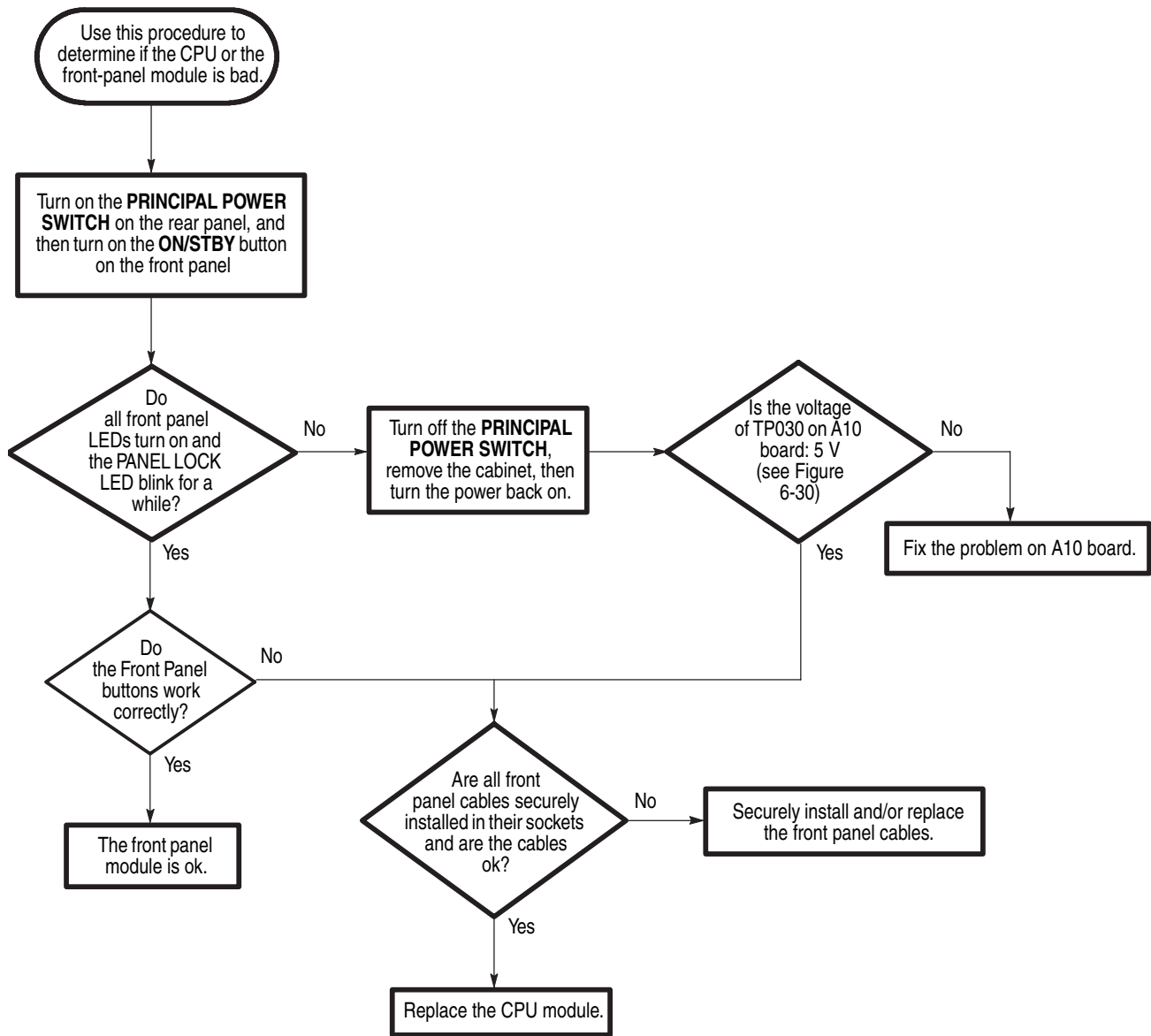


Figure 6-28: Troubleshooting procedure 2 — CPU or front panel module

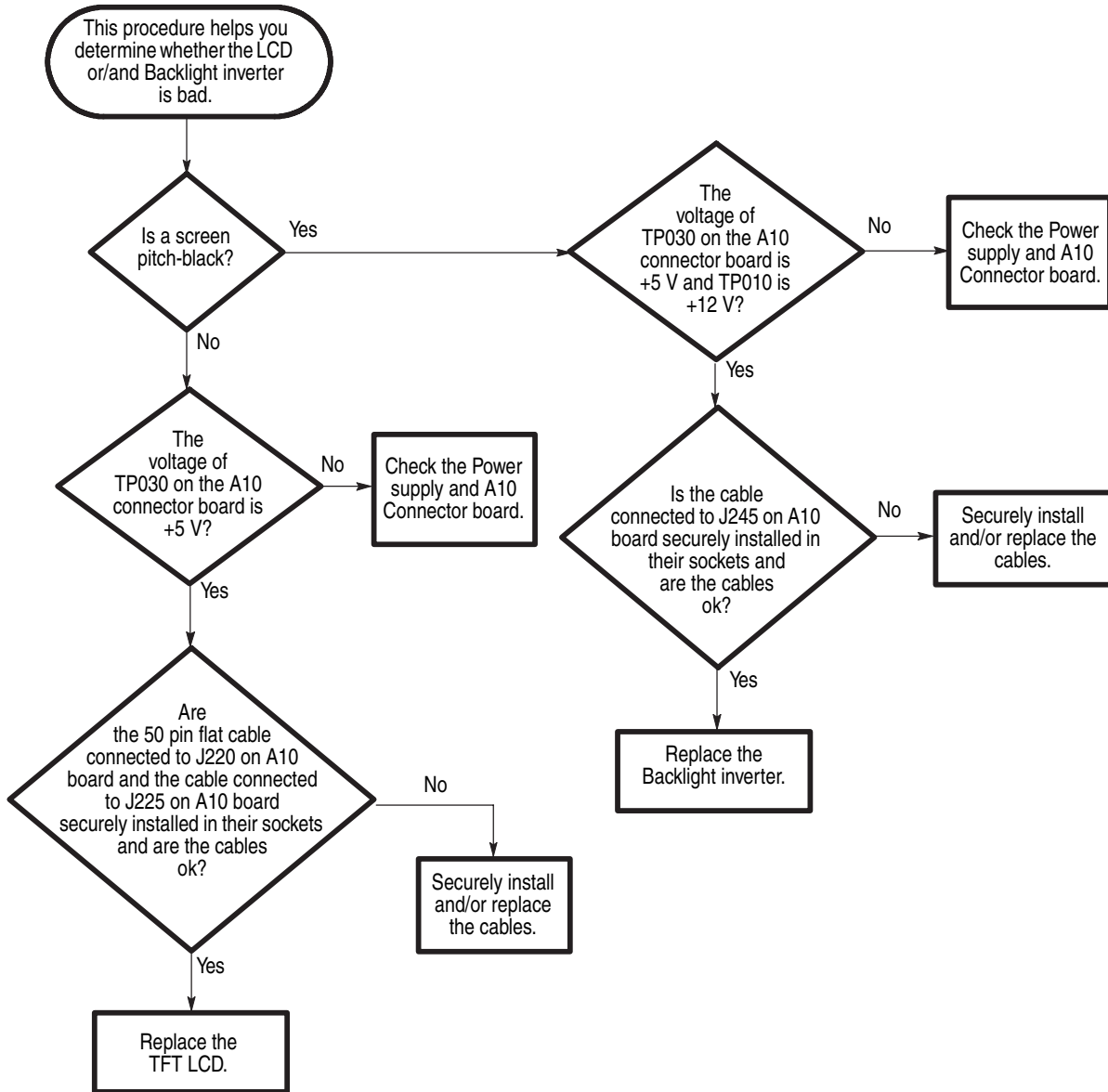


Figure 6-29: Troubleshooting procedure 3 — LCD module

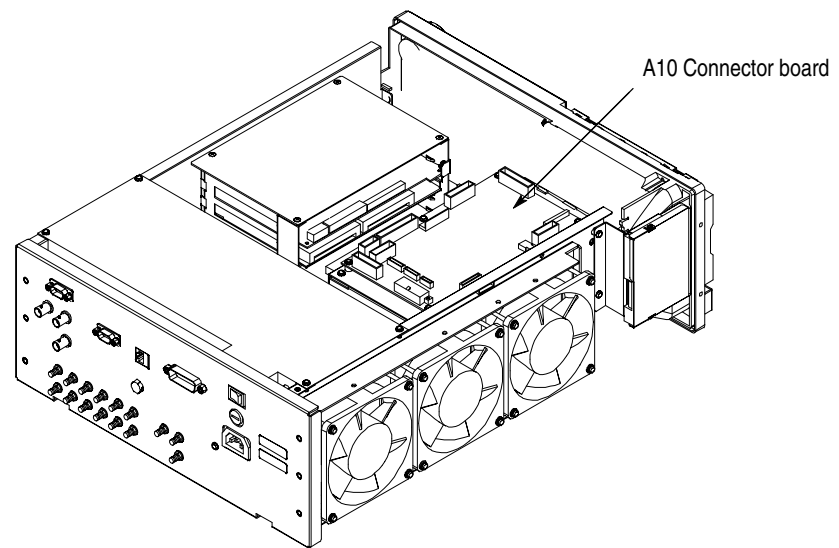
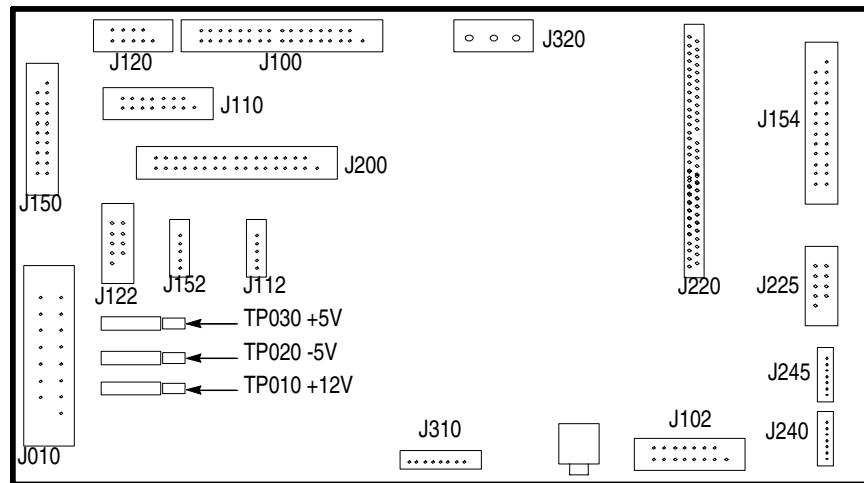


