TEK OPERATORS MANUAL

Part No.: 070-6317-00
Product Group 26

2756P
SPECTRUM ANALYZER

Please Check for CHANGE INFORMATION at the Rear of This Manual

First Printing May 1987

Tektronix
COMMITTED TO EXCELLENCE

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Serial Number____________________

PREFACE

This manual is one of a set of product manuals for the TEKTRONIX 2756P Spectrum Analyzer. The manual describes the instrument installation and operation. These instructions assume a thorough knowledge of frequency domain analysis. The purpose of this manual is to explain the operation of the 2756P so that measurements will be meaningful whether made under adverse or laboratory conditions. The manual organization is shown in the Table of Contents. The manuals that are available in addition to this Operators Manual are the

- 2756P Service Manuals, Volume 1 and 2 (optional accessories) and
- 2756P Programmers Manual (standard accessory)

For manual ordering information, contact your local Tektronix Field Office or representative or refer to the Accessories portion of the Replaceable Mechanical Parts list in the Service Manual, Volume 2.

Standards and Conventions Used

Most terminology is consistent with standards adapted by IEEE and IEC. A glossary of terms is provided in Appendix A. Abbreviations in the documentation are consistent with ANSI Y1.1-1972. GPIB functions conform to the IEEE 488-1978 Standard. Copies of ANSI and IEEE standards can be ordered from the Institute of Electrical and Electronic Engineers Inc.

Change/History Information

Any change information that involves manual corrections or additional information is located behind the tabbed Change Information page at the back of this manual.

History information, as well as the updated data, is combined within this manual when the page(s) is revised. A revised page is identified by a revision date located in the lower inside corner of the page.

Unpacking and Initial Inspection

Instructions for unpacking and preparing the instrument for use are described in Section 5.

Storage and Repackaging

Instructions for short- and long-term storage and instrument repackaging for shipment are described in Section 3.

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SAFETY SUMMARY

(Refer all servicing to qualified servicing personnel)

The safety information in this summary is for both operating and servicing personnel. Specific warnings and cautions will be found throughout the manual where they apply, but may not appear in this summary.

CONFORMANCE TO INDUSTRY STANDARDS

This instrument complies with the following Industry Safety Standards and Regulatory Requirements.

Safety

CSA: Electrical Bulletin

FM: Electrical Utilization Standard Class 3820

ANSI C39.5 — Safety Requirements for Electrical and Electronic Measuring and Controlling Instrumentation.

IEC 348 (2nd edition) — Safety Requirements for Electronic Measuring Apparatus.

Regulatory Requirements

VDE 0871 Class B — Regulations for RFI Suppression of High Frequency Apparatus and Installations.

TERMS

In This Manual

CAUTION statements identify conditions or practices that could result in damage to the equipment or other property.

WARNING statements identify conditions or practices that could result in personal injury or loss of life.

As Marked on Equipment

CAUTION indicates a personal injury hazard not immediately accessible as one reads the marking, or a hazard to property, including the equipment itself.

DANGER indicates a personal injury hazard immediately accessible as one reads the marking.

SYMBOLS

In This Manual

⚠ This symbol indicates where applicable cautionary or other information is to be found.

As Marked on Equipment

ϟ DANGER — High voltage.

⏚ Protective ground (earth) terminal.

⚠ ATTENTION — refer to manual.

ⓘ Refer to manual

POWER

Power Source

This product is intended to operate from a power source that will not apply more than 250 V rms between the supply conductors or between either supply conductor and ground. A protective ground connection by way of the grounding conductor in the power cord is essential for safe operation.

Grounding the Product

This product is grounded through the grounding conductor of the power cord. To avoid electrical shock, plug the power cord into the power terminal. A protective ground connection by way of the grounding conductor in the power cord is essential for safe operation.

Danger From Loss of Ground

Upon loss of the protective-ground connection, all accessible conductive parts (including knobs and controls that may appear to be insulating) can render an electric shock.

Use the Proper Power Cord

Use only the power cord and connector specified for your product.

Use only a power cord that is in good condition.

CSA certification applies to the spectrum analyzer with CSA-certified power cords only (the power cord shipped with your instrument and Tektronix Option A4). International power cords (Tektronix Options A1, A2, A3, and A5) are approved only for the country of use, and are not included in the CSA certification.

Refer cord and connector changes to qualified service personnel.

For detailed information on power cords and connectors, see the Maintenance section in the Service Manual, Volume 1.

Use the Proper Fuse

To avoid fire hazard or equipment damage, use only the fuse of correct type, voltage rating, and current rating for your product (as specified in the Replaceable Electrical Parts list in Volume 2 of the Service Manual). Refer fuse replacement to qualified service personnel.

OPERATIONAL PRECAUTIONS

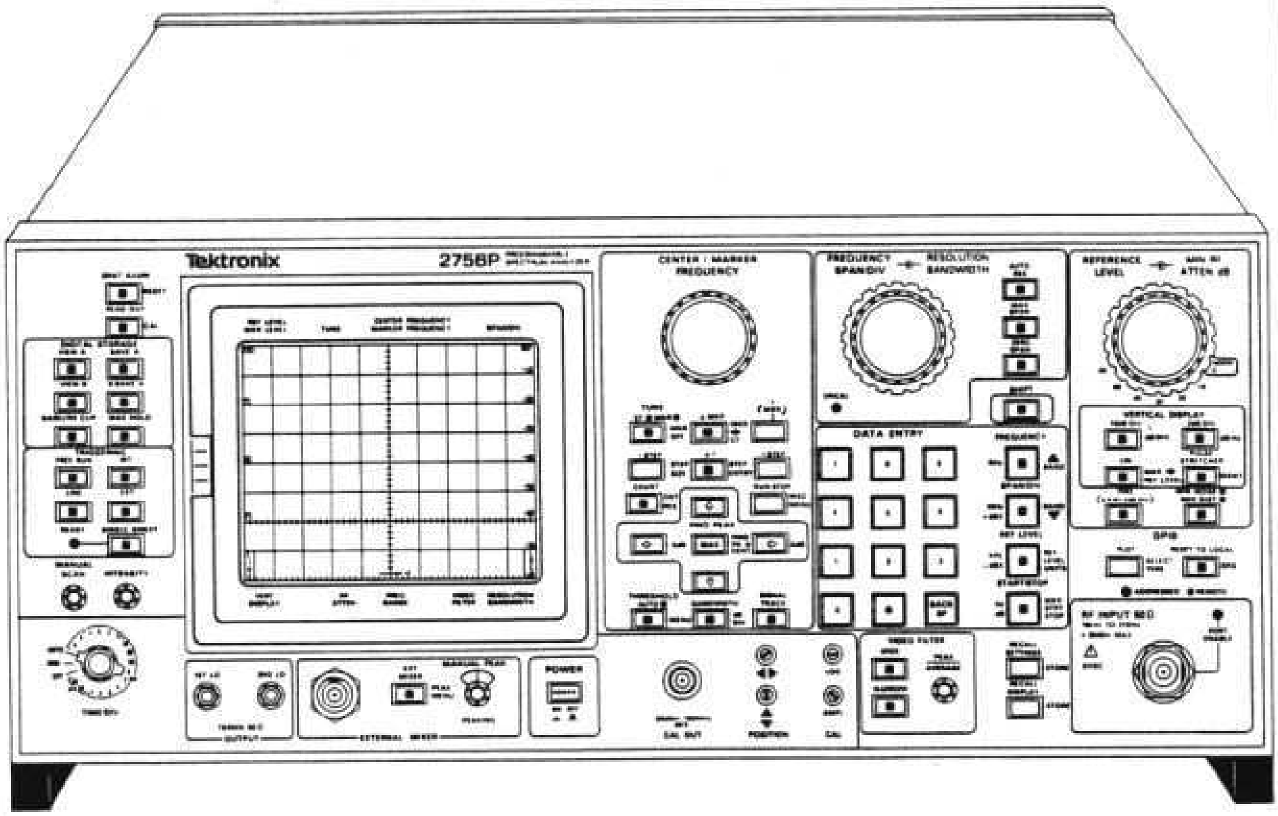
Do Not Operate in Explosive Atmospheres

To avoid explosion, do not operate this product in an explosive atmosphere unless it has been specifically certified for such operation.

Do Not Remove Covers or Panels

To avoid personal injury, do not remove the product covers or panels unless you are qualified to do so. Do not operate the product without the covers and panels properly installed.

Dangerous voltages exist at several points in this product. To avoid personal injury, do not touch exposed connections and components while power is on. REFER ALL SERVICING TO QUALIFIED SERVICE PERSONNEL.



TEKTRONIX 2756P Programmable Spectrum Analyzer

GENERAL INFORMATION

PRODUCT OVERVIEW

The TEKTRONIX programmable 2756P Spectrum Analyzer is a high performance, laboratory instrument. Microcomputer control of most functions simplifies and enhances operation.

The following is a list of the main instrument features.

- single and delta marker modes
- synthesizer frequency accuracy
- precision signal counting ability
- precise amplitude measurement capability
- digital storage display
- internal memory to retain front-panel settings and displays
- front-panel DATA ENTRY pushbuttons
- ability to plot the display, readout, and graticule
- ability to hold 8 personalized macros in memory
- 10 Hz to 3 MHz resolution
- multiband sweep capability

The frequency range is 10 kHz to 21 GHz with the internal mixer, and up to 325 GHz when using external waveguide mixers. A minimum resolution bandwidth of 10 Hz, with a minimum span of 10 Hz/div, provides measurement resolution that is proportional to the frequency accuracy. Digital storage provides flicker-free displays plus SAVE A, B−SAVE A, and MAX HOLD to compare and subtract displays and save maximum values. In addition to conventional digital storage features, internal memory stores up to nine separate displays with their readouts and dot markers, which can be recalled later for additional analysis and comparison. It is also possible to store up to ten different front-panel control setups for future recall. The signal counting feature allows the spectrum analyzer to selectively count a particular signal out of several that may be present at its input.

Select center frequency either by rotating the front-panel CENTER/MARKER FREQUENCY control or by entering it with the Data Entry pushbuttons. Other parameters, such as vertical display and reference level, are pushbutton selectable with the flexibility previously available only under program control of the general purpose interface bus (GPIB).

The single and delta markers provide direct readout of frequency and amplitude information of any point along any displayed trace. Relative (delta) frequency and amplitude information between any two points along any displayed trace or between traces is also available. The CENTER/MARKER FREQUENCY control can move the markers, or it can move the display with a stationary frequency marker. For additional marker information, refer to Using the Markers Feature in Section 6 of this Manual.

The front-panel controls (except those intended exclusively for local use, such as INTENSITY) can be remotely operated through the GPIB port, which allows the spectrum analyzer to be used with a variety of systems and controllers. Refer to the Programmers Manual for additional information.

The instrument also features macroinstructions (macros). The memory has 8K bytes set aside for the construction of made-to-order macros. The macro menu can hold the titles of eight macros for easy access. Specific macro information is located in the Programmers Manual.

Firmware Version and Error Message Readout

This feature of the spectrum analyzer provides readout that identifies the version of firmware installed. The readout is momentarily displayed when the power is turned on. All front-panel lights will temporarily flash on when the power is first turned on. In addition, the instrument will flash that information and the GPIB address and macro status when RESET TO LOCAL is pressed.

If the spectrum analyzer fails to complete any routine or function, an error message will flash on the screen explaining the failure.

Accessories

The Replaceable Mechanical Parts list in the Service Manual, Volume 2, contains the part numbers, descriptions, and ordering information for all standard and optional accessories offered for the spectrum analyzer at this time.

The following list includes all standard accessories currently shipped with each instrument. Refer to the Options section of this manual for alternate information.

- 50 Ω coaxial cable; N to N connector, 72 inch
- 50 Ω coaxial cable; bnc to bnc connector, 18 inch
- Adapter; N male to bnc female

- 4A fast-blow fuses[1]; 2 each
- Power cord[1]
- Cord clamp
- Crt light filters; 2 - one each amber and grey
- Crt mesh filter
- 2756P Operators Manual
- 2756P Programmers Manual

Table 1-1 lists the Tektronix waveguide mixers that are available as optional accessories.

Table 1-1
TEKTRONIX WAVEGUIDE MIXERS

Mixer	Frequency Range
WM 490K	18 to 26.5 GHz
WM 490A	26.5 to 40 GHz
WM 490Q	33 to 50 GHz
WM 490U	40 to 60 GHz
WM 490V	50 to 75 GHz
WM 490E	60 to 90 GHz
WM 490W	75 to 110 GHz
WM 490F	90 to 140 GHz
WM 490D	110 to 170 GHz
WM 490G	140 to 220 GHz
WM 490G Option 01 Band Flange Transition	220 to 325 GHz

Options

The Options section of this Manual contains information on all of the options currently available for the spectrum analyzer.

[1] If the instrument is wired for 220-240 V operation (Options A1, A2, A3, A4, A5) or if Option 52 is installed (North American configuration for 220 V with standard power cord), 2A medium-blow fuses are used.

SPECIFICATION

This section includes the electrical, physical, and environmental characteristics of this instrument. Any instrument specification changes due to options are listed in the Options section of this manual.

ELECTRICAL CHARACTERISTICS

The following tables of electrical characteristics and features apply to the spectrum analyzer after a 30-minute warm up and after doing the front-panel CAL adjustments, except as noted. The Performance Requirement column defines some characteristics in quantitative terms and in limit form. The Supplemental Information column explains performance requirements or provides performance information. Statements in this column are not considered to be guaranteed performance and are not ordinarily supported by a performance check procedure. Procedures to verify performance requirements are provided in the Performance Check portion of the Service Manual, Volume 1.

The instrument performs an internal calibration check each time power is turned on. This check verifies that the instrument frequency and amplitude performance is as specified. An Instrument Check Out procedure, which requires little external test equipment or technical expertise, is provided in Section 5 of this manual. This procedure will satisfy most incoming inspections and will help familiarize you with the instrument capabilities.

Verification of Tolerance Values

Perform compliance tests of specified limits, listed in the Performance Requirement column, only after a 30-minute warm-up time (except as noted) and after a doing the front-panel CAL procedure. Use measurement instruments that do not affect the values measured. Measurement tolerance of test equipment should be negligible when compared to the specified tolerance. If the tolerance is not negligible, add the error of the measuring device to the specified tolerance.

Table 2-1
Frequency Related Characteristics

Characteristic	Performance Requirement	Supplemental Information
Center/Marker Frequency		
Operating Range		
Internal Mixer		10 kHz to 21 GHz Tuned by the CENTER/MARKER FREQUENCY control or the DATA ENTRY keypad.
External Mixers (optional)		10 kHz to 325 GHz. (See Options Section)
Accuracy (After front-panel CAL has been performed)		Center/Marker Frequency Accuracy is specified by three characteristics: ● initial accuracy (Firmware corrected) ● reference frequency error ● center frequency drift during the sweep

Table 2-1 (Continued)
Frequency Related Characteristics

Characteristic	Performance Requirement	Supplemental Information
Center/Marker Frequency (Continued) Initial (start of sweep) Bands 1 & 5—12 with SPAN/DIV >200 kHz, and Bands 2—4 with SPAN/DIV >100 kHz (1st LO unlocked)	±(20%D + (CF × REF) + 15N kHz) Where: D = SPAN/DIV or RESOLUTION BANDWIDTH, whichever is greater CF = Center Frequency REF = Reference Frequency Error N = Harmonic Number	Refer to 'IF, LO Range, and Harmonic Number' specification for the N value. Allow a settling time of one second for each GHz change in CF within a band. In bands 4-12, divide the CF change by N.
Bands 1 & 5—12 with SPAN/DIV ⩽200 kHz, and Bands 2—4 with SPAN/DIV ⩽100 kHz (1st LO locked)	±(20%D + (CF × REF) + (2N + 25)Hz) Where: D = SPAN/DIV or RESOLUTION BANDWIDTH, whichever is greater CF = Center Frequency REF = Reference Frequency Error N = Harmonic Number	Refer to 'IF Frequency, LO Range, and Harmonic Number (N)' specification for the N value.
Reference Frequency Error Aging Rate Short Term		$\leqslant 1\times10^{-9}$ per day $\leqslant 7\times10^{-9}$ per week
First six months		$\leqslant 1\times10^{-7}$ in first six months
After the first six months		$\leqslant 1\times10^{-7}$ per year
Accuracy During Warmup at +25°C 30 Minutes After Power Up		Within 5×10^{-8} of the frequency after 24 hours
Temperature Sensitivity		Within 2×10^{-8} over the operating temperature range, referenced to +25° C.

Table 2-1 (Continued)
Frequency Related Characteristics

Characteristic	Performance Requirement	Supplemental Information
Center Frequency Drift		With constant ambient temperature and fixed center frequency. Any error is observed during sweep time. Correction will occur at the end sweep or as often as necessary to maintain specifications.
After 30 minute warmup SPAN/DIV >200 kHz Bands 1&5—12 SPAN/DIV >100 kHz Bands 2—4 (1st LO unlocked)		<(25 kHz)N per minute of sweep time.
SPAN/DIV ≤200 kHz Bands 1&5—12 SPAN/DIV ≤100 kHz Bands 2—4 (1st LO locked)		<150 Hz per minute of sweep time.
After 1 hour warmup SPAN/DIV >200 kHz Bands 1&5—12 SPAN/DIV >100 kHz Bands 2—4 (1st LO unlocked)		<(5 kHz)N per minute of sweep time.
SPAN/DIV ≤200 kHz Bands 1&5—12 SPAN/DIV ≤100 kHz Bands 2—4 (1st LO locked)	≤50 Hz per minute	
Readout Resolution		≤ 10% of Span/Div

Table 2-1 (Continued)
Frequency Related Characteristics

Characteristic	Performance Requirement	Supplemental Information
Residual FM		Short term, after 1 hour warmup.
SPAN/DIV >200 kHz Bands 1 & 5—12 SPAN/DIV >100 kHz Bands 2—4 1st LO unlocked	⩽(7 kHz)N total excursion in 20 ms.	Refer to 'IF, LO Range, and Harmonic Number' specification for the N value.
SPAN/DIV ⩽200 kHz Bands 1 & 5—12 SPAN/DIV ⩽100 kHz Bands 2—4 1st LO locked	⩽(5+N)Hz total excursion in 20 ms.	
Resolution Bandwidth (6 dB down)	Within 20% of selected bandwidth for all but the 10 Hz filter.	10 Hz to 1 MHz in decade steps, and 3 MHz
Resolution Bandwidth Shape Factor (60 dB/6 dB)	7.5:1 or less for all but the 10 Hz filter.	
60 dB Bandwidth 10 Hz filter	⩽150 Hz	
Noise Sidebands Resolution Bandwidths ⩽ 100 Hz Resolution Bandwidths ⩾ 1 kHz	 ⩽ −70 dBc ⩽ −75 dBc	Measured at an offset of 30 × the resolution bandwidth
Line-related sidebands 47-440 Hz		⩽−55 dBc

Table 2-1 (Continued)
Frequency Related Characteristics

Characteristic	Performance Requirement	Supplemental Information
Signal Counter		
Accuracy With Span to Resolution Bandwidth Ratios ≤10:1	±((CF × REF) + (5+N)Hz + 1 count) Where: CF = Center or Marker Frequency REF = Reference Frequency Error N = Harmonic Number	Refer to 'IF Frequency, LO Range, and Harmonic Number (N)' specification for the value of N. Count at center, marker, or delta markers
Sensitivity	Signal level, at center screen or at marker, must be 20 dB or more above the average noise level and within 60 dB of the reference level	
Readout Resolution		Selectable from 1 Hz to 1 GHz in decade steps Selected with <SHIFT> CNT RES sequence
ΔF Accuracy	±((ΔF×REF)+(10+2N)Hz+1 count) Where ΔF = Delta Frequency REF = Reference Frequency Error	Refer to IF, LO Range, and Harmonic Number specification later in this table for the N value
Marker(s)		When activated, the marker is a bright dot positioned by the CENTER/MARKER FREQUENCY control or the DATA ENTRY pushbuttons.
Normal Accuracy	Identical to center frequency accuracy	For the active trace
Δ MKR Accuracy	±1% of the total span	For the active trace. 5% on multiband and stored displays Displays delta time in Zero Span mode ΔMKR activates a second marker at the position of the single marker on the trace. Parentheses appear on the marker display line indicating that the delta mode is active. The display shows the difference in frequency and amplitude. 1—MKR→2 selects which marker is tuned.
Δ MKR Resolution		≤ 10% of Span/Div

Table 2-1 (Continued)
Frequency Related Characteristics

Characteristic	Performance Requirement	Supplemental Information	
Frequency Span/Div			
Overall Range			
With SPAN/DIV control		10 Hz to 10 GHz (in a 1-2-5 sequence)	
With the DATA ENTRY Keypad.		10 Hz to 15 GHz (to two significant digits)	
With Multiband Mode		In bands 2 through 5, START/STOP permits entry of a start frequency in one band and the stop frequency in another band (Multiband Mode). Maximum range is 1.7 GHz to 21 GHz. Start and Stop frequencies are limited to a single band in Band 1 and bands 6 through 12. The FREQ RANGE readout displays MULTIBD in Multiband mode.	
Minimum Span/Div		10 Hz in all bands.	
Maximum Span/Div		**With SPAN/DIV Control**	**With DATA ENTRY Keypad**
Band 1 (0–1.8 GHz)		100 MHz	170 MHz
Band 2 (1.7–5.5 GHz)		200 MHz	370 MHz
Band 3 (3–7.1 GHz)		200 MHz	400 MHz
Band 4 (5.4–18 GHz)		1 GHz	1.2 GHz
Band 5 (15–21 GHz)		500 MHz	590 MHz
Band 6 (18–27 GHz)		500 MHz	790 MHz
Band 7 (26–40 GHz)		1 GHz	1.3 GHz
Band 8 (33–60 GHz)		2 GHz	2.6 GHz
Band 9 (50–90 GHz)		2 GHz	3.9 GHz
Band 10 (75–140 GHz)		5 GHz	6.4 GHz
Band 11 (110–220 GHz)		10 GHz	10 GHz
Band 12 (170–325 GHz)		10 GHz	15 GHz
		In addition, MAX SPAN sweeps across an entire band and ZERO SPAN provides a 0 Hz display.	
Accuracy/Linearity		Measured over the center 8 divisions. Specification applicable to singleband mode only.	
SPAN/DIV ⩾ 50 Hz	Within 5% of the selected Span/Div		
SPAN/DIV < 50 Hz	Within 10% of the selected Span/Div		

Table 2-1 (Continued)
Frequency Related Characteristics

Characteristic	Performance Requirement	Supplemental Information		
IF Frequency, LO Range, and Harmonic Number (N)				
Band and Freq. Range		1st IF (MHz)	LO Range (MHz)	(N)
1 (0–1.8 GHz)		2072	2072–3872	1 –
2 (1.7–5.5 GHz)		829	2529–6329	1 –
3 (3.0–7.1 GHz)		829	2171–6271	1 +
4 (5.4–18 GHz)		829	2076–6276	3 –
5 (15–21 GHz)		2072	4309–6309	3 +
6 (18–27 GHz)		2072	2655–4071	6 +
7 (26–40 GHz)		2072	2443–3793	10 +
8 (33–60 GHz)		2072	3092–5790	10 +
9 (50–90 GHz)		2072	3195–5862	15 +
10 (75–140 GHz)		2072	3170–6000	23 +
11 (110–220 GHz)		2072	2917–5890	37 +
12 (170–325 GHz)		2072	2998–5841	56 +

Table 2-2
Amplitude Related Characteristics

Characteristic	Performance Requirement	Supplemental Information
Vertical Display Modes		10 dB/Div, 2 dB/Div, and Linear. Any integer between 1–15 dB/Div can also be selected via the DATA ENTRY keypad.
Display Dynamic Range		90 dB maximum for Log Mode ⩾12 dB/div. 8 divisions for Linear Mode.
Display Amplitude Accuracy 10 dB/DIV Mode	±1.0 dB/10 dB to a maximum cumulative error of ±2.0 dB over 80 dB range	
2 dB/DIV Mode	±0.4 dB/2.0 dB to a maximum cumulative error of ±1.0 dB over 16 dB range	
LIN Mode	±5% of full scale	
Marker/s Accuracy		Identical to REF LEVEL accuracy plus cumulative error of display scale (Dependent on vertical position)
Reference Level		Top of the graticule
Range Log Mode		From −117 dBm to +50 dBm; +50 dBm includes 20 dB of IF gain reduction (+30 dBm is the maximum safe input). Alternate reference levels are: ●dBV (−130 dBV to +37 dBV) ●dBmV (−70 dBmV to +97 dBmV) ●dBμV (−10 dBμV to +157 dBμV)
LIN Mode		39.6 nV/Div to 2.8 V/Div (1W maximum safe input)

Table 2-2 (Continued)
Amplitude Related Characteristics

Characteristic	Performance Requirement	Supplemental Information
Reference Level (Continued) Steps 10 dB/DIV Mode		10 dB for the coarse mode. 1 dB for the FINE mode.
2 dB/DIV Mode		1 dB for the coarse mode. 0.25 dB for the FINE mode.
LIN Mode		1-2-5 sequence for coarse mode. 1 dB equivalent steps for FINE mode.
Set via DATA ENTRY Keypad		Steps correspond to the display mode in coarse, except for 2 dB/DIV where steps are 1 dB. In FINE mode: 1 dB when the mode is 5 dB/Div or more 0.25 dB for display modes of 4 dB/Div or less (referred to as ΔA mode)
Accuracy		Dependent on the following characteristics: ●RF Attenuation Accuracy ●IF Gain Accuracy ●Resolution Bandwidth ●Frequency Response ●<SHIFT> CAL routine reduces error between resolution bandwidths at −20 dBm REF LEVEL. Other REF LEVELs may have larger errors. ●Temperature variation (±0.15 dB/°C maximum)
RF Attenuator Range		0–60 dB in 10 dB steps
Accuracy Dc to 1.8 GHz	Within 0.5 dB/10 dB to a maximum of 1 dB over the 60 dB range	
1.8 GHz to 18 GHz	Within 1.5 dB/10 dB to a maximum of 3 dB over the 60 dB range	
18 GHz to 21 GHz	Within 3.0 dB/10 dB to a maximum of 6 dB over the 60 dB range	

Table 2-2 (Continued)
Amplitude Related Characteristics

Characteristic	Performance Requirement	Supplemental Information
IF Gain Range		87 dB of gain increase, 20 dB of gain decrease (MIN NOISE activated), in 10 dB and 1 dB steps.
Accuracy 1 dB Step	≤ 0.2 dB/dB step to 0.5 dB/9 dB steps except at the decade transitions.	
Decade Transitions −29 to −30 dBm −39 to −40 dBm −49 to −50 dBm −59 to −60 dBm	0.5 dB or less	Maximum 1 dB cumulative error over 10 dB.
Maximum Deviation over the 97 dB Range	±2 dB	
Gain Variation Between Resolution Bandwidths		Measurement conditions: ●Measured at −20 dBm ●MIN DISTORTION mode ●After CAL routine
With respect to 3 MHz Filter	±0.4 dB	
Between Any Two Filters	≤0.8 dB	

Table 2-2 (Continued)
Amplitude Related Characteristics

Characteristic	Performance Requirement		Supplemental Information
Frequency Response			Measured with 10 dB RF Attenuation and Peaking optimized for each center frequency setting (when applicable). Response is affected by: ● input VSWR ● harmonic number (N) ● gain variation ● mixer Display flatness is typically 1 dB greater than frequency response. Refer to the Options Section in this manual for variations in this specification.
Coaxial (direct) Input Band and Freq. Range	About the mid-point between two extremes	Referenced to 100 MHz	
1 (10 kHz–1.8 GHz)	±1.5 dB	±2.5 dB	
2 (1.7–5.5 GHz)	±2.5 dB	±3.5 dB	
3 (3.0–7.1 GHz)	±2.5 dB	±3.5 dB	
4 (5.4–18 GHz)	±3.5 dB	±4.5 dB	
5 (15–21 GHz)	±5.0 dB	±6.5 dB	
With TEKTRONIX Waveguide Mixers (WM 490 Series) Band and Freq. Range			
6 (18–26.5 GHz)	±2.0 dB	±6.0 dB	
7 (26.5–40 GHz)	±2.0 dB	±6.0 dB	
8 (33–50 GHz) (40–60 GHz)	±2.0 dB ±2.5 dB	±6.0 dB ±6.0 dB	
9 (50–90 GHz)			Typically ±3 dB over any 5 GHz range.
10 (75–140 GHz)			Typically ±3 dB over any 5 GHz range.
11 (110–220 GHz)			Typically ±3 dB over any 5 GHz range.
12 (170–325 GHz)			Typically ±3 dB over any 5 GHz range.

Table 2-2 (Continued)
Amplitude Related Characteristics

Characteristics	Performance Requirement	Supplemental Information		
Video Bandwidth		Normal	WIDE	NARROW
		3 MHz	30 kHz	3 kHz
		1 MHz	30 kHz	3 kHz
		100 kHz	3 kHz	300 Hz
		10 kHz	300 Hz	30 Hz
		1 kHz	30 Hz	3 Hz
		100 Hz	3 Hz	0.3 Hz
		10 Hz	3 Hz	0.3 Hz
Pulse Stretcher Fall-Time		30 μs/div of pulse amplitude.		

Table 2-2 (Continued)
Amplitude Related Characteristics

<table>
<tr><th>Characteristic</th><th>Performance Requirement</th><th colspan="3">Supplemental Information</th></tr>
<tr><td>Differential Amplitude Measurement</td><td></td><td colspan="3">ΔA mode provides differential measurements in 0.25 dB increments.
(This is not related to the ΔMKR mode.)</td></tr>
<tr><td>Range</td><td></td><td colspan="3">Maximum range of 57.75 dB dependent on Reference Level when ΔA mode is activated.</td></tr>
<tr><td rowspan="5">Accuracy</td><td rowspan="5"></td><th>Difference</th><th>Steps</th><th>Error</th></tr>
<tr><td>0.25 dB</td><td>1</td><td>0.15 dB</td></tr>
<tr><td>2 dB</td><td>8</td><td>0.4 dB</td></tr>
<tr><td>10 dB</td><td>40</td><td>1.0 dB</td></tr>
<tr><td>20-57.75 dB</td><td>80-231</td><td>2.0 dB</td></tr>
</table>

Table 2-2 (Continued)
Amplitude Related Characteristics

Characteristic	Performance Requirement							Supplemental Information
Sensitivity	Equivalent Input Noise in dBm vs. Resolution Bandwidth							Equivalent maximum input noise for each resolution bandwidth.
Frequency Range	10 Hz	100 Hz	1 kHz	10 kHz	100 kHz[a]	1 MHz	3 MHz	
10 kHz–1.8 GHz	−134	−125	−115	−105	−95	−85	−80	Measured at 25° C with:
1.7 GHz–5.5 GHz& 3.0–7.1 GHz	−125	−119	−109	−99	−89	−79	−74	● 0 dB attenuation (Min Atten 0 dB)
5.4 GHz–12 GHz	−111	−105	−95	−85	−75	−65	−60	● Narrow Video Filter on ● Vertical Display 2dB/Div
12 GHz–21 GHz	−107	−100	−90	−80	−70	−60	−55	● Digital Storage on
18 GHz–26.5 GHz[b]	−116	−108	−100	−90	−80	−70	−65	● Max Hold off ● Peak/Average in Average
26.5 GHz–60 GHz[b]	−111	−103	−95	−85	−75	−65	−60	● 1 sec Time/Div ● Zero Span ● Input terminated in 50 Ω
50 GHz–90 GHz[b] (1 kHz Bandwidth)								Typically −95 dBm at 50 GHz, degrading to −85 dBm at 90 GHz.
75 GHz–140 GHz[b] (1 kHz Bandwidth)								Typically −90 dBm at 75 GHz, degrading to −75 dBm at 140 GHz.
110 GHz–220 GHz[b] (1 kHz Bandwidth)								Typically −80 dBm at 110 GHz, degrading to −65 dBm at 220 GHz.
170 GHz–325 GHz[b] (1 kHz Bandwidth)								Typically −70 dBm at 170 GHz, degrading to −55 dBm at 325 GHz.

[a] Option 07 replaces the 100 kHz filter with a 300 kHz filter.

[b] Specified using external TEKTRONIX High Performance Waveguide Mixers.

Table 2-2 (Continued)
Amplitude Related Characteristics

Characteristic	Performance Requirement	Supplemental Information
Spurious Responses		
Residual	−100 dBm or less	No input signal, 0 dB RF Attenuation and fundamental mixing Bands 1—3. Terminate input in 50Ω.
3rd Order Intermodulation Products	−70 dBc or less	From any two on-screen signals within any frequency span. In MIN DISTORTION mode.
Harmonic Distortion		
10 kHz to 1.8 GHz (Band 1)	−60 dBc or less	Measured at −40 dBm input level in MIN DISTORTION mode, and without reduced gain mode.
1.7 GHz to 21 GHz (Bands 2 — 5)	Not discernible above the average noise floor	⩽−100 dBc
LO Emission	Less than −70 dBm to 21 GHz.	With 0 dB RF Attenuation.

Table 2-3
Input Signal Characteristics

Characteristic	Performance Requirement	Supplemental Information
RF INPUT		Type N female connector, specified to 21 GHz. (See Option 07 for supplemental specifications concerning an additional 75 Ω input.)
Impedance		50 Ω
VSWR With RF Attenuation ≥10 dB 10 kHz—2.5 GHz		1.3:1 (typically 1.2:1)
2.5—6 GHz		1.7:1 (typically 1.5:1)
6—18 GHz		2.3:1 (typically 1.9:1)
18—21 GHz		3.5:1 (typically 2.7:1)
VSWR With 0 dB RF Attenuation		Measured from 10 kHz to 1.8 GHz on Band 1, and measured within 3 MHz of the center of the preselector on Bands 2, 3, 4, and 5.
10 kHz—2.5 GHz		Typically 1.9:1
2.5—6 GHz		Typically 1.9:1
6—18 GHz		Typically 2.3:1
18—21 GHz		Typically 3.0:1
Maximum Safe Input (With 0 dB RF Attenuation)		+30 dBm (1 W) continuous or 75 W peak, pulse width of 1 μs or less with a maximum duty factor of 0.001 (attenuator limit) DO NOT APPLY DC VOLTAGE TO THE RF INPUT.
1 dB Compression Point (Minimum) for Bands 1—5 (10 kHz—21 GHz) In Min Distortion mode In Min Noise mode	−20 dBm −10 dBm	With no RF attenuation Measured at 10 MHz IF Output
EXT REF IN Frequency	1 MHz, 2 MHz, 5 MHz, or 10 MHz ±5 PPM	
Power	−15 dBm to +15 dBm	
Waveshape		Sinewave, ECL or TTL, with a duty cycle of 40%–60%
Impedance		50 Ω ac and 500 Ω dc

Table 2-3 (Continued)
Input Signal Characteristics

Characteristic	Performance Requirement	Supplemental Information
HORIZ/TRIG		Dc coupled input for external horizontal drive (selected by the EXT position of the TIME/DIV control) and ac coupled input for external trigger signals (selected at other positions of the TIME/DIV control).
Sweep Input Voltage Range		0 to +10V (dc + peak ac) for full screen deflection
Trigger Input Voltage Range Minimum	At least 1.0 V peak from 15 Hz to 500 kHz.	Typically 1.0 MHz at 1.5V peak.
Maximum dc + peak ac		50V
ac		$30V_{rms}$ to 10 kHz, then derate linearly to $3.5V_{rms}$ at 100 kHz and above.
Pulse Width		0.1 μs minimum
MARKER/VIDEO		External Video input or External Video Marker input, switched by pin 1 of the ACCESSORIES connector.
MARKER Input Level		0 to −10V Interfaces with TEKTRONIX 1405 Sideband Adapter.
VIDEO Input Level		0 to +4 V for full screen display with pin 1 of the ACCESSORIES connector low
ACCESSORY Connector (J104)		25-pin connector (Not RS-232 compatible) Provides bi-directional access to the instrument bus. Also provides external Video select. All lines are TTL compatible. Maximum voltage on all lines is ±15V.
Pin 1		External Video Select Low selects External VIDEO Input. High (default) selects Video MARKER Input.
Pin 2		External Preselector Drive — Drive signal for an external preselector. Output voltage is proportional to center frequency.
Pin 3		External Preselector Return — Ground return for the External Preselector signal.

Table 2-3
Input Signal Characteristics

Characteristic	Performance Requirement	Supplemental Information
ACCESSORY (J104) (Continued)		
Pin 4		Internal Control. High (default) selects internal control. Instrument bus lines are output at the ACCESSORIES connector. Low selects External control. Instrument bus lines at the ACCESSORIES connector accept input from an external controller.
Pin 5		Chassis Ground
Pins 6–13[a]		Instrument Bus Address lines 7–0[a]
Pin14[a]		Instrument Bus Data Valid signal[a]
Pin 15[a]		Instrument Bus Service Request signal[a]
Pin 16[a]		Instrument Bus Poll signal[a]
Pin 17		Data Bus Enable input signal for external controller. High (unasserted) disables external data bus. Low enables external data bus.
Pins 18–25		Instrument Bus Data lines 0–7 Active when External Data Bus Enable (pin 17) is low.

[a]Output when internally controlled (pin 4 high) and input when externally controlled (pin 4 low).

Table 2-4
Output Signal Characteristics

Characteristic	Performance Requirement	Supplemental Information
Calibrator (CAL OUT)	−20 dBm ±0.3 dB at 100 MHz	100 MHz comb of markers provide amplitude calibration at 100 MHz. Phase-locked to Reference Oscillator
1st LO and 2nd LO OUTPUTs		Provide access to the output of the respective local oscillators. THESE PORTS MUST BE TERMINATED IN 50 Ω AT ALL TIMES.
1st LO OUTPUT Power		+7.5 dBm to +15 dBm
2nd LO OUTPUT Power		−12 dBm ±5 dBm.
EXTERNAL MIXER		When EXT MIXER is selected, provides bias from a 70 Ω source for an external mixer. Bias is set by the MANUAL PEAK control or internally set if AUTO PEAK is selected. Replaced by 75 Ω RF Input for Option 07. See Options.
Bias Range		+1.0 V to −2.0 V (default) or, −1.0 V to +2.0 V (internally selectable)
VERT Output		Provides 0.5V ±5% (open circuit) of signal per division of video that is above and below the centerline. Full range −2.0V to +2.0V. Source impedance is approximately 1 kΩ.
HORIZ Output		Provides 0.5V/Div (open circuit) either side of center. Full range −2.5V to +2.5V. 250 mV Max ripple. Source impedance is approximately 1 kΩ.
PEN LIFT		TTL compatible, nominal +5V to lift plotter pen.
10 MHz IF Output		Output level is approximately −5 dBm for a full screen signal at −30 dBm reference level. Nominal impedance is approximately 50 Ω.

Table 2-4 (Continued)
Output Signal Characteristics

Characteristic	Performance Requirement	Supplemental Information
IEEE STD 488 PORT		In accordance with IEEE 488-78 standard and Tektronix Codes and Formats standard (version 81.1). Implemented as SH1, AH1, T5, L3, SR1, RL1, PP1, DC1, DT1, and C0.
PROBE POWER		Provides operating voltages for active probes.
Outputs		
Pin 1		+5V at 100 mA maximum
Pin 2		Ground
Pin 3		−15V at 100 mA maximum
Pin 4		+15V at 100 mA maximum
ACCESSORIES (J104)		All inputs and outputs are listed in part 2.7.3 Input Characteristics.

