

# Instruction Manual



**2706**  
**RF Preselector**  
**070-8545-02**

**Warning**

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

**[www.tektronix.com](http://www.tektronix.com)**

Copyright © Tektronix, Inc. All rights reserved.

Tektronix products are covered by U.S. and foreign patents, issued and pending. Information in this publication supercedes that in all previously published material. Specifications and price change privileges reserved.

Tektronix, Inc., P.O. Box 500, Beaverton, OR 97077

TEKTRONIX and TEK are registered trademarks of Tektronix, Inc.

## WARRANTY

Tektronix warrants that this product will be free from defects in materials and workmanship for a period of one (1) year from the date of shipment. If any such product proves defective during this warranty period, Tektronix, at its option, either will repair the defective product without charge for parts and labor, or will provide a replacement in exchange for the defective product.

In order to obtain service under this warranty, Customer must notify Tektronix of the defect before the expiration of the warranty period and make suitable arrangements for the performance of service. Customer shall be responsible for packaging and shipping the defective product to the service center designated by Tektronix, with shipping charges prepaid. Tektronix shall pay for the return of the product to Customer if the shipment is to a location within the country in which the Tektronix service center is located. Customer shall be responsible for paying all shipping charges, duties, taxes, and any other charges for products returned to any other locations.

This warranty shall not apply to any defect, failure or damage caused by improper use or improper or inadequate maintenance and care. Tektronix shall not be obligated to furnish service under this warranty a) to repair damage resulting from attempts by personnel other than Tektronix representatives to install, repair or service the product; b) to repair damage resulting from improper use or connection to incompatible equipment; or c) to service a product that has been modified or integrated with other products when the effect of such modification or integration increases the time or difficulty of servicing the product.

**THIS WARRANTY IS GIVEN BY TEKTRONIX WITH RESPECT TO THIS PRODUCT IN LIEU OF ANY OTHER WARRANTIES, EXPRESSED OR IMPLIED. TEKTRONIX AND ITS VENDORS DISCLAIM ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. TEKTRONIX' RESPONSIBILITY TO REPAIR OR REPLACE DEFECTIVE PRODUCTS IS THE SOLE AND EXCLUSIVE REMEDY PROVIDED TO THE CUSTOMER FOR BREACH OF THIS WARRANTY. TEKTRONIX AND ITS VENDORS WILL NOT BE LIABLE FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES IRRESPECTIVE OF WHETHER TEKTRONIX OR THE VENDOR HAS ADVANCE NOTICE OF THE POSSIBILITY OF SUCH DAMAGES.**

# Contents

<b>List of Figures</b> .....	<b>ii</b>
<b>List of Tables</b> .....	<b>ii</b>
<b>Preface</b> .....	<b>iii</b>
Welcome .....	iii
About this Manual .....	iii
What you Need to Know .....	iv
How to Use This Manual .....	iv
Manual Conventions .....	v
Contacting Tektronix .....	v
<b>General Safety Summary</b> .....	<b>vii</b>
<b>Service Safety Summary</b> .....	<b>ix</b>

## User Information

<b>Introduction</b> .....	<b>1-1</b>
Preselector Controls and Connectors .....	1-1
What you Need to Use the Preselector .....	1-2
<b>Using the Preselector</b> .....	<b>2-1</b>
Manual Operation .....	2-1
Remote Operation .....	2-1
GPIB Common and Device Commands .....	2-3

## Service Information

<b>Performance Verification</b> .....	<b>3-1</b>
Performance Verification Procedure .....	3-1
Troubleshooting .....	3-2
Replacing the Fuse .....	3-3
<b>Applications</b> .....	<b>4-1</b>
EMI Testing .....	4-1
Susceptibility Testing .....	4-2
Benchtop Analysis .....	4-2

## Appendixes

<b>Appendix A: Specifications</b> .....	<b>A-1</b>
Electrical Specifications .....	A-1
Mechanical Specifications .....	A-2
Environmental Specifications .....	A-2
Certifications and Compliances .....	A-3
<b>Appendix B: Using the GPIB Interface</b> .....	<b>B-1</b>
Interface Compatibility .....	B-1
Controller Commands .....	B-2
Sample Program .....	B-3
GPIB Commands .....	B-5

<b>Appendix C: Options</b> .....	<b>C-1</b>
Power Cord Options .....	C-1
Option 01 .....	C-1
<b>Appendix D: Parts List</b> .....	<b>D-1</b>
Standard Accessories .....	D-1
Options .....	D-1
<b>Appendix E: Repackaging for Shipment</b> .....	<b>E-1</b>

## List of Figures

<b>Figure 1-1: The Preselector's Front Panel</b> .....	<b>1-1</b>
<b>Figure 1-2: The Preselector's Rear Panel</b> .....	<b>1-2</b>
<b>Figure 3-1: The fuse location</b> .....	<b>3-4</b>

## List of Tables

<b>Table 2-1: Commands Supported by the Preselector</b> .....	<b>2-3</b>
<b>Table A-1: Preselector Band Related Specifications</b> .....	<b>A-1</b>
<b>Table A-2: Certifications and compliances</b> .....	<b>A-3</b>

# Preface

This preface describes the features of the Tektronix 2706 stepped Radio Frequency Preselector. It also tells you how to use this manual and what you should know before you use the Preselector.

## Welcome

Congratulations on your purchase of a 2706 RF Preselector. This instrument improves the flexibility and accuracy of your spectrum analyzer measurements, and is especially useful for EMI applications.

Some of the outstanding characteristics of the Preselector are:

- Multiple filters – the Preselector has 7 bandpass filter steps covering the range from 9 kHz to 1000 MHz, and a high-pass filter covering the range from 1000 MHz to 1800 MHz.
- Reduced distortion – the Preselector limits potentially distorting input to a spectrum analyzer by attenuating signals outside the frequency range of interest.
- Increased broadband dynamic range – the Preselector increases sensitivity to low-level signals by attenuating strong signals outside the frequency range of interest.
- Manual or remote operation – you can operate the Preselector using its front-panel controls or a GPIB equipped controller or computer.
- Bypass mode – you can remove the Preselector from the testing circuit without disconnecting it.
- Convenient installation – the Preselector mounts below Tektronix 271X-Series Spectrum Analyzers with the optional mounting plate and rigid coaxial cable assembly (see the Parts List in Appendix D).

## About this Manual

This manual contains the following sections:

- Chapter 1, “Introduction,” lists the features of the Tektronix 2706 RF Preselector and what you need to use the Preselector.
- Chapter 2, “Using the Preselector,” describes how to control the Preselector manually or using a GPIB controller.

