



**SPG700**  
**Master Sync / Clock Reference Generator**  
**Service Manual**

[www.tek.com](http://www.tek.com)



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- In North America, call 1-800-833-9200.
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## Important safety information

This manual contains information and warnings that must be followed by the user for safe operation and to keep the product in a safe condition.

To safely perform service on this product, additional information is provided at the end of this section. (See page vi, *Service safety summary*.)

### General safety summary

Use the product only as specified. Review the following safety precautions to avoid injury and prevent damage to this product or any products connected to it. Carefully read all instructions. Retain these instructions for future reference.

Comply with local and national safety codes.

For correct and safe operation of the product, it is essential that you follow generally accepted safety procedures in addition to the safety precautions specified in this manual.

The product is designed to be used by trained personnel only.

Only qualified personnel who are aware of the hazards involved should remove the cover for repair, maintenance, or adjustment.

Before use, always check the product with a known source to be sure it is operating correctly.

This product is not intended for detection of hazardous voltages.

While using this product, you may need to access other parts of a larger system. Read the safety sections of the other component manuals for warnings and cautions related to operating the system.

When incorporating this equipment into a system, the safety of that system is the responsibility of the assembler of the system.

**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.

**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, make sure that the product is properly grounded.

Do not disable the power cord grounding connection.

**Power disconnect.** The power cord disconnects the product from the power source. See instructions for the location. Do not position the equipment so that it is difficult to operate the power cord; it must remain accessible to the user at all times to allow for quick disconnection if needed.

**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 apply a potential to any terminal, including the common terminal, that exceeds the maximum rating of that terminal.

**Do not operate without covers.** Do not operate this product with covers or panels removed, or with the case open. Hazardous voltage exposure is possible.

**Avoid exposed circuitry.** Do not touch exposed connections and components when power is present.

**Do not operate with suspected failures.** If you suspect that there is damage to this product, have it inspected by qualified service personnel.

Disable the product if it is damaged. Do not use the product if it is damaged or operates incorrectly. If in doubt about safety of the product, turn it off and disconnect the power cord. Clearly mark the product to prevent its further operation.

Before use, inspect voltage probes, test leads, and accessories for mechanical damage and replace when damaged. Do not use probes or test leads if they are damaged, if there is exposed metal, or if a wear indicator shows.

Examine the exterior of the product before you use it. Look for cracks or missing pieces.

Use only specified replacement parts.

**Do not operate in wet/damp conditions.** Be aware that condensation may occur if a unit is moved from a cold to a warm environment.

**Do not operate in an explosive atmosphere.**

**Keep product surfaces clean and dry.** Remove the input signals before you clean the product.

**Provide proper ventilation.** Refer to the installation instructions in the manual for details on installing the product so it has proper ventilation.

Slots and openings are provided for ventilation and should never be covered or otherwise obstructed. Do not push objects into any of the openings.

**Provide a safe working environment.** Always place the product in a location convenient for viewing the display and indicators.

Be sure your work area meets applicable ergonomic standards. Consult with an ergonomics professional to avoid stress injuries.

Use only the Tektronix rackmount hardware specified for this product.

## Service safety summary

The *Service safety summary* section contains additional information required to safely perform service on the product. Only qualified personnel should perform service procedures. Read this *Service safety summary* and the *General safety summary* before performing any service procedures.

**To avoid electric shock.** Do not touch exposed connections.

**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, switch off the product power and disconnect the power cord from the mains power before removing any covers or panels, or opening the case for servicing.

**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.

**Verify safety after repair.** Always recheck ground continuity and mains dielectric strength after performing a repair.

## Terms in this manual

These terms may appear in this manual:



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

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

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## Symbols and 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.



When this symbol is marked on the product, be sure to consult the manual to find out the nature of the potential hazards and any actions that must be taken to avoid them. (This symbol may also be used to refer the user to ratings in the manual.)

The following symbol(s) may appear on the product:



CAUTION  
Refer to Manual



Protective Ground  
(Earth) Terminal

## Environmental considerations

### Product end-of-life handling

Observe the following guidelines when recycling an instrument or component:

This product contains a small installed lithium metal button cell. Please properly dispose of or recycle the cell at its end of life according to local government regulations.

**Perchlorate materials.** This product contains one or more type CR lithium batteries. According to the state of California, CR lithium batteries are classified as perchlorate materials and require special handling. See [www.dtsc.ca.gov/hazardouswaste/perchlorate](http://www.dtsc.ca.gov/hazardouswaste/perchlorate) for additional information.

### Transporting batteries

The small lithium primary cell contained in this equipment does not exceed 1 gram of lithium metal content per cell, and the cell type has been shown by the manufacturer to comply with the applicable requirements of the UN Manual of Tests and Criteria Part III, Sub-section 38.3. Consult your carrier to determine which lithium battery transportation requirements are applicable to your configuration, including to its re-packaging and re-labeling, prior to reshipment of the product by any mode of transport.



# Preface

This manual contains information needed to service an SPG700 Master Sync / Clock Reference Generator to the module level.

If the instrument does not function properly, troubleshooting and corrective measures should be taken immediately to prevent additional problems.

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**NOTE.** *Contact your local Tektronix representative for information on where to return your instrument if it requires repair during the warranty period.*

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To prevent personal injury or damage to the SPG700, consider the following before beginning service:

- The procedures in this manual should be performed only by a qualified service person.
- Read the *General safety summary*. (See page iv.)
- Read the *Service safety summary*. (See page vi.)

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

## Manual structure

This manual is divided into the following sections:

- *Theory of operation* contains circuit descriptions that support service to the module level.
- *Adjustment procedures* contains procedures for adjusting an SPG700 generator to meet warranted characteristics.
- *Maintenance* contains information and procedures for performing preventive and corrective maintenance for the SPG700 generator. These instructions include cleaning and fault isolation to the module level.
  - *Remove and replace procedures* contains procedures to safely remove replaceable modules from the instrument.
  - *Troubleshooting procedures* contains information and procedures to help you isolate and fix various problems.
- *Replaceable parts* includes a table of all replaceable modules, their descriptions, and their Tektronix part numbers.

## Manual conventions

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

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 SPG700 front panel and menus.
- Instruction steps are numbered unless there is only one step.
- **Bold** text refers to specific interface elements that you are instructed to select, click, or clear.
  - Example: Press the **ENTER** button to access the PRESET submenu.
- *Italic* text refers to document names or sections. Italics are also used in NOTES, CAUTIONS, and WARNINGS.
  - Example: The *Theory of operation* section includes a block diagram.

**Modules** Throughout this manual, the term module appears. A module is composed of electrical and mechanical assemblies, circuit cards, and interconnecting cables.

**Safety** Symbols and terms related to safety appear in the *General safety summary*.

## Product documentation

The following table lists the user documents for the SPG700 generator:

**Table i: Product documentation**

Document	Tektronix Part Number	Description	Availability	
			Print	Web
Installation and Safety Instructions	071-3480-xx (English)	Describes how to install the instrument and provides basic operating information	✓	✓
	077-1223-xx (Japanese)			✓
	077-1224-xx (Russian)			✓
User Manual	077-1225-xx (English)	Provides detailed operating information		✓
	077-1227-xx (Russian)			
Specifications and Performance Verification	077-1228-xx	Lists the product specifications and provides procedures for verifying the performance of the instrument		✓
Service Manual	077-1229-xx	Describes how to service the instrument to the module level (such as circuit boards and fuses)		✓
Declassification and Security Instructions	077-1230-xx	Describes how to clear or sanitize the data storage (memory) devices in the product for customers with data security concerns		✓
Release Notes	077-1231-xx	Describes the new features, improvements, and limitations of the instrument firmware		✓
SPG70UP Upgrade Instructions	075-1093-xx	Provides instructions for upgrading your SPG700 instrument		✓
Video Sync Pulse Generator and Electronic Changeover Unit System Integration Technical Reference	077-0563-xx (ECO422D) 077-0877-xx (ECO8000, ECO8020)	Provides information for system integrators who are designing systems for high-definition (HD) and standard-definition (SD) digital video content where Tektronix electronic changeover units and video sync pulse generators are to be deployed.		✓



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# Theory of operation

## Base instrument theory of operation

This section describes the basic operation of the major circuit blocks or modules in the SPG700 generator. The block diagram shows the modules and functional blocks in the instrument. (See Figure 1.)

Information about the circuit blocks, including a detailed block diagram of the Genlock/Black board, follows the SPG700 block diagram.

**Main board**     The Main board consists of the following seven blocks.

**Processor core.** The processor core consists of the CPU and all of its support circuits such as flash memory, DDR memory, clocks, buffers, reset circuit, configuration memory, and decoder PLD.

The CPU controls the front panel, LCD display, USB port, network interface, GPI interface, and installed generator boards. The CPU also controls execution of remote commands and downloading and uploading of signal files through the Ethernet interface.

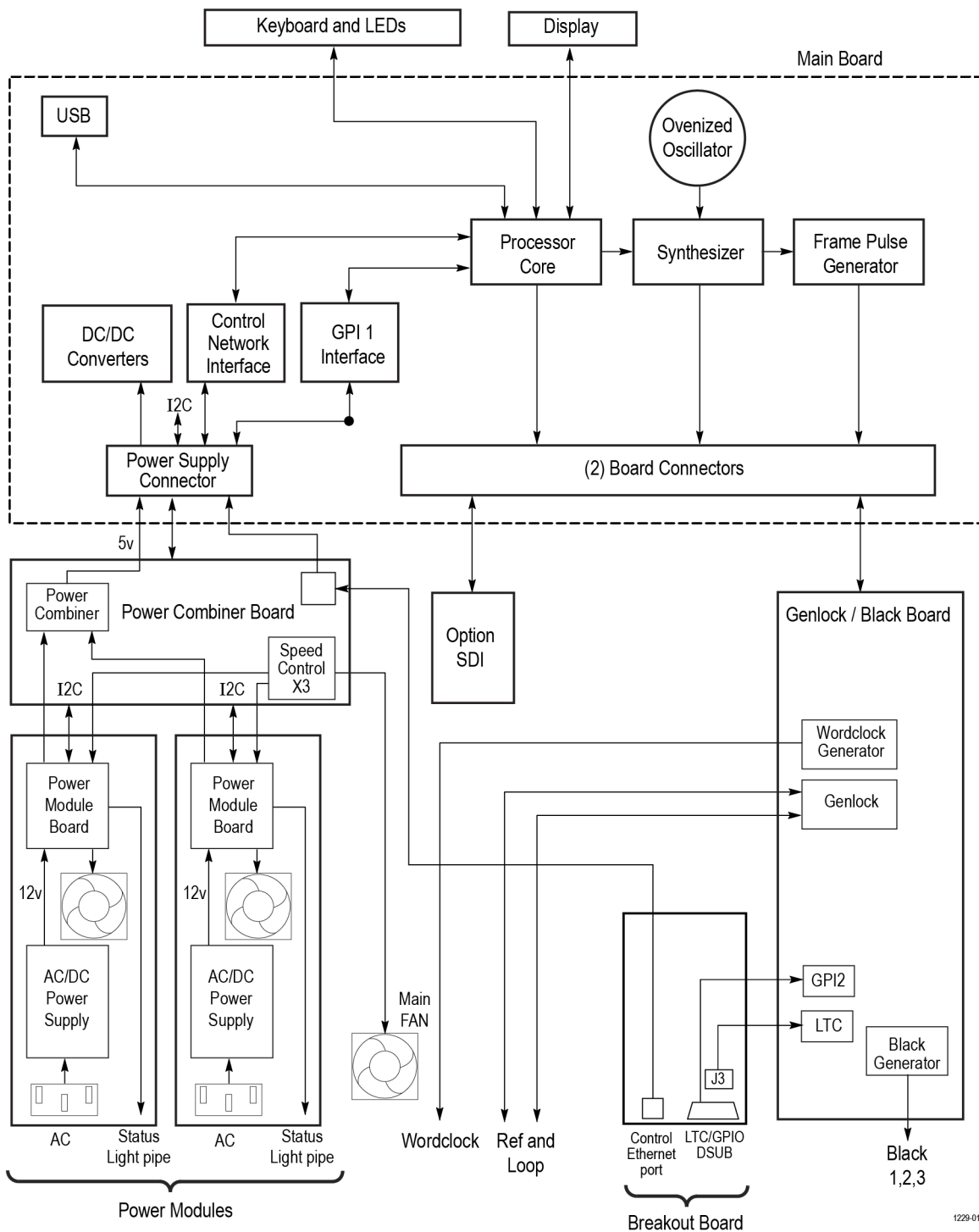
The flash memory holds the firmware data and signal data used to generate outputs from some modules. During Genlock referenced operation, the CPU reads data from the input module, and controls the frequency of the secondary clocks.

**Ovenized oscillator.** The ovenized oscillator provides the stable time base for generating signals. This is a fixed 20 MHz and is not adjustable.

**Video / audio clocks.** The synthesizer creates the video and audio clocks from the oven output. The video clocks are a 54 MHz master clock signal and HD rate clocks of 74.25 MHz and a 74.25/1.001 MHz. The audio clock is 12.288 MHz. The CPU can control the ratio between the oven and these clocks. By controlling this ratio, the system can lock to external signals for Genlock reference. The ratio is also adjusted to achieve calibration, with the resulting value stored in flash memory.

The 54 MHz and the 12.288 MHz are delivered to each generator card. For the HD rate clocks, the CPU controls four multiplexers that independently allow each generator card to get either the 74.25 MHz or 74.25/1.001 MHz clock. The diagnostics monitor that each clock is correctly locked to the oven or master 54 MHz clock.

**Frame pulse generator.** The frame pulse generator uses the 54 MHz clock to generate the three frame pulses at 2.997 Hz, 6.25 Hz, and 3.00 Hz that are used to synchronize the signal formats generated by the installed options.



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Figure 1: SPG700 block diagram

**DC/DC converters.** This block converts the +5 V supplied by the Power Combiner board to -5 V, 3.3 V, 8 V, and 5 V analog for use by the circuit boards. Various voltages needed only on the Main board, such as to drive the DDR and processor core, are also provided.

The high current 5 V and 3.3 V voltages supplied to the slots are fused at the connector to each generator board. All of the major voltages, including both sides of each fuse, are monitored by the voltage diagnostic.

**Control network interface.** This block controls the Ethernet interface for the Control Ethernet Port.

The Ethernet port is located on the Breakout board at the instrument rear panel.

**GPI interface.** The GPI interface allows the CPU block to access the user inputs and outputs through the GPI port located on the instrument rear panel.

There are two GPI circuit blocks, GPI 1 and GPI 2. GPI 1 is located on the Main board. GPI 2 is located on the Genlock/Black board. Both sets of GPI signals route through the cable to the Breakout board. The Breakout board houses the rear panel GPI/LTC, and Ethernet connections. The signals from GPI 1 are used to restore presets. They are connected to pins 3, 4 and 11 of the LTC/GPIO connector. The GPI 2 signals are used to assert user configurable events, and to signal outputs on certain conditions. These are connected to pins 1, 2 and 3. Note that pin 3 is dual use. It may be used as one of the bits which selects a preset, or as the general purpose input.

## Power supply

The SPG700 has a redundant power subsystem, which contains three major components: the two power supply modules and the Power Combiner board. Operation with one power supply module is also supported, but there is no redundancy.

The power supply modules contain the line filter, the 100-240 VAC to 12 V supply, a fan, and the power module board, which adapts the cables to a board-to-board header. The power module board also has LEDs to drive the light pipe that shows power status on the rear panel of the power supply module.

The power module board has an EEPROM to log hours of operation. Since the power module board tracks the use time on the other supply components, replacing components within the supply module is not allowed.

The Power Combiner board takes in the 12 V from the one or two supplies, and converts to 5 V for the rest of the instrument. If there are two good supplies, the embedded microcontroller in the combiner chooses the preferred one. If either supply has an issue, the microcontroller chooses the best one. 12 V storage capacitors allow time for the system to switch supplies without any disruption of the 5 V output. During the start up of the combiner microcontroller, the combiner functions in diode mode and uses the supply with the higher voltage, or a mix of the two.

The Power Combiner board also has the fan controllers, so the speed of all three fans can be set and sensed by the instrument processor over the I2C interface. The network interface signals pass through the combiner but only connect to the two connectors.

An I2C interface is used to allow the processor to access the micro-controller on the power combiner, the fan speed control, and the EEPROMS in the power supply modules.

## Optional modules theory of operation

The instrument has a standard Genlock/Black generator board, plus an orderable SDI board. This section describes the functions associated with those boards.

### Genlock/Black board theory of operation

The standard Genlock/Black board provides black, LTC and wordclock generation, as well as genlock and VITC/LTC time code input. This subsection describes the basic operation of the major circuit blocks on the standard Genlock/Black board.

**Genlock control loop.** The rear-panel REF and passive LOOP connectors accept reference video input. The reference video is then buffered, and drives a sync separator and an Analog to Digital Converter (ADC). The sync signals allow the Genlock logic to roughly align the internal sync to the incoming video. The sync signal also allows the genlock logic to window on the ADC samples from the sync edge or the burst. The samples are read by the SW which then "closes the loop" by writing to the DAC that controls the OCXO. This sets the phase and frequency of all the internal clocks.

All access to this circuitry occurs through the address and data busses, shown as the CPU I/O bus.

**MTOD clock.** The Master Time of Day (MTOD) clock contains the precise current time, which is phase locked to the selected time source. The MTOD is used for all time code generation and positioning of the frame reset pulses.

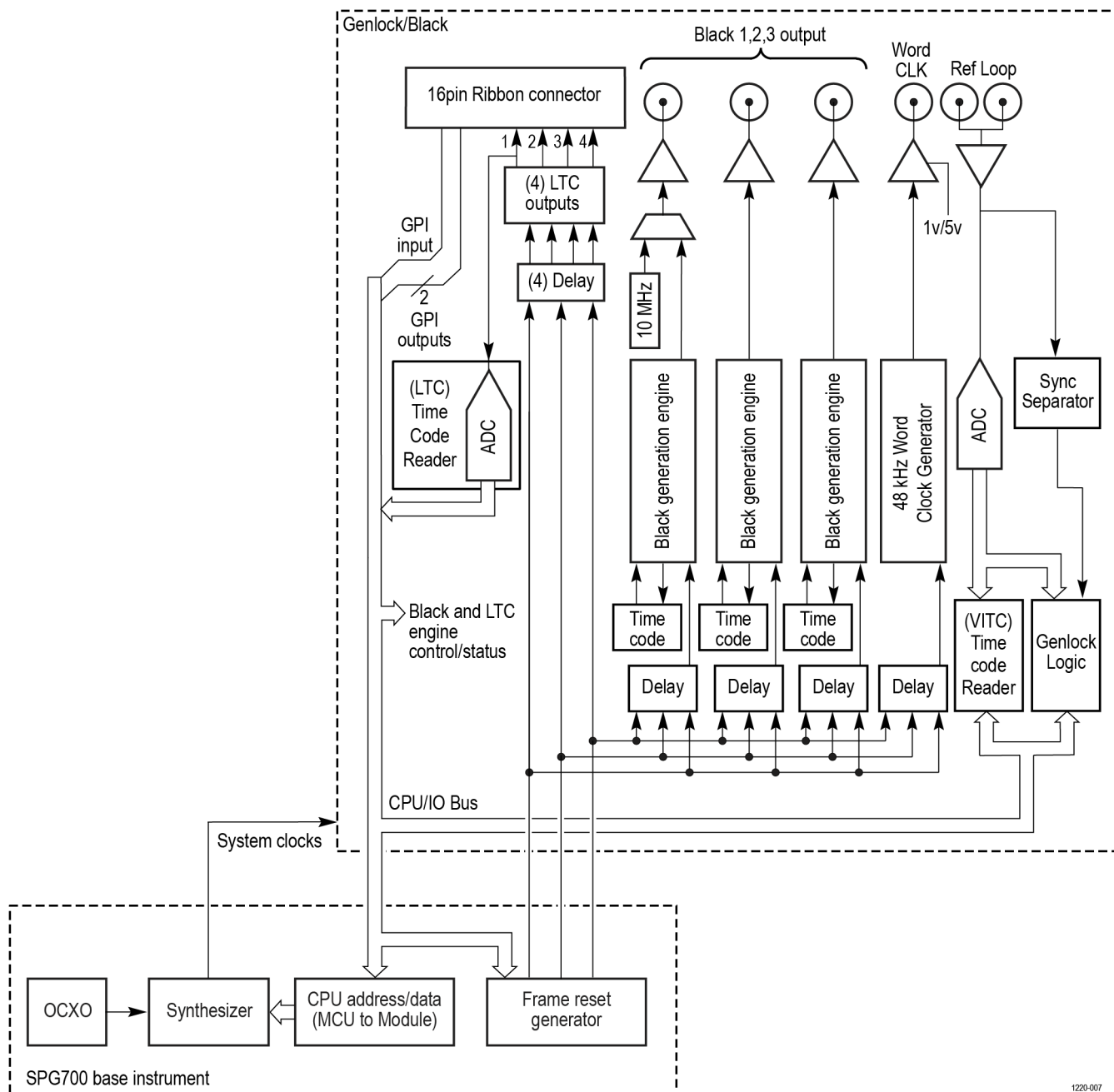
**Outputs.** The three Black Generation Engines and the four LTC engines each receive one of three frame reset pulses from the mainframe, which lock the video frames in all engines to exact references based on MTOD.

**48 kHz word clock generator.** The base black generator generates a 48 kHz clock (word clock) signal. You can configure this clock through the user interface for 1 V or 5 V.

**VITC time code reader.** The VITC time code reader operates on the same ADC data as the genlock. This data is processed to extract the VITC bits and check for valid CRC and continuity. When valid time code is detected, the SW reads the time values from the reader circuits.



**LTC time code reader.** LTC1 can be configured as an input. An ADC digitizes the LTC input and FPGA logic decodes the time data. The CPU reads the time data and sets the MTOD.

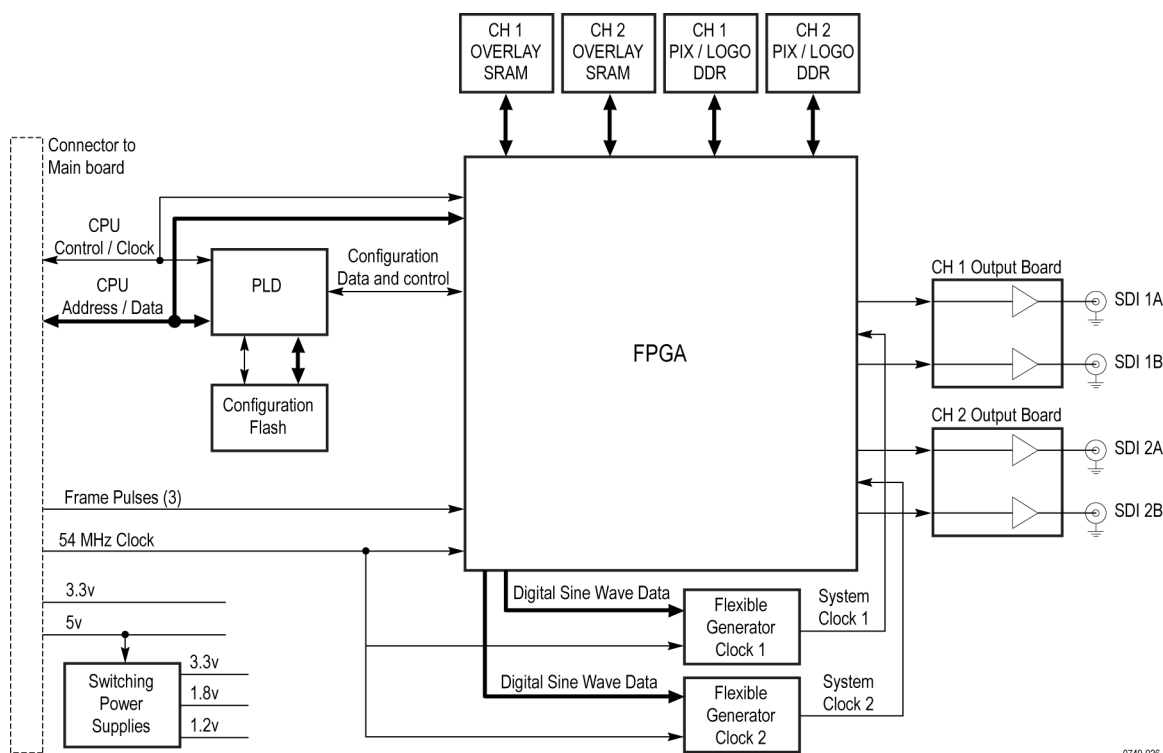


**Figure 2: Simplified block diagram of the Genlock/Black board circuitry**

### Option SDI theory of operation

This section describes the basic operation of the major circuit blocks in the Option SDI. The discussions relate to the Block Diagram. (See Figure 3.)