Table 2-5
General Characteristics

Characteristic	Performance Requirement	Supplemental Information
Sweep		Triggered, auto, manual, and external
Sweep Time	20 μs/Div to 5 s/Div in 1-2-5 sequence (10 s/Div available in AUTO)	
Accuracy	±5% over center 8 divisions	
Triggering		INTERNAL, EXTERNAL, FREE RUN, and LINE.
Internal Trigger Level	2 divisions or more of signal	
EXTERNAL Trigger Input Level	1.0V peak, minimum	EXTERNAL is ac-coupled (15 Hz—1 MHz). Maximum external trigger input is 50V (dc + peak ac).
Crt Readout		Displays all parameters listed on the crt bezel, plus operating messages.
Battery-Powered Memory		Instrument settings, macros, displays, calibration offsets, and preselector peaking codes for each band are stored in battery-powered non-volatile RAM.
Battery Life At +55°C Ambient Temperature		1–2 years
At +25°C Ambient Temperature Lithium (Standard)		At least 5 years
Silver (Option 39)		2 years
Temperature Range for Retaining Data Operating		0°C to +50°C
Non-Operating		−30°C to +75°C

Table 2-6
Power Requirements

Characteristic	Performance Requirement	Supplemental Information
Line Frequency Range	47–63 Hz	47 Hz to 440 Hz. Operation over 63 Hz exceeds protective grounding conductor leakage current of 3.5 mA. A redundant protective grounding means is essential to protect against electric shock.
Line Voltage Range	90 V_{ac} to 132 V_{ac}	115 V nominal
	180 V_{ac} to 250 V_{ac}	230 V nominal
Line Fuse 115V Nominal		4A
230V Nominal		2A Medium-Blow
Input Power	210 W maximum (3.2A)	At 115V and 60 Hz
Leakage Current 47-63 Hz else		3.5 mA maximum with the EMI filter at 250 V. 5 mA maximum

Table 2-7
Environmental Characteristics

Meets the following MIL T-28800C, type III class 5, style E specifications:		
Characteristic	**Description**	
Temperature		
Operating	0°C to +50°C	
Non-operating[a]	−40°C to +75°C	
Humidity		
Operating	95% ±5% below +30°C. 75% ±5% above +30°C. 45% ±5% above +40°C.	
Altitude		
Operating	10,000 feet (3050 meters)	
Non-operating	40,000 feet (12000 meters)	
Vibration, Operating (instrument secured to a vibration platform during test)	MIL-Std-810, Method 514 Procedure I (modified). Resonant searches along all three axes at 0.013 inch displacement, for 15 minutes. Dwell for an additional 10 minutes in each axis at the frequency of the major resonance or at 33 Hz if none was found. Resonance is defined as twice the input displacement. Total vibration time is 75 minutes.	
Shock (Operating and Non-operating)	Three 30g, one-half sine, guillotine-type shocks, 11 ms duration in each direction along each major axis; total of 18 shocks.	
Electromagnetic Interference (EMI)	Meets requirements described in MIL-Std-461B Part 4, except as noted.	
	Test Method	**Remarks**
Conducted Emissions	CE01—60 Hz to 15 kHz	1 kHz to 15 kHz only
	CE03—15 kHz to 50 MHz power leads	15 kHz to 50 kHz, relaxed by 15 dB
Conducted Susceptibility	CS01—30 Hz to 50 kHz power leads	Full limits
	CS02—50 kHz to 400 MHz power leads	Full limits
	CS06—spike power leads	Full limits
	Test Method	**Remarks**
Radiated Emissions	RE01—30 Hz to 50 kHz magnetic field (measured at 30 cm).	30 — 36 kHz exceptioned.
	RE02—14 kHz to 10 GHz	Full limit
Radiated Susceptibility	RS01—30 Hz to 50 kHz	Full limit
	RS02—Magnetic Induction	To 5 A only, 60 Hz
	RS03—14 kHz to 10 GHz	Up to 1 GHz, 1 V/m

Table 2-8
Physical Characteristics

Characteristic	Description
Weight	50 lbs maximum Including standard accessories, except manuals.
Dimensions (See Figure 2-1) Without handles or feet	7 × 17 × 24 inches (17.78 × 43.18 × 60.96 cm)

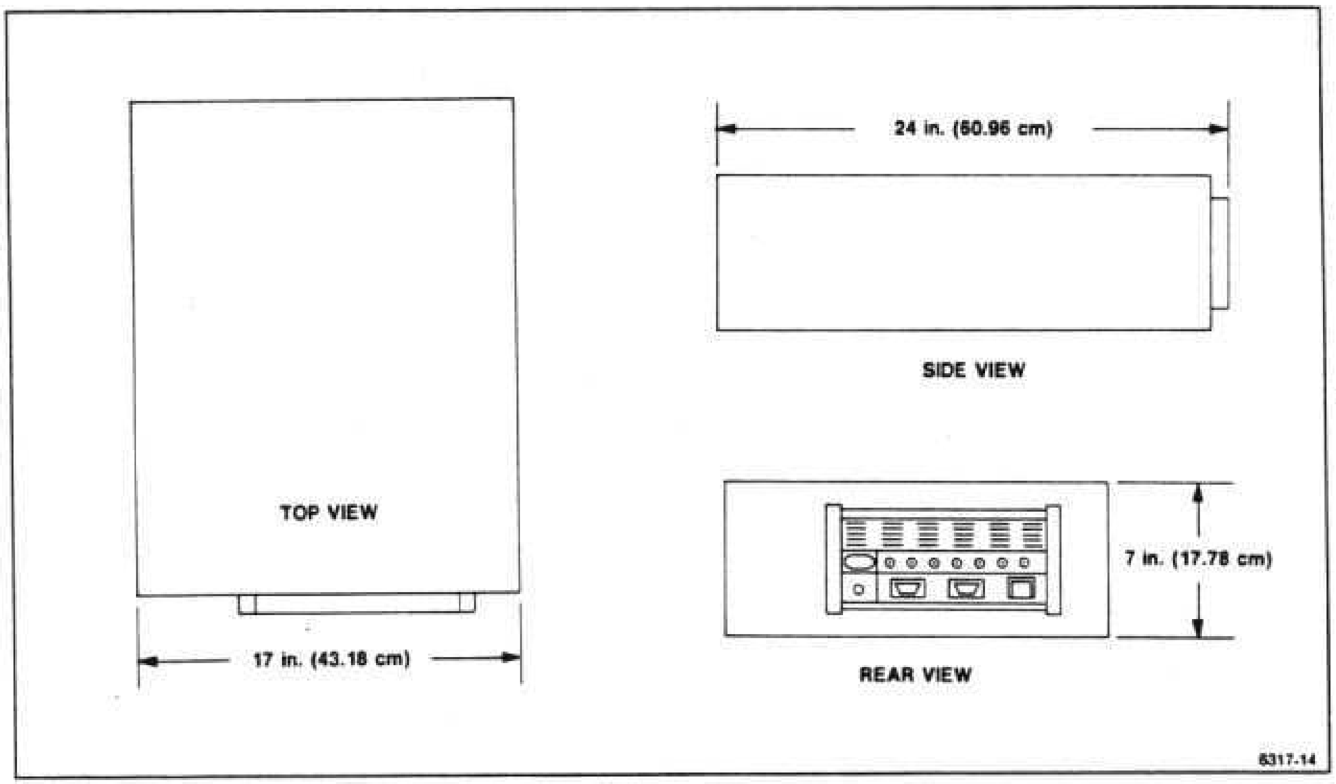


Figure 2-1. Dimensions.

PREPARATION FOR USE

This section describes unpacking, installation, power requirements, storage information, and repackaging for the spectrum analyzer.

UNPACKING AND INITIAL INSPECTION

Before unpacking the spectrum analyzer, inspect the shipping container for signs of external damage. If the container is damaged, notify the carrier as well as Tektronix, Inc. The shipping container contains the basic instrument and its standard accessories. For a list of the standard accessories, refer to Standard Accessories, in Section 1 of this Manual (or, for ordering information, refer to the list following the Replaceable Mechanical Parts list in the Service Manual, Volume 2).

If the contents of the shipping container are incomplete, if there is mechanical damage or defect, or if the instrument does not meet operational check requirements, contact your local Tektronix Field Office or representative.

Keep the shipping container if the instrument is to be stored or shipped to Tektronix for service or repair. Refer to Storage and Repackaging for Shipment later in this section.

The instrument was inspected both mechanically and electrically before shipment, and it should be free of mechanical damage and meet or exceed all electrical specifications. The Operation section of this Manual contains procedures to check functional or operational performance. Perform the functional check procedure to verify that the instrument is operating properly. This check is intended to satisfy the requirements for most receiving or incoming inspections. (A detailed electrical performance verification procedure in the Service Manual, Volume 1, provides a check of all specified performance requirements, as listed in the Specification section.)

The instrument can be operated in any position that allows air flow in the bottom and out the rear of the instrument. Feet on the four corners allow ample clearance even if the instrument is stacked with other instruments. The air is drawn in by a fan through the bottom and expelled out the back. Avoid locating the instrument where paper, plastic, or any other material might block the air intake.

INSTALLATION

The spectrum analyzer is equipped with a flipstand to adjust the viewing angle.

WARNING

Removing or replacing the cabinet on the instrument can be hazardous. Only qualified service personnel should attempt to remove the instrument cabinet.

Rackmount Instrument

Refer to the Service Manual, Volume 1, for installation instructions for the rackmount version of the instrument. Refer installation to qualified service personnel.

CAUTION

If the rackmount instrument is extended out of the rack and tipped up to gain access to the bottom or back panels of the cabinet, securely hold the instrument so it cannot fall back into the rack. Use care when doing this to avoid damaging the instrument front panel or equipment that may be mounted above the instrument.

Rack Adapter Kit

A field-installable kit is available to permit the spectrum analyzer to be rack mounted in a standard 19" wide rack on a non-tilting slide-out track. Fan-forced ventilation of the rack enclosure is highly recommended. If the rack-adapter assembly is installed in an enclosed rack, a minimum depth of 25" behind the front panel is recommended for proper air circulation. The rack adapter kit comes complete with the slide-out tracks and all mounting hardware. Contact your local Tektronix Field Office or representative for additional information and ordering instructions.

POWER SOURCE AND POWER REQUIREMENTS

The spectrum analyzer is intended to be operated from a single-phase power source that has one of its current-carrying conductors (neutral) at ground (earth) potential. It is not recommended to operate the spectrum analyzer from power sources where both current-carrying conductors are isolated or above ground potential (such as phase-to-phase on a multi-phase system or across the legs of a 110-220 V single-phase, three-wire system). In this method of operation, only the line conductor has over-current (fuse) protection within the unit. Refer to the Safety Summary at the front of this Manual.

The ac power connector is a three-wire, polarized plug with the ground (earth) lead connected directly to the instrument frame to provide electrical shock protection. If the unit is connected to any other power source, connect the unit frame to an earth ground.

Operate the spectrum analyzer from either 115 Vac or 230 Vac nominal line voltage with a range of 90 to 132 or 180 to 250 Vac, at 48 to 63 Hz. Power and voltage requirements are printed on a back-panel plate mounted below the power input jack. Refer power input changes to qualified service personnel. The Service Manual, Volume 1, contains instructions to change the input voltage range.

The international power cord and plug configuration is shown in Figure 7-1 in Section 7 of this Manual.

WARNING

Do not attempt to change the power input requirements. Unfamiliarity with safety procedures can result in personal injury. Refer all power input changes to qualified service personnel. Refer to the Safety Summary at the front of this Manual.

STORAGE AND REPACKAGING

Storage

Short Term (less than 90 days) — For short term storage, store the instrument in an environment that meets the non-operating environmental specifications in Table 2-7 in Section 2 of this Manual.

Long Term — For instrument storage of more than 90 days, use the original shipping container to repackage the instrument. In Option 39 instruments, we recommend removing the silver battery during long-term storage. Package the instrument in a vapor bag with a drying material and store in a location that meets the non-operating environmental specifications in Table 2-9 in Section 2 of this Manual.

If you have any questions, contact your local Tektronix Field Office or representative.

Repackaging for Shipment

When the spectrum analyzer is to be shipped to a Tektronix Service Center for service or repair, attach a tag that shows the owner and address, the name of the individual at your location that can be contacted, the complete instrument serial number, and a description of the service required. If the original shipping container is unfit for use or not available, use the following repackaging information.

1. Use a container of corrugated cardboard with a test strength of 375 pounds (140 kilograms) and inside dimensions that are at least six inches more than the equipment dimensions (refer to Table 2-8 in Section 2), to allow for cushioning.

2. Install the instrument front cover, and surround the instrument with plastic sheeting to protect the finish.

3. Cushion the equipment on all sides with packing material or plastic foam.

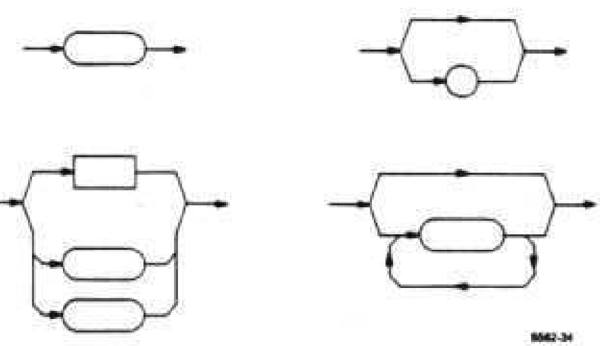
4. Seal the container with shipping tape or an industrial, heavy-duty stapler.

CONTROLS, CONNECTORS, AND INDICATORS

This section includes the descriptions of the instrument's main operating modes. It also covers the functions of the controls, selectors, indicators, and connectors for the spectrum analyzer, which are shown and identified in Figures 4-1 through 4-3 and 4-11 through 4-17. Some of the functions are described in greater detail in Section 5.

Included with many of the descriptions are syntax diagrams that graphically display the function. The ovals and circles indicate a pushbutton that must be pressed exactly as shown. Boxes contain a name for an element (i.e., DATA ENTRY represents numbered pushbuttons 0 through 9 and the units terminators). The arrows that connect the elements of the syntax diagrams show the possible paths through the diagram. Parallel paths mean that one, and only one, of the paths must be followed. A path around an element or group of elements indicates an optional skip. Arrows indicate the direction that must be followed (usually the flow is to the right; but, if an element may be repeated, an arrow returns from the right to the left of the element).

The following examples illustrate basic syntax diagram structure.



When numbers are shown within DATA ENTRY boxes, the numbers represent the valid range available for that particular command.

OPERATING MODES

Initial Entry Functions (Black-Labels)

Most of the spectrum analyzer operating modes are selected by a single pushbutton press or control turn; i.e., FREE RUN, TIME/DIV, PULSE STRETCHER, MAX HOLD, PEAK/AVERAGE. Generally, these selections are the same as all Tektronix 2750-Series Spectrum Analyzers.

Multiple-Pushbutton Sequence Functions (SHIFT Pushbutton)

<SHIFT> Functions — There are many general operating modes and two marker operating modes selected with multiple-pushbutton presses. Press the <SHIFT> pushbutton before selecting a blue-labeled function; i.e., STEP ENTRY, CAL. For some of these functions, menu prompts appear on the screen to guide you.

Terminating Multiple-Pushbutton Sequences

A SHIFT multiple-pushbutton sequence can be terminated at any time. Push the <SHIFT> pushbutton once to stop the sequence and return the spectrum analyzer to the previous activity.

DATA ENTRY Functions

Some operations require the entry of numerical data; for example, to set frequency or enter a number to select a choice from a menu. This will be as part of a multiple-pushbutton sequence, and the crt will prompt you when a number is required. Enter the number with the DATA ENTRY pushbuttons. Numerical data is entered first, with a units terminator entered last; e.g., 100.00 MHz or 20 −dBx.

Correcting Numerical Entry Errors

Use the BACKSPACE pushbutton to correct errors in numerical data that have been entered with the DATA ENTRY pushbuttons. Each pushbutton press backs the cursor up one space, erasing the number in that location. You can then enter the correct numerical data and end the sequence with a units pushbutton.

INSTRUMENT POWER CONTROL AND FREQUENCY

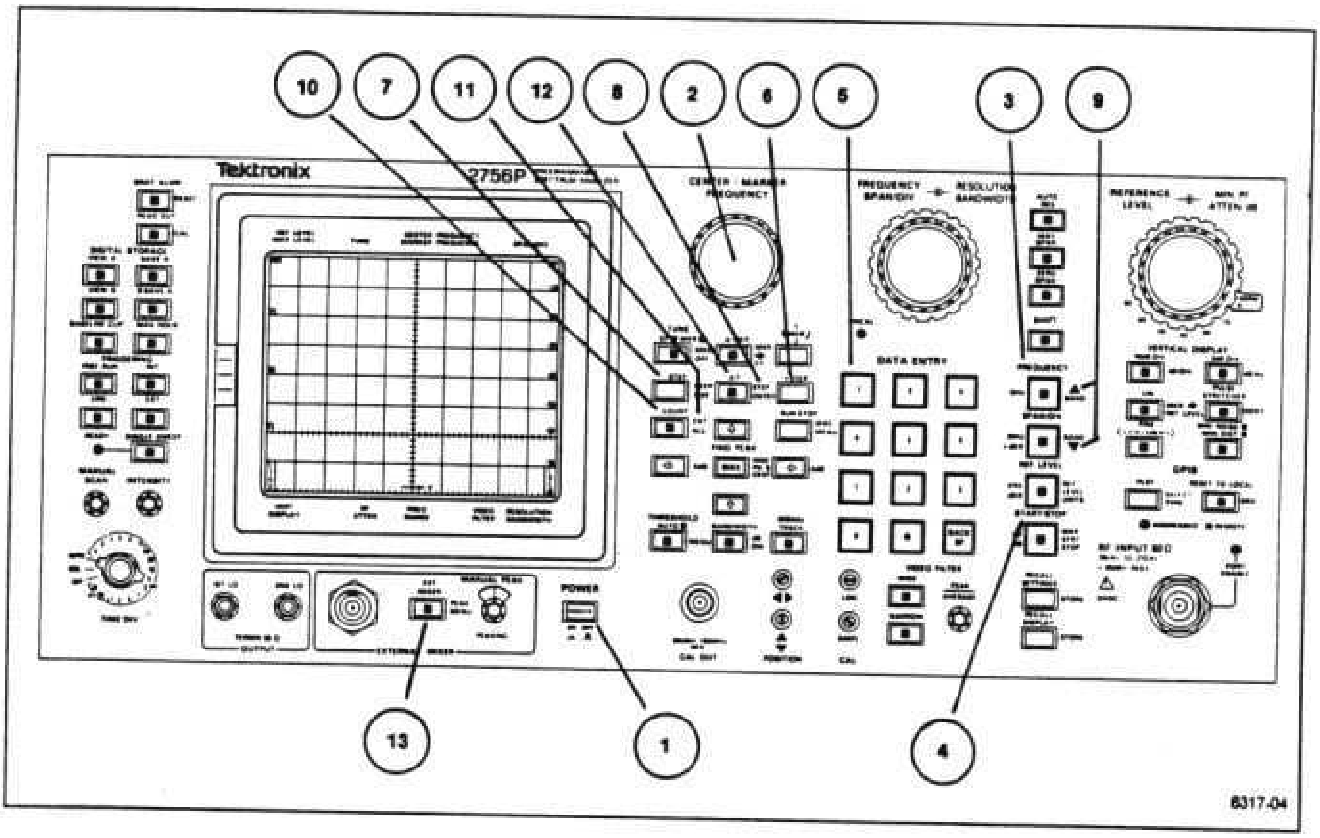
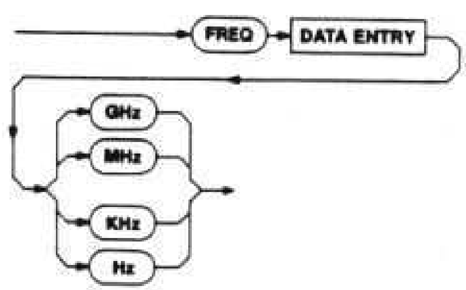


Figure 4-1. Instrument Power Control and Frequency.

1 **POWER** — This push-push switch turns the main power supply ON (green light on) and OFF (in—ON, out—OFF). When power is switched off, the current instrument front-panel set-up is stored in memory register 0 (see RECALL SETTINGS/STORE in Section 5) so this set-up can be easily recalled. Full RF attenuation is switched in when power is switched off to protect the 1st mixer from overload and damage.

2 **CENTER/MARKER FREQUENCY** — This control tunes the center frequency or marker, if selected (this function is limited to the edge of the screen). Tuning of center frequency is done in 0.1 division increments, regardless of the selected FREQUENCY SPAN/DIV. For marker frequency, tuning is either 0.01, 0.033, or 0.1 division increments, depending on how fast the control is turned. In MAX SPAN, the center fequency is fixed, and only the marker or frequency dot is tuned.

3 **FREQUENCY** — This pushbutton allows direct entry of center or marker frequency to 1 Hz resolution (it will be displayed to 1 kHz), from the DATA ENTRY pushbuttons. If the center frequency entered is not in the current frequency range, the nearest frequency range that contains the frequency will be automatically selected. The center frequency range that can be selected is 0 Hz to 325 GHz. Values that are entered outside this range will be ignored. Frequency digits that are entered from the DATA ENTRY pushbuttons are terminated with one of the four unit pushbuttons (GHz, MHz, kHz, or Hz).



4 **START STOP** — This pushbutton allows you to use the DATA ENTRY pushbuttons to enter a start frequency (at the left edge of the display) and a stop frequency (at the right edge of the display).

5 **<SHIFT> 7** (Disable Frequency Corrections; not identified on the front panel) — This pushbutton sequence disables the frequency correction for the local oscillators. This enables the instrument to be operated with reduced performance if the oscillator frequency cannot be corrected.

6 **+STEP** — When the instrument is in the Tune Center Frequency mode (TUNE CF/MKR pushbutton unlit), this pushbutton increases the center frequency by steps (this function is limited to the edge of the screen). The step size is determined by <SHIFT> STEP ENTRY or <SHIFT> STEP SIZE. See +STEP later in this section under Marker Functions for alternate operation.

7 **−STEP** — When the instrument is in the Tune Center Frequency mode (TUNE CF/MKR pushbutton unlit), this pushbutton decreases the center or marker frequency by steps (this function is limited to the edge of the screen). The step size is determined by <SHIFT> STEP ENTRY or <SHIFT> STEP SIZE. See −STEP later in this section under Marker Functions for alternate operation.

8 **<SHIFT> STEP ENTRY** — This pushbutton sequence allows you to enter a desired center or marker frequency step size with the DATA ENTRY pushbuttons.

9 **<SHIFT> ΔBAND/BAND∇** — These two pushbuttons step up or down through the frequency ranges. The frequency range of the current band is displayed by the crt readout. When the frequency range (band) is changed, an attempt is made to preserve the 1st and 2nd LO frequencies. If this is not possible, the nearest center frequency limit of the band is selected. When returning to a previous band, without changing center frequency, the original LO frequencies are always used, so the center frequency is preserved. External mixers are automatically selected in frequency ranges above 21 GHz.

10 **COUNT** — When this pushbutton is pressed, the signal at the center or marker position is counted with up to 1 Hz resolution at any frequency span/division. The actual resolution is selected with <SHIFT> CNT RES. The signal must be 20 dB or more above the noise level and above a level that is 60 dB down from the REF LEVEL.

11 **<SHIFT> CouNT RESolution** — This pushbutton sequence allows you to select the desired counter resolution with the DATA ENTRY pushbuttons. Terminate with one of the unit (GHz, MHz, kHz, or Hz) pushbuttons. The counter resolution will be truncated to the decade that is less than or equal to the selected resolution.

12 **ΔF** — This pushbutton allows measurement of the frequency differences. When pressed (lit), the frequency readout goes to zero. The readout now shows only the offset, or deviation, from this reference as the center frequency is changed. The resolution of the readout will be the less accurate of either the current center frequency resolution or the center frequency resolution when ΔF was activated. Do not confuse this pushbutton with Δ MKR, which is described later in this section under Marker Functions.

13 **EXTernal MIXER** — (Not available on instruments with Option 07 or Option 08 installed) This pushbutton selects the External Mixer mode and disables the RF input. This is the bias source for external mixers, as well as the IF input to the analyzer. The External Mixer mode is indicated by EXT on the crt readout in place of RF ATTENUATION. Bias voltage is set by MANUAL PEAK when selected by the <SHIFT> PEAK MENU. See External Mixers in Section 6 for connecting external mixers and mixer operation.

CAUTION

Do not exceed mixer input limits. Refer to External Mixers in Section 6.

FREQUENCY SPAN AND RESOLUTION

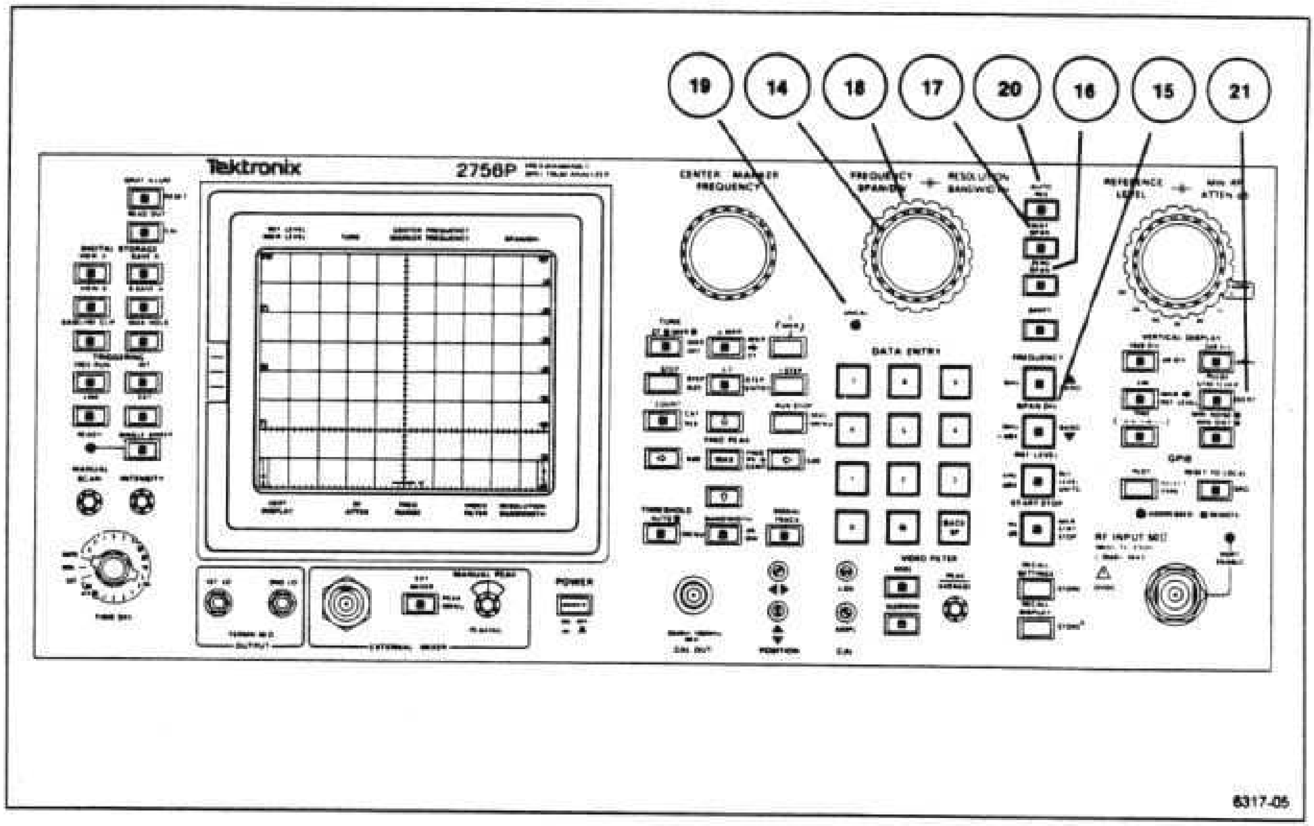


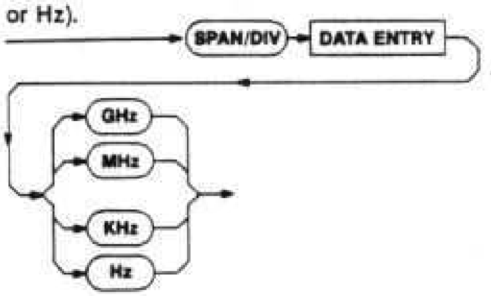
Figure 4-2. Frequency Span and Resolution.

14 **FREQUENCY SPAN/DIV** — This control selects the frequency span swept by the spectrum analyzer. The span/div is indicated by the crt readout. The range of this control depends on the frequency band. Selection is in a 1-2-5 sequence plus max span and zero, or time domain. FREQUENCY SPAN/DIV can also be entered with the SPAN/DIV pushbutton and the DATA ENTRY pushbuttons. The spectrum analyzer will try to maintain a calibrated display if the TIME/DIV control is in the AUTO position or the AUTO RES pushbutton is active (lit). (An example of when the instrument will not be able to maintain a calibrated display is if it is changed to 10 Hz while in Max Span mode).

When the FREQUENCY SPAN/DIV is in the maximum span mode, the full band is displayed. A dot near the top of the screen indicates the center frequency readout position on the span. This dot and the center frequency position will be center screen when the FREQUENCY SPAN/DIV is reduced from the MAX span position. When the markers are on, they show the frequency position, and the dot goes to center.

When the FREQUENCY SPAN/DIV is reduced to zero, the spectrum analyzer operates like a tunable receiver. The spectrum analyzer displays signals within the resolution bandwidth in the time domain, with the crt reading out time/div instead of frequency span/div.

15 **SPAN/DIV** — This pushbutton allows direct entry of FREQUENCY SPAN/DIV, with two significant digits of resolution. The span/div range that can be selected is 20 Hz/div to 10 GHz/div. The maximum range available is a function of frequency range. If a value outside the allowable range is entered, the Span/Div will switch to the lowest non-zero or maximum span. Spans entered from the DATA ENTRY pushbuttons are terminated with one of the four unit pushbuttons (GHz, MHz, kHz, or Hz).



16 **ZERO SPAN** — This pushbutton switches the span to zero for time domain display. When deactivated, the Span/Div returns to its previous value.

17 **MAX SPAN** — When activated, the spectrum analyzer sweeps the entire range of the current frequency band. The position of the spectrum analyzer's center frequency is shown with a dot near the top of the screen. When this function is turned off, the span returns to the previous Frequency Span/Div setting. When the markers are on, they show the frequency position, and the dot goes to center.

18 **RESOLUTION BANDWIDTH** — This control selects the bandwidth of the spectrum analyzer. Selected bandwidth is indicated on the crt readout. The bandwidth selections are 10 Hz, 100 Hz, 1 kHz, 10 kHz, 100 kHz, 1 MHz, and 3 MHz. Time/div is automatically selected to match the selected bandwidhth when the TIME/DIV control is in the AUTO position.

19 **UNCAL** — This indicator lights when the display amplitude or frequency is no longer calibrated; e.g., the sweep rate is not compatible with the frequency span/div and resolution bandwidth. Select a slower sweep rate or larger resolution bandwidth to return to calibrated operation.

20 **AUTO RESolution** — When this function is on, resolution bandwidth is automatically selected to maintain a calibrated display for the selected Freq Span/Div, Time/Div, Video Filter, and Vertical Display modes. When the TIME/DIV control is in the AUTO position, resolution bandwidth is selected as a function of Freq Span/Div only, and Time/Div is selected to maintain a calibrated display at the highest sweep rate. The RESOLUTION BANDWIDTH control will not operate when AUTO RES is on (the message AUTO RES MUST BE OFF TO CHANGE RESOLUTION will appear on the screen).

21 **<SHIFT> IDENTify** — This pushbutton sequence separates real signals from spurious responses when using the spectrum analyzer without a preselected front end, as is the case when using external waveguide mixers. This pushbutton causes every other trace to be displaced vertically. The 1st and 2nd local oscillator frequencies shift so that real, or true, signals are not displaced horizontally on alternate sweeps (displaced less than 2 MHz in external waveguide bands, 1/2 division in internal bands), while spurious signals can be shifted to more than 100 MHz, or even off screen. The FREQ SPAN/DIV must be 50 kHz or less for the coaxial bands (0 to 21 GHz) or 50 MHz or less for the waveguide bands before the Identify mode can be used. When using IDENTify with waveguide mixers, the 1st LO frequency is shifted 2072/N MHz on alternate sweeps. Peaking should, therefore, be performed while using the Identify mode if the signal disappears, since a true conversion may not appear on alternate sweeps.

MARKER FUNCTIONS

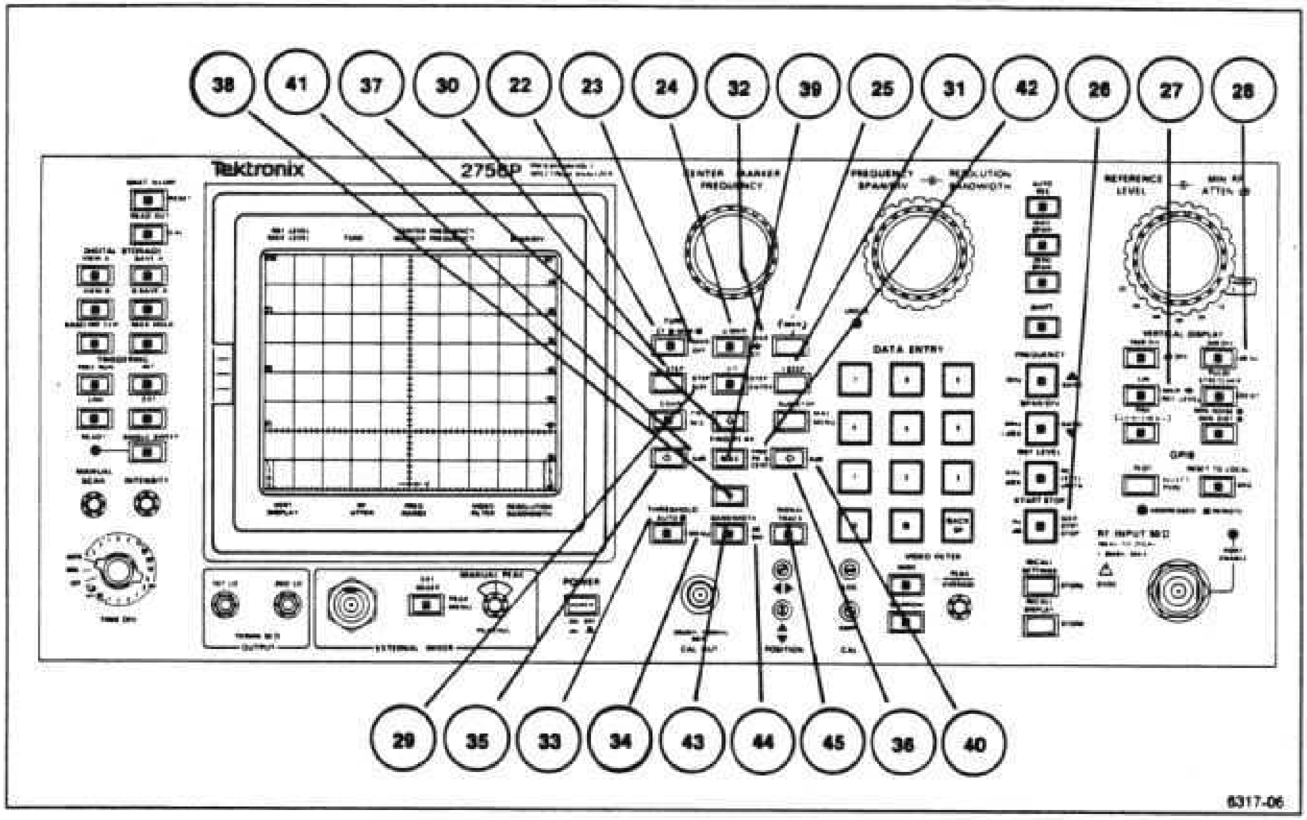


Figure 4-3. Marker Functions.

22 **TUNE CF/MKR** — When this pushbutton is lit, a single marker is turned on at the trace of hightest priority, and you can move the marker with CENTER/MARKER FREQUENCY control. When the pushbutton is pressed again, the marker remains and does not change its horizontal position; the CENTER/MARKER FREQUENCY control now adjusts the center frequency.

23 **<SHIFT> MKR OFF** — This pushbutton sequence turns the marker(s) off.

24 **Δ MKR** — This pushbutton is the on-off switch for the Delta Marker mode. When activated, a second marker appears. The symbols ( ) will appear on the screen on the marker frequeny readout line to indicate delta frequency and delta amplitude. To use Delta Marker, select TUNE CF/MKR and set the marker to one point of interest on the trace using the CENTER/MARKER FREQUENCY control. Activate the Delta Marker Mode and move one of the markers of the second point of interest. Push Δ MKR again to turn delta markers off.

25 **1—MKR→2** — This pushbutton alternately selects which marker will be tuned when Δ MKR is on.

26 **<SHIFT> MKR START STOP** — This pushbutton sequence allows you to set the start and stop frequencies directly from the delta marker position (this function is not available with a stored trace). Δ MKR must be on for this function to operate.

27 **<SHIFT> MKR → REF LVL** — This pushbutton sequence changes the reference level of the top graticule to the present marker amplitude (this function is not available with a stored trace).

28 **<SHIFT> dB/Hz** — This pushbutton sequence mathematically figures the average noise power in a 1 Hz bandwidth at the current marker position.

29 **<SHIFT> STEP SIZE** — This pushbutton sequence defines the frequency step as the center frequency, marker frequency, or the delta marker frequency, whichever mode is active.

30 **−STEP** — When the instrument is in the tune marker mode (the TUNE CF/MKR pushbutton is lit), this pushbutton decreases the marker frequency by steps (this function is limited to the edge of the screen when not on an active trace). The step size is determined by <SHIFT> STEP SIZE or <SHIFT> STEP ENTRY. See −STEP earlier in this section under Frequency for alternate operation.

31 **+STEP** — When the instrument is in the tune marker mode (the TUNE CF/MKR pushbutton is lit), this pushbutton increases the marker frequency by steps (this function is limited to the edge of the screen when not on an active trace). The step size is determined by <SHIFT> STEP SIZE or <SHIFT> STEP ENTRY. See +STEP earlier in this section under Frequency for alternate operation.

32 **<SHIFT> MKR → CF** — This pushbutton sequence centers the signal at the active marker by setting the center frequency equal to the marker frequency (this function is not available with a stored trace). When doing counted frequency, this moves the counted frequency to center.

33 **THRESHOLD** — In Auto mode (button lit) the instrument selects the minimum signal level recognized in FIND PEAK ↑, FIND PEAK ↓, FIND PEAK →, FIND PEAK ←, FIND PEAK MAX, dB BW, and SIGNAL TRACK. When the button is pushed, signal threshold can be entered manually.

34 **<SHIFT> MENU** — This pushbutton calls up a menu display on the crt that allows selection of SET SIGNAL TYPE and SET XdB.

SET SIGNAL TYPE — This alters the marker functions to recognize one of three signal types above the threshold.

CW — Identifies continuous wave signals and ignores spurious signals and impulses.

PULSE — Identifies the peak of pulsed RF lobes for either line (lines must be <2 minimum divisions apart), or dense spectra.

SPURS — Identifies all signals.

SET XdB — Using the DATA ENTRY keypad, enter the number of dB for the marker to move when using ← XdB or → XdB>.

Figure 4-4 is a signal enlarged to show how the spectrum analyzer locates the signal peak with one of the signal processing functions. The signal processing functions are FIND PEAK ←, FIND PEAK →, FIND PEAK ↓, FIND PEAK ↑. The spectrum analyzer looks at both the individual left-most and right-most peaks of a signal. From this reading, the spectrum analyzer calculates the exact center of the signal. If this location is a digital storage point, the marker is positioned here. If, as in Figure 4-4, the calculated center of the signal is not equal to the maximum digital storage point, the marker is positioned on the closest point to the center. At the end of this Marker Functions portion are five illustrations showing the use of this signal finding command.

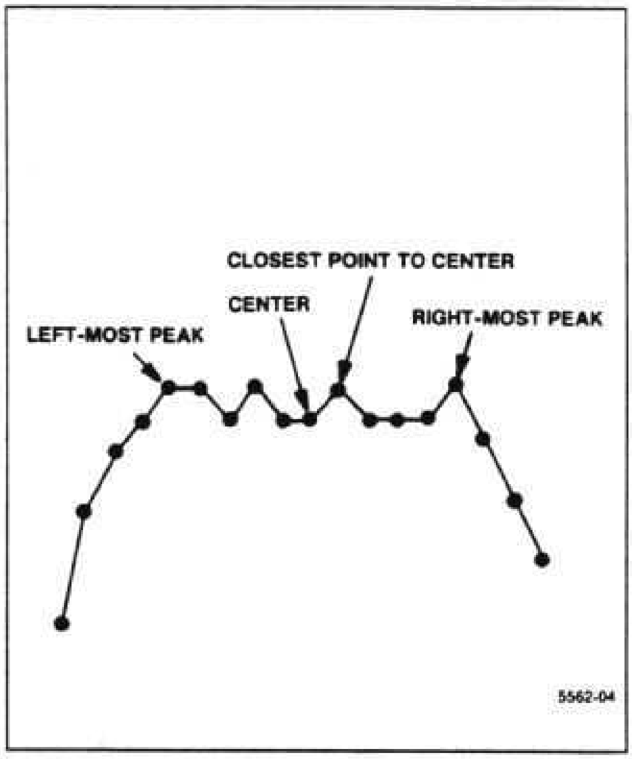


Figure 4-4. Locating the signal peak.

35 **FIND PEAK ←** — This moves the Marker to the next signal lower in frequency than the present marker. If there is no signal lower in frequency than the Marker that meets threshold and signal type parameters, one of the following messages will be displayed on screen (depending on whether CW, PULSE, or SPURS has been selected as signal type) —

NO CW TO THE LEFT ABOVE THRESHOLD

NO PULSE TO THE LEFT ABOVE THRESHOLD

NO SPUR TO THE LEFT ABOVE THRESHOLD

36 **FIND PEAK →** — This moves the Marker to the next signal higher in frequency than the present marker. If there is no signal higher in frequency

than the Marker that meets threshold and signal type parameters, one of the following messages will be displayed on screen (depending on whether CW, PULSE, or SPURS has been selected as signal type) —

NO CW TO THE RIGHT ABOVE THRESHOLD

NO PULSE TO THE RIGHT ABOVE THRESHOLD

NO SPUR TO THE RIGHT ABOVE THRESHOLD

37 **FIND PEAK ↑** — This moves the Marker to the next signal higher in amplitude than the present marker. If there is no signal higher in amplitude than the Marker that meets threshold and signal type parameters, one of the following messages will be displayed on screen (depending on whether CW, PULSE, or SPURS has been selected as signal type —

NO HIGHER CW SIGNAL ABOVE THRESHOLD

NO HIGHER PULSE SIGNAL ABOVE THRESHOLD

NO HIGHER SPUR ABOVE THRESHOLD

38 **FIND PEAK ↓** — This moves the Marker to the next signal lower in amplitude than the present marker. If there is no signal lower in amplitude than the Marker that meets threshold and signal type parameters, one of the following messages will be displayed on screen (depending whether CW, PULSE, or SPURS has been selected as signal type —

NO LOWER CW SIGNAL ABOVE THRESHOLD

NO LOWER PULSE SIGNAL ABOVE THRESHOLD

NO LOWER SPUR ABOVE THRESHOLD

39 **FIND PEAK MAX** — This pushbutton places the Primary marker at the peak of the highest on-screen signal without regard to signal type (CW, PULSE, SPURS). Peak B would be selected from the cluster in Figure 4-5A, peak A would be selected in Figure 4-5B because the low point (B) would stop a search from continuing to the cluster (C).

