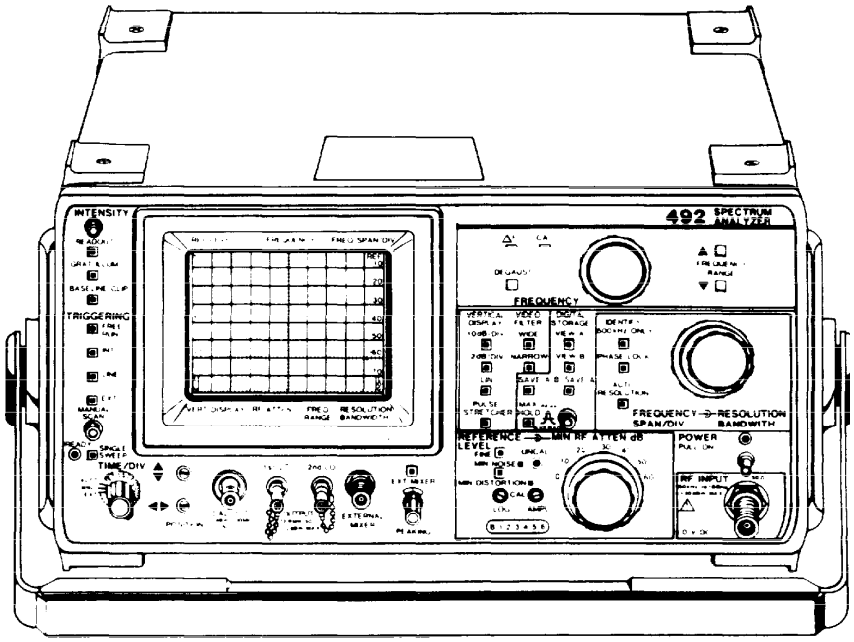
OPERATOR'S AND ORGANIZATIONAL MAINTENANCE MANUAL FOR SPECTRUM ANALYZER AN/USM-489(V)1 (NSN 6625-01-079-9495) (EIC: KND)



HEADQUARTERS, DEPARTMENT OF THE ARMY
15 OCTOBER 1986

5 **SAFETY STEPS TO FOLLOW IF SOMEONE IS THE VICTIM OF ELECTRICAL SHOCK:**

1 **DO NOT TRY TO PULL OR GRAB THE INDIVIDUAL.**

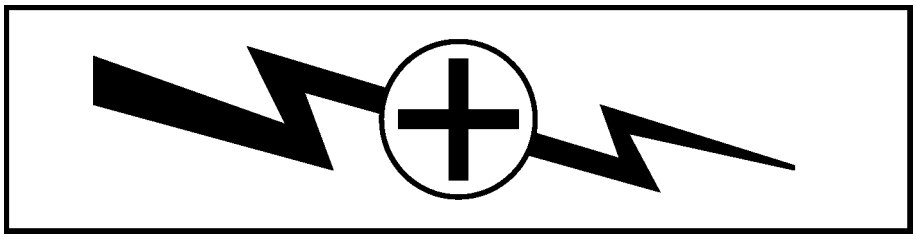
2 **IF POSSIBLE, TURN OFF THE ELECTRICAL POWER.**

3 **IF YOU CANNOT TURN OFF THE ELECTRICAL POWER, PULL, PUSH, OR LIFT THE PERSON TO SAFETY USING A DRY WOODEN POLE OR A DRY ROPE OR SOME OTHER INSULATING MATERIAL.**

4 **SEND FOR HELP AS SOON AS POSSIBLE.**

5 **AFTER THE INJURED PERSON IS FREE OF CONTACT WITH THE SOURCE OF ELECTRICAL SHOCK, MOVE THE PERSON A SHORT DISTANCE AWAY AND IMMEDIATELY START ARTIFICIAL RESUSCITATION.**

WARNING



HIGH VOLTAGE

is used in the operation of this equipment

DEATH ON CONTACT

may result if personnel fail to observe safety precautions

Never work on electronic equipment unless there is another person nearby who is familiar with the operation and hazards of the equipment and who is competent in administering first aid. When technicians are aided by operators, they must warn them about dangerous areas.

Be careful not to contact high-voltage connections of 115 volt ac input when installing or operating this equipment.

Whenever the nature of the operation permits, keep one hand away from the equipment to reduce the hazard of current flowing through the body.

WARNING

Do not be misled by the terms "LOW VOLTAGE." Potentials as low as 50 volts can cause death under certain conditions.

For First Aid, refer to FM 4-25.11.

WARNING

A periodic review of safety precautions in TB 385-4, Safety Precautions for Maintenance of Electrical and Electronic Equipment, is recommended. When the equipment is operated with covers removed, DO NOT TOUCH exposed connections or components. MAKE CERTAIN you are not grounded when making connections or adjusting components inside the test instrument.

WARNING

Hot equipment parts can cause serious burns. Before working on equipment that has just been shut down, allow equipment to cool.

CHANGE
No. 1

Headquarters
Department of the Army
Washington, D.C., 5 December 2006

OPERATOR'S AND ORGANIZATIONAL MAINTENANCE MANUAL
FOR
SPECTRUM ANALYZER
AN/USM-489(V)1
(NSN 6625-01-079-9495) (EIC: KND)

HAZARDOUS MATERIAL INFORMATION – This document has been reviewed for the presence of solvents containing hazardous materials as defined by the EPCRA 302 and 313 lists by the Engineering, Environment, and Logistics Oversight Office. As of the base document, dated 15 October 1986, all references to solvents containing hazardous materials have been removed from this document by substitution with non-hazardous or less-hazardous materials where possible.

OZONE DEPLETING CHEMICAL INFORMATION – This document has been reviewed for the presence of Class I ozone depleting chemicals by the Engineering, Environment, and Logistics Oversight Office. As of the base document, dated 15 October 1986, all references to Class I ozone depleting chemicals have been removed from this document by substitution with chemicals that do not cause atmospheric ozone depletion.

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iii and iv	iii/(iv blank)
1-1 and 1-2	1-1 and 1-2
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TM 11-6625-3136-12
C1

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Cover	Cover

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PETER J. SCHOOMAKER
General, United States Army
Chief of Staff

Official:

JOYCE E. MORROW
Administrative Assistant to the
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A	1	3-24 blank	0
B blank	1	A-1	1
i and ii	1	A-2 blank	1
iii and iv	1	B-1 through B-3	0
1-1 and 1-2	1	B-4 blank	0
1-3 through 1-7	0	B-5 through B-9	0
1-8 blank	0	B-10 blank	0
1-9 through 1-11	0	C-1 through C-3	0
1-12 blank	0	C-4 blank	0
2-1 through 2-17	0	E-1	1
2-18 blank	0	E-2 blank	1
2-19 through 2-40	0	Glosary-1 through Glossary-4	0
3-1	0	Index-1 through Index-4	0
3-2 blank	0		

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TECHNICAL MANUAL
NO. 11-6625-3136-12

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 15 October 1986

OPERATOR'S AND ORGANIZATIONAL MAINTENANCE MANUAL FOR SPECTRUM ANALYZER, AN/USM-489(V)1 (NSN 6625-01-079-9495) (EIC: KND)

REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS

You can help improve this manual. If you find any mistakes or if you know of a way to improve the procedures, please let us know. Mail your letter or DA Form 2028 (Recommended Changes to Publications and Blank Forms) directly to: Commander, U. S. Army Aviation and Missile Command, AMSAM-MMC-MA-NP, Redstone Arsenal, AL 35898-5000. A reply will be furnished to you. You may also provide DA Form 2028 information to AMCOM via email, fax or the World Wide Web. Our fax number is: DSN 788-6546 or Commercial 256-842-6546. Our email address is: 2028@redstone.army.mil. Instructions for sending an electronic 2028 may be found at the back of this manual immediately preceding the hardcopy 2028. For the World Wide Web use: https://amcom2028.redstone.army.mil.

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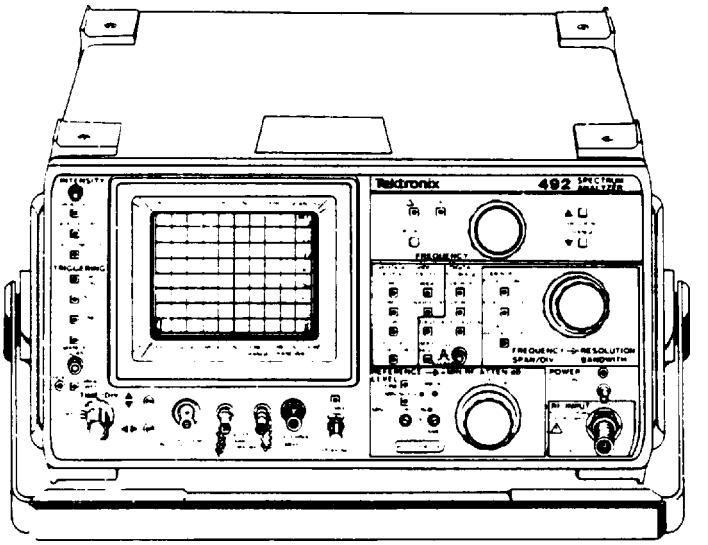
TABLE OF CONTENTS

HOW TO USE THIS MANUAL

This manual tells you about your Spectrum Analyzer, AN/USM-489(V)1, and contains instructions about how to use it while testing and maintaining other equipment.

The technical manual for the equipment you are maintaining will give you some guidance in the correct method to make certain connections when testing and troubleshooting with the Spectrum Analyzer, AN/USM-489(V)1.

When you first receive your Spectrum Analyzer, AN/USM-489(V)1, start at the front of the manual and go all the way through to the back, and become familiar with every part of the manual and the Spectrum Analyzer, AN/USM-489(V)1.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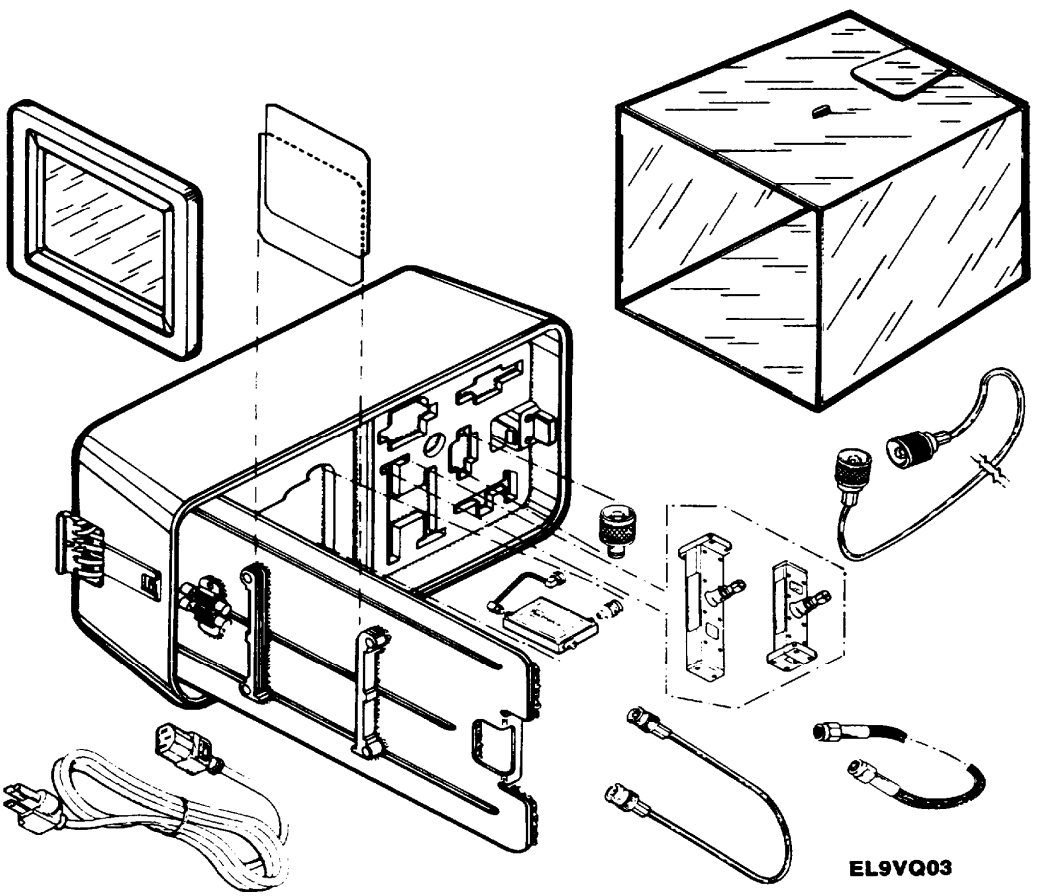
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CHAPTER 1
INTRODUCTION

Section I. GENERAL INFORMATION

1-1. SCOPE

This manual includes procedures for operating, cleaning, inspecting, testing and servicing the equipment, as authorized for operator's and organizational maintenance for Spectrum Analyzer, AN/USM-489(V)1.

1-2. CONSOLIDATED ARMY PUBLICATIONS AND FORMS INDEX

Refer to the latest issue of DA Pam 25-30 to determine whether there are new editions, changes, or additional publications pertaining to the equipment.

1-3. MAINTENANCE FORMS, RECORDS, AND REPORTS

a. Reports of Maintenance and Unsatisfactory Equipment. Department of the Army forms and procedures used for equipment maintenance will be those prescribed by DA Pam 750-8, as contained in The Army Maintenance Management System (TAMMS) Users Manual.

b. Reporting of Item and Packaging Discrepancies. Fill out and forward SF 364 (Report of Discrepancy (ROD)) as prescribed in AR 735-11-2/DLAI 4140.55/SECNAVINST 4355.18A/AFJMAN 23-215.

c. Transportation Discrepancy Report (TDR) (SF 361). Fill out and forward Transportation Discrepancy Report (TDR) (SF 361) as prescribed in DA Pam 750-8.

1-4. DESTRUCTION OF ARMY ELECTRONICS MATERIEL TO PREVENT ENEMY USE

Destruction of Army electronics materiel to prevent enemy use shall be in accordance with TM 750-244-2.

1-5. PREPARATION FOR STORAGE OR SHIPMENT

Preparation instructions for storage and shipment are in Chapter 3, Section V.

1-6. QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

Maintenance standards for Spectrum Analyzer, AN/USM-489(V)1, are outlined in the operator preventive maintenance section and the organizational maintenance chapter of this manual. By performing PMCS and maintenance procedures, quality control of the equipment will be maintained.

1-7. REPORTING EQUIPMENT IMPROVEMENT RECOMMENDATIONS (EIR)

If your Spectrum Analyzer needs improvement, let us know. Send us an EIR. You, the user, are the only one who can tell us what you don't like about your equipment. Let us know why you don't like the design or performance. Put it on an SF 368 (Product Quality Deficiency Report). Mail it to: Commander, US Army Aviation and Missile Command, AMSAM-MMC-MA-NM, Redstone Arsenal, AL 35898-5000. We'll send you a reply.

1-8. WARRANTY INFORMATION

The Spectrum Analyzer is warranted for 12 months. Warranty starts on the date of shipment to the original buyer. Report all defects in material or workmanship to your supervisor, who will take appropriate action.

1-9. NOMENCLATURE CROSS-REFERENCE LIST

Common names will be used when major components of the Spectrum Analyzer, AN/USM-489(V)1, are used in this manual.

NOTE

Official nomenclatures will be used when filling out report forms or looking up technical manuals.

Common Name	Official Nomenclature
Spectrum Analyzer	Spectrum Analyzer, AN/USM-489(V)1

SECTION II. EQUIPMENT DESCRIPTION

1-10 EQUIPMENT CHARACTERISTICS, CAPABILITIES, AND FEATURES

a. Characteristics

- Portable.
- Simplified operation.
- On screen readouts of all major display parameters.
- Microcomputer controlled.

b. Capabilities and Features

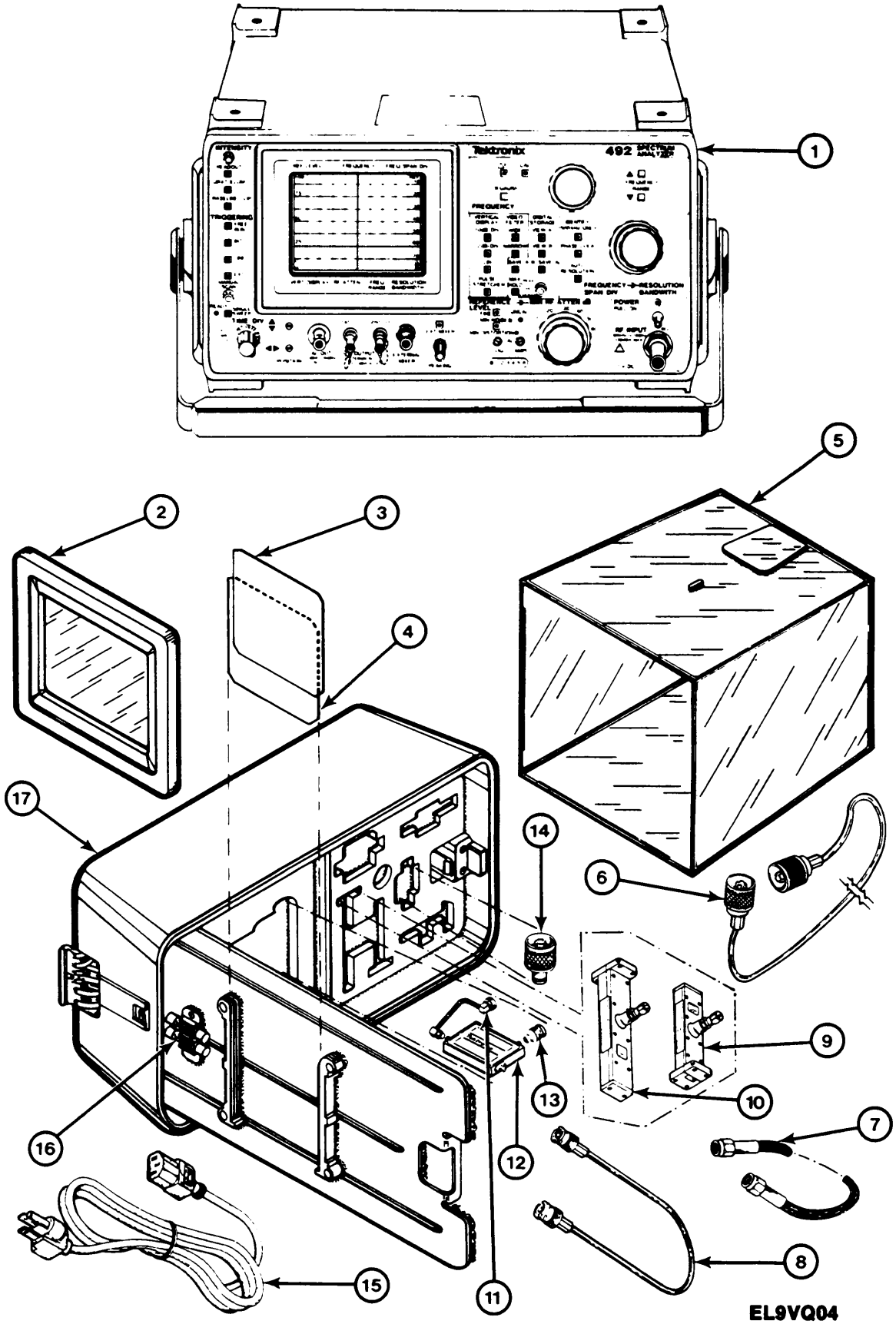
- Displays dynamic range of 80 dB with calibrated reference level readout from -123 dBm to +30 dBm, in 10 dB and 2 dB steps.
- Resolution bandwidths from 100Hz to 1 MHz in decade steps.
- Shape Factor of 7.5:1 or better.
- Intermodulation products are 70 dB or more down.
- Harmonic distortion is down 70 dB or better.
- Sensitivity:

50KHz	to	7.1GHz	—	110 dBm
5.4GHZ	to	18GHZ	—	95 dBm
15GHZ	to	21GHZ	—	85 dBm
18GHz	to	26GHz	—	100 dBm
26GHz	to	40GHz	—	95 dBm

- Frequency Response:

50KHz to 4.2GHz	±1.5 dB
1.7GHz to 7.1GHz	±2.5 dB
5.1GHz to 18GHz	±3.5 dB
15GHz to 21GHz	±5.0 dB
18GHz to 40GHz	±2.0 dB

- Digital storage features peak detection and digital signal averaging.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1-11 LOCATION AND DESCRIPTION OF MAJOR COMPONENTS

SPECTRUM ANALYZER (1)	Supplies a display of the power distribution of an incoming signal as a function of frequency.
FILTER, MESH, EMI (2)	Offers protection against EMI.
FILTER, LIGHT, CRT, AMBER, PLASTIC (3)	Provides color preference.
FILTER, LIGHT, CRT, GRAY, PLASTIC (4)	Provides color preference.
VISOR, CRT, FOLDING (5)	Provides a shade to block out any glare on the CRT.
CABLE "ASSEMBLY, RF, 50 Ω COAXIAL, 72.0 IN. (6)	Connects equipment under test to the spectrum analyzer.
CABLE ASSEMBLY. SMA TO SMA CONNECTORS (7)	Connects equipment under test to the external mixers.
CABLE, ASSEMBLY, RF, 50 Ω COAXIAL, 20.0 IN. (8)	Connects equipment under test to the spectrum analyzer.
WAVEGUIDE MIXER, 26.5–40.0 GHz (9)	Increases equipment range.
WAVEGUIDE MIXER, 18.0–26.5 GHz) (10)	Increases equipment range.
CABLE ASSEMBLY, RF, 50Ω COAXIAL, 3.382 IN. (11)	Connects the diplexer to the external mixer.
WAVEGUIDE MIXER, DIPLEXER (12)	Allows the instrument to analyze more than one signal from more than one transmitter.
ADAPTER, CONNECTOR, TNC MALE TO SMA MALE (13)	Connects diplexer to the spectrum analyzer.
ADAPTER, CONNECTOR, BNC FEMALE TO N MALE (14)	Connects RF input to RF cable assembly.
CABLE ASSEMBLY, POWER; 3, 16 AWG 125 V, 90.0 IN. (15)	Supplies power to the instrument from the 120 V wall socket.
FUSE, CARTRIDGE, 3 AG, 4 A, 250 V, FAST BLOW (16)	Protects the power supply.
COVER, FRONT, PLASTIC, PAINTED (17)	Stores a portion of the major components.

1-12 EQUIPMENT DATA

WEIGHT AND DIMENSIONS

WEIGHT

Net:	44 lbs (20 kg.)
Shipping:	50 lbs. (22.7 kg.)

DIMENSIONS

Height:	6.9 in. (17.5 cm.)
Width:	12.87 in. (32.69 cm.)
Depth:	19.65 in. (49.91 cm.)

OPERATING CHARACTERISTICS

Power:	90 to 132 VAC or 180 to 250 VAC, 48 to 440KHz 210 W.
Operating Temperate:	–59° to 131° F (-15° to 55° C).
Operating Altitude:	15,000 feet.
Non-Operating Altitude:	40,000 feet.

PERFORMANCE CHARACTERISTICS

FREQUENCY RELATED

Center Frequency Range (Internal Mixer)	50KHz to 21GHz.
Frequency Accuracy	±0.2% or 5MHz, whichever is greater, +20% of span/div.
Frequency Readout Resolution	Within 1 MHz.
Frequency Span Accuracy	±5% of span/div measured over center eight divisions.

Frequency Span/Div (Range)

BAND	NARROW SPAN	WIDE SPAN
BAND 1–3 (0–7.lGHz)	500Hz/Div	200MHz/Div
BAND 4—5 (5.4–21GHz)	500Hz/Div	500MHz/Div
BAND 6 (18—26GHz)	500Hz/Div	1GHz/Div
BAND 7 (26-40GHz)	500Hz/Div	2GHz/Div

Two additional positions provide full band display (MAXspan) or OHz (Time domain display.)

Resolution Bandwidth (-6 dB) Points	100Hz in decade steps, plus an AUTO position. Resolution is within 20940 of selected bandwidth.
Resolution Shape Factor (60/6 dB)	7.5:1 or less.
Residual FM	1 KHz peak-to-peak for 2 ms time duration, improves to (50 Hz) for 20 ms with phaselock.
Long Term Drift (at constant temperature and fixed center frequency)	200KHz/hour unphaselocked, 15KHz/30 minutes phase-locked for fundamental mixing.

SPURIOUS RESPONSE

Residual (no input signal referenced to mixer input)	–100 dBm or less.
Harmonic Distortion (CW signal, MIN distortion mode)	At least -60 dBc for full screen signal in the MIN Distortion mode to 21 GHz. At least – 100 dBc for preselected.
LO Emissions (referenced to input mixer)	–70 dBm maximum.

AMPLITUDE RELATED	
Reference Level Range	Full screen, top of graticule -123 dBm to +40 dBm (+40 dBm, includes maximum safe input of +30 dBm and 10 dB gain of IF gain reduction) for 10dB/ div and 2 dB/div log modes. 20 nV/div to 2 V/div (1 W maximum safe input) in the linear mode.
Reference Level Steps	10 dBm, 1 dB, and 0.25 dB for relative level (A) measurements in log mode. 1-2-5 sequence and 1 dB equivalent increments in LIN mode.
Display Dynamic Range	80 dB @ 10 dB/div, 16 dB @ 2 dB/div and 8 divisions in linear mode.
Display Amplitude Accuracy	±1 dB/10 dB to maximum of ±2 dB/80 dB; ±0.4 dB/2 dB to maximum of ±1 dB/16 dB; ±5 of of full screen in LIN mode.
RF Attenuator Range	0 to 60 dB in 10 dB steps.
Resolution Bandwidth Gain Variation	±0.5 dB.
Input Signal Characteristics	RF Input — Type N female connector.
Input Impedance	50 Ω,VSWR 1.45 to 18GHz, and 3.5 to 21GHz, with 10 dB or more attenuation.
Input Level (Optimum Level for Linear Operation)	–30 dBm referenced to input mixer. Full screen not exceeded and MIN Distortion control settings.
1 dB Compression Point	-28 dBm from 1.7 to 2GHz.
Maximum Safe Input Level (RF attenuation at zero dB)	+30 dBm (1W).
Maximum Input Level (with 20 dB or more RF attenuation)	+30 dBm (1W) continuous, 75 W peak for 1 µs or less pulse width and 0.001 maximum duty factor (attenuation limit). DC must never be applied to RF input.
OUTPUT CHARACTERISTICS	
Calibrator (Cal Out)	-20 dBm ±0.3 dB at 100 MHz ±1.7KHz.
1 ST and 2 ND L O	Provides access to the output of the respective local oscillators (1st LO + 7.5 dBm minimum to a maximum of +15 dBm, 2nd LO -16 dBm minimum to a maximum of +15 dBm). These ports must be terminated in 50 Ω at all times.

