Agilent Technologies 8594Q
Option 190 DVB-C QAM Analyzer
(Includes Option 195 Data Measurements)

Getting Started
and
Quick Reference Guide

Agilent Technologies

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Notice

Regulatory Information

The regulatory information is in the calibration guide for your analyzer.

Warranty

This Agilent Technologies instrument product is warranted against defects in material and workmanship for a period of one year from date of shipment. During the warranty period, Agilent Technologies will, at its option, either repair or replace products which prove to be defective.

For warranty service or repair, this product must be returned to a service facility designated by Agilent Technologies. Buyer shall prepay shipping charges to Agilent Technologies and Agilent Technologies shall pay shipping charges to return the product to Buyer. However, Buyer shall pay all shipping charges, duties, and taxes for products returned to Agilent Technologies from another country.

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Assistance

Product maintenance agreements and other customer assistance agreements are available for Agilent Technologies products.

For any assistance, contact your nearest Agilent Technologies Sales and Service Office.

Contents

1 About this Guide

Welcome to the *Agilent 8594Q Option 190 DVB-C QAM Analyzer Getting Started and Quick Reference Guide*. This guide includes Option 195 Data Measurements and is divided into two basic sections:

Getting Started	Chapter 1, Chapter 2, and Chapter 3 instruct you how to prepare the QAM analyzer for use, and introduce you to the QAM analyzer and its features.
Quick Reference	Chapter 4 and Chapter 5 provide you with a quick reference for commonly used functions of the *Agilent Technologies 8594Q Option 190 QAM Analyzer*. Refer to the *Agilent Technologies 8594Q Option 190 DVB-C QAM Analyzer User's Guide and Programming Reference* and *Agilent Technologies 8594Q Option 190 DVB-C QAM Analyzer Spectrum Analyzer Reference User Guide* for more detailed information.

Other 8594Q QAM Analyzer Documentation

In addition to this guide, other printed guides will help you learn about the 8594Q Option 190 DVB-C QAM Analyzer and locate information quickly.

Agilent Technologies 8590 Series Analyzers Calibration Guide

- Tells you how to test your spectrum analyzer to determine if the spectrum analyzer meets its specifications.

Agilent Technologies 8594Q QAM Analyzer User's Guides There are two user's guides included with the QAM analyzer:

Option 190 DVB-C QAM Analyzer

- Tells you how to make DVB-C measurements with your QAM analyzer.
- Describes the DVB-C analyzer mode features.
- Describes the Option 195 data measurement mode features.
- Describes remote command operation.

Spectrum Analyzer Reference

- Tells you how to make measurements using the spectrum analyzer mode.
- Describes the spectrum analyzer mode features.
- Tells you what to do in case of a failure.

Documentation Options

Option 910: Additional User's Documentation

Provides an additional copy of the user's guides, the calibration guide, and the quick reference guide.

Option 915: Assembly-Level and Component-Level Repair Service Guides

Describes troubleshooting and repair of the spectrum analyzer.

Option 915 consists of two manuals:

Agilent Technologies 8590 Series Analyzers Assembly-Level Repair Service Guide

- Describes adjustment and assembly-level repair of the analyzer.

Agilent Technologies 8590 Series Analyzers Component-Level Repair Service Guide

- Provides information for component-level repair of the analyzer.

How to Order Guides

Each of the guides listed above can be ordered individually. To order, contact your local Agilent Technologies Sales and Service Office.

Before You Begin

Become familiar with the conventions and safety information provided in this chapter before you begin using your QAM analyzer.

Conventions

This guide uses the following conventions:

[Front-Panel Key]	A boxed name in this typeface represents a key physically located on the instrument.
Softkey	A word written in this typeface indicates a “softkey,” a key whose label is determined by the instrument's firmware.
Softkey ON OFF (ON)	A word written in this typeface with the words ON and OFF can turn a function on or off. The underlined function is shown parenthetically.
Softkey AUTO MAN (AUTO)	A 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 parenthetically.
Screen Text	Text printed in this typeface indicates text displayed on the analyzer screen.

Safety Notes

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

CAUTION *Caution* denotes a hazard. It calls attention to a procedure that, 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 ***Warning* denotes a hazard. It calls attention to a procedure that, 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.**

General Safety Considerations

WARNING

- ***Before this instrument is switched on*, make sure it has been properly grounded through the protective conductor of the ac power cable to a socket outlet provided with protective earth contact.**

  Any interruption of the protective (grounding) conductor, inside or outside the instrument, or disconnection of the protective earth terminal can result in personal injury.

- **There are many points in the instrument which can, if contacted, cause personal injury. Be extremely careful. Any adjustments or service procedures that require operation of the instrument with protective covers removed should be performed only by trained service personnel.**
- **For continued protection against fire hazard replace line fuse only with same type and rating (F 5A/250V). The use of other fuses or material is prohibited.**
- **No operator serviceable parts inside. Refer servicing to qualified personnel. To prevent electrical shock, do not remove covers.**
- **If this instrument is used in a manner not specified by Agilent Technologies, the protection provided by the instrument may be impaired.**

CAUTION

- *Before this instrument is switched on*, make sure its primary power circuitry has been adapted to the voltage of the ac power source.
- Failure to set the ac power input to the correct voltage could cause damage to the instrument when the ac power cable is plugged in.
- Always use the three-prong ac power cord supplied with this instrument. Failure to ensure adequate earth grounding by not using this cord may cause instrument damage.

Symbols Used on the QAM Analyzer

The instruction documentation symbol. The product is marked with this symbol when it is necessary for the user to refer to the instructions in the documentation.

The CE mark is a registered trademark of the European Community. (If this mark is accompanied by a year, it indicates when the design was proven.)

The C-Tick mark is a registered trademark of the Spectrum Management Agency of Australia. This signifies compliance with the Australian EMC Framework Regulations under the terms of the Rdiocommunicatins Act of 1992.

2 Preparing for Use

What You'll Learn in This Chapter

This chapter describes the process of getting the QAM analyzer ready to use when you have just received it. In this chapter you will:

- Perform an initial inspection
- Set the QAM analyzer for the selected AC power source
- Turn the QAM analyzer on for the first time
- Perform automatic self-calibration routines

Preparing Your QAM Analyzer for Use

Prepare the QAM analyzer for use by performing the following procedure:

1. Perform an initial inspection.
2. Set the line voltage selector switch.
3. Check the fuse.
4. Connect the power cable.
5. Turn on the QAM analyzer for the first time.
6. Perform the frequency and amplitude self-calibration routines.

Detailed information for all of the steps in this process are included in this chapter in the following pages.

REDUCING DAMAGE CAUSED BY ESD

The following suggestions may help reduce ESD damage that occurs during testing and servicing operations:

- Before connecting any coaxial cable to an QAM analyzer connector for the first time each day, momentarily ground the center and outer conductors of the cable.
- Personnel should be grounded with a resistor-isolated wrist strap before touching the center pin of any connector and before removing any assembly from the unit.
- Be sure that all instruments are properly earth-grounded to prevent a buildup of static charge.

Refer to the *Agilent Technologies 8594Q QAM Analyzer Spectrum Analyzer Reference User's Guide* for more information about static-safe accessories that can be obtained from Agilent Technologies.

Step 1. Perform an Initial Inspection

Inspect the shipping container for damage. If the shipping container or cushioning material is damaged, keep it until you have verified that the contents are complete and you have tested the QAM analyzer mechanically and electrically.

Table 2-1 contains the accessories shipped with the QAM analyzer. If the contents are incomplete or if the QAM analyzer does not pass the verification tests in the calibration guide, notify the nearest Agilent Technologies office. If the shipping container is damaged or the cushioning material shows signs of stress, also notify the carrier. Keep the shipping materials for the carrier's inspection. The Agilent Technologies office will arrange for repair or replacement without waiting for a claim settlement.

If the shipping materials are in good condition, retain them for possible future use. You may wish to ship the QAM analyzer to another location or to return it to Agilent Technologies for service. See "Returning the QAM Analyzer for Service" in the *Agilent Technologies 8594Q QAM Analyzer Spectrum Analyzer Reference User's Guide* for more information about shipping materials.

NOTE Complete instructions for installing your QAM analyzer in an equipment rack are provided in a installation note that is included with Options 908 and 909 Rack Mounting Kits.

Table 2-1 Accessories Supplied with the Analyzer

Description	Part Number	Comments
Option 190, DVB-C RF and modulation quality measurements personality	08594-10002	Shipped with analyzer.
Adapter (Type N to BNC)	1250-0780	Shipped with analyzer.
Cable, 50Ω BNC	8120-2682	Shipped with analyzer.
Keyboard overlay	5181-8207	Shipped with analyzer.
Memory card holder	9222-1545	Shipped with analyzer.
Memory card, 128 kilobyte	HP/Agilent 82215A	Shipped with analyzer.
Power cable	See Table 2-3.	Shipped with analyzer.
Reference connector	1250-1499	Shipped connected between the 10 MHz REF OUTPUT and the EXT REF IN on the rear panel of the analyzer.
Documentation:		
• *Agilent Technologies 8594Q QAM Analyzer Spectrum Analyzer Reference User's Guide*	[a]	Shipped with analyzer.
• *Agilent Technologies 8594Q Option 190 DVB-C QAM Analyzer User's Guide*	[a]	Shipped with analyzer.
• *Agilent Technologies 8590 Series Analyzers Calibration Guide*	[a]	Shipped with analyzer.
• *Agilent Technologies 8594Q Option 190 DVB-C QAM Analyzer Getting Started and Quick Reference Guide* (this book)	[a]	Shipped with analyzer
• *Agilent Technologies 8590 Series Analyzers Assembly-Level Repair Service Guide*	[a]	Shipped with analyzer. *(Option 915 only)*
• *Agilent Technologies 8590 Series Analyzers Component Level Repair Service Guide*	[a]	Shipped with analyzer. *(Option 915 only)*

a. Contact your nearest sales and service center for current part number

Step 2. Set the Line Voltage Selector Switch

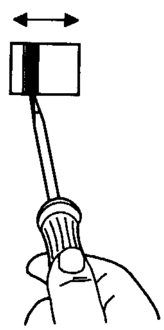
The QAM analyzer is a portable instrument and requires no physical installation other than connection to a power source.

Do not connect AC power until you have verified that the line voltage is correct, the proper fuse is installed, and the line voltage selector switch is properly positioned, as described in the following paragraphs. Damage to the equipment could result.

Table 2-2 Power Requirements

Characteristic	115 V Requirement	230 V Requirement
Input Voltage	90 to 132 V rms	198 to 264 V rms
Frequency	47 to 440 Hz	47 to 66 Hz
Power	<500 VA, < 180 W	<500 VA, < 180 W

Figure 2-1 Setting the Line Voltage Selector Switch

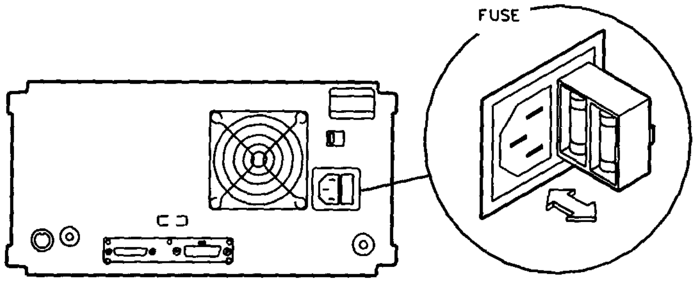


CAUTION Before connecting the QAM analyzer to the power source, you must set the rear-panel voltage selector switch correctly to adapt the QAM analyzer to the power source. An improper selector switch setting can damage the QAM analyzer when it is turned on.

Set the instrument’s rear-panel voltage selector switch to the line voltage range (115 V or 230 V) corresponding to the available AC voltage. See Table 2-1. Insert a small screwdriver or similar tool in the slot and slide the switch up or down so that the proper voltage label is visible.

Step 3. Check the Fuse

Figure 2-2 Checking the Line Fuse



The recommended fuse is size 5 by 20 mm, rated F5A, 250 V (IEC approved). This fuse may be used with input line voltages of 115 V or 230 V, Its part number is 2110-0709.

With an input line voltage of 115 V an alternate fuse can be used. In areas where the recommended fuse is not available, a size 5 by 20 mm, rated fast blow, 5 A, 125 V (UL/CSA approved) fuse may be substituted. Its part number is 2110-0756.

The line fuse is housed in a small container beside the rear-panel power connector. See Figure 2-2. The container provides space for storing a spare fuse, as shown in the figure.

To check the fuse, insert the tip of a screwdriver in the slot at the middle of the container and pry gently to extend the container.

NOTE The fuse container is attached to the line module; it cannot be removed.

The fuse closest to the QAM analyzer is the fuse in use. If the fuse is defective or missing, install a new fuse in the proper position and reinsert the fuse container.

Step 4. Connect the Power Cable

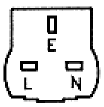
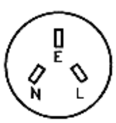
The QAM analyzer is equipped with a three-wire power cable, in accordance with international safety standards. When connected to an appropriate power line outlet, this cable grounds the instrument cabinet.

WARNING **Failure to ground the QAM analyzer properly can result in personal injury. Before turning on the QAM analyzer, you must connect its protective earth terminals to the protective conductor of the main power cable. Insert the main power cable plug only into a socket outlet that has a protective earth contact. DO NOT defeat the earth-grounding protection by using an extension cable, power cable, or autotransformer without a protective ground conductor.**

If you are using an autotransformer, make sure its common terminal is connected to the protective earth contact of the power source outlet socket.

Various power cables are available to connect the QAM analyzer to the types of AC power outlets unique to specific geographic areas. The cable appropriate for the area to which the QAM analyzer is originally shipped is included with the unit. You can order additional AC power cables for use in different areas. Table 2-3 lists the available AC power cables, illustrates the plug configurations, and identifies the geographic area in which each cable is appropriate.

Table 2-3 AC Power Cables Available

Plug Type[a]	Cable Part Number	Plug Description	Cable Length cm (inches)	Cable Color	For Use in Country
250 V 	8120-1351 8120-1703	Straight[b] BS1363A 90°	229 (90) 229 (90)	Mint Gray Mint Gray	Great Britain, Cyprus, Nigeria, Singapore, Zimbabwe
250 V 	8120-1369 8120-0696	Straight[b] NZSS198/ASC112 90°	210 (79) 221 (87)	Gray Gray	Argentina, Australia, New Zealand, Mainland China
250 V 	8120-1689 8120-1692	Straight[b] CEE7-Y11 90°		Mint Gray Mint Gray	East and West Europe, Central African Republic, United Arab Republic (unpolarized in many nations)
125 V 	8120-1348 8120-1538	Straight[b] NEMA5-15P 90°	203 (80) 203 (80)	Black Black	United States, Canada, Japan (100 V or 200 V), Brazil, Colombia, Mexico, Philippines, Saudi Arabia, Taiwan
	8120-1378 8120-4753 8120-1521 8120-4754	Straight[b] NEMA5-15P 90° Straight 90° 90°	203 (80) 230 (90) 203 (80) 230 (90)	Jade Gray Jade Gray Jade Gray Jade Gray	
250 V 	8120-5182 8120-5181	Straight[b] NEMA5-15P 90°	200 (78) 200 (78)	Jade Gray Jade Gray	Israel

a. E= Earth Ground, L= Line, N= Neutral
b. Part number for plug is industry identifier for plug only. Number shown for cable is Part Number for complete cable, including plug.

Step 5. Turn On the QAM Analyzer for the First Time

When you turn the QAM analyzer on for the first time, you should perform frequency and amplitude self-calibration routines to generate correction factors and indicate that the unit is functioning correctly. The QAM analyzer should be allowed to warm up for 30 minutes before performing the self-calibration routines. See the *Agilent Technologies 8594Q QAM Analyzer Spectrum Analyzer Reference User's Guide* for helpful guidelines on how often the self-calibration routines should be performed.

Perform the following steps:

1. Ensure the reference connector is connected between the 10 MHz OUTPUT and EXT REF IN rear-panel connectors.

   If you wish to use an external 10 MHz source as the reference frequency, disconnect the reference connector from the rear panel and connect an external reference source to the EXT REF IN rear-panel connector.

2. Press **[LINE]**.

   After a few seconds, the screen displays the firmware revision date in the YYMMDD format. For example, 930522 indicates May 22, 1993. The interface address (`GPIB ADRS`: XX) is also displayed.

   If your QAM analyzer is equipped with Option 043 (RS-232 interface), the appropriate baud rate (`RS232:` XXXX) in place of the interface address, also appears on the screen.

NOTE Record the firmware date and keep it for reference. If you should ever need to call Agilent Technologies for service or with any questions regarding your QAM analyzer, it will be helpful to have the firmware date readily available.

Step 6. Perform the Frequency and Amplitude Self-Calibration Routines

1. To meet QAM analyzer specifications, allow a 30 minute warm-up before attempting to make any calibrated measurements. Be sure to calibrate the QAM analyzer only *after* the QAM analyzer has met the operating temperature conditions.
2. Connect the 50 Ω coaxial cable between the front-panel CAL OUT and the INPUT 50 Ω connector.

NOTE Remove all connections to the GATE TRIGGER INPUT rear-panel connector before performing the self-calibration routines.

3. Perform the frequency and amplitude self-calibration routine by pressing **[CAL]** and **CAL FREQ & AMPTD**.

   During the frequency routine, `CAL: SWEEP`, `CAL: FREQ`, and `CAL: SPAN` and `CAL: FM GAIN + OFFSET` are displayed as the sequence progresses.

   During the amplitude routine, `CAL; AMPTD`, `CAL: 3 dB BW`, `CAL: ATTEN`, and `CAL: LOGAMP` are displayed as the sequence progresses. `CAL: DONE` appears when the routine is completed. Any failures or discrepancies produce a message on the screen. See Error Messages.
4. When the frequency and amplitude self-calibration routines have been completed successfully, store the correction factors by pressing **CAL STORE.**

The self-calibration routines calibrate the QAM analyzer by generating correction factors. The softkey **CAL STORE** stores the correction factors in the area of QAM analyzer memory that is stored when the QAM analyzer is turned off; the QAM analyzer will automatically apply these factors in future measurements. If **CAL STORE** is not pressed, the correction factors remain in effect until the QAM analyzer is turned off.

3 Quick Tour

What You'll Learn in This Chapter

This chapter introduces the basic functions and features of the Agilent 8594Q Option 190 DVB-C QAM Analyzer. In this chapter, you will:

- Get acquainted with the front-panel and rear-panel features.
- Get acquainted with the menus and softkeys.
- Learn about screen annotation.
- Learn about the Option 190 DVB-C RF and Modulation Quality Measurements personality.
- Learn about the Option 195 Data Measurements personality.
- Make a basic measurement using the calibration signal.
- Learn how to improve measurement accuracy by using self-calibration routines.
- Learn about the memory card.
- Learn about the analyzer battery.

Getting Acquainted with the 8594Q QAM Analyzer

The 8594Q QAM analyzer is a small, lightweight test instrument that covers the 9 kHz to 2.9 GHz frequency range. The 8594Q QAM analyzer is a portable instrument ideal for field use.

The 8594Q QAM analyzer comes equipped with the Option 190 DVB-C RF and Modulation Quality Measurements personality installed. The Option 190 DVB-C RF and Modulation Quality Measurements personality is a downloadable program (DLP) consisting of measurement routines useful for digital transmission measurements.

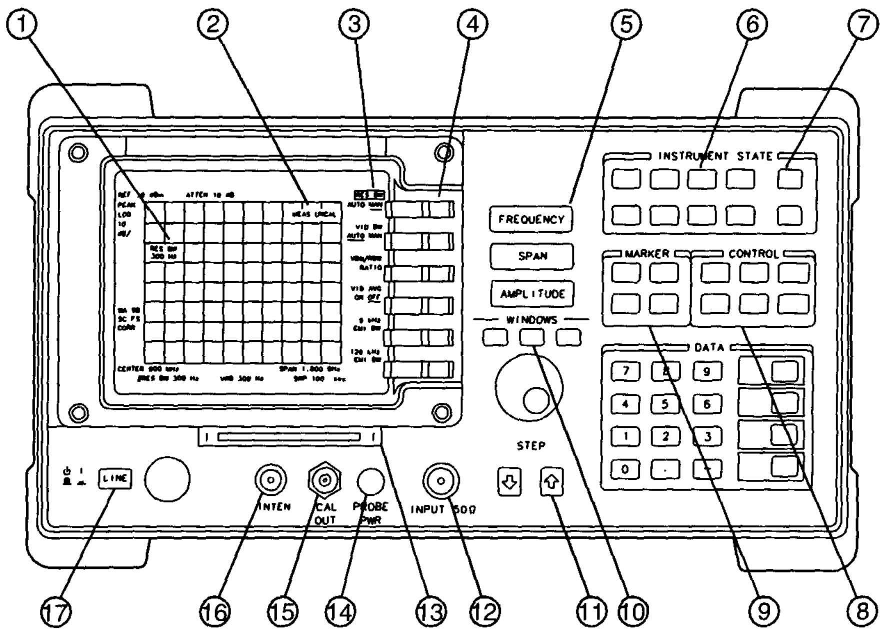
Option 195 Data Measurements, if installed, adds a real time Forward Error Correction (FEC) decoder and additional measurements. This allows recovery of the MPEG-2 transport stream, Bit Error Ratio (BER) measurements and some MPEG-2 header analysis. The MPEG-2 data is also made available from the DVB-ASI (DVB Asynchronous Serial Interface) and DVB-PI (DVB Parallel Interface) connectors on the rear panel, allowing video recovery from the MPEG-2 signal or further protocol analysis.

In addition to these measurements, the analyzer also has some simple one-button setups for conventional analog TV signals. While these do not make any automatic measurements, you can visually check analog TV signals (PAL) on your network.

Front-Panel Features

The following section provides a brief description of front-panel features. Refer to Figure 3-1.

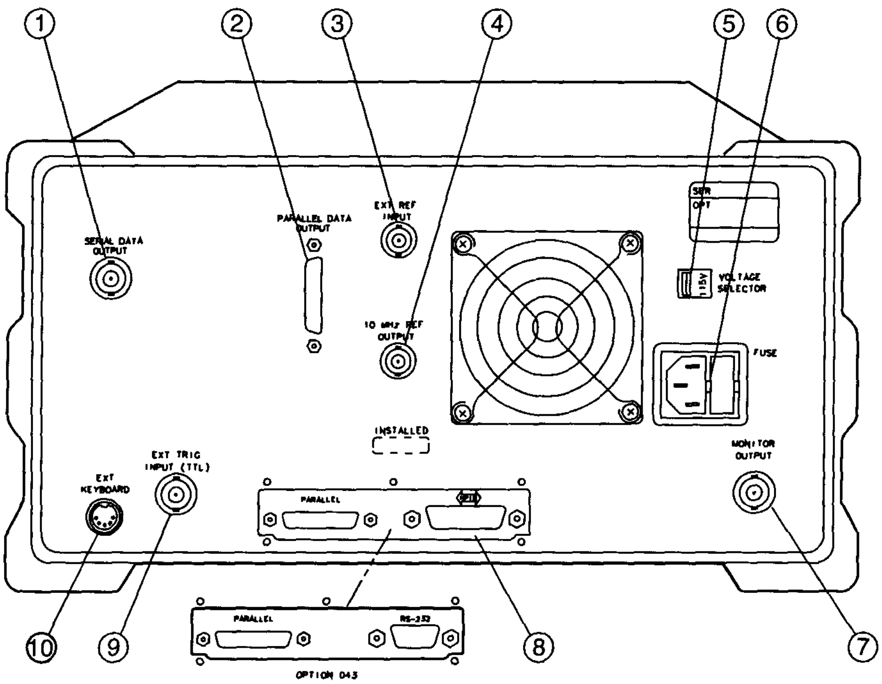
Figure 3-1 Front-Panel Feature Overview



1	**Active function block**	is the space on the screen that indicates the active function.
2	**Message block**	is the space on the screen where MEAS UNCAL and the asterisk appear.
3	**Softkey labels**	are the annotation on the screen next to the unlabeled keys.
4	**Softkeys**	are the unlabeled keys next to the screen.
5	**[FREQUENCY], [SPAN]**, and **[AMPLITUDE]**	are the three large dark-gray keys that activate the and primary analyzer functions and access menus of related functions.
6	**INSTRUMENT STATE**	functions affect the state of the entire analyzer.
7	**[COPY]**	prints screen data.
8	**CONTROL**	functions access menus that allow you to adjust the resolution bandwidth, adjust the sweep time, store and manipulate trace data, and control the instrument display.
9	**MARKER**	functions control the markers, read out frequencies and amplitudes along the analyzer trace, automatically locate the signals of highest amplitude, and keep a signal at the marker position in the center of the screen.
10	**WINDOWS**	keys, turn on the windows display mode.
11	**DATA** keys, **STEP** keys and **knob**	allow you to change the numeric value of an active function.
12	**INPUT 50 Ω**	is the signal input for the analyzer.
13	**Memory card reader**	reads from or writes to a memory card.
14	**PROBE PWR**	provides power for high-impedance ac probes or other accessories.
15	**CAL OUT**	provides a calibration signal of 300 MHz at –20 dBm.
16	**VOL-INTEN**	changes the brightness of the display and the volume of the internal speaker.
17	**[LINE]**	turns the instrument on and off

Rear-Panel Features

Figure 3-2 Rear-Panel Feature Overview



1	**Serial Data Output**	(Option 195 only) provides DVB-ASI (DVB Asynchronous Serial Interface) like output of the decoded MPEG-2 data stream when data measurements are selected.
2	**Parallel Data Output**	(Option 195 only) provides DVB-PI (DVB Parallel Interface) output of the decoded MPEG-2 data stream when data measurements are selected.(LVDS levels.)
3	**EXT REF IN**	accepts an external frequency source to provide the 10 MHz, –2 to +10 dBm frequency reference used by the analyzer.
4	**10 MHz REF OUTPUT**	provides a 10 MHz, 0 dB minimum, time-based reference signal.
5	**VOLTAGE SELECTOR**	adapts the unit to the power source: 115 V or 230 V.
6	**Power input**	is the input for the line power source.Make sure that the line-power source outlet has a protective ground contact.
7	**MONITOR OUTPUT**	drives an external monitor with a signal (spectrum analyzer display) that has a 15.7 kHz horizontal synchronizing rate or, a PAL or NTSC composite monitor (selected by pressing **[CONFIG]**).
8	**Interface connectors**	for GPIB and parallel interface (standard) or RS-232 and parallel interface (Option 043).
9	**EXT TRIG INPUT (TTL)**	accepts the positive edge of an external voltage input that triggers the analyzer internal sweep source.
10	**EXT KEYBOARD**	DIN connection is provided for keyboard operation.

Data Controls

Data controls are used to change values for functions such as center frequency, start frequency, resolution bandwidth, and marker position.

The data controls will change the active function in a manner prescribed by that function. For example, you can change center frequency in fine steps with the knob, in discrete steps with the step keys, or to an exact value with the number/units keypad. For example, resolution bandwidth, which can be set to discrete values only, is changed to predetermined values with any of the data controls.

HoldKey

Deactivate functions with **HOLD** which is found under the **[DISPLAY]** key. The active function readout is blanked, indicating that no entry will be made inadvertently by using the knob, step keys, or keypad. (Pressing a function key re-enables the data controls.)

Knob

The knob allows continuous change of functions such as center frequency, reference level, and marker position. It also changes the values of many functions that change in increments only. Clockwise rotation of the knob increases values. For continuous changes, the extent of alteration is determined by the size of the measurement range; the speed at which the knob is turned does not affect the rate at which the values are changed.

The knob enables you to change the center frequency, start or stop frequency, or reference level in smooth scrolling action. The smooth scrolling feature is designed to move the trace display to the latest function value as the knob is turned. When either center frequency or reference level is adjusted, the signal will shift right or left or up or down with the rotation of the knob before a new sweep is actually taken. An asterisk is placed in the message block (the upper right-hand comer of the analyzer display) to indicate that the data on-screen does not reflect data at the current setting.

NOTE

When using the knob to change frequency or amplitude settings, the trace data is shifted. Therefore, when using **MAX HOLD A**, **MAX HOLD B**, or **MIN HOLD C**, moving the center frequency with the knob will not simulate a drifting signal.

Number/Units Keypad

The number/units keypad allows entry of exact values for many of the analyzer functions. You may include a decimal point in the number portion. If not, the decimal point is placed at the end of the number.

Numeric entries must be terminated with a units key. The units keys change the active function in a manner prescribed by that function. For example, the units keys for frequency span are **[GHz]**, **[MHz]**, **[kHz]** and **[Hz]**, whereas the units for reference level are and **[+dBm]**, **[–dBm]**, **[mV]** and **[uV]**.

NOTE If an entry from the number/units keypad does not coincide with an allowed function value (for example, that of a 12 MHz bandwidth), the analyzer defaults to the nearest allowable value.

Step Keys

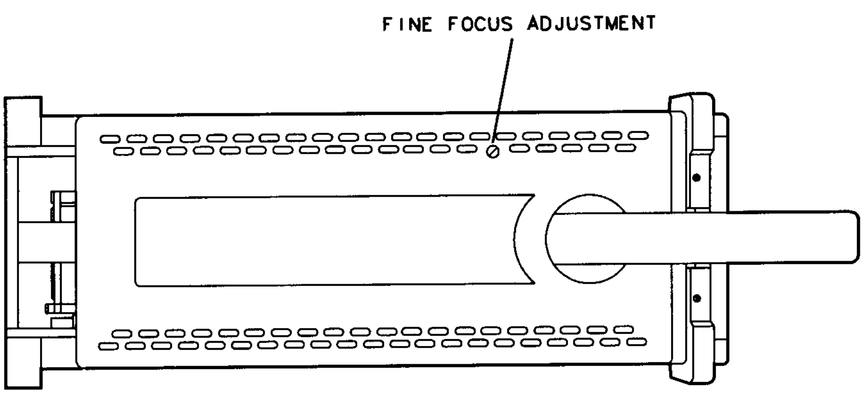
The step keys allow discrete increases or decreases of the active function value. The step size depends upon the analyzer measurement range or on a preset amount. Each press results in a single step change. For those parameters with fixed values, the next value in a sequence is selected each time a step key is pressed. Changes are predictable and can be set for some functions. Out-of-range values or out-of-sequence values will not occur using these keys.

Fine-Focus Control

The fine-focus control is located on the side of the analyzer. Use the following procedure to adjust the fine-focus control:

1. Adjust the front-panel intensity control for a comfortable viewing intensity.
2. Use an adjustment tool or small screwdriver to access the fine-focus adjustment. See Figure 3-3. Adjust for a focused display.

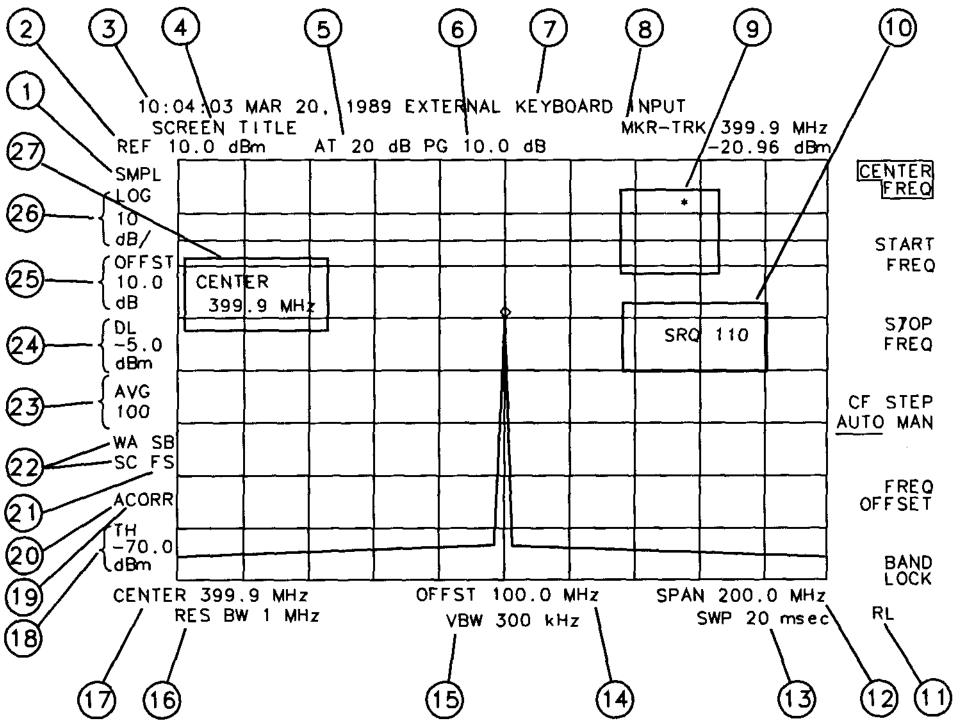
Figure 3-3 Adjusting the Fine Focus



Spectrum Analyzer Screen Annotation

Figure 3-4 shows an example of the annotation that may appear on an analyzer screen. The screen annotation is referenced by numbers and is listed in Table 3-2 on page 40. The function key column indicates which front-panel key or softkey activates the function related to the screen annotation.

Figure 3-4 Spectrum Analyzer Screen Annotation



In Figure 3-4, item 21 refers to the trigger and sweep modes of the analyzer. The first letter (“F”) indicates the analyzer is in free-run trigger mode. The second letter (“S”) indicates the analyzer is in single-sweep mode.

Item 22 refers to the trace modes of the analyzer. The first letter ("W") indicates that the analyzer is in clear-write mode. The second letter is "A", representing trace A. The trace B trace mode is "SB", indicating trace B ("B") is in the store-blank mode ("S"). The trace mode annotation for trace C is displayed under the trace mode annotation of trace A. In Figure 3-4, the trace C trace mode is "SC", indicating trace C ("C") is in the store blank mode ("S").

Refer to Table 3-1 for the screen annotation codes for trace, trigger, and sweep modes.

The WINDOWS display mode splits the screen into two separate displays. Only one of these displays is active at a time. The currently active window will have a solid line around the graticule rather than a broken line. The complete annotation is not available for each window because of space limitations.

The display will be compressed slightly when using the PAL or NTSC format for the MONITOR OUTPUT, instead of the normal format. The PAL and NTSC formats have less vertical resolution than the analyzer display. The top and bottom of the analyzer display are compressed slightly so that all of the information can be fit into the size required by the MONITOR OUTPUT.

Table 3-1 Screen Annotation for Trace, Trigger, and Sweep Modes

Trace Mode	Trigger Mode	Sweep Mode
W = clear write (traces A/B/C)	F = free run	C = continuous
M = maximum hold (traces A/B)	L = line	S = single sweep
V = view (traces A/B/C)	V = video	
S = store blank (traces A/B/C)	E = external	
M = minimum hold (trace C)	T=TV	

Table 3-2 Spectrum Analyzer Screen Annotation

Item	Description	Function Key
1	detector mode	**DETECTOR SMP PK**
2	reference level	**REF LVL**
3	time and date display	**Time Date**
4	screen title	**Change Title**
5	RF attenuation	**ATTEN AUTO MAN**
6	preamplifier gain	**EXTERNAL PREAMPG**
7	external keyboard entry	Refer to “External Keyboard” in the *Agilent Technologies 8594Q QAM Analyzer Spectrum Analyzer Reference User’s Guide.*
8	marker readout	**[MKR]**, **[MKR →]**, **[MKR FCTN]**, or **[PEAK SEARCH]**
9	measurement uncalibrated or function-in-progress messages	**[AUTO COUPLE]**
10	service request	See “Service Requests” in the *Agilent Technologies 8594Q QAM Analyzer Spectrum Analyzer Reference User’s Guide.*
11	remote operation	See “(LOCAL)” in *Agilent Technologies 8594Q QAM Analyzer Spectrum Analyzer Reference User’s Guide.*
12	frequency span or stop frequency	**[SPAN]**, **STOP FREQ**
13	sweep time	**SWP TIME AUTO MAN**
14	frequency offset	**FREQ OFFSET**
15	video bandwidth	**VID BW AUTO MAN**
16	resolution bandwidth	**RES BW AUTO MAN**
17	center frequency or start frequency	**CENTER FREQ, START FREQ**

Table 3-3 Spectrum Analyzer Screen Annotation

Item	Description	Function Key
18	threshold	**THRESHLD ON OFF**
19	correction factors on	**CORRECT ON OFF**
20	amplitude correction factors	See "Learn How to Enter Amplitude Correction Factors" in the *Agilent Technologies 8594Q QAM Analyzer Spectrum Analyzer Reference User's Guide*.
21	trigger	**[TRIG]**
22	trace mode	**[TRACE]**
23	video average	**VID AVG ON OFF**
24	display line	**DSP LINE ON OFF**
25	amplitude offset	**REF LVL OFFSET**
26	amplitude scale	**SCALE LOG LIN**
27	active function block	Refer to the description of the softkey function that was activated.

Menu and Softkey Overview

The keys labeled AMPLITUDE, FREQUENCY, CAL, and MKR are all examples of front-panel keys. Pressing most front-panel keys accesses menus of functions that are displayed along the right side of the display. These menus are called softkey menus.

Softkey menus list functions other than those accessed directly by the front panel keys. To activate a function on the softkey menu, press the unlabeled key immediately to the right of the annotation on the screen. The unlabeled keys next to the annotation on the display screen are called softkeys.

Front-panel keys are designated with brackets around the key label, for example, **[AMPLITUDE]**; softkeys are designated using bold font for the key label, for example, **REF LVL**. The softkeys that are displayed depend on which front-panel key is pressed and which menu level is enabled.

If a softkey function's value can be changed, it is called an active function. The function label of the active function appears in inverse video. For example, press **[AMPLITUDE]**. This calls up the softkey menu of related amplitude functions. Note the function labeled **REF LVL** appears in inverse video. REF LVL also appears in the active function block, indicating that it is the active amplitude function and can now be changed using any of the data entry controls.

A softkey with ON and OFF in its label can be used to turn the softkey's function on or off. To turn the function on, press the softkey so that ON is underlined. To turn the function off, press the softkey so that OFF is underlined. The following example demonstrates how an ON or OFF softkey function will be annotated: **VID AVG ON OFF (ON)**.

A function with AUTO and MAN in the label can either be auto-coupled or have its value manually changed. The function's value can be changed manually by pressing the softkey until MAN is underlined, and then changing its value with the numeric keypad, knob, or step keys. To auto couple a function, press the softkey so that AUTO is underlined. The following example demonstrates how an AUTO or MAN softkey function will be annotated: **ATTEN AUTO MAN (AUTO).**

A summary of all front-panel keys and their related softkeys can be found in the *Agilent Technologies 8594Q QAM Analyzer Spectrum Analyzer Reference User's Guide.*

Option 190 DVB-C RF and Modulation Quality Measurements Personality

The Option 190 DVB-C RF and modulation quality measurements personality is a downloadable program (DLP) consisting of measurement routines useful for digital transmission measurement applications. The DVB-C measurements personality is installed in the 8594Q QAM analyzer.

The tests included in the DVB-C measurements personality are:

- Average channel power
- Average symbol rate
- IQ constellation
- Modulation accuracy
- Adjacent channel power
- Symbol error rate
- Carrier to noise
- Implementation margin
- Equalizer impulse response
- Channel frequency
- Channel phase response
- Channel group delay

Refer to chapter 4, of this manual, for descriptions and procedures for performing the digital transmission measurements. The *Agilent Technologies 8594Q Option 190 QAM Analyzer User's Guide* is useful for more detailed information about the digital transmission measurements.

Option 195 Data Measurements Personality

The Option 195 data measurements personality requires additional hardware (Forward Error Correction decoder) and measurement software in the form of a downloadable program (DLP). The measurement software is fully integrated with the Option 190 DLP, Option 195 is pre-installed at the factory if specified at the time of ordering, however it can be retrofitted by an Agilent Technologies Service Center. Refer to the *8594Q Spectrum Analyzer Reference User's Guide* for help in contacting Agilent Technologies.

In addition to the Option 190 DVB-C RF and modulation quality measurements, Option 195 provides the following measurements:

- Reed-Solomon error analysis (non-intrusive in-service measurement)
- PID analysis and Multiplex Overview (helps identify problem data streams within a multiplex)
- BER testing using various test signals (allows 3 in-service and 2 out of service measurements)

Refer to chapter 4, of this manual, for descriptions and procedures for performing data measurements on the recovered MPEG-2 transport stream.