There is some circuitry on the Option SDI Main circuit board that is not used. Unused circuitry is not represented in the block diagram, nor is it discussed in this theory of operation.



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**Figure 3: Simplified block diagram of Option SDI**

**Overview.** The Option SDI has three circuit boards: the Option SDI board, which mounts horizontally and contains the bulk of the circuitry, and two small output boards. These output boards plug into the SDI board vertically and provide the rear BNC connections and the circuits required to buffer the high-speed output signals.

The heart of the Option SDI generator is an FPGA, with other circuits that provide support and ancillary functions. For signal generation, the FPGA creates the output signal such as color bars or a ramp. For some signals, the information to create the signals is completely contained within the FPGA. For other signals, data from the memories is used as well. Serialization and scrambling is also done in the FPGA.

**FPGA and associated circuits.** A Programmable Logic Device (PLD) configures the FPGA by loading a file from the Flash at power up. This configures the FPGA for normal operation; there is a separate file for calibration.

The CPU interface connects to both the PLD and FPGA. During SW upgrade, the Flash files are loaded from the mainframe through the PLD. The FPGA uses the CPU connection to access the control registers.

**Signal generation.** The FPGA contains horizontal and vertical counters, which create the raster structure for the selected signal. For most test signals, these counters drive the FPGA elements that create the actual video signals such as color bars or flat field, along with the EAV and SAV info and CRCs, if appropriate. The video signals are then scrambled, serialized, and sent at 270 Mb/s, 1.5 Gb/s or 3 Gb/s from the FPGA to the output boards.

When generating frame picture signals, similar horizontal and vertical counters access the DDR memory for the given channel. In this mode, the data from the user's picture file is used to create the test signal. This data stream is combined with the standard test signal stream to add the other required elements, and the result is then serialized.

For logo overlay, the frame picture system is used, but only for a portion of the image. The user logo information is read from the DDR memory, and blended with the test signal information.

The circle and text overlay functions are generated from the SRAM for each channel. This data is blended with the active portion of the test signal or frame picture information to produce the combined signal information.

**Clocks and frames.** The SPG700 circuitry provides three frame pulse signals. The actual frame signal used is the appropriate one for the rate of the signal being generated. The selected input frame resets the counters in the FPGA, establishing the correct video timing.

The SPG700 circuitry also provides a 54 MHz clock for generator mode. This 54 MHz clock drives a DDS in the FPGA to create a digitized sine wave, which is then applied to the flexible generator clock circuit. Depending on the output format the flexible clock output is at either 148.5 MHz or 148.35 MHz. This clock is fed back to the FPGA to drive the generator core functions, and sent to the FPGA serializer clock inputs and the trigger output multiplexer.

The 54 MHz input clock also registers the input frame pulse. After it is registered at 54 MHz, it must cross to the 148.5 MHz domain. For this to work deterministically the phase of the two clocks is automatically controlled. The status of this automatic control system is shown in the diagnostic menu as DDS0 phase (channel 1) and DDS1 phase (channel 2).

**SDI output boards.** The two SDI Output boards (one for each output channel) take two channels from the FPGA serializers and buffers them to drive 75  $\Omega$  cable. The output level is set by nonvolatile electronic potentiometers on the output board, so the calibration is captured in the board.

**Power supplies.** This option has three switching supplies, and several linear supplies. Most of the power comes in as 5 V and is converted to the voltage needed by the switching supplies. The SPG700 circuitry provides a small amount of 3.3 V for the processor interface, but the bulk of the 3.3 V used on the board is produced by the switching supply.

There are also 1.8 V and 1.2 V supplies, which are used for the memory and FPGA cores.

# Adjustment procedures

This section provides procedures for the adjustments that can be performed by trained service technicians.



**CAUTION.** All Adjustment procedures are to be performed only by trained service technicians.

## Adjust master clock using a frequency signal generator

Use this procedure to adjust the frequency of the master clock.

**Warm-up period.** Allow a 20 minute warm-up time in a +20 °C to +30 °C environment before making this adjustment.

Adjustments done before the operating temperature has stabilized may cause errors in performance. In addition, the signal generators require appropriate warm-up time to meet the frequency accuracy.

**Required equipment.** The following table lists the equipment required to adjust the master clock frequency using a frequency signal generator.

Table 1: Equipment required to adjust the master clock using a signal generator

Item	No.	Minimum requirement	Recommended equipment
Frequency standard	1	Frequency: 10 MHz $\pm 1 \times 10^{-9}$ Amplitude: 8 dBm	A reference Tektronix SPG8000A, with Option GPS installed and locked to GPS, GLONASS or equivalent Spectracom/Pendulum 6689
75 $\Omega$ BNC cable	1	Length: 42 inches	Tektronix part number 012-0074-00

### Procedure

Perform the following procedure to adjust the master clock frequency using a frequency standard.

1. Set the output of the frequency standard as follows:  
Frequency: 10.000000 MHz  
Output level: 8 dBm
2. Use the 75  $\Omega$  BNC cable to connect the rear-panel REF connector to the output of the frequency standard as shown in the following figure, and attach a 75  $\Omega$  terminator to the REF loop-through connector.

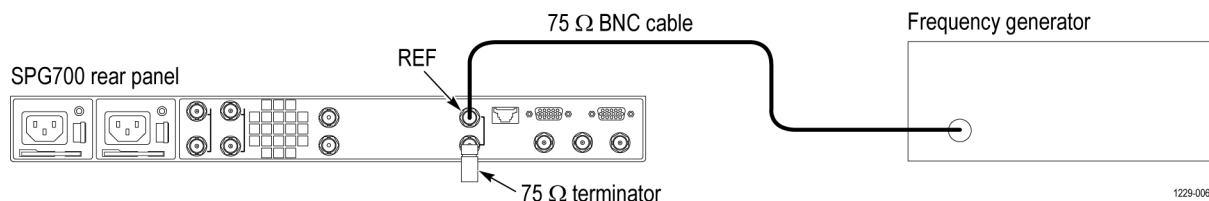


Figure 4: Adjusting the master clock frequency using a frequency standard

3. Restart the instrument in Factory mode. (See page 80, *To power up in factory mode.*)
4. Let the instrument warm up for 20 minutes before proceeding.
5. Set the reference source to CW as follows:
  - a. Press the **REF** button to display the REFERENCE menu.
  - b. Press the left (◀) or right (▶) arrow button to select **CW**, and then press the **ENTER** button.
6. Calibrate the oven system:
  - a. Press the **SYSTEM** button.
  - b. Press the up (▲) or down (▼) arrow button to select **CALIBRATE : OVEN**.
  - c. Press the **ENTER** button.
  - d. A message will be displayed asking you to verify that you want to execute the calibration. Press the **ENTER** button to proceed with the calibration.
  - e. Verify that the message **CALIBRATION result = xxxxxxx** is displayed. The result should be seven characters near the value of **2,097,152**. Press the **ENTER** button to exit the calibration mode.
7. Verify the calibration:
  - a. Press the **SYSTEM** button.
  - b. Press the up (▲) or down (▼) arrow button to select **DIAGNOSTICS**.
  - c. Press the **ENTER** button.
  - d. Press the up (▲) or down (▼) arrow button to select **DIAGNOSTICS : CALIBRATION**.
  - e. Check that the CAL value is less than **2.5 e-6**.

---

**NOTE.** If the CAL value is greater than  $2.6 e^{-6}$ , the oscillator oven may need to be serviced.

---

## Adjust Genlock/Black board

The adjustments on this module are Black burst level and Black burst offset. The procedures to adjust black burst level and offset are provided in this section.

**Warm-up period.** Allow a 20 minute warm-up time in a +20 °C to +30 °C environment before making these adjustments. Adjustments done before the operating temperature has stabilized may cause errors in performance.

**Required equipment.** The following table lists the equipment required to make the adjustments.

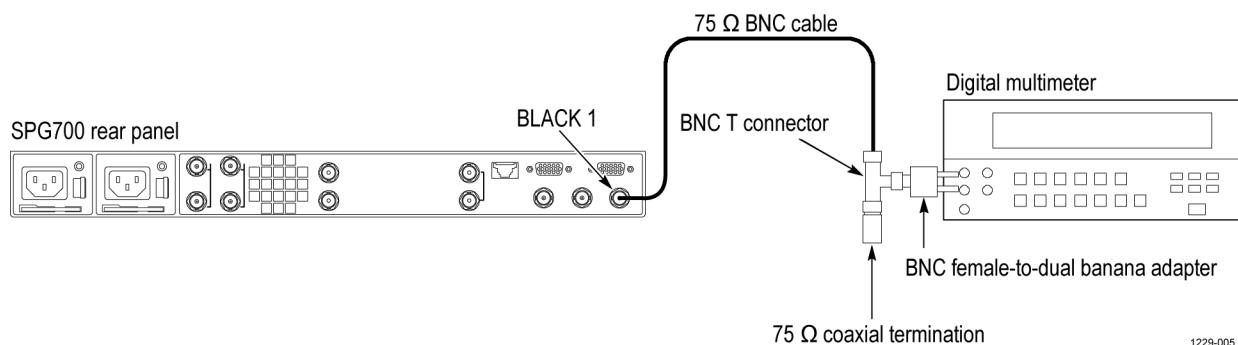
**Table 2: Equipment required for the Genlock/Black board adjustment procedures**

Item	No.	Minimum requirement	Recommended equipment
Digital multimeter	1	5 1/2 digits	FLUKE 8842A
75 $\Omega$ BNC cable	1	Length: 42 inches	Tektronix part number 012-0074-00
75 $\Omega$ coaxial precision terminator	1	75 $\Omega$ $\pm 0.1\%$	Tektronix part number 011-0102-03
BNC T connector	1		Tektronix part number 103-0030-00
BNC female to dual banana adapter	1		Tektronix part number 103-0090-00

### Adjust the black burst level and offset

Perform the following procedure to adjust the black burst level and offset.

1. Restart the instrument in Factory mode. (See page 80, *To power up in factory mode.*)
2. Connect the BLACK 1 output to the multimeter as shown in the following figure. (See Figure 5.)



**Figure 5: Equipment connections for Genlock/Black adjustments**

3. Press the **BLACK** button until you see **BLACK 1** on the display.
4. **Set the Black level:**
  - a. Press the up (▲) or down (▼) arrow button to select **CALIBRATION**.
  - b. Press the left (◀) or right (▶) arrow button to select **CALIBRATION : AMPLITUDE**.
  - c. Press the **ENTER** button.
  - d. Press the left (◀) or right (▶) arrow button to select the **0 V** signal.
  - e. Make a note of the voltmeter reading.
  - f. Press the left (◀) or right (▶) arrow button to select the **700 mV** signal.
  - g. Make a note of the voltmeter reading.
  - h. Subtract the voltage measured in part e of this step (0 mV setting) from the voltage measured in part f of this step (700 mV setting).
  - i. If the result is <698 mV or >702 mV, use the up (▲) or down (▼) arrow buttons to adjust the gain.
  - j. Repeat parts d through i of this step until the difference between the two signals is  $700 \text{ mV} \pm 2 \text{ mV}$ .
  - k. Press the **ENTER** button to save the setting and exit the amplitude calibration menu.
5. **Set Black offset:**
  - a. Proceeding from the previous step, use the left (◀) or right (▶) arrow button to select **CALIBRATION : OFFSET**.
  - b. Press the **ENTER** button.
  - c. Use the left (◀) or right (▶) arrow button to select the **0 V** signal.
  - d. Measure the offset voltage.
  - e. If necessary, use the up (▲) or down (▼) arrow buttons to adjust the offset voltage to  $0 \text{ V} \pm 5 \text{ mV}$ .
  - f. Press the **ENTER** button to save the setting and exit the offset calibration menu.
6. Move the cable to the next output and repeat steps 3 through 5 for the **BLACK 2** and **BLACK 3** outputs.



## Adjust Option SDI

There is only one adjustment for Option SDI. This adjustment sets the SDI output amplitude. Perform this adjustment for each channel if the instrument fails the SDI Output Amplitude portion of the performance verification procedure. This procedure replicates part of that procedure.

**Warm-up period.** Allow a 20 minute warm-up time in a +20 °C to +30 °C environment before making these adjustments. Adjustments done before the operating temperature has stabilized may cause errors in performance.

**Required equipment.** The following table lists the equipment required to make the adjustments.

**Table 3: Equipment required for the Option SDI adjustment procedures**

Item	No.	Minimum requirement	Recommended equipment
TV signal generator platform	1		Tektronix SPG700 with Option SDI installed
Digital signal analyzer	1	Digital signal analyzer with a 20 GHz electrical sampling module and a probe interface module	Tektronix DSA8200 with an 80E04 electrical sampling module and an 80A03 Tek Connect Probe Interface module
Stable 10 kHz sine wave generator	1	CW sine wave with 800 mV <sub>p-p</sub> ±5% into 75 Ω, THD < 60 dBc, 10 kHz, and <50 mV DC offset	Tektronix AFG3101
Tekconnect 75 Ω to 50 Ω adapter with BNC input connector	1		Tektronix TCA75
Precision RMS voltmeter	1		Keithley 2700 DMM
6 dB SMA attenuator	1		Tektronix part number 015-1001-01
SMA (male) to BNC (female) adapter			Tektronix part number 015-0554-00
1 m (3 ft.) BNC to BNC high-bandwidth cable	1		Belden 1694, MarkerTek 1694-B-B-3
1 m (3 ft.) BNC to BNC 50 Ω cable	1		Tektronix part number 012-0057-01
75 Ω precision terminator	1	75 Ω ±0.1%	Tektronix part number 011-0102-03
BNC T connector	1		Tektronix part number 103-0030-00
BNC female to dual banana adapter	1		Tektronix part number 103-0090-00

**SDI output amplitude  
adjustment table**

Print this table for use during the adjustment procedure.

**Table 4: SDI output amplitude**

	Minimum	Value	Maximum	
Characterization				
DMM Measurement (typically 0.2880 V)	—	—	—	
Oscilloscope Cycle RMS (typically 116 mV)	—	—	—	
Oscilloscope Cycle Mean (typically 1 mV)	—	—	—	
Sine wave RMS amplitude (typically 116 mV)	$\sqrt{(Cycle\ RMS)^2 - (Cycle\ Mean)^2}$		—	
Attenuation Factor	2.35		2.55	
Adjustment Record				
	Minimum	Value		Maximum
		Before adjustment	After adjustment	
SDI 1A amplitude				
Measured value (μ) with attenuation	776 mV			824 mV
SDI 1B amplitude				
Measured value (μ) with attenuation	776 mV			824 mV
SDI 2A amplitude				
Measured value (μ) with attenuation	776 mV			824 mV
SDI 2B amplitude				
Measured value (μ) with attenuation	776 mV			824 mV

**Characterize the test system amplitude**

Before adjusting the SDI Output Amplitude, you must first characterize the test system amplitude.

There are three parts to the amplitude characterization:

- Part A: Sets up a characterization reference to the DMM.
- Part B: Set up the DSA oscilloscope.
- Part C: Characterizes the test system.

**Part A: characterize the reference against the DMM.**

1. Connect the equipment as follows:
  - a. Connect one end of a 1 m high bandwidth cable to the AFG3101 output.
  - b. Connect the other end of the 1 m cable to the BNC T.
  - c. Connect the BNC T to a BNC to banana adapter.
  - d. Connect the other end of the BNC T to a precision terminator.
  - e. Connect the end of the banana adapter to the input of the DMM.
2. Set the AFG3101 to output a sine wave into a load impedance of 75  $\Omega$ .
3. Set the AFG3101 to a 10 kHz output into a load impedance of 75  $\Omega$ .
4. Set the AFG3101 to a 800 mVp-p output into a load impedance of 75  $\Omega$ .
5. Check that the output of the AFG3101 is On.
6. Set the DMM to measure AC voltage using a medium filter setting. Set the range to allow for four digits of RMS amplitude.
7. Record the DMM measurement in the SDI output amplitude table. (See Table 4 on page 14.)

### Part B: Set up the digital signal analyzer.



**CAUTION.** *Electrostatic discharge can damage the oscilloscope modules. To prevent damage, always work in a static free environment and discharge the static voltage from your body by wearing a grounded antistatic wrist strap while handling these modules.*

---

1. Install the 80A03 output cable into the Channel 1/2 slot of the oscilloscope.
2. Install the 80E04 sampling head into the 80A03 adapter and connect the two using the SMA cables.
3. Install the TCA-75 into the left port of the 80A03.
4. Install the TCA-BNC into the right port of the 80A03.
5. If needed, press the Default Settings button on the oscilloscope.
6. Press the Channel 1 button on the 80E04 sampling head to activate Channel 1.

### Part C: Characterize the test system.

1. Connect the equipment as follows:
  - a. Connect the AFG3101 output to 1 m high bandwidth cable.
  - b. Connect the other end of the cable to a TCA-75.
  - c. Connect the TCA-75 to the 80A03 in the oscilloscope and plug-in.
  - d. Connect a 50  $\Omega$  cable from the AFG3101 trigger output.
  - e. Connect the other end of the 50  $\Omega$  cable to the BNC to SMA adapter.
  - f. Connect the SMA adapter to the 6 dB pad.
  - g. Connect the 6 dB pad to the trigger direct input on the oscilloscope.
2. Keep the AFG3101 at the same output as in Part A of this test.
3. Set the oscilloscope as follows:

**Time/Div:** 20  $\mu$ s  
**Volts/Div:** 50 mV  
**Averaging:** 16  
**Record Length:** 4000 points
4. On the oscilloscope, select measurement 1 and then pulse amplitude and set it to measure Cycle RMS.
5. On the oscilloscope, select measurement 2 and then pulse amplitude and set it to measure Cycle Mean.

6. Record the Cycle RMS and Cycle Mean values in the SDI output amplitude table.
7. Calculate the corrected RMS amplitude of the sine wave:  $\sqrt{(cycle\ RMS)^2 - (cycle\ mean)^2}$
8. Record the result in the test record.
9. Calculate the total attenuation factor for the system. This is the DMM measurement divided by the corrected RMS sine wave amplitude.
10. Record the attenuation factor value in the SDI output amplitude table.
11. Enter the attenuation factor value into the oscilloscope:
  - a. On the oscilloscope, press the SETUP DIALOG button.
  - b. Select the “Vert” tab from the top of the setup page.
  - c. Select the “External Attenuation” box, and enter the attenuation factor calculated in step 9 above.

#### Adjust the SDI output amplitude

1. Restart the instrument in Factory mode. (See page 80, *To power up in factory mode.*)
2. Press the **SDI** button until **SDI 1** appears.
3. Connect a 1 m high-bandwidth cable from the **SDI 1A** output of the module to the TCA75 BNC on the oscilloscope adapter.
4. Connect a 50  $\Omega$  cable from the **SDI 1B output** (through the BNC to SMA adapter, with or without the 6 dB pad) to the trigger direct input on a sampling oscilloscope.
5. Press the **SDI** button until **SDI7[x-1]: STATUS** appears.
6. Use the up (**▲**) or down (**▼**) arrow button to select **CALIBRATION**.
7. Press the **ENTER** button.
8. Press the right (**►**) arrow button to select **20 Bits Square**.
9. Press the **ENTER** button.
10. If necessary, set the oscilloscope as follows:
 

**Time/Div:** 2 ns  
**Volts/Div:** 100 mV  
**Averaging:** 16  
**Record Length:** 4000 points

11. On the oscilloscope, select Measurement 3, Pulse-Amplitude, and then Amplitude to measure the amplitude on the flat part of the long pulse.
12. Right click the measurement readout, and select **Show Statistics** and **Show Annotations** from the pop-up menu.
13. Note the expected average value, which is indicated by the letter  $\mu$ , displayed on the oscilloscope.
14. Press the **Clear Data** button on the oscilloscope and wait about 5 seconds before proceeding to the next step.
15. Record the average value, which is indicated by the letter  $\mu$ , in the *Signal 1A amplitude* row *Before adjustment value* column of the SDI output amplitude table.

---

**NOTE.** *If you entered the attenuation factor into the oscilloscope at the end of the amplitude characterization procedure, the oscilloscope will display the multiplication result.*

---

16. If adjustment is necessary, press the up ( $\blacktriangle$ ) or down ( $\blacktriangledown$ ) arrow button, and then press the **ENTER** button, to activate the adjustment mode.
17. Press the **Clear Data** button on the oscilloscope and wait about 5 seconds before proceeding to the next step.
18. Press the up ( $\blacktriangle$ ) or down ( $\blacktriangledown$ ) arrow button to change the amplitude to the expected average value noted in step 13.
19. Repeat steps 17 and 18 until the average measured value ( $\mu$ ) is within 1 mV of 800 mV, and then press the **ENTER** button to save the new amplitude calibration value.
20. Record the new measured attenuation corrected value in the *Signal 1A amplitude* row *After adjustment value* column of the SDI output amplitude table.
21. Press the **Back** button to exit the Channel 1: Top Calibration mode.
22. Connect the **SDI 1A** output to the trigger input of the DSA using the 1 meter 50  $\Omega$  cable. Connect the SDI 1B output to the TCA-75 using the high-bandwidth 75  $\Omega$  cable.
23. Use the left ( $\blacktriangleleft$ ) or right ( $\blacktriangleright$ ) arrow buttons to select **Channel 1: Bottom** to adjust the SDI 1B output.
24. Press the **ENTER** button.
25. Press the right ( $\blacktriangleright$ ) arrow button to select **20 Bits Square**.
26. Press the **ENTER** button.
27. Repeat steps 15 through 21 for the SDI 1B output.

28. Move the 1 m high-bandwidth cable from the **SDI 1B** output to the **SDI 2A** output.
29. Move the 50  $\Omega$  cable from the SDI 1 A output to SDI 2 B.
30. Press the left (◀) or right (▶) arrow buttons to select **Channel 2: Top** to adjust the Signal 2A output.
31. Press the **ENTER** button.
32. Press the right (▶) arrow button to select **20 Bits Square**.
33. Repeat steps 15 through 21 for the Signal 2A output.
34. Move the 1 m high-bandwidth cable from the **SDI 2A** output to the **SDI 2B** output and swap the trigger input to connect to SDI 2A
35. Use the left (◀) or right (▶) arrow buttons to select **Channel 2: Bottom**.
36. Press the **ENTER** button.
37. Press the right (▶) arrow button to select **20 Bits Square**.
38. Press the **ENTER** button.
39. Repeat steps 15 through 21 for the SDI 2B output.
40. Cycle the power on the SPG700 to return the generator to normal operating mode.





