TM 11-6625-220-10

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

OPERATION
ECHO BOX TS-488A/UP

Note. This manual replaces AF TO 33A1-3-71-1, 15 December 1955, for use within the Department of the Army.

HEADQUARTERS, DEPARTMENT OF THE ARMY

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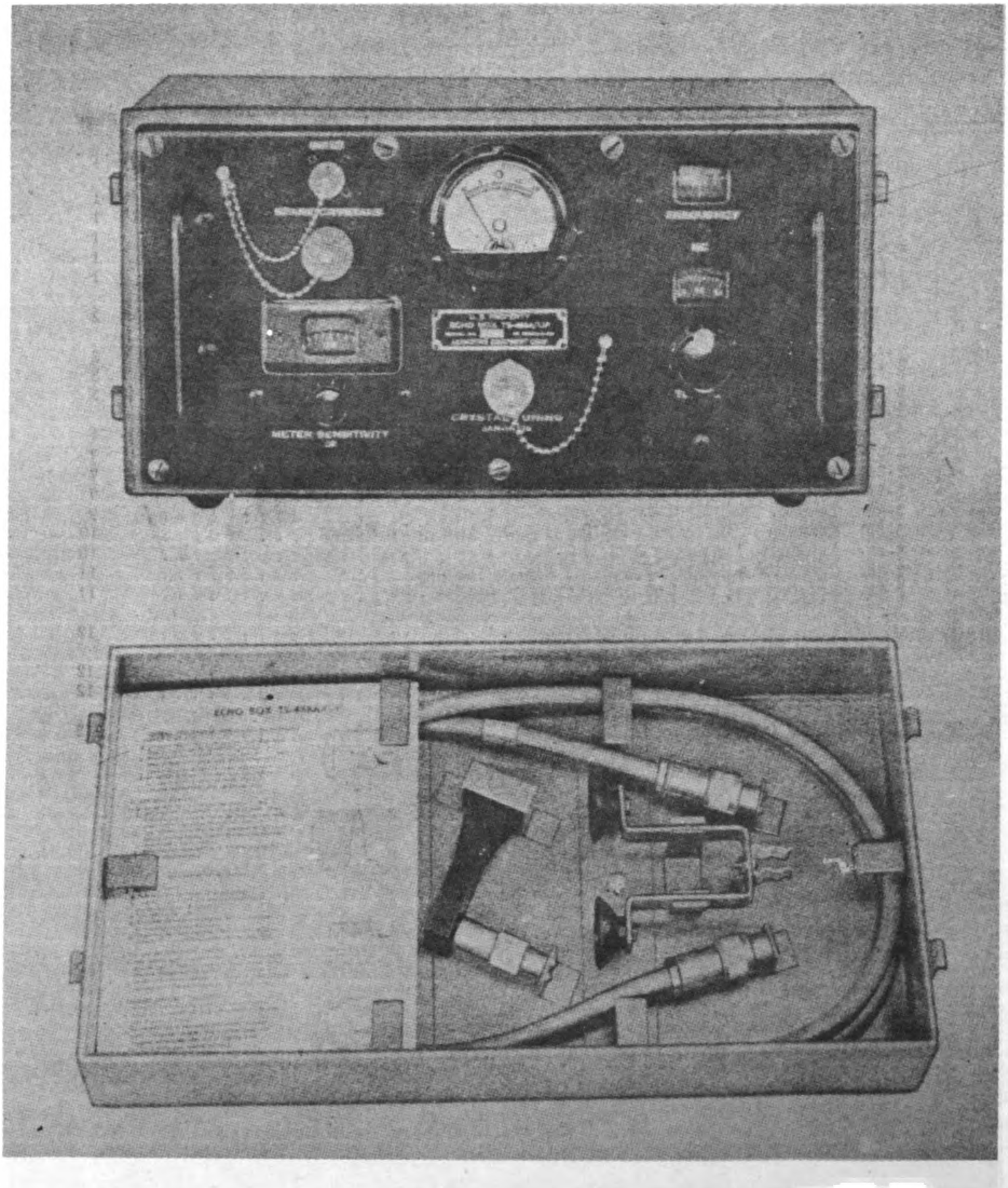


Figure 1-1. Echo Box TS-488A/UP

SECTION I
GENERAL DESCRIPTION

1-1. GENERAL.

1-2. This handbook contains operating instructions for Echo Box TS-488A/UP manufactured by Aermotive Equipment Corporation, Kansas City, Missouri and is issued as one of four basic handbooks covering the equipment. The other three handbooks are: Handbook of Service Instructions (T.O. 33A1-3-71-2); Handbook of Overhaul Instructions (T.O. 33A1-3-71-3); and Illustrated Parts Breakdown (T.O. 33A1-3-71-4).

1-2.1
1-2.2

1-3. EQUIPMENT SUPPLIED.

1-4. The complete equipment consists of the items listed in Table I.

1-5. DESCRIPTION. (See figure 1-1.)

