# Operating and Service Guide

## Agilent Technologies 85902A
## Burst Carrier Trigger and RF Preamplifier

Agilent Technologies

**Manufacturing Part Number: 85902-90002 Supersedes: 85902-90001**

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# Contents

# 1 Quick Start Guide

## What You'll Learn in this Chapter

This chapter consists of the following:

- A summarized description of the 85902A Burst Carrier Trigger and RF Preamplifier.
- A description of all the items shipped with your 85902A.
- A description of the front and rear panel features of your 85902A.
- Instructions on making a simple measurement using your 85902A.
- An illustrated set of typical test configurations using the 85902A.

## What is the Burst Carrier Trigger?

The 85902A detects the burst RF carrier of a digital communication system and provides a TTL output trigger to synchronize a spectrum analyzer. The 8590 and 8560 - series spectrum analyzers are well suited to use the 85902A. The triggering function is especially useful when performing time dependent measurements such as power versus time and adjacent channel power gated measurements. Typical dynamic range is 60 dB without need for adjustment. The 85902A is compatible with most digital communication formats, including NADC-TDMA, E-TDMA, JDC, GSM, DCS-1800, CT2-CAI, DECT, PHP, and CDMA.

The triggering circuit is an RF envelope detector, consisting of biased Schottky diodes that can respond to -30 dBm signal levels and frequencies well into the microwave region. Typical frequency response is 10 Mhz to 2 GHz.

The following 8560 and 8590 - series spectrum analyzers are compatible with the burst carrier trigger function of the 85902A:

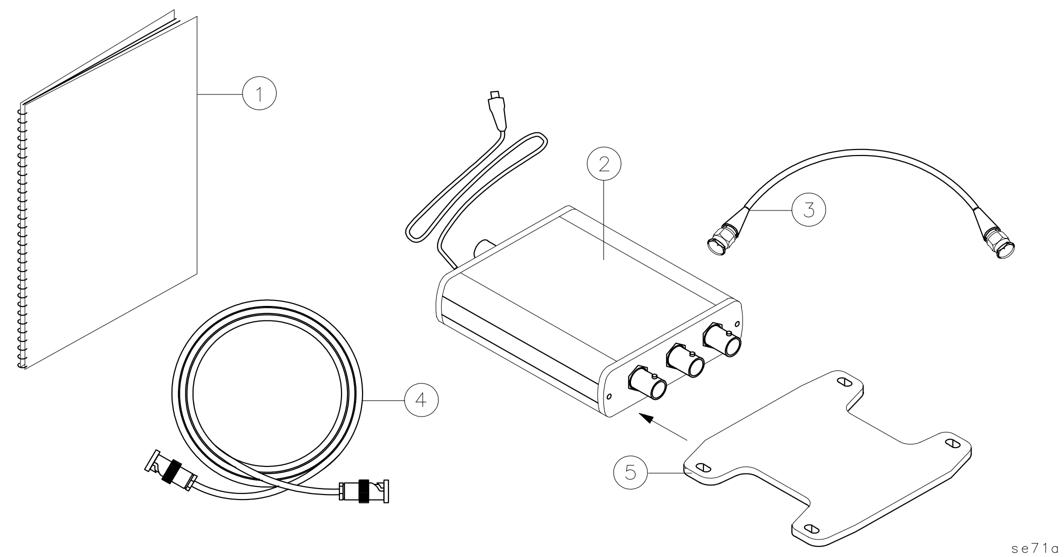
- 856XE,EC
- 8591E
- 8593E
- 8594E
- 8595E
- 8596E

Separate from the triggering circuitry but included inside the 85902A is a 10 MHz to 2 GHz preamplifier. It provides a typical 12 to 18 dB gain for added triggering sensitivity, *if required*. DC power for the unit is supplied through the probe power connector located on the front panel of the spectrum analyzer.

# To Verify Receipt of All Equipment

Unpack the contents and confirm that all items have been received. Figure 1-1 shows the 85902A and all items included with the product.

**Figure 1-1 Items Included with the 85902A**

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3 BNC Cable - 23 cm (9 inches) long

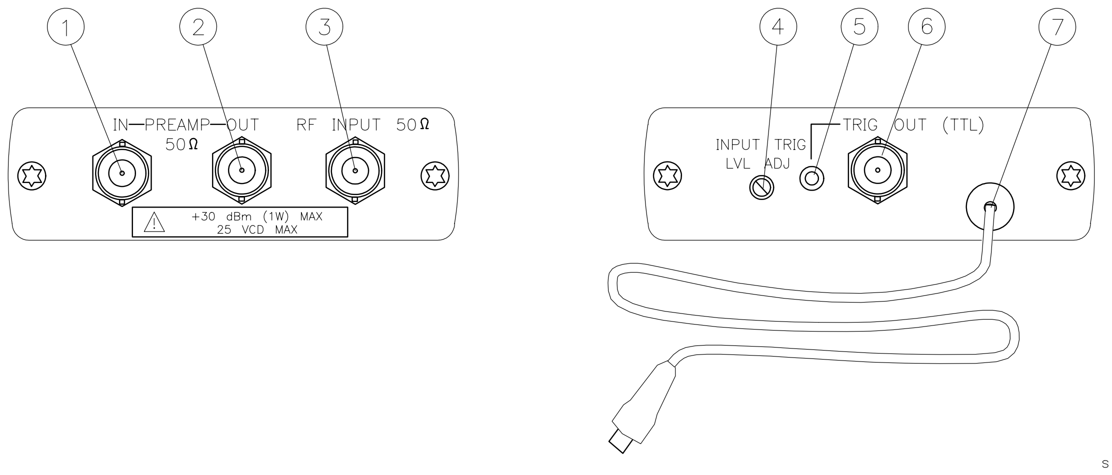
4 BNC Cable - 122 cm (48 inches) long

5 Mounting bracket (installed on unit as option 001 only).

# Front and Rear Panel Features

The following section provides a brief description of front and rear panel features. The explanations to the numbered callouts in Figure 1-2 are provided below.

**Figure 1-2 Front and Rear Panel Features**




## Front Panel Features

1 RF preamplifier input BNC female connector. Connect an RF input signal here for pre-amplification. The preamplifier may be used before the burst carrier trigger, or it may be used alone.

2 RF preamplifier output BNC female connector. Connect this to the input of a device or instrument. For example, it may be connected to the burst carrier trigger RF Input connector, or to a spectrum analyzer RF input connector.

3 Burst carrier trigger TTL output BNC female connector. Connect this output to the spectrum analyzer EXTERNAL GATE TRIGGER INPUT connector. The TTL output signal at this connector triggers the analyzer on the rising edge of the RF pulse applied to the RF input of the burst carrier trigger.

## Rear Panel Features

4 Input trigger threshold screwdriver adjustment. Use a small flat blade screwdriver or electronic adjustment tool here to vary the trigger sensitivity on the leading edge of the RF burst. This is a normal operating adjustment, but should seldom need changing because it is adjusted at the factory for the best overall operating range.

5 Trigger indicator LED. This LED illuminates for each rising edge of the output pulse. The LED remains off if the trigger threshold is set either too low or too high, or if a burst signal is not present at the RF Input.

6 Burst carrier trigger TTL output BNC female connector. Connect this output to the spectrum analyzer EXTERNAL GATE TRIGGER INPUT connector. The TTL output signal at this connector triggers the analyzer on the rising edge of the RF pulse applied to the RF input of the burst carrier trigger.

7 DC power cord and connector. DC power is supplied to the 85902A through this 50 cm (20 inch) cord and female probe power connector. Power may be conveniently supplied using analyzers with front panel probe power connectors, or with the 11899A probe power supply. Alternately, the end connector may be removed and the cable connected directly to a suitable dc supply.

# To Make a Measurement

Let's begin using the burst carrier trigger/RF preamplifier to trigger the spectrum analyzer and make a power versus time measurement. We will use a mobile station with an NADC-TDMA format, but any applicable format may be used.

This procedure takes approximately five minutes to perform.

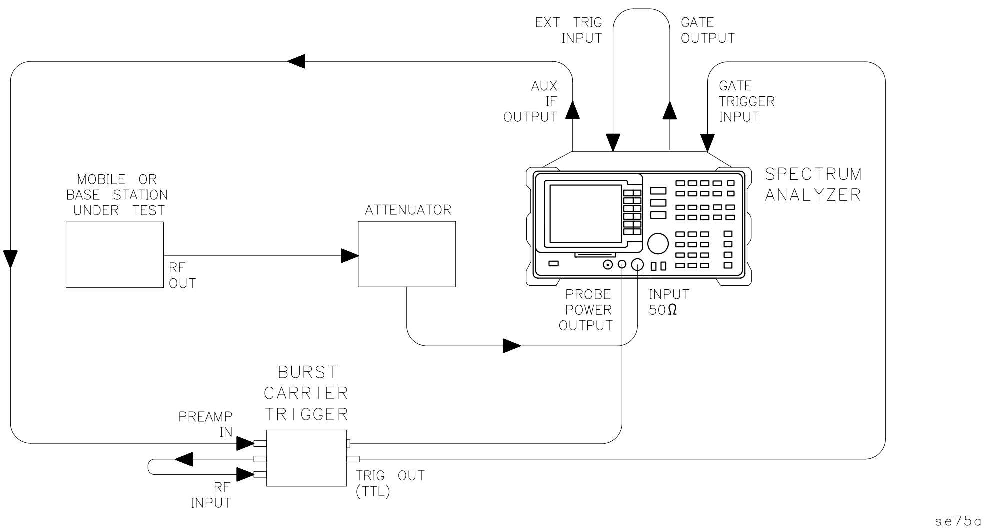
## Equipment Required:

- 85902A burst carrier trigger/RF preamplifier
- 859X-series spectrum analyzer with option 105
- 85718A NADC-TDMA measurements personality
- Five BNC cables
- Type N male to BNC female adapter
- An attenuator to reduce the mobile station RF power output to avoid exceeding the analyzer RF input limitations.

## Procedure

This configuration uses the spectrum analyzer IF output signal as the burst carrier trigger RF input signal. This configuration takes advantage of the built-in RF preamplifier to increase the IF output signal level before it is connected to the triggering circuitry. This is only one of several typical configurations possible. Other configurations will be explained later.

**Figure 1-3 Making a Power Versus Time Measurement**




1. Connect the equipment as shown in Figure 1-3.

**CAUTION** Adjust the external attenuator for sufficient attenuation to avoid damage to the spectrum analyzer.

2. Load the measurement personality in the spectrum analyzer and select the NADC mode. Press **MODE**, **NADC ANALYZER**, **Power vs Time**. Make sure that the channel number selection agrees with the transmitter RF output.
3. Press **P vs T BURST** to display the transmission burst. The signal should be triggered on the display, indicating the burst carrier trigger is operational.

   If the signal is not triggered, make sure the burst carrier trigger unit supply cable is plugged into the probe power connector on the analyzer. Then check all other cables and connections to the 85902A and the analyzer, especially the rear panel connections.
4. If the burst is not symmetrical with respect to the limit lines, press **TRIG DELAY**, then use the large knob on the spectrum analyzer's front panel to adjust the trigger delay until the burst is symmetrical with respect to the limit lines. Also, if you know the actual trigger time delay, you can enter the time delay by pressing **TRIG DELAY**, enter the number with the data keys, and then press the appropriate units key **sec**, **ms**, or **µs**.
5. Press **Previous Menu** when you are done with the P vs T BURST measurement, or use one of the post-measurement functions.

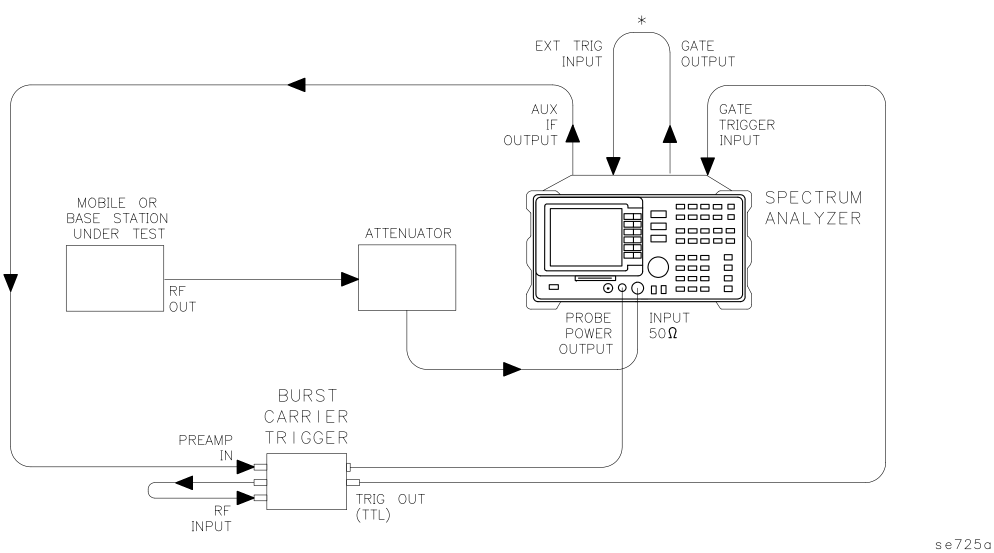
# Typical Configurations Using the 85902A

The burst carrier trigger unit may be configured to trigger 8560 or 8590 - series spectrum analyzers by either using the transmitted RF signal, or the IF output signal from the analyzer. Examples of both configuration methods are shown in Figure 1-4 through Figure 1-9.