1-13 SAFETY, CARE AND HANDLING

Observe all WARNINGS, CAUTIONS and NOTES in this manual. This equipment can be extremely dangerous if these instructions are not followed.

SECTION III. PRINCIPLES OF OPERATION

1-14 GENERAL FUNCTIONAL DESCRIPTION

Spectrum Analyzer AN/USM-489(V)1 accepts signals (from 50 KHz to 40 GHz) and displays frequency components on the CRT. Signals can be applied to the RF INPUT or the EXTERNAL MIXER, which extends the measurement range of the instrument.

The frequency component display of the input signal appears on the CRT as a graph where the horizontal axis is frequency and the vertical axis is amplitude.

(1) First, Second and Third Converters each have a mixer, local oscillator and filters. One frequency can be converted in each mixer and pass through all bandpass filters and reach the detector. This analysis frequency is changed by simply changing the frequency of any of the local oscillators in the converters.

The front end (the first converter) converts the input signal frequency to an intermediate frequency (IF) of either 829 MHz or 2072MHz, depending on which band is in use. The internal mixer covers signals from 50 KHz to 21 GHz. An external mixer may be required for analysis of the millimeter wavelengths. When the internal mixer is used, a preselector and lowpass filter attenuate unwanted signals.

The AN/USM-489(V)1 actually has 2 second converters. The correct converter is automatically selected for each band so the input frequency range does not overlap the first IF frequency. Each of the second converters has its own local oscillator (LO), mixer, and filters. The signal is converted by the second converter to 110MHz and is sent to the third converter.

The third converter passes the signal to the IF section for detection after amplifying the 110MHz IF signal and converting it to the final intermediate frequency of 10MHz.

(2) The IF section analyzes the amount of power present in the frequency component converted to 10MHz. These functions are performed here:

- Weak signals are amplified to allow for analysis. By amplifying the signal, the vertical window (dynamic display range) is shifted up or down.
- The RESOLUTION BANDWIDTH control selects one of several 10MHz band pass filters to pass the signal. Narrow bandwidths require longer sweep times but because of greater selectivity, too closely spaced signals can be better resolved. The microcomputer, unless overridden by the operator, will select the best combination of bandwidth and sweep time.
- A combination of a logarithmic amplifier and a linear amplitude detector detect the remaining signal. The output voltage of the combination corresponds to the signal strength in decibels. The amplitude detector output is sent to the display section vertical channel to show the strength of the particular component.

(3) The Display Section draws the display on the CRT. Vertical deflection of the beam is increased as the output of the amplitude detector increases. The horizontal position is controlled by the frequency control section and corresponds to the frequency analyzed at that instant.

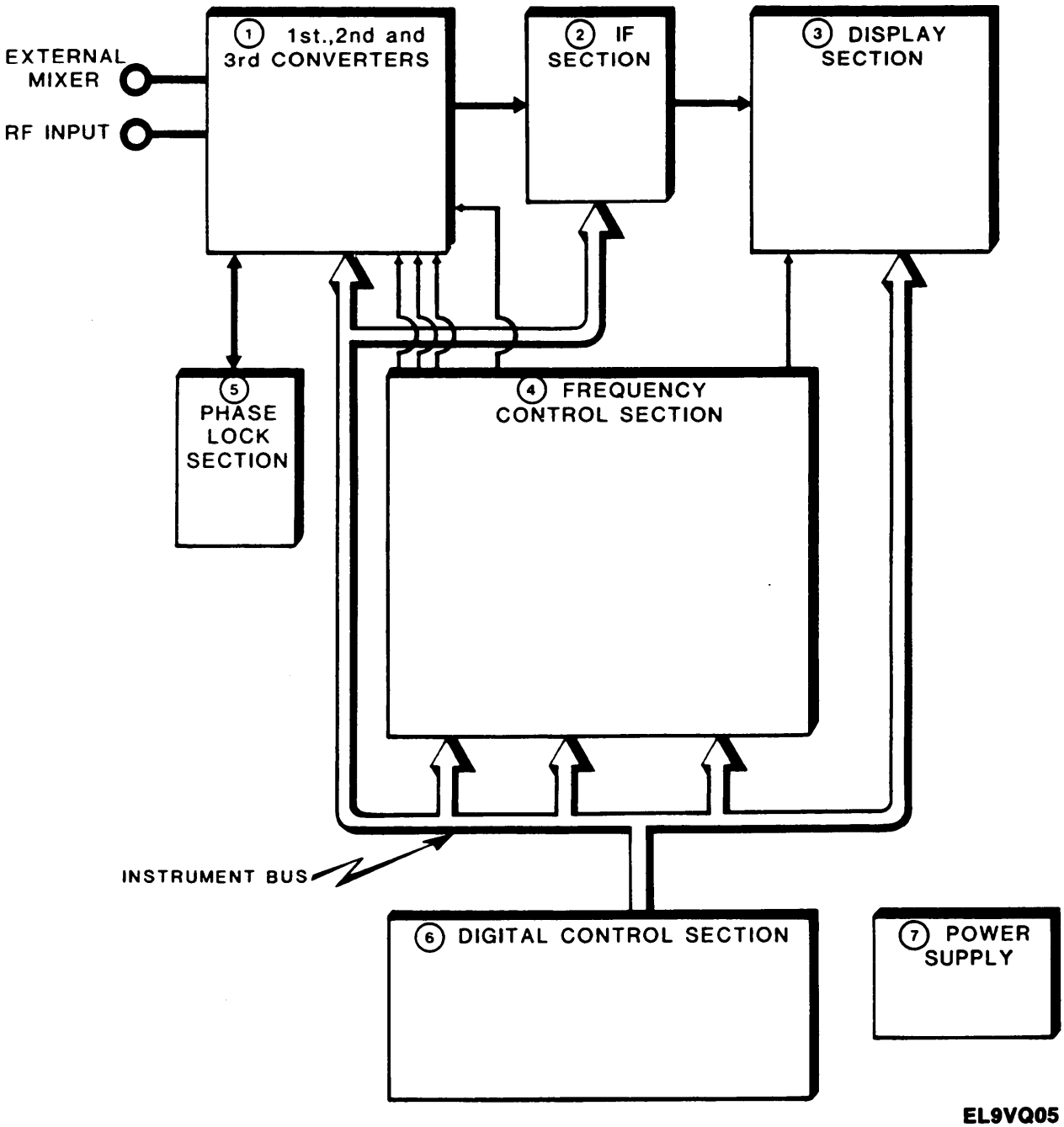
(4) Frequency Control Section. The instantaneous frequency analyzed is controlled by local oscillator frequencies. To analyze another frequency, a local oscillator frequency is changed so that the new frequency is converted by the three converters to 10MHz and passes through the IF section. Only local oscillators of the first two converters are changed to vary the frequency analyzed; the third local oscillator remains fixed.

The instrument periodically sweeps and analyzes a frequency range centered about the frequency set by the FREQUENCY knob. This knob tunes the first and second local oscillators. The sweep generator and span attenuator generate the analyzer sweep. The trace is deflected across the CRT as the sweep generator sweeps through its range. The span attenuator controls the frequency sweep, which scales the sweep according to the current SPAN/DIV. The 1ST LO is driven to sweep the wide spans by the output of the span attenuator. The span attenuator also drives the 2ND LO to sweep narrow spans.

(5) The phaselock section is a frequency control system designed to improve stabilization of the 1ST Local Oscillator.

(6) Digital Control Section. Internal functions are controlled from the front panel through a microcomputer. An internal instrument bus allows communication from the microcomputer to the instrument. Front panel control data goes to the microcomputer on this bus. The microcomputer controls the following circuit functions on this bus: span attenuator, IF gain and CRT readout. The microcomputer receives information from circuit functions such as sweep and phaselock circuitry, on this bus.

(7) The power supply system provides regulated dc power for this instrument. The switching supply is capable of regulation over a wide line of frequency and line voltage ranges.


EXTERNAL MIXER
RF INPUT
1 1st.,2nd and 3rd CONVERTERS
2 IF SECTION
3 DISPLAY SECTION
5 PHASE LOCK SECTION
4 FREQUENCY CONTROL SECTION
INSTRUMENT BUS
6 DIGITAL CONTROL SECTION
7 POWER SUPPLY
EL9VQ05

CHAPTER 2

OPERATING INSTRUCTIONS

SECTION I. DESCRIPTION AND USE OF OPERATOR'S CONTROLS AND INDICATORS

2-1 GENERAL

Before trying to operate the equipment, be sure you know where all control's, indicators and connectors are located, what each does, and what information the indicators are giving.

2-2 CONTROLS, INDICATORS AND CONNECTORS

Operator’s controls, indicators, and connectors of the spectrum analyzer are shown in Figure 2-1, sheets 1 thru 7, and Figure 2-2 and described in Tables 2-1 and 2-2. Most operational functions of AN/USM-489(V)1 are microprocessor controlled and are switch selected, not vernier adjusted.

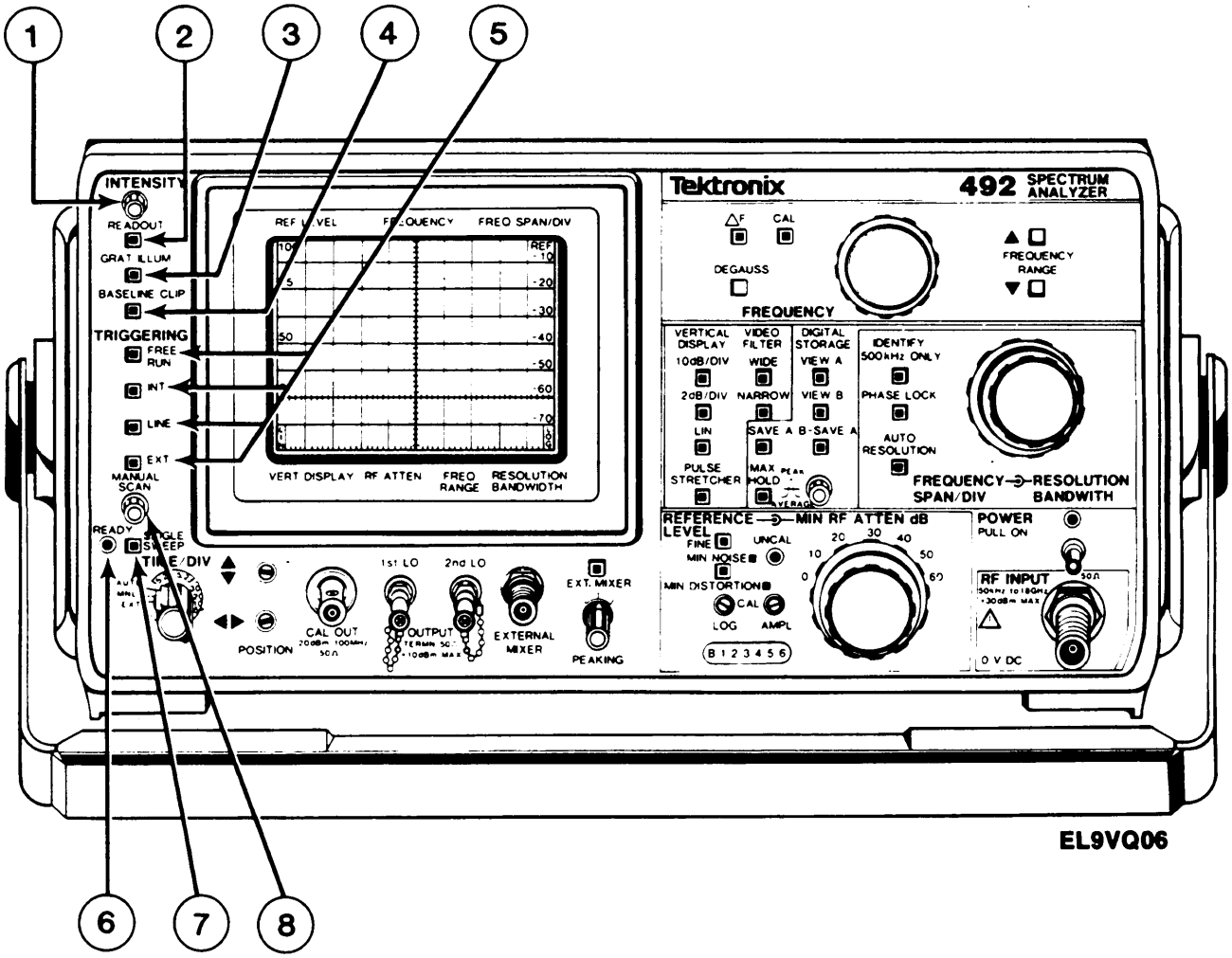


Figure 2-1. (Sheet 1 of 7)

TABLE 2-1. FRONT PANEL CONTROLS, INDICATORS, AND CONNECTORS

KEY	CONTROL OR INDICATOR	FUNCTION
1	INTENSITY	Controls brightness of the CRT trace and CRT readout. Focus is set electronically.
2	READOUT	Turns CRT readout on/off. All spectrum analyzer parameters are read out except Time/Div. The brightness is equal to trace brightness and can be readjusted by service personnel.
3	GRAT ILLUM	Controls graticule light.
4	BASELINE CLIP	When on, the baseline of the display is clipped or subdued to increase contrast between it and the display.
5	TRIGGERING	A triggering mode is chosen by one of four switches that light when selected. A SINGLE SWEEP switch and a READY indicator provide single sweep operation. FREE RUN – When activated, the sweep ignores all trigger signals. When selected, all other triggering modes are canceled. INT — When activated, the sweep is triggered by signals at the left edge of the display with an amplitude of 2.0 divisions or more. Other trigger modes are canceled. LINE — When activated, a sample of the ac power line voltage triggers the sweep. All other modes are canceled. EXT – When selected, the sweep is triggered by signals between 1.0 volt peak (minimum) to 50 volts peak (maximum), applied through the back panel EXT IN HORIZ/TRIG connector. When this function is selected, all other modes are canceled.
6	READY	When SINGLE SWEEP is selected, this indicator lights while sweep circuit is armed and ready for a trigger signal. The indicator stays lit until the sweep ends.
7	SINGLE SWEEP	When selected, one sweep is initiated after the sweep circuit is triggered. Pushing this switch does not cancel the trigger modes. Press the switch to rearm the sweep circuit after the sweep has run. When single sweep mode is first selected, the present sweep is aborted and the sweep circuit is not armed. To cancel single sweep, press any trigger mode switch.
8	MANUAL SCAN	When the TIME/DIV selector is in MNL position, this manually scans the spectrum.

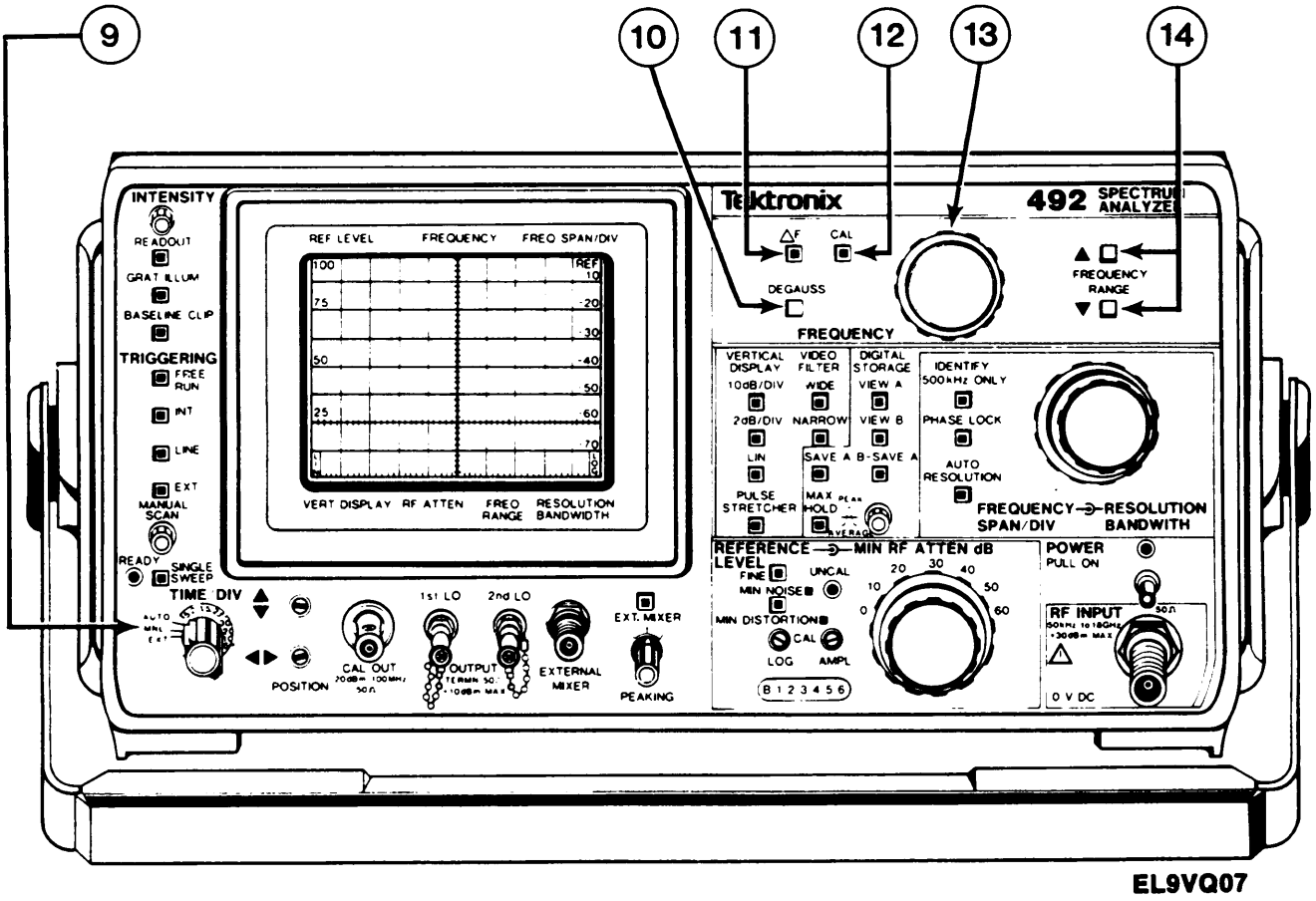
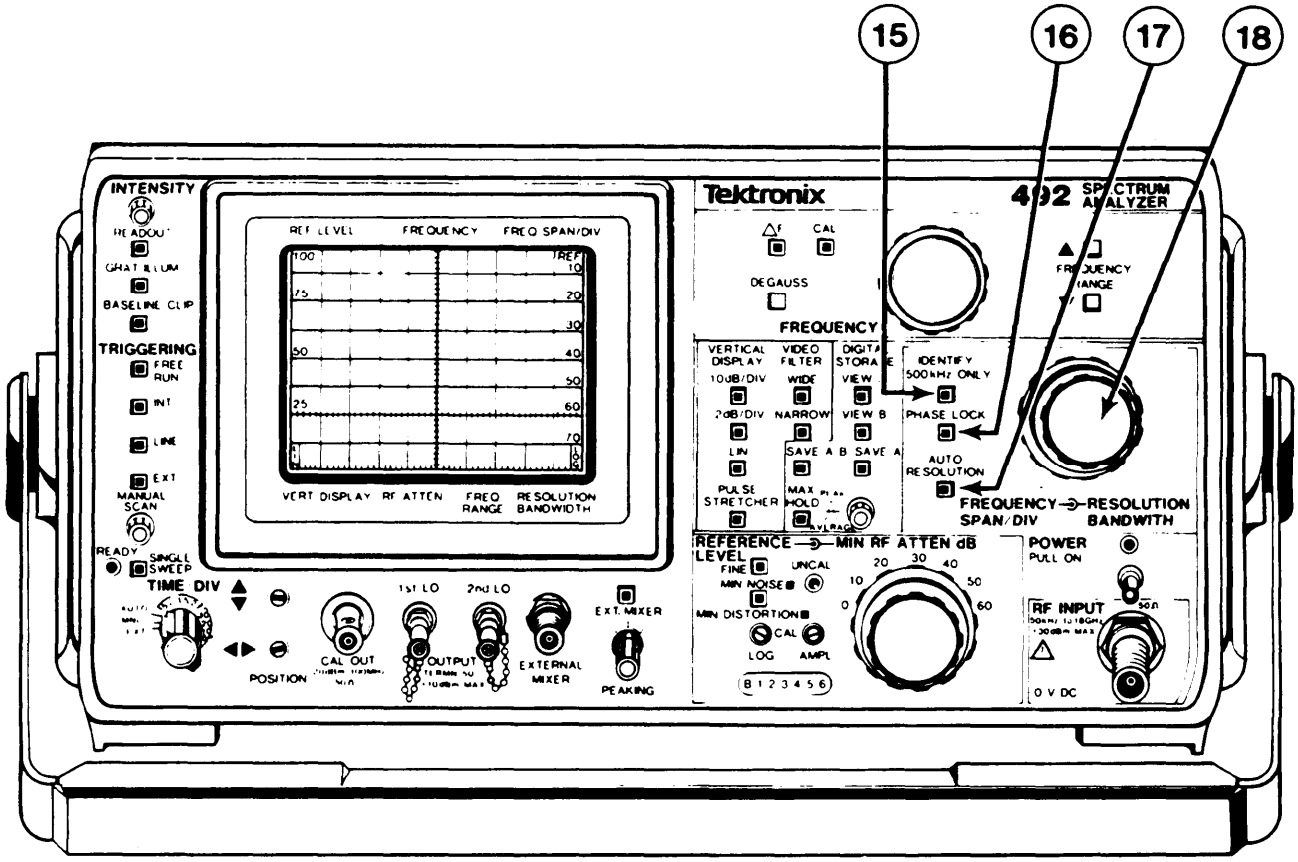


Figure 2-1. (Sheet 2 of 7)

TABLE 2-1. FRONT PANEL CONTROLS, INDICATORS, AND CONNECTORS (CONT'D)

KEY	CONTROL OR INDICATOR	FUNCTION
9	TIME/DIV	Selects sweep rates from 5 s/div to 20 µs/div in 5-2-1 sequence. This also selects AUTO, EXT, and MNL modes. AUTO (Automatic) — In this position, the sweep rate is selected by the microcomputer to hold a calibrated display for any FREQ SPAN/DIV, RESOLUTION, AND VIDEO FILTER combination. EXT (External input) — This position connects the rear panel EXT IN HORIZ/TRIB connector to the horizontal sweep circuit. A voltage ramp of 0 to +10 volts sweeps 10 divisions of the horizontal axis (X). MNL (Manual) — In this position, the horizontal axis can be swept with MANUAL SCAN control.
10	DEGAUSS	When the DEGAUSS switch is pressed, current through the tuning coils of the YIG oscillator (1st LO) and YIG preselector is reduced to zero to lessen hysteresis effects. This improves center frequency and display amplitude accuracy. DEGAUSS does not function when the FREQ SPAN/DIV is less than 1 MHz/Div. Degauss tuning coils after significant frequency changes and before calibrating the center frequency readout.
11	ΔF	A convenience for measuring frequency difference between signals. When chosen, the frequency readout goes to zero. It will read out the deviation from this reference as the FREQUENCY is tuned to the desired second points.
12	CAL	When activated, the frequency readout is calibrated to center frequency by setting the FREQUENCY control to the correct reading. When calibrated, deactivate the CAL mode.
13	FREQUENCY	Tunes center frequency. The tune rate is equal to the selected FREQ SPAN/DIV. The signal moves across the display at a constant rate for all spans. In MAX span, tuning range depends on the band; for example: in Band 2 (1.7 — 5.5GHz) the frequency dot will not tune to the extreme left edge of the graticule; in Band 6 (15 — 21 GHz) the dot tunes only to the right of center. Range of tuning is limited to 4.5 MHz in the narrow spans.
14	FREQUENCY RANGE (band)	These two switches shift center frequency range up or down. Frequency range of the band is shown on the CRT readout.



EL9VQ08

Figure 2-1. (Sheet 3 of 7)

TABLE 2-1. FRONT PANEL CONTROLS, INDICATORS, AND CONNECTORS (CONT'D)

KEY	CONTROL OR INDICATOR	FUNCTION
15	IDENTIFY 500 KHz ONLY	The signal identify feature works when the FREQ/SPAN DIV is 500KHz. When activated (switch lit) true signals change amplitude with each sweep; images and spurious response signals shift horizontally or off screen. To ensure that the signal changes amplitude every sweep, decrease the sweep rate to analyze each sweep. Activate SAVE A, VIEW B. When the true signal is centered. under the dot marker after degauss, the FREQUENCY readout is signal frequency. To degauss, press DEGAUSS at a FREQ SPAN/DIV setting of 1 MHz or 2MHz.
16	PHASE LOCK	The 1^{ST} LO is locked to a stable internal reference and the 2nd LO is swept to a lower residential FM in narrow spans; the switch lights when phase lock is active. In narrow spans, phase lock is turned off or on by pressing the switch. The microcomputer automatically selects phase lock for these spans: BAND — SPAN/DIV 1, 2, 3 — 50KHz and below 4 — 100KHz and below 5 and below — 200KHz and below Switching PHASE LOCK off may cause the signal position to shift. In narrow spans, the signal could shift off screen. The signal usually returns to its phase locked position within minutes.
17	AUTO RESOLUTION	This switch activates automatic bandwidth selection for the selected FREQ SPAN/DIV and TIME/DIV and VIDEO FILTER. An internal microcomputer selects bandwidth to hold a calibrated display. When the TIME/DIV is in AUTO mode, resolution bandwidth is a function of FREQ SPAN/DIV selection.
18	FREQUENCY SPAN/DIV	This continuous detented control selects FREQUENCY SPAN/DIV. SPAN/DIV is indicated by CRT readout. Range of SPAN/DIV selection depends on frequency band and options. When MAX span is selected, the span shows the full band. Sweep beyond the band is clamped to the baseline. A dot marker near the top of the screen indicates position on the span of CRT frequency readout. This dot and frequency point will be center screen when the FREQ SPAN/DIV is reduced below MAX span position. When zero span is chosen, TIME/DIV is read out, not SPAN/DIV.