1-6. The complete equipment is housed in a metal carrying case with a removable cover. The pick-up antenna, antenna mounting bracket, wrenches, trouble shooting chart, and interconnecting cable are all mounted to the inside of the cover. The instrument controls and indicators are exposed when the cover is removed. The top of the instrument serves as a control panel and contains the controls and indicators necessary for operation of the echo box. The controls and indicators are: TUNING control, two FREQUENCY indicator dials, METER SENSITIVITY control, DB indicator dial, CRYSTAL TUNING control, and Output Meter. In addition, the control panel contains a holder for spare JAN-IN23B crystals and the echo box INPUT connector for connecting the echo box to the radar directional coupler or to the pick-up antenna. The pick-up antenna is used to pick up transmitted energy from the radar and reradiate the energy from the echo box back to the radar.

1-7. PURPOSE OF EQUIPMENT.

1-8. Echo Box TS-488A/UP is a portable test instrument which operates over a frequency range of 8990 to 9610 megacycles and is used to check the performance of X-Band radar equipment that operates within this frequency range. The echo box is used to check the over-all radar system performance and to make the following radar equipment checks:

a. Comparative measurement of average power output of radar transmitter.

b. Frequency spectrum of radar transmitter.

c. Radar transmitter for multiple moding.

d. Radar transmitter for frequency pulling.

e. Speed of recovery of radar T-R box and receiver.

1-9. PRINCIPLE OF OPERATION.

1-10. R-f energy from the radar equipment under test is taken from the radar directional coupler or picked up by the pick-up antenna and fed into the echo box resonant cavity. The energy is stored in the resonant cavity in the form of damped oscillations. Some of the energy from the resonant cavity is rectified and measured in the echo box output meter. The meter serves as a visual tuning indicator for the echo box resonant cavity and also provides a comparative power output measurement for the radar transmitter. The remaining energy is allowed to discharge from the resonant cavity back into the radar receiver. The shape and character of the pattern on the radar indicator resulting from the energy returned by the echo box shows the condition of the radar receiver.

TABLE I
EQUIPMENT SUPPLIED

Quantity	Name	Army/Navy Type Designation
1	Echo Box (including the following items)	TS-488A/UP
1	Pick-up Antenna	AT-68/UP
1	Antenna Bracket	
1	Interconnecting Cable	CG-92A/U
1	Trouble Shooting Chart	
2	Wrench	

SECTION II
OPERATING PROCEDURES

2-1. OPERATING CONTROLS AND INDICATORS. (See figure 2-1.)

2-2. Table II contains a list of the operating controls and indicators and their functions.

TABLE II

OPERATING CONTROLS AND INDICATORS

Index No.	Name	Function
1	METER SENSITIVITY Control	Operates an attenuator in the meter output circuit of the resonant cavity to reduce amount of r-f energy fed to the meter circuit and thus reduce the output meter readings. Minimum attenuation is in the circuit when the control is in the full clockwise position. CAUTION Never leave the METER SENSITIVITY control in the full clockwise position. Always return the control to the full counterclockwise position (maximum attenuation) after use. This precaution may prevent damage to the instrument caused by the application of an unknown amount of power.
2	Output Meter	Serves as a tuning indicator and also provides a comparative output measurement for the radar transmitter. The meter scale is calibrated in microamperes.
3	DB Indicator Dial	Indicates attenuation in the output meter circuit. The dial is calibrated in decibels in one decibel graduations from zero to 25 decibels. The dial is driven by the METER SENSITIVITY control.
4	TUNING Control	Operates a piston within the resonant cavity to tune the cavity by changing its dimensions.
5	FREQUENCY Indicator Dials	Indicates the frequency of the resonant cavity. Consists of two dials driven by the TUNING control. The two dials are divided into two calibrated scales. The top dial indicates frequency in 10 megacycle intervals. The bottom dial is divided into large intervals indicating one-half megacycle and into small intervals indicating 0.1 megacycle.
6	CRYSTAL TUNING Control	The CRYSTAL TUNING control is the crystal extractor. The control adjusts the position of the crystal rectifier which results in an increase or decrease in the output meter reading. (Always adjust for maximum meter reading.)

