
TECHNICAL MANUAL

**OPERATOR'S, ORGANIZATIONAL, DIRECT SUPPORT,
AND GENERAL SUPPORT MAINTENANCE MANUAL
INCLUDING REPAIR PARTS AND SPECIAL TOOLS LIST
FOR
FREQUENCY METER FR-194/U
(NSN 6625-00-730-8570)**

This manual contains copyright material by permission of the Hewlett-Packard Company.

TECHNICAL MANUAL

No. 11-6625-1539-14 & P

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, DC, 20 October 1981

**OPERATOR'S, ORGANIZATIONAL, DIRECT SUPPORT, AND
GENERAL SUPPORT MAINTENANCE MANUAL
INCLUDING REPAIR PARTS AND SPECIAL TOOLS LIST
FOR
FREQUENCY METER FR-194/U
(NSN 6625-00-730-8570)
(HEWLETT-PACKARD MODEL 532A/B
Current as of 15 May 1981**

REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS

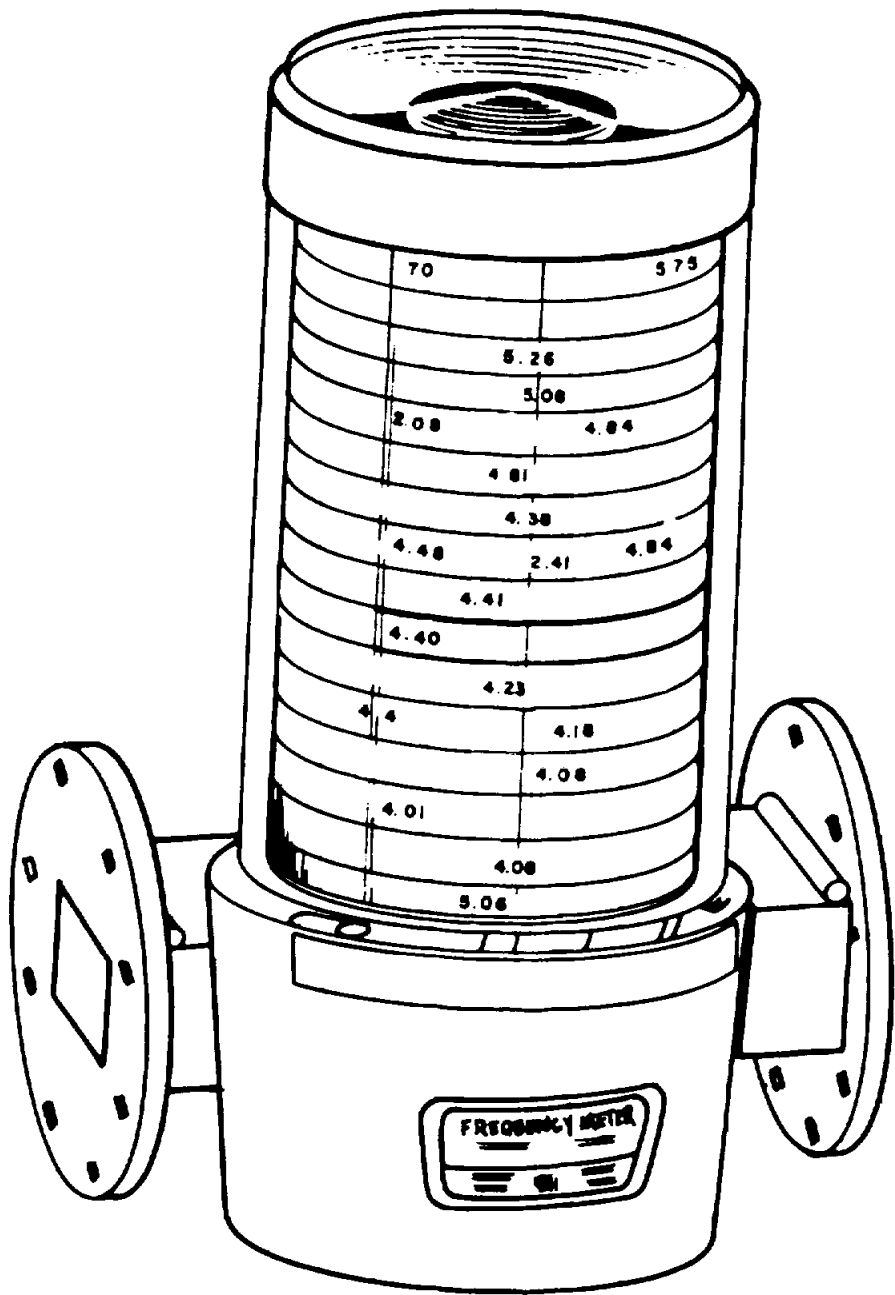
You can help improve this manual. If you find any mistakes or if you know of a way to improve the procedures, please let us know. Mail your letter or DA Form 2028 (Recommended Changes to Publications and Blank Forms) direct to: Commander, US Army Communications-Electronics Command, ATTN: DRSEL-ME-MQ, Fort Monmouth, NJ 07703.

In either case, a reply will be furnished direct to you.

TABLE OF CONTENTS

	Page
SECTION 0.	
Paragraph 0.	INTRODUCTION..... 2
1.	DESCRIPTION..... 4
6.	UNPACKING AND INSPECTION 4
8.	REPACKAGING FORSHIPMENT..... 4
9.	Using Original Packaging 4
12.	Using Other Packaging 4
14.	OPERATION 4
15.	Operating Precautions..... 4
18.	Operating Instructions 4
22.	MAINTENANCE..... 5
24.	PERFORMANCE TEST 5
25.	Test Equipment Required..... 5
27.	Procedures 5
APPENDIX A.	REFERENCES..... A-1
B.	MAINTENANCE ALLOCATION
SECTION I.	Introduction..... B-1
II.	Maintenance Allocation Chart for Frequency Meter. FR- 194/U..... B-4
III.	Tool and Test Equipment Requirements for Frequency Meter, FR-194/U..... B-5
IV.	Remarks (Not applicable)
APPENDIX C.	OPERATOR'S, ORGANIZATIONAL, DIRECT SUPPORT, AND GENERAL SUPPORT MAINTENANCE REPAIR PARTS AND SPECIAL TOOLS LIST..... C-1

This manual is an authentication of the manufacturer's commercial literature which, through usage, has been found to cover the data required to operate and maintain this equipment. Since the manual was not prepared in accordance with military specifications and AR-310-3, the format has not been restricted to consider levels of maintenance, nor is it structured to the normal style of military publications.



EL3DR001

Figure 0. Frequency Meter FR- 194/U

SECTION 0

0. INTRODUCTION

a. Scope. This manual describes Frequency Meter FR-194/U and provides instructions for operation and maintenance. Throughout this manual, the FR-1941U is referred to as the Hewlett-Packard 532A/B which has a frequency range of 7.0 through 10 GHz.-

b. Indexes of Publications.