Use the analyzer IF output method for the following zero span measurements on a base or mobile station:

- power versus time
- carrier power
- carrier off power
- frequency deviation, cordless telephone 2 (CT2)

**Figure 1-4 Using Analyzer IF Output Triggering (off-air trigger)**



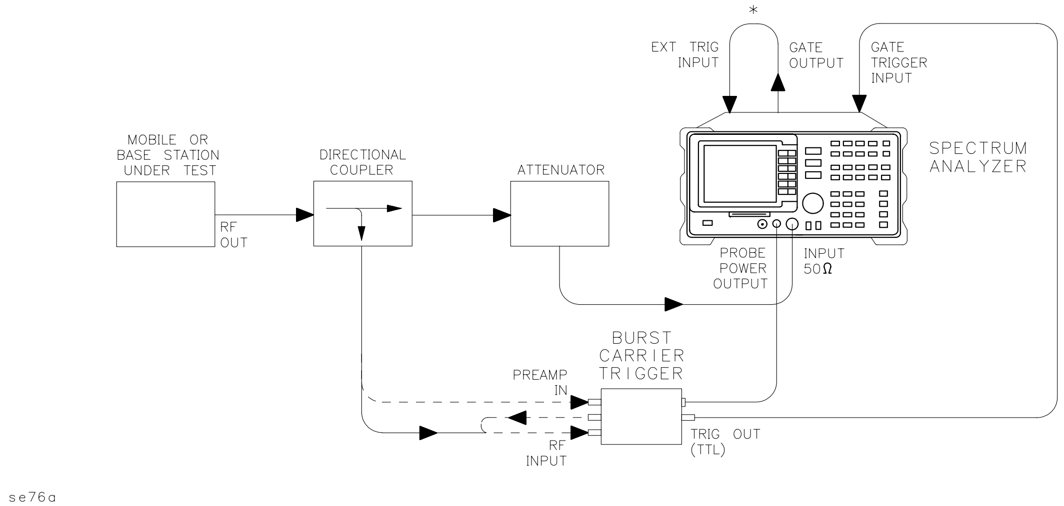

* Cable used with 8590-series analyzers only.

**CAUTION** Adjust the external attenuator for sufficient attenuation to avoid damage to the spectrum analyzer.

Use the direct RF triggering method with a base or mobile station for both time domain (zero span) and frequency domain non-zero span measurements (Figure 1-5 through Figure 1-9):

- power versus time
- carrier power
- carrier off power
- frequency deviation, cordless telephone 2 (CT2)
- gated adjacent channel power (ACP)

**Figure 1-5 Using Direct RF Triggering with a Directional Coupler**

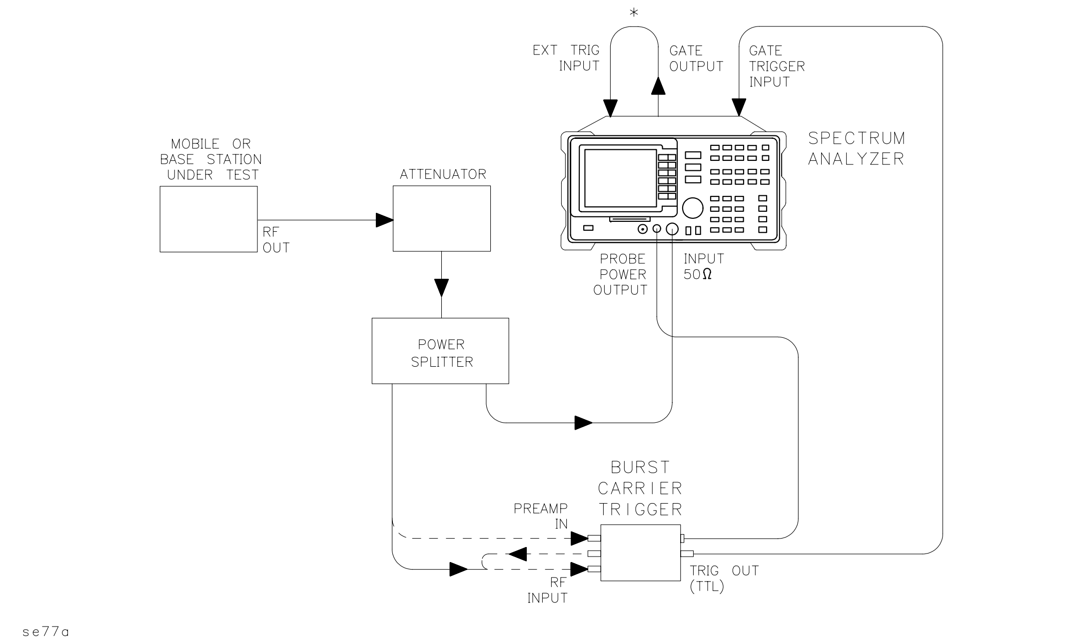



* Cable used with 8590-series analyzers only.

**CAUTION** Adjust the external attenuator for sufficient attenuation to avoid damage to the spectrum analyzer.

**NOTE** You may connect the preamplifier for added sensitivity, indicated by the dashed lines.

**Figure 1-6 Using Direct RF Triggering with a Power Splitter**



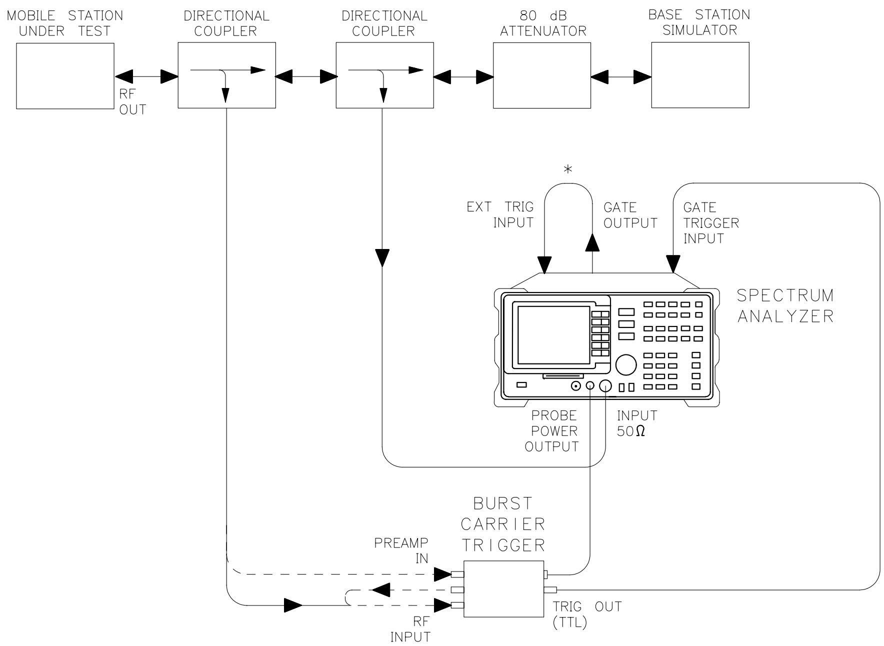

* Cable used with 8590-series analyzers only.

**CAUTION** Adjust the external attenuator for sufficient attenuation to avoid damage to the spectrum analyzer.

**NOTE** You may connect the preamplifier for added sensitivity, indicated by the dashed lines.

Use the configuration in Figure 1-7 for mobile station testing using JDC or NADC formats.

**Figure 1-7 Using Direct RF Triggering with a Mobile Station Under Test and a Base Station Simulator (Method 1)**

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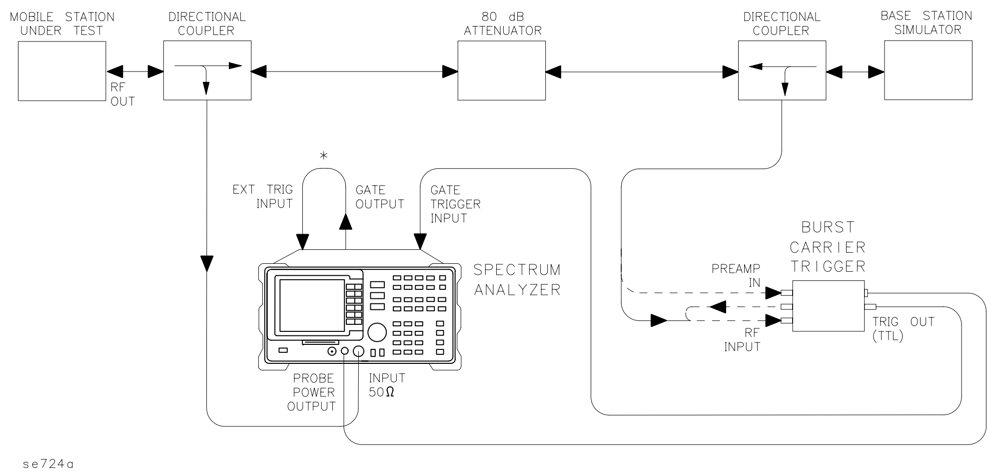
* Cable used with 8590-series analyzers only.

**NOTE** You may connect the preamplifier for added sensitivity, indicated by the dashed lines.

Use the configuration shown in Figure 1-8 for mobile station testing using JDC or NADC formats. This setup has the following advantages:

- Timing of the trigger signal is completely independent of the station under test carrier level
- The trigger signal is still present even if the station under test has a serious malfunction. This makes the setup good for troubleshooting.

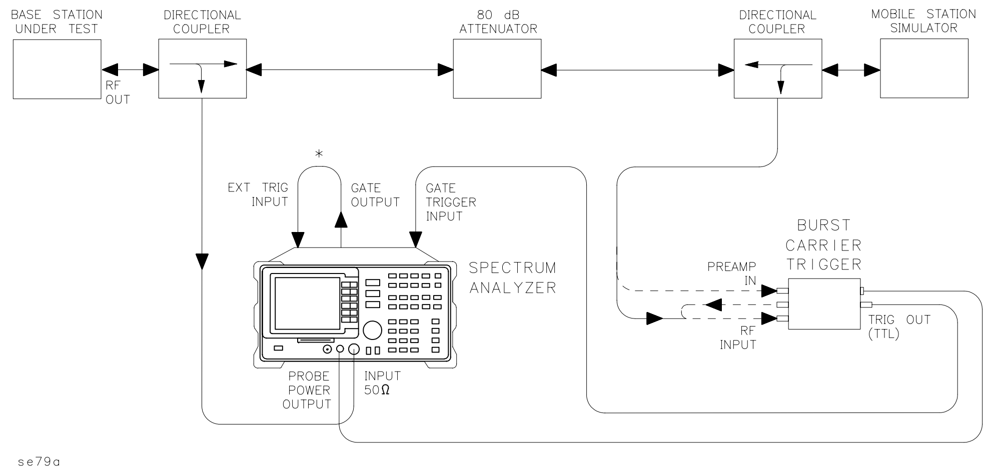
**Figure 1-8 Using Direct RF Triggering with a Mobile Station Under Test and a Base Station Simulator (Method 2)**




* Cable used with 8590-series analyzers only.

**NOTE** You may connect the preamplifier for added sensitivity, indicated by the dashed lines.

**Figure 1-9 Using Direct RF Triggering with a Base Station Under Test and a Mobile Station Simulator**




* Cable used with 8590-series analyzers only.

**NOTE** You may connect the preamplifier for added sensitivity, indicated by the dashed lines.

Use the configuration shown in Figure 1-9 for mobile station testing using JDC or NADC formats. This setup has the following advantages:

- Timing of the trigger signal is completely independent of the station under test carrier level
- The trigger signal is still present even if the station under test has a serious malfunction. This makes the setup good for troubleshooting.

# 2 Specifications and Characteristics

This chapter contains specifications and characteristics for the 85902A Burst Carrier Trigger/RF Preamplifier. First the specifications are described, and then the characteristics.

| | |
|---|---|
| **General** | General specifications |
| **Frequency** | Frequency-related characteristics |
| **Amplitude** | Amplitude-related characteristics |
| **Physical** | Input, output and physical characteristics |

This distinction between specifications and characteristics is described as follows.