# Maintenance

If your instrument does not function properly, troubleshooting and corrective measures should be taken immediately to prevent additional problems.

---

**NOTE.** *Contact your local Tektronix representative for information on where to return your instrument if it requires repair during the warranty period.*

---

This section contains information needed to safely and effectively service the SPG700 generator to the module level.

To isolate a failure, use the fault isolation procedures found in the troubleshooting section. To remove and replace any failed module, follow the instructions in the removal procedure section. Use the replaceable parts list section for part numbers and ordering information for all replaceable modules.

## General service information

### Service prerequisites

To prevent personal injury or damage to the instrument, ensure the following before servicing this instrument:

- The procedures in this manual should be performed only by a qualified service person.
- Read the *General safety summary* and the *Service safety summary* at the beginning of this manual.
- When using this manual for servicing, be sure to follow all warnings, cautions, and notes.
- *Inspection and cleaning* describes how to inspect for dirt and damage and how to clean the exterior and interior of the instrument. (See page 24.)
- The *Remove and replace procedures* describe how to install or remove a replaceable module. (See page 27.)

### Performance check interval

Generally, the performance check described in the *SPG700 Specifications and Performance Verification Technical Reference* manual should be done every 12 months. In addition, a performance check is recommended after repair.

If the SPG700 generator does not meet performance criteria, repair is necessary.

### Terms in the manual

Throughout this manual, the term module appears, referring to any field-replaceable component or assembly.

<b>Tektronix service offerings</b>	<p>Tektronix provides service to cover repair under warranty and other services that may provide a cost-effective answer to your service needs.</p> <p>Whether providing warranty repair service or any of the other services listed below, Tektronix service technicians are well trained to service the SPG700 generator. They have access to the latest information on improvements to the SPG700 and the latest new options.</p>
<b>Warranty repair service</b>	<p>Tektronix warrants this product for one year from date of purchase. The warranty appears after the title page in this manual. Tektronix technicians provide warranty service at most Tektronix service locations. The Tektronix product catalog lists all worldwide service locations. You can also visit our Web site for service information: <a href="http://www.tektronix.com">www.tektronix.com</a>.</p>
<b>Self service</b>	<p>Tektronix supports repair to the module level by providing module exchange.</p> <p><b>Module exchange.</b> This service reduces downtime for repair by allowing you to exchange most modules for remanufactured ones. Each module comes with a 90-day service warranty.</p> <p><b>For more information.</b> Contact your local Tektronix service center or sales engineer for more information on any of the repair or adjustment services just described.</p>

**Electrostatic damage prevention**

This instrument contains electrical components that are susceptible to damage from electrostatic discharge. Static voltages of 1 kV to 30 kV are common in unprotected environments.

Before servicing this product, read the General Safety Summary and the Service Safety Summary at the front of the manual, as well as the following ESD information.



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**CAUTION.** *Static discharge can damage any semiconductor component in this instrument.*

---

When performing any service that requires internal access to the instrument, adhere to the following precautions to avoid damaging internal modules and their components due to electrostatic discharge (ESD):

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

## Inspection and cleaning

*Inspection and Cleaning* describes how to inspect for dirt and damage. It also describes how to clean the exterior and interior of the instrument. Inspection and cleaning are done as preventive maintenance. Preventive maintenance, when done regularly, may prevent malfunction and enhance reliability.

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

How often maintenance should be performed depends on the severity of the environment in which the instrument is used. A proper time to perform preventive maintenance is just before any instrument adjustment.

**General care**     The cabinet helps keep dust out and should normally be in place during operation.



**WARNING.** *To prevent injury or death, power off the instrument and disconnect it from line voltage before performing any procedure that follows.*

---

**Interior cleaning**     Use a dry, low-velocity stream of air to clean the interior of the chassis. Use a soft-bristle, nonstatic-producing brush for cleaning around components. If you must use a liquid for minor interior cleaning, use a 75% isopropyl alcohol solution and rinse with deionized water.

**Exterior cleaning**     Clean the exterior surfaces of the chassis with a dry lint-free cloth or a soft-bristle brush. If any dirt remains, use a cloth or swab dipped in a 75% isopropyl alcohol solution. Use a swab to clean narrow spaces around controls and connectors. Do not use abrasive compounds on any part of the instrument that may be damaged by it.



**CAUTION.** *Avoid the use of chemical cleaning agents that might damage the plastics used in the instrument. Use only deionized water when cleaning the front-panel buttons. Use a glass cleaner to clean the LCD. For the rest of the instrument, use a 75% isopropyl alcohol solution as a cleaner and rinse with deionized water. Before using any other type of cleaner, consult your Tektronix Service Center or representative.*

---

**Inspection – exterior.** Inspect the outside of the instrument for damage, wear, and missing parts, using the following table as a guide. Immediately repair defects that could cause personal injury or lead to further damage to the instrument.

**Table 5: External inspection checklist**

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

**Inspection – interior.** To access the inside of the instrument for inspection and cleaning, you must remove the top cover.

Inspect the internal portions of the instrument for damage and wear, using Table 4-2 as a guide. Defects found should be repaired immediately.

If any circuit board is repaired or replaced, see if it is necessary to adjust the instrument. (See Table 6 on page 25.)



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

**Table 6: Internal inspection checklist**

Item	Inspect for	Repair action
Circuit boards	Loose, broken, or corroded solder connections. Burned circuit boards. Burned, broken, or cracked circuit-run plating.	Remove and replace damaged circuit board.
Resistors	Burned, cracked, broken, blistered condition.	Remove and replace damaged circuit board.

**Table 6: Internal inspection checklist (cont.)**

Item	Inspect for	Repair action
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 and replace damaged circuit board.
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.** To clean the instrument interior, perform the following 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.)

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

3. If steps 1 and 2 do not remove all the dust or dirt, the instrument may be spray washed using a solution of 75% isopropyl alcohol by doing steps 4 through 6.
4. Gain access to the parts to be cleaned by removing easily accessible shields and panels.
5. Spray wash dirty parts with the isopropyl alcohol and wait 60 seconds for the majority of the alcohol to evaporate.
6. Dry all parts with low-pressure, deionized air.

**Lubrication.** There is no periodic lubrication required for the instrument.

## Remove and replace procedures

This section contains procedures for removal and installation of customer-replaceable modules in the SPG700. Any electrical or mechanical module, assembly, or part listed in the *Replaceable parts list* section of this manual is a module.

### Preparation.



---

**WARNING.** Before performing this or any other procedure in this manual, read the General safety summary and the Service safety summary found at the beginning of this manual. Also, to prevent possible damage to the SPG700 components, read the information on preventing ESD in this section. (See page 23, *Electrostatic damage prevention*.)

---

This subsection contains the following items:

- List of equipment required to remove and disassemble all modules.
- A module locator diagram for finding the replaceable modules in the SPG700. (See Figure 7.)
- Interconnect illustrations and tables, showing where to reconnect cables after removal. (See page 31, *Interconnect illustrations*.)
- Procedures for removal and reinstallation of the electrical and mechanical modules.



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

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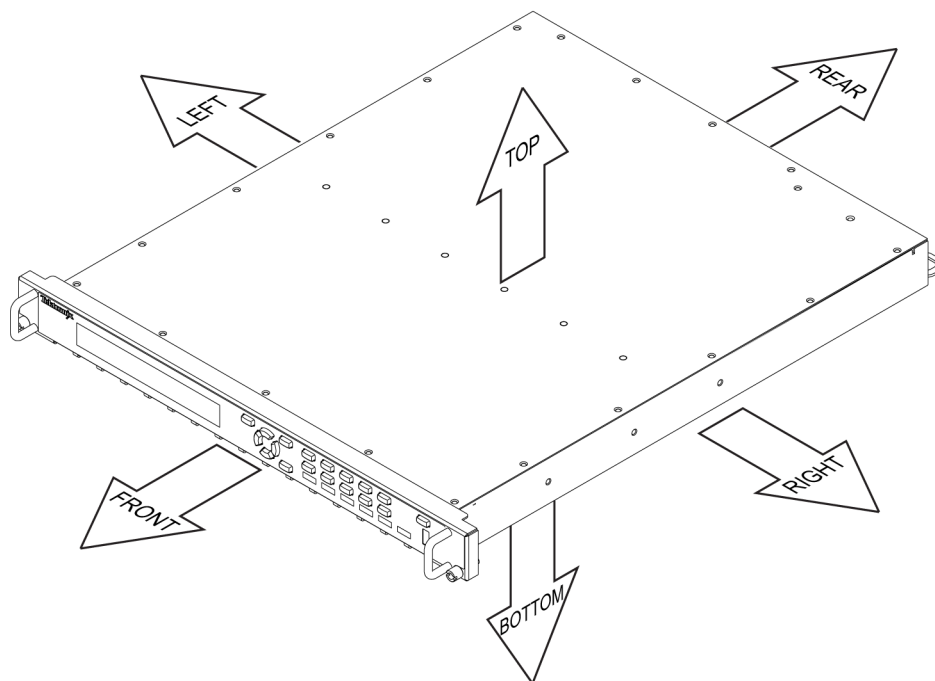
**Required equipment.** Many of the modules in the SPG700 can be removed with a screwdriver handle mounted with a #2 Phillips tip. Use this tool whenever a procedure step instructs you to remove or install a screw unless a different size screwdriver is specified in that step.

**Table 7: Required tools for removal and replacement of modules**

Name	Description
Screwdriver handle	Accepts Phillips-driver bits.
#1 and #2 Phillips tips	Phillips-driver bits for #1 and #2 size screw heads.
Torque driver	Accepts 1/4 inch screwdriver bits. Torque range of 5 to 14 in/lb.
T10 TORX tip	TORX driver bit for T10 size screw heads.
T15 TORX tip	TORX driver bit for T15 size screw heads.
3/16" socket	Socket or nut driver to remove jackscrews from DSUB connector.
Nut driver, 9/16"	Wrench or deep nut driver, to remove nuts from BNC connectors.
Nut driver, 7/32"	Wrench or deep nut driver, to remove nuts from bracket securing the SDI output modules.
Flat-blade screwdriver	Blade should be at approximately 1/4" wide. For disconnecting circuit boards from the Main board.
Terminator, BNC, closed	Used for pulling the Genlock/Black generator board from the instrument.



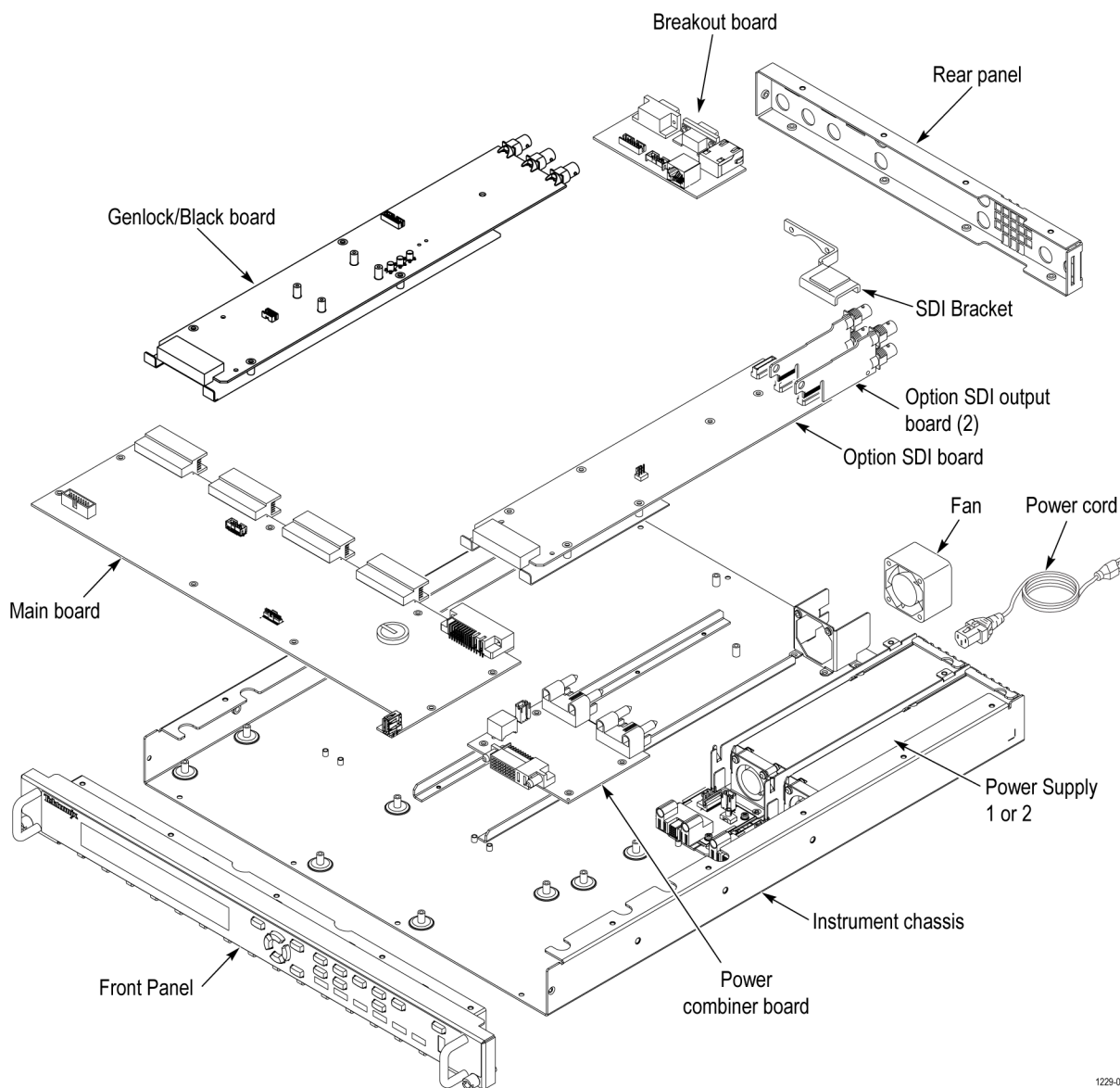
**Instrument orientation.** In this manual, procedures refer to "front," "rear," "top," etc. of the instrument. The following figure shows how the sides are referenced.



1220-014

**Figure 6: Instrument orientation**

The following figure shows the location of the replaceable modules in the SPG700.



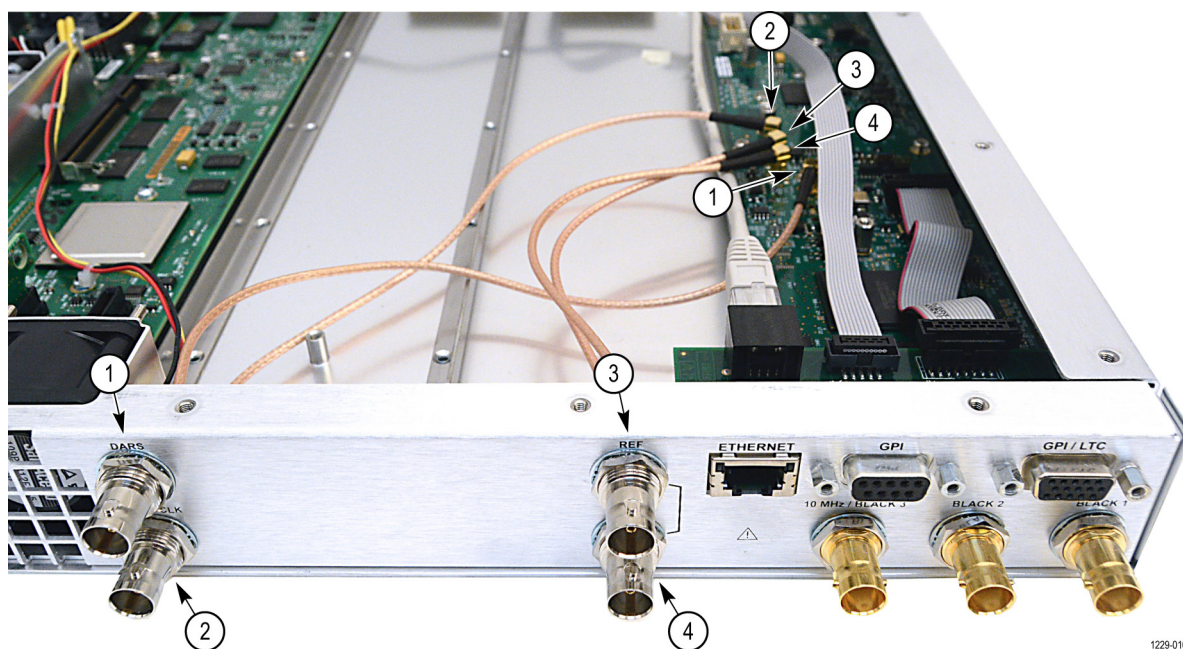
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**Figure 7: Module locator diagram**

**Interconnect illustrations** The following illustrations and tables show where to reconnect cables.

**Table 8: Cable connections table 1 of 3**

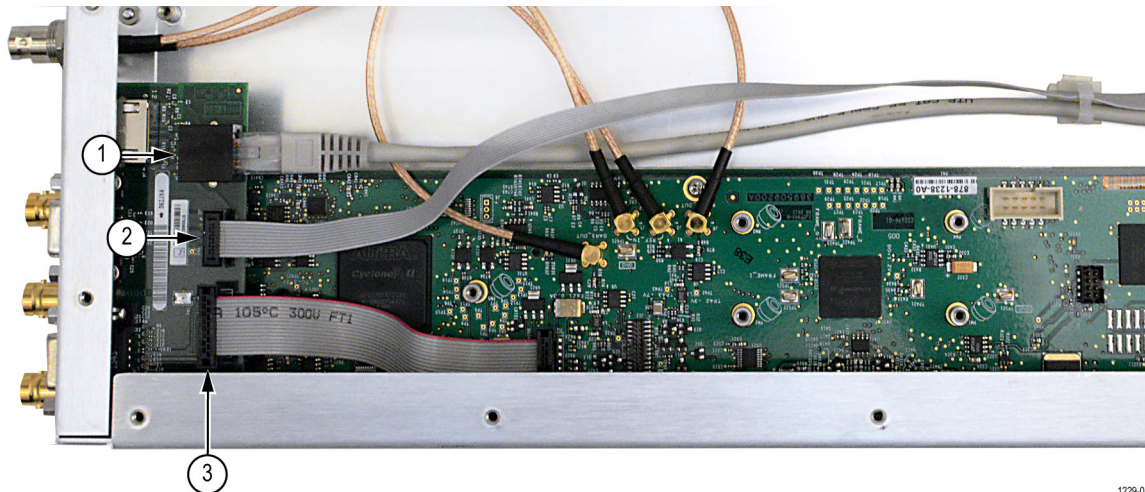
Figure number	Rear-panel connector	Connects to
8- 1	DARS	J14 on Genlock/Black board
8-2	WORD CLK	J9 on Genlock/Black board
8-3	REF	J7 on Genlock/Black board
8-4	LOOP	J3 on Genlock/Black board



**Figure 8: Cable connections 1 of 3**

Table 9: Cable connections table 2 of 3

From		To	
Figure number	Description	Figure number	Description
9-1	Breakout board J1	10-2	Power combiner board JR101
9-2	Breakout board J2	10-4	Main board J703
9-3	Breakout board J3	10-4	Genlock/Black board J10



1229-011

Figure 9: Cable connections 2 of 3



Table 10: Cable connections table 3 of 3

From		To	
Figure number	Description	Figure number	Description
10-1	Power combiner board J101	8-1	Fan cable from fan
10-2	Power combiner board JR101	9-1	Breakout board J1
10-3	Main board J711	(See Figure 12.)	Front panel board
10-4	Main board J703	9-2	Breakout board J2
10-5	Main board J725	(See Figure 12.)	Front panel board

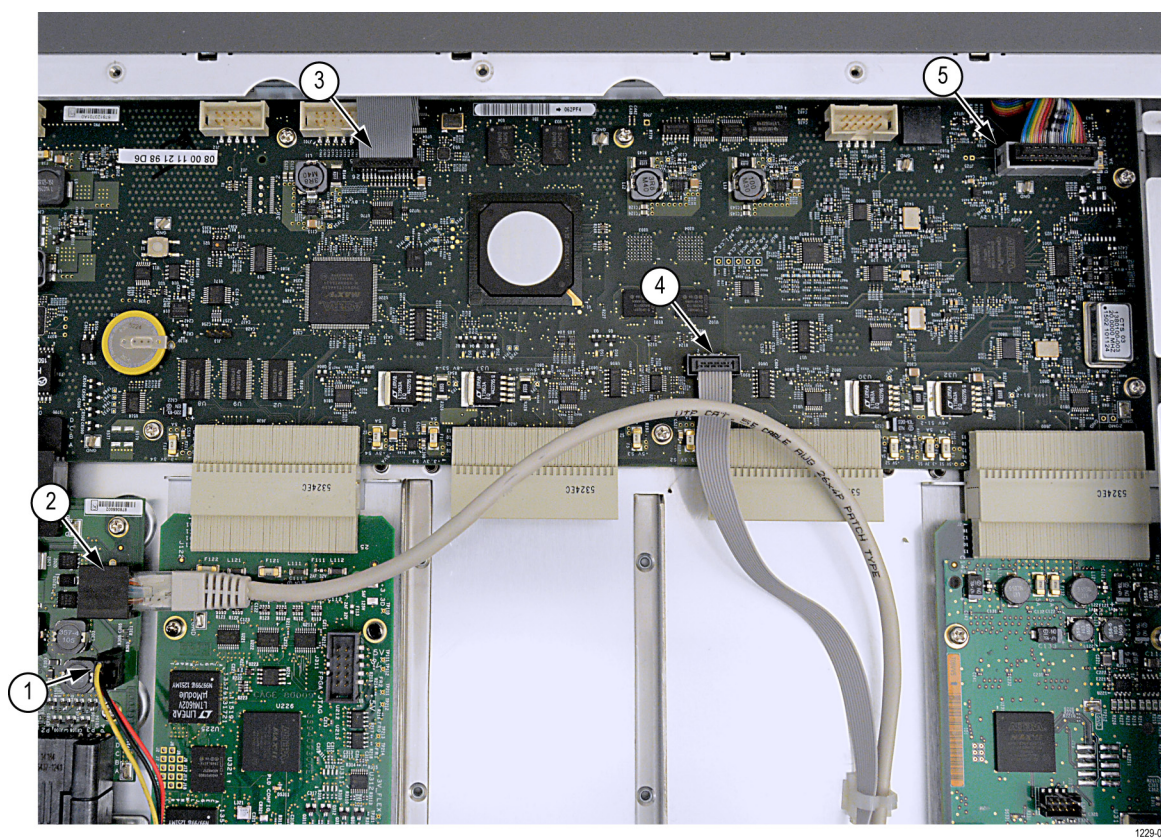
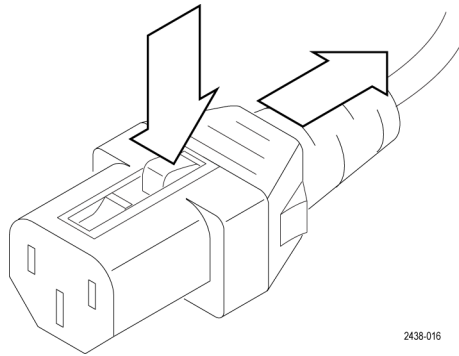


Figure 10: Cable connections 3 of 3

**Locking line cord**

1. You need no equipment to perform this removal procedure. Locate the line cord in the locator diagram. (See Figure 7.)
2. Set the SPG700 so the instrument bottom is down on the work surface and the rear is facing you.
3. Find the line cord on the rear panel. The locking cord has a release latch on the top that must be pressed to remove the cord. Grasp the plug, press the release latch, and pull the line cord and clamp away from the instrument.
4. To reinstall, insert the line cord into the power receptacle on the SPG700 rear panel until it latches into place.

