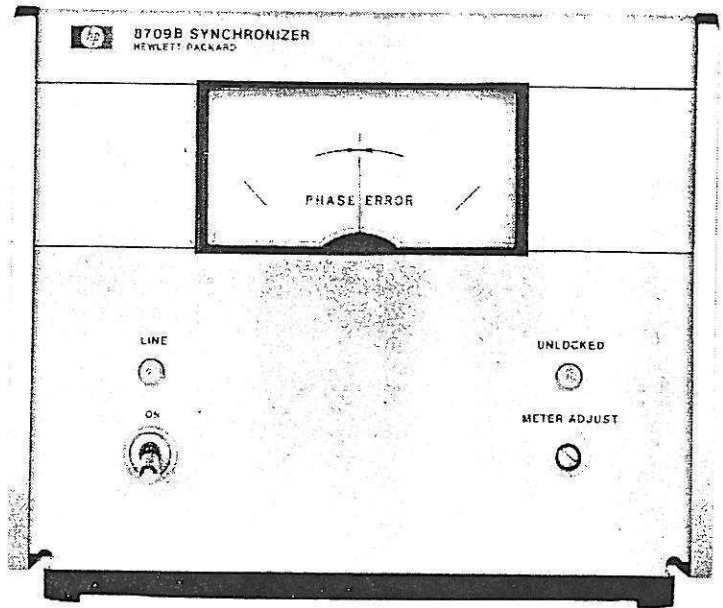


8709B SYNCHRONIZER



HEWLETT
PACKARD

CERTIFICATION

Hewlett-Packard Company certifies that this product met its published specifications at the time of shipment from the factory. Hewlett-Packard further certifies that its calibration measurements are traceable to the United States National Bureau of Standards, to the extent allowed by the Bureau's calibration facility, and to the calibration facilities of other International Standards Organization members.

WARRANTY

This Hewlett-Packard instrument product is warranted against defects in material and workmanship for a period of one year from date of shipment. During the warranty period, Hewlett-Packard Company will, at its option, either repair or replace products which prove to be defective.

For warranty service or repair, this product must be returned to a service facility designated by HP. Buyer shall prepay shipping charges to HP and HP shall pay shipping charges to return the product to Buyer. However, Buyer shall pay all shipping charges, duties, and taxes for products returned to HP from another country.

HP warrants that its software and firmware designated by HP for use with an instrument will execute its programming instructions when properly installed on that instrument. HP does not warrant that the operation of the instrument, or software, or firmware will be uninterrupted or error free.

LIMITATION OF WARRANTY

The foregoing warranty shall not apply to defects resulting from improper or inadequate maintenance by Buyer, Buyer-supplied software or interfacing, unauthorized modification or misuse, operation outside of the environmental specifications for the product, or improper site preparation or maintenance.

NO OTHER WARRANTY IS EXPRESSED OR IMPLIED. HP SPECIFICALLY DISCLAIMS THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

EXCLUSIVE REMEDIES

THE REMEDIES PROVIDED HEREIN ARE BUYER'S SOLE AND EXCLUSIVE REMEDIES. HP SHALL NOT BE LIABLE FOR ANY DIRECT, INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, WHETHER BASED ON CONTRACT, TORT, OR ANY OTHER LEGAL THEORY.

ASSISTANCE

Product maintenance agreements and other customer assistance agreements are available for Hewlett-Packard products.

For any assistance, contact your nearest Hewlett-Packard Sales and Service Office. Addresses are provided at the back of this manual.

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SAFETY CONSIDERATIONS

GENERAL

This product and related documentation must be reviewed for familiarization with safety markings and instructions before operation. This product has been designed and tested in accordance with international standards.

SAFETY SYMBOLS



Instruction manual symbol: the product will be marked with this symbol when it is necessary for the user to refer to the instruction manual (refer to Table of Contents).



Indicates hazardous voltages.



Indicates earth (ground) terminal.

WARNING

The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which, if not correctly performed or adhered to, could result in personal injury. Do not proceed beyond a WARNING sign until the indicated conditions are fully understood and met.

CAUTION

The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which, if not correctly performed or adhered to, could result in damage to or destruction of part or all of the product. Do not proceed beyond a CAUTION sign until the indicated conditions are fully understood and met.

SAFETY EARTH GROUND

This is a Safety Class I product (provided with a protective earthing terminal). An uninterruptible safety earth ground must be provided from the main power source to the product input wiring terminals, power cord, or supplied power cord set. Whenever it is likely that the protection has been impaired, the product must be made inoperative and be secured against any unintended operation.

BEFORE APPLYING POWER

Verify that the product is configured to match the available main power source per the input power configuration instructions provided in this manual.

If this product is to be energized via an autotransformer, make sure the common terminal is connected to the neutral (grounded) side of mains supply.

SERVICING

WARNING

Any servicing, adjustment, maintenance, or repair of this product must be performed only by qualified personnel.

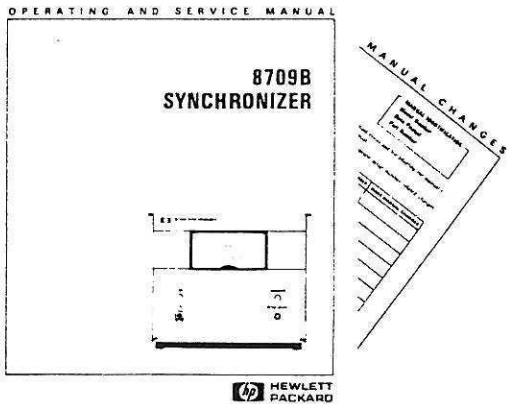
Adjustments described in this manual may be performed with power supplied to the product while protective covers are removed. Energy available at many points may, if contacted, result in personal injury.

Capacitors inside this product may still be charged even when disconnected from its power source.

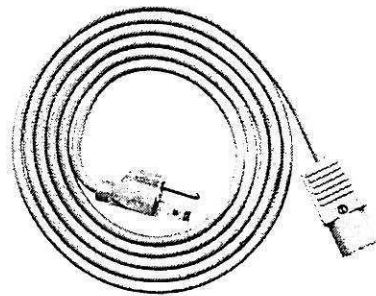
To avoid a fire hazard, only fuses with the required current rating and of the specified type (normal blow, time delay, etc.) are to be used for replacement.



OPERATING AND SERVICE MANUAL
with Manual Changes Supplement (if necessary)



LINE POWER CABLE



Power cable and plug supplied according to country of destination. Refer to Section II for Part Number information.

Figure 1-1. Model 8709B Synchronizer and Accessories supplied

SECTION I GENERAL INFORMATION

1-1. INTRODUCTION

1-2. This Operating and Service Manual contains information required to install, operate, test, adjust, and service the Hewlett-Packard Model 8709B Synchronizer. Figure 1-1 shows the HP 8709B and supplied accessories.

1-3. This manual is divided into eight major sections which provide the following information:

- a. **SECTION I, GENERAL INFORMATION**, includes a brief description of the instrument, safety considerations, specifications, supplemental characteristics, instrument identification, options available, accessories available, and a list of recommended test equipment.
- b. **SECTION II, INSTALLATION**, provides information for initial inspection, preparation for use, rack mounting, storage, and shipment.
- c. **SECTION III, OPERATION**, provides operating instructions, characteristics of operation, and operator's checks and maintenance.
- d. **SECTION IV, PERFORMANCE TESTS**, presents procedures required to verify that performance of the instrument is in accordance with published specifications.
- e. **SECTION V, ADJUSTMENTS**, presents procedures required to properly adjust and align the HP 8709B Synchronizer after repair.
- f. **SECTION VI, REPLACEABLE PARTS**, provides information required to order all parts and assemblies.
- g. **SECTION VII, MANUAL BACKDATING CHANGES**, provides backdating information required to make this manual compatible with earlier shipment configurations.
- h. **SECTION VIII, SERVICE**, provides an overall instrument block diagram with troubleshooting and repair procedures. Each assembly within the instrument is covered on a separate Service Sheet which contains a circuit description, schematic diagram, component location diagram, and troubleshooting information to aid the proper maintenance of the instrument.

1-4. On the front cover of this manual is a "Microfiche" part number. This number may be used to order 10- by 15-centimetre (4- by 6-inch) microfilm transparencies of the Manual. Each microfiche contains up to 60 photo duplicates of the manual pages. The microfiche package also includes the latest Manual Change Sheet, as well as all pertinent Service Notes.

1-5. Refer any questions regarding this manual, the Manual Change Sheet, or the instrument to the nearest HP Sales/Service Office. Always identify the instrument by model number, complete name, and complete serial number in all correspondence. Refer to the inside rear cover of this manual for a worldwide listing of HP Sales/Service Offices.

1-6. SPECIFICATIONS

1-7. Listed in Table 1-1 are the specifications for the Model 8709B Synchronizer. These specifications are the performance standards, or limits, against which the instrument may be tested. Table 1-2 lists supplemental characteristics for the HP 8709B; supplemental characteristics are not specifications but are typical characteristics included as additional information for the user.

1-8. SAFETY CONSIDERATIONS

1-9. General

1-10. This product and related documentation must be reviewed for familiarization with safety markings and instructions before operation. This product has been manufactured and tested in accordance with international safety standards.

1-11. Safety Symbols

1-12. A complete listing of the safety symbols used in this manual is given on the page following the Table of Contents. Included are descriptions of symbols which refer the operator to the manual from the instrument, Protective Earth Ground, Frame or Chassis Terminals, Warning, and Caution symbols.

1-13. INSTRUMENTS COVERED BY MANUAL

1-14. Attached to the rear panel of the instrument is a serial number label, similar to the label shown in Figure 1-2. The serial number is in two parts: The first four digits followed by a letter comprise the serial number prefix, the last five digits form the sequential suffix that is unique to each instrument. The content of this manual applies directly to instruments having the same serial number prefix as those listed on the Title Page of this manual under SERIAL NUMBER.

1-15. An instrument manufactured after the printing of this manual may have a serial prefix that is not listed on the Title Page. An unlisted serial prefix indicates that the instrument is different from those documented in this manual. The manual for the instrument is then supplied with a Manual Changes supplement that documents the differences.

1-16. In addition to change information, the Manual Changes supplement contains information for correcting errors in the manual. To keep this manual as current as possible, Hewlett-Packard recommends that you periodically request the latest Manual Changes supplement. The supplement for this manual is keyed to the manual's print date and part number, both of which appear on the Title Page. Complimentary copies of the Manual Changes supplement are available on request from Hewlett-Packard.

1-17. For information concerning a serial number prefix that is not listed on the Title Page or in the Manual Changes supplement, contact your nearest Hewlett-Packard Sales/Service Office.

1-18. DESCRIPTION

1-19. The Hewlett-Packard Model 8709B Synchronizer is a phase comparator used to stabilize frequency sources. Frequency stabilization is accomplished through phase lock circuits that lock the external frequency source signal to the very stable internal reference signal.

1-20. Typically, the HP 8709B is used in HP 8409-series Automatic Network Analyzer systems. The nucleus of the HP 8409-series system is the HP 8410C Network Analyzer, which has an intermediate frequency (IF) of 20.278 MHz. The task of the HP 8709B Synchronizer is to stabilize system frequency sources to the IF of the HP 8410C Network Analyzer.

1-21. In operation, the HP 8709B compares the input signal to an internal 20.278 MHz source. If the input signal is not 20.278 MHz, the HP 8709B activates a blanking signal and a search signal: The blanking signal blanks the CRT displays of the HP 8409-series system; the search signal initiates a corrective frequency change in the frequency source.

1-22. The front panel of the HP 8709B has a meter and a lamp that indicate the phase lock status of the system: The UNLOCKED lamp is on (lighted) when the HP 8709B is searching for a 20.278 MHz signal, and the lamp is off when that signal is found and phase locked; the PHASE ERROR meter indicates the phase difference between the internal and external 20.278 MHz signals.

