

Service Manual



DG2040 Data Generator

071-0259-50

Warning

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

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General Safety Summary

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

Only qualified personnel should perform service procedures.

To Avoid Fire or Personal Injury

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

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

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

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

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.

Introduction

This manual contains information needed to properly service the DG2040 Data Generator, as well as general information critical to safe and effective servicing.

To prevent personal injury or damage to the DG2040 Data 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 vii
- Read the *Operating Information* section beginning on page 2-1

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

Performance Verification Interval

Generally, the performance verification should be done every 12 months and is recommended after the replacement of a module.

If the DG2040 Data Generator does not meet performance criteria, repair is necessary.

Strategy for Servicing

This manual contains all the information needed for periodic maintenance of the DG2040 Data Generator. (Examples of such information are procedures for checking performance.)

Further, the manual contains all information for corrective maintenance at the module level. To isolate a failure to a module, use the troubleshooting procedures found in *Maintenance:Troubleshooting section*, beginning on page 6-1. To remove and replace any failed module, follow the instructions in the *Maintenance:Removal and Installation Procedures* beginning on page 6-15. After isolating a faulty module, replace it with a fully-tested module obtained from your local Tektronix distributor or sales office. The *Replaceable Mechanical Parts section*, beginning on page 10-1, 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 trained to service the DG2040 Data Generator. They have access to the latest information on improvements to the DG2040 Data Generator as well as the latest new options.

Warranty Repair Service

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

Preface

This is the service manual for the DG2040 Data Generator. The manual contains information needed to service the data generator to the module level.

Manual Structure

This manual is divided into sections, such as the *Specification* and *Theory of Operation*. 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. Following is a brief description of each manual section.

- The *Specification* section contains a description of the DG2040 Data Generator and the characteristics that apply to it.
- The *Operating Information* section includes general information and operating instructions.
- The *Theory of Operation* section contains circuit descriptions that support service to the module level.
- The *Performance Verification* section contains procedures to verify that the DG2040 Data Generator functions properly and meets warranted limits.
- The *Adjustment Procedure* section contains a statement explaining that no adjustment is needed for the DG2040 Data Generator.
- The *Maintenance* section contains information and procedures to perform preventive and corrective maintenance of the DG2040 Data Generator. These instructions include cleaning, module removal and installation, and fault isolation to the module.
- The *Options* section contains information for servicing factory-installed options.
- The *Replaceable Electrical Parts* section contains a statement that refers you to the *Replaceable Mechanical Parts*. Both the electrical and mechanical replaceable parts are listed in the mechanical section.
- The *Diagrams* section contains block diagrams and an interconnect diagram.
- The *Replaceable Mechanical Parts* section 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 DG2040 Data Generator front panel and menus. Front panel names are all upper-case letters; for example, SETUP MENU, HARDCOPY, etc.
- Instruction steps are numbered unless there is only one step.

Modules

Throughout this manual, any replaceable component, assembly, or part of the DG2040 Data 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 DG2040 Data 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 DG2040 Data Generator includes:

- The DG2040 Data Generator User Manual contains a tutorial that explains how to operate the DG2040 Data Generator. Also included is instructions explaining how to use other DG2040 Data Generator features.
- The DG2040 Data Generator Programmer Manual explains how to use a GPIB or RS-232 interface to remotely control the DG2040 Data Generator.

Contacting Tektronix

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

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

Product Overview

The DG2040 Data Generator is a portable digital data generator designed for high performance and ease of use. The DG2040 Data Generator is easy to use for testing and evaluating semiconductors and logic circuits, which are continually becoming faster and more complex. The DG2040 Data Generator provides high performance and a wide range of functions in a compact package.

Main Features

Following are the main features of the DG2040 Data Generator :

- Maximum data rate of 1.1 GHz
- 256 K word pattern memory
- Flexible sequence looping (which does the equivalent of over a billion word patterns)
- Two channels (Complementary)
- For each output channel:
 - Variable output levels (from -1.125 to $+3.5$ V, into $50\ \Omega$)
 - Edge Control function (CH0 only)
 - Delay setting (-1.0 ns to $+2.0$ ns, 10 ps resolution)
- Serial/Parallel pattern editing

Any memory size from 360 words to 256 K words can be used easily with no restrictions within that range. Either of the two bit data channels can be assigned to any output channel. The output channels support setting of high and low output voltage levels, and delay time. CH0 supports edge position.

The DG2040 Data Generator also provides a 4000-step sequence controller, which enables the generation of not only a data pattern longer than the pattern memory but also dynamic pattern change triggered by external events.

The DG2040 Data Generator provides flexible data editing functions, including word and line unit input and extended data creation functions. The DG2040 Data Generator also provides functions that are required for system construction, such as a sequencing function which is a jump function using external input.

Applications

Following are some of the DG2040 Data Generator applications:

- Supports subassembly and system testing by simulating the digital signals from incomplete sections of a product
- Performs margin tests by using the DG2040 Data Generator to generate patterns that have a low probability of occurrence or are difficult to generate
- Constructs interactive digital simulation systems by using the sequence output, external jump, and tristate control functions
- Uses flexible data output functions to make the DG2040 Data Generator an ideal data generator for simulation of semiconductor devices and drivers specific to serial data communication and all types of digital circuits
- Performs various timing analysis and jitter/wander tests by using the edge control function to generate jitter on all the edges or selected edge(s)

Specifications

General Characteristics

This section describes the general characteristics of the DG2040 Data Generator.

All specifications are guaranteed unless labeled “typical”. Typical specifications are provided for your convenience but are not guaranteed. Specifications marked with the \surd symbol are checked in the performance verification procedure beginning on page 4-1.

The certification and compliances for the DG2040 Data Generator are found at the end of this appendix.

Performance Conditions

The electrical characteristics are valid under the following conditions:

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

Table 1-1: Electrical characteristics

Characteristics	Description
Operation mode ¹	
Repeat	Pattern data is repeatedly output. When a sequence is specified, patterns are repeated according to the sequence order. The extended sequence functions such as trigger wait, event jump, and so on are ignored in this mode.
Single	Pattern data is output only once. When a sequence is specified, a trigger signal outputs according to the sequence order.
Step	Pattern data is output based on the clock, not specified by the clock source, but generated by pressing the STEP/EVENT button on the front panel. This mode is the same as the Repeat mode except for the clock.
Enhanced	Pattern data is output completely according to a sequence. All extended sequence functions, such as trigger wait, and event jump, are valid in this mode. This mode is the same as the Repeat mode except for the extended sequence functions.

Table 1-1: Electrical characteristics (Cont.)

Characteristics	Description
Output pattern	
Pattern length	360 to 262144 points
Number of channels	2 Channels, Complementary
Sequence	Maximum 4000 steps
Number of blocks	Maximum 256
Internal trigger generator	
Internal trigger rate	
Range	1.0 μ s to 10.0 s
Resolution	3 digits, 0.1 μ s min.
Accuracy	\pm 0.01 %
Clock generator	
√ Internal clock	
Frequency	0.1 Hz to 1.1 GHz
Resolution	7 digits
Accuracy	\pm 0.0001 %, 1 year after shipment from factory
Data and clock out^{1, 2}	
Connectors	CH0, $\overline{\text{CH0}}$, CH1, $\overline{\text{CH1}}$. (SMA connectors at front panel) CLOCK OUT, $\overline{\text{CLOCK OUT}}$ (SMA connector at rear panel) All outputs are complementary.
√ Output voltage	
Accuracy	
DC (data out)	(\pm 3 % of setting) \pm 50 mV (into 50 Ω)
Amplitude (clock out)	(\pm 5 % of setting) \pm 50 mV (into 50 Ω) at 1 MHz
Maximum Output Current	\pm 100 mA
Aberration	
Overshoot	< 5 % at 1.5 V_{p-p} at 10 MHz
Undershoot	< 5 % at 1.5 V_{p-p} at 10 MHz
√ Rise/fall time (20% to 80%)	< 150 ps at 1 V_{p-p} at 10 MHz, measured with a 0.5 m (20 inches), 50 Ω cable. See Optional Accessories on page 7-3 for details.
√ Channel skew	< \pm (25° C - T_a \times 15 ps \pm 100 ps), where T_a is the ambient temperature °C. At 10 MHz, 1.0 V high, 0 V low, in Repeat Mode, the pattern is Clock except when using the Edge Control function.

Table 1-1: Electrical characteristics (Cont.)

Characteristics	Description
Period jitter (typical)	Measured by TDS694C-1MHD with TDSJIT1 Refer to Table 1-2.
Cycle to cycle jitter (typical)	Measured by TDS694C-1MHD with TDSJIT1 Refer to Table 1-3.
√ Delay function	
Delay channel	CH0 ($\overline{\text{CH0}}$), and CH1 ($\overline{\text{CH1}}$),
Delay time	-1.0 ns to +2.0 ns
Resolution	10 ps
Accuracy	$< (\pm 3 \% \text{ of setting}) \pm 25^\circ \text{C} - T_a \times 15 \text{ ps} \pm 100 \text{ ps}$, where T_a is the ambient temperature $^\circ\text{C}$. At 10 MHz, 1.0 V high, 0 V low, in Repeat Mode, the pattern is Clock except when using the Edge Control function.
Output impedance (typical)	50 Ω
Output voltage	
High level (V_{OH})	-1.75 V to +7.00 V (into 1 M Ω) -0.875 V to +3.5 V (into 50 Ω)
Low level (V_{OL})	-2.25 V to +6.50 V (into 1 M Ω) -1.125 V to +3.25 V (into 50 Ω)
Resolution	10 mV (into 1 M Ω) 5 mV (into 50 Ω)
Voltage swing ($V_{OH} - V_{OL}$)	0.5 V to 5 V (into 1 M Ω) 0.25 V_{p-p} to 2.5 V_{p-p} (into 50 Ω)
Event input	
Connector	BNC at rear panel
Threshold level	-5.0 V to +5.0 V, +1.4 V at default
Resolution	0.1 V
Input impedance (typical)	1 k Ω
Turning point for event jump	230.5 to 254.5 clocks before the next block. Refer to T_{ac} in Figure 1-3 on page 1-11.
Maximum input voltage	$\pm 5 \text{ V}$
Polarity	Positive (rising edge)
Minimum pulse width	$\cong 100 \text{ ns}$
Sensitivity	$\cong 1.0 V_{p-p}$

Table 1-1: Electrical characteristics (Cont.)

Characteristics	Description
Event output	
Connector	BNC at rear panel
Level	
High level (V_{hi})	Approximately 5 V into 1 M Ω Approximately 2.5 V into 50 Ω
Low level (V_{lo})	Approximately 0 V into both 1 M Ω and 50 Ω
Delay time	194.5 to 214.5 clocks before data output change. Refer to T_{d5} in Figure 1-3 on page 1-11.
Pulse width	180 to 200 clocks. Refer to P_{W2} in Figure 1-3 on page 1-11.
Impedance	50 Ω
Sync output	
Connector	BNC at rear panel
Level (typical)	
High level (V_{OH})	Approximately 5 V (into 1 M Ω) Approximately 2.5 V (into 50 Ω)
Low level (V_{OL})	Approximately 0 V (into both 1 M Ω and 50 Ω)
Trigger Input (typical)	$55 \text{ ns} + 8/F_{\text{clk}} (\text{GHz}) \leq T_{d1} \leq 55 \text{ ns} + 12/F_{\text{clk}} (\text{GHz})$ (Typical)
Delay time from external trigger input signal (typical)	Internal Reference. Refer to T_{d1} in Figure 1-3 on page 1-11.
Delay time to clock out and data out (typical)	1.5 Clocks, Refer to T_{d2} in Figure 1-3 on page 1-11.
Pulse width (typical)	32 or 36 clocks. Refer to P_{W1} in Figure 1-3 on page 1-11.
Impedance (typical)	50 Ω
Trigger input	
Connector	BNC at front panel
Threshold level	-5.0 V to +5.0 V, +1.4 V at default
Resolution	0.1 V
Threshold accuracy	($\pm 5\%$ of setting) ± 0.1 V
Minimum pulse width	≥ 10 ns
Sensitivity	$\geq 0.5 V_{p-p}$
Impedance	50 $\Omega \pm 2 \Omega$ 1 k $\Omega \pm 100 \Omega$
Polarity	Positive or Negative
Maximum input	± 10 V into 1 k Ω ± 5 V into 50 Ω
Trigger holdoff	Minimum 100 ns

Table 1-1: Electrical characteristics (Cont.)

Characteristics	Description
Reference 10 MHz clock input	
Connector	BNC at front panel
Input voltage range	0.2 V to 3.0 V _{p-p}
Input voltage level	± 10 V Max
Impedance	50 Ω, AC Coupling
Frequency Range	10 MHz ± 0.1 MHz
Edge control input	
Connector	BNC at front panel
Voltage Range (typical)	- 1 V to +1 V
Input Impedance (typical)	50 Ω
Frequency Range (typical)	DC to less than 500 MHz (-3 dB)
Transfer Function (typical)	See Figure 1-2 on page 1-11.
Display	
Display area	Width: 13.2 cm (5.2 inches) Height: 9.9 cm (3.9 inches)
Resolution	Horizontal: 640 pixels Vertical: 480 pixels
AC line power	
Rating Voltage	100-240 V AC
Voltage Range and Frequency Range	90-250 V AC, Input voltage frequency range is 48 Hz to 63 Hz
	90-127 V AC, Input voltage frequency range is 48 Hz to 440 Hz
Maximum power	300 W
Maximum current	4 A
Fuse rating	6A FAST, 250 V, UL 198G (3AG)
	5A (T), 250 V, IEC 127

¹ Clock outputs continuously regardless of the operation mode.

² The data output duty cycle varies from 3:7 to 7:3 at 1.0 V_{p-p} during the 10 μs just after the output has been started. The clock continuously outputs regardless of the run mode or sequence.

Table 1-2: Period Jitter

Clock frequency	1.1 GHz		800 MHz	
	StdDev	Pk-Pk	StdDev	Pk-Pk
Measurement				
Clock output	3.0 ps	16 ps	3.0 ps	13 ps
CH0 output	3.5 ps	20 ps	3.5 ps	20 ps

Table 1-3: Cycle to Cycle Jitter

Clock frequency	1.1 GHz		800 MHz	
	StdDev	Pk-Pk	StdDev	Pk-Pk
Measurement				
Clock output	5.0 ps	28 ps	4.0 ps	22 ps
CH0 output	5.5 ps	32 ps	5.5 ps	32 ps

Table 1-4: Mechanical characteristics

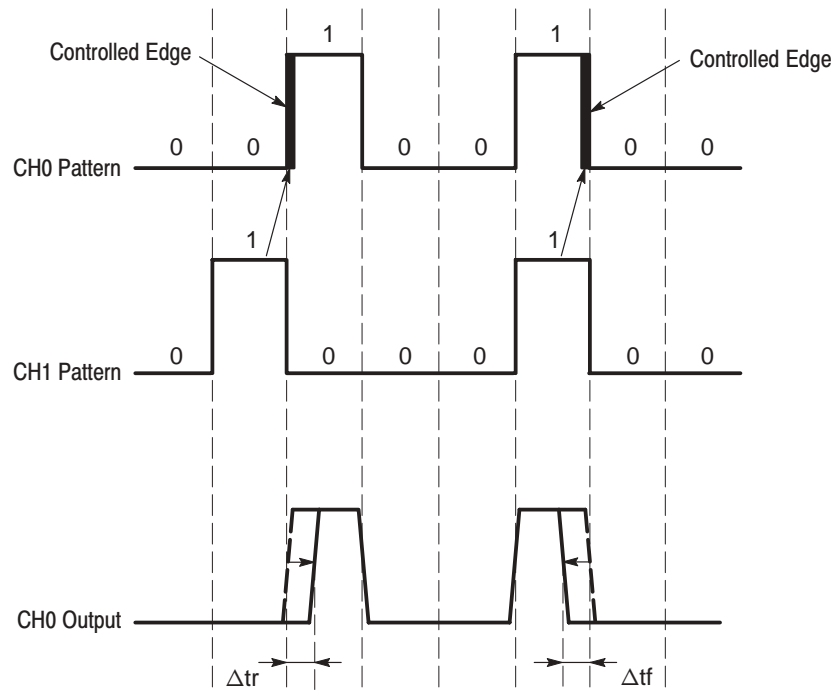
Characteristics	Description
Net weight	
Standard	10.3 kg (22.7 lb)
Dimensions	
Height	164 mm (6.4 inches) including feet
Width	362 mm (14.3 inches) including handle
Length	491 mm (19.25 inches) including front cover 576 mm (22.2 inches) with handle extended

Table 1-5: Environmental characteristics

Characteristics	Description
Temperature	
Operating	+10° C to +40° C
Nonoperating	-20° C to +60° C
Relative humidity	
Operating	20% to 80% (No condensation) Maximum wet-bulb temperature 29.4° C
Nonoperating	5% to 90% (No condensation) Maximum wet-bulb temperature 40.0° C

Table 1-5: Environmental characteristics (Cont.)

Characteristics	Description
Altitude	
Operating	To 4.5 km (15,000 feet). Maximum operating temperature decreases 1 °C each 300 m above 1.5 km.
Nonoperating	To 15 km (50,000 feet).
Dynamics	
Vibration	
Operating	0.27 G _{rms} , 5 to 500 Hz
Nonoperating	2.28 G _{rms} , 5 to 500 Hz
Shock	
Nonoperating	294 m/s ² (30 G), half-sine, 11 ms duration. Three shocks per axis in each direction (18 shocks total)
Installation requirements	
Power consumption	300 watts maximum. Maximum line current is 4 A _{rms} at 50 Hz
Dissipation (fully loaded)	90 V line, with 5% clipping
Surge current	≤ 9 A peak for less than 5 line cycles at 25° C after product has been off for at least 30 s.
Cooling clearance	
Top clearance	2.5 cm (1 inch)
Side clearance	15 cm (6 inches)
Rear clearance	7.5 cm (3 inches)



The rising edge moves to the right and falling edge moves to the left, when the position offset is set to more than 0 ps or when the edge control input is more than 0V.

Figure 1-1: Timing definition in edge control input

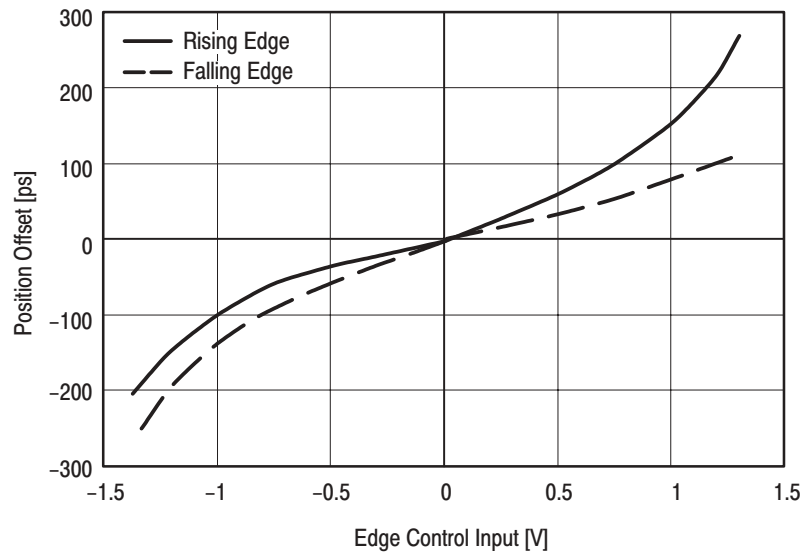


Figure 1-2: Transfer function for edge control input

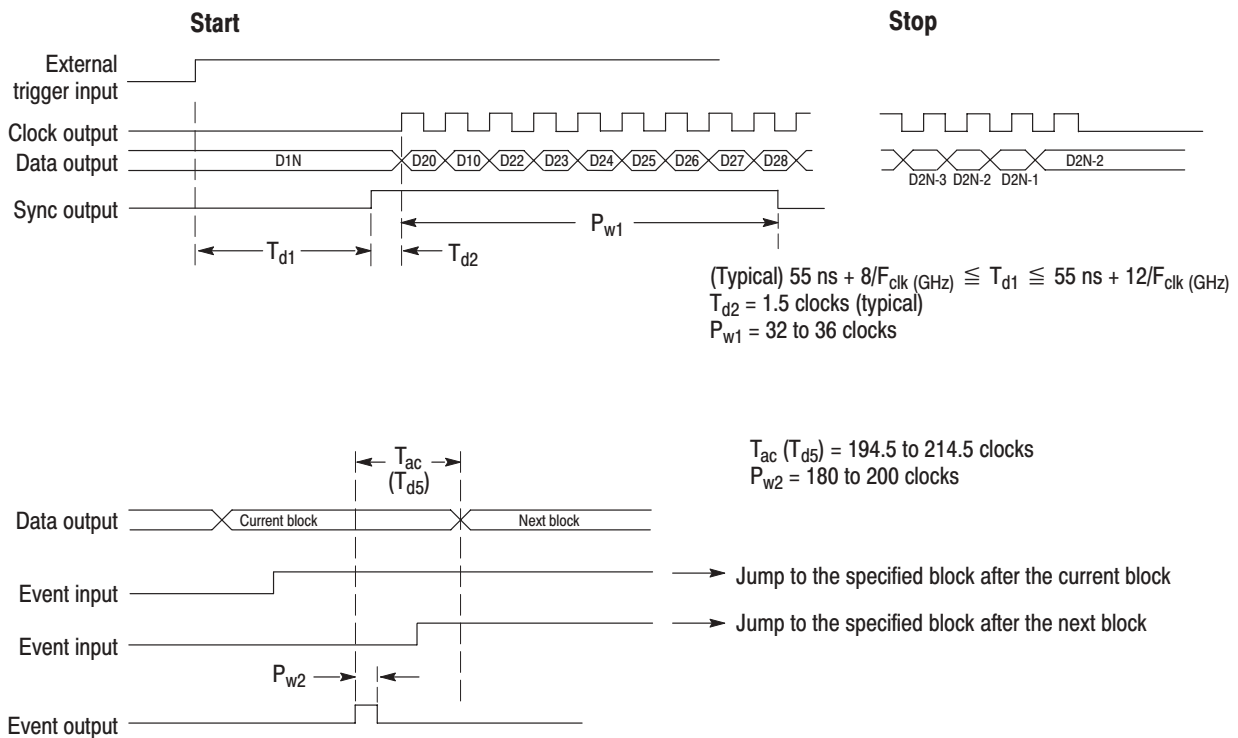


Figure 1-3: Signal timing

Certification and Compliances

The certification and compliances for the DG2040 Data Generator are listed in Table 1-6.

Table 1-6: Certifications and compliances

Category	Standards or description
<p>EC Declaration of Conformity – EMC</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> <p>EMC Directive 89/336/EEC:</p> <p style="padding-left: 40px;">EN 55011</p> <p>Class A Radiated and Conducted Emissions</p> <p style="padding-left: 40px;">EN 50081-1 Emissions:</p> <p style="padding-left: 80px;">EN61000-3-2</p> <p>AC Power Line Harmonic Emissions</p> <p style="padding-left: 40px;">EN 50082-1 Immunity:</p> <p style="padding-left: 80px;">EN61000-4-2</p> <p>Electrostatic Discharge Immunity</p> <p style="padding-left: 40px;">EN61000-4-3</p> <p>RF Electromagnetic Field Immunity</p> <p style="padding-left: 40px;">EN61000-4-4</p> <p>Electrical Fast Transient/Burst Immunity</p> <p style="padding-left: 40px;">EN61000-4-6</p> <p>Conducted Disturbance Induced by Radio–frequency Field</p> <p style="padding-left: 40px;">EN61000-4-8</p> <p>Power Frequency Electromagnetic Field Immunity</p> <p style="padding-left: 40px;">EN61000-4-11</p> <p>Voltage Dips and Interruptions Immunity</p>
<p>Australian/New Zealand declaration of Conformity - EMC</p>	<p>Complies with EMC provision of Radio–communications Act per the following standard:</p> <p>AS/NZS 2064.1/2 Industrial, Scientific, and Medical Equipment: 1992</p>
<p>EC Declaration of Conformity – Low Voltage</p>	<p>Compliance was demonstrated to the following specification as listed in the Official Journal of the European Communities:</p> <p>Low Voltage Directive 73/23/EEC, amended by 93/68/EEC</p> <p style="padding-left: 40px;">EN 61010-1/A1:1992</p> <p>Safety requirements for electrical equipment for measurement, control and laboratory use.</p>
<p>Approvals</p>	<p>Complies with the following safety standards:</p> <p>UL3111–1, First Edition Standard for electrical measuring and test equipment.</p> <p>CAN/CSA C22.2 No.1010.1-92</p> <p>Safety requirements for electrical equipment for measurement, control and laboratory use.</p>

Table 1-6: Certifications and compliances (cont.)

Category	Standards or description								
Installation Category Description	<p>Terminals on this product may have different installation (over-voltage) category designations. The installation categories are:</p> <table border="0"> <tr> <td data-bbox="521 478 678 510">Category</td> <td data-bbox="716 478 1495 510">Examples of products in this category</td> </tr> <tr> <td data-bbox="521 520 597 552">CAT III</td> <td data-bbox="716 520 1495 583">Distribution-level mains (usually permanently connected). Equipment at this level is typically in a fixed industrial location.</td> </tr> <tr> <td data-bbox="521 594 597 625">CAT II</td> <td data-bbox="716 594 1495 657">Local-level mains (wall sockets). Equipment at this level includes appliances, portable tools, and similar products. Equipment is usually cord-connected.</td> </tr> <tr> <td data-bbox="521 667 597 699">CAT I</td> <td data-bbox="716 667 1495 699">Secondary (signal level) or battery operated circuits of electronic equipment.</td> </tr> </table>	Category	Examples of products in this category	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.
Category	Examples of products in this category								
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	<p>A measure of the contaminates that could occur in the environment around and within a product. Typically the internal environment inside a product is considered to be the same as the external. Products should be used only in the environment for which they are rated.</p> <table border="0"> <tr> <td data-bbox="521 825 703 856">Pollution Degree 2</td> <td data-bbox="808 825 1495 972">Normally only dry, nonconductive pollution occurs. Occasionally a temporary conductivity that is caused by condensation must be expected. This location is a typical office/home environment. Temporary condensation occurs only when the product is out of service.</td> </tr> </table>	Pollution Degree 2	Normally only dry, nonconductive pollution occurs. Occasionally a temporary conductivity that is caused by condensation must be expected. This location is a typical office/home environment. Temporary condensation occurs only when the product is out of service.						
Pollution Degree 2	Normally only dry, nonconductive pollution occurs. Occasionally a temporary conductivity that is caused by condensation must be expected. This location is a typical office/home environment. Temporary condensation occurs only when the product is out of service.								
Conditions of Approval	<p>Safety Certifications/Compliances are made for the following conditions:</p> <p>Altitude (maximum operation): 2000 meters</p>								
IEC Characteristics	<p>Equipment type:</p> <p>Test and Measuring Installation Category II (as defined in IEC 61010-1, Annex J) Pollution Degree 2 (as defined in IEC 61010-1) Safety Class I (as defined in IEC 61010-1, Annex H)</p>								



Operating Information

Operating Information

This subsection provides the following information:

- Operating environment
- Supplying operating power
- Applying and interrupting power
- Checking the fuse

NOTE. Read all information and heed all warnings in this subsection before connecting the DG2040 Data Generator to a power source.

Refer to the Specification section of this manual for line voltage and frequency ranges.



WARNING. To avoid equipment failure and potential fire or personal shock hazards, do not exceed the maximum rated operating voltage of 250 V between the voltage-to-ground (earth) and either pole of the power source. The DG2040 Data Generator operates from a single-phase power source and has a three-wire power cord with a two-pole, three-terminal grounding plug. Also, before making connection to the power source, be sure the DG2040 Data Generator has a suitable two-pole, three-terminal grounding-type plug.

To avoid personal shock hazard, do not touch conductive parts. All accessible conductive parts are directly connected through the grounding conductor of the power cord to the grounded (earth) contact of the power plug. The DG2040 Data Generator is safety Class 1 equipment (IEC designation).



WARNING. To avoid personal shock hazard, do not defeat the grounding connection. Insert the power input plug only in a mating receptacle with a grounding contact where earth ground has been verified by a qualified service person. Also, for electrical shock protection, make the grounding connection before making connection to the DG2040 Data Generator input or output terminals.

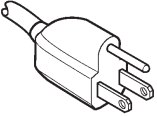
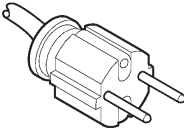
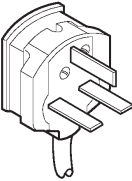
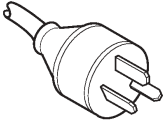
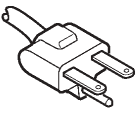
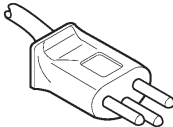
Power Cord Information

The DG2040 Data Generator is shipped with the required power cord as ordered by the customer. Table 2-1 gives the color-coding of the conductors in the power cord. Table 2-2 shows information on the available power cords.

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 Environment

To ensure proper DG2040 Data Generator operation and long life, note the following environmental requirements.



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

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

Operating Temperature

The DG2040 Data Generator operates correctly in ambient temperatures from +10° C to +40° C and in relative humidity from 20% to 80%.

Ventilation Requirements

Verify that there is at least 2.5 cm (1 inch) of clearance on top and bottom, 15.0 cm (6 inches) on the left and right sides, and 7.5 cm (3 inches) at the rear of the instrument to allow for heat dissipation. Verify that the air intake holes on the sides and bottom of the cabinet are not obstructed.

The feet on the bottom of the DG2040 Data Generator cabinet provide the required clearance when it is set on a flat surface.



CAUTION. *To prevent temporary shutdown of the DG2040 Data Generator, do not restrict air flow through the chassis. If the DG2040 Data Generator shuts down unexpectedly, improve ventilation around the DG2040 Data Generator and wait a few minutes to allow it to cool down; then switch the power on again.*

Fuse Type and Rating

The DG2040 Data Generator uses the same fuse for all operating line voltage ranges. One of two fuse types is installed in the instrument, depending upon the power cord option. Table 2-3 provides the available types and ratings.



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

Check Fuse

Check the fuse to be sure it is the proper type and rating.

To check the fuse, remove the fuse holder on the rear panel. Refer to Figure 2-3 for the location of the fuse holder. To remove the fuse holder, turn it counter-clockwise with a screwdriver while pushing it in.



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

Use a slotted screwdriver to remove the fuse. Push in and turn the fuse holder cap counterclockwise. See Figure 2-1 for the fuse location.

The instrument order specified either a UL approved or an IEC approved fuse. Each fuse requires its own cap. See Table 2-3.

Table 2-3: Fuse and fuse cap part numbers

Fuse	Tektronix fuse part number	Tektronix fuse cap part number
0.25 inch × 1.25 inch (UL 198.6, 3 AG): 6 A fast, 250	159-0239-00	200-2264-00
5 mm × 20 mm (IEC 127): 5 A (T), 250 V	159-0210-00	200-2265-00

NOTE. The second fuse listed in Table 2-3 is approved under the IEC standards. This fuse is used in equipment sold in the European market.

Check Voltage Settings

Check that you have the proper electrical connections. Refer to Table 2-4 for power requirements.

Table 2-4: AC line power requirements

Name	Description
Line voltage range	90 V – 250 V
Line frequency	48 Hz – 440 Hz (90 V – 127 V) 48 Hz – 63 Hz (127 V – 250 V)
Maximum power	300 W

Connect Power Cable

Connect the proper power cord from the rear panel power connector to the power system. Refer to Table 2-2 for power cord identification.



CAUTION. The instrument is shipped with a power cord appropriate for use with your power systems (normal 115 V power system or 230 V power system). If the instrument is to be used with a power system other than what the order specified, the power cord must be replaced with one appropriate for the power source used.

Standby Power

Apply power to the standby circuit of the instrument by pushing the **PRINCIPAL POWER SWITCH** on the rear panel of the instrument. Refer to Figure 2-1.

NOTE. After the instrument is installed, leave the **PRINCIPAL POWER SWITCH** on and use the **ON/STBY** switch as the power switch.

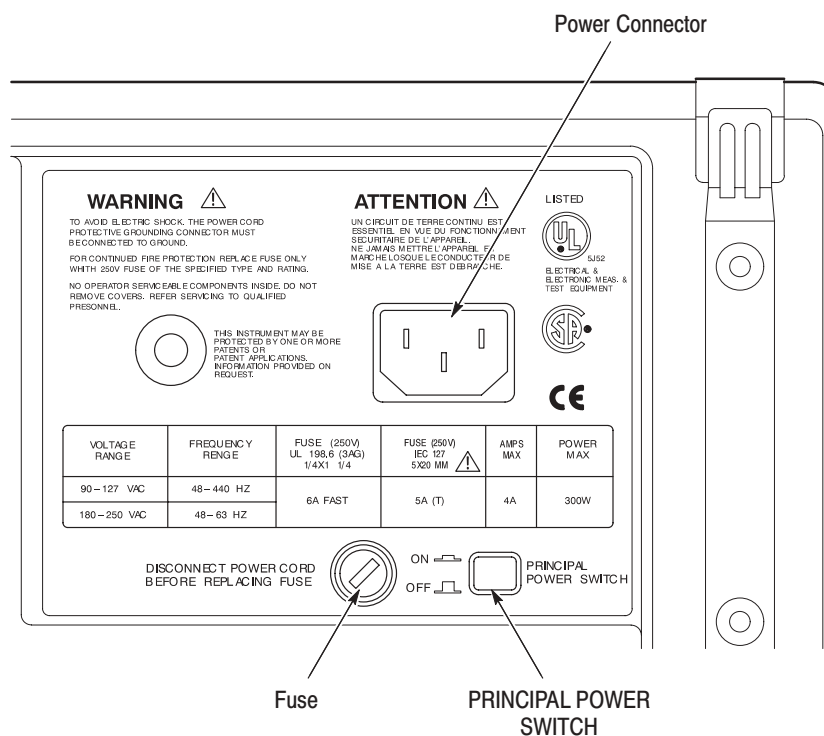


Figure 2-1: Rear panel power switch, fuse holder, and connector

Power On

Press the **ON/STBY** switch on the lower left side of the front panel to power on the instrument. Refer to Figure 2-2.

Verify that the fan is operating.

NOTE. Allow a 20 minute warm-up period prior to calibrating the clock for the instrument to operate at its optimum precision.



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

Start-Up Diagnostics

The DG2040 Data Generator automatically runs diagnostics when the instrument is powered on from the ON/STBY switch. These diagnostics check whether the instrument is performing within its defined operating characteristics. If all the diagnostic items have been completed without error, the instrument displays the EDIT menu.

NOTE. If the instrument chassis temperature is outside the specified operating range, an error will occur during the power-up diagnostics. If this happens, power off the instrument, wait until the chassis temperature is within normal operating range, and then power on the instrument again.

If an error is displayed, contact your Tektronix Field Office or representative.

Power Off

To power off the DG2040 Data Generator, press the **ON/STBY** switch.

NOTE. The **ON/STBY** switch disables the outputs of the power supply. The **PRINCIPAL POWER SWITCH** on the rear panel disconnects the instrument from the primary voltage source.

Rear Panel Controls

Figure 2-3 shows the rear panel controls for the DG2040 Data Generator.

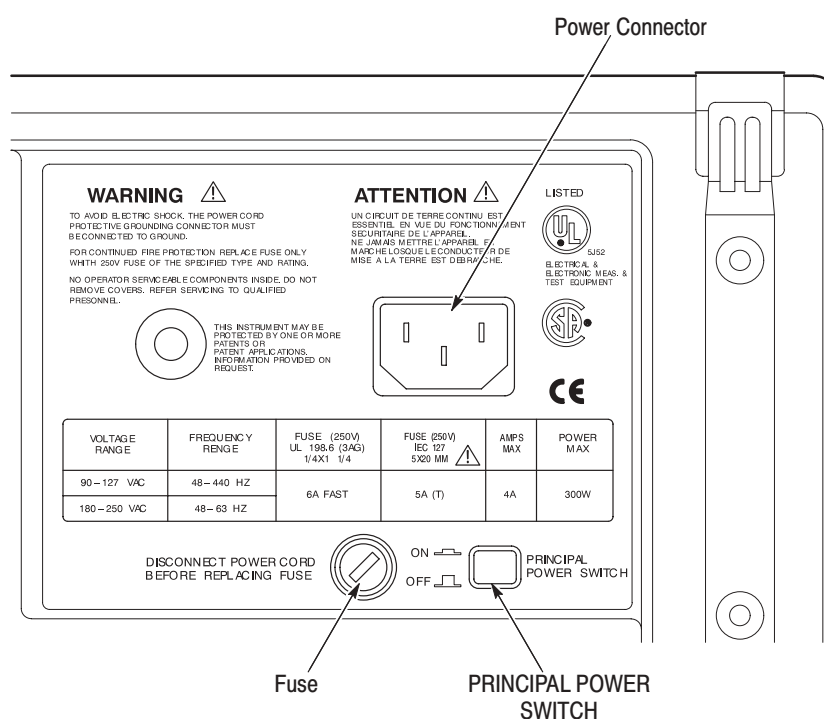


Figure 2-3: Rear panel controls

Applying and Interrupting Power

Consider the following information when you power on or power off the DG2040 Data Generator, or when external power loss occurs.

Power-on Cycle

At power-on, the start-up diagnostics check the DG2040 Data Generator operation. If all diagnostic items complete without error, the DG2040 Data Generator displays the **EDIT** menu.

If the diagnostics detect an error, the DG2040 Data Generator displays the error code. To exit the diagnostics menu, press any key; then the system displays the **EDIT** menu. See the *Maintenance:Troubleshooting* section, beginning on page 6-1 for information on diagnostics and fault isolation.

NOTE. *If the ambient temperature goes outside the specified operating temperature range, an error occurs during the diagnostics at power-on. If this happens, power off the DG2040 Data Generator and wait until the chassis temperature is appropriate; then switch the power on again.*

Power-off Cycle

Wait for the DG2040 Data Generator to finish the operation when saving data files. Improper power-off or unexpected loss of power to the DG2040 Data Generator can result in the corruption of data stored in nonvolatile memory.

Memory Backup Power

A lithium battery maintains internal nonvolatile memory, allowing the DG2040 Data Generator to retain data files if AC power is lost. This battery has a shelf life of about three years. Partial or total loss of stored information at power-on may indicate that the battery needs to be replaced.



WARNING. *To avoid risk of fire or explosion, replace the DG2040 Data Generator battery with a lithium battery having the part number listed in the Replaceable Mechanical Parts section beginning on page 10-10.*

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

Repackaging Instructions

If this instrument is shipped by commercial transportation, use the original packaging material. If the original packaging is unfit for use or is not available, repackage the instrument as follows:

1. Obtain a corrugated cardboard shipping carton having inside dimensions at least six inches greater than the instrument dimensions and having a carton test strength of at least 124.74 kg (275 pounds).

2. If the instrument is being shipped to a Tektronix Service Center for repair or calibration, attach a tag to the instrument showing the following: owner of the instrument (with address), the name of a person at your firm who may be contacted if additional information is needed, complete instrument type and serial number, and a description of the service required.
3. Wrap the instrument with polyethylene sheeting or equivalent to protect the outside finish and prevent entry of packing materials into the instrument.
4. Cushion the instrument on all sides by tightly packing dunnage or urethane foam between the carton and the instrument, allowing for three inches of padding on each side (including top and bottom).
5. Seal the carton with shipping tape or with an industrial stapler.

Operating Instructions

Before servicing the DG2040 Data Generator, read the following operating instructions. These instructions are at the level appropriate for servicing the DG2040 Data Generator. The user manual contains complete operator instructions.

The *Performance Verification* section, beginning on page **2222**, includes instructions for making the front-panel settings required to check DG2040 Data Generator characteristics.

How to Power On

To power-on the DG2040 Data Generator, follow these steps:

1. Set the **PRINCIPAL POWER SWITCH** (on the rear of the DG2040 Data Generator) to the ON position. This switch is the main power switch; it routes power to the standby circuit in the DG2040 Data Generator.
2. Press the **ON/STBY** (standby) switch on the front (lower-left corner) of the DG2040 Data Generator. This switch applies power to the remaining circuits of the DG2040 Data Generator. Allow at least 20 minutes for the DG2040 Data Generator to warm up.



WARNING. To avoid personal shock hazard, turn off both the **ON/STBY** switch and the **PRINCIPAL POWER SWITCH** before servicing. The **PRINCIPAL POWER SWITCH** on the rear panel is the true power disconnect switch. The **ON/STBY** (standby) switch simply toggles operation on and off. When connected to a power source and when the **PRINCIPAL POWER SWITCH** is on, the internal power supplies and much of the other circuitry of the DG2040 Data Generator remain energized regardless of the setting of the **ON/STBY** switch.

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

Internal Diagnostics Routines

At power-on, the DG2040 Data Generator performs internal start-up diagnostics. These diagnostics check the internal circuit function and report any failures. In addition, you can initiate internal diagnostics using the **Diag** item in the **UTILITY** menu; these diagnostics differ from the start-up diagnostics in that they do more extensive memory checking.

User Interface

The DG2040 Data Generator uses a combination of front-panel buttons, keys, a knob, and on-screen menus to control generator functions. Some front-panel controls select menus and manipulate menu items. Others enter values and units, allow manual triggering, start/stop DG2040 Data Generator output, advance the pattern data, generate an event pulse, and make a hard copy. On-screen graphics show various aspects of the current DG2040 Data Generator configuration.

On-screen menus set most DG2040 Data Generator functions. Main menus provide access to lower-level submenus. Buttons in the center of the front panel select the main menus.