- Specifications describe warranted performance over the temperature range 0 °C to +55 °C, unless otherwise noted. The unit will meet its specifications after two hours of storage at a constant temperature within the operating temperature range, and 30 minutes after DC power has been applied.
- Characteristics provide useful, but non-warranted information about the functions and performance of the burst carrier trigger/RF preamplifier unit. Characteristics are specifically identified.
- Typical Performance, where listed, is not warranted, but indicates performance that at least 80% of all units will exhibit.
- Nominal Value indicates the expected, but not warranted, value of the parameter.

# General Specifications

All specifications apply over the temperature range 0 °C to +55 °C, unless otherwise noted. The unit will meet its specifications after two hours of storage at a constant temperature within the operating temperature range, and 30 minutes after DC power has been applied.

| | |
|---|---|
| **Temperature Range** | |
| Operating | 0 °C to +55 °C |
| Storage | –40 °C to +75 °C |

| | |
|---|---|
| **Operating Humidity** | Type tested to 95% relative humidity at 40°C for 5 days. |

| | |
|---|---|
| **EMI Compatibility** | See the Declaration of Conformity located at the front of this guide. |

| | |
|---|---|
| **Power Requirements*** | +15 Vdc at 100 mA<br>–12.6 Vdc at 40 mA |
| * The probe power connector on the front panel of any HP/Agilent spectrum analyzer meets the power requirements. | |

| | |
|---|---|
| **Maximum Safe Input Level** | |
| Average Continuous: | |
| RF Input | +30 dBm (1 Watt) |
| Preamp In/Out | +30 dBm (1 Watt) |
| DC: | |
| RF Input | 25 Vdc |
| Preamp In/Out | 25 Vdc |

# Frequency and Amplitude Characteristics

These are not specifications. Characteristics provide useful but non warranted information about instrument performance.

## Envelope Trigger Characteristics*

| | |
|---|---|
| **Frequency Range** | 10 MHz to 2000 MHz |

| | |
|---|---|
| **Amplitude Range** | –30 dBm to +30 dBm |

| | |
|---|---|
| **Burst** | |
| Burst RF Rate | 25 Hz to 2.0 kHz |
| Minimum Burst Width | 100 µs |
| Minimum Recovery Time Between RF Bursts | 300 µs |

| | |
|---|---|
| **Trigger Output** | |
| Delay | < 20 µs for RF input >– 25 dBm |
| Jitter | < 2 µs for a consistent burst signal |
| Level | TTL/CMOS logic level |

| | |
|---|---|
| **Compatible Formats** | |
| Formats | GSM, DCS-1800, NADC-TDMA, E-TDMA, JDC, CT2-CAI, DECT, PHP, CDMA |

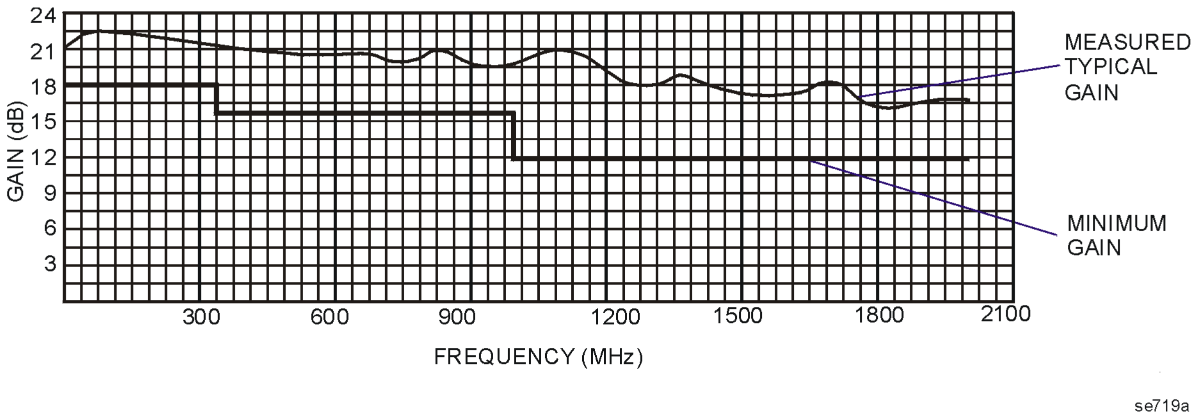
*At the RF Input BNC of the Burst Carrier Trigger unit.

## Pre-Amplifier Characteristics

| | |
|---|---|
| **Overall Frequency Range** | 10 MHz to 2000 MHz |

| **Frequency Range** | **Minimum Gain** |
|---|---|
| 10 to 350 MHz | 18 dB |
| 350 to 1000 MHz | 16 dB |
| 1000 to 2000 MHz | 12 dB |

**Figure 2-1 Nominal Gain versus Frequency**




| | |
|---|---|
| **Noise Figure** | <10 dB |

| | |
|---|---|
| **1 dB (output) Gain Compression** | > +10 dBm |

# Physical Characteristics

## Front Panel Inputs and Outputs

| | |
|---|---|
| **PREAMP IN** | |
| Connector | BNC female |
| Impedance | 50 Ω |

| | |
|---|---|
| **PREAMP OUT** | |
| Connector | BNC female |
| Impedance | 50 Ω |

| | |
|---|---|
| **RF INPUT** | |
| Connector | BNC female |
| Impedance | 50 Ω |

## Rear Panel Features

| | |
|---|---|
| **Threshold Level** | |
| INPUT TRIG LVL ADJ | Screwdriver adjustable potentiometer |

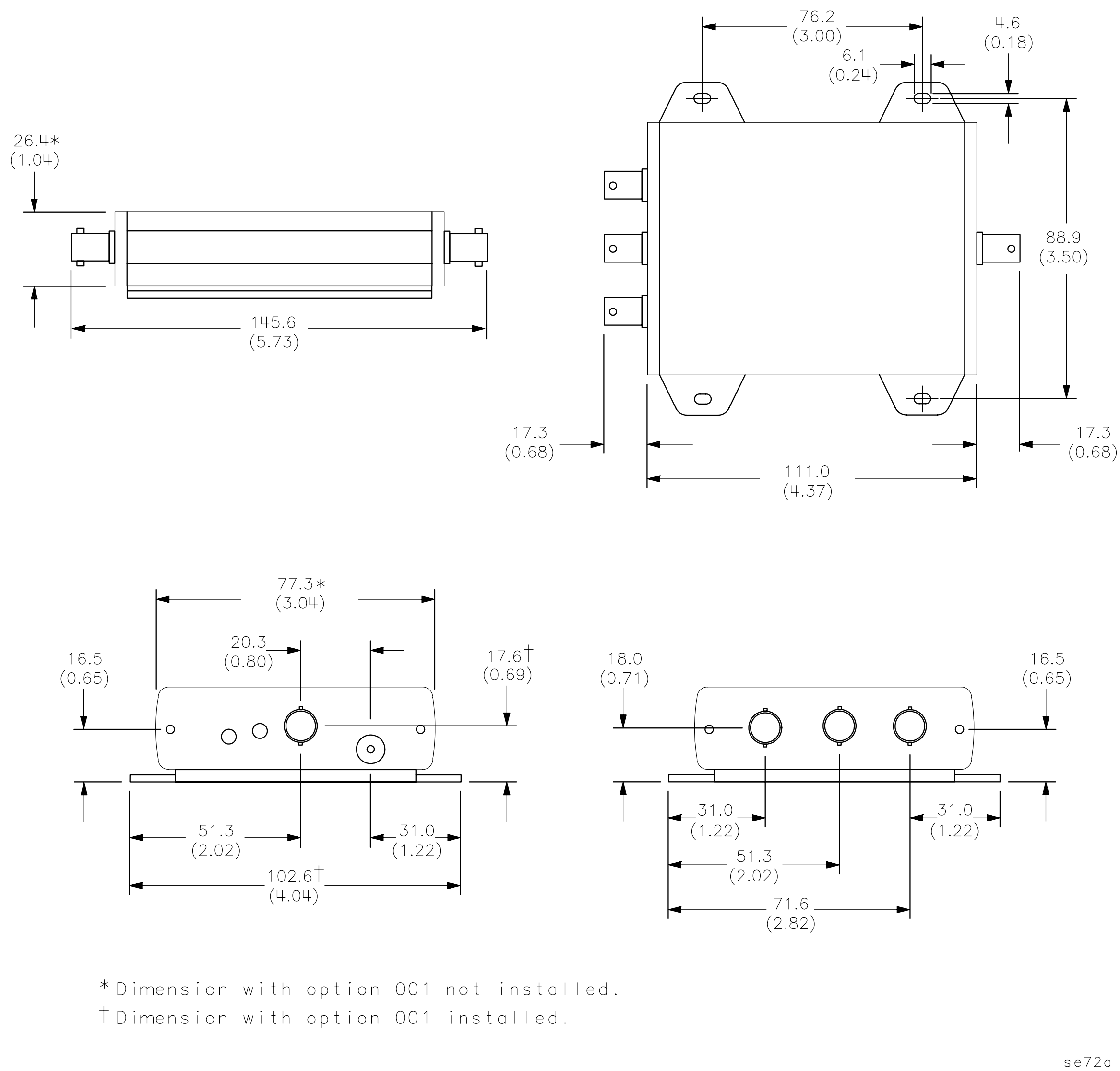
| | |
|---|---|
| **Trigger Indicator** | |
| TRIG OUT | LED |

| | |
|---|---|
| **TRIG OUT** | |
| Connector | BNC female |
| | TTL/CMOS |

## Weight

| Weight* | |
|---|---|
| Net (standard product) | 341 grams (12 ounces) |
| Shipping (standard product) | 909 grams (32 ounces) |
| Net (with Option 001) | 426 grams (15 ounces) |
| Shipping (with Option 001) | 995 grams (35 ounces) |
| * Approximate values. | |

**Figure 2-2 85902A Physical Dimensions**




Dimensions in the figure are shown in millimeters first and in inches (in parenthesis) second.

# To Perform a Functional Test

The following functional test confirms that the burst carrier trigger and RF preamplifier are both operational. The burst carrier trigger is tested for trigger delay and the RF preamplifier is tested for swept flatness gain over its operating frequency.

This check is NOT to verify any specifications or supplemental characteristics; its purpose is to determine whether or not the unit is basically operational. This test can be used during the troubleshooting procedure, or as an operational check during incoming inspection. It takes approximately 90 minutes to perform both the burst carrier trigger and either of the RF preamplifier functional tests.

### Equipment Required

The following equipment is required for the burst carrier trigger functional tests:

- 54501A oscilloscope
- 8116A pulse generator
- 11899A probe power supply
- 8642B or 8663A RF source with pulse modulation
- Four BNC cables
- BNC tee
- 3.5 mm female to BNC female adapter

The following equipment is required for the RF preamplifier functional test:

- 8560E/EC spectrum analyzer with option 002 (tracking generator)
- Three BNC cables
- Type N male to BNC female adapter

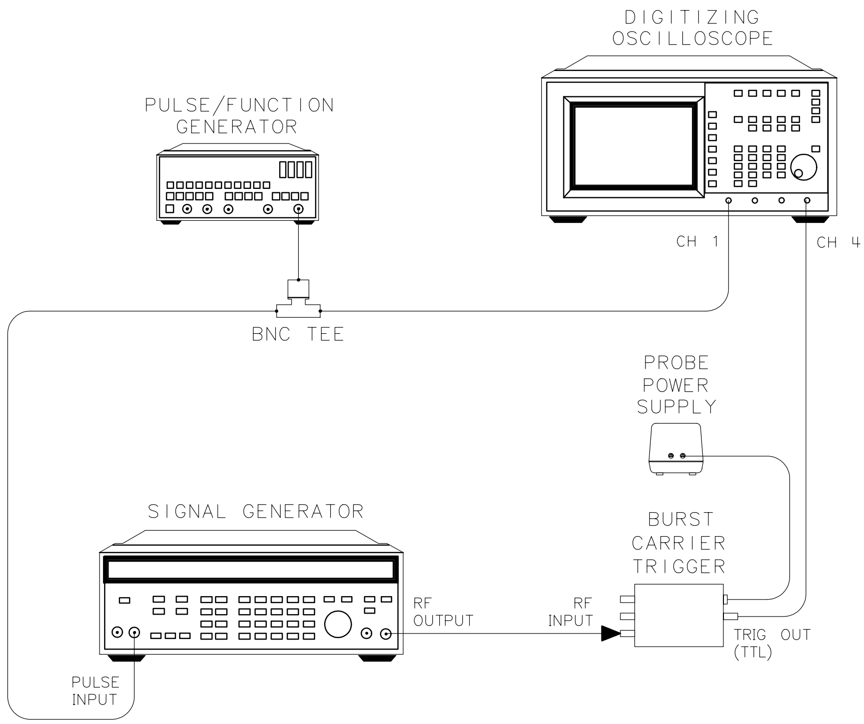
OR

- 8753ES network analyzer
- 11667A option 001 power splitter
- 8491B 20 dB attenuator
- Three BNC cables
- Four Type N male to BNC female adapters
- BNC female barrel adapter

## Burst Carrier Trigger Functional Test Procedure

### Procedure

**Figure 2-3 Equipment Setup for the Burst Carrier Trigger Functional Test**

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1. Connect the equipment as shown in Figure 2-3.
2. Set the test equipment controls as follows:
   - Signal Generator:

| | |
|---|---|
| CW frequency | 1 GHz |
| Power level | 5 dBm |
| MENU SELECT | MOD |
| Pulse On/Off | Extrnl |

- Pulse/Function Generator

| | |
|---|---|
| Mode | NORM |
| Frequency (FRQ) | 500 Hz |
| Waveform | Pulse |
| Width (WID) | 100 μs |
| Amplitude (AMP) | 4.5V |
| Offset (OFS) | 0 mV |
| Disable | Off |

3. On the oscilloscope, press the following keys to set the sensitivity of active channels 1 and 4. Press MENUS, **CHAN, CHANNEL 1, on, V/div**, **1 V dc**. Next press **CHANNEL 2 off**, **CHANNEL 3 off**, **CHANNEL 4 on, V/div, 1 V dc**, **offset**, **2.5 V**.

