

Service Manual



AWG510 & AWG520 Arbitrary Waveform Generator

071-0101-00

Warning

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



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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



Double
Insulated

Service Safety Summary

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

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

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

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

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

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

To avoid electric shock, do not touch exposed connections.

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

Memory Backup Battery. This product contains a Lithium:poly-carbon monofluoride battery for memory backup purposes. This battery is not user replaceable.

Preface

This is the service manual for the AWG510 and AWG520 Arbitrary Waveform-Generator. The manual contains information needed to service the waveform generator to the module level.

Manual Structure

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

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

- *Specifications* contains a description of the waveform generator and the characteristics that apply to it.
- *Operating Information* includes general information and operating instructions.
- *Theory of Operation* contains circuit descriptions that support service to the module level.
- *Performance Verification* contains procedures for confirming that the waveform generator functions properly and meets warranted limits.
- *Adjustment Procedures* contains a statement explaining that adjustment is unnecessary for the waveform generator.
- *Maintenance* contains information and procedures for performing preventive and corrective maintenance of 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* contains a statement referring you to *Mechanical Parts List*, where both electrical and mechanical modules are listed.
- *Diagrams* contains block diagrams and an interconnection diagram.
- *Mechanical Parts List* includes a table of all replaceable modules, their descriptions, and their Tektronix part numbers.

Manual Conventions

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

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

- Names of front panel controls and menus appear in the same case (initial capitals, all uppercase, etc.) in the manual as is used on the waveform generator front panel and menus. Front panel names are all upper-case letters; for example, SETUP, UTILITY, HARDCOPY etc.
- 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. In general, a module is an assembly (like a circuit board), rather than a component (like a resistor or an integrated circuit). Sometimes a single component is a module; for example, the chassis of the waveform generator is a module.

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

Finding Other Information

Other documentation for the AWG510 and AWG520 Arbitrary Waveform Generator includes:

- The *AWG510 and AWG520 User Manual* contains a tutorial to quickly describe how to operate the waveform generator. It also includes an in-depth discussion on how to more completely use the waveform generator features.
- The *AWG500 Series Programmer Manual* explains how to use a GPIB interface to remotely control the waveform generator.

Introduction

This manual contains information needed to properly service the AWG510 and AWG520 Arbitrary Waveform Generators, as well as general information critical to safe and effective servicing.

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

- The procedures in this manual should be performed only by a qualified service person
- Read the *General Safety Summary* and the *Service Safety Summary*, beginning on page xi
- Read *Preparation for Use* in section 2, *Operating Information*

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

Performance Check Interval

Generally, the performance check described in section 4, *Performance Verification*, should be done 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 failure to a module, use the troubleshooting procedures found in section 6, *Maintenance*. To remove and replace any failed module, follow the instructions in *Removal and Installation Procedures*, also part of section 6. After isolating a faulty module, replace it with a fully-tested module obtained from the factory. Section 10, *Mechanical Parts List*, contains part number and ordering information for all replaceable modules.

Tektronix Service Offerings

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

Whether providing warranty repair service or any of the other services listed below, Tektronix service technicians are well equipped to service the waveform generator. Tektronix technicians train on Tektronix products; they have access to the latest information on improvements to the AWG510 and AWG520 as well as new options.

Warranty Repair Service

Tektronix warrants this product for one year from date of purchase. The warranty appears on the back of the title page in this manual. Tektronix technicians provide warranty service at most Tektronix service locations. 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 down-time 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.

Contacting Tektronix

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

Specifications

Product Overview

The AWG510 and AWG520 Arbitrary Waveform Generators can generate both simple and arbitrary waveforms. The AWG510 generates one-channel differential output, while the AWG520 generates two-channel single-end arbitrary waveforms and function generator waveforms.

The AWG500-Series Generator contains a 1 GHz clock frequency, a 10-bit DA converter, and a 4 M-word waveform memory. The instrument also provides two-channel arbitrary marker outputs and a Digital Data Out option (Option 03) that bypasses the DA converter to directly output the waveform memory digital data.

The AWG510 and AWG520 includes five waveform editors, as described in the following table.

Table 1-1: AWG 500-Series waveform editors

Editor	Description
Waveform	Creates analog waveform data in graphic or tabular form.
Pattern	Creates digital 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.

The AWG500-Series function generator produces sine, triangle, square, and ramp waves, as well as direct current and noises signals. It allows you to 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 remotely control the instrument by sending commands through the GPIB interface, as well as transfer waveform data directly from a digital storage oscilloscope to the AWG500 instrument using the GPIB interface. This enables you to use the instrument in combination with other measurement equipment and/or a computer.

Specifications

The specifications on the waveform generator can be classified into three sub-sections: *Warranted Characteristics*, *Typical Characteristics* and *Nominal Traits*. *Certifications and Compliances* are also found at the last page in this section.

The all characteristics in the specifications are listed up in tables that are divided into categories. In these tables, the sub-categories may also appear in **boldface** under the column **Characteristics**.

Warranted Characteristics

This section lists the various *warranted characteristics* that describe the AWG510 and AWG520 Arbitrary Waveform Generator. Electrical and environmental characteristics are included.

Warranted characteristics are described in terms of quantifiable performance limits which are warranted.

In these tables, those warranted characteristics that are checked in the procedure *Performance Verification* are preceded by the asterisk (*) in the column *Characteristics* and the page number referenced to the corresponding performance verification procedures can be found in the column *PV reference page*.

As stated above, this section lists only warranted characteristics. A list of *typical characteristics* starts on page 1–9.

Performance Conditions

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

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

Table 1-2: Warranted characteristics — Clock generator

Characteristics	Description	PV reference page
Internal clock ¹		
* Frequency accuracy	± 1 ppm (25 °C), during 1 year after calibration	Page 4-32

¹ The internal reference oscillator is used.

Table 1-3: Warranted characteristics — Internal trigger generator

Characteristics	Description	PV reference page
Internal trigger rate ²		
* Accuracy	$\pm 0.1\%$	Page 4-47

² The internal reference oscillator is used.

Table 1-4: Warranted characteristics — Main output

Characteristics ³	Description	PV reference page
DA converter		
Differential non-linearity	Within 1 bit	
Integral non-linearity	Within 1 bit	
Reverse power protection	Up to 0.4 W	
Normal out		
* DC accuracy	$\pm (1.5\% \text{ of amplitude} + 2 \text{ mV})$, offset: 0 V	Page 4-34
* Offset accuracy	$\pm (1\% \text{ of offset} + 10 \text{ mV})$, 20 mV amplitude (waveform data: 0)	Page 4-34
* Pulse response	(Waveform data: -1 and 1, offset: 0 V, and filter: through)	Page 4-42
Rise time (10 % to 90 %)	≤ 2.5 ns (amplitude > 1.0 V) ≤ 1.5 ns (amplitude ≤ 1.0 V)	
Fall time (10 % to 90 %)	≤ 2.5 ns (amplitude > 1.0 V) ≤ 1.7 ns (amplitude ≤ 1.0 V)	
* Aberration	(500 MHz Bandwidth) $\pm 10\%$ (amplitude > 1.0 V) $\pm 7\%$ (amplitude ≤ 1.0 V)	Page 4-42
* Flatness	$\pm 3\%$ (after 50 ns from rise and fall edges)	

Table 1-4: Warranted characteristics — Main output (Cont.)

Characteristics ³	Description	PV reference page
* Sinewave characteristics	(Clock: 1 GHz, waveform points: 32, frequency: 31.25 MHz, amplitude: 1.0 V, offset: 0 V, filter: through)	
Harmonics	≤ -50 dBc (DC to 400 MHz)	
Noise	≤ -53 dBc (DC to 400 MHz)	
Phase Noise	≤ -90 dBc / Hz (10 kHz offset)	
Direct DA out		
* DC accuracy		
Amplitude	0.5 Vp-p ± 10 %	Page 4-38
DC offset	-0.27 V ± 10 %	
* Pulse response	(Waveform data: -1 and 1)	Page 4-42
Rise time (10 % to 90 %)	≤ 700 ps	
Fall time (10 % to 90 %)	≤ 700 ps	

³ The characteristics are specified at the end of the BNC cable (012-0482-00).

Table 1-5: Warranted characteristics — Auxiliary outputs

Characteristics	Description	PV reference page
Marker ⁴		
* Accuracy	Within $\pm (0.1$ V +5 % of setting)	Page 4-64
Noise ⁵		
Accuracy	± 2.5 dB (at 100 MHz, -105 dBm/Hz)	
Flatness	± 2.5 dB (1 MHz to 300 MHz, at 105 dBm/Hz, 100 MHz Reference)	

⁴ The characteristics are specified at the end of the BNC cable (012-1459-00).

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

Table 1-6: Warranted characteristics — Digital data out (option 03)

Characteristics ⁶	Description	PV reference page
* Output level accuracy	Within $\pm (0.1$ V +5 % of setting)	Page 4-71
* Skew between data	≤ 1 ns	

⁶ The characteristics are specified at the end of the BNC cable (012-1459-00).

Table 1-7: Warranted characteristics — Auxiliary inputs

Characteristics	Description	PV reference page
Trigger input ⁷		
Impedance	50 Ω \pm 2 Ω 1 k Ω \pm 100 Ω	
Input voltage range	\pm 10 V, into a 1 k Ω load \pm 5 V, into a 50 Ω load	
* Threshold accuracy	\pm (5 % of level + 0.1 V)	Page 4-49
Pulse width	Minimum 10 ns, 0.2 V amplitude	
Trigger dead time	Maximum 500 ns	
Delay to marker	30 ns + 1 clock (typical) See Figure 1-1 for T _{d2}	
Event trigger input		
Pulse width	Minimum 64 clocks	
Input voltage range	0 V to +5 V (DC + peak AC)	
Delay to analog out	\leq 384 clocks + 20 ns	
CH1 ADD input		
Input voltage range	-1 V to +1 V (DC + peak AC)	
Bandwidth	DC to 200 MHz (-3 dB), 1 V _{p-p} input	
Amplitude accuracy	\pm 5 % NOTE: CH1 output cannot exceed \pm 2 V (into a 50 Ω load).	
Reference 10 MHz clock input		
Input range	0.2 V to 3.0 V _{p-p} (into a 50 Ω load, AC coupling)	
Reference frequency	10 MHz \pm 0.1 MHz	

⁷ The characteristics are specified at the end of the BNC cable (012-0482-00).

Table 1-8: Warranted characteristics — AC line power

Characteristics	Description	PV reference page
Source frequency	48.0 Hz to 63 Hz (voltage range from 100 VAC to 240 VAC)	
Maximum consumption	AWG510 (Standard)	400 W
	AWG520	600 W
Maximum current	AWG510 (Standard)	5 A
	AWG520	8 A

Table 1-9: Warranted characteristics — Installation requirement

Characteristics	Description	PV reference page
Heat dissipation		
Maximum power	600 W (maximum line current: 8 Arms, 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	Bottom	2 cm (0.8 in.) <i>NOTE:</i> The feet on the bottom provides the required clearance when set on a flat surface.
	Sides	15 cm (6 in.)
	Rear	7.5 cm (3 in.)

Table 1-10: Warranted characteristics — 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	
Operating	Up to 4.5 km (15 000 ft) Maximum operating temperature decreases 1 °C each 300 m (1 000 ft) above 1.5 km (5 000 ft)
Non-operating	Up to 15 km (50 000 ft)
Dynamics	
Random vibration	
Operating	0.27 g rms, from 5 Hz to 500 Hz, 10 minutes
Non-operating	2.28 g rms, from 5 Hz to 500 Hz, 10 minutes
Shock	
Non-operating	294 m/s ² (30 G), half-sine, 11 ms duration

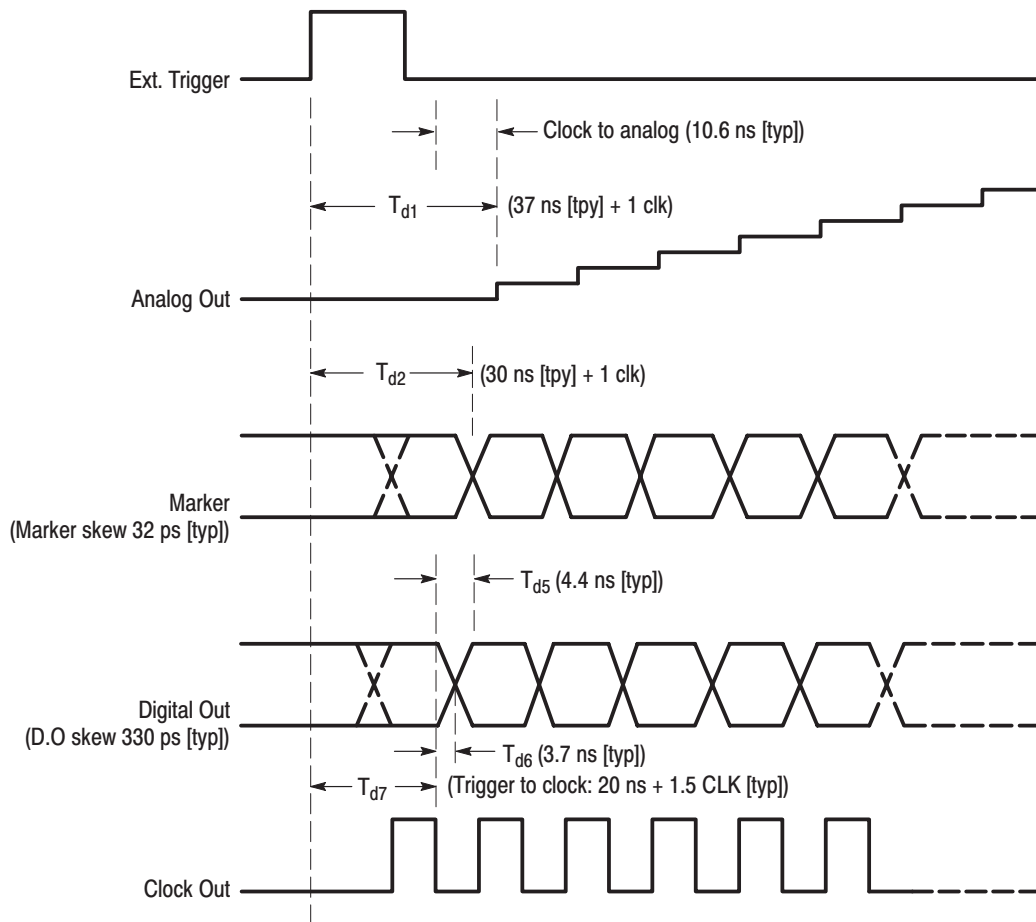


Figure 1-1: Signal timing

Typical Characteristics

This subsection contains tables that list the various *typical characteristics* which describe the AWG510 and AWG520 Arbitrary Waveform Generator.

Typical characteristics are described in terms of typical or average performance. Typical characteristics are not warranted.

Table 1-11: Typical characteristics — Clock generator

Characteristics	Description
Phase noise	-80 dBc / Hz (1 GHz with 10 kHz offset) -100 dBc/Hz (1 GHz with 100 kHz offset)

Table 1-12: Typical characteristics — Main output

Characteristics ⁸	Description
Output impedance	50 Ω
Normal out Small signal bandwidth	300 MHz (-3 dB, amplitude fixed to 0.5 V)

⁸ The characteristics are specified at the end of the BNC cable (012-0482-00).

Table 1-13: Typical characteristics — Filter

Characteristics	Description	
Rise time (10 % to 90 %)	10 MHz	35 ns
	20 MHz	17 ns
	50 MHz	7.0 ns
	100 MHz	3.5 ns
Delay from trigger	10 MHz	77 ns + 1 clock
	20 MHz	57 ns + 1 clock
	50 MHz	47 ns + 1 clock
	100 MHz	42 ns + 1 clock
	Through	37 ns + 1 clock
See Figure 1-1 for T _{d1}		

Table 1-14: Typical characteristics — Auxiliary outputs

Characteristics	Description
Marker ⁹	
Rise and fall times (10 % to 90 %)	0.5 ns (1 Vp-p, Hi: +0.5 V, Lo: -0.5 V) 1.0 ns (2 Vp-p, Hi: +1 V, Lo: -1 V) 2.0 ns (4 Vp-p, Hi: +2 V, Lo: -2 V)
Marker skew	32 ps

⁹ The characteristics are specified at the end of the BNC cable (012-1459-00).

Table 1-15: Typical characteristics — Digital data out (option 03)

Characteristics ¹⁰	Description
Rise and fall times (10 % to 90 %)	0.5 ns (1 Vp-p, Hi: +0.5 V, Lo: -0.5 V) 1.0 ns (2 Vp-p, Hi: +1 V, Lo: -1 V) 2.0 ns (4 Vp-p, Hi: +2 V, Lo: -2 V)
Skew between data	330 ps
Delay	
Data to marker	4.4 ns. See Figure 1-1 for T _{d5} .
Clock to data	3.7 ns. See Figure 1-1 for T _{d6} .

¹⁰ The characteristics are specified at the end of the BNC cable (012-1459-00).

Table 1-16: Typical characteristics — Auxiliary inputs

Characteristics	Description
Trigger input ¹¹	
Delay (Filter:Through)	
To analog output (Triggered mode)	37 ns + 1 clock. See Figure 1-1 for T _{d1} .
To analog output (Gated mode)	Maximum 45 ns + 430.5 clocks Minimum 45 ns + 358.5 clocks
To marker	30 ns + 1 clock. See Figure 1-1 for T _{d2} .
Jitter	
Trigger	Maximum 1.6 ns
Gate	Maximum 32 clocks

¹¹ The characteristics are specified at the end of the BNC cable (012-0482-00).

Nominal Traits

This section contains a collection of tables that list the various *nominal traits* that describe the AWG510 and AWG520 Arbitrary Waveform Generator. Electrical and mechanical traits are included.

Nominal traits are described using simple statements of fact such as “Four, all identical” for the trait “Output Channels, Number of,” rather than in terms of limits that are performance requirements.

Table 1-17: Nominal traits — Operation modes

Characteristics	Description
Continuous	Waveform is continuously output in this mode. When a sequence is defined, waveforms are sequentially or repeatedly output in the order defined by the sequence. The extended sequence functions such as trigger input, event jump, etc. 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, etc. are neglected in this mode.
Gated	The waveform is output as the same way as in the continuous mode only when the gate is opened. The gate is opened by the gated signal.
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, etc. are effective and waveforms are controlled for output by this functions in this mode.

Table 1-18: Nominal traits — Arbitrary waveforms

Characteristics	Description	
Waveform memory	Memory length: 4,194,048 words (10 bits/1 word)	
Marker memory	Memory length:	
	AWG510	4,194,048 words (2 markers × 1 bit / 1 word)
	AWG520	4,194,048 words (4 markers × 1 bit / 1 word)
Sequence memory	Maximum 8000 steps The sequence operates for both CH1 and CH2 in the AWG520.	
Sequence counter	1 to 65536, or Infinite	
Waveform data points	Multiple of 4 in the range from 256 to 4,198,048 points	

Table 1-19: Nominal traits — Clock generator

Characteristics	Description
Sampling frequency	50.000 000 kHz to 1.000 000 0 GHz
Resolution	8 digits

Table 1-20: Nominal traits — Internal trigger generator

Characteristics ¹²	Description
Internal trigger rate	
Range	1.0 μ s to 10.0 s
Resolution	3 digits, minimum 0.1 μ s

¹² The internal reference oscillator is used.

Table 1-21: Nominal traits — Main output

Characteristics ¹³	Description
Output connector	Front panel BNC connectors
Output signal	AWG510 Complementary; CH1 and CH1
	AWG520 Single-ended; CH1 and CH2
DA converter	
Resolution	10 bits
Normal out	
Output voltage	-2.0 V to +2.0V, into a 50 Ω load
Amplitude	
Range	20 mV to 2 V, into a 50 Ω load
Resolution	1 mV
Offset	
Range	-1.000 V to 1.000 V, into a 50 Ω load
Resolution	1 mV
Direct DA out	
Output voltage	0.5 Vp-p (with -2.7 V offset), into a 50 Ω load

¹³ The characteristics are specified at the end of the BNC cable (012-0482-00).

Table 1-22: Nominal traits — Filter

Characteristics	Description
Type	Bessel low pass filter, 100 MHz, 50 MHz, 20 MHz, and 10 MHz

Table 1-23: Nominal traits — Auxiliary outputs

Characteristics	Description
Marker ¹⁴	
Number of markers	AWG510 2
	AWG520 4
Level (Hi/Lo)	-2.0 V to +2.0 V, into a 50 Ω load -4.0 V to +4.0 V, into a 1 M Ω load
Resolution	0.05 V
Variable delay	
Range	0 ns to +2 ns
Resolution	20 ps
Connector	Rear panel SMB connectors
Clock output ¹⁴	
Level	ECL 100 K compatible (internally loaded in 50 Ω to -2 V and 43 Ω series terminated)
Connector	Rear panel BNC connectors
Noise ¹⁵	
Level	-145 dBm / Hz to -105 dBm / Hz
Attenuator	1 dB step
Connector	Rear panel BNC connector
Type	Gaussian

¹⁴ The characteristics are specified at the end of the BNC cable (012-1459-00).

¹⁵ The characteristics are specified at the end of the BNC cable (012-0482-00).

Table 1-24: Nominal traits — Digital data out (option 03)

Characteristics ¹⁶	Description
Output signal	D0 to D9
Connector	Rear panel SMB connectors
Level (Hi/Lo)	-2.0 V to +2.0 V, into a 50 Ω load -4.0 V to +4.0 V, into a 1 M Ω load
Resolution	0.05 V

¹⁶ The characteristics are specified at the end of the BNC cable (012-1459-00).

Table 1-25: Nominal traits — Auxiliary inputs

Characteristics	Description
Trigger input ¹⁷	
Connector	Rear panel BNC connector
Impedance	1 k Ω or 50 Ω
Polarity	POS (positive) or NEG (negative)
Threshold	
Level	-5.0 V to 5.0 V
Resolution	0.1 V
Event trigger input	
Connector	9-pin, D type on the rear panel
Number of events	4 bits
Input signal	4 event bits and Strobe
Threshold	TTL level
Impedance	2.2 k Ω , pull-up to +5 V
CH1 ADD input	
Impedance	50 Ω
Connector	Rear panel BNC connector
Reference 10 MHz clock input	
Voltage range	Maximum ± 10 V
Impedance	50 Ω , AC coupling
Connector	Rear panel BNC connector

¹⁷ The characteristics are specified at the end of the BNC cable (012-0482-00).

Table 1-26: Nominal traits — Display and CPU board battery

Characteristics	Description	
Display		
Display area	Horizontal	13.2 cm (5.2 in.)
	Vertical:	9.9 cm (3.9 in.)
Resolution	640 (H) × 480 (V) pixels	
CPU board battery	Note: this battery is not user-replaceable. The CPU board must be replaced as a unit.	
Type	Lithium	
Output	3 V, 190 mAh	
Service life	6 years	

Table 1-27: Nominal traits — AC line power

Characteristics	Description
Line voltage	100 to 240 VAC
Fuse rating	10 A FAST, 250 V, UL 198G (3 AG) 5 A (T), 250 V, IEC 127

Table 1-28: Nominal traits — Interface connectors

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

Table 1-29: Nominal traits — Mechanical

Characteristics	Description	
Net weight (AWG520)	17 kg (37.5 lbs.)	
Dimensions	Height	178 mm (7.0 in.)
	Width	422 mm (16.6 in.)
	length	560 mm (22.0 in.)

Certification and Compliances

The certification and compliances for the AWG510 and AWG520 Arbitrary Waveform Generator are listed in Table 1–30.

Table 1–30: Certifications and compliances

<p>EC declaration of conformity</p>	<p>Meets intent of Directive 89/336/EEC for Electromagnetic Compatibility. Compliance was demonstrated to the following specifications as listed in the Official Journal of the European Communities:</p> <table border="0"> <tr> <td>EN 55011</td> <td>Class A Radiated and Conducted Emissions</td> </tr> <tr> <td>EN 50081-1 Emissions:</td> <td></td> </tr> <tr> <td> EN 61000-3-2</td> <td>AC Power Line Harmonic Emissions</td> </tr> <tr> <td>EN 50082-1 Immunity:</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>RF Electromagnetic Field Immunity</td> </tr> <tr> <td> EN 61000-4-4</td> <td>Electrical Fast Transient 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 Fields</td> </tr> <tr> <td> EN 61000-4-8</td> <td>Power Frequency Electromagnetic Field</td> </tr> <tr> <td> EN 61000-4-11</td> <td>Power Line Interruption Immunity</td> </tr> <tr> <td> ENV 50204</td> <td>Radiated Electromagnetic Field from Digital Telephones</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</p> <table border="0"> <tr> <td>EN 61010-1:1993</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 50081-1 Emissions:		EN 61000-3-2	AC Power Line Harmonic Emissions	EN 50082-1 Immunity:		EN 61000-4-2	Electrostatic Discharge Immunity	EN 61000-4-3	RF Electromagnetic Field Immunity	EN 61000-4-4	Electrical Fast Transient Immunity	EN 61000-4-5	Surge Immunity	EN 61000-4-6	Conducted Disturbances Induced by RF Fields	EN 61000-4-8	Power Frequency Electromagnetic Field	EN 61000-4-11	Power Line Interruption Immunity	ENV 50204	Radiated Electromagnetic Field from Digital Telephones	EN 61010-1:1993	Safety requirements for electrical equipment for measurement, control, and laboratory use
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ENV 50204	Radiated Electromagnetic Field from Digital Telephones																										
EN 61010-1:1993	Safety requirements for electrical equipment for measurement, control, and laboratory use																										
<p>FCC compliance</p>	<p>FCC Code of Federal Regulations, 47 CFR, Part 15, Subpart B, Class A</p>																										
<p>Australian declaration of conformity – EMC</p>	<p>Conforms with the following standards in accordance with the Electromagnetic Compatibility Framework:</p> <table border="0"> <tr> <td>AS/NZS 2064.1/2</td> <td>Class A radiated and Conducted Emissions</td> </tr> </table>	AS/NZS 2064.1/2	Class A radiated and Conducted Emissions																								
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<p>Approvals</p>	<p>UL3111-1 – Standard for electrical measuring and test equipment</p> <p>CAN/CSA C22.2 No. 1010.1 – Safety requirements for electrical equipment for measurement, control and laboratory use</p> <p>IEC1010-1 – Safety requirements for electrical equipment for measurement, control, and laboratory use</p>																										

Table 1-30: Certifications and compliances (Cont.)

Installation category	Power Input – Installation Category II (as defined in IEC 1010-1, Annex J)	
	Terminals on this product may have different installation category designations. The installation categories are:	
	<i>Category</i>	<i>Descriptions</i>
	CAT III	Distribution-level mains (usually permanently connected). Equipment at this level is typically in a fixed industrial location
CAT II	Local-level mains (wall sockets). Equipment at this level includes appliances, portable tools, and similar products. Equipment is usually cord-connected	
CAT I	Secondary (signal level) or battery operated circuits of electronic equipment	
Pollution degree	Pollution Degree 2 (as defined in IEC 1010-1)	

Operating Information

Operating Information

This section is divided into following two subsections:

- *Preparation for Use.* Describes the installation, environmental requirements, information on how to power on or off, and so on.
- *Instruction for Operation.* Describes the general menu operating information and Diag/Cal menu structure.

Preparation for Use

This subsection describes:

- Supplying Operating Power
- Operating Environment
- Applying and Interrupting Power.

Supplying Operating Power

NOTE. Read all information and heed all warnings in this subsection before connecting the AWG500 to a power source.



WARNING. AC POWER SOURCE AND CONNECTION. The waveform generator operates from a single-phase power source. It has a three-wire power cord and two-pole, three-terminal grounding type plug. The voltage to ground (earth) from either pole of the power source must not exceed the maximum rated operating voltage, 250 volts.

Before making connection to the power source, be sure the waveform generator has a suitable two-pole, three-terminal grounding-type plug.

GROUNDING. This instrument is safety Class 1 equipment (IEC designation). All accessible conductive parts are directly connected through the grounding conductor of the power cord to the grounded (earthing) contact of the power plug.



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

For electric shock protection, the grounding connection must be made before making connection to the instrument's input or output terminals.

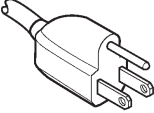
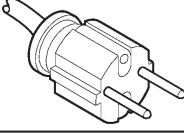
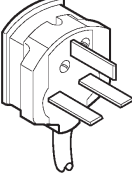
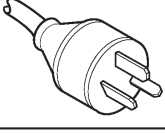
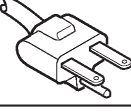
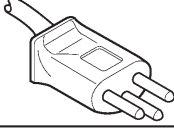
Power Cord Information

A power cord with the appropriate plug configuration is supplied with each AWG500. Table 2–1 gives the color-coding of the conductors in the power cord. If you require a power cord other than the one supplied, refer to Table 2–2, Power Cord Identification.

Table 2-1: Power-cord conductor identification

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

Table 2-2: Power cord identification

Plug Configuration	Normal Usage	Option Number
	North America 125 V	Standard
	Europe 230 V	A1
	United Kingdom 230 V	A2
	Australia 230 V	A3
	North America 230 V	A4
	Switzerland 230 V	A5

Operating Voltage This AWG500 operates with any line voltage from 100 to 240 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 AWG500 to retain some types of data upon loss of the AC power source. The stored adjustment constants, saved front-panel settings, current front-panel settings (instrument status), and in-memory waveform data are retained.

The on-board batteries of the memory modules have a shelf life of about five years. Partial or total loss of stored settings upon power on may indicate that the memory module batteries need to be replaced. You must return the modules to an authorized Tektronix field service facility to replace the batteries and reload calibration constants.

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 is from 10° C to +40° C with no diskette in the floppy drive. Store the AWG500 in ambient temperatures from -20° C to +60° C with no diskette in the floppy drive. 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 exhausted through the cabinet side panels by an internal fan. To ensure proper cooling of the waveform generator, allow at least 6 inches (15 cm) clearance on both sides, 0.8 inches (2 cm) on the bottom, and 3 inches (7.5 cm) on the rear of the AWG500. (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 goes over 80° C, the AWG500 may temporarily shut down to protect the internal modules. To prevent temporary shutdown of the AWG500, do not restrict air flow through the chassis.*

In firmware version 1.4 and later, the AWG500 displays the message “Power fail or out of temperature limit” before shutting down.

If the AWG500 shuts down unexpectedly, improve ventilation around the AWG500 and wait a few minutes to allow it to cool down; then switch the power on again.

Applying and Interrupting Power

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



CAUTION. *You can not 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.*

Power On

Upon power on, the waveform generator runs a power-on self check. If it passes, the AWG500 displays a *Pass* status message and a prompt to press any key to continue. If it fails, the AWG500 displays a diagnostic log that identifies the area(s) that failed and a prompt to press any key to continue. Refer to Section 6, *Maintenance*, 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 Section 5, Adjustment Procedures. To do so might result in the loss of internally stored adjustment constants.*

In general, 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 or unexpected loss of power to the AWG500 can result in calibration data corruptions on the hard disk.

Repackaging Instructions

Use a corrugated cardboard shipping carton having a test strength of at least 375 pounds and with an inside dimension at least six inches greater than the instrument dimensions.

If the instrument is being shipped to a Tektronix Service Center, enclose the following information: the owner's name, address, phone number of a contact person, type and serial number of the instrument, reason for returning, and a complete description of the service required.

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

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

Installed Options

Your instrument may be equipped with one or more instrument options. Except for the line-cord options described in Table 2-2 (on page 2-4 of this section), all options and optional accessories are listed and described in Section 7, *Options*. For further information and prices of instrument options, refer to your Tektronix Products catalog or contact your Tektronix Field Office.

Basic Operations

This section describes the AWG500-Series Waveform Generator menu system and numeric and text input methods.

Menu Operations

There are four menu buttons, labeled EDIT, SETUP, APPL, and UTILITY, as shown in Figure 2–1. 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 2–1. 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 and exits to the previous instrument state.

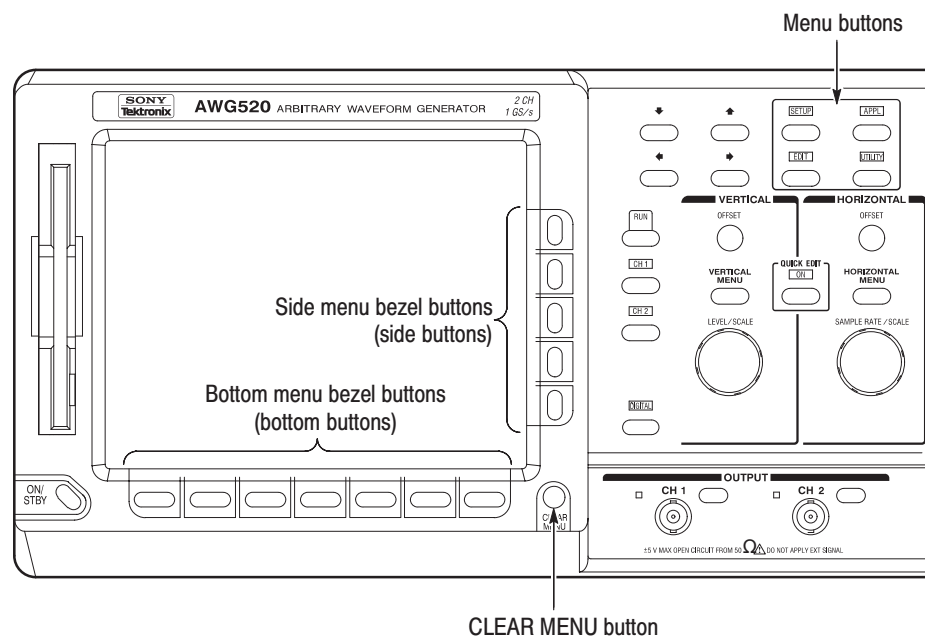


Figure 2–1: Menu buttons, bezel menu buttons, and the CLEAR MENU button

Menu Elements

Pushing a front-panel menu button displays that buttons screen and bottom menu items. 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 2–2 through 2–4 show examples of the side menu, pop-up menu and dialog box, respectively.

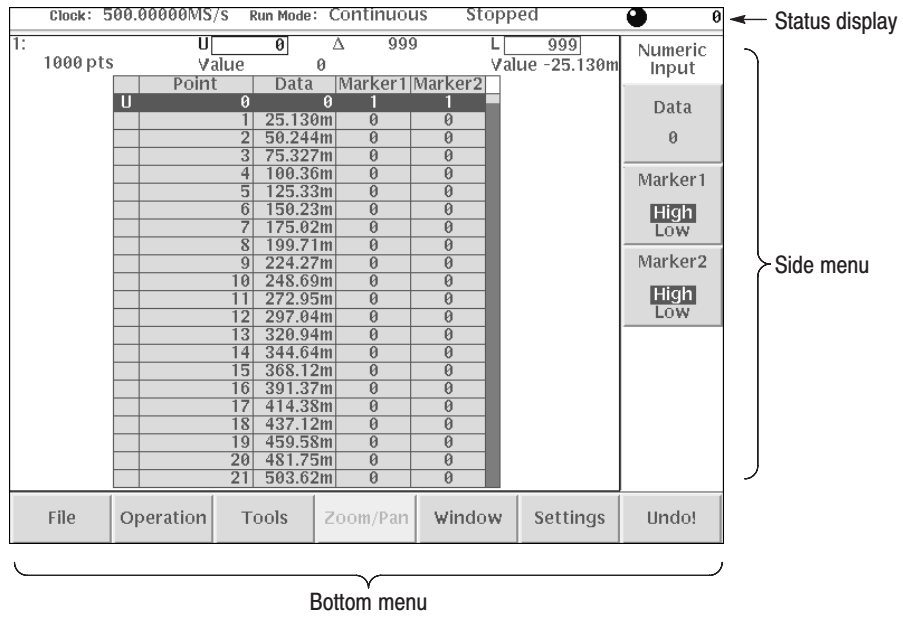


Figure 2–2: Bottom and side menus

You use a side menu button to enter into the side submenu, set a parameter, perform a feature, or cancel an operation. You can find various type of side buttons as show in Table 2–3 describing the side menu button types.

Table 2-3: Side menu elements

Menu items	Descriptions	Menu items	Descriptions
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 sub menus. Note that the label on the item is followed by an ellipsis (...).

A pop-up menu, shown in Figure 2-3, 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.

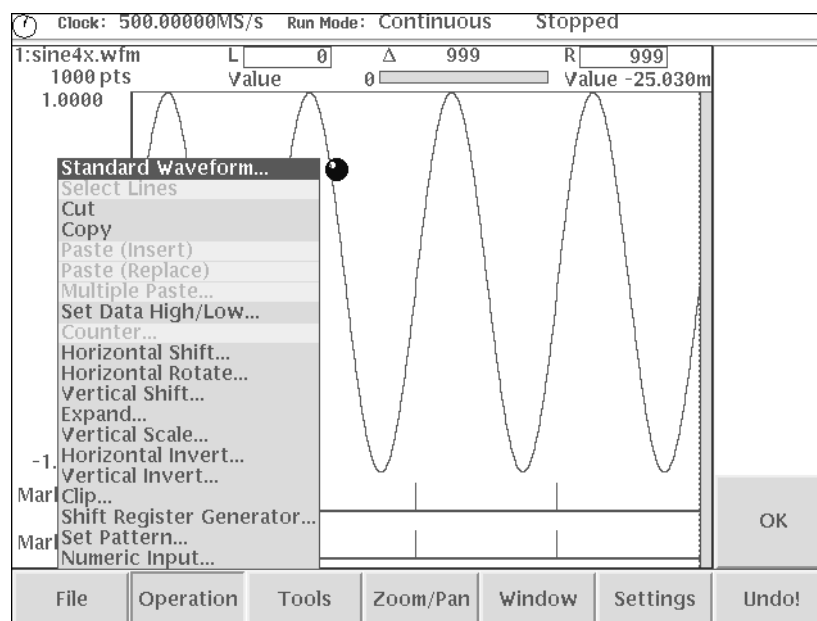


Figure 2-3: Pop-up menu example

A dialog box, shown in Figure 2–4, displays a form in which you make selections or enter values. Use the front-panel arrow buttons to move in the list and select items or fields. Use the keypad buttons or the general purpose knob to change values in selected text/numeric fields or change 1-of-N fields. 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.

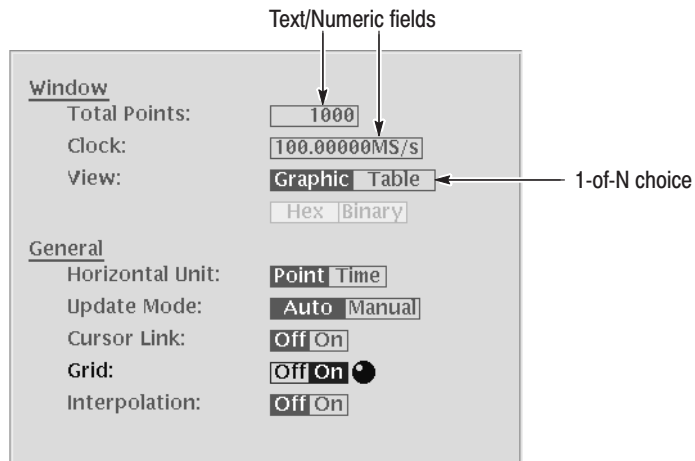


Figure 2–4: Dialog box example

Refer to *Numeric Input* on page 2–13 and *Text Input* on page 2–15 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 2–5.

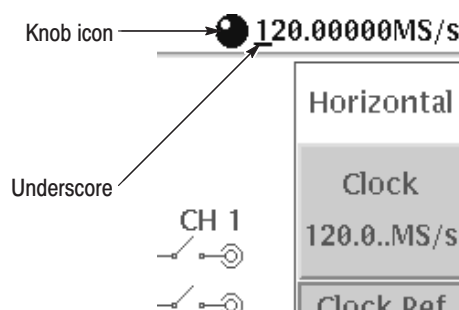


Figure 2–5: Knob icon displayed in Status Display Area

The General Purpose Knob

A knob icon with a numeric value that includes an underscore character indicates that you can change the value by using the general purpose knob or keypad buttons.

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.

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.

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 2–6 shows the numeric keypad, with descriptions of the button operations.

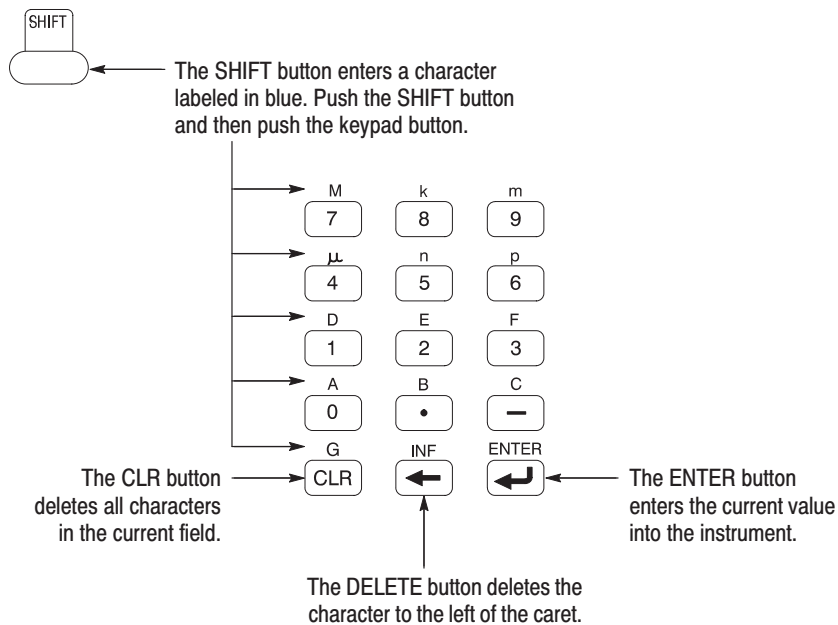


Figure 2-6: Keypad buttons

The G, M, k, m, μ , n, and p buttons are for entering measurement units. 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 μ s, push **2**, **0**, **0**, **.**, **5**, μ (SHIFT + 4), and **ENTER**.

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. As the same fashion, 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 great 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 **5**, **0** and **ENTER** buttons in this order, the Clock will be set to 50.0 MS/s. To set to 500 kS/s, press **0**, **.**, **5** and **ENTER** buttons, or **5**, **0**, **0**, **SHIFT**, and **8** 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 the text dialog boxes, shown in Figure 2–7. 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.

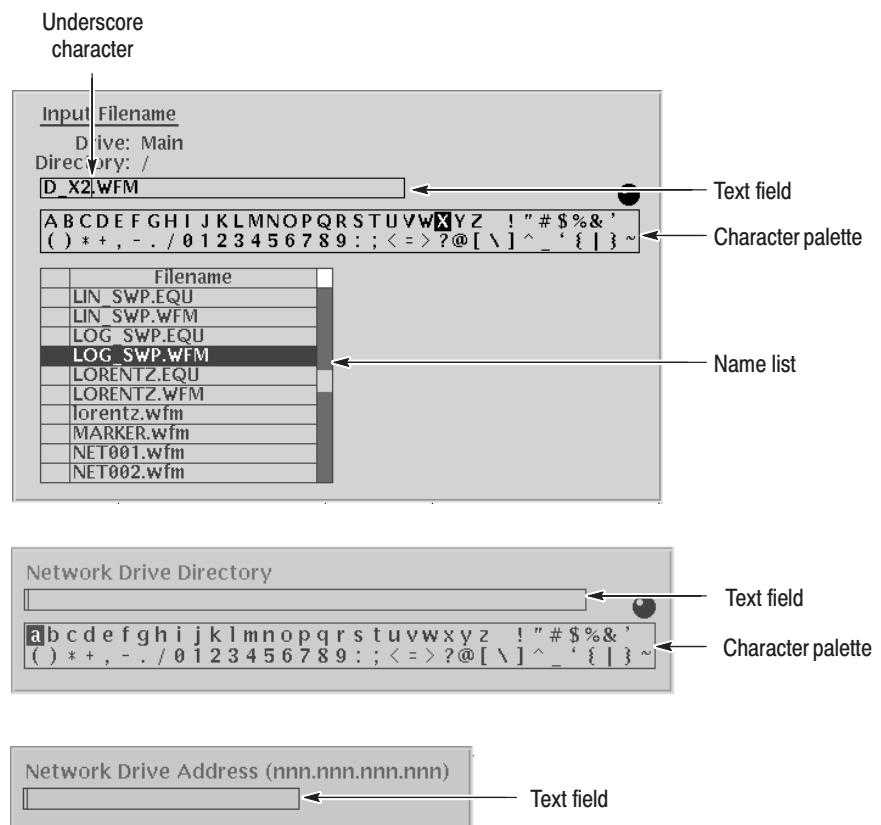


Figure 2–7: Three type of Input text dialog boxes

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 at the location of the character underscore. 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 2-4 describes all the controls you can use for entering and editing textual input.

Table 2-4: 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 2–8 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 2–5 describes the shortcut controls.

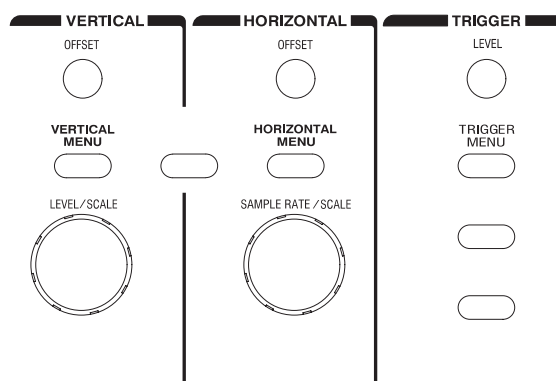


Figure 2–8: Shortcut controls

Table 2–5: Shortcut control descriptions






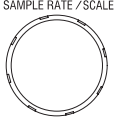


Controls	Descriptions
VERTICAL	
	Displays the Vertical side menu. This is the same operation as selecting SETUP (front)→ Vertical (bottom).
	Adjusts the vertical offset parameters. This is the same as selecting SETUP (front)→ Vertical (bottom)→ Offset (side), and then turning the general purpose knob.
	Adjusts the amplitude parameters. This is the same as selecting SETUP (front)→ Vertical (bottom)→ Amplitude (side), and then turning the general purpose knob.
HORIZONTAL	
	Displays the Horizontal side menu. This is the same as selecting SETUP (front)→ Horizontal (bottom).
	Shifts data in the area specified by the area cursor. This control can be used only for the quick editing. Refer to <i>Quick Editing</i> in the user manual for more details on quick editing.

Table 2-5: Shortcut control descriptions (cont.)

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

File Management

The AWG500-Series Waveform Generator uses numerous file formats to hold different types of data. These file types are listed in Table 2-6. Note that the instrument checks the file format when reading and processes the file based on its content, regardless of the file extension.

Table 2-6: AWG500-Series Waveform Generator file types

Extensions	Files	Description
.WFM	Waveform file	Contains waveform data. All signal data must be in waveform format before it can be output. Created with the waveform editor, by compiling an equation file, or when importing waveforms from external equipment.
.PAT	Pattern file	Contains digital pattern data. Created with the pattern editor.
.SEQ	Sequence file	Contains waveform sequence and trigger data. Created with the sequence editor.
.EQU	Equation file	Contains equations that describe a waveform. Created with the equation/text editor.
.TXT	Text file	Contains ASCII text. Created with the equation/text editor.
.SET	Setup file	Contains instrument setup and configuration data. Created from the SETUP menu.

Locating Files

There are three locations for storing waveform data on the AWG500-Series Waveform Generator: 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 main screen Drive

and Directory bottom menu buttons to open side menus that let you change the current drive location. Table 2–7 describes the Drive and Directory bottom buttons.

Table 2–7: Drive and Directory menus

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

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. If you are prompted, refer to Saving Files on page 2–21.

Copying Files

Copying files is done from the EDIT menu screen. Do the following steps to copy a file:

1. Push **EDIT** (front). The instrument displays the file list.
2. Select the file to copy.
3. Push **File** (bottom)→**Copy** (side)
4. Enter the new name for the copied file in the file name field
5. Push **OK** (side). The file is copied and renamed.

Renaming Files

Renaming files is done from the EDIT menu screen. 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

Deleting files is done from the EDIT menu screen. 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 an attribute: read only or read/write 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 **Read/Write** or **Read Only** that is the attribution of the selected file. Pushing this side button causes to immediately change the file attribute.

The file with read only attribute is marked by  , and the directory by  . See Figure 2–9.

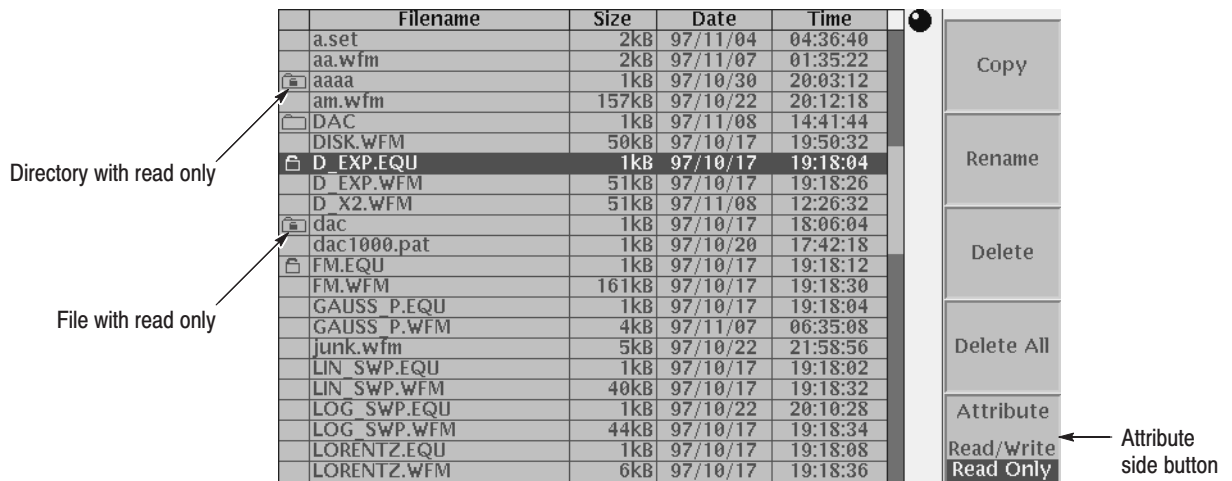


Figure 2-9: Files and directories with read only attribute

Saving Files

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

If you are saving a waveform for the first time, the instrument opens the Input Filename dialog box, shown in Figure 2-10. Use this dialog box to enter a file name. If necessary, you can select a different storage media or directory by pushing the **Drive...** side menu button. When you are done entering the file name, push the **OK** side button or the **ENTER** front-panel button to close the dialog box and save the file.

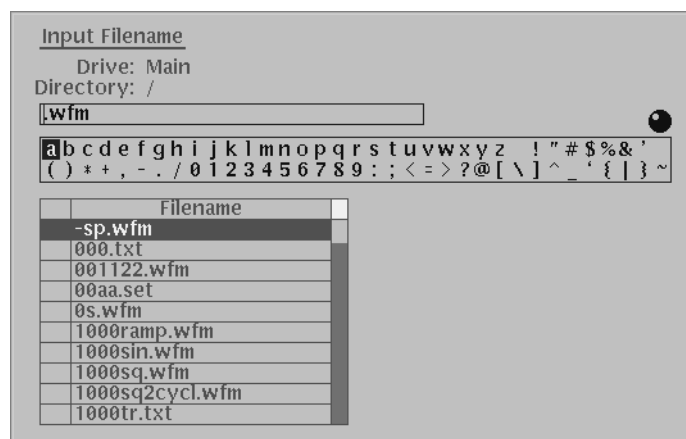


Figure 2-10: Input Filename dialog box

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 2–10. Use this dialog box to enter a file name. If necessary, you can select a storage media or directory by pushing the **Drive...** side menu button. When you are done entering the file name, push the **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 256 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 2–8. 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 2–8: Waveform record length adjustment messages

Message	Descriptions
Leave as it is	The data is saved, as it is, without making changes.
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 4M points, this will cause an error.

Theory of Operation

Theory of Operation

This section describes the electrical operation of the AWG510 and AWG520 Arbitrary Waveform Generator of the major circuit blocks or modules. Refer to Figure 9–1 while reading this text.

Module Overview

The AWG510 and AWG520 are portable dual-channel waveform generator (differential for the AWG510 and single-ended for the AWG520). The waveform generator reads the digital waveform data loaded into its waveform memory. The point rate clock determines the rate at which the data is read. The waveform generator converts the data from digital to analog format and outputs the resulting arbitrary waveform.

Clock and Trigger (A40, Clock Board)

The Clock board provides the clock and trigger signals for the A50 AWG board. The VCO generates the clock source signal. The frequency is controlled by DDS and PLL circuitry. The point rate clock is adjustable from 50 kHz to 1 GHz for reading data from the internal waveform memory. The reference clock is supplied from either the internal 10 MHz TCXO or the Reference Clock Input on the rear panel.

The trigger signal is sent to the AWG board from the internal interval timer or the Trigger Input on the rear panel.

Waveform Generation (A50, AWG Board)

This functional block is a core of the waveform generator. It receives system clocks from the Clock board to generate analog signal that is sent to the Output board.

The AWG board contains sequence circuitry and memory, waveform memory boards, shift registers, clock control circuitry, 1 GHz DAC, interface for the Clock board and the Output board, and optional digital data out circuitry.

Digital-to-Analog Converter (DAC). This functional block is a 10-bit high-speed digital-to-analog converter. It converts the digital data from the waveform memory into analog signals.

Waveform Memory (A60, Memory Board)

This functional block contains RAM memory that holds waveform data, address latch registers, and read/write control circuitry. There are 10 bits for waveform data and 2 bits for markers.

**Analog Processing
(A71/A72, Analog Output
Board)**

This functional block amplifies the DAC analog signals to the specified output level. The input signals may pass through the low-pass filters and attenuators in this block. If an offset is specified, the Offset circuitry will add it. This board also has an adder circuitry for adding the signal from the A75 Noise Generator board or the Add Input on the rear panel to the output waveform.

The output waveforms are supplied at two BNC connectors on the front panel with 50 Ω impedance (AWG510: CH 1 normal and CH 1 invert. AWG520: CH 1 and CH2).

**Noise Generation
(A75, Noise Generator
Board)**

This block is in the Output block and generates noise for adding to CH 1, $\overline{\text{CH 1}}$, or the external output.