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

Display Elements

Figure 2-4 shows the display elements, including bottom and side menus, work area, status lines, and so on. Also shown are a pop-up menu and message box. Table 2-5 describes each element in detail.

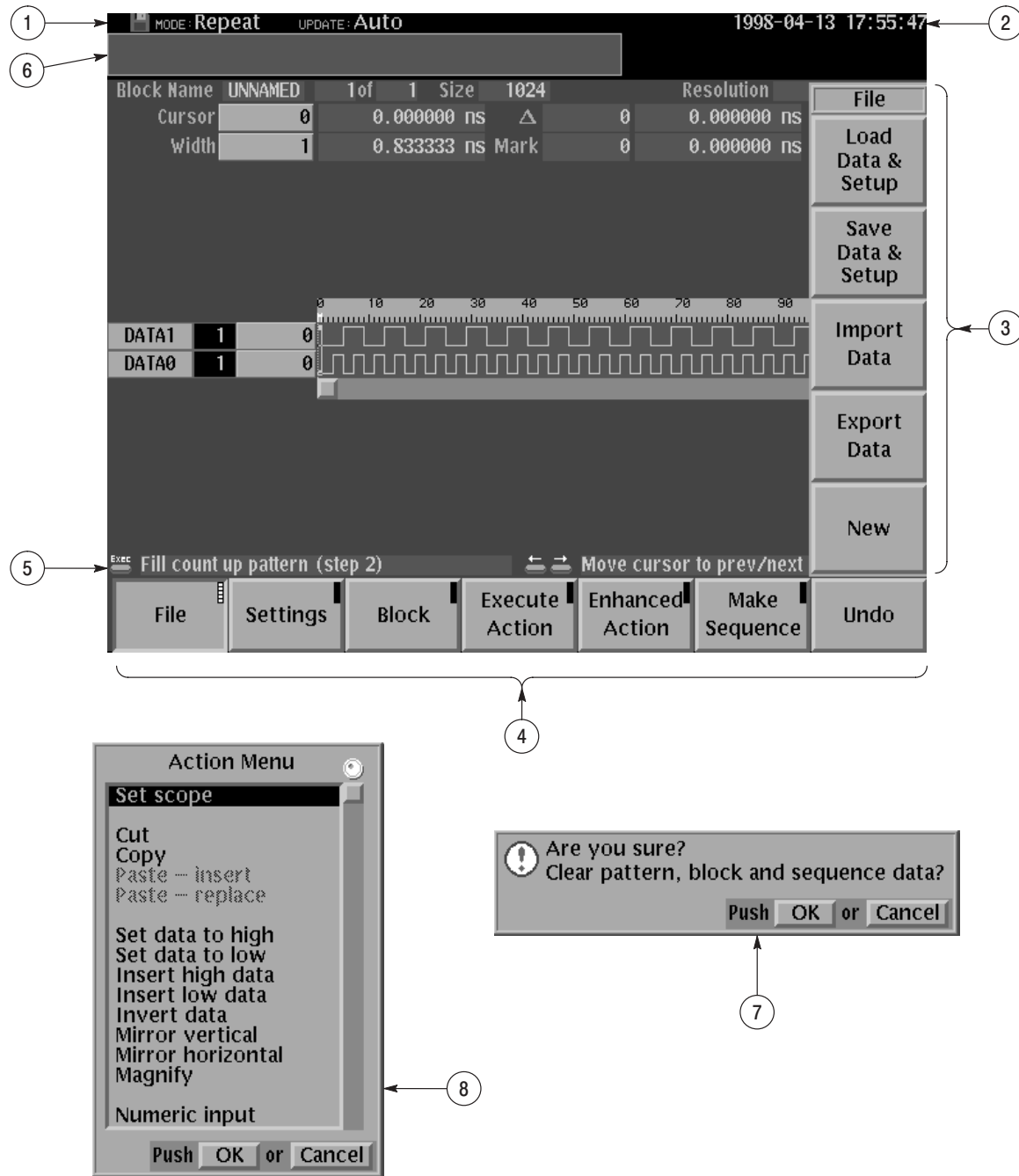


Figure 2-4: Display elements

Table 2-5: DG2040 Data Generator display elements

Figure number	Label	Description
1	Status area	<p>Displays the current status of the instrument. This status line is always displayed, whichever menu is displayed. The status line displays the following two items.</p> <p>MODE: Displays the run mode in which pattern data will be output.</p> <p>UPDATE: Displays the update method for pattern data output when data is updated.</p> <p>In addition, there is also a disk icon that indicates whether or not a floppy disk is inserted in the disk drive. A clock icon may also be displayed at the left end of the status line. When this icon is displayed, the instrument is busy with internal processing and cannot accept other inputs.</p>
2	Date and Time display area	The date and time display can be turned on or off using the UTILITY menu.
3	Side menu	Related side menu items are displayed here when a bottom menu item is selected. The topmost entry in the side menu displays either a label representing the side menu or the operation name for the confirmed item.
4	Bottom menu	When one of the buttons in the menu section is pressed, the corresponding bottom menu is displayed. When a bottom menu item is selected the corresponding side menu is displayed. Selecting the same bottom menu item again closes the side menu.
5	Button function description area	Displays descriptions of the functions of the front panel buttons.
6	Message display area	Displays messages that report on the current processing state. This area can be also used by remote commands to display user messages.
7	Pop-up message box	When required, the instrument temporarily displays a window at the center of the screen to display a warning or question for the user.
8	Pop-up menu	The instrument sometimes displays a pop-up menu when a bottom menu or side menu item is selected. Enter a numeric value or select an item using either the general purpose knob or the front panel buttons.

Menus

The DG2040 Data Generator operation is primarily controlled by means of menus that correspond to the EDIT, SETUP, APPLICATION and UTILITY buttons in the MENU column. To display one of these main menus on the screen, push the corresponding button. The button LED indicates which menu is currently selected. Refer to the DG2040 Data Generator User Manual for more details concerning these menus.

- EDIT Menu

Provides functions for editing pattern data and creating sequences.

- SETUP Menu

Provides functions for defining groups, setting up channels, and setting output channel voltages, the operating mode, and triggers.

- APPLICATION Menu

The current version of the firmware provides edge control functions under the APPLICATION menu.

- UTILITY Menu

This menu provides functions for manipulating the basic instrument settings.

Pattern Storage and I/O

The DG2040 Data Generator has internal nonvolatile memory (NVRAM) for pattern file storage. The DG2040 Data Generator generates patterns from files residing in internal nonvolatile memory.

The DG2040 Data Generator also has a floppy-disk drive for loading files from a floppy disk into internal nonvolatile memory, and for saving files from memory to a floppy disk. The disk drive accepts 3.5-inch floppy disks in the MS-DOS format.

Loading Files

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

1. Turn the disk so the side with the arrow is on top; insert the disk into the DG2040 Data Generator floppy disk drive.
2. Press the **EDIT** button on the front panel.

3. Select **File** from the bottom menu.
4. Select **Load Data & Setup** from the side menu. The menu in Figure 2-5 appears.
5. Turn the general purpose knob to highlight the file you want to load and select **OK** from the sub menu.
6. Push the floppy drive button and remove the disk from the floppy drive.

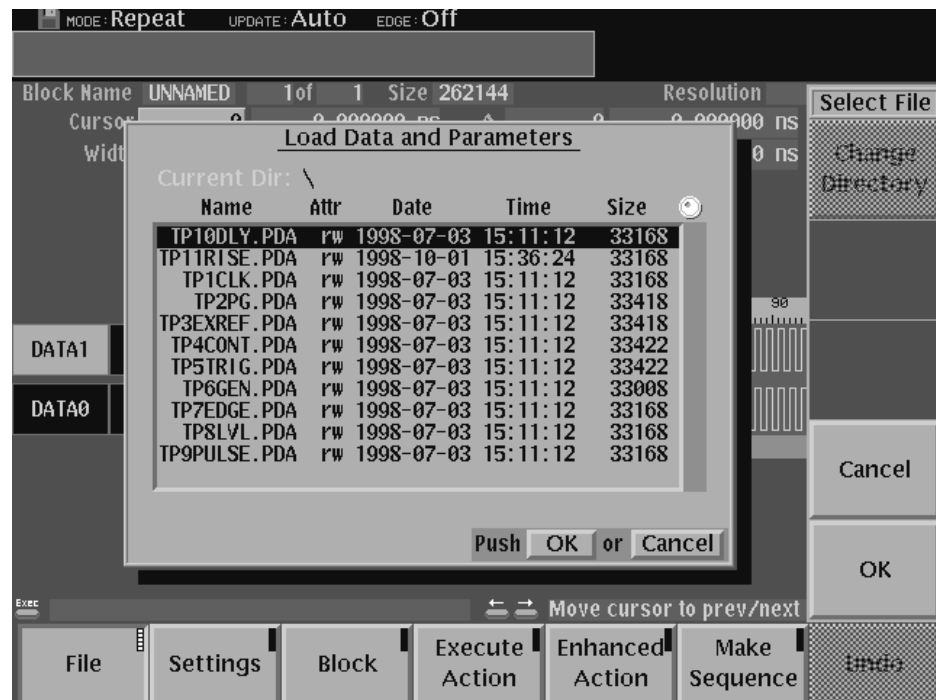


Figure 2-5: Load Data and Parameters menu

Signal Output

The procedure assumes that data has already been loaded as explained in the previous section.

The following example first groups the data bits from the pattern data already created and allocates each data bit to output channels. Next, this procedure sets all the settings required for signal output and actually outputs the signals.

- Tables such as the one below shows the sequence of the operating procedure. Execute the action on the left side of the top row first. Then execute actions from left to right across the row. When one row has been completed, move to the left side of the next row down. For pop-up menus, use the general purpose knob to select items from the menu list. Operations such as Operation 6 (below) do not involve pressing the buttons shown in the row above, but rather are descriptions of operations to be performed. Figure 2-6 shows the buttons used and the menu layout.

Menu button	Bottom button	Pop-up menu	Side button	Front panel button
Operation 1	Operation 2	Operation 3	Operation 4	Operation 5
Operation 6 (For example, set to xx with general purpose knob.)				
			Operation 7	

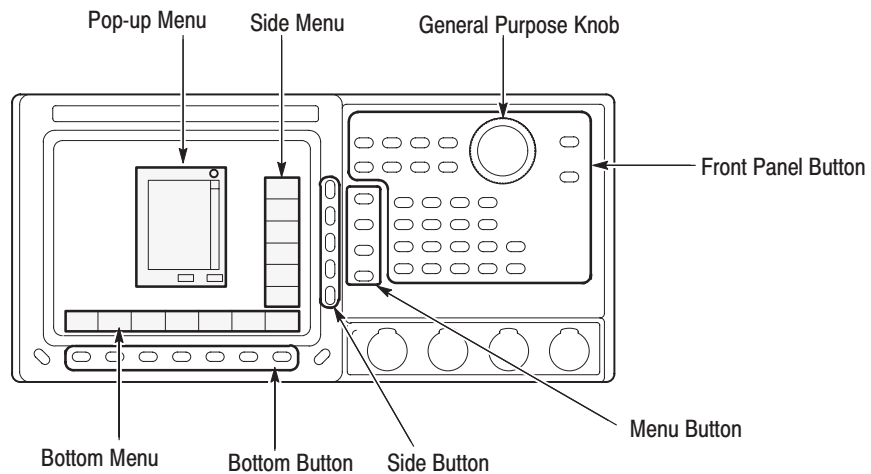


Figure 2-6: Operating buttons and menu layout

Setting Sampling Clock Frequency

1. Set the sampling clock frequency to 800 MHz.

Menu button	Bottom button	Pop-up menu	Side button	Front panel button
	Clock		Source (Select Int)	
			Int FREQ	800 MHz

Setting Signal Generation Mode

- Set the signal generation mode to continuous mode.

Menu button	Bottom button	Pop-up menu	Side button	Front panel button
	Run Mode		Repeat	

Setting Output Level

The output level is always at the TTL level.

- Set the output channel **CH0** and **CH1** output levels to 2 V for the high level and -1 V for the low level.

Menu button	Bottom button	Pop-up menu	Side button	Front panel button
	Level Condition			

Select channel CH0 using the front panel up and down arrow buttons.

			High Level	2 ENTER
			Low Level	-1 ENTER

Set the output levels for channels CH1 to CH7 in the same manner.

Setting Delay Timing

The delay time for each channel can be set.

- Set the delays for the output channel **CH0** and **CH1** to 2 ns.

Menu button	Bottom button	Pop-up menu	Side button	Front panel button

Select channel CH1 by pressing the front panel up and down arrow buttons.

			Delay	10 ENTER
--	--	--	-------	-------------

Set the delays for channels CH5 to CH7 in the same manner.

Delay Time Setting
↓

Output Voltage Level Settings

Ch	Data[Group:Bit]	High [V]	Low [V]	Delay [ns]
CH0	D1[DATA1:0]	2.400	0.000	0.00
CH1	D1[DATA1:0]	0.200	-0.200	0.00
CLK	-----	0.600	0.000	(REF)

Group | Output | Level | Timing | Run Mode | Trigger

Figure 2-7: Output voltage level and delay time display

Signal Output This step actually outputs the signals.

5. Press the **START/STOP** button on the front panel.

Theory of Operation

This section describes the basic operation of the major circuit blocks or modules in the DG2040 Data Generator. The *Diagrams* section, beginning on page 9-1, includes a block diagram and an interconnect diagram. Figure 9-1 shows the modules and functional blocks of the DG2040 Data Generator. Figure 9-2 shows how the modules interconnect.

Module Overview

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

The DG2040 Data Generator consists of two major electrical sections; the Main Frame section and the PG (Pulse Generator) & Output section. The Main Frame section consists of Clock Board, CPU Board, Back Plane, Bezel Switch, Display Monitor, Power Supply, Auxiliary Power Supply, FDD (Floppy Disk Drive), and Fan. The PG & Output section consists of PG circuitry and Output circuitry.

Main Frame Section

The Main Frame section consists of the following modules and components.

Clock Board (A30). The clock board contains the clock generator, trigger circuit, and miscellaneous control circuit for the PG and Output board. This trigger signal is provided from the connector on the front panel.

CPU Board (A6). The CPU board receives commands from the front panel or the GPIB/RS-232-C interface and controls the PG section through the Back Plane board. It also sends the video signal to the display monitor for displaying various graphical menus, data pattern figures, message texts, etc. The CPU board contains MPU, ROM, RAM, video display, bus timing circuitry, and the interfaces to GPIB, RS-232-C, FDD, and the front panel.



CAUTION. To avoid losing pattern data files stored in NVRam, save the files to a floppy disk before removing the A6 CPU board or A16 Back plane board. Then restore the files from floppy disk to the DG2040 Data Generator nonvolatile memory after installing the new board(s).

Back Plane Board (A16). The DG2040 Data Generator back plane has five slots which accommodate the CPU board and Clock board. This board receives

power from the Power Supply module and distributes the power to the boards in the slots. This board also interconnects various lines such as the CPU buses and other control signals.

Power Supply. The power supply module receives the filtered line power from Auxiliary Power board and sends regulated voltages to the Back Plane board. The module supplies the following voltages: +5 V, -4.6 V, -2 V, +15 V, and -15 V.

This module features a remote control with the ON/STBY switch on the bezel. The remote switching signal which is generated on the bezel is sent to the CPU board by the Back Plane board. The signal is transformed by the CPU board and sent to the Power Supply by way of the Back Plane.

Front Panel (A6, CPU Board). The front panel contains menu buttons, LEDs, a rotary encoder and so on, for entering selections. User selections from the front panel are sent to the processor. This interface is compatible with TDS series oscilloscope. Commands from the processor control the LED in the buttons.

Display Monitor (A6, CPU Board). The Display Monitor consists of a raster scan CRT and its driver circuitry. It receives the sync and video signals from the CPU board and +15 V DC power from the Power Supply. The Display Monitor is serviced as a module; no adjustment procedure or circuit description is provided.

Bezel Switch. The buttons at the bottom and side of the display are bezel switches. This is a flexible circuit which is sealed in the chassis.

Auxiliary Power Supply (A100). The Auxiliary Power Supply consists of a main power switch, a fuse, and AC power.

GPIB (A6, CPU Board). This functional block is the General Purpose Interface Bus (GPIB) interface drive, which controls communication with external devices over the parallel interface. The GPIB connector is on the rear panel.

RS-232C (A6, CPU Board). This functional block is the RS-232-C interface circuit which controls serial communication with external devices over the RS-232-C interface. The RS-232-C interface connector is on the rear panel.

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

Fan. This is a brushless DC fan which draws approximately 0.5 A from +12 V. The fan prevents heat build-up inside the cabinet; it pulls air into the right (floppy-disk) side of the DG2040 Data Generator and exhausts air out the left side.

PG & Output Section

The PG (Pulse Generator) & Output Section consists of the following circuit blocks.

PG Circuitry (A50, PG & Output Board). The PG circuitry is the core of the DG2040 Data Generator and consists of the pattern memory, shift register, and address generator. The sequence of the output pattern is controlled by the address generator. This block receives the system clock from the Clock board and sends the digital pattern data to the Output circuit.

Output Circuit (A50, PG & Output Board). The output circuitry contains the Pin Driver, edge control circuit and the delay control circuit. The Pin Driver outputs the digital pattern and converts the signal levels for various types of logics such as TTL, CMOS, LVCOMS, ECL, and PECL. It also has the ability of changing the output signal edge control (CH0 only). This block contains the data latch clock signal. This signal generated by the Pin Driver is the same as data outputs, the signal levels can be converted like data outputs.

Performance Verification

Two types of performance tests can be performed on this product. You may not need to perform all of these procedures, depending on what you want to accomplish.

- Self test

The DG2040 Data Generator incorporates a diagnostic system that performs comprehensive instrument testing. This system verifies that the DG2040 Data Generator is operating correctly. The self tests execute quickly and require no special equipment during execution.

- Performance test

The performance test verifies the operation of the items that are marked with a (√) symbol in *Appendix A: Specifications*. The equipment listed in Table 4-2 is required to perform these performance tests.

Before Running the Performance Tests

Do the following before running the performance tests:

Warm Up A 20 minute warm up period is required prior to running the operation tests.

File Loading The performance check disk provided with the DG2040 Data Generator includes the files listed in Table 4-1. The specified file must be loaded into the DG2040 Data Generator for each operation test item. These files include pattern data and setup information.

Table 4-1: Performance check disk files

File name	Operation test
TP1CLK.PDA	Internal clock frequency
TP2PG.PDA	Sequence and data output
TP3EXREF.PDA	External reference input
TP4CONT.PDA	Maximum operating frequency (Continuous)
TP5TRIG.PDA	Maximum operating frequency (Trigger operation)
TP6GEN.PDA	Internal trigger generator and external trigger input
TP7EDGE.PDA	Edge control mode
TP8LVL.PDA	Data output level
TP9PULSE.PDA	Clock output amplitude
TP10DLY.PDA	Delay time
TP11RISE.PDA	Rise and fall time

Follow the procedure below to load the file required by a performance test into the instrument:

1. Insert the performance check disk into the DG2040 Data Generators floppy disk drive.
2. Select **EDIT** → **File** → **Load Data & Setup**.
3. Select the required file using the general purpose knob.
4. Select **OK** from the submenu.

Required Equipment Table 4-2 lists the equipment required for the performance tests.

Table 4-2: Required equipment

Item	No.	Required precision	Recommended equipment
Frequency counter	1	Frequency range: 0.1 Hz to 1250 MHz Precision: 7 digits or higher	ANRITSU MF 1603A
Digital multimeter	1	DC voltage range: ± 10 V Precision: 0.01 V	Tektronix DM2510
Performance check disk	1		Tektronix part no. 063-3121-XX (provided with the DG2040 Data Generator)
Oscilloscope	1	Bandwidth: 1 GHz or higher	Tektronix TDS784D
Sampling oscilloscope with head	1	Bandwidth: 6 GHz or higher	Tektronix 11801C with head SD-22
Function generator	1	Amplitude: 4 V, offset: 2 V (50 Ω termination), Frequency: 1 MHz or higher	Tektronix AFG320
BNC cable	5	Impedance: 50 Ω Length: 24 inches	Tektronix part no. 012-1342-00
SMA cable	5	Impedance: 50 Ω Length: 20 inches	Tektronix part no. 174-1427-00
SMA female-to-BNC male adapter	2		Tektronix part no. 015-0572-00
Precision 50 Ω termination	1	Impedance: 50 Ω (0.1 %)	Tektronix part no. 011-0129-00
SMA X5 attenuator (14 dB)	3		Tektronix part no. 015-1002-00
N-to-BNC adapter	1		Tektronix part no. 103-0045-00
BNC-dual-banana adapter	1		Tektronix part no. 103-0090-00
50 Ω SMA termination	2		Tektronix part no. 015-1022-00

Test Procedure Notes

The following conventions are used in this section for describing the self tests and performance tests.

- The test items are described in the following order.
 - Characteristic tested
 - Required equipment
 - Connections
 - Test procedure
- The test procedure is presented in order starting with step 1, and progresses through the end of the procedure. Tables such as the one shown below appear in these steps. For these steps, press the buttons in the order shown in the table, either from left to right or from top to bottom, to select the required menu item. For pop-up menus, use the general purpose knob to select items from the menu list. Operations such as Operation 6 do not involve pressing the buttons shown in the row above, but rather are descriptions of operations to be performed. Figure 4-1 shows the buttons used and the menu layout.

Menu button	Bottom button	Pop up menu	Side button	Front panel button
Operation 1	Operation 2	Operation 3	Operation 4	Operation 5
Operation 6 (for example, insert a disk in the disk drive.)				
			Operation 7	

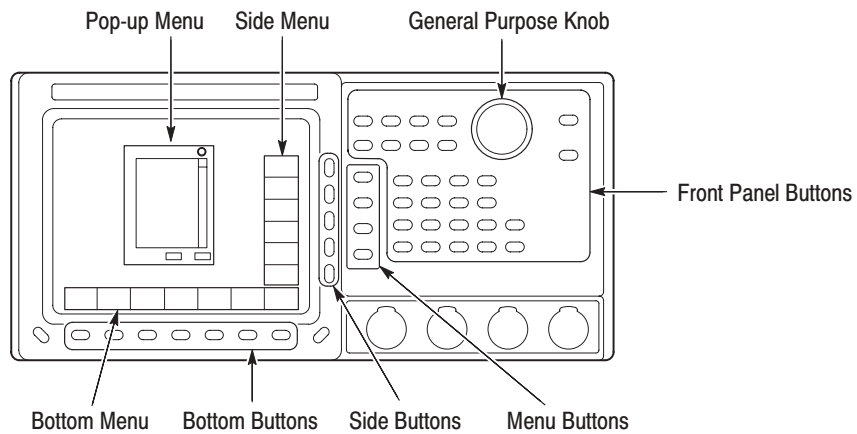


Figure 4-1: Operating buttons and menu layout

Self Tests

Execute the DG2040 Data Generator self tests and verifies that no errors occurred.

1. Press the required buttons in the following order. Selecting **All** from the **Type** side button causes the instrument to run the self-test on all test items.

Menu button	Bottom button	Pop up menu	Side button	Front panel button
UTILITY	Diag		Type (Select All)	
			Execute	

2. Verify that all self tests passed by checking the **Status** display area shown in Figure 4-2.

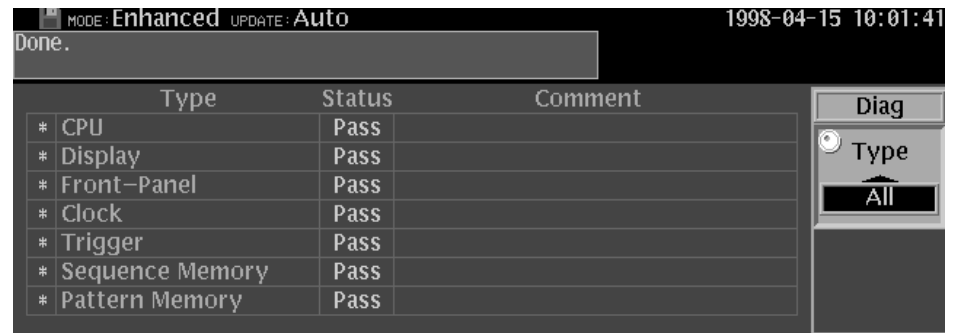


Figure 4-2: Diagnostics menu

If **Fail** is listed in the **Status** display area, an error code will be displayed in the **Comment** column. See Table 4-3 for the meanings of the error codes.

NOTE. Contact your Tektronix sales representative if an error occurs.

Table 4-3: Error codes

Error code	Error meaning	Failed component
1XX	CPU diagnostics error	A6 CPU board
2XX	Display diagnostics error	A6 CPU board
3XX	Front panel diagnostics error	A12 Key board
4XX	Clock diagnostics error	A40 Clock board
5XX	Trigger diagnostics error	A40 Clock board
6XX	Sequence memory diagnostic error	A50 PG & Output board
7XX	Pattern memory diagnostics error	A50 PG & Output board

Performance Tests

The performance test for the DG2040 Data Generator must be completed in the following order:

1. Internal clock frequency
2. Sequence and data output
3. External reference input
4. Maximum operating frequency
5. Internal trigger generator and external trigger input
6. Edge control mode operation
7. Output level accuracy
8. Clock output amplitude accuracy
9. Delay time accuracy
10. Rise and fall time accuracy

Internal Clock Frequency

This test verifies the frequency accuracy of the internal clock of the DG2040 Data Generator.

The following equipment is required.

Equipment Required	
	Frequency counter
	Two SMA cables
	Two 50 Ω terminations
	Two SMA female-to-BNC male adapters
	N-to-BNC adapter
	Performance check disk

Connections. Refer to Figure 4-3 for connections.

Use the N-to-BNC adapter, an SMA female-to-BNC male adapter, and an SMA cable to make the following connection:

- Connect the **CLOCK** output from the DG2040 Data Generator rear panel to the frequency counter input (INPUT B).

Use the second SMA cable, the second female-to-BNC male adapter, and the 50 Ω termination to make the following connection:

- Terminate the **CLOCK** output.

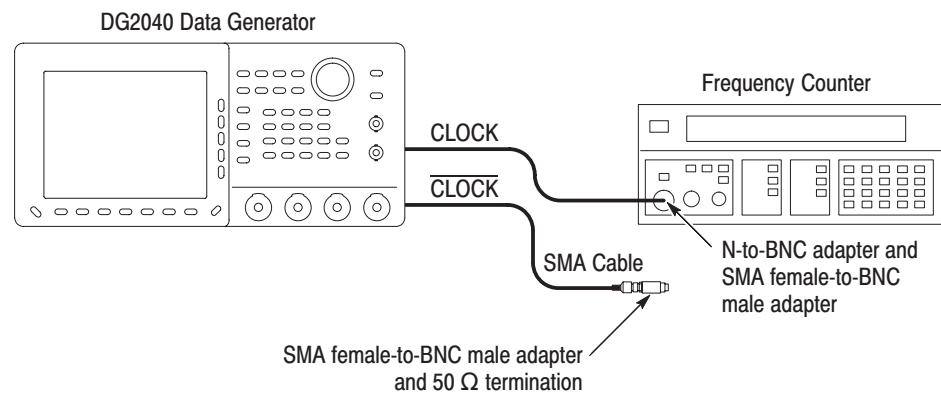


Figure 4-3: Frequency measurement connections

Setup. Set the frequency counter to frequency measurement mode.

Procedure. Follow the steps below to verify the accuracy of the internal clock frequencies:

1. Load the **TP1CLK.PDA** test pattern file from the performance check disk. When the file is loaded, the DG2040 Data Generator clock frequency will be set to 1100 MHz internally.

NOTE. Refer to Table 4-4 for steps 2 through 5.

2. Perform the following steps to check the 1.100000 GHz clock frequency accuracy:
 - a. Press the **START/STOP** button on the front panel. The LED corresponding to the button should be on.

- b. Set the counter trigger to an appropriate value and verify that the counter displays a frequency in the range of 1.09999989 to 1.1000011 GHz. Refer to Table 4-4.
3. Perform the following steps to check the 650.1000 MHz clock frequency accuracy:
 - a. Press the following buttons to set the DG2040 Data Generator clock frequency to 650.1 MHz.

Menu button	Bottom button	Pop up menu	Side button	Front panel button
SETUP	Clock		Int FREQ	650.1 MHz/ μ s

- b. Set the counter trigger to an appropriate value, and verify that the counter displays a frequency in the 650.09935 MHz to 650.10065 MHz range.
4. Perform the following steps to check the 200.0000 kHz clock frequency accuracy:
 - a. Change the frequency counter input to INPUT A through the 50 Ω termination with the SMA cable.
 - b. Set the DG2040 Data Generator clock frequency to 200 kHz.
 - c. Set the counter trigger to an appropriate value, and verify that the counter displays a frequency in the 199.99980 kHz to 200.00020 kHz range.
5. Perform the following steps to check the 100.0000 mHz clock frequency accuracy:
 - a. Set the DG2040 Data Generator clock frequency to 100 mHz (0.1 Hz).
 - b. Set the counter trigger to an appropriate value, and verify that the counter displays a frequency in the range 99.99990 mHz to 100.00010 mHz.

Table 4-4: Internal clock frequency accuracy

Internal clock frequencies	Clock frequency ranges
1.100000 GHz	1.0999989 GHz ~ 1.1000011 GHz
650.1000 MHz	650.09935 MHz ~ 650.10065 MHz
200.0000 kHz	199.99980 kHz ~ 200.00020 kHz
100.0000 mHz (10.0 s)	99.99990 mHz ~ 100.00010 mHz

- Press the **START/STOP** button on the front panel to stop the output (the buttons LED goes off).

Sequence & Data Output

This test verifies that the pattern data that is output from the DG2040 Data Generator output channel ports (CH0, $\overline{\text{CH0}}$, CH1, and $\overline{\text{CH1}}$) is functioning correctly.

The following equipment is required.

Equipment Required	
	Oscilloscope
	Function generator
	Three BNC cables
	Two SMA cables
	Two SMA female-to-BNC male adapters
	Performance check disk

Connections. Refer to Figure 4-4 for connections.

Use the SMA cables and the SMA female-to-BNC male adapters to make the following connections:

- Connect CH0 output from the DG2040 Data Generator front panel to the oscilloscope CH1 input.
- Connect $\overline{\text{CH0}}$ output from the DG2040 Data Generator front panel to the oscilloscope CH2 input.

Use the BNC cables to make the following connections:

- Connect the function generator CH1 output to the DG2040 Data Generator rear panel event input.
- Connect the event output from the DG2040 Data Generator rear panel to the oscilloscope CH3 input.

- Connect the sync output from the DG2040 Data Generator rear panel to the oscilloscope CH4 input.

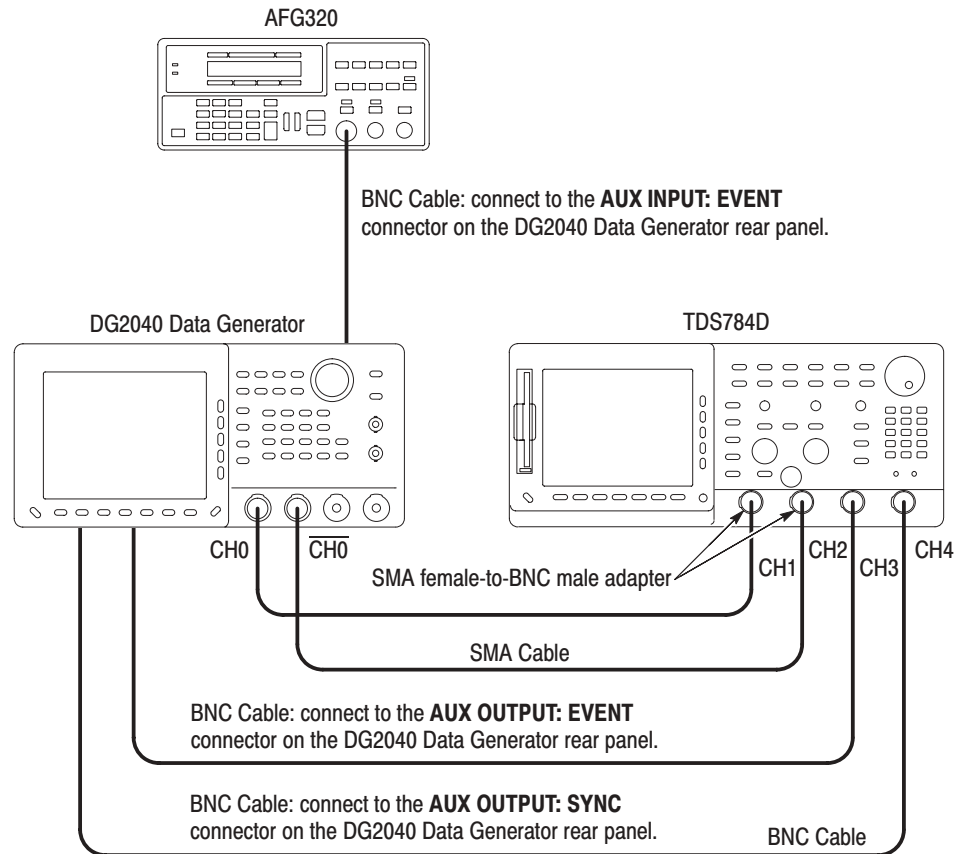


Figure 4-4: Sequence & data output connections

Setup. Set the oscilloscope and AFG320 Function Generator as indicated below:

■ Oscilloscope

Displayed channel CH1, CH2, CH3 and CH4
 Vertical axis . 1 V/div for CH1 and CH2
 5 V/div for CH3 and CH4
 Horizontal axis 5 μ s/div
 Record length 500
 Acquire mode Peak Detect
 Acquire sequence RUN/STOP button only
 Trigger mode Auto
 Trigger level . 2 V
 Trigger source CH3
 Trigger position 50 %
 Trigger slope . Falling Edge
 Input coupling DC
 Input impedance 50 Ω for CH1 and CH2
 1 M Ω for CH3 and CH4

■ Function generator

Output channel CH1
 Waveform . . . Square wave
 Frequency . . . 500 Hz
 Amplitude . . . 1 V (50 Ω termination)
 Offset 500 mV

Procedure. Follow the steps below to verify pattern data output:

1. Load the **TP2PG.PDA** test pattern file from the performance check disk.
2. Press the **START/STOP** button on the front panel. The LED, corresponding to the button, should be on.
3. Verify that the data pattern shown in Figure 4-5 appears on the oscilloscope.
4. Disconnect the SMA cable from the CH0 output connector and the $\overline{\text{CH0}}$ output connector on the DG2040 Data Generator, and then connect them to the CH1 output connector and the $\overline{\text{CH1}}$ output connector on the DG2040 Data Generator.
5. Verify that the pattern data shown in Figure 4-5 appears on the oscilloscope.
6. Disconnect the BNC cable from event input connector on the DG2040 Data Generator rear panel.
7. Change the oscilloscope acquisition sequence to Single Acquisition Sequence.

8. Press the **STEP/EVENT** button on the front panel.
9. Verify that the data pattern shown in Figure 4-5 appears on the oscilloscope.
10. Press the **START/STOP** button on the front panel to stop output (the buttons LED goes off).

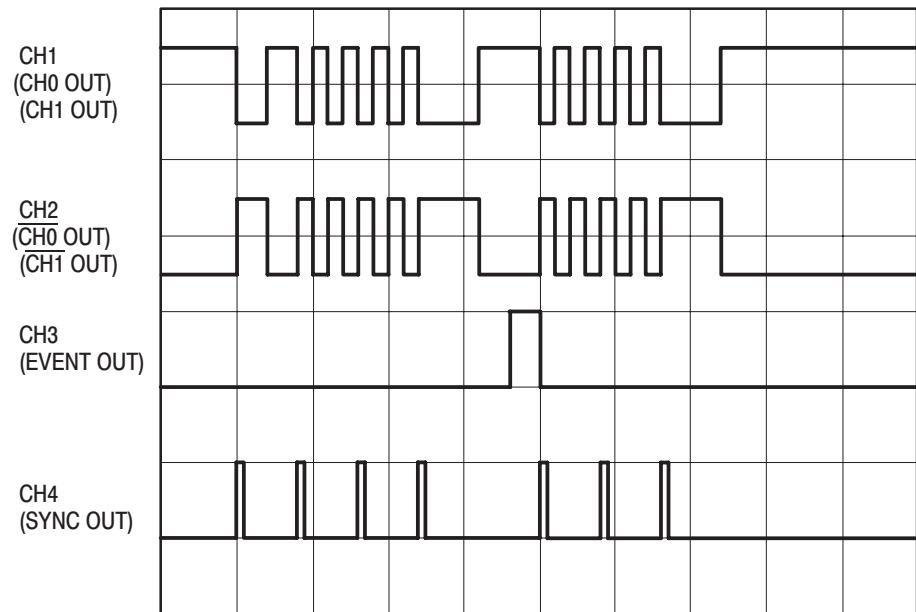


Figure 4-5: Sequence & data output timing chart

External Reference Input

This test verifies that the external reference input operation is functioning correctly.

The following equipment is required.

Equipment Required	Oscilloscope Function generator Four BNC cables Two SMA cables Two SMA female-to-BNC male adapters Performance check disk
---------------------------	--

Connections. Refer to Figure 4-6 for connections.

Use the SMA cables and the SMA female-to-BNC male adapters to make the following connections:

- Connect CH1 output from the DG2040 Data Generator front panel to the oscilloscope CH1 input.
- Connect $\overline{\text{CH1}}$ output to the DG2040 Data Generator front panel to the oscilloscope CH2 input.

Use the BNC cables to make the following connections:

- Connect the function generator CH1 output to the DG2040 Data Generator rear panel event input.
- Connect the function generator CH2 output to the DG2040 Data Generator rear panel reference input.
- Connect the event output from the DG2040 Data Generator rear panel to the oscilloscope CH3 input.
- Connect the sync output from the DG2040 Data Generator rear panel to the oscilloscope CH4 input.

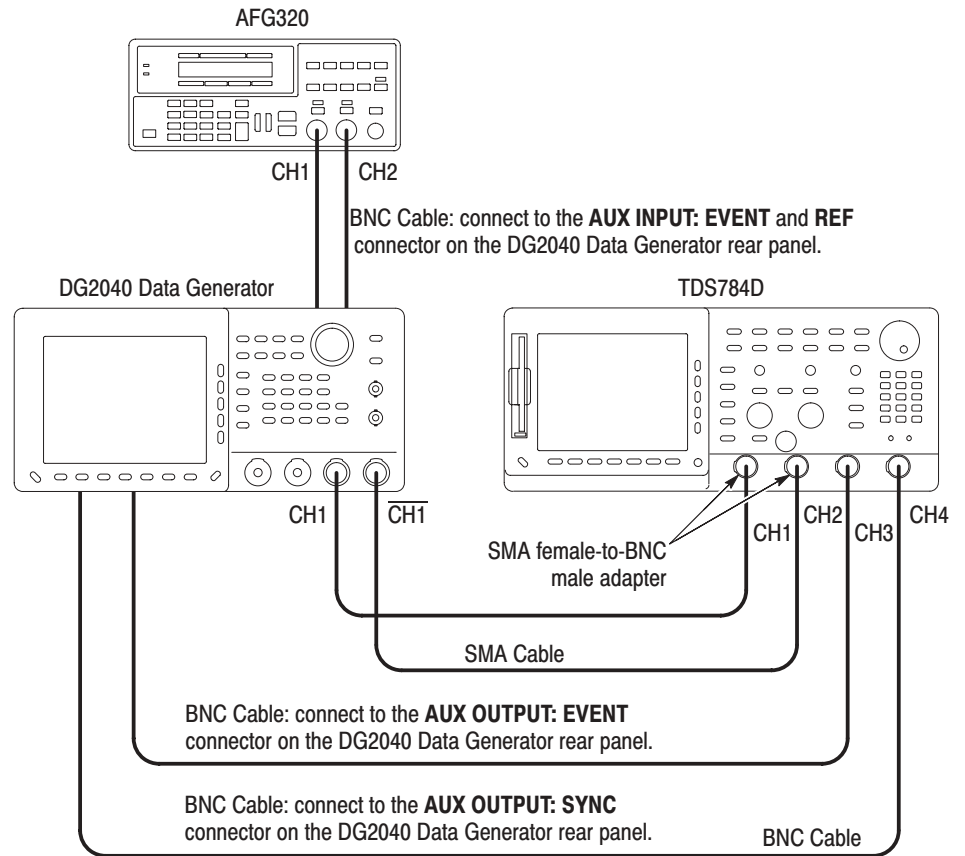


Figure 4-6: External reference input connections

Setup. Set the oscilloscope and AFG320 Function Generator as indicated below:

■ Oscilloscope

Displayed channel CH1, CH2, CH3, and CH4
Record length 500
Acquisition mode Peak Detect
Acquire sequence RUN/STOP button only
Vertical axis . 1 V/div for CH1 and CH2
 5 V/div for CH3 and CH4
Input coupling DC
Input impedance 50 Ω for CH1 and CH2
 1 M Ω for CH3 and CH4
Horizontal axis 10.00 μ s/div
Trigger mode Auto
Trigger level . 2 V
Trigger source CH3
Trigger coupling DC
Trigger slope . Falling Edge
Trigger position 50 %

■ Function generator

Output channel CH1 and CH2
Waveform . . . Square wave for CH1
 Sine wave for CH2
Frequency . . . 500 Hz for CH1
 10 MHz for CH2
Amplitude . . . 1 V for CH1 and CH2(50 Ω termination)
Offset 500 mV for CH1
 0 mV for CH2

Procedure. Follow the steps below to verify the external reference input operation:

1. Load the **TP3EXREF.PDA** test pattern file from the performance check disk.
2. Press the **START/STOP** button on the front panel. The LED, corresponding to the button, should be on.
3. Run the oscilloscope for acquisition, and verify that the data pattern shown in Figure 4-5 appears on the oscilloscope.
4. Press the **START/STOP** button on the front panel to stop output (the button's LED goes off).