(1) *DA PAM 310-4.* Refer to the latest issue of DA Pam 310-4 to determine whether there are new editions, changes, additional publications or modification work orders pertaining to the equipment.

c. Maintenance Forms, Records, and Reports.

(1) *Reports of Maintenance and Unsatisfactory- Equipment.* Department of the Army forms and procedures used for equipment maintenance will be those prescribed by TM 38-750, The Army Maintenance Management System.

(2) *Report of Packaging and Handling Deficiencies.* Fill out and forward SF 364 (Report of Discrepancy (ROD)) as prescribed in AR 735-11-2/DLAR 4140.55/NAVMATINST 4355.73/AFR 400.54/MCO 4430.3E.

(3) *Discrepancy in Shipment Report (DISREP) (SF361).* Fill out and forward Discrepancy in Shipment Report (DISREP) (SF 361) as prescribed in AR55-38/NAVSUPINST 4610.33BIAFR 75-18/MCOP4610.19C and DLAR 4500.15.

d. Reporting Equipment Improvement Recommendations (EIR). If your Frequency Meter FR-194/U 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. Tell us why a procedure is hard to perform. Put it on an SF 368 (Quality Deficiency Report). Mail it to Commander, US Army Communications-Electronics Command, ATTN: DRSEL-ME-MQ, Fort Monmouth, NJ 07703. We'll send you a reply. *e. Administrative Storage.* Administrative storage of equipment issued to and used by Army activities shall be in accordance with paragraphs 8 thru 13.

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

Table 1. Specifications

Model	G532A	J532A ¹	H532A	X532B	M532A	P532A	K532A ⁵	R532A ⁵
Frequency Range (GHz)	3.95-5.85	5.3-8.2	7.0-10	8.2-12.4	10-15	12.4-18	18-26.5	26.5-40
Overall Accuracy ²	0.065%	0.065%	0.075%	0.08%	0.085%	0.10%	0.11%	0.12%
Calibration Increments	1 MHz	2 MHz	2 MHz	5 MHz	5 MHz	5 MHz	10 MHz	10 MHz
Scale Length in. (mm)	155 (3937)	140 (3556)	125 (3145)	77 (1956)	74 (1880)	75 (1905)	72 (1829)	75 (1905)
Dial Accuracy ³	0.033%	0.033%	0.040%	0.050%	0.053%	0.068%	0.077%	0.083%
Fits Waveguide (in.) (EIA)	2 x 1 WR187	1-1/2 x 3/4 WR137	1-1/4 x 5/8 WR112	1 x 1/2 WR90	.850 x .475 WR75	.702 x .391 WR62	1/2 x 1/4 WR42	.360 x .220 WR28
Equiv Flange	UG-407/U	UG-441/U	UG-138/U	UG-39/U	Cover	UG-419/U	UG-595/U	UG-599/U
Max Temp Coef $^{\circ}\text{C}/^{\circ}\text{C}$	0.0012	0.0012	0.0015	0.0010	0.0012	0.0012	0.0013	0.0017
Size, in., (mm)								
Length	6-1/4 (159)	6-1/4 (159)	6-1/4 (159)	4-1/2 (114)	4-1/2 (114)	4-1/2 (114)	4-1/2 (114) ⁴	4-1/2 (114) ⁴
Height	9-1/2 (241)	9-1/8 (232)	8 (203)	6-1/8 (156)	6-1/4 (159)	6-1/4 (159)	5-3/8 (137)	5-1/2 (140)
Depth	5 (127)	5-1/2 (114)	4-3/8 (111)	2-7/8 (73)	2-3/4 (70)	2-3/4 (70)	2-7/8 (73)	2-3/4 (70)
Net Weight lb, (kg)	9-1/2 (4, 1)	7-1/2 (3, 4)	6 (2, 7)	3-1/2 (1, 6)	3-1/2 (1, 6)	3 (1, 4)	1-1/2 (0, 7)	1-1/2 (0, 7)

FOR ALL MODELS

DIP AT RESONANCE: 1dB or more

MINIMUM CALIBRATION SPACING: 1/32 inch

¹Because of the wide frequency range of the J532A, frequencies from 7.6 to 8.2 GHz can excite the TE₁₁₂ mode when the dial is set between 5.3 and 5.6 GHz.²Includes dial accuracy, 20° C temperature variation (23° ± 10° C) and 0.02% for 0 to 100% relative humidity.³Includes mechanical tolerances and backlash.⁴With circular flange adapter, 5-5/16" (135 mm).⁵Circular flange adapters available: specify HP 11515A (UG-425/U) for "K" band; HP 11516A (UG-381/U) for "R" band.

1. DESCRIPTION.

2. The Model 532A/B direct-reading frequency meters offer good accuracy over an entire waveguide band. The meter consists of a TE111 mode resonant cavity coupled to a waveguide section. When tuned to resonance, a fraction of the power is absorbed, and consequently there is a dip of about 1 dB in the transmitted power. The frequency at which this dip occurs may be read directly from the scale.

3. A long spiral scale, with small calibration increments and well-separated marks, provide the high resolution needed for measuring small frequency differences. Even at the high frequency end of each meter minimum spacing of the calibration marks is 1/3:2 of an inch. The spiral scale is enclosed in a transparent cylinder so that the entire scale is always visible. The portion of the band that contains the frequency to which the meter is tuned is clearly marked by horizontal red cursor lines.

4. The high-Q resonant cavity is tuned by a choke plunger. Adjustment of the plunger is by means of a precision lead screw which is spring-loaded to prevent backlash. There are no sliding contacts. The base of the 532A/B will accommodate the shaft of a waveguide stand such as the HP Model 11540A.

5. Complete specifications for each Model 532A/B are given in Table 1.

6. UNPACKING AND INSPECTION.

7. Inspect the frequency meter for mechanical damage incurred in transit, and test electrical performance. If there is damage or deficiency, see paragraph 0 c(2) and (3).

8. REPACKAGING FOR SHIPMENT.

9. USING ORIGINAL PACKAGING.

10. The same type containers and materials used in factory packaging can be obtained through the Hewlett Packard sales and service offices listed at the rear of this manual.

11. Deleted.

12. USING OTHER PACKAGING.

13. The following general instructions should be used for repackaging with commercially-available materials:

a. Wrap the frequency meter in heavy paper or plastic.

b. Use a strong shipping container. A double-wall carton made of 350 pound test material is adequate.

c. Use enough shock-absorbing material (3- to 4-inch layer) around all sides of the frequency meter to provide firm cushion and prevent movement inside the container. Protect the dial with cardboard.

d. Seal the shipping container securely.

e. Mark the shipping container FRAGILE to assure careful handling.

14. OPERATION.

15. OPERATING PRECAUTIONS.

16. When making initial equipment setup, align the flanges carefully with connecting equipment to reduce reflections due to flange mating. Scoring or burring of the mating surfaces may increase reflections; therefore, keep flange covers on when frequency meter is not in use to protect flanges from damage and to prevent foreign matter from entering the cavity.