CPU Unit

The CPU Unit has four slots and contains the CPU module, a hard disk and a flash disk, the Ethernet LAN and GPIB interface cards, and a backplane.

Backplane. The backplane has four ISA bus slots. This board receives power from Power Supply and sends it to each card board. Commands are also transmitted via the backplane.

CPU module. The first slot of the CPU Unit has the CPU module that contains the Intel DX4 (100 MHz) CPU and system RAM (64 MB SIMM).

The CPU module directs operation of all internal circuits based on the front panel control and commands received over the GPIB interface. It also generates and sends vertical (VSYNC) and horizontal (HSYNC) sync signals to the tube assembly.

Hard disk/Flash disk. The second slot of the CPU Unit has a flash disk for storing the waveform generator firmware and 1.4 GB hard disk for mass storage. They are fixed with brackets and don't use ISA bus.

LAN Interface Card. The third slot of the CPU Unit has the Ethernet LAN interface card. It controls Ethernet communication in LAN environment. The waveform generator has a 10BASE-T connector on the rear panel.

	<p>A30, GPIB Board. The fourth slot of the CPU Unit has the General Purpose Interface Bus (GPIB) interface driver, which controls communication with external devices over the parallel interface. The GPIB connector is on the rear panel.</p> <p>The GPIB Board also has the bus that sends the control signals to the Clock, AWG, and Analog Output board.</p>
User Interface (A10, Connector Board)	The Connector board receives control signals for the display, floppy disk, and front panel from the CPU Unit and sends them to each module. This board also has the fan control circuitry.
Monitor Display	The monitor display consists of a raster scan CRT and its driver. This receives the sync and video signal from the CPU module. The monitor displays video on a 17.8 cm (7 in.) CRT screen. The display resolution is 480 × 640 pixels.
Front Panel (A20, Front Panel Board)	The CPU module sends instructions to and receives information from the front-panel processor on the A20 Front Panel Board. The front-panel processor reads the front-panel switches and potentiometers. Any changes in their settings are reported to the processor system. The front-panel processor also turns the LEDs on and off and generates the bell signal.
Floppy Disk Drive	The 1.44 MB 3.5-inch floppy disk drive supports 2HD MS-DOS format.
Keyboard	The ASCII 101 key or JIS 106 key keyboard can be used through 6-pin mini-DIN connector on the rear panel.
Low Voltage Power Supply Unit	<p>The low voltage power supply provides +5 V, +8 V, +12 V, +24 V, -2 V, -4.6 V, and -8 V for all of the circuitry in the waveform generator. It also has an AC inlet, fuse, and the principal POWER switch on the rear panel.</p> <p>The principal POWER switch controls all power to the waveform generator including the Low Voltage Power Supply. The ON/STBY switch, located on the front panel, also controls all of the power to the waveform generator except for part of the circuitry in the Low Voltage Power Supply.</p>
Fan	Three brushless DC fans on the left (floppy disk) side provide forced air cooling for the waveform generator. The fan control circuitry on the A10 Connector board controls power to the fans sensing the temperature in the cabinet.

Digital Data Out Option 03

The Digital Data Out option (03) directly outputs the digital data in the waveform memory without passing it through the digital-to-analog converter. This option is installed on the AWG board.

For more information about options, refer to section 7, *Option*.

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.

- To rapidly confirm that the Waveform Generator functions and was adjusted properly, just do the *Self Tests*, which begin on page 4–3.

Advantages: These procedures require minimal additional time to perform, require no additional equipment, and more completely test the internal hardware of the Waveform Generator. They can be used to quickly determine if the waveform generator is suitable for putting into service, such as when it is first received.

- If more extensive confirmation of performance is desired, do the *Performance Tests*, beginning on page 4–12, after doing the *Self Tests* just referenced.

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 4–13).

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 on follow this format: **FRONT PANEL BUTTON**→**Main Menu Button**→**Side Menu Button**. For example, “Push **UTILITY**→**System**→**Reset to Factory**→**OK**”
- In steps and substeps, the lead-in statement in italics instructs you what to do, while the instructions that follow tell you how to do it, as in the example step below, “*Initialize the AWG500-Series Waveform Generator controls*” by doing “Push **UTILITY** (front panel)→**System** (bottom)→**Reset to Factory** (side)→**OK** (side). Now, push the front panel menu button...”.
- Where instructed to use a front-panel button or knob, or select from a bottom or side menu, 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 the waveform file **SINE.WFM** from the file list.”

STOP. *The symbol at the left is accompanied by information you must read to do the procedure properly.*

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 these internal routines:

- **Diagnostics**

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

- **Calibration**

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

Diagnostics

This procedure uses internal routines to verify that the instrument functions and was adjusted properly. No test equipment or hookups are required.

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

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

1. *Confirm that no output is performed:* Confirm that the RUN LED does not light. If not, push the **RUN** button so that the RUN LED goes off.
2. *Verify that internal diagnostics pass:* Do the following substeps to verify passing of internal diagnostics.
 - a. *Display the diagnostics menu and select all tests:*
 - Push **UTILITY** (front panel)→**Diag** (bottom)→**Diagnostic All** (side).
 - If All is not displayed, select All using the general purpose knob.

The screen as shown in Figure 4–1 appears.

The list on the screen shows the test items and results in the calibration and diagnostics previously made. For the diagnostics, in addition to selecting all of the test items shown on the screen, you can select only a test item that you want to run using the general purpose knob. 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, 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.

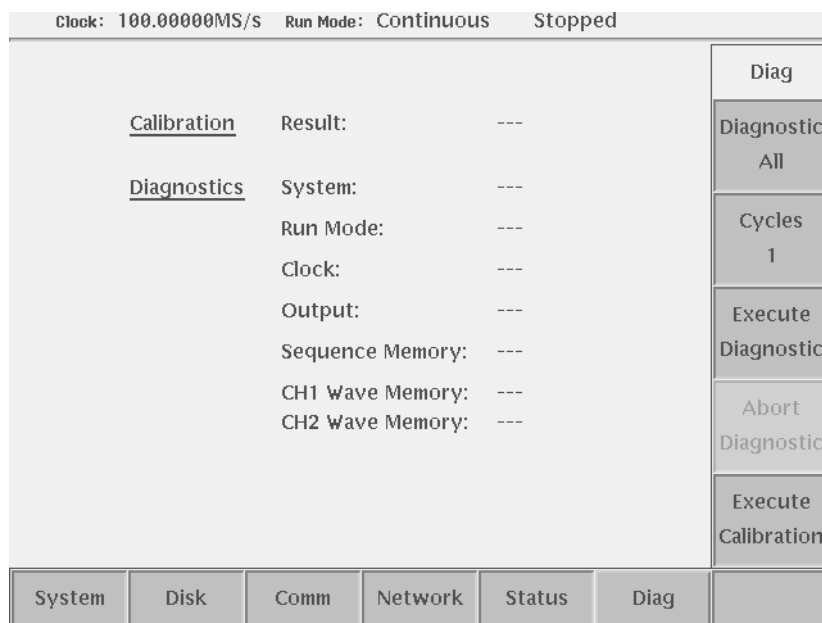


Figure 4-1: Diagnostic menu



- b. Run the diagnostics:** Push the **Execute Diagnostic** side button. This executes all the AWG500 diagnostics automatically.
- c. Wait:** The internal diagnostics do an extensive verification of AWG500 functions. While this verification progresses, the screen displays the clock icon. When finished, the resulting status appears on the screen.
- d. Confirm that no failures are found:** Verify that no failures are found and reported on-screen. If the diagnostics 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.

See Table 4–1 for details on error codes.

3. *Return to regular service:* 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.

1. *Confirm that no output is performed:* Confirm that the RUN LED does not light. If not, push the **RUN** button so that the RUN LED goes off.

NOTE. *When you start calibration while the output is being performed, some calibration items may be failed.*

2. *Verify that internal adjustments pass:* Do the following substeps to verify passing of internal adjustments.
 - a. *Run the adjustments routine:* Push **UTILITY** (front panel)→**Diag** (bottom)→**Execute Calibration** (side). This executes the AWG500 calibration routines automatically.
 - b. *Wait:* The internal calibration does an exhaustive verification of proper AWG500 function. 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.



CALIBRATION RESULTS		
	CH1	CH2
Output Offset:	Pass	Pass
Internal Offset:	Pass	Pass
Gain:	Pass	Pass
Attenuator 3db:	Pass	Pass
6db:	Pass	Pass
12db:	Pass	Pass
20db:	Pass	Pass
Filter 100MHz:	Pass	Pass
50MHz:	Pass	Pass
20MHz:	Pass	Pass
10MHz:	Pass	Pass

Figure 4-2: Calibration result message box

- c. *Confirm that no failures are found:* 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.
3. *Return to regular service:* Push the **OK** side button and then any bottom or menu button (other than the **UTILITY**) to exit the diag screen.

NOTE. *When the instrument is powered off while the calibrations is executed, the calibration data in the memory may be loss.*

Table 4-1: Diagnostic categories and error codes

Categories	Error codes	Descriptions
System	2100	Bios test error
	2101	Realtime clock power fail
	2102	CMOS checksum fail
	2103	FDD missing fail
	2104	Memory size fail
	2105	Flash disk fail
	2106	Date and time fail
	2110	Front panel test error
	2111	Configuration fail
	2112	Communication fail
	2113	RAM fail
	2114	ROM fail
	2115	AD fail
	2116	Timer fail
	2300	A30 board test error
2301	Unrecognized A30 board	
2400	Clock delay data test error	
2401	Not found	
2402	Checksum fail	
2700	Cal data test error	
2701	Uncaled	
2702	Checksum fail	
Run mode	3100	CTRL1 registers test error
	3101 to 3104	BIT0 to BIT3 fail (BIT0: 3101)
	3200	Event table memory data bus error
	3201 to 3216	DATA00 to DATA15 fail (DATA00: 3201)
	3250	Event table address bus error
3251 to 3274	ADD00 to ADD23 fail (ADD00: 3251)	
3300	Event table CS test error	
3301 to 3302	CS0 to CS1 fail (CS0: 3301)	
3350	Event memory cell test error	
3351 to 3352	CHIP0 to CHIP1 fail (CHIP0: 3351)	
Clock	4100	A40 clock board test error
	4101	PLL unlock check at 500 MHz fail
	4102	PLL lock check at 630 MHz fail
	4103	PLL lock check at 1350 MHz fail
	4104	PLL unlock check at 1500 MHz fail

Table 4-1: Diagnostic categories and error codes (Cont.)

Categories	Error codes	Descriptions
Sequence Memory	5100 5101 to 5116	Data bus test error DATA00 to DATA15 fail (DATA00: 5101)
	5150 5151 to 5174	Address bus test error ADD00 to ADD23 fail (ADD00: 5151)
	5200 5201 to 5206	CS test error CS0 to CS7 fail (CS0: 5201)
	5250 5251 to 5256	Cell test error CHIP0 to CHIP5 (CHIP0: 5501)
Waveform memory (CH1)	5300 5301 to 5316	Data bus test error DATA00 to DATA15 fail (DATA00: 5301)
	5350 5351 to 5374	Address bus test error ADD00 to ADD13 fail (ADD00: 5351)
	5400 5401 to 5464	Module test error Refer to <i>Finding Faulty Modules</i> on page 4-10 for detail.
	5500 5501 to 5549	Cell test error Refer to <i>Finding Faulty Modules</i> on page 4-10 for detail.
Waveform memory (CH1 or CH2)	5600 5601 to 5616	Data bus test error DATA00 to DATA15 fail (DATA00: 5601)
	5650 5651 to 5674	Address bus test error ADD00 to ADD23 fail (ADD00: 5651)
	5700 5701 to 5764	Module test error Refer to <i>Finding Faulty Modules</i> on page 4-10 for detail.
	5800 5801 to 5849	Cell test error Refer to <i>Finding Faulty Modules</i> on page 4-10 for detail.
ARB DAC (CH1)	5900 5901 to 5912	ARB DAC test error DATA00 to DATA11 fail (DATA00: 5901)
ARB DAC (CH1 or CH2)	5950 5951 to 5962	ARB DAC test error DATA00 to DATA11 fail (DATA00: 5951)

Table 4-1: Diagnostic categories and error codes (Cont.)

Categories	Error codes	Descriptions
Output (CH1)	7110 7111	Output offset device test error Output offset fail
	7120 7121	Internal offset device test error Internal offset fail
	7130 7131	ARB gain test error ARB gain fail
	7140 7141 7142 7143 7144	ATTEN test error X3dB attenuator fail X6dB attenuator fail X12dB attenuator fail X20dB attenuator fail
	7150 7151 7152 7153 7154	Filter test error 10 MHz filter fail 20 MHz filter fail 50 MHz filter fail 100 MHz filter fail
	7170 7171	OUTPUT ON key test error OUTPUT ON key fail
	Output (CH1 or CH2)	7210 7211
7220 7221		Internal offset device test error Internal offset fail
7230 7231		ARB gain test error ARB gain fail
7240 7241 7242 7243 7244		ATTEN test error X3dB attenuator fail X6dB attenuator fail X12dB attenuator fail X20dB attenuator fail
7250 7251 7252 7253 7254		Filter test error 10 MHz filter fail 20 MHz filter fail 50 MHz filter fail 100 MHz filter fail
7270 7271		OUTPUT ON key test error OUTPUT ON key fail

Finding Faulty Modules

Table 4–2 shows the module test error code examples. The error code composes of 54XX and 57XX, which corresponds to J7XX and J6XX modules and to J12XX and J11XX, respectively. The lower two digits (XX) indicates the possible faulty module, whose lower 6 bits correspond to the modules as shown in Table 4–2.

The 1 in the table indicates a possible faulty module. For example, the 1s are placed in the J620 and J610 columns for the line of the error code 5406. The lower two–digit 06 is driven from the binary bit array 000110, which means that the J620 and/or J610 can be faulty.

Table 4-2: Module test error code examples

Error code	Possibly faulty modules					
	J720	J710	J700	J620	J610	J600
5406	0	0	0	1	1	0
5407	0	0	0	1	1	1
5448	1	1	0	0	0	0
5456	1	1	1	0	0	0
Error code	Possibly faulty modules					
	J1220	J1210	J1200	J1120	J1110	J1100
5706	0	0	0	1	1	0
5707	0	0	0	1	1	1
5748	1	1	0	0	0	0
5756	1	1	1	0	0	0

Table 4–3 shows the matrix of faulty modules and memory cells driven from the lower two digits in the memory cell test error code. The J6XX and J7XX modules correspond to the error code 55XX, and the J11XX and J12XX modules correspond to the error code 58XX. If an error code is displayed, first you find a lower two–digits in the table, and then find a faulty module included in the corresponding column and a memory cell included in the corresponding line.

For example, if the error code 5827 is displayed, the J1200 module and/or U120 memory cell can be indicated as a faulty.

Table 4-3: Waveform memory cell test errors

Faulty memory cell	Faulty modules					
	J600	J610	J620	J700	J710	J720
	J1100	J1110	J1120	J1200	J1210	J1220
U100	01	09	17	25	33	41
U110	02	10	18	26	34	42
U120	03	11	19	27	35	43
U130	04	12	20	28	36	44
U140	05	13	21	29	37	45
U150	06	14	22	30	38	46
U160	07	15	23	31	39	47
U170	08	16	24	32	40	48

Performance Tests

This section contains a collection of procedures for checking that the AWG500-Series Waveform Generator performance as warranted.

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

Table 4-4: Performance test items

Titles	Test items	See (specifications)
Operating mode tests	Continuous, Triggered, and Gated mode normality	
Clock frequency tests	Clock frequency accuracy	Page 1-4
Amplitude and offset accuracy tests (normal out)	Amplitude accuracy, and DC offset accuracy	Page 1-4
Amplitude, DC offset and rise time accuracy tests (direct DA out)	Amplitude accuracy, DC offset accuracy and Rise time accuracy	Page 1-5
Pulse response tests	Rise time accuracy, Abberation, and Flatness	Page 1-4
Sine wave tests	Harmonics level accuracy, and Noise level accuracy	Page 1-5
Internal trigger tests	Trigger interval normality	Page 1-4
Trigger input tests	Trigger level accuracy, and Trigger function normality	Page 1-6
Event input and enhanced mode tests	External event input function normality, and Event mode normality	
10 MHz reference input tests	Reference input normality, and clock output frequency accuracy	Page 1-6
Add input tests	Add input function normality, and Input level accuracy	Page 1-6
Marker output tests	Marker output level accuracy	Page 1-5
Marker delay tests	Marker delay function	
Digital data output tests (Option 03 only)	High and low level accuracies, Output period accuracy, and Skew	Page 1-5
Clock output tests	Clock output normality	
Noise output tests	Noise level accuracy	Page 1-5

They check all the characteristics that are designated as checked in *Specifications*. (The characteristic items that must be checked are listed with the asterisk (*) under *Warranted Characteristics* in *Specifications*).

STOP. *These procedures extend the confidence level provided by the basic procedures described on page 4-3. The basic procedures should be done first, then these procedures performed if desired.*

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 4–3.
- The waveform generator must have been last 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.

Related Information

Read *Conventions* on page 4–1.

Equipment Required

These procedures use external, traceable signal sources to directly check warranted characteristics. The required equipment list follows this introduction.

Table 4–5: Test equipments

Item number and description	Minimum requirements	Example (recommended)	Purpose
1. Frequency Counter	1 MHz to 100 MHz, Accuracy: < 0.2 ppm	Anritu MF1603A	Used to check reference input test.
2. Digital multi meter	DC volts range: 0.05 V to 10 V, Accuracy: ± 0.1 %	Fluke 8842A	Used to check to measure voltage.
3. Oscilloscope	Bandwidth: > 500 MHz, 1 MΩ and 50 Ω inputs	Tektronix TDS784C	Checks output signals. Used in many procedures.
4. Oscilloscope	Bandwidth: > 1 GHz, Rise time: < 500 ps, 50 Ω input	Tektronix TDS820	Checks direct DA rise time.
5. Spectrum Analyzer	1 KHz to 1 GHz	Tektronix 497P or Advantest R4131	Checks output signals.
6. Function Generator	Output voltage: -5 V to +5 V, Frequency accuracy: < 0.01 %	Tektronix AFG2020	Generates external input signals. Used in many input signal test procedures.
7. Programmable Voltage Source	Output voltage: -5 V to +5 V, Voltage accuracy: < 1 %, Output current: > 10 mA	Data Precision 8200	Used to check trigger input.
8. BNC Coaxial Cable (3 required)	50 Ω, male to male BNC connectors	Tektronix part number 012-0482-00	Signal interconnection
9. SMB to BNC Coaxial Cable (2 required)	50 Ω, male SMB to male BNC connectors	Tektronix part number 012-1459-00	Signal interconnection
10. BNC to N Connector	Male BNC to female N	Tektronix part number 103-0045-00	Signal interconnection

Table 4-5: Test equipments (cont.)

Item number and description	Minimum requirements	Example (recommended)	Purpose
11. Dual-Banana Connector	Female BNC to dual banana	Tektronix part number 103-0090-00	Signal interconnection
12. DC block	N type, 50 Ω	Tektronix part number 015-0509-00	DC block
13. Adapter	SMA (male) to BNC (female), 50 Ω	Tektronix part number 015-1018-00	Checks direct DA rise time.
14. Precision Terminator	50 Ω, 0.1 %, BNC	Tektronix part number 011-0129-00	Signal termination
15. Performance check disk	Must use example listed	Supplied with the product, Tektronix part number 063-2983-00	Used to provide waveform files
16. Ground closure (loop-back cable) with 9-pin, D-type connector		Custom, See Figure 4-4.	Used for event mode test

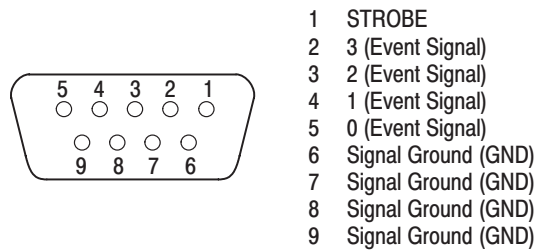


Figure 4-3: EVENT IN connector pins and signals

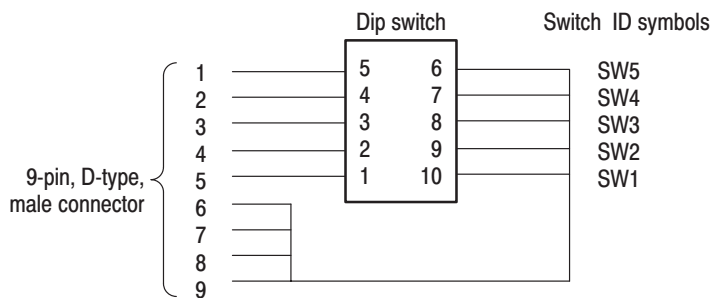


Figure 4-4: Ground closure with 9-pin D-type connector

Loading Files

The following steps explain how to load files from the Performance Check/Adjustment disk (063-2983-XX) into waveform memory and/or sequence memory.

1. Insert the disk into the Waveform Generator floppy disk drive.
2. Select **SETUP** (front)→**Waveform/Sequence** (bottom)→**Load...** (side)→**Drive...** (side) to display the Select Drive dialog box. The dialog box is as show in Figure 4–5.
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 up on the Select File dialog box.

4. With the general purpose knob, 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.

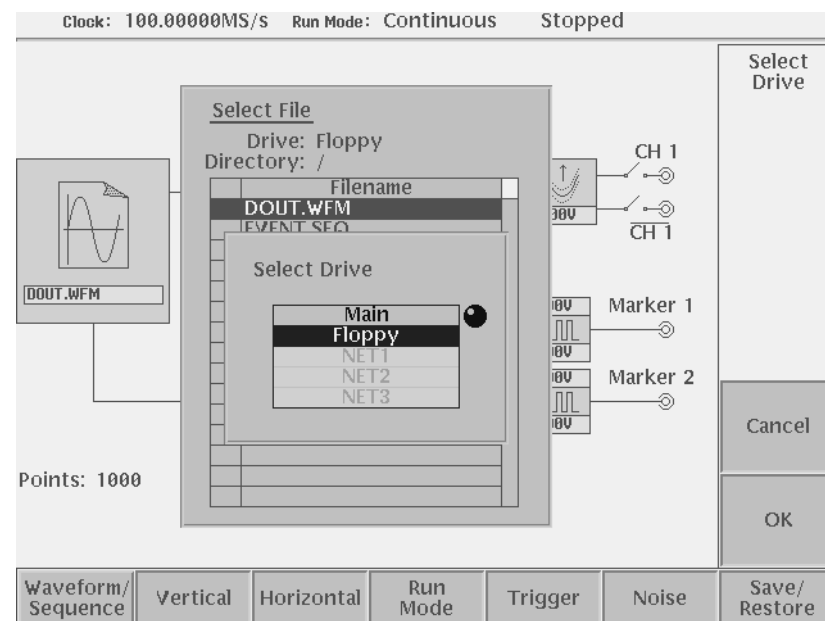


Figure 4–5: Loading file; selecting storage drive

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

Performance Check/Adjustment Files

Table 4–6 lists the sequence and waveform files on the Performance Check/Adjustment disk (063-2983-XX) that are used in these performance tests, the AWG500-Series 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 4–6: Waveforms and sequences in performance check disk

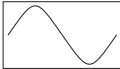

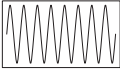


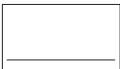


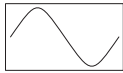
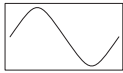
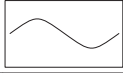

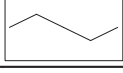
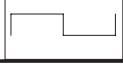
No.	File name	EDIT menu		SETUP menu				Marker setup	Usage
		Form	Points	Clock	Filter	Ampl	Offset		
1	MODE.WFM		1000	1 GHz	Through	1 V	0 V	Marker1,2: 0 to 499: High, 500 to 999: Low	Run mode, Trigger level, Marker
2	PULSE.WFM		1000	100 MHz	Through	1 V	0 V		Pulse amplitude, Internal trigger accuracy
3	SINE.WFM		256	1 GHz	Through	1 V	0 V		Sine characteristics
4	DOUT.PAT		512	100 MHz	Through	1 V	0 V		Digital data out
5	AMP1.SEQ								Amplitude accuracy (Normal out)
6	AMP2.SEQ								Amplitude accuracy (Direct out)
7	DC_P.WFM (AMPx.SEQ) ¹		1000	100 MHz	Through	1 V	0 V		Amplitude accuracy
8	DC_M.WFM (AMPx.SEQ) ¹		1000	100 MHz	Through	1 V	0 V		Amplitude accuracy
9	DC0.WFM (AMP2.SEQ)		1000	100 MHz	Through	1 V	0 V		Amplitude accuracy
10	OFFSET.WFM		1000	100 MHz	Through	20 mV	0 V		Offset accuracy

Table 4-6: Waveforms and sequences in performance check disk (Cont.)

No.	File name	EDIT menu		SETUP menu				Marker setup	Usage
		Form	Points	Clock	Filter	Ampl	Offset		
11	TRIG.WFM		100	1 MHz	Through	1 V	0 V		Trigger input
12	PT_EVENT.SEQ								Event input
13	PT_STROB.SEQ								Event input
14	S260.WFM (PT_XXXX.SEQ) ²		260	100 MHz	Through	1 V	0 V		Event input
15	S260H.WFM (PT_XXXX.SEQ) ²		260	100 MHz	Through	1 V	0 V		Event input
16	R260H.WFM (PT_XXXX.SEQ) ²		260	100 MHz	Through	1 V	0 V		Event input
17	T260H.WFM (PT_XXXX.SEQ) ²		260	100 MHz	Through	1 V	0 V		Event input
18	Q260H.WFM (PT_XXXX.SEQ) ²		260	100 MHz	Through	1 V	0 V		Event input

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

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

Test Record

Photocopy the following 4 pages and use them to record the performance test results for your AWG510/520.

AWG510 & AWG520 Test Record (Page 1 of 4)

Serial Number:

Certificate Number:

Calibration Date:

Technician:

Clock frequency tests	Low limit	Test result	High limit
10 MHz clock frequency accuracy	9,999,990 Hz		10,000,010 Hz

Amplitude and offset tests		Low limit	Test result	High limit
CH1 Amplitude accuracy	20 mV	17.7 mV		22.3 mV
	200 mV	195 mV		205 mV
	2V	1.968 V		2.032 V
CH2 or CH1 Amplitude accuracy	20 mV	17.7 mV		22.3 mV
	200 mV	195 mV		205 mV
	2V	1.968 V		2.032 V
CH1 Offset accuracy	0 V	-10 mV		+10 mV
	1 V	0.980 V		1.020 V
	-1 V	-1.020 V		-0.980 V
CH2 or CH1 Offset accuracy	0 V	-10 mV		+10 mV
	1 V	0.980 V		1.020 V
	-1 V	-1.020 V		-0.980 V

Direct DA Output tests		Low limit	Test result	High limit
CH1	Amplitude accuracy	0.45 V		0.55 V
CH2 or $\overline{\text{CH1}}$	Amplitude accuracy	0.45 V		0.55 V
CH1	Offset accuracy	-0.297 V		-0.243 V
CH2 or $\overline{\text{CH1}}$	Offset accuracy	-0.297 V		-0.243 V
CH1	Pulse rise time			700 ps
CH2 or $\overline{\text{CH1}}$	Pulse rise time			700 ps

AWG510 & AWG520 Test Record (Page 2 of 4)

Pulse response tests		Low limit	Test result	High limit
CH1 1 V amplitude	Rise time			1.5 ns
	Aberration	-7 %		+7 %
	Flatness (after 50 ns)	-3 %		+3 %
CH1 2 V amplitude	Rise time			2.5 ns
	Aberration	-10 %		+10 %
	Flatness (after 50 ns)	-3 %		+3 %
CH2 or CH1 1 V amplitude	Rise time			1.5 ns
	Aberration	-7%		+7 %
	Flatness (after 50 ns)	-3 %		+3 %
CH2 or CH1 2 V amplitude	Rise time			2.5 ns
	Aberration	-10 %		+10 %
	Flatness (after 50 ns)	-3 %		+3 %

Sine wave tests		Low limit	Test result	High limit
CH1 Harmonics level	0 Hz – 400 MHz			-50 dBc
CH1 Noise level	0 Hz – 400 MHz			-53 dBc
CH2 Harmonics level	0 Hz – 400 MHz			-50 dBc
CH2 Noise level	0 Hz – 400 MHz			-53 dBc

Trigger input tests		Low limit	Test result	High limit
Trigger level accuracy	5 V	4.65 V		5.35 V
	-5 V	-5.35 V		-4.65 V

10MHz reference input tests		Low limit	Test result	High limit
Clock output frequency	10.0 MHz reference	49,990 kHz		50,010 kHz
	10.1 MHz reference	50,490 kHz		50,510 kHz

AWG510 & AWG520 Test Record (Page 3 of 4)

Add input tests		Low limit	Test result	High limit
Output level	Input 0 V	-10 mV		+10 mV
	Input 1.0 V	0.95 V		1.05 V

Marker output tests			Low limit	Test result	High limit
CH 1	Marker 1	Low level	-2.2 V		-1.8 V
		High level	1.8 V		2.2 V
CH 1	Marker 2	Low level	-2.2 V		-1.8 V
		High level	1.8 V		2.2 V
CH 2	Marker 1	Low level	-2.2 V		-1.8 V
		High level	1.8 V		2.2 V
CH 2	Marker 2	Low level	-2.2 V		-1.8 V
		High level	1.8 V		2.2 V

Digital data output tests (Option 03 only)		Low limit	Test result	High limit
D0 output level	Low level	-2.2 V		-1.8 V
	High level	1.8 V		2.2 V
D1 output level	Low level	-2.2 V		-1.8 V
	High level	1.8 V		2.2 V
D2 output level	Low level	-2.2 V		-1.8 V
	High level	1.8 V		2.2 V
D3 output level	Low level	-2.2 V		-1.8 V
	High level	1.8 V		2.2 V
D4 output level	Low level	-2.2 V		-1.8 V
	High level	1.8 V		2.2 V
D5 output level	Low level	-2.2 V		-1.8 V
	High level	1.8 V		2.2 V
D6 output level	Low level	-2.2 V		-1.8 V
	High level	1.8 V		2.2 V
D7 output level	Low level	-2.2 V		-1.8 V
	High level	1.8 V		2.2 V

AWG510 & AWG520 Test Record (Page 4 of 4)

Digital data output tests (Option 03 only)		Low limit	Test result	High limit
D8 output level	Low level	-2.2 V		-1.8 V
	High level	1.8 V		2.2 V
D9 output level	Low level	-2.2 V		-1.8 V
	High level	1.8 V		2.2 V
Maximum skew between D ₋ and D ₋				1 ns

Noise output tests		Low limit	Test result	High limit
Noise level at 100 MHz, -105 dBm/Hz		-107.5 dBm/Hz		-102.5 dBm/Hz

Operating Mode Tests

These procedures check operation of the Cont, Triggered and Gated modes.

Check Cont Mode

Equipment required	A 50 Ω coaxial cable and an oscilloscope.
Prerequisites	The AWG500-Series Waveform Generator must meet the prerequisites listed on page 4-13.

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

- a. *Hook up the oscilloscope:* Connect the AWG500-Series Waveform Generator **CH1** output connector through the coaxial cable to the oscilloscope CH1 input connector (see Figure 4-6).

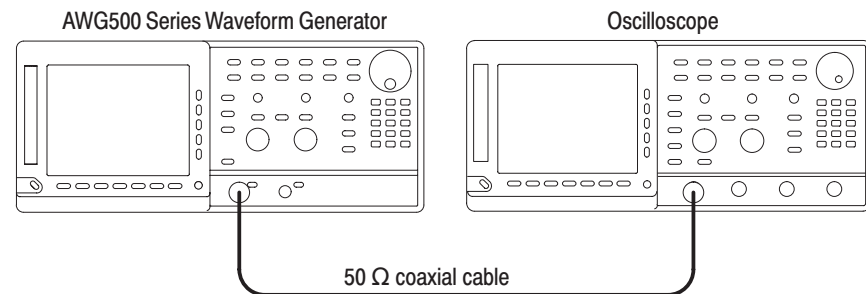


Figure 4-6: Cont mode initial test hookup

- b. *Set the oscilloscope controls:*

Vertical	CH1
CH1 coupling	DC
CH1 scale	0.2 V/div
CH1 input impedance	50 Ω
Horizontal	
Sweep	500 ns/div
Trigger	
Source	CH1
Coupling	DC
Slope	Positive
Level	+100 mV
Mode	Auto

2. *Set the AWG500-Series Waveform Generator controls and select the waveform file:*
 - a. *Initialize the AWG500-Series Waveform Generator controls:* Push **UTILITY** (front panel)→**System** (bottom)→**Factory Reset** (side)→**OK** (side).
 - b. *Select the waveform file:* Load the **MODE.WFM** as referring to the procedures on page 4–15.
3. *Turn on the AWG500-Series Waveform Generator CH1 output:* Push the **RUN** and **CH1 OUT** buttons so that the LEDs above the RUN button and CH1 output connector light.
4. *Check against limits:* Check that the amplitude of the sine wave displayed on the oscilloscope is 5 vertical divisions and that the waveform of one cycle per 2 horizontal divisions is displayed.
5. *End procedure:* Disconnect the oscilloscope.

Check Triggered Mode

Equipment required	Two 50 Ω coaxial cables, a function generator, and an oscilloscope.
Prerequisites	The AWG500-Series Waveform Generator meets the prerequisites listed on page 4–13.

1. *Install the test hookup and set test equipment controls:*
 - a. *Hook up the oscilloscope:* Connect the AWG500-Series Waveform Generator **CH1** output connector through the 50 Ω BNC coaxial cable to the oscilloscope CH1 input connector.
 - b. *Hook up the function generator:* Connect the AWG500-Series Waveform Generator **TRIG IN** connector through a 50 Ω BNC coaxial cable to the function generator output connector (see Figure 4–7).

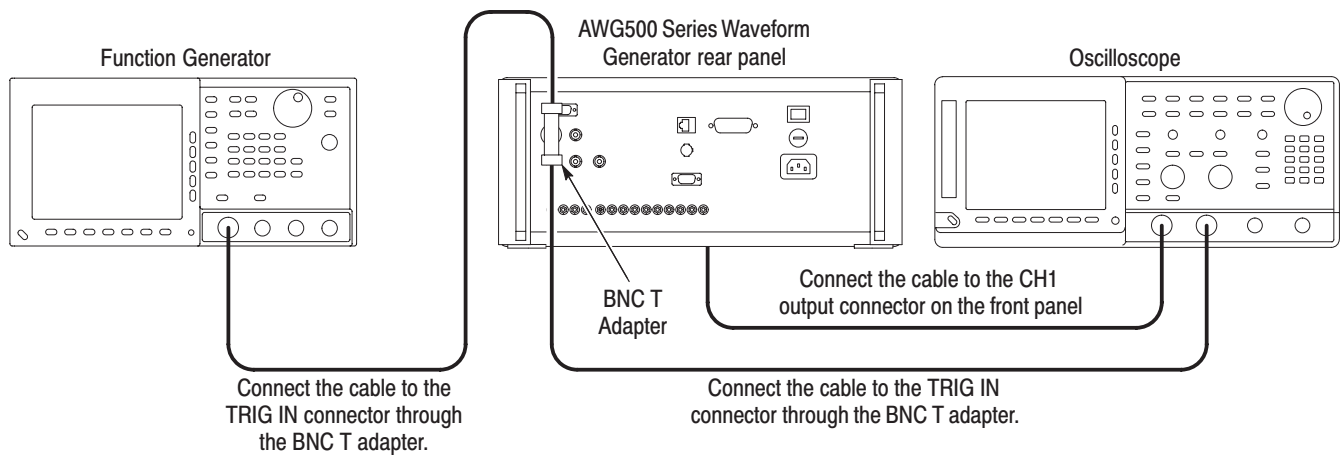


Figure 4-7: Triggered mode initial test hookup

c. Set the oscilloscope controls:

Vertical	CH1 and CH2
CH1 coupling	DC
CH1 scale	0.2 V/div
CH2 scale	2 V/div
CH1 input impedance	50 Ω
CH2 input impedance	1 M Ω
Horizontal	
Sweep	500 ns/div
Trigger	
Source	CH1
Coupling	DC
Slope	Positive
Level	+100 mV
Mode	Auto

d. Set the function generator (AFG2020) controls:

Function	Square
Mode	Continuous
Parameters	
Frequency	400 kHz
Amplitude	2.0 V (4 V into open circuit)
Offset	1.0 V (2 V into open circuit)
Output	Off

2. *Set AWG500-Series Waveform Generator controls and select the waveform file:*
 - a. *Initialize the AWG500-Series Waveform Generator controls:*
Push **UTILITY** (front panel)→ **System** (bottom)→ **Factory Reset** (side)→**OK** (side).
 - b. *Set trigger input impedance to 1 k Ohms:*
Push **SETUP** (front panel)→ **Trigger** (bottom)→ **Impedance** (side) to select 1 k Ohm.
 - c. *Set triggered mode:* Push **SETUP** (front panel)→**Run Mode** (bottom)→**Triggered** (side) to set the AWG500-Series Waveform Generator to triggered mode.
 - d. *Select the file:* Load the **MODE.WFM** as referring to the procedures on page 4–15.
3. *Turn on the AWG500-Series Waveform Generator CH1 output:* Push the **RUN** and **CH1 OUT** buttons so that the LEDs above the **RUN** button and **CH1** output connector light.
4. *Check triggered mode with manual triggering:* Push the AWG500-Series Waveform Generator **FORCE TRIGGER** button and check that when the button is pushed, the oscilloscope displays a one-cycle sine wave.
5. *Check triggered mode with external triggering:*
 - a. *Enable function generator output:* Turn on the function generator output.
 - b. *Check triggering:* Check that for each trigger supplied by the function generator, the oscilloscope displays a one-cycle sine wave (see Figure 4–8).
6. *End procedure:* Turn off the function generator output. Retain the test hookup.

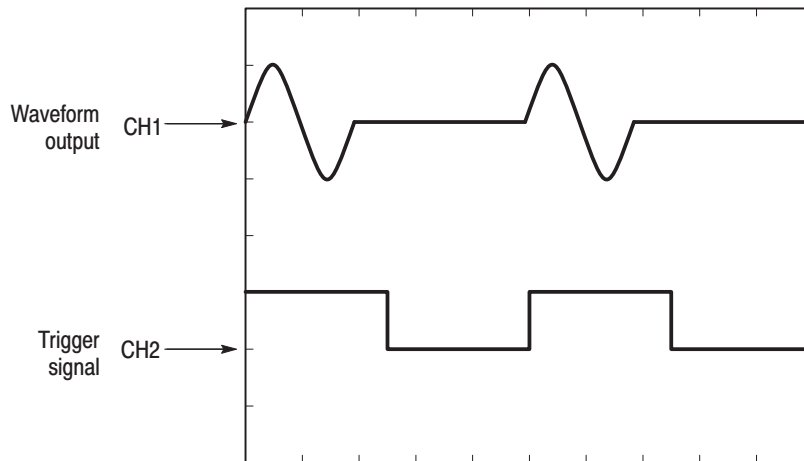


Figure 4-8: Relationship between trigger signal and waveform output

Check Gated Mode

Equipment required	Three 50 Ω coaxial cables, an adapter (BNC T male to 2 females), a function generator, and an oscilloscope.
Prerequisites	The AWG500 meets the prerequisites listed on page 4-13.

1. Use the test hookup from previous check.
2. Set the test equipment controls:
 - a. Set the oscilloscope controls:

Vertical	CH1 and CH2
CH1 and CH2 coupling	DC
CH1 scale	0.5 V/div
CH2 scale	2 V/div
CH1 input impedance	50 Ω
CH2 input impedance	1 MΩ
Horizontal	
Sweep	1 μs/div
Trigger	
Source	CH1
Coupling	AC
Slope	Positive
Level	0 V
Mode	Auto

- b. *Set the function generator (AFG2020) controls:*

Function	Square
Mode	Continuous
Parameters	
Frequency	10 kHz
Amplitude	2.0 V (4 V into open circuit)
Offset	1.0 V (2 V into open circuit)
Output	Off

3. *Set the AWG500-Series Waveform Generator controls and select the waveform file:*

- a. *Initialize the AWG500-Series Waveform Generator controls:*

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

- b. *Set gated mode:* Push **SETUP** (front panel)→**Run Mode** (bottom)→**Gated** (side).

- c. *Set trigger input impedance to 1 k Ohms:*

Push **SETUP** (front panel)→ **Trigger** (bottom)→
Impedance (side) to select 1 k Ohm.

- d. *Select the waveform file:* Load the **MODE.WFM** as referring to the procedures on page 4–15.

4. *Turn on the AWG500-Series Waveform Generator CH1 output:* Push the **RUN** and **CH1 OUT** buttons so that the LEDs above the **RUN** button and **CH1** output connector light.

5. *Check gated mode with manual trigger:* Hold down the AWG500-Series Waveform Generator **FORCE TRIGGER** button, and check that the oscilloscope continuously displays a sine wave while you are holding down the **FORCE TRIGGER** button.

6. *Check gated mode with gate signal:*

- a. Change the oscilloscope horizontal sweep setting to 20 μ s/div.

- b. Set the oscilloscope trigger source to CH2.

- c. *Apply gate signal:* Turn on the function generator output.

- d. *Check gated mode with positive gate signal:* Check that the oscilloscope displays a sine wave while the function generator gate signal amplitude is equal to or larger than 1 V (see Figure 4–9).

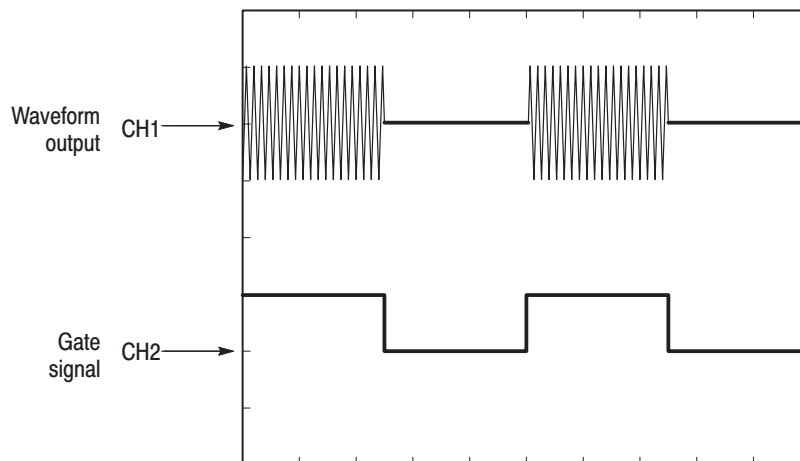


Figure 4-9: Relationship between gate signal and waveform output

- e. *Change the AWG500-Series Waveform Generator trigger polarity to negative:* Push **SETUP** (front panel)→**Trigger** (bottom)→**Negative** (side).
 - f. *Check gated mode with a negative gate signal:* Check that the oscilloscope displays a sine wave while the function generator gate signal amplitude is equal to or less than 1 V.
7. *End procedure:* Turn off the function generator output, and disconnect the function generator and oscilloscope.

Clock Frequency Tests

These procedures check the AWG500-Series Waveform Generator clock frequency accuracy.

Equipment required	A 50 Ω coaxial cable, a 50 Ω precision terminator and a frequency counter.
Prerequisites	The AWG500-Series Waveform Generator must meet the prerequisites listed on page 4-13.

1. Install test hookup and set test equipment controls:

- a. Hook up frequency counter:** Connect the AWG500-Series Waveform Generator clock output connector through a 50 Ω BNC coaxial cable and a 50 Ω precision terminator to the frequency counter input A connector (see Figure 4-10).

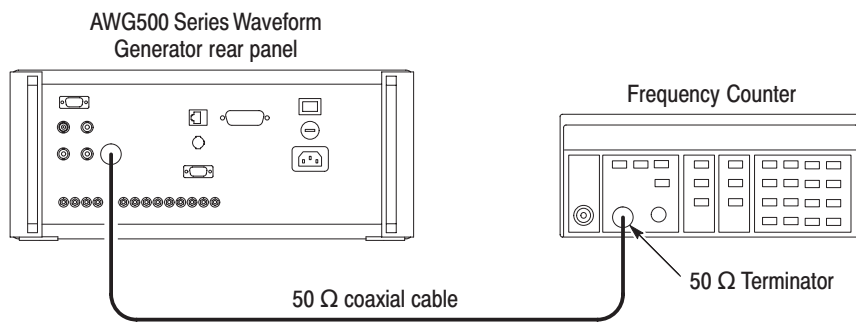


Figure 4-10: Clock frequency initial test hookup

- b. Set frequency counter controls:**

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

2. *Set AWG500-Series Waveform Generator controls and select the waveform:*
 - a. *Initialize the AWG500-Series Waveform Generator controls:*
Push **UTILITY** (front panel)→
System (bottom)→**Factory Reset** (side)→**OK** (side).
 - b. *Select the file:* Load the **MODE.WFM** as referring to the procedures on page 4–15.
 - c. *Set clock frequency:*
 - Push **HORIZONTAL MENU** (front panel)→**Clock** (side).
 - *Enter numeric value of 10M:* Push **1**, **0** and **M** (SHIFT+7) keys in this order.
3. *Turn on the AWG500-Series Waveform Generator output:* Push the **RUN** button so that the LEDs above the RUN button lights.
4. *Check clock frequency accuracy:* Check that the frequency counter reading is 10 MHz ±10 Hz (1 ppm).
5. *End procedure:* Disconnect the frequency counter.

Amplitude and Offset Accuracy Tests (Normal Out)

These procedures check the accuracy of the AWG500-Series Waveform Generator normal waveform outputs; amplitude and offset.

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

Check Amplitude Accuracy

Equipment required	A 50 Ω coaxial cable, a 50 Ω precision terminator, a BNC (female)-to-dual banana adapter, and a digital multimeter (DMM).
Prerequisites	The instrument must meet the prerequisites listed on page 4-13.

1. *Install the test hookup and set test equipment controls:*
 - a. *Hook up DMM:* Connect the AWG500-Series Waveform Generator **CH1** output through a 50 Ω BNC coaxial cable, a 50 Ω precision terminator, and an adapter (BNC-to-dual banana) to the DMM input connector (see Figure 4-11).

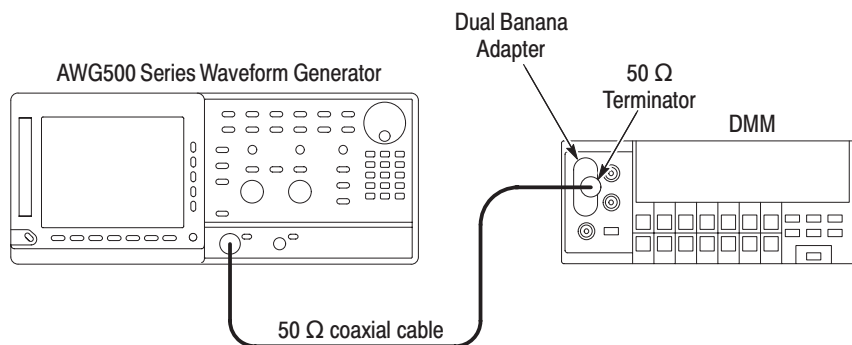


Figure 4-11: Amplitude accuracy initial test hookup

- b. *Set the DMM controls:*

Mode VDC
 Range Auto
 Input Front

2. *Set AWG500-Series Waveform Generator controls and select the sequence file:*
 - a. *Initialize the AWG500-Series Waveform Generator controls:*
Push **UTILITY** (front panel)→
System (bottom)→**Factory Reset** (side)→**OK** (side).
 - b. *Set enhanced mode:* Push **SETUP** (front panel)→**Run Mode** (bottom)→**Enhanced** (side) to set the AWG500-Series Waveform Generator to enhanced mode.
 - c. *Select the sequence file:* Load the **AMP1.SEQ** as referring to the procedures on page 4–15.
3. *Turn on the AWG500-Series Waveform Generator CH1 output:* Push the **RUN** and **CH1 OUT** buttons so that the LEDs above the **RUN** button and CH1 output connector light.
4. *Check amplitude accuracy:*
 - a. *Set the AWG500-Series Waveform Generator amplitude and confirm the offset setting:*
 - Push **VERTICAL MENU** (front panel)→**Amplitude** (side).
 - *Enter numeric value of 0.02:* Push **0**, **.**, **0**, **2** and **ENTER** keys in this order to set the amplitude to 0.020 V.
 - *Confirm the current offset setting:* Confirm that the offset setting display on the **Offset** side button is 0.000 V. If not, push the **Offset** side button, and push **0** and then **ENTER** key.
 - b. *Check the amplitude accuracy of 20 mV amplitude setting:*
 - Write the reading on DMM as a positive voltage.
 - Push the **FORCE EVENT** button.
 - Write the reading on DMM as a negative voltage.
 - Check that the positive minus negative voltages fall within $20\text{ mV} \pm 2.3\text{ mV}$.
 - c. *Set the AWG500-Series Waveform Generator amplitude:* Push **0**, **.**, **2** and **ENTER** keys in this order to set the amplitude to 0.200 V.

- d. *Check the amplitude accuracy of 200 mV amplitude setting:*
 - Push the **FORCE EVENT** button.
 - Write the reading on DMM as a positive voltage.
 - Push the **FORCE EVENT** button.
 - Write the reading on DMM as a negative voltage.
 - Check that the positive minus negative voltages fall within $200\text{ mV} \pm 5\text{ mV}$.
 - e. *Enter numeric value of 2:* Push **2** and **ENTER** keys in this order to set the amplitude to 2 V.
 - f. *Check the amplitude accuracy of 2 V amplitude setting:*
 - Push the **FORCE EVENT** button.
 - Write the reading on DMM as a positive voltage.
 - Push the **FORCE EVENT** button.
 - Write the reading on DMM as a negative voltage.
 - Check that the positive minus negative voltages fall within $2\text{ V} \pm 0.032\text{ V}$.
5. *Check CHI or CH2:* Repeat the *Check Amplitude Accuracy* for the AWG510 CHI or the AWG520 CH2, depending on the instrument that you are currently testing.
 6. *End procedure:* Retain the test hookup and control settings.

Check Offset Accuracy

1. *Use the test hookup and settings from previous check.*
2. *Set AWG500-Series Waveform Generator controls and select the sequence file:*
 - a. *Initialize the AWG500-Series Waveform Generator controls:* Push **UTILITY** (front panel)→**System** (bottom)→**Factory Reset** (side)→**OK** (side).
 - b. *Select the sequence file:* Load the **OFFSET.WFM** as referring to the procedures on page 4–15.

- c. Push **VERTICAL MENU** (front panel)→**Amplitude** (side).
 - d. *Set the AWG500-Series Waveform Generator amplitude:* Push **0**, **.**, **0**, **2** and **ENTER** keys in this order to set the amplitude to 0.020 V.
 3. *Turn on the AWG500-Series Waveform Generator CH1 output:* Push the **RUN** and **CH1** buttons so that the LEDs above the **RUN** button and **CH1** output connector light.
 4. *Check offset accuracy:*
 - a. *Set the AWG500-Series Waveform Generator offset:*
 - Push the **Offset** side button.
 - *Enter numeric value of 0:* Push **0** and **ENTER** keys in this order.
 - b. *Check the offset accuracy of 0 V offset setting:* Check that the reading on the DMM falls within $0\text{ V} \pm 10\text{ mV}$.
 - c. *Change the AWG500-Series Waveform Generator offset to 1 V:* Push **1** and **ENTER** keys in this order.
 - d. *Check the offset accuracy of 1 V offset setting:* Check that the reading on the DMM falls within $1\text{ V} \pm 0.020\text{ V}$.
 - e. *Change the AWG500-Series Waveform Generator offset to -1 V:* Push **-**, **1** and **ENTER** keys in this order.
 - f. *Check the offset accuracy of -1 V offset setting:* Check that the reading on the DMM falls within $-1\text{ V} \pm 0.020\text{ V}$.
 5. *Check CH1 or CH2:* Repeat the *Check Offset Accuracy* for the AWG510 CH1 or the AWG510 CH2, depending on the instrument that you are currently testing.
 6. *End procedure:* Disconnect the DMM and 50 Ω terminator.

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

These procedures check the accuracy of the AWG500-Series Waveform Generator direct waveform outputs; amplitude and offset.

Check Amplitude and DC Offset

Equipment required	Two 50 Ω terminators, a dual-banana Adapter, Two 50 Ω coaxial cables, a function generator, and a DMM.
Prerequisites	The AWG500-Series Waveform Generator meets the prerequisites listed on page 4-13.

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

- a. *Hook up DMM:* Connect the AWG500-Series Waveform Generator CH1 output through a 50 Ω BNC coaxial cable, a 50 Ω precision terminator, and an adapter (BNC-to-dual banana) to the DMM input connector (see Figure 4-12).

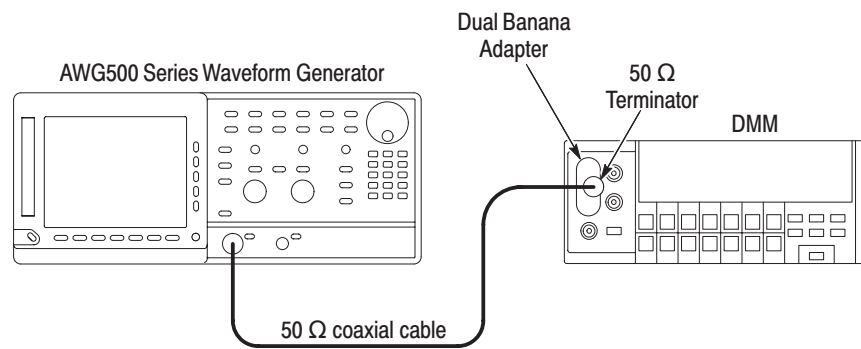


Figure 4-12: Direct DA out amplitude accuracy initial test hookup

- b. *Set the DMM controls:*

Mode VDC
 Range 2 V
 Input Front

2. *Set the AWG500-Series Waveform Generator controls and select the waveform file:*
 - a. *Initialize the AWG500-Series Waveform Generator controls:*
Push **UTILITY** (front panel)→
System (bottom)→**Factory Reset** (side)→**OK** (side).
 - b. *Set enhanced mode:* Push **SETUP** (front panel)→**Run Mode** (bottom)→**Enhanced** (side) to set the AWG500-Series Waveform Generator to enhanced mode.
 - c. *Set direct DA mode:* Push **VERTICAL MENU** (front panel)→**Add/Direct Out** (side)→**Output** (side)→**Direct** (side).
 - d. *Select the file:* Load the **AMP2.SEQ** as referring to the procedures on page 4–15.
3. *Turn on the AWG500-Series Waveform Generator CH1 output:* Push the **RUN** and **CH1 OUT** buttons so that the LEDs above the RUN button and CH1 output connector light.
4. *Check direct DA amplitude accuracy:*
 - a. *Check the value at the high state:*
 - Check that the reading from the oscilloscope display is about 0 V.
 - Write the reading value.
 - b. *Check the value at the low state:*
 - Push the **FORCE EVENT** button.
 - Check that the reading from the oscilloscope display is about –0.5 V.
 - Write the reading value.
 - c. *Check the amplitude:* Check that the high state value minus low state value falls within $0.5\text{ V} \pm 0.05\text{ V}$.
 - d. *Check the DC offset:*
 - Push the **FORCE EVENT** button.
 - Check that the reading from the oscilloscope display is about $-0.27\text{ V} \pm 0.027\text{ V}$.
5. *Check $\overline{\text{CH1}}$ or CH2:* Repeat the step 4 for the AWG510 $\overline{\text{CH1}}$ or the AWG510 CH2, depending on the instrument that you are currently testing.
6. *End procedure:* Disconnect the DMM.