Figure 6-30: A10 connector board

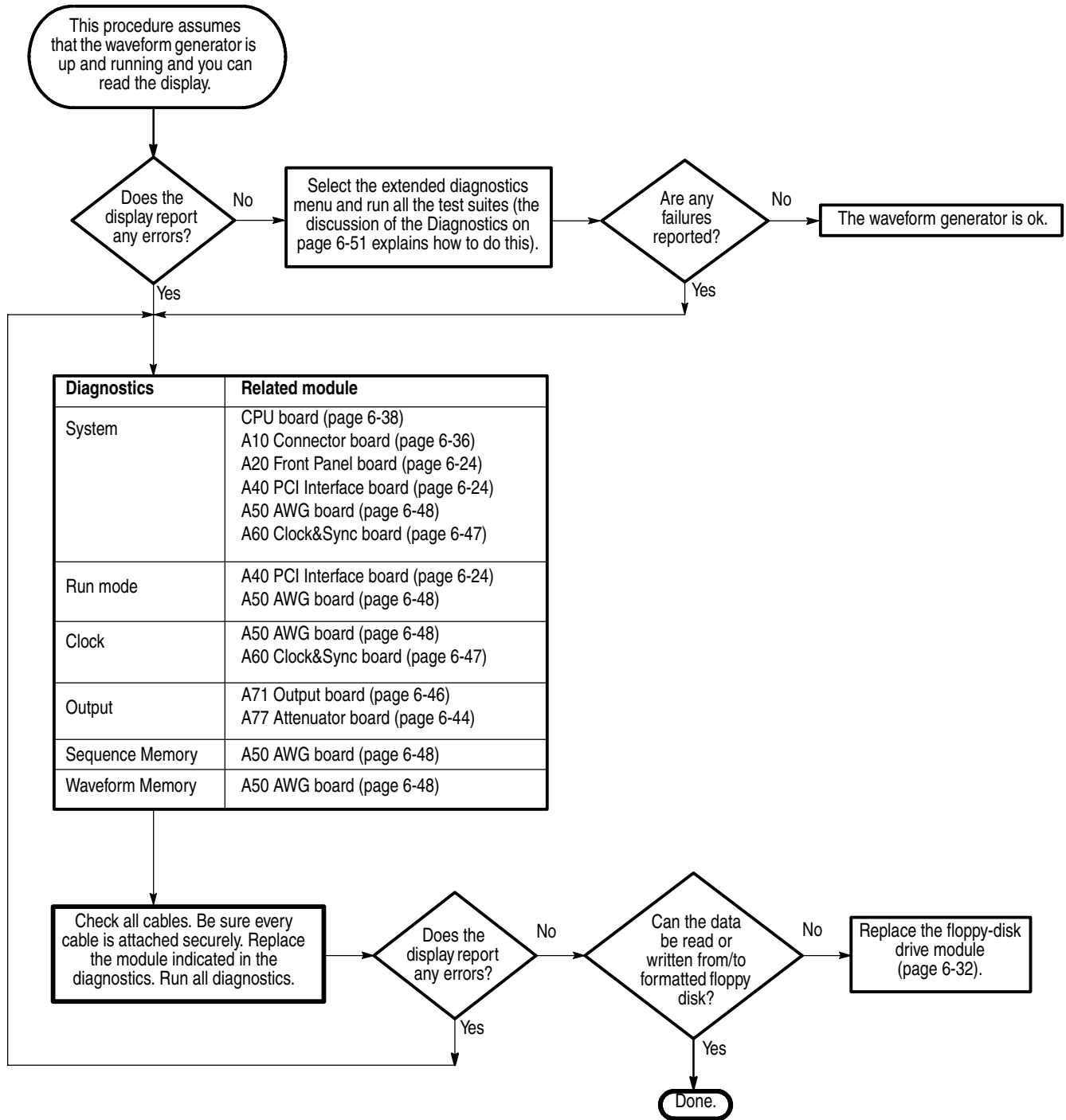


Figure 6-31: Troubleshooting procedure 4 — Module isolation

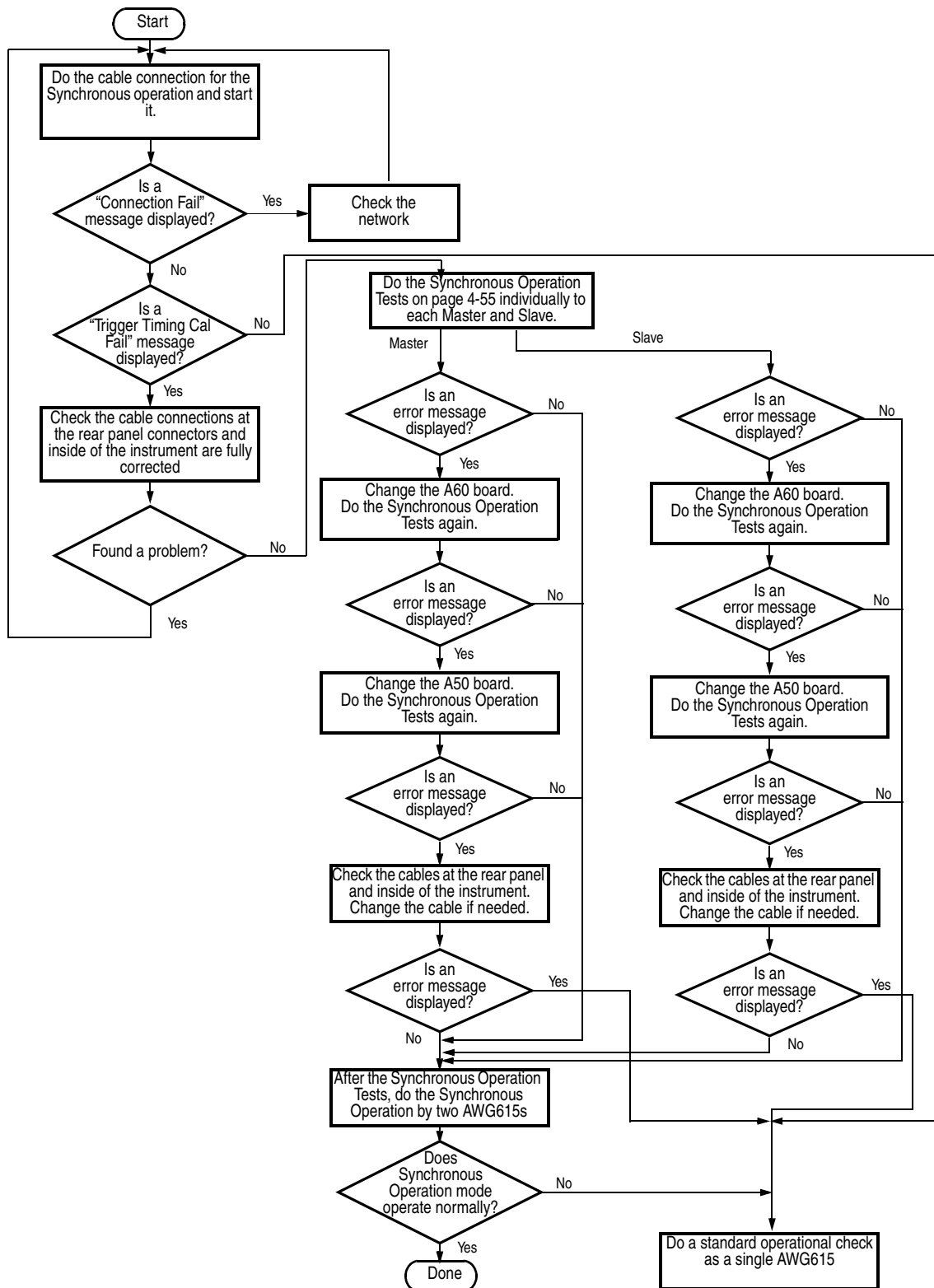


Figure 6-32: Troubleshooting procedure 5— Synchronous operation

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 Table 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
-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

Table 6-6: Command errors (cont.)

Error code	Error message
-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
-253	Corrupt media
-254	Media full
-255	Directory full
-256	File name not found
-257	File name error

Table 6-7: Execution errors (cont.)

Error code	Error message
-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 AWG615 Waveform Generator.

Table 6-11: User request events

Event code	Event message
-600	User request

Request Control Events

This event is unused in the AWG615 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 AWG615 series error code and their meaning.

Table 6-14: Messages and codes

Error 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	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	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	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	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	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	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	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	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	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	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	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	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	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	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.)

Error 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/A71 were exchanged.
2701	Calibration data not found	Flash Disk	Check Flash Disk. Also possible no calibration after A50/A71 were exchanged.
2702	Calibration data checksum	Flash Disk	Check Flash Disk. Also possible no calibration after A50/A71 were exchanged.
2703	Calibration data invalid	Flash Disk	Check Flash Disk. Also possible no calibration after A50/A71 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), A60 (CLOCK&SYNC)	Check A50 (AWG), A60 (CLOCK&SYNC).
4100	PLL lock/unlock failure	A50 (AWG), A60 (CLOCK&SYNC)	Check A50 (AWG), A60 (CLOCK&SYNC).

Table 6-14: Messages and codes (cont.)

Error code	Error message	Related module	Supplementary Information
<i>/* ---- Sequence Memory Diagnostics ---- */</i>			
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).
<i>/* ---- Waveform Memory Diagnostics ---- */</i>			
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).
<i>/* ---- Output Diagnostics ---- */</i>			
7000	Output failure	A71 (Output)	Also possible D/A converter and so forth on A50.
7100	Internal offset failure	A71 (Output)	Also possible D/A converter and so forth on A50.
7101	CH1 internal offset	A71 (Output)	Also possible D/A converter and so forth on A50.
7104	CH1 internal offset	A71 (Output)	Also possible D/A converter and so forth on A50.
7200	Output offset failure	A71 (Output)/A77 (ATT)	Check A71 (Output), A77 (ATT) and connection.

Table 6-14: Messages and codes (cont.)

Error 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.
7704	Reference level failure	A71 (Output)/A77 (ATT)	Check A71 (Output), A77 (ATT) and connection.

Table 6-14: Messages and codes (cont.)

Error code	Error message	Related module	Supplementary Information
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

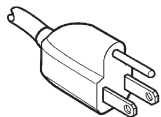
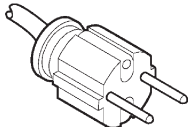
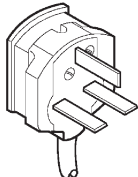
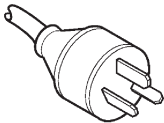
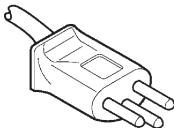
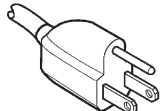
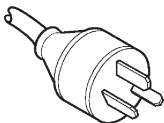
Options and Accessories

This subsection describes the various options as well as the standard and optional accessories that are available for the AWG615 Arbitrary Waveform Generator.

Power Cord Options

Table 7-1 lists the power cords available with the AWG615 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
	Japan 100 V	A6
	China 230 V	A10
	No power cord supplied.	A99

Language Options

The following two language options are provided for the AWG615 Arbitrary Waveform Generator.

Table 7-2: Language options

Option	Description	Part number
L0	English manuals	
	User manual	071-1512-xx
	Programmer manual	071-1513-xx
	Registration card	001-1121-01
L5	Japanese manuals	
	User manual	071-1514-xx
	Programmer manual	071-1515-xx
	Registration card	000-A058-00

Accessories

Standard Accessories

The AWG615 Arbitrary Waveform Generator includes the standard accessories listed in Table 7-3:

Table 7-3: Standard accessories

Accessory	Part number
User Manual	See Table 7-2 for part number
Programmer Manual	
Sample waveform floppy disk, 3.5 inch	063-3779-xx
Sample program floppy disk, 3.5 inch	062-A258-xx
Performance check/adjustment floppy disk, 3.5 inch	063-3780-xx
ArbExpress Software	063-3763-xx
ArbExpress Instructions	061-4288-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 following optional accessories, listed in Table 7-4, are recommended for use with the instrument:

Table 7-4: Optional accessories

Accessory	Part number
Service Manual	071-1516-xx
Front cover	200-3696-01
Rack Mount Kit (for field conversion)	020-2556-00
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
BNC terminator, 50 Ω	011-0049-02
BNC power divider, 50 Ω , DC to 300 MHz, VSWR: 1.2 max.	015-0660-00
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 , 1.5 m, (4.92 ft), Male-Male	174-1428-00
SMA precision delay cable, 1 ns, Male-Male	015-0562-00
SMA precision delay cable, 2 ns, Male-Male	015-0560-00
SMA precision delay cable, 5 ns, Male-Male	015-0561-00
SMA T-connector, Male-Female & Female	015-1016-00
SMA 50 Ω divider, Male	015-1014-00
SMA-BNC adapter, Male-Female	015-0554-00
SMA-BNC adapter, Female-Male	015-0572-00
SMA adapter kit	020-1693-00
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
SMA delay cable, 1 ns, Male-Male	015-0562-00
AC Current Probe CT-1	CT1
AC Current Probe CT-2	CT2
AC Current Probe CT-3	CT6
Cart	K475

Options

This subsection describes the following options available with the AWG615 Arbitrary Waveform Generator:

- Option 01 (64.8 M Words memory)
- Option 02 (High Bandwidth output)
- Option 1R (Rack mounting)
- Option 10 (Flash disk, 256 MB)
- Option D1 (Test result report, English)
- Option TDAT (Test result report, Japanese)

Each of these options is discussed in detail in the following paragraphs.