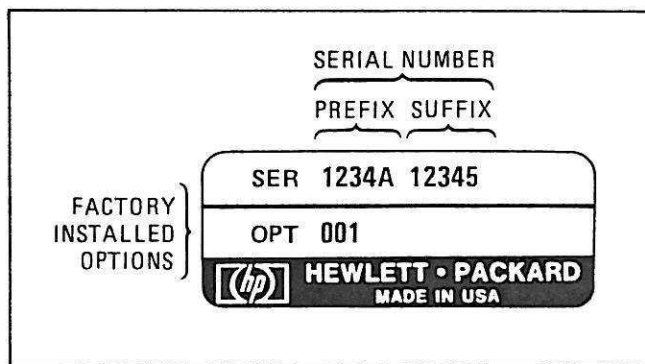


Figure 1-2. Typical Serial Number Label

1-23. OPTIONS**1-24. Option 910, Extra Operating and Service Manual**

1-25. The standard instrument is supplied with one Operating and Service Manual. Each Option 910 provides one additional Operating and Service Manual. To obtain additional Operating and Service Manuals after initial shipment, order by Manual Part Number, listed on the Title Page and rear cover of this manual.

1-26. ACCESSORIES SUPPLIED

1-27. The HP 8709B is supplied with an Operating and Service Manual, and a power cable. The power cable supplied depends on the country of destination. Refer to Section II of this

manual for HP Part Number information.

1-28. EQUIPMENT AVAILABLE

1-29. Hewlett-Packard Combining Case, Model 1051A or 1052A, can conveniently rack or bench mount the HP 8709B, and other small, modular Hewlett-Packard instruments. These cases can be stacked on top of each other, or on top of any full module instrument.

1-30. The Hewlett-Packard Rack Adaptor Frame, HP Part Number 5060-8762 CD0, is available for rack mounting the HP 8709B. Where quick removal and reinstallation of the HP 8709B from the rack is desirable, use the HP Combining Case (Model 1051A, or 1052A); however, use the HP Rack Adaptor Frame when permanent or semipermanent rack mounting is desired.

Table 1-1. HP Model 8709B Specification

Internal Oscillator Frequency 20.278 MHz \pm 1.0 kHz	Input Sensitivity -65 dBm
--	-------------------------------------

Table 1-2. HP Model 8709B Supplemental Characteristics

Internal Oscillator Stability 2 ppm/24 hours Maximum Input Voltage 1.0V rms Modulation Sensitivity -6.0 MHz/Volt Minimum Error Signal Output 10V p-p Impedance of Error Signal Output <200 ohms 20.278 MHz IF Leakage <5 μ V at Error Signal Output	Lock Point Rejection Will not lock when the reference oscillator harmonic is 20.278 MHz below the microwave source frequency. Unblanking Output -3V when phase-locked, -16V when unlocked. Capture Time <20 ms Power Requirements 115 or 230 Vac \pm 10%, 48 to 440 Hz, <34 volt-amps. Weight Net, 4.5 kg (10 lb.) Shipping, 5.45 kg (12 lb.) Dimensions 155 cm (6-3/32 inches) high, 190 cm (7-25/32 inches) wide, and 279 cm (11 inches) deep.
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1-31. For servicing the HP 8709B, a Service Extender Board (HP Part Number 5060-0049 CD0) improves the accessibility of the components on the HP 8709B board assemblies.

1-32. RECOMMENDED TEST EQUIPMENT

1-33. Equipment required for testing and adjustment of the HP 8709B is described in Sections IV (Performance Tests), V (Adjustments), and VIII (Service) of this manual. Other equipment may be substituted if it meets or exceeds the critical specifications listed in Table 1-3.

Table 1-3. Recommended Test Equipment

Instrument	Critical Specification	Recommended Model	Use*
CW Source	Capable of 20.278 MHz, -65 dBm output. Frequency Modulation (FM) of -6 MHz/Volt.	HP 8350A HP 83592A Opt. 002	P, A, T
Frequency Counter	Capable of measuring 20.278 MHz, with 1 kHz resolution.	HP 5335A	P, A, T
Oscilloscope	Dual trace oscilloscope, capable of 20.278 MHz measurements.	HP 1980B	P, A, T
Voltmeter	dc Voltmeter with 1 mV accuracy	HP 3465A	A, T
Milliammeter	dc milliammeter, 0-500 mA. Clip-on probe recommended.	HP 428B	T
dc Power supply	dc power supply, 0 \pm 2V range.	HP 6112A	T

Note: Use of these test instruments is (P) Performance Tests, (A) Adjustments, and (T) Service (testing).

SECTION II INSTALLATION

2-1. INTRODUCTION

2-2. This section provides installation instructions for the Hewlett-Packard Model 8709B Synchronizer and its accessories. This section also includes information about initial inspection and damage claims, preparation for use, packaging, storage, and shipment.

2-3. INITIAL INSPECTION

2-4. Figure 2-1 shows the factory packaging of the HP 8709B. Inspect the shipping container and packaging materials for damage. If they are damaged, the instrument might also be damaged and all shipping materials should be saved for inspection by the freight company.

2-5. Carefully unpack the shipping container, and compare the contents to what is shown in Figure 1-1. If anything is damaged or missing notify the nearest Hewlett-Packard Sales/Service Office. Hewlett-Packard will arrange for repair or replacement of your instrument without waiting for claim settlement.

WARNING

Do not operate a damaged instrument.

Do not operate an instrument that might have internal damage from shipping.

2-6. Procedures for checking electrical performance are given in Section IV, Performance Tests, of this manual. If the instrument does not pass the electrical Performance Tests, refer to Section V, Adjustments, of this manual. If, after adjustments have been made, the instrument still fails to meet specifications refer to the troubleshooting procedures in Section VIII, Service, of this manual. If the instrument does not pass the electrical Performance Tests, or if the shipment is incomplete, or if there is mechanical damage or defect, notify the nearest Hewlett-Packard Sales/Service Office.

2-7. PREPARATION FOR USE

2-8. Power Requirements

2-9. The Model 8709B Synchronizer requires either 115 or 230 Vac $\pm 10\%$, 48 to 440 Hz, single phase. Power consumption is less than 34 volt-amps.

2-10. Line Voltage and Fuse Selection

2-11. Select the line voltage and fuse as follows:

- a. Measure the AC line voltage.
- b. Select the position on the rear-panel LINE VOLTAGE selector switch that is closest to the voltage you measured in step a. If the measured line voltage is not within $\pm 10\%$ of the line voltages shown in Table 2-1 you must use an autotransformer between the power source and the HP 8709B.
- c. Make sure the correct fuse is installed in the fuse holder. The required rating for each line voltage is indicated in Table 2-1.

CAUTION

To prevent damage to the instrument, make the correct line voltage and fuse selection before connecting line power to the instrument.

2-12. Power Cable

2-13. In accordance with international safety standards, this instrument is equipped with a three-wire power cable. When connected to an appropriate outlet, this cable grounds the instrument cabinet. Table 2-2 shows the styles of plugs available on power cables supplied with HP instruments. The HP Part Numbers for the plugs are part numbers for the complete power cables. The type of power cable/plug shipped with the instrument depends upon the country of destination.

Table 2-1. Line Voltage/Fuse Selection

<p>Measured ac Line Voltage 230 \pm10%</p> <p>Fuse 0.2A slow-blow</p> <p>HP Part Number for Fuse 2110-0235, CD0</p>	<p>Measured ac Line Voltage 115 \pm10%</p> <p>Fuse 0.4A slow-blow</p> <p>HP Part Number for Fuse 2110-0340, CD8</p>
---	---

WARNING

Before switching on this instrument, be sure that only the specified power cable is used. The instrument is provided with a three-wire power cord which grounds the instrument cabinet. This power cord should only be inserted into a socket outlet provided with a protective earth contact. This protective action should not be negated by the use of an extension cord (power cable) that does not have a protective conductor (ground). Grounding one conductor of a two-conductor outlet is not sufficient protection.

2-14. The offset pin of the three-prong connector is the grounding pin. When operating the HP 8709B from a two-terminal outlet, the protective grounding feature can be preserved by using a three-prong to two-prong adapter (USA connectors only, HP Part Number 1251-0048, CD0) and connecting the green wire of the adapter to ground.

2-15. MOUNTING

2-16. The HP Model 8709B Synchronizer is usually rack mounted as part of an HP 8409-series Automatic Network Analyzer system. Rack mounting is accomplished with an HP combining case, or an HP adapter frame.

2-17. Combining Case. The combining case (HP Model 1051A, or HP Model 1052A), shown in Figure 2-2, will accept one or more Hewlett-Packard instruments of 17.8 cm (7 inches) height, whose total width is less than 48.3 cm (19 inches). Filler panels can be used when the instruments do not fill the case. The combining case can be rack mounted, or used as a multi-instrument bench-top case. Figure 2-2 illustrates the procedure for placing the HP 8709B into the combining case.

2-2

2-18. Adapter Frame. The adapter frame (HP Part Number 5060-8762, CD0) will accept one or more Hewlett-Packard instruments of 17.8 cm (7 inches) height, whose total width is less than 48.3 cm (19 inches). Filler panels can be used when instruments do not fill the frame. The frame is assembled as follows:

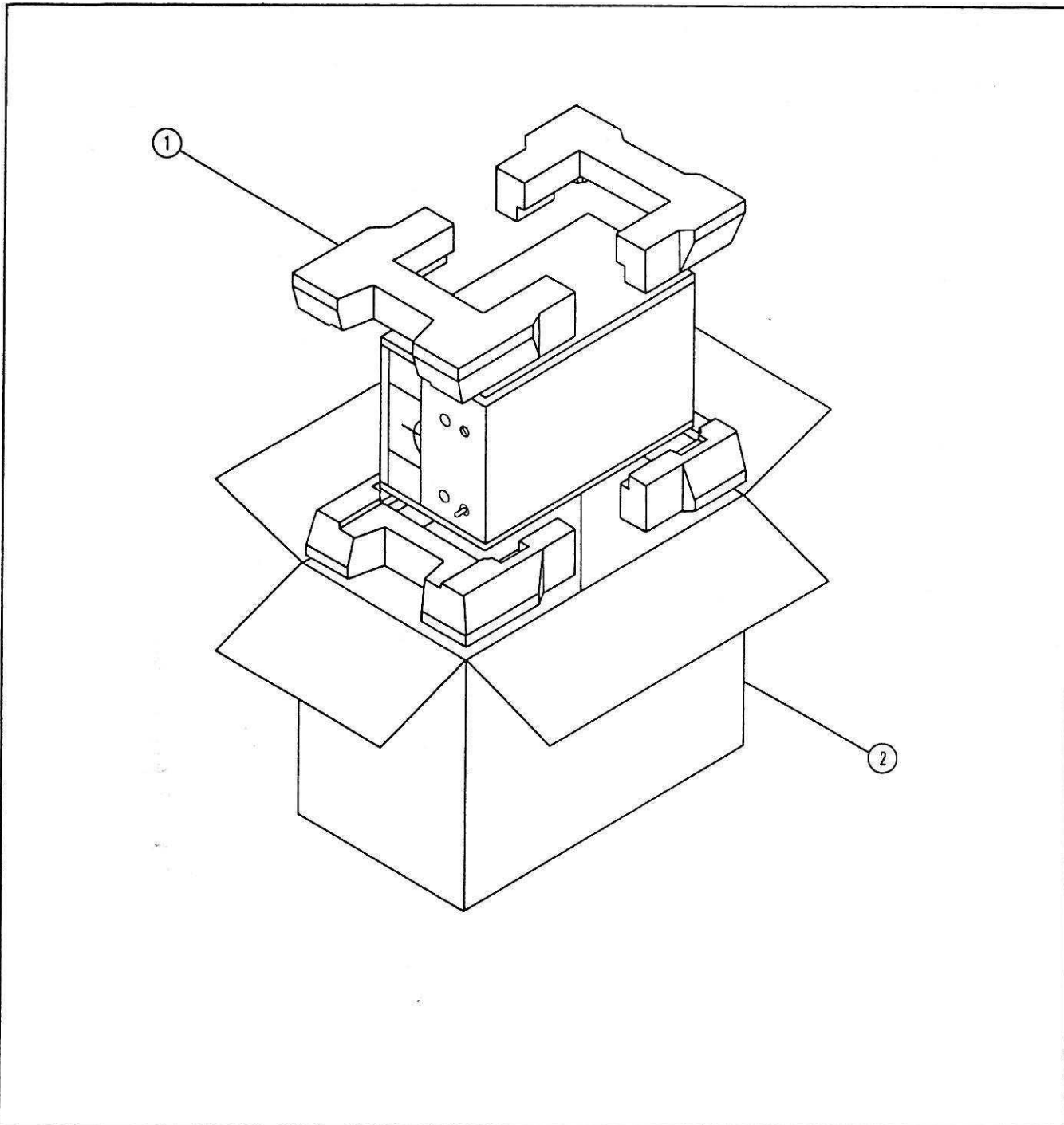
- Place the adapter frame on the edge of a bench, as shown in step 1, Figure 2-3.
- Stack the submodular units in the frame, as shown in step 2. Place the spacer clamps between instruments, step 3.
- Place spacer clamps on the two end instruments (step 4), and push the combination into the frame.
- Insert screws on either side of the frame, and tighten until all submodular instruments are secure.
- The completed assembly is ready for rack mounting.