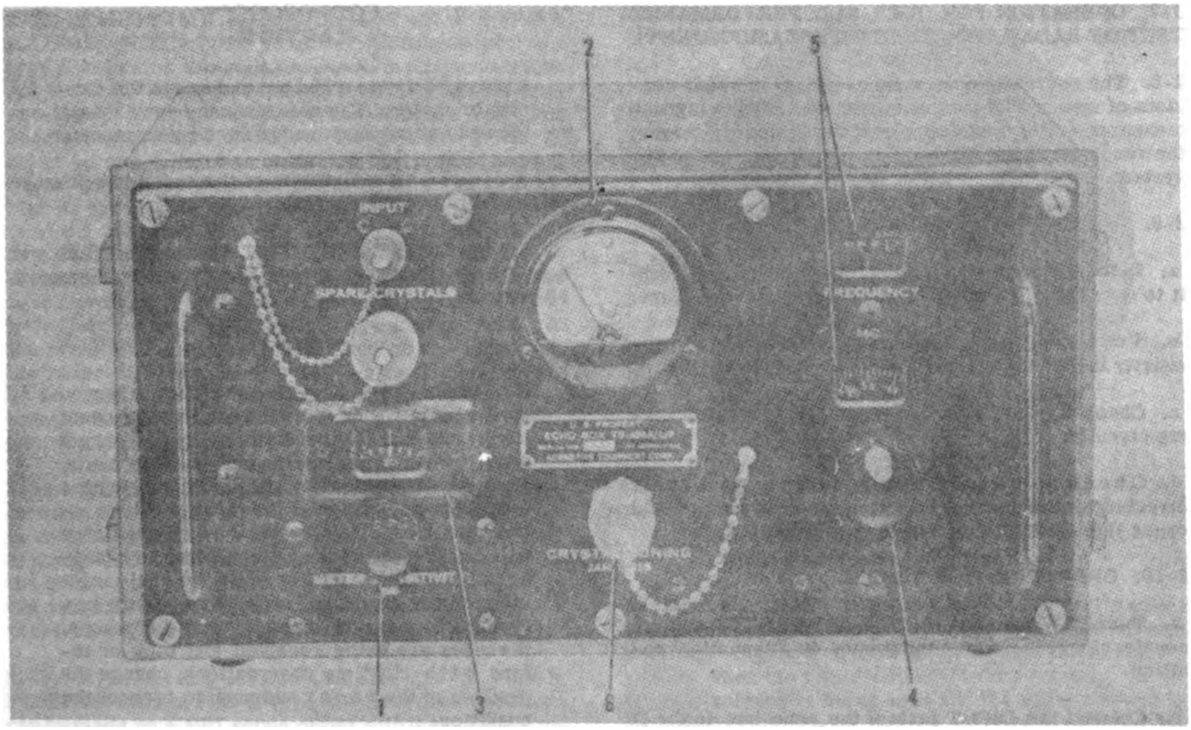


Figure 2-1. Echo Box TS-488A/UP Operating Controls and Indicators

2-3. CONNECTION OF ECHO BOX TO RADAR EQUIPMENT DIRECTIONAL COUPLER.

2-4. Radar systems in general are equipped with a directional coupler in the transmission line to the antenna. R-f energy can be abstracted from the wave guide transmission line through the directional coupler for test purposes. If the directional coupler has a coupling loss of 20 to 25 decibels, it will be well suited for ringtime observation. The echo box may be connected to the radar directional coupler by connecting the interconnecting cable between the directional coupler and the INPUT connector on the panel of the echo box.

CAUTION

Be sure to turn the echo box METER SENSITIVITY control to the full counterclockwise position (maximum attenuation) before turning the radar equipment on.

2-5. USE OF PICK-UP ANTENNA AT-68/UP.

2-6. For day-to-day radar performance checks, the echo box should be connected to the radar directional coupler, however, the pick-up antenna enables periodic checks to be made through the radar antenna, which take into account the loss in the antenna transmission line. If the pick-up antenna is to be used, select a location for the antenna where maximum energy will be received from the radar antenna. Avoid locations where interference patterns are formed by large reflecting surfaces. Decide on a fixed antenna location for each type of radar and adhere to it in all tests. In this way the results of the tests will be directly comparable. Set the antenna up as follows:

a. Connect the pick-up antenna to the echo box by using the interconnecting cable provided.

b. Attach the antenna bracket to the antenna and secure to a smooth surface by means of the suction cups on the antenna bracket.

CAUTION

Do not place the echo box where it will be exposed to strong radar r-f fields while in use. Never locate the echo box in the direct antenna beam.

c. Place the radar equipment in operation and allow it to warm up.

d. Position the radar antenna so that there will be no extraneous echo signals which may interfere with the measurement of ringtime.

2-7. OPERATION FOR OVER-ALL PERFORMANCE TEST OF RADAR SET (RINGTIME MEASUREMENT).

2-8. The over-all performance test of the radar consists of measuring the radar ringtime. The ringtime measurement is a measure of the transmitter power, the receiver sensitivity, and the efficiency of the r-f system.

2-9. PRELIMINARY OPERATIONS.

a. Place the radar equipment in operation and allow it to warm up to its normal operating temperature.

b. Turn off any anti-jamming provisions and sensitivity time control on the radar.

c. Check the calibration of the radar accurate ranging circuits.

d. Check to be sure that the radar antenna is not directed toward nearby reflecting surfaces which could cause the transmitter frequency to be pulled.

2-10. OPERATION FOR TEST.

a. Turn the echo box METER SENSITIVITY control counterclockwise to the maximum db attenuation position.

b. Connect the INPUT jack of the echo box to the D jack of the radar directional coupler using the interconnecting cable provided with the test set.

c. Adjust the echobox METER SENSITIVITY control for about 15 db attenuation.

d. Adjust the echo box TUNING and CRYSTAL TUNING controls for maximum indication on the echo box output meter. Keep the meter reading on scale by adjusting the METER SENSITIVITY control.