- Chapter 3, “Performance Verification,” tells you how to check that the Preselector is operating within specification, and how to troubleshoot problems with the Preselector.
- Chapter 4, “Applications,” describes ways you can use the Preselector.
- Appendix A, “Specifications,” lists the electrical, environmental, and mechanical specifications of the Preselector.
- Appendix B, “Using the GPIB Interface,” describes in detail the commands you use to operate the Preselector remotely.
- Appendix C, “Options,” describes in detail the power cord and extended service options of the Preselector.
- Appendix D, “Parts List,” lists the part numbers of the standard and optional Preselector accessories.
- Appendix E, “Repackaging for Shipment,” describes how to package the Preselector for shipment.

## What you Need to Know

To use this manual, you need to know two things:

- How to operate a spectrum analyzer.
- The basic concepts of signal analysis.

If you plan to operate the Preselector remotely, you also need to know how to use your GPIB controller.

## How to Use This Manual

This manual is designed to help you learn to use the Preselector quickly and easily.

Follow these steps to use this manual:

1. Read the rest of this preface.
2. Read Chapter 1, “Introduction,” for an overview of the Preselector’s features.
3. Follow the instructions in Chapter 2, “Using the Preselector,” to learn how to use the Preselector.
4. Use Chapter 3, “Performance Verification,” and Appendix A, “Specifications,” to check that the Preselector is working correctly.

5. Use Chapter 4, “Applications,” to see ways you can use the Preselector.
6. If you plan to operate the Preselector from a GPIB controller, use Appendix B, “Using the GPIB Interface.”

## Manual Conventions

To make this manual easier to use, text is shown in several type styles:

- References to other manuals or documents are in *italics*: *ANSI/IEEE Std 488.2–1987*.
- Command names, and panel and cable labels are in **bold type**.
- Text that you type into a GPIB controller is in `single space type`.

## Contacting Tektronix

Product Support	<p>For questions about using Tektronix measurement products, call toll free in North America: 1-800-833-9200 6:00 a.m. – 5:00 p.m. Pacific time</p> <p>Or contact us by e-mail: tm_app_supp@tek.com</p> <p>For product support outside of North America, contact your local Tektronix distributor or sales office.</p>
Service support	<p>Tektronix offers a range of services, including Extended Warranty Repair and Calibration services. Contact your local Tektronix distributor or sales office for details.</p> <p>For a listing of worldwide service centers, visit our web site.</p>
Toll-free Number	<p>In North America: 1-800-833-9200 An operator can direct your call.</p>
Postal Address	<p>Tektronix, Inc. Department or name (if known) P.O. Box 500 Beaverton, OR 97077 USA</p>
Web site	<p>www.tektronix.com</p>





# General Safety Summary

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

*Only qualified personnel should perform service procedures.*

While using this product, you may need to access other parts of the system. Read the *General Safety Summary* in other system manuals for warnings and cautions related to operating 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.

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

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

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

Connect the ground lead of the probe to earth ground only.

Do not apply a potential to any terminal, including the common terminal, that exceeds the maximum rating of that terminal.

**Do Not Operate Without Covers.** Do not operate this product with covers or panels removed.

**Use Proper Fuse.** Use only the fuse type and rating specified for this product.

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

**Do Not Operate With Suspected Failures.** If you suspect there is damage to this product, have it inspected by qualified service personnel.

**Do Not Operate in Wet/Damp Conditions.**

**Do Not Operate in an Explosive Atmosphere.**

**Keep Product Surfaces Clean and Dry.**

**Provide Proper Ventilation.** Refer to the manual's installation instructions for details on installing the product so it has proper ventilation.

## Symbols and Terms

**Terms in this Manual.** These terms may appear in this manual:



---

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

---



---

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

---

**Terms on the Product.** These terms may appear on the product:

DANGER indicates an injury hazard immediately accessible as you read the marking.

WARNING indicates an injury hazard not immediately accessible as you read the marking.

CAUTION indicates a hazard to property including the product.

**Symbols on the Product.** The following symbols may appear on the product:



# Service Safety Summary

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

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

**Disconnect Power.** To avoid electric shock, switch off the instrument power, then disconnect the power cord from the mains power.

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

To avoid electric shock, do not touch exposed connections.





# User Information

# Introduction

This chapter describes the features of the Tektronix 2706 RF Preselector and what you need to use it.

## Preselector Controls and Connectors

This section presents a brief tour of the Preselector controls and connectors.

**Front Panel** The Preselector front panel has the following controls:

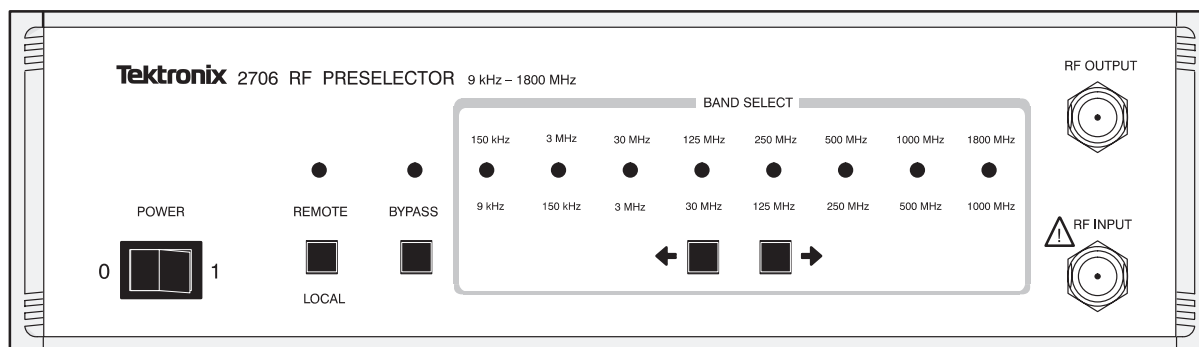


Figure 1-1: The Preselector's Front Panel

- **POWER** switch – this turns instrument operating power on (1) or off (0).
- **REMOTE/LOCAL** switch – this transfers control of the Preselector from remote (GPIB controlled) mode to local (manually controlled) mode. The **REMOTE** LED lights when remote mode is selected.
- **BYPASS** switch – this disconnects all Preselector filters so that the entire RF signal is sent directly to the spectrum analyzer. The **BYPASS** LED lights when bypass mode is selected.
- **BAND SELECT** <- and -> switches – these select the signal routing band from among 7 bandpass filters and a high-pass filter. An LED lights on the front panel to indicate the selected filter.
- **RF INPUT** – this connects the Preselector to the signal source using a type N plug.
- **RF OUTPUT** – this connects the preselected output to the spectrum analyzer using a type N plug.