4. Press MENUS, **TIME BASE, delay**, **0 s**, then **TIMEBASE**, **5 μs, reference cntr** to center the time base reference on the screen at 5 microseconds per division. Press **window off** to show one window only.

5. Press MENUS, **TRIG**, **source 1**. Then press the symbol that shows a leading edge trigger to trigger the signal on channel 1.

6. Press SYSTEM CONTROL, **RUN/STOP** if there are no pulses displayed. Press MENUS, **DISPLAY**, **connect dots on**, to show a solid line for the rising edges for both pulses.

7. Press MENUS, **Δt ΔV**, **ΔV markers off**, **Δt markers on**, **start marker** and use the rotary pulse generator (RPG) knob to align the start limit line (vertically-dashed) over the rising edge signal trace on the left pulse. Press **stop marker** and, in a similar manner, align the dashed stop limit line over the signal trace rising edge on the right pulse. Align the stop limit line in the approximate center of the rising edge.

8. Read the Δt value given on the screen. It should read less than 20 μs.

## RF Preamplifier Functional Test #1

**NOTE**

Verify operation of the RF preamplifier by performing either RF preamplifier functional test #1 or test #2. It is not necessary to perform both tests together. Each test confirms operation using different test equipment; both methods are provided for your convenience.

Functional test #2 uses an 8753ES network analyzer and 11667A power splitter. Functional test #1 uses an 8593E spectrum analyzer with Option 010, or an 8560-series spectrum analyzer with option 002.

### Procedure

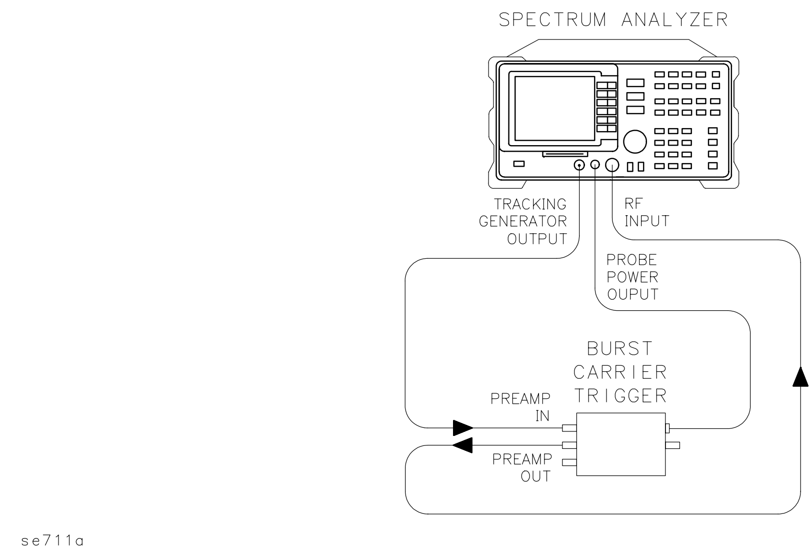
**NOTE**

This procedure was written for an 8560E/EC spectrum analyzer with Option 002. The procedure may vary when using an 8593E spectrum analyzer.

1. Turn the spectrum analyzer on. On the spectrum analyzer, press **PRESET**, **FREQUENCY, START FREQ**, 10 MHz, **STOP FREQ**, 350 MHz to set the frequency range of interest.
2. Press **AMPLITUDE, LOG dB/DIV, 5 dB** to set the vertical sensitivity to 5 dB per division.
3. Connect the tracking generator output to the RF input of the analyzer using a BNC cable. Press **AUX CTRL, TRACKING GENERATOR RANGE LVL**, **30 dB** to set the dynamic range of the analyzer.
4. Press **SRC PWR ON, SRC PWR ON**, **SOURCE CAL MENU**, **CAL THRU**, **STORE THRU** to turn the tracking generator on and to perform a thorough calibration.
5. Press **NORMLIZE ON**, **NORM REF POSN**, **2 dB** to normalize the tracking generator frequency response and position the trace near the bottom of the graticule.
6. Connect the equipment as shown in Figure 2-4.
7. Press **MKR** and turn the rotary pulse generator (RPG) knob to read the minimum power level on the trace. This amplitude should be greater than 18 dB.
8. Connect the tracking generator output to the RF input of the analyzer using a BNC cable. Press **FREQUENCY**, **START FREQ**, 350 MHz, **STOP FREQ**, 1 GHz to set the new frequency range of interest.
9. Press **AUX CTRL, TRACKING GENERATOR**, **SOURCE CAL MENU**, **CAL THRU**, **STORE THRU** to perform a thorough calibration. Press **NORMLIZE ON** to normalize the tracking generator frequency response.

10.Connect the equipment as shown in Figure 2-4.

**Figure 2-4 Equipment Setup #1 for the RF Preamplifier Functional Test**




11.Press **MKR** and turn the rotary pulse generator (RPG) knob to read the minimum power level on the trace. The amplitude should be greater than 16 dB.

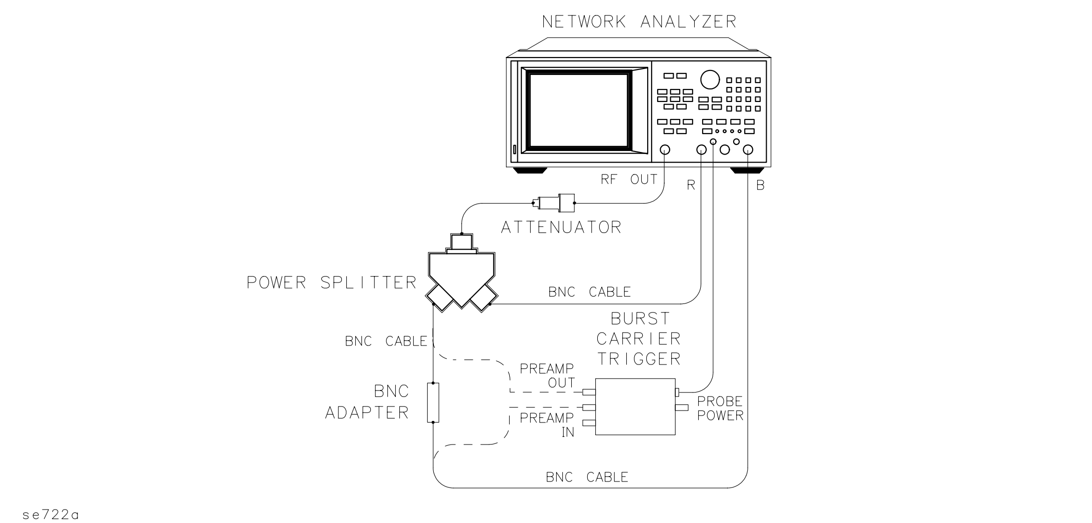
12.Connect the tracking generator output to the RF input of the analyzer using a BNC cable. Press **FREQUENCY, START FREQ**, 1 GHz, **STOP FREQ,** 2 GHz to set the new frequency range of interest. Repeat step 9 through step 11, except the amplitude should be greater than 12 dB in step 11.

## RF Preamplifier Functional Test #2

**NOTE** Verify operation of the RF preamplifier by performing either RF preamplifier functional test #1 or test #2. It is not necessary to perform both tests together. Each test confirms the operation using different test equipment; both methods are provided for your convenience.

Functional test #1 uses an 8560-series spectrum analyzer with option 002. This functional test uses an 8753ES network analyzer and 11667A power splitter.

**Figure 2-5 Equipment Setup #2 for the RF Preamplifier Functional Test**




### Procedure

1. Connect the equipment as shown in Figure 2-5. Use a female BNC adapter to connect the two BNC cables together. Connect one cable end to network analyzer PORT B, and the other end to the power splitter. The attenuator connects directly to the network analyzer RF OUTPUT port and to the power splitter.
2. On the network analyzer, press **PRESET**.
3. Press STIMULUS **START**, 10 MHz, **STOP**, 350 MHz to set the frequency of interest.
4. Press RESPONSE **MEAS**, **S PARAMETERS, Trans: FWD S21 (B/R)** to set the analyzer to make a forward transmission measurement.
5. Press RESPONSE **SCALE REF, SCALE/DIV, 5 x1**, **REFERENCE POSITION**, **2 x1** to set the scale to 5 dB per division and move the reference position lower on the graticule.

6. Press RESPONSE **CAL, CALIBRATE MENU, RESPONSE THRU** to perform a transmission response calibration. Wait until the message `WAIT--MEASURING CAL STANDARD` disappears from the display. Then press **DONE: RESPONSE** to temporarily store the calibration.

7. Remove the BNC female barrel adapter connecting the two BNC cables together. Connect the free end of the cable attached to the power splitter to the 85902A PREAMP IN connector. Connect the cable from the analyzer port B to the 85902A PREAMP OUT connector.

8. Press RESPONSE **MKR FCTN**, **MKR SEARCH, SEARCH: MIN** to activate the marker minimum search function.

9. Read the minimum gain in the upper right hand corner of the screen above the graticule. It should be greater than 18 dB.

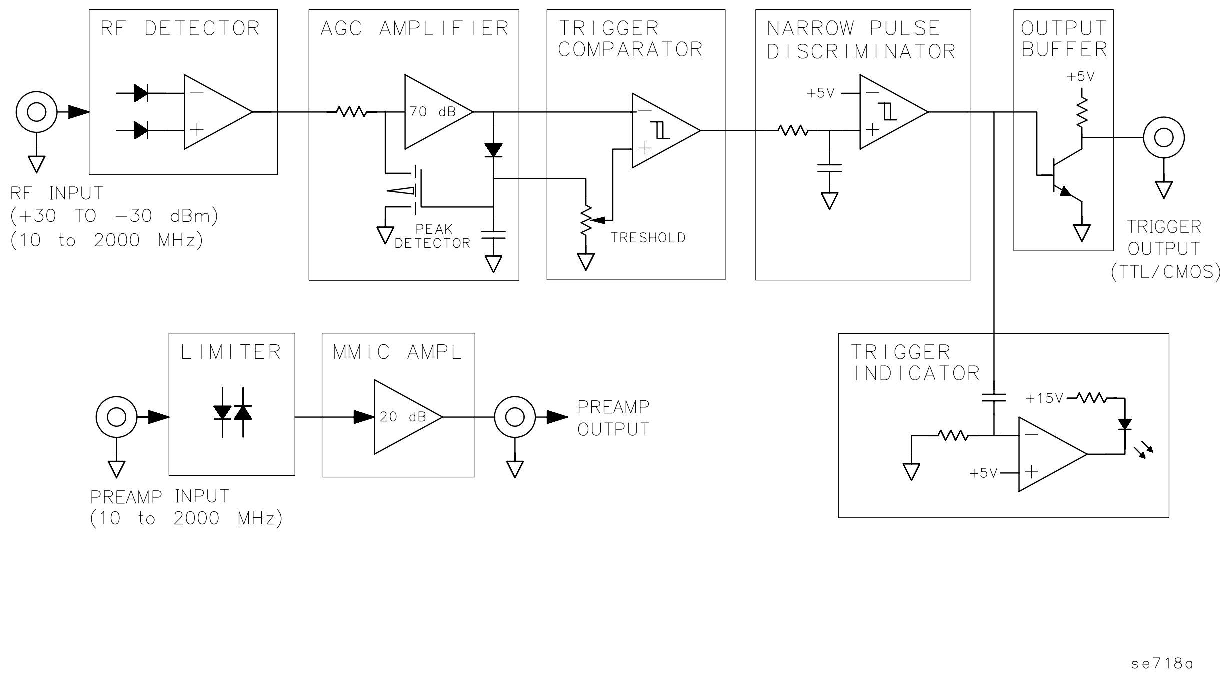
10. Press STIMULUS **START,** 350 MHz, **STOP**, 1 GHz to change the frequency of interest. Use a BNC female barrel adapter to connect the BNC cables together that are attached to the 85902A PREAMP IN and PREAMP OUT connectors. Repeat step 6 through step 9, except the gain should be greater than 16 dB in step 9.