17. Maximum power limitations are 0.7 of the power handling capability for equivalent waveguide.

18. OPERATING INSTRUCTIONS.

19. Insert the frequency meter in the equipment set-up so that the RF energy passes through the meter. The frequency meter should be isolated from the signal source to prevent frequency pulling when the meter is tuned to resonance. The RF energy must be detected and the detected signal applied to an indicator. When the frequency meter is tuned to the RF input frequency, power is absorbed by the meter and a power dip of about 1 dB will occur in the detected signal.

20. For single frequency measurements the detector meter combination (shown in Figure 1) can be either a thermistor and power meter such as the HP Model 486 Thermistor Mount and 431 Power Meter or detector and high-gain voltmeter such as the HP Model 424 Detector and 415 VSWR Meter. Either a crystal or barretter can be used with the 415. The RF source must be modulated with 1000 Hz square-wave when the 415 is used as the indicator. Tune frequency meter for the point of maximum dip on the indicator, and read frequency meter dial by observing the indication under the black vertical line between the two horizontal red cursor lines.

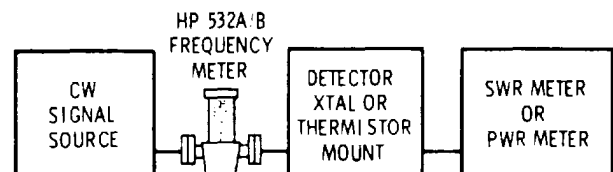


Figure 1. Typical Frequency-Measuring Setup

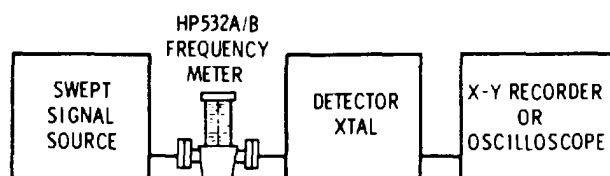


Figure 2. Simplified Swept-Frequency Setup

21. For swept-frequency measurements (see Figure: the detector is normally a crystal and the indicator an oscilloscope or X-Y recorder. When the frequency meter is tuned to a frequency included in the swept frequency band displayed on the oscilloscope or X-Y trace. To determine the frequency, adjust the frequency meter to place the dip at any point on the displayed trace. Then read the frequency meter dial by observing the indication under the black vertical line between the two horizontal red cursor lines. The frequency axis of the swept display can be calibrated by setting the frequency meter to a given frequency. A dip will then occur in the displayed trace corresponding to the frequency meter setting.

22. MAINTENANCE.

23. The Model 532A/B frequency meters require no maintenance. The frequency meters are not normally field repairable; therefore, if the meter is damaged or does not meet specifications return it to a higher category of maintenance.

24. PERFORMANCE TEST.

25. TEST EQUIPMENT REQUIRED.

26. The test instruments and accessories required to make the performance checks are listed in Table 3. Test instruments other than the ones listed can be used provided their performance equals or exceeds the Critical Specifications listed.

27. PROCEDURES.

28. The procedures in Figure 3 check the Model 532A/B performance for incoming inspection and periodic evaluation. The specifications of Table 1 are the performance standards. Table 2 is a performance test record. This may be used during the test to record the test values obtained. This provides a permanent record of the test values for use at a later time during calibration or periodic evaluation.

Table 2. Test Card

FR-194/U Frequency Meter	Date _____ Tested by _____
OVERALL ACCURACY	
Maximum Dial Error _____ %	Specification _____ %
POWER DIP AT RESONANCE	
High End of Band _____ dB	Specifications >1 dB
Center of Band _____ dB	Specifications >1 dB
Low End of Band _____ dB	Specifications >1 dB

Table 3. Recommended Test Equipment

Instrument	Critical Specifications	Recommended Model
Sweep Oscillator ²	Equipment required for all frequency bands Frequency: To cover the range of 532A/B under test Power: >1 mW into 50 ohms Sweep Out: dc voltage proportional to output frequency	HP 8690A/B Mainframe with HP 8690 Series RF Unit
Transfer Oscillator	Fundamental Frequency: Variable from 195 to 205 MHz	HP 540B
Electronic Counter	Frequency Range: 195 to 205 MHz Accuracy: >0. 0001%	HP 5245L/5253B
Oscilloscope	Vertical Input: Minimum Sensitivity: 200 liV/cm Bandwidth: 40 kHzJ Horiz Input: Compatible with sweep oscillator sweep output	HP 140A/1400A/1420A
Power Meter and Thermistor Mount	Frequency: To cover the range of 532A/B under test Instrument Accuracy: $\pm 3\%$ Power Range: 0 to -20 dBm	HP 431B/C or 432A (Meters) and HP 486A (Mount)
Low-Pass Filter	Passband: To cover the range of 532A/B under test	G-band Microphase ⁴ LTP 6000 J-band Microphase LTP 8200 H-band Microphase LTP 10500 X-band HP X362A P-band HP P362A K-band HP K362A R-band HP R362A
Isolator	Frequency: To cover the range of 532A/B under test Isolation: >20 dB	G-band Ferrotec ⁵ I-152L J-band Ferrotec I-153L H-band Ferrotec I-154L X-band Ferrotec I-155L P-band Ferrotec I-156L K-band Ferrotec I-157L R-band Ferrotec I-158L
Attenuator	Frequency: To cover the range of 532A/B under test Attenuation: Continuously variable to 20 dB	HP G382A/J382A/H382A/ X375A/P375A/K382A/R382A
Directional Coupler	Frequency: To cover the range of 532A/B under test Coupling: 3 dB(10 dB for K and R bands)	HP 752A HP 752C (for K and R bands)
Crystal Detector	Minimum Sensitivity: 0.3 mV/SW	HP G6424A/J424A./H424A/ X424A/P424A/K422A/R422A

¹For M532A from 10 to 12.4 GHz, use equipment for X band plus (2) X to M adapters (HP MX2 2B) and from 12.4 to 15 GHz, use equipment for P band plus (2) P to M adapters (HP MP292B).

²Power Leveling may be used for a more convenient oscilloscope display; however, if the sweep oscillator does not have internal leveling, additional equipment is required to provide for external leveling.

³For oscilloscopes with greater bandwidth, connect a 40-kHz low pass filter to vertical input.

⁴Ferrotec Inc., 217 California St Newton, Mass. ⁵Microphase 35 River Rd., Cos Cob, Conn.