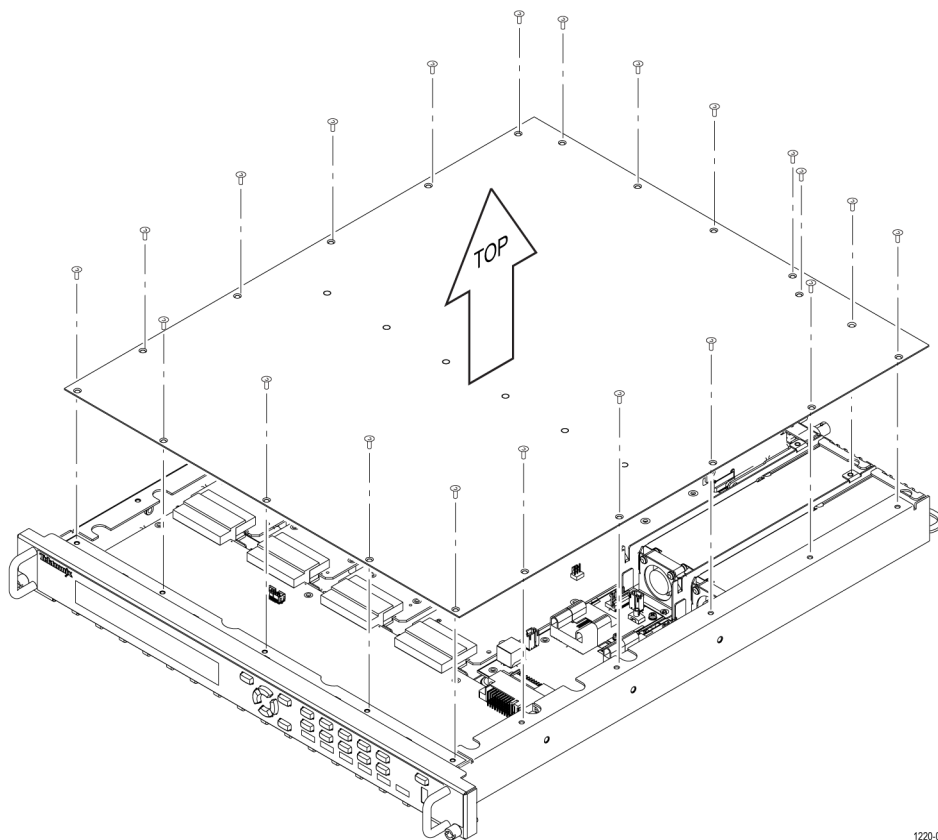


## Top cover



**CAUTION.** When handling circuit boards, follow the ESD instructions. (See page 23, *Electrostatic damage prevention.*)

1. Set the SPG700 so that the bottom is down on the work surface and the rear is facing you.
2. Remove the top cover as follows:
  - a. Use a screwdriver with a #1 Phillips tip or #2 Phillips tip (depending on your unit) to remove the 22 screws securing the top over to the instrument.
  - b. Lift the top cover off the chassis. (See Figure 11.)
3. To reinstall the top cover, reverse the steps. Torque all screws to 5.5 in/lbs.



1220-015

Figure 11: Removing the top cover

## Rear panel

The following steps identify which cables need to be disconnected and which nuts, washers, and screws need to be removed before removing the rear panel. Some of the rear-panel connectors will remain installed in the rear panel.

1. Position the instrument so that the top cover is on the work surface and the rear panel is facing you.
2. Use a screwdriver with a #1 or #2 Phillips tip to remove the four screws attaching the rear panel to the chassis.
3. Turn the instrument over so the bottom is on the work surface.
4. Remove the top cover. (See page 35, *Top cover*.)
5. Disconnect the following:
  - Locate all of the cables that connect to the rear panel and disconnect all of these cables where they attach to the boards (the cables are permanently attached to the BNCs). Refer to *Interconnect illustrations*. (See page 31, *Interconnect illustrations*.)
  - Do not remove the light pipe from the rear-panel antenna power indicator. Instead, pull the light pipe from the header on the Genlock/Black generator board. When you remove the rear panel, the light pipe will come with it. When you reinstall the rear panel, reattach the light pipe to the header on the Genlock/Black generator board.
  - Remove the jackscrews that hold the GPI/LTC multi-pin connectors to the rear panel.
  - Use a 9/16" socket to remove the nuts and lock-washers from the gold rear-panel connectors labeled: BLACK 1, BLACK 2, BLACK 3, SDI 1A, SDI 2A, SDI 1B, and SDI 2B. This will allow the rear-panel to slide off the chassis. These BNCs will remain attached to the circuit boards, while the remaining BNCs will remain attached to the rear panel.
6. Pull the rear panel straight out from the chassis, carefully sliding the rear panel over the gold and multi-pin connectors that remain attached to the instrument.
7. To reinstall, reverse the procedure. Tighten the nuts on the BNCs to 14 in/lbs. Tighten the screws that attach the rear panel to the chassis, to 4 in/lbs.



- Main fan** To remove and replace the chassis fan, follow these instructions:
1. Locate the chassis fan in the locator diagram. (See Figure 7 on page 30.)
  2. Remove the instrument rear panel. (See page 36, *Rear panel*.)
  3. Remove the two screws that attach the fan to the fan bracket and slide the fan out of the bracket.
  4. To replace the fan, disconnect the cable from the Power Combiner board and reverse the procedure.

- Front panel assembly**
1. Locate the Front Panel assembly in the locator diagram. (See Figure 7 on page 30.)
  2. Remove the top cover. (See page 35, *Top cover*.)

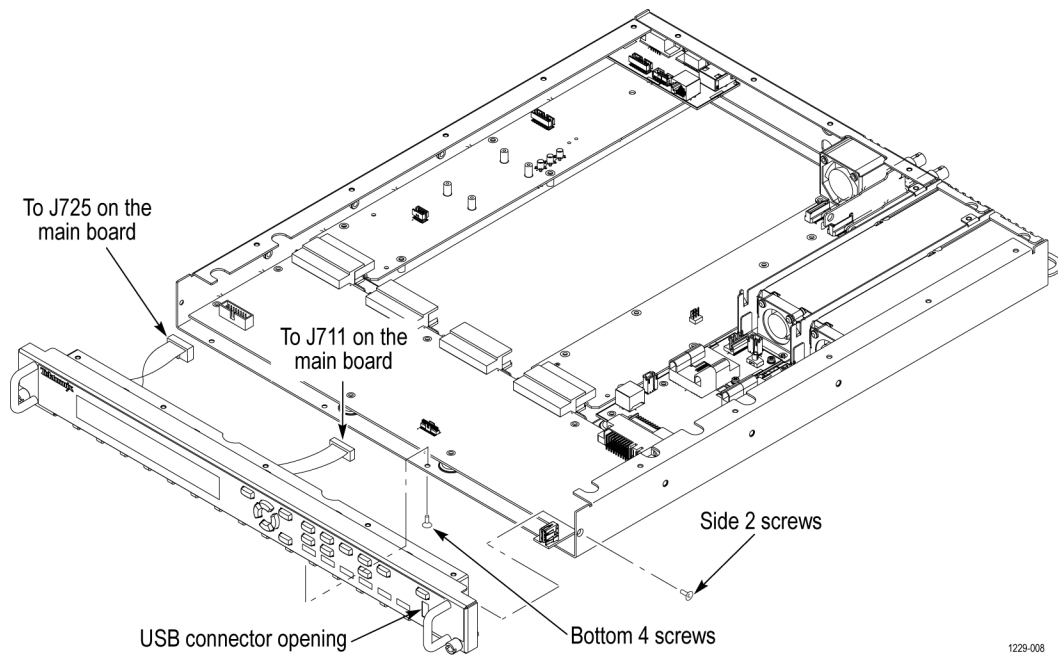


---

**CAUTION.** To prevent damage to the USB connector, use care when removing the Front Panel assembly. It is recommended that you remove the screws from the bottom of the instrument before you turn the instrument over to remove the side screws. This will prevent the Front Panel assembly from moving and damaging the USB connector.

---

3. Remove the Front Panel assembly as follows: (See Figure 12.)
  - a. Set the instrument top down on the work surface with the front facing you.
  - b. Use a screwdriver with a #2 Phillips tip to remove the four screws securing the Front Panel assembly to the bottom of the instrument chassis.
  - c. Turn the instrument bottom down on the work surface with the front facing you.
  - d. Use a screwdriver with a #2 Phillips tip to remove the two screws securing the Front Panel assembly to the side of the chassis (one screw on each side).
  - e. Disconnect the cables at J711 and J725 on the Main board.
  - f. Grasp the Front Panel assembly and carefully pull it forward over the USB connector so that you do not damage the connector.
4. To reinstall the Front Panel assembly, perform steps 2 through 3 in reverse order. Torque all screws to 5.5 in/lbs.



**Figure 12: Removing the front panel assembly**

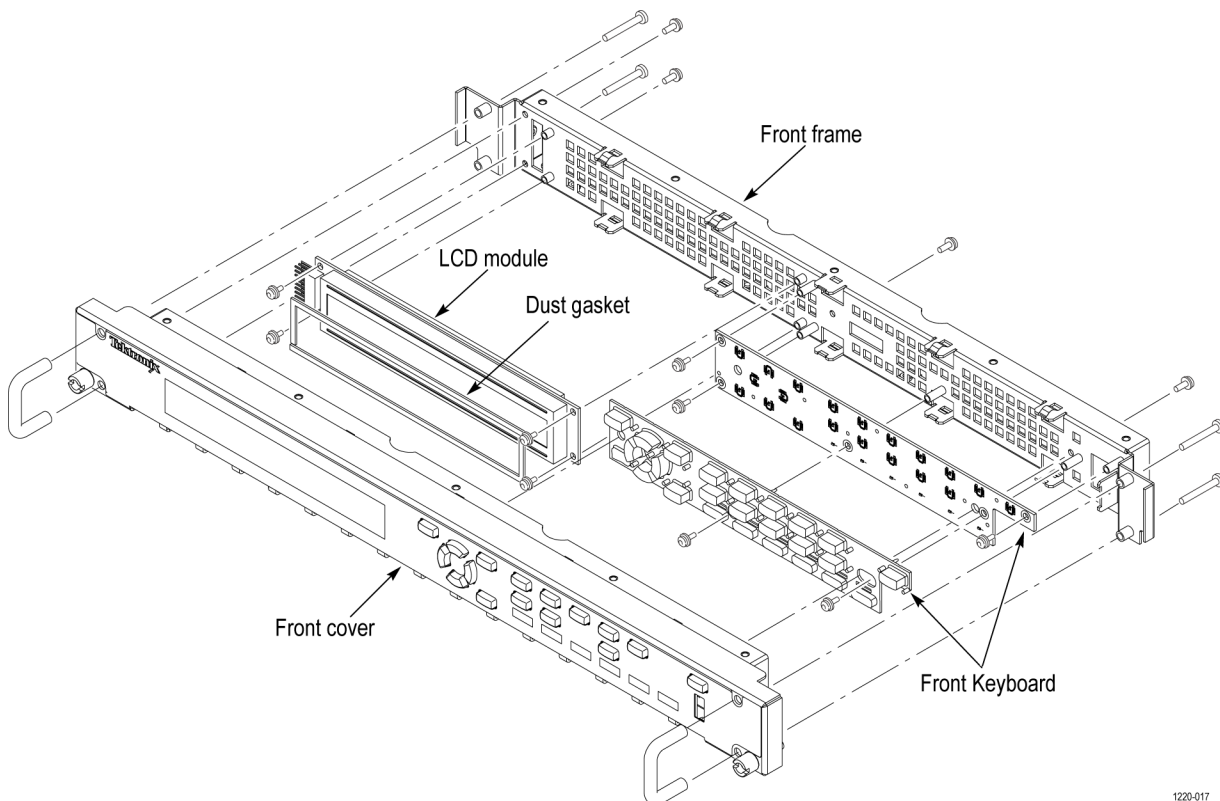
**Front panel subassemblies**

1. Remove the Front Panel assembly. (See page 37, *Front panel assembly*.)
2. Set the Front Panel assembly so that you can access the screws on the back side of the assembly.



**CAUTION.** To prevent dirt from being trapped between the LCD display and the front cover, keep the back of the Lexan cover clean while you are disassembling the Front Panel assembly.

3. Remove the front cover as follows. (See Figure 13.)
  - a. Use a screwdriver with a TORX T15 tip to remove the four screws securing the U-shaped handles to the front cover (two screws on each side).
  - b. Use a screwdriver with a #2 Phillips tip to remove the four screws securing the front cover to the front frame.
  - c. Grasp the front cover and pull it forward.



1220-017

Figure 13: Disassembling the front panel assembly

4. Remove the Front Panel Keyboard as follows. (See Figure 13.)
  - a. Use a screwdriver with a #2 Phillips tip to remove the four screws securing the keyboard to the front frame.
  - b. Lift the board away.
  - c. To remove the keypad from the board, carefully pull up on the keypad. There are eight tails from the keypad that extend through to the back side of the board.



**CAUTION.** *To prevent dirt from being trapped between the LCD display and the front cover, keep the LCD display clean while you are disassembling the Front Panel assembly.*

---

5. Remove the LCD module as follows. (See Figure 13.)
  - a. Use a screwdriver with a #2 Phillips tip to remove the four screws securing the LCD module to the front frame.
  - b. Lift the board away.
6. If necessary, hand disassemble any remaining components of the Front Panel assembly.
7. To reinstall the Front Panel assembly:

---

**NOTE.** *The connector on the display is not polarized, so be careful to attach it as described.*

---

- a. Attach the cable to the LCD by connecting pin 1 to the brown wire at the edge of the cable. This must be at the bottom of the instrument. If necessary, swap ends on the cable so that you can route it back toward the Main board, while keeping pin 1 down.

---

**NOTE.** *If you are replacing the LCD, you must add the dust gasket. Refer to the exploded view. (See Figure 24.)*

---

- c. Perform steps 1 through 6 in reverse order.
  - d. Torque all screws to 5.5 in/lbs.
8. The connector on the display is not polarized so you must be careful how it connected. Pin 1 is connected to the brown wire at the edge of the cable. This must be at the bottom of the instrument. If necessary, swap ends on the cable to make it route back toward the Main board, while keeping pin 1 down.

**Power supply**

There can be one or two power supplies installed in the SPG700. If only one is installed, it should be in slot one. The power module blank cover should be installed in the other slot.

The power supply modules are replaced as a unit. There are no replaceable subassemblies.



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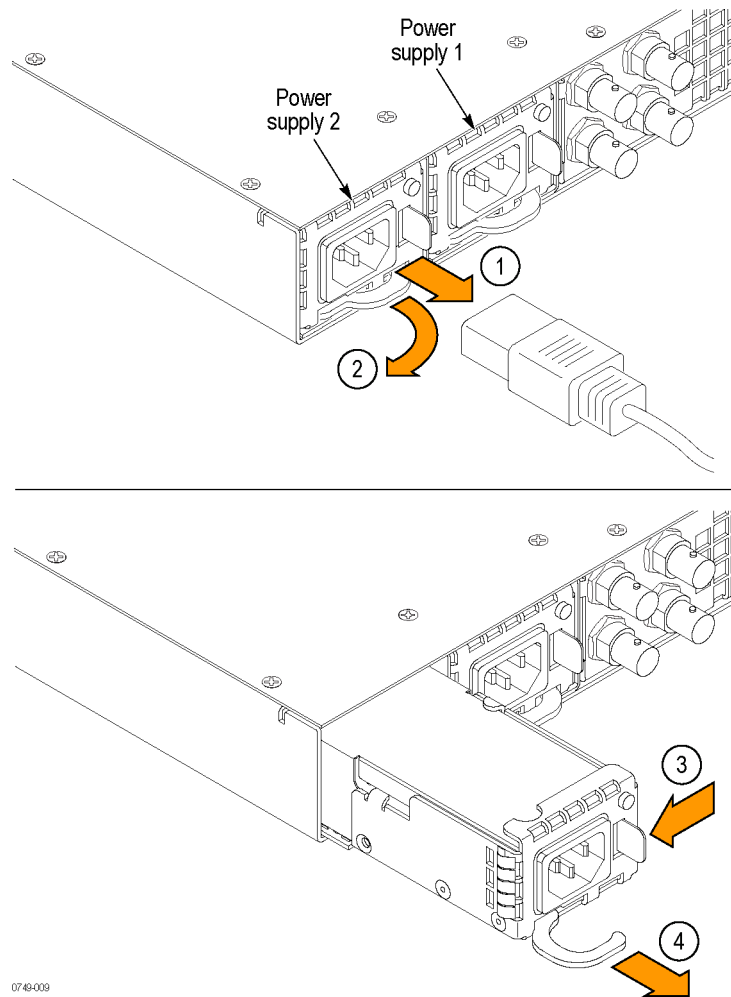
**WARNING.** *Disconnect the power cord before removing the rear panel.*

*Disconnect the power cord when the power supply module is not installed. High voltage inside.*

---

No tools are needed to remove the power supply. You do not need to remove the instrument cover. The power supply module slides out the rear of the instrument as a module. (See Figure 14.)

1. Disconnect the locking power cord.
2. Turn the power supply handle to the left.
3. Push the metal tab under the STATUS light to the left.
4. While holding that tab to the left, use the handle to pull the power supply module out of the instrument.
5. To replace the power supply, reverse the procedure.



0748-009

**Figure 14: Removing the power supply**

**Power Combiner board**

The power combiner board combines the power from the two power supplies and provides connections for the fan and Ethernet.

1. Remove all power supply modules from the instrument. (See page 41, *Power supply*.) The power supply modules will disconnect from the Power Combiner board. (See Figure 15.)
2. Remove the instrument top cover. (See page 35, *Top cover*.)
3. Disconnect the two cables from the Power Combiner board.
4. Remove the four screws that attach the Power Combiner board to the instrument chassis.
5. Pull the Power Combiner board away from the Main board connectors and out of the instrument.
6. To replace the board, reverse the procedure. To reconnect the cables, see the interconnect illustrations. (See page 31, *Interconnect illustrations*.)



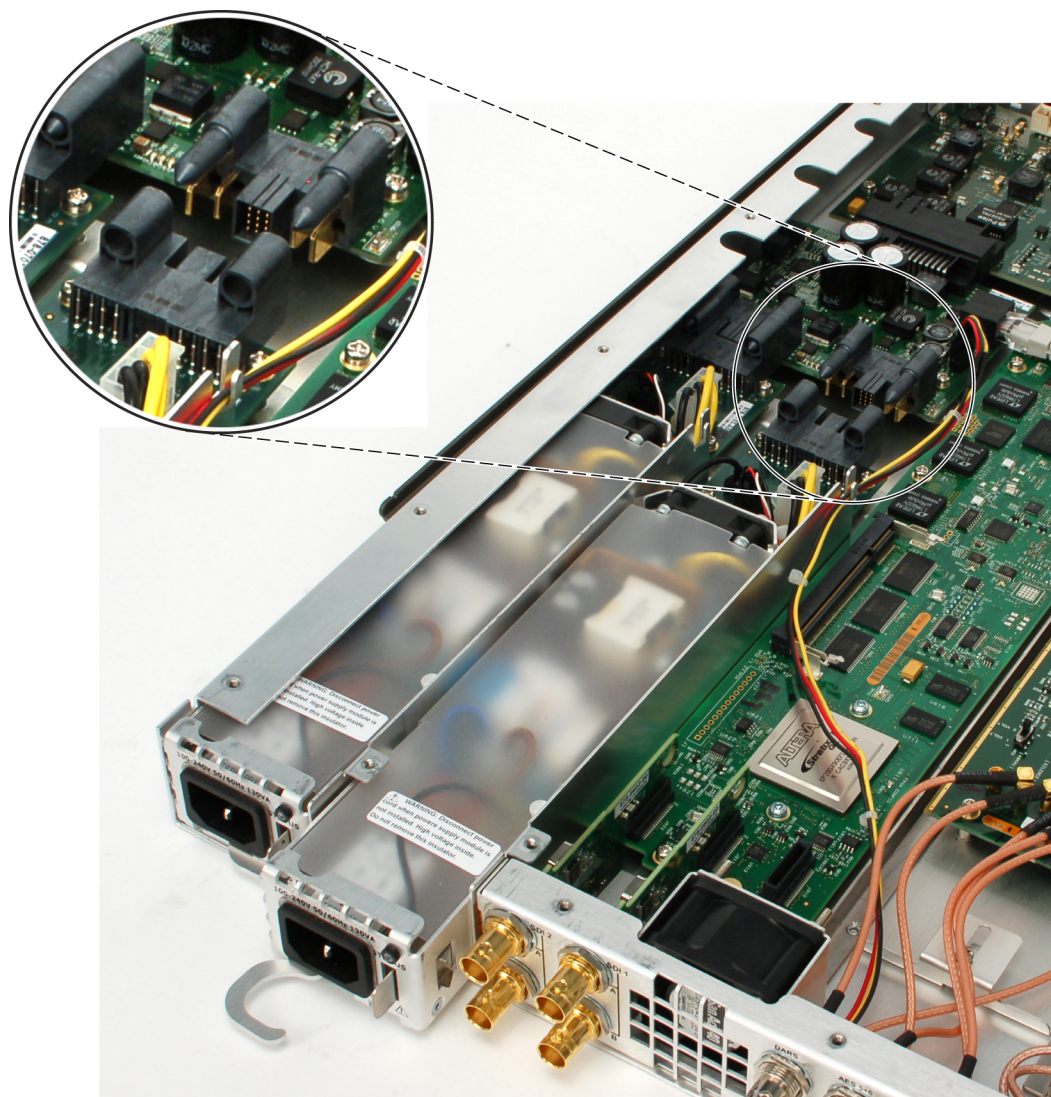


Figure 15: Removing the Power Combiner board

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**NOTE.** The preceding figure shows the Power Combiner board being removed from the SPG8000A. The location of the Power Combiner board and the process for removing it is the same for both the SPG700 and the SPG8000A.

---



- Main board**
1. Locate the Main board in the locator diagram. (See Figure 7.) Refer also to the exploded view diagram for more details. (See Figure 23.)
  2. Remove the Front Panel assembly. This is required because of the USB connector on the Main board. (See page 37, *Front panel assembly*.)
  3. Remove the Power Supply module(s). (See page 41, *Power supply*.)
  4. Remove the Power Combiner board. (See page 43, *Power Combiner board*.)
  5. Remove the rear panel. (See page 36, *Rear panel*.)
  6. Remove the Genlock/Black generator assembly. (See page 46, *Genlock/Black board*.)
  7. Remove all installed option boards. (See page 48, *Option SDI board and Option SDI Output boards*.)
  8. Verify that all cables are disconnected from the Main board.
  9. Set the instrument bottom down on the work surface with the right side facing you.
  10. Remove the Main board as follows.
    - a. Use a screwdriver with a #2 Phillips tip to remove the eight screws securing the Main board to the chassis.
    - b. Lift the board up and away from the chassis.
  11. To replace the Main board, perform steps 2 through 10 in reverse order. Torque all screws to 5.5 in/lbs.

