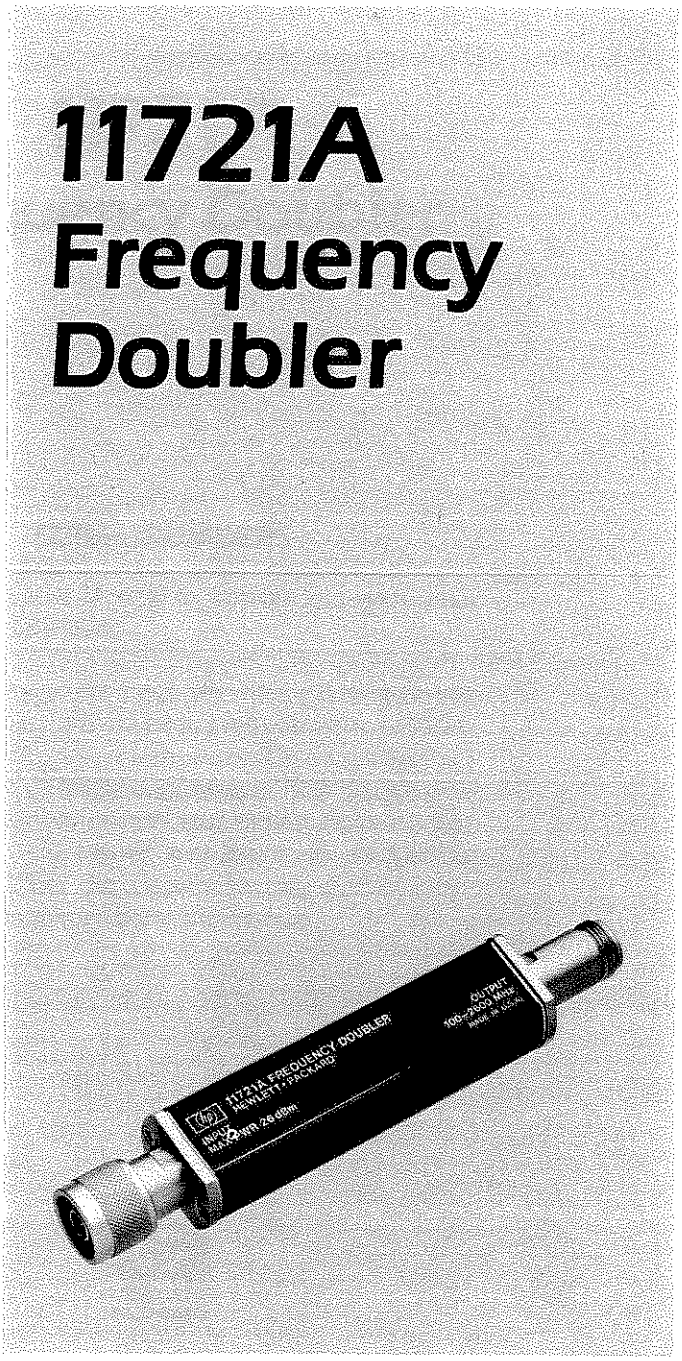
OPERATING AND SERVICE MANUAL

11721A Frequency Doubler



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HEWLETT PACKARD

OPERATING AND SERVICE MANUAL

11721A
Frequency Doubler

SERIAL NUMBERS

This manual applies directly to instruments with serial numbers prefixed 1950A.

An instrument manufactured after the printing of this manual may have a serial number prefix other than 1950A. The manual for this newer instrument is accompanied by a yellow Manual Changes supplement. This supplement contains "change information" that explains how to adapt the manual to the newer instrument. In addition to change information, the supplement may contain information for correcting errors to the manual.

1501 PAGE MILL ROAD, PALO ALTO, CALIFORNIA, U.S.A.

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GENERAL INFORMATION

This Operating and Service Manual contains information required to operate, test and service the Hewlett-Packard Model 11721A Frequency Doubler. The Doubler was designed as an accessory for the HP Model 8662A Synthesized Signal Generator, but may be used with other signal generators that have outputs in the same frequency range.