Table 3. Recommended Test Equipment (Contd)

Instrument	Critical Specifications	Recommended Model
Additional equipment required for G, J, H, and X bands only		
Adapter Coax to Waveguide (2 required)	Frequency: To cover the range of 532A/B under test SWR: less than 1.25	HP 281A or 281B Option 13
Additional equipment required for P band only		
Mixer	Frequency Range: To cover the range of 532A/B under test Min. Video Output: 0.4 mV with 0 dBm input	HP P932A
Additional equipment required for K and R bands only		
Mixer under test	Frequency: To cover the range of	HP 11517A
Adapter or Transition	Adapter from waveguide of directional coupler to HP 11517A Mixer	HP K11519A HP R11520A
Adapter (UG-201 A/U)	BNC female to Type N male	UG-201 A/U HP Part No. 1250-0780
Microwave Amplifier	Frequency Range: 2-4 GHz Output Power: 500mW	HP 491C

FIGURE 3. PERFORMANCE TEST

1. Overall Accuracy

SPECIFICATION:

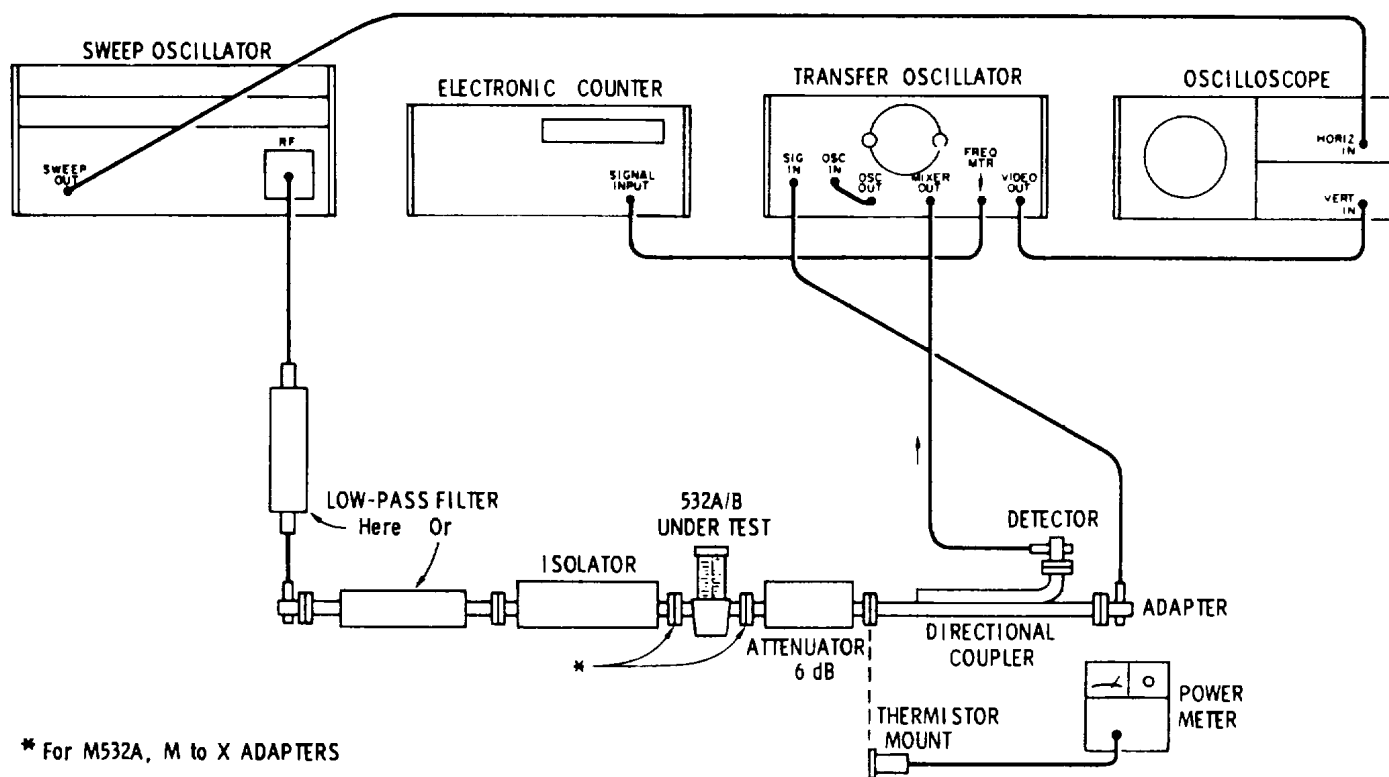
G532A, 0.065%
 J532A, 0.065%
 H532A, 0.075%
 X532B, 0.08%

M532A, 0.085%
 P532A, 0.10%
 K532A, 0.11%
 R532A, 0.12%

DESCRIPTION:

The 532A/B frequency meter dial is set to a multiple of 200 MHz. The sweep oscillator is set to sweep across the frequency setting of the 532A/B. With the transfer oscillator frequency set to approximately 200 MHz, the sweep oscillator signal and transfer oscillator signal mix and a beat note marker or birdie occurs at each harmonic of the transfer oscillator frequency. The detected output signal displayed on an oscilloscope shows the frequency meter's absorption dip and the marker birdies. A marker birdie is placed at the center of the absorption dip. Because the transfer oscillator frequency is related to the frequency of the absorption dip by some harmonic number, percent of error is determined from the difference between the transfer oscillator frequency with zero error (200 MHz) and the actual transfer oscillator frequency.

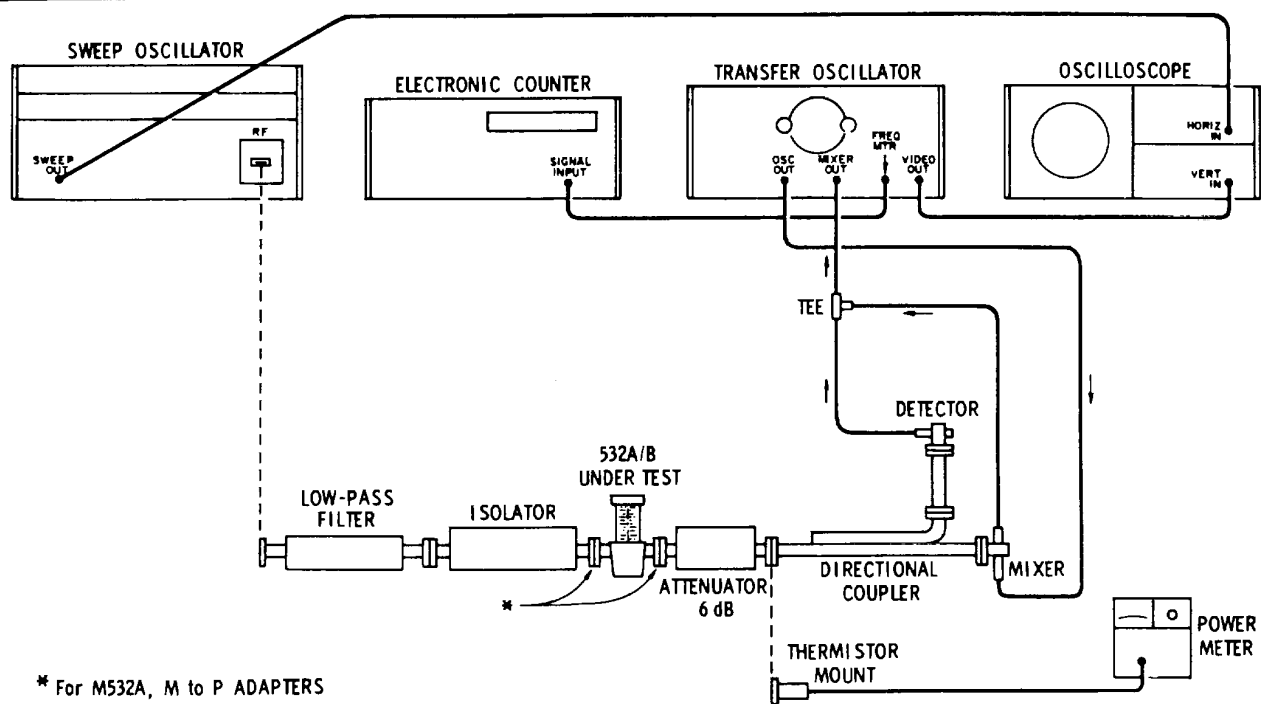
TEST SETUP:



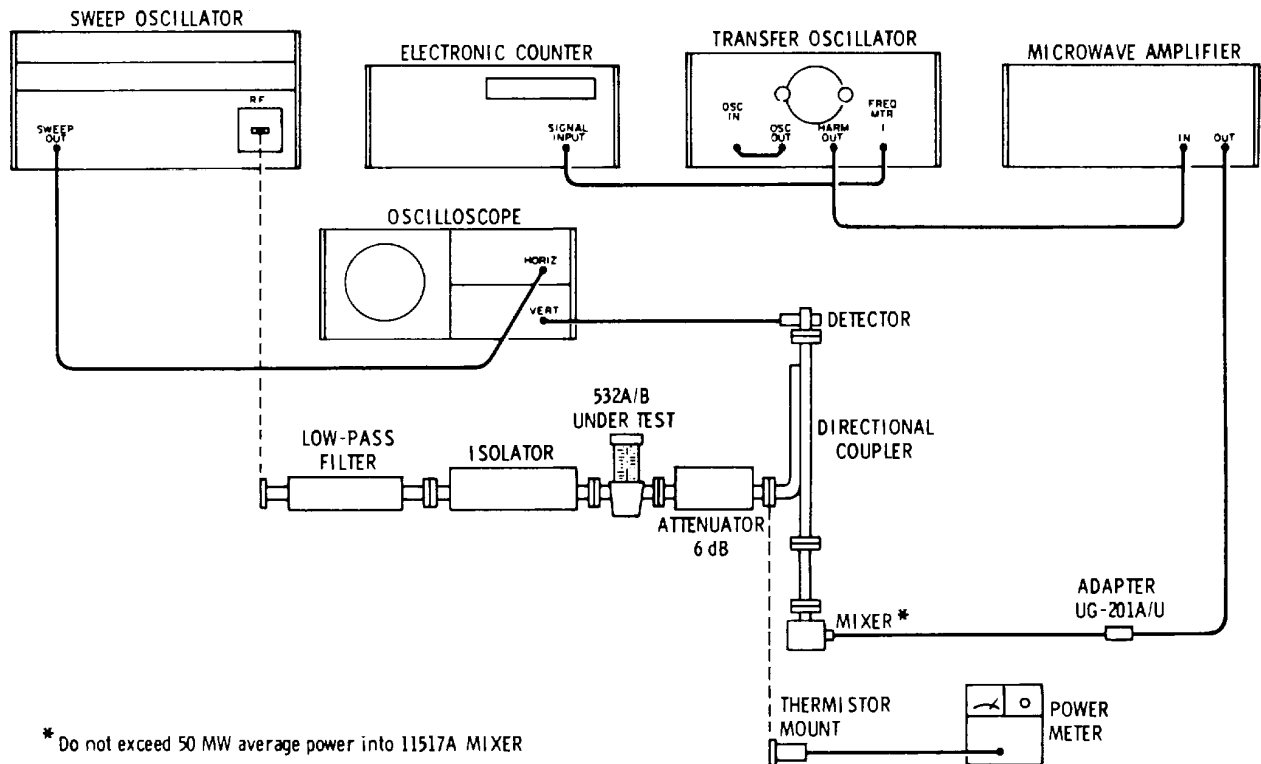
(Continued)

FIGURE 3. PERFORMANCE TEST

FIGURE 3. PERFORMANCE TEST



12.4 to 18 GHz (P-band and M-band 12.4 to 15 GHz)



(Continued)

FIGURE 3. PERFORMANCE TEST**PROCEDURE:**

- a. Select test setup for appropriate frequency range, and connect equipment as shown.

CAUTION

Before connecting the microwave amplifier output to the 11517A Mixer, measure the microwave amplifier average output power and adjust for 50 mW (+17 dBm).

- b. Turn ON the sweep oscillator, transfer oscillator, electronic counter, and oscilloscope. Allow 30 minutes for warm up.
- c. Set the sweep oscillator for automatic sweep, leveled RF output, AF operation, and sweep width of 100 to 200 MHz. Adjust AF center frequency so that sweep width brackets the lowest frequency in the frequency meter's band.
- d. Set the transfer oscillator frequency to 200 MHz. Beat note markers or birdies will occur at multiples of the transfer oscillator frequency (see Waveform A).
- e. Adjust the sweep oscillator AF center frequency to display the lowest frequency birdie at the center of the oscilloscope CRT.
- f. Set the 532A/B under test to the lowest frequency which is a multiple of 200 MHz. Reduce the Sweep Oscillator AF sweep width to approximately 10 MHz (see Waveform B).
- g. Adjust the transfer oscillator frequency to place a marker birdie at the center of the test 532A/B absorption dip (see Waveforms C, D, and E).

- h. Determine the 532A/B accuracy as follows:

(1) Measure the transfer oscillator frequency (counter converter frequency of 190 MHz + counter indication).

$$\text{Percent error} = \frac{\text{Difference between 200 MHz and transfer oscillator frequency}}{2}$$

EXAMPLE: Transfer oscillator frequency = 200.13 MHz. Percent error is 0.13 divided by 2, or 0.065%.

(2) The percent error must not exceed the overall accuracy specification.

- i. Increase the 532A/B frequency setting by 200 MHz.
- j. Adjust the sweep oscillator AF center frequency to place the absorption dip at the center of the oscilloscope CRT.
- k. Adjust the transfer oscillator frequency to place a marker birdie at the center of the absorption dip.
- m. Determine percent error as in step h.
- n. Repeat steps h through m every 200 MHz.

If birdie amplitude is insufficient, check detector sensitivity.

(Continued)

FIGURE 3. PERFORMANCE TEST

2. Dip of Resonance**SPECIFICATION.** ≥ 1 dB**DESCRIPTION:**

A power meter is connect to the output of the frequency meter. A reference power level is established with the frequency meter tuned off resonance. The frequency meter is tuned for the maximum power dip. The difference in power between the reference level and the level at maximum dip must be 1 dB or greater.

