

OPERATING AND SERVICE MANUAL

11721A Frequency Doublers

General Information
Installation
Operation
Performance Tests
Replaceable Parts
Service



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.



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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
- Altitude 4600 metres (15 000 feet)

Operating Instructions



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.

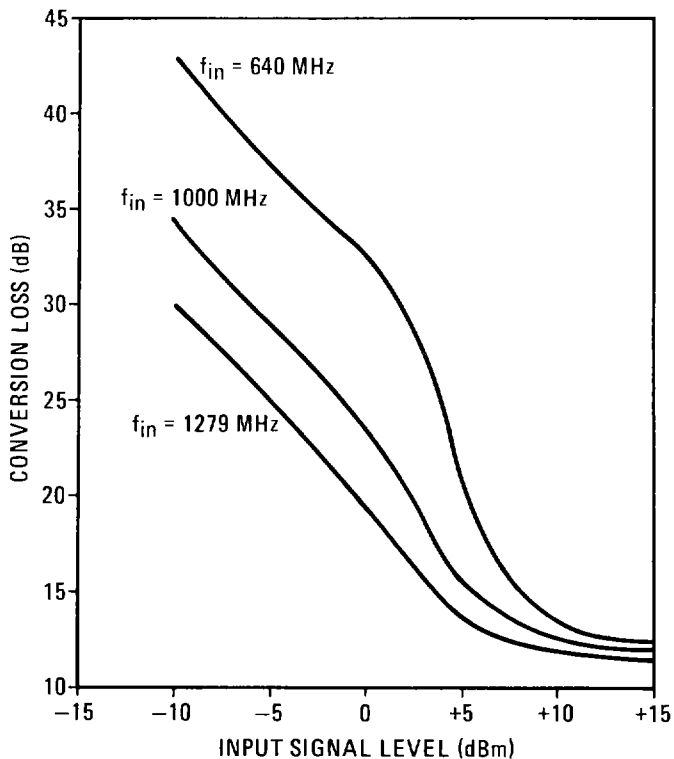


Figure 1. Conversion Loss versus Input Signal Level

PERFORMANCE TESTS

The specifications in Table 1 can be verified using the signal generator and spectrum 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 ($f/2$).

$$f/2 = \text{_____ dBm}$$

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).

$$f = \text{_____ dBm}$$

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

$$\text{Conversion Loss} \text{ _____ } 15 \text{ dB}$$

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 .

$$(f/2) \text{ } 15 \text{ dB} \text{ _____}$$

$$(3f/2) \text{ } 15 \text{ dB} \text{ _____}$$

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 elec-

trical 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.

