Manual Changes Supplement

Agilent Technologies
85027E
Directional Bridge
Operating and Service Manual
85027-90014

Agilent Technologies

Manufacturing Part Number: 85027-90020

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MANUAL CHANGES SUPPLEMENT

HP 85027E Directional Bridge Operating and Service Manual

NOTE

Manual Change Supplements are revised as often as necessary to keep manuals as current and accurate as possible. Hewlett-Packard recommends that you periodically order the latest edition of this supplement. Copies are available through all HP offices. When ordering copies, quote the Supplement Part Number from the bottom of this page or the model number and print date from the title page of the manual.

MANUAL IDENTIFICATION

Manual Part Number: 85027-90014
Date Printed: October 1987

This supplement contains important information for correcting manual errors and for adapting the manual to instruments containing improvements made after the printing of the manual.

TO USE THIS SUPPLEMENT, make all changes applicable to the serial number prefix of your instrument (NUMBERED CHANGES) as indicated in the following reference table.

Note that there may be more than one title page and/or Parts Cross Reference Table included in this supplement. The last change(s) applicable to your instrument will contain the most current information for these specific pages.

■ = NEW ITEM, CHANGED ITEM

Manual Change Supplement Part Number: 85027-90020

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REFERENCE TABLE

Serial Prefix or Number	Make Manual Changes
All Serials	1

Serial Prefix Number	Change Number	Assemblies Affected	New Assembly Part Number	Manual Sections Affected
■ All Serials	1	N/A	N/A	Performance Tests

CHANGE 1

Change 1 applies to all HP 85027E directional bridges, regardless of serial number.

The directivity performance test was not included in the HP 85027E operating and service manual. Instead the operator is referred to the HP 85028E directivity verification standards, and the procedure provided with them.

When the manual went to press, the HP 85028E standards were not yet ready for shipment. This supplement provides an interim directivity verification procedure which can be used until the HP 85028E directivity verification standards are available.

NOTE: The interim procedure provided in this supplement has much greater measurement uncertainty than the HP 85028E verification standards. The HP 85028E verification standards/procedure should be substituted as the approved test method as soon as they are available. Contact your nearest Hewlett-Packard Sales Office for availability.

INSTRUCTIONS

Add the attached change 1 pages after page 4-2. Do not remove or discard any manual pages.

The pages from change 1 should be removed from the manual and discarded when the HP 85028E directivity verification standards are available.

INTERIM DIRECTIVITY VERIFICATION PROCEDURE

NOTE: This procedure should be used in lieu of the HP 85028E directivity verification standards. This interim procedure should be replaced by the HP 85028E verification standards as soon as they are available. Because of measurement uncertainties, conformance to specification can usually not be proven with this interim procedure. This test is intended to provide reasonable confidence that the bridge is functional and meets its specifications.

Specification

0.01 to 20.0 GHz	40 dB
20.0 to 26.5 GHz	36 dB

Description

Directivity is a measure of the ability of a directive device (in this case the HP 85027E) to discriminate between incident and reflected signals. In theory, directivity can be measured accurately when the test port is terminated with a perfect load that absorbs (and thereby eliminates) all reflected signals. In this perfect situation, any remaining signals detected would be directivity errors, the result of reflections due to imperfections of the bridge itself.

In practice, loads reflect some of the incident power back toward the source. This undesired reflection gets added into the directivity measurement, adding measurement uncertainty.

A load of average quality can introduce significant amounts of measurement uncertainty, such that one can not be sure if the bridge meets specification. The better the load used, the less uncertainty is introduced. A load of very high quality is required to accurately verify a 40 dB directivity bridge.

Figure 4-b shows worst case uncertainty for loads with a given return loss. When performing this test, it is likely that the measured directivity will be less than the specified directivity of the bridge. Again, this is most likely the fault of the load being used in the test. Under these circumstances, it is difficult to prove the performance of the bridge. However, if measured directivity falls within the tolerance shown in Figure 4-b, there is a 90% probability that the bridge meets or exceeds its specification.