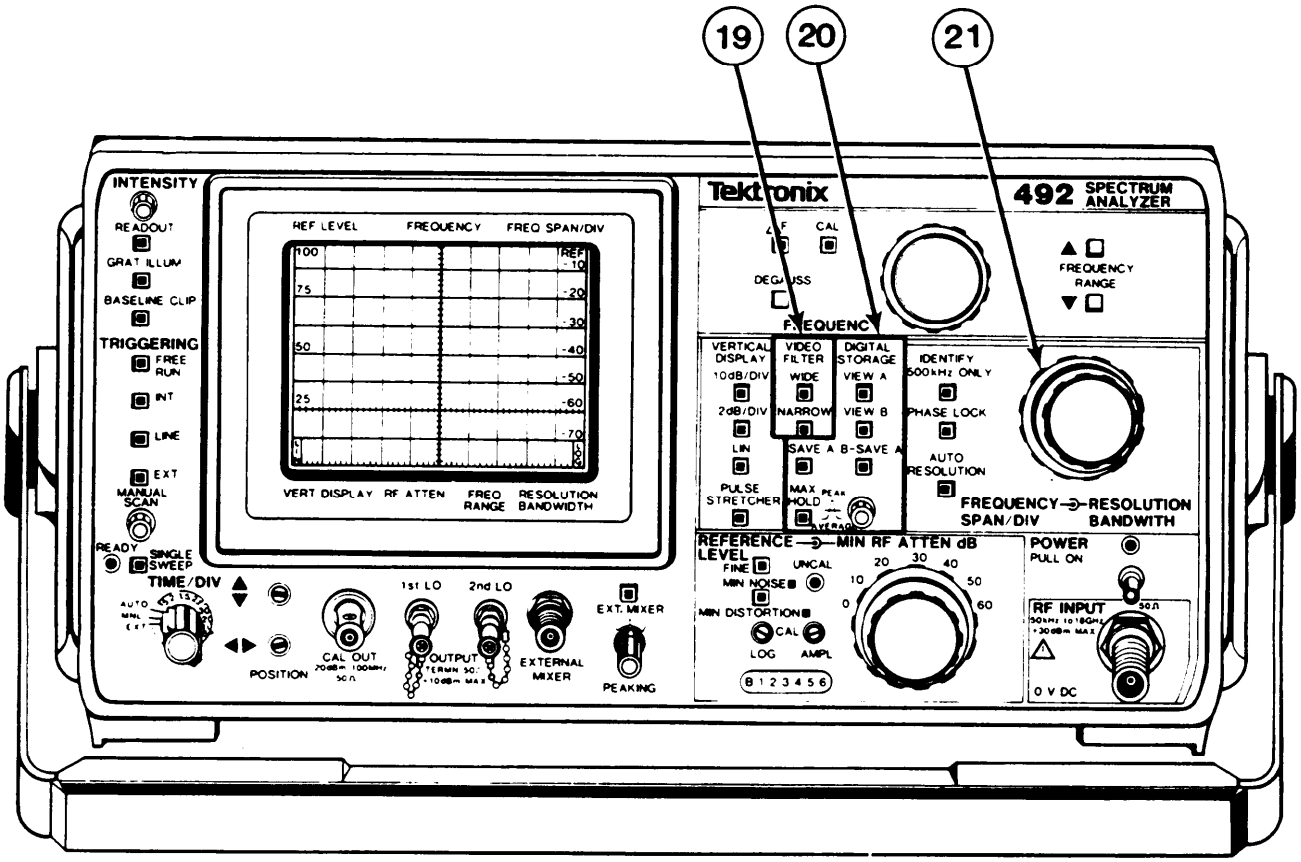


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Figure 2-1. (Sheet 4 of 7)

TABLE 2-1. FRONT PANEL CONTROLS, INDICATORS, AND CONNECTORS (CONT'D)

KEY	CONTROL OR INDICATOR	FUNCTION
19	VIDEO FILTER	One of two filters (NARROW and WIDE) can be activated to reduce video bandwidth and high frequency components for display noise averaging. The NARROW filter is about 1/300 TH of the chosen resolution bandwidth; the WIDE filter is about 1/30 TH the bandwidth. Activating one filter cancels the other. Press the switch again to switch filters off.
20	DIGITAL STORAGE	Five switches and one control operate digital storage functions. With no switches on, the AN/USM-489(V)1 display is not stored. VIEW A, VIEW B — When one or both switches are chosen, the switch lights and contents of memory A and/or memory B are shown. With Save A mode off, memory locations are shown and updated. Data in A memory is combined with data from B memory. SAVE A — When activated, this holds data in A memory and stops further updating. With SAVE A and VIEW A active, data in A memory is displayed but not updated, serving as a reference to compare contents of B memory. B-SAVE A — When activated, the arithmetic difference of data in B memory and the saved data in memory A is shown. SAVE A mode is activated and SAVE A switch is illuminated. The zero difference point is nominally set at middle graticule line with positive differences displayed above this line and negative differences below. (The zero difference position on screen is internally switch selectable.) MAX HOLD — When activated, the digital storage memory holds maximum signal amplitude at each memory location. This permits visual monitoring of signal frequency and amplitude at each memory location over an indefinite period of time. This feature measures drift, stability, and record peak amplitudes. PEAK/AVERAGE — This selects the amplitude where the vertical display is either peak detected or averaged. Video signals below the cursor are digitally averaged and stored.
21	RESOLUTION BANDWIDTH	This continuous detented control selects resolution bandwidth. Bandwidth is indicated by CRT readout. Range of selection is 100Hz to 1 MHz in decade steps. Changing resolution bandwidth this way deactivates AUTO RESOLUTION.

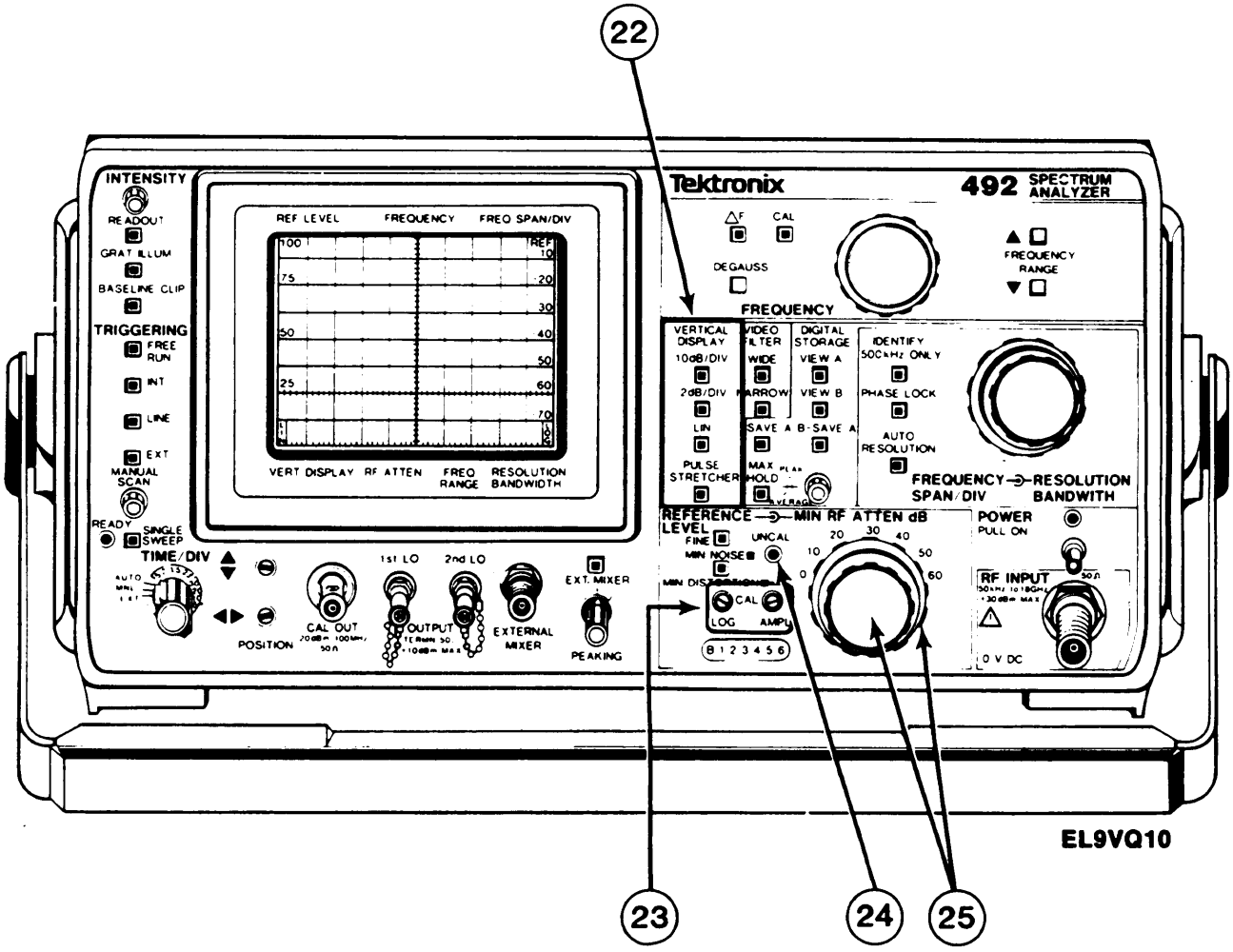


Figure 2-1. (Sheet 5 of 7)

TABLE 2-1. FRONT PANEL CONTROLS, INDICATORS, AND CONNECTORS (CONT'D)

KEY	CONTROL OR INDICATOR	FUNCTION
22	VERTICAL DISPLAY	These four switches choose a display mode. CRT readout indicates scale factor. 10 dB/DIV — When activated, dynamic range of display is a calibrated 80 dB with each major graticule meaning 10 dB. 2dB/DIV — Increases resolution so each major graticule division represents 2 dB. LIN — Selects linear display between zero volts (bottom graticule line) and reference level (top graticule line) scaled in volts/division. ***See REFERENCE LEVEL (25).*** PULSE STRETCHER — Increases the fall time of pulse signals so narrow pulses in a line spectrum display are seen. The effect is apparent for distinct signals analyzed at resolution bandwidths, which are narrow compared to the span; PULSE STRETCHER may be needed for digital storage of such signals, if they are averaged.
23	LOG and AMPL CAL	These adjustments calibrate dynamic range of display. LOG calibrates logarithmic gain in dB/Div, AM PL calibrates reference level of the top graticule line at' the top of the screen.
24	UNCAL	This lights when display amplitude is not calibrated (e.g., selecting a sweep rate not compatible with the frequency span/d iv and resolution bandwidth).
25	MIN RF ATTEN/REFERENCE LEVEL	REFERENCE LEVEL — Concentric controls that set the analyzer reference level one step per detent. In the 10 dB/DIV Vertical Display mode, the steps are 10 dB and 1 dB when FINE is switched on. In the 2 dB/DIV mode, the steps are 1 dB or 0.25 dB for the FINE mode. When FINE is activated in the 2 dB/DIV mode, the AA mode is operational. The REFERENCE LEVEL goes to 0.00 dB then steps in 0.25 dB increments from an initial 0.00 dB reference level. MIN RF ATTEN dB — Chooses the lowest value of attenuation allowed; RF attenuation is set by the microcomputer according to the algorithm chosen by MIN NOISE/MIN DISTORTION. RF attenuation is increased by changing MIN RF ATTEN, and the microcomputer automatically changes IF gain to hold the current reference level.

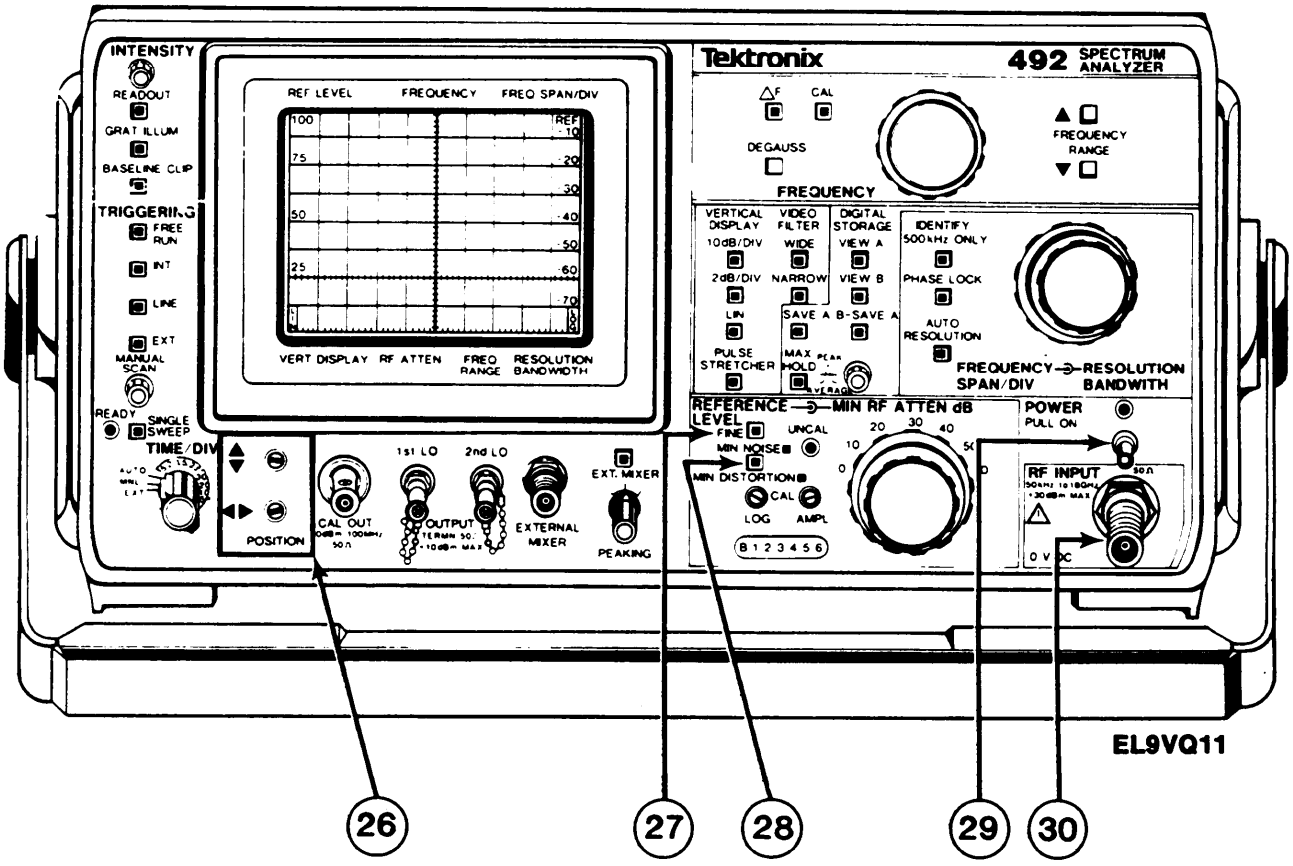


Figure 2-1. (Sheet 6 of 7)

TABLE 2-1. FRONT PANEL CONTROLS, INDICATORS, AND CONNECTORS (CONT'D)

KEY	CONTROL OR INDICATOR	FUNCTION
26	POSITION	These controls position the display on horizontal and vertical axes.
27	FINE	When activated, REF LEVEL switches in 1 dB increments for 10 dB/DIV display mode, and 0.25 dB for 2 dB/DIV display mode. In the 2 dB/DIV display mode, FINE activates ΔA mode to provide differential measurements in 0.25 dB increments. VERTICAL DISPLAY MODE — FINE INCREMENT 10 dB/DIV — 1 dB 2 dB/DIV — 0.25 dB (ΔA mode) LIN — Voltage equivalent to 1 dB
28	MIN NOISE/MIN DISTORTION	One of two algorithms controls attenuator and IF gain. MIN NOISE (switch illuminated) reduces noise level by reducing attenuation 10 dB and lF gain 10 dB. MIN DISTORTION reduces IM distortion, caused by input mixer overload. To observe any change, the RF ATTEN displayed by CRT readout must be 10 dB higher than that set by MIN RF ATTEN selector. In MIN DISTORTION mode (switch unlit) distortion is minimum.
29	POWER	A pull type switch that turns main power supply on.
30	RF INPUT	A 50Ω coaxial input connector for signals 21 GHz or below. With 0 dB attenuation, maximum input level is limited to +13 dBm by input mixer. ***CAUTION*** *With 20 dB or more attenuation, maximum input level is limited to +30 dBm (1 watt average, 75 watts peak, pulse width 1 µs, with a duty cycle that does not exceed 0.001). Burn-out occurs above 1 watt.* *If* MIN NOISE *is activated and* RF ATTEN is 60 *dB, the +30 dBm rating could be exceeded. If input signal level is increased for full screen display, the input level is +40 dBm. Reduce high level signals with external attenuators. Use external attenuators and the* MIN RF ATTEN *to reduce the/eve/into the 1ST mixer to -10 dBm or less. Input voltage to the input mixer must not contain any dc component.*

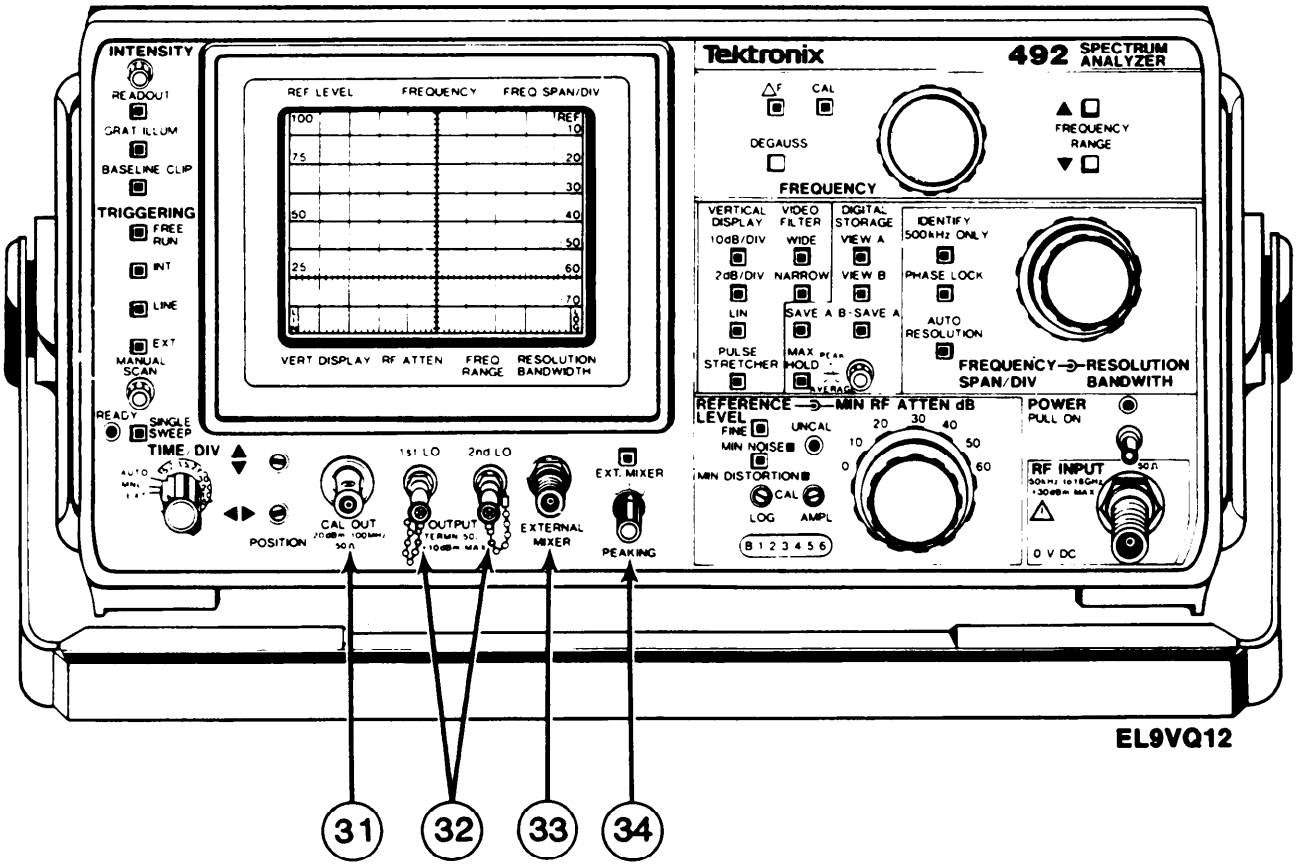


Figure 2-1. (Sheet 7 of 7)

TABLE 2-1. FRONT PANEL CONTROLS, INDICATORS, AND CONNECTORS (CONT'D)

KEY	CONTROL OR INDICATOR	FUNCTION
31	CAL OUT (Calibrator output)	The source of a calibrated -20 dBm (±0.3 dB) 100 MHz (±0.01%) signal, and a comb of frequency markers 100MHz, apart is used as a reference for calibrating the reference level and log scale. The comb of 100 MHz markers is used to check span and frequency readout accuracy.
32	OUTPUT 1ST and 2 ND LO	These connectors provide access to output of respective local oscillators. The connectors must be terminated into 50Ω when they are not connected to some external device.
33	EXT MIXER	When EXT MIXER switch is activated, bias is provided out of the EXT MIXER port for external waveguide mixers. The IF output from the external mixer is applied through the EXT MIXER port to the 2ND converter. ***CAUTION*** *Do not exceed mixer input limits. Too much power can cause signal compression or if excessive, it can destroy the 1sr mixer. Signals greater than -30 dBm or -20 dBm in* MIN NOISE *mode should be attenuated by the* RF ATTENUATOR. *Signals above the safe input level(+30 dBm) must be attenuated by external attenuators. Ensure that the frequency range of external attenuators is adequate.*
34	PEAKING	This varies mixer bias for external mixers in EXT MIXER mode. The control adjusts the preselector tracking for 1.7 to 21 GHz frequency range (Bands 2—5). It is adjusted for maximum signal amplitude. Refer to External Mixer Operation for detailed information.

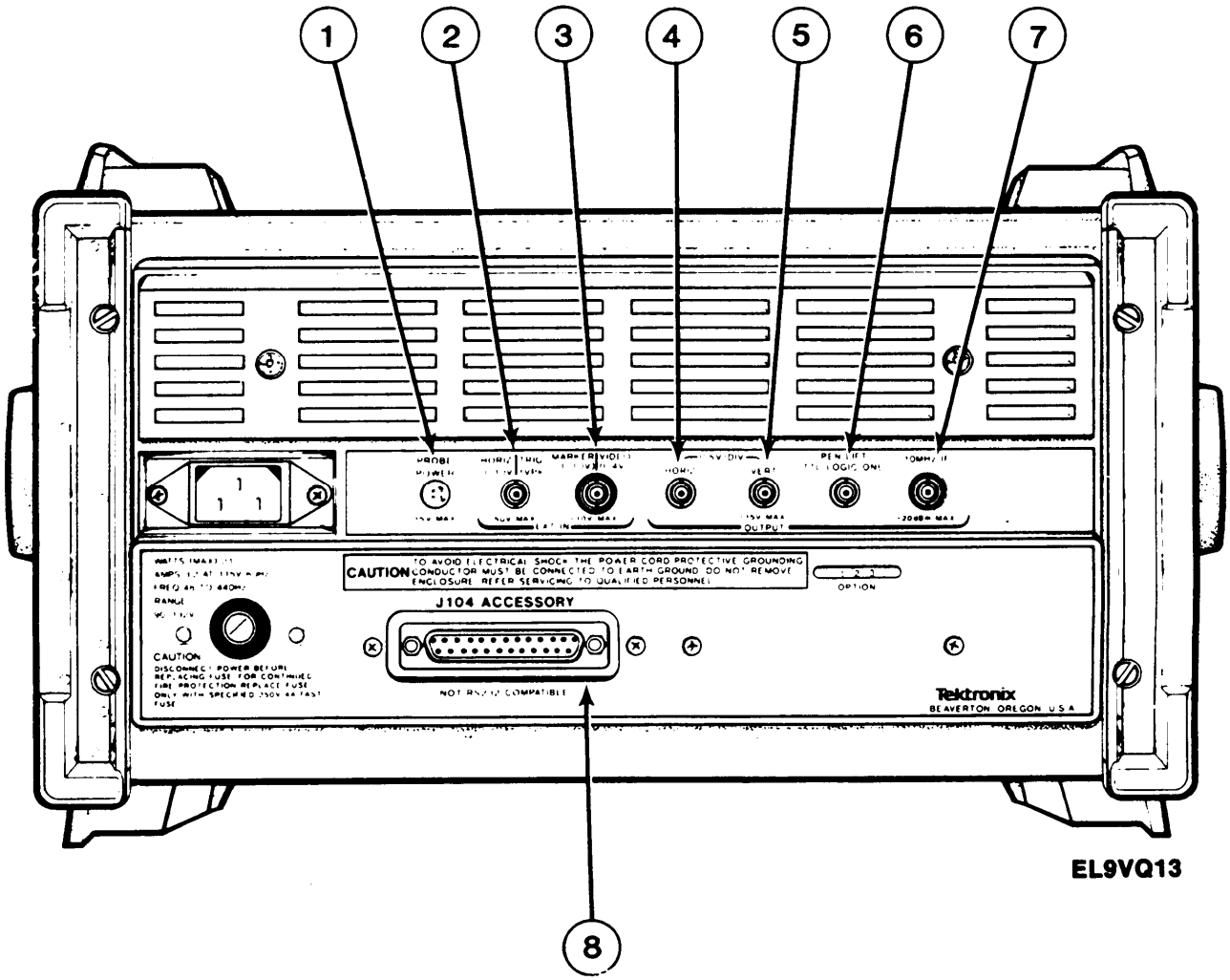

1
2
3
4
5
6
7
8
CAUTION
J104 ACCESSORY
Tektronix
BEAVERTON OREGON U.S.A.
EL9VQ13

Figure 2-2

TABLE 2-2. REAR PANEL CONNECTORS

KEY	CONTROL OR INDICATOR	FUNCTION
1	PROBE POWER	PROBE POWER connector on the rear panel provides operating power for active probe systems. These connectors should not be used as a power source for applications, except for compatible probes or accessories designed for this source.
2	EXT IN HORIZ/TRIG	Dc coupled input for horizontal drive voltages and ac coupled for trigger signal. A 0 to 50 volt ramp produces full sweep. 1.0 to 50 peak signals are required for trigger (0.1 µs minimum pulse width), 15Hz to 1MHz. Selection for HORIZ or TRIG mode depends on front panel TRIGGERING and TIME/DIV selections.
3	MARKER/VIDEO	Allows markers from a TV sideband adapter to be displayed on CRT.
4	HORIZ (Output)	Source of a signal that is 0.5 V for each division of display.
5	VERT (Output)	Source of a signal that is 0.5 V for each division of display. If signal drives a chart recorder, digital storage should be off. If signal drives a slave monitor and PEN LIFT is used for blanking, the screen goes blank during retrace time.
6	PEN LIFT	TTL compatible, nominal +5 V provided to lift the pen of a chart recorder.
7	10MHz IF (+20 dBm MAX)	Access to the 10MHz IF signal. Output level is about -10 dBm with full screen signal at -30 dBm reference level, maximum output is +20 dBm.
8	J104 ACCESSORY	Possible future applications for the AN/USM-489(V)1 may use this connector.