2-19. INTERCONNECTIONS

2-20. There are four plug-in interconnections on the rear panel of the HP 8709B: INPUT, UNBLANKING OUTPUT, ERROR SIGNAL OUTPUT, INJECTION LOCK INPUT. The usual interconnections in an HP 8409-series Automatic Network Analyzer system are:

HP 8709B INPUT to the HP 8410C Network Analyzer (IF OUT)

HP 8709B UNBLANKING OUTPUT to a BNC TEE joining the HP 59313A A/D Converter (CH4) and the HP 8410C Network Analyzer (BLANK IN)



Item	Qty	HP Part Number	CD	Description
1	4	9220-1545	7	Foam Pads
2	1	9211-1347	8	Carton, Corrugated Cardboard
Not shown	1	9222-0484	5	Plastic Bag (for Manual)
Not shown	1	9222-0487	8	Cushioned Kraft Envelope (for Accessories)

Figure 2-1. HP 8709B Factory Packaging Materials

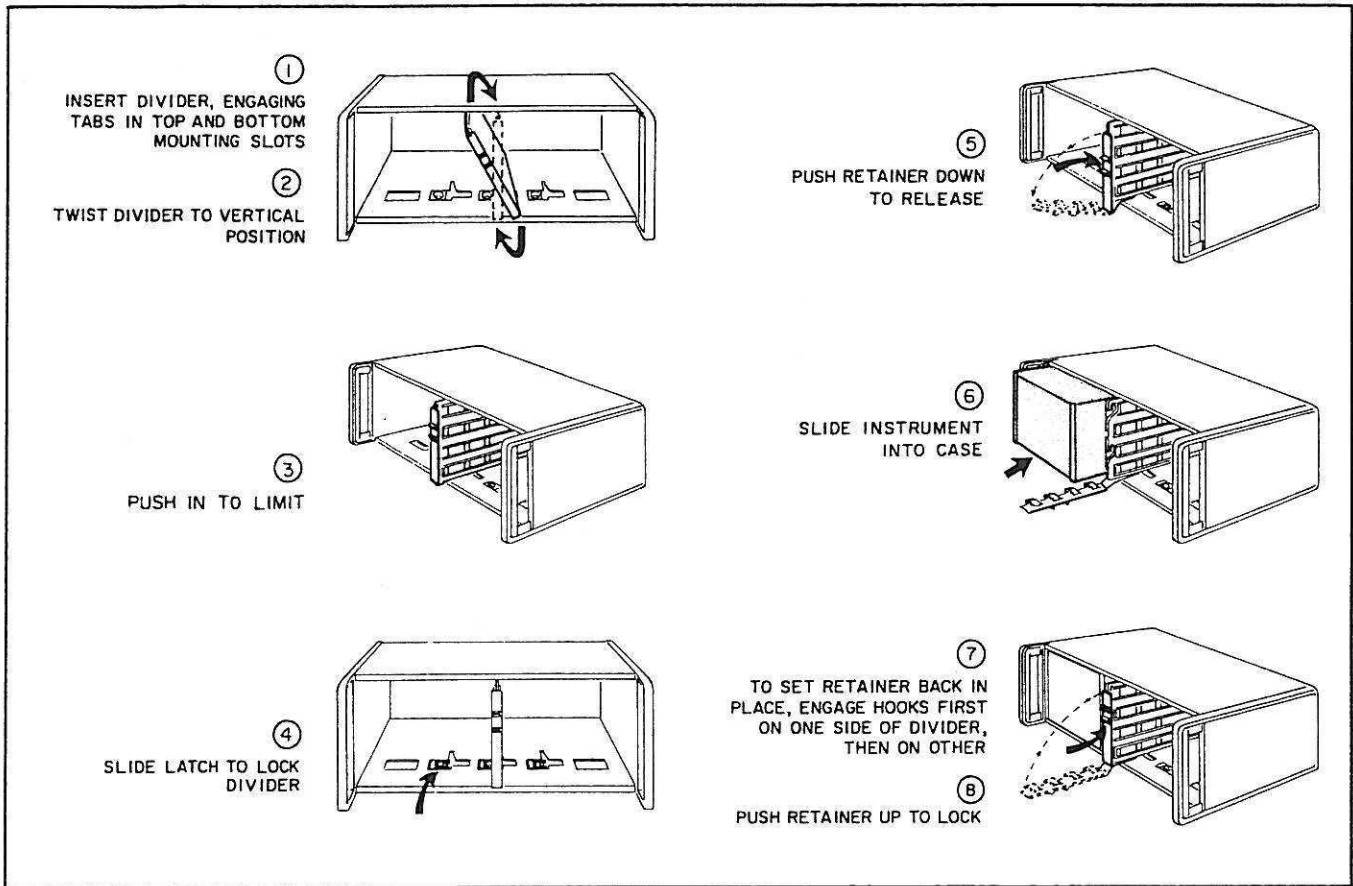


Figure 2-2. Steps to Place Instrument into Combining Case

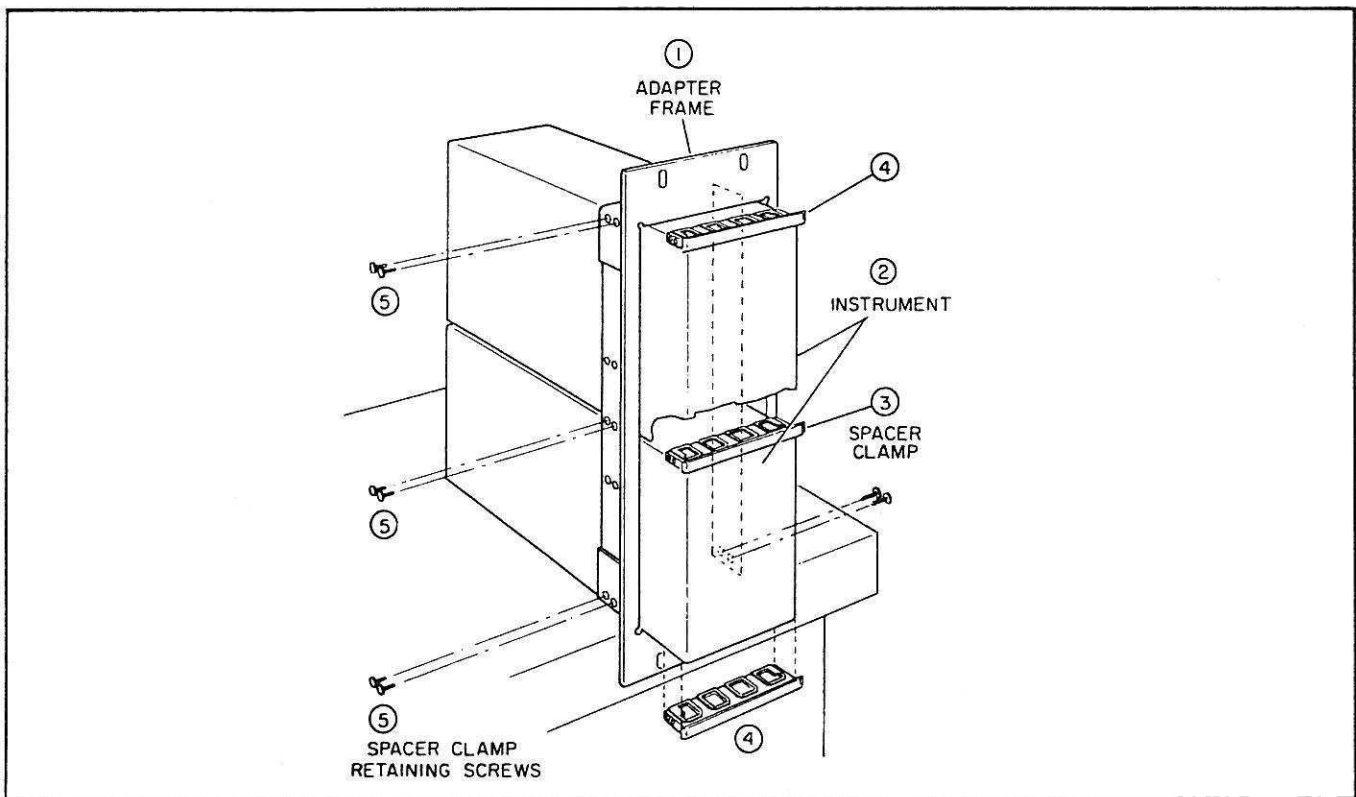


Figure 2-3. Mounting Sub-Module Units into Adapter Frame

HP 8709B ERROR SIGNAL OUTPUT to the HP 11859A Amplifier/Switch (FM IN)

HP 8709B INJECTION LOCK INPUT is not normally used in an HP 87409-series system.

Section VIII of the HP 8409-series Automatic Network Analyzer Operating and Service Manual (HP Part Number 08409-90069, CD5) contains detailed interconnection information.

2-21. Mating Connectors

2-22. All connections to the HP 8709B are made through rear-panel BNC connectors. Any standard, UG-88C/U BNC (m) connector will mate with the HP 8709B; several suitable connectors, cables, and adapters are listed in the HP Catalog. The HP 8409-series Automatic Network Analyzer system includes all necessary BNC cables.

2-23. OPERATING ENVIRONMENT

2-24. Temperature. The instrument may be operated in temperatures from 0°C to +55°C.

2-25. Humidity. The instrument may be operated in environments with humidity from 5% to 80% relative, at +25°C to +40°C. However, the instrument should always be protected from temperature extremes that could cause condensation within the instrument.

2-26. Altitude. The instrument may be operated at altitudes up to 4572 metres (approximately 15,000 feet).

2-27. Cooling. Clearances for ventilation should be at least 10 cm (4 inches) at the rear of the cabinet. The clearances provided by the plastic feet in bench stacking, and the filler strips in rack mounting are adequate for the top and bottom cabinet surfaces.

2-28. STORAGE AND SHIPMENT

2-29. Environment

2-30. The instrument may be stored or shipped in environments within the following limits:

Temperature -40°C to +75°C
 Humidity 5% to 95% relative at 0°C to +40°C
 Altitude <15,240 meters (approximately 50,000 feet)

2-31. PACKAGING

2-32. Original Packaging. The best package for your instrument is the original factory container. If the original container is no longer available, Hewlett-Packard Offices can supply suitable replacements. Figure 2-1 shows the factory packaging materials, and their HP Part Numbers.

2-33. Other Packaging. If your instrument must be packaged in other containers, the following sequence should be observed:

1. Protect the front and rear panels with cardboard or plastic foam.
2. Wrap the instrument in strong paper or plastic. If shipping to a Hewlett-Packard office or service center, attach a tag indicating the service required, return address, model number, and full serial number (blue service-request cards are located at the end of Section VIII in this manual).
3. Use a strong shipping container. A double-wall carton made from 2.4 MPa (350 PSI) test material is recommended.
4. Shock-absorbing material appropriate to the weight and fragility of the instrument should be used, with a minimum of 75-100 mm (3-4 inches) of cushioning on all sides.
5. Seal the container securely, and place FRAGILE labels on all sides.

Figure 2-4 illustrates the recommended packaging procedure.