11. Press STIMULUS **START,** 1 GHz, **STOP**, 2 GHz to change the frequency of interest. Use a BNC female barrel adapter to connect the BNC cables together that are attached to the 85902A PREAMP IN and PREAMP OUT connectors. Repeat step 6 through step 9, except the gain should be greater than 12 dB in step 9.

# 3 Theory of Operation

This chapter consists of an overall block diagram of the 85902A, and an explanation of the various circuit functional blocks.

**Figure 3-1 Overall Block Diagram**



# Theory of Operation - Burst Carrier Trigger

Refer to Figure 3-1 when reading the following theory of operation.

For a typical time division multiple access (TDMA) or time division duplex (TDD) measurement, the burst carrier is split into two paths with a power splitter. One path goes to the RF input of the spectrum analyzer, while the other path goes to the RF INPUT of the burst carrier trigger (BCT). In the BCT, the RF signal is detected by an RF detector and then amplified by a 70 dB AGC amplifier. The amplified detected carrier signal is then sent to the trigger comparator. When the amplified signal exceeds the threshold trigger level, the trigger comparator switches states. The switching action is enhanced with positive feedback which also provides a small amount of hysteresis to reduce triggering jitters for slow rising/falling and/or noisy envelope signals.

The narrow pulse discriminator then receives the triggered outputs and rejects those narrow pulses which may be the result of noise or amplitude modulation. Finally, a transistor buffer is used to convert the bipolar output of the narrow pulse discriminator into TTL/CMOS logic levels.

The trigger threshold is varied by adjusting a potentiometer with a small screwdriver. The trigger indicator is an RC differentiator that lights an LED on the rising edge of each output pulse. If the trigger threshold is set too low or too high, the trigger output is always high or low. If this occurs, the LED does not light, indicating that no trigger is occurring.

The RF detector uses a pair of biased Schottky diodes that can respond to signal levels below -30 dBm and frequencies up to 2 GHz. The maximum input level without clipping is approximately +5 dBm. The input damage level is determined by the input termination resistor(s), internal to the unit. These allow +30 dBm (1 watt) of continuous power handling capability.

# Theory of Operation - RF Preamplifier

The RF preamplifier includes a monolithic microwave integrated circuit (MMIC) that provides a nominal 15 dB of gain. The purpose of the preamplifier is to improve sensitivity of the RF burst detector, when required. This amplifier is a stand-alone unit with its own input and output BNC connectors. For this reason, it can be used as a general purpose amplifier as well as a preamplifier for the burst carrier trigger.

# 4 Chapter Troubleshooting

This chapter consists of two procedures that may be used to troubleshoot a suspected problem in the 85902A triggering circuitry, or preamplifier circuitry. The scope of this chapter is limited to identifying whether or not these two independent circuits are operating. Component level repair is not provided.

# Before Troubleshooting

Before troubleshooting, make sure that the dc supply cable is plugged in, all cables in the equipment setup used are attached to the correct ports, and that the cables are in good electrical condition. These are the most likely causes of failure.

**CAUTION** Static Sensitive Parts. The 85902A contains static-sensitive components that must be properly protected. Read the section entitled "Protection from Electrostatic Discharge" in Chapter 1 of this guide before troubleshooting this product.

Perform the functional tests in Chapter 2 of this guide whenever these troubleshooting procedures confirm that the suspected part of the 85902A is working properly. These functional tests more completely confirm the functionality of the 85902A.

# No TTL Trigger Output

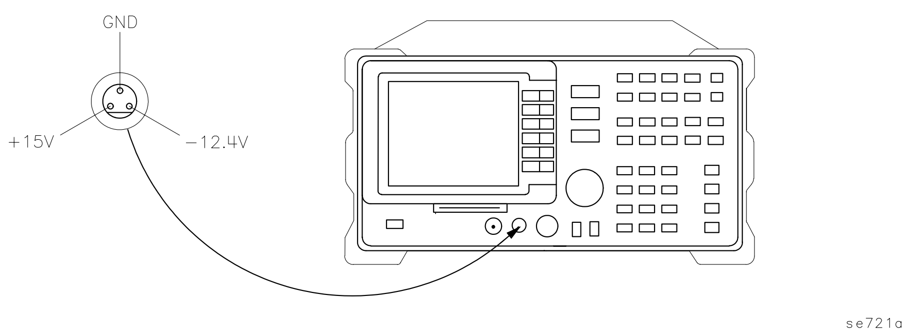
1. First, make sure that the dc supply cable is plugged in, all cables in the equipment setup used are attached to the correct ports, and that the cables are in good electrical condition. These are the most likely causes of failure.

   Choose an equipment configuration that does not use the RF preamplifier portion of the 85902A. If you think that the preamplifier is not working, refer to the procedure entitled "Bad RF Preamplifier Output" in this chapter.

2. Verify with a spectrum analyzer that there is a pulsed RF signal at the end of the cable attached to the "RF INPUT" port of the 85902A. Make sure that the amplitude and frequency of this signal is within the range of the characteristics given in Chapter 2 of this guide.

3. Use a voltmeter to check the dc voltages at the probe power output connector of the spectrum analyzer or power supply. The burst trigger circuitry uses both the -12.4 V and +15 V supplies. Figure 4-1 shows the nominal voltages on each of the probe power connector pins.

**Figure 4-1 Probe Power Connector Pin Voltages**




4. If the proper voltages are present at the spectrum analyzer probe power connector, check the "RF INPUT" and "TRIG OUT (TTL)" BNC connectors for damage. Replace any bad connectors found.

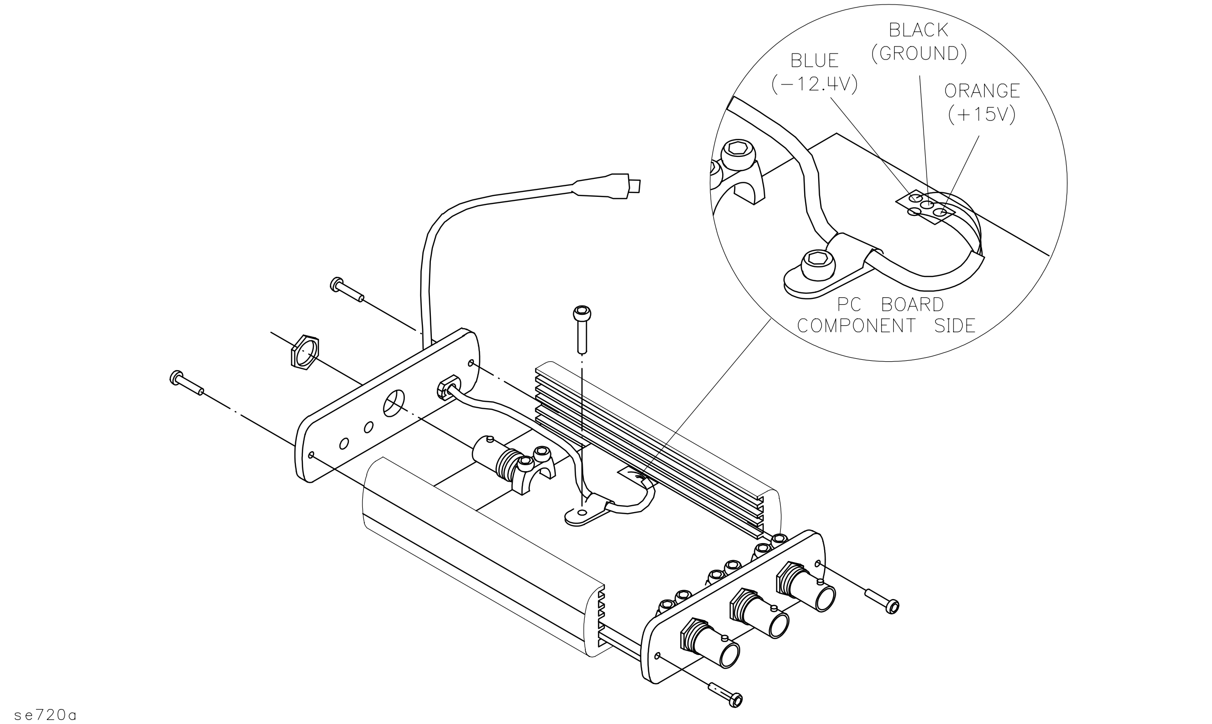
5. If the connectors look good, connect the dc supply cable to the probe power output port of an analyzer or a suitable power supply. Attach the cable supplying the RF burst to the "RF INPUT" port of the 85902A. Then connect an oscilloscope to the "TRIG OUT (TTL)" connector and observe the output.

6. If a TTL pulse is observed, the 85902A trigger circuitry is working. If

a TTL pulse is not observed, then there may be an open wire in the dc supply cable.

7. Remove the bottom cover of the 85902A. Refer to the "End and Bottom Covers Removal" procedure in Chapter 6 of this guide. Connect the dc supply cable to the probe power output port of an analyzer and use a voltmeter to carefully check the voltages on the printed circuit board, as indicated in Figure 4-2.

**Figure 4-2 DC Supply Voltages on the PC Board Assembly**




8. If either voltage is missing, replace the dc supply cable. If the voltages are correct, visually check the "RF INPUT" and "TRIG OUT (TTL)" BNC connectors, especially where they are soldered to the PC board assembly. Make sure they are making good electrical connection.

9. If the BNC connectors are good, then the burst carrier trigger circuitry is not working; replace the PC board assembly.

# Bad RF Preamplifier Output

1. First, make sure that the dc supply cable is plugged in, all cables in the equipment setup used are attached to the correct ports, and that the cables are in good electrical condition. These are the most likely causes of failure.
2. Use a voltmeter to check the dc voltages at the probe power output connector of the spectrum analyzer or power supply. The RF preamplifier circuitry uses only the +15 V supply, although the burst trigger circuitry uses both supplies. Figure 4-1 shows the nominal voltages on each of the probe power connector pins.
3. If the proper voltages are present at the spectrum analyzer probe power connector, check the "PREAMP IN" and "PREAMP OUT" BNC connectors for damage. Replace any bad connectors found.
4. If the connectors look good, then perform one of the preamplifier functional tests in Chapter 2 of this guide. Each test confirms operation using different test equipment.
5. If the functional test fails, there may be an open wire in the dc supply cable. Remove the bottom cover of the 85902A. Refer to the "End and Bottom Covers Removal" procedure in Chapter 6 of this guide. Connect the dc supply cable to the probe power output port of an analyzer and use a voltmeter to carefully check the voltages on the printed circuit board, as indicated in Figure 4-2.
6. If either voltage is missing, replace the dc supply cable. If the voltages are correct, visually check the "PREAMP IN" and "PREAMP OUT" BNC connectors, especially where they are soldered to the PC board assembly. Make sure they are making good electrical connection.
7. If the BNC connectors are good, then the RF preamplifier circuitry is not working; replace the PC board assembly.

# 5 Replaceable Parts

This chapter contains information for identifying and ordering replacement assemblies and unique electrical and mechanical parts for the 85902A. Most PC board component-level parts are not included.

# How to Order Replaceable Parts

To order replacement parts listed in this chapter, contact your nearest Agilent Technologies Sales and Service Office and quote the part number and quantity desired. Customers within the USA can also use either the direct mail-order system, or the direct phone-order system, which has a toll-free phone number available. Each of these systems is described below.

## USA Direct Mail-Order System

Within the USA, Agilent Technologies can supply parts through a direct mail-order system. Advantages of using the system are:

- Direct ordering and shipment from Agilent Technologies.
- No maximum or minimum on any mail order. Parts ordered through a local Agilent Technologies office that require billing and invoicing include a minimum order amount for parts.
- Transportation is prepaid, although each order includes a small handling charge.
- No invoices

To provide these advantages, a check or money order must accompany each order. Mail-order forms and specific ordering information are available through your local Agilent Technologies office.

## USA Direct Phone-Order System

Within the USA, a phone order system is available for regular and hotline replacement parts service. A toll-free phone number is available, and Mastercard and Visa are accepted.