CAUTION

Always be very careful not to damage the crystal or meter. The meter must never be allowed to go off scale under any circumstances.

e. Adjust the sensitivity of the radar indicator to that used in normal operation.

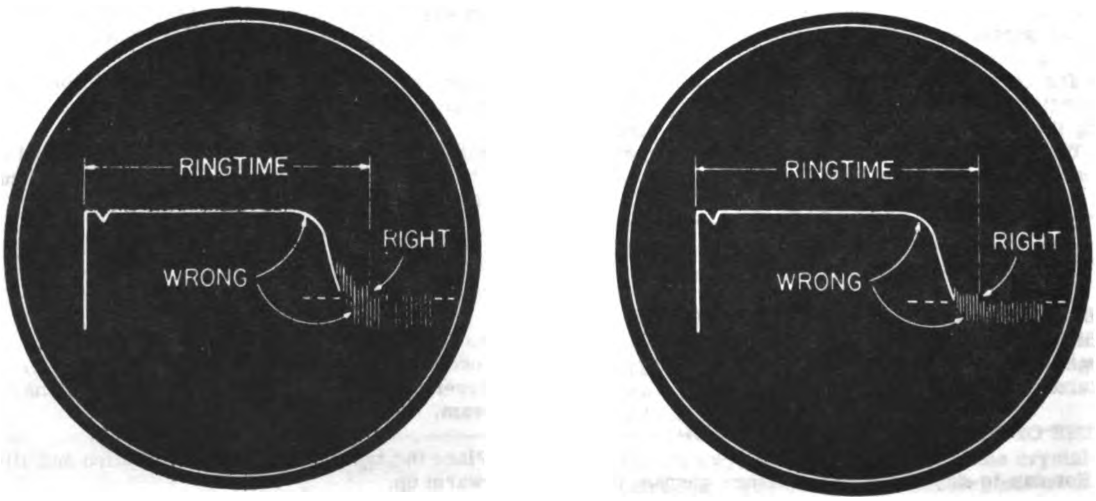
f. Set the METER SENSITIVITY control at 25 db and note the ringtime on the radar indicator to the nearest 50 yards.

NOTE

It is important to know that the trace observed on the indicator is from the echobox resonant cavity and that it is not distorted by real target echoes when a ringtime measurement is made. This can be checked by manually varying the frequency adjustment of the radar receiver local oscillator. Varying the local oscillator will cause the ringtime indication to change in range on the indicator while the real target indication will change only in amplitude on a type A scope or in intensity on a PPI scope. If echoes are being received and they interfere with ringtime observations, change the position of the radar antenna to correct the condition.

g. Repeat every ringtime measurement at least four times and retune the echo box from time to time by adjusting the TUNING and CRYSTAL TUNING controls to be sure that it has not become detuned as a result of a small radar transmitter frequency drift.

h. Compare measurement obtained with corresponding values on previous tests to determine the overall performance of the radar equipment.



Medium Gain   Low Gain

Figure 2-2. Ringtime Indications on Type-A Indicator

2-11. RINGTIME MEASUREMENT ON A TYPE A RADAR INDICATOR. Ringtime measurements on a type A indicator are best made with the radar antenna not moving. The appearance of good ringtime patterns on a type A indicator are illustrated in figure 2-2. The receiver gain should be set so that the "grass" [redacted] noise is one-quarter to one-third the total saturated signal height on the indicator. Setting the gain too high or too low may make it difficult or impossible to read the ringtime with any accuracy. It is essential that grass be present. The point at which the pattern disappears into the grass caused by background noise is independent of the indicator gain setting within fairly wide limits when the ringtime is correctly read. In the event that no grass can be seen on the indicator, the radar receiver is not working properly and should be repaired. Refer to the appropriate radar maintenance handbook for the necessary information to repair the radar receiver.

2-12. The exact end of the ringtime occurs at the farthest point to the right at which the top of the grass is noticeably above the general signal level of the rest of the grass. Do not judge ringtime by the bottom of the grass, nor by the end of the saturated portion of the ringtime because these items are influenced by the receiver gain setting and other factors.

2-13. RINGTIME MEASUREMENT ON A PLAN POSITION INDICATOR (PPI). Ringtime measurements can be made on a PPI scope either with the antenna rotating or stopped. The receiver gain should be set at at a minimum and the indicator intensity adjusted so that there is a very slight radial trace on the PPI. After the intensity has been adjusted, the receiver gain should be increased until the PPI screen seems to be about half covered with flecks of snow.

2-14. Good ringtime patterns are shown in figure 2-3. Pattern A shows correct results when the echo box is connected to the radar directional coupler and the radar antenna is rotating. Pattern B shows correct results when using the pick-up antenna with the radar antenna rotating. Figure 2-4 shows the ringtime pattern which results when the radar antenna is not rotating. If the pick-up antenna is being used and the radar antenna is not rotating, the radar antenna must be positioned for maximum ringtime as indicated on the PPI scope.