Check Pulse Rise Time

Equipment required	A 50 Ω coaxial cable, SMA-to-BNC adapter and an oscilloscope (TDS820).
Prerequisites	The instrument must meet the prerequisites listed on page 4-13.

1. Install test hookup and set test equipment controls:

- a. *Hook up the oscilloscope:* Connect the AWG500-Series Waveform Generator **CH1** output connector and the oscilloscope CH1 input connector through the 50 Ω BNC coaxial cable and the SMA-to-BNC adapter (see Figure 4-13).

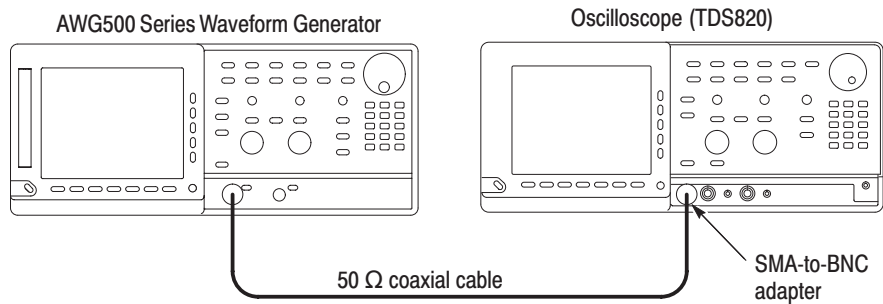



Figure 4-13: Direct DA out pulse rise time initial test hookup

- b. *Set oscilloscope controls:*

Vertical	CH1
CH1 coupling	DC
CH1 scale	100 mV/div
CH1 vertical position	About 2.7 Div
Horizontal	
Sweep	500 ps/div
Trigger	
Source	CH1
Slope	
Level	-250 mV
Mode	Auto

NOTE. The pulse rise time tests use the AWG500-Series Waveform Generator control setting that have been used in the amplitude and DC offset tests. Do not initialize the AWG500-Series Waveform Generator controls.

2. Set the AWG500-Series Waveform Generator controls and select the waveform file:
 - a. *Select the file:* Load the **PULSE.WFM** as referring to the procedures on page 4–15.
 - b. *Set enhanced mode:* Push **SETUP** (front panel)→**Run Mode** (bottom)→**Continue** (side) to set the AWG500-Series Waveform Generator to continue mode.
3. *Turn on the AWG500-Series Waveform Generator CH1 output:* Push the **RUN** and **CH1 OUT** buttons so that the LEDs above the RUN button and CH1 output connector light.
4. *Check pulse rise time:* Check that the rise time of the pulse waveform displayed on the oscilloscope is equal to or less than 700 ps.
5. *Check $\overline{CH1}$ or CH2:* Repeat the step 4 for the AWG510 $\overline{CH1}$ or the AWG510 CH2, depending on the instrument that you are currently testing.
6. *End procedure:* Disconnect the oscilloscope.

Pulse Response Tests

This procedure checks the pulse response characteristics of the AWG500-Series Waveform Generator output waveforms at amplitudes of 1 V and 2 V.

Equipment required	A 50 Ω coaxial cable and an oscilloscope.
Prerequisites	The instrument must meet the prerequisites listed on page 4-13.

1. Install test hookup and set test equipment controls:

- a. Hook up the oscilloscope:** Connect the AWG500-Series Waveform Generator **CH1** output connector through the 50 Ω BNC coaxial cable to the oscilloscope CH1 input connector (see Figure 4-14).

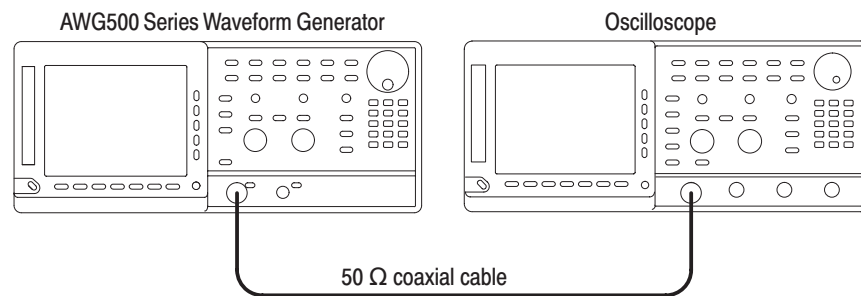


Figure 4-14: Pulse response initial test hookup

b. Set oscilloscope controls:

Vertical	CH1
CH1 coupling	DC
CH1 scale	0.2 V/div
CH1 input impedance	50 Ω
Horizontal	
Sweep	500 ps/div
Trigger	
Source	CH1
Coupling	DC
Slope	Positive
Level	0 V
Mode	Auto

2. *Set the AWG500-Series Waveform Generator controls and select the waveform file:*
 - a. *Initialize the AWG500-Series Waveform Generator controls:*
Push **UTILITY** (front panel)→
System (bottom)→**Factory Reset** (side)→**OK** (side).
 - b. *Select the file:* Load the **PULSE.WFM** as referring to the procedures on page 4–15.
3. *Turn on the AWG500-Series Waveform Generator CH1 output:* Push the **RUN** and **CH1 OUT** buttons so that the LEDs above the RUN button and CH1 output connector light.
4. *Check pulse response at 1 V amplitude:*
 - a. *Check rise time:* Check that the rise time of the waveform displayed on the oscilloscope from 10% to 90% point is equal to or less than 1.5 ns.
 - b. *Check aberration:*
 - Set oscilloscope sweep to 12.5 ns/div (or 20 ns/div).
 - Check that the aberration of the displayed waveform on the oscilloscope screen is within $\pm 7\%$.
 - c. *Check flatness:*
 - Set oscilloscope sweep to 200 ns/div.
 - Check that the flatness of the displayed waveform on the oscilloscope is within $\pm 3\%$ after 50 ns from the rising edge.
5. *Check pulse response at 2 V amplitude:*
 - a. *Change the oscilloscope controls:*

Vertical	CH1
CH1 scale	0.5 V/div
 - b. *Change the AWG500-Series Waveform Generator controls:*
 - Push **VERTICAL MENU**→**Amplitude**.
 - *Enter numeric value of 2:* Push **2** and **ENTER** keys in this order.

- c. *Repeat substeps 4a through 4c, as checking to the follow limits:*
 - Rise time 2.5 ns, maximum
 - Aberration $\pm 10 \%$, maximum
 - Flatness $\pm 3 \%$, maximum
6. *Check $\overline{CH1}$ or CH2:* Repeat the *Check Pulse Response* for the AWG510 $\overline{CH1}$ or the AWG510 CH2, depending on the instrument that you are currently testing.
7. *End procedure:* Disconnect the oscilloscope.

Sine Wave Tests

This procedure checks the sine wave characteristics of the AWG500-Series Waveform Generator output waveforms.

Equipment required	A 50 Ω coaxial cable, a DC block, an adapter (N male to BNC female), and a spectrum analyzer.
Prerequisites	The instrument must meet the prerequisites listed on page 4-13.

1. *Install test hookup and set test equipment controls:*
 - a. *Hook up the spectrum analyzer:* Connect the AWG500-Series Waveform Generator CH1 output connector through the coaxial cable, adapter, and DC Block to the input connector on the spectrum analyzer (see Figure 4-15).

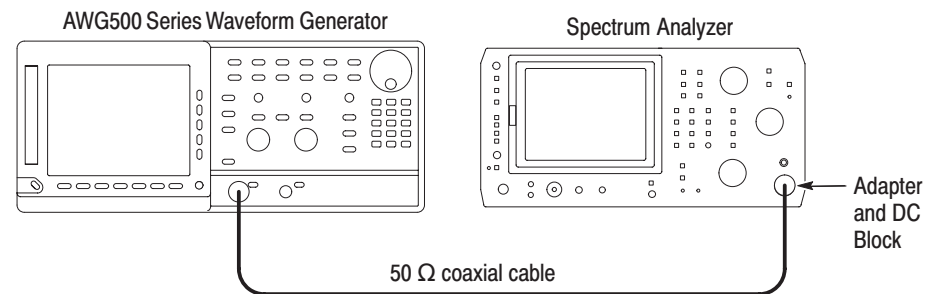


Figure 4-15: Sine wave initial test hookup

- b. *Set spectrum analyzer controls:*

Center frequency	200 MHz
Full Span	500 MHz
Reference level	10 dBm
RF attenuation	20 dB
Video filter	1 kHz
Resolution BW	1 MHz

2. *Set the AWG500-Series Waveform Generator controls and select the waveform file:*
 - a. *Initialize the AWG500-Series Waveform Generator controls:* Push **UTILITY** (front panel)→**System** (bottom)→**Factory Reset** (side)→**OK** (side).
 - b. *Select the file:* Load the **SINE.WFM** as referring to the procedures on page 4–15.
3. *Turn on the AWG500-Series Waveform Generator CH1 output:* Push the **RUN** and **CH1 OUT** buttons so that the LEDs above the RUN button and CH1 output connector light.
4. *Check harmonics and noise level:*
 - a. *Check harmonics level:* Check that the harmonics level of the spectrum displayed on the spectrum analyzer from 0 Hz to 400 MHz is –50 dBc or less.
 - b. *Check noise level:* Check that the noise level of the spectrum displayed on the spectrum analyzer from 0 Hz to 400 MHz is –53 dBc or less.
5. *Check CH2:* Repeat the *Sine Wave Tests* for the AWG520 CH2, depending on the instrument that you are currently testing.
6. *End procedure:* Disconnect the spectrum analyzer.

Internal Trigger Tests

These procedures check internal trigger function of the AWG500-Series Waveform Generator.

Equipment required	A 50 Ω coaxial cable and an oscilloscope.
Prerequisites	The instrument must meet the prerequisites listed on page 4-13.

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

- a. Hook up the oscilloscope:** Connect the AWG500-Series Waveform Generator **CH1** output connector through the coaxial cable to the oscilloscope CH1 input connector on the oscilloscope (see Figure 4-16).

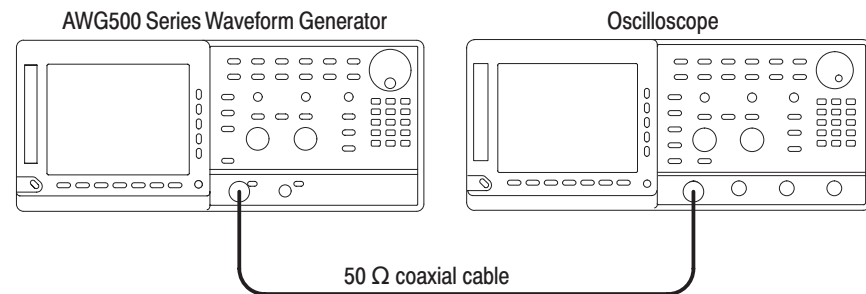


Figure 4-16: Internal trigger initial test hookup

b. Set the oscilloscope controls:

Vertical	CH1
CH1 coupling	DC
CH1 scale	0.5 V/div
CH1 input impedance	50 Ω
Horizontal	
Sweep	1 ms/div
Trigger	
Source	CH1
Coupling	DC
Slope	Positive
Level	0.2 V
Mode	Auto

2. *Set the AWG500-Series Waveform Generator controls and select the waveform file:*
 - a. *Initialize the AWG500-Series Waveform Generator controls:*
Push **UTILITY** (front panel)→
System (bottom)→**Factory Reset** (side)→**OK** (side).
 - b. *Select the file:* Load the **MODE.WFM** as referring to the procedures on page 4–15.
 - c. *Set trigger mode:* Push **SETUP** (front panel)→**Run Mode** (bottom)→**Triggered** (side).
 - d. *Set trigger interval:*
 - Push **SETUP** (front panel)→**Trigger** (bottom)→**Source** (side)→**Internal** (side).
 - Push the **Interval** side button.
 - *Enter numeric value of 1 m:* Push **1** and **m** (SHIFT+9) keys in this order.
3. *Turn on the AWG500-Series Waveform Generator CH1 output:* Push the **RUN** and **CH1 OUT** buttons so that the LEDs above the **RUN** button and **CH1** output connector light.
4. *Check the trigger interval:* Check that the period of the waveform displayed on the oscilloscope is one horizontal divisions.
5. *Change the trigger interval:*
 - a. *Enter numeric value of 2 ms:* Push **2** and **m** (SHIFT+9) keys in this order.
6. *Check the trigger interval:* Check that the period of the waveform displayed on the oscilloscope is two horizontal divisions.
7. *End procedure:* Disconnect the oscilloscope.

Trigger Input Tests

These procedures check the trigger level accuracy of the AWG500-Series Waveform Generator.

Equipment required	A BNC-to-banana adapter, a dual banana adapter, two 50 Ω coaxial cables, a programmable voltage source, and an oscilloscope.
Prerequisites	The instrument must meet the prerequisites listed on page 4-13.

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

- a. *Hook up the oscilloscope:* Connect the AWG500-Series Waveform Generator CH1 output connector through the coaxial cable to the oscilloscope CH1 input connector.
- b. *Hook up the voltage source:* Connect the voltage source output connector through the adapter and coaxial cable to the **TRIG IN** connector on the AWG500-Series Waveform Generator rear panel.

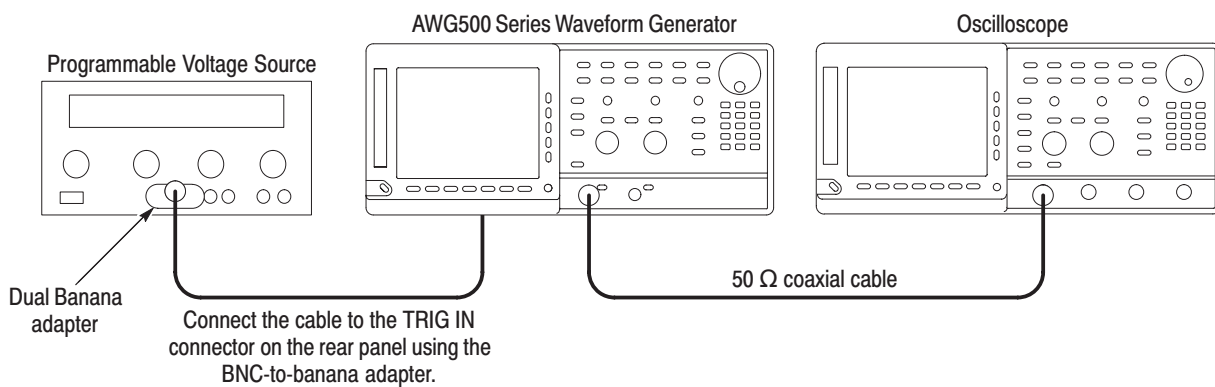


Figure 4-17: Trigger input initial test hookup

c. *Set the oscilloscope controls:*

Vertical	CH1
CH1 coupling	DC
CH1 scale	0.5 V/div
CH1 input impedance	50 Ω
Horizontal	
Sweep	200 μ s/div

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

d. *Set the voltage source controls:*

Voltage	0 V
Output	On

2. *Set AWG500-Series Waveform Generator controls and select the waveform file:*

a. *Initialize the AWG500-Series Waveform Generator controls:*

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

b. *Modify the AWG500-Series Waveform Generator default settings:* Push **SETUP** (front panel)→**Run Mode** (bottom)→**Gated** (side).

c. *Select the file:* Load the **TRIG.WFM** as referring to the procedures on page 4–15.

3. *Turn on the AWG500-Series Waveform Generator CH1 output:* Push the **RUN** and **CH1 OUT** buttons so that the LEDs above the RUN button and CH1 output connector light.

4. *Check trigger level accuracy at 5 V:*

a. *Set the trigger level to 5 V:*

- Push **SETUP** (front panel)→**Trigger** (bottom)→**Level** (side).
- *Enter numeric value of 5:* Push **5** and **ENTER** keys in this order.

b. *Set the trigger input voltage to 4.65 V:* Set the output voltage of the voltage source to 4.65 V.

c. *Check that the trigger is not active:* Check that the no waveform is displayed on the oscilloscope.

d. *Set the trigger input voltage to 5.35 V:* Set the output voltage of the voltage source to 5.35 V.

e. *Check that the trigger is active:* Check that a sine wave is displayed on the oscilloscope.

5. *Check trigger level accuracy at -5 V:*
 - a. *Set the trigger level to -5 V:* Push **-**, **5** and **ENTER** keys in this order.
 - b. *Set the trigger input voltage to -5.35 V:* Set the output voltage of the voltage source to -5.35 V.
 - c. *Check that the trigger is not active:* Check that the no waveform is displayed on the oscilloscope.
 - d. *Set the trigger input voltage to -4.65 V:* Set the output voltage of the voltage source to -4.65 V.
 - e. *Check that the trigger is active:* Check that a sine wave is displayed on the oscilloscope.
6. *End procedure:* Turn off the voltage source output, and disconnect the voltage source and oscilloscope.

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 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 last test.

Check Event Input with Strobe Off

Equipment required	A 50 Ω coaxial cable, an oscilloscope, and custom-made ground closure. See Figure 4-4 for the connections.
Prerequisites	The AWG500-Series Waveform Generator must meet the prerequisites listed on page 4-13.

1. *Install the test hookup and set test equipment controls:*
 - a. *Hook up the oscilloscope:* Connect the AWG500-Series Waveform Generator **CH1** output connector through the coaxial cable to the oscilloscope CH1 input connector (see Figure 4-18).

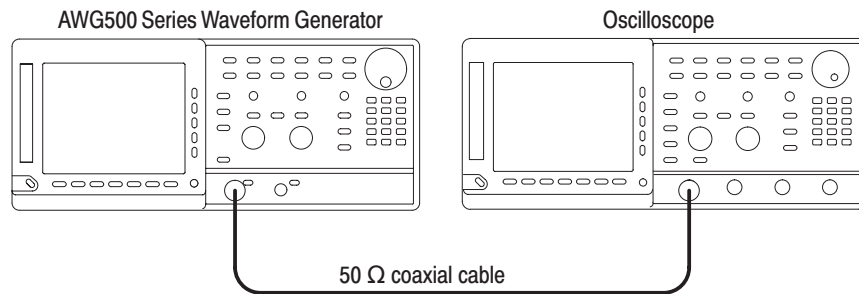


Figure 4-18: Event input and enhanced mode initial test hookup

- b. *Connect the ground closure:* Connect the ground closure to the **EVENT IN** connector on the AWG500-Series Waveform Generator rear panel.
- c. *Set the oscilloscope controls:*

Vertical	CH1
CH1 coupling	DC
CH1 scale	0.2 V/div
CH1 input impedance	50 Ω
Horizontal	
Sweep	0.5 μ s/div

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

2. Set all the switches of the ground closure to open.
3. Set the AWG500-Series Waveform Generator controls and select the sequence file:
 - a. Initialize the AWG500-Series Waveform Generator controls: Push **UTILITY** (front panel)→**System** (bottom)→**Factory Reset** (side)→**OK** (side).
 - b. Select the sequence file: Load the **PT_EVENT.SEQ** as referring to the procedures on page 4-15.
 - c. Set the AWG500-Series Waveform Generator to enhanced mode: Push **SETUP** (front panel)→**Run Mode** (bottom)→**Enhanced** (side) to set the enhanced mode.
4. Turn on the AWG500-Series Waveform Generator CH1 output: Push the **RUN** and **CH1 OUT** buttons so that the LEDs above the RUN button and CH1 output connector light.
5. Check the **EVENT IN** connector pin 0 input:
 - a. Confirm the waveform on the oscilloscope: Confirm that the waveform being displayed on the oscilloscope is as shown in Figure 4-19.

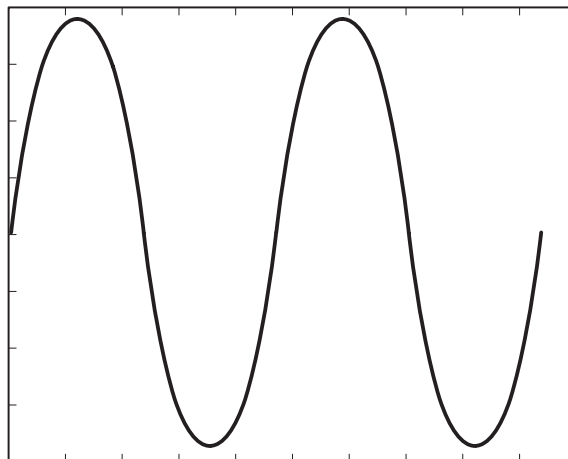


Figure 4-19: Waveform while all ground disclosure switches are open

- b. *Generate an event signal:* Close the SW1 of the ground closure to generate an event signal on the **EVENT IN** connector pin 0.
- c. *Confirm the waveform on the oscilloscope:* Confirm that the oscilloscope displays the waveform as shown in Figure 4–20 and that the waveform amplitude is almost as half as that in Figure 4–19.

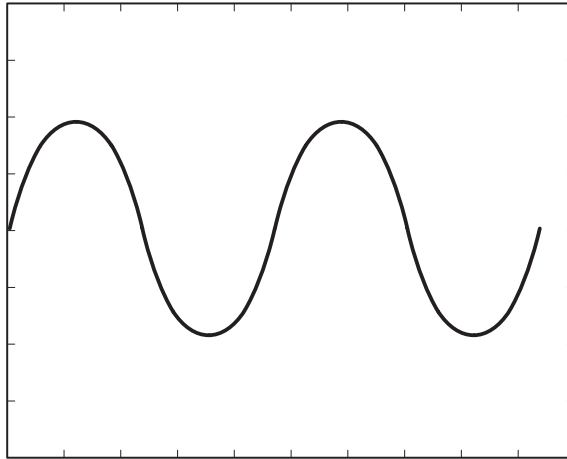


Figure 4-20: Waveform output when the SW1 is closed

- d. *Degenerate the event signal:* Open the SW1 of the ground closure to degenerate the event signal.
 - e. *Confirm the waveform on the oscilloscope:* Confirm that the oscilloscope displays back the waveform in Figure 4–19.
- 6. Check the *EVENT IN* connector pin 1 input:**
- a. *Generate an event signal:* Close the SW2 of the ground closure to generate an event signal on the **EVENT IN** connector pin 1.
 - b. *Confirm the waveform on the oscilloscope:* Confirm that the oscilloscope displays the waveform as shown in Figure 4–21.

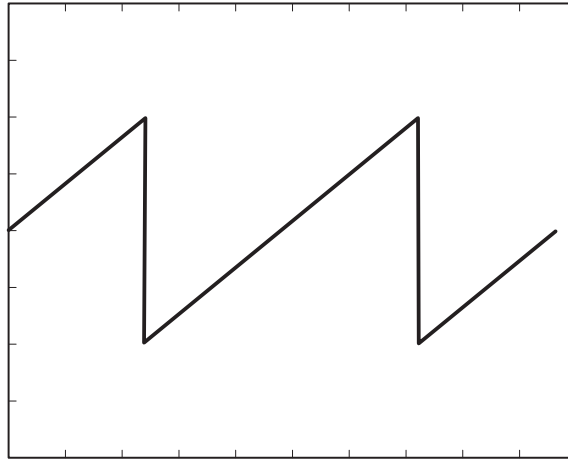


Figure 4-21: Waveform output when the SW2 is closed

- c. *Degenerate the event signal:* Open the SW2 of the ground closure to degenerate the event signal.
 - d. *Confirm the waveform on the oscilloscope:* Confirm that the oscilloscope displays back the waveform in Figure 4-19.
- 7. Check the *EVENT IN* connector pin 2 input:**
- a. *Generate an event signal:* Close the SW3 of the ground closure to generate an event signal on the **EVENT IN** connector pin 2.
 - b. *Confirm the waveform on the oscilloscope:* Confirm that the oscilloscope displays the waveform as shown in Figure 4-22.

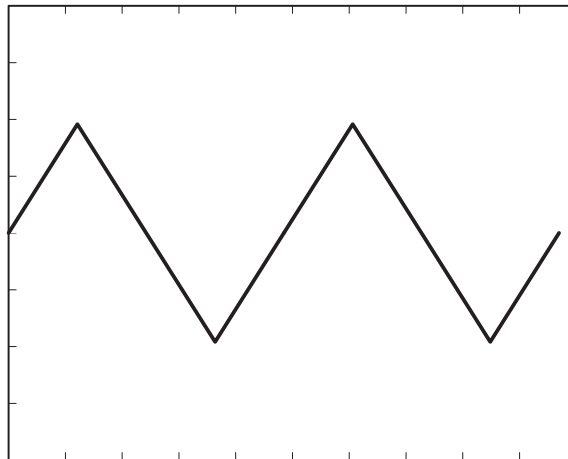


Figure 4-22: Waveform output when the SW3 is closed

- c. *Degenerate the event signal:* Open the SW3 of the ground closure to degenerate the event signal.
 - d. *Confirm the waveform on the oscilloscope:* Confirm that the oscilloscope displays back the waveform in Figure 4–19.
8. *Check the **EVENT IN** connector pin 3 input:*
- a. *Generate an event signal:* Close the SW4 of the ground closure to generate an event signal on the **EVENT IN** connector pin 3.
 - b. *Confirm the waveform on the oscilloscope:* Confirm that the oscilloscope displays the waveform as shown in Figure 4–23.

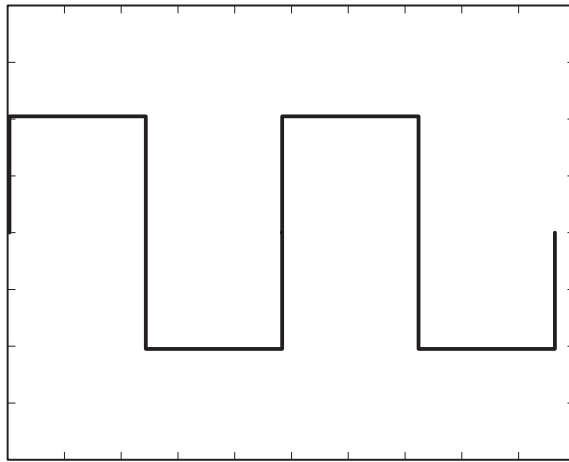


Figure 4-23: Waveform output when the SW4 is closed

- c. *Degenerate the event signal:* Open the SW4 of the ground closure to degenerate the event signal.
 - d. *Confirm the waveform on the oscilloscope:* Confirm that the oscilloscope displays back the waveform in Figure 4–19.
9. *End procedure:* Retain the test hookup and control settings.

Check Strobe Input

1. Use the test hookup and oscilloscope settings from previous check.
2. Set the AWG500-Series Waveform Generator controls and select the sequence file:
 - a. Initialize the AWG500-Series Waveform Generator controls: Push **UTILITY** (front panel)→**System** (bottom)→**Factory Reset** (side)→**OK** (side).
 - b. Select the waveform file: Load the **PT_STROB.SEQ** as referring to the procedures on page 4-15.
 - c. Set the AWG500-Series Waveform Generator to enhanced mode: Push **SETUP** (front panel)→**Run Mode** (bottom)→**Enhanced** (side) to set the run mode to enhanced.
3. Turn on the AWG500-Series Waveform Generator CH1 output: Push the **RUN** and **CH1 OUT** buttons so that the LEDs above the RUN button and CH1 output connector light.
4. Check the **EVENT IN** connector strobe pin input:
 - a. Confirm the waveform on the oscilloscope: Confirm that the waveform being displayed on the oscilloscope is as shown in Figure 4-24.

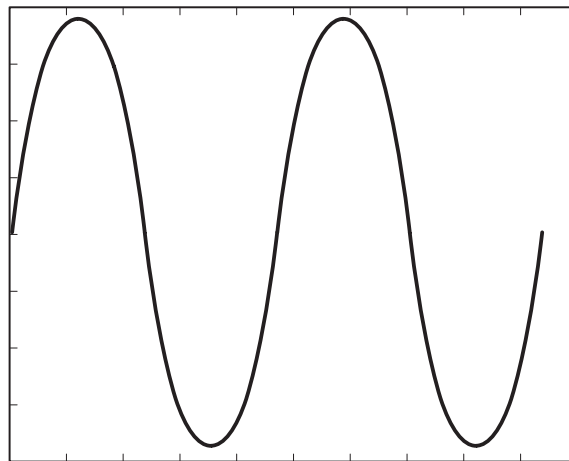


Figure 4-24: Initial waveform output

- b. *Generate a strobe signal:* Close the SW5 of the ground closure to generate an event signal on the **EVENT IN** connector strobe pin.
- c. *Confirm the waveform on the oscilloscope:* Confirm that the oscilloscope displays the dc waveform as shown in Figure 4–25.

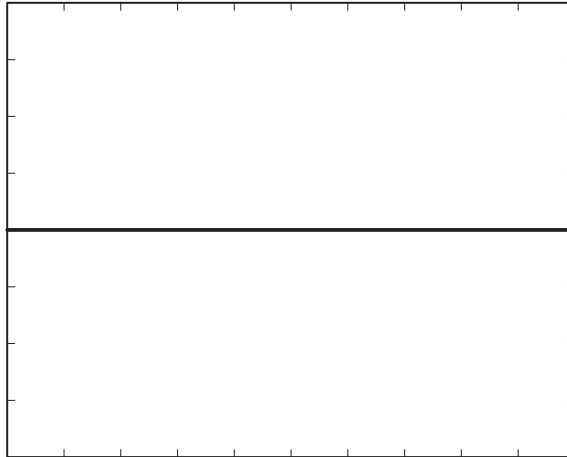


Figure 4–25: DC waveform output when the SW5 is closed

- d. *Degenerate the strobe signal:* Open the SW5 of the ground closure to degenerate the strobe signal on the **EVENT IN** connector strobe pin.
 - e. *Confirm the waveform on the oscilloscope:* Confirm that the dc waveform is kept displaying on the oscilloscope.
 - f. *Generate a strobe signal:* Close the SW5 of the ground closure again.
 - g. *Confirm the waveform on the oscilloscope:* Confirm that the oscilloscope displays back the waveform in Figure 4–24.
5. *End procedure:* Disconnect the oscilloscope and ground closure.

10 MHz Reference Input Tests

These procedures check the 10 MHz reference input function of the AWG500-Series Waveform Generator.

Equipment required	Two 50 Ω coaxial cables, a frequency counter, and a function generator.
Prerequisites	The AWG500-Series Waveform Generator meets the prerequisites listed on page 4-13.

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

- a. *Hook up the frequency counter:* Connect the AWG500-Series Waveform Generator **CLOCK OUT** connector through the coaxial cable to the input A connector on the frequency counter.
- b. *Hook up the function generator:*
 - Connect the AWG500-Series Waveform Generator **10 MHz REF IN** connector through a coaxial cable to the function generator output connector (see Figure 4-26).

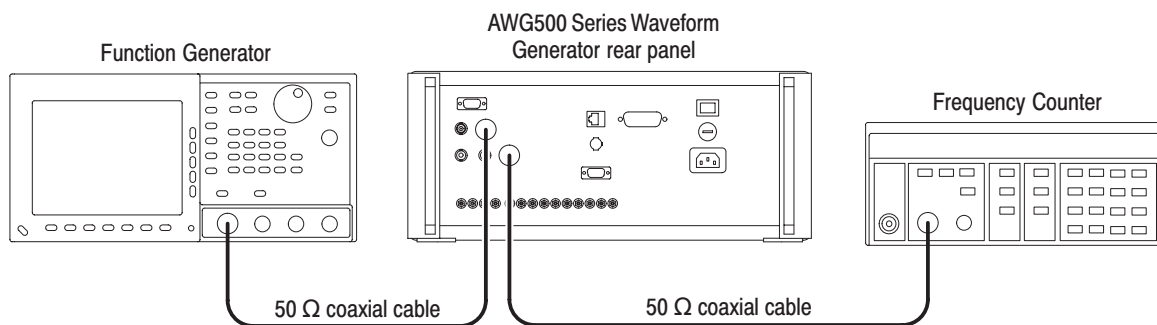


Figure 4-26: 10 MHz reference initial test hookup

c. *Set the frequency counter controls:*

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

d. Set the function generator (AFG2020) controls:

Function	Square
Mode	Continuous
Parameters	
Frequency	10 MHz
Amplitude	2.0 V (4 V into open circuit)
Offset	0 V
Output	On

2. Set the AWG500-Series Waveform Generator controls and select the waveform file:

a. Initialize the AWG500-Series Waveform Generator controls:

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

b. Select the file: Load the **MODE.WFM** as referring to the procedures on page 4–15.

c. Set the AWG500-Series Waveform Generator clock reference to external:

- Push **HORIZONTAL MENU** (front panel)→**Clock Ref** (side) so that the clock reference is set to **External**.
- Push the **Clock** side button.
- Enter numeric value of 50M: Push **5, 0, M** (SHIFT+7) keys in this order.

3. Turn on the AWG500-Series Waveform Generator output: Push the **RUN** button so that the LED above the RUN button lights.

4. Check the clock output frequency with 10.0 MHz reference: Check that the frequency counter reading is 50.0 MHz ± 10 kHz.

5. Modify the function generator controls:

Frequency	10.1 MHz
-----------------	----------

6. Check the clock output frequency with 10.1 MHz reference: Check that the frequency counter reading is 50.5 MHz ± 10 kHz.

7. End procedure: Turn the function generator output off and disconnect the function generator and frequency counter.

Add Input Tests

This procedure checks the AWG500-Series Waveform Generator Add Input function.

Equipment required	A 50 Ω terminators, a dual-banana adapter, Two 50 Ω coaxial cables, a function generator, and a DMM.
Prerequisites	The AWG500-Series Waveform Generator meets the prerequisites listed on page 4-13.

1. *Install the test hookup and set test equipment controls:*
 - a. *Hook up the function generator:* Connect the AWG500-Series Waveform Generator **ADD IN** connector through a 50 Ω BNC coaxial cable to the function generator output connector.
 - b. *Hook up DMM:* Connect the AWG500-Series Waveform Generator CH1 output through a 50 Ω BNC coaxial cable, a 50 Ω precision terminator, and an adapter (BNC-to-dual banana) to the DMM input connector (see Figure 4-27).

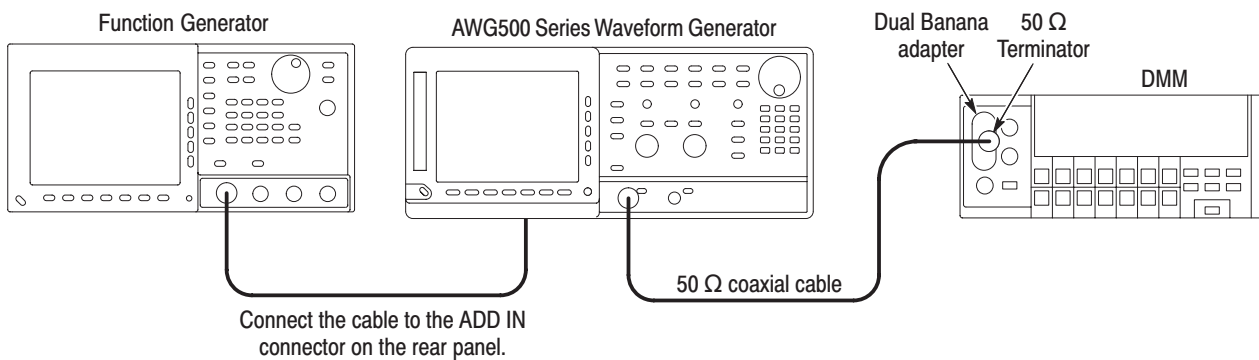


Figure 4-27: Add operation initial test hookup

- c. *Set the DMM controls:*

Mode VDC
 Range 2 V
 Input Front

d. *Set the function generator (AFG2020) controls:*

Function	Square
Mode	Continuous
Parameters	
Frequency	1 kHz
Amplitude	0 V
Offset	1.0 V
Output	Off

2. *Set AWG500-Series Waveform Generator controls:*

a. *Initialize the AWG500-Series Waveform Generator controls:*

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

b. *Set the amplitude settings:*

- Push **VERTICAL MENU** (front panel)→**Amplitude** (side).
- *Enter numeric value of 0.02:* Push **0**, **.**, **0**, **2** and **ENTER** keys in this order.

c. *Connect the ADD IN connector to CH1 output:*

- Push **ADD/Direct Out...** (side) → **External** (side).

d. *Select the waveform file:* Load the **DC0.WFM** as referring to the procedures on page 4–15.

3. *Turn on the AWG500-Series Waveform Generator CH1 output:* Push the **RUN** and **CH1 OUT** buttons so that the LEDs above the RUN button and CH1 output connector light.

4. *Check the output level corresponds to the input level:*

a. *Check the level when the function generator output is off:*

- *Check the reading on DMM:* Check that the value is within the range from –10 mV to +10 mV, and note this reading value.

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

- c. *Check the level when the function generator output is on:*
 - *Check the reading on DMM:* Check that the reading of the DMM minus the value read in step 4.a is within the range between 0.95 V and 1.05 V.
- 5. *End procedure:* Turn off the function generator output, and disconnect the function generator and DMM.

Marker Output Tests

These procedures check the accuracy of the AWG500-Series Waveform Generator marker output level.

Equipment required	A 50 Ω SMB-to-BNC coaxial cable and an oscilloscope.
Prerequisites	The instrument must meet the prerequisites listed on page 4-13.

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

- a. *Hook up the oscilloscope:* Connect the AWG500-Series Waveform Generator **MARKER OUT:CH1 M1** connector through a SMB-to-BNC coaxial cable to the oscilloscope CH1 input connector (see Figure 4-28).

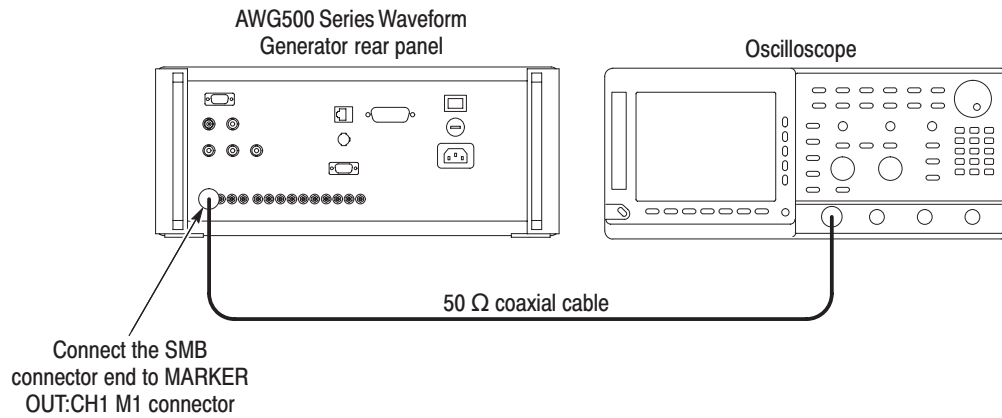


Figure 4-28: Marker output initial test hookup

- b. *Set oscilloscope controls:*

Vertical	CH1
CH1 coupling	DC
CH1 scale	1 V/div
CH1 input impedance	50 Ω
CH1 offset	0 V
Horizontal	
Sweep	2 μ s/div

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

2. *Set the AWG500-Series Waveform Generator controls and select the waveform file:*
 - a. *Initialize the AWG500-Series Waveform Generator controls:*
Push **UTILITY** (front panel)→**System** (bottom)→**Factory Reset** (side)→**OK** (side).
 - b. *Select the waveform for the CH1:* Load the **MODE.WFM** as referring to the procedures on page 4–15.
 - c. *Select the waveform for the CH2 (for the AWG520 only):*
 - Push the **CH2** button.
 - *Select the waveform:* Load the **MODE.WFM** as referring to the procedures on page 4–15.
 - d. *Set the clock frequency:*
 - Push **HORIZONTAL MENU** (front panel)→**Clock** (side).
 - *Enter numeric value of 100M:* Push **1**, **0**, **0** and **M** (SHIFT+7) keys in this order.
 - e. *Set the marker controls for the CH1:*
 - Push the **CH1** button.
 - Push **VERTICAL MENU** (front panel)→**Marker...** (side)→**Marker1 Low Level** (side).
 - *Enter numeric value of –2:* Push **–**, **2** and **ENTER** keys in this order.
 - Push the **Marker2 Low Level** side button.
 - *Enter numeric value of –2:* Push **–**, **2** and **ENTER** keys in this order.
 - f. *Set the marker controls for the CH2:* Push **CH2** button instead of CH1 to do the procedures in step 2.e.

3. *Turn on the AWG500-Series Waveform Generator output:* Push the **RUN** , **CH1 OUT** and **CH2 OUT** button so that the RUN LED, CH1 OUT LED and CH2 OUT LED light.

NOTE. *At the marker level measurements from an oscilloscope, do not measure the high and low level voltages that contain the ringing by overshoot or undershoot. Always perform the measurements after the level has been stabled.*

4. *Check CH1 marker output level accuracy:*
 - a. *Check Marker 1 output level:*
 - Check that the reading for the low level on the oscilloscope screen is within the range between -2.2 V and -1.8 V .
 - *Check Marker 1 output high level:* Check that the reading for the high level on the oscilloscope screen is in the range between 1.8 V and 2.2 V .
 - b. *Change the hook up:* Disconnect the SMB-to-BNC cable from the AWG500-Series Waveform Generator **MARKER OUT:CH1 M1** connector and connect it to the **MARKER OUT:CH1 M2** connector
 - c. *Check Marker 2 output level:*
 - Check that the reading for the low level on the oscilloscope screen is within the range between -2.2 V and -1.8 V .
 - *Check Marker 1 output high level:* Check that the reading for the high level on the oscilloscope screen is within the range between 1.8 V and 2.2 V .
5. *Check CH2 marker output level accuracy (for the AWG520 only):*
 - a. *Change the hook up:* Disconnect the SMB-to-BNC cable from the AWG500-Series Waveform Generator **MARKER OUT:CH1 M2** connector and connect it to the **MARKER OUT:CH2 M1** connector
 - b. *Check Marker 1 output level:*
 - *Check Marker 1 output low level:* Check that the reading for the low level on the oscilloscope screen is within the range between -2.2 V and -1.8 V .
 - *Check Marker 1 output high level:* Check that the reading for the high level on the oscilloscope screen is within the range between 1.8 V and 2.2 V .

- c. *Change the hook up:* Disconnect the SMB-to-BNC cable from the AWG500-Series Waveform Generator **MARKER OUT:CH2 M1** connector and connect it to the **MARKER OUT:CH2 M2** connector
 - d. *Check Marker 2 output level:*
 - *Check Marker 1 output low level:* Check that the reading for the low level on the oscilloscope screen is within the range between -2.2 V and -1.8 V .
 - *Check Marker 1 output high level:* Check that the reading for the high level on the oscilloscope screen is within the range between 1.8 V and 2.2 V .
6. *End procedure:* Disconnect the oscilloscope.

Marker Delay Tests

These procedures check the marker delay function of the AWG500-Series Waveform Generator.

Equipment required	Two 50 Ω SMB-to-BNC coaxial cables and an oscilloscope.
Prerequisites	The instrument must meet the prerequisites listed on page 4–13.

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

- a. *Hook up the oscilloscope:* Connect the AWG500-Series Waveform Generator **MARKER OUT CH1:M1** and **M2** outputs through 50 Ω SMB-to-BNC coaxial cables to the oscilloscope CH1 and CH2 input connectors, respectively (see Figure 4–29).

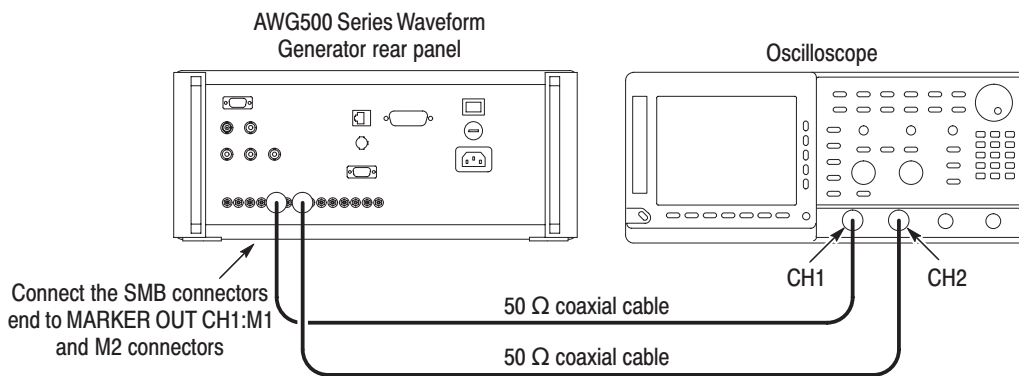


Figure 4–29: Digital data output initial test hookup

- b. *Set the oscilloscope controls:*

Vertical	CH1 and CH2
CH1 and CH2 coupling	DC
CH1 and CH2 scale	1 V/div
CH1 and CH2 offset	0 V
CH1 and CH2 input impedance ...	50 Ω
Horizontal	
Sweep	500 ps/div

Trigger	
Source	CH2
Coupling	DC
Slope	Positive
Level	1 V
Mode	Normal

2. *Set the AWG500-Series Waveform Generator controls and select the waveform file:*
 - a. *Initialize the AWG500-Series Waveform Generator controls:*
Push **UTILITY** (front panel)→**System** (bottom)→**Factory Reset** (side)→**OK** (side).
 - b. *Select the waveform for the CH1:* Load the **MODE.WFM** as referring to the procedures on page 4-15.
3. *Turn on the AWG500-Series Waveform Generator output:* Push the **RUN** button so that the RUN LED lights.
4. *Check the CH1 Marker 1 delay function works:*
 - a. Push **HORIZONTAL MENU** (front panel)→**Marker 1 Delay** (side)
 - b. Continuously change the Marker 1 delay from 0 s to 2.0 ns by turning the general purpose knob.
 - c. Confirm that the Marker 1 output delay relative to the Marker 2 output varies from 0 s to 2.0 ns on the oscilloscope screen.
5. *Set the AWG500-Series Waveform Generator and oscilloscope controls:*
 - a. *Enter numeric value of 0 s:* Push **0** and **ENTER** keys to set the Marker 1 Delay back to 0 s.
 - b. *Change the oscilloscope controls:* Change the oscilloscope trigger source from CH2 to CH1.

Trigger	
Source	CH1

- 6. *Check the CH1 Marker 2 delay function works:*
 - a. Push the **Marker 2 Delay** side button.
 - b. Continuously change the Marker 2 delay from 0 s to 2.0 ns by turning the general purpose knob.
 - c. Confirm that the Marker 2 output delay relative to the Marker 1 output varies from 0 s to 2.0 ns on the oscilloscope screen.

- 7. *Check the CH2 Marker delay if your instrument model is the AWG520:*
 - a. *Set the AWG500-Series Waveform Generator and oscilloscope controls:*
 - *Enter numeric value of 0 s:* Push **0** and **ENTER** keys to set the Marker 2 Delay back to 0 s.
 - *Change the oscilloscope controls:* Change the oscilloscope trigger source from CH1 to CH2.

Trigger
Source CH2

- b. *Change the cable connection on the AWG500-Series Waveform Generator:*
 - Disconnect the cable from the **MARKER OUT CH1: M1**, and connect the cable to the **MARKER OUT CH2: M1**.
 - Disconnect the cable from the **MARKER OUT CH1: M2**, and connect the cable to the **MARKER OUT CH2: M2**.
 - c. Repeat the *Marker Delay Tests* for the CH2.
- 8. *End procedure:* Disconnect the oscilloscope.

Digital Data Output Tests (Option 03 Only)

These procedures check the AWG500-Series Waveform Generator digital data output level accuracy and skew.

Check Output Levels

Equipment required	A 50 Ω SMB-to-BNC coaxial cable, and an oscilloscope.
Prerequisites	The instrument must meet the prerequisites listed on page 4-13.

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

- a. *Hook up the oscilloscope:* Connect the AWG500-Series Waveform Generator **DIGITAL DATA OUT:D0** output through a 50 Ω SMB-to-BNC coaxial cable to the oscilloscope input connector (see Figure 4-30).

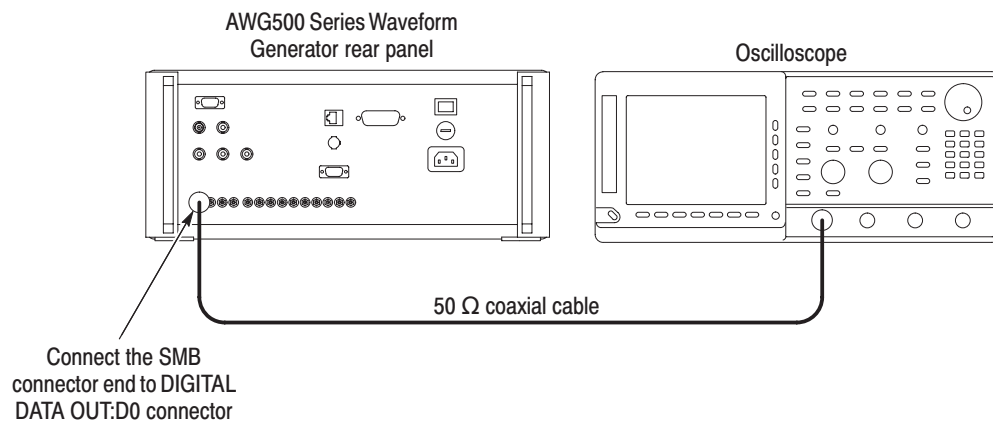


Figure 4-30: Digital data output level initial test hookup

- b. *Set the oscilloscope controls:*

Vertical	CH1
CH1 coupling	DC
CH1 scale	1 V/div
CH1 offset	0 V
CH1 input impedance	50 Ω
Horizontal	
Sweep	1 μ s/div

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

2. *Set the AWG500-Series Waveform Generator controls:*
 - a. *Initialize the AWG500-Series Waveform Generator controls:*
 Push **UTILITY** (front panel)→
System (bottom)→**Factory Reset** (side)→**OK** (side).
 - b. *Select waveform file for DIGITAL:*
 - Push the **DIGITAL** button.
 - *Select the waveform for the DIGITAL:* Load the **DOUT.PAT** as referring to the procedures on page 4–15.
 - c. *Set the digital data output low level:*
 - *Set the low level:* Push **VERTICAL MENU** (front panel)→
Low Level (side).
 - *Enter numeric value of -2:* Push **-, 2** and **ENTER** keys in this order.
 - d. *Turn on the digital data out:* Push the **Output** side button so that the Output is set to On.
3. *Turn on the AWG500-Series Waveform Generator output:* Push the **RUN** button so that the LEDs above the RUN button lights.

NOTE. *At the output level measurements from an oscilloscope, do not measure the high and low level voltages that contain the ringing by overshoot or undershoot. Always perform the measurements after the level has been stabled.*

4. *Check the digital data output level accuracy:*
 - a. *Check the D0 output level:*
 - *Check the low level:* Check the reading for the low level on the oscilloscope screen is within the range between -2.2 V and -1.8 V.
 - *Check the high level:* Check the reading for the high level on the oscilloscope screen is in the range between 1.8 V and 2.2 V.

b. *Check the output level from D1 to D9:*

- *Change the cable connection:* Disconnect the SMB-to-BNC cable from the **DIGITAL DATA OUT:D0** connector and connect it to the **D1** connector. Proceed this step as changing the cable connection from D1 to D9
- *Check the low level, high level and period:* Do the procedures in step 4.a for each of **DIGITAL DATA OUT** connectors from **D1** to **D9**.

5. *End procedure:* Retain the AWG520 settings.

Check Skew

Equipment required	Two 50 Ω SMB-to-BNC coaxial cables (same length), and an oscilloscope.
Prerequisites	The instrument must meet the prerequisites listed on page 4-13.

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

- a. *Hook up the oscilloscope:* Connect the AWG500-Series Waveform Generator **DIGITAL DATA OUT:D0** and **D1** outputs through 50 Ω SMB-to-BNC coaxial cables with the same length to the oscilloscope CH1 and CH2 input connectors, respectively (see Figure 4-31).

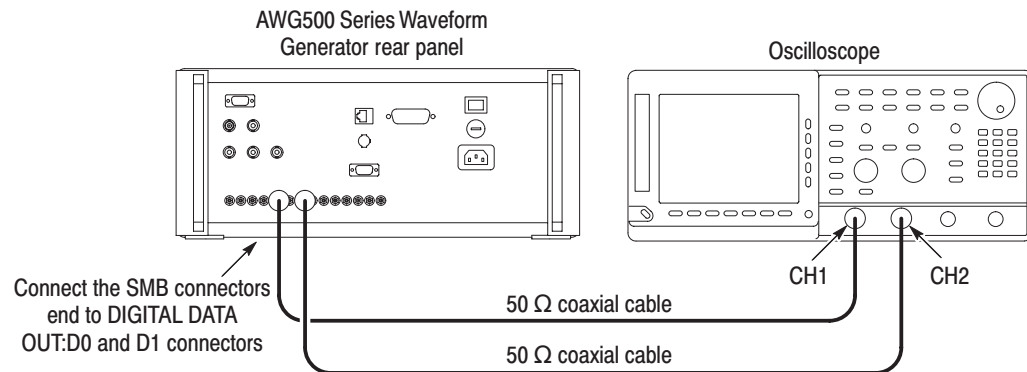


Figure 4-31: Digital data output initial test hookup

b. *Set the oscilloscope controls:*

Vertical	CH1 and CH2
CH1 and CH2 coupling	DC
CH1 and CH2 scale	1 V/div
CH1 and CH2 offset	0 V
CH1 and Ch2 input impedance	50 Ω
Horizontal	
Sweep	0.5 μs/div
Trigger	
Source	CH1
Coupling	AC
Slope	Positive
Level	0 V
Mode	Auto

2. *Measure the delay time at any combination of two digital data outputs:*

- a.** Write the delay time read from the oscilloscope screen.
- b.** Do the step a as changing the cable from the oscilloscope CH2 connector to **Dx** to **D9**.