Option 01 (64.8 MB Words Memory)

Increase memory length up to 64.8 M word (64,800,000 points)(AWG615).

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 20mVp-p to 2Vp-p is changed to 500mVp-p to 1Vp-p into a 50 Ohm load.

Option 1R (Rack Mounting)

AWG615 Arbitrary Waveform Generator comes configured for installation in a 19-inch wide instrument rack. For later field conversions, order Rack Mount Kit (020-2556-00) or contact your local Tektronix sales office or representative.

Option 10 (256MB Flash Disk)

256 MB 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 AWG615 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/STB switch is left in the off position, you will not be able to power on/off the instrument using the principal power switch or an external power switch unit*

Option D1 (Test Result Report)

A calibration data test result report will be provided with the AWG615 Arbitrary Waveform Generator when this option is specified.



Replaceable Electrical Parts



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

Diagrams

This section contains the Block & Interconnect Diagram for the AWG615 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, 9-2).

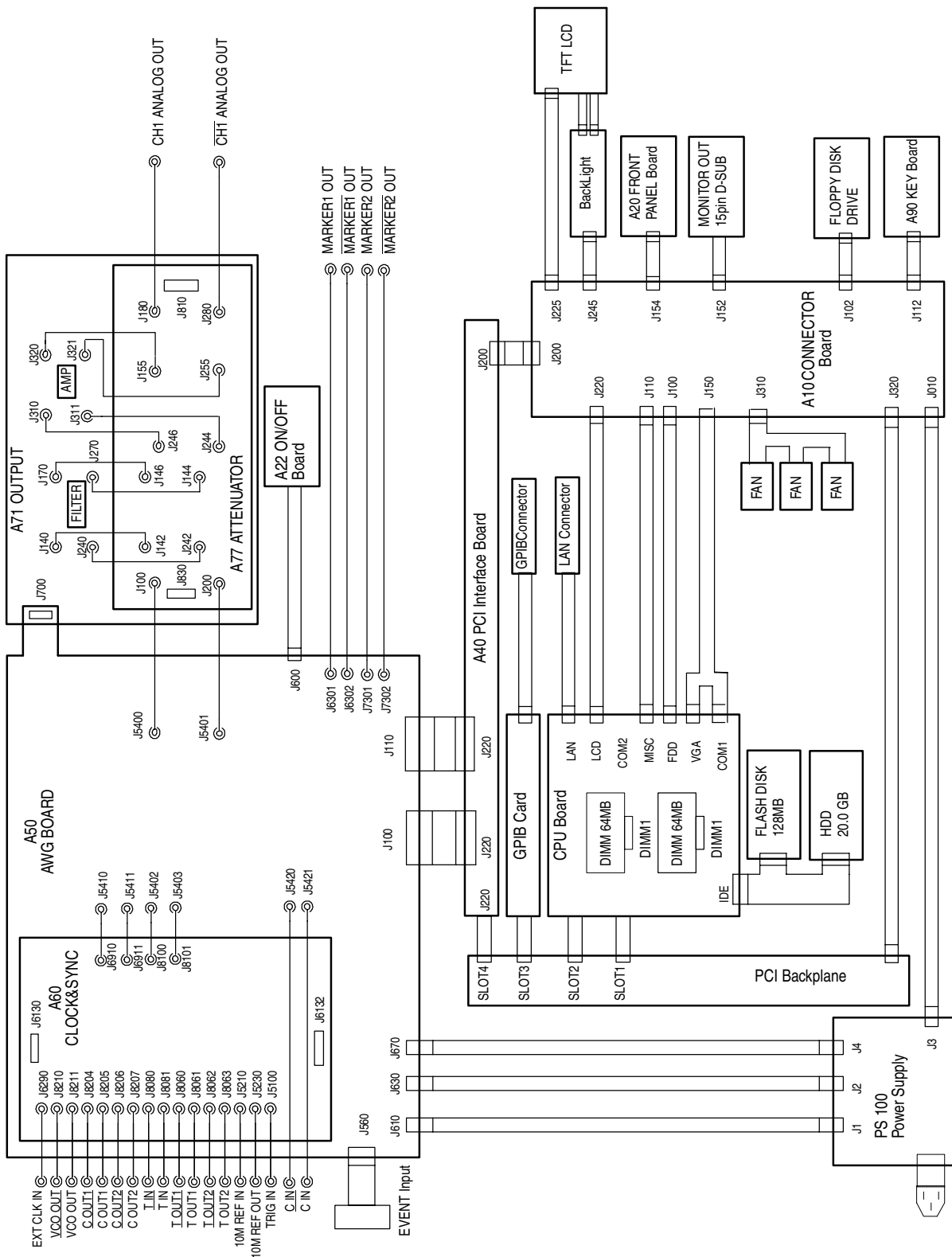


Figure 9-1: Block and interconnect diagram for the AWG615 Arbitrary Waveform Generator

AWG710B and AWG615 A50-A60 Cable Connection

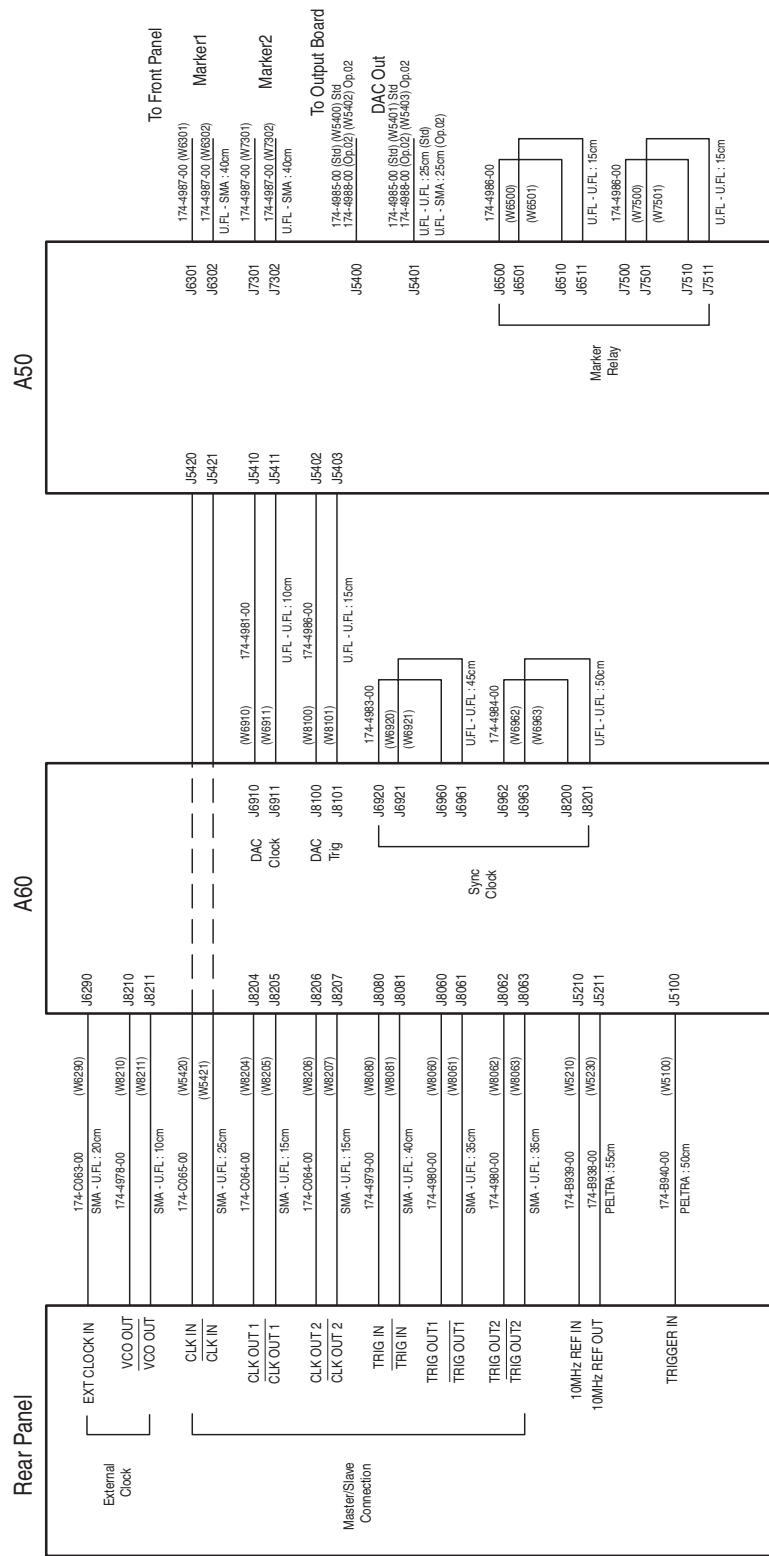


Figure 9-2: Block and interconnect diagram for A60, A50 and Rearpanel

Cable Assembling Parts List

Tektronix part number	Connection point. A	Connection point. B	W number
174-B940-00	A60 AWG Board:J5100	TRIG IN	W5100
174-B938-00	A60 AWG Board:J5230	10MHz REF OUT	W5230
174-B939-00	A60 AWG Board:J5210	10MHz REF IN	W5210
174-C063-00	A60 CLK&SYNC Board:J6290	EXT CLOCK IN	W6290
174-4987-00	A60 CLK&SYNC Board:J8210	VCO OUT	W8210
174-4987-00	A60 CLK&SYNC Board:J8211	$\overline{\text{VCO OUT}}$	W8211
174-C065-00	A50 AWG Board:J5420	C IN	W5420
174-C065-00	A50 AWG Board:J5421	$\overline{\text{C IN}}$	W5421
174-C064-00	A60 CLK&SYNC Board:J8204	C OUT1	W8204
174-C064-00	A60 CLK&SYNC Board:J8205	$\overline{\text{C OUT1}}$	W8205
174-C064-00	A60 CLK&SYNC Board:J8206	C OUT2	W8206
174-C064-00	A60 CLK&SYNC Board:J8207	$\overline{\text{C OUT2}}$	W8207
174-4979-00	A60 CLK&SYNC Board:J8080	T IN	W8080
174-4979-00	A60 CLK&SYNC Board:J8081	$\overline{\text{T IN}}$	W8081
174-4980-00	A60 CLK&SYNC Board:J8060	TOUT1	W8060
174-4980-00	A60 CLK&SYNC Board:J8061	$\overline{\text{T OUT1}}$	W8061
174-4980-00	A60 CLK&SYNC Board:J8062	T OUT2	W8062
174-4980-00	A60 CLK&SYNC Board:J8063	$\overline{\text{T OUT2}}$	W8063
174-3878-00	A50 AWG Board:J1000	EVENT INPUT	W560
174-B929-00	A50 AWG Board:	PS100 Power Supply:J1	W1
174-B930-00	A50 AWG Board:	PS100 Power Supply:J2	W2
174-B931-00	A50 AWG Board:	PS100 Power Supply:J4	W4
174-B883-00	A50 AWG Board:J100	A40 PCI Interface Board J220	W300
174-4315-00	A50 AWG Board:J110	A40 PCI Interface Board J220	W310
174-B882-00	A50 AWG Board:J600	A22 ON/OFF Board	
174-4985-00	A50 AWG Board:J5400	A77 ATTENUATOR Board J100	W5400
174-4985-00	A50 AWG Board:J5401	A77 ATTENUATOR Board J200	W5401
174-4988-00	A50 AWG Board:J5400	A72 OUTPUT Board (Opt. 02)	W5402
174-4988-00	A50 AWG Board:J5401	A72 OUTPUT Board (Opt. 02)	W5403
174-4981-00	A50 AWG Board:J5410	A60 CLK&SYNC Board:J6910	W6910
174-4981-00	A50 AWG Board:J5411	A60 CLK&SYNC Board:J6911	W6911
174-4983-00	A60 CLK&SYNC Board:J6920	A60 CLK&SYNC Board:J6960	W6920
174-4983-00	A60 CLK&SYNC Board:J6921	A60 CLK&SYNC Board:J6961	W6921
174-4984-00	A60 CLK&SYNC Board:J6962	A60 CLK&SYNC Board:J8200	W6962
174-4984-00	A60 CLK&SYNC Board:J6963	A60 CLK&SYNC Board:J8201	W6963
174-4986-00	A50 AWG Board:J6500	A50 AWG Board:J6510	W6500
174-4986-00	A50 AWG Board:J6501	A50 AWG Board:J6511	W6501

Cable Assembling Parts List (cont.)

