Notice

Hewlett-Packard to Agilent Technologies Transition

This documentation supports a product that previously shipped under the Hewlett-Packard company brand name. The brand name has now been changed to Agilent Technologies. The two products are functionally identical, only our name has changed. The document still includes references to Hewlett-Packard products, some of which have been transitioned to Agilent Technologies.

Printed in USA March 2000

HP 11770A
Link Measurements Personality
User's Guide

HP Part No. 11770-90006
Printed in UK June 1994

By internet, phone, or fax, get assistance with all your test and measurement needs.

Table 1-1 Contacting Agilent

Online assistance: `www.agilent.com/find/assist`

United States
(tel) 1 800 452 4844

Latin America
(tel) (305) 269 7500
(fax) (305) 269 7599

Canada
(tel) 1 877 894 4414
(fax) (905) 282-6495

Europe
(tel) (+31) 20 547 2323
(fax) (+31) 20 547 2390

New Zealand
(tel) 0 800 738 378
(fax) (+64) 4 495 8950

Japan
(tel) (+81) 426 56 7832
(fax) (+81) 426 56 7840

Australia
(tel) 1 800 629 485
(fax) (+61) 3 9210 5947

Asia Call Center Numbers

Country	Phone Number	Fax Number
Singapore	1-800-375-8100	(65) 836-0252
Malaysia	1-800-828-848	1-800-801664
Philippines	(632) 8426802 1-800-16510170 (PLDT Subscriber Only)	(632) 8426809 1-800-16510288 (PLDT Subscriber Only)
Thailand	(088) 226-008 (outside Bangkok) (662) 661-3999 (within Bangkok)	(66) 1-661-3714
Hong Kong	800-930-871	(852) 2506 9233
Taiwan	0800-047-866	(886) 2 25456723
People's Republic of China	800-810-0189 (preferred) 10800-650-0021	10800-650-0121
India	1-600-11-2929	000-800-650-1101

Hewlett-Packard Software Product License Agreement and Limited Warranty

Important

Please carefully read this License Agreement before opening the media envelope or operating the equipment. Rights in the software are offered only on the condition that the Customer agrees to all terms and conditions of the License Agreement. Opening the media envelope or operating the equipment indicates your acceptance of these terms and conditions. If you do not agree to the License Agreement, you may return the unopened package for a full refund.

License Agreement

In return for payment of the applicable fee, Hewlett-Packard grants the Customer a license in the software, until terminated, subject to the following:

Use

- Customer may use the software on one spectrum-analyzer instrument.
- Customer may not reverse assemble or decompile the software.

Copies and Adaptations

- Customer may make copies or adaptations of the software:
  - For archival purposes, or
  - When copying or adaptation is an essential step in the use of the software with a computer so long as the copies and adaptations are used in no other manner.
- Customer has no other rights to copy unless they acquire an appropriate license to reproduce which is available from Hewlett-Packard for some software.
- Customer agrees that no warranty, free installation, or free training is provided by Hewlett-Packard for any copies or adaptations made by Customer.
- All copies and adaptations of the software must bear the copyright notices(s) contained in or on the original.

Ownership

- Customer agrees that they do not have any title or ownership of the software, other than ownership of the physical media.
- Customer acknowledges and agrees that the software is copyrighted and protected under the copyright laws.
- Customer acknowledges and agrees that the software may have been developed by a third party software supplier named in the copyright notice(s) included with the software, who shall be authorized to hold the Customer responsible for any copyright infringement or violation of this License Agreement.

Transfer of Rights in Software

- Customer may transfer rights in the software to a third party only as part of the transfer of all their rights and only if Customer obtains the prior agreement of the third party to be bound by the terms of this License Agreement.
- Upon such a transfer, Customer agrees that their rights in the software are terminated and that they will either destroy their copies and adaptations or deliver them to the third party.
- Transfer to a U.S. government department or agency or to a prime or lower tier contractor in connection with a U.S. government contract shall be made only upon their prior written agreement to terms required by Hewlett-Packard.

Sublicensing and Distribution

- Customer may not sublicense the software or distribute copies or adaptations of the software to the public in physical media or by telecommunication without the prior written consent of Hewlett-Packard.

Termination

- Hewlett-Packard may terminate this software license for failure to comply with any of these terms provided Hewlett-Packard has requested Customer to cure the failure and Customer has failed to do so within thirty (30) days of such notice.

Updates and Upgrades

- Customer agrees that the software does not include future updates and upgrades which may be available from HP under a separate support agreement.

Export

- Customer agrees not to export or re-export the software or any copy or adaptation in violation of the U.S. Export Administration regulations or other applicable regulations.

Limited Warranty

Software

Hewlett-Packard warrants for a period of **90 days** from the date of purchase that the software product will execute its programming instructions when properly installed on the spectrum-analyzer instrument indicated on this package. Hewlett-Packard does not warrant that the operation of the software will be uninterrupted or error free. In the event that this software product fails to execute its programming instructions during the warranty period, customer's remedy shall be to return the measurement card ("media") to Hewlett-Packard for replacement. Should Hewlett-Packard be unable to replace the media within a reasonable amount of time, Customer's alternate remedy shall be a refund of the purchase price upon return of the product and all copies.

Media

Hewlett-Packard warrants the media upon which this product is recorded to be free from defects in materials and workmanship under normal use for a period of **90 days** from the date of purchase. In the event any media prove to be defective during the warranty period, Customer's remedy shall be to return the media to Hewlett-Packard for replacement. Should Hewlett-Packard be unable to replace the media within a reasonable amount of time, Customer's alternate remedy shall be a refund of the purchase price upon return of the product and all copies.

Notice of Warranty Claims

Customer must notify Hewlett-Packard in writing of any warranty claim not later than thirty (30) days after the expiration of the warranty period.

Limitation of Warranty

Hewlett-Packard makes no other express warranty, whether written or oral, with respect to this product. Any implied warranty of merchantability or fitness is limited to the **90 day** duration of this written warranty.

This warranty gives specific legal rights, and Customer may also have other rights which vary from state to state, or province to province.

Exclusive Remedies

The remedies provided above are Customer's sole and exclusive remedies. In no event shall Hewlett-Packard be liable for any direct, indirect, special, incidental, or consequential damages (including lost profit) whether based on warranty, contract, tort, or any other legal theory.

Warranty Service

Warranty service may be obtained from the nearest Hewlett-Packard sales office or other location indicated in the owner's manual or service booklet.

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 Institute of Standards and Technology, to the extent allowed by the Institute's calibration facility, and to the calibration facilities of other International Standards Organization members.

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.

Safety Symbols

The following safety symbols are used throughout this manual. Familiarize yourself with each of the symbols and its meaning before operating this instrument.

Caution

The *caution* sign denotes a hazard. It calls attention to a procedure which, if not correctly performed or adhered to, could result in damage to or destruction of the instrument. Do not proceed beyond a *caution* sign until the indicated conditions are fully understood and met.

Warning

The *warning* sign denotes a hazard. It calls attention to a procedure which, if not correctly performed or adhered to, could result in injury or loss of life. Do not proceed beyond a *warning* sign until the indicated conditions are fully understood and met.

Conventions

This guide uses the following conventions:

Front-Panel Key	A boxed, uppercase name in this typeface represents a key physically located on the instrument.
Softkey	A boxed word written in this typeface indicates a "softkey," a key whose label is determined by the instrument's firmware.
Softkey ON OFF (ON)	A boxed word written in this typeface with the words ON and OFF can turn a function on or off. The underlined function is shown in parenthesis.
Softkey AUTO MAN (AUTO)	A boxed word written in this typeface with the words AUTO and Man can either be auto-coupled or have its value manually changed. The underlined function is shown in parenthesis.
Screen Text	Text printed in this typeface indicates text displayed on the spectrum analyzer screen.

Contents

C. Theory

Figures

Tables

1

Getting Started

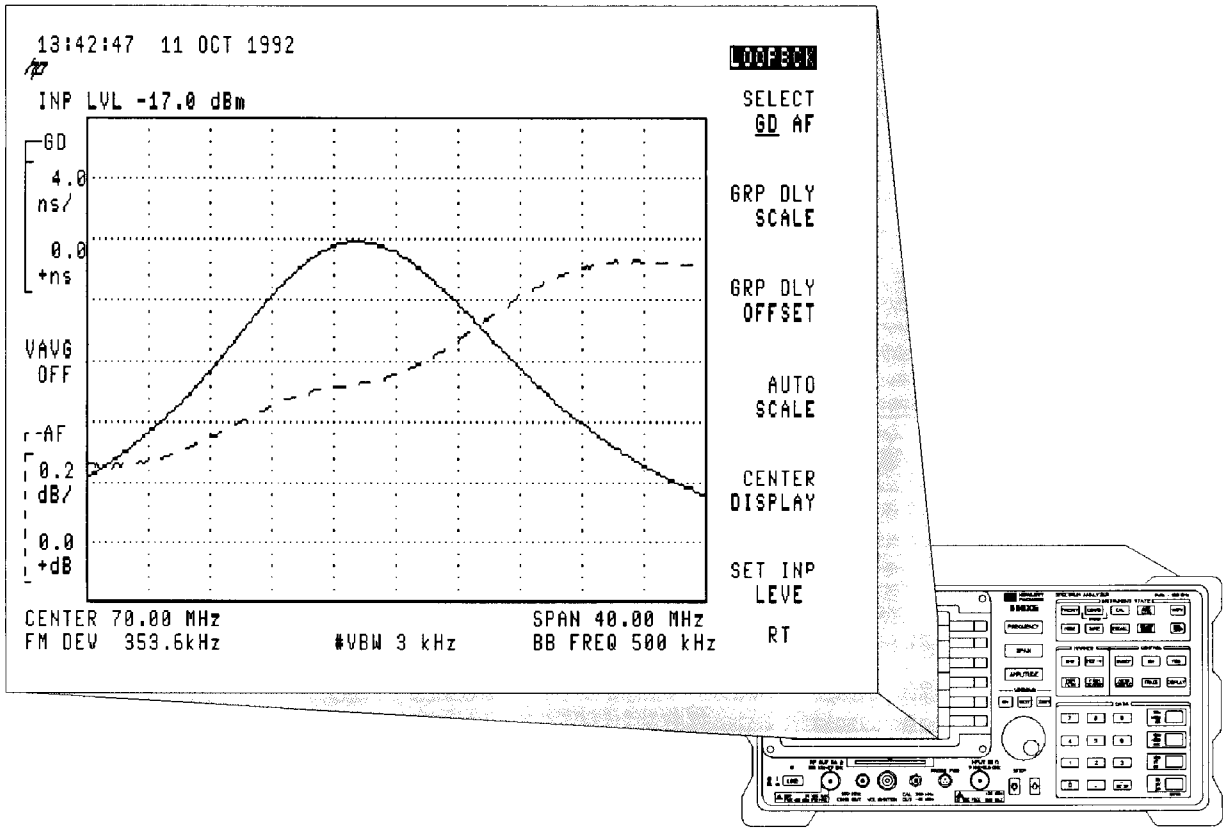
Introducing the HP 11770A Link Measurements Personality

The HP 11770A Link Measurements Personality gives a *suitably equipped* HP 859xE Series Spectrum Analyzer the capability of making **group delay and amplitude flatness measurements.**

Note

HP 11770A Link Measurements Personality rev A.02.00 is compatible with firmware of revision 930506 or greater.

Suitably equipped means the spectrum analyzer must be one of the types listed in the "Ordering Group Delay" section in this chapter, and must be fitted with the Group Delay and Amplitude Flatness Measurements Card.



HP 11770A Features

- End-to-End or Loopback Measurements Configuration
- Autoscale
- Markers
- Peak-to-Peak Measurements
- Linear and Parabolic Group Delay Measurements
- Save and Recall Test States and Traces

End-to-End Measurements

Satellite, DMR or cable links can all be tested, by using two spectrum analyzers with group delay and amplitude flatness measurement capability. For this type of measurement, one spectrum analyzer is located at the transmitter end of the link and runs the **Link Transmitter mode**. The other spectrum analyzer is located at the receiver end of the link and runs the **Link Receiver mode**. When the test starts, the receiver automatically searches for and synchronizes with the transmitter's sweep, allowing group delay and amplitude flatness measurements to be made.

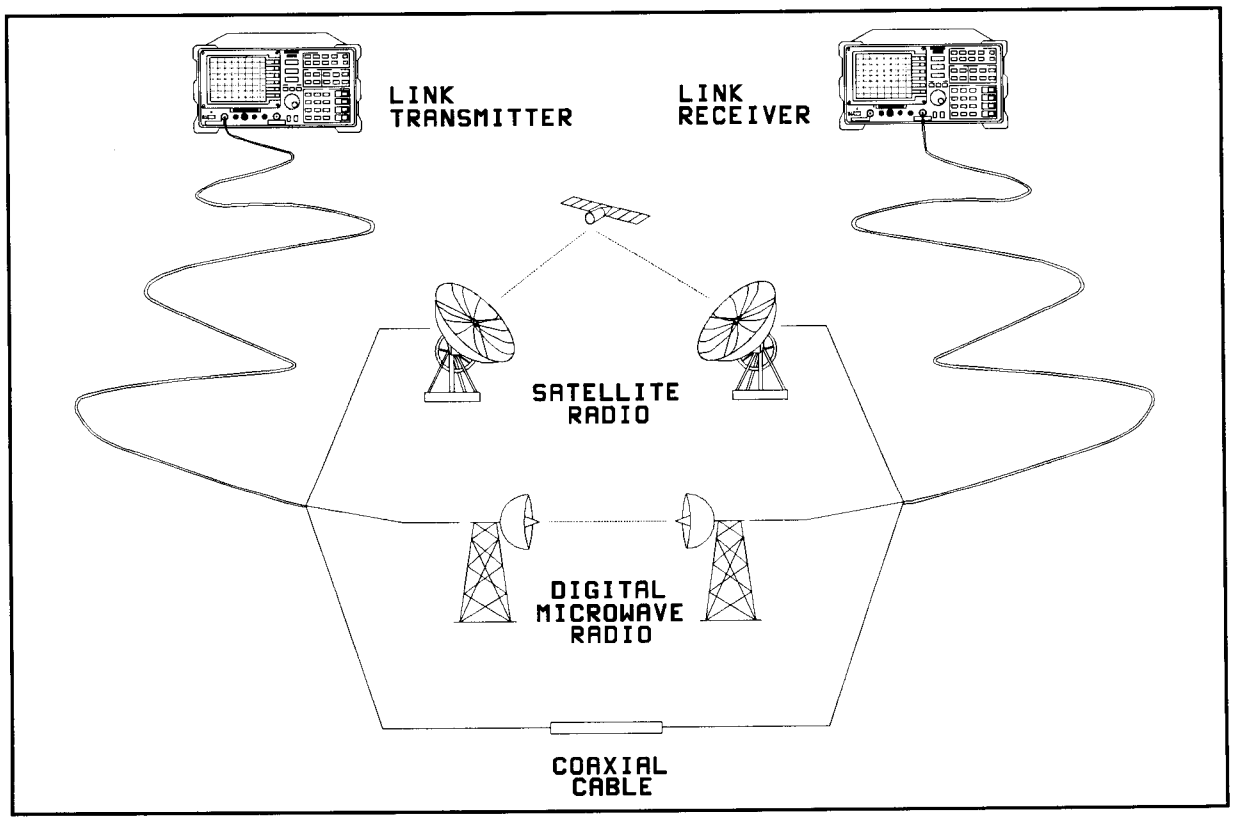


Figure 1-1. End to End Measurements Using the Link Transmitter and Link Receiver Modes

Loopback Measurements

With the **Link Loopback mode**, you can measure the group delay and amplitude flatness characteristics of a device using only one spectrum analyzer. In this type of measurement, the spectrum analyzer is used to both transmit and receive the swept signal. Figure 1-2 and Figure 1-3 give examples of how the loopback measurements may be made.

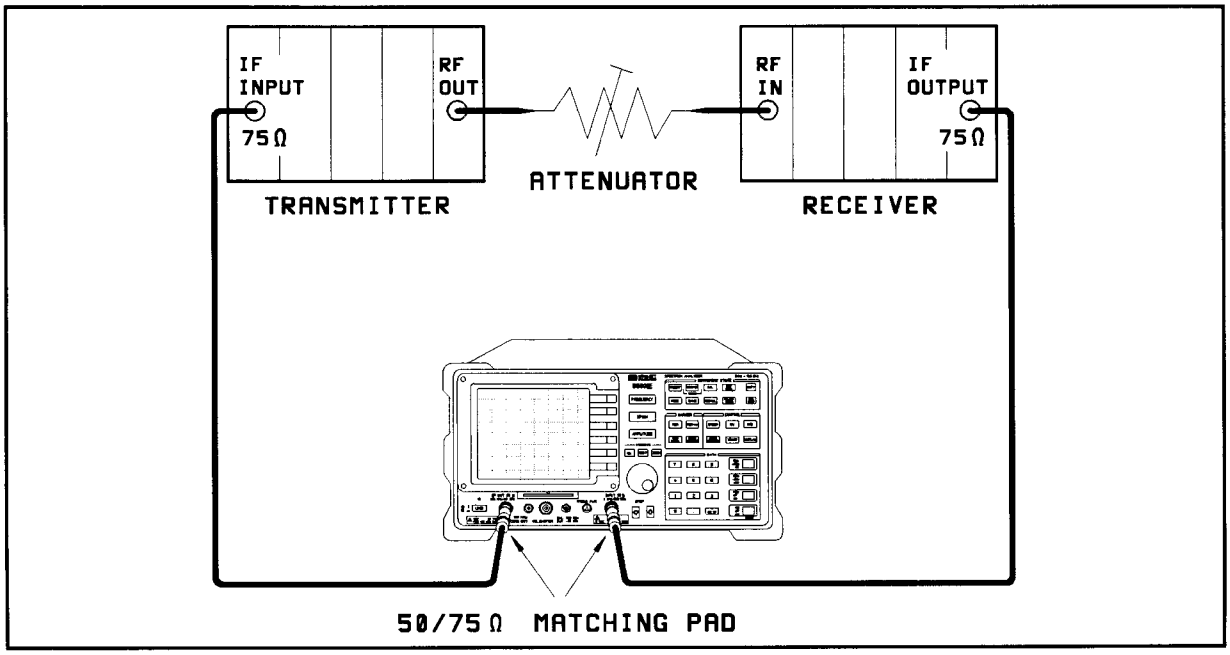


Figure 1-2. DMR Testing Using the Link Loopback Mode

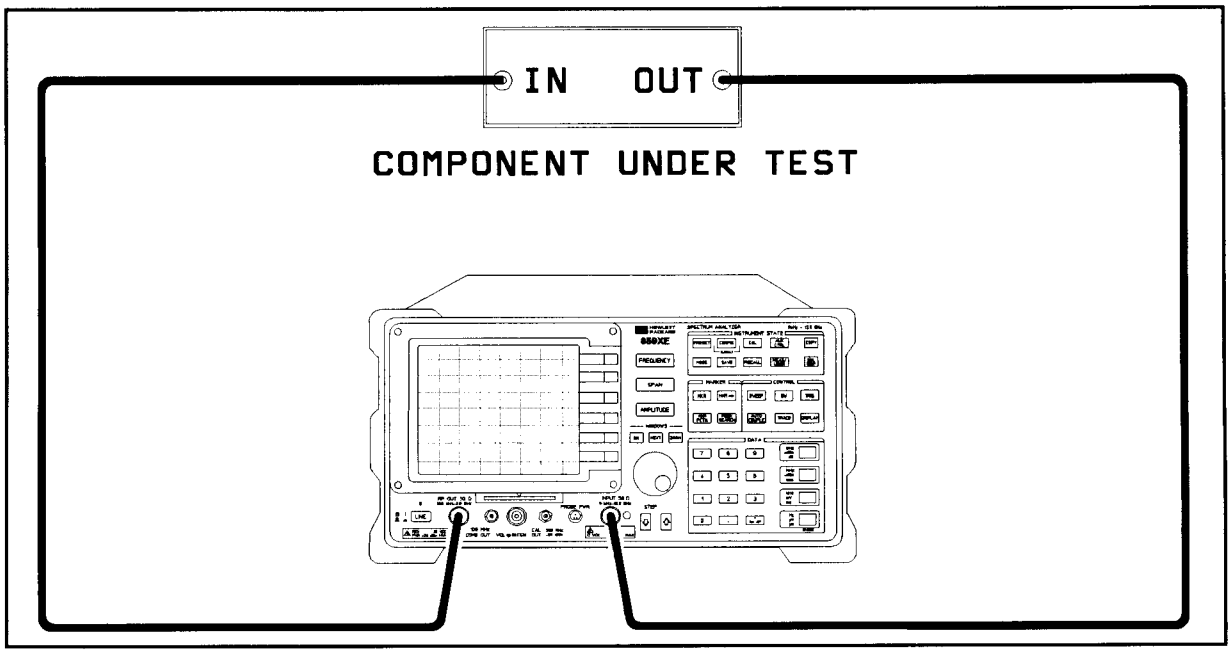


Figure 1-3. Component Testing Using the Link Loopback Mode

Ordering Group Delay

Because the HP 11770A Link Measurements Personality is not a stand-alone product, several product and option numbers are used for ordering convenience and to allow for retrofitting. The following information describes how to order the group delay and amplitude flatness capability as:

1. A **retrofit** to an existing HP 859xE Series Spectrum Analyzer or HP 11758T/U/V Digital Radio Test System (DRTS)
2. An **option** to a new HP 859xE Series Spectrum Analyzer
3. An **option** to a new HP 11758V DRTS

This section also lists some of the available accessories.

As a Retrofit

HP 11768A Group Delay and Amplitude Flatness Retrofit Kit

The HP 11768A is used to retrofit the following instruments:

- HP 8593A with Option 010 (Tracking Generator)
- HP 8593E with Option 010 (Tracking Generator)
- HP 8594E with Option 010 (Tracking Generator)
- HP 8595E with Option 010 (Tracking Generator)
- HP 8596E with Option 010 (Tracking Generator)
- HP 11758T DRTS
- HP 11758U DRTS
- HP 11758V DRTS

Note

Retrofitting can only be carried out at a Hewlett-Packard factory. An HP 8591A *cannot* be retrofitted with Group Delay.

Option to an HP 859xE Spectrum Analyzer

To order the group delay measurement capability as an option to an HP 8593E, HP 8594E, HP 8595E or HP 8596E Spectrum Analyzer, order Option 111. Option 111 does not include the HP 11770A Link Measurement Personality. This must be ordered seperately.

Option to an HP 11758V DRTS

To order the group delay measurement capability as an option to an HP 11758V DRTS, order Option 201.

Accessories

HP 11766A DADE Switch

The HP 11766A Diversity Antenna Delay Equalization (DADE) Switch can extend the group delay measurement capability of your spectrum analyzer, by enabling you to make diversity antenna measurements.

HP 11767A Tracking Generator Amplifier

The output power from the tracking generator (RF OUT) can be amplified using the HP 11767A Tracking Generator Amplifier. This product will amplify the output signal by approximately 8.2 dB (typical).

HP 11769A Return Loss Bridge

The HP 11769A Return Loss Bridge can be used to measure the IF Return Loss of the device under test.

Refer to Appendix A ("Accessories") for more details on each of these accessories.

Selecting a Mode

The HP 11770A Link Measurement Personality is used to set up the spectrum analyzer to make group delay and amplitude flatness measurements. When the Link Measurement Personality is being used, the instrument should be thought of as a **link analyzer** rather than a spectrum analyzer.

The Link Measurement Personality actually consists of four modes. Three of these modes are **personalities** which determine the link analyzer's function in making these measurements. The fourth mode is the Group Delay Verification mode, which is a self-test program that checks the link analyzer's main functions.

The four modes are as follows:

Softkey	Mode Name
LINK TRANSMTR	Link Transmitter
LINK RECEIVER	Link Receiver
LINK LOOPBACK	Link Loopback
GRP DLY VERIFY	Group Delay Verification

This section describes how to load, run and exit these modes.

Loading a Mode

The method used to load the link measurement modes into the analyzer's memory is dependent on the instrument or system you are using.

If you are using a stand-alone HP 859xE Series Spectrum Analyzer, load the link measurement modes using the Link Loader.

If you are using an HP 11758T/U/V DRTS, load the link measurement modes using the HP 11758V DRTS Mode Loader.

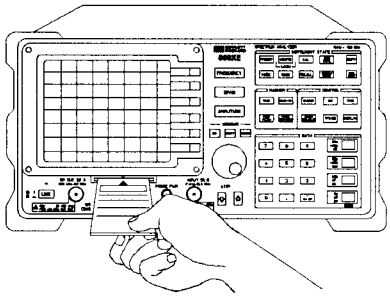
Loading a Mode Using the Link Loader

The Link Loader program provides a convenient way to automatically dispose of and load the various modes used with the link analyzer.

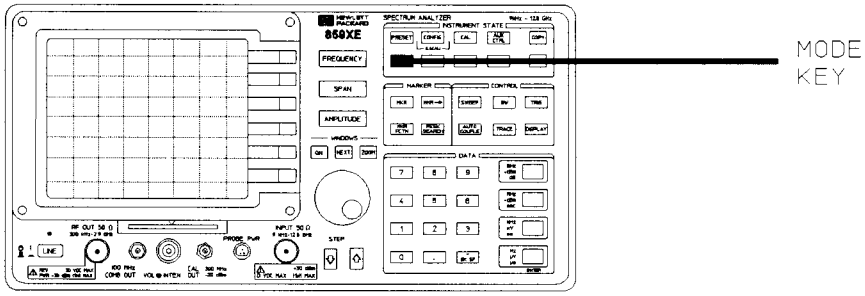
Note

The Link Loader should only be used with a stand-alone HP 859xE Series Spectrum Analyzer. If you are using an HP 11758T/U/V DRTS, refer to the "Loading a Mode Using the HP 11758V DRTS Mode Loader" procedure in this section.

1 The Link Loader program is stored on the same ROM card as the link measurement modes. Insert the Link Measurement Personality ROM card into the spectrum analyzer with the card's arrow matching the raised arrow on the bezel around the card-insertion slot.

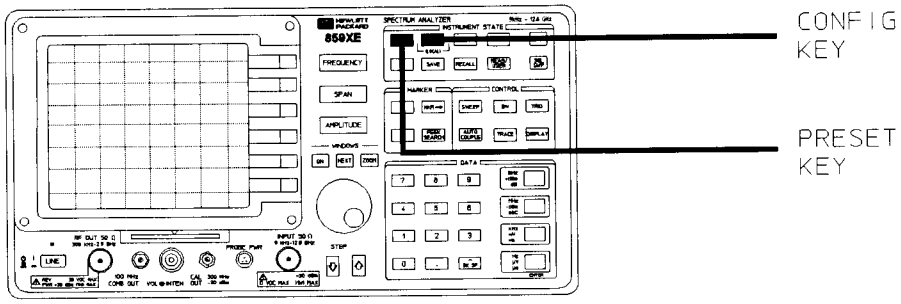


2 Press (MODE). The softkey menu lists the DLP's that are stored in the analyzer memory.

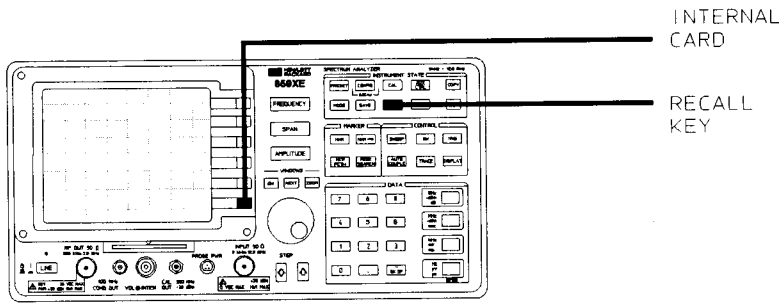


3 If the mode that you want to load is listed, skip the rest of this procedure and turn to the "Running a Mode" procedure in this section, otherwise carry on with this procedure from step 4.

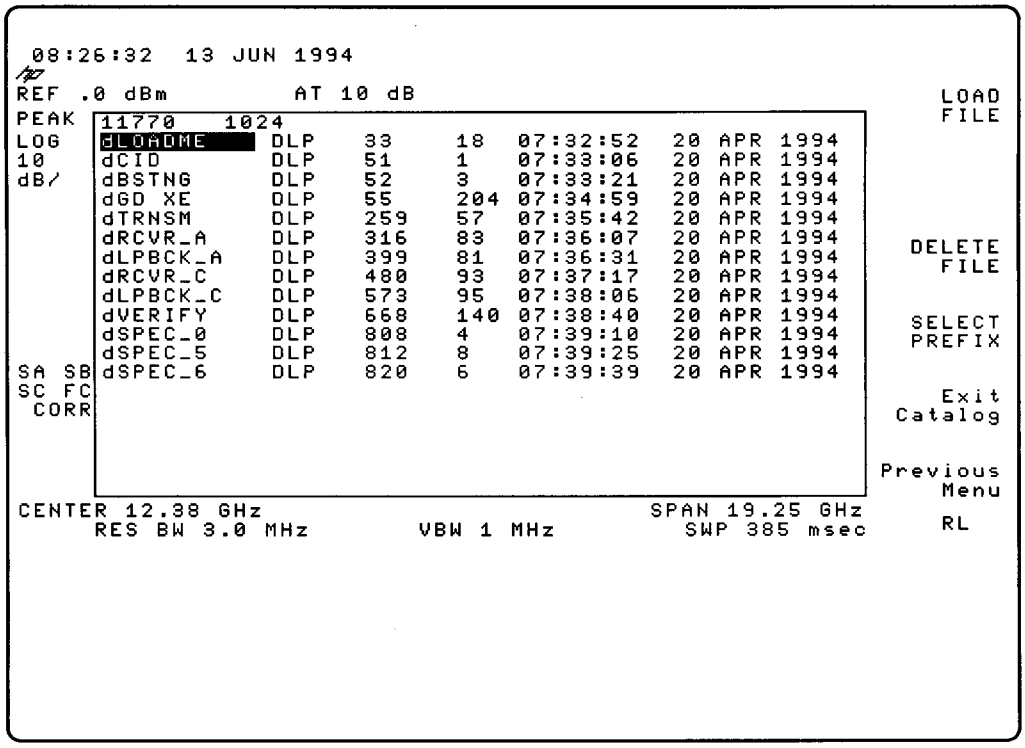
4 Press (PRESET). The spectrum analyzer will return to its default mode. Press (CONFIG), **MORE 1 of 3**, **DISPOSE USER MEM**, **DISPOSE USER MEM**.



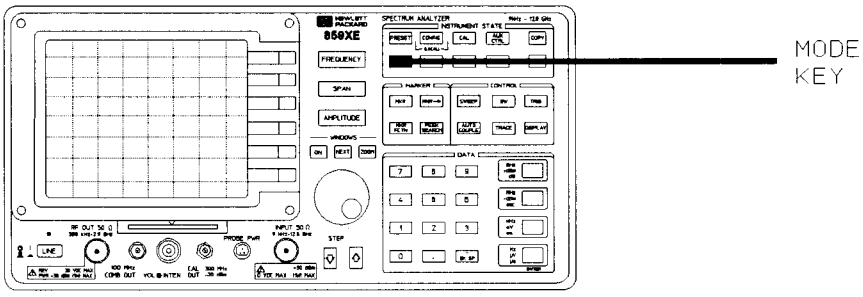
5 Press (RECALL) followed by **INTERNAL CARD** so that CARD is underlined.



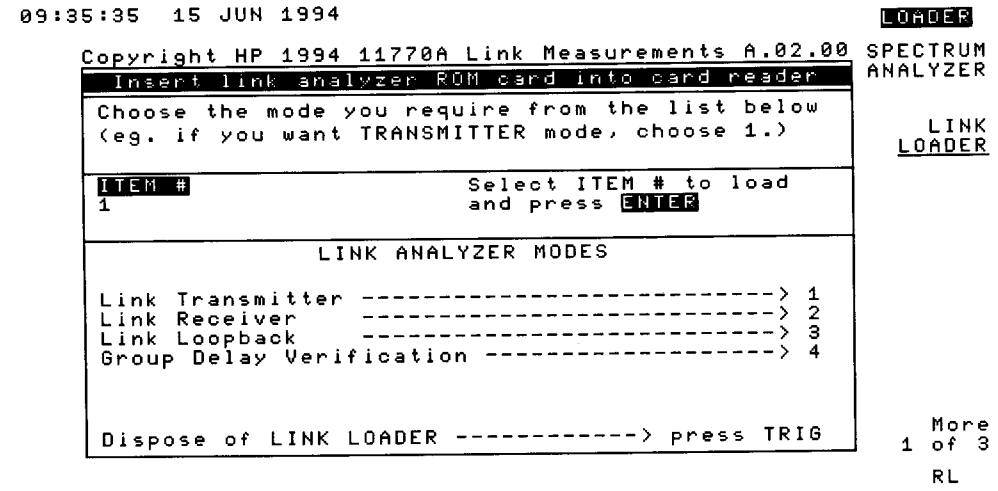
6 To display the contents of the ROM Card, press **CATALOG CARD**, **CATALOG ALL**. All the programs on the card will be displayed on the screen. Turn the knob, until the top program **dLOADME** is highlighted, then press **LOAD FILE**. This will load the Link Loader into the memory.



7 The Link Loader will take about 3 seconds to load. When it has loaded, press (MODE).



8 Press **LINK LOADER**. The Link Loader screen will appear, as shown below.



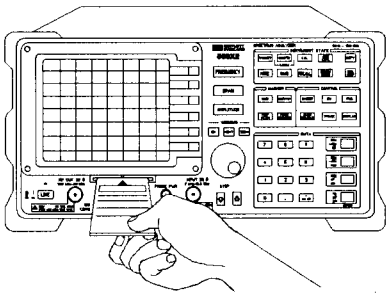
9 Use the DATA keys to select ITEM # 1, 2, 3 or 4, then press (ENTER). The mode you have chosen will be loaded into the memory. For details on running the mode, refer to the "Running a Mode" procedure in this section.

Loading a Mode Using the HP 11758V DRTS Mode Loader

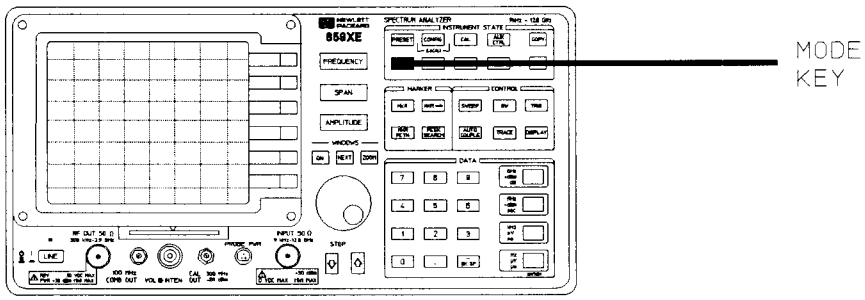
Note

The HP 11758V DRTS Mode Loader should only be used with an HP 11758T/U/V DRTS. If you are using a stand-alone HP 859xE Series Spectrum Analyzer, refer to the "Loading a Mode Using the Link Loader" procedure in this section.

1 Insert the HP 11758V Digital Radio Test System ROM Measurement Card into the spectrum analyzer, with the card's arrow matching the raised arrow on the bezel around the card-insertion slot.