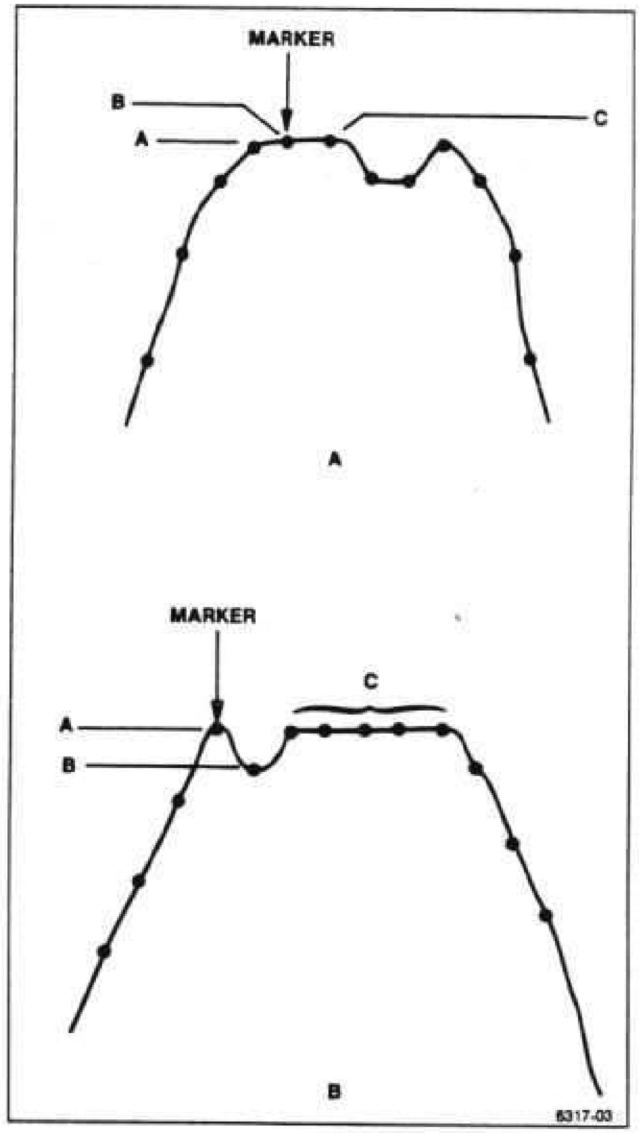


Figure 4-5. Using FIND PEAK MAX.

40 **<SHIFT> XdB →** — This allows you to select the number of dB to move the Primary marker down in frequency while staying on the trace (horizontal movement to the left). If there is no level to the left of the Primary marker that meets threshold and signal type parameters, the message NO POINT TO THE LEFT TO MOVE TO will be displayed on screen.

41 **<SHIFT> XdB ←** — This allows you to select the number of dB to move the Primary marker up in frequency while staying on the trace (horizontal movement to the right). If there is no level to the right of the Primary marker that meets threshold

and signal type parameters, the message NO POINT TO THE RIGHT TO MOVE TO will be displayed on screen.

42 **<SHIFT> FIND PK & CENT** — This places the active marker at the peak of the highest on-screen signal (refer to FIND PEAK MAX description earlier in this section). If a signal is present, the center frequency is set equal to the marker frequency; this centers the signal of interest. If there is no signal above the threshold, the message NO POINT FOUND ABOVE THE THRESHOLD will be displayed on the screen, and the marker will not move, which is useful to center a signal just before reducing the span/div by several settings at once.

43 **BANDWIDTH** — This pushbutton places markers on a selected signal and displays the XdB bandwidth (select <SHIFT> dB BW to set X). The screen will display NO SIGNAL — BW IDLE when there is no signal at the marker that meets threshold and bandwidth parameters. Set the parameters by selecting SET SIGNAL THRESHOLD and ENTER BANDWIDTH NUMBER after calling up the MENU each time.

44 **<SHIFT> dB BW** — This selects the value for the Bandwidth mode.

45 **SIGNAL TRACK** — This pushbutton automatically maintains tuning of a drifting signal within limits. While this mode is active SIGNAL TRACK will be displayed on the screen; SIGNAL TRACK IDLE will be displayed when there is no signal above the threshold. Select SET SIGNAL THRESHOLD from the Menu to set the threshold.

Signal Finding

To the finding routine, a "candidate" signal consists of a peak above threshold and two points (one on each side of the peak) that are 3 dB below the peak. The location of the signal is the highest amplitude point on the signal. Whether or not the candidate is recognized as a signal depends upon the processing mode chosen. When SPURS is chosen, all candidates are taken to be signals. When CW is chosen, a signal (to be a signal) must be at least half as wide as would be predicted from the resolution filter in use. (Note that this is not the same algorithm as the one used by the data-point-related commands. In particular, the data-point algorithm looks for a particular width, while the marker-related algorithm looks only for a minimum width. Note also that if the span is wide in comparison with the resolution bandwidth, there may be no difference between SPURS and CW.) The minimum bandwidth criterium for CW is defined as the two 3 dB down points that must be less than 1/2 a resolution bandwidth apart. When PULSE is chosen, if two candidate signals are within two minor divisions (0.4 of a major division), they are assumed to be either time-related lines or spectral lines belonging to the same pulse. This extends to multiple lines; in a group of such lines, the highest-amplitude line will be identified as the center of the signal. Related information is located in the Helps and Hints section of the Programmers Manual under Understanding How Waveform Processing Works.

Figures 4-6 through 4-10 illustrate the use of SET SIGNAL TYPE that can be selected from the MENU. All of the figures use the signal processing function FIND PEAK →. Any of the other signal processing functions (FIND PEAK ←, FIND PEAK ↓, FIND PEAK ↑) work similarly, according to their specific function.

Figures 4-6, 4-7, and 4-8 — If CW was selected, the spectrum analyzer would not identify any signal because none of the signals displayed meets the minimum bandwidth criteria. If PULSE was selected, the signals labeled D, E, and F would be identified because the other signals in the display are less than 2 minor divisions apart. If the signals were greater than 2 minor divisions apart, PULSE would have identified all labeled signals (A, B, C, etc.). If SPURS was selected, all signals would be identified (A, B, C, etc.).

Figure 4-9 — The FIND PEAK → function begins at the left screen margin. With this display, CW, PULSE, and SPURS will each identify all of the signals because they all meet the minimum bandwidth criteria (i.e., the selections would be A, B, C, D, and E).

Figure 4-10 — The threshold is assumed to be −70 dBm. If CW was selected, signals B, E, F, and G would be identified. The other signals would not be identified because they do not meet the minimum bandwidth criteria. If PULSE was selected, signals A, B, D, E, F, and G would be identified. Signal C would be skipped, because it is within 2 minor divisions from signal B. The PULSE algorithm will think signal C is a part of signal B. If SPURS was selected, all signals would be identified.

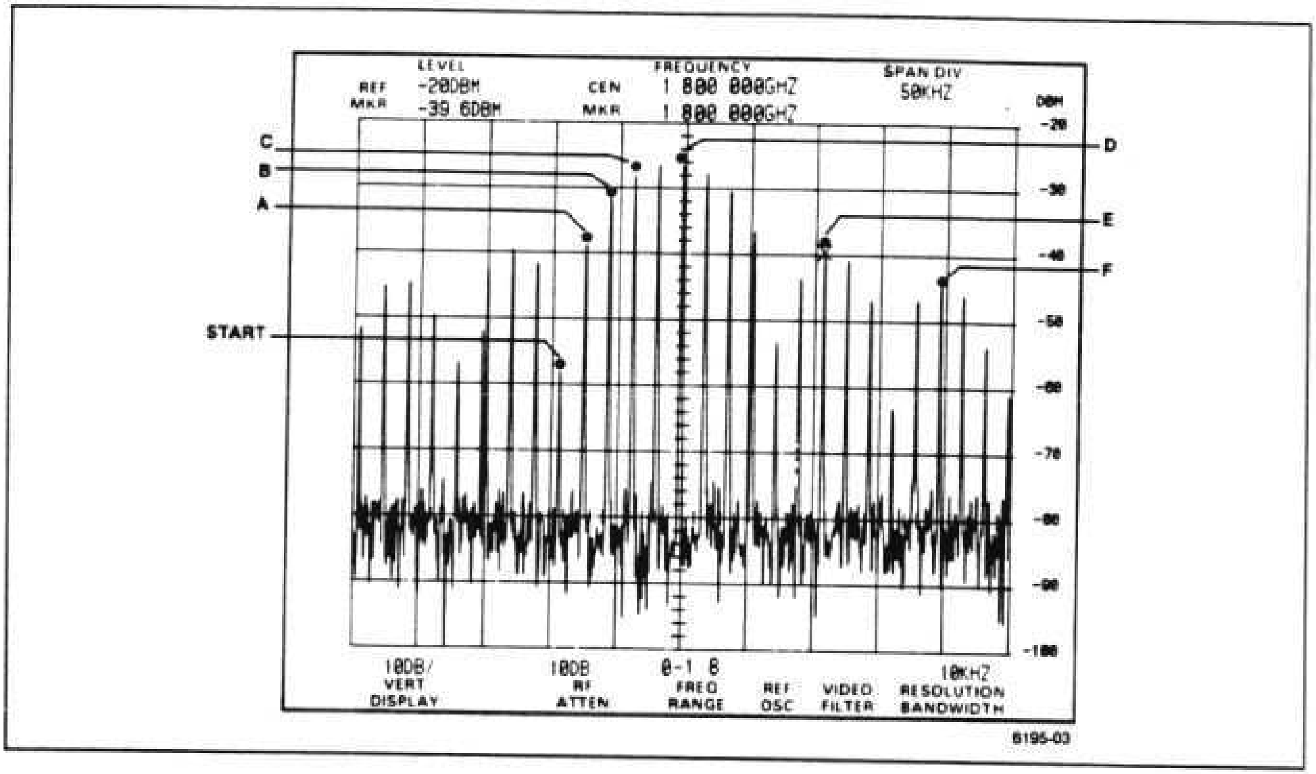


Figure 4-6. Signal finding example

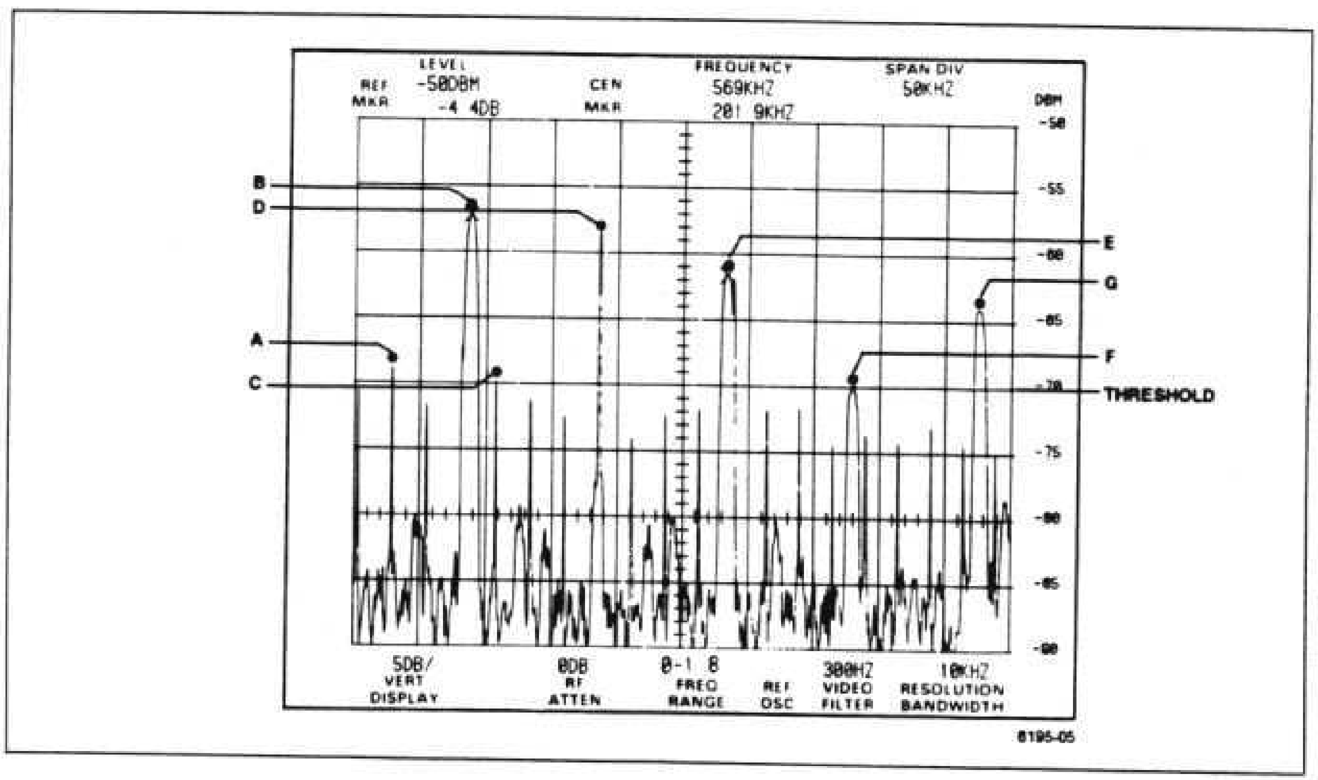


Figure 4-7. Signal finding example.

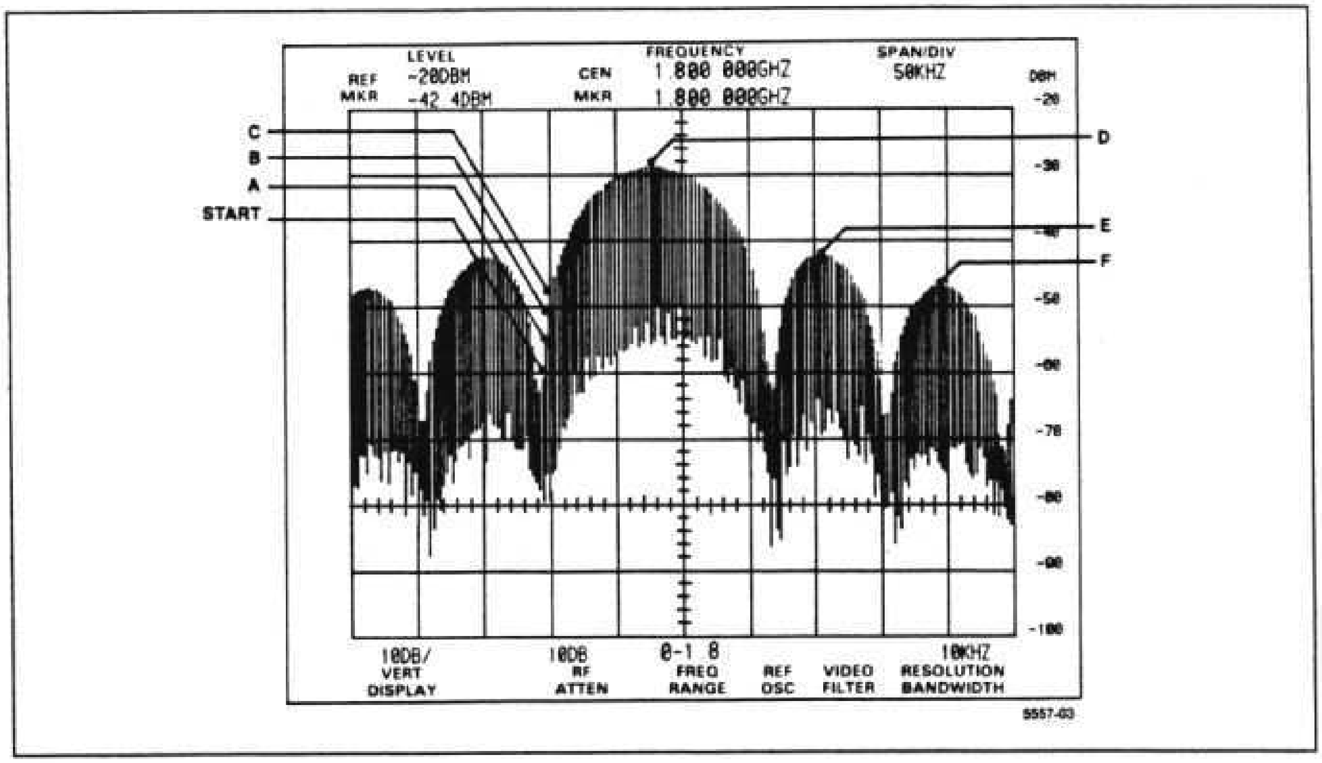


Figure 4-8. Signal finding example.

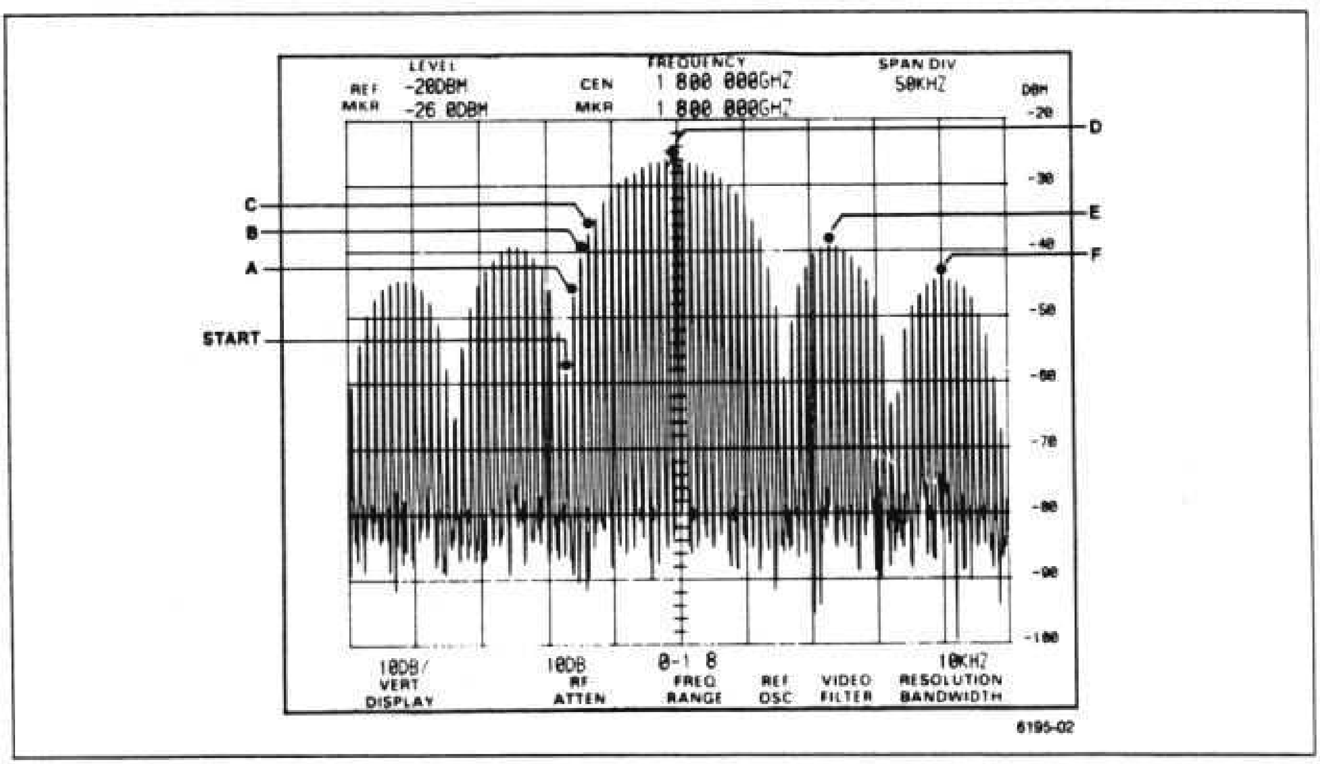


Figure 4-9. Signal finding example.

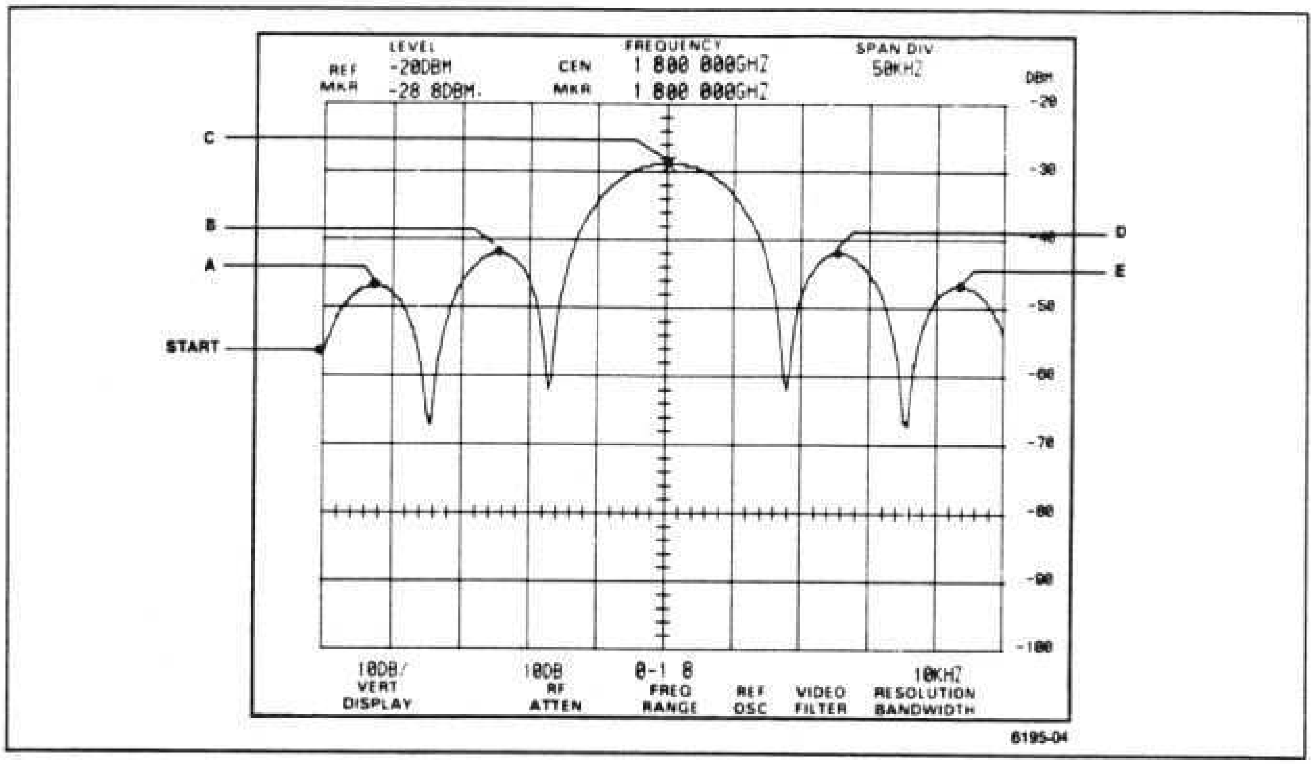


figure 4-10. Signal finding example.

DISPLAY PARAMETERS

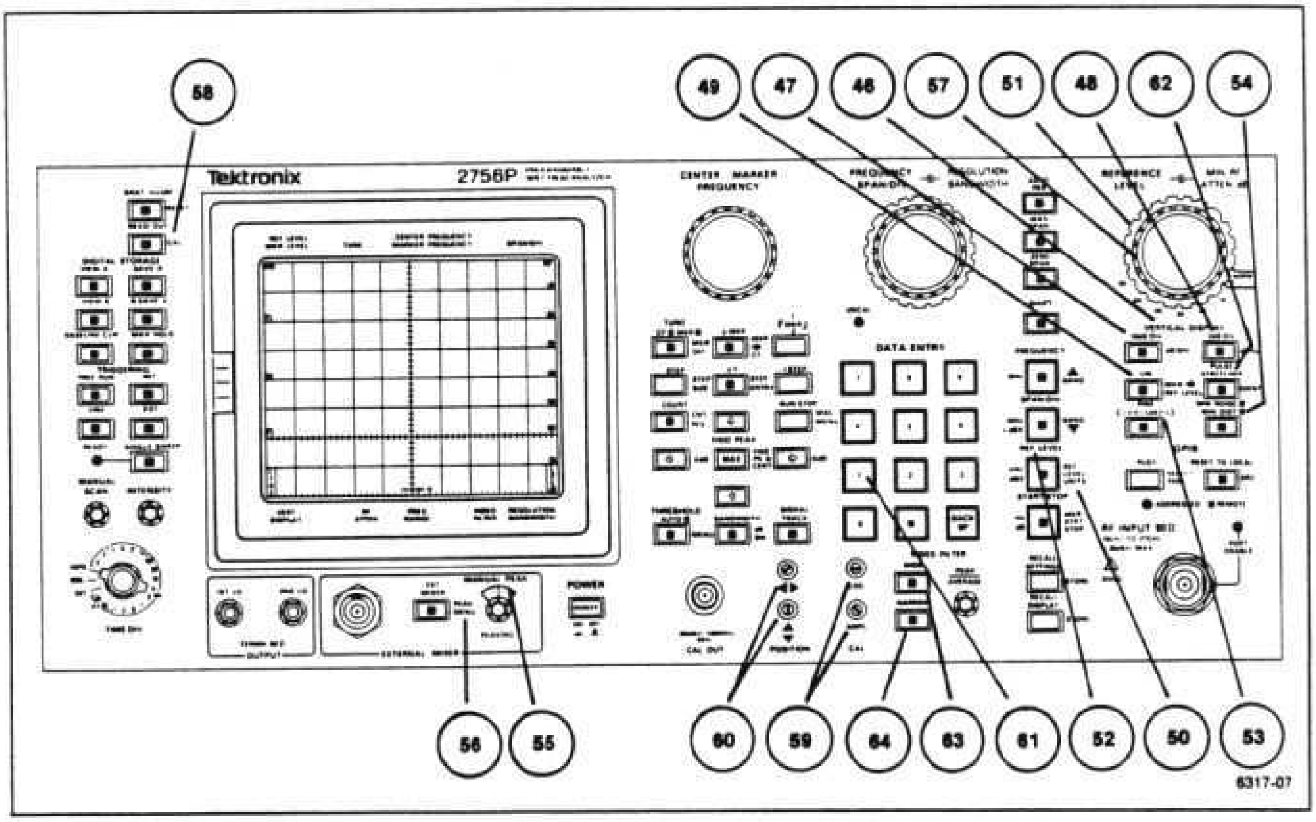


Figure 4-11. Display Parameters.

46 **<SHIFT> dB/DIV** — This pushbutton sequence allows direct entry of the desired amplitude display factor. The range is 1 to 15 dB/div in 1 dB increments. Numbers outside the allowable range will be ignored. Terminate the dB/div number entered with the dB pushbutton.

VERTICAL DISPLAY — These three pushbuttons select the vertical display factors. The crt readout indicates the selection. The vertical display factor, in the Log mode, can also be entered with the DATA ENTRY pushbuttons.

47 **10 dB/DIV** — With this pushbutton activated, the dynamic range of the display is a calibrated 80 dB with each major graticule division representing 10 dB.

48 **2 dB/DIV** — This pushbutton increases resolution so that each major graticule division represents 2 dB. Display dynamic range is 16 dB.

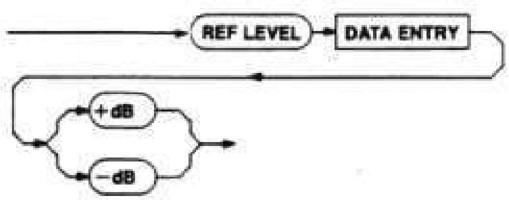
49 **LIN** — With this pushbutton activated, a linear display between zero volts (bottom graticule line) and the reference level (top graticule line), scaled in volts/division, is selected (see the REFERENCE LEVEL description).

50 **<SHIFT> REF LEVEL UNITS** — This pushbutton sequence allows the selection of reference level units to be dBm, dBV, dBmV, or dBμV.

51 **REFERENCE LEVEL** — This control changes the reference level one step for each stop. Automatic selection of the IF gain and RF attenuation provide for the best overall noise and distortion performance. In the Log Vertical Display mode, when FINE is not activated, the step size equals the

selected dB/div factor; except for 2 dB/div, where step size is 1 dB. When FINE is activated, the step size is 1 dB for dB/div factors of 5 or more and 0.25 dB for Vertical Display factors of <5 dB/div. When the display factor is less than 5 dB/div and FINE is activated, the Delta A mode is selected. Refer to Section 6 for a description of the Delta A mode.

52 **REF LEVEL** — This pushbutton allows direct entry of reference level, with 1 dB resolution. The range is +30 dBm to −117 dBm (+50 dBm if the Minimum Noise mode is selected). Values entered outside this range are ignored (values will be in the selected units; dBm, dBV, dBmV, or dBuV). Either the +dBx or −dBx pushbutton terminates the reference level numbers entered.



53 **FINE (Δ A IN <5 dB/DIV)** — This pushbutton selects step size for the REFERENCE LEVEL control. When FINE is off, step size is equal to 10 dB/div, except 2 dB/div where step size is 1 dB. When FINE is on, step size is 1 dB for display factors of 5 dB/div or more, and 0.25 dB for display factors of less than 5 dB/div. When step size is 0.25 dB, the Delta A mode is selected. The crt Ref Level readout goes to 0.00 dB, and the REFERENCE LEVEL control steps in 0.25 dB increments. Refer to Delta A mode operation in Section 6 for more details.

54 **MIN NOISE/MIN DISTortion**

MIN NOISE (pushbutton lit) — In this mode, the noise level is reduced by changing the RF attenuation and IF gain used for a particular reference level. Both are reduced 10 dB so noise generated in the IF stages is decreased; however, intermodulation distortion products will increase. RF attenuation must be at least 10 dB for this control to have any effect.

MIN DISTortion (pushbutton not lit) — In this mode, intermodulation distortion products are minimized.

55 **MANUAL PEAK (PEAKING)** — This control varies the mixer bias for external mixers and peaks the internal preselector tracking in the 1.7 GHz to 21 GHz frequency range (bands 2 through 5). In preselected bands, the peak code consists of numbers at 500 MHz intervals. The control is used to peak signal response. Refer to External Mixer Operation in Section 6 of this manual for more information.

56 **<SHIFT> PEAK MENU** — This pushbutton sequence calls up a menu that lists the available methods to adjust the preselector tracking or external mixer bias, which are

- 0 — Select the MANUAL PEAK control
- 1 — Select a previously-stored peaking value for the frequency
- 2 — Input a number from 0 to 1023 for electronic peaking
- 3 — Execute an automatic peaking routine

57 **MIN RF ATTEN dB** — This control specifies the lowest value of input attenuation that will be used when REF LEVEL is selected. This allows operator-control to protect the front end of the analyzer against overload and/or damage from excessive signal level into the 1st mixer. Actual attenuation is set according to the MIN RF ATTEN dB, REFERENCE LEVEL, and MIN NOISE/MIN DISTortion selections and is displayed on the crt readout. If the MIN RF ATTEN dB setting is increased, the IF gain is automatically changed to maintain the current reference level, if possible. The normal position is 0 to obtain the best noise level performance.

58 **<SHIFT> CAL** — This pushbutton sequence starts a frequency and reference level measurement procedure that uses the spectrum analyzer calibrator. Messages on the crt screen will guide you through the adjustments of vertical and horizontal POSITION, and LOG and AMPL CAL. The spectrum analyzer then runs an automatic frequency, noise bandwidth, and relative amplitude measurement routine for the resolution bandwidth filters.

The frequency measuring routine adjusts center frequency by measuring the frequency of each resolution bandwidth filter to reduce center frequency variation when changing resolution bandwidth. The relative amplitude measuring routine reduces reference level variation when changing Resolution Bandwidth. The noise bandwidth routine measures the resolution filter bandwidth and computes the factor for 1 Hz equivalent noise. To ensure that the instrument meets frequency and amplitude performance characteristics, run this routine whenever the instrument's surrounding temperature changes significantly. Cal factors that are used internally to correct for the errors measured by this function are retained in memory when the instrument power is off. To display these factors, press <SHIFT> 1.

59 **LOG and AMPL CAL** — These screwdriver adjustments calibrate the vertical portion of the display. LOG CAL adjusts the logarithmic gain in dB/div, and AMPL CAL adjusts the display amplitude. Press <SHIFT> CAL to initiate a procedure that will guide you through these adjustments, as well as the vertical and horizontal POSITION adjustments. Refer to <SHIFT> CAL for additional information.

60 **POSITION ▲▼ ◄►** — These screwdriver adjustments position the display along the horizontal and vertical axes. The <SHIFT> CAL pushbutton sequence will guide you through the adjustment of these controls. Refer to <SHIFT> CAL for additional information.

61 **<SHIFT> 1** (Self-Measurement Results; not identified on the front panel) — The factors used to internally correct for frequency and amplitude errors are displayed. The factors shown are as measured with the last <SHIFT> CAL operation. If one of the factors could not be measured at the last operation, the old value will be noted. This means that the previously measured value is used. If < or > appears next to the amplitude calibration factor, it means that this filter's amplitude related to the 1 MHz filter is outside the range of correction (correction is set to the limit). Press <SHIFT> to exit.

62 **PULSE STRETCHER** — This pushbutton causes the fall-time of pulse signals to be increased so very narrow pulses can be seen. The effect is most apparent for pulsed RF signals where pulse width is small compared to one division of sweep time. Pulse stretcher operation may be necessary for a digital storage display of such signals, to ensure that the correct amplitude is displayed.

VIDEO FILTER

63 **WIDE** — This pushbutton reduces video bandwidth and high-frequency components for display noise averaging. The video bandwidth selected is approximately 1/30th of the selected resolution bandwidth (1/100 for 3 MHz. Selecting WIDE cancels NARROW. The filter value is displayed in the lower readout.

64 **NARROW** — This pushbutton reduces video bandwidth and high-frequency components for display noise averaging. The video bandwidth selected is approximately 1/300th of the selected resolution bandwidth (1/1000 for 3 MHz). Selecting NARROW cancels WIDE. The filter value is displayed in the lower readout.

SWEEP

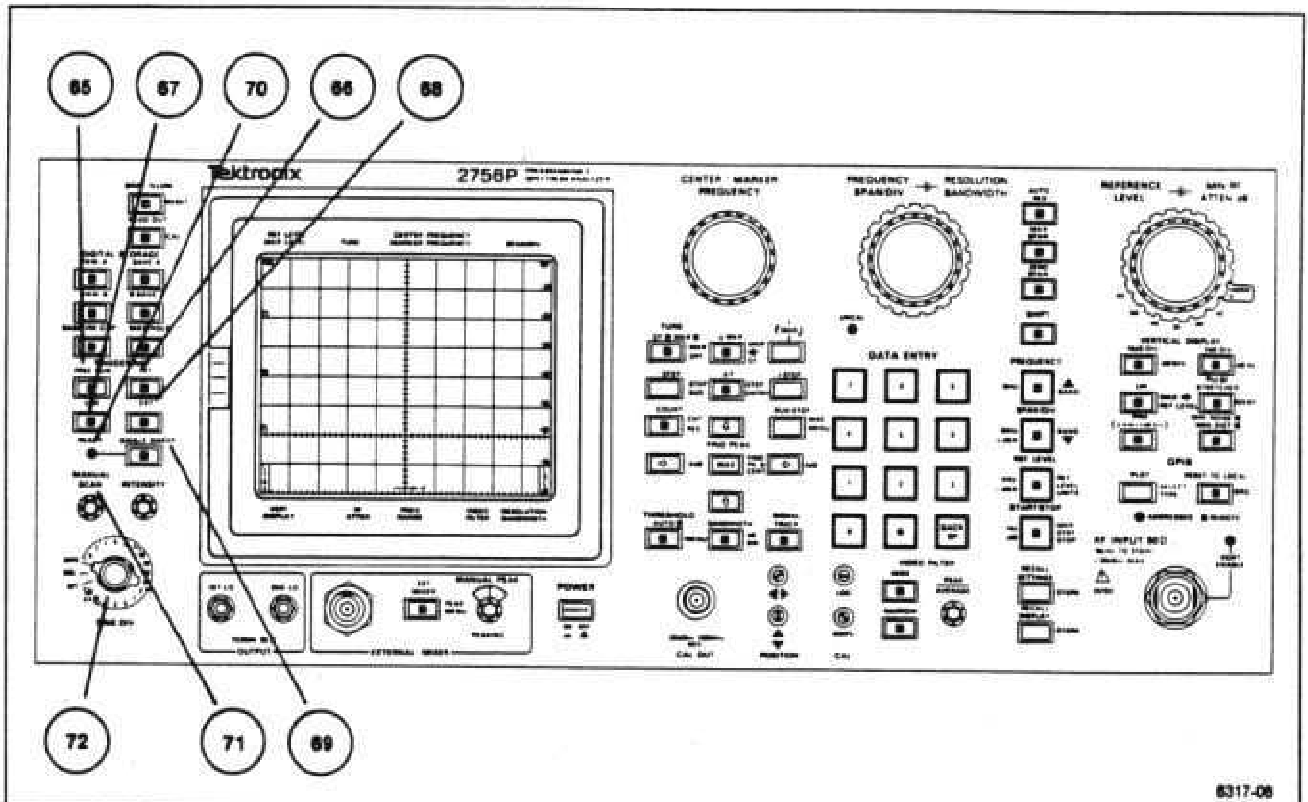


Figure 4-12. Sweep.

TRIGGERING

65 **FREE RUN** — This pushbutton allows the sweep to free run without regard to trigger source. Other TRIGGERING selections are cancelled, including single-sweep.

66 **INT** — This pushbutton allows the sweep to be triggered by any signal at the left edge of the display that has an amplitude of 2.0 divisions or more. Other TRIGGERING selections are cancelled, including single-sweep.

67 **LINE** — This pushbutton allows a sample of the ac power line voltage to trigger the sweep. Other TRIGGERING selections are cancelled, including single-sweep.

68 **EXT** — This pushbutton allows the sweep to be triggered by signals that are applied through the rear-panel HORIZ|TRIG (EXT IN) connector. Other TRIGGERING selections are cancelled, including single-sweep.

69 **SINGLE SWEEP** When first pressed, this pushbutton activates the single-sweep mode and aborts the current sweep. When pressed again, the sweep trigger circuit is armed, the READY indicator is lit, and the center frequency is corrected. The sweep will run only after it receives a trigger signal. When SINGLE SWEEP is selected, the TRIGGERING selection (i.e., FREE RUN, INTernal, LINE, or EXTernal) is not changed. Select any TRIGGERING selection to cancel SINGLE SWEEP.

70 **READY** (only used in the Single Sweep mode) — This indicator lights when the trigger circuit is armed and ready for a trigger signal. It remains lit until the sweep ends.

71 **MANUAL SCAN** — With TIME/DIV in the MNL position, rotate this control to manually scan the spectrum.

72 **TIME/DIV** — This control selects sweep rates from 5 s/div (10 s/div in AUTO) to 20 us/div, in a 1-2-5 sequence, in addition to AUTO, MaNuaL, and EXTernal sweeps.

AUTO (automatic) — This position allows the sweep rate to be selected automatically to maintain a calibrated display for most FREQUENCY SPAN/DIV, RESOLUTION BANDWIDTH, VIDEO FILTER, and Vertical Display selections.

EXT (external sweep) — This position allows the sweep circuit to be driven by a signal applied to the rear-panel HORIZ | TRIG (EXT IN) connector. A voltage ramp of 0 to +10 V will sweep 10 divisions of horizontal (X) axis.

MNL (Manual) — This position allows the spectrum or display to be manually swept with the MANUAL SCAN control.