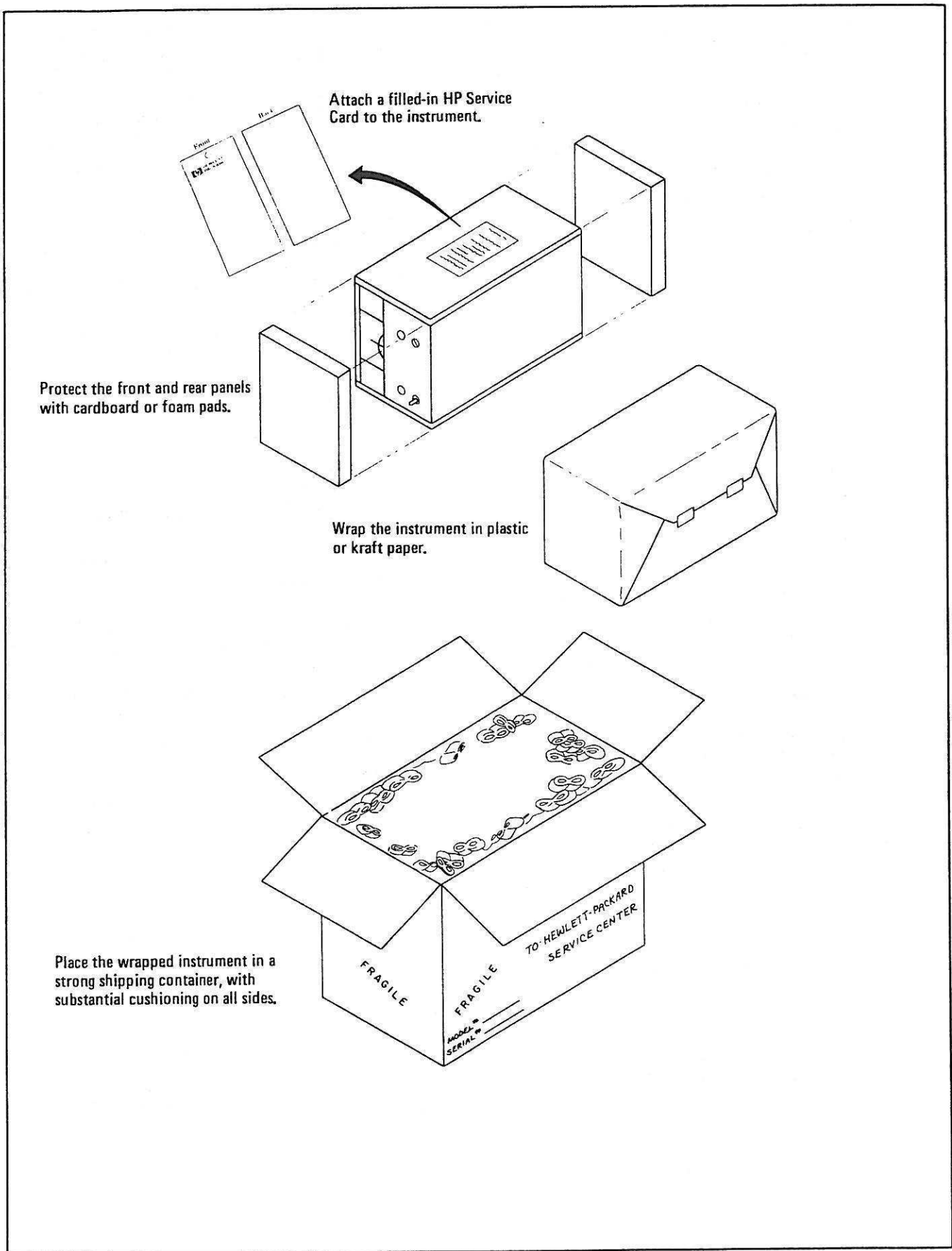


Figure 2-4. Packaging for Shipment

SECTION III OPERATING INFORMATION

3-1. INTRODUCTION

3-2. This section provides operating instructions for the Hewlett-Packard Model 8709B Synchronizer. This section also includes information about operating characteristics, operator's checks, and operator's maintenance.

3-3. SAFETY

3-4. Before applying power, refer to SAFETY CONSIDERATIONS in Section I of this manual.

3-5. The information, cautions, and warnings in this manual must be followed to ensure safe operation.

WARNING

Before the instrument is switched on, all protective earth terminals, extension cords, auto-transformers, and devices attached to this instrument must be connected to a protective earth-grounded socket. Any interruption of the protective earth grounding will cause a potential shock hazard that could result in personal injury.

Only fuses of the required current rating and specified type should be used. Do not use repaired fuses or a short-circuited fuseholder; to do so could cause a shock or fire hazard.

CAUTION

Before the instrument is switched on, it must be set to the voltage of the power source or damage to the instrument might result.

3-6. OPERATING CHARACTERISTICS

3-7. The HP 8709B Synchronizer is a phase comparator designed to stabilize the frequency source in an HP 8409-series Automatic Network Analyzer system by phase locking the source to

a reference oscillator. Under phase locked conditions, the stability of the system is primarily determined by the stability of the reference oscillator. Any Hewlett-Packard sweep oscillator having -6MHz/Volt modulation sensitivity and operating from 0.01 to 18 GHz can be phase locked in an HP 8409-series system.

3-8. The input locking frequency of the HP 8709B is 20.278 MHz, with a sensitivity of -65 dBm . This frequency is obtained by multiplying and mixing the reference oscillator signal with the microwave source signal. The HP 8709B will lock on the reference oscillator harmonic that is 20.278 MHz above the microwave source signal; the HP 8709B will reject the reference oscillator harmonic that is 20.278 MHz below the source signal.

3-9. When searching for a 20.278 MHz lock signal, the HP 8709B outputs a 70-130 Hz search signal with 10 V p-p amplitude. The modulation sensitivity of the frequency source in an HP 8409-series Automatic Network Analyzer system is -6.0 MHz/volt ; therefore, under maximum search conditions the output search signal of the HP 8709B initiates a frequency change in the microwave frequency source of $\pm 30\text{ MHz}$. Typical capture time for a 20.278 MHz signal to be found and phase locked in an HP 8409-series system is $< 20\text{ ms}$.

3-10. When the 20.278 MHz signal is phase locked, the HP 8709B outputs a dc voltage that stabilizes the microwave frequency source. The dc voltage has a range of -5 to $+5$ volts, which affects the frequency source by $\pm 30\text{ MHz}$ (e.g., if the HP 8709B dc output voltage is -2.5 V , the microwave frequency source would be affected by $+15\text{ MHz}$: -2.5 V times -6.0 MHz/V equals $+15\text{ MHz}$.)

3-11. The HP 8709B also has an UNBLANKING output that blanks the CRT displays when the system is not phase locked.

3-12. The front panel of the HP 8709B has two indicators of the phase locking process: 1) The UNLOCKED lamp is off (unlighted) when the system is phase locked, on (lighted) when the HP 8709B is searching for a lockable signal; 2) the PHASE ERROR meter shows the phase difference between the input signal and the internal 20.278 MHz signal. The deflection of the PHASE ERROR meter's needle also indicates the polarity and magnitude of the dc output voltage being sent from the HP 8709B to the microwave frequency source.

3-13. The HP 8709B is intended for dedicated use in an HP 8409-series Automatic Network Analyzer system. The HP 8409-series system manuals contain additional operating information concerning the HP 8709B.

3-14. PANEL FEATURES

3-15. Front panel features are described in Figure 3-1.

3-16. Rear panel features are described in Figure 3-2.

3-17. OPERATOR'S CHECKS

3-18. The operator's check allows the operator to make a quick check of the phase locking function of the HP 8709B. This check assumes that the HP 8709B is correctly installed in an HP 8409-series Automatic Network Analyzer system. The operator's check is performed as follows:

1. Place the HP 8709B POWER toggle switch to ON (up), and observe that the LINE (ac power) indicator light is lighted.
2. Set the HP 8410C Network Analyzer SOURCE switch to the PHASE LOCK position.
3. Set the microwave frequency source (typically, an HP 8350 Sweep Oscillator) to any convenient CW frequency (2.0 GHz is used as an example in this procedure). Set the power level of the RF plug-in to +6.0 dBm, and turn the RF plug-in's CW filter switch to off. The RF plug-in modulation sensitivity should be set to -6.0 MHz/V (refer to Figure 4-2 and the RF plug-in manual for specific information if necessary).

4. Determine the frequency of the reference oscillator (typically, an HP 3335 Frequency Synthesizer). The HP 8409-series system doubles the frequency of the reference oscillator, then sends that frequency through a 140 MHz bandpass filter; consequently, the frequency of the reference oscillator must be approximately 70 MHz. The exact reference oscillator frequency is found as follows:

a. Determine the required harmonic frequency. The HP 8709B will lock on the harmonic that is 20.278 MHz higher than the microwave source frequency; thus, for this 2.0 GHz example, the required harmonic frequency is 2.020278 GHz.

b. Divide the required harmonic frequency by 140 MHz (in this example, $2,020.278 \text{ MHz} / 140 \text{ MHz}$ equals 14.43), then round the result to the next highest whole number (15 in this example).

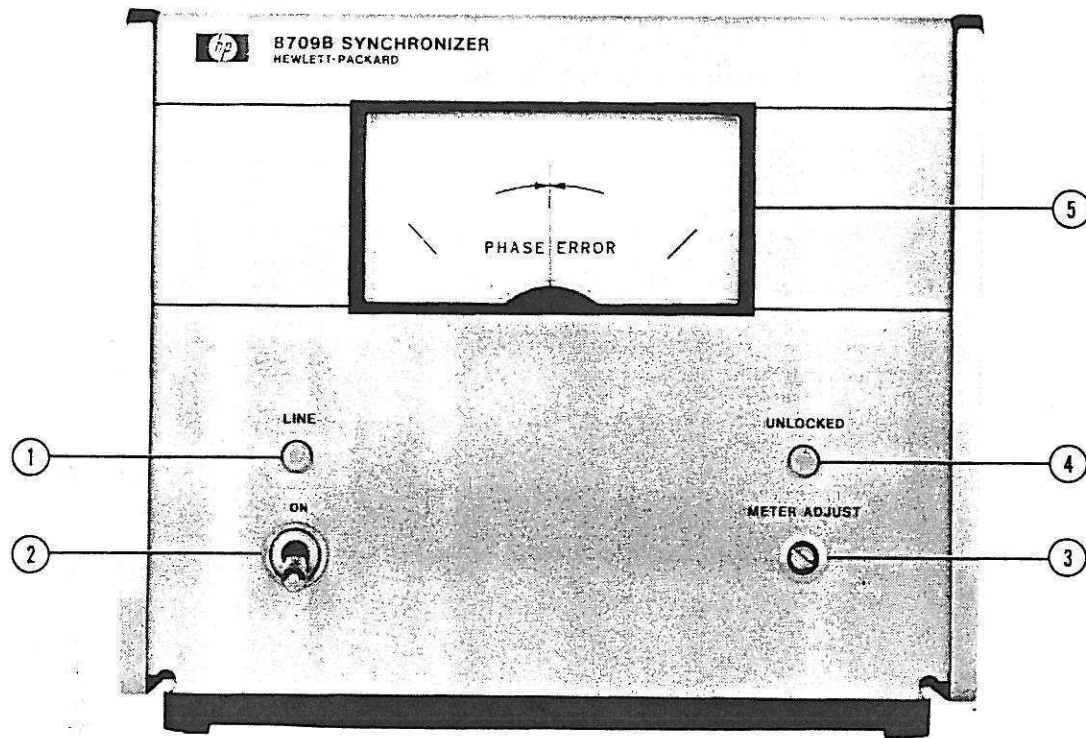
c. Divide the required harmonic frequency by the whole number obtained in step b, which gives the doubled frequency of the reference oscillator ($2,020.278 \text{ MHz} / 15$ equals 134.6852 MHz). The reference oscillator should be set to 1/2 of that doubled frequency (67.3426 in this example).

5. Set the output power level of the reference oscillator to +6.0 dBm.

6. The HP 8709B should now be phase locked: The UNLOCKED light will be off, and the PHASE ERROR meter needle will be on the scale (although probably not centered).

7. Next, manually change the frequency of the microwave source. As the microwave source frequency changes, the HP 8709B PHASE ERROR meter will track the change until the HP 8709B loses phase lock. Phase lock will be lost at approximately 30 MHz above, or 30 MHz below the original frequency of the microwave source (phase lock will be lost at 2.030 GHz, and 1.070 GHz in this example).