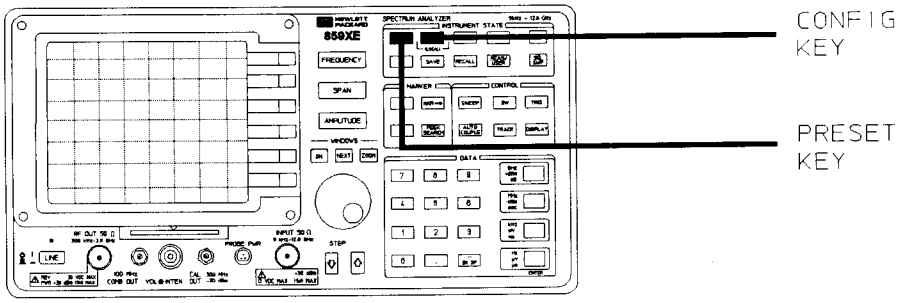


2 Press (MODE). The softkey menu lists the DLP's that are stored in the analyzer memory.

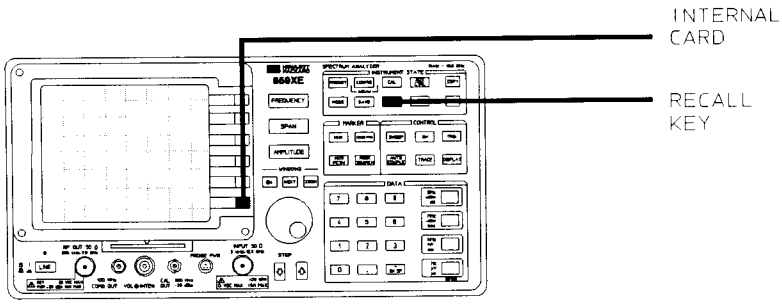


3 If the mode that you want to load is listed, skip the rest of this procedure and turn to the "Running a Mode" procedure in this section, otherwise continue this procedure from step 4.

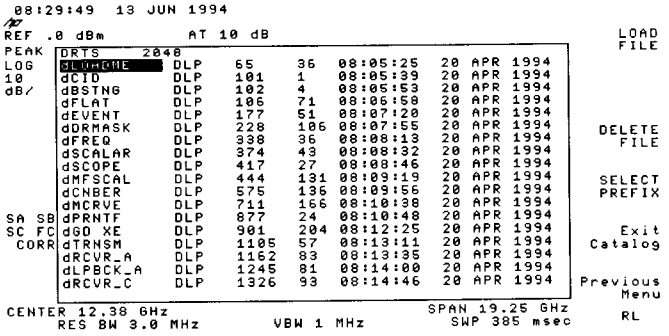
4 Press (PRESET). The spectrum analyzer will return to its default mode. Press (CONFIG), **MORE 1 of 3**, **DISPOSE USER MEM**, **DISPOSE USER MEM**.



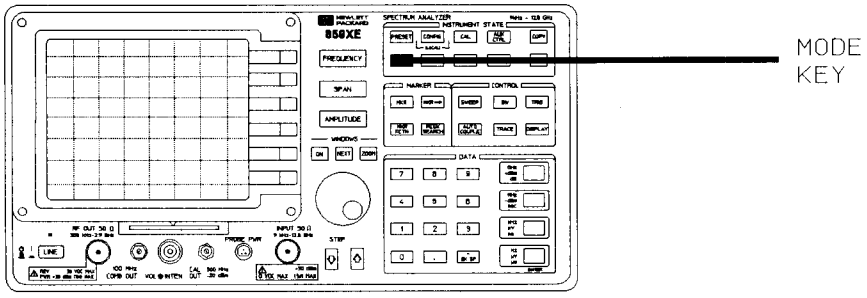
5 Press (RECALL) followed by **INTERNAL CARD** so that CARD is underlined.



6 To display the contents of the ROM Card, press **CATALOG CARD**, **CATALOG ALL**. All the programs on the card will be displayed on the screen. Turn the knob, until the top program **dLOADME** is highlighted, then press **LOAD FILE**.



7 The program will take about 3 seconds to load. When it has loaded, press (MODE).



8 Press **MODE LOADER**. The Mode Loader screen will appear, as shown below.

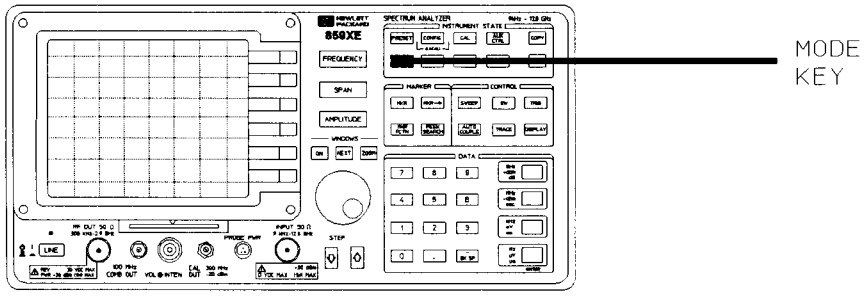
```
09:38:20  15 JUN 1994                                        LOADER
     Copyright 1993 HP DRTS Measurements                    A.02.00
  INSERT HP 11768-80012 ROM CARD INTO CARD READER
  FREQ CNTR, FLATNESS & SOURCES ------------- 1
  DIGITAL RADIO MASKS and FREQUENCY COUNTER -- 2
  SCALAR ANALYZER and LF OSCILLOSCOPE -------- 3
  ITEM #                      Select ITEM # to load
  1                           and press ENTER
  FLATNESS ANALYZER & SOURCES ---------------- 4
  EVENT COUNTER ------------------------------ 5
  DIGITAL RADIO MASKS ------------------------ 6
  FREQUENCY COUNTER -------------------------- 7
  SCALAR ANALYZER ---------------------------- 8
  LOW FREQ OSCILLOSCOPE ---------------------- 9
  MULTIPATH FADING SIMULATOR CALIBRATE ------- 10
  MULTIPATH FADE ----------------------------- 11
  CARRIER TO NOISE --------------------------- 12
                                                          NEXT
                                                          PAGE
                                                          RL
```

9 Press **NEXT PAGE**. Use the DATA keys to select ITEM number 13 or 14 then press (ENTER). 13 loads all three group delay personalities(loopback, receiver and transmitter) refer to the "Running a Mode" procedure in this section.

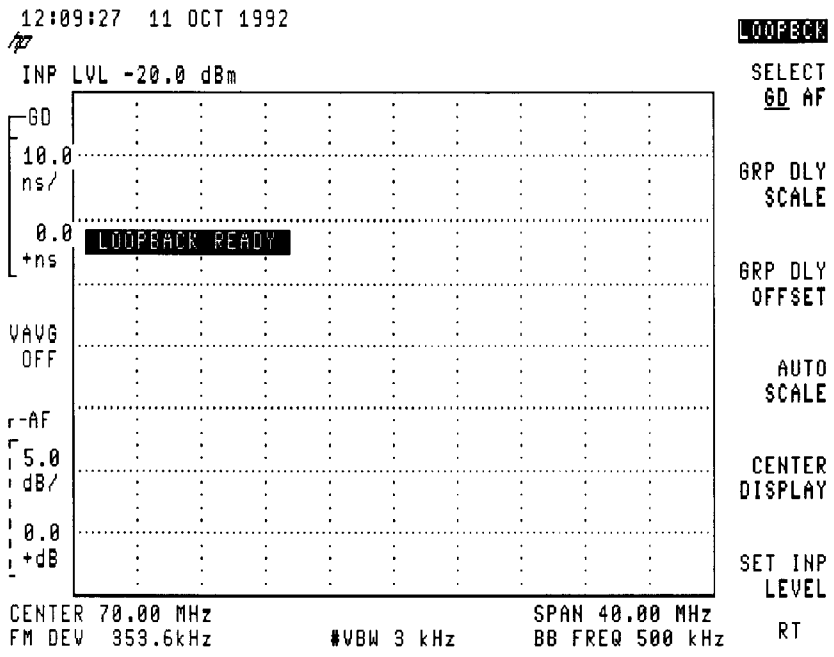
Running a Mode

Once the mode you want is loaded into the analyzer memory, it can be run as follows:

1 Press (MODE). To run the mode, press **LINK RECEIVER**, **LINK TRANSMTR**, **LINK LOOPBACK** or **GRP DLY VERIFY**, depending on which mode you require.



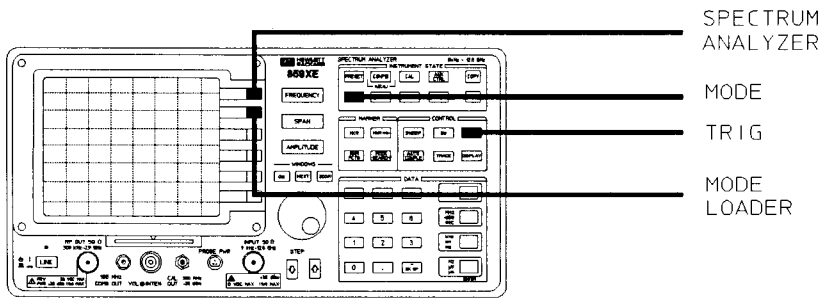
2 When the mode is running, the name of the mode will be displayed in the softkey menu. That is, **RECEIVR**, **TRNSMTR**, **LOOPBCK** or **VERIFY** will be displayed.



Exiting a Mode

The procedure for exiting from the link analyzer modes and mode loader involves returning to the mode loader, and selecting the appropriate option.

1 Press (MODE), **MODE LOADER** and (TRIG) twice to dispose of mode loader.



2 Press (MODE), **SPECTRUM ANALYZER** and then **PRESET SPECTRUM** on the next screen to exit the present mode.

Getting Acquainted with the Link Measurements Personality

The HP 11770A uses the HP 859xE Series Spectrum Analyzer as a platform to allow it to make group delay and amplitude flatness measurements. However when the personality is being used, the instrument should be thought of as a **link analyzer** rather than a spectrum analyzer.

The link analyzer is controlled by using the **front panel keys** to access **softkey menus**. The menus contain all the functions necessary for you to make group delay and amplitude flatness measurements.

However, because the Link Measurements Personality effectively transforms the spectrum analyzer into a different instrument, the front panel keys and the softkeys are used for different functions. Some of the front panel keys are not used at all and are therefore disabled. Similarly, the traces and annotation displayed on the screen have different meanings, depending on what is being measured.

This section describes how each of the front panel features are used when the instrument is set up as a link analyzer.

Front Panel Features

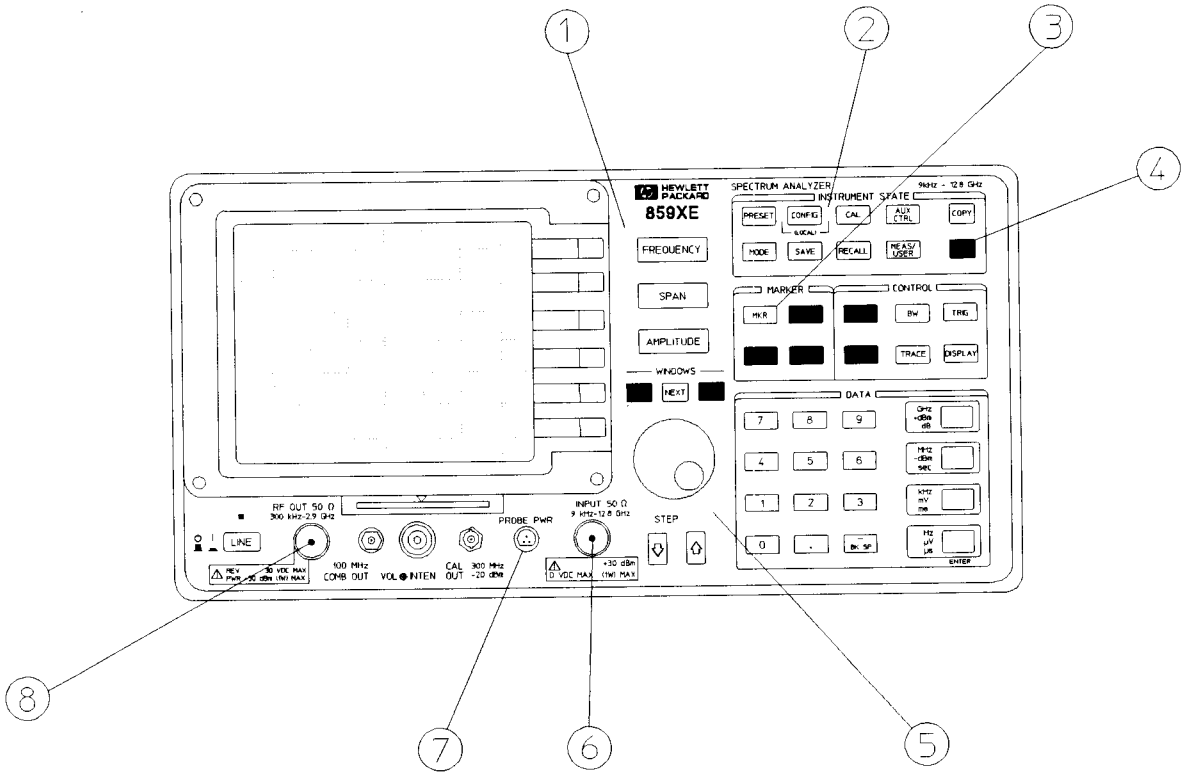


Figure 1-4. Front Panel Feature Overview

① [FREQUENCY] and [SPAN] access the same softkey menu. The softkeys in the menu are used to set the frequency range of the sweep and the modulation parameters. When you are running the Link Receiver mode or Link Loopback mode, [AMPLITUDE] is used to set the scale and offset of the traces.

② [PRESET], [CONFIG] and [MODE] behave as normal. [SAVE] and [RECALL] enable you to use the analyzer's memory, or a RAM card, to save a test trace or set-up. The softkeys activated by pressing [CAL] are used to calibrate the link analyzer. [AUX CTRL] controls the tracking generator. [MEAS/USER] lets you make special measurements.

③ Markers can be used to assist in making measurements by pressing [MKR].

④ The keys that are shown in black have no function.

⑤ The **DATA** keys, **STEP** keys and **knob** are used to change the numeric value of an active function.

⑥ **INPUT 50Ω** is the signal input to the link analyzer. This input is used in the Link Receiver and Link Loopback modes only.

⑦ **PROBE PWR** is used as a power supply for the HP 11766A and HP 11767A accessories.

⑧ **RF OUT 50Ω** is the tracking generator output signal. This output is used in the Link Transmitter and Link Loopback modes only.

Screen Annotation

Figure 1-5 shows an example of the annotation that may appear on the link analyzer screen. The screen annotation is referenced by numbers and is listed in Table 1-1. The Function Key column indicates which front panel key or softkey activates the function relating to the screen annotation. Refer to the "Key Descriptions" section in Chapter 4 for more information on a specific softkey.

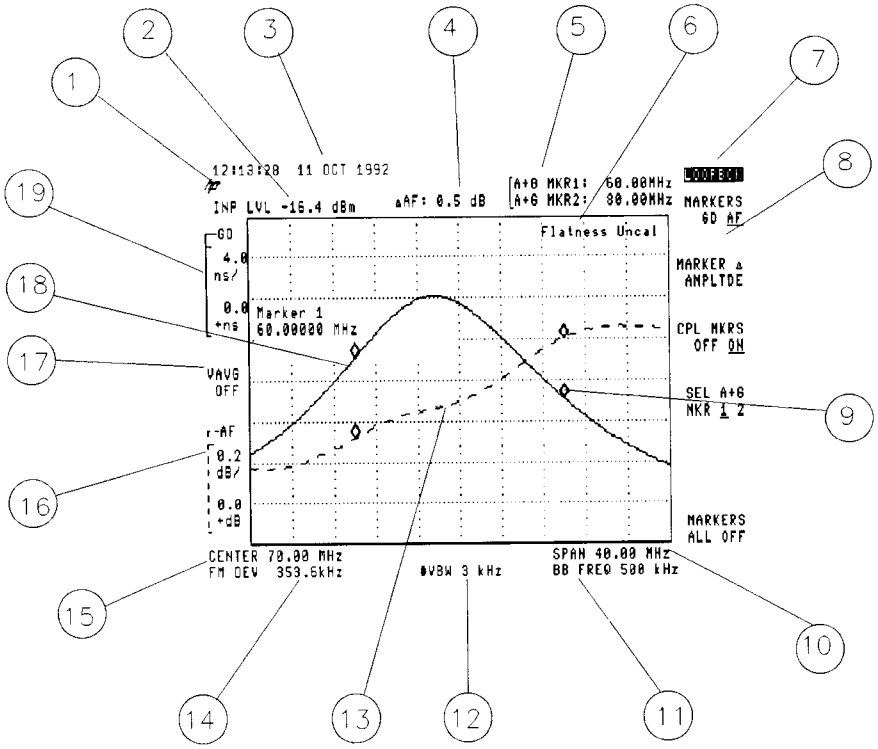


Figure 1-5. Screen Annotation

Table 1-1. Screen Annotation

Item	Description	Function Key
1	Screen Title	CHANGE TITLE
2	Input Signal Level	LVL MON OFF ON (OFF)
3	Time and Date Display	Time Date
4	Markers Difference	MARKER Δ GRP DLY or MARKER Δ AMPLTDE.
5	Markers/Measurements Readout. The annotation displayed here will change depending on the function selected. The area is used to display markers, peak-peak, linear and parabolic delay distortion, or velocity factor and cable length.	(MKR), MEAS PK-PK, MEAS LIN PARBL GD, MEAS CBL LENGTH or VELOCITY FACTOR.
6	Flatness is Not Calibrated	Refer to the "Calibrating the Link Analyzer" section in Chapter 3.
7	Mode Name	Refer to the "Selecting a Mode" section in Chapter 1.
8	Softkey Menu	Not Applicable
9	Marker	(MKR)
10	Frequency Span	(SPAN) or SPAN
11	Baseband Frequency	BB FREQ
12	Video Bandwidth	(BW)
13	Amplitude Flatness Trace	DISPLAY A G A+G (A)
14	FM Deviation/Receiver Unlocked. The annotation displayed here will change depending on which mode is running. In Link Loopback mode, the frequency deviation of the modulation is displayed. In Link Receiver mode, "Receiver Unlocked" refers to the receiver's state.	FM DEV or (TRIG)
15	Center Frequency	(FREQUENCY) or CENTER FREQ
16	Amplitude Flatness Scale and Offset	AMPLTDE SCALE and AMPLTDE OFFSET
17	Video Averaging (No. of Samples)	VID AVG OFF ON (OFF)
18	Group Delay Trace	
19	Group Delay Scale and Offset	GRP DLY SCALE and GRP DLY OFFSET

Entering Data

Data can be entered using the DATA keys, STEP keys or knob. However, the way you use the DATA keys can vary depending on the parameter you are changing. Some of the DATA keys can be used to enter particular units, for example (MHz) and (dB). However a unit such as nanoseconds (ns) does not have a special key and (ENTER) must be used instead.

Table 1-2 details the various units that need to be entered when using the link analyzer, along with examples of the functions that use them, and the keys that should be used.

Table 1-2. Entering Data

Units	Example of Function	Keys to Use	Example
dB	AMPLTDE OFFSET	(dB) or (ENTER)	(8) (dB) = 8 dB
dB/div	AMPLTDE SCALE	(dB) or (ENTER)	(3) (ENTER) = 3 dB/div
dBm or **– dBm**	SRC PWR OFF ON	(+ dBm), (– dBm) or (ENTER)	(1) (– dBm) = –1 dBm
GHz or **MHz**	CENTER FREQ , SPAN	(GHz) or (MHz)	(7) (0) (MHz) = 70 MHz
kHz RMS	FM DEV	(kHz)	(5) (9) (kHz) = 59 kHz RMS
ns	GRP DLY OFFSET	(ENTER)	(–) (4) (ENTER) = –4 ns
ns/div	GRP DLY SCALE	(ENTER)	(3) (ENTER) = 3 ns/div
no units	VELOCITY FACTOR	(ENTER)	(.) (7) (ENTER) = 0.7

2

Link Transmitter Mode

This chapter describes how to set up the transmitter end of the link to make Group Delay and Amplitude Flatness measurements. The chapter comprises of the following sections:

"**Setting Up the Link Transmitter**" describes how the tracking generator from the HP 859xE Series Spectrum Analyzer is used to provide the output signal.

"**Making Measurements**" describes how to change the following measurement parameters:

- Center Frequency
- Frequency Span
- Baseband Frequency
- FM Deviation
- Output Power

"**Using Save and Recall**" details how to save and recall a test state to the analyzer's internal memory or to a RAM card.

Setting Up the Link Transmitter

Note

If your analyzer's RF OUT terminal and INPUT terminal have working impedances of 50 Ω, and the impedance of the device under test is 75 Ω, use the 50-75 Ω Matching Pad (HP Part No. 08590-60090) as shown in Figure 2-1. Ensure that the cables you use are also of the correct impedance.

1 Load and run the Link Transmitter mode. For details, refer to "Selecting a Mode" in Chapter 1.

2 Connect the RF OUT connector (the tracking generator output) to the input of the device under test. The example below shows the transmitter end of a Digital Microwave Radio (DMR) link.

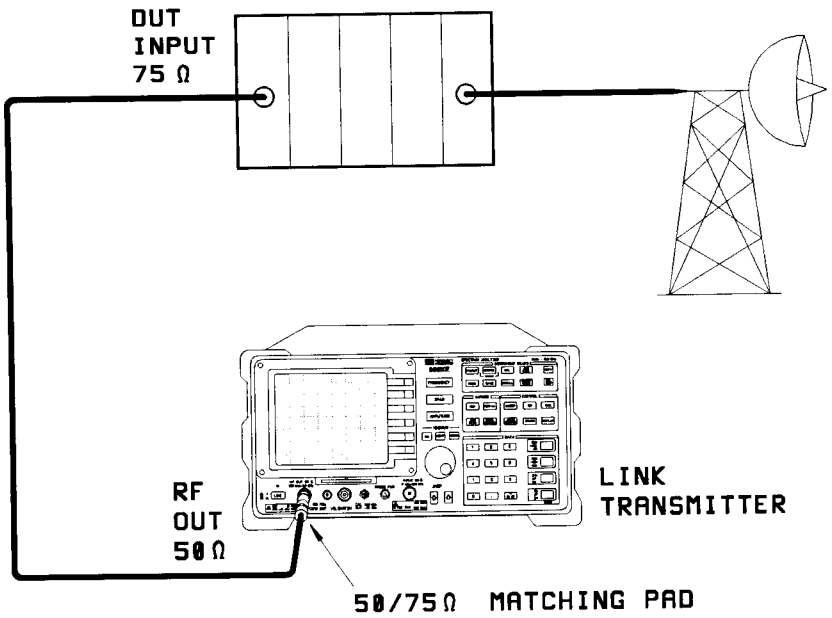


Figure 2-1.

Making Measurements

When the Link Transmitter mode is loaded, the tracking generator sets to the following defaults:

Carrier Center Frequency ..... 70 MHz

Carrier Frequency Span ..... 40 MHz

Baseband Frequency ..... 500 kHz

FM Deviation ..... 353.55 kHz RMS

Source Power ..... OFF (−10 dBm when set to ON)

This section describes how to change these parameters, so you can make the measurements required.

These parameter values are shown at all times in the Tx Setup Information Window, as shown in Figure 2-2. Check this window to ensure that the values you have entered have been accepted.

Notes

1. When the source power is **OFF**, the Tx Setup Information Window shows this by displaying **OFF**. It also shows a value in dBm. This value is the power level that the tracking generator will be set to when it is turned **ON**.
2. If **SRC PWR OFFSET** has been used to offset the tracking generator power, the table will show the source power value with this offset taken into account. The **Source Power** annotation in the table will change to **Source Power#** to remind you that an offset has been specified.

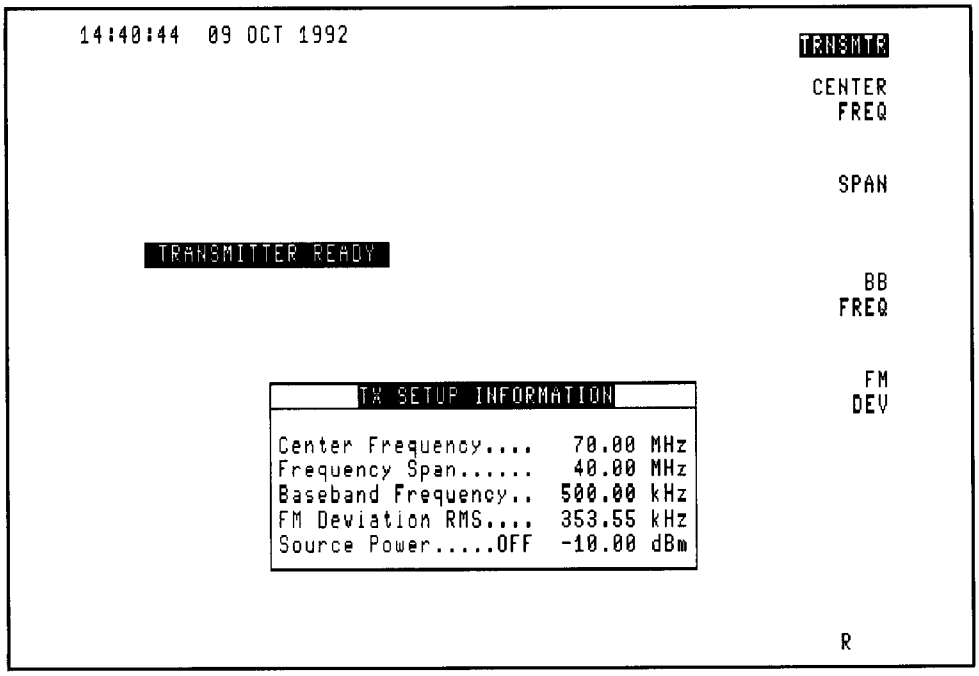


Figure 2-2. TX Setup Information Window

Changing the Carrier Frequency Range

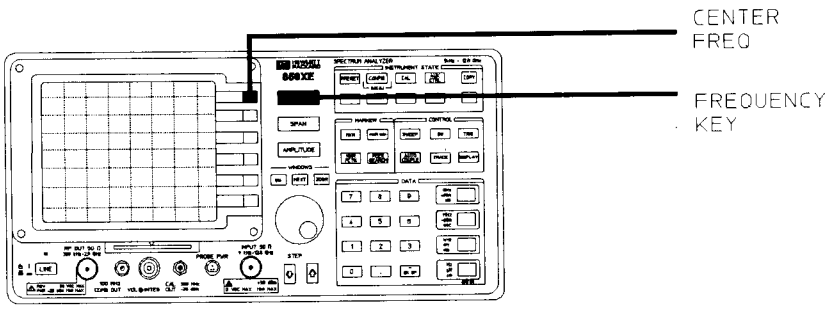
To set the frequency range of the sweep, you must specify the center frequency and span required.

Note

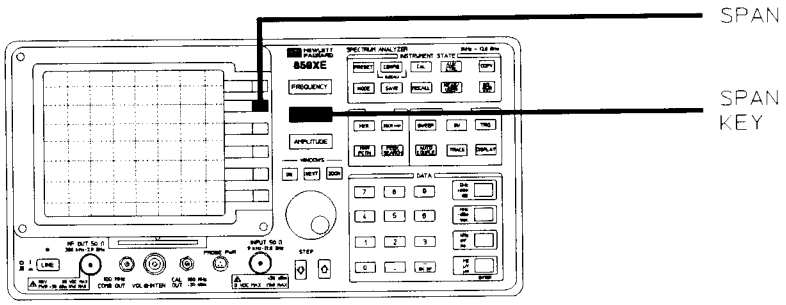
It is essential that the frequency span is set to the same value as the receiver. This also applies to the center frequency, unless there is a frequency translation between the transmitter and receiver.

If there is a frequency translation, the center frequency of the Link Transmitter mode and the center frequency of the Link Receiver mode must differ accordingly.

1 Press (FREQUENCY). **CENTER FREQ** should already be highlighted and so the center frequency can be entered.



2 Press (SPAN). **SPAN** should already be highlighted and so the frequency span can be entered.



Note

The HP 859xE Spectrum Analyzer with Group Delay and Amplitude Flatness Card, is specified to measure group delay and amplitude flatness over the frequency ranges of 70 MHz ± 20 MHz and 140 MHz ± 20 MHz. You can set the center frequency and span so that the analyzer sweeps outside these limits, however, the accuracy of the measurement is not specified.

The maximum frequency range of the sweep is from 300 kHz to 2.9 GHz. A combination of center frequency and frequency span that exceeds either of these limits is not permitted.

If either of these parameters is changed such that the combination produces a stop frequency greater than 2.9 GHz, or a start frequency less than 300 kHz, the other parameter will automatically be changed to bring the combination back within the limits.

For example, if the center frequency is at 2.2 GHz, and the frequency span is changed to 2 GHz, this would give a stop frequency of 3.2 GHz which is outside the allowed limit. In this case the center frequency would automatically change to 1.9 GHz to bring the stop frequency down to 2.9 GHz.

Similarly, if the center frequency was then changed to 3.5 GHz, the analyzer would set the frequency span to it's minimum value of 0.5 MHz and the center frequency to 2.9 GHz.

Changing the Modulation Parameters

The modulation can be set to give a specific baseband frequency and FM deviation, as the following steps describe.

1 Press (FREQUENCY), **BB FREQ**. The required baseband frequency can be chosen from the following selection: **55 kHz**, **66 kHz**, **83 kHz**, **92 kHz** and **200 kHz**. Pressing **MORE 1 of 2** will also give you the choice of **250 kHz**, **277 kHz**, **500 kHz** and **555 kHz**.

2 Press (FREQUENCY), **FM DEV**. The required FM deviation (RMS) can now be specified. The default FM deviation has been chosen to give a modulation index of approximately 1. Table 2-1 gives the FM deviation default value and upper limit for each of the baseband frequencies.

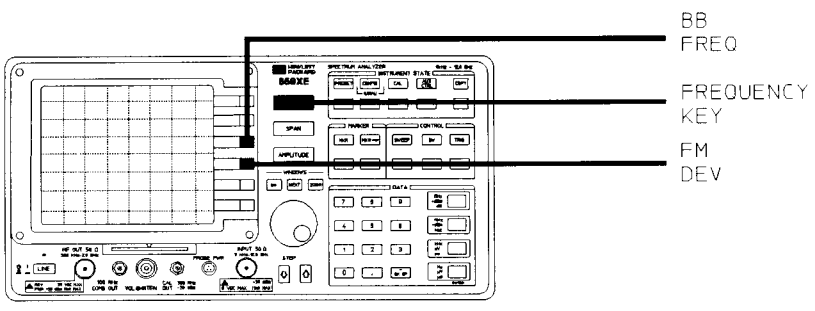


Table 2-1. FM Deviation Limits

Baseband Frequency (kHz)	FM Deviation Upper Limit (kHz RMS)	Default FM Deviation (kHz RMS)
55	117	39
66	141	47
83	176	59
92	196	65
200	424	141
250	530	176
277	589	196
500	1060	354
555	1179	393

Note

Whenever the baseband frequency is changed, the FM deviation is set to its default value. Therefore, if a specific FM deviation is required, first set the baseband frequency and then the FM deviation.

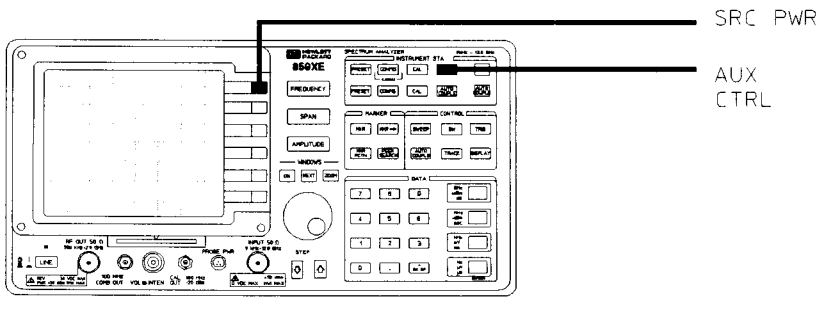
Changing the Output Power

The output power range of the tracking generator is specified between −66 dBm and −1 dBm (−10 dBm and +1 dBm for the HP 859xA Spectrum Analyzers). The power can actually be set as high as +2.75 dBm but is not calibrated to this level. The default condition has the source power turned off. To set the power level take the following steps:

1 Press (AUX CTRL), then **SRC PWR** once. A new output power value can be entered. If **OFF** was underlined before the new value was entered, it will change to **ON**.

2 If no power level has previously been entered, but **SRC PWR** is pressed until **ON** is underlined, the power level will default to −10 dBm.

3 To turn the source power off, press **SRC PWR** until **OFF** is underlined.



Notes

1. In the Link Transmitter mode, pressing (AMPLITUDE) will display the same menu as pressing (AUX CTRL) and can be used to provide the same softkey functions.
2. An HP 11767A Tracking Generator Amplifier can be used to amplify the output signal if more power is required. Refer to "Accessories" (Appendix A) for details.
3. When calculating the output power required for the measurement, remember to take into account any system losses, such as through the 50-75 Ω Matching Pads (HP Part No. 08590-60090) or the HP 11769A Return Loss Bridge. These losses are:

Matching Pad (08590-60090)	−5.7 dB
HP 11769A Return Loss Bridge	−6 dB
HP 11767A TG Amplifier	+8.2 dB (gain)

4. SRC PWR OFFSET can be used to offset the tracking generator output power displayed on the screen.

Using Save and Recall

Having set up a test with the parameters you require, you may find it useful to save the test state so that it can be recovered later.

The Link Transmit mode enables you to save up to 10 test states to the analyzer's user memory. If you have a suitable memory card, you can use it to save a further 10 test states.

Note

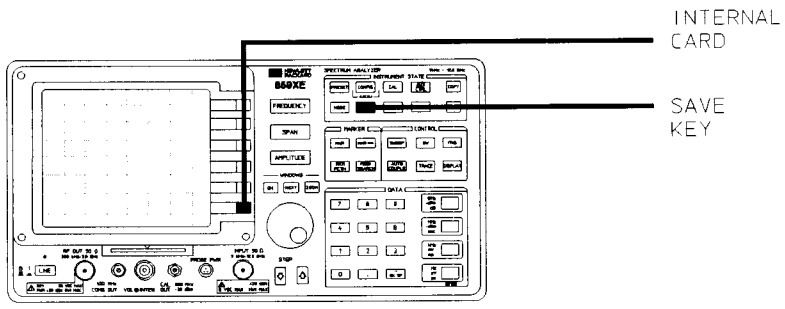
You **cannot** save states to the Link Measurement Personality ROM card, or the DRTS ROM Measurement Card. The HP 85700A 32K RAM card is an example of a suitable memory card. Refer to Chapter 9 of the *HP 859xE Series Spectrum Analyzer User's Guide* for details of other cards that can be used.

Saving to Internal Memory

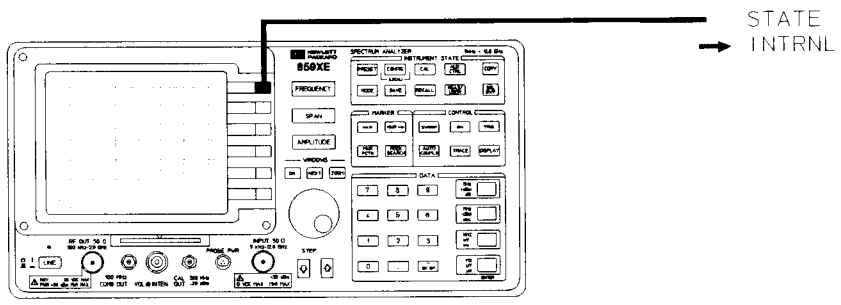
Note

When a test state is saved using the Link Transmit mode, the data is stored in the spectrum analyzer trace register 28. Therefore, any data you have previously saved in this register may be overwritten when a save is performed.

1 Press (SAVE). If **INTERNAL CARD** has **CARD** underlined, press **INTERNAL CARD** so that **INTERNAL** is underlined.