On the back cover of this manual, below the manual part number, is a "Microfiche" part number. This number may be used to order a 100 x 150 mm (4 x 6 inch) microfilm transparency of the manual.

Specifications

The Doubler's specifications are listed in Table 1. These specifications are the performance standards, or limits against which the Doubler may be tested.

Table 1. Specifications

Input Frequency Range: 50—1300 MHz

Output Frequency Range: 100—2600 MHz

Conversion Loss: <15 dB at +13 dBm input

Spurious Referenced to Desired Output Frequency f (+13 dBm input with harmonics <–50 dBc, 50 to 1280 MHz):

$\frac{f}{2}$ –15 dB

$\frac{3f}{2}$ –15 dB

Input SWR: 1.5 typical

Input/Output Impedance: 50 ohms nominal

Operating Temperature Range: 0 to +55°C

Connectors: Input — Type N male
Output — Type N female

Dimensions: 161 mm long x 30 mm wide x 20.5 mm high (6-3/8 x 1-3/16 x 13/16 inches)

Weight: 355 grams (11.8 oz.)

Description

The Doubler utilizes a balanced full wave rectifier to double 50 to 1300 MHz input signals. The full wave rectifier generates a high amplitude second harmonic of the input while suppressing the fundamental signal at the output.

Conversion loss and spurious signals in the Doubler's output are dependent upon the characteristics of the input signal. To fully realize the Doubler's specifications, the signal generator used with the Doubler must have specifications as good as or better than the following:

a. a harmonic level of ≤–50 dBc,

b. a drive level of +13 dBm ±1 dB

The Doubler's output level is not a linear function of its input level. Changes in RF amplitude that constitute amplitude modulation at the Doubler input are not exactly reproduced at the output. As a result, amplitude modulation is generally degraded except at very low depths (less than 20% may result in less than 3% AM distortion). Frequency modulation, while not distorted, will be changed by the Doubler in that the peak deviation of the output signal will be double that of the input signal.

Refer to HP application Note 283-2 for a more complete description of Doubler performance when used with the HP Model 8662A.

INSTALLATION

Initial Inspection

Inspect the shipping container for damage. If the shipping container or cushioning material is damaged it should be kept until the contents of the shipment have been checked for completeness and the Doubler has been checked mechanically and electrically. The contents of the shipment should be as shown on the front cover of this manual. Procedures for checking electrical performance are given under PERFORMANCE TESTS. If the contents are incomplete, if there is mechanical damage or defect, or if the Doubler does not pass the electrical performance test, notify the nearest Hewlett-Packard office. If the shipping container is damaged, or the cushioning material shows signs of stress, notify the carrier as well as the Hewlett-Packard office. Keep the shipping materials for the carrier's inspection.

Storage and Shipment

Environment. The Doubler should be stored in a clean, dry environment. The following environmental limitations apply to both sotrage and shipment:

Temperature ..... –55°C to +75°C
Humidity ..... Up to 95% at 40°C
Altitude..... Up to 15 300 metres (50 000 feet)

Original Packaging. Containers and materials identical to those used in factory packaging are available through Hewlett-Packard offices. If the Doubler is being returned to Hewlett-Packard for servicing, attach a tag indicating the type of service required, return address, model number, and full serial number. Also, mark the container FRAGILE to ensure careful handling. In any correspondence, refer to the Doubler by model number and full serial number.

Mating Connectors

Mating connectors used with the Doubler should be 50 ohm Type N connectors.

OPERATION

Environment

The operating environment should be within the following limitations:

Temperature: ..... 0 to +55°C
Humidity ..... 95% at 40°C
Altitutde ..... 4600 metres (15 000 feet)

Operating Instructions

CAUTION

Do not apply more than +26 dBm to the Doubler. Also, subjecting the Doubler to high reverse RF power will most likely cause damage.

Since the Doubler is a uni-directional device, the input signal should be applied only to the male Type N connector.

The insertion of a low pass filter between the Doubler and the signal source may be required to obtain a signal with a harmonic level lower than –50 dB.