DIGITAL STORAGE

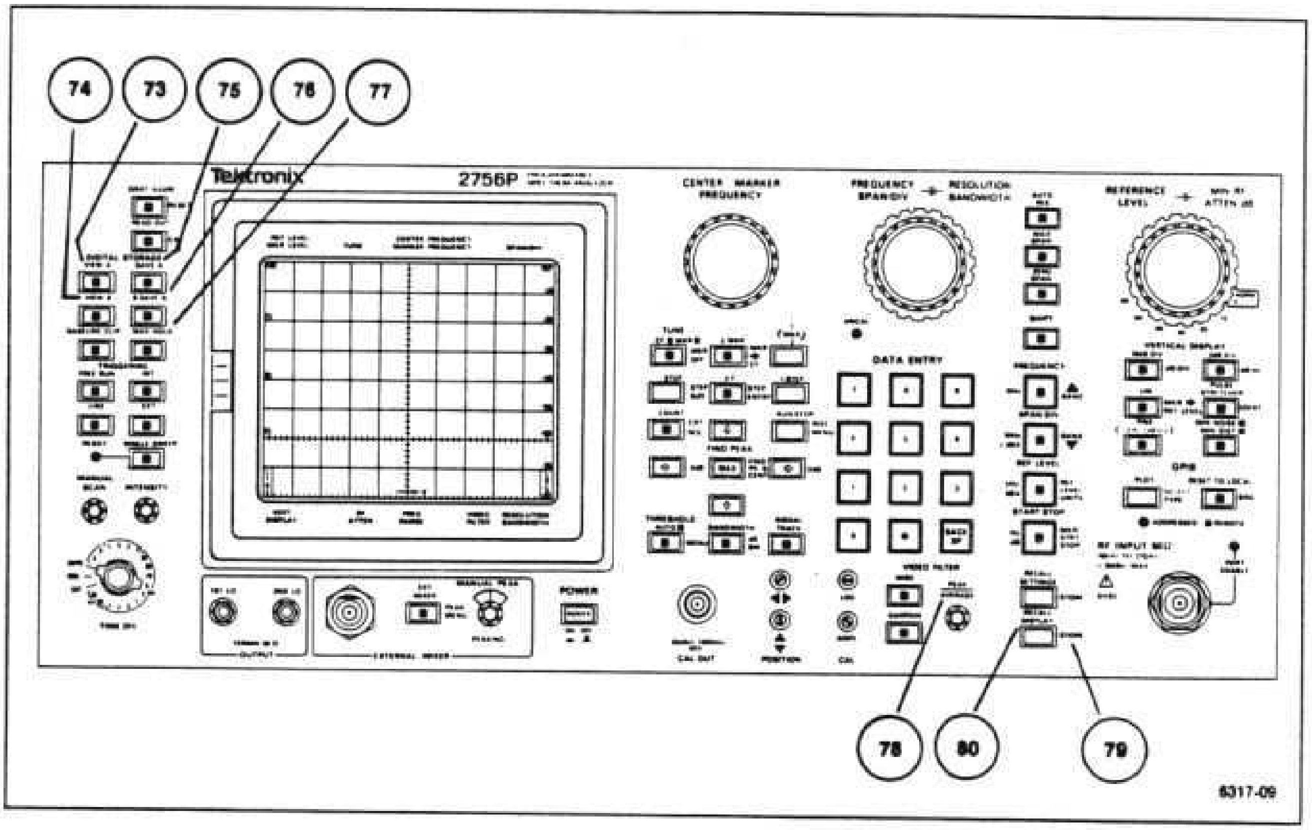


Figure 4-13. Digital Storage.

DIGITAL STORAGE — These pushbuttons allow either or both sections of memory to be selected to provide digital storage. When VIEW A and VIEW B are activated, contents of both the A and B memories are displayed on the screen. Both sections are updated with each sweep.

73 **VIEW A** — This pushbutton causes the A waveform to be displayed. If SAVE A is on and only the A waveform is being viewed, the crt readout will show the settings when the A waveform was stored.

74 **VIEW B** — This pushbutton causes the B waveform to be displayed.

75 **SAVE A** — This pushbutton saves the A waveform and its readout. The readout stored with the waveform is displayed if both SAVE A and VIEW A are on and VIEW B and B−SAVE A are off; if either VIEW B or B−SAVE A is on, the readout reflects the current spectrum analyzer settings. Turning SAVE A off cancels B−SAVE A, if it is on. If SAVE A is off and either VIEW A or VIEW B is on, both waveforms will be displayed. The A waveform is not updated by the sweep if SAVE A is on.

76 **B−SAVE A** — When activated, the spectrum analyzer displays the difference between the B waveform and the A waveform and automatically turns on SAVE A. The factory-set zero reference line is mid-screen, and positive differences are displayed above this line and negative differences below. Refer any change in the position of the zero reference line to authorized service personnel.

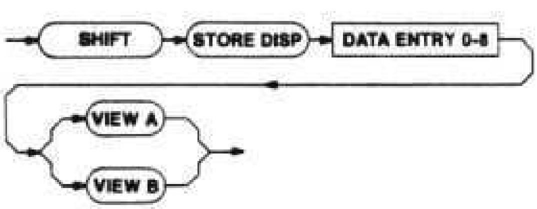
77 **MAX HOLD** — This pushbutton causes digital storage to retain the maximum signal amplitude at every storage location (500 locations; or 1000 locations if SAVE A is off). If SAVE A is on, the A

waveform is not affected. Use MAX HOLD to measure frequency drift or peak amplitude excursions of a signal.

78 **PEAK/AVERAGE** — This control selects the vertical position (shown on the screen by a horizontal line) at which digital storage switches from peak detection to signal averaging. Video signals above the cursor are peak detected; video signals below the cursor are digitally averaged.

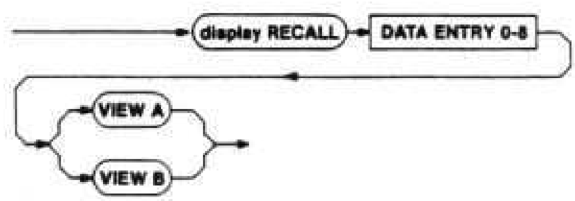
Store/Recall

79 **<SHIFT> STORE display** — This pushbutton sequence starts a multiple-pushbutton sequence that stores either the A or B waveform and its associated readout and marker(s) in a numbered (0 through 8) memory register. Information is held in memory while instrument power is off. Messages displayed on the crt aid in completing the multiple-pushbutton sequence. After selecting <SHIFT> STORE display, a list of the center frequencies of stored displays is shown. The number of digits in a center frequency in the menu list is an indication the span/div of that stored display (a larger number of digits indicates a narrower span). This display includes a prompt asking for the register number (0–8) into which the display will be stored. Select the register from the DATA ENTRY pushbuttons. When SAVE A is on, there is an operator prompt that asks whether the A or B waveform is to be saved.



80 **RECALL DISPLAY** — This pushbutton sequence starts a multiple-pushbutton sequence that recalls a selected waveform, with its readout and marker(s) from one of the memory registers (0 through 8) and puts it in either the A or B display, for viewing. Information is held in memory while the instrument is off. After selecting <SHIFT> RECALL DISPLAY, a list of center frequencies of stored displays is shown. This display includes a prompt asking for the register number (0–8) from which the display will be recalled. Select the register from the DATA ENTRY pushbuttons. The readout for a recalled A waveform will only be displayed if VIEW B and B–SAVE A are off and VIEW A is on. The readout for a recalled B waveform will only be displayed if both VIEW B or B–SAVE A are on and SINGLE SWEEP is selected. The marker(s) will only be displayed if markers are turned on.

SAVE A is activated to allow the separate display of the A or B waveform. Remember to turn on SINGLE SWEEP before recalling a waveform to B to prevent overwrite by the sweep. The waveform cannot be recalled into B when in Manual or External Sweep.



DISPLAY

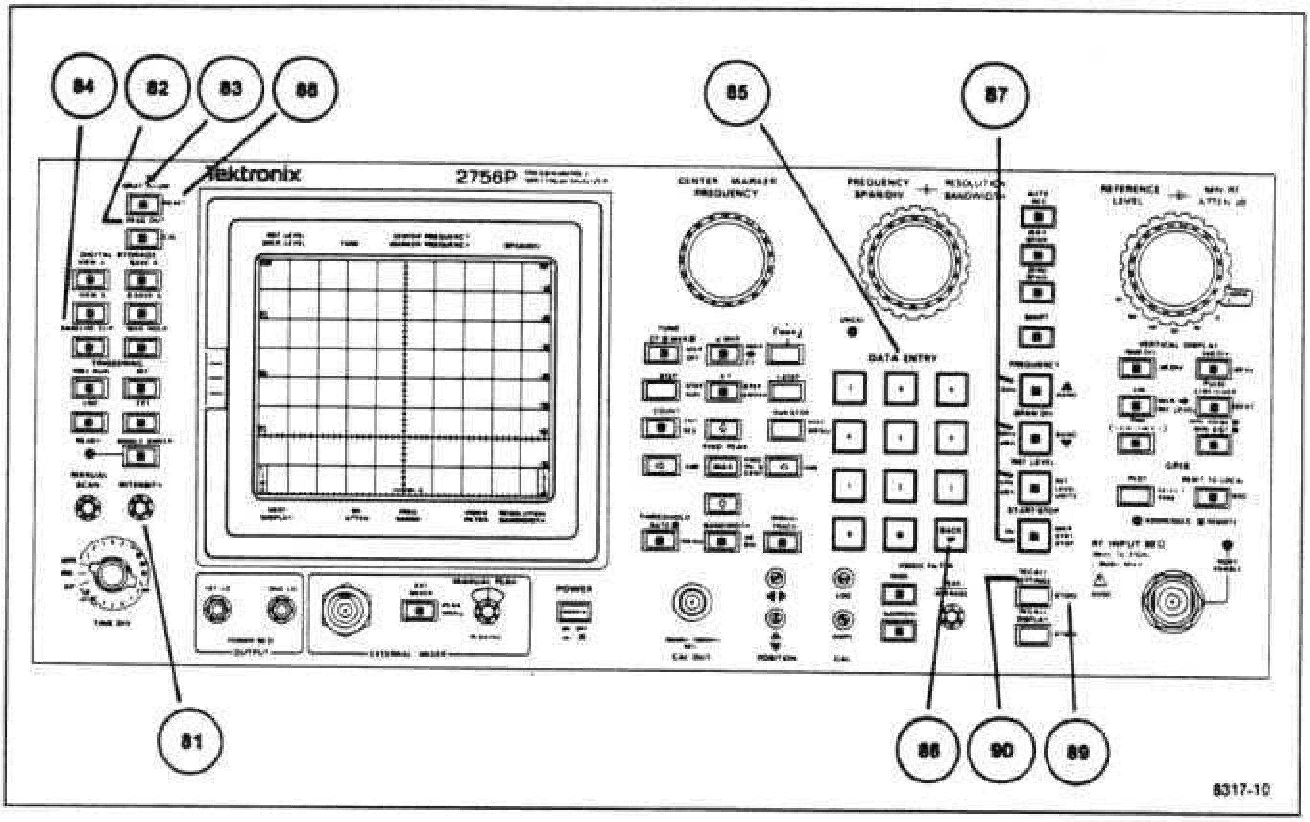


Figure 4-14. Display.

81 **INTENSITY** — This control adjusts the brightness of the crt trace, readout, and text. Beam focus is automatically controlled.

82 **READOUT** — This pushbutton turns crt readout on and off. The brightness is proportional to the trace brightness. This pushbutton does not affect prompt or help messages.

83 **GRAT ILLUM** — This pushbutton switches the graticule lights from dim for low-light viewing to bright for photographing displays.

84 **BASELINE CLIP** — This pushbutton clips, or blanks, about one graticule division of the spectrum trace at the baseline of the display. Use BASELINE CLIP to observe the readout at the bottom of the screen or to eliminate the bright baseline when photographing displays.

85 **DATA ENTRY** — These pushbuttons are used to enter data directly from the front panel when directed by a message on the crt.

Numbers — The numbers 0 through 9 and a decimal point are available to enter data from the front panel.

86 **BACKSPACE** — This pushbutton backs the cursor up one space each time it is pressed, erasing the number in that location. This allows you to enter correct numerical data before finishing the sequence with a units pushbutton.

87 **Units** — The units GHz, MHz, kHz, Hz, +dBx, −dBx, and dB are available to complete a number-entry function from the front panel.

88 **<SHIFT> RESET** This pushbutton sequence resets all front-panel settings to their original condition as if power was just turned on.

89 **<SHIFT> STORE settings** — This pushbutton sequence allows a front-panel setup to be stored in memory. The crt displays a list of center frequencies of each setup as an aid in identifying the contents of each register. Select the desired register, and the setup is stored. The instrument settings are automatically stored in register 0 when the spectrum analyzer is turned off, overwriting the settings previously stored there.

90 **RECALL SETTINGS** — This pushbutton recalls an instrument front-panel setup from memory. The crt displays a list of the center frequencies of each stored setup as an aid in identifying the contents of each register. To return to these settings, press RECALL SETTINGS 0; however, the time and minimum RF attenuation settings stay at the knob values. Select the desired register number, and the front-panel controls automatically switch to that setup. The instrument settings are automatically stored in register 0 when the spectrum analyzer is turned off, overwriting the settings previously stored there.

GENERAL PURPOSE

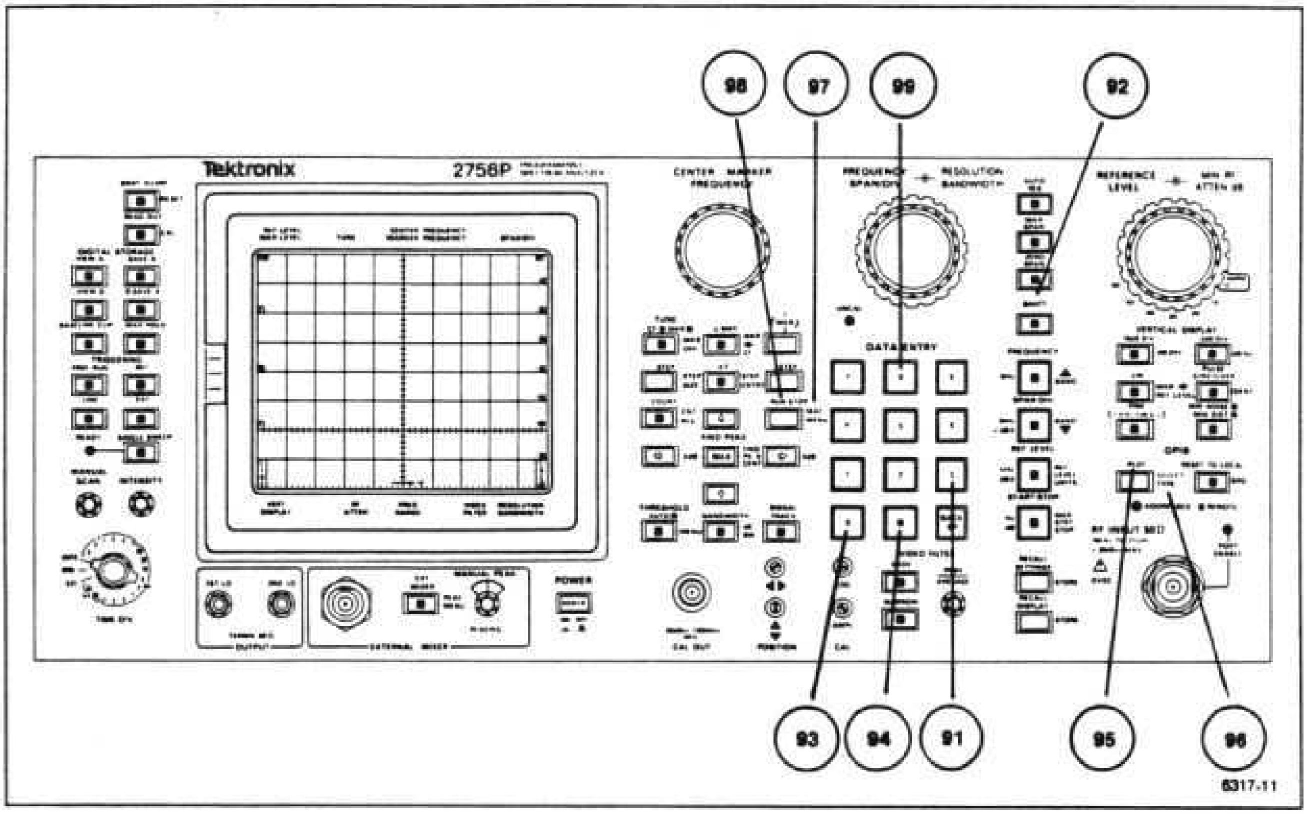


Figure 4-15. General Purpose.

91 <SHIFT> 3 — (Plot B–Save A Offset; not identified on the front panel) The vertical position of the zero reference line for the B–SAVE A display is set with an internal switch selection. However, when using the PLOT function, the position of zero reference for the plot must be entered using this function. The range for the position is 0 to 255 (25 points/division) with 125 representing center screen. Enter the position with the DATA ENTRY pushbuttons when prompted by the crt message, and terminate with the Hz pushbutton. The entered position is then stored in memory.

92 <SHIFT> — This pushbutton allows selection of the blue-labeled front-panel pushbutton functions. Press <SHIFT> each time before selecting a blue-lettered function. <SHIFT> also stops multiple-pushbutton sequence operations.

93 <SHIFT> 0 — (Diagnostic Aids; not identified on the front panel) This pushbutton sequence displays a menu on the crt of all the available diagnostic aids for use while troubleshooting.

WARNING

MOST OF THIS INFORMATION IS FOR QUALIFIED SERVICE PERSONNEL ONLY. UNFAMILIARITY WITH SAFETY PROCEDURES CAN RESULT IN PERSONAL INJURY. PERFORM ONLY THE OPERATIONS THAT CAN BE COMPLETED FROM THE INSTRUMENT FRONT PANEL. DO NOT ATTEMPT TO REMOVE THE INSTRUMENT PANELS OR PERFORM ANY INTERNAL OPERATIONS; CONTACT QUALIFIED SERVICE PERSONNEL.

94 **<SHIFT> .** — (Instrument Errors; not identified on the front panel) This pushbutton sequence displays on the crt all the detected instrument errors; for use while troubleshooting.

95 **PLOT** — This pushbutton causes display information to directly drive a plotter. The plotter type is selected by pressing the <SHIFT> SELECT TYPE pushbutton sequence. Refer to Plotting The Display in Section 6 for details. The plotters that can be driven are

- Tektronix 4662 Option 01
- Tektronix 4662 Option 31
- Tektronix 4663 (emulating the 4662)
- Hewlett-Packard HP7470A
- Hewlett-Packard HP7475A
- Hewlett-Packard HP7580B
- Hewlett-Packard HP7585B
- Hewlett-Packard HP7586B
- Gould 6310
- Gould 6320

96 **<SHIFT> SELECT TYPE** — This pushbutton sequence displays the list of the plotter types available for use with the PLOT pushbutton. Select the desired plotter type by choosing one of the menu items and entering the number on the DATA ENTRY pushbuttons. (Any plotter that is compatible with one of those listed can also be used.) The selected plotter type is stored in memory. The menu choices are

- 0 – Tektronix 4662 Option 01 or the 4663 in a one-pen setup
- 1 – Tektronix 4662 Option 31 or the 4663 in a two-pen setup
- 2 – HP7470A or Gould 6310 or 6320
- 3 – HP7475A, HP7580B, HP7585B, or HP7586B.

97 **<SHIFT> MACro MENU** — This pushbutton sequence has three functions depending on the status of macros. The title of the macro is displayed next to the macro number. The functions are

- select a macro to be executed
- abort a macro
- return the readout to normal

98 **RUN/STOP** — This pushbutton has three functions, depending on the status of macros.

- If a macro is running, press RUN/STOP to stop the macro.
- If a macro is stopped, press RUN/STOP to restart the macro.
- If no macro is running or stopped, press RUN/STOP to run the last macro that was executed.

99 **<SHIFT> 8** — (Special Modes Menu; not identified on the front panel) This pushbutton sequence brings up a menu from which you can select the special modes available within the instrument. (Refer to Section 6 for additional information.)

0 — TRACKING GENERATOR MODE

1 — SIDEBAND ANALYZER MODE

2 — REDUCED GAIN MODE

3 — EOS CORRECTIONS MODE

4 — ZERO-SPAN TIME MODE

FRONT-PANEL INPUT/OUTPUT AND GPIB

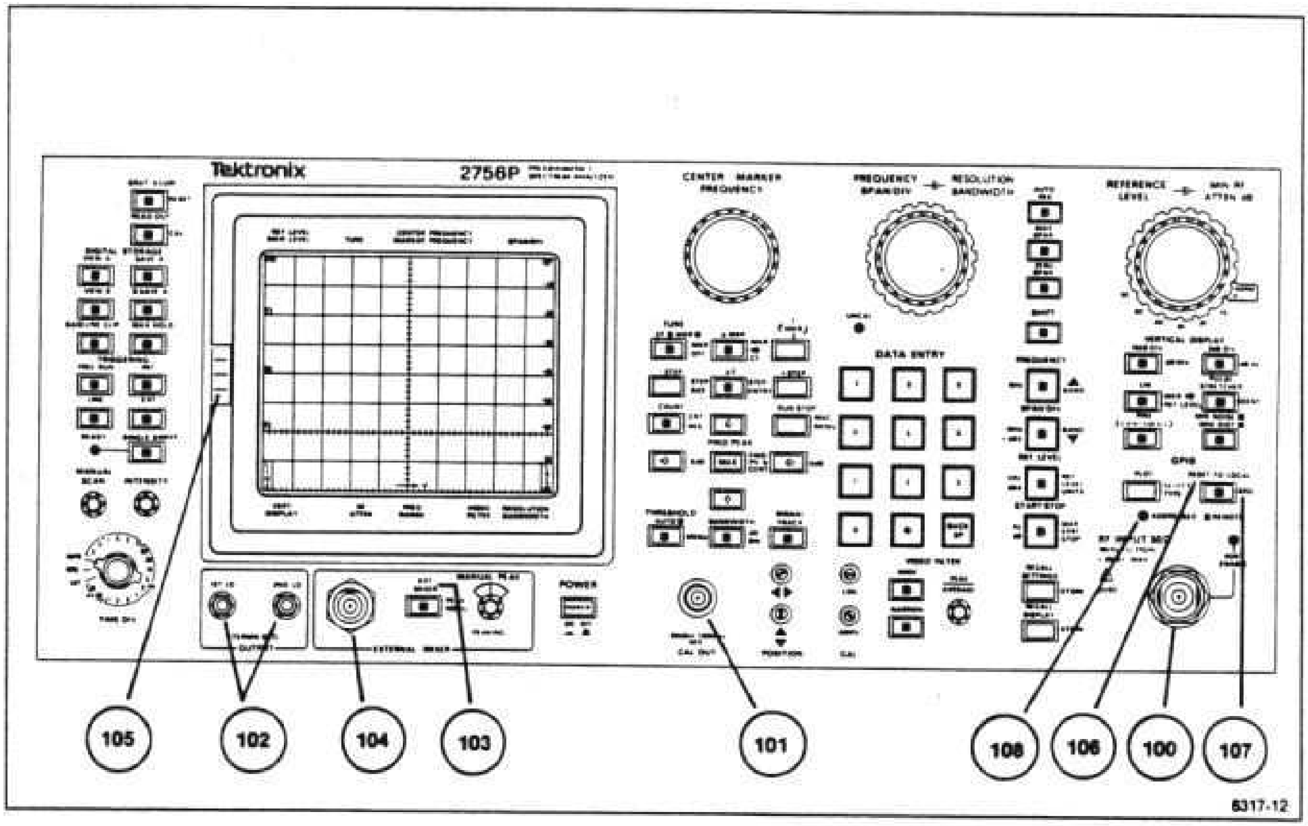


Figure 4-16. Front-Panel Input/Output and GPIB.

100 **RF INPUT 50 Ω** — This 50 Ω coaxial input connector is for RF signals to 21 GHz. If the input signal has a dc component, use a blocking capacitor in line with the signal.

CAUTION

The maximum, non-destructive input signal level to the input mixer is +13 dBm or 20 mW. Signals above −18 dBm may cause compression.

The maximum rating of the RF attenuator is +30 dBm (1 W average, 75 W peak pulse width 1 ms or less, with a duty cycle that does not exceed 0.001). Burn-out occurs above 1 W. If MIN NOISE is activated and the RF ATTEN is 60 dB, the +30 dBm rating will be exceeded if the signal level is increased to a full-screen display. Under these conditions the input level will be +40 dBm. Reduce the level of high-powered signals with external attenuators. Input signals to the mixer must not contain any dc component. Refer to Signal Application in Section 6.

101 **CAL OUT (Calibrator output)** — This connector is the source of a calibrated −20 dBm ±0.3 dB), 100 MHz signal and a comb of frequency markers 100 MHz apart. This 100 MHz source is the instrument reference frequency. In Option 07 instruments using the 50 Ω input, the signal is the same as the standard instrument, and using the 75 Ω input, the signal is +20 dBmV, ±0.5 dB.

102 **OUTPUT (1ST LO/2ND LO)** — These connectors are the outputs of the respective local oscillators. The connectors must be terminated into 50 Ω when they are not connected to an external device.

103 **EXTERNAL MIXER** — When the EXT MIXER pushbutton is pushed, this connector is the bias source for external mixers, as well as the IF input to the spectrum analyzer. The External Mixer mode is indicated by EXT on the crt readout in place of RF ATTENUATION. Bias voltage is set by the MANUAL PEAK control or set internally when another Auto-Peak Menu option is selected.

104 I **RF INPUT 75 Ω** — (Option 07 instruments only) This connector provides calibrated 75 Ω measurement capability.

105 **Camera Power** — This connector is the source of power for the Tektronix C-50 Series Cameras that have electrically-actuated shutters (either the C-5 or the C-59 is recommended). Single-sweep reset is not provided.

106 **RESET TO LOCAL/REMOTE** — This pushbutton is lit when the spectrum analyzer is in the remote state. While the instrument is remote, the other front-panel controls are not active except for PEAK/AVERAGE, INSTENSITY, MANUAL SCAN, and MANUAL PEAK, if enabled. Indicators still reflect the current state of front-panel functions. This pushbutton is not lit when the spectrum analyzer is in the local state. While the spectrum analyzer is under local control, no GPIB messages are executed that would conflict with front-panel controls or change the waveforms in digital storage. See Programming Features in Section 6 for additional information.

107 **<SHIFT> SRQ** — This pushbutton sequence sends a service request over the GPIB bus to the controller.

108 **ADDRESSED** — This indicator lights when the spectrum analyzer is addressed to either talk or listen. The characters T, L, and/or S appear in the crt readout to indicate talk, listen, and/or SRQ, respectively.

REAR-PANEL INPUT/OUTPUT AND GPIB

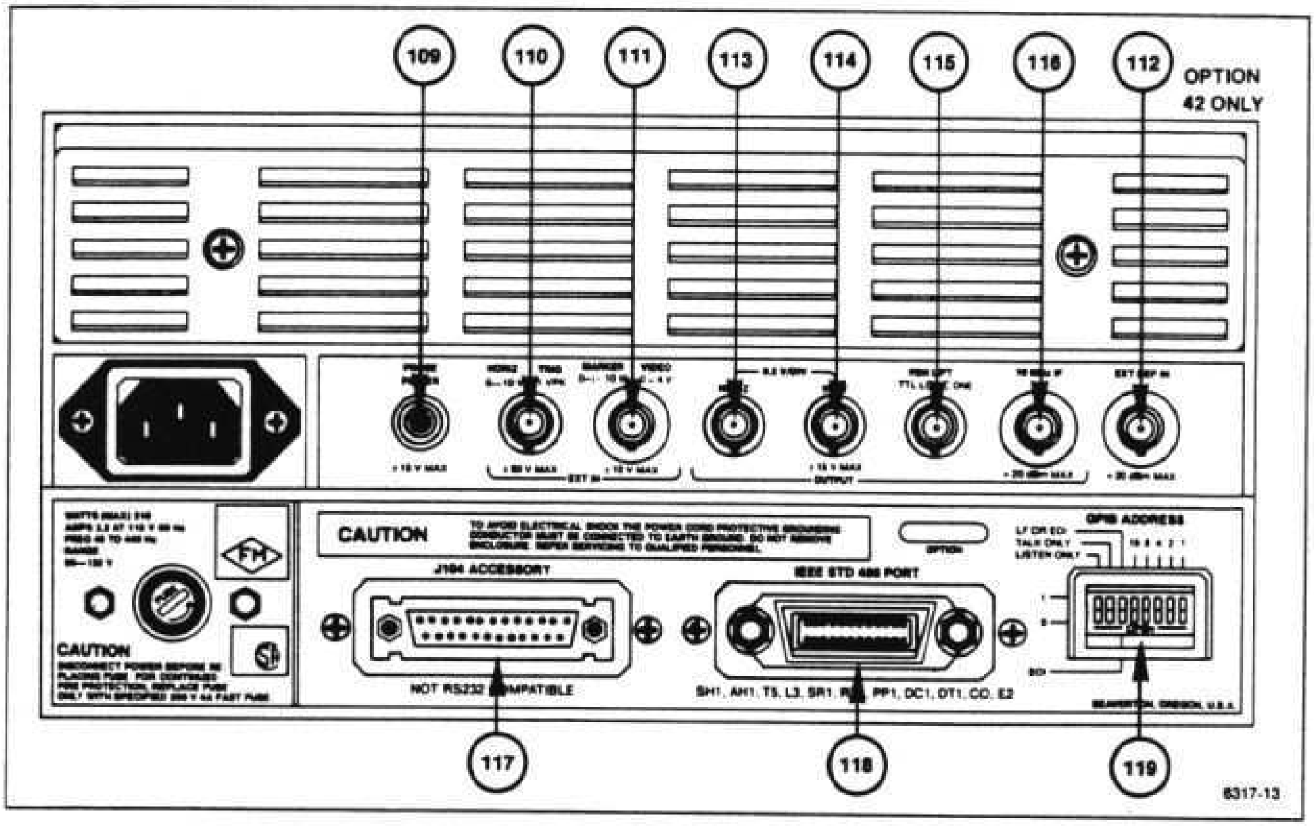


Figure 4-17. Rear-Panel Input/Output and GPIB.

109 **PROBE POWER** — This connector provides operating power for active probe systems. This connector should be used only with compatible probes or accessories specifically designed for use with this power source.

110 **HORIZ/TRIG (EXT IN)** — Horizontal or triggering modes depend on the TRIGGERING and TIME/DIV selections. In the External Triggering mode, the connector is an ac coupled input for trigger signals. Trigger amplitudes from 1.0 V to 50 V peak, with a 0.1 ms minimum pulse width or within the frequency range of 15 Hz to 1 MHz, are required for triggering. When the TIME/DIV selection is EXT, the connector is a dc coupled input for horizontal sweep voltages. Deflection sensitivity is 1 V/div. A 0 to +10 voltage will deflect the beam across the screen from left to right.

111 **MARKER/VIDEO (EXT IN)** — (Available on instruments without Option 42 only). This connector interfaces the spectrum analyzer with a Tektronix 1405 TV Adapter to display an externally-generated marker.

112 **EXT REF IN** — A 50Ω input for a 1, 2, 5, or 10 MHz external reference signal, within −15 dBm to +15 dBm level. Phase noise should be no greater than −110 dBc, in a 1 Hz bandwidth at 10 Hz offset, referenced to 10 MHz. Input signal must be a sinewave with a duty cycle symmetry of 35 to 65%. Input is ECL or TTL.

113 **HORIZ (OUTPUT)** — This connector supplies a 0.5 V/div horizontal signal. Full range is −2.5 V to +2.5 V. Source impedance is approximately 1 kΩ.

114 **VERT (OUTPUT)** — This connector provides access to the video signal with 0.5 V for each division of displayed video that is above and below the center line. Source impedance is approximately 1 kΩ.

NOTE

Both HORIZ and VERT output signals are driven from digital storage if it is on. Both signals are driven from the analyzer sweep and video amplifier stage if digital storage is off.

115 **PEN LIFT (OUTPUT)** — This connector provides access to a TTL compatible signal to lift the pen of a chart recorder during spectrum analyzer sweep retrace. This signal is always derived from the spectrum analyzer sweep, regardless of the selection of the digital storage.

In Option 42 instruments, use this connector to input external video signals if pin 1 of the ACCESSORIES connector is grounded (refer any questions about this connection to qualified service personnel).

116 **10 MHz IF (OUTPUT)** — This connector provides access to the output of the 10 MHz IF. The output level is approximately −16 dBm for a full-screen signal at −30 dBm reference level.

117 **J104 ACCESSORY** — This connector provides bi-directional access to the instrument bus. It is not RS 232 compatible. A TTL 0 applied to pin 1 selects External Video. Video signals, which are applied to rear-panel MARKER/VIDEO, are connected to the video path ahead of the video filters.

118 **IEEE STD 488 PORT (GPIB)** — This connector interfaces the spectrum analyzer to the plotter and to the GPIB bus. The interface functions provided are listed in Table 4-1.

Table 4-1
INTERFACE FUNCTIONS

Function	2756P
Source Handshake	SH1
Acceptor Handshake	AH1
Talker	T5
Listener	L3
Service Request	SR1
Remote/Local	RL1
Parallel Poll	PP1
Device Clear	DC1
Device Trigger	DT1
Controller	C0

119 **GPIB ADDRESS** — These switches set the value of the lower five bits of the instrument GPIB address; this value is the instrument's primary address. These switches also select the Talk Only and Listen Only operating modes, and the message terminator for input and output. Address 31 (11111) logically disconnects the spectrum analyzer from the bus. Address 0 (00000) is reserved for Tektronix 4050-Series controllers. If these switches are changed after the instrument is already active, press RESET TO LOCAL or PLOT to cause the spectrum analyzer to re-read them.

Details of how the switches are used in remote control are in the Programmers Manual.

INSTRUMENT CHECK OUT

This section includes the basic instrument check-out procedures and first-time preparation for use. An instrument operational check is included for the front-panel pushbuttons and controls and some of the operating functions. Little extra equipment is required to perform these check-out procedures, and the instrument covers do not need to be removed. Refer any additional instrument check out to qualified service personnel.

FIRMWARE VERSION AND ERROR MESSAGE READOUT

Firmware Version

When the spectrum analyzer is first turned on, all the front-panel LEDs will light up, and instrument self-test will be performed, and then the front-panel processor and microprocessor firmware versions will be displayed on the screen for approximately two seconds.

Error Message Readout

If the instrument detects an internal hardware failure, a failure report comes on screen and remains for approximately 2 seconds. A status message then appears and remains for as long as the failure exists. Press <SHIFT> . to bring error messages to the screen that explain the impact of the failure on instrument operation.

There are error messages to report a calibration failure, power supply failure, and battery-operated RAM checksum error. Promptly report any error messages to qualified service personnel.

PREPARATION FOR USE

The following procedure creates a display and calibrates center frequency readout, display reference level, and bandwidth. Whenever the SHIFT pushbutton is required in this procedure to precede a multiple-pushbutton sequence, it is enclosed in arrows; i.e. <SHIFT>.

1. Initial Turn On

a. Connect the spectrum analyzer power cord to an appropriate power source (see Power Source And Power Requirements in Section 3 of this manual) and push the POWER switch ON.

When POWER is switched ON (power-up), the processor runs a memory and I/O test. If no processor system problems are found, the power-up program will complete in approximately 7 seconds, and the instrument will be ready to operate. The crt readout is functioning properly if it is as shown in Figure 5-1 after the 7-second power-up period. If a problem does exist within the instrument, a message will appear on the screen. To bypass the failed test and attempt to use the instrument, press the pushbutton as directed in the error message. However, performance may not be as specified.

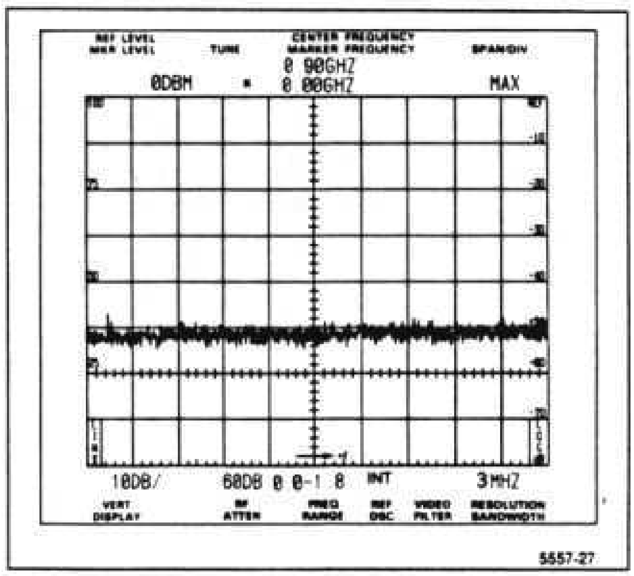


Figure 5-1. Crt display and readout at initial turn on.

The spectrum analyzer operating functions and modes will initialize to the following power-up states.

REF LEVEL	0 dBm
Center FREQUENCY	0.90 GHZ
Dot Marker FREQUENCY	0.00 GHZ
SPAN/DIV	MAXimum
VERTICAL DISPLAY	10 dB/DIV
RF ATTENUATION	Value of MIN RF ATTEN dB
FREQ RANGE	0 to 1.8 GHz
REFERENCE OSCILLATOR	INT (May read INT UNLK (unlocked) on initial turn-on and up to 5 minutes of operation, due to warmup of the reference oscillator oven. This is normal.)
RESOLUTION BANDWIDTH	3 MHZ (In AUTO TIME/DIV)
READOUT	On
TRIGGERING	FREE RUN
AUTO RESolution	On
DIGITAL STORAGE	VIEW A/VIEW B On
MIN NOISE/MIN DISTORTION	MIN NOISE
THRESHOLD	On
All other pushbuttons	Inactive or Off

b. Set the MIN RF ATTEN dB control to 0 (NORM), REF LEVEL to −30 dBm, and the PEAK/AVERAGE control fully counterclockwise. Set the TIME/DIV control to AUTO and adjust the INTENSITY control for the desired brightness. Note that the RF ATTENUATION readout is now 0 DB.

c. Connect a 50 Ω coaxial cable between the CAL OUT connector and RF INPUT to apply the CAL OUT signal to the RF INPUT connector.

d. A dot marker will appear in the upper portion of the screen in the MAX frequency mode. This marker indicates the spectrum analyzer center frequency when the span is reduced from MAX. With a frequency readout of 0.00 GHz, the marker will be in the upper left portion of the screen. Rotate the CENTER/MARKER FREQUENCY control and watch the dot marker move across the display. Notice that the Center FREQUENCY readout (top line) remains at 0.90 GHz, and that the Marker FREQUENCY readout (second line) changes according to the position of the marker (dot).

e. A comb of 100 MHz markers will be displayed, as shown in Figure 5-2. To select 100 MHz center frequency, press the pushbutton sequence of FREQUENCY 1 0 0 MHz.

f. To change the FREQ SPAN/DIV readout to 100 MHz, press the pushbutton sequence of SPAN/DIV 1 0 0 MHz. The dot marker is now horizontally centered, and the 100 MHz calibrator signal is at center screen.

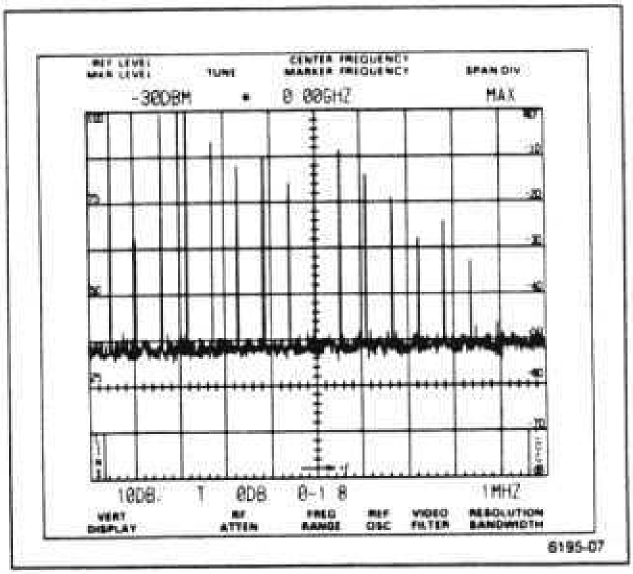


Figure 5-2. Typical display of calibration markers in the maximum span position.

2. Calibrate Position, Center Frequency, Reference Level, and Bandwidth

NOTE

When the <SHIFT> CAL sequence is pressed, the spectrum analyzer performs a center frequency, bandwidth, and reference level calibration. Prompts appear on the screen to guide you step-by-step through the procedure. This calibration should be done at regular intervals. It must be done before the instrument will meet its center frequency and reference level accuracy performance specifications. It should also be done any time the instrument ambient temperature is substantially different from the last calibration. An explanation of reference level accuracy with respect to ambient temperature is described in the Specification section of this manual.

To see the results after the spectrum analyzer has completed a calibration routine, press the <SHIFT> 1 sequence. A message will appear on the screen that shows the correction factors used by the spectrum analyzer to center the resolution bandwidth filters to produce a calibrated center frequency. It also shows the correction that was required to bring the amplitude level within 0.4 dB of the 3 MHz filter.

Press the <SHIFT> CAL sequence to start the calibration routine. Prompt messages on the screen will guide you through setting the four front-panel adjustments of vertical and horizontal POSITION, and AMPL and LOG CAL. This sets the absolute reference level for the 3 MHz resolution bandwidth filter. An automatic calibration is then done, which measures and corrects for absolute frequency and amplitude (relative to 3 MHz) errors of the filters. This takes approximately 60 seconds. If a message appears on the screen, refer to Error Message Readout earlier in this section. The correction factors are held in memory. Press FINE to continue calibration as instructed or either SHIFT pushbutton to exit the routine.