Customers who require documented evidence of directivity during incoming inspection must obtain a load of appropriate quality for the frequency range required. Hewlett-Packard warrants this directional bridge to provide its specified directivity at time of delivery, traceable to the National Bureau of Standards. Hewlett-Packard also offers a verification service for customers who desire periodic verification of performance, which includes a certificate of calibration. Contact your nearest Hewlett-Packard office for details.

Equipment

Network Scalar Analyzer .... HP 8757
Sweep Oscillator .... HP 8350
RF Plug-in .... HP 83595
Connector Saver, 3.5mm (f) to (f) .... HP Part Number 85027-60005
(required for plug-in to bridge input)
Open/Short .... HP Part Number 85027-60004
Sliding Load .... HP 911C w/3.5 mm (f) connector
Fixed Load .... HP 909D Option 040

NOTE: Using an adapter on the directional bridge's test port will significantly degrade the measured directivity. Use of adapters or connector savers (on the test port) during this test is not recommended. Use only terminations of the correct type and sex, and connect them directly to the test port of the bridge.

NOTE: This test must be performed between 20°C and 30°C to be valid.

Procedure

1. Connect the equipment as shown in Figure 4-a. Do not connect anything to the bridge test port yet.

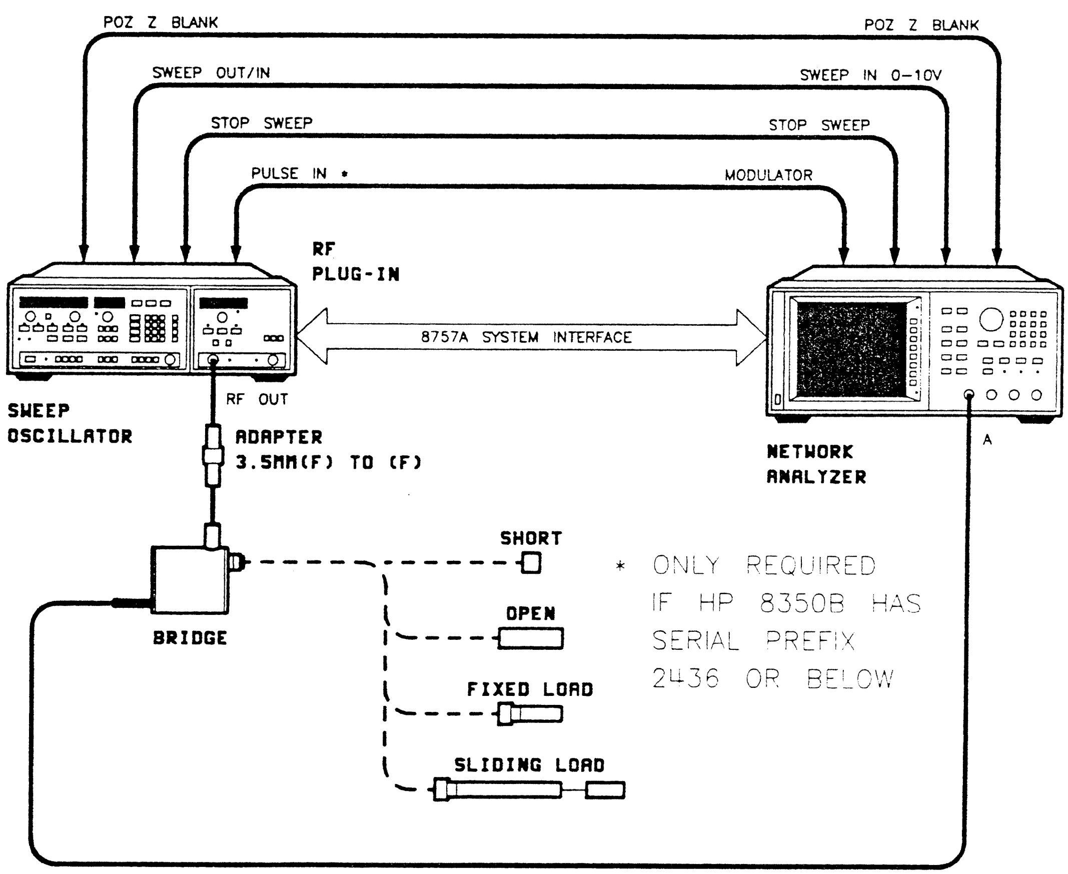

Figure 4-a. Directivity Performance Test Setup

2. On the HP 8757, press **[PRESET]** to configure the system. Preset causes the following to occur:
   - Set the sweep time
   - Turn on the sweep oscillator's modulation
   - Turn on the RF output
   - Set the power level of the RF plug-in