Making a Measurement

CAUTION Do not exceed the maximum input power.

The maximum input power for the 8594Q QAM analyzer is +30 dBm (1 watt) continuous and 50 Vdc (ac-coupled) or 0 Vdc (dc-coupled) with the preamplifier off. The input attenuation must be 10 dB or more.

Let's begin using the analyzer by measuring an input signal. Since the 300 MHz calibration signal (CAL OUT) is readily available, we will use it as our input signal.

You cannot damage the analyzer by using the calibration signal and pressing any of the keys described in this section. Don't be afraid to play with the knob, step keys, or number/units keypad. (If you have experimented with other keys and wish to return to a known state, press the **[PRESET]** key.)

1. First, turn the instrument on by pressing **[LINE]**. Wait for the power-up process to complete.
2. Press the **[PRESET]** key.
3. Connect the analyzer CAL OUT to the INPUT 50 Ω with an appropriate cable.
4. Set the frequency.

   Press the **[FREQUENCY]** key. CENTER appears on the left side of the screen, indicating that the center-frequency function is active. The **CENTER FREQ** softkey label appears in inverse video to indicate that center frequency is the active function. The active function block is the space on the screen within the graticule where the center frequency messages appear. Functions appearing in this block are active: their values can be changed with the knob, step keys, or number/units keypad. Set the center frequency to 300 MHz with the DATA keys by pressing 300 **[MHz]**. The knob and step keys can also be used to set the center frequency.
5. Set the span.

Press **[SPAN]**. SPAN is now displayed in the active function block, and the **SPAN** softkey label appears in inverse video to indicate it is the active function. Reduce the span to 20 MHz by using the knob, pressing the down key [⇓], or pressing 20 **[MHz]**.

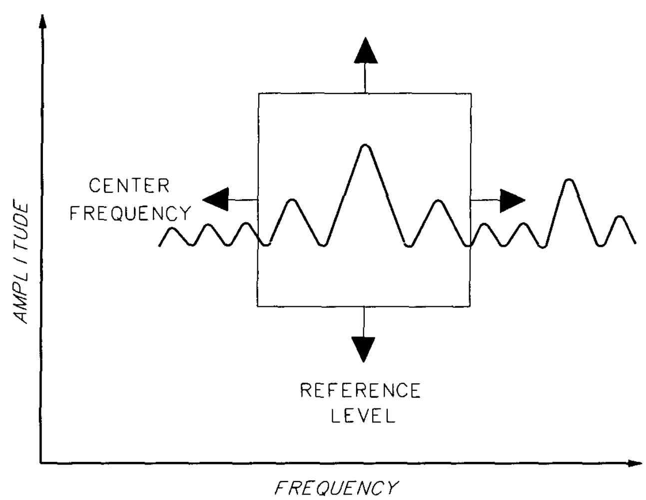
6. Set the amplitude.

When the peak of a signal does not appear on the screen, it may be necessary to adjust the amplitude level on the screen. Press **[AMPLITUDE]**. `REF LEVEL 0 dBm` appears in the active function block. **The REF LVL** softkey label appears in inverse video to indicate that reference level is the active function. The reference level is the top graticule line on the display and is set to 0 dBm. Changing the value of the reference level changes the amplitude level of the top graticule line

If desired, use the reference level function to place the signal peak on the screen using the knob, step keys, or number/units keypad. (Marker functions determine the frequency and amplitude of a signal.)

Figure 3-5 demonstrates the relationship between center frequency and reference level. The box in the figure represents the analyzer screen. Changing the center frequency changes the horizontal placement of the signal on the screen. Changing the reference level changes the vertical placement of the signal on the screen. Increasing the span increases the frequency range that appears horizontally on the screen.

Figure 3-5 Relationship between Frequency and Amplitude



7. Set the marker.

You can place a diamond-shaped marker on the signal peak to find the signal's frequency and amplitude.

To activate a marker, press the **[MKR]** key (located in the MARKER section of the front panel). The **MARKER NORMAL** label appears in inverse video to show that the marker is the active function. Turn the knob to place the marker at the signal peak.

You can also use the **[PEAK SEARCH]** key, which automatically places a marker at the highest point on the trace.

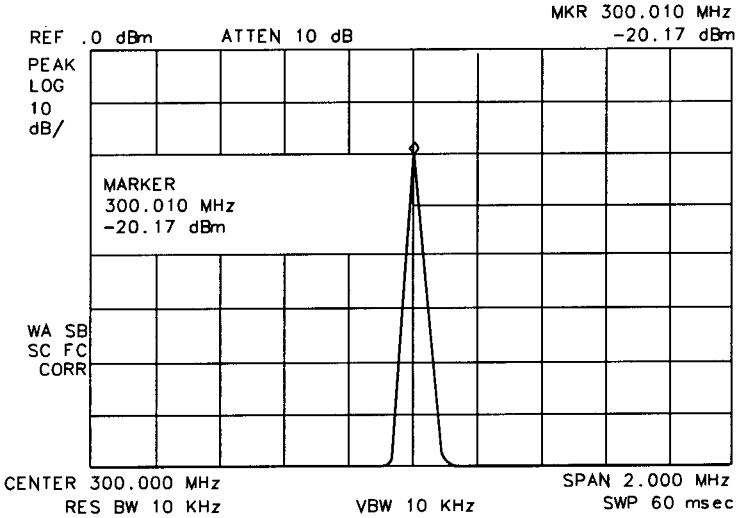
Readouts of marker amplitude and frequency appear in the active function block and in the upper-right comer of the display. Look at the marker readout to determine the amplitude of the signal.

If another function is activated, the frequency and amplitude can still be identified by looking at the marker readout in the upper-right comer of the screen.

Measurement Summary

1. Connect the analyzer CAL OUT to the INPUT 50 Ω and press the **[PRESET]** key.
2. Set the center frequency by pressing the following keys: **[FREQUENCY]**, 300 **[MHz]**.
3. Set the span by pressing the following keys: **[SPAN]** 20 **[MHz]**.
4. The calibration signal is 20 dB (two graticule divisions) below the top of the screen using these analyzer settings. If desired, adjust the reference level: press **[AMPLITUDE]** to activate the reference level, and use the knob or step keys to change the reference level.
5. Determine the amplitude and frequency of the signal. You can either press **[PEAK SEARCH]** or press **[MKR]** and move the marker to the signal peak. Read the amplitude and frequency. The display screen should look like the one in Figure 3-6. Frequency is displayed horizontally, and amplitude (power) is displayed vertically.

Figure 3-6 Reading the Amplitude and Frequency



Improving Accuracy with Self-Calibration Routines

Data from the self-calibration routine is necessary for analyzer operation.Executing the self-calibration routine regularly ensures that the analyzer is using current calibration data that improves the analyzer frequency and amplitude accuracy. Press the **[CAL]** key to view the self-calibration routine menus. The last softkey on this menu, labeled More 1 of 4, provides access to additional self-calibration functions. For more detailed information on the self-calibration softkeys, refer to the *Agilent Technologies 8594Q QAM Analyzer Spectrum Analyzer Reference User Guide*.

The self-calibration routines add correction factors to internal circuitry. The addition of the correction factors is required to meet frequency and amplitude specifications.

When the correction factors are added to internal circuitry, `CORR` (corrected) appears on the left side of the screen.

Warm-Up Time

In order for the analyzer to meet its specifications, allow the analyzer to warm up for 30 minutes after being turned on before attempting to make ally calibrated measurements. Be sure to calibrate the analyzer only after it has met operating temperature conditions.

The analyzer frequency and amplitude self-calibration routines are initiated by the **CAL FREQ & AMPTD** softkey in the menu located under the **[CAL]** key.

1. To calibrate the instrument, connect the analyzer CAL OUT to the INPUT 50 Ω connector with an appropriate cable.

NOTE A low-loss cable should be used for accurate calibration. Use the 50 Ω cable shipped with the analyzer.

2. On the analyzer, press **[CAL]** and **CAL FREQ & AMPTD**. `Cal signal not found` will be displayed if CAL OUT is not connected to the analyzer input. The frequency and amplitude self-calibration functions take approximately 5 minutes to finish, at which time the internal adjustment data is in working RAM.
3. To save this data in the area of analyzer memory that is saved when the analyzer is turned off, press **CAL STORE**.

NOTE To interrupt the calibration routines started by **CAL FREQ**, **CAL AMPTD**, or **CAL FREQ & AMPTD**, press **[PRESET]**, **[CAL]**, and **More 1 of 4**, and **CAL FETCH. CAL FETCH** retrieves the previous correction factors. Improperly interrupting the self-calibration routines may result in corrupt correction factors. (If this occurs, press **CAL FREQ & AMPTD** to rerun the frequency and amplitude self calibration routines.)

The frequency and amplitude self-calibration functions can be done separately by using the **CAL FREQ** or **CAL AMPTD** softkeys instead of **CAL FREQ & AMPTD**.

NOTE If the frequency calibration **CAL FREQ** and the amplitude calibration **CAL AMPTD** self-calibration routines are used, the frequency calibration should be performed before the amplitude calibration, unless the frequency data is known to be accurate.

The **CAL FREQ** starts the frequency self-calibration routine adjusts the frequency, sweep time, and span accuracy in approximately 2 minutes.

The **CAL AMPTD** softkey starts the amplitude calibration routine. This routine takes approximately 3 minutes to adjust the bandwidths, log and linear switching, IF gains, IF frequency centering, RF attenuation, and log amplifier. When the amplitude calibration routine has finished, the preset display returns and CAL DONE is displayed.

Although the analyzer stores the correction factors in battery-backed RAM, the data will not be saved when the analyzer power is turned off unless the data has been stored with **CAL STORE**. Using **CAL STORE** stores the correction factors in an area of analyzer memory that is accessed when the analyzer is turned on. After the frequency and amplitude self-calibration routines are complete, CORR (corrected) now appears on the left side of the screen, indicating that the analyzer is using its frequency and amplitude correction factors. Correction factors can be turned off by pressing **CORRECT ON OFF**. When OFF is underlined, most amplitude correction factors and some frequency correction factors are not used.

If the self-calibration routines cannot be performed, see “Check the Basics” in the *Agilent Technologies 8594Q QAM Analyzer Spectrum Analyzer Reference User's Guide.*

Printing

You may wish to obtain a permanent record of data displayed on the QAM analyzer screen. This can be done using the **[COPY]** key of the analyzer, and a printer.

NOTE If you have selected the parallel printer (**PRN PORT GPIB PAR** PAR underlined), ensure a printer is connected before pressing **PRINTER SETUP** or **[COPY]**.

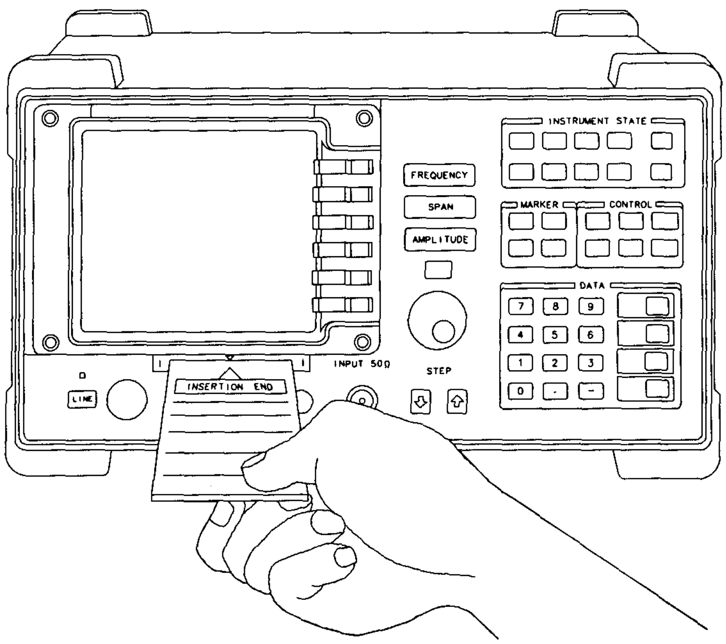
Refer to the *Agilent Technologies 8594Q QAM Analyzer Spectrum Analyzer Reference User's Guide* for more information about printing.

Memory Card Insertion and Battery Replacement

You can use a memory card to save traces, displays and setups for future reference Use the following information to ensure that the memory card is inserted correctly. Improper insertion causes error messages to occur, but generally does not damage the card or instrument. Care must be taken, however, not to force the card into place. The cards are easy to insert when installed properly.

1. Locate the arrow printed on the card's label.
2. Insert the card with its arrow matching the raised arrow on the bezel around the card-insertion slot. See Figure 3-7.

Figure 3-7 Inserting the Memory Card



3. Press the card into the slot. When correctly inserted, about 19 rnm (0.75 in) of the card is exposed from the slot.

Changing the Memory Card Battery

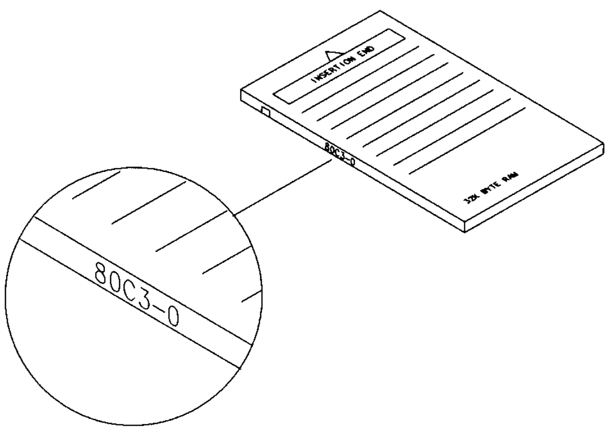
It is recommended that the memory card battery be changed every 2 years. The battery is a lithium commercial CMOS type battery, part number CR 2016 or part number 1420-0383.

NOTE The minimum lifetime of the battery (under ordinary conditions) is more than 2 years.

The date that the memory card battery was installed is either engraved on the side of the memory card or written on a label on the memory card.

If the memory card does not have a label with the date that the battery was installed, use the date code engraved on side of the memory card. The date code engraved on the memory card consists of numbers and letters engraved in the black plastic on the side of the memory card. See Figure 3-8. The first number indicates the year, the following two characters indicate the month, and the following number indicates the week in the month that the memory card battery was installed. For example, 8OC3 indicates the battery was installed in the third week in October in 1988.

Figure 3-8 Memory Card Battery Date Code Location



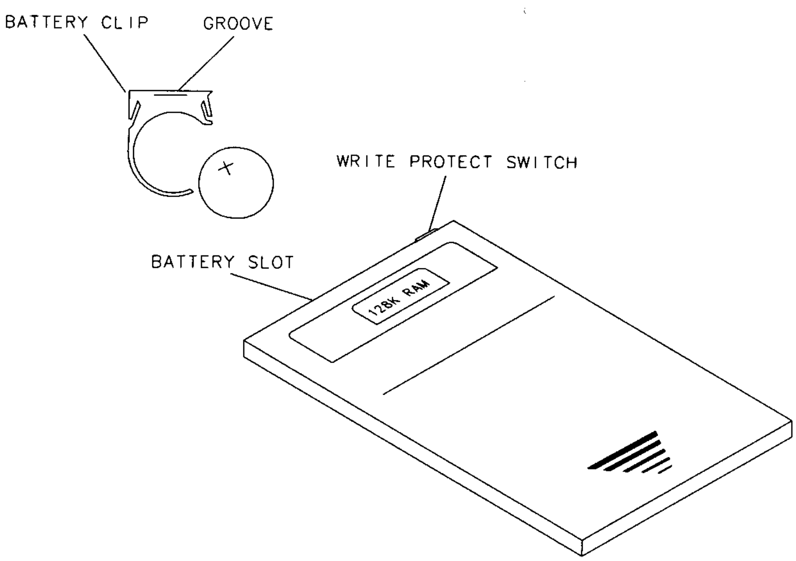
Procedure to Change the Memory Card Battery

The battery is located beside the card's write-protect switch on the end opposite the connector.

NOTE The battery power enables the memory card's memory to retain data. You can lose the data when the battery is removed. Replace the battery while the card is installed in a powered-up instrument.

1. Locate the groove along the edge of the battery clip. See Figure 3-9.
2. Gently pry the battery clip out of the card. The battery fits within this clip.
3. Replace the battery, making sure the plus (+) sign on the battery is on the same side as the plus (+) sign on the clip.
4. Insert the battery clip into the memory card, holding the clip as oriented in Figure 3-9. (Face the "open" edge of the clip toward the write-protect switch on the memory card.)
5. Write the date that the battery was replaced on the memory card label. This will help you to remember when the battery should be replaced.

Figure 3-9 Memory Card Battery Replacement



Analyzer Battery Information

The 8594Q QAM analyzer use a 3.6 V lithium battery to enable the analyzer memory to retain data. The date when the battery was installed is on a label on the rear panel of the analyzer. See Figure 3-10

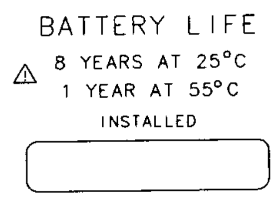
The minimum life expectancy of the battery is 8 years at 25°C, or 1 year at 55°C. If you experience problems with the battery or the recommended time period for battery replacement has elapsed, see "Returning the Analyzer for Service" in the *Agilent Technologies 8594Q QAM Analyzer Spectrum Analyzer Reference User's Guide*.

If you wish to replace the battery yourself, you can purchase the service documentation that provides all necessary test and maintenance information. The battery is soldered onto the analyzer processor board.

You can order the service documentation for an 8594Q QAM analyzer through your Agilent Technologies Sales and Service office. The documentation is described in the front of this manual.

After replacing the analyzer battery, write the date of battery replacement on the rear-panel label.

Figure 3-10 Rear-Panel Battery Information Label



4 Making Measurements Using DVB-C Analyzer Mode

What You'll Find in This Chapter

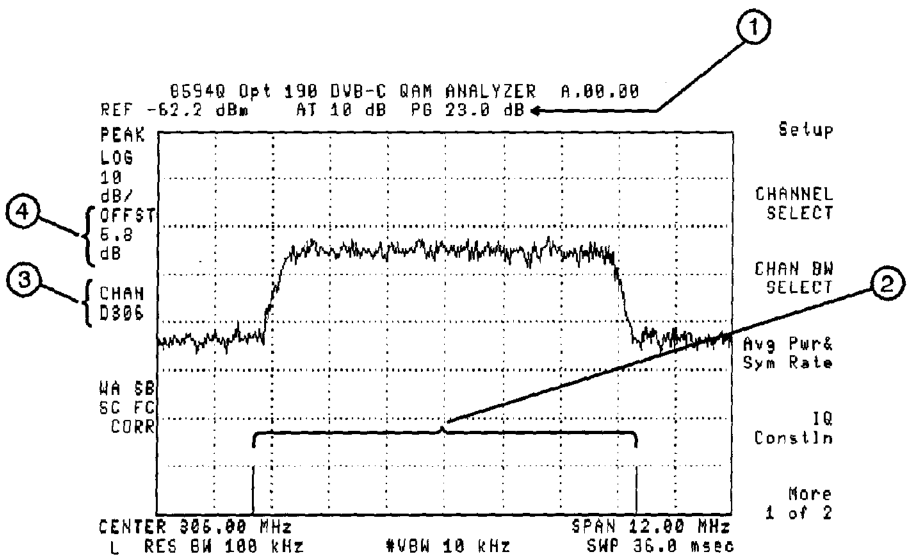
This chapter describes how to make QAM analysis measurements using the DVB-C Analyzer mode of operation. Also, detailed at the end of this chapter are utilities to allow quick checks of any analog TV signals present on your network.

DVB-C is the European Community standard for transmission of video data through a digitally modulated signal over a coaxial cable system. This chapter contains information on making the DVB-C measurements.

Measurement Screen Annotation

This section illustrates the unique annotation that may appear on an analyzer screen during the Option 190 DVB-C RF and modulation quality measurements. The screens are referenced by numbers and are listed in the tables following each illustration.

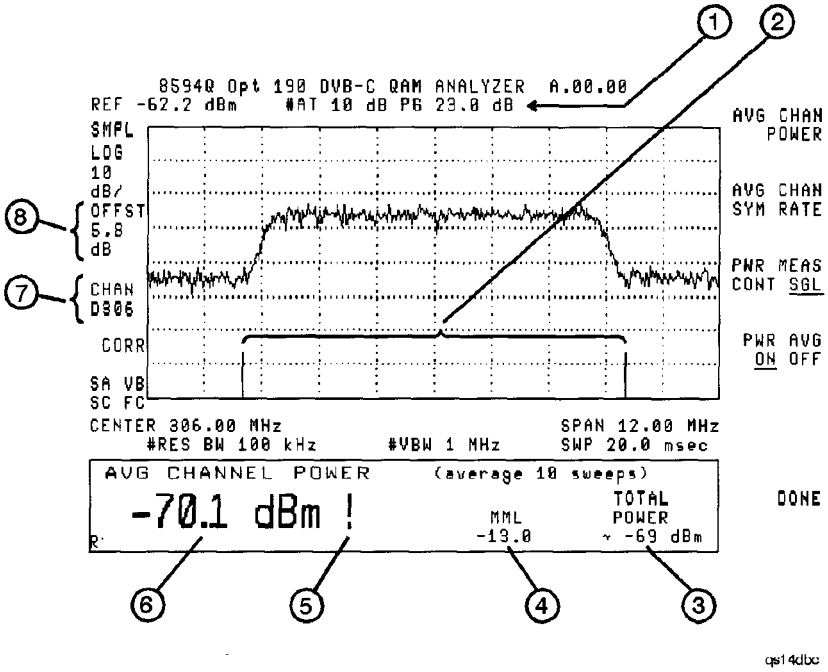
Figure 4-1 DVB-C Analyzer Screen Annotation



Item	Display Annotation	Description
1	PG	Displays the preamplifier gain in dB (if preamplifier is on).
2	-	Shows frequency limits of the channel.
3	CHAN XXXX or USER CHAN	Displays channel number or indicates user defined channel.
4	OFFST	Displays the amount of external attenuation in dB (if **EXT PAD YES NO** is set to YES.)

Average Channel Power Screen Annotation

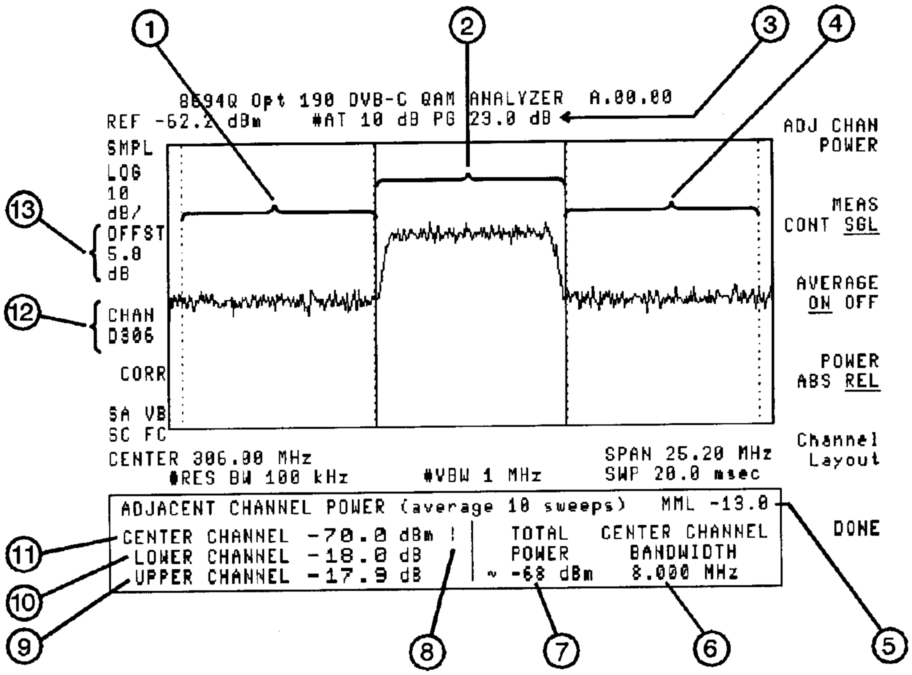
Figure 4-2 Average Channel Power Screen Annotation



Item	Display Annotation	Description
1	PG	Displays the preamplifier gain in dB (if preamplifier is on).
2	-	Shows frequency limits of the channel.
3	TOTAL POWER	Displays the total power if **CHANNELS MULT SGL** is set to MULT. The ~ denotes that `EXT FILT YES NO` is set to NO, otherwise ≃ is displayed.
4	MML	Displays the value of **MAX MXR LEVEL** (in dBm) if it is set lower than its default of –10 dBm.
5	!	Denotes that the power value is within 10 dB of the calculated analyzer noise floor.
6	AVG CHANNEL POWER	Displays the average channel power.
7	CHAN XXXX or USER CHAN	Displays channel number or indicates user defined channel.
8	OFFST	Displays the amount of external attenuation in dB (if **EXT PAD YES NO** is set to YES.)

Adjacent Channel Power Screen Annotation

Figure 4-3 Adjacent Channel Power Screen Annotation

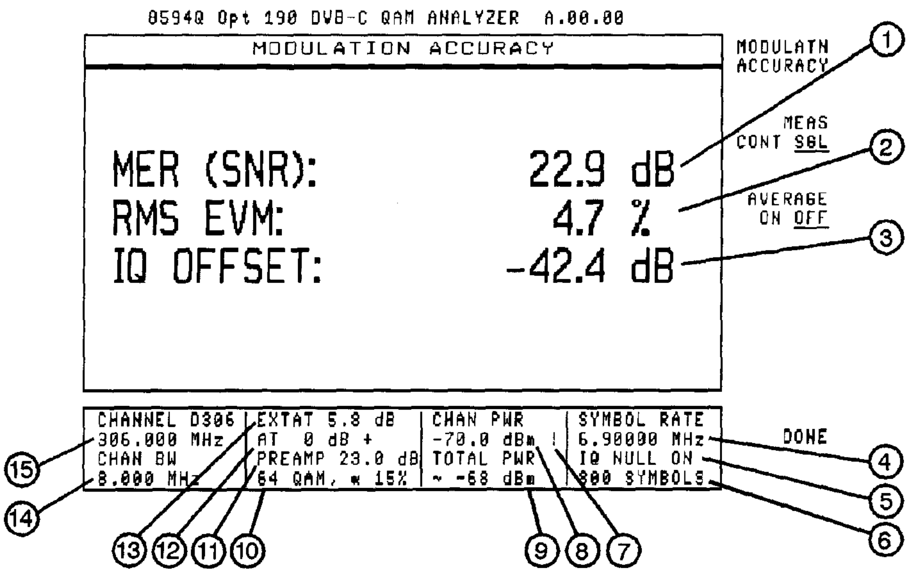


Item	Display Annotation	Description
1	-	Shows the frequency limits of the lower adjacent channel.
2	-	Shows the frequency limits of the center channel.
3	PG	Displays the preamplifier gain in dB (if preamplifier is on).
4	-	Shows the frequency limits of the upper adjacent channel.
5	MML	Displays the value of **MAX MXR LEVEL** (in dBm) if it is set lower than its default of –10 dBm.
6	Center Channel Bandwidth	Displays the bandwidth of the center channel.
7	TOTAL POWER	Displays the total power if **CHANNELS MULT SGL** is set to MULT. The ~ denotes that **EXT FILT YES NO** is set to NO, otherwise ≃ is displayed.
8	!	Denotes that the power value is within 10 dB of the calculated analyzer noise floor.

Item	Display Annotation	Description
9	UPPER CHANNEL	Displays the power value for the upper adjacent channel.
10	LOWER CHANNEL	Displays the power value for the lower adjacent channel.
11	CENTER CHANNEL	Displays the power value for the center channel.
12	CHAN XXXX or USER CHAN	Displays channel number or indicates user defined channel.
13	OFFST	Displays the amount of external attenuation in dB (if **EXT PAD YES NO** is set to YES).

Modulation Accuracy Screen Annotation

Figure 4-4 Modulation Accuracy Screen Annotation

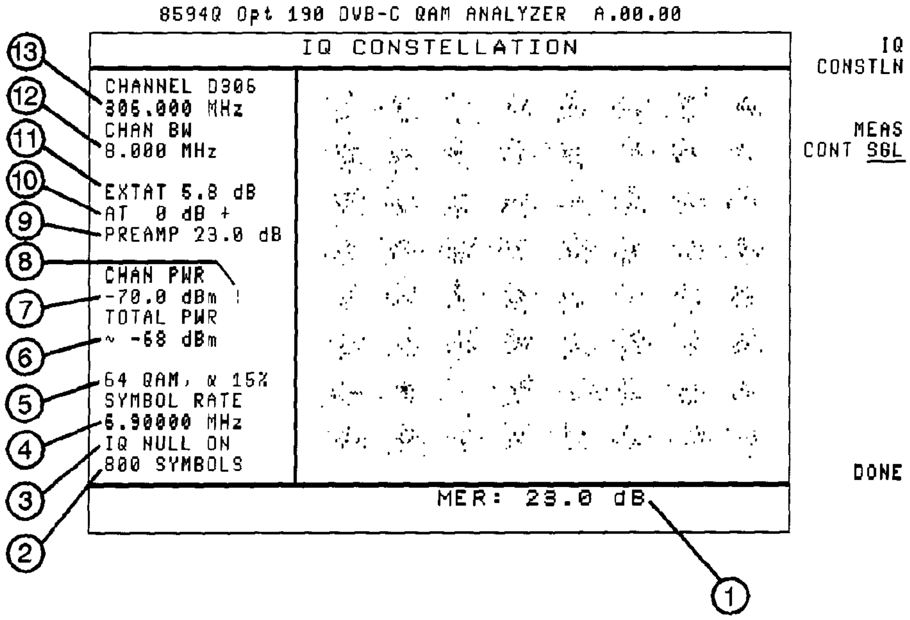


Item	Display Annotation	Description
1	MER (SNR)	Displays Modulation Error Ratio in dB.
2	RMS EVM	Displays the RMS value of Error Vector Magnitude in %.
3	IQ OFFSET	Displays the IQ offset value in dB (if **IQ NULL ON OFF** is set to ON).
4	SYMBOL RATE	Displays the symbol rate in MHz.
5	IQ NULL	Displays the state of **IQ NULL ON OFF**.
6	SYMBOLS	Displays the number of symbols set by **SYMBOLS/MEAS**.
7	!	Denotes that the power value is within 10 dB of the calculated analyzer noise floor.
8	CHAN PWR	Displays the channel power.
9	TOTAL PWR	Displays the total power if **CHANNELS MULT SGL** is set to MULT. The ~ denotes that **EXT FILT YES NO** is set to NO, otherwise ≃ is displayed.
10	QAM, ∝	Displays the modulation format and Nyquist filter factor.
11	PREAMP	Displays the preamplifier gain in dB (if preamplifier is on).

Item	Display Annotation	Description
12	AT	Displays the value of the internal attenuation in dB. The + denotes that the value of **MAX MXR LEVEL** is set lower than its default of –10 dBm.
13	EXTAT	Displays the amount of external attenuation in dB (if **EXT PAD YES NO** is set to YES).
14	CHAN BW	Displays the channel bandwidth in MHz.
15	CHANNEL	Displays the channel center frequency in MHz.

IQ Constellation Screen Annotation

Figure 4-5 IQ Constellation Screen Annotation



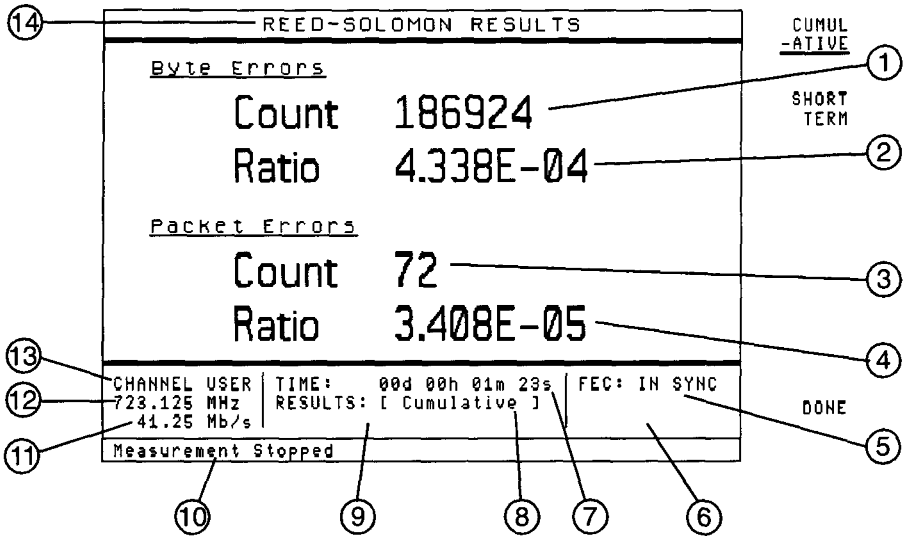
Item	Display Annotation	Description
1	MER or EVM	Displays the modulation accuracy metric, selected by **DISPLAY EVM MER**.
2	SYMBOLS	Displays the number of symbols set by **SYMBOLS/MEAS**.
3	IQ NULL	Displays the state of **IQ NULL ON OFF**.
4	SYMBOL RATE	Displays the symbol rate in MHz.
5	QAM, ∝	Displays the modulation format and Nyquist filter factor.
6	TOTAL PWR	Displays the total power if **CHANNELS MULT SGL** is set to MULT. The ~ denotes that **EXT FILT YES NO** is set to NO, otherwise ≃ is displayed.
7	CHAN PWR	Displays the channel power.
8	!	Denotes that the power value is within 10 dB of the calculated analyzer noise floor.
9	PREAMP	Displays the preamplifier gain in dB (if preamplifier is on).

Item	Display Annotation	Description
10	AT	Displays the value of the internal attenuation in dB. The + denotes that the value of **MAX MXR LEVEL** is set lower than its default of –10 dBm.
11	EXTAT	Displays the amount of external attenuation in dB (if **EXT PAD YES NO** is set to YES).
12	CHAN BW	Displays the channel bandwidth in MHz.
13	CHANNEL	Displays the channel center frequency in MHz.

Data Error Screen Annotation (Option 195 Only)

This screen is used for the Reed-Solomon Error measurement and PRBS/ Packetized Bit Error measurements.

Figure 4-6 **BER/PER Screen Annotation**

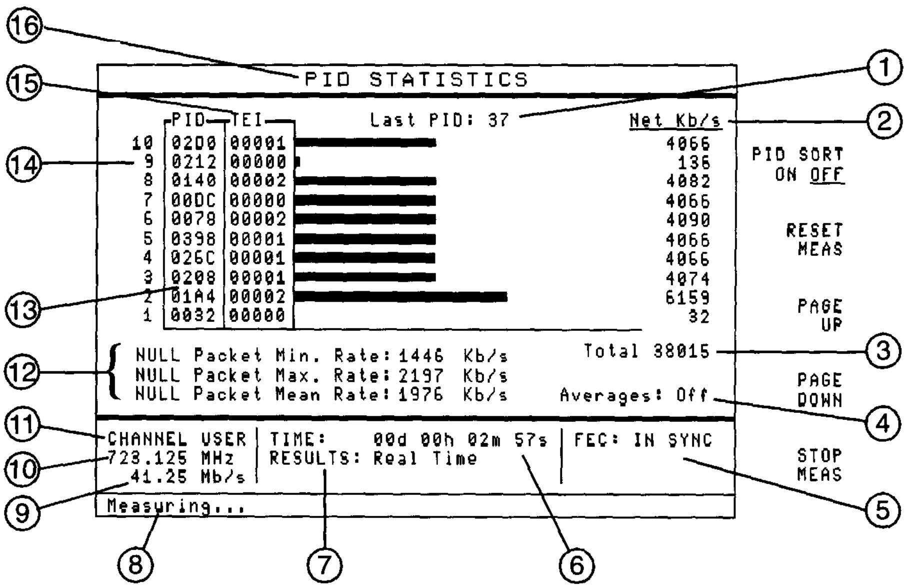


Item	Display Annotation	Description
1	Count (Byte or Bit Errors)	During the Reed-Solomon measurement, the total number of bytes corrected by the analyzer FEC system is displayed. (Select estimated bit error count by pressing **ERRORS BYTE BIT**.) During the PRBS/Packetized measurement an actual bit error count is displayed. In both measurements, you can configure a cumulative or periodic count.
2	Ratio (Byte or Bit Errors)	Displays the ratio of estimated Bit errors or Byte errors during a Reed-Solomon measurement and the ratio of Bit errors during PRBS/Packetized measurements, (total errors/total bits or bytes received).
3	Count (Packet Errors)	Displays running total of Packet Errors during a Reed-Solomon measurement. A Packet Error is counted when there are too many errors for the FEC system to correct. Not relevant and not displayed during PRBS/Packetized measurements.
4	Ratio (Packet Errors)	Displays the ratio of Packet Errors during a Reed-Solomon measurement, (total errors/total packets received). Not relevant and not displayed during PRBS/Packetized measurements.

Item	Display Annotation	Description
5	FEC:	Displays NO SYNC if 2 or more consecutive synchronization bytes are not detected. Otherwise IN SYNC is displayed.
6	PID:	Displays the specified PID to be used in the Sync + PID + PRBS bit error measurement.
7	TIME:	Displays the total elapsed time in days, hours, minutes, seconds format since pressing **START PRBS** or **START REEDSOL**. Updated even if measurement is in a NO SYNC state. Restarted when **RESET MEAS** or **RE-LOCK MEAS** is pressed.
8	RESULTS:	Displays Cumulative or Short Term as configured by selecting **Result Type**.
9	PERIOD:	Displayed only when **SHORT TERM** is selected. The current measurement period value is also displayed.
10	measurement status	Displays the status of the measurement. Setting Up Measurement... Measuring... and Measurement Stopped are among the displayed messages during a complete measurement operation.
11	Mb/s	Displays the gross data rate of the channel. (1Mb/s = 1E6 bits/second.)
12	MHz	Displays the currently selected channel center frequency.
13	CHANNEL	Displays the currently selected channel name.
14	TITLE	Displays the measurement type or data pattern used for the displayed measurement results: REED-SOLOMON, CONTINUOUS PRBS, 203 BYTE PRBS, SYNC + 187 BYTE PRBS, SYNC + PID + 184 BYTE PRBS or SYNC + NULL + ZEROS.

PID and Multiplex Overview Screen Annotation (Option 195 Only)

Figure 4-7 PID and Multiplex Overview Screen Annotation



Item	Display Annotation	Description
1	Last PID:	Displays a running total of the number of different PIDs (elementary streams) detected in the current channel or multiplex.
2	Net Kb/s	Displays the net data rate of each signal in the multiplex in 1E3 bits/second (Kb/s).
3	Total	Displays the total net data rate of the channel including NULL packets.
4	Averages:	Displays either `Off` or the currently selected averaging value. Averaging is applied to the histograms and net data rates but not to the Null Packet information.
5	FEC:	Displays `NO SYNC` if 2 or more consecutive synchronization bytes are not detected. Otherwise `IN SYNC` is displayed.
6	TIME:	Displays the total elapsed time in days, hours, minutes, seconds format since pressing **START PIDSTATS** or **MULTIPLX OVERVIEW**. Updated even if measurement is in a `NO SYNC` state. Restarted when **RESET MEAS** or **RE-LOCK MEAS** is pressed.

Item	Display Annotation	Description
7	RESULTS:	Real Time is always displayed indicating the measurement runs continuously.
8	measurement status	Displays the status of the measurement. Setting Up Measurement... Measuring... and Measurement Stopped are among the displayed messages during a complete measurement operation.
9	Mb/s	Displays the gross data rate for the channel. (1Mb/s = 1E6 bits/second.)
10	MHz	Displays the currently selected channel center frequency.
11	CHANNEL	Displays the currently selected channel name.
12	NULL Packet Rates:	Displays the maximum, minimum and mean Null Packet rate in the multiplex from the start of the measurement. The results are unaffected by averaging.
13	PID column	Displays the Packet Identifiers (PIDs) in the multiplex in ascending order. If off is selected using **PID SORT ON OFF**, the PIDs are displayed in the order they are received.
14	numeric column	Simply labels each elementary stream in the multiplex or channel with an index.
15	TEI column	Displays a running count of packets for each PID arriving with the TEI (Transport Error indicator) bit set. The counter saturates and stops counting at 65535. When a packet is determined corrupt by the analyzer the TEI bit is set if on is selected from **TEI SET ON OFF**. If off is selected, no change is made.
16	Title bar	Displays measurement title, PID STATISTICS or MULTIPLEX OVERVIEW.