FUNCTIONAL OR OPERATIONAL CHECK

This procedure uses minimum test equipment to check instrument operating modes, functions, and basic performance. The procedure checks that the instrument is operating properly. The internal calibrator and attenuator are used as the source to check most of the operational characteristics. Since both are very accurate, this check should satisfy most incoming inspection or pre-operational check-out requirements. This check will also help familiarize you with the instrument operation. A detailed Performance Check that verifies all performance requirements in the Specification section is included in the Service Manual, Volume 1.

Equipment Required

The external equipment used is an N-male-to-bnc-female adapter and the 50 Ω coaxial cable, which are supplied as standard accessories, and an external controller (we used the Tektronix 4041).

Preliminary Preparation

Perform the procedure described under Preparation for Use, then allow the instrument to warm up for at least 30 minutes before proceeding with this check.

1. Check Operation of Front-Panel Pushbuttons and Controls

This procedure checks the operation of all front-panel pushbuttons and controls and ensures that the buttons illuminate when the function is active.

Pushbuttons indicating a mode light when the function is active. Pushbuttons that have an immediate, one-time effect on the crt display, such as +STEP, are not illuminated.

Connect the CAL OUT signal to the RF INPUT with the 50 Ω cable and bnc-to-N adapter. Tune the 100 MHz, −20 dBm signal to center screen. Reduce the FREQ SPAN/DIV readout to 20 kHz, and change the VERTICAL DISPLAY to 2 dB/DIV. Press or change the following pushbuttons and controls and note their affect on the operation.

INTENSITY — Rotate the control through its range and note the crt beam brightness change.

GRAT ILLUM — When activated, the graticule is illuminated.

MENU — Press the <SHIFT> MENU pushbutton sequence to display a menu of available commands that are not assigned to a front-panel pushbutton.

DATA ENTRY — Some functions require a parameter or command to be entered that includes numerical data. This data is entered with the DATA ENTRY pushbuttons.

(a) Set the FREQ SPAN/DIV readout to 50 kHz and turn AUTO RESolution on. Set the FREQUENCY readout to 2.0 GHz by pressing <blue-SHIFT> FREQ 2 GHz with the DATA ENTRY pushbuttons. This sets the FREQUENCY to 2.000 GHz. (The number of digits is a function of the span/div that was previously entered.)

(b) Enter frequencies of 200 MHz and 200 kHz by repeating the procedure in step a. The FREQUENCY readout will be set to the figures entered with the DATA ENTRY pushbuttons.

(c) With the DATA ENTRY pushbuttons, set the SPAN/DIV readout to any desired setting. The SPAN/DIV readout will be set to the figures entered with the DATA ENTRY pushbuttons (rounded to 2 digits).

(d) Enter a reference level with the DATA ENTRY pushbuttons. The REF LEVEL readout will be set to the figures entered with the DATA ENTRY pushbuttons.

(e) Enter a desired vertical display factor with the DATA ENTRY pushbuttons. The VERTICAL DISPLAY readout will be set to the figures entered with the DATA ENTRY pushbuttons (rounded to 2 digits).

TRIGGERING — To activate the triggering mode, press one of four pushbuttons. The pushbutton illuminates when in the active state. Press any one of the pushbuttons to cancel or deactivate any other mode. Turn VIEW A and VIEW B off to better observe the triggering effect.

FREE RUN — In the active state, the trace free runs.

INT — When active, the sweep is triggered when the signal or noise level at the left edge is ≥2.0 division.

(a) Tune one of the 100 MHz calibrator signals to the center of the display and adjust the REFERENCE LEVEL control so the amplitude of the signal is 2 or more divisions.

(b) Activate INT TRIGGERING to trigger the sweep.

(c) Activate FREE RUN, and set the VERTICAL DISPLAY to 2 dB/DIV so the amplitude at the left edge is less than 1 division.

(d) Reactivate INT TRIGGERING. The sweep is no longer triggered.

LINE — When active, the trace is triggered at power line frequency. Switch to LINE and the sweep will be triggered.

EXT — When this function is active, the trace runs only when an external signal ≥1.0 V peak is applied to the back-panel HORIZ|TRIG EXT IN connector. The following steps will allow the sweep to exteranl trigger when storage is on, but not when storage is off.

(a) Connect a BNC-BNC cable between the rear-panel VERT (OUTPUT) and HORIZ|TRIG (EXT IN) connectors.

(b) Select 10 dB/div and 3 MHz resolution with VIEW A and VIEW B on and B−SAVE A off.

(c) Select EXT TRIGGERING. The display should be triggered by the digital storage waveform.

(d) Set VIEW A and VIEW B off. Triggering should stop since the digital storage waveform is no longer coming from the VERT (OUTPUT) connector.

SINGLE SWEEP — When this function is active, single sweep aborts the current sweep. Press the pushbutton again to arm the sweep generator and light the READY indicator. When triggering conditions are met after the circuit is armed, the analyzer makes only one sweep. The indicator will remain lit until the sweep has run. The single sweep mode is cancelled when any TRIGGERING pushbutton is pressed. The effect of SINGLE SWEEP is more apparent with VIEW A and VIEW B off.

(a) Press FREE RUN TRIGGERING, and set TIME/DIV to 0.5 s.

(b) Press SINGLE SWEEP to abort the sweep.

(c) Press SINGLE SWEEP again, and the READY indicator lights and the sweep runs.

(d) Press FREE RUN to cancel single sweep; return TIME/DIV to AUTO.

TIME/DIV — This control selects sweep rate, manual scan, and external sweep operation. In the MNL position, the MANUAL SCAN control should move the crt beam across the horizontal axis of the crt graticule. In the EXT position, a voltage of 0 to +10 V, applied to the rear-panel HORIZ|TRIG connector, should deflect the crt beam across the full 10 division screen.

VERTICAL DISPLAY — Display modes are activated by three pushbuttons. Press any of these pushbuttons to cancel any other mode. Turn VIEW A and VIEW B on.

10 dB/DIV — When this pushbutton is activated, the display is a calibrated 10 dB/division with an 80 dB dynamic range.

(a) With a REF LEVEL readout of −20 dBm, activate 10 dB/DIV. Set the FREQ SPAN/DIV to 20 kHz and tune the calibrator signal to center screen.

(b) Change REF LEVEL, and the display steps in 1 division increments, representing 10 dB/division. Return the REF LEVEL readout to −20 dBm.

2 dB/DIV — When this pushbutton is pressed, the display is a calibrated 2 dB/division with 16 dB of dynamic range.

(a) Activate 2 dB/DIV, and change the REF LEVEL readout to −6 dBm. The display now steps 1.0 division for each two steps of the REFERENCE LEVEL control.

(b) Return the REF LEVEL readout to −20 dBm.

LIN — When this pushbutton is pressed, the display is linear between the reference level (top of the graticule) and zero volts (bottom of the graticule), and the crt VERTICAL DISPLAY reads out in volts/division.

Activate LIN, and the Vertical Display readout changes to mV/division.

PULSE STRETCHER — When this pushbutton is pressed, the fall-time of video signals increases so narrow video pulses will show on the display.

(a) Increase the FREQ SPAN/DIV readout to 100 MHz, change the VERTICAL DISPLAY to 10 dB/DIV, increase TIME/DIV to 1 ms, and switch VIEW A and VIEW B both off.

(b) The markers should increase in brightness when PULSE STRETCHER is activated.

(c) Turn the PULSE STRETCHER off, return TIME/DIV to AUTO, and turn both VIEW A and VIEW B on.

VIDEO FILTER — Two filters can be separately selected to provide WIDE or NARROW (approximately 1/30th or 1/300th of the resolution bandwidth) filtering to reduce noise.

(a) Change the FREQ SPAN/DIV readout to 500 kHz, and tune the calibrator signal to center screen.

(b) Alternately activate WIDE and NARROW Video Filters. The noise in each filter is reduced as the filter is switched in (see Figure 5-3). The NARROW filter will have a more pronounced effect on noise reduction. Note the change in sweep rate when the TIME/DIV selector is in the AUTO position, when the Digital Storage is off.

(c) Turn both Video Filters off.

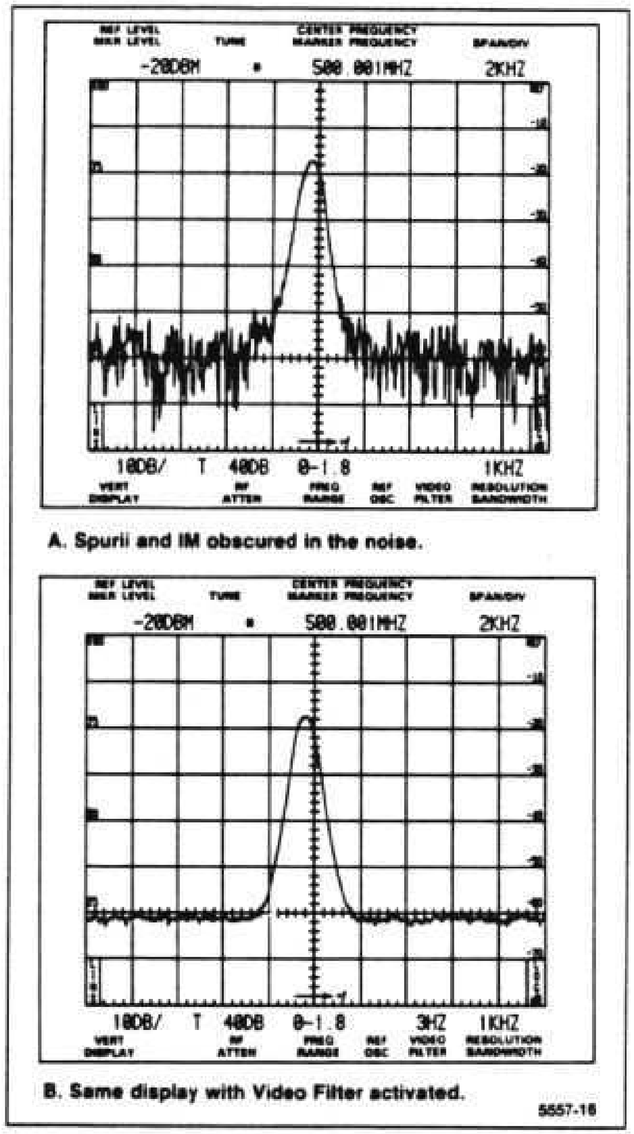
DIGITAL STORAGE — Select either one or both of the A and B waveforms from digital storage. The amplitude of a signal should remain constant when digital storage is turned on (VIEW A or VIEW B activated). The PEAK/AVERAGE control positions a cursor over the vertical window of the screen, with noise and signal level averaged below the cursor and peak-detected above the cursor.

VIEW A — When this pushbutton is pressed, the A waveform from digital storage is displayed. With SAVE A off, the A waveform is updated each sweep as the beam travels from left to right. With SAVE A on, the waveform is not updated.

VIEW B — When this pushbutton is pressed, the B waveform is displayed. When both VIEW A and VIEW B are active, the A and B waveforms are interlaced and displayed. Both waveforms are updated each sweep. Update of the A waveform depends on the state of SAVE A.

SAVE A — When SAVE A is activated, the A waveform with its readout is saved. In this mode, the data for the A waveform is not updated each sweep. Turn VIEW B off, and change the setting of the REFERENCE LEVEL control . The A display will not change. The readout for the saved waveform will be displayed any time SAVE A is on and VIEW B and B–SAVE A are off. If either VIEW B or B–SAVE A is on, the readout reflects the current analyzer setup.

MAX HOLD — When this pushbutton is pressed, the maximum signal amplitude at each memory location is stored. The waveform is updated only when signal data is greater than that previously stored. To



A. Spurii and IM obscured in the noise.

B. Same display with Video Filter activated.

5557-16

Figure 5-3. Integrating a display with the VIDEO FILTER.

verify operation, change the settings of the CENTER/MARKER FREQUENCY or REFERENCE LEVEL controls; the maximum level at each location will be retained.

B–SAVE A — Press this pushbutton to display the arithmetic difference between an updated B waveform and a SAVE A waveform. The SAVE A function is automatically activated when B–SAVE A is pressed.

Press B–SAVE A, and change the REFERENCE LEVEL setting so the difference between the B and SAVE A waveform is displayed with VIEW A and VIEW B off. The reference (zero difference) level is factory set at graticule center. The position of this reference level can be changed by qualified service personnel. Positive differences between the two displays appear above this line and negative differences below the line.

PEAK/AVERAGE — When digital storage is on, this control positions a horizontal line, or cursor, anywhere within the graticule window. Signals above the cursor are peak detected, signals below the cursor are averaged by the digital storage. To verify operation, move the cursor within the noise level; the noise amplitude will change as the cursor is positioned.

IDENTify — When you push <SHIFT> IDENT, every other sweep with its waveform is vertically displaced from the other. The frequencies of the 1st and 2nd local oscillators are moved so that true signals are not displaced horizontally on alternate sweeps while spurious signals are shifted significantly, or off screen. The FREQUENCY SPAN/DIV setting must be 50 kHz or less for the coaxial bands and 50 MHz or less for the waveguide bands (21 GHz or more) before the processor will activate the Identify mode. Refer to Using the Signal Identifier under General Operating Information, in Section 6 of this manual.

(a) With the 500 MHz calibrator harmonic tuned to center frequency, decrease the FREQUENCY SPAN/DIV setting to 50 kHz or less and press <SHIFT> IDENT.

(b) There wil be no horizontal displacement of the 500 MHz signal on alternate sweeps. To help determine if the signal is true or spurious (see Figure 5-4), decrease the sweep rate or push SAVE A with both VIEW A and VIEW B on, so a comparison can be made.

(c) Turn IDENT off.

AUTO RESolution — When this pushbutton is pressed and FREQUENCY SPAN/DIV and TIME/DIV settings are changed, resolution bandwidth is automatically selected by the processor to maintain a calibrated display. To check operation, change FREQUENCY SPAN/DIV or TIME/DIV settings; the RESOLUTION BANDWIDTH will change. The UNCAL indicator should not light over the FREQUENCY SPAN/DIV range if the TIME/DIV selector is in the AUTO position.

MAX SPAN — When activated, the span switches to maximum and the analyzer sweeps the full band. When deactivated, the Span/Div returns to its previous setting.

ZERO SPAN — When activated, the span shifts to zero for a time-domain display. When deactivated, the span returns to its previous setting.

FREQUENCY SPAN/DIV — As this control is rotated, the Span/Div changes between 0 and Max, and the display indicates the change. The range of selections depends on the frequency band (see specifications in Section 2).

RESOLUTION BANDWIDTH — As this control is rotated from a full counterclockwise position, the resolution bandwidth changes in decade steps from 10 Hz to 1 MHz then to 3 MHz.

REFERENCE LEVEL — With 10 dB/DIV VERTICAL DISPLAY active and FINE off, the REF LEVEL readout steps in 10 dB increments as the control is rotated. When FINE is activated, the steps are 1 dB. In the 2 dB/DIV mode, the steps are 1 dB with FINE off and 0.25 dB with FINE active. When the Vertical Display factor is 4 dB/div or less with FINE on, the analyzer switches to the delta A mode. In the delta A mode, the REF LEVEL readout goes to 0.00 dB, then steps in 0.25 dB increments as the REFERENCE LEVEL control is rotated.

(a) Set the MIN RF ATTEN dB control to 0 dB and VERTICAL DISPLAY to 10 dB/DIV. Rotate the REFERENCE LEVEL control counterclockwise to 30 dBm, then clockwise to −110 dBm.

(b) The REF LEVEL readout changes in 10 dB increments.

(c) Press FINE, and change the setting of the REFERENCE LEVEL control. The REF LEVEL readout now steps in 1 dB increments.

(d) Press <SHIFT> dB/DIV and 4 dB with the DATA ENTRY pushbuttons, and the REF LEVEL readout goes to 0.00 dB. Rotate the REFERENCE LEVEL control. The REF LEVEL now steps in 0.25 dB increments from the 0.00 dB reference.

(e) Return the REF LEVEL readout to −20 dBm, and 10 dB of RF ATTENUATION is switched in.

MIN RF ATTEN dB — This control sets the minimum amount of RF attenuation in the signal path, regardless of the REFERENCE LEVEL control setting. To check operation, set the MIN RF ATTEN dB selector to 20 and change the REFERENCE LEVEL control settings. The RF ATTENUATION readout will not go below 20 dB.

FINE — When activated, the REFERENCE LEVEL control steps decrease. (Refer to the REFERENCE LEVEL check earlier in this section).

MIN NOISE/MIN DISTORTION — This pushbutton selects one of two methods that select RF attenuator and IF gain. MIN NOISE (button illuminated) reduces the noise level by reducing attenuation 10 dB and decreasing IF gain 10 dB. MIN DISTORTION reduces IM distortion due to input mixer overload.

(a) Set the FREQUENCY readout to 100 MHz, FREQ SPAN/DIV to 500 kHz, REF LEVEL readout to −20 dBm and MIN RF ATTEN dB to 0 dB. The RF ATTENUATION readout will indicate 0 dB.

(b) Activate MIN DISTORTION. The noise floor will rise drop approximately 1 dB, and the RF ATTENUATION readout will change to 10 dB.

(c) Deactivate MIN DISTORTION.

UNCAL — This indicator lights when the display is uncalibrated.

(a) Set the TIME/DIV control to 50 ms, deactivate AUTO RES, and set RESOLUTION BANDWIDTH to 10 kHz.

(b) The UNCAL indicator should light and remain lit until the FREQ SPAN/DIV readout is reduced to 200 kHz or the RESOLUTION BANDWIDTH is increased to 100 kHz.

(c) Return TIME/DIV control to AUTO, press AUTO RES, and set the FREQUENCY SPAN/DIV control to 100 MHz.

SHIFT — This pushbutton shifts multiple-function pushbuttons to their alternate function. The names of most of these alternate functions are printed in blue lettering next to the pushbutton. The shift mode deactivates after the function has been performed.

RECALL SETTINGS/STORE — When this pushbutton is pressed, the processor lists the settings, with their center frequency, that are stored in memory (registers 0–9). The 0 register holds the power-down settings so they can be recalled after power-up. Press <SHIFT> STORE to store the existing front-panel setup in one of the available registers.

(a) Press <SHIFT> STORE, and select register number 1 with the DATA ENTRY pushbuttons to store the current front-panel setup.

(b) Change front-panel pushbutton and control settings.

(c) Press RECALL SETTINGS, then DATA ENTRY 1 to recall the setup.

(d) The instrument front-panel set-up returns to that previously entered, with the exception of the Time/Div and RF Attenuation setting.

Δ F — When the delta F function is activated, FREQUENCY readout initializes to 0. The frequency difference, to a desired signal or point on the display, can be determined by tuning that point to center screen and noting the readout. Check by measuring the difference between calibrator harmonics. If the delta frequency is tuned below 0, the readout will include a minus sign.

TUNE CF/MARKER — When this pushbutton is activated, a Marker appears as a bright spot on the screen and the CENTER/MARKER FREQUENCY control tunes the Marker; the CENTER FREQUENCY readout remains constant. An asterisk (*) between the MARKER FREQUENCY and MKR LEVEL readout indicates that the CENTER/MARKER FREQUENCY control is tuning the Marker Frequency. The marker level and marker frequency appear on the 2nd readout line on the crt.

STEP ENTRY — Activate <SHIFT> STEP ENTRY to set the step to a desired amount. Perform the following steps while in the Tune Marker mode.

Press <SHIFT> STEP ENTRY and enter a step frequency of 10 MHz. Activate +STEP and note that the MARKER FREQUENCY readout is 160 MHz. Push −STEP to return the MARKER FREQUENCY setting to 150 MHz. Turn off the marker by pressing <SHIFT> MKR OFF.

+STEP/−STEP — When these pushbuttons are pressed, the marker or center frequency is increased or decreased by steps. Perform the following steps while in the Tune CF mode.

(a) Reduce the SPAN/DIV readout to 50 MHz, set the FREQUENCY readout to 100 MHz. Press <SHIFT> STEP ENTRY; enter 25 MHz with the DATA ENTRY pushbuttons. Press +STEP, the FREQUENCY readout will increase to 125 MHz. Press +STEP again, and the FREQUENCY readout will increase to 150 MHz.

(b) Push the −STEP pushbutton. The FREQUENCY readout will decrease to 125 MHz, and push −STEP again to return the FREQUENCY readout to 100 MHz.

EXT MIXER — If the spectrum analyzer is operating in the External Mixer mode, the peaking routine sets the external mixer bias to peak the mixer response. If a signal is not present, the algorithm reverts to the previous bias setting stored in memory; or, if there is no previous setting, it sets the bias voltage mid range. In the External Mixer mode the crt readout for RF ATTENUATION reads EXT. To exit this mode, press EXT MIXER again. The REF LEVEL automatically goes to +30 dBm and the RF ATTENUATION to 60 dB to protect the internal mixer from any high-level signals at the RF INPUT. Refer to the <SHIFT> PEAK MENU dicussion that follows for additional information and operation.

PEAK MENU — Press <SHIFT> PEAK MENU to select one of four peaking options.

- 0 – KNOB, for manual operation using the MANUAL PEAK control
- 1 – STORED VALUE
- 2 – INPUT
- 3 – REPEAK

If REPEAK is selected, any signal within one division on either side of thge marker is peaked. If the marker system is off, peaking occurs within one division of either side of center. The resulting peaking code is stored in memory and peaking switches to the STORED VALUE mode. If there is no signal to be peaked, the previous value is used.

If INPUT is chosen, a menu allows input of a peaking code with DATA ENTRY pushbuttons for the Primary marker frequency, or the center frequency if the marker system is off. After the value is input, the instrument switches to the Stored Value mode.

If STORED VALUE is selected, the instrument uses values from the automatic peaking routine or from user input to maintain peaking as the center frequency and frequency range are changed. In the 1.7–21 GHz bands, a peaking value is stored every 500 MHz. For external mixer peaking in the other bands, one value is stored per band. If no value was stored (either by REPEAK or INPUT), a mid-range value is used. After a setting has been stored, you can switch between preselector bands with the assurance that the preselector is peaked well enough to track the oscillator and provide reasonable sensitivity.

(a) With the calibrator signal applied to the RF INPUT, select a FREQUENCY of 2.0 GHz by pressing FREQUENCY 2.0 GHz with the DATA ENTRY pushbuttons. Select a REF LEVEL readout of −40 dBm SPAN/DIV readout of 10 kHz, and a RESOLUTION BANDWIDTH of 1 kHz.

(b) Peak the 2 GHz signal with the MANUAL PEAK control by pressing <SHIFT> PEAK MENU, and select item 0. The message PEAKING will appear on screen and the READY indicator for the SINGLE SWEEP mode will flash as the processor runs the auto-peak routine.

(c) Press <SHIFT> PEAK MENU and select item 3 to repeak the signal.

(d) When complete, the signal amplitude should equal or exceed that obtained with manual peaking.

(d) Change bands by pressing <SHIFT> BAND Δ or BAND ∇, then return to band 2. Auto peak will maintain the setting stored in memory.

(e) Press EXT MIXER, and the analyzer should shift to the External Mixer mode (indicated by a readout of EXT above RF ATTENUATION).

(f) If you have a voltmeter available, connect it between the EXTERNAL MIXER port and ground. Measure the bias voltage. If in the Auto Peak mode, the bias should be a steady dc voltage. (If Auto Peak has not been run for this band, the bias voltage will read approximately −1.25 V.)

(g) Switch to the manual peak mode by pressing <SHIFT> PEAK MENU, item 0. The bias voltage at the EXTERNAL MIXER port should now vary between approximately −2.5 V to +1.0 V as the MANUAL PEAK control is rotated through its range.

Following is an alternate procedure.

Remote bias or peak operation can be checked by using a Tektronix 4041 controller connected to the spectrum analyzer with a general purpose interface bus (GPIB) cable. Set the GPIB ADDRESS switches on the back panel of the spectrum analyzer to a value of 1, then enter and run the following program.

```
80  Z=1 ! ADDRESS OF SPECTRUM
    ANALYZER EQUALS 1
100 Print "ENTER VALUE ";
110 Input A$
120 Print #1:"PEAK ";A$
130 Go to 100
```

The program will wait until the value 0 to 1023 has been entered (the full range of the bias). If you have a problem, incorporate a SRQ handler.

```
80  Z=1 ! ADDRESS OF SPECTRUM
    ANALYZER EQUALS 1
90  On SRQ Then 140
100 Print "ENTER VALUE ";
110 Input A$
120 Print #1:"PEAK";A$
130 Go to 100
140 Poll A,B;1
150 Print "SRQ ";B
160 Return
```

(h) Enter the value 0, then 1023. With a voltmeter, measure the mixer bias for each value at the EXTERNAL MIXER port. The bias should equal the two extremes of the bias range (+1 to −2.5 V). Turn off the EXT MIXER.

Enter AUTO instead of a number. The spectrum analyzer will run an auto peak routine, and the word PEAKING will appear on screen during the routine.

MAC MENU — The <SHIFT> MACro MENU pushbutton sequence is used to select a macro to be run. The title of the macro is displayed next to the macro number (0–7). Perform the following steps to check out the operation of the MACro MENU pushbutton.

(a) With the instrument under remote control, enter the following 4041 test program to enter a macro into menu location 5.

CAUTION

THIS PROGRAM WILL DELETE ANY PROGRAM STORED IN MACRO LOCATION 5.

```
80 Z=1 ! ADDRESS OF SPECTRUM ANALYZER
100 Print #z:KILL 5
110 Print #z:STMAC 5,"return test"
120 Print #z:FREQ 100M;GOSUB 1
130 Print #z:FREQ 200M;GOSUB 1
140 Print #z:FREQ 300M;GOSUB 1
150 Print #z:DONE
160 Print #z:LABEL 1;SWEEP;MFBIG;MCSTOP;RETURN
170 Print #z:EMAC
```

Line 80 defines z as the spectrum analyzer address. Line 100 clears out location 5, in case there was already a macro there. Line 110 gets the spectrum analyzer ready to store macro in location 5 with the title of "return test". Line 120 sets the center frequency to 100 MHz then goes to line 160 to start a new sweep, move the primary marker to the peak of the largest on-screen signal, stop the macro to wait for you to press RUN/STOP on the instrument front panel to continue; and return to the next line. Lines 130 and 140 perform like line 120, only for 200 MHz and 300 MHz, respectively. Line 170 tells the spectrum analyzer that this is the end of the macro and to quit storing.

(b) Press RESET TO LOCAL to exit remote control and return the instrument to local control.

(c) Press <SHIFT> MAC MENU. The current macro menu will appear on the screen with the titles of all stored macros and the menu locations where they are stored.

(d) To select the test program just entered into location 5, press DATA ENTRY pushbutton 5. The macro will begin running.

(e) When the macro has moved the primary marker to the peak of the 100 MHz signal, the macro will wait (MCSTOP) for you to push RUN/STOP to run another sweep at 200 MHz.

(f) When the macro has moved the primary marker to the peak of the 200 MHz signal, the macro will wait (MCSTOP) for you to push RUN/STOP to run another sweep at 300 MHz.

(g) If you press RESET TO LOCAL at any time, the message MACRO-STOP(5), or MACRO-RUN, will appear on the right-center of the screen. This means that the macro in menu location 5 is now running, or stopped. This will have no effect on the performance of the macro.

(h) When the macro has moved the primary marker to the peak of the 300 MHz signal, the macro will know that it is done.

(i) If you press RESET TO LOCAL now, the message MACRO-OFF(5) will appear on the screen. This means that the last macro you were running was from menu location 5 and it is now off.

RUN/STOP — This pushbutton has three different functions, depending on the current status of the macros.

(a) If a macro is running, pressing RUN/STOP will stop the macro.

(b) If a macro is stopped (because RUN/STOP was pressed or because of the MCSTOP command as in the MACro MENU example), pressing RUN/STOP restarts the macro.

(c) If there is no macro running or stopped, pressing RUN/STOP will cause the last macro that was run to be run again.

RESET TO LOCAL — The RESET TO LOCAL pushbutton is lighted when the spectrum analyzer is under control of the GPIB controller. While under remote control, the other front-panel controls are not active, but indicators will still reflect the current state of all front-panel functions, except Time/Div, Peak/Average and RF Attenuation.

This pushbutton is not lighted when the spectrum analyzer is under local operator control. While under local control, the spectrum analyzer does not execute GPIB messages that would conflict with front-panel controls or change the waveforms in digital storage.

When the pushbutton is pressed, local control is restored to the operator unless the controller prevents this with the local lockout message. Programmable functions do not change when switching from remote to local control, except as necessary to match the settings of front-panel controls for TIME/DIV, MIN RF ATTEN dB, PEAKING, and PEAK/AVERAGE.

The internal instrument and macro status firmware version numbers and the GPIB address are flashed on the crt when the pushbutton is pressed. The GPIB primary address is updated if the GPIB ADDRESS switches have been changed.

For another function of this pushbutton when in the talk-only mode, refer to Talk-Only/Listen-Only Operation in Section 6 of this manual.

GPIB Function Readout — A single character appears in the lower crt readout when the spectrum analyzer is talking (T), listening (L), or requesting service (S). Two characters will appear in this location if the spectrum analyzer is talking or listening and also requesting service, or is in the talk/listen mode.

RECALL DISPLAY — Press RECALL DISPLAY, the register number from the displayed menu, and the part of digital storage (A or B) where you want to have the recalled waveform placed.

SAVE A is automatically activated to prevent an overwrite. If A is selected, VIEW A must be on to observe the recalled waveform and VIEW B must be off to see the readout that applies to the recalled waveform. If VIEW B and VIEW A are on, both the recalled waveform in A and the current waveform in B will be displayed. Readout will apply to the current B waveform.

If B is selected, the next sweep will overwrite the display unless SINGLE SWEEP was activated before selecting B; a message will appear on the screen as a reminder of this. VIEW B must be on to observe the recalled waveform and its readout. Remember to deactivate SINGLE SWEEP when leaving this recalled mode.

STORE — Press <SHIFT> STORE, the register number from the displayed menu, and the display you want stored.

(a) Establish a display on the screen. Press <SHIFT> STORE display, the memory register number (0–8) to place the display, and the display (A or B) you wish stored.

(b) Change the characteristics of the current display with either REFERENCE LEVEL or FREQUENCY SPAN/DIV control.

(c) Press RECALL DISPLAY, the register number where the display was stored (note the center frequency listing of the stored displays in each register), then VIEW A so the recalled waveform is placed in the A part of digital storage.

(d) If VIEW A is on and VIEW B off, the recalled display with its readout will now become the A display. SAVE A will activate to prevent overwrite. If VIEW A and VIEW B are on, both the recalled display and the current B display will be on screen. Since the most current display is the B waveform, the readout will show the parameters for the B display. Switch VIEW B off to see the readout applicable to the recalled A waveform.

(e) Recall a stored display into the B section by repeating the process in step d. Before starting the process, press SINGLE SWEEP so the recalled waveform will not be overwritten by the next sweep; a message will appear when you select the B section to remind you of this.) Remember to deactivate SINGLE SWEEP when returning to normal operation.

NOTE

If an attempt is made to recall a display from an empty location, error message NVRAM CHECKSUM ERROR will be issued.

MKR OFF — Press <SHIFT> MKR OFF to turn off the markers.

MKR → CF — Press <SHIFT> MKR → CF to bring a marker signal to center screen.

(a) Set the REF LEVEL readout to −20 dBm, FREQUENCY readout to 100 MHz. Set FREQ SPAN/DIV to 200 kHz, and VERTICAL DISPLAY to 10 dB/DIV; set RESOLUTION BANDWIDTH to 100 kHz.

(b) Tune the signal off center, activate TUNE MKR. Tune the Marker to the top of the signal and press <SHIFT> MKR → CF. The signal should move to center screen.

BAND Δ/BAND ∇ — These <SHIFTed> pushbuttons shift the frequency range up or down from the current band. Press one and then the other and the frequency bands will change accordingly. If the frequency is selected from the DATA ENTRY pushbuttons, the spectrum analyzer automatically selects the appropriate frequency range.

READOUT — Press READOUT to turn off the crt readout of the markers, REF LEVEL, FREQUENCY, SPAN/DIV, VERTICAL DISPLAY, RF ATTENUATION, FREQ RANGE, RESOLUTION BANDWIDTH, and VIDEO FILTERS. Press READOUT to reactivate the readout on the display.

START STOP — Activating START STOP allows you to enter a start and stop frequency within the selected band with the DATA ENTRY pushbuttons.

(a) Enter a start frequency of FREQUENCY 90 MHz with the DATA ENTRY pushbuttons. Enter stop frequency 210 MHz.

(b) The signals at the 1st and 9th graticule line should be 100 MHz apart. Set the VERTICAL DISPLAY to 10 dB/DIV, and observe that the SPAN/DIV readout is 12 MHz.

BASELINE CLIP — Press BASELINE CLIP to clip (blank) the baseline of the display up to about one graticule division.

RESET — Press <SHIFT> RESET to return the instrument to the original power-up state.

REF LEVEL UNITS — Disconnect the calibrator signal from the RF INPUT, and change the REF LEVEL readout to 0 dBm. Press <SHIFT> REF LEVEL UNITS. Select item 1, and note the REF LEVEL readout change to −13dBV. Select item 2, and note the REF LEVEL readout change to 47 dBmV. Select item 3, and note the REF LEVEL readout change to 107 dBμV. Press 0 to return the readout to 0 dBm. Reconnect the calibrator signal to the RF INPUT.

Markers — The markers provide direct readout of frequency and amplitude information of any point along any displayed trace or relative (delta frequency) and amplitude information between any two points along any displayed trace or traces (in delta only). In the delta mode, only the difference in frequency and amplitude will be displayed. Two independent marker frequencies and amplitudes cannot be displayed at the same time.

With the FREQUENCY readout at 100 MHz, a REF LEVEL readout of −10 dBm, and a FREQ SPAN/DIV of 5 MHz, press TUNE CF/MARKER. A bright dot, the marker, appears on screen, as well as a second line of readout with an asterisk between the REF LEVEL and FREQUENCY readout. Turn the CENTER/MARKER FREQUENCY knob, and note that the marker tunes.

Press TUNE CF/MARKER again, the indicator button will not be lit but the marker remains on screen. When the CENTER/MARKER FREQUENCY knob is rotated now, the marker does not move, but both the Center Frequency and the Marker Frequency change. Also, the asterisk has now moved to the first readout line to indicate that the center frequency is being tuned.

Return the FREQUENCY readout to 100 MHz, and press TUNE CF/MARKER to activate the marker.

FIND PEAK MAX — Press FIND PEAK MAX to move the marker to the top of the signal.

Δ MKR, 1→MKR→2, MKR START STOP, MKR → REF LEVEL — Press Δ MKR to activate a second marker at the position of the single marker on the trace. Parentheses will be added to the second line readout.

(a) Rotate the CENTER/MARKER FREQUENCY control; two markers will be on screen. Set the delta marker readout to 5 MHz.

(b) Press 1→MKR→2. The left marker is now brighter as an indication that it is being tuned. Tune the marker until the readout shows −10 MHz, which is the difference in frequency between the two markers (the delta marker frequency).

(c) Press <SHIFT> MKR START STOP. The markers now appear at the left and right edge of the screen. The waveform will be "zoomed in".

(d) Press Δ MKR again, there will be just a single marker now, and the parentheses around the second line of readout will disappear.

(e) Press FIND PEAK MAX, then <SHIFT> MKR→CENTER. The signal is now at center screen.

(f) Press <SHIFT> MKR→REF LEVEL, the signal and the marker will now be a the top of the screen.

(g) Reduce the FREQ SPAN/DIV readout to 500 kHz, and set the RESOLUTION BANDWIDTH to 1 MHz.

(h) Press <SHIFT> dB BW, and enter 10 with the DATA ENTRY pushbuttons. Observe that the Delta MKRs have moved down 10 dB from the top of the signal. Delta frequency is a little over 1 MHz wide. Press <SHIFT> dB BW again.

(i) Press <SHIFT> MKR OFF, and using the DATA ENTRY pushbuttons, set the FREQUENCY readout to 200 MHz and the FREQ SPAN/DIV readout to 25 MHz. Set the Peak/Average cursor to the bottom of the screen. Press TUNE CF/MKR.

(j) Press FIND PEAK MAX. The marker will now be positioned on the 100 MHz calibrator signal (the left-most tall signal of the three signals on screen).

(k) Press FIND PEAK ↑. The marker will move to the 300 MHz calibrator harmonic. Press the FIND PEAK ↑ pushbutton one more time; the marker will move to the 200 MHz calibrator harmonic. Press FIND PEAK ↓ twice to return the marker to the original 100 MHz signal. Press TUNE CF/MKR to turn the marker off.

SIGNAL TRACK — Press the SIGNAL TRACK to keep a drifting signal on screen.

(a) Set the REF LEVEL readout to −20 dBm, the FREQUENCY readout to 100.000 MHz, the SPAN/DIV readout to 5 kHz. Push the VERTICAL DISPLAY 10 dB/DIV pushbutton, and the RESOLUTION BANDWIDTH to 1 kHz. The signal should be on screen.

(b) Press the SIGNAL TRACK. The TUNE MKR lights and the signal will be moved back to center screen. Signal Track will be indicated in the marker readout on the crt.

(c) To deactivate the function, press SIGNAL TRACK again.

2. Check Gain Variation Between Resolution Bandwidths

(± 0.4 dB with respect to the 3 MHz filter and less than 0.8 dB between any two filters)

a. Calibrate the Center/Marker Frequency, Reference Level, and Bandwidth as described earlier in this section.

b. Set the FREQUENCY readout to 100 MHz by pressing FREQUENCY 1 0 0 MHz with the DATA ENTRY pushbuttons. Set the FREQUENCY SPAN/DIV control to 1 MHz, the RESOLUTION BANDWIDTH to 3 MHz, the REFERENCE LEVEL control to −20dBm, TIME/DIV to AUTO, and activate AUTO RESolution.

c. Apply 100 MHz markers from the CAL OUT connector to the RF INPUT. Set the Vertical Display factor to 1 dB/DIV by pressing <SHIFT> dB/DIV 1 dB.

d. Verify that the amplitude of the 100 MHz signal is at the top graticule line. If not, repeat the front-panel calibration procedure by pressing <SHIFT> CAL.

e. Change the REF LEVEL readout to −19 dBm, and activate SAVE A. This is the reference for checking the other filters.

f. Change the RESOLUTION BANDWIDTH to 100 MHz.

g. Check the amplitude of the 100 MHz signal. It should be within 0.4 dB of the 3 MHz reference established in part e.

h. Set the RESOLUTION BANDWIDTH control to each of the remaining positions and the FREQ SPAN/DIV readout for a readable display. The amplitude accuracy and frequency can now be checked with respect to the 3 MHz reference and between any two filters. Reference level error should not exceed 0.4 dB from the reference and 0.8 dB between any filter.

i. Turn SAVE A off.

3. Check Counter Accuracy

(within (5 + N)Hz + 1 count)

Press COUNT to activate a count for any signal at the center or marker, or below the dot marker. The signal to be counted must be 20 dB above the noise floor and within 60 dB of the reference level. The resolution of the counter is selected when in the Count Resolution mode.

a. With the calibrator signal applied to the RF INPUT, set the crt readout for FREQUENCY to 100 MHz, FREQ SPAN/DIV to 500 kHz, and REF LEVEL to 0 dBm, and set TIME/DIV to AUTO.

b. To select 1 Hz counter resolution, press <SHIFT> CNT RES, and enter 1 Hz with the DATA ENTRY pushbuttons.

c. Press COUNT. The counter error over several counts should not exceed ±7 Hz (10.000 07 to 9.999 993).

d. Change the FREQ SPAN/DIV to 200 kHz and repeat part c.

e. Select a counter resolution of 1 kHz and repeat the count accuracy check as described above. Counter error should not exceed ±1 kHz.

f. Press VIDEO FILTER NARROW and set CENTER FREQUENCY to one of the calibrator markers at the high end of the band (1.6 to 1.8 GHz). Signal amplitude must equal or exceed 20 dB above the noise floor.

g. Repeat the count accuracy check as described above.

4. Check Span Accuracy and Linearity

Span accuracy is the displacement error of calibrator markers from the center reference over ±4 major divisions of span. Linearity accuracy is determined by the displacement of calibrator frequency markers from their specified positions over the center eight divisions of the display area, using the 1st graticule line as the reference.

a. Set the FREQUENCY readout to 500 MHz, the FREQUENCY SPAN/DIV control to 100 MHz, the REF LEVEL readout to −20 dBm, and activate AUTO RESolution. Change the VERTICAL DISPLAY to 10 dB/DIV.

b. Span is accurate when the 100 MHz markers are within 5% of their reference graticule line over the center eight divisions. (It may be easier to observe the markers with DIGITAL STORAGE off.)

c. Tune CENTER/MARKER FREQUENCY to align one of the markers at the 1st graticule line from the left edge.

d. Linearity is accurate when the displacement of successive markers, over the center eight divisions, does not exceed 5% of 100 MHz (the FREQ SPAN/DIV setting) or 0.2 division.