Tektronix part number	Connection point. A	Connection point. B	W number
174-4986-00	A50 AWG Board:J7500	A50 AWG Board:J7510	W7500
174-4986-00	A50 AWG Board:J7501	A50 AWG Board:J7511	W7501
174-4986-00	A60 CLK&SYNC Board:J8100	A50 AWG Board:J5402	W8100
174-4986-00	A60 CLK&SYNC Board:J8101	A50 AWG Board:J5403	W8101
174-B932-00	A71 OUTPUT Board: J140	A77 OUTPUT Board J142	W730
174-B932-00	A71 OUTPUT Board: J240	A77 OUTPUT Board J242	W732
174-B932-00	A71 OUTPUT Board: J170	A77 OUTPUT Board J146	W740
174-B932-00	A71 OUTPUT Board: J270	A77 OUTPUT Board J144	W742
174-B932-00	A71 OUTPUT Board: J310	A77 OUTPUT Board J246	W750
174-B932-00	A71 OUTPUT Board: J311	A77 OUTPUT Board J244	W752
174-B932-00	A71 OUTPUT Board: J320	A77 OUTPUT Board J155	W760
174-B932-00	A71 OUTPUT Board: J321	A77 OUTPUT Board J255	W762
174-B649-00	A71 OUTPUT Board: J180	CH1 ANALOG OUT	W701
174-B650-00	A71 OUTPUT Board: J280	$\overline{\text{CH1}}$ ANALOG OUT	W702
174-C046-00	A72 OUTPUT Board: J180	CH1 ANALOG OUT (Opt. 02)	W701
174-C047-00	A72 OUTPUT Board: J280	$\overline{\text{CH1}}$ ANALOG OUT (Opt. 02)	W702
174-4987-00	A50 AWG Board:J6301	MARKER1 OUT	W6301
174-4987-00	A50 AWG Board:J6302	$\overline{\text{MARKER1}}$ OUT	W6302
174-4987-00	A50 AWG Board:J7301	MARKER2 OUT	W7301
174-4987-00	A50 AWG Board:J7302	$\overline{\text{MARKER2}}$ OUT	W7302
174-B884-00	GPIB Card	GPIB Connector	W170
174-B941-00	GPIB Board:LAN	LAN Connector	W116
174-4302-00	CPU Board :LCD	A10 CONNECTOR Board J220	W220
174-B335-00	CPU Board :MICS	A10 CONNECTOR Board J110	W110
174-B334-00	CPU Board :FDD	A10 CONNECTOR Board J100	W100
174-4298-00	CPU Board :VGA,COM1	A10 CONNECTOR Board J150	W150
174-B892-00	A10 CONNECTOR Board: J310	FAN	W31
174-B891-00	CPU Board :IDE	FLASH DISK,HDD	W114
174-B887-00	A10 CONNECTOR Board :J320	PCI Backplane	W320
174-B356-00	A10 CONNECTOR Board :J010	PS100 Power supply J3	W3
174-B338-00	A10 CONNECTOR Board:J112	A90 Key Board	W112
174-B329-01	A10 CONNECTOR Board:J102	FLOPPY DISK DRIVE	W102
174-B926-00	A10 CONNECTOR Board:J225	TFT LCD	W225
174-3879-00	A10 CONNECTOR Board:J152	MONITOR OUT(15pin,D-Sub)	W152
174-B337-00	A10 CONNECTOR Board:J154	A20 FRONT PANEL Board	
174-B889-00	A10 CONNECTOR Board:J245	Back Light	W240
174-B886-00	A10 CONNECTOR Board:J200	A40 PCI Interface Board J200	W200



Replaceable Mechanical Parts

Replaceable Mechanical Parts

This section contains a list of the replaceable modules for the AWG615 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
0JR05	TRIQUEST CORP	3000 LEWIS AND CLARK HWY	VANCOUVER WA 98661-2999
0KB01	STAUFFER SUPPLY	810 SE SHERMAN	PORTLAND OR 97214
00779	AMP INC	2800 FULLING MILL PO BOX 3608	HARRISBURG PA 17105
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	335-1161-00			1	MARKER, IDENT:MKD AWG615, POLYCARBONATE		335-1161-00
-2	101-0142-01			1	TRIM,DECORATIVE:FRONT,RACK MOUNT		101-0142-01
-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		348-1276-00
-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 (W225)		174-B926-00
-16	174-B889-00			1	CA, ASSY, SP, ELEC:6, 26AWG, 15CM L, W/HOLDER, 1MM CTR (W240)		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

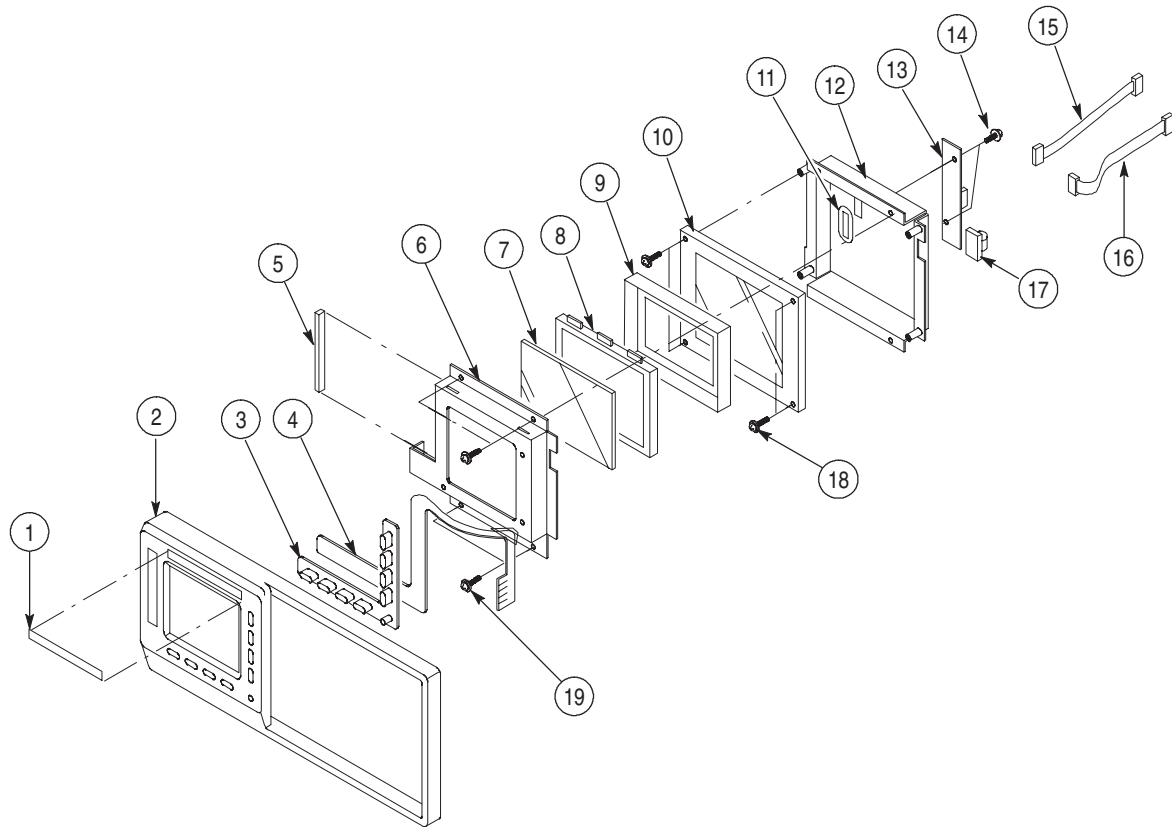


Figure 10-1: Front and Display unit

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, AWG615, POLYCARBONATE		333-A414-00
-2	386-A838-00			1	SUBPANEL, FRONT:KEYBOARD, AL, AWG615		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-B081-51			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