Making QAM Analysis Measurements

This section explains the steps that are necessary to make DVB-C measurements. The steps are as follows:

1. Configure the test system.
2. Make the measurements.

Step 1. Configure the test system

The **Setup** menu is used to define the channels to be measured, set up the analyzer input conditions, and the QAM demodulator settings.

Setup information is stored in non-volatile memory. This means that the analyzer retains the information, even when power is turned off or **[PRESET]** is pressed, until you access the **Setup** menu again and change it, or press the **DEFAULT SETUP** key twice. **CHANNEL SELECT, CHAN BW SELECT** and all Option 190 setup values *except* **PREAMP ON OFF** (or **PREAMP YES NO**) are retained during a power cycle or instrument preset. Table 4-1 on page 74.

NOTE To protect the internal preamplifier, the preamplifier is automatically deactivated after a power cycle, pressing **[PRESET]**, or exiting the DVB-C analyzer mode.

Setting up the analyzer includes the following steps.

1. Connect the signal to the input.
2. Access the Setup menu.
3. Establish the channel tuning.
4. Set up the analyzer input conditions.
5. Set up the analyzer to use a preamplifier.
6. Set up for digital demodulation (64 QAM).
7. Set up for data measurements (Required only if Option 195 is installed).

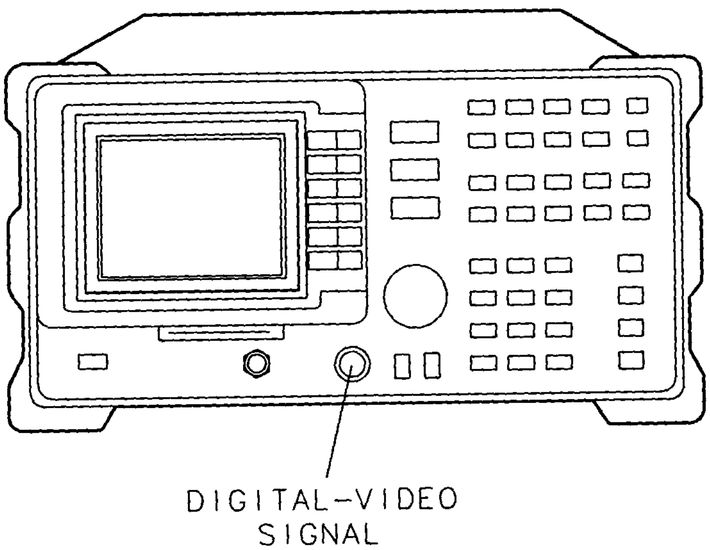
1. Connect the Signal to the Input

CAUTION To prevent the analyzer input from being damaged, the total power at the analyzer input must be less than +30 dBm when the internal preamplifier is off, -5 dBm when on. The maximum DC voltage is 50 V while in AC coupled input mode.

Use the necessary adapters to connect the RF DVB-C signal to the analyzer RF Input. Figure 4-8.

NOTE The Agilent 8594Q QAM analyzer has a 50 Ω input impedance. Use a 75 Ω to 50 Ω matching pad or transformer if measuring a 75 Ω system. Refer to the **EXT PAD YES NO** key instructions later in this chapter.

Figure 4-8 Connecting the DVB-C Signal to the Analyzer Input



2. Access the Setup Menu

This section describes the Setup menu softkeys and how to access them. If the **Setup** softkey is displayed, press it now. Otherwise, press **[MODE]**, **DVB-C ANALYZER** to access the Option 190 QAM analyzer menus, then **Setup** to access the Setup menu.

Setup Menu Softkeys

Setup	Accesses the menus to set up the QAM analyzer for measurement.
Channel Tuning	Accesses the menu for defining the desired frequency band to measure.
Analyzer Setup	Accesses the menus used to configure the analyzer input, the preamplifier, and the units for power measurements.
Demod Setup	Accesses the menus for preparing for digital demodulation and measurement of a digitally modulated signal.
FEC Setup	Accesses the setup menu for the Option 195 data measurement functions.
DEFAULT SETUP	Restores a known state to the analyzer setup. See Table 4-1 on page 74.

Table 4-1 Default Setup Conditions

Option 190	Function Softkey	Default Value
	CHAN BW SELECT	8 MHz
	CHANNEL SELECT	330
	Channel Tuning	DVB-C D303-445
	CHANNELS MULT SGL	Single (SGL underlined)
	DISP EVM MER	MER (MER underlined)
	EQUALIZR ON OFF	On (ON underlined)
	EXT FILT YES NO	No (NO underlined)
	EXT PAD YES NO	No (NO underlined)
	IQ NULL ON OFF	On (ON underlined)
	MAX MXR LEVEL	–10 dBm
	MER LMT ON OFF	On (ON underlined)

Table 4-1 Default Setup Conditions

Option 190	Function Softkey	Default Value
	Power Units	dBm
	PREAMP EXT INT	Internal (INT underlined)
	PREAMP GAIN	23.0 dB for internal 30.0 dB for external
	PREAMP ON OFF	Off (OFF underlined)
	PREAMP NZ FIG	5 dB
	Symbol Rate	1 (6.900 MHz)[a]
	SYMBOLS/MEAS	800
	TARGETS ON OFF	Off (OFF underlined)
	TOTL PWR SPAN	40 MHz
	TOTL PWR STOP FRQ	550 MHz
	TOTL PWR STRT FRQ	10 MHz
	View Results	Hidden
Option 195 only	DATA OUT AUTO OFF	Auto (AUTO underlined)
	ASI OUT 188 204	188 bytes (188 underlined)
	PI OUT 188 204	188 bytes (188 underlined)
	TEI SET ON OFF	On (ON underlined)
	I,Q INV ON OFF	On (ON underlined)

a. Special Option analyzers may default to a different setting. Check the displayed value.

3. Establish the Channel Tuning

This section provides information about the Channel Tuning menu and how to set up the channel tuning using the `Channel Tuning` softkey, located under `Setup`.

Channel Tuning Softkeys

Channel Tuning	Accesses the menu for defining the desired frequency band to measure.
USER DEFINED	Used to define an arbitrary channel center frequency for measurement. Any frequency from 10 MHz to 2.9 GHz.
CHANNEL SELECT	Defines the center frequency of the channel to be measured. Interacts with the selection on the Channel Tuning menu, this key is replaced with **CENTER FREQ** on the Main menu when **USER DEFINED** is selected. Standard frequency ranges may be selected using the menu under **Channel Tuning**. This softkey is located in the Main menu.
CHAN BW SELECT	Defines the bandwidth of the channel being measured, for example, in the DVB-C standard, channels can be 8 MHz, 4 MHz, or 2 MHz wide depending on the symbol rate used in the channel. This softkey is located in the Main menu.
DVB-C D031-041	Selects a frequency band of carriers centered at 31 MHz to 41 MHz to measure.
DVB-C D303-445	Selects a frequency band of carriers centered at 303 MHz to 445 MHz to measure.
CCIR VHF S21-41	Selects a group of channels defined by CCIR standards to be used when choosing a channel centered at 306 MHz to 466 MHz to measure.
CCIR UHF U21-69	Selects a group of channels defined by CCIR standards to used when choosing a channel centered at 474 MHz to 858 MHz to measure.
DONE	Pressing this softkey indicates you are finished with the current menu and will return you to the previous menu in the menu tree.

Procedure

1. Establish the channel tuning by pressing **Channel Tuning**, then select the appropriate frequency band from one of the following softkeys. See Table 4-2 on page 77.

   - Press **DVB-C D3031-041**, **DVB-C D303-445**, **CCIR VHF S21-41**, or **CCIR UHF U21-69** for a frequency band.
   - Press **USER DEFINED**, to tune to a custom channel center frequency, then enter the desired frequency using the analyzer DATA keys. The **USER DEFINED** softkey permits you to adjust the channel to be measured to any frequency within the instrument tuning range.

2. Press **DONE** once the tuning channel has been established.

CHANNEL SELECT (or **CENTER FREQ**) and **CHAN BW SELECT** can be used after the channel tuning has been established to change the channel within the selected band and to change the bandwidth of the selected channel.

Table 4-2 Channel Tuning Frequencies

Channel Tuning Configuration	Lowest Channel		Highest Channel	
	Number	CF (MHz)	Number	CF (MHz)
DVB-C D031-041	31	31	41	41
DVB-C D303-445	303	303	445	445
CCIR VHF S21-41	21	306	41	466
CCIR UHF U21-69	21	474	69	858

NOTE Selecting a non-user defined frequency will automatically select a channel bandwidth. This automatically selected channel bandwidth may be subsequently overridden by using thew **CHAN BW SELECT** key.

4. Set Up the Analyzer Input Conditions

This section provides information about setting up the analyzer input conditions and specifying the power units for the analyzer. To access these functions press **Setup** then **Analyzer Setup**.

Analyzer Setup Softkeys

Analyzer Setup	Accesses the Analyzer Setup menu.
Analyzer Input Setup	Accesses the Analyzer Input Setup menu to configure the analyzer to accommodate the current conditions at the analyzer RF input. Analyzer input setup includes preparing for measurement in the presence of single or multiple signals; compensating for an external channel filter or attenuator; setting the conditions for measuring the total power at the RF input of the analyzer.
Preamp	Accesses the Preamplifier Setup menu.
MAX MXR LEVEL	Adjusts the set point of the power permitted at the first mixer in the analyzer signal processing chain. This function allows you to trade off analyzer noise floor and distortion. Decreasing the value of the maximum mixer level from its default value of –10 dBm will increase the amount of internal attenuation used, thus constraining the power at the first mixer to the new, lower value. Decreasing the power at the first mixer will decrease analyzer-generated distortion, but at the expense of an increased noise floor. Use this function only if you wish to minimize analyzer-generated distortion and your signal is high enough in amplitude from the analyzer noise floor to allow the increased noise. Note that since the internal attenuator steps in 10 dB increments, the degree of control is coarse.
Power Units	Accesses the menu to select the power units for reporting the results of signal power measurements. The power units available are dBm, dBmV, or dBuV.
DONE	Pressing this softkey indicates you are finished with the current menu and will return you to the previous menu in the menu tree.

Analyzer Input Setup

To define the power conditions at the input of the analyzer, first determine the number of active signals at the input of the analyzer.

There are two setup procedures included in this section, “Single Carrier Setup” and “Multiple Carrier Setup.” The number of carriers at the input determine which procedure you will perform. For example, if you are measuring the output of a single headend modulator, you have a single carrier signal. If you are measuring at a subscriber connection, you may have many analog and digital signals. You must select which of these two conditions you have. Do you have a single carrier or multiple carriers at the input?

- Single, press **CHANNELS MULT SGL** to underline SGL, then continue with “Single Carrier Setup” below.
- Multiple, press **CHANNELS MULT SGL** to underline MULT, then continue with “Multiple Carrier Setup” later in this section.

Analyzer Input Setup Softkeys

CHANNELS MULT SGL	Adjusts the analyzer for measuring in the presence of a single active channel, or for multiple active channels at the input of the analyzer. If MULT is underlined, a channel selection filter (SAW) is added to the analyzer RF down converter signal processing path and the analyzer sets its input attenuator based on the measured total incident power.
EXT FILT YES NO	Sets up the analyzer to measure in the presence of an external filter at the input. An external filter is often used to select a small number of channels to be present at the analyzer input. This key is only present when multiple channels is selected (**CHANNELS MULT SGL**, MULT is underlined).
EXT PAD YES NO	Sets up the analyzer to measure in the presence of an external pad or attenuator. The insertion loss of the pad will be automatically compensated for when power measurement results are reported.
Totl Pwr Setup	Accesses the menu to define the measurement of total power incident at the analyzer input.
MEASURE TOTL PWR	Initiates a measurement of the total power incident at the analyzer input.
TOTL PWR STRT FRQ	Defines the frequency where the total power measurement begins.
TOTL PWR STOP FRQ	Defines the frequency where the total power measurement ends.
TOTL PWR SPAN	Defines the span to use when measuring total power with an external filter present.
Power Units	Accesses the menu to select the power units for reporting the results of signal power measurements. The power units available are **dBM**, **dBmV**, or **dBuV**.
DONE	Pressing this softkey indicates you are finished with the current menu and will return you to the previous menu in the menu tree.

Single Carrier Setup

Perform the following procedure if you have a single carrier at the input. If you have multiple carriers at the input, proceed to the next section, “Multiple Carrier Setup.”

1. Press Analyzer Input to access the Analyzer Input Setup menu.
2. Do you have external attenuation? If you are using a 50 Ω to 75 Ω matching pad or transformer, enter its insertion loss here.
   - Yes, press **EXT PAD YES NO** to underline YES. Verify the amount of loss shown is correct for the device you are using. The default value is 5.8 dB, which is the nominal value for the minimum loss pad supplied. Use the DATA keys and press **[ENTER]** if a different value is required.
   - No, press **EXT PAD YES NO** to underline NO.
3. Press **DONE** to return to the Analyzer Setup menu.
4. Select the displayed power units by pressing **Power Units**, then select the desired power units, **dBm**, **dBmV**, or **dBuV**.

   Once the power units have been selected press **DONE**.

If you wish to use an internal or external preamplifier with the analyzer proceed to “5. Set Up to Use a Preamplifier.”

Analyzer setup is now complete for single-carrier mode. Press **DONE** to return to the Setup menu, then proceed to “6. Set Up for Digital Demodulation.”

Multiple Carrier Setup

Perform the following procedure if you have multiple carriers at the input. If you have a single carrier at the input go back to the previous section, "Single Carrier Setup."

1. Do you have an external filter? An external filter can be used to select a small set of desired channels. Note that the EXT FILT YES NO softkey is not available when measuring single channels.
   - Yes, press **EXT FILT YES NO** to underline YES.
   - No, press **EXT FILT YES NO** to underline NO.
2. Do you have external attenuation? If you are using a 50 Ω to 75 Ω matching pad or transformer, enter its insertion loss here.
   - Yes, press **EXT PAD YES NO** to underline YES. Verify the amount of loss shown is correct for the device you are using. The default value is 5.8 dB which is the nominal value for the minimum loss pad supplied. Use the DATA keys and press **[ENTER]** if a different value is required. If you are using an external filter, you may also add its insertion loss to this value.
   - No, press **EXT PAD YES NO** to underline NO.
3. Set up the analyzer to measure the approximate total power at the input of the analyzer. In the multiple-carrier mode, the total input power measurement is performed automatically before each measurement. This value of total power is used to optimize signal to noise in the analyzer while avoiding overload. Press **Total Pwr Setup** to access the Total Power Setup menu.
4. Enter the start and stop frequency over which the analyzer scans to measure the **TOTL PWR STRT FREQ** and **TOTL PWR STOP FREQ** or **TOTL PWR SPAN** softkeys. If you can reduce the frequency range scanned during the total power measurement, measurement accuracy is optimized. Note that if you are using a filter, the **TOTL PWR STRT FREQ** and **TOTL PWR STOP FREQ** softkeys are not available and are replaced with the **TOTL PWR SPAN** softkey. In this case, select a span which includes all the incident power to at least 20 dB below the channel power. Select the desired softkey, then enter the start or stop frequency, or span using the analyzer DATA keys.

NOTE The total power measurement is only approximate to set the analyzer input attenuator. This value is not intended to be used as a metric measurement.

5. If desired, press **MEASURE TOTL PWR** to measure the total power at the analyzer input. The approximate total power is displayed on screen.

6. Press **DONE** to return to the Analyzer Input menu.
7. Select the displayed power units by pressing Power Units, then select the desired power units, **dBm**, **dBmV**, or **dBuV**.

   Once the power units have been selected, press **DONE**.

If you wish to use an internal or external preamplifier with the analyzer proceed to “5. Set Up to Use a Preamplifier.”

Analyzer setup is now complete for multiple-carrier mode. Press **DONE** to return to the Setup menu, then proceed to “6. Set Up for Digital Demodulation.”

5. Set Up to Use a Preamplifier

Using a preamplifier with the 8594Q QAM analyzer permits measurements to be made at low signal levels in the cable system. A preamplifier reduces the instrument noise figure to be lower than that of the analyzer alone. This improves the analyzer sensitivity for making measurements on low-level signals.

However, in the presence of strong signal power from high-level signals or multiple signals at the amplifier input, the preamplifier will generate distortion products, reducing the dynamic range of the measurement. High signal power applied to a preamplifier at the input of the analyzer might not only impair measurement results but also damage the input circuits of the instrument. An external tunable bandpass filter connected before the preamplifier and analyzer can decrease the total power contribution from signals outside the channel of interest and allow significantly lower signals to be measured, than with the preamplifier and analyzer alone.

The 8594Q QAM analyzer is equipped with an internal preamplifier. The instrument can also be used with an external amplifier. By properly setting up the instrument, amplifier gain from either an internal or external preamplifier will automatically be included in measurement results.

When to use a preamplifier

The internal preamplifier can be used when *both* conditions described below apply.

- The average channel power of the signal being measured is less than –30 dBm. Refer to the Average Power and Symbol Rate measurement later in this chapter to measure the average channel power if you are not sure.
- The total power at the input of the analyzer is less than –5 dBm. Refer to the “Multiple Carrier Setup” procedure located in “4. Set Up the Analyzer Input Conditions” section of this chapter.

CAUTION To prevent the analyzer input mixer from being damaged, the total power at the analyzer input must be less than –5 dBm when the internal preamplifier is on. When using an external preamplifier, the total power must be less than *20 dBm – External Preamp Gain*. You can use the total power measurement with the preamplifier off to determine how much total power is present.

Perform the following procedure to set up the analyzer to use an internal or an external preamplifier. To access these functions press **Setup**, **Analyzer Setup**, then **Preamp**.

Preamplifier Setup Softkeys

Preamp	Accesses the Preamplifier Setup menu.
PREAMP EXT INT	Defines whether the analyzer is using the internal preamplifier or has an external preamplifier at the input.
PREAMP ON OFF	Activates and deactivates the internal preamplifier. This key is replaced by PREAMP YES NO when using an external preamplifier.
PREAMP GAIN	Defines the gain of the preamplifier being used. The preamplifier gain is compensated in reporting power measurement results.
PREAMP NZ FIG	Defines the noise figure of the external preamplifier being used.
DONE	Pressing this softkey indicates you are finished with the current menu and will return you to the previous menu in the menu tree.

Procedure

1. Are you using a preamplifier?
   - Yes, continue with the next step.
   - No, be sure that the internal preamplifier is OFF; using the **PREAMP ON OFF** softkey, OFF is underlined. Or, **PREAMP YES NO** is set to NO (NO is underlined) if **PREAMP EXT INT**, is set to external (EXT is underlined).
2. Is the preamplifier an internal or external preamplifier?
   - External, press **PREAMP EXT INT** to underline EXT.
   - Internal, press **PREAMP EXT INT** to underline INT.
3. If using an external preamplifier, enter the gain of the preamplifier by pressing **PREAMP GAIN**, then enter the gain using the analyzer data keys. Refer to "MEASURING THE PREAMPLIFIER GAIN (OPTIONAL)" later in this section for more information. Note, you may also optimize the accuracy of measurements made using the internal preamplifier by using this procedure.
4. If using an external preamplifier, enter the preamplifier noise figure by pressing **PREAMP NZ FIG**, then enter the nominal preamplifier noise figure. Preamp noise figure is used to calculate the approximate analyzer noise floor with the benefit of the preamplifier. A warning (**!**) is automatically displayed, adjacent to power values, if the signal is too close to the calculated noise floor for accurate power measurements.
5. Place the preamplifier in the signal path performing the appropriate method listed below.
   - If you are using an internal preamplifier, press **PREAMP ON OFF** to underline ON. The analyzer will display a reminder to check your total power at the input to avoid damaging the instrument. Press **PREAMP ON OFF** again to activate the preamplifier.
   - If you are using an external preamplifier, press **PREAMP YES NO** to underline YES, then connect it to the analyzer input.

NOTE

The analyzer will automatically insert internal attenuation to optimize measurement accuracy. The amount of internal attenuation is controlled by **MAX MXR LEVEL** so that no more than that amount of power appears at the first mixer of the analyzer. The default value of –10 dBm for **MAX MXR LEVEL** insures that mixer compression does not occur. For the internal preamplifier, this value also controls how much power appears at the preamplifier input.

Max Power at Preamp Input = (Max Mixer Level) – (Preamp Gain)

To minimize distortion products, the value of maximum mixer level can be decreased from its default value to increase the amount of internal attenuation used. However, increasing the amount of internal attenuation will increase the noise floor of the analyzer.

6. Remove the preamplifier from the signal path by performing the appropriate method listed below.
   - If you are using the internal preamplifier, press **PREAMP ON OFF** to underline OFF.
   - If you are using the external preamplifier, disconnect it from the analyzer input, then press **PREAMP YES NO** to underline NO.
7. Once the preamplifier has been set up press **DONE**.

NOTE The preamplifier function is always deactivated upon leaving the DVB-C measurement mode, pressing **[PRESET]**, or power cycling the analyzer. The preamplifier must always be manually activated through the Preamp menu softkeys.

MEASURING THE PREAMPLIFIER GAIN (OPTIONAL)

The preamp gain value is used to compensate for the amplitude offset of the preamp gain in absolute power measurements. If you want to optimize amplitude measurement accuracy at the specific channel you are measuring use the following procedure to set the **PREAMP GAIN** to the proper value.

1. Press **[PRESET**], then **DVB-C Analyzer**.
2. Attach a CW signal to the analyzer input at the channel frequency of interest. Note that the internal preamplifier frequency range is 1 MHz to 1 GHz. For best accuracy, the CW signal power at the analyzer input should be less than: –*Preamp Gain dBm*. If no external CW signal source is available, the analyzer calibration signal provides a signal at 300 MHz center frequency, at –20 dBm amplitude. Calibration signal amplitude may be reduced by using an external pad.

   If a signal less than: –*Preamp Gain dBm* is not available, a signal as large as 0 *dBm + Internal Attenuator – Preamp Gain* may be used. Accuracy of this procedure may be reduced.
3. Adjust the channel tuning to center the signal under test. Press **Setup**, **Channel Tuning**, **USER DEFINED**, then enter the frequency of the input signal. The signal should be seen at the center of the display. Press **DONE**.
4. Enter the Preamp menu by pressing **Analyzer Setup**, then **PREAMP**.
5. Bring the signal to the reference level by using **[PEAK SEARCH]**, **[MKR →]**, **MARKER → REF LVL**.
6. Activate the Delta marker by using **[PEAK SEARCH**], **Marker** Δ, then press **[MODE]**, **[MODE]** (MODE key twice) to return to the DVB-C Analyzer Mode menus.

7. Enter the approximate gain of the preamplifier you are using by pressing **PREAMP GAIN**, then enter the value using the analyzer data keys.
   - If you are using the internal preamplifier, the value should be 23 dB.
   - If you are using an external preamplifier, use the nominal gain of the amplifier.
8. Place the preamplifier in the signal path.
   - If you are using the internal preamplifier, press **PREAMP ON OFF** to underline ON. The analyzer will display a reminder to check your total power at the input to avoid damaging the instrument. Press **PREAMP ON OFF** again to activate the internal preamplifier.
   - If you are using an external preamplifier, connect it to the analyzer input. Select external preamplifier by pressing **PREAMP ON OFF** to underline YES.
9. Read the delta marker and adjust the value entered under **PREAMP GAIN**. You can also simply adjust the **PREAMP GAIN** to make the delta marker as close to 0 dB as possible.

   PREAMP GAIN (new) = PREAMP GAIN (old) + Marker Delta Value

The analyzer is now adjusted to properly compensate for the gain of the preamplifier.

6. Set Up for Digital Demodulation

The Digital Demodulation Setup menu allows you to set up the symbol rate (turn the IQ offset nulling on or off, and choose which modulation results will be displayed. To access the Digital Demodulation Setup menu press **Setup** then **Demod Setup**.

Digital Demodulation Setup Softkeys

Demod Setup	Accesses the Digital Demodulation Setup menu.
Symbol Rate	Accesses the menu to select the symbol rate at which to run the digital demodulator. Symbol rate is the rate at which data is transmitted in the digitally modulated signal. The softkeys located in the Symbol Rate menu are **1**, **2**, **3**, and **4**. Refer to Table 4-3 on page 90. Select a symbol rate to be used to perform DVB-C analyzer measurements. The symbol rate depends on the bit rate of data flowing through the system, and the modulation format being used. For example, a data rate of 41.34 Mbit/s modulated in a 64 QAM (6 bits/symbol) format, yields a symbol rate of 6.89 Msymbols/s.
IQ NULL ON OFF	Activates the removal of the IQ offset from the modulation accuracy metrics (EVM and MER). If IQ NULL is on (ON is underlined), the EVM and MER value will not include the effect of the IQ offset. IQ offset is then displayed separately in dB.
SYMBOLS/MEAS	Defines the number of symbols to include in the measurement. A symbol is a set of data bits defined by the digital modulation format.
DISPLAY EVM MER	Selects either EVM (Error Vector Magnitude) or MER (Modulation Error Ratio) to be displayed as a modulation accuracy metric.
MER LMT ON OFF	Activates automatic warning when the MER value indicates the signal is too impaired for valid measurements. The warning may be disabled by selecting OFF (OFF is underlined).
DONE	Pressing this softkey indicates you are finished with the current menu and will return you to the previous menu in the menu tree.

Procedure

1. Set up the symbol rate by pressing **Symbol Rate** then select the desired rate, **1**, **2**, **3**, or **4**. Refer to Table 4-3 and Table 4-4.

   Once the symbol rate has been selected press **DONE** to return to the Digital Demodulation Setup menu.

Table 4-3 Standard Symbol Rates

Softkey	Symbol Rate		
	8 MHz CHAN BW	4 MHz CHAN BW	2 MHz CHAN BW
1	6.900 MHz	3.4500 MHz	1.72500 MHz
2	6.890 MHz	3.4450 MHz	1.72250 MHz
3	6.875 MHz	3.4375 MHz	1.71875 MHz
4	6.872 MHz	3.4360 MHz	1.71800 MHz

Table 4-4 Special Option H98 Symbol Rates

Softkey	Symbol Rate		
	8 MHz CHAN BW	4 MHz CHAN BW	2 MHz CHAN BW
1	6.900 MHz	3.4500 MHz	1.72500 MHz
2	6.890 MHz	3.4450 MHz	1.72250 MHz
3	6.875 MHz	3.4375 MHz	1.71875 MHz
4	6.872 MHz	3.4360 MHz	1.71800 MHz

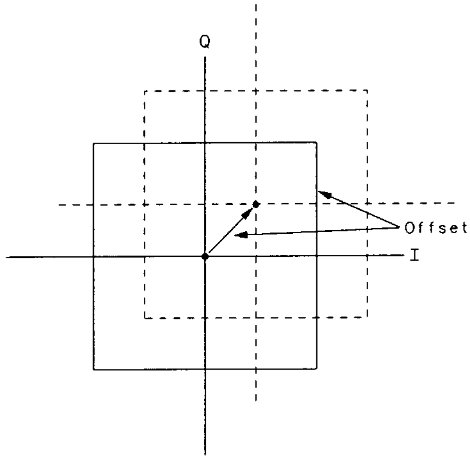
NOTE Although **CHAN BW SELECT** allows arbitrary channel bandwidths, only discrete values of symbol rate are available. Therefore, for digital demodulation measurements, channel bandwidth should be set to 8, 4, or 2 MHz.

2. Turn IQ null on or off by pressing **IQ NULL ON OFF** to underline on or off as desired.

   IQ null is used in the Modulation Accuracy measurement. Turning IQ null on will cause the measurement to remove the effect of any IQ offset from the modulation accuracy metrics. The amount of IQ offset that was removed is then displayed. See Figure 4-9 on page 91.

Turning IQ null off will leave the effect of an IQ offset in the modulation metrics EVM and MER included. No separate IQ offset information is displayed.

Figure 4-9 IQ Offset Example



Measurements can be accompanied by the display of a metric: either as EVM (Error Vector Magnitude, in percent) or as MER (Modulation Error Ratio, in dB).

Press **DISPLAY EVM MER** to underline EVM or MER as desired.

3. If you do not want the `MER too low` warning to halt the modulation accuracy measurement, press **MER LMT ON OFF** (OFF is underlined) to select off. To leave this limit-checking activity, press **MER LMT ON OFF** (ON is underlined) to select on.

Digital demodulation setup is now complete. Press DONE to return to the Setup menu.

Refer to the “Modulation Accuracy” measurement for more information about EVM and MER.

7. Set Up for Data Measurements

The FEC (Forward Error Correction decoder) Setup menu allows you to set up the packet size, IQ inversion, data outputs and configure control of the Transmission Error Indicator bit (TEI) in the output data stream. To access the data measurements setup menu press **Setup** then **FEC Setup**.

NOTE You need only carry out this procedure if Option 195 is installed and you want to make data quality measurements or make use of the recovered MPEG-2 data available from the DVB-PI and DVB-ASI ports on the rear panel.

FEC Setup Softkeys

FEC Setup	Accesses the Forward Error Correction (Option 195 only) Setup menu.
DATA OUT AUTO OFF	Sets up the analyzer to output the recovered MPEG-2 data stream to the rear panel serial (ASI) and parallel (PI) ports. When AUTO is selected, (AUTO is underlined) both ports are enabled when a data measurement is selected (Reed-Sol Errors, Prbs/Pkt Bit Errors or Pid Stats). Selecting OFF disables the output ports.
ASI OUT 188 204	Selects 188 byte (188 is underlined) or 204 byte (204 is underlined) packet format for the serial output port. In 204 byte mode, the last 16 bytes which are reserved for Reed-Solomon encoding, are nulled (set to zero).
PI OUT 188 204	Selects 188 byte (188 is underlined) or 204 byte (204 is underlined) packet format for the parallel output port. In 204 byte mode, the last 16 bytes which are reserved for Reed-Solomon encoding, are nulled (set to zero).
TEI SET ON OFF	Configures the analyzer to set the TEI bit when it determines a packet is uncorrectable (ON underlined). By selecting OFF (OFF is underlined), the TEI bit is unaffected by the analyzer.
I,Q INV ON OFF	Sets up the analyzer to invert (ON underlined) the signal spectrum (I,Q becomes I,-Q) prior to the DVB-C decoding processes.
DONE	Pressing this softkey indicates you are finished with the current menu and will return you to the previous menu in the menu tree.

Procedure

1. Turn the recovered MPEG-2 data output on or off by pressing **DATA OUT AUTO OFF** to underline auto or off as desired.

   Selecting auto delivers the recovered MPEG-2 data stream to the DVB-ASI and DVB-PI ports on the rear panel when the data measurements are enabled (Reed-Solomon, PRBS or PID measurements).

   Selecting off disables both DVB output ports.

2. Select 188 or 204 byte packet output from the DVB-ASI port by pressing **ASI OUT 188 204** to underline 188 or 204 as desired.

3. Select 188 or 204 byte packet output from the DVB-ASI port by pressing **PI OUT 188 204** to underline 188 or 204 as desired.

   With 188 selected the MPEG-2 data is available from the DVB ports (when enabled) in 188 byte packets. With 204 selected, MPEG-2 data is available from the DVB ports (when enabled) in 204 byte packets. The choice of packet size helps ensure compatibility with other MPEG-2 equipment should you want to apply further processing to the recovered data stream.

   The additional 16 bytes in the 204 byte packet are used to contain forward error correction data generated during the Reed-Solomon *encoding* process. These 16 bytes are nulled (set to zero) during the MPEG-2 recovery processes in the 8594Q. Therefore, the 204 byte packet contains 188 bytes of information followed by 16 zero bytes.

4. Turn control of the Transmission Error Indicator bit (TEI) on or off by pressing **TEI SET ON OFF** to underline on or off as desired.

   Selecting on allows the 8594Q to set (to a ‘1’) the TEI bit if the packet is determined to be corrupt during the data recovery processes.

   The analyzer has no control of the TEI bit when off is selected. If the TEI bit has been set at some prior stage, it remains set. Likewise, the analyzer cannot set the TEI bit even if intact data could not be recovered.

5. Turn IQ inversion on or off by pressing **I,Q INV ON OFF** to underline on or off as desired.

   Selecting on inverts the signal spectrum prior to the data recovery processes. Specifically, (I, Q) vector pairs become (I, -Q).

Data measurements setup is now complete. Press **DONE** to return to the Setup menu.

Step 2. Make the Measurements

The QAM analysis measurements can be performed in any order. The measurements can be performed at the headend or at the point of delivery to the subscriber. Most measurements update the result at the end of a sweep or at the end of multiple sweeps. Refer to each measurement type.

The tests are listed below along with the softkey that activates them.

Table 4-5 DVB-C Measurements

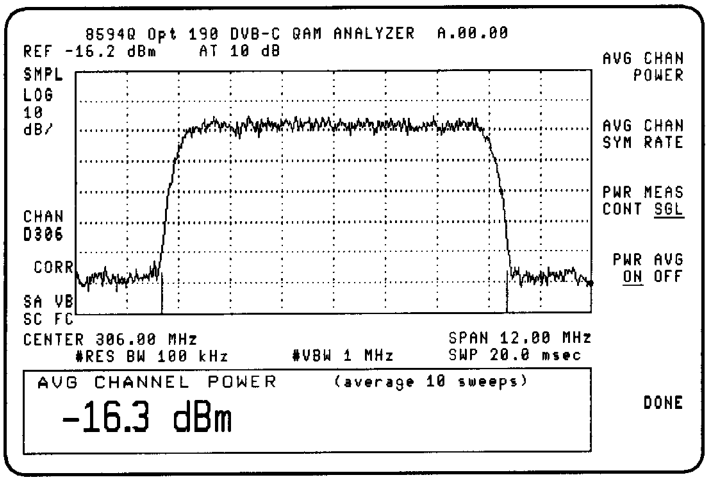
	To activate	Press
RF Spectrum and Modulation Quality Measurements	Average Channel Power	AVG CHAN POWER
	Average Symbol Rate	AVG CHAN SYM RATE
	IQ Constellation	IQ CONSTLN
	Modulation Accuracy	MODULATN ACCURACY
	Adjacent Channel Power	ADJ CHAN POWER
	Symbol Error Rate, Carrier to Noise and Implementation Margin	SER, C/N Margin
	Equalizer Impulse Response	EQ IMPUL RESPONSE
	Channel Frequency Response	CH FREQ RESPONSE
	Channel Phase Response	CH PHASE RESPONSE
	Channel Group Delay	CH GROUP DELAY
Data Quality Measurements	Reed-Solomon Bit, Byte and Packet Errors	Reed-Sol Errors
	Bit Error Rate	Prbs/pkt Bit Errs
	PID Statistics and Multiplex Overview	Pid Stats

Average Channel Power

The average channel power measurement measures the average power of the signal in the desired channel. This assists you to maintain the proper carrier power levels at the headend and throughout the system. The measurement allows you to view the spectrum of the signal for a qualitative check for confidence that the proper signal is there.

The average channel power is calculated by sweeping the channel and taking an average of the power levels at each measurement point across the swept trace. Power readings of the trace between the two vertical lines at the bottom of the display are used to obtain a true power average. See Figure 4-10.

Figure 4-10 Average Channel Power Measurement Example



Average Channel Power Softkeys

Avg Pwr & Sym Rate	Accesses the Average Channel and Symbol Rate Measurement menu.
AVG CHAN POWER	Executes the average channel power measurement.
PWR MEAS CONT SGL	Defines how the average channel power measurement will be performed. If single (SGL underlined) is selected the measurement will be performed once. If continuous (CONT is underlined) is selected the measurement will be performed continuously until STOP MEAS is pressed or the measurement is exited.
PWR AVG ON OFF	Permits a series of Average Channel Power measurements to be averaged together. In the average channel power measurement, the power readings at each frequency in the channel bandwidth are RMS averaged together to obtain a single channel power reading. If **PWR AVG ON OFF** is on (ON is underlined), a group of average channel power readings is averaged together to produce a mean average channel power measurement. This will reduce the variability of the measurement results. The number of measurements to be averaged together is defined when averaging is activated.
STOP MEAS	Halts the current measurement in progress.
DONE	Pressing this softkey indicates you are finished with the current menu and will return you to the previous menu in the menu tree.

Procedure

1. Press **Avg Pwr & Sym Rate**.
2. Select the desired measurement method. The average channel power can be measured using one of the following methods:
   - Single, press **PWR MEAS CONT SGL** to underline SGL. The analyzer will make one complete measurement and pause.
   - Continuous, press **PWR MEAS CONT SGL** to underline CONT. The measurement results will be continuously updated from sweep to sweep.
3. Pressing **PWR AVG ON OFF** turns power measurement averaging on or off as described below. Note that power averaging is used only in single (SGL) mode.

   Press **PWR AVG ON OFF** to underline ON to turn measurement averaging on. See Figure 4-11 on page 98. When averaging is on, multiple sweeps are taken across the channel. These sweeps are averaged together to form a composite trace, usually smoother than a single trace that is not averaged. The average channel power is calculated from the smoothed trace.

   The number of swept traces for the measurement can be changed to any value between 2 and 999 by pressing **PWR AVG ON OFF** until ON is underlined, then enter the number of averages desired using the data keys on the analyzer. Ten swept traces is the default.

   Note that when **PWR AVG ON OFF** is pressed, the analyzer display changes to an active function display that allows you to change the number of averages.

   Press **PWR AVG ON OFF** to underline OFF to turn measurement averaging off. See Figure 4-12 on page 98.
4. To start the measurement of average channel power, press **AVG CHAN POWER**.

   The measurement can be stopped at any time by pressing **STOP MEAS**. Note that when using the single method the measurement will stop automatically when the measurement is completed. However, the measurement can always be stopped before the measurement is complete by pressing **STOP MEAS**.
5. Press **DONE** to exit the Average Power and Symbol Rate menu.

Figure 4-11 Power Average On Example

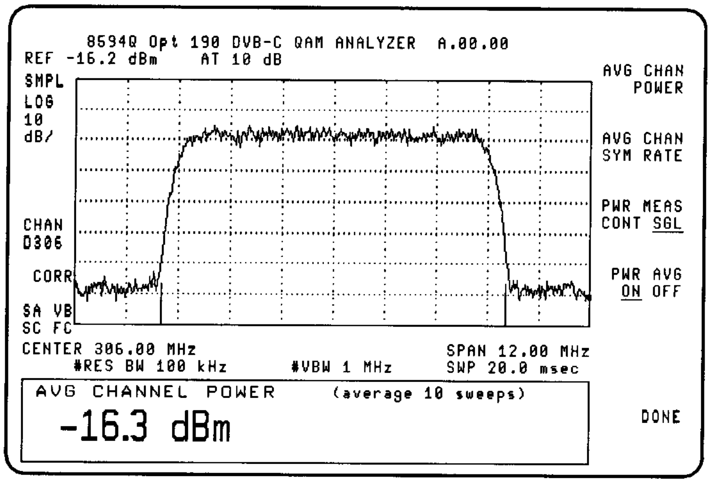
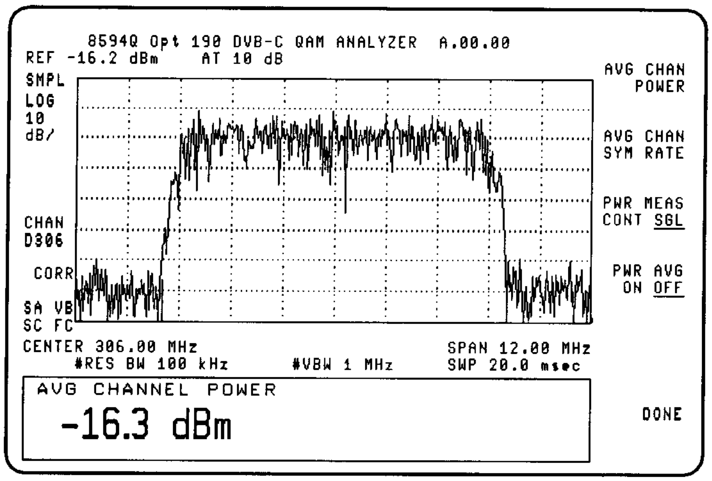


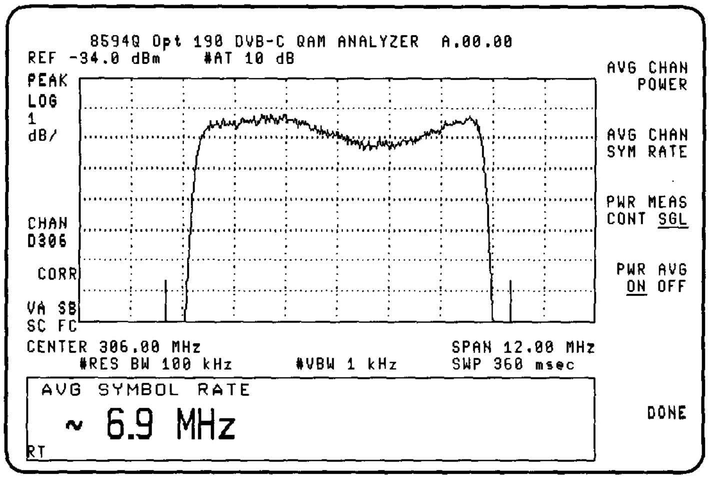
Figure 4-12 Power Average Off Example



Average Symbol Rate

The symbol rate is the speed at which data is sent in the digitally modulated signal. The average symbol rate measurement displays the signal and estimates the symbol rate from the bandwidth of the signal. See Figure 4-13.