5. Check Resolution Bandwidth and Shape Factor

(bandwidth is within 20% of the selected bandwidth for all but the 10 Hz filter. Shape factor is 7.5:1 for all but the 10 Hz filter. 60 dB Bandwidth for the 10 Hz filter is ⩽150 Hz.).

a. With the Calibrator output applied to the RF INPUT and the FREQUENCY readout at 100 MHz, set the REFERENCE LEVEL control to −20 dBm, the FREQ SPAN/DIV control to 500 kHz, RESOLUTION BANDWIDTH to 1 MHz, TIME/DIV at AUTO, VERTICAL DISPLAY to 2 dB/DIV.

b. Measure the 6 dB down bandwidth (see Figure 5-4A). Bandwidth should equal 1 MHz, ±200 kHz.

c. Change VERTICAL DISPLAY to 10 dB/DIV, and measure the 60 dB down bandwidth (see Figure 5-4B).

d. Calculate the shape factor as the ratio of −60 dB/−6 dB bandwidths (see Figure 5-4). Shape factor should equal 7.5:1 or less.

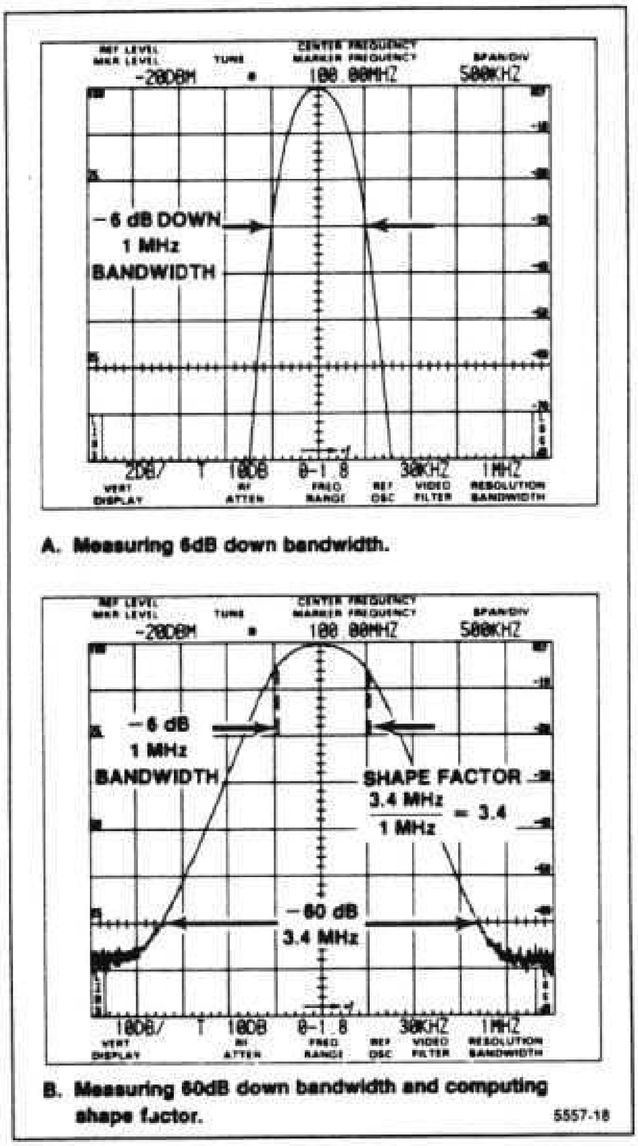
e. Change the RESOLUTION BANDWIDTH setting to 100 kHz and the FREQ SPAN/DIV to 100 kHz.

f. Check the resolution bandwidth and shape factor of the 100 kHz filter by repeating the above process.

g. Repeat the process to check the resolution bandwidth and shape factor for the 10 kHz, 1 kHz, 100 Hz and 10 Hz filters. Shape factor should equal 7.5:1 for all but the 10 Hz filter.

h. To check the 60 dB bandwidth of the 10 Hz filter, set the Span/Div to 50 Hz, and the REFERENCE LEVEL to −20 dBm. Push AUTO RES, VIDEO FILTER WIDE, and set PEAK/AVERAGE to Average.

i. Check that the 60 dB bandwidth is ⩽150 Hz.



A. Measuring 6dB down bandwidth.

B. Measuring 60dB down bandwidth and computing shape factor.

Figure 5-4. Displays that illustrate how bandwidth and shape factor are determined.

6. Check Reference Level Gain and RF Attenuator Steps

a. With the Calibrator signal applied to the RF INPUT and the FREQUENCY readout set to 100 MHz, set the FREQ SPAN/DIV and RESOLUTION BANDWIDTH controls to 100 kHz. Set VERTICAL DISPLAY to 10 dB/DIV, REF LEVEL readout to −20 dBm, and activate MIN NOISE and NARROW VIDEO FILTER.

b. To check the attenuator, increase REF LEVEL readout to +40 dBm; the signal peak will decrease 1 major division per 10 dB step of the RF ATTENUATION.

c. Set FREQUENCY readout to 200 MHz and the REFERENCE LEVEL control to −20 dBm.

d. Increase the MIN RF ATTEN dB to 60 dB; the noise level will increase 1 division for each 10 dB step.

e. To check IF gain steps, switch REFERENCE LEVEL control between −20 dBm and +40 dBm. The noise level will decrease 1 division per step.

f. Activate FINE; then, check that the trace rises 1 dB/step of the reference level as it is changed to +30 dBm.

g. Switch FINE off, and reduce MIN RF ATTEN setting to 0.

h. Switch MIN NOISE off; the noise floor will rise about 1 division as the RF ATTENUATION increases 10 dB. REF LEVEL readout should not change.

i. Change REF LEVEL to −60 dBm, and switch VERTICAL DISPLAY to 2 dB/DIV. Adjust REF LEVEL so the signal level is near the top graticule line.

j. Change the REFERENCE LEVEL control; the signal amplitude will change in 1 dB increments (0.5 div).

k. Set VERTICAL DISPLAY readout to 1 dB/DIV with the <SHIFT> dB/DIV 1 dB with the DATA ENTRY pushbuttons.

l. Change the REFERENCE LEVEL control positions; the REF LEVEL readout will change in 1 dB steps, and the display in 1 division steps.

m. Activate FINE (Delta A mode). The REF LEVEL now reads 0.00 dB, which denotes the Delta A mode.

n. Change the REFERENCE LEVEL control positions; the REF LEVEL readout will change in + or − 0.25 dB increments.

o. Deactivate FINE. Change the VERTICAL DISPLAY to 10 dB/DIV and the REF LEVEL readout to −20 dBm.

7. Check Sensitivity (refer to Table 5-1)

NOTE

Sensitivity is specified according to the input mixer average noise level. The calibrator signal is the reference used to calibrate the display.

a. Remove the calibrator signal from the RF INPUT. Set VERTICAL DISPLAY to 10 dB/DIV, REF LEVEL readout to −30 dBm, FREQ SPAN/DIV readout to 5 MHz, the RESOLUTION BANDWIDTH control to 1 MHz, the TIME/DIV control at 1 second. Adjust the PEAK/AVERAGE cursor so it is off the top of the screen, and activate the WIDE VIDEO FILTER.

b. The noise floor (level) should be at least −80 dBm (as indicated in Table 5-1) or five divisions down from the REF LEVEL readout of −30 dBm.

c. Change the REFERENCE LEVEL control to −40 dBm, the FREQUENCY SPAN/DIV control to 1 MHz, and the RESOLUTION BANDWIDTH control to 100 kHz.

d. The noise floor should be at least −90 dBm (refer to Table 5-1).

e. Change the REFERENCE LEVEL control to −60 dBm, the FREQUENCY SPAN/DIV to 10 kHz, the TIME/DIV control to AUTO and the RESOLUTION BANDWIDTH control to 1 kHz.

f. Check that the average noise level for the 1 kHz resolution bandwidth is as listed in Table 5-1.

g. Change REFERENCE LEVEL control to −70 dBm, the FREQUENCY SPAN/DIV control to 200 Hz, and RESOLUTION BANDWIDTH control to 100 HZ.

h. Check that the noise level for the 100 Hz resolution bandwidth is as listed in Table 5-1.

i. Repeat this procedure for the remaining coaxial input frequency range (0–21 GHz). If desired, the waveguide band sensitivity can be checked against the figures listed in Table 5-1. The 50 GHz to 140 GHz numbers are typical and should not be used as a performance requirement.

NOTE

Table 5-1 shows the equivalent maximum input noise (average noise) for each resolution bandwidth with internal mixer and Tektronix High Performance Waveguide Mixers.

Table 5-1

SENSITIVITY

		Equivalent Input Noise (dBm) versus Resolution Bandwidth						
Band	Frequency	10 Hz	100 Hz	1 kHz	10 kHz	100 kHz[a]	1 MHz	3 MHz
Band 1	10 kHz–1.8 GHz	−134	−125	−115	−105	−95	−85	−80
Bands 2 and 3	1.7–7.1 GHz	−125	−119	−109	−99	−89	−79	−74
Band 4	5.4–12 GHz	−111	−105	−95	−85	−75	−65	−60
Bands 4 and 5	12–21 GHz	−107	−100	−90	−80	−70	−60	−55
Band 6[b]	18–27 GHz	−116	−108	−100	−90	−80	−70	−65
Band 7[b]	26–40 GHz	−111	−103	−95	−85	−75	−65	−60
Band 8[b]	33–60 GHz	−111	−103	−95	−85	−75	−65	−60
Band 9[b]	50–90 GHz	Typically −95 dBm for 1 kHz resolution bandwidth at 50 GHz, degrading to −85 dBm at 90 GHz						
Band 10[b]	75–140 GHz	Typically −90 dBm for 1 kHz resolution bandwidth at 75 GHz, degrading to −75 dBm at 140 GHz						
Band 11[b]	110–220 GHz	Typically −80 dBm for 1 kHz resolution bandwidth at 110 GHz, degrading to −65 dBm at 220 GHz						
Band 12[b]	170–325 GHz	Typically −70 dBm for 1 kHz resolution bandwidth at 170 GHz, degrading to −55 dBm at 325 GHz						

[a]Option 07 replaces the 100 kHz filter with a 300 kHz filter.

[b]Specified using external Tektronix High-Performance Waveguide Mixers.

8. Check Residual FM

(within 7 kHz over 20 ms, with FREQ SPAN/DIV greater than 200 kHz for bands 1 and 5–12 or greater than 100 kHz for bands 2–4, and within 12 Hz over 20 ms, with FREQ SPAN/DIV of 200 kHz or less for bands 1 and 5–12 or 100 kHz or less for bands 2–4)

a. With the calibrator signal applied to the RF INPUT, set the FREQUENCY readout to 100 MHz, the FREQ SPAN/DIV readout to 1 MHz, the RESOLUTION BANDWIDTH control to 100 kHz, VERTICAL DISPLAY to 2 dB/DIV, and the REFERENCE LEVEL readout to −23 dBm.

b. Press <SHIFT> 7. A message will appear on the screen to indicate that the 1st LO synthesis and phase lock are disabled. This is normal. It is now possible to switch the FREQUENCY SPAN/DIV control to narrower spans with the 1st LO phase lock disabled.

c. Decrease the FREQUENCY SPAN/DIV and RESOLUTION BANDWIDTH settings to 10 kHz. Keep the 100 MHz calibrator signal centered on the screen with the CENTER/MARKER FREQUENCY control.

d. Switch the VERTICAL DISPLAY to LIN. Position the signal so the slope (horizontal versus vertical excursion) of the response can be determined (see Figure 5-5A). It may help to determine slope by using SINGLE SWEEP and SAVE A to freeze the display at a convenient point on the graticule for measurement, as shown in Figure 5-5A; this will allow you to find the Hz/division.

e. If SINGLE SWEEP and SAVE A where used in part d, deactivate SAVE A and SINGLE SWEEP. Push ZERO SPAN, set the TIME/DIV setting to 20 ms, and adjust the CENTER/MARKER FREQUENCY control to position the display near center screen as shown in Figure 5-5B. Use SINGLE SWEEP and SAVE A to freeze the display for ease in measuring the FM (frequency modulation). Using the value determined in step d, measure the FM. The peak-to-peak amplitude of the display measured over any 20 ms interval is the FM.

f. Press <SHIFT> 7 to re-enable the phase lock, and set the FREQUENCY readout to 100 MHz. Switch the TIME/DIV setting to AUTO, and reduce the FREQUENCY SPAN/DIV to 200 Hz and RESOLUTION BANDWIDTH settings to 100 Hz.

g. Adjust the CENTER/MARKER FREQUENCY control to position the signal so its slope can be determined. It will be easier if you use SINGLE SWEEP and SAVE A to freeze the display at a convenient position on the graticule.

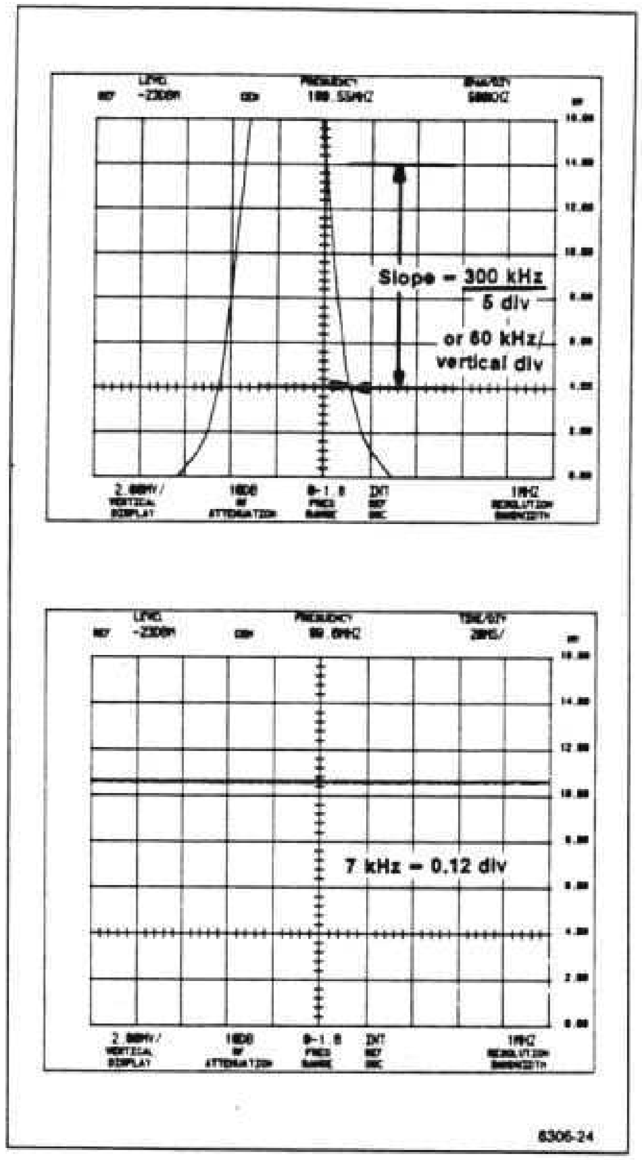


Figure 5-5. Typical display showing how to determine residual FM.

h. Deactivate SAVE A and SINGLE SWEEP, and switch the TIME/DIV control to 20 ms. Activate ZERO SPAN, and position the display near center screen so the vertical excursions per horizontal division (20 ms) can be measured. Residual FM must not exceed 12 Hz.

9. Check Frequency Drift or Stability

(50 Hz or less, when the FREQ SPAN/DIV is 200 kHz or less, after 1 hour of warmup, and within a stable ambient temperature)

a. With the Calibrator signal applied to the RF INPUT, set the FREQUENCY readout to 100 MHz, the TIME/DIV control to AUTO, the FREQUENCY SPAN/DIV control to 200 Hz, the RESOLUTION BANDWIDTH control to 100 HZ, VERTICAL DISPLAY to 2 dB/DIV, and the REFERENCE LEVEL control to −23 dBm. Switch VIEW A and VIEW B on.

b. Adjust the CENTER/MARKER FREQUENCY control so one side of the signal intersects the sixth division graticule line from the left edge. Press SINGLE SWEEP, and activate SAVE A to save the display.

c. Select the NARROW VIDEO FILTER, and press SINGLE SWEEP again to start the sweep. The sweep will now run at a 10 s/div rate.

d. Note the frequency difference between the two displays at the sixth graticule line. Label this difference Δf.

e. Δf must not be more than 50 Hz.

10. GPIB Verification Program

The Service Manual, Volume 1, contains a GPIB verification program. If you wish to check the operation of the GPIB interface, request the program from service personnel.

OPERATION

This section describes the normal operating features of the spectrum analyzer. Many instrument features and operating modes are described, and examples are included to show some typical applications.

INSTRUMENT OPERATING FEATURES

Firmware Version and Error Message Readout

Refer to Section 5 for information.

Crt Light Filters

The instrument comes equipped with a gray light filter. In addition, three filters are supplied as standard accessories: amber and blue light filters and a mesh filter with EMI shielding. Select the filter that best suits the surrounding light conditions, light reflections, and your viewing needs. To install the filter, pull the top of the plastic mask out and place the filter behind it. Remove the light filter when taking display photographs.

Intensity Level and Beam Alignment

Operate the instrument with the intensity level no higher than that required to clearly see the display. Trace alignment and beam focus are internal adjustments that must be performed by qualified service personnel.

The required intensity level for some displays may be high enough to produce a bright and flared baseline. This bright baseline can be eliminated (clipped) with the BASELINE CLIP pushbutton. BASELINE CLIP is useful when photographing displays, and it also allows the lower readout characters to be more easily viewed. When the markers are turned on, set the intensity below the level where dot "blooming" or defocusing occurs.

Signal Application

Signal frequencies to 21 GHz can be applied through a short, high-quality, 50 Ω coaxial cable to the RF INPUT connector. These signals pass through an internal RF attenuator to the 1st mixer. The instrument automatically selects either a low-pass filter or tuned preselector (depending on frequency range) between the RF attenuator and the 1st mixer.

An external mixer can be used (not applicable to instruments with Option 07 or Option 08 installed) by connecting it through the diplexer (optional accessory) to the EXTERNAL MIXER port. Signals from the external mixer by-pass the internal RF attenuator, preselector, and 1st mixer. External mixers above 21 GHz, and their applications, are described in detail later in this section.

I RF INPUT Connector

The nominal input impedance of the coaxial RF INPUT is 50 Ω, and 75 Ω on the optional 75 Ω INPUT (Option 07). Because cable losses can be significant at microwave frequencies, it is important to keep the cables as short as possible. Impedance mismatch between the signal source and the RF INPUT will produce reflections that degrade flatness, frequency response, and sensitivity and may increase spurious responses. Impedance mismatch can be caused by poor connections, incorrect signal source impedance, and long or low-quality coaxial cable. When optimum flatness or frequency response is desired and signal strength is adequate, set the MIN RF ATTEN dB control to 10 dB or more. The addition of the attenuator helps minimize reflections to improve the input characteristics.

CAUTION

The front end of the spectrum analyzer is specified at +30 dBm maximum. It is possible to set the reference level to +50 dBm with MIN NOISE and reduced gain mode activated. If the signal level is increased for a full-screen display, the input level will exceed the power rating of the attenuator. Do not apply any dc potential to the RF INPUT. Use a dc block if a signal is riding on any dc potential. For dc block ordering information, see the Optional Acessories in the Service Manual, Volume 2, or contact your local Tektronix Field Office or representative.

Spurious responses can be minimized if the signal amplitude is kept within the graticule window. A recommended procedure is to select a reference level setting that limits stronger signals to the graticule window.

High-level signals can cause compression (refer to the input compression specification in the Input Signal Characteristics table in the Specification section of this manuals). Excessive high-level signals (above +30 dBm) may destroy the 1st mixer or attenuator. Signals above

+30 dBm must be reduced by external attenuators. Ensure that the frequency range of any external attenuator is adequate.

Line impedance stabilizing networks, used for conducting EMI/RF measurements, will often have several volts of 60 Hz signal at the output. To protect the input mixer, use a dc block (refer to the Service Manual, Volume 2, or your local Tektronix Field Office or representative for ordering information). It is important to be sure that all equipment being tested has power applied through the line stabilizing networks before any RF signal is connected to the spectrum analyzer input.

Connecting to a 75 Ω Source — Signals from a 75 Ω source, at the lower frequencies (1 MHz to 1 GHz), can be applied directly to the 75 Ω INPUT if Option 07 is installed or to the RF INPUT by using a 75 Ω-to-50 Ω minimum loss attenuator (refer to the Tektronix catalog or your local field office or representative for ordering information). A circuit diagram of a suitable matching pad for this purpose is shown in Figure 6-1.

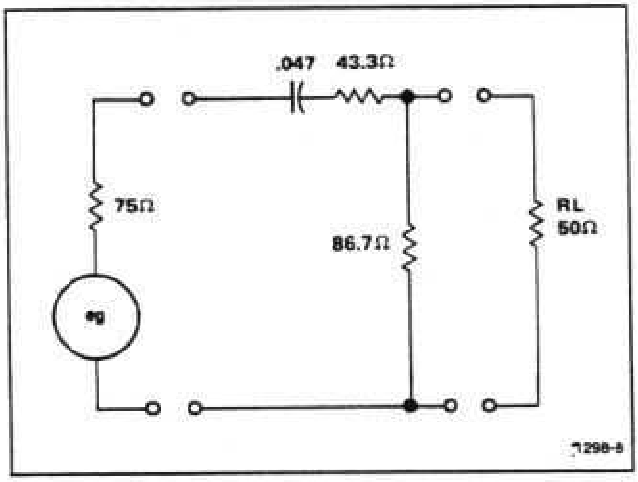


Figure 6-1. Circuit of a 75 to 50 Ω matching pad (ac coupled).

Sensitivity and power levels are often rated in dBm (dB with reference to 1 mW regardless of impedance). Sensitivity and power levels for 75 Ω systems are usually rated in dBmV (dB with reference to 1 mV across 75 Ω). Figure 6-2 shows the relationship between 50 Ω and 75 Ω units with matching attenuators included. The conversion to alternate reference level units is listed below for 75 Ω and is shown in Table 6-1 for 50 Ω.

1. dBmV (75 Ω) = dBm (50 Ω) +54.47 dB:
e.g. −60 dBm (50 Ω) + 54.47 dB = −5.5 dBmV (75 Ω).
2. dBm (75 Ω) = dBm (50 Ω) +5.72 dB:
e.g. −60 dBm (50 Ω) + 5.72 dB = −54.3 dBm (75 Ω).

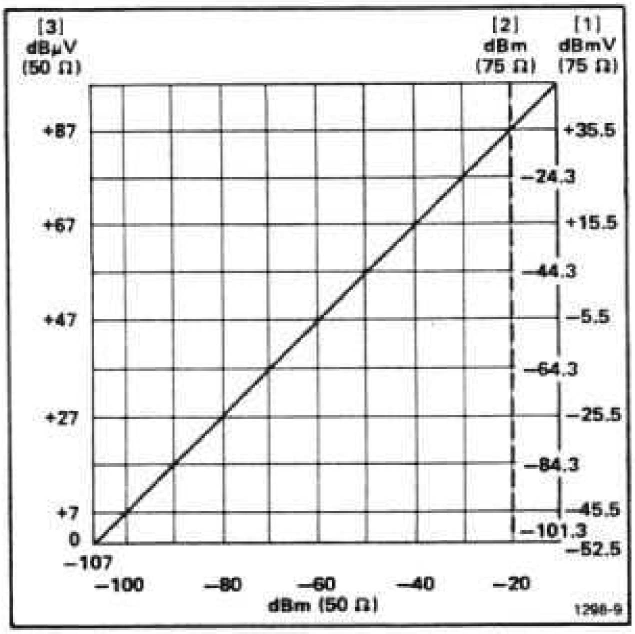


Figure 6-2. Graph illustrating the relationship between dBm, dBmV, and dBμV (matching attenuator included where necessary). When the alternate 75 Ω input is used, the reference level readout is correct for any units without additonal conversions.

Input Networks and Reference Level Offset — If the measurement system includes any matching pads, attenuators, amplifiers, or other input networks, use the reference level offset feature of the spectrum analyzer to compensate for the network. If the gain or loss through the network is entered as an offset, the reference and marker levels will apply to the input of the network rater than to the input of the instrument. Enter attenuation as a postive offset, and enter gain as a negative offset. Some networks have a different offset in the linear (voltage) mode than in the log (power) mode. For example, the matching pad shown in Figure 6-1 has a power attenuation of 5.72 dB, but a voltage attenuation of 7.48 dB. (Strictly speaking, the voltage loss in dB is meaningless between points with different impedance. However, 7.48 dB (7.5 dB) is the offset value needed in the linear mode for the reference and marker levels to be those at the input to the pad.) For more information, see Reference Level Offset later in this section.

Table 6-1
50 Ω SYSTEM REFERENCE LEVEL CONVERSION

To / From	dBm	dBmV	dBμV
dBm	0	+47	+107
dBmV	−47	0	−60
dBμV	−107	+60	0

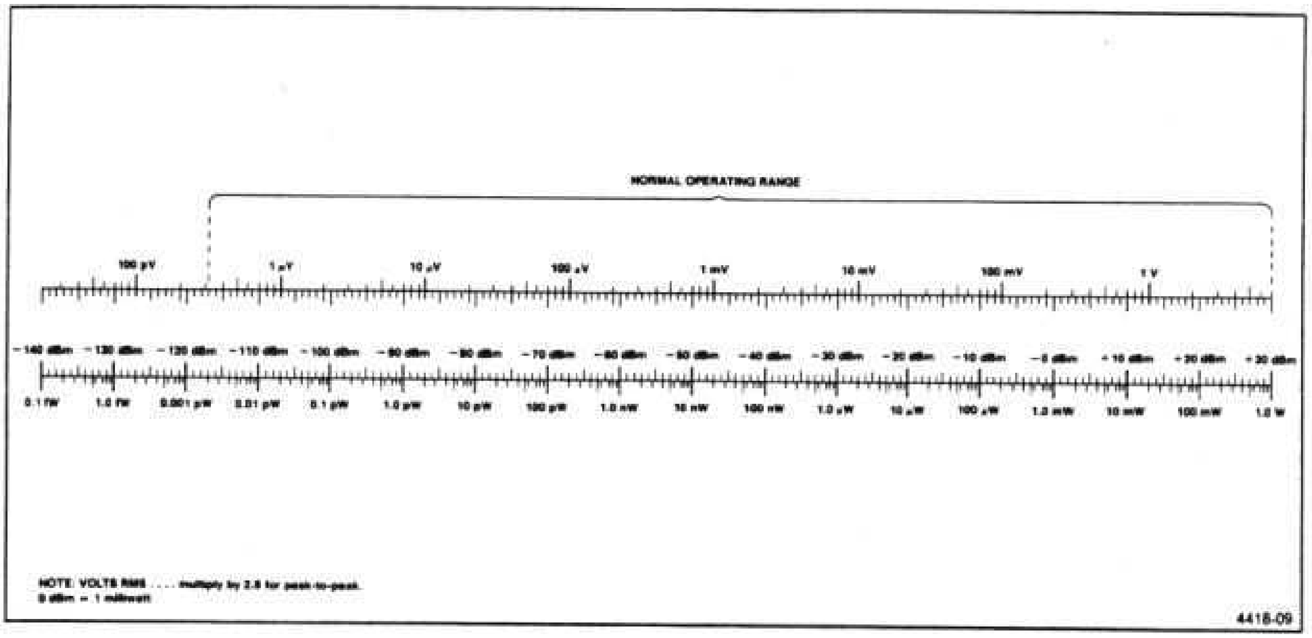


Figure 6-3. Volts-dBm-Watts conversion chart for 50 Ω impedance.

Amplitude Conversion — A conversion chart, as shown in Figure 6-3, can be used to convert input signal levels of voltage or power to dBm, dBV, dBmV, and dBμV.

Resolution Bandwidth, Frequency Span, and Sweep Time

Resolution is the ability of the spectrum analyzer to display discrete frequency components within a frequency span. This ability is a function of the instrument bandwidth, sweep time, frequency span, and incidental FM. Bandwidth also has an effect on the noise level. As the bandwidth decreases, the sensitivity increases so maximum sensitivity is attained with the narrow resolution bandwidths.

As the spectrum analyzer sweep rate is increased, a critical rate is reached where both sensitivity and resolution are degraded. Therefore, sweep time for a calibrated display is dependent on the resolution bandwidth and frequency span.

In MAX SPAN, the display represents the full frequency range of a band. The frequency readout on the crt is indicated on the display by a frequency dot if markers are off or by the primary marker if markers are turned on. This frequency point will shift to center screen when the FREQ SPAN/DIV is reduced to some setting other than MAX. The frequency span/division setting depends on the particular measurement application. Wide spans are usually used to monitor a frequency spectrum for spurious signals, or check harmonic content. When wide spans are used for non-digital store displays, the sweep rate is usually set for minimum flicker, which requires wider resolution bandwidths to maintain a calibrated display. Narrow spans are used to analyze the characteristics about or near a particular signal, such as modulation side bands, bandwidth, or power line related distortion. Slow sweep rates are required when using narrow spans and narrow resolution to observe signal phenomena.

The spectrum analyzer will select the sweep rate and resolution bandwidth so the display remains calibrated for the selected frequency span/division, if TIME/DIV is in the AUTO position and AUTO RES is on. AUTO RES optimizes bandwidth for the selected FREQ SPAN/DIV and TIME/DIV settings unless either is outside the range of calibration. When this occurs, UNCAL lights and a > symbol prefixes the REF LEVEL and MKR LEVEL readout on the crt display.

To analyze pulsed signals, a wider bandwidth than that provided by the automatic feature is usually required. Set RESOLUTION BANDWIDTH to approximately 1/10 the side lobe frequency width or the reciprocal of the pulse width, if known, in order to ensure adequate bandwidth. The resolution bandwidth is usually set for optimum main lobe detail after the sweep rate has been selected.

Using the MANUAL PEAK Control or Automatic Peaking

The MANUAL PEAK control sets the bias voltage out of the EXTERNAL MIXER port or sets the internal preselector tracking for the 1.7–21 GHz bands. There are four methods of peaking operation for the instrument. The methods are KNOB, STORED VALUE, INPUT, and REPEAK, and they can be selected from the Auto-Peak Menu by activating <SHIFT> PEAK MENU.

KNOB — The front-panel MANUAL PEAK control is selected. It should be adjusted for maximum signal amplitude or optimum conversion. This is the active peaking mode when the instrument is first turned on.

STORED VALUE — A previously-stored peaking value is selected for the frequency. In the Stored Value mode, the instrument uses values from the automatic peaking routine (REPEAK) or from user input (INPUT) to maintain peaking while the center frequency and frequency range are changed. In the 1.7–21 GHz bands (bands 2–5) with the internal preselector, a peaking value is stored approximately every 500 MHz. For external mixer peaking, one value is stored per band. If no value was stored (either by REPEAK or INPUT), a mid-range value of 512 is used. The stored values are maintained in memory even when power to the instrument is turned off.

INPUT — A number from the peaking code, which is 0 (fully counterclockwise) to 1023 (fully clockwise), is selected for the stored value. When INPUT is selected, a menu appears that allows input of a peaking code of the Primary marker frequency, or the center frequency if the marker system is off. After the value is input, the instrument switches to the Stored Value mode.

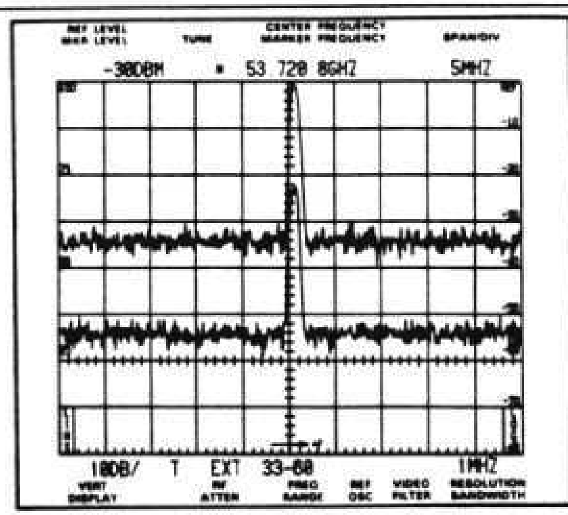
REPEAK — An automatic peaking routine is selected. When peaking the preselector, peaking occurs ±1 division or 0 MHz (whichever is less) on either side of center or marker. If there is no signal at the location to be peaked, the previous stored value is used. The resulting peaking code is stored in memory and peaking switches to the Stored Value mode. REPEAK is not available in band 1, with external mixers, or in the Multiband Sweep mode.

It is always good practice to re-adjust peaking before making amplitude or power measurements, especially if the measurement is to be made after a significant change in center frequency. Re-adjustment is not necessary if you are in the Stored Value mode, since the previous values will be used.

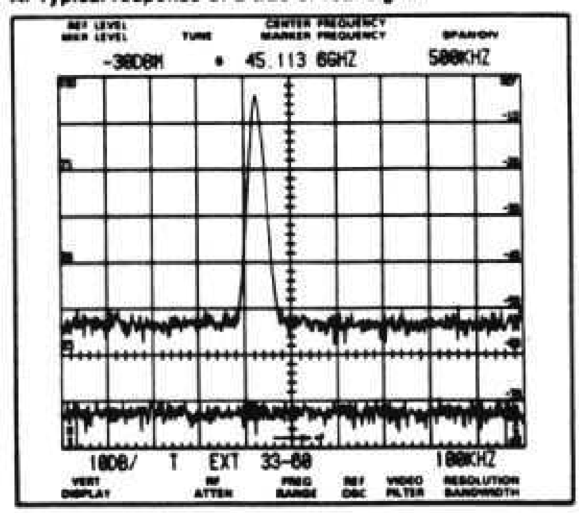
Using the Signal Identifier

When external mixers are used, there is no preselection ahead of the mixer. Many spurious responses are generated in the 1st mixer. This is due to multiple harmonics of the local oscillator and incoming signals converting to intermediate frequencies that are within the band pass of the 1st IF. These responses pass through the IF band-pass and appear as signals on the screen.

The spectrum analyzer features a Signal Identify mode to help identify true signals from false signals. When in this mode, the frequency of the local oscillators are shifted on alternate sweeps. At the same time, the sweeps are vertically offset about two divisions. True signals shift only a small amount on alternate sweeps, while false signals or spurious responses will shift at least 1 division.



A. Typical response of a true or real signal.



B. Typical response from a false signal. Signal for bottom sweep is off screen.

5557-15

Figure 6-4. Typical example of identifier mode displays.

This mode can only be activated when the FREQ SPAN/DIV is 50 kHz or less for the coaxial bands (0 to 21 GHz) and 50 MHz or less for the waveguide bands (18 to 325 GHz).

The 1st LO is not phase locked when the FREQ SPAN/DIV is 500 kHz or more in the waveguide bands. Therefore, true or real signals can shift a slight amount between sweeps, due to limits of the oscillator setting accuracies. True signals can shift up to 2 MHz, but false signals will shift 70 MHz or more. If there is any question as to whether the signal is true or false, decrease the FREQ SPAN/DIV setting to 200 kHz or less so the oscillator is phase locked.

In the millimeter wave bands, the oscillator frequency is shifted far enough so that it is possible to lose the signal on alternate sweeps. If no signal is visible for the alternate sweep, re-adjust MANUAL PEAK so that the signal will appear on both sweeps if it is true.

Figure 6-4 illustrates two typical examples of signal identification. The amount of horizontal displacement depends on the band and the harmonic number of the oscillator fundamental.

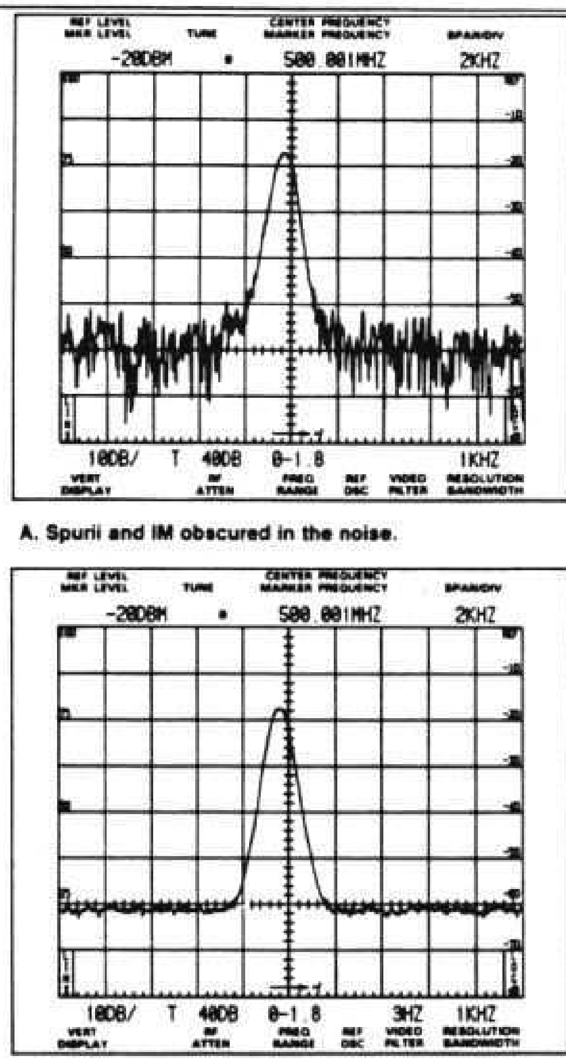
Using the Video Filters

The video filters restrict the video bandwidth so noise is reduced (see Figure 6-5). When signals are closely spaced, the filter can reduce the modulation between two signals to make it easier to analyze the display. The filters can also be used to average the envelope of pulsed RF spectra that has a relatively high pulse repetition frequency (prf); however, because the filter is basically an integrating circuit, the video filter will not be very effective when measuring low prf spectra.

The WIDE filter reduces the bandwidth to approximately 1/30th the selected resolution bandwidth; the NARROW filter to approximately 1/300th. Using the filter may require a reduction in the sweep rate to maintain a calibrated display. UNCAL lights if the sweep rate is not compatible with the other parameters to maintain a calibrated display. When either the WIDE or NARROW filter is selected, the filter bandwidth is displayed on the crt lower readout line.

Using Time Domain Operation

When the FREQ SPAN/DIV is zero, the spectrum analyzer functions as a tunable receiver to display time domain characteristics within the selected resolution bandwidth. Characteristics like modulation pattern and pulse repetition rates can now be analyzed with TIME/DIV selections. Resolution bandwidth is usually maximum (3 MHz) for time domain analysis of the signal.



A. Spurii and IM obscured in the noise.

B. Same display with Video Filter activated.

5557-16

Figure 6-5. Typical display mixed with the VIDEO FILTER.

Triggering the Display

The Triggering mode is usually FREE RUN for spectrum displays. However, it may be desirable or necessary to trigger the display when the event is time related to some source, or when the frequency span has been reduced to zero for time domain analysis. In FREE RUN, the sweep will not synchronize with any input signal.

In addition to FREE RUN, the sweep can be internally triggered (INT) by the video signal, at the line frequency rate of the power supply (LINE), or by an external signal (EXT) applied to the HORIZ|TRIG EXT IN connector on the rear panel. The required amplitude for triggering is 2.0 divisions or more for internal triggering and from 1.0 to 50 V maximum (dc + peak ac) for external triggering.

In addition to the Triggering source selections, SINGLE SWEEP is provided. In SINGLE SWEEP, the sweep will run once after the circuit has been armed and a trigger signal arrives. READY lights when the circuit is armed and waiting to be triggered and remains lit during sweep time. Push SINGLE SWEEP once to activate the Single Sweep mode and cancel the current sweep. Push SINGLE SWEEP again to arm the trigger circuit so it is ready for a trigger signal (if the instrument is in FREE RUN, it will not wait for a signal). This mode is useful for viewing single events.

Sweeping the Display

Horizontal sweep voltage for the display can be internal or from an external source. Sweep rate and source are selected with the TIME/DIV control. When the TIME/DIV control is in the AUTO position, the sweep rate is automatically set to maintain a calibrated display.

When TIME/DIV is in the EXT position, a signal source of 0 to +10 V, applied to the HORIZ/TRIG EXT IN connector will sweep the crt beam across the 10 division span. The input is dc coupled and sensitivity is 1 V/div. External input impedance is approximately 10 kΩ.

The beam can be manually positioned by the MANUAL SCAN control when TIME/DIV is in the MNL position (see Manual Scan of the Spectrum that follows).

Manual Scan of the Spectrum

The MANUAL SCAN control is usually used to examine a particular point or sector of a display. One example is looking at one of the null points of a frequency modulation spectrum. Another example is when it takes unnecessarily long to look at a small segment of the full span because of the slow sweep rate. With a wide span/div and/or a narrow resolution bandwidth, it is very possible to manually scan too fast to achieve an accurate display. Best results are obtained without digital storage; digital storage can produce unpredictable results due to the sweep rate, and the digital storage display is only updated when scanning from left to right.

Reference Level, RF Attenuation, and Vertical Display

When a change is made to REF LEVEL, the gain distribution (IF gain and input RF attenuation) is automatically selected for the new reference level. The selection is made according to the settings of VERTICAL DISPLAY, FINE, MIN RF ATTEN dB, MIN NOISE/MIN DISTortion, and reduced gain mode.

The amount of input RF attenuation set is based on the reference level requested and the settings of MIN RF ATTEN dB and MIN NOISE/MIN DISTortion. The spectrum analyzer assumes the MIN RF ATTEN dB selection is the minimum attenuation required for the expected signal levels, and will not reduce RF attenuation below this value. As MIN RF ATTEN dB is increased, the lowest reference level is raised an equal amount. At 0 dB minimum attenuation, the lowest reference level is −117 dBm; at 10 dB minimum attenuation, the lowest reference level is −107 dBm, and so on. The best ratio of RF attenuation IF gain is selected according to the Minimum Noise/Minimum Distortion mode (see the description later in this section).