Figure 2-4. Ringtime Indications on Plan Position Indicator, Antenna Stopped

2-15. Care should be taken in determining the end of the ringtime signal. The end is not at the point where the bright or saturated part of the signal ends, but where the outer portion of the signal disappears into the background noise or "snow." Therefore, when reading ringtime on a PPI, be sure to read to the last point at which the snow is unusually bright, not just to the end of the solid portion of the display.

Pattern A

Pattern B

Figure 2-3. Ringtime Indications on Plan Position Indicator (PPI), Antenna Rotating

2-16. RINGTIME MEASUREMENT FACTORS. The following factors may affect the ringtime measurements:

a. The performance of the radar set.

b. Certain other constants of the radar set, such as the pulse length and receiver band width.

c. The ringing ability of the particular echo box at the freouency of the particular radar set.

d. The ringing ability of the echo box at a specific temperature and particular horizontal operating position.

e. The attenuation between the echo box and the radar set resulting from coupling loss of the directional coupler and the loss in the connecting cable.

2-17. Ordinarily none of the above factors change except the performance of the radar set. The ringtime may, therefore, be noted from day to day as an index of this performance. When a radar set under test shows a ringtime less than normal, it is an indication that the service range is below normal. No precise relationship between loss in ringtime and loss of range can be given because of the different behavior of various kinds of targets and the very large effect of the weather. Table III shows the relative loss in the effective range of the radar equipment as compared with the small loss in the observed ringtime.

TABLE III

LOSS IN RADAR RANGE AS SHOWN BY LOSS IN RINGTIME

Observed Ringtime—Percent of Normal	Corresponding Approximate Operation Range - Percent of Normal
100	100
95	80
90	70
85	60
80	50
70	30
60	20
50	15

2-18. If the radar transmitter power output is satisfactory when checked in accordance with instructions in paragraph 2-20 but ringtime is low, the radar receiving system is the probable source of trouble.

2-19. VARIATION OF RINGTIME WITH TEMPERATURE. The electrical resistance of the resonant cavity changes with a variation of temperature causing a slight variation in the "Q" of the cavity which, in turn, alters the ringtime. The ringtime increases at low temperatures and decreases as the temperature rises. In general, to adjust the measured value to a standard condition, a correction factor can be applied as shown in Table IV. Even under extreme changes of temperature, the variation of ringtime is relatively small so any large change in observed ringtime indicates that the variation is probably in the performance of the radar equipment. When this occurs, service the radar receiver in accordance with the appropriate radar handbook of maintenance instructions.

TABLE IV

TEMPERATURE CORRECTION OF RINGTIME

Temperature		To Correct to Standard
Centigrade	Fahrenheit	Multiply Ringtime by
—40	—40	0.89
—29	—20	0.91
—18	0	0.93
—7	+ 20	0.95
+ 4	+ 40	0.97
+ 16	+ 60	0.99
+ 21	+ 70	1.00
+ 27	+ 80	1.01
+ 38	+ 100	1.03
+ 49	+ 120	1.05
+ 54	+ 130	1.06

CAUTION

Since the echo box radiates on an extremely narrow frequency band as compared with the spectrum of the transmitter, do not attempt any alignment of the radar receiver i-f stages by means of the echo from the echo box. If such alignment is attempted, the receiver band width may be narrowed. If the receiver band width is reduced, there will be an increase in the ringtime indication, however such i-f alignment will actually impair the performance of the radar set.

2-20. OPERATION FOR COMPARATIVE POWER CHECK OF RADAR TRANSMITTER.

NOTE

In order to establish a standard by which to compare power output, steps a. through d. of the following procedure should be performed when the radar set is known to be in excellent operating condition.

a. Set up the echo box and complete the operations described in paragraph 2-9 of this section.

b. Adjust the echo box TUNING and CRYSTAL TUNING controls for maximum indication on the echo box output meter. Keep the meter reading on scale by adjusting the METER SENSITIVITY control.

c. Adjust the METER SENSITIVITY control until the output meter indicates 10 microamperes.

d. Record the dial setting of the METER SENSITIVITY control in the radar log book or any form used for keeping records.

e. Compare the METER SENSITIVITY control setting recorded with the established standard of previous tests. This comparison shows whether or not the radar transmitter is radiating its normal amount of power.

NOTE

If the METER SENSITIVITY control is rotated clockwise toward zero to restore a low meter reading to 10, the radar power has decreased approximately by the number of db that the control was moved to bring the reading back to 10.

2-21. SPECTRUM ANALYSIS.

2-22. Radar transmitters are designed to transmit short square pulses of r-f energy. This r-f energy is not all concentrated at a single frequency but spreads out over a band of frequencies. The principal band width is about 2/L megacycles wide and centered about the nominal frequency. (L is the transmitter pulse width in microseconds). Beyond this principal band are weaker side lobes. This band of transmitted frequencies is known as the transmitter spectrum. Examination of the spectrum with a view to determining the condition of the transmitter is known as spectrum analysis. When this test is properly performed and the results are correctly interpreted, the spectrum analysis will disclose troubles which may otherwise be difficult to locate.