SECTION II. OPERATOR PREVENTIVE MAINTENANCE CHECKS AND SERVICES (PMCS)

2-3 GENERAL

Operator's Preventive Maintenance Checks and Services (PMCS) are the required daily and weekly inspection and care of equipment needed to keep it in operating condition.

2-4 PMCS PROCEDURES

a. Tools, Materials, and Equipment needed for Preventive Maintenance. No tools or equipment are needed for operator preventive maintenance. These materials will be useful:

- Lint-free cloths (Item 2, APP. E).
- Dishwashing compound or detergent (Item 1, APP. E).

b. Routine Checks and Services. Routine checks and services are not listed in the PMCS table. They should be done any time they are needed. If a routine check or service is found in your PMCS table, it was listed because operators reported problems with this item. Do these routine checks and services as needed:

- Clean
- Dust
- Check for cut or frayed cables
- Check for dented, bent, or broken components
- Check for rusting
- Check controls for smooth operation
- Cover unused receptacles
- Check for loose nuts, bolts, and connectors
- Check for completeness of equipment
- Check for completeness and current changes to publications

c. Preventive Maintenance Checks and Services. (See Table 2-3)

(1) Do your Before (B) preventive maintenance just before you operate your equipment. Note **CAUTIONS** and **WARNINGS.**

(2) Do your During (D) preventive maintenance while equipment is operating.

(3) Do your After (A) preventive maintenance right after operating equipment. Note **CAUTIONS** and **WARNINGS.**

(4) If something does not work, troubleshoot with instructions in this manual and tell your supervisor.

(5) Always do your preventive maintenance in the same order, so it becomes a habit. After practicing, you will spot problems immediately.

(6) If something looks wrong and YOU cannot fix it, write it on DA Form 2404. If something is seriously wrong, report it to organizational maintenance **RIGHT NOW.**

d. Explanation* of *Columns. This is an explanation of columns of Table 2-3.

(1) Item no. This contains a number for procedures performed. When reporting malfunctions or failures on DA Form 2404, Equipment Inspection and Maintenance Worksheet, place number in the TM Item No. column.

EQUIPMENT INSPECTION AND MAINTENANCE WORKSHEET

For use of this form, see TM 38 750, the proponent agency is the Office of the Deputy Chief of Staff for Logistics

1 ORGANIZATION					2 NOMENCLATURE AND MODEL	
3 REGISTRATION/SERIAL/NSN	4a MILES	b HOURS	c ROUNDS FIRED	d HOT STARTS	5 DATE	6 TYPE INSPECTION

7 APPLICABLE REFERENCE			
TM NUMBER	TM DATE	TM NUMBER	TM DATE

COLUMN a – Enter TM item number.

COLUMN b – Enter the applicable condition status symbol.

COLUMN c – Enter deficiencies and shortcomings.

COLUMN d – Show corrective action for deficiency or shortcoming listed in Column c.

COLUMN e – Individual ascertaining completed corrective action initial in this column.

STATUS SYMBOLS

"X" – Indicates a deficiency in the equipment that places it in an inoperable status.

CIRCLED "X"–Indicates a deficiency, however, the equipment may be operated under specific limitations as directed by higher authority or as prescribed locally, until corrective action can be accomplished.

HORIZONTAL DASH "(–)"–Indicates that a required inspection, component replacement, maintenance operation check, or test flight is due but has not been accomplished, or an overdue MWO has not been accomplished.

DIAGONAL "(/)"–Indicates a materiel defect other than a deficiency which must be corrected to increase efficiency or to make the item completely serviceable.

LAST NAME INITIAL IN BLACK, BLUE-BLACK INK, OR PENCIL Indicates that a completely satisfactory condition exists.

FOR AIRCRAFT Status symbols will be recorded in red.

ALL INSPECTIONS AND EQUIPMENT CONDITIONS RECORDED ON THIS FORM HAVE BEEN DETERMINED IN ACCORDANCE WITH DIAGNOSTIC PROCEDURES AND STANDARDS IN THE TM CITED HEREON

8a SIGNATURE (Person(s) performing inspection)	8b TIME	9a SIGNATURE (Maintenance Supervisor)	9b TIME	10 MAN-HOURS REQUIRED

TM ITEM NO a	STATUS b	DEFICIENCIES AND SHORTCOMINGS c	CORRECTIVE ACTION d	INITIAL WHEN CORRECTED e

USE PMCS ITEM NO.

DA FORM 2404 1 APR 79 — Replaces edition of 1 Jan 64 which will be used

EL9VQ14

(2) Interval. These tell when to do a procedure. Columns that apply will contain an asterisk (*). Some procedures have asterisks in more than one column.

NOTE

All PMCS are done scheduled and under these conditions:

- *Before equipment is used on a mission*
- *When equipment is installed*
- *When equipment is reinstalled after being removed for any reason*

(3) Item inspected/procedure. This contains the name of items inspected and how to do required checks and services. Carefully follow instructions and perform them in this order.

(4) Equipment is not ready/available if: This column tells you:

- Why equipment cannot be used
- Why there is a problem with item inspected
- Identifies the problem with the procedure

NOTE

If equipment is kept in continuous operation, check and service items that can be checked and serviced without disturbing operation. Make complete checks and services when equipment is shut down.

These checks are made in the order listed, within designated intervals.

TABLE 2-3. PREVENTIVE MAINTENANCE CHECKS AND SERVICES CHECKLIST

B-BEFORE OPERATION D-DURING OPERATION A-AFTER OPERATION

Item No.	Interval			Item Inspected/Procedure	Equipment is Not Ready/Available if:
	B	D	A		
1				Front Panel Controls	
	*			a. Check knobs are not cracked or broken.	Knobs are broken or missing.
	*			b. Check switches and controls are not loose.	
	*			c. Check switches and controls turn easily and are aligned with front panel markings.	Switches or controls stick, bind, or cannot be aligned with panel markings.
2				Front Panel Connectors	
	*			a. Check for tarnish or dirt on connectors.	
	*			b. Check for bent or loose connectors.	Connectors are broken or cannot be used.
3				Front Panel	
	*			a. Check for complete and readable front panel markings.	
		*		b. Check that power indicator is lit when POWER switch is ON.	
4				Chassis	
	*			a. Check cover is secure and in place.	Cover is not in place.
	*			b. Check the handle is secure and is not broken.	
	*			c. Check that chassis feet are not missing or broken.	
	*		*	d. Check chassis for dents, deep scratches, and chipped paint.	
5				Power Cable	
	*			a. Check power cable is not frayed or cut.	Power cable is damaged.
6				Rear Panel	
		*		a. Check air is being drawn into chassis when POWER switch is set to on.	Air is not being drawn into chassis.

SECTION III. OPERATION UNDER USUAL CONDITIONS

2-5 INITIAL CHECKS AND ADJUSTMENTS

GENERAL

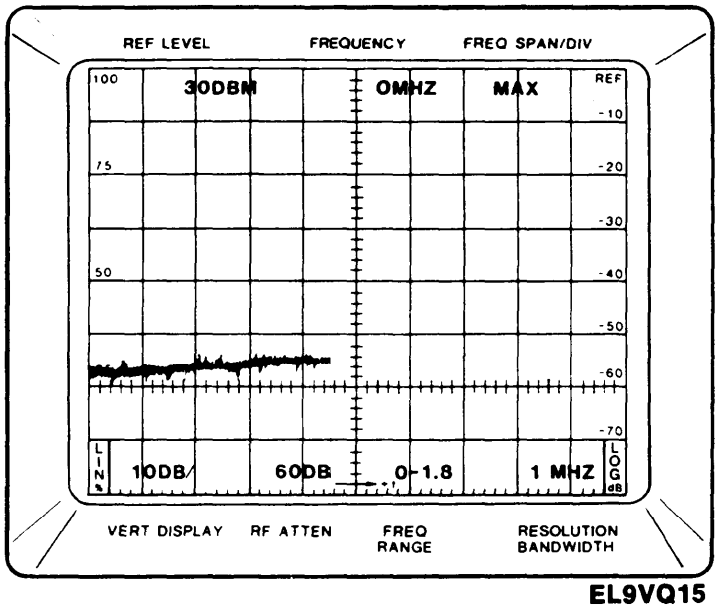
The initial adjustments should be performed after the instrument has been turned on. These tests verify that the instrument is aligned properly. If the instrument is to be left on, these tests should be periodically performed to assure accuracy.

a. INITIAL TURN ON

Switch on Spectrum Analyzer AN/USM-489(V)1. During the initial turn-on cycle, the firmware version in the instrument will flash on the CRT for about two seconds. The operating functions and modes of the Spectrum Analyzer's "power up" states are as follows:

CONTROL/INDICATOR ON CRT DISPLAY	CONDITION
REF LEVEL	30 dBm
FREQUENCY	OMHZ
FREQ SPAN/DIV	MAX
VERT DISPLAY	10 dB/
RF ATTEN	60 dB
FREQ RANGE	0.0—1.8GHZ
RESOLUTION BANDWIDTH	1MHz

CONTROL/INDICATOR ON FRONT PANEL	CONDITION
READOUT	LIT
TRIGGERING (FREE RUN)	LIT
VERTICAL DISPLAY (10 dB/DIV)	LIT
DIGITAL STORAGE VIEW A	LIT
VIEW B	LIT
AUTO RESOLUTION	LIT
ALL OTHER SWITCH/indicators	OFF



EL9VQ15

When the above appears on the CRT, wait for the instrument to stabilize, about 4 minutes.

b. OPERATOR ADJUSTMENTS

GENERAL

Use the following steps for the alignment of the center frequency readout on the CRT, the display reference and the dynamic range.

(1) Turn the INTENSITY to a comfortable brightness.

(2) Turn the MIN RF ATTEN to 0 dB.

(3) Set the PEAK/AVERAGE control fully to the left.

- The noise floor level rises about 1 division.

(4) Set the TIME/DIV to AUTO.

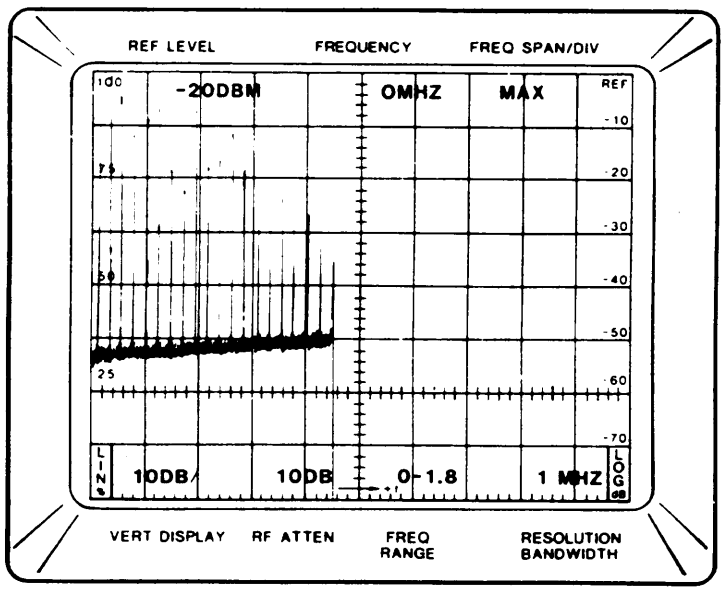
- The noise floor moves to about the 3RD graticule line from the bottom of the CRT.

(5) Set the REF LEVEL to –20 dBm.

- The RF ATTEN changes to 10 dB when the REF LEVEL is changed to -20 dBm.

(6) Connect CAL OUT to the RF INPUT with a 50Ω coaxial cable and an adapter (KN-99-35).

- A comb of twenty lines appears on the CRT. The line on the 1ST graticule line is the fundamental line and the last line in the comb is the 1.9GHz line. The other lines are in 100MHz divisions.



EL9VQ16

c. ALIGNMENT OF CRT CENTER FREQUENCY

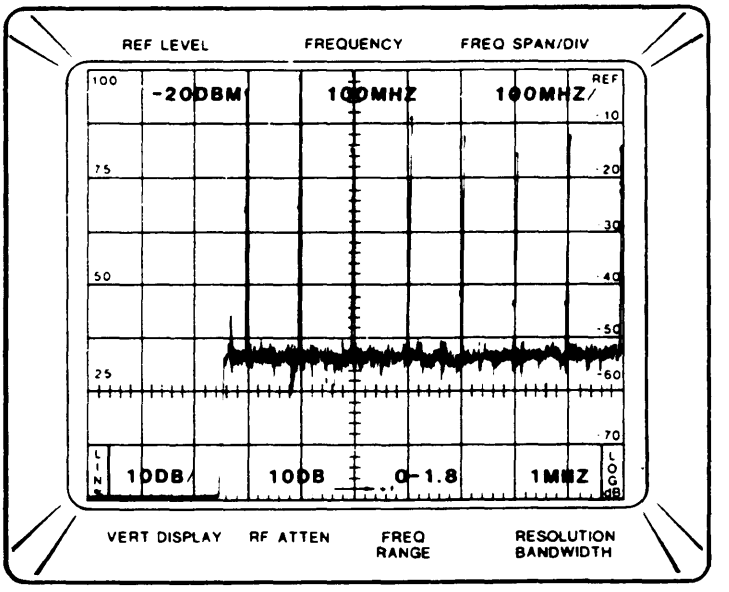
(1) Set the frequency display to 100MHz (±10MHz) by tuning the center frequency control.

- The dot marker moved to about the second comb line.

NOTE

The dot marker is moved horizontally by turning the center frequency control. The dot marker is on the 1ST graticule line when the frequency is OMHz. The dot marker is near the center graticule line when the frequency is in the highest position of the range; in this case 1.842GHz.

(2) Set the FREQ SPAN/DIV to 100MHz.



EL9VQ17

- The entire display moves to the right of the CRT so that the dot marker is on the center graticule line and the 100 MHz calibrator marker is near the center graticule.

(3) Adjust the dot marker to the center graticule with the HORIZONTAL (⧓) POSITION control if the dot marker is not centered.

(4) Reset the VERTICAL DISPLAY to 2 dB/DIV.

- The noise floor level falls to the bottom graticule line.
- The VERT DISPLAY, shown on the CRT, changes to 2 dB/.

(5) Adjust the VERTICAL (⧗) POSITION control to center the baseline on the bottom graticule if the baseline is not already centered.

(6) Reset the VERTICAL DISPLAY to 10 dB/DIV.

- The noise floor level returns to its original position.
- The VERT DISPLAY on the CRT shows 10 dB/DIV.

(7) Reduce the FREQ SPAN/DIV to 10MHz.

(8) Press the DEGAUSS switch two or three times until the signal returns to the same position on the CRT.

(9) Center the signal on the center graticule line with the Center Frequency Control.

(10) Reduce the FREQ SPAN/DIV to 1 MHz and repeat 8 and 9.

NOTE

Degauss function is inoperative when the FREQ SPAN/DIV is less than 1 MHz.

(11) Press the CAL switch to turn on the calibration function if the FREQUENCY readout is not 100MHz.

(12) Adjust the FREQUENCY readout to 100 MHz with the Center Frequency Control.

(13) Turn off CAL and set FREQ SPAN/DIV to 20MHz.

d. ACCURACY OF CENTER FREQUENCY

(1) Turn the FREQUENCY CONTROL to other multiples of the 100 MHz calibrator signal and perform the degauss function as described above.

- The readout should be within ±(5MHz + 20% of span/div) or ±(0.2% of center frequency + 20% of span/div), whichever is greater.

(2) Return the frequency to 100 MHz (If above or below 100 MHz, DEGAUSS and recalibrate).

e. ***ALIGN REFERENCE LEVEL AND DYNAMIC RANGE***

(1) Reduce the FREQ SPAN/DIV to 1 MHz.

(2) Press the DEGAUSS switch.

(3) Adjust the calibrator signal to the center graticule line.

(4) Reduce FREQ SPAN/DIV to 20KHz.

(5) Adjust the calibrator signal to the center graticule with the CENTER FREQUENCY control.

f. CHECK ACCURACY OF PEAK AMPLITUDE SIGNAL

A check of the accuracy of the peak amplitude of the 10 dB/DIV and the 2 dB/DIV VERTICAL DISPLAY mode is required.

(1) Switch between 10 dB/DIV and 2 dB/DIV and observe the amplitude of the signals near the top graticule line.

(2) Adjust the amplitude of each VERTICAL DISPLAY to the top graticule line with the AMPL CAL if either of the signals does not meet or exceeds the top graticule line.

g. ***TOP GRATICULE LINE ALIGNMENT***

(1) Reset the VERTICAL DISPLAY to 10 dB/DIV.

(2) Adjust the LOG CAL to set the 100MHZ calibrator signal to the top graticule line if calibrator signal does not meet or exceeds the top graticule line. This will calibrate the top graticule line to –20 dBm.

(3) Switch REF LEVEL in 10 dB steps from –20 dBm to +30 dBm.

- Display amplitude decreases 10 dB or one division per step. This checks the display log scale over 50 dB of dynamic range.

(4) Reset REF LEVEL to -20 dBm and VERTICAL DISPLAY to 2 dB/DIV.

(5) Change REF LEVEL to –10 dBm in 1 dB steps.

- REF LEVEL readout and amplitude reduce 1 dB/step, a total of 10 dB ±1.3 dB.

(6) Reset the REF LEVEL to –20 dBm and press the switch to activate FINE for the ΔA mode.

- REF LEVEL has changed to *0.00 dB.

(7) Change the REF LEVEL display to +2 dB by using the REFERENCE LEVEL control.

- The REF LEVEL changes in 0.25 dB steps.
- The display reduces an amplitude of 2 dB ±0.4 dB (1 division + 1 minor division).

(8) Return REF LEVEL to *0.00 dB.

(9) Reset VERTICAL DISPLAY mode to 10 dB/DIV.

(10) Change REF LEVEL from –20 dBm to -10 dBm.

- REF LEVEL changes in 1 dB increments.
- The display amplitude changes a total of 10 dBm ±1 dB ±1 division ±.5 minor division).

(11) Return REF LEVEL to –20 dBm and cancel FINE ΔA mode.

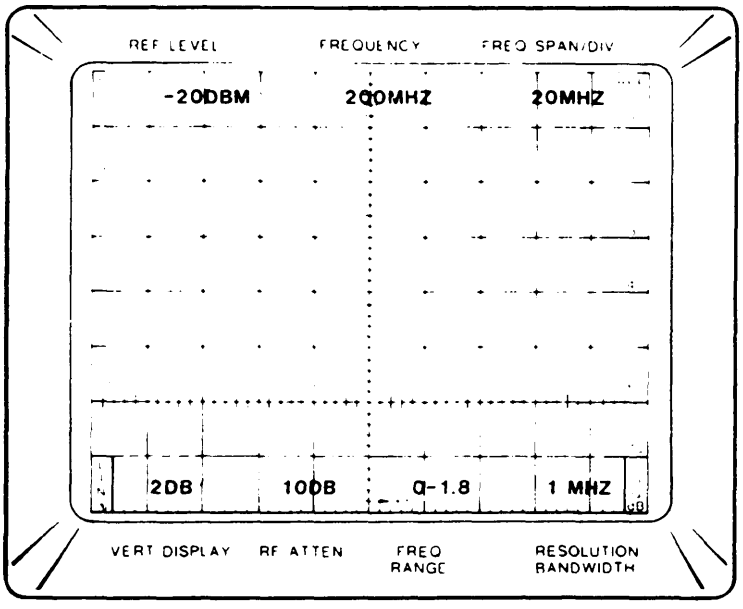
2-6 OPERATING PROCEDURES

a. *BANDWIDTH MEASUREMENT*

(1) Perform Initial Turn On (para 2-5).

(2) Set the front panel controls and indicators as follows:

FREQUENCY RANGE	0—1.8 GHz
FREQUENCY	200 MHz
FREQ SPAN/DIV	20 MHz
RESOLUTION BANDWIDTH	1 MHz
VERTICAL DISPLAY	2 dB/DIV
REF LEVEL	–20 dBm
MIN RF ATTEN	0 dB
PEAK/AVERAGE	AVERAGE



EL9VQ18

(3) Connect the unit under test to the RF INPUT.

(4) Adjust FREQUENCY to center the signal on the CRT and measure the bandwidth.

(5) Disconnect the unit under test from the RF INPUT.

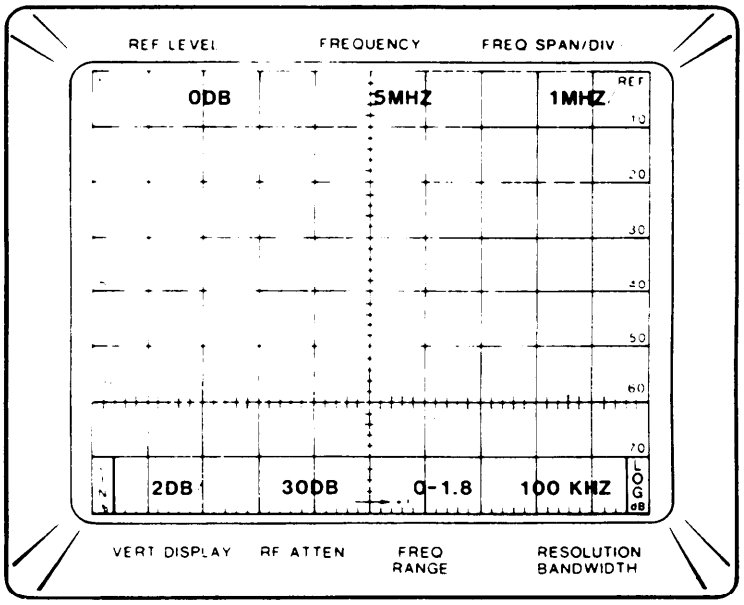
(6) Set the Power Switch to OFF.

b. FREQUENCY RESPONSE MEASUREMENT

(1) perform initial Turn On (para 2-5).

(2) Set front panel controls and indicators as follows:

FREQUENCY RANGE	0—1.8 GHz
FREQUENCY	5 MHz
FREQ SPAN/DIV	1 MHz
MIN RF ATTEN	–30 dB
REF LEVEL	0 dBm
AUTO RESOLUTION	ON
TIME/DIV	20 ms
VERTICAL DISPLAY	2 dB/DIV



EL9VQ19

(3) Connect the unit under test to the RF INPUT.

(4) Adjust FREQUENCY to center the signal on the CRT and measure the response.

(5) Disconnect the unit under test from RF INPUT.

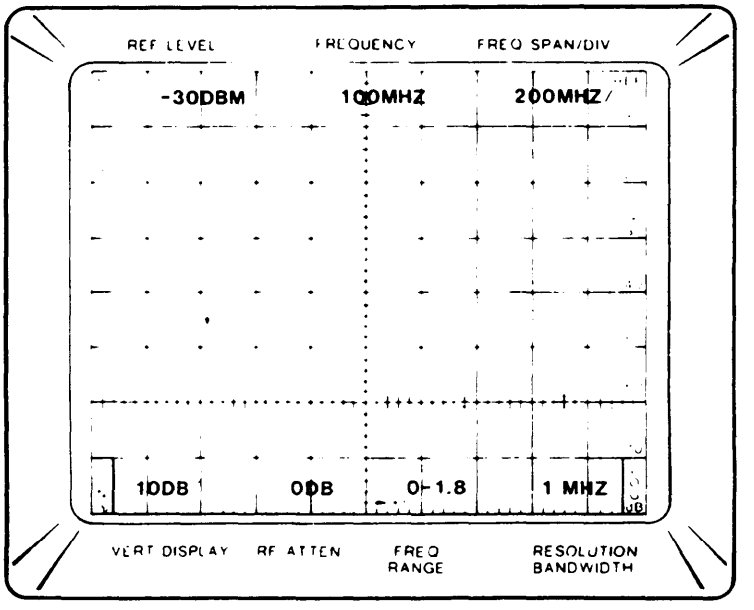
(6) Set the Power Switch to OFF.

c. FREQUENCY SPAN MEASUREMENT

(1) Perform Initial Turn On (para 2-5).

(2) Set front panel controls and indicators as follows:

FREQUENCY RANGE	0—1.8 GHz
RESOLUTION BANDWIDTH	1 MHz
FREQ SPAN/DIV	200 MHz
TIME/DIV	.1s
VERTICAL DISPLAY	10 dB/DIV
REF LEVEL	-30 dBm
MIN RF ATTEN	0 dB
DIGITAL STORAGE	VIEW A/VIEW B



EL9VQ20

(3) Connect the unit under test to the RF INPUT.

(4) Adjust FREQUENCY to center the signal on the CRT and measure the span.

(5) Disconnect the unit under test from the RF INPUT.

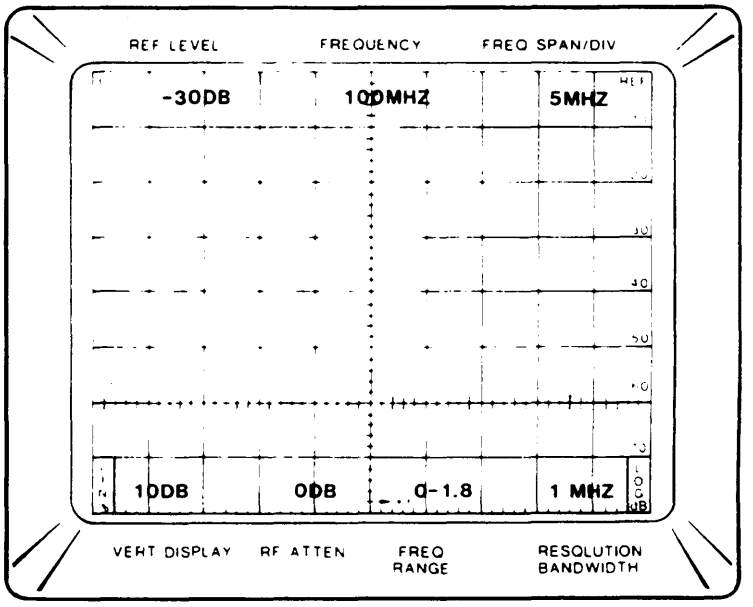
(6) Set the Power Switch to OFF.

d. HARMONIC DISTORTION MEASUREMENT

(1) Perform Initial Turn On (para 2-5).