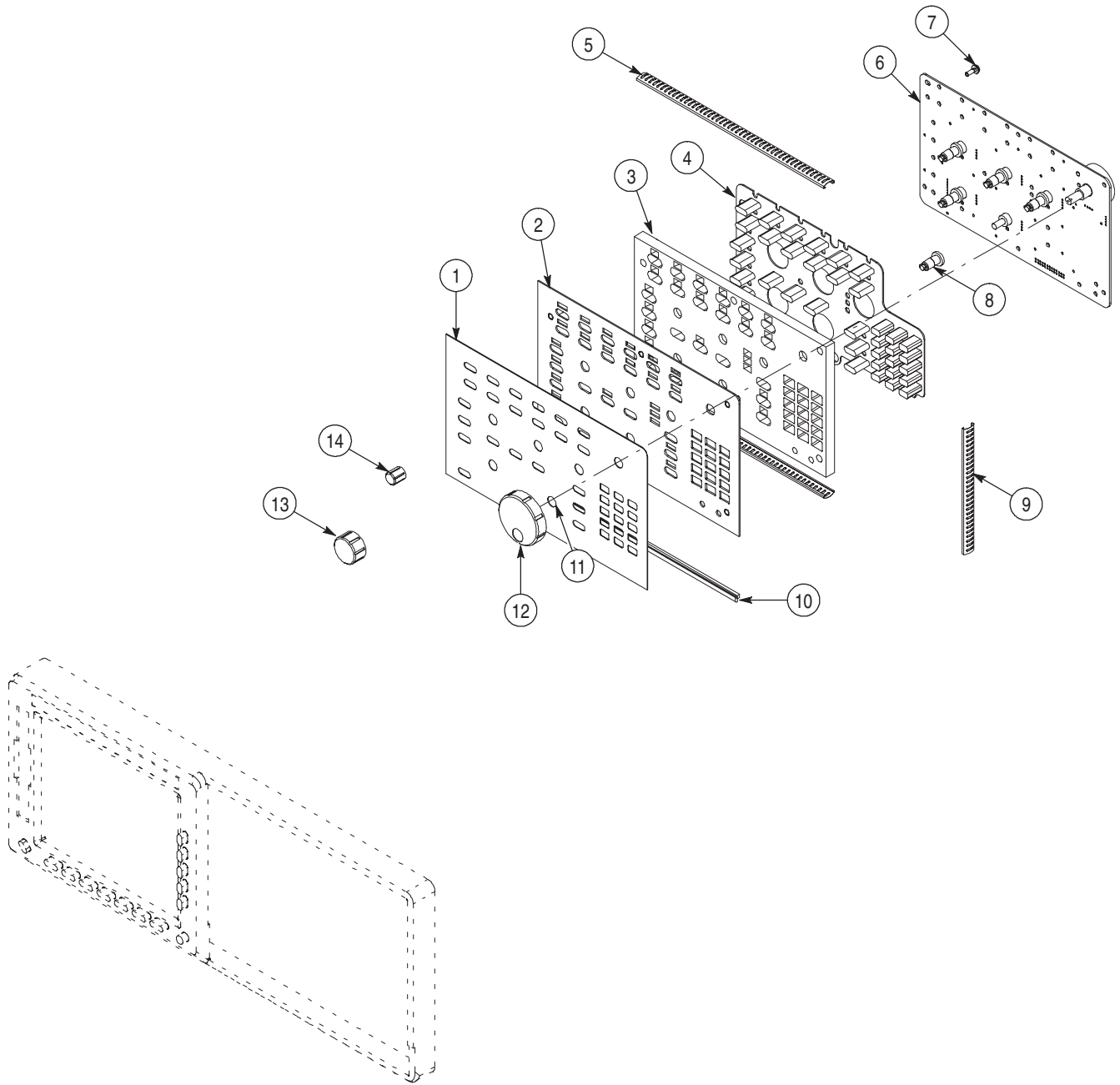


Figure 10-2: Front panel

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	174-4987-00			1	CA ASSY,RF:50 OHM COAX,40CM L,SMA(PANEL) TO U.FL (W7302)		174-4987-00
-2	174-4987-00			1	CA ASSY,RF:50 OHM COAX,40CM L,SMA(PANEL) TO U.FL (W7301)		174-4987-00
-3	174-4987-00			1	CA ASSY,RF:50 OHM COAX,40CM L,SMA(PANEL) TO U.FL (W6302)		174-4987-00
-4	174-4987-00			1	CA ASSY,RF:50 OHM COAX,40CM L,SMA(PANEL) TO U.FL (W6301)		174-4987-00
-5	174-B650-00			1	CA ASSY,RF:50 OHM COAX,15CM L,9-2,SMA TO PELTORA, SST SHELL (W702)		174-B650-00
-6	174-B649-00			1	CA ASSY,RF:50 OHM COAX,15CM L,9-1,SMA TO PELTORA, SST SHELL (W701)		174-B649-00
-7	333-4487-00			1	PANEL,FRONT:KEYBOARD,MTX100,POLYCARBONATE,T0.2		333-4487-00
-8	407-5008-00			1	BRACKET, ASSY:OUTPUT CONNECTOR, AL		407-5008-00
-9	211-0751-00			5	SCREW,MACHINE:M3X8MM L,PNH,STL,ZN-C,CROSS REC W/FLAT&LOCK WASHERS		211-0751-00
-10	150-0201-00				LT EMITTING DIO: YELLOW(D), 4V, 50MA, 125MW		150-0201-00
-11	361-A165-00			3	SPACER, LED: 6MM L X 4.5MM OD, TPE		361-A165-00
-12	366-0753-00			3	PUSH BUTTON:TEK TAN, ABS		366-0753-00
-13	260-2156-00				SWITCH, TACT: SPST, 12VDC, 20MA		260-2156-00
-14	671-5827-00			1	CIRCUIT BOARD ASSY: A22 KEY ON/OFF,389-B153-00, WIRED		671-5827-00
-15	211-0871-00			3	SCREW,MACHINE:M3X6MM L,PNH,STL,ZN-C,CROSS REC W/FLAT(7MM OD)&LOCK WASHERS		211-0871-00
-16	343-0549-00			2	STRAP,TIEDOWN:1.6-19MM DIA,66NYLON		343-0549-00

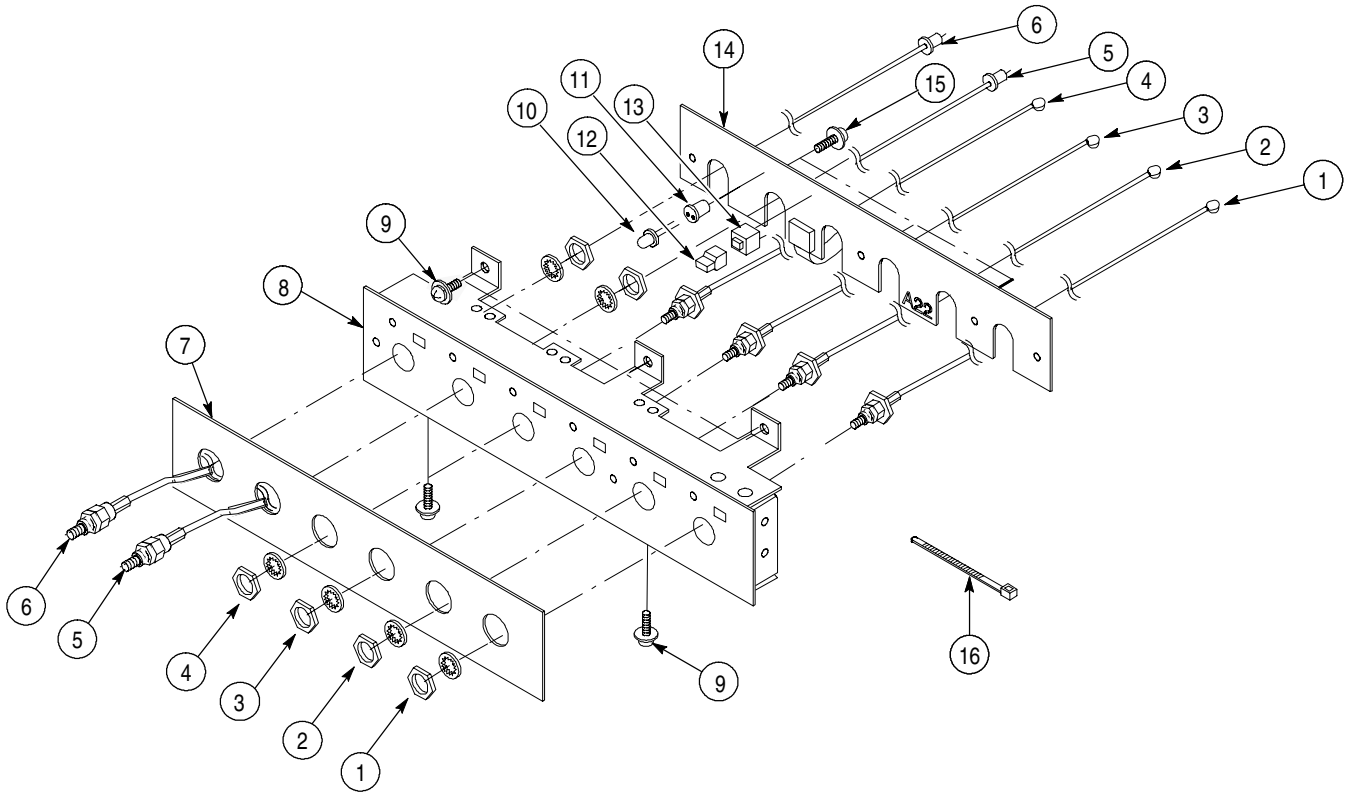


Figure 10-3: Front Output unit (except option 02)

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	174-4987-00			1	CA ASSY,RF:50 OHM COAX,40CM L,SMA(PANEL) TO U.FL (W7302)		174-4987-00
-2	174-4987-00			1	CA ASSY,RF:50 OHM COAX,40CM L,SMA(PANEL) TO U.FL (W7301)		174-4987-00
-3	174-4987-00			1	CA ASSY,RF:50 OHM COAX,40CM L,SMA(PANEL) TO U.FL (W6302)		174-4987-00
-4	174-4987-00			1	CA ASSY,RF:50 OHM COAX,40CM L,SMA(PANEL) TO U.FL (W6301)		174-4987-00
-5	174-C047-00			1	CA ASSY,RF:50 OHM COAX,15CM L,SMA- MALE TO SMA-MALE, MKD-2 (W702)		174-C047-00
-6	174-C046-00			1	CA ASSY,RF:50 OHM COAX,15CM L,SMA- MALE TO SMA-MALE, MKD-2 (W701)		174-C046-00
-7	333-4487-00			1	PANEL,FRONT:KEYBOARD,MTX100,POLYCARBONATE,T0.2		333-4487-00
-8	407-5008-00			1	BRACKET, ASSY:OUTPUT CONNECTOR, AL		407-5008-00
-9	211-0751-00			5	SCREW,MACHINE:M3X8MM L,PNH,STL,ZN-C,CROSS REC W/FLAT&LOCK WASHERS		211-0751-00
-10	150-0201-00				LT EMITTING DIO: YELLOW(D), 4V, 50MA, 125MW		150-0201-00
-11	361-A165-00			3	SPACER, LED: 6MM L X 4.5MM OD, TPE		361-A165-00
-12	366-0753-00			3	PUSH BUTTON:TEK TAN, ABS		366-0753-00
-13	260-2156-00				SWITCH, TACT: SPST, 12VDC, 20MA		260-2156-00
-14	671-5827-00			1	CIRCUIT BOARD ASSY: A22 KEY ON/OFF,389-B153-00, WIRED		671-5827-00
-15	211-0871-00			3	SCREW,MACHINE:M3X6MM L,PNH,STL,ZN-C,CROSS REC W/FLAT(7MM OD)&LOCK WASHERS		211-0871-00
-16	343-0549-00			2	STRAP,TIEDOWN:1.6-19MM DIA,66NYLON		343-0549-00

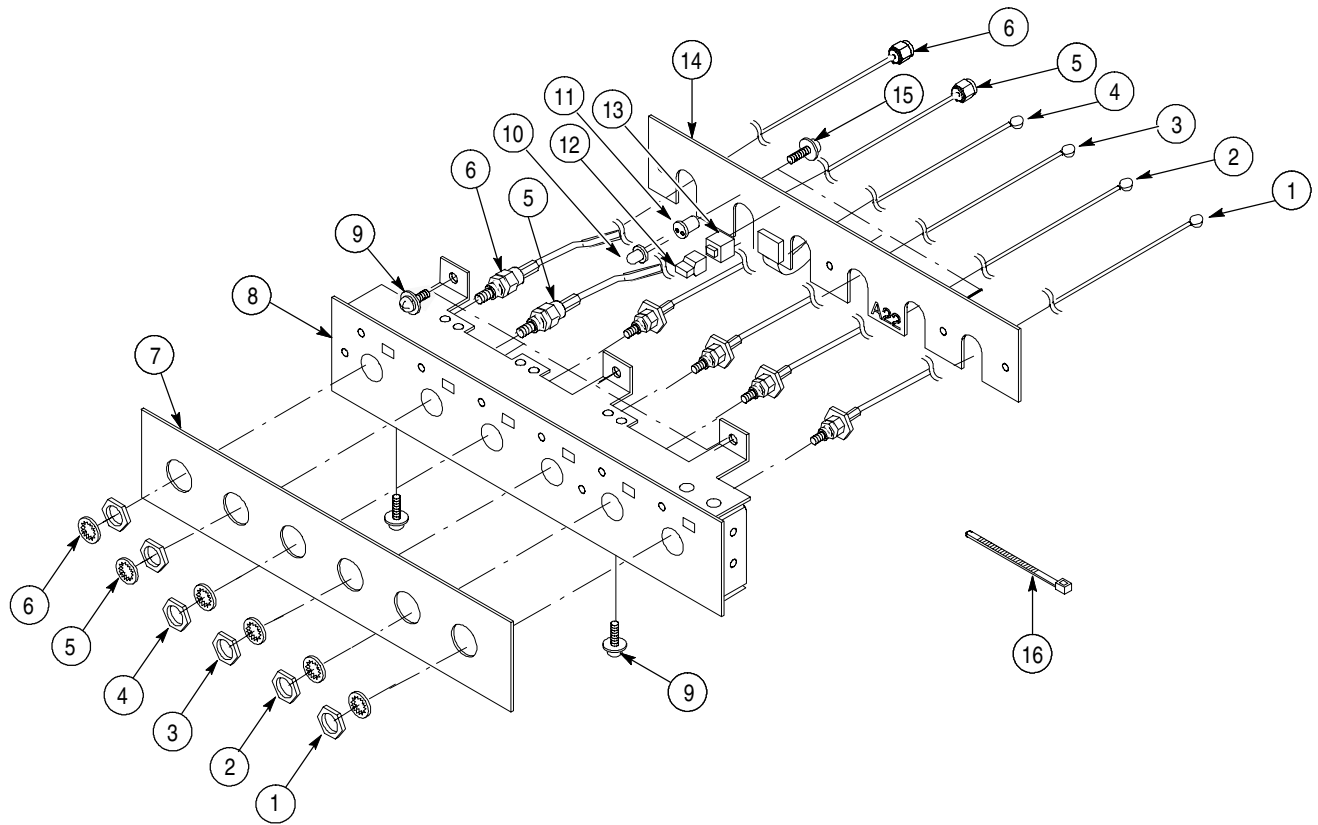


Figure 10-4: Front Output unit (for option 02)