NOTE

Frequency measurements may be made to within ± 8 megacycles at normal temperature and humidity with the echo box. Frequencies 60 megacycles apart may be read to within ±1.5 megacycles.

2-23. OPERATION FOR SPECTRUM ANALYSIS.

a. Place the radar equipment in operation and allow it to warm up to its normal operating temperature.

b. Check to be sure that the radar set antenna is not directed toward nearby reflecting surfaces which could cause the transmitter frequency to be pulled.

c. Turn the echo box METER SENSITIVITY control counterclockwise to the maximum db attenuation position.

d. Connect the INPUT jack of the echo box to D jack of radar directional coupler using the interconnecting cable provided.

e. Adjust echo box TUNING and CRYSTAL TUNING controls for maximum reading on echo box output meter. Keep meter reading on scale by adjusting METER SENSITIVITY control.

f. Adjust METER SENSITIVITY control until the output meter indicates 18 microamperes.

g. Check to see that echo box is tuned to transmitter (maximum on meter when TUNING control is rotated through resonant point).

NOTE

Do not disturb the METER SENSITIVITY control setting from the position established in step f. above.

h. Turn the TUNING control slowly from below resonant to well above resonance and record output meter reading and frequency every 0.5 megacycle or less.

NOTE

Cover the frequency range desired by turning the TUNING control in the same direction, not by turning it back and forth. In this way error due to any backlash in the dial gearing may be minimized.

i. Make a graph or chart with output meter readings plotted against frequency in megacycles. The resulting graph should resemble one of those illustrated in figure 2-5.

2-24. ALTERNATE METHOD FOR SPECTRUM ANALYSIS. A second method may be used when a particularly good spectrum with small side lobes produces meter deflections too small to be easily readable. In this case the following procedure may be used:

a. Retune the echo box to resonance and adjust the METER SENSITIVITY control to a value between 5 and 10 divisions on the output meter and make note of the value for later use.

b. Turn the TUNING control slowly in steps of one megacycle from the resonant point to a point well off resonance.

c. At each megacycle interval, adjust the METER SENSITIVITY control to obtain the reference value selected in step a. above.

d. Record the METER SENSITIVITY control settings together with the corresponding frequency settings.

e. Restore the METER SENSITIVITY control to its original setting, retune the echo box to resonance and proceed as in steps b. through d. above except detune in the opposite direction.

f. Make a graph or chart with METER SENSITIVITY control readings in db plotted against the TUNING control settings in megacycles. The resultant graph should be similar to that shown in figure 2-5A.