Figure 1 shows typical conversion loss versus input signal level. For best performance, the Doubler should be driven with an input signal level greater than +12 dBm.

Post-doubler attenuation can be used between the Doubler and its load to improve the source match and to enable the operator to vary the signal level from the Doubler.

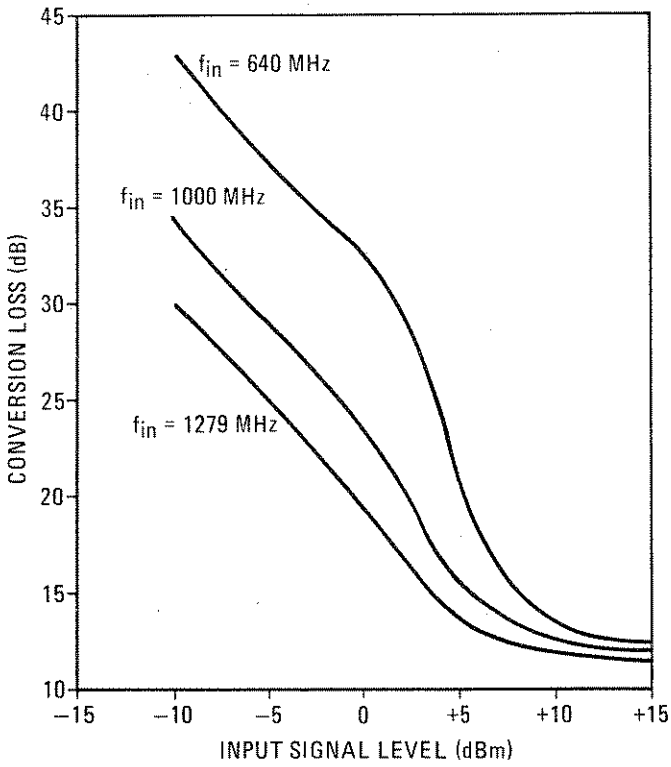

Figure 1. Conversion Loss versus Input Signal Level

PERFORMANCE TESTS

The specifications in Table 1 can be verified using the signal generator and specturm analyzer listed in Table 2. Substitute test equipment can be used if

Table 2. Recommended Test Equipment

Instrument	Critical Specifications	Suggested Model
Spectrum Analyzer	Frequency Range: 50 MHz to 5.2 GHz Band Flatness: ±1.25 dB Amplitude Display Linearity: ±1.5 dB	HP 8555A/ 8552B/141T
Signal Generator with Low Pass Filter (for second harmonic)	Frequency Range: 50 to 1280 MHz Amplitude Level: +13 dBm 2nd Harmonic: ≤–50 dBc	HP 8640B Opt. 002 (or HP 8662A*) with HP 360A/B

*The HP 8662A is HP-IB compatible.

its specifications meet or exceed those listed in the table.

To check the Doubler's performance, set the signal generator to any frequency (f/2) between 50 and 1280 MHz at a +13 dBm signal level. Set the spectrum analyzer's reference level to +13 dBm and the frequency controls to scan from the generator's output signal to its third harmonic (3f/2). Connect the output of the generator to the input of the analyzer and record the displayed level of generator's output (f/2).

f/2 = _____ dBm

Put a low pass filter at the output of the generator. Then, connect the Doubler between the low pass filter and the analyzer. Record the displayed level of the Doubler's output (f).

f = _____ dBm

To compute conversion loss, subtract the level of signal f from the level of f/2. The difference should be less than 15 dB.

Conversion Loss _____ 15 dB

To check spurious signals referenced to the Doubler's output frequency, compare the levels of f/2 and 3f/2 on the display of the spectrum analyzer to the level f; both f/2 and 3f/2 should be greater than 15 dB below f.

(f/2) 15 dB _____

(3f/2) 15 dB _____

ADJUSTMENTS

The Doubler requires no mechanical or electrical adjustments.

