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Service Manual

Tektronix

DG2020A
Data Generator

071-0055-50

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.

Preface

This is the service manual for the DG2020A Data Generator. The manual contains information needed to service the DG2020A to the module level.

Manual Structure

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

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

- *Specifications* contains a description of the DG2020A and the characteristics that apply to it.
- *Operating Information* includes general information and operating instructions at the level needed to safely power on and service the DG2020A.
- *Theory of Operation* contains circuit descriptions that support general service to the module level.
- *Performance Verification* contains a collection of procedures for confirming that the DG2020A functions properly and meets warranted limits.
- *Adjustment Procedures* contains a statement explaining that adjustment is unnecessary for the DG2020A.
- *Maintenance* contains information and procedures for performing preventive and corrective maintenance of the DG2020A. These instructions include cleaning, module removal and installation, and fault isolation to the module.
- *Options* contains information on servicing any of the factory-installed options that your DG2020A includes.
- *Electrical Parts List* contains a statement referring you to *Mechanical Parts List*, where both electrical and mechanical modules are listed. See below.
- *Diagrams* contains block diagrams and an interconnection diagram useful in isolating failed modules.
- *Mechanical Parts List* includes a table of all replaceable modules, their descriptions, and their Tektronix part numbers.

Manual Conventions

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

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

- 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 DG2020A 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 DG2020A 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 DG2020A 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 DG2020A Data Generator includes:

- The DG2020A *User Manual* contains a tutorial to quickly describe how to operate the DG2020A. It also includes an in-depth discussion on how to more completely use DG2020A features.
- The DG2020A *Programmer Manual* explains how to control the DG2020A with a computer through the GPIB or RS-232-C interface.

Introduction

This manual contains information needed to properly service the DG2020A Data Generator, as well as general information critical to safe and effective servicing.

To prevent personal injury or damage to the DG2020A, 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 near the beginning of this manual
- Read *Preparation for Use* in section 2, *Operating Information*

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

Performance Check Interval

Generally, the performance check described in section 4, *Performance Verification*, should be done every 12 months. In addition, performance check is recommended after module replacement.

If the DG2020A does not meet performance criteria, repair is necessary.

Strategy for Servicing

Throughout this manual, the term, module, refers to any field-replaceable component, assembly, or part of the DG2020A.

This manual contains all the information needed for periodic maintenance of the DG2020A. (Examples of such information are procedures for checking performance.)

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

Tektronix Service Offerings

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

Whether providing warranty repair service or any of the other services listed below, Tektronix service technicians are well equipped to service the DG2020A. Tektronix technicians train on Tektronix products; they have access to the latest information on improvements to the DG2020A as well as the latest new options.

Warranty Repair Service

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

Self Service

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

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

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

Product Description

The DG2020A is a digital data generator designed for high performance and ease of use. The DG2020A is easy to use for testing and evaluating semiconductors and logic circuits, which are continually becoming faster and more complex.

The DG2020A provides, in a compact package, high performance and a wide range of functions. Features include a maximum data rate of 200 MHz, a 64K word pattern memory, 12 channels (with support for up to 36 channels by adding optional modules), a 100 ps timing skew adjustment function, and variable output levels (from –3 to +7V).

Any memory size from 64 words to 64K words can be used easily, with no restrictions within that range. TTL output level and variable output level pods can be selected as the data output pods. Both pod types support setting of their output stages to a high-impedance state. Each module supports delays in 4 of its 12 channels with a 100-ps-resolution variable delay time.

The DG2020A provides flexible data editing functions, including word and line unit input and extended data creation functions. Furthermore, the DG2020A provides a rich set of functions required for system construction, such as a sequencing function, a jump function using external input, and an inhibit function.

Features

- The DG2020A supports smooth and rapid product development by simulating the digital signals from incomplete sections of a product.
- Logic function test systems can be constructed by combining this instrument with a logic analyzer.
- Margin tests can be easily performed by using this instrument to generate patterns that have a low probability of occurrence or are difficult to generate. This can increase end-product reliability.
- Interactive digital simulation systems can be constructed using the sequence output, external jump, and tristate control functions.
- Flexible data output functions make the DG2020A an ideal data generator for simulation of LCD display units, CCD line and area sensors, and all types of digital circuits.

Performance Characteristics

The performance characteristics on the DG2020A can be divided into three categories:

- Nominal Traits. General characteristics are described not by equipment performance and limits but by such things as memory capacity.
- Warranted Characteristics. Warranted characteristics are described in terms of quantifiable performance limits which are guaranteed.
- Typical Characteristics. Typical characteristics are described in terms of typical or average performance for the DG2020A. The characteristics described herein are not absolutely guaranteed.

Items marked with ***** are tested in the *Performance Verification* (Section 4).

The certification and compliances for the DG2020A are also found at the end of this appendix.

Warranted Characteristics

This section will describe the warranted characteristics of the DG2020A. These can be divided into two main categories: electrical characteristics and environmental characteristics.

Performance Conditions

The electrical characteristics are valid under the following conditions:

1. The instrument must be in an environment whose limits are described in Environmental Characteristics.
2. All tolerance limits apply after a 20 minute warm up.
3. The instrument is operating at an ambient temperature between +10 °C to +40 °C, unless otherwise noted.

Items marked with ***** are tested in the Performance Verification (Appendix B)

Table 1-1: Warranted electrical characteristics

Characteristics	Description	Performance Test
Clock generator		
*Internal clock		Check internal clock frequency, page 4-6.
Frequency accuracy		
PLL on	±50 ppm (±0.005%)	
PLL off	±3%	
P3410 (TTL output pod)		
Data output		Check output voltage levels, page 4-19.
*Output voltage		
V_{OH}	> 4.4 V into 1 MΩ > 3.5 V at 10 mA	
V_{OL}	< 0.1 V into 1 MΩ < 0.8 V at 10 mA	
Rise / fall time	< 5 ns (20% to 80%, into 1 MΩ 10 pF)	
*Delay accuracy	±2.0 ns (CH0 reference)	Check variable delay, page 4-20.

Table 1-1: Warranted electrical characteristics (Cont.)

Characteristics	Description		Performance Test
P3420 (Variable output pod)			
Data output			Check output voltage levels, page 4-25.
*Output voltage accuracy	± 3% ± 0.1 V (into 1 MΩ)		
*Delay accuracy	± 3% ± 0.8 ns (CH0 reference)		Check variable delay, page 4-29.
Rise / fall time	< 4ns (20% to 80%, into 1 MΩ 10 pF, 0 to 5 V Swing)		
Auxiliary outputs			
Sync output			
Delay from external trigger input	(T_{d1} in Figure 1-1)		
	Clock Setting	Delay	
	Internal Clock, PLL ON, > 6.25 MHz	18 ns to 55 ns	
	Internal Clock, PLL ON, ≦ 6.25 MHz	30 ns to 70 ns	
	Internal Clock, PLL OFF, > 6.25 MHz	20 ns to 50 ns	
	Internal Clock, PLL OFF, ≦ 6.25 MHz	35 ns to 70 ns	
	External Clock	(15 ns + 0.5 clock) to (30 ns + 1.5 clock)	
Delay from external clock input	16 ns to 30 ns		
Clock output			
Level	V_{OH} > 0.8 V (typ. 1.0 V) V_{OL} < 0.2 V (typ. 0.0 V) (into 50 Ω)		
Delay from external trigger input	(T_{d2} in Figure 1-1)		
	Clock Setting	Delay	
	Internal Clock, PLL ON, > 6.25 MHz	15 ns to 40 ns	
	Internal Clock, PLL ON, ≦ 6.25 MHz	25 ns to 60 ns	
	Internal Clock, PLL OFF, > 6.25 MHz	15 ns to 45 ns	
	Internal Clock, PLL OFF, ≦ 6.25 MHz	25 ns to 60 ns	
	External Clock	(7 ns + 0.5 clock) to (20 ns + 1.5 clock)	
Delay from external clock input	8 ns to 15 ns		

Table 1-1: Warranted electrical characteristics (Cont.)

Characteristics	Description		Performance Test
Auxiliary inputs			
Trigger input			
Threshold			
Accuracy	± 5% ± 0.1 V		
Pulse width	> 5 ns (at 0.2 V amplitude)		
Sensitivity	> 0.2 V (at 1 MHz square wave)		
Maximum input	± 10 V (1 kΩ)		
	± 5 V (50 Ω)		
Delay to P3410 data output	(T_{d3} in Figure 1-1)		
	Clock Setting	Delay	
	Internal Clock, > 6.25 MHz	30 ns to 65 ns	
	Internal Clock, ≦ 6.25 MHz	45 ns to 80 ns	
	External Clock	(25 ns + 0.5 clock) to (45 ns + 1.5 clock)	
Delay to P3420 data output	(T_{d3} in Figure 1-1)		
	Clock Setting	Delay	
	Internal Clock, > 6.25 MHz	30 ns to 60 ns	
	Internal Clock, ≦ 6.25 MHz	40 ns to 70 ns	
	External Clock	(20 ns + 0.5 clock) to (40 ns + 1.5 clock)	
Trigger hold off	< 500 ns		
*External clock input			Check external clock input, page 4-8.
Threshold level	V_{IH} > 0.7 V, V_{IL} < 0.3 V		
Maximum input voltage	± 2 V		
Frequency	DC to 200 MHz		
Delay to P3410 data output	25 ns to 45 ns		
Delay to P3420 data output	20 ns to 40 ns		

Table 1-1: Warranted electrical characteristics (Cont.)

Characteristics	Description	Performance Test
AC line power		
Rating voltage	100 to 240 V AC	
Voltage range		
90 ∼ 250 V AC	48.0 to 63.0 Hz	
90 ∼ 127 V AC	48.0 to 440 Hz	
Maximum power	300 W	
Maximum current	4 A	

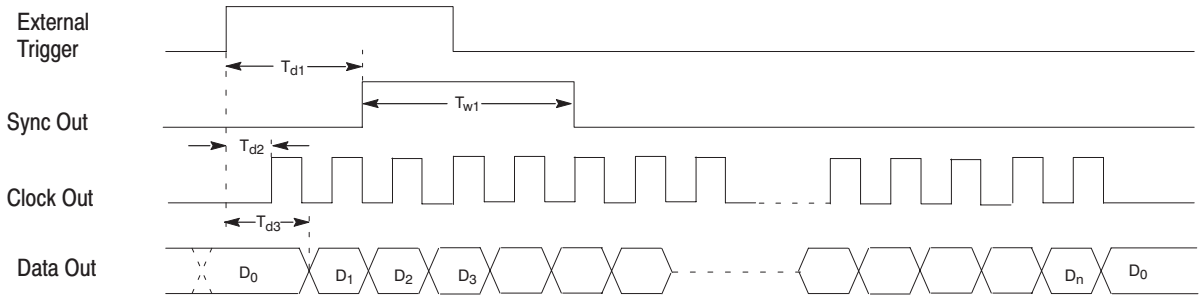


Figure 1-1: Trigger delay

Table 1-2: Warranted environmental characteristics

Characteristics	Description
Temperature	
Operating	+10 °C to +40 °C
Non operating	–20 °C to +60 °C
Relative humidity	
Operating	20% to 80% (No condensation) Maximum wet-bulb temperature 29.4 °C
Non operating	5% to 90% (No condensation) Maximum wet-bulb temperature 40.0 °C
Altitude	
Operating	To 4.5 km (15,000 feet). Maximum operating temperature decreases 1 °C each 300 m above 1.5 km.
Non operating	To 15 km (50,000 feet).
Dynamics	
Vibration	
Operating	0.33 mm_{p-p}, 10 to 55 Hz, 15 minutes
Shock	
Non operating	294 m/s^2 (30 G), half-sine, 11 ms duration.
Installation requirements	
Power consumption (Fully loaded)	300 watts max. Maximum line current is 4 A rms at 50 Hz, 90 V line.
Surge current	30 A peak for < 5 line cycles, after product has been off for at least 30 s.
Cooling clearance	
Top clearance	1 inch
Side clearance	6 inches
Rear clearance	3 inches

Typical Characteristics

This section will describe the typical characteristics for the DG2020A. These values represent typical or average performance and are not absolutely guaranteed.

Table 1-3: Electrical characteristics (typical)

Characteristics	Description
Clock generator	
Internal clock	
Period jitter	Measured by TDS694C–1MHD with TDSJIT1 Refer to Table 1-4.
Cycle to cycle jitter	Measured by TDS694C–1MHD with TDSJIT1 Refer to Table 1-5.
P3410 (TTL output pod)	
Data output	
Over / under shoot	< 0.5 V (into 1 MΩ 10 pF)
Rise / fall time	2 ns (20% to 80%, into 1 MΩ 10 pF)
Channel skew	< 3 ns (CH0 and other channels, same pod) < 2 ns (CH0 and CH0, two pods of same type)
Internal inhibit delay	–5 ns
Inhibit input	
Delay to data output	18 ns
P3420 (Variable output pod)	
Data output	
Output current	Total output current < 500 mA < –30 mA (Sink) > +30 mA (Source)
Over / under shoot	< ±(5% of Swing) ± 0.1 V (into 1 MΩ 10 pF)
Rise / fall time	2 ns (20% to 80%, into 1 MΩ 10 pF, 0 to 5 V swing)
Channel skew	< 3 ns (CH0 and other channels, same pod) < 2 ns (CH0 and CH0, two pods of same type)
Internal inhibit delay	–2 ns
Inhibit input	
Delay to data output	16 ns

Table 1-3: Electrical characteristics (typical) (Cont.)

Characteristics	Description
P3420 (Variable output pod)	
Period jitter	Measured by TDS694C–1MHD with TDSJIT1 Refer to Table 1-4.
Cycle to cycle jitter	Measured by TDS694C–1MHD with TDSJIT1 Refer to Table 1-5.
Auxiliary outputs	
Sync output	
Duration	6 clocks (T_{w1} in Figure 1-1)
Clock output	
Delay to data output	24 ns (P3410) 20 ns (P3420)
Auxiliary inputs	
External clock input	
Delay to P3410 data output	36 ns
Delay to P3420 data output	33 ns

Table 1-4: Period JItter

Clock frequency	200 MHz (When PLL to On.)		100 MHz (When PLL to On.)	
Measurement	StdDev	Pk–Pk	StdDev	Pk–Pk
Clock output	13.0 ps	70.0 ps	10.0 ps	60.0 ps
Data output (CH0 output)	6.0 ps	35.0 ps	5.5 ps	34.0 ps

Table 1-5: Cycle to Cycle JItter

Clock frequency	200 MHz (When PLL to On.)		100 MHz (When PLL to On.)	
Measurement	StdDev	Pk–Pk	StdDev	Pk–Pk
Clock output	20.0 ps	115.0 ps	17.0 ps	110.0 ps
Data output (CH0 output)	9.0 ps	52.0 ps	8.5 ps	50.0 ps

Nominal Traits

This section describes general characteristics of the DG2020A. These can be divided into two main categories: electrical characteristics and mechanical characteristics.

Table 1-6: Nominal traits – electrical characteristics

Characteristics	Description
Output pattern	
Pattern length	64 word to 64 K word (non sequenced operation)
	64 word to unlimited (sequenced operation)
Number of channels	Up to 12, 24 (Option 01), 36 (Option 02)
Memory capacity	
Pattern memory	64 K word × 12 bits
	64 K word × 24 bits (Option 01)
	64 K word × 36 bits (Option 02)
Sequence memory	2048 steps
	***NOTE**: More than 2,048 lines can be input in the Sequence table. However, only first 2,048 steps expanded in the sequence memory are effective when executed.*
NV RAM	0.5 M bytes
Clock generator	
Internal clock	
Frequency	0.1 Hz to 200 MHz
Resolution	4 digits
Reference oscillator	
Frequency	10 MHz
P3410 (TTL output pod)	
Data output	
Impedance	50 Ω
Delay channel	CH8, CH9, CH10 and CH11
Delay time	0 to 20 ns
Delay resolution	0.1 ns
Event input	
Level	TTL
Impedance	1 kΩ
Setup time to next block	47 clock to 54 clock

Table 1-6: Nominal traits – electrical characteristics (Cont.)

Characteristics	Description
P3410 (TTL output pod)	
Inhibit input	
Level	TTL
Impedance	1 kΩ
P3420 (Variable output pod)	
Data output	
Output impedance	50 Ω
Output voltage	
V_{OH}	–2.0 V to +7.0 V into 1 MΩ
V_{OL}	–3.0 V to +6.0 V into 1 MΩ
Resolution	0.1 V
Maximum swing	9.0 V_{p-p}
Minimum swing	0.5 V_{p-p}
Delay channel	CH8, CH9, CH10 and CH11
Delay time	0 to 20 ns
Delay resolution	0.1 ns
Event input	
Threshold	
Level	–5.0 V to +5.0 V
Resolution	0.1 V
Impedance	1 kΩ
Setup time to next block	47 clock to 54 clock
Inhibit input	
Threshold	
Level	–5.0 V to +5.0 V
Resolution	0.1 V
Impedance	1 kΩ

Table 1-6: Nominal traits – electrical characteristics (Cont.)

Characteristics	Description	
Auxiliary outputs		
SYNC output		
Level	Positive TTL pulse	
	2.4 V < V_{OH} < 5.0 V (into 1 MΩ)	
	0 V < V_{OL} < 0.5 V (into 1 MΩ)	
Output resistance	50 Ω	
Connector	BNC (at front panel)	
EVENT output		
Level	Positive TTL pulse	
	2.4 V < V_{OH} < 5.0 V (into 1 MΩ)	
	0 V < V_{OL} < 0.5 V (into 1 MΩ)	
Delay time	22 clocks before Data Output change	
Duration	8 clocks	
Output resistance	50 Ω	
Connector	BNC (at front panel)	
CLOCK output		
Output resistance	50 Ω	
Connector	SMB (at rear panel)	
Auxiliary inputs		
TRIGGER input		
Threshold		
Level	–5.0 V to +5.0 V	
Resolution	0.1 V	
Impedance	1 kΩ or 50 Ω (selectable)	
Connector	BNC (at front panel)	
Data output delay uncertainty	Clock Setting	Delay Uncertainty
	Internal Clock, PLL:ON	5 ns to 10 ns
	Internal Clock, PLL:OFF	None
	External Clock	1 clock period
External clock input		
Impedance	50 Ω, terminated to +0.5 V	
Connector	SMB (at rear panel)	

Table 1-6: Nominal traits – electrical characteristics (Cont.)

Characteristics	Description
Display	
Display area	5.2 inches (width) × 3.9 inches (height)
Resolution	640 (H) × 480 (V) pixels
Power source	
AC line power	
Fuse Rating	6A FAST, 250 V, UL 198G (3AG)
	5A (T), 250 V, IEC 127
Battery	
Type	Li3 V, 650 mAH

Table 1-7: Nominal traits – mechanical characteristics

Characteristics	Description
DG2020A	
Net weight	
Standard	9.7 kg
Dimensions	
Height	6.4 inches including feet
Width	14.3 inches including handle
Length	19.25 inches including front cover
	22.2 inches with handle extended
P3410 (TTL output pod)	
Net weight	0.5 kg (excluding cables)
Dimensions	
Height	2.0 inches including feet
Width	5.9 inches
Length	4.0 inches
P3420 (Variable output pod)	
Net weight	1.0 kg (excluding cables)
Dimensions	
Height	2.0 inches including feet
Width	10.0 inches
Length	6.3 inches
Pod cable	
Length	1.2 m

Certification and Compliances

The certification and compliances for the DG2020A are listed in Table 1-8.

Table 1-8: Certifications and compliances

Category	Standards or description
EC Declaration of Conformity – EMC	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: EMC Directive 89/336/EEC: EN 55011 — Class A Radiated and Conducted Emissions EN 50081-1 Emissions: EN61000-3-2 — AC Power Line Harmonic Emissions EN 50082-1 Immunity: EN61000-4-2 — Electrostatic Discharge Immunity EN61000-4-3 — RF Electromagnetic Field Immunity EN61000-4-4 — Electrical Fast Transient/Burst Immunity EN61000-4-6 — Conducted Disturbance Induced by Radio–frequency Field EN61000-4-8 — Power Frequency Electromagnetic Field Immunity EN61000-4-11 — Voltage Dips and Interruptions Immunity
Australian/New Zealand declaration of Conformity - EMC	Complies with EMC provision of Radio–communications Act per the following standard: AS/NZS 2064.1/2 — Industrial, Scientific, and Medical Equipment: 1992
EC Declaration of Conformity – Low Voltage	Compliance was demonstrated to the following specification as listed in the Official Journal of the European Communities: Low Voltage Directive 73/23/EEC, amended by 93/68/EEC EN 61010-1/A1:1992 — Safety requirements for electrical equipment for measurement, control and laboratory use.
Approvals	Complies with the following safety standards: UL3111–1 [1], First Edition — Standard for electrical measuring and test equipment. CAN/CSA C22.2 No.1010.1-92 [1] — Safety requirements for electrical equipment for measurement, control and laboratory use.
Installation Category Description	Terminals on this product may have different installation (over–voltage) category designations. The installation categories are: 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.

Table 1-8: Certifications and compliances (cont.)

Category	Standards or description
Pollution Degree	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. 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	Safety Certifications/Compliances are made for the following conditions: Altitude (maximum operation): 2000 meters
IEC Characteristics	Equipment type: 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)

1 CSA-C22.2 No.1010.1, UL3111-1, IEC61010-1 Safety Certification Compliance:
Altitude (maximum operating): 2000 meters

Preparation for Use

This section describes how to prepare the DG2020A Data Generator for use. The information describes these items:

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

Supplying Power

Before installing the DG2020A, note these precautions:



WARNING. *To avoid equipment failure and potential fire or personal shock hazards, do not exceed the maximum rated operating voltage of 250 V between the voltage-to-ground (earth) and either pole of the power source. The DG2020A 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 DG2020A has a suitable two-pole, three-terminal grounding-type plug.*

To avoid personal shock hazard, do not contact conductive parts. All accessible conductive parts are directly connected through the grounding conductor of the power cord to the grounded (earthing) contact of the power plug. The DG2020A is safety Class 1 equipment (IEC designation).

To avoid personal shock hazard, do not defeat the grounding connection. Insert the power input plug only in a mating receptacle with a grounding contact where earth ground has been verified by a qualified service person. Also, for electrical shock protection, make the grounding connection before making connection to the DG2020A input or output terminals.

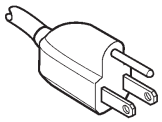
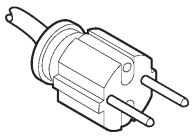
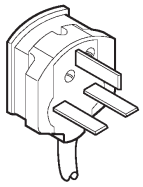
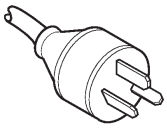
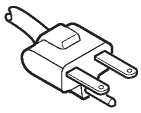
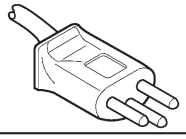
Power Cord Information

The DG2020A ships with the required power cord as ordered by the customer. Table 2-1 gives the color-coding of the conductors in the power cord. 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 DG2020A operation and long life, note the following environmental requirements.

Operating Temperature

The DG2020A operates in an environment with an ambient air temperature between +10° C and +40° C. The DG2020A storage temperature ranges from –20° C to +60° C. After storage at temperatures outside the operating limits, allow the DG2020A chassis to stabilize at a safe operating temperature before applying power.

Ventilation Requirements

Air drawn in and exhausted through the cabinet side and bottom panels cools DG2020A internal circuits. To ensure proper cooling, allow the following clearances:

Top	2.5 cm (1 in.)
Back	7.5 cm (3 in.)
Left and right	15 cm (6 in.)

The feet on the bottom of the DG2020A cabinet provide the required clearance when it is set on a flat surface. The top of the DG2020A does not require ventilation clearance.



CAUTION. *To prevent temporary shutdown of the DG2020A, do not restrict air flow through the chassis. If the DG2020A shuts down unexpectedly, improve ventilation around the DG2020A and wait a few minutes to allow it to cool down; then switch the power on again.*

Rear Panel Controls

Section 1, *Specifications*, lists the line voltage and frequency ranges over which the DG2020A operates.

Figure 2-1 shows the rear panel controls for the DG2020A.

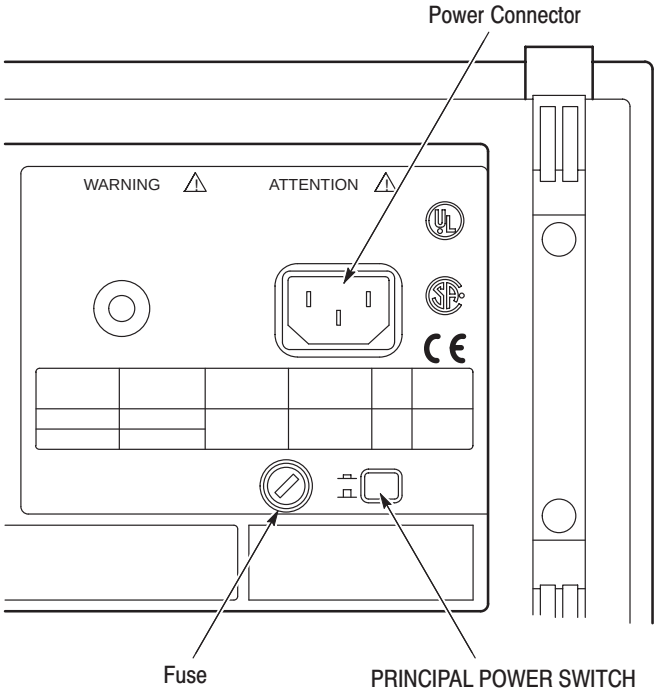


Figure 2-1: Rear panel controls

Fuse Type and Rating

The DG2020A 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.

Table 2-3: Fuse type and rating

Power cord option	Fuse	Fuse part number	Fuse cap part number
Standard, Option A4	0.25 inch × 1.25 inch (UL 198G,3AG):6A FAST,250V	159-0239-00	200-2264-00
Option A1, A2, A3, A5	5 mm × 20 mm (IEC 127): 5A(T),250V	159-0210-00	200-2265-00



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

To check the fuse, remove the fuse holder on the rear panel. Refer to Figure 2-1 for the location of the fuse holder. To remove the fuse holder, turn it counter-clockwise with a screwdriver while pushing it in. Then remove the fuse from the fuse holder.

Applying and Interrupting Power

Consider the following information when you power on or power off the DG2020A, or when external power loss occurs.



CAUTION. *When connecting the DG2020A to a pod with a pod connection cable, turn off the DG2020A power before connecting the cable. Connecting the cable with the power in the on state can damage the DG2020A and the pod.*

Power-on Cycle

At power-on, the start-up diagnostics check the DG2020A operation. If all diagnostic items complete without error, the DG2020A displays the **EDIT** menu.

If the diagnostics detect an error, the DG2020A displays the error code. To exit the diagnostics menu, press any key; then the system displays the **EDIT** menu. See section 6, *Maintenance*, for information on diagnostics and fault isolation.

NOTE*. If the ambient temperature goes outside the specified operating temperature range, an error occurs during the diagnostics at power-on. If this happens, power off the DG2020A and wait until the chassis temperature is appropriate; then switch the power on again.*

Power-off Cycle

Wait for the DG2020A to finish the operation when saving data files. Improper power-off or unexpected loss of power to the DG2020A can result in the corruption of data stored in nonvolatile memory.

Memory Backup Power

A lithium battery maintains internal nonvolatile memory, allowing the DG2020A 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 DG2020A battery with a lithium battery having the part number listed in section 10,* Mechanical Parts List*. This battery is a safety-controlled part.*

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

Repackaging Instructions

Use a corrugated cardboard shipping carton having a test strength of at least 275 pounds and with an inside dimension at least six inches greater than the DG2020A dimensions. (If available, use the original shipping carton, which meets these requirements.)

If the DG2020A is shipped to a Tektronix Service Center, enclose the following information:

- The owner's address
- Name and phone number of a contact person
- Type and serial number of the DG2020A
- Reason for returning
- A complete description of the service required

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

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

Installed Options

Your DG2020A may include one or more options. To determine which options are installed, look at the instrument option configuration listed on the rear panel.

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

Operating Instructions

Before servicing the DG2020A, read the following operating instructions. These instructions are at the level appropriate for servicing the DG2020A. The user manual contains complete operator instructions.

In addition, Section 4, *Performance Verification*, includes instructions for making the front-panel settings required to check DG2020A characteristics.

How to Make Connection to Pods

Connect the DG2020A connector to the pod using a pod connection cable as shown in Figure 2-2 while paying attention to following points:

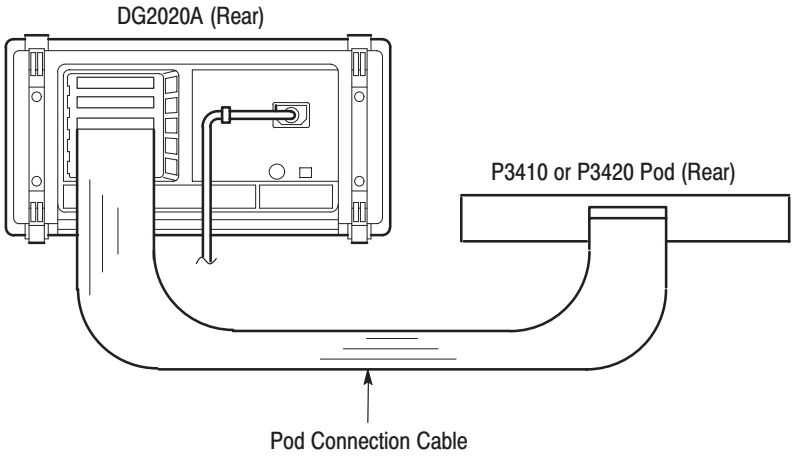


Figure 2-2: Pod connection

Note that the connectors on the DG2020A rear panel are installed with the tab slot down, and the connector on the pod rear panel is installed with the tab slot up (see Figure 2-3).

To connect a cable between the DG2020A and a pod, align the yellow wire end of the cable connector with the triangular yellow index mark on the DG2020A or pod connector. Doing this also correctly aligns the connector alignment tab. See Figure 2-3. Then carefully but firmly insert the cable connector into the DG2020A or pod connector.

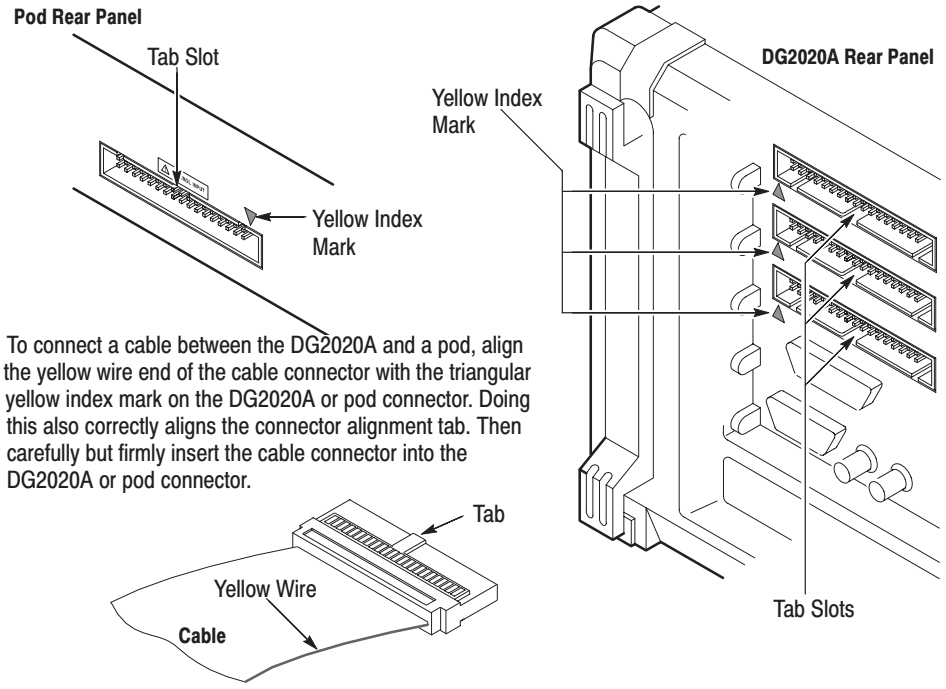


Figure 2-3: Yellow index mark and yellow wire for cable connection

CAUTION. *Turn off the instrument before connecting it to the pod. Connecting the instrument to the pod with the power on could damage the instrument itself and the pod. When attaching the pod cable, ensure that the plug and socket are aligned correctly.*

Make sure that you have correctly inserted the cable plug in the DG2020A and the pod before turning on power. The yellow wire end of the connector must be aligned with the triangular yellow index mark on the DG2020A or pod. Incorrectly connected cables will damage the DG2020A and the pod.

The cable and the pod are coupled very tightly. Hold the connector housing to avoid stress applied to the cable when attaching or removing the cable.

Electrostatic discharge can permanently damage the delicate ICs used in the pod. Do not touch connector pins with bare hands, and do not bring conductive materials, other than the DG2020A connection cable, close to the pod.

How to Power On

To power-on the DG2020A, follow these steps:

1. Set the **PRINCIPAL POWER SWITCH** (on the back of the DG2020A) to the ON position. This switch is the main power switch; it routes power to the standby circuit in the DG2020A.
2. Then, press the **ON/STBY** (standby) switch on the front (lower-left corner) of the DG2020A. This switch applies power to the remaining circuits of the DG2020A. Allow at least 20 minutes for the DG2020A 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 DG2020A 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 DG2020A performs internal start-up diagnostics. These diagnostics check 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 DG2020A 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 DG2020A output, advance the pattern data, generate an event pulse, and make a hard copy. On-screen graphics show various aspects of the current DG2020A configuration.

On-screen menus set most DG2020A functions. Main menus provide access to lower-level nested submenus. Buttons in the center of the front panel select the main menus.

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

Display

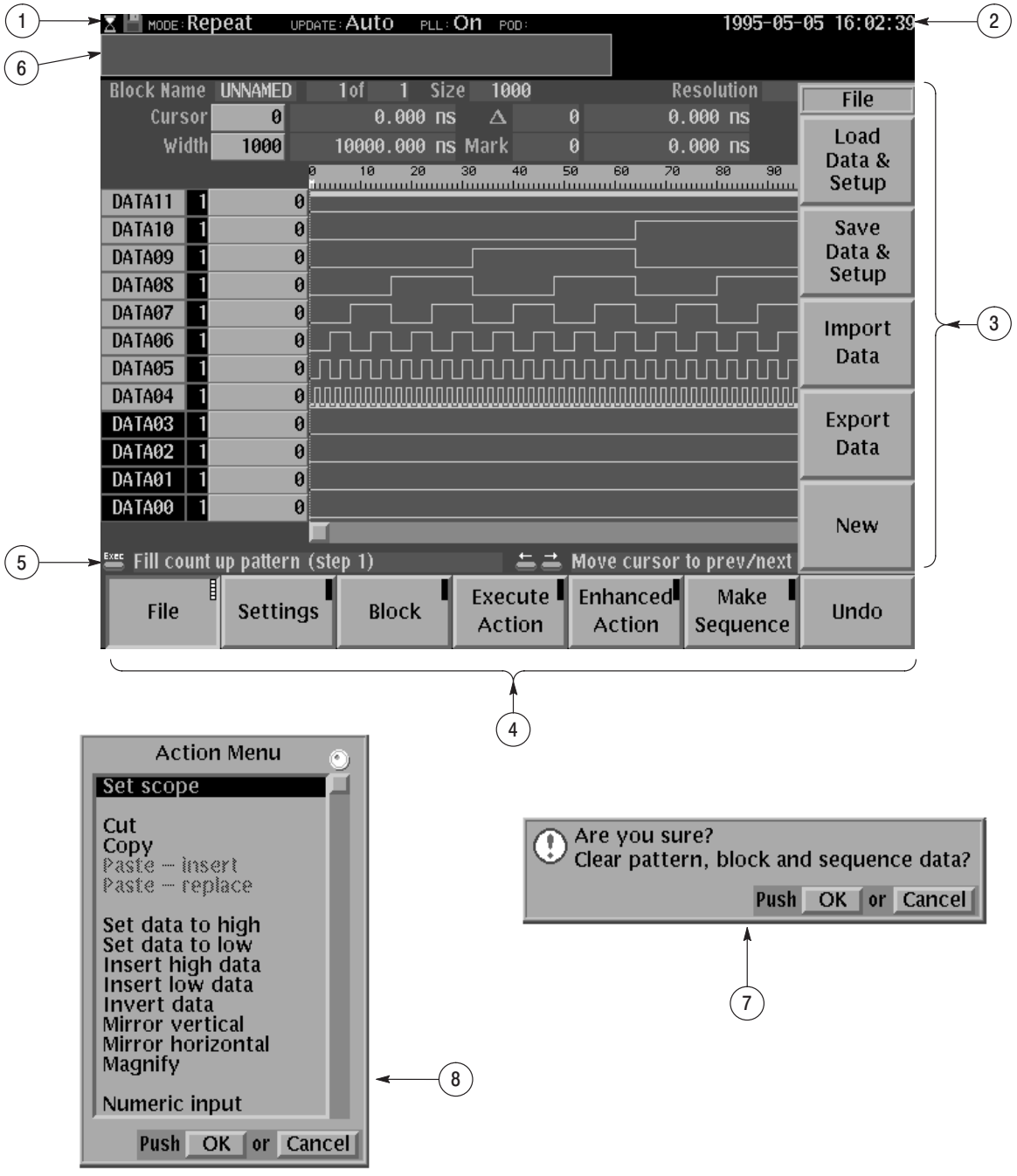


Figure 2-4: CRT display

Table 2-4: DG2030 display elements

Figure number	Label	Description page
1	Status area	Displays the current status of the instrument. This status line is always displayed, whichever menu is displayed. The status line displays the following four items. MODE: Displays the run mode in which pattern data will be output. UPDATE: Displays the update method for pattern data output when data is updated. PLL: Displays whether or not the PLL circuit is used as the internal oscillator circuit. POD: Displays the configuration of pods attached to the instrument. 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.
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	Popup 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	Popup 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 DG2020A operation is primarily controlled by means of menus that correspond to the **SETUP**, **EDIT**, **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 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 pod voltages, the operating mode, and triggers.

- **APPLICATION Menu**

  Although the current version of the firmware does not provide any functions under the **APPLICATION** menu, Tektronix plans to provide functions that support various application areas under this menu in future upgrades to the firmware.

- **UTILITY Menu**

  This menu provides functions for manipulating the basic instrument settings.

Pattern Storage and I/O

The DG2020A has internal nonvolatile memory (NVRAM) for pattern file storage. The DG2020A generates patterns from file residing in internal nonvolatile memory.

The DG2020A also has a floppy-disk drive for loading files from floppy disk into internal nonvolatile memory, and for saving files from memory to 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 DG2020A floppy disk drive.
2. Push the **EDIT** button in the MENU column.
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.