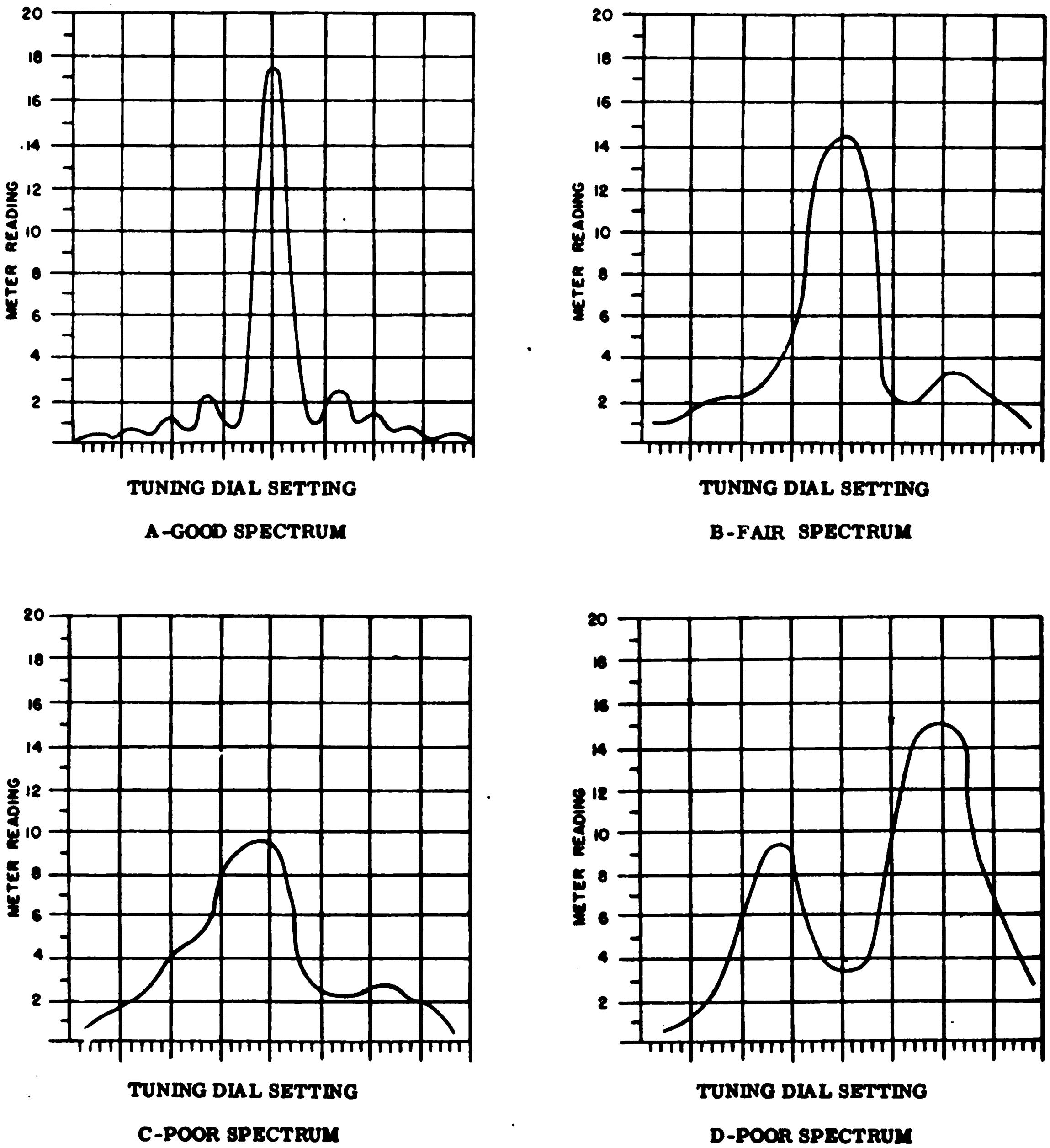
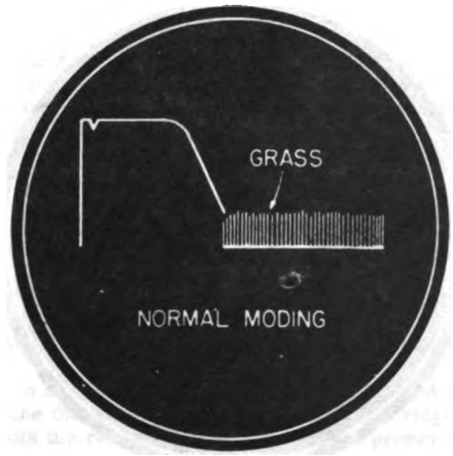
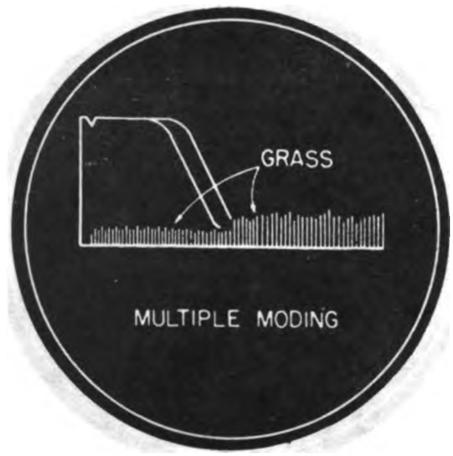


Figure 2-5. Transmitter Spectrum Analysis Diagrams



A



B

Figure 2-6. Normal and Multiple Traces

2-25. ANALYSIS OF RESULTS. A radar transmitter in good working condition should give a spectrum curve similar to figure 2-5A or 2-5B. Good curves are those in which the two halves are symmetrical and the minimum points are well defined on both sides of the main peak. A curve without deep minima (see figure 2-5C) indicates that the transmitter is frequency modulated during the pulse. This may be caused by a poorly shaped high voltage transmitter firing pulse whose sides are not steep enough or does not have a flat top. Frequency modulation may also be caused by a transmitter tube which is unstable or one which is operated with improper voltage, current, or weak magnetic field.

2-26. When the spectrum is extremely irregular as shown in figure 2-5D, it is an indication of severe frequency modulation. This will probably cause trouble in the receiver automatic frequency control circuits as well as a general loss in signal strength. When the spectrum has two large peaks quite far apart, it is an indication that the transmitter is double moding. This can be caused by bad standing waves in the transmission line or a bad transmitter tube. This faulty spectrum can often be improved by removing the cause of the standing waves such as a faulty line connection, a bad antenna rotating joint, or obstructions in the line. If double moding continues, try replacing the transmitting tube.

2-27. In the case of a good or fair spectrum curve with sharply defined minima on both sides of the main peak, the distance between the two minima indicates the duration of the transmitted pulse. Since the duration of the pulse determines the distribution of power in the sideband frequencies, the pulse length may be found from the spectrum graph. The procedure is to determine the distance in megacycles between the minima on either side of the main peak and then apply the following equation:

$$\text{Pulse in microseconds} = \frac{2}{\text{distance in megacycles between minima}}$$

2-28. Any great change in the spacing in megacycles of the minima of the spectrum from the known standard or that obtained with another radar set of the same type indicates an improper pulse duration. The shorter the pulse, the wider the frequency band which the signals occupy. This shows on the graph as a wide span between the minima of the curve. An abnormally narrow spectrum shows the transmitted pulse is too long. Such a pulse could result in a long ringtime and high power reading on the echo box output meter thus falsely indicating superior radar system performance.

2-29. TEST FOR UNSTABLE RADAR OPERATION.