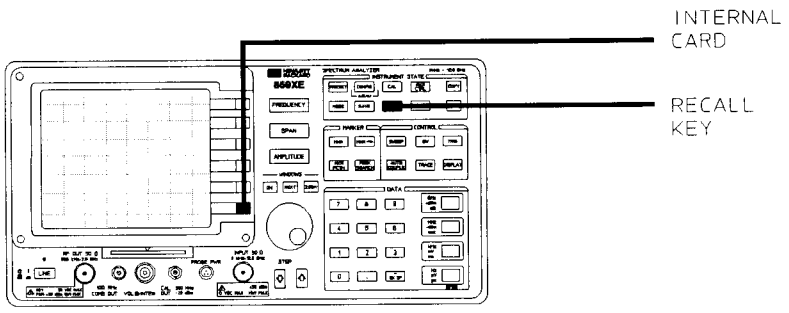
2 Press **STATE** → **INTRNL** .



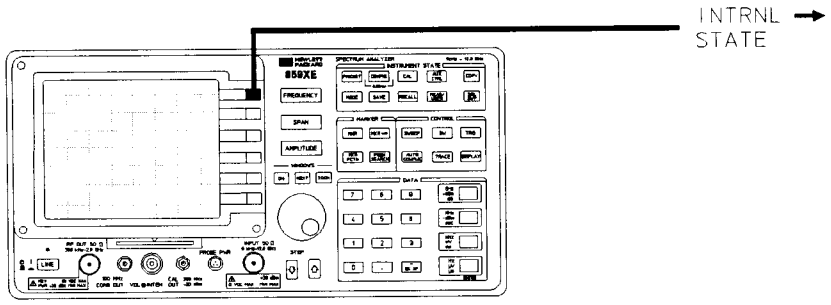
3 Using the data keys, enter a memory location between 1 and 10. The state will be saved to the analyzer's internal memory.

Recalling from Internal Memory

1 Press (RECALL). If **INTERNAL CARD** has **CARD** underlined, press **INTERNAL CARD** so that **INTERNAL** is underlined.

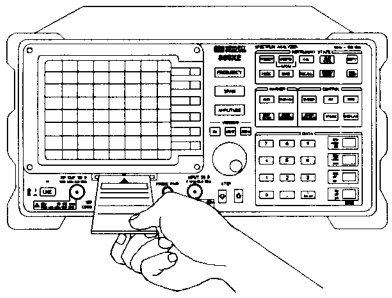


2 Press **INTRNL** → **STATE**, then enter the number of the state to be recalled. The analyzer will set up the same parameters that were set when the save was made.

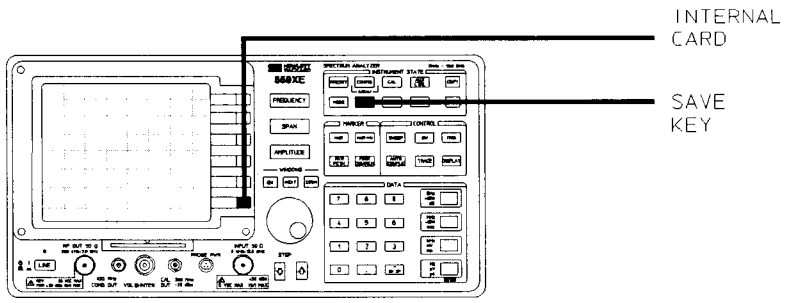


Saving to a Memory Card

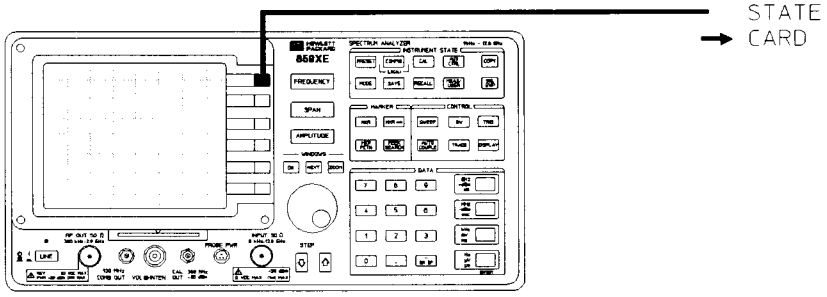
1 Insert a memory card, with the Read/Write protect switch set to allow reading and writing.



2 Press (SAVE). If **INTERNAL CARD** has **INTERNAL** underlined, press **INTERNAL CARD** so that **CARD** is underlined.



3 Press **STATE** → **CARD** .

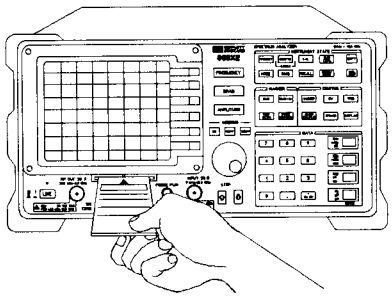


4 Using the data keys, enter a memory location between 1 and 10. The state will be saved to the memory card

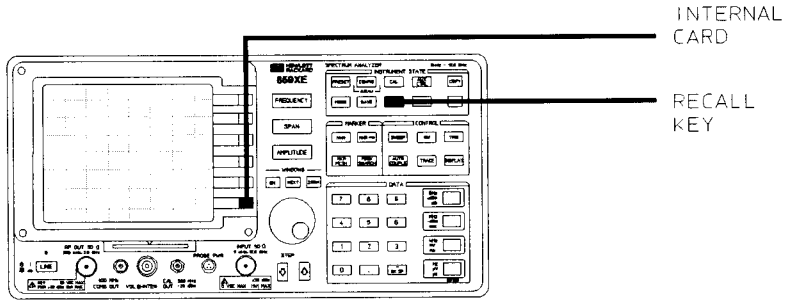
Recalling from a Memory Card

The states that you have saved can be quickly recalled as follows:

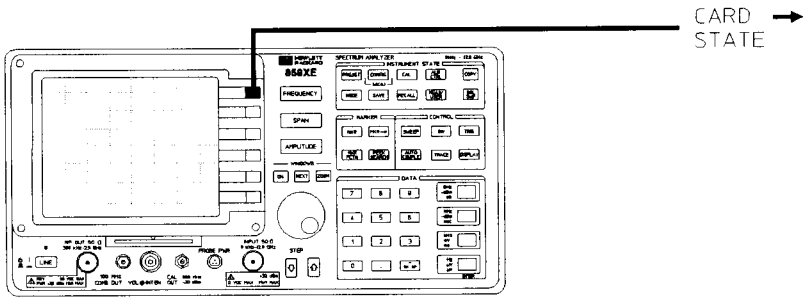
1 Insert the memory card, as shown.



2 Press (RECALL). If **INTERNAL CARD** has **INTERNAL** underlined, press **INTERNAL CARD** so that **CARD** is underlined.



3 Press **CARD** → **STATE**, then enter the number of the state to be recalled. The analyzer will set up the same parameters that were set when the save was made.



3

Link Receiver and Link Loopback Modes

This chapter describes how to use the Link Receiver and Link Loopback modes to make group delay and amplitude flatness measurements.

The Link Receiver mode is used for making end-to-end measurements. In this type of measurement the link transmitter and link receiver may be in separate locations connected by some transmission medium, for example radio, satellite or cable. In this type of test, the link receiver must be set up so that it can synchronize with the swept signal from the link transmitter.

In Link Loopback mode, one link analyzer is used as both the link transmitter and link receiver to test the device.

Despite the obvious differences between the two modes, the process of making measurements is very similar. The procedures in this chapter apply to both modes unless otherwise stated.

The chapter comprises of the following sections:

"**Setting Up the Link Analyzer**" illustrates how to connect the link analyzer to run the Link Receiver mode or to run the Link Loopback mode.

"**Calibrating the Link Analyzer**" describes how to calibrate group delay and amplitude flatness measurements.

"**Making Measurements**" describes how to change the test parameters and the display features to make the measurement you want. It also describes how to make special measurements, such as linear and parabolic group delay distortion.

"**Using Markers**" describes how to set markers on the traces and how to use them to make group delay and amplitude flatness measurements.

"**Using the HP 11766A DADE Switch**" details how to use the HP 11766A DADE Switch to make diversity antenna measurements.

"**Using Save and Recall**" describes how to save and recall test states, calibration data and traces to internal memory or RAM card.

Setting up the Link Analyzer

Using the Link Receiver Mode

1 Load and run the Link Receiver mode. For details, refer to the "Selecting a Mode" section in Chapter 1.

2 Connect the output from the device under test to the analyzer's INPUT connector. The example below shows the receiver end of a DMR link.

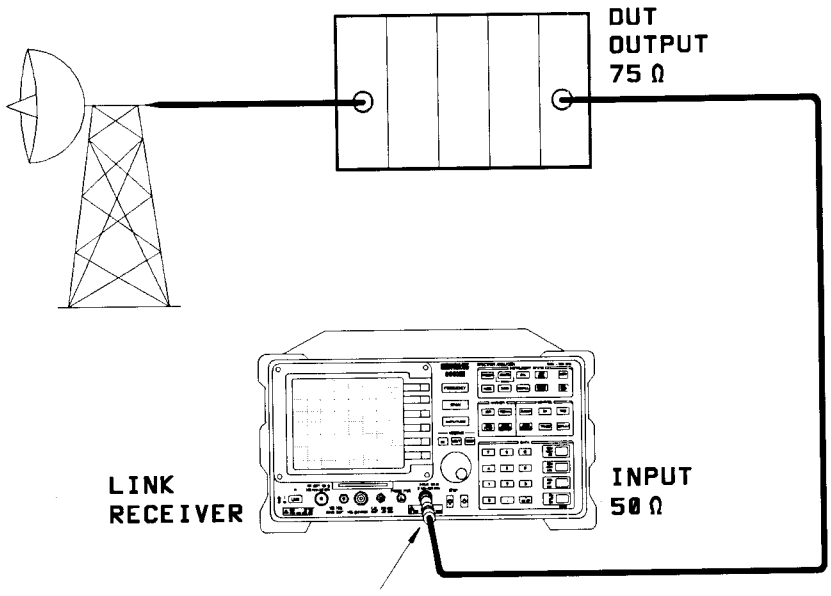


Figure 3-1.

Note

If your analyzer's RF OUT terminal and INPUT terminal have working impedances of 50 Ω, and the impedance of the device under test is 75 Ω, use the 50-75 Ω Matching Pad (HP Part No. 08590-60090) as shown in Figure 3-1 and Figure 3-2 . Ensure that the cables you use are also of the correct impedance.

Using the Link Loopback Mode

1 Load and run the Link Loopback mode. For details, refer to the "Selecting a Mode" section in Chapter 1.

2 Connect the RF OUT connector (the tracking generator output) to the input of the device under test and the output from the device under test, to the analyzer's INPUT connector. The example below shows the Link Loopback mode being used to test a DMR transmitter and receiver.

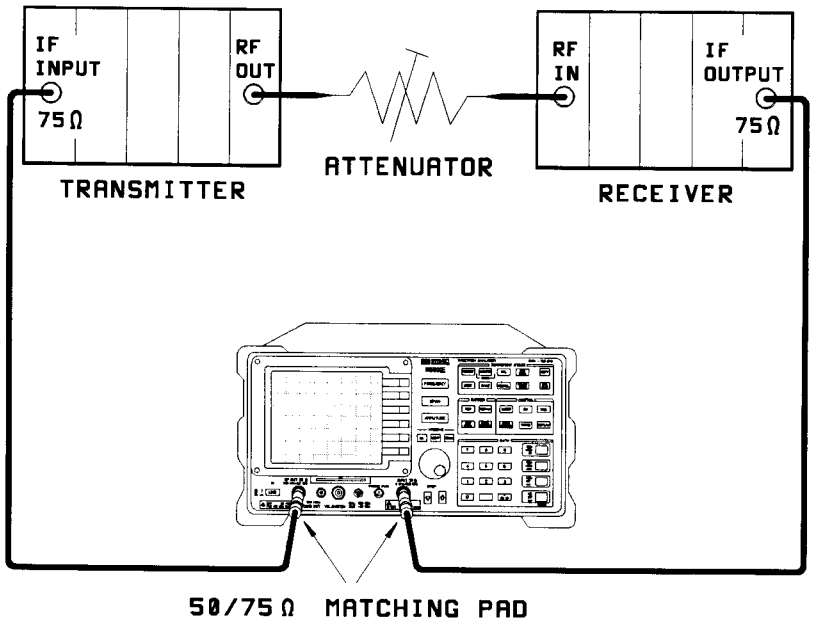


Figure 3-2.

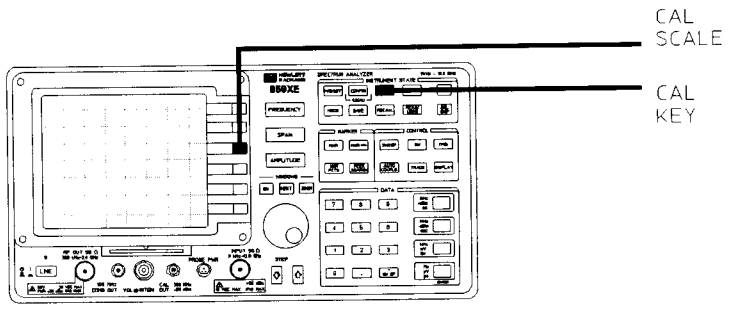
Calibrating the Link Analyzer

The Link Receiver and Link Loopback modes include self-calibration routines which can be used to improve the accuracy of your measurements. The first of these routines is used to calibrate the ns/div scale of the display and is common to both Link Loopback and Link Receiver modes. A second routine is used to remove the effects of the analyzer and additional hardware from the measurement, by calibrating the input circuitry against it's own tracking generator. The final calibration (available only for Receiver mode) allows normalisation against an external source.

Calibrating the Scale

The ns/div scale of the display can be calibrated as follows:

1 Press (CAL) then **CAL SCALE**. No connections are required to perform this calibration.



2 The calibration should take approximately 25 seconds to complete.

Notes

1. The data obtained from this calibration is stored in the analyzer's non-volatile memory, which means it is stored even if the analyzer is switched off. This calibration is performed automatically when the Link Loopback or Link Receiver modes are run, unless data is already saved in this memory.
2. Running a local flatness calibration will also calibrate the ns/div scale as detailed above. It will also run the second calibration routine as described in the "Calibrating the Flatness" procedure in this section.

Calibrating the Flatness

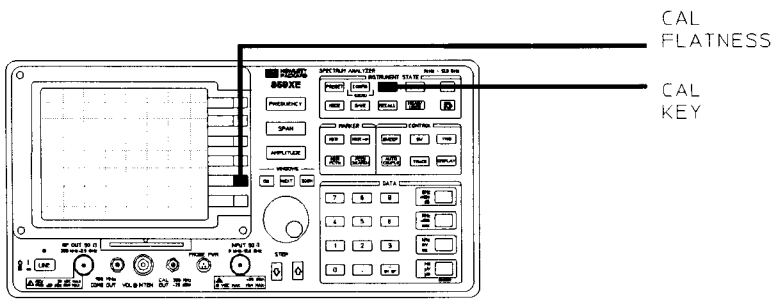
When group delay and amplitude flatness measurements are made, the accuracy of the measurement may be compromised because of the group delay and amplitude flatness characteristics of the test equipment and interconnecting cables. For example, the group delay response of the cables you use to connect the link analyzer to the device under test (DUT) may not be entirely flat, causing an error in the measurement.

This self-calibration routine measures the characteristics of the analyzer and any hardware connected during the calibration. These characteristics are then removed from those obtained during the actual test, leaving the group delay and amplitude flatness responses of the DUT only.

Note

The data obtained from the flatness calibration is stored in the spectrum analyzer trace registers 26 and 27. Therefore, any data you have previously saved in these registers may be overwritten when the calibration is made.

1 Press (CAL) then **CAL FLATNESS**. The analyzer will prompt you to connect the instruments RF OUT to INPUT. This connection should be made using any hardware you will use in the actual test (with the exception of the DUT itself).



2 The analyzer will prompt you to connect the instruments RF OUT to RF INPUT. If the instrument is in Loopback mode , only a local calibration is available. If in receiver mode, you must now choose a Local calibration.

Do this by pressing **FLAT CAL LCL END** (LCL).

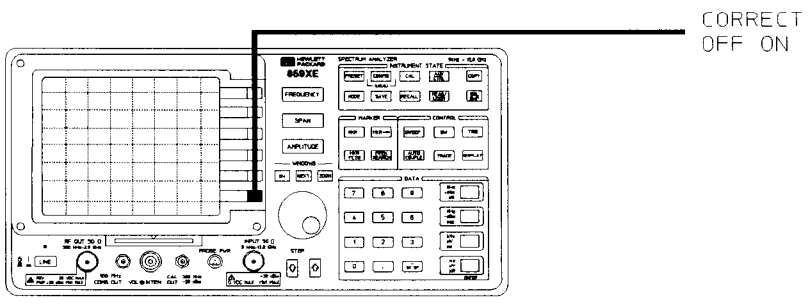
You will be given the choice of two frequency ranges. The first option enables you to calibrate from 40 MHz to 190 MHz. The second option allows you to calibrate over the range that was set before (CAL) was pressed.

For example, if the analyzer sweep was set to a center frequency of 70 MHz and a span of 40 MHz, the second option will enable you to calibrate between 50 MHz and 90 MHz. The calibration is more accurate if the measurement span is equal to the calibration span.

Press **CONTINUE** softkey to start the calibration.

```
                                                          LOOPBCK
CONNECT RF OUT TO SPECTRUM ANALYZER INPUT

CALIBRATE OVER  40.00MHz - 190.00MHz --------->  CONTINUE

CALIBRATE OVER  50.00MHz -  90.00MHz --------->  CONTINUE

                                                          ABORT

                                                          RL
```

3 The self-calibration routine will first measure the group delay characteristic of the set-up then measure the amplitude flatness characteristic. The measurements will take approximately 40 seconds. When they are complete, **CORRECT OFF ON** will be automatically set to **ON**. **CORRECT OFF ON** determines whether the calibration data will be used to "correct" the measured traces. If a DUT is tested with **CORRECT OFF ON** set to **ON**, after a calibration, the traces displayed should represent the characteristics of the DUT only. Press **CORRECT OFF ON** to toggle between **OFF** and **ON**.



End to End Calibration

1 Connect the Group Delay transmitter directly to the Group Delay receiver, See Figure 3-3

2 The transmitter and receiver must have identical center frequencies, spans and base band frequencies.

3 Lock the receiver to the transmitter, as described in pages 3.17-3.18 of this manual ("Setting the Input Attenuation" and "Starting the Measurement").

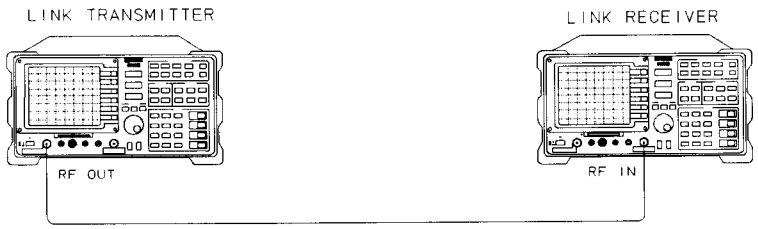
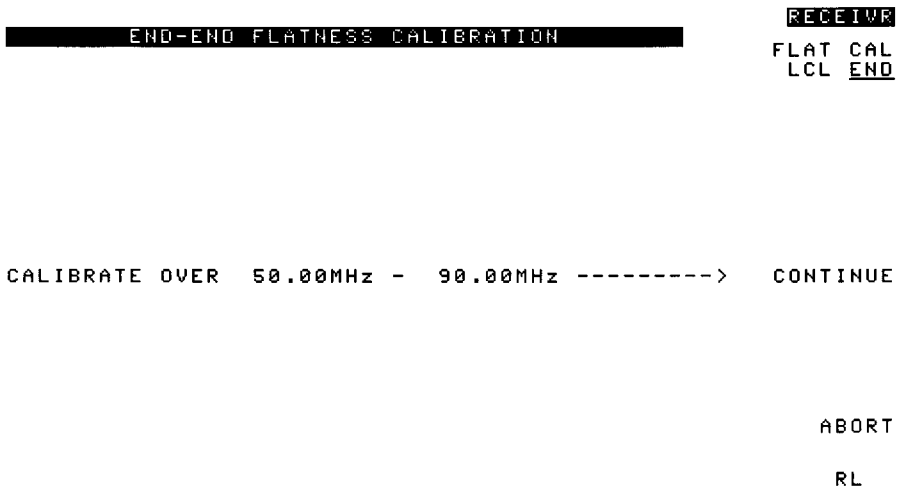
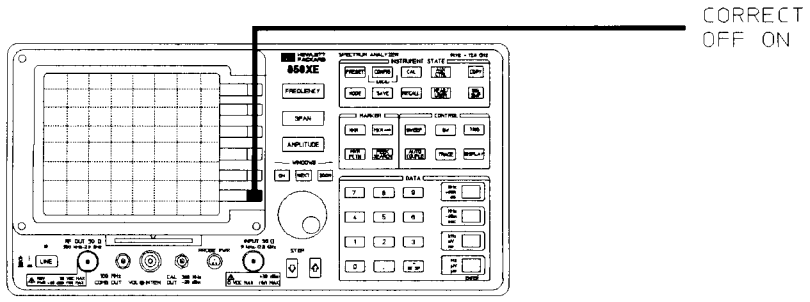


Figure 3-3. Connections for End To End Calibration

4 If the instrument is in Receiver mode , a choice of local (LCL) or End to End (END) calibration is available. **FLAT CAL LCL END** toggles between these two choices. The procedure for a local calibration is identical to that for Loopback mode. End to End calibration requires that the receiver is locked to the transmitter before entering the (CAL) menus. The following procedure is then followed:
Press **FLAT CAL LCL END** (END).
Only one frequency range is displayed, which reflects the current instruments settings.
Press the **CONTINUE** softkey to start the calibration.



5 The self-calibration routine will first measure the group delay characteristic of the set-up then measure the amplitude flatness characteristic. The measurements will take approximately 40 seconds. When they are complete, **CORRECT OFF ON** will be automatically set to **ON**. **CORRECT OFF ON** determines whether the calibration data will be used to "correct" the measured traces. If a DUT is tested with **CORRECT OFF ON** set to **ON**, after a calibration, the traces displayed should represent the characteristics of the DUT only. Press **CORRECT OFF ON** to toggle between **OFF** and **ON**.

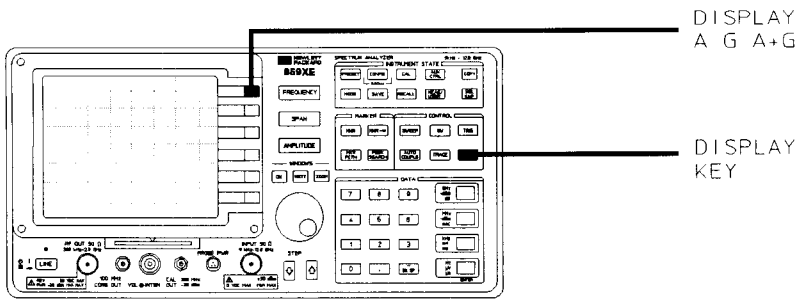


Upon completion of the calibration, a DONE flag is displayed on the receiver screen.

To select single trace mode

Select single trace mode as follows:

1 Press (DISPLAY). Press the **DISPLAY A G A+G** softkey until the A or G is underlined.



Notes

1. If you are using an HP 859xE Series Spectrum analyzer, the data calculated during the calibration **cannot** be used to correct the traces if both traces are selected. If the calibration is performed when both traces are selected, the data *will* be calculated correctly, however **CORRECT OFF ON** will remain at **OFF**. Pressing **CORRECT OFF ON** will cause the message **AVAILABLE ONLY IN SINGLE TRACE MODE** to be displayed
2. The data obtained from this calibration is stored in the analyzer's non-volatile memory, which means it is stored even if the analyzer is switched off. This calibration is *not* performed automatically when the modes are run, but the warning message **Flatness Uncal** will be displayed if no calibration data can be found in the memory.
3. The **Flatness Uncal** message will also be displayed if the frequency range of the sweep extends beyond the calibrated range.
4. Pressing **CAL SCALE** will calibrate the flatness as detailed above. It will also run the ns/div calibration routine as described in the "Calibrating the Scale" procedure in this section.
5. The use of the **LCL/END** calibration method is described in chapter 4 "Extending The Group Delay Frequency Range"

Making Measurements

Once a measurement is underway, the process of changing parameters is virtually the same for the Link Receiver and Link Loopback modes. Most procedures in this section refer to both modes unless otherwise stated.

The main difference between the modes, is that additional steps must be taken when making end-to-end measurements, to enable the Link Receiver to lock up to the Link Transmitter's sweep.

When the Link Receiver mode is running, the link analyzer can be in one of two states.

In the first state, the receiver attempts to lock up with the incoming signal. To allow it to do this, the receiver must be "told" what sort of signal to expect. That is, it must be given details about the transmitted signal's center frequency, frequency span and baseband frequency. Also, the analyzer's input attenuation must be set up to bring the signal level into the optimal range of the input circuitry.

When the link analyzer is not locked or attempting to lock with a signal, it is said to be in the `Receiver Unlocked` state. In this state, the center frequency, frequency span and baseband frequency can all be changed.

The Link Receiver test set-up sequence is:

1. Set the receiver state to `Receiver Unlocked`
2. Set the frequency parameters to the same values as the transmitter (unless there is a frequency translation in the system)
3. Set the input attenuation
4. Start the measurement by locking up with the transmitter

The Link Loopback test set-up sequence is:

1. Set the frequency parameters and output power
2. Set the input attenuation
3. The trace will be locked automatically

This section describes how to take these steps. It also details how to:

- Select which trace to display
- Use the trace identification function
- Change the scale and offset values
- Use the trace hold function
- Use the input level monitor
- Change the video bandwidth and use video averaging
- Measure the peak to peak signal
- Measure the linear and parabolic group delay distortion
- Change the video bandwidth and use video averaging

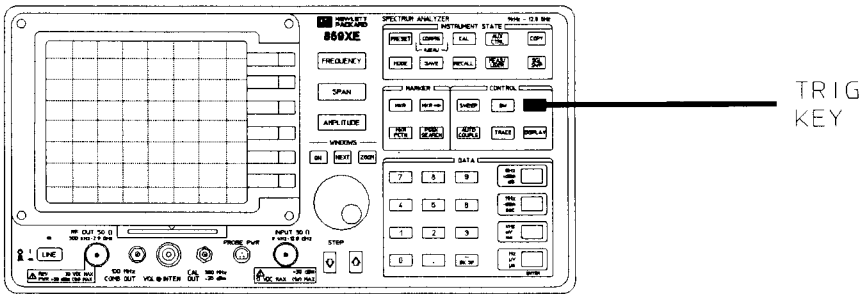
Note

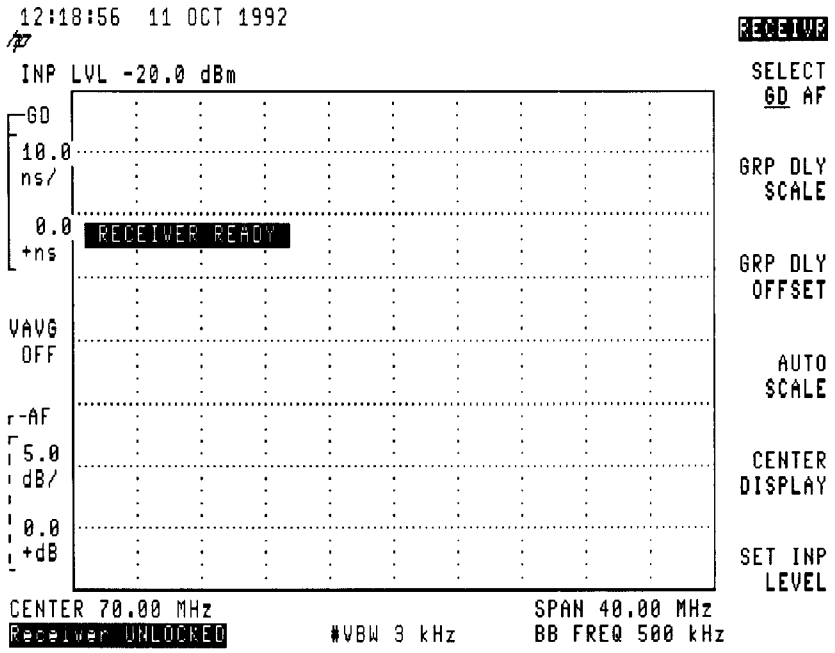
The default parameter values are:

Center Frequency	70 MHz
Span	40 MHz
Baseband Frequency	500 kHz
FM Deviation (Tx and Loopback only)	353.55 kHz RMS
Output Power (Tx and Loopback only)	OFF (−10 dBm when ON)

Changing to the Receiver Unlocked State (Link Receiver Mode Only)

1 Press the TRIG key until **Receiver Unlocked** appears on the screen, as shown below. In this state, the receiver is out of lock with the transmitter, and the display may appear unstable. Pressing the TRIG key will toggle in and out of the **Receiver Unlocked** state.





Changing the Carrier Frequency Range

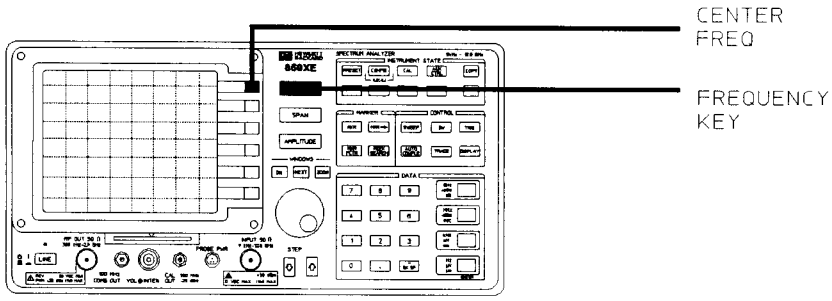
This procedure describes how to set the frequency range of the measurement.

Note

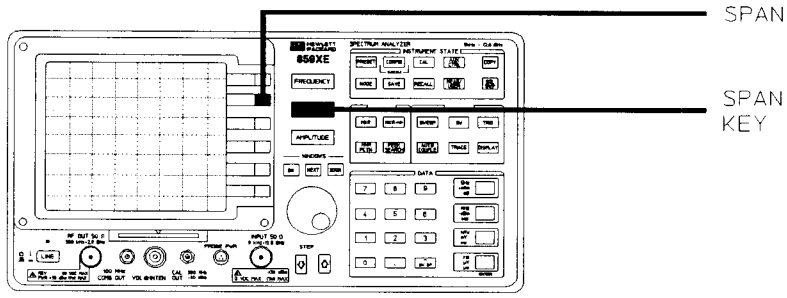
If you are running the Link Receiver mode, it is **essential** that the span is set to the same value as the transmitter. This also applies to the center frequency, unless there is a frequency translation between the transmitter and receiver.

If there is a frequency translation in the test path, the center frequency of the Link Transmitter and the center frequency of the Link Receiver must differ accordingly.

1 Press (FREQUENCY). **CENTER FREQ** should already be highlighted and so the center frequency can be entered.



2 Press (SPAN). **SPAN** should already be highlighted and so the frequency span can be entered.



Note

An HP 859xE Series Spectrum Analyzer with Group Delay and Amplitude Flatness Card, is specified to measure group delay and amplitude flatness over the frequency ranges of 70 MHz ± 20 MHz and 140 MHz ± 20 MHz. You can set the center frequency and span so that the analyzer sweeps outside these limits, however, the accuracy of the measurement is not specified.

The maximum frequency range of the sweep is from 300 kHz to 2.9 GHz in loopback mode, but the full frequency range of the spectrum analyzer is permitted in receiver mode. A combination of center frequency and frequency span that exceeds either of these limits is not permitted.

If either of these parameters is changed such that the combination produces a stop or a start frequency outwith these limits, the other parameter will automatically be changed to bring the combination back within the limits.

For example in loopback mode, if the center frequency is at 2.2 GHz, and the frequency span is changed to 2 GHz, this would give a stop frequency of 3.2 GHz which is outside the allowed limit. In this case the center frequency would automatically change to 1.9 GHz to bring the stop frequency down to 2.9 GHz.

Similarly, if the center frequency was then changed to 3.5 GHz, the analyzer would set the frequency span to it's minimum value of 0.5 MHz and the center frequency to 2.9 GHz.

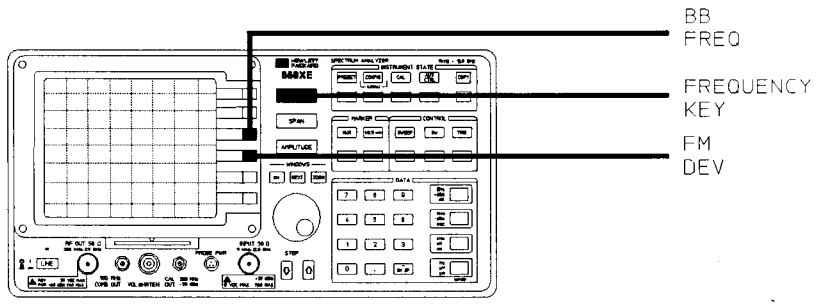
Changing the Modulation Parameters

If you are running the Link Loopback mode, you can change the modulation parameters to give a specific baseband frequency and FM deviation.

If you are running the Link Receiver mode, there is no FM deviation parameter to set. However a baseband frequency value must be specified to allow the receiver to lock up to the transmitter. This must be the same as the value set at the transmitter.

1 To set the baseband frequency, press (FREQUENCY), **BB FREQ**. The required value can now be chosen from the following selection: **55 kHz**, **66 kHz**, **83 kHz**, **92 kHz** and **200 kHz**. Pressing **MORE 1 of 2** will also give you the choice of **250 kHz**, **277 kHz**, **500 kHz** and **555 kHz**.

2 Press (FREQUENCY), **FM DEV**. The required FM deviation (RMS) can now be specified. The default FM deviation has been chosen to give a modulation index of approximately 1. Table 2-1 in Chapter 2, gives the FM deviation default value and upper limit for each of the baseband frequencies.



Note

In the Link Loopback Mode, whenever the baseband frequency is changed, the FM deviation is set to its default value. Therefore if a specific FM deviation is required, first set the baseband frequency and then the FM deviation.

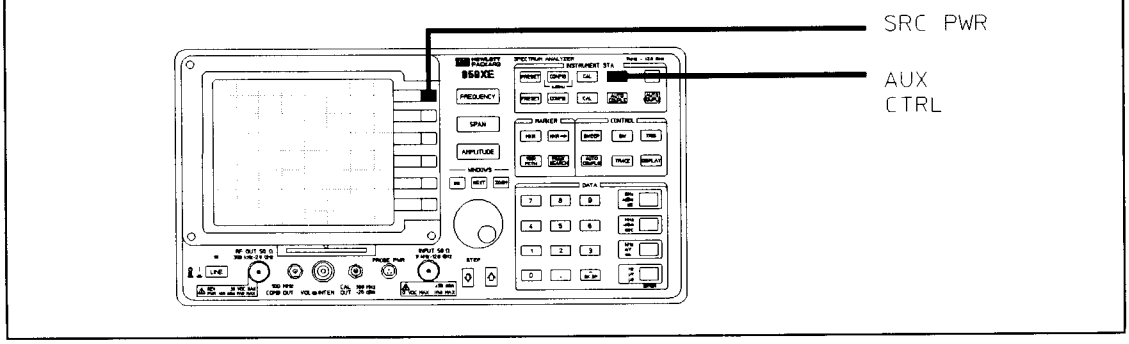
Changing the Output Power (Link Loopback Mode)

The source power from the tracking generator can be set to any level between −66 dBm (−10 dBm for HP 859xE Analyzers) and +2.75 dBm, or can be turned **OFF** (specified maximum is −1 dBm for an HP 859xE Series Spectrum Analyzer and +1 dBm for an HP 859xA Series Spectrum Analyzer . The default condition has the source power turned off. To set the power level take the following steps:

1 Press (AUX CTRL), then **SRC PWR** once. A new output power value can be entered. If **OFF** was underlined before the new value was entered, it will now change to **ON**.