   Do not reset the power level. Press the analyzer's **[CHAN 2 OFF]** softkey to turn off channel 2.

BELOW 2 GHz:

3. On the HP 8350 set the start frequency to 0.01 GHz and the stop frequency to 2.0 GHz.
4. Perform a short/open calibration by pressing **[CAL]** on the HP 8757A and then following the prompts on the CRT.
5. Attach the fixed load to the test port of the directional bridge. On the analyzer, press **[CURSOR]** and softkeys **[CURSOR ON]** and **[MAX]** to find the point of minimum return loss (the high point on the trace). Record the displayed CURSOR value on the appropriate line in the test record (located at the end of this section). Note that this value represents the scalar sum of directivity signals (the desired measurement plus signals reflected from the fixed load) measured in dB. Thus, fixed load quality directly affects the quality of directivity measurements. Record this value in the test record.

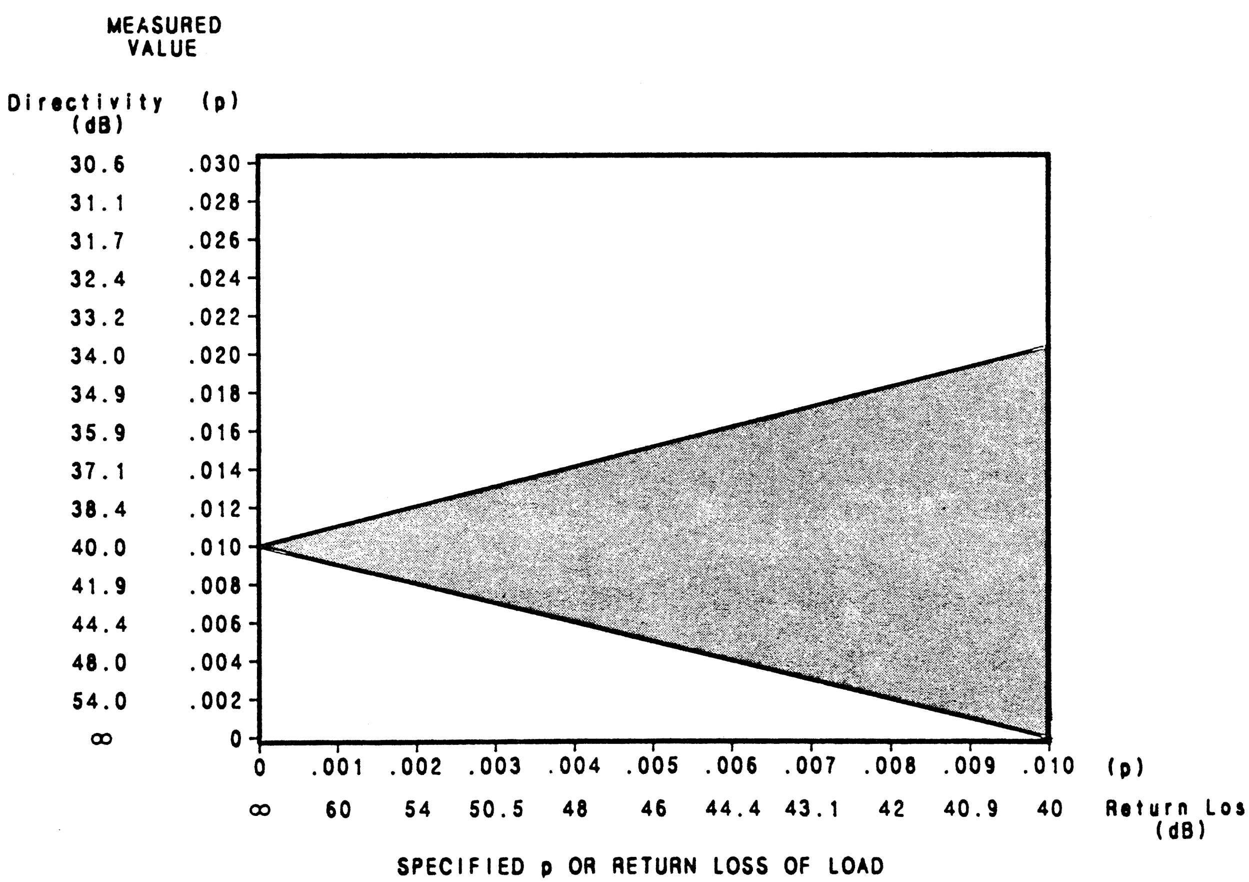

Figure 4-b. Measurement Uncertainty from 0.01 to 20 GHz

Determining Measurement Uncertainty Below 2 GHz:

6. Refer to Figure 4-b. The chart shows the measurement uncertainty range as a shaded area. This is relative to the specified directivity of the bridge (40 dB). To determine measurement uncertainty, locate the reflection coefficient (ρ) or return loss of the fixed load on the horizontal axis (the HP 909D's ρ is 0.01). Move up from that point to the shaded error limit window. The actual directivity could be anywhere within the error limit lines (read maximum and minimum possible values on the vertical axis). For the HP 909D option 040, move up from the 0.010 value on the horizontal axis, actual directivity could be anywhere from 34 db to infinity (read on the vertical axis). Record the uncertainty in the test record.

   Any measured directivity **below** the shaded area on Figure 4-b ensures conformance to specification. A measured directivity **anywhere within** the shaded area indicates a 90% probability that the product meets specified directivity. This is based on factory observations.

NOTE: Measurement uncertainties may be reduced by characterizing the actual return loss of the fixed load with a vector network analyzer such as the HP 8510. Use of the load's actual return loss reduces measurement uncertainty.