Figure 4-13 Average Symbol Rate Measurement Example



NOTE The average symbol rate measurement is approximate only. It cannot distinguish among the different symbol rates of a given channel bandwidth.

Average Symbol Rate Softkeys

Avg Pwr & Sym Rate	Accesses the Average Channel and Symbol Rate Measurement menu.
AVG CHAN SYM RATE	Executes the average channel symbol rate measurement.
STOP MEAS	Halts the current measurement in progress.
DONE	Pressing this softkey indicates you are finished with the current menu and will return you to the previous menu in the menu tree.

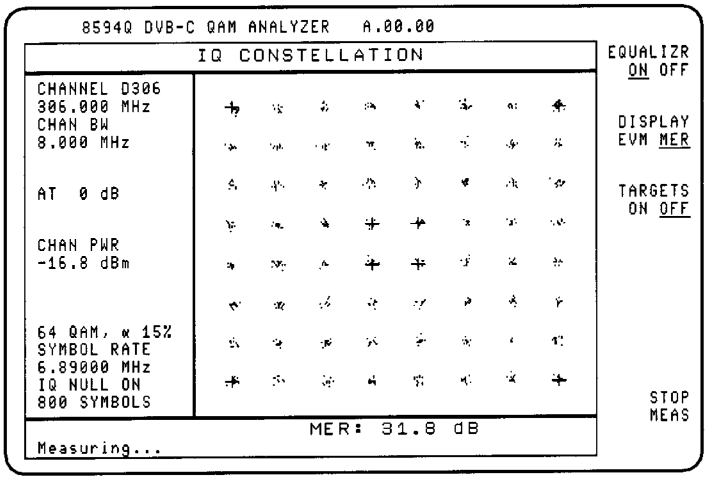
Procedure

1. Press **Avg Pwr & Sym Rate.**
2. Press **AVG CHAN SYM RATE** to estimate the average symbol rate. The measurement result will be an approximate value derived from the signal bandwidth.
3. Press **DONE** to exit the Average Power and Symbol Rate menu.

IQ Constellation

The IQ Constellation is a qualitative measurement used to verify the modulation quality from the headend modulator and for checking the signal quality throughout the distribution network. The IQ constellation measurement provides a graphical representation of the constellation to enable you to view any large degradation in the signal.

Figure 4-14 IQ Constellation Measurement Example



IQ Constellation Softkeys

IQ Constln Accesses the IQ Constellation Measurement menu.

IQ CONSTLN Activates the measurement and display of the digitally modulated signal constellation.

MEAS CONT SGL Defines how the measurement will be performed. If single (SGL underlined) is selected the measurement will be performed once. If continuous (CONT is underlined) is selected the measurement will be performed continuously until STOP MEAS is pressed or the measurement is exited.

EQUALIZR ON OFF Turns the adaptive equalizer on or off. Note that restarting the measurement always turns the adaptive equalizer back on.

DISPLAY EVM MER Selects either EVM (Error Vector Magnitude) or MER (Modulation Error Ratio) to be displayed as a modulation accuracy metric.

TARGETS ON OFF Turns the target symbols on or off.

STOP MEAS Halts the current measurement in progress.

DONE Pressing this softkey indicates you are finished with the current menu and will return you to the previous menu in the menu tree.

Procedure

1. Press **IQ Constln** to access the Measurement menu.
2. Select the desired measurement method. The IQ constellation can be executed using one of the following methods:
   - Single, press **MEAS CONT SGL** to underline SGL. When the measurement is started, the analyzer will display a snapshot of the constellation map based on the number of symbols selected.
   - Continuous, press **MEAS CONT SGL** to underline CONT. The analyzer will display the constellation based on the number of symbols selected, repeating the map until **STOP MEAS** is pressed.
3. Press **IQ CONSUTLN** to start the measurement. Note that the analyzer pauses as it sets up the analyzer conditions for the measurement. The constellation will then be displayed in the constellation area of the screen.

   The measurement can be stopped at any time by pressing **STOP MEAS**. Note that when using the single measurement method the measurement will stop automatically when the measurement is complete. However, the measurement can always be stopped before the measurement is complete by pressing **STOP MEAS.**
4. The adaptive equalizer can be turned off using **`EQUALIZR ON OFF`**. Note that restarting a measurement always turns the adaptive equalizer back on.
5. Measurements are accompanied by the display of a metric: either as EVM (Error Vector Magnitude, in percent) or as MER (Modulation Error Ratio, in dB). While a continuous measurement is running, you may press **DISPLAY EVM MER** to underline EVM or MER as desired.
6. The target symbols can be turned on by pressing **`EQUALIZR ON OFF`** to select on (ON is underlined). Note that when target symbols are turned off (OFF is underlined) the corner and inner target symbols always remain on.
7. Press **DONE** exit the IQ Constellation menu.

Modulation Accuracy

The modulation accuracy is a quantitative measurement of modulation impairments which will affect the ability of the receiver to recover data bits. For averaged measurements, the analyzer can also generate a statistical display of the measurement results. The maximum, minimum, and 90% confidence limits of modulation accuracy measurements are calculated and stored. The 90% confidence value is 1.65 times the standard deviation. Assuming a Gaussian distribution in the variation of MER or EVM values, 90% of the modulation accuracy measurement will fall within the mean ±90% confidence limit. The measurement makes it easy to identify trends over multiple averaged measurements by comparing quantitative metrics using the View Results menu.

Figure 4-15 Modulation Accuracy Continuous Measurement Example

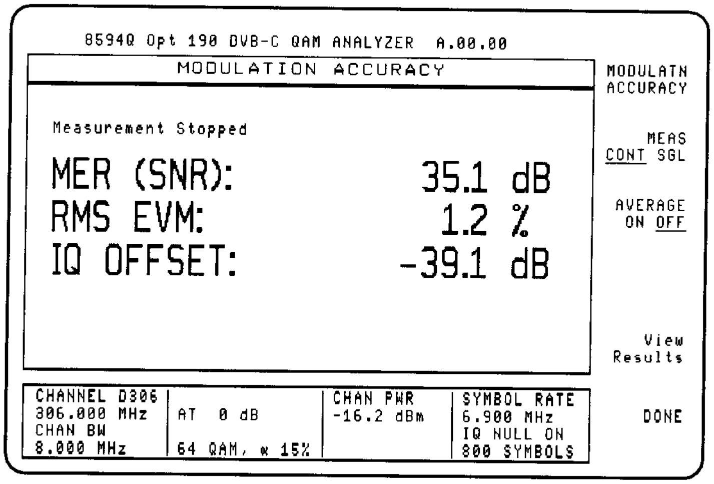
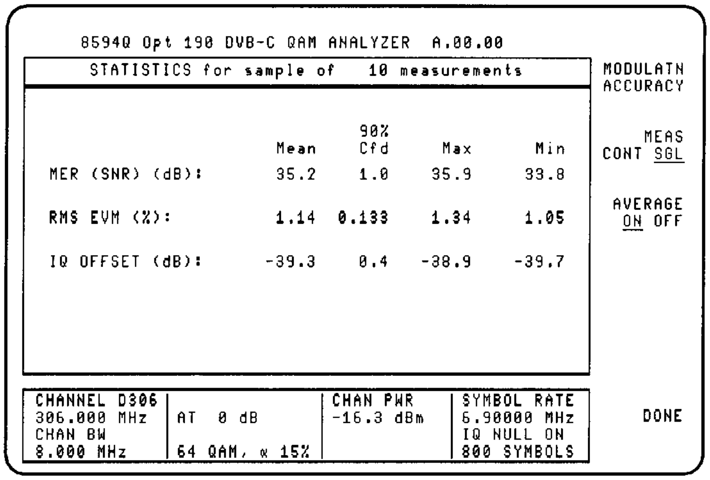


Figure 4-16 Modulation Accuracy Averaged Measurement Example



Modulation Accuracy Softkeys

Modulatn Accuracy	Accesses the Modulation Accuracy Measurement menu.
MODULATN ACCURACY	Initiates the modulation accuracy measurement.
MEAS CONT SGL	Defines how the measurement will be performed. If single (SGL underlined) is selected the measurement will be performed once. If continuous (CONT is underlined) is selected the measurement will be performed continuously until STOP MEAS is pressed the measurement is exited.
AVERAGE ON OFF	Permits a series of measurements to be averaged together. Averaging will reduce the variability of the measurement results. The number of measurements to be averaged together is defined when averaging is activated (ON is underlined).
EQUALIZR ON OFF	Turns the adaptive equalizer on or off. Note that restarting the measurement always turns the adaptive equalizer back on.
View Results[a]	Accesses the menu used to view and compare multiple averaged modulation accuracy measurement results.
VIEW EVM MER[a]	Displays the measurement statistics as EVM or MER. If EVM is selected (EVM is underlined) all EVM measurements currently in the View Results memory will be displayed for comparison. If MER is selected (MER is underlined) all MER measurements currently in the View Results memory will be displayed for comparison. Note that MER is sometimes referred to as in-channel SNR (Signal to Noise Ratio).
CLEAR RESULT[a]	Erases the modulation accuracy data saved for comparing a series of modulation accuracy measurements under View Results.
STOP MEAS	Halts the current measurement in progress.
DONE	Exits you from the current menu.

a. This softkey is accessible only after entering a passkey sequence. See “Viewing Results.”

Procedure

1. Press **More 1 of 3**, then **Modulatn Accuracy** to access the Modulation Accuracy Measurement menu.
2. Select the desired measurement method. The measurement can be executed using one of the following methods.
   - Single, press **MEAS CONT SGL** to underline SGL. When the measurement is started, the analyzer will display results.
   - Continuous, press **MEAS CONT SGL** to underline CONT. When the measurement is started, the analyzer will display continuously updated results.
3. Pressing **AVERAGE ON OFF** turns measurement averaging on or off as described below.
   - Press **AVERAGE ON OFF** to underline ON to turn measurement averaging on.

     The number of measurements to be averaged can be changed to any value between 2 and 999 by pressing **AVERAGE ON OFF**, ON is underlined, then enter the number of averages desired using the data keys on the analyzer. Ten average measurements is the default.

     Note that when **AVERAGE ON OFF** is pressed the analyzer display changes to an active function display that allows you to change the number of averages, then proceeds back to the statistics display.

     Press **AVERAGE ON OFF** to underline OFF to turn measurement averaging off.
4. Press **MODULATN ACCURACY** to execute the measurement. The analyzer takes a few moments to set up for the measurement, then proceeds to perform the measurement.
5. The adaptive equalizer can be turned off using **EQUALIZR ON OFF**. Note that restarting a measurement always turns the adaptive equalizer back on.

Viewing Results Averaged modulation accuracy measurement results are stored in memory. You can view and compare several modulation accuracy measurements using the View Results menu as described below.

NOTE The **VIEW RESULTS** softkey is hidden until a passkey code is entered into the instrument. See “INFORMATION ABOUT VIEWING RESULTS” for procedures to reveal and hide this softkey.

1. Press **VIEW RESULTS** to access the View Results menu.
2. Select the desired measurement statistics from one of the following.
   - Modulation Error Ratio (MER), press **VIEW EVM MER** to underline MER. For more information about MER refer to “INFORMATION ABOUT EVM AND MER” later in this section. See Figure 4-17.
   - Error Vector Magnitude (EVM), press **VIEW EVM MER** to underline EVM. For more information about EVM refer to “INFORMATION ABOUT EVM AND MER” later in this section. See Figure 4-18.
3. Press the analyzer **[⇑]** (step up) or **[⇓]** (step down) keys to scroll through and compare the measurement results in memory.
4. Press **CLEAR RESULTS** to clear the memory of any measurements stored. Note that when the instrument power is cycled the stored results will automatically be cleared from memory.
5. Press **DONE** at any time to exit the View Results menu.

INFORMATION ABOUT VIEWING RESULTS

The **VIEW RESULTS** softkey is hidden until a passkey code is entered into the instrument. A passkey code is required to reveal, and to hide the **VIEW RESULTS** softkey. Both procedures follow below.

Revealing the View Results Softkey

To reveal the **VIEW RESULTS** softkey, perform the following steps:

1. Enter the Modulation Accuracy menu, as you would to make modulation metrics measurements.
2. Press **AVERAGE ON OFF** to select on, (ON is underlined).
3. Press **[—]**, **[1]**, **[0]**, then **[ENTER]**.

   The **VIEW RESULTS** softkey will appear on the Modulation Accuracy menu.

Hiding the View Results Softkey

To hide the **VIEW RESULTS** softkey, perform the following steps:

4. Enter the Modulation Accuracy menu, as you would to make modulation metrics measurements.
5. Press **AVERAGE ON OFF** to select on, (ON is underlined).

Press **[0]**, then **[ENTER]**. The **VIEW RESULTS** softkey will be removed from the Modulation Accuracy menu.

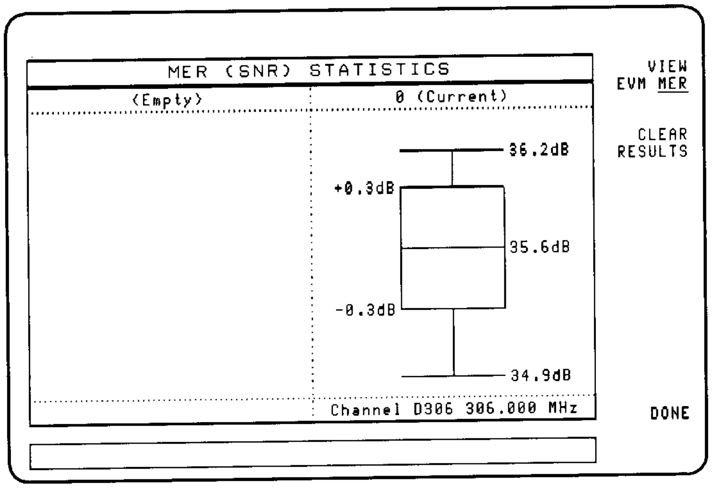


Figure 4-17 MER (SNR) View Results Example

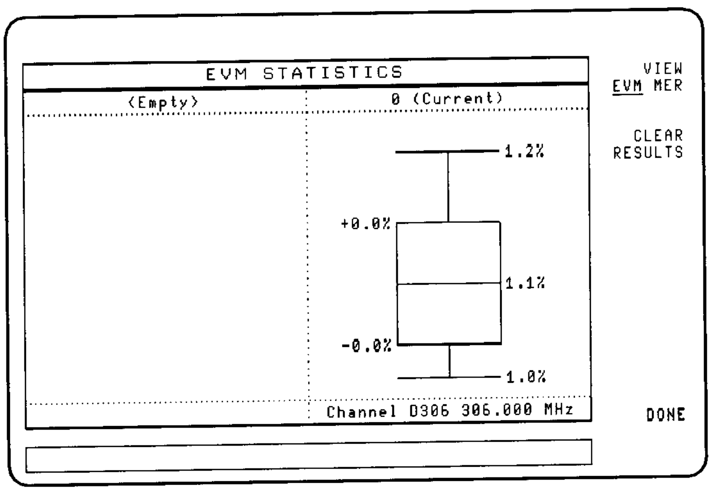


Figure 4-18 EVM View Results Example

INFORMATION ABOUT EVM AND MER

EVM (Error Vector Magnitude) is a linear measure of the impairment added to the digital modulation. As EVM increases, the size of the clusters of points on the constellation increase, as does the probability of making a bit error. See Figure 4-19.

Conceptually,

$$EVM = \frac{\text{Modulation Error Magnitude}}{\text{Peak Modulation Magnitude}} \times 100\%$$

MER (Modulation Error Ratio) is a logarithmic measure of the impairment added to digital modulation. MER is the effective in-channel signal-to-noise ratio of a transmitted signal including not only noise, but impairment due to spurs, distortion and IQ offset. In a digitally modulated signal, spurs, distortion, and IQ offset add impairments that appear to be noise-like. As MER decreases, impairments worsen, increasing the probability of making a bit error.

Conceptually,

$$\text{MER} = 10\log = \frac{\text{Average Modulation Error Magnitude}^2}{\text{Average Modulation Magnitude}^2}$$

In both MER and EVM cases,

$$\text{Modulation Error} = \text{distortion} + \text{noise} + \text{spurs} + \text{IQ offset}$$

IQ offset may be removed from the EVM or MER metric to clarify the measurement of noise, spurs, and distortion. See Figure 4-20 on page 112 for an IQ offset example.

In both EVM and MER equations, if IQ offset is removed from the EVM and MER metrics,

$$\text{Modulation Error} = \text{distortion} + \text{noise} + \text{spurs}$$

If **IQ NULL ON OFF** is set to on (ON is underlined), the IQ offset is automatically removed. The amplitude of the IQ offset is shown as a separate metric.

Figure 4-19 Modulation Error Example

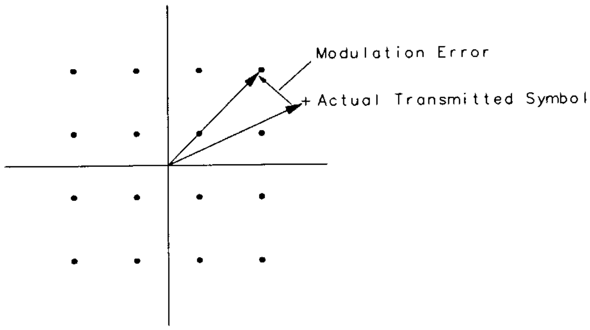
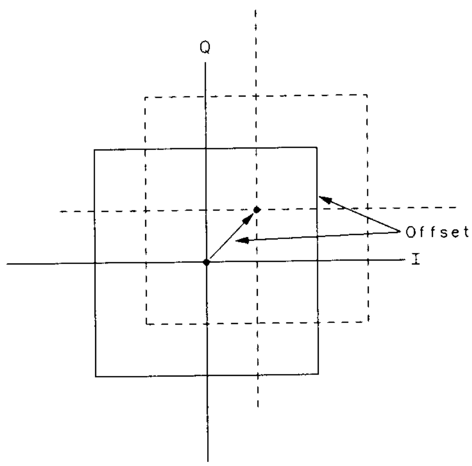


Figure 4-20 IQ Offset Example



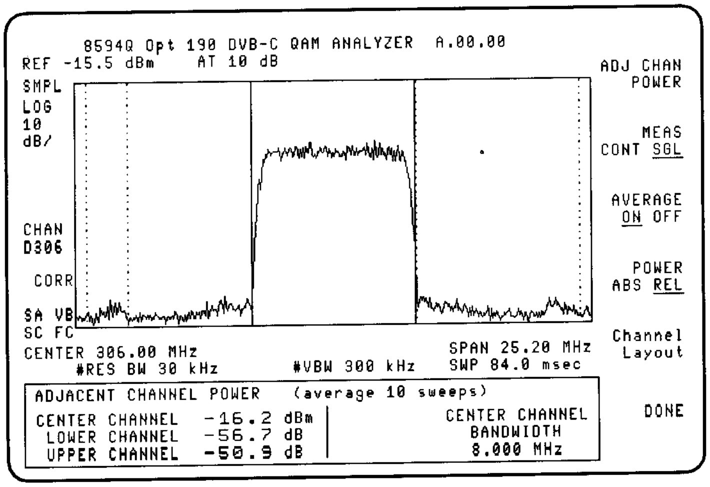
Adjacent Channel Power

The adjacent channel power measurement assists you in measuring the power in the adjacent channels. The measurement calculates the adjacent channel power ratio of both the upper and lower channels, with respect to the reference (center) channel. The absolute power of the reference (center) channel is displayed. The power in adjacent channels in absolute units can also be displayed.

The measurement results can be used to assist in adjusting the power of adjacent carriers. For continuous measurements, the measurement displayed on the analyzer is real time, allowing you to see any problems in the transmission signal or adjacent channels; for example, interference from other channels.

The channel bandwidths and channel spacing can be set to a standard 2, 4, or 8 MHz, or can be customized using the Customized Layout menu.

Figure 4-21 Adjacent Channel Power Measurement Example



Adjacent Channel Power Softkeys

Adj Chan Power	Accesses the Adjacent Channel Power Measurement menu.
ADJ CHAN POWER	Executes the adjacent channel power measurement. The power is measured in the desired reference channel and compares it to the power found in the upper and lower adjacent channels. The absolute power of the reference center channel is displayed. The adjacent channel power ratios of both adjacent channels are displayed. The vertical dotted and solid lines indicate the bandwidth edges of the three different channels being measured.
MEAS CONT SGL	Defines how the measurement will be performed. If single (SGL underlined) is selected the measurement will be performed once. If continuous (CONT is underlined) is selected the measurement will be performed continuously until STOP MEAS is pressed or the measurement is exited.
AVERAGE ON OFF	Permits a series of measurements to be averaged together. Averaging will reduce the variability of the measurement results. The number of measurements to be averaged together is defined when averaging is activated (ON is underlined).
POWER ABS REL	Defines how the adjacent channels will be measured, as absolute (ABS is underlined) or relative (REL is underlined) power to the center channel.
Channel Layout	Accesses the menus for configuring the channels to be measured in the adjacent channel power measurement.
LAYOUT STD CUST	Selects between a standard (STD is underlined) configuration of adjacent channel and custom (CUST is underlined) configuration of adjacent channel bandwidths for adjacent channel power measurement. Standard allows selection of 2 MHz and 8 MHz channel bandwidths. Custom allows arbitrary channel bandwidths.

LOWER CH 2 4 8	Selects the bandwidth of the lower adjacent channel, choosing between 2 MHz, 4 MHz, or 8 MHz standard DVB-C channel bandwidths.
LOWER CH OFFSET	Defines the position of the lower adjacent channel relative to the center frequency of the reference channel.
LOWER CHAN BW	Selects the bandwidth of the lower adjacent channel, using the front-panel knob to adjust to a custom arbitrary channel bandwidth. This softkey is only present in the custom mode (LAYOUT STD CUST CUST is underlined).
UPPER CHAN 2 4 8	Selects the bandwidth of the upper adjacent channel, choosing between 2 MHz, 4 MHz, or 8 MHz standard DVB-C channel bandwidths.
UPPER CH OFFSET	Defines the position of the upper adjacent channel relative to the center frequency of the reference channel.
UPPER CHAN BW	Selects the bandwidth of the upper adjacent channel, using the front-panel knob to adjust to a custom arbitrary channel bandwidth. This softkey is only present in the custom mode (**LAYOUT STD CUST** CUST is underlined).
STOP MEAS	Halts the current measurement in progress.
DONE	Pressing this softkey indicates you are finished with the current menu and will return you to the previous menu in the menu tree.

NOTE Channel layout parameters are stored in non-volatile memory like the parameters in the Setup menu. This means that the analyzer retains the information, even when power is turned off or **[PRESET]** is pressed, until you access the Channel Layout menu again and change it or press the **DEFAULT SETUP** key twice. See Table 4-5.

Table 4-6 Channel Layout Default Conditions

Function Softkey	Default Value
LAYOUT STD CUST	Standard (STD underlined)
LOWER CH 2 4 8	8 MHz (8 underlined)
LOWER CH OFFSET	8 MHz
UPPER CH 2 4 8	8 MHz (8 underlined)
UPPER CH OFFSET	8 MHz

Procedure

1. Press **More 1 of 3**, then **Adj Chan Power** to access the Adjacent Channel Power Measurement menu.
2. Select the desired measurement method. The adjacent channel power can be measured using one of the following methods:
   - Single, press **MEAS CONT SGL** to underline SGL. When the measurement is started the analyzer will make one complete measurement and pause.
   - Continuous, press **MEAS CONT SGL** to underline CONT. When the measurement is started the measurement results will be continuously updated from sweep to sweep.
3. Pressing **AVERAGE ON OFF** turns measurement averaging on or off as described below.
   - Press **AVERAGE ON OFF** to underline ON to turn measurement averaging on. Note that averaging is only used in single (SGL) mode.

     The number of measurement sweeps for the test can be changed to any value between 2 and 999 by pressing **AVERAGE ON OFF** until ON is underlined, then enter the number of sweeps to averaged using the data keys on the analyzer. Ten average measurements is the default.

     Note that when **AVERAGE ON OFF** is pressed the analyzer display changes to an active function display that allows you to change the number of averages.

     Press **AVERAGE ON OFF** to underline OFF to turn measurement averaging off.
4. Select the method to display the power of adjacent channels.
   - Relative (to the center channel) power, press **POWER ABS REL** to underline REL.
   - Absolute power, press **POWER ABS REL** to underline ABS.
5. Define the adjacent channels by pressing **Channel Layout**, then select the desired upper and lower channel bandwidths and offsets using one of the following methods.
   - Standard, **LAYOUT STD CUST** is underlined.

     The lower and upper bandwidths over which the power is measured is selected using the softkeys **LOWER CH 2 4 8** and **UPPER CH 2 4 8** (underline the desired bandwidth).

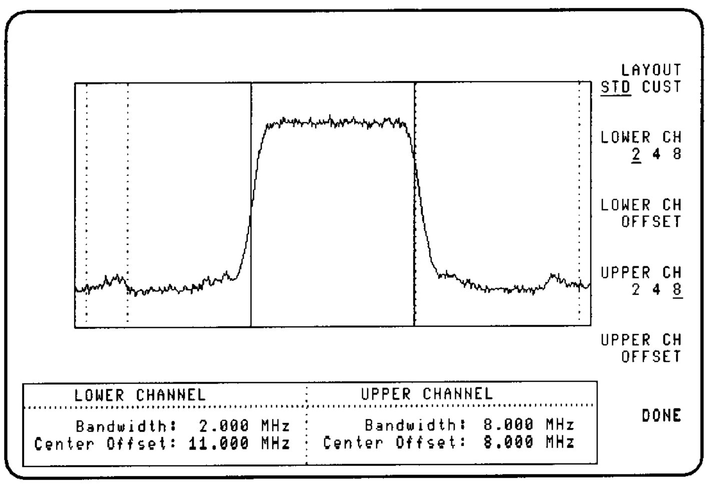
The lower and upper channel offsets defines the position of the bandwidth and can be set using the softkeys **LOWER CH OFFSET** and **UPPER CH OFFSET**. Press the key until the desired offset is achieved. Note that the offset is defined by dashed vertical lines on the analyzer display.

- Custom, **LAYOUT STD CUST** CUST is underlined.

  The lower and upper bandwidths over which the power is measured is selected using the softkeys **LOWER CHAN BW** and **UPPER CHAN BW**. The front-panel knob is used to define the channel bandwidth. Note that the bandwidth is defined by dotted vertical lines on the analyzer display.

  The lower and upper channel offsets defines the position of the bandwidth and can be set using the softkeys **LOWER CH OFFSET** and **UPPER CH OFFSET**. The front-panel knob is used to define the channel offsets. Note that the offset is defined by dashed vertical lines on the analyzer display.

Figure 4-22 Adjacent Channel Power Layout Example



6. To measure the adjacent channel power, press **ADJ CHAN POWER**.

   The measurement can be stopped at any time by pressing **STOP MEAS**. Note that when using the single method, the measurement will stop automatically when the measurement is completed. However, the measurement can always be stopped before the measurement is complete by pressing **STOP MEAS.**

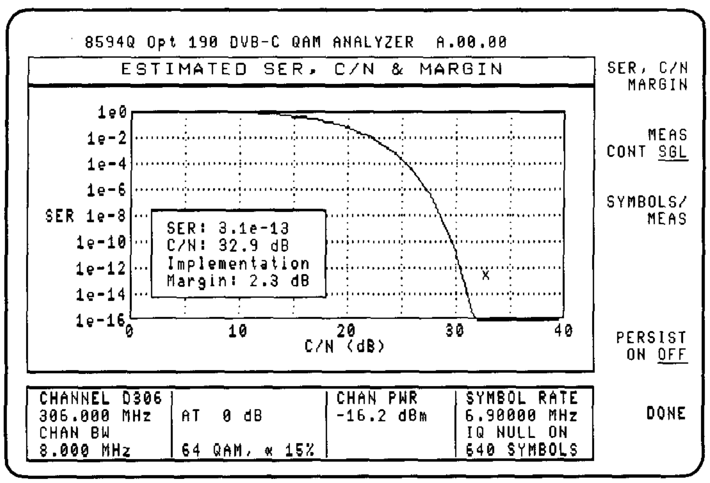
7. Press **DONE** to exit the Adjacent Channel Power Measurement menu.

SER, C/N and Margin

The symbol error rate (SER), carrier-to-noise ratio (C/N) and implementation margin measurement estimates SER, and carrier-to-noise, and calculates the implementation margin of the transmission signal. The SER, C/N margin measurement is a qualitative measurement that is useful in comparing systems.

The estimated SER is the probability of making a symbol error during the transmission. C/N is the ratio of the average signal power to the noise power. The implementation margin illustrates how far away from theoretical perfect is the transmission. The SER is displayed on the y-axis of the display, C/N is displayed on the x-axis. An “X” is displayed on screen to denote the current estimated system operating point. The implementation margin is how far from the theoretical perfect (curve drawn on screen) is the measurement result in the x-direction. See Figure 4-23.

Figure 4-23 SER, C/N Margin Measurement Example



SER, Carrier-to-Noise Margin Softkeys

SER, C/N Margin Accesses the SER, Carrier to Noise and Implementation Margin Measurement menu.

SER, C/N MARGIN Executes the SER, Carrier to Noise and Implementation Margin Measurement.

MEAS CONT SGL Defines how the measurement will be performed. If single (SGL underlined) is selected the measurement will be performed once. If continuous (CONT is underlined) is selected the measurement will be performed continuously until **STOP MEAS** is pressed or the measurement is exited.

SYMBOLS/MEAS Defines the number of symbols to include in the measurement. A symbol is a set of data bits defined by the digital modulation format.

PERSIST ON OFF Each previous measurement point remains on screen over multiple measurements when persist is on (ON is underlined).

STOP MEAS Halts the current measurement in progress.

DONE Pressing this softkey indicates you are finished with the current menu and will return you to the previous menu in the menu tree.

Procedure

1. Press **More 1 of 3**, then **SER, C/N Margin** to access the Symbol Error Rate and Carrier to Noise Measurement menu.
2. Select the desired measurement method. The symbol error rate (SER) and carrie to noise margin measurement can be measured using one of the following methods:
   - Single, press **MEAS CONT SGL** to underline SGL. The measurement result is of one sweep.
   - Continuous, press **MEAS CONT SGL** to underline CONT. The measurement result is displayed as it is continuously updated.
3. To change the number of symbols per measurement, press **SYMBOLS/MEAS**, then enter the number of symbols desired for the measurement using the analyzer data keys. The default symbols per measurement is 640.

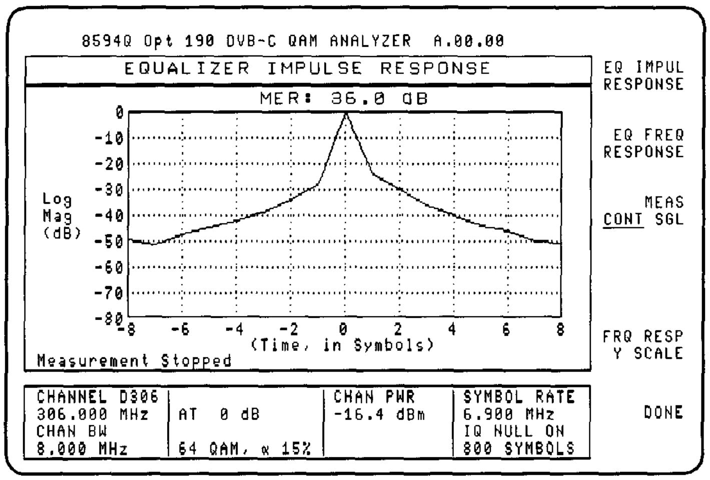
NOTE It is recommended to use the default of 640 symbols. The more symbols chosen, the longer the measurement will take.

4. If desired, turn persist on by pressing **PERSIST ON OFF** to underline ON. Persist allows you to make measurement comparisons over time by allowing multiple measurement results to remain on screen. Press **PERSIST ON OFF** to underline OFF to turn this function off.
5. Press **DONE** exit the SER, C/N Margin Measurement menu.

Equalizer Impulse Response

The equalizer (EQ) impulse response measurement is helpful in identifying echoes and the distance and size of micro-reflections in the cable network. The analyzer displays the response of the adaptive equalizer incorporated in the analyzer. The displayed response is a function of time, in symbols limited to –8 to +8. See Figure 4-24. Depending on the symbol rate used, the time in symbols can be translated into a distance to the reflection.

Figure 4-24 Equalizer Impulse Response Measurement Example



EQ Impulse Response Softkeys

Channel Response	Accesses the menu for viewing the 8594Q QAM analyzer internal adaptive equalizer time and frequency response.
EQ IMPUL RESPONSE	Initiates the measurement and display of the internal adaptive equalizer impulse response. This reflects the time response of the actual transmission channel, exposing micro-reflections within the range of the adaptive equalizer.
MEAS CONT SGL	Defines how the measurement will be performed. If single (SGL underlined) is selected the measurement will be performed once. If continuous (CONT is underlined) is selected the measurement will be performed continuously until **STOP MEAS** is pressed or the measurement is exited.
EQUALIZR ON OFF	Turns the adaptive equalizer on or off. Note that restarting the measurement always turns the adaptive equalizer back on.
DISPLAY EVM MER	Selects either EVM (Error Vector Magnitude) or MER (Modulation Error Ratio) to be displayed as a modulation accuracy metric.
STOP MEAS	Halts the current measurement in progress.
DONE	Pressing this softkey indicates you are finished with the current menu and will return you to the previous menu in the menu tree.

Procedure

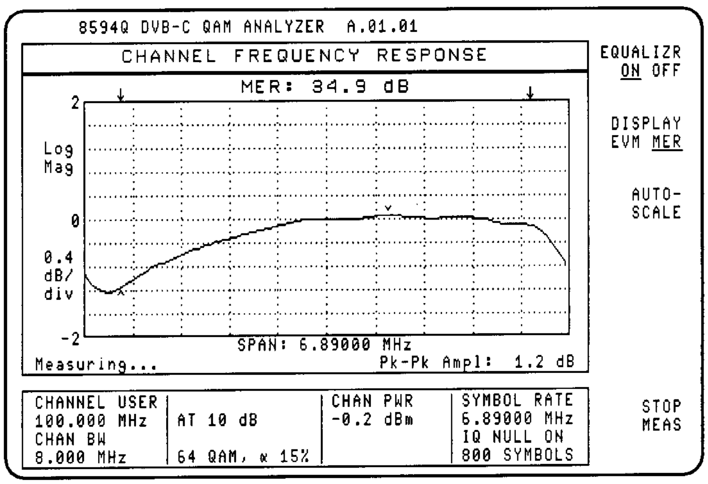
1. Press **More 1 of 3**, then **Channel Response** to access the Equalizer (EQ) Measurement menu.
2. Select the desired measurement method. The channel response measurements can be measured using one of the following methods:
   - Single, press **MEAS CONT SGL** to underline SGL. The measurement result is of one sweep.
   - Continuous, press **MEAS CONT SGL** to underline CONT. The measurement result is displayed as it is continuously updated.
3. The adaptive equalizer can be turned off using **EQUALIZR ON OFF**. Note that restarting a measurement always turns the adaptive equalizer back on.
4. Measurements are accompanied by the display of a metric: either as EVM (Error Vector Magnitude, in percent) or as MER (Modulation Error Ratio, in dB). While a continuous measurement is running, you may press DISPLAY EVM MER to underline EVM or MER as desired.
5. To measure the EQ impulse response, press **EQ IMPUL RESPONSE**.

   The measurement can be stopped at any time by pressing **STOP MEAS**. Note that when using the single method the measurement will stop automatically when the measurement is completed. However, the measurement can always be stopped before the measurement is complete by pressing **STOP MEAS**.
6. Press **DONE** to exit the Channel Response Measurement menu.

Channel Frequency Response

The channel (CH) frequency response is a non-intrusive measurement helpful in identifying the passband amplitude characteristics of the channel. The analyzer displays the inverse of the corrections made by the internal adaptive equalization filter of the analyzer to make the channel flat. The displayed response is a function of frequency with a span equal to the symbol rate. The measurement range is indicated by markers at the top of the grid while trace markers indicate the peak-to peak amplitude flatness excursions. See Figure 4-25.

Figure 4-25 Channel Frequency Response Measurement Example



The measurement range is calculated as follows:

$$Measurement\ Range = Symbol\ Rate - (\alpha \times Symbol\ Rate)$$

Where α is the baseband filter shaping factor, 0.15 (15% for example).

CH Frequency Response Softkeys

Channel Response	Accesses the menu for viewing the internal adaptive equalizer time and frequency response.
CH FREQ RESPONSE	Initiates the measurement and display of the frequency response of the transmission channel. This is the inverse of the frequency response of the internal adaptive equalizer.
MEAS CONT SGL	Defines how the measurement will be performed. If single (SGL underlined) is selected the measurement will be performed once. If continuous (CONT is underlined) is selected the measurement will be performed continuously until **STOP MEAS** is pressed or the measurement is exited.
EQUALIZR ON OFF	Turns the adaptive equalizer on or off. Note that restarting the measurement always turns the adaptive equalizer back on.
DISPLAY EVM MER	Selects either EVM (Error Vector Magnitude) or MER (Modulation Error Ratio) to be displayed as a modulation accuracy metric.
FRQ RESP Y SCALE	Allows you to adjust the y-axis dB scaling for best display of the channel frequency response.
AUTO-SCALE	Automatically adjusts the y-axis dB scaling for best display of the channel frequency response.
STOP MEAS	Halts the current measurement in progress.
DONE	Pressing this softkey indicates you are finished with the current menu and will return you to the previous menu in the menu tree.

Procedure

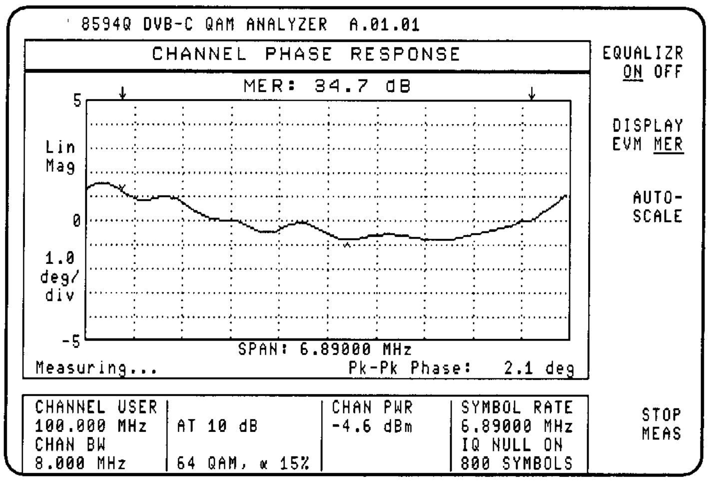
1. Press **More 1 of 3**, then **Channel Response** to access the Equalizer (EQ) Measurement menu.
2. Select the desired measurement method. The channel response measurements can be measured using one of the following methods:
   - Single, press **MEAS CONT SGL** to underline SGL. The measurement result is of one sweep.
   - Continuous, press **MEAS CONT SGL** to underline CONT. The measurement result is displayed as it is continuously updated.
3. The adaptive equalizer can be turned off using **EQUALIZR ON OFF**. Note that restarting a measurement always turns the adaptive equalizer back on.
4. Measurements are accompanied by the display of a metric: either as EVM (Error Vector Magnitude, in percent) or as MER (Modulation Error Ratio, in dB). While a continuous measurement is running, you may press **DISPLAY EVM MER** to underline EVM or MER as desired.
5. To change the scale of the “Y” axis of the EQ frequency response measurement display press FRQ RESP Y SCALE. The analyzer display changes to an active function display that allows you to enter the desired scale for the “Y” axis using the analyzer data keys. This function allows you to adjust the display for the best range.
6. To measure the channel frequency response, press **CH FREQ RESPONSE**. Press **AUTO-SCALE** to automatically adjust the “Y” axis scaling if required.