2 If no power level has been entered, but **SRC PWR** is pressed until **ON** is underlined, the power level will default to −10 dBm.

3 To turn the source power off, press **SRC PWR** until **OFF** is underlined.



Notes

1. In the Link Transmitter mode, pressing (AMPLITUDE) will display the same menu as pressing (AUX CTRL) and can be used to provide the same softkey functions.
2. An HP 11767A Tracking Generator Amplifier can be used to amplify the output signal if more power is required. Refer to "Accessories" (Appendix A) for details.
3. When calculating the output power required for the measurement, remember to take into account any system losses, such as through the 50-75 Ω Matching Pads (HP Part No. 08590-60090) or the HP 11769A Return Loss Bridge. These losses are:

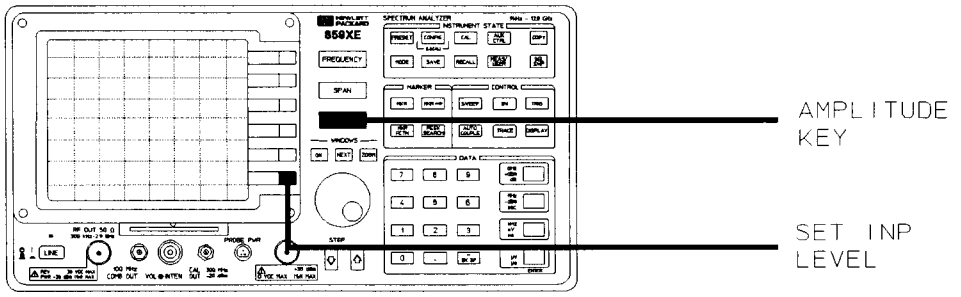
Matching Pad (08590-60090)	−5.7 dB
HP 11769A Return Loss Bridge	−6 dB
HP 11767A TG Amplifier	+8.2 dB (gain)

4. In the Link Transmitter and Link Loopback modes, SRC PWR OFFSET can be used to offset the tracking generator output power displayed on the screen. Similarly, in the Link Receiver and Link Loopback modes, INP LVL OFFSET can be used to offset the displayed input power level (this key has the same function as the spectrum analyzer key REF LVL OFFSET). Refer to the *HP 859xE Series Spectrum Analyzer User's Guide* for a description of SRC PWR OFFSET and REF LVL OFFSET .

Setting the Input Attenuation

This procedure describes how to set the input attenuation of the analyzer. Before setting the input attenuation, ensure that a signal is connected to the analyzer's INPUT connector.

1 Press (AMPLITUDE), then SET INP LEVEL. The input attenuation will be automatically set to a suitable level.



Notes

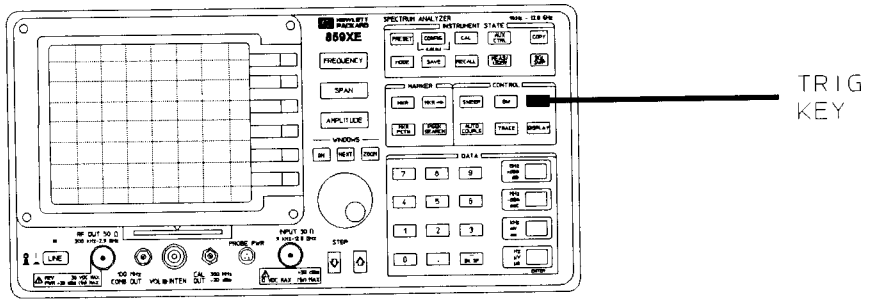
1. The input attenuation is also set automatically, whenever AUTO SCALE or CENTER DISPLAY are pressed. See the "Changing the Scale and Offset Automatically" procedure in this section for details.
2. The accuracy of the measurements depend on the input attenuation being set correctly. We recommend that the input attenuation should be set whenever the received power level changes by more than 2 dB.

Starting the Measurement (Link Receiver Mode Only)

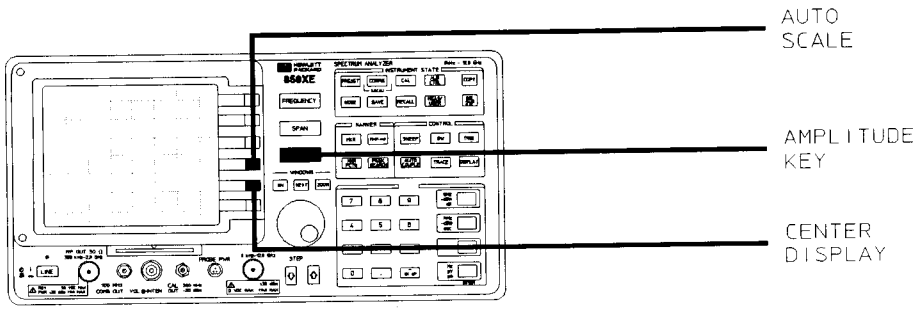
In the Link Receiver mode, the analyzer must lock up with the transmitted signal before you can start making measurements. For signal lock to be achieved, the receiver must be set to the same center frequency, frequency span and baseband frequency as the transmitted signal. Refer to the procedures, "Changing to the Receiver Unlocked State", "Changing the Carrier Frequency Range" and "Changing the Modulation Parameters" in this section for details.

1 Once all the required parameters have been set and the analyzer has been connected to the DUT, set the analyzer's input attenuation. Refer to the "Setting the Input Attenuation" procedure in this section for details.

2 The measurement may be started by pressing (TRIG). This enables the receiver to start searching for the expected signal. The message **Receiver Unlocked** should disappear.



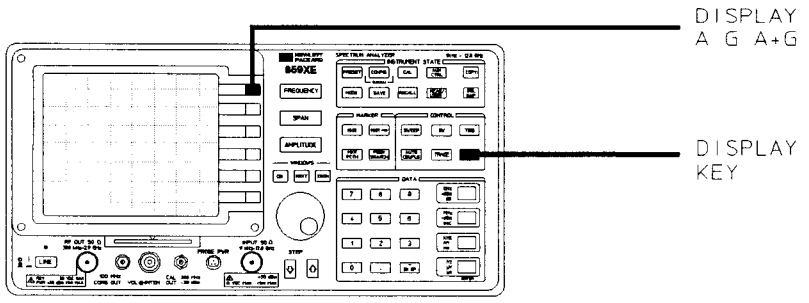
3 When the receiver is locked up to the transmitter, the display will stabilize. Press (AMPLITUDE). If you want to automatically set the scale of the traces press **AUTO SCALE**, otherwise press **CENTER DISPLAY** to bring the traces to the center of the display.



Selecting the Traces

The link analyzer display can be configured to show the group delay response, the amplitude flatness response or both at the same time. To select the display that you require:

1 Press (DISPLAY). Press the **DISPLAY A G A+G** softkey until the configuration you want is underlined. For example if you want both amplitude and group delay responses to be shown, press **DISPLAY A G A+G** (A+G)



Note

To enable easy identification of the traces, the amplitude flatness trace is shown as a broken line (HP 859xE Series Spectrum analyzer only). For more details on this function, refer to the "Identifying the Traces" procedure in this section.

Identifying the Traces

When measurements are being made that involve displaying both traces on the screen at the same time, it may be difficult to identify which trace is showing the amplitude flatness characteristic and which is showing the group delay.

The Link Receiver and Link Loopback modes have a trace identification function that changes the amplitude flatness trace from a solid line to a broken line, enabling you to quickly identify which trace is which.

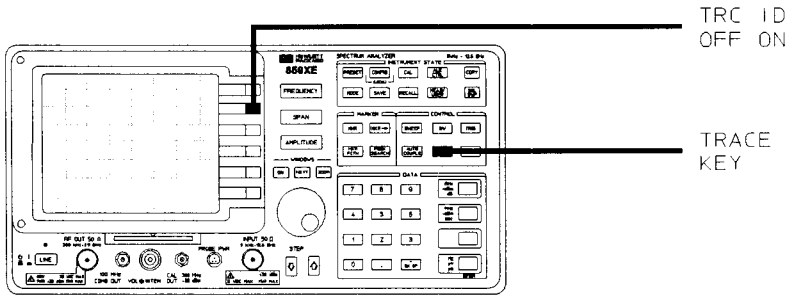
The default for the trace identification function is **ON**. This procedure describes how to turn the function off and on.

Note

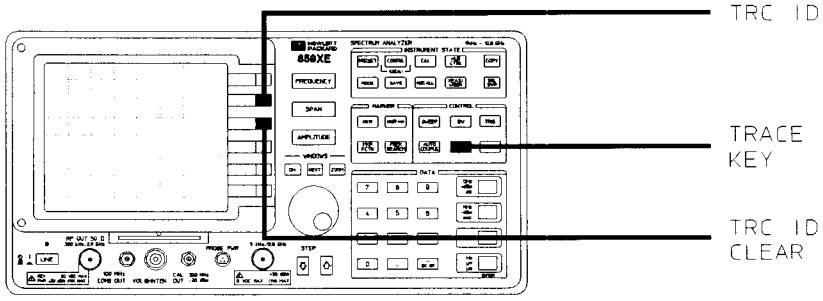
If you are using an HP 859xA Series Spectrum Analyzer, the trace identification function will **not** display the amplitude flatness trace as a broken line, but will identify the traces by labelling them with **AF** and **GD**. This function is only available when both traces are selected.

---

1 If you are using an HP 859xE Series Spectrum Analyzer, press (TRACE) then **TRC ID OFF ON**. This key will toggle the trace identification function between **OFF** and **ON**.



2 If you are using an HP 859xA Series Spectrum Analyzer, press (TRACE) then **TRC ID**. This key will label the traces with **AF** and **GD**, however if the traces move, the labels will not change position. To remove the labels, press **TRC ID CLEAR**.



Changing the Scale and Offset Automatically

If the traces that are displayed on the screen are too small or too large for you to make the measurements you require, or if they are in an inconvenient position on the screen, the scale and offset of the traces can be changed.

For group delay, the scale is measured in nanoseconds per division (ns/div) and the offset in nanoseconds (ns). With no offset, the zero point is positioned at the center of the display's y-axis.

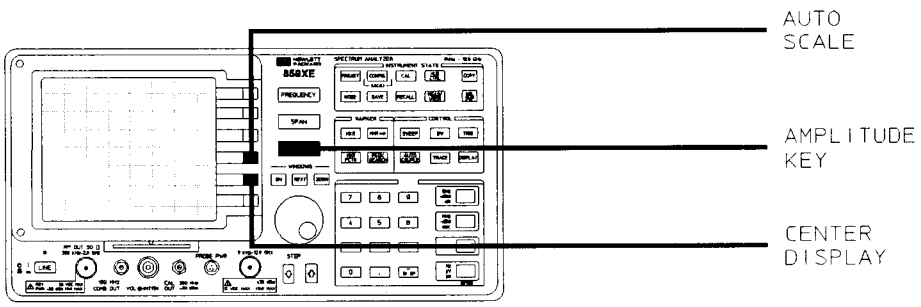
For amplitude measurements, the scale is in decibels per division (dB/div) and the offset in decibels (dB). With no offset, the zero point is positioned at the center of the display's y-axis.

The following procedure describes how to set the scale of the traces automatically:

1 Press (AMPLITUDE).

2 To automatically center both traces on the screen, without changing the scales, press **CENTER DISPLAY**. Any offset on the traces will be removed. If only one trace is selected, it will be only that trace that is centered.

3 To automatically set the display, so the traces "best fit" the screen, press **AUTO SCALE**. This will remove any offset on the traces and set the scales to suitable values.



Notes

1. Whenever **AUTO SCALE** is pressed, the input attenuation is set automatically. This is equivalent to pressing the **SET INP LEVEL** softkey. Refer to the "Setting the Input Attenuation" procedure in this section for details.
2. If **AUTO SCALE** is pressed when only 1 trace is selected, the autoscale will be performed on that trace only.

Changing the Scale and Offset Manually

The scale and offset of the displayed trace can be changed manually as follows:

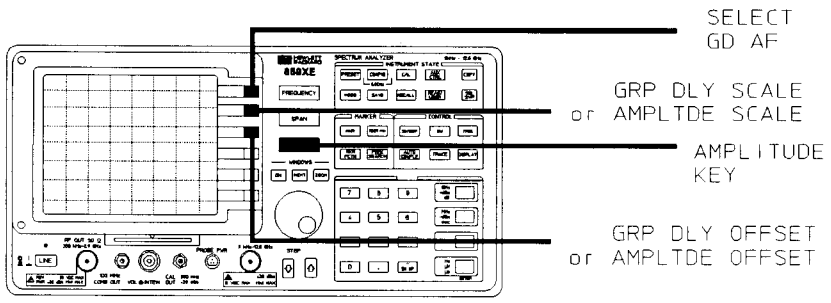
1 Press (AMPLITUDE).

2 If both traces are selected, the functions of the second and third softkeys in this menu, are determined using the **SELECT GD AF** softkey. This key is blanked if only one trace is selected.

3 If you press **SELECT GD AF** until **GD** is underlined, the second and third softkeys will appear as **GRP DLY SCALE** and **GRP DLY OFFSET**. With **AF** underlined, the keys change to **AMPLTDE SCALE** and **AMPLTDE OFFSET**. Press **SELECT GD AF** until the trace you want to change is underlined.

4 To manually change the scale of the trace you've selected, press the **GRP DLY SCALE / AMPLTDE SCALE** softkey and then change the scale using the DATA keys, STEP keys or knob. The scale is measured in ns/div or dB/div, for group delay or amplitude flatness respectively.

5 To manually change the offset of the trace you've selected, press the **GRP DLY OFFSET / AMPLTDE OFFSET** softkey and then change the offset using the DATA keys, STEP keys or knob. The offset is measured in ns or dB, for group delay or amplitude flatness respectively.



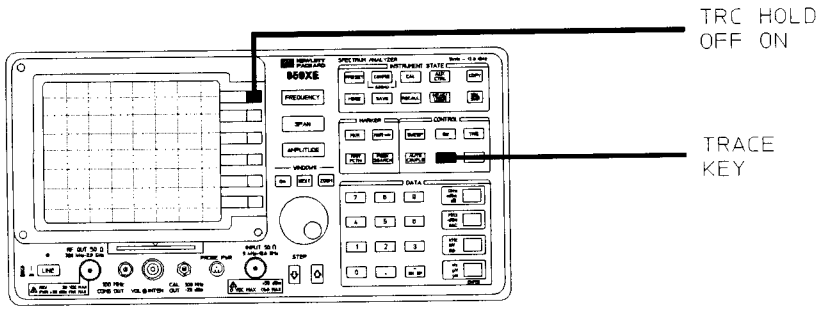
Using the Trace Hold Function

It can be useful when making measurements to temporarily *freeze* the display. The following steps describe how this can be done.

1 Press (TRACE).

2 Press **TRC HOLD OFF ON** until **ON** is underlined. The traces displayed on the screen, will appear frozen.

3 To restart the traces, press **TRC HOLD OFF ON** until **OFF** is underlined.



Notes

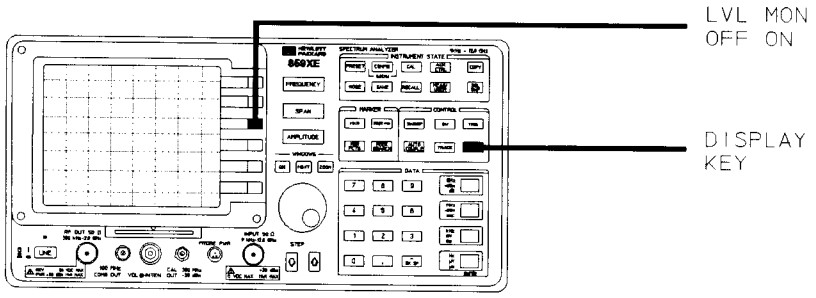
1. When the Trace Hold function is **ON**, markers can be used in the normal way and the trace will remain frozen. Refer to the "Using Markers" section in this chapter for details.
2. The Trace Hold function will turn **OFF** automatically if the (FREQUENCY), (SPAN) or (AMPLITUDE) keys are pressed, or if the **DISPLAY A G A+G** or **DADE ON OFF** softkeys are pressed.

Displaying the Input Level

The HP 11770A Link Measurements Personality has an Input Level Monitor function which can be used to display the actual power level appearing at the input of the spectrum analyzer.

1 To turn on the Input Level Monitor, press (DISPLAY), then **LVL MON OFF ON** until **ON** is underlined.

2 The **INP LVL** annotation on the display will be highlighted, to show that the input level is being updated once every sweep.



3 To turn off the Input Level Monitor, press **LVL MON OFF ON** until **OFF** is underlined. **INP LEVEL** will no longer be highlighted, and the value displayed will remain constant.

Note

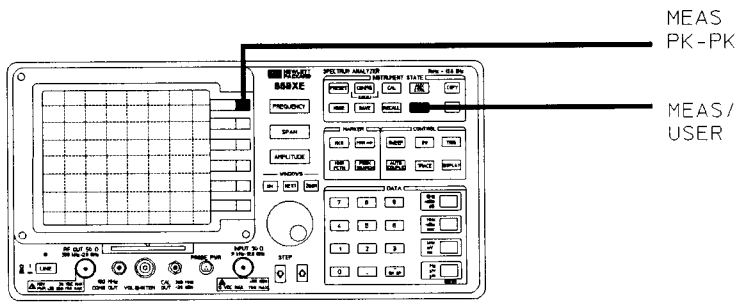
When the input level monitor is on, the analyzer must update the input level at the end of each sweep. This slows down the overall update rate of the display.

Measuring the Peak-to-Peak Value

The Link Measurements Personality's Peak-to-Peak function, enables you to find the difference in magnitude between the highest and lowest points of a trace over the frequency range displayed. If both group delay and amplitude flatness are being measured, this function will display the peak-to-peak values of both traces.

1 If required, you can temporarily freeze the traces before making the measurement. Refer to the "Using the Trace Hold Function" procedure in this section for details.

2 Press (MEAS/USER), **MEAS PK-PK**. The peak-to-peak values will be measured, and displayed at the top of the screen.



Notes

1. **MEAS PK-PK** will only give an accurate reading, if the maximum and minimum points of the trace are within the top and bottom boundaries of the graticule. If the trace clips at any point, the magnitude of the boundary it clips will be used in the calculation.
2. This function will always measure the peak-to-peak value of the whole frequency range, even if markers are set on the traces.

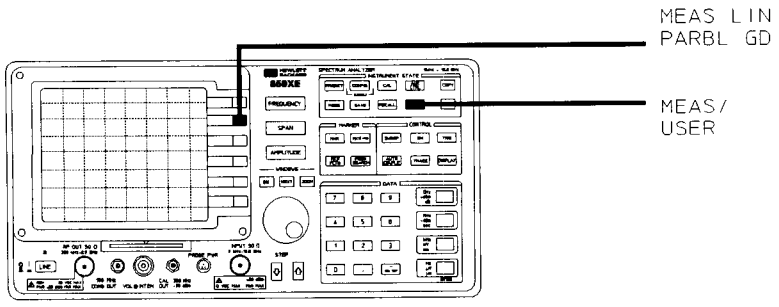
Measuring the Linear and Parabolic Group Delay Distortion

The Link Measurements Personality can be used to measure the linear delay distortion and the parabolic delay distortion between 2 points on the group delay trace.

1 If required, you can temporarily freeze the traces before making the measurement. Refer to the "Using the Trace Hold Function" procedure in this section for details.

2 These measurements are made between 2 distinct points on the group delay trace. If required you can use markers to specify the 2 points, otherwise the start and stop frequencies of the sweep will be used. Refer to the "Using Markers" section in this chapter for details.

3 Press (MEAS/USER), **MEAS LIN PARBL GD**. The linear and parabolic delay distortion will be calculated, and displayed at the top of the screen. If amplitude flatness is the only trace selected, **MEAS LIN PARBL GD** will be blanked out. For details on how these values are calculated, refer to Appendix C "Theory".



Changing the Video Bandwidth

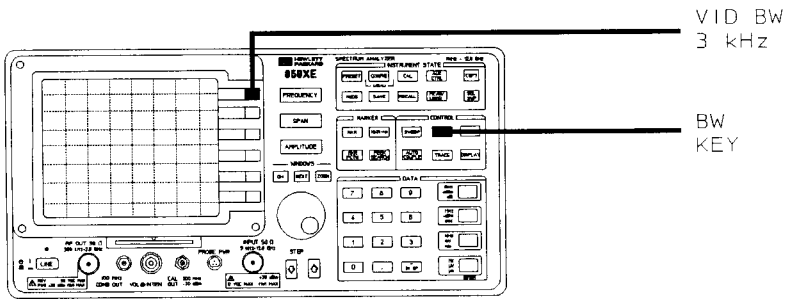
The video bandwidth is the cut-off frequency (3dB point) of an adjustable low-pass filter in the analyzer's video circuit. As this bandwidth is decreased, some of the higher frequency fluctuations displayed are removed, resulting in a smoother trace. However, the traces may appear distorted when fast rising or falling edges are present.

The video bandwidth can be set to 300 Hz, 1 kHz, 3 kHz (default) or 10 kHz. The following steps describe how it can be changed:

1 Press (BW). If the video bandwidth is set to the default value, the first softkey will be **VID BW 3 kHz** .

2 Pressing **VID BW 3 kHz** will change the video bandwidth to 10 kHz and the key will now read **VID BW 10 kHz**.

3 If the key is pressed twice more, it will change to **VID BW 1 kHz** before returning to **VID BW 3 kHz**



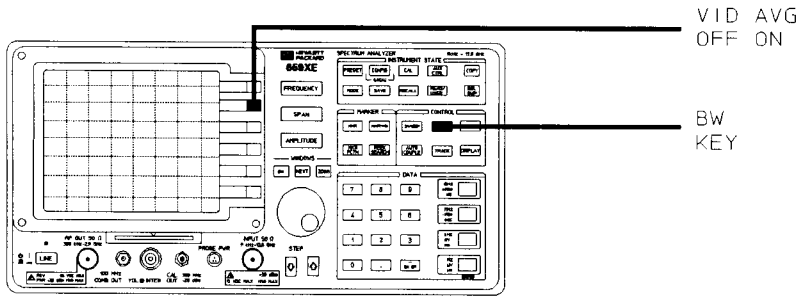
Using Video Averaging

Video averaging initiates a digital averaging routine that averages the displayed signal and noise. This feature is not available when both group delay and amplitude flatness are selected.

1 Press (BW), then **VID AVG OFF ON** until **ON** is underlined. If both traces are selected, this key will be blanked.

2 You can now choose the number of averaging samples that are taken. The default is 100, but you can choose from 1 to 100.

3 To stop the video averaging, press **VID AVG OFF ON** until **OFF** is underlined.



Using Markers

You can use frequency markers to assist in making group delay and amplitude flatness measurements. A pair of markers can be placed on either one or both of the traces.

If all four markers are being used, the markers can be controlled as either two separate pairs or can be coupled, so that the two pairs track each other.

This section describes how to:

- Set markers on the traces
- Measure the magnitude difference between 2 markers
- Remove the markers

Note

If **DADE OFF ON** in the (DISPLAY) menu has been set to **ON**, pressing the (MKR) key will not display the markers menu. For details on using markers to make diversity antenna measurements, refer to the "Using the HP 11766A DADE Switch" section in this chapter.

Setting Markers on the Traces

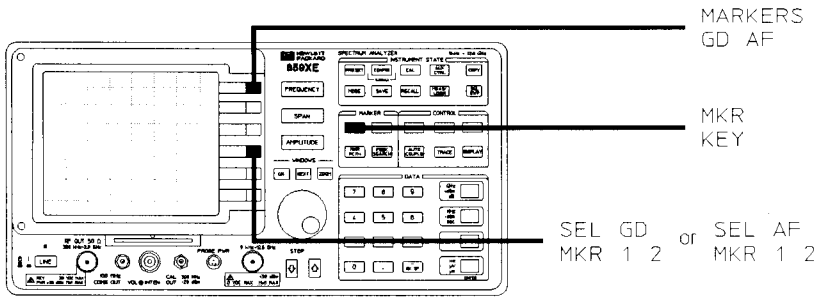
The following procedure explains how to place markers on the traces.

1 Press (MKR). The menu that is displayed is dependent on which traces are selected. If both traces are selected, the top softkey will be **MARKERS GD AF**. Pressing this key determines which set of markers are controlled. If only one trace is selected, this key will be blanked out.

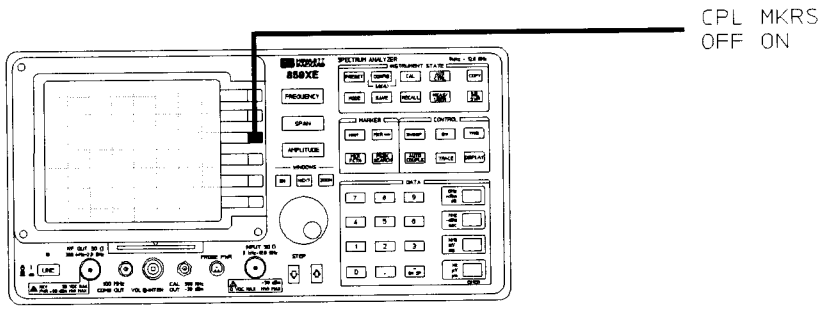
2 If both traces are selected, press **MARKERS GD AF** until either GD or AF is underlined, depending on which markers you want to control.

3 Press **SEL GD MKR 1 2/SEL AF MKR 1 2** until the **1** is underlined, then using the knob, step keys or data keys, set the first marker to the required frequency. The frequencies of the markers you have selected are shown at the top of the screen. Press **SEL GD MKR 1 2/SEL AF MKR 1 2** again, until **2** is underlined, then set the frequency of the second marker.

4 If you want markers set on both traces, repeat steps 2 and 3 for the second trace.



5 To couple both sets of markers so that they track each other, press **CPL MKRS OFF ON** until **ON** is underlined. Now, if the frequency of any of the markers is changed, the equivalent marker on the other trace will change frequency accordingly. To cancel this, press **CPL MKRS OFF ON** until **OFF** is underlined.



Notes

1. If the DADE function is on, that is **DADE OFF ON** is set to **ON**, no menu will be displayed when (MKR) is pressed. (MKR) is used to toggle the markers on and off.
2. If you are only displaying one trace, **CPL MKRS OFF ON** will be blanked out. When two trace mode is reentered, **CPL MKRS OFF ON** always defaults to **OFF**

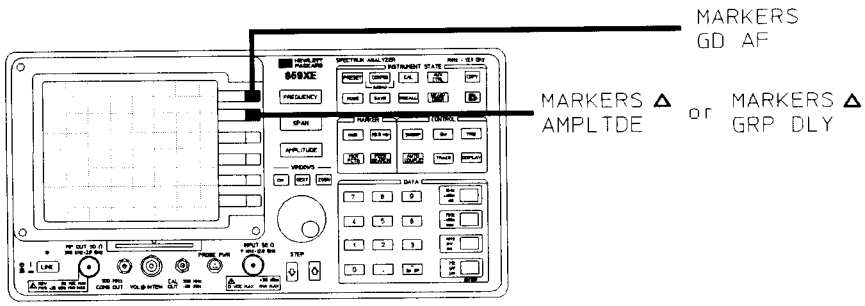
Measuring the Magnitude Difference Between 2 Markers

Using markers, you can measure the difference in magnitude of one point on a trace relative to another point.

1 Set markers onto either one or both of the traces as described in the "Setting Markers on the Traces" procedure in this section.

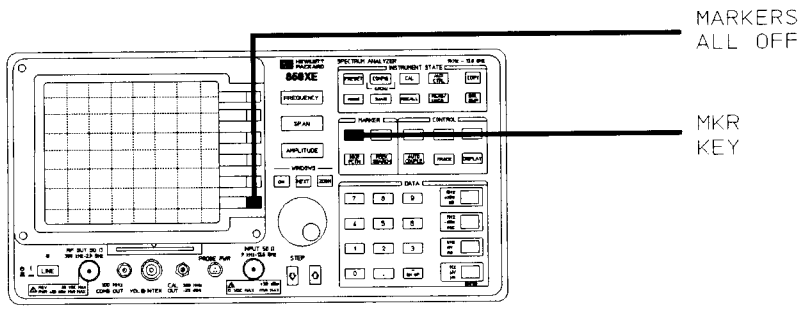
2 Select which trace you wish to measure by pressing the **MARKERS GD AF** softkey, until either **GD** or **AF** is underlined.

3 Press **MARKER Δ AMPLTDE / MARKER Δ GRP DLY** . The difference between the 2 markers is displayed at the top of the screen. This value is measured in ns for group delay, and dB for amplitude flatness. As this value represents the magnitude of Marker 2 relative to Marker 1, it will have a negative value if Marker 1 is greater.



Removing Markers from the Traces

1 Press (MKR), **MARKERS ALL OFF** . This will remove all markers from the display.



Frequency Translation Measurements

It is often required to measure the group delay and amplitude flatness responses through some frequency conversion device i.e. the transmitted frequency is not the same as the received. This can take several forms:

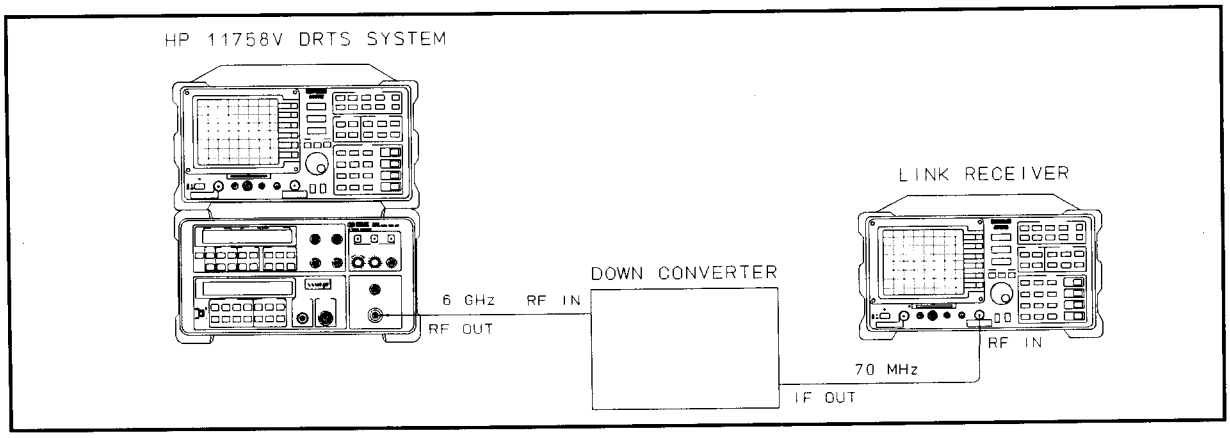


Figure 3-4. RF-IF measurement

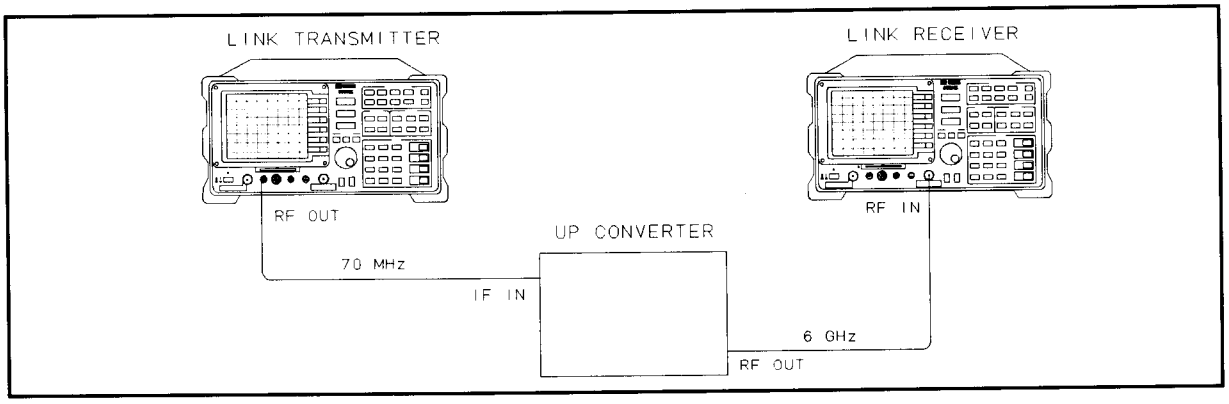


Figure 3-5. IF-RF measurement

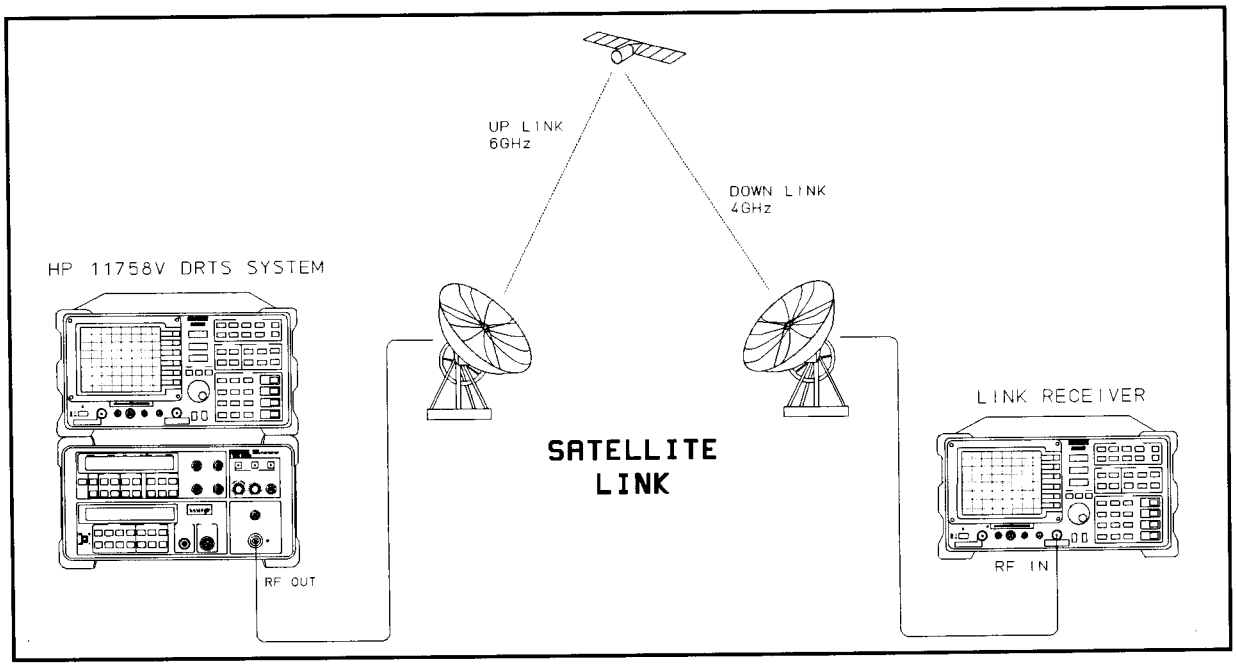
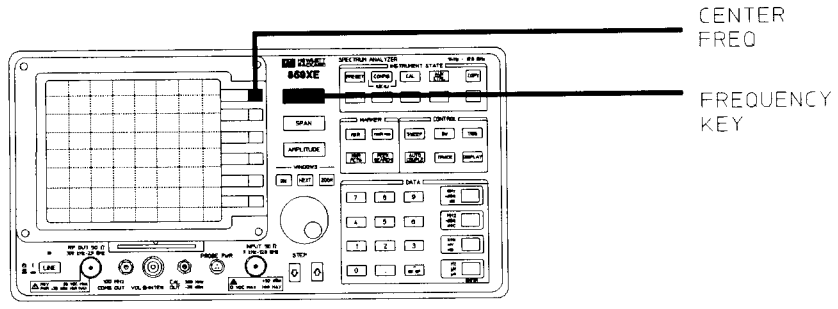


Figure 3-6. RF-RF measurement (with frequency offset)

Although it is not possible to normalise the system response at the two different frequencies (Transmitter and Receiver) simultaneously, improvement in measurement accuracy can be achieved by using offset calibration. The first step is to conduct an end to end calibration, as outlined in page 3-8 and 3-9 of this manual. The frequency of calibration should normally be that of the receiver.