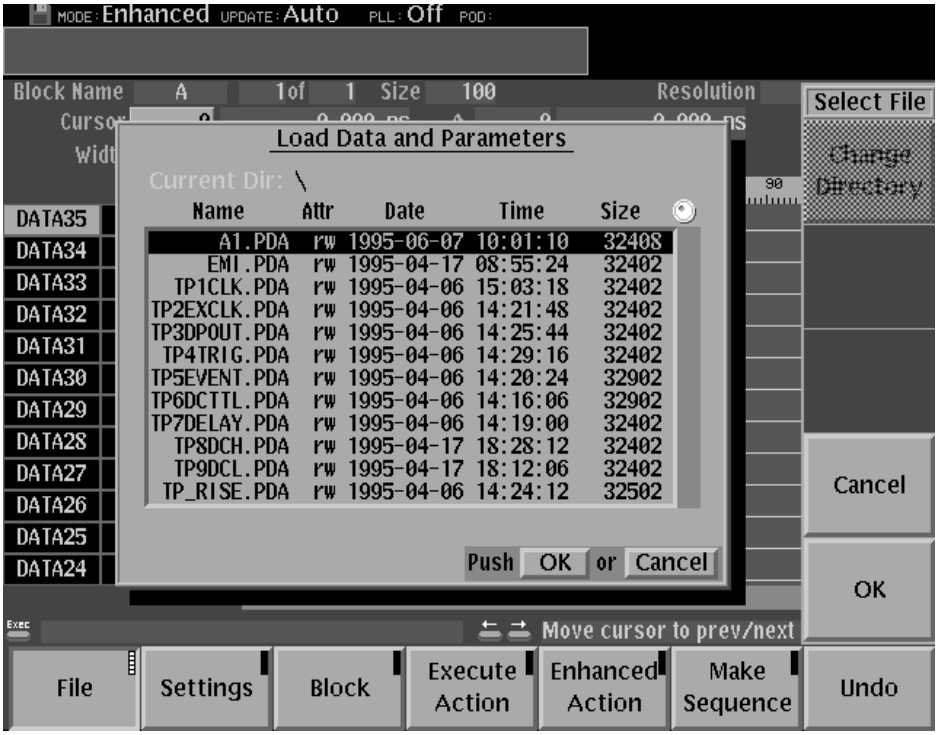


Figure 2-5: Load data & setup menu

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 pod pins. Next, this procedure sets all the settings required for signal output and actually outputs the signals.

- Tables such as the one below show in the operating procedure. Execute the action in left end of the top row first. Then execute actions from left to right along the row. When one row has been completed, move to the left end of the next row down, and repeat. 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	Popup 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	

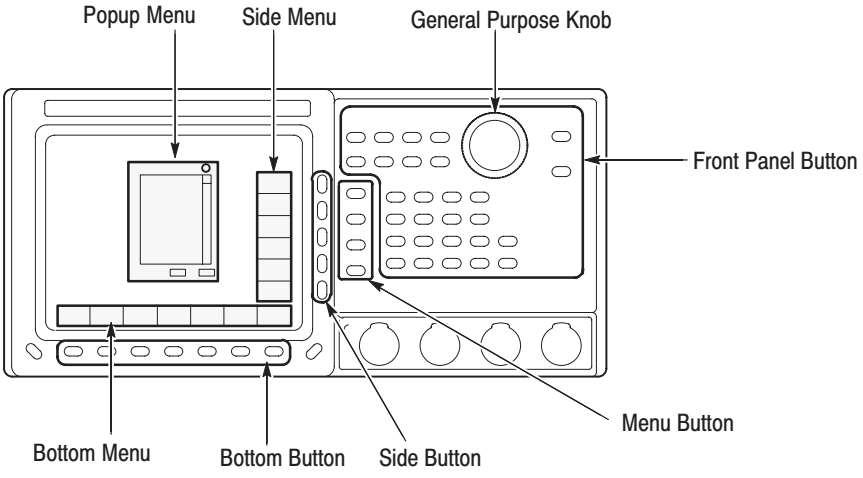


Figure 2-6: Operating buttons and menu layout

Grouping the data bits

1. Assign DATA00 to DATA03 to a group called IC1.

a. Reset all bit allocations.

Menu button	Bottom button	Popup menu	Side button	Front panel button
SETUP	Group Assign		Reset All bits Assign	
			OK	

b. Set the MSB and LSB to D03 and D00, respectively.

Menu button	Bottom button	Popup menu	Side button	Front panel button
		Select 32 DATA03.	Group Bit(s) Config	
			MSB (Set D03.)	
			LSB (Set D00.)	
			OK	

NOTE. *The MSB setting may change depending on the direction the general purpose knob is turned. If that happens, the MSB setting must be set again.*

c. Attach the name IC1 to the newly created group.

Menu button	Bottom button	Popup menu	Side button	Front panel button
			Rename	
			Clear String	
		I, C, 1	OK	

2. Assign DATA04 to DATA07 to a group called IC2.

a. Set the MSB and LSB.

Menu button	Bottom button	Popup menu	Side button	Front panel button
		Select 28 DATA07.	Group Bit(s) Config	
			MSB (Set D07.)	
			LSB (Set D04.)	
			OK	

***NOTE**. The MSB setting may change depending on the direction the general purpose knob is turned. If that happens, the MSB setting must be set again.*

b. Attach the name IC2 to the group.

Menu button	Bottom button	Popup menu	Side button	Front panel button
			Rename	
			Clear String	
		I, C, 2	OK	

Allocating Data Bits to the Pod Channels

3. Allocate data bits to pod channels **A-00** to **A-11**.

a. Clear the pod channel for channels **A-00** to **A-03**.

Menu button	Bottom button	Popup menu	Side button	Front panel button
	Pod Assign			
Press the front panel up arrow button to select channel A-00 from the POD assign list.				
			Release	
Clear the A-01 to A-03 allocations in the same manner.				

b. Allocate the IC1 group data to the pod channels **A-04** to **A-07** and turn off the output impedance control for each channel.

Menu button	Bottom button	Popup menu	Side button	Front panel button
Press the front panel down arrow button to select channel A-04 from the POD assign list.				
Select data D03 (IC1:03) from the Data bits list using the general purpose knob.				
			Assign	
			Change Inhibit Control	
		Select OFF.	OK	
Allocate D02 to D00 to A-05 to A-07 using the same procedure and turn off the output impedance control for each channel.				
			OK	

***NOTE**. Press the **OK** button when done to activate the allocations. Note that the allocations will not become valid unless the **OK** button is pressed.*

c. Allocate the **IC2** group data to the pod channels **A-08** to **A-11** and turn off the output impedance control for each channel.

Menu button	Bottom button	Popup menu	Side button	Front panel button
	Pod Assign			
Press the front panel down arrow button to select channel A-08 from the POD assign list.				
Select data D07 (IC2:03) from the Data bits list using the general purpose knob.				
			Assign	
			Change Inhibit Control	
		Select OFF.	OK	
Allocate D06 to D04 to A-09 to A-11 using the same procedure and turn off the output impedance control for each channel.				
			OK	

***NOTE**. Press the **OK** button when done to activate the allocations. Note that the allocations will not become valid unless the **OK** button is pressed.*

To summarize, the above has allocated data bits to the pods as shown in Figure 2-7.

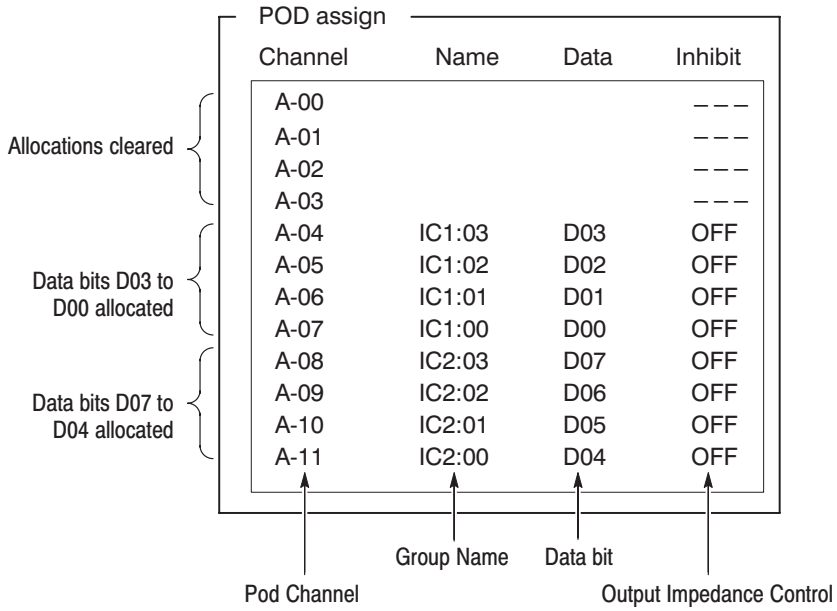


Figure 2-7: Pod channel data bit allocation

Setting the Sampling Clock Frequency

4. Set the sampling clock frequency to 50 MHz.

Menu button	Bottom button	Popup menu	Side button	Front panel button
	Oscillator		Source (Select Int.)	
			Int Frequency	5, 0, MHz
			PLL (Select On.)	

Setting the Signal Generation Mode

5. Set the signal generation mode to continuous mode.

Menu button	Bottom button	Popup menu	Side button	Front panel button
	Run Mode		Repeat	

Setting the Pod Output Level (P3420 Only)

There are two pod models that can be used with the DG2020A. The P3410 pod output level is always at the TTL level. However, the P3420 pod output level is variable. This step sets output levels for the P3420 pod.

6. Set the pod channel A-04 to A-11 output levels to 4V for the high level and 0V for the low level.

Menu button	Bottom button	Popup menu	Side button	Front panel button
	Level/Delay			
Select channel A-04 using the front panel up and down arrow buttons.				
			High Level	4, ENTER
			Low Level	0, ENTER
Set the output levels for channels A-05 to A-11 in the same manner.				

Setting the Pod Delay Time

The delay time for channels **A-08** to **A-11** is variable in both the P3410 and the P3420 pod.

7. Set the delays for the pod channels **A-08** to **A-11** to 5 ns.

Menu button	Bottom button	Popup menu	Side button	Front panel button
	Level/Delay			
Select channel A-08 using the front panel up and down arrow buttons.				
			Delay	5, ENTER
Set the delays for channels A-09 to A-11 in the same manner.				

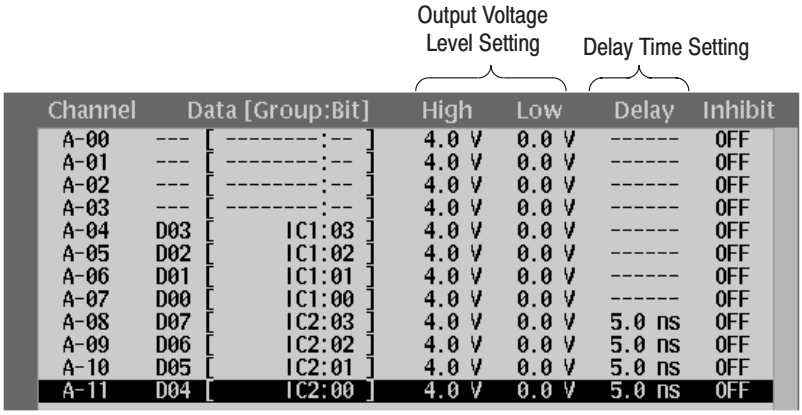


Figure 2-8: Output voltage level and delay time display for the P3420 pod

Signal Output

This step actually outputs the signals.

8. 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 DG2020A. Section 9, *Diagrams*, includes a block diagram and a interconnect diagram. Figures 9-1 shows the modules and functional blocks of the DG2020A with Options 01 and 02 installed. Figure 9-2 shows how the modules interconnect.

Module Overview

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

The DG2020A Data Generator is a portable instrument with 12 to 36 channel output. The DG2020A reads out the digital pattern data loaded into its pattern data memory. The point rate clock determines the rate at which data is read out. The DG2020A outputs the pattern data at this rate.

Clock Generator (A30 Clock Board)

The clock generator is made up of a blocking oscillator that operates between 100 MHz and 200 MHz, a 10 MHz reference oscillator, and a dividing circuit. The blocking oscillator is combined with the 10 MHz reference oscillator to form a phase lock loop (PLL) circuit. The PLL operation can also be prevented; in such cases, oscillation begins as soon as an external trigger signal is received. The output of the blocking oscillator is divided by the dividing circuit and supplied to the A50 PG Master board and A51 PG Slave board as a point rate clock signal ranging from 200 MHz to 0.1 Hz.

Trigger Circuit (A30, Clock Board)

The trigger circuit corrects the external trigger signal, and sets the trigger level and trigger slope. The output from this circuit controls the clock output from the clock generator.

Sequence Memory (A50, PG Master Board)

Stored in the sequence memory is a type of program that designates the sequence and repetitions for the output of pattern data. The contents of the sequence memory are determined by the **Make Sequence** sub menu in the **EDIT** menu.

Pattern Data Memory (A50, PG Master Board and A51, PG Slave Board)

The pattern data memory stores the pattern data output from the pod. Its contents are read out in the order in which they were programmed in sequence memory, and sent to the shift register.

Shift Register (A50, PG Master Board and A51, Slave Board)

The shift register performs parallel/serial conversion for the data sent from the pattern data memory.

Delay Circuit (A60, TTL Pod Board and A65, Variable Pod Board)

Channels 08 through 11 in the TTL pod and variable pod are equipped with delay circuits that can delay the pattern data from 0 ns to 20 ns.

Level Control (A65, Variable Pod Board)

The variable pod has a function for varying the high and low output levels. This function is made possible by the DAC and the pin driver.

CPU and Memory (A6, CPU Board)

This functional block directs operation of all internal circuits, based on front panel control operation and commands received over the GPIB or RS-232-C interface. This circuit includes the 68000 CPU, DRAM, EPROM, and SRAM. Data in memory is retained by a lithium battery on the A17 Backplane board.



CAUTION. *To avoid losing pattern data files stored in NVRam, save the files to a floppy disk before removing the A6 CPU board or A17 Backplane board. Then restore the files from floppy disk to DG2020A nonvolatile memory after reinstalling the board(s).*

GPIB (A6, CPU Board)

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

RS-232-C (A6, CPU Board)

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

Display Control (A6, CPU Board)

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

Display Monitor

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

Front Panel (A12, Keyboard)

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

Floppy Disk Drive

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

Low Voltage Power Supply (A4 Power Board)

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

Fan

The fan prevents heat build-up inside the cabinet. It pulls air into the right (floppy-disk) side of the DG2020A and exhausts it out the left side.

Options

The following three options are available on the DG2020A:

- **Option 01: 24-Channel Output**
  This option adds another 12 channels to allow the instrument to output a total of 24 channels. This option allows 2 individual pods, pod A and pod B, to be used at the same time.
- **Option 02: 36-Channel Output**
  This option adds another 24 channels to allow the instrument to output a total of 36 channels. This option allows 3 individual pods, pod A, pod B, and pod C, to be used at the same time.

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

Performance Verification

Introduction

This section describes the operation tests for the DG2020A data generator and the P3410 and P3420 pods, and the procedures for those test. The operation tests can be divided into two categories.

- Self Tests

  The DG2020A incorporates a diagnostic system that performs comprehensive instrument testing. This system confirms that the DG2020A is operating correctly. The self tests execute quickly and require no special equipment during execution.

- Performance Tests

  There are 3 performance test groups.

  Performance tests for the DG2020A plus pod combination

  Performance tests for the P3410 pod

  Performance tests for the P3420 pod

  These tests confirm the operation of the items that are marked with an asterisk (*****) in the guaranteed items in the operating specifications listed in Section 1, ”Specification”. The equipment listed in Table 4-2 is required to perform these performance tests.

Before Running the Operation 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 DG2020A includes the files listed in Table 4-1. The specified file must be loaded into the DG2020A for each operation test item. These files include pattern data and setup information.

Table 4-1: Performance check disk's file list

File name	Operation test	Unit tested
TP1CLK.PDA	Internal clock frequency	DG2020A
TP2EXCLK.PDA	External clock input	DG2020A
TP3DPOUT.PDA	Digital output	DG2020A
TP4TRIG.PDA	External trigger operation	DG2020A
TP5EVENT.PDA	Event operation Event input and inhibit input	DG2020A, P3410, P3420
TP6DCTTL.PDA	Output voltage level	P3410
TP7DELAY.PDA	Variable delay	P3410, P3420
TP8DCH.PDA	Output voltage level	P3420
TP9DCL.PDA	Output voltage level	P3420

Use the following procedure to load the file required by a performance test into the instrument.

■ **Operation :** File load

1. Insert the performance check disk into the DG2020A's floppy disk drive.
2. Press **EDIT** button from the **MENU** buttons.
3. Select **File** from the bottom menu.
4. Select **Load Data & Setup** from the side menu.
5. Select the required file using the general purpose knob.
6. Select **OK** from the sub menu.

Required Equipment

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

Table 4-2: Required equipment

Item	No.	Required precision	Recommended equipment	Unit tested
Frequency counter	1	Frequency range: 0.1 Hz to 200 MHz Precision: 7 digits or higher	ANRITSU MF 1603A	DG2020A
Digital multimeter	1	DC voltage range: ±10 V Precision: 0.01 V	Tektronix DM2510	P3410, P3420
Performance check disk	1		Tektronix part no. 063-1899-XX (provided with the DG2020A)	DG2020A P3410, P3420
Oscilloscope	1	Bandwidth: 500 MHz or higher	Tektronix TDS520, TDS540, or equivalent	DG2020A P3410, P3420
Function generator	1	Amplitude: 4 V, offset: 2 V (50 Ω termination), frequency: 1 MHz or higher	Tektronix AFG2020	DG2020A
Data generator	1		Tektronix DG2020A	P3410, P3420
Pod	1		Tektronix P3410 or P3420	DG2020A
SMB-to-pin-header cable	2	Impedance: 50Ω Connector: SMB to pin header Length: 20 inches	Tektronix part no. 012-1503-00	DG2020A, P3410
SMB-to-BNC cable	2	Impedance: 50 Ω Connector: SMB to BNC Length: 40 inches	Tektronix part no. 012-1459-00	DG2020A, P3420
SMB-to-SMB cable	1	Impedance: 50 Ω Connector: SMB to SMB Length: 40 inches	Tektronix part no. 012-1458-00	DG2020A, P3420
BNC cable	2	Impedance: 50 Ω Connector: BNC Length: 24 inches	Tektronix part no. 012-1342-00	DG2020A
50 Ω termination	1	Impedance: 50 Ω	Tektronix part no. 011-0049-01	DG2020A
N-to-BNC adapter	1		Tektronix part no. 103-0045-00	DG2020A
SMB-to-BNC conversion adapter	2		Tektronix part no. 015-0671-00	DG2020A, P3410
BNC-dual-banana adapter	1		Tektronix part no. 103-0090-00	P3410, P3420
1 MΩ resistor	1	1% tolerance	Tektronix part no. 321-0481-00	P3410, P3420
Pod connection cable	1		Tektronix part no. 174-3548-00 (provided with the DG2020A)	DG2020A P3410, P3420
T-connector	1		Tektronix part no. 103-0030-00	DG2020A

Test Procedure Notes

The following conventions are used in this manual 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 popup 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	Popup menu	Side button	Front panel button
Operation 1	Operation 2	Operation 3	Operation 4	Operation 5
Operation 6 (e.g., insert a disk in the disk drive.)				
			Operation 7	

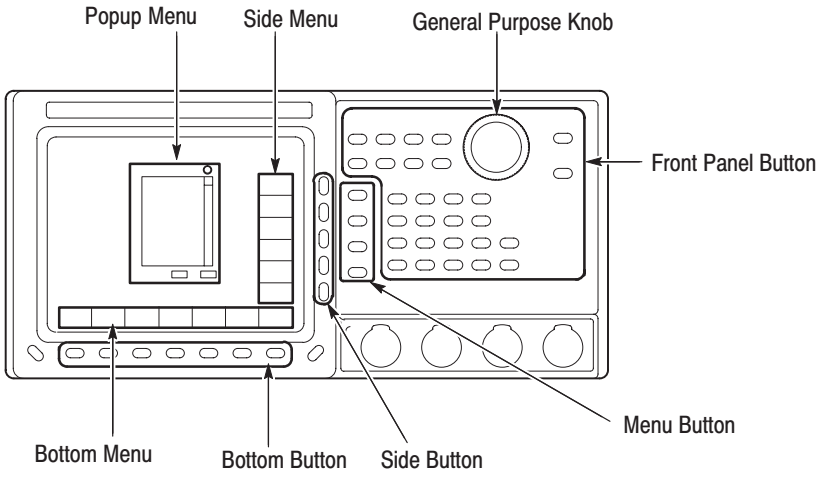


Figure 4-1: Operating buttons and menu layout

Self Tests

Execute the DG2020A self tests and confirm that no errors occurred.

1. Press the required buttons in the following order. If **All** is selected as the **Type**, all test items will be run.

Menu button	Bottom button	Popup menu	Side button	Front panel button
UTILITY	Diag		Type (Select All.)	
			Execute	

2. Confirm that all items passed by checking the **Status** display area shown in Figure 4-2.

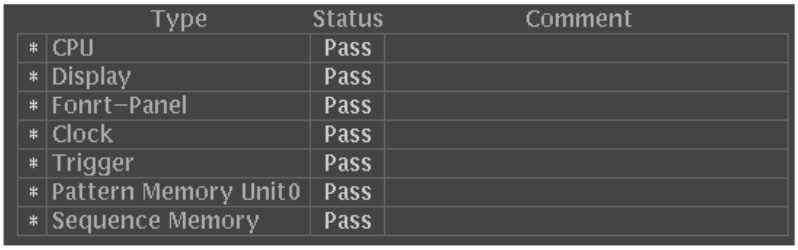


Figure 4-2: Diagnostics menu

If **Fail** is displayed 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 diagnostic error	A6 CPU board
2XX	Display diagnostic error	A6 CPU board
3XX	Front panel diagnostic error	A12 keyboard
4XX	Clock diagnostic/calibration error	A30 Clock board
5XX	Trigger diagnostic/calibration error	A30 Clock board
6XX	Sequence memory diagnostic error	A50/A51 PG board
7XX	Pattern memory diagnostic error	A50/A51 PG board

Performance Tests for the DG2020A/Pod Combination

The items in this performance test are for the DG2020A in combination with a pod. Perform these test items in the following order.

- Internal clock frequency 4-6
- External clock input 4-8
- Digital output 4-9
- External trigger operation 4-12
- Event operation 4-14

Internal Clock Frequency

This test confirms the frequency precision of the DG2020A internal clock.

With the PLL circuit on: Clock frequency ±50 ppm

With the PLL circuit off: Clock frequency ±3 %

■ Required Equipment

- Frequency counter
- SMB-to-BNC cable
- 50Ω termination
- N-to-BNC adapter
- Performance check disk

■ Connections Connect the clock output from the DG2020A rear panel to the frequency counter input (INPUT B) through the N-to-BNC adapter with the SMB-to-BNC cable.

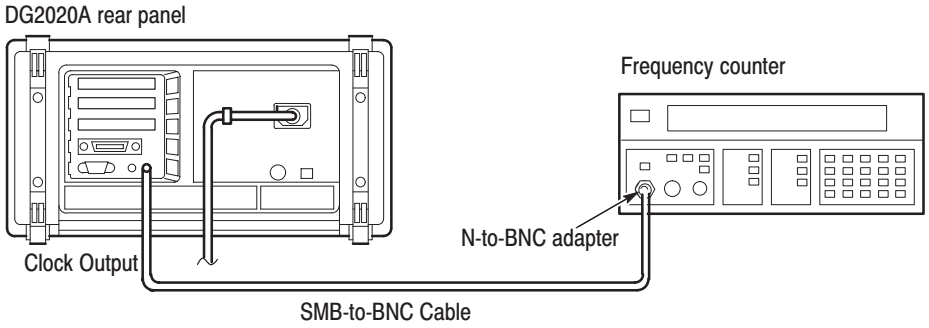


Figure 4-3: Frequency measurement connections

■ **Setup**. Set the frequency counter to frequency measurement mode.

■ **Characteristics Confirmation Procedure**

1. Load the **TP1CLK.PDA** test pattern file from the performance check disk. When the file is loaded, the DG2020A clock frequency will be set to 200 MHz internally and the PLL circuit will be turned on.

The following two steps check the clock frequency precision with the PLL circuit on and the internal clock frequency set to 200 MHz

2. Press the **START/STOP** button on the front panel so that the button's LED indicator lights.

3. Set the counter trigger to an appropriate value and confirm that the counter displays a frequency in the range 199.99 to 200.01 MHz.

The following five steps check the clock frequency precision with the PLL circuit on and the internal clock frequency set to 200 kHz or 100.0 mHz.

4. Change the frequency counter input to INPUT A through the 50 Ω termination with the SMB-to-BNC cable.

5. Press the following buttons to set the DG2020A clock frequency to 200 kHz.

Menu button	Bottom button	Popup menu	Side button	Front panel button
SETUP	Oscillator		Int Frequency	2,0,0,kHz/ms/mV

6. Set the counter trigger to an appropriate value, and confirm that the counter displays a frequency in the range 199.99 to 200.01 kHz.

7. Set the DG2020A clock frequency to 100 mHz.

8. Set the frequency counter to frequency measurement mode.

9. Set the counter trigger to an appropriate value, and confirm that the counter displays a frequency in the range 99.995 to 100.005 mHz.

The following two steps check the clock frequency precision with the PLL circuit off and the internal clock frequency set to 200 MHz, 200 kHz and 100.0 mHz.

10. Press the following buttons to turn the PLL circuit off.

Menu button	Bottom button	Popup menu	Side button	Front panel button
SETUP	Oscillator		PLL (Set to Off.)	

11. Set the internal clock frequency to 200 MHz, 200 kHz, and 100.0 mHz, and confirm that the frequencies and periods measured by the frequency counter fall within the ranges shown in Table 4-4.

Table 4-4: Internal clock frequency precision (PLL off)

Internal clock frequency (Int Frequency)	Clock frequency range
200.0 MHz	194 MHz to 206 MHz
200.0 kHz	194 kHz to 206 kHz
100.0 mHz (10.0 s)	97 mHz to 103 mHz (9.709 s to 10.31 s)

External Clock Input

This test confirms external clock input operation. Confirm that the clock signal is output from the **CLOCK OUT** connector when a square wave signal with a frequency of 1 MHz and an amplitude of 1 V (V_{IH} > 0.7 V, V_{IL} < 0.3 V) is input as an external clock signal.

- **Required Equipment**
  - Oscilloscope
  - Function generator
  - Two SMB-to-BNC cables
  - Performance check disk
- **Connections** Connect the clock output from the DG2020A rear panel to the oscilloscope CH1 input with an SMB-to-BNC cable. Connect the function generator output to the DG2020A rear panel clock input with the other SMB-to-BNC cable.

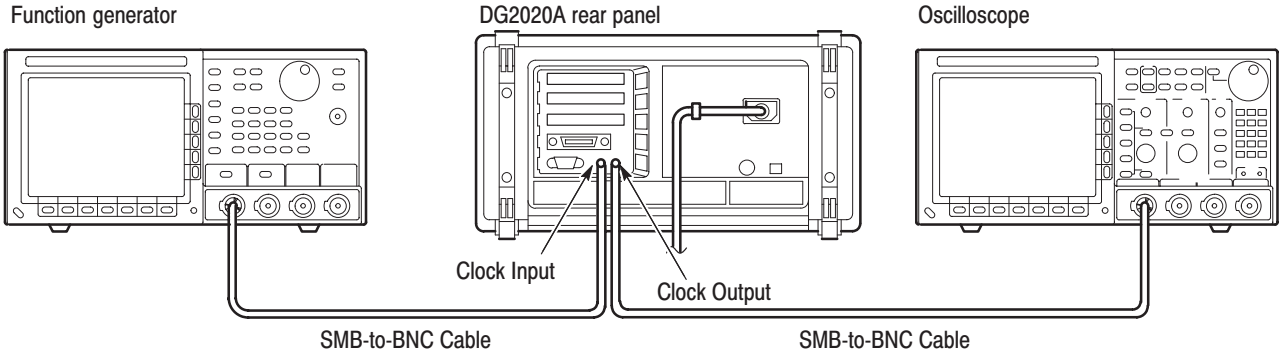


Figure 4-4: External clock input connection

■ **Setup**

- Oscilloscope

  Displayed channel CH1
  Vertical axis . . . . . 500 mV/div
  Horizontal axis . . . 1 μs/div
  Trigger mode . . . . Auto
  Trigger level . . . . . 500 mV
  Input coupling . . . . DC
  Input impedance . . 50 Ω

- Function generator

  Waveform . . . . . Square wave
  Frequency . . . . . 1 MHz
  Amplitude . . . . . 1 V (50 Ω termination)
  Offset . . . . . 500 mV (50 Ω termination)

■ **Characteristics Confirmation Procedure**

1. Load the **TP2EXCLK.PDA** test pattern file from the performance check disk.
2. Press the **START/STOP** button on the front panel so that the button's LED indicator lights.
3. Confirm that the clock pulse waveform can be observed on the oscilloscope.

Digital Output

This test confirms that pattern data is output from the pod data outputs (CH0 through CH11).

■ **Required Equipment**

- Oscilloscope
- P3410 or P3420 pod
- Pod connection cable
- SMB-to-pin-header cable (when a P3410 pod is used)
- SMB to BNC adapter (when a P3410 pod is used)
- SMB-to-BNC cable (when a P3420 pod is used)
- Performance check disk

■ **Connections** Connect the DG2020A rear panel pattern data output-connector (POD A) to the data input-connector on the rear panel of a P3410 or P3420 pod using a pod connection cable.

CAUTION. *When connecting the DG2020A to a pod with a pod connection cable, turn off the DG2020A power before connecting the cable. Connecting the cable with the power in the on state can damage the DG2020A and the P3410 pod. When attaching the pod cable, ensure that the plug and socket are aligned correctly.*

Make sure that you have correctly inserted the cable plug in the DG2020A and the pod before turning on power. The yellow wire end of the connector must be aligned with the triangular yellow index mark on the DG2020A or pod. Incorrectly connected cables will damage the DG2020A and the pod.

For more details, refer to How to Make Connection to Pods *on page 2-7.*

Next, connect the pod CH0 signal output to the oscilloscope CH1 input using an SMB-to-pin-header cable and an SMB to BNC adapter (for a P3410 pod) or an SMB-to-BNC cable (for a P3420 pod). See Figure 4-5 for the general method of connection. Also, see Figures 4-6 and 4-7 for detailed views of the pod data output connectors.

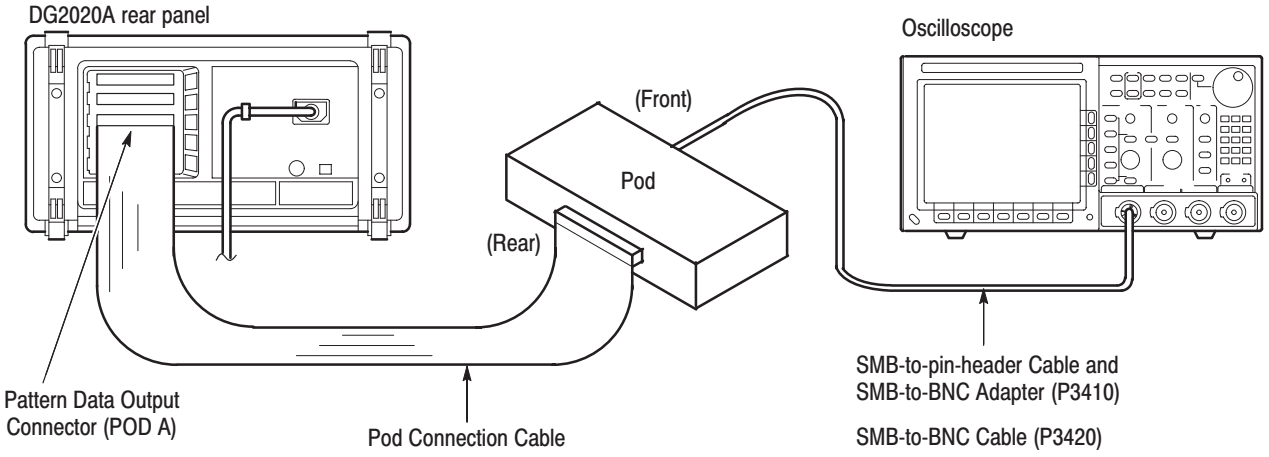


Figure 4-5: Pod connection

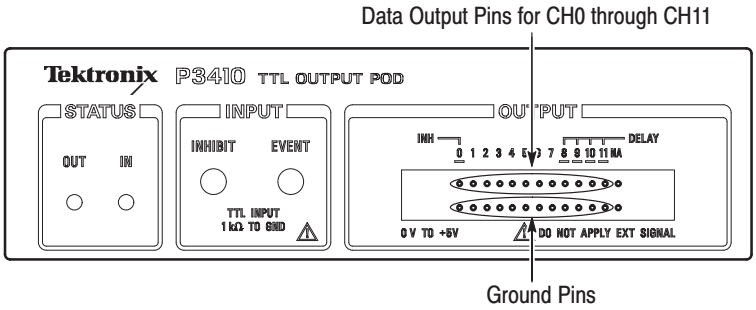


Figure 4-6: P3410 data output connectors

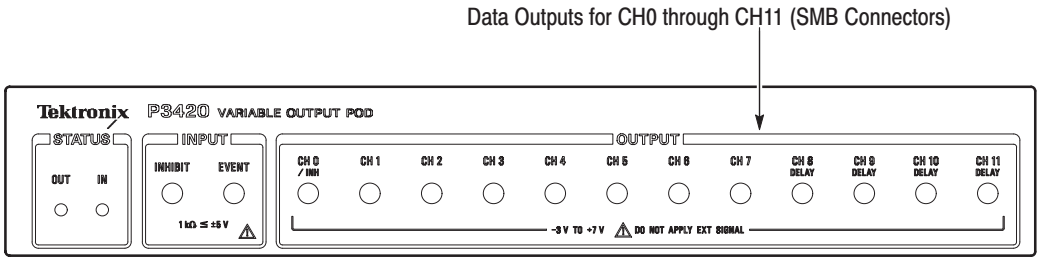


Figure 4-7: P3420 data output connectors

■ Setup

- Oscilloscope

Displayed channel	CH1
Vertical axis	2 V/div
Horizontal axis . . .	5.0 ns/div
Trigger mode	Auto
Trigger level	2 V
Input coupling	DC
Input impedance . .	1 MΩ

■ Characteristics Confirmation Procedure

1. Load the **TP3DPOUT.PDA** test pattern file from the performance check disk.
2. Press the **START/STOP** button on the front panel so that the button's LED indicator lights.
3. Confirm that the clock pulse waveform can be observed on the oscilloscope. This clock pulse is output by the **EDIT** screen DATA35 data pattern.
4. Switch the SMB-to-pin-header cable (P3410) or SMB-to-BNC cable (P3420) to the pod CH1 output.

5. Confirm that the clock pulse waveform can be observed on the oscilloscope. This clock pulse is output by the **EDIT** screen DATA34 data pattern.
6. Repeat steps 4 and 5 for the pod outputs CH2 through CH11. Confirm that the DATA33 to DATA24 data patterns are output from these channels respectively.
7. If the option 01 (24 channels) or the option 02 (36 channels) is installed, repeat this procedure for POD B and POD C.

External Trigger Operation

This test confirms that pattern data output is started by an external trigger signal.

- **Required Equipment**
  - Oscilloscope
  - Function generator
  - P3410 or P3420 pod
  - Pod connection cable
  - SMB-to-pin-header cable (when a P3410 pod is used)
  - SMB to BNC adapter (when a P3410 pod is used)
  - SMB-to-BNC cable (when a P3420 pod is used)
  - Two BNC cables
  - T-connector
  - Performance check disk
- **Connections** The pod is connected in the same way as shown in Figure 4-5. Additionally, use the T-connector and BNC cables to connect the function generator output to the DG2020A trigger input connector and to the oscilloscope CH2 input as shown in Figure 4-8.

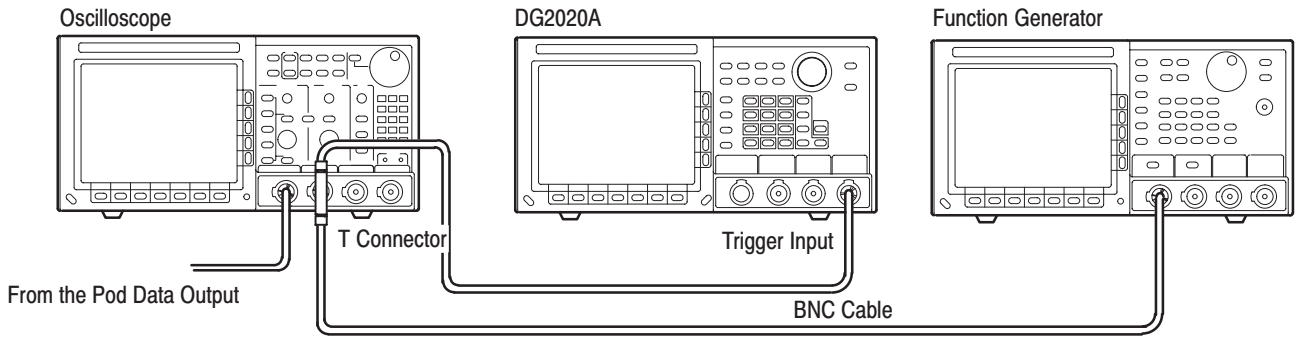


Figure 4-8: External trigger operation connections

■ Setup

- Oscilloscope

  Displayed channels . . . . . CH1 and CH2
  Vertical axis (CH1 and CH2) . 2 V/div
  Horizontal axis . . . . . 200 ns/div
  Trigger mode . . . . . Auto
  Trigger level . . . . . 2 V
  Trigger source CH2
  Input coupling . . . . . DC
  Input impedance
  (CH1 and CH2) . . . . . 1 MΩ

- Function generator

  Waveform . . . . . Square wave
  Frequency . . . . . 1 MHz
  Amplitude . . . . . 4 V (50 Ω termination)
  Offset . . . . . 2 V (50 Ω termination)

■ Characteristics Confirmation Procedure

1. Load the **TP4TRIG.PDA** test pattern file from the performance check disk.
2. Press the **START/STOP** button on the front panel so that the button's LED indicator lights.
3. Confirm that the function generator output signal (the oscilloscope CH2 signal) and a square wave synchronized with this signal (the oscilloscope CH1 signal) are displayed on the oscilloscope.

Event Operation

This test confirms event jump operation. It confirms that a synchronization signal and an event signal are output at the same time.

■ Required Equipment

- Oscilloscope
- P3410 or P3420 pod
- Pod connection cable
- Two SMB-to-pin-header cables (when a P3410 pod is used)
- SMB to BNC adapter (when a P3410 pod is used)
- SMB-to-BNC cable (when a P3420 pod is used)
- SMB to SMB cable (when a P3420 pod is used)
- Performance check disk

■ Connections The connections for this test are the same as shown in Figure 4-5.

■ Setup

- Oscilloscope

Displayed channel	CH1
Vertical axis	2 V/div
Horizontal axis . . .	200 ns/div
Trigger mode	Auto
Trigger source	CH1
Trigger level	1.5 V
Input coupling	DC
Input impedance . .	1 MΩ
Hold Off	9 μs

■ Characteristics Confirmation Procedure

The following steps confirm event jump operation.

1. Load the **TP5EVENT.PDA** test pattern file from the performance check disk.
2. Press the **START/STOP** button on the front panel so that the button's LED indicator lights.
3. Confirm that a square wave with a 1 μs period is displayed on the oscilloscope.
4. Press the front panel **STEP/EVENT** button.
5. Confirm that a square wave with a 500 ns period is displayed on the oscilloscope.