Measuring Directivity Above 2 GHz:

7. On the sweep oscillator, set the start frequency to 2.0 GHz and the stop frequency to 20.0 GHz.
8. Perform a short/open calibration.
9. Connect the sliding load to the test port of the bridge. (Refer to the sliding load's manual if necessary). Make sure the sliding load center conductor pin depth is set prior to connection. Do not use the bridge port to position the sliding load outer conductor.
10. On the HP 8757 press **[AUTOSCALE]** to position the trace on the display. Slowly move the sliding load back and forth: the trace should change slightly as the phase of the sliding load reflection changes.

    Note the frequency at which the largest change occurs. Write down the maximum and minimum measured return loss for that frequency.

11. The maximum and minimum measured return loss values correspond to the directivity signal and the sliding load signal adding and subtracting. You can separate these two signals with the signal separation chart, Figure 4-c. Calculate the difference in dB between the maximum and minimum measured return loss for the first chosen frequency and locate this value on the vertical axis of Figure 4-c. Draw a horizontal line across the chart from this point and note the two places where it intersects the curves. The intersections are the two correction values in dB. Add each of them to the minimum measured return loss. The resulting two corrected values are the directivity signal and the sliding load reflected signal. Exactly *which* value represents directivity is determined later in this procedure.

    Example: At 3 GHz you measure a maximum measured return loss of −42 dB and a minimum return loss of −30 dB. The difference is 11 dB. Refer to Figure 4-c. Find 12 dB on the vertical axis, and draw a horizontal line across the figure from that point. Note the correction values on the horizontal axis are −4 dB and −8.5 dB. Adding each of these to the minimum measured return loss results in two values: −34 dB and -38.5 dB. One on these values is the directivity value, the other is the return loss of the sliding load's load element.