**Rear Panel** The Preselector rear panel has these connectors and switches:

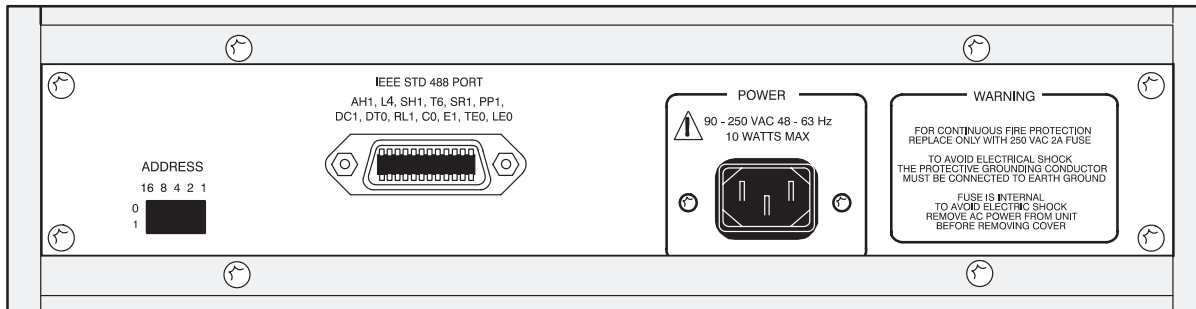


Figure 1-2: The Preselector's Rear Panel

- **IEEE STD 488 PORT** – this connects the Preselector to a controller.
- **ADDRESS** switch – this selects the GPIB address for the Preselector.
- **POWER** – this plugs the Preselector into the AC power source (90–250 VAC, 48–63 Hz).

## What you Need to Use the Preselector

To use the Preselector, you need the following:

- an RF signal source, such as an antenna or test device (Chapter 4, “Applications,” describes example setups)
- a spectrum analyzer, such as the Tektronix 271X–, 278X–, or 279X–Series (or equivalent)
- two RF connecting cables with type N connectors or adapters

If you will operate the Preselector remotely, you will also need the following:

- an IEEE STD 488 GPIB 24-pin cable with a D-type shell (Tektronix part number 012–0991–00)
- an IEEE–488 GPIB controller, or an IBM PC/AT or compatible 80386 (or better) personal computer with a National Instruments PCII/IIA type card and communications drivers
- a copy of the Tektronix S26EM12 Commercial EMI Test Software (optional)



# Using the Preselector

This chapter describes how to operate the Preselector manually or with a GPIB controller.

## Manual Operation

This section tells you how to use the Preselector manually by using its front-panel controls.

Use the Preselector as follows:

1. Plug the Preselector into a power source (90–250 VAC, 48–63 Hz).
2. Connect the spectrum analyzer input to the **RF OUTPUT** connector on the Preselector's front panel.
3. Turn on the Preselector. The front-panel LEDs will light sequentially. When the **BYPASS** LED lights, the unit is ready to use.

---

***NOTE.** If any of the LEDs do not light, refer to Chapter 3, Performance Verification.*

---

4. Turn on the spectrum analyzer.
5. Use the **BAND SELECT** <- and -> switches to select the filter you want. The Preselector will pass the frequency range printed above and below the lit LED.
6. Connect the RF source to the **RF INPUT** connector on the Preselector's front panel.

The Preselector is now ready for operation.

## Remote Operation

This section tells you how to operate the Preselector remotely with a controller or computer that uses the IEEE Standard 488.2-1987 (GPIB) interface.

The smallest GPIB network that you can use is a Preselector and a controller; you will also probably connect a spectrum analyzer to the network.

---

**NOTE.** *To operate the Preselector remotely, you need to consult the documentation for your controller to determine how to send commands and interpret received messages in your controller's programming language.*

---

Use the Preselector remotely as follows:

1. Plug the Preselector into a power source (90–250 VAC, 48–63 Hz).
2. Connect the spectrum analyzer input to the **RF OUTPUT** connector on the Preselector's front panel.
3. Connect a GPIB 24-pin cable to the **IEEE STD 488 PORT** connector on the rear panel of your Preselector and to the GPIB network.
4. Verify that the bus address on the rear-panel **ADDRESS** switch is not used by any other device on the network. If the address is used by another device, use the switch to select a new address. The Preselector will use the new address when it is turned on.
5. To make sure that your GPIB network will operate reliably, verify that:
  - Each device on the network has a unique device address.
  - The network has fewer than 16 devices.
  - No more than 2 meters (6 feet) of cable separates any two devices, and that the entire network uses less than 20 meters (65 feet) of GPIB cable.
  - At least two-thirds of the devices on the network are turned on when the network is operating.
  - The network uses a star or linear configuration, not a loop or parallel configuration.
6. Turn on the Preselector. The front-panel LEDs will light sequentially. When the **BYPASS** LED lights, the unit is ready to use.

---

**NOTE.** *If the LEDs do not light, refer to Chapter 3, Performance Verification.*

*Pressing the **REMOTE/LOCAL** switch will not turn on remote operation; it only turns remote operation off.*

---

7. Turn on the spectrum analyzer.
8. Turn on the controller and start the GPIB communications software.
9. Connect the RF source to the **RF INPUT** connector on the Preselector's front panel.

The Preselector is now ready for remote operation. You can operate it by using a controller to send commands described in the following *GPIB Common and Device Commands* section.

Refer to Appendix B, *Using the GPIB Interface*, and your controller's operating manual for detailed information about sending GPIB commands.

## GPIB Common and Device Commands

This section briefly lists the common and device commands used to operate the Preselector from a remote GPIB controller. Appendix B, *Using the GPIB Interface*, contains a detailed, alphabetical listing of these commands and provides an example program.

Common commands (preceded by an asterisk in Table 2.1) are used by all devices that meet IEEE Std. 488.2-1987. Device commands (listed without an asterisk in Table 2.1) are specific to the Preselector and are defined only in this manual. The Preselector has two device commands: **B** and **STS?**.

---

**NOTE.** *You do not need to use timing commands such as \*WAI, \*OPC, and \*OPC? with the Preselector. For example, the \*WAI command normally prevents a GPIB device from executing commands until all pending operations finish. Because the Preselector executes commands sequentially, the \*WAI command always continues immediately.*

---

**Table 2-1: Commands Supported by the Preselector**

Name	Full Command Title
B<NR1>	Select band filter (NR1 stands for an integer from 0 to 8)
*CLS	Clear Status
*ESE and *ESE?	Standard Event Status Enable
*ESR?	Standard Event Status Register Query
*IDN?	Identification Query
*IST?	Individual Status Query
*OPC and *OPC?	Operation Complete
*PRE and *PRE?	Parallel Poll Register Enable
*RST	Reset
*SRE and *SRE?	Service Request Enable
*STB?	Read Status Byte
STS?	Status Selected Band Query

**Table 2-1: Commands Supported by the Preselector (Cont.)**

Name	Full Command Title
*TST?	Self-Test
*WAI	Wait To Continue

**WARNING**

*The following servicing instructions are for use only by qualified personnel. To avoid injury, do not perform any servicing other than that stated in the operating instructions unless you are qualified to do so. Refer to all safety summaries before performing any service.*





# Service Information

# Performance Verification

This chapter describes how to check that the Preselector is operating within specification and how to troubleshoot simple problems the Preselector may have.