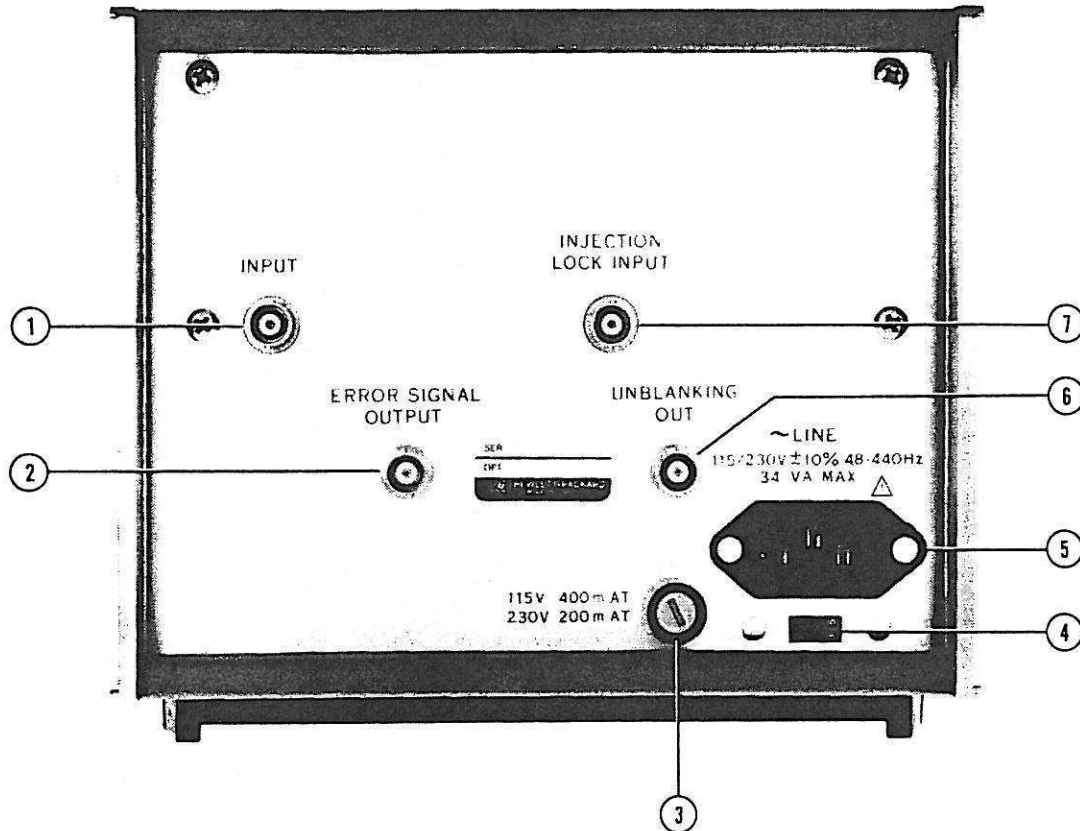
FRONT PANEL FEATURES



1. LINE power indicator light. This light is ON when the HP 8709B is receiving ac line power.
2. Power ON/OFF toggle switch.
3. METER ADJUST potentiometer shaft: This adjusts the symmetry of the ERROR SIGNAL OUTPUT waveform. The adjustment procedure is described in Section V (Adjustments) of this manual.
4. UNLOCKED indicator lamp: This lamp is ON when the 8709B is searching for a 20.278 MHz signal, and is OFF when that signal is found and phase locked to the internal reference oscillator.
5. PHASE ERROR meter: This indicates the phase difference between the INPUT frequency and the internal reference frequency.

Figure 3-1. HP 8709B Front Panel Controls and Indicators

REAR PANEL FEATURES



1. INPUT: Input the 20.278MHz (1.0 V p-p maximum) signal at this BNC connector. Typically connected to the HP 8410B/C Network Analyzer IF OUT.
2. ERROR SIGNAL OUTPUT: A search signal (10 V p-p, 70-130 Hz) is present when the system is not phase locked. An error signal (-5 to +5 Vdc) is present when the system is phase locked. Typically connected to the HP 11859A Amplifier/Switch FM IN.
3. FUSE: Refer to Table 2-1 for fuse information.
4. LINE VOLTAGE SELECTOR: Select either 115 +/- 10% Vac, or 230 +/- 10% Vac (48 to 440 Hz).
5. LINE CORD RECEPTACLE: Refer to Table 2-2 for power cord information. The center pin of this receptacle is connected to the instrument chassis.
6. UNBLANKING OUTPUT: The dc output voltage is -16 V when the system is phase locked, -3 V when not phase locked. Typically connected to a BNC TEE joining the HP 59313A A/D Converter (CH 4) and the HP 8410B/C Network Analyzer (BLANK IN).
7. INJECTION LOCK INPUT: This allows injection locking of the internal 20.278 MHz oscillator to an external 20.278 MHz +/- 200 Hz (0.1 to 2.5 V rms) signal. This input is not used in a typical HP 8409-series Automatic Network Analyzer system.

Figure 3-2. HP 8709B Rear Panel Connectors and Switches

This completes the Operator's Check. If the HP 8709B did not perform as described, refer to Sections IV (Performance Tests) and V (Adjustments) of this manual.

3-19. OPERATING INSTRUCTIONS

3-20. After the HP 8709B is correctly installed in an HP 8409-series Automatic Network Analyzer system, no further operator manipulation of the HP 8709B is required.

3-21. Because the HP 8709B is intended for dedicated use in an HP 8409-series Automatic Network Analyzer system, the HP 8409-series system manuals should be consulted for further information.

3-22. OPERATOR'S MAINTENANCE

3-23. Operator's maintenance consists of replacing a defective fuse, replacing burned-out indicator lights, and cleaning the BNC connectors. These maintenance procedures are explained in the following paragraphs.

3-24. Fuses

3-25. The ac line fuse, located on the rear panel of the HP 8709B, may be replaced by the operator if it is defective. The value for the fuse is printed on the rear panel of the instrument. The value and HP Part Number for the fuse can be found in Sections II (Installation) and VI (Replaceable Parts) of this manual.

WARNING

For continued protection against fire hazard, replace the ac line fuse only with a fuse of the same rating and type as the original fuse.

The ac line fuse may blow if the fuse is defective, or if the instrument malfunctions; ascertain the cause of a blown fuse before resuming operation of the instrument.

3-26. To replace the ac line fuse, switch the HP 8709B POWER switch to off (down), and unplug the ac line cord from the power source. The fuse

can then be changed by unscrewing the fuse cap, removing the old fuse, and installing the new one.

3-27. Indicator Lights

3-28. There are two indicator lights, LINE (ac power) and UNLOCKED, on the front panel of the HP 8709B that may be replaced by the operator. To replace one or both lights, turn the POWER switch to off (down), unplug the ac line cord from the power source, and unscrew the plastic lens that covers the light. The HP Part Number for the replacement light can be found in Section VI (Replaceable Parts) of this manual.

CAUTION

The UNLOCKED light is an integral part of the HP 8709B electrical circuits, and must be replaced immediately if it burns out. The HP 8709B will not operate without a functioning UNLOCKED light.

WARNING

The LINE (ac power) light is an important safety indicator and should be replaced promptly if it burns out.

3-29. Plug-In Interconnect

3-30. If BNC plug-in cables are changed frequently, and/or the interconnectors are dirty, the HP 8709B rear-panel BNC connectors may require periodic cleaning to avoid voltage losses.

3-31. Service Tag Information

3-32. If the HP 8709B Synchronizer requires service beyond the level of operator's maintenance, the instrument may be sent to the nearest HP Service Center, as described in Section II of this manual. Before returning the instrument, fill out and attach one of the blue service cards found in Section VIII of this manual. List any special control settings or failure symptoms on the service card.

SECTION IV PERFORMANCE TESTS

4-1. INTRODUCTION

4-2. The procedures described in this section test the electrical performance of the HP 8709B Synchronizer, and verify the specifications that are listed in Section I of this manual.

4-3. Performance testing of the HP 8709B may be required at incoming receiving inspection, as confidence checking at regular or irregular intervals, or as a preamble to internal troubleshooting. Performance testing is confined to rapid and relatively simple testing procedures that use only the external connections of the HP 8709B; however, comparison of the test results with the Specifications (Table 1-1) and Supplemental Characteristics (Table 1-2) will indicate whether dismantling the instrument and examining the internal circuitry is warranted. Four performance parameters are measured by these Performance Tests: 1)INPUT FREQUENCY, 2)INPUT SENSITIVITY, 3)UNBLANKING OUTPUT, and 4)ERROR SIGNAL OUTPUT.

4-4. EQUIPMENT REQUIRED

4-5. Equipment required to test and adjust the HP 8709B Synchronizer is listed in the Recommended Test Equipment table in Section I of this manual. Any equipment that satisfies the critical specifications given in the Recommended Test Equipment table may be substituted for the recommended model. Figure 4-1 illustrates the recommended equipment and the recommended test configuration.

4-6. OPERATION VERIFICATION

4-7. For a simple screening test to verify that the HP 8709B Synchronizer is functioning properly, perform the Operator's Check described in Section III of this manual. Although the Operator's Check is neither comprehensive nor infallible, it will detect coarse instrument malfunctions.

4-8. TEST RECORD

4-9. Results of the performance tests may be tabulated on the Test Record located at the end of this Section of the manual. The Test Record lists all of the test values and their acceptable limits.

4-10. TEST SEQUENCE

4-11. The INPUT FREQUENCY TEST should be performed first, followed by the other Performance Tests in any sequence. If any test result is unsatisfactory, the Adjustment procedures of Section V, or the Service procedures in Section VIII should be performed.

4-12. CALIBRATION CYCLE

4-13. Hewlett-Packard recommends periodic verification of the performance of the HP 8709B. Depending on the amount of use and the operating environment, the HP 8709B should be checked at least once every year.

4-14. PERFORMANCE TESTS

4-15. Specific Equipment Requirements

4-16. The following equipment, or functionally equivalent equipment, is required for all of the Performance Tests described in this Section of the manual:

1. Oscilloscope, dual channel, bandwidth > 20.278 MHz.
2. Frequency counter, capable of measuring > 20.278 MHz.
3. CW signal generator capable of generating a 20.278 MHz signal, and having a frequency modulation (FM) input with -6 MHz/Volt modulation sensitivity. The Hewlett-Packard Model 8350A Sweep Oscillator with an HP 83592A-OPT002 RF Plug-In is the preferred CW source.