The **Dx** means the connector just right to the connector currently connected to the oscilloscope CH1 connector. For example, if the **D4** is connected to the oscilloscope CH1 connector in step c, **Dx** will be **D5**.

- c.** Do the step a and b for any two digital data outputs as changing the cable from the oscilloscope CH1 connector to **D0** to **D8**.

3. *Check the skew:*

- a.** *Find the maximum delay:* Find the maximum delay time from the values measured in step2 .
- b.** *Check the skew:* Check that the maximum delay time is equal to or less than 1 ns.

4. *End procedure:* Disconnect the oscilloscope.

Clock Output Tests

These procedures check the AWG500-Series Waveform Generator clock output signal.

Equipment required	A 50 Ω BNC coaxial cable, and an oscilloscope.
Prerequisites	The instrument must meet the prerequisites listed on page 4-13.

1. *Install the test hookup and set test equipment controls:*
 - a. *Hook up the oscilloscope:* Connect the AWG500-Series Waveform Generator **CLOCK OUT** output through a 50 Ω BNC coaxial cable to the oscilloscope input connector (see Figure 4-32).

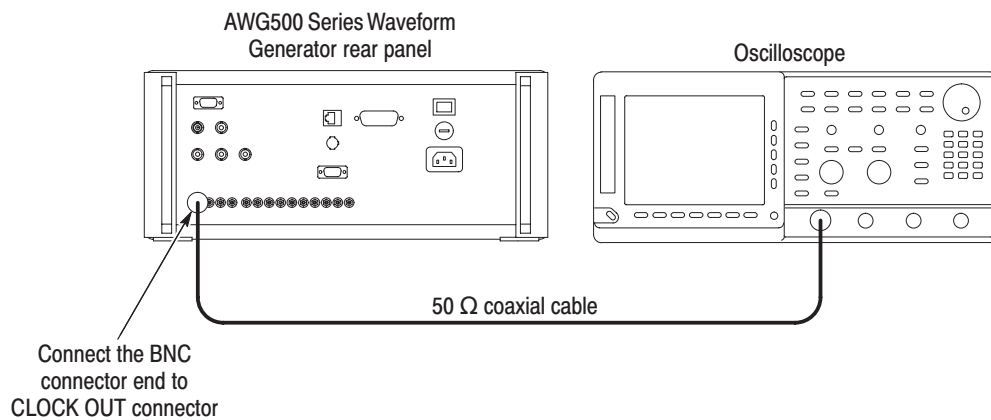


Figure 4-32: Clock output initial test hookup

- b. *Set the oscilloscope controls:*

Vertical	CH1
CH1 coupling	DC
CH1 scale	0.5 V/div
CH1 offset	-1.3 V
CH1 input impedance	1 M Ω
Horizontal	
Sweep	5 ns/div

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

2. *Set the AWG500-Series Waveform Generator controls:*
 - a. *Initialize the AWG500-Series Waveform Generator controls:*
 Push **UTILITY** (front panel)→
System (bottom)→**Factory Reset** (side)→**OK** (side).
 - b. *Select the waveform file:* Load the **MODE.WFM** as referring to the procedures on page 4-15.
 - c. *Set the clock frequency:*
 - Push **HORIZONTAL MENU** (front panel)→**Clock** (side).
 - *Enter numeric value of 50M:* Push **5, 0** and **M** (SHIFT+7) keys in this order.
3. *Turn on the AWG500-Series Waveform Generator output:* Push the **RUN** button so that the LEDs above the **RUN** button lights.
4. *Check the clock output signal:* Check that the clock signal amplitude is equal to or larger than 0.5 V, and the clock signal period is 20 ns.
5. *End procedure:* Disconnect the oscilloscope.

Noise Output Tests

This procedure checks the AWG500-Series Waveform Generator noise output characteristics.

Equipment required	A 50 Ω coaxial cable, a DC block, an adapter (N male to BNC female), and a spectrum analyzer.
Prerequisites	The instrument must meet the prerequisites listed on page 4-13.

1. *Install test hookup and set test equipment controls:*
 - a. *Hook up the spectrum analyzer:* Connect the AWG500-Series Waveform Generator **NOISE OUT** connector through the coaxial cable, adapter, and DC Block to the input connector on the spectrum analyzer (see Figure 4-33).

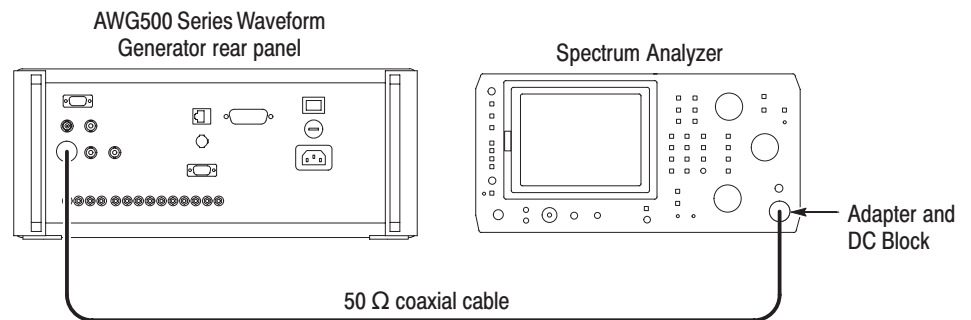


Figure 4-33: Noise output initial test hookup

- b. *Set spectrum analyzer controls:*

Center frequency	100 MHz
Full span	500 MHz
Vertical	10 dB/div
Reference level	0 dB/div
RF attenuation	20 dB
Video filter	10 kHz
Resolution BW	1 MHz

2. *Set the AWG500-Series Waveform Generator controls and select the waveform file:*
 - a. *Initialize the AWG500-Series Waveform Generator controls:*
Push **UTILITY** (front panel)→
System (bottom)→**Factory Reset** (side)→**OK** (side).
 - b. *Select the waveform file:* Load the **MODE.WFM** as referring to the procedures on page 4–15.
 - c. *Set the noise on:*
 - Push **SETUP** (front panel)→**NOISE** (bottom)→**Level** (side).
 - Set the noise level to **–105 dBm/Hz** using the general purpose knob.
 - d. *Set the noise on:* Push the **Output** side button so that the **On** is selected
3. *Check noise level:*
 - a. *Change the unit in the spectrum analyzer:* Change the unit to dBm/Hz when the dBm is currently set.
 - b. *Check noise Level:* Check that the noise level of the spectrum displayed on the spectrum analyzer is **–105 dBm/Hz ± 2.5 dBm/Hz** at 100 MHz.
4. *End procedure:* Disconnect the spectrum analyzer.

Adjustment Procedures

Adjustment Procedures

This section contains information needed to manually adjust the AWG510 and AWG520 Arbitrary Waveform Generators.

The section consists of two subsections:

- *Before Adjustments*. Provides general information about adjusting the waveform generator and the Performance Check/Adjustment disk files.
- *Adjustments*. Procedures for manually adjusting the waveform generator.

Purpose Use the *Adjustments* subsection to return the waveform generator to conformance with performance specified in Section 1, *Specifications*. This procedure is not required to verify waveform generator performance; for performance verification procedures refer to Section 4, *Performance Verification*.

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

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

Adjustments There are six adjustment procedures, as listed in Table 5–1.

Table 5-1: Adjustments

Adjustments	Refer to
Clock frequency	Page 5-7
Clock duty	Page 5-9
DAC clock timing	Page 5-12
DAC linearity	Page 5-15
Noise output	Page 5-18
Low-voltage power supply	Page 5-20

NOTE. Whenever replacing the low-voltage power supply unit, do the procedure Low-Voltage Power Supply on page 5–20.

Requirements for Adjustments

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. Adjustments done before the operating temperature has stabilized may cause errors in performance.
Access	The cabinet must be removed and additional cooling fan must be provided when making the adjustments in this procedure. Refer to <i>Before Adjustments</i> on the next page for detailed information.
Self Calibration	Calibrate the waveform generator using the self calibration routine. Refer to the subsection, <i>Maintenance</i> , in Section 4, <i>Performance Verification</i> for instructions.
Performance Check/Adjustments Files	These adjustment procedures require loading 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 5–2 lists all test equipment required to adjust the waveform generator.

Equipment Required

Table 5–2 lists the test equipment required to adjust the waveform generator.

Table 5–2: Test equipment

Item description	Minimum requirements	Example	Purpose
1. Oscilloscope	Bandwidth > 500 MHz	Tektronix TDS784	Output signal adjustments
2. Frequency counter	1 MHz to 10 MHz Accuracy < 0.2 ppm	Anritsu MF1603A	Output signal adjustments
3. Spetrum analyzer	1 KHz to 1 GHz	Tektronix 497P or Advantest R4131	Output signal adjustments
4. Digital multi meter	DC volts range: 0.05 V to 10 V, Accuracy: $\pm 0.1\%$	Fluke 8842A	Check voltage.
5. BNC cable	Impedance 50 Ω	Tektronix part 012–0482–00	Signal interconnection
6. BNC to N adaptor	BNC female to N male	Tektronix part number 103-0045-00	Signal interconnection
7. DC block	N type, 50 Ω	Tektronix part number 015-0509-00	DC block
8. Adjustment Tool	Less than 1/8 inch diameter and over 4 inches long		Manual adjustments
9. Fan			Cooling the waveform generator

Before Adjustments

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

Providing Access

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



CAUTION. To avoid damaging the eject button, remove the floppy disk (if present) from the floppy disk drive before removing the cabinet.

Cooling With the rear cover and cabinet removed, the waveform generator assembly does not cool properly while power is applied. A separate fan is needed to prevent heat build-up. Place the fan so it blows air to the A50 AWG board, as shown in Figure 5-1.



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

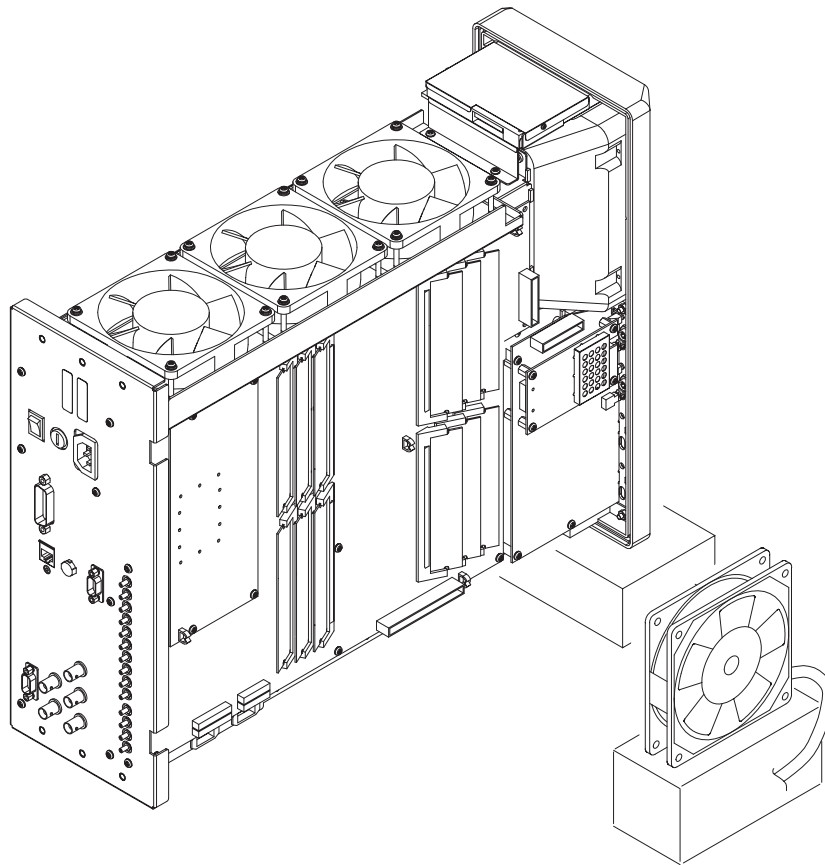


Figure 5-1: Cooling the waveform generator during adjustment procedures

Enabling Service Mode

The DAC clock timing adjustment procedure uses the **Service** menu in **Utility**. To enter this menu, you must do the following step to enable service mode using the switch on the A10 Connector board:

- Power on the waveform generator by pushing **ON/STB** button while pressing the service switch on the A10 Connector board. See Figure 5-2.

If you perform the adjustment procedure without removing the cabinet, you must insert the adjustment tool (Item 8) in the hole on the left side of the waveform generator about 4 inches to engage the service switch.

Powering off the waveform generator disables the service mode.

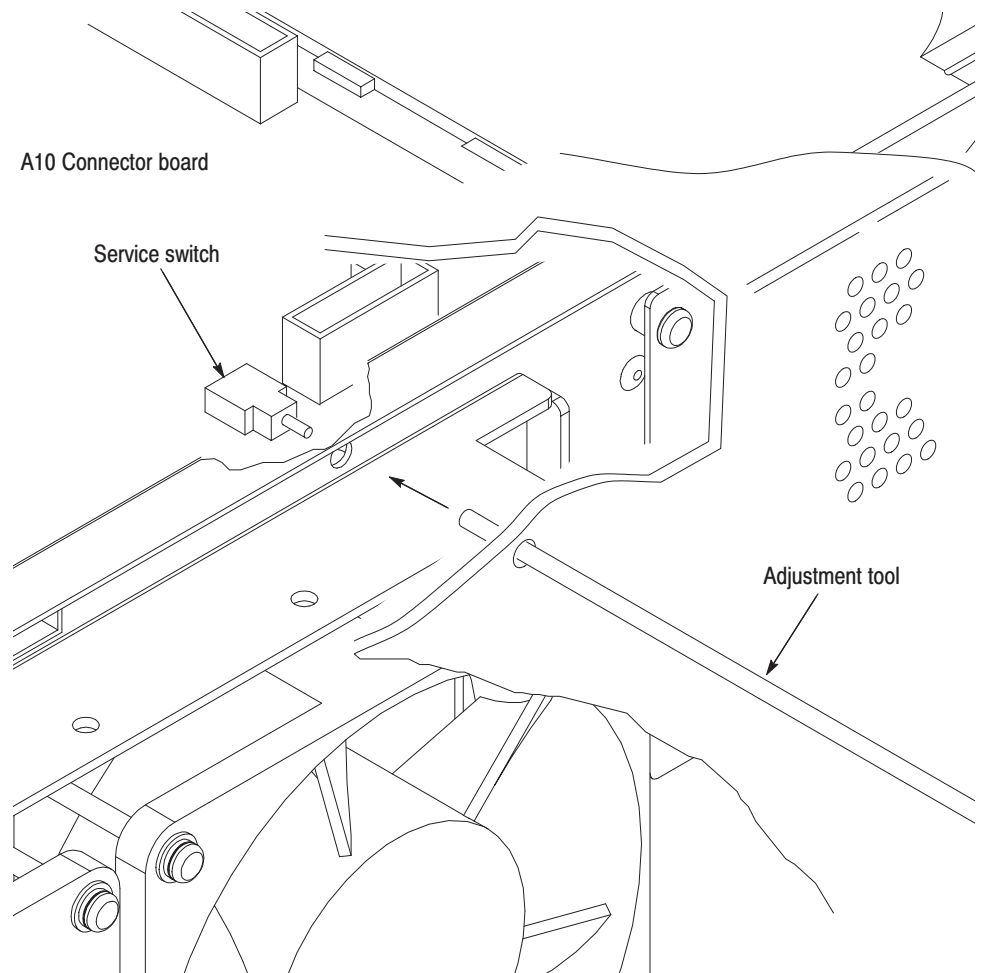



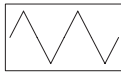
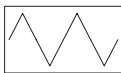
Figure 5-2: Accessing the service switch

Performance Check/Adjustment Files

Table 5–3 lists the waveform files provided on the Performance Check/Adjustment disk that is required to do the adjustments. The table lists the front-panel settings that the file sets up and the adjustment procedures that use the files.

For instructions on loading files, see *Loading Files* on page 4–15. After loading the files, press the floppy disk drive eject button and remove the floppy disk.

Table 5–3: File List for Performance Check/Adjustment Disk

No.	File Name	Wfm Shape	Wfm Point	Clock	Usage
1	MODE.WFM		1000	1 GHz	Clock frequency adjustment
2	TRI512.PAT		512	1 GHz	Clock duty adjustment DAC delay adjustment
3	TRIM.PAT		480	10 MHz	DAC linearity adjustment

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

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

Adjustment Instructions

Clock Frequency This procedure adjusts Y330 on the A40 Clock board to set the AWG500 clock frequency.

Equipment Required	One frequency counter (Item 2)
	One 50 Ω coaxial cable (Item 5)

1. *Connect the test equipment and set test equipment controls:*
 - a. *Connect the frequency counter:* Connect the AWG500 Clock Output connector through a BNC coaxial cable to the input A connector on the frequency counter.

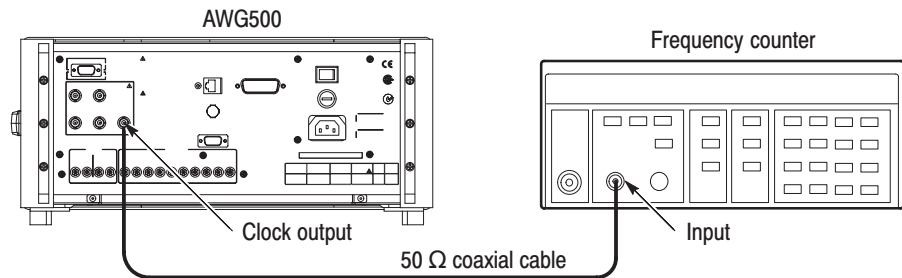


Figure 5-3: Hookup for the clock frequency adjustment

- b. *Set frequency counter controls:*

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

2. *Set AWG500 controls:*
 - a. *Initialize AWG500 controls:* Press **UTILITY** → **System** → **Factory Reset** → **OK**.
 - b. *Load waveform:*
 - Press **SETUP** → **Waveform/Sequence** → **Load...**
 - 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. *Set clock frequency:*
 - Press **SETUP** → **Horizontal** → **Internal Clock**.
 - Enter **10 MHz** with numeric keypad and press **Enter** .
 - d. *Start clock generation:* Press **RUN** button.
3. *Adjust clock frequency:* Adjust Y330 on the Clock board (A40) so that the frequency counter reading is in the range of 10.0 MHz \pm 2 Hz (0.2 ppm).

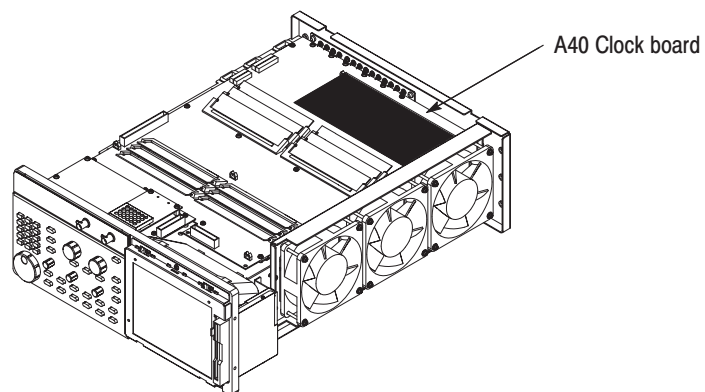
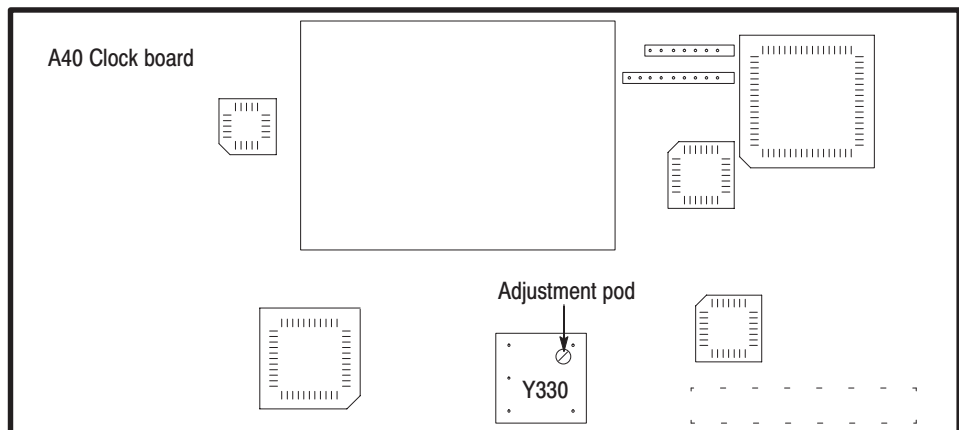


Figure 5-4: Adjustment location for clock frequency

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

Clock Duty

This procedure adjusts R5004 on the A50 AWG board to set the clock duty of the AWG circuits. See Figure 5–6 on page 5–11 for the adjustment location .

Equipment Required	One oscilloscope (Item 1)
	One 50 Ω coaxial cable (Item 5)

1. Install test equipment connections and set test equipment controls:

- a. Connect the oscilloscope:** Connect the AWG500 CH 1 output connector through a BNC coaxial cable to the CH 1 input connector on the oscilloscope.

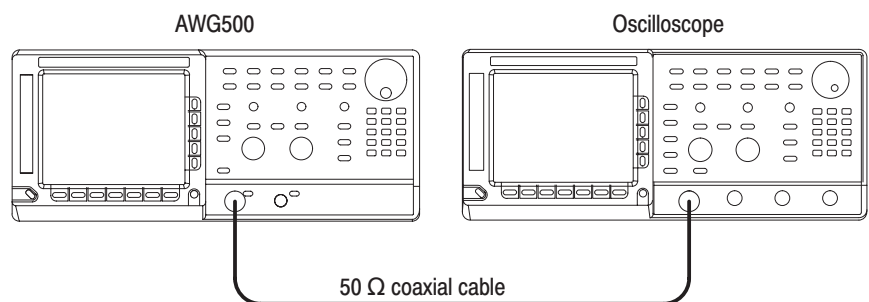


Figure 5–5: Hookup for the clock duty adjustment

b. Set oscilloscope controls:

Vertical	CH 1
CH 1 coupling	DC
CH 1 scale	0.2 V/div
CH 1 input impedance	50 Ω
Horizontal	
Sweep	100 ns/div
Trigger	
Source	CH 1
Coupling	DC
Slope	Positive
Level	0 V
Mode	Auto

2. *Set the waveform generator controls:*
 - a. *Initialize AWG500 controls:* Press **UTILITY** → **System** → **Factory Reset** → **OK**.
 - b. *Load and start CH 1 waveform:*
 - Press **SETUP** → **Waveform/Sequence** → **Load...** → **Drive...**
 - Turn the general purpose knob to select **Floppy**.
 - Push **OK**.
 - Turn the general purpose knob to display the list of waveform files and highlight the file **TR1512.PAT**.
 - Push **OK** to select and load the file.
 - Push **RUN** button.
 - Push **CH 1 OUTPUT** button to **ON**.
3. *Adjust clock duty:*
 - Set R5004 trimmer position to the center.
 - Rotate left slowly R5004 from center position to find the position of output waveform corrupted. Mark the position as (L).
 - Set R5004 trimmer position to the center and restart waveform generation by press **RUN** button twice (STOP and START).
 - Rotate right slowly R5004 from center position to find the position of output waveform corrupted. Mark the position as (R).
 - Set R5004 position to the middle of (L) and (R).
 - Restart waveform generation by press **RUN** button twice (STOP and START) and make sure the output waveform is not corrupted.
4. *End procedure:* Disconnect the oscilloscope.

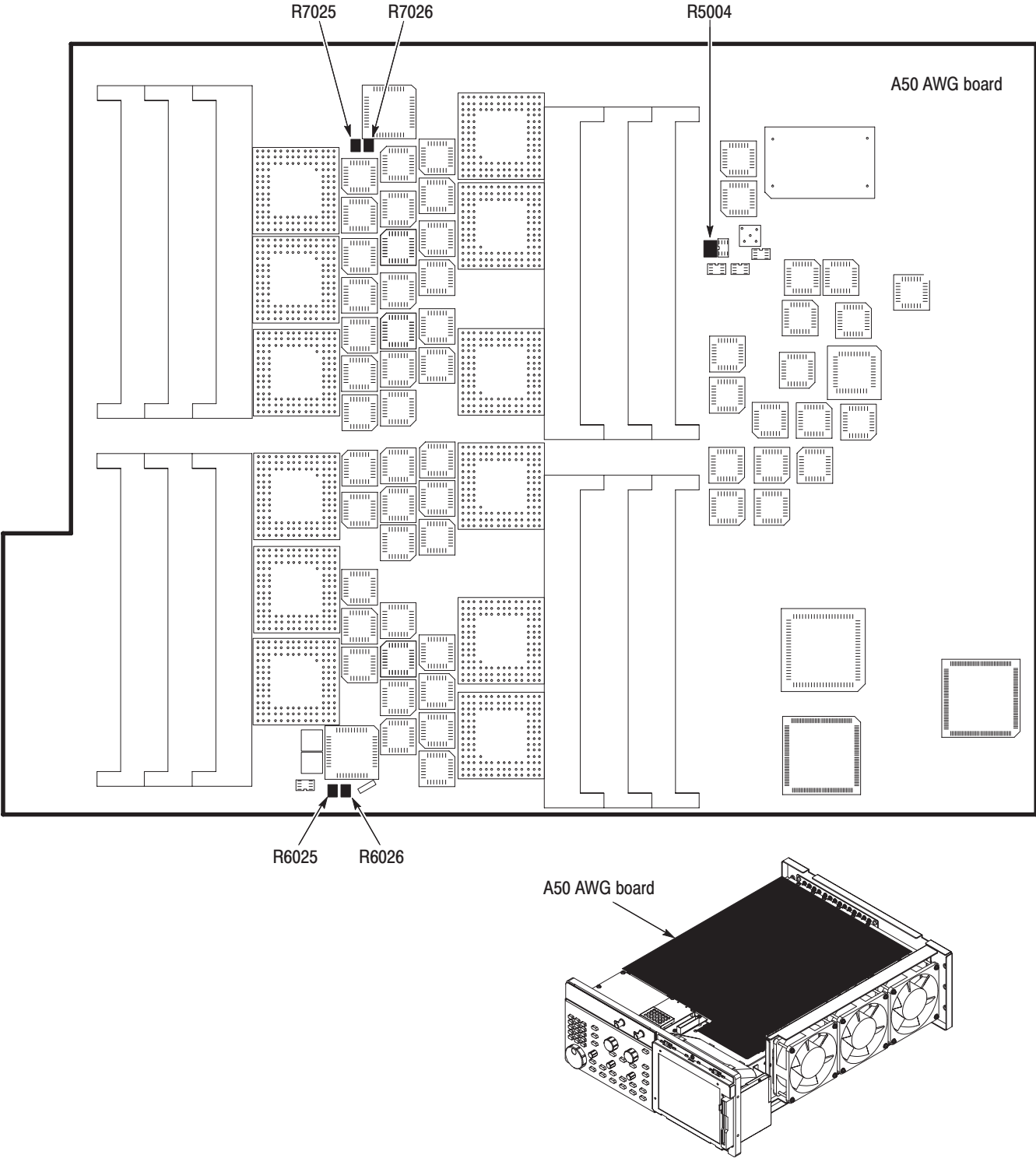


Figure 5-6: Adjustment location for clock duty, timing, and linearity

DAC Clock Timing

This procedure adjusts variable delay setting on the A50 AWG board for the DAC clock timing. See Figure 5-6 on page 5-11 for the adjustment location.

Equipment Required	One oscilloscope (Item 1)
	One 50 Ω coaxial cable (Item 5)

1. *Connect the test equipment and set test equipment controls:*
 - a. *Connect the oscilloscope:* Connect the AWG500 CH 1 output connector through a BNC coaxial cable to the CH 1 input connector on the oscilloscope.

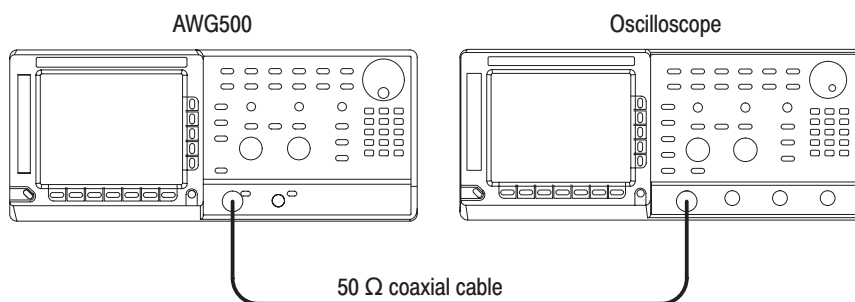


Figure 5-7: Hookup for the DAC clock timing adjustment

- b. *Set oscilloscope controls:*

Vertical	CH 1
CH 1 coupling	DC
CH 1 scale	200 mV/div
CH 1 input impedance	50 Ω
Horizontal	
Sweep	100 ns/div
Trigger	
Source	CH 1
Coupling	DC
Slope	Positive
Level	0 V
Mode	Auto

2. *Set the waveform generator controls:*

- a. *Initialize AWG500 controls:* Press **UTILITY** → **System** → **Factory Reset** → **OK**.
- b. *Load CH 1 waveform:*
 - Press **SETUP** → **Waveform/Sequence** → **Load...**
 - Turn the general purpose knob to display the list of waveform files and highlight the file **TRI512.PAT**.
 - Press **OK** to select and load the file.
- c. *Start waveform generation:*
 - Press **CH 1 OUTPUT** button.

The following steps **d** and **e** are for the AWG520 only. For the AWG510, go to the step **3**.

- d. *Load CH 2 waveform: (for AWG520 only)*
 - Press **CH 2** button to select the channel.
 - Press **SETUP** → **Waveform/Sequence** → **Load...**
 - Turn the general purpose knob to display the list of waveform files and highlight the file **TRI512.PAT**.
 - Press **OK** to select and load the file.
- e. *Start waveform generation:*
 - Press **CH 2 OUTPUT** button.

3. *Enter DAC adjust menu:* Press **UTILITY** → **Service** → **DAC Delay** → **OK**.

4. *Adjust CH 1 DAC clock timing:*

- a. *Set AWG500 controls:* Press **DAC1 Delay**.
- b. *Adjust timing:*
 - Turn the general purpose knob to find the setting at which the output waveform corrupts. The value should be near 40.
 - Turn the general purpose knob to find the lower limit for the waveform corrupted area. Note the value as N1.

- Turn the general purpose knob to find the upper limit for the waveform corrupted area. Note the value as N2.
- Calculate $(N1+N2)/2-28$ and set the value to it. That is the proper setting. For example, if N1=40 and N2=50, then set the value to 17.

The following step **5** is for the AWG520 only. For the AWG510, go to the step **6**.

5. *Adjust CH 2 DAC clock timing: (for AWG520 only)*

- a.** *Modify the AWG500 hookup:* Disconnect the coaxial cable on the CH 1 output connector and connect it to the CH 2 output connector.
- b.** *Set AWG500 controls:* Press **DAC2 Delay**.
- c.** *Adjust timing:*
 - Turn the general purpose knob to find the setting of output waveform corrupted. The value should be near 40.
 - Turn the general purpose knob to find the lower limit for waveform corrupted area. Note the value as N1.
 - Turn the general purpose knob to find the upper limit for waveform corrupted area. Note the value as N2.
 - Calculate $(N1+N2)/2-28$ and set the value to it. That is proper setting.

6. *Save the settings:* Press **Save**.

7. *End procedure:* Disconnect the oscilloscope.

DAC Linearity

This procedure adjusts R6025, R6026, R7025 (AWG520), and R7026 (AWG520) on the A50 AWG board for the DAC Linearity. See Figure 5–6 for the adjustment location on page 5–11.

Equipment Required	One oscilloscope (Item 1)
	One 50 Ω coaxial cable (Item 5)

1. *Connect the test equipment and set test equipment controls:*
 - a. *Connect the oscilloscope:* Connect the AWG500 CH 1 output connector through a BNC coaxial cable to the CH 1 input connector on the oscilloscope.

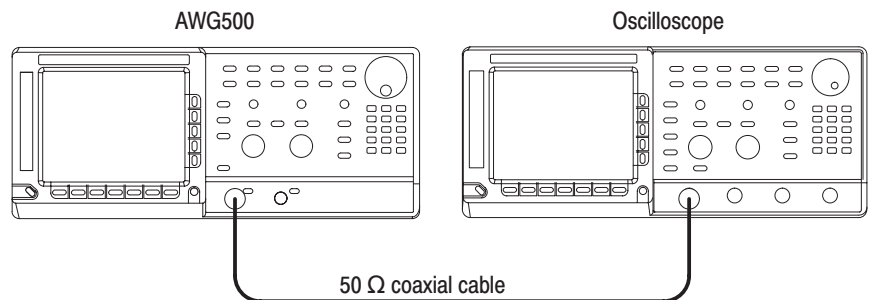


Figure 5–8: Hookup for the DAC linearity adjustment

- b. *Set oscilloscope controls:*

Vertical	CH 1
CH 1 coupling	DC
CH 1 scale	10 mV/div
CH 1 input impedance	50 Ω
Horizontal	
Sweep	2 μ s/div
Trigger	
Source	CH 1
Coupling	AC
Slope	Positive
Level	0 V
Mode	Auto

2. *Set AWG500 controls:*
 - a. *Initialize AWG500 controls:* Press **UTILITY** → **System** → **Factory Reset** → **OK**.
 - b. *Load waveform:*
 - Press **SETUP** → **Waveform/Sequence** → **Load...**
 - Turn the general purpose knob to display the list of waveform files and highlight the file **TRIM.PAT** (triangle waveform; 10 MS/s).
 - Press **OK** to select and load the file.
 - c. *Start waveform generation:*
 - Press **RUN** button.
 - Press **CH 1 OUTPUT** button.
3. *Adjust CH 1 DAC linearity:*
 - a. Make sure that the position of R6025 and R6026 is near center.
 - b. *Adjust low range bits of the DAC:* Adjust R6026 on the AWG (A50) board so that rise and fall slope to be linear.
 - c. *Adjust mid range bits of the DAC:* Adjust R6025 on the AWG (A50) board so that rise and fall slope to be linear.
 - d. *Readjust low range bits of the DAC:* Adjust R6026 on the AWG (A50) board so that rise and fall slope to be linear.

The following steps **4** and **5** are for the AWG520 only. For the AWG510, go to the step **6**.

4. *Setup for CH 2 DAC Adjust: (AWG520 only)*
 - a. *Connect the oscilloscope:* Disconnect the BNC on CH 1 output, then connect it to the AWG500 CH 2 output connector.
 - b. *Load waveform to CH 2:*
 - Push CH 2 button
 - Press **SETUP** → **Waveform/Sequence** → **Load...**
 - Turn the general purpose knob to display the list of waveform files and highlight the file **TRIM.PAT** (triangle waveform; 10 MS/s).
 - Press **OK** to select and load the file.

- c. *Start waveform generation:*
 - Press **CH 2 OUTPUT** button.
5. *Adjust CH 2 DAC linearity: (AWG520 only)*
 - a. Make sure that the position of R7025 and R7026 is near center.
 - b. *Adjust low range bits of the DAC:* Adjust R7026 on the AWG (A50) board so that rise and fall slope to be linear.
 - c. *Adjust mid range bits of the DAC:* Adjust R7025 on the AWG (A50) board so that rise and fall slope to be linear.
 - d. *Readjust low range bits of the DAC:* Adjust R7026 on the AWG (A50) board so that rise and fall slope to be linear.
6. *End procedure:* Disconnect the oscilloscope.

Noise Output This procedure adjusts the AWG500 noise output level.

Equipment Required	One spectrum analyzer (Item 1) One 50 Ω coaxial cable (Item 5) One adapter; BNC female to N male (Item 6) One DC block (Item 7)
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1. *Connect the test equipment and set test equipment controls:*
 - a. *Connect the the spectrum analyzer:* Connect the AWG500 **NOISE OUT** connector through the coaxial cable, adapter, and DC Block to the input connector on the spectrum analyzer (see Figure 4–33).

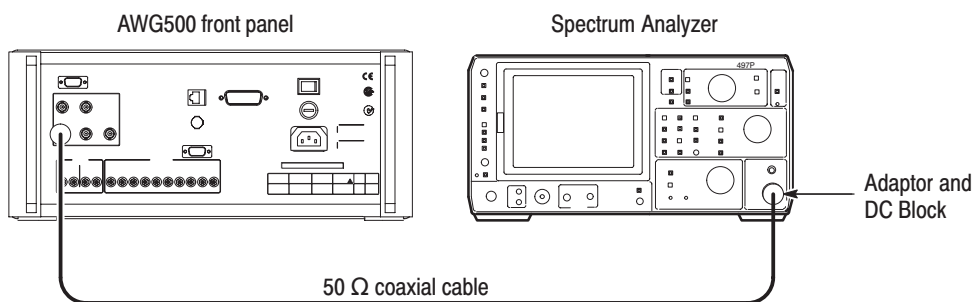


Figure 5-9: Hookup for the noise output adjustment

- b. *Set spectrum analyzer controls:*

Center frequency	100 MHz
Span	10 MHz
Vertical	10 dB/div
Reference level	0 dB/div
RF attenuation	20 dB
Video filter	10 kHz
Resolution BW	1 MHz

2. *Set the AWG500 controls and select the waveform file:*
 - a. *Initialize the AWG500 controls:* Select **UTILITY** → **System** → **Factory Reset** → **OK**.
 - b. *Set the noise on:*
 - Select **SETUP** → **NOISE** → **Level**.
 - Set the noise level to -105 dB/Hz using the general purpose knob.
 - c. *Set the noise on:* Press **Output** side button so that the **On** is selected
3. *Adjust noise level:*
 - a. *Adjust noise level:* Adjust R237 (see Figure 5–10) so that the noise level of the spectrum displayed on the spectrum analyzer is -105 dBm/Hz ± 2.5 dBm/Hz at 100 MHz.
4. *End procedure:* Disconnect the spectrum analyzer.

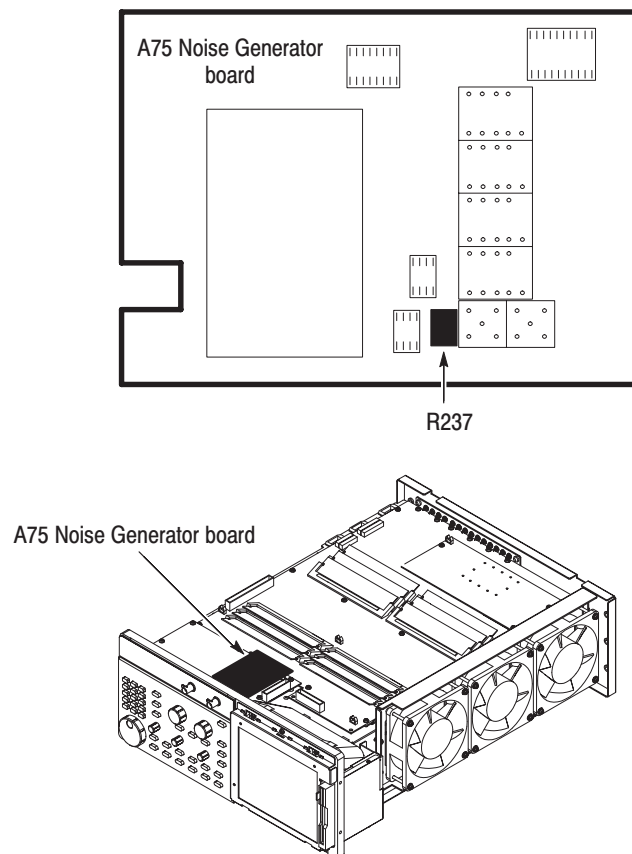


Figure 5–10: Adjustment location for noise level

Low-Voltage Power Supply

This procedure adjusts the level of the low-voltage power supply.

NOTE. Do this procedure only when replacing the low-voltage power supply unit.

Equipment Required	One digital multi meter (Item 4)
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- **Adjust the voltage level:** Adjust -5 V pod on the power supply unit so that TP103 (VEE) on the A10 Connector board is $-4.60\text{ V} \pm 0.02\text{ V}$. See Figure 5-11.

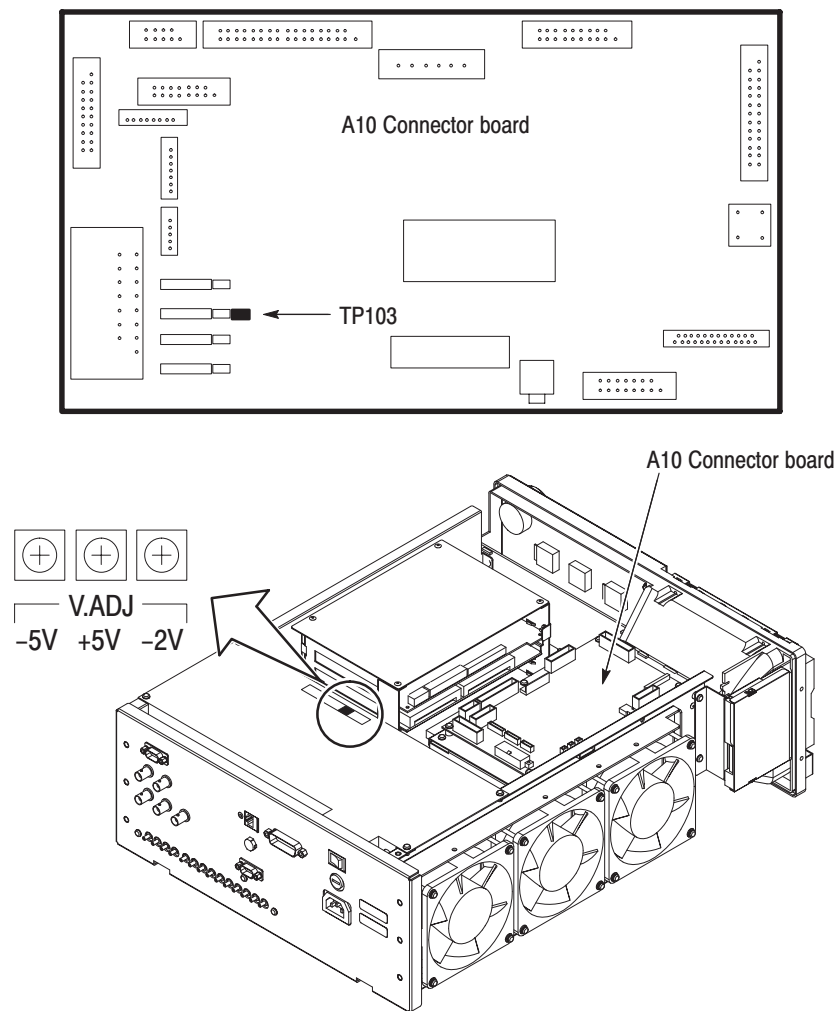


Figure 5-11: Adjustment location for the power supply unit

Maintenance

Maintenance

This section contains the information needed to do periodic and corrective maintenance on the AWG510 and AWG520 Arbitrary Waveform Generators. The following subsections are included:

- *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 its 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's 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 sections contain information and procedures related to maintenance.

- Section 2, *Operating Information*, covers instructions useful when operating the waveform generator in order to troubleshoot it. It also details the service strategy and lists options for obtaining maintenance service and for replacing failed modules.
- Section 3, *Theory of Operation*, contains a circuit description at the module, or block, level.
- Section 4, *Performance Verification*, contains procedures that may be useful in isolating problems to modules by testing the waveform generator performance.
- Section 5, *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.
- Section 9, *Diagrams*, contains a block diagram using individual modules as blocks and an interconnection diagram showing connections between the modules.
- Section 10, *Mechanical Parts List*, 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.*

Preventing ESD

When performing any service which requires internal access to the waveform generator, adhere to the following precautions to avoid damaging internal modules and their components due to electrostatic discharge (ESD).

1. Minimize handling of static-sensitive modules.
2. Transport and store static-sensitive modules in their static protected containers or on a metal rail. Label any package that contains static-sensitive modules.
3. Discharge the static voltage from your body by wearing a grounded antistatic wrist strap while handling these modules. Do service of static-sensitive modules only at a static-free work station.
4. Nothing capable of generating or holding a static charge should be allowed on the work station surface.
5. Handle circuit boards by the edges when possible.
6. Do not slide the modules over any surface.
7. Avoid handling modules in areas that have a floor or work-surface covering capable of generating a static charge.

Susceptibility to ESD

Table 6–1 lists the relative susceptibility of various classes of semiconductors. Static voltages of 1 kV to 30 kV are common in unprotected environments.

Table 6–1: Relative susceptibility to static-discharge damage

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

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

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

Inspection and Cleaning

Inspection and Cleaning describes how to inspect for dirt and damage. It also describes how to clean the exterior and interior of the AWG510 and AWG520 Arbitrary Waveform Generators. Inspection and cleaning are done as preventive maintenance. Preventive maintenance, when done regularly, may prevent the 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 to do maintenance depends on the severity of the environment in which the waveform generator is used. A proper time to perform preventive maintenance is just before 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 it 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 a generator failure, especially under high-humidity conditions.



CAUTION. *Avoid the use of chemical cleaning agents which might damage the plastics used in this waveform generator. Use only deionized water when cleaning the menu buttons or front-panel buttons. Use a 75% isopropyl alcohol solution as a cleaner and rinse with deionized water. Before using any other type of cleaner, consult your Tektronix Service Center or representative.*

Inspection — Exterior. Inspect 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 abused 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.

Cleaning Procedure — Exterior. 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 in a general purpose detergent-and-water solution. Do not use abrasive cleaners.
3. Clean the light filter protecting the monitor screen with a lint-free cloth dampened with either isopropyl alcohol or, preferably, a gentle, general purpose detergent-and-water solution.



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

Inspection — Interior. 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.	Resolder joint and clean with isopropyl 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.

Cleaning Procedure — Interior. 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 isopropyl alcohol (75% solution) and rinse with warm deionized water. (A cotton-tipped applicator is useful for cleaning in narrow spaces and on circuit boards.)

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

3. If steps 1 and 2 do not remove all the dust or dirt, the generator may be spray washed using a solution of 75% isopropyl 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 the isopropyl alcohol and wait 60 seconds for the majority of the alcohol to evaporate.
6. Use hot (120° F to 140° F) deionized water to thoroughly rinse 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 (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 Section 10 of this manual is a module.

Preparation — Please Read



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 this generator's components, read Installation in Section 2, and Preventing ESD in this section.*

This subsection contains the following items:

- This 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 6–4) in this generator.
- Procedures for removal and reinstallation of the electrical and mechanical modules.
- A disassembly procedure for removal of all the 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 could cause serious injury or death.*

List of Modules Section 10 lists all modules.

General Instructions ***STOP. READ THESE GENERAL INSTRUCTIONS BEFORE REMOVING A MODULE.***

First read over the Summary of Procedures that follows to understand how the procedures are grouped. Then read Equipment Required for a list of the tools needed to remove and install modules in this waveform generator.

If you are removing a module for service, begin by doing the Access Procedure 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.

Summary of Procedures The procedures are described in the order in which they appear in this section. In addition, you can look up any procedure for removal and reinstallation of any module in the *Table of Contents* of this manual.

- The *Access Procedure* on page 6–16 first 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 are procedures for removing modules that do not require internal access to the generator.
- *Procedures for Outer-Chassis Modules* on page 6–30 are procedures for removing modules the removal of which require access internal to the instrument but external to the chassis.
- *Procedures for Inner-Chassis Modules* on page 6–44 are procedures for removing modules the removal of which require access internal to the instrument and internal to the chassis.

Equipment Required. Most modules in this generator can be removed with 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 reinstall a module are listed in the first step of each procedure.

Table 6-4: Tools required for module removal

Item No.	Name	Description	Tektronix Part Number
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 mm	Standard tool	
8	Nutdriver, 7 mm	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	
14	Adhesive	TRA-CON: Tra-Bond #BA-2114	

**AWG510 and AWG520
Orientation**

In this manual, procedures refer to “front,” “right,” “top,” etc. of the waveform generator. Figure 6–1 shows how the sides are referenced.