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-B130-50			1	CIRCUIT BD ASSY: A10 CONNECTOR, 389-B099-XX WIRED		671-B130-50
-5	407-A648-00			1	BRACKET:HDD, CONNECTOR BD, AL, AWG615		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", "20 GB, IDE I/F", FORMATTED	IBM	119-B090-00
-7	119-B071-00			1	MEMORY MODULE:"2.5",FLASH DISK,256MB (Opt.10)		119-B071-00
-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	119-7030-00			1	MEMORY MODULE:SOLID STATE DRIVE, 32MB, IDE-I/F F/W INSTALLED		119-7030-00
-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:M3X10MM L, FLH, STL ZN PL, CROSS REC		211-A044-00
-21	441-A287-00			1	CHASSIS, ASSY:AL, FRONT&REAR PNL,BUILD ON MAIN		441-A287-00
-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	255-1107-00			CM	PLASTIC CHANNEL:1.7MM X 3.7MM X 4.0MM, NATURAL, NYLON		255-1107-00
-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: M2.6X6MM L, PNH, STL, ZN-C, CROSS REC 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:20.0MM L, M4 INT/EXT THD, 7MM HEX, STL ZN-C PL		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, TUBE AXIAL: 12V, 370MA, 4.44W, 2500RPM, 103.8CFM, 66.7PA, FBL12G12H, W/O LEAD	MATSU SHITA	FBL12G12H

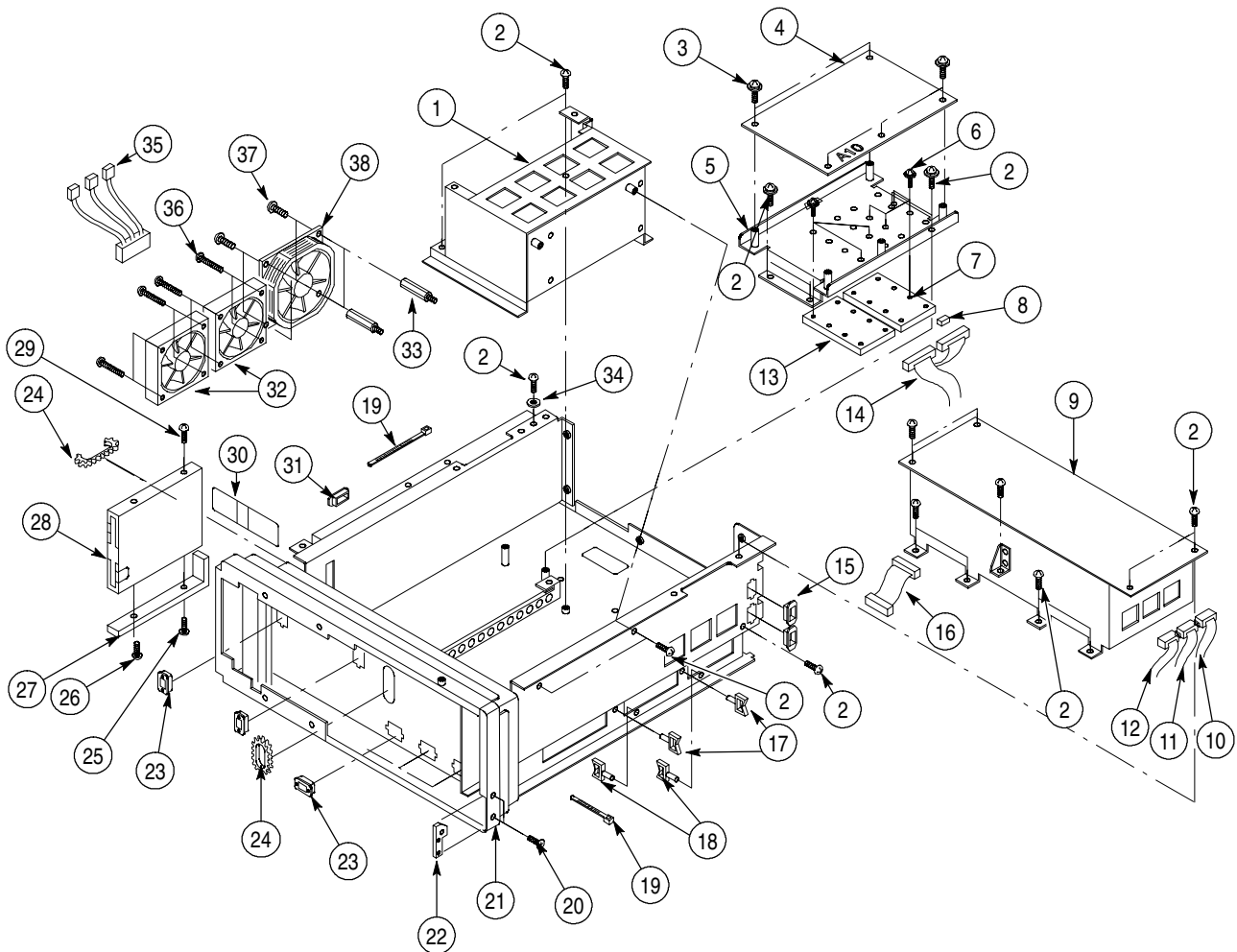


Figure 10-5: Chassis

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, AWG615		441-A282-00
-2	343-A345-00			1	RETAINER,CKT BD:CPU,AL,AWG615		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-B083-010			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, AWG615		407-A647-00
-9	174-B334-00			1	CA ASSY, SP, ELEC:34, 28AWG, 9CM L, FLAT (W100)		174-B334-00
	174-B335-00			1	CA ASSY, SP, ELEC:16, 28AWG, 11CM L, FLAT, DISPLAY (W110)		174-B336-00
	174-4298-00			1	CA ASSY,SP,ELEC:20CON/9CON/15CON,AWG26,23CM L (W150)		174-4298-00
	174-B886-00			1	CA, ASSY, SP, ELEC:26, 28AWG, FLAT, 25CM L (W200)		174-B886-00
	174-4302-00			1	CA ASSY,SP,ELEC:50,AWG28,20CM L,FLAT, 1MM (W220)		174-4302-00
	174-B883-00			1	CA, ASSY, SP, ELEC:80, 30AWG, FLAT, 27CM L, 0.65CTR (W300)		174-B883-00
	174-4315-00			1	CA ASSY,SP,ELEC: 100,AWG32,30CM L,FLAT (W310)		174-4315-00
	174-B887-00			1	CA, ASSY, SP, ELEC:3, 18AWG, 30CM L (W320)		174-B887-00
-10	343-1644-00				CLAMP,CABLE:CLIP LOCKING WIRE,NYLON		343-1644-00