6. Confirm that square waves with 1 μs and 500 ns periods are displayed on the oscilloscope alternately each time the front panel **STEP/EVENT** button is pressed.

7. Connect the pod data output CH1 to the pod **EVENT INPUT**. Use an SMB-to-pin-header cable for the P3410 pod and an SMB to SMB cable for the P3420 pod. See Figures 4-9 and 4-10.

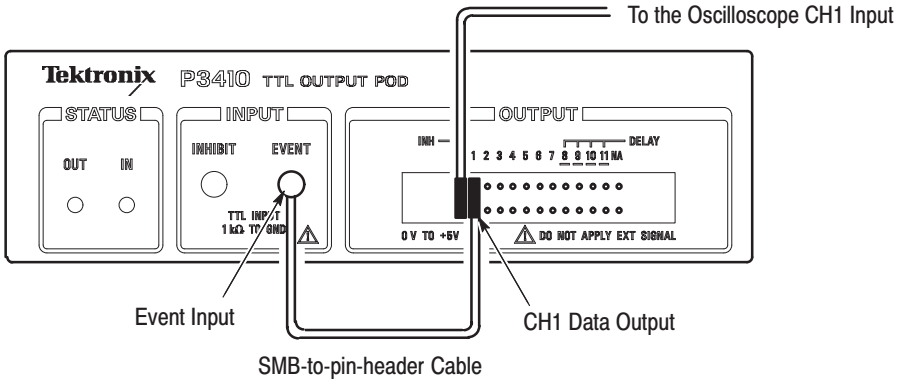


Figure 4-9: P3410 event input connections

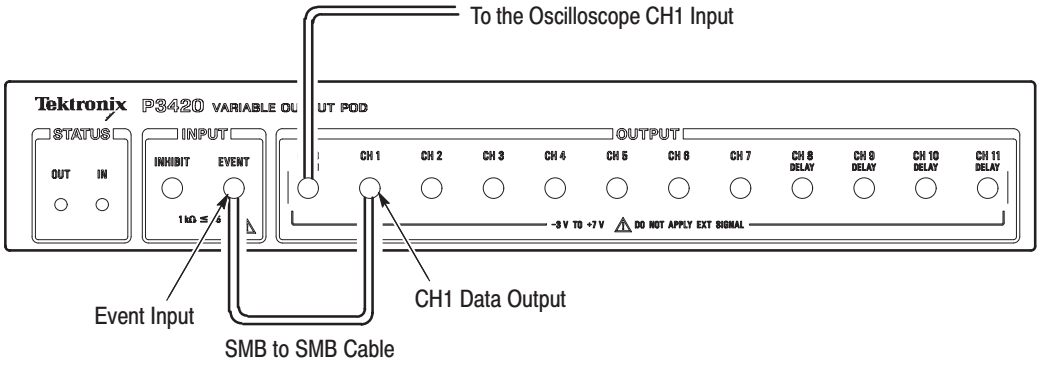


Figure 4-10: P3420 event input connections

8. Confirm that a 1 μs square wave and a 500 ns square wave are displayed on the oscilloscope alternately for 1 cycle and 2 cycles respectively.

The following three steps confirm the event output signal operation.

9. Connect the DG2020A **EVENT OUTPUT** to the oscilloscope's CH2 with a BNC cable.

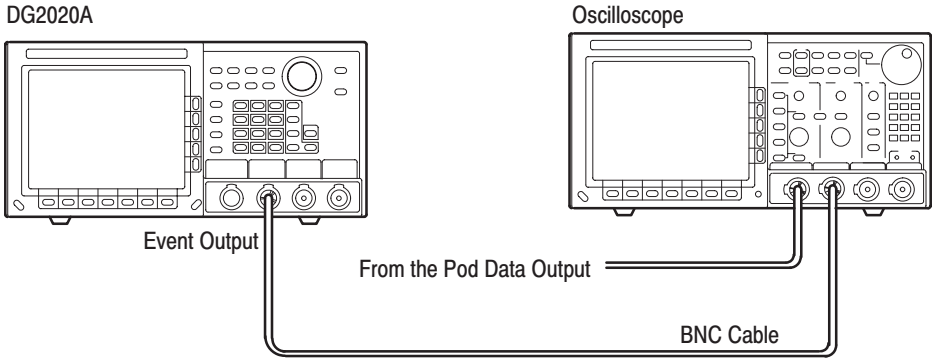


Figure 4-11: DG2020A event output connections

10. Switch the oscilloscope display channel from CH1 to CH2.

11. Confirm that the event output signal is displayed on the oscilloscope.

The following two steps confirm the synchronization output signal operation.

12. Switch the BNC cable from the DG2020A **EVENT OUTPUT** connector to the **SYNC OUTPUT** connector.

13. Confirm that the synchronization signal appears on the oscilloscope.

P3410 Pod Performance Test

The items in this performance test are only for the P3410 pod. Perform these test items in the following order.

- Output voltage levels 4-19
- Variable delay 4-20
- Event input and inhibit input . 4-22

P3410 Pod Installation

Perform the following procedures to install the P3410.

1. Connect the DG2020A rear panel pattern data output connector to the P3410 rear panel data input connector using a pod connection cable. See Figure 4-12.

CAUTION. *When connecting the DG2020A to a pod with a pod connection cable, turn off the DG2020A power before connecting the cable. Connecting the cable with the power in the on state can damage the DG2020A and the P3410 pod. When attaching the pod cable, ensure that the plug and socket are aligned correctly.*

Make sure that you have correctly inserted the cable plug in the DG2020A and the pod before turning on power. The yellow wire end of the connector must be aligned with the triangular yellow index mark on the DG2020A or pod. Incorrectly connected cables will damage the DG2020A and the pod.

For more details, refer to How to Make Connection to Pods *on page 2-7.*

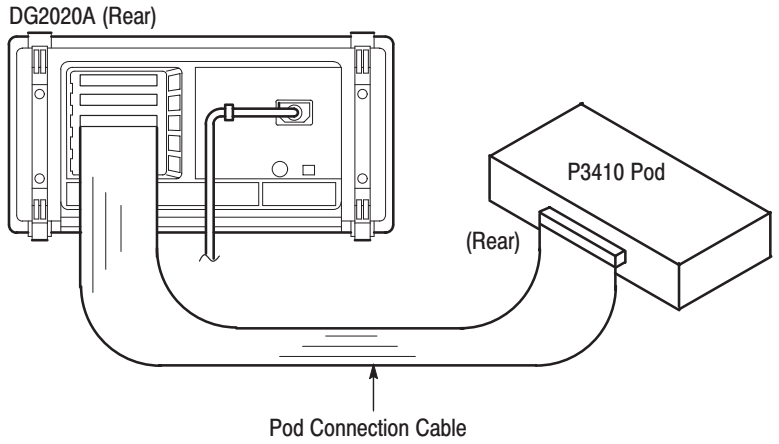


Figure 4-12: Pod connection

2. Turn on the DG2020A power.

3. Press the DG2020A **SETUP** button. Confirm that TTL high (HI) and TTL low (LO) are displayed in the voltage level column on the DG2020A screen. (See Figure 4-13.)

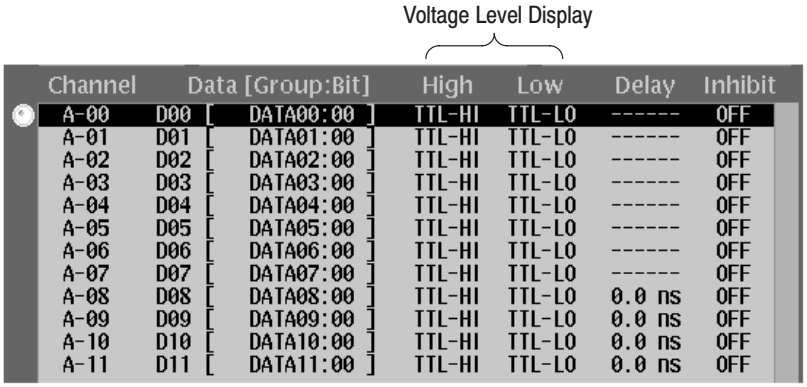


Figure 4-13: P3410 voltage level display

P3410 Output Pins and Pin Header Cables

Refer to Figure 4-14 when connecting a pin header cable to a P3410 output pins. There are two types of pin header with different shapes. (See Figure 4-15.) Check which header pin you are using carefully.

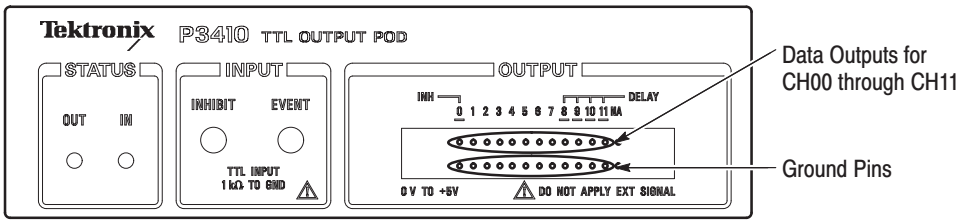


Figure 4-14: P3410 output pins

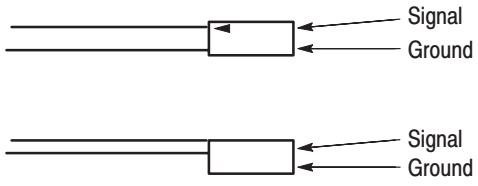


Figure 4-15: Pin header cable types

Output Voltage Levels

This test confirms the pod output voltages into a 1 MΩ load.

High level . . . 4.4 V or higher

Low level . . . 0.1 V or lower

■ Required Equipment

- DG2020A
- Pod connection cable
- BNC to dual banana adapter
- SMB-to-pin-header cable
- SMB to BNC adapter
- 1 MΩ resistor
- Performance check disk

■ **Connections** Connect the CH0 data output pin for the pod connected to the DG2020A to the digital multimeter input through an SMB-to-pin-header cable, and SMB to BNC adapter, and a BNC to dual banana adapter. Connect the 1 MΩ resistor across the BNC to dual banana adapter terminals.

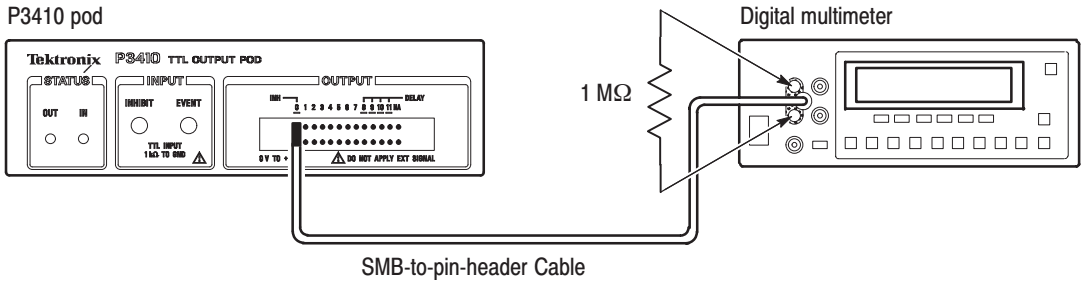


Figure 4-16: Output voltage test connections

■ Setup

- Digital multimeter

  Function . . . . . DCV
  Range . . . . . Auto

■ Characteristics Confirmation Procedure

1. Load the **TP6DCTTL.PDA** test pattern file from the performance check disk.

2. Press the **START/STOP** button on the front panel so that the button's LED indicator lights.
3. Confirm that the digital multimeter display reads 0.1 V (the low level) or lower.
4. Press the front panel **FORCE TRIGGER** button.
5. Confirm that the digital multimeter display reads 4.4 V (the high level) or higher.
6. Move the pin header cable connected to the P3410 CH0 output pin to the CH1 pin and repeat steps 3 through 5. Confirm the output levels for CH2 through CH11 in the same manner.

Variable Delay

This test confirms that accuracy of the delay relative to CH0 in the P3410 is within the range ±2 ns. This test is for the channels that support variable delay times, i.e., channels CH8 to CH11.

- **Required Equipment**
  - DG2020A
  - Pod connection cable
  - Oscilloscope
  - Two SMB-to-pin-header cables
  - Two SMB to BNC adapters
  - Performance check disk
- **Connections** Connect the P3410 CH0 and CH8 data output pins to the oscilloscope CH1 and CH2 inputs, respectively, using the SMB-to-pin-header cables and the SMB to BNC adapters.

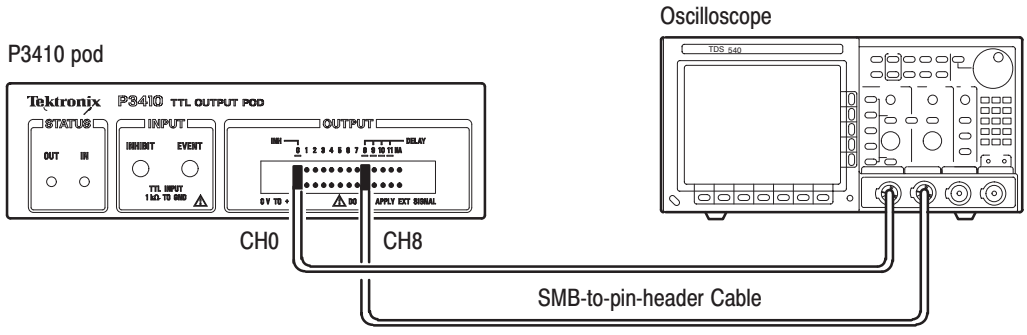


Figure 4-17: Variable delay test connections

■ Setup

- Oscilloscope

Displayed channels	CH1 and CH2
Vertical axis (CH1 and CH2)	2 V/div
Horizontal axis	2 ns/div
MEASURE	CH1 → CH2 DLY
Record Length	2500 point in 50 divs
Trigger source	CH1
Input coupling (CH1 and CH2)	DC
Input impedance (CH1 and CH2)	1 MΩ

■ Characteristics Confirmation Procedure

1. Load the **TP7DELAY.PDA** test pattern file from the performance check disk.

2. Press the following buttons in the order shown. In this state the CH8 through CH11 delay settings will all be 0.0 ns.

Menu button	Bottom button	Popup menu	Side button	Front panel button
SETUP	Level/Delay			
Move the cursor to CH08 using the general purpose knob.				
			Delay	

3. Press the **START/STOP** button on the front panel so that the button's LED indicator lights.

4. Observe the two clock pulses on the oscilloscope, and read off the CH8 delay value referenced to CH0 with the timing measured between points with voltages of 50% of the peak value. Confirm that the values measured with the oscilloscope for the delay settings in Table 4-5 fall within ranges in the table below.

Table 4-5: Delay precision

Settings	Delay span range
0.0 ns	–2.0 ns to 2.0 ns
2.0 ns	0.0 ns to 4.0 ns
5.0 ns	3.0 ns to 7.0 ns

Table 4-5: Delay precision (Cont.)

Settings	Delay span range
10.0 ns	8.0 ns to 12.0 ns
20.0 ns	18.0 ns to 22.0 ns

5. Move the pin header cable connected to the P3410 CH8 to channels CH9 through CH11 in order and repeat step 3 to confirm the delay values.

Event Input and Inhibit Input

This test confirms that the event jump and inhibit operations function correctly in response to signals applied to the P3410 pod event and inhibit inputs.

- **Required Equipment**
  - DG2020A
  - Oscilloscope
  - Pod connection cable
  - Two SMB-to-pin-header cables
  - SMB to BNC adapter
  - Performance check disk
- **Connections** Connect the P3410 CH0 output pin to the oscilloscope CH1 input using an SMB-to-pin-header cable and an SMB to BNC adapter. Also connect the P3410 CH1 output pin to the P3410 **EVENT INPUT** using the other SMB-to-pin-header cable.

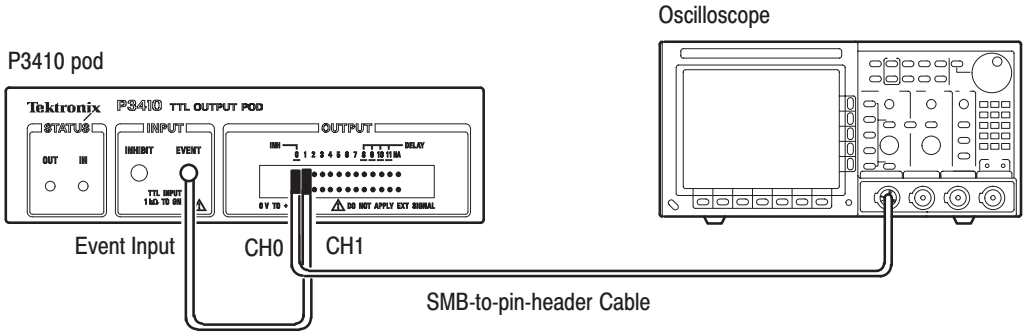


Figure 4-18: Event input operation confirmation connections

■ **Setup**

■ Oscilloscope

Displayed channel	CH1
Vertical axis	2 V/div
Horizontal axis . . .	200 ns/div
Trigger mode	Auto
Trigger level	1.5 V
Input coupling	DC
Hold off	9 μs
Input impedance . .	1 MΩ

■ **Characteristics Confirmation Procedure**

The following three steps confirm the event input operation.

1. Load the **TP5EVENT.PDA** test pattern file from the performance check disk.
2. Press the **START/STOP** button on the front panel so that the button's LED indicator lights.
3. Confirm that a 1 μs square wave and a 500 ns square wave are displayed on the oscilloscope alternately for 1 cycle and 2 cycles respectively.

The following four steps confirm the inhibit input operation.

4. Remove the header pin connected to pod CH0 and connect it to CH2. Next, remove the header pin connected to CH1 and connect it to CH0. Remove the SMB connector connected to **EVENT INPUT** and connect it to **INHIBIT INPUT**.

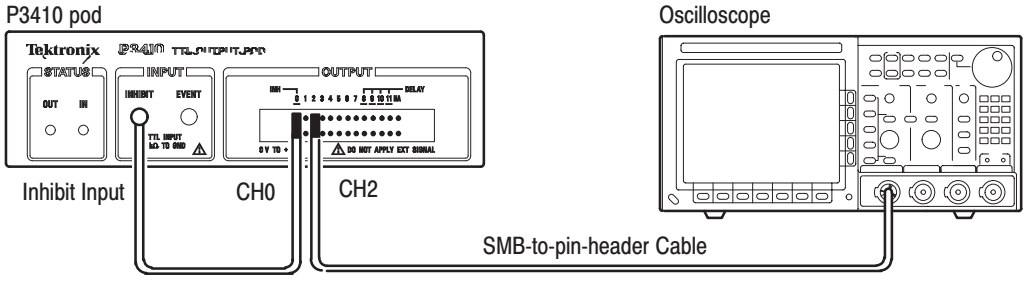


Figure 4-19: Inhibit operation confirmation connections

5. Set the oscilloscope CH1 input impedance to 50 Ω.
6. Press the **START/STOP** button on the front panel twice.
7. Confirm that a square wave with a 1 μs period is displayed on the oscilloscope.

P3420 Pod Performance Test

The items in this performance test are only for the P3420 pod. Perform these test items in the following order.

- Output voltage levels 4-25
- Variable delay 4-29
- Event input and inhibit input . 4-31

P3420 Pod Installation

Perform the following procedures to install the P3420.

1. Connect the DG2020A rear panel pattern data output connector to the P3420 rear panel data input connector using a pod connection cable. See Figure 4-20.

CAUTION. *When connecting the DG2020A to a pod with a pod connection cable, turn off the DG2020A power before connecting the cable. Connecting the cable with the power in the on state can damage the DG2020A and the P3410 pod. When attaching the pod cable, ensure that the plug and socket are aligned correctly.*

Make sure that you have correctly inserted the cable plug in the DG2020A and the pod before turning on power. The yellow wire end of the connector must be aligned with the triangular yellow index mark on the DG2020A or pod. Incorrectly connected cables will damage the DG2020A and the pod.

For more details, refer to How to Make Connection to Pods *on page 2-7.*

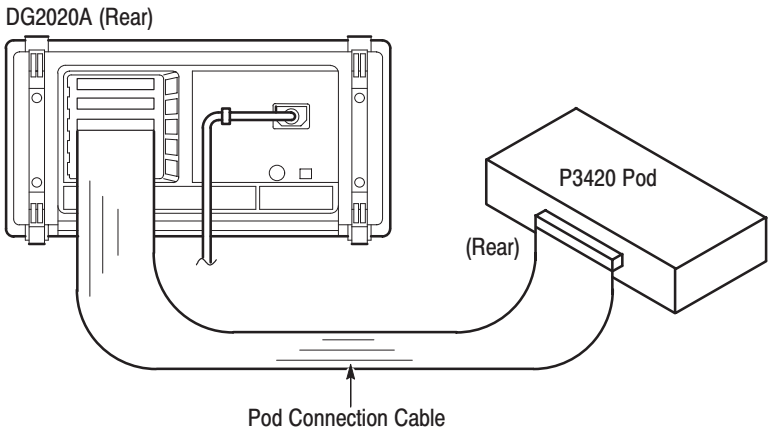


Figure 4-20: Pod connection

2. Turn on the DG2020A power.

3. Press the DG2020A **SETUP** button. Confirm that the high and low level voltage values are displayed in the voltage levels column on the DG2020A screen. (See Figure 4-21.)

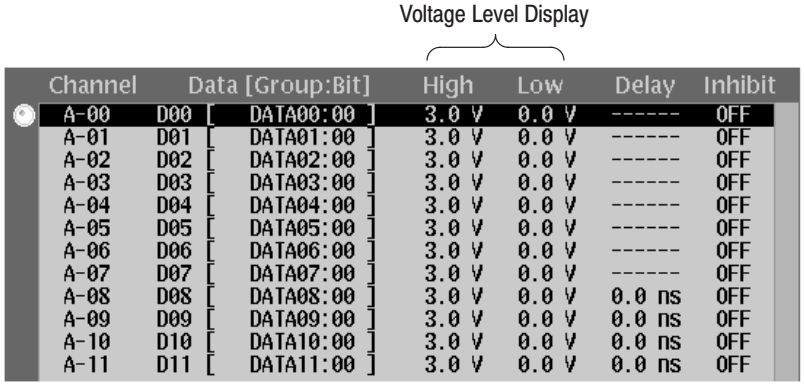


Figure 4-21: P3420 voltage level display

P3420 Output Connections

Figure 4-22 shows the output connections for the P3420.

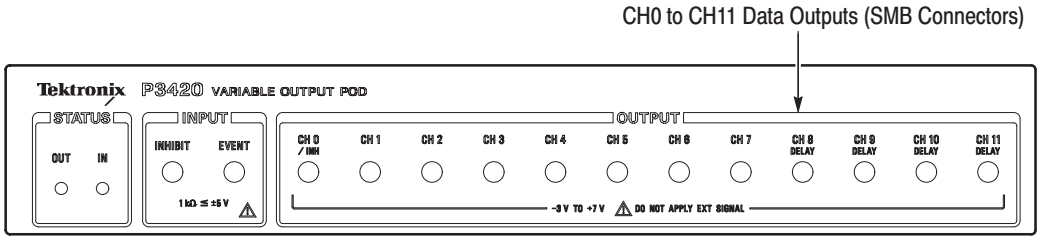


Figure 4-22: P3420 output connectors

Output Voltage Levels

This test confirms pod output voltages into a 1 MΩ load.

Precision : ±(3% of Amplitude) ± 0.1 V

Variable voltage levels for the amplitude

High level: –2 V to +7 V

Low level: –3 V to +6 V

■ **Required Equipment**

- DG2020A
- Pod connection cable
- BNC to dual banana adapter
- SMB-to-BNC cable
- 1 MΩ resistor
- Performance check disk

■ **Connections** Connect the CH0 data output pin for the pod connected to the DG2020A to the digital multimeter input through an SMB-to-BNC cable, and a BNC to dual banana adapter. Connect the 1 MΩ resistor across the BNC to dual banana adapter terminals.

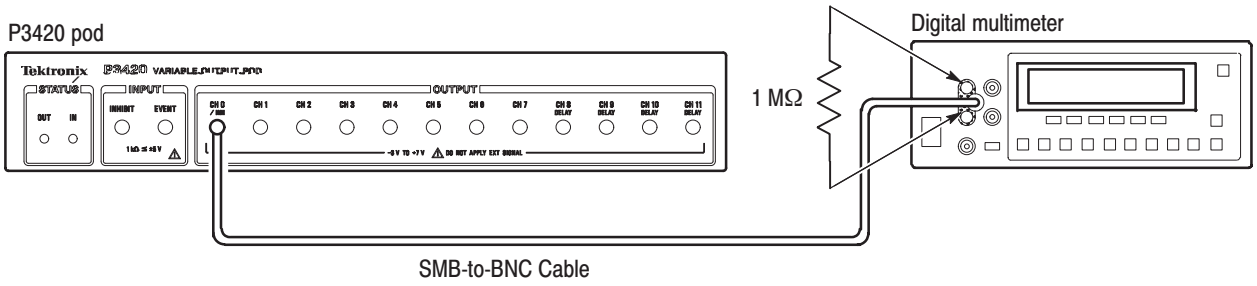


Figure 4-23: Output voltage level measurement connections

■ **Setup**

- Digital multimeter

  Function . . . . . DCV
  Range . . . . . Auto

■ **Characteristics Confirmation Procedure**

The following six steps confirm the high level output voltage accuracy.

1. Load the **TP8DCH.PDA** test pattern file from the performance check disk.
2. Press the keys shown below in the indicated order to set the high level voltage to –2 V and the low level voltage to –3 V.

Menu button	Bottom button	Popup menu	Side button	Front panel button
SETUP	Level/Delay			
Move the cursor to CH00 with the general purpose knob.				
			High Level	–, 2, ENTER
			Low Level	–, 3, ENTER

3. Press the **START/STOP** button on the front panel so that the button's LED indicator lights.

4. Confirm that the reading on the digital multimeter is in the range –2.16 to –1.84 V.

5. Set the high level voltage to 0 V, 2.0 V, 4.0 V and 7.0 V as shown in Table 4-6, and confirm that the digital multimeter reading falls within the specified voltage ranges. Note that the low level voltage is automatically set to –2 V when the high level voltage is set to 7 V.

Table 4-6: High level output voltage ranges for a 1 MΩ load

Settings		High level output voltage range
High level	Low level	
0 V	–3.0 V	–0.10 V to 0.10 V
2.0 V	–3.0 V	1.84 V to 2.16 V
4.0 V	–3.0 V	3.78 V to 4.22 V
7.0 V	–2.0 V	6.69 V to 7.31 V

6. Move the SMB-to-BNC cable connected to the P3420 CH0 output connector to CH1 through CH11 in turn, and confirm the high level output voltage ranges in the same way for each of these channels.

The remaining steps confirm the low level output voltage accuracy.

7. Move the SMB-to-BNC cable connected to the P3420 data output connector back to CH0.

8. Load the **TP9DCL.PDA** test pattern file from the performance check disk.

9. Press the keys shown below in the indicated order to set the low level voltage to 6 V and the high level voltage to 7 V.

Menu button	Bottom button	Popup menu	Side button	Front panel button
SETUP	Level/Delay			
Move the cursor to CH00 with the general purpose knob.				
			Low Level	6, ENTER
			High Level	7, ENTER

10. Press the **START/STOP** button on the front panel so that the button's LED indicator lights.

11. Confirm that the reading on the digital multimeter is in the range 5.72 to 6.28 V.

12. Set the low level voltage to 4.0 V, 2.0 V, 0.0 V and –3.0 V as shown in Table 4-7, and confirm that the digital multimeter reading falls within the specified voltage range. Note that the high level voltage is automatically set to 6 V when the low level voltage is set to –3 V.

Table 4-7: Low level output voltage ranges for a 1 MΩ load

Settings		High level output voltage range
Low level	High level	
4.0 V	7.0 V	3.78 V to 4.22 V
2.0 V	7.0 V	1.84 V to 2.16 V
0.0 V	7.0 V	–0.10 V to 0.10 V
–3.0 V	6.0 V	–3.19 V to –2.81 V

13. Move the SMB-to-BNC cable connected the P3420 CH0 output connector to CH1 through CH11 in turn, and confirm the low level output voltage ranges in the same way for each of these channels.

Variable Delay

This test confirms that the delay with respect to the P3420 CH0 is within the range ±(0.8 ns + 3% of the delay time). This test is for the channels that support variable delay times, i.e., channels CH8 to CH11.

- **Required Equipment**
  - DG2020A
  - Pod connection cable
  - Oscilloscope
  - Two SMB-to-BNC cables
  - Performance check disk
- **Connections** Connect the P3420 CH0 and CH8 data output pins to the oscilloscope CH1 and CH2 inputs using the SMB-to-BNC cables.

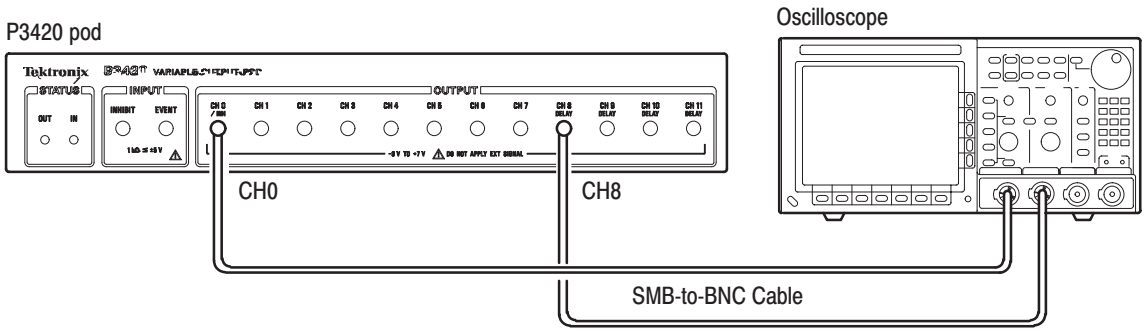


Figure 4-24: Variable delay precision check

- **Setup**
  - Oscilloscope

Displayed channels	CH1 and CH2
Vertical axis	2 V/div
Horizontal axis	2 ns/div
MEASURE	CH1 → CH2 DLY
Record Length	2500 points in 50 divs
Trigger source	CH1
Input coupling (CH1 and CH2)	DC
Input impedance (CH1 and CH2)	1 MΩ

■ Characteristics Confirmation Procedure

1. Load the **TP7DELAY.PDA** test pattern file from the performance check disk.

2. Press the following keys in the order shown. In the present state the CH8 through CH11 delay settings will all be 0.0 ns.

Menu button	Bottom button	Popup menu	Side button	Front panel button
SETUP	Level/Delay			
Move the cursor to CH08 with the general purpose knob.				
			Delay	

3. Press the **START/STOP** button on the front panel so that the button's LED indicator lights.

4. Observe the two clock pulses on the oscilloscope, and read off the CH8 delay value referenced to CH0 with the timing measured between points with voltages of 50% of the peak value. Confirm that the values measured with the oscilloscope for the delay settings in Table 4-8 fall within the delay span ranges in the table below.

Table 4-8: Delay precision

Settings	Delay span range
0.0 ns	–0.80 ns to 0.80 ns
2.0 ns	1.14 ns to 2.86 ns
5.0 ns	4.05 ns to 5.95 ns
10.0 ns	8.90 ns to 11.10 ns
20.0 ns	18.60 ns to 21.40 ns

5. Move the pin header cable connected to the P3420 CH8 to channels CH9 through CH11 in turn, and repeat step 3 to confirm the delay values.

Event Input and Inhibit Input

This test confirms that the event jump and inhibit operations function correctly in response to signals applied to the P3420 pod event and inhibit inputs.

- **Required Equipment**
  - DG2020A
  - Oscilloscope
  - Pod connection cable
  - SMB-to-BNC cable
  - SMB to SMB cable
  - Performance check disk
- **Connections** Connect the P3420 CH0 output connector to the oscilloscope CH1 input using an SMB-to-BNC cable. Also, connect the P3420 CH1 output pin to the P3420 pod **EVENT INPUT** using an SMB to SMB cable.

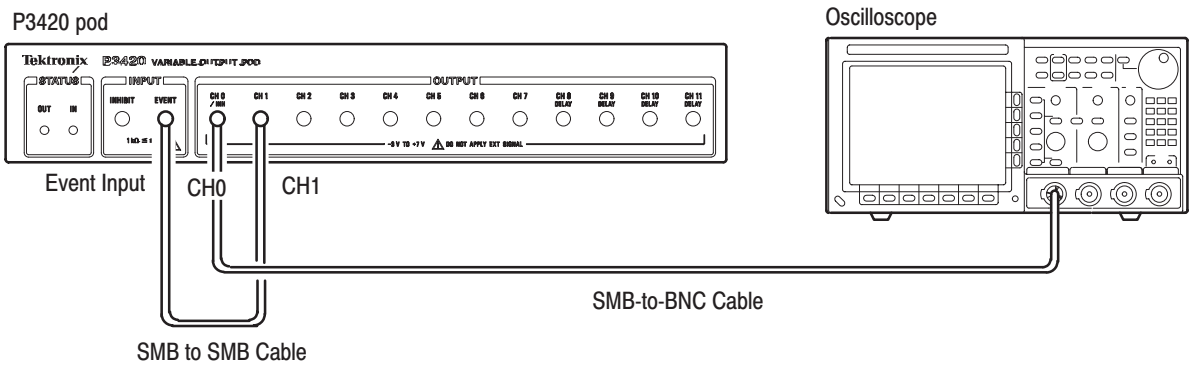


Figure 4-25: Event input operation confirmation connections

- **Setup**
  - Oscilloscope

Displayed channel	CH1
Vertical axis	2 V/div
Horizontal axis . . .	200 ns/div
Trigger mode	Auto
Trigger level	1.5 V
Input coupling	DC
Hold off	9 μs
Input impedance . .	1 MΩ

■ Characteristics Confirmation Procedure

The following three steps confirm the event input operation.

1. Load the **TP5EVENT.PDA** test pattern file from the performance check disk.
2. Press the **START/STOP** button on the front panel so that the button's LED indicator lights.
3. Confirm that a 1 μs square wave and a 500 ns square wave are displayed on the oscilloscope alternately for 1 cycle and 2 cycles respectively.

The following four steps confirm the inhibit input operation.

4. Remove the SMB connector connected to the pod CH0 and connect it to CH2. Next, remove the SMB connector connected to CH1 and connect it to CH0. Remove the SMB connector connected to **EVENT INPUT** and connect it to **INHIBIT INPUT**.

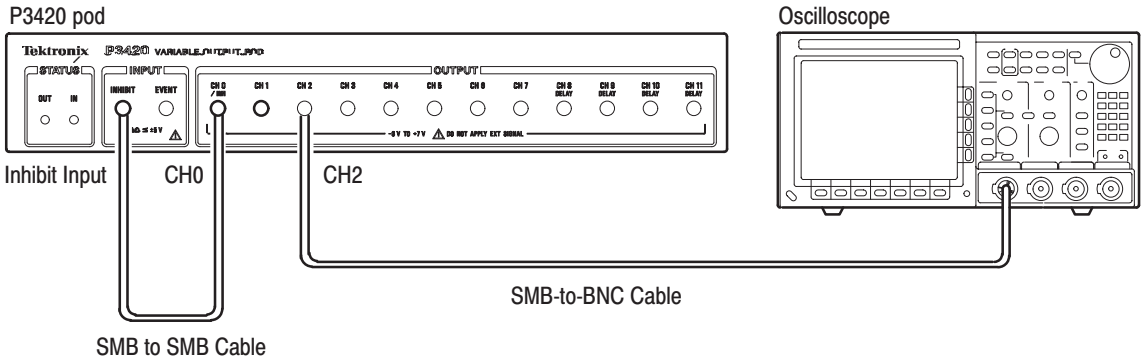


Figure 4-26: Inhibit input operation confirmation connections

5. Set the oscilloscope CH1 input impedance to 50Ω.
6. Press the **START/STOP** button on the front panel twice.
7. Confirm that a square wave with a 1 μs period is displayed on the oscilloscope.

Adjustment Procedures

The DG2020A does not contain any adjustments.

Maintenance

This section contains the information needed to do periodic and corrective maintenance on the DG2020A Data Generator. Specifically, the following subsections are included:

- *Preparation*. This subsection includes this introduction plus general information on preventing damage to internal modules when doing maintenance. See below.
- *Inspection and Cleaning*. Information and procedures for inspecting the DG2020A and cleaning its external and internal modules. See page 6-4.
- *Repacking*. Procedures for removing defective modules and replacing new or repaired modules. See page 6-9.
- *Repacking*. Information on packaging the DG2020A properly for shipment. See page 6-45.
- *Troubleshooting*. Information for isolating failed modules. Included are instructions for operating the DG2020A internal diagnostic routines and troubleshooting flowcharts for fault isolation. Most of the flowcharts make use of the internal diagnostic routines to speed fault isolation to a module. See page 6-47.

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* and the *Service Safety Summary*, beginning on page vii near the beginning of this manual.
- Read the *Strategy for Servicing* on page xiii near the beginning of this manual.
- Read section 2, *Operating Information*, before servicing the DG2020A.

Preventing ESD



CAUTION. *Static discharge can damage any semiconductor component in the DG2020A.*

Precautions. When performing service which requires internal access to the DG2020A, 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 DG2020A cabinet unless you have met precaution number 3, above. Consider all internal modules static-sensitive.
5. Do not allow anything capable of generating or holding a static charge on the work station surface.
6. Handle circuit boards by the edges when possible.
7. Do not slide the modules over any surface.
8. Avoid handling modules in areas that have a floor or work-surface covering capable of generating a static charge.
9. Do not use high-velocity compressed air when cleaning dust from modules.

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

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

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

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

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

Inspection and Cleaning

This subsection describes how to determine whether the DG2020A needs cleaning, and how to do the cleaning. Inspection and cleaning are preventive maintenance procedures. When done regularly, preventive maintenance may prevent DG2020A malfunction and enhance reliability.

Preventive maintenance consists of visually inspecting and cleaning the DG2020A, and using general care when operating it.

How often to do maintenance depends on the severity of the environment in which the DG2020A operates.

General Care

The cabinet helps keep dust out of the DG2020A and is a major component of the instrument cooling system. The cabinet should normally be in place when operating the DG2020A. The DG2020A front cover (optional accessory) protects the front panel and display from dust and damage. Install it when storing or transporting the instrument.

Inspection and Cleaning Procedures

Inspect and clean the DG2020A as operating conditions require. The collection of dirt on components inside can cause them to overheat and break down. (Dirt acts as an insulating blanket, preventing efficient heat dissipation.) Dirt also provides an electrical conduction path that can cause an instrument failure, especially under high-humidity conditions.



WARNING. *To avoid personal injury or death due to electric shock, unplug the power cord from the line voltage source before cleaning the DG2020A.*



CAUTION. *To prevent damaging the plastics used in the DG2020A, do not use chemical cleaning agents. Use only deionized water when cleaning the menu buttons or front-panel buttons. Use a 75% isopropyl alcohol solution as a cleaner, and rinse with deionized water. Before using any other type of cleaner, consult your Tektronix Service Center or representative.*

To prevent damaging DG2020A components, do not use high-pressure compressed air when cleaning dust from the interior of the DG2020A. (High pressure air can cause electrostatic discharge.) Instead, use low pressure compressed air (about 9 psi).

Inspection — Exterior. Inspect the outside of the DG2020A for damage, wear, and missing parts, using Table 6-2 as a guide. If the DG2020A appears to have been dropped or otherwise abused, check it thoroughly to verify correct operation and performance. Repair any defects that may cause personal injury or lead to further damage to the DG2020A.