**Genlock/Black board**

You can replace the Genlock/Black board, the light pipe connector, and the Genlock/Black board mounting plate. The high-speed BLACK 1, BLACK 2, and BLACK 3 connectors are not replaceable.

**To remove the Genlock/Black board.**

1. Remove the rear panel. (See page 36, *Rear panel*.)
2. The Genlock/Black board is installed on top of a metal mounting plate, or “sled.” Do not remove the screws that attach the board to the plate at this time. (See Figure 25.)
3. Verify that all necessary cables are disconnected and that you have a clear path to slide the board and mounting plate assembly from the rear of the instrument.



---

**CAUTION.** *Circuit boards are sensitive to pressure. When disconnecting the option boards from the Main board, be careful not to exert pressure on the Main board.*

---

5. Loosen the Genlock/Black circuit board from the Main board. Pull the Genlock/Black board straight out the rear of the chassis and place it on a static-free surface.

**To replace the Genlock/Black board.**

1. Verify that your replacement Genlock/Black board is installed on the mounting plate and that all screws attaching the board to the plate are installed. Verify that the light pipe header is installed on the board. This must be pressed in before the board is mounted on the sled.
2. Starting with the rear panel removed, slide the replacement Genlock/Black assembly into a position that is close to where it will connect to the Main board. See the Module locator diagram. (See Figure 7.)
3. Line up the connector on the replacement Genlock/Black assembly with the corresponding connector on the Main board. Make sure that the pins line up and are not offset.
4. Mate the connectors on the Main board with the replacement Genlock/Black board connectors by “pinching” them together.
5. Replace the rear panel and all nuts and locking washers that were removed from the rear panel.
6. Connect all cables that were disconnected. Refer to *Interconnect illustrations*. (See page 31, *Interconnect illustrations*.)

**To remove and replace the light-pipe connector.** To replace the light-pipe board connector, proceed as follows:



**CAUTION.** *Do not remove the light pipe board connector from the board unless you have a replacement board connector available. Removing the light pipe board connector damages it, so it cannot be reused.*

1. Pull the light pipe out of the board connector. This is a slip-fit and should come apart easily.
2. Remove the instrument rear panel. (See page 36, *Rear panel*.)
3. Move the instrument rear panel away from the chassis, pulling the light pipe out with it.
4. Pull the light pipe out of the light pipe lens in the external rear panel. This is a slip-fit and should come apart easily.
5. Gently remove the light pipe lens from the instrument rear panel.
6. When reassembling, follow this sequence:
  - a. Insert the light pipe into the new light pipe lens.
  - b. Thread the light pipe through the instrument rear panel until the lens is against the rear panel.
  - c. Gently push the light pipe lens into place in the rear panel.
  - d. Replace the instrument rear panel.
  - e. Plug the light pipe into the light pipe board connector.

**To remove and replace the Genlock/Black board mounting plate.** To remove the mounting plate, follow the procedure for removing a mounting plate. (See page 52, *Mounting plate*.)

### Option SDI board and Option SDI Output boards

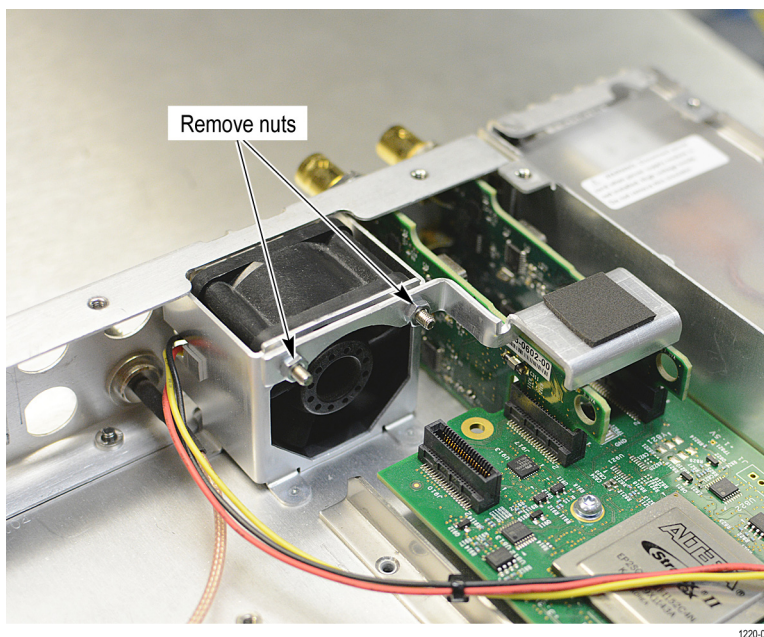
You can remove and replace the Option SDI board, the two Option SDI Output boards, and the Option SDI board mounting plate. The four gold rear-panel BNCs attached to the Option SDI Output boards are not replaceable.

**To remove and replace the bracket securing the SDI output boards.**



**WARNING.** *Attaching and removing cables from the SDI Output boards can loosen them from the SDI board connectors. This can cause the pins between the output boards and SDI board connectors to not be fully engaged. The bracket attached to the chassis fan keeps the output boards connections secure.*

1. Remove the instrument top cover. (See page 35, *Top cover*.)
2. Remove the two nuts securing the bracket to the chassis fan screws using a 7/32 inch nut driver.



**Figure 16: Remove the two nuts**

3. Pull the bracket from the two extended screws on the chassis fan and remove it from the instrument.

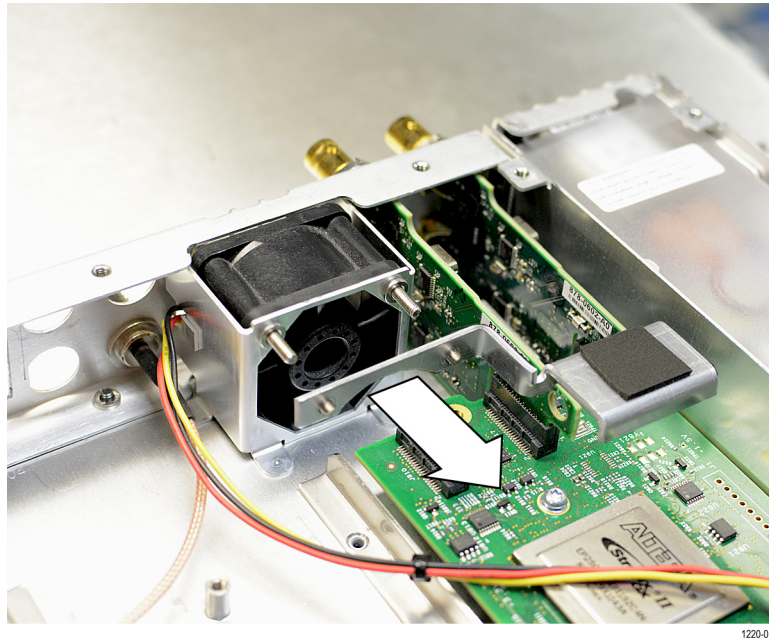


Figure 17: Remove the bracket from the fan

4. To replace the bracket reverse steps 1 through 3.

**To remove and replace the Option SDI Output boards.**



**CAUTION.** *These output boards contain sensitive components that are easily damaged. Be careful not to flex the boards as you remove them. Adhere to proper handling procedures, shown in the beginning of this section.*

1. Remove the SDI output board bracket. (See page 48, *To remove and replace the bracket securing the SDI output boards.*)
2. Remove the rear panel. (See page 36, *Rear panel.*)
3. Remove the output boards by carefully pulling them straight up and away from the Option SDI board.
4. Place the output boards on a static-safe surface.
5. To replace the output boards, handle them carefully, so that you do not flex the boards or touch the components on the boards. Install the output boards into J922 and J917 on the Option SDI board.
6. After replacement, secure the output boards to the SDI board with the bracket attached to the chassis fan.

**To remove the Option SDI board.**

1. Remove the SDI output board bracket. (See page 48, *To remove and replace the bracket securing the SDI output boards.*)
2. Remove the rear panel and the Option SDI Output Boards. (See page 48, *To remove and replace the bracket securing the SDI output boards.*)
3. The Option SDI board is installed on a metal mounting plate, or “sled.” Do not remove the screws that attach the board to the mounting plate at this time. One screw near the rear of the chassis attaches the mounting plate to the chassis. Remove only that one screw.
4. Verify that all necessary cables are disconnected and that you have a clear path to slide the board and mounting plate assembly from the rear of the instrument.



**CAUTION.** *Circuit boards are sensitive to pressure. When disconnecting the option boards from the Main board, be careful not to exert pressure on the Main board.*

---

6. Loosen the Option SDI circuit board from the Main board. Pull the option board straight out the rear of the chassis and place it on a static-free surface.

**To remove and replace the mounting plate or heat sink.** Follow this procedure to remove and replace a heat sink or mounting plate for the Option SDI.

---

**NOTE.** *You can reuse a removed heat sink, but you must use a new gap pad.*

---

1. Remove the Option SDI board and sled from the instrument. (See page 48, *Option SDI board and Option SDI Output boards.*)
2. Remove the three screws attaching the heat sink to the mounting plate.
3. Remove the 7 screws that attach the SDI board to the mounting plate and heat sink (2 screws are next to the FPGA) and remove the board. Place the removed circuit board assembly on a static-free surface. Follow proper handling instructions for a circuit board. Instructions are provided at the beginning of this remove and replace section.
4. Turn the SDI board upside down and gently remove the heat sink. Be careful not to flex the circuit board. Clean any remaining parts of the old gap pad off the circuit board using alcohol. Allow the board to dry.
5. Install the new heat sink to the sled using the three screws.
6. Peel the protective film from one side of new the gap pad and install it on top of the heat sink.
7. Remove the film from the other side of the new gap pad.
8. Position the Option SDI board over the heat sink and gap pad, aligning the holes in the circuit board (on each side of the FPGA) with the threaded posts of the heat sink. Use care not to damage the gap pad.
9. Loosely install the two T10 TORX screws with English threads through the circuit board and into the heat sink. Do not tighten.
10. Loosely install the 5 additional screws (Phillips head metric) that attach the circuit board to the mounting plate.
11. Tighten all 7 screws attaching the Option SDI board to the mounting plate and torque to 5.5 in/lb.



**To replace the Option SDI board.**

1. Verify that the Option SDI board is installed on the metal mounting plate.
2. Starting with the rear panel removed, slide the replacement Option SDI assembly into a position that is close to where it will connect to the Main board, as shown in the module locator diagram. (See Figure 7.)
3. Line up the connector on the replacement Option SDI board with the corresponding connector on the Main board. Make sure that the pins line up and are not offset.
4. Mate the connectors on the Main board with the replacement board connectors by “pinching” them together.
5. Install the two SDI Output boards in connectors J922 and J917 on the Option SDI board.
6. Reinstall the rear panel and all of the nuts and lock washers that were removed from the rear panel.
7. Install the screw that attaches the Option SDI assembly (near the rear of the mounting plate) to the chassis.
8. Reinstall the bracket that secures the SDI output boards by reversing the remove procedure for the bracket. (See page 48.)
9. Connect all cables that were disconnected. Refer to *Interconnect illustrations*. (See page 31, *Interconnect illustrations*.)
10. Replace the instrument top cover.

**Mounting plate**

The Genlock/Black, Option BG, and Option AG are mounted on a metal mounting plate or “sled”. This piece protects the circuit board from being flexed during installation or removal. If you need to replace this mounting plate, follow these instructions:

1. Remove the circuit board assembly from the instrument. See the remove and replace instructions for that board. (See page 46, *Genlock/Black board*.)
2. Remove the screws that attach the circuit board to the mounting plate. (Genlock/Black board 4 screws, Option BG board 6 screws, Option AG board 5 screws).
3. Carefully remove the circuit board from the mounting plate and place the circuit board on a static-safe surface. Do not flex the circuit board.
4. To replace the mounting plate, reverse the procedure. Tighten the screws to 5.5 in/lbs.



## Troubleshooting

This section contains information about how to troubleshoot instrument problems to isolate faulty modules in the SPG700.

### Diagnostics and performance checks

When troubleshooting an unknown instrument problem, perform the performance verification procedures for the SPG700 and installed options. If the problem is known, run only the diagnostic portion of the performance verification procedures to gain information about the subsystems. (See the *SPG700 Specifications and Performance Verification Technical Reference* manual.)

Included in the performance verification procedures are instructions for running and viewing the SPG700 internal diagnostics. The diagnostics include the following:

- Readouts of tests including power-on diagnostics, clock frequencies, temperatures, Main board and slot voltages, and fan speed
- Read/write tests for the signal memory of Option BG.
- Diagnostics for Genlock/Black and Option SDI
- Slot diagnostics to test the power supply and signal connections on the Main board I/O slot connectors.

If the message **Fail: "a module name" Diag error** is displayed, replace the module.

### Back up your instrument settings



---

**CAUTION.** *After you execute the diagnostics, you must cycle power on the instrument. If you have not saved the instrument settings, be sure to save the current instrument settings to a preset, and then recall the settings after the diagnostic tests are completed.*

---

1. Press the **SYSTEM** button.
2. Press the up (▲) or down (▼) arrow button to select **PRESET**.
3. Press the **ENTER** button.
4. Press the up (▲) or down (▼) arrow button to select **SAVE**.
5. Press the left (◀) or right (▶) arrow button to select the preset number to which you will save the instrument settings.
6. Press the **ENTER** button.

**To power up in factory mode**

Putting the instrument into factory mode allows access to calibration, and it allows the module to show in the menus even if it fails the POST routine. When you perform a procedure that requires you to restart the instrument in factory mode, proceed as follows:

1. Press and hold the **STATUS**, **ENTER**, and **Front Panel ENABLE** buttons simultaneously.
2. Continue holding the buttons until the message **SPG700 Booting...** displays.
3. When the message **SPG700 Booting...** displays, while continuing to hold the **Front Panel ENABLE** button, release the **STATUS** and **ENTER** buttons.
4. When the message **SPG700 Start up with Factory Mode** displays, release the **Front Panel ENABLE** button.

**Oscillator calibration**

The diagnostic readouts in the **SYSTEM : DIAGNOSTICS** menu include readouts for Tune and Cal, which are related to the oscillator calibration as described below:

- **TUNE** The Tune readout indicates how far the system is being pulled from the calibrated internal frequency value to lock to an external reference. If the SPG is locked to a video source that is 5 parts per million high, the tune will say  $+5e-6$ . This allows you to measure the frequency of the reference input and to see if the input is near the end of the available tuning range. If the system is in internal mode, the tune value should be  $0.00 e-6$  and the integer values will equal the calibration value.

The integer values indicate the actual tuning control word. The allowed range of this tuning word is 0 to 4,194,304. The first number is the actual value at the present time, and the second value is the target value for the control loop. In most cases, these two values are the same. However, when the system must make a large frequency change (depending on instrument mode), the value may slew slowly to the target value to stay inside the allowed slew rate for reference systems. In this case, the first value will slew over seconds or minutes until it equals the second value. If the instrument is taking a long time to lock, this display may provide valuable information about what is happening.

- **CALIBRATION** This readout represents the correction applied to the oven oscillator clock to calibrate the frequency when in internal mode. The integer value is the tuning control word to make this happen. An example readout is " $0.59e-6$ ". This is the fractional correction being applied, which in this case this is 0.59 parts in 1 million. When the instrument calibration is performed, this number will typically change.

**Slot I/O Test**     The Slot I/O test runs diagnostics on the busses between the main instrument and the generator modules. This test provides a message that tells whether the slot passed, and if not, provides an error code. The error codes and meanings are shown in the table. (See Table 11.)

**To run the slot I/O test.**

1. Power up the instrument in factory mode. (See page 80, *To power up in factory mode.*)
2. Press the **SYSTEM** button.
3. Use the up (▲) or down (▼) arrow button to select **DIAGNOSTICS**.
4. Press **ENTER**.
5. Use the up (▲) or down (▼) arrow button to select **SLOT I/O**.
6. Press **ENTER** to run.
7. Check to see whether the slot passed the test, or whether there is an error message to help you troubleshoot the problem.

Table 11: Slot I/O test error codes

Error code	Description
1	Data Bus Test 1
1A	Data Bus Test 2
2	Data Bus Test 3
3	Data Bus Test 4
4	Data Bus Test 5
5	Data Bus Test 6
6	Address Bus Test 1
7	Address Bus Test 2
8	Address Bus Test 3
9	MCLK Test
A	ACLK Test
B	54 MHz CLK test
C	74.176 MHz CLK test
BC	Frame 0 / 54 and 74.176 MHz clock test
D	54 MHz CLK test
E	74.25 MHz CLK test
DE	Frame 1 / 54 and 74.25 MHz clock test
F	Frame 2 / 54 MHz test
10	Genlock Frame test
11	+5 V test
12	+8 V test
13	–5 V and +3.3 V test
14	IRQ signal test
99	Incorrect Hardware configuration

**SPG700 diagnostics**

The following table lists the diagnostics that are available in the SPG700. (See Table 12.) The diagnostic type is accessed using the up and down arrow buttons (▲ / ▼). The tests are accessed using the left and right arrow buttons (◀ / ▶). To check the results of a diagnostic test, proceed as follows:

1. Enter the factory mode. (See page 80, *To power up in factory mode.*)
2. Press the SYSTEM button.
3. Use the up (▲) or down (▼) arrow button to select **DIAGNOSTICS**.
4. Press **ENTER**.
5. Use the up, down, right, and left arrow buttons to navigate through all of the diagnostic reports, as shown in the following table. (See Table 12.)
6. Check that the tests report **(OK)** unless otherwise specified in the following table. If a warning is given, take corrective action until the test reports **(OK)**.

**Table 12: SPG700 system diagnostics**

**SYSTEM: DIAGNOSTICS:**

<b>TUNE: (▲ / ▼)</b>
Tune: (◀ / ▶) "Tune" indicates how much the Genlock reference is pulling the box from the Cal value. If not externally referenced, this will be zero.
Phase: (◀ / ▶) "Phase" shows the phase measurements and the synthesizer correction value.
<b>CALIBRATION: (▲ / ▼)</b>
Cal: This test indicates the correction applied to the oven to calibrate the clocks.
<b>PLL STATUS MAIN: (▲ / ▼)</b>
12.288Lk 54:Lk 74.25Lk 74.176Lk
This test checks the lock status of the four secondary audio and video clocks. All should read "Lk" to indicate locked.
<b>PLL STATUS SDI: (◀ / ▶)</b>
Flex0: Lock Flex1: Lock
This tests the Flexible Clock Generators on the SDI board. "Unlock" indicates an error.
<b>DDS STATUS SDI: (◀ / ▶)</b>
DDS0 Phase: Lock DDS1 Phase: Lock
This tests that each DDS in the SDI flexible clock generator is phased up to the selected incoming frame.
"Unlock" indicates an error.
<b>TEMPERATURE: (▲ / ▼)</b> These tests check the temperature of the internal sensors:
Main & CPU (◀ / ▶)
Ref Brd (◀ / ▶)
SDI BOARD & SDI FPGA (◀ / ▶)
<b>VOLTAGE: (▲ / ▼)</b> These tests check voltages on various supplies and fuses; all should indicate "OK".
Main board – voltage checks for the Main board (+5.0 V, +3.3 V, +2.5 V, +1.8 V, +1.5 V, +1.2 V, –5.00 V, +3.3 AV) (◀ / ▶)
Slots 1 through 4 voltage checks (+5.00 V, +3.3 V, +8.0 AV, +5.0 AV) (◀ / ▶)
Fan +5.0 V check (◀ / ▶)

Table 12: SPG700 system diagnostics (cont.)

RTC Battery (◀ / ▶)
REF BRD 1: +5 V and +8 V (◀ / ▶)
REF BRD 2: -5 V relative to +3.3 V (◀ / ▶)
SDI Bd 1: 1.2 V & 1.2 VA checks (◀ / ▶)
SDI Bd 2: 3.3 V & 3.3 VA checks (◀ / ▶)
SDI Bd 3: 1.5 V & 3.0 VA checks (◀ / ▶)
SDI Bd 4: 1.8 V & Dref checks (◀ / ▶)
<b>FAN SPEED: (▲ / ▼)</b>
Main: (◀ / ▶)
PS1: (◀ / ▶)
PS2: (◀ / ▶)
<b>POWER SUPPLY 1 and POWER SUPPLY 2: (▲ / ▼)</b>
Active: / Standby: (◀ / ▶) Hours of use as the active or standby supply.
TMP WTD: (◀ / ▶) Temperature Weighted hours of use.
12.0 V: (◀ / ▶)
Manufacture date: (◀ / ▶)
<b>GPS ADC BUS: (▲ / ▼)</b>
Stuck: / Short (◀ / ▶)
In the Stuck field, an <i>H</i> or an <i>L</i> indicates that the bit is not moving.
In the Short field, an <i>S</i> indicates a short between some of the bits.
<b>GENLOCK INPUT: (▲ / ▼)</b>
Min: / Max:
<b>LTC INPUT: (▲ / ▼)</b>
POS: Min (Raw) & Max (Raw): (◀ / ▶)
NEG: Min (Raw) & Max (Raw): (◀ / ▶)
<b>DDS SWEEP (▲ / ▼)</b>
<b>SRAM ADDR BUS 1 through 3: (▲ / ▼)</b>
<b>SRAM DATA bus 1 through 3: (▲ / ▼)</b>
<b>SRAM MEM TEST: (▲ / ▼)</b>
<b>DDR2 ADDRESS BUS 1 and BUS 2: (▲ / ▼)</b>
<b>DDR2 MEM TEST: (▲ / ▼)</b>
<b>RUN: (▲ / ▼)</b> Pressing <b>ENTER</b> runs the module memory tests.
<b>MANUAL TUNE: (▲ / ▼)</b> Press (◀ / ▶) buttons to tune the synthesizer outputs.
<b>GPS IO TEST: (▲ / ▼)</b> Press <b>ENTER</b> to run the Slot I/O test.

**SPG700 troubleshooting**

The following table lists some common problems and tells how to troubleshoot them.

**Table 13: SPG700 troubleshooting procedures**

<b>Problem</b>	<b>Troubleshooting steps</b>
No power or lights	<p>Check the main power supply as follows:</p> <ol style="list-style-type: none"> <li>1. Remove instrument top cover.</li> <li>2. Apply AC power.</li> <li>3. Use a voltmeter to check the voltage on TP21 / Fuse F1. TP21 is unlabeled; it is located just to the left of Fuse F1. (See Figure 18 on page 60.)</li> <li>5. If power is present on TP21, check fuses F1 and F2. Replace fuses if necessary.</li> <li>4. If 5 V is not present, check the Power Combiner board, then the power supply module(s).</li> <li>6. If there still no power, replace the Main board.</li> </ol>
Fault LED illuminated	<p>All of the conditions that drive the fault light should be displayed in the mainframe diagnostic screen. To view the diagnostics, refer to <i>SPG700 System Diagnostics</i>. (See page 57, <i>SPG700 diagnostics</i>.)</p>
Any of the fans not working	<p>Run diagnostics and check the fan speeds. The main fan is near the rear panel. The PS1 fan is in the first supply, and the PS2 fan is in power supply 2.</p> <p>If one of the three fans is not working, check the voltage on the three fans with a voltmeter. The voltage should be in the 8 V to 12 V range. If the voltage is not within that range, replace the Power Combiner board. If the voltage is within the range, replace the fan.</p>
Instrument not able to genlock	<p>Adjust/check the master clock. (See page 9, <i>Adjust master clock using a frequency signal generator</i>.) After adjustment, go into the diagnostics and verify that the CAL value readout is less than <math>\pm 2.5e-6</math>. If it is not, replace the oven or the Main board.</p> <p>In Factory mode, run the PLL Range Check from the diagnostics (perform the common diagnostic tests in the <i>SPG700 Specifications and Performance Verification Technical Reference</i> manual). Verify that all the secondary clocks can tune at least <math>\pm 90e-6</math>. If they cannot, replace the Main board.</p>
Display problems	<p>On power up, the LCD display should initially be dark except for a visible set of black squares on the top row. After a second or two, the LCD backlight should come on and a booting message should appear. If the backlight does not come on, check fuse F700 on the Main board, and then replace the display. If the text is not there, replace the display, then the cable, and finally the Main board, if necessary.</p>

Table 13: SPG700 troubleshooting procedures (cont.)