REPLACEABLE PARTS

To order any of the parts listed in Table 3, quote the Hewlett-Packard part number, description, and check digit. Indicate the quantity required and address the order to the nearest Hewlett-Packard office.

SERVICE

If the Doubler's connectors have been damaged or have become worn, or if the Doubler does not meet its specifications because one or more of its electrical components have failed, the Doubler can be disassembled. After the defective part has been replaced, the Doubler can then be reassembled.

Disassembly

The Doubler can be disassembled at either end. Steps 1 through 4 are performed on the end that is being disassembled.

1. Loosen one of the RF connector bodies (J1MP6 or J4MP1) with a 9/16 open end wrench. Remove the connector by turning it counterclockwise.

2. Remove the two screws from that same end.

3. Remove the cover plate (MP5 or MP6) by turning it counterclockwise.

4. Slide the gasket (MP9 or MP10) and end plate (MP7 or MP8) off the body bulkhead (J1MP3 or J4MP6).

5. Remove the remaining two screws.

6. Slide the housing (MP11) off the circuit board.

Repair

A pencil-type soldering iron rated at 20 watts or less should be used when replacing components on the circuit board.

Assembly

To assemble the Doubler, reverse the disassembly procedures outlined above. If the connectors have been removed from the circuit board, be sure to orient them as indicated in the Illustrated Parts Breakdown (Figure 2).

The male Type N connector at the input side of the Doubler consists of three parts that are not separately replaceable (J1MP6, 7 and 8). When replacing the connector, it is necessary to order all three parts. Once assembled, the three parts cannot be disassembled. To assemble, slide ring J1MP7 into the groove on connector J1MP6. Then, slip nut J1MP8 over the ring and connector. A pair of longnose pliers may be necessary to compress the ring (after it is on the connector) to allow the nut to fit over it.