## Performance Verification Procedure

To verify that your Preselector is operating within specification, you need:

- a spectrum analyzer with a tracking generator, such as the Tektronix 2712 (or equivalent)
- two RF connecting cables with type N connectors or adapters

Test the Preselector as follows:

1. Plug the Preselector into a power source (90–250 VAC, 48–63 Hz).
2. Connect the spectrum analyzer input to the **RF OUTPUT** connector on the Preselector's front panel.
3. Connect the spectrum analyzer's tracking generator output to the **RF INPUT** connector on the Preselector's front panel.
4. Turn on the Preselector. The front-panel LEDs will light sequentially. When the **BYPASS** LED lights, the unit is ready to use.

---

***NOTE.** If any of the LEDs do not light, refer to the troubleshooting section that follows this procedure.*

---

5. Turn on the spectrum analyzer.
6. Set the spectrum analyzer controls as follows:
  - Reference level =  $-10$  dBm
  - Vertical scale = 5 dB/div
  - Tracking generator = On
  - Tracking generator output level =  $-20$  dBm
7. Select **Frequency Start/Stop** from the spectrum analyzer's **Mkr/Freq Menu**.
8. Leave the start frequency at the 0 Hz default value.

9. Enter the stop frequency from the table below.

Preselector band	Stop frequency
9 kHz – 150 kHz	400 kHz
150 kHz – 3 MHz	10 MHz
3 MHz – 30 MHz	50 MHz
30 MHz – 125 MHz	300 MHz
125 MHz – 250 MHz	300 MHz
250 MHz – 500 MHz	1.8 GHz
500 MHz – 1 GHz	1.8 GHz
1 GHz – 1.8 GHz	1.8 GHz

10. Use the Preselector **BYPASS** switch to select bypass mode.
11. Verify that the tracking generator reference trace is at  $-20$  dBm. The flat output signal from the tracking generator should be one major division below the top of the display.
- Use the **Demod/TG Menu** to adjust the tracking generator if necessary in the lower bands.
12. Store the display in register A.
13. Use the **BAND SELECT** <- and -> switches to select the filter corresponding to the stop frequency you selected.
14. Read the frequency response and insertion loss from the spectrum analyzer's screen. If the values exceed those in *Appendix A, Specifications*, ship the Preselector to your nearest Tektronix service center (follow the Repackaging for Shipment Instructions in Appendix E).
15. Repeat steps 7 to 14 for each of the Preselector's bands.

The Preselector has now passed its performance test.

## Troubleshooting

Follow these instructions if the Preselector does not turn on or select RF bands correctly:

1. Check that all cables are connected correctly to the Preselector.
2. Check that power is available.



3. Turn on the Preselector. If the Preselector does not turn on, have qualified personnel replace the fuse as described in “Replacing the fuse,” later in this section.
4. All the LEDs should light at least once during the power-on test. If some of the LEDs do not light, or the Preselector does not finish its test with the **BYPASS** LED lit, or the Preselector does not otherwise work correctly, ship it to your nearest Tektronix service center (follow the Repackaging for Shipment Instructions in Appendix E).

## Replacing the Fuse

The fuse is located on the power supply board inside the Preselector. This procedure assumes that the rear panel of the Preselector is closest to you.

Replace the fuse as follows:

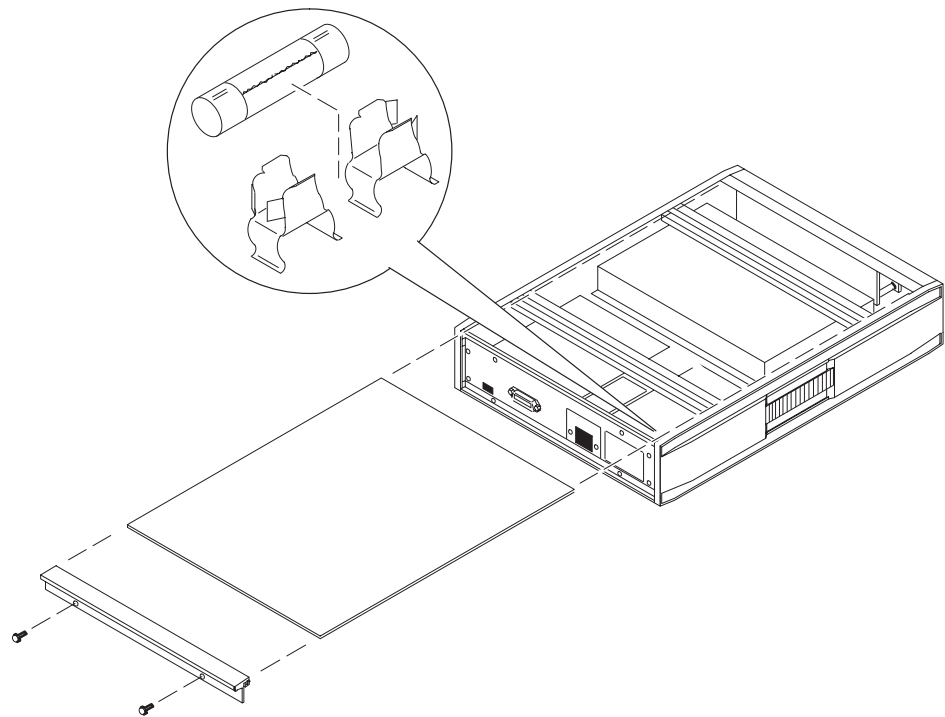


---

**WARNING.** To avoid injury, unplug the Preselector before replacing the fuse.

---

1. Disconnect the Preselector power cord.
2. Remove the two upper screws on the rear panel that hold the top panel to the Preselector cabinet.
3. Firmly grip the top cover and slide it toward the rear of the cabinet.
4. Find fuse holder **F1** on the power supply, as shown in Figure 3.1.



**Figure 3-1: The fuse location**

5. Using needle-nose pliers, gently pull out the fuse.



---

**CAUTION.** To avoid the risk of fire, replace a damaged fuse only with a fuse of the specified type and rating.

---

6. Replace the fuse with a 250 VAC 2 A model 3AG Med-Blo fuse.
7. Seat all ribbon cables by pressing firmly on all the connectors.
8. Slide the top panel back onto the cabinet.
9. Replace the two screws on the rear panel.
10. Plug the Preselector back in.