The REFERENCE LEVEL control steps depend on the VERTICAL DISPLAY and FINE settings. With LOG selected, the REFERENCE LEVEL control steps in 1 dB to 15 dB increments with FINE off. With FINE on, it steps in 1 dB increments for display factors of 5 dB/div or more and 0.25 dB for display factors of 4 dB/DIV or less. The 0.25 dB increments apply to the Delta A mode (see the description later in this section). With LIN selected, the bottom of the crt graticule is zero volts, and the top of the crt graticule is eight times the vertical display factor. With FINE off, the display factor changes in a 1-2-5 volts/division sequence from 500 mV to 50 nV. With FINE on, the reference level changes in 1 dB steps.

Reference Level Offset

Reference level offset will affect the readout of reference and marker levels. To set an offset to the reference level, press <SHIFT> REF LEVEL UNITS, and choose selection 4 from the menu. An asterisk (*) on the screen in front of the reference and marker levels indicates that a non-zero offset is in use. (If there currently is no reference level offset, but the marker is on a saved or stored trace taken with an offset, there will be an * in front of the marker readout only.) If there is an uncalibrated condition while using a reference level offset, the uncal symbol (>) will not be displayed. However, UNCAL on the front-panel will still light whenever the instrument settings are uncalibrated.

Any offset alters the readouts without affecting instrument settings. For example, if the reference level is −30 dBm without offset and an offset of 30 dB is entered, the reference level will become 0 dBm; but, the RF attenuation, IF gain, an on-screen signal levels will not change.

Reference level and threshold entry must include the offset. For instance, to increase the reference level by 10 db in the case just described, the value entered should be 10 dBm, not −20 dBm. Whenever the offset is non-zero, it is indicated in both the reference level menu (<SHIFT> REF LEVEL UNITS) and threshold entry menu (MENU).

Alternate Reference Level Units Selection

The following discussion assumes the 50 Ω input is in use. When the 75 Ω input is used (Option 07 only), different results can be expected.

It is a simple procedure to select an alternate to dBm reference level units. For example, the REF LEVEL readout is 0 dBm. Press <SHIFT> REF LEVEL UNITS to get the reference level units menu. To change to dBV, select 1 from the menu, and the REF LEVEL readout changes to −13 dBV. To change to dBmV, select 2 from the menu, and the REF LEVEL readout will change to 47 dBmV. To change to dBμV, select 3 from the menu, and the REF LEVEL readout changes to 107 dBμV. To change back to dBm, select 0 from the menu, and the REF LEVEL readout changes to 0 dBm.

Using the Delta A Mode

To select the Delta A mode, push FINE while the vertical display factor is 4 dB/div or less. The REF LEVEL readout goes to 0.00 dB and the REFERENCE LEVEL control steps in 0.25 dB increments from this reference.

The Delta A mode accurately measures relative amplitude difference. This is possible because the gain distribution (IF gain and RF attenuation) does not change in the Delta A mode. The REF LEVEL is changed by shifting the log amplifier offset. The total range of the Delta A mode is 57.75 dB. The measurement range depends on the REF LEVEL that is current at the time the Delta A mode is activated. The overall instrument reference level range of −117 dBm to +50 dBm cannot be exceeded.

When the verical display factor is increased above 4 dB/div, FINE is turned off, or the gain distribution is changed with MIN RF ATTEN dB or MIN NOISE selections, the Delta A mode is turned off. The spectrum analyzer also turns off the Delta A mode when EXT MIXER is selected.

Signals with large amplitude differences that are within the Delta A range can be compared without the distortion usually introduced when signals are driven off-screen. Signals shifted off-screen by changes in the Delta A reference level are not overdriving the input. This is because the attenuator and IF gain do not change; so, the mixers do not see any change in signal levels even though the Delta A reference level changes.

Follow these five steps to measure the amplitude level differences of two signals.

1. Select the Delta A mode by pressing FINE. Select a vertical display of 4 dB/div or less with the dB/DIV pushbutton or push the 2 dB/DIV pushbutton.

2. Set the peak of the larger signal to a graticule line with the REFERENCE LEVEL control.

3. Press the FINE pushbutton twice to turn the Delta A mode off an on. The readout will return to 0.00 dB.

4. With the REFERENCE LEVEL control, set the peak of the lower amplitude signal to the same graticule line established in step 2.

5. The REF LEVEL readout will now indicate the amplitude difference between the two signals in dB.

NOTE

Do not confuse the Delta A mode with the delta marker mode.

Using MIN NOISE, MIN DISTORTION, or the Reduced Gain Mode

One of three methods can be selected to control RF attenuator and IF gain settings. MIN NOISE minimizes noise level by decreasing input attenuation and IF gain by 10 dB. MIN DISTORTION minimizes input mixer overload by increasing input attenuation and IF gain 10 dB.

The Reduced Gain mode uses the identify offset to reduce the effective gain of the spectrum analyzer, which lowers the displayed noise level. Because the identify offset is 1 division, and because the RF attenuator is controllable only in 10 dB steps, the Reduced Gain mode will have an effect only when the instrument is set for 10 dB/div. Even though the Reduced Gain mode can be selected when the instrument is set to other than 10 dB/div, the following discussion applies only when the instrument is in 10 dB/div.

The Reduced Gain mode reduces the IF gain and RF attenuation by 10 dB for any reference level for which the RF attenuation (in the non-reduced gain mode) is at least 10 dB greater than the MIN RF ATTEN dB control setting.

CAUTION

With MIN NOISE on and MIN RF ATTEN dB set to 60 dB, the REF LEVEL can be set to +40 dBm. Do not increase input signal level to full screen with a REF LEVEL of +40 dBm because this will exceed the attenuator rating. In the Reduced Gain mode, the reference level may be set to +40 dBm (with MIN DISTORTION on) or +50 dBm (with MIN NOISE on). However, the maximum input level of the spectrum analyzer is still +30 dBm. NEVER apply more than +30 dBm to the input of the spectrum analyzer at any time, regardless of the indicated reference level.

Select the Reduced Gain mode from the Special Modes Menu (<SHIFT> 8). Item 2 in the menu toggles the Reduced Gain mode from off to on or vice versa each time it is selected. The Reduced Gain mode is indicated by an R on the right-hand-side of the second top readout line. (If an error message is using all or part of this readout line, the R will not be displayed.)

The Reduced Gain mode can be used with either MIN DISTORTION or MIN NOISE on. With MIN DISTORTION on, the Reduced Gain mode will have the same effect as if MIN NOISE is on. With MIN NOISE on, the Reduced Gain mode will further increase the distortion. Also, on-screen compression may occur. Because of this, any digital storage data over the top of the visible screen (that is, data values of 225 to 250) is likely to be inaccurate.

When identify is used in reduced gain mode, the identify sweep will be moved up instead of down on the crt.

Using Digital Storage

Digital storage provides a smooth, flicker-free display. Two complete displays can be digitized and stored. In addition, the instrument Store Display and Recall functions will store up to nine displays in memory (see Using the Store and Recall Features later in this section). One of the two digitized waveforms can be saved and then compared to later waveforms. The Max Hold feature updates digital storage data only when the input signal amplitude is greater than previous data. This allows monitoring and graphic plotting of display changes (amplitude and frequency) with time.

The display is divided by a horizontal line that is positioned with the PEAK/AVERAGE control. Above the line, video information is peak detected; below the line, signal averaging occurs. This feature subdues noise in the portion below the line and allows full peak detection above the line. An intensified spot on the line indicates the horizontal position where memory is being updated. The average (number of samples) is a function of the sweep rate; the slower the rate the more samples.

The digital storage display is divided into an A and B section. Data can be stored in either A or B or in both. There are 500 horizontal locations in A and 500 horizontal locations in B. When both are displayed, the origin of the B waveform is shifted so the A and B coordinates are interlaced to provide 1000 display increments. Data in memory is continually updated with each sweep so the display is always current.

When SAVE A is turned on, data in the A section is saved and only the B section of storage is updated. This takes place whether the A waveform is displayed or not. This mode captures an event or waveform, with its readout, for comparison with a subsequent event displayed by the B display. If VIEW B is on, the readout applies to the current B waveform. If SAVE A and VIEW A are on and VIEW B and B−SAVE A are off, the readout applies to the saved A waveform.

When B−SAVE A is turned on, the arithmetic difference between the B waveform and the saved A waveform is displayed (see Figure 6-6). This convenient mode can be used to align filters or other devices. The reference waveform is stored in A and the unknown is displayed in B. The reference level is usually set mid-screen so positive and negative quantities can be observed. The position of the zero reference can be changed by an internal switch. Contact qualified service personnel to have the reference level repositioned.

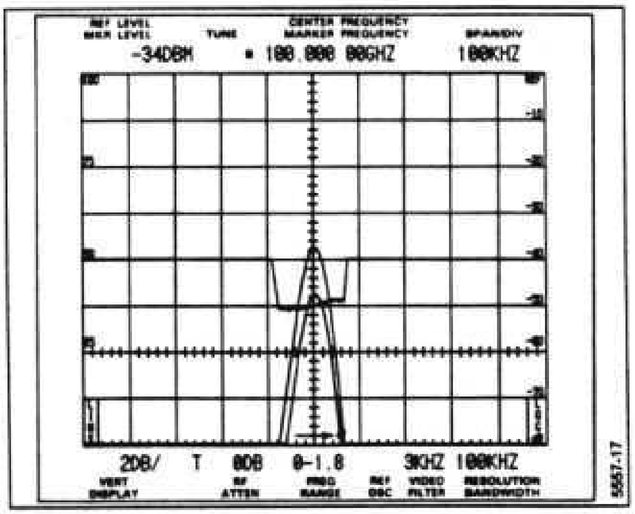


Figure 6-6. Typical display using B−SAVE A to observe the difference between SAVE A and B displays.

MAX HOLD causes the memory to be updated only if the new input is of higher magnitude than the former (B memory only if SAVE A is active). This allows monitoring of signals that may change with time and provides a graphic record of amplitude/frequency excursions.

Signal averaging is useful for suppressing noise. The number of samples averaged per horizontal digitized slot is a function of the spectrum analyzer sweep rate. The slower the sweep speed, the more samples averaged per horizontal slot. Resolution bandwidth affects the amplitude difference between peak detected and average levels of cw signals. When the resolution bandwidth is less than 1/30th the span/division (e.g., 100 kHz or less with 5 MHz span/div) there will be significant error in the average amplitude levels of cw signals, especially if only A or B is displayed. The peak value will be the true value. When using narrow resolution bandwidth with wide frequency spans, it is best to run digital storage with both the A and B waveforms interlaced and the cursor (horizontal line) at the bottom of the display.

To measure signal amplitude level, set the cursor to the bottom of the screen. To average noise, set the horizontal line at least one division above the noise level.

Using the Store and Recall Features

The spectrum analyzer features two functions to store up to nine waveforms, with marker(s) and readout, in memory to be recalled later for review or analyses. To save the display currently on the screen, press <SHIFT> STORE display, the register number (0–8) where you want to store the display, and if SAVE A is on the identity of the display you want stored (A or B). To later recall this same display, press RECALL DISPLAY, and the register menu showing the center frequency of each stored display will appear on the crt. Select the correct register number with a DATA ENTRY pushbutton, and then select the part of the digital storage (A or B) where you want to place the recalled display.

SAVE A is automatically activated to prevent an overwrite. If location A is selected, VIEW A must be on to see the recalled display and VIEW B must be off to see the readout that applies to the recalled display. If VIEW B and VIEW A are on, both the display recalled in A and the current display in B will be visible on the screen. The readout shown applies to the current B display. Turn VIEW B off to see the readout that applies to the recalled A display.

If location B is selected, the next sweep will overwrite the display unless SINGLE SWEEP was activated before selecting B; a message will appear on the screen as a reminder of this. VIEW B must be on to observe the recalled display. Remember to deactivate SINGLE SWEEP when leaving this recalled mode.

Plotting the Display

Press PLOT to drive many external plotters such as the

- Tektronix 4662 Option 01
- Tektronix 4662 Option 31
- Tektronix 4663 (emulating the 4662)
- Hewlett-Packard HP7470A
- Hewlett-Packard HP7475A
- Hewlett-Packard HP7580B
- Hewlett-Packard HP7585B
- Hewlett-Packard HP7586B
- Gould 6310
- Gould 6320

To use the plot feature, connect the plotter to the spectrum analyzer with a IEEE STD 488 (GPIB) cable, and complete the following steps.

1. Set the corners of the plot for a 3:2 aspect ratio for the Tektronix plotters, or 6:5 for the Hewlett Packard and Gould plotters. The plotter must be in the Listen Only mode and the spectrum analyzer must be in the TALK ONLY or TALK/LISTEN ONLY mode. The TALK ONLY switch on the rear-panel GPIB ADDRESS switch bank must be closed or in the 1 position.

2. Set the plotter interface switches as follows:

Tektronix 4662 Option 01 or 4662 Option 31 (rear panel)

A = 0, 1, 8, or 9
B = C or D
C = X (don't care)
D = X (don't care)

Tektronix 4663

Interface Select = 1 if Option 04 or 2 if Option 01
Initial Command/Response Format = 5
Interface Mode = Listen Only

Hewlett-Packard or Gould Plotters

Address = 31

3. Press <SHIFT> SELECT TYPE on the spectrum analyzer, and select the desired plotter type from the menu on the crt. The selection is stored in memory and does not need to be selected again unless the plotter type is changed.

4. Select the display and the information that you wish to plot. The Plot feature is similar to using a camera, in that a plot is made of everything that is turned on for the crt display. The information plotted depends on the setting of several front-panel pushbuttons and controls. If READOUT is on, the crt readout will be plotted with the display. If GRAT ILLUM is on, the bezel and graticule information will be included with the plot. If VIEW A, VIEW B, or B−SAVE A are on, these waveforms will be part of the plot. Therefore, if any of these functions are off, they will not be plotted. (Refer to Using PLOT with Macros in the Helps and Hints section of the Programmers manual for additional information).

The zero level for a B−SAVE A waveform is usually the graticule center line. (Switches within the instrument can set the level. Contact your service personnel for this change.) If you want to shift the zero level for the plotting function only, press <SHIFT> 3, and enter the desired level in display units (25 is the bottom graticule line, 25 units/div). This zero level is retained in memory. It is not related to the display zero level, since the processor has no way of determining the internally-set zero level for the crt display and no way of changing it.

Instrument Interface Functions

The plotting function of the spectrum analyzer is compatible with IEEE STD 488-1978. The connector and the signal levels follow the IEEE 488 standard.

Using the Markers Feature

The marker modes provide direct readout of frequency and amplitude information of any point along any displayed trace. Relative (delta) frequency and amplitude information between any two points along any displayed trace or between traces is also available. Two independent marker frequencies and amplitudes cannot be displayed at the same time.

Marker Terms — The following definitions of marker terms are used throughout this section.

- Active Trace — Any combination of the A trace when SAVE A is off and/or the B trace; or, the B−SAVE A trace. A trace recalled into B is not an active trace.
- Inactive Trace — A SAVE A trace or a trace recalled into the B display before the sweep is started.
- Primary Marker — The marker displayed in the Single Marker mode whose frequency and/or position is changed when tuning with the CENTER/MARKER FREQUENCY control. When two markers are displayed, the brightest marker is the Primary marker.
- Secondary Marker — The "second" marker; displayed only in the Delta Marker mode.

Marker Turn On — The Single Marker mode places one marker (Primary marker) on the spectrum to display marker frequency and amplitude. The Delta Marker mode places two markers (Primary marker and Secondary marker) that display the difference in frequency and amplitude between the two markers. When two markers are displayed, the Primary marker is brighter. The Primary marker position and frequency can be changed with the CENTER/MARKER FREQUENCY control or from the GPIB. The Secondary marker is fixed at the frequency it was at when turned on.

The marker(s) can be turned on by pushing many of the pushbuttons related to marker action.

- TUNE CF/MKR (pushbutton lit) turns on the Primary marker
- <SHIFT> MKR → CENTER turns on the Primary marker
- FIND PEAK MAX turns on the Primary marker
- SIGNAL TRACK turns on the Primary marker
- MKR → REF LVL turns on the Primary marker
- 1—MKR→2 turns on both the Primary and Secondary markers
- Δ MKR turns on both the Primary and Secondary markers

There are four ways to turn the marker(s) off.

- <SHIFT> MKR OFF turns off all marker functions
- <SHIFT> RESET turns off all marker functions (the instrument is returned to the initial turn-on condition)
- Δ MKR (when both markers are on) turns off the Secondary marker and returns the instrument to the Single Marker mode
- Recalling a setting that does not have markers turned on.

The markers are visible only when DIGITAL STORAGE functions are on; there can be no markers on a real-time trace. When a trace with a marker or markers is stored, the marker positions and frequencies are also stored. When the trace is recalled and the marker system is on, the marker(s) first appears at the stored location(s). Therefore there is a greater accuracy than is normally possible on an inactive trace. This is especially true if the stored marker frequency was the result of a signal count. The increased accuracy is lost as soon as the marker is tuned.

In either the Single or Delta marker mode, a second line of readout appears at the top of the crt. In the Single Marker mode, the marker frequency readout is displayed directly below the center frequency readout, and the marker amplitude is displayed directly below the reference level readout. In the Delta Marker mode, the frequency of the Primary marker with respect to that of the Secondary marker is displayed directly below the frequency readout, and the amplitude of the Primary marker with respect to that of the Secondary marker is displayed directly below the reference level readout. When in the Delta Marker mode, the relative amplitude and frequency readouts are enclosed on the screen in parentheses. If the marker amplitude is outside the digital storage range, OVER or UNDER is displayed in the amplitude readout field.

Assigning Markers — When the marker mode is first turned on from the front panel, the trace(s) on which the marker(s) appears is determined by the traces that are currently displayed, as indicated in Table 6-2. When a trace is turned off, any marker(s) on it are re-located according to Table 6-2. Previous marker locations do not change when a trace is turned on, except in maximum span or in signal track mode the marker always jumps to the active trace. Also, in the time mode when the primary maker is put on a zero span trace, the secondary marker will follow.

Table 6-2

MARKER TRACE ORGANIZATION

VIEW A	VIEW B	SAVE A	B-SAVE A	PRIMARY MARKER ON	SECONDARY MARKER ON
Off	Off	Off	Off	Full*	Full*
Off	Off	On	Off	A*	A*
Off	Off	On	On	B-SAVEA	B-SAVEA
Off	On	Off	Off	Full	Full
Off	On	On	Off	B	B
Off	On	On	On	B	B
On	Off	Off	Off	Full	Full
On	Off	On	Off	A	A
On	Off	On	On	B-SAVE A	B-SAVE A
On	On	Off	Off	Full	Full
On	On	On	Off	B	A
On	On	On	On	B	A

*Not applicable. Since no digital storage traces are being viewed, there is no visible marker. The listed trace is that for which marker readouts are given.

Tuning Markers — Move the Primary marker with the front-panel CENTER/MARKER FREQUENCY control (when the TUNE CF/MKR pushbutton is lit). Since only the Primary marker can be moved with the CENTER/MARKER FREQUENCY control, the Secondary marker position can be changed only after it has been made the Primary marker. To do this, push 1←MKR→2 to swap the Primary and Secondary marker positions. Move the Primary marker (which used to be the Secondary marker), and then push 1←MKR→2 again to swap the Primary marker back to its previous location.

The marker normally moves over the fixed display. Marker tuning (both frequency and position) stops when the screen edge is reached while using the CENTER/MARKER FREQUENCY control. If the marker is on a trace containing a band edge, the marker may be tuned over the in-band portion only. This is true for both active and inactive traces. However, if the marker is on the B-SAVE A trace and the A trace contains a band edge but the B trace does not, the tuning is not limited.

The marker tuning rate depends on the speed with which the TUNE CF/MKR control is turned. If the control is turned rapidly, the marker moves l/10 of a division per increment. If the knob is turned quite slowly, the marker moves 1/100 of a division per increment. At intermediate turning speeds, the marker moves approximately 1/30 of a division per increment.

When two markers are displayed (delta-marker mode) and the marker frequency, center frequency, and span are changed, the Secondary marker remains fixed at its original frequency and is allowed to move off the screen. If the Primary and Secondary markers are swapped (with the 1←MKR→2 pushbutton) while the Secondary marker is off the screen, the display is centered on the frequency of the old Secondary marker (now the new Primary marker). The old Primary marker (now the new Secondary marker) is placed off the screen.

Using Signal Count

The signal count function provides a way to exactly determine the frequency of an input signal. The advantage of the spectrum analyzer over a counter is that the spectrum analyzer will selectively count a particular signal out of several that may be present at its input.

Front-panel Control — The two front-panel controls associated with signal count are COUNT and <SHIFT> CNT RES.

Press COUNT to turn the signal count on (the pushbutton will light). Press COUNT again to turn signal count off.

The <SHIFT> CNT RES multiple-pushbutton sequence brings up a menu that allows entry of the resolution to which the signal count will be displayed. The range is 1 Hz to 1 GHz. If a non-decade resolution value is entered, the display resolution will be the next decade that is more accurate than the entry. (For example, if 23 kHz is entered, the resolution will be to 10 KHz.)

From 1 Hz to 1 kHz, selecting a less-accurate resolution will speed the count. Above 1 kHz, the resolution affects the display only.

In either the Delta F or Delta Marker mode, the displayed number may be the difference of counted and uncounted frequencies or of frequencies counted to different resolutions. In such cases, the display resolution is the less-accurate of the two resolutions.

When signal count is on, a C count indicator will appear in the appropriate top (center frequency or marker frequency) readout line in the TUNE indicator position When a counted frequency is tuned, the corresponding non-counted frequency is displayed from the time the frequency is changed until it is again counted (at the end of the sweep or after a short interval if in single sweep). While the non-counted frequency is displayed, the C indicator disappears and the displayed resolution changes to the non-counted value for the span in use.

Counted Locations — The spectrum analyzer counts at different locations depending upon the status of the marker system. It there is a marker, or markers, on a non-saved trace, signal count will occur at the marker(s). Otherwise, signal count will occur at center screen. (In MAX span, counting will occur at the dot marker position, rather than at center screen). A C in the TUNE indicator position in the center frequency readout line indicates that the center frequency is being counted. (See Figure 6-7A). Likewise, a C in the TUNE indicator position in the marker frequency readout line indicates that the marker frequency is being counted. (See Figure 6-7B). The count location is independent of the TUNE CF/MKR status. An asterisk (*) will appear in the TUNE indicator location if the non-counted frequency is being tuned.

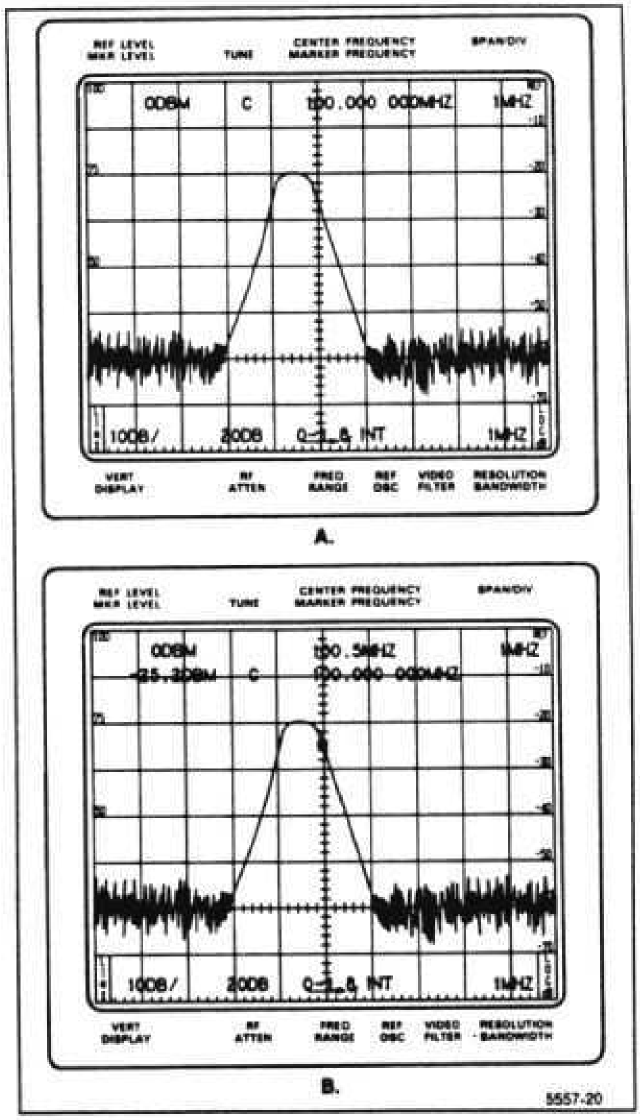


Figure 6-7. Simulated displays when counting at the (A) center frequency or (B) marker frequency. The C indicates the frequency that is being counted.

The frequency counted is that of the signal peak, even when the signal is not exactly centered (when counting at center), or the marker is not at the signal peak (when counting at the marker). The requirement is that the signal level at the center or marker be 20 dB greater than the average noise level and be within 60 dB of the reference level (top of screen). However, there may be an error between the true electrical location of the center or marker and its apparent on-screen location. This error should be less than 0.1 division, but it can become significant at large span/division to resolution bandwidth ratios. At ratios of over 10, the marker or center point should be placed at the signal peak. At ratios of over 50, it may be difficult to get a good count.

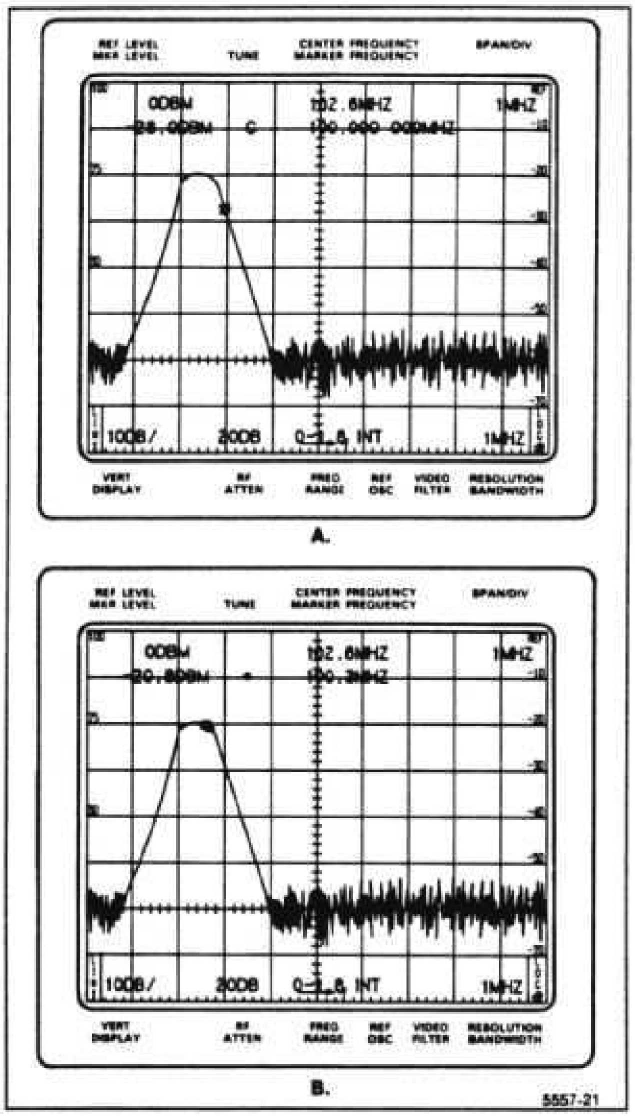


Figure 6-8. Simulated display of stored displays with signal counts. (A) Display when the marker has just been assigned/reassigned to the trace. (B) Display after the marker is tuned.

Signal Counting and Stored Traces — Signals cannot be counted on a trace saved with SAVE A or stored and recalled with RECALL DISPLAY/STORE. However, if there was a counted frequency on the display when it was saved or stored, that frequency is remembered.

If the frequency is a counted center frequency, it, along with the C count indicator, is displayed whenever the readout for the saved or stored trace is displayed. Any markers are scaled from the nominal center frequency however.

If the frequency is a counted marker frequency, the marker position, the counted frequency, and the C count indicator are displayed when markers are initially assigned to the trace or are moved back to the trace after being reassigned. (See Figure 6-8A). When the marker is moved, the C indicator disappears and the marker frequency is scaled from center frequency and span and is displayed to the appropriate span-based resolution. (See Figure 6-8B). If both Primary and Secondary markers were stored on the trace, the appropriate marker is used for any marker placed on the trace. If only one marker was stored, it is used when either type of marker is placed on the trace.

Signal Count Familiarization — The following procedure illustrates most of the features of signal count and requires only the instrument calibrator to perform.

Connect CAL OUT to the RF INPUT connector. Set Center Frequency to 100.0 MHz, Span to 5 MHz/div, Resolution Bandwidth to 1 MHz, Vertical Display to 10 dB/div, and Reference Level to −20 dBm. Be sure that the marker system is off (i.e., no markers or marker readout line will be displayed).

Activate COUNT. Press <SHIFT> CNT RES and enter 1 Hz. At the end of the sweep the tuning indicator will change to C, and the readout will expand to display the counted frequency to 1 Hz resolution.

Tune the signal approximately two divisions away from center. While tuning, the C disappears and the readout contracts until the end of the sweep. The counted frequency will vary as the counter counts the noise at the center frequency. Turn on the marker system with FIND PEAK MAX. The marker will appear at the peak of the calibrator signal. The C will disappear from the center frequency readout and the readout will change to the non-counted value and resolution. At the end of the sweep the C will appear in front of the marker frequency readout, and that readout will expand to the counted resolution.

Press TUNE CF/MKR to change to the center frequency tuning mode. The * in the center frequency readout line indicates the center frequency is being tuned, while the C in the marker readout line indicates the marker is still being counted. (See Figure 6-9). Return to the marker tuning mode by again pressing TUNE CF/MKR.

Turn off VIEW A and VIEW B. The long delay between sweeps is caused by the time needed to move the oscillators and to count. Select <SHIFT> CNT RES and enter 10 Hz. The delay between sweeps is now less. Enter 100 Hz count resolution. The delay is even less. Return the count resolution to 1 Hz.

Turn on VIEW A and SAVE A. The counted frequency is now remembered and the C will remain on the marker readout line. Tune the marker. The marker frequency readout will change to indicate a non-counted frequency and will not show the counted frequency, even if the

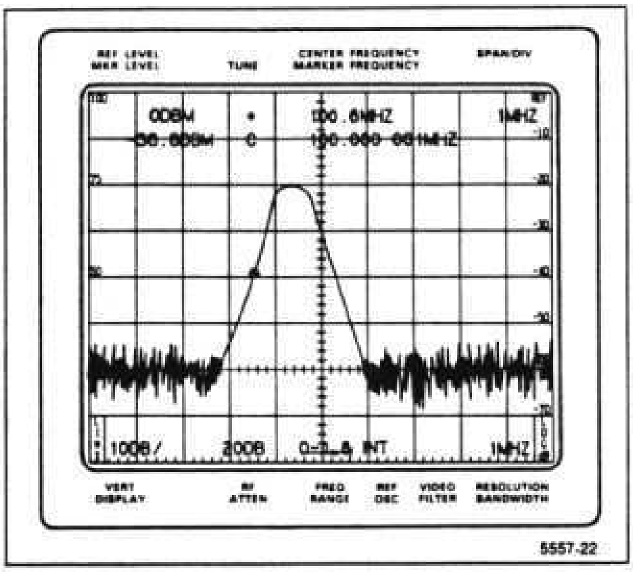


Figure 6-9. Simulated display showing counting being done at the marker while the center frequency is being tuned.

marker is placed in the same position as it had before it was tuned. Turn off SAVE A and turn on VIEW B.

Tune the marker over the signal. The displayed count does not vary by more than the specified count accuracy as long as the marker remains at least 20 dB above the displayed noise level. Change the span to 20 MHz/div and again tune the marker over the calibrator signal. Now, a displayed marker position meeting the amplitude standards may give an incorrect count. Since there are now fewer digital storage locations representing the signal, the horizontal error in the marker may result in an actual marker location below the counting threshold. Turn on MAX SPAN. Tune the marker to the peak of the 100 MHz signal. The count may be incorrect even with the marker at the peak. (If the signals were of unknown frequency, it could be much harder to detect an incorrect count.)

Turn off MAX SPAN. Set the Center Frequency to 350 MHz and leave the span at 20 MHz/div. Press FIND PEAK MAX, 1—MKR→2, and FIND PEAK MAX to place a marker at the peak of each signal. The frequency of each signal is now counted and the difference is displayed.

Press <SHIFT> MKR → CENTER and reduce the span to 5 MHz/div. The counted delta is still accurate because the off-screen counted frequency is remembered.

Position the marker approximately two divisions below the signal peak. Turn the delta markers off and back on (push Δ MKR twice) to reset the delta to zero. Turn on SAVE A. Because the counted frequency is used on the saved trace, the delta readout should be 0 Hz, within the count accuracy. Tune the Primary marker over the signal peak. As before, the displayed frequency does not change by more than the count accuracy. Note that although the display resolution changes as the marker is tuned, the C remains because the counted Secondary marker is used to form the delta even during tuning. Press MKR 1—MKR→2. This places the Primary marker on the saved trace. Tune the marker. As soon as the marker is moved, the saved counted marker frequency is forgotten, the Primary marker frequency is scaled from center frequency and span, and the resolution of the delta frequency readout changes appropriately. Because the counted marker frequency represents the signal peak and the non-counted marker frequency represents the actual marker frequency, the delta will not be zero when the markers are positioned together.

Figure 6-10 shows delta marker operation with signal count on a saved display. The markers are nearly together, but the delta frequency is non-zero because the counted frequency of the secondary marker on the active trace is that of the signal peak, while the frequency of the Primary marker on the saved trace is that of the marker location.

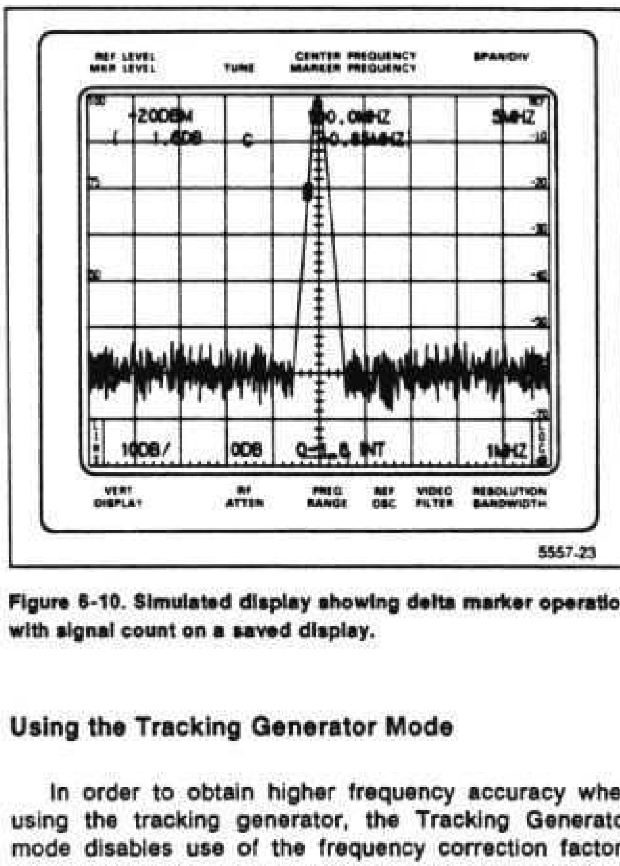


Figure 6-10. Simulated display showing delta marker operation with signal count on a saved display.

Using the Tracking Generator Mode

In order to obtain higher frequency accuracy when using the tracking generator, the Tracking Generator mode disables use of the frequency correction factors for all resolution bandwidth filters wider than 10 kHz. These wide filters may be centered too far from 10 MHz for the difference to be corrected with the Tracking Adjust control on the tracking generator.

All amplitude correction factors are used.

For maximum frequency and amplitude accuracy, always adjust the Tracking Adjust control to peak the response in the resolution bandwidth filter you are using. Remaining amplitude errors can be corrected by using the B−SAVE A mode of digital storage.

Use the <SHIFT> 8 pushbutton sequence to enter the Special Modes Menu to select 0 − TRACKING GENERATOR MODE (select the mode again to turn it off). When this mode is on, a T appears on the right side of the second top readout line, except when an error message is being displayed.

Using the Sideband Analyzer Mode

Since the 1405 sideband analyzer only uses the first local oscillator of the spectrum analyzer, it is only useful when the first local oscillator is sweeping (not phase locked). The Sideband Analyzer Mode extends the usefulness of the 1405 by causing the spectrum analyzer to phase lock in 50 kHz/div instead of the normal 200 kHz/div in Band 1. Refer to the manual you received with the 1405 for additional information.

Use the <SHIFT> 8 pushbutton sequence to enter the Special Modes Menu to select 1 − SIDEBAND ANALYZER MODE (select the mode again to turn it off). When this mode is on, an S appears on the right side of the second top readout line, except when an error message is being displayed.

Using the EOS Correction Mode

The instrument normally measures the drift rate of its oscillators and corrects them when needed to maintain specified accuracy. When the EOS Correction mode is on, the oscillators are corrected at the end of every sweep.

Use the <SHIFT> 8 pushbutton sequence to enter the Special Modes Menu to select 3 − EOS CORRECTION MODE (select the mode again to turn it off). When this mode is on, an E appears on the right side of the second top readout line, except when an error message is being displayed.

Using the Multiband Sweep Mode

It is possible to sweep a frequency range that covers more than one band as long as the entire frequency range is within the range of the preselector (1.7 GHz − 21 GHz) when using the internal mixer. The low-pass filter/preselector boundary may not be crossed, as this would lead to excessive wear of the preselector switch. The multiband function is also available if the external mixer is in use, where the range that can be swept is 10 kHz − 21 GHz. In the waveguide bands, the sweep range is restricted to a single band, since each band normally requires a different mixer.

Entering the Multiband Sweep Mode — Enter the Multiband Sweep mode with the front-panel <SHIFT> START/STOP pushbutton or when a setting using multiband sweep is recalled (refer to Using the Multiband Sweep Mode in the Programmers Manual for an alternate method for instruments under program control). Multiband sweep is started automatically when FREQ START STOP is used to enter a sweep that covers more than one band within the allowed multiband range. Follow these steps (for exiting methods, refer to Exiting the Multiband Sweep Mode later in this sequence).

1. Press START/STOP.

2. A menu will come on the screen. The current starting frequency is shown at the top of the screen. You are prompted to enter a new starting frequency. Enter the desired left-edge start frequency with the DATA ENTRY pushbuttons and end with a units terminator pushbutton.

3. When the units terminator pushbutton is pressed, another menu comes on the screen showing the current stopping frequency. Enter the desired right-edge stopping frequency with the DATA ENTRY pushbuttons and end with a units terminator pushbutton.

Multiband Sweep Operation — To sweep a range that covers more than one band, the spectrum analyzer first determines the bands involved and calculates the center frequency and span needed in each band to cover the desired range. Then, the microcomputer successively sets the instrument and performs one sweep in each band. The digital data is collected in the B digital display. This data is then compressed to cover the appropriate portion of the screen and is displayed in the A storage display. During multiband sweep operation, MULTIBD is displayed at the bottom center of the screen.

If the start frequency is less than 3 GHz and the stop frequency is greater than 7.1 GHz, the 3 GHz−7.1 GHz band is not used.

Instrument Operating Differences When in the Multiband Sweep Mode — Because of the method used to obtain a multiband sweep, certain instrument functions must be locked out and others will operate differently from normal. To remind you of these differences, the message MULTIBAND SWEEP STARTED is displayed at the center of the screen at entry to the mode, and MULTIBAND SWEEP STOPPED is displayed at the center of the screen when you exit from the mode.

Following are the functional operating differences that are present when in the Multiband Sweep mode.

- To allow data collection in the B display of digital storage while the A display is being viewed, the storage must be set with View A on and View B and B−SAVED A off. These settings are changed automatically when the Multiband Sweep mode is entered and cannot be changed while in the mode. The existing settings are restored when multiband sweep is exited. If there is a waveform saved in the

A display, you are given the option to save it before multiband sweep is started (a warning message that requires a yes or no response comes on the screen). SAVE A and MAX HOLD operate normally. Since only the A waveform is displayed, SAVE A stops display updating.