Maximum Operating Frequency (Continuous)

This test verifies maximum operating frequency (continuous) is functioning correctly.

The following equipment is required.

Equipment Required	
	Oscilloscope
	Function generator
	Three BNC cables
	Four SMA cables
	Four SMA female-to-BNC male adapters
	Performance check disk

Connections. Refer to Figure 4-7 for connections.

Use the SMA cables and the SMA female-to-BNC male adapters to make the following connections:

- Connect CH0 output from the DG2040 Data Generator front panel to the oscilloscope CH1 input.
- Connect CH1 output to the DG2040 Data Generator front panel to the oscilloscope CH2 input.
- Use the remaining two SMA cables, the remaining two SMA female-to-BNC male adapters, and the 50 Ω terminations to terminate the CH0 and CH1 outputs.

Use the BNC cables to make the following connections:

- Connect the function generator Ch1 output to the DG2040 Data Generator rear panel event input.
- Connect the event output from the DG2040 Data Generator rear panel to the oscilloscope CH3 input.
- Connect the sync output from the DG2040 Data Generator rear panel to the oscilloscope CH4 input.

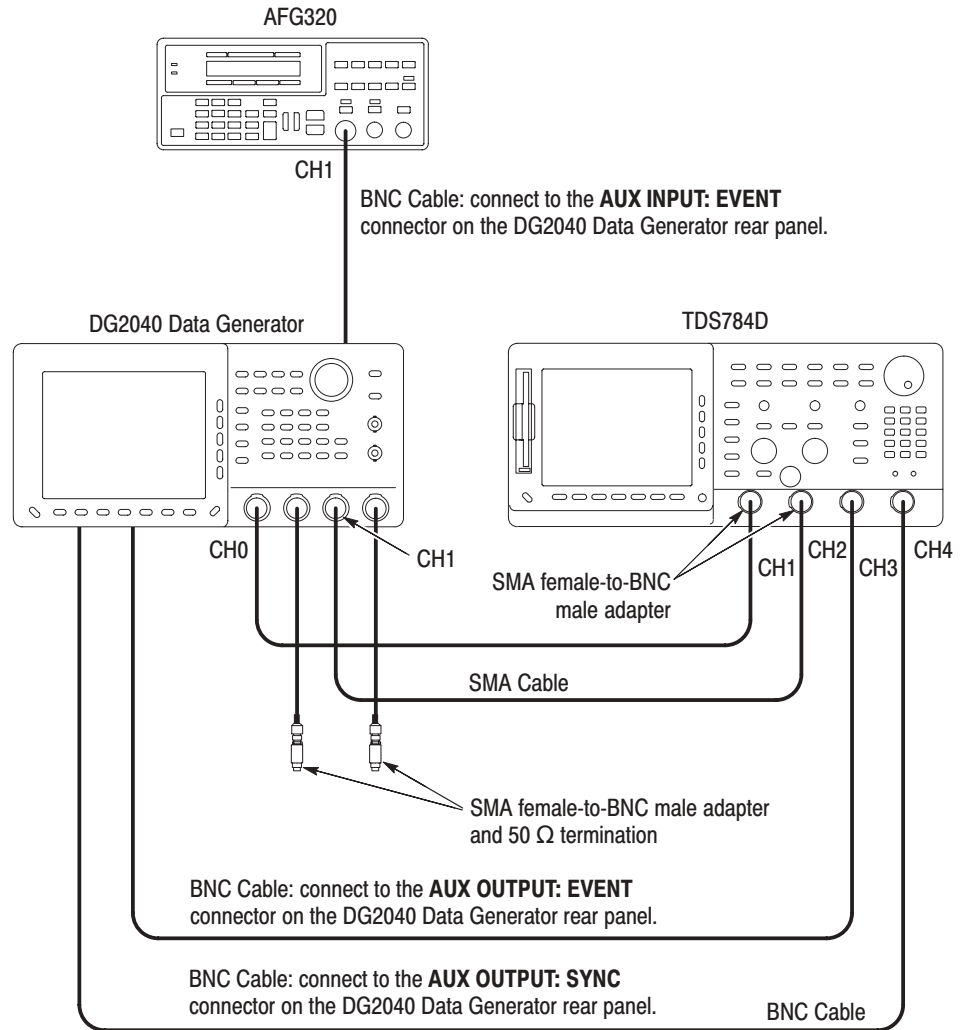


Figure 4-7: Maximum operating frequency connections

Setup. Set the oscilloscope and AFG320 Function Generator as indicated below:

■ Oscilloscope

Displayed channel CH1 and CH2
 Vertical axis . 1 V/div for CH1 and CH2
 5 V/div for CH3 and CH4
 Horizontal axis 5.00 ns/div
 Record length 15000
 Acquire mode Peak Detect
 Acquire sequence RUN/STOP button only
 Trigger mode Auto
 Trigger level . 2 V
 Trigger source CH3
 Trigger slope . Falling Edge
 Trigger position 50 %
 Input coupling DC
 Input impedance 50 Ω for CH1 and CH2
 1 M Ω for CH3 and CH4
 InstaVu Infinite Persistence

■ Function generator

Output channel CH1
 Waveform . . . Square wave
 Frequency . . . 500 Hz
 Amplitude . . . 1 V (50 Ω termination)
 Offset 500 mV

Procedure. Follow the steps below to verify the maximum operating frequency (continuous):

1. Load the **TP4CONT.PDA** test pattern file from the performance check disk.
2. Press the **START/STOP** button on the front panel. The LED, corresponding to the button, should be on.
3. Verify that a stable data pattern as shown in Figure 4-8 appears on the oscilloscope screen.
4. Change the oscilloscope trigger slope setting to Rising Edge.
5. Verify that a stable data pattern as shown in Figure 4-9 appears on the oscilloscope screen.
6. Change the oscilloscope trigger source to CH4 and trigger slope to Falling Edge.
7. Verify that a stable data pattern as shown in Figure 4-10 appears on the oscilloscope screen.

8. Press the **START/STOP** button on the front panel to stop output (the buttons LED goes off).

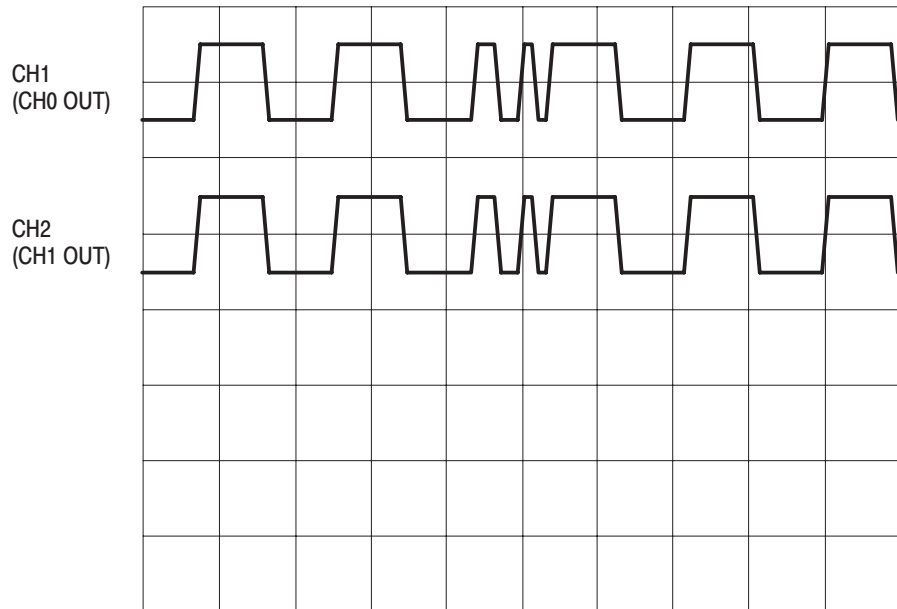


Figure 4-8: Maximum operating frequency (1)

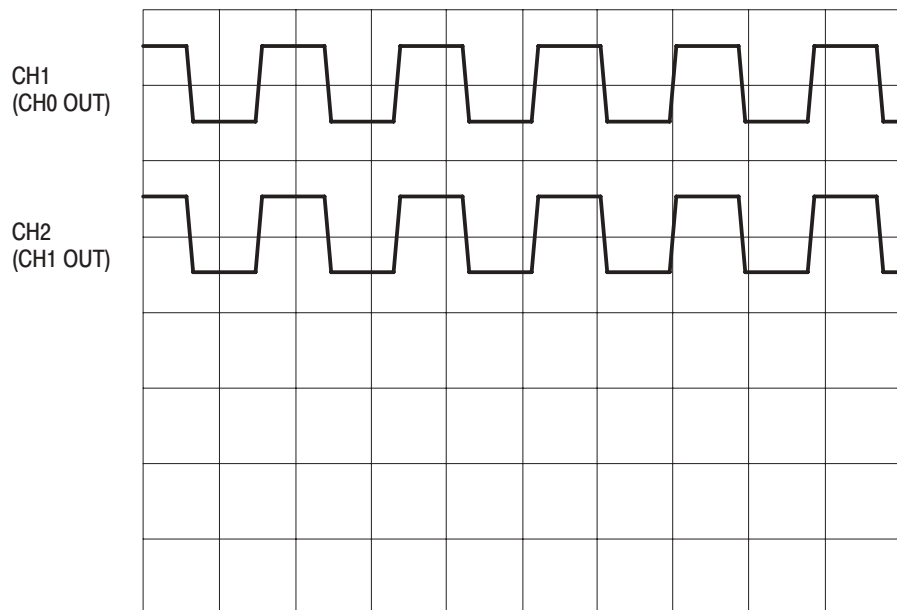


Figure 4-9: Maximum operating frequency (2)

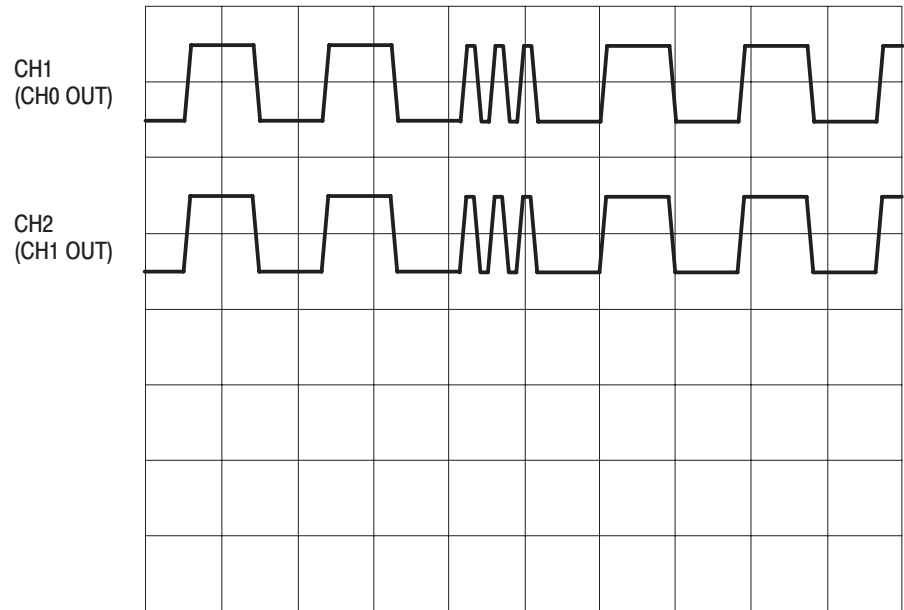


Figure 4-10: Maximum operating frequency (3)

Maximum Operating Frequency (Trigger Operation)

This test verifies that the maximum operating frequency (trigger operation) is functioning correctly.

The following equipment is required.

Equipment Required	Oscilloscope Function generator Three BNC cables Four SMA cables Four SMA female-to-BNC male adapters Performance check disk
---------------------------	---

Connections. Refer to Figure 4-11 for connections.

Use the SMA cables and the SMA female-to-BNC male adapters to make the following connections:

- Connect CH0 output from the DG2040 Data Generator front panel to the oscilloscope CH1 input.
- Connect CH1 output from the DG2040 Data Generator front panel to the oscilloscope CH2 input.
- Use the remaining two SMA cables, the remaining two SMA female-to-BNC male adapters, and the 50 Ω terminations to terminate the CH0 and CH1 outputs.

Use the BNC cables to make the following connections:

- Connect the function generator CH1 output to the DG2040 Data Generator rear panel event input.
- Connect the event output from the DG2040 Data Generator rear panel to the oscilloscope CH3 input.
- Connect the sync output from the DG2040 Data Generator rear panel to the oscilloscope CH4 input.

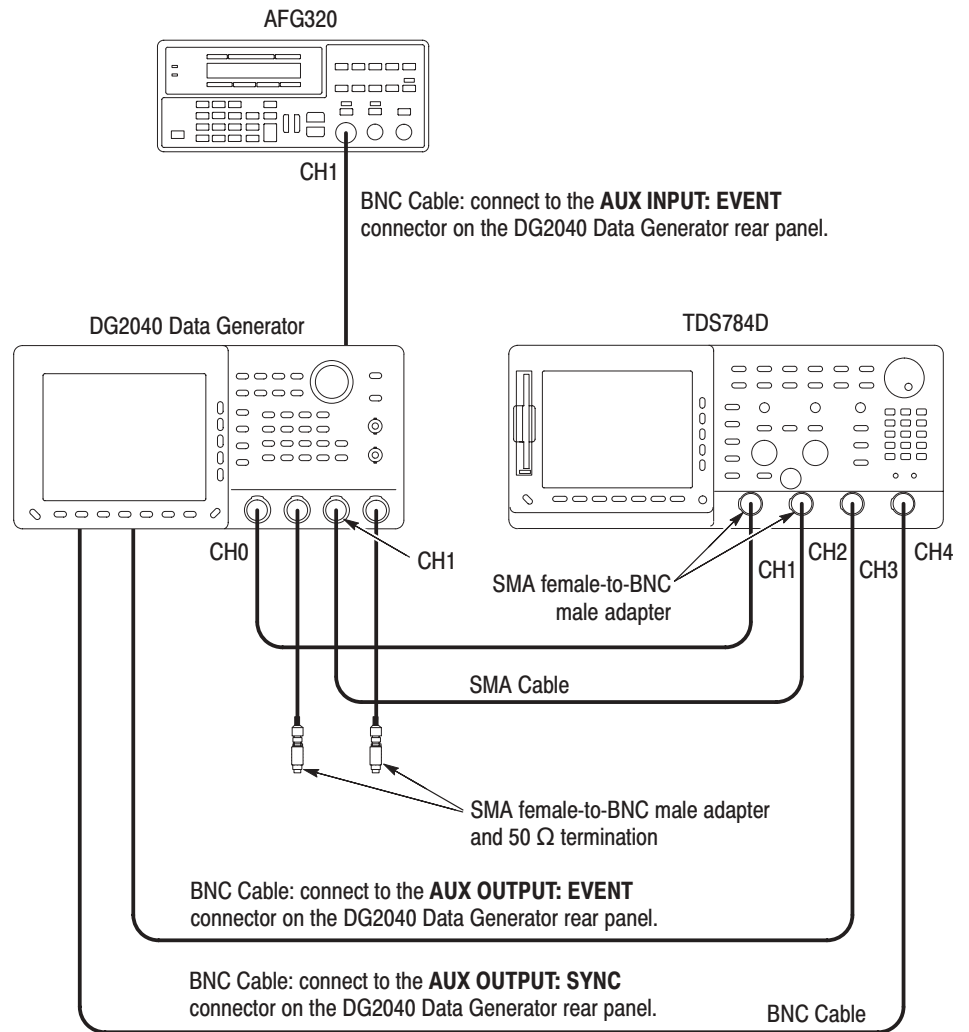


Figure 4-11: Maximum operating frequency connections

Setup. Set the oscilloscope and AFG320 Function Generator as indicated below:

■ Oscilloscope

Displayed channel CH1 and CH2
Vertical axis . 1 V/div for CH1 and CH2
 5 V/div for CH3 and CH4
Horizontal axis 5.00 ns/div
Record length 15000
Acquire mode Peak Detect
Acquire sequence RUN/STOP button only
Trigger mode Auto
Trigger level . 2 V
Trigger source CH3
Trigger slope . Falling Edge
Trigger position 50 %
Input coupling DC
Input impedance 50 Ω for CH1 and CH2
 1 M Ω for CH3 and CH4
InstaVu Infinite Persistence

■ Function generator

Output channel CH1
Waveform . . . Square wave
Frequency . . . 500 Hz
Amplitude . . . 1 V (50 Ω termination)
Offset 500 mV

Procedure. Follow the steps below to verify that the maximum operating frequency (trigger operation) is functioning correctly.

1. Load the **TP5TRIG.PDA** test pattern file from the performance check disk.
2. Press the **START/STOP** button on the front panel. The LED, corresponding to the button, should be on.
3. Verify that a stable data pattern as shown in Figure 4-12 appears on the oscilloscope screen.
4. Change the oscilloscope trigger source to CH4 and trigger slope to Rising Edge.
5. Verify that a stable data pattern as shown in Figure 4-13 appears on the oscilloscope screen.
6. Press the **START/STOP** button on the front panel to stop output (the buttons LED goes off).

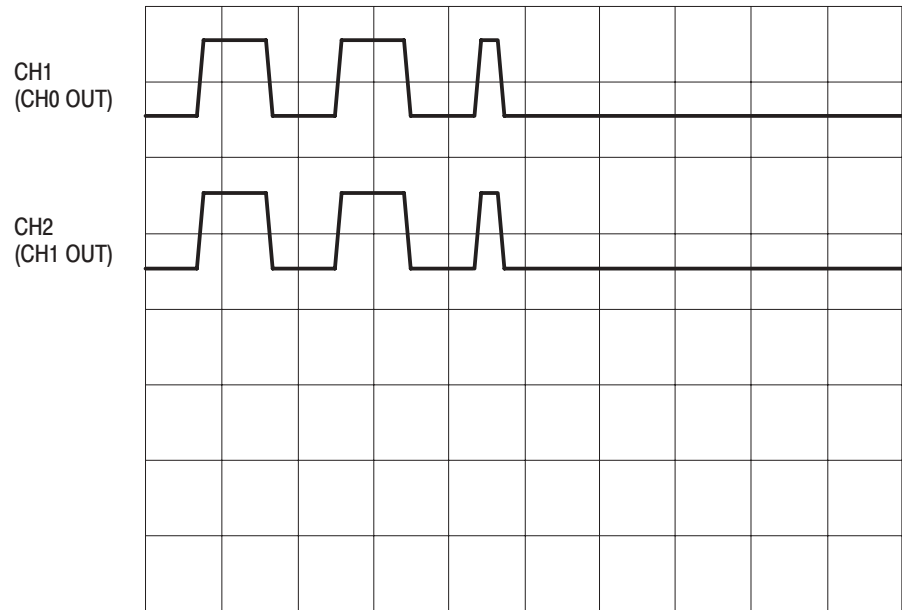


Figure 4-12: Maximum operating frequency (4)

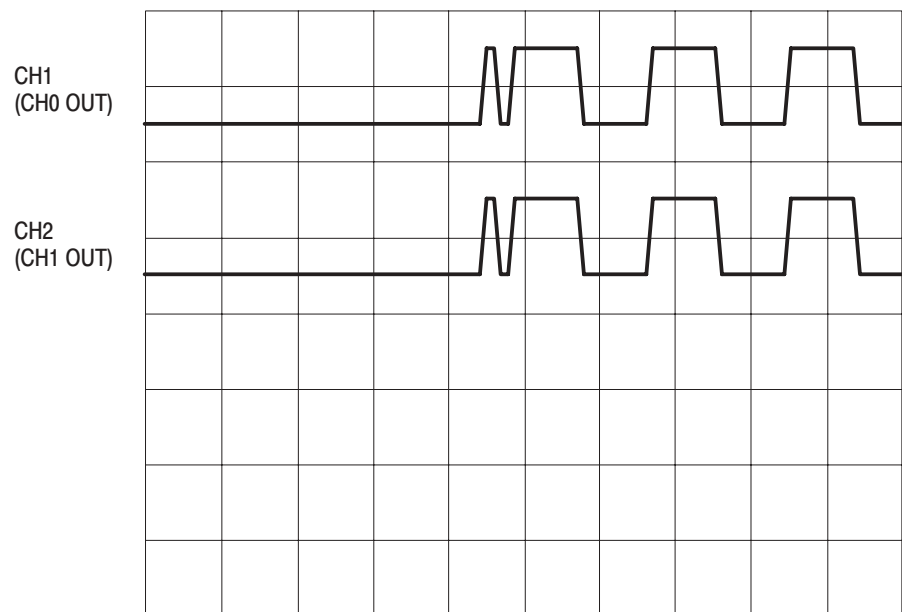


Figure 4-13: Maximum operating frequency (5)

Internal Trigger Generator & External Trigger Input

This test verifies that the internal trigger generator and the external trigger input are functioning correctly.

The following equipment is required.

Equipment Required	Oscilloscope
	Function generator
	Two BNC cables
	Performance check disk

Connections. Refer to Figure 4-14 for connections.

Use the BNC cables to make the following connections:

- Connect the sync output from the DG2040 Data Generator rear panel to the oscilloscope CH4 input.
- Connect the function generator output to the DG2040 Data Generator front panel trigger input.

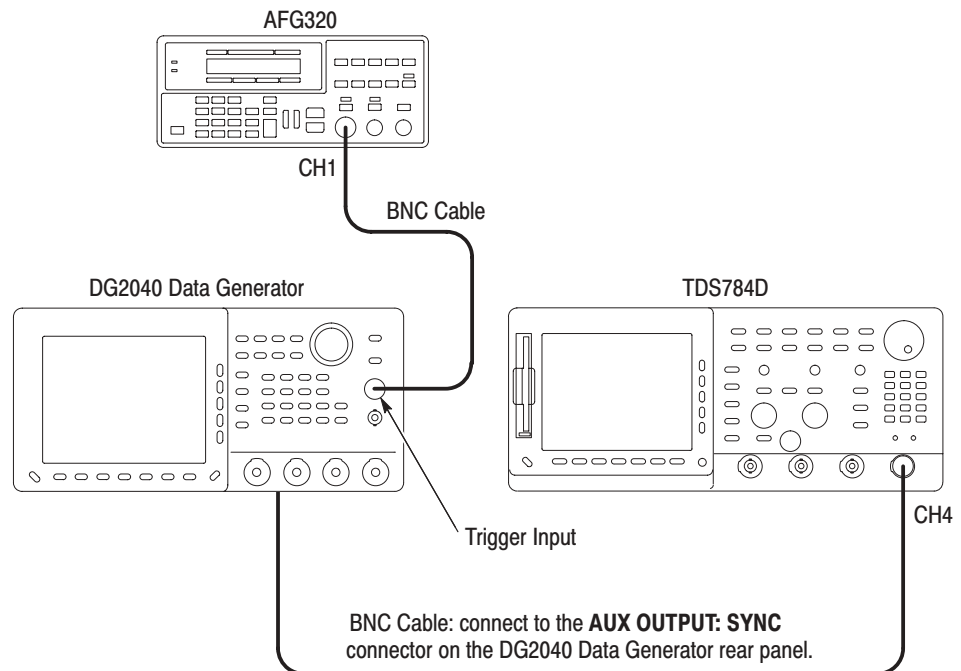


Figure 4-14: Internal trigger generator & external trigger input connection

Setup. Set the oscilloscope and AFG320 Function Generator as indicated below:

■ Oscilloscope

Displayed channel CH4
 Vertical axis . 5 V/div for CH4
 Horizontal axis 1.00 μ s/div
 Record length 500
 Acquire mode Peak Detect
 Acquire sequence RUN/STOP button only
 Trigger mode Auto
 Trigger level . 2 V
 Trigger source CH4
 Trigger slope . Falling Edge
 Trigger position 50 %
 Input coupling DC
 Input impedance 1 M Ω for CH4
 InstaVu off

■ Function generator

Output channel CH1
 Waveform . . . Square wave
 Frequency . . . 500 Hz
 Amplitude . . . 1 V (50 Ω termination))
 Offset 500 mV

Procedure. Follow the steps below to verify that the Internal Trigger Generator and the External Trigger Input are functioning correctly:

1. Load the **TP6GEN.PDA** test pattern file from the performance check disk.
2. Press the **START/STOP** button on the front panel. The LED, corresponding to the button, should be on.
3. Verify that the sync signal appears every 1 μ s on the oscilloscope screen.
4. Press the following buttons to set the DG2040 Data Generator trigger interval to 10 s.

Menu button	Bottom button	Pop up menu	Side button	Front panel button
SETUP	Trigger		Interval	
			State (Set to On)	
			Time	10 Hz/s/V

5. Change the oscilloscope horizontal axis setting to 2.00 s/div.
6. Verify that the sync signal appears in every 10 s on the oscilloscope screen.
7. Press the following buttons to set the DG2040 Data Generator trigger interval to 10 ms.

Menu button	Bottom button	Pop up menu	Side button	Front panel button
SETUP	Trigger		Interval	
			State (Set to On)	
			Time	10 kHz/ms/mV

8. Change the oscilloscope horizontal axis setting to 2.00 ms/div.
9. Press the following buttons to set the DG2040 Data Generator trigger interval to turn off.

Menu button	Bottom button	Pop up menu	Side button	Front panel button
SETUP	Trigger		Interval	
			State (Set to Off)	

10. Verify that **Waiting for trigger** message appears on the DG2040 Data Generator screen, and no waveform appears on the oscilloscope screen.
11. Press the following buttons to set the DG2040 Data Generator trigger interval to Ext.

Menu button	Bottom button	Pop up menu	Side button	Front panel button
SETUP	Trigger		Source (set to Ext)	

12. Verify that the sync signal appears every 2 ms on the oscilloscope screen.
13. Press the **START/STOP** button on the front panel to stop output. The LED, corresponding to the button, is turned off.

Edge Control Mode Operation

This test verifies the edge control mode operation is functioning correctly.

The following equipment is required.

Equipment Required	
	Sampling oscilloscope with head
	Function generator
	BNC cable
	Four SMA cables
	SMA female-to-BNC male adapter
	50 Ω termination
	Three SMA X5 attenuators
	Performance check disk

Connections. Refer to Figure 4-15 for connections.

Use the SMA cables and the SMA 5X attenuators to make the following connections:

- Connect CH0 output from the DG2040 Data Generator front panel to the sampling oscilloscope CH1 input.
- Connect CH1 output to the DG2040 Data Generator front panel to the sampling oscilloscope CH2 input.
- Connect the $\overline{\text{CH1}}$ output from the DG2040 Data Generator front panel to the sampling oscilloscope TRIGGER INPUTS DIRECT.
- Use the remaining SMA cable, the SMA female-to-BNC male adapter, and the 50 Ω termination to terminate the DG2040 Data Generator CH0 output.

Use the BNC cable to make the following connection:

- Connect the function generator CH1 output to the DG2040 Data Generator front panel edge control input.

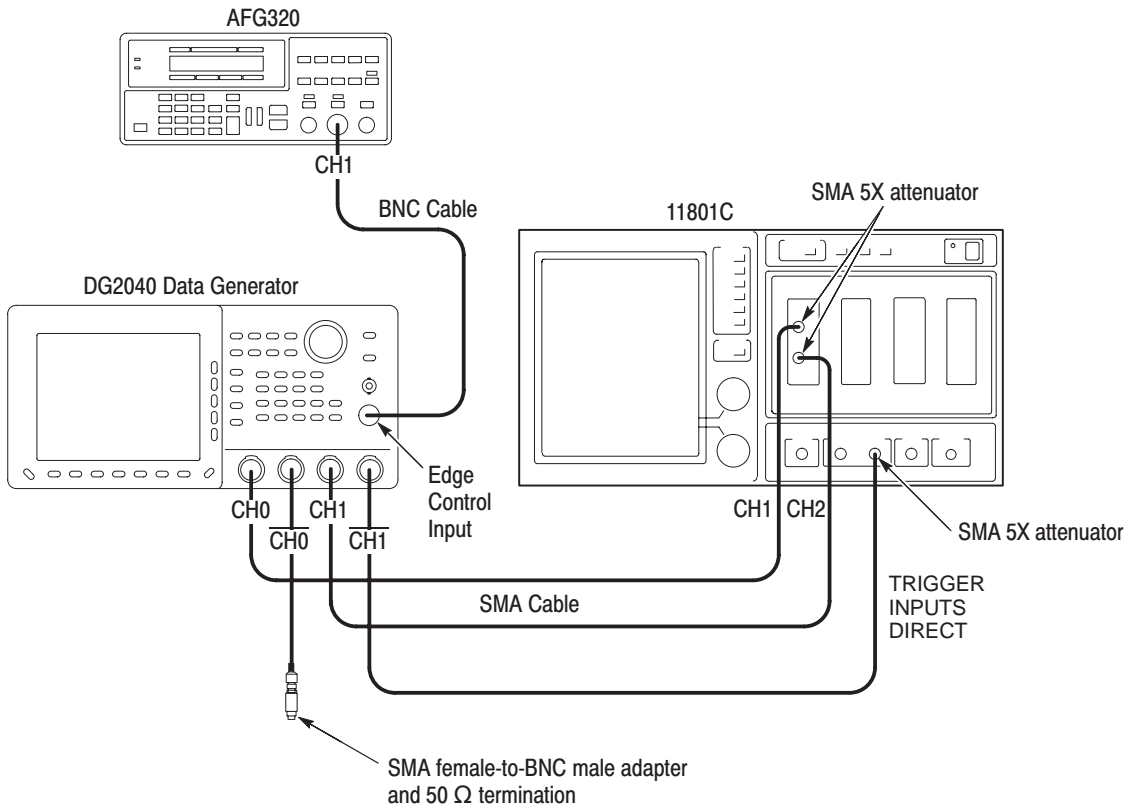


Figure 4-15: Edge control mode operation connection

Setup. Set the sampling oscilloscope and AFG320 Function Generator as indicated below:

- Sampling oscilloscope

Displayed channel CH1 and CH2
 Vertical axis . 100 mV/div for CH1 and CH2
 Horizontal axis 500 ps/div
 Trigger mode Norm
 Trigger level . 0 V
 Trigger source External Direct
 Trigger slope . Falling Edge
 Trigger position 50 %
 Vectored Trace Off

■ Function generator

Output channel CH2
Waveform . . . Square wave
Frequency . . . 10 MHz
Amplitude . . . 2 V
Offset 0 mV

Procedure. Follow the steps below to verify that the edge control mode operation is functioning correctly.

1. Load the **TP7EDGE.PDA** test pattern file from the performance check disk.
2. Press the **START/STOP** button on the front panel. The LED, corresponding to the button, should be on.
3. Adjust the Main Pos control on the sampling oscilloscope front panel. Verify that jitter appears only on the rising edge portion on the CH0 output signal after the CH1 output signal rises. See figure 4-16.
4. Press the **START/STOP** button on the front panel to stop output. The LED, corresponding to the button, is turned off.

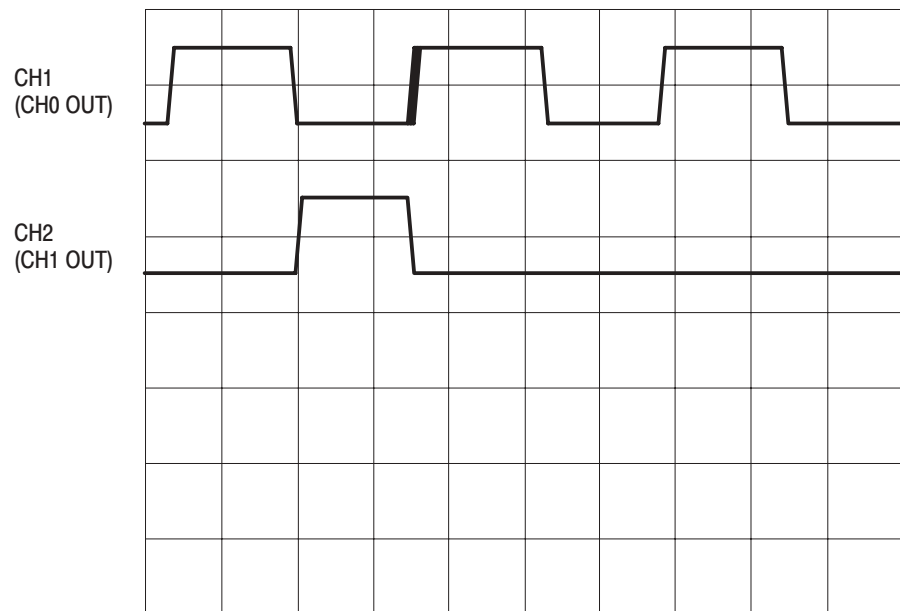


Figure 4-16: Edge control mode

Output Level Accuracy

This test verifies that the output level accuracy of the DG2040 Data Generator output is functioning correctly.

Variable voltage levels for the amplitude

High level: -0.875 V to $+3.50\text{ V}$ into $50\ \Omega$

Low level: -1.125 V to $+3.25\text{ V}$ into $50\ \Omega$

Output Level (CH0, $\overline{\text{CH0}}$, CH1, and $\overline{\text{CH1}}$)

Accuracy: $\pm (3\% \text{ of setting}) \pm 50\text{ mV}$ into $50\ \Omega$

The following equipment is required.

Equipment Required	Digital multimeter (DMM) SMA cable SMA female-to-BNC male adapter Precision $50\ \Omega$ termination BNC to dual banana adapter Performance check disk
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Connections. Refer to Figure 4-17 for connections.

Use the SMA cable, the SMA female-to-BNC male adapter, the precision $50\ \Omega$ termination, and the BNC to dual banana adapter to make the following connection:

- Connect CH0 output from the DG2040 Data Generator front panel to the digital multimeter input.

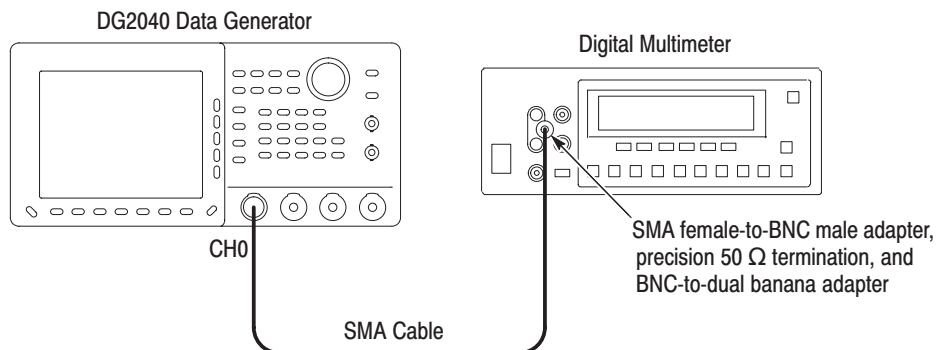


Figure 4-17: Output level measurement connections

Setup. Set the digital multimeter as indicated below:

■ Digital multimeter

Function DCV
Range Auto

Procedure. Follow the steps below to verify the output level accuracy:

1. Load the **TP8LVL.PDA** test pattern file from the performance check disk.
2. Press the following buttons to set the DG2040 Data Generator high and low voltage levels.

Menu button	Bottom button	Pop up menu	Side button	Front panel button
SETUP	Level Condition			
Move the cursor to CH0 with the general purpose knob.				
			High	-0.875 ENTER
			Low	-1.125 ENTER

3. Press the **START/STOP** button on the front panel. The LED, corresponding to the button, should be on.
4. Verify the high voltage level by following the procedures below:
 - a. Press the **STEP/EVENT** button on the DG2040 Data Generator front panel once to output high voltage level.
 - b. Set the high and low voltage levels to the values indicated in Table 4-5, and verify that the digital multimeter reading for each high voltage level setting falls within the specified voltage range.
 - c. Repeat Step b for all high and low voltage settings in Table 4-5.
 - d. Repeat Steps a to c for output channels $\overline{\text{CH0}}$, CH1, and $\overline{\text{CH1}}$ output each time the SMA cable connection is changed.

Table 4-5: High level output voltage accuracy

Settings		High level output voltage ranges
High voltage level (V)	Low voltage level (V)	
-0.875	-1.125	-0.951 V to -0.799 V
0	-1.125	-0.050 V to +0.050 V
+1.00	-1.125	+0.920 V to +1.080 V
+2.00	-0.500	+1.890 V to +2.110 V
+3.50	+1.00	+3.345 V to +3.655 V

5. Verify the low voltage level by following the procedure below:
 - a. Change the SMA cable connection of the DG2040 Data Generator from $\overline{\text{CHI}}$ output to $\overline{\text{CH0}}$ output.
 - b. Press the **STEP/EVENT** button on the DG2040 Data Generator front panel once to output low voltage level.
 - c. Set the low and high voltage levels to the values as shown in Table 4-6, and verify that the digital multimeter reading for each voltage setting falls within the specified voltage range.
 - d. Repeat Step c for all high and low voltage settings in Table 4-6.
 - e. Repeat Steps b to d for output channels $\overline{\text{CH0}}$, $\overline{\text{CH1}}$, and $\overline{\text{CH2}}$ each time the SMA cable connections changed.

Table 4-6: Low level output voltage accuracy

Settings		Low level output voltage ranges
Low voltage level (V)	High voltage level (V)	
-1.125	+1.375	-1.209 V to -1.041 V
0	+2.50	-0.050 V to +0.050 V
+1.00	+3.50	+0.920 V to +1.080 V
+2.00	+3.50	+1.890 V to +2.110 V
+3.25	+3.50	+3.103 V to +3.398 V

6. Press the **START/STOP** button on the front panel to stop output. The LED, corresponding to the button, is turned off.

Clock Output Amplitude Accuracy

This test verifies the clock output amplitude accuracy of the DG2040 Data Generator

Variable voltage levels for the amplitude

High level: -0.875 V to $+3.50\text{ V}$ into $50\ \Omega$

Low level: -1.125 V to $+3.25\text{ V}$ into $50\ \Omega$

Output Level (CLOCK and $\overline{\text{CLOCK}}$)

Accuracy: $\pm (5\% \text{ of setting}) \pm 50\text{ mV}$ into $50\ \Omega$

The following equipment is required.

Equipment Required	
	Oscilloscope
	Two SMA cables
	Two SMA female-to-BNC male adapters
	Performance check disk

Connections. Refer to Figure 4-18 for connections.

Use the SMA cables and the SMA female-to-BNC male adapters to make the following connections:

- Connect the CLOCK output from the DG2040 Data Generator rear panel to the oscilloscope CH1 input.
- Connect the $\overline{\text{CLOCK}}$ output from the DG2040 Data Generator rear panel to the oscilloscope CH2 input.

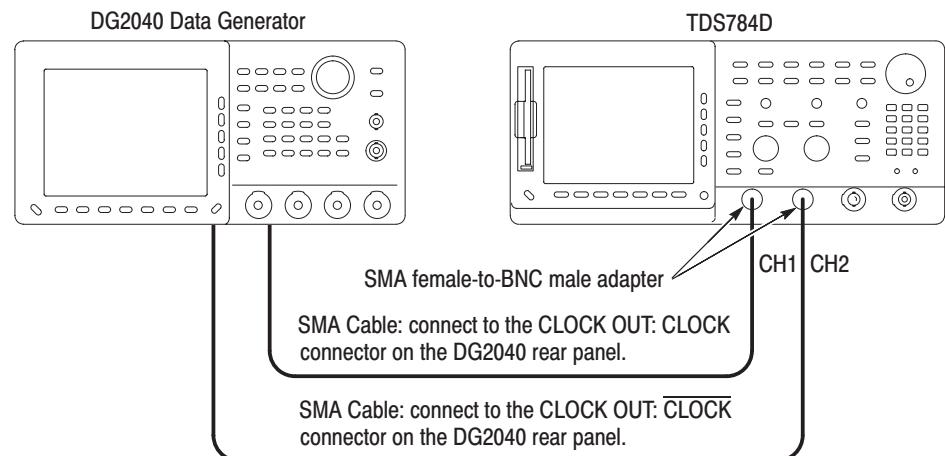


Figure 4-18: Clock output amplitude measurement connection

Setup. Set the oscilloscope as indicated below:

■ Oscilloscope

- Displayed channel CH1 and CH2
- Vertical axis . 100 mV/div for CH1 and CH2
- Horizontal axis 200 ns/div
- Record length 500
- Acquire mode Average 32
- Acquire sequence RUN/STOP button only
- Vertical offset -1 V
- Trigger mode Norm
- Trigger level . -200 mV
- Trigger source CH2
- Trigger slope . Rising Edge
- Trigger position 50 %
- Trigger coupling DC
- Display Vectors
- Input coupling DC
- Input impedance 50 Ω for CH1 and CH2

Procedure. Follow the steps below to verify the clock output amplitude accuracy:

1. Load the **TP9PULSE.PDA** test pattern file from the performance check disk.
2. Press the following buttons to set the DG2040 Data Generator high and low voltage levels.

Menu button	Bottom button	Pop up menu	Side button	Front panel button
SETUP	Level Condition			
Move the cursor to CLK with the general purpose knob.				
			High	-0.875 ENTER
			Low	-1.125 ENTER

3. Adjust the trigger level and vertical scale settings to get trace on the oscilloscope. Perform the measurement under the low and high voltage settings shown in Table 4-7 and verify that the peak-to-peak amplitude for each voltage setting is within the specified range.