   The measurement can be stopped at any time by pressing **STOP MEAS**. Note that when using the single method the measurement will stop automatically when the measurement is completed. However, the measurement can always be stopped before the measurement is complete by pressing **STOP MEAS**.
7. Press **DONE** to exit the Channel Response Measurement menu.

Channel Phase Response

The channel (CH) phase response is a non-intrusive measurement helpful in identifying the passband phase characteristics of the channel. The analyzer uses the corrections made by the internal adaptive equalization filter to determine the channel phase characteristics. The displayed response, in degrees, is a function of frequency with a span equal to the symbol rate. The measurement range is indicated by markers at the top of the grid while trace markers indicate the peak-to-peak phase excursions. See Figure 4-26.

Figure 4-26 Channel Phase Response Measurement Example



The measurement range is calculated as follows:

$$\textit{Measurement Range} = \textit{Symbol Rate} - (\alpha \times \textit{Symbol Rate})$$

Where α is the baseband filter shaping factor, 0.15 (15% for example).

CH Phase Response Softkeys

Phase Response	Accesses the menu for viewing the channel time and phase response.
CH PHASE RESPONSE	Initiates the measurement and display of the phase response of the transmission channel.
MEAS CONT SGL	Defines how the measurement will be performed. If single (SGL underlined) is selected the measurement will be performed once. If continuous (CONT is underlined) is selected the measurement will be performed continuously until **STOP MEAS** is pressed or the measurement is exited.
EQUALIZR ON OFF	Turns the adaptive equalizer on or off. Note that restarting the measurement always turns the adaptive equalizer back on.
DISPLAY EVM MER	Selects either EVM (Error Vector Magnitude) or MER (Modulation Error Ratio) to be displayed as a modulation accuracy metric.
PHA RESP Y SCALE	Allows you to adjust the y-axis degree scaling for best display of the channel phase response. Range 1 to 500 degrees.
AUTO-SCALE	Automatically adjusts the y-axis degree scaling for best display of the channel phase response.
STOP MEAS	Halts the current measurement in progress.
DONE	Pressing this softkey indicates you are finished with the current menu and will return you to the previous menu in the menu tree.

Procedure

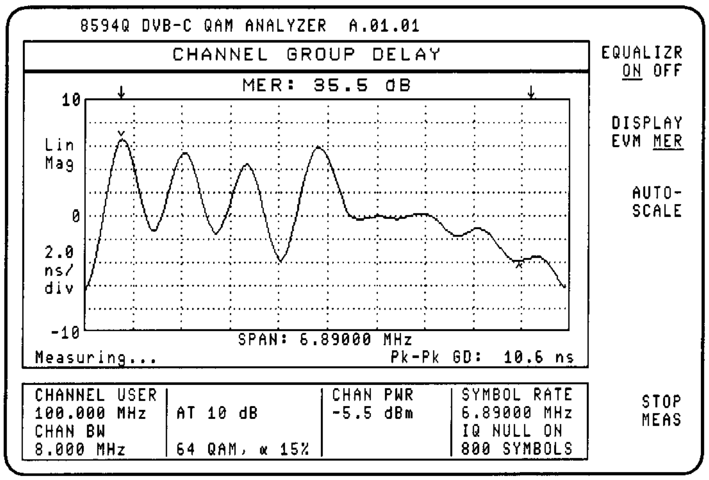
1. Press **More 1 of 3**, then **Phase Response** to access the Phase Measurement menu.
2. Select the desired measurement method. The phase response measurements can be measured using one of the following methods:
   - Single, press **MEAS CONT SGL** to underline SGL. The measurement result is of one sweep.
   - Continuous, press **MEAS CONT SGL** to underline CONT. The measurement result is displayed as it is continuously updated.
3. The adaptive equalizer can be turned off using **EQUALIZR ON OFF**. Note that restarting a measurement always turns the adaptive equalizer back on.
4. Measurements are accompanied by the display of a metric: either as EVM (Error Vector Magnitude, in percent) or as MER (Modulation Error Ratio, in dB). While a continuous measurement is running, you may press **DISPLAY EVM MER** to underline EVM or MER as desired.
5. To change the scale of the “Y” axis of the CH frequency response measurement display press **PHA RESP Y SCALE**. The analyzer display changes to an active function display that allows you to enter the desired scale for the “Y” axis using the analyzer data keys. This function allows you to adjust the display for the best range.
6. To measure the channel phase response, press **CH PHASE RESPONSE**. Press **AUTO-SCALE** to automatically adjust the “Y” axis scaling if required.

   The measurement can be stopped at any time by pressing **STOP MEAS**. Note that when using the single method the measurement will stop automatically when the measurement is completed. However, the measurement can always be stopped before the measurement is complete by pressing **STOP MEAS**.
7. Press **DONE** to exit the Phase Response Measurement menu.

Channel Group Delay

The channel (CH) group delay is a non-intrusive measurement helpful in identifying the passband group delay characteristics of the channel. The analyzer uses the corrections made by the internal adaptive equalization filter. The displayed response, in nano-seconds, is a function of frequency with a span equal to the symbol rate. The measurement range is indicated by markers at the top of the grid while trace markers indicate the peak-to-peak group delay excursions. See Figure 4-27.

Figure 4-27 Channel Group Delay Measurement Example



The measurement range is calculated as follows:

$$Measurement\ Range = Symbol\ Rate - (\alpha \times Symbol\ Rate)$$

Where α is the baseband filter shaping factor, 0.15 (15% for example).

CH Group Delay Softkeys

Phase Response	Accesses the menu for viewing the channel time and phase response.
CH GROUP DELAY	Initiates the measurement and display of the group delay in the transmission channel.
MEAS CONT SGL	Defines how the measurement will be performed. If single (SGL underlined) is selected the measurement will be performed once. If continuous (CONT is underlined) is selected the measurement will be performed continuously until **STOP MEAS** is pressed or the measurement is exited.
EQUALIZR ON OFF	Turns the adaptive equalizer on or off. Note that restarting the measurement always turns the adaptive equalizer back on.
DISPLAY EVM MER	Selects either EVM (Error Vector Magnitude) or MER (Modulation Error Ratio) to be displayed as a modulation accuracy metric.
GRP DLY Y SCALE	Allows you to adjust the y-axis nanosecond scaling for best display of the channel group delay. Range 1 to 500 nanoseconds.
AUTO-SCALE	Automatically adjusts the y-axis nanosecond scaling for best display of the channel group delay.
STOP MEAS	Halts the current measurement in progress.
DONE	Pressing this softkey indicates you are finished with the current menu and will return you to the previous menu in the menu tree.

Procedure

1. Press **More 1 of 3**, then **Phase Response** to access the Phase Measurement menu.
2. Select the desired measurement method. The channel response measurements can be measured using one of the following methods:
   - Single, press **MEAS CONT SGL** to underline SGL. The measurement result is of one sweep.
   - Continuous, press **MEAS CONT SGL** to underline CONT. The measurement result is displayed as it is continuously updated.
3. The adaptive equalizer can be turned off using **EQUALIZR ON OFF**. Note that restarting a measurement always turns the adaptive equalizer back on.
4. Measurements are accompanied by the display of a metric: either as EVM (Error Vector Magnitude, in percent) or as MER (Modulation Error Ratio, in dB). While a continuous measurement is running, you may press **DISPLAY EVM MER** to underline EVM or MER as desired.
5. To change the scale of the “Y” axis of the group delay measurement display press **GRP DLY Y SCALE**. The analyzer display changes to an active function display that allows you to enter the desired scale for the “Y” axis using the analyzer data keys. This function allows you to adjust the display for the best range.
6. To measure the channel group delay, press **CH GROUP DELAY**. Press **AUTO-SCALE** to automatically adjust the “Y” axis scaling if required.

   The measurement can be stopped at any time by pressing **STOP MEAS**. Note that when using the single method the measurement will stop automatically when the measurement is completed. However, the measurement can always be stopped before the measurement is complete by pressing **STOP MEAS**.
7. Press **DONE** to exit the Phase Response Measurement menu.

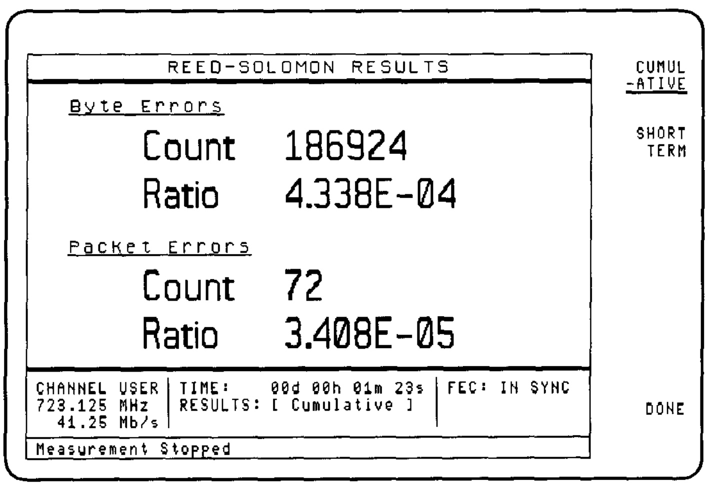
Reed-Solomon Bit, Byte and Packet Error

(Option 195 required)

Bit Error Ratio (BER) is a generally accepted measurement of quality in digital systems. Option 195 offers 2 methods of making this measurement. To gain an indication of system performance, the Reed-Solomon Bit/Packet Error Measurement allows in-service BER estimation. While this is a recommended method for in-service testing, true measurement of BER requires test data patterns and is best performed out-of-service, typically during installation or troubleshooting. Use the ""PRBS and Packetized Bit Error Rate" on page 138 for full BER testing.

To enable the correction of transmission errors, Forward Error Correction (FEC) is applied to the signal. For DVB-C, Reed-Solomon channel coding is implemented. The 8594Q QAM analyzer with Option 195 uses a real-time decoder to recover the MPEG-2 transport stream. While good transportation requires little error correction, poor performance in the system requires high error correction activity. This error correction activity in the decoder is continually monitored and used to generate the Bit (estimated), Byte and Packet Error Counts and Ratios presented on the analyzer display. See Figure 4-28.

Figure 4-28 Reed-Solomon Byte/Packet Error Measurement Example



Reed-Solomon Softkeys

Reed-Sol Errors	Accesses the Reed-Solomon error counting measurement menu.
START REEDSOL	Initiates the measurement and display of the byte and packet errors determined by Forward Error Correction system during the real-time decoding of the transport stream.
ERRORS BYTE BIT	Use this softkey to display byte (BYTE underlined) or estimated[a] bit (BIT underlined) errors in the top half of the measurement display window. The lower half always displays Packet errors.
RESET MEAS	Stops the current measurement, resets all counters and displayed results. The measurement is then restarted.
Result Type	Accesses the cumulative/short term menu.
CUMULATIVE	Pressing this softkey configures the analyzer to perform the measurement continuously, incrementing the displays until **STOP MEAS** or **RESET MEAS** is pressed.
SHORT TERM	This softkey configures the analyzer to accumulate errors during intervals specified by pressing **PERIOD**. The results are displayed at the end of each interval and a new measurement is initiated.
PERIOD	Use this softkey to specify the measurement duration when you have selected **SHORT TERM** from the **Result Type** menu. A duration of 1 to 999 seconds is valid.
RE-LOCK MEAS	Restart the measurement from an error condition. (All previous measurement data is discarded.)
STOP MEAS	Halts the measurement.
DONE	Pressing this softkey returns you to the previous menu in the menu tree.

a. Refer to MEASUREMENT NOTES for more details of Bit Error estimation.

Procedure

1. Press **More 1 of 3**, **More 2 of 3**, then **Reed-Sol Errors** to access the Reed-Solomon Measurement menu.
2. Select the desired measurement and display method by pressing **Result Type**.
   - To accumulate the error count, press **CUMULATIVE**. Each new error increments the counter and displayed result.
   - To count errors for a specific time interval, press **SHORT TERM**. The errors are counted during the time interval specified. At the end of the period the result is displayed, the counter reset and a new measurement interval started. The result remains visible until each subsequent measurement is complete.

   Press **DONE** to return to the previous menu.
3. If you selected SHORT TERM at the previous step, now press **PERIOD** to specify the time interval. Use the Data Keys, Step Keys or Knob to enter the required time value in seconds. (The range is 1 to 999 seconds.)
4. To start the measurement, press **START REEDSOL**. The measurement can be stopped at any time by pressing **STOP MEAS**. You can stop and restart the measurement by pressing **RESET MEAS**.

   If **MEAS UNLOCK** is displayed at any time press **RE-LOCK MEAS** to reacquire the signal or **STOP MEAS** to terminate the measurement.
5. Display byte errors by pressing **ERRORS BYTE BIT** to underline BYTE. To display bit errors press **ERRORS BYTE BIT** to underline BIT.
6. Press **STOP MEAS**, **DONE** to exit the measurement.

MEASUREMENT NOTES

There are only two possible packet types; ‘Good’ and ‘Bad’. The forward Error Correction system (Reed-Solomon) used in DVB-C can correct up to 8 byte errors in any one packet. Thus errors which can be corrected result in ‘Good’ packets. Higher error rates cannot be corrected, the packet is therefore labeled ‘Bad’.

Error rates lower than 8 bytes per packet increment the Byte/Bit Error Count. When packets are found to have more than 8 byte errors (‘Bad’) the Packet Error Count is incremented. However, ‘Bad’ packets do not increment the Byte/Bit Error Count since the actual quantity of byte errors is undetermined.

When there are no Packet Errors, the recovered MPEG-2 transport stream available from the analyzer is error free. Ensure you have selected auto (AUTO underlined) from the **FEC Setup**, **DATA OUT AUTO OFF** menu if you want to make the transport stream available at the DVB-PI and DVB-ASI ports.

The relationship between symbol, byte and bit errors is not the simple 1:1 ratio which might be expected.

The majority of symbol errors cause only one bit error due to the GRAY coding implemented within each quadrant of IQ space. However, symbol errors which cause the received symbol to be decoded in the wrong quadrant can cause multiple bit errors, and also affect more than one symbol due to differential decoding. The byte to symbol mapping means that each byte is made up from more than one symbol this can lead to more than one byte error for a single symbol error. Hence, a measured byte error may mean more than one bit error.

The above effect is included in the estimation calculation of the displayed Bit Error Count and Ratio.

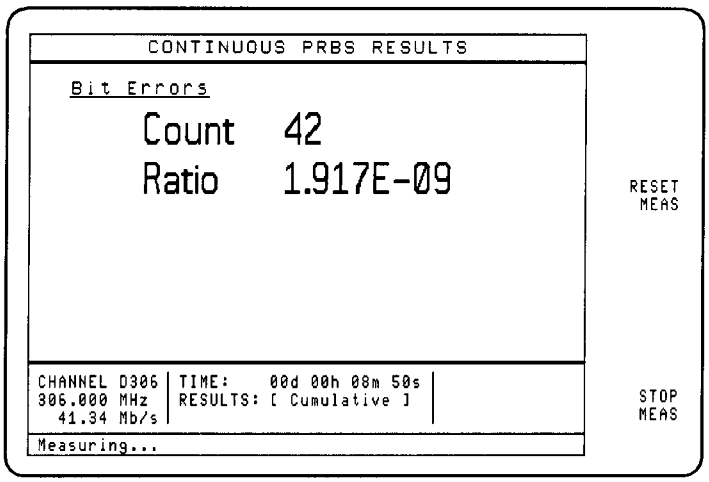
PRBS and Packetized Bit Error Rate

(Option 195 required)

Bit Error Ratio (BER) is a generally accepted measurement of quality in digital systems. Option 195 offers 2 methods of making this measurement. BER measurements require a known data pattern and are best performed out-of-service, typically during installation or troubleshooting. A non-intrusive, in-service estimation of BER can be achieved using the “Reed-Solomon Bit, Byte and Packet Error”. The PRBS and Packetized Bit Error Rate Measurement enables true BER testing.

The 8594Q QAM analyzer with Option 195 is configured to make BER measurements using a variety of data patterns. While a continuous 2^{23}-1 PRBS provides a basic test pattern, measuring the payload of only specific packets (identified by PID) adds versatility to the measurement. The results are displayed as shown in Figure 4-29.

Figure 4-29 Continuous PRBS Measurement Example



PRBS/Pkt Softkeys

PRBS/Pkt Bit Errors Accesses the PRBS and Packetized measurement menu.

START PRBS Initiates the measurement and display of the bit errors contained in the continuous or packetized data stream.

RESET MEAS Stops the current measurement, resets all counters and displayed results. The measurement is then restarted.

Meas Type Pressing this softkey accesses the data format menu, allowing you to set up the analyzer to measure continuous or packetized data streams.

CONTINUOUS Pressing this softkey performs the bit error measurement using a continuous 2^{23}-1 PRBS data stream. Each measurement is made over 204 bytes. Reed-Solomon encoding is not applied to this data stream. See Figure 4-30.

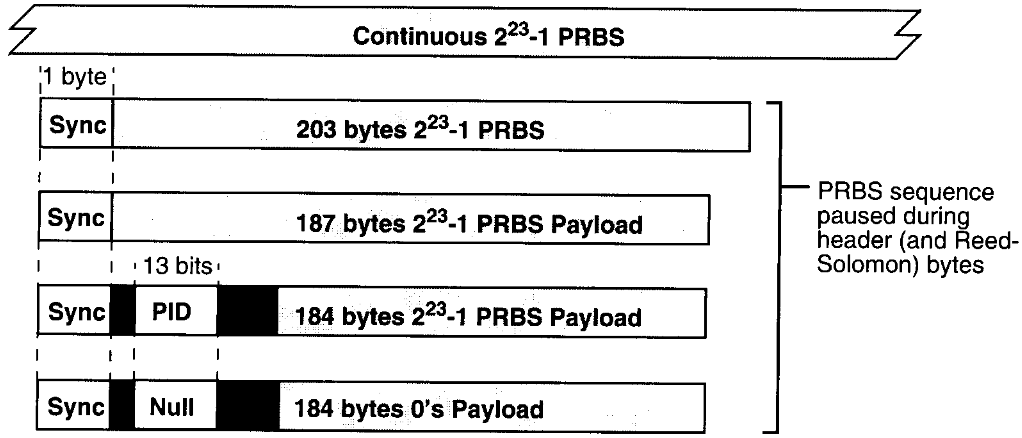
SYNC+203 PRBS Pressing this softkey performs the bit error measurement using 203 bytes of a 204 byte data stream consisting of a synchronization byte (47 hex) and 203 bytes of 2^{23}-1 PRBS. Reed-Solomon encoding is not applied to this data stream. See Figure 4-30.

SYNC+187 PRBS Pressing this softkey performs the bit error measurement using only 187 bytes of the 188 byte packets recovered from 204 byte Reed-Solomon encoded packets. The packet consists of a synchronization byte (47 hex) and a 187 byte payload of 2^{23}-1 PRBS. See Figure 4-30.

SYNC+PID+PRBS Pressing this softkey performs the bit error measurement using only 184 bytes of the 188 byte packets identified by a specified PID recovered from 204 byte Reed-Solomon encoded packets. The packet consists of a synchronization byte (47 hex), PID and a 184 byte payload of 2^{23}-1 PRBS. See Figure 4-30.

SYNC+NUL+0000’s	Pressing this softkey performs the bit error measurement using all 188 bytes of the packets identified by a Null PID recovered from 204 byte Reed-Solomon encoded packets. The packet consists of a synchronization byte (47 hex), Nulled PID and a 184 byte payload of zeros. See Figure 4-30.
Result Type	Accesses the cumulative/short term menu.
CUMULATIVE	Pressing this softkey configures the analyzer to run the measurement and continuously update the display until **STOP MEAS** or **RESET MEAS** is pressed.
SHORT TERM	This softkey configures the analyzer to accumulate errors during the interval specified by pressing **PERIOD**. The results are displayed at the end of the interval and a new measurement is initiated.
PERIOD	Use this softkey to specify the measurement duration when you have selected **SHORT TERM** from the **Result Type** menu. A duration of 1 to 999 seconds is valid.
STOP MEAS	Halts the measurement.
SET PID	Accesses the menu where you can specify the PID (in Hex) for the packetized SYNC + PID + PRBS data format. Numeric values are entered using the Data Keys while **A**, **B**, **C**, **D**, **E** and **F** softkeys enable alpha value entry.
RE-LOCK MEAS	Restart the measurement from an error condition. (All previous measurement data is discarded.)
DONE	Pressing this softkey returns you to the previous menu in the menu tree.

Figure 4-30 PRBS/Packetized BER Measurement Data Formats

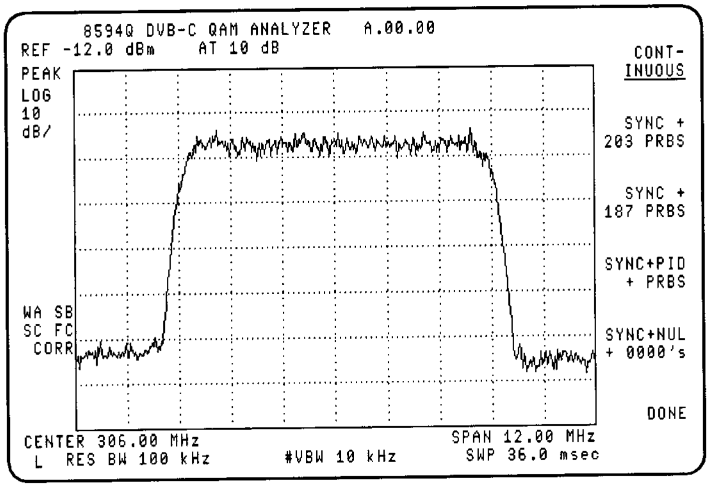


Procedure

1. Press **More 1 of 3**, **More 2 of 3**, then **PRBS,Pkt BER** to access the PRBS and Packetized BER Measurement menu.
2. Select the desired measurement and display method by pressing **Result Type**.
   - To accumulate the error count, press **CUMULATIVE**. Each new error increments the counter and displayed result.
   - To count errors for a specific time interval, press **SHORT TERM**. The errors are counted during the time interval specified. At the end of the period the result is displayed, the counter reset and a new measurement started. The result remains visible until each subsequent measurement is complete.

   Press **DONE** to return to the previous menu.
3. If you selected SHORT TERM at the previous step, now press **PERIOD** to specify the time interval. Use the Data Keys, Step Keys or Knob to enter the required time value in seconds. (The range is 1 to 999 seconds.)
4. Press **Meas Type** to access the measurement type menu and configure the analyzer to use the transport streams available on your network.
   - To use a continuous stream of 2^{23}-1 PRBS data, press **CONTINUOUS**.
   - To use a continuous stream of sync byte followed by 203 bytes of 2^{23}-1 PRBS data, press `SYNC+203 PRBS`.
   - To use Reed-Solomon encoded packetized data with each packet containing a sync byte and a payload of 187 bytes of 2^{23}-1 PRBS data, press **SYNC+187 PRBS**.
   - To use Reed-Solomon encoded packetized data with each packet containing a sync byte, a Packet Identifier (PID) and a payload of 184 bytes of 2^{23}-1 PRBS data, press **SYNC+PID+PRBS**.
   - To use Reed-Solomon encoded packetized data with each packet containing a sync byte, a nulled Packet Identifier (PID) and a payload of zero's, press **SYNC+NUL+0000's**.

Figure 4-31 Test Signal Selection Menu



5. If you selected **SYNC+PID+PRBS** at the previous step now press **SET PID** to specify the identity (and hence source) of the packets to be used in the BER measurement. Enter the PID (in hex and in the range 0 to 1FFF) as follows:
   - Use the Data Keys to enter numeric characters.
   - Use the **A**, **B**, **C**, **D**, **E** and **F** softkeys to enter the alpha characters.
   - Press **[ENTER]** to terminate the entry.
6. To start the measurement, press **START PRBS**. The measurement can be stopped at any time by pressing **STOP MEAS**. You can stop and restart the measurement by pressing **RESET MEAS**.

   If **MEAS UNLOCK** is displayed at any time press **RE-LOCK MEAS** to reacquire the signal or **STOP MEAS** to terminate the measurement.
7. Press **DONE** to exit the measurement.

MEASUREMENT NOTES: A continuous 2^{23}-1 Pseudo Random Binary Sequence (PRBS) provides the most basic data pattern for the BER measurement. However, some modulators require a (47 hex) synchronization byte at 204 byte intervals to maintain optimum performance. The **SYNC+203+PRBS** setup is intended for systems with modulators of this type. Three packetized data patterns (**SYNC+187 PRBS**, **SYNC+PID+PRBS** and **SYNC+NUL+0000's**) can also be used where more sophisticated test sources are available. The measurement is applied to part, or all, of the contents of the 188 byte packets recovered from Reed-Solomon encoded 204 byte packets. Identifying high Error Rate packets by PID (**SYNC+PID+PRBS**) can help identify the source of errors beyond the multiplex under test.

PID Statistics and Multiplex Overview

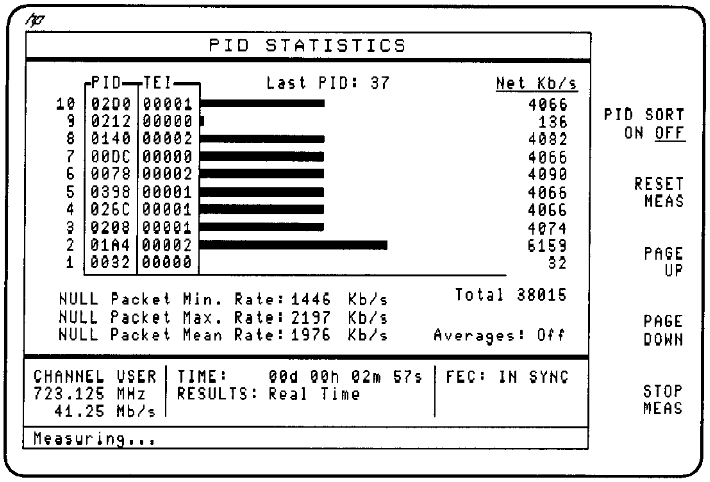
(Option 195 required)

To enable the association of the elementary streams of a program within a multi-program transports stream, 13 bits of the 188 byte packets are used as packet labels. These labels, Packet Identifiers (PIDs), can be analyzed for measurement and diagnostic purposes as follows:

- List the PIDs in a decoded channel and verify the multiplex has the correct content.
- Examine the data rates for each elementary stream, including null packets, to determine if the multiplex is approaching full capacity or could have more programs added.
- Examine the Transport Error Indicator (TEI) bit associated with each PID to determine if and where uncorrectable errors have occurred.

The 8594Q QAM analyzer with Option 195 uses a histogram to display the data rate of each elementary stream in the multiplex. The PIDs, TEI count, data rates and null packet data rates are displayed as shown in Figure 4-32. Two measurements are available. Selecting PID Statistics enables the continuous and instant update for up to 64 PIDs. Multiplex Overview can handle up to 5000 PIDs but trades off some of the data collection and updating features of the PID Statistics mode. Table 4-7 on page 147 details the differences.

Figure 4-32 PID Statistics Measurement Example



PID and Multiplex Softkeys

Pid Stats	Accesses the menu for viewing the PIDs, Transport Error Indicators (TEI) and data rate histograms.
START PIDSTATS	Initiates the measurement of the TEI count, data rate and histogram associated with each PID for up to 64 PIDs. Data for up to 10 PIDs is displayed. All data is continually updated even when entries are not currently displayed. The measurement is performed continuously until **STOP MEAS** or **RESET MEAS** is pressed.
MULTIPLX OVERVIEW	Initiates the overview measurement. Can handle up to 5000 PIDs in the multiplex. Only the 10 displayed entries are updated at any time and scrolling up or down the histogram resets the TEI counts.
AVERAGE ON OFF	Selecting on (ON underlined) applies averaging to the data rates. This is achieved by averaging the current sampled rate with a specified number of immediately preceding rates. You can choose to use up to 20 preceding samples.
PID SORT ON OFF	Selecting on (ON underlined) sorts the histogram with the PIDs in ascending order. Selecting off (OFF underlined) sorts the histogram into the order the PIDs were first received. Sort is available only for the PID Statistics (**START PIDSTATS**) measurement.
FIND PID	Pressing this softkey allows you to display the data for a specified PID. Use the Data Keys and the **A**, **B**, **C**, **D**, **E** and **F** softkeys to enter the required PID. If the entered PID is not in the multiplex or out of range, the nearest PID value is displayed. Find is available only for the Multiplex Overview (**MULTIPLX OVERVIEW**) measurement.
PID REFRESH	Pressing this softkey re-scans the channel and updates the existing histogram. PID Refresh is only available for the Multiplex Overview measurement and resets the TEI counter.

PAGE UP	Pressing this softkey scrolls the display up one page (10 PIDs) at a time. In Multiplex Overview mode (**MULTIPLX OVERVIEW**) the TEI counts for current PID entries are reset when the histogram is scrolled. In PID Statistics mode (**START PIDSTATS**) TEI counts are accumulated, even off screen.
PAGE DOWN	Pressing this softkey scrolls the display down one page (10 PIDs) at a time. In Multiplex Overview mode (**MULTIPLX OVERVIEW**) the TEI counts for current PID entries are reset when the histogram is scrolled. In PID Statistics mode (**START PIDSTATS**) TEI counts are accumulated, even off screen.
[⇑]	Pressing this front panel key scrolls the display up one PID at a time. In Multiplex Overview mode (**MULTIPLX OVERVIEW**) the TEI counts for current PID entries are reset when the histogram is scrolled. In PID Statistics mode (**START PIDSTATS**) TEI counts are accumulated, even off screen.
[⇓]	Pressing this front panel key scrolls the display down one PID at a time. In Multiplex Overview mode (**MULTIPLX OVERVIEW**) the TEI counts for current PID entries are reset when the histogram is scrolled. In PID Statistics mode (**START PIDSTATS**) TEI counts are accumulated, even off screen.
RESET MEAS	Stops the current measurement, resets all counters and displayed results. The measurement is then restarted.
RE-LOCK MEAS	Restart the measurement from an error condition. (All previous measurement data is discarded.)
STOP MEAS	Halts the measurement.
DONE	Pressing this softkey returns you to the previous menu in the menu tree.

Table 4-7 PID Statistics and Multiplex Overview Comparison

Parameter and Function	PID Statistics	Multiplex Overview
Maximum number of PIDs in the histogram.	64	5000
Number of PIDs displayed simultaneously	10	10
Cumulative TEI count	Yes. Up to 64 identified PIDs are monitored and updated continuously although only 10 are visible at any time.	Yes, but only for the 10 PIDs displayed. PIDs off screen are not measured. Also, scrolling the displayed list resets all TEI counters to zero.
New PID collection	Any new PID is immediately added to the list. Measurement of the new PID parameters is continuous.	New PIDs are added to the list only when you initiate a refresh from the softkey menu.
Pre-measurement sampling time	None	~1 second
PID ordered sorting	On or Off	Always sorted
Find and display a specific PID in the list by entering a 4 digit hex value.	No	Yes

Procedure

1. Press **More 1 of 3**, **More 2 of 3**, then **Pid Stats** to access the PID Statistics and Multiplex Overview Measurement menu.
2. Select the required averaging as follows:
   - To turn averaging off, press **AVERAGE ON OFF** to underline OFF.
   - To turn averaging on, press **AVERAGE ON OFF** to underline ON. Averaging is applied to the data rates.

     When ON is selected, the message `NUMBER of AVERAGES` and the current value is displayed. Use the data keys, knob or the step keys to specify the averaging window size required (2 to 20). Press **[ENTER]** to terminate the entry.
3. Now select the measurement as follows:
   - Press **START PIDSTATS** if there are 64 or less PIDs in the multiplex or, you need to ensure all parameters (TEI counts, data rates) are continually updated even when they are not currently displayed.
   - Press **MULTIPLX OVERVIEW** if you expect more than 64 PIDs in the multiplex. Only the displayed PID parameters are updated.

     After setting up the selected measurement, the elementary stream data rate values and histograms are displayed. Each has an associated PID and TEI counter. Null packet rates are shown in the lower half of the display. The `Last PID:` message tells you how many PIDs have been identified.
4. If you selected **MULTIPLX OVERVIEW** proceed to step 5. If you selected **START PIDSTATS** proceed as follows:
   - To order the PIDs into ascending order according to PID value, press **PID SORT ON OFF** to select on (ON underlined). Pressing **PID SORT ON OFF** again (OFF underlined) displays the PIDs in the order they were first received.
   - Use **PAGE UP** to scroll up the list of PIDs, 10 at a time.
   - Use **PAGE DOWN** to scroll down the list of PIDs, 10 at a time.
   - Use [⇑] to scroll up the list of PIDs, one at a time.
   - Use [⇓] to scroll down the list of PIDs, one at a time.

     Proceed to step 6.
5. If you selected **MULTIPLX OVERVIEW** proceed as follows:
   - Use **FIND PID** if you would like to view a known PID which is too far away in the list to access using **PAGE UP** or **PAGE DOWN**. If the PID is not in the multiplex or is out of range, the nearest (in numerical PID value) is displayed.
   - Use **PAGE UP** to scroll up the list of PIDs, 10 at a time.

- Use **PAGE DOWN** to scroll down the list of PIDs, 10 at a time.
- Use [⇑] to scroll up the list of PIDs, one at a time.
- Use [⇓] to scroll down the list of PIDs, one at a time.
- Use **PID REFRESH** to add any new PIDs to the histogram.

NOTE All TEI counts are reset when you scroll up and down the display or carry out a PID refresh. Parameters are only monitored and updated for the displayed PIDs.

6. You can stop and restart the measurement by pressing **RESET MEAS**. The measurement can be stopped at anytime by pressing **STOP MEAS**.

   If MEAS UNLOCK is displayed at any time press **RE-LOCK MEAS** to reacquire the signal or **STOP MEAS** to terminate the measurement.

7. Press **DONE** to exit the measurement.

MEASUREMENT NOTES: If there are less than 64 PIDs in the channel, use the PID Statistics mode. You can take advantage of the continuous updating of all measurement parameters using this mode. If however, the channel under test contains more than 64 PIDs, Multiplex Overview mode is required. Although this does not have the continuous update feature you can quickly find a specific PID from a large list and start collecting measurement results.

The Transport Error Indicator (TEI) bit also provides useful information. If you configured the analyzer to NOT set the TEI bit when a ‘bad’ packet is decoded (OFF underlined from **TEI SET ON OFF** accessed from the FEC Setup menu), any TEIs flagged in the displayed column have been set by a prior process. You can use this method to find if any PIDs are being added to the multiplex with an error already flagged.

By setting **TEI SET ON OFF** on (ON underlined) you can ensure transportation errors detected by the analyzer are included in the output data stream.

Analog Tests

This section details the analog TV Tests. These utilities allow you to perform quick checks on an analog TV signal.

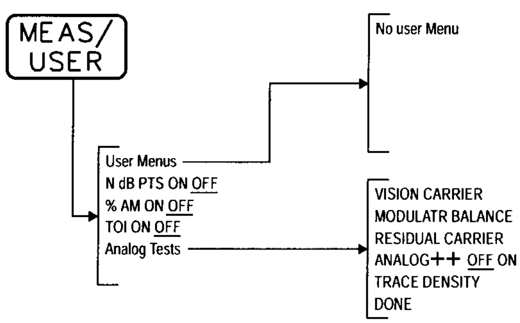
The utilities require the Option 190 measurement personality.

The following functions are available:

- Vision Carrier - Enter the channel vision carrier to have analyzer display the channel, automatically setting the center frequency and reference level to view the full channel band.
- Modulator Balance - After setting up the channel, use Modulator Balance to have the analyzer display the modulated vision carrier helping you make modulator adjustments.
- Residual Carrier - After setting up the channel, use Residual Carrier to have the analyzer measure and display the depth of luminance modulation as a residual carrier value in dB.
- Analog++ - After setting up the channel, use Analog++ to have the analyzer display the signal in the manner of older, analog measurement and display technology. You can adjust the trace density to make best use of the display method.

Analog Tests Menu Map

With the Option 190 personality loaded, **[MEAS/USER]** accesses the following:



Using the Analog Tests

Use the Analog Tests to make quick measurements of any conventional analog TV signals on your network.

NOTE You can only access the Analog Tests menu when the analyzer is in Spectrum Analyzer mode.

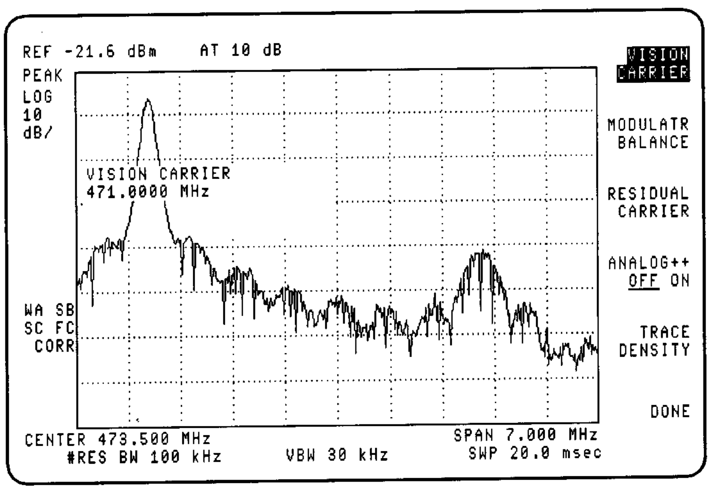
Access the Analog Tests as follows:

1. Press **[MODE]**. If **SPECTUM ANALYZER** is underlined press **[MEAS/USER]**, otherwise first select **SPECTUM ANALYZER** then press **[MEAS/USER]**.
2. Select **Analog Tests**.

   Enter the vision carrier frequency before proceeding:
3. Press **VISION CARRIER** and use the data keys to enter the vision carrier frequency.

   The analyzer automatically sets the reference level and center frequency to display the channel band.

Figure 4-33 Analog TV Channel



4. Press **MODULATR BALANCE**, **RESIDUAL CARRIER**, and **ANALOG++ OFF ON** as required. You can adjust the perceived persistence of the Analog++ display by selecting **TRACE DENSITY**. Use the knob or data keys to enter values between 1 and 30.