- Displays may only be recalled into the A register. The display recall routine automatically places any recalled display into A, without a user prompt.
- If the multiband mode is exited using either the MAX SPAN or ZERO SPAN pushbuttons, the saved span will be the multiband span. The span will return to this value, or default to maximum, when either the Max or Zero Span Mode is cancelled (refer to the information under Changing the span in Exiting Multiband Sweep for additional information). The instrument will not return to the multiband mode.
- The multiband frequency range displayed can only be changed by entering new start and stop frequencies. Changing the span or directly entering a center frequency exits the Multiband Sweep mode. The center frequency knob is disabled in the Tune CF mode. Markers may be tuned over the displayed range only.
- The marker system treats the multiband display as if it were a saved or stored display; the tuning limits were mentioned previously.
- If AUTO RES is selected, the resolution bandwidth used is the widest value required by the bands being swept. If any of the bands is uncalibrated, the UNCAL light will come on.
- If TIME/DIV AUTO is selected, the sweep speed may vary as each band is swept. Any time/division value refers to a division of the sweep that gathered the data, not to a division of the compressed display.
- If the sweep is not in TRIGGERING FREE RUN, the triggering conditions selected will be used for only the first (lowest-frequency) sweep of the sweep needed to do one complete multiband sweep. After this sweep is triggered, the remaining sweeps will be done in the Free Run mode. Similarily, once a single sweep is started, the number of sweeps needed to form a complete display will occur. If a multiband sweep is interrupted by the SINGLE SWEEP pushbutton being pressed, the next sweep will be the lowest-frequency sweep.
- TIME/DIV MaNuaL or EXTernal sweeps cannot be used when sweeping a multiband range. If either is chosen, a message that the frequency range cxanot be swept in MNL or EXT sweep will appear on the screen and remain until the sweep mode is changed.
- Signal counting may not be done in the Multiband Sweep mode.
- Auto peaking will be done as usual in a 2-division window centered on the center or marker frequency. If this range covers more than one band, peaking will be done in all bands covered. If there is at least one signal within a band, or portion of a band, the peak value of the frequency window that contains the largest signal will be updated.

Exiting Multiband Sweep — Multiband sweep may be exited in several ways.

- Using the FREQUENCY and DATA ENTRY pushbuttons to enter a frequency, or the +STEP or −STEP pushbuttons to enter a frequency while in the TUNE CF mode. Multiband sweep will be stopped even if the frequency is within the multiband range being swept.
- Recalling a setting with a sweep that falls within one band
- Using the START/STOP or <SHIFT> MKR STRT STOP pushbuttons to enter a sweep that falls within only one band
- Using the <SHIFT> ΔBAND/BAND∇ pushbuttons
- Changing the span

If the marker is on when the multiband mode is exited, the center frequency is set to the Primary marker frequency. If the marker is not on, the center frequency remains at the center frequency of the multiband sweep. The span is set to the span of the multiband sweep, or is defaulted to maximum if the multiband sweep value is larger than the maximum span of the band containing the center frequency. The control change that caused the exit from multiband sweep will then change either the center frequency or span, or both.

Using the Time Measurement Feature

This instrument employs a special time measurement feature that is available when the instrument is in the zero span mode, with either one or two markers on. Select the Zero-Span Time mode from the Special Modes Menu, which is called up by pressing <SHIFT> 8. (Refer to Using the Time Measurement Feature in the Programmers Manual for an alternate method for use with instruments under program control.)

In the Zero-Span Mode, the marker frequency readout or delta-marker frequency readout is replaced by a time or delta time readout, respectively. The time readout in the single-marker mode is the time to the marker position from the trigger point; this point is 1/2 division to the left of the screen. In the Delta Marker Mode, the delta time readout gives the time difference between the two markers. In both cases, the time value is scaled from the marker position(s) and the time/division. No actual time measurement is done.

The time measurement feature is available only during certain timing conditions. If the TIME/DIV setting is MNL or EXT or is faster than 1 ms/division, the message TIME UNAVAILABLE is displayed in the location of the normal readout.

When in the delta-time readout mode, both markers must be on the same trace for time measurement. If the markers are on different traces when zero span is entered, the secondary marker will move to the trace of the primary marker. (This marker will not move back when leaving zero span.) When either marker is assigned to a new trace, both markers (assuming delta markers are on) will move together.

In frequency-mode marker operation, the secondary marker remains at a constant frequency, while the primary marker remains at a constant horizontal location. However, in the time mode, both markers remain at constant horizontal positions as the sweep speed is changed.

Most of the frequency-related marker functions remain frequency related in zero span. The <SHIFT> STEP SIZE pushbutton sequence still defines the frequency step size for the marker or delta-marker.

In the tune marker mode, FREQUENCY and the DATA ENTRY pushbuttons will enter marker time. If the TIME UNAVAILABLE message is displayed, the entry functions will be disabled.

The <SHIFT> MKR→CF pushbutton function is not available in zero span.

Bandwidth mode and signal track will go to idle in zero span. Since the idle message appears in the frequency/time readout location, these functions will have to be turned off in order to see the time display on the screen.

PROGRAMMING FEATURES

Setting GPIB Address Switches

The general purpose interface bus (GPIB) ADDRESS switches on the rear panel set the value of the instrument's GPIB addresses. The Programmers manual contains details of how the switches are used in remote control operations.

The switches can be set as desired, except when using Tektronix 4050-Series controllers. They reserve address 0 for their own use. Selecting a primary address of 31 logically removes the instrument from the bus; it does not respond to any GPIB address, but remains both unlistened and untalked. If the switches are changed after power-up, the RESET TO LOCAL or PLOT pushbutton must be activated so the spectrum analyzer will update the primary address.

Set the LF OR EOI switch to EOI (down) for use with Tektronix equipment and up for most other controllers. The switches marked 1, 2, 4, 8, and 16 may be set to any combination except all ones (decimal 31), which logically disconnects the spectrum analyzer from the bus or all zeroes when using the instrument with a 4050-Series controller.

TALK ONLY, LISTEN ONLY Switches

The spectrum analyzer switches for talk-only and listen-only operation are part of the GPIB ADDRESS switch bank. You can have talk only, listen only, or both talk only and listen only features. If the spectrum analyzer power is on, press RESET TO LOCAL or PLOT for a change in these switches to take effect. Both the TALK ONLY and LISTEN ONLY switches must be off (down) when the spectrum analyzer is used with any controller.

Personalized Macros

This programmable spectrum analyzer allows you to personalize your instrument to fill your specific needs. Eight programs compiled by you to your specifications can be stored in memory to be called up and run at any time. This feature makes it possible for you to perform complete tests with only the spectrum analyzer; without the need of a controller. These unique programs made up of existing, prepared commands are macroinstructions (macros).

There is 8K available memory originally set aside for personalized macros. When you create the macro, you have 22 characters available to you for the definitive name. Refer to the Programmers Manual for the available commands and their use, the amount of memory needed for each usable command, examples, and sample macros.

EXTERNAL MIXER OPERATION

(Not Applicable When Option 07 or Option 08 Is Installed)

External mixers are usually the waveguide type that extend the frequency range above that of the internal coaxial mixer. The WM 490-Series Tektronix Waveguide Mixers (18 to 325 GHZ range) are two-port, broad-band mixers designed specifically for use with the Tektronix 275X-Series Spectrum Analyzers. The mixers cover both microwave and millimeter wave frequency bands. The 18 to 26.5 GHz and 26.5 to 40 GHz frequency ranges are considered microwave bands; frequencies above 40 GHz are considered millimeter wave bands.

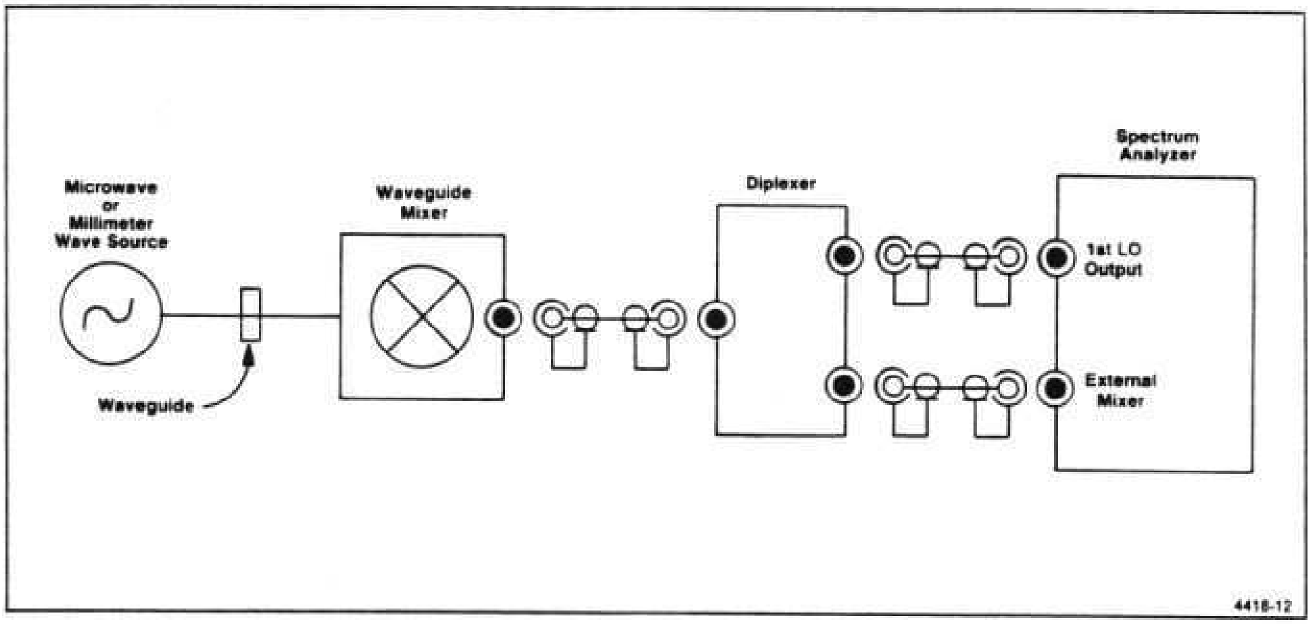


Figure 6-11. Block diagram showing external waveguide mixer installation.

The two microwave mixers that cover the 18 to 26.5 GHz and 26.5 to 40 GHz bands have standard rectangular flanges. Each uses a field replaceable diode and has a frequency response of ±2 dB, when used with the spectrum analyzer. The millimeter wave mixers are NOT field repairable and must be returned to Tektronix, Inc. for repair.

Eight millimeter wave mixers cover the 33 to 220 GHz range in the standard Mil-spec band ranges. A mixer is designed specifically for the 140 to 220 GHz range, or a flange transition can be used to allow the 90 to 140 GHz mixer to cover this range. A flange transition is also available to allow the 140 to 220 GHz mixer to be used in the 220 to 325 GHz band. The mixers are optimized for flatness over each waveguide band. Typical performance characteristics for the mixers are listed in the Specification section of this manual.

External Mixers and Diplexer

When an external mixer is used with the spectrum analyzer, the EXTERNAL MIXER port is the source for mixer bias and receives IF output from the mixer. A diplexer is used to couple the dc bias and the local oscillator signal to the mixer and couple the IF signal from the mixer to the EXTERNAL MIXER connector. (Refer to the Optional Accessories in the Service Manual, Volume 2, or your local Tektronix field office or representative for diplexer ordering information.) Connect the diplexer between the EXTERNAL MIXER port and the 1ST LO OUTPUT on the spectrum analyzer and then to the external mixer. Connect the 1ST LO OUTPUT to the LO port of the diplexer through a short semi-rigid 50 Ω coaxial cable. Connect the mixer to the diplexer through a standard 50 Ω coaxial cable (see Figure 6-11).

Reference Level Readout and Conversion Loss for External Mixers

When EXT MIXER is on, the internal RF attenuation is no longer in the signal path. Therefore the reference level can never be greater than that obtained with 0 dB attenuation.

Conversion loss of the WM 490 Mixers for the 50 to 90 GHz and 75 to 140 GHz bands is approximately 20 dB more than the lower waveguide bands. Typical loss for mixers in the 110 to 220 GHz and 175 to 325 GHz bands is about 30 dB more than the lower waveguide bands. This means the REF LEVEL readout is 20 dB and 30 dB higher for these bands; however, the display measurement dynamic range is not affected.

The reference level is calibrated to compensate for the nominal conversion loss of the waveguide mixers in each waveguide band. Slight variations between waveguide mixers result in an amplitude inaccuracy of approximately 6 dB, including the 3 dB frequency response of each mixer. The absolute power level accuracy of each waveguide mixer/spectrum analyzer system can be calibrated to within 3 dB. To do this, input a signal of known amplitude and enter a reference level offset so the reference level is correct. For example, if the signal is known to have a level of −30 dbm and the spectrum analyzer shows the level to be −28 dBm, enter a reference level offset of −2 dB.

Handling

CAUTION

The mixers can be damaged unless these instructions on handling and installing the mixers are followed.

Handle the waveguide mixers with care. The mixer diode is sensitive to static discharges and excessive RF energy. The maximum input level to all Tektronix waveguide mixers is +20 dBm (100 mW) cw and 1 W peak with 0.001 maximum duty factor and 1 μs pulse width for pulse signals. Bias for Tektronix waveguide mixers is a −2.0 V to +0.5 V (with respect to the mixer body) voltage. Check bias requirements of non-Tektronix mixers before connecting them to the Tektronix spectrum analyzer.

NOTE

If your mixer requires positive-going bias, the spectrum analyzer bias polarity can be reversed. Contact your service personnel or a Tektronix Field Representative for this change.

Ensure that the shorting cap is installed when the mixer is not in use, and install the flange cover on the mixer before returning it to the storage box.

The mixer diode can also be destroyed by mechanical vibration or shock.

Do not use an ohmmeter to test or check the mixer diode. The voltage across the test leads of many ohmmeters is capable of destroying the diode.

Avoid scratching the flange surface. Scratches can degrade the performance.

Installation

CAUTION

The bias voltage out of the EXTERNAL MIXER port is negative-going. This is the bias requirement for Tektronix mixers. Your service personnel or a Tektronix Field Representative can change this bias to positive-going if desired. If changed, attach a label near the EXTERNAL MIXER port to reflect this change.

When EXT MIXER is turned on or the frequency range is in the external mixer bands, the internal RF attenuator is no longer in the signal path.

The waveguide mixer is connected to the diplexer and the analyzer as shown in Figure 6-11. The mixer is bolted to a waveguide flange at or near the RF signal source. When installing the mixer, make sure the flange surfaces are clean and free of scratches. Install and tighten all flange screws evenly. This care will minimize input vswr and provide optimum frequency response. Ball tipped 3/32-inch and 5/64-inch Allen screwdrivers are required to access the flange screws that are at an angle.

The diplexer assembly includes a sma-to-tnc adapter and a shaped semi-rigid coaxial cable to connect the diplexer to the 1ST LO OUTPUT and the EXTERNAL MIXER port. When installing, be sure that the connectors are not cross threaded. Use a flexible cable to connect the mixer to the External Mixer port on the diplexer. Connect the cable to the diplexer External Mixer port first to discharge any static build-up in the cable before connecting it to the waveguide mixer. Static can damage the mixer diode. For best performance, use the cable supplied with the waveguide mixer set, and do not extend its length.

Never apply more than +20 dBm of continuous RF energy to the input of the waveguide mixer port. If the input level is unknown, use a general purpose mixer or appropriate waveguide attenuator and RF power meter to check the input level.

Tektronix mixers require +7 dBm (min) to +15 dBm (max), typically +10 dBm, of LO signal and a variable bias from −2.0 V to +0.5 V through a current limiting resistor to meet sensitivity and frequency response characteristics.

Operation

When the frequency range is switched to the waveguide bands, the instrument automatically switches to the External Mixer mode. If there is no signal on screen, push <SHIFT> PEAK MENU and select KNOB PEAKING, then set the MANUAL PEAK control mid-range. If in the stored value mode, mixer bias will be set to the previous setting stored in memory or it will be set to mid-range if there is no stored setting. If a signal is present, tune to center screen and peak the response with the MANUAL PEAK control, or use automatic peaking. Adjusting the MANUAL PEAK control through its range produces several peaks. Select the maximum of these peaks as your setting.

Because there is no preselection or filters ahead of the mixer, many spurious signals will usually occur. A typical display, generated by a −30 dBm signal at 40 GHz, is shown in Figure 6-12. Before an analysis can be made of any signal, it must be determined if the signal is true or real. True or false signal identification is best accomplished with the IDENTify feature, which was covered earlier in this section.

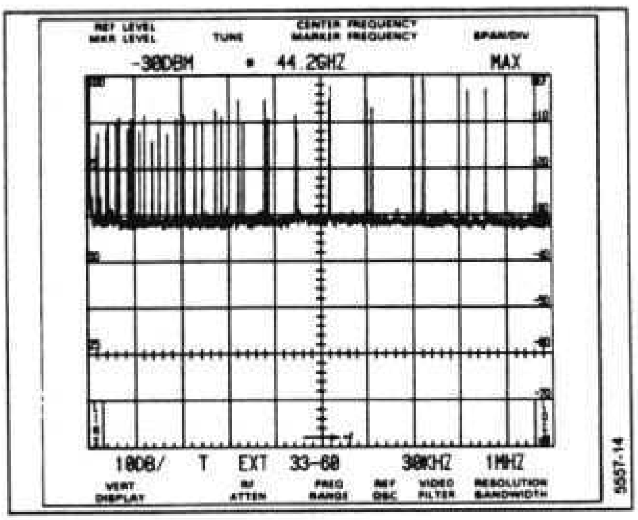


Figure 6-12. A typical display from an external mixer.

Because of the many spurious signals on screen, and the tedious task of operating the IDENTify feature on each signal, the approximate frequency of the signal should be known. A cavity wavemeter can be used to determine the signal frequency. The dip when the meter is tuned to the input frequency, is easily seen on a power meter if it is connected into the signal path. If not connected, use the 2 dB/div or less display mode to observe the dip.

Set the center frequency near the signal frequency, and peak the response with the MANUAL PEAK control or use automatic peaking. It may be desirable to increase the instrument sensitivity by reducing the span/div and resolution bandwidth. Reduce the Freq Span/Div to 50 MHz or less so the IDENTify feature can be used. If there is a significant change in input signal frequency and the Frequency setting, it is best to readjust peaking to maintain sensitivity and frequency response characteristics.

OPERATIONAL CONSIDERATIONS AND PRECAUTIONS

Following are some operational precautions to observe and traps that can occur when analyzing displays.

1. I RF INPUT Power Limit

CAUTION — DO NOT EXCEED THE RF INPUT POWER LIMIT OF +30 DBM. DO NOT APPLY DC VOLTAGE TO THE RF INPUT.

2. Instrument Warm-up After Storage

After storage below −15° C, allow 30 minutes instrument warm-up time, turn the power off and back on, then follow normal warm-up procedures as called out in Section 5 under Initial Turn On.

3. Auto Resolution

Use AUTO RES with care when measuring absolute amplitude level. Always use a bandwidth wider than the incidental FM of the signal source.

4. Waveguide Mixer/Spectrum Analyzer System

The reference level is calibrated to compensate for the nominal conversion loss of the waveguide mixers in each waveguide band. Slight variations between mixers result in an amplitude accuracy of approximately ±6 dB, including the ±3 dB frequency response of each mixer. The absolute power level accuracy of each waveguide mixer/spectrum analyzer system can be calibrated to within 3 dB by using the reference level offset so the display amplitude is correct for the known level of an external input signal. Readjust the instrument with <SHIFT> CAL when again using the bands below 21 GHz.

5. Measurements Outside Specified Frequency and Tuning Range vs Display Span

Signal level or frequency measurements outside the specified frequency range of the band are not reliable. In wide spans the total span of the display can exceed the frequency range; for example, the display extends below the 1.7 GHz lower limit of Band 2 and below the 15 GHz limit of Band 5 (15 to 21 GHz). The center frequency tuning range corresponds to the specified frequency range of the band. It can be confusing if a displayed signal, outside the frequency range of the band, will not tune to center screen.

The frequency range for external mixer bands is equal to the frequency range of the waveguide mixers.

6. Level of Pulsed Signals

The spectrum for a pulsed signal is spread out. Consequently, the height of the crt response is less for a pulsed signal than for a cw signal of the same peak amplitude. This loss in display height means, in effect, a loss in sensitivity. The amount of loss can be computed from the following formula.

Voltage loss = $(t_o B)(1.5)$
where t_o = pulse duty cycle
B = resolution bandwidth

The power of the self-generated noise increase is proportional to bandwidth. Pulsed RF voltage level is also proportional to bandwidth. Since power is proportional to voltage squared, a wider bandwidth gives better sensitivity and greater dynamic range for pulsed RF inputs.

When in doubt about signal level overdrive problems, reduce the signal level by inserting RF attenuation; then, repeat the measurement. If the two agree, the measurement is correct; if not, the input mixer stage is probably overdriven.

An important consideration for pulsed RF measurements is the peak signal level at the mixer. The signal level is greater by $(t_o B)(1.5)$ than the peak level displayed on the crt. Taking the sensitivity loss into account is the only way of being sure that the mixer peak power input for linear operation is not exceeded.

7. Level of Continuous Wave Signals

Problems similar to those described in 6 can occur when analyzing cw signals at relatively narrow span widths. The large cw signal may not appear on screen because its frequency is outside the set span width. The mixer, nevertheless, is saturated and will compress signals.

8. Excessive Input Signal Level

Too much input power will destroy the front-end mixer or attenuator. Replacement mixers and attenuators are costly. When working with high power signals, use couplers or other devices to reduce the signal down to acceptable levels. Once the signal is down below the rating of the RF attenuator, prevent possible mixer damage by starting with MIN RF ATTEN dB at 20 dB, then reduce attenuation if needed.

9. No Crt Trace

BASELINE CLIP is used to reduce the brightness of the baseline on the crt for easier viewing of the readout. If TRIGGERING, INTENSITY, and vertical POSITION all seem to be in order and there is no crt trace, check the status of BASELINE CLIP; the trace may be turned off.

10. PEAK/AVERAGE

PEAK/AVERAGE should normally be fully counterclockwise so narrow signals in wide spans are not reduced in amplitude.

11. Digital Storage Effects on Signal Analyses

When using digital storage, the display is divided into storage slots. For peak displays, above the cursor (horizontal line) the display point in each slot corresponds to the maximum sampled value of the signal. Samples are taken at about 9 μs intervals. When sweeping at 1 second per division, this is about 1000 samples per slot. For average displays, below the cursor) the values of all samples per slot are added and divided by the number of samples to compute the display point for each slot. Each display point is connected to create a smooth display. When A or B memory are displayed independently, only half of the slots are connected. The following are a few pitfalls that can occur.

If the cursor set by PEAK/AVERAGE is above the signal level, the average value for each digital slot will be displayed. With narrow resolution bandwidths compared to the slot width, the average value of the resolution response shape will be displayed, which has nothing to do with signal amplitude.

To avoid the above pitfalls, run digital storage with A and B interlaced. Do not set the PEAK/AVERAGE cursor to average a cw signal. It is best if the cursor is about 1/4 division above the signal to be averaged and about 1/2 division below the signal to be analyzed.

None of these restrictions apply when the resolution bandwidth is wide compared to a digital storage slot (e.g., 5 MHz/div with 1 MHz resolution).

12. Stored Display Averaged in Wide Spans

When operating in wide spans with digital storage, low level signals will be averaged with the noise and lost if the PEAK/AVERAGE cursor is above the display. Turn the control fully counterclockwise for peak detection when operating with wide spans.

13. TRIGGERING

TRIGGERING is set to FREE RUN for most applications. In pulsed RF applications, a triggered display is required to measure between pulse repetition lines to determine the pulse repetition rate.

Internal triggering requires one or more divisions of signal amplitude. Tune the center frequency so a reasonably-sized signal is located at the sweep start before changing the trigger source from FREE RUN to INT.

SERVICE INFORMATION

Service Manual

The spectrum analyzer Service Manuals are separate optional publications. The Service Manual, Volume 1, includes circuit descriptions, troubleshooting information, calibration procedures, and maintenance procedures. The Service Manual, Volume 2, includes the electrical and mechanical parts lists, standard and optional accessories, and schematic diagrams. Service Manuals are intended for use by QUALIFIED SERVICE PERSONNEL ONLY. To avoid electrical shock, DO NOT perform any servicing unless qualified to do so. Service personnel should read the Safety information at the beginning of the Service Manuals before performing any servicing.

Product Service

To assure adequate product service and maintenance for our instruments, Tektronix, Inc. has established Field Offices and Service Centers at strategic points throughout the United States and in all other countries where our products are sold. Contact your local Service Center, representative, or sales engineer for details regarding Warranty, Calibration, Emergency Repair, Repair Parts, Scheduled Maintenance, Maintenance Agreements, Pickup and Delivery, On-Site Service for fixed installations, and other services available through these centers.

Emergency Repair

This service provides immediate attention to instrument malfunction if you are in an emergency situation. Contact any Tektronix Service center for assistance to get you on your way within a minimum of time.

Maintenance Agreements

Several types of maintenance or repair agreements are available. For example; for a fixed fee, a maintenance agreement program provides maintenance and recalibration on a regular basis. Tektronix, Inc. will remind you when a product is due for recalibration and perform the service within a specified time-frame. Refer to Options M1 through M3 in Section 7 for extended service and warranty options available. Any Service Center can furnish complete information on costs and types of maintenance programs.

OPTIONS

This section describes the options available at this time for the spectrum analyzer. Changes in specifications, if any, are described in this section. Contact your local Tektronix Field Office or representative for additional information and ordering instructions (unless otherwise indicated).

Options are usually factory installed; however, field kits are available for some options. Contact your local Tektronix Field Office or representative for information on field kits and their installation.

Options A1, A2, A3, A4, and A5 (Power Cord Options)

There are five international power cord options offered for the spectrum analyzer (see Table 7-1). The physical descriptions of the cord plugs are illustrated in Figure 7-1. For ordering purposes, refer to the Replaceable Mechanical Parts list in the Service Manual, Volume 2, for the Tektronix Part Number.

Table 7-1

POWER CORD OPTIONS

Option	Description
A1	European, 220 V/50 Hz @ 16A
A2	United Kingdom, 240 V/50 Hz @ 13A
A3	Australian, 240 V/50 Hz, @ 10A
A4	North American, 240 V/60 Hz, @ 15A
A5	Swiss, 220 V/50 Hz, @ 10A

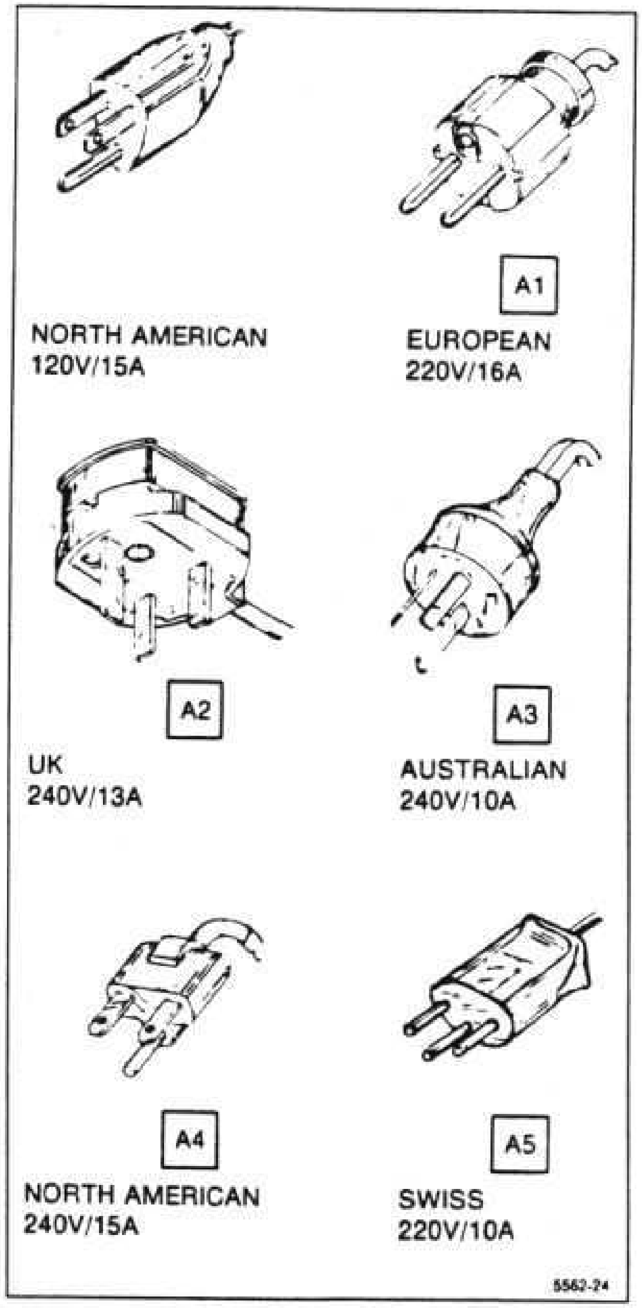


Figure 7-1. International power cord options for the spectrum analyzer.

Option B1 (Service Manuals)

Option B1 provides for a set of optional service manuals for the spectrum analyzer.

Options M1, M2, and M3 (Extended Service and Warranty Options)

There are three extended service and warranty options offered for the spectrum analyzer (see Table 7-2) that go beyond the basic one-year coverage. Contact our local Tektronix Field Office or representative for additional information to satisfy your specific requirements.

Table 7-2

EXTENDED SERVICE AND WARRANTY OPTIONS

Option	Description
M1	Two routine calibrations to published specifications; one each in years two and three of warranty coverage, plus two years remedial service
M2	Four years remedial service
M3	Four routine calibrations to published specifications; one each in years two, three, four, and five of product ownership, plus four years of remedial service

Option 07

Option 07 provides an optional 75Ω input and +20 dBmV calibrator in addition to the standard 50Ω input and +20 dBm calibrator. This optional input replaces the external mixer capability. Table 7-3 lists the changes and additions to the standard instrument electrical characteristics. These characteristics apply to the 75Ω Input.

Table 7-3

OPTION 07 ALTERNATE SPECIFICATIONS

Characteristic	Performance Requirement	Supplemental Information
INPUT Input Impedance Return Loss 5 MHz–800 MHz		75Ω 17 dB (1.35:1 VSWR)
800 MHz–1000 MHz		13 dB (1.6:1 VSWR) with ⩾10 dB attenuation
Maximum Input Level With 0 dB Attenuation		+75 dBmV
With 20 dB or More Attenuation		78 dBmV, 100 V_{dc} maximum (dc + peak ac)
FREQUENCY Center Frequency Operating Range		1–1000 MHz
Static Resolution Bandwidth	Within 20% of 300 kHz bandwidth (6 dB down)	300 kHz resolution filter replaces the standard instrument 100 kHz filter.
Frequency Response 5 MHz–1000 MHz Coaxial Input	±2.0 dB	Measured about the midpoint between the two extremes with ⩾10 dB RF attenuation. The response figure includes the effects of: • input vswr • gain variations
1 MHz–5 MHz		Typically <3 dB down from the 5 MHz response
AMPLITUDE Reference Level Range (with 0 reference level offset)		−68 dBmV to +89 dBmV +99 dBmV is achievable in MIN NOISE mode

Table 7-3 (Continued)

OPTION 07 ALTERNATE SPECIFICATIONS

Characteristic	Performance Requirement	Supplemental Information
SENSITIVITY Equivalent Input Noise Sensitivity 5 MHz – 1000 MHz 75 Ω INPUT 10 Hz	−85 dBmV	Measured at 25°C with • 0 dB attenuation (Min Atten 0 dB) • VIDEO FILTER NARROW on • VERTICAL DISPLAY 2 dB/DIV (5 dB/div in 10 Hz RBW) • DIGITAL STORAGE on • MAX HOLD off • PEAK/AVERAGE in Average • 1 sec TIME/DIV • ZERO SPAN on • Input terminated
100 Hz	−76 dBmV	
1 kHz	−66 dBmV	
10 kHz	−56 dBmV	
300 kHz	−41 dBmV	
1 MHz	−36 dBmV	
3 MHz	−31 dBmV	
50 Ω INPUT		
300 kHz		
Band 1	−90 dBmV	
Bands 2 & 3	−84 dBmV	
Band 4[a]	−70 dBmV	
Band 4[b]	−65 dBmV	
Band 5	−65 dBmV	
OUTPUT Calibrator Output (CAL OUT) Level (phase locked to reference oscillator)	+20 dBmV, ±0.5 dB at 100 MHz	100 MHz comb of markers provide amplitude calibration
Impedance		75Ω nominal

[a]5.4GHz to 12 GHz
[b]12 GHz to 18 GHz

Option 08

Option 08 deletes the external mixer capability. The frequency range is 10 kHz to 21 GHz.

Options 21 and 22

Option 21 includes a set of two high-performance waveguide mixers (18–40 GHz). Option 22 includes a set of three high-performance waveguide mixers (18 to 60 GHz). Both options also include an interface cable and a diplexer assembly. See Table 7-4 for characteristics. To order, refer to the back of the Replaceable Mechanical Parts list in the Service Manual, Volume 2, for the Tektronix Part Number.

NOTE

The characteristics in Table 7-4 for Options 21 and 22 assume that the waveguide mixer is connected to a continuous wave signal source and that PEAK/AVERAGE is adjusted for maximum signal amplitude. The signal must be stable (not frequency modulated more than the resolution bandwidth); otherwise, frequency response performance cannot be met.

Table 7-4

OPTIONS 21 AND 22
(WAVEGUIDE MIXERS) ALTERNATE SPECIFICATIONS

Characteristic	Description
SENSITIVITY Equivalent Input Noise Sensitivity Frequency Range Noise @ 1 kHz Bandwidth (Maximum) 18.0–26.5 GHz	−100 dBm
26.5–40.0 GHz	−95 dBm
40.0–60.0 GHz (Option 22 only)	−95 dBm
Frequency Response 18.0–26.5 GHz	±2.0 dB referenced to 100 MHz, ±6.0 dB
26.5–40.0 GHz	±2.0 dB referenced to 100 Hz, ±6.0 dB
40.0–60.0 GHz (Option 22 only)	±2.5 dB referenced to 100 Hz, ±6.0 dB
PHYSICAL Weight with standard accessories, except manuals Option 21	Adds 3 pounds to weight of standard instrument.
Option 22	Adds 3 pounds, 0.03 ounces to weight of standard instrument.

Option 31

Option 31 provides the cabling necessary to access all the front-panel connectors at the cabinet rear panel. Because of the extra cabling, frequency response flatness may degrade at the high end of the frequency range.

Table 7-5

OPTION 31 CHARACTERISTICS AND ALTERNATE SPECIFICATIONS

Characteristic	Description
FREQUENCY Residual FM	Degrades according to rack frame, typically by a factor of two
AMPLITUDE Frequency Response	Typically 1.5 dB more variation
Residual Spurious Responses	−90 dBm or less

Table 7-5 (Continued)
OPTION 31 CHARACTERISTICS AND ALTERNATE SPECIFICATIONS

Characteristic	Performance Requirement	Supplemental Information
Sensitivity Frequency Range 10 kHz–1.8 GHz	−85 dBm	Equivalent maximum input noise for the 100 kHz resolution bandwidth
1.7–7.1 GHz	−84 dBm	
5.4–12 GHz	−80 dBm	
12–18 GHz	−75 dBm	
15–21 GHz	−75 dBm	

Option 39

Option 39 provides silver batteries for the instrument's battery-powered memory. The battery life at +55°C is 1–2 years and 2–5 years at +25°C. We recommend removing the silver batteries during long-term storage.

Option 41

Option 41 provides extra measurement capabilities for Digital Microwave Radio. Table 7-6 lists the changes from the standard instrument.

Table 7-6

OPTION 41 ALTERNATE SPECIFICATIONS

Characteristic	Performance Requirement	Supplemental Information
FREQUENCY Frequency Span/Div Accuracy	5 MHz/div, within ±1%	Measured over the center 6 divisions of the display
Video Filter Narrow		30 Hz (1/3000th) with 100 kHz resolution bandwidth
Preselector Filter Bandwidth		30 MHz minimum from 1.7 GHz to 5 GHz; 35 MHz minimum from 5 GHz to 16 GHz; 45 MHz minimum from 16 GHz to 21 GHz

Option 42

This option provides a 110 MHz IF output with bandwidth greater than 5 MHz for broadband, swept receiver applications. Table 7-7 lists the changes from the standard instrument.

Table 7-7

OPTION 42 ALTERNATE SPECIFICATIONS

Characteristic	Performance Requirement	Supplemental Information
FREQUENCY Center Frequency	108.5 MHz to 111.5 MHz	
3 dB Bandwidth	⩾5 MHz	
Bandpass Ripple	⩽0.5 dB	
Symmetry about 110 MHz	±1.0 MHz	
POWER Power Out With −30 dBm Input and Signal at Full Screen	Nominal output impedance is 50 Ω 1 dB compression of output ⩾0 dBm, in Minimum Distortion Mode only	
Band 1	⩽0 dBm	
Band 5	⩾−40 dBm	

Option 45

This option provides the spectrum analyzer with the software/firmware necessary to meet Modular Automated Test Equipment Compatibility Options (MATECO). A MATECO Programmers Manual is included as an accessory with this option.

Option 52

Option 52 provides a North American 220 V configuration with the standard power cord. The fuses are replaced with 2A slow blow.

MANUAL CHANGE INFORMATION

At Tektronix, we continually strive to keep up with latest electronic developments by adding circuit and component improvements to our instruments as soon as they are developed and tested.

Sometimes, due to printing and shipping requirements, we can't get these changes immediately into printed manuals. Hence, your manual may contain new change information on following pages.

A single change may affect several sections. Since the change information sheets are carried in the manual until all changes are permanently entered, some duplication may occur. If no such change pages appear following this page, your manual is correct as printed.

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MANUAL CHANGE INFORMATION

Date: 8-31-87
Product: See list

Change Reference: C1/887
Manual Part No: See List

Product Group: 26

INSTRUMENT	PART NO.	S/N B010170 and up
2756P Operators	070-6317-00	
2756P Service 1	070-6318-00	

Replace Sensitivity table in the Specification Section with the table below.

AMPLITUDE RELATED CHARACTERISTICS

Characteristic	Performance Requirement							Supplemental Information
Sensitivity	Equivalent Input Noise in dBm vs. Resolution Bandwidth							Equivalent maximum input noise for each resolution bandwidth.
Frequency Range	10 Hz	100 Hz	1 kHz	10 kHz	100 kHz •	1 MHz	3 MHz	
10 kHz—1.8 GHz	-134	-125	-115	-105	-95	-85	-80	Measured at 25° C with: • 0 dB attenuation (Min Atten 0 dB) • Narrow Video Filter on • Vertical Display 2dB/Div • Digital Storage on • Max Hold off • Peak/Average in Average • 1 sec Time/Div • Zero Span • Input terminated in 50Ω
1.7 GHz—5.5 GHz& 3.0—7.1 GHz	-125	-119	-109	-99	-89	-79	-74	
5.4 GHz—12 GHz	-111	-105	-95	-85	-75	-65	-60	
12 GHz—18 GHz	# -107	-100	-90	-80	-70	-60	-55	
15 GHz—21GHz	# -106	-99	-89	-79	-69	-59	-54	
18 GHz—26.5 GHz‣	-116	-108	-100	-90	-80	-70	-65	
26.5 GHz—60 GHz‣	-111	-103	-95	-85	-75	-65	-60	
50 GHz—90 GHz‣ (1 kHz Bandwidth)								Typically -95 dBm at 50 GHz, degrading to -85 dBm at 90 GHz.
75 GHz—140 GHz‣ (1 kHz Bandwidth)								Typically -90 dBm at 75 GHz, degrading to -75 dBm at 140 GHz.
110 GHz—220 GHz‣ (1 kHz Bandwidth)								Typically -80 dBm at 110 GHz, degrading to -65 dBm at 220 GHz.
170 GHz—325 GHz‣ (1 kHz Bandwidth)								Typically -70 dBm at 170 GHz, degrading to -55 dBm at 325 GHz.

•Option 07 replaces the 100 kHz filter with a 300 kHz filter.
‣ Specified using external TEKTRONIX High Performance Waveguide Mixers.
 # Revised 9-1-87

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MANUAL CHANGE INFORMATION

Date: 6-01-88	Change Reference: M66071	Eff/SN B010100
Product: See list	Manual Part No: See list	Product Group: 26

INSTRUMENT		PART NO.
494A/AP	Operators	070-5557-01
495/P	Operators	070-5082-00
2753P	Operators	070-6305-00
2754/P	Operators	070-6096-00
2756P	Operators	070-6317-00
492B/BP	Operators	070-5562-01
2755A/AP	Operators	070-6031-01
494A/AP	Service 1	070-5560-00
495/P	Service 1	070-5084-00
2753P	Service 1	070-6306-00
2754/P	Service 1	070-6097-00
2756P	Service 1	070-6318-00
492B/BP	Service 1	070-5565-01
2755A/AP	Service 1	070-6032-01

ADD:

OPTION 43

Option 43 provides a reduced graticule ray tube. This option also enables the main display readout characters to be positioned outside the graticule area.

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MANUAL CHANGE INFORMATION

Date: 11-Sep-91 Change Reference: C1–991

Product: See List Manual Part No.: See List

DESCRIPTION Product Group 2E

Effective for All Serial Numbers:

492A/AP & 492B/BP	070-5562-01,	Operators Manual
494A/AP	070-5557-01,	Operators Manual
495/P (B020100)	070-6888-00,	Operators Manual
497P	070-7677-00,	Operators Manual
2753/P	070-6306-00,	Operators Manual
2754/P	070-6096-00,	Operators Manual
2755/P & 2755A/AP	070-6031-01,	Operators Manual
2756P	070-6317-00,	Operators Manual

Make the following change in your Operators manual:

Section 2 — Specification

Change the 1 dB Compression specification as shown below.

1 dB Compression Point (Minimum) Coaxial Bands	0 dBm	Measured in Min Noise mode with no RF attenution.