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.
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>
<thead>
<tr>
<th>Table 1. Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Input Frequency Range:</strong> 50—1300 MHz</td>
</tr>
<tr>
<td><strong>Output Frequency Range:</strong> 100—2600 MHz</td>
</tr>
<tr>
<td><strong>Conversion Loss:</strong> &lt;15 dB at +13 dBm input</td>
</tr>
<tr>
<td><strong>Spurious Referenced to Desired Output Frequency f</strong></td>
</tr>
<tr>
<td>(+13 dBm input with harmonics &lt;-50 dBc, 50 to 1280 MHz):</td>
</tr>
<tr>
<td>$\frac{f}{2}$ &amp; -15 dB</td>
</tr>
<tr>
<td>$\frac{3f}{2}$ &amp; -15 dB</td>
</tr>
<tr>
<td><strong>Input SWR:</strong> 1.5 typical</td>
</tr>
<tr>
<td><strong>Input/Output Impedance:</strong> 50 ohms nominal</td>
</tr>
<tr>
<td><strong>Operating Temperature Range:</strong> 0 to +55°C</td>
</tr>
<tr>
<td><strong>Connectors:</strong> Input — Type N male</td>
</tr>
<tr>
<td><strong>Dimensions:</strong> 161 mm long x 30 mm wide x 20.5 mm high (6-3/8 x 1-3/16 x 13/16 inches)</td>
</tr>
<tr>
<td><strong>Weight:</strong> 355 grams (11.8 oz.)</td>
</tr>
</tbody>
</table>

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 storage 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**

**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.

**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 necessary.

---

**Figure 1. Conversion Loss versus Input Signal Level**

**Table 2. Recommended Test Equipment**

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

*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 \( f/2 \).

\[
f/2 = \quad \text{dBm}
\]

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 \( f \).

\[
f = \quad \text{dBm}
\]

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

\[
\text{Conversion Loss} = 15 \text{ dB}
\]

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 \( f \).

\[
(f/2) 15 \text{ dB} \\
(3f/2) 15 \text{ dB}
\]

**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.
<table>
<thead>
<tr>
<th>Reference Designation</th>
<th>HP Part Number CD</th>
<th>Qty</th>
<th>Description</th>
<th>Mfr Code</th>
<th>Mfr Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>11721-0001</td>
<td>8</td>
<td>1 FREQUENCY DOUBLER ASSEMBLY</td>
<td>28460</td>
<td>11721-0001</td>
</tr>
<tr>
<td>AICR1</td>
<td>1060-0018</td>
<td>4</td>
<td>1 DIODE-MATCHED IV (INCLUDES CR2, CR3 &amp; CR4) PART OF CRI</td>
<td>28460</td>
<td>1900-0008</td>
</tr>
<tr>
<td>AICR2</td>
<td></td>
<td></td>
<td>PART OF CRI</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AICR3</td>
<td></td>
<td></td>
<td>PART OF CRI</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AICR4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AIE1</td>
<td>9160-0020</td>
<td>3</td>
<td>4 CORE-SMELTING READ</td>
<td>28460</td>
<td>9160-0020</td>
</tr>
<tr>
<td>AIE2</td>
<td>9160-0020</td>
<td>3</td>
<td>CORE-SMELTING READ</td>
<td>28460</td>
<td>9160-0020</td>
</tr>
<tr>
<td>AIE3</td>
<td>9160-0020</td>
<td>3</td>
<td>CORE-SMELTING READ</td>
<td>28460</td>
<td>9160-0020</td>
</tr>
<tr>
<td>AIE4</td>
<td>9160-0020</td>
<td>3</td>
<td>CORE-SMELTING READ</td>
<td>28460</td>
<td>9160-0020</td>
</tr>
<tr>
<td>AIE6</td>
<td>9160-0020</td>
<td>3</td>
<td>CORE-SMELTING READ</td>
<td>28460</td>
<td>9160-0020</td>
</tr>
<tr>
<td>AIL1</td>
<td>9200-0922</td>
<td>6</td>
<td>1 Coil=Fixed 250 KHz</td>
<td>28460</td>
<td>9200-0922</td>
</tr>
<tr>
<td>A1H1</td>
<td>11721-0004</td>
<td>7</td>
<td>1 CABLE-DOVY RETURN</td>
<td>28460</td>
<td>11721-0004</td>
</tr>
<tr>
<td>A1H2</td>
<td>11721-0005</td>
<td>8</td>
<td>1 CABLE-DOVY OUTPUT</td>
<td>28460</td>
<td>11721-0005</td>
</tr>
</tbody>
</table>