The Preselector is now ready for use.

# Applications

This chapter briefly describes several applications that can benefit from using the Preselector.

These include:

- Electromagnetic interference (EMI) testing
- Susceptibility testing
- Benchtop analysis

In each case, you can use the Preselector manually or remotely (with a controller connected to the IEEE-488 GPIB interface).

## EMI Testing

The Preselector can increase the accuracy of your EMI compliance tests for standards such as:

- FCC regulations (USA)
- CENELEC regulations (EC)
- VDE regulations (Germany)
- CISPR (International)
- VCCI standards (Japan)
- MIL-STD-461/462

## Measuring Conducted EMI Emissions

The Preselector can help your spectrum analyzer measure EMI conducted out of a device by attenuating strong signals outside the band of interest.

Use a Line Impedance Stabilization Network (LISN) for conducted emissions tests.



---

**CAUTION.** To avoid damage to the spectrum analyzer, always use a transient limiter with the LISN. Connect the transient limiter between the LISN and the Preselector. The Preselector alone cannot protect the spectrum analyzer from power surges.

---

A LISN provides a known source impedance for the connected power line and provides access to the RF signals of the device under test.

## Radiated EMI Testing

The Preselector, with appropriate antennas and other equipment, can help your spectrum analyzer measure EMI radiated from a particular device. The Preselector attenuates radio and television transmissions and other RF interference outside the range of interest. Test setups use one of three basic antenna types:

- tuned dipole: used to measure radiated EMI in the 30 MHz to 1000 MHz range. Different baluns and adjustable dipole elements cover the entire frequency range.
- biconical: used to measure horizontal and vertical polarization of radiated EMI in the 30 MHz to 300 MHz range. Use a biconical antenna (Tektronix part number 119-4148-00 or equivalent).
- log periodic: used to measure horizontal and vertical polarization of radiated EMI in the 200 MHz to 1000 MHz range. Use a log periodic antenna (Tektronix part number 119-4142-00 or equivalent).

Once you determine the frequency and strength of the radiated EMI, you can take appropriate corrective action or note the results for specifications.

## Susceptibility Testing

A spectrum analyzer, with the Preselector, can monitor field strengths during susceptibility testing.



---

**CAUTION.** To avoid damage to the Preselector and your spectrum analyzer, do not connect signals higher than +20 dBm or 50 VDC to the Preselector.

---

## Benchtop Analysis

The Preselector can improve the frequency response measurement of a circuit or devices such as cables, mixers, amplifiers, and IF bandwidth chains by passing only the frequencies you want to the spectrum analyzer. (This is especially useful if you are using a broad-band noise source.)



# Appendices

# Appendix A: Specifications

This appendix describes the electrical, mechanical, and environmental specifications of the Tektronix 2706 RF Preselector.

## Electrical Specifications

<b>A-1</b>	Range:	9 kHz to 1800 MHz
	Insertion loss (max):	2.0 dB
<b>Filters</b>	Frequency Range:	9 kHz to 1800 MHz
	Bandpass/high-pass flatness:	1.5 dB max

**Table A-1: Preselector Band Related Specifications**

Band	Bandpass	Nominal loss	-6.0 dB bandpass (typical)	-40 dB bandpass (typical)
1	9 kHz – 150 kHz	2.0 dB max	6.2 kHz – 220 kHz	3.2 kHz – 440 kHz
2	150 kHz – 3.0 MHz	2.0 dB max	90 kHz – 4.5 MHz	50 kHz – 9.0 MHz
3	3 MHz – 30 MHz	2.0 dB max	2.5 MHz – 35 MHz	1.6 MHz – 45 MHz
4	30 MHz – 125 MHz	2.0 dB max	23 MHz – 145 MHz	12 MHz – 260 MHz
5	125 MHz – 250 MHz	1.5 dB $\pm$ 1.0 dB	110 MHz – 280 MHz	100 MHz – 340 MHz
6	250 MHz – 500 MHz	2.0 dB $\pm$ 1.0 dB	225 MHz – 600 MHz	150 MHz – 950 MHz
7	500 MHz – 1000 MHz	2.0 dB $\pm$ 1.0 dB	400 MHz – 1190 MHz	225 MHz – 1400 MHz
8	1000 MHz – 1800 MHz	4.0 dB $\pm$ 1.0 dB	775 MHz	350 MHz

RF input/output connectors:	Type N
Input/output impedance:	50 $\Omega$ nominal
VSWR (max):	1.8:1
Ultimate rejection, stop band:	60 dB typical 40 dB min <500 MHz 30 dB min >500 MHz
Maximum input:	+20 dBm, 50 VDC
Switching speed (max):	10 ms

GPIB interface:	Meets IEEE Std. 488.2–1987
GPIB interface supports:	AH1, L4, SH1, T6, SR1, PP1, DC1, DT0, RL1,C0, E1, TE0, and LE0
Input Voltage:	90/250 VAC, 48 – 63 Hz, 10 W

## Mechanical Specifications

Dimensions (H x W x D):	88 mm x 327 mm x 431 mm (3.46 in x 12.87 in x 16.97 in)
Weight:	5.9 kg (13 lbs)

## Environmental Specifications

Temperature, operating:	0°C to 50°C (32°F to 122°F)
Temperature, storage:	–40°C to 75°C (–40°F to 167°F)
Humidity, storage:	Five cycles (120 hrs) per MIL–T–28800C, Class 5
Vibration:	Meets MIL–T–28800C Method 514 Procedure (modified)
Shock, operating and storage:	Three guillotine-type shocks of 30 g, one-half sine, 11 ms duration each direction along each major axis; total of 18 shocks