(2) Set front panel controls and indicators as follows:

FREQUENCY RANGE	Band 1
FREQ SPAN/DIV	5 MHz
AUTO RESOLUTION	ON
VERTICAL DISPLAY	10 dB/DIV
REF LEVEL	–30 dBm
MIN RF ATTEN	0 dB
VIDEO FILTER	WIDE
DIGITAL STORAGE	VIEW A/VIEW B



EL9VQ21

(3) Connect the unit under test to the RF INPUT.

(4) Adjust FREQUENCY to center the signal on the CRT and measure the distortion.

(5) Disconnect the unit under test from the RF INPUT.

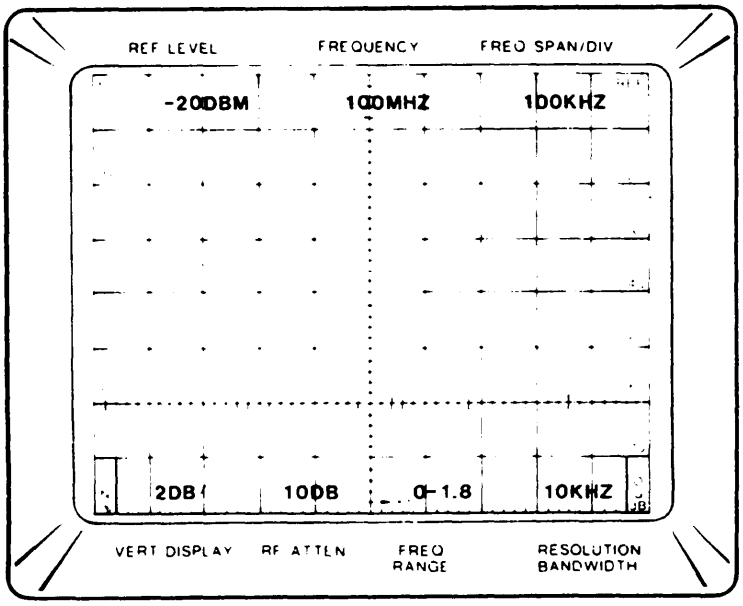
(6) Set the Power Switch to OFF.

e. AMPLITUDE MEASUREMENT

(1) Perform Initial Turn On (para 2-5).

(2) Set front panel controls and indicators as follows:

FREQUENCY	100 MHz
TRIGGERING	FREE RUN
TIME/DIV	AUTO
VERTICAL DISPLAY	2 dB/DIV
RESOLUTION BANDWIDTH	100 KHz
FREQ SPAN/DIV	100 KHz
REF LEVEL	-20 dBm
DIGITAL STORAGE	OFF



EL9VQ22

(3) Connect the unit under test to RF INPUT.

(4) Adjust FREQUENCY to center the signal on the CRT and measure the amplitude.

(5) Disconnect the unit under test from the RF INPUT.

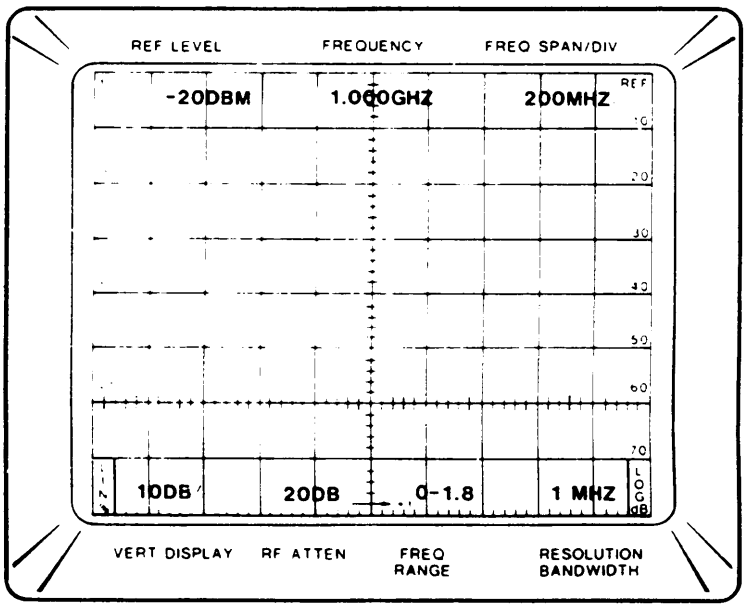
(6) Set the Power Switch to OFF.

f. FREQUENCY MEASUREMENT

(1) Perform Initial Turn On (para 2-5).

(2) Set front panel controls and indicators as follows:

FREQUENCY RANGE	0—1.8 GHz
FREQUENCY	1.0 GHz
FREQ SPAN/DIV	200 MHz
AUTO RESOLUTION	ON
MIN RF ATTEN	20 dB
VERTICAL DISPLAY	10 dB/DIV
VIDEO FILTER	WIDE
TIME/DIV	AUTO
DIGITAL STORAGE	VIEW A/VIEW B



EL9VQ23

(3) Connect the unit under test to RF INPUT.

(4) Adjust FREQUENCY to center the signal on the CRT and measure the frequency.

(5) Disconnect the unit under test from the RF INPUT.

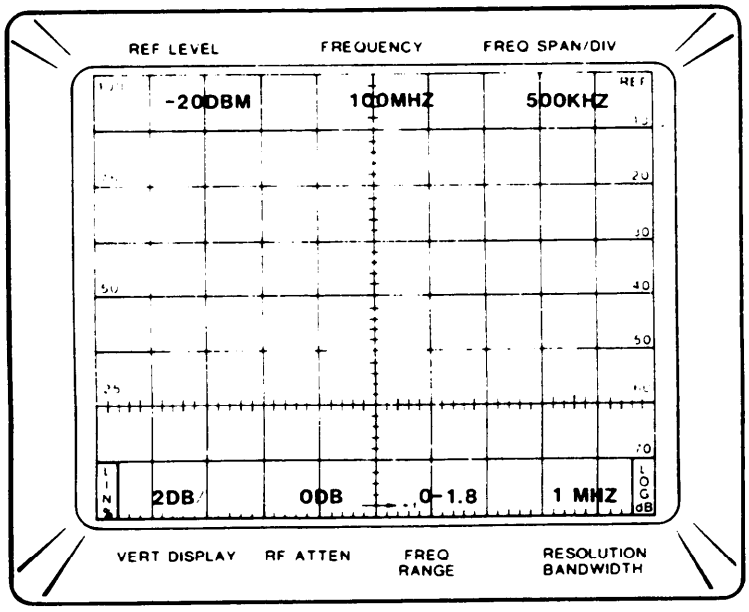
(6) Set the Power Switch to OFF.

g. RESOLUTION BANDWIDTH AND SHAPE FACTOR MEASUREMENT

(1) Perform Initial Turn On (para 2-5).

(2) Set front panel controls and indicators as follows:

FREQUENCY RANGE	0—1.8 GHz
FREQUENCY	100 MHz
REF LEVEL	–20 dBm
VERTICAL DISPLAY	2 dB/DIV
FREQ SPAN/DIV	500 KHz
RESOLUTION BANDWIDTH	1 MHz
PEAK/AVERAGE	Fully cw
DIGITAL STORAGE	VIEW A/VIEW B
TIME/DIV	AUTO
MIN NOISE	ON



EL9VQ24

(3) Connect the unit under test to RF INPUT.

(4) Adjust FREQUENCY to center the signal on the CRT and measure the bandwidth.

(5) Disconnect the unit under test from the RF INPUT.

(6) Set the Power Switch to OFF.

2-7. GENERAL OPERATING INFORMATION

a. ERROR MESSAGE READOUT

Malfunctions during operation will be displayed on the CRT screen as shown below:

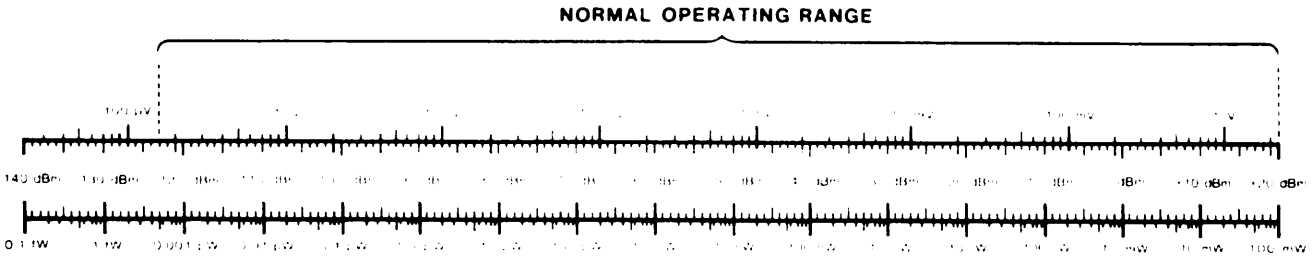
ERROR #	MEANING
57	Tune routine failed.
58	Failed to phase lock.
59	Lost phase lock.
60	Failed to recenter frequency when phase lock canceled or when switching to an unlocked span/div setting. (Phase lock occurs for 50 KHz or less in Bands 1 through 3, 100 KHz or less for Band 4, and 200 KHz or less for Bands 5 and above.)

b. CRT LIGHT FILTERS

The AN/USM-489(V)1 accessories are supplied with two light filters: amber and grey. Selecting the correct filter depends on ambient light conditions, light reflections and operator's viewing needs. To install the filter, see Replace Light Filter (para 3-12).

c. AMPLITUDE CONVERSION

The spectrum analyzer reads out signal levels in dBm. The following conversion chart provides a way to determine input signal levels from a voltage or power source.



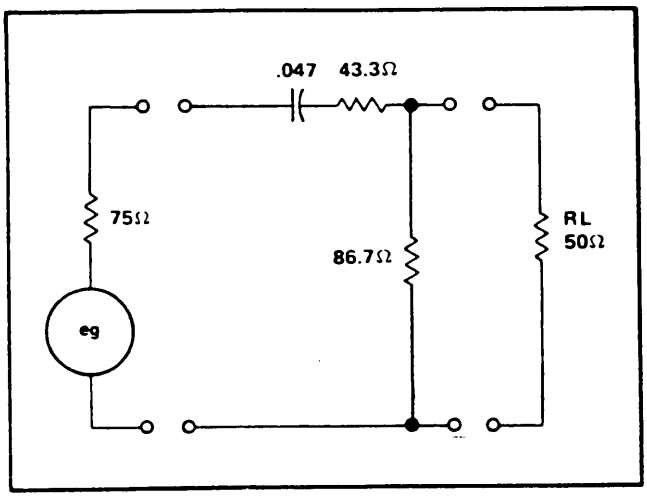
EL9VQ25

NOTE: VOLTS RMS ....multiply by
2.8 for peak-to-peak.
0 dBm 1 milliwatt

d. CONNECTING TO 75Ω SOURCE

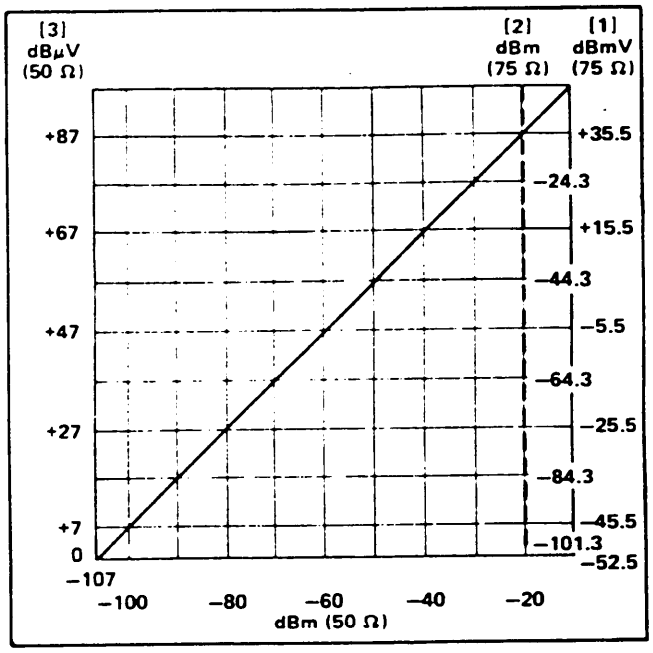
The AN/USM-489(V)1 can be used at lower frequencies (100KHz—1GHz) with a 75Ω signal source by using a 75 Ω to 50 Ω minimum loss attenuator.

Sensitivity and power levels are often rated in dBm (dB with reference to 1 mV regardless of impedance). Sensitivity and power levels for 75Ω systems are normally rated in dBmV (dB with reference to 1 mV across 75Ω). The following is a circuit diagram of a suitable matching pad for this purpose:



EL9VQ26

The relationship between 50 Ω and 75 Ω units, with matching attenuators, is shown in the following graph.



EL9VQ27

The conversion is described as follows:

(1) dBm V (75Ω) = dBm (50Ω) + 54.47 dB
e.g., –60 dBm (50Ω) + 54.47 dB = -5.5 dBm V (75Ω)

(2) dBm (75Ω) = dBm (50Ω) + 5.72 dB
e.g., –60 dBm (50Ω) + 5.72 dB = -54.3 dBm (75Ω)

(3) For some applications you may wish to know the relationship between dBm and dB μV. For 50Ω systems dB μV = dBm + 107 dB

e. SIGNAL APPLICATION

Signal applications up to 21GHz are applied through a short high quality 50Ω coaxial cable to the RF INPUT connector. These signals pass through an internal RF attenuator to either a low-pass filter or tuned preselector (depending on the frequency band) and then through to the 1ST Mixer.

All signals above 21GHz are applied to an external waveguide mixer. The waveguide mixer output is then applied through the EXT MIXER port to the second converter of the instrument.

f. RF INPUT CONNECTOR

The nominal input impedance of the coaxial RF INPUT is 50Ω. Due to possible significant cable losses 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 and degrade flatness, frequency response, sensitivity, and increase spurious responses. Impedance mismatch can be caused by poor connections, incorrect signal source impedance, long or low quality coaxial cable, etc. When optimum flatness or frequency response is desired and signal strength is adequate, set the MIN RF Attenuation for 10 dB or more. The addition of the attenuator helps minimize reflections to improve the input characteristics.

CAUTION

Do not increase input signal level to full screen with a ref level of +40 dBm because this will exceed the attenuator rating. DC input is limited to zero (0) volts.

Too much power can cause signal compression or it can destroy the 1ST mixer. Signals greater than –30 dBm (or -20 dBm in MIN NOISE mode) should be attenuated by the RF ATTENuator. External attenuators must be used to attenuate signals above the safe input level (+30 dBm). Make sure that the frequency range of external attenuators is adequate.

Line stabilizing networks used for conducting EMI/RF measurements will often have several volts of 60Hz signal at the output. A dc block will protect the input mixer and prevent destruction.

Signal levels of -10 dBm or more (-28 dBm, for 1.7 to 1.8GHz range) may be compressed. This could degrade signal reference level measurements and create spurious responses.

Spurious responses can be minimized by selecting a REF LEVEL that places stronger signals in the graticule window. In some cases, it may be best to add RF Attenuation.

g. RESOLUTION BAND WIDTH FREQUENCY SPAN AND SWEEP TIME

Resolution is the ability of a spectrum analyzer to display discrete frequency components within a frequency span. This ability is a function of the analyzer bandwidth, sweep time, frequency span and incidental FM. Frequency span and sweep time are usually chosen to provide the minimum resolution bandwidth setting for a certain cw signal. Bandwidth also has an effect on noise level. As the bandwidth decreases, signal-to-noise ratio or sensitivity increases. Maximum sensitivity is then attained at the narrow resolution bandwidth settings.

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

In spans other than MAX SPAN, frequency span is proportional around the center frequency. In MAX SPAN the display represents the full frequency range of the selected band. The FREQUENCY readout indicates the location of the frequency dot on the spectrum. The frequency span used depends on the application. To monitor a frequency spectrum for spurious signals, check harmonic content, etc., wide spans are normally used. Narrow spans are used to identify the characteristics around a certain signal, such as modulation side bands, bandwidth, power line distortion, etc.

Sweep rate on non-store displays is usually increased to eliminate flicker, when wide spans are used. This calls for wider resolution bandwidths. Narrow spans are used to observe signal phenomenons. This calls for narrow resolution bandwidths and therefore slower sweep speeds.

The AN/USM-489(V)1 features microcomputer circuitry that selects sweep rate and resolution bandwidth to correlate with the selected frequency span. The display is calibrated for each FREQ SPAN/DIV selection when both TIME/DIV and RESOLUTION are in AUTO mode. With the TIME/DIV selector in the AUTO position, sweep speed is tied to the analyzer span/div and resolution bandwidth. If either the FREQ SPAN/DIV and TIME/DIV settings are outside the range of correction, the AUTO mode of the RESOLUTION BANDWIDTH makes effective use of the bandwidth. When one is out of range of correction, the UNCAL indicator lights and a ">" symbol prefixes the ref level readout cm the CRT display.

A wider bandwidth than that provided by AUTO is normally desired when analyzing pulse signals. The resolution bandwidth should be about 1/10 TH the side lobe frequency width, or the reciprocal of the pulse width, to ensure adequate resolution. After the sweep rate has been selected, the RESOLUTION BANDWIDTH is normally set for the best main lobe detail.

h. USING THE PEAKING CONTROL

The PEAKING control adjusts bias for the EXT MIXER port and preselector tracking. This control is adjusted for maximum conversion or maximum signal amplitude. The control greatly effects performance when operating in the higher frequency ranges. Mixer peaking must be adjusted before relative amplitude and sensitivity measurements are made when operating above Band 1 (1.8GHz). After any major frequency change, DEGAUSS, then adjust PEAKING for maximum signal amplitude. Degauss with FREQ SPAN/DIV of 2MHz or 1MHz.

i. PHASE LOCK OPERATION

Phase lock is activated for the narrower spans to lock the 1 ST LO to a stable reference. If phase lock mode is active and PHASE LOCK is turned off, the signal may shift position and in narrower spans it may shift off screen.

j. USING THE SIGNAL IDENTIFIER

Conversion in the 1ST mixer creates many spurious responses. The spurious responses are due to the multiple harmonics of the local oscillator converting input signals to an intermediate frequency within the bandpass of the IF. This is especially true when the waveguide mixers are in use. To help in the identification of the true signals, the spectrum analyzer features an "identify" mode. This mode only works when FREQ SPAN/DIV is set at 500kHz. With FREQ SPAN/DIV set at 500kHz, turn on the IDENTIFY 500kHz/ONLY. True signals shift horizontally or off screen.

k. USING THE VIDEO FILTERS

The video filters restrict the video bandwidth so that noise or beat signals are reduced. The filters are useful in reducing modulation between two closely spaced signals. This makes the signals easier to analyze. The filters can also be used to average the envelope of pulsed RF spectra that has a relatively high Pulse Repetition frequency (PRF). Selecting a video filter when measuring low PRF produces poor results, because the filter is basically an integrating circuit.

The WIDE filter reduces the bandwidth about 1/30 TH the selected resolution bandwidth; the NARROW filter about 1/300 TH. The sweep rate may have to be reduced to maintain a calibrated display. The UNCAL indicator will light if the sweep speed is too fast for a calibrated display.

l. TIME DOMAIN OPERATION

When the FREQ SPAN/DIV is reduced to zero, the analyzer displays time domain characteristics within the capabilities of the resolution bandwidth. The TIME/DIV selector can now be used to analyze characteristics like modulation pattern, pulse repetition rates, etc.

m. TRIGGERING THE DISPLAY

Triggering 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 the FREE RUN mode, the sweep will not synchronize with any input signal.

The sweep can be triggered internally from the vertical or video signal, at the line frequency rate of the power supply, or from an external signal applied to the EXT IN HORIZ/TRIG jack on the back panel. The amplitude of the signal required to trigger the sweep is two (2.0) divisions or more, for internal triggering, and 1.0 volt to a maximum of 50 volts (dc + peak ac) for external triggering.

Trigger source is selected by activating one of the triggering switches. SINGLE SWEEP mode can be selected in addition to the four trigger source selections. Pushing the SINGLE SWEEP switch once turns on the sweep mode; pushing the switch a second time arms the trigger circuit. The READY indicator lights and remains lit until the sweep has run.

n. SWEEPING *THE DISPLAY*

Horizontal sweep for the display is either internal or from an external sweep source. TIME/DIV switch selects the sweep rate and source. An internal microcomputer controls the sweep rate when the TIME/DIV switch is in the AUTO position.

When the TIME/DIV switch is in EXT, a signal source of 0 to +10 volts, applied to the EXT IN HORIZ/TRIG connector, will sweep the CRT beam the full 10 graticule division. The input is dc coupled, sensitivity is 1V/div. External input impedance is about $10K\Omega$.

o. *MANUAL SCAN OF THE SPECTRUM*

Manual scan is used to examine particular points of displays, such as a null point of a frequency modulation spectrum. When the TIME/DIV control is set in the MNL position, the display is swept with the MANUAL SCAN control. The sweep scan is normally first calibrated in one of the time sweep positions. With a wide span/div and/or a narrow resolution bandwidth setting, it is possible to scan too rapidly to achieve an accurate display. Digital storage can give unpredictable results when used with the manual scan mode. Digital storage updates during a scan to the right.

p. REFERENCE LEVEL RF ATTENUATION AND VERTICAL DISPLAY

A change in the REFERENCE LEVEL control asks the microcomputer to change the display reference level, represented by the top of the CRT graticule. The microcomputer selects the gain distribution (IF gain and input RF attenuation) for the new reference level according to the setting of the FINE, VERTICAL DISPLAY mode, MIN RF ATTEN dB, and MIN NOISE/MIN DISTORTION selectors.

The microcomputer sets the amount of attenuation between the RF INPUT and the first mixer. This is based on the reference level requested and the mode of the MIN RF ATTEN dB and MIN NOISE/MIN DISTORTION selectors. The microcomputer assumes that the MIN RF ATTEN dB is set to the minimum attenuation needed for the expected signal levels. The microcomputer doesn't reduce RF ATTENUATION below this value. The microcomputer selects the best RF attenuation and IF gain ratio according to the MIN NOISE/MIN DISTORTION mode. The lower limit reference level range is selected by MIN RF ATTEN. The lower limit reference increases the same amount as the MIN RF ATTEN dB.

The reference level increments depend on the Vertical Display modes and Fine selector mode. The reference level for the log displays are 10 dB and 1 dB with FINE turned off. With FINE turned on the reference levels are 1 dB and 0.25 dB (.25 dB apply to Δ A). The microcomputer selects the reference level, an equivalent of an 8-division signal, for LIN displays with FINE off. The display factor changes in a 1-2-5 volt/division sequence. For LIN displays with FIN Eon, the reference level changes in 1 dB steps and the scale factor is 1/8 the voltage equivalent of the reference level.

q. DELTA A MODE

To select this mode, activate 2 dB/DIV and FINE; the REF LEVEL readout becomes *0.00 dB and the REFERENCE LEVEL steps in 0.25 dB increments.

The ΔA mode is useful for measuring relative amplitude differences of signals more accurately. This occurs because gain distribution (IF gain and RF attenuation) is not changed when ΔA mode is turned on. The REF LEVEL is changed by shifting the log amplifier offset. With the ΔA mode activated, the measurement range is at least from 10 dB above to 40 dB below; however, the overall instrument display characteristic of -123 dBm to +30 dBm cannot be exceeded. The asterisk in the REF LEVEL readout remains until the ΔA mode gain distribution is changed.

When either FINE or 2 dB/DIV or a selector that could change gain distribution (MIN RF ATTEN or MIN NOISE) is changed, ΔA mode is cancelled. ΔA mode is also turned off when EXT MIXER or an external mixer frequency range is selected.

Signals with large differences in amplitude within the ΔA range can be compared without the distortion usually introduced when signals are driven off screen. The input is not being overdriven because of signals shifted off-screen by changes in the ΔA reference level. This is because the attenuator and IF gain are not changed; thus the mixers do not see any change in signal levels due to the ΔA reference level changes.

To measure amplitude level differences of two signals:

(1) Select ΔA mode by activating 2 dB/DIV and FINE.

(2) Using the REF LEVEL control, set the larger amplitude signal to a graticule line.

(3) Deactivate, then reactivate ΔA mode by pressing the FINE switch twice.

(4) Use the REF LEVEL control to set the lower amplitude signal to the same graticule line established in step 2.

(5) The REF LEVEL readout displays the amplitude level difference in dB.

r. MIN NOISE/MIN DISTORTION

This switch selects one of two algorithms that control attenuator and IF gain settings. MIN NOISE minimizes noise level while MIN DISTORTION minimizes input mixer overload. To observe any change when MIN NOISE is activated, the RF ATTEN readout must be 10 dB higher than that set by the MIN RF ATTEN selector.

CAUTION

With MIN NOISE activated and 60 dB of MIN RF ATTEN, the REF LEVEL can be set to +40 dBm. The spectrum analyzer's front end is specified at +30 dBm maximum. Do not increase input signal level to full screen with a REF LEVEL of +40 dBm because this will cause the attenuator to exceed its rating. Dc input is zero (0) volts.

s. DIGITAL STORAGE

Digital storage provides a smooth display. Digital storage can store two complete events. One of these can be saved and then compared to subsequent updated information. A MAX HOLD feature updates the stored data in memory when the new input is of higher amplitude. This allows monitoring and graphic plotting of display changes with time. PEAK/AVERAGE control can position a horizontal line to divide the vertical information. Video information above the line is peak detected and displayed; below the line signal averaging occurs. The average (number of samples) is a function of

sweep speed. The slower the sweep, the greater the number of samples averaged. Signal averaging suppresses noise below the line. Peak detection allows full peak detection of vertical data above the horizontal line. The point at which memory is being updated is indicated by an intensified spot on the horizontal line.

When digital storage is used, an additional 0.5% of error of full screen must be added to the amplitude performance characteristics (i.e., frequency response, sensitivity, etc.)

Digital storage memory is functionally divided into two sections — A and B. Data can be stored in A or B or both. There are 512 horizontal positions in A and also in B. When both are displayed, the coordinates are interfaced to provide 1024 display increments. Data in memory is continually updated with each sweep so the display, when viewing A or B, is always current.

Data in memory A is held in storage and only B memory is updated when SAVE A is activated. This inhibition takes place whether A is displayed or not. This mode captures an event or waveform and compares it with a subsequent event displayed by VIEW B mode. All of memory A and then memory B are displayed, each by a separate sweep.