PROCEDURE:

- a. Switch the sweep oscillator to standby (RF off) and connect power meter thermistor mount as shown in Test 1 equipment setup.
- b. Set the sweep oscillator for single frequency operation at the highest frequency in the band.
- c. Establish a power meter reference level with the frequency meter tuned close to, but not at, the sweep oscillator frequency. Note this reference level.
- d. Tune the frequency meter for the maximum power dip. The difference between the reference level and the level at maximum dip must be 1 dB or greater.
- e. Repeat steps c and d at a sweep oscillator frequency in the center of the band and again at the lowest frequency.

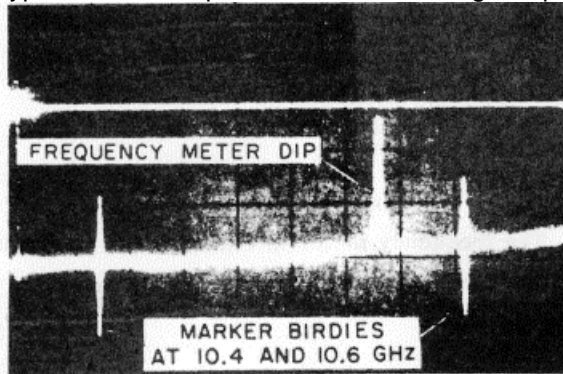
NOTE

For K532A or R532A repeat steps c and d at 1 GHz intervals across the band.

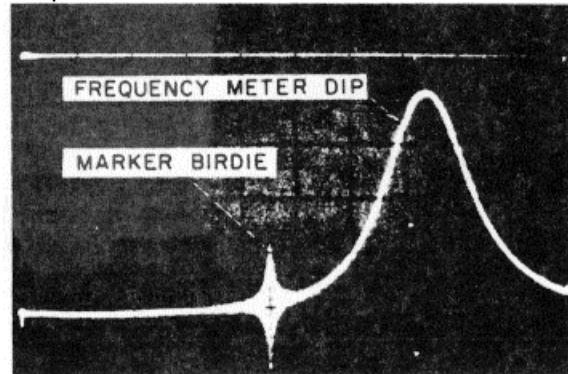
(Continued)

FIGURE 3. PERFORMANCE TEST

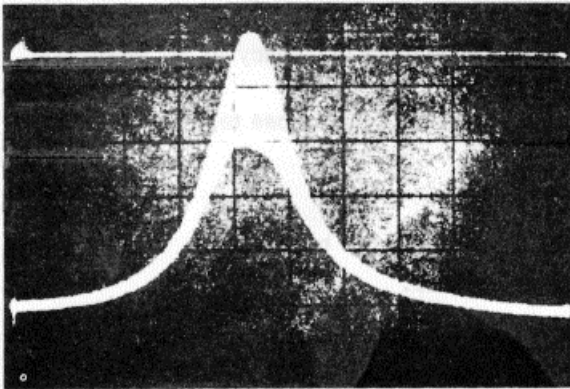
Typical Oscilloscope Waveforms Showing Frequency Meter Power Dip and Marker Birdies.



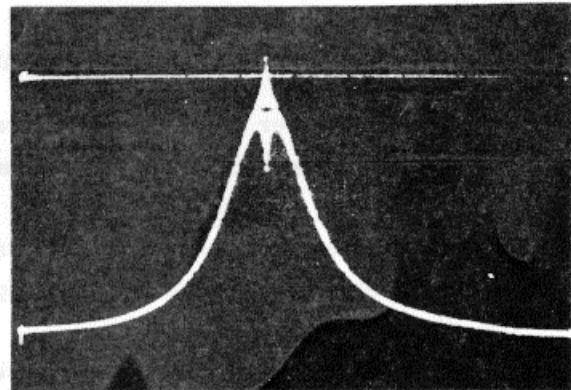
A. Frequency meter dip between two beat not markers or birdies. ΔF sweep width = 300 MHz, Vert. Sens. = 1 mV/cm



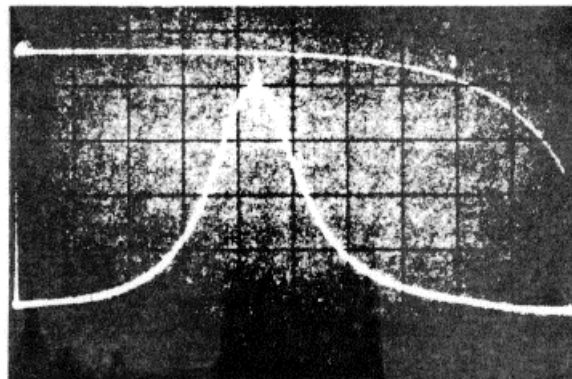
B. ΔF sweep width = 10 MHz Reducing the ΔF sweep width expands the Frequency Meter's dip for greater resolution



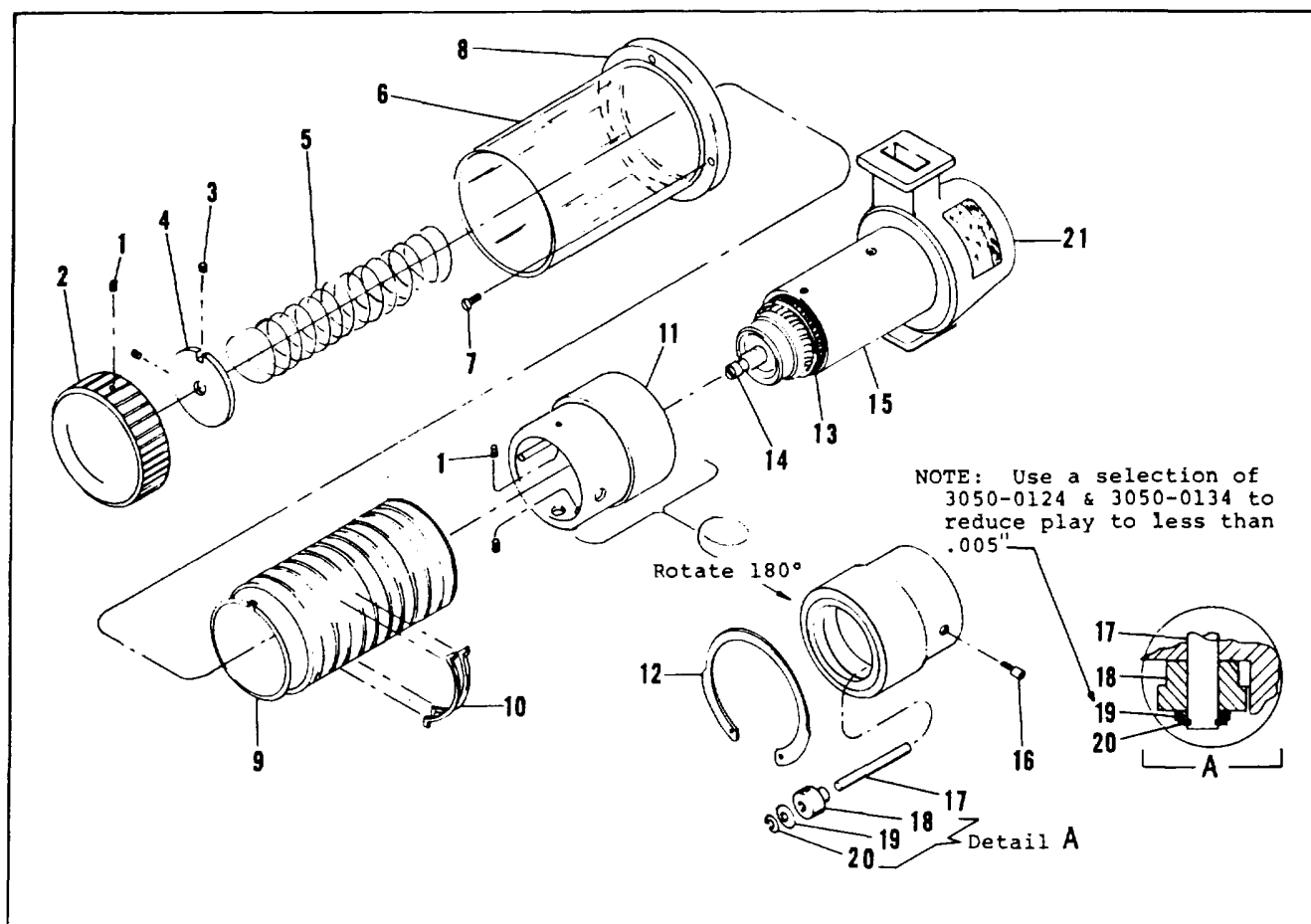
C. Oscilloscope vertical amplifier bandwidth of 400 kHz. Poor resolution