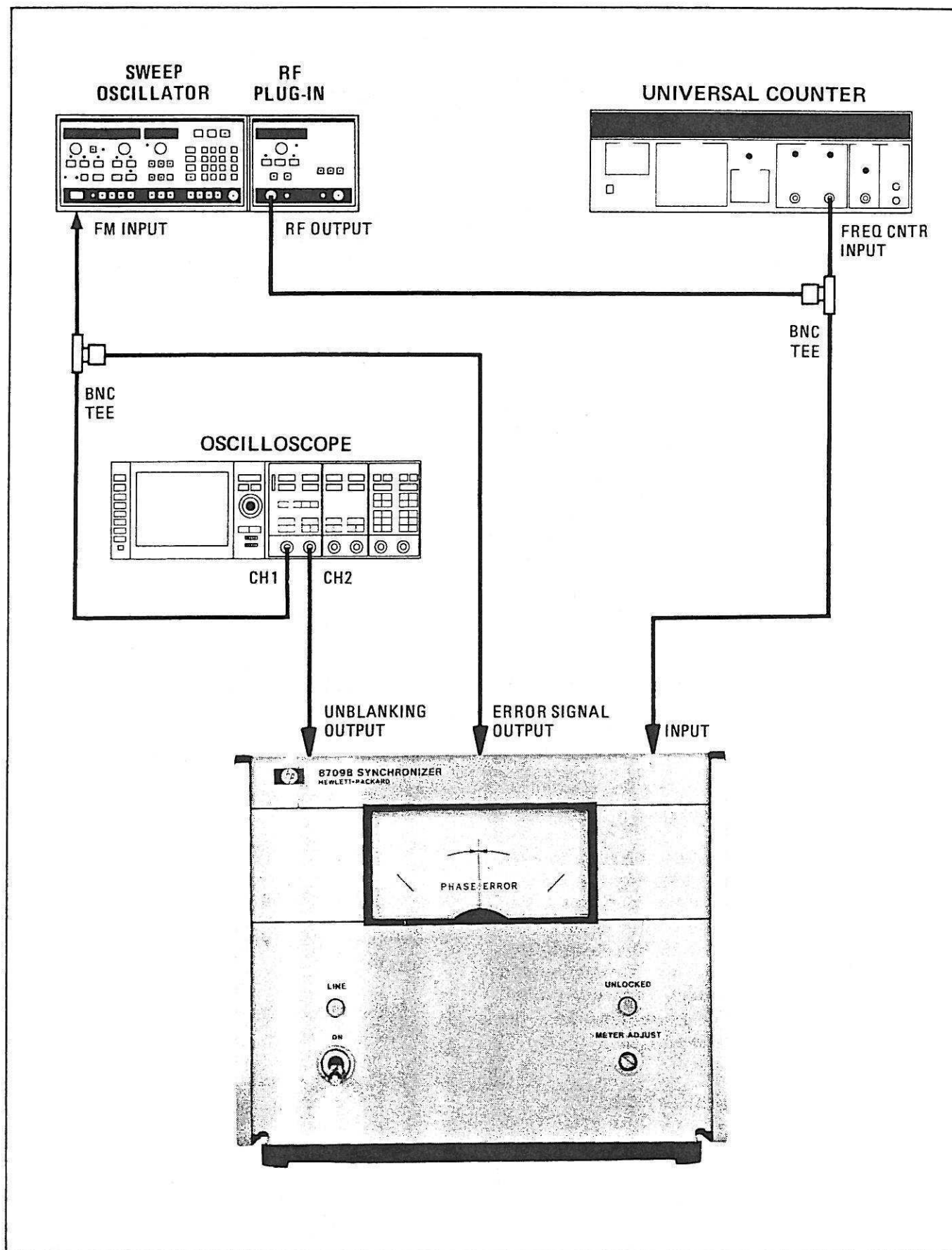


Figure 4-1. HP 8709B Performance Testing Equipment Interconnections.

When using an HP 83592A-OPT002 RF Plug-IN (or other HP 83500-family RF plug-ins), three controls should be checked:

1. The modulation sensitivity is controlled by a switch that is located just inside of the plug-in. Figure 4-2 shows the correct switch settings to obtain the required -6 MHz/Volt sensitivity.
2. Make sure the front-panel CW FILTER is OFF (not lighted).
3. The front-panel FREQ CAL knob affects the output frequency; adjust this knob as needed until the output frequency agrees with the frequency indicated on the HP 8350A display.

1. HP 8709B INPUT to a BNC Tee connector; one arm of the BNC Tee connects to the frequency counter, while the other arm connects to the RF OUTPUT of the CW oscillator.
2. HP 8709B ERROR SIGNAL OUTPUT to a BNC Tee connector; one arm of the BNC Tee connects to the FM INPUT of the CW oscillator, while the other arm connects to the oscilloscope input.
3. HP 8709B UNBLANKING OUTPUT connects to the remaining input channel of the oscilloscope.
4. HP 8709B INJECTION LOCK INPUT is not connected to any test equipment.

4-17. Equipment Interconnections

4-18. Connect the HP 8709B rear-panel BNC connectors to the other test instruments, as follows:

This equipment interconnection scheme, shown in Figure 4-1, is used for all Performance Tests.

NOTES

1. Switch Positions:
 - 1 = Switch Open = High
 - 0 = Switch Closed = Low (Ground)
 - X = Don't Care
 - * = Varies. 1 if Opt. 002, 0 if no Opt. 002.
2. Required switch settings:

Switch No.	1	2	3	4	5	6	7	8
Position	0	0	0	X	1	0	*	X

Figure 4-2. RF Plug-in Switch Settings

4-19. INPUT FREQUENCY TEST

Test Specification

The HP 8709B will phase lock with a 20.278 MHz \pm 1 kHz INPUT signal that has a power level greater than or equal to -65 dBm.

Test Procedure

1. Connect all equipment to the HP 8709B, as described under Equipment Interconnections (Paragraph 4-17). Allow all equipment to warm up thoroughly (at least 30 minutes of operation) before proceeding with the Performance Test.
2. Set the RF Plug-in to an output power level of -40 dBm. Although the HP 8709B will capture a signal that has a -65 dBm power level, many frequency counters require a signal with a higher power level; a preliminary setting of -40 dBm is a good starting point, but adjust the power level as needed for the frequency counter used.
3. Set the CW frequency to 20 MHz on the sweep oscillator. The HP 8709B should capture the 20 MHz signal, and output an FM correction voltage that will adjust the CW oscillator to 20.278 MHz.

Test Results

An HP 8709B that is functioning correctly will capture and phase lock the 20.278 MHz \pm 1 kHz INPUT signal. Indications of capture and phase lock are:

1. The front-panel UNLOCKED indicator light on the HP 8709B will be off, indicating phase lock. If the UNLOCKED light is on, the HP 8709B is not phase locked; if this occurs, adjust the fine frequency tuning on the CW frequency generator until phase lock is obtained.
2. The HP 8709B front-panel PHASE ERROR meter's needle will be on the meter's scale (although probably not centered), and the needle will track as you fine tune the CW frequency generator throughout the frequency-capture window. (The frequency-capture window depends on the CW oscillator and RF plug-in, but it is typically several megahertz above and below the 20.278 \pm 1 kHz MHz center frequency.) The HP 8709B is not operating correctly if the PHASE ERROR meter does not track fine frequency adjustments.
3. The HP 8709B rear-panel ERROR SIGNAL OUTPUT will be a steady dc voltage somewhere between -5 and $+5$ Vdc; this dc voltage will track fine frequency adjustments of the CW frequency generator throughout the phase lock capture window. A 70-130 Hz waveform at the ERROR SIGNAL OUTPUT indicates that the HP 8709B is not phase locked.
4. The rear-panel UNBLANKING OUTPUT of the HP 8709B will be -16 ± 2 Vdc when phase locked. If the UNBLANKING OUTPUT reads -3 ± 1 Vdc, the HP 8709B is not phase locked.

The frequency of the phase-locked signal, as indicated by the frequency counter, is exactly equal to the internal frequency of the HP 8709B.

4-20. INPUT SENSITIVITY TEST

Test Specification

The HP 8709B will capture and phase lock a 20.278 MHz \pm 1 kHz signal that has a power level greater than or equal to -65 dBm.

Test Procedure

1. Perform the previously described INPUT FREQUENCY TEST.
2. Change the power level on the RF Plug-In to -65 dBm. (Note: Your frequency counter might not function properly at a power level of -65 dBm, but the frequency counter is not essential for this test.)

Test Results

An HP 8709B that is functioning correctly will capture and phase lock a 20.278 MHz \pm 1 kHz signal at -65 dBm, exactly as it did in the INPUT FREQUENCY TEST; that is, at the specified frequency and power level:

1. The HP 8709B UNLOCKED indicator light will be off.
2. The HP 8709B PHASE ERROR meter will track fine frequency adjustments of the CW frequency generator throughout the frequency-capture window.
3. The HP 8709B ERROR SIGNAL OUTPUT will be a dc voltage between -5 and $+5$ Vdc that tracks fine frequency adjustments of the CW frequency generator throughout the frequency window.
4. The HP 8709B UNBLANKING OUTPUT will be a steady -16 ± 2 Vdc.

4-21. UNBLANKING OUTPUT TEST

Test Specification

The HP 8709B rear-panel UNBLANKING OUTPUT will be -16 ± 2 Vdc when phase locked, -3 ± 1 Vdc when not locked.

Test Procedure

1. Perform the previously described INPUT FREQUENCY TEST.
2. Observe the UNBLANKING OUTPUT voltage of the HP 8709B while phase locked.
3. Adjust the coarse frequency control on the CW frequency generator until the HP 8709B is no longer phase locked (the HP 8709B front-panel UNLOCKED indicator light will be on when the HP 8709B is not phase locked). Observe the UNBLANKING OUTPUT voltage.

Test Results

The HP 8709B UNBLANKING OUTPUT measures -16 ± 2 Vdc when the instrument is phase locked, and -3 ± 1 Vdc when not locked.

4-22. ERROR SIGNAL OUTPUT TEST

Test Specification

When phase locked, the HP 8709B rear-panel ERROR SIGNAL OUTPUT is a steady dc voltage ranging from -5 to $+5$ Vdc that tracks the INPUT frequency throughout the frequency-capture window; when not phase locked, the ERROR SIGNAL OUTPUT is a 70-130 Hz, 10 V p-p periodic waveform.

Test Procedure

1. Perform the previously described INPUT FREQUENCY TEST.
2. Measure the ERROR SIGNAL OUTPUT voltage while the HP 8709B is phase locked. Adjust the fine frequency control on the CW frequency generator to cover the frequency-capture window, and observe the tracking voltage of the HP 8709B ERROR SIGNAL OUTPUT.
3. Adjust the coarse frequency control on the CW frequency generator until the HP 8709B is no longer phase locked (the HP 8709B front-panel UNLOCKED indicator light will light when this happens), then measure the frequency and amplitude of the ERROR SIGNAL OUTPUT waveform.

Test Results

1. When the HP 8709B is phase locked, the ERROR SIGNAL OUTPUT has a steady dc voltage ranging from -5 to $+5$ Vdc that tracks the INPUT frequency through the frequency-capture window.
2. When the HP 8709B is phase locked, the ERROR SIGNAL OUTPUT has a 70-130 Hz (8-14 ms period), 10 V p-p periodic waveform (the waveform is sinusoidal, possibly having clipped peaks).

4-23. TEST RECORD LIST

The following summary of test values is provided for recording test results:

Table 4-1. Test Record Card

Test	Minimum Value	Measured Value	Maximum Value
Input Frequency	20.277 MHz		20.279 MHz
Input Sensitivity	-65 dBm		
Unblanking-Output			
Phase Locked	-14V	_____	-18V
Unlocked	-2V	_____	-4V
Error Signal Output			
Phase Locked, Correction Voltage Range	-5 to +5 Vdc	_____	
Unlocked, Search Signal Frequency	70 Hz	_____	130 Hz
Search Signal Voltage	10V p-p	_____	

SECTION V ADJUSTMENTS

5-1. INTRODUCTION

5-2. This section describes adjustment procedures for the HP Model 8709B Synchronizer. These procedures should not be performed as routine maintenance but should be used (1) after replacement of a part or component, or (2) when performance tests show that the specifications of Table 1-1 cannot be met. Adjustments can be made to three parts of the HP 8709B: 1) the power supply, 2) the internal oscillator, and 3) the front-panel PHASE ERROR meter.

5-3. SAFETY CONSIDERATIONS

5-4. Although this instrument has been designed in accordance with international safety standards, this manual contains information, cautions, and warnings which must be followed to ensure safe operation and to retain the safety provisions of the instrument. Service and adjustments should be performed only by a skilled person who is aware of the hazards involved.

WARNING

Adjustments in this section are performed with power supplied to the instrument while protective covers are removed. There are voltages at points in the instrument which can, if contacted, cause personal injury. Be extremely careful. Adjustments should be performed only by a skilled person who is aware of the hazards involved.

WARNING

Capacitors inside the instrument may still be charged, even if the instrument has been disconnected from its power supply source.

NOTE

Use a non-metallic adjustment tool whenever possible.

5-5. EQUIPMENT REQUIRED

5-6. The equipment required for these adjustments is shown in Figure 5-1, and described in each procedure. If the recommended test equipment is unavailable, other equipment may be substituted if its performance meets the test equipment specifications. Table 1-3 lists the recommended test equipment and their critical specifications.

5-7. FACTORY-SELECT COMPONENTS

5-8. Factory-select components are components that were selected during the manufacturing process to specifically match the unique characteristics and tolerances of each individual instrument. Factory-select components are designated by an asterisk (*) on the schematic diagrams and parts list, but the values given are only typical values and may not be the values for the components in your instrument. Table 5-1 lists the factory-selected components for the HP 8709B. Table 5-2 lists HP Part Numbers that correspond to the factory-select components in the HP 8709B.

5-9. RELATED ADJUSTMENTS

5-10. Adjustments to the HP 8709B power supply should always be the first adjustment performed. Adjustments to the internal oscillator, and the PHASE ERROR meter, can be made (in any sequence) following the power supply adjustment.