With B-SAVE A on the contents of data in B memory minus contents saved in A are displayed. This shows the difference between the two events by presenting the algebraic difference of the two displays. This mode can be used to align filters or other devices when tuning for a null. The reference waveform is stored in A and the unknown in B. If the device tested is active, the waveform for B may be larger than the reference which results in a shift in the zero reference line. The reference level is usually set at mid screen so that both positive and negative quantities can be observed.

MAX HOLD updates digital memory 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 second of amplitude/frequency excursions.

Signal averaging is useful for suppressing noise. The number of samples averaged per increment is a function of the sweep rate. The slower the sweep rate, the more samples averaged per resolution bandwidth. Resolution bandwidth also affects the amplitude difference between peak detected and average levels of cw signals. There will be a major difference between peak and average amplitude levels of cw signals when the resolution bandwidth is less than 1/30TH of the span/division (e.g., 100kHz or less with 5MHz span/div). The peak value is a true value, the average value is in error, especially if only A or B is displayed. Then using a narrow resolution bandwidth with wide frequency spans, run digital storage with both A and B interlaced.

To analyze signal amplitude level, set the horizontal line at least 1/4 division below the signal peak. To average noise, set the line at least 1/4 division above the noise level.

CHAPTER 3
ORGANIZATIONAL MAINENANCE

SECTION I. REPAIR PARTS; SPECIAL TOOLS; TEST, MEASUREMENT, AND DIAGNOSTIC EQUIPMENT (TMDE); AND SUPPORT EQUIPMENT

3-1. COMMON TOOLS AND EQUIPMENT

Common tools and equipment required for organizational maintenance of Spectrum Analyzer, AN/USM-489(V)1, are listed in Appendix B (Maintenance Allocation Chart).

3-2. SPECIAL TOOLS, TMDE, AND SUPPORT EQUIPMENT

There are no special tools required for organizational maintenance of the spectrum analyzer.

3-3. REPAIR PARTS

Repair parts are listed and illustrated in the repair parts and special tools list, TM 11-6625-3136-24P, which covers organizational and general support maintenance for this equipment.

SECTION II. SERVICE UPON RECEIPT

3-4. SERVICE UPON RECEIPT OF MATERIAL

a. Unpacking. The spectrum analyzer is packed in its own shipping carton. Unpack the equipment as follows:

- Open shipping carton and remove equipment.
- Place equipment on a suitable clean and dry surface for inspection.
- Keep all shipping materials for use in repacking and reshipping.

b. Checking Unpacked Equipment

- Inspect the equipment for damage incurred during shipment. If the equipment has been damaged, report the damage on SF 364, Report of Discrepancy (ROD).
- Check the equipment against the packing slip to see if the shipment is complete. Report all discrepancies with the instructions of DA Pam 750-8.
- Check to see if the equipment has been modified.

3-5. PRELIMINARY SERVICING AND ADJUSTMENT OF EQUIPMENT

a. To remove fuse, see paragraph 3-10. Check that the fuse is correct for input line voltage being used. To install fuse, see paragraph 3-10.

b. Perform operational test. See paragraph 3-9.

SECTION III. TROUBLESHOOTING

3-6 GENERAL

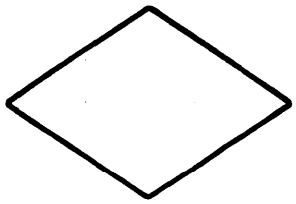
Troubleshooting at organizational maintenance level requires quick location of trouble. The amount of troubleshooting you can do is based on what the Maintenance Allocation Chart says you can fix. Trouble symptoms found here could be caused by faulty items you can fix.

NOTE

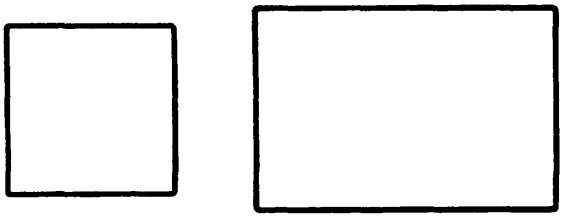
Before using the troubleshooting flowcharts, check the work order and talk to the operator, if possible, for a description of symptoms if trouble occurred while equipment was in operation.

3-7 USING THE TROUBLESHOOTING FLOWCHARTS

The following symbols are used on the troubleshooting flowcharts:



This symbol is used as a direction, such as showing the start or routing to a continuing flowchart to fix a particular malfunction.



These symbols are used to show a process, operation or a setting.

This symbol is used to show that a decision is required.

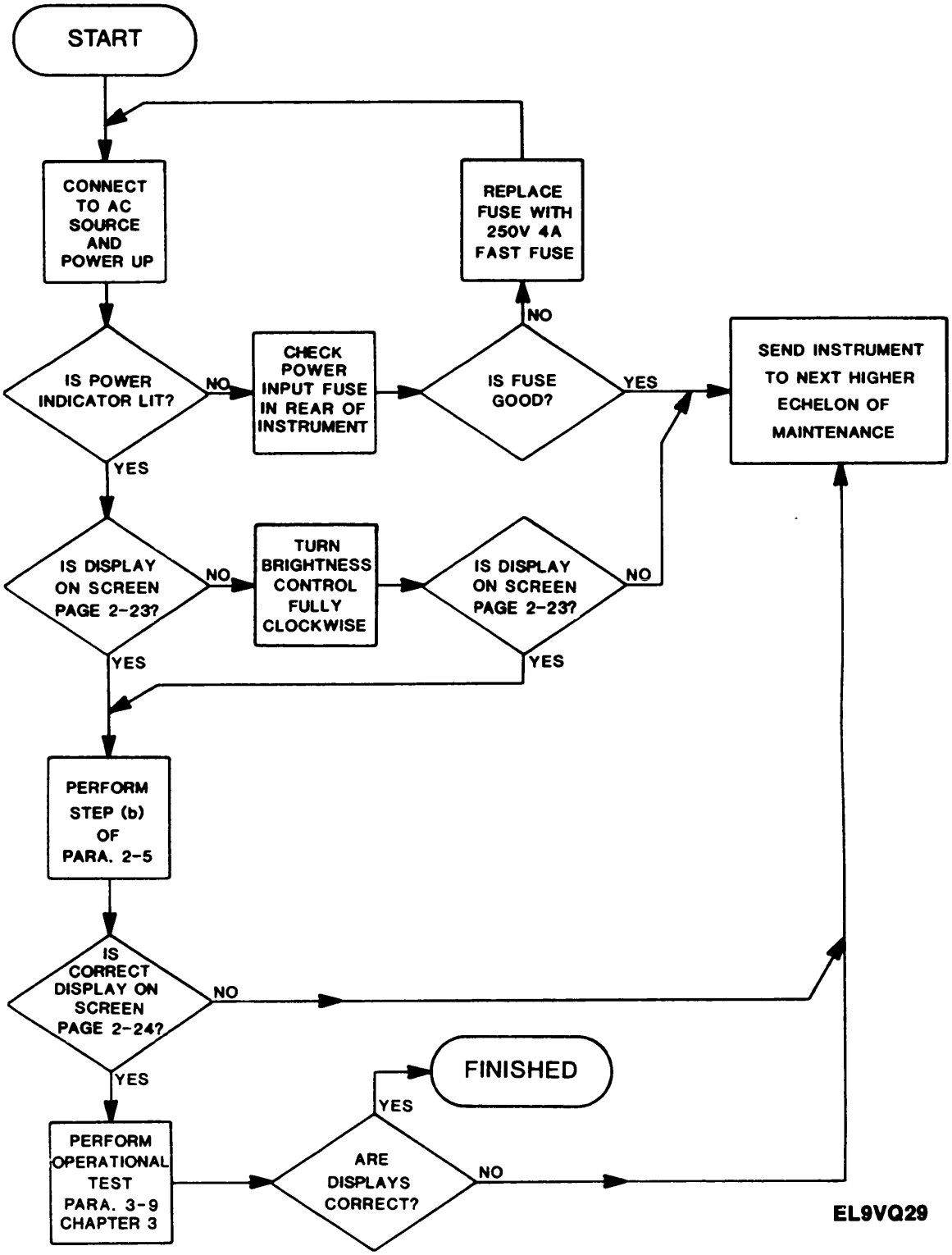
EL9VQ28

When the symptom has been isolated, use these symbols to understand the flowchart corresponding to the symptoms.

3-8 TROUBLESHOOTING FLOWCHARTS

Troubleshooting flowcharts are used to identify common malfunctions found during operation or maintenance of the spectrum analyzer. Perform the tests/inspections and corrective actions in the order listed.

TROUBLESHOOTING SPECTRUM ANALYZER AN/USM-489(V)1



SECTION IV. MAINTENANCE PROCEDURES

3-9 OPERATIONAL TEST

a. CHECK FREQUENCY READOUT ACCURACY. Readout accuracy is ± (5MHz + 20% of span/division) or ± (0.2% of center frequency + 20% span/division), whichever is greater.

NOTE

Due to hysteresis in the 1st (YIG) oscillator frequency readout accuracy is checked by pressing the DEGAUSS switch and setting FREQ SPAN/DIV to 2MHz.

(1) Calibrate the frequency readout as described under Para. 2-5, INITIAL CHECK AND ADJUSTMENTS.

(2) Set the FREQ SPAN/DIV to 1 MHz or 2MHz.

(3) Tune the 200 MHz calibrator marker to the center graticule.

(4) DEGAUSS the tuning coils of the oscillator by pressing the DEGAUSS switch.

(5) Reduce FREQ SPAN/DIV to 500kHz.

(6) Center the calibrator marker under the frequency dot before noting the readout for center frequency.

- The readout should be within ± (5MHz + 20% 40 of span/division) of the calibrator marker.

NOTE

For faster execution set FREQ SPAN/D/V to 50MHz, center the desired marker then reduce FREQ SPAN/D/V to 500kHz.

(7) Repeat steps 2 through 6 for the remaining calibrator markers of the frequency range.

(8) In Bands 2 and 3 it may be necessary to activate WIDE VIDEO FILTER and MIN NOISE.

(9) Set FREQ SPAN/DIV to 10MHZ.

(10) Set RESOLUTION BANDWIDTH to 100kHz.

(11) Adjust PEAKING as you approach each check point.

(12) If the calibrator harmonic signals are small, ignore them or reduce the RESOLUTION BANDWIDTH to increase sensitivity. The sweep time is long when using narrow resolution bandwidths.

b. ***CHECK FREQUENCY SPAN/DIV RANGE AND ACCURACY.*** Span accuracy specifies the greatest amount of displacement error of the calibrator markers from their reference graticule lines. Linearity is the displacement error between successive markers, with respect to FREQ SPAN/GIV setting across the reference graticule divisions of span.

(1) Set the FREQ SPAN/DIV to 200MHz.

(2) Set the REF LEVEL to –30 dBm.

(3) Tune the CENTER FREQUENCY to the 900 MHz calibrator signal.

(4) Turn on AUTO RESOLUTION.

(5) Check the span/div accuracy by observing the amount of marker error from the respective graticule line.

- The error should be no more than 5% or 2 minor divisions.

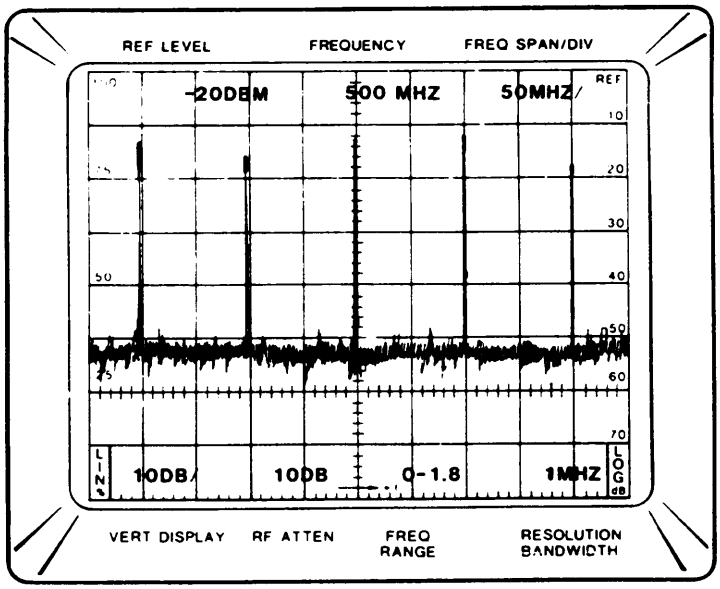
(6) Check the accuracy for the FREQ SPAN/DIV from 200 MHz to 10MHz using the 100MHz calibrator markers of the comb.

c. ***CHECK SPAN ACCURACY AND LINEARITY.*** Span accuracy is the amount of space the calibrator markers are from the center reference, over a ±4 division span. Using the first graticule line as a reference, linearity is the amount of space between markers at specified points on the display area.

(1) Set FREQ SPAN/DIV to 50MHz.

(2) Set 500MHz calibrator marker to the center frequency dot marker using the CENTER FREQUENCY control.

- The 100MHZ markers displayed should be within 5% of their reference graticule line over the center eight divisions. This results in no error for span accuracy.



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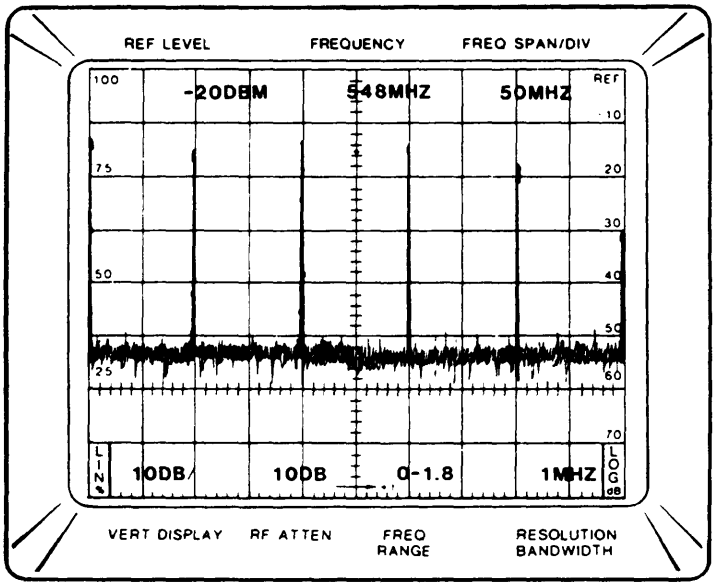
(3) Tune any of the 100MHz markers to the first graticule line.

- The space between the markers should be within 5% of their reference graticule line across the CRT.



d. CHECK RESOLUTION BANDWIDTH AND SHAPE FACTOR

NOTE

Bandwidth, 1 KHz to 1MHz ± 20% in decade steps; Shape Factor, 7.5:1 or less.

(1) Set REF LEVEL to –20 dBm.

(2) Set the 100MHZ marker to center graticule.

(3) Set FREQ SPAN/DIV to 500KHz. (Keep marker centered)

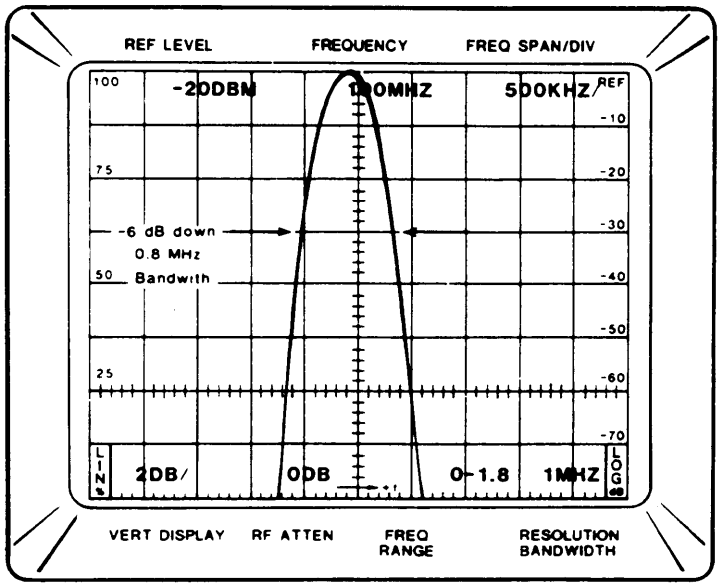
(4) Adjust RESOLUTION BANDWIDTH to 1 MHz.

(5) Turn TIME/DIV to AUTO.

(6) Change VERTICAL DISPLAY to 2 dB/DIV.

(7) Turn on MIN NOISE.

(8) Measure the bardwidth 6 dB down from the top graticule line.



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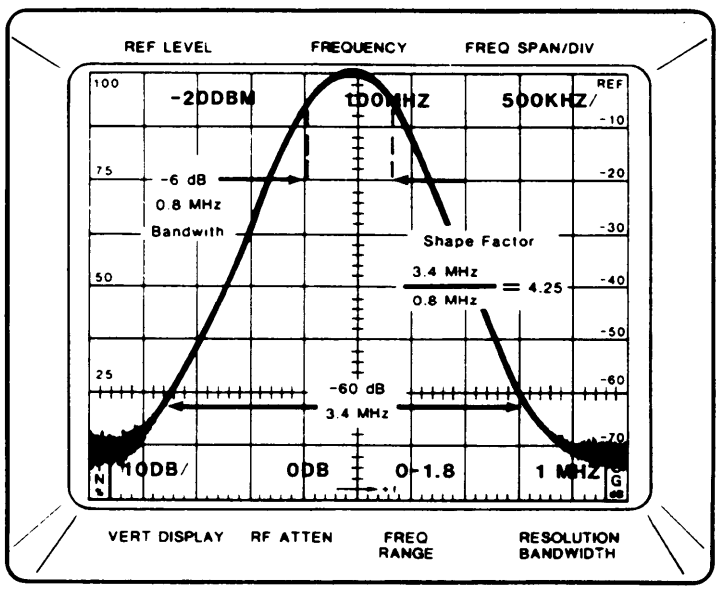
• The bandwidth should equal 1 MHz ±200KHz.

(9) Change the VERTICAL DISPLAY to 10 db/DIV.

(10) Measure the –60 dB down bandwidth.



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(11) To calculate the shape factor, divide the -60 dB bandwidth measurement by the –6 dB bandwidth measurement.

- The shape factor should equal 7.5:1 or less.

(12) Switch RESOLUTION BANDWIDTH to 100KHz.

(13) Set the FREQ SPAN/DIV to 100KHz.

(14) Check the bandwidth and shape factor of the 100KHz filter by repeating the procedures described above.

(15) After completion of the 100KHz filter, continue with remaining selections from the RESOLUTION BANDWIDTH, adjusting the FREQ SPAN/DIV as necessary to check the bandwidth and shape factor of each selection.

- The bandwidth should be within 20% of that selected and the shape factor should be 7.5:1 or better.

e. CHECK REFERENCE LEVEL GAIN AND RF ATTENUATOR STEPS

(1) Set the front panel controls as follows:

CONTROL/INDICATOR ON CRT DISPLAY	**CONDITION**
REF LEVEL	–30 dBm
FREQUENCY	100 MHz
FREQ SPAN/DIV	10 MHz
VERT DISPLAY	10 dB/DIV
RF ATTEN	0 dB
FREQ RANGE	0–1.8GHZ
RESOLUTION BANDWIDTH	1MHz

CONTROL/INDICATOR ON FRONT PANEL	**CONDITION**
READOUT	LIT
TRIGGERING (FREE RUN)	LIT
TIME/DIV	AUTO
VERTICAL DISPLAY (10 dB/DIV)	LIT
MIN NOISE (ON)	LIT
VIDEO FILTER (NARROW)	LIT
DIGITAL STORAGE VIEW A	LIT
VIEW B	LIT
ALL OTHER SWITCH/INDICATOR	OFF

(2) Set FREQUENCY to 200MHz.

(3) Reduce FREQ SPAN/DIV and RESOLUTION BANDWIDTH to 100KHz.

(4) Center the 200MHz marker using the CENTER FREQUENCY control.

(5) Increase REF LEVEL to 40 dBm in 10 dB steps, this checks the attenuator.

- The signal peak drops 1 division per step.
- RF ATTEN increases to 60 dB in 10 dB steps.

(6) Reset the REF LEVEL to –20 dBm and increase MIN RF ATTEN dB to 60 dB as shown on front panel scale.

- The noise floor level rises about 1 division per step.
- RF ATTEN changes to 60 dB.

(7) Switch REF LEVEL from -20 dBm to +40 dBm to check IF gain steps.

- The display shown on the CRT decreases so the noise floor level rests on the bottom graticule line.

(8) Activate FINE and change the REF LEVEL in 1 dB (0.1 division) steps to +30 dBm.

- The noise floor level and trace will rise about 1 division.

(9) Switch off FINE and reduce MIN RF ATTEN dB to 0 (on panel scale).

- The noise floor level decreases.
- The RF ATTEN changes from 60 dB to 50 dB.

(10) Turn off MIN NOISE.

- Noise floor level rises 1 division.
- RF ATTEN changes from 50 dB to 60 dB.

(11) Adjust the REF LEVEL to position the signal peak near the top of the graticule.

- Peak amplitude rises.

(12) Change VERTICAL DISPLAY to 2 dB/DIV.

- Trace reduces about 3 divisions.

(13) Rotate REFERENCE LEVEL control and observe the REF LEVEL and signal peak.

- REF LEVEL and signal peak change in 1 dB steps.

(14) Activate FINE for ΔA mode.

- REF LEVEL readout changes to * 0.00 dB.

(15) Turn the REFERENCE LEVEL and check that the REF LEVEL and signal amplitude change in 0.25 dB steps.

(16) Set VERTICAL DISPLAY to 10 dB/DIV and REF LEVEL to a multiple of 10 dBm.

(17) Switch off FINE.

f. CHECK SENSITIVITY

NOTE

Sensitivity is specified according to the input mixer average noise level. The AN/USM-489(V)1 calibrator signal is the reference used to calibrate the display. Accuracy of the calibrator output level is proven by using a 100MHz bandpass filter with known loss and an accurate power meter.

(1) Set the front panel controls as follows:

CONTROL/INDICATOR ON CRT DISPLAY	CONDITION
REF LEVEL	-30 dBm
FREQ SPAN/DIV	5MHZ
FREQUENCY	WITHIN BAND 1 (100 KHz to 1.8GHz)
VERT DISPLAY	10 dB/DIV
RF ATTEN	0 dB
FREQ RANGE	0.0-1.8GHZ
RESOLUTION BANDWIDTH	1 MHz

CONTROL/INDICATOR ON FRONT PANEL	CONDITION
READOUT	LIT
TRIGGERING (FREE RUN)	LIT
VERTICAL DISPLAY (10 dB/DiV)	LIT
VIDEO FILTER (WIDE)	LIT
DIGITAL STORAGE VIEW A	LIT
VIEW B	LIT
ALL OTHER SWITCH/indicators	OFF

(2) Set the TIME/DIV to .5s

- The trace speed slows down.

(3) Turn the MIN RF ATTEN to 0 dB (on the panel scale).

(4) Turn the PEAK/AVERAGE control fully to the right.

- The trace drops about .5 divisions.

(5) Disconnect the CAL OUT from the RF INPUT.

- The calibrator marker disappears from the display.

(6) Using the reference level of -30 dBm, (top graticule line), check that the noise level is not above that specified in Table 3-1.

Table 3-1

Average Noise Level dBm (max)

FREQUENCY RANGE	RESOLUTION BANDWIDTH				
	1 MHz	100 KHz	10 KHz	1 KHz	100Hz
100KHz — 4.2GHz (Bands 1 – 3)	–85	-95	-105	-115	-123
5.4 — 18GHz (Band 4)	-70	–80	–90	-100	-108
15 — 21.0GHZ (Band 5)	-65	-75	-85	-95	–103
18 — 26GHz (Band 6)	-70	-80	–90	-100	-108
26 — 40GHz (Band 7)	-65	–75	– 85	-95	–103

(7) Change REF LEVEL to -40 dBm.

(8) Change FREQ SPAN/DIV to 1 MHz.

(9) Change RESOLUTION BANDWIDTH to 100KHz.

(10) Use the reference level of -40 dBm to check that the noise level is not above that shown in Table 3-1.

(11) Change the RESOLUTION BANDWIDTH to 10KHz.

(12) Repeat step 10.

(13) Change the REF LEVEL to -60 dBm.

(14) Reduce FREQ SPAN/DIV to 10KHZ.

(15) Change VIDEO FILTER to NARROW.

(16) Reset TIME/DIV to AUTO.

(17) Change RESOLUTION BANDWIDTH to 1 KHz.

(18) Use the -60 dBm reference level to check that the noise level is not above that shown in Table 3-1.

(19) Change RESOLUTION BANDWIDTH to 100Hz.

(20) Reduce FREQ SPAN/DIV to 500 Hz.

(21) Repeat step 18.

NOTE

This procedure may be used to check sensitivity characteristics with external waveguide mixers when an accurate signal source is used to establish the reference.

(22) Repeat these procedures for the remaining coaxial input frequency range (100KHz —21GHz).

g. ***CHECK FREQUENCY DRIFT OR STABILITY.***

For AN/USM-489(V)1, the drift will be within 15KHz/10 minutes.

NOTE

This measurement, and the one for residual FM, are dependent on oscillator stability. The instrument must warm up in a stable, ambient temperature for at least 2 hours.

(1) Set the front panel controls as follows:

CONTROL/INDICATOR ON CRT DISPLAY	CONDITION
REF LEVEL	-20 dBm
FREQUENCY	WITHIN BAND 1
FREQ SPAN/DIV	10 MHz
VERT DISPLAY	10 dB/DIV
RF ATTEN	10 dB
FREQ RANGE	0.0-1.8GHZ
RESOLUTION BANDWIDTH	1 KHz

CONTROL/INDICATOR ON FRONT PANEL	CONDITION
READOUT	LIT
TRIGGERING (FREE RUN)	LIT
TIME/DIV	AUTO
VERTICAL DISPLAY (10 dB/DIV)	LIT
DIGITAL STORAGE VIEW A	LIT
VIEW B	LIT
AUTO RESOLUTION	LIT
ALL OTHER SWITCH/indicators	OFF

(2) Connect CAL OUT to RF INPUT

- The calibrator marker appears on the CRT.

(3) Tune the calibrator marker to the center graticule line.