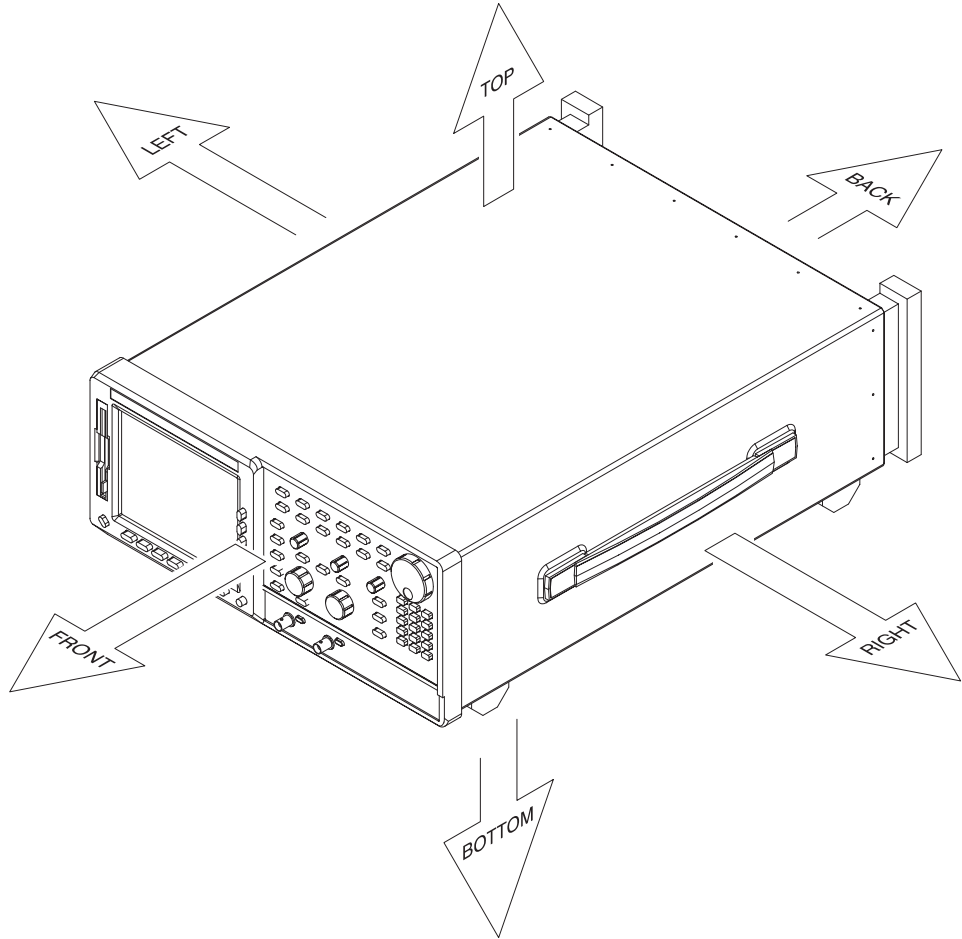


Figure 6–1: AWG510 and AWG520 Orientation

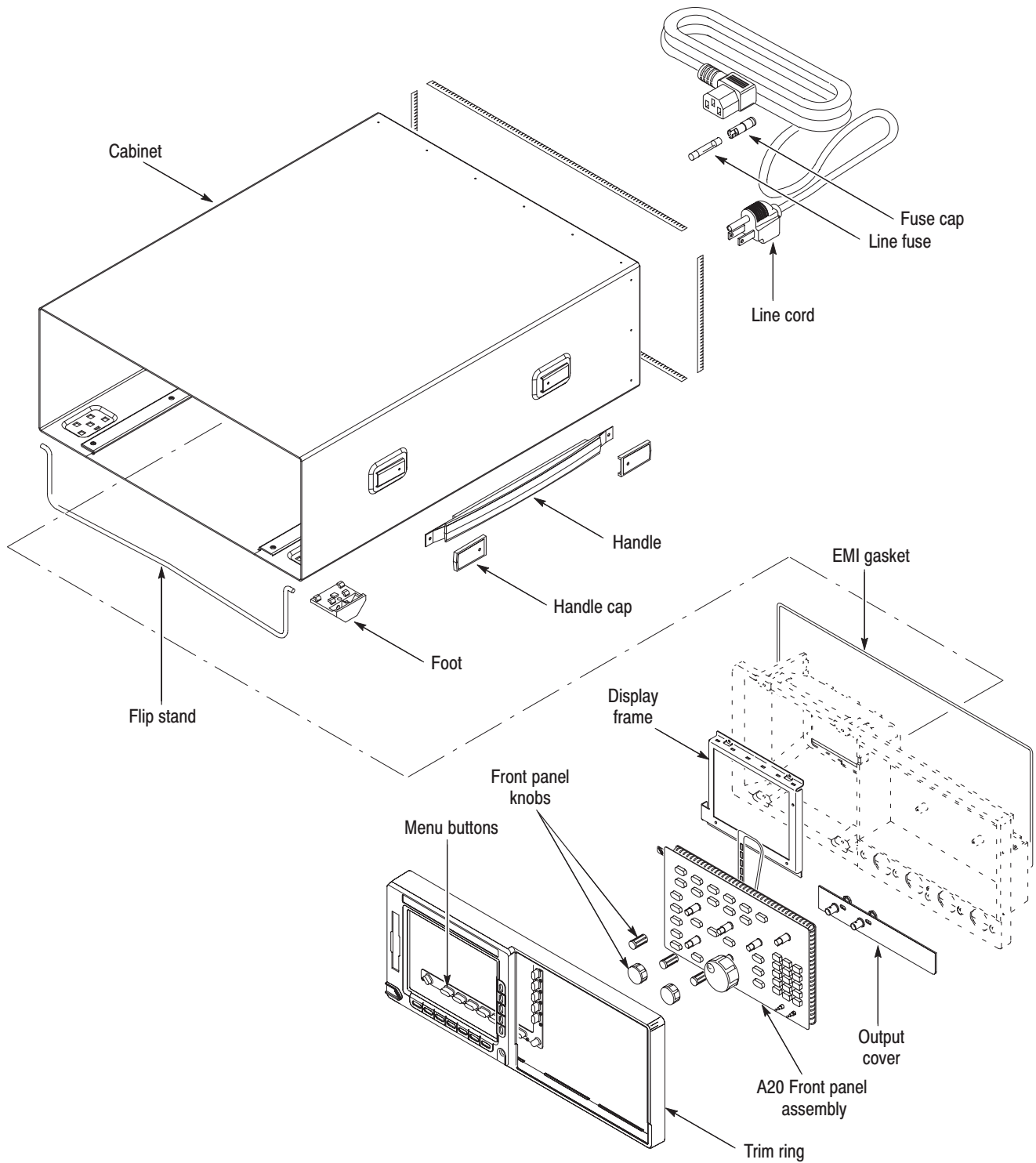


Figure 6-2: External modules

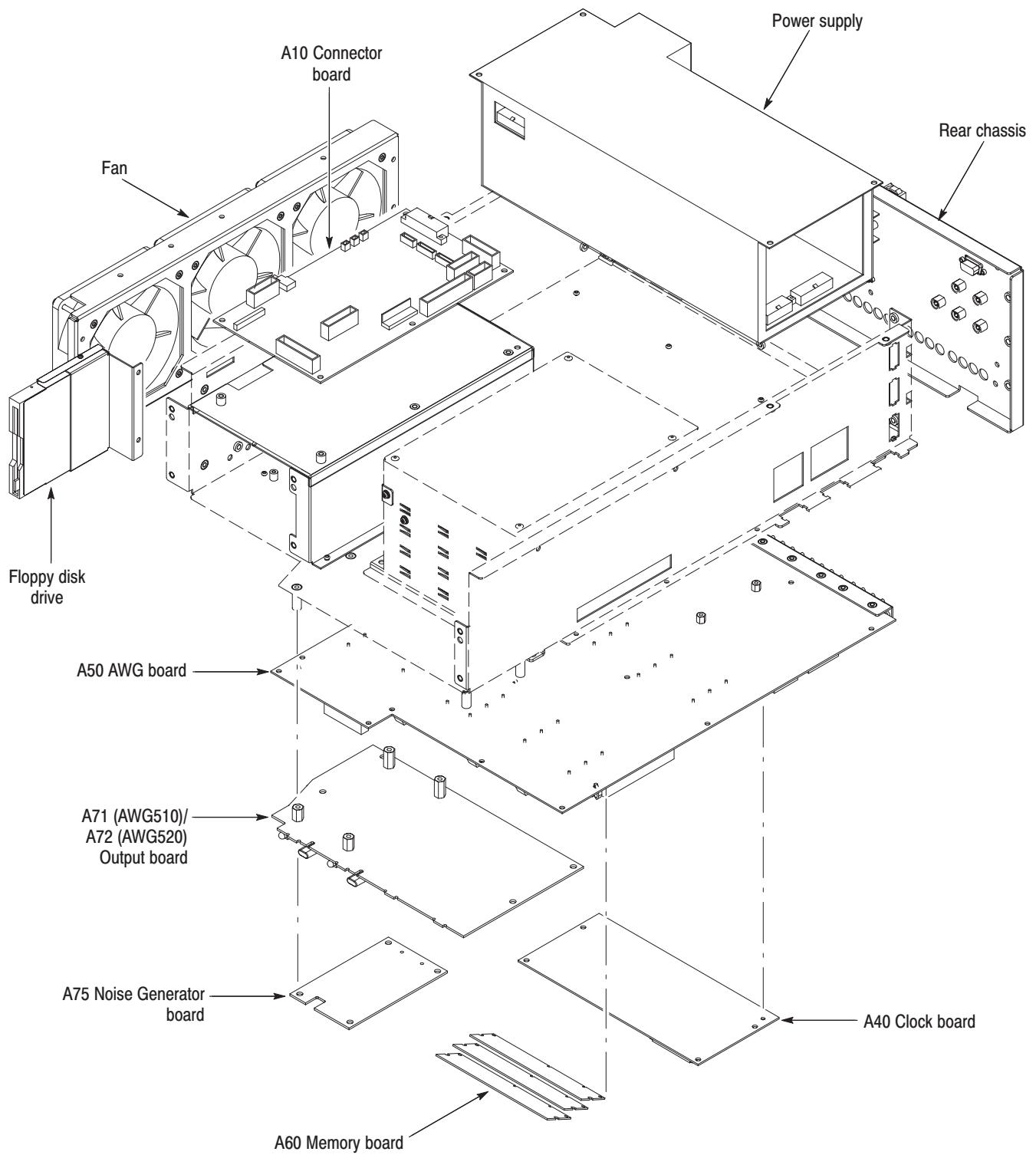


Figure 6-3: Outer-chassis modules

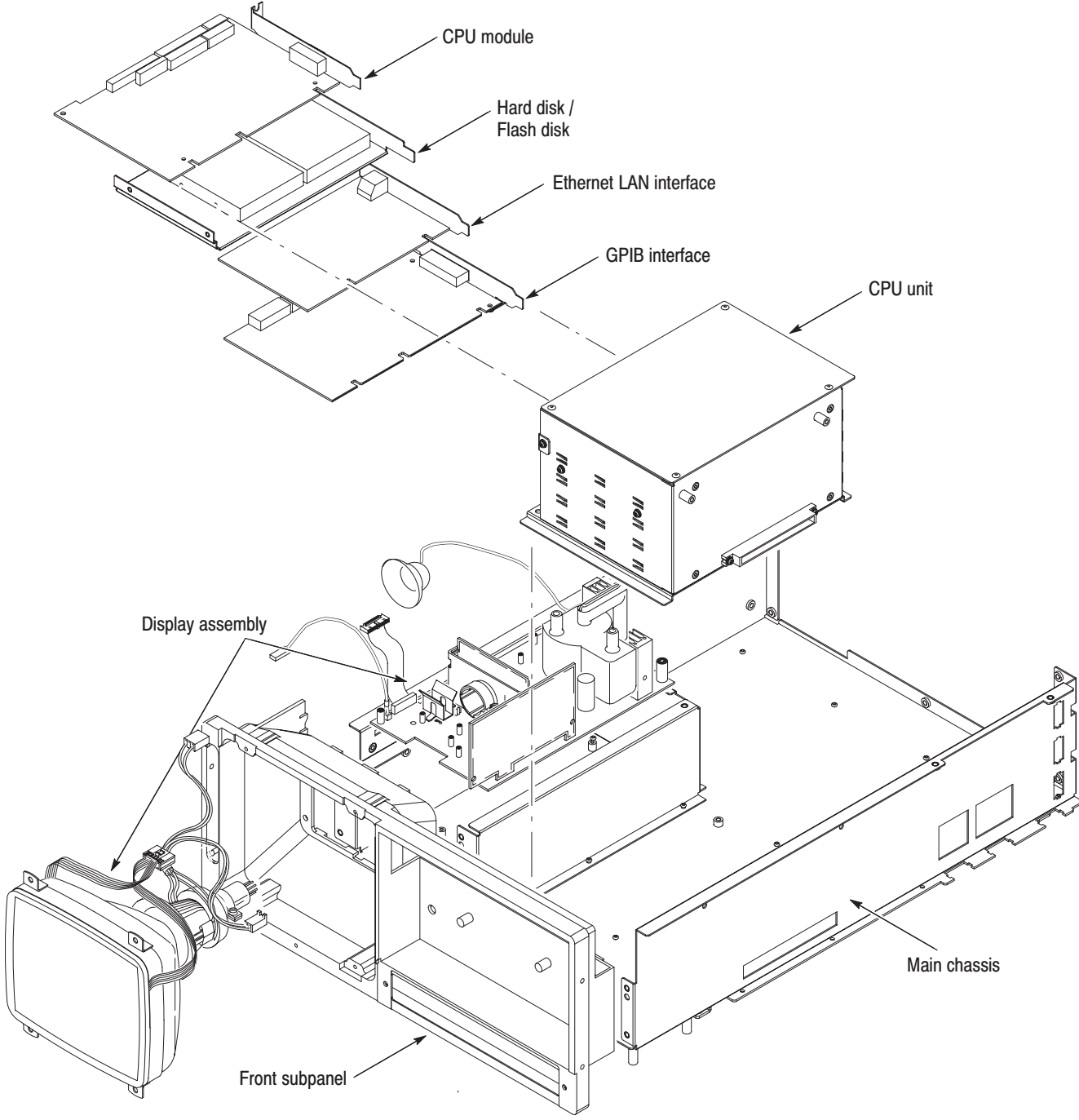


Figure 6-4: Inner-chassis modules

Access Procedure

Begin with this procedure when you have identified a module to be removed for service and have read *General Instructions* found earlier in this section.

1. *Locate module to be removed:*
 - a. Find the module to be removed in the module locator diagrams, Figures 6–2 through 6–4.
 - b. Once the module is found, note from the title of the figure whether the module is an external, outer-chassis mounted, or inner-chassis mounted part.
2. *If the module is externally mounted, no internal access is required; remove the module:* Find and do the procedure whose title matches the name of the module to be removed under *Procedures for External Modules* (page 6–17).
3. *If the module is an outer- or inner-chassis module, access the inside of the instrument:*
 - a. First do the procedure *Line Fuse and Line Cord*; then do the procedure *Cabinet*. Both are found under *Procedures for External Modules* immediately following this procedure.
 - b. After completing those procedures, return to this procedure and continue with step 4.
4. *If the module is an outer-chassis module, remove it:*
 - a. If removing the attenuator or display-frame assembly, first do the procedure *Trim Ring, Menu Buttons, and Output Panel*, found under *Procedures for External Modules* (page 6–17).
 - b. Find and do the procedure whose title matches the name of the module to be removed under *Procedures for Outer-Chassis Modules*, on page 6–30.

5. *If the module is an inner-chassis module, access the inner-chassis:*
 - a. If removing the display tube, display-driver board, or the front subpanel, first do the procedure *Trim Ring, Menu Buttons, and Output Panel*, found under *Procedures for External Modules*. Also remove the display-frame assembly found under *Procedures for External Modules*, on page 6–17.
 - b. Also, if removing the front subpanel, do *A20 Front-Panel Assembly* also found under *Procedures for External Modules*.
 - c. Do the procedure *A10 Connector Board* found under *Procedures for Outer-Chassis Modules*, page 6–30.
 - d. Find and do the procedure whose title matches the name of the module to be removed under *Procedures for Inner-Chassis Modules*, page 6–44.
6. *Reinstall all modules removed:* Read the instructions found at the end of the procedure that removes the module to be service. These instructions will guide you in reinstalling all modules removed.

Procedures for External Modules

Do the *Access Procedure* (page 6–16) before doing any procedure in this collection.

The following procedures are found here and are listed in order presented.

- *Front-Panel Knobs*
- *Line Fuse and Line Cord*
- *EMI Gaskets*
- *Cabinet*
- *Trim Ring, Menu Buttons, and Output Panel*
- *A20 Front-Panel Assembly*
- *Display Frame Assembly*
- *Cabinet Modules*

Front-Panel Knobs

1. *Assemble equipment and locate modules to be removed:* Have an angled-tip tweezers (Item 10) handy. Find the knob(s) to be removed on the front panel.
2. *Orient the waveform generator:* Set the generator so its bottom is down on the work surface and its front is facing you.
3. *Remove the knob(s):* Grasp any knob you want to remove and pull it straight out from the front panel slightly to create some clearance between the base of the knob and the front panel. Insert the tweezers between the knob and front panel and use them to remove the knob. See Figure 6-5.
4. *Reinstallation:* To reinstall, align knob to shaft and push it in until it snaps into place.

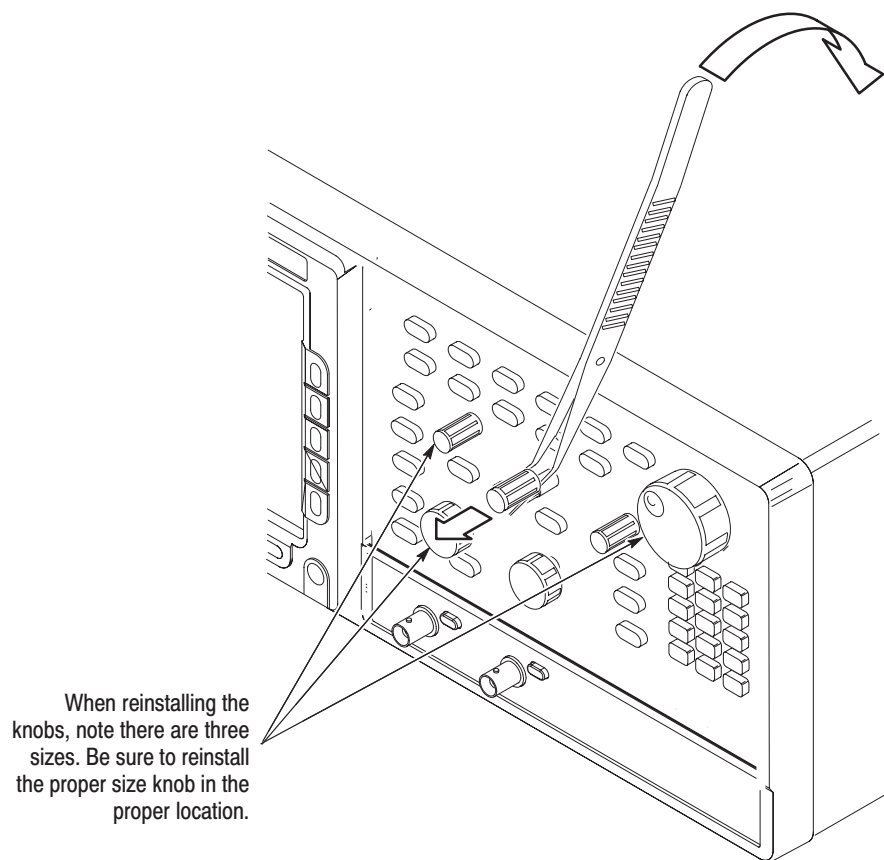
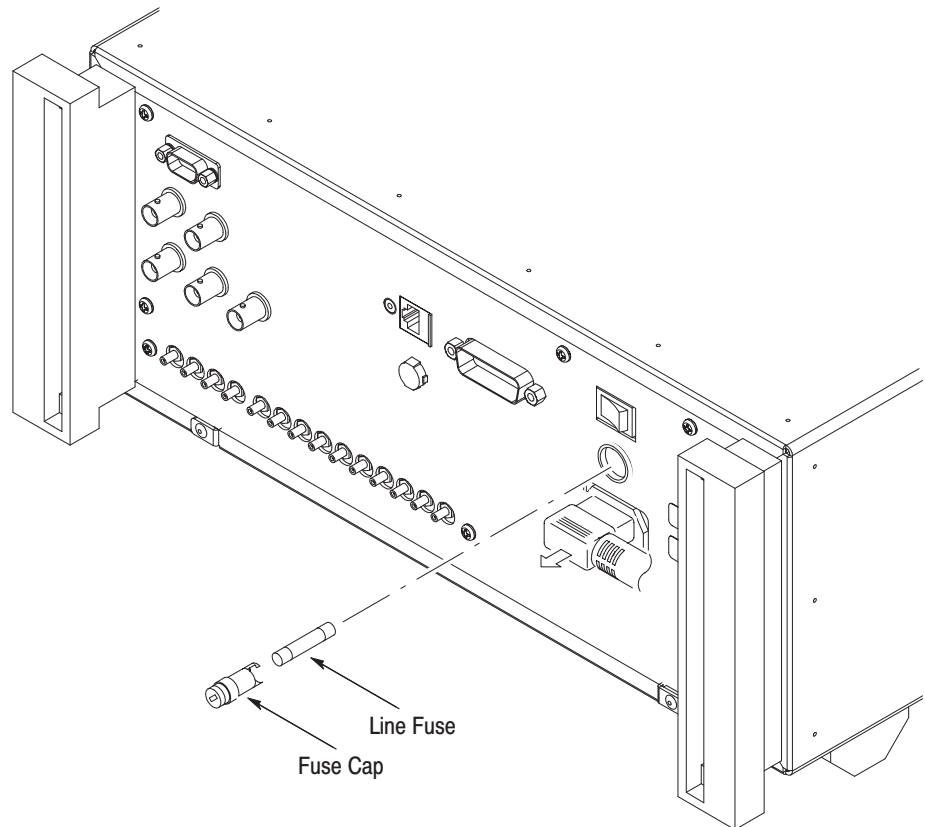


Figure 6-5: Knob Removal

Line Fuse and Line Cord

1. *Assemble equipment and locate modules to be removed:* Have a flat-blade screwdriver (Item 4) handy. Locate the line fuse and line cord in the locator diagram *External modules*, Figure 6-2.
2. *Orient the generator:* Set the generator so its bottom is down on the work surface and its rear is facing you. If you are servicing the line fuse, do the next step; if you are servicing the line cord, skip to step 4.
3. *Remove line fuse:* Find the fuse cap on the rear panel. (See Figure 6-6.) Now, remove the fuse cap by turning it counterclockwise using a flat-blade screwdriver, and remove the line fuse. Reverse procedure to reinstall.
4. *Remove line cord:* Find the line cord on the rear cover. (See Figure 6-6.) Pull the line cord to complete the removal. Reverse procedure to reinstall.
5. *Reinstallation:* Do in reverse steps 3 and 4 to reinstall the line cord and then the line fuse.

**Figure 6-6: Line Fuse and Line Cord Removal**

EMI Gaskets See *Cabinet* procedure below.

- Cabinet**
1. *Assemble equipment and locate modules to be removed:*
 - a. Have handy a screwdriver with a size Phillips #2 tip (Items 1 and 3).
 - b. Make sure the generator's front cover (optional accessory) is installed; if it's not, install it by snapping its edges over the trim ring.
 - c. Locate the cabinet in the locator diagram *External modules*, Figure 6–2.
 2. *Orient the generator:* Set the generator so its face is down with its front cover on the work surface and its bottom facing you.
 3. *Disconnect the line cord:* Unplug the line cord from its receptacle at the rear cover.
 4. *Remove the cabinet:*
 - a. At the rear of the cabinet, remove the six screws securing the two feet.
 - b. At the rear of the cabinet, grasp its left and right edges.
 - c. Pull upward to slide the cabinet off the generator. Take care not to bind or snag the cabinet on the generator's internal cabling as you remove it.

STOP. *DO NOT* do steps 5 through 7 to remove the EMI gasket(s) unless they must be replaced due to damage. If you are not replacing those gaskets, skip to step 8.

When reinstalling 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).

5. *Assemble equipment and locate modules to be removed:*
 - a. Have handy a pair of needle-nose pliers (Item 6).
 - b. Locate the modules to be removed in the locator diagram *External modules*, Figure 6–2.

6. *Remove the EMI gaskets:*
 - a. Look for the point where the ends of the gasket touch in the channel at the rear edge of the cabinet.
 - b. Use a pair of needle-nose pliers to pry up one of the ends.
 - c. Grasp the EMI gasket, and gently pull it out of the its channel.
 - d. Repeat substeps a through c to remove the gasket from its channel on the front casting.
7. *Reinstallation of EMI gaskets:* Press each EMI gasket back into its groove at the rear edge of the cabinet or front casting. Make sure the ends of the gasket touch, but do not overlap, when installing. (Cut off excess length if required to prevent overlap.)
8. *Reinstallation of cabinet and rear cover:*
 - a. Do in reverse order steps 3 and 4 to reinstall the cabinet.
 - b. Take care not to bind or snag the cabinet on internal cabling; redress cables an necessary.
 - c. When sliding the cabinet, be sure that the front edge of the cabinet aligns with the groove containing the EMI shield on the front casting.
 - d. Be sure that the ridge around the rear chassis slides into the groove containing a second EMI cable on the rear of the cabinet.
 - e. When reinstalling the four screws at the rear panel, tighten them to 16 foot-lbs torque.
 - f. See the procedure *Line Fuse and Line Cord* to reinstall the line cord, which completes the generator reassembly.

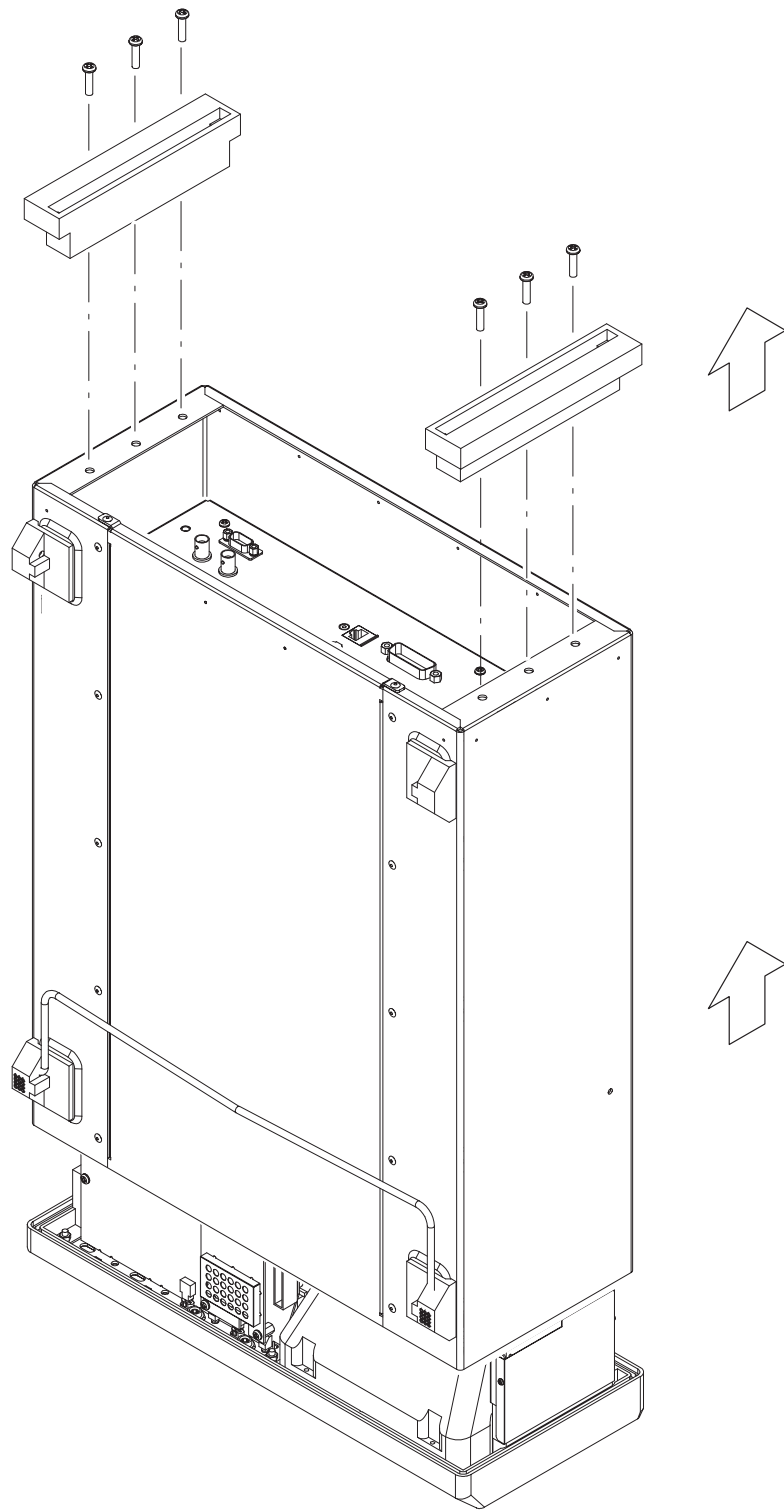


Figure 6-7: Cabinet removal

Trim Ring, Menu Buttons, and Output Panel

1. *Assemble equipment and locate modules to be removed:* No tools are needed. Locate the modules to be removed in the locator diagram *External modules*, Figure 6-2.
2. *Orient the generator:* Set the generator so its rear is down on the work surface and its bottom is facing you.
3. *Remove the front cover:* Grasp the front cover by its left and right edges and snap it off of the front subpanel. When reinstalling, align and snap back on. See Figure 6-8.

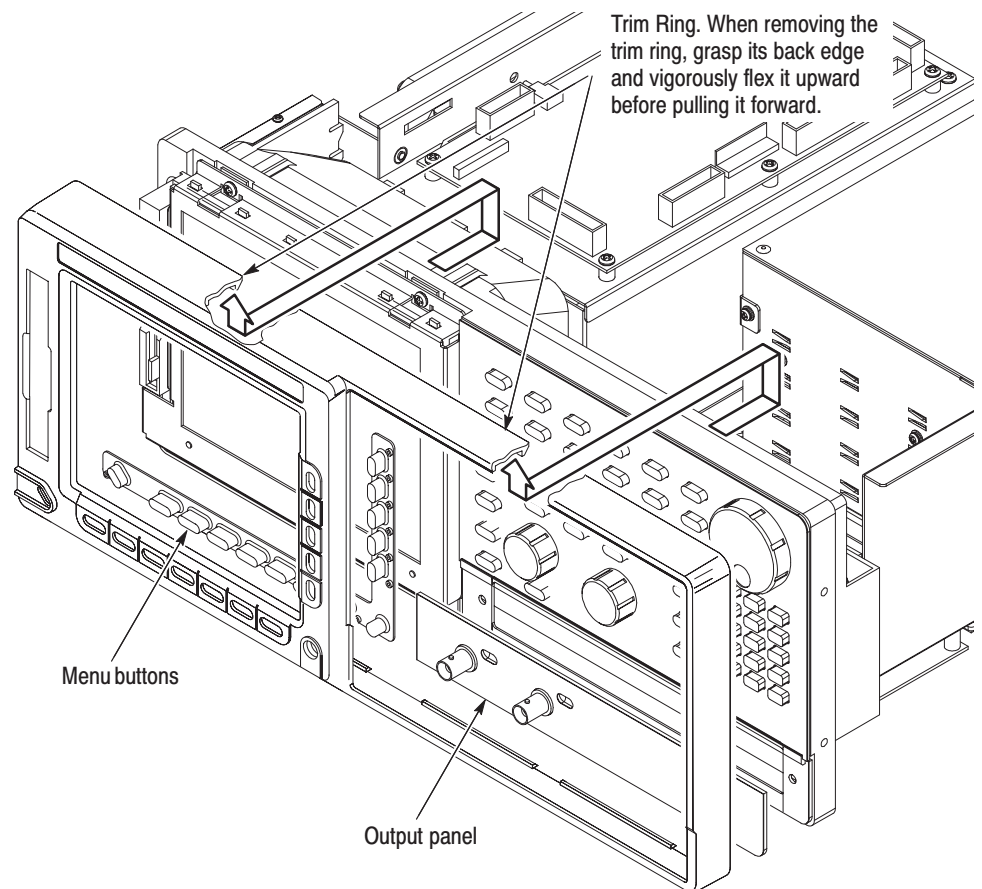


Figure 6-8: Trim ring, Menu buttons, and Output panel removal

STOP. DO NOT touch the carbon contact points on the menu buttons installed in the trim ring. Also, do not touch the contacts on the flex circuit exposed when you remove the trim ring.

4. *Remove the trim ring:* Grasp the trim ring by its top edge and pry it up and lift it forward to snap it off of the front subpanel. If servicing the menu buttons, lift them out of the trim ring. (When reinstalling, reinsert the menu buttons, align the trim ring to the front subpanel and press it back on.)
5. *Remove the output panel:* Gently pry, using your fingers, the snap-off/snap-on output panel away from the front subpanel to remove it. (When reinstalling, use your hands to press it back on.)
6. *Reinstallation:* Do in reverse steps 3–5 to reinstall the output panel, menu buttons, and trim ring, following the reinstallation instructions found in each step.

A20 Front-Panel Assembly

NOTE. *This procedure includes removal and reinstallation instructions for the front panel and front panel buttons. Unless either of those modules are being serviced, do not do step 4, “Further disassembly of front-panel assembly.”*

1. *Assemble equipment and locate modules to be removed:*
 - a. Have handy a screwdriver with a size Phillips #2 tip (Items 1 and 3).
 - b. Locate the modules to be removed in the locator diagram *External modules*, Figure 6–2.
 - c. Do the procedure *Trim Ring, Menu Buttons, and Output Panel*, steps 1–5, immediately preceding this procedure.
2. *Orient the waveform generator:* Set the generator so its bottom is down on the work surface and its front is facing you.
3. *Remove the front-panel assembly:*
 - a. Lift the front-panel assembly out of the front subpanel until you can reach the interconnect cable connecting it to the Connector board.
 - b. Disconnect that cable at J121 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 6–9.
 - c. Finally, lift the front-panel assembly out of the front subpanel to complete the removal.

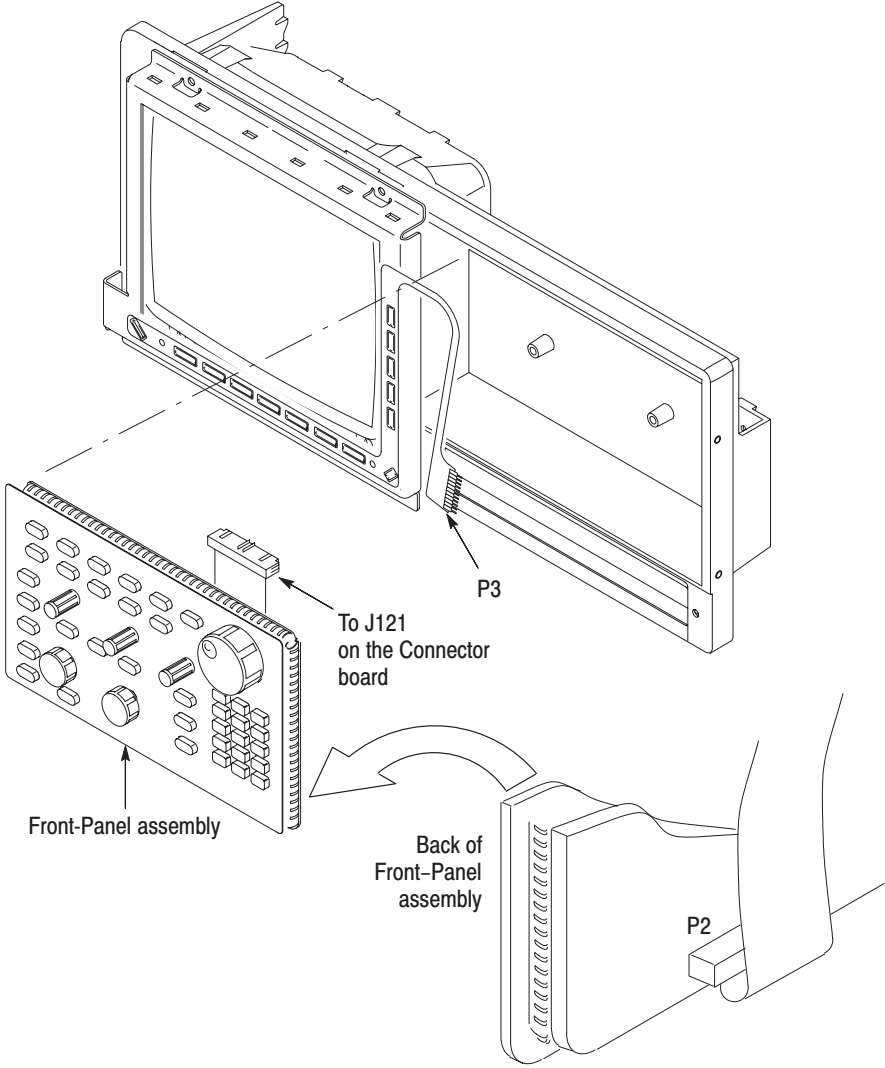


Figure 6-9: A20 Front-Panel Assembly removal

4. *Further disassembly of front-panel assembly:* If the front panel or the front-panel buttons are to be serviced, do the following substeps:
 - a. Remove the front-panel control knobs from the front-panel assembly using the method described in *Front-Panel Knobs* on page 6-18.
 - b. Remove the eight screws mounting the front-panel board to the front panel.
 - c. Now hand disassemble the front-panel assembly components using Figure 6-10 as a guide. Reverse procedure to reassemble, again using Figure 6-10 as a guide.

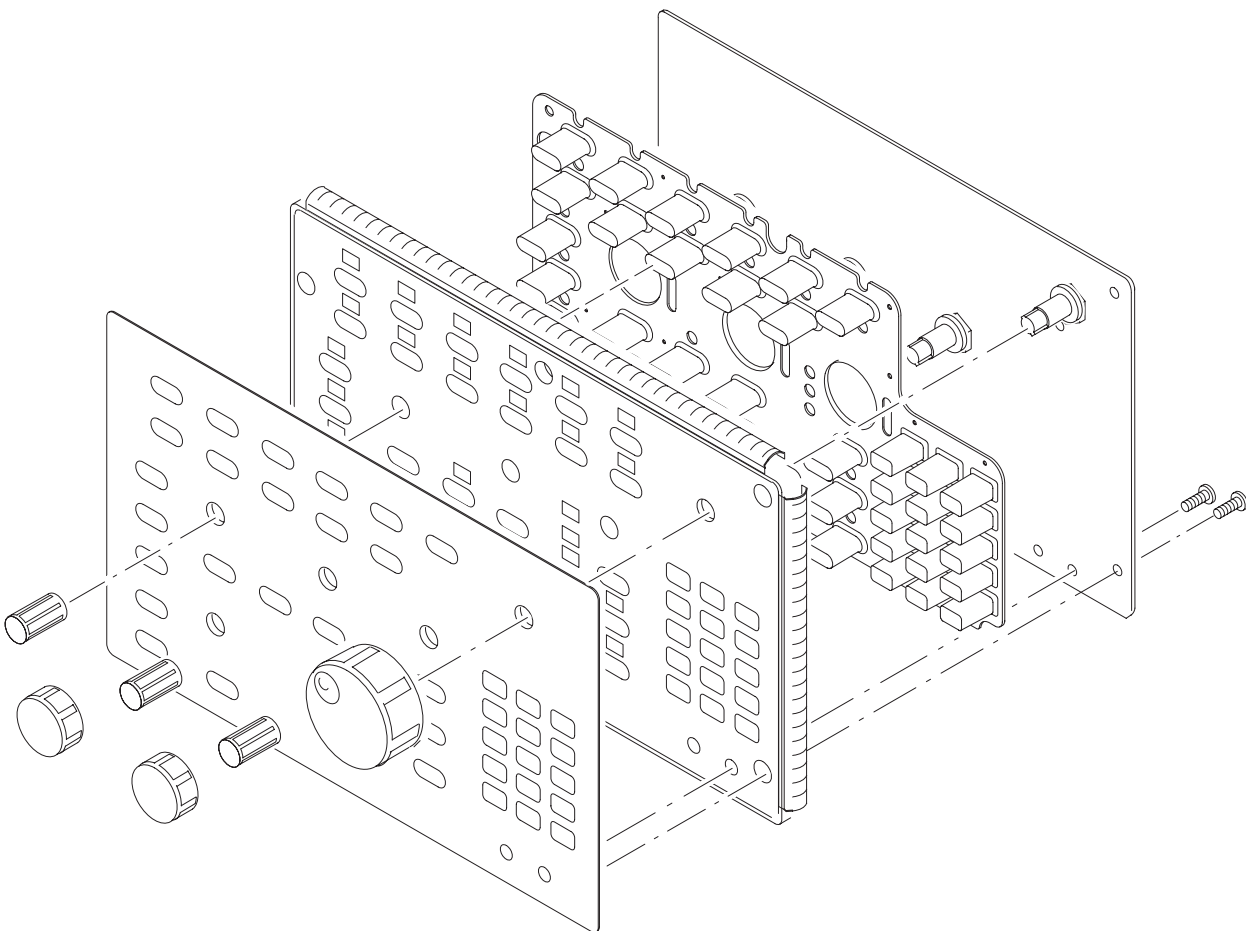


Figure 6-10: Disassembly of Front-Panel Assembly

5. *Reinstallation:* If the front-panel assembly was further disassembled in step 4, then reverse substeps 4a–4c to reassemble, using Figure 6–10 as a guide. Then do step 3, reversing the procedure outlined in each substep. Last, reinstall the trim ring and, if desired, the front cover, referring to the procedure *Trim Ring, Menu Buttons, and Output Panel* (page 6–23).

Display-Frame Assembly

1. *Assemble equipment and locate modules to be removed:* Have handy a screwdriver with a size Phillips #2 tip (Items 1 and 3). Locate the modules to be removed in the locator diagram *External Modules*, Figure 6–2, page 6–13.
2. *Orient the waveform generator :* Set the generator so its bottom is down on the work surface and its front is facing you.
3. *Remove the display-frame assembly:*
 - a. Do the procedure *Trim Ring, Menu Buttons, and Output Panel* (page 6–23) to remove the front cover and trim ring.
 - b. Lift the front-panel assembly out of the front subpanel until you can reach P2 on the front-panel assembly. Disconnect the flex cable coming from the display-frame assembly at P3 of the front-panel assembly.
 - c. Do the procedure *Floppy Disk* (page 6–31) to remove the floppy disk drive.
 - d. Remove the three screws securing the display-frame assembly to the front subpanel and remove that assembly.
4. *Reinstallation:*
 - a. Do, in reverse order, substeps 3b–3d, reversing each step to reinstall the display-frame assembly. Then see the procedure *Trim Ring, Menu Buttons, and Output Panel* (page 6–23) to complete reassembly of the generator.

Cabinet Modules

1. *Assemble equipment and locate modules to be removed:* Have handy a pair of needle-nose pliers (Item 5). Locate the modules to be removed in the locator diagram *External modules* (see Figure 6–2).
2. *Orient the waveform generator:* Set the generator so the left side is down on the work surface and its handle is facing upwards.

3. *Remove the handle:*
 - a. Insert the tips of a pair of needle-nose pliers (Item 5) into the hole of either handle cap. Push and hold to depress the handle release.
 - b. While holding the handle released, pull it out of the slot in the handle cap. Repeat procedure to remove the handle from the other handle cap.
 - c. Reverse procedure to reinstall.
4. *Remove the handle caps:*
 - a. Insert the retaining ring pliers (Item 9) into the opening created in the handle cap when you removed the handle.
 - b. While using the pliers to expand the handle cap outward, grasp it and snap it off.
 - c. Repeat procedure to remove the remaining cap as needed; push the cap(s) back on to reinstall.
5. *Remove the flip stand:* Grasp the flip stand by both sides near 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.
6. *Remove the flip stand foot (or feet):*
 - a. Do *Cabinet* procedure (page 6–20) to gain access to inside of the cabinet.
 - b. 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.
 - c. Repeat procedure to remove as many of the remaining feet as needed; insert the two retainers back in their slots in the cabinet and snap into place any flip stand foot removed.
7. *Reinstallation:* If any flip stand feet were removed, reinstall as directed in step 6c; then see *Cabinet* procedure (page 6–20) to reinstall the rear cover and cabinet. Do in reverse order steps 3 and 5, reversing each step, to reinstall the flip stand, then the handle caps (if removed), then the handle.

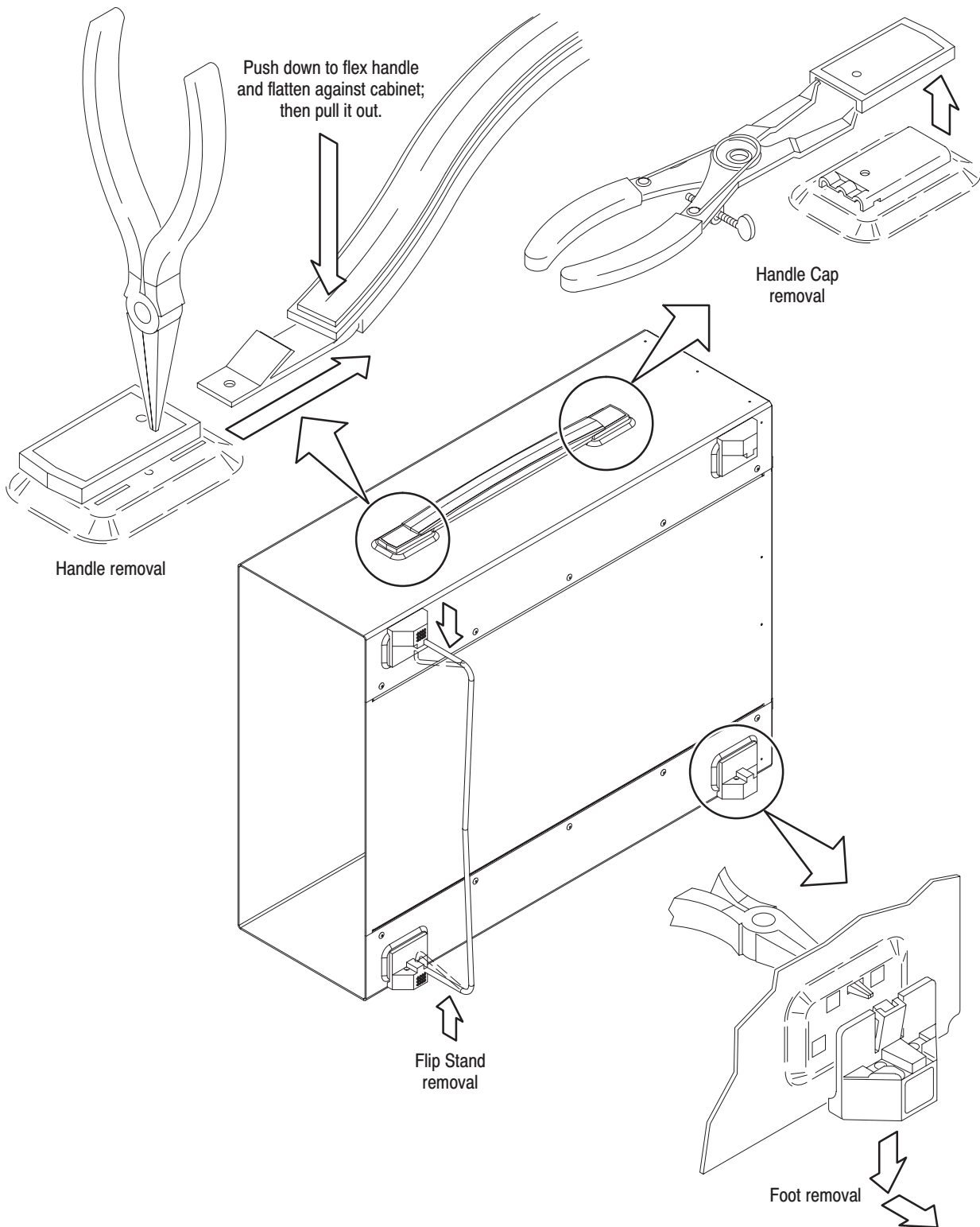


Figure 6-11: Cabinet modules removal

Procedures for Outer-Chassis Modules

You should have completed the *Access Procedure* before doing any procedure in this collection. This section describes removal/installation procedures for the following modules:

- *Fan*
- *Floppy Disk*
- *PS100 Low Voltage Power Supply*
- *A10 Connector Board*
- *A60 Memory Board*
- *A75 Noise Generator Board*
- *A71 (AWG510)/A72 (AWG520) Output Board*
- *A40 Clock Board*
- *A50 AWG Board*
- *Rear Chassis*

- Fan**
1. *Assemble equipment and locate module to be removed:* Have handy a screwdriver with a size Phillips #2 tip (Items 1 and 3). Locate the fan on the locator diagram *Outer-Chassis Modules*, Figure 6–3, page 6–14.
 2. *Orient the waveform generator :* Set the generator so its bottom is down on the work surface and its left side is facing you.
 3. *Disconnect the fan from the Connector board:* Unplug three fans' power cables from J910, J911, and J912.
 4. *Remove the fan:* Remove the four screws securing the fan bracket to the main chassis, and lift the fans away from the chassis. When removing each fan, remove the four screws securing the fan to the bracket, and lift it away from the bracket.
 5. *Reinstallation:* Do in reverse order substeps 3 and 4, reversing the removal instructions in each substep to reinstall the assembly. Refer to the procedure *Cabinet* (page 6–20) to complete reassembly of the generator.

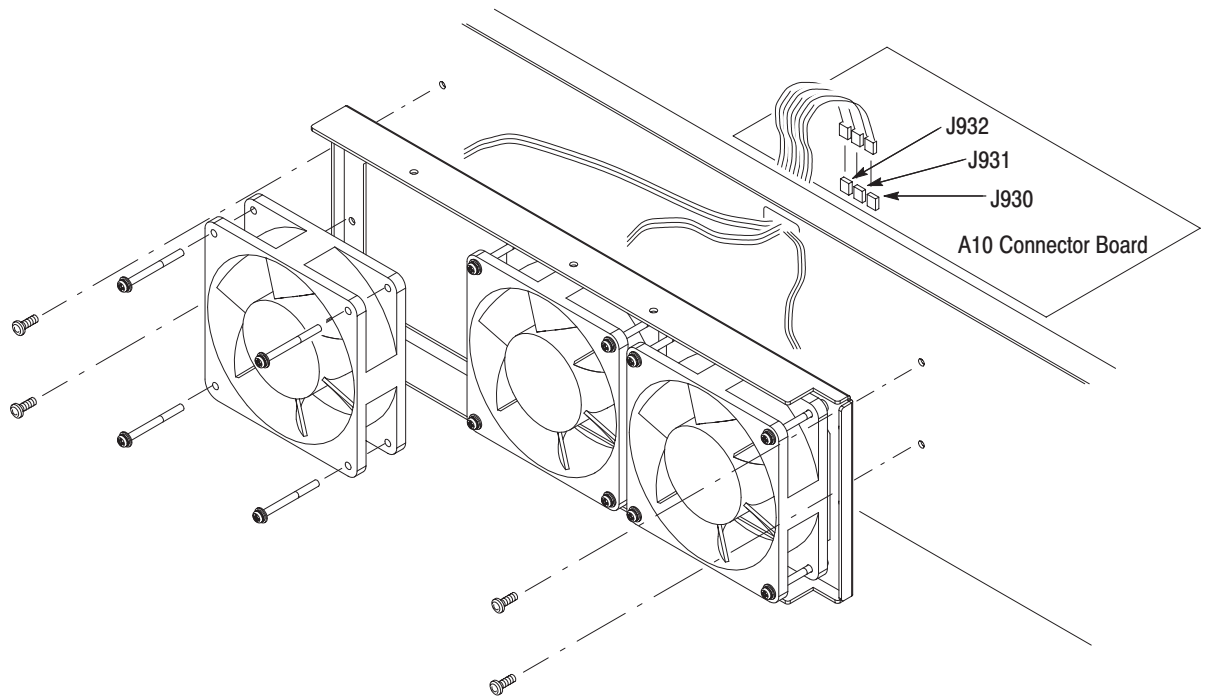


Figure 6-12: Fan removal

Floppy Disk

1. *Assemble equipment and locate modules to be removed:*
 - a. Have handy a screwdriver with a size Phillips #2 tip (Items 1 and 3), and if removing the disk drive main body, Phillips #1 head (Items 2).
 - b. Locate the modules to be removed, including those listed under *Additional Modules Removed* in the locator diagram *Outer-Chassis Modules*, Figure 6-3, page 6-14.
 - c. Do the procedure *Trim Ring, Menu Buttons, and Output Panel* (page 6-23).
2. *Orient the waveform generator:* Set the generator so its top is down on the work surface and its left side is facing you.

3. *Remove the Floppy Disk Drive:* Use Figure 6–13 as a guide.
 - a. Unplug the J124 floppy driver connector (ribbon interconnect cable) that connects the disk drive to the A10 Connector board.
 - b. Use the screwdriver with Phillips #2 tip to remove the two screws securing the floppy disk bracket to the main chassis, and lift it away from the chassis. When removing the disk drive main body, use the screwdriver with Phillips #1 tip to remove the two screws securing the drive to the bracket, then pull out the disk drive.

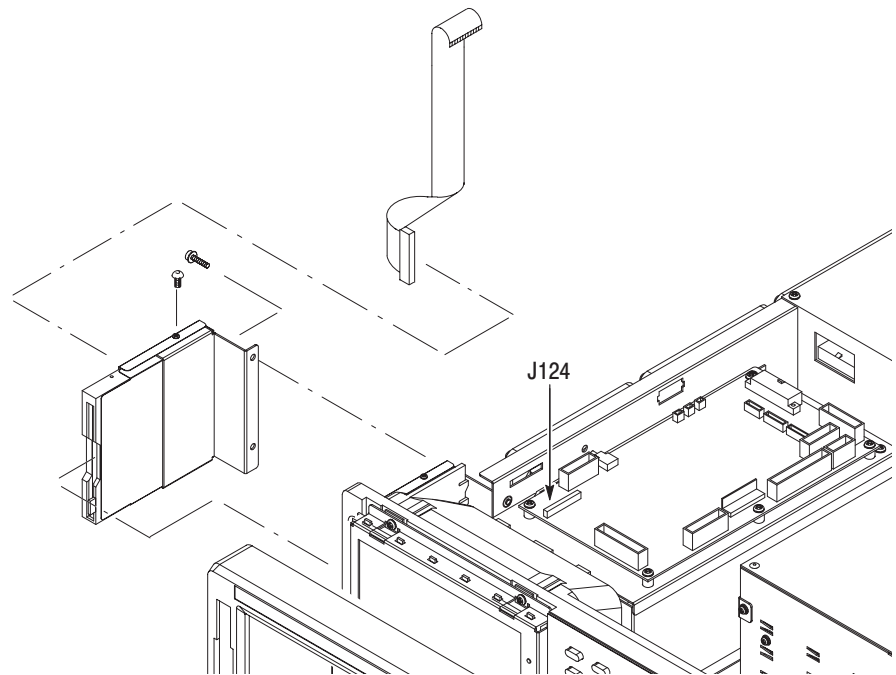


Figure 6–13: Floppy Disk removal

4. *Reinstallation:* Do, in reverse order, substeps 3b then 3a to reinstall the floppy disk drive. Then refer to the procedure *Cabinet* (page 6–20) to complete reassembly of the generator:

PS100 Low Voltage Power Supply

1. *Assemble equipment and locate module to be removed:* Have handy a screwdriver with a size Phillips #2 tip (Items 1 and 3). Locate the fan in the locator diagram *Outer-Chassis Modules*, Figure 6–3, page 6–14.
2. *Orient the waveform generator:* Set the generator so its bottom is down on the work surface and its right side is facing you.

3. *Remove the low-voltage power supply:*
 - a. Unplug three power cables from J1, J2, and J3 (on the A10 Connector board). See Figure 6-14.
 - b. Remove the two screws from the rear of the generator that mount the low-voltage power supply to the rear chassis.
 - c. Remove the four screws from the top of the generator that mount the supply to the main chassis. Then remove the screw securing the ground lead to the main chassis.
 - d. Lift the module up out of the generator to complete removal.