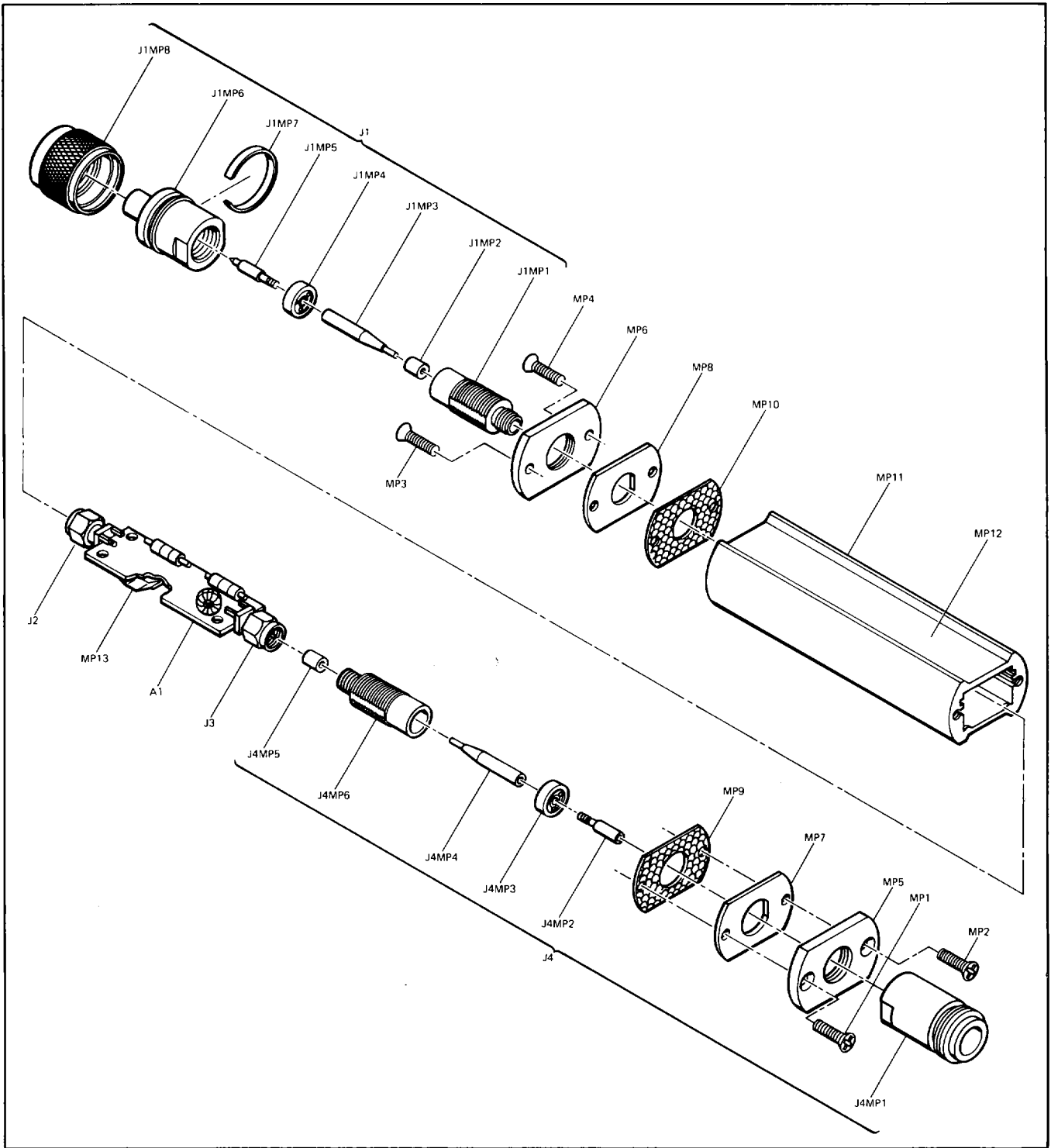


Figure 2. Illustrated Parts Breakdown

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 A1CR2 A1CR3 A1CR4	1906-0098	9	1	DIODE-MATCHED 1V (INCLUDES CR2,CR3 & CR4) PART OF CR1 PART OF CR1 PART OF CR1	28480	1906-0098
A1E1 A1E2 A1E3 A1E8	9170-0029	3	6	CORE-SHIELDING BEAD CORE-SHIELDING BEAD CORE-SHIELDING BEAD CORE-SHIELDING BEAD	28480 28480 28480 28480	9170-0029 9170-0029 9170-0029 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 A1W2	11721-20004 11721-20005	7 8	1 1	CABLE=COAX, RETURN CABLE=COAX, OUTPUT	28480 28480	11721-20004 11721-20005
CHASSIS PARTS						
J1				CONNECTOR=INPT, NOT REPLACEABLE AS A UNIT INCLUDES JIMP1 THRU JIMP8		
JIMP1 JIMP2 JIMP3 JIMP4 JIMP5	08555-20094 08761-2027 08555-20093 5040-0306 1250-0917	6 4 5 0 0	2 2 2 2 1	BODY=BULKHEAD INSULATOR CONTACT=JACK INSULATOR CONTACT=RF CONN SER APC=N MALE	28480 28480 28480 28480 02660	08555-20094 08761-2027 08555-20093 5040-0306 131-147
JIMP6	1250-0916	9	1	CONNECTOR=RF APC=N M UNMTD 50-OHM NOT SEPARATELY REPLACEABLE ALSO ORDER JIMP7 AND JIMP8	28480	1250-0916
JIMP7	1250-0016	0	1	RING=RF CONNECTOR SERIES NT .75IN OD NOT SEPARATELY REPLACEABLE ALSO ORDER JIMP6 AND JIMP8	02660	82-1138-6
JIMP8	1250-0918	1	1	NUT=RF CONN SERIES APC=N 8BT NOT SEPARATELY REPLACEABLE ALSO ORDER JIMP6 AND JIMP7	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 JAMP1 THRU JAMP6		
JAMP1 JAMP2 JAMP3	1250-0914 1250-0915 5040-0306	7 8 0	1 1	CONNECTOR=RF APC=N FEM UNMTD 50-OHM CONTACT=RF CONN SER APC=N FEMALE INSULATOR	28480 02660 28480	1250-0914 131-149 5040-0306
JAMP4 JAMP5 JAMP6	08555-20093 08761-2027 08555-20094	5 4 6		CONTACT=JACK INSULATOR BODY=BULKHEAD	28480 28480 28480	08555-20093 08761-2027 08555-20094
MP1 MP2 MP3 MP8 MP5	2200-0169 2200-0169 2200-0169 2200-0169 11721-20003	0 0 0 0 6	4	SCREW=MACH 4-40 .5-IN-LG 82 DEG SCREW=MACH 4-40 .5-IN-LG 82 DEG SCREW=MACH 4-40 .5-IN-LG 82 DEG SCREW=MACH 4-40 .5-IN-LG 82 DEG COVER, PLATE	00000 00000 00000 00000 28480	ORDER BY DESCRIPTION ORDER BY DESCRIPTION ORDER BY DESCRIPTION ORDER BY DESCRIPTION 11721-20003
MP6 MP7 MP8 MP9 MP10	11721-20003 11721-00001 11721-00001 11721-00002 11721-00002	6 2 2 3 3	2 2	COVER, PLATE END PLATE END PLATE GASKET=END PLATE GASKET=END PLATE	28480 28480 28480 28480 28480	11721-20003 11721-00001 11721-00001 11721-00002 11721-00002
MP11 MP12	00346-20031 7120-8720	2 0	1 1	HOUSING LABEL=IDENTIFICATION	28480 28480	00346-20031 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