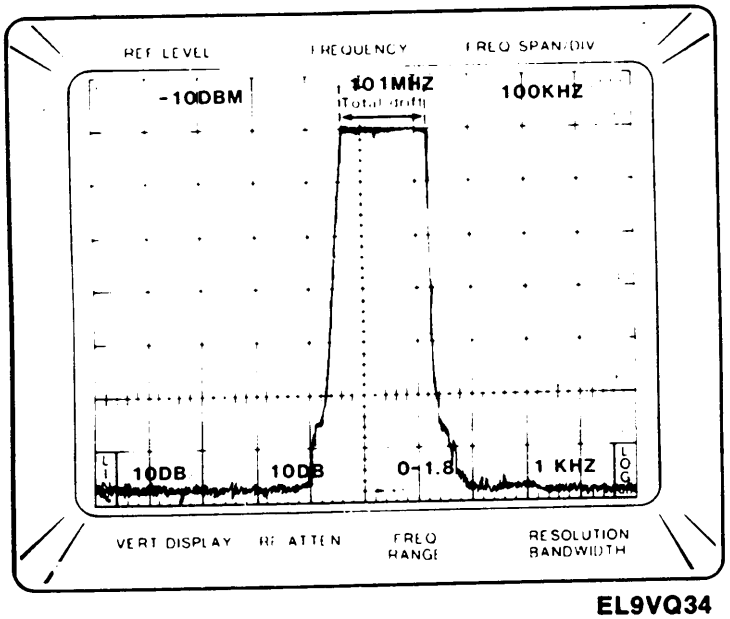
(4) DEGAUSS the signal and center the marker, or calibrate if the readout is not the correct frequency.

(5) Set the REF LEVEL for a signal amplitude of about seven divisions.

(6) Reduce FREQ SPAN/DIV to 100KHz.

(7) Adjust FREQUENCY to center calibrator marker.

(8) Allow the instrument to remain at a fixed frequency for at least 30 minutes.



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(9) Activate SAVE A and MAX HOLD.

(10) Turn off VIEW A.

(11) Reactivate VIEW A after allowing floor level to rise.

(12) Check as frequency drifts 15 KHz/10 minutes.

(13) Cancel MAX HOLD and SAVE A.

h. CHECK RESIDUAL FM

(1) Set the front panel controls as follows:

CONTROL/INDICATOR ON FRONT PANEL	CONDITION
READOUT	LIT
TRIGGERING (FREE RUN)	LIT
TIME/DIV	AUTO
VERTICAL DISPLAY (LIN)	LIT
DIGITAL STORAGE VIEW A	LIT
VIEW B	LIT
ALL OTHER SWITCHES/indicators	OFF

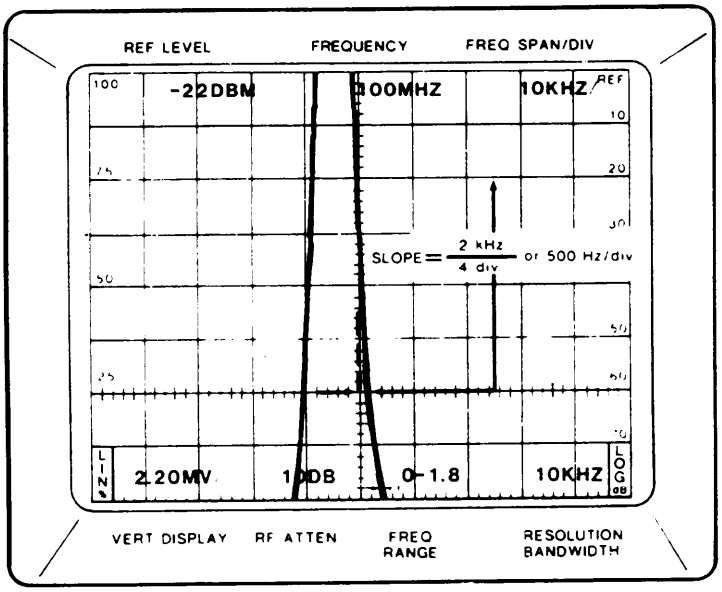
CONTROL/INDICATOR ON CRT DISPLAY	CONDITION
REF LEVEL	-10 dBm
FREQUENCY	WITHIN BAND 1
FREQ SPAN/DIV	10KHZ
VERT DISPLAY	8.92 MV/
RF ATTEN	20 dB
FREQ RANGE	0.0-1 .8GHZ
RESOLUTION BANDWIDTH	10KHZ

(2) Activate FINE.

(3) Adjust REF LEVEL for a full screen display on the CRT.

- The VERT DISPLAY changes.
- The trace rises.
- The REF LEVEL readout changes.

(4) Use the FREQUENCY control to position the calibrator marker so the slope (horizontal versus vertical excursion) of the response can be measured. Single sweep can be used to freeze the trace on the CRT. Turn off single sweep.



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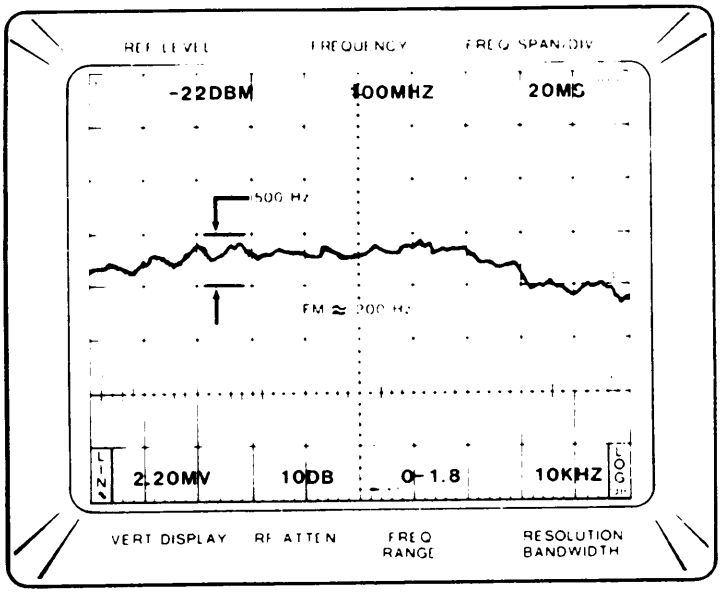
(5) Change FREQ SPAN/DIV to 10 mS (time domain).

- The trace has become a noise floor and is very erratic.

(6) Change TIME/DIV to 20 mS.

- FREQ SPAN/DIV changes to 20 mS.
- The noise floor may leave the CRT.

(7) Adjust FREQUENCY to position the display near the center of the CRT. Single Sweep can be used to freeze the trace on the CRT.



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(8) Using the conclusion from the measurement taken in step 4, measure the peak to peak amplitude of' the display within any horizontal division. Residual FM must not exceed 1 KHz for 20 mS.

(9) Turn off single sweep.

For a more accurate reading, do the following:

(I0) Switch TIME/DIV to AUTO.

(11) Activate PHASE LOCK.

- The line becomes much finer.

(12) Set FREQ SPAN/DIV to 500Hz.

(13) Set RESOLUTION BANDWIDTH to 1 KHz.

- The trace has appeared.

(14) Center the trace to the center of the CRT with the FREQUENCY control.

(15) Calculate the slope as in step 4.

(16) Switch FREQ SPAN/DIV to 10 mS.

- The trace becomes a noise floor.

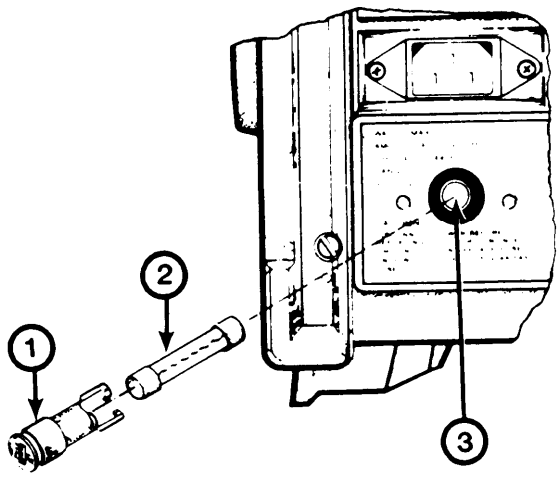
(17) Switch TIME/DIV to 10 mS/DIV.

(18) Measure the residual FM using technique shown in steps 4 and 8. Residual FM must not exceed 50Hz for a 20 mS period or two divisions.

3-10 REPLACE FUSE

DESCRIPTION

This procedure covers: Remove. Install.



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REMOVE

1. Turn power off at front panel by pressing POWER switch.
2. Unplug cable from power source.
3. Working at the rear panel, depress and turn fuseholder cap (1) 1/4 turn left.
4. Pull fuseholder cap (1) from instrument.
5. Remove fuse (2) from cap.

INSTALL

1. Working at rear panel, put fuse (2) into fuseholder cap (1).
2. Push fuseholder cap (1) into socket (3) and turn 1/4 right.
3. Plug cable into power source.
4. Working at front panel, activate AN/USM-489(V)1 by pulling the POWER switch.

End of Task

3-11 REPLACE FRONT PANEL CONTROL KNOBS

DESCRIPTION

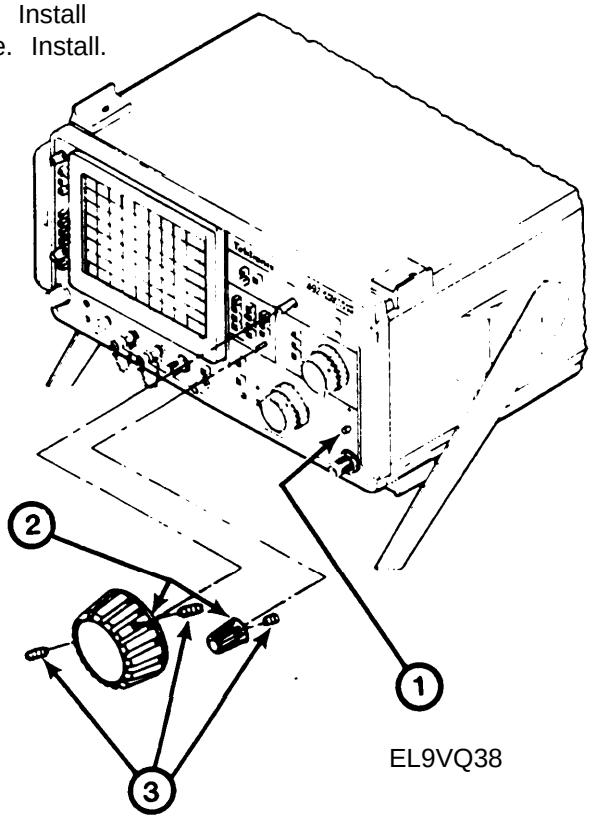
This procedure covers: Shafts With One Knob. Remove. Install
Shafts With Two Knobs. Remove. Install.

REMOVE KNOB FROM SHAFT (1 KNOB)

1. Turn power off at front panel by pressing POWER switch (1).
2. Turn knob (2) left (for TIME/DIV, turn to a panel mark where setscrew(s) (3) are available).
3. Loosen setscrew(s) (3).
4. Pull knob (2) from shaft.

INSTALL KNOB ON SHAFT (1 KNOB)

1. Push knob (2) onto shaft.
2. Turn knob (2) left (for TIME/DIV, turn to same panel marking set at to remove).
3. Tighten setscrew(s) (3).
4. Turn knob (2) and check that knob marker aligns with marks on the front panel.



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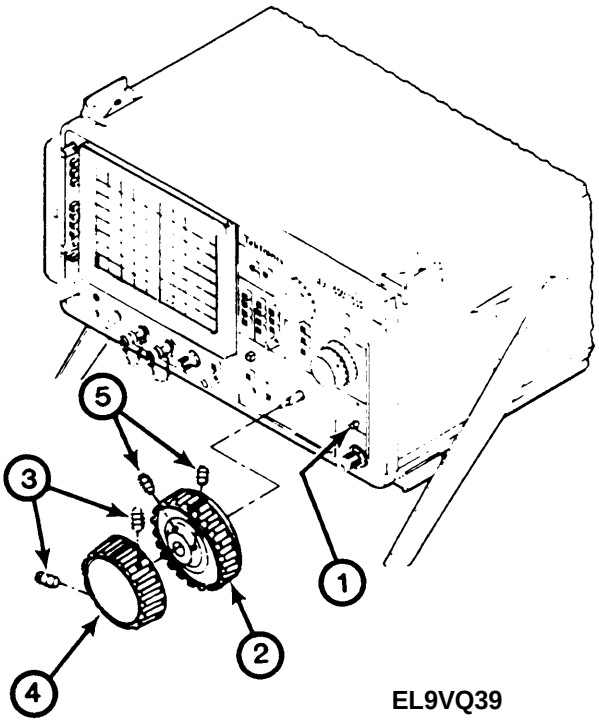
End of Task

REMOVE KNOB FROM SHAFT (2 KNOBS)

NOTE

To remove outer knob, use procedures for (1 KNOB).

1. Turn power off at front panel by pressing POWER switch (1).
2. Turn inner knob (2) left:
3. Turn outer knob (4) so setscrew(s) (3) are accessible.
4. Loosen setscrew(s) (3) in outer knob.
5. Pull outer (4) knob from shaft.
6. Loosen two setscrews (5) of inner knob.
7. Pull inner knob (2) from shaft.



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INSTALL KNOBS ON SHAFT (2 KNOBS)

NOTE

To install outer knob, perform steps 4 and 5.

1. Push inner knob (2) on shaft.
2. Turn inner knob (2) so it aligns with mark on the left.
3. Tighten two setscrews (5) of inner knob.
4. Push outer knob (4) onto shaft.
5. Tighten setscrew(s) (3) of outer knob.

End of Task

3-12 REPLACE LIGHT FILTER

DESCRIPTION

This procedure covers: Remove. Install.

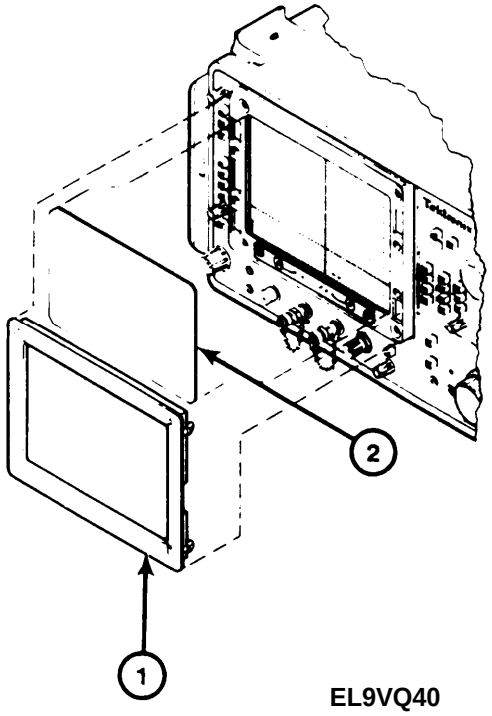
REMOVE

1. Working at the front panel, remove the CRT bezel (1) by pulling the bezel out near the center of the top.
2. Remove the light filter (2) simply by picking it up off the CRT surface.

INSTALL

1. Place the light filter (2) on the CRT surface.
2. Position the bezel (1) over the light filter and press in place.

End of Task



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SECTION V. PREPARATION FOR STORAGE OR SHIPMENT

3-13 PREPARATION FOR STORAGE OR SHIPMENT

a. Find a carton of corrugated cardboard with inside measurements that are 6 inches more than the equipment dimensions (to allow for cushioning).

b. Install the front panel cover on the spectrum analyzer and wrap the equipment in heavy paper or plastic to protect the finish. Place the equipment in the container.

c. Cushion the instrument on all surfaces with packing material or foam.

d. Seal the container with shipping tape or an industrial stapler.

3-14 TYPES OF STORAGE

a. ***Short-term (admlnistrative)*** = 1 to 45 days. All equipment in administrative storage must be able to be made ready within 24 hours for use on a mission. Before placing any item in administrative storage, make sure the next scheduled PMCS have been done and any deficiencies have been corrected. The administrative storage site should provide required protection from extreme weather conditions and allow you access to the equipment for visual inspections or exercises when applicable.

b. ***Intermediate*** = 46 to 180 days.

c. ***Long-term*** = over 180 days.

APPENDIX A
REFERENCES

A-1. SCOPE

This appendix lists all forms, field manuals, technical manuals, and miscellaneous publication references in this manual.

A-2. FORMS

Equipment Inspection and Maintenance Worksheet ..... DA Form 2404

Product Quality Deficiency Report ..... SF 368

Recommended Changes to Publications and Blank Forms ..... DA Form 2028

Report of Discrepancy (ROD) ..... SF 364

Transportation Discrepancy Report (TDR) ..... SF 361

A-3. TECHNICAL MANUALS

Procedures for Destruction of Electronics Materiel to Prevent Enemy Use (Electronics Command) ..... TM 750-244-2

Organizational, Direct Support and General Support Maintenance Repair Parts and Special Tools List for Spectrum Analyzer, AN/USM-489(V)1 (NSN 6625-01-079-9495) ..... TM 11-6625-3136-24P

A-4. MISCELLANEOUS PUBLICATIONS

The American Society of Mechanical Engineers, Abbreviations and Acronyms ..... ASME Y14.38

The Army Maintenance Management System (TAMMS) Users Manual ..... DA Pam 750-8

Expendable/Durable Items (Except Medical, Class V, Repair Parts, and Heraldic Items) ..... CTA 50-970

Consolidated Army Publications and Forms Index ..... DA Pam 25-30

First Aid ..... FM 4-25.11

Reporting of Supply Discrepancies ..... AR 735-11-2

Safety Requirements for Maintenance of Electrical and Electronic Equipment ..... TB 385-4

APPENDIX B

MAINTENANCE ALLOCATION CHART

SECTION I. INTRODUCTION

B-1 GENERAL

This section provides a summary of the maintenance operations for the Spectrum Analyzer AN/USM-489(V)1. It authorizes categories of maintenance for specific maintenance functions on repairable items and components and the tools and equipment required to perform each function. This appendix may be used as an aid in planning maintenance operations.

B-2 MAINTENANCE FUNCTIONS

Maintenance functions will be limited to and defined as follows:

a. ***Inspect.*** To determine the serviceability of an item by comparing its physical, mechanical, and/or electrical characteristics with established standards through examination.

b. ***Test.*** To verify serviceability and to detect incipient failure by measuring the mechanical or electrical characteristics of an item and comparing those characteristics with prescribed standards.

c. ***Service.*** Operations required periodically to keep an item in proper operating condition; i.e., to clean (decontaminate), to preserve, to drain, to paint, or to replenish fuel, lubricants, hydraulic fluids, or compressed air supplies.

d. ***Adjust.*** To maintain, within prescribed limits, by bringing into proper or exact position, or by setting the operating characteristics to the specified parameters.

e. ***Aline.*** To adjust specified variable elements of an item to bring about optimum or desired performance.

f. ***Calibrate.*** To determine and cause corrections to be made or to be adjusted on instruments or test, measuring, and diagnostic equipments used in precision measurement. Consists of comparisons of two instruments, one of which is a certified standard of known accuracy, to detect and adjust any discrepancy in the accuracy of the instrument being compared.

g. ***Install.*** The act of emplacing, seating, or fixing into position an item, part, or module (component or assembly) in a manner to allow the proper functioning of the equipment or system.

h ***Replace.*** The act of substituting a serviceable like type part, subassembly, or module (component or assembly) for an unserviceable counterpart.

i. ***Repair.*** The application of maintenance services (inspect, test, service, adjust, aline, calibrate, replace) or other maintenance actions (welding, grinding, riveting, straightening, facing, remachining, or resurfacing) to restore serviceability to an item by correcting specific damage, fault, malfunction, or failure in a part, subassembly, module (component or assembly), end item, or system.

j. Overhaul. That maintenance effort (service/action) necessary to restore an item to a completely serviceable/operational condition as prescribed by maintenance standards (i.e., DMWR) in appropriate technical publications. Overhaul is normally the highest degree of maintenance performed by the Army. Overhaul does not normally return an item to like new condition.

k. ***Rebuild.*** Consists of those services/actions necessary for the restoration of unserviceable equipment to a like new condition in accordance with original manufacturing standards. Rebuild is the highest degree of materiel maintenance applied to Army equipment. The rebuild operation includes the act of returning to zero those age measurements (hours, miles, etc.) considered in classifying Army equipments/components.

B-3 COLUMN ENTRIES

a. ***Column 1, Group Number.*** Column 1 lists group numbers, the purpose of which is to identify components, assemblies, subassemblies, and modules with the next higher assembly.

b. ***Column 2, Component/Assembly.*** Column 2 contains the noun names of components, assemblies, subassemblies, and modules for which maintenance is authorized.

c. ***Column 3, Maintenance Function.*** Column 3 lists the functions to be performed on the item listed in column 2. When items are listed without maintenance functions, it is solely for the purpose of having the group numbers in the MAC and RPSTL coincide.

d. ***Column 4, Maintenance Category.*** Column 4 specifies, by the listing of a "worktime" figure in the appropriate subcolumn(s), the lowest level of maintenance authorized to perform the function listed in column 3. This figure represents the active time required to perform that maintenance function at the indicated category of maintenance. If the number or complexity of the tasks within the listed maintenance function vary at different maintenance categories, appropriate "worktime" figures will be shown for each category. The number of task-hours specified by the "worktime" figure represents the average time required to restore an item (assembly, subassembly, component, module, end item, or system) to a serviceable condition under typical field operating conditions. This time includes preparation time, troubleshooting time, and quality assurance/quality control time in addition to the time required to perform the specific tasks identified for the maintenance functions authorized in the maintenance allocation chart. Subcolumns of column 4 are as follows:

C Operator/Crew

O Organizational

F Direct Support

H General Support

D Depot

e. ***Column 5, Tools and Equipment.*** Column 5 specifies by code, those common tool sets (not individual tools) and special tools, test, and support equipment required to perform the designated function.

f. ***Column 6, Remarks.*** Column 6 contains an alphabetic code which leads to the remark in Section IV, Remarks, which is pertinent to the item opposite the particular code.

B-4 TOOL AND TEST EQUIPMENT REQUIREMENTS (SECTION Ill)

a. ***Tool or Test Equipment Reference Code.*** The numbers in this column coincide with the numbers used in the tools and equipment column of the MAC. The numbers indicate the applicable tool or test equipment for the maintenance functions.

b. ***Maintenance Category.*** The codes in this column indicate the maintenance category allocated the tool or test equipment.

c. ***Nomenclature.*** This column lists the noun name and nomenclature of the tools and test equipment required to perform the - maintenance functions.

d. ***National/NATO Stock Number.*** This column lists the National/NATO stock number of the specific tool or test equipment.

e. **Tool** ***Number.*** This column lists the manufacturer's part number of the tool followed by the Federal Supply Code for Manufacturers (5-digit) in parentheses.

B-5 REMARKS (SECTION IV)

a. ***Reference Code.*** This code refers to the appropriate item in Section II, Column 6.

b. ***Remarks.*** This column provides the required explanatory information necessary to clarify items appearing in Section II.