Table 6-2: External inspection check list

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

Cleaning Procedure — Exterior.



WARNING. *To avoid potential electric shock hazard or damage to the DG2020A circuits, do not allow any moisture inside the DG2020A during external cleaning; use only enough liquid to dampen the cloth or applicator.*

1. Remove loose dust on the outside of the DG2020A with a lint free cloth.
2. Remove remaining dirt with a lint free cloth dampened in a general purpose detergent-and-water solution. Do not use abrasive cleaners.
3. Clean the light filter protecting the monitor screen with a lint-free cloth dampened with either isopropyl alcohol or, preferably, a gentle, general purpose detergent-and-water solution.

Inspection — Interior. To access the inside of the DG2020A for inspection and cleaning, refer to the *Removal and Installation Procedures* in this section.

Inspect the internal portions of the DG2020A for damage and wear using Table 6-3 as a guide. Repair any defects immediately.



CAUTION. *To prevent damage from electrical arcing, ensure that circuit boards and components are dry before applying power to the DG2020A.*

Table 6-3: Internal inspection check list

Item	Inspect for	Repair action
Circuit boards	Loose, broken, or corroded solder connections; burned circuit boards; burned, broken, or cracked circuit-run plating	Remove failed modules and replace with a new module.
Resistors	Burned, cracked, broken, blistered condition	Replace failed module and replace with a new module.
Solder connections	Cold solder or rosin joints	Resolder joint and clean with isopropyl alcohol.
Capacitors	Damaged or leaking cases; corroded solder on leads or terminals	Remove damaged module and replace with a new module from the factory.
Semiconductors	Loosely inserted in sockets.; distorted pins.	Firmly seat loose semiconductors. Remove devices that have distorted pins. Carefully straighten pins (as required to fit the socket), using long-nose pliers, and reinsert firmly. Ensure that straightening action does not crack pins, causing them to break off.
Wiring and cables	Loose plugs or connectors; burned, broken, or frayed wiring.	Firmly seat connectors. Repair or replace modules with defective wires or cables.
Chassis	Dents, deformations, and damaged hardware	Straighten, repair, or replace defective hardware.

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

1. Blow off dust with dry, low-pressure, deionized air (approximately 9 psi).
2. Remove any remaining dust with a lint-free cloth dampened in isopropyl alcohol (75% solution), and rinse with warm deionized water. (A cotton-tipped applicator is useful for cleaning in narrow spaces and on circuit boards.)
3. If steps 1 and 2 do not remove all the dust or dirt, the DG2020A may be spray washed using a solution of 75% isopropyl alcohol by doing step 4 through 8.

4. Gain access to the parts to be cleaned by removing easily accessible shields and panels (see *Removal and Installation Procedures* in this section).
5. Spray wash dirty parts with the isopropyl alcohol, and wait 60 seconds for the majority of the alcohol to evaporate.
6. Use hot (48.9° C to 60° C/120° F to 140° F) deionized water to thoroughly rinse the parts.
7. Dry all parts with low-pressure, deionized air.
8. Dry all components and assemblies in an oven or drying compartment using low-temperature (51.7° C to 65.6° C/125° F to 150° F) circulating air.

Lubrication. There is no periodic lubrication required for the DG2020A.

Removal and Installation Procedures

This subsection describes removing and installing the mechanical and electrical modules in the DG2020A.

Preparation

This subsection contains the following information:

- Preparatory information needed to properly do the procedures that follow
- A list of equipment required when removing modules
- Module locator diagrams for finding each module in the DG2020A
- Procedures for removing and installing electrical and mechanical modules



WARNING. *To avoid possible personal injury or damage to DG2020A components, read the* Preparation for Use *subsection on page 2-1, and* Preventing ESD *on page 6-2. Before doing this or any other procedure in this manual, read the* General Safety Summary *and the* Service Safety Summary, *beginning on page vii near the beginning of this manual.*

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

List of Mechanical Parts

Section 10, *Mechanical Parts List*, lists all mechanical parts in the DG2020A.

General Instructions

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

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

To remove a module, begin by doing the *Access Procedure* (on page 6-12). 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 6-12 identifies the procedure for removing each module. These categories separate the procedures based on their location in the DG2020A.

- *Procedures for External Modules* on page 6-15 describes how to remove modules which can be removed without internal access to the DG2020A.
- *Procedures for Internal Modules* on page 6-26 describes how to remove modules which require internal access to the DG2020A.

Equipment Required

The removal of most modules in the DG2020A requires only a screwdriver handle mounted with a size T-15, Torx® screwdriver tip. Use this tool whenever a procedure step instructs you to remove or install a screw, unless a different size screwdriver is specified in that step. The first step of a module procedure lists all equipment required to remove and reinstall the module.

Table 6-4: Equipment required

Name	Description	Part number
Screwdriver handle	Accepts Torx®-driver bits	003-0524-00
T-9 Torx® tip	Torx®-driver bit for T-9 size screw heads	003-0965-00
T-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-bladed screwdriver	Screwdriver for removing standard-headed screws	
Hex wrench, 0.050 inch	Standard tool	
Hex wrench, $^{1}/_{16}$ inch	Standard tool	
Needle-nose pliers	Standard tool	
Nut driver, $^{1}/_{2}$ inch	Standard tool	
Nut driver, $^{1}/_{4}$ inch	Standard tool	
Nut driver, $^{5}/_{16}$ inch	Standard tool	
Nut driver, 5 mm	Standard tool	
Open-end wrench $^{1}/_{2}$ inch	Standard tool	
Soldering iron	Standard tool	

DG2020A Orientation

In this manual, procedures refer to “front,” “back,” “top,” etc. of the DG2020A. Figure 6-1 shows how the sides are referenced.

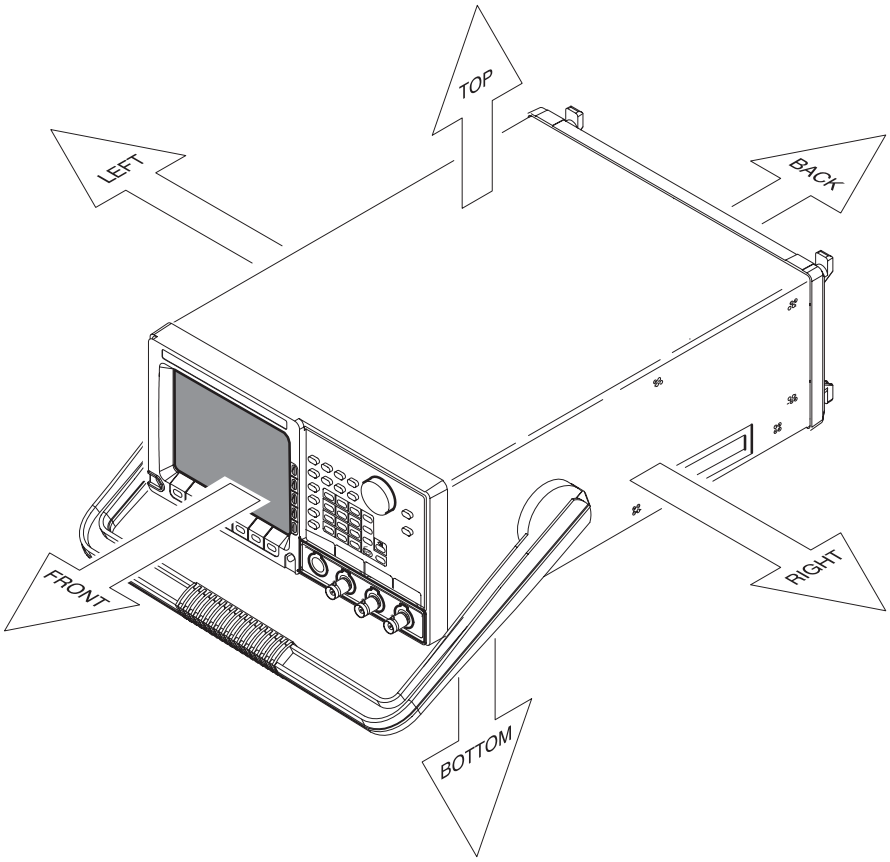


Figure 6-1: DG2020A orientation

Access Procedure

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

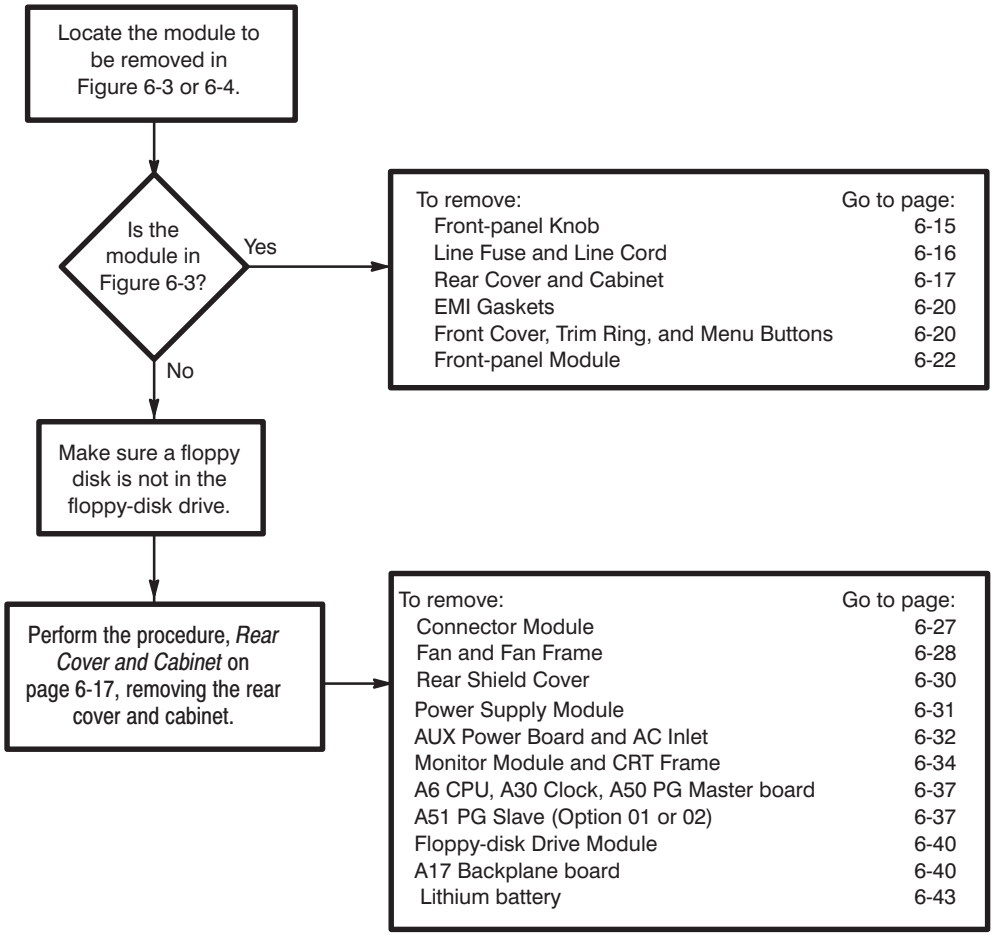


Figure 6-2: Guide to removal procedures

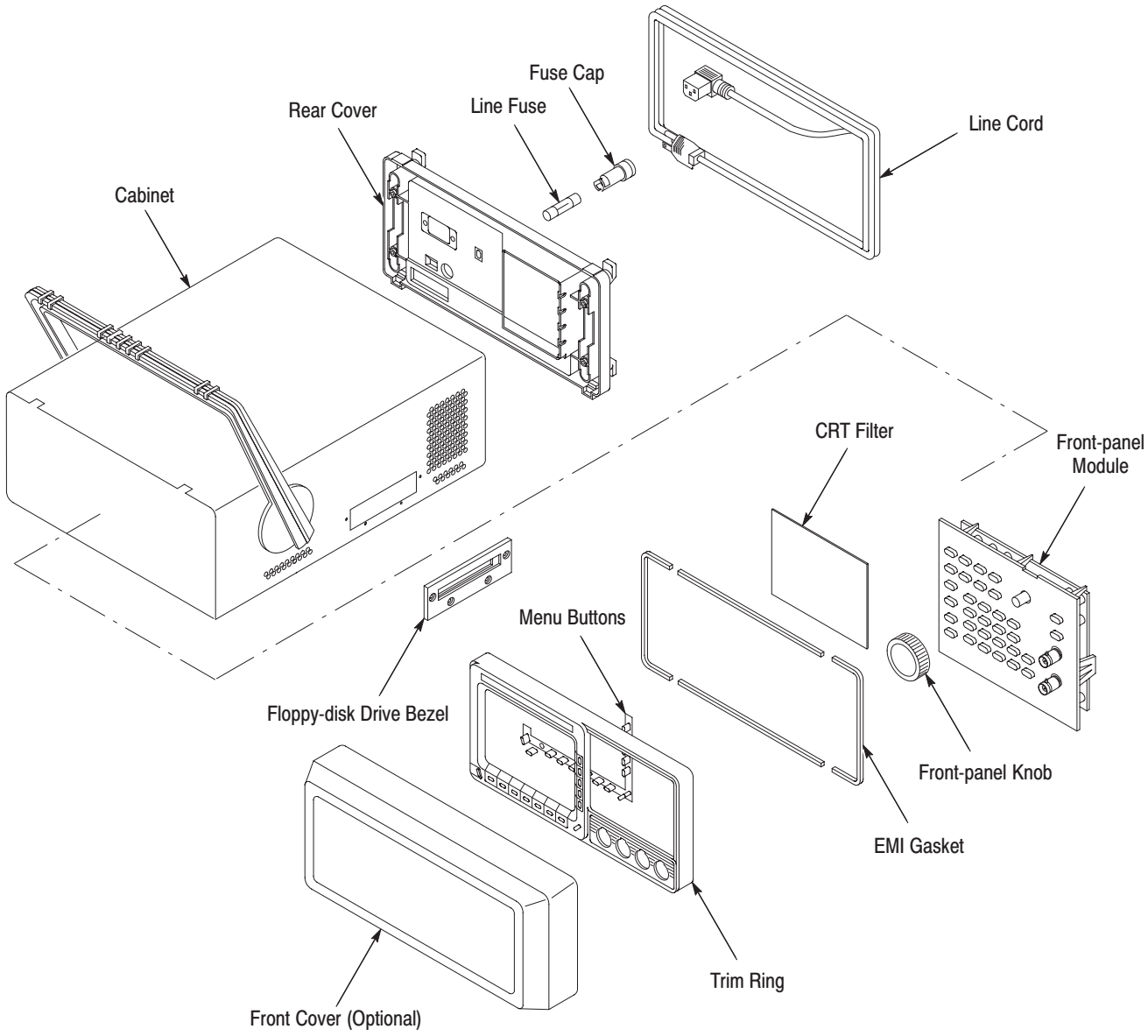


Figure 6-3: External modules

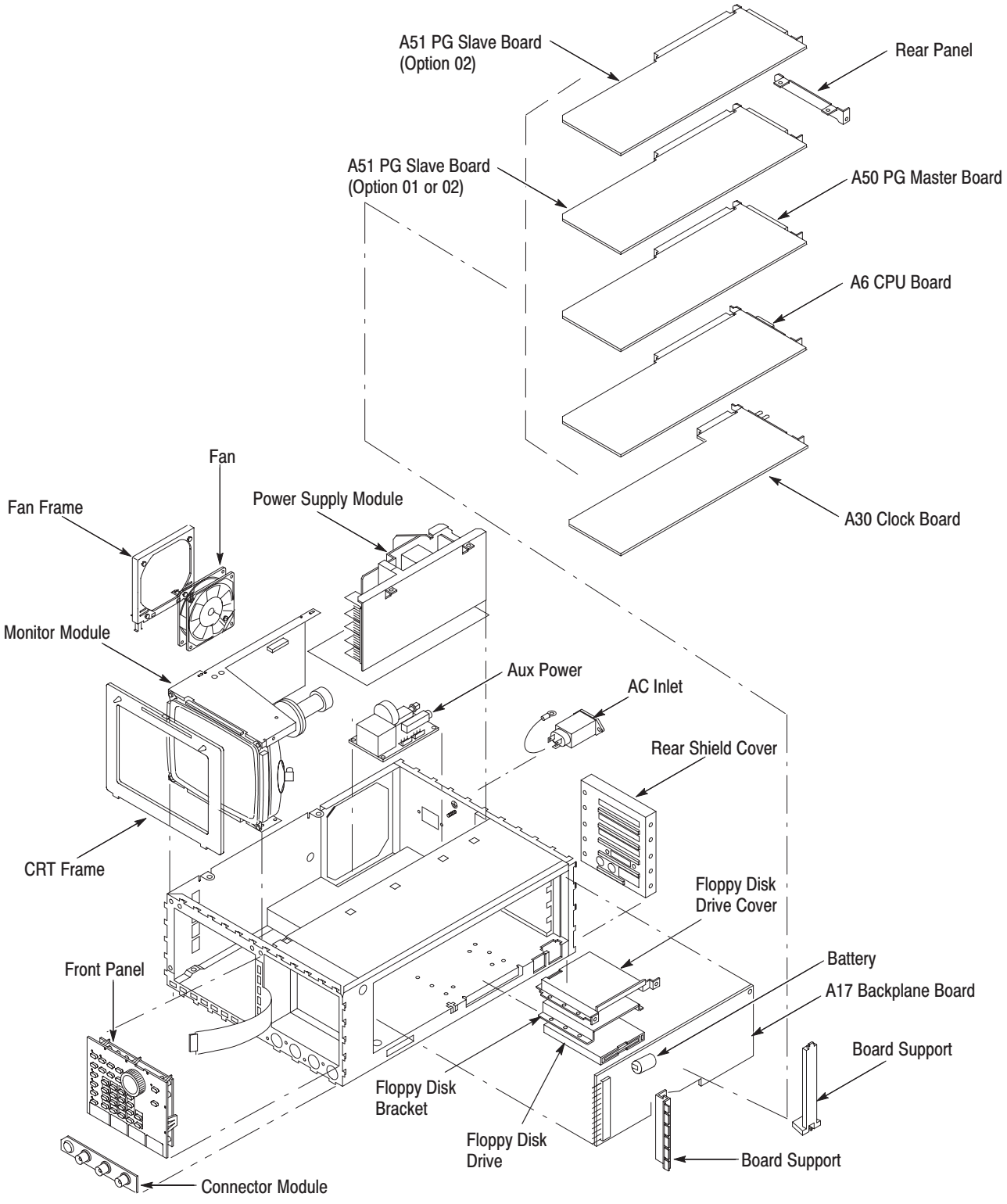


Figure 6-4: Internal modules

Procedures for External Modules

Perform the *Access Procedure* (page 6-12) 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 the locator diagram, *External Modules*, Figure 6-3.
2. *Orient instrument:* Set the DG2020A with the bottom down on the work surface and the front facing you (see Figure 6-5).
3. *Remove front cover:* If the optional front cover is installed, grasp the front cover by the left and right edges and snap it off of the trim ring. (When reinstalling, align and snap back on.)
4. *Remove knob:* Loosen the setscrew securing the knob using the $\frac{1}{16}$-inch hex wrench. Pull the knob toward you to remove it.
5. *Reinstallation:* Place the knob onto the shaft, and tighten the setscrew using the $\frac{1}{16}$-inch hex wrench.

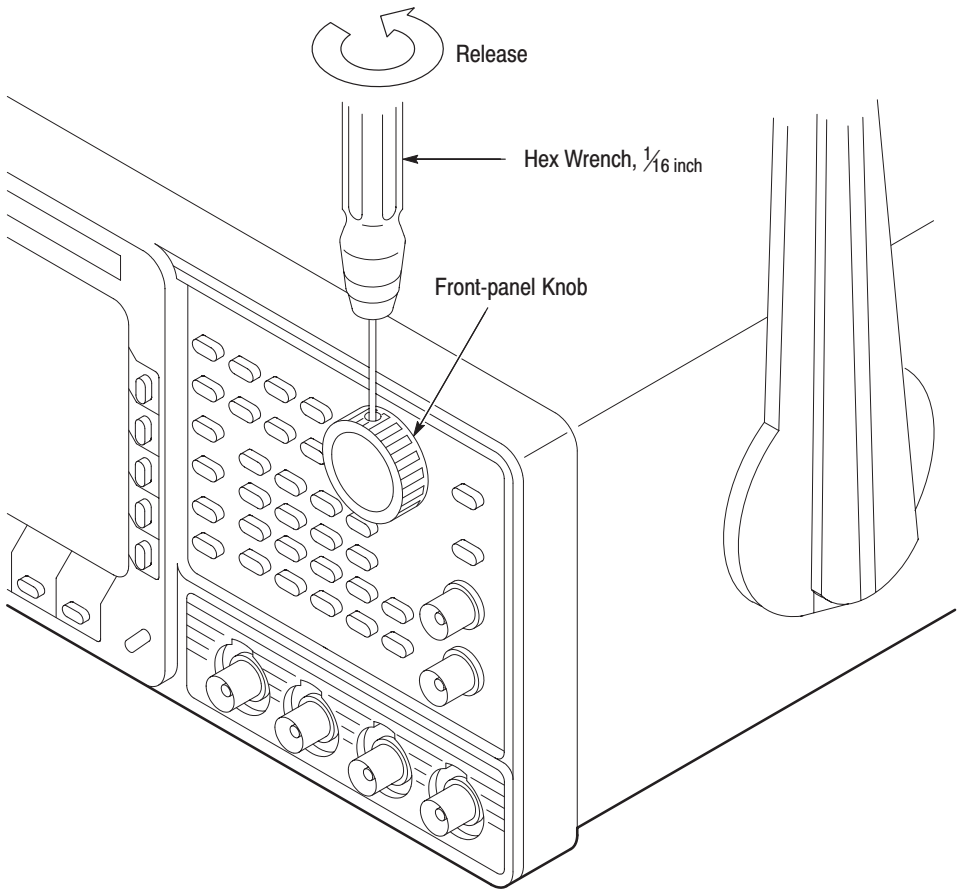


Figure 6-5: Front-panel knob removal

Line Fuse and Line Cord

1. *Assemble equipment and locate modules to be removed:* You will need a flat-bladed screwdriver for this procedure. Locate the line fuse and line cord in the locator diagram, *External Modules*, Figure 6-3.
2. *Orient instrument:* Set the DG2020A with the bottom down on the work surface and the back facing you. If you are servicing the line fuse, do the next step; if you are servicing the line cord, skip to step 4.
3. *Remove line fuse:* Find the fuse cap on the rear panel. See Figure 6-6. Now, remove the fuse cap by turning it counter-clockwise using a flat-bladed screwdriver, and remove the line fuse. Reverse the procedure to reinstall.
4. *Remove line cord:* Find the line cord on the rear cover. See Figure 6-6. Now, remove the line-cord retaining clamp by first unplugging the line cord from the line cord receptacle (1). Next, grasp both the line cord and the retaining

clamp and rotate it 90 degrees, counter-clockwise (2). Pull the line cord and clamp away to complete the removal (3). Reverse the procedure to reinstall.

5. *Reinstallation:* Perform steps 3 and 4 in reverse order to reinstall the line cord, and then the line fuse.

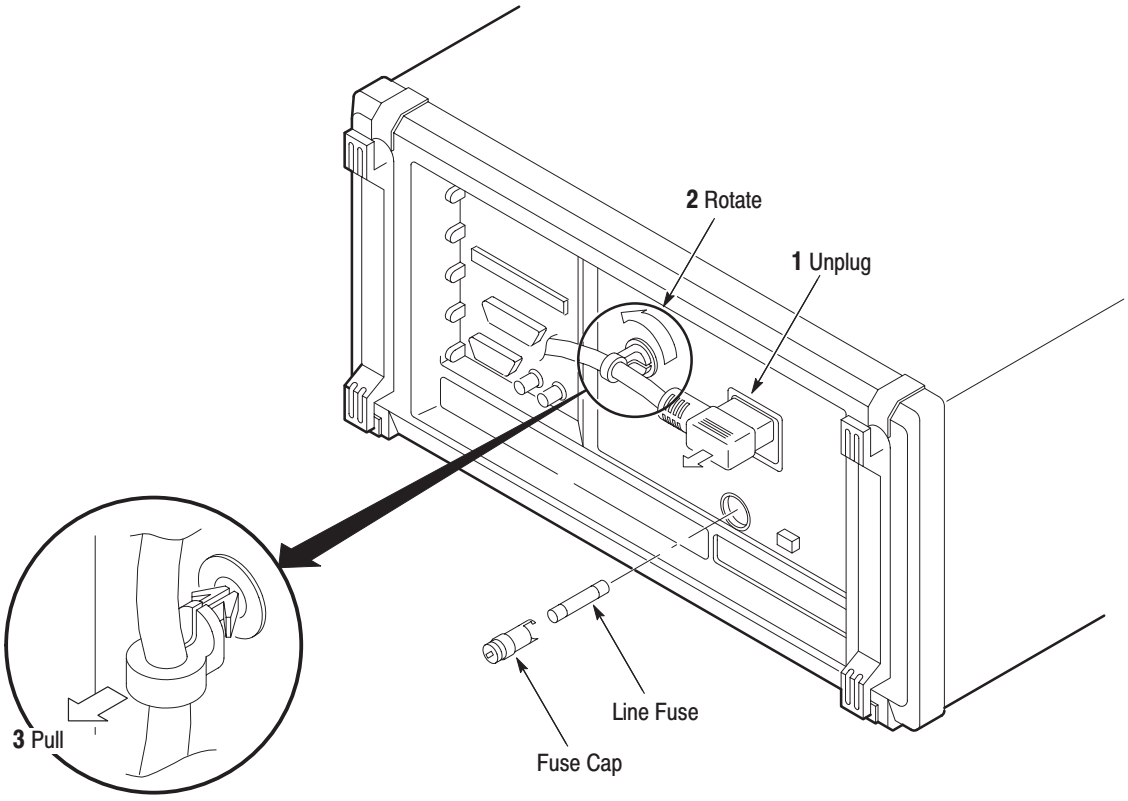


Figure 6-6: Line fuse and line cord removal

Rear Cover and Cabinet

1. *Assemble equipment and locate modules to be removed:*
   - **a.** You will need a screwdriver with size T-9 and T-15 Torx tips for this procedure.
   - **b.** Make sure the DG2020A front cover (optional accessory) is installed. If it is not, install it by snapping the edges of the front cover over the trim ring.
   - **c.** Locate the rear cover and cabinet in the locator diagram, *External Modules*, Figure 6-3.
2. *Orient instrument:* Set the DG2020A face 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 6-16, removing only the line cord.

4. *Remove rear cover:* Using a screwdriver with a size T-15 Torx tip, remove the four screws securing the rear cover to the instrument. Lift off the rear cover.

5. *Orient instrument:* Set the DG2020A face down, with the front cover on the work surface and right side facing you.

6. *Remove floppy disk drive bezel:* Using a screwdriver with a size T-9 Torx tip, remove the four screws securing the floppy-disk drive bezel to the cabinet. Lift off the floppy-disk drive bezel.

7. *Remove cabinet:*



CAUTION. *To prevent damaging the eject button, make sure floppy disk is not inserted in the floppy disk drive, before removing the cabinet from the DG2020A.*

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

   b. Grasp the right and left edges of the cabinet toward the back.

   c. Pull upward to slide the cabinet off the instrument. Take care not to bind or snag the cabinet on internal cabling as you remove it.

8. *Reinstall cabinet and rear cover:*

   a. Perform steps 3 through 7 in reverse order to reinstall the cabinet.

   b. Take care not to bind or snag the cabinet on internal cabling; redress cables as necessary.

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

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

   e. See the procedure, *Line Fuse and Line Cord,* on page 6-16 to reinstall the line cord. This completes the DG2020A reassembly.

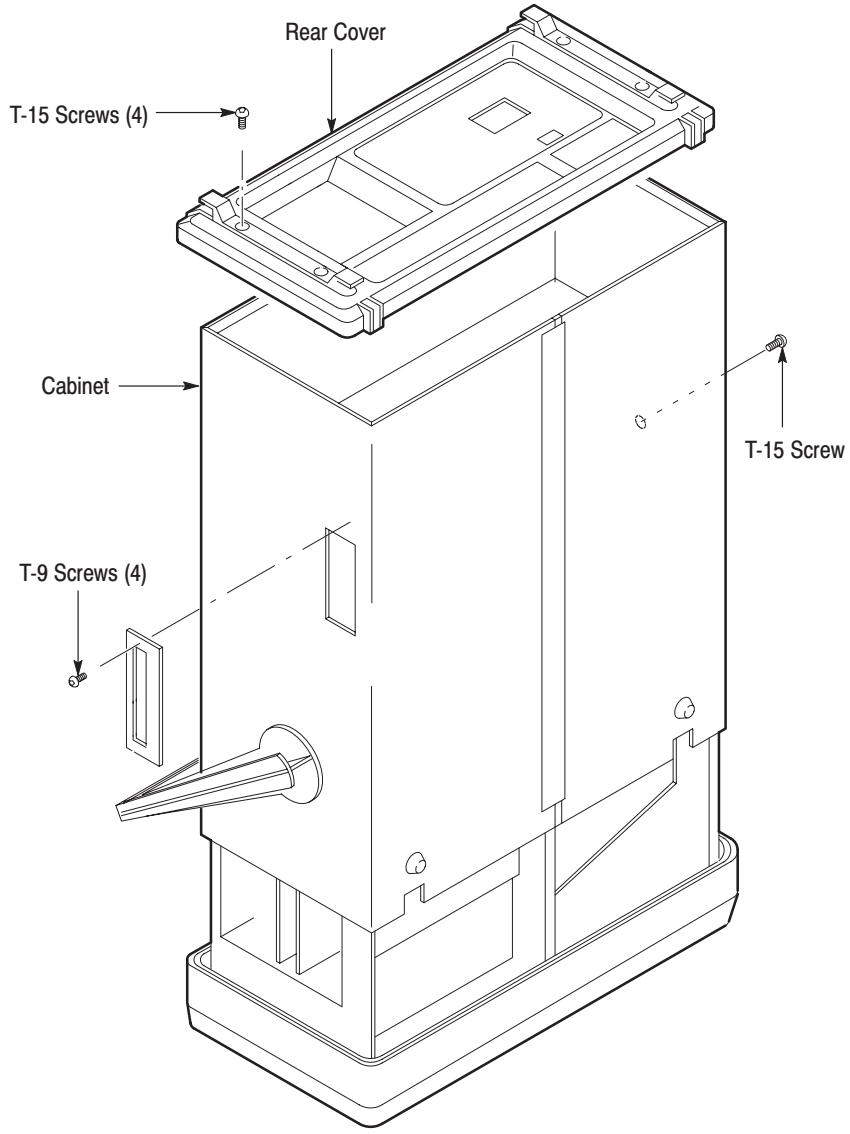


Figure 6-7: Rear cover and cabinet removal

EMI Gaskets

1. *Remove front cover and trim ring:* Perform the *Front Cover, Trim Ring, and Menu Buttons* procedure on page 6-20, removing only the front cover and trim ring.



CAUTION. *To prevent exceeding the environmental characteristics for EMI, carefully follow the instructions given, when reinstalling the EMI gaskets and/or the DG2020A cabinet.*

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

Front Cover, Trim Ring, and Menu Buttons

1. *Assemble equipment and locate modules to be removed:* No tools are needed. Locate the modules to be removed in the locator diagram, *External Modules*, in Figure 6-3.
2. *Orient instrument:* Set the DG2020A 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. (When reinstalling, align and snap back on.)
4. *Remove front-panel knob:* Perform the *Front-panel Knob* procedure, on page 6-15.

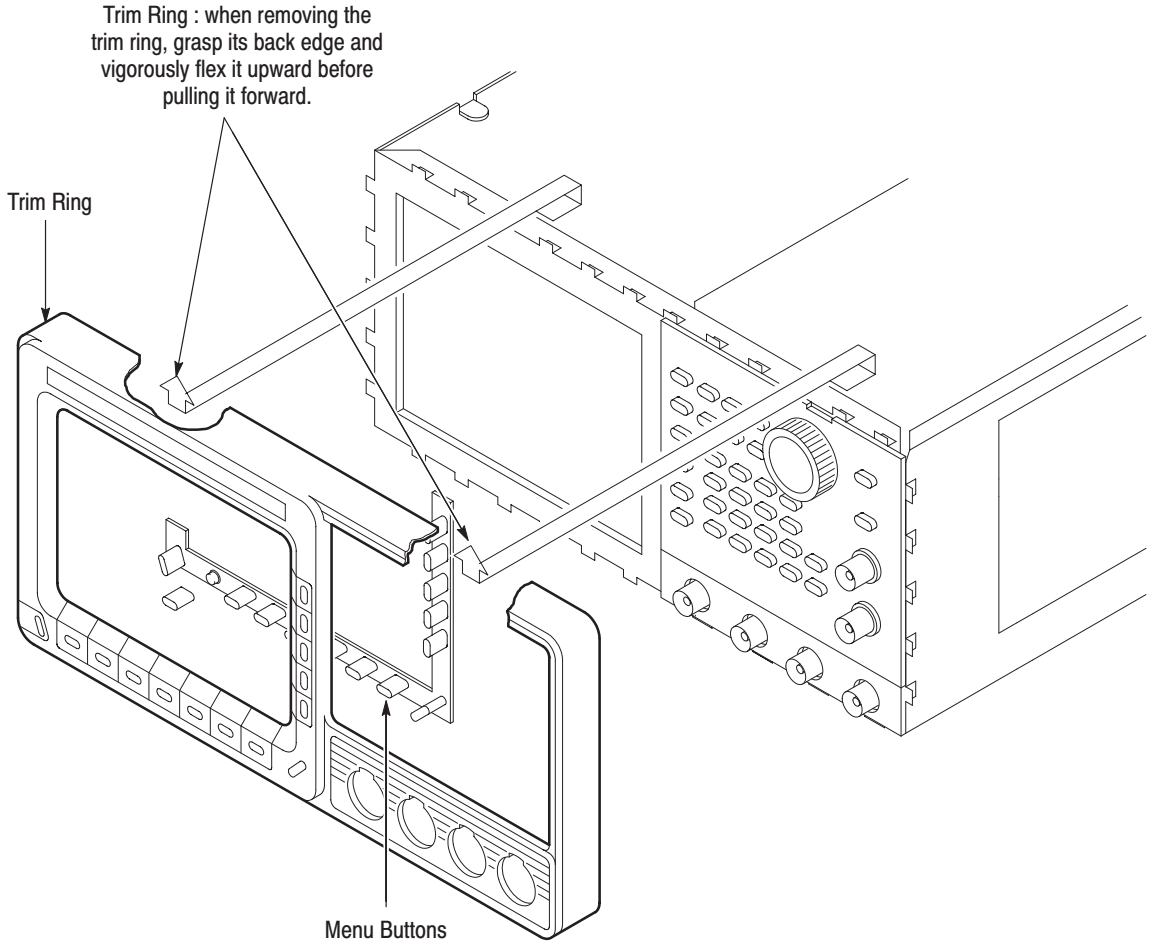


Figure 6-8: Front cover, trim ring, and menu button removal (front cover not shown)



CAUTION. *To prevent contaminating DG2020A parts, do not touch the carbon contact points on the menu buttons installed in the trim ring. Also, do not touch the contacts on the flex circuit exposed when you remove the trim ring.*

5. *Remove trim ring:* Grasp the trim ring by the top edge and pry it up and lift it forward to snap it off of the trim ring. If servicing the menu buttons, lift them out of the trim ring. (When reinstalling, reinsert the menu buttons, align the trim ring to the chassis and press it back on.)

6. *Reinstallation:* Perform steps 3–5 in reverse order to reinstall the menu buttons, trim ring and the front cover, following the reinstallation instructions found in each step.

Front-panel Module

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

1. *Assemble equipment and locate modules to be removed:*
   a. You will need a flat-bladed screwdriver and a 0.05-inch and $\frac{1}{16}$-inch hex wrench for this procedure.
   b. Locate the modules to be removed in the locator diagram, *External Modules*, in Figure 6-3.
   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 6-15.
3. *Remove front cover, trim ring, and menu buttons:* Perform the *Front Cover, Trim Ring, and Menu Button*s procedure on page 6-20 removing only the module(s) you want to service.
4. *Orient instrument:* Set the DG2020A with the bottom down on the work surface and the front facing you.
5. *Remove front-panel module:*
   a. As shown in Figure 6-9, release the snap at the right of the front-panel module using a flat-bladed screwdriver. Lift the front-panel module out of the chassis until you can reach the interconnect cable.
   b. Disconnect the ribbon interconnect cable at J101 and flexible board connector at JP301 on the A12 Keyboard assembly.
   c. Finally, lift the front-panel module out of the chassis to complete the removal.

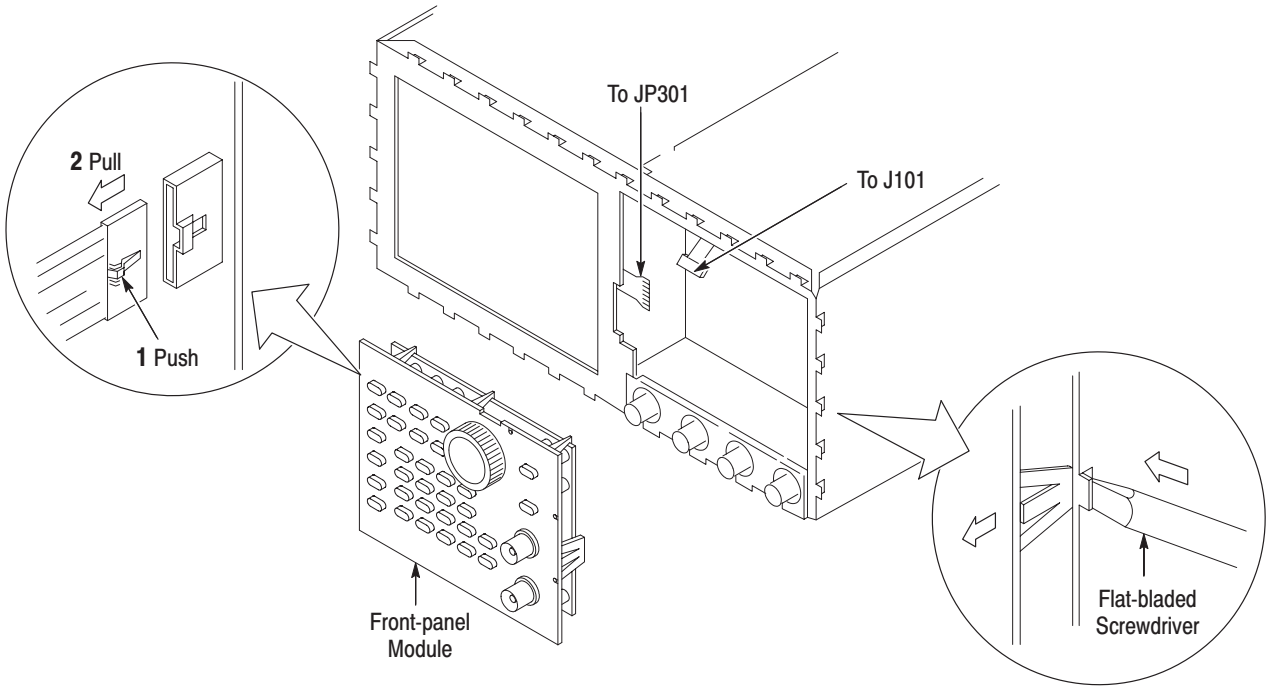


Figure 6-9: Front-panel module removal

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

   a. Remove the front-panel knob from the front-panel module using the method described in the procedure, *Front-panel Knob,* on page 6-15.