## Certifications and Compliances

Table A-2: Certifications and compliances

Category	Standards or description
EC Declaration of Conformity – EMC	<p>Meets intent of Directive 89/336/EEC for Electromagnetic Compatibility. Compliance was demonstrated to the following specifications as listed in the Official Journal of the European Union:</p> <p>EN 50081-1 Emissions:  EN 55022                      Class B Radiated and Conducted Emissions  EN 60555-2                    AC Power Line Harmonic Emissions</p> <p>EN 50082-1 Immunity:  IEC 801-2                      Electrostatic Discharge Immunity  IEC 801-3                      RF Electromagnetic Field Immunity  IEC 801-4                      Electrical Fast Transient/Burst Immunity</p> <p>High quality shielded cables must be used to ensure compliance to the above listed standards.</p>
FCC Compliance	Emissions comply with FCC Code of Federal Regulations 47, Part 15, Subpart B, Class A Limits.
Installation (Overvoltage) Category	<p>Terminals on this product may have different installation (overvoltage) category designations. The installation categories are:</p> <p>CAT III    Distribution-level mains (usually permanently connected). Equipment at this level is typically in a fixed industrial location.</p> <p>CAT II    Local-level mains (wall sockets). Equipment at this level includes appliances, portable tools, and similar products. Equipment is usually cord-connected.</p> <p>CAT I    Secondary (signal level) or battery operated circuits of electronic equipment.</p>
Pollution Degree	<p>A measure of the contaminates that could occur in the environment around and within a product. Typically the internal environment inside a product is considered to be the same as the external. Products should be used only in the environment for which they are rated.</p> <p>Pollution Degree 1                      No pollution or only dry, nonconductive pollution occurs. Products in this category are generally encapsulated, hermetically sealed, or located in clean rooms.</p> <p>Pollution Degree 2                      Normally only dry, nonconductive pollution occurs. Occasionally a temporary conductivity that is caused by condensation must be expected. This location is a typical office/home environment. Temporary condensation occurs only when the product is out of service.</p> <p>Pollution Degree 3                      Conductive pollution, or dry, nonconductive pollution that becomes conductive due to condensation. These are sheltered locations where neither temperature nor humidity is controlled. The area is protected from direct sunshine, rain, or direct wind.</p> <p>Pollution Degree 4                      Pollution that generates persistent conductivity through conductive dust, rain, or snow. Typical outdoor locations.</p>



**Table A-2: Certifications and compliances (cont.)**

Category	Standards or description
Safety Standards	
U.S. Nationally Recognized Testing Laboratory Listing	UL1244 Standard for electrical and electronic measuring and test equipment.
Canadian Certification	CAN/CSA C22.2 No. 231 CSA safety requirements for electrical and electronic measuring and test equipment.
European Union Compliance	Low Voltage Directive 73/23/EEC, amended by 93/69/EEC EN 61010-1 Safety requirements for electrical equipment for measurement, control, and laboratory use.
Additional Compliance	IEC61010-1 Safety requirements for electrical equipment for measurement, control, and laboratory use.
Safety Certification Compliance	
Temperature, operating	+5 to +40° C
Altitude (maximum operating)	2000 meters
Equipment Type	Test and measuring
Safety Class	Class 1 (as defined in IEC 1010-1, Annex H) – grounded product
Overvoltage Category	Overvoltage Category II (as defined in IEC 1010-1, Annex J)
Pollution Degree	Pollution Degree 2 (as defined in IEC 1010-1). Note: Rated for indoor use only.

# Appendix B: Using the GPIB Interface

This appendix describes the GPIB commands that you can use to control the Preselector.

To run the Preselector automatically from a controller, you can either write your own software or use commercial software.

## Interface Compatibility

GPIB controllers such as the National Instruments PCII/IIA with communications drivers are compatible with the Preselector's GPIB interface. If you are building or programming your own interface, refer to the Capability Identification Codes section in the *ANSI/IEEE Std 488.2-1987 Handbook* for detailed information about the Preselector's GPIB capabilities.

The Preselector GPIB interface meets the compatibility requirements of the IEEE codes listed below. (These codes are also marked below the **IEEE STD 488 PORT** on the rear panel.)

<b>Capability Code</b>	<b>Meaning</b>
AH1:	Acceptor Handshake Capability
L4:	Listener (Basic Listener, Unaddressed To Listen On TAG) Capability
SH1:	Source Handshake Capability
T6:	Talker (Basic Talker, Serial Poll, Unaddressed To Talk On LAG) Capability
SR1:	Service Request Capability
PP1:	Parallel Poll Capability (Remote Configuration)
DC1:	Device Clear Capability
DT0:	No Device Trigger Capability
RL1:	Remote/Local Capability
C0:	No Controller Capability
E1:	Open Collector Bus Drivers
TE0:	No Extended Talker Capabilities
LE0:	No Extended Listener Capabilities

## Controller Commands

The Preselector accepts the following commands from any GPIB controller.

### REMOTE Command

To put the Preselector into remote mode, you must use your controller's REMOTE command to set the GPIB REN line. The specific command you use to do this will depend on your controller. If you send the REMOTE command as an addressed command group (UAGC), the Preselector will go into remote mode immediately.

To use a controller while leaving the Preselector in local mode, do not set the REN line. The Preselector will then accept commands from the controller but remain in local mode.

The Preselector lights the front-panel **REMOTE** LED to indicate that it is in remote mode.

### LOCAL LOCKOUT Command

All Preselector switches, with the exception of the power switch, can be locked out (made inoperative) by having your controller set the GPIB LOCAL LOCKOUT state. Short of turning the Preselector off and on, or removing the GPIB cable, the only way to cancel LOCAL LOCKOUT is to use your controller's equivalent of the GO TO LOCAL command.

---

**NOTE.** Put the Preselector into remote mode before using LOCAL LOCKOUT, or you will not be able to control the Preselector manually or remotely.

Pressing the **REMOTE/LOCAL** switch will not turn on remote operation; it only turns remote operation off.

---

### Polling Commands

Your controller can periodically check (poll) devices on the GPIB network to see if a particular device needs service, or to determine which device sent a service request (SRQ).

The controller can use a serial poll to access each device on the network individually to read an 8-bit status byte. It then decodes the status byte to find out what type of service the device needs.

The controller can use a parallel poll to quickly check if any devices require service or to determine which device requested service. You can configure the Preselector to respond to any one of 8 data lines during a parallel poll. The Preselector will then assert its assigned data line during a parallel poll if it needs service. If two devices share a data line, a serial poll of each device is necessary to determine which one requires service.

Refer to your controller's manual for more information about GPIB polling.

## Sample Program

The following is a typical program you can use to automatically control your Preselector. This program instructs the Preselector and a Tektronix 271X-Series GPIB compatible spectrum analyzer to scan 40 MHz to 100 MHz, then 150 MHz to 200 MHz. It first selects a Preselector filter, then instructs the spectrum analyzer to scan that frequency range. This operation can be repeated for all eight Preselector filters.

---

**NOTE.** You must correct for the different losses in Preselector filters when you switch between filters. For example, if you switch from band 7 (nominal loss: 2.0 dB,  $\pm 1.0$  dB) to band 8 (nominal loss: 4.0 dB,  $\pm 1.0$  dB) you must increase the spectrum analyzer's gain by 2.0 dB in the *INSERT.LOSS* subroutine at the end of the following program.