Problem	Troubleshooting steps
Keyboard/front panel problems	<p>On power up, the front panel buttons and indicators should light up in groups of 3 to 5. This sequence will repeat about 4 times while waiting for the instrument to start. The flashing sequence is controlled by the front panel, only power is required from the Main board. So if the flashing does not occur, replace the front panel.</p> <p>An unprogrammed new front panel will not flash until the instrument software has fully booted and loaded the code into the front panel. After the system has booted, run the keyboard diagnostics as follows:</p> <ol style="list-style-type: none"> <li>1. Restart the instrument in Factory mode. (See page 80, <i>To power up in factory mode.</i>)</li> <li>2. Press the SYSTEM button.</li> <li>3. Use the up arrow (▲) to get to DIAGNOSTICS.</li> <li>4. Press ENTER.</li> <li>5. Use the up arrow (▲) to select DIAGNOSTICS : RUN.</li> <li>6. Use the right arrow (▶) to select FRONT PANEL KEY test.</li> <li>7. Press ENTER.</li> <li>8. Follow the instructions on the display to run the keyboard diagnostics.</li> </ol> <p>If there is an error, replace the keyboard. If that does not fix the problem, replace the cable. If that does not fix the problem, replace the Main board.</p>
Remote interface problems	Use the GPI submenu under the SYSTEM menu to verify that the GPI alarm output is enabled and that the desired error conditions are also enabled
Module(s) not working properly	Refer to the troubleshooting procedure in this section for the module in question.

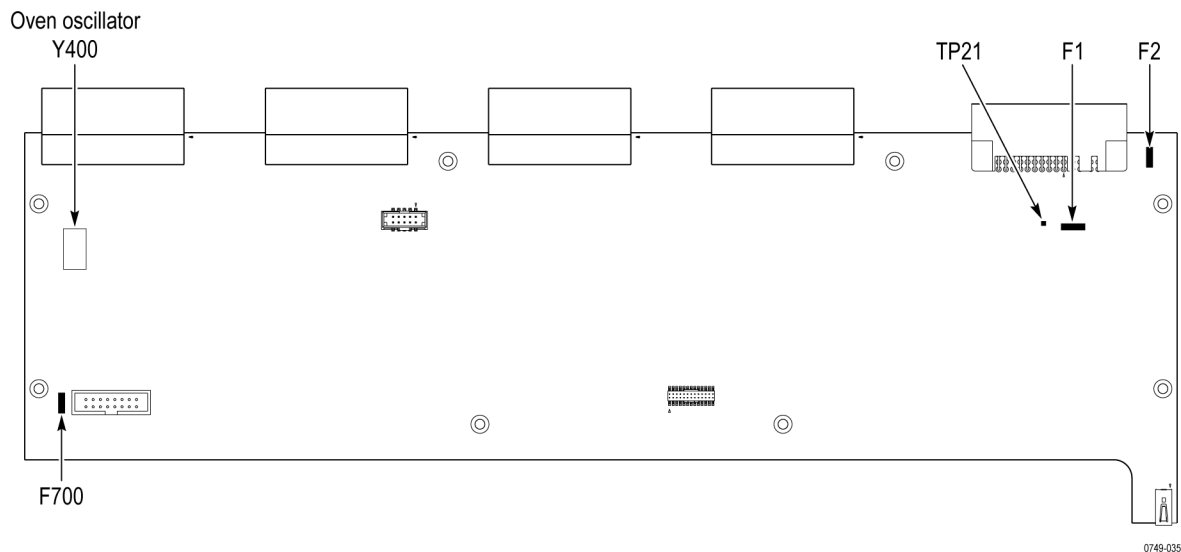


Figure 18: Main board (view from top)



**Genlock/Black troubleshooting**

This section contains instructions and procedures for troubleshooting Genlock/Black board. These procedures help you decide whether it is necessary to replace your module.

If the SPG700 does not start up or if the display is not working, go to the beginning of the troubleshooting section. (See page 53, *Troubleshooting*.)

**Required equipment.** The equipment listed in the following table is needed to troubleshoot the Genlock/Black generator module.

**Table 14: Equipment required for troubleshooting the Genlock/Black generator module**

Equipment	Requirement	Suggested equipment
Digital Multimeter	Used to check power supply voltages and fuses	Fluke 87 or equivalent
75 $\Omega$ BNC cables (4)	Length: 42 inches, used to connect the instruments	Tektronix part number 012-0074-00
ROHS compliant ESD safe soldering workstation	Any soldering must be ROHS compliant	
Frequency Counter (optional)	Used for an alternate method to check frequency accuracy	Fluke PM6685 or equivalent

**Performance verification.** If there is a problem, first perform the Base Unit Functional Test, found in the *SPG700 Specifications and Performance Verification* manual. Any problems found using that procedure can be a starting point for troubleshooting. Even if you do not perform the entire performance verification procedure, at a minimum check the diagnostics. These give valuable information on the generator board and the mainframe signals that drive it.

**General problems.** General problems and actions to follow are shown in the following table. (See Table 15.)

**Table 15: General problems – Genlock/Black board**

Problem	Actions
■ Fails Power On Self Test (POST)	<ul style="list-style-type: none"> <li>■ Run power on test procedure. (See page 62, <i>Power on self test (POST)</i>.)</li> <li>■ Check for current software. (See page 63, <i>Check the installed firmware version</i>.)</li> <li>■ Run power supply test. (See page 65, <i>Test power supply</i>.)</li> <li>■ Power up in factory mode and run the slot I/O test. (See page 55, <i>Slot I/O Test</i>.)</li> </ul>
■ No Black Burst outputs	<ul style="list-style-type: none"> <li>■ Run power supply test.</li> </ul>
■ No LTC outputs	<ul style="list-style-type: none"> <li>■ Verify configuration by setting to factory defaults. (See page 63, <i>Set to factory defaults (Genlock/Black)</i>.)</li> <li>■ Check diagnostics reported values. (See page 64, <i>Check diagnostic reported values</i>.)</li> <li>■ Power up in factory mode and run the slot I/O test. (See page 55, <i>Slot I/O Test</i>.)</li> <li>■ If no other problems found, replace the Genlock/Black board.</li> </ul>
■ Unstable genlock or unable to genlock	<ul style="list-style-type: none"> <li>■ Run Internal Mode Oven test. (See page 68, <i>Test internal mode oven</i>.)</li> <li>■ Check that the reference select is set to the correct mode. See the SPG700 User manual for directions.</li> <li>■ Verify reference signal is valid and is the correct format. Use a WFM7120 or WFM8300 waveform monitor.</li> <li>■ Check ADC Bus diagnostics. (See page 69, <i>ADC bus diagnostics</i>.)</li> <li>■ Power up in factory mode and run the slot I/O test. (See page 55, <i>Slot I/O Test</i>.)</li> <li>■ If no other problem found, replace Genlock/Black generator board.</li> </ul>
■ Unable to detect or use time code	<ul style="list-style-type: none"> <li>■ Verify that the time code is present on the input signal. Use a WFM7120 or WFM8300 waveform monitor.</li> <li>■ Verify that the time source select is set to VITC. See the <i>SPG700 Technical Reference</i> manual for directions.</li> <li>■ Verify that the time sync method is set as needed. The “Follow” mode is best for troubleshooting purposes. <i>SPG700 Technical Reference</i> manual for directions.</li> <li>■ Check the STATUS menu for the Genlock input amplitude and VITC present indicators. See the <i>SPG700 Technical Reference</i> manual for directions.</li> <li>■ Power up in factory mode and run the slot I/O test. (See page 55, <i>Slot I/O Test</i>.)</li> <li>■ If no other problem found, replace the Genlock/Black generator module.</li> </ul>

**Power on self test (POST).** When you first apply power to an SPG700, the Genlock/Black generator board runs a Power On Self Test (POST). If an error is encountered during this POST, the display will show one of several error codes.

Watch the display as the instrument powers on, and note any error codes. Check the table to see the meaning of the error codes. (See Table 16.)

**Table 16: POST error codes for the Genlock/Black module**

Error Code	Meaning
1:	CPLD constant 1 check (0xAAAA or 0x00AA based on cpld version at addr 0x8)
2:	CPLD constant 2 check (0x5555 or 0x0055 based on cpld version at addr 0xA)
3:	CPLD R/W error (writes 0x5555 to addr 0x102 and confirms)
4:	CPLD R/W error (writes 0xAAAA to addr 0x102 and confirms)
5:	Error copying DO Fpga to Genlock/Black EEPROM
7:	Error copying BB Fpga to Genlock/Black EEPROM
9:	DO Fpga constant check (0x55 at addr 0x501000)
10:	DO Fpga R/W error (writes 0x5555 to addr 0x501024 and confirms)
11:	DO Fpga R/W error (writes 0xAAAA to addr 0x501024 and confirms)
12:	BB Fpga R/W error (writes 0x5555 to addr 0x400008 and confirms)
13:	BB Fpga R/W error (writes 0xAAAA to addr 0x400008 and confirms)
255:	Not an error. This code may appear following some firmware updates.

#### Check the installed firmware version.

1. Press the **SYSTEM** button.
2. Press the up (▲) or down (▼) arrow buttons to select **VERSION INFO (F/W)**.
3. Read the firmware version.
4. If the version is not **V 1.3** or later, install current software. The latest software is available on the Web at [www.tektronix.com/downloads](http://www.tektronix.com/downloads).

**Set to factory defaults (Genlock/Black).** The SPG700 under test and the SPG700 reference unit must be configured correctly to avoid problems while troubleshooting. Ensure a common setup by setting both instruments to the factory presets as follows. (After troubleshooting, disconnect and reconnect the power cord to return the unit to your previous settings.)

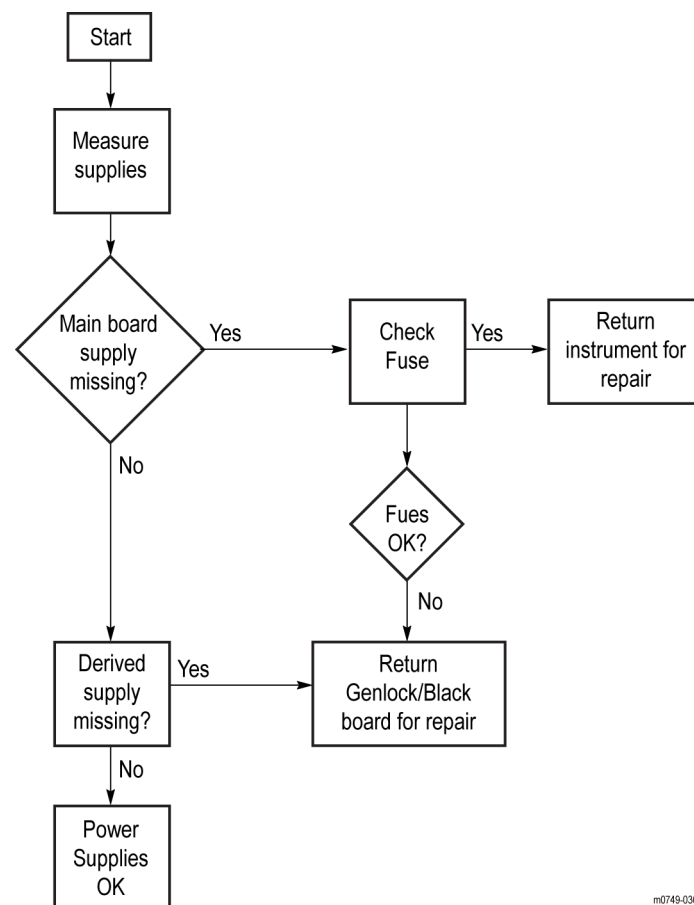
1. Press the **SYSTEM** button.
2. Press the up (▲) or down (▼) arrow button to select **PRESET**.
3. Press the **ENTER** button.
4. Press the up (▲) or down (▼) arrow button to select **RECALL**.
5. Press the left (◀) or right (▶) arrow button to select **FACTORY DEFAULT**.
6. Press the **ENTER** button to load the factory defaults.

**Check diagnostic reported values.** There are several internally detected physical measurements which are reported by the Main board and the Genlock/Black generator board. Check the following (see the *SPG700 Technical Reference* manual for more information on these diagnostics).

- **Tune – DDS value:** The DDS value is the control word the processor has written to the clock synthesizer. In internal mode, this is the calibration value needed to compensate for the any small error in the master oven frequency. The valid range of the DDS word is 0 to 4,194,303. If the DDS word is near either end of this range, the system is near the frequency limits to which it can lock.
- **Voltage Mon 1 (+5 V, +8 V), Voltage Mon 2 (-5 V rel to +3.3 V):** The voltage monitors measure the mainframe supplies, If the display indicates that they are out of range, check them manually. (See page 65, *Test power supply*.) If one of these supplies is bad, replace the Main board.
- **12.288/54/74.25/74.176 PLL Status page:** The VCO lock page verifies that all the clocks are all correctly phase locked. The 54MHz locks to the 20MHz Oven clock, so if it is not locked then troubleshoot that first. The other VCOs lock to the 54MHz.

**Test power supply.** There are two types of power supplies in the Genlock/Black circuitry: those provided by the instrument and those that are derived by the Genlock/Black generator. The supplies that are provided by the instrument are fused on the Genlock/Black board; they have an 'M' at the start of the supply name. (See Table 17.) Derived supplies depend on the instrument supply fuses for protection.

1. Remove the SPG700 top cover. (See page 35, *Top cover*.)
2. Use the following flowchart and table of power supply test points to determine if the Genlock/Black generator power supply is operating correctly. (See Figure 19.) (See Table 17.)



m0749-036

Figure 19: Genlock/Black generator module power supply test

Table 17: Power supply test points

Test point	Supply name	Limits	Notes
<b>Mainframe supplies</b>			
TP111	M +5 VD	+4.75 V to +5.25 V	Main board Fused 5 V digital supply, fuse F132
TP211	M +3.3 V	+3.1 V to +3.5 V	Main board Fused 3.3 V digital supply, fuse F131
TP213	M-5 VA	-4.75 V to -5.25 V	Main board Fused -5 V analog supply, fuse F111
TP214	M +5 VA	+4.75 V to +5.25 V	Main board Fused +5 V analog supply, fuse F121
TP215	M +8 V	+7.6 V to +8.4 V	Main board Fused +8 V analog supply, fuse F122
<b>Derived supplies</b>			
TP311	ANT+5 V	0 to 5.8 V	Switched GPS or GLONASS antenna supply – user setup
TP411	RAMP +7 V	6.75 V to 7.25 V	Derived from M +8 V
TP511	RAMP -4 V	-4.25 V to -3.75 V	Derived from M -5 V
TP711	CIR +2.5 V	2.375 V to 2.625 V	Derived from M +3.3 V
TP911	VID +4.1	4.08 V to 4.11 V	Derived from M +5 VA
TP821	LTC +3.3 V	3.30 V to 3.39 V	Derived from M +5 VA
TP0821	BB +1.2 V	1.15 V to 1.25 V	Derived from M +3.3 V
TP0421	DO +1.2 V	1.15 V to 1.25 V	Derived from M +3.3 V, test point is under the Option GPS Receiver board

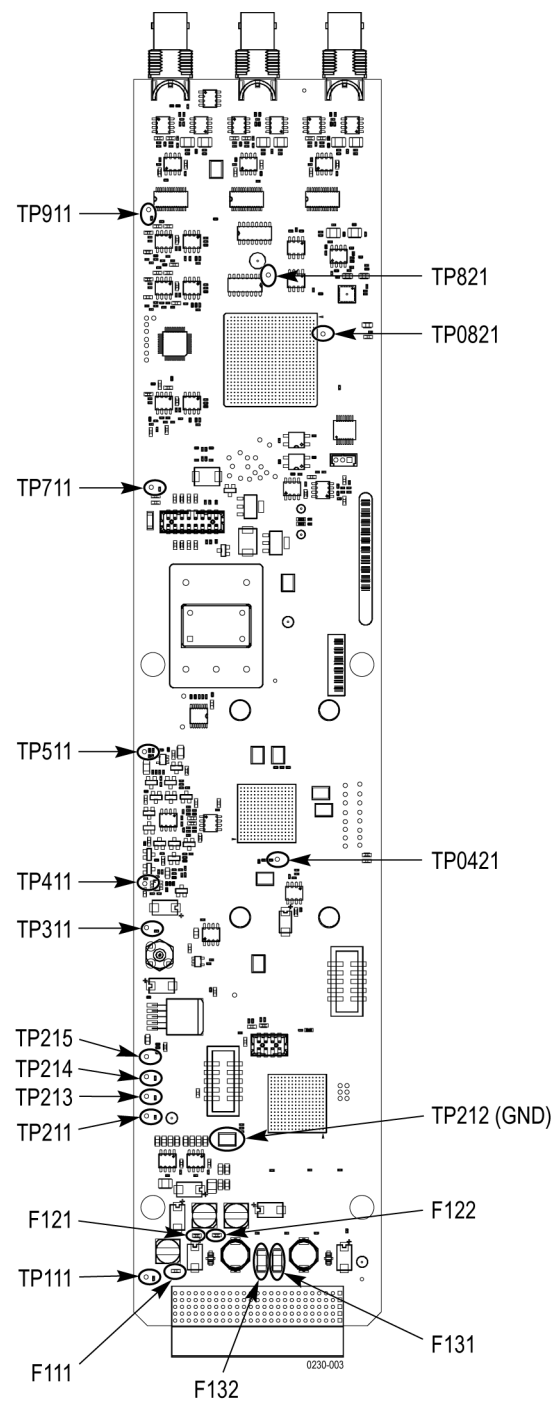


Figure 20: Genlock/Black generator board voltage test point and fuse locations

**Test internal mode oven.** Perform this procedure to determine if the oven oscillator is working and within specifications.

1. Set the instrument to internal reference mode as follows:
  - a. Press the **REF** button.
  - b. Press the up (▲) or down (▼) arrow buttons to select **SOURCE**.
  - c. Press the **ENTER** button.
  - d. Press the left (◀) or right (▶) arrow buttons to select **INTERNAL**, and then press the **ENTER** button.
2. Compare the Black Burst signals.
  - You can use the frequency accuracy setup from the *SPG700 Specifications and Performance Verification Technical Reference* manual to compare the Black Burst signals from the under test to the signals from the reference unit.
  - As an alternative, you can use the following procedure to compare the signals:
    - a. Connect the frequency counter to the **BLACK 3** output.
    - b. Configure the **BLACK 3** output to produce a 10 MHz CW signal.
    - c. Measure the frequency accuracy directly. At 10 MHz, 1 ppm = 10 Hz, so a measured frequency of 10,000,010 Hz is 1 ppm high.
    - d. If either measurement method yields an internal frequency error of more than 0.1 ppm, the instrument may need calibration, or the oven may not be able to tune to the correct frequency.
    - e. If the internal frequency is >3 ppm off, replace the Main board.



**ADC bus diagnostics.** Perform this procedure to determine if all the bits on the ADC are properly connected to the FPGA logic.

1. Connect the BLACK 1 output to the REF IN connector. Make sure the loop through is unconnected and unterminated.
2. Press the **REF** button.
3. Press the up (▲) or down (▼) arrow button until **SOURCE** appears in the display.
4. Press the right (▶) arrow button until **NTSC BURST** appears.
5. Press the **ENTER** button.
6. Press the **BLACK** button until **BLACK 1** appears.
7. Press the left (◀) or right (▶) arrow button to select **NTSC**.
8. Press the **ENTER** button.
9. Press the up (▲) or down (▼) arrow button until **FIELD REF** appears.
10. Press the left (◀) or right (▶) arrow button to select **ENABLE**.
11. Press the **ENTER** button.
12. Press the **SYSTEM** button.
13. Press up (▲) or down (▼) arrow button until **DIAGNOSTICS** appears.
14. Press the **ENTER** button.
15. Press the up arrow button until **GPS ADC BUS DIAGNOSTICS** appears.
16. Check for the following conditions:
  - If any bits in the *Stuck* field show an *H* or an *L*, the bit is not moving. Replace the Genlock/Black generator.
  - If any bits in the *Short* field show an *S*, there is a short between some of the bits. Replace the Genlock/Black generator.

**Option SDI troubleshooting**

This section contains instructions and procedures to troubleshoot Option SDI. These procedures will help you decide whether it is necessary to replace your module.

If the SPG700 does not start up or if the display is not working, refer to *SPG700 troubleshooting*. (See Table 13.)

**Required equipment.** The equipment listed here is needed to troubleshoot Option SDI.

**Table 18: Equipment required to troubleshoot the Option SDI**

Equipment	Requirement	Suggested equipment
HD Waveform monitor	Must be able to display 3 Gb/s SDI signal and jitter	Tektronix WFM7120
Oscilloscope	>500 MHz bandwidth, 50 $\Omega$ input	Tektronix DPO4104
Digital Multimeter	Used to check power supply voltages and fuses	Fluke 87 or equivalent
75 $\Omega$ BNC cables (2)	Length: 42 inches, used to connect the instruments	Tektronix part number 012-0074-00
50 $\Omega$ BNC cable (1)	Length: 43 inches, used to test trigger output	Tektronix part number 012-0057-01
ROHS compliant ESD safe soldering workstation	The Option SDI boards do not contain any user-serviceable parts, but any soldering must be ROHS compliant	
Other modules	Used to test instrument operation	Option BG – or – A TG8000 with an AVG7 module or a DVG7 module installed.

**Problem identification.** If there is a problem, first perform the Option SDI Performance Verification procedure, found in the *SPG700 Specifications and Performance Verification* manual. Any problems found with that procedure can be a starting point for troubleshooting.

General problems and actions to follow are shown in the following table.

**Table 19: Option SDI troubleshooting**

<b>Problem</b>	<b>Actions</b>
■ Fails Power On Self Test (POST)	■ Run power on test procedure.
■ SDI does not appear in menu	■ Run power on in Factory mode test procedure.
	■ Check for current software.
	■ Run power supply test.
	■ Perform the slot I/O test on the Genlock/Black generator module to test the instrument resources.
	■ Make sure that the output cards are properly seated into the connectors on the SDI FPGA board.
■ No output from Signal BNCs	■ Run power on test procedure.
	■ Check diagnostics reported values.
	■ Run power supply test.
	■ Verify configuration.
	■ Make sure that the output cards are properly seated into the connectors on the SDI FPGA board.
■ Generator video color errors	■ Verify configuration.
	■ Restore Factory Defaults, save them as power-on preset, and reboot instrument.
■ Unstable video	■ Check diagnostics reported values.
■ Excessive jitter	■ Run Test Multiple Frame Rate procedure.
■ Generator output lost when format is changed	■ Run Test Multiple Frame Rate procedure.
■ No 3 Gb/s signal formats available in the menus	■ Verify that Option 3G is enabled. (See page 80, <i>Verify that Option 3G is enabled.</i> )
■ Frame picture mode is not working	■ Run the <i>Check module diagnostics</i> procedure. (See page 73, <i>Check the SDI diagnostics.</i> )
	■ Run the <i>Download a frame picture with a known good image</i> procedure. (See page 81.)
	■ If no other problem found, replace the Option SDI module.