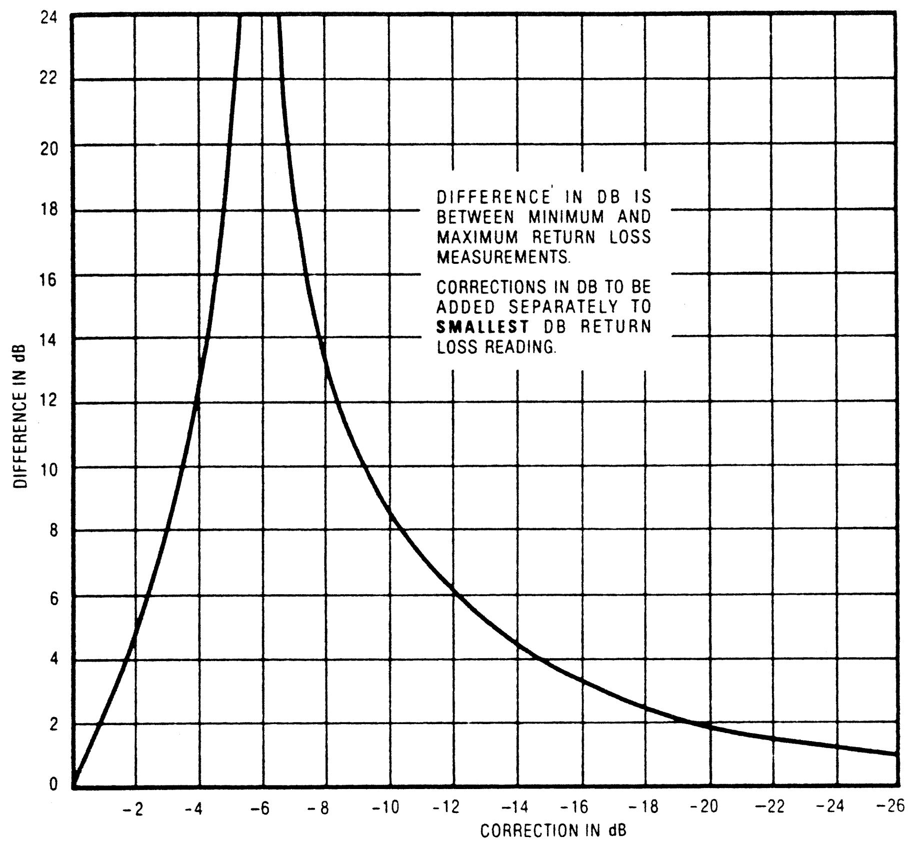

Figure 4-c. Signal Separation Chart

12. Usually the larger return loss value is the measured directivity. You can verify this by performing the following step.

13. Slowly retract the center conductor of the sliding load about 2 mm. This will introduce a discontinuity at the directional bridge test port and change the measured directivity. Repeat steps 10 and 11 above. Use Figure 4-c to separate the signals. One of the new values should match one of the original values — and is the sliding load's return loss. *The value that changed is the measured directivity.*

    Example: After performing step 13 you get two values, −34 dB and −37 dB. Refer to the earlier example where −34 db and −42 dB values were obtained.

	Return Loss Of Load (No Change)	**Directivity (Changed)**
Step 11:	−34	-38.5 ←**Actual Directivity**
Step 13:	−34	−37

The two matching (or approximately matching) values represent the return loss of the sliding load. The value that changed was the directivity value, which degraded when the center conductor of the sliding load was retracted. This verifies that the original signal was the actual directivity.

14. Enter the directivity on the test record, located at the end of this section.

Determining Measurement Uncertainty Above 2 GHz

15. Although the signal separation procedure removes reflections of the load itself, the mismatch of the sliding load connector and airline introduces reflections and uncertainties. To estimate these uncertainties, refer to Figure 4-b. Locate the return loss of the sliding load connector on the horizontal axis (convert from the specified SWR). Move up from this point to the upper limit of the shaded area of the chart. Find the corresponding dB value on the vertical axis and enter this value in the test record. Actual directivity can be anywhere within the shaded area. Record the uncertainty in the test record.