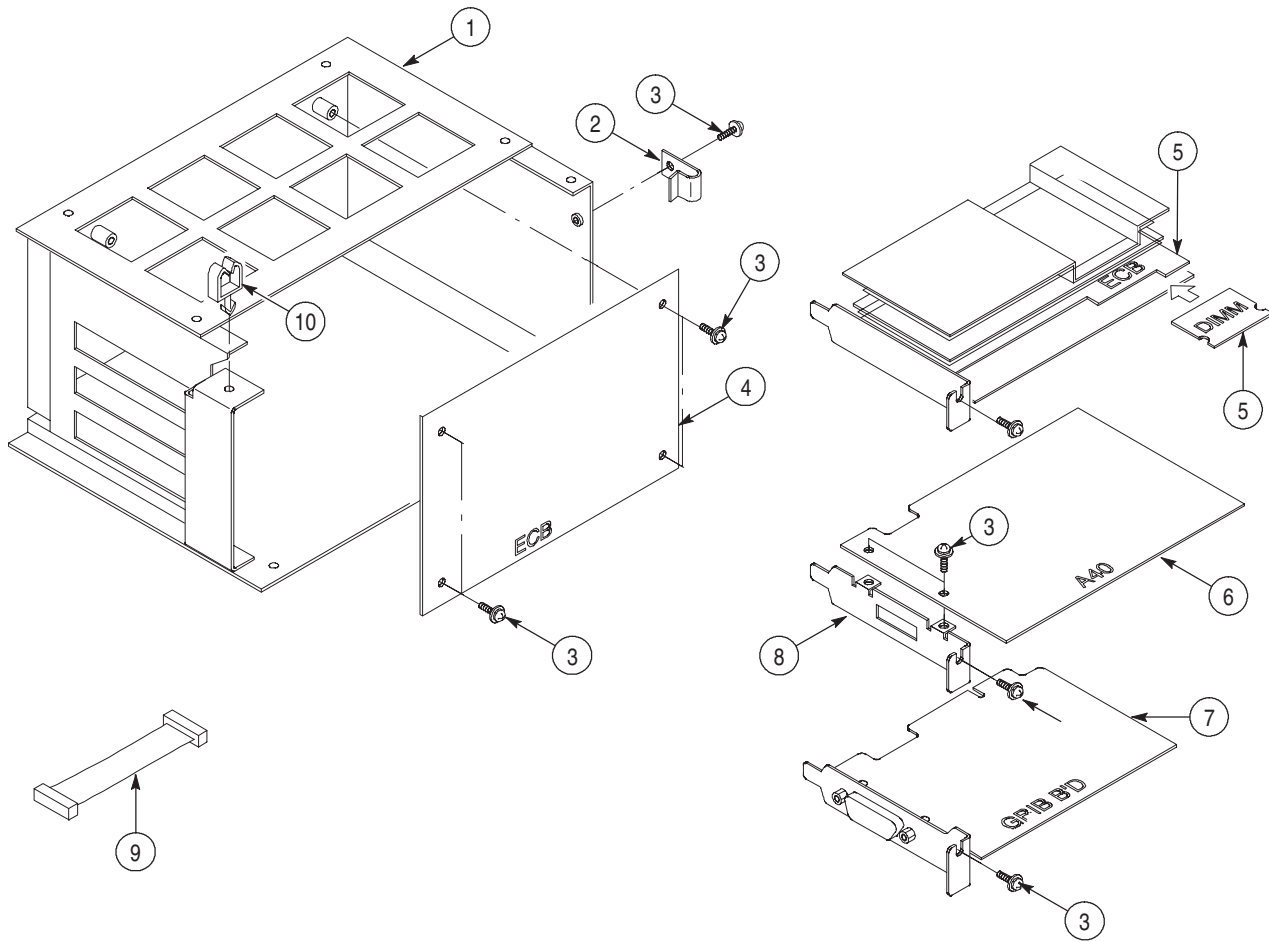


Figure 10-6: CPU unit

Replaceable Mechanical Parts

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 (W730, W732, W740, W742, W750, W752, W760, W762)		174-B932-00
-5	174-4985-00			2	CA, ASSY, RF:500HM COAX, 25CM L, U.FL-U.FL (W5400,W5401)		174-4985-00
-5	174-4986-00			2	CA, ASSY, RF:500HM COAX, 15CM L, U.FL-U.FL (W6500,W6501)		174-4986-00
-5	174-4981-00			2	CA, ASSY, RF:500HM COAX, 10CM L, U.FL-U.FL (W6910,W6911)		174-4981-00
-5	174-4983-00			2	CA, ASSY, RF:500HM COAX, 45CM L, U.FL-U.FL (W6920,W6921)		174-4983-00
-5	174-4984-00			2	CA, ASSY, RF:500HM COAX, 50CM L, U.FL-U.FL (W6962,W6963)		174-4984-00
-5	174-4986-00			2	CA, ASSY, RF:500HM COAX, 15CM L, U.FL-U.FL (W7500,W7501)		174-4986-00
-5	174-4986-00			2	CA, ASSY, RF:500HM COAX, 15CM L, U.FL-U.FL (W8100,W8101)		174-4986-00
-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-B147-50			1	CIRCUIT BD ASSY:A71 OUTPUT, 389-B150-50 WIRED		671-B147-50
-12	671-5881-00			1	CIRCUIT BD ASSY:A50 MAIN, BT RESIN, STD, 32MB		671-5881-00
-12	671-5882-00			1	CIRCUIT BD ASSY:A50 MAIN, BT RESIN, Opt.01, 64MB		671-5882-00
-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	671-5813-00			1	CIRCUIT BD ASSY:A77 ATT, 389-xxxx-xx WIRED		671-5813-00
-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

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
-27	211-0751-00			5	SCREW,MACHINE:M3X8MM L,PNH, STL, ZN-C, CROSS REC W/FLAT&LOCK WASHERS		211-0751-00
-28	671-5787-00			1	CIRCUIT BOARD ASSY:A60 CLOCK&SYNC, BT RESIN 389-3558-00 WIRED		671-5787-00
	407-4981-00			1	BRACKET:A60		407-4981-00

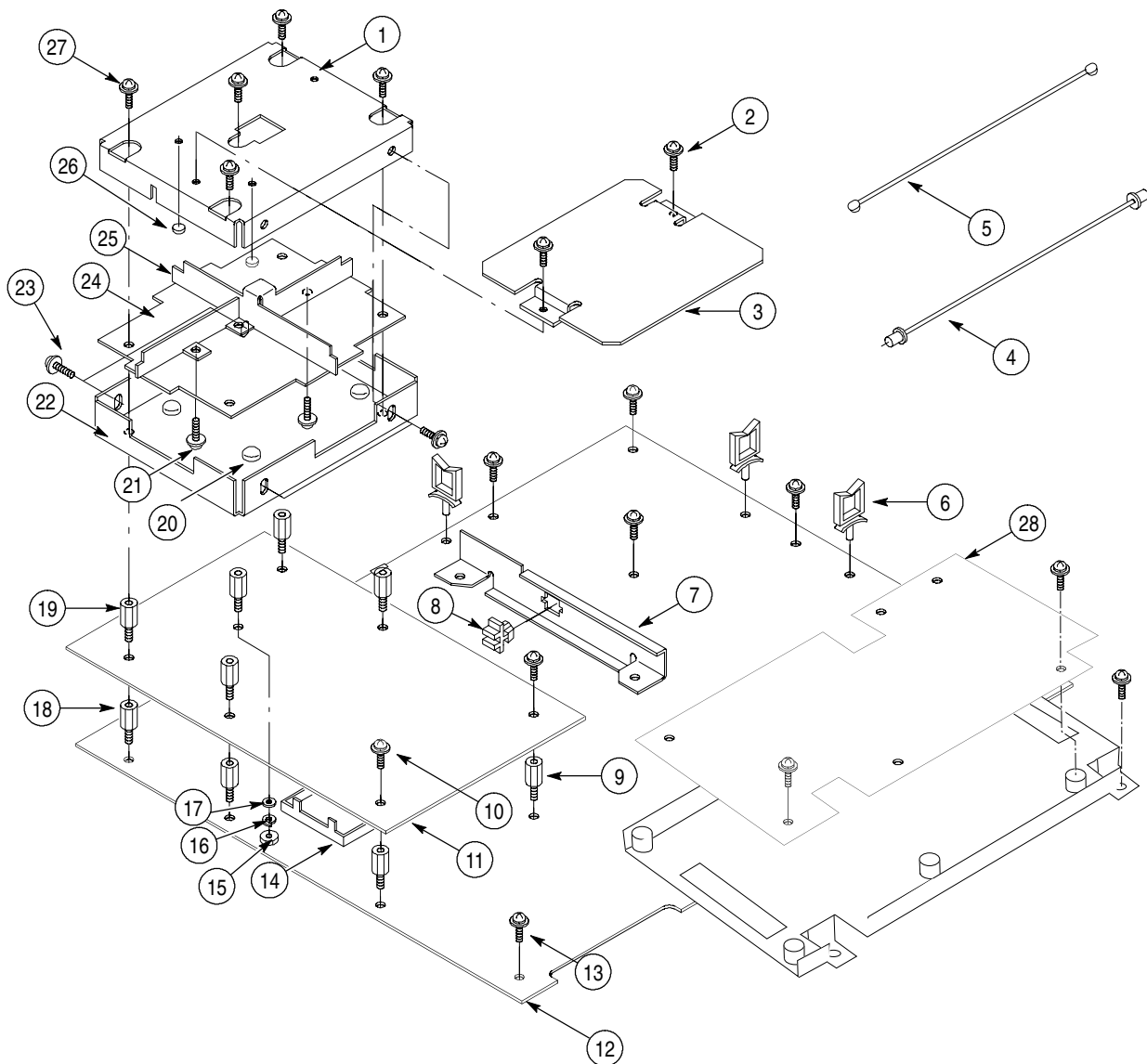


Figure 10-7: Circuit boards (except option 02)

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-A079-01			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-C051-00			1	W520, 10CM L, MKD 2, SMA-PELTRA (K200 - A72:J520)		174-C051-00
-7	174-C050-00			1	W510, 10CM L, MKD 1, SMA-PELTRA (K100 - A72:J510)		174-C050-00
-8	343-A360-00			1	CLAMP, CABLE: LOCKING WIRE SADDLE 11MM X 7.2MM, 66NYLON		343-A360-00
-9	174-4988-00			1	CA ASS, RF:50OHM, COAX, 25CM L, SMA(J)-U.FL W5402,		174-4988-00
-10	174-4988-00			1	CA ASS, RF:50OHM, COAX, 25CM L, SMA(J)-U.FL W5403,		351-4988-00
-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

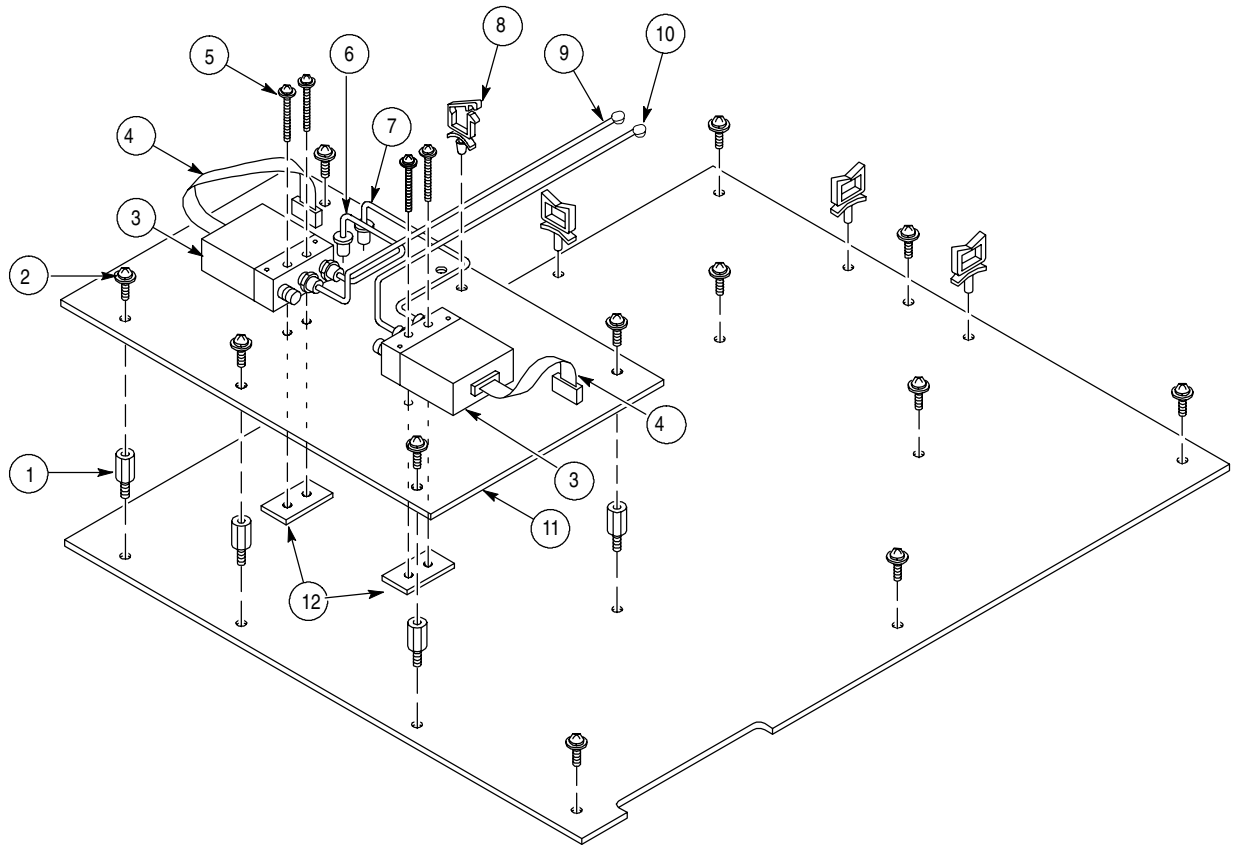


Figure 10-8: Circuit boards (for option 02)

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	333-4494-00			1	PANEL, REAR:AWG615, AL		333-4494-00
-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
-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 (W5100)		174-B940-00
-12	174-B939-00			1	CA, ASSY, RF:50OHM COAX, 55CM L, MKD R0, PELTRA (W5210)		174-B939-00
-12	174-B938-00			1	CA, ASSY, RF:50OHM COAX, 55CM L, MKD R1, PELTRA (W5230)		174-B938-00
-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
-20	174-C065-00			1	CA, ASSY, RF: 50OHM COAX, 25CM L, SMA(PANEL) - U.FL (W5420)		174-C065-00
-20	174-C065-00			1	CA, ASSY, RF: 50OHM COAX, 25CM L, SMA(PANEL) - U.FL (W5421)		174-C065-00
-20	174-C063-00			1	CA, ASSY, RF: 50OHM COAX, 20CM L, SMA-U.FL (W6290)		174-C063-00
-20	174-4980-00			1	CA, ASSY, RF: 50OHM COAX, 35CM L, SMA(PANEL) - U.FL (W8060)		174-4980-00
-20	174-4980-00			1	CA, ASSY, RF: 50OHM COAX, 35CM L, SMA(PANEL) - U.FL (W8061)		174-4980-00
-20	174-4980-00			1	CA, ASSY, RF: 50OHM COAX, 35CM L, SMA(PANEL) - U.FL (W8062)		174-4980-00
-20	174-4980-00			1	CA, ASSY, RF: 50OHM COAX, 35CM L, SMA(PANEL) - U.FL (W8063)		174-4980-00
-20	174-4979-00			1	CA, ASSY, RF: 50OHM COAX, 40CM L, SMA(PANEL) - U.FL, SAFETY CONTROLLED (W8080)		174-4979-00