D. Oscilloscope vertical amplifier bandwidth of 400 kHz. Good resolution



E. Oscilloscope vertical amplifier bandwidth reduce to 4 kHz. Note the narrower marker birdie.



ITEM	QTY.	DESCRIPTION	HP PART NUMBER		
			G532	H532	J532
1		8-32 SCREW SET HEX	3030-0001	-	-
2		KNOB	0370-0082	-	-
3		6-32 x 3/16 SET SCREW	3030-0033	-	-
4		CAP	H532A-16	-	-
5		SPRING	1460-0055	-	-
6		WINDOW	J532A-7	H532A-18	J532A-7
7		4-40 x 1/4 FLAT HD SCREW	2210-0002	-	-
8		RETAINING RING	H532A-20	-	-
9		DIAL	G532A-4	H532A-9	J532A-7
10		CURSOR	H532A-21	-	-
11		DIAL HOLDER	J532A-4	-	-
12		RETAINING RING	10-0072	-	-
13		BALL BEARING	1410-0026	-	-
14		CHOKE ASSY	G532A-5	H532A-12	J532A-5
15		CAVITY ASSY	G532A-2	H532A-3	J532A-2
16		2-56 x 1/4 FILL HD SCREW	0520-0012	-	-
17		SHAFT	H532A-5	-	-
18		STOP GEAR	P532A-19	-	-
19		WASHER	3050-0134	-	-
20		RETAINING RING	0510-0070	-	-
21		BASE CASTING	G532A-1	H532A-1	J532A-1

Figure 4. Stop Gear Replacement for HP Model G, H, and J532A (Sheet 1 of 3)

The following special tools are required for this procedure. An INDUSTRIAL PLIER #105 modified by bending one inch of tip end 45° and a WALDES TRUARC PLIER #5 modified by bending tips 90°. Upon completion of the stop gear replacement it will be necessary to check the frequency calibration of the instrument.

PROCEDURE:

1. Remove knob (2).
 2. Scribe dial position to give approximate location of dial on dial holder. (Do not use pencil as this may inadvertently erase.)
 3. Unscrew four flat head screws (7) holding window retaining ring (8).
 4. Remove ring and window.
 5. Loosen two #8 Allen set screws (1) holding dial. (These are located inside of dial holder (11).)
 6. Turn dial holder until cap (4) is approximately flush with top of dial holder (near high frequency stop position).
 7. Scribe a line from lead screw on plunger to cap for later alignment.
 8. Loosen both #6 Allen setscrews (3) holding cap in place on lead screw. These screws are spaced about 90° apart and access to them is through two inspection holes in the dial holder through two inspection holes in the dial holder (11).
 9. While holding cap in place back out both screws sufficiently to allow removal of cap (approximately three full turns of the Allen screw). Dial holder cap is spring loaded; therefore, release tension slowly and remove cap and spring.
- CAUTION**
- DO NOT TURN OR REMOVE PLUNGER**
10. Turn the 532 upside down and remove the tru Arc retaining ring (12) holding dial holder (11). (This requires special tru-Arc pliers or Industrial #105 pliers.
 11. Lift 532 off dial holder and place base assembly upright again. Examine both sections for pieces of broken stop gear.

12. Inspect bearing and gear rack to make sure that these haven't been damaged by portions of the broken stop gear. If any of the internal workings other than stop gear have been damaged, return the meter to a
13. If gear and bearings look satisfactory, replace small stop gear using the following procedure:
 - a. Remove small C ring (20) holding stop gear. Long nose pliers held at a fixed opening may be used to push the C ring out of the shaft groove.
 - b. Remove washer (19) and broken stop gear (18).
 - c. Replace with new stop gear and position washers as shown in exploded view.
 - d. Replace C ring so that it properly engages the groove of shaft.
 - e. Take excess grease from old gear and shaft (17): use to moderately lubricate new gear.
14. Replace dial holder taking care not to damage gears when engaging stop gear with gear rack.
15. Check rotation of the dial holder. There should be approximately 15 turns for G & J band and 12 for H band. If the dial makes less, disengage and try again with a new gear position.
16. When the stop gear is positioned to give the correct number of turns from stop to stop, secure dial holder with the tru Arc retaining ring. Make sure ring is seated properly on inside groove of dial holder.
17. Turn dial holder to stop at high frequency end of dial.
18. Insert spring into dial holder; large diameter end first.
19. Replace cap by compressing spring. Note alignment of cap and lead screw. See step 6 and 7.
20. Tighten both #6 Allen set screws holding cap to lead screw.
21. Turn dial holder counterclockwise (towards lower frequency) to expose dial retaining set screws.
22. Place dial on dial holder and check alignment with scribe mark of step 2.
23. Tighten both #8 Allen setscrews to hold dial in place.

CAUTION

Do not tighten excessively as knob may not slip into place in the dial/dial holder.

Figure 4. Stop Gear Replacement for HP Model G, H, and J532A (Sheet 2 of 3)

24.	Turn dial clockwise near the stop at the high frequency end (high frequency mark should be 1/3 turn from stop for G & J band and 1/5 turn for H band) and place both cursors into dial grooves to indicate approximately 5.85 for G, 10.0 for H and 8.2 for J band.	27.	Replace the four screws holding window retaining ring.
25.	Carefully replace window and window retaining ring making sure that cursors ride in the window grooves.	28.	Turn from stop to stop. Check for binding or other erratic behavior. It may be necessary to make slight adjustments in screw tightness or dial position so that no binding occurs during dial rotation.
26.	Align window with base. Window key must be in the base groove.	29.	When assured of smooth operation, check calibration. Calibration should be reasonably close if care was taken in alignment of the cap, lead screw and dial. Replace knob.