After calibration, unlock the receiver from the transmitter and insert the DUT into the measurement path. Move the transmitter fequency to that required for the measurement. Relock the receiver to the transmitter. For example, in an RF-IF measurement (6 GHz to 70 MHz), calibrate the system at 70 MHz. Add the DUT to the measurement path, and move the transmitter frequency from 70 MHz to 6 GHz. Press the following buttons on the Transmitter:

1 Press (FREQUENCY), **CENTER FREQ**. Enter center fequency of 6 GHz.



In some circumstances, it may be advisable to calibrate at the transmitter frequency. For example, if you wish to remove the group delay or amplitude flatness response of the up-converter in Figure 3-7, then a calibration would be carried out at 6 GHz.

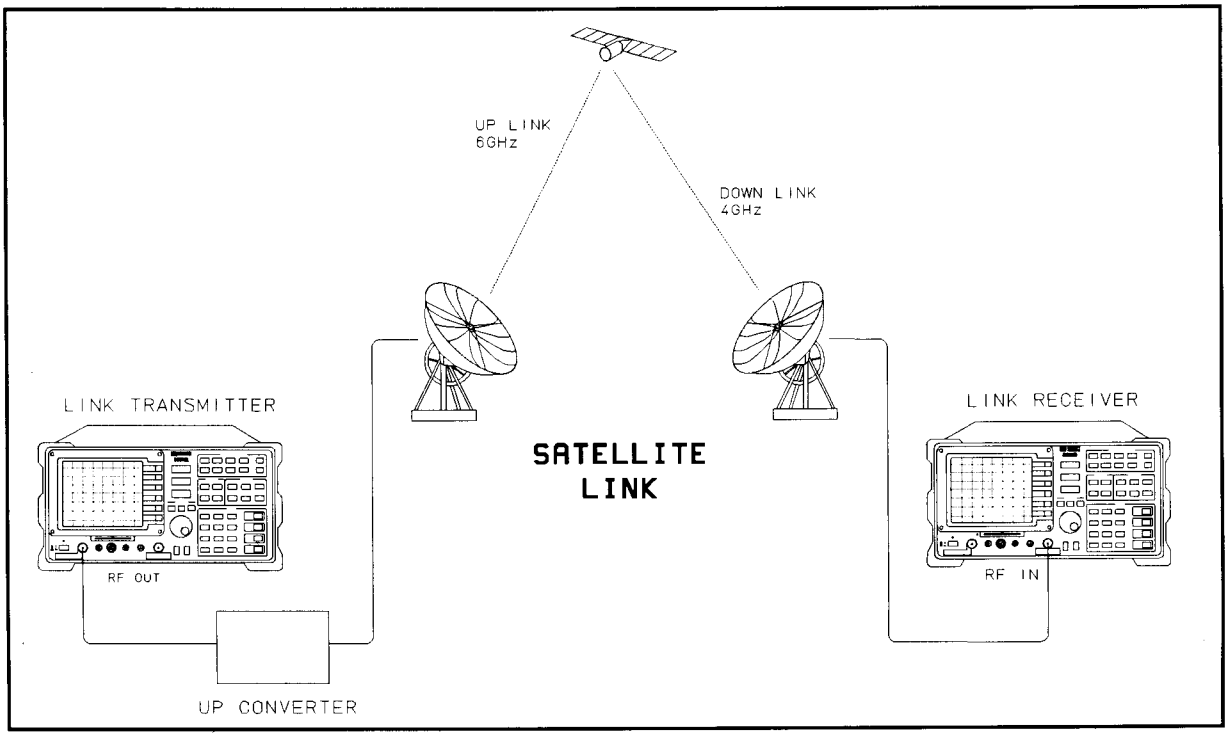
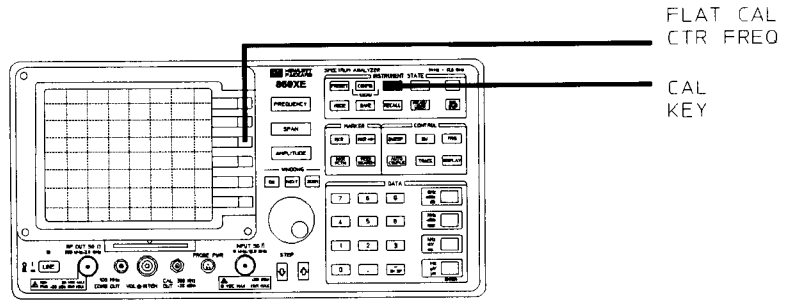


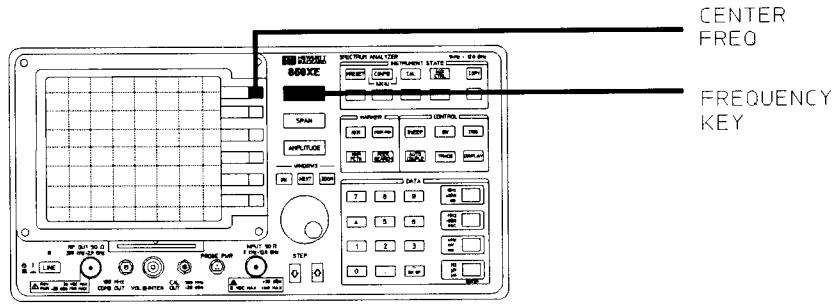
Figure 3-7. Example measurement set up when calibrating at the transmit frequency

After completing an end to end calibration at this frequency the receiver's frequency must be moved. This is accomplished by moving the calibration data's center frequency then the receiver's center frequency to match that of the new center frequency.

1 Press (CAL), **FLAT CAL CTR FREQ**. Enter new center fequency.



2 Now press (FREQUENCY), **CENTER FREQ**. Enter same new center frequency.



In the final measurement configuration (Figure 3-6), it is possible that the transmitter and receiver will be remote from each other. In this situation, the instruments must be brought together for calibration. The calibration data and instrument set ups must be stored on a RAM card. (Part No. 85700A) When the instruments are in their final locations, their set ups are recalled from the RAM cards (See "Using Save and Recall"). In a similar manner, it is possible for you to calibrate the system against a characterised device.

Using the HP 11766A DADE Switch

The group delay measurement capability of your link analyzer can be extended by using the HP 11766A Diversity Antenna Delay Equalization (DADE) Switch.

The RF signals from the 2 diversity antennae are fed into the radio receivers (down converters) as shown in Figure 3-8. By connecting the DADE switch to the IF outputs of the two receivers, you can simultaneously display the group delay characteristics of both paths. Any differences in the two characteristics can then be measured.

Note

DADE measurements can be made using the Link Loopback mode, however the measurements will be uncalibrated.

The HP 11766A DADE Switch has 5 connections. It has 2 input connections for the IF sources and 1 output which connects to the analyzer input. It also has a power supply connection which is fed by the analyzer's PROBE PWR output, and a control line which is connected to the analyzer's HIGH SWEEP IN/OUT (TTL) output. When operating, the set-up is as shown in Figure 3-8 and Figure 3-9.

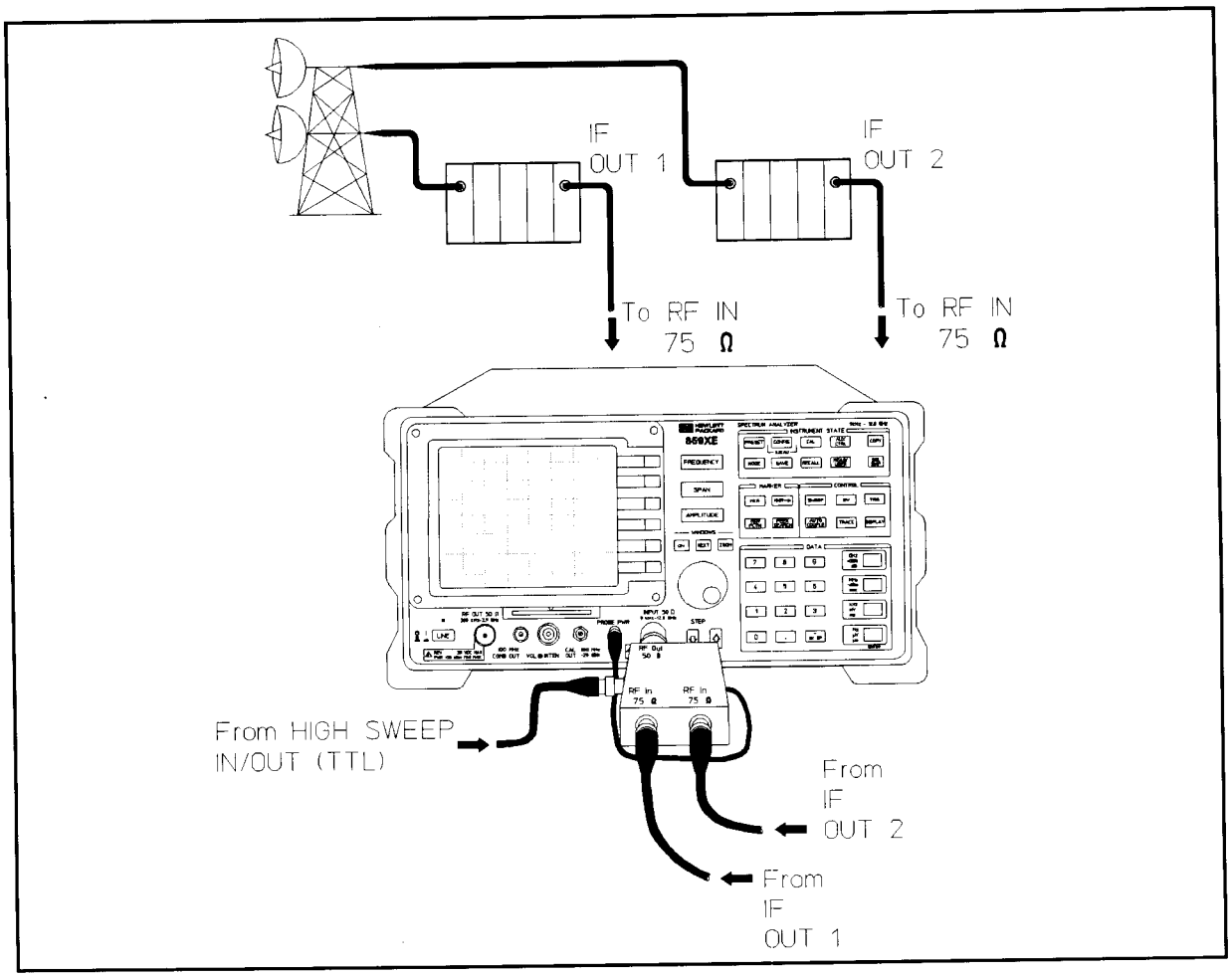


Figure 3-8. DADE Switch Connections

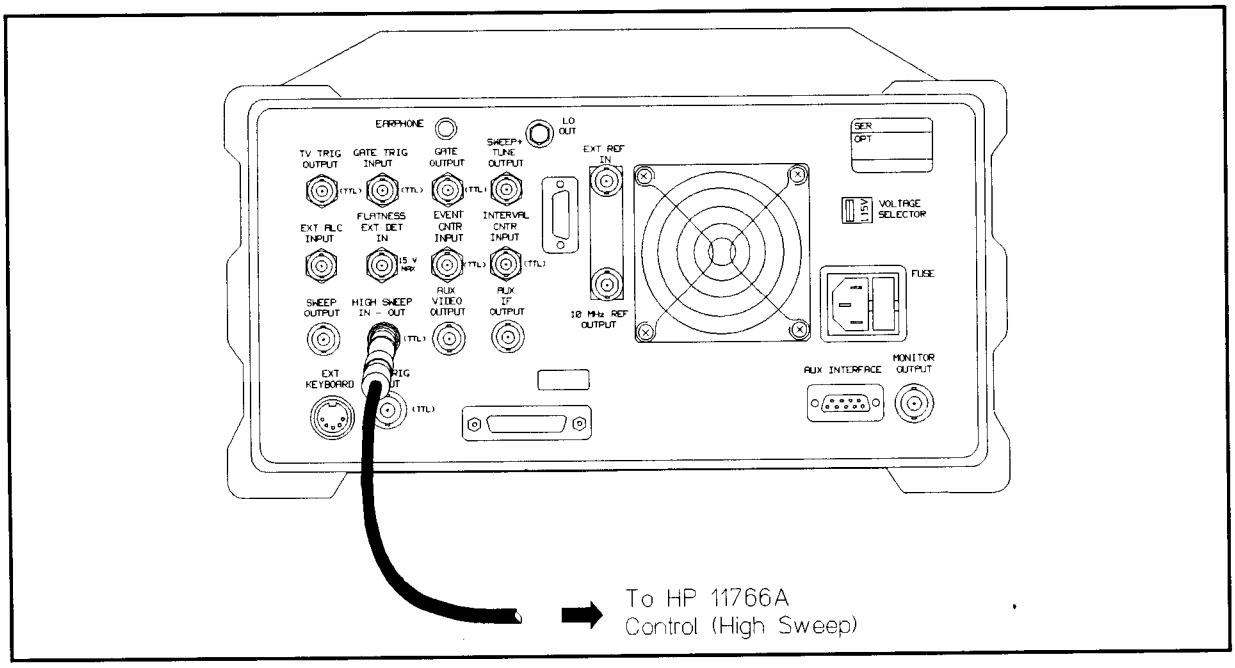
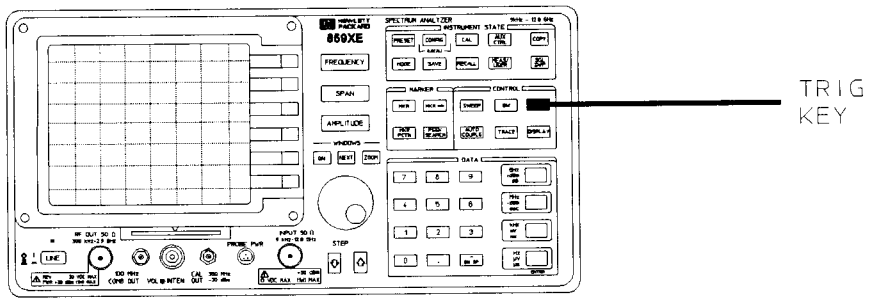


Figure 3-9. High Sweep Output Connection

This section describes how to:

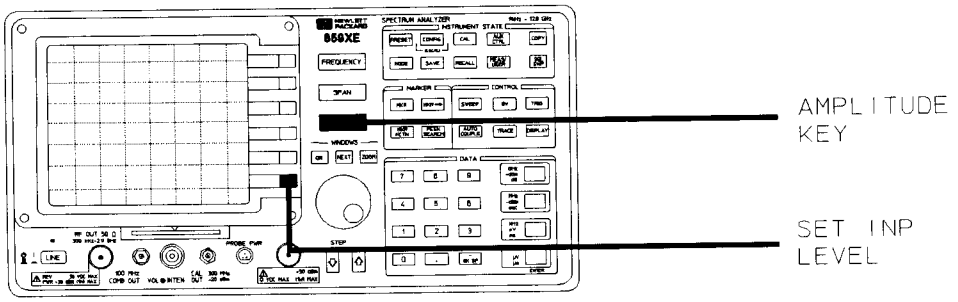
- Set up the diversity antenna measurement
- Use markers to make measure diversity antenna delay differences
- Calculate the cable length for delay equalization

Setting Up the Diversity Antenna Measurement

1 Connect the DADE switch to the link analyzer and radio, as shown in Figure 3-8, except leave the Control (High Sweep) terminal unconnected. Because the control line is not connected, the switch will be inactive. One of the input signals will be connected through to the link analyzer.
2 If you are using the Link Receiver mode, ensure the analyzer is in the **Receiver Unlocked** state. If it is not, press [TRIG] so that **Receiver Unlocked** appears on the display.


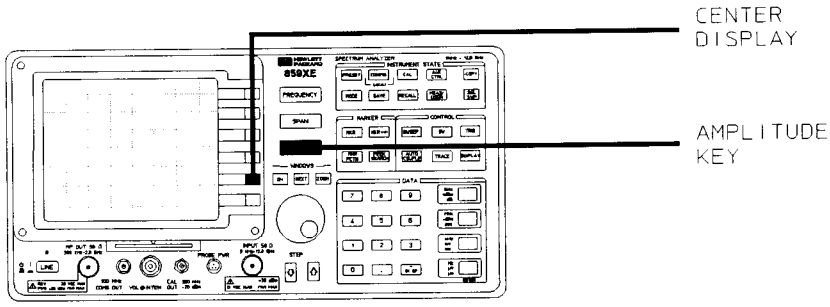
3 Set the frequency range and modulation parameters of the sweep. If you are using the Link Loopback mode, set the tracking generator output power as well. Refer to the "Making Measurements" section in this chapter for details on setting these parameters.

4 Press (AMPLITUDE), then **SET INP LEVEL**. If you are using the Link Receiver mode, press (TRIG) so the **Receiver Unlocked** message disappears.

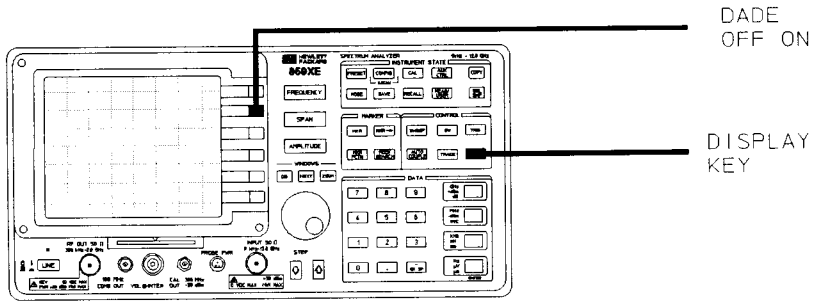


5 Set the ns/div scale to an appropriate level (for example 1 ns/div). Refer to "Changing the Scale and Offset Manually" in the "Making Measurements" section of Chapter 3.

6 Press (AMPLITUDE) then **CENTER DISPLAY** to set the trace to the center of the screen.



7 Press (DISPLAY), **DADE OFF ON** until **ON** is underlined. This sets up the link analyzer for DADE. The analyzer will automatically select group delay only.



8 Connect the Control (High Sweep) terminal to the HIGH SWEEP IN/OUT (TTL) output on the analyzer. See Figure 3-9. The DADE switch will now toggle between the inputs on alternate sweeps and the second trace should appear.

Note **AUTO SCALE** cannot be used with the DADE function.

Using Markers to Measure Diversity Antenna Delay Differences

Markers can be used to measure the delay difference at a particular frequency.

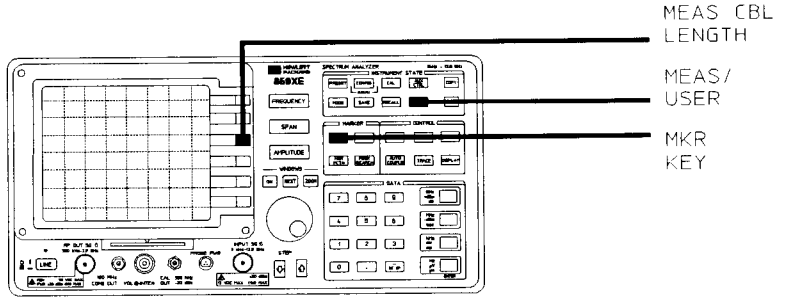
1 Set up the link analyzer to make DADE measurements. Refer to the "Setting Up the Diversity Antenna Measurement" procedure for details.

2 Press (MKR). One marker will appear on each trace. Both will be set to the same frequency.

3 Using the knob, step keys or data keys, set the markers to the frequency required.

4 Press (MEAS/USER) then **MEAS CBL LENGTH**. The group delay difference between the 2 markers will be displayed along with the cable length and velocity factor.

5 Press (MKR) again to remove the markers.



Calculating the Cable Length for Delay Equalization

To minimize the delay differences between the signals from the two diversity antennae, the delay of the shorter path can be increased by adding a length of cable.

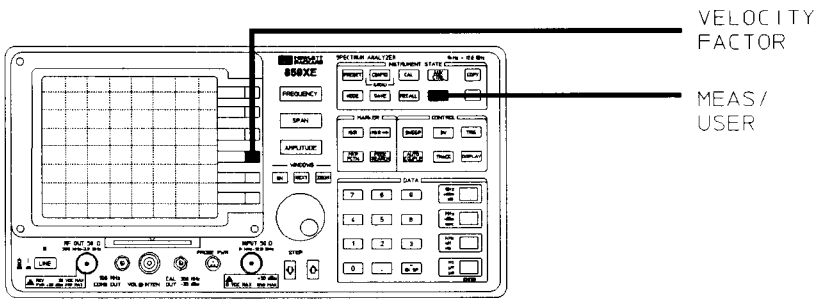
To calculate the length of cable required, the Link Measurement Personality must be told the velocity factor of the cable used. If no velocity factor is entered, the default value of 0.659 is used. The following steps describe how to enter the velocity factor and calculate the length of cable required for equalization.

Note Appendix C "Theory" gives details on how the cable length is calculated.

1 Set up the link analyzer to measure the delay differences between the 2 paths, as described in the "Setting Up the Diversity Antenna Measurement" procedure in this section.

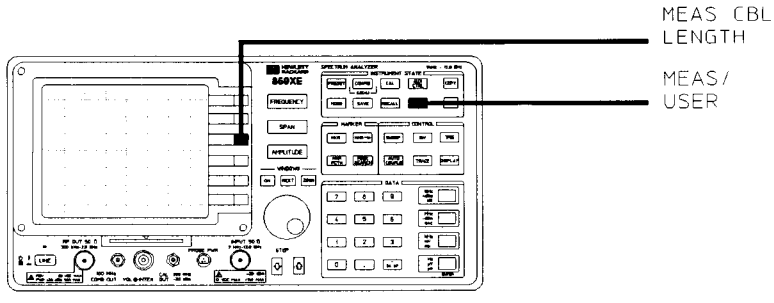
2 Press (MEAS/USER).

3 To change the velocity factor (from the default value of 0.659), press **VELOCITY FACTOR**. A value between 0.5 and 1 can be entered.



4 Set markers if required. Refer to the "Using Markers to Measure Diversity Antenna Delay Difference" procedure for details. If markers are used, the cable length will be calculated based on the group delay between the points marked. If no markers are used, the analyzer will calculate the mean value of each trace, find the difference (in ns), and then calculate the cable length based on that difference.

5 Press (MEAS/USER) then **MEAS CBL LENGTH**. The required length of cable will be calculated and the result displayed in the annotation at the top of the display.



Using Save and Recall

Having set up a test with the parameters you require, you may find it useful to save the test state so that it can be recovered later. You may also want to save the display so that the resulting group delay and amplitude flatness traces can be viewed later. Saving any instrument state will also save any valid calibration data. The Link Receiver and Link Loopback modes enable you to save a maximum of 10 test states and 10 traces to the analyzer's user memory. If you have a suitable memory card, you can use it to save a further 10 test states and 10 traces.

Note

You **cannot** save states or traces to the Link Measurement Personality ROM card, or the DRTS ROM Measurement Card. The HP 85700A 32K RAM card is an example of a suitable memory card. Refer to Chapter 9 of the *HP 8590 Series Spectrum Analyzer User's Guide* for details of other cards that can be used.

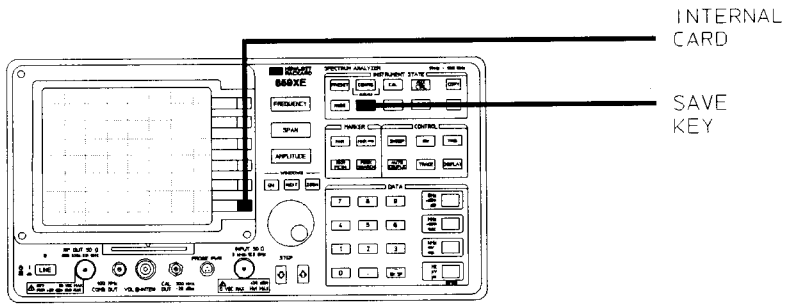
This section describes how to use the [SAVE] and [RECALL] keys to store test states and traces.

Saving to Internal Memory

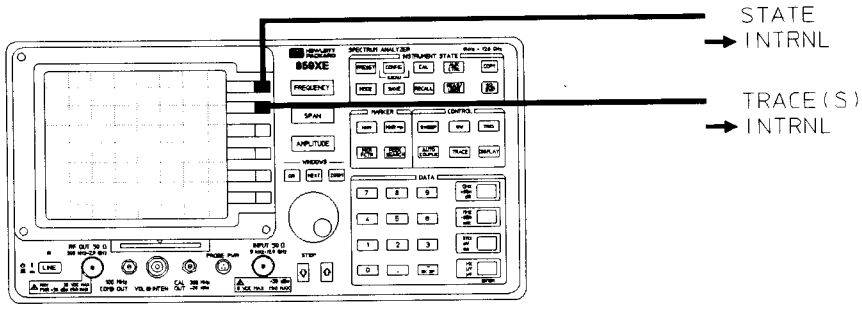
Note

When a test state or trace is saved using the Link Receiver and Link Loopback modes, the data is stored in the spectrum analyzer trace registers 28-49. Therefore, any data you have previously saved in these registers may be overwritten when a save is made.

1 Press [SAVE]. If **INTERNAL CARD** has **CARD** underlined, press **INTERNAL CARD** so that **INTERNAL** is underlined.



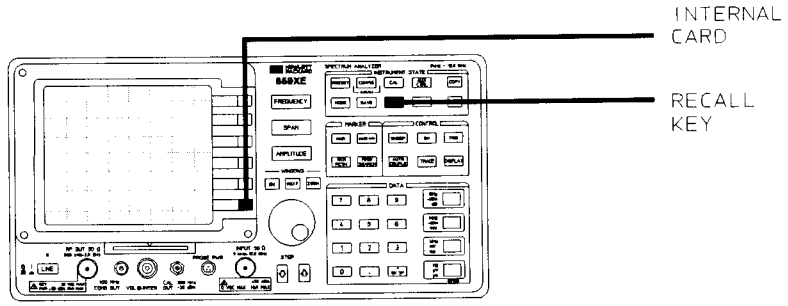
2 To save the test state, press **STATE** → **INTRNL** . To save the displayed traces, press **TRACE(S)** → **INTRNL**



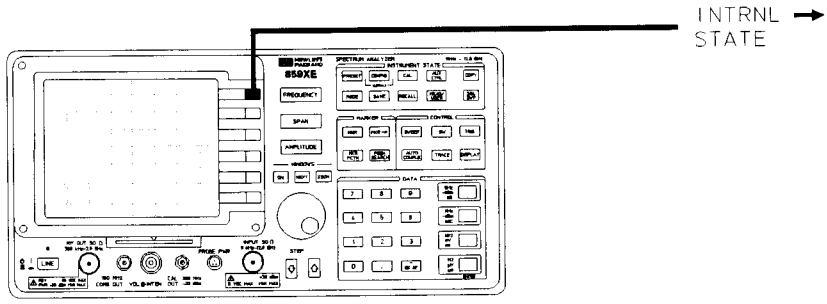
3 Using the data keys, enter a memory location between 1 and 10. The state or trace will be saved to the analyzer's internal memory.

Recalling from Internal Memory

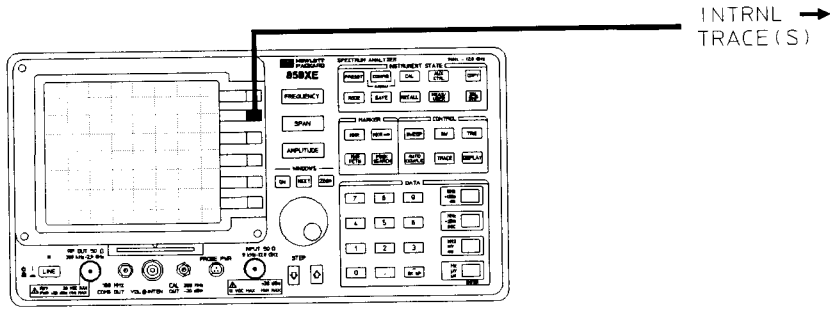
1 Press (RECALL). If **INTERNAL CARD** has **CARD** underlined, press **INTERNAL CARD** so that **INTERNAL** is underlined.



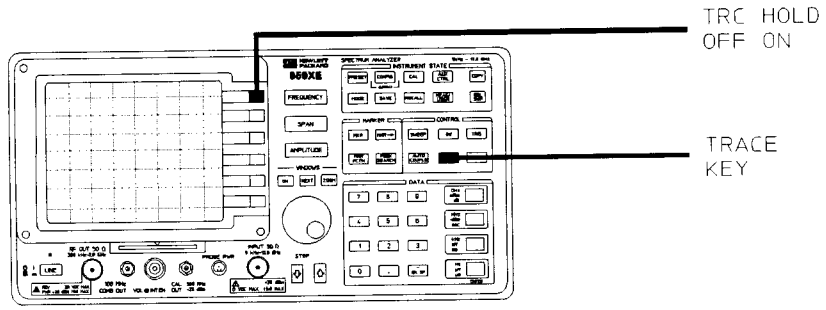
2 To recall a test state, press **INTRNL** → **STATE** , then enter the number of the state to be recalled. The analyzer will set up the same parameters that were set when the save was made. The Link Receiver mode will *always* return to the **Receiver Unlocked** state.



3 To recall a trace, press **INTRNL → TRACE(S)**, then enter the number of the trace to be recalled.

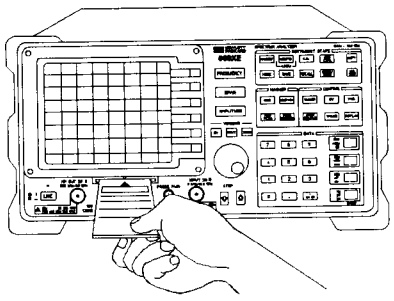


4 The trace will appear on the screen as it was when the save was made, except **TRC HOLD OFF ON** will always be **ON**. To remove the trace from the screen, press (TRACE), then **TRC HOLD OFF ON** so that **OFF** is underlined. The trace will be removed from the screen, and the analyzer will be set to the state it was in when the save was made.

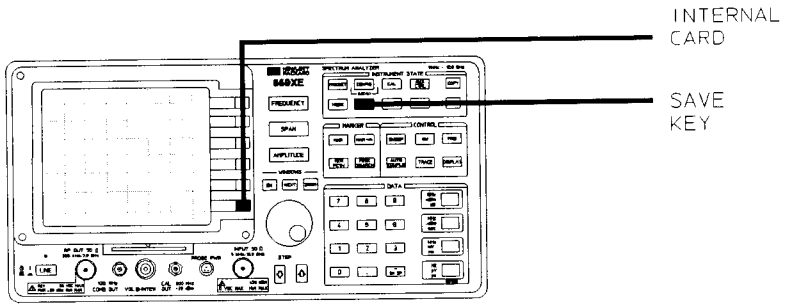


Saving to a Memory Card

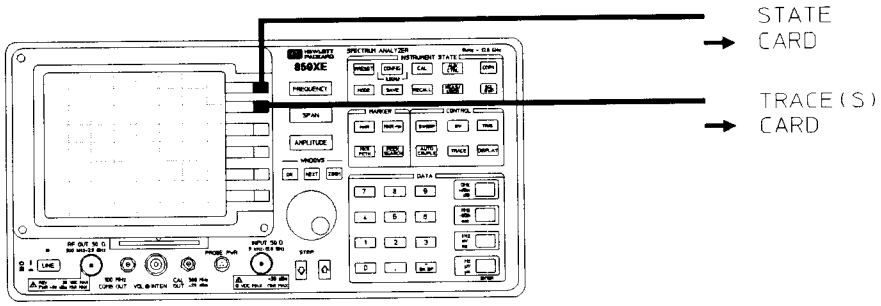
1 Insert a memory card, with the Read/Write protect switch set to allow reading and writing.



2 Press (SAVE). If **INTERNAL CARD** has **INTERNAL** underlined, press **INTERNAL CARD** so that **CARD** is underlined.



3 To save the test state, press **STATE** → **CARD**. To save the displayed traces, press **TRACE(S)** → **CARD**

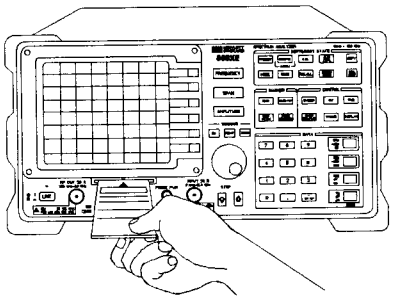


4 Using the data keys, enter a memory location between 1 and 10. The state or trace will be saved to the memory card

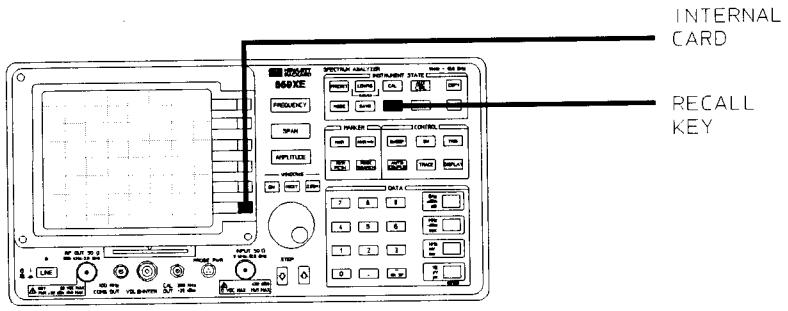
Recalling from a Memory Card

The states and traces that you have saved can be quickly recalled as follows:

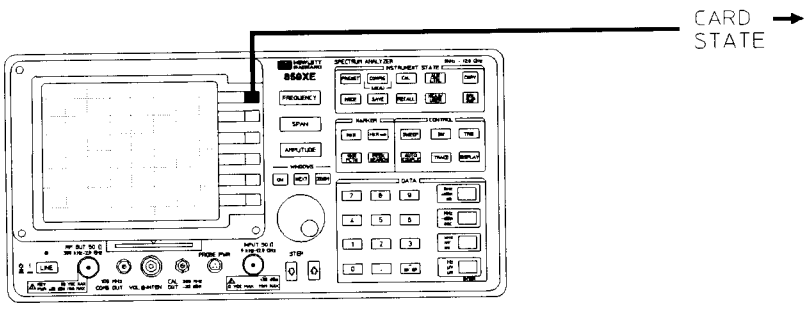
1 Insert the memory card, as shown.