SECTION II. MAINTENANCE ALLOCATION CHART
FOR
SPECTRUM ANALYZER AN/USM-489(V)1

(1) GROUP NUMBER	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE CATEGORY					(5) TOOLS AND EQPT.	(6) REMARKS
			C	0	F	H	D		
00	SPECTRUM ANALYZER	INSPECT		0.4					A
		TEST	0.3						B
		TEST				1.0			
		SERVICE	0.1						
		CALIBRATE				10.0			C
		ADJUST				2.0		3,4,15,19	
		REPAIR		0.2				1	D
		REPAIR				4.0		1 THRU 29	E
		REPAIR					10.0		F
01	FRONT PANEL ASSEMBLY	INSPECT				0.1			
		REPAIR				0.5		2,3,4,22,25,26	G
0101	FRONT PANEL CIRCUIT BOARD ASSEMBLY (A38)	INSPECT				0.1			
		REPLACE				0.2		2,3,4,22,25,26	
		REPAIR					5.5		F
02	REAR PANEL ASSEMBLY	INSPECT				0.1			
		REPAIR				0.5		2,3,4,22,25,26	G
0201	MAIN POWER SUPPLY (A30)	INSPECT				0:1			
		REPAIR				0.6		2,3,4,22,25,26	H
020101	CIRCUIT BOARD ASSEMBLY: MAIN POWER SUPPLY (A30A1)	INSPECT				0.1			
		REPLACE				0.3		2,3,4,22	
		REPAIR					2.5		F
03	2ND LO ASSEMBLY: PHASE LOCK (A22)	INSPECT				0.1			
		REPLACE				0.5		2,3,4,22	
		REPAIR					5.5		F
04	2ND CONVERTER ASSEMBLY: 829 MHz (A23)	INSPECT				0.1			
		REPLACE				0.5		2,3,4,22	
		REPAIR					2.0		F
05	VARIABLE RESOLUTION MODULES (A681A69)	INSPECT				0.1			
		REPLACE				0.2		2,3,4,22	
		REPAIR					2.0		F
06	PHASE LOCK SYNTHESIZER (A50)	INSPECT				0.1			
		REPLACE				0.2		2,3,4,22	
		REPAIR					2.0		F
07	CIRCUIT CARD ASSEMBLY: MOTHER BOARD (A28)	INSPECT				0.2			I
		INSPECT					1.0		
		REPAIR					1.5		F
08	VARIABLE STEP ATTENUATOR (AT10)	INSPECT				0.1			
		REPLACE				0.2		2,3,4,22	
		REPAIR					2.0		F

SECTION II. MAINTENANCE ALLOCATION CHART FOR

SPECTRUM ANALYZER AN/USM-489(V)1

(1) GROUP NUMBER	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE CATEGORY					(5) TOOLS AND EQPT.	(6) REMARKS
			C	O	F	H	D		
09	PHASE GATE DETECTOR (A24)	INSPECT				0.1			
		REPLACE				0.2		2,3,4,22	
		REPAIR					2.0		F
10	1ST CONVERTER MODULE (A12)	INSPECT				0.1			
		REPLACE				0.2		2,3,4,22	
		REPAIR					2.0		F
11	2072MHz 2ND CONVERTER (A18)	INSPECT				0.1			
		REPLACE				0.2		2,3,4,22	
		REPAIR					2.0		F
12	1ST LOCAL OSCILLATOR (A16)	INSPECT				0.1			
		REPLACE				0.2		2,3,4,22	
		REPAIR				1.0		2,3,4,22	J
		REPAIR					2.0		F

SECTION III. TOOL AND TEST EQUIPMENT REQUIREMENTS FOR SPECTRUM ANALYZER AN/USM-489(V)1

TOOL OR TEST EQUIPMENT REF CODE	MAIN-TENANCE CATEGORY	NOMENCLATURE	NATIONAL/NATO STOCKNUMBER	TOOL NUMBER
1	0	TOOL KIT, ELECTRONIC EQUIPMENT TK-101/G	5180-00-064-5178	
2	H,D	TOOL KIT, ELECTRONIC EQUIPMENT WPC-7	4931-01-019-7878	W-E 1916 (93459)
3	H,D	TOOL KIT, ELECTRONIC EQUIPMENT JTK-17	5180-01-073-3845	
4	H,D	TOOL KIT, ELECTRONIC EQUIPMENT APC-7	4931-01-019-7879	HP 11591A (28480)
5	H,D	ADAPTER CABLE (BNC TO SEALECTRO)		175-0419-00 (80009)
6	H,D	ADAPTER (N MALE TO BNC FEMALE)	5935-00-739-2243	10519457 (18876)
7	H,D	ADAPTER (N MALE TO SMA FEMALE)		AF 117A-69-36 (93459)
8	H,D	ATTENUATOR, STEP	6625-01-063-9297	7910807 (18876)
9	H,D	CABLE, COAXIAL 50 Ω	6625-01-028-5989	012-0482-00 (80009)
10	H,D	CONNECTOR, “T” BNC	5935-00-259-0205	103-0045-00 (80009)
11	H,D	COUNTER, FREQUENCY	6695-01-074-7955	DC 508A (80009)
12	H,D	FILTER, LOW PASS 200 MHz	5915-01-010-1140	TLC 200-6EF (04423)
13	H,D	GENERATOR, COMB	6625-01-110-0316	067-0885-00 (80009)
14	H,D	MODULE, COMB GENERATOR		015-1054-00 (80009)
15	H,D	GENERATOR, FUNCTION	6695-01-074-7956	FG 502 (80009)
16	H,D	OSCILLOSCOPE CALIBRATOR	6695-01-054-3085	6126M (50423)
17	H,D	GENERATOR, SIGNAL	4931-01-085-4229	MIS-28707 86403 (28480)
18	H,D	GENERATOR, SIGNAL	6625-01-067-6018	4312M16P-CA211-2 (93459)
19	H,D	TEST OSCILLATOR	6625-00-113-2943	652A (28480)

SECTION III. TOOL AND TEST EQUIPMENT REQUIREMENTS FOR SPECTRUM ANALYZER AN/USM-489(V)1

TOOL OR TEST EQUIPMENT REF CODE	MAIN-TENANCE CATEGORY	NOMENCLATURE	NATIONAL/NATO STOCK NUMBER	TOOL NUMBER
20	H,D	GENERATOR, SWEEP	6695-01-131-6349	4310AK-16P-25 (93459)
21	H,D	KIT, MAINTENANCE		035-2160-00 (80009)
22	H,D	METER, POWER	6625-00-148-8069	E12-432A (28480)
23	H,D	THERMISTOR MOUNT	6625-00-811-2435	8478B (28480)
24	H,D	MULTIMETER, DIGITAL	6625-01-075-8583	DM 501A (80009)
25	H,D	OSCILLOSCOPE	6695-01-074-7954	SC 504 (80009)
26	H,D	POWER, SPLITTER	6695-01-108-9833	1870A (93459)
27	D	SPECTRUM ANALYZER	6625-01-079-9495	492 (80009)
28	H,D	MODULAR POWER MAIN FRAME	6625-01-048-8920	MIS-30526/1 (80009)
29	H,D	TERMINATOR 50 Ω		

SECTION IV. REMARKS

REFERENCE CODE	REMARKS
A	VISUAL INSPECTION.
B	OPERATIONAL TEST.
C	CALIBRATE USING TECHNICAL BULLETIN 9-6625-2134-35.
D	REPAIR BY REPLACEMENT OF KNOBS AND FUSES.
E	REPAIR IS IMPLEMENTED BY REPLACEMENT OF A10, A11, A12, A13, A14, A16, A16A1, A18, A22, A23, A24, A32, A34, AT10, AT11, AT12, FL10, FL11, FL12, FL15, FL16, FL36, S11, S12, S13, A40, A42, A44, A46, A46A1, A46A3, A48, A50, A57, A54, A58, A60, A61, A62, A64, A66, A68169, A70, A72, A74, A77 AND THE CATHODE RAY TUBE.
F	DEPOT LEVEL REPAIR IS TO BE PERFORMED BY TEKTRONIX FACTORY SERVICE CENTER. FAILED ASSEMBLIES ARE TO BE SHIPPED TO: TRANSPORTATION OFFICER W62G2R SACRAMENTO ARMY DEPOT SACRAMENTO, CA 95813 M/F C/C “F’ STOCK THE NSN OF THE ASSEMBLY IS TO BE INCLUDED ON THE SHIPPING LABEL.
G	REPAIR IS IMPLEMENTED BY REPLACEMENT OF PANEL SUBASSEMBLIES.
H	REPAIR IS IMPLEMENTED BY REPLACEMENT OF A30A1, A30A2, A30A76, AND FUSES.
I	WHEN A28 IS FOUND TO BE FAULTY, THE ENTIRE SPECTRUM ANALYZER IS TO BE RETURNED FOR DEPOT LEVEL REPAIR.
J	REPAIR IS IMPLEMENTED BY REPLACEMENT OF A16A1.

APPENDIX C
COMPONENTS OF END ITEMS AND BASIC ISSUE ITEMS LISTS

SECTION I. INTRODUCTION

C-1 SCOPE

This appendix lists components of end item and basic issue for the AN/USM-489(V)1 to help you inventory items required for safe and efficient operation.

C-2 GENERAL

The Components of End Item and Basic Issue Items Lists are divided into the following sections:

a. ***Section II. Components of End Item.*** This listing is for informational purposes only, and is not authority to requisition replacements. These items are part of the end item, but are removed and separately packaged for transportation or shipment. As part of the end item, these items must be with the end item whenever it is issued or transferred between property accounts. Illustrations are furnished to assist you in identifying the items.

b. ***Section Ill. Basic Issue Items.*** Not Applicable.

C-3 EXPLANATION OF COLUMNS

The following provides an explanation of columns found in the tabular listings:

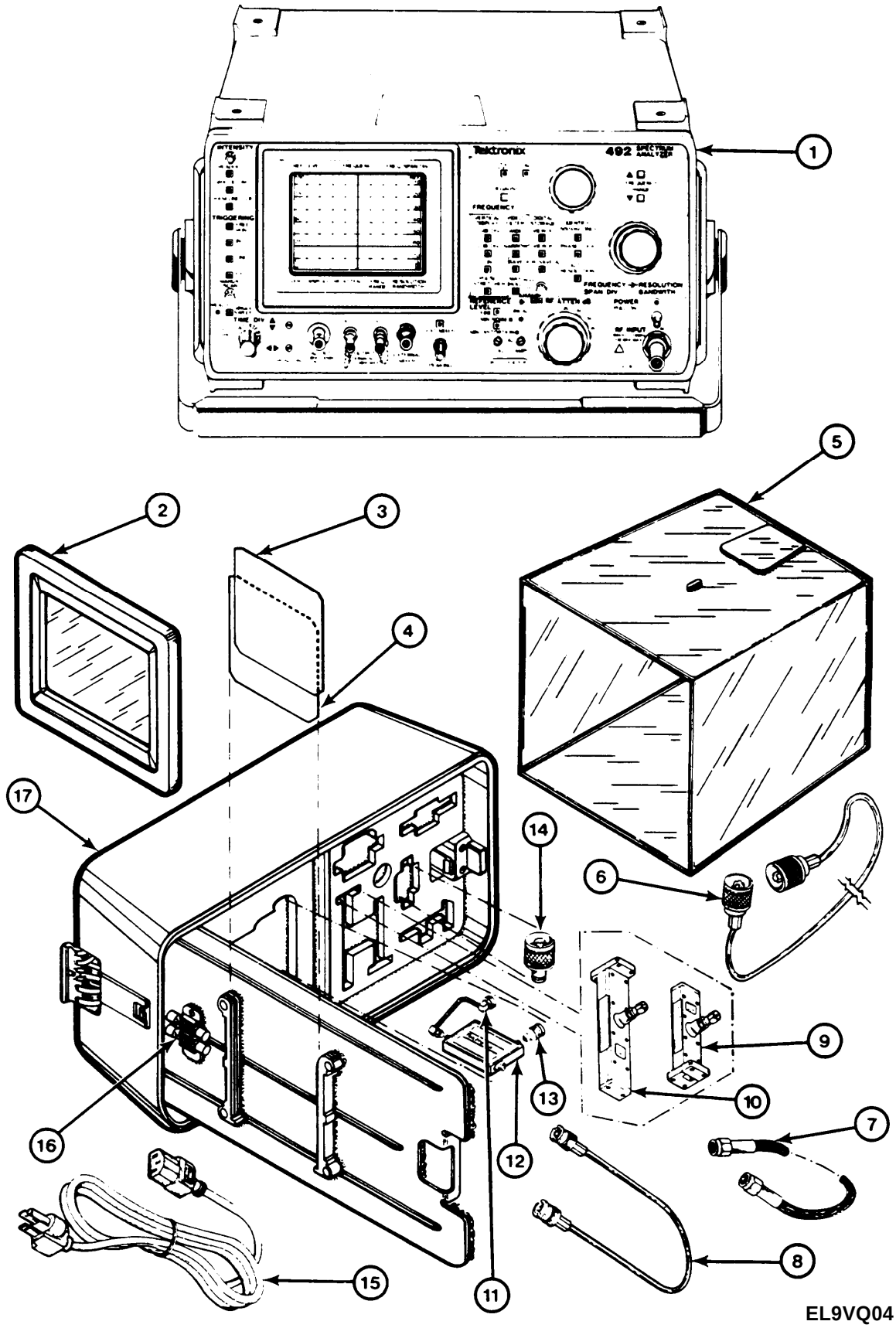
a. ***Column (1) - Illustration Number (Illus Number).*** This column indicates the number of the illustration in which the item is shown.

b. ***Column (2) - National Stock Number.*** Indicates the National stock number assigned to the item and will be used for requisitioning purposes.

c. ***Column (3) - Description.*** Indicates the Federal item name and, if required, a minimum description to identify and Iocate the item. The last Iine for each item indicates the FSCM (in parentheses) followed by the part number.

d. ***Column (4) - Unit of Measure (U/M).*** Indicates the measure used in performing the actual operational/ maintenance function. This measure is expressed by a two-character alphabetical abbreviation (e.g., ea, in, pr).

e. ***Column (5) - Quantity required*** **(Qty** ***rqr).*** Indicates the quantity of the item authorized to be used with/on the equipment.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SECTION II. COMPONENTS OF END ITEMS

(1) Illus No.	(2) National Stock Number	(3) Description FSCM and Part Number	(4) U/M	(5) Qty Rqr
1	6625-01-079-9495	Spectrum Analyzer	EA	1
2		Mesh Filter, EMI (80009) 378-0887-00	EA	1
3		Filter, Light, CRT; Amber, Plastic (80009) 378-0115-01	EA	1
4		Filter, Light, CRT; Gray, Plastic (80009) 378-0115-02	EA	1
5		Visor, CRT, Folding (80009) 016-0653-00	EA	1
6		Cable Assembly; RF, 50 Ω Coaxial, 72 In. (80009) 012-0114-00	EA	1
7		Cable Assembly; SMA to SMA Connector (80009) 012-0649-00	EA	1
8		Cable Assembly; RF, 50 Ω Coaxial, 20 In. (80009) 012-0076-00	EA	1
9		Wave Guide Mixer; 26.5 -40.0 GHz (80009) 016-0632-01	EA	1
10		Wave Guide Mixer; 18.0-26.5 GHz (80009) 016-0631-01	EA	1
11		Cable Assembly; RF, 50 Ω Coaxial, 3.382 In. (80009) 015-1055-00	EA	1
12		Wave Guide Mixer; Diplexer (80009) 015-3855-00	EA	1
13		Adapter, Connector; TNC Male to SMA Male (80009) 015-0388-00	EA	1
14		Adapter, Connector; BNC Female to N Male (80009) 103-0045-00	EA	1
15		Cable Assembly, Power; 3, 16 AWG 125 V 90 In. (80009) 161-0118-00	EA	1
16		Fuse, Cartridge; 3 AG, 4A; 250 V Fast Blow (80009) 159-0017-00	EA	2
17		Cover, Front; Plastic, Painted (80009) 200-2218-01	EA	1

APPENDIX E
EXPENDABLE SUPPLIES AND MATERIALS LIST

Section I. INTRODUCTION

E-1. SCOPE

This appendix lists expendable supplies and materials you will need to operate and maintain the Spectrum Analyzer, AN/USM-489(V)1. These items are authorized to you by CTA 50-970, Expendable/Durable Items (Except Medical, Class V, Repair Parts, and Heraldic Items).

E-2. EXPLANATION OF COLUMNS

a. **Column (1) - Item Number.** This number is assigned to the entry in the listing and is referenced in the narrative instructions to identify the material. (e.g., "Use cleaning compound, item 1, App. E").

b. **Column (2) - Level.** This column identifies the lowest level of maintenance that requires the listed item.

C - Operator/Crew
O - Organizational Maintenance
F - Direct Support Maintenance
H - General Support Maintenance

c. **Column (3) - National Stock Number.** This is the national stock number assigned to the item; use it to request or requisition the item.

d. **Column (4) - Description.** Indicates the federal item name and, if required, a description to identify the item. The last line for each item indicates the Federal Supply Code for Manufacturer (FSCM) in parentheses followed by the part number.

e. **Column (5) - Unit of Measure (U/M).** Indicates the measure used in performing the actual maintenance function. This measure is expressed by a two-character alphabetical abbreviation (e.g., ea, in, pr). If the unit of measure differs from the unit of issue, requisition the lowest unit of issue that will satisfy your requirements.

Section II. EXPENDABLE SUPPLIES AND MATERIALS LIST

(1) ITEM NUMBER	(2) LEVEL	(3) NATIONAL STOCK NUMBER	(4) DESCRIPTION	(5) U/M
1	C	8305-00-267-3015	Cloth, Cheesecloth, Cotton, Lintless, CCC-C-440, Type II, Class 2 (81348)	YD
2	C		Detergent, Mild, Liquid	OZ

GLOSSARY

The following glossary is presented as an aid to better understand the terms as they are used in this document.

SECTION I. ABBREVIATIONS

There are no unusual abbreviations in this manual.

SECTION II. DEFINITION OF UNUSUAL ITEMS

BASELINE CLIPPER (INTENSIFIER) - Increases the brightness of the signal relative to the baseline portion of the display.

CENTER FREQUENCY - That frequency which corresponds to the center of a frequency span, expressed in hertz.

EFFECTIVE FREQUENCY RANGE - That range of frequency over which the instrument performance is specified. The lower and upper limits are expressed in hertz.

ENVELOPE DISPLAY - The display produced on a spectrum analyzer when the resolution bandwidth is greater than the spacing of the individual frequency components.

FREQUENCY BAND - A part of effective frequency range over which the frequency can be adjusted, expressed in hertz.

FULL SPAN (MAXIMUM SPAN) - A mode of operation in which the spectrum analyzer scans an entire frequency band.

INTERMODULATION SPURIOUS RESPONSE (INTERMODULATION DISTORTION) - An unwanted spectrum analyzer response resulting from the mixing of the nth order frequencies. This is due to non-linear elements of the spectrum analyzer, resulting in an unwanted spurious response being displayed.

LINE DISPLAY - The display produced on a spectrum analyzer when the resolution bandwidth is less than the spacing of the signal amplitudes of the individual frequency components.

LINE SPECTRUM - A spectrum composed of signal amplitudes of the discrete frequency components.

MAXIMUM SAFE INPUT POWER -

WITHOUT DAMAGE - The maximum power applied at the input which will not cause degradation of the instrument characteristics.

WITH DAMAGE - The minimum power applied at the input which will damage the instrument.

PULSE STRETCHER - A pulse shaper that produces an output pulse, whose duration is greater than that of the input pulse, and whose amplitude is proportional to that of the peak amplitude of the input pulse.

SCANNING VELOCITY - Frequency span divided by sweep time and expressed in hertz per second.

SIGNAL IDENTIFIER - A means to identify the spectrum of the input signal when spurious responses are possible.

SPECTRUM ANALYZER - An apparatus which is generally used to display the power distribution of an incoming signal as a function of frequency.

NOTE

It is useful in analyzing the characteristics of repetitive electrical waveforms in general, since repetitive/y sweeping through the frequency range of interest will display all components of the signal.

VIDEO FILTER - A post detection low-pass filter.

ZERO SPAN - A mode of operation in which the frequency span is reduced to zero.

TERMS RELATED TO FREQUENCY

DISPLAY FREQUENCY - The input frequency as indicated by the spectrum analyzer and expressed in hertz.

FREQUENCY DRIFT - Gradual shift or change in displayed frequency over the specified time due to internal changes in the spectrum analyzer, and expressed in hertz per second, where other conditions remain constant.

FREQUENCY LINEARITY ERROR - The error of the relationship between the frequency of the input signal and the frequency displayed (expressed as a ratio).

FREQUENCY SPAN (DISPERSION) - The magnitude of the frequency band displayed, expressed in hertz or hertz per division.

IMPULSE BANDWIDTH - The displayed spectral level of an applied pulse divided by its spectral voltage density level assumed to be flat within the pass-band.

RESIDUAL FM (INCIDENTAL FM) - Short term displayed frequency instability or jitter due to instability in the spectrum analyzer local oscillators, given in terms of peak-to-peak frequency deviation and expressed in hertz or percent of the displayed frequency.

SHAPE FACTOR (SKIRT SELECTIVITY) - The ratio of the frequency separation of the two (60 dB/6 dB) down points on the response curve to the static resolution bandwidth.

STATIC (AMPLIFIER) RESOLUTION BANDWIDTH - The specified bandwidth of the spectrum analyzer's response to a cw signal, if sweep time is kept substantially long.

NOTE

This bandwidth is the frequency separation of two down points, usually 6 dB, on the response curve, if it is measured either by manual scan (true static method) or by using a very lows weep speed (quasi-static method).

ZERO PIP (RESPONSE) - An output indication which corresponds to zero input frequency.

TERMS RELATED TO AMPLITUDE

DEFLECTION COEFFICIENT - The ratio of the input signal magnitude to the resultant output indication.

NOTE

The ratio may be expressed in terms of volts (rms) per division, decibels per division, watts per division, or any other specified factor.

DISPLAY DYNAMIC RANGE - The maximum ratio of the levels of two non-harmonically related sinusoidal signals each of which can be simultaneously measured on the screen to a specified accuracy.

DISPLAY FLATNESS - The unwanted variation of the displayed amplitude over a specified frequency span, expressed in decibels.

DISPLAY LAW - The mathematical law that defines the input-output function of the instrument.

NOTE

The following cases apply:

1. *Linearity — A display in which the scale divisions are a linear function of the input signal voltage.*
2. *Square law (power) — A display in which the scale divisions are a linear function of the input signal power.*
3. *Logarithmic — A display in which the scale divisions are a logarithmic function of the input signal voltage.*

DISPLAY REFERENCE LEVEL - A designated vertical position representing a specified input level.

NOTE

The level may be expressed in decibels (e.g., 1 mW), volts, or any other units.

DYNAMIC RANGE - The maximum ratio of the levels of two signals simultaneously present at the input which can be measured to a specified accuracy.

EQUIVALENT INPUT NOISE SENSITIVITY - The average level of a spectrum analyzer's internally generated noise referenced to the input.

FREQUENCY RESPONSE - The unwanted variation of the displayed amplitude over a specified center frequency range, measured at the center frequency, expressed in decibels.

GAIN COMPRESSION - Maximum input level where the scale linearity error is below that specified.

HUM SIDEBANDS - Undesired responses created within the spectrum analyzer, appearing on the display, that are separated from the desired response by the fundamental or harmonic of the power line frequency.

INPUT IMPEDANCE - The impedance at the desired input terminal.

NOTE

Usually expressed in terms of VSWR, return loss, or other related terms for low impedance devices and resistance-capacitance parameters for high impedance devices.

NOISE SIDEBANDS - Undesired responses caused by noise internal to the spectrum analyzer that appears on the display around a desired response.

RELATIVE DISPLAY FLATNESS - The display flatness measured relative to the display amplitude at a fixed frequency within the frequency span, expressed in decibels.

NOTE

Display flatness is closely related to frequency response. The main difference is that the spectrum display is not recentered.

RESIDUAL RESPONSE - A spurious response in the absence of an input signal. (Noise and zero pip are excluded).

SENSITIVITY - Measure of a spectrum analyzer's ability to display minimum level signals, at a given IF bandwidth, display mode, and any other influencing factors, and expressed in decibeis.

SPURIOUS RESPONSE - A response of a spectrum analyzer wherein the displayed frequency does not conform to the input frequency.

TERMS RELATED TO DIGITAL STORAGE OR SPECTRUM ANALYZERS

CLEAR (ERASE) - Presets memory to a prescribed state, usually that denoting zero.

DIGITALLY AVERAGED DISPLAY - A display of the average value of digitized data computed by combining serial samples in a defined manner.

DIGITALLY STORED DISPLAY - A display method whereby the displayed function is held in a digital memory. The display is generated by reading the data out of memory.

MAX HOLD (PEAK MODE) - Digitally stored display mode which, at each frequency address, compares the incoming signal level to the stored level and retains the greater. In this mode, the display indicates the peak level at each frequency after several successive sweeps.

MULTIPLE DISPLAY MEMORY - A digitally stored display having multiple memory sections which can be displayed separately or simultaneously.

SAVE - A function that inhibits storage update, saving existing data in a section of a multiple memory (e.g., Save A).

SCAN ADDRESS - A number representing each horizontal data position increment on a directed beam type display. An address in a memory is associated with each scan address.

VIEW (DISPLAY) - Enables viewing of contents of the chosen memory section (e.g., "View A" displays contents of memory A; "View B" displays the contents of memory B).

SUBJECT INDEX

By Order of the Secretary of the Army:

JOHN A. WICKHAM, JR.
General, United States Army
Chief of Staff

Official:

R.L. DILWORTH
Brigadier General, United States Army
The Adjutant General

DISTRIBUTION:
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These are the instructions for sending an electronic 2028

The following format must be used if submitting an electronic 2028. The subject line must be exactly the same and all fields must be included; however only the following fields are mandatory: 1, 3, 4, 5, 6, 7, 8, 9, 10, 13, 15, 16, 17, and 27.

From: "Whomever" <whomever@wherever.army.mil>
To: 2028@redstone.army.mil

Subject: DA Form 2028

1. ***From:*** Joe Smith
2. *Unit:* home
3. ***Address:*** 4300 Park
4. ***City:*** Hometown
5. ***St:*** MO
6. ***Zip:*** 77777
7. ***Date Sent:*** 19−OCT−93
8. ***Pub no:*** 55−2840−229−23
9. ***Pub Title:*** TM
10. ***Publication Date:*** 04−JUL−85
11. *Change Number:* 7
12. *Submitter Rank:* MSG
13. ***Submitter FName:*** Joe
14. *Submitter MName:* T
15. ***Submitter LName:*** Smith
16. ***Submitter Phone:*** 123−123−1234
17. ***Problem:*** **1**
18. *Page:* 2
19. *Paragraph:* 3
20. *Line:* 4
21. *NSN:* 5
22. *Reference:* 6
23. *Figure:* 7
24. *Table:* 8
25. *Item:* 9
26. *Total:* 123
27. ***Text:***

This is the text for the problem below line 27.

RECOMMENDED CHANGES TO PUBLICATIONS AND BLANK FORMS For use of this form, see AR 25–30; the proponent agency is ODISC4.	Use Part II (*reverse)* for Repair Parts and Special Tool Lists (RPSTL) and Supply Catalogs/ Supply Manuals (SC/SM)	DATE 8/30/02
TO: (*Forward to proponent of publication or form)(Include ZIP Code)* Commander, U.S. Army Aviation and Missile Command ATTN: AMSAM–MMC–MA–NP Redstone Arsenal, 35898	FROM: (*Activity and location)(Include ZIP Code)* MSG, Jane Q. Doe 1234 Any Street Nowhere Town, AL 34565	

PART 1 – ALL PUBLICATIONS (EXCEPT RPSTL AND SC/SM) AND BLANK FORMS

PUBLICATION/FORM NUMBER	DATE	TITLE
TM 9–1005–433–24	16 Sep 2002	Organizational, Direct Support, And General Support Maintenance Manual for Machine Gun, .50 Caliber M3P and M3P Machine Gun Electrical Test Set Used On Avenger Air Defense Weapon System

ITEM NO.	PAGE NO.	PARA–GRAPH	LINE NO. *	FIGURE NO.	TABLE NO.	RECOMMENDED CHANGES AND REASON
1	WP0005 PG 3		2			Test or Corrective Action column should identify a different WP number.

** Reference to line numbers within the paragraph or subparagraph.*

TYPED NAME, GRADE OR TITLE	TELEPHONE EXCHANGE/ AUTOVON, PLUS EXTENSION	SIGNATURE
MSG, Jane Q. Doe, SFC	788–1234	

TO: (*Forward direct to addressee listed in publication)*	**FROM:** (*Activity and location) (Include ZIP Code)*	**DATE**
Commander, U.S. Army Aviation and Missile Command ATTN: AMSAM–MMC–MA–NP Redstone Arsenal, 35898	MSG, Jane Q. Doe 1234 Any Street Nowhere Town, AL 34565	8/30/02

PART II – REPAIR PARTS AND SPECIAL TOOL LISTS AND SUPPLY CATALOGS/SUPPLY MANUALS

PUBLICATION NUMBER	DATE	TITLE

PAGE NO.	COLM NO.	LINE NO.	NATIONAL STOCK NUMBER	REFERENCE NO.	FIGURE NO.	ITEM NO.	TOTAL NO. OF MAJOR ITEMS SUPPORTED	RECOMMENDED ACTION

PART III – REMARKS (*Any general remarks or recommendations, or suggestions for improvement of publications and blank forms. Additional blank sheets may be used if more space is needed.)*

TYPED NAME, GRADE OR TITLE	TELEPHONE EXCHANGE/AUTOVON, PLUS EXTENSION	SIGNATURE
MSG, Jane Q. Doe, SFC	788–1234	

RECOMMENDED CHANGES TO PUBLICATIONS AND BLANK FORMS For use of this form, see AR 25–30; the proponent agency is ODISC4.	Use Part II (*reverse)* for Repair Parts and Special Tool Lists (RPSTL) and Supply Catalogs/ Supply Manuals (SC/SM)	DATE
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