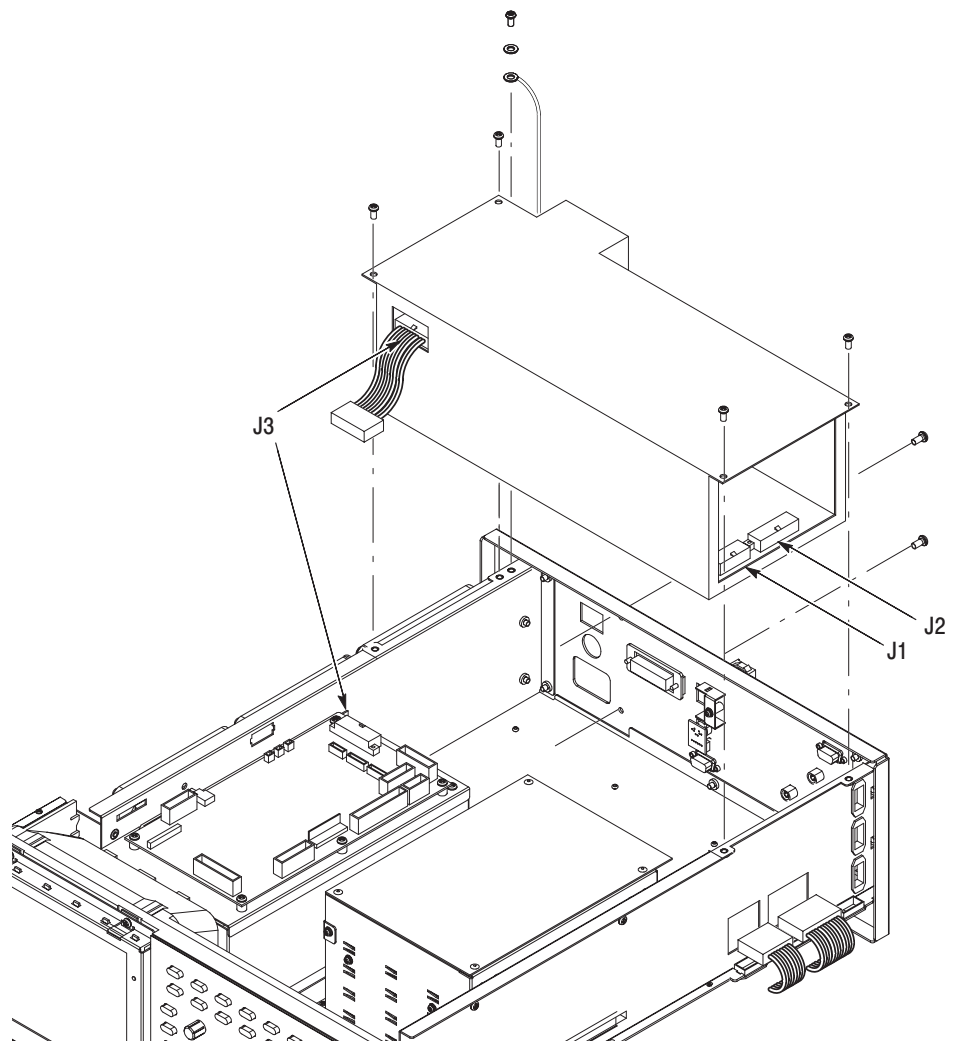


Figure 6-14: Power supply module removal

4. *Reinstallation:* Do, in reverse order, substeps 3a through 3d to reinstall the low-voltage power supply. Then refer to the procedure *Cabinet* (page 6–20) to complete reassembly of the generator:

A10 Connector Board

1. *Assemble equipment and locate modules to be removed:* Have handy a screwdriver with a size Phillips #2 tip (Items 1 and 3). Find the modules to be removed in the locator diagram *Outer-Chassis Modules*, Figure 6–3, page 6–14.
2. *Orient the waveform generator:* Set the generator so its bottom is down on the work surface and its front is facing you.
3. *Remove the A10 Connector Board:*
 - a. Disconnect these cables and connectors. See Figure 6–15 as a guide.
 - Three fan's power cables at J930, J931, and J932.
 - The cable from the low-voltage power supply at J3.
 - The interconnect cables from CPU board at J110, J112, and J113.
 - The interconnect cables to the Monitor Out at J127 and the A90 Key board at J128.
 - The interconnect cable from the A30 GPIB board at J115.
 - The interconnect cable from the Back Plane at J122.
 - The cables from the A20 Front Panel board at J121.
 - J125 video signal connector and J124 floppy driver connector.
 - b. Using a screwdriver with a size Phillips #2 tip, remove the five screws attaching the A10 Connector board to the chassis.
 - c. Lift the board up and away from the chassis to complete the removal.
4. *Reinstallation:* Do, in reverse order, substeps 3a through 3c reversing each step to reinstall the A10 Connector board. Then refer to the procedure *Cabinet* (page 6–20) to complete reassembly of the generator:

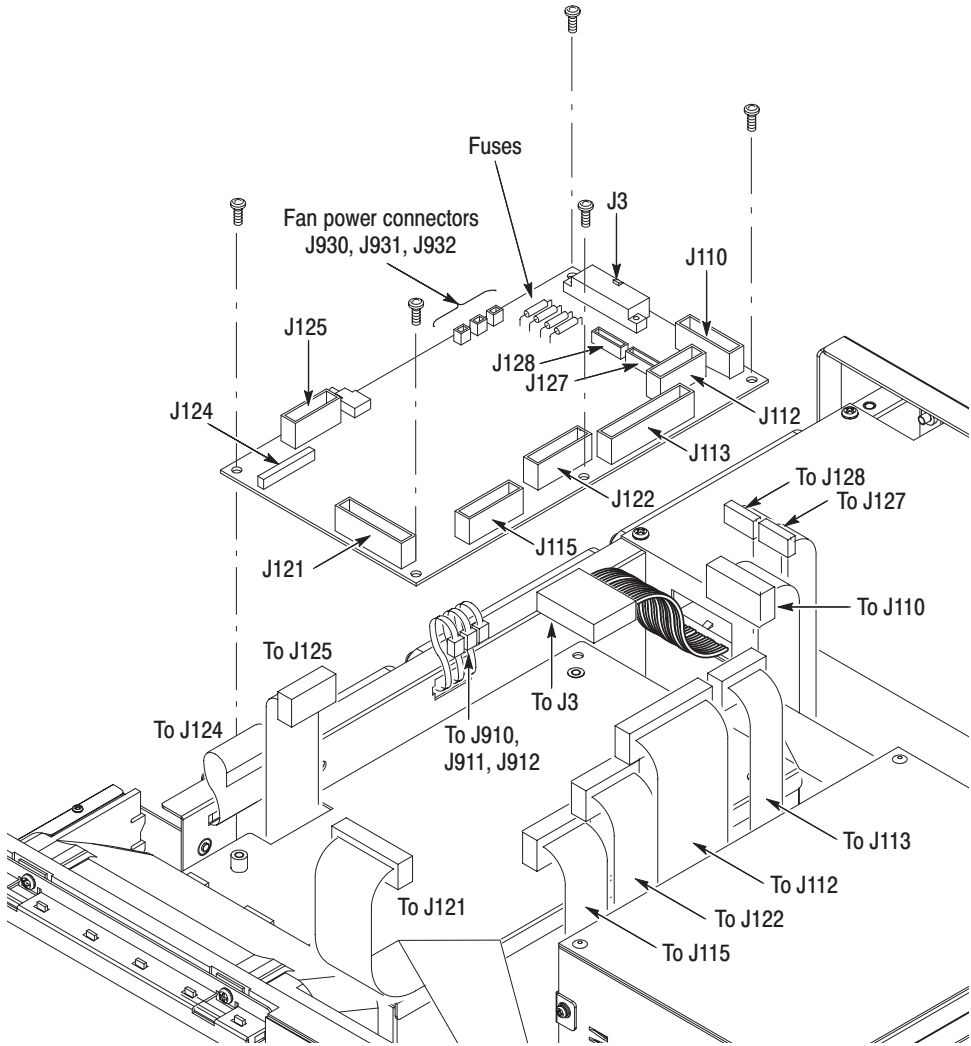


Figure 6-15: A10 Connector board removal

A60 Memory Board

1. *Assemble equipment and locate modules to be removed:* Have an angled-tip tweezers (Item 10) handy. Find the modules to be removed in the locator diagram *Outer-Chassis Modules*, Figure 6-3, page 6-14.
2. *Orient the waveform generator:* Set the generator so its top is down on the work surface and its right side is facing you.

3. *Remove the A60 Memory Board.*
 - a. Release the retainer latches securing the memory boards to the A50 AWG board. See Figure 6–16. Using the tweezers, pinch the tab of the retainer out of the hole of the memory board. Then, insert the tweezers' tip into the hole of the retainer to slide it out.
 - b. Open the lever on one side of the connector, and lift out the memory board.
 - c. Repeat 3a and 3b to remove the other memory boards.

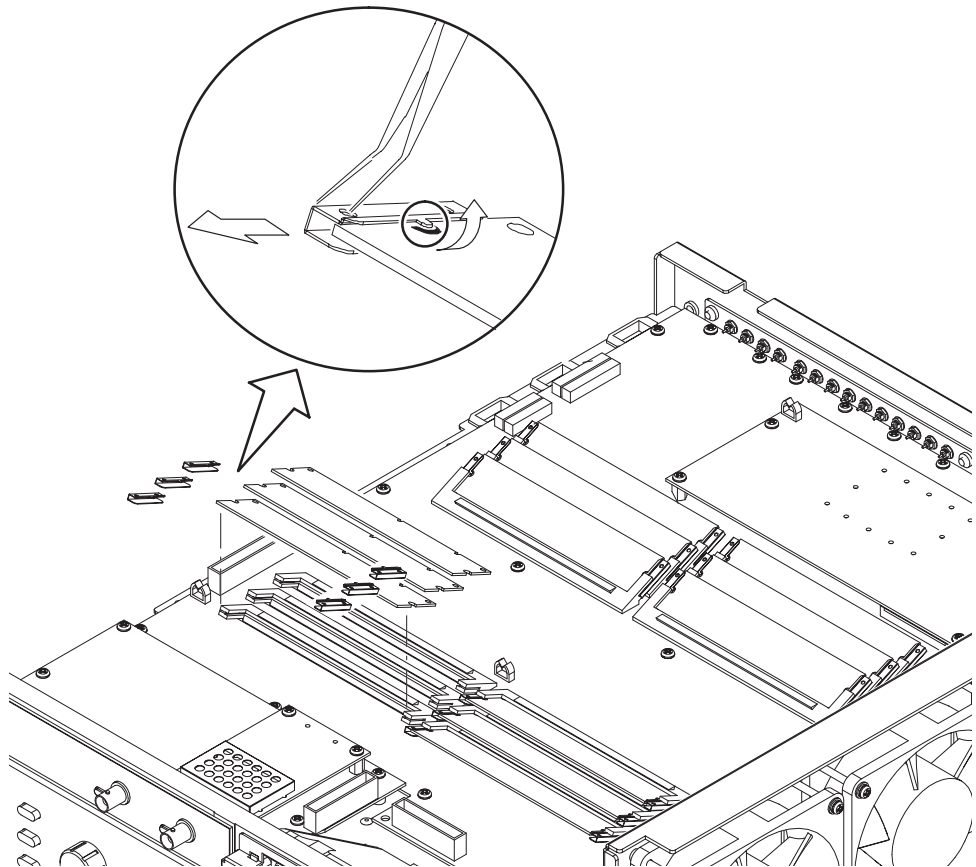


Figure 6–16: A60 Memory Board removal

4. *Reinstallation:* Do substeps 3b then 3a reversing each step to reinstall each memory board.

A75 Noise Generator Board

1. *Assemble equipment and locate modules to be removed:* Have handy a screwdriver with a size Phillips #2 tip (Items 1 and 3). Find the modules to be removed in the locator diagram *Outer-Chassis Modules*, Figure 6–3, page 6–14.
2. *Orient the waveform generator:* Set the generator so its top is down on the work surface and its front is facing you.
3. *Remove the A75 Noise Generator Board:* Use Figure 6–17 as a guide.
 - a. Disconnect two coax cables at J197 and J198.
 - b. Remove the five screws attaching the A75 Noise Generator board to the A71/A72 Output board.
 - c. Disconnect the Noise Generator board from the Output board, then lift it up away to complete removal.
4. *Reinstallation:* Do, in reverse order, steps 3a through 3c reversing the removal instructions of each step to reinstall the Noise Generator board.

**A71 AWG510)/
A72 (AWG520)
Output Board**

1. *Assemble equipment and locate modules to be removed:*
 - a. Have handy a screwdriver with a size Phillips #2 tip (Items 1 and 3).
 - b. Locate the modules to be removed in the locator diagram *Outer-Chassis Modules*, Figure 6–3, page 6–14.
 - c. Do the procedure A75 Noise Generator Board that precedes this procedure to remove the interconnect cables.
2. *Orient the waveform generator:* Set the generator so its top is down on the work surface and its front is facing you.
3. *Remove A71 (AWG510)/A72 (AWG520) Output Board:* Use Figure 6–17 as a guide.
 - a. Unplug these cables and connector:
 - The coax cables from ADD INPUT at J300, NOISE IN at J310, CH 1 OUTPUT at J195, and CH 2 (AWG520)/CH 1 INVERT (AWG520) OUTPUT at J295.
 - The interconnect cables from the A50 AWG board at J100, J102, J200, and J202.
 - The cable connector from the A50 AWG board at J700.
 - b. Remove the four screws attaching the Output board to the main chassis.
 - c. Lift the Output board up away from the main chassis to complete the removal.

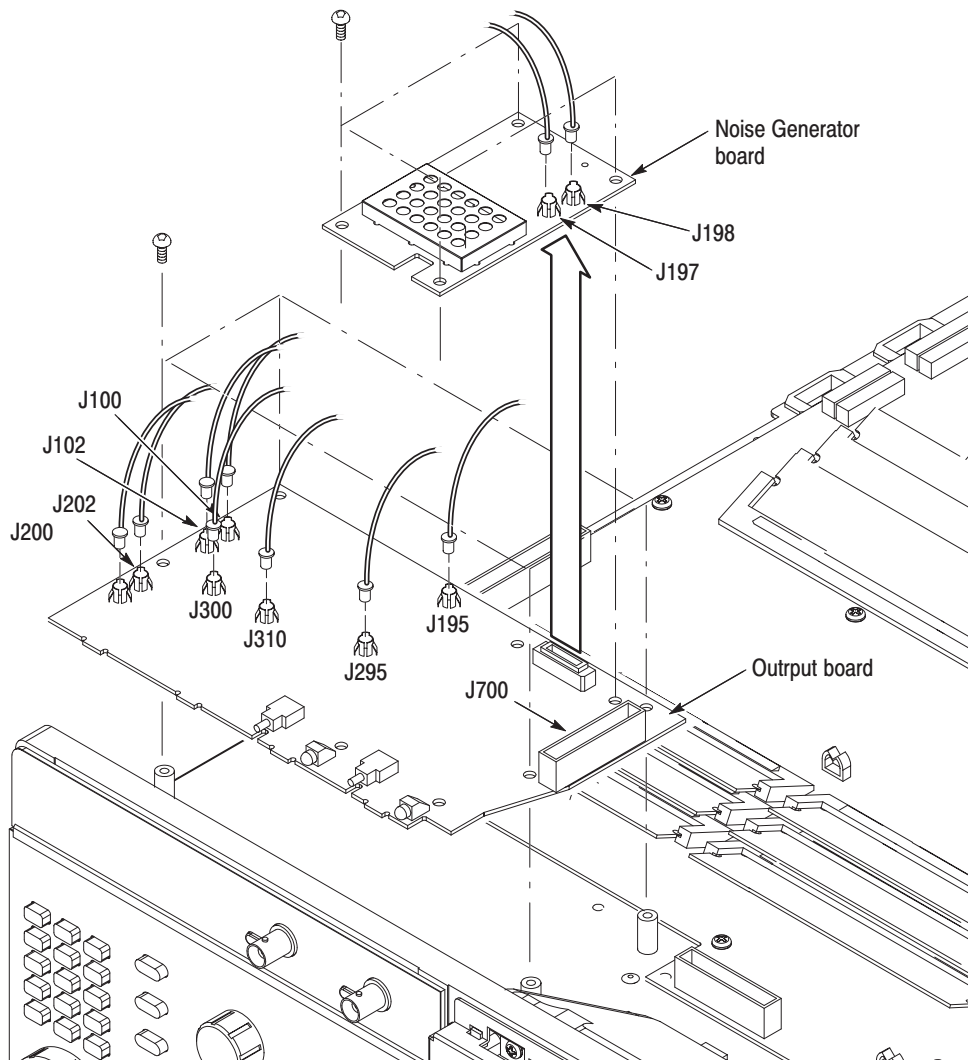
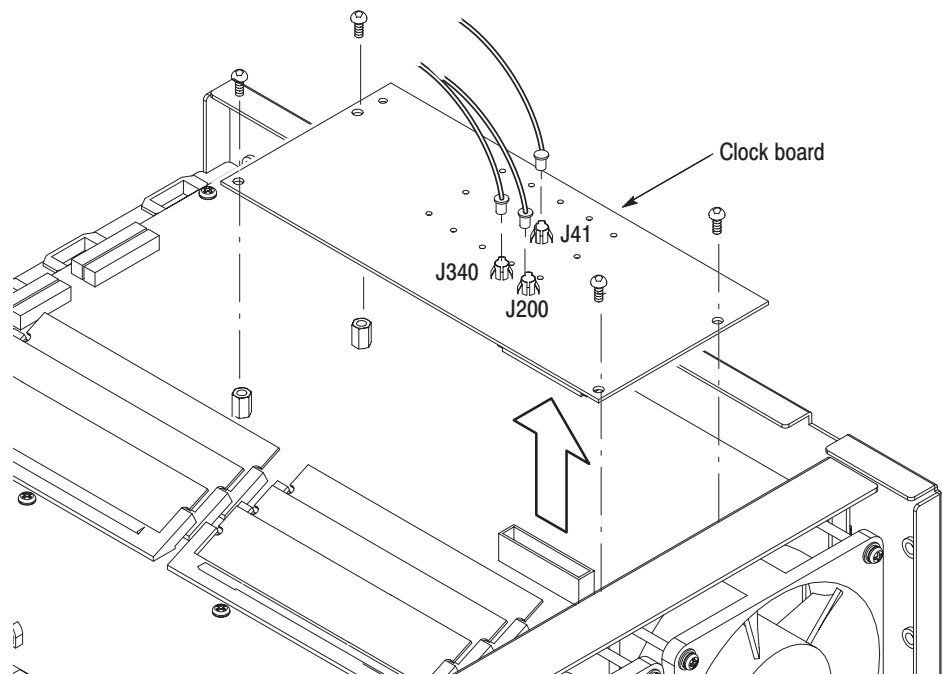


Figure 6-17: A75 Noise Generator Board and A71 (AWG510)/A72 (AWG520) Output Board removal

4. *Reinstallation:* Do, in reverse order, steps 3a through 3c reversing the removal instructions of each step to reinstall the Output board. Then refer to the procedure *A75 Noise Generator Board* (page 6-37) and *Cabinet* (page 6-20) to complete the reassembly.

A40 Clock Board

1. *Assemble equipment and locate modules to be removed:* Have handy a screwdriver with a size Phillips #2 tip (Items 1 and 3). Find the modules to be removed in the locator diagram *Outer-Chassis Modules*, Figure 6-3, page 6-3.
2. *Orient the waveform generator:* Set the generator so its top is down on the work surface and its rear is facing you.
3. *Remove the A40 Clock Board.:* Use Figure 6-18 as a guide.
 - a. Unplug two interconnect cables at J41, J200, and J340 on the A40 Clock board.
 - b. Remove the four screws attaching the Clock board to the AWG board.
 - c. Disconnect the Clock board from the AWG board, then lift it up away to complete the removal.

**Figure 6-18: A40 Clock Board removal**

4. *Reinstallation:* Do, in reverse order, steps 3a through 3c reversing the removal instructions of each step to reinstall the Clock board.

A50 AWG Board

1. *Assemble equipment and locate modules to be removed:*
 - a. Have handy a screwdriver with a size Phillips #2 tip (Items 1 and 3).
 - b. Locate the modules to be removed in the locator diagram *Outer-Chassis Modules*, Figure 6–3, page 6–14.
 - c. Do the procedure *A71 (AWG510)/A72 (AWG520) Output Board* that precedes this procedure to remove the Output board.
2. *Orient the waveform generator:* Set the generator so its left side is down on the work surface and its rear is facing you.
3. *Remove the A50 AWG Board.:* Use Figure 6–19 as a guide while doing the following substeps.
 - a. Unplug these cables and connectors:
 - Two connectors J1 and J2 on the low–voltage power supply.
 - The cable from EVENT INPUT at J200 on the AWG Board.
 - The coax cable to CLOCK OUTPUT at J500 on the AWG Board.
 - The interconnect cable from J130 on the A30 GPIB board to J100 on the AWG board at the cable junction. See also Figure 6–21, page 6–45.
 - b. Remove the twelve screws on top of the AWG board and two from the rear panel.
 - c. Lift the AWG board up away from the main chassis to complete the removal.
4. *Reinstallation:* Do, in reverse order, substeps 3b then 3a reversing each step to reinstall the board. Then refer to the following procedures, in order listed, to complete the reassembly.
 - *A71 (AWG510)/A72 (AWG520) Output Board*
 - *Cabinet* (page 6–20).

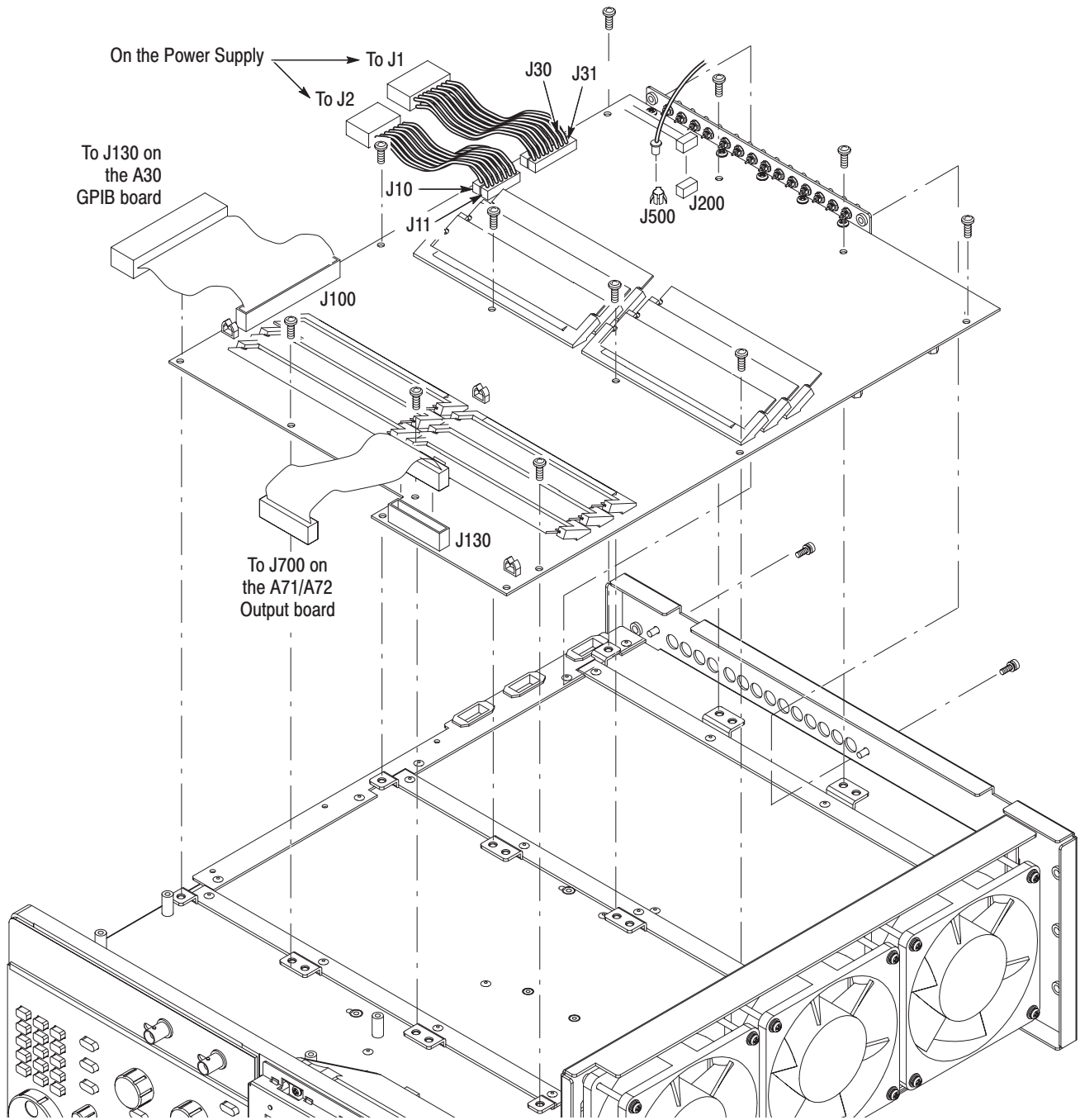


Figure 6-19: A50 AWG board removal

Rear Chassis

1. *Assemble equipment and locate modules to be removed:*
 - a. Have handy a screwdriver with a size Phillips #2 tip (Items 1 and 3).
 - b. Locate the modules to be removed in the locator diagram *Outer-Chassis Modules*, Figure 6–3, page 6–14.
 - c. Do the procedure *PS100 Low Voltage Power Supply* (page 6–32) to remove the power supply module.
 - d. Do the procedure *A40 Clock Board* (page 6–39) to remove the interconnect cables.
 - e. Do the procedure *A50 AWG Board* (page 6–40) to remove the AWG board and the Output board.
 - f. Install the front cover (optional accessory) if it's not already installed.
2. *Orient the waveform generator:* Set the generator so its bottom is down on the work surface and its rear is facing you.
3. *Remove the rear chassis:* Use Figure 6–20 as a guide when doing the following substeps:
 - a. Unplug these cables:
 - The GPIB interconnect cable at J110 on the A30 GPIB Board.
 - The LAN interconnect cable at the connector on the LAN interface.
 - The cable to DISPLAY MONITOR OUT at J127 and KEYBOARD at J128 on the A10 Connector board.
 - b. Remove the 5 screws securing the rear chassis to the main chassis.

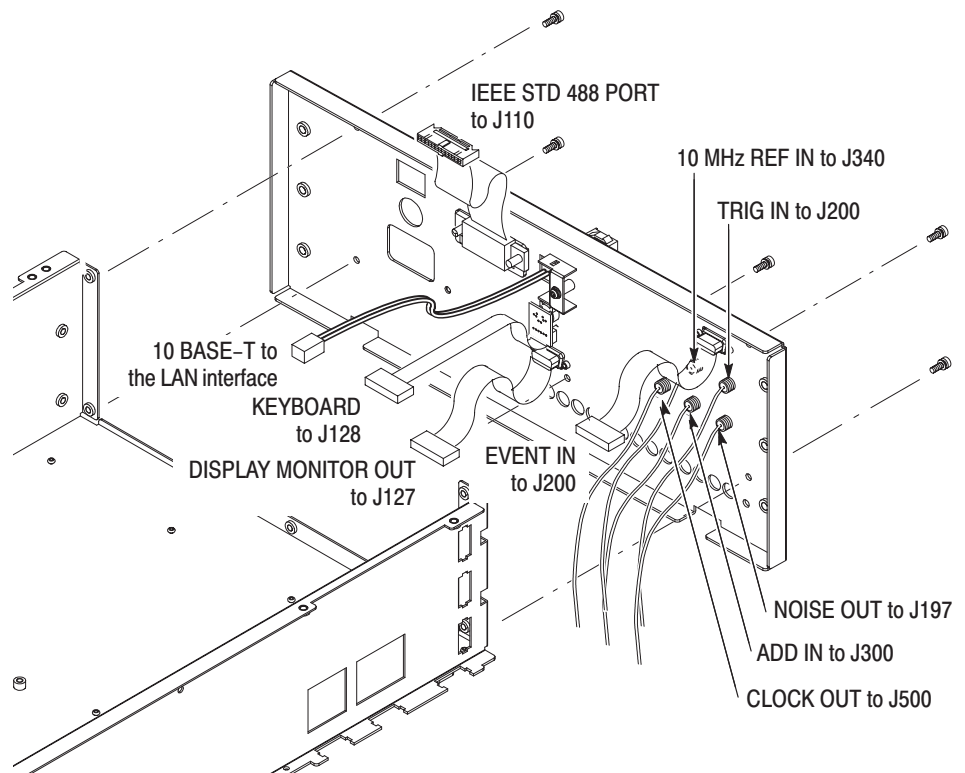


Figure 6-20: Rear Chassis removal

4. *Reinstallation:* Do, in reverse order, substeps 3a–3b, reversing each step to reinstall the rear chassis. Then see the following procedures, in the order listed, to complete reassembly of the generator.
 - *A50 AWG Board* (page 6–40)
 - *A40 Clock Board* (page 6–39)
 - *PS100 Low Voltage Power Supply* (page 6–32)
 - *Cabinet* (page 6–20)

Procedures for Inner-Chassis Modules

You should have completed the *Access Procedure* (page 6–16) before doing any of the procedures for the Inner-Chassis modules. The procedures are presented in the following order:

- *CPU Unit*
 - *CPU Board*
 - *Hard disk and Flash disk*
 - *LAN Board*
 - *A30 GPIB Board*
 - *Back Plane Board*
- *Display Assembly and Supply Fuse*
- *Front Subpanel*

CPU Unit

This procedure describes how to remove these circuit boards contained in the CPU unit:

- *CPU Board*
- *Hard disk and Flash disk*
- *LAN Board*
- *A30 GPIB Board*
- *Back Plane*

1. *Assemble equipment and locate modules to be removed:*
 - a. Have handy a screwdriver with a size Phillips #2 tip (Items 1 and 3).
 - b. Locate the modules to be removed in the locator diagram, *Internal Modules*, in Figure 6–4, page 6–15.
 - c. Do the procedure *A10 Connector Board* (page 6–39) to remove the interconnect cables to the CPU board and the A30 GPIB board. It is not necessary to pull the Connector board out.
2. *Orient the waveform generator:* Set the generator so its bottom is down on the work surface and the right side facing you.

3. *Remove the CPU Unit:* Use Figure 6–21 as a guide while doing the following substeps.
 - a. Unplug the GPIB interconnect cable at J110 on the A30 GPIB board and the LAN interconnect cable of the LAN interface board.
 - b. Unplug the interconnect cable from J100 on A50 AWG board.
 - c. Remove the two screws on the bottom and another two from the right side.
 - d. Lift the CPU Unit up away from the main chassis.

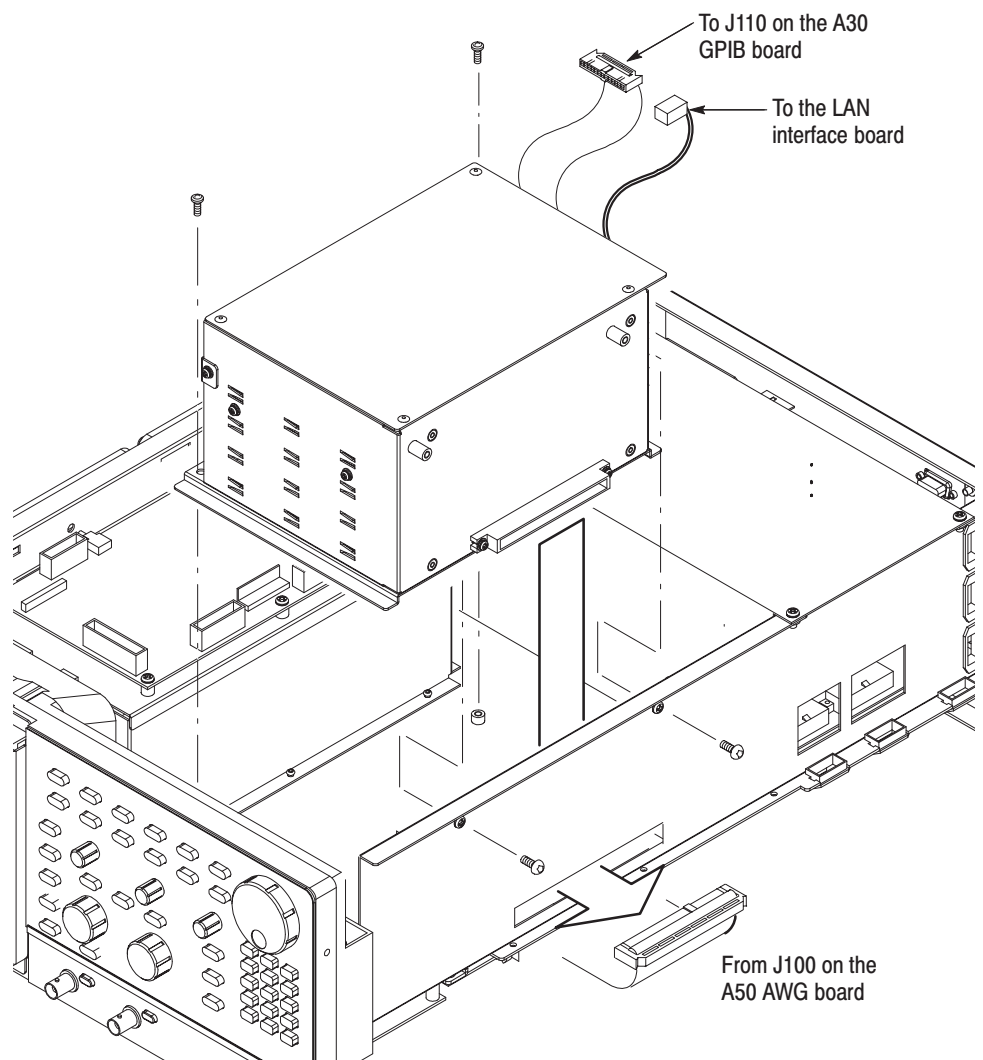


Figure 6–21: CPU Unit removal

4. **Remove the CPU Board:** Use Figure 6–22 as a guide while doing the following steps:
 - a. Unplug the VGA and COM1 connectors on the left side of the CPU board.
 - b. Unplug the interconnect cable from the flash disk.
 - c. Using a screwdriver with a size Phillips #2 tip, remove the screw securing the CPU board to the frame with a retainer on the the right side of the unit.
 - d. Remove the screw on the left side of the CPU board.
 - e. Grasp the board and slide it out of the unit.

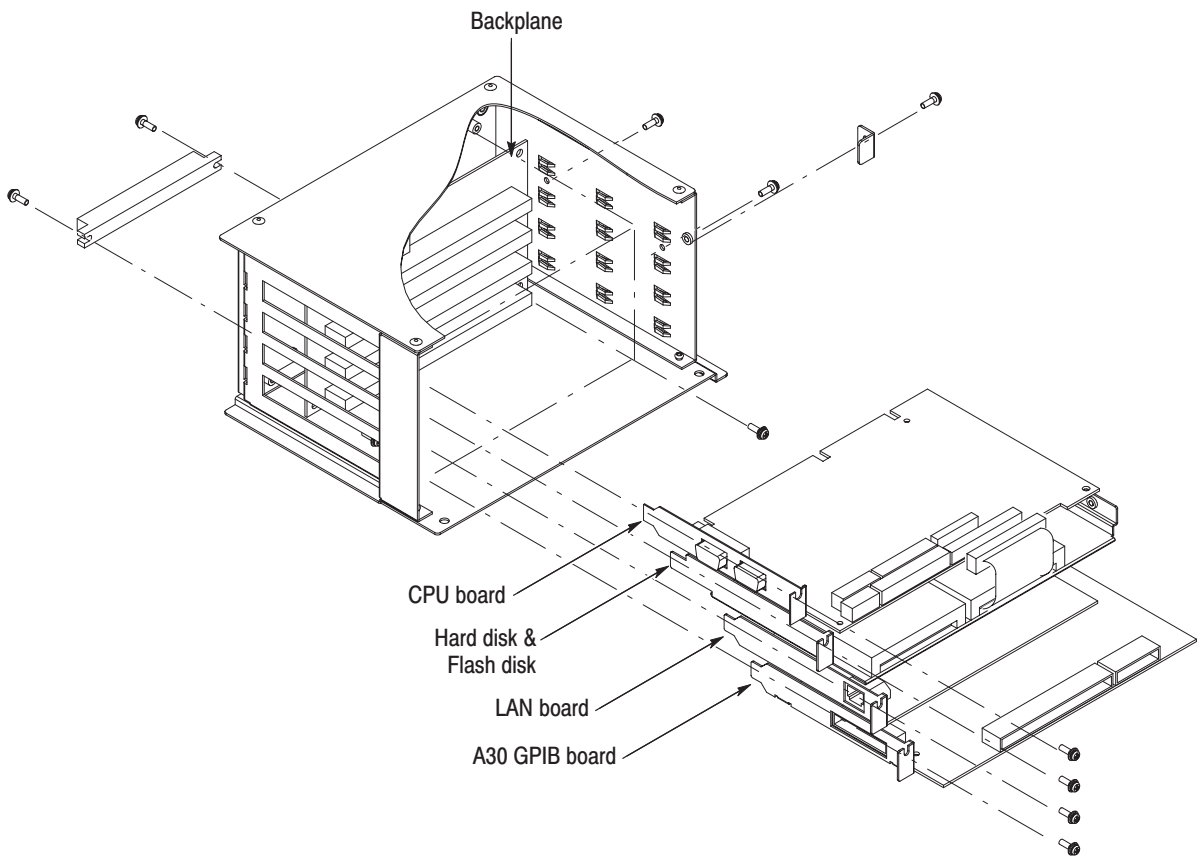
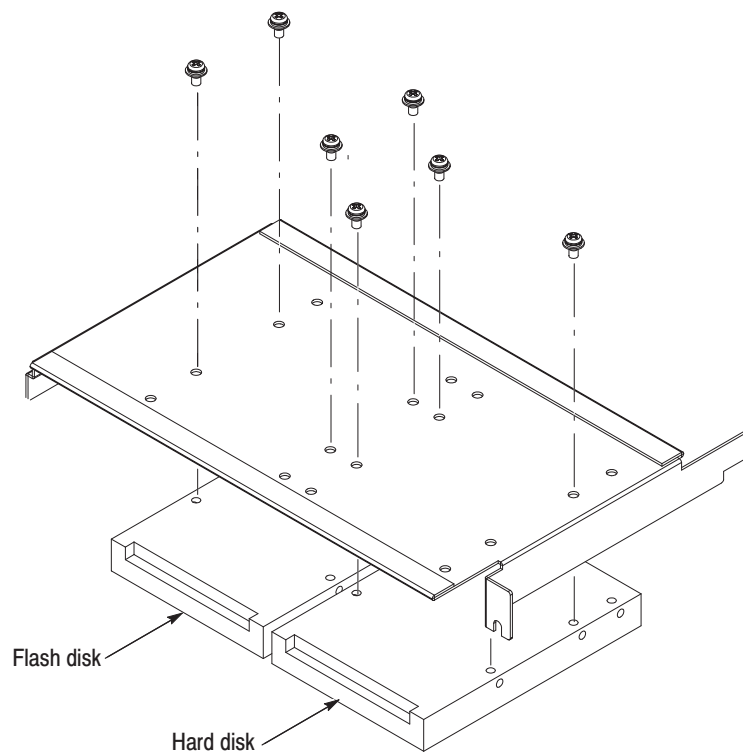


Figure 6–22: CPU, HDD/Flash disk, LAN, and GPIB boards removal

5. Remove the *Hard disk and Flash disk*:

- a. Using a screwdriver with a size Phillips #2 tip, remove the two screws securing the hard disk and flash disk bracket to the frame on the right side of the CPU Unit. See Figure 6-22.
- b. Remove the screw on the left side of the bracket.
- c. Grasp the bracket and slide it out.
- d. Using a screwdriver with a size Phillips #2 tip, remove the three screws securing the hard disk to the bracket. See Figure 6-23.
- e. Remove the four screws securing the flash disk to the bracket.

**Figure 6-23: Hard disk and flash disk removal**

6. Remove the LAN Board:

- a. Using a screwdriver with a size Phillips #2 tip, remove the screw on the left side of the LAN board. See Figure 6–22, page 6–45.
- b. Grasp the board and slide it out.

7. Remove the A30 GPIB Board:

- a. Using a screwdriver with a size Phillips #2 tip, remove the screw on the left side of the GPIB board. See Figure 6–22, page 6–45.
- b. Grasp the board and slide it out.

8. Remove the Back Plane:

- a. Using a screwdriver with a size Phillips #2 tip, remove the four screws securing the board to the frame. See Figure 6–22, page 6–45.
- b. Grasp the board and slide it out.

9. Reinstallation:

- a. Do, in reverse order, steps 4 through 8, reversing each step to reinstall all boards in the CPU Unit.
- b. Do, in reverse order, substeps 3a through 3c, reversing each step to reinstall the CPU Unit.
- c. Refer to the following procedures, in order, to complete reassembly of the waveform generator.
 - *A10 Connector Board* (cables only, page 6–34)
 - *Cabinet* (page 6–20)

Display Assembly and Supply Fuse

NOTE. *The display and the display-driver board are a single module and must be removed and replaced as such. They are listed as a single module in the Replaceable Parts List.*

1. *Assemble equipment and locate modules to be removed:* Have handy a screwdriver with a size Phillips #2 tip (Items 1 and 3). Locate the modules to be removed in the locator diagram *Inner-Chassis Modules*, Figure 6-4, on page 6-15.
2. *Orient the waveform generator:* Set the generator so its bottom is down on the work surface and its rear is facing you.
3. *Remove the high-voltage fuse:* If you are servicing this fuse, remove the fuse from its fuse holder. Reverse the procedure to reinstall.



WARNING. Display tube handling: *Use care when handling a display tube. If you break a display tube it may implode, scattering glass fragments with high velocity and possibly injuring you. Wear protective clothing, including safety glasses (preferably a full-face shield). Avoiding striking the display tube with or against any object.*

Display tube storage: *Store the display tube face down in a protected location, placing it on a soft, nonabrasive surface to prevent scratching the face plate.*

4. *Remove the display tube:*
 - a. Take the precautions outlined in the warning above. See Figure 6-24 while doing the following substeps.
 - b. Unplug the display tube connector from the back of the display tube and the display tube yoke connector from the display circuit board (J340). Loosen the screw on the video board that holds the CRT sockets. Then pull back on the video board slightly. This separates the board from the socket.
 - c. Remove the two screws that secure the band circling the front of display tube to the front subpanel. Carefully guide display tube forward to partially remove it from the front subpanel and to access the anode lead connected to the display tube.



WARNING. High-voltage is present on the anode lead. Before unplugging the anode in the following substep, you must discharge it: ground a flat-bladed screwdriver (Item 4) with an insulated handle to the chassis through a suitable grounding strap. Next, probe under the insulating cap of the anode lead and touch the lead's metal conductor to discharge. Repeat. After unplugging the anode in substep d, touch its metal conductor to the chassis for a few minutes to further ensure discharge.

- d. Discharge the anode lead as described in the immediately preceding **WARNING**, unplug it from the display tube, and discharge that lead (again see **WARNING**).
- e. Be sure you have read the **WARNING** on display tube handling and storage found at the start of this display tube removal procedure. Then pull the display tube out through the front subpanel to complete removal. Store as directed in the previous **WARNING** message.

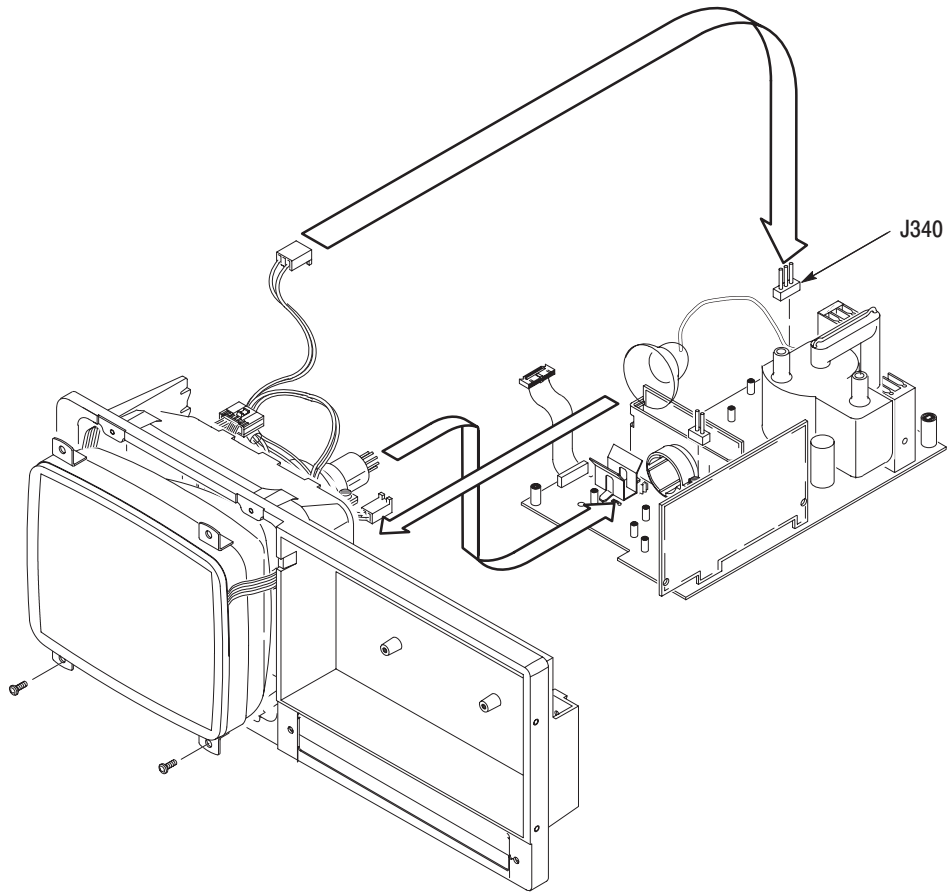


Figure 6-24: Display assembly removal

5. Remove the display supply board: Use Figure 6–25 as a guide.



CAUTION. If any RTV Silicon is removed from the generator, it must be replaced in order to maintain the warranted characteristics for random vibration.

- a. Remove the six screws that mount the display-driver board to the main chassis.
- b. Grasp the display driver board. Work from the front and top to tilt the board so its right edge is up and its left side is down and lift it out of the top of the generator's main chassis.

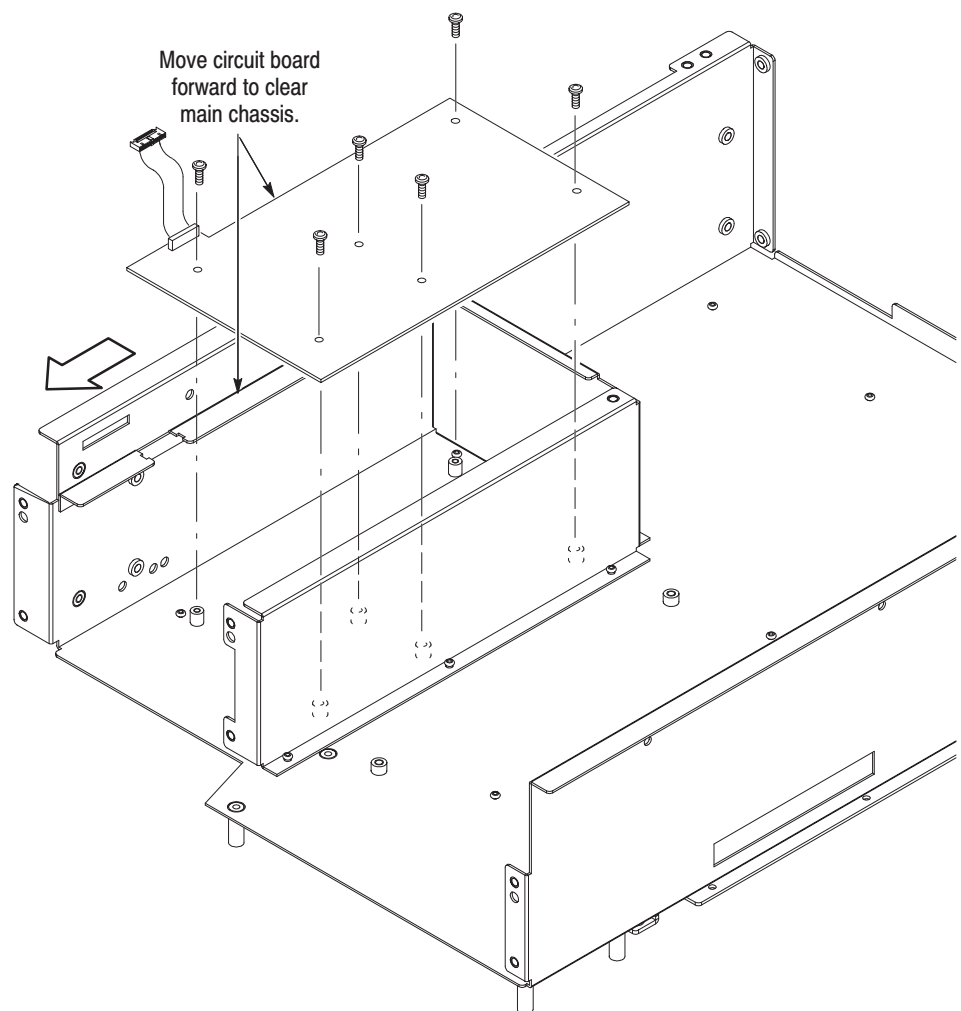


Figure 6–25: Display Driver Board removal

6. Reinstallation:

- a. Do, in reverse order, substeps 5a–5b, reversing each step to reinstall Display-Driver board.
- b. Do, in reverse order, substeps 4a–4e, reversing each step to reinstall the display tube if removed.
- c. See step 3 to reinstall the supply fuse if it was removed.
- d. See the following procedures, in order, to complete reassembly of the waveform generator:
 - *A10 Connector Board* (page 6–34)
 - *Display-Frame Assembly*
 - *Trim Ring, Menu Buttons, and Output Panel* (page 6–23)
 - *Cabinet* (page 6–20) (completes reassembly)

Front Subpanel

- 1. *Assemble equipment and locate modules to be removed:*
 - a. Have handy a screwdriver with a size Phillips #2 tip (Items 1 and 3).
 - b. Do the procedure *Display Assembly and Supply Fuse* (page 6–49). Do not remove the display-driver board.
 - c. Locate the modules to be removed in the locator diagram *Inner-Chassis Modules*, Figure 6–3, page 6–14.
- 2. *Orient the waveform generator:* Set the generator so its rear is down on the work surface and its bottom is facing you.
- 3. *Remove the front subpanel:* Remove the six screws securing the front subpanel to the main chassis. (See Figure 6–26 for screw locations.) Lift the front subpanel up away from the main chassis to complete the removal.
- 4. *Reinstallation:* Do the following substeps to reinstall the front subpanel and reassemble the remainder of the generator:
 - a. Align the front subpanel to the main chassis, taking care to ensure that the main chassis slips into its alignment slot on the front subpanel (see magnified view, Figure 6–26.) Then reinstall the six screws removed in step 3.
 - b. See the procedure *Display Assembly and Supply Fuse* (page 6–49) to reinstall the display-frame assembly and display tube.

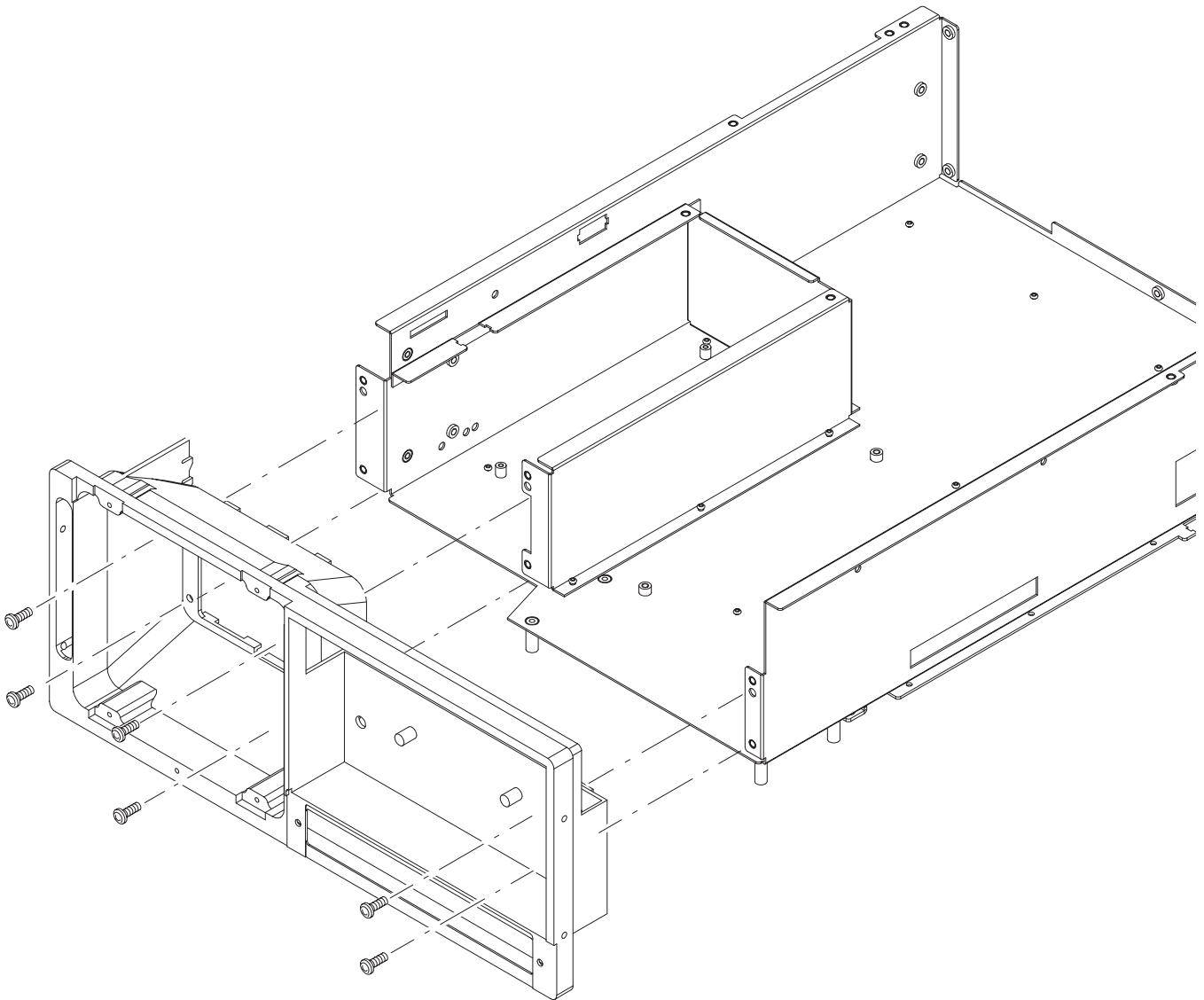


Figure 6-26: Front Subpanel Removal

- c. See the following procedures, in the order listed, for instructions for reinstalling the remaining modules.
 - *A10 Connector Board* (page 6-34)
 - *Display-Frame Assembly*
 - *Trim Ring, Menu Buttons, and Output Panel* (page 6-23)
 - *Cabinet* (page 6-20)

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* located in this section.

This subsection consists of the following flowcharts:

- Figure 6–27: Primary Troubleshooting Procedure
- Figure 6–28: Troubleshooting Procedure 1 — Power Supply Module
- Figure 6–30: Troubleshooting Procedure 2 — CPU or Front-panel Module
- Figure 6–32: Troubleshooting Procedure 3 — Monitor Module
- Figure 6–37: Troubleshooting Procedure 4 — Module Isolation

Diagnostics

The waveform generator has two levels of internal diagnostics that focus on verifying, adjusting, and if need be, isolating faulty modules.

Both levels of 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. At power 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 oscilloscope function. This verification will take several minutes. When finished, the waveform generator will display a report of any bad modules and/or interfaces.