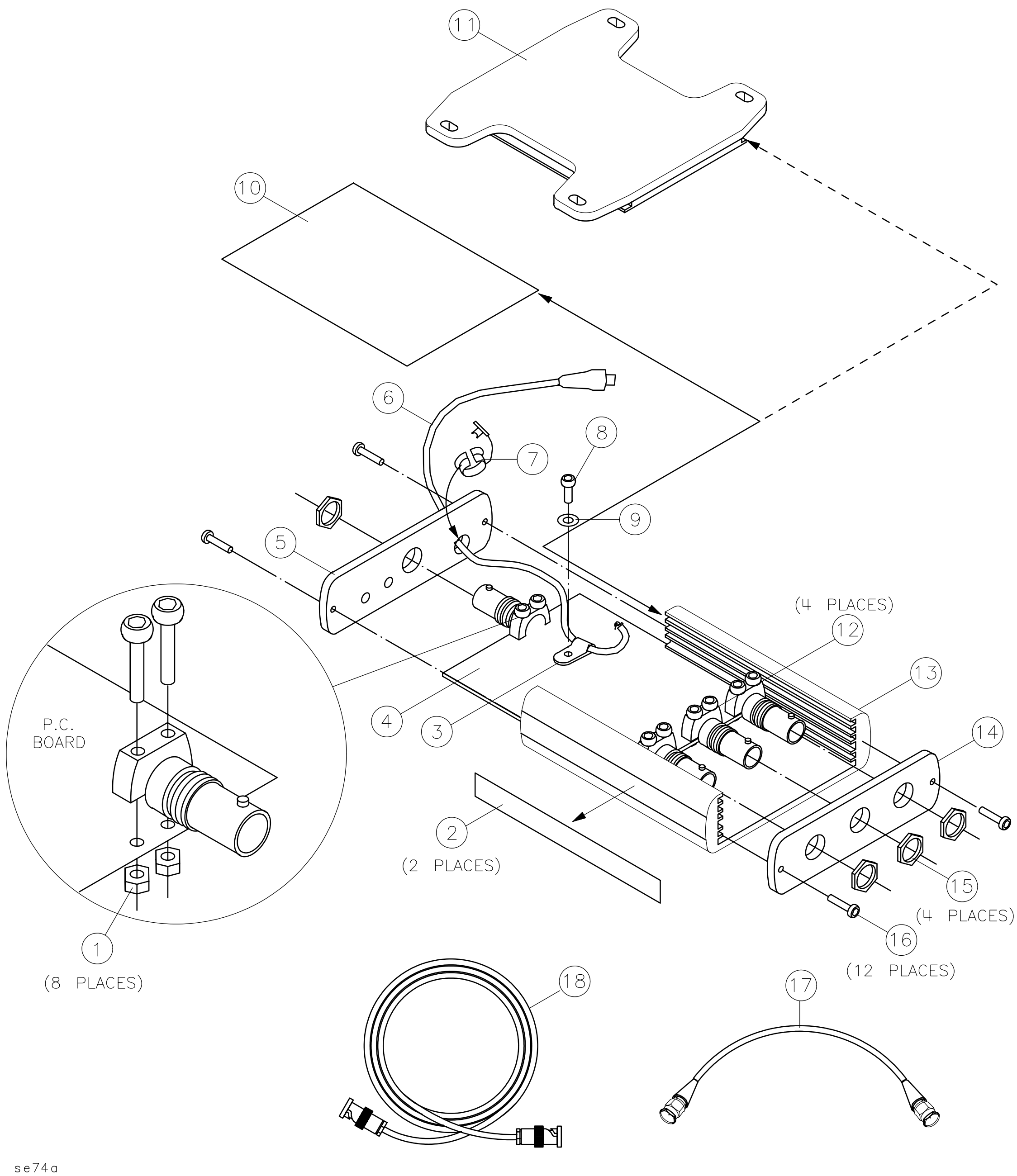
## Regular Orders.

The toll-free phone number, (800) 227-8164, is available Monday through Friday, 6 AM to 5 PM, Pacific Standard time. Regular orders have a four-day delivery time.

## Hotline Orders.

Hotline service is available 24 hours a day, 365 days per year, for emergency parts ordering. The toll-free phone number, (800) 227-8164 is available Monday through Friday, 6 AM to 5 PM, Pacific Standard time. After-hours and on holidays, call (916) 795-8468. To cover the cost of freight and special handling, there is an additional hotline charge on each order. Hotline orders are normally delivered the next business day after they are ordered.

**Figure 5-1 85902A Replaceable Parts**



| Item | Agilent Technologies Part Number | Description |
|---|---|---|
| 1 | 0535-0031 | M3 nut with lockwasher |
| 2 | 85902-80001 | Identification label |
| 3 | 1400-0082 | DC supply cable holder |
| 4 | 85902-60001 | Burst carrier PC board assembly (includes item number 12,quantity 4) |
| 5 | 85902-20003 | End cover, power cable end |
| 6 | 85902-60002 | DC supply cable assembly |
| 7 | 0400-0019 | DC supply cable grommet |
| 8 | 0515-0372 | M3-8 torx screw with lockwasher |
| 9 | 3050-0893 | M4.0 ID flat washer |
| 10 | 85902-00001 | Bottom cover |
| 11 | 83006-20007 | Bottom cover/mounting bracket (option 001) |
| 12 | 1250-0524 | RF BNC connector |
| 13 | not replaceable | Main housing |
| 14 | 85902-20002 | End cover, RF input/output end |
| 15 | 0590-1251 | 15/32-32 hex nut |
| 16 | 0515-0665 | M3-14 torx screw with lockwasher |
| 17 | 8120-2682 | BNC cable assembly, 23 cm (9 in.) |
| 18 | 8120-2582 | BNC cable assembly, 122 cm (48 in.) |
| not shown | 85902-90001 | Operating and Service Guide |

# 6 Replacement Procedures

This chapter contains step-by-step procedures that explain how to replace certain parts and assemblies of the 85902A.

# Before You Start

There are two things you must do before you perform any of the replacement procedures in this chapter:

1. Familiarize yourself with the safety notes given below.
2. Read the section entitled “Protection from Electrostatic Discharge” in this chapter.

# Safety Notes

The following safety notes are used throughout this manual. Familiarize yourself with these notes before operating this instrument.

WARNING **Warning denotes a hazard. It calls attention to a procedure which, if not correctly performed or adhered to, could result in injury or loss of life. Do not proceed beyond a warning note until the indicated conditions are fully understood and met.**

CAUTION Caution denotes a hazard. It calls attention to a procedure that, if not correctly performed or adhered to, could result in damage to or destruction of the instrument. Do not proceed beyond a caution sign until the indicated conditions are fully understood and met.

## General Safety Considerations

Before servicing the 85902A Burst Carrier Trigger and RF Preamplifier, familiarize yourself with the safety markings on the instrument and the safety instructions in this operating and service guide. This accessory has been manufactured and tested according to international safety standards. To ensure safe operation of the unit and the personal safety of the user and service personnel, the cautions and warnings in this operating and service guide must be heeded.

# Reliability Considerations

## Protection from Excessive Input Signals

The 85902A input circuitry can be damaged by power levels that exceed the maximum safe input level. See General Specifications Table on page 23 for maximum safe input levels. To prevent input damage, these levels must not be exceeded.

## Protection from Electrostatic Discharge

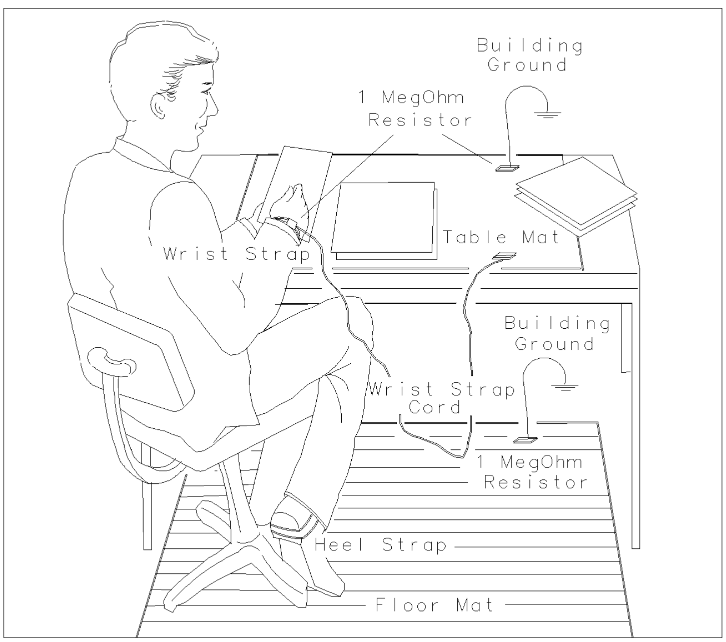
Electrostatic discharge can damage or destroy electronic components. All work on electronic assemblies should be performed at a static-safe work station. Figure 6-1 illustrates an example of a static-safe work station using two types of ESD protection:

- Conductive table-mat and wrist-strap combination.
- Conductive floor-mat and heel-strap combination.

Both types, when used together, provide a significant level of ESD protection. Of the two, only the table-mat and wrist-strap combination provides adequate ESD protection when used alone.

WARNING **These techniques for a static-safe work station should not be used when working on circuitry with a voltage potential greater than 500 volts.**

**Figure 6-1 Example of a Static-Safe Workstation**



## Handling of Electronic Components and ESD

The possibility of unseen damage caused by ESD is present whenever components are transported, stored, or used. The risk of ESD damage can be greatly reduced by close attention to how all components are handled.

- Perform work on all components at a static-safe workstation.
- Keep static-generating materials at least one meter away from all components.
- Store or transport components in static-shielding containers.

**CAUTION** Always handle printed circuit board assemblies by the edges. This will reduce the possibility of ESD damage to components and prevent contamination of exposed plating.

**Table 6-1 Static Safe Accessories**

| Agilent Technologies Part Number | Description |
|---|---|
| 9300-0797 | Set includes: 3M static control mat 0.6 m × 1.2 m (2 ft. × 4 ft.) and 4.6 cm (15 ft.) ground wire. (The wrist-strap and wrist-strap cord are not included. They must be ordered separately.) |
| 9300-0980 | Wrist-strap cord 1.5 m (5 ft.) |
| 9300-1383 | Wrist-strap, color black, stainless steel, without cord, has four adjustable links and a 7 mm post-type connection. |
| 9300-1169 | ESD heel-strap (reusable 6 to 12 months) |

## Test Equipment Usage and ESD

- Before connecting any coaxial cable to an instrument connector for the first time each day, momentarily short the center and outer conductors of the cable together.
- Personnel should be grounded with a 1 MΩ resistor-isolated wrist-strap before touching the center pin of any connector and before removing any assembly from the instrument.
- Be sure that all instruments are properly earth-grounded to prevent build-up of static charge.

### For Additional Information about ESD

For more information about preventing ESD damage, contact the Electrical Over Stress/Electrostatic Discharge (EOS/ESD) Association, Inc. The ESD standards developed by this agency are sanctioned by the American National Standards Institute (ANSI).

**CAUTION** Important assembly processes are explained in these procedures which are otherwise not apparent. Follow the replacement procedures in this chapter to avoid damage to the unit.

**CAUTION** **Static Sensitive Parts.** The 85902A contains static-sensitive components that must be properly protected. Always handle printed circuit board assemblies by the edges. This will reduce the possibility of ESD damage to components and prevent contamination of exposed plating.

# Replacement Procedures

## Tools Required

These tools are required to perform all the replacement procedures:

- static-safe work station
- socket wrench and 9/16-inch deep socket
- T-10 TORX screwdriver
- pliers
- needle-nose pliers
- wire cutters
- soldering iron
- rosin-core solder
- masking tape

## Available Options for the 85902A

### Instrument Options:

Option 001: Adds a flat mounting bracket attached to the bottom of the unit. The bracket contains four flanges that extend outward from the bottom cover. Each flange has an oblong hole drilled through it for easy mounting to a flat surface.