**Power on self test.** When you first apply power to the instrument, it runs a Power On Self Test (POST). If an error is encountered during this POST, the display will show one of several error codes. (See Table 20.) Watch the display during start up and note any error codes. Error codes may appear for as short a time as three seconds.

**Table 20: POST error codes for Option SDI**

Error code	Meaning	Action
2:	No output board in slot 1 or slot 2 - The output module is not detected by the processor.	Make sure the module is correctly seated into the connector on the SDI FPGA board. <b>IF</b> that does not work replace the Output module.
3:	PLD keyword != 0xAAAA - The processor did not read the correct code interfacing to the module.	These errors indicate a failure of basic communications between the mainframe processor and the PLD on the module. Run the slot I/O test on the Genlock/Black board to test common instrument resources. (See page 55, <i>Slot I/O Test</i> .) If that passes, replace the Option SDI module.
4:	PLD keyword != 0x5555 - The processor did not read the correct code interfacing to the module.	
5:	FPGA not configured	Check the SW version. If necessary, reload the Module flash that holds the FPGA configuration file. (See page 72, <i>Reload the module flash</i> .) If the SW is current and correctly installed and this error is still encountered, replace the Option SDI module.
6:	FPGA R/W check 0x55 failed (0x20040A)	These errors indicate the main processor cannot communicate with the FPGA on the SDI board..Run the slot I/O test on the Genlock/Black board. (See page 55, <i>Slot I/O Test</i> .) If that passes, replace the Option SDI module.
7:	FPGA R/W check 0x55 failed (0x20040C)	
8:	FPGA R/W check 0xAA failed (0x20040A)	
9:	FPGA R/W check 0xAA failed (0x20040C)	

**Reload the module flash.** It might become necessary to reload the module flash that holds the FPGA configuration file. (See Table 20.) To reload the module flash, proceed as follows:

1. Press the **STATUS** button.
2. Press up (▲) or down (▼) arrow button to display **STATUS: SDI1:**.
3. Press and hold the **ENTER** button for 5 seconds.
4. When the upgrade message appears, press **ENTER** to accept.

**Check the SDI diagnostics.** There are several internally detected physical measurements, which are reported by the Option SDI diagnostics. Some of the diagnostic tests are available only in factory mode.

Perform the following procedure to access the Option SDI diagnostics:

1. Restart the instrument in Factory mode. (See page 80, *To power up in factory mode.*)
2. Press the **SYSTEM** button.
3. Press the up (▲) or down (▼) arrow buttons to choose **DIAGNOSTICS**.
4. Press the **ENTER** button.
5. Press the up (▲) or down (▼) arrow buttons to scroll through the following diagnostics. In some cases, you will need to use the left (◀) or right (▶) arrow buttons to scroll through the choices within a certain diagnostics submenu, such as **TEMPERATURE**, **PLL**, or **RUN**.
  - **PLL Status SDI:** Flex0:Lock (output channel 1) and Flex1:Lock (output channel 2) should be displayed. If the appropriate Locked message is not displayed when expected, it can indicate a problem with the Option SDI module or with the instrument's input clock.
  - **DDS Status:** DDS0 Phase:Lock (output channel 1) and DDS1 Phase:Lock (output channel 2) should be displayed. If the appropriate Locked message is not displayed when expected, it can indicate a problem with the option board or with the instrument's input clock.
  - **Temperatures:** The Option SDI module detects the temperature on the board. This temperature is normally about 15 °C above ambient temperature. If the temperature is very high or low, check that the fan is operating, the installation clearances are correct, and that all cables are connected properly. If there is still a problem, replace the Option SDI board.
  - **FPGA Version:** *Current:* shows the FPGA version that is loaded. *Expected:* shows the version that the operating firmware expects. If these are different, consider upgrading the firmware.
  - **Voltage Mon (1, 2, 3, & 4):** All internal voltages except the +5 V supply are measured and displayed with "OK" if they are within the established limits (+1.2 V, +1.5 V, +1.8 V, and +3.3 V). If any voltages are out of the established limits, the Option SDI board must be replaced.
  - **DDS Sweep:** This diagnostic capability is available only in factory mode and is not used in normal module troubleshooting. If you run this test, you must restart the instrument to continue.

- **SRAM Address Bus (1, 2, & 3):** Each of the 18 dashes represents one address bus line. A dash “-” indicates OK, “S” indicates shorted, “H” indicates stuck high, and “L” indicates stuck low.
  - **SRAM Data Bus (1, 2, & 3):** Each of the 16 dashes represents one data bus line. A dash “-” indicates OK, “S” indicates shorted, “H” indicates stuck high, and “L” indicates stuck low.
  - **SRAM Memory Test:** Press the ENTER button to start the test. The test takes approximately 60 seconds to complete. If **0 bad sectors detected** is not displayed, replace the Option SDI.
  - **DDR2 Address Bus (1 & 2):** Each of the 15 dashes represents one address bus line. A dash “-” indicates OK, “S” indicates shorted, “H” indicates stuck high, and “L” indicates stuck low.
  - **DDR2 Data Bus (1 & 2):** Each of the 16 dashes represents one data bus line. A dash “-” indicates OK, “S” indicates shorted, “H” indicates stuck high, and “L” indicates stuck low.
  - **DDR2 Memory Test:** Press the ENTER button to start the test. The test takes approximately 7 seconds to complete. If **0 errors detected** is not displayed, replace the Option SDI module.
6. Remove power and then reapply power to the SPG700 to exit the factory mode.

#### Check the installed firmware version.

Use this procedure to check the installed firmware versions:

1. Press the **SYSTEM** button.
2. Press the up (▲) or down (▼) arrow buttons to select **VERSION INFO (F/W)**.
3. Read the firmware version.
4. If the version is not **V 1.3** or later, install current software. The latest software is available on the Web at [www.tektronix.com/downloads](http://www.tektronix.com/downloads).

#### Verify the configuration.

To eliminate the configuration of the SPG700 as the source of a problem, reset the instrument to the factory default settings:

1. If necessary, save the user configuration in a preset. (The user configuration may already be saved as the power on preset.)
2. Restore the factory default:
  - a. Press the **ENTER** button.
  - b. Press **Enter** to select **Preset**.

- c. Press the up (▲) or down (▼) arrow button to select **RECALL**.
  - d. Press the left (◀) or right (▶) arrow button to select **Factory Default**.
  - e. Press the **ENTER** button to reset the instrument to the factory default settings.
3. Check to see if the problem still exists.

If the problem has been fixed, compare the settings between the factory default and the user configuration to find the issue. (See Table 21.)

**Table 21: Option SDI module factory default settings**

Menu item name	Settings
TEST SIGNAL	100% Color Bars
FORMAT	1080 59.94i
SAMPLE STRUCTURE/DEPTH	YCbCr 4:2:2 10b
OUTPUT MODE	HD (1920 x 1080)
MOVING PICTURE	
H Step	0 Sample(s)
V Step	0 Line(s)
Period	1 Frame(s)
Random	Disable

Table 21: Option SDI module factory default settings (cont.)

Menu item name	Settings
OVERLAY : LOGO	
Status	Disable
Source	Tektronix_logo_500x125.bmp
	<p><b>NOTE.</b> The default logo is the "first" file in the SDI7/LOGO directory, as sorted by the date of the logo file (oldest first). If the factory-provided logo files are installed, the default logo is "Tektronix_logo_500x125.bmp."</p> <p>However, if the user has removed the factory-provided logo files and added their own custom files, the default logo will be the oldest file installed in the SDI7/LOGO directory.</p>
X Position	-5 % APW
Y Position	-5 % APH
OVERLAY : ID TEXT	
Status	Disable
Source	User-entered string
X Position	5.0 % APW
Y Position	5.0 % APH
Font Size	8.0 % APH
OVERLAY : CIRCLE	
Status	Disable
X Position	0.0 % APW
Y Position	0.0 % APH
Diameter	90.0 % APH
OVERLAY : BLINK	
Text/Circle Blink	Off
OVERLAY : BORDER	
Text/Circle Border	Enable



Table 21: Option SDI module factory default settings (cont.)

Menu item name	Settings
AUDIO (EMBEDDED)	
Status (Level A)	
Group 1–4	Disable
Status (Level B)	
Group 1–4 Link A	Disable
Group 1–4 Link B	Disable
Channel	
Status	Active
Frequency	1000
Amplitude	–20 dBFS
Audio Click	OFF
Channel Origin	A1-1 through A4-4
Sampling	Frame
TIMING	
Vertical	0 Line(s)
Horizontal	0.0000 $\mu$ s
Relative To	Serial (0H)
TIMECODE	
Source	Local (DST)
30 Drop Frame	Enable
ATC-LTC	OFF
ATC-VITC	OFF
VIDEO	
Y	ON
Cb	ON
Cr	ON
Edge Filter	Enable
AV Timing Mode	OFF
EDH (SD output mode only)	ON

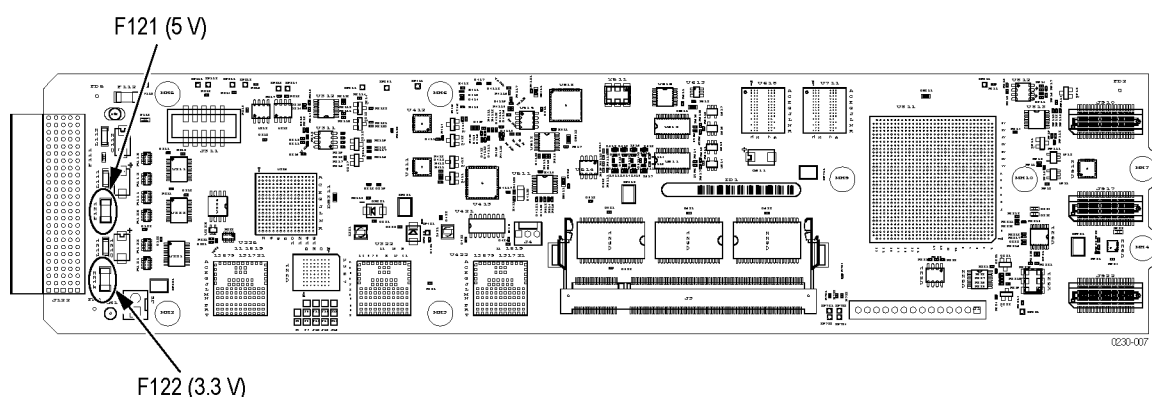
Table 21: Option SDI module factory default settings (cont.)

Menu item name	Settings
ANC PAYLOAD	
Output	Disable
Parity	Automatic
DID	0x101
SDID	0x200
DC	0x101
UDW	0x200
CS	0x200
Auto-Calculate CS	Enable
Line	9
Field 1, Line:	9
Field 2, Line:	9
Start Sample	1928
Video Channel	Luma
Link Location	Link A
Stream Location	HS Stream 1
SMPTE 352 PAYLOAD	Enable
SECONDARY OUTPUT	Test Pattern

**Check the power supplies.** Two of the power supplies require manual verification.

1. Remove the SPG700 top cover. (See page 35, *Top cover*.)
2. Check the +5 V supply by measuring the voltage at F121, which should be in the range of +4.75 V to +5.25 V. (See Figure 9.)
3. Check the +3.3 V supply by measuring the voltage at F122, which should be in the range of +3.135 V to +3.465 V. (See Figure 9.)

Make sure that the voltage is present on both ends of the fuse. If the voltage is present on only one end of the fuse, the Option SDI board must be replaced. If the voltage is not present on either end of the fuse, check the power and the connector between the SDI board and the Main board. If they are okay, the instrument must be repaired.



**Figure 21: SDI power supply test points**

**Check the multiple frame rates.**

The Main board provides three frame pulses, which are used to set the module timing relative to the rest of the instrument. Different frame pulses are used, depending on the signal format the instrument is set for. Use this procedure to investigate problems in that circuitry.

1. Connect the SDI outputs to a waveform monitor.
2. Apply power to the SPG700.
3. Recall the Factory Default preset as follows:
  - a. Press the **ENTER** button.
  - b. Press **Enter** to select **Preset**.
  - c. Press the up (▲) or down (▼) arrow button to select **RECALL**.
  - d. Press the left (◀) or right (▶) arrow button to select **Factory Default**.
  - e. Press the **ENTER** button to reset the instrument to the factory default settings.

4. Verify that all four SDI signal outputs (SDI 1A, SDI 1B, SDI 2A, and SDI 2B) are set to provide a 59.94, 1080i format, 100% color bar signal (factory default signal).
5. Check the DDS0:Phase and DDS1:Phase lock status, as described in the Module Diagnostics. (See page 73, *Check the SDI diagnostics*.)
6. Change the SDI signal format to 50 Hz:
  - a. Press the **SDI** button until **SDI 1** appears on the display.
  - b. Press the up (▲) or down (▼) arrow button to select **FORMAT**.
  - c. Press the left (◀) or right (▶) arrow button to select **1080 50i**.
  - d. Press the **ENTER** button.
  - e. Repeat the steps to set the **SDI 2** channel to **1080 24p**.
7. Check the DDS0:Phase and DDS1:Phase lock status, as described in the Module Diagnostics. (See page 73, *Check the SDI diagnostics*.)

If one of the formats (59.94 Hz, 50 Hz, or 24 Hz) works correctly, but the other one does not, the sync pulse may be missing.

**To power up in factory mode.** Putting the instrument into factory mode allows access to calibration, but it also allows the module to show in the menus even if it fails the POST routine.

Restart the instrument in factory mode. (See page 80, *To power up in factory mode*.)

1. Run the **Check module diagnostics** routine. (See page 73, *Check the SDI diagnostics*.)

**Verify that Option 3G is enabled.** If your instrument has Option 3G enabled, an option key was entered to enable the 3G software option. You need to enter the option key only once.

Perform the following steps to verify that Option 3G is enabled.

1. Press the front-panel **SYSTEM** button.
2. Press the up (▲) or down (▼) arrow button until **SYSTEM : OPTIONS** are displayed.  
  
Press the **ENTER** button.
3. Press the up (▲) or down (▼) arrow button and check for **SYSTEM: OPTIONS : ENABLED: 3G**, which indicates that this option is enabled.

**Download a frame picture with a known good image.** If you are having problems with generating a frame picture using Option SDI, perform the following steps to install a known good frame picture so that you can determine whether the problem is with the signal you were trying to generate or with the module:

1. Download one of the sample frame pictures from the *SPG700 SW Library and Documentation DVD* that shipped with your product. The sample images are located in the *SAMPLE/SDI7* directory on the DVD.

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**NOTE.** For information on how to transfer or install user files to your SPG700, refer to the *Quick Start User Manual*, Tektronix part number 071-3080-XX.

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2. Configure the Option SDI to output a 1080i 59.94 format HD signal.
3. Press the **SDI** button to display **SDI 1**.
4. Press the up (▲) or down (▼) arrow button to select **TEST SIGNAL**.
5. Press **ENTER**.
6. Press the up (▲) or down (▼) arrow button to select **FRAME PICTURE**.
7. Press the left (◀) or right (▶) arrow button to select the file you downloaded.
8. Press the **ENTER** button to load that signal into the generator.
9. Check to see if the Option SDI is providing a proper frame picture:
  - a. If a proper frame picture is generated when using the signal that you downloaded, but not when using a customer signal, the problem is probably something in the customer signal.
  - b. If a proper frame picture is not generated with the signal that you downloaded, there is probably a problem with the Option SDI.

## Repackaging instructions

Use the following instructions to prepare your instrument for shipment to a Tektronix, Inc., Service Center:

1. Attach a tag to the instrument showing: the owner, complete address and phone number of someone at your firm who can be contacted, the instrument serial number, and a description of the required service.
2. Package the instrument in the original packaging materials. If the original packaging materials are not available, follow these directions:
  - a. Obtain a carton of corrugated cardboard having inside dimensions six or more inches greater than the dimensions of the instrument. Use a shipping carton that has a test strength of at least 250 pounds (113.5 kg).
  - b. Surround the module with a protective (anti-static) bag.
  - c. Pack dunnage or urethane foam between the instrument and the carton. If using Styrofoam kernels, overfill the box and compress the kernels by closing the lid. There should be three inches of tightly packed cushioning on all sides of the instrument.
3. Seal the carton with shipping tape, industrial stapler, or both.

# Replaceable parts

This section contains a list of the replaceable modules for the SPG700 generator and available options. Use this list to identify and order replacement parts.

## Parts ordering information

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

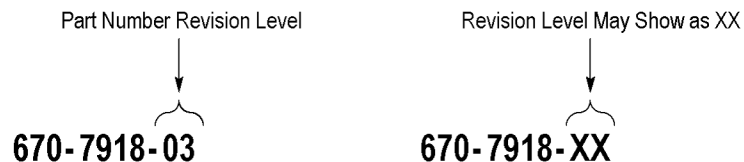
Changes to Tektronix products are sometimes made to accommodate improved components as they become available and to give you the benefit of the latest improvements. Therefore, when ordering parts, it is important to include the following information in your order.

- 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 was replaced with a different or improved part, your local Tektronix field office or representative will contact you concerning any change in part number.

### Part number revision level

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



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

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

**Module exchange.** In some cases you may exchange your module for a remanufactured module. These modules cost significantly less than new modules and meet the same factory specifications. For more information about the module exchange program, call 1-800-833-9200. Outside North America, contact a Tektronix sales office or distributor; see the Tektronix Web site for a list of offices: [www.tektronix.com](http://www.tektronix.com)

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

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

## Using the replaceable parts list

This section contains a list of the mechanical and/or electrical components that are replaceable for the SPG700. Use this list to identify and order replacement parts. The following table describes each column in the parts list.

**Table 22: 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.

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

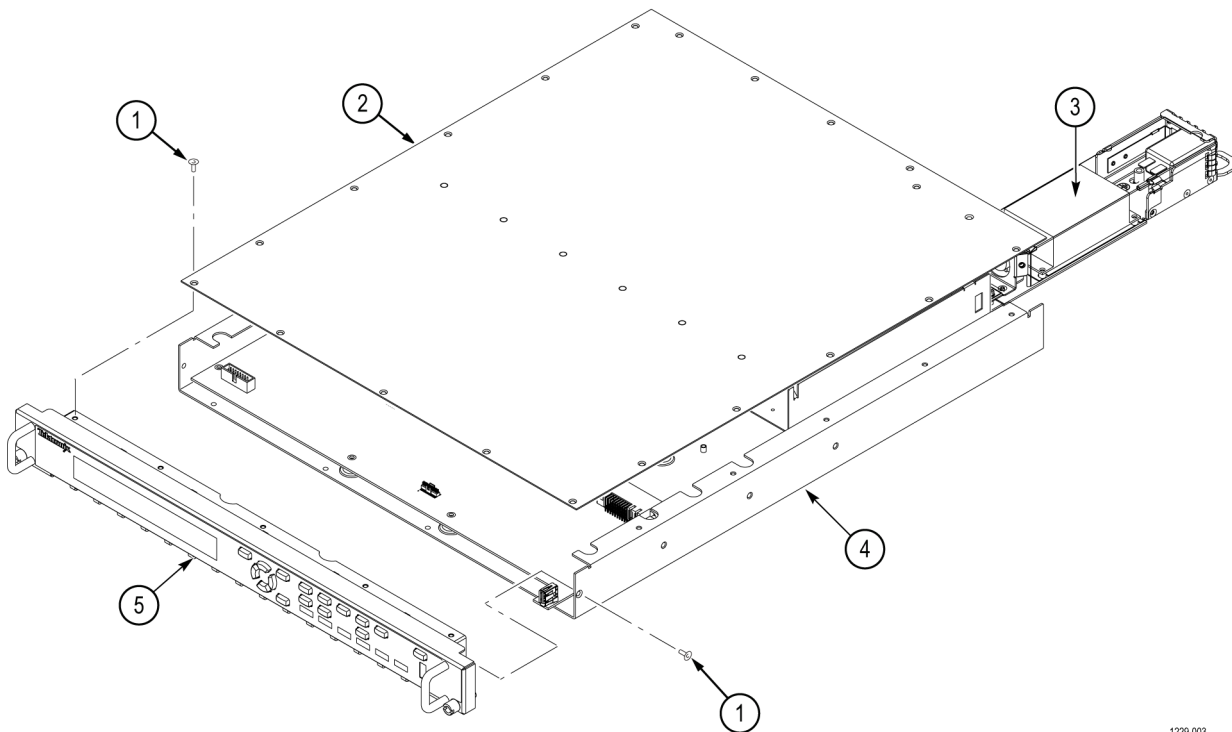


## Replaceable parts lists

The following tables list the replaceable parts for the SPG700.

**Table 23: Main instrument replaceable parts**

Fig. & index number	Tektronix part number	Qty	Name & description
22-1	211-1194-XX	28	SCREW, MACHINE; M3 X 6MM, FLH BLACK, CROSS REC
-2	200-5248-XX	1	CABINET; TOP MAIN CHASSIS
-3	650-5545-XX	1	POWER SUPPLY ASSY STANDARD
		2	POWER SUPPLY ASSY OPTION DPW
-4	441-2691-XX	1	CHASSIS, MAIN, SAFETY CONTROLLED The chassis assembly has replaceable subparts. (See Figure 23 on page 87.)
-5	???-????-XX	1	FRONT PANEL ASSY The Front Panel assembly has replaceable subparts. (See Figure 24 on page 89.)