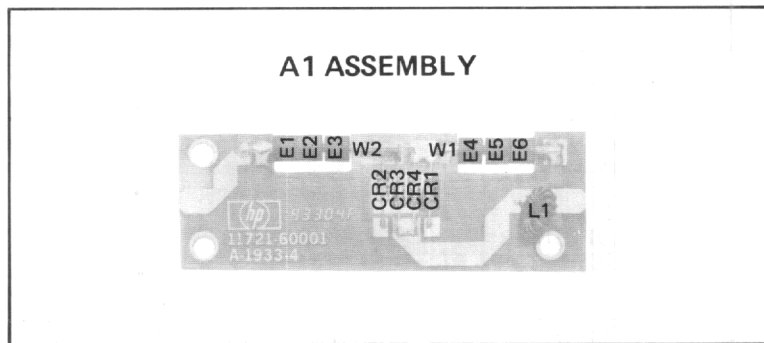


Figure 3. Component Locations

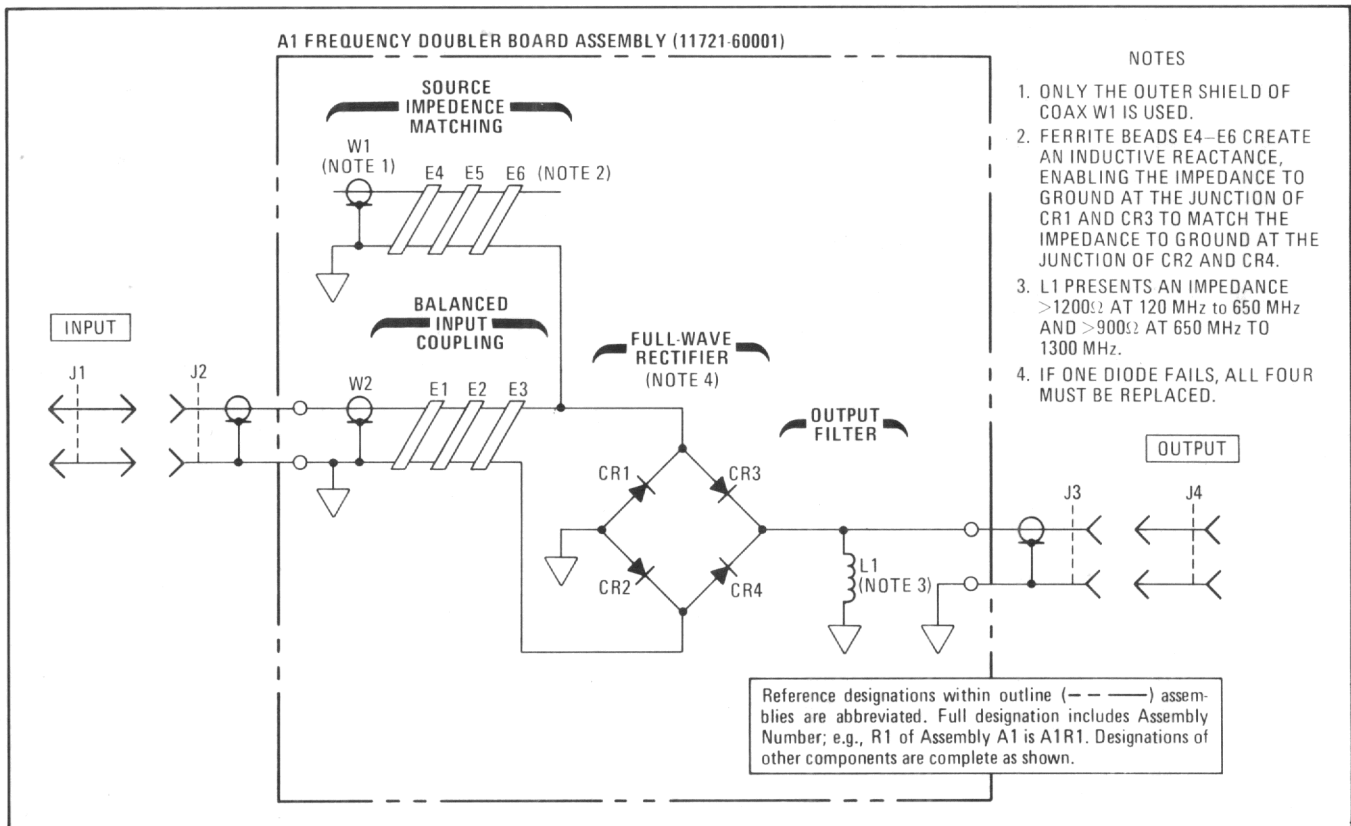


Figure 4. Schematic Diagram