Figure 4-34 Modulator Balance Display

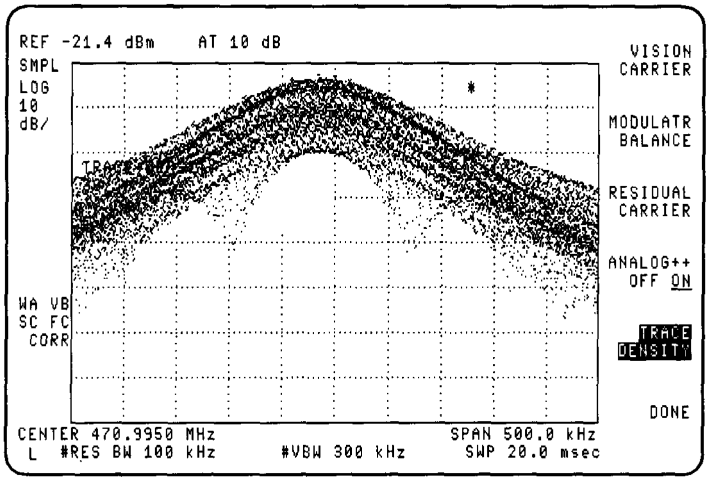


Figure 4-35 Residual Carrier Display

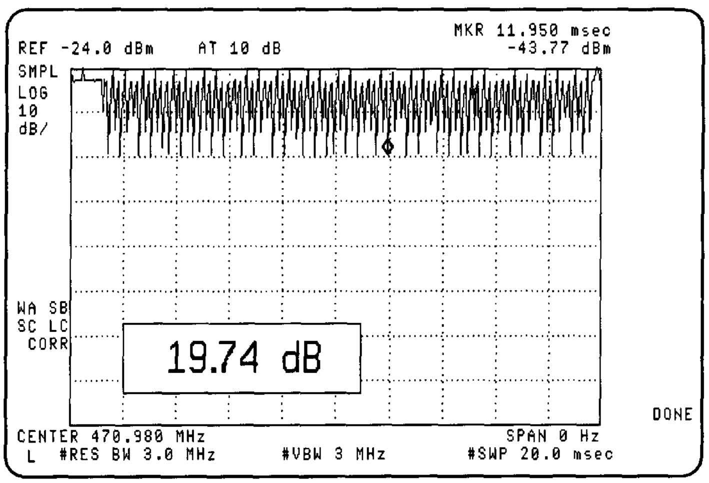
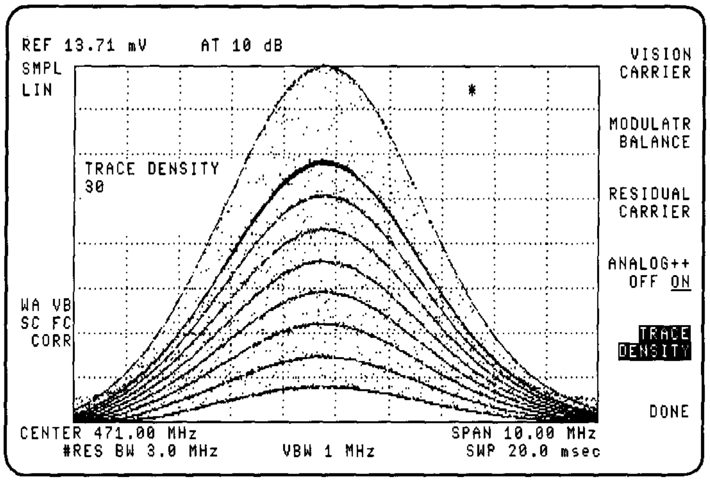


Figure 4-36 Analog++ Display



5. Press **DONE**, **[MODE]** and **SPECTUM ANALYZER** for spectrum analyzer operating mode or **DVB-C ANALYZER** for DVB-C QAM analyzer operating mode.

5 Making Basic Measurements using Spectrum Analyzer Mode

What You'll Learn in This Chapter

This chapter demonstrates basic spectrum analyzer measurements with examples of typical measurements; each measurement focuses on different functions. The measurement procedures covered in this chapter are listed below.

- Resolving signals of equal amplitude using the resolution bandwidth function.
- Resolving small signals hidden by large signals using the resolution bandwidth function.
- increasing the frequency readout resolution using the marker counter.
- Decreasing the frequency span using the marker track function.
- Tracking unstable signals using marker track and the maximum hold and minimum hold functions.
- Comparing signals using delta markers.
- Measuring low-level signals using attenuation, video bandwidth, and video averaging.
- Identifying distortion products using the RF attenuator and traces.
- Using the spectrum analyzer as a receiver in zero frequency span.

To find descriptions of specific spectrum analyzer functions, refer to the *Agilent Technologies 8594Q QAM Analyzer Spectrum Analyzer Reference User's Guide.*

Resolving Signals of Equal Amplitude Using the Resolution Bandwidth Function

In responding to a continuous-wave signal, a swept-tuned spectrum analyzer traces out the shape of the spectrum analyzer's intermediate frequency (IF) filters. As we change the filter bandwidth, we change the width of the displayed response. If a wide filter is used and two equal-amplitude input signals are close enough in frequency, then the two signals appear as one. Thus, signal resolution is determined by the IF filters inside the spectrum analyzer.

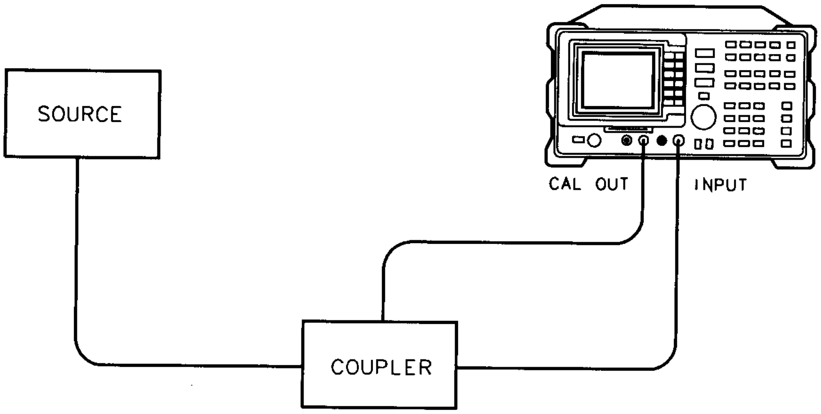
The resolution bandwidth (RES BW) function selects an IF filter setting for a measurement. Resolution bandwidth is defined as the 3 dB bandwidth of the filter. The 3 dB bandwidth tells us how close together equal amplitude signals can be and still be distinguished from each other.

Generally, to resolve two signals of equal amplitude, the resolution bandwidth must be less than or equal to the frequency separation of the two signals. If the bandwidth is equal to the separation a dip of approximately 3 dB is seen between the peaks of the two equal signals, and it is clear that more than one signal is present. See Figure 5-2.

In order to keep the spectrum analyzer calibrated, sweep time is automatically set to a value that is inversely proportional to the square of the resolution bandwidth. So, if the resolution bandwidth is reduced by a factor of 10, the sweep time is increased by a factor of 100 when sweep time and bandwidth settings are coupled. (Sweep time is proportional to $1/BW^2$.) For fastest measurement times, use the widest resolution bandwidth that still permits discrimination of all desired signals. The spectrum analyzer allows you to select from 1 kHz to 3 MHz resolution bandwidth in a 1, 3, 10 sequence, plus 5 MHz, for maximum measurement flexibility.

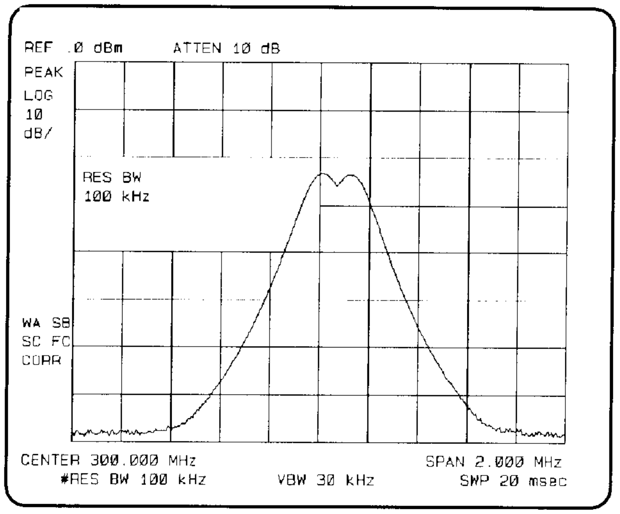
Example: Resolve two signals of equal amplitude with a frequency separation of 100 kHz.

Figure 5-1 Set-Up for Obtaining Two Signals



1. To obtain two signals with a 100 kHz separation, connect the calibration signal and a signal source to the spectrum analyzer input as shown in Figure 5-1. (If available, two sources can be used.)
2. If you are using the 300 MHz calibration signal, set the frequency of the source 100 kHz greater than the calibration signal (that is, 300.1 MHz). The amplitude of both signals should be approximately –20 dBm.
3. On the spectrum analyzer, press **[PRESET]**. Set the center frequency to 300 MHz, the span to 2 MHz, and the resolution bandwidth to 300 kHz by pressing **[FREQUENCY]** 300 **[MHz]**, **[SPAN]** 2 **[MHz]**, then **[BW]** 300 **[kHz]**, A single signal peak is visible.
4. Since the resolution bandwidth must be less than or equal to the frequency separation of the two signals, a resolution bandwidth of 100 kHz must be used. Change the resolution bandwidth to 100 kHz by pressing **[BW]** 100 **[kHz]**. Two signals are now visible as in Figure 5-2. Use the knob or step keys to further reduce the resolution bandwidth and better resolve the signals.

Figure 5-2 Resolving Signals of Equal Amplitude



As the resolution bandwidth is decreased, resolution of the individual signals is improved and the sweep time is increased. For fastest measurement times, use the widest possible resolution bandwidth. Under preset conditions, the resolution bandwidth is "coupled" (or linked) to span.

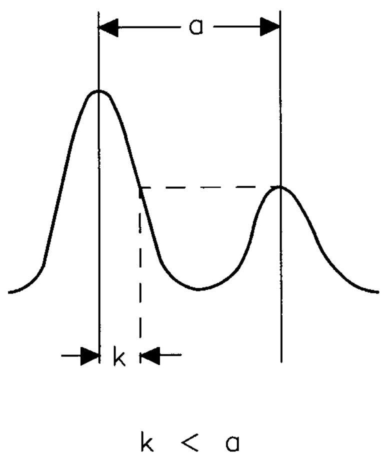
Since the resolution bandwidth has been changed from the coupled value, a "#" mark appears next to RES BW in the lower-left corner of the screen, indicating that the resolution bandwidth is uncoupled. (Also see the **[AUTO COUPLE]** key description in the *Agilent Technologies 8594Q QAM Analyzer Spectrum Analyzer Reference User's Guide*.)

NOTE To resolve two signals of equal amplitude with a frequency separation of 200 kHz, the resolution bandwidth must be less than the signal separation, and resolution of 100 kHz must be used. The next larger filter, 300 kHz, would exceed the 200 kHz separation and would not resolve the signals.

Resolving Small Signals Hidden by Large Signals Using the Resolution Bandwidth Function

When dealing with resolution of signals that are not equal in amplitude, you must consider the shape of the IF filter as well as its 3 dB bandwidth. The shape of the filter is defined by the shape factor, which is the ratio of the 60 dB bandwidth to the 3 dB bandwidth. (Generally, the IF filters in this spectrum analyzer have shape factors of 15:1 or less.) If a small signal is too close to a larger signal, the smaller signal can be hidden by the skirt of the larger signal. To view the smaller signal, you must select a resolution bandwidth such that k is less than a. See Figure 5-3.

Figure 5-3 Resolution Bandwidth Requirements for Resolving Small Signals



The separation between the two signals must be greater than half the filter width of the larger signal at the amplitude level of the smaller signal.

Example: Resolve two input signals with a frequency separation of 200 kHz and an amplitude separation of 60 dB.

1. To obtain two signals with a 200 kHz separation, connect the equipment as shown in the previous section, See "Resolving Signals of Equal Amplitude Using the Resolution Bandwidth Function".

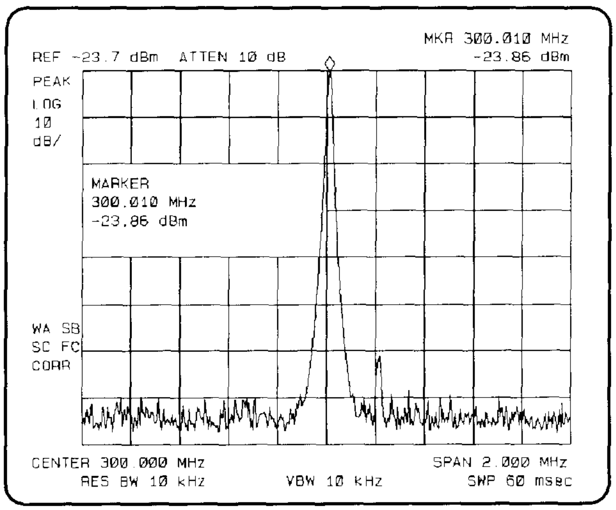
2. Set the center frequency to 300 MHz and the span to 2 MHz: press **[FREQUENCY]** 300 **[MHz]**, then **[SPAN]** 2 **[MHz]**.

3. Set the source to 300.2 MHz, so that the signal is 200 kHz higher than the calibration signal. Set the amplitude of the signal to –80 dBm (60 dB below the calibration signal).

4. Set the 300 MHz signal to the reference level by pressing **[PEAK SEARCH]**, then **[MKR →]**, then MARKER REF ⇒ LVL.

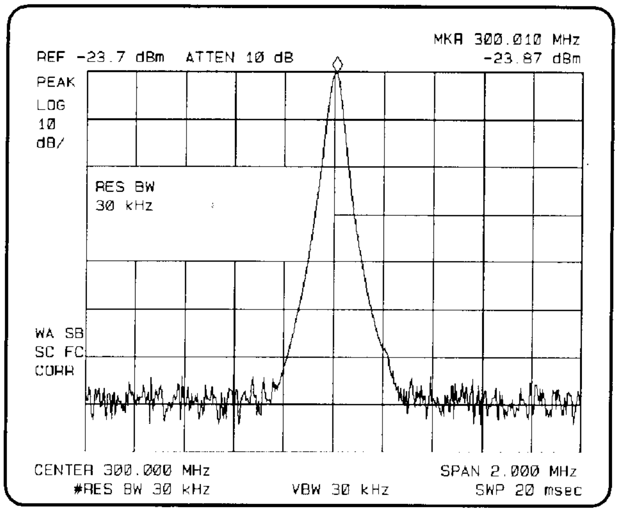
   If a 10 kHz filter with a typical shape factor of 15:1 is used, the filter will have a bandwidth of 150 kHz at the 60 dB point. The half-bandwidth (75 kHz) is narrower than the frequency separation, so the input signals will be resolved.

Figure 5-4 Signal Resolution with a 10 kHz Resolution Bandwidth



If a 30 kHz filter is used, the 60 dB bandwidth will be 450 kHz. Since the half-bandwidth (225 kHz) is wider than the frequency separation, the signals most likely will not be resolved. See Figure 5-5. (To determine resolution capability for intermediate values of amplitude level differences, consider the filter skirts between the 3 dB and 60 dB points to be approximately straight. In this case, we simply used the 60 dB value.)

Figure 5-5 Signal Resolution with a 30 kHz Resolution Bandwidth



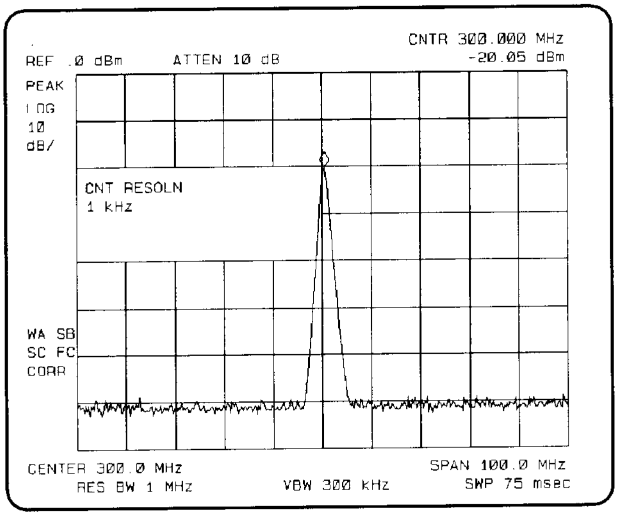
Increasing the Frequency Readout Resolution Using the Marker Counter

The marker counter increases the resolution and accuracy of frequency readout. When using the marker count function, if the bandwidth to span ratio is too small (less than 0.01), the `Reduce Span` message appears on the display. If `Widen RES BW` is displayed, it indicates that the resolution bandwidth is too narrow. If the signal being counted is the largest signal within the 300 Hz bandwidth then the count will be correct. If there is another, larger signal (even off the display), the count will be for the larger signal.

Example: Increase the resolution and accuracy of the frequency readout on the signal of interest.

1. Place a marker on the signal of interest. (If you are using the CAL OUT signal, place the marker on the 300 MHz calibration signal. Press [**FREQUENCY]** 300 **[MHz]**, **[SPAN]** 100 **[MHz]**, and **[PEAK SEARCH**].)
2. Press **[MKR FCTN]**, then **MK COUNT ON OFF** (ON should be underlined) to turn the marker counter on. `COUNTER` and the frequency and amplitude of the marker will appear in the active function area.
3. Increase the counter resolution by pressing **More 1 of 2**, **CNT RES AUTO MAN** and then entering the desired resolution using the step keys or the number/units keypad. For example, press 1 **[kHz]**. The marker counter readout is in the upper-right comer of the screen. The resolution can be set from 10 Hz to 100 kHz.
4. The marker counter remains on until turned off. Turn off the marker counter by pressing **[MKR FCTN]**, then **MK COUNT ON OFF** (until OFF is underlined). (**MARKER ALL OFF** also turns the marker counter off.)

Figure 5-6 Using the Marker Counter



Decreasing the Frequency Span Using the Marker Track Function

Using the spectrum analyzer's marker track function, you can quickly decrease the span while keeping the signal at center frequency.

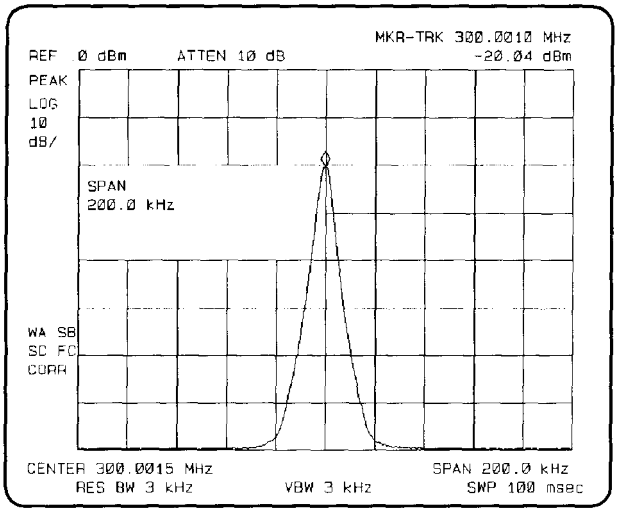
Example: Examine a carrier signal in a 200 kHz span.

1. Press **[PRESET]** tune to a carrier signal, and place a marker at the peak. (If you are using the CAL OUT signal, place the marker on the 300 MHz calibration signal. Press **[FREQUENCY]**, 300 **[MHz]**, **[SPAN]**, 200 **[MHZ]** and **[PEAK SEARCH]**.
2. Press **[MRKR FCTN]**, **MK TRACK ON OFF** (ON) and the signal will move to the center of the screen,if it is not already positioned there (note that the marker must be on the signal). Because the marker track function automatically maintains the signal at the center of the screen, you can reduce the span quickly for a closer look. If the signal drifts off of the screen as you decrease the span, use a wider frequency span.
3. Press, **[SPAN]** 200 **[kHz].** The span decreases in steps as automatic zoom is completed. See Figure 5-7. You can also use the knob or step keys to decrease the span or use the **PEAK ZOOM** function under **[SPAN]**.

Press **MK TRACK ON OFF** again so that (OFF) is underlined to turn off the marker track function.

NOTE When you are finished with the example, turn off the marker tracking function.

Figure 5-7 After Zooming In on the Signal



Tracking Unstable Signals Using Marker Track and the Maximum Hold and Minimum Hold Functions

The marker track function is useful for tracking unstable signals that drift with time. The maximum hold and minimum hold functions are useful for displaying modulated signals which appear unstable, but have an envelope that contains the information-bearing portion of the signal.

MK TRACK ON OFF may be used to track these unstable signals. Use **[PEAK SEARCH]** to place a marker on the highest signal on the display. Pressing **MK TRACK ON OFF** (ON) will bring that signal to the center frequency of the graticule and adjust the center frequency every sweep to bring the selected signal back to the center. **SPAN ZOOM** is a quick way to perform the **[PEAK SEARCH]**, **[MKR FCTN]**, **MK TRACK ON OFF**, **[SPAN]** key sequence.

Note that the primary function of the marker track function is to track unstable signals, not to track a signal as the center frequency of the spectrum analyzer is changed. If you choose to use the marker track function when changing center frequency, check to ensure that the signal found by the tracking function is the correct signal.

Example: Use the marker track function to keep a drifting signal at the center of the display and monitor its change.

This example requires a modulated signal. An acceptable signal can be easily found by connecting an antenna to the spectrum analyzer input and tuning to the FM broadcast band (88 to 108 MHz). Set the spectrum analyzer center frequency for 100 MHz with a span of 20 MHz, an attenuator setting of 0 dB, and reference level setting of approximately –40 dBm. Your circumstances may be slightly different, depending on building shielding and proximity to transmitters.

1. Connect an antenna to the spectrum analyzer input.
2. Press **[PRESET]**, **[FREQUENCY]**, 100 **[MHz]**, **[SPAN]**, 20 **[MHz]**.

NOTE Use a different signal frequency if no signal is available at 100 MHz in your area.

3. Press **[AMPLITUDE]**, 40 **[–dBm]**, **ATTEN AUTO MAN**, 0 **[+dBm]**.

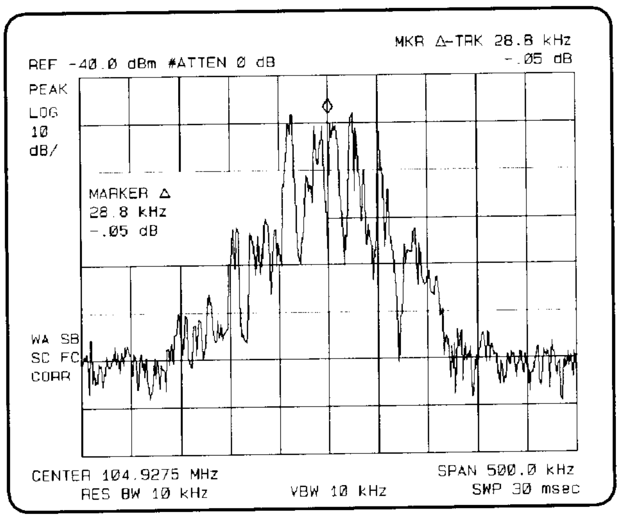
4. Press **[SPAN]**, **SPAN ZOOM**, 500 **[kHz]**.

   Notice that the signal has been held in the center of the display.

NOTE If the signal you selected drifts too quickly for the spectrum analyzer to keep up with, use a wider span.

5. The signal frequency drift can be read from the screen if both the marker track and marker delta functions are active. Press **[MKR]**, **MARKER Δ**, **[MKR FCTN]**, **MK TRACK ON OFF**; the marker readout indicates the change in frequency and amplitude as the signal drifts. See Figure 5-8.

Figure 5-8 Using Marker Tracking to Track an Unstable Signal



The spectrum analyzer can measure the short and long-term stability of a source. The maximum amplitude level and the frequency drift of an input signal trace can be displayed and held by using the maximum-hold function. The minimum amplitude level can be displayed by using minimum hold (available for trace C only).

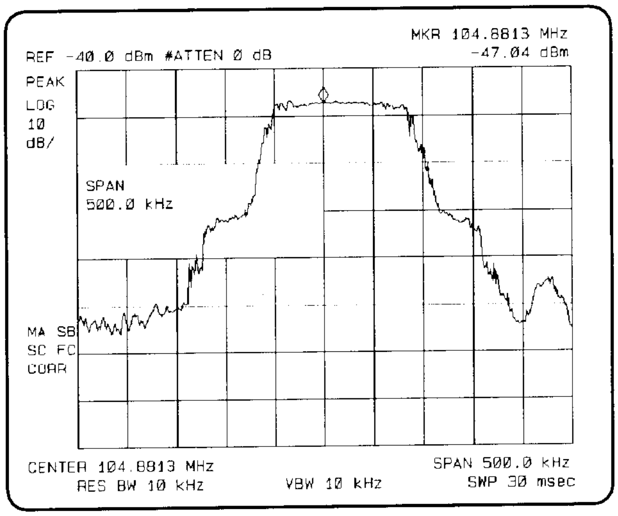
You can use the maximum-hold and minimum-hold functions if, for example, you want to determine how much of the frequency spectrum an FM signal occupies.

Example: Using the maximum-hold and minimum hold functions, monitor the envelopes of a signal.

1. Connect an antenna to the spectrum analyzer input.
2. Press **[PRESET]**, **[FREQUENCY]**, 100 **[MHz]**, and **[SPAN]** 20 **[MHz]**.
3. Press **[AMPLITUDE]**, 40 **[–dBm]**, **ATTEN AUTO MAN**, 0 **[+dBm]**, **[SPAN]**, **SPAN ZOOM** 500 **[kHz]**.

   Refer to Figure 5-9. Notice that the signal has been held in the center of the display.
4. Turn off the marker track function by pressing **MK TRACK ON OFF** (OFF).
5. To measure the excursion of the signal, press **[TRACE]** then **MAX HOLD A**. As the signal varies, maximum hold maintains the maximum responses of the input signal, as shown in Figure 5-9.

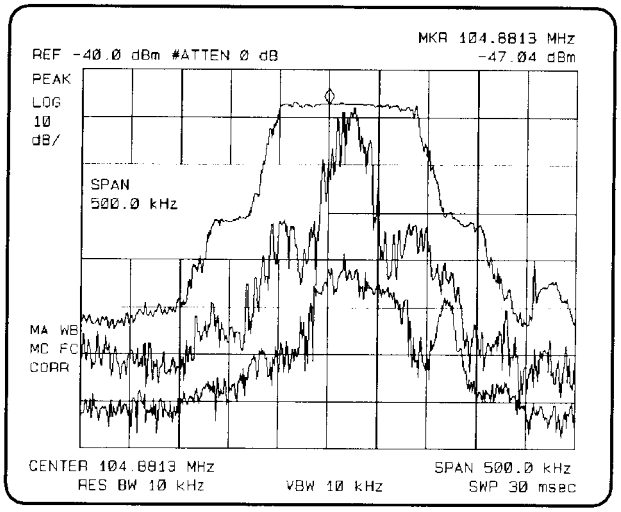
Figure 5-9 Viewing an Unstable Signal Using Max Hold A



Annotation on the left side of the screen indicates the trace mode. For example, MA SB SC indicates trace A is in maximum-hold mode, trace B and trace C are in store-blank mode. See “Spectrum Analyzer Screen Annotation”.

6. Press **[TRACE]**, **TRACE A B C** to select trace B. (Trace B is selected when B is underlined.) Press **CLEAR WRITE B** to place trace B in clear-write mode, which displays the current measurement results as it sweeps. Trace A remains in maximum-hold mode, showing the frequency shift of the signal.
7. Press **TRACE A B C** to select trace C (C should be underlined). Press **MIN HOLD C**. Trace C is in the minimum-hold mode and displays the minimum amplitude of the frequency drift of the signal.

Figure 5-10 Viewing an Unstable Signal With Max Hold, Clear Write, and Min Hold



Comparing Signals Using Delta Markers

Using the spectrum analyzer, you can easily compare frequency and amplitude differences between signals, such as radio or television signal spectra. The spectrum analyzer's delta marker function lets you compare two signals when both appear on the screen at one time or when only one appears on the screen.

Example: Measure the differences between two signals on the same display screen.

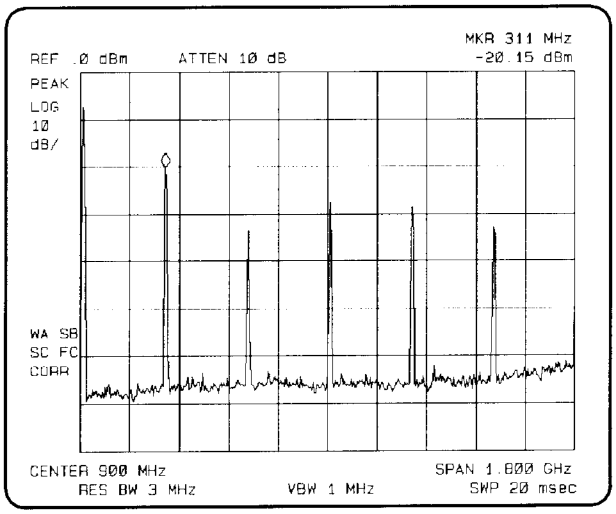
1. Connect the spectrum analyzer's CAL OUT to the INPUT 50 Ω. Press **[PRESET]**.

   The calibration signal and its harmonics appear on the display.

2. Press **[PEAK SEARCH]** to place a marker at the highest peak on the display. The **NEXT RK RIGHT** and **NEXT PK LEFT** softkeys move the marker from peak to peak. Press **NEXT PK RIGHT** to move the marker to the 300 MHz calibration signal. See Figure 5-11.

   The signal that appears at the left edge of the screen is the spectrum analyzer's local oscillator (LO) and represents 0 Hz.

Figure 5-11 Placing a Marker on the CAL OUT Signal

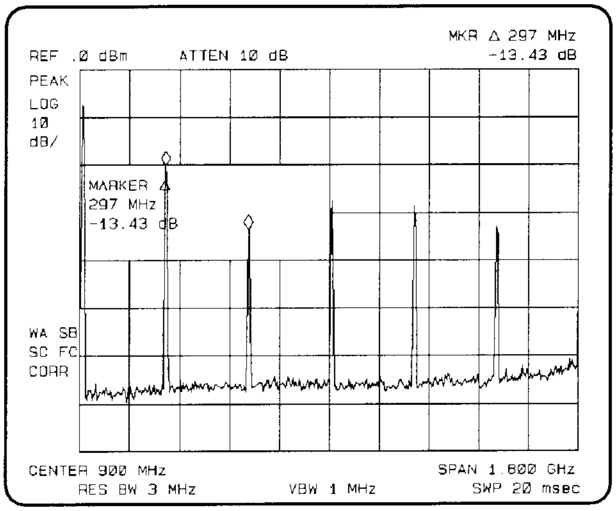


3. Press, **MARKER** Δ to activate a second marker at the position of the first marker. Move the second marker to another signal peak using the **NEXT PK RIGHT** or **NEXT PK LEFT** softkeys or the knob.

4. The amplitude and frequency difference between the markers is displayed in the active function block and in the upper-right comer of the screen. See Figure 5-12.

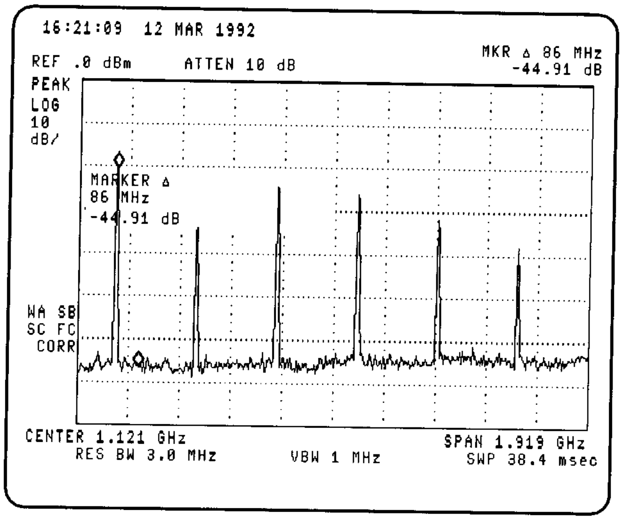
   Press **[MKR]**, **More 1 of 2**, then **MARKER ALL OFF** to turn the markers off.

Figure 5-12 Using the Marker Delta Function



5. The **MARKER → PK-PK** softkey can be used to find and display the frequency and amplitude difference between the highest and lowest-amplitude signals. To use this automatic function, press **[MKR→]**, **More 1 of 2**, **MARKER → PK-PK** See Figure 5-13.

Figure 5-13 Using the Marker to Peak/Peak Function



The frequency and amplitude differences between the signals appear in the active function block. In addition, the softkeys accessed by **[MKR→]** appear on the screen.

Example: Measure the frequency and amplitude difference between two signals that do not appear on the screen at one time. (This technique is useful for harmonic distortion tests when narrow span and narrow bandwidth are necessary to measure the low-level harmonics.)

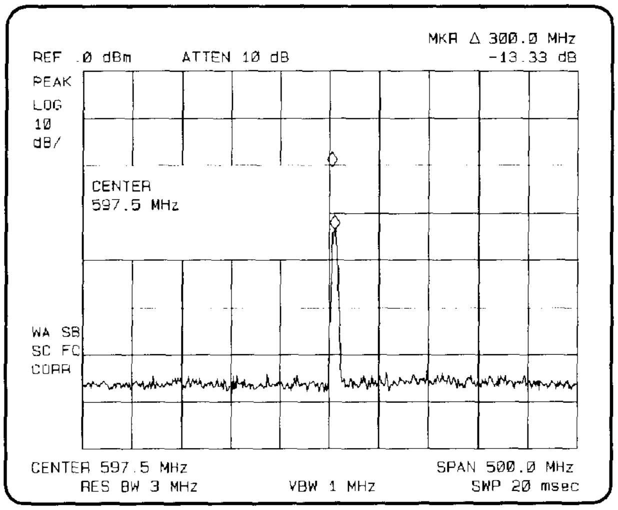
1. Connect the spectrum analyzer's CAL OUT to the INPUT 50 Ω (if you have not already done so). Press **[PRESET]**, **[FREQUENCY]**, 300 **[MHz]**, **[SPAN]** and the step down key **[⇓]** to narrow the frequency span until only one signal appears on the screen.
2. Press **[PEAK SEARCH]** to place a marker on the peak.
3. Press **MARKER** Δ to identify the position of the first marker.
4. Press **[FREQUENCY]** to activate center frequency. Turn the knob clockwise slowly to adjust the center frequency until a second signal peak is placed at the position of the second marker. It may be necessary to pause occasionally while turning the knob to allow a sweep to update the trace. The first marker remains on the screen at the amplitude of the first signal peak.

NOTE Changing the reference level changes the marker delta amplitude readout.

The annotation in the upper-right comer of the screen indicates the amplitude and frequency difference between the two markers. See Figure 5-14.

To turn the markers off, press **[MKR]**, **More 1 of 3**, then **MARKER ALL OFF**.

Figure 5-14 Frequency and Amplitude Difference Between Signals



Measuring Low-Level Signals Using Attenuation, Video Bandwidth, and Video Averaging

Spectrum analyzer sensitivity is the ability to measure low-level signals. It is limited by the noise generated inside the spectrum analyzer. The spectrum analyzer input attenuator and bandwidth settings affect the sensitivity by changing the signal-to-noise ratio. The attenuator affects the level of a signal passing through the instrument, whereas the bandwidth affects the level of internal noise without affecting the signal. In the first two examples in this section, the attenuator and bandwidth settings are adjusted to view low-level signals.

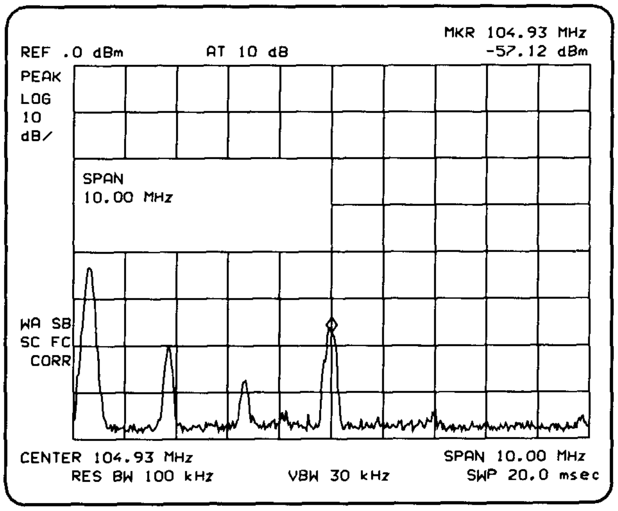
If, after adjusting the attenuation and resolution bandwidth, a signal is still near the noise, visibility can be improved by using the video-bandwidth and video-averaging functions, as demonstrated in the third and fourth examples.

Example: If a signal is very close to the noise floor, reducing input attenuation brings the signal out of the noise. Reducing the attenuation to 0 dB maximizes signal power in the spectrum analyzer.

NOTE The total power of all input signals at the spectrum analyzer input must not exceed the maximum power level for the spectrum analyzer.

1. Connect an antenna to the spectrum analyzer input. Press **[PRESET]**.
2. Reduce the frequency range to view a low-level signal of interest. For example, narrow the frequency span from 88 MHz to 108 MHz by pressing **[FREQUENCY]**, **START FREQ**, 88 **[MHz]**, **STOP FREQ**, 108 **[MHz]**.
3. Place a marker on the low-level signal of interest. Press **[MKR]** and use the knob to position the marker at the signal's peak.
4. Place the signal at center frequency by pressing **[MKR →]** then **MARKER → CF**.
5. Reduce the span to 10 MHz. Press **[SPAN]** and then use the step-down key **[⇓]**. See Figure 5-15.

Figure 5-15 Low-Level Signal

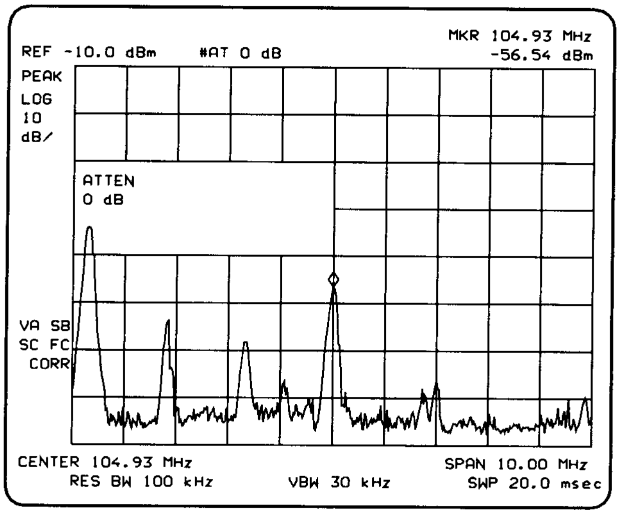


6. Press **[AMPLITUDE]**, **ATTEN AUTO MAN**. Press the step-up key **[⇑]** once to select 20 dB attenuation. Increasing the attenuation moves the noise floor closer to the signal.

   A "#" mark appears next to the AT annotation at the top of the display, indicating the attenuation is no longer coupled to other spectrum analyzer settings.

7. To see the signal more clearly, press 0 **[+dBm]**. Zero attenuation makes the signal more visible. (As a precaution to protect the spectrum analyzer's input mixer, 0 dB RF attenuation can be selected only with the number/units keypad.)

Figure 5-16 Using 0 dB Attenuation

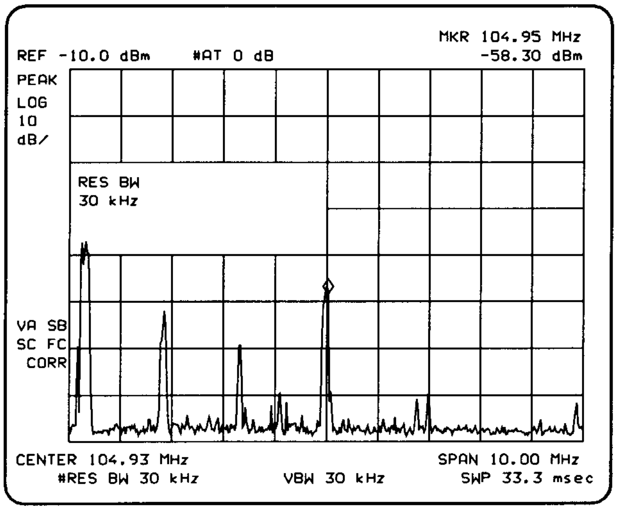


Before connecting other signals to the spectrum analyzer input, increase the RF attenuation to protect the spectrum analyzer's input mixer: press **ATTEN AUTO MAN** so that AUTO is underlined or press **[AUTO COUPLE]** and **AUTO ALL**.

Example: The resolution bandwidth can be decreased to view low-level signals.

1. As in the previous example, connect an antenna to the spectrum analyzer input. Set the spectrum analyzer to view a low-level signal.
2. Press **[BW]** then **[⇓]**. The low-level signal appears more clearly because the noise level is reduced. See Figure 5-17.

Figure 5-17 Decreasing Resolution Bandwidth



A "#" mark appears next to the RES BW annotation at the lower-left comer of the screen, indicating that the resolution bandwidth is uncoupled.

As the resolution bandwidth is reduced, the sweep time is increased to maintain calibrated data.

Example: The video-filter control is useful for noise measurements and observation of low-level signals close to the noise floor. The video filter is a post-detection low-pass filter that smooths the displayed trace. When signal responses near the noise level of the spectrum analyzer are visually masked by the noise, the video filter can be narrowed to smooth this noise and improve the visibility of the signal. (Reducing video bandwidths requires slower sweep times to keep the spectrum analyzer calibrated.)

Using the video bandwidth function, measure the amplitude of a low-level signal.