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

   c. As shown in Figure 6-10, release the four hooks, and then remove the A12 Keyboard from the chassis.

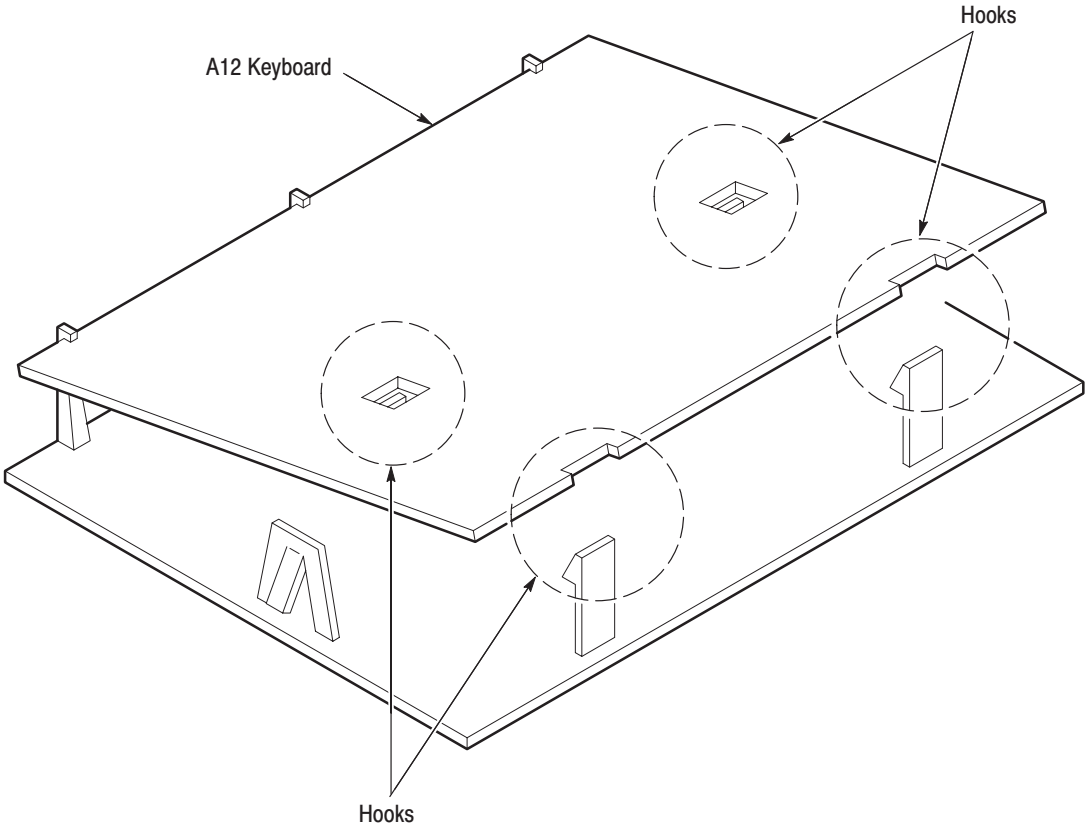


Figure 6-10: A12 keyboard removal

d. Now hand disassemble the front-panel module components using Figure 6-11 as a guide. Reverse the procedure to reassemble.

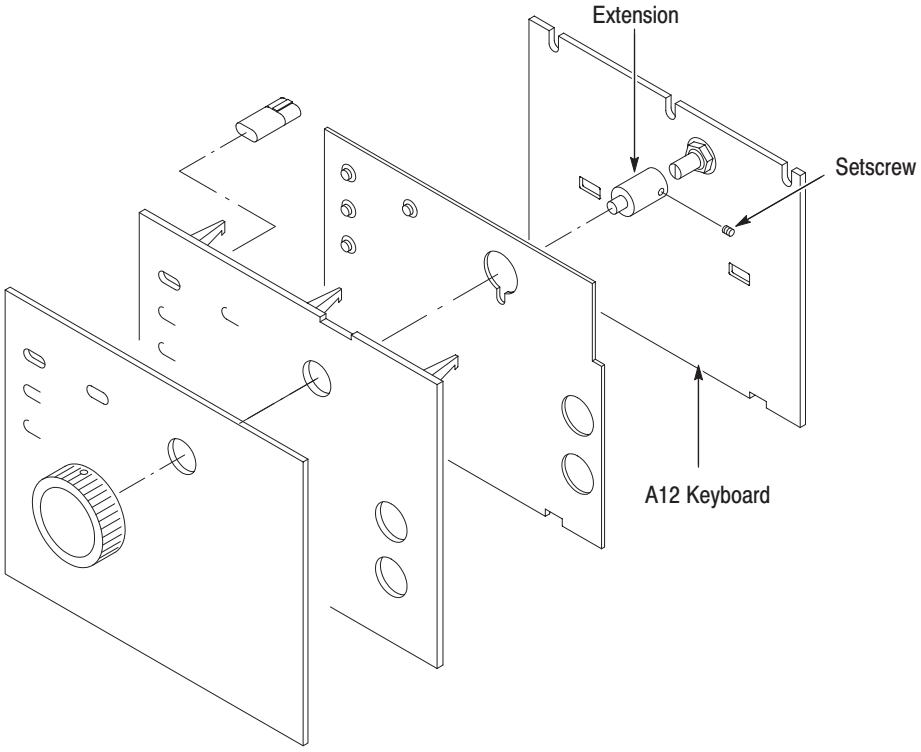


Figure 6-11: Disassembly of front-panel module

7. *Reinstallation:* If the front-panel module was further disassembled in step 6, then reverse substeps 6a–6d to reassemble, using Figure 6-11 as a guide. Then do the substeps in step 3 in reverse order, reversing the order of the items in each substep. Last, reinstall the trim ring and, if desired, the front cover, referring to the procedure, *Front Cover, Trim Ring, and Menu Buttons* (page 6-20).

Procedures for Internal Modules

Perform the *Access Procedure* (on page 6-12) before doing any procedure in this group.

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

- 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 Clock Board
  - A50 PG Master Board
  - For Option 01: A51 PG Slave Board
  - For Option 02: A51 PG Slave Board
- A17 Backplane 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 the locator diagram, *Internal Modules*, in Figure 6-4.

2. *Remove front-panel knob:* Perform the *Front-panel Knob* procedure, on page 6-15.

3. *Remove front cover, trim ring, and menu buttons:* Perform the *Front Cover, Trim Ring, and Menu Buttons* procedure on page 6-20.

4. *Orient instrument:* Set the DG2020A 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 EVENT OUTPUT, SYNC OUTPUT, and TRIGGER INPUT 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 BNC connector:*

   a. To remove a BNC connector, remove the nut attaching the BNC connector to the panel using a ½-inch nut driver, and then remove the BNC connector from the panel.

7. *Reinstallation:*

   a. *Install BNC connector:* Perform substep 6a, reversing the order of the items in the substep.

   b. *Install connector module:* Install the connector module by doing substeps 5a–5b in reverse order.

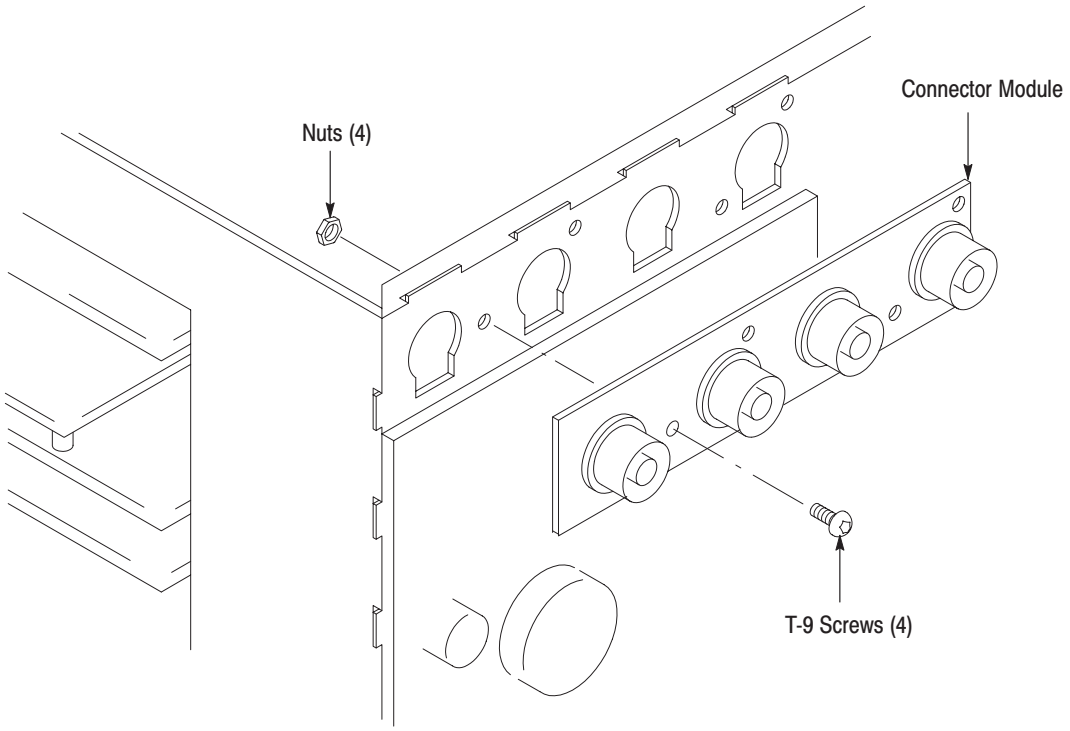


Figure 6-12: Connector module removal

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 the locator diagram, *Internal Modules,* in Figure 6-4.
2. *Orient instrument:* Set the DG2020A with the bottom down on the work surface and the left side facing you.
3. *Remove fan and fan frame:*
   - **a.** Disconnect the ribbon interconnect cable from J3 of the power supply module. See Figure 6-13.
   - **b.** As shown in Figure 6-13, slide (2) in the direction indicated by arrow (1) while pushing it, and then remove the fan and fan frame.
   - **c.** Release the four hooks securing the fan, separate the fan and fan frame.

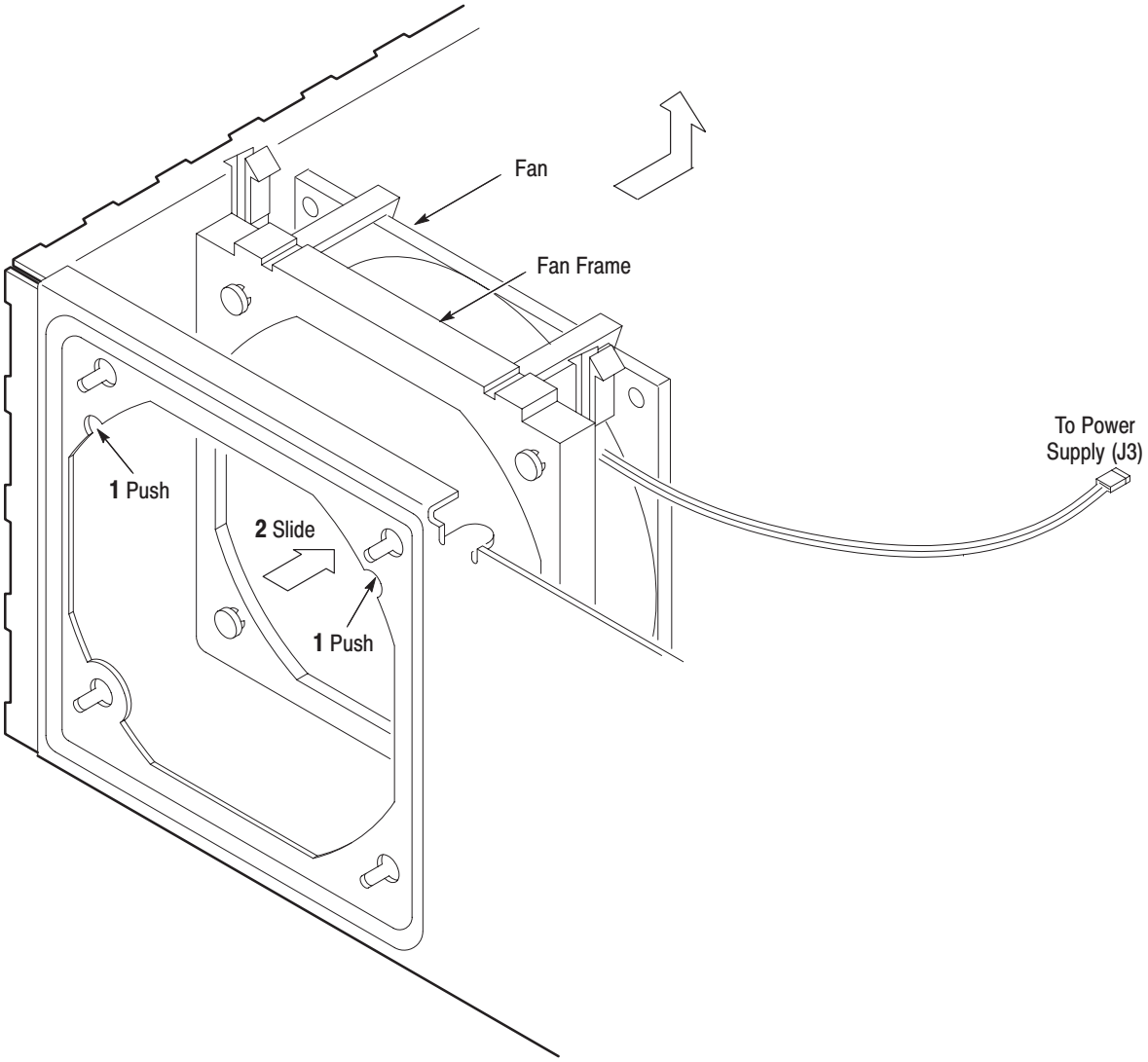


Figure 6-13: Fan and fan frame removal

4. *Reinstallation:*
   a. Secure the fan to the fan frame.
   b. Connect the cable (J3) to 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, and then install them.

Rear Shield Cover

1. *Assemble equipment and locate modules to be removed:*
   - **a.** You will need a screwdriver with a size T-15 Torx tip and a $^1/_4$-inch nut driver, a 5 mm nut driver and a $^1/_2$-inch nut driver for this procedure.
   - **b.** Locate the modules to be removed in the locator diagram, *Internal Modules*, Figure 6-4.
2. *Orient instrument:* Set the DG2020A with the bottom down on the work surface and the back facing you (see Figure 6-14).
3. *Remove rear shield cover:*
   - **a.** Using a screwdriver with a size T-15 Torx tip, remove the five screws securing the rear shield cover to the chassis from the back side.
   - **b.** Using a screwdriver with a size T-15 Torx tip, remove the five screws securing the rear shield cover to the chassis from the left side.
   - **c.** Using a $^1/_4$-inch nut driver, remove the IEEE STD 488 PORT cover by removing the two spacer posts.
   - **d.** Grasp the tab of the rear shield cover, pull the rear shield cover toward you and then remove the rear shield cover.
   - **e.** You can remove the rear panel of a slot in which no board is mounted.
4. *Reinstallation:* Install the rear shield cover by doing substeps 3a–3e in reverse order.

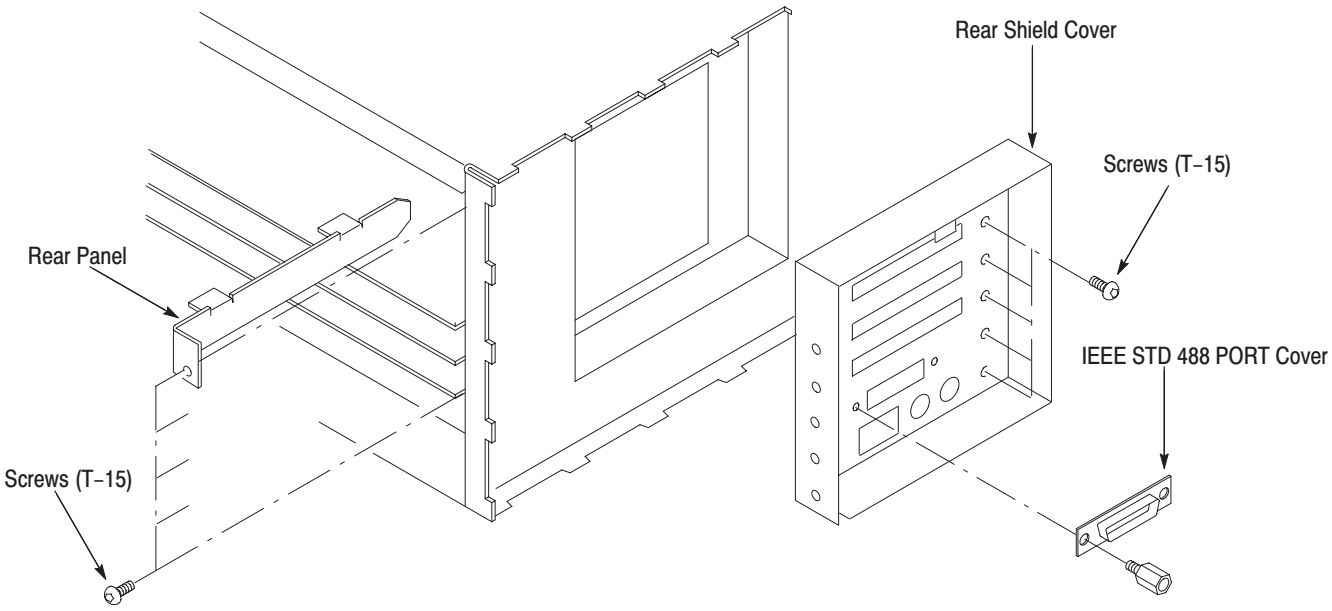


Figure 6-14: Rear shield cover removal

Power Supply Module

1. *Assemble equipment and locate 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 the locator diagram, *Internal Modules*, in Figure 6-4.
2. *Orient instrument:* Set the DG2020A with the bottom down on the work surface and the left side facing you.
3. *Remove 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.

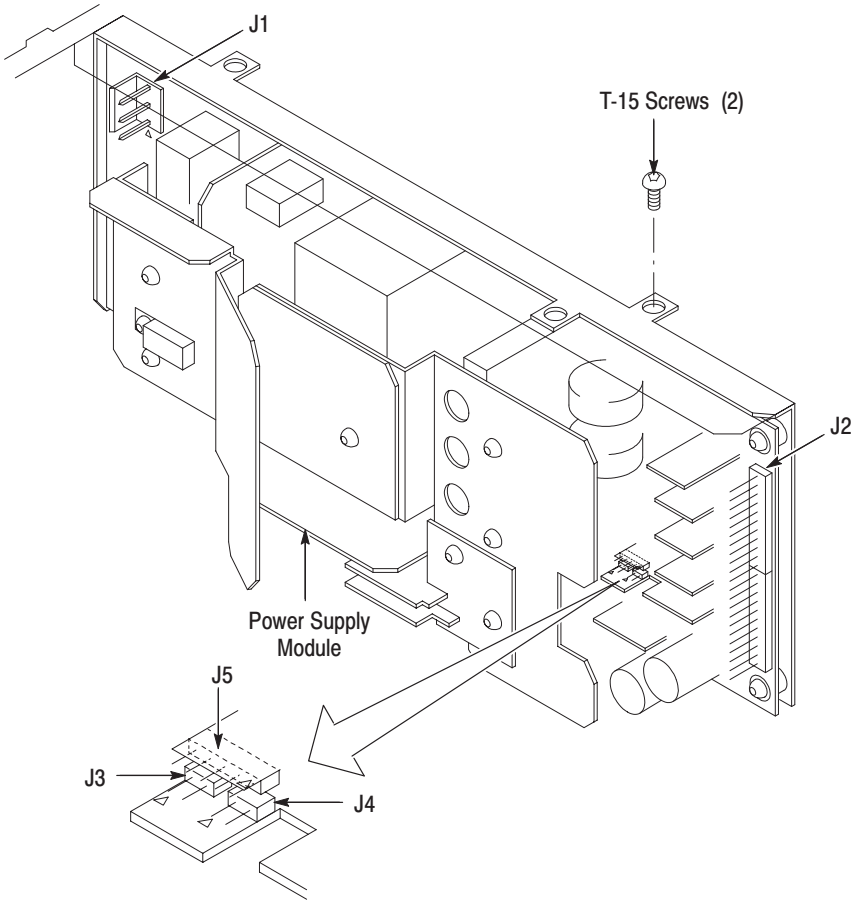


Figure 6-15: Power supply module removal

4. *Reinstallation:* Perform substeps 3a–3c in reverse order to reinstall the power supply module.

AC Inlet and AUX Power Board

1. *Assemble equipment and locate modules to be removed:*
   a. You will need a screwdriver with a size T-15 Torx tip and a 5/16-inch nut driver and a soldering iron for this procedure.
   b. Locate the modules to be removed in the locator diagram, *Internal Modules*, in Figure 6-4.
2. *Remove fan and fan frame:* Perform the *Fan and Fan Frame* procedure on page 6-28.
3. *Orient instrument:* Set the DG2020A 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 procedure, *Power Supply Module*, on page 6-31.
5. *Remove AC inlet:*
   a. Disconnect the interconnect cable at CN1 on the AUX Power board.
   b. Using a 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.

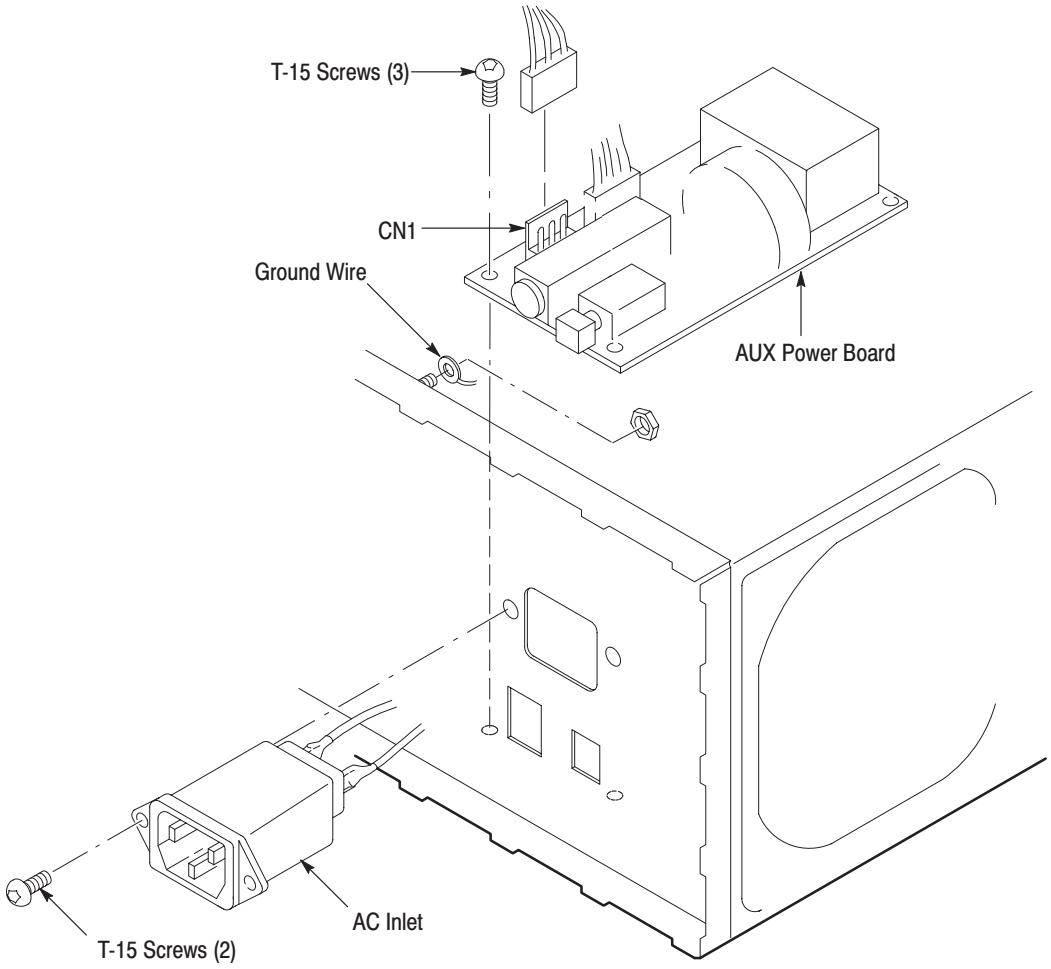


Figure 6-16: AUX power board and AC inlet removal

7. *Reinstallation:*

   a. Install the AUX Power board by doing substeps 6a–6c in reverse order.

   b. Install the AC Inlet by doing substeps 5a–5e in reverse order.

Monitor Module and CRT Frame

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

   a. You will need a screwdriver with a size T-15 Torx tip for this procedure.

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

2. *Remove front cover, trim ring, and menu buttons:* Perform the *Front Cover, Trim Ring, and Menu Button*s procedure on page 6-20.

3. *Orient instrument:* Set the DG2020A with the bottom down on the work surface and the left side facing you.

4. *Remove monitor module:*

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

   a. 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 the screwdriver with a size T-15 Torx tip into the right hole of the chassis, and then remove the screw securing the monitor module.

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

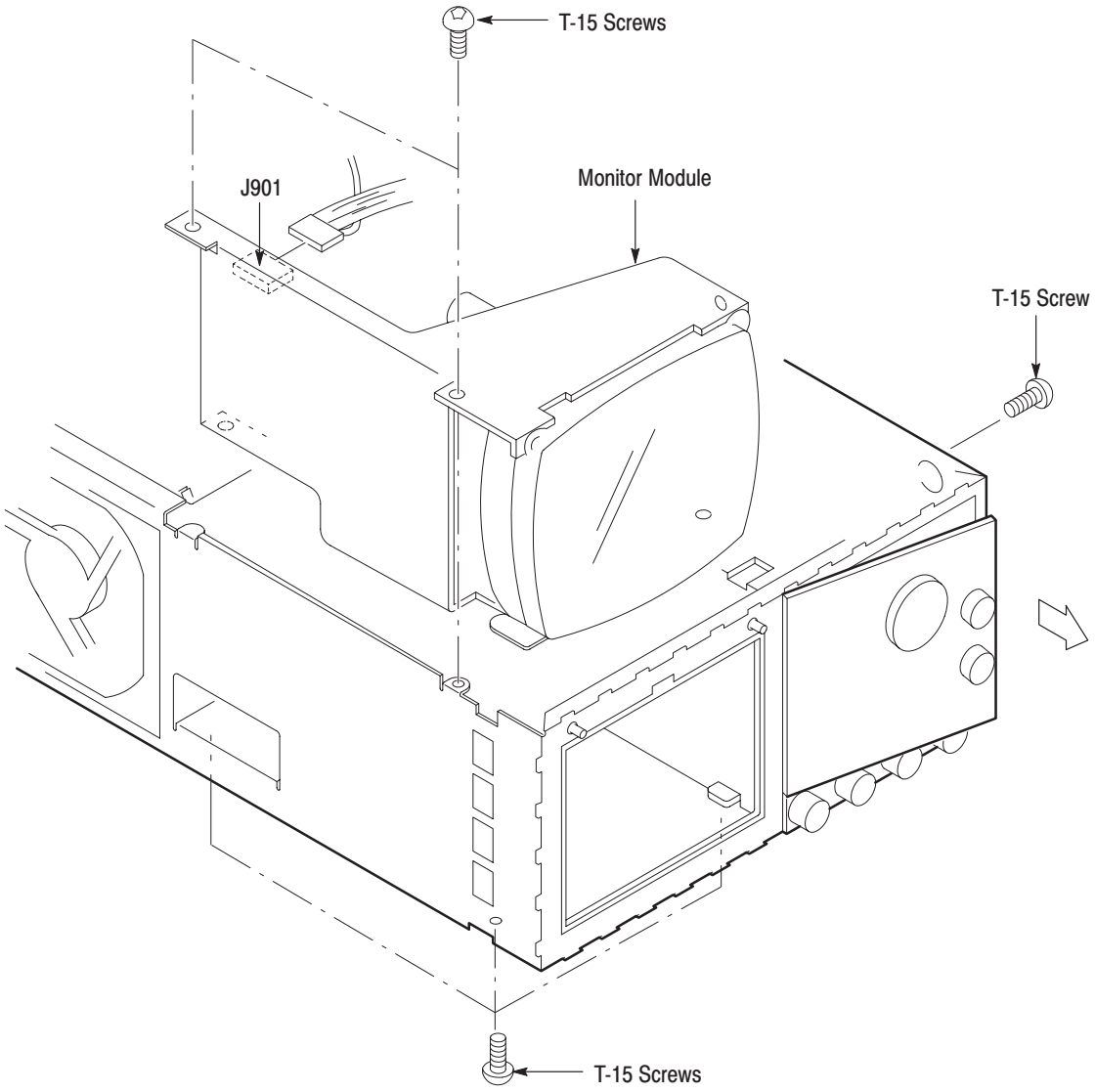


Figure 6-17: Monitor module removal

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

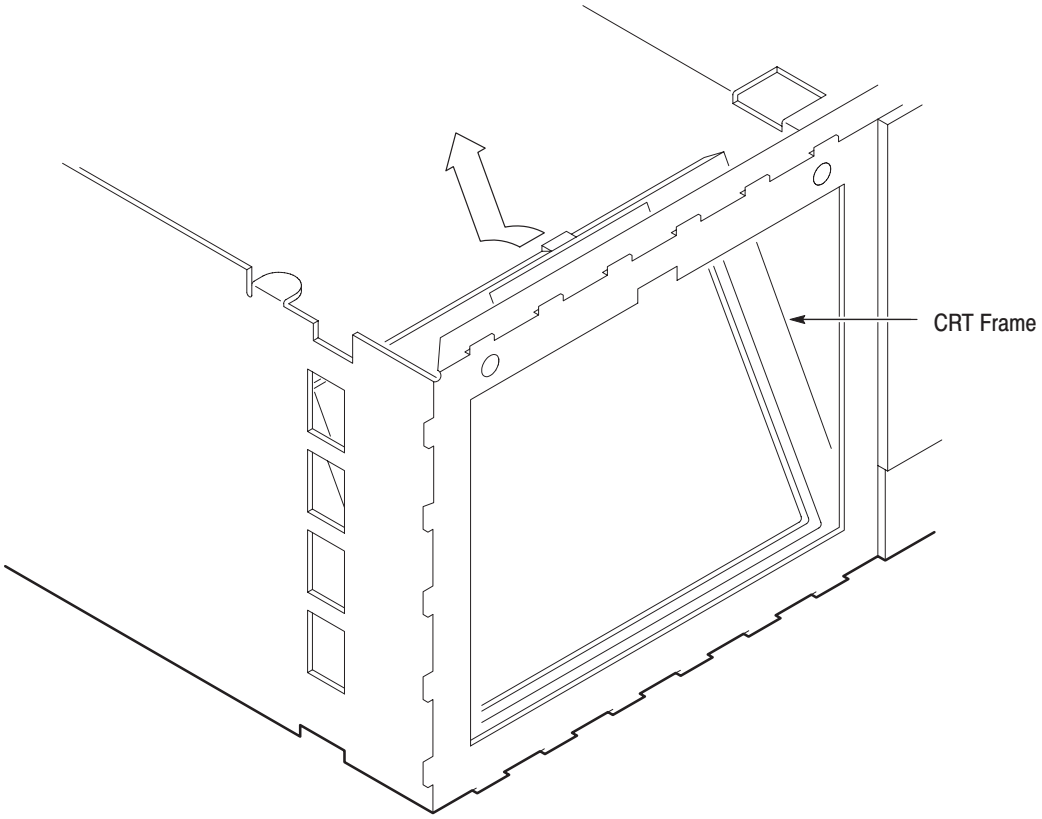


Figure 6-18: CRT frame removal

6. *Reinstallation:*

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

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

Circuit Boards

This procedure describes how to remove these circuit boards:

- A6 CPU Board
- A30 Clock Board
- A50 PG Master Board
- For Option 01: A51 PG Slave Board
- For Option 02: Two A51 PG Slave Boards

1. *Assemble equipment and locate modules to be removed:* No tools are needed; however, the maintenance kit includes an ejector that is useful in removing circuit boards from the chassis. Locate the modules to be removed in the locator diagram, *Internal Modules*, in Figure 6-4.
2. *Remove the rear shield cover:* Perform the procedure, *Rear Shield Cover*, on page 6-30.
3. *Orient instrument:* Set the DG2020A with the left side down on the work surface and the top facing you.
4. *Remove board support:* Remove the board support upward while pushing its hook to the inside.
5. *Remove A6 CPU board:*



CAUTION. *To avoid permanent loss of pattern data file, note the following: A lithium battery which maintains the nonvolatile memory during power-off time is located on the A17 Backplane 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 A17 Backplane board, save the pattern data file in the instrument nonvolatile memory to a floppy disk. Then, after reinstalling the board(s), reload the file into nonvolatile memory.*

   a. Disconnect the ribbon interconnect cables at J30, 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 Clock board:*
   a. Disconnect the interconnect cables at J220, J510 and J511 on the A30 Clock board (see Figure 6-19).

b. Disconnect the interconnect cables at J160 on the A50 PG Master board (see Figure 6-19).

c. For the instrument with Option 01, disconnect the interconnect cables at J520 and J521 on the A30 Clock board (see Figure 6-19).

d. For the instrument with Option 02, disconnect the interconnect cables at J520, J521, J530 and J531 on the A30 Clock board (see Figure 6-19).

e. Grasp the upper part of the A30 Clock board and pull upward to remove it.

7. *Remove A50 PG Master board:*

a. Disconnect the interconnect cables at J160, J510, J511, J940 and J942 on the A50 PG Master board (see Figure 6-19).

b. Grasp the upper part of the A50 PG Master board, and pull upward to remove it.

8. *Remove A51 PG Slave board (Option 01):* The option adds the A51 PG Slave board in the second slot from the top.

a. Disconnect the interconnect cables at J510 and J511 on the A51 PG Slave board (see Figure 6-19).

b. Disconnect the flat cable at J400 on the A51 PG Slave board (see Figure 6-19).

c. Grasp the upper part of the A51 Slave board and pull it upward to remove it.

9. *Remove two A51 PG Slave boards (Option 02):* The option adds two A51 PG Slave boards in the first and second slots from the top.

a. Disconnect the interconnect cables at J510 and J511 on the A51 PG Slave board (the first slot from the top). See Figure 6-19.

b. Disconnect the flat cable at J400 on the A51 PG Slave board (see Figure 6-19).

c. Grasp the upper part of the A51 Slave board (the first slot from the top) and pull it upward to remove it.

d. Disconnect the interconnect cables at J510 and J511 on the A51 PG Slave board (the second slot from the top). See Figure 6-19.

e. Disconnect the flat cable at J400 on the A51 PG Slave board (see Figure 6-19).

f. Grasp the upper part of the A51 Slave board (the second slot from the top) and pull it upward to remove it.

10. *Reinstallation:* Perform the board removal procedures in reverse order, reversing the order of the items in each procedure.

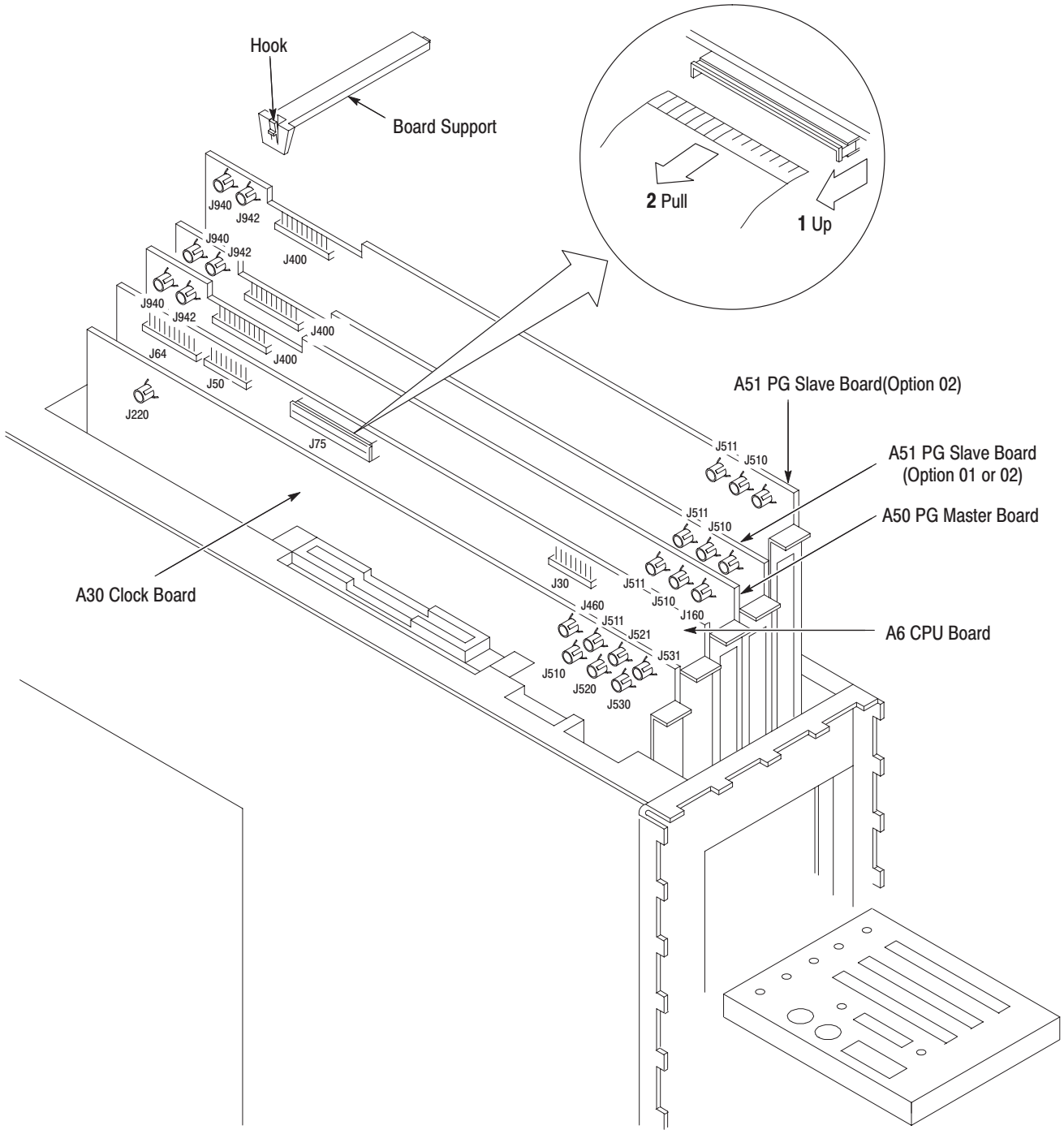


Figure 6-19: Circuit boards removal

A17 Backplane 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 A17 Backplane 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 A17 Backplane board, save the pattern data file in the instrument nonvolatile memory to a floppy disk. Then, after reinstalling 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-bladed screwdriver for this procedure.
   - **b.** Locate the modules to be removed in the locator diagram, *Internal Modules*, in Figure 6-4.
2. *Orient instrument:* Set the DG2020A with the left side down on the work surface and the top facing you.
3. *Remove all boards:* Perform the procedure, *Circuit Boards*, on page 6-37.
4. *Remove A17 Backplane board:*
   - **a.** Remove the five screws and a nut securing the shield cover (see Figure 6-20).
   - **b.** Grasp the shield cover, and take it out.
   - **c.** Disconnect the ribbon interconnect cable at J10 on the A17 Backplane board.
   - **d.** Disconnect the flat cable at J6 on the A17 Backplane board.
   - **e.** Remove the remaining four screws securing the A17 Backplane board to the chassis.
   - **f.** Using a flat-bladed screwdriver, release the four hooks of the circuit board support that holds the A17 Backplane board, lift the A17 Backplane board sideways, and then take it out.
5. *Reinstallation:*
   - **a.** *Install the A17 Backplane board:* Perform substeps 4a–4f in reverse order to install the board.

b. *Install the other boards:* Perform the procedure, *Circuit Boards*, on page 6-37, in reverse order, reversing the items in each step.