Table 4-7: Clock output voltage accuracy

Settings		Low level output voltage ranges
Low voltage level (V)	High voltage level (V)	
-1.125	-0.875	0.250 V, \pm 0.062 V (0.188 V to 0.312 V)
+1.000	+1.25	0.250 V, \pm 0.062 V (0.188 V to 0.312 V)
+3.250	+3.50	0.250 V, \pm 0.062 V (0.188 V to 0.312 V)
-1.125	+1.375	2.50 V, \pm 0.175 V (2.325 V to 2.675 V)
0.000	+2.50	2.50 V, \pm 0.175 V (2.325 V to 2.675 V)
+1.000	+3.50	2.50 V, \pm 0.175 V (2.325 V to 2.675 V)

4. Press the **START/STOP** button on the front panel to stop output. The LED, corresponding to the button, is turned off.

Delay Time Accuracy

This test verifies the delay time accuracy referenced to the clock output on each channel of the DG2040 Data Generator.

$$\text{Accuracy: } \pm(3 \% \text{ of setting}) \pm |T_a - 25 \text{ }^\circ\text{C}| \times 15 \text{ ps} \pm 100 \text{ ps}$$

The following equipment is required.

Equipment Required	Sampling oscilloscope with head Five SMA cables (three of them must be same length) Two SMA female-to-BNC male adapters Two 50 Ω terminations Three SMA X5 attenuators Performance check disk
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Connections. Refer to Figure 4-19 for connections.

Use the SMA cables (three cables must be same length) and the SMA 5X attenuators to make the following connections:

- Connect the CLOCK output from the DG2040 Data Generator rear panel to the sampling oscilloscope CH1 input.
- Connect the CH0 output from the DG2040 Data Generator front panel to the sampling oscilloscope CH2 input.
- Connect the $\overline{\text{CH1}}$ output from the DG2040 Data Generator front panel to the sampling oscilloscope TRIGGER INPUTS DIRECT.

Use the SMA female-to-BNC male adapter and the 50 Ω termination to make the following connection:

- Terminate the $\overline{\text{CH0}}$ output of the DG2040 Data Generator.
- Terminate the CH1 output of the DG2040 Data Generator.

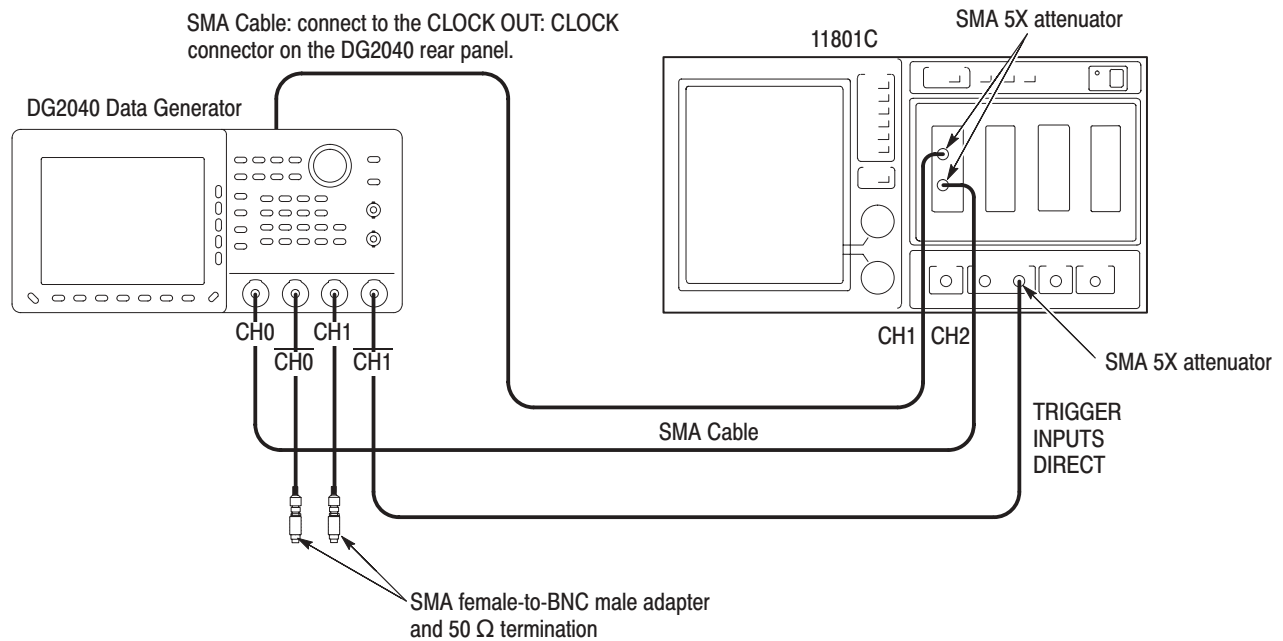


Figure 4-19: Delay time measurement connection

Setup. Set the sampling oscilloscope as indicated below:

■ Sampling oscilloscope

Displayed channel CH1 and CH2
 Vertical axis . 50 mV/div for CH1 and CH2
 Horizontal axis 500 ps/div
 Acquire mode Average 32
 Vertical offset 100 mV
 Trigger mode Norm
 Trigger level . 100 mV
 Trigger source CH2
 Trigger slope . Rising Edge
 Trigger position 50 %
 Vectored Trace Off

Procedure. Follow the steps below to verify the delay time accuracy:

1. Load the **TP10DLY.PDA** test pattern file from the performance check disk.
2. Press the **START/STOP** button on the front panel. The LED, corresponding to the button, should be on.
3. Press the following buttons to set the DG2040 Data Generator CH0 output delay time to -1.00 ns.

Menu button	Bottom button	Pop up menu	Side button	Front panel button
SETUP	Timing Condition			
Move the cursor to CH0 with the general purpose knob.				
			Delay	-1.0 ENTER

4. Set the delay time to -1.00 ns, -0.50 ns, +0.50 ns, +1.00 ns, and +2.00 ns in turn. Perform the delay time measurement for each delay time setting with the sampling oscilloscope. Verify that the data output delay times referenced to the clock signal are within the accuracy ($\pm(3\% \text{ of setting}) \pm |T_a - 25^\circ\text{C}| \times 15 \text{ ps} \pm 100 \text{ ps}$) for each of these delay time settings.
5. Change the SMA cable connection from the DG2040 Data Generator CH0 output to CH1 and repeat step 4. When measuring CH1 output delay time, connect the CH0 output on the DG2040 Data Generator front panel to the TRIGGER INPUTS DIRECT connector on the sampling oscilloscope front panel.
6. From above measurement results at 0.00 ns delay time setting on two output channels, verify that the delay time differences between two channels is within $\pm |T_a - 25^\circ\text{C}| \times 15 \text{ ps} \pm 100 \text{ ps}$.
7. Press the **START/STOP** button on the front panel to stop output. The LED, corresponding to the button, is turned off.

Rise Time and Fall Time Accuracy

This test verifies the rise and fall time accuracies of the DG2040 Data Generator output.

Rise/Fall Times

Limit: < 150 ps (20 % to 80 %)

The following equipment is required.

Equipment Required	
	Sampling oscilloscope with head
	Three SMA cables (three must be same length)
	Three SMA X5 attenuators
	SMA female-to-BNC male adapter
	Performance check disk

Connections. Refer to Figure 4-20 for connections.

Use the SMA cables and the SMA 5X attenuators to make the following connections:

- Connect CLOCK OUT on the DG2040 Data Generator rear panel to the CH1 input on the sampling oscilloscope .
- Connect CLOCK OUT on the DG2040 Data Generator rear panel to the CH2 input on the sampling oscilloscope.

Use the SMA female-to-BNC male adapter, the third SMA cable, and the third SMA 5X attenuator to make the following connections:

- Connect SYNC OUT from the DG2040 Data Generator rear panel to the TRIGGER INPUTS DIRECT on the sampling oscilloscope .

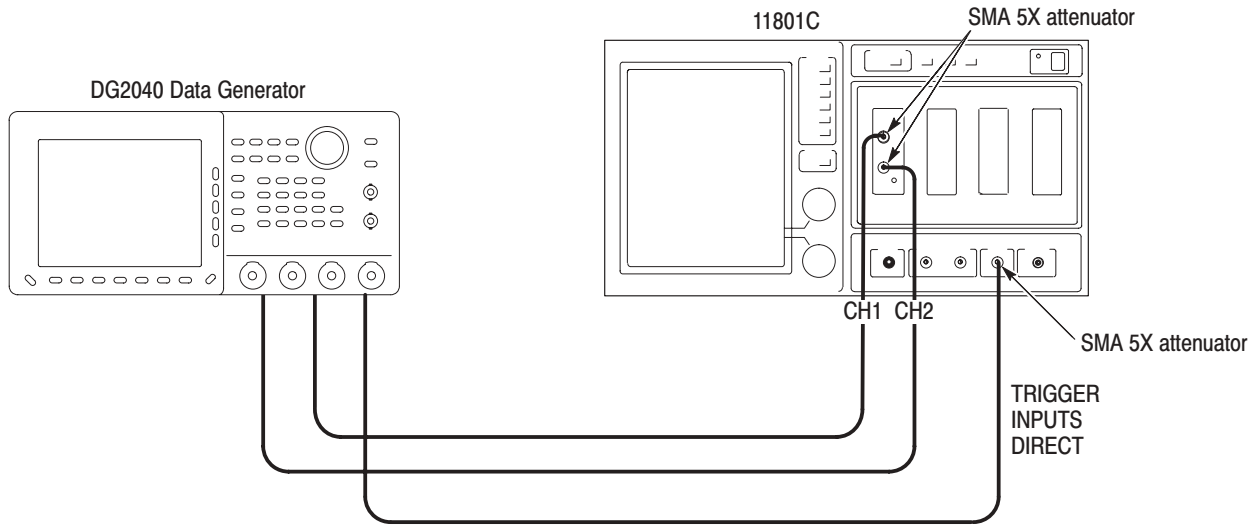


Figure 4-20: Rise time and fall time measurement connection

Setup. Set the sampling oscilloscope as indicated below:

- Sampling oscilloscope
 - Displayed channel CH1 and CH2
 - Vertical axis . 50 mV/div for CH1 and CH2
 - Horizontal axis 200 ps/div
 - Record length 500
 - Acquire mode Average 32
 - Timebase position 0s
 - Vertical offset 100 mV
 - Trigger mode Norm
 - Trigger level . 100 mV
 - Trigger source DIRECT
 - Trigger slope . Rising Edge

Procedure. Follow the steps below to verify the rise and fall time accuracy:

1. Load the **TP11RISE.PDA** test pattern file from the performance check disk.
2. Press the following buttons to set the DG2040 Data Generator clock frequency.

Menu button	Bottom button	Pop up menu	Side button	Front panel button
SETUP	Clock		Int FREQ	100 MHz/ μ s

3. Use the sampling oscilloscope measurement functions to perform the clock signal rise and fall time measurement under the clock frequency settings shown in Table 4-8.
4. Change the SMA cable connection from the CLOCK and $\overline{\text{CLOCK}}$ outputs to CH0 and $\overline{\text{CH0}}$ outputs, respectively, and repeat step 3 for each of these channels. Verify that the rise and fall times are within the specified ranges.
5. Change the SMA cable connection from the CH0 and $\overline{\text{CH0}}$ outputs to CH1 and $\overline{\text{CH1}}$ outputs, respectively, and repeat step 3 for each of these channels. Verify that the rise and fall times are within the specified ranges.

Table 4-8: Rise and fall time accuracies

Voltage settings		Clock frequency	Rise and fall time limit
Low level	High level		
0 V	+1.00 V	100 MHz	< 150 ps (20 % - 80 %)
0 V	+1.00 V	500 MHz	< 150 ps (20 % - 80 %)
0 V	+1.00 V	1100 MHz	< 150 ps (20 % - 80 %)

6. Press the **START/STOP** button on the front panel to stop output (the button's LED goes off).

This completes the performance verification procedures.

Test Record

Photocopy the following 4 pages and use them to record the performance test results for your DG2040 Data Generator.

DG2040 Test Record

Serial Number:

Certificate Number:

Calibration Date:

Technician:

Table 4-9: DG2040 test record

Clock frequency tests		Low limit	Test result	High limit
Internal clock frequency accuracy	1.100 000 GHz	1.099 998 9 GHz		1.100 001 1 GHz
	650.100 0 MHz	650.099 35 MHz		650.100 65 MHz
	200.000 0 kHz	199.999 80 kHz		200.000 20 kHz
	100.000 0 mHz	99.999 90 mHz		100.000 10 mHz
High level output voltage accuracy (DC Data Out)		Low limit	Test result	High limit
CH0 Output	-0.875 V	-0.951 V		-0.799 V
	0 V	-0.050 V		0.050 V
	+1.00 V	0.920 V		1.080 V
	+2.00 V	1.890 V		2.110 V
	+3.50 V	3.345 V		3.655 V
$\overline{\text{CH0}}$ Output	-0.875 V	-0.951 V		-0.799 V
	0 V	-0.050 V		0.050 V
	+1.00 V	0.920 V		1.080 V
	+2.00 V	1.890 V		2.110 V
	+3.50 V	3.345 V		3.655 V
CH1 Output	-0.875 V	-0.951 V		-0.799 V
	0 V	-0.050 V		0.050 V
	+1.00 V	0.920 V		1.080 V
	+2.00 V	1.890 V		2.110 V
	+3.50 V	3.345 V		3.655 V
$\overline{\text{CH1}}$ Output	-0.875 V	-0.951 V		-0.799 V
	0 V	-0.050 V		0.050 V
	+1.00 V	0.920 V		1.080 V
	+2.00 V	1.890 V		2.110 V
	+3.50 V	3.345 V		3.655 V

Table 4-9: DG2040 test record (cont.)

Low level output voltage accuracy (DC Data Out)		Low limit	Test result	High limit
CH0 Output	-1.125 V	-1.209 V		-1.041 V
	0 V	-0.050 V		0.050 V
	+1.00 V	0.920 V		1.080 V
	+2.00 V	1.890 V		2.110 V
	+3.25 V	3.103 V		3.398 V
$\overline{\text{CH0}}$ Output	-1.125 V	-1.209 V		-1.041 V
	0 V	-0.050 V		0.050 V
	+1.00 V	0.920 V		1.080 V
	+2.00 V	1.890 V		2.110 V
	+3.25 V	3.103 V		3.398 V
CH1 Output	-1.125 V	-1.209 V		-1.041 V
	0 V	-0.050 V		0.050 V
	+1.00 V	0.920 V		1.080 V
	+2.00 V	1.890 V		2.110 V
	+3.25 V	3.103 V		3.398 V
$\overline{\text{CH1}}$ Output	-1.125 V	-1.209 V		-1.041 V
	0 V	-0.050 V		0.050 V
	+1.00 V	0.920 V		1.080 V
	+2.00 V	1.890 V		2.110 V
	+3.25 V	3.103 V		3.398 V
Delay time accuracy		Low limit	Test result	High limit
CH0 Delay Time Settings	Ta ¹ : Room tempera- ture	Nominal value	2	3
-1.00 ns	-1.00 ns			
-0.50 ns	-0.50 ns			
+0.50 ns	+0.50 ns			
+1.00 ns	+1.00 ns			
+2.00 ns	+2.00 ns			
CH1 Delay Time Settings	Ta ¹ : Room tempera- ture	Nominal value	2	3
-1.00 ns	-1.00 ns			
-0.50 ns	-0.50 ns			

Table 4-9: DG2040 test record (cont.)

Delay time accuracy		Low limit	Test result	High limit	
+0.50 ns	+0.50 ns				
+1.00 ns	+1.00 ns				
+2.00 ns	+2.00 ns				
Output voltage accuracy (Clock Out)		Low limit	Test result	High limit	
CLOCK Output					
Settings		Nominal value			
High level	Low Level				
-1.125 V	-0.875 V	0.250 V	0.188 V	0.312 V	
+1.000 V	+1.25 V	0.250 V	0.188 V	0.312 V	
+3.250 V	+3.50 V	0.250 V	0.188 V	0.312 V	
-1.125 V	+1.375 V	2.500 V	2.325 V	2.675 V	
0.000 V	+2.50 V	2.500 V	2.325 V	2.675 V	
+1.000 V	+3.50 V	2.500 V	2.325 V	2.675 V	
CLOCK Output					
Settings		Nominal value			
High level	Low Level				
-1.125 V	-0.875 V	0.250 V	0.188 V	0.312 V	
+1.000 V	+1.25 V	0.250 V	0.188 V	0.312 V	
+3.250 V	+3.50 V	0.250 V	0.188 V	0.312 V	
-1.125 V	+1.375 V	2.500 V	2.325 V	2.675 V	
0.000 V	+2.50 V	2.500 V	2.325 V	2.675 V	
+1.000 V	+3.50 V	2.500 V	2.325 V	2.675 V	
Rise time and fall time accuracy		Frequency	Low limit	Test result	High limit
CLOCK signal Rise time		100 MHz			< 150 ps
		500 MHz			< 150 ps
		1100 MHz			< 150 ps
CLOCK signal Fall time		100 MHz			< 150 ps
		500 MHz			< 150 ps
		1100 MHz			< 150 ps
CLOCK signal Rise time		100 MHz			< 150 ps
		500 MHz			< 150 ps
		1100 MHz			< 150 ps

Table 4-9: DG2040 test record (cont.)

Rise time and fall time accuracy	Frequency	Low limit	Test result	High limit
CLOCK signal Fall time	100 MHz			< 150 ps
	500 MHz			< 150 ps
	1100 MHz			< 150 ps
CH0 signal Rise time	100 MHz			< 150 ps
	500 MHz			< 150 ps
	1100 MHz			< 150 ps
CH0 signal Fall time	100 MHz			< 150 ps
	500 MHz			< 150 ps
	1100 MHz			< 150 ps
CH0 signal Rise time	100 MHz			< 150 ps
	500 MHz			< 150 ps
	1100 MHz			< 150 ps
CH0 signal Fall time	100 MHz			< 150 ps
	500 MHz			< 150 ps
	1100 MHz			< 150 ps
CH1 signal Rise time	100 MHz			< 150 ps
	500 MHz			< 150 ps
	1100 MHz			< 150 ps
CH1 signal Fall time	100 MHz			< 150 ps
	500 MHz			< 150 ps
	1100 MHz			< 150 ps
CH1 signal Rise time	100 MHz			< 150 ps
	500 MHz			< 150 ps
	1100 MHz			< 150 ps
CH1 signal Fall time	100 MHz			< 150 ps
	500 MHz			< 150 ps
	1100 MHz			< 150 ps

¹ $T_a = \text{Degree C} = (\text{Fahrenheit} + 32)5/9$

² $\text{Low limit} = |T_a - 25 \text{ degree C}| \times 15 \text{ ps} - 100\text{ps}$

³ $\text{High Limit} = |T_a - 25 \text{ degree C}| \times 15 \text{ ps} + 100\text{ps}$



Adjustment Procedures

The DG2040 Data Generator Data Generator does not require any adjustments.

Maintenance

This section contains the information needed to do periodic and corrective maintenance on the DG2040 Data Generator. The following subsections are included:

- *Preparation.* This subsection includes this introduction plus general information on preventing damage to internal modules when doing maintenance.
- *Inspection and Cleaning.* Information and procedures for inspecting the DG2040 Data Generator and cleaning its external and internal modules. Refer to page 6-4.
- *Removal and Installation Procedures.* Procedures for removing defective modules and replacing new or repaired modules. Refer to page 6-7.
- *Troubleshooting.* Information for isolating failed modules. Included are instructions for operating the DG2040 Data Generator internal diagnostic routines and troubleshooting flowcharts. Most of the flowcharts make use of the internal diagnostic routines to speed fault isolation to a module. Refer to page 6-45.

Preparation

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

- Only trained service technicians should perform these procedures.
- Read the *General Safety Summary* beginning on page vii and the *Service Safety Summary*, beginning on page ix.
- Read the *Strategy for Servicing* on page xi.
- Read the *Operating Instructions* section, beginning on page 2-11, before servicing the DG2040 Data Generator.

Preventing ESD



CAUTION. *Static discharge can damage any semiconductor component in the DG2040 Data Generator.*

Precautions. When performing service which requires internal access to the DG2040 Data Generator, follow these precautions to avoid damaging internal modules and their components due to electrostatic discharge (ESD).

1. Minimize handling of static-sensitive modules.
2. Transport and store static-sensitive modules in their static-protected containers or on a metal rail. Label any package that contains static-sensitive modules.
3. Discharge the static voltage from your body by wearing a grounded antistatic wrist strap while handling these modules. Do service of static-sensitive modules only at a static-free work station.
4. Do not remove the DG2040 Data Generator cabinet unless you have met precaution number 3, above. Consider all internal modules static-sensitive.
5. Do not allow anything capable of generating or holding a static charge on the work station surface.
6. Handle circuit boards by the edges when possible.
7. Do not slide the modules over any surface.
8. Avoid handling modules in areas that have a floor or work-surface covering capable of generating a static charge.
9. Do not use high-velocity compressed air when cleaning dust from modules.

Susceptibility to ESD

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

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

Semiconductor classes	Relative susceptibility levels¹
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 V to 500 V	6 = 600 V to 800 V
2 = 200 V to 500 V	7 = 400 V to 1000 V (est.)
3 = 250 V	8 = 900 V
4 = 500 V	9 = 1200 V
5 = 400 V to 600 V	

Inspection and Cleaning

Inspect and clean the instrument as often as operating conditions require. The collection of dirt can cause instrument overheating and breakdown. Dirt acts as an insulating blanket, preventing efficient heat dissipation. Dirt also provides an electrical conduction path that can cause an instrument failure, especially under high-humidity conditions.



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

Avoid the use of high pressure compressed air when cleaning dust from the interior of this instrument. (High pressure air can cause ESD.) Instead, use low pressure compressed air (about 9 psi).

Exterior Inspection

Using Table 6-2 as a guide, inspect the outside of the instrument for damage, wear, and missing parts. You should thoroughly check instruments that appear to have been dropped or otherwise abused to verify correct operation and performance. Immediately repair defects that could cause personal injury or lead to further damage to the instrument.

Table 6-2: External Inspection Check List

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

Exterior Cleaning

Follow the steps below to clean the exterior:



WARNING. To avoid injury or death, unplug the power cord from line voltage before cleaning the instrument. To avoid getting moisture inside the instrument during external cleaning, use only enough liquid to dampen the cloth or applicator.

1. Remove loose dust on the outside of the instrument 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 monitor screen with a lint-free cloth dampened with either ethyl alcohol or, preferably, a gentle, general purpose detergent-and-water solution.

Interior Inspection

Inspect the internal portions of the instrument 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 function 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 ethyl alcohol.
Capacitors	Damaged or leaking cases. Corroded solder on leads or terminals.	Remove damaged module and replace with a new module from the factory.
Semiconductors	Burned, cracked, broken condition. Loosely inserted in sockets. Distorted pins.	Remove failed module and replace with a new module.

Table 6-3: Internal inspection check list (Cont.)

Item	Inspect for	Repair action
Wiring and cables	Loose plugs or connectors. Burned, broken, or frayed wiring.	Firmly seat connectors. Repair or replace modules with defective wires or cables.
Chassis	Dents, deformations, and damaged hardware.	Straighten, repair, or replace defective hardware.

Interior Cleaning

Follow the steps below to clean the generator interior:

1. Blow off dust with dry, low-pressure, deionized air (approximately 9 psi).
2. Remove any remaining dust with a lint-free cloth dampened in ethyl alcohol and rinse with warm deionized water. (A cotton-tipped applicator is useful for cleaning in narrow spaces and on circuit boards.)

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 ethyl alcohol by doing steps 4 through 8.
4. Gain access to the parts to be cleaned by removing easily accessible shields and panels.
5. Spray wash dirty parts with the ethyl 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 instrument.

Removal and Installation Procedures

This subsection describes removing and installing the DG2040 Data Generator mechanical and electrical modules.

Preparation

This subsection contains the following information:

- Procedure information
- Equipment needed for removing modules
- Module locator diagrams
- Removal and installation procedures



WARNING. *To avoid possible personal injury or damage to the DG2040 Data Generator components, read Operating Information beginning on page 2-1, and Maintenance: Preventing ESD on page 6-2. Before doing this or any other procedure in this manual, read the General Safety Summary, beginning on page vii and the Service Safety Summary, beginning on page ix.*

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

List of Mechanical Parts

The *Replaceable Mechanical Parts* section lists all replaceable parts in the DG2040 Data Generator.

General Instructions

NOTE. *Read these general instructions before removing a module.*

Read the *Summary of Procedures* that follows to understand how the procedures are organized. Then read *Equipment Required*, on page 6-8, to find out the tools needed to remove and install modules.

Refer to the *Access Procedure* beginning on page 6-10 to remove a module. By following the instructions in that procedure, you can remove the desired module without unnecessarily removing other modules.

Summary of Procedures

The *Access Procedure* on page 6-10 identifies the procedure for removing each module. These categories separate the procedures based on their location in the DG2040 Data Generator.

- *Procedures for External Modules* on page 6-13 describes how to remove modules that do not require internal access to the DG2040 Data Generator.
- *Procedures for Internal Modules* on page 6-24 describes how to remove modules that require internal access to the DG2040 Data Generator.

Equipment Required

The removal of most modules in the DG2040 Data Generator requires only a Torx driver mounted with a size T-15, Torx® screwdriver tip. Use this tool whenever a procedure step instructs you to remove or install a screw, unless a different size screwdriver is specified in that step. The first step of a module procedure lists all equipment required to remove and install the module.

Table 6-4: Equipment required

Name	Description	Part Number
Torx driver or equivalent	Accepts Torx®-driver bits	003-0524-00
T-9 Torx® tip	Torx®-driver bit for T-9 size screw heads	003-0965-00
T-10 Torx® tip	Torx®-driver bit for T-10 size screw heads	003-0815-00
T-15 Torx® tip	Torx®-driver bit for T-15 size screw heads	003-0966-00
#1 Phillips tip	Phillips-driver bit for #1 size screw heads	003-0335-00
Flat-blade screwdriver	Screwdriver for removing flat headed screws	-----
Torque driver	4 to 30 kgf.cm (3.5 inch-pounds to 26 inch-pounds)	-----
Hex wrench, 0.050 inch	Standard tool	-----
Hex wrench, 1/16 inch	Standard tool	-----
Needle-nose pliers	Standard tool	-----
Nut driver, 1/2 inch	Standard tool	-----
Nut driver, 1/4 inch	Standard tool	-----
Nut driver, 5/16 inch	Standard tool	-----
Nut driver, 5 mm	Standard tool	-----
Nut driver, 8 mm	Standard tool	-----
Open-end wrench 1/2 inch	Standard tool	-----
Soldering iron, 60 watt	Standard tool	-----

DG2040 Data Generator Orientation

See Figure 6-1 for instrument orientation that is called out in these procedures.

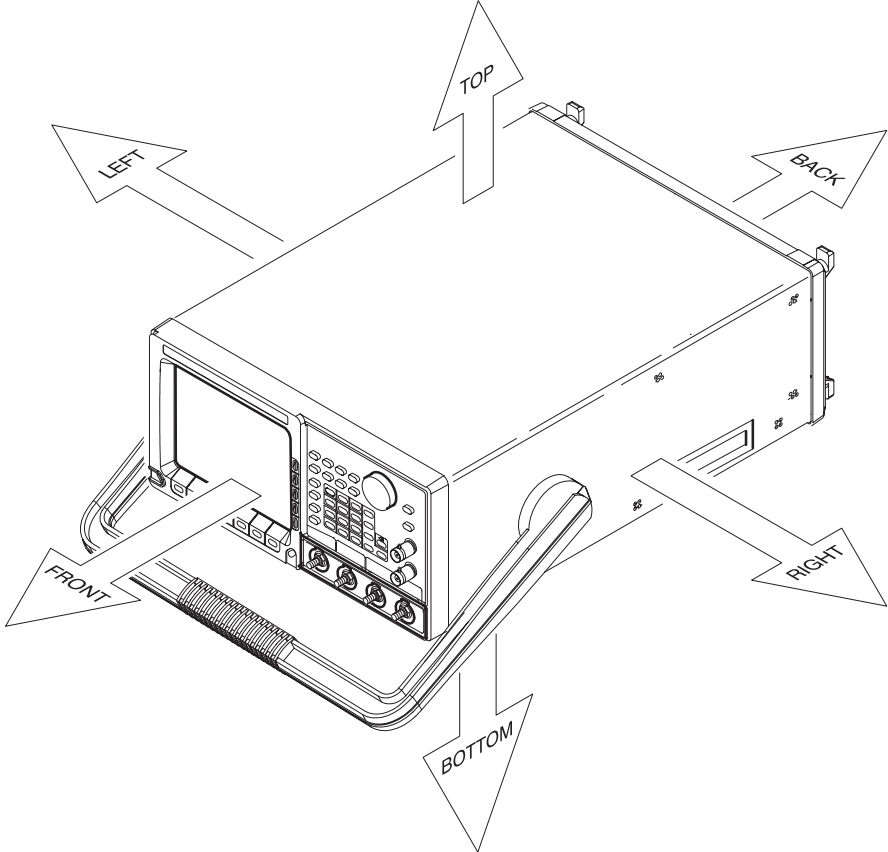


Figure 6-1: DG2040 Data Generator orientation

Access Procedure

Use the flowchart in Figure 6-2 to determine which procedures to use for removing the module. The removal procedures end with installation instructions.

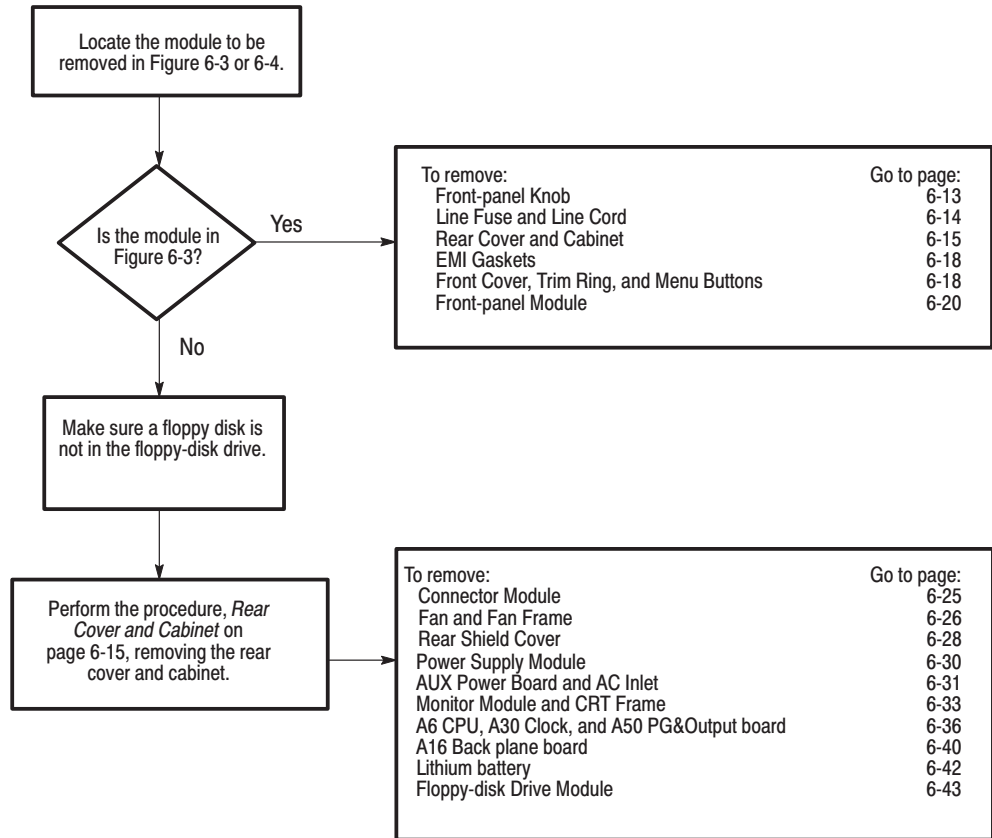


Figure 6-2: Guide to removal procedures

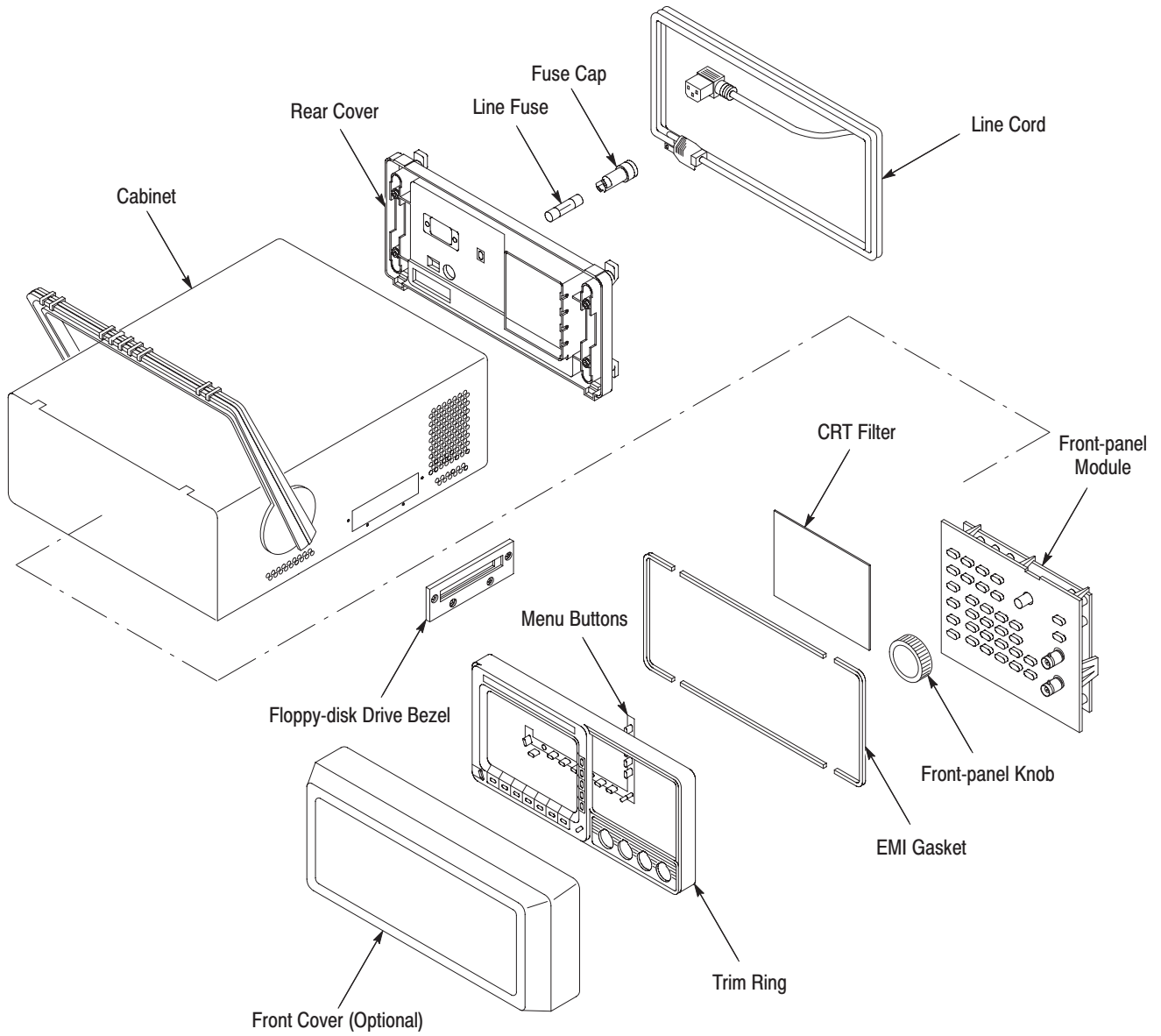


Figure 6-3: External modules

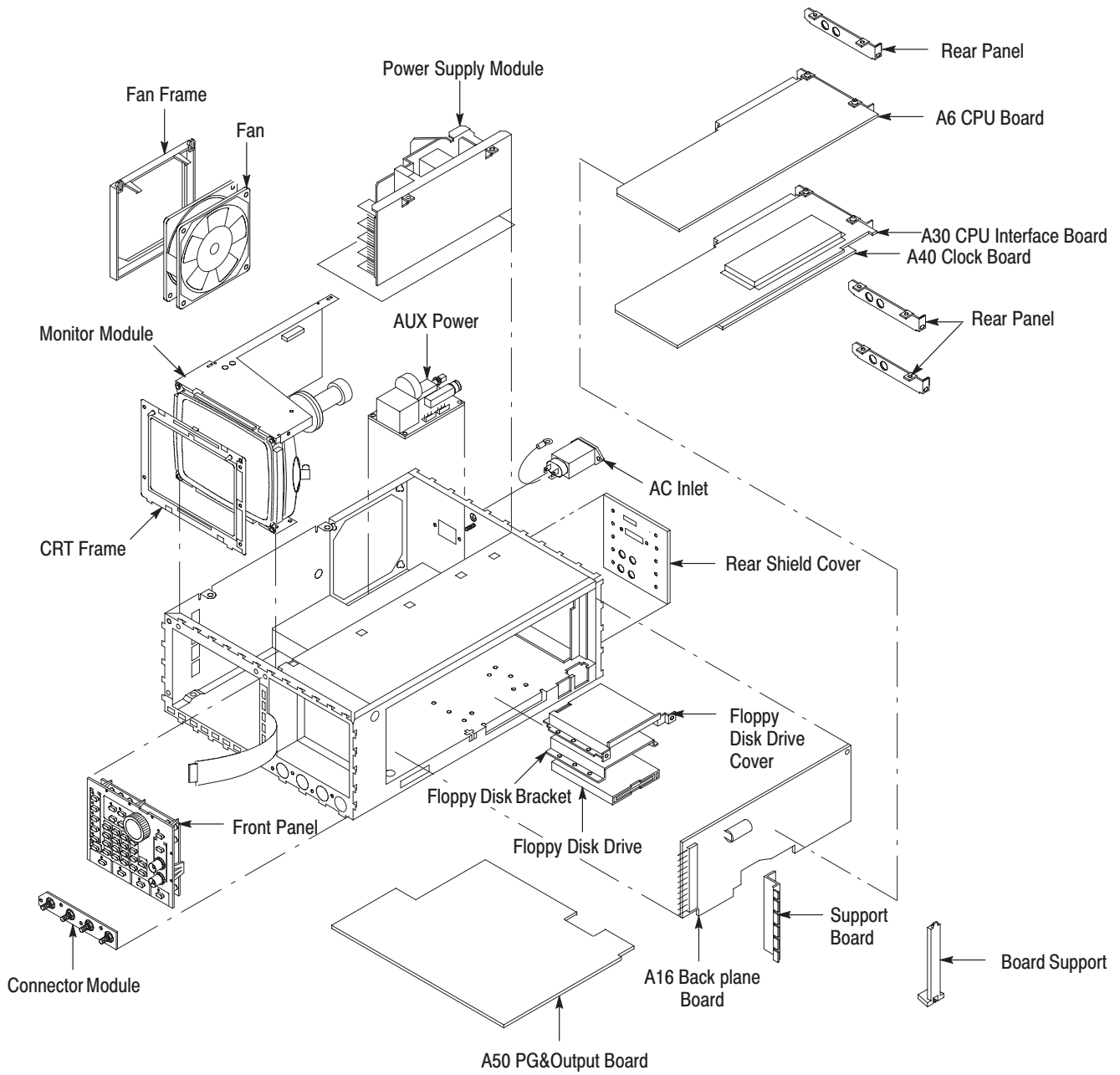


Figure 6-4: Internal modules

Procedures for External Modules

Perform the *Access Procedure* (page 6-10) before doing any procedure in this group.

This group contains the following procedures:

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

Front-panel Knob

1. Assemble equipment and locate modules to be removed. You will need a $\frac{1}{16}$ -inch hex wrench for this procedure. Find the front-panel knob on the front panel in Figure 6-3:External Modules.
2. Orient instrument. Set the DG2040 Data Generator with the bottom down on the work surface and the front facing you (see Figure 6-5).
3. Remove front cover. If the optional front cover is installed, grasp the front cover by the left and right edges and snap it off of the trim ring. When installing, align the front cover and snap it back on.
4. Remove knob. Loosen the setscrew securing the knob using the $\frac{1}{16}$ -inch hex wrench. Pull the knob toward you to remove it.
5. Installation. Place the knob onto the shaft, and tighten the setscrew using the $\frac{1}{16}$ -inch hex wrench.