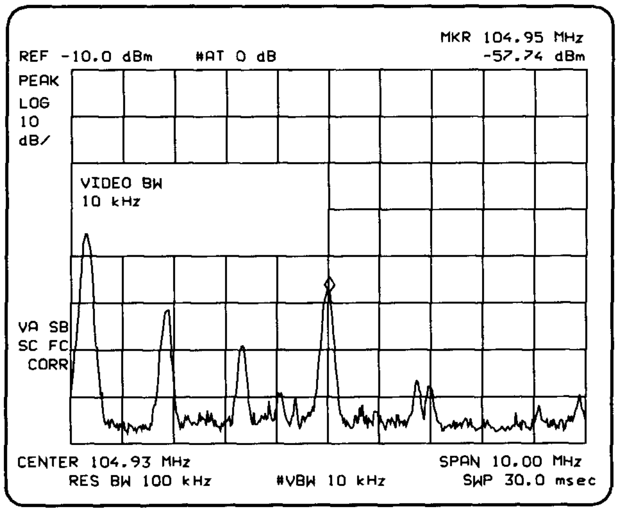
1. As in the first example, connect an antenna to the spectrum analyzer input. Set the spectrum analyzer to view a low-level signal.
2. Narrow the video bandwidth by pressing **[BW]**, **VID BW AUTO MAN**, and the step-down key **[⇓]**. This clarifies the signal by smoothing the noise, which allows better measurement of the signal amplitude.

A "#" mark appears next to the VBW annotation at the bottom of the screen, indicating that the video bandwidth is not coupled to the resolution bandwidth.

Instrument preset conditions couple the video bandwidth to the resolution bandwidth so that the video bandwidth is equal to or narrower than the resolution bandwidth. If the bandwidths are uncoupled when video bandwidth is the active function, pressing **VID BW AUTO MAN** (so that AUTO is underlined) recouples the bandwidths. See Figure 5-18. **VBW**

NOTE The video bandwidth must be set wider than the resolution bandwidth when measuring impulse noise levels.

Figure 5-18 Decreasing Video Bandwidth



Example: If a signal level is very close to the noise floor, video averaging is another way to make the signal more visible.

NOTE The time required to construct a full trace that is averaged to the desired degree is approximately the same when using either the video-bandwidth or the video averaging technique. The video bandwidth technique completes the averaging as a slow sweep is taken, whereas the video averaging technique takes many sweeps to complete the average. Characteristics of the signal being measured such as drift and duty cycle determine which technique is appropriate.

Video averaging is a digital process in which each trace point is averaged with the previous trace-point average. Selecting video averaging changes the detection mode from peak to sample. The result is a sudden drop in the displayed noise level. The sample mode displays the instantaneous value of the signal at the end of the time or frequency interval represented by each display point, rather than the value of the peak during the interval. Sample mode is not used to measure signal amplitudes accurately because it may not find the true peak of the signal.

Video averaging clarifies low-level signals in wide bandwidths by averaging the signal and the noise. As the spectrum analyzer takes sweeps, you can watch video averaging smooth the trace.

1. Position a low-level signal on the spectrum analyzer screen.
2. Press **[TRACE]**, **More 1 of 3**, then **VID AVG ON OFF**. When ON is underlined, the video-averaging routine is initiated. As the averaging routine smooths the trace, low-level signals become more visible. VID AVG 100 appears in the active function block.

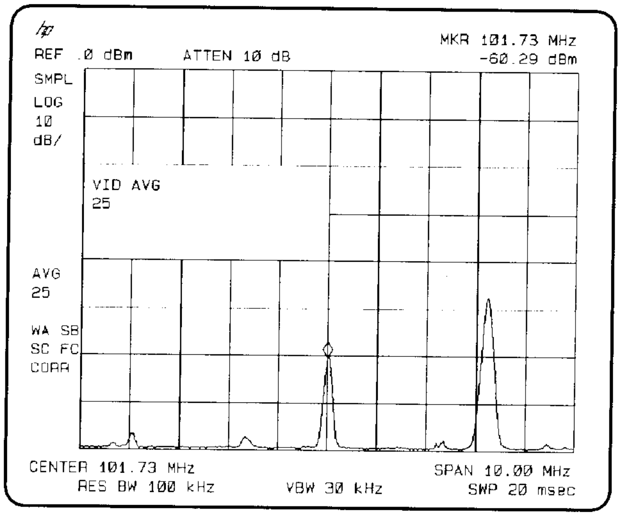
   The number represents the number of samples (or sweeps) taken to complete the averaging routine.
3. To set the number of samples, use the number/units keypad. For example, press **VID AVG ON OFF**, (so that ON is underlined), 25 **[Hz]**. Turn video averaging off and on again by pressing **VID AVG ON OFF** (OFF), **VID AVG ON OFF** (ON).

The number of samples equals the number of sweeps in the averaging routine

During averaging, the current sample appears at the left side of the graticule. Changes in active functions settings, such as the center frequency or reference level, will restart the sampling. The sampling will also restart if video averaging is turned off and then on again.

Once the set number of sweeps has been completed, the spectrum analyzer continues to provide a running average based on this set number.

Figure 5-19 Using the Video Averaging Function

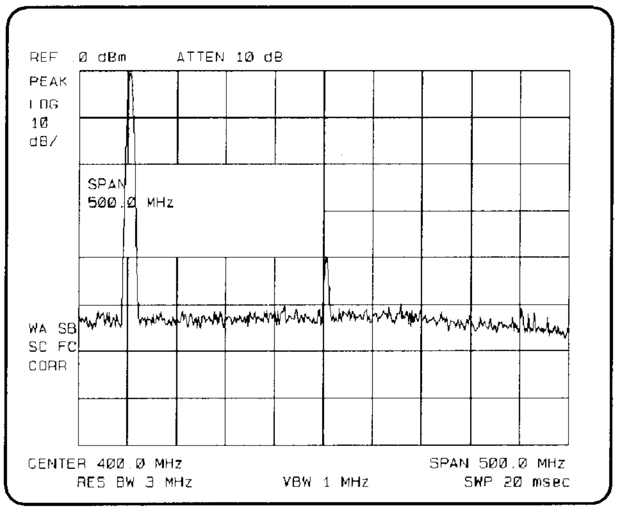


Identifying Distortion Products Using the RF Attenuator and Traces

Distortion from the Analyzer

High-level input signals may cause spectrum analyzer distortion products that could mask the real distortion measured on the input signal. Using trace B and the RF attenuator, you can determine which signals, if any, are internally generated distortion products.

Figure 5-20 Harmonic Distortion



Example: Using a signal from a signal generator, determine whether the harmonic distortion products are generated by the spectrum analyzer.

1. Connect a signal generator to the spectrum analyzer's INPUT 50 Ω. Set the signal generator frequency to 200 MHz and the amplitude to 0 dBm.

   Set the center frequency of the spectrum analyzer to 400 MHz and the span to 500 MHz: press **[FREQUENCY]**, 400 **[MHz]**, **[SPAN]** 500 **[MHz]**.The signal shown in Figure 5-20 produces harmonic distortion products in the spectrum analyzer's input mixer.

2. Change the span to 200 MHz: press **[SPAN]** 200 **[MHz]**.

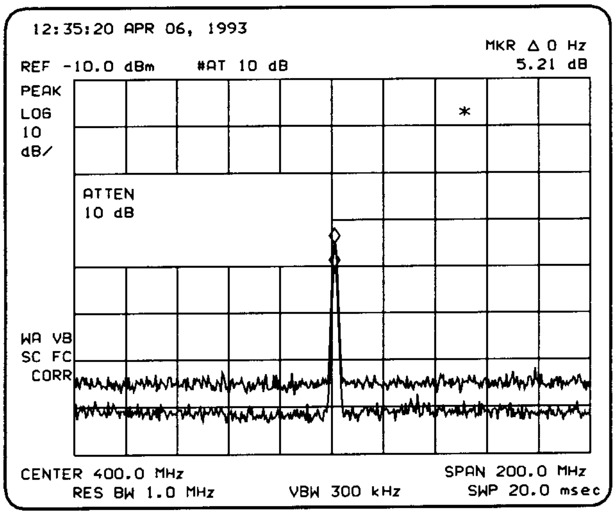
3. Change the attenuation to 0 dB: press **[AMPLITUDE]**, **ATTEN AUTO MAN** 0 **[+dBm]**.

4. To determine whether the harmonic distortion products are generated by the spectrum analyzer, first save the screen data in trace B.

   Press **[TRACE]**, **TRACE A B C** (until trace B is underlined), then Allow the trace to update (two sweeps) and press **[PEAK SEARCH]**, **Marker** Δ. The spectrum analyzer display shows the stored data in trace B and the measured data in trace A.

5. Next, increase the RF attenuation by 10 dB: press **[AMPLITUDE], ATTEN AUTO MAN**, and the step-up key **[⇑]** once. See Figure 5-21.

Figure 5-21 RF Attenuation of 10 dB

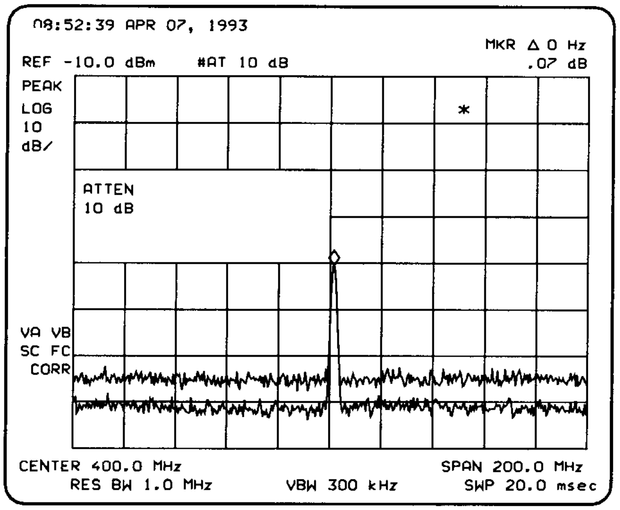


6. Compare the response in trace A to the response in trace B. If the distortion product decreases as the attenuation increases, distortion products are caused by the spectrum analyzer's input mixer.

   The change in the distortion product is shown by the marker-delta value. The high-level signals causing the overload conditions must be attenuated to eliminate the interference caused by the internal distortion.

If the responses in trace A and trace B differ, as in Figure 5-21, then attenuation is required. If there is no change in the signal level, the distortion is not caused internally. For example, the signal amplitude in Figure 5-22 is not high enough to cause internal distortion in the spectrum analyzer so any distortion that is displayed is present on the input signal.

Figure 5-22 No Harmonic Distortion



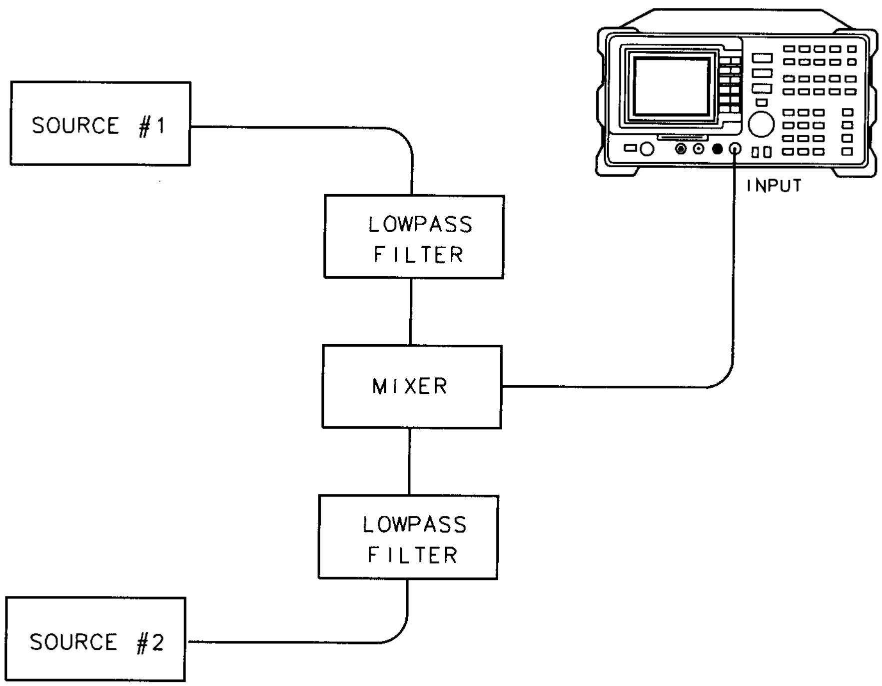
Third-Order Intermodulation Distortion

Two-tone, third-order intermodulation distortion is a common problem in communication systems. When two signals are present in a system, they can mix with the second harmonics generated and create third-order intermodulation distortion products, which are located close to the original signals. These distortion products are generated by system components such as amplifiers and mixers.

Example: Test a device for third-order intermodulation. This example uses two sources, one set to 300 MHz and the other to approximately 301 MHz. (Other source frequencies may be substituted, but try to maintain a frequency separation of approximately 1 MHz)

1. Connect the equipment as shown in Figure 5-23.

Figure 5-23 Third-Order Intermodulation Equipment Setup



2. Set one source to 300 MHz and the other source to 301 MHz for a frequency separation of 1 MHz. Set the sources equal in amplitude (in this example, the sources are set to –5 dBm).

3. Tune both signals onto the screen by setting the center frequency between 300 and 301 MHz. Then, using the knob, center the two signals on the display. Reduce the frequency span to 5 MHz for a span wide enough to include the distortion products on the screen. To be sure the distortion products are resolved, reduce the resolution bandwidth until the distortion products are visible. Press **[BW]**, **RES BW**, and the then use the step down key **[⇓]** to reduce the resolution, and then use the step bandwidth until the distortion products are visible.

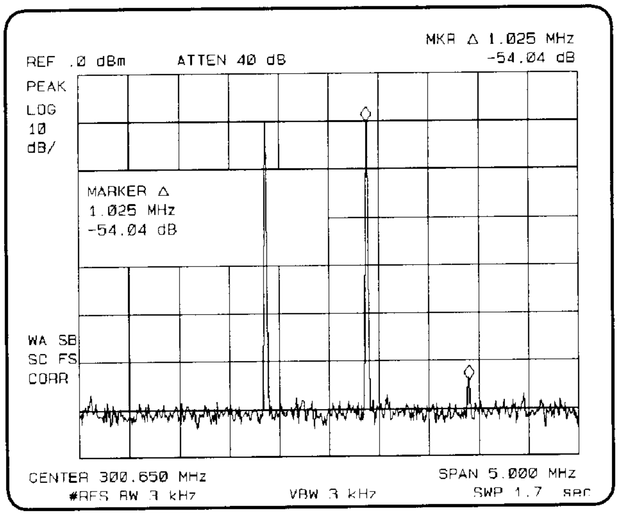
4. For best dynamic range, set the mixer input level to –30 dB and move the signal to the reference level: press **[AMPLITUDE]**, **More 1 of 2**, **MAX MXR LEVEL**, 30 **[–dBm]**.

   The spectrum analyzer automatically sets the attenuation so that a signal at the reference level will be a maximum of –40 dBm at the input mixer.

5. To measure a distortion product, press **[PEAK SEARCH]** to place a marker on a source signal, To activate the second marker, press **Marker** ∆. Using the knob, adjust the second marker to the peak of the distortion product that is beside the test tone. The difference between the markers is displayed in the active function block.

   To measure the other distortion product, press **[PEAK SEARCH]**, **NEXT PEAK**. This places a marker on the next highest peak, which, in this case, is the other source signal. To measure the difference between this test tone and the second distortion product, press **Marker** ∆ and use the knob to adjust the second marker to the peak of the second distortion product. See Figure 5-24.

Figure 5-24 Measuring the Distortion Product



Using the Analyzer As a Receiver in Zero Frequency Span

The spectrum analyzer operates as a fixed-tuned receiver in zero span. The zero span mode can be used to recover modulation on a carrier signal

Center frequency in the swept-tuned mode becomes the tuned frequency in zero span. The horizontal axis of the screen becomes calibrated in time, rather than frequency. Markers display amplitude and time values.

The following functions establish a clear display of the video waveform:

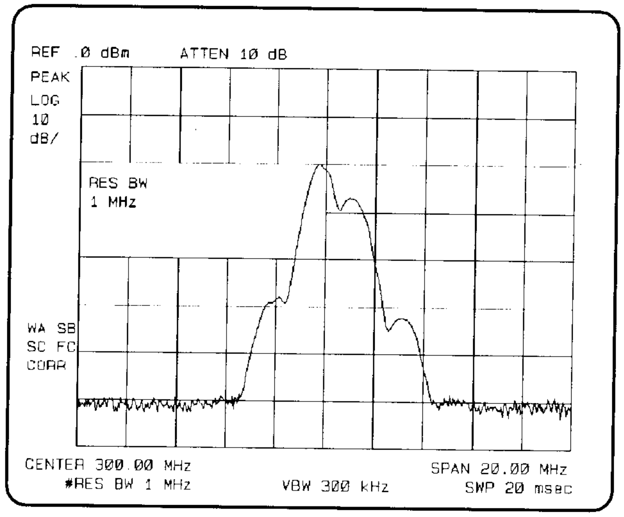
- Trigger stabilizes the waveform trace on the display by triggering on the modulation envelope. If the signal's modulation is stable, video trigger synchronizes the sweep with the demodulated waveform.
- Linear mode should be used in amplitude modulation (AM) measurements to avoid distortion caused by the logarithmic amplifier when demodulating signals.
- Sweep time adjusts the full sweep time from 20 ms (20 µ in zero span), to 100 s. The sweep time readout refers to the full 10-division graticule. Divide this value by 10 to determine sweep time per division.
- Resolution and video bandwidth are selected according to the signal bandwidth.

Each of the coupled function values remains at its current value when zero span is activated. Video bandwidth is coupled to resolution bandwidth. Sweep time is not coupled to any other function.

Example: View the modulation waveform of an AM signal in the time domain.

1. To obtain an AM signal, you can either connect an antenna to the spectrum analyzer input and tune to a commercial AM broadcast station or you can connect a source to the spectrum analyzer input and set the percent modulation of the source. (If a headset is used with the VIDEO OUT connector, the spectrum analyzer will operate as a radio.)
2. First, center and zoom in on the signal in the frequency domain. (See “Decreasing the Frequency Span Using the Marker Track Function”) Be sure to turn off the marker track function, since the marker track function must be off for zero span. See Figure 5-25.

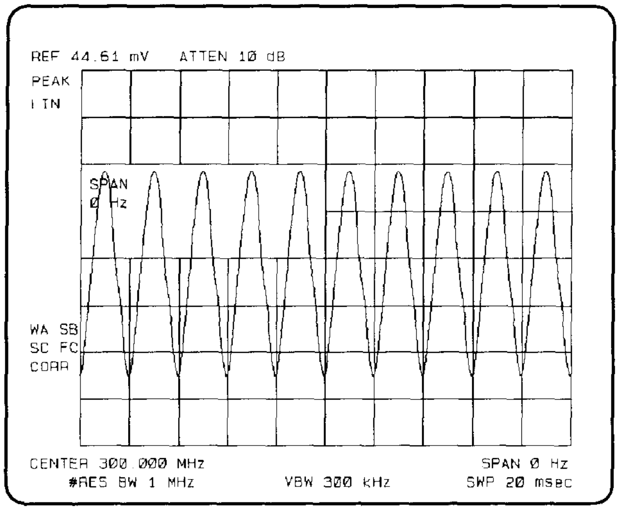
Figure 5-25 Viewing an AM Signal



3. To demodulate the AM, press **[BW]**. Increase the resolution bandwidth to include both sidebands of the signal within the passband of the spectrum analyzer.
4. Next, position the signal peak near the reference level and select a linear voltage display. Press **[AMPLITUDE]** and change the reference level, then press **SCALE LOG LIN** to underline LIN.
5. To select zero span, either press **[SPAN]** 0 **[Hz]** or press **ZERO SPAN**. See Figure 5-26. If the modulation is a steady tone (for example, from a signal generator), use video trigger to trigger on the waveform and stabilize the display. Adjust the sweep time to change the horizontal scale.

Use markers and delta markers to measure time parameters of the waveform.

Figure 5-26 Measuring Modulation In Zero Span



6 Key Menus

What You'll Find in This Chapter

This chapter contains the menus used in the Agilent 8594Q Option 190 DVB-C QAM analyzer. The menu maps are separated and illustrated into the following sections.

- DVB-C Analyzer Mode
- Spectrum Analyzer Mode

DVB-C Analyzer Mode

This section contains the menu map illustrating all of the DVB-C analyzer mode softkeys and how they are accessed. Press **[MODE]**, **DVB-C ANALYZER** to enter DVB-C analyzer mode.

Figure 6-1 DVB-C Analyzer Menu Map (1 of 3)

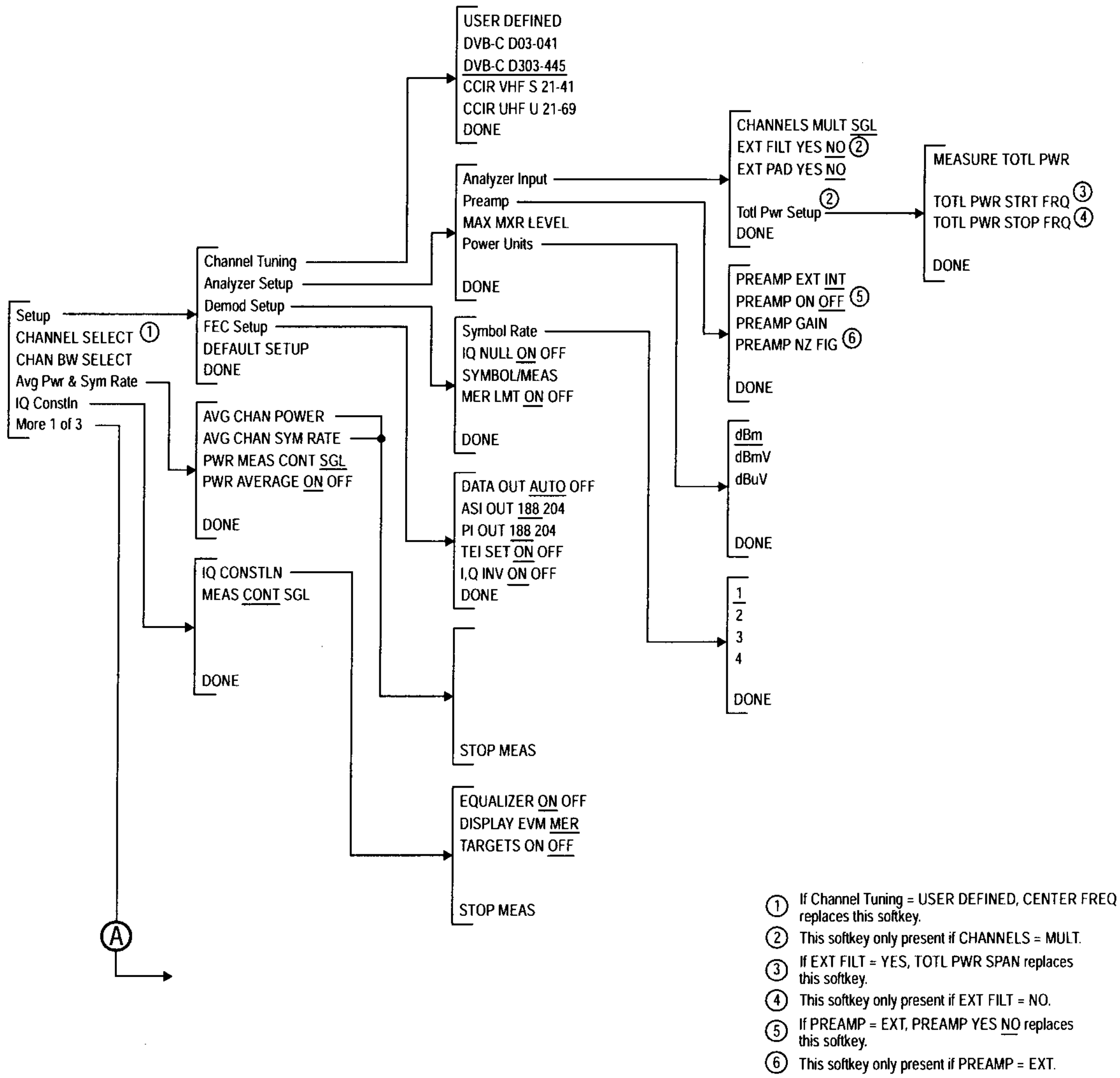


Figure 6-2 DVB-C Analyzer Menu Map (2 of 3)

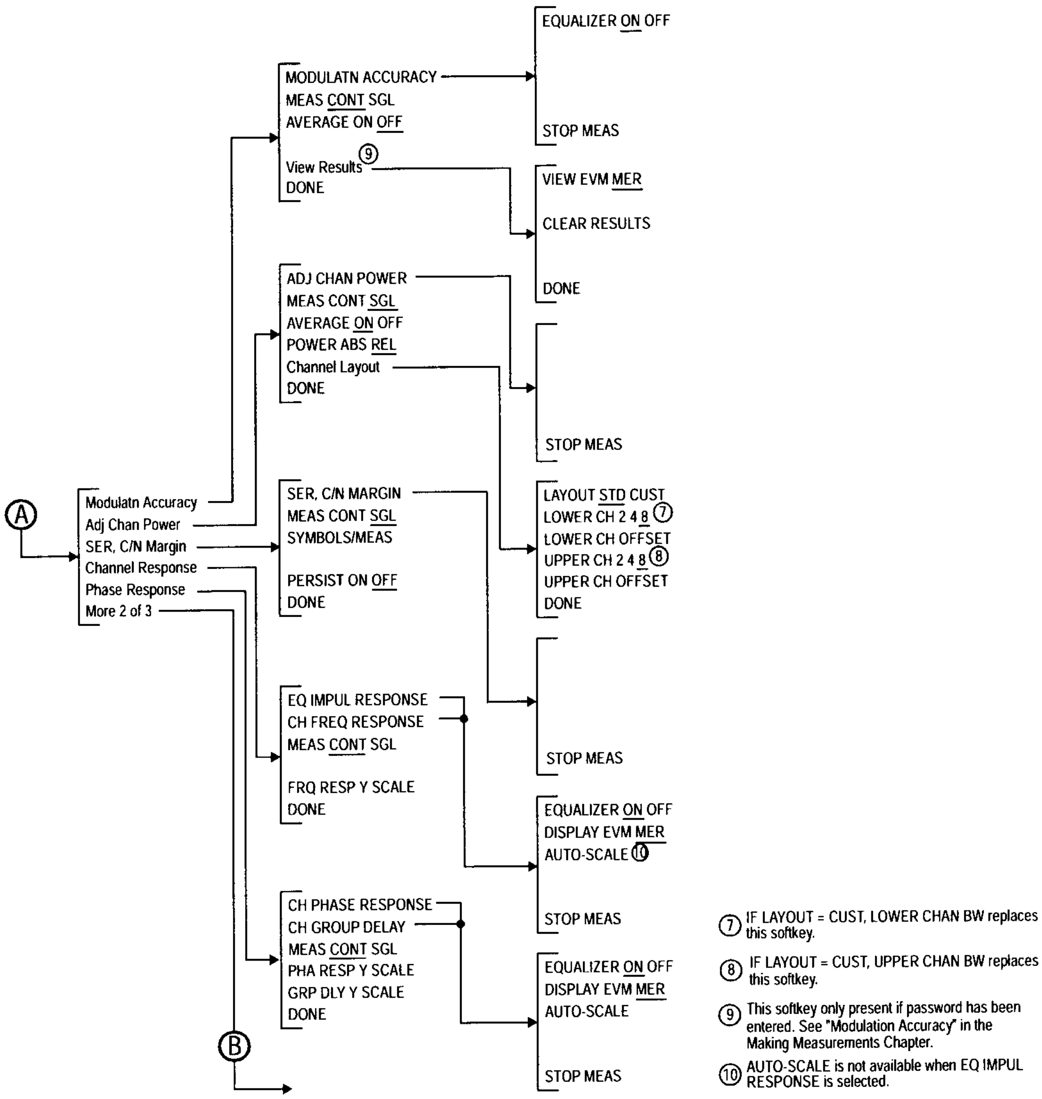
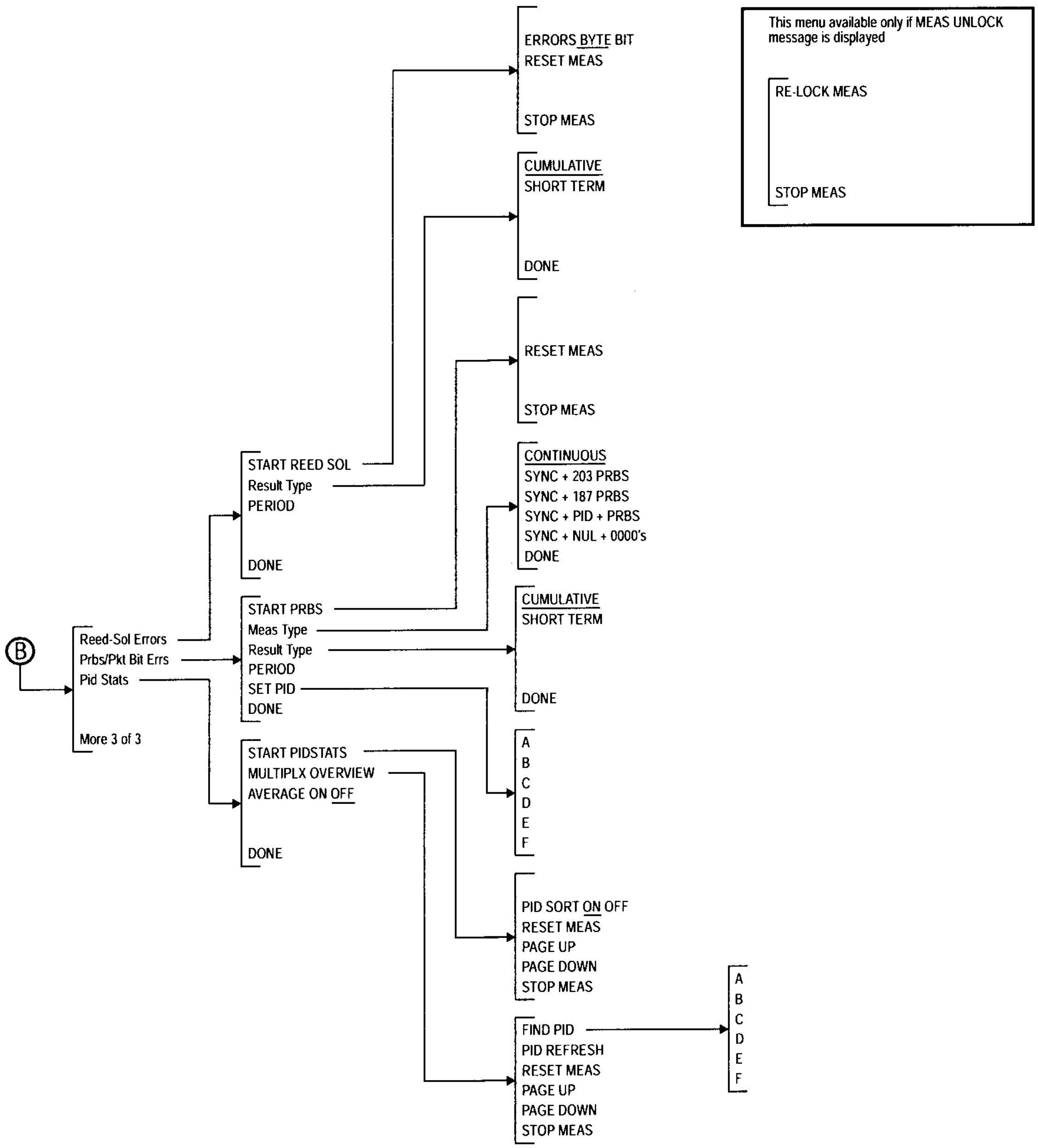


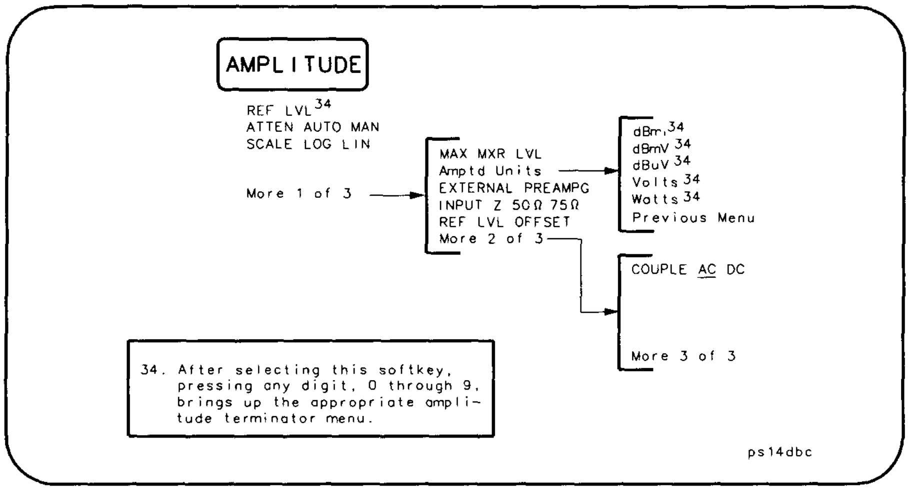
Figure 6-3 DVB-C Analyzer Menu Map (3 of 3)

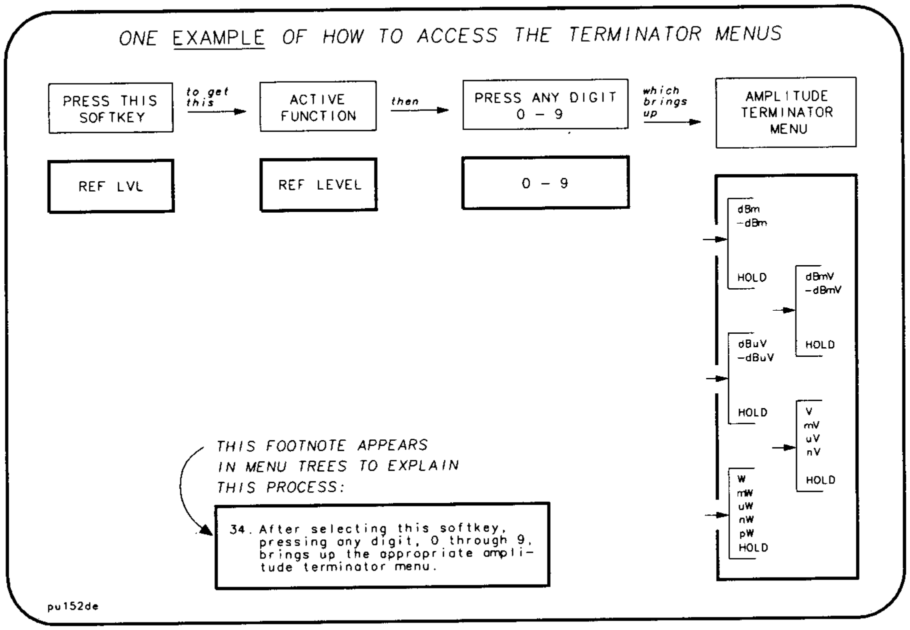


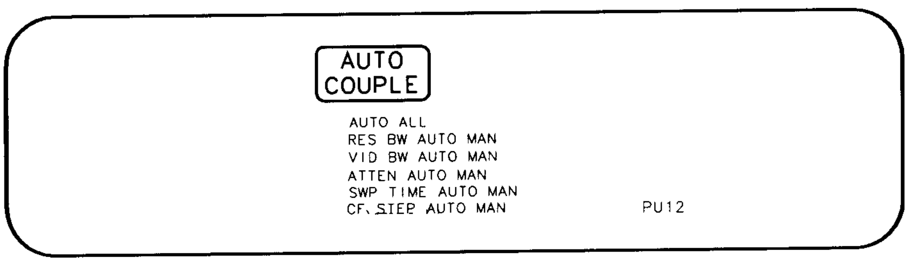
Spectrum Analyzer Mode

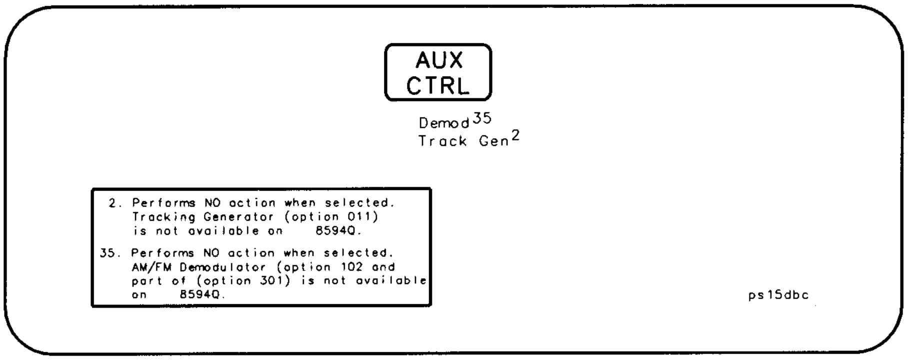
This section contains the key menu diagrams for the spectrum analyzer mode of operation of the 8594Q QAM analyzer. Press **[MODE], SPECTRUM ANALYZER** to enter spectrum analyzer mode.