Figure 4. Stop Gear Replacement for HP Model G,H, and J532A (Sheet 3 of 3)

Table 4. Part Number—National Stock Number-Cross Reference Index

<i>PART NUMBER</i>	<i>FSCM</i>	<i>NATIONAL STOCK NUMBER</i>
H532A-21	28480	5355-00-063-9092
P532A-19	28480	3020-00-056-1906
0370-0082	28480	5355-00-057-2796
3030-0001	28480	5305-00-719-5342

APPENDIX A

REFERENCES

DA Pam 310-4	Index of Technical Manuals.
TM 38-750	The Army Maintenance Management System (TAMMS).
TM 750-244-2	Procedures for Destruction of Electronics Materiel to Prevent Enemy Use (Electronics Com-mand).

A-1/(A-2 Blank)

APPENDIX B

MAINTENANCE ALLOCATION

Section I. INTRODUCTION

B-1. General

This appendix provides a summary of the maintenance operations for the FR-1941U. 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 Function

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. Align.* 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, 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, align, 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, sub-assemblies, and modules for which maintenance is authorized.

- c. Column 3, Maintenance Functions.* 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 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 "work time" 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 "work time" figures will be shown for each category. The number of task-hours specified by the "work time" 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 (Sec. III)

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 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 (Sec. 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
Frequency Meter, FR-194/U

(1) GROUP NUMBER	(2) COMPONENT ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL					(5) TOOLS AND EQUIPMENT	(6) REMARKS
			C	O	F	H	D		
00	FREQUENCY METER, FR-194/U	Inspect Test Repair Overhaul B-4	0.1			1.0 1.0	3.0	18 1 thru 17 18 1 thru 18	Visual

**SECTION III TOOL AND TEST EQUIPMENT REQUIREMENTS
FOR
FREQUENCY METER, 194/U**

TOOL OR TEST EQUIPMENT REF CODE	MAINTENANCE CATEGORY	NOMENCLATURE	NATIONAL/NATO STOCK NUMBER	TOOL NUMBER
1	H, D	OSCILLATOR, SWEEP SG-1121(V)1/U	6625-00-007-6661	
2	H, D	RF PLUG-IN HP-862IA	6625-00-773-5449	
3	H, D	RF PLUG-IN MODULE HP-86302A (0.1 - 2.0 GHZ)	6625-00-321-5142	
4	H, D	RF PLUG-IN MODULE HP-86330A (1.8 - 4.2 GHZ)	6625-00-321-5130	
5	H, D	RF PLUG-IN MODULE HP-86341A (3.2 - 6.5 GHz)	6625-00-321-5131	
6	H, D	RF PLUG-IN MODULE HP-86342A (5.9 - 9.0 GHz)	6625-00-321-5123	
7	H, D	RF PLUG-IN MODULE HP-86350A (8.0 - 12.4 GHz)	6625-00-773-5683	
8	H, D	OSCILLOSCOPE, AN/USM-281C	6625-00-106-9622	
9	H, D	COUNTER, FREQUENCY, ELECTRONIC TD-1225	6625-00-498-8946	
10	H, D	METER, POWER AN/USM-260A	6625-00-917-3099	
11	H, D	OSCILLATOR, TRANSFER AN/USM-144	6625-00-080-7204	
12	H, D	LOW-PASS FILTER (7 - 10 GHz)		
13	H, D	ISOLATOR (7 - 10 GHz)		
14	H, D	ATTENUATOR CM-1367/U	6625-00-679-0625	
15	H, D	DIRECTIONAL COUPLER HP-752A OR EQUIV		
16	H, D	CRYSTAL DETECTOR H-424A OR EQUIV		
17	H, D	ADAPTER, COAX HP-281A OR EQUIV		
18	C, H, D	COMMON TOOLS NECESSARY TO THE PERFORMANCE OF THIS MAINTENANCE FUNCTION ARE AVAILABLE TO MAINTENANCE PERSONNEL FOR THE MAINTENANCE CATEGORY LISTED.		
B-5				

APPENDIX C

**OPERATOR'S ORGANIZATIONAL, DIRECT SUPPORT, AND GENERAL
SUPPORT MAINTENANCE REPAIR PARTS AND SPECIAL TOOLS LIST**

NOTE

Refer to figure 4 and table 4 for all maintenance repair parts.

*U.S. GOVERNMENT PRINTING OFFICE: 1994) - 342-421/81242

By Order of the Secretary of the Army:

Official

ROBERT M. JOYCE
Brigadier General, United States Army
The Adjutant General

E. C. MEYER
General, United States Army
Chief of Staff

DLSTRIUTION:

To be distributed in accordance with Special Distribution List.

RECOMMENDED CHANGES TO EQUIPMENT TECHNICAL PUBLICATIONS

SOMETHING WRONG WITH THIS PUBLICATION?

THEN... JOT DOWN THE
DOPE ABOUT IT ON THIS
FORM, CAREFULLY TEAR IT
OUT, FOLD IT AND DROP IT
IN THE MAIL!

FROM: (PRINT YOUR UNIT'S COMPLETE ADDRESS)

DATE SENT

PUBLICATION NUMBER

TM 11-5825-270-10

PUBLICATION DATE

23 Jul 81

PUBLICATION TITLE

Radio Frequency R-2176/FRN

BE EXACT... PIN-POINT WHERE IT IS

PAGE
NO.PARA-
GRAPHFIGURE
NO.TABLE
NO.IN THIS SPACE TELL WHAT IS WRONG
AND WHAT SHOULD BE DONE ABOUT IT:

PRINTED NAME, GRADE OR TITLE, AND TELEPHONE NUMBER

SIGN HERE:

DA FORM 2028-2
1 JUL 79PREVIOUS EDITIONS
• ARE OBSOLETE.P.S.—IF YOUR OUTFIT WANTS TO KNOW ABOUT YOUR
RECOMMENDATION MAKE A CARBON COPY OF THIS
AND GIVE IT TO YOUR HEADQUARTERS.

TEAR ALONG PERFORATED LINE

This fine document...

Was brought to you by me:



[Liberated Manuals -- free army and government manuals](#)

Why do I do it? I am tired of sleazy CD-ROM sellers, who take publicly available information, slap “watermarks” and other junk on it, and sell it. Those masters of search engine manipulation make sure that their sites that sell free information, come up first in search engines. They did not create it... They did not even scan it... Why should they get your money? Why are not letting you give those free manuals to your friends?

I am setting this document FREE. This document was made by the US Government and is NOT protected by Copyright. Feel free to share, republish, sell and so on.

I am not asking you for donations, fees or handouts. If you can, please provide a link to liberatedmanuals.com, so that free manuals come up first in search engines:

<A HREF=<http://www.liberatedmanuals.com/>>Free Military and Government Manuals

- Sincerely
Igor Chudov
<http://igor.chudov.com/>
- [Chicago Machinery Movers](#)