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
-20	174-4979-00			1	CA, ASSY, RF: 50OHM COAX, 40CM L, SMA(PANEL) - U.FL, SAFETY CONTROLLED (W8081)		174-4979-00
-20	174-C064-00			1	CA, ASSY, RF: 50OHM COAX, 15CM L, SMA(PANEL) - U.FL (W8204)		174-C064-00
-20	174-C064-00			1	CA, ASSY, RF: 50OHM COAX, 15CM L, SMA(PANEL) - U.FL (W8205)		174-C064-00
-20	174-C064-00			1	CA, ASSY, RF: 50OHM COAX, 15CM L, SMA(PANEL) - U.FL (W8206)		174-C064-00
-20	174-C064-00			1	CA, ASSY, RF: 50OHM COAX, 15CM L, SMA(PANEL) - U.FL (W8207)		174-C064-00
-20	174-4978-00			1	CA, ASSY, RF: 50OHM COAX, 10CM L, SMA-U.FL (W8210)		174-4978-00
-20	174-4978-00			1	CA, ASSY, RF: 50OHM COAX, 10CM L, SMA-U.FL (W8211)		174-4978-00
	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

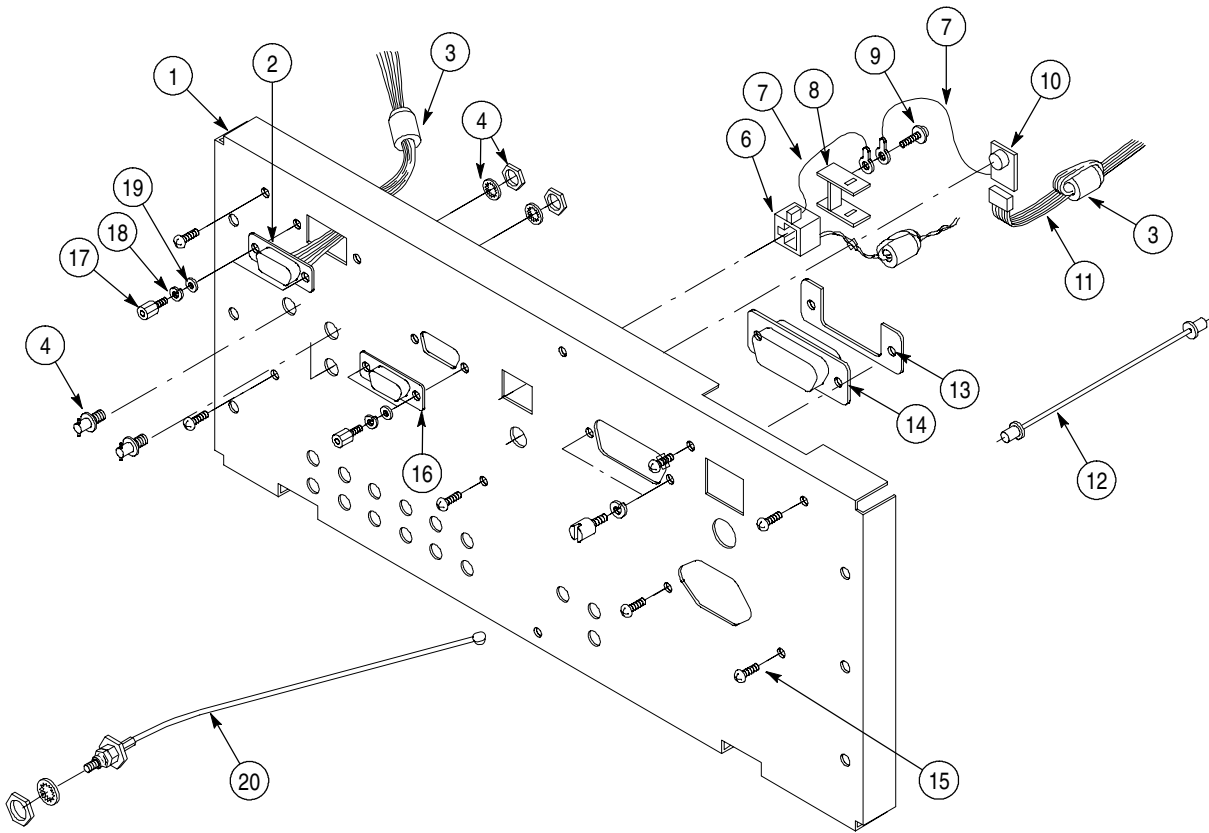


Figure 10-9: Rear Panel

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

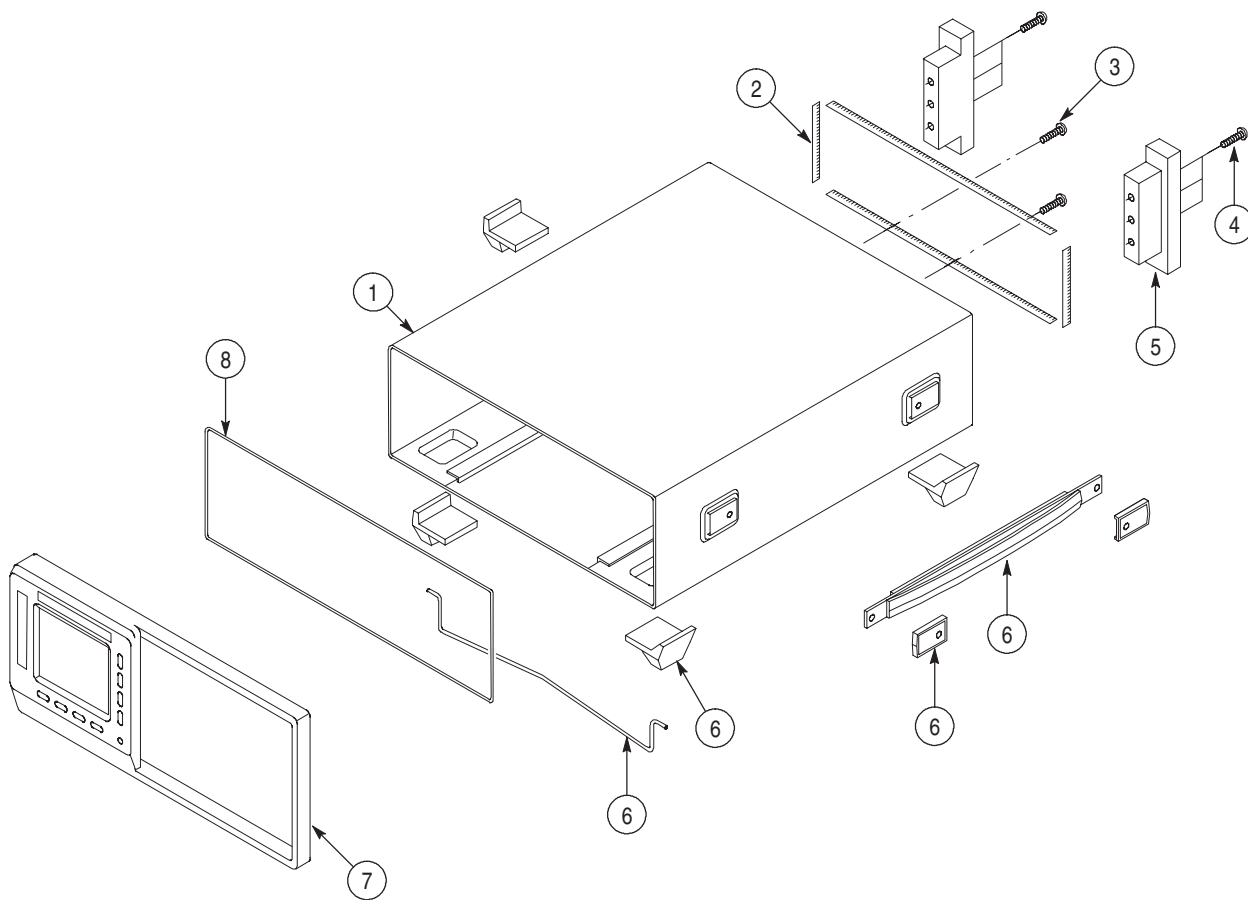


Figure 10-10: Cabinet

Replaceable Parts List

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discount'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, AWG615		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

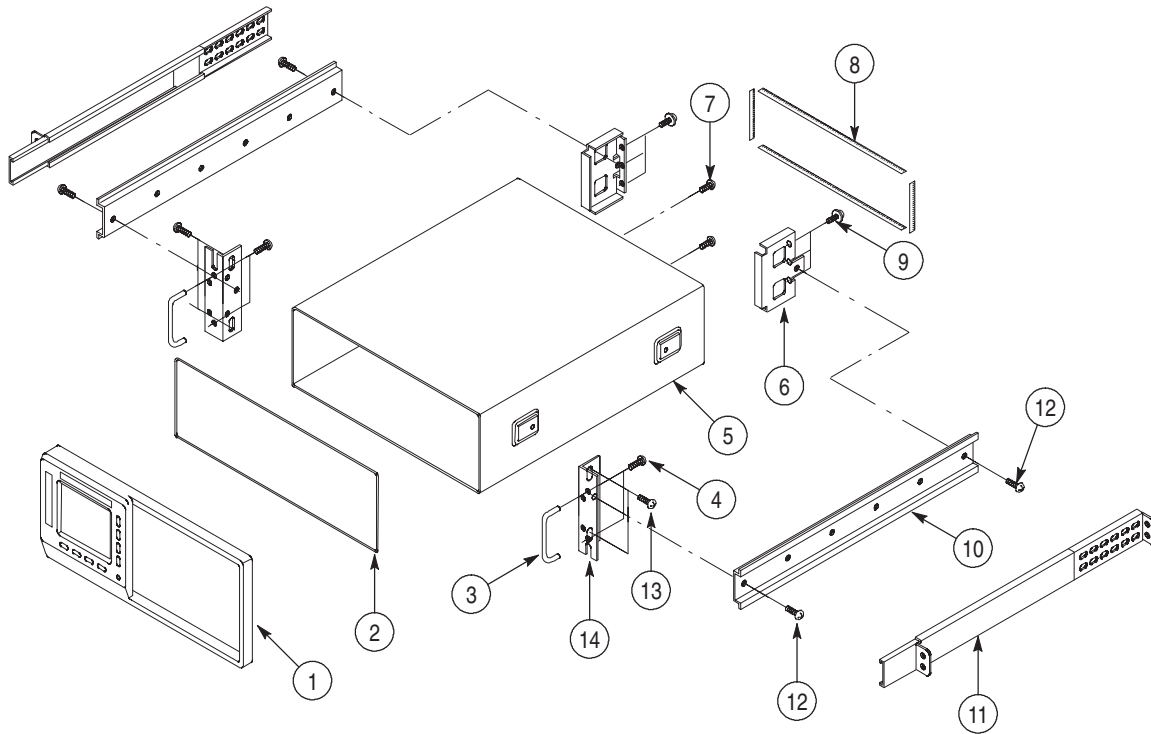


Figure 10-11: Rack mount