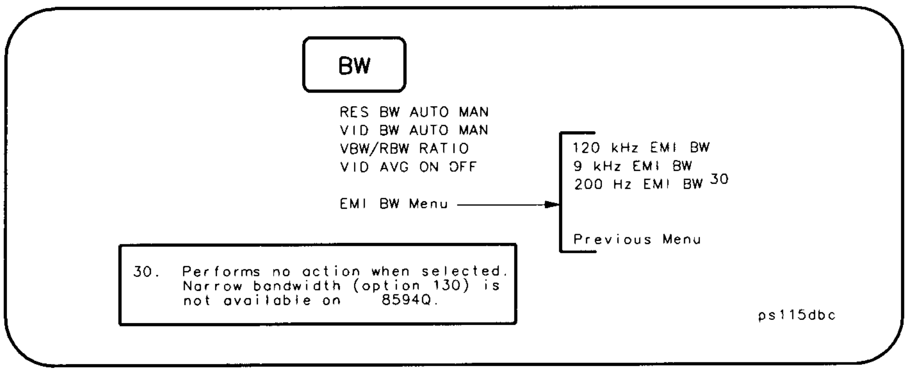
Each key menu diagram is arranged alphabetically according to the front-panel key name

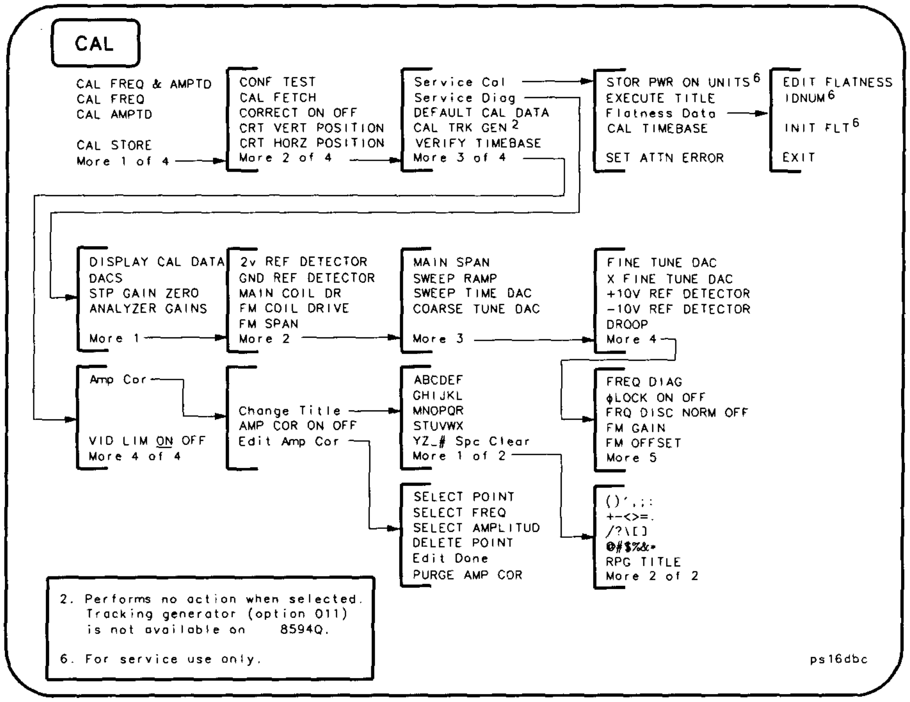


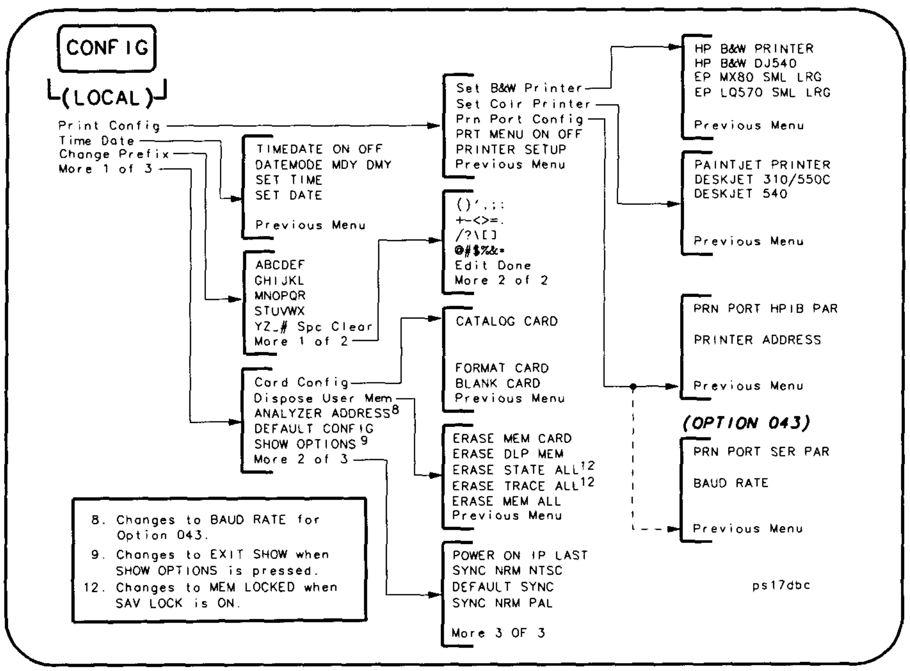

ONE EXAMPLE OF HOW TO ACCESS THE TERMINATOR MENUS
PRESS THIS SOFTKEY
to get this
ACTIVE FUNCTION
then
PRESS ANY DIGIT 0 – 9
which brings up
AMPLITUDE TERMINATOR MENU
REF LVL
REF LEVEL
0 – 9
dBm
–dBm
HOLD
dBmV
–dBmV
HOLD
dBuV
–dBuV
HOLD
V
mV
uV
nV
HOLD
W
mW
uW
nW
pW
HOLD
THIS FOOTNOTE APPEARS IN MENU TREES TO EXPLAIN THIS PROCESS:
34. After selecting this softkey, pressing any digit, 0 through 9, brings up the appropriate amplitude terminator menu.
pu152de

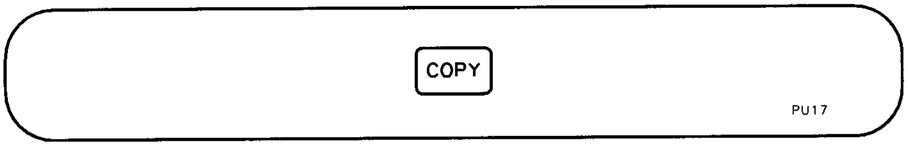

AUTO COUPLE
AUTO ALL
RES BW AUTO MAN
VID BW AUTO MAN
ATTEN AUTO MAN
SWP TIME AUTO MAN
CF STEP AUTO MAN
PU12

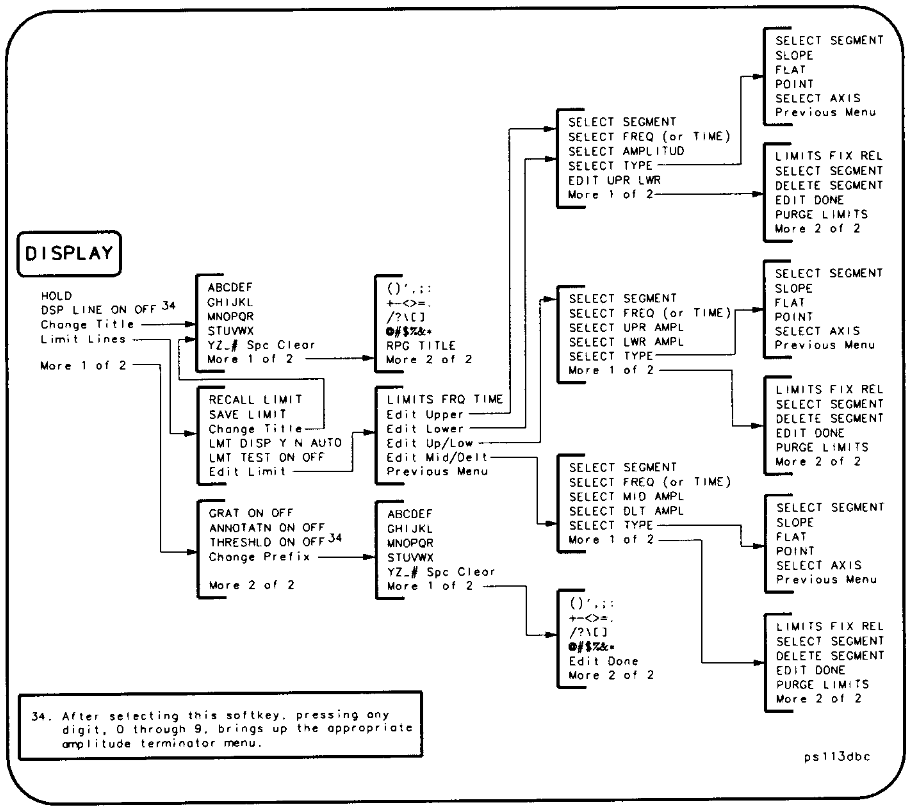

AUX CTRL
Demod 35
Track Gen 2
2. Performs NO action when selected. Tracking Generator (option 011) is not available on 8594Q.
35. Performs NO action when selected. AM/FM Demodulator (option 102 and part of (option 301) is not available on 8594Q.
ps15dbc

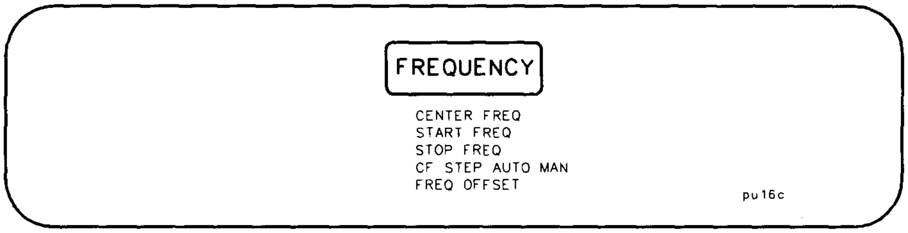

BW
RES BW AUTO MAN
VID BW AUTO MAN
VBW/RBW RATIO
VID AVG ON OFF
EMI BW Menu
120 kHz EMI BW
9 kHz EMI BW
200 Hz EMI BW 30
Previous Menu
30. Performs no action when selected. Narrow bandwidth (option 130) is not available on 8594Q.
ps115dbc

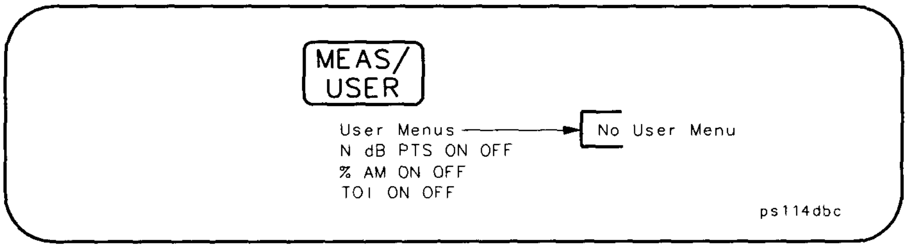

CAL
CAL FREQ & AMPTD
CAL FREQ
CAL AMPTD
CAL STORE
More 1 of 4
CONF TEST
CAL FETCH
CORRECT ON OFF
CRT VERT POSITION
CRT HORZ POSITION
More 2 of 4
Service Cal
Service Diag
DEFAULT CAL DATA
CAL TRK GEN 2
VERIFY TIMEBASE
More 3 of 4
STOR PWR ON UNITS 6
EXECUTE TITLE
Flatness Data
CAL TIMEBASE
SET ATTN ERROR
EDIT FLATNESS
IDNUM 6
INIT FLT 6
EXIT
DISPLAY CAL DATA
DACS
STP GAIN ZERO
ANALYZER GAINS
More 1
2v REF DETECTOR
GND REF DETECTOR
MAIN COIL DR
FM COIL DRIVE
FM SPAN
More 2
MAIN SPAN
SWEEP RAMP
SWEEP TIME DAC
COARSE TUNE DAC
More 3
FINE TUNE DAC
X FINE TUNE DAC
+10V REF DETECTOR
−10V REF DETECTOR
DROOP
More 4
Amp Cor
VID LIM ON OFF
More 4 of 4
Change Title
AMP COR ON OFF
Edit Amp Cor
ABCDEF
GHIJKL
MNOPQR
STUVWX
YZ_# Spc Clear
More 1 of 2
FREQ DIAG
ϕLOCK ON OFF
FRQ DISC NORM OFF
FM GAIN
FM OFFSET
More 5
SELECT POINT
SELECT FREQ
SELECT AMPLITUD
DELETE POINT
Edit Done
PURGE AMP COR
()',;:
+−<>=.
/?\[]
@#$%&*
RPG TITLE
More 2 of 2
2. Performs no action when selected. Tracking generator (option 011) is not available on 8594Q.
6. For service use only.
ps16dbc

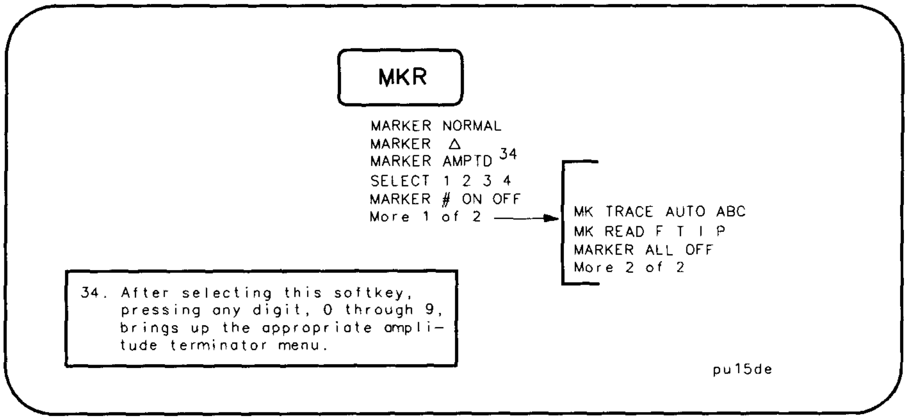

CONFIG
(LOCAL)
Print Config
Time Date
Change Prefix
More 1 of 3
TIMEDATE ON OFF
DATEMODE MDY DMY
SET TIME
SET DATE
Previous Menu
Set B&W Printer
Set Colr Printer
Prn Port Config
PRT MENU ON OFF
PRINTER SETUP
Previous Menu
HP B&W PRINTER
HP B&W DJ540
EP MX80 SML LRG
EP LQ570 SML LRG
Previous Menu
PAINTJET PRINTER
DESKJET 310/550C
DESKJET 540
Previous Menu
()',;:
+−<>=.
/?\[]
@#$%&*
Edit Done
More 2 of 2
ABCDEF
GHIJKL
MNOPQR
STUVWX
YZ_# Spc Clear
More 1 of 2
CATALOG CARD
FORMAT CARD
BLANK CARD
Previous Menu
PRN PORT HPIB PAR
PRINTER ADDRESS
Previous Menu
Card Config
Dispose User Mem
ANALYZER ADDRESS 8
DEFAULT CONFIG
SHOW OPTIONS 9
More 2 of 3
ERASE MEM CARD
ERASE DLP MEM
ERASE STATE ALL 12
ERASE TRACE ALL 12
ERASE MEM ALL
Previous Menu
(OPTION 043)
PRN PORT SER PAR
BAUD RATE
Previous Menu
POWER ON IP LAST
SYNC NRM NTSC
DEFAULT SYNC
SYNC NRM PAL
More 3 OF 3
8. Changes to BAUD RATE for Option 043.
9. Changes to EXIT SHOW when SHOW OPTIONS is pressed.
12. Changes to MEM LOCKED when SAV LOCK is ON.
ps17dbc

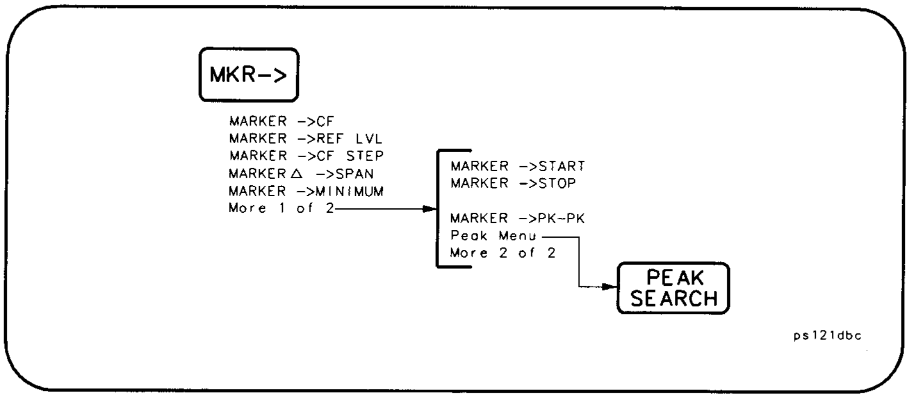

COPY
PU17

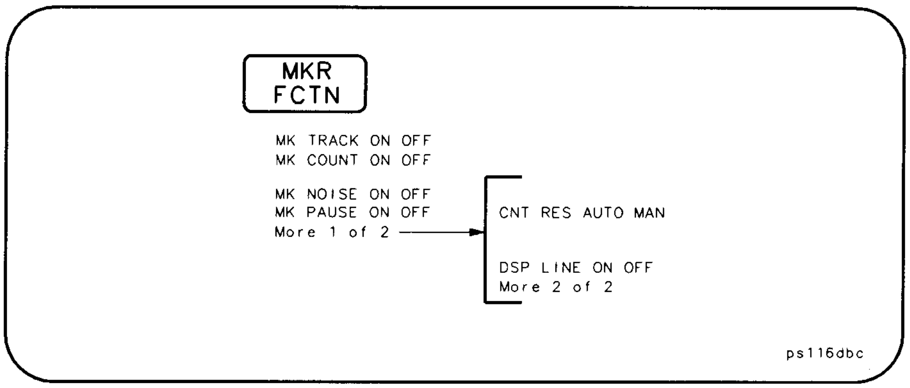

DISPLAY
HOLD
DSP LINE ON OFF 34
Change Title
Limit Lines
More 1 of 2
ABCDEF
GHIJKL
MNOPQR
STUVWX
YZ_# Spc Clear
More 1 of 2
()',;:
+-<>=.
/?\[]
@#$%&*
RPG TITLE
More 2 of 2
RECALL LIMIT
SAVE LIMIT
Change Title
LMT DISP Y N AUTO
LMT TEST ON OFF
Edit Limit
LIMITS FRQ TIME
Edit Upper
Edit Lower
Edit Up/Low
Edit Mid/Delt
Previous Menu
GRAT ON OFF
ANNOTATN ON OFF
THRESHLD ON OFF 34
Change Prefix
More 2 of 2
ABCDEF
GHIJKL
MNOPQR
STUVWX
YZ_# Spc Clear
More 1 of 2
()',;:
+-<>=.
/?\[]
@#$%&*
Edit Done
More 2 of 2
SELECT SEGMENT
SELECT FREQ (or TIME)
SELECT AMPLITUD
SELECT TYPE
EDIT UPR LWR
More 1 of 2
SELECT SEGMENT
SELECT FREQ (or TIME)
SELECT UPR AMPL
SELECT LWR AMPL
SELECT TYPE
More 1 of 2
SELECT SEGMENT
SELECT FREQ (or TIME)
SELECT MID AMPL
SELECT DLT AMPL
SELECT TYPE
More 1 of 2
SELECT SEGMENT
SLOPE
FLAT
POINT
SELECT AXIS
Previous Menu
LIMITS FIX REL
SELECT SEGMENT
DELETE SEGMENT
EDIT DONE
PURGE LIMITS
More 2 of 2
34. After selecting this softkey, pressing any digit, 0 through 9, brings up the appropriate amplitude terminator menu.
ps113dbc

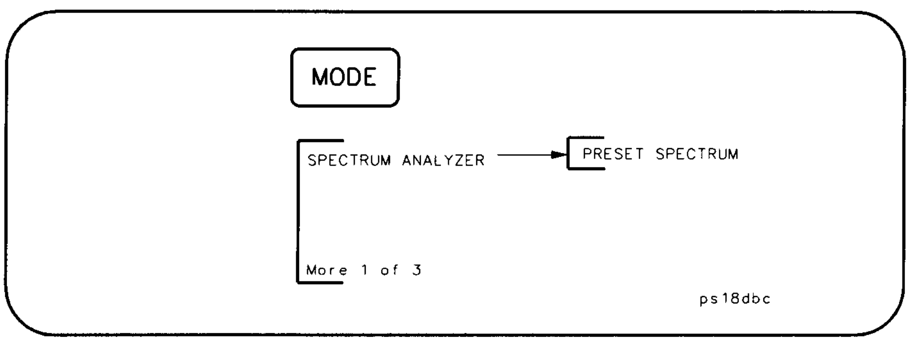

FREQUENCY
CENTER FREQ
START FREQ
STOP FREQ
CF STEP AUTO MAN
FREQ OFFSET
pu16c

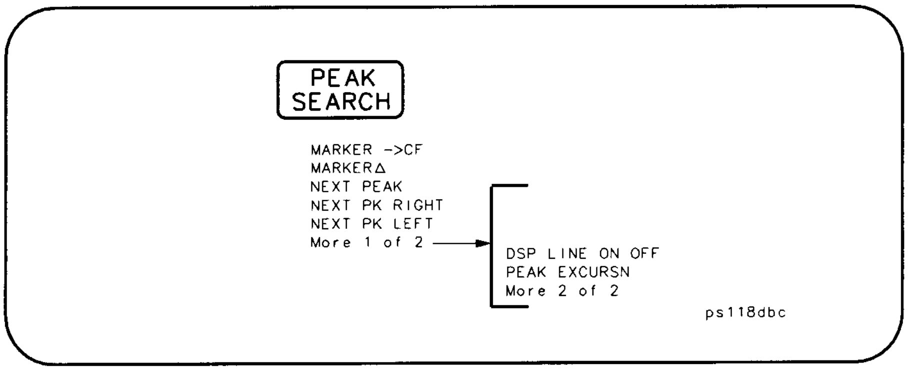

MEAS/ USER
User Menus
No User Menu
N dB PTS ON OFF
% AM ON OFF
TOI ON OFF
ps114dbc

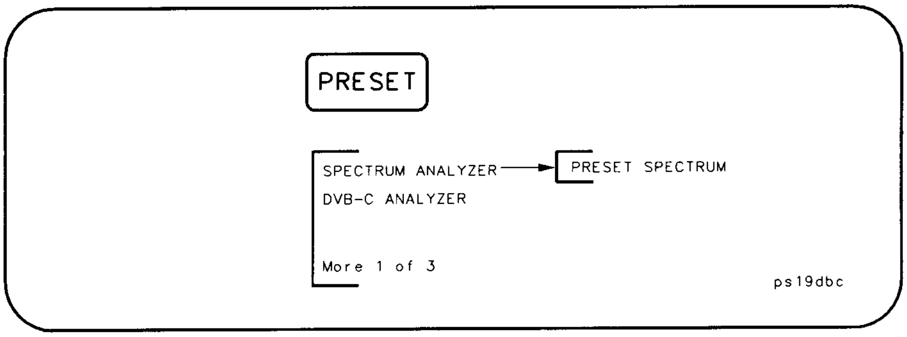

MKR
MARKER NORMAL
MARKER Δ
MARKER AMPTD 34
SELECT 1 2 3 4
MARKER # ON OFF
More 1 of 2
MK TRACE AUTO ABC
MK READ F T I P
MARKER ALL OFF
More 2 of 2
34. After selecting this softkey, pressing any digit, 0 through 9, brings up the appropriate ampli-tude terminator menu.
pu15de

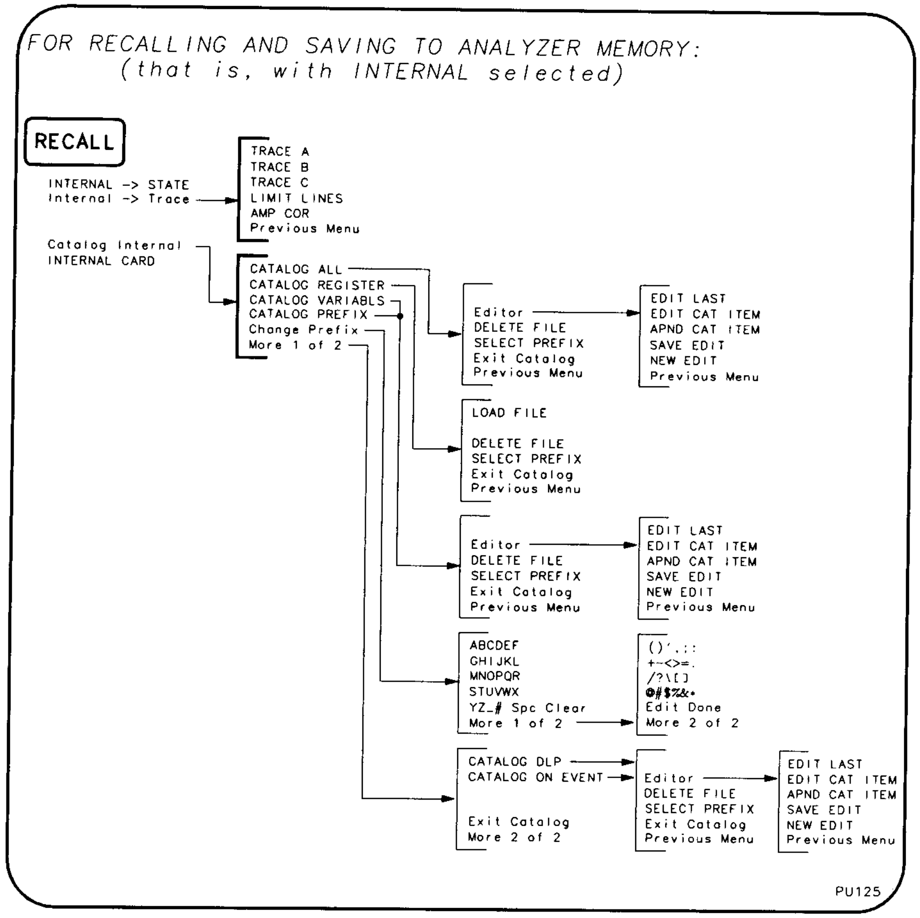

MKR->
MARKER ->CF
MARKER ->REF LVL
MARKER ->CF STEP
MARKER Δ ->SPAN
MARKER ->MINIMUM
More 1 of 2
MARKER ->START
MARKER ->STOP
MARKER ->PK-PK
Peak Menu
More 2 of 2
PEAK SEARCH
ps121dbc

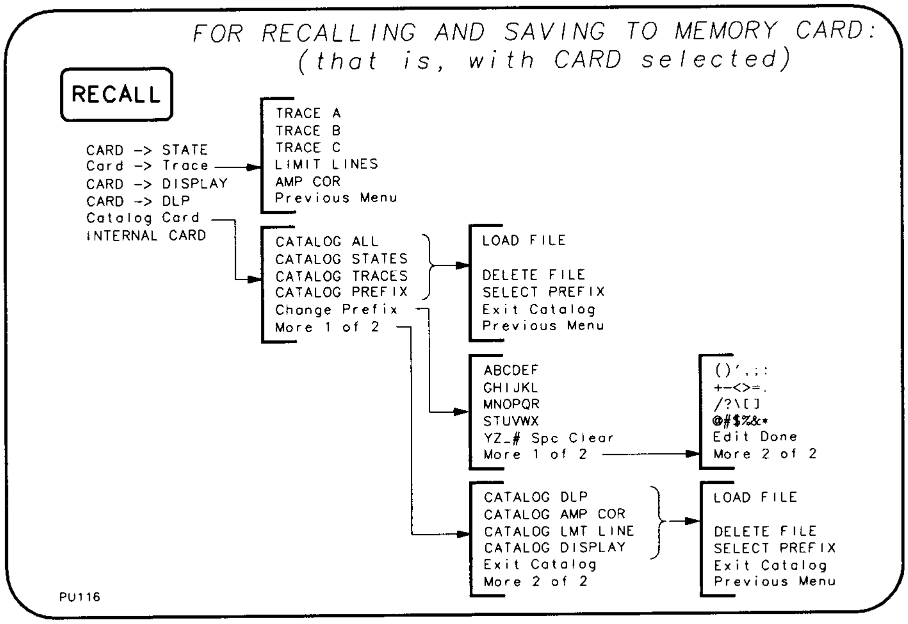

MKR FCTN
MK TRACK ON OFF
MK COUNT ON OFF
MK NOISE ON OFF
MK PAUSE ON OFF
More 1 of 2
CNT RES AUTO MAN
DSP LINE ON OFF
More 2 of 2
ps116dbc

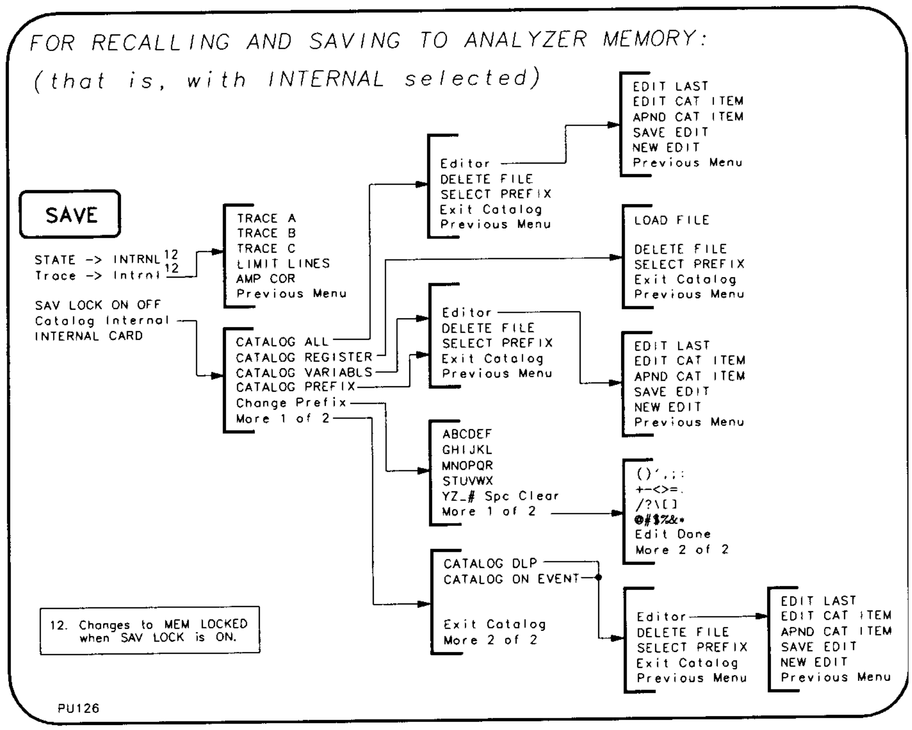

MODE
SPECTRUM ANALYZER
PRESET SPECTRUM
More 1 of 3
ps18dbc

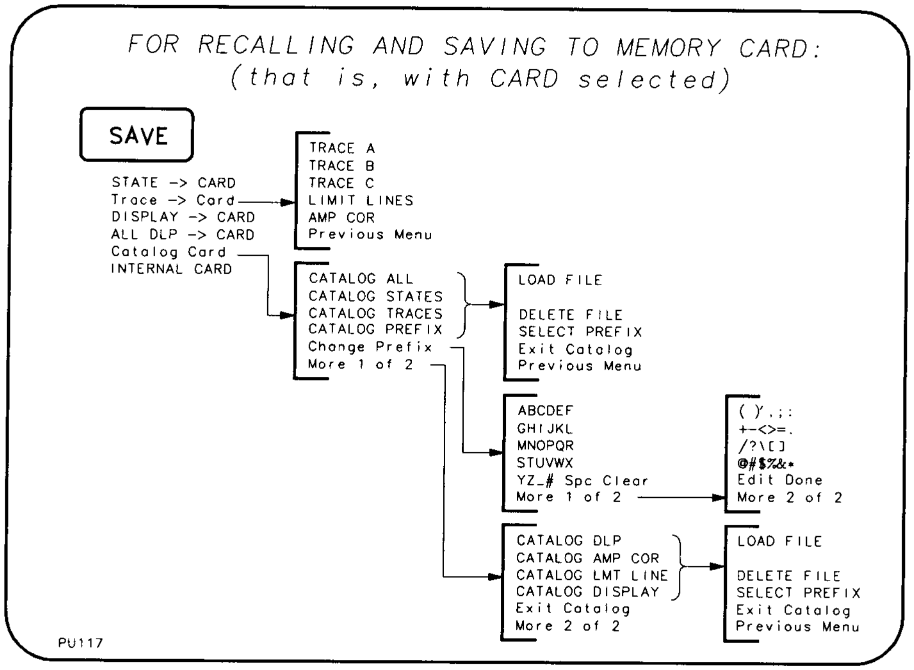

PEAK SEARCH
MARKER ->CF
MARKER Δ
NEXT PEAK
NEXT PK RIGHT
NEXT PK LEFT
More 1 of 2
DSP LINE ON OFF
PEAK EXCURSN
More 2 of 2
ps118dbc

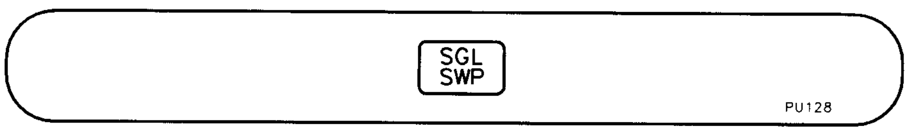

PRESET
SPECTRUM ANALYZER
PRESET SPECTRUM
DVB-C ANALYZER
More 1 of 3
ps19dbc

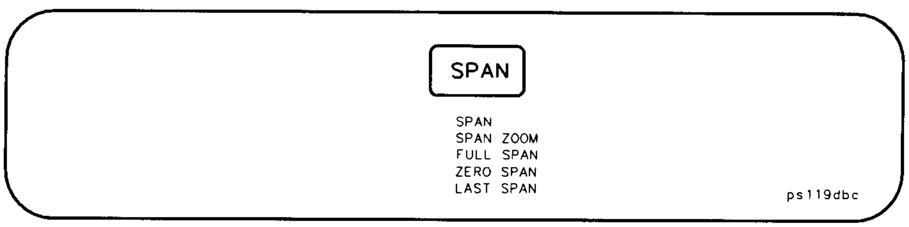

FOR RECALLING AND SAVING TO ANALYZER MEMORY:
(that is, with INTERNAL selected)
RECALL
INTERNAL -> STATE
Internal -> Trace
TRACE A
TRACE B
TRACE C
LIMIT LINES
AMP COR
Previous Menu
Catalog Internal
INTERNAL CARD
CATALOG ALL
CATALOG REGISTER
CATALOG VARIABLS
CATALOG PREFIX
Change Prefix
More 1 of 2
Editor
DELETE FILE
SELECT PREFIX
Exit Catalog
Previous Menu
EDIT LAST
EDIT CAT ITEM
APND CAT ITEM
SAVE EDIT
NEW EDIT
Previous Menu
LOAD FILE
DELETE FILE
SELECT PREFIX
Exit Catalog
Previous Menu
Editor
DELETE FILE
SELECT PREFIX
Exit Catalog
Previous Menu
EDIT LAST
EDIT CAT ITEM
APND CAT ITEM
SAVE EDIT
NEW EDIT
Previous Menu
ABCDEF
GHIJKL
MNOPQR
STUVWX
YZ_# Spc Clear
More 1 of 2
Edit Done
More 2 of 2
CATALOG DLP
CATALOG ON EVENT
Exit Catalog
More 2 of 2
Editor
DELETE FILE
SELECT PREFIX
Exit Catalog
Previous Menu
EDIT LAST
EDIT CAT ITEM
APND CAT ITEM
SAVE EDIT
NEW EDIT
Previous Menu
PU125

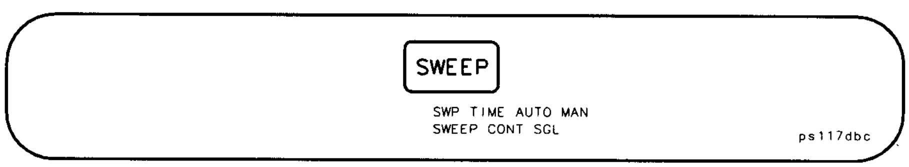

FOR RECALLING AND SAVING TO MEMORY CARD:
(that is, with CARD selected)
RECALL
CARD -> STATE
Card -> Trace
CARD -> DISPLAY
CARD -> DLP
Catalog Card
INTERNAL CARD
TRACE A
TRACE B
TRACE C
LIMIT LINES
AMP COR
Previous Menu
CATALOG ALL
CATALOG STATES
CATALOG TRACES
CATALOG PREFIX
Change Prefix
More 1 of 2
LOAD FILE
DELETE FILE
SELECT PREFIX
Exit Catalog
Previous Menu
ABCDEF
GHIJKL
MNOPQR
STUVWX
YZ_# Spc Clear
More 1 of 2
Edit Done
More 2 of 2
CATALOG DLP
CATALOG AMP COR
CATALOG LMT LINE
CATALOG DISPLAY
Exit Catalog
More 2 of 2
LOAD FILE
DELETE FILE
SELECT PREFIX
Exit Catalog
Previous Menu
PU116

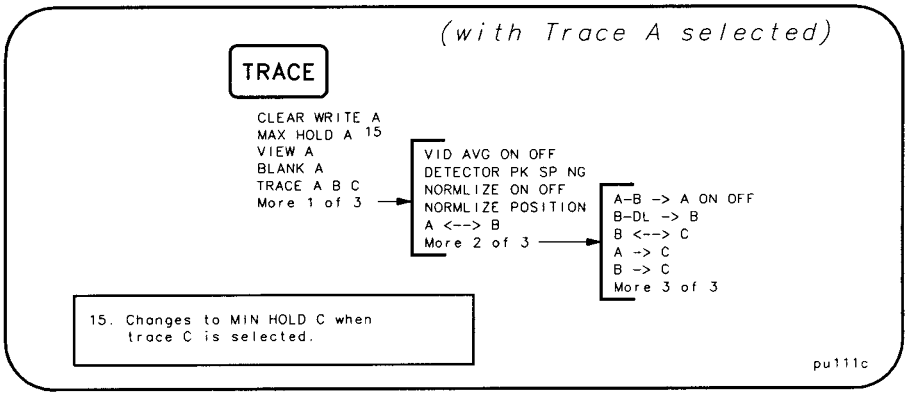

FOR RECALLING AND SAVING TO ANALYZER MEMORY:
(that is, with INTERNAL selected)
SAVE
STATE -> INTRNL 12
Trace -> Intrnl 12
SAV LOCK ON OFF
Catalog Internal
INTERNAL CARD
TRACE A
TRACE B
TRACE C
LIMIT LINES
AMP COR
Previous Menu
CATALOG ALL
CATALOG REGISTER
CATALOG VARIABLS
CATALOG PREFIX
Change Prefix
More 1 of 2
Editor
DELETE FILE
SELECT PREFIX
Exit Catalog
Previous Menu
EDIT LAST
EDIT CAT ITEM
APND CAT ITEM
SAVE EDIT
NEW EDIT
Previous Menu
LOAD FILE
DELETE FILE
SELECT PREFIX
Exit Catalog
Previous Menu
ABCDEF
GHIJKL
MNOPQR
STUVWX
YZ_# Spc Clear
More 1 of 2
Edit Done
More 2 of 2
CATALOG DLP
CATALOG ON EVENT
Exit Catalog
More 2 of 2
12. Changes to MEM LOCKED when SAV LOCK is ON.
PU126

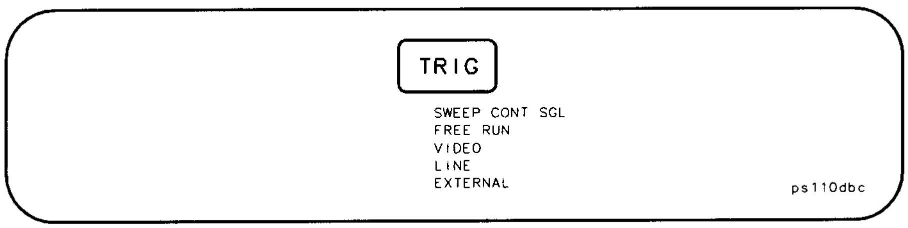

FOR RECALLING AND SAVING TO MEMORY CARD:
(that is, with CARD selected)
SAVE
STATE -> CARD
Trace -> Card
DISPLAY -> CARD
ALL DLP -> CARD
Catalog Card
INTERNAL CARD
TRACE A
TRACE B
TRACE C
LIMIT LINES
AMP COR
Previous Menu
CATALOG ALL
CATALOG STATES
CATALOG TRACES
CATALOG PREFIX
Change Prefix
More 1 of 2
LOAD FILE
DELETE FILE
SELECT PREFIX
Exit Catalog
Previous Menu
ABCDEF
GHIJKL
MNOPQR
STUVWX
YZ_# Spc Clear
More 1 of 2
( ) , ; :
+-<>=.
/?\[ ]
@#$%&*
Edit Done
More 2 of 2
CATALOG DLP
CATALOG AMP COR
CATALOG LMT LINE
CATALOG DISPLAY
Exit Catalog
More 2 of 2
LOAD FILE
DELETE FILE
SELECT PREFIX
Exit Catalog
Previous Menu
PU117

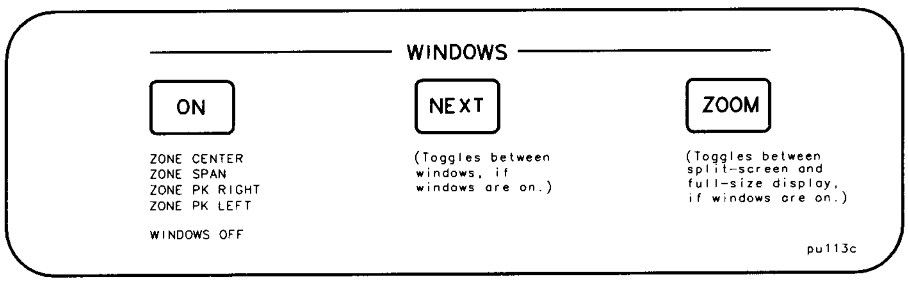

SGL SWP
PU128


SPAN
SPAN
SPAN ZOOM
FULL SPAN
ZERO SPAN
LAST SPAN
ps119dbc


SWEEP
SWP TIME AUTO MAN
SWEEP CONT SGL
ps117dbc


(with Trace A selected)
TRACE
CLEAR WRITE A
MAX HOLD A 15
VIEW A
BLANK A
TRACE A B C
More 1 of 3
VID AVG ON OFF
DETECTOR PK SP NG
NORMLIZE ON OFF
NORMLIZE POSITION
A <--> B
More 2 of 3
A-B -> A ON OFF
B-DL -> B
B <--> C
A -> C
B -> C
More 3 of 3
15. Changes to MIN HOLD C when trace C is selected.
pu111c


TRIG
SWEEP CONT SGL
FREE RUN
VIDEO
LINE
EXTERNAL
ps110dbc


WINDOWS
ON
ZONE CENTER
ZONE SPAN
ZONE PK RIGHT
ZONE PK LEFT
WINDOWS OFF
NEXT
(Toggles between windows, if windows are on.)
ZOOM
(Toggles between split-screen and full-size display, if windows are on.)
pu113c

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Numerics

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