---

### Program Listing

```
'--- Set up linkage to spectrum analyzer and initialize
  DEVICE$ = "TEK SA"
  CALL GPIB.CONTROLLER(1) ' identify the device
  CALL GPIB.CONTROLLER(7) ' force timeout to 30 seconds

'--- Initialize the analyzer
  wrt$ = "MXHLD OFF;GRAT ON;REDOUT ON;TRIG FRERUN;VRT LOG:10;VIDFLT
  OFF;VIEW A:OFF,B:ON,C:OFF,D:ON;SAVE A:OFF,B:OFF,C:OFF;"
  CALL GPIB.CONTROLLER(3)

'--- Set Center Frequency
  wrt$ = "FRE 70 MHZ"
  CALL GPIB.CONTROLLER(3)

'--- Set Span
  wrt$ = "SPA 6 MHZ"
  CALL GPIB.CONTROLLER(3)

'--- Set Reference Level
  wrt$ = "REF - 20"
  CALL GPIB.CONTROLLER(3)

'--- Set Resolution Bandwidth
  wrt$ = "RES 120 KHZ"
  CALL GPIB.CONTROLLER(3)

'--- Adjust Preselector to proper band
  DEVICE$ = "PRE SEL"
  CALL GPIB.CONTROLLER(1)
  wrt$ = "B4" 'set PRESELECTOR for 30 MHz to 125 MHz
  CALL GPIB.CONTROLLER(3)
  DEVICE$ = "TEK SA" 're - address analyzer
  CALL GPIB.CONTROLLER(1)
```

```

'--- Set single sweep mode on to begin measurement process
  wrt$ = "SIGSWP;SIGSWP;WAIT;fre?;mxhld on"
  CALL GPIB.CONTROLLER(3)
  CALL GPIB.CONTROLLER(4)

'--- Put spectrum analyzer in free run with max hold
  wrt$ = "tri fre"
  CALL GPIB.CONTROLLER(3)

'--- Make measurement
  GOSUB MAKE.MEASUREMENT

'--- ReSet Center Frequency for next measurement and turn off maxhold
  wrt$ = "mxhld off;FRE 175 MHZ"
  CALL GPIB.CONTROLLER(3)

'--- Set Span
  DEVICES$ = "TEK_SA"
  CALL GPIB.CONTROLLER(1) ' identify the device
  CALL GPIB.CONTROLLER(7) ' force timeout to 30 seconds
  wrt$ = "SPA 5 MHZ"
  CALL GPIB.CONTROLLER(3)

'--- Adjust Preselector to proper band
  DEVICES$ = "PRE SEL"
  CALL GPIB.CONTROLLER(1)
  wrt$ = "B5" 'set PRESELECTOR for 125 MHz to 250 MHz
  CALL GPIB.CONTROLLER(3)
  DEVICES$ = "TEK SA" 're - address analyzer
  CALL GPIB.CONTROLLER(1)

'--- Set single sweep mode on to begin measurement process
  wrt$ = "SIGSWP;SIGSWP;WAIT;fre?;mxhld on"
  CALL GPIB.CONTROLLER(3)
  CALL GPIB.CONTROLLER(4)

'--- Replace spectrum analyzer into free run with max hold on
  wrt$ = "tri fre"
  CALL GPIB.CONTROLLER(3)

'--- Make measurement and finish
  GOSUB MAKE.MEASUREMENT
  END
  MAKE.MEASUREMENT:
  INPUT "Press {Enter} to acquire data ";In$
  wrt$ = "wfm wfid:b,encdgc:bin;curve?"
  CALL GPIB.CONTROLLER(3)
  CALL GPIB.CONTROLLER(11)
  GOSUB INSERT.LOSS
  RETURN

  INSERT.LOSS:
  'Adjust for insertion loss here
  RETURN

```

## GPIB Commands

This section contains an alphabetical listing of the common commands (preceded by an asterisk) and device commands used to operate the Preselector from a remote GPIB controller. The listing explains the function and syntax of each command and gives examples of its use.

Most of these commands can be used either as set commands or queries. However, some commands can only be used to set: these have the words “No Query Form” included with the command name. Other commands can only be used to query: these have a question mark appended to the header, and include the words “Query Only” in the command name.

**B (No Query Form)** The B (Band) command selects the RF filter of the Preselector.

Related Commands: STS?

*Syntax* B <NR1>

<NR1> is an integer value in the range from 0 through 8 that selects one of the following filters:

Number	Bandpass filter
0	Bypass mode – no filter selected
1	9 kHz – 150 kHz
2	150 kHz – 3.0 MHz
3	3 MHz – 30 MHz
4	30 MHz – 125 MHz
5	125 MHz – 250 MHz
6	250 MHz – 500 MHz
7	500 MHz – 1000 MHz
8	1000 MHz – 1800 MHz

*Example:* B5 – selects the Preselector’s filter 5.

**\*CLS (No Query Form)** The \*CLS (Clear Status) command clears the Preselector status data structures, and puts the Preselector in the Operation Complete Command Idle State and in the Operation Complete Query Idle State. While in these states, the Preselector has nothing in its buffers and does not execute commands or queries.

The \*CLS command clears the following:

- the Event Queue
- the Standard Event Status Register (SESR)
- the Status Byte Register (except the MAV bit; see below)

Related commands: \*ESE, \*ESR, \*SRE, \*STB.

*Syntax:* \*CLS

If the \*CLS command immediately follows a <PROGRAM MESSAGE TERMINATOR>, the Output Queue and MAV bit (Status Byte Register bit 4) are also cleared.

**\*ESE** The \*ESE (Standard Event Status Enable) command sets and queries the bits in the Standard Event Status Enable Register (SESER). The SESER prevents events from being reported to the Standard Event Status Register (SESR).

Related commands: \*CLS, \*ESR, \*SRE, \*STB.

*Syntax:* \*ESE <NR1>

\*ESE?

<NR1> is an integer value in the range from 0 through 255. The binary bits of the SESER are set according to this value.

*Example:* \*ESE 209 – sets the SESER to binary 11010001.

\*ESE? – might return the string \*ESE 186, showing that the SESER contains the binary value 10111010.

**\*ESR? (Query Only)** \*ESR? (Standard Event Status Register) query returns the contents of the Standard Event Status Register (SESR). \*ESR? also clears the SESR (since reading the SESR clears it).

Related commands: \*CLS, \*ESE, \*SRE, \*STB.

*Syntax:* \*ESR?

*Example:* \*ESR? – might return the value 213, showing that the SESR contains the equivalent binary value 11010101.

**IDN? (Query Only)** \*IDN? (Identification) returns the Preselector's unique identification code.

*Syntax:* \*IDN?

The query response is an ASCII string separated into four fields by commas, and containing this information: Manufacturer, Model, Serial number, Firmware version.

*Example:* \*IDN? – might return the string Made for Tektronix by Electro – Metrics, 2706, 43, 1.00.