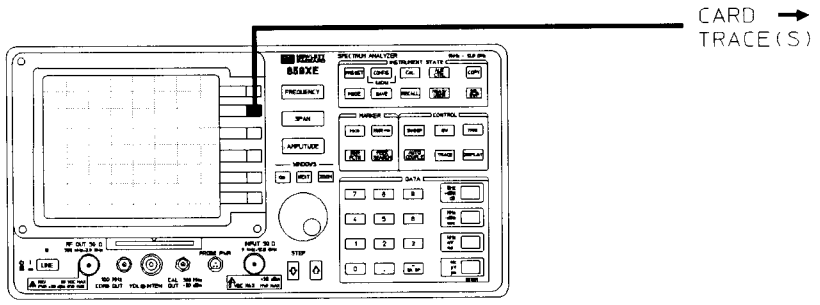
2 Press (RECALL). If **INTERNAL CARD** has **INTERNAL** underlined, press **INTERNAL CARD** so that **CARD** is underlined.



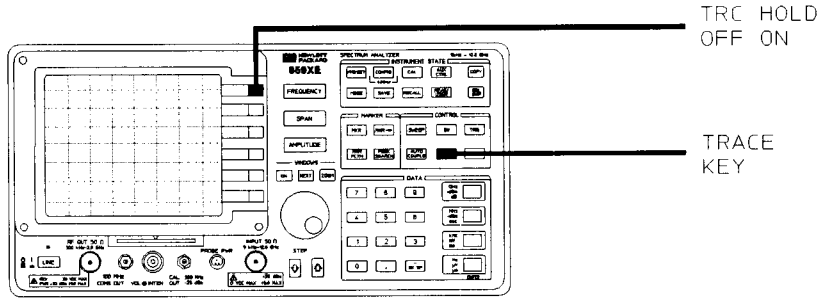
3 To recall a test state, press **CARD** → **STATE**, then enter the number of the state to be recalled. The analyzer will set up the same parameters that were set when the save was made. The Link Receiver mode will *always* return to the **Receiver Unlocked** state.



4 To recall a trace, press **CARD → TRACE(S)**, then enter the number of the trace to be recalled.



5 The trace will appear on the screen as it was when the save was made, except **TRC HOLD OFF ON** will always be **ON**. To remove the trace from the screen, press (TRACE), then **TRC HOLD OFF ON** so that **OFF** is underlined. The trace will be removed from the screen, and the analyzer will be set to the state it was in when the save was made.



Extending The Group Delay Frequency Range 4

Using The HP 11758V Digital Radio Test System (DRTS)

What You'll Learn in this Chapter

The normal transmitter range of the HP 11770A when used with an HP 859xE spectrum analyzer is limited to the frequency range of the spectrum analyzer's tracking generator which is 2.9 GHz. This chapter describes how an operator can use the HP 11758V's RF Source to extend the transmitter range to that of the RF Source.

Selecting DRTS Mode

The transmitter *must* be an HP 11758V with RF Source and the Group Delay measurement capability (Option 201). Load the Group Delay personalities into the spectrum analyzer section of the HP 11758V DRTS system using the DLP Mode Loader menu.
Run the Link Transmitter Personality.

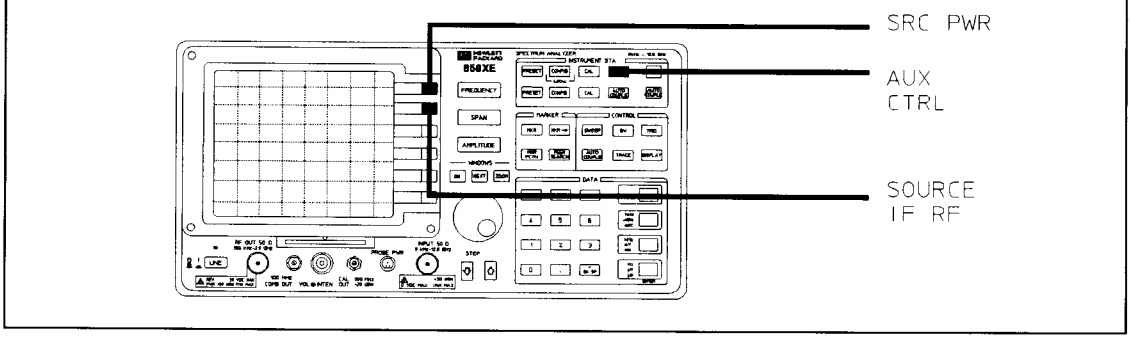
Note

See Loading & Running a Mode Using the HP 11758V DRTS Mode Loader (Pages 1-11 to 1-14 in this manual)

Setting System Transmitter Parameters

To enable the DRTS RF source, do the following:

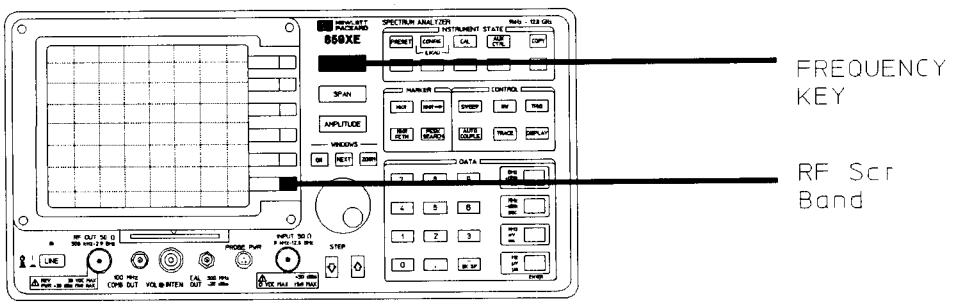
1 Press (AUX CTRL) then SOURCE IF RF (RF). Now press SRC PWR ON OFF (ON)



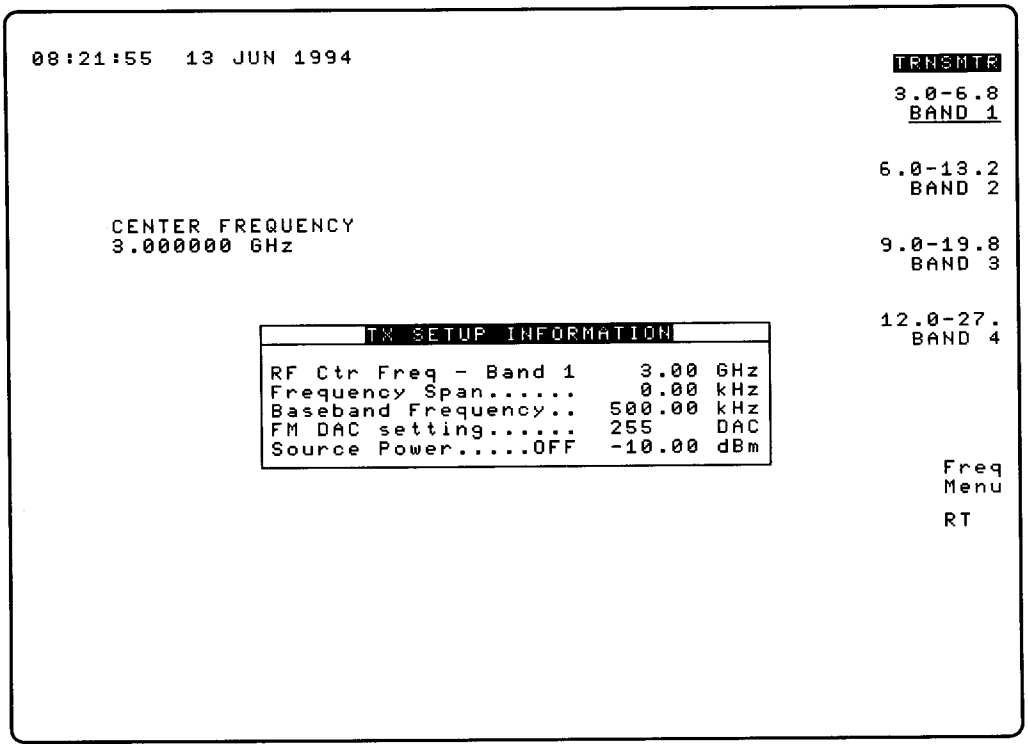
Now enter the desired power in dBm.

Select the required RF source band as follows:

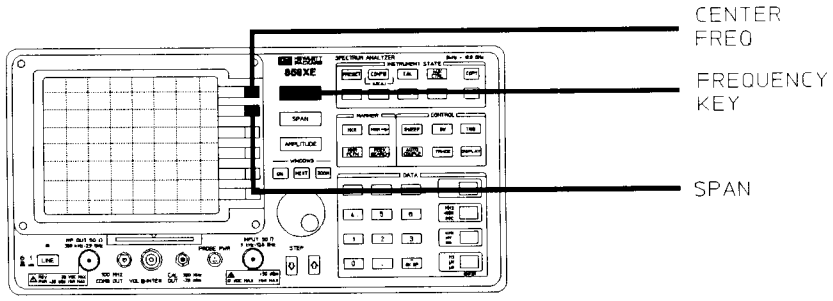
1 Press (FREQUENCY). Press **RF Src Band**.



2 Select the required frequency band



3 Press (FREQUENCY). Select **CENTER FREQ** and enter value. Press **SPAN** and enter value. See Table 4-1



Note

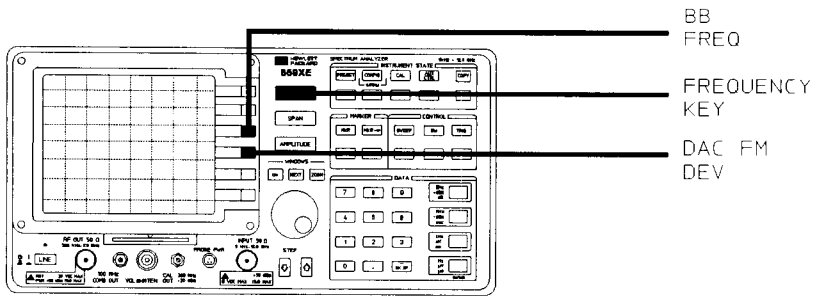
This table provides information on the minimum span allowable in each RF Source Band.

Table 4-1. Minimum Span Data

RF Source Band	Minimum Span
1	> 10.0 MHz
2	> 20.0 MHz
3	> 30.0 MHz
4	> 40.0 MHz

4 To set the baseband frequency, press (FREQUENCY), **BB FREQ**. The required value can now be chosen from the following selection: **55 kHz**, **66 kHz**, **83 kHz**, **92 kHz** and **200 kHz**. Pressing **MORE 1 of 2** will also give you the choice of **250 kHz**, **277 kHz**, **500 kHz** and **555 kHz**.

5 Press (FREQUENCY), and adjust the FM deviation if required. This is done using the **DAC FM DEV** key and the procedure outlined next.



Setting the FM Deviation on the RF Source

- Set the transmitter frequency span to 0 Hz, press (FREQUENCY) SPAN (0) (Hz).
- Connect the RF OUTPUT to the receiver analyzer INPUT using the leveling head and cable. See Figure 4-1

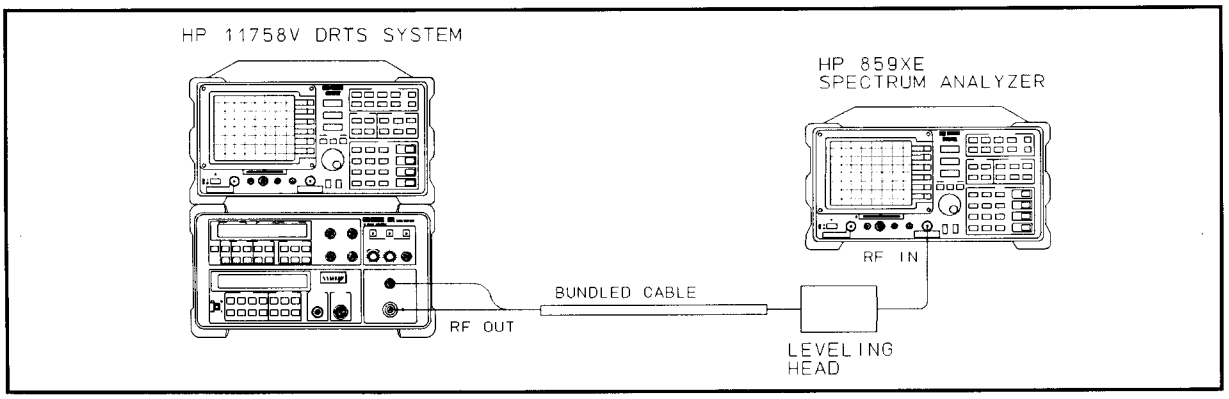


Figure 4-1. Connections for setting RF Source FM deviation

On the receiver analyzer:

- Setup the spectrum analyzer mode. This can be achieved by pressing the (PRESET) key.
- Set the center frequency to the same as the transmitter. Set the span to approximately 10 × the baseband frequency For example, using the 500 kHz default setting for the baseband frequency, set the span to 5 MHz.
- Adjust the center frequency in order to position the first sideband left of the carrier, to the left handside of the display. See Figure 4-2

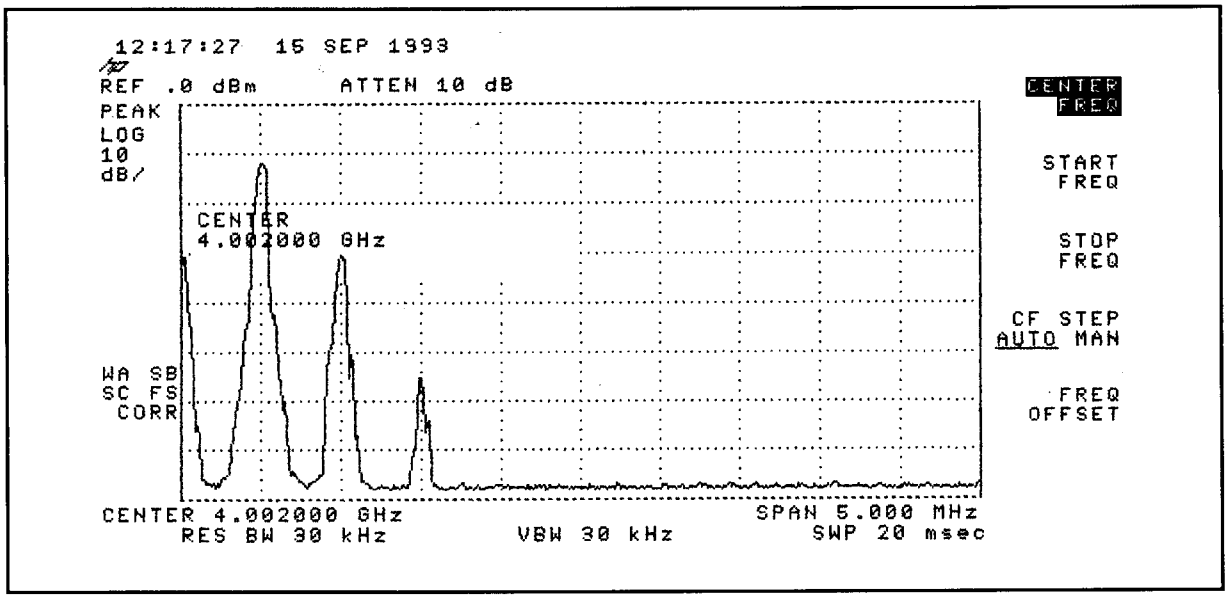


Figure 4-2. Adjustment of 1st Sideband

In the FREQUENCY menu of the transmitter analyzer, select DAC FM DEV . To adjust the RF frequency deviation use the DATA keys to enter a value in the range 0 to 255. The value sets the digital to analog converter (DAC) on the group delay measurement board which controls the modulation index of the FM. A value of 255 provides the maximum modulation index and 0 switches the FM deviation off.

Note

Bessel functions can be used to set the FM deviation. For details on how modulation information can be determined from the carrier and sidebands, refer to the HP 859xE Series Spectrum Analyzer Quick Reference Guide, Appendix B (part no. 5960-6535).

Setting System Receiver Parameters

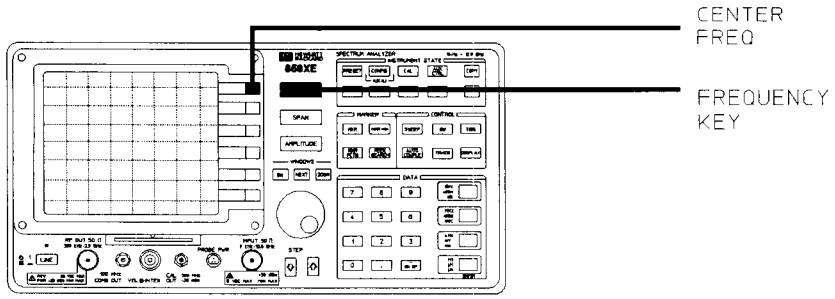
Prior to making RF group delay measurements it is *good practice* to perform the spectrum analyzer's frequency, tracking generator and YTF amplitude self-calibration routines.

The receiver can either be an HP 11758V with Group Delay measurement capability, or a stand-alone HP 859xE Series Spectrum Analyzer, with option 111. Load the Group Delay personalities into the spectrum analyser section of the HP 11758V DRTS system using the DLP Mode Loader menu or HP 859xE Series Spectrum analyzer Link Loader menu and run Link Receiver Personality.

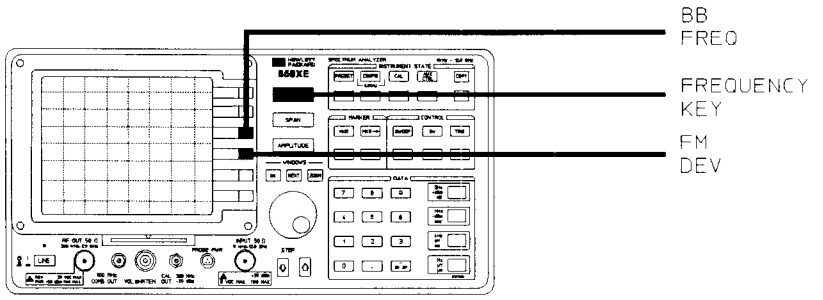
Note

See Loading & Running a Mode Using the Link/Mode Loader (Pages 1-7 to 1-14 in this manual)

1 Press (FREQUENCY). Select **CENTER FREQ** and enter value. Press **SPAN** and enter value. See Table 4-1



2 To set the baseband frequency, press (FREQUENCY), **BB FREQ**. The required value can now be chosen from the following selection: **55 kHz**, **66 kHz**, **83 kHz**, **92 kHz** and **200 kHz**. Pressing **MORE 1 of 2** will also give you the choice of **250 kHz**, **277 kHz**, **500 kHz** and **555 kHz**.



Note

If there is frequency translation in the measurement (that is the Transmitter frequency *is not* equal to the Receiver frequency), refer to the section **FREQUENCY TRANSLATION MEASUREMENTS** in Chapter 3 for details.

Bring the Transmitter and Receiver together (See Figure 4-1) and conduct an End to End flatness calibration, see (Chapter 3 **End to End Flatness Calibration**).

When the calibration is complete, unlock the receiver from the transmitter. Insert the DUT in the measuring path between the HP 11758V RF Source External Levelling Head and the receiver input. Set the receiver input attenuation, and relock the receiver to the transmitter (as outlined on pages 3-17 and 3-18 of this manual)

5

Quick Reference

This chapter consists of the following sections:

"**Key Descriptions**"	Describes the function of each key used with the HP 11770A Link Measurement Personality.
"**Menu Maps**"	Illustrates graphically the softkey menus accessed by each front-panel key.
"**Problem Solving**"	Provides quick solutions to problems you may encounter when using the link analyzer.

Each of these sections is arranged alphabetically to enable quick access to the information you require.

Key Descriptions

This section describes the function of each softkey or front panel key, used with the HP 11770A Link Measurement Personality. Any softkey marked with an asterix (as in SOFTKEY *) performs a normal Spectrum Analyzer function, and the *HP 859xE Series Spectrum Analyzer User's Guide* should be referred to for details.

The keys are listed alphabetically, followed by a description of the function.

Keys Used with the Link Measurement Personality

These softkeys are all used in either the Link Transmitter, Link Receiver or Link Loopback modes. Each key is common to all 3 modes, unless otherwise stated.

ABORT (Link Receiver and Link Loopback modes only). This key enables you to abort the flatness calibration and return to the [CAL] main menu. The flatness calibration must be aborted *before* CONTINUE has been pressed.
Accessed by pressing [CAL], then CAL FLATNESS or CAL ALL.

ALC INT EXT * Refer to the *HP 859xE Series Spectrum Analyzer User's Guide* for details.

[AMPLITUDE] In the Link Receiver and Link Loopback modes, [AMPLITUDE] accesses the softkeys that enable you to change the scale and offset of the traces, both manually and automatically. The softkeys in this menu also enable you to automatically center the traces and set the input attenuation of the analyzer. In the Link Transmitter mode, [AMPLITUDE] accesses the [AUX CTRL] menu.

AMPLTDE OFFSET (Link Receiver and Link Loopback modes only). This key enables you to manually change the offset of the amplitude flatness trace. With no offset, the 0 dB point is set to the center of the graticule's y-axis.
Accessed by pressing [AMPLITUDE].

AMPLTDE SCALE (Link Receiver and Link Loopback modes only). This key enables you to manually change the scale of the amplitude flatness trace. The value entered must be between 0.1 dB/div and 5 dB/div.
Accessed by pressing [AMPLITUDE].

ANALYZER ADDRESS * Refer to the *HP 859xE Series Spectrum Analyzer User's Guide* for details.

ANNOTATN ON OFF * Refer to the *HP 859xE Series Spectrum Analyzer User's Guide* for details.

AUTO SCALE (Link Receiver and Link Loopback modes only). This key automatically sets the scale of the traces that are being measured. If only one trace is being measured, the scale of that trace only will be set. In addition to this function, **AUTO SCALE** will also center the traces on the screen and set the input attenuation of the analyzer (as if **CENTER DISPLAY** and **SET INP LEVEL** were pressed).
Accessed by pressing [AMPLITUDE].

[AUX CTRL] In the Link Transmitter and Link Loopback modes, the softkey menu contains **SRC PWR OFF ON** which allows you to set the tracking generator output power. Also included in this menu are some other functions that appear in the [AUX CTRL] menu when in the Spectrum Analyzer mode. In the Link Receiver mode, the only softkey in the menu is **INP LVL OFFSET**. When DRTS is used as the RF source **SOURCE IF RF** replaces **INP LVL OFFSET**

BB FREQ Activates another softkey menu, with a selection of baseband frequency values. You can choose from 55.60 kHz, 66.70 kHz, 83.33 kHz, 92.59 kHz, 200.00 kHz, 250.00 kHz, 277.78 kHz, 500.00 kHz and 555.56 kHz. If making end-to-end measurements, the baseband frequency must be the same value at the transmitter and receiver.
Accessed by pressing [FREQUENCY] or [SPAN].

BLANK CARD * Refer to the *HP 859xE Series Spectrum Analyzer User's Guide* for details.

[BW] (Link Receiver and Link Loopback modes only). The activated menu contains **VID BW 3kHz** and **VID AVG OFF ON**. Video averaging is not available when both traces are selected hence, **VID AVG OFF ON** will be blanked.

B&W PRINTER * Refer to the *HP 859xE Series Spectrum Analyzer User's Guide* for details.

[CAL] (Link Receiver and Link Loopback modes only). This key activates the calibration menu which enables you to calibrate the group delay

scale and the measurement flatness. Refer to "Calibrating the Link Analyzer" in Chapter 3 for more details.

CAL FLATNESS (Link Receiver and Link Loopback modes only). This function calibrates the measurement flatness. Refer to "Calibrating the Link Analyzer" in Chapter 3 for more details.
Accessed by pressing (CAL).

CAL SCALE (Link Receiver and Link Loopback modes only). This function calibrates the group delay scale and measurement flatness. Refer to "Calibrating the Link Analyzer" in Chapter 3 for more details.
Accessed by pressing (CAL).

Card Config * Refer to the *HP 859xE Series Spectrum Analyzer User's Guide* for details.

CARD →STATE This key enables you to recall up to 10 test states from a memory card.
Accessed by pressing (RECALL).

CARD →TRACE(S) (Link Receiver and Link Loopback modes only). This key enables you to recall up to 10 test traces from a memory card.
Accessed by pressing (RECALL).

CATALOG CARD * Refer to the *HP 859xE Series Spectrum Analyzer User's Guide* for details.

CENTER DISPLAY (Link Receiver and Link Loopback modes only). This key sets the traces to the center of the display, and sets their respective offset values to zero.
Accessed by pressing (AMPLITUDE).

CENTER FREQ Enables you to select the frequency that will be at the center of the screen. The value of this parameter must be such that when applied to the current value of frequency span, the resulting start and stop frequencies of the sweep, are between 300 kHz and 2.9 GHz. The center frequency has a minimum value of 0.55 MHz.
Accessed by pressing (FREQUENCY) or (SPAN).

Change Prefix * Refer to the *HP 859xE Series Spectrum Analyzer User's Guide* for details.

CHANGE TITLE * Accessed by pressing (DISPLAY).

(CONFIG) Accesses the same menus that are used in the Spectrum Analyzer mode, except that an extra key has been added. This key is **DISPOSE LOOPBACK**, **DISPOSE RECEIVER** or **DISPOSE TRANSMTR**, depending on which mode is running.

CONTINUE (Link Receiver and Link Loopback modes only). There are two of these keys in the (CAL) softkey menus. They are used to select the frequency range over which the flatness calibration is performed. Refer to "Calibrating the Link Analyzer" in Chapter 3 for more details.
Accessed by pressing (CAL), then **CAL FLATNESS** or **CAL ALL**.

COPY DEV PRNT PLT * — Refer to the *HP 859xE Series Spectrum Analyzer User's Guide* for details.

CORRECT OFF ON — (Link Receiver and Link Loopback modes only). This key is used in conjunction with CAL FLATNESS to calibrate the flatness of the measurements. When CORRECT OFF ON is ON, the data obtained from the flatness calibration is used to remove the flatness error from the traces. Refer to "Calibrating the Link Analyzer" in Chapter 3 for more details.
Accessed by pressing (CAL).

CPL MKRS OFF ON — (Link Receiver and Link Loopback modes only). When this function is set to ON, the 2 pairs of markers will track each other. For example, if the frequency position of marker 1 on the amplitude flatness trace is changed, the frequency position of marker 1 on the group delay trace will change to the same value. If only one trace is displayed, this key is blanked out.
Accessed by pressing (MKR).

DAC FM DEV — (Link Transmitter Mode only).When the DRTS is used as the RF source the FM can be set by entering a DAC value via this key.
255 - Max FM Deviation.
0 - FM switched Off.
Accessed by pressing (FREQUENCY)

DADE OFF ON — (Link Receiver and Link Loopback modes only). This key is used when making diversity antenna measurements to turn on the DADE function. If DISPLAY A G A+G is set to A+G or A when DADE OFF ON is changed to ON, the selection will automatically change to G. Also, when the DADE function is ON, the (MEAS/USER) menu will change so that MEAS PK-PK and MEAS LIN PARBL GD are blanked out, and MEAS CBL LENGTH and VELOCITY FACTOR are added. When the DADE function is on, the (MKR) key is only used to turn the markers on and off.
Accessed by pressing (DISPLAY).

DATEMODE MDY DMY * — Refer to the *HP 859xE Series Spectrum Analyzer User's Guide* for details.

DEFAULT CONFIG * — Refer to the *HP 859xE Series Spectrum Analyzer User's Guide* for details.

DEFAULT SYNC * — Refer to the *HP 859xE Series Spectrum Analyzer User's Guide* for details.

(DISPLAY) — In the Link Receiver and Link Loopback modes, the menu activated by this key enables you to select the type of measurement you want to make, that is group delay only, amplitude flatness only or both. You can also choose to make DADE measurements. The menu also enables you to turn off the graticule and the annotation, and change the title of the display. In Link Transmitter mode, the key is used to refresh the display.

DISPLAY A G A+G

(Link Receiver and Link Loopback modes only). Used to select which traces are displayed. Pressing SELECT GD AF will switch between A, G and A+G. With A or G underlined, the only trace selected will be amplitude flatness or group delay respectively. With A+G underlined, both traces will be selected. The combination of traces selected by this key determines the function of other softkeys, for example SELECT GD AF , MARKERS GD AF and CPL MARKERS OFF ON . All of these keys are blanked out if only one trace is selected.
Accessed by pressing (DISPLAY).

DISPOSE LOOPBACK

(Link Loopback mode only). Used to exit the mode and erase it from memory.

DISPOSE RECEIVER

(Link Receiver mode only). Used to exit the mode and erase it from memory.

DISPOSE TRANSMTR

(Link Transmitter mode only). Used to exit the mode and erase it from memory.

DISPOSE USER MEM *

Refer to the *HP 859xE Series Spectrum Analyzer User's Guide* for details.

FLAT CAL LCL END

(Link receiver mode only).Selects a flatness calibration which was the spectrum analyzer's own tracking generator(LCL) or a seperate RF source (END).
Accessed by pressing (CAL) CAL FLATNESS

FLAT CAL CTR FREQ

(Link receiver mode only).Selects a flatness calibration which was the spectrum analyzer's own tracking generator(LCL) or a seperate RF source (END).
Accessed by pressing (CAL) CAL FLATNESS

FM DEV

(Link Transmitter and Link Loopback modes only). Whenever the baseband frequency is changed (using BB FREQ), the FM deviation (RMS) is automatically changed, to maintain a modulation index of approximately 1. FM DEV can be used after setting the baseband frequency to set a different FM deviation.
Accessed by pressing (FREQUENCY) or (SPAN).

FORMAT CARD *

Refer to the *HP 859xE Series Spectrum Analyzer User's Guide* for details.

(FREQUENCY)

Activates a softkey menu, containing CENTER FREQ , SPAN and BB FREQ . In the Link Transmit and Link Loopback modes, FM DEV is also available.

GRAT OFF ON *

Refer to the *HP 859xE Series Spectrum Analyzer User's Guide* for details.

GRP DLY OFFSET

(Link Receiver and Link Loopback modes only). This key enables you to manually change the offset of the group delay trace. With no offset, the 0 ns point is set to the center of the graticule's y-axis.
Accessed by pressing (AMPLITUDE).

GRP DLY SCALE (Link Receiver and Link Loopback modes only). This key enables you to manually change the scale of the group delay trace.
Accessed by pressing (AMPLITUDE).

INP LVL OFFSET * Refer to **REF LVL OFFSET** in the *HP 859xE Series Spectrum Analyzer User's Guide* for details.

INTERNAL CARD This key is used with the save and recall functions to select whether the analyzer's internal memory, or a memory card will be used with the function.
Accessed by pressing (SAVE) or (RECALL).

INTRNL → STATE

This key enables you to recall up to 10 test states from the analyzer's internal memory.
Accessed by pressing (RECALL).

INTRNL → TRACE(S)

(Link Receiver and Link Loopback modes only). This key enables you to recall up to 10 test traces from the analyzer's internal memory.
Accessed by pressing (RECALL).

LVL MON OFF ON

(Link Receiver and Link Loopback modes only). This key controls the input level monitor function. When ON, the input level will be measured at the end of every sweep and the INP LVL annotation updated.
Accessed by pressing (DISPLAY).

LINK LOADER

Runs the Link Loader. The Link Loader DLP is used to load the Link Measurement Personality's 4 modes.
Accessed by pressing (MODE).

LINK LOOPBACK

Runs the Link Loopback mode. This key is only available if the dlp has been loaded into the memory.
Accessed by pressing (MODE).

LINK RECEIVER

Runs the Link Receiver mode. This key is only available if the dlp has been loaded into the memory.
Accessed by pressing (MODE).

LINK TRANSMTR

Runs the Link Transmitter mode. This key is only available if the dlp has been loaded into the memory.
Accessed by pressing (MODE).

MAN TRK ADJUST *

Refer to the *HP 859xE Series Spectrum Analyzer User's Guide* for details.

MARKER Δ AMPLTDE

(Link Receiver and Link Loopback modes only). This function measures the magnitude difference between marker 1 and marker 2 on the amplitude flatness trace. If the only trace displayed is group delay, this key is replaced with MARKER Δ GRP DLY
Accessed by pressing (MKR).

MARKER Δ GRP DLY

(Link Receiver and Link Loopback modes only). This function measures the magnitude difference between marker 1 and marker 2 on the group delay trace. If the only trace displayed is amplitude flatness, this key is replaced with MARKER Δ AMPLTDE
Accessed by pressing (MKR).

MARKERS ALL OFF

(Link Receiver and Link Loopback modes only). Pressing this key will remove all markers from the traces.
Accessed by pressing (MKR).

MARKERS GD AF

(Link Receiver and Link Loopback modes only). This key selects which pair of markers are controlled and determines the function of the second and fourth softkeys in the (MKR) menu. It is only used if both the group delay and amplitude flatness traces are being measured, otherwise it is blanked out. Pressing **MARKERS GD AF** will alternately underline **GD** and **AF**. When **GD** is underlined, the second and fourth softkeys are **MARKER Δ GRP DLY** and **SEL GD MKR 1 2** respectively. When **AF** is underlined, they become **MARKER Δ AMPLTDE** and **SEL AF MKR 1 2**.
Accessed by pressing (MKR).

MEAS CBL LENGTH

(Link Receiver and Link Loopback modes only). This key is only available when **DADE OFF ON** is set to **ON**, otherwise the key is blanked out. The function measures the difference in the group delay between the 2 paths being tested and calculates the additional length of cable that should be added to the shorter path for delay equalization. The cable's velocity factor is used for this calculation and can be entered using **VELOCITY FACTOR**.
Accessed by pressing (MEAS/USER).

MEAS LIN PARBL GD

(Link Receiver and Link Loopback modes only). When pressed, this key will display the linear delay distortion and the parabolic delay distortion. This key is blanked out, if only amplitude flatness is selected, or if **DADE OFF ON** is set to **ON**.
Accessed by pressing (MEAS/USER).

MEAS PK-PK

(Link Receiver and Link Loopback modes only). When pressed, this key will display the difference between the maximum and minimum values of the displayed traces. The key is blanked out if **DADE OFF ON** is set to **ON**.
Accessed by pressing (MEAS/USER).

(MEAS/USER)

(Link Receiver and Link Loopback modes only). The menu that this key activates, enables you to measure the peak-to-peak values of the traces, the linear delay distortion and the parabolic delay distortion. Also, when making DADE measurements, you can calculate the length of cable required for delay equalization.

(MKR)

(Link Receiver and Link Loopback modes only). This key activates a menu containing all the softkeys that allow you to use markers to make measurements. When **DADE OFF ON** is **ON**, this key will not display any menu, it will simply toggle markers on and off.

(MODE)

Displays which modes are loaded into the memory.

PAINTJET PRINTER *

Refer to the *HP 859xE Series Spectrum Analyzer User's Guide* for details.

Plot Config *

Refer to the *HP 859xE Series Spectrum Analyzer User's Guide* for details.

PLOTTER ADDRESS *

Refer to the *HP 859xE Series Spectrum Analyzer User's Guide* for details.

PLT MENU ON OFF * — Refer to the *HP 859xE Series Spectrum Analyzer User's Guide* for details.

PLTS/PG 1 2 4 * — Refer to the *HP 859xE Series Spectrum Analyzer User's Guide* for details.

POWER ON IP LAST * — Refer to the *HP 859xE Series Spectrum Analyzer User's Guide* for details.

(PRESET) * — Refer to the *HP 859xE Series Spectrum Analyzer User's Guide* for details.

Print Config * — Refer to the *HP 859xE Series Spectrum Analyzer User's Guide* for details.

PRINTER SETUP * — Refer to the *HP 859xE Series Spectrum Analyzer User's Guide* for details.

PRT MENU ON OFF * — Refer to the *HP 859xE Series Spectrum Analyzer User's Guide* for details.

PWR SWP ON OFF * — Refer to the *HP 859xE Series Spectrum Analyzer User's Guide* for details.

(RECALL) — Contains the softkeys that enable you to recall test states and traces from internal memory or from a RAM card.