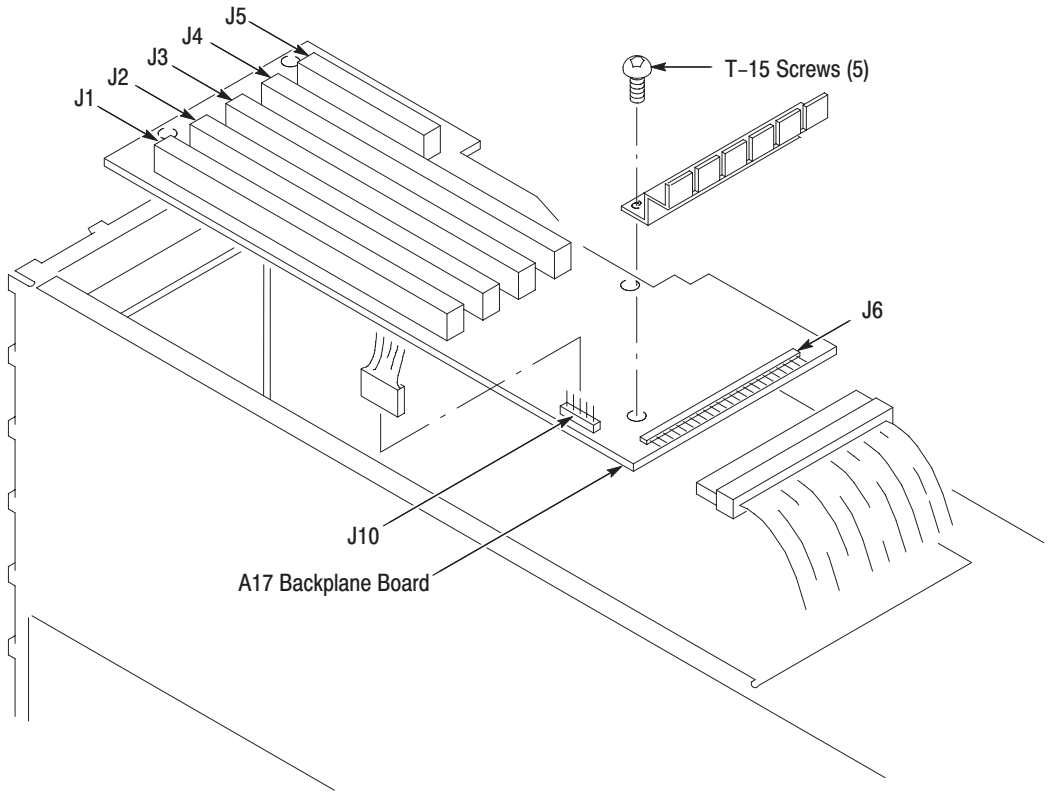


Figure 6-20: A17 backplane board removal

Lithium Battery



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

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

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

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

- **a.** You will need a soldering iron for this procedure.
- **b.** You will also need a replacement lithium battery having the part number listed in section 10, *Mechanical Parts List.*
- **c.** Locate the battery to be removed in the locator diagram, *Internal Modules*, in Figure 6-4.

2. *Remove A17 Backplane board:* Perform the *A17 Backplane Board* procedure on page 6-40.

3. *Orient board:* Set the A17 Backplane board on an insulating surface.

4. *Remove used battery:*

- **a.** Unsolder the tabs at the ends of the battery, taking care not to heat the battery (see Figure 6-21).
- **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.

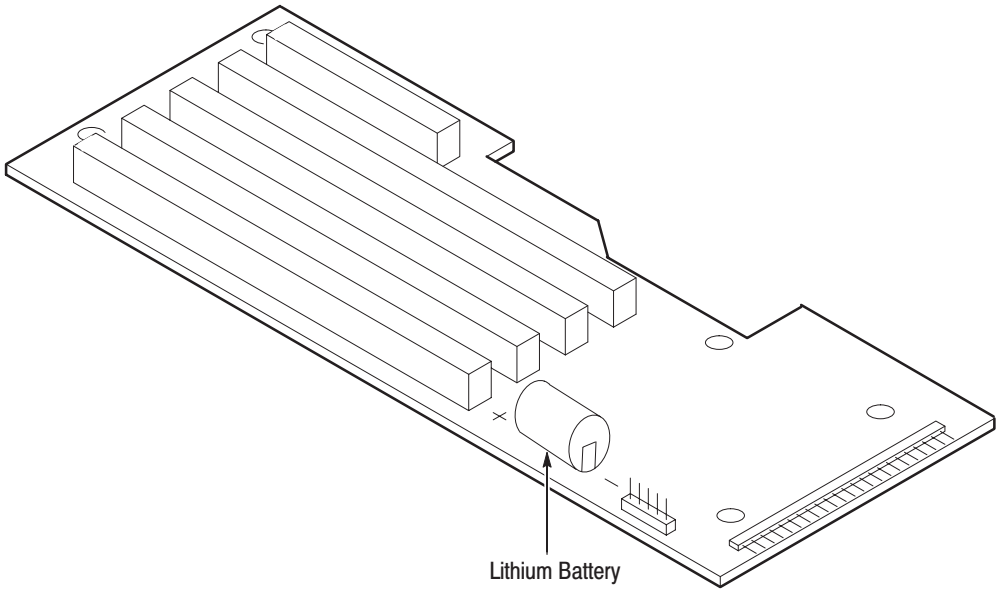


Figure 6-21: Battery location on the A17 backplane board

Floppy-disk Drive Module

1. *Assemble equipment and locate modules to be removed:*
   - **a.** You will need a screwdriver with a size T-10 Torx tip and a size #1 Phillips tip for this procedure.
   - **b.** Locate the modules to be removed in the locator diagram, *Internal Modules*, in Figure 6-4.
2. *Remove rear shield cover:* Perform the *Rear Shield Cover* procedure on page 6-30.
3. *Orient instrument:* Set the DG2020A with the left side down on the work surface and the bottom facing you.
4. *Remove all circuit boards:* Perform the procedure, *Circuit Boards*, on page 6-37.
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 **¿¿¿¿**).
   - **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 screws securing the spacer to floppy-disk drive.

e. Grasp the upper part of the floppy-disk drive, and pull it upward to remove it.

6. *Reinstallation:*

a. *Install floppy-disk drive module:* Perform substeps 5**¿¿¿¿**–5**¿¿¿¿** in reverse order.

b. *Install circuit boards:* Perform the procedure, *Circuit Boards*, on page 6-37, in reverse order.

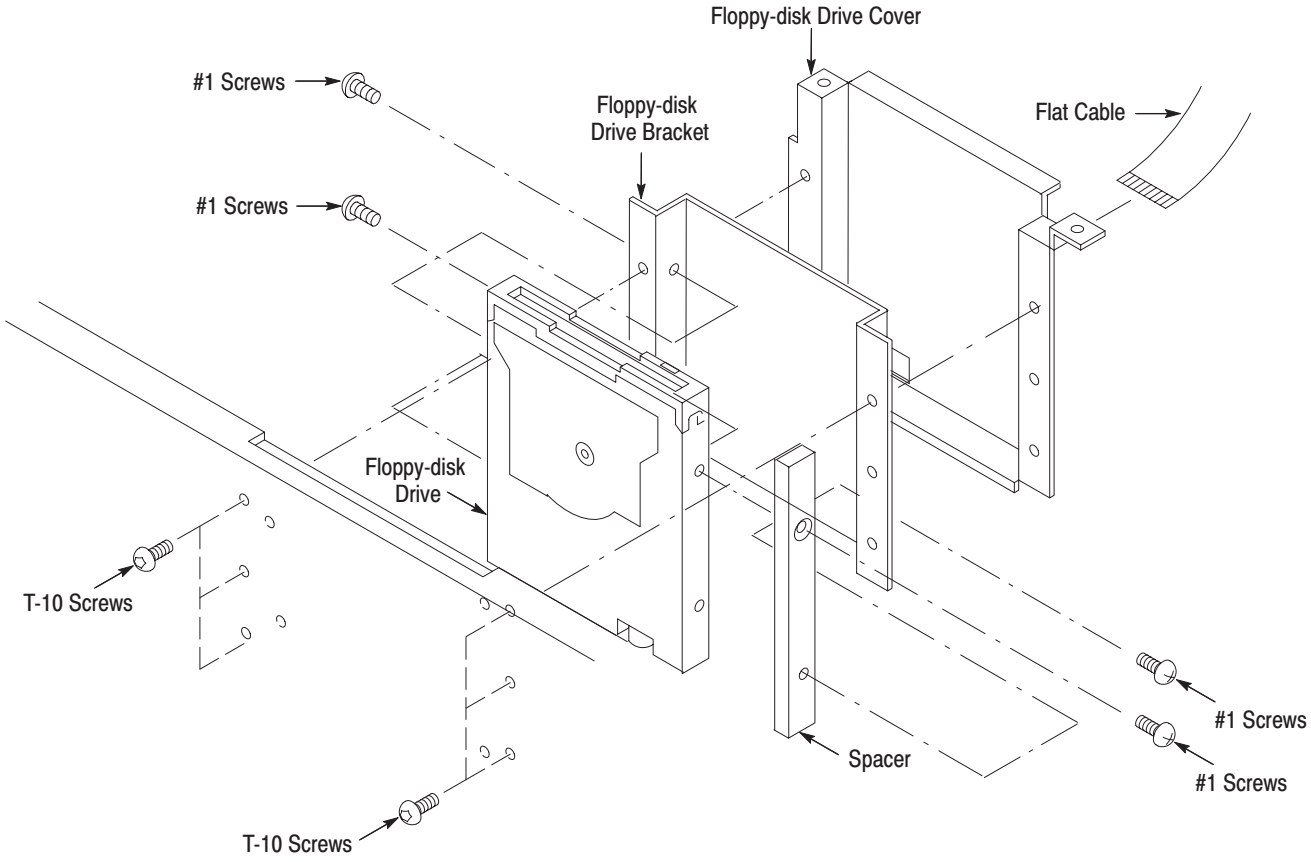


Figure 6-22: Floppy-disk drive module removal

Repackaging

This subsection contains information about repackaging the DG2020A for shipment.

Repackaging Instructions

Use a corrugated cardboard shipping carton having a test strength of at least 275 pounds and with an inside dimension at least six inches greater than the DG2020A dimensions. (If available, use the original shipping carton, which meets these requirements.)

If the DG2020A is shipped to a Tektronix Service Center, enclose the following information:

- The owner's address
- Name and phone number of a contact person
- Type and serial number of the DG2020A
- Reason for returning
- A complete description of the service required

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

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

Troubleshooting

This subsection contains information and procedures designed to isolate faulty modules in the DG2020A 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 these flowcharts.

- Figure 6-24: Primary Troubleshooting Procedure
- Figure 6-27: Troubleshooting Procedure 1 — Power Supply Module
- Figure 6-30: Troubleshooting Procedure 2 — A6 CPU Board or Front-panel Module
- Figure 6-32: Troubleshooting Procedure 3 — Monitor Module
- Figure 6-36: Troubleshooting Procedure 4 — Module Isolation

To use these procedures, begin with the Primary Troubleshooting Procedure. It prompts you to check various indications of DG2020A functionality and directs you to the other troubleshooting procedures.

DG2020A Diagnostics

The DG2020A has internal diagnostics that verify circuit functionality. The DG2020A automatically executes the internal diagnostics at power-on. You can also run the internal diagnostics by using the **UTILITY** menu. See *Checking Diagnostics Tests* below. The difference between the two methods of running the internal diagnostics routine is that the power-on method does not do as much memory checking.

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

Checking Diagnostics Tests

Prerequisites — Power on the DG2020A and allow a 20 minute warmup 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 *Troubleshooting Procedure 4 — Module Isolation* on page 6-59. The table in the flowchart shows which module is related to each diagnostic test. If the tests pass but there is still a problem, go to the *Primary Troubleshooting Procedure* on page 6-49.

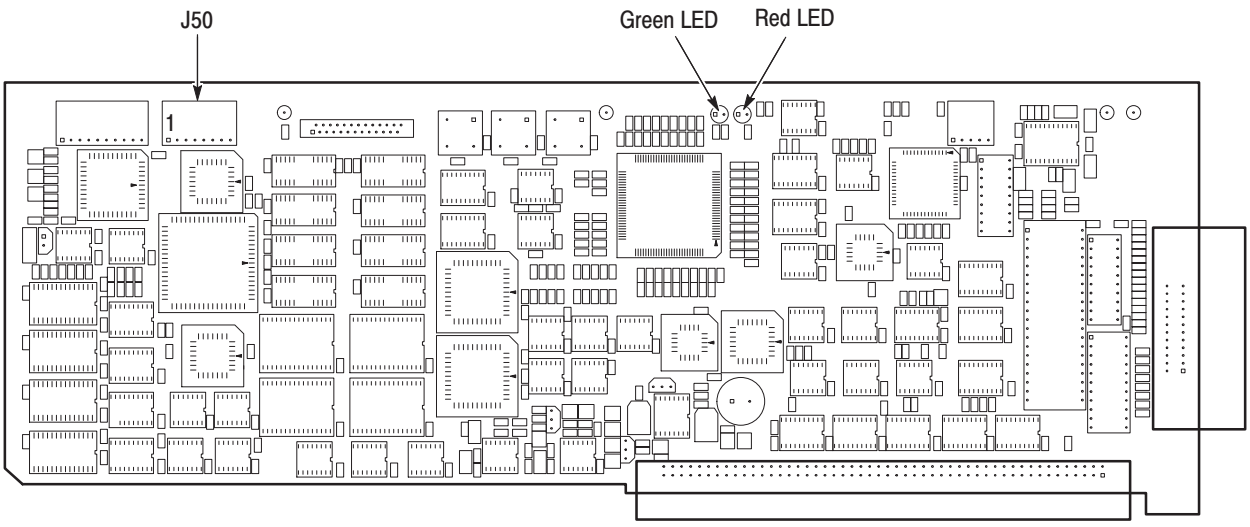


Figure 6-23: A6 CPU board

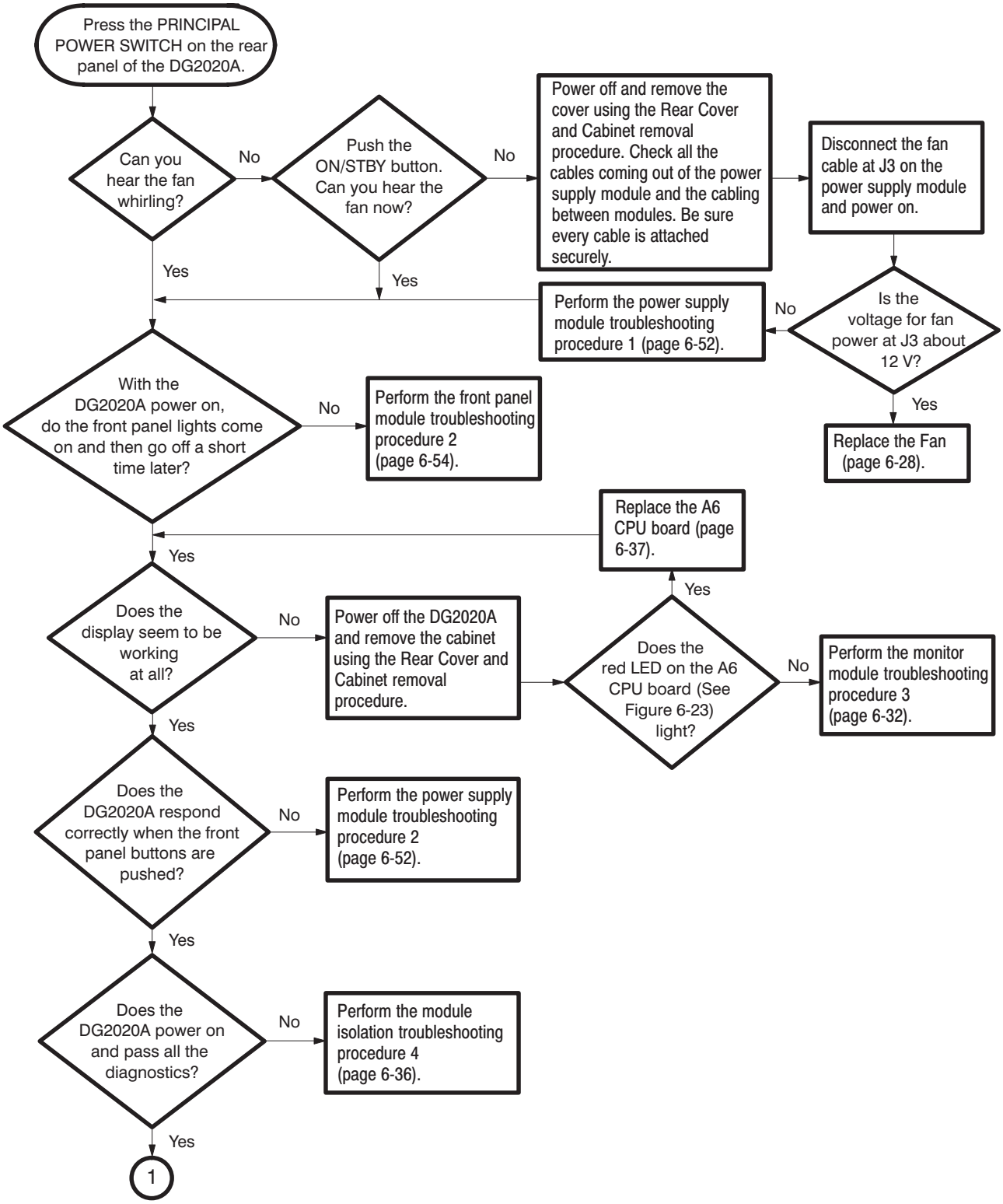


Figure 6-24: Primary troubleshooting procedure–(1)

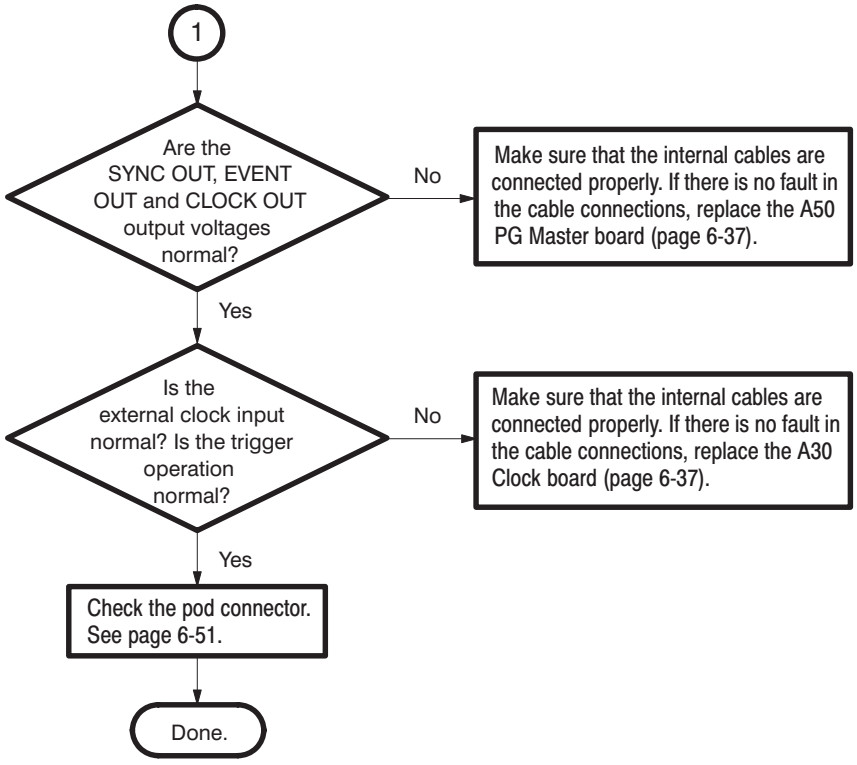


Figure 6-25: Primary troubleshooting procedure–(2)