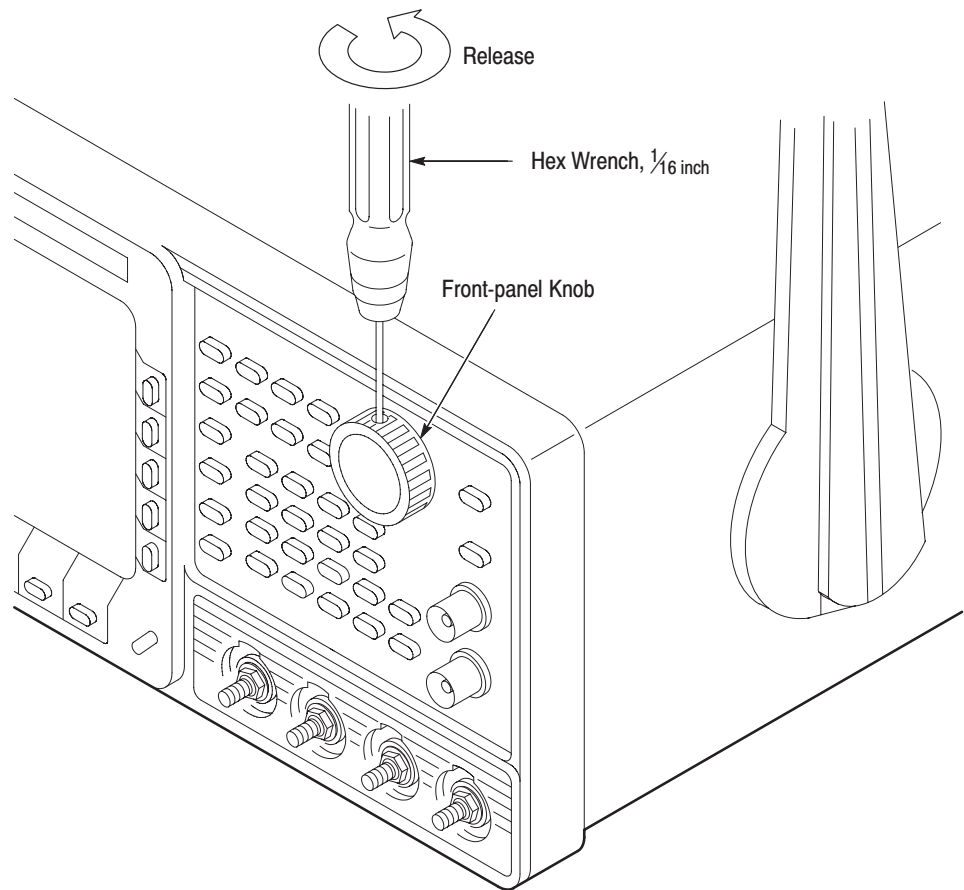


Figure 6-5: Front-panel knob removal

Line Fuse and Line Cord

1. Assemble equipment and locate modules to be removed. You will need a flat-blade screwdriver for this procedure. Locate the line fuse and line cord in Figure 6-3:External Modules.
2. Orient instrument. Set the DG2040 Data Generator with the bottom down on the work surface and the back facing you. If you are servicing the line fuse, do the next step; if you are servicing the line cord, skip to step 4.
3. Remove line fuse. Find the fuse cap on the rear panel. See Figure 6-6. Remove the fuse cap by turning it counter-clockwise using a flat-blade screwdriver, and remove the line fuse.
4. Remove line cord. Find the line cord on the rear cover. See Figure 6-6. Remove the line-cord retaining clamp by first unplugging the line cord from the line cord receptacle (1). Next, grasp both the line cord and the retaining clamp and rotate it 90 degrees, counter-clockwise (2). Pull the line cord and clamp away to complete the removal (3).

5. Installation. Perform steps 3 and 4 in reverse order to install the line cord, and then install the line fuse.

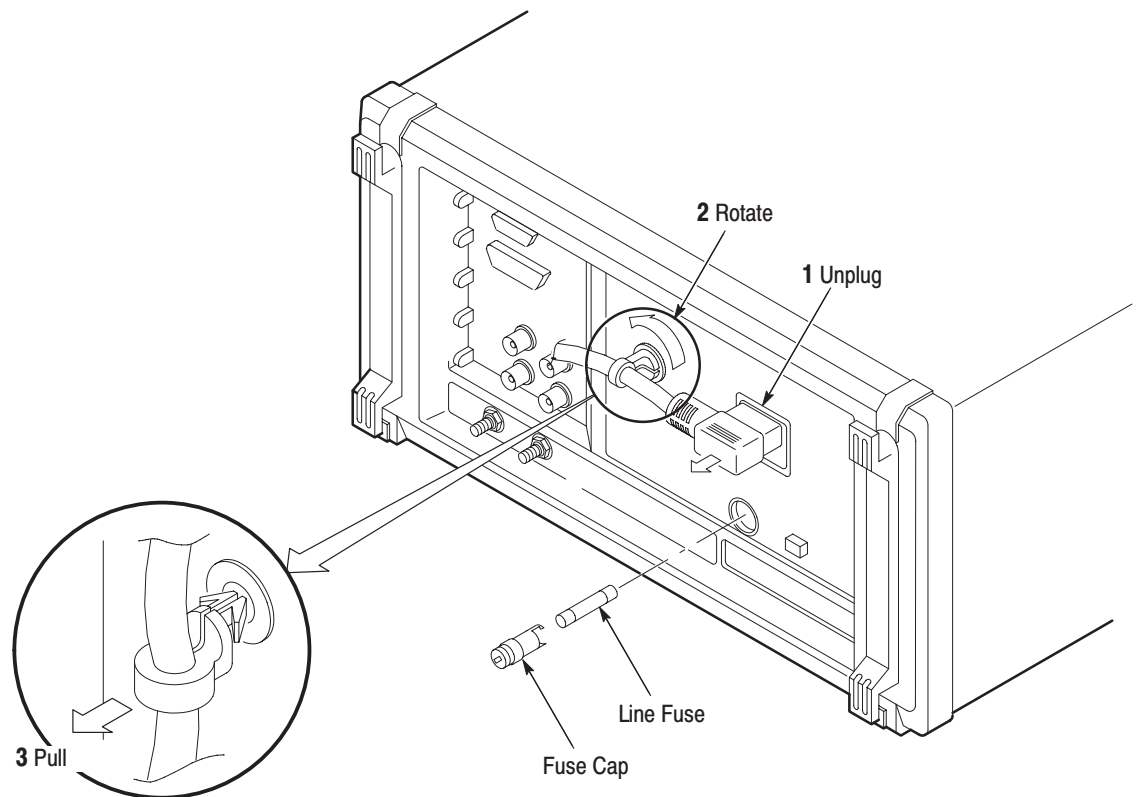


Figure 6-6: Line fuse and line cord removal

Rear Cover and Cabinet

1. Assemble the equipment and locate the modules to be removed.
 - a. You will need a screwdriver with size T-9 and T-15 Torx tips for this procedure.
 - b. Make sure the DG2040 Data Generator front cover (optional accessory) is installed. If it is not, install it by snapping the edges of the front cover over the trim ring.
 - c. Locate the rear cover and cabinet in Figure 6-3: External Modules.
2. Orient instrument. Set the DG2040 Data Generator front down, with the front cover on the work surface and the instrument bottom facing you (see Figure 6-7).
3. Disconnect line cord. Perform the *Line Fuse and Line Cord* procedure on page 6-14. Remove only the line cord.

4. Remove rear cover. Using a screwdriver with a size T-15 Torx tip, remove the four screws securing the rear cover to the instrument. Lift off the rear cover.
5. Orient instrument. Set the DG2040 Data Generator face down, with the front cover on the work surface and right side facing you.
6. Remove floppy disk drive bezel. Using a screwdriver with a size T-9 Torx tip, remove the four screws securing the floppy-disk drive bezel to the cabinet. Lift off the floppy-disk drive bezel.
7. Remove the cabinet.



CAUTION. *To prevent damaging the eject button, make sure the floppy disk is not inserted in the floppy disk drive, before removing the cabinet from the DG2040 Data Generator.*

- a. Using a screwdriver with a size T-15 Torx tip, remove the screw securing the left side of the cabinet to the instrument.
 - b. Grasp the right and left edges of the cabinet toward the back.
 - c. Pull upward to slide the cabinet off the instrument. Take care not to bind or snag the cabinet on internal cables as you remove it.
8. Install the cabinet and rear cover.
- a. Perform steps 3 through 7 in reverse order to install the cabinet.
 - b. Take care not to bind or snag the cabinet on internal cables; redress cables as necessary.
 - c. When sliding the cabinet, be sure that the front edge of the cabinet aligns with the groove containing the four EMI shields on the trim ring.
 - d. When installing the four screws at the rear panel, tighten them to a torque of 16 kg-cm (6 in-lbs).
 - e. See the *Line Fuse and Line Cord* procedure on page 6-14, to install the line cord.

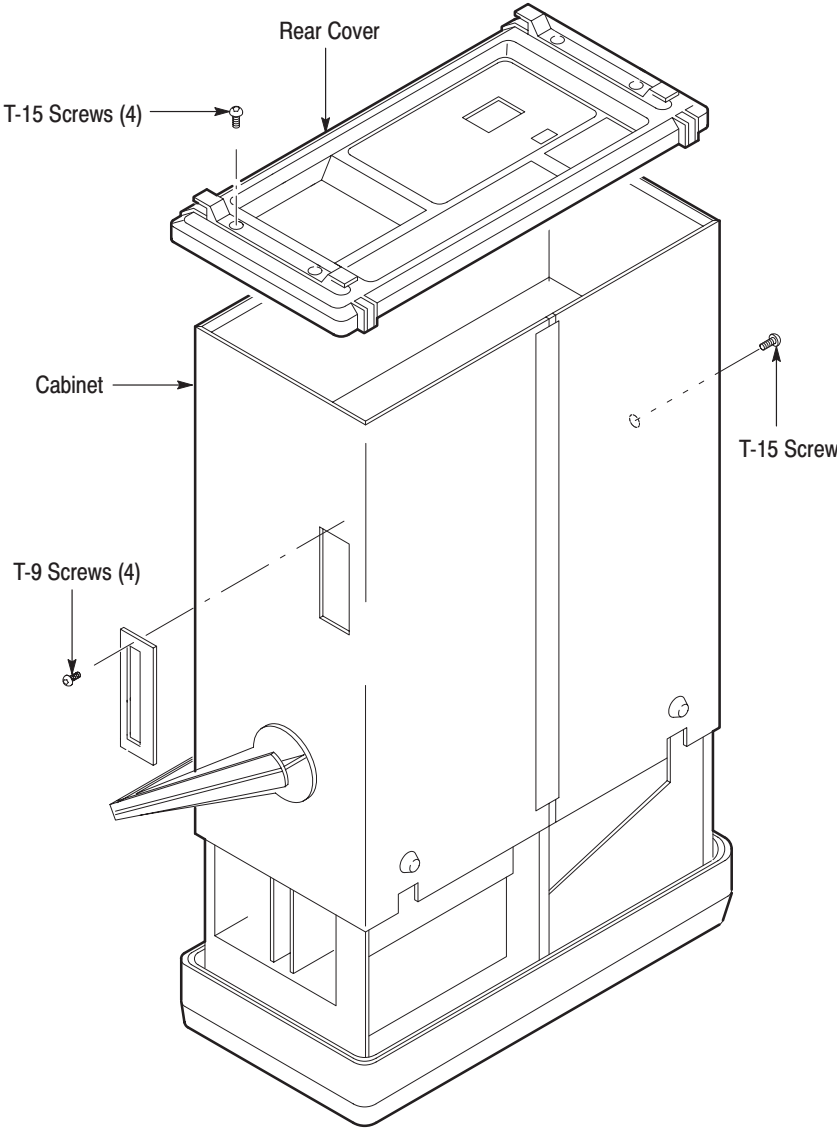


Figure 6-7: Rear cover and cabinet removal

EMI Gaskets

1. Remove the front cover and trim ring. Perform the *Front Cover, Trim Ring, and Menu Buttons* procedure that follows on this page. Remove only the front cover and trim ring.



CAUTION. *To prevent exceeding the environmental characteristics for EMI, carefully follow the instructions given, when installing the EMI gaskets and/or the DG2040 Data Generator cabinet.*

2. Follow the steps below to remove the EMI gasket.
 - a. You will need a pair of needle-nose pliers for this part of the procedure.
 - b. Locate the EMI gaskets in Figure 6-3:External Modules.
 - c. Use a pair of needle-nose pliers to remove the four sections of EMI gaskets from the groove in the trim ring.
3. Install the EMI gaskets. Press the EMI gaskets back into the groove in the trim ring.

Front Cover, Trim Ring, and Menu Buttons

1. Assemble equipment and locate modules to be removed. No tools are needed. Locate the modules in Figure 6-3:External Modules.
2. Orient instrument. Set the DG2040 Data Generator with the back down on the work surface and bottom facing you. See Figure 6-8.
3. Remove front cover. If the optional front cover is installed, grasp the front cover by the left and right edges and snap it off of the trim ring. To install, align and snap back on.
4. Remove the front-panel knob. Perform the *Front-panel Knob* procedure, on page 6-13.

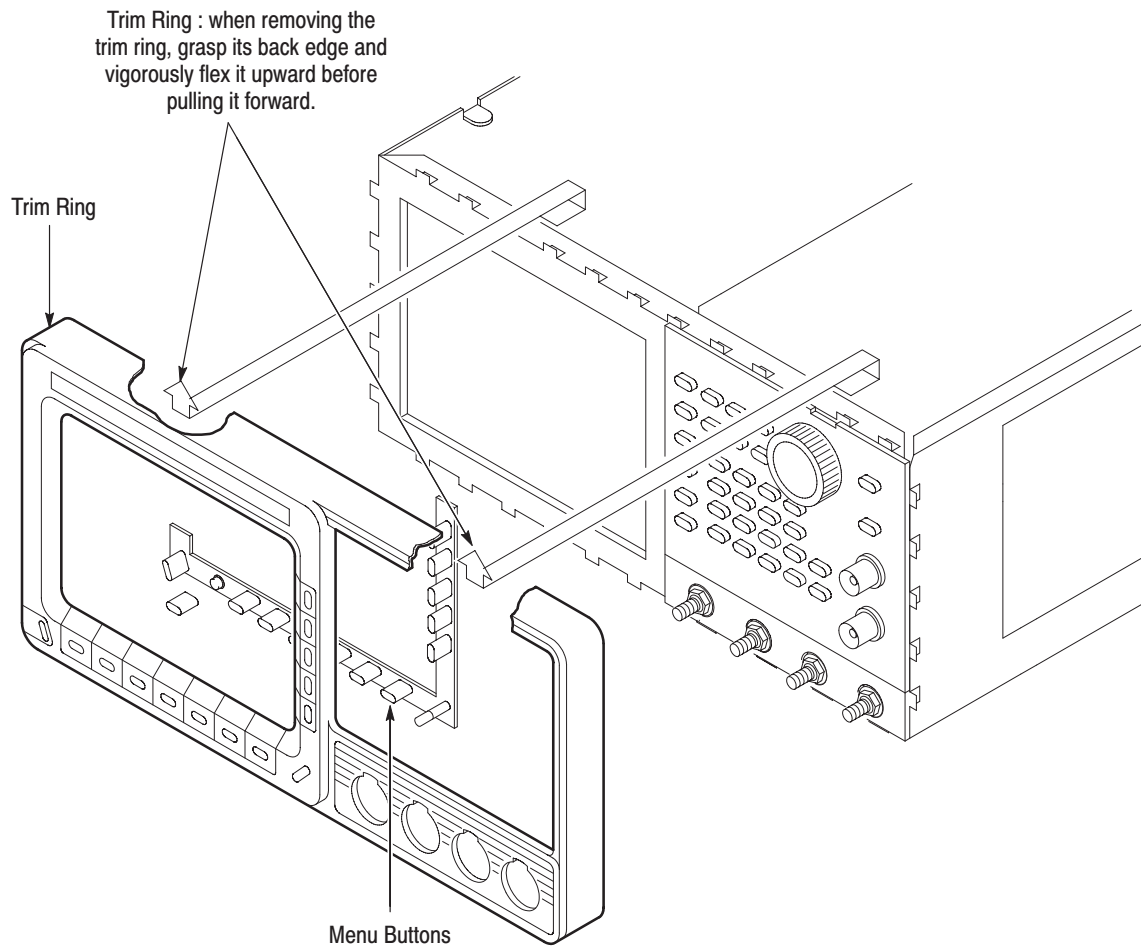


Figure 6-8: Front cover, trim ring, and menu button removal (front cover not shown)



CAUTION. To prevent contaminating the DG2040 Data Generator parts, do not touch the carbon contact points on the menu buttons installed in the trim ring. Also, do not touch the contacts on the flex circuit exposed when you remove the trim ring.

5. Remove trim ring. Grasp the trim ring by the top edge and pry it up and lift it forward to snap it off of the trim ring. If servicing the menu buttons, lift them out of the trim ring. (When installing, insert the menu buttons, align the trim ring to the chassis and press it back on.)
6. Installation. Perform steps 3 through 5 in reverse order to install the menu buttons, trim ring and the front cover, following the installation instructions found in each step.

Front-panel Module

NOTE. *This procedure includes removal and installation instructions for the front-panel module and front-panel buttons. Unless either of those modules are being serviced, do not do step 6.*

1. Follow the steps below to assemble equipment and locate modules to be removed.
 - a. You will need a flat-blade screwdriver and a 0.05-inch and $\frac{1}{16}$ -inch hex wrench for this procedure.
 - b. Locate the modules to be removed in Figure 6-3:External Modules.
 - c. Perform the procedure, *Front Cover, Trim Ring, and Menu Buttons*, steps 1–6 (immediately preceding this procedure).
2. Remove front-panel knob. Perform the *Front-panel Knob* procedure on page 6-13.
3. Remove front cover, trim ring, and menu buttons. Perform the *Front Cover, Trim Ring, and Menu Buttons* procedure on page 6-18 removing only the module(s) you want to service.
4. Orient instrument. Set the DG2040 Data Generator with the bottom down on the work surface and the front facing you.
5. Follow the steps below to remove front-panel module.
 - a. Release the snap at the right of the front-panel module using a flat-blade screwdriver as shown in Figure 6-9. Lift the front-panel module out of the chassis until you can reach the interconnect cable.
 - b. Disconnect the ribbon interconnect cable at J101 and flexible board connector at JP301 on the A12 Keyboard assembly.
 - c. Lift the front-panel module out of the chassis to complete the removal.

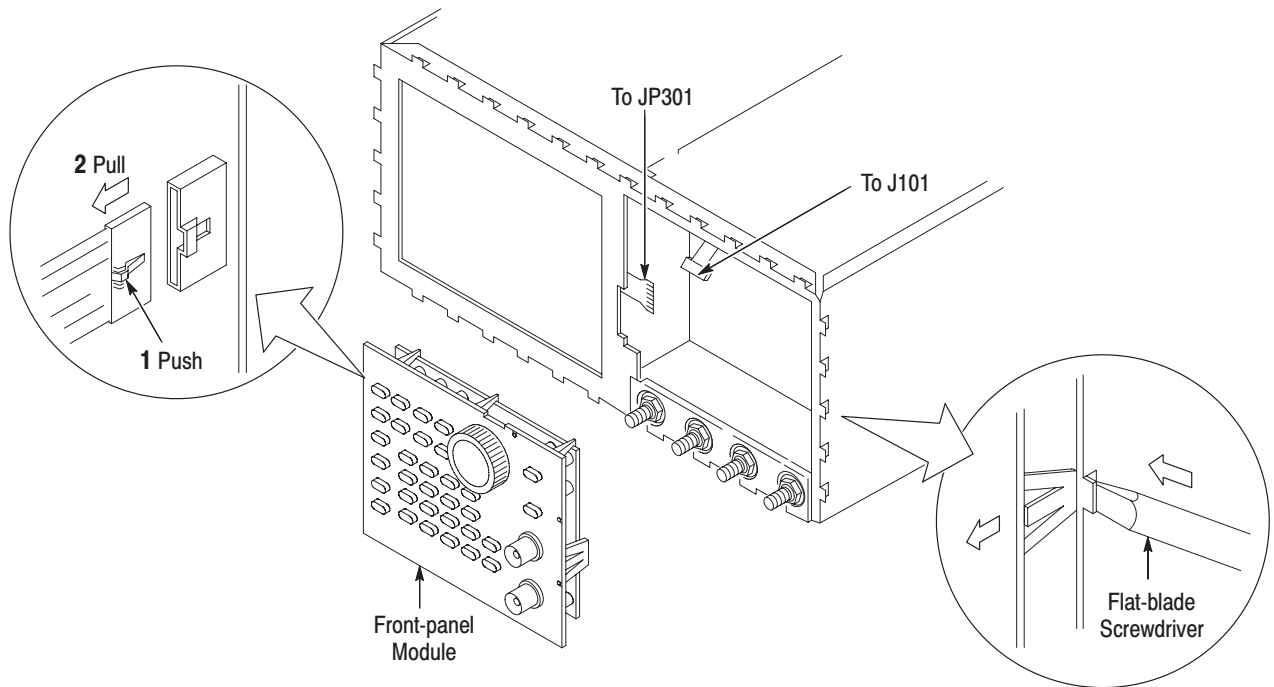


Figure 6-9: Front-panel module removal

6. If the front-panel module or the front-panel buttons are to be serviced, do the following steps:
 - a. Remove the front-panel knob from the front-panel module using the method described in the *Front-panel Knob* procedure, on page 6-13.
 - b. Remove the setscrew completely from the extension using the 0.05-inch hex wrench, and then remove the extension from the shaft of the rotary switch.
 - c. Release the four hooks, and then remove the A12 Keyboard from the chassis as shown in Figure 6-10.
 - d. Disassemble the front-panel module components using Figure 6-11 as a guide. Reverse the procedure for assembly.

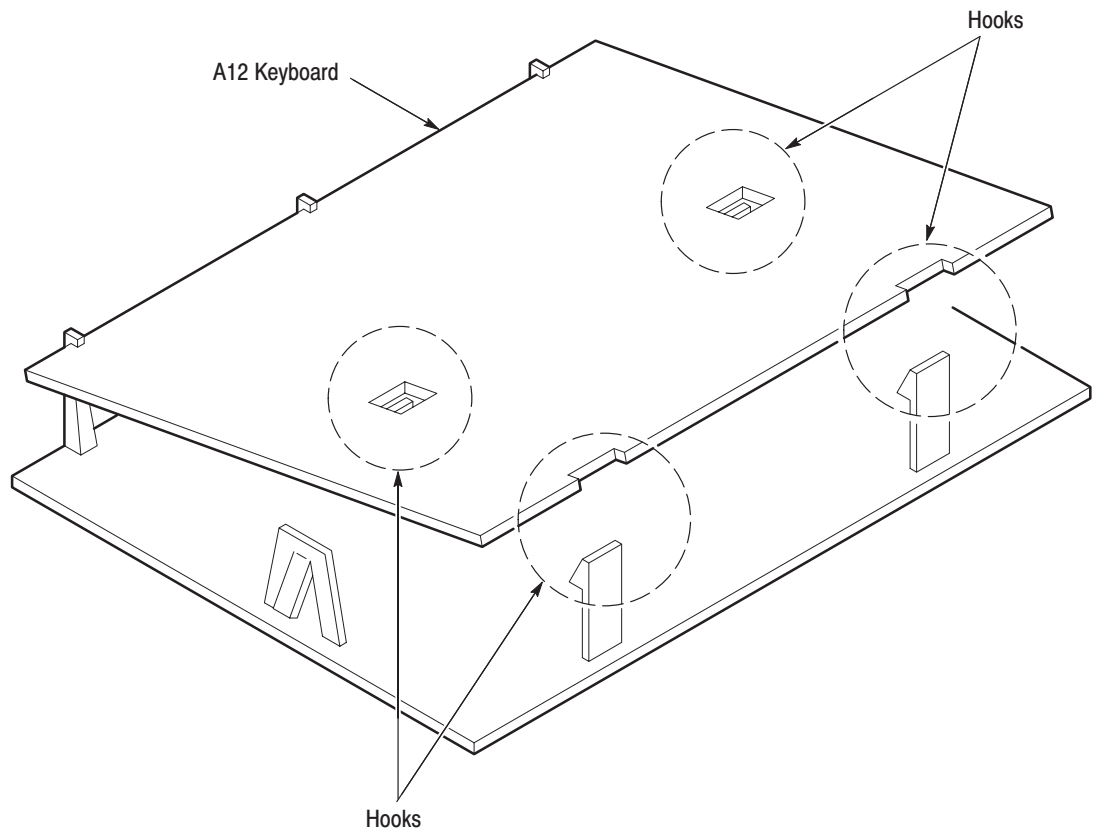


Figure 6-10: A12 keyboard removal

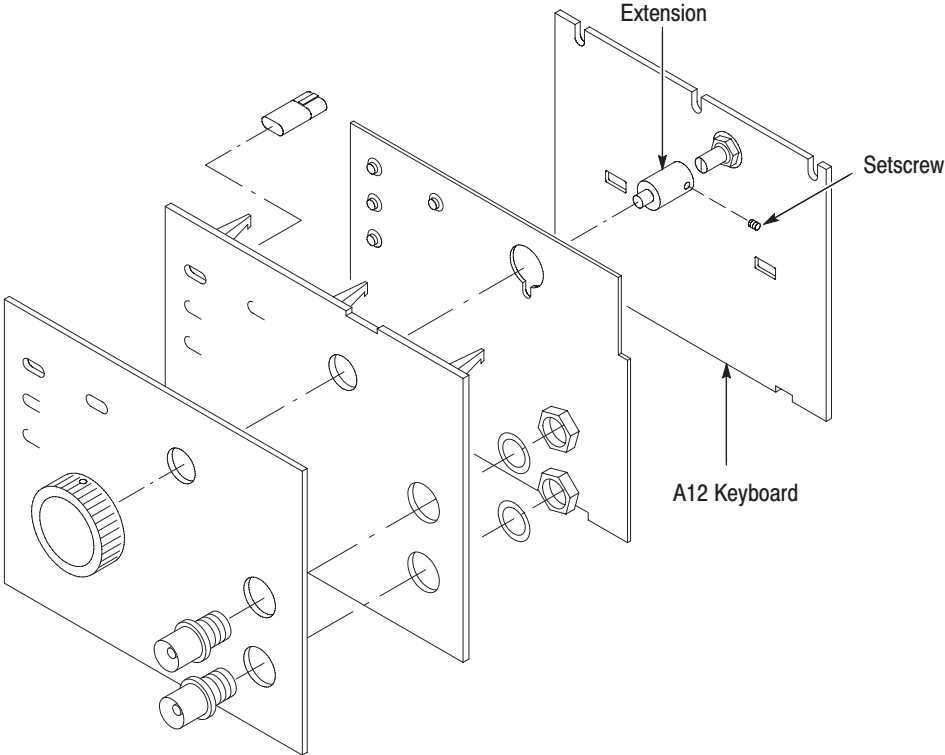


Figure 6-11: Front-panel module disassembly

- 7. Installation. If the front-panel module was further disassembled in step 6, then reverse steps 6a through 6d to reassemble. Use Figure 6-11 as a guide and do the steps in step 3 in reverse order. Install the trim ring and, if desired, the front cover, referring to the procedure, *Front Cover, Trim Ring, and Menu Buttons* on page 6-18.

Procedures for Internal Modules

Perform the *Access Procedure* (on page 6-10) before doing any procedure in this group.

This subsection contains the following removal and installation procedures:

- Connector Module
- Fan and Fan Frame
- Rear Shield Cover
- Power Supply Module
- AC Inlet and AUX Power Board
- Monitor Module and CRT Frame
- Circuit Boards:
 - A6 CPU Board
 - A30 CPU Interface Board A40 Clock Board
 - A50 PG&Output Board
- A16 Back Plane Board
- Lithium Battery
- Floppy Disk Drive Module

Connector Module

1. Assemble equipment and locate modules to be removed.
 - a. You will need a screwdriver with a size T-9 Torx tip and a ½-inch nut driver for this procedure.
 - b. Locate the modules to be removed in Figure 6-4: Internal Modules.
2. Remove front-panel knob. Perform the *Front-panel Knob* procedure, on page 6-13.
3. Remove front cover, trim ring, and menu buttons. Perform the *Front Cover, Trim Ring, and Menu Buttons* procedure on page 6-18.
4. Orient instrument: Set the DG2040 Data Generator with the top down on the work surface and the right side facing you.
5. Remove connector module.
 - a. Disconnect the interconnect cables at the CH 0, CH1, CH 2, and CH 3 connector.
 - b. Using the screwdriver with a size T-9 Torx tip, remove the four screws attaching the connector module to the chassis. See Figure 6-12.
6. Remove the SMA connector. To remove an SMA connector, remove the nut attaching the SMA connector to the panel using a 8 mm nut driver, and then remove the SMA connector from the panel.
7. Installation.
 - a. Install the SMA connector. Perform step 6, reversing the order of the items in the substep.
 - b. Install the connector module. Install the connector module by doing steps 5a through 5b in reverse order.

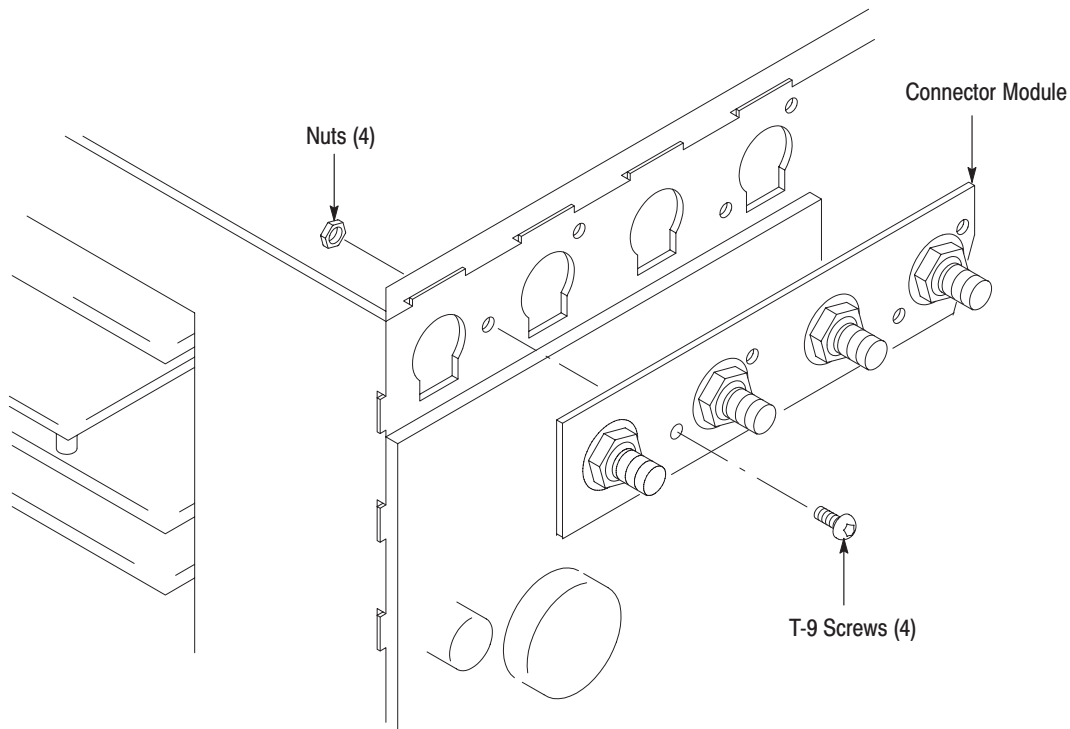


Figure 6-12: Connector module removal

Fan and Fan Frame

1. Assemble equipment and locate modules to be removed.
 - a. No tools are needed for this procedure.
 - b. Locate the modules to be removed in Figure 6-4:Internal Modules.
2. Orient the instrument. Set the DG2040 Data Generator with the bottom down on the work surface and the left side facing you.
3. Remove the fan and fan frame.
 - a. Disconnect the ribbon interconnect cable from J3 of the power supply module. See Figure 6-13.
 - b. Slide (2) as shown in Figure 6-13, in the direction indicated by the arrow (1) while pushing it. Remove the fan and fan frame.
 - c. Release the four hooks securing the fan, separate the fan and fan frame.

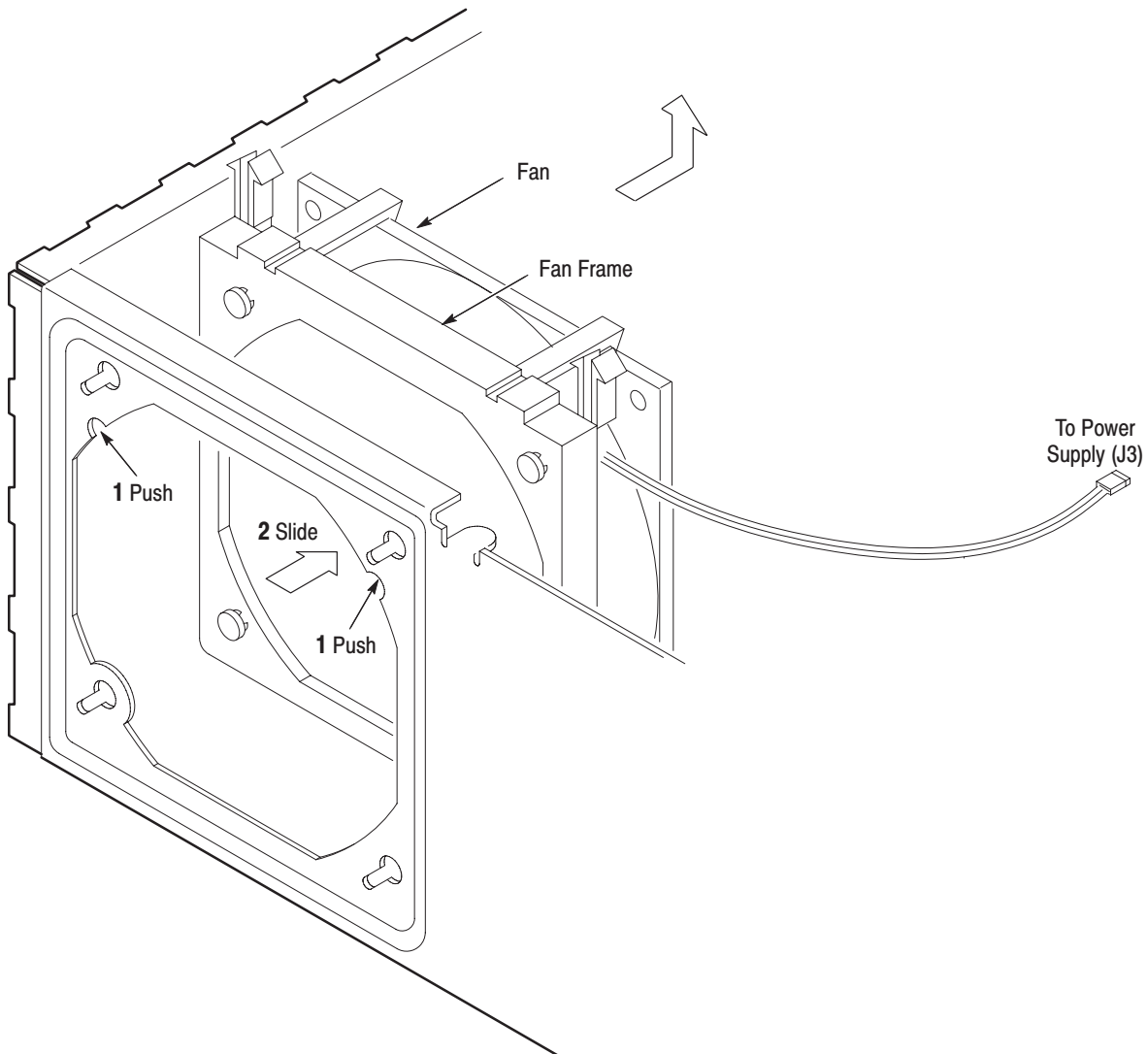


Figure 6-13: Fan and fan frame removal

4. Installation.
 - a. Secure the fan to the fan frame.
 - b. Connect the cable (J3) to the power supply module.
 - c. Align the four protrusions of the fan frame with the holes of the chassis, slide the fan and fan frame to the lower left.

Rear Shield Cover

- 1.** Assemble equipment and locate the modules to be removed.
 - a.** You will need a screwdriver with a size T-9 Torx tip, a size T-15 Torx tip, and a $\frac{1}{4}$ -inch nut driver, and a 5 mm nut driver for this procedure.
 - b.** Locate the modules to be removed in Figure 6-4: Internal Modules.
- 2.** Orient instrument. Set the DG2040 Data Generator with the bottom down on the work surface and the back facing you (see Figure 6-14).
- 3.** Remove rear shield cover.
 - a.** Disconnect the ribbon interconnect cable from J30 on the A6 CPU board. See Figure 6-14 .
 - b.** Using a screwdriver with a size T-9 Torx tip, remove the ten screws securing the rear shield cover to the chassis from the back side.
 - c.** Using a $\frac{1}{4}$ -inch nut driver, remove the IEEE STD 488 PORT cover by removing the two spacer posts.
 - d.** Grasp the serial interface connector, pull the rear shield cover toward you taking care not to damage the cable, and then remove the rear shield cover.
- 4.** Remove serial interface connector. Use a 5 mm nut driver to remove the nut attaching the serial interface connector to the rear shield cover, then remove the connector.
- 5.** Remove rear panel.
 - a.** Using a screwdriver with a size T-15 Torx tip, remove the three screws securing the rear shield cover to the chassis from the left side.
 - b.** You can remove the rear panel of a slot in which no board is mounted.
- 6.** Installation.
 - a.** Install the rear panel if you removed it by reversing the items in step 5.
 - b.** Install the serial interface connector if it was previously removed, by reversing the items in step 4.
 - c.** Install the rear shield cover by doing steps 3a through 3d in reverse order.

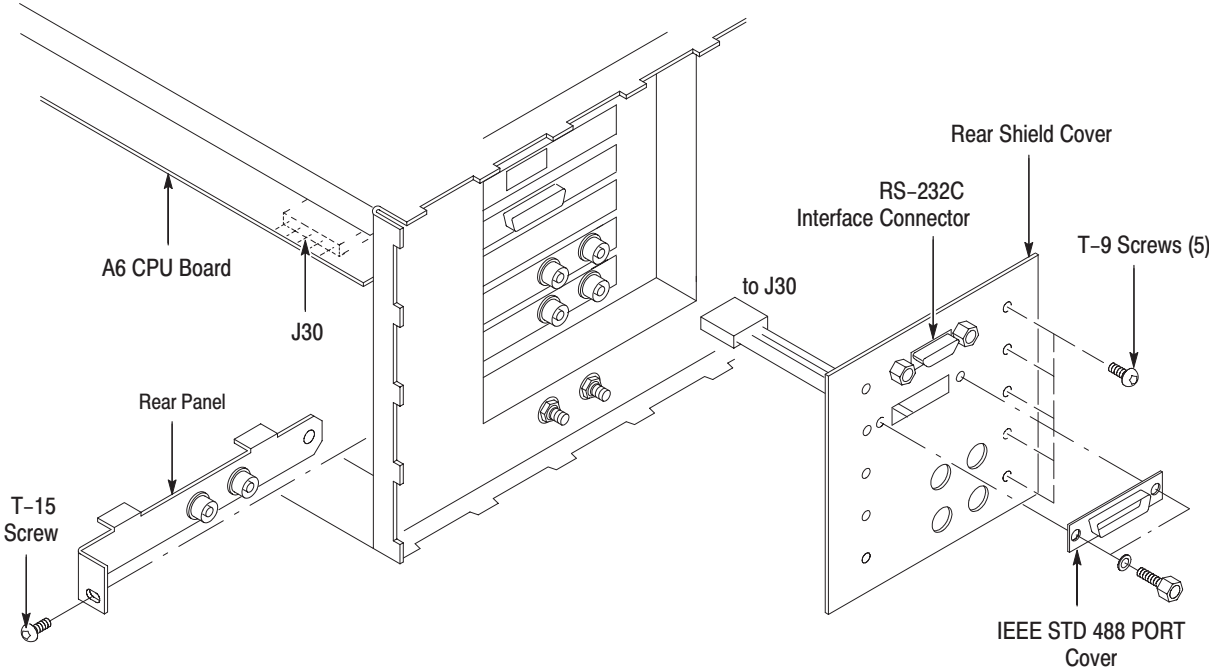


Figure 6-14: Rear shield cover removal

Power Supply Module

1. Assemble equipment and locate the modules to be removed. You will need a screwdriver with a size T-15 Torx tip for this procedure. Locate the modules to be removed in Figure 6-4:Internal Modules.
2. Orient instrument. Set the DG2040 Data Generator with the bottom down on the work surface and the left side facing you.
3. Remove the power supply module.
 - a. Disconnect the ribbon interconnect cables at J1, J3, J4, and J5 on the power supply module. See Figure 6-15.
 - b. Disconnect the flat cable at J2 on the power supply module.
 - c. Using a screwdriver with a size T-15 Torx tip, remove the two screws attaching the power supply module to chassis.
4. Installation. Perform steps 3a through 3c in reverse order to install the power supply module.