5-11. ADJUSTMENT LOCATIONS

5-12. The adjustable components of the HP 8709B are readily accessible: Remove the HP 8709B bottom cover to expose the adjustable components of the power supply, and remove the HP 8709B top cover to expose the adjustable components of the internal oscillator and PHASE ERROR meter. No other disassembly of the HP 8709B is required for the adjustment procedures.

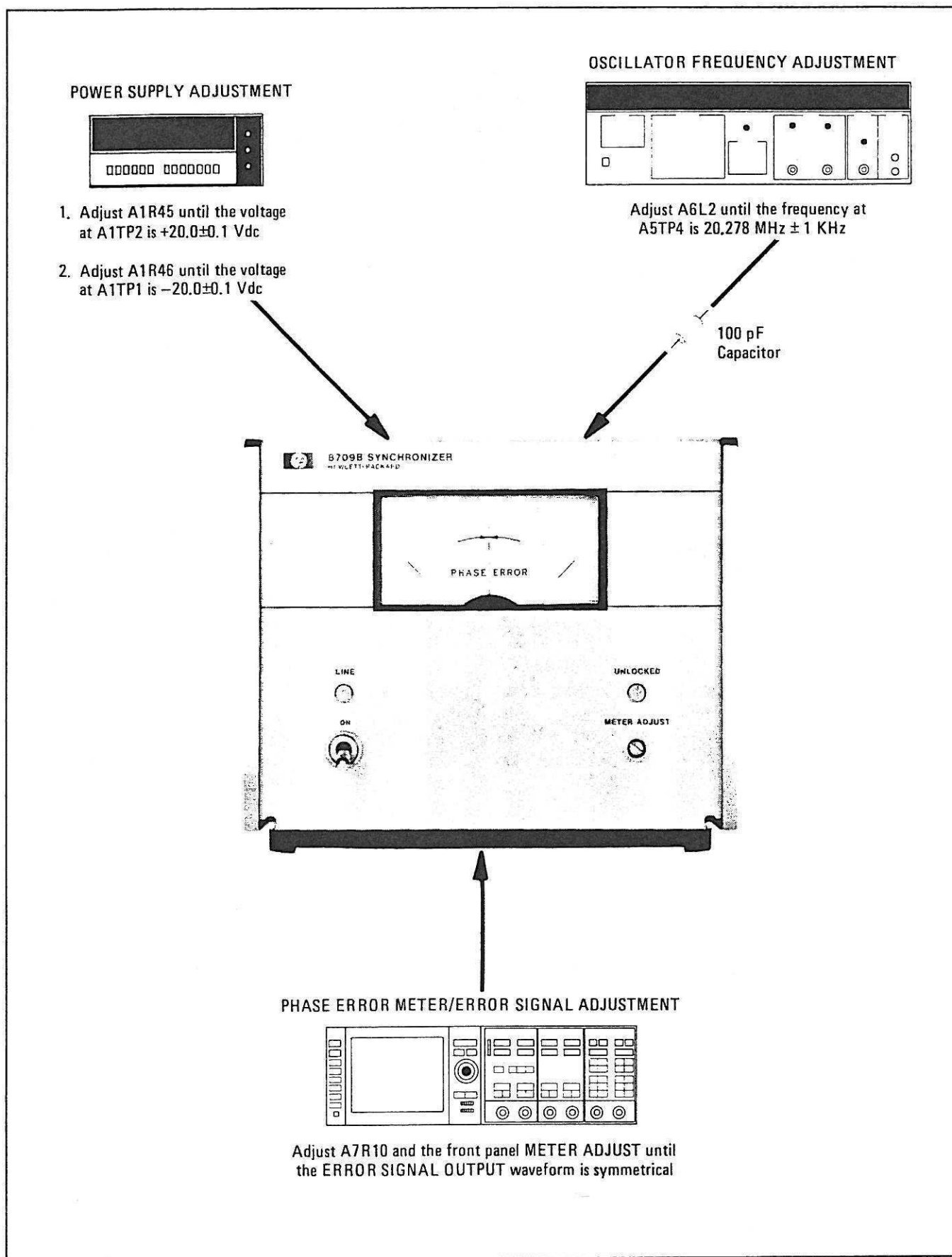


Figure 5-1. Adjustments to the HP 8709B.

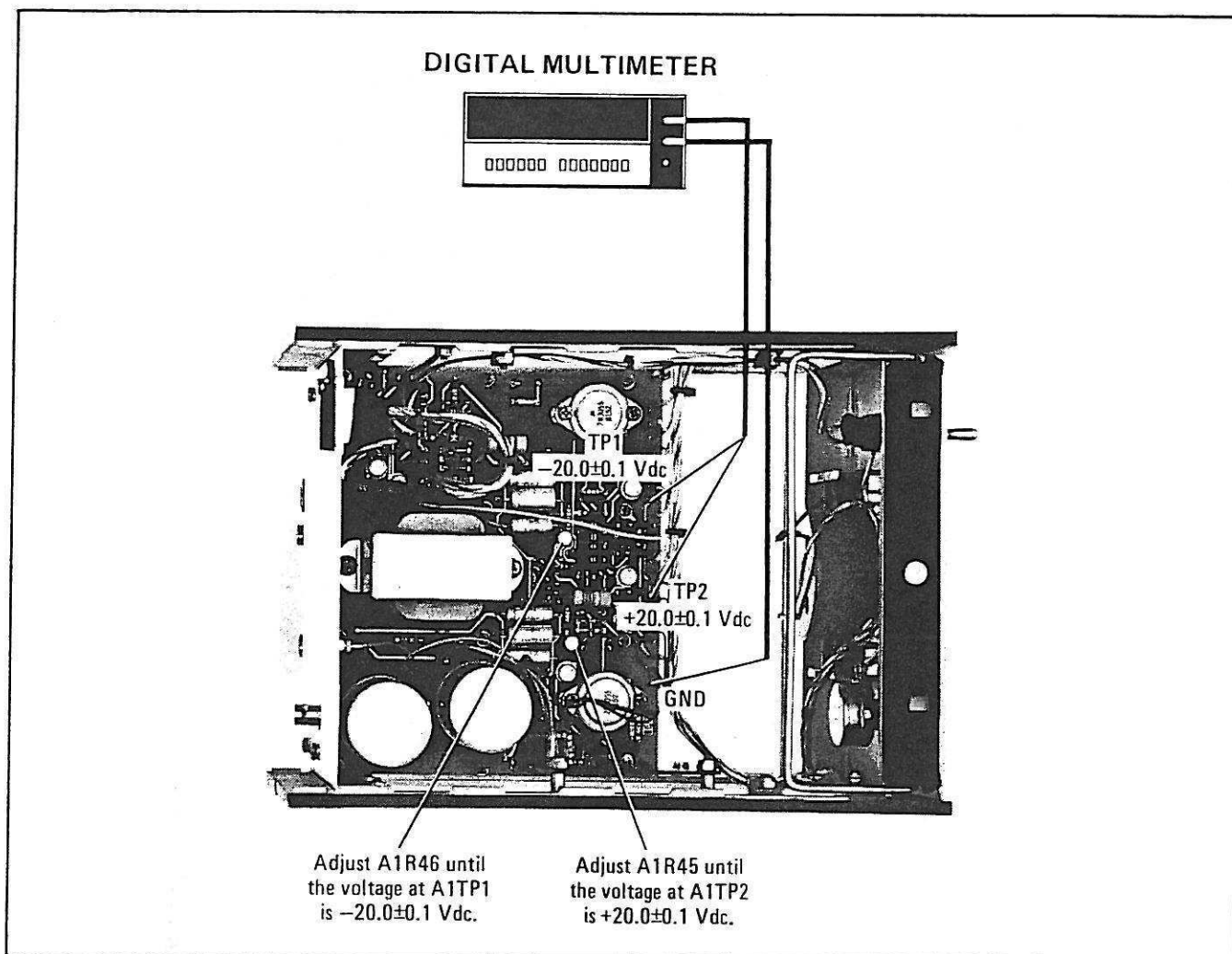


Figure 5-2. HP 8709B Power Supply Adjustment

5-13. POWER SUPPLY ADJUSTMENT

Adjustment description

The HP 8709B power supply provides $+20.0 \pm 0.1$ Vdc regulated, and -20.0 ± 0.1 Vdc regulated. The following procedure explains how to adjust the +20 and -20 voltages.

Equipment Required

1. A high-impedance voltmeter (HP Model 3465A, or equivalent).

Adjustment Procedure

1. With the power cable disconnected, remove the bottom cover from the HP 8709B. Locate test points A1TP1 and A1TP2, and adjustable resistors A1R45 and A1R46 on the A1 power supply board (HP Part Number 08709-60105), as shown in Figure 5-2.
2. Connect the voltmeter probe to test point A1TP2. Apply power to the HP 8709B, and adjust A1R45 until the voltage reading at test point A1TP2 is $+20.0 \pm 0.1$ Vdc.

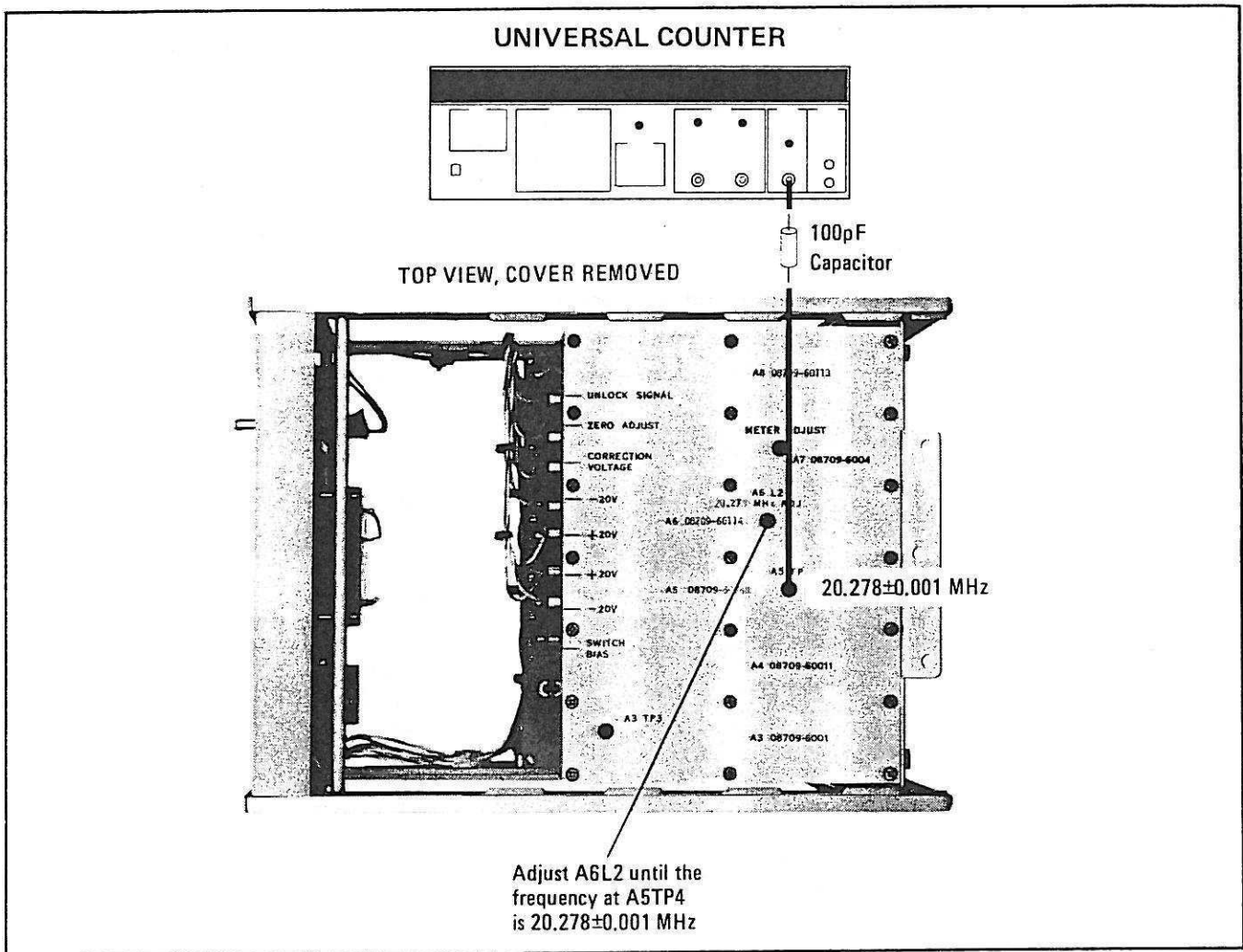


Figure 5-3. HP 8709B Oscillator Frequency Adjustment

3. Connect the voltmeter probe to test point A1TP1, and adjust A1R46 until the voltage at test point A1TP1 is -20.0 ± 0.1 Vdc.
4. Allow the HP 8709B to warm up thoroughly (at least 30 minutes), then verify that test points A1TP1 and A1TP2 have the correct voltage values.
5. If the correct, stable voltages cannot be achieved at the two test points refer to Section VIII of this manual for troubleshooting procedures.