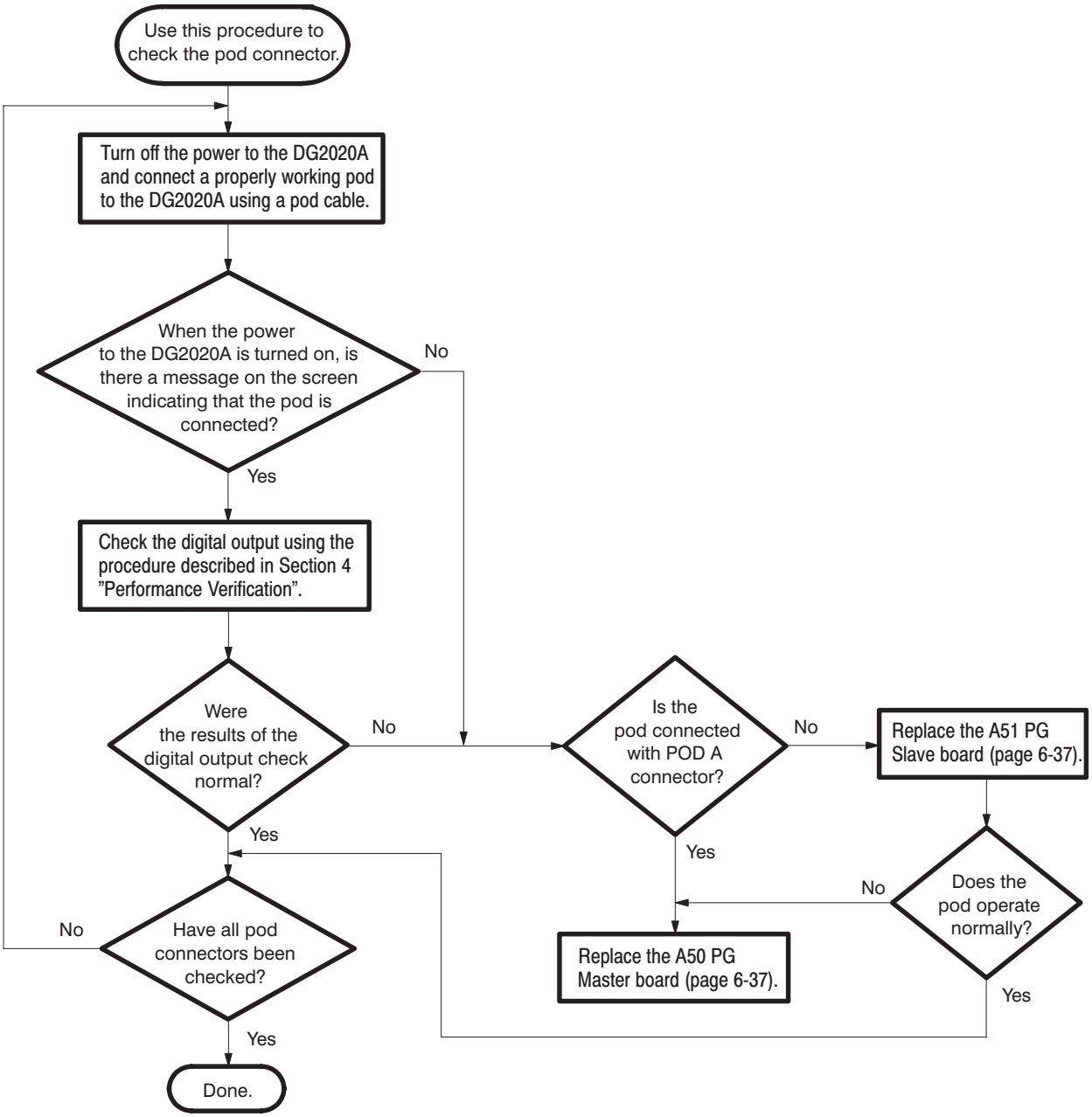


Figure 6-26: POD connector troubleshooting procedure

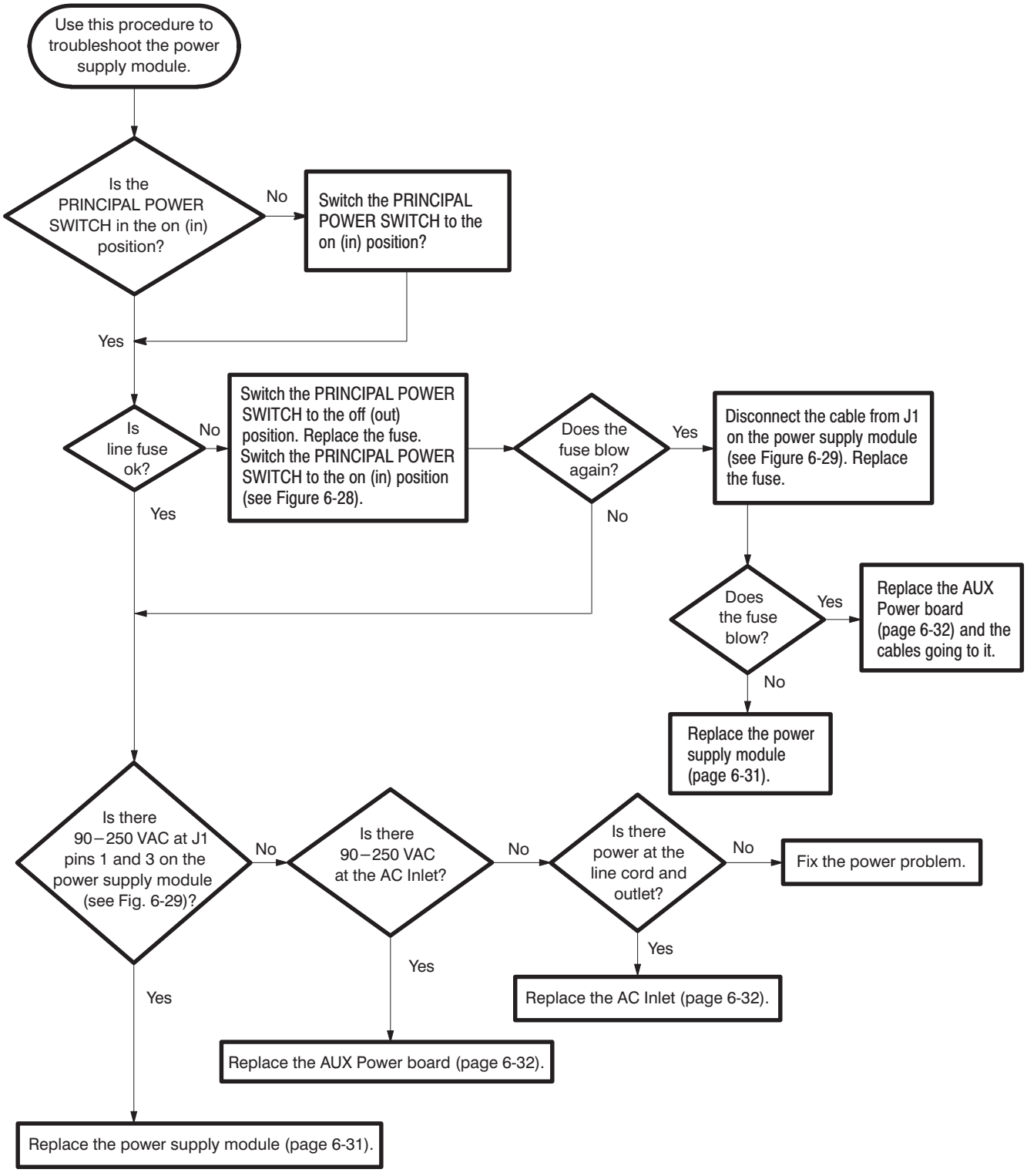


Figure 6-27: Troubleshooting procedure 1 — power supply module

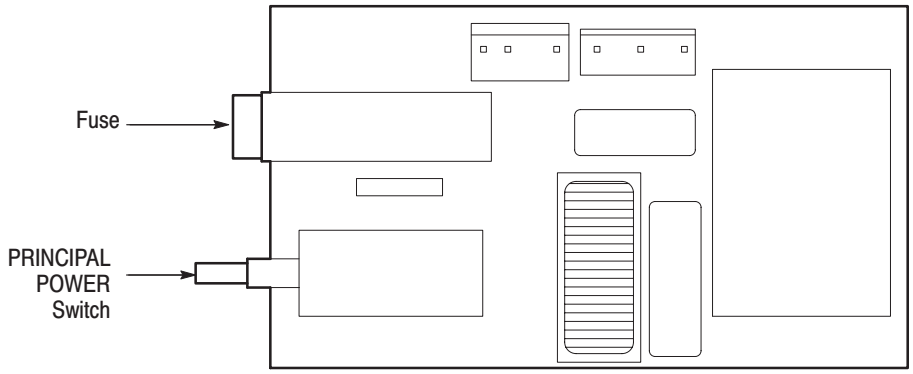


Figure 6-28: AUX power board

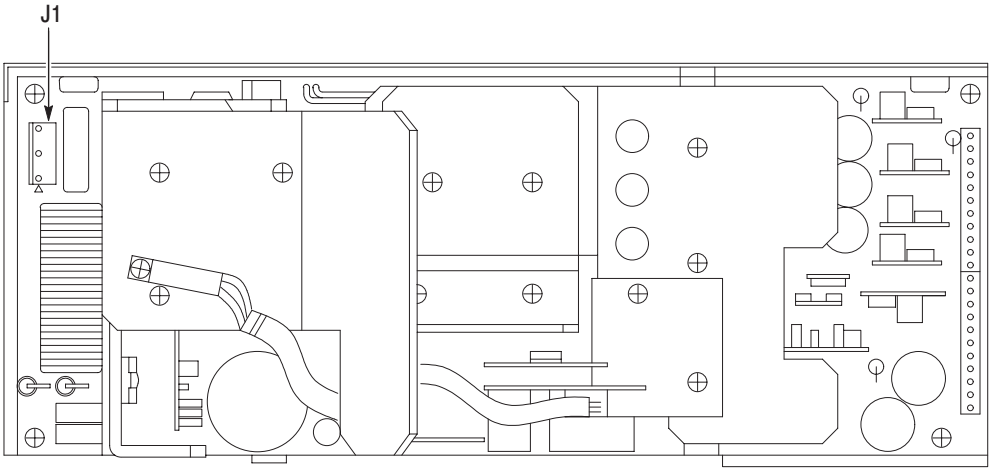


Figure 6-29: Power supply module

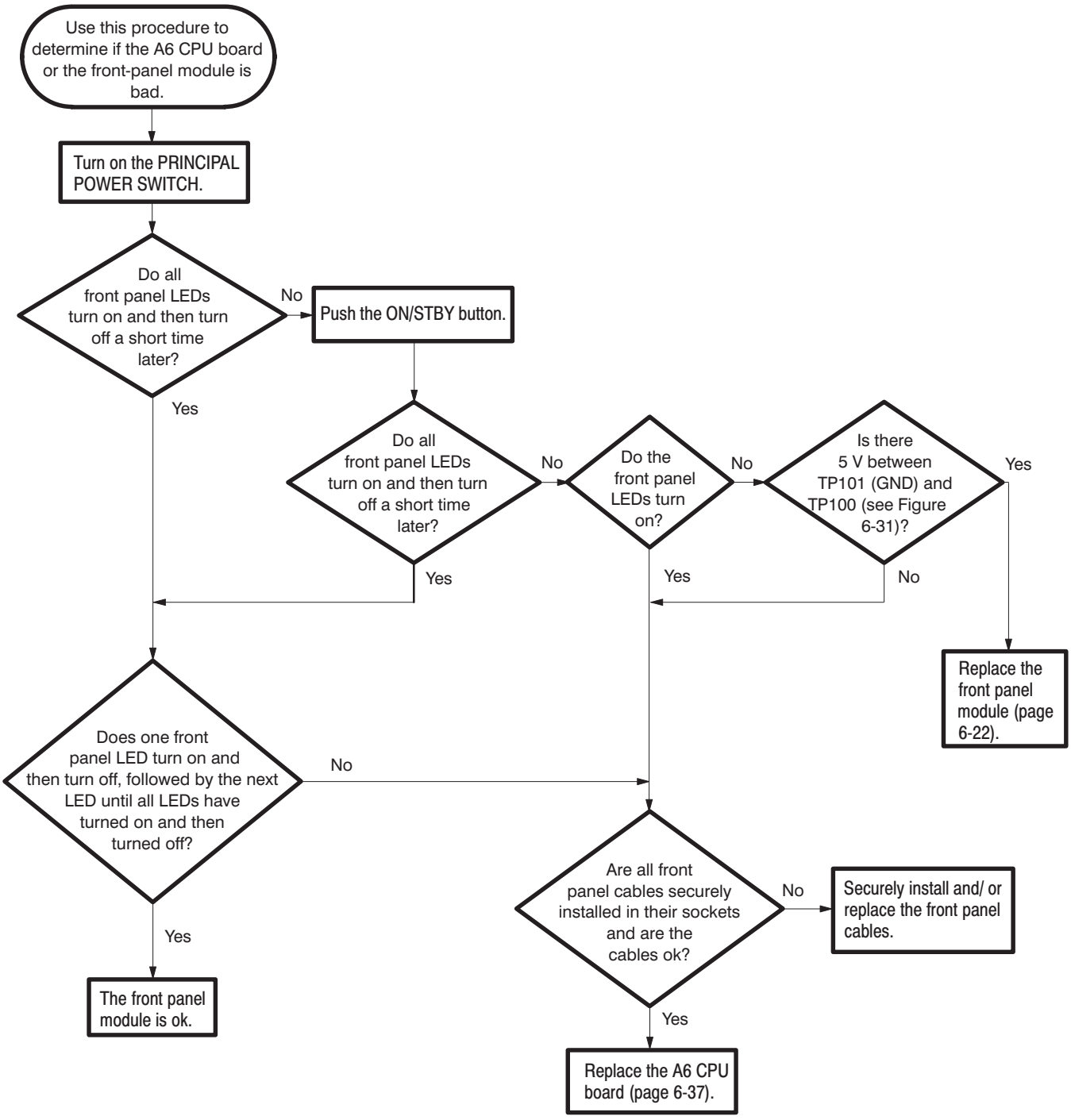


Figure 6-30: Troubleshooting procedure 2 — A6 CPU board or front-panel module

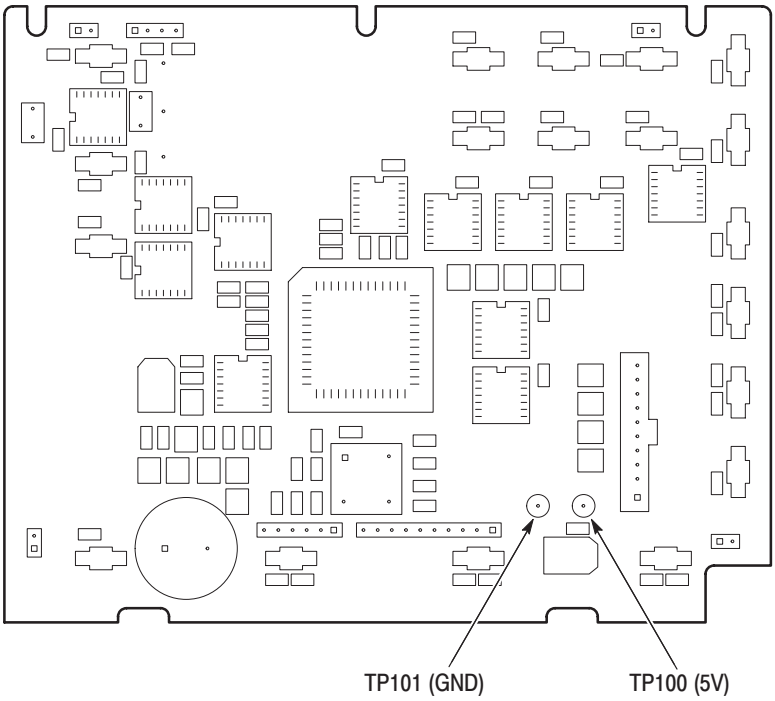


Figure 6-31: Key board

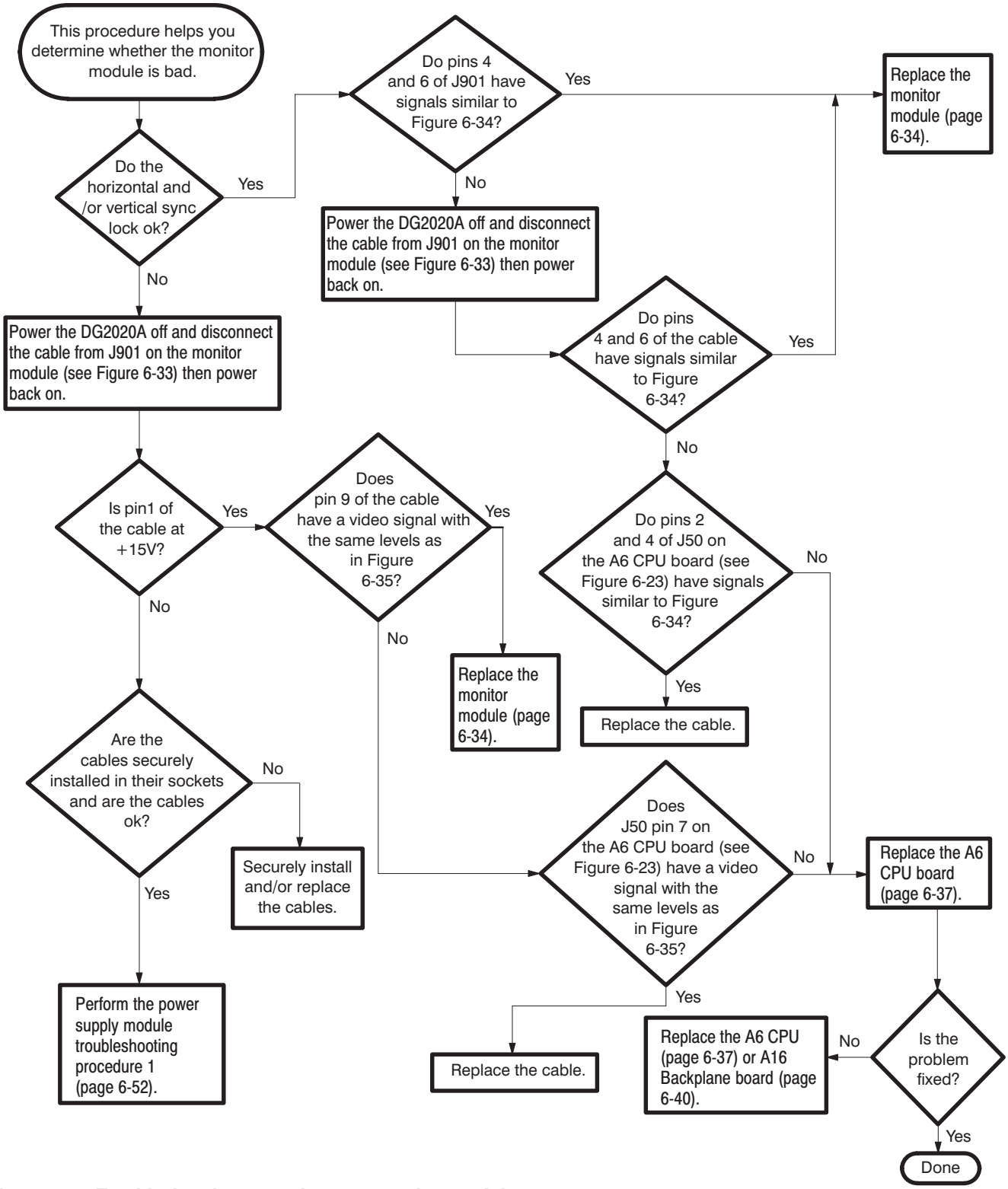


Figure 6-32: Troubleshooting procedure 3 — monitor module

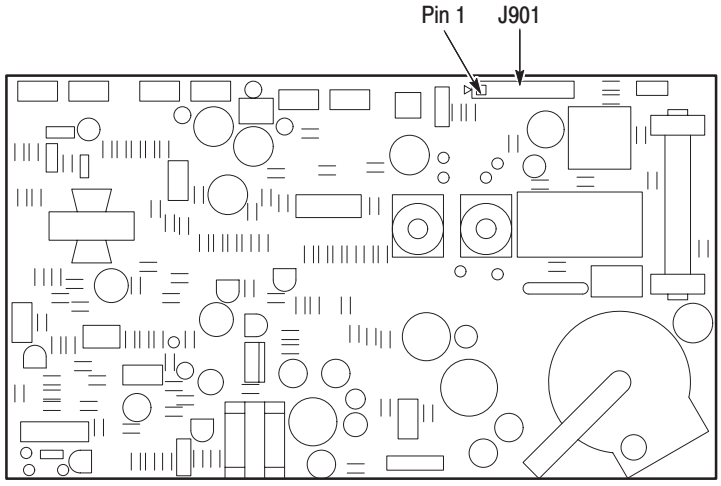


Figure 6-33: Monitor module

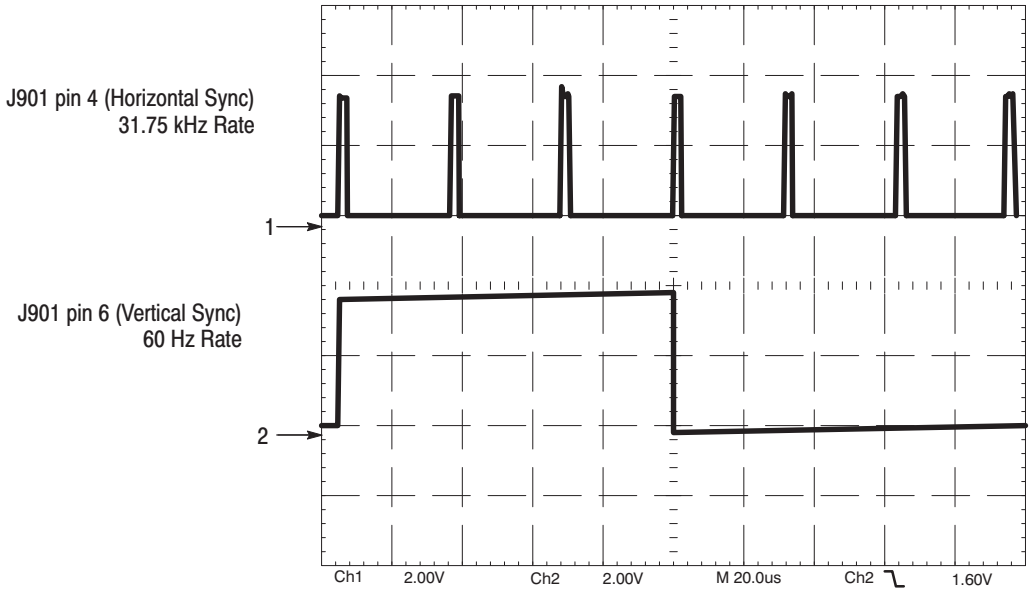


Figure 6-34: Horizontal and vertical sync signals

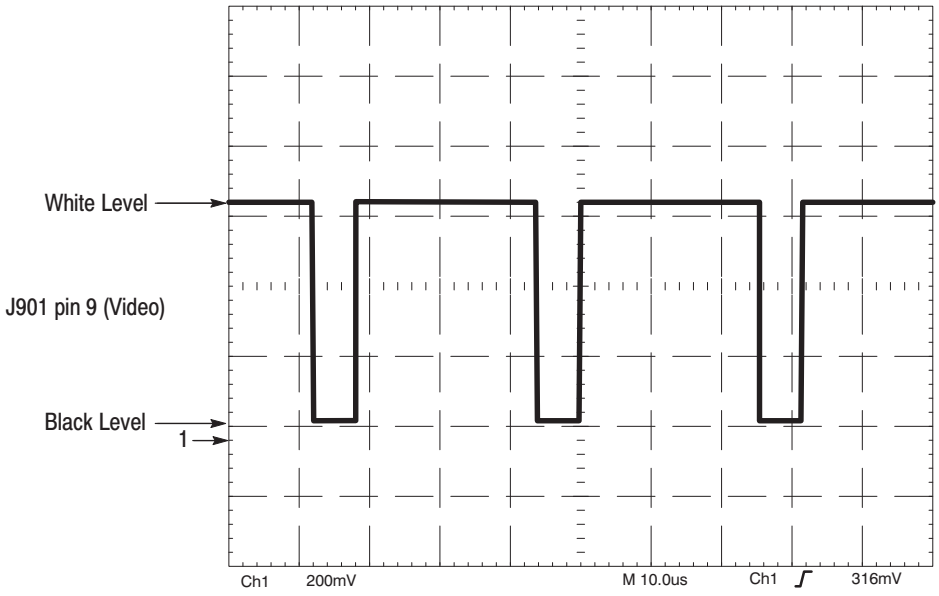
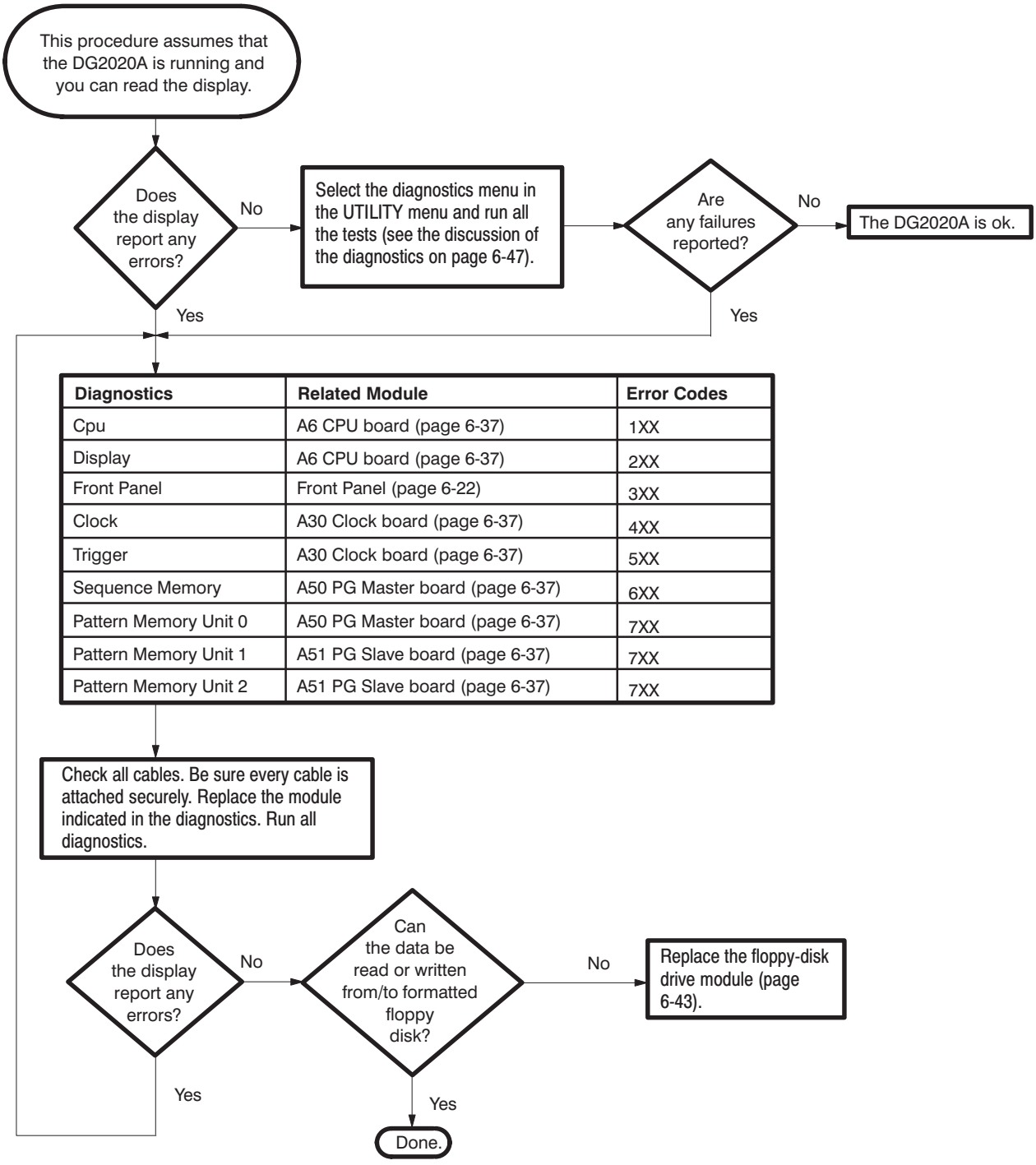


Figure 6-35: A video signal with white and black levels



Diagnostics	Related Module	Error Codes
Cpu	A6 CPU board (page 6-37)	1XX
Display	A6 CPU board (page 6-37)	2XX
Front Panel	Front Panel (page 6-22)	3XX
Clock	A30 Clock board (page 6-37)	4XX
Trigger	A30 Clock board (page 6-37)	5XX
Sequence Memory	A50 PG Master board (page 6-37)	6XX
Pattern Memory Unit 0	A50 PG Master board (page 6-37)	7XX
Pattern Memory Unit 1	A51 PG Slave board (page 6-37)	7XX
Pattern Memory Unit 2	A51 PG Slave board (page 6-37)	7XX

Figure 6-36: Troubleshooting procedure 4 — module Isolation

Options and Accessories

This section describes the various options as well as the standard and optional accessories that are available for the DG2020A Data Generator.

The following options are available for the DG2020A:

- *Option A1–A5* changes the standard power cord to one of five alternate power cord configurations. Refer to page 7-1 for details.
- *Option 01* adds 12-channels output. Refer to page 7-2 for details.
- *Option 02* adds 24-channels output. Refer to page 7-2 for details.
- *Option 1R* ships the data generator configured for installation in an instrument rack. Refer to page 7-2 for details.
- *Option 95* ships with test result report. Refer to page 7-2 for details.
- *Option B1* adds the Service Manual and the Performance Check Disk.

The following options are available for the P3410 and P3420:

- *Option 95* ships with test result report. Refer to page 7-3 for details.

Options A1–A5

In place of the standard North American, 110 V, 60 Hz power cord, Tektronix ships any of five alternate power cord configurations with the 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 01 Description

This option has another 12 channels to allow the instrument to output a total of 24 channels. This option allows 2 individual pods, pod A and pod B, to be used at the same time. The connector for pod B is added on the rear panel. Although pod connection cables are included with this option, the additional pod itself is not included. Thus P3410 or P3420 pod must be ordered separately. Contact your Tektronix sales representative if you intend to add this option to a DG2020A that you are already using.

Option 02 Description

This option has another 24 channels to allow the instrument to output a total of 36 channels. This option allows 3 individual pods, pod A, pod B, and pod C, to be used at the same time. Connectors for pods B and C are added on the rear panel. Although pod connection cables are included with this option, the additional pods themselves are not included. Thus P3410 and/or P3420 pods must be ordered separately. Contact your Tektronix sales representative if you intend to add this option to a DG2020A that you are already using.

Option 1R Description

When option 1R is specified, the DG2020A is shipped in a form appropriate for mounting in a 19 inch rack . The floppy disk drive is moved so that it can be accessed from the front panel in this instrument. Contact your Tektronix sales representative for details on converting a non-rack mounting DG2020A to rack mounting.

See the Instruction Sheet provided with the rack mounting kit for details on the rack mounting adapter.

Option 95 Description

A test result report will be provided with the DG2020A when this option is specified.

When the option 95 is specified, the test result report of only the DG2020A is provided. If the test result report of the P3410 or the P3420 is necessary, the P3410 Option 95 or the P3420 Option 95 must be specified.

P3410 Option 95 Description

A test result report will be provided with the P3410 when this option is specified.

When the option 95 is specified, the test result report of only the P3410 is provided. If the test result report of the DG2020A is necessary, the DG2020A Option 95 must be specified.

P3420 Option 95 Description

A test result report will be provided with the P3420 when this option is specified.

When the option 95 is specified, the test result report of only the P3410 is provided. If the test result report of the DG2020A is necessary, the DG2020A Option 95 must be specified.

Accessories

Standard Accessories

The following standard accessories are provided with each instrument:

Table 7-2: Standard accessories

Standard accessory	Part number
User Manual	071-0053-XX
Programmer Manual	071-0054-XX
Performance Check Disk, 3.5-inch	063-2918-XX
GPIB Sample Program Disk, 3.5-inch	063-2919-XX
DG-LINK Application Program Disk, 3.5-inch	063-2920-XX
Pod Connection Cable	174-3548-XX
Power cord 125V/6A	161-0230-01
Certificate of Calibration	

Table 7-3 list the standard accessories for the P3410 and P3420 pods

Table 7-3: Standard accessories for pods

Pod	Standard accessorie	Part number
P3410	Set of 12 cables	012-1502-XX
P3420	Set of 12 cables	012-1504-XX
P3410/P3420	Certificate of Calibration	
P3410/P3420	Instructions Sheet	

Optional Accessories

Table 7-4 lists the optional accessories that are recommended for use with the DG2020A, P3410, and P3420.

Table 7-4: Optional accessories

Optional accessory	DG2020A	P3410	P3420	Part number
Service Manual	X			071-0055-XX
Front Cover	X			200-3232-XX
Oscilloscope Camera Adapter	X			016-1154-XX
Accessory Pouch	X			016-1159-XX
Rackmount kit	X			040-1444-XX
Upgrade kit (add 12/24 output channels)	X			040-1514-XX
Fuse 6A Fast (UL198G/3AG)	X			159-0239-XX
Fuse cap	X			200-2264-XX
Fuse 5A (T) (IEC127)	X			159-0210-XX
Fuse cap	X			200-2265-XX
50 Ω termination	X			011-0049-XX
GPIB Cable	X			012-0991-XX
50 Ω BNC Cable (double shield)	X			012-1256-XX
50 Ω BNC Cable	X			012-1342-XX
50 Ω pin header to pin header cable 20 inch (50.8 cm)	X	X		012-1505-XX
50 Ω SMB to SMB cable 40 inch (101.6 cm)		X	X	012-1458-XX
50 Ω SMB to BNC cable 40 inch (101.6 cm)		X	X	012-1459-XX
50 Ω SMB to pin header cable 20 inch (50.8 cm)		X	X	012-1503-XX
50 Ω SMB to pin header cable 50 inch (127 cm)		X	X	012-1506-XX
Set of 12 SMB-to-pin-header cables with a connector 50 inch (127 cm)		X	X	012-1507-XX

Table 7-4: Optional accessories (Cont.)

Optional accessory	DG2020A	P3410	P3420	Part number
1 CH lead set (set of 5) [1]		X	X	012-1508-XX
4 CH lead set (set of 3) [1]		X	X	012-1509-XX
50Ω SMB to BNC adapter		X	X	015-0671-XX
Connector with 12 pin header sockets [2]		X	X	131-5919-XX
Maintenance Kit (See Table 7-5)	X			067-0282-XX
P3410 Exchange Kit		X		650-3420-XX
P3420 Exchange Kit			X	650-3421-XX

1 Used to provide the flexible connection of output signal and ground by attaching to the pin-header side of the 50 Ω cable (SMB to pin header or pin header to pin header).

2 Used for housing of the pin header.

Table 7-5: Maintenance kit contents

Description	Quantity	Part number
Extender-A board (for slot 1, 2, 3, 4)	1	671-2331-XX
Extender-B board (for slot 5)	1	671-2487-XX
Cable kit	1	198-5855-XX
Ejector	2	003-1315-XX
Header	1	131-5537-XX
50 Ω SMB to BNC adapter	2	015-0671-XX
50 Ω SMB to pin header cable 20 inch (50.8 cm)	2	012-1503-XX
50 Ω SMB to SMB cable 40 inch (101.6 cm)	2	012-1458-XX

Electrical Parts List

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

Diagrams

This section contains following diagrams:

- Block Diagram of DG2020A with Options 01 and 02
- Interconnect Diagram of DG2020A with Options 01 and 02

Block diagrams show the modules and functional blocks in the DG2020A. Interconnect diagrams show how the modules in the DG2020A connect together.

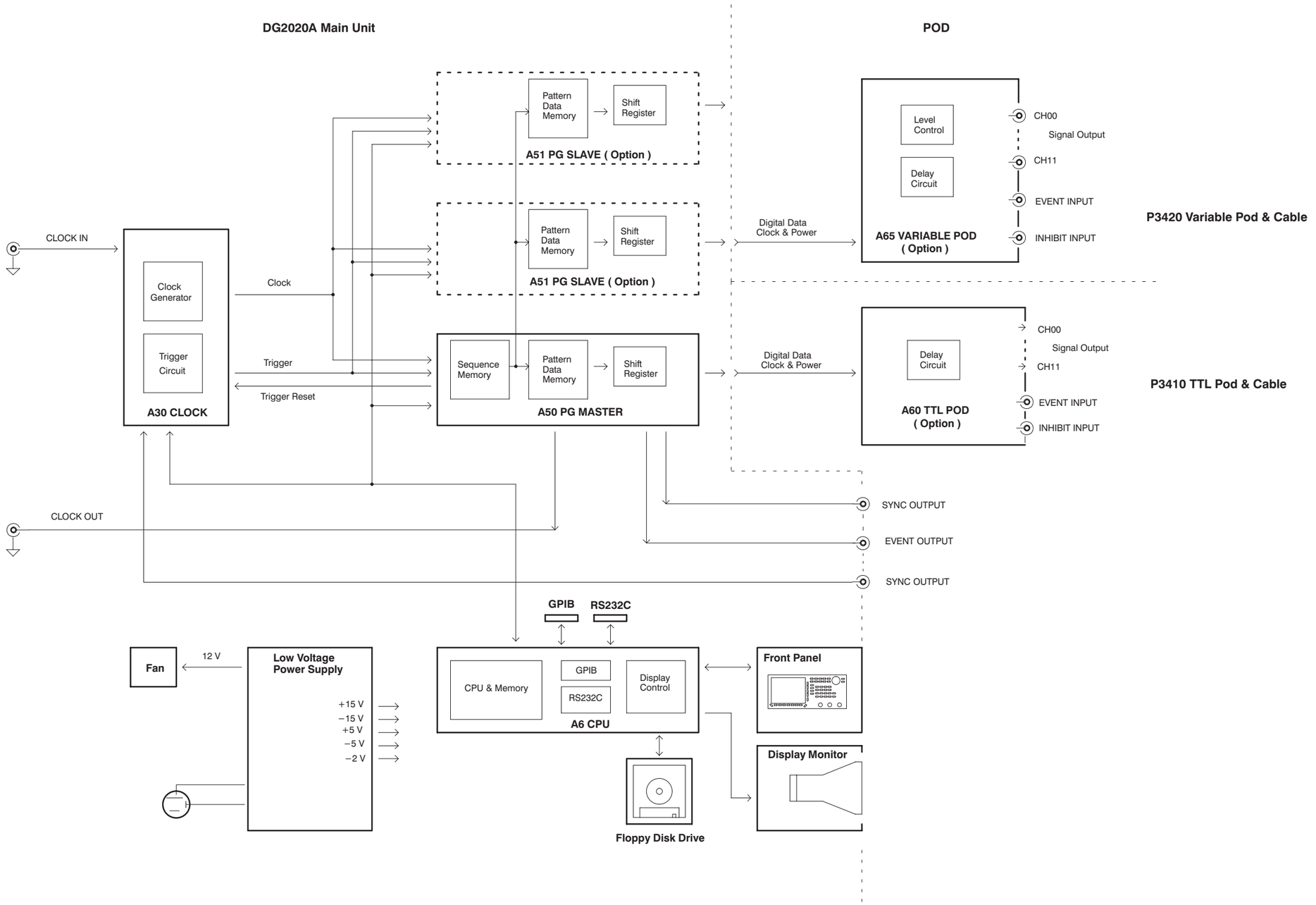


Figure 9-1: Block diagram of DG2020A with options 01 and 02

Please cut away the area below the line.

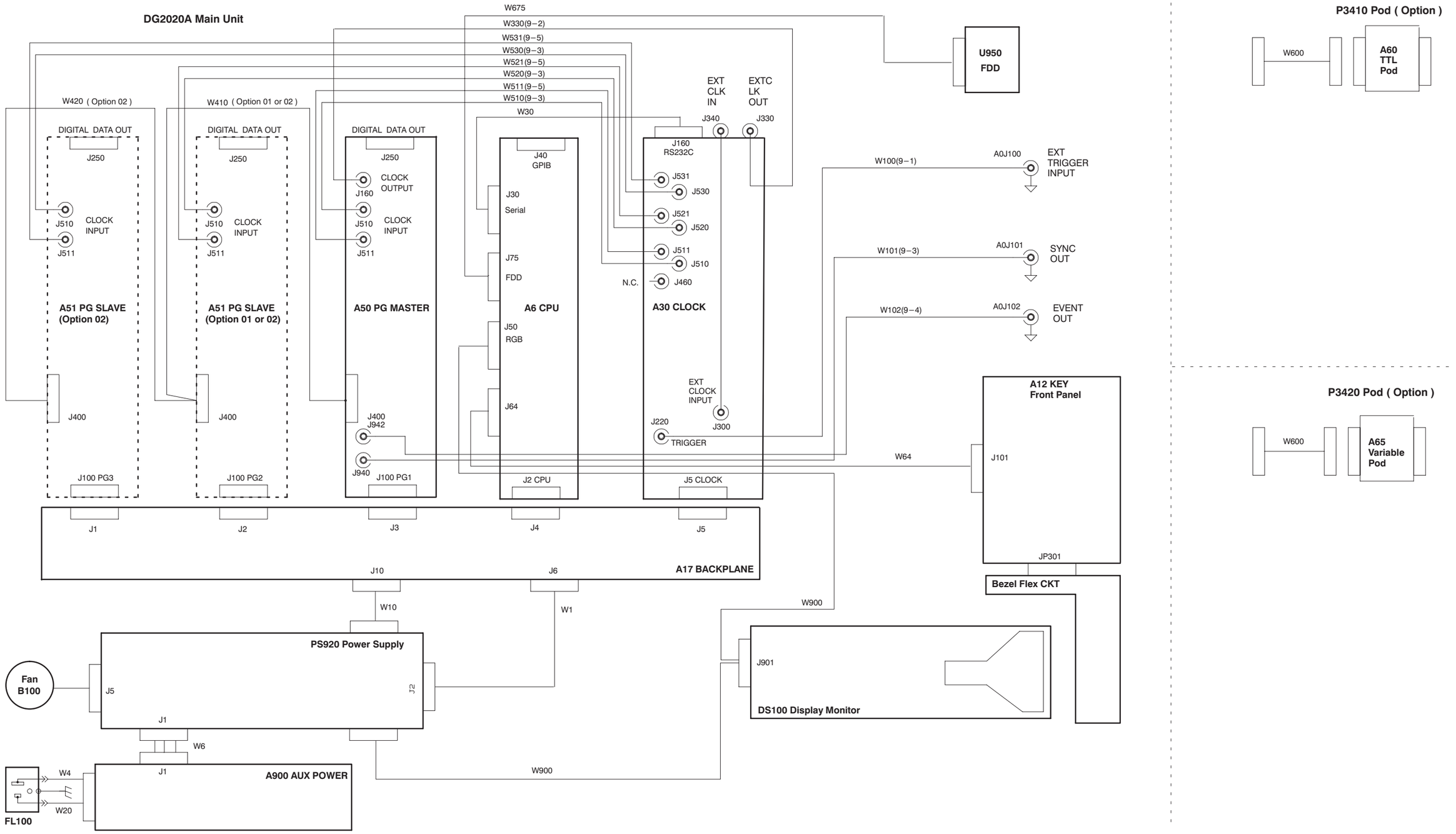


Figure 9-2: Interconnect diagram of DG2020A with options 01 and 02

Please cut away the area below the line.

Replaceable Mechanical Parts

This section contains a list of the replaceable modules for the DG2020A. 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.

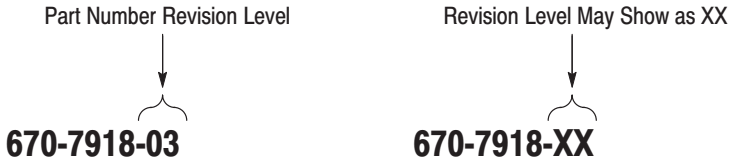
- Part number (see Part Number Revision Level below)
- Instrument type or model number
- Instrument serial number
- Instrument modification number, if applicable

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 theDG2020A. 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 CIRRUS DRIVE	BEAVERTON OR 97005-6448
TK0435	LEWIS SCREW CO	4300 S RACINE AVE	CHICAGO IL 60609-3320
TK1163	POLYCAST INC	9898 SW TIGARD ST	TIGARD OR 97223
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
0JR05	TRIQUEST CORP	3000 LEWIS AND CLARK HWY	VANCOUVER WA 98661-2999
0KB01	STAUFFER SUPPLY	810 SE SHERMAN	PORTLAND OR 97214
00779	AMP INC	2800 FULLING MILL PO BOX 3608	HARRISBURG PA 17105
07416	NELSON NAME PLATE CO	3191 CASITAS	LOS ANGELES CA 90039-2410
2W733	BELDEN CORPORATION	2200 US HIGHWAY 27 SOUTH PO BOX 1980	RICHMOND IN 47375-0010
24931	SPECIALTY CONNECTOR CO INC	2100 EARLYWOOD DR PO BOX 547	FRANKLIN IN 46131
6D224	HARBOR TRI-TEC A BERG ELECTRONICS COMPANY	14500 SOUTH BROADWAY	GARDENA, CA 90248
61058	MATSUSHITA ELECTRIC CORP OF AMERICA PANASONIC INDUSTRIAL CO DIV	TWO PANASONIC WAY	SECAUCUS NJ 07094
61857	SAN-0 INDUSTRIAL CORP	91-3 COLIN DRIVE	HOLBROOK NY 11741
61935	SCHURTER INC	1016 CLEGG COURT	PETALUMA CA 94952-1152
64537	KDI/TRIANGLE ELECTRONICS	60 S JEFFERSON ROAD	WHIPPANY, NJ 07981
73743	FISCHER SPECIAL MFG CO	111 INDUSTRIAL RD	COLD SPRING KY 41076-9749
78189	ILLINOIS TOOL WORKS INC SHAKEPROOF DIV	ST CHARLES ROAD	ELGIN IL 60120
80009	TEKTRONIX INC	14150 SW KARL BRAUN DR PO BOX 500	BEAVERTON OR 97077-0001
86928	SEASTROM MFG CO INC	701 SONORA AVE	GLENDALE CA 91201-2431

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–XX			1	CLAMP,PWR CORD:POLYMIDE	TK1163	ORDER BY DESC
–2	161–0230–XX			1	CABLE ASSY,PWR,:3,18 AWG,92 L,SVT,TAN (STANDARD ACCESSORY)	TK2432	ORDER BY DESC
–3	334–8705–XX			1	MARKER,IDENT:MKD,WARNING/FUSE DATA	80009	3348705XX
–4	334–3388–XX			1	MARKER,IDENT:MKD,TEKTRONIX JAPAN LTD	80009	3343388XX
–5	334–9114–XX			1	MARKER,IDENT:BLANK	80009	3349114XX
–6	211–0691–XX			4	SCREW,MACHINE:6–32 X 0.625,PNH,STL	0KB01	ORDER BY DESC
–7	200–3991–XX			1	COVER,REAR:HARD,POLYCARBONATE,LEXAN	TK1163	ORDER BY DESC
–8	390–1137–XX			1	CABINET,SCOPE:EMI VERSION,W/HANDLE	80009	3901145XX
–9	211–0378–XX			4	SCR,ASSEM WSHR:4–40 X 0.375.PNH,STL,CD PL	0KB01	ORDER BY DESC
–10	200–3983–XX			1	BEZEL:FDD,AL	80009	2003983XX
–11	348–1276–XX			1	GASKET,SHIELD:CONDUCTIVE FORM STRIP	80009	3481276XX
–12	260–2539–XX			1	SWITCH SET:BEZEL	TK1918	2602539XX
–13	366–0753–XX			14	PUSH BUTTON:SMOKE TAN	80009	3660753XX
–14	354–0709–XX			1	RING,TRIM:LEXAN 940	80009	3540709XX
–15	334–9561–XX			1	MARKER,IDENT:MKD DG2020A,	80009	3349561XX
–16	378–0404–XX			1	FILTER,LT,CRT:BLUE SMOKE,112MM X 145MM	80009	3780404XX
–17	348–1289–XX			1	SHLD GSKT,ELEK:MESH TYPE,3.2MM X 4.7MM	80009	3481289XX
–18	211–0722–XX			1	SCREW,MACHINE:6–32 X 0.25,PNH,STL	0KB01	ORDER BY DESC

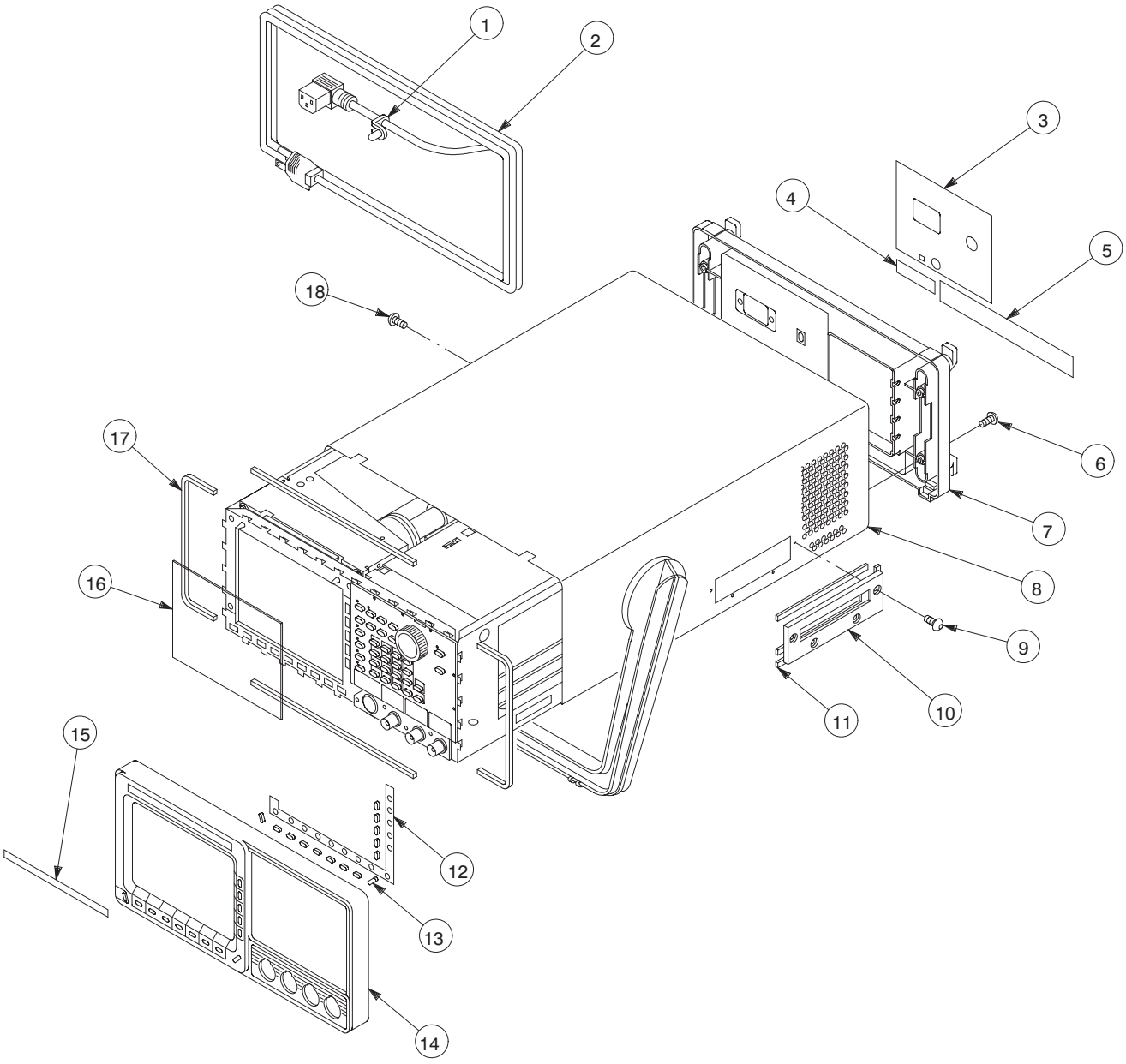


Figure 10-1: Cabinet

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–XX			6	SCREW,TPG,TR:6–32 X 0.437 TAPTITE,PNH,STL	0KB01	ORDER BY DESC
–2	119–4322–XX			1	FAN,TUBAXIAL:12VDC,2.4M/M,5.8MM HZO,6W (B100)	80009	1194322XX
–3	252–0571–XX			1	PLASTIC SHEET:EXTR CHAN,5MM X 3.3MM	80009	2520571XX
–4	342–0993–XX			1	INSULATOR,FILM:PWR SPLY,POLYCARBONATE	80009	3420993XX
–5	211–0722–XX			2	SCREW,MACHINE:6–32 X 0.25,PNH,STL	0KB01	ORDER BY DESC
–6	620–0065–XX			1	POWER SUPPLY:IN 90–250V,48–63HZ OUT 15V,12V,5V,–15V,–5V,–2V (PS920)	80009	6200065XX
–7	213–0882–XX			4	SCREW,TPG,TR:6–32 X 0.437 TAPTITE,PNH,STL	0KB01	ORDER BY DESC
–8	366–1480–XX			1	PUSH BUTTON:BLK,0.328 X 0.253 X 0.43	0JR05	ORDER BY DESC
–9	––––––––			1	CAP,FUSEHOLDER: (P/O TABLE 2–3)		
–10	––––––––			1	FUSE,CARTRIDGE: (P/O TABLE 2–3)		
–11	671–3351–XX			1	CIRCUIT BD ASSY:AUX,POWER SUPPLY (A900)	80009	6713351XX
–12	213–0882–XX			2	SCREW,TPG,TR:6–32 X 0.437 TAPTITE,PNH,STL	0KB01	ORDER BY DESC
–13	119–2683–XX			1	FILTER,RFI:6A,250VAC,50/60HZ,FLANGE MT (FL100)	80009	1192683XX
–14	426–2426–XX			1	FRAME,FAN MTG:POLYCARBONATE	80009	4262426XX
–15	210–0457–XX			1	NUT,PL,ASSEM WA:6–32 X 0.312,STL CD PL	TK0435	ORDER BY DESC
–16	334–3379–XX			1	MARKER,IDENT:MARKED GROUND SYMBOL	07416	ORDER BY DESC
–17	441–2074–XX			1	CHASSIS ASSY:AL	80009	4412074XX
–18	210–0586–XX			2	NUT,PL,ASSEM WA:4–40 X 0.25,STL CD PL	TK0435	ORDER BY DESC
–19	344–0472–XX			1	CLIP,CABLE:NYLON,GRAY	80009	3440472XX
–20	131–1315–XX			3	CONN,RF JACK:BNC/PNL,;50 OHM,FEMALE (J100, J101, J102)	24931	28JR306-1
–21	407–4394–XX			1	BRKT,CMPNT,BNC:ALUMINUM,5.250 X 1.050	80009	4074394XX
–22	211–0325–XX			4	SCR,ASSEM WSHR:4–40 X 0.25,PNH,STL	0KB01	ORDER BY DESC
–23	134–0218–XX			1	BUTTON,PLUG:0.625 DIA,PLASTIC,TAN	80009	1340218XX
–24	259–0086–XX			1	FLEX CIRCUIT:BEZEL BUTTON (S100)	07416	ORDER BY DESC
–25	348–1313–XX			1	GASKET,SHIELD:CONDUCTIVE URETHANE FORM	80009	3481313XX
–26	426–2436–XX			1	FRAME,CRT FLTR:POLYCARBONATE	TK1163	ORDER BY DESC
–27	348–1302–XX			1	GASKET,SHIELD:CONDUCTIVE URETHANE FORM	80009	3481302XX
–28	640–0081–XX			1	DISPLAY MONITOR:7 INCH,480 X 640 PIXEL (DS100)	80009	6400081XX