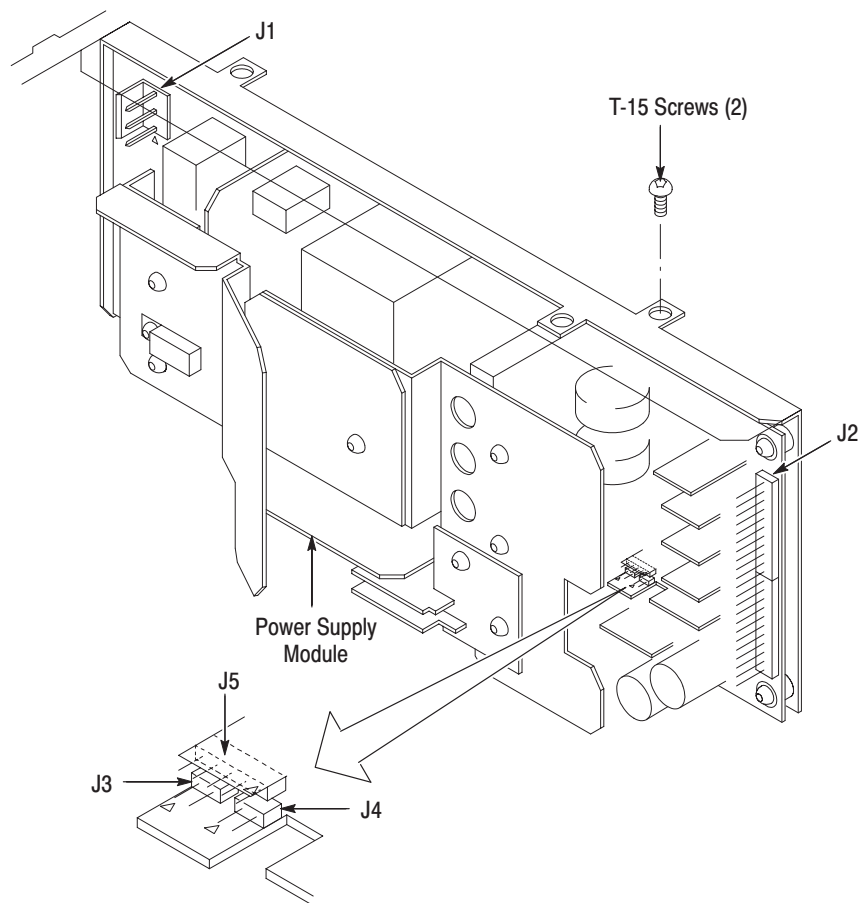


Figure 6-15: Power supply module removal

AC Inlet and AUX Power Board

1. Assemble equipment and locate the modules to be removed.
 - a. You will need a screwdriver with a size T-15 Torx tip and a $\frac{5}{16}$ -inch nut driver and a soldering iron for this procedure.
 - b. Locate the modules to be removed in Figure 6-4: Internal Modules.
2. Remove the fan and fan frame. Perform the *Fan and Fan Frame* procedure on page 6-26.
3. Orient instrument. Set the DG2040 Data Generator with the bottom down on the work surface and the back facing you (see Figure 6-16).
4. Remove the power supply module. Perform the *Power Supply Module* procedure, on page 6-30.
5. Remove AC inlet.
 - a. Disconnect the interconnect cable at CN1 on the AUX Power board.
 - b. Using a $\frac{5}{16}$ -inch nut driver, remove the nut attaching the ground wire to the chassis.
 - c. Remove the two insulating tubes of cables attached to the AC inlet.
 - d. Unsolder the three interconnect cables attached to the AC inlet.
 - e. Using a screwdriver with a size T-15 Torx tip, remove the two screws securing the AC inlet to the chassis.
6. Remove AUX Power board.
 - a. Disconnect the interconnect cable at CN2 on the AUX Power board.
 - b. Remove the three screws attaching the AUX Power board to the chassis.
 - c. Lift the AUX Power board up and away from the chassis to complete the removal.
7. Installation.
 - a. Install the AUX Power board by doing steps 6a through 6c in reverse order.
 - b. Install the AC Inlet by doing steps 5a through 5e in reverse order.

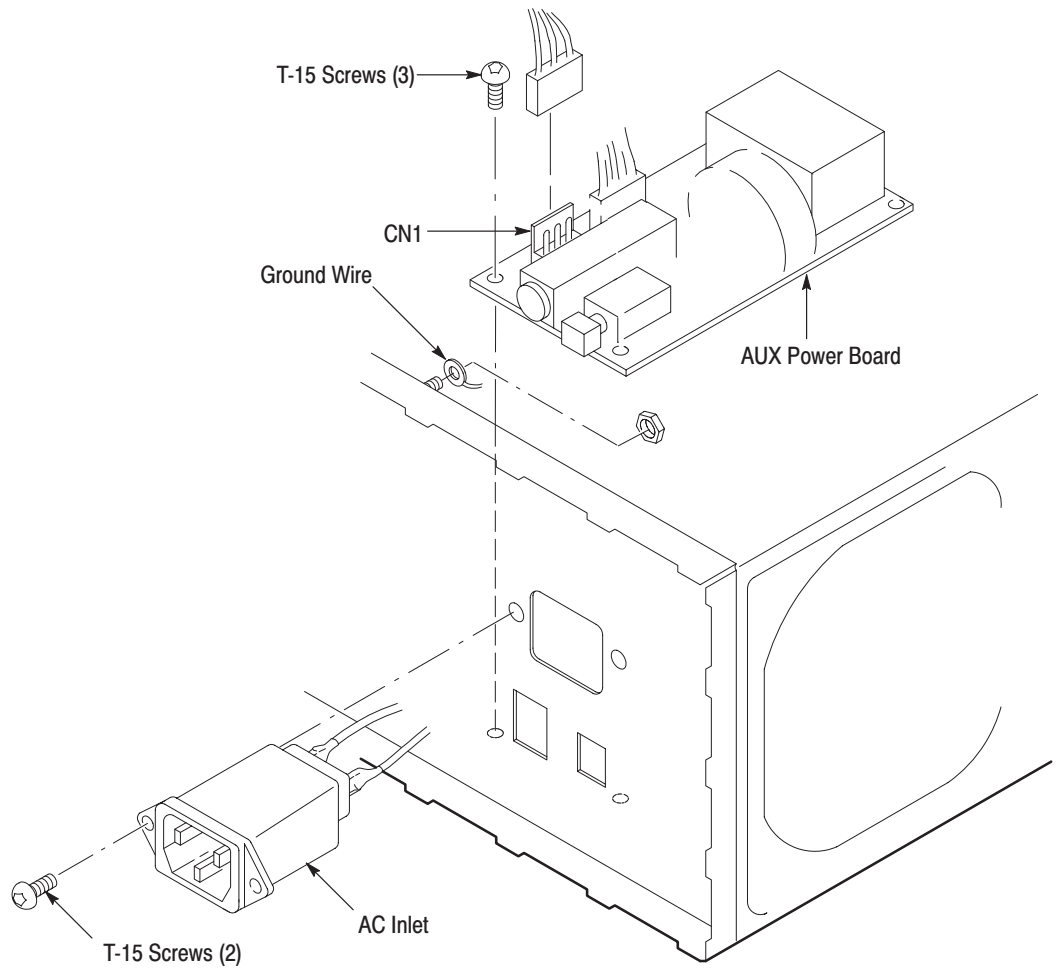


Figure 6-16: AUX power board and AC inlet removal

**Monitor Module and CRT
Frame**

1. Assemble equipment and locate the modules to be removed.
 - a. You will need a screwdriver with a size T-15 Torx tip for this procedure.
 - b. Locate the modules to be removed in Figure 6-4:Internal Modules.
2. Remove front cover, trim ring, and menu buttons. Perform the *Front Cover, Trim Ring, and Menu Buttons* procedure on page 6-18.
3. Orient instrument. Set the DG2040 Data Generator with the bottom down on the work surface and the left side facing you.
4. Remove the monitor module.

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

- a. Disconnect the ribbon interconnect cable at J901 on the monitor module. See Figure 6-17.
- b. Remove the five screws securing the monitor module top and bottom to the chassis.
- c. Release the snap at the right of the front-panel module and shift the assembly. Insert a screwdriver with a size T-15 Torx tip into the right hole of the chassis, and then remove the screw securing the monitor module.
- d. Lift the monitor module up and away from the chassis to complete the removal.

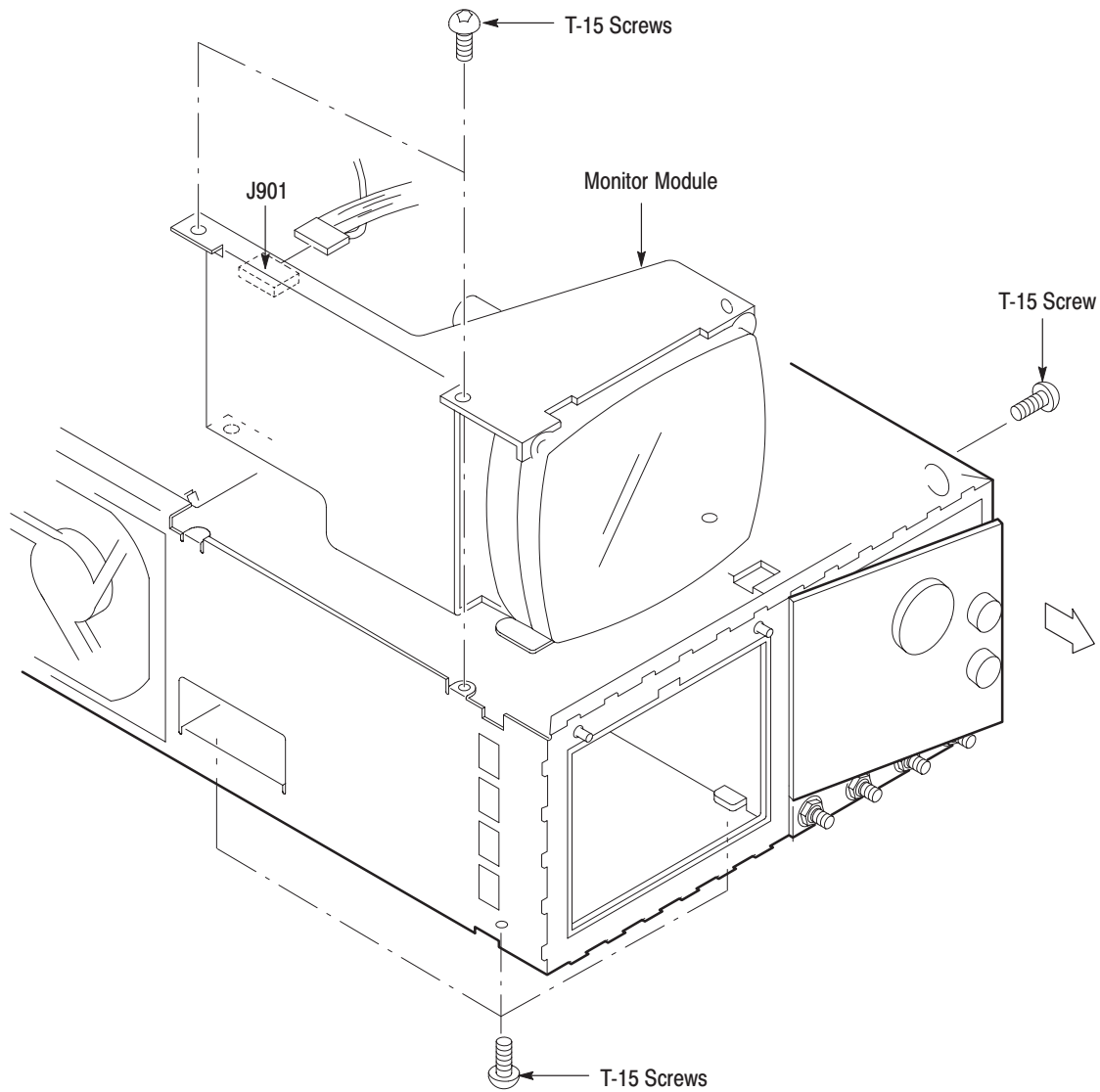


Figure 6-17: Monitor module removal

5. Remove CRT frame. Grasp the upper part of the CRT frame and lift it out as shown in Figure 6-18.

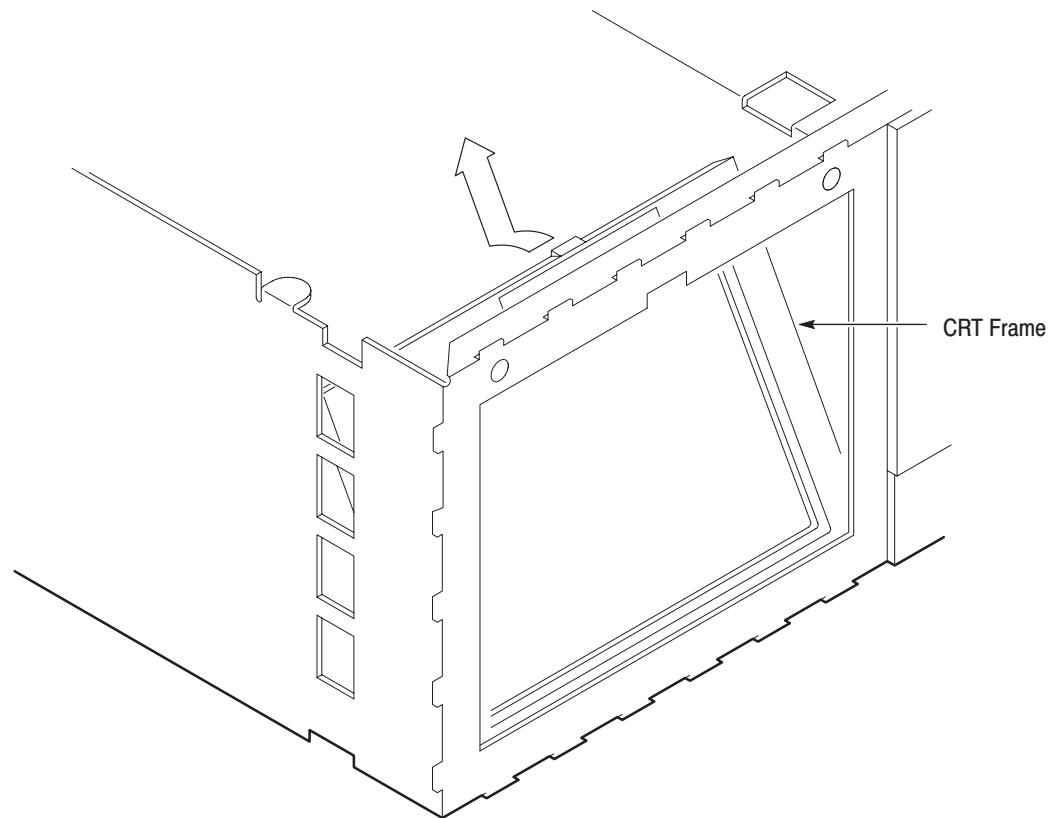


Figure 6-18: CRT frame removal

6. Installation.

- a.** Grasp the upper part of the CRT frame, align the notch of the chassis with the protrusion of the CRT frame, and place the CRT frame in the chassis.
- b.** Install the monitor module by doing steps from 4a through 4d in reverse order.

Circuit Boards

This procedure describes how to remove the following circuit boards:

- A6 CPU Board
- A30 CPU Interface Board and A40 Clock Board
- A50 PG&Output Board

A6 CPU Board, A30 CPU Interface and A40 Clock Board.

1. Assemble the equipment and locate the modules to be removed in Figure 6-4:Internal Modules.
2. Remove the rear shield cover. Perform the procedure, *Rear Shield Cover*, on page 6-28.
3. Orient instrument. Set the DG2040 Data Generator with the left side down on the work surface and the top facing you.
4. Remove the board support. Remove the board support by lifting upward while pushing its hook to the inside.
5. Remove A6 CPU board.



CAUTION. *To avoid permanent loss of pattern data file, note the following: A lithium battery which maintains the nonvolatile memory during power-off time is located on the A16 Back plane board. The nonvolatile memory that contains the pattern data and its setup parameter data is located on the A6 CPU board. Removing either board will cause the pattern data file in nonvolatile memory to be permanently lost. Before removing either the A6 CPU board or the A16 Back plane board, save the pattern data file in the instrument nonvolatile memory to a floppy disk. Then, after installing the board(s), reload the file into nonvolatile memory.*

- a. Disconnect the ribbon interconnect cables at J50 and J64 on the A6 CPU board (see Figure 6-19).
- b. Disconnect the flat cable at J75 on the A6 CPU board. Remove the flat cable as shown in Figure 6-19.
- c. Grasp the upper part of the A6 CPU board, and pull upward to remove it.

6. Remove A30 CPU Interface board and A40 Clock board.
 - a. Disconnect the ribbon cable at J110 on the A30 CPU Interface board (see Figure 6-19).
 - b. Disconnect the interconnect cables at J210 and J220 on the A30 Clock board, and disconnect at J200 and J430 on the A40 Clock board (see Figure 6-19).
 - c. Grasp the upper part of the A30 CPU Interface board and pull upward to remove it.

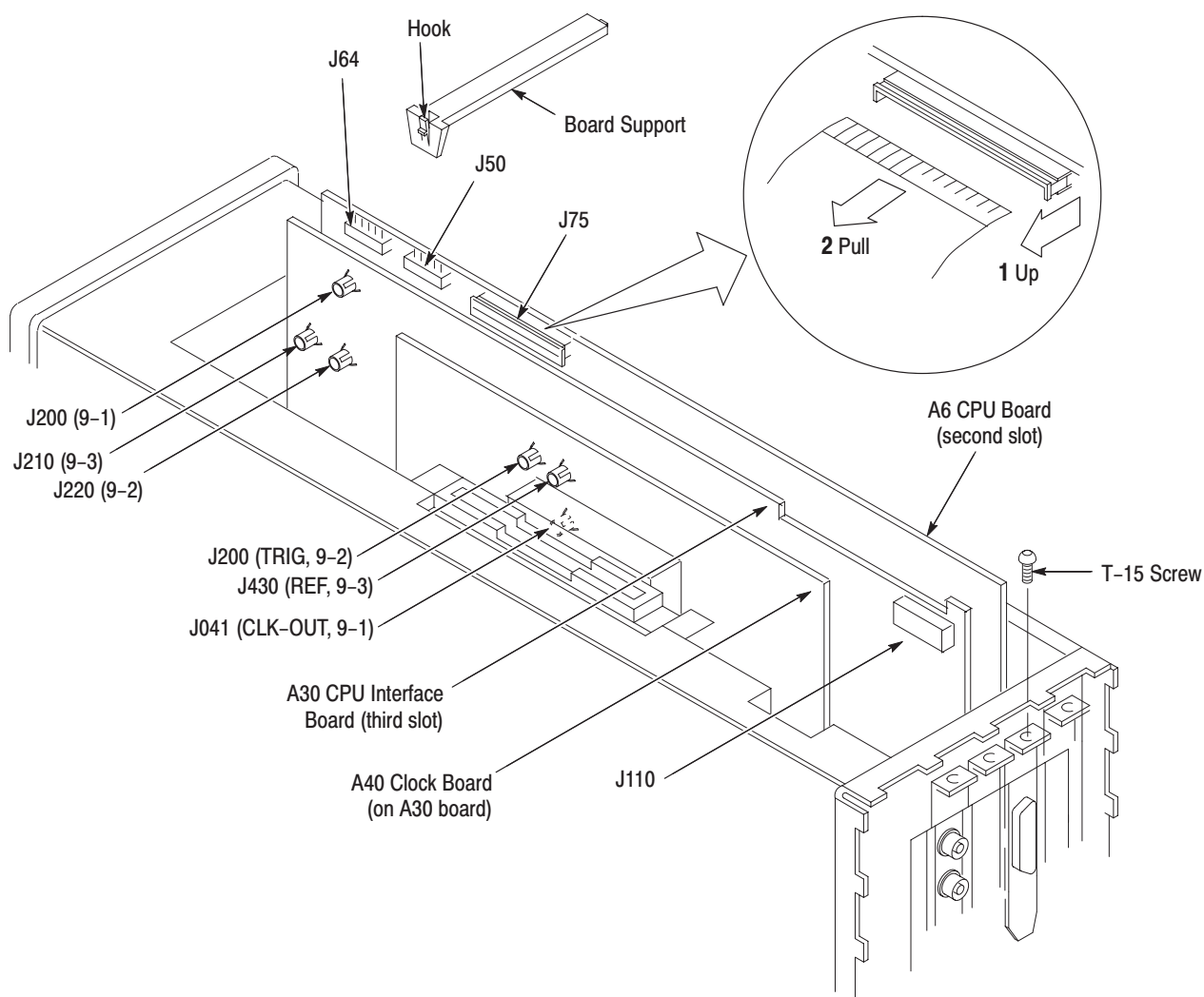


Figure 6-19: A6 CPU board, A30 CPU Interface board and A40 Clock board removal

A50 PG & Output Board. Follow the instructions below to remove the A50 PG & Output board.

1. Assemble equipment and locate modules to be removed.
 - a. You will need a screwdriver with a size T-10 Torx tip to do this procedure. (see Figure 6-19).
 - b. Locate the modules to be removed in Figure 6-4:Internal Modules.
2. Orient instrument. Set the DG2040 Data Generator with the top down on the work surface and the right side facing you.
3. Remove the A50 PG & Output board.
 - a. Disconnect the nineteen interconnect cables at J800, J810, J1900, J1100, J1110, J1600, J1602, J1604, J1606, J1608, J1610, J1700, J1702, J1704, J1706 and J1902. See Figure 6-20.

The W100 on the A50 PG&Output board is connected with the J110 connector on the A30 CPU Interface board.

The W1300 on the A50 PG&Output board is connected with the J15 connector on the A16 Back plane board. To disconnect the J15 connector, release the latch on W1300 plug and pull upward.

- b. Using a screwdriver with a size T-10 Torx tip, remove the nine screws attaching the A50 PG&Output board.
 - c. Lift the A50 PG&Output board up and away from the chassis to complete the removal.
4. Installation. Do steps 3a through 3c in reverse order to install the A50 PG & Output board.

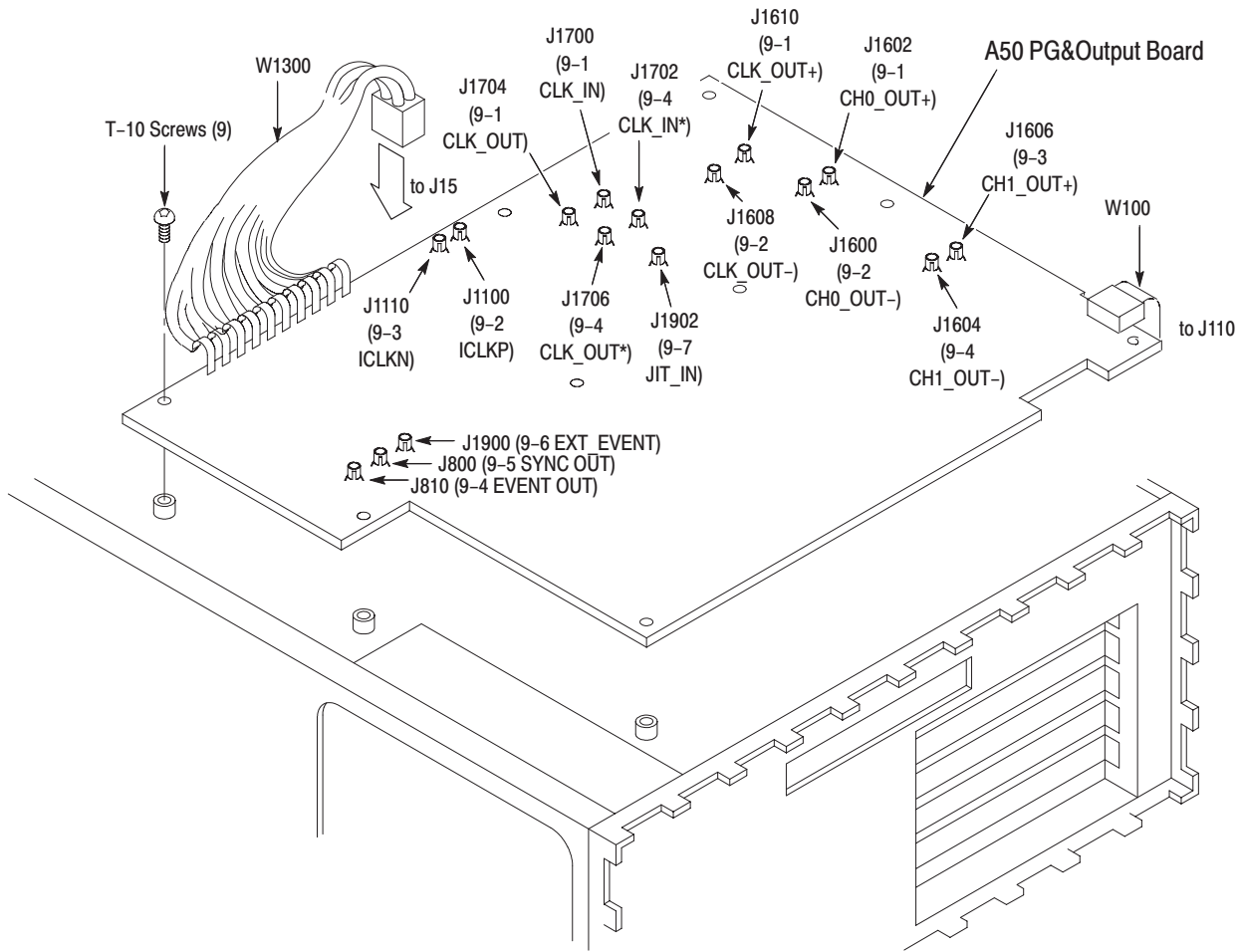


Figure 6-20: A50 PG & Output board removal

A16 Back plane Board



CAUTION. To avoid the permanent loss of pattern data file, note the following: A lithium battery which maintains the nonvolatile memory during power-off time is located on the A16 Back plane board. The nonvolatile memory that contains the pattern data and its setup parameter data is located on the A6 CPU board.

Removing either board will cause the pattern data file in nonvolatile memory to be permanently lost. Before removing either the A6 CPU board or the A16 Back plane board, save the pattern data file in the instrument nonvolatile memory to a floppy disk. Then, after installing the board(s), reload the file into nonvolatile memory.

1. Assemble equipment and locate modules to be removed.
 - a. You will need a screwdriver with a size T-15 Torx tip and a flat-blade screwdriver for this procedure.
 - b. Locate the modules to be removed in Figure 6-4:Internal Modules.
2. Orient instrument. Set the DG2040 Data Generator with the left side down on the work surface and the top facing you.
3. Remove all boards. Perform the *Circuit Boards* procedure, beginning on page 6-36.
4. Remove A16 Back plane board.
 - a. Remove the five screws and a nut securing the shield cover (see Figure 6-21).
 - b. Grasp the shield cover, and take it out.
 - c. Disconnect the ribbon interconnect cable at J10 on the A16 Back plane board.
 - d. Disconnect the flat cable at J6 on the A16 Back plane board.
 - e. Remove the remaining four screws securing the A16 Back plane board to the chassis.
 - f. Using a flat-blade screwdriver, release the four hooks of the circuit board support that holds the A16 Back plane board, lift the A16 Back plane board sideways and lift it out.

- 5. Install the A16 Back Plane board. Perform steps 4a through 4f in reverse order to install the board.
- 6. Install the other boards. Perform the *Circuit Boards* procedure, beginning on page 6-36, in reverse order.

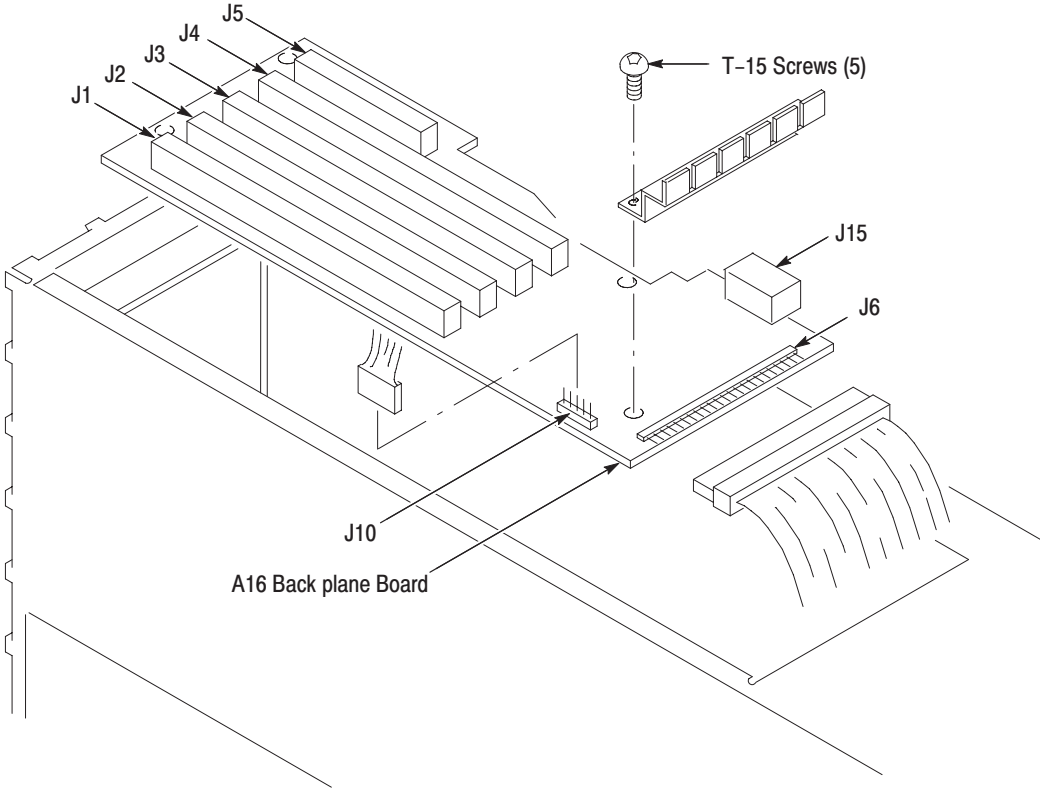


Figure 6-21: A16 Back plane board removal

Lithium Battery



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

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

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

1. Assemble equipment and locate modules to be removed.
 - a. You will need a soldering iron for this procedure.
 - b. You will also need a replacement lithium battery. The part number is listed in the *Replaceable Mechanical Parts* section of this manual.
 - c. Locate the battery to be removed in the locator diagram, Figure 6-4:Internal Modules.
2. Remove A16 Back plane board. Perform the *A16 Back plane Board* procedure on page 6-40.
3. Orient board. Set the A16 Back plane board on an insulating surface.
4. Remove used battery.
 - a. Unsolder the tabs at the ends of the battery, taking care not to heat the battery (see Figure 6-22).
 - b. Grasp the battery, and lift it away from the board.
5. Install new battery.
 - a. Place the new battery on the board with the negative tab of the battery closest to the board edge connector.
 - b. Solder the tabs to the board.

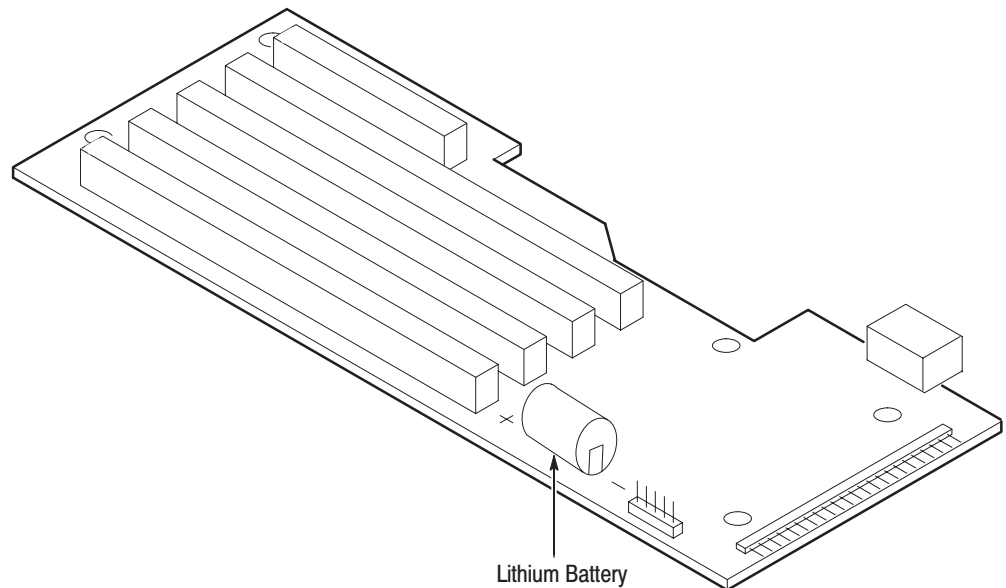


Figure 6-22: Battery location on the A16 Back plane board

Floppy-disk Drive Module

1. Assemble equipment and locate modules to be removed.
 - a. You will need a screwdriver with a size T-10 Torx tip and a size #1 Phillips tip for this procedure.
 - b. Locate the modules to be removed in Figure 6-4:Internal Modules.
2. Remove rear shield cover. Perform the *Rear Shield Cover* procedure on page 6-28.
3. Orient instrument. Set the DG2040 Data Generator with the left side down on the work surface and the bottom facing you.
4. Remove all circuit boards. Perform the *Circuit Boards* procedure, on page 6-36.
5. Remove floppy-disk drive module.
 - a. Using a screwdriver with a size T-10 Torx tip, remove the six screws securing the floppy-disk drive cover to the chassis (see Figure 6-23).
 - b. Disconnect the flat cable of the floppy disk drive.
 - c. Using a screwdriver with a size #1 Phillips tip, remove the three screws securing the floppy-disk drive to the bracket.
 - d. Using a screwdriver with a size #1 Phillips tip, remove the screw securing the spacer to the floppy-disk drive.

- e. Grasp the upper part of the floppy-disk drive, and pull it upward to remove it.
- 6. Install the floppy-disk drive module. Perform steps 5a through 5e in reverse order.
- 7. Install the circuit boards. Perform the *Circuit Boards* procedure, on page 6-36, in reverse order.

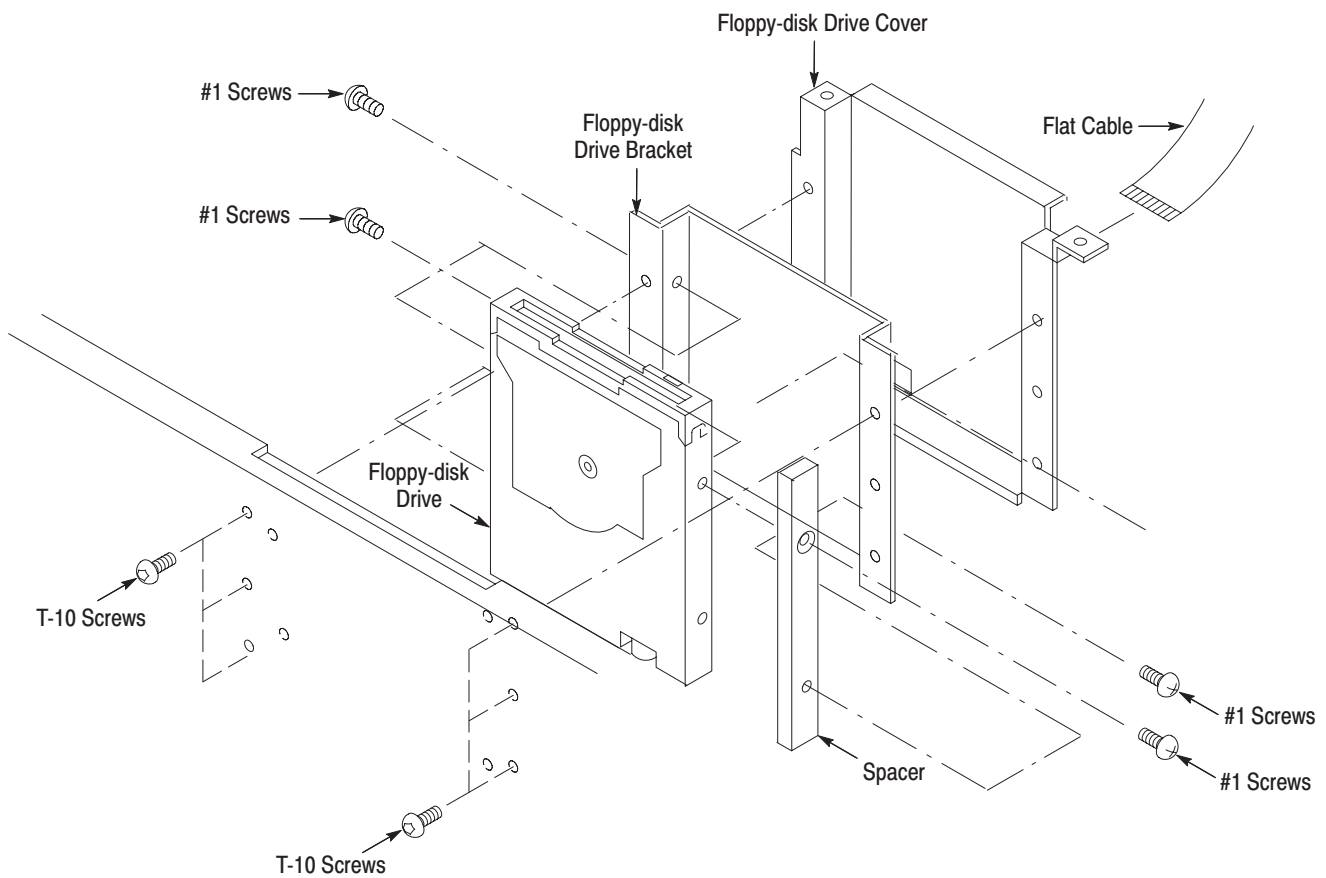


Figure 6-23: Floppy-disk drive module removal

Troubleshooting

This subsection contains information and procedures designed to isolate faulty modules in the DG2040 Data Generator. If these procedures indicate a module needs to be replaced, follow the *Removal and Installation Procedures* in the preceding subsection.

Troubleshooting Procedures

The troubleshooting procedures in this subsection consist of the following flowcharts:

- Primary Troubleshooting Procedure (Figure 6-25)
- Power Supply Module (Figure 6-27)
- A6 CPU Board or Front-panel Module (Figure 6-30)
- Monitor Module (Figure 6-32)
- A30 CPU Interface Board and A40 Clock Board or A50 PG&Output Board (Figure 6-36)
- Module Isolation (Figure 6-37)

To use these procedures, begin with the Primary Troubleshooting Procedure. It prompts you to check various indications of the DG2040 Data Generator functionality and directs you to the other troubleshooting procedures.

DG2040 Data Generator Diagnostics

The DG2040 Data Generator has internal diagnostics that verify circuit functionality. The DG2040 Data Generator automatically executes the internal diagnostics at power-on. You can also run the internal diagnostics by using the **UTILITY** menu. Refer to *Checking Diagnostics Tests* on page 6-46. The difference between the two methods of running the internal diagnostics routine is that the power-on method does not do as much memory checking.

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

Checking Diagnostics Tests

Prerequisites. Power on the DG2040 Data Generator and allow a 20 minute warm up before doing this procedure.

1. Push the **UTILITY**→**Diag** bottom button.
2. Select **Type** from the side menu.
3. Select **All** with the general purpose knob.
4. Select **Execute** from the side menu. This executes all the diagnostics automatically. As each test finishes, the result is displayed on the screen.
5. Check the diagnostic test results. If any test failed, go to Figure 6-37:Module Isolation Troubleshooting Procedure on page 6-57. The table in the flowchart shows which module is related to each diagnostic test. If the tests passed but there is still a problem, go to Figure 6-25:Primary Troubleshooting Procedure 1 on page 6-47.