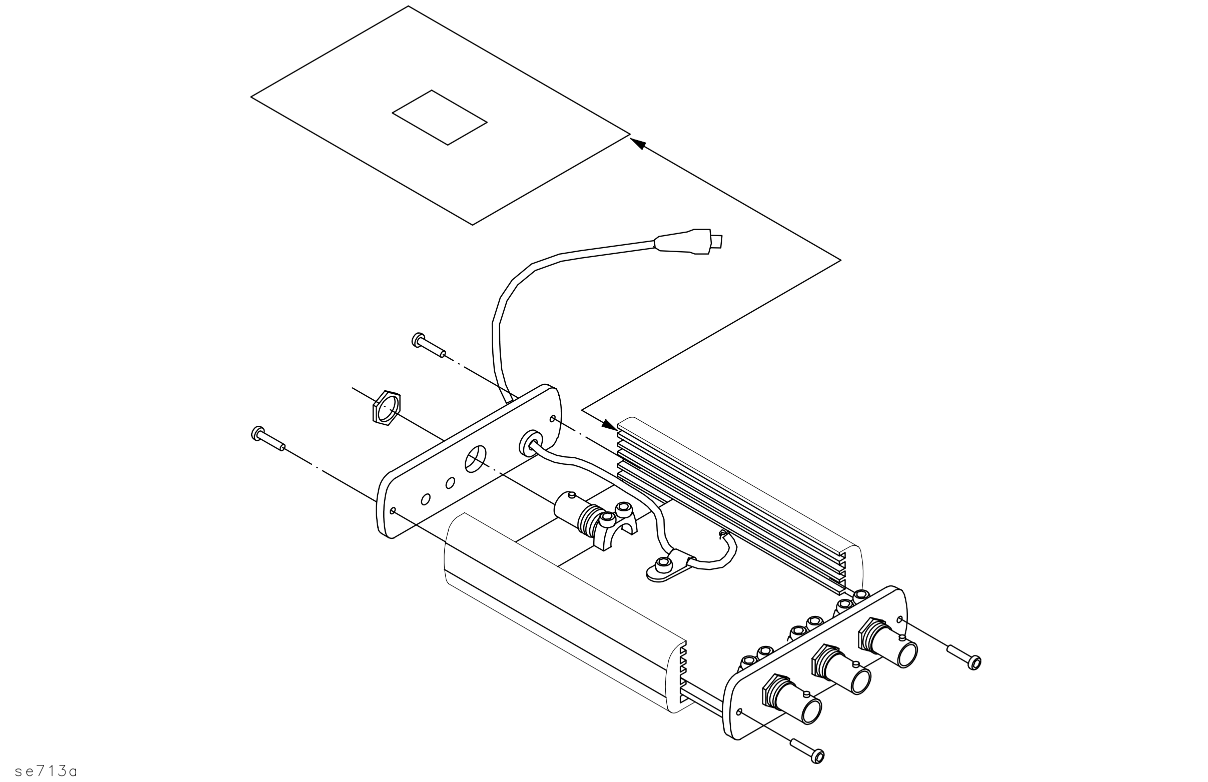
### Documentation Options:

Option 0BN: Provides an additional copy of the operating and service guide when ordered at the time the instrument is ordered. To order extra operating and service guides after the product has been delivered, order the Agilent Technologies part number on the title page of this operating and service guide. You can place the order through your local Agilent Technologies Sales and Service Office.

## End and Bottom Covers Removal

Perform this general procedure when directed to do so from any other replacement procedure in this chapter. This procedure is required as part of most other procedures.

**Figure 6-2 Removing End and Bottom Covers**



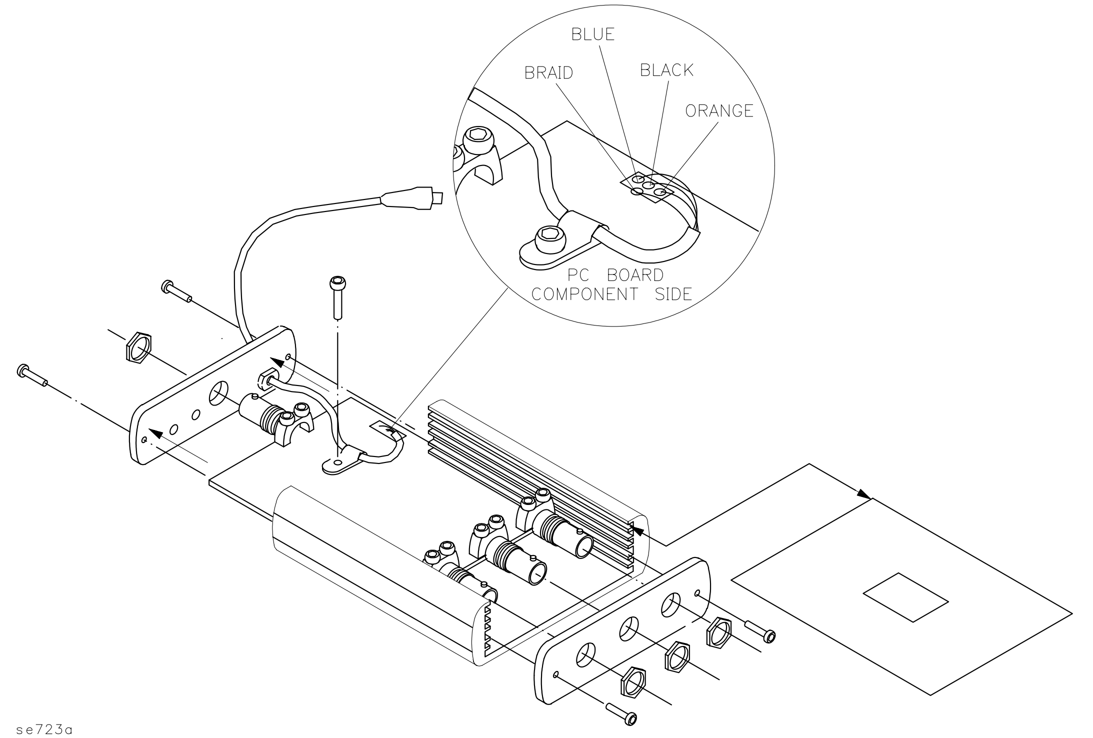

### Procedure

This procedure takes approximately 10 minutes to complete. Refer to Figure 6-2.

1. Put masking tape on the leading edge of a 9/16-inch socket. This will prevent the tool from scratching the end cover in the next step.
2. Use the socket wrench in step 1 to remove the hex nut holding the BNC connector to the DC supply cable end cover.
3. Use a T-10 TORX screwdriver to remove the four M3-14 screws holding the two end covers to the main housing.
4. Carefully remove the DC supply cable end cover. Turn the 85902A upside-down and slide the bottom cover off the unit.

## PC Board Replacement

**Figure 6-3 Removing the PC Board Assembly**




### Procedure

This procedure takes approximately two hours to perform. Refer to Figure 6-3.

1. Put masking tape on the front edge of a 9/16-inch deep socket. This will prevent the tool from scratching the end cover in the next step.
2. Use the socket wrench in step 1 to remove the four hex nuts holding the BNC connectors onto both end covers.
3. Use a T-10 TORX screwdriver to remove the four M3-14 screws from both end covers.
4. Carefully remove the input/output end cover. Turn the 85902A upside-down and slide the bottom cover off the unit.
5. Carefully slide the PC board assembly out of the main housing toward the DC supply end cover.
6. Turn the PC board assembly over, trace-side up. Use a pencil soldering iron to desolder and remove the four wires soldered to the PC board assembly at J5.

7. Use a T-10 TORX screwdriver to loosen the M3-8 screw holding the DC supply cable holder to the board. Remove the cable holder.

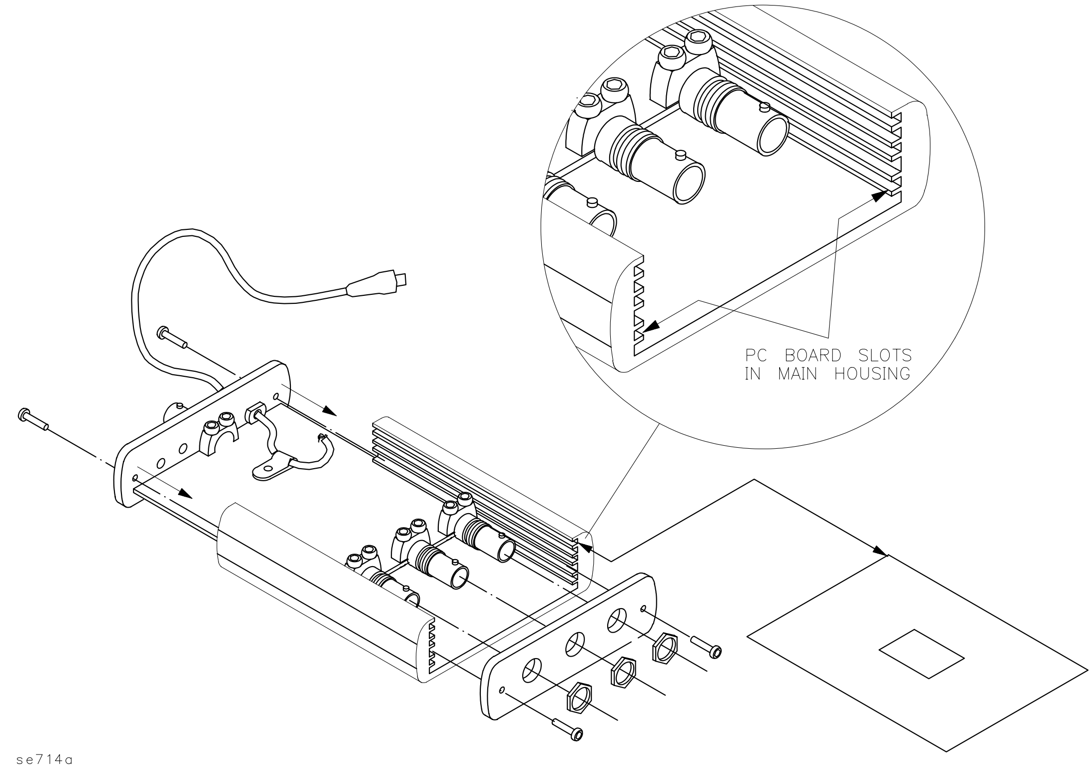
8. Carefully remove the DC supply cable end cover and position it over the BNC connector on the new PC board assembly.

9. Attach the DC supply cable holder to the board using a T-10 TORX screwdriver and an M3-8 screw.

10. Solder the four DC supply cable wires onto the new PC board assembly as shown in Figure 6-3.

11. Refer to Figure 6-4 and carefully slide the PC board assembly back into the main housing toward the input/output end cover.

**Figure 6-4 Installing the New PC Board Assembly**




12. Turn the 85902A upside-down and slide the bottom cover onto the unit.

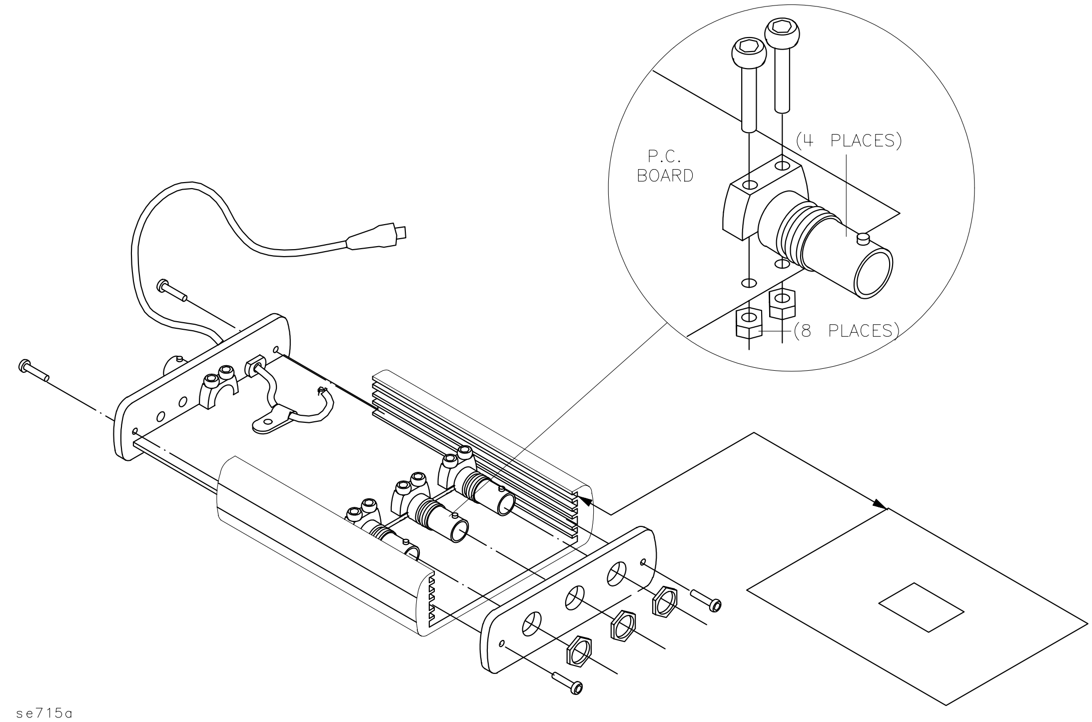
13. Use a T-10 TORX screwdriver and four M3-14 screws to attach both end covers to the main housing.

14. Use the socket wrench to attach the four hex nuts to secure the BNC connectors onto both end covers.

15. To confirm electrical operation, perform the functional tests in Chapter 2 .

## BNC Connector Replacement

**Figure 6-5 Replacing a BNC Connector**




### Procedure

This procedure takes approximately two hours to complete, and applies when replacing any of the BNC connectors. Refer to Figure 6-5.