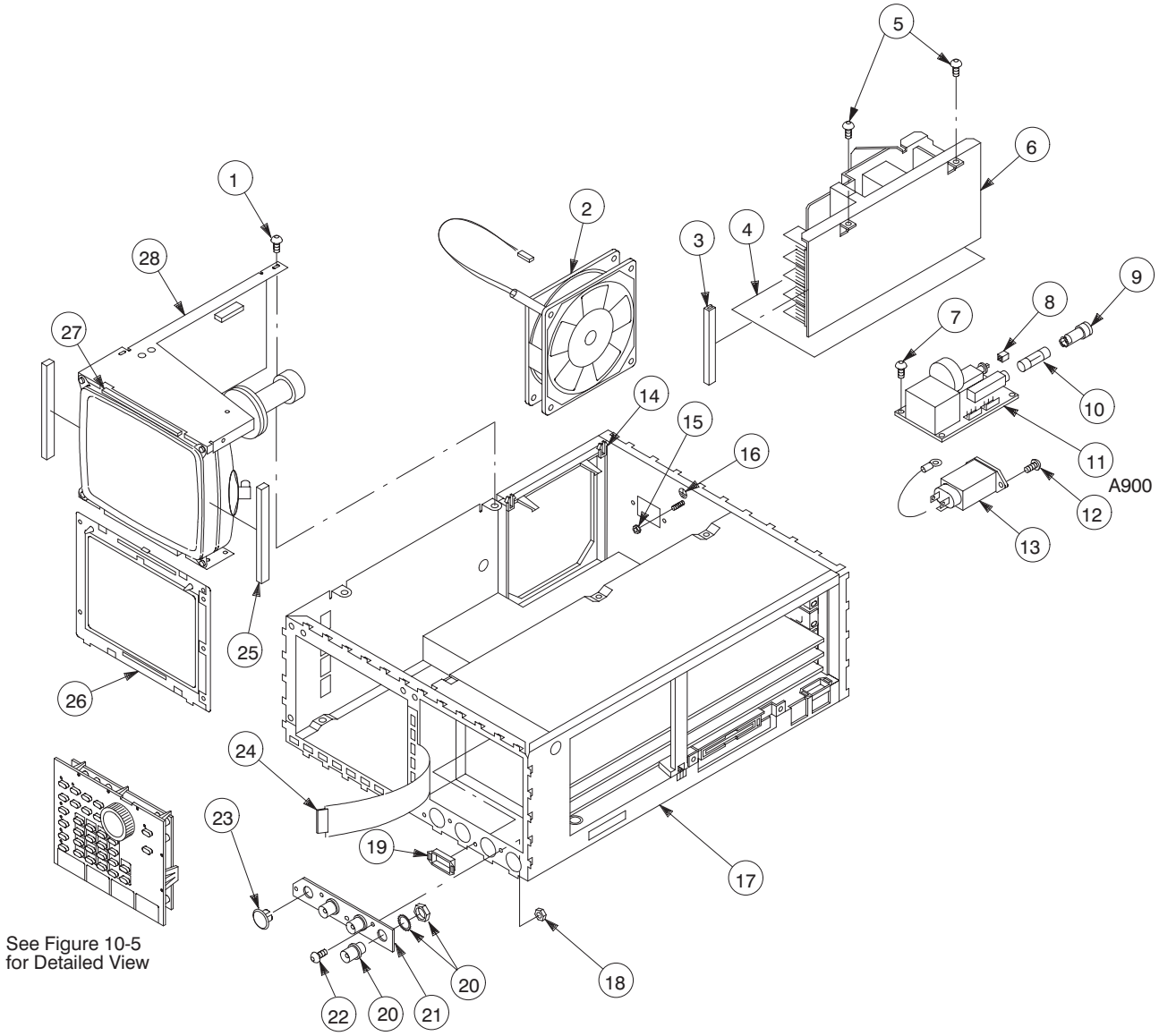


Figure 10-2: Main chassis and CRT

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	348–1314–XX			1	GASKET,SHIELD:FINGER TYPE,BE–CU,609.6MM	80009	348131400
–2	211–0722–XX			5	SCREW,MACHINE:6–32 X 0.25,PNH,STL	0KB01	ORDER BY DESC
–3	129–1443–XX			2	SPACER,POST:0.98 L,6–32 EXT & M3.5 INT THD	TK1287	1291443XX
–4	337–4084–XX			1	SHIELD,ELEC:REAR, WITH REAR PANEL AND EMI GASKET	80009	3374084XX
–5	344–0472–XX			1	CLIP,CABLE:NYLON,GRAY	80009	344–0472–XX
–6	252–0571–33			1	PLASTIC SHEET:EXTR CHAN,5MM X 3.3MM,NYL	80009	252–0571–XX
–7	342–0302–XX			1	INSULATOR,FILM:CHASSIS,MYLAR	80009	342–0302–XX
–8	343–1639–00			3	CLAMP,CABLE:9–13MM ID,NYLON W/CUSHION	TK0191	343–1639–00
–9	337–3983–XX	J300101	J310xxx	1	SHIELD,ELEC:FDD,AL	TK0191	337–3983–XX
	337–4088–XX	J310xxx		1	SHIELD,ELEC:FDD,AL	TK0191	337–4088–XX
–10	407–4643–00			1	BRACKET,FDD,STL	80009	407–4693–00
–11	348–1276–00			2	GASKET,SHIELD:CONDUCTIVE FORM STRIP	80009	348–1276–XX
–12	119–4404–XX	J300101	J310xxx	1	DISK DRIVE:FLOPPY,3.5 INCH W/INTERFACE (U950)	80009	119–4404–XX
	119–5953–XX	J310xxx		1	DISK DRIVE:FLOPPY,3.5 INCH W/INTERFACE (U950)	80009	119–5953–XX
–13	105–1081–00			1	BRACKET,SPACER	TK1163	105–1081–XX
–14	211–1032–00			1	SCREW,MACHINE:M2.6 X 8MM L,PNH,STL,,MFZN–D,CROSS REC	TK0191	211–1032–XX
–15	211–1033–00			3	SCREW,MACHINE:M2.6 X 3MM L,PNH,STL,,MFZN–D,CROSS REC	TK0191	211–1033–XX
–16	211–0722–XX			6	SCREW,MACHINE:6–32 X 0.25,PNH,STL	0KB01	ORDER BY DESC
–17	671–3785–XX			1	CIRCUIT BD ASSY:BACKPLANE (A17)	80009	6713785XX
–18	146–0055–XX			1	BATTERY,DRY:3.0V,1200 MAH,LITHIUM (A17BT001)	61058	BR-2/3A-E2P
–19	337–4030–XX			1	SHIELD,ELEC:CENTER,AL	80009	3374030XX
–20	211–0373–XX			6	SCREW,ASSEM WSFR:4–40 x 0.25,PNH,STL	0KB01	ORDER BY DESC
–21	343–1084–XX			1	CLAMP,CABLE:NYLON	80009	3431084XX
–22	348–0948–XX			1	GROMMET,PLASTIC:BLACK,RING,9.5MM ID	80009	3480948XX
–23	252–0571–XX			1	PLASTIC SHEET:EXTR CHAN,5MM X 3.3MM	80009	2520571XX
–24	348–1472–XX			1	GASKET,SHIELD,ELEC	80009	3481472XX

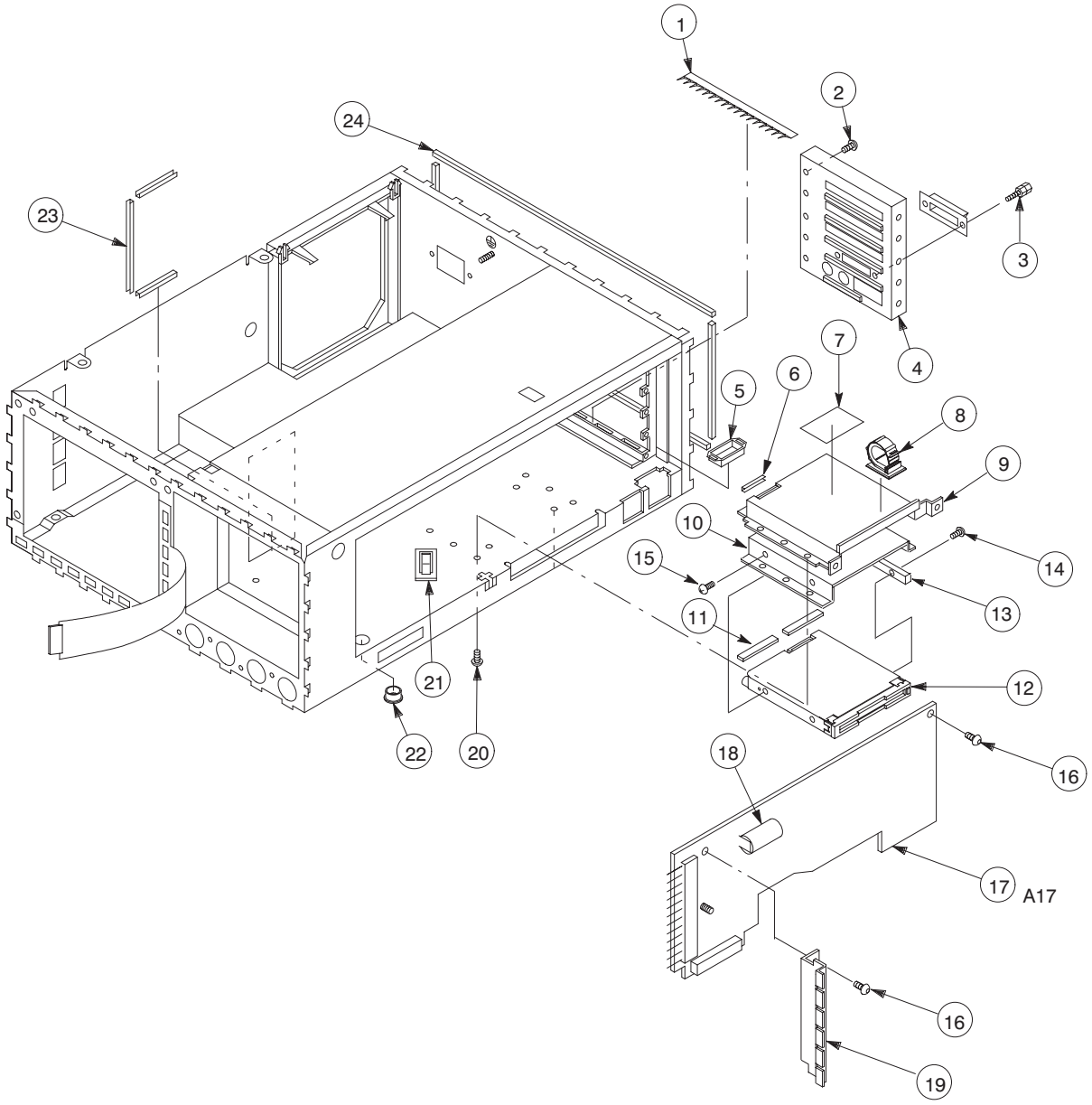


Figure 10-3: Main chassis and circuit boards

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	671–4241–XX			1	CIRCUIT BD ASSY:PG MASTER (A50)	80009	6714241XX
–2	333–3976–XX			2	BRACKET,CRT BD;BRASS, NI PL	80009	3333976XX
–3	211–0722–XX			5	SCREW,MACHINE:6–32 X 0.25,PNH,STL	0KB01	ORDER BY DESC
–4	671–B265–00			1	CIRCUIT BD ASSY:CPU (A6)	80009	671–B265–00
–5	160–M394–00			1	IC,MEMORY:EPROM;CMOS,256K X 16,100NS (A6U305)	80009	160–B394–00
–6	160–M393–00			1	IC,DIGITAL:CMOS,262144 X 16 BIT EPROM,PRGM (A6U300)	80009	160–B393–00
–7	131–5165–XX			1	CONN,RIBBON:PCB,;FEMALE,RTANG,24 POS (A6J40)	00779	555139-1
–8	386–6158–XX			1	SUPPORT,CKT BD:MAT MATERIAL	80009	3866158XX
–9	131–0450–XX			2	CONN,RF JACK:SMB,50OHM,FEMALE (A30J330, J340)	80009	1310450XX
–10	129–1051–XX			2	SPACER,POST:12.5 MM L,W/4–40 INT THD	80009	1291051XX
–11	671–3782–XX			1	CIRCUIT BD ASSY:CLOCK (A30)	80009	6713782XX

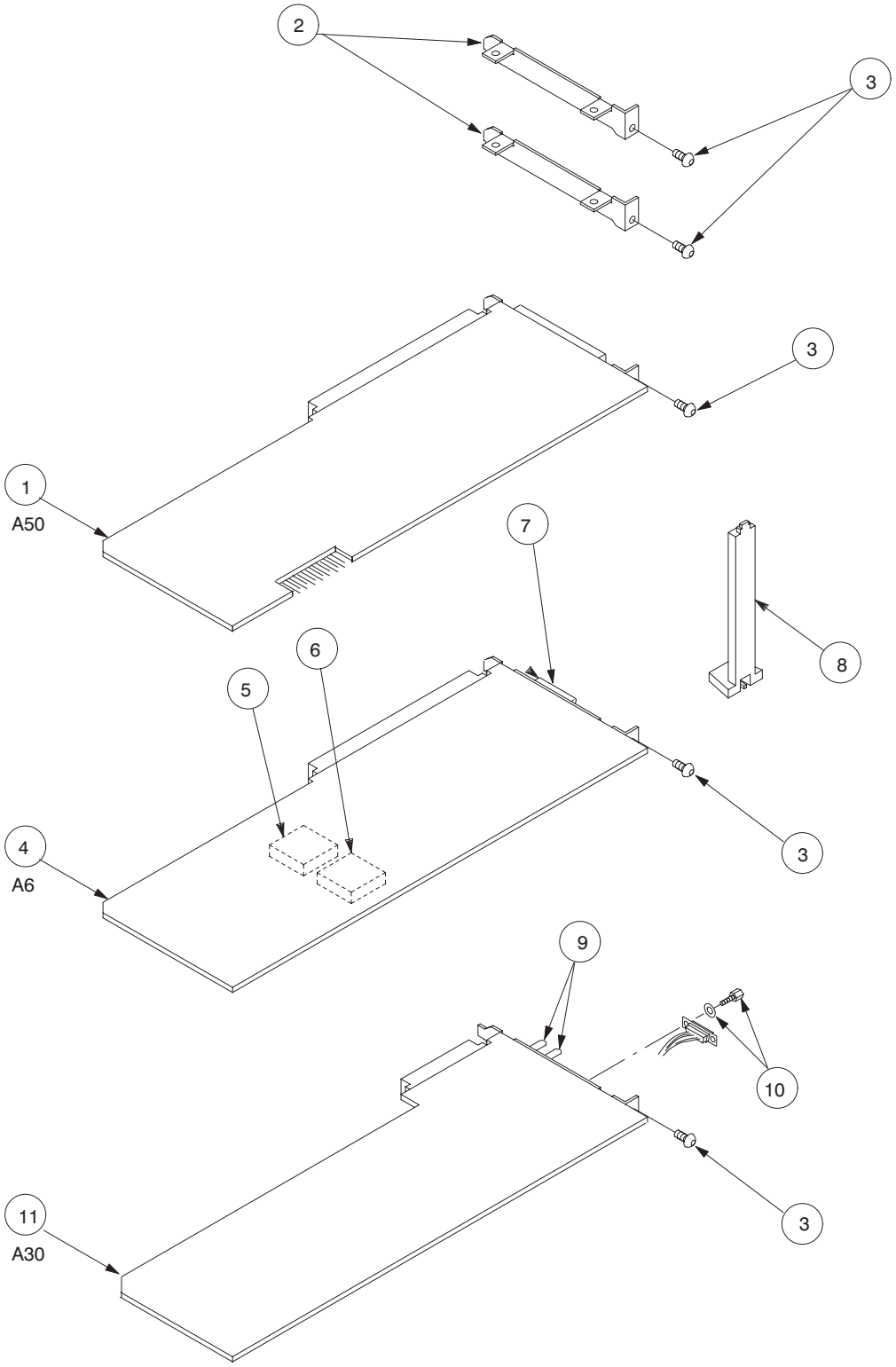


Figure 10-4: Circuit boards

Replaceable Parts List

Fig. & Index Number	Tektronix Part Number	Serial No. Effective	Serial No. Discont'd	Qty	Name & Description	Mfr. Code	Mfr. Part Number
10–5–1	671–3783–XX			1	CIRCUIT BD ASSY:KEYBOARD (A12)	80009	6713783XX
–2	213–0048–XX			1	SETSCREW:4–40 X 0.125,STL	TK0392	ORDER BY DESC
–3	260–2497–XX			1	SWITCH, ROTARY ENCODER	TK0392	ORDER BY DESC
–4	384–1686–XX			1	EXTENSION SHAFT:0.790 L X 0.500 DIA,PLASTIC	80009	3841686XX
–5	160–7853–XX			1	IC,PROCESSOR:CMOS,MICROCOMPUTER;8–BIT (A12U101)	04713	MC68HC705B5FN
–6	348–1276–XX			1	GASKET,SHIELD:CONDUCTIVE FORM STRIP	80009	3481276XX
–7	366–0768–XX			1	KNOB:IVORY GRAY,SCROLL,1.243 IDX 1.4 OD	80009	3660768XX
–8	213–0153–XX			1	SETSCREW:5–40 X 0.125,STL	TK0392	ORDER BY DESCP
–9	333–4186–XX			1	PANEL,FRONT:MAIN KEY	80009	3334186XX
–10	380–1060–XX			1	HOUSING,SWITCH:POLYCARBONATE,AFG2020	80009	3801060XX
–11	260–2552–XX			1	SWITCH,PUSH:50 BUTTON,SP/ST	80009	2602552XX
–12	366–0769–XX			32	PUSH BUTTON:IVORY GRAY,OVAL	80009	3660769XX

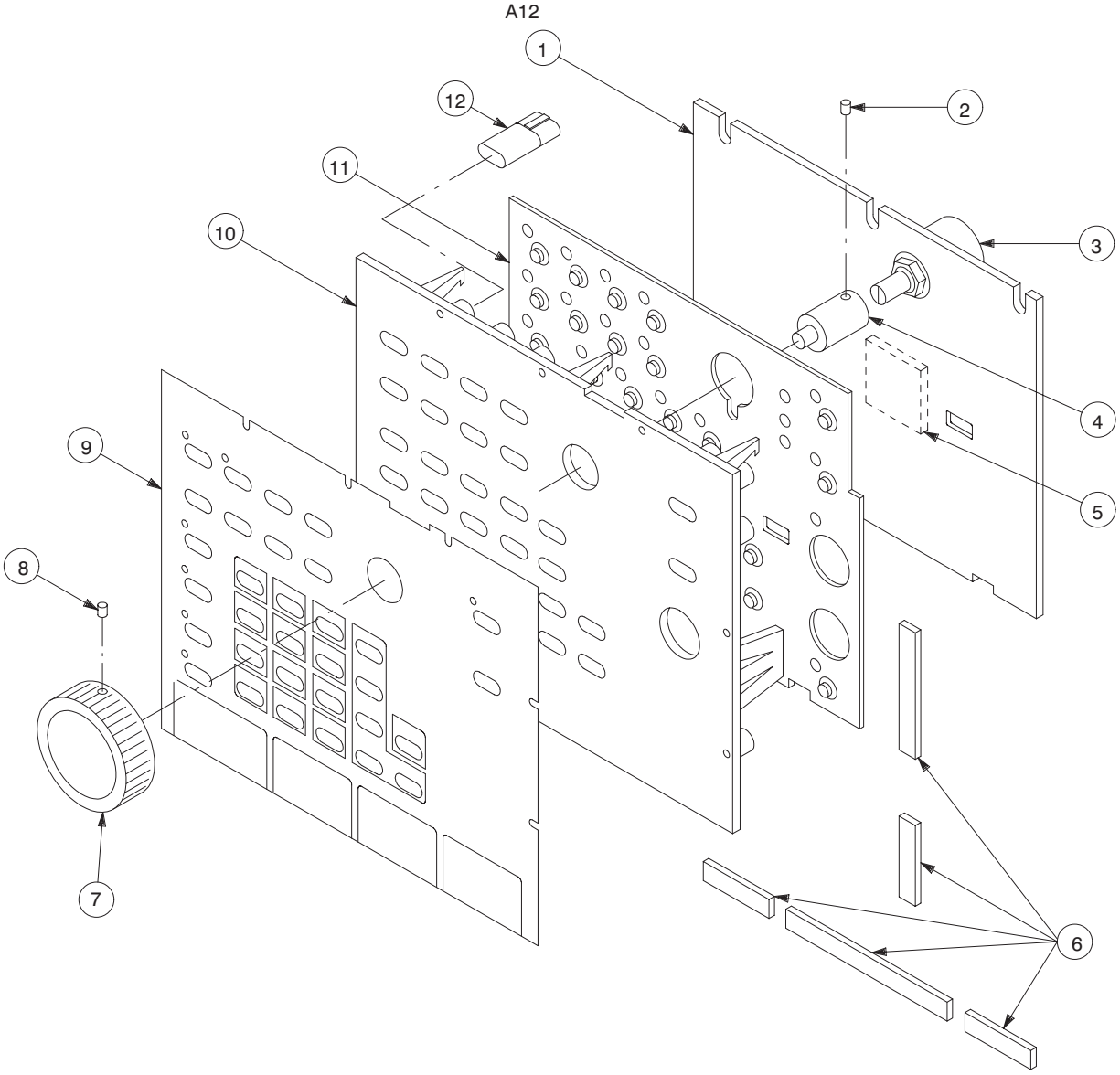


Figure 10-5: Front panel assembly

Replaceable Parts List

Fig. & Index Number	Tektronix Part Number	Serial No. Effective	Serial No. Discont'd	Qty	Name & Description	Mfr. Code	Mfr. Part Number
					OPTION 01		
10–6–1	671–4242–XX			1	CIRCUIT BD ASSY:PG SLAVE (A51)	80009	6714242XX

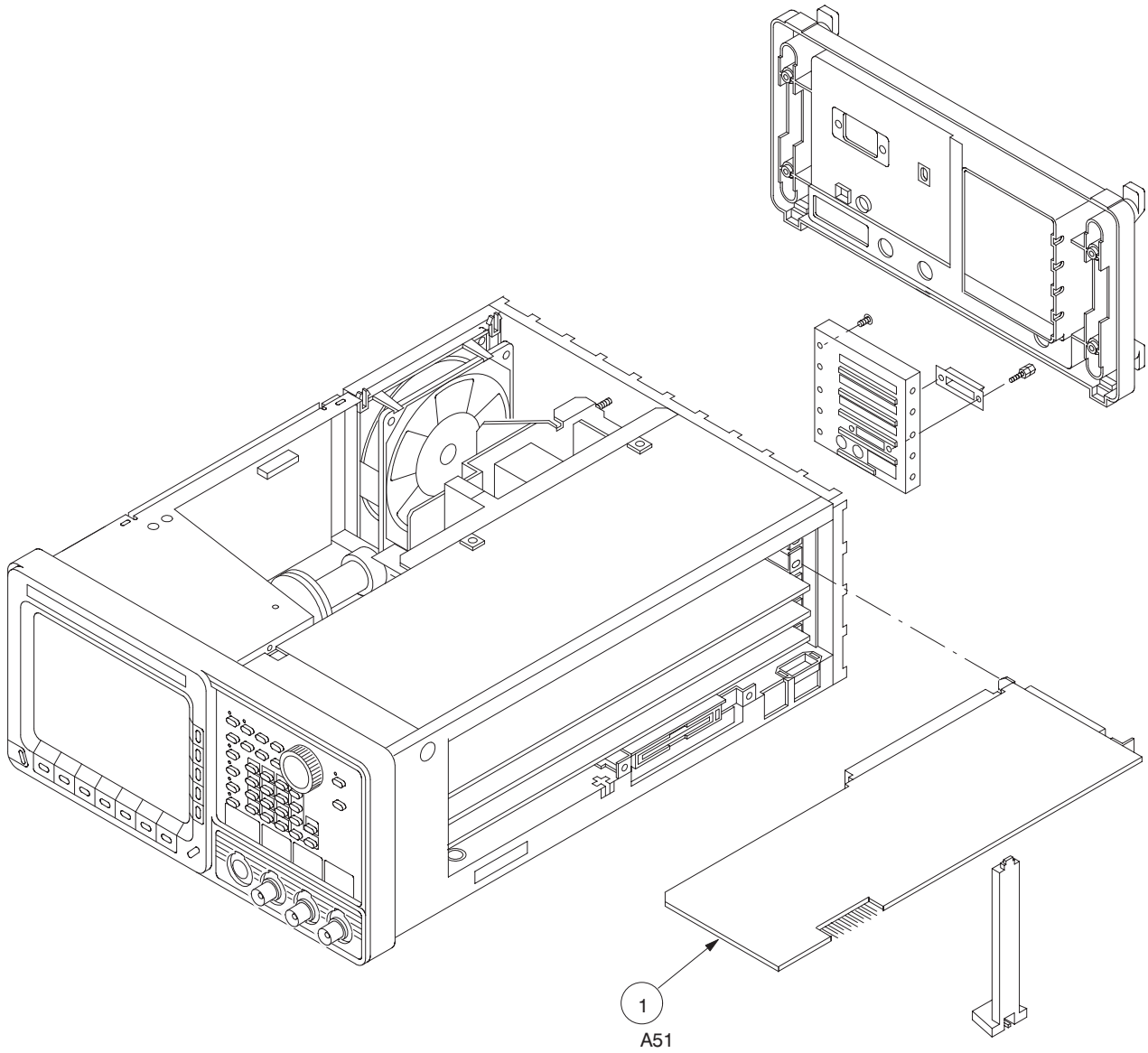


Figure 10-6: Option 01

Replaceable Parts List

Fig. & Index Number	Tektronix Part Number	Serial No. Effective	Serial No. Discont'd	Qty	Name & Description	Mfr. Code	Mfr. Part Number
					OPTION 02		
10–7–1	671–4242–XX			2	CIRCUIT BD ASSY:PG SLAVE (A51)	80009	6714242XX

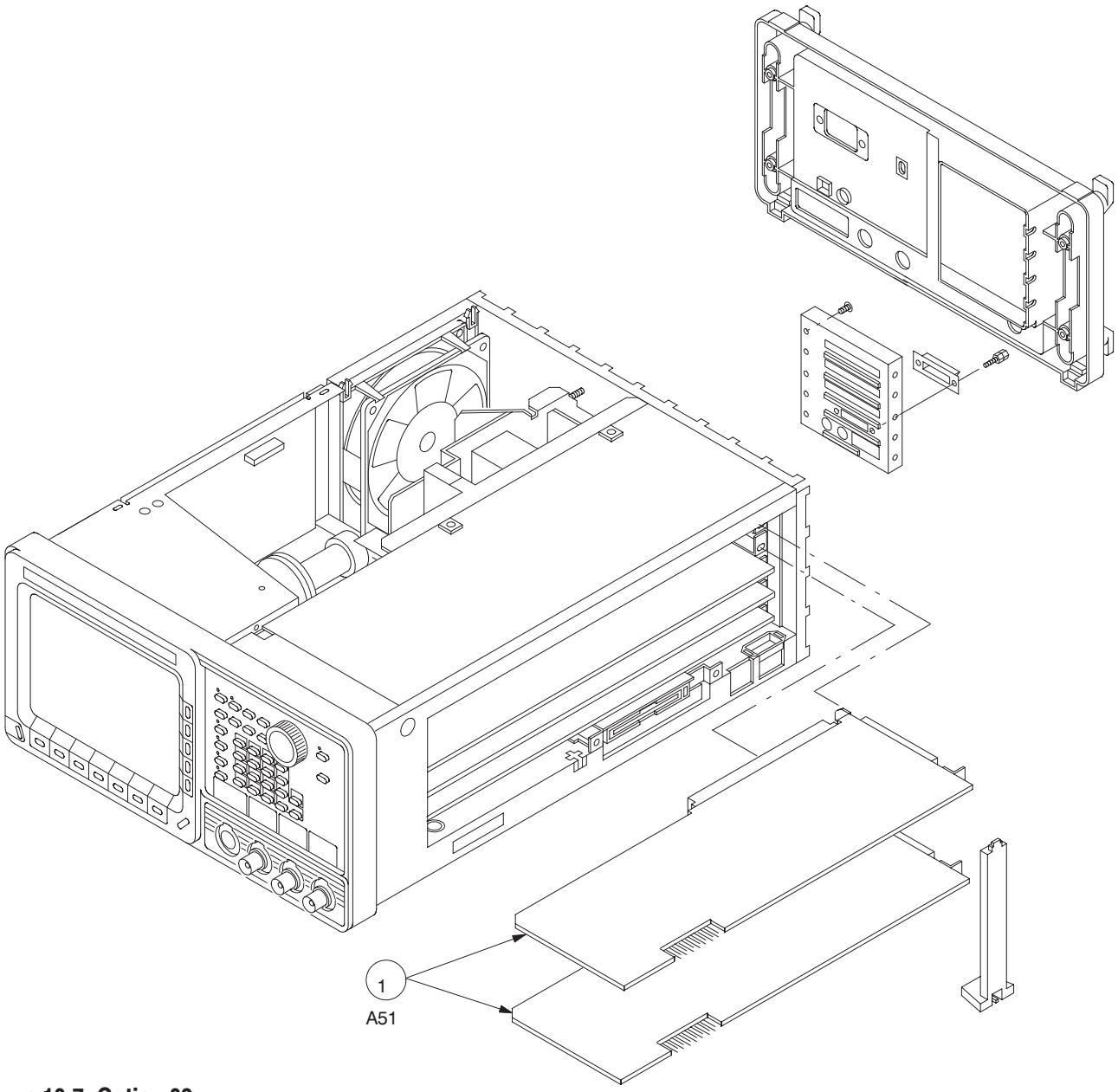


Figure 10-7: Option 02

Component Number	Tektronix Part No.	Serial No. Effective Dscont	Name & Description	Mfr. Code	Mfr. Part No.
			CABLE ASSEMBLIES		
W1	174–2971–XX		CA ASSY,SP,ELEC:22,18 AWG,10CM L	80009	1742971XX
W4	174–2803–XX		CA ASSY,SP,ELEC:2,18 AWG,12CM L,W/FSTN	80009	1742803XX
W6	174–2934–XX		CA ASSY,SP,ELEC:3,18 AWG,18CM L	80009	1742934XX
W10	174–2936–XX		CA ASSY,SP,ELEC:5,26 AWG,26CM L,RIBBON	80009	1742936XX
W20	196–3112–XX		LEAD,ELECTRICAL:18 AWG,6.0 L,5–4	80009	1963112XX
W30	174–2933–XX		CA ASSY,SP,ELEC:5,26 AWG,15CM L,RIBBON W/D–SUB	80009	1742933XX
W64	174–2945–XX		CA ASSY,SP,ELEC:10,26 AWG,23CM L,RIBBON	80009	1742945XX
W100	174–3210–XX		CA ASSY,RF:50 OHM COAX,15CM L,9–1 W/PELTOLA BOTH ENDS	80009	1743210XX
W101	174–3215–XX		CA ASSY,RF:50 OHM COAX,25CM L,9–2, W/PELTOLA	80009	1743215XX
W102	174–3213–XX		CA ASSY,RF:50 OHM COAX,25CM L,9–1, W/PELTOLA	80009	1743213XX
W330	174–3456–XX		CA ASSY,RF:50 OHM COAX,20CM L,9–2, W/PELTOLA & SMB CONN	80009	1743456XX
W510	174–3203–XX		CA ASSY,RF:50 OHM COAX,20CM L,9–3, W/PELTOLA BOTH ENDS	80009	1743203XX
W511	174–3205–XX		CA ASSY,RF:50 OHM COAX,20CM L,9–5, W/PELTOLA BOTH ENDS	80009	1743205XX
W675	174–2775–XX		CA ASSY,SP,ELEC:26,350MM L,FLAT FLEX	80009	1742775XX
W900	174–2770–XX		CA ASSY,SP,ELEC:10,26 AWG,390MM L,RIBBON	80009	1742770XX
			DG2020A Option 01 Only		
W410	174–3218–XX		CA ASSY,SP:30,28 AWG,3CM L,FLAT	80009	1743218XX
W520	174–3203–XX		CA ASSY,RF:50 OHM COAX,20CM L,9–3, W/PELTOLA BOTH ENDS	80009	1743203XX
W521	174–3205–XX		CA ASSY,RF:50 OHM COAX,20CM L,9–5, W/PELTOLA BOTH ENDS	80009	1743205XX
			DG2020A Option 02 Only		
W420	174–3547–XX		CA ASSY,SP,ELEC:30,28 AWG,6CM L,FLAT	80009	1743547XX
W520	174–3203–XX		CA ASSY,RF:50 OHM COAX,20CM L,9–3, W/PELTOLA BOTH ENDS	80009	1743203XX
W521	174–3205–XX		CA ASSY,RF:50 OHM COAX,20CM L,9–5, W/PELTOLA BOTH ENDS	80009	1743205XX
W530	174–3203–XX		CA ASSY,RF:50 OHM COAX,20CM L,9–3, W/PELTOLA BOTH ENDS	80009	1743203XX
W531	174–3205–XX		CA ASSY,RF:50 OHM COAX,20CM L,9–5, W/PELTOLA BOTH ENDS	80009	1743205XX

Fig. & Index No.	Tektronix Part No.	Serial No. Effective Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
				STANDARD ACCESSORIES		
	063–2918–XX		1	SOFTWARE PKG:PERFORMANCE,3.5IN	80009	0632918XX
	063–2919–XX		1	SOFTWARE PKG:GPIB SAMPLE PROGRAM,3.5IN	80009	0632919XX
	063–2920–XX		1	SOFTWARE PKG:DG–LINK APPLICATON PROGRAM,3.5IN	80009	0632920XX
	071–0053–XX		1	MANUAL,TECH:USERS	80009	0710053XX
	071–0054–XX		1	MANUAL,TECH:PROGRAMMER	80009	0710054XX
	174–3548–XX		1	CABLE ASSY,RF:48.50 OHM COAX (STANDARD) W600	80009	1743548XX
	174–3548–XX		2	CABLE ASSY,RF:48.50 OHM COAX (FOR OPTION 01) W600	80009	1743548XX
	174–3548–XX		3	CABLE ASSY,RF:48.50 OHM COAX (FOR OPTION 02) W600	80009	1743548XX
	012–1502–XX		1	CABLE ASSY SET,RF:12 EA OF 50 OHM,RF CABLE ASSY(PIN TO PIN) & 2 EA OF CARRIER (FOR P3410)	80009	0121502XX
	012–1504–XX		1	CABLE ASSY SET,RF:12 EA OF 50 OHM,RF CABLE ASSY(SMB TO PIN) & 1 EA OF CARRIER (FOR P3420)	80009	0121504XX
	--------		1	CABLE ASSY,PWR,:3,18 AWG,92 L,SVT,TAN (SEE FIGURE 2–1)		
	161–0104–05		1	CABLE ASSY,PWR,:3,18 AWG,240V,98.0 L (OPTION A3–AUSTRALIAN)	S3109	SAA/3-OD3CCFC3X
	161–0104–06		1	CABLE ASSY,PWR,:3 X 0.75MM SQ,220V,98.0 L (OPTION A1–EUROPEAN)	S3109	VIIGSOPO-HO5VVF
	161–0104–07		1	CABLE ASSY,PWR,:3,1.0MM SQ,240 VOLT,2.5 M (OPTION A2–UNITED KINGDOM)	S3109	ORDER BY DESC
	161–0104–08		1	CABLE ASSY,PWR,:3,18 AWG,98 L,SVT,GREY/BLK (OPTION A4–NORTH AMERICAN)	70903	ORDER BY DESC
	161–0167–00		1	CABLE ASSY,PWR,:3.0 X 0.75,6A,240V,2.5M L (OPTION A5–SWITZERLAND)	S3109	ORDER BY DESC
				OPTIONAL ACCESSORIES FOR DG2020A		
	071–0055–XX		1	MANUAL,TECH:SERVICE	80009	0710055XX
	200–3232–XX		1	COVER,FRONT:ABS	TK1908	ORDER BY DESC
	016–1154–XX		1	HOOD ASSEMBLY:2KDSO	80009	0161154XX
	016–1159–XX		1	POUCH:POUCH & PLATE,GPS SIZE	80009	0161159XX
	040–1444–XX		1	RACKMOUNT KIT	80009	0401444XX
	040–1514–XX		1	UPGRADE KIT (ADD 12/24 OUTPUT CHANNELS)	80009	0401514XX
	159–0210–XX		1	FUSE,CARTRIDGE:DIN 5 x 20MM,5A,250V,SLOW	80009	1590210XX
	159–0239–XX		1	FUSE,CARTRIDGE:3AG,6A,250V,MEDIUM	80009	1590239XX
	200–2264–XX		1	CAP,FUSEHOLDER:3AG FUSE SAFETY CONTROLLED (FOR 159–0239–XX)	80009	2002264XX
	200–2265–XX		1	CAP,FUSEHOLDER:5 X 20MM,FUSE SAFETY CONTROLLED (FOR 159–0210–XX)	80009	2002265XX
	011–0049–XX		1	TERMN,COAXIAL:50 OHM,5W,BNC	80009	0110049XX
	012–0991–XX		1	CABLE,COMPOSITE:IDC,GPIB:2 METER	00779	553577-3

Fig. & Index No.	Tektronix Part No.	Serial No. Effective Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
	012–1256–XX		1	CABLE,INTCON:50 OHM COAX,98.0 L	TK0BD	7220369010
	012–1342–XX		1	CABLE ASSY,RF:50 OHM COAX,24.0 L	80009	0121342XX
	012–1505–XX		1	CABLE ASSY,RF:50 OHM COAX,PIN TO PIN, 20 INCH L	80009	0121505XX
	067–0282–XX		1	FIXTURE,CAL:MAINTENANCE	80009	0670282XX
	650–3421–XX		1	EXCHANGE KIT FOR P3420	80009	6503421XX
				OPTIONAL ACCESSORIES FOR P3410		
	012–1458–XX		1	CABLE ASSY,RF:50 OHM,100 CM L,SMB TO SMB,DOUBLE SHIELD CABLE	80009	0121458XX
	012–1459–XX		1	CABLE ASSY,RF:50 OHM,100 CM L,SMB TO BNC,DOUBLE SHIELD CABLE	80009	0121459XX
	012–1503–XX		1	CABLE ASSY,RF:50 OHM CAX, 50 CM L,W/SMB & HEADER	80009	0121503XX
	012–1505–XX		1	CABLE ASSY,RF:50 OHM COAX,PIN TO PIN, 20 INCH L	80009	0121505XX
	012–1506–XX		1	CABLE ASSY,RF:50 OHM COAX,SMB TO PIN, 50 INCH L	80009	0121506XX
	012–1507–XX		1	CABLE ASSY,RF:12 EA OF 50 OHM,RF CABLE ASSY(SMB TO PIN) & 1 EA OF CARRIER	80009	0121507XX
	012–1508–XX		1	LEAD SET,ELEC:2,26 AWG,7.5 CM L,PKG OF 5 EA	80009	0121508XX
	012–1509–XX		1	LEAD SET,ELEC:8,26 AWG,12 CM L,PKG OF 3 EA	80009	0121509XX
	015–0671–XX		1	ADAPTER,CONN:SMB(FEMALE) TO BNC(MALE)	80009	0150671XX
	131–5919–XX		1	CONNECTOR:WITH 12 PIN HEDER SOCKETS	80009	1315919XX
				OPTIONAL ACCESSORIES FOR P3420		
	012–1458–XX		1	CABLE ASSY,RF:50 OHM,100 CM L,SMB TO SMB,DOUBLE SHIELD CABLE	80009	0121458XX
	012–1459–XX		1	CABLE ASSY,RF:50 OHM,100 CM L,SMB TO BNC,DOUBLE SHIELD CABLE	80009	0121459XX
	012–1503–XX		1	CABLE ASSY,RF:50 OHM CAX, 50 CM L,W/SMB & HEADER	80009	0121503XX
	012–1506–XX		1	CABLE ASSY,RF:50 OHM COAX,SMB TO PIN, 50 INCH L	80009	0121506XX
	012–1507–XX		1	CABLE ASSY,RF:12 EA OF 50 OHM,RF CABLE ASSY(SMB TO PIN) & 1 EA OF CARRIER	80009	0121507XX
	012–1508–XX		1	LEAD SET,ELEC:2,26 AWG,7.5 CM L,PKG OF 5 EA	80009	0121508XX
	012–1509–XX		1	LEAD SET,ELEC:8,26 AWG,12 CM L,PKG OF 3 EA	80009	0121509XX
	015–0671–XX		1	ADAPTER,CONN:SMB(FEMALE) TO BNC(MALE)	80009	0150671XX
	131–5919–XX		1	CONNECTOR:WITH 12 PIN HEDER SOCKETS	80009	1315919XX
	650–3421–XX		1	EXCHANGE KIT FOR P3420	80009	6503421XX

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