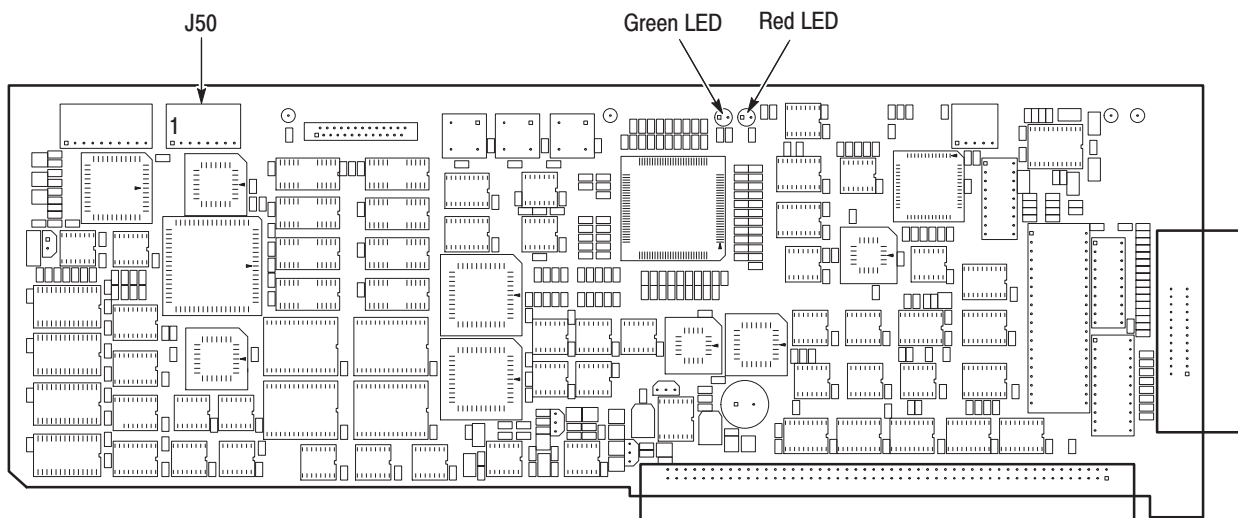


Figure 6-24: A6 CPU Board

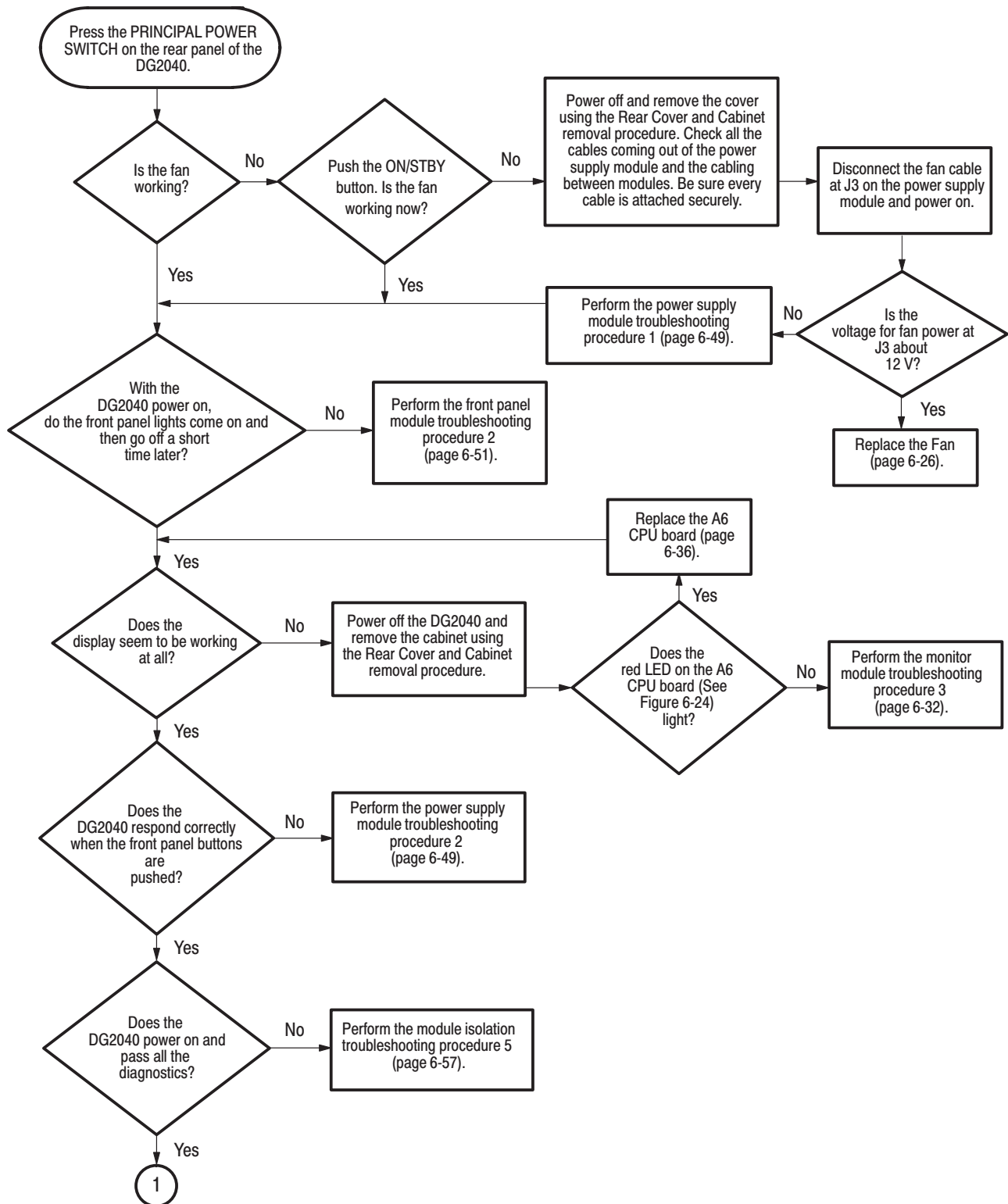


Figure 6-25: Primary troubleshooting procedure 1

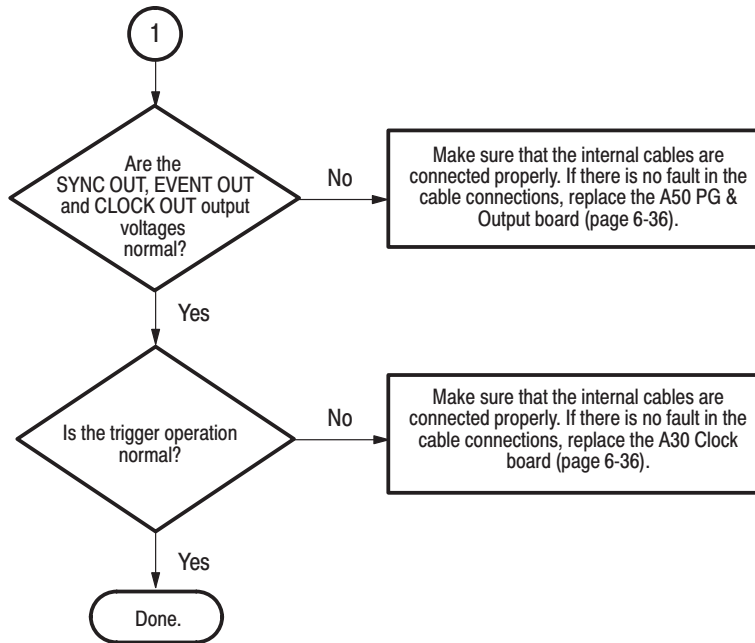


Figure 6-26: Primary troubleshooting procedure 2

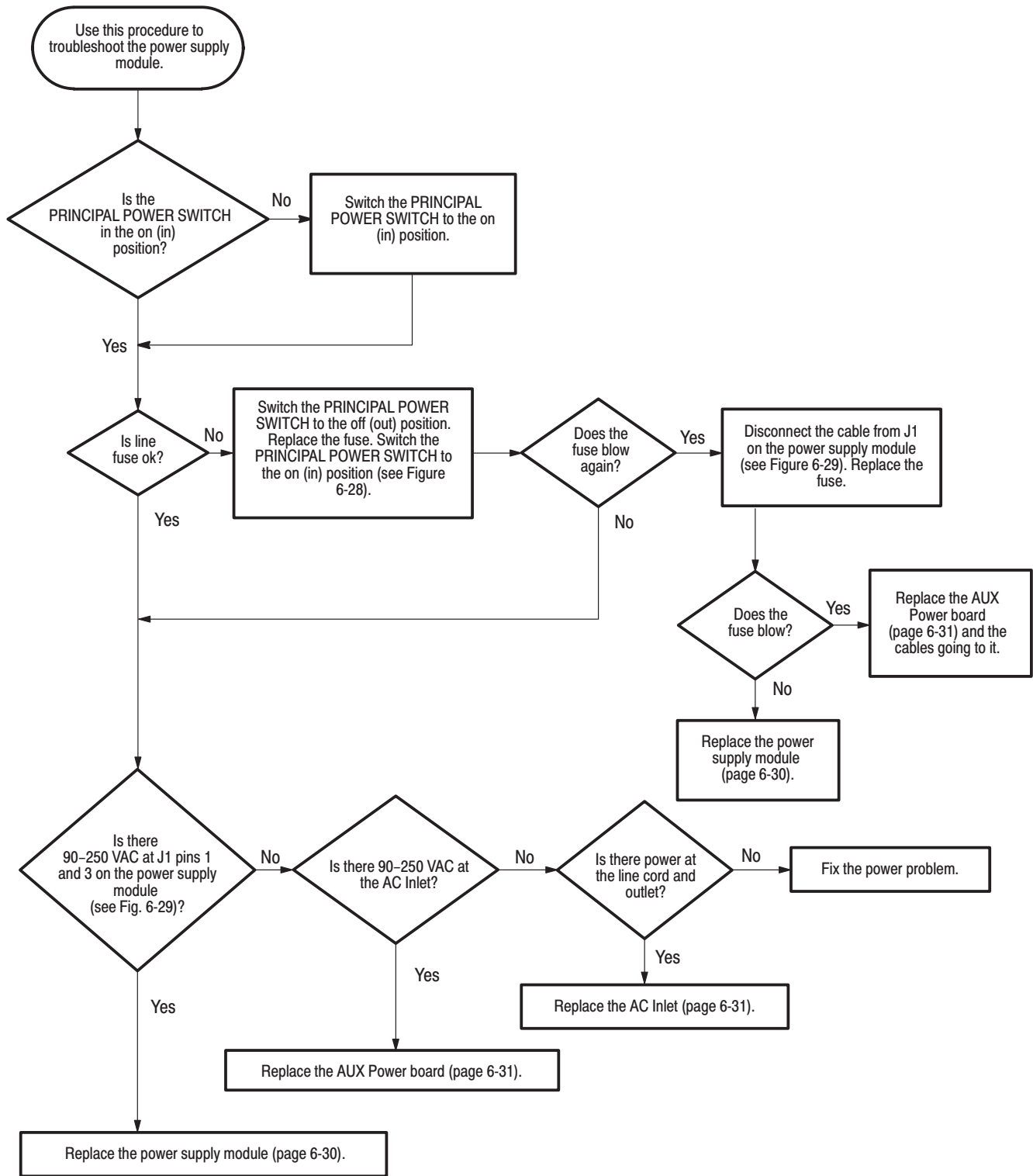


Figure 6-27: Power Supply module troubleshooting procedure

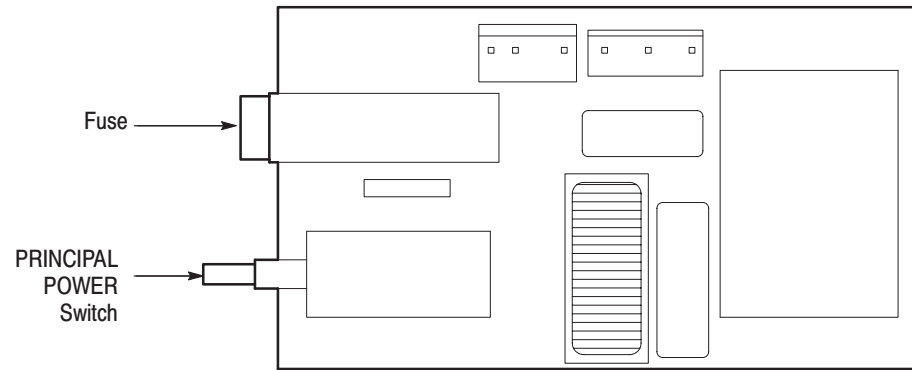


Figure 6-28: AUX Power board

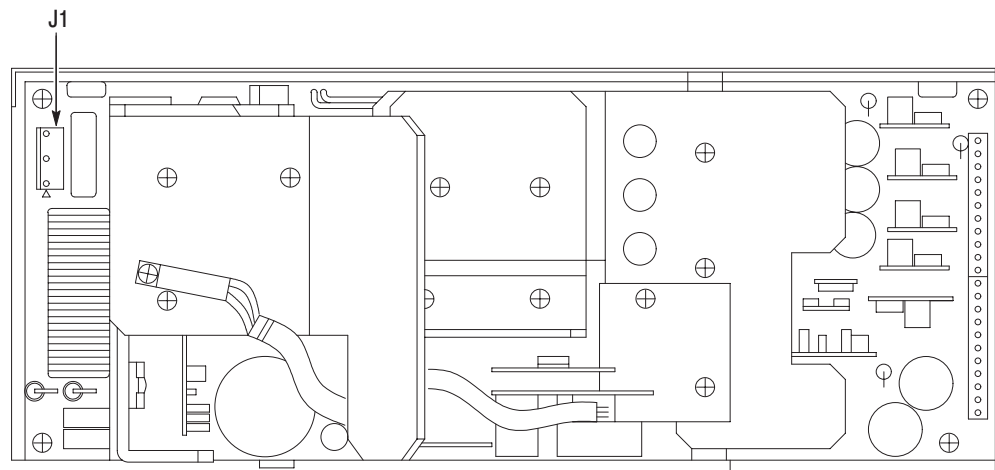


Figure 6-29: Power Supply module

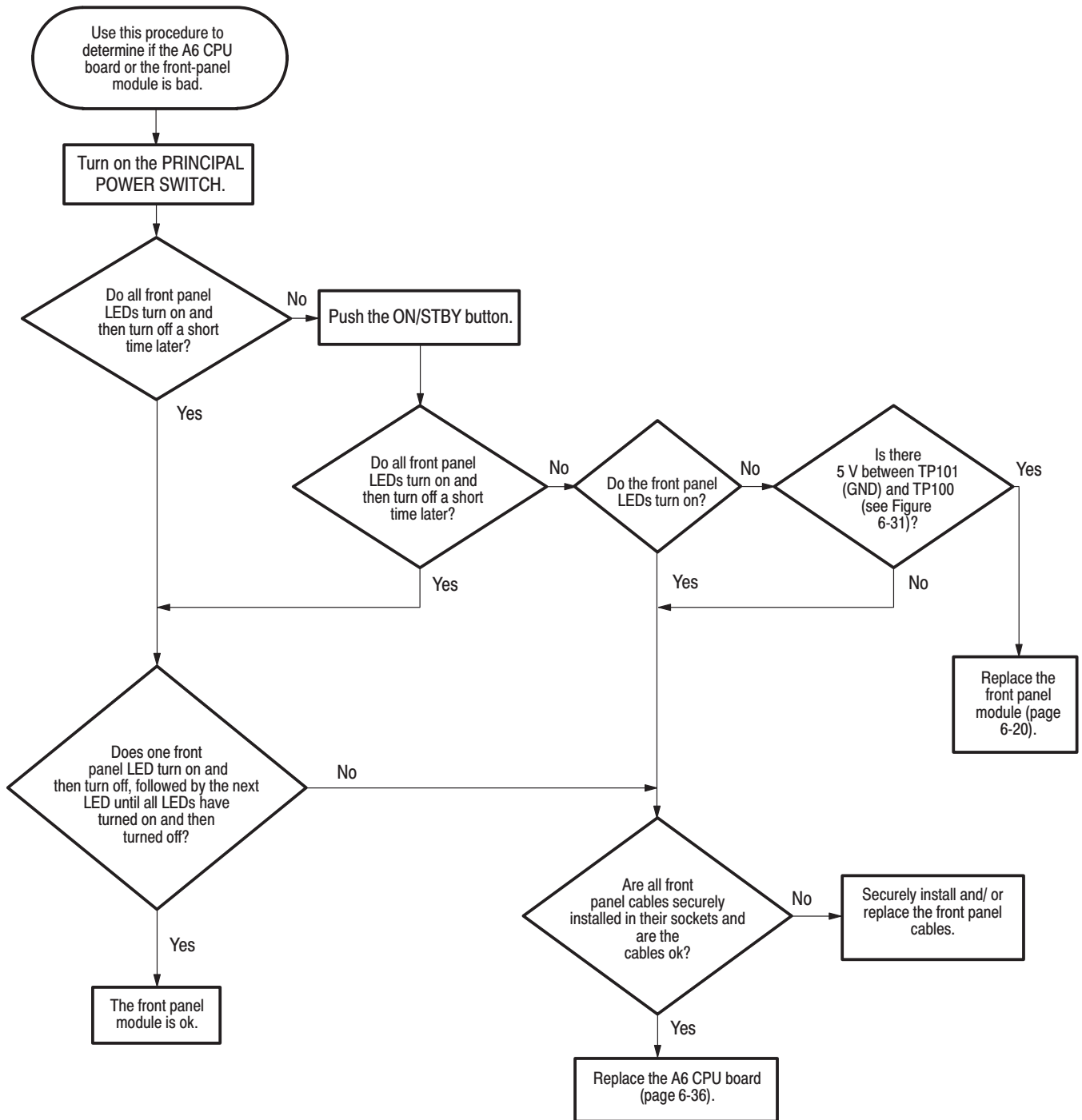


Figure 6-30: A6 CPU Board or front-panel module troubleshooting procedure

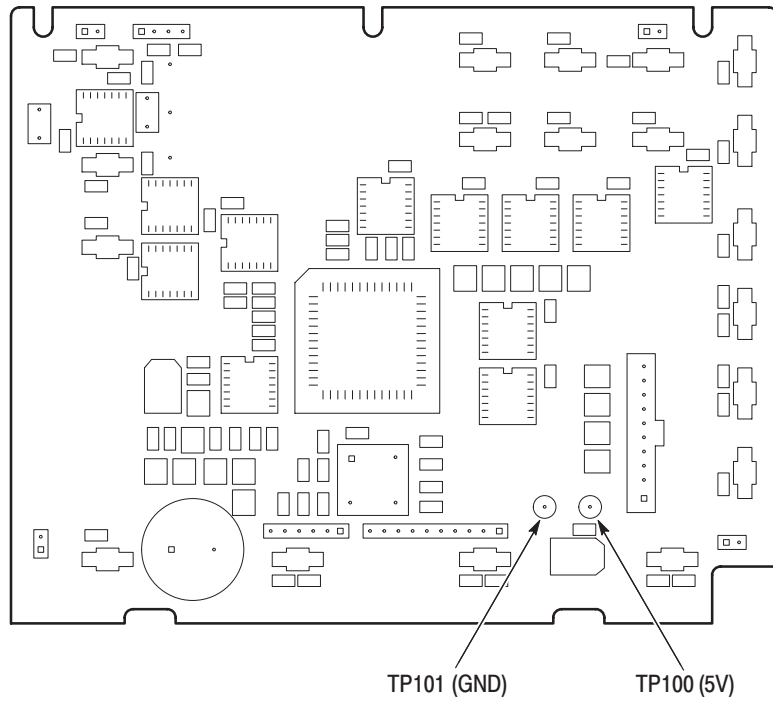


Figure 6-31: Key board

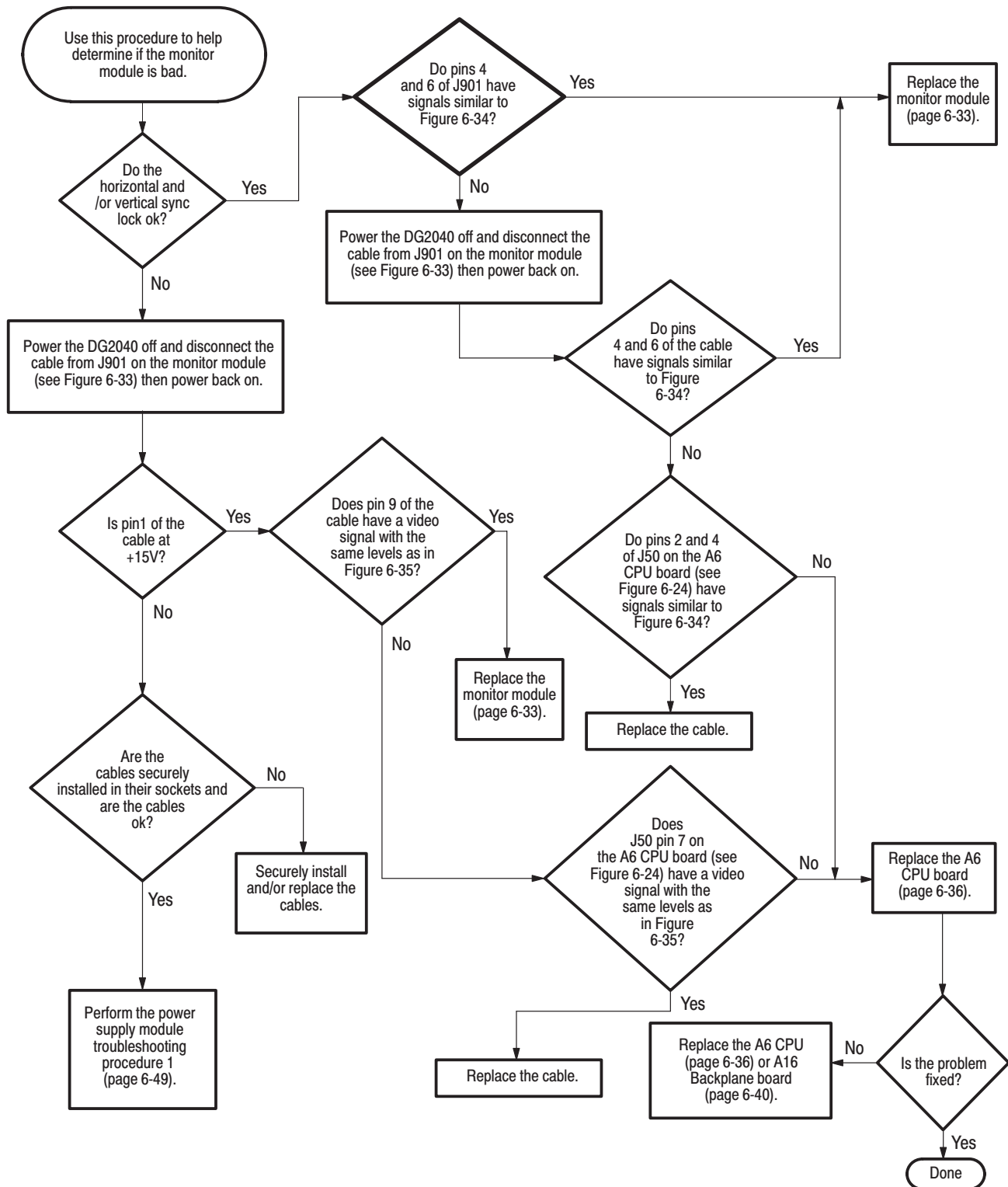


Figure 6-32: Monitor module troubleshooting procedure

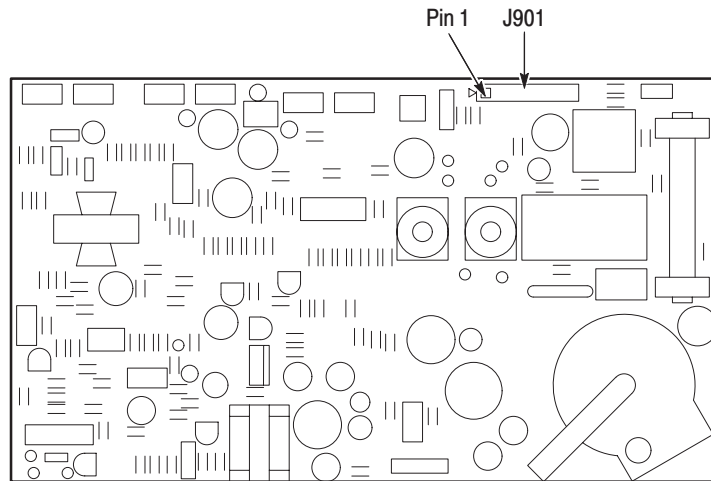


Figure 6-33: Monitor module

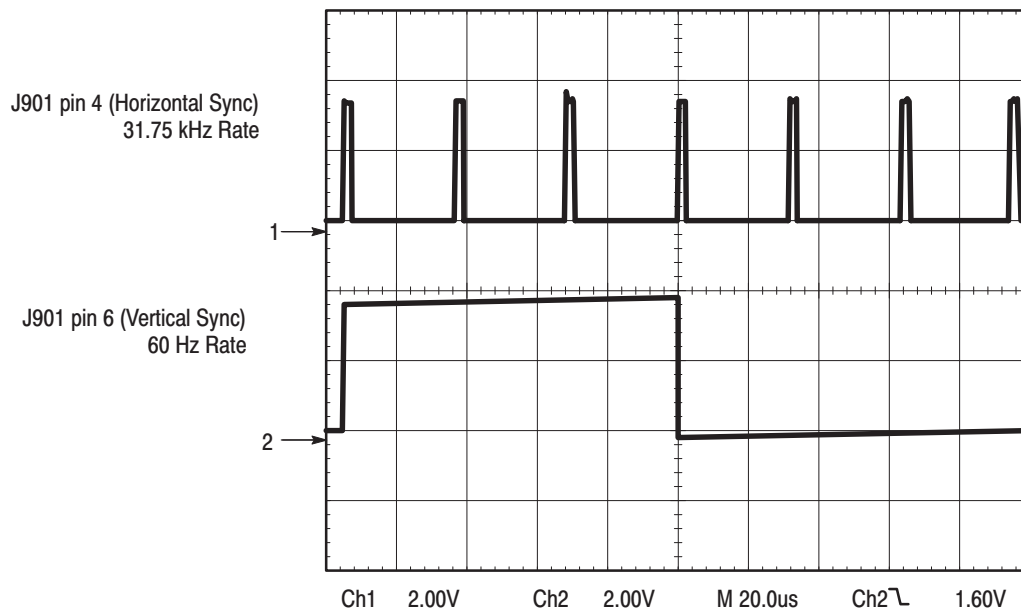


Figure 6-34: Horizontal and vertical sync signals

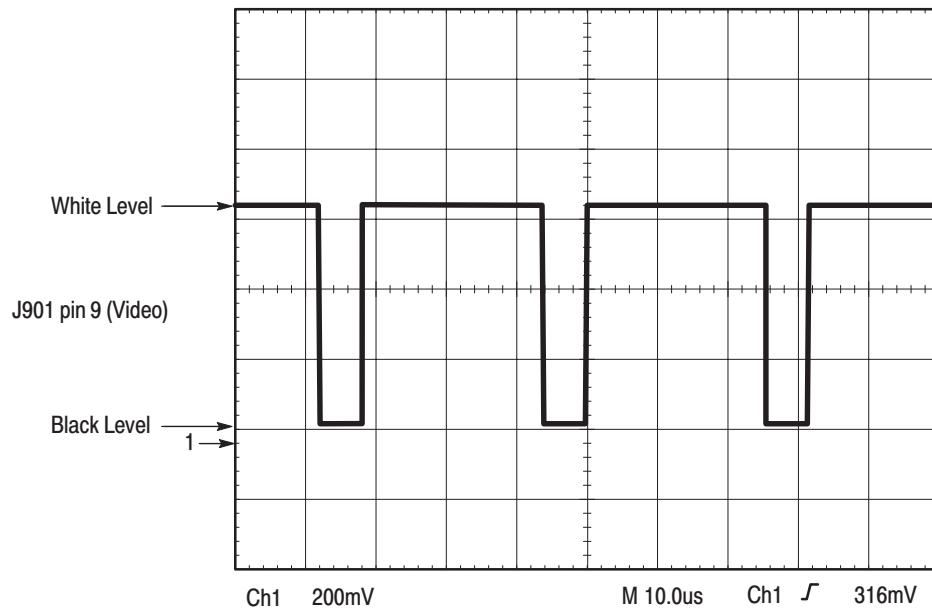


Figure 6-35: A video signal with white and black levels

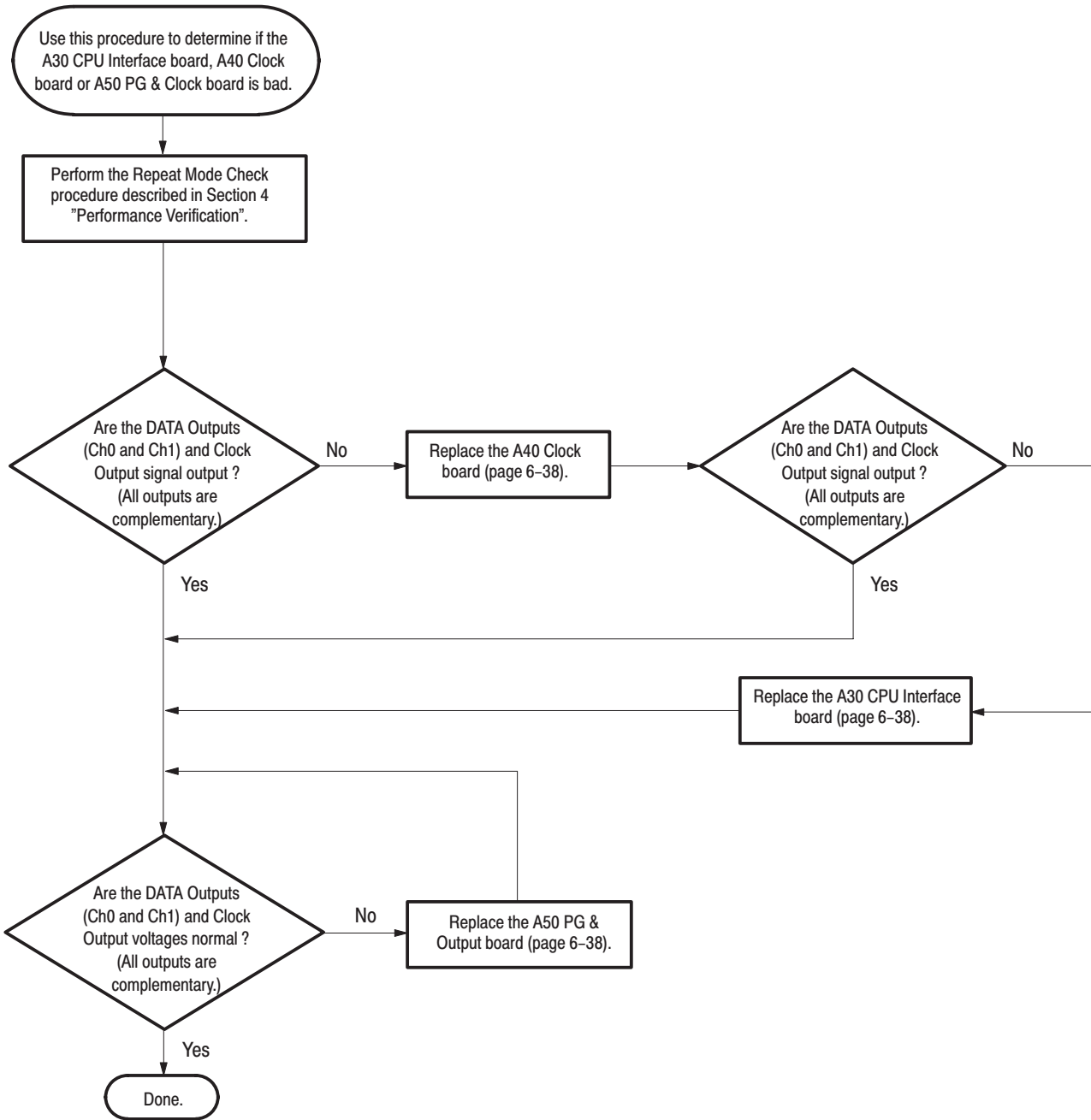


Figure 6-36: A30 CPU Interface board, A40 Clock board or A50 PG & Output board troubleshooting procedure

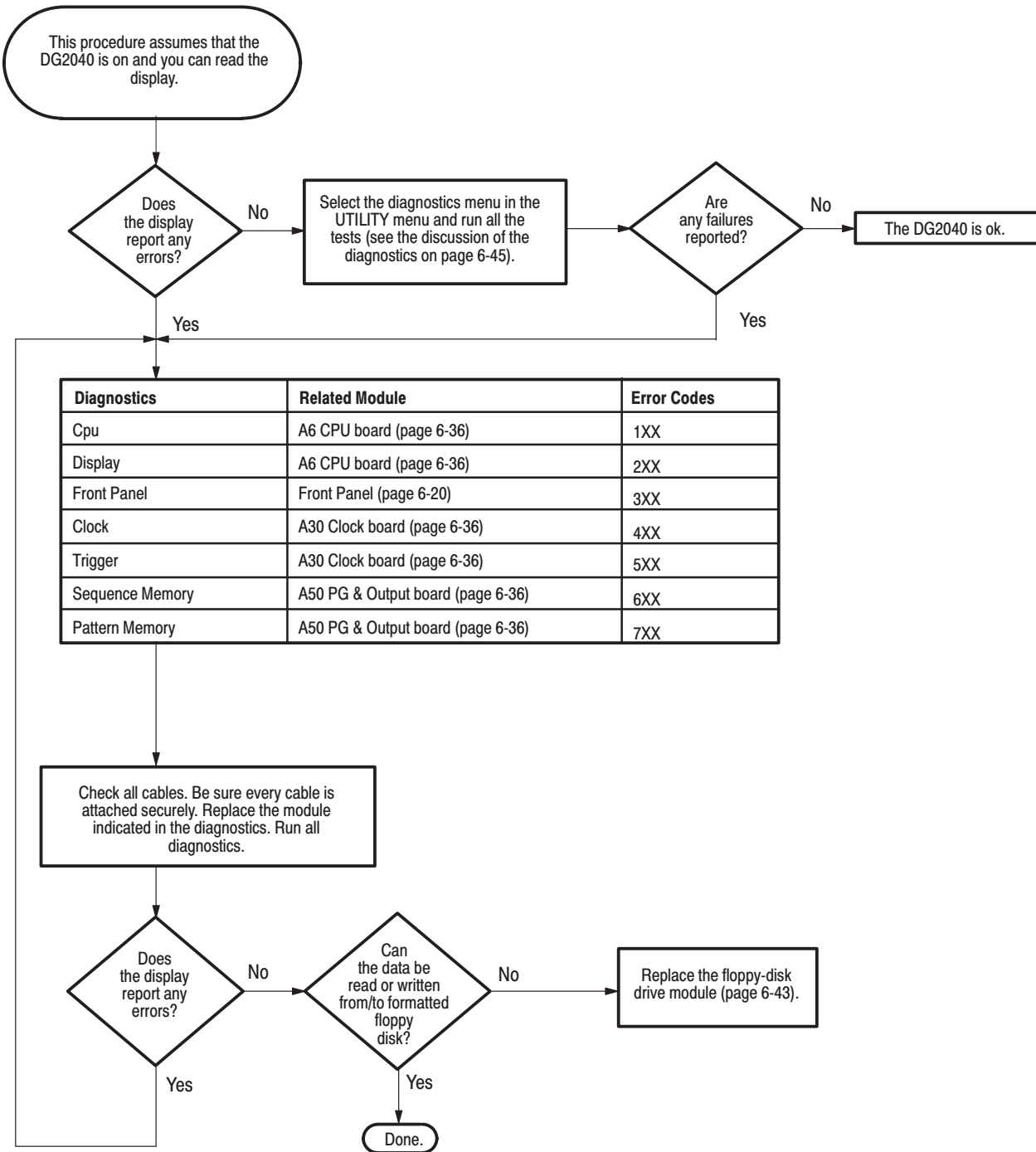


Figure 6-37: Module isolation troubleshooting procedure

Options and Accessories

Options

This section describes the various options as well as the standard and optional accessories that are available for the DG2040 Data Generator.

Power Cords Option A1 through A5 changes the standard power cord to one of five alternate power cord configurations. Refer to page 2-2 for more details.

In place of the standard North American, 110 V, 60 Hz power cord, Tektronix ships any of five alternate power cord configurations with the DG2040 Data Generator. See Table 7-1 for a list of the power cord configurations.

Table 7-1: International Power Cords

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

Option 1R Option 1R ships the data generator configured for installation in an instrument rack. Refer to page 7-3 for details.

When option 1R is specified, the DG2040 Data Generator is shipped for mounting in a 19-inch rack. The floppy disk drive is moved so that it can be accessed from the front panel. Contact your Tektronix sales representative for details on converting a nonrack mounting DG2040 Data Generator to rack mounting.

See the instruction sheet provided with the rack mounting kit for details on the rack mounting adapter.

Option D1 Option D1 provides a test result report.

Accessories

Standard Accessories

Table 7-2 contains a list of standard accessories that are provided with each instrument.

Table 7-2: Standard accessories

Standard accessories	Tektronix part number
User Manual	071-0257-00
Programmer Manual	071-0258-00
Performance Check Disk, 3.5-inch	063-3121-00
GPIB Sample Program Disk, 3.5-inch	063-3122-00
DG-LINK Application Program Disk, 3.5-inch	063-2920-01
Power cord 125V/6A	161-0230-01
Fuse 6A Fast 250V (UL198G/3AG)	159-0239-00
Certificate of Calibration	-----

Optional Accessories

Table 7-3 lists the optional accessories that are recommended for use with the DG2040 Data Generator.

Table 7-3: Optional accessories

Optional accessory	Tektronix part number
DG2040 Data Generator Service Manual	071-0259-00
Front Cover	200-3232-01
Accessory Pouch	016-1159-00
Rackmount kit	040-1444-00
Fuse 6A Fast 250 V (UL198G/3AG)	159-0239-00
Fuse cap	200-2264-00
Fuse 5A 250 V (T) (IEC127)	159-0210-00
Fuse cap	200-2265-00
GPIB Cable	012-0991-00
50 Ω SMA Cable, 1 m (39 inches), male	174-1341-00
50 Ω SMA Cable, 2 m (21 inches), male	174-0679-00
50 Ω SMA Cable, 0.5 m (20 inches), male	174-1427-00
SMA Precision Delay Cable, 1 ns, male	015-0562-00
SMA Precision Delay Cable, 2 ns, male	015-0560-00
SMA Precision Delay Cable, 4 ns, male	015-0561-00
50 Ω BNC Cable, 1 m (43 inches), male	012-0057-01
50 Ω BNC Cable, 0.6 m (24 inches), male	012-1342-00
50 Ω BNC Cable, double shield 2.5m (98 inches), male	012-1256-00
SMA T Connector, male to female, male	015-1016-00
50 Ω SMA termination, male	015-1022-00
50 Ω SMA Divider, male	015-1014-00
SMA Male to BNC Female Adapter,	015-0554-00
SMA Adapter Kit	020-1693-00



Replaceable Electrical Parts

All replaceable modules are listed in the *Replaceable Mechanical Parts*. Refer to that section for part numbers when using this manual.

Diagrams

This section contains the following diagrams:

- Block Diagram of DG2040 Data Generator
- Interconnect Diagram of DG2040 Data Generator

Block diagrams show the modules and functional blocks in the DG2040 Data Generator. Interconnect diagrams show how the modules in the DG2040 Data Generator connect together.

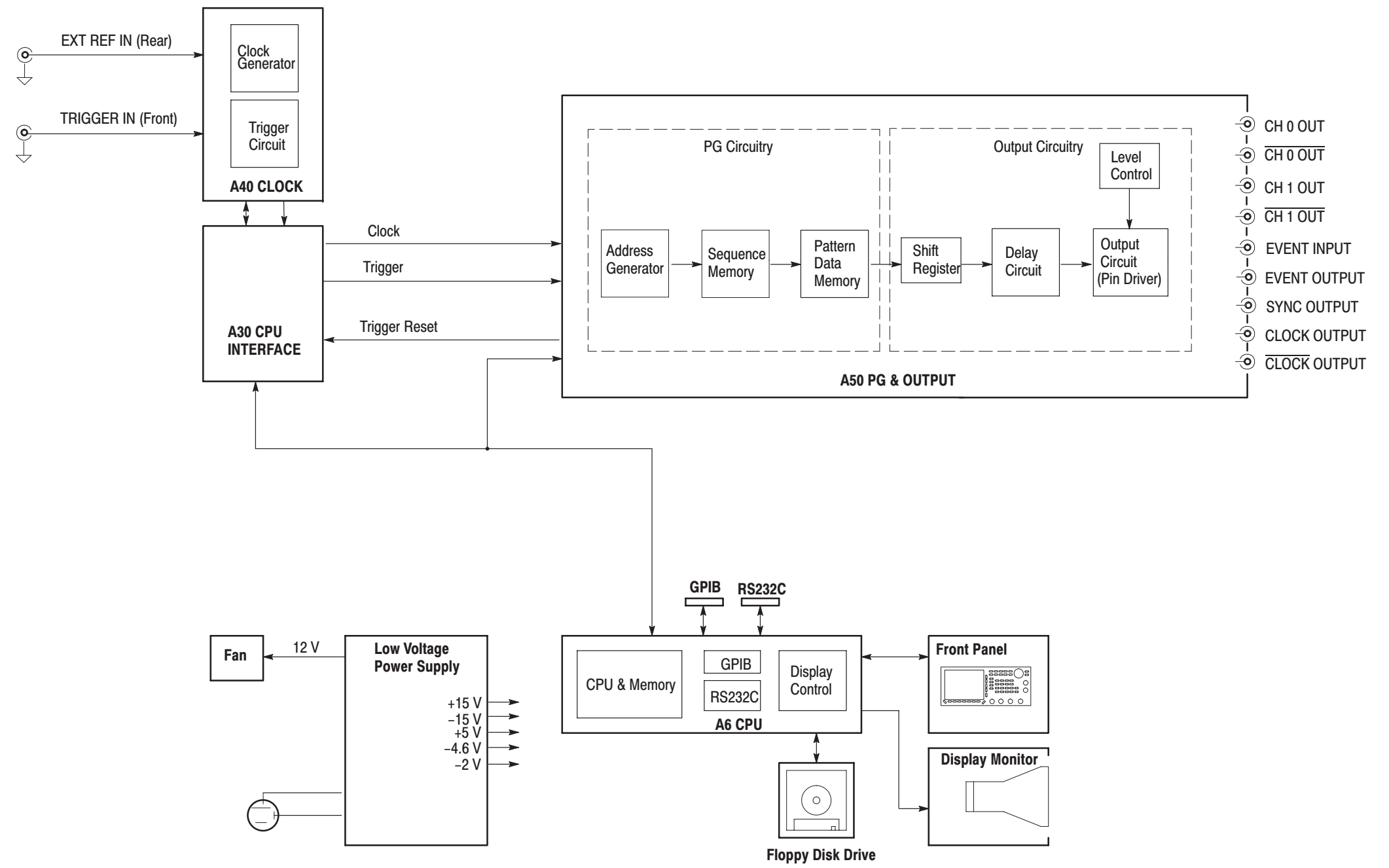


Figure 9-1: DG2040 Data Generator block diagram

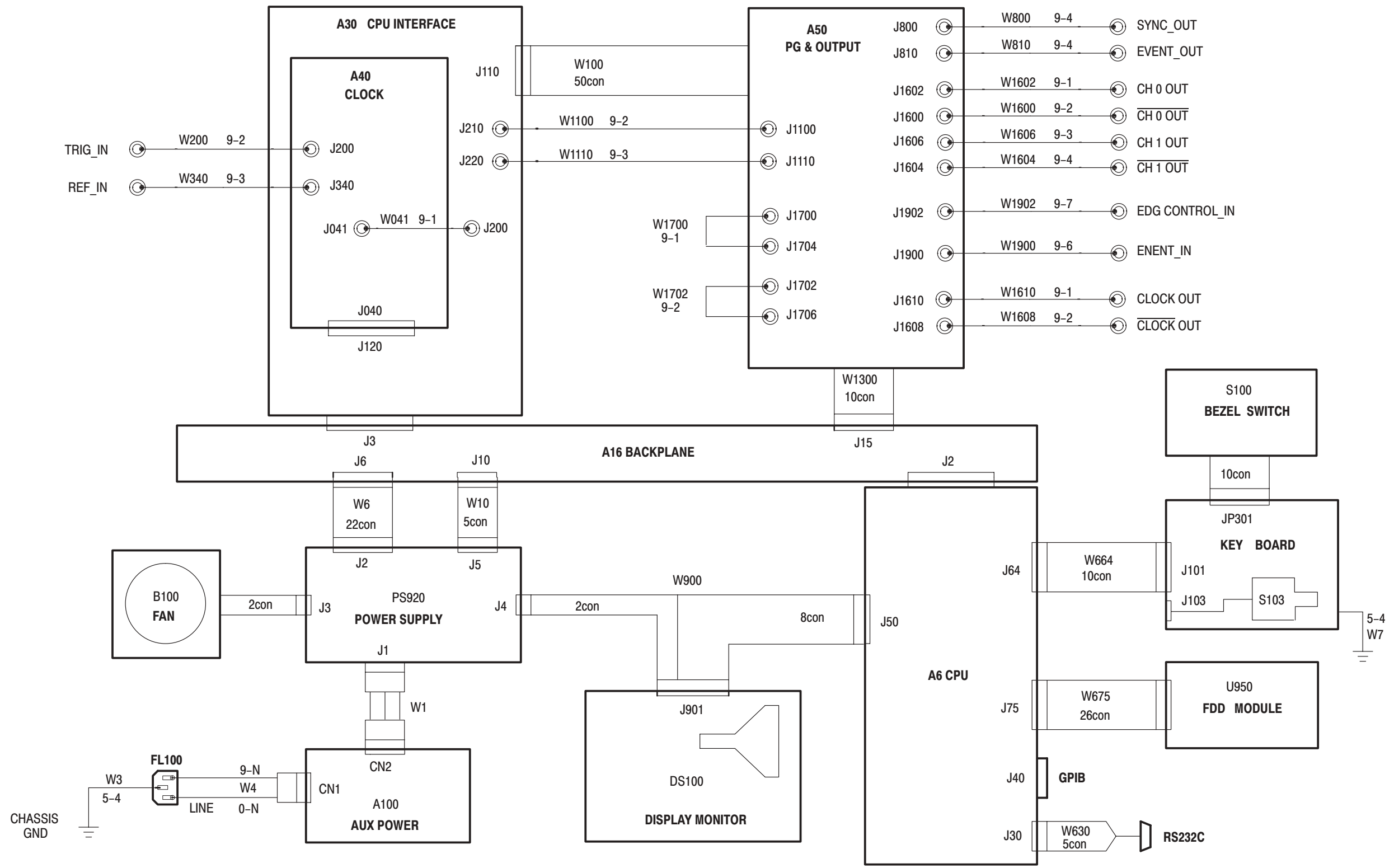


Figure 9-2: DG2040 interconnect diagram

Replaceable Mechanical Parts

This section contains a list of the replaceable modules for the DG2040 Data Generator. Use this list to identify and order replacement parts.