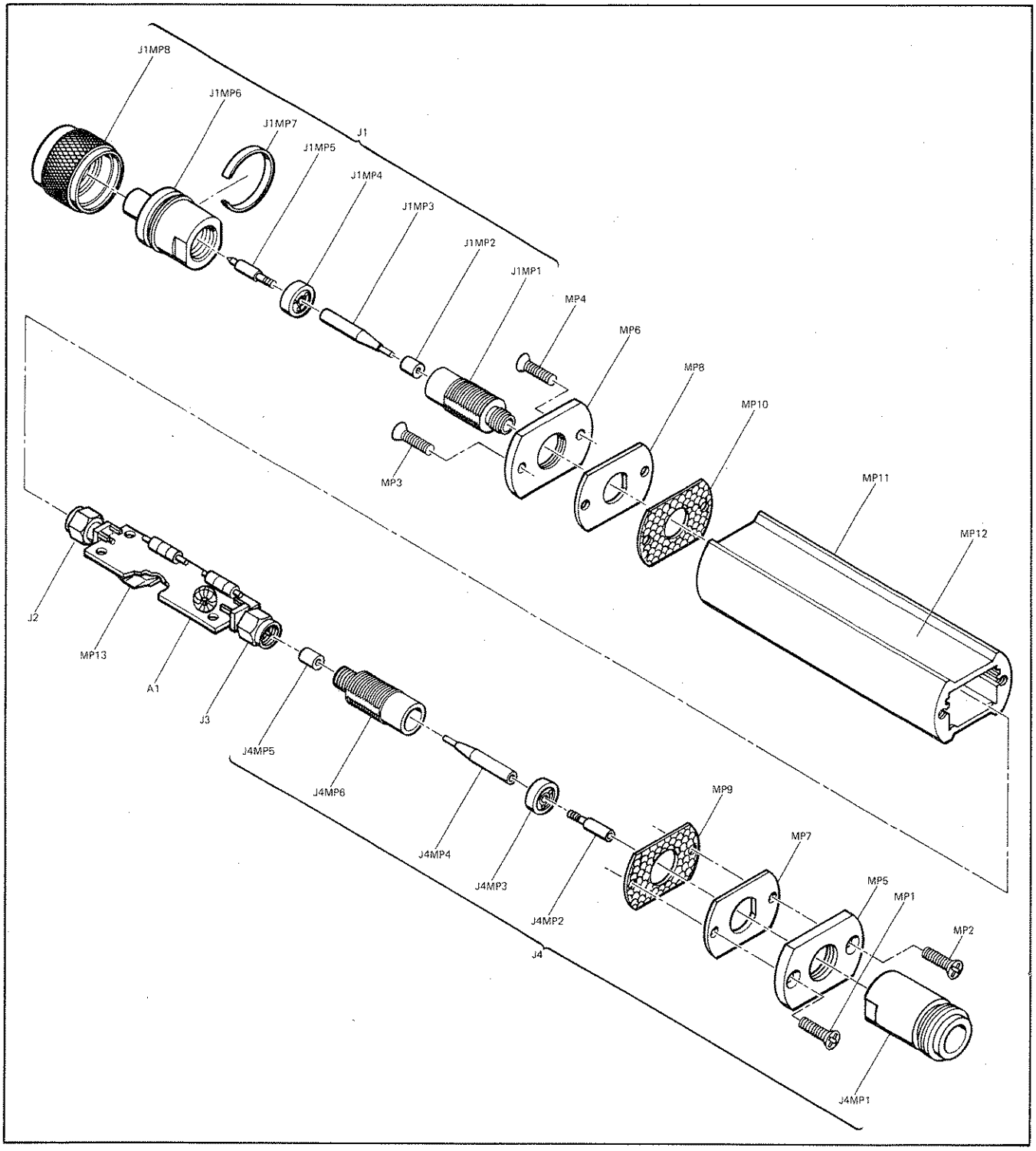

Figure 2. Illustrated Parts Breakdown

Table 3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1	11721-60001	8	1	FREQUENCY DOUBLER ASSEMBLY	28480	11721-60001
A1CR1	1906-0098	9	1	DIODE-MATCHED 1V (INCLUDES CR2,CR3 & CR4)	28480	1906-0098
A1CR2				PART OF CR1		
A1CR3				PART OF CR1		
A1CR4				PART OF CR1		
A1E1	9170-0029	3	6	CORE-SHIELDING BEAD	28480	9170-0029
A1E2	9170-0029	3		CORE-SHIELDING BEAD	28480	9170-0029
A1E3	9170-0029	3		CORE-SHIELDING BEAD	28480	9170-0029
A1E5	9170-0029	3		CORE-SHIELDING BEAD	28480	9170-0029
A1E6	9170-0029	3		CORE-SHIELDING BEAD	28480	9170-0029
A1L1	9100-3922	4	1	COIL-FIXED 120-1300 HZ	28480	9100-3922
A1W1	11721-20004	7	1	CABLE-COAX, RETURN	28480	11721-20004
A1W2	11721-20005	8	1	CABLE-COAX, OUTPUT	28480	11721-20005
				CHASSIS PARTS		
J1				CONNECTOR-INPT,NOT REPLACEABLE AS A UNIT INCLUDES J1MP1 THRU J1MP8		
J1MP1	08555-20094	6	2	BODY-BULKHEAD	28480	08555-20094
J1MP2	08761-2027	4	2	INSULATOR	28480	08761-2027
J1MP3	08555-20093	5	2	CONTACT-JACK	28480	08555-20093
J1MP4	5040-0306	0	2	INSULATOR	28480	5040-0306
J1MP5	1250-0917	0	1	CONTACT-RF CONN SER APC-N MALE	02660	131-147
J1MP6	1250-0916	9	1	CONNECTOR-RF APC-N M UNMTD 50-OHM NOT SEPARATELY REPLACEABLE ALSO ORDER J1MP7 AND J1MP8	28480	1250-0916
J1MP7	1250-0016	0	1	RING-RF CONNECTOR SERIES N .75IN OD NOT SEPARATELY REPLACEABLE ALSO ORDER J1MP6 AND J1MP8	02660	82-1138-6