RECALL FLATNESS — (Link receiver and Link loopback modes only) Recalls a stored local or End to End flatness calibration from internal memory or from a RAM card.
Accessed by pressing (RECALL)

SAV LOCK OFF ON — (All modes) When pressed this key will lock the abillity to save test states, cal data and traces to internal memory only.
Accessed by pressing (SAVE) INTERNAL CARD (INTERNAL)

(SAVE) — Contains the softkeys that enable you to save test states and traces to internal memory or to a RAM card.

SAVE FLATNESS — (Link receiver and Link loopback modes only) Saves a stored local or End to End flatness calibration to internal memory or to a RAM card.
Accessed by pressing (SAVE)

SELECT AF MKR 1 2 — (Link Receiver and Link Loopback modes only). This key is used to select the marker you want to position. If the only trace displayed is group delay, this key is replaced with SELECT GD MKR 1 2 . Once selected, the marker can be positioned using the DATA keys, STEP keys or knob.
Accessed by pressing (MKR).

SELECT GD AF — (Link Receiver and Link Loopback modes only). This key determines the function of the second and third softkeys in the (AMPLITUDE) menu. It is only used if both the group delay and amplitude flatness traces are being measured, otherwise it is blanked out. Pressing SELECT GD AF will alternately underline GD and AF. When GD is underlined, the second and third softkeys are GRP DLY SCALE and

GRP DLY OFFSET respectively. When AF is underlined, they become AMPLTDE FLATNESS and AMPLTDE OFFSET.
Accessed by pressing (AMPLITUDE).

SELECT GD MKR 1 2 (Link Receiver and Link Loopback modes only). This key is used to select the marker you want to position. If the only trace displayed is amplitude flatness, this key is replaced with SELECT AF MKR 1 2. Once selected, the marker can be positioned using the DATA keys, STEP keys or knob.
Accessed by pressing (MKR).

SET DATE * — Refer to the *HP 859xE Series Spectrum Analyzer User's Guide* for details.

SET INP LEVEL — (Link Receiver and Link Loopback modes only). This key is used to automatically set the analyzer's input attenuation to a value appropriate to the magnitude of the input signal. The accuracy of the measurements depend on the input attenuation being set correctly. It is recommend that the input attenuation should be set, whenever the input power level changes by more than 2 dB. Accessed by pressing (AMPLITUDE).

SET TIME * — Refer to the *HP 859xE Series Spectrum Analyzer User's Guide* for details.

SHOW CAL STR STOP — (Link receiver and Link loopback modes) Pressing this key shows the start and the stop frequencies of the performed calibration whether it is of a local or an end to end calibration. Accessed by pressing (CAL)

SHOW OPTIONS * — Refer to the *HP 859xE Series Spectrum Analyzer User's Guide* for details.

(SPAN) — Activates a softkey menu, containing CENTER FREQ , SPAN and BB FREQ . In the Link Transmit and Link Loopback modes, FM DEV is also available.

SPAN — Enables you to change the frequency range, symmetrically about the center frequency. The value of this parameter must be such that when applied to the current value of frequency span, the resulting start and stop frequencies of the sweep, are between 300 kHz and 2.9 GHz. The frequency span has a minimum value of 500 kHz. Accessed by pressing (FREQUENCY) or (SPAN).

SRC ATN MAN AUTO * — Refer to the *HP 859xE Series Spectrum Analyzer User's Guide* for details.

SRC PWR OFF ON — This key is used to control the output power of the tracking generator. The output power range is specified between −66 dBm and −1 dBm (−10 dBm and +1 dBm for the HP 859XA Spectrum Analyzers). The power setting can be up to +2.75 dBm although it is not calibrated to this level. (Link Transmitter and Link Loopback modes only) The default condition has the source power turned off. Accessed by pressing (AUX CTRL).

SRC PWR OFFSET * — Refer to the *HP 859xE Series Spectrum Analyzer User's Guide* for details.

SRC PWR STP SIZE * — Refer to the *HP 859xE Series Spectrum Analyzer User's Guide* for details.

STATE → CARD — This key enables you to save up to 10 test states to a memory card. Accessed by pressing (SAVE).

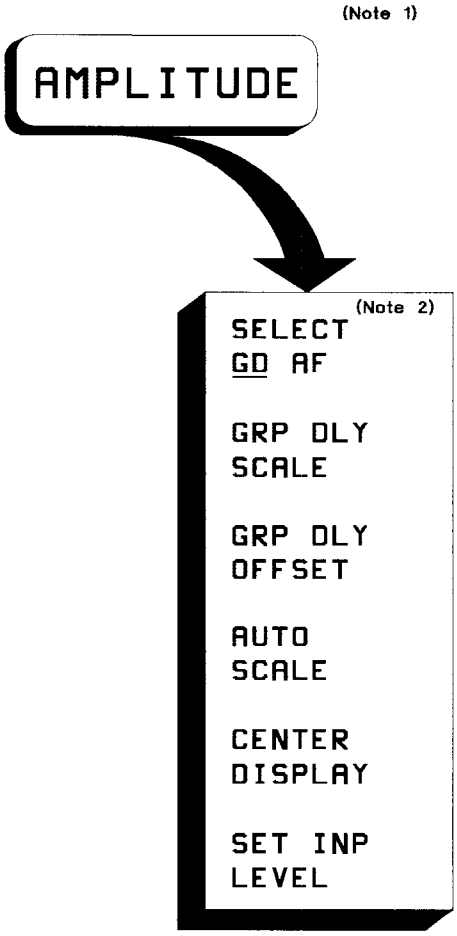
STATE → INTRNL — This key enables you to save up to 10 test states to internal memory. Accessed by pressing (SAVE).

`SWP CPLG SR SA` *	Refer to the *HP 859xE Series Spectrum Analyzer User's Guide* for details.
`SYNC NRM NTSC` *	Refer to the *HP 859xE Series Spectrum Analyzer User's Guide* for details.

SYNC NRM PAL *	Refer to the *HP 859xE Series Spectrum Analyzer User's Guide* for details.
Time Date *	Refer to the *HP 859xE Series Spectrum Analyzer User's Guide* for details.
TIME DATE ON OFF *	Refer to the *HP 859xE Series Spectrum Analyzer User's Guide* for details.
(TRACE)	(Link Receiver and Link Loopback modes only). Contains the TRC HOLD OFF ON and TRC ID OFF ON keys.
TRACE(S) → CARD	(Link Receiver and Link Loopback modes only). This key enables you to save up to 10 test traces to a memory card. Accessed by pressing (SAVE).
TRACE(S) → INTRNL	(Link Receiver and Link Loopback modes only). This key enables you to save up to 10 test traces to the analyzer's internal memory. Accessed by pressing (SAVE).
TRC HOLD OFF ON	(Link Receiver and Link Loopback modes only). When this key is pressed so that ON is underlined, the traces displayed on the screen will appear to freeze, allowing you to make more stable measurements. Accessed by pressing (TRACE).
(TRIG)	(Link Receiver mode only). Pressing this key, toggles the receiver in and out of the Receiver Unlocked state.
VELOCITY FACTOR	(Link Receiver and Link Loopback modes only). This key is only available when DADE OFF ON is set to ON, otherwise the key is blanked out. The velocity factor is a parameter used to calculate the additional cable length required for delay equalization, when DADE measurements are being made. If no value is entered using VELOCITY FACTOR, the parameter will default to 0.659. MEAS CBL LENGTH is used to make the calculation. Accessed by pressing (MEAS/USER).
VID AVG OFF ON *	This key is blanked out if both traces are selected. Accessed by pressing (BW).
VID BW 3kHz	(Link Receiver and Link Loopback modes only). The 3kHz shown on this key, will change between 300 Hz, 1kHz, 3kHz and 10 kHz as the key is pressed. The video bandwidth will change accordingly. Accessed by pressing (BW).

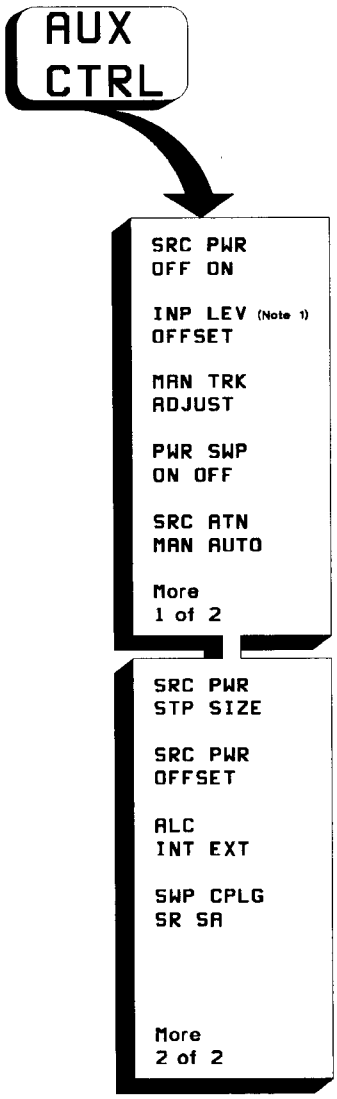
Menu Maps

This section contains the softkey menu maps for the Link Transmitter, Link Receiver and Link Loopback modes. The menus are shown alphabetically, according to the front-panel key that activates them. Some of the menus may change, depending on the mode that is running and the functions that are active. Notes have been added where appropriate to highlight these differences.



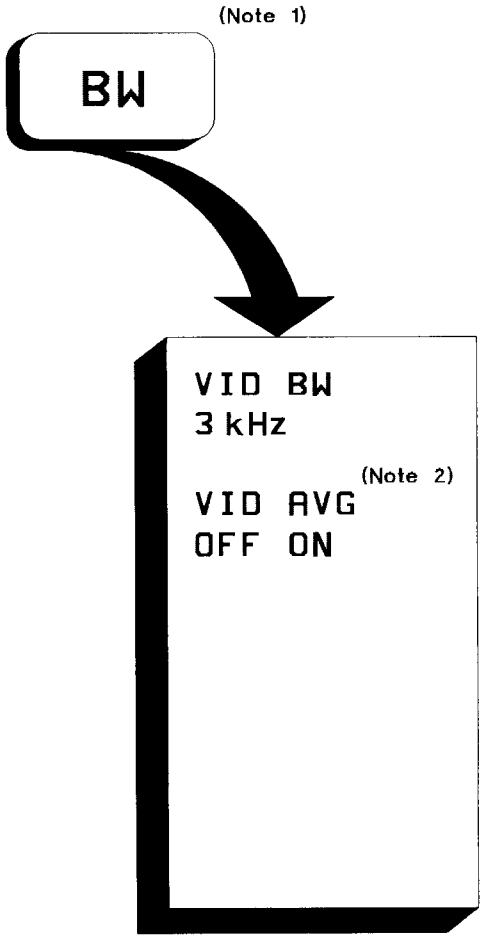
Note

1. In the Link Transmitter mode, [AMPLITUDE] will activate the same menu map as [AUX CTRL].
2. In the Link Receiver and Link Loopback modes, the `SELECT GD AF` softkey only appears on the menu when both traces are displayed. The key determines the name and function of the other softkeys in the menu. If `GD` is underlined as shown, or if group delay is the only trace displayed, then the softkeys will appear as shown above. If `AF` is underlined, or if amplitude flatness is the only trace shown, `GRP DLY SCALE` and `GRP DLY OFFSET` will change to `AMPLTDE SCALE` and `AMPLTDE OFFSET` respectively.



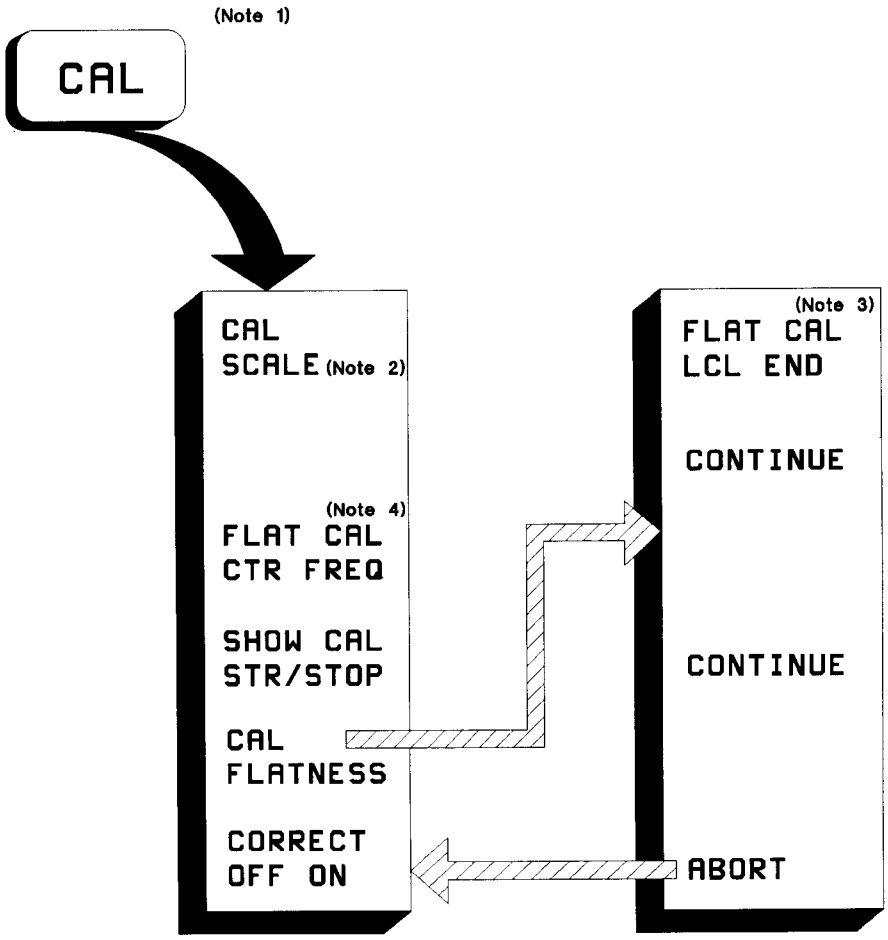
Note

1. In the Link Transmitter mode, `INP LEVEL OFFSET` is blank but `SOURCE IF RF` is displayed when the RF source is a DRTS source. In the Link Receiver mode, `INP LVL OFFSET` is the only key in the menu, all others are blanked out.



Note

1. BW is not active in the Link Transmitter mode.
2. Video averaging is not available when both traces are displayed. Therefore, if both traces are selected, the `VID AVG OFF ON` softkey is blank.



Note

1. CAL is not active in the Link Transmitter mode.
2. This key is unavailable on HP859xA Series Spectrum Analyzer.
3. Available only in link receiver mode.
4. This key is unavailable on HP859xA Series Spectrum Analyzer.

(NOTE 1)

CONFIG

Note

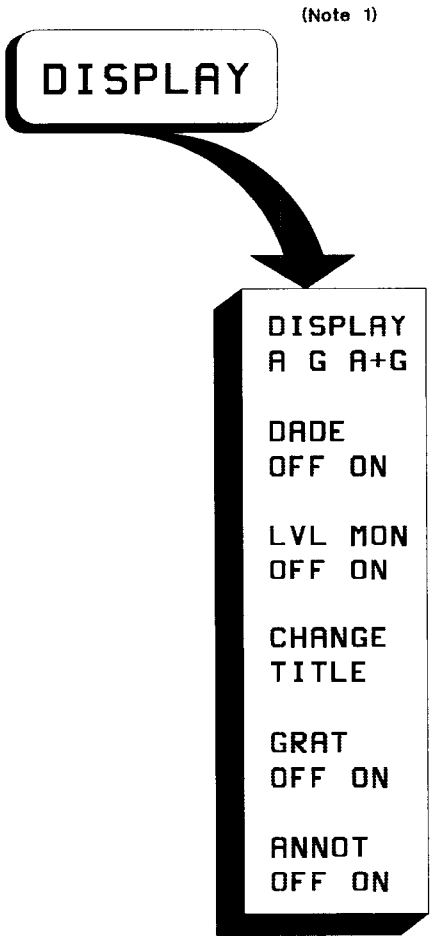
1. The menu map produced by pressing CONFIG is the same as the spectrum analyzer menu map, except there is one extra softkey. This softkey is accessed by pressing CONFIG, MORE 1 of 3, MORE 2 of 3 and is named, DISPOSE LOOPBACK, DISPOSE TRANSMTR or DISPOSE RECEIVER, depending on which mode is running. The CONFIG menu is shown in Chapter 7 of the *HP 859xE Series Spectrum Analyzer User's Guide*.

(NOTE 1)

COPY

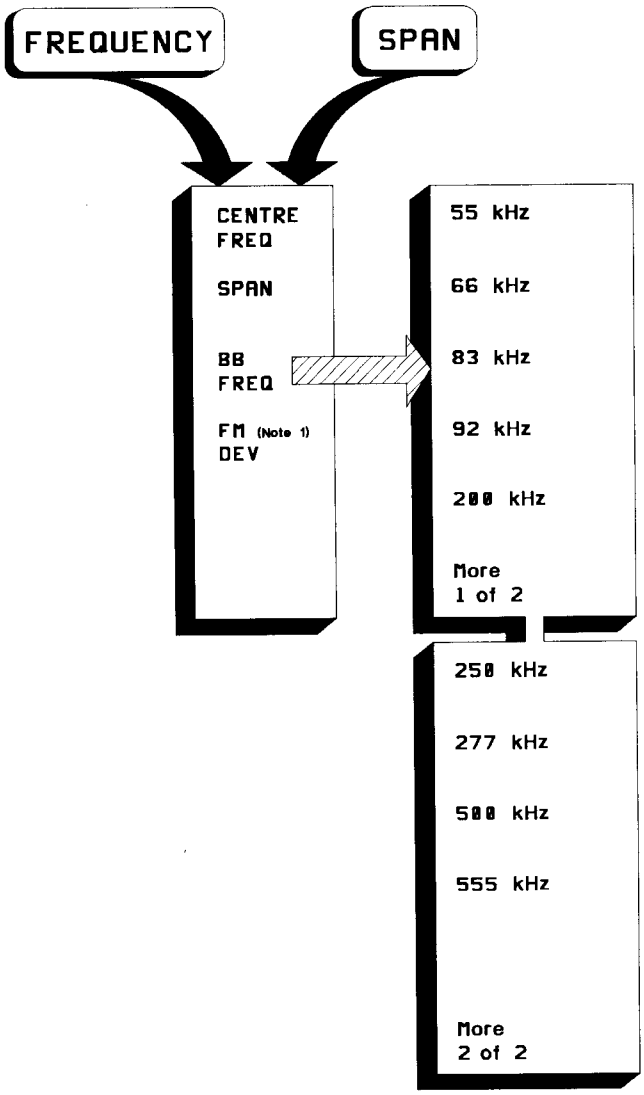
Note

1. This key is used in the same way as the spectrum analyzer mode. Refer to *HP 859xE Series Spectrum Analyzer User's Guide* for more details.



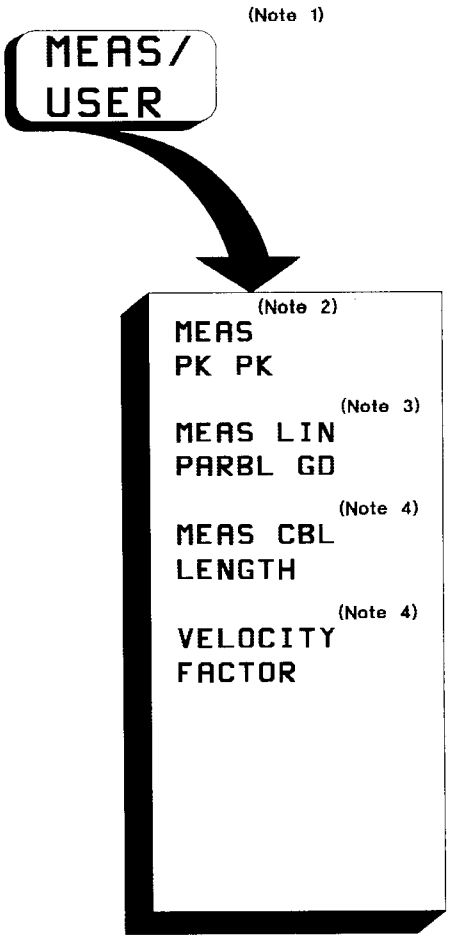
Note

1. In the Link Transmitter mode, there is no menu associated with DISPLAY. Pressing this key will redraw the transmitter screen.



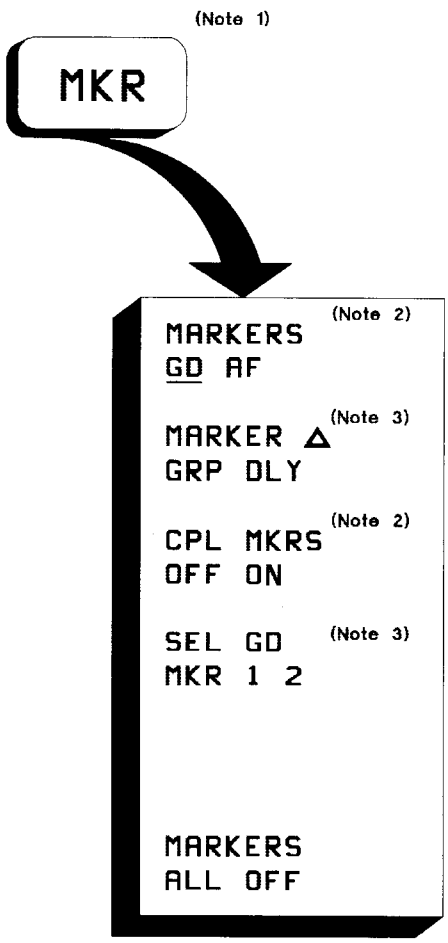
Note

1. In the Link Receiver mode, `FM DEV` is blanked out. When a DRTS is used as the RF source this key changes to `DAC FM DEV`.



Note

1. MEAS/USER is not active in the Link Transmitter mode.
2. MEAS PK-PK is blanked out when the DADE function is on.
3. MEAS LIN PARBL GD is blanked out when DADE is on, or when only amplitude flatness is selected.
4. MEAS CBL LENGTH and VELOCITY FACTOR are both blanked when the DADE function is off.



Note

1. (MKR) is not active in the Link Transmitter mode. Also, when the DADE function is ON no menu is displayed when (MKR) is pressed, but the key is used to toggle markers off and on.
2. MARKERS GD AF and CPL MKRS OFF ON will be blanked out if only one trace is selected.
3. If MARKERS GD AF has GD underlined as shown, or if group delay is the only trace displayed, then the softkeys will appear as shown above. If AF is underlined, or if amplitude flatness is the only trace shown, MARKER Δ GRP DLY and SEL GD MKR 1 2 will change to MARKER Δ AMPLTDE and SEL AF MKR 1 2 respectively.

(NOTE 1)

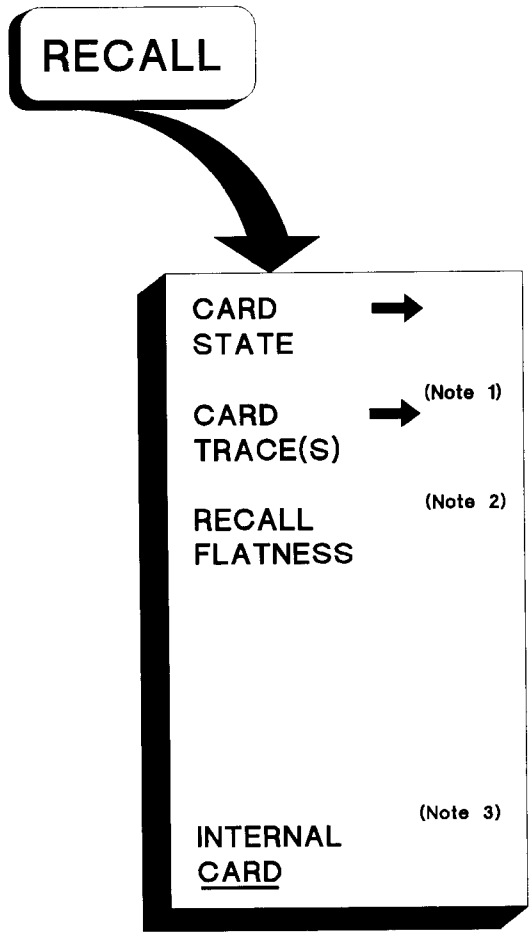
Note

1. (MODE) is used in the same way as the spectrum analyzer mode. Refer to the *HP 859xE Series Spectrum Analyzer User's Guide* for more details.

(NOTE 1)

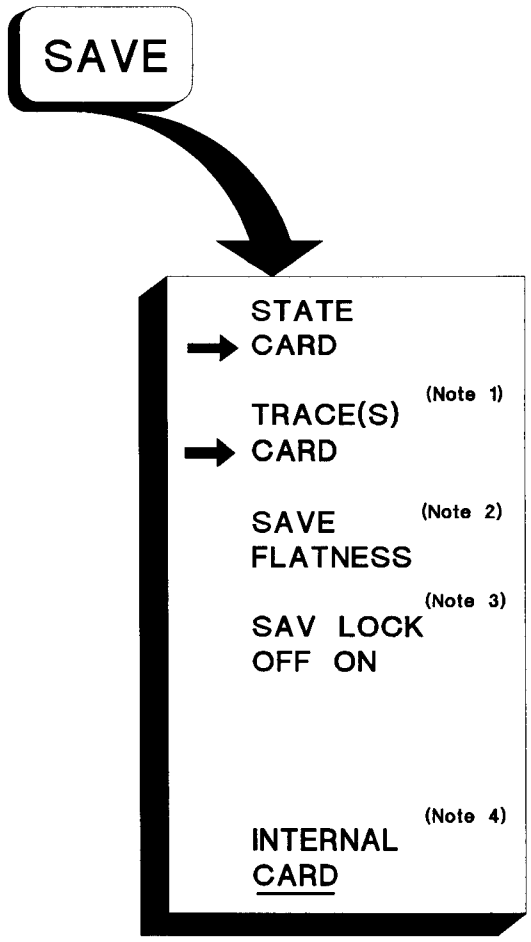
Note

1. (PRESET) is used in the same way as the spectrum analyzer mode. Refer to the *HP 859xE Series Spectrum Analyzer User's Guide* for more details.



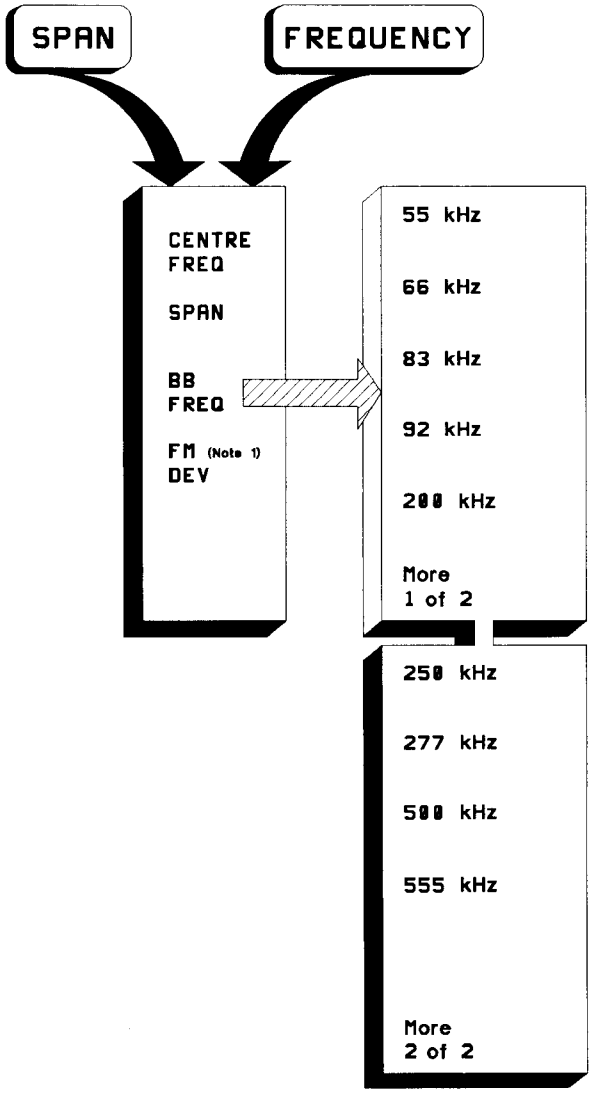
Note

1. In the Link Transmitter mode, `CARD → TRACE(S)` will be blanked out.
2. In the Link Transmitter mode, `RECALL FLATNESS` is blanked out.
3. In the Link Receiver and Link Loopback modes, if `INTERNAL CARD` has `CARD` underlined, the softkeys will appear as shown. If `INTERNAL` is underlined, `CARD → STATE` and `CARD → TRACE(S)` become `INTRNL → STATE` and `INTRNL → TRACE(S)`, respectively.



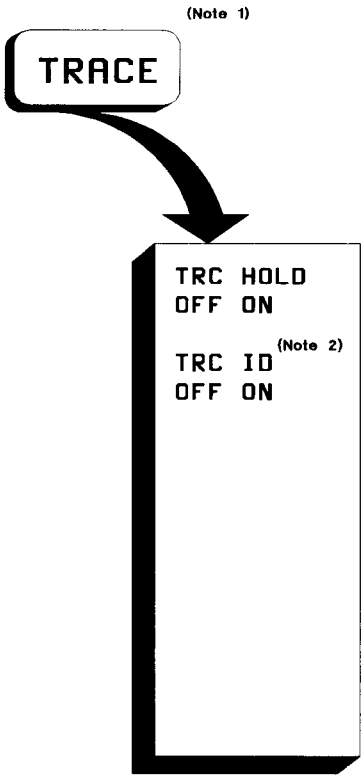
Note

1. In the Link Transmitter mode, `TRACE(S) → CARD` will be blanked out.
2. In the Link Transmitter mode, `SAVE FLATNESS` will be blanked out.
3. When `SAV LOCK OFF ON` (ON) and `INTERNAL` are selected the top two softkeys will change to `MEM LOCKED`
4. In the Link Receiver and Link Loopback modes, if `INTERNAL CARD` (CARD) the softkeys will appear as shown. If `INTERNAL` is underlined, `STATE → CARD` and `TRACE(S) → CARD` become `STATE → INTRNL` and `TRACE(S) → INTRNL`, respectively.



Note

1. In the Link Receiver mode, FM DEV is blanked out.



Note

1. TRACE is not active in the Link Transmitter mode.
2. If you are using an HP 859XA spectrum analyzer, the `TRC ID OFF ON` becomes `TRC ID`, and an additional key `TRC ID CLEAR` is used.

Note

1. TRIG is only active in the Link Receiver mode, and does not have a softkey menu associated with it. The key is used to toggle in and out of the `Receiver Unlocked` state. Refer to "Changing to the Receiver Unlocked State (Link Receiver Mode Only" in the "Making Measurements" section of Chapter 3.

Problem Solving

This section describes some problems that you may encounter while using the HP 11770A Link Measurement Personality, and suggests possible solutions to the problems.

Annotation has Disappeared

If you are using the Link Receiver or Link Loopback modes and the screen annotation has disappeared, most likely the **ANNOTATN ON OFF** key has been set to **OFF**. To turn the annotation on again, press (DISPLAY) then **ANNOTATN ON OFF** until **ON** is underlined.

If you are using the Link Transmitter mode and the TX Setup Window disappears, or is in some way disturbed, the display can be refreshed by pressing (DISPLAY).

Display Is Unstable

If the display appears to be unstable, with either a trace that is jittery or simply noisy, it is likely that the link analyzer has not locked on to the received signal. The following instructions describe the steps you should take to lock up the signal.

1. If you are running the Link Receiver mode, ensure the center frequency, frequency span and baseband frequency are set to the same values as the transmitter (unless there is a frequency translation in the system). Refer to "Changing the Carrier Frequency Range" in the "Making Measurements" section of Chapter 3 for more details.
2. If you are running the Link Transmitter or Link Loopback mode, press (AUX CTRL). Make sure **SRC PWR OFF ON** has **ON** underlined. If it does not, press **SRC PWR OFF ON** until it does, then enter the required power level. For more details, refer to "Changing the Output Power" in the "Making Measurements" section of Chapter 2 (for Link Transmitter) or Chapter 3 (for Link Loopback).
3. If you are running the Link Receiver mode, you should make sure the receiver is not in the "Receiver Unlocked" state. If it is, the message **Receiver Unlocked** will be displayed on the screen. Press (TRIG) so that the message disappears. Press (AMPLITUDE) then **AUTO SCALE** to set up the traces on the screen.

"Flatness Uncal" Message is Displayed

The Link Receiver and Link Loopback modes have a self-calibration routine that measures the group delay and amplitude flatness characteristics of the link analyzer and any other test equipment used when making measurements (for example, cables). The data obtained from the calibration can then be subtracted from the characteristics obtained when a device is tested, to leave the group delay and amplitude flatness responses of the DUT only.

The **Flatness Uncal** message appears when there is no calibration data available for the frequency span set, or that the data available is not being used to "correct" the measurement.

If you want to use the calibration data to correct the measurement, press (CAL) then **CORRECT OFF ON** until **ON** is underlined. If the message **CAL FLATNESS FIRST** appears, there is no data available and you should run the self-calibration routine. For details, refer to "Calibrating the Flatness" in the "Calibrating the Link Analyzer" section of Chapter 3.

Frequency Range is Not What You Entered

It is possible to enter values of center frequency and frequency span that are not accepted by the link analyzer. This happens when the combination of center frequency and frequency span takes either the start or stop frequencies beyond the maximum frequency range of the analyzer. The maximum range is 300 kHz to 2.9 GHz in loopback mode, and the full input frequency. If the combination exceeds either of these limits, the analyzer will automatically adjust the parameters to bring the range within the limits.

For example, if the center frequency is at 2.2 GHz, and the frequency span is changed to 2 GHz, the stop frequency would be 3.2 GHz which is outside the allowed limit. In this case the center frequency would automatically change to 1.9 GHz to bring the stop frequency down to 2.9 GHz.

Similarly, if the center frequency was then changed to 3.5 GHz, the analyzer would set the frequency span to it's minimum value of 0.5 MHz and the center frequency to 2.9 GHz.

For more details on changing the center frequency and frequency span, refer to "Changing the Carrier Frequency Range", in the "Making Measurements" section of Chapter 2 (for the Link Transmitter mode) or Chapter 3 (for the Link Receiver and Link Loopback modes).

Group Delay Trace is Inverted

If you are making group delay measurements without having without having used the CENTER DISPLAY function, it is possible that the group delay trace may appear on the screen inverted.

To display the trace correctly, press (AMPLITUDE) then CENTER DISPLAY.

Link Analyzer is Faulty

If you suspect the Link Analyzer may be faulty, you should:

1. Refer to Chapter 5 for details on how to verify the performance of the link analyzer
2. Take a note of any error messages. If the Group Delay Verification mode detected an error, take a note of the test number that failed.
3. Refer to Chapter 8 of the *HP 859xE Spectrum Analyzer User's Guide* for details on how to have the analyzer repaired.

One or Both of the Traces are Missing

Having set up all the frequency parameters of the sweep, you may find that one or both of the traces do not appear on the screen. The following steps outline the most likely causes of the problem.

1. If you want both traces on the screen, but only one is displayed, press (DISPLAY). The softkey DISPLAY A G A+G should have A+G underlined. If it does not, press DISPLAY A G A+G until it does.

2. If you are running the Link Receiver mode, ensure the center frequency, frequency span and baseband frequency are set to the same values as the transmitter (unless there is a frequency translation in the system). Refer to "Changing the Carrier Frequency Range" in the "Making Measurements" section of Chapter 3.