**CHASSIS PARTS**

**CONNECTOR-INPUT, NOT REPLACEABLE AS A UNIT, INCLUDES JIMP1 THRU JIMP7**

| J1 | 11721-0001 | 7 | 1 CONNECTOR-NAME AND UNIT TO UNIT 50 OHM NOT SEPARATELY REPLACEABLE ALSO ORDER JIMPI AND JIMP7 | 28460 | 11721-0001 |
| J1M | 11721-0002 | 9 | 1 CONNECTOR-NAME AND UNIT TO UNIT 50 OHM NOT SEPARATELY REPLACEABLE ALSO ORDER JIMPI AND JIMP7 | 28460 | 11721-0004 |
| J1MP | 11721-0003 | 5 | 1 CONNECTOR-NAME AND UNIT TO UNIT 50 OHM NOT SEPARATELY REPLACEABLE ALSO ORDER JIMPI AND JIMP7 | 28460 | 11721-0005 |
| J2 | 11721-0006 | 8 | 2 CONNECTOR-NAME AND UNIT TO UNIT 50 OHM NOT SEPARATELY REPLACEABLE ALSO ORDER JIMPI AND JIMP7 | 28460 | 11721-0007 |

See introduction to this section for ordering information.
Table 4. Code List of Manufacturers

<table>
<thead>
<tr>
<th>Mfr Code</th>
<th>Manufacturer Name</th>
<th>Address</th>
<th>Zip Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>00000</td>
<td>ANY SATISFACTORY SUPPLIER</td>
<td></td>
<td>60153</td>
</tr>
<tr>
<td>02660</td>
<td>AMPHENOL SALES DIV OF BLUNKER-RAMO</td>
<td>BROADVIEW IL</td>
<td>60153</td>
</tr>
<tr>
<td>28480</td>
<td>HEWLETT-PACKARD CO CORPORATE HQ</td>
<td>PALO ALTO CA</td>
<td>94304</td>
</tr>
</tbody>
</table>

Figure 3. Component Locations

Figure 4. Schematic Diagram
CERTIFICATION

Hewlett-Packard Company certifies that this product meets 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, as 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.

HEWLETT-PACKARD SERVICE OFFICES

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

UNITED STATES
NO. CALIFORNIA (San Francisco Area)
333 Logee 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
NEW JERSEY
W. 120 Century Rd.
Parsippany, NJ 07052
AUSTRALIA
Hewlett-Packard Australia Ltd.
31-41 Joseph Street
Blackburn, Victoria 3130

CANADA
Hewlett-Packard (Canada) Ltd.
6977 Gorsey Drive
Mississauga, Ontario
Canada L4V 1M5

ITALY
Hewlett-Packard Italia S.p.A.
Via G. In Vittoria, 9
20061 Ceroneco
Sul Naviglio (MI)

FRANCE
Hewlett-Packard France
Quartier de Courtaboeuf
Boite Postale No. 6
F-91401 Orsay Cedex

GERMAN FEDERAL REPUBLIC
Hewlett-Packard GmbH
Vertriebszentrale Frankfurt
Bernerstrasse 117
Postfach 560 140
D-6000 Frankfurt 06

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Hewlett-Packard Benelux N.V.
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P.O. Box 687
NL-Amstelveen, 1134

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Palo Alto, CA 94304