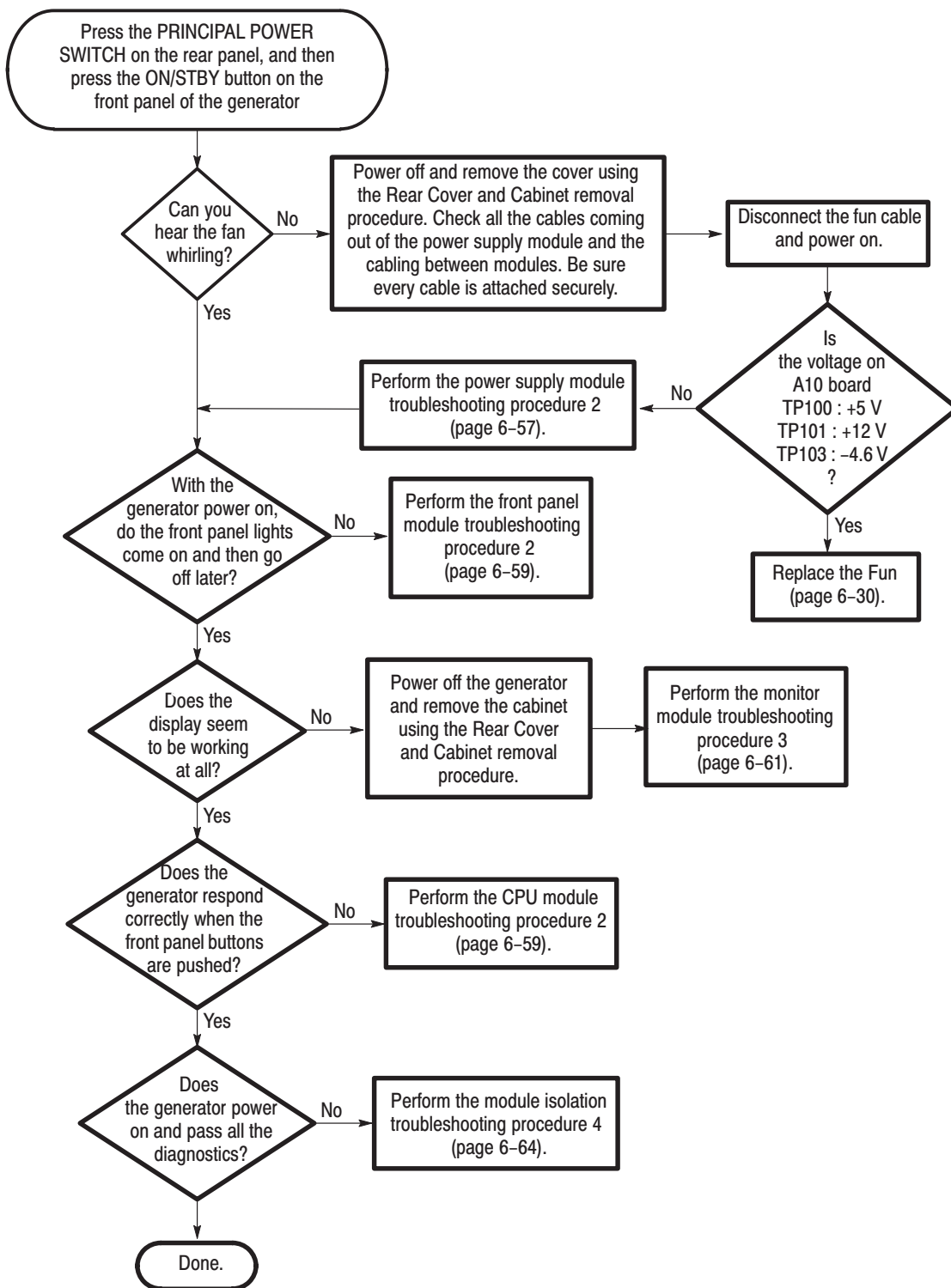


Figure 6-27: Primary troubleshooting procedure

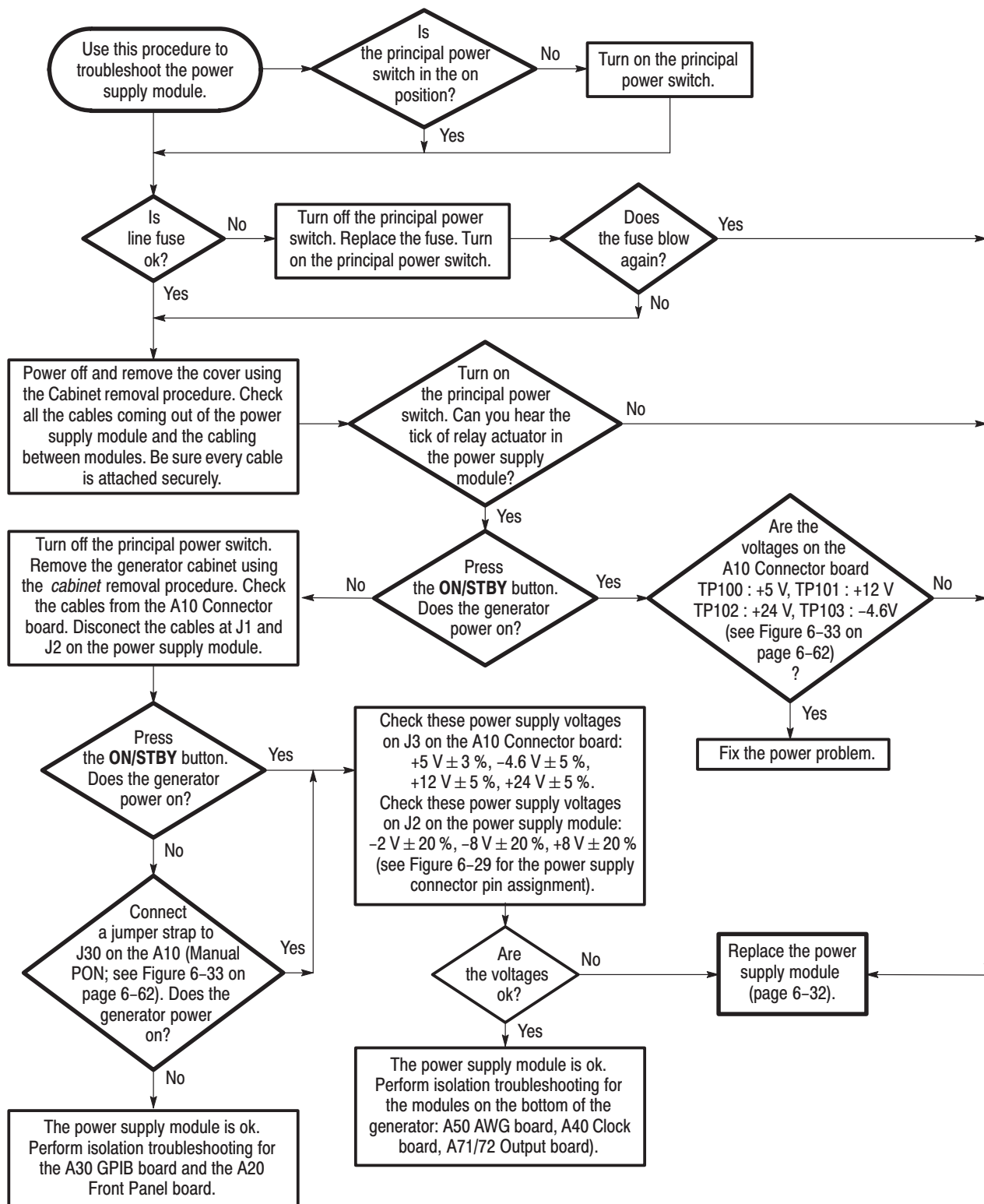


Figure 6-28: Troubleshooting procedure 1 — Power Supply module

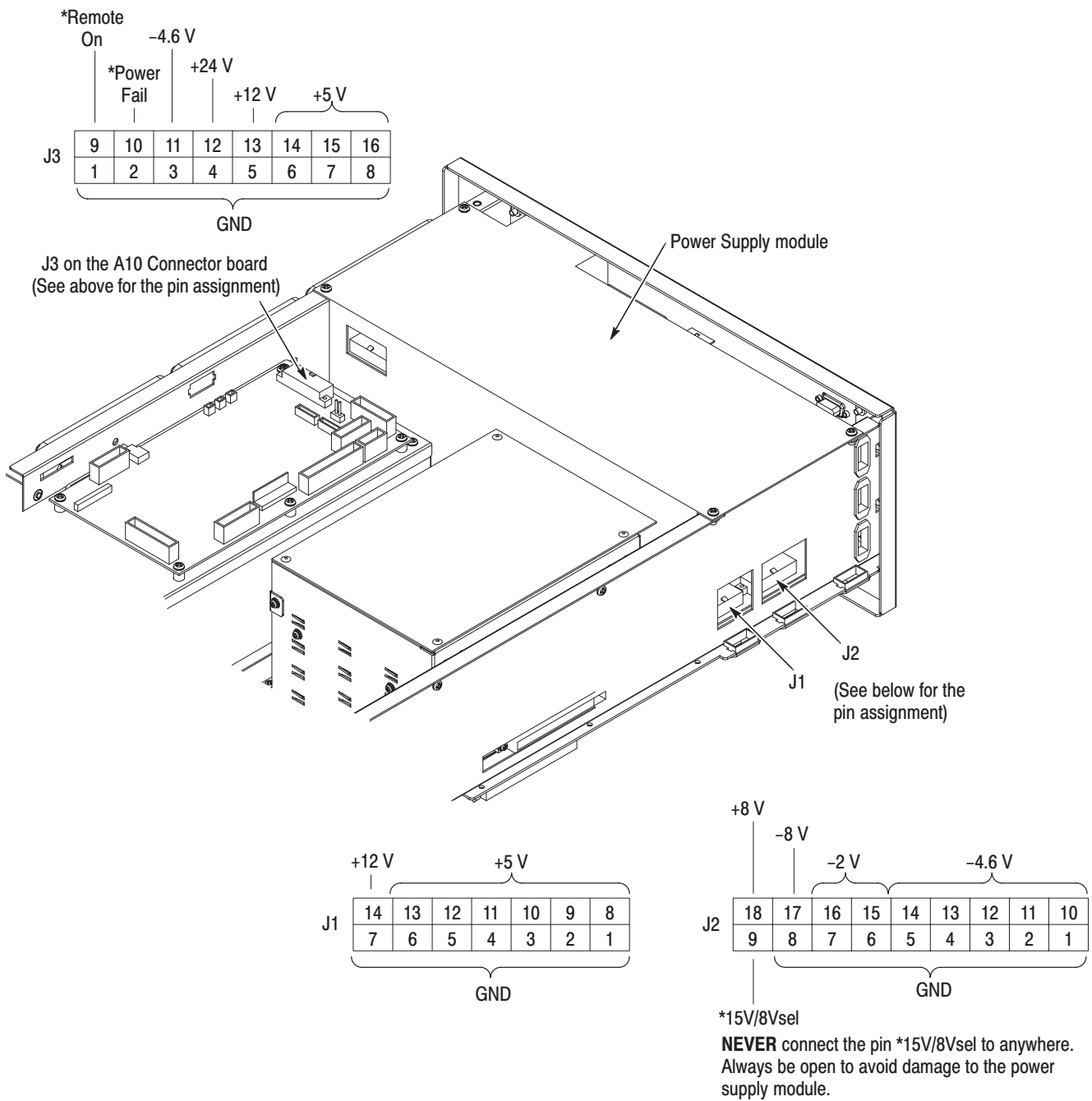


Figure 6-29: Power Supply connectors

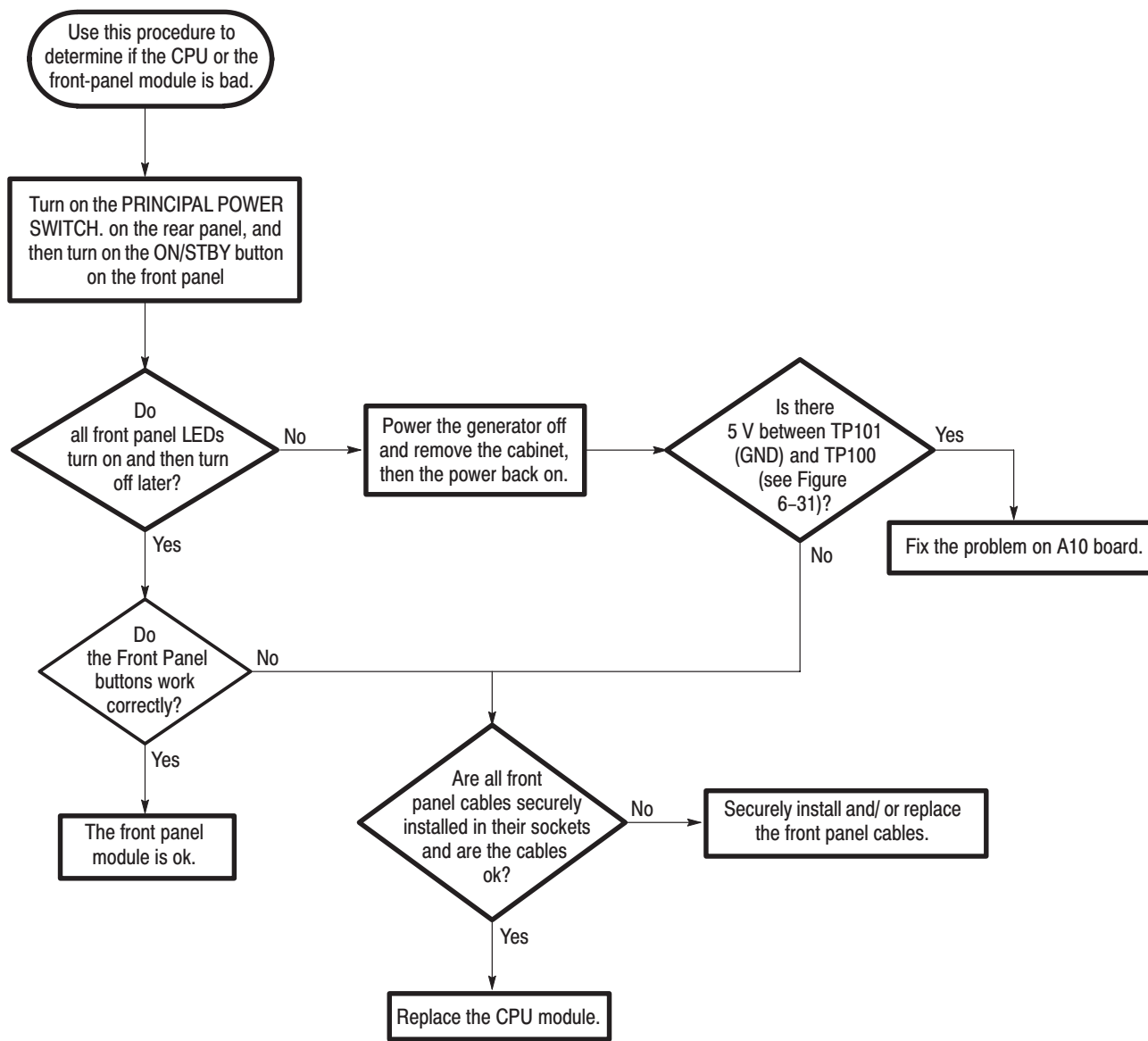


Figure 6-30: Troubleshooting procedure 2 — CPU or Front Panel module

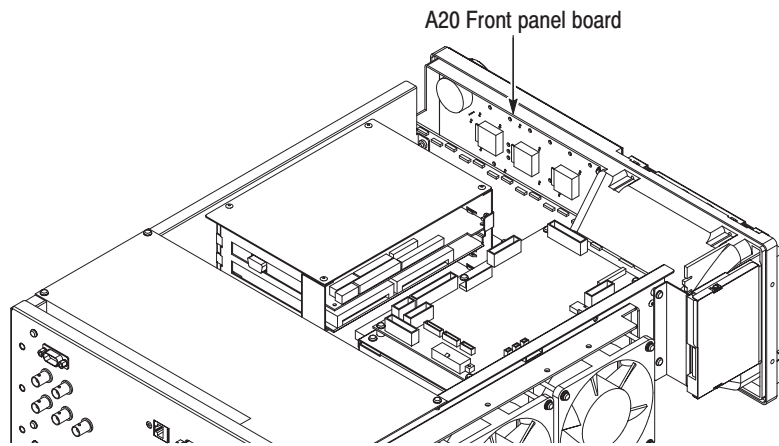
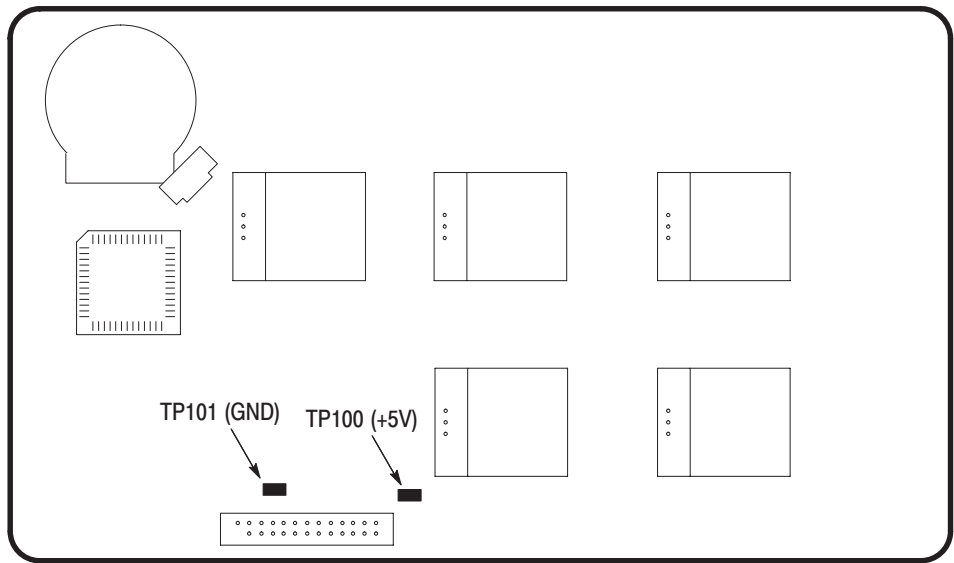


Figure 6-31: A20 Front Panel board

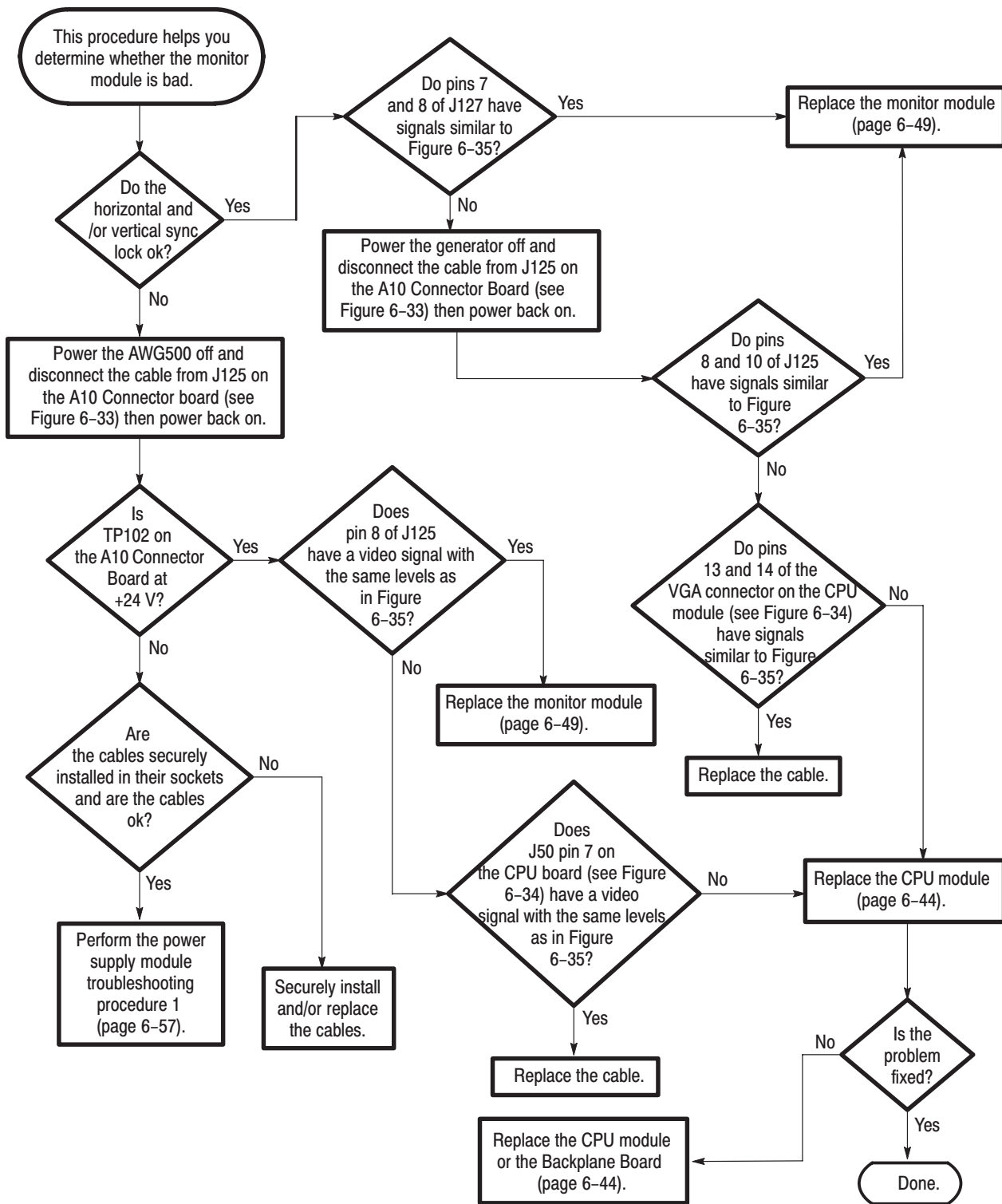


Figure 6-32: Troubleshooting procedure 3 — Monitor module

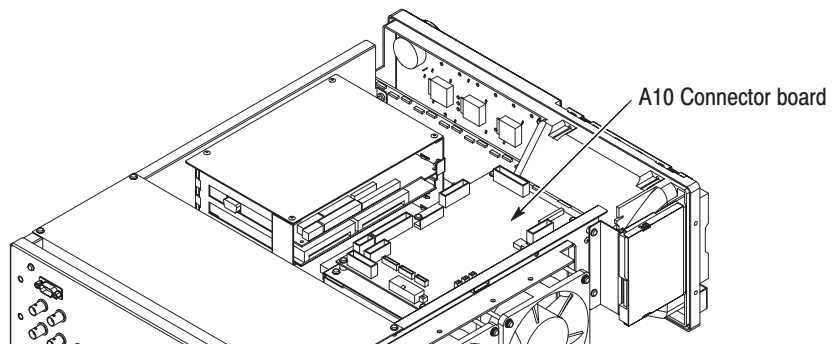
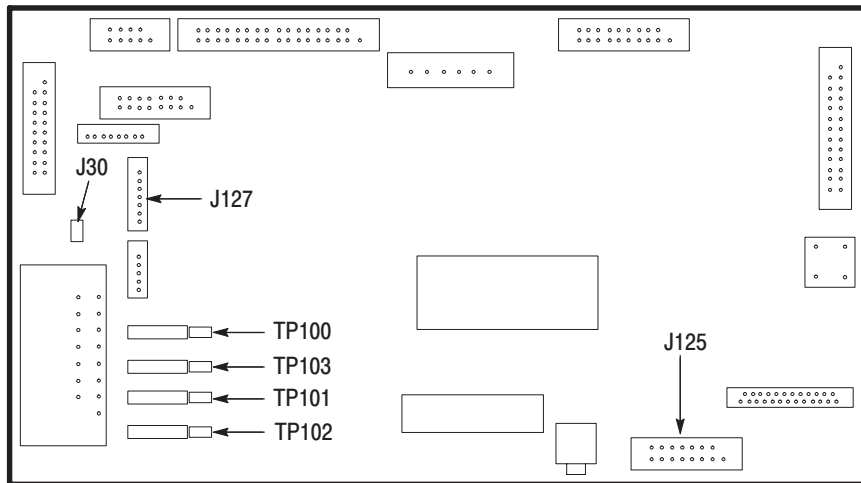


Figure 6-33: A10 Connector board

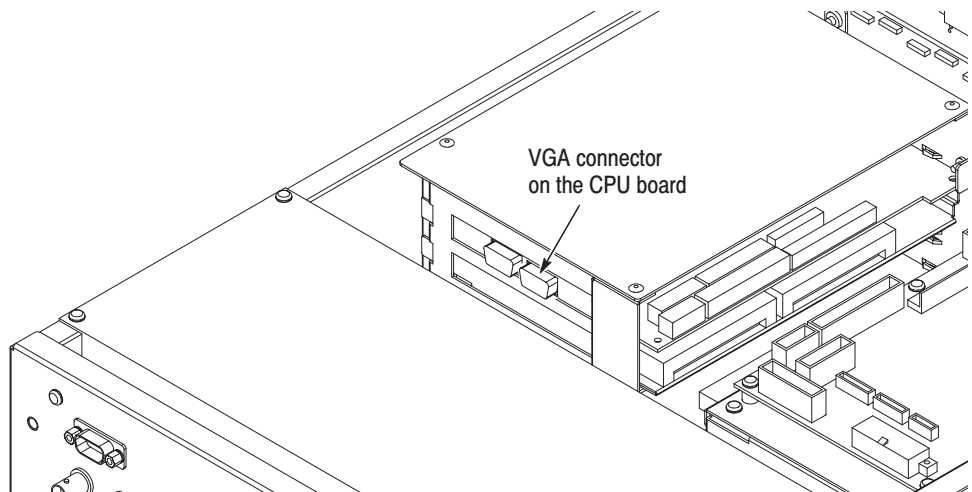


Figure 6-34: Location of the VGA connector

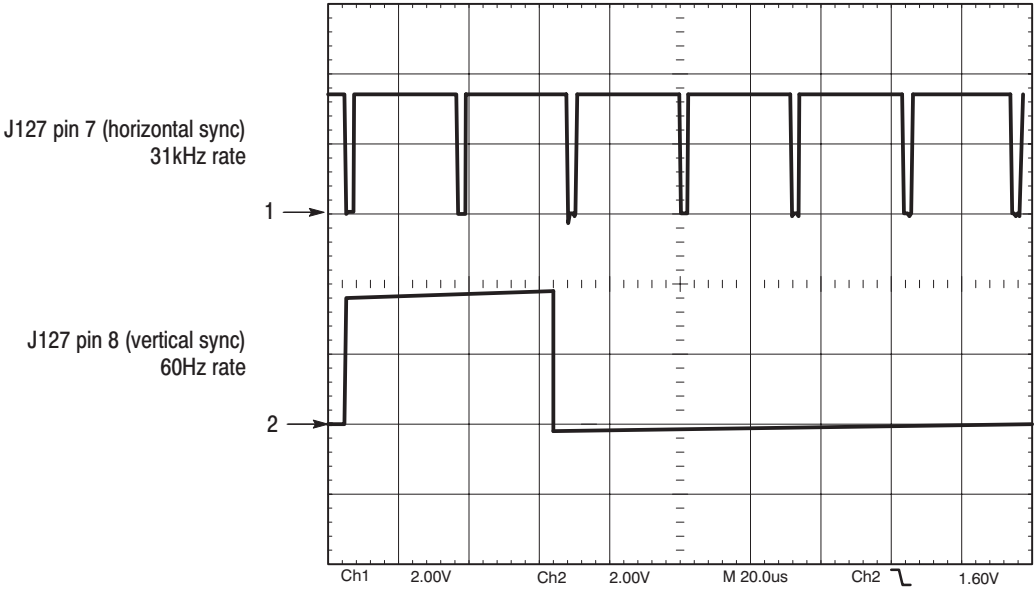


Figure 6-35: Horizontal and vertical sync signals

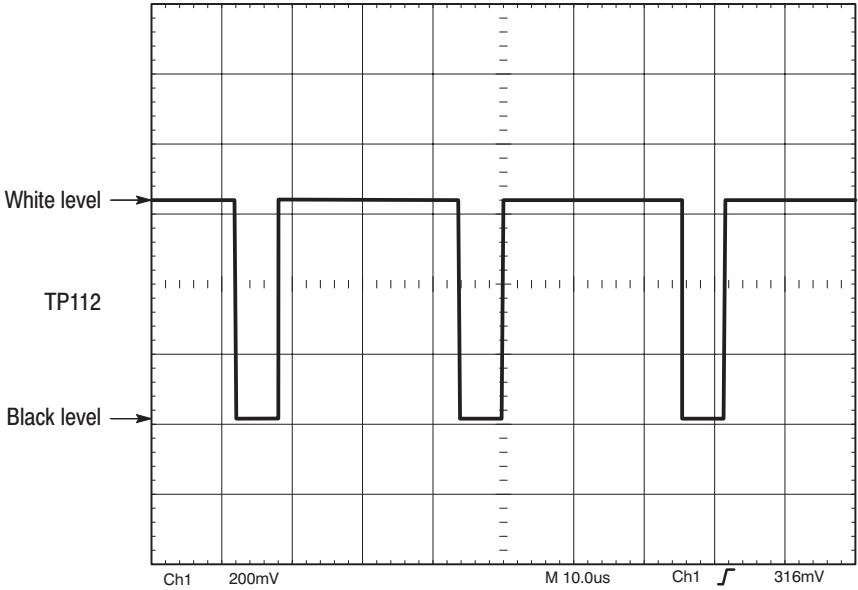


Figure 6-36: A video signal with white and black levels

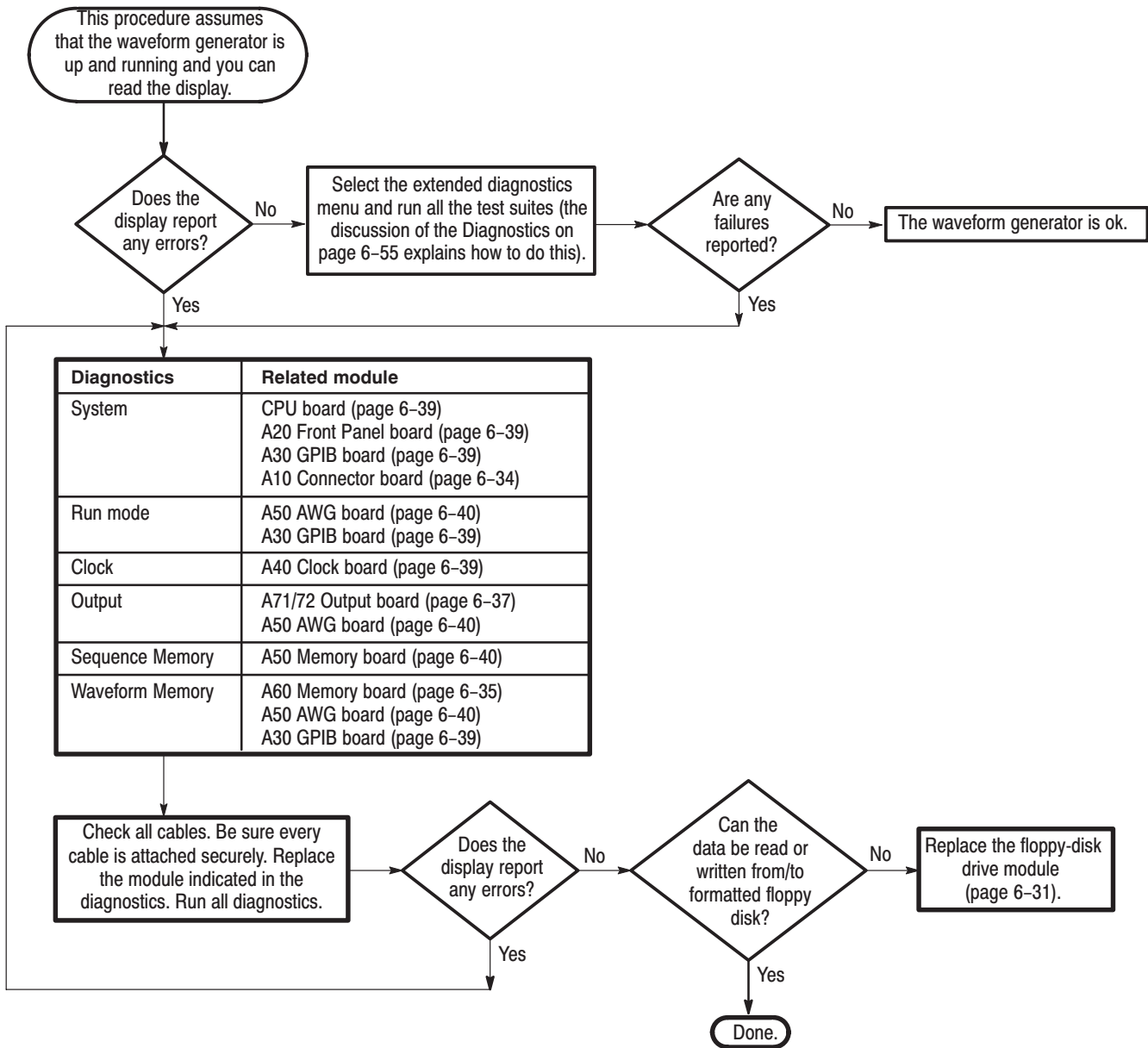


Figure 6-37: Troubleshooting procedure 4 — Module isolation

Messages and Codes

Table 6–5 lists instrument error codes and their meaning.

Table 6–5: Device errors

Error code	Error message
1101	CH1 internal offset
1102	CH1 output offset
1103	CH1 gain
1111	CH1 x3dB attenuator
1112	CH1 x6dB attenuator
1113	CH1 x12dB attenuator
1114	CH1 x20dB attenuator
1121	CH1 10MHz filter
1122	CH1 20MHz filter
1123	CH1 50MHz filter
1124	CH1 100MHz filter
1201	CH2 internal offset
1202	CH2 output offset
1203	CH2 gain
1211	CH2 x3dB attenuator
1212	CH2 x6dB attenuator
1213	CH2 x12dB attenuator
1214	CH2 x20dB attenuator
1221	CH2 10MHz filter
1222	CH2 20MHz filter
1223	CH2 50MHz filter
1224	CH2 100MHz filter
2100	System failure
2101	Real-time clock power
2102	Configuration record and checksum status
2103	Incorrect configuration
2104	Memory size miscompare
2105	Fixed-disk drive initialization status

Table 6-5: Device errors (cont.)

Error code	Error message
2106	Time status
2110	Front panel failure
2111	Front panel configuration
2112	Front panel communication
2113	Front panel RAM
2114	Front panel ROM
2115	Front panel A/D
2116	Front panel timer
2301	A30 board failure
2401	Clock delay data not found
2402	Clock delay data checksum
2700	Calibration data failure
2701	Calibration data not found
2702	Calibration data checksum
3100	Control1 register failure
3101 to 3104	Control1 register bit0 to bit3
3200	Event table data bus failure
3201 to 3216	Event table data bus bit0 to bit15
3250	Event table address bus failure
3251 to 3274	Event table address bus bit0 to bit23
3300	Event table memory chip select failure
3301	Event table memory chip select 0
3302	Event table memory chip select 1
3350	Event table memory chip cell failure
3351	Event table memory chip 0
3352	Event table memory chip 1
4100	A40 board failure
4101	PLL 500MHz locked
4102	PLL 600MHz unlocked
4103	PLL 1350MHz unlocked
4104	PLL 1500MHz locked
5100	Sequence memory data bus failure
5101 to 5116	Sequence memory data bus bit0 to bit15

Table 6-5: Device errors (cont.)

Error code	Error message
5150	Sequence memory address bus failure
5151 to 5174	Sequence memory address bus bit0 to bit23
5200	Sequence memory chip select failure
5201 to 5206	Sequence memory chip select 0 to select 5
5250	Sequence memory chip cell failure
5251 to 5256	Sequence memory chip 0 to chip 5
5300	CH1 Waveform memory data bus failure
5301 to 5316	CH1 Waveform memory data bus bit0 to bit15
5350	CH1 Waveform memory address bus failure
5351 to 5374	CH1 Waveform memory address bus bit0 to bit23
5400	CH1 Waveform memory chip select failure
5401 to 5449	CH1 Waveform memory chip select 0 to select 48
5500	CH1 Waveform memory chip cell failure
5501 to 5549	CH1 Waveform memory chip 0 to chip 48
5600	CH2 or $\overline{\text{CH1}}$ Waveform memory data bus failure
5601 to 5616	CH2 or $\overline{\text{CH1}}$ Waveform memory data bus bit0 to bit15
5650	CH2 or $\overline{\text{CH1}}$ Waveform memory address bus failure
5651 to 5674	CH2 or $\overline{\text{CH1}}$ Waveform memory address bus bit0 to bit23
5700	CH2 or $\overline{\text{CH1}}$ Waveform memory chip select failure
5701 to 5748	CH2 or $\overline{\text{CH1}}$ Waveform memory chip select 0 to select 47
5800	CH2 or $\overline{\text{CH1}}$ Waveform memory chip cell failure
5801 to 5848	CH2 or $\overline{\text{CH1}}$ Waveform memory chip 0 to chip 47
5900	CH1 Arb D/A failure
5901 to 5912	CH1 Arb D/A data bit0 to bit11
5950	CH2 Arb D/A failure
5951 to 5962	CH2 Arb D/A data bit0 to bit11
7110	CH1 output offset failure
7111	CH1 output offset
7120	CH1 internal offset failure
7121	CH1 internal offset
7130	CH1 Arb gain failure
7131	CH1 Arb gain
7140	CH1 attenuator failure

Table 6-5: Device errors (cont.)

Error code	Error message
7141	CH1 3dB attenuator
7142	CH1 6dB attenuator
7143	CH1 12dB attenuator
7144	CH1 20dB attenuator
7150	CH1 filter failure
7151	CH1 10MHz filter
7152	CH1 20MHz filter
7153	CH1 50MHz filter
7150	CH1 100MHz filter
7170	CH1 output key failure
7171	CH1 output key
7210	CH2 or $\overline{\text{CH1}}$ output offset failure
7211	CH2 or $\overline{\text{CH1}}$ output offset
7220	CH2 or $\overline{\text{CH1}}$ internal offset failure
7221	CH2 or $\overline{\text{CH1}}$ internal offset
7230	CH2 or $\overline{\text{CH1}}$ Arb gain failure
7231	CH2 or $\overline{\text{CH1}}$ Arb gain
7240	CH2 or $\overline{\text{CH1}}$ attenuator failure
7241	CH2 or $\overline{\text{CH1}}$ 3dB attenuator
7242	CH2 or $\overline{\text{CH1}}$ 6dB attenuator
7243	CH2 or $\overline{\text{CH1}}$ 12dB attenuator
7244	CH2 or $\overline{\text{CH1}}$ 20dB attenuator
7250	CH2 or $\overline{\text{CH1}}$ filter failure
7251	CH2 or $\overline{\text{CH1}}$ 10MHz filter
7252	CH2 or $\overline{\text{CH1}}$ 20MHz filter
7253	CH2 or $\overline{\text{CH1}}$ 50MHz filter
7254	CH2 or $\overline{\text{CH1}}$ 100MHz filter
7270	CH2 or $\overline{\text{CH1}}$ output key failure
7271	CH2 or $\overline{\text{CH1}}$ output key

Options

Options and Accessories

This appendix describes the various options as well as the standard and optional accessories that are available for the AWG510 and AWG520 Arbitrary Waveform Generator.

Options

Tektronix will ship the options shown in Table 7-1:

Table 7-1: Options

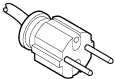
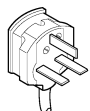
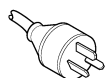
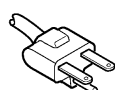
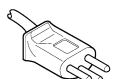
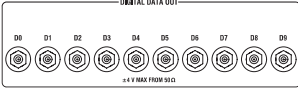
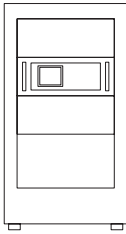
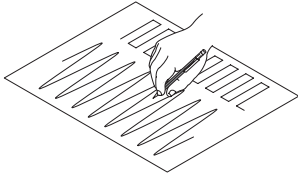
	Option #	Label	Description
	A1	Universal European power cord	220 V, 50 Hz power cord Fuse 5A (T) (IEC 127) Fuse Cap Cable Retainer
	A2	UK power cord	240 V, 50 Hz power cord Fuse 5A (T) (IEC 127) Fuse Cap Cable Retainer
	A3	Australian power cord	240 V, 50 Hz power cord Fuse 5A (T) (IEC 127) Fuse Cap Cable Retainer
	A4	North American power cord	240 V, 60 Hz power cord Cable Retainer
	A5	Switzerland power cord	220 V, 50 Hz power cord Fuse 5A (T) (IEC 127) Fuse Cap Cable Retainer

Table 7-1: Options (Cont.)

	Option #	Label	Description
	03	Digital data out	<p>On waveform generators for which Option 03 has been installed, digital data from the waveform memory is output directly to the DIGITAL DATA OUT connectors on the rear panel without passing through the D/A converter.</p>
	1R	Rackmount	<p>Waveform generator comes configured for installation in a 19 inch wide instrument rack. For later field conversions, order kit # 016-1675-XX.</p>
	1S	WaveWriter S3FTx00	<p>WaveWriter is an application program used to create waveforms for advanced signal generating and processing instruments. Many Tektronix instruments, such as arbitrary waveform generators and oscilloscopes with the “save-on-delta” feature, are enhanced by this program. WaveWriter helps users configure waveforms with a minimum of effort.</p> <p>With the WaveWriter package, you can create new waveforms or edit waveforms acquired from various instrument sources. WaveWriter gives you interactive control of the waveform generating process. WaveWriter operates within the Microsoft Windows™ environment.</p> <p>A Certificate of Traceable Calibration is provided when this option is specified.</p>

Standard Accessories

The waveform generator comes standard with the accessories listed in Table 7–2.

Table 7–2: Standard Accessories

Accessory	Part number
User Manual	071-0099-XX
Programmer Manual	071-0100-XX
Sample waveform floppy disk, 3.5 inch	063-2981-XX
GPIB sample program floppy disk, 3.5 inch	063-2982-XX
Performance check/adjustment floppy disk, 3.5 inch	063-2983-XX
Fuse, 10 A FAST (UL198G, 3 AG) (installed)	159-0407-XX
Fuse cap (installed)	200-2264-00
U.S. Power Cord	161-0230-01

Optional Accessories

You can also order the optional accessories listed in Table 7–3.

Table 7–3: Optional Accessories

Accessory	Part number
Service Manual	071-0101-XX
Front cover	200-3696-01
Rack Mount Kit (for field conversion)	016-1675-XX
GPIB cable, 2 m	012-0991-00
BNC cable, 50 Ω	012-1342-00
BNC cable, 50 Ω , double-shield	012-1256-00
SMB cable, 50 Ω	012-1458-00
SMB-to-BNC cable, 50 Ω	012-1459-00
BNC terminator, 50 Ω	011-0049-01
BNC power divider, 50 Ω , DC to 300 MHz, VSWR: 1.2 max.	015-0660-00
BNC low pass filter, 400 MHz	015-0659-00
BNC low pass filter, 200 MHz	015-0658-00
BNC low pass filter, 100 MHz	015-0657-00

Accessory Software

The optional accessories listed in Table 7–4 are Tektronix software products recommended for use with your waveform generator.

Table 7–4: Accessory Software

Software	Part Number
WaveWriter: AWG and waveform creation editor	S3FTx00

Electrical Parts List

Electrical Parts List

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

Diagrams

Diagrams

This section contains following diagrams:

- Block Diagram for the AWG501 and AWG502 with Options 03
- Interconnect Diagram for the AWG501 and AWG502 with Option 03

Block diagrams show the modules and functional blocks in the waveform generator. Interconnect diagrams show how the modules in the waveform generator connect together.

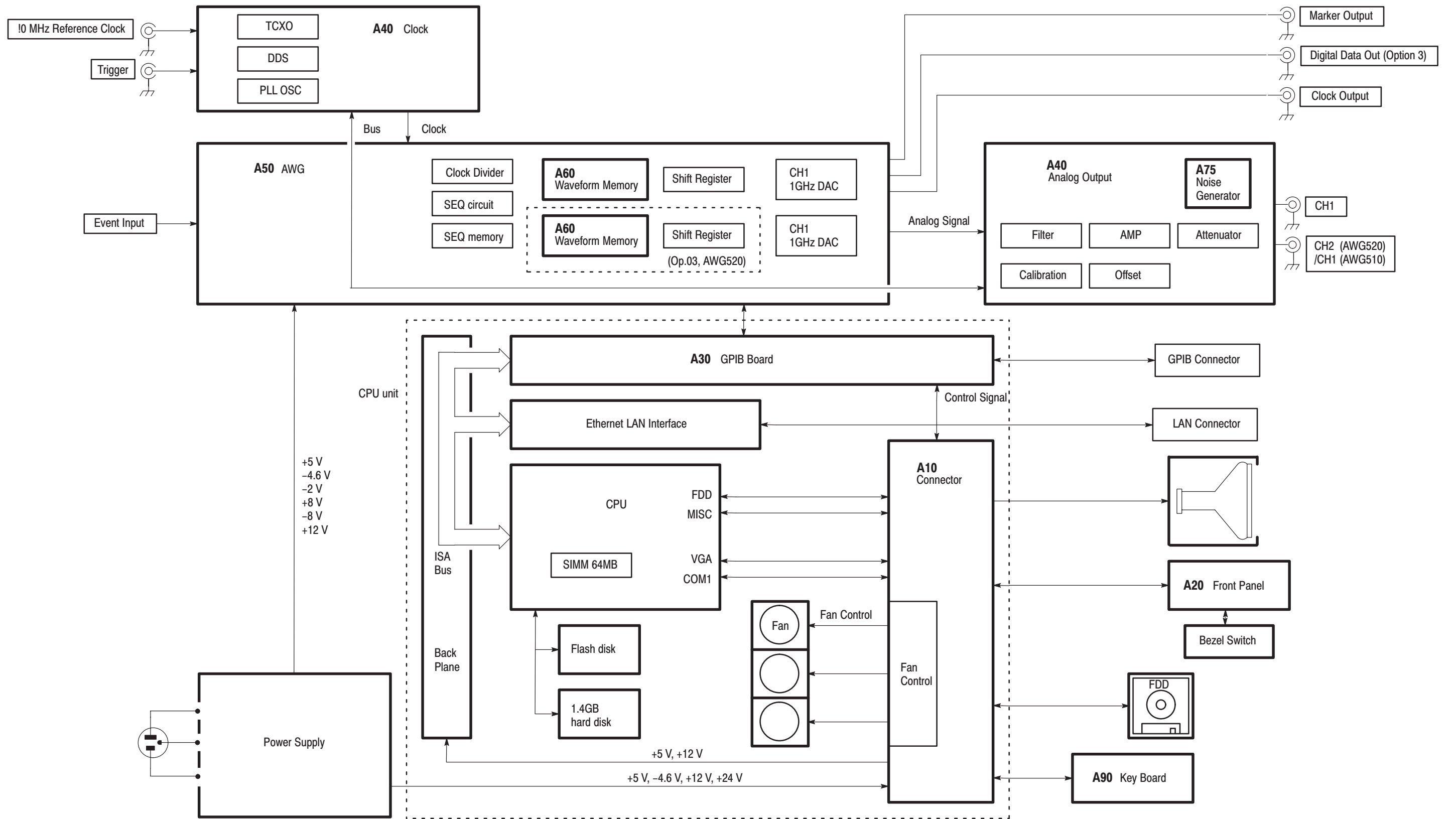


Figure 9-1: Block diagram

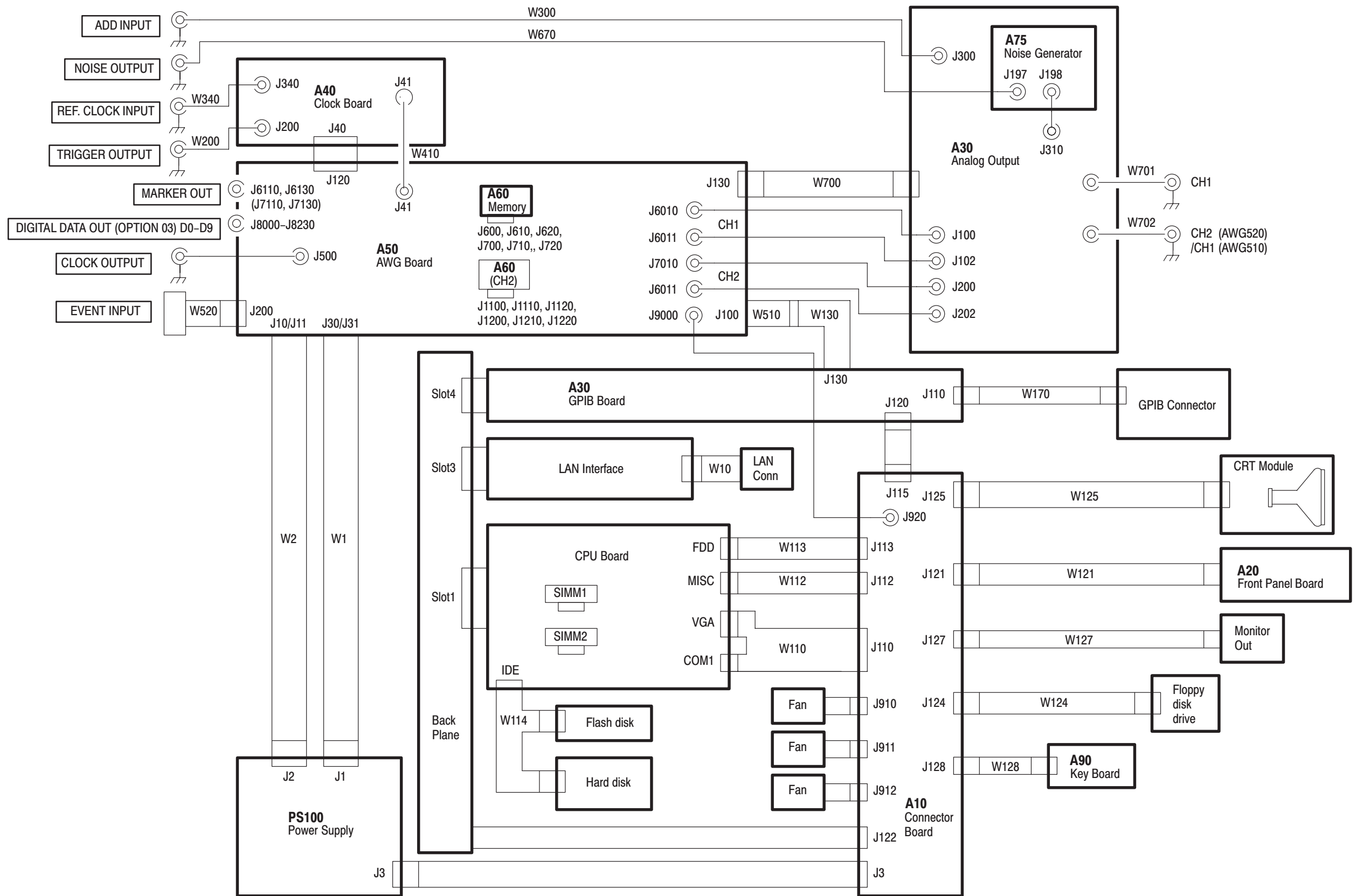


Figure 9-2: Interconnections

Mechanical Parts List

Replaceable Mechanical Parts

This section contains a list of the replaceable modules for the AWG510 and AWG520. 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.

Change information, if any, is located at the rear of this manual.

Part Number Revision Level

Tektronix part numbers contain two digits that show the revision level of the part. For most parts in this manual, you will find the letters XX in place of the revision level number.



When you order parts, Tektronix will provide you with the most current part for your product type, serial number, and modification (if applicable). At the time of your order, Tektronix will determine the part number revision level needed for your product, based on the information you provide.

Module Servicing

Modules can be serviced by selecting one of the following three options. Contact your local Tektronix service center or representative for repair assistance.

Module Exchange. In some cases you may exchange your module for a remanufactured module. These modules cost significantly less than new modules and meet the same factory specifications. For more information about the module exchange program, call 1-800-TEK-WIDE, extension 6630.

Module Repair and Return. You may ship your module to us for repair, after which we will return it to you.

New Modules. You may purchase replacement modules in the same way as other replacement parts.

Using the Replaceable Parts List

This section contains a list of the mechanical and/or electrical components that are replaceable for the generator. Use this list to identify and order replacement parts. The following table describes each column in the parts list.

Parts List Column Descriptions

Column	Column Name	Description
1	Figure & Index Number	Items in this section are referenced by component number.
2	Tektronix Part Number	Use this part number when ordering replacement parts from Tektronix.
3 and 4	Serial Number	Column three indicates the serial number at which the part was first effective. Column four indicates the serial number at which the part was discontinued. No entries indicates the part is good for all serial numbers.
5	Qty	This indicates the quantity of parts used.
6	Name & Description	An item name is separated from the description by a colon (:). Because of space limitations, an item name may sometimes appear as incomplete. Use the U.S. Federal Catalog handbook H6-1 for further item name identification.
7	Mfr. Code	This indicates the code of the actual manufacturer of the part. (Code to name and address cross reference is located after this page.)
8	Mfr. Part Number	This indicates the actual manufacturer's or vendor's part number.

Abbreviations

Abbreviations conform to American National Standard ANSI Y1.1-1972.

Mfr. Code to Manufacturer Cross Index

The following table cross indexes codes, names, and addresses of manufacturers or vendors of components listed in the parts list.