J1MP8	1250-0918	1	1	NUT-RF CONN SERIES APC-N SST NOT SEPARATELY REPLACEABLE ALSO ORDER J1MP6 AND J1MP7	02660	131-135-1
J2	1250-1707	8	2	CONNECTOR-RF	28480	1250-1707
J3	1250-1707	8		CONNECTOR-RF	28480	1250-1707
J4				CONNECTOR-OUTPUT, NOT REPLACEABLE AS A UNIT, INCLUDES J4MP1 THRU J4MP6		
J4MP1	1250-0914	7	1	CONNECTOR-RF APC-N FEM UNMTD 50-OHM	28480	1250-0914
J4MP2	1250-0915	8	1	CONTACT-RF CONN SER APC-N FEMALE	02660	131-149
J4MP3	5040-0306	0		INSULATOR	28480	5040-0306
J4MP4	08555-20093	5		CONTACT-JACK	28480	08555-20093
J4MP5	08761-2027	4		INSULATOR	28480	08761-2027
J4MP6	08555-20094	6		BODY-BULKHEAD	28480	08555-20094
MP1	2200-0169	0	4	SCREW-MACH 4-40 .5-IN-LG 82 DEG	00000	ORDER BY DESCRIPTION
MP2	2200-0169	0		SCREW-MACH 4-40 .5-IN-LG 82 DEG	00000	ORDER BY DESCRIPTION
MP3	2200-0169	0		SCREW-MACH 4-40 .5-IN-LG 82 DEG	00000	ORDER BY DESCRIPTION
MP4	2200-0169	0		SCREW-MACH 4-40 .5-IN-LG 82 DEG	00000	ORDER BY DESCRIPTION
MP5	11721-20003	6	2	COVER,PLATE	28480	11721-20003
MP6	11721-20003	6		COVER,PLATE	28480	11721-20003
MP7	11721-00001	2	2	END PLATE	28480	11721-00001
MP8	11721-00001	2		END PLATE	28480	11721-00001
MP9	11721-00002	3	2	GASKET-END PLATE	28480	11721-00002
MP10	11721-00002	3		GASKET-END PLATE	28480	11721-00002
MP11	00346-20031	2	1	HOUSING	28480	00346-20031
MP12	7120-8720	0	1	LABEL-IDENTIFICATION	28480	7120-8720