NOTE: When determining measurement uncertainty for frequencies above 20 GHz, refer to Figure 4-d instead of 4-b. The directivity specification changes above 20 GHz and this affects the uncertainty chart.

16. Set the start and stop frequencies of the source to the next frequency band. Repeat steps 8 through 15 for a start and stop frequency of 20.0 to 26.5 GHz.

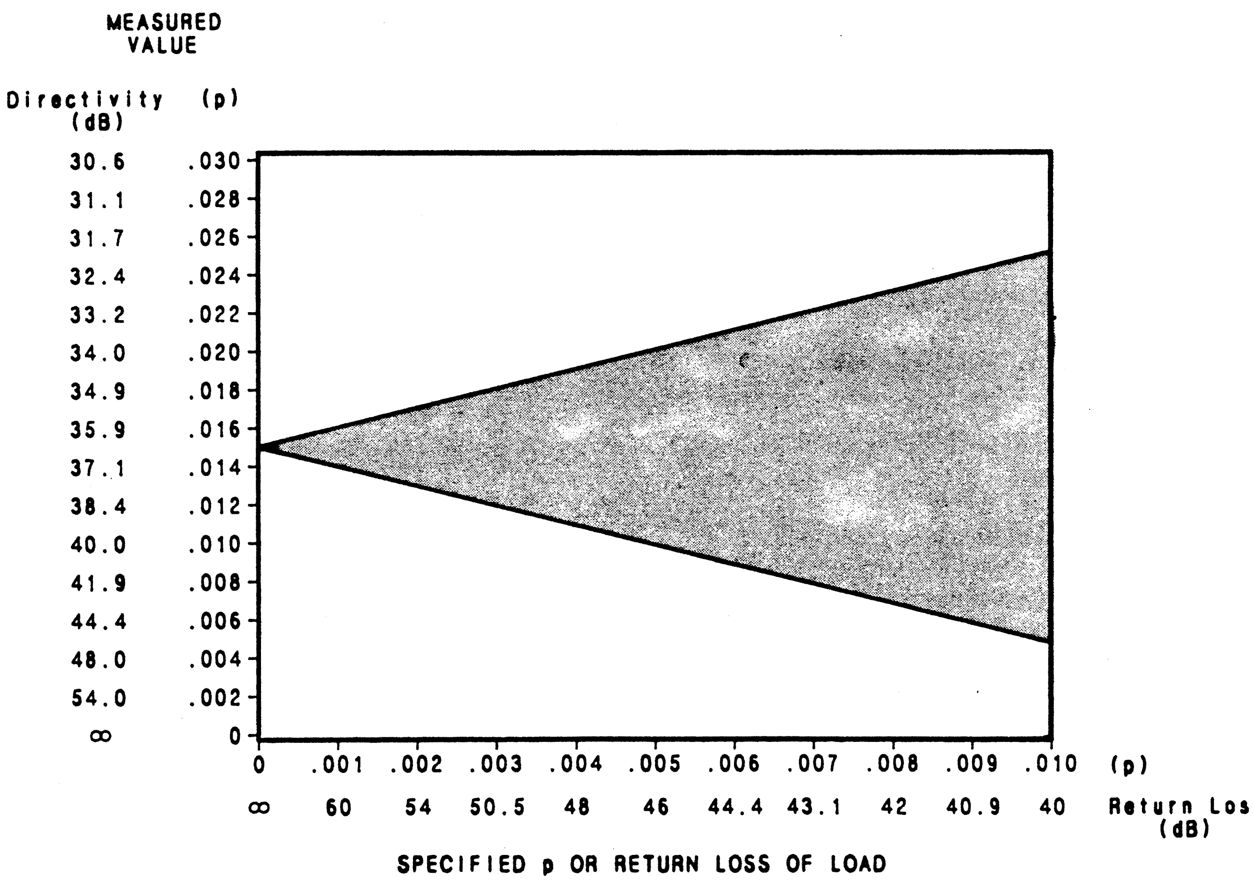

Figure 4-d. Measurement Uncertainty above 20 GHz

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