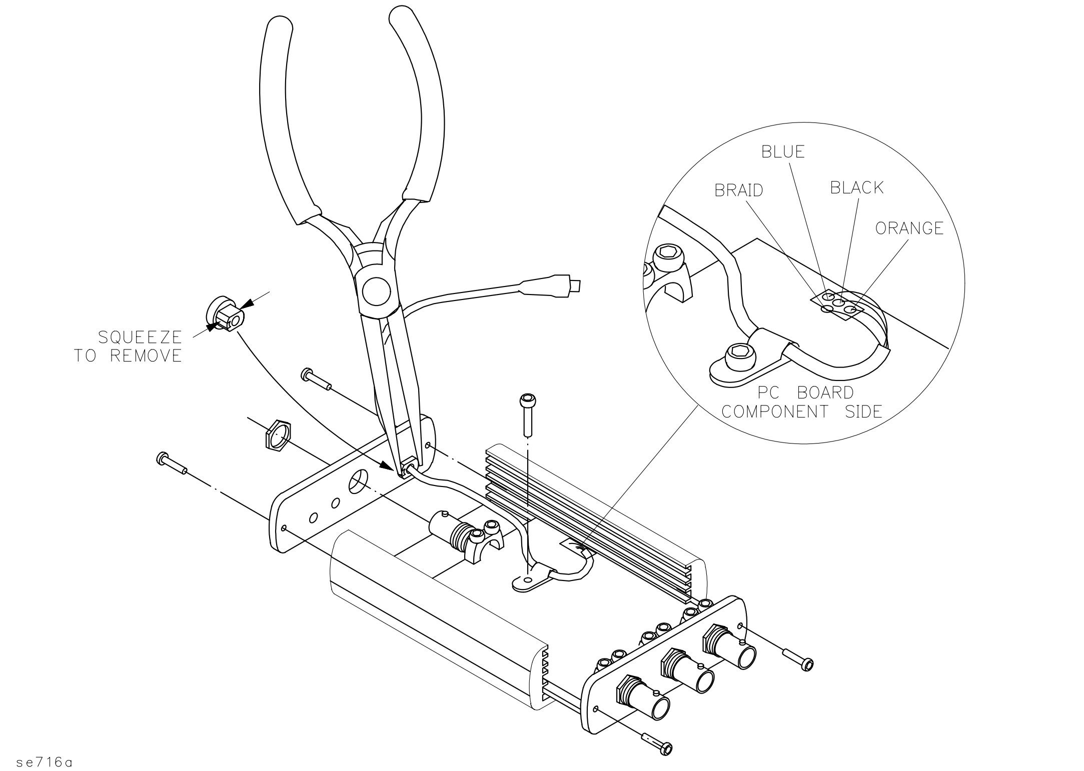
1. If only the TRIG OUT (TTL) BNC connector is being replaced, perform the “End and Bottom Covers Removal” procedure described earlier in this chapter and continue with step 6. If any other BNC connectors are to be replaced, continue with step 2.
2. Put masking tape on the front edge of a 9/16-inch deep socket. This will prevent the tool from scratching the end cover in the next step.
3. Use the socket wrench in step 2 to remove the three hex nuts holding the BNC connectors onto the input/output end cover.
4. Use a T-10 TORX screwdriver to remove the four M3-14 screws from both end covers.
5. Carefully remove the input/output end cover. Turn the 85902A upside-down and slide the bottom cover off the unit.
6. Carefully slide the PC board assembly out of the main housing.
7. Use a T-10 TORX screwdriver to remove the two M3-14 screws and M3 nuts with lockwashers that hold the bad BNC connector to the PC board assembly.

8. Use a small pencil soldering iron to desolder and remove the bad BNC center pin from the PC board assembly. Be careful NOT to heat any surface mount components with the iron.
9. Heat the center pin of the replacement BNC connector and fill it with solder. Make sure the center pin of the replacement BNC connector is oriented so that the closed edge of the center pin is touching the PC board assembly when installed on the PC board assembly.
10. Loosely attach the replacement BNC connector onto the PC board assembly. Assemble two M3-14 screws and M3 nuts with lockwashers finger-tight through the BNC connector and PC board. Do NOT solder the connector center conductor yet.
11. Slide the PC board assembly into the main housing and attach both end covers by tightening four M3-14 screws using a T-10 TORX screwdriver. The bottom cover should be OFF at this time.
12. Secure all BNC connectors to the end cap using a 9/16-inch deep socket and 15x32-32 hex nuts. Tighten the nut or nuts to approximately 20 in-lbs.
13. Use a T-10 TORX screwdriver to tighten the two M3-14 screws holding the new BNC connector to the PC board assembly. Tighten these screws to approximately 6 in.-lbs.
14. Use a small pencil soldering iron to solder the new BNC center pin to the PC board assembly. Be careful NOT to heat any surface mount components with the iron.
15. Use a 9/16-inch deep socket to remove the hex nut holding the BNC connector to the DC supply cable end cover.
16. Use a T-10 TORX screwdriver to remove the two M3-14 screws from the DC supply cable end cover and carefully remove the end cover.
17. Slide the bottom cover onto the main housing and replace the DC supply cable end cover.
18. Use a T-10 TORX screwdriver to tighten the two M3-14 screws holding the end cover to the main housing.
19. Use a 9/16-inch deep socket to tighten the hex nut holding the BNC connector onto the DC supply cable end cover.
20. To confirm electrical operation, perform the functional tests in Chapter 2 .

Replacement Procedures

## DC Power Cable Replacement

**Figure 6-6 Replacing the DC Power Cable**




### Procedure

This procedure takes approximately two hours to complete. Refer to Figure 6-6.

1. Perform the “End and Bottom Covers Removal” procedure described earlier in this chapter.
2. Carefully slide the PC board assembly out of the main housing toward the input/output end cover.
3. Turn the PC board assembly over, trace side up. Use a pencil soldering iron to desolder and remove the four wires soldered to the PC board at J5.
4. Use a T-10 TORX screwdriver to loosen the M3-8 screw holding the DC supply cable holder to the board. Remove the cable holder.
5. Use pliers or needle-nose pliers to squeeze the DC supply cable grommet and push it out of the hole toward the outside surface of the side cover.

6. Pull the DC supply cable through its hole in the side cover. Insert the replacement cable through the side cover hole and re-install the grommet approximately 10 centimeters (4 inches) from the pigtail end of the DC supply cable. Squeeze the grommet and re-install it in the side cover hole from the outside surface of the side cover.
7. See Figure 6-5 inset. Solder the four wires of the DC supply cable into the three holes of J5 on the PC board. Take note of the wire colors.
8. Use a T-10 TORX screwdriver and an M3-8 screw to re-install the DC supply cable holder, securing the cable to the PC board. Allow approximately 7 centimeters (8.75 inches) of cable between the cable holder and the DC supply cable side cover.
9. Carefully slide the PC board assembly into the main housing.
10. Slide the bottom cover onto the main housing towards the input/output end cover. Attach both end covers to the main housing with four M3-14 screws and a T-10 TORX screwdriver.
11. Use a 9/16-inch deep socket to tighten the hex nut holding the BNC connector onto the DC supply cable end cover.
12. To confirm electrical operation, perform the functional tests in Chapter 2 .

## Main Housing End Cover Replacement, DC Supply End

### Procedure

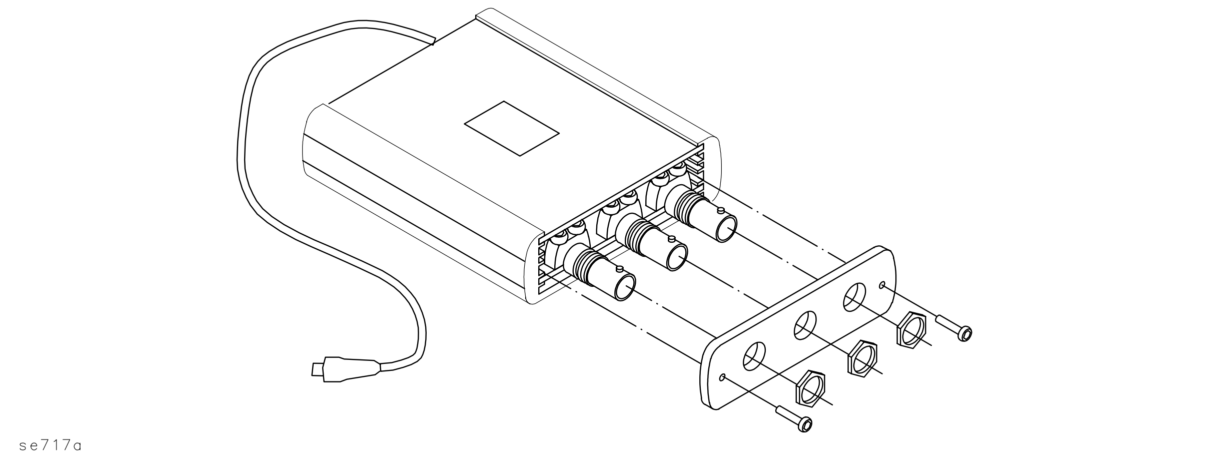
This procedure takes approximately two hours to complete.

Perform the "DC Power Cable Replacement" procedure in this chapter, except replace step 6 with the following:

1. Perform the “End and Bottom Covers Removal” procedure described earlier in this chapter.
2. Carefully slide the PC board assembly out of the main housing toward the input/output end cover.
3. Turn the PC board assembly over, trace side up. Use a pencil soldering iron to desolder and remove the four wires soldered to the PC board at J5.
4. Use a T-10 TORX screwdriver to loosen the M3-8 screw holding the DC supply cable holder to the board. Remove the cable holder.
5. Use pliers or needle-nose pliers to squeeze the DC supply cable grommet and push it out of the hole toward the outside surface of the side cover.
6. Pull the DC supply cable through its hole in the side cover. Insert the cable through the replacement side cover hole and re-install the grommet at the location it was removed from the cable. Look for the bend impressions made in the cable for this location. Squeeze the grommet and re-install it in the side cover hole from the outside surface of the side cover.
7. See Figure 6-5 inset. Solder the four wires of the DC supply cable into the three holes of J5 on the PC board. Take note of the wire colors.
8. Use a T-10 TORX screwdriver and an M3-8 screw to re-install the DC supply cable holder, securing the cable to the PC board. Allow approximately 7 centimeters (8.75 inches) of cable between the cable holder and the DC supply cable side cover.
9. Carefully slide the PC board assembly into the main housing.
10. Slide the bottom cover onto the main housing towards the input/output end cover. Attach both end covers to the main housing with four M3-14 screws and a T-10 TORX screwdriver.
11. Use a 9/16-inch deep socket to tighten the hex nut holding the BNC connector onto the DC supply cable end cover.
12. To confirm electrical operation, perform the functional tests in Chapter 2 .

## Main Housing End Cover Replacement, Input/Output End

**Figure 6-7** **Replacing the Main Housing End Cover, Input/Output End**




### Procedure

This procedure takes approximately 90 minutes to complete. Refer to Figure 6-7.

1. Put masking tape on the leading edge of a 9/16-inch deep socket. This will prevent the tool from scratching the end cover in the next step.
2. Use the socket wrench in step 1 to remove the three hex nuts holding the BNC connectors onto the input/output end cover.
3. Use a T-10 TORX screwdriver to remove the two M3-14 screws from the input/output end cover.
4. Carefully remove the input/output end cover and put the new end cover over the three BNC connectors.
5. Use the 9/16-inch deep socket to attach the three hex nuts holding the BNC connectors onto the input/output end cover.
6. Attach the new end cover to the main housing using two M3-14 screws and a T-10 TORX screwdriver.
7. To confirm electrical operation, perform the functional tests in Chapter 2.

Replacement Procedures

### Table 6-2 Agilent Technologies Sales and Service Offices

| | | |
|---|---|---|
| **UNITED STATES** | | |
| Instrument Support Center<br>Hewlett-Packard Company<br>(800) 403-0801 | | |
| **EUROPEAN FIELD OPERATIONS** | | |
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| **INTERCON FIELD OPERATIONS** | | |
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| Japan<br>Hewlett-Packard Japan, Ltd.<br>Measurement Assistance Center<br>9-1, Takakura-Cho, Hachioji-Shi,<br>Tokyo 192-8510, Japan<br>TEL (81) -426-56-7832<br>FAX (81) -426-56-7840 | Singapore<br>Hewlett-Packard Singapore (Pte.) Ltd.<br>150 Beach Road<br>#29-00 Gateway West<br>Singapore 0718<br>(65) 291-9088 | Taiwan<br>Hewlett-Packard Taiwan<br>8th Floor, H-P Building<br>337 Fu Hsing North Road<br>Taipei, Taiwan<br>(886 2) 712-0404 |
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