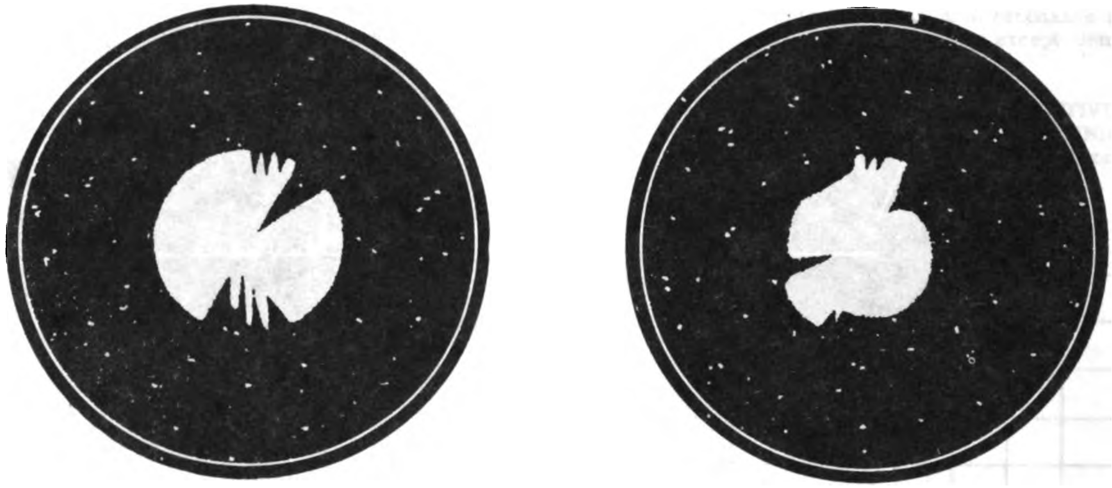
2-30. Unstable operation of a radar transmitter may be caused by misfiring or multiple moding. It may also be caused by fluctuation of local oscillator voltages or by AFC (automatic frequency control) jitter. This test requires the use of a type A indicator. If the radar equipment under test does not contain an A indicator, a synchroscope such as TS-239/UP must be used.

2-31. OPERATION FOR TEST FOR UNSTABLE RADAR OPERATION.

a. Perform the operations described in paragraph 2-9.

b. Observe the ringtime patterns on the A indicator or synchroscope. Refer to paragraphs 2-10 through 2-15 for ringtime measurement.

2-32. ANALYSIS OF RESULTS. If the radar transmitter is operating normally, a ringtime pattern similar to that in figure 2-6A should be obtained. If grass appears at part or all of the bottom of the ringtime trace, as shown in figure 2-6B, the transmitter is misfiring or double moding. If a multiple decay line is present, which may have a twining motion, look for improper connections or ripple on the local oscillator heater supply. If a jittery multiple decay trace is present, having one or two alternate positions, listen



A

B

Figure 2-7. Transmitter Frequency Pulling on PPI Screen

for arcing in the r-f transmission line. If a fuzzy multiple decay trace is present, check to see that the echo box is in exact tune. If a jittery multiple decay trace is present, having many positions all close together, suspect AFC jitter. Refer to appropriate radar manual for corrective measures.

2-33. TRANSMITTER FREQUENCY PULLING OF RADAR WITH PPI INDICATOR.

a. Turn off the automatic frequency control on the radar receiver.

b. With the radar antenna stopped in a direction in which there are no obstructions, adjust the TUNING control on the echo box for maximum deflection on the echo box output meter.

c. Allow the antenna to rotate and observe the ringtime pattern on the PPI screen.

NOTE

If nearby echoes are causing trouble, reduce the sensitivity of the radar receiver with the receiver gain control.

2-34. ANALYSIS OF RESULTS. If the transmitter is operating normally, a good ringtime pattern similar to that shown in figure 2-3A will be seen. If there are blank spaces on the PPI screen or ringtime is reduced on certain azimuths as illustrated in figure 2-7A, the transmitter is being pulled off frequency. A further indication of frequency pulling may be noted on the output meter. If the transmitter is being pulled off frequency, the echo box output meter will fluctuate as the antenna rotates. A check on the amount that the transmitter frequency is being pulled may be made by measuring the frequency on those azimuths where transmitter frequency pulling is suspected and comparing with the previous frequency setting on the echo box.

2-35. The frequency pulling may be caused by a bad rotating joint in the r-f transmission line or by a reflecting surface near the antenna. Refer to the appropriate radar handbook for detailed information to correct the trouble.

2-36. AUTOMATIC FREQUENCY CONTROL CHECKS.

2-37. CHECKING AFC OPERATION. When the radar transmitter frequency is being pulled as shown in figure 2-7A, it is important to know whether the receiver local oscillator is following the frequency shift to keep the receiver in tune. Check AFC as follows:

a. Set up the echo box as for transmitter frequency pulling test in paragraph 2-33.

b. Stop the antenna on an azimuth where the ringtime pattern is broken and retune the echo box with the TUNING control for maximum indication on the output meter.