Parts Ordering Information

Replacement parts are available through your local Tektronix field office or representative.

Changes to Tektronix products are sometimes made to accommodate improved components as they become available and to give you the benefit of the latest improvements. Therefore, when ordering parts, it is important to include the following information in your order.

- Part number (see Part Number Revision Level below)
- 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 DG2040 Data 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 figure and index numbers to the exploded view illustrations that follow.
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.
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 table titled Manufacturers Cross Index shows 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
80009	TEKTRONIX, INC.	P.O. BOX 500	BEAVERTON, OR, 97077-0001
K1072	GREENPAR CONNECTORS LTD	PO BOX 15	HARLOW ESSEX, CM20 2ER UK
S3109	FELLER	72 VERONICA AVE UNIT 4	SUMMERSET NJ 08873
TK0BD	TAISHO ELECTRIC IND CO LTD	5-28-16 OKUSAWA SETAGAYA-KU	TOKYO JAPAN
TK0191	TEKTRONIX JAPAN	PO BOX 5209 TOKYO INTERNATIONAL	TOKYO JAPAN 100-31
TK0392	NORTHWEST FASTENER SALES INC	7923 SW CIRRRUS DRIVE	BEAVERTON OR 97005-6448
TK0435	LEWIS SCREW CO	4300 S RACINE AVE	CHICAGO IL 60609-3320
TK1163	POLYCAST INC	9898 SW TIGARD ST	TIGARD OR 97223
TK1572	RAN-ROB INC	631 85TH AVE	OAKLAND CA 94621-1254
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
78189	ILLINOIS TOOL WORKS INC SHAKEPROOF DIV	ST CHARLES ROAD	ELGIN IL 60120
86928	SEASTROM MFG CO INC	701 SONORA AVE	GLENDALE CA 91201-2431
060D9	UNITREK CORPORATION	3000 COLUMBIA HOUSE BLVD, SUITE 1 20	VANCOUVER, WA 98661
0GZV8	HUBER & SUHNER INC	19 THOMPSON DRIVE	ESSEX JUNCTION, VT 05452-3408

Manufacturers cross index (Cont.)

Mfr. code	Manufacturer	Address	City, state, zip code
24931	BERG ELECTRONICS INC	RF/COAXIAL DIV 2100 EARLYWOOD DR PO BOX 547	FRANKLIN, IN 46131
26805	M/A COM OMNI SPECTRA INC	MICROWAVE CONNECTOR DIV 140 4TH AVE	WALTHAM, MA 02254
60381	PRECISION INTERCONNECT CORP.	16640 SW 72ND AVE	PORTLAND, OR 97224
64537	KDI/TRIANGLE CORPORATION	60 S JEFFERSON RD	WHIPPANY, NJ 07981
80009	TEKTRONIX INC	14150 SW KARL BRAUN DR PO BOX 500	BEAVERTON, OR 97077-0001
91836	KINGS ELECTRONICS COMPANY INC	40 MARBLEDALE ROAD	TUCKAHOE, NY 10707-3420

Replaceable parts list

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description	Mfr. code	Mfr. part number
10-1-1	343-1213-00			1	CLAMP,PWR CORD:POLYIMIDE	TK1163	ORDER BY DESC
-2	161-0230-00			1	CABLE ASSY,PWR.:3,18 AWG,92 L,SVT,TAN (STANDARD ACCESSORY)	TK2432	ORDER BY DESC
-3	-----			1	S/N LABEL	80009	-----
-4	334-8705-XX			1	MARKER,IDENT:MKD WARNING/FUSE DATASAFETY CONTROLLED,POLYCARBONATE	TK0191	334-8705-XX
-5	334-9752-XX			1	MARKER,IDENT:BLANK,POLYCARBONATE	TK0191	334-9752-XX
-6	211-0691-00			4	SCREW,MACHINE:6-32 X 0.625,PNH,STL CD PL,TORX,T15	0KB01	ORDER BY DESC
-7	200-3991-01			1	COVER,REAR	TK1163	ORDER BY DESC
-8	-----			2	FOOT,REAR (ATTACHING PART OF 10-1-14)	TK0191	ORDER BY DESC
-9	390-1134-XX			1	CABINET:EMI ,AL	TK0191	390-1134-XX
-10	211-0378-00			4	SCR,ASSEM WSHR:4-40 X 0.375.PNH,STL,CD PL	0KB01	ORDER BY DESC
-11	200-3983-00			1	BEZEL:FDD,AL	80009	200-0378-00
-12	348-1276-00			35.5 cm	GASKET,SHIELD:CONDUCTIVE FORM STRIP	80009	348-1276-00
-13	367-0356-01			1	HANDLE,CARRING	0J9P9	367-0356-01
-14	348-0659-00			2	FOOT,CABINET:BLACK POLYURETHANE	0J9P9	ORDER BY DESCRIPTION
-15	260-2539-00			1	SWITCH SET:BEZEL	TK1918	2602539XX
-16	366-0753-XX			14	PUSH BUTTON:SMOKE TAN	TK0191	366-0753-XX
-17	354-0709-00			1	RING,TRIM:LEXAN 940	80009	354-0709-XX
-18	334-9744-XX			1	MARKER,IDENT:MKD DG2040	TK0191	334-9744-XX
-19	378-0404-00			1	FILTER,LT,CRT:BLUE SMOKE,112MM X 145MM	80009	378-0404-00
-20	348-1289-00			23 cm	SHLD GSKT,ELEC:MESH TYPE,3.2MM X 4.7MM,SI SPONGE CORE,100M ROOL [EMS-32-47-MSS]	80009	348-1289-XX
-21	212-0144-00			1	SCREW,TPG,TF:8-16 X 0.562 L,PLASTITE,SPCL HD	0KB01	ORDER BY DESC
-22	211-0722-00			1	SCREW,MACHINE:6-32 X 0.25,PNH,STL	0KB01	ORDER BY DESC
-23	348-1472-00			84 cm	SHLD GASKET,ELEC:CONDUCTIVE FORM STRIP, W/ADHESIVE TAPE. 1M L [UC-300281(WITH TAPE)]	80009	348-1472-XX

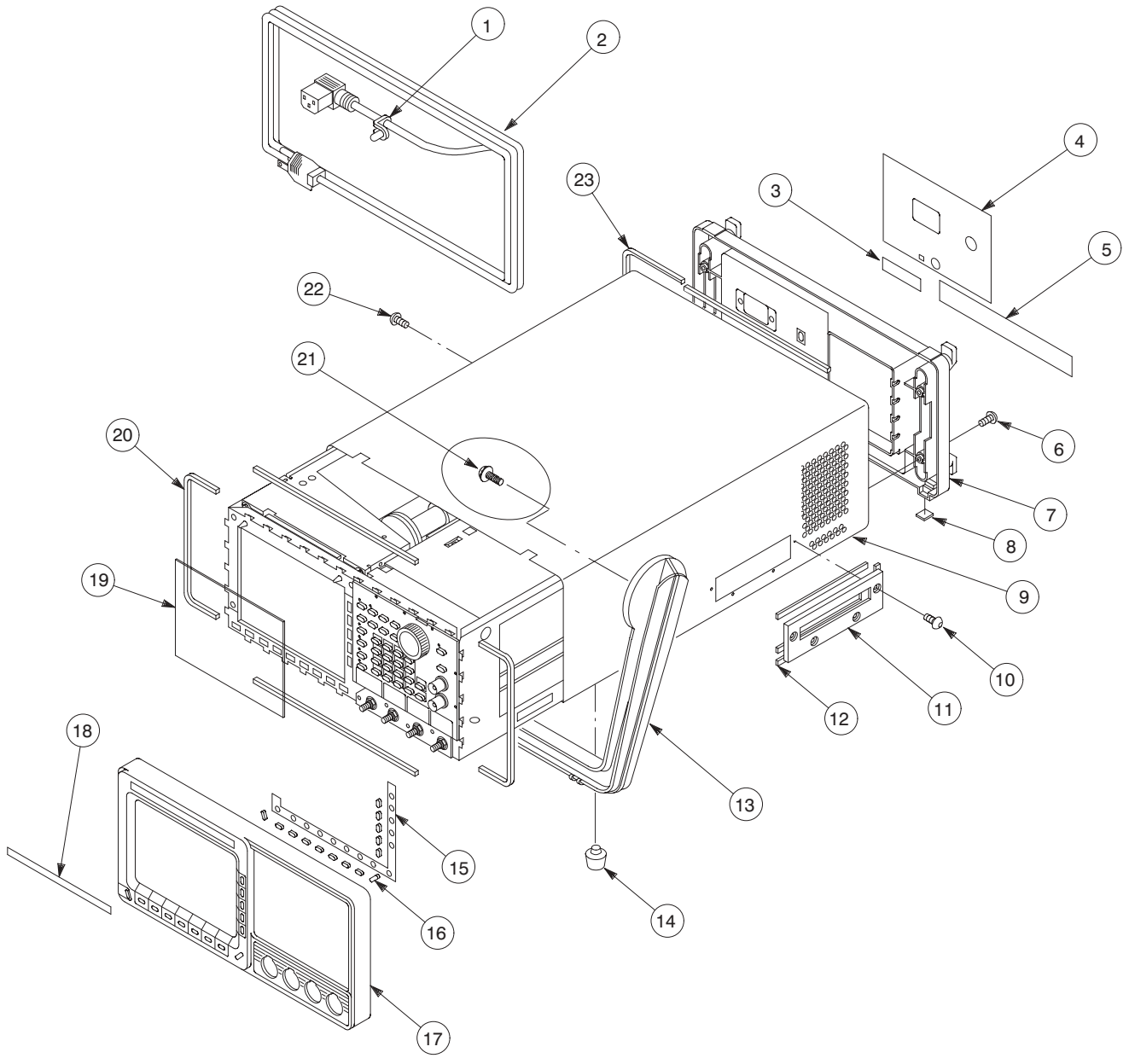


Figure 10-1: Cabinet

Replaceable parts list

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description	Mfr. code	Mfr. part number
10-2-1	213-0882-00			6	SCREW,TPG,TR:6-32 X 0.437 TAPTITE,PNH,STL	0KB01	ORDER BY DESC
-2	119-4322-00			1	FAN,TUBAXIAL:12VDC,2.4M/M,5.8MM HZO,6W,0.5A	80009	119-4322-00
-3	252-0571-33			1	PLASTIC SHEET:EXTR CHAN,5MM X 3.3MM	85471	ORDER BY DESC
-4	342-0993-00			1	INSULATOR,FILM:PWR SPLY,POLYCARBONATE	80009	342-0993-00
-5	211-0722-00			2	SCREW,MACHINE:6-32 X 0.25,PNH,STL	0KB01	ORDER BY DESC
-6	620-0058-XX			1	POWER SUPPLY:185W;SWITCHING,15V/4A,12V/0.5A	TK0191	620-0058-XX
-7	213-0882-00			4	SCREW,TPG,TR:6-32 X 0.437 TAPTITE,PNH,STL	0KB01	ORDER BY DESC
-8	366-1480-00			1	PUSH BUTTON:BLK,0.328 X 0.253 X 0.43	0JR05	ORDER BY DESC
-9	671-3351-XX			1	CIRCUIT BD ASSY:AUX,POWER SUPPLY	80009	671-3351-XX
-10	213-0882-00			2	SCREW,TPG,TR:6-32 X 0.437 TAPTITE,PNH,STL	0KB01	ORDER BY DESC
-11	119-2683-XX			1	FILTER,RFI:50/60HZ,250VAC,6A	TK2058	ZUB2206H-F
-12	426-2426-00			1	FRAME,FAN MTG:POLYCARBONATE	80009	426-2426-XX
-13	210-0457-00			1	NUT,PL,ASSEM WA:6-32 X 0.312,STL CD PL	TK0435	ORDER BY DESC
-14	334-3379-00			1	MARKER,GROUND:6MM DIAMETER	07416	ORDER BY DESC
-15	441-2055-XX			1	CHASSIS ASSY:AL	TK0191	441-2055-XX
-16	343-1182-00			1	CLAMP,LOOP:10MM ID,NYLON	80009	343-1182-00
-17	210-0586-00			2	NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL	TK0435	ORDER BY DESC
-18	344-0472-00			1	CLIP,CABLE:NYLON,GRAY	80009	344-0472-00
-19	407-4621-00			1	BRKT,CMPNT,BNC:ALUMINUM,5.250 X 1.050	TK0191	407-4621-XX
-20	-----			4	CONN,SMA,50 OHM,FEMALE(ATTACHING PART OF W1600)	80009	ORDER BY DESC
-21	211-0325-00			4	SCR,ASSEM WSHR:4-40 X 0.25,PNH,STL	0KB01	ORDER BY DESC
-22	259-0086-XX			1	FLEX CIRCUIT:BEZEL BUTTON	07416	ORDER BY DESC
-23	348-1313-00			10 cm	GASKET,SHIELD:CONDUCTIVE URETHANE FORM	80009	348-1313-00
-24	426-2436-01			1	FRAME,CRT FLTR:POLYCARBONATE	TK1163	ORDER BY DESC
-25	348-1302-00			11 cm	GASKET,SHIELD:CONDUCTIVE URETHANE FORM	80009	348-1302-XX
-26	640-0081-00			1	DISPLAY MONITOR:7 INCH,480 X 640 PIXEL,MONO	80009	640-0081-00
-27	333-4291-XX			3	PANEL,REAR:DATA OUT,AL	TK0191	333-4291-XX
-28	211-0722-00			5	SCREW,MACHINE:6-32 X 0.25,PNH,STL CD PL,TORX,T15	0KB01	ORDER BY DESC
-29	671-4540-XX			1	CKT BD ASSY:CPU,A6	TK0191	671-4540-XX
-30	386-6158-00			1	SUPPORT,CKT BD:MAT MATERIAL	80009	386-6158-00
-31	671-4539-XX			1	CKT BD ASSY:CPU INTERFACE,A30	TK0191	671-4539-XX
-32	671-4316-XX			1	CKT BD ASSY:CLOCK,A40	TK0191	671-4316-XX
-33	129-1505-00			4	SPACER,POST:10 MM L,M4 INT THRU,STL,ZN-C,7 MM HEX	TK0191	129-1505-XX
-34	211-1017-00			8	SCREW,MACHINE:M4 X 6 MM L,PNH,BRS NI PL CROSS REC	TK0191	211-1017-XX
-35	163-1146-XX			1	IC,MEMORY:CMOS,EPROM,256K X 16,100NS,PRGM,PLCC44,SMD,U305	TK0191	163-1146-XX
-36	163-1145-XX			1	IC,MEMORY:CMOS,EPROM,256K X 16,100NS,PRGM,PLCC44,SMD,U300	TK0191	163-1145-XX

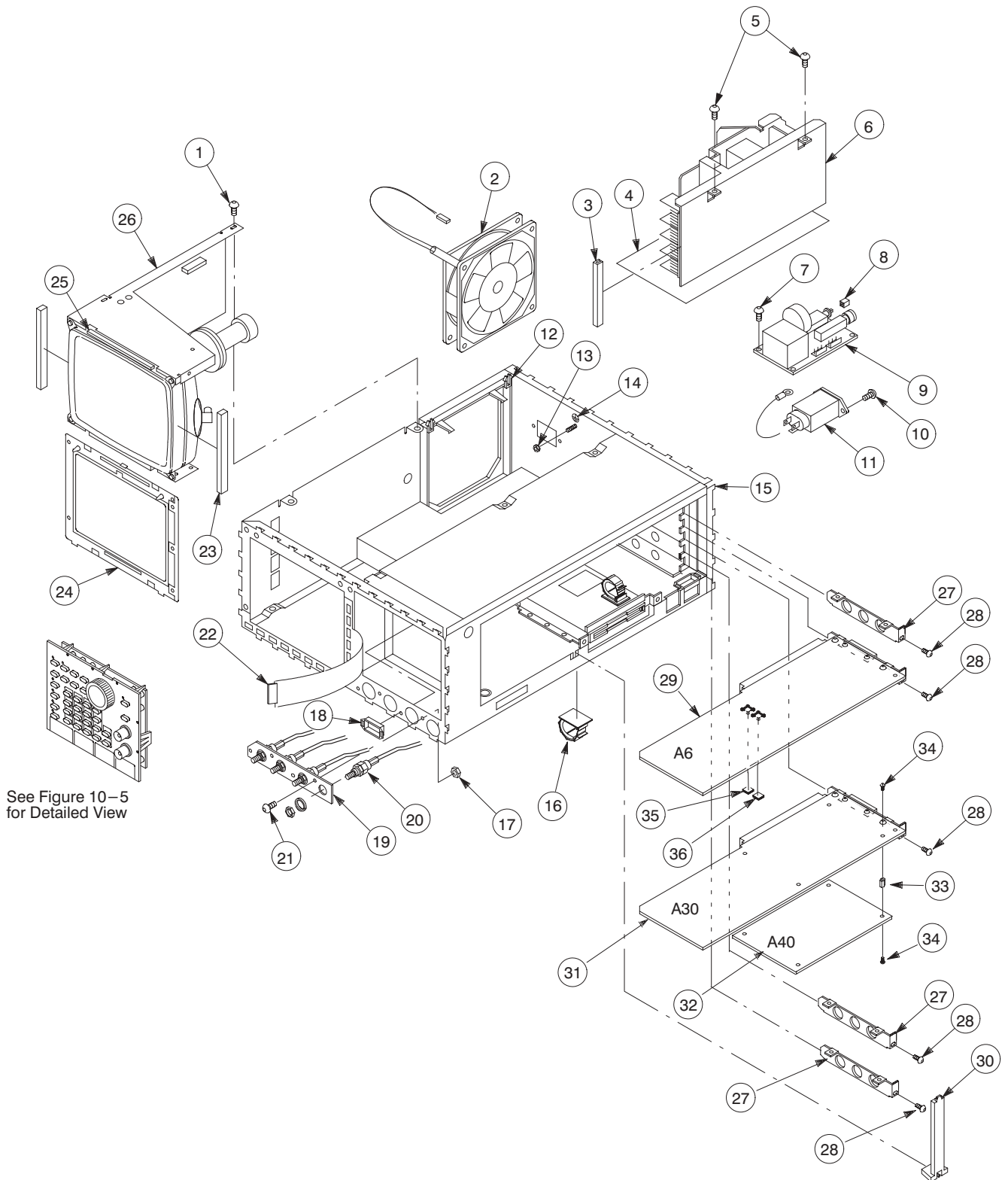


Figure 10-2: Main chassis and CRT

Replaceable parts list

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description	Mfr. code	Mfr. part number
10-3-1	-----			2	NUT(ATTACHING PART OF 10-3-7)		-----
-2	-----			2	WASHER,LOCK,HELICAL (ATTACHING PART OF 10-3-7)		-----
-3	-----			1	SEE W630		-----
-4	211-0378-00			10	SCR,ASSEM WSHR:4-40 X 0.375.PNH,STL,T9	0KB01	ORDER BY DESC
-5	-----			2	WASHER,PLAIN (ATTACHING PART OF 10-3-7)		-----
-6	129-1051-00			2	SPACER,POST:12.5 MM L,4-40 INT/4-40EXT,STL,4.8 MM HEX,W/NUT & LOCK WASHERS	80009	129-1051-00
-7	-----			1	SHIELD (ATTACHING PART OF W630)		
-8	129-1443-00			2	SPACER,POST:0.98 L,M3.5 INT & 6-32 EXT,STL,7MM HEX	80009	129-1443-00
-9	337-4177-00			1	SHIELD,ELEC:REAR,AL	TK0191	337-4177-00
-10	255-1106-00			6 cm	PLASTIC CHANNEL:1.3 X 3.3 X 4.0MM,NYLON	80009	255-1106-00
-11	255-0334-00			6 cm	PLASTIC CHANNEL:2.4 X 4.4 X 4.0MM,NYLON	11897	122-NN-2500-060A
-12	252-0571-33			3 cm	PLASTIC SHEET:EXTR CHAN,5MM X 3.3MM,NYLON	80009	252-0571-XX
-13	342-0302-00			1	INSULATOR,FILM:CHASSIS,MYLAR	80009	342-0302-00
-14	343-1612-00			3	CLAMP,CABLE:9-13MM ID,NYLON W/CUSSHION	TK0191	343-1612-00
-15	337-4088-02			1	SHIELD,ELEC:FDD,AL	TK0191	337-4088-XX
-16	407-4643-00			1	BRACKT, FDD	80009	407-4643-00
-17	348-1276-00			10 cm	GASKET,SHIELD:CONDUCTIVE FORM STRIP,3.3MM X 4.8MM,W/ADHESIVE TAPE, 1M L	80009	348-1276-00
-18	119-5953-00			1	DISK DRIVE:FLOPPY,3.5 INCH W/INTERFACE (U950)	TK0191	119-5953-XX
-19	105-1081-00			1	BRACKET,,SPACER	TK1163	105-1081-XX
-20	211-1032-00			1	SCREW,MACHINE:M2.6 X 8MM L,PNH,STL,MFZN-C,CROSS REC	TK0191	211-1032-XX
-21	211-1033-00			3	SCREW,MACHINE:M2.6 X 3MM L,PNH,STL,MFZN-C,CROSS REC	TK0191	211-1033-XX
-22	211-0373-00			6	SCREW,MACHINE:4-40 X 0.250,PNH,STL,T-10	0KB01	ORDER BY DESC
-23	343-1084-00			1	CLAMP,CABLE:NYLON	80009	343-1084-00
-24	348-0948-00			1	GROMMET,PLASTIC:BLACK,RING,9.5MM ID	80009	348-0948-00
-25	211-0722-00			4	SCREW,MACHINE:6-32 X 0.250,PNH,STL,T-15	0KB01	ORDER BY DESC
-26	671-3092-XX			1	CKT BD ASSY:A16 BACKPLANE (A16)	TK0191	671-3092-XX
-27	146-0055-XX			1	BATTERY,DRY:3.0V,1200 MAH,LITHIUM (A5BT001)	61058	BR-2/3A-E2P
-28	211-0722-00			2	SCREW,MACHINE:6-32 X 0.250,PNH,STL,T-15	0KB01	ORDER BY DESC
-29	337-4030-01			1	SHIELD,ELEC:CENTER,AL	80009	337-4030-01
-30	386-1657-00			1	SPACER,CKT BD	OJR05	ORDER BY DE- SCRIPTION
-31	211-0325-00			9	SRC,ASSEM WSHR:4-40 X 0.25,PNH,STL,TORX T9 MACHINE	0KB01	ORDER BY DESC
-32	671-4538-XX			1	CKT BD ASSY:A50 PG&OUTPUT	TK0191	671-4538-XX

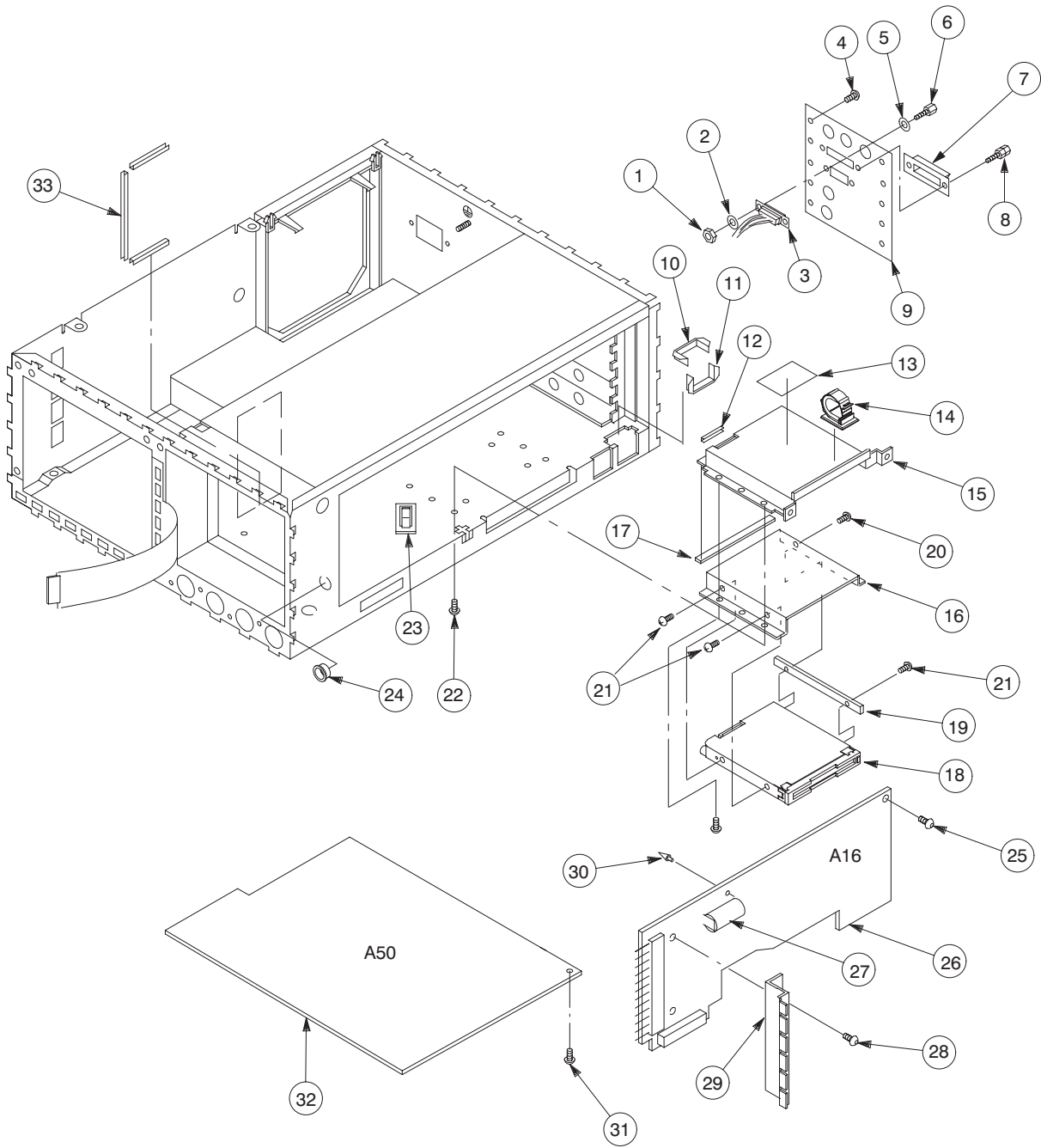


Figure 10-3: Main chassis and circuit boards

Replaceable parts list

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description	Mfr. code	Mfr. part number
10-4-1	671-3783-XX			1	CKT BD ASSY:KEYBOARD	80009	671-3783-XX
-2	213-0048-00			1	SETSCREW:4-40 X 0.125,STL	TK0392	ORDER BY DESC
-3	260-2497-XX			1	SWITCH,ROTARY:ENCODER,5VDC,70MA,INCREMENTAL	TK0191	260-2497-XX
-4	384-1686-00			1	EXTENSION SHAFT:0.790 L X 0.500 DIA,PLASTIC	80009	384-1686-XX
-5	348-1276-00			40 cm	GASKET,SHIELD:CONDUCTIVE FORM STRIP	80009	348-1276-XX
-6	131-1315-XX			2	CONN,RF JACK:BNC/PNL,,;50 OHM,FEMALE	24931	28JR306-1
-7	366-0768-00			1	KNOB:IVORY GRAY,SCROLL,1.243 IDX 1.4 OD	80009	366-0768-XX
-8	333-4284-00			1	PANEL,FRONT:MAIN KEY,POLYCARBONATE	TK0191	333-4284-XX
-9	380-1060-01			1	HOUSING,SWITCH:POLYCARBONATE	80009	380-1060-01
-10	260-2552-00			1	SWITCH,PUSH:50 BUTTON,SPST	80009	260-2552-00
-11	366-0769-00			30	PUSH BUTTON:IVORY GRAY,OVAL	80009	366-0769-00

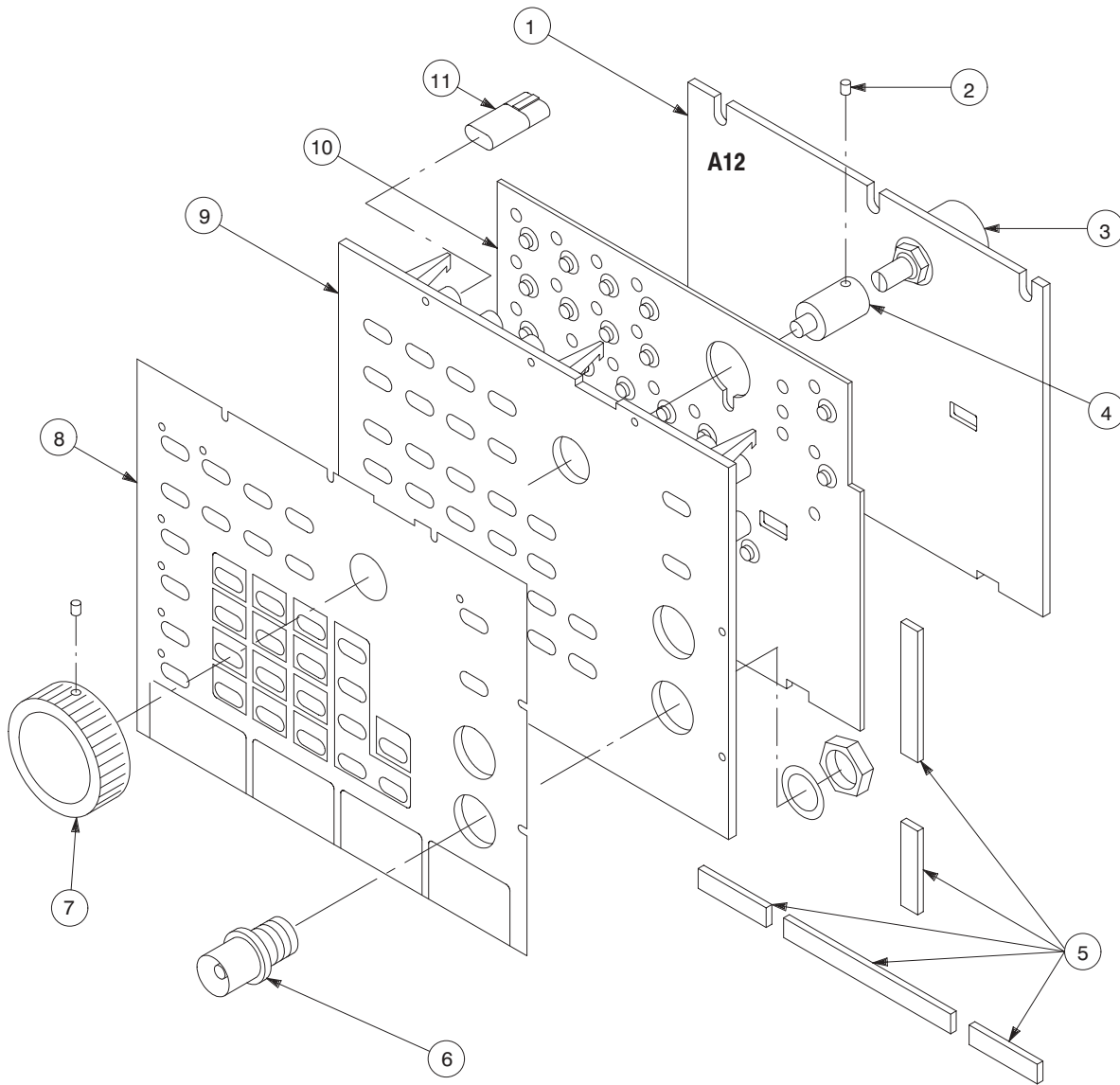


Figure 10-4: Front panel assembly

Replaceable parts list

Component number	Tektronix part number	Serial no. effective	Serial no. discontinued	Qty	Name & description	Mfr. code	Mfr. part number
CABLE ASSEMBLIES							
W1	174-2934-00				CA ASSY,SP,ELEC:3,18 AWG,16CM L	80009	174-2934-00
W3	196-3112-00				LEAD,ELECTRICAL:18 AWG,6.0 L,5-4	80009	196-3112-00
W4	174-2803-00				CA ASSY,SP,ELEC:2,18 AWG,12CM L,W/FSTN,TWISTED	80009	174-2803-00
W6	174-2971-00				CA ASSY,SP,ELEC:22,18 AWG,10CM L	80009	174-2971-00
	174-4035-00				CA ASSY,RF:CABLE SET	TK0191	174-4035-XX
W41	-----				CA ASSY,RF:CABLE SET (INCLUDED IN 174-4035-00)		
W1100	-----				CA ASSY,RF:CABLE SET (INCLUDED IN 174-4035-00)		
W1110	-----				CA ASSY,RF:CABLE SET (INCLUDED IN 174-4035-00)		
W1700	-----				CA ASSY,RF:CABLE SET (INCLUDED IN 174-4035-00)		
W1702	-----				CA ASSY,RF:CABLE SET (INCLUDED IN 174-4035-00)		
	174-4034-00				CA ASSY,RF:CABLE SET	TK0191	174-4034-XX
W340	-----				CA ASSY,RF:CABLE SET (INCLUDED IN 174-4034-00)		
W800	-----				CA ASSY,RF:CABLE SET (INCLUDED IN 174-4034-00)		
W810	-----				CA ASSY,RF:CABLE SET (INCLUDED IN 174-4034-00)		
W1608	-----				CA ASSY,RF:CABLE SET (INCLUDED IN 174-4034-00)		
W1610	-----				CA ASSY,RF:CABLE SET (INCLUDED IN 174-4034-00)		
W1900	-----				CA ASSY,RF:CABLE SET (INCLUDED IN 174-4034-00)		
W630	174-2933-00				CA ASSY,SP,ELEC:5,26 AWG,15CM L,RIBBON W/D-SUB	80009	174-2933-00
W664	174-2945-00				CA ASSY,SP,ELEC:10,26 AWG,25CM L,RIBBON	80009	174-2945-00
W675	174-2775-00				CA ASSY,SP,ELEC:26,COND,350MM L,FLAT FLEX	80009	174-2775-00
W900	174-2770-XX				CA ASSY,SP,ELEC:10,26 AWG,390MM L,RIBBON	80009	174-2770-00
	174-4033-00				CA ASSY,RF:CABLE SET	TK0191	174-4033-XX
W1600	-----				CA ASSY,RF:CABLE SET (INCLUDED IN 174-4033-00)		
W1602	-----				CA ASSY,RF:CABLE SET (INCLUDED IN 174-4033-00)		
W1604	-----				CA ASSY,RF:CABLE SET (INCLUDED IN 174-4033-00)		
W1606	-----				CA ASSY,RF:CABLE SET (INCLUDED IN 174-4033-00)		

Replaceable parts list (Cont.)

Component number	Tektronix part number	Serial no. effective	Serial no. discontinued	Qty	Name & description	Mfr. code	Mfr. part number
STANDARD ACCESSORIES							
	063-2920-XX			1	SOFTWARE PKG:TLA APPLICATION,3.5IN	TK0191	063-2920-XX
	063-3121-XX			1	SOFTWARE PKG:PERFORMANCE,3.5IN	TK0191	063-3121-XX
	063-3122-XX			1	SOFTWARE PKG:GPIB SAMPLE PROGRAM,3.5IN	TK0191	063-3122-XX
	071-0257-XX			1	MANUAL,TECH:USERS	TK0191	071-0257-XX
	071-0258-XX			1	MANUAL,TECH:PROGRAMMER	TK0191	071-0258-XX
	161-0230-01			1	CABLE ASSY,PWR,:3,18 AWG,92 L,SVT,TAN (SEE FIGURE 2-2)	2W733	ORDER BY DESCRIPTION
	161-0104-05			1	CABLE ASSY,PWR,:3,18 AWG,240V,98.0 L (OPTION A3-AUSTRALIAN)	S3109	SAA/3-OD3CCFC3X
	161-0104-06			1	CABLE ASSY,PWR,:3 X 0.75MM SQ,220V,98.0 L (OPTION A1-EUROPEAN)	S3109	VIIGSOPO-H05VVF
	161-0104-07			1	CABLE ASSY,PWR,:3,1.0MM SQ,240 VOLT,2.5 M (OPTION A2-UNITED KINGDOM)	S3109	ORDER BY DESC
	161-0104-08			1	CABLE ASSY,PWR,:3,18 AWG,98 L,SVT,GREY/BLK (OPTION A4-NORTH AMERICAN)	70903	ORDER BY DESC
	161-0167-00			1	CABLE ASSY,PWR,:3.0 X 0.75,6A,240V,2.5M L (OPTION A5-SWITZERLAND)	S3109	ORDER BY DESC
OPTIONAL ACCESSORIES							
	012-0057-XX			1	CABLE ASSY,RF:50 OHM COAX,43.0 L	80009	012-0057-00
	012-0991-00			1	CABLE,COMPOSITE:IDC,GPIB:2 METER	00779	553577-3
	012-1256-00			1	CABLE,INTCON:50 OHM COAX,98.0 L	TK0BD	7220369010
	012-1342-XX			1	CABLE ASSY,RF:50 OHM COAX,24.0 L	060D9	012-1342-XX
	015-0554-XX			1	FEMALE BNC TO MALE SMA	24931	29JP170-1
	015-0560-XX			1	CABLE ASSY,RF:50 OHM,2NS,W/CONN,SMA,MALE,EACH END	0GZV8	SF104PE,460MM,2X 11SMA-451
	015-0561-XX			1	CABLE ASSY,RF:50 OHM,4NS,W/CONN,SMA,MALE,EACH END	0GZV8	SF104PE,920MM,2X 11SMA-451
	015-0562-XX			1	CABLE ASSY,RF:50 OHM,1NS,W/CONN,SMA,MALE,EACH END	0GZV8	SF104PE,230MM,2X 11SMA-451
	015-0572-XX			1	SMA FEMALE TO BNC MALE	91836	879-4-15-MA9
	015-1014-XX			1	50 OHM,SMA	64537	D241S
	015-1016-XX			1	SMA MALE TO 2 SMA FEMALES	24931	29JP145-4
	015-1022-XX			1	50 OHM,0,5W,SMA	26805	2001-4401-00
	016-1159-00			1	POUCH:POUCH & PLATE,GPS SIZE	80009	016-1159-00
	020-1693-XX			1	SMA KIT	80009	020-1693-00
	040-1444-XX			1	RACKMOUNT KIT	TK0191	040-1444-XX
	071-0259-XX			1	MANUAL,TECH:SERVICE	TK0191	071-0259-XX
	159-0210-00			1	FUSE,CARTRIDGE:DIN 5 x 20MM,5A,250V,SLOW	61857	ET 5 AMP
	159-0239-00			1	FUSE,CARTRIDGE:3AG,6A,250V,MEDIUM	80009	159-0239-00

Replaceable parts list (Cont.)

Component number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description	Mfr. code	Mfr. part number
	174-1341-00			1	CABLE ASSY,RF:50 OHM COAX,39.37 L,8-NSAFETY CONTROLLED	60381	500-1117-00
	174-1428-XX			1	CABLE ASSY,RF:50 OHM COAX,60.0 LW/BLACK VINYL	060D9	174-1428-XX
	174-1427-XX			1	CABLE ASSY,RF:50 OHM COAX,20.0 LW/BLACK VINYL	060D9	174-1427-XX
	200-2264-00			1	CAP,FUSEHOLDER:3AG FUSE SAFETY CONTROLLED (FOR 159-0239-XX)	80009	200-2264-00
	200-2265-00			1	CAP,FUSEHOLDER:5 X 20MM,FUSE SAFETY CONTROLLED (FOR 159-0210-XX)	80009	200-2265-00
	200-3232-01			1	COVER,FRONT:ABS	TK1908	ORDER BY DESC