Manufacturers Cross Index

Mfr. Code	Manufacturer	Address	City, State, Zip Code
S3109	FELLER	72 VERONICA AVE UNIT 4	SUMMERSET NJ 08873
TK0392	NORTHWEST FASTENER SALES INC	8058 SW NIMBUS AVENUE	BEAVERTON OR 97008
TK0435	LEWIS SCREW CO	4300 S RACINE AVE	CHICAGO IL 60609-3320
TK1163	POLYCAST INC	9898 SW TIGARD ST	TIGARD OR 97223
TK1287	ENOCH MFG CO	14242 SE 82ND DR PO BOX 98	CLACKAMAS OR 97015
TK1908	PLASTIC MOLDED PRODUCTS	4336 SO ADAMS	TACOMA WA 98409
TK1918	SHIN-ETSU POLYMER AMERICA INC	1181 NORTH 4TH ST	SAN JOSE CA 95112
TK2058	TDK CORPORATION OF AMERICA	1600 FEEHANVILLE DRIVE	MOUNT PROSPECT, IL 60056
TK2432	UNION ELECTRIC	15/F #1, FU-SHING N. ROAD	TAIPEI, TAIWAN ROC
TK2548	XEROX BUSINESS SERVICES DIV OF XEROX CORPORATION	14181 SW MILLIKAN WAY	BEAVERTON OR 97077
OJR05	TRIQUEST CORP	3000 LEWIS AND CLARK HWY	VANCOUVER WA 98661-2999
OKB01	STAUFFER SUPPLY	810 SE SHERMAN	PORTLAND OR 97214
00779	AMP INC	2800 FULLING MILL PO BOX 3608	HARRISBURG PA 17105
07416	NELSON NAME PLATE CO	3191 CASITAS	LOS ANGELES CA 90039-2410
2W733	BELDEN CORPORATION	2200 US HIGHWAY 27 SOUTH PO BOX 1980	RICHMOND IN 47375-0010
24931	SPECIALTY CONNECTOR CO INC	2100 EARLYWOOD DR PO BOX 547	FRANKLIN IN 46131
6D224	HARBOR TRI-TEC A BERG ELECTRONICS COMPANY	14500 SOUTH BROADWAY	GARDENA, CA 90248
61058	MATSUSHITA ELECTRIC CORP OF AMERICA PANASONIC INDUSTRIAL CO DIV	TWO PANASONIC WAY	SECAUCUS NJ 07094
61857	SAN-0 INDUSTRIAL CORP	91-3 COLIN DRIVE	HOLBROOK NY 11741
61935	SCHURTER INC	1016 CLEGG COURT	PETALUMA CA 94952-1152
64537	KDI/TRIANGLE ELECTRONICS	60 S JEFFERSON ROAD	WHIPPANY, NJ 07981
73743	FISCHER SPECIAL MFG CO	111 INDUSTRIAL RD	COLD SPRING KY 41076-9749
75915	LITTELFUSE TRACOR INC SUB OF TRACOR INC	800 E NORTHWEST HWY	DES PLAINES IL 60016-3049
78189	ILLINOIS TOOL WORKS INC SHAKEPROOF DIV	ST CHARLES ROAD	ELGIN IL 60120
80009	TEKTRONIX INC	14150 SW KARL BRAUN DR PO BOX 500	BEAVERTON OR 97077-0001
86928	SEASTROM MFG CO INC	701 SONORA AVE	GLENDALE CA 91201-2431
98291	SEAELECTRO CORP BICC ELECTRONICS	40 LINDEMAN DR	TURNBULL CT 06611-4739

Replaceable Parts List

Fig. & Index Number	Tektronix Part Number	Serial No. Effective	Serial No. Discont'd	Qty	Name & Description	Mfr. Code	Mfr. Part Number
1-1	390-1183-XX			1	CABINET,ASSY:AWG500,AL	80009	3901183XX
-2	348-1115-XX			2	FOOT,CABINET:SLATE GRAY,PLASTIC	80009	3481115XX
-3	212-0210-XX			6	SCREW,MACHINE:M5X20MM L,PNH,STL,MFZN-C, CROSS REC JIS B1111	80009	ORDER BY DESC
-4	159-0407-00			1	FUSE,CARTRIDGE:3AG,6A,250V,FAST BLOW (AMERICAN)	80009	159040700
	159-0210-00				FUSE,CART:DIN 5 X 20MM,5AMP,250VSLOW (EUROPEAN)	61857	ET 5 AMP
-5	200-2264-XX			1	CAP,FUSEHOLDER:3AG FUSES (AMERICAN)	61935	FEK 031.1666
	200-2265-XX			1	CAP,FUSEHOLDER:5 X 20MM FUSES (EUROPEAN)	61935	FEK 031.1663
-6	161-0230-01			1	CABLE ASSY,PWR,;3,18 AWG,92 L,SVT,TAN (STANDARD ACCESSORY)	TK2432	ORDER BY DESC
-7	334-9589-XX			1	MARKER,IDENT:MKD AWG510,POLYCARBONATE	80009	3349589XX
	334-9590-XX			1	MARKER,IDENT:MKD AWG520,POLYCARBONATE	80009	3349590XX
-8	101-0142-XX			1	TRIM,DECORATIVE:FRONT	80009	1010142XX
-9	214-4287-XX			1	ACTUATOR:ELASTOMER MAT,FRONT PANEL,RUBBER	80009	2144287XX

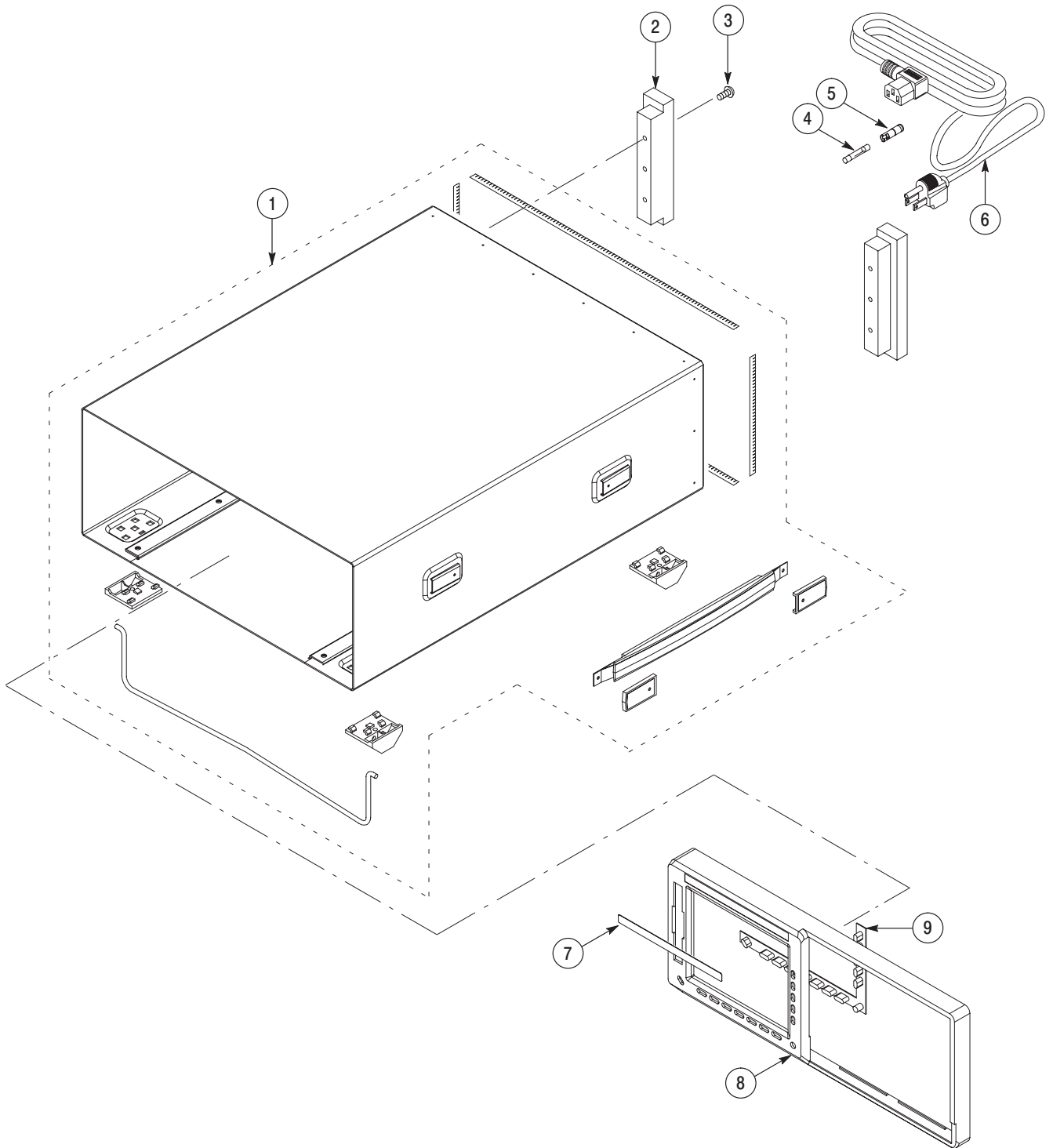


Figure 10-1: Cabinet

Replaceable Parts List

Fig. & Index Number	Tektronix Part Number	Serial No. Effective	Serial No. Discont'd	Qty	Name & Description	Mfr. Code	Mfr. Part Number
2-1	366-2114-XX			2	KNOB:.925DIA	80009	3662114XX
-2	366-2111-XX			3	KNOB:.425DIA	80009	3662111XX
-3	366-2170-XX			1	KNOB:1.700DIA	80009	3662170XX
-4	333-4264-XX			1	PANEL,FRONT:KEYBOARD,AWG500,POLYCARBONATE	80009	3334264XX
-5	124-0469-XX			1	STRIP,TRIM:FRONT PANEL,AL	80009	1240469XX
-6	386-7047-XX			1	SUBPANEL,FRONT:KEYBOARD,AL	80009	3867047XX
-7	380-0927-XX			1	HOLDER,SWITCH	80009	3800927XX
-8	348-1160-XX			2	SHIELD,ELEC:SST,W/CHEVRONS,0.4 PITCH,8.0 L	80009	3481160XX
-9	348-1159-XX			2	SHIELD,ELEC:SST,W/CHEVRONS,0.4 PITCH,5.0 L	80009	3481159XX
-10	214-4287-XX			1	ACTUATOR:ELASTOMER MAT,FRONT PANEL,RUBBER	80009	2144287XX
-11	377-0579-XX			5	INSERT,KNOB:PLASTIC	80009	3770579XX
-12	671-4325-XX			1	CIRCUIT BOARD:A20,FRONT PANEL	80009	6714325XX
-13	211-0946-XX			6	SCREW,ASSEM WSHR:M3 X 10MM,PNH,STL ZN PL, W/FLAT & LOCK WSHR	80009	ORDER BY DESC
-14	348-1368-XX			36 cm	GASKET,SHIELD:FINGER TYPE,BE-CU, 609.6MM LW/ADHESIVE	80009	3481368XX
-15	386-7046-XX			1	SUBPANEL,FRONT:BNC,AL	80009	3867046XX
-16	333-4262-XX			1	PANEL,FRONT:BNC,AWG510,POLYCARBONATE	80009	3334262XX
	333-4263-XX			1	PANEL,FRONT:BNC,AWG520,POLYCARBONATE	80009	3334263XX
-17	131-1315-XX			1	CONN,RF,JACK:BNC,50OHM,FEMALE,STR,PELTORA, PANEL MOUNT	80009	1311315XX

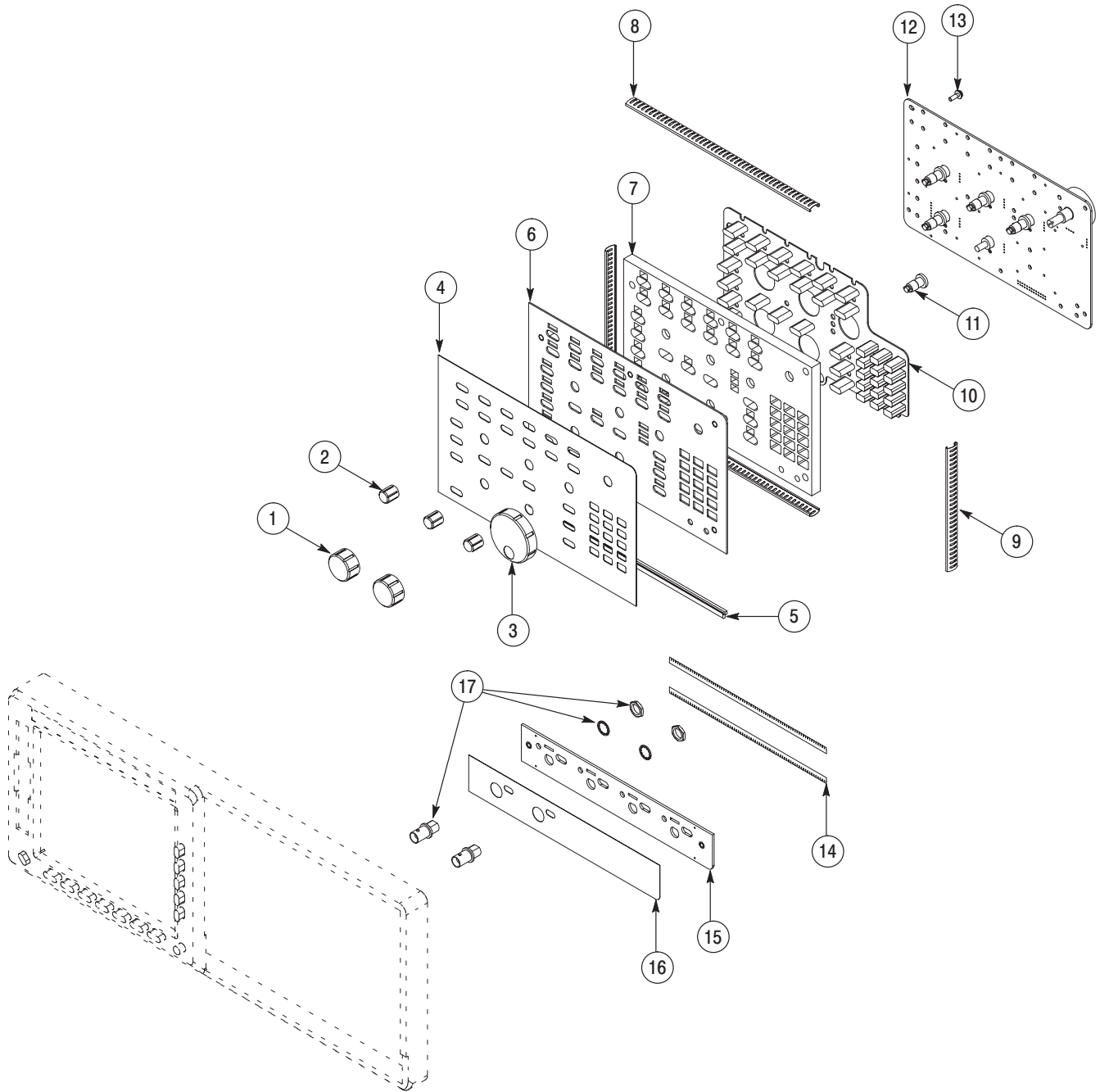


Figure 10-2: Front panel

Replaceable Parts List

Fig. & Index Number	Tektronix Part Number	Serial No. Effective	Serial No. Discont'd	Qty	Name & Description	Mfr. Code	Mfr. Part Number
3-1	671-4324-XX			-	CIRCUIT BOARD:A10,CONNECTOR	80009	6714324XX
-2	159-0236-01			1	FUSE,WIRE-LEAD:AXI,10A,125V,FAST	80009	159023601
-3	159-0335-00			1	FUSE,WIRE-LEAD:AXI,1A,125V,FAST	80009	159033500
-4	159-0416-00			1	FUSE,WIRE-LEAD:AXI,7A,125V,FAST	80009	159041600
-5	159-0059-01			1	FUSE,WIRE-LEAD:AXI,5A,125V,FAST	80009	159005901
-6	212-0216-XX			5	SCREW,MACHINE:M4X8MM L,PNH,STL,MFZN-C, CROSS REC	80009	ORDER BY DESC
-7	211-0945-XX			1	SCREW,MACHINE:M4X8MM L,PNH,STL,MFZN-C, CROSS REC	80009	ORDER BY DESC
-8	210-0008-XX			1	WSHR,LOCK:#8 INTL,0.02 THK,STL CD PL	80009	2100008XX
-9	620-0067-XX			-	POWER SUPPLY	80009	6200067XX
-10	211-0945-XX			6	SCREW,MACHINE:M4X8MM L,PNH,STL,MFZN-C, CROSS REC	80009	ORDER BY DESC

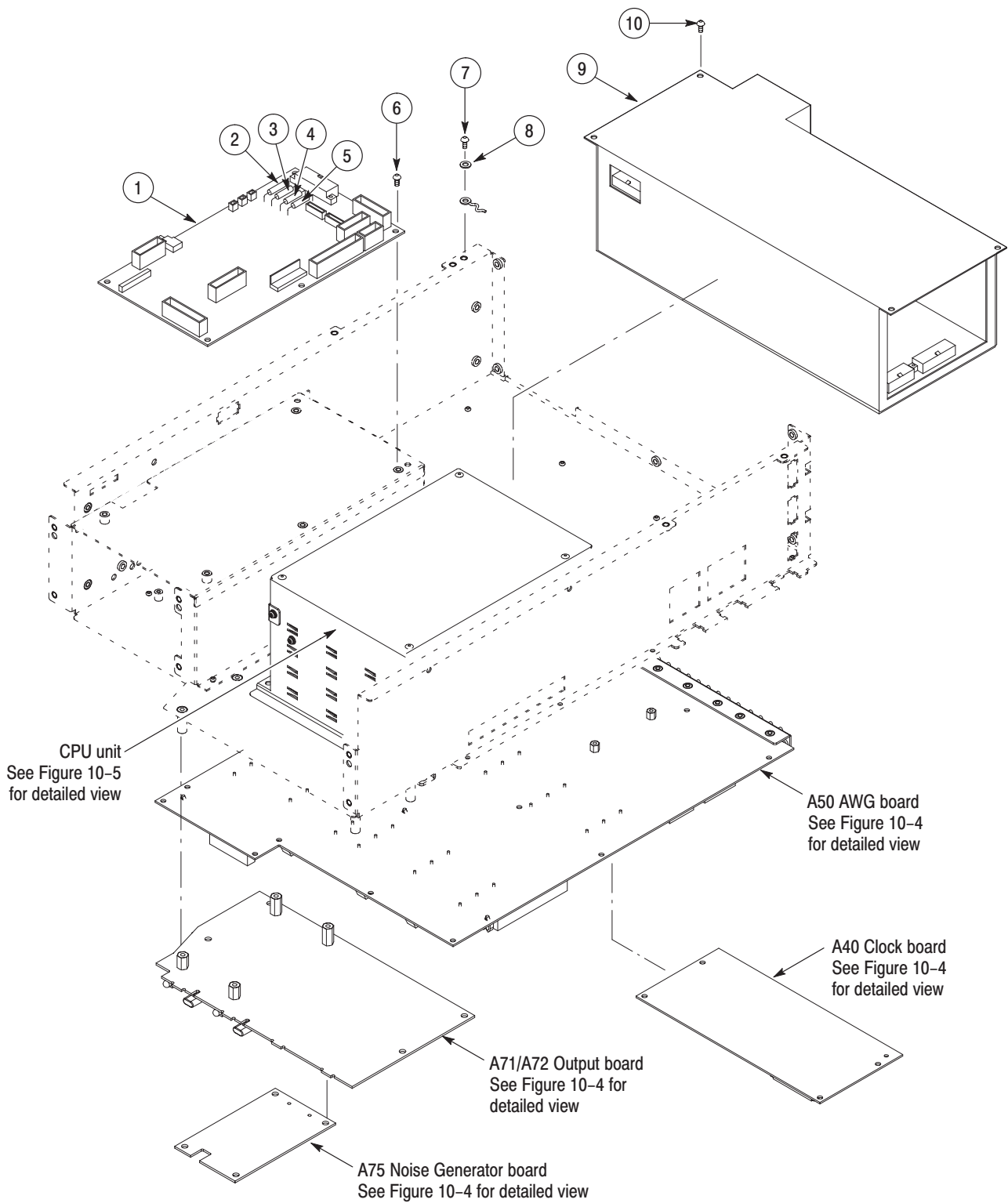


Figure 10-3: Outer chassis modules

Replaceable Parts List

Fig. & Index Number	Tektronix Part Number	Serial No. Effective	Serial No. Discont'd	Qty	Name & Description	Mfr. Code	Mfr. Part Number
4-1	671-4319-XX			-	CIRCUIT BOARD:A71/A72,OUTPUT (AWG510)	80080	6714319XX
	671-4320-XX			-	CIRCUIT BOARD:A71/A72,OUTPUT (AWG520)	80080	6714320XX
-2	212-0216-XX			4	SCREW,MACHINE:M4X8MM L,PNH,STL,MFZN-C, CROSS REC	80009	ORDER BY DESC
-3	212-0216-XX			4	SCREW,MACHINE:M4X8MM L,PNH,STL,MFZN-C, CROSS REC	80009	ORDER BY DESC
-4	671-4321-XX			-	CIRCUIT BOARD:A75,NOISE GENERATOR	80009	6714321XX
-5	366-0793-XX			2	PUSH BUTTON:TEK TAN	80009	3660793XX
-6	343-1613-XX			4	RETAINER,CKT BD:A60 MEMORY,SST	80009	3431613XX
-7	671-4318-XX			-	CIRCUIT BOARD:A60,MEMORY	80009	6714318XX
-8	212-0216-XX			6	SCREW,MACHINE:M4X8MM L,PNH,STL,MFZN-C, CROSS REC	80009	ORDER BY DESC
-9	131-6391-XX			-	CONN,RF JACK:SMB,;MALE,STR,50OHM,PNL MOUNT; LEAD 5MM L	80009	1316391XX
-10	212-0216-00			4	SCREW,MACHINE:M4X8MM L,PNH,STL,MFZN-C, CROSS REC	80009	ORDER BY DESC
-11	671-4316-XX			-	CIRCUIT BOARD:A40,CLOCK	80009	6714316XX
-12	212-0216-XX			12	SCREW,MACHINE:M4X8MM L,PNH,STL,MFZN-C, CROSS REC	80009	ORDER BY DESC
-13	671-4317-XX			-	CIRCUIT BOARD:A50,AWG (AWG510 STANDARD)	80009	6714317XX
	671-4335-XX			-	CIRCUIT BOARD:A50,AWG (AWG510 OPTION 03)	80009	6714335XX
	671-4333-XX			-	CIRCUIT BOARD:A50,AWG (AWG520 STANDARD)	80009	6714333XX
	671-4334-XX			-	CIRCUIT BOARD:A50,AWG (AWG520 OPTION 03)	80009	6714334XX

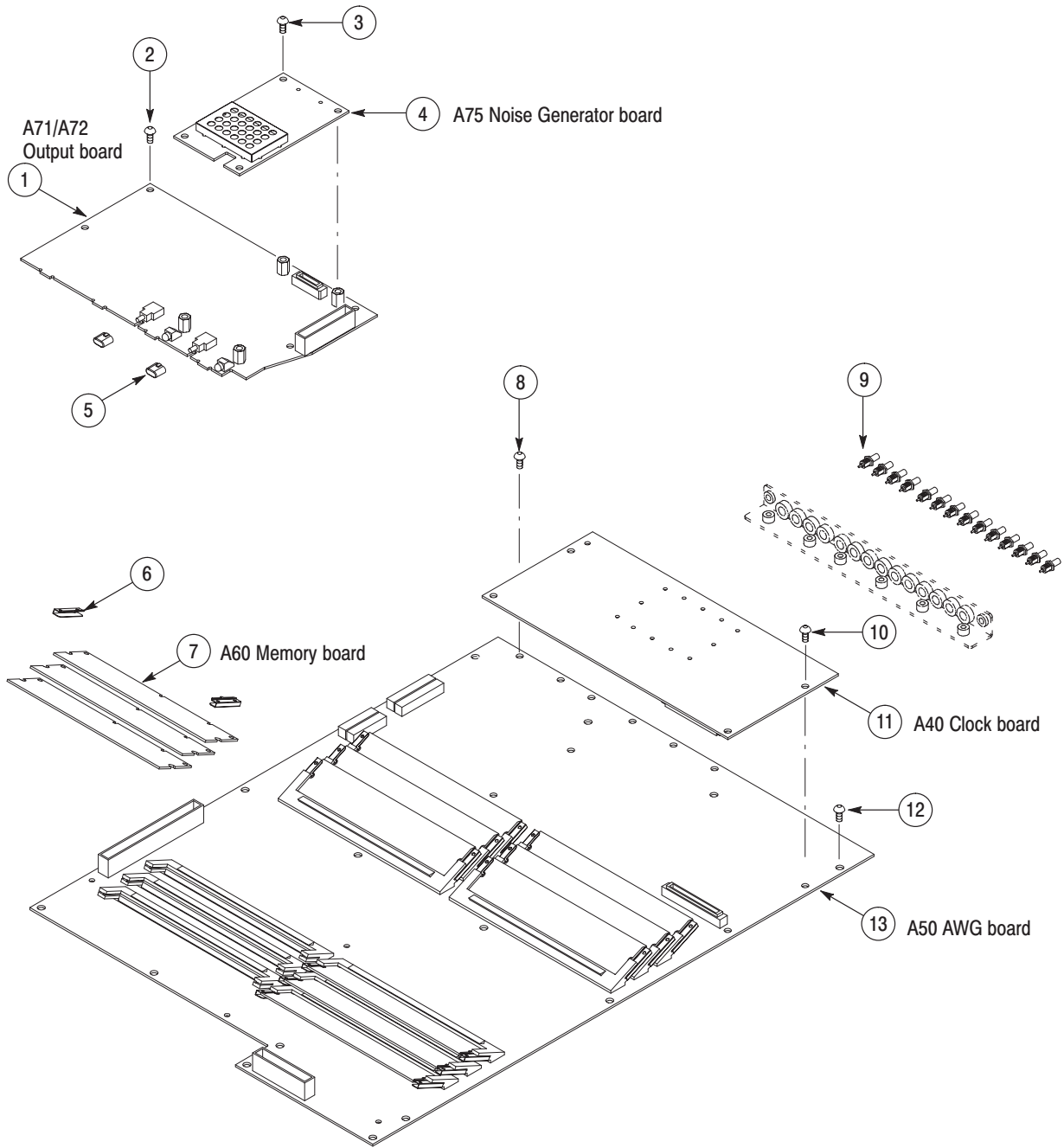


Figure 10-4: Circuit boards

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	119-5774-XX			-	BOARD,ASSY:BACKPLANE	80009	1195774XX
-2	211-0946-XX			4	SCREW,ASSEM WSHR:M3 X 10MM,PNH,STL ZN PL, W/FLAT & LOCK WSHR	80009	ORDER BY DESC
-3	211-0946-XX			2	SCREW,ASSEM WSHR:M3 X 10MM,PNH,STL ZN PL, W/FLAT & LOCK WSHR	80009	ORDER BY DESC
-4	343-1614-XX			1	RETAINER,CKT BD:CPU,AL	80009	3431614XX
-5	211-0946-XX			1	SCREW,ASSEM WSHR:M3 X 10MM,PNH,STL ZN PL, W/FLAT & LOCK WSHR	80009	ORDER BY DESC
-6	119-5775-XX			-	BOARD,ASSY:CPU ¹ NOTE: The 3 V, 190 mAh Lithium battery on the CPU board is not user-replaceable. Removing the battery erases configuration and calibration data. Replace the CPU board as a unit.	80009	1195775XX
-7	119-5776-XX			-	BOARD,ASSY:LAN ¹	80009	1195776XX
-8	671-4315-XX			-	CIRCUIT BOARD:A30,GPIB	80009	6714315XX
-9	211-0946-XX			4	SCREW,ASSEM WSHR:M3 X 10MM,PNH,STL ZN PL, W/FLAT & LOCK WSHR	80009	ORDER BY DESC
-10	211-0871-XX			4	SCREW,ASSEM WSHR:M3 X 6MM L,STL,ZN PL, W/FLAT & LOCK WSHR	80009	ORDER BY DESC
-11	211-0871-XX			3	SCREW,ASSEM WSHR:M3 X 6MM L,STL,ZN PL, W/FLAT & LOCK WSHR	80009	ORDER BY DESC
-12	119-5779-XX			-	FLASH DISK ¹	80009	1195779XX
-13	119-5778-XX			-	HARD DISK ¹	80009	1195778XX

1 These modules are calibrated and initialized before shipment.

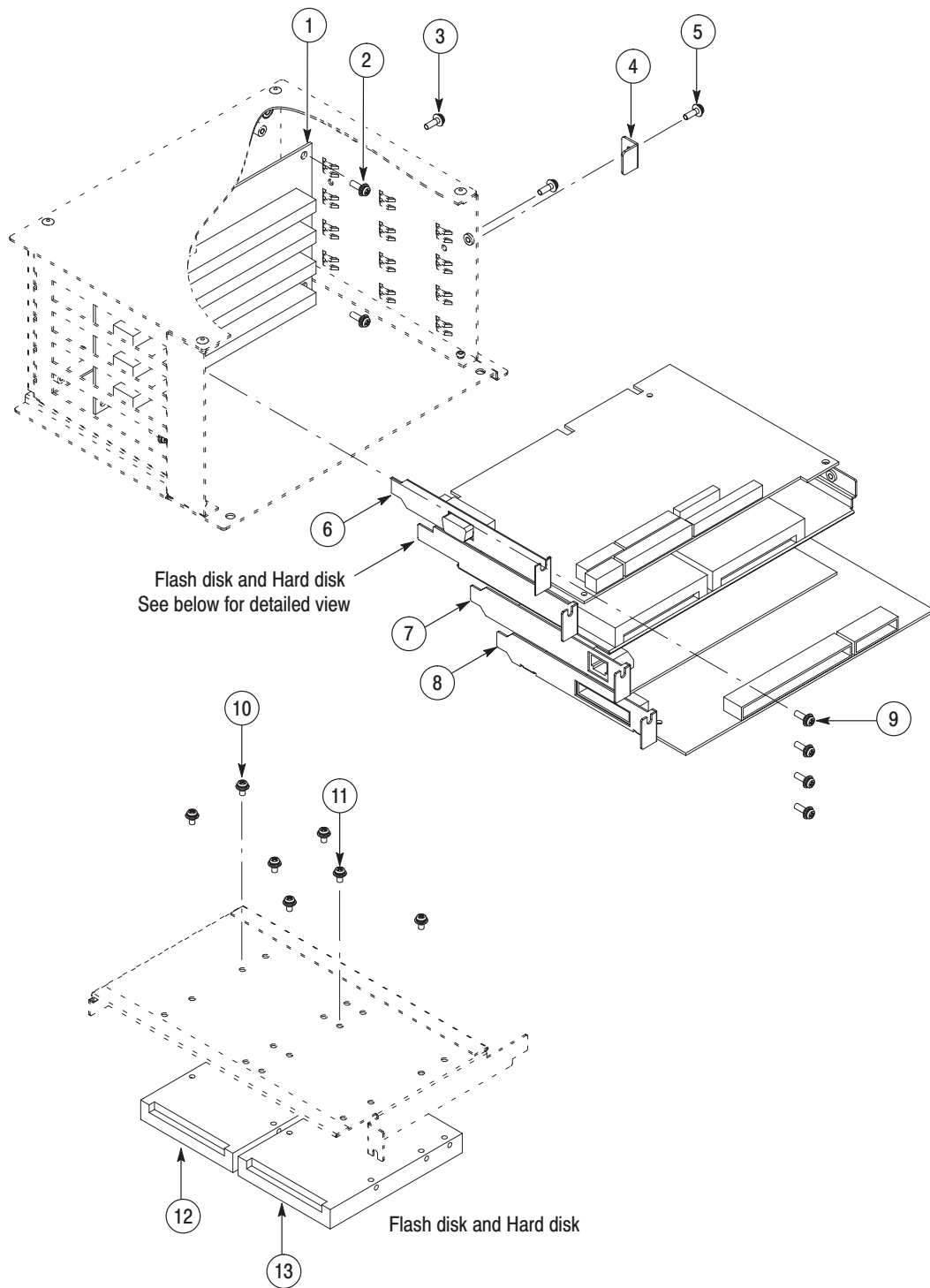


Figure 10-5: CPU unit

Replaceable Parts List

Fig. & Index Number	Tektronix Part Number	Serial No. Effective	Serial No. Discont'd	Qty	Name & Description	Mfr. Code	Mfr. Part Number
6-1	211-0946-XX			1	SCREW,ASSEM WSHR:M3 X 10MM,PNH,STL ZN PL, W/FLAT & LOCK WSHR	80009	ORDER BY DESC
-2	407-4554-XX			1	BRACKET,CONN:MODULAR CONN	80009	4074554XX
-3	174-3880-XX			-	CABLE,ASSY:W10,LAN	80009	1743880XX
-4	220-0194-XX			1	NUT,PLATE:STL	80009	ORDER BY DESC
-5	174-3881-XX			-	CABLE,ASSY:W170,GPIB	80009	1743881XX
-6	671-4326-XX			-	CIRCUIT BOARD:A90,KEYBOARD	80009	6714326XX
-7	129-1493-XX			2	SPACER,POST:5MM L,M3.5 INT/M3 EXT,STL,BLK ZN PL, 7MM HEX	80009	1291493XX
-8	174-3879-XX			-	CABLE,ASSY:W127,DISPLAY MONITOR OUT	80009	1743879XX
-9	129-1051-XX			4	SPACER,POST:4.8MM L,4-40INT/4-40EXT, STL 4.8MM HEX W/WSHR	80009	1291051XX
-10	174-3878-XX			-	CABLE,ASSY:W520,EVENT OUT	80009	1743878XX
-11	131-1315-XX			-	CONN,RF,JACK:BNC,50OHM,FEMALE,STR,PELTORA, PANEL MOUNT	80009	1311315XX
-12	211-0945-XX			6	SCREW,MACHINE:M4X8MM L,PNH,STL,MFZN-C, CROSS REC	80009	ORDER BY DESC
-13	386-7000-XX			1	SUBPANEL,FRONT(FINISHED)	80009	3867000XX
-14	348-1569-XX			114 cm	SHLD GASKET,ELEC:MESH TYPE,3.2MM OD, SI SPONGE CORE	80009	3481569XX
-15	344-0472-XX			8	BUSHING:BUSHING,NYLON,GRAY	80009	3440472XX
-16	343-0549-XX			3	STRAP,TIEDOWN:1.6-19MM DIA,66NYLON	80009	3430549XX
-17	220-0193-XX			2	NUT,PLAIN,HEX:M4X7MM HEX,STL,ZN-C	80009	ORDER BY DESC

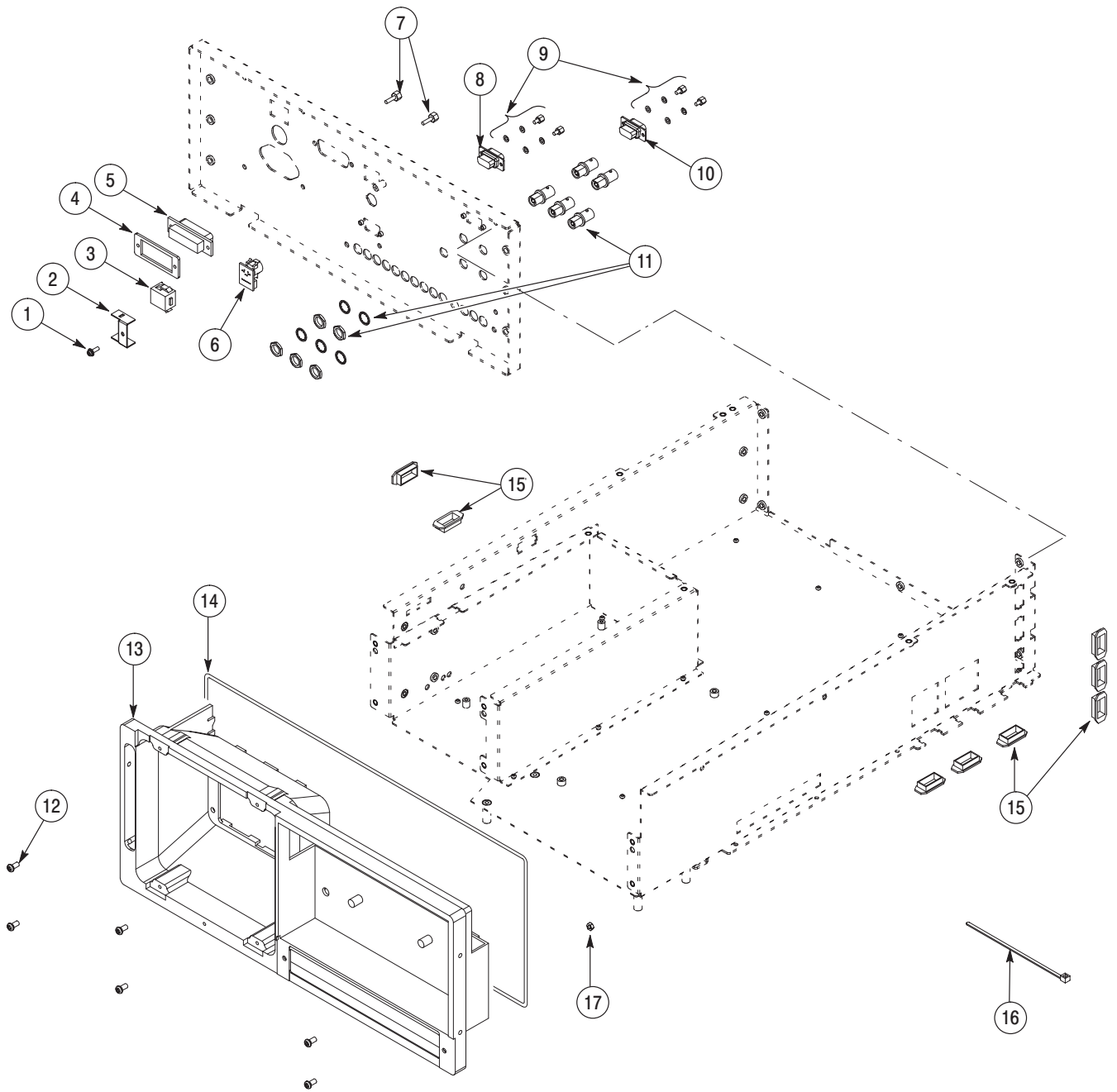


Figure 10-6: Chassis

Replaceable Parts List

Fig. & Index Number	Tektronix Part Number	Serial No. Effective	Serial No. Discont'd	Qty	Name & Description	Mfr. Code	Mfr. Part Number
7-1	211-0854-XX			2	SCREW,MACHINE:M2.6 X 4MM L,BDGH,STL,MFZN-C, CLOSS REC,JIS B1111	80009	ORDER BY DESC
-2	119-4404-XX			-	FLOPPY DISK DRIVE:	80009	1194404XX
-3	211-0945-XX			2	SCREW,MACHINE:M4X8MM L,PNH,STL,MFZN-C, CROSS REC	80009	ORDER BY DESC
-4	211-0948-XX			12	SCREW,MACHINE:M4X45MM L,PNH,STL,MFZN-C, CROSS REC W/FLAT & LOCK WSHR	80009	ORDER BY DESC
-5	119-5777-XX			-	FAN,TUBEAXIAL:12V,0.6A,7.2W,2520RPM,3.04MMM	80009	1195777XX
-6	343-0549-XX			4	STRAP,TIEDOWN:1.6-19MM DIA,66NYLON	80009	3430549XX

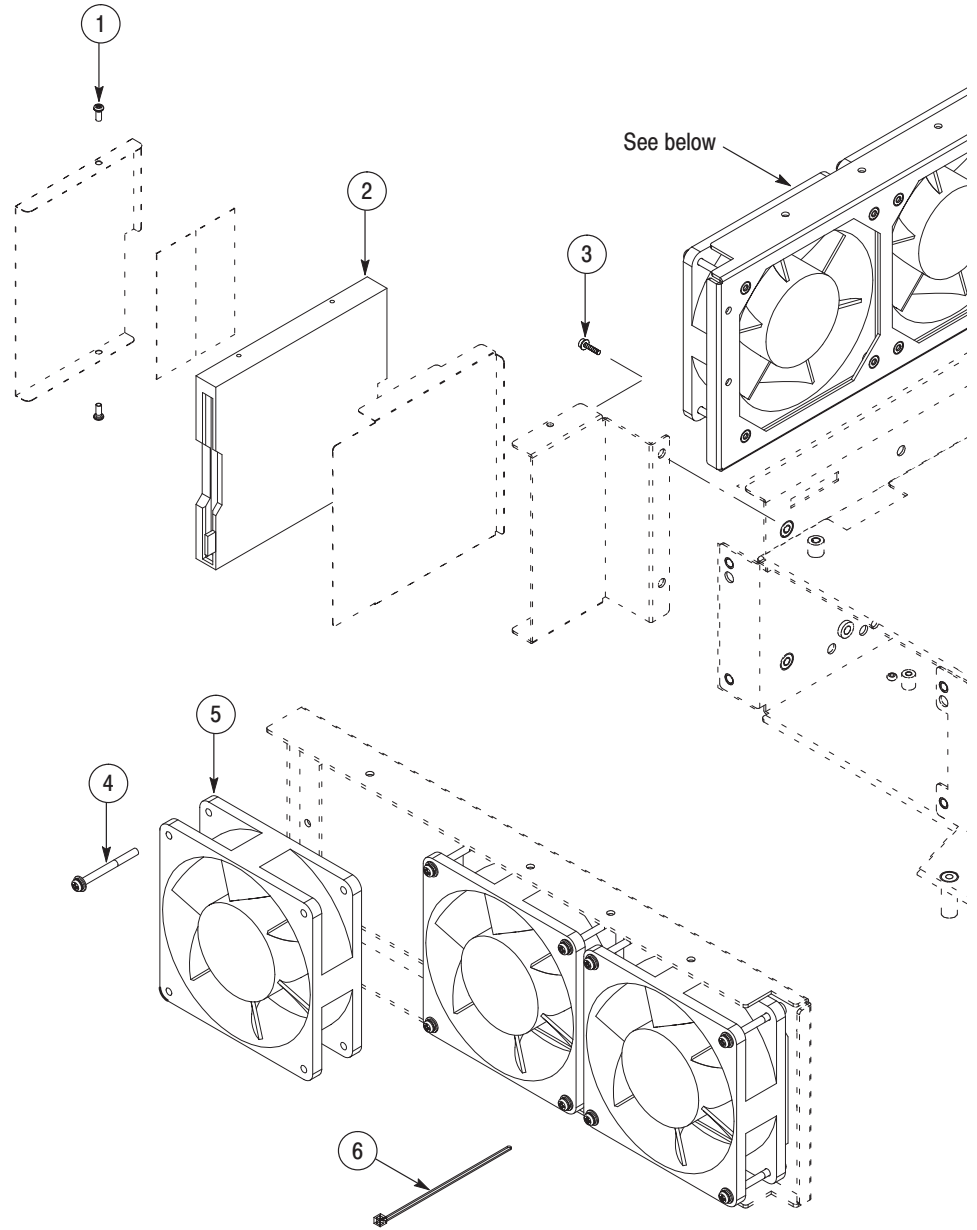


Figure 10-7: Floppy disk and Fan

Replaceable Parts List

Fig. & Index Number	Tektronix Part Number	Serial No. Effective	Serial No. Discont'd	Qty	Name & Description	Mfr. Code	Mfr. Part Number
8-1	211-0945-XX			3	SCREW,MACHINE:M4X8MM L,PNH,STL,MFZN-C, CROSS REC	80009	ORDER BY DESC
-2	259-0070-XX			1	FLEX CIRCUIT:	80009	2590070XX
-3	426-2576-XX			1	FRAME,DISPLAY:MAIN FILTER,AL	80009	4262576XX
-4	378-0448-XX			1	FILTER,LIGHT:ACRILIC	80009	3780448XX
-5	386-6211-02			1	RETAINER,FILTER:DUST SEAL ASSY,LEXAN	80009	386621102
-6	211-0945-XX			2	SCREW,MACHINE:M4X8MM L,PNH,STL,MFZN-C, CROSS REC	80009	ORDER BY DESC
-7	640-0071-04			-	CRT	80009	640007104
-8	211-0946-XX			6	SCREW,ASSEM WSHR:M3 X 10MM,PNH,STL ZN PL, W/FLAT & LOCK WSHR	80009	ORDER BY DESC
-9	211-0945-XX			2	SCREW,MACHINE:M4X8MM L,PNH,STL,MFZN-C, CROSS REC	80009	ORDER BY DESC

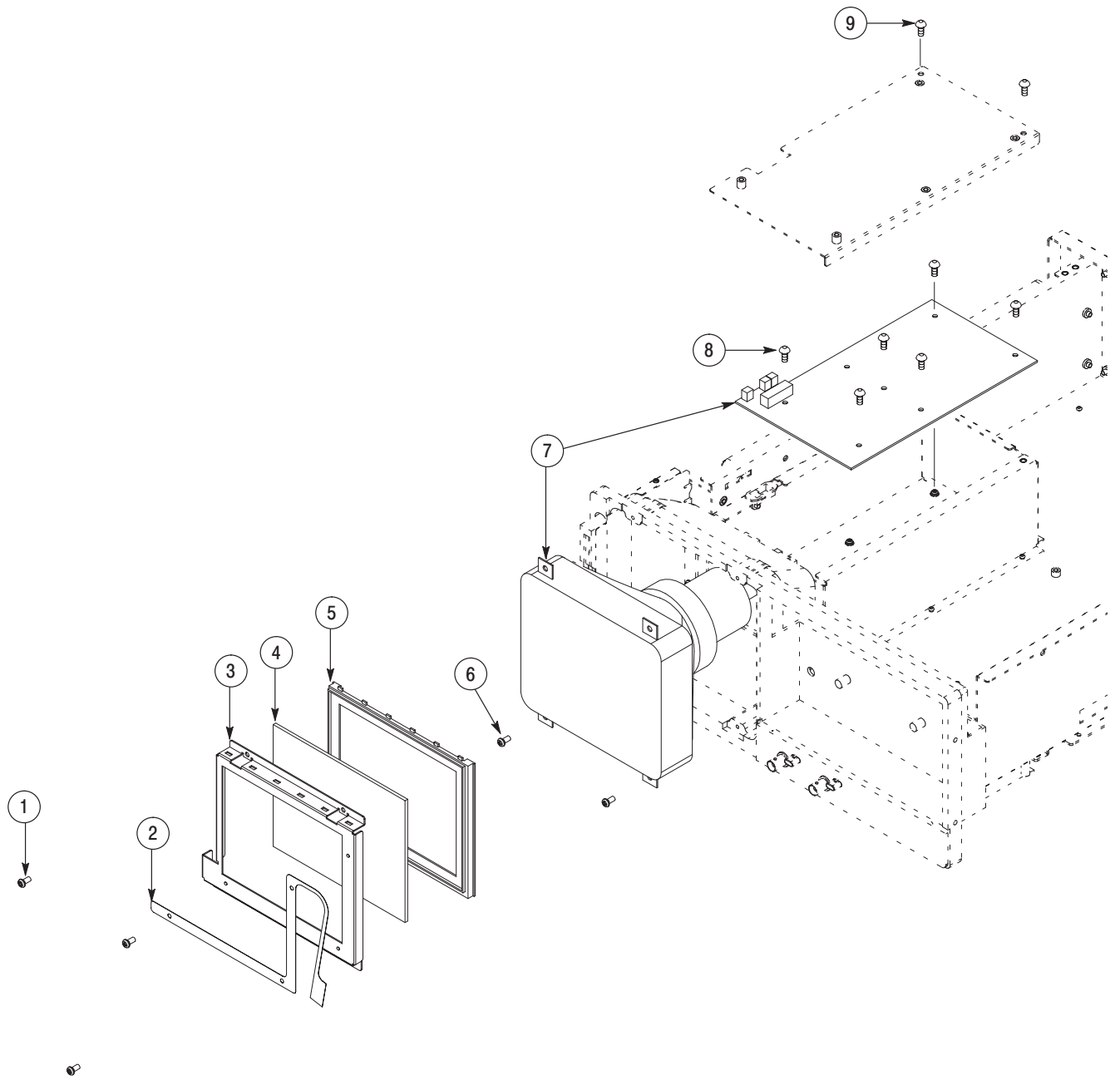


Figure 10-8: Display

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	351-0623-XX			1	SLIDE,DWR,EXT:22.0 X 1.54,STEELSAFETY CONTROLLED	80009	3510623XX
-2	212-0507-XX			4	SCREW,MACHINE:10-32 X 0.375,PNH,STL CD PL,POZ	80009	ORDER BY DESC
-3	351-0313-XX			1	GUIDE,RACKMOUNT:19.218 L,PAIR	80009	3510313XX
-4	407-4555-XX			2	BRACKET,SUPPORT:SIDE,RACKMOUNT,AL	80009	4074555XX
-5	212-0214-XX			6	SCREW,MACHINE:M5X12MM L,PNH,STL ZN PL, CROSS REC W/FLAT & LOCK WSHR	80009	ORDER BY DESC
-6	212-0509-XX			4	SCREW,MACHINE:10-32 X 0.625,PNH,STL CD PL,POZ	80009	ORDER BY DESC
-7	210-1003-XX			4	WSHR,FLAT:0.2 ID X 0.438 OD X 0.036 BRS NP	80009	ORDER BY DESC
-8	210-0142-XX			4	WSHR,PLAIN:5.5MM ID X 12MM OD,TEFLON	80009	ORDER BY DESC
-9	212-0215-XX			4	SCREW,MACHINE:M4X12MM L,PNH,STL,MFZN-C, CROSS REC	80009	ORDER BY DESC
-10	407-4020-XX			2	BRACKET,SUPPORT:FRONT,ALUMINUM	80009	4074020XX
-11	212-0507-XX			4	SCREW,MACHINE:10-32 X 0.375,PNH,STL CD PL,POZ	80009	ORDER BY DESC
-12	367-0022-XX			2	HANDLE,BOW:4.579 L,BRS CRPL	80009	3670022XX
-13	101-0142-01			1	TRIM,DECORATIVE:FRONT	80009	101014201

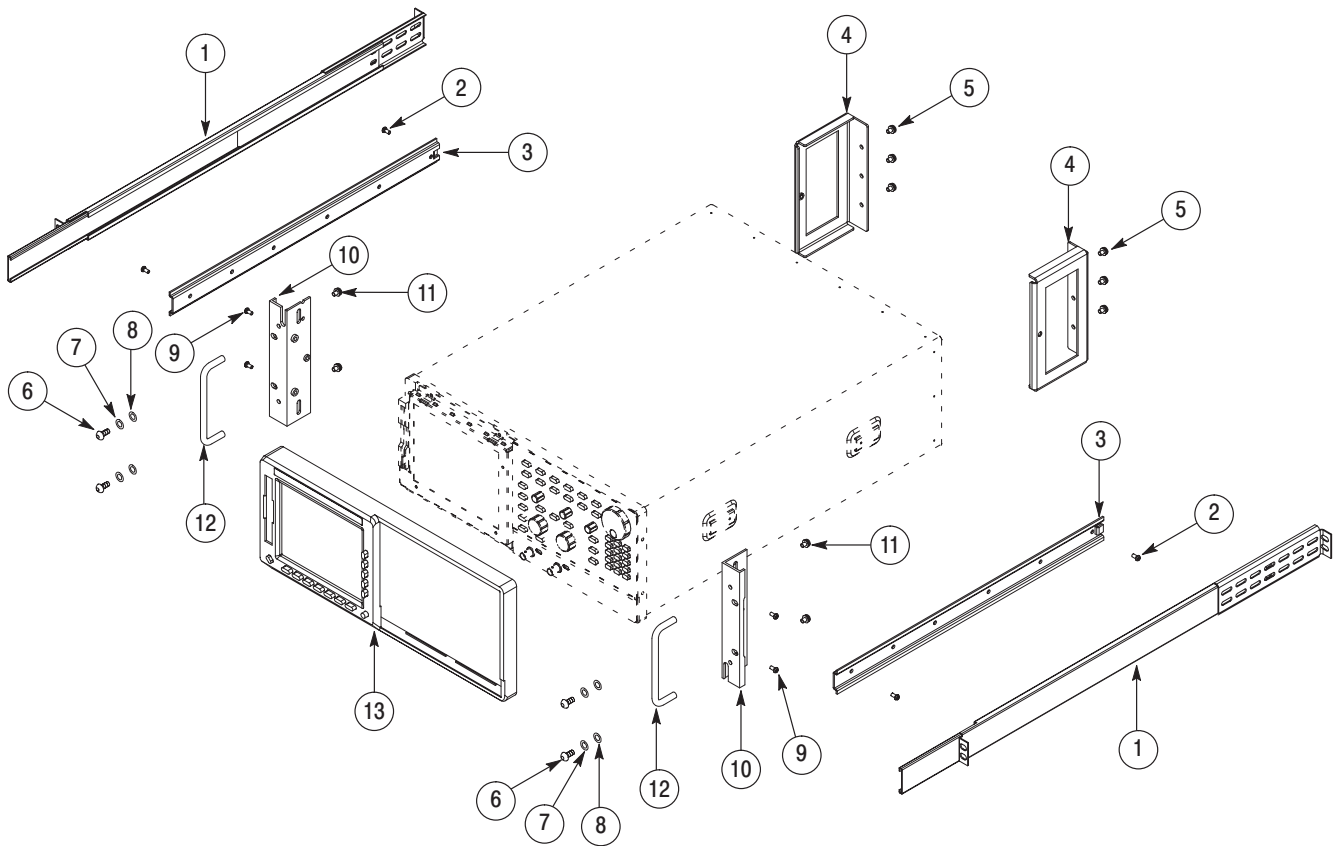


Figure 10-9: Rack mount

Replaceable Parts List

Fig. & Index Number	Tektronix Part Number	Serial No. Effective	Serial No. Discont'd	Qty	Name & Description	Mfr. Code	Mfr. Part Number
STANDARD ACCESSORIES							
	063-2981-XX			1	SOFTWARE PKG:3.5 DISK,AWG500 WAVEFORM LIB		0632981XX
	063-2982-XX			1	SOFTWARE PKG:3.5 DISK,AWG500 SERIES SAMPLE PRGM		0632982XX
	063-2983-XX			1	SOFTWARE PKG:3.5 DISK,AWG500 PERF CHECK/ADJ		0632983XX
	071-0099-XX			1	MANUAL,TECH:USER,AWG500		0710099XX
	071-0100-XX			1	MANUAL,TECH:PROGRAMMER,ENGLISH VERSION,AWG		0710100XX
	-----			1	CABLE ASSY,PWR:3,18 AWG,92 L,SVT,TAN (SEE FIGURE 10-1-6)		
	161-0104-06			1	CA ASSY,PWR:3,1.0MM SQ,250V/10A,2.5 METER (OPTION A1 - EUROPEAN)	S3109	198-010
	161-0104-07			1	CA ASSY,PWR:3,1.0MM SQ,240V/10A,2.5 METER (OPTION A2 - UNITED KINGDOM)	S3109	209010
	161-0104-05			1	CA ASSY,PWR:3,1.0MM SQ,250V/10A,2.5 METER (OPTION A3 - AUSTRALIAN)	S3109	198-010
	161-0104-08			1	CA ASSY,PWR:3,18 AWG,250/10A,98 INCH L (OPTION A4 - NORTH AMERICAN)	2W733	ORDER BY DESC
	161-0167-00			1	CA ASSY,PWR:3,0.75MM SQ,250V/10A,2.5 METER (OPTION A5 - SWITZERLAND)	S3109	ORDER BY DESC
OPTIONAL ACCESSORIES							
	011-0049-XX			1	TERMN,COAXIAL:50 OHM,2W,BNC	64537	T132DS
	012-0991-XX			1	CABLE,INTCON:SHLD CMPST,GPIB;CRC,12 TW PR	6D224	81190-020
	012-1256-XX			1	CABLE,INTCON:50 OHM COAX,98.0 L	80009	0121256XX
	012-1342-XX			1	CA ASSY,RF:COAXIAL,;RFD,50 OHM,24 L,BNC,MALE	80009	0121342XX
	012-1458-XX			1	CA ASSY,RF:50 OHM COAX,100CM L,SMB-SMB	80009	0121458XX
	012-1459-XX			1	CA ASSY,RF:50 OHM COAX,100CM L,SMB-BNC	80009	0121459XX
	015-0657-XX			1	FILTER,LOW PASS:100MHZ,50 OHM,BNC,TUBULAR	80009	0150657XX
	015-0658-XX			1	FILTER,LOW PASS:200MHZ,50 OHM,BNC,TUBULAR	80009	0150658XX
	015-0659-XX			1	FILTER,LOW PASS:400MHZ,50 OHM,BNC,TUBULAR	80009	0150659XX
	015-0660-XX			1	FILTER,LOW PASS:DC-800MHZ,50 OHM,0.5W,BNC	80009	0150660XX
	200-3696-01			1	COVER,FRONT:PLASTIC	80009	200369601
	071-0101-XX			1	MANUAL,TECH:SERVICE,AWG500	80009	0710101XX