See introduction to this section for ordering information

Table 4. Code List of Manufacturers

Mfr Code	Manufacturer Name	Address	Zip Code
00000	ANY SATISFACTORY SUPPLIER		
02660	AMPHENOL SALES DIV OF BUNKER-RAMO	BROADVIEW IL	60153
28480	HEWLETT-PACKARD CO CORPORATE HQ	PALO ALTO CA	94304

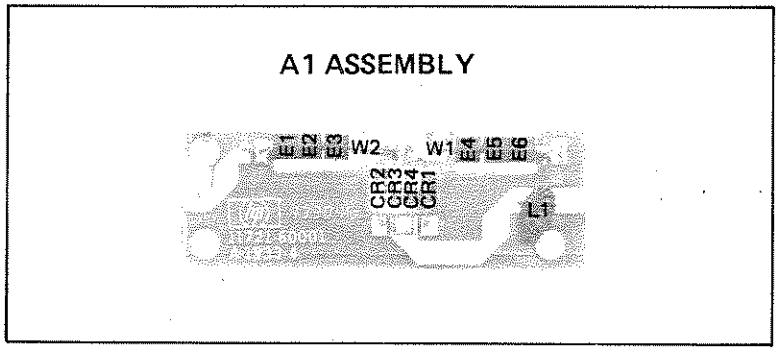

Figure 3. Component Locations

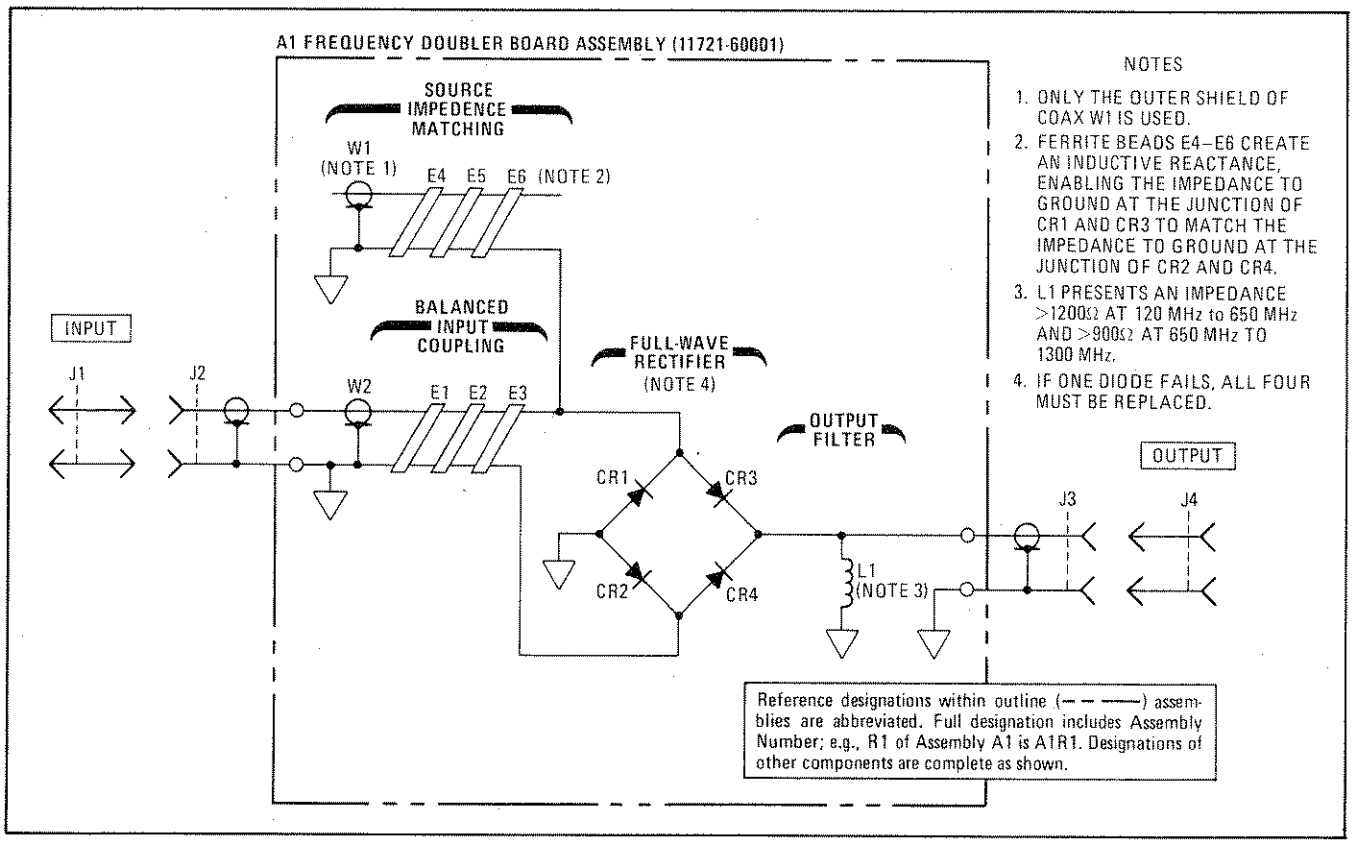

Figure 4. Schematic Diagram

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.

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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.

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To obtain servicing information, contact the nearest Hewlett-Packard Sales and Service Office in HP Catalog, or contact the nearest regional office listed below.

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NO. CALIFORNIA (San Francisco Area)
333 Logue Ave.
Mt. View, CA 94043

SO. CALIFORNIA (Los Angeles Area)
5400 West Rosecrans Blvd.
Lawndale, CA 90260

GEORGIA
450 Interstate N. Parkway
Atlanta, GA 30348

ILLINOIS
5201 Tollview Dr.
Rolling Meadows, IL 60008

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W. 120 Century Rd.
Paramus, NJ 07652

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