3. If you are running the Link Transmitter or Link Loopback mode, press (AUX CTRL). Make sure SRC PWR OFF ON has ON underlined. If it does not, press SRC PWR OFF ON until it does, then enter the required power level. For more details, refer to "Changing the Output Power" in the "Making Measurements" section of Chapter 2 (for Link Transmitter) or Chapter 3 (for Link Loopback).

4. Press (AMPLITUDE) then AUTO SCALE (Link Loopback and Link Receiver modes only). This will set the input attenuation of the analyzer and the scale and offset of the traces. Both traces should appear on the screen. Refer to "Changing the Scale and Offset Automatically" in the "Making Measurements" section of Chapter 3 for more details.

Softkey Menu is Not as Expected

Some of the softkeys used with the link analyzer modes do not appear in the menus all the time. When certain conditions apply, the key may be blanked out, or the function may change slightly.

For example, the softkeys MEAS CBL LENGTH and MEAS LIN PARBL GD are only used when DADE measurements are being made. When DADE OFF ON is set to OFF, the keys are blanked out.

Another example is the (MKR) key. When the DADE function is off, pressing (MKR) gives you access to a whole menu of softkeys relating to using the markers. When the DADE function is turned on, the entire menu is disabled and the key is simply used to toggle the markers on and off.

For details about a particular softkey, or softkey menu, refer to the "Key Descriptions" and "Menu Maps" sections in this chapter.

6

Performance Verification

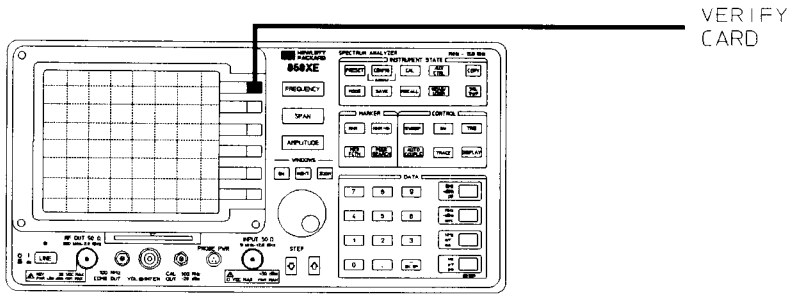
This chapter describes how you can check that your link analyzer is functioning correctly.

Verifying the Performance of the Link Analyzer

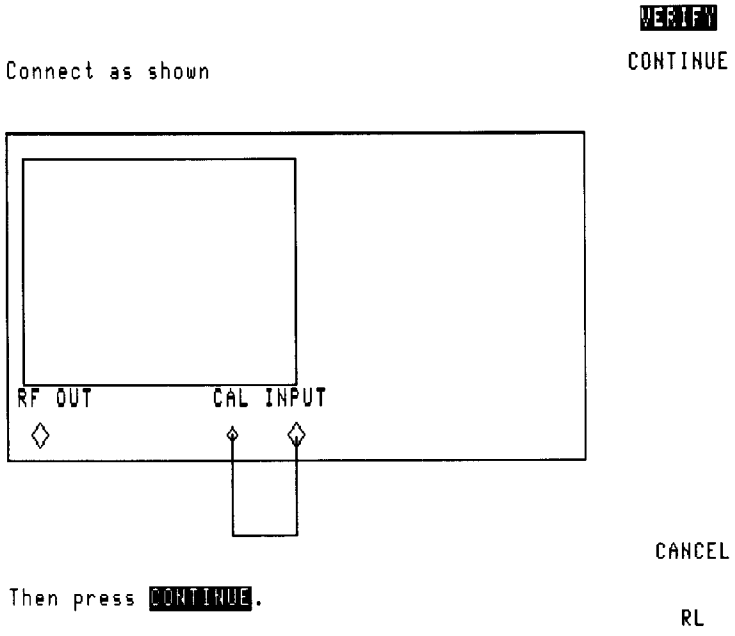
The performance of the link analyzer can be checked using the Group Delay Verification mode. This mode is stored along with Link Transmitter, Link Receiver and Link Loopback modes on the HP 11770A Link Measurement Personality ROM Card.

The Group Delay Verification mode enables you to quickly test the link analyzer for correct functionality.

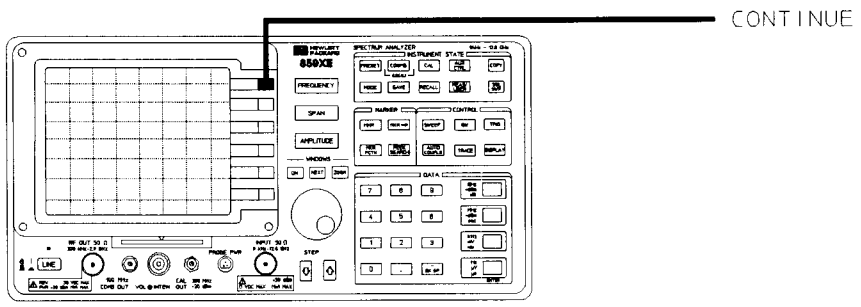
Using the Group Delay Verification Mode

1 Ensure that the HP 859xE Spectrum Analyzer is calibrated and is functioning correctly. Refer to Chapter 8 of the *HP 859xE Series Spectrum Analyzer User's Guide* for details on how to calibrate the spectrum analyzer, and check for basic problems.
2 Load the Group Delay Verification mode. For details, refer to the "Selecting a Mode" section in Chapter 1.
3 When the Group Delay Verification mode is running, the mode annotation at the top right of the screen will change to **VERIFY**
4 Press **VERIFY CARD**.


5 A drawing of the analyzer will appear on the screen, prompting you to connect CAL OUT to INPUT.



6 Make the connections shown and press **CONTINUE**. This will start the first set of tests.

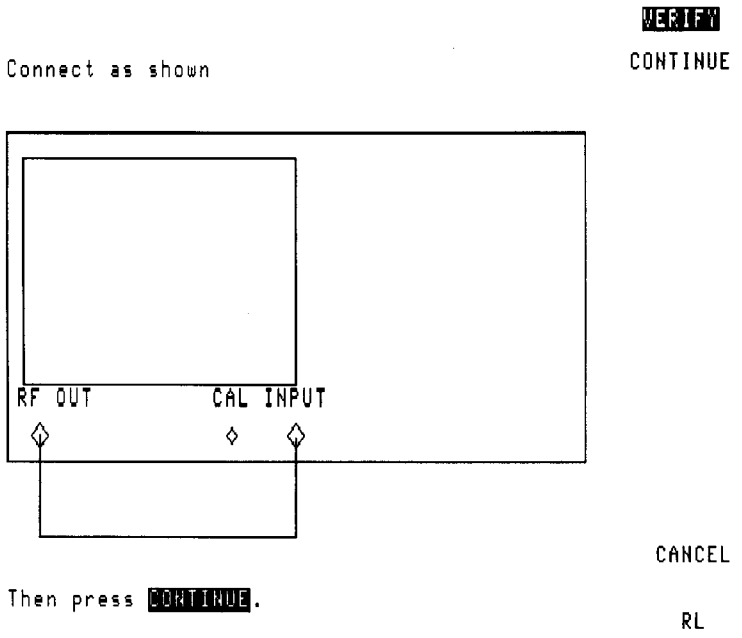


7 If an error is detected, the tests will stop and the message, **FAILED CONFIDENCE TEST NO.** followed by a test number, will appear on the screen. Take a note of the test number that failed, and refer to the "If an Error is Detected" procedure in this section.

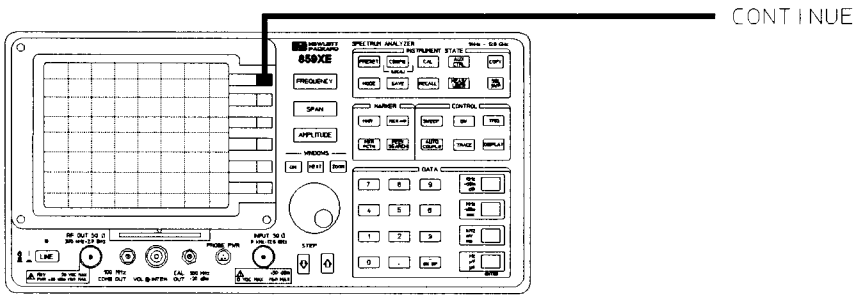
Note

If the spectrum analyzer is option K94 then there will be no tracking generator, so the following steps 8 & 9 must be omitted by pressing **CANCEL**

8 If no error is found, these tests will last approximately 30 seconds. You will then be prompted to connect RF OUT to INPUT.

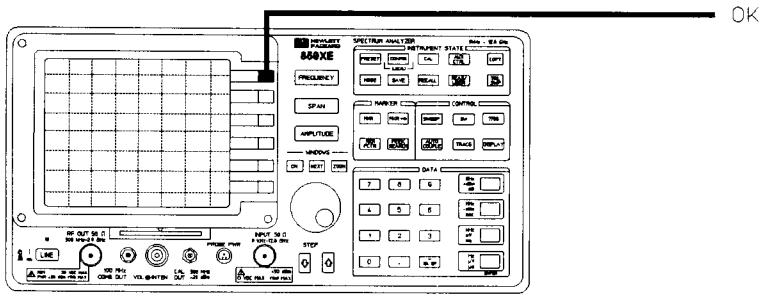


9 Make the connections shown and press **CONTINUE**. This will start the second set of tests.

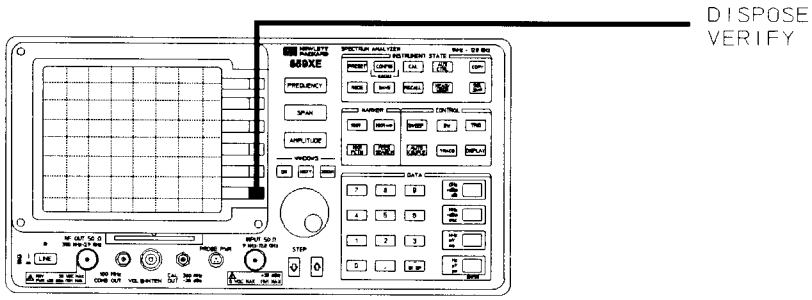


10 If an error is detected, the tests will stop and the message, **FAILED CONFIDENCE TEST NO.** followed by a test number, will appear on the screen. Take a note of the test number that failed, and refer to the "If an Error is Detected" procedure in this section.

11 If no error is found, the message **NO ERROR FOUND** will appear on the screen. Press **OK**. This will return you to the Group Delay Verification mode main menu.



12 To exit the Group Delay Verification mode, press **DISPOSE VERIFY** twice.



Note

Pressing **CANCEL** will return you to the Group Delay Verification mode main menu. This key appears in the same menu as **CONTINUE**.

If an Error is Detected

If you have followed the instructions in this section and suspect that the analyzer may be faulty:

1. Take a note of any error messages. If the Group Delay Verification mode detected an error, take a note of the test number that failed.
2. Refer to Chapter 8 of the *HP 859xE Spectrum Analyzer User's Guide* for details on how to have the analyzer repaired.

A

Accessories

HP 11766A DADE Switch

Using the DADE Switch

The HP 11766A DADE Switch can be used when running the Link Receiver or Link Loopback modes. The "Using the HP 11766A DADE Switch" section in Chapter 3 describes how to use the switch.

HP 11766A Technical Specifications

Frequency Range	25 MHz to 190 MHz
Differential Delay	± 0.1 ns
Power Rating	+ 15 dBm
Input Connectors	75 Ω Type BNC (f) (> 26 dB Return Loss)
Output Connector	50 Ω Type N (m)

HP 11767A Tracking Generator Amplifier

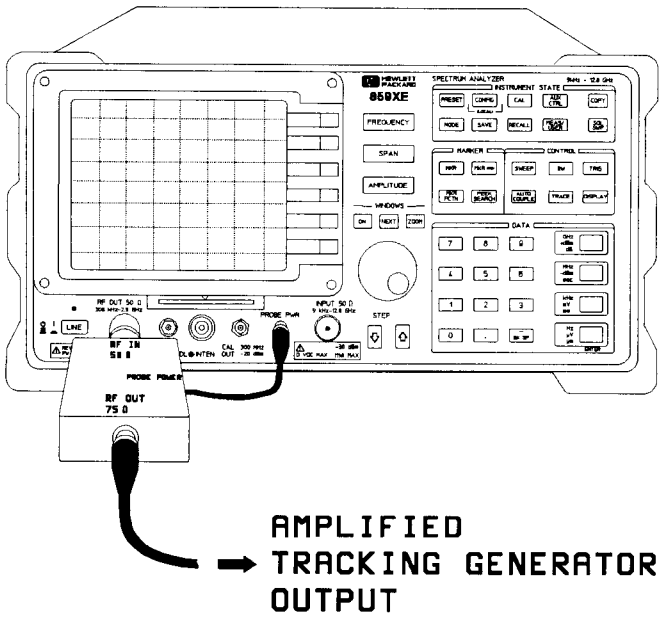
This product can be used to increase the tracking generator output power by approximately 8.2 dB.

Using the HP 11767A Tracking Generator Amplifier

1 Connect the HP 11767A input (RF IN 50 Ω) to the analyzer's tracking generator output (RF OUT).

2 Connect the Probe Power lead to the analyzer's PROBE PWR output. The Probe Power female connector is required if more than one accessory is being used at once, for example if the amplifier is used with the HP 11766A DADE Switch.

3 The amplified tracking generator signal is taken from the HP 11767A output (RF OUT 75 Ω) as shown below.



HP 11767A Technical Specifications

Frequency Range	45 MHz to 190 MHz
Gain	8.2 dB Typical
Flatness	± 0.1 ns ± 0.1 dB
1 dB Compression Point	10 dBm Output typical
Input Connector	50 Ω Type N (m)
Output Connector	75 Ω Type BNC (f) (> 26 dB Return Loss)

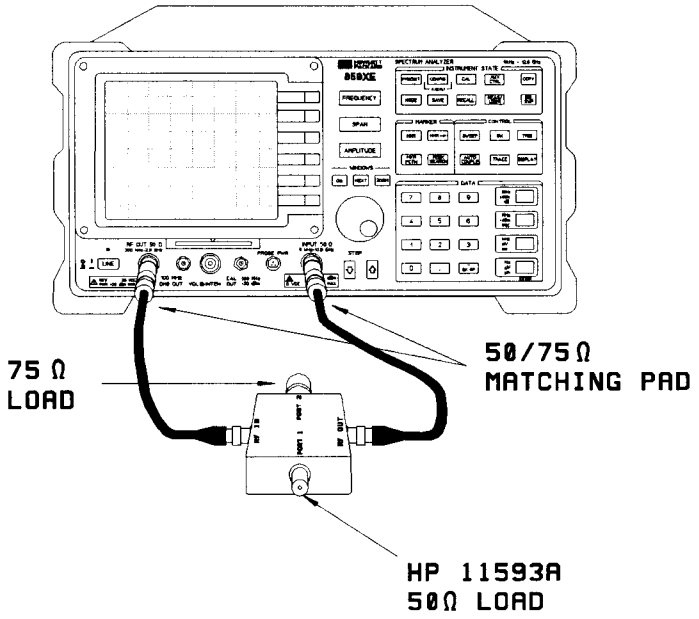
HP 11769A Return Loss Bridge

This product can be used with an HP 859xE Series Spectrum Analyzer to measure the return loss of a DUT (such as the IF input to a radio transmitter).

Making Return Loss Measurements

1 Connect the HP 11769A Return Loss Bridge as shown below. If your analyzer's RF OUT terminal and INPUT terminal have working impedances of 50 Ω, use 50-75 Ω Matching Pads (HP Part No. 08590-60090) as shown below. Ensure that the cables you use are also of the correct impedance.

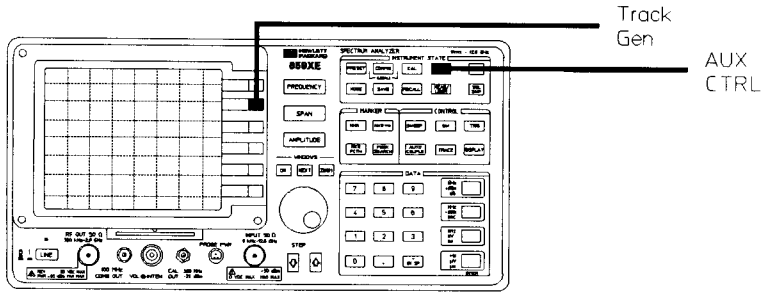
A 75 Ω load should be used to terminate PORT 2 on the device. The HP 11593A 50 Ω Load is connected to PORT 1. It is used to calibrate the return loss bridge because it has a known return loss (approximately 14 dB).



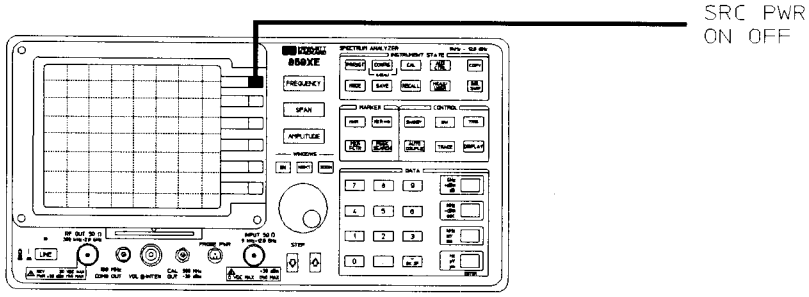
2 Press (PRESET). This will ensure the analyzer is in Spectrum Analyzer mode, and has returned to its default settings.

3 Press (FREQUENCY), then enter the required center frequency. Press (SPAN) to enter the required frequency span.

4 Press (AUX CTRL) then **Track Gen**.

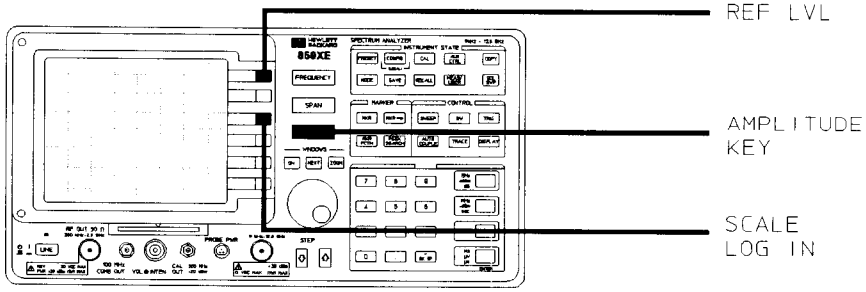


5 Press **SRC PWR OFF ON** until **ON** is underlined, and enter the required power level.



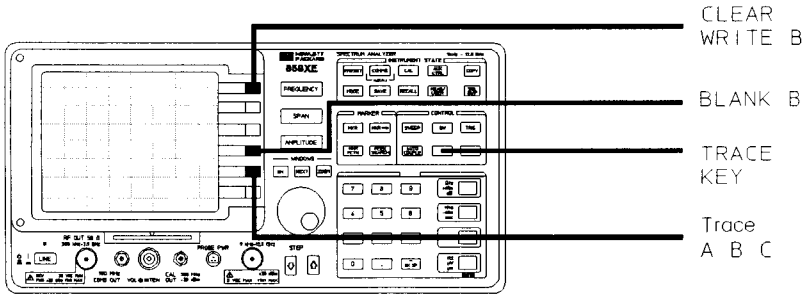
6 Press (AMPLITUDE), **REF LEVEL**, and set the reference level to approximately 20 dB above the displayed trace. For example, if the trace is at −30 dBm, set the reference level to −10 dBm.

7 Press **SCALE LOG LIN** and set the scale to 5dB/div (typically).



8 Press (TRACE), **Trace A B C** until **B** is underlined. Press **CLEAR WRITE B**, then **BLANK B**.

9 Press **MORE 1 of 3** and **NORMLIZE ON OFF** until **ON** is underlined.

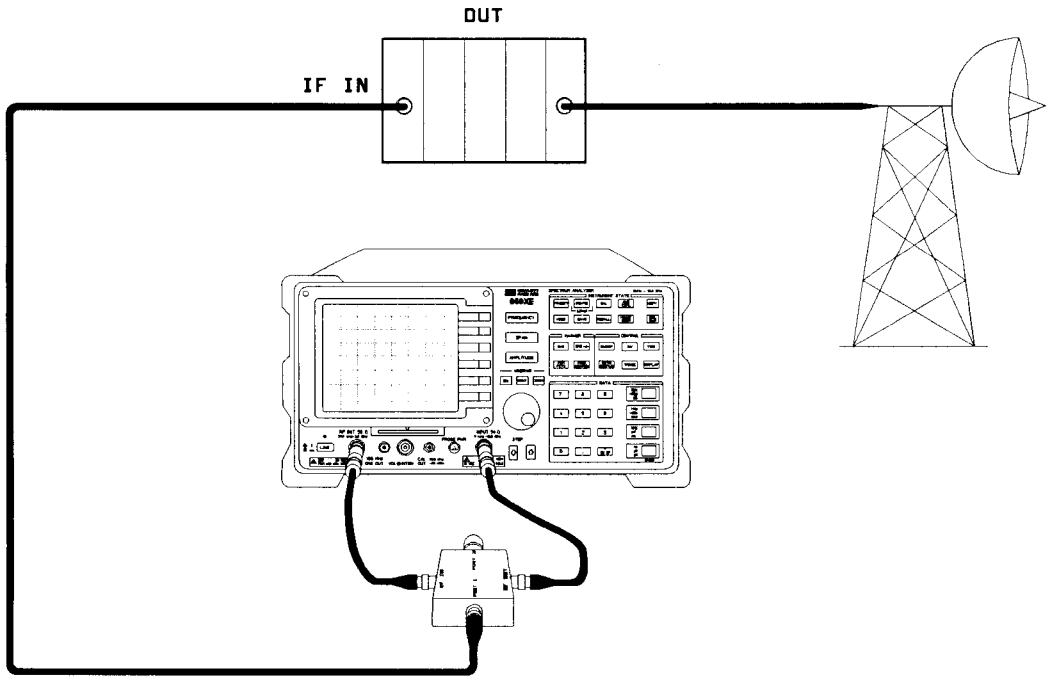


10 Press (MKR) to set a marker on the trace. The annotation at the top of the screen should display the markers level as approximately 0 dBm.

11 Press (TRACE), **More 1 of 3**, **NORMLIZE POSITION**, and use the knob to move the trace to the top of the screen. The trace will not go above the top of the graticule.

12 Press (AMPLITUDE), **REF LEVEL**. Using the knob, adjust the reference level until the marker level reads −14 dBm. This is the return loss of the HP 11593A 50 Ω Load.

13 Remove the HP 11593A 50 Ω Load from PORT 1 on the bridge, and connect PORT 1 to the input of the DUT. The return loss of the DUT will now be displayed. In the example below, the DUT is a radio transmitter.



Notes

1. When calculating the output power required for the measurement, remember to take into account any system losses, such as through the 50-75 Ω Matching Pads (HP Part No. 08590-60090) or the HP 11769A Return Loss Bridge. These losses are:

Matching Pad (08590-60090)	−5.7 dB
HP 11769A Return Loss Bridge	−6 dB
HP 11767A TG Amplifier	+8.2 dB (gain)

2. `SRC PWR OFFSET` can be used to offset the tracking generator output power displayed on the screen. Similarly, `REF LVL OFFSET` can be used to offset the displayed input power level. Refer to the *HP 8590 Series Spectrum Analyzer User's Guide* for a description of `SRC PWR OFFSET` and `REF LVL OFFSET`.

HP 11769A Technical Specifications

Frequency Range	25 MHz to 190 MHz
Directivity	> 40 dB
Coupling	6 dB

B

Technical Specifications

All specifications apply after 2 hours storage at a constant temperature between 0°C and 50°C, 30 minutes after turn on, after the spectrum analyzer's CAL FREQ, CAL AMPLTD and CAL YTF have been run and after the Link Measurement Personality's CAL GRP DLY and CAL FLATNESS have been run.

These specifications apply when the transmitter is the tracking generator of an HP 859xE Series Spectrum Analyzer, and the receiver is an HP 859xE Series Spectrum Analyzer input.

In addition to guaranteed specifications, supplemental, or typical characteristics are shown. Typical characteristics provide useful, but nonwarranted information about the instrument's performance.

Amplitude Flatness Measurement Characteristics

The following data applies to amplitude flatness measurements made using an end-to-end or loopback set-up.

End-to-End Measurements

Maximum Range	16 dB
Maximum Sensitivity	0.1 dB/div
Residual Flatness	± 0.15 dB (typical) (Carrier Frequency = 70/140 MHz ± 20 MHz)

Loopback Measurements

Maximum Range	16 dB
Maximum Sensitivity	0.1 dB/div
Residual Flatness	± 0.1 dB (Carrier Frequency = 70/140 MHz ± 20 MHz)

Group Delay Measurement Characteristics

The following data applies to group delay measurements made using an end-to-end or loopback set-up.

End-to-End Measurements

Maximum Range	± 2000 ns (BB Frequency = 55 kHz) ± 200 ns (BB Frequency = 555 kHz)
Maximum Sensitivity	0.1 ns/div
Residual Flatness	± 0.15 ns (typical) (Carrier Frequency = 70/140 MHz ± 20 MHz)
Noise	< 0.1 ns rms (typical) (BB Frequency = 250 kHz, FM Dev = 200 kHz, Video Bandwidth = 1 kHz)

Loopback Measurements

Maximum Range	± 2000 ns (BB Frequency = 55 kHz) ± 200 ns (BB Frequency = 555 kHz)
Maximum Sensitivity	0.1 ns/div
Residual Flatness	± 0.1 ns (Carrier Frequency = 70/140 MHz ± 20 MHz)
Noise (HP 859XE Only)	< 0.1 ns rms (BB Frequency = 250 kHz, FM Dev = 200 kHz, Video Bandwidth = 1 kHz)

Link Analyzer Characteristics

The following data describes the characteristics of the link analyzer, when running the Link Measurement Personality's modes. The data applies to all 3 modes (Link Transmitter, Link Receiver and Link Loopback), unless otherwise stated.

Frequency Range	300 kHz to 2.9 GHz (loopback mode) 300 kHz to input frequency of the spectrum analyzer (receiver mode)
Frequency Span Range	500 kHz to 100 MHz
Input Level Range (Receiver and Loopback Only)	−50 dBm to +30 dBm
Output Level Range (Transmitter and Loopback Only)	−1 dBm to −66 dBm (HP 859xE Series Spectrum Analyzer) +2 dBm to −66 dBm typical (< 200 MHz) +1 dBm to −10 dBm (HP 859xA Series Spectrum Analyzer) +2 dBm to −10 dBm typical (< 200 MHz)
Baseband Frequencies	55.60 kHz, 66.70 kHz, 83.33 kHz, 92.59 kHz, 200.00 kHz, 250.00 kHz, 277.78 kHz, 500.00 kHz and 555.56 kHz.
FM Deviation Range (Transmitter and Loopback Only)	< 2.1 × BB Frequency (kHz rms)
Amplitude Flatness Scale (Receiver and Loopback Only)	0.1 ns/div to 50 ns/div (BB Freq = 555 kHz) 0.1 ns/div to 500 ns/div (BB Freq = 55 kHz)
Group Delay Scale (Receiver and Loopback Only)	0.1 dB/div to 2 dB/div
Spurious (Harmonic and non-harmonic)	< −25 dBc (< 400 MHz) < −15 dBc (≥ 400 MHz)
Sweep Time	20 ms (fixed)
Sweep Shape	Sawtooth
Video Averaging Samples	1-100

C

Theory

Link Analyzer Calculations

This section describes how the Link Measurement Personality makes the following calculations:

- DADE Cable Length
- Linear Delay Distortion
- Parabolic Delay Distortion

The "Linear Delay Distortion Calculation" and "Parabolic Delay Distortion Calculation" procedures in this section were produced using information obtained from the *Intelsat SSOG 308 QPSK/FDMA: IDR Data Sheet.*

DADE Cable Length Calculation

To minimize the delay differences between the diversity antenna's paths, the delay of the shortest path can be increased by adding a length of cable.

The time delay of a length of cable is given by the following equation:

$$\tau = \frac{l}{vc}$$

Where,

τ = Time Delay (s)
l = Cable Length (m)
v = Velocity Factor
c = Speed of Light in a Vacuum

This equation is used by the Link Measurement Personality, to calculate the necessary length of cable. The velocity factor value defaults to 0.659, however this parameter is dependent on the type of cable used and can be changed.

Refer to the "Using the HP 11766A DADE Switch" section in Chapter 3 for details on how to make this calculation.

Linear Delay Distortion Calculation

The linear delay distortion between two points on a group delay trace, is defined as the group delay difference between the 2 points, divided by the occupied bandwidth, as the following equation shows:

$$LDD = \frac{\tau_{gb} - \tau_{ga}}{f_b - f_a}$$

Where A and B are two points on the group delay trace and,

LDD = Linear Delay Distortion (ns/MHz) between points A and B.
$\tau_{gb} - \tau_{ga}$ = group delay difference between points A and B.
f_a = frequency at point A
f_b = frequency at point B

In Figure C-1, the Linear Delay Distortion is represented by the gradient of the straight line AB.

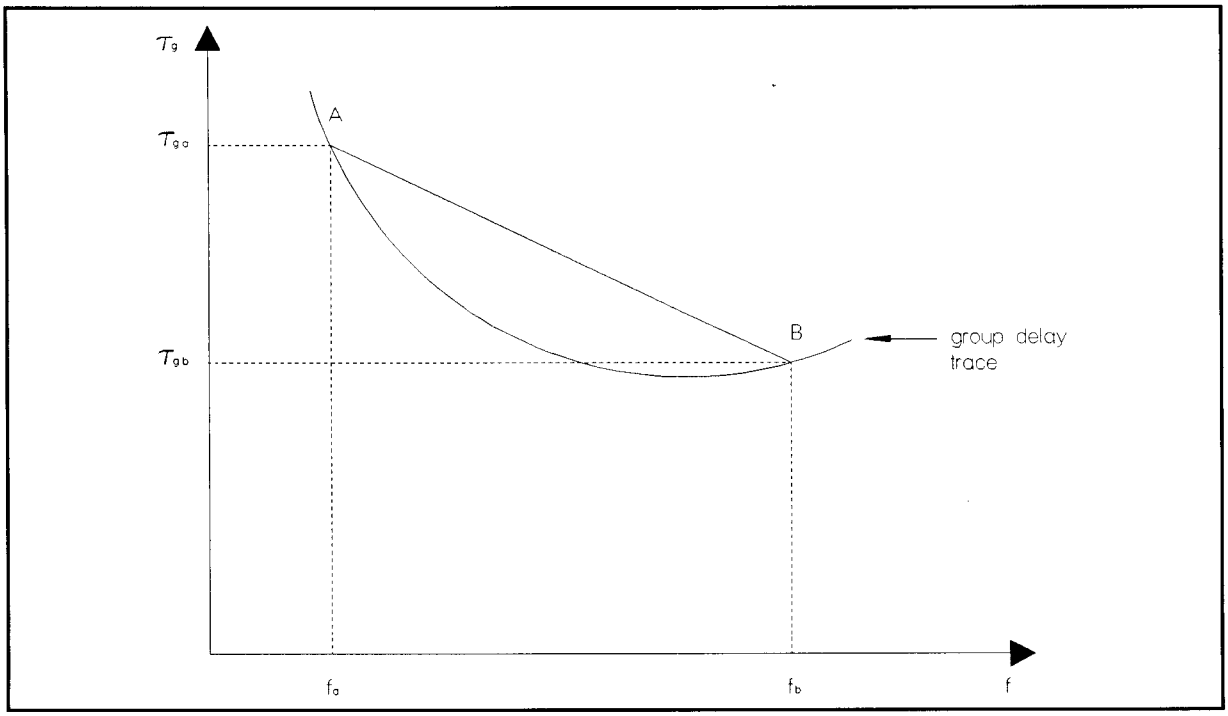


Figure C-1. Linear Delay Distortion Graph

Refer to the "Making Measurements" section in Chapter 3 for details on how to make this measurement.

Parabolic Delay Distortion Calculation

Figure C-2 is used to describe how the parabolic delay distortion between two points on a group delay trace is calculated.

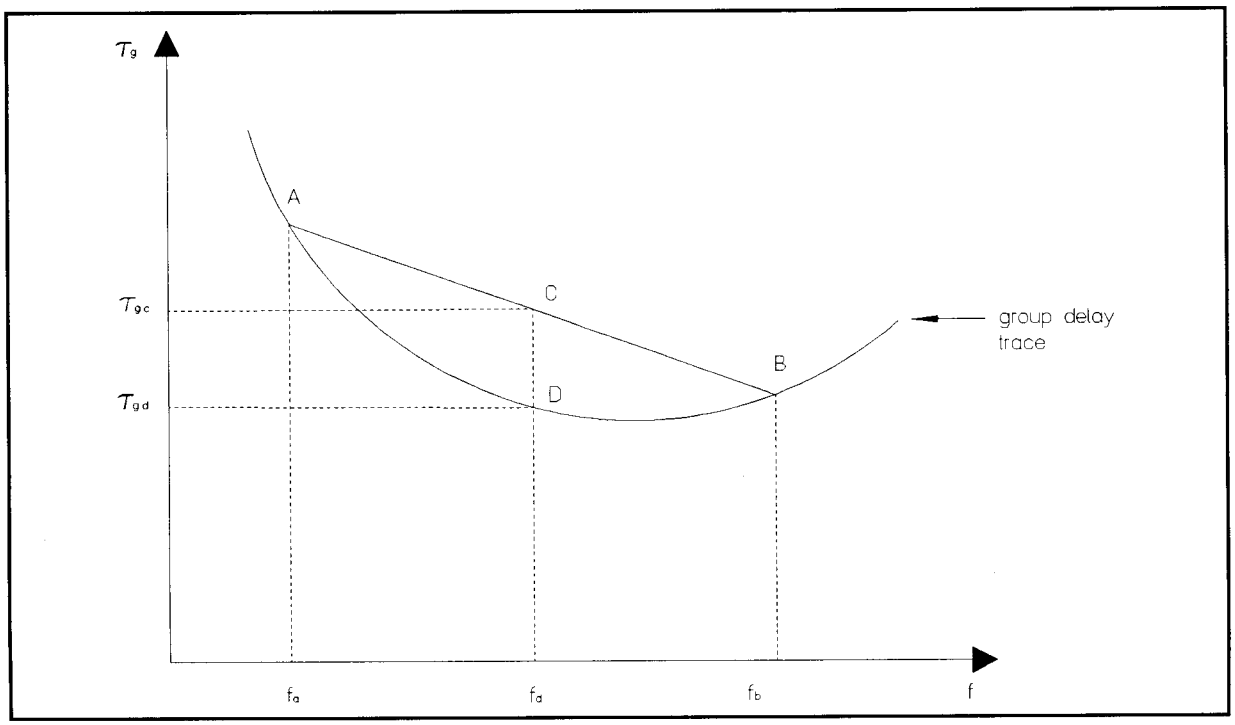


Figure C-2.

1. A straight line is drawn between the two points A and B on the group delay trace.
2. Point C is the point on the line mid-way between points A and B. Point D is the point on the group delay trace at the same frequency as point C.
3. The parabolic delay distortion is defined as the group delay difference between points C and D, divided by the square of one half of the bandwidth between points A and B.

This is shown by the equation below,

$$PDD = \frac{\tau_{gc} - \tau_{gd}}{\left(\frac{f_b - f_a}{2}\right)^2}$$

Where,

PDD = Parabolic Delay Distortion (ns/MHz^2) between points A and B.
$\tau_{gc} - \tau_{gd}$ = group delay difference between points c and d.
f_a = frequency at point A
f_b = frequency at point B

Refer to the "Making Measurements" section in Chapter 3 for details on how to make this measurement.

Index

S

T