**\*OPC** The \*OPC (Operation Complete) command sets the operation complete bit in the Standard Event Status Register as soon as it is received. \*OPC? places the ASCII character 1 into the Output Queue and sets the MAV status bit as soon as it is received. Because the Preselector executes commands sequentially, you do not need to use the \*OPC and \*OPC? commands in your programs. The OPC and \*OPC? commands are included for IEEE compatibility.

Related commands: \*OPT, \*WAI.

*Syntax:* \*OPC  
\*OPC?

**\*PRE** The \*PRE (Parallel Poll Register Enable) command sets and queries the status of parallel polling. \*PRE sets the Parallel Poll Enable Register (PPER) that is used with the Status Byte Register to determine how the Preselector responds during a parallel poll. \*PRE? returns the contents of the PPER.

Related commands: \*CLS, \*ESR, \*SRE, \*STB.

*Syntax:* \*PRE <NR1>  
\*PRE?

<NR1> is an integer value in the range from 0 through 255. The binary bits of the PPER are set according to this value.

**\*RST** The \*RST (Reset) command returns the Preselector to a known set of instrument settings. \*RST does the following:

- Puts the Preselector into the Operation Complete Command Idle State.
- Puts the Preselector into the Operation Complete Query Idle State.
- Puts the Preselector in **BYPASS** mode.

The \*RST command does not alter the following:

- The state of the IEEE 488.1 interface.
- The Standard Event Status Enable setting.

*Syntax:* \*RST



**\*SRE** The \*SRE (Service Request Enable) command sets the bits in the Service Request Enable Register (SRER). The Preselector asserts the SRQ line on the GPIB if it detects a hardware error and \*SRE was used as in the example. It will assert the SRQ line until the controller performs a serial poll or the fault is corrected. For more information about this command, refer to the Parallel Poll section in the *ANSI/IEEE Std 488.2–1987 Handbook*.

Related commands: \*CLS, \*ESE, \*ESR, \*STB.

*Syntax:* \*SRE<NR1>

\*SRE?

<NR1> is an integer value in the range from 0 to 255. Numbers outside this range will cause the Preselector to operate inconsistently.

The binary bits of the SRER are set according to this value, which represent conditions listed in the \*STB? description that allow the Preselector to assert the SRQ line. If <NR1> is 0, then the Preselector will never request service (this is the default condition).

*Example:* \*SRE 1 – sets the bits in the SRER to 00000001 binary, which allows a hardware error to assert the SRQ line.

\*SRE? – might return a value of 0, showing that the bits in the SRER have the binary value 00000000 and that the Preselector will never request service.

**\*STB? (Query Only)** \*STB? (Read Status Byte) query returns the Status Byte (STB) using the Master Summary Status (MSS) bit.

Related commands: \*CLS, \*ESE, \*ESR, \*SRE.

*Syntax:* \*STB?

The Preselector status byte contains the following status bits:

Bit set	Meaning
0	Hardware error
1 – 3	Not used
4	MAV (Message available)
5	ESB (Event status bit)
6	RQS (Request service)
7	Not used

*Example:* \*SRB? – might return the value 65 (binary 01000001). Because bits 0 and 6 are set, the Preselector requests service for a hardware error.

**STS? (Query Only)** STS? (Status Selected band) query reports the number (0 – 8) of the Preselector filter in use. See the B command for a listing of filters.

Related Commands: B

*Syntax:* STS?

*Example:* STS? – might return the value 5, which means the Preselector is using filter 5.

**\*TST? (Query Only)** \*TST? (Self-Test) runs the Preselector’s internal self-test and reports the results. The self-test does not require operator interaction. Upon completion of \*TST?, the Preselector returns to the state it was in just prior to the self-test.

*Syntax:* \*TST?

The test response is either 0 (no errors detected) or non-zero (a micro-processor error). Send the Preselector to the nearest Tektronix servicing center if the test response is not zero.

*Example:* \*TST? – might return the value 220, showing that several microprocessor logic lines are not working properly.

**\*WAI (No Query Form)** The \*WAI (Wait-to-Continue) command prevents a GPIB device from executing further commands or queries until all pending operations finish. You do not need to use \*WAI in your programs; because the Preselector executes commands sequentially, the \*WAI command continues immediately.

Related commands: \*OPC, \*OPT.

*Syntax:* \*WAI



# Appendix C: Options

This appendix describes the options available for the Preselector.

## Power Cord Options

The following international power cord options are available for the Preselector:

<b>Option</b>	<b>Description</b>
A1	Universal Euro, 220 V/50 Hz at 16 A
A2	United Kingdom, 230 V/50 Hz at 13 A
A3	Australian, 230 V/50 Hz at 13 A
A4	North American, 230 V/60 Hz at 12 A
A5	Swiss, 230 V/50 Hz at 6 A

## Option 01

This option provides mounting hardware to connect the 2706 RF Preselector to the 271X-Series Spectrum Analyzer to form a single unit. An interface cable is also included.



# Appendix D: Parts List

This appendix lists the part numbers of the Preselector standard accessories and instrument options.

## Standard Accessories

The following accessories are included with your Preselector:

<b>Description</b>	<b>Tektronix Part Number</b>
1 Manual, Instruction	070-8545-01
1 Coaxial cable, Semi-rigid	118-8801-00
Power cord, USA, 110 V	161-0104-00

## Options

The following Preselector options are available through your local Tektronix Field Office:

<b>Description</b>	<b>Tektronix Part Number</b>
Power cord, European, 230 V (Option A1)	161-0104-06
Power cord, UK, 230 V (Option A2)	161-0104-07
Power cord, Australian, 230 V (Option A3)	161-0104-05
Power cord, North American, 230 V (Option A4)	161-0134-00
Power cord, Swiss, 230 V (Option A5)	161-0167-00
2714 mounting hardware and interface cable (Option 01)	118-8800-00



## Appendix E: Repackaging for Shipment

Pack the Preselector for shipping to a Tektronix Service Center for service or repair as follows:

1. Attach a tag to the instrument that shows:
  - the owner's name and address
  - the name of an individual at your location who can be contacted
  - the complete instrument serial number (stamped on a label attached to the instrument rear panel)
  - a description of the service required
2. Use a container of corrugated cardboard with a test strength of 140 kg (375 lbs) and inside dimensions that are at least 15 cm. (6 in.) more than the Preselector cabinet dimensions, to allow for cushioning.
3. Wrap the Preselector with plastic sheeting to protect the finish.
4. Cushion the Preselector on all sides with packing material or plastic foam.
5. Seal the container with shipping tape or an industrial, heavy-duty stapler.
6. Send the container to your nearest Tektronix Service Center.