1229-003

**Figure 22: Main instrument exploded view**

**Table 24: Chassis assembly replaceable parts**

Fig. & index number	Tektronix part number	Qty	Name & description
23-1	441-2691-XX	1	CHASSIS, MAIN, SAFETY CONTROLLED
-2	878-1237-XX	1	CIRCUIT BD ASSY; MAIN
-3	211-A245-XX	10	SCREW, MACHINE; M3 X 6MM L, PNH, STL, NI PL, CROSS REC, W/PLAIN & SPLIT LOCK WASHER
-4	344-0629-XX	1	MOUNT, CLIP; WIRE ROUTING CLIP, NYLON 6/6, ADHESIVE BACKING, NATURAL COLOR
-5	174-6138-XX	1	CABLE ASSY, 2 X 5 FEMALE TO FEMALE, KEYED
-6	174-6143-XX	1	CABLE 2 X 8, 2 MM PITCH, RIBBON FEMALE TO FEMALE, TAB
-7	174-6137-XX	1	CAT5E CABLE CABLE ASSEMBLY, RJ45, MALE/MALE, 2 FT
-8	878-0649-XX	1	CIRCUIT BOARD ASSY; FRONT PANEL
-9	214-3903-XX	4	SCREW, JACK; 4-40 X 0.312 EXT THD, 4-40 INT THD, 0.188 HEX, ZINC PLATED STEEL
-10	333-4803-XX	1	REAR PANEL SPG 700
-11	----	1	CIRCUIT BD ASSY: Genlock/Black board (See Figure 25.)
-12	----	1	OPTION SDI ASSY (See Figure 26.)
-13	348-A156-XX	1	GASKET, SHIELD: FINGER TYPE, BE-CU, 8.13MM W X 2.79MM H X 406.4MM L
-14	119-7933-XX	1	FAN ASSY (12 V, 8.62 CFM) 40 X 40 X 28 MM, TERMINATED
-15	211-A265-XX	2	SCREW, MACHINE; M3 X 40MM L, PNH, STL, NI PL, CROSS REC, W/NUT & LOCK WASHER
-16	878-0650-XX	1	CIRCUIT BD ASSY; POWER COMBINER
-17	407-6120-XX	1	BRACKET PCB, HOLD DOWN
-18	220-A095-XX	2	NUT, PLAIN, HEX:M3, STL, NI PL, W/EXT TOOHEED WASHER
-19	211-1194-XX	6	SCREW, MACHINE; M3 X 6MM, FLH BLACK, CROSS REC
-20	146-0109-XX	1	BATTERY, DRY; 3.0 V, LITHIUM MANGANESE DIOXIDE, 210MAH, 20 X 3.22MM COIN CELL WITH SOLDER TABS, CR2032-1HF1
<b>Main board fuses (not shown)</b>			
	159-5018-XX	2	FUSE; 3.0A, 125 V, FAST BLOW, 0.1 X 0.1 X 0.24, UL REG, CSA CERT
	159-5022-XX	15	FUSE; 5.0A, 125 V; FAST BLOW, 0.1 X 0.1 X 0.24, UL REG, CSA CERT; 451005

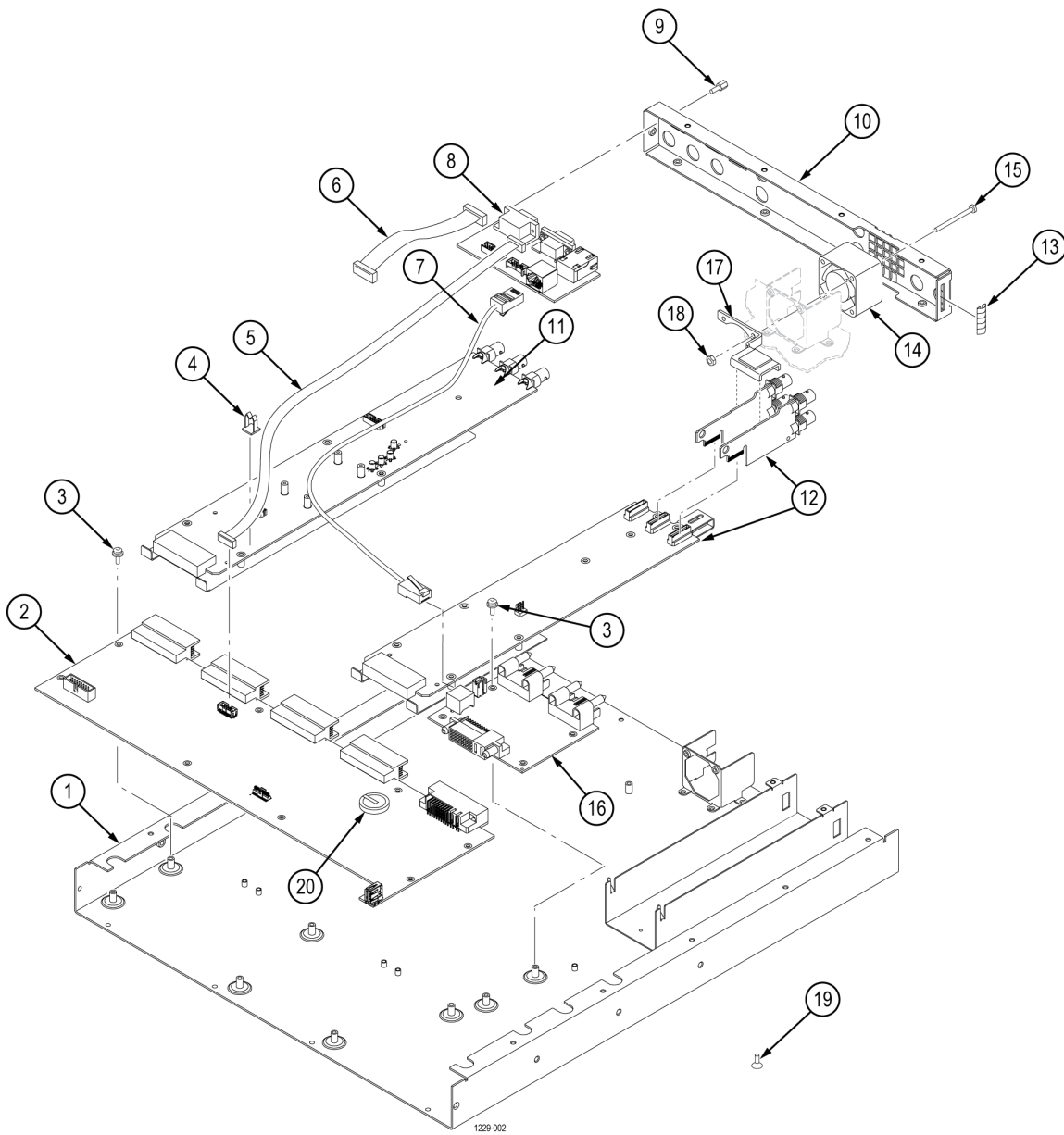
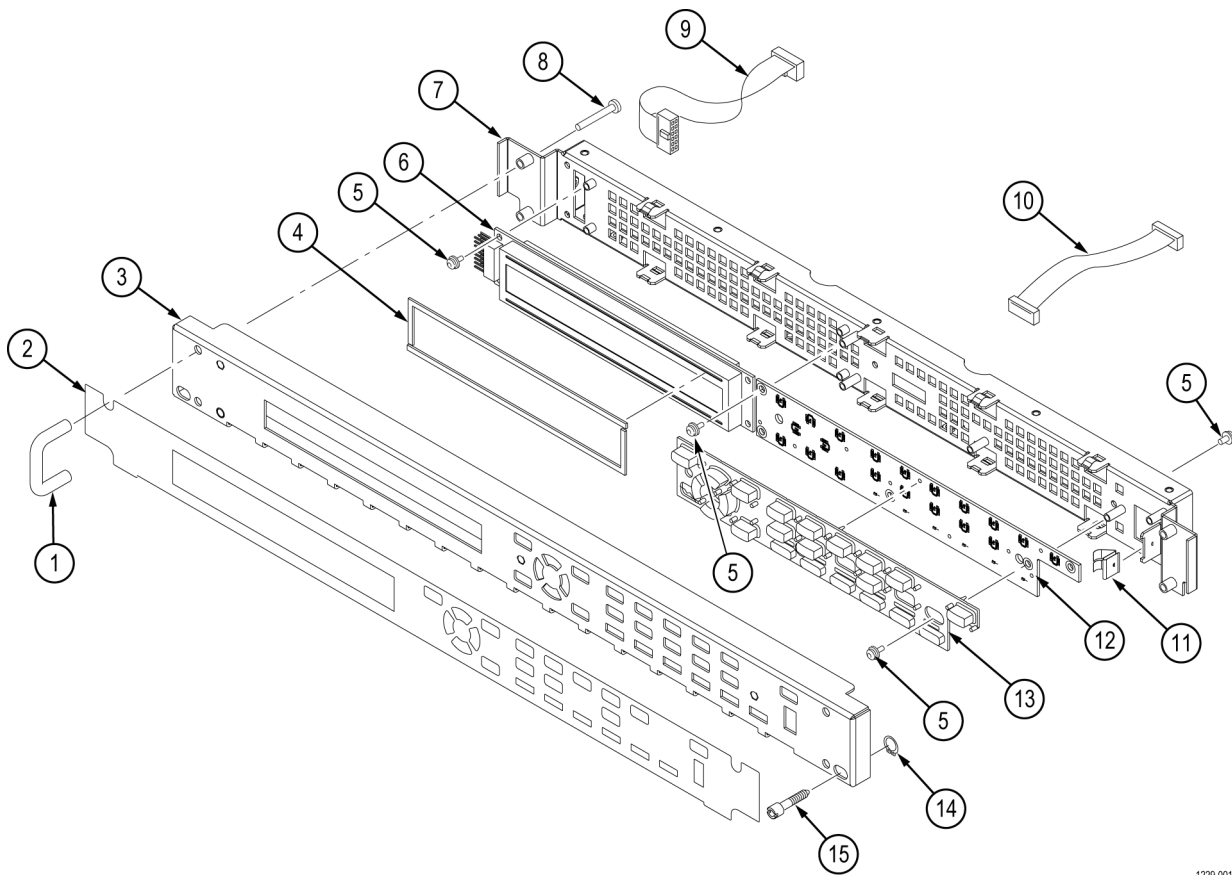


Figure 23: Chassis assembly exploded view

**Table 25: Front panel assembly replaceable parts**

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discount'd	Qty	Name & description
24-	???-????-XX			1	FRONT PANEL ASSY
-1	367-0530-XX			2	HANDLE, BOW; AL, 1.0 X 1.25, STAIN FINISH, SAFETY CONTROLLED
-2	335-3574-XX			1	LABEL, FRONT PANEL
-3	426-2637-XX			1	FRONT PANEL BEZEL
-4	348-2061-XX			2	GASKET, DISPLAY DUST SEAL
-5	211-A245-XX			13	SCREW, MACHINE; M3 X 6 MM L, PNH, STL, NI PL, CROSS REC, W/PLAIN & SPLIT LOCK WASHER
-6	119-7930-XX			1	DISPLAY MODULE ASSEMBLY TORINO, SAFETY CONTROLLED
-7	407-5730-XX			1	FRONT PANEL SUPPORT BRACKET
-8	211-0738-XX			4	SCREW, MACHINE; 6-32 X 0.625, PNH, STL BLK ZI, TORX
-9	174-6136-XX			1	CABLE, RIBBON, LCD, 2X8, 0.100 P FEMALE TO FEMALE
-10	174-6135-XX			1	CABLE 2 X 13, RIBBON, KEYBOARD FEMALE TO FEMALE
-11	131-6521-XX			1	CONTACT, ELEC; EMI, CLIP-ON, 0.38 L X 0.460 W (2 CONTACTS) X 0.45 HIGH, ELECTROLESS NICKEL PLATE
-12	878-0649-XX			1	CIRCUIT BOARD ASSY; FRONT PANEL
-13	260-3058-XX			1	SWITCH KEYPAD; ELASTOMERIC MAT
-14	354-0025-XX			2	RING, RETAINING; EXTERNAL, U/O 0.187 DIA SFT, ZINC PLATED STEEL
-15	213-0216-XX			2	THUMBSCREW; 10-32 X 0.85, 0.375 OD HD, ZINC PLATED STEEL, W/SLOT

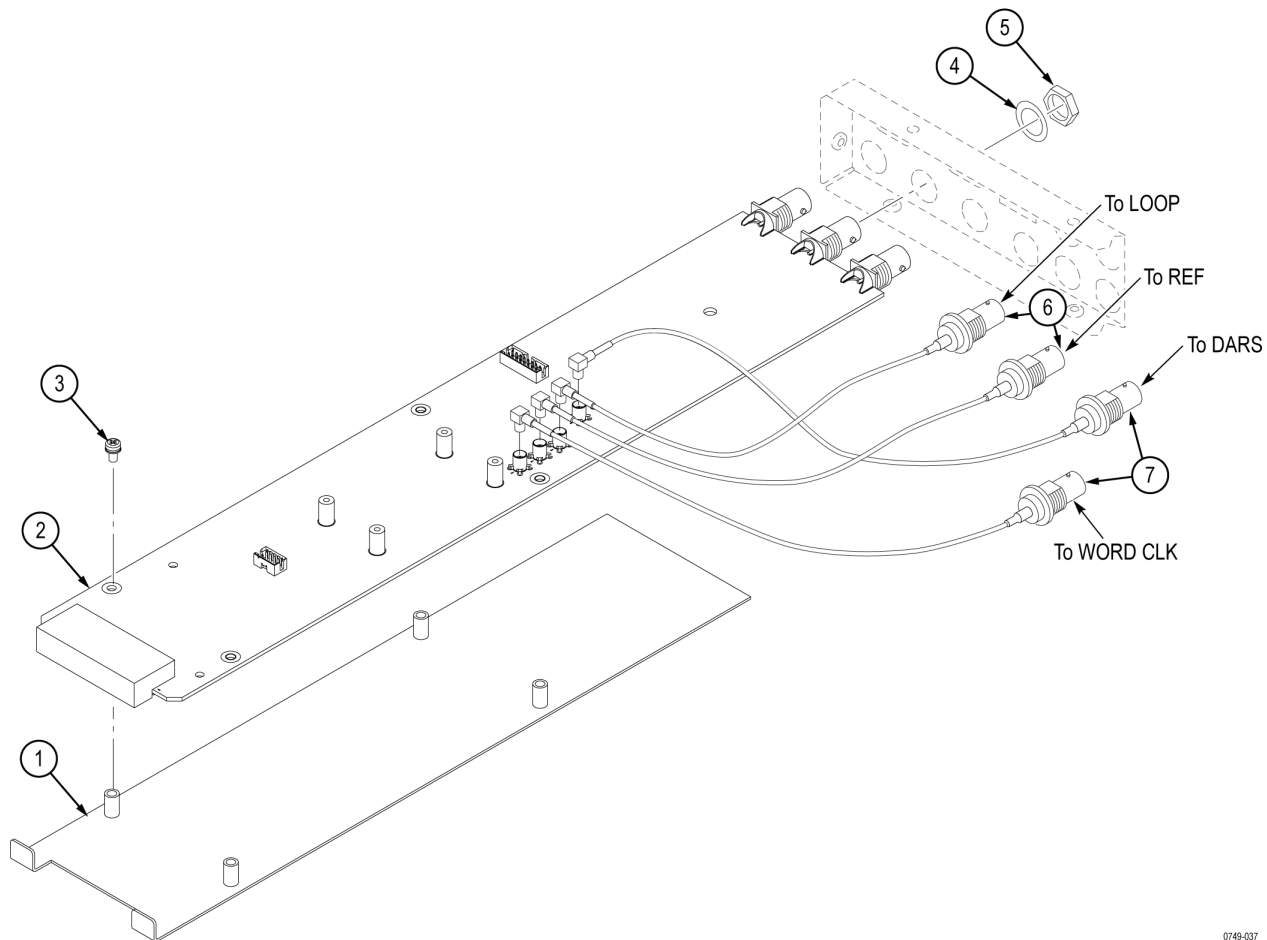


1229-001

Figure 24: Front panel assembly exploded view

**Table 26: Genlock/Black board – replaceable parts**

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description
25-1	441-2694-XX			1	MOUNTING PLATE, GPS7
-2	878-1238-XX			1	ASSEMBLY, CIRCUIT BOARD, GPS FPGA
-3	211-A245-XX			4	SCREW, MACHINE; M3 X 6 MM L, PNH, STL, NI PL, CROSS REC, W/PLAIN & SPLIT LOCK WASHER
-4	210-1039-XX			1	WASHER, LOCK INTERNAL TOOTH
-5	220-0497-XX			1	NUT, PLAIN, HEX; 0.5-28 X 0.562 HEX, BRS, NI (NICKEL) PLATED
-6	174-6141-XX			2	CABLE, COAXIAL, MCX TO FEMALE BNC (LENGTH 8 INCHES, 75 OHM)
-7	174-6142-XX			2	CABLE, COAXIAL, MCX TO FEMALE BNC (LENGTH-11 INCHES, 75 OHM)

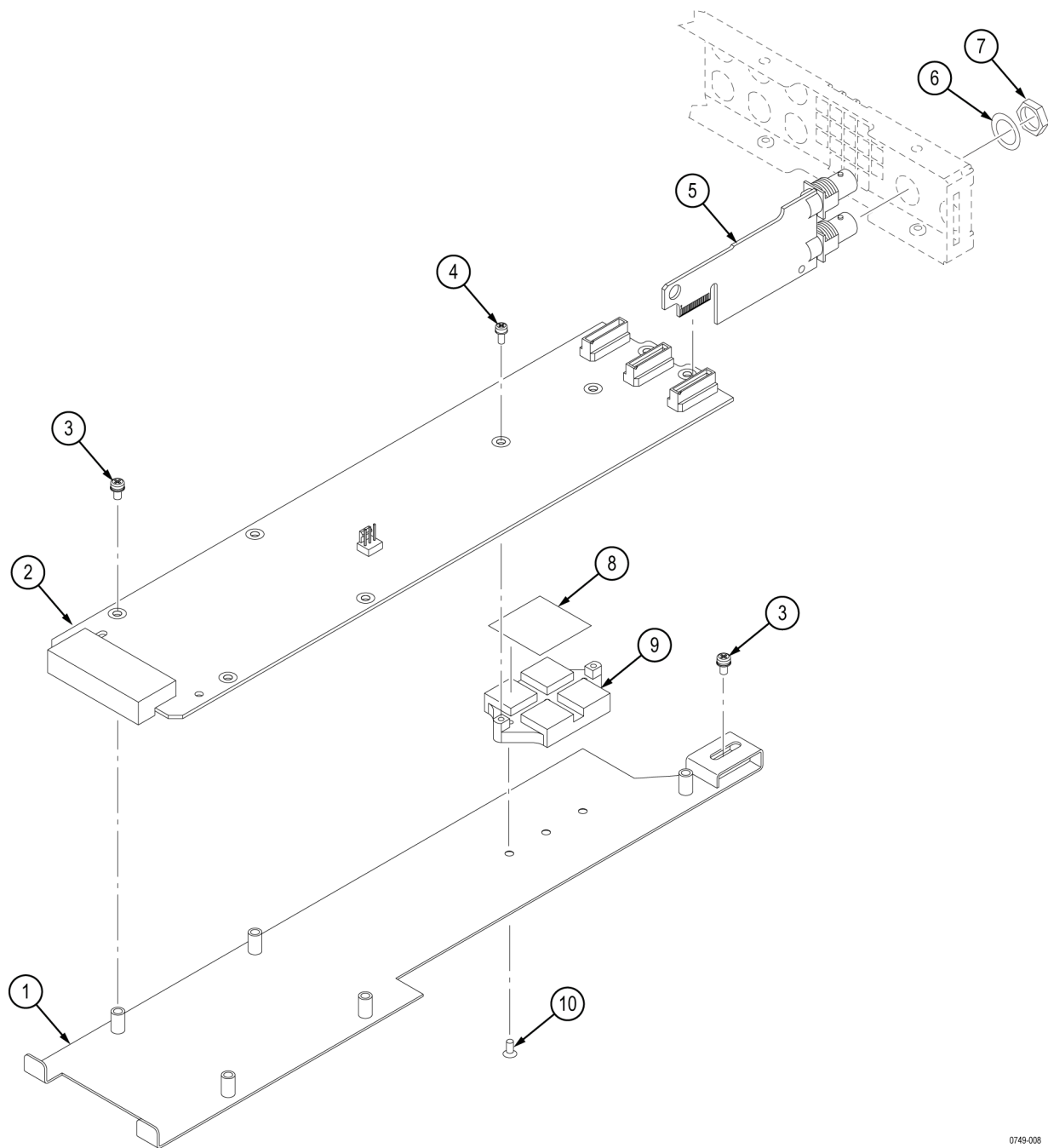


0749-037

**Figure 25: Genlock/Black board exploded view**

Table 27: Option SDI – replaceable parts

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description
26-1	441-2695-XX			1	MOUNTING PLATE, SD17
-2	878-0580-XX			1	CIRCUIT BOARD SUBASSY; TEST SIGNAL GENERATOR
-3	211-A245-XX			5	SCREW, MACHINE; M3 X 6 MM L, PNH, STL, NI PL, CROSS REC, W/PLAIN & SPLIT LOCK WASHER
-4	211-0408-XX			2	SCR, ASSY, WSHR; 4-40 X 0.250, PNH, STEEL, ZINC FINISH, T-10 TORX DR, SEMS
-5	878-0602-XX			2	CIRCUIT BD ASSY; OUTPUT
-6	210-1039-XX			4	WASHER, LOCK INTERNAL TOOTH
-7	220-0497-XX			4	NUT, PLAIN, HEX; 0.5-28 X 0.562 HEX, BRS, NI (NICKEL) PLATED
-8	348-1944-XX			1	GAP PAD 3000S30
-9	214-5166-XX			1	HEATSINK, PCB TO CHASSIS
-10	211-0101-XX			3	SCREW, MACHINE; 4-40 X 0.25, FLH, 100 DEG, ZINC PLATED STEEL, T8



0749-008

Figure 26: Option SDI board and Option SDI Output board exploded view



Table 28: Standard and optional accessories for the SPG700

Component number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description
<b>Standard Accessories</b>					
	351-1137-XX			1	RACK, KIT, RAILS
	071-2746-XX			1	RACKMOUNT KIT INSTRUCTIONS
	071-3480-XX			1	INSTALL/SAFETY INSTRUCTIONS; ENGLISH
	077-1223-XX			1	INSTALL/SAFETY INSTRUCTIONS; JAPANESE
	077-1224-XX			1	INSTALL/SAFETY INSTRUCTIONS; RUSSIAN
	161-0364-XX			1	CABLE ASSY, PWR; 3, 18 AWG, 125 V/10 A, 2M, STR, IEC320, C13, RCPT, NEMA 5-15P, V-LOCK, US, SAFETY CONTROLLED STANDARD
	NA 1			1	D-SUB TO XLR/BNC ADAPTER CABLE (OPTION XLR ONLY)
<b>Power cord options</b>					
	161-0364-XX			1	OPTION A0: NORTH AMERICA CABLE ASSY, PWR; 3, 18 AWG, 125 V/10 A, 2M, STR, IEC320, C13, RCPT, NEMA 5-15P, V-LOCK, US, SAFETY CONTROLLED
	161-0365-XX			1	OPTION A1: UNIVERSAL EURO CABLE ASSY, PWR; 3, 1MM SQ, 250 V/10 A, 2M, STR, IEC320, C13, RCPT, CEE 7 / VII, V-LOCK, EURO, SAFETY CONTROLLED
	161-0366-XX			1	OPTION A2: UNITED KINGDOM CABLE ASSY, PWR; 3, 1MM SQ, 250 V/10 A, 2M, STR, IEC320, C13, RCPT, BS1363, V-LOCK, UK, SAFETY CONTROLLED
	161-0367-XX			1	OPTION A3: AUSTRALIA CABLE ASSY, PWR; 3, 1MM SQ, 250 V/10 A, 2M, STR, IEC320, C13, RCPT, AS3112, V-LOCK, AUSTRALIA, SAFETY CONTROLLED
	161-0368-XX			1	OPTION A5: SWITZERLAND CABLE ASSY, PWR; 3, 1MM SQ, 250 V/10 A, 2M, STR, IEC320, C13, RCPT, SEV 1011, V-LOCK, SWISS, WITH PARTIALLY INSULATED PINS; SAFETY CONTROLLED; CIQB
	161-0369-XX			1	OPTION A6: JAPAN CABLE ASSY, PWR; 3, 1.25MM SQ, 125 V/12 A, 2M, STR, IEC320, C13, RCPT, JIS 8303, V-LOCK, JAPAN, SAFETY CONTROLLED
	161-0370-XX			1	OPTION A10: CHINA CABLE ASSY, PWR; 3, 1MM SQ, 250 V/10 A, 2M, STR, IEC320, C13, RCPT, GB 2099, V-LOCK, CHINA, SAFETY CONTROLLED
	161-0400-XX			1	OPTION A11: INDIA CABLE ASSY, PWR; 3, 1.0 MM SQ, 250 V/6 A, 2.5 METER, STR, IEC320/C13, RCPT, PLUG, INDIA
	161-0356-XX			1	OPTION A12: BRAZIL CABLE ASSY, PWR; 3, 1.00MM SQ, 250 V/10 A, 2.5 METER, RT ANGLE, IEC320/C13 CERTIFICATION, RCPT, BRAZIL, SAFETY CONTROLLED

<sup>1</sup> For a replacement cable, order SPG70UP Option XLR.