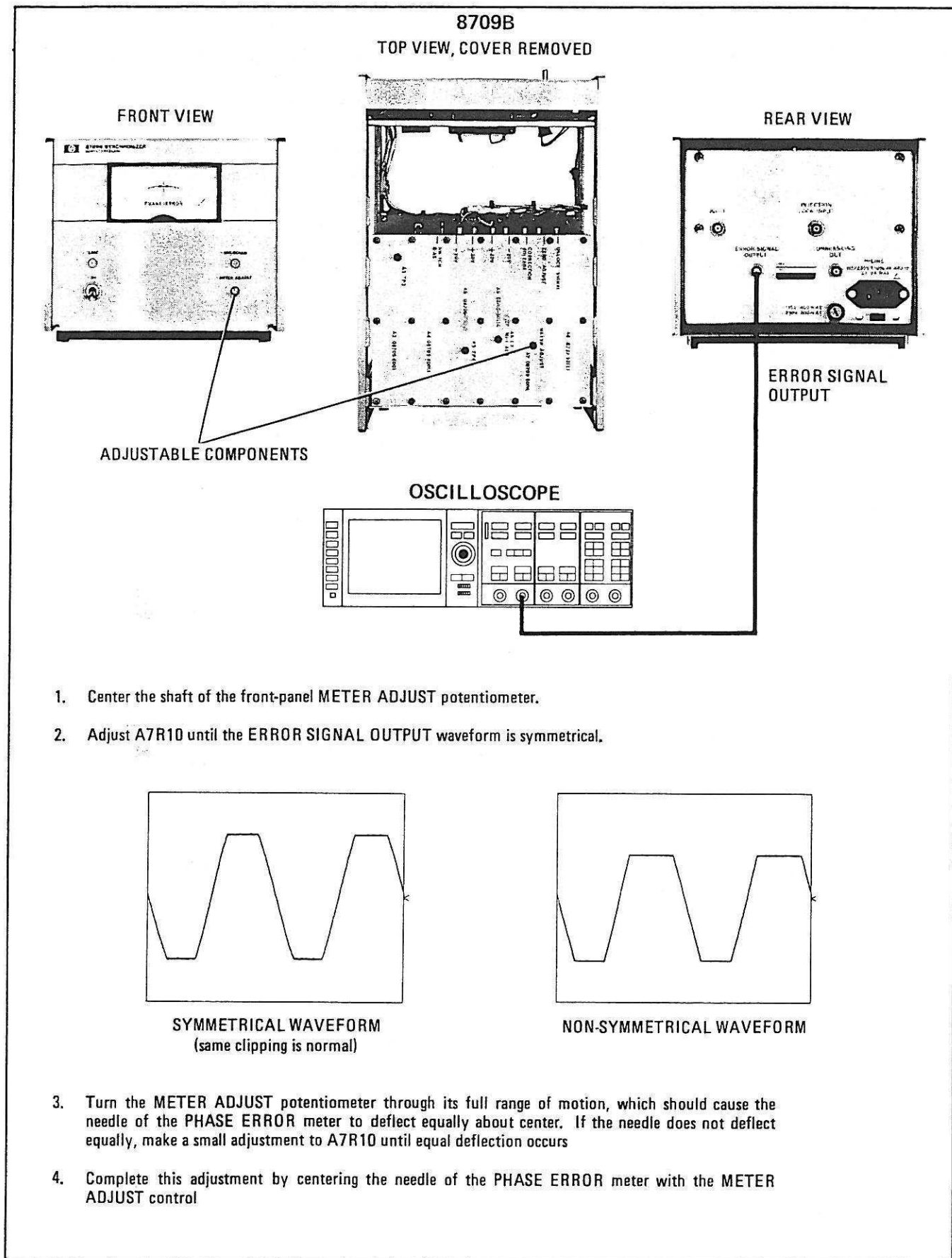
5-14. INTERNAL OSCILLATOR ADJUSTMENT

Adjustment Description

This procedure adjusts the internal oscillator to $20.278 \text{ MHz} \pm 1 \text{ kHz}$.

Equipment Required

1. A frequency counter capable of measuring 20.278 MHz (HP Model 5335A, or equivalent).



Adjustment Procedure

1. With the power cable disconnected, remove the top cover from the HP 8709B. Locate test point A5TP4 and adjustment point A6L2, as shown in Figure 5-3. Component A6L2 is an adjustable inductor, but only the adjustment access hole in a cover plate is visible at this level of disassembly.
2. Apply power to the HP 8709B, and allow the instrument to warm up thoroughly (at least 30 minutes).
3. Connect a 100 pF capacitor to the frequency counter probe, and touch the other end of the capacitor to test point A5TP4.
4. Adjust A6L2 until the frequency at test point A5TP4 is $20.278 \text{ MHz} \pm 1 \text{ kHz}$.
5. If the frequency will not adjust to a stable value of $20.278 \text{ MHz} \pm 1 \text{ kHz}$, refer to the troubleshooting procedures of Section VIII in this manual.

5-15. PHASE ERROR METER ADJUSTMENT

Adjustment Description

This procedure adjusts the range of the front-panel METER ADJUST control, and centers the needle of the front-panel PHASE ERROR meter.

Equipment Required

1. An oscilloscope capable of measuring a 70-130 Hz, 10 Volt p-p waveform (any HP oscilloscope is satisfactory).

Adjustment Procedure

1. With the power cable disconnected, remove the top cover from the HP 8709B, and locate adjustment point A7R10, as shown in Figure 5-4. Component A7R10 is an adjustable resistor, but only the A7R10 adjustment access hole is visible at this level of disassembly.
2. Connect the HP 8709B ERROR SIGNAL OUTPUT to the oscilloscope input.
3. Apply power to the HP 8709B and allow it to warm up thoroughly (at least 30 minutes).
4. Turn the METER ADJUST control, located on the front panel of the HP 8709B, until the shaft of the control is at the midpoint of its range of motion.
5. Adjust A7R10 until the needle of the front-panel PHASE ERROR meter is centered.
6. Turn the METER ADJUST control through its full range of motion, which should cause the needle of the PHASE ERROR meter to deflect equally on both sides of center.
7. Readjust A7R10, if necessary, until the METER ADJUST control causes the needle of the PHASE ERROR meter to deflect symmetrically around the center.
8. Observe the HP 8709B ERROR SIGNAL OUTPUT signal on the oscilloscope. Adjustable resistor A7R10 and the METER ADJUST control, which affect the symmetry of


the PHASE ERROR meter, simultaneously affect the symmetry of the ERROR SIGNAL OUTPUT waveform. When the needle of the PHASE ERROR meter is centered, the ERROR SIGNAL OUTPUT waveform should be symmetrical. If the waveform is not symmetrical, continue adjusting A7R10 and the METER ADJUST control until the waveform is symmetrical and the PHASE ERROR meter's needle is centered.

9. Make a final centering of the PHASE ERROR meter's needle, using the METER ADJUST control.
10. If the needle of the PHASE ERROR meter cannot be made to deflect symmetrically around the center, or if the ERROR SIGNAL OUTPUT waveform is not symmetrical, refer to the trouble shooting procedures of Section VIII in this manual.

Table 5-1. Factory Selected Components

Reference Designator	Typical Value	Basis of Selection
A8R2	82.5 Ohms	A8R2 is selected to ensure that the turn-on potential for A8Q1 is between +150 to +210 mVdc.
A8R39	100 Ohms	A8R39 is selected to ensure that the turn-on potential for A8Q8 is between -150 to -210 mVdc.

Table 5-2. HP Part Numbers of Standard Value Replacement Components

RESISTORS											
RANGE: 10 to 1.47M Ohms											
TYPE: Fixed-Film											
WATTAGE: .5 at 125°C											
TOLERANCE: ±1%											
											
Value (Ω)	HP Part Number	C D	Value (Ω)	HP Part Number	C D	Value (Ω)	HP Part Number	C D	Value (Ω)	HP Part Number	C D
10.0	0757-0984	4	215	0698-3401	0	4.64K	0698-3348	4	110K	0757-0859	2
11.0	0575-0985	5	237	0698-3102	8	5.11K	0757-0833	2	121K	0757-0860	5
12.1	0757-0986	6	261	0757-1090	5	5.62K	0757-0834	3	133K	0757-0310	0
13.3	0757-0001	6	287	0757-1092	7	6.19K	0757-0196	0	147K	0698-3175	5
14.7	0698-3388	2	316	0698-3402	1	6.81K	0757-0835	4	162K	0757-0130	2
16.2	0757-0989	9	348	0698-3403	2	7.50K	0757-0836	5	178K	0757-0129	9
17.8	0698-3389	3	383	0698-3404	3	8.25K	0757-0837	6	196K	0757-0063	0
19.6	0698-3390	6	422	0698-3405	4	9.09K	0757-0838	7	215K	0757-0127	7
21.5	0698-3391	7	464	0698-0090	7	10.0K	0757-0839	8	237K	0698-3424	7
23.7	0698-3392	8	511	0757-0814	9	12.1K	0757-0841	2	261K	0757-0064	1
26.1	0757-0003	8	562	0757-0815	0	13.3K	0698-3413	4	287K	0757-0154	0
28.7	0698-3393	9	619	0757-0158	4	14.7K	0698-3414	5	316K	0698-3425	8
31.6	0698-3394	0	681	0757-0816	1	16.2K	0757-0844	5	348K	0757-0195	9
34.8	0698-3395	1	750	0757-0817	2	17.8K	0698-0025	8	383K	0757-0133	5
38.3	0698-3396	2	825	0757-0818	3	19.6K	0698-3415	6	422K	0757-0134	6
42.2	0698-3397	3	909	0757-0819	4	21.5K	0698-3416	7	464K	0698-3426	9
46.4	0698-3398	4	1.00K	0757-0159	5	23.7K	0698-3417	8	511K	0757-0135	7
51.1	0757-1000	7	1.10K	0757-0820	7	26.1K	0698-3418	9	562K	0757-0868	3
56.2	0757-1001	8	1.21K	0757-0821	8	28.7K	0698-3103	9	619K	0757-0136	8
61.9	0757-1002	9	1.33K	0698-3406	5	31.6K	0698-3419	0	681K	0757-0869	4
68.1	0757-0794	4	1.47K	0757-1078	9	34.8K	0698-3420	3	750K	0757-0137	9
75.0	0757-0795	5	1.62K	0757-0873	0	38.3K	0698-3421	4	825K	0757-0870	7
82.5	0757-0796	6	1.78K	0698-0089	4	42.2K	0698-3422	5	909K	0757-0138	0
90.0	0757-0797	7	1.96K	0698-3407	6	46.4K	0698-3423	6	1M	0757-0059	4
100	0757-0198	2	2.15K	0698-3408	7	51.1K	0757-0853	6	1.1M	0757-0139	1
110	0757-0798	8	2.37K	0698-3409	8	56.2K	0757-0854	7	1.21M	0757-0871	8
121	0757-0799	9	2.61K	0698-0024	7	61.9K	0757-0309	7	1.33M	0757-0194	8
133	0698-3399	5	2.87K	0698-3101	7	68.1K	0757-0855	8	1.47M	0698-3464	5
147	0698-3400	9	3.16K	0698-3410	1	75.0K	0757-0856	9			
162	0757-0802	5	3.48K	0698-3411	2	82.5K	0757-0857	0			
178	0698-3334	8	3.83K	0698-3412	3	90.9K	0757-0858	1			
196	0757-1060	9	4.22K	0698-3346	2	100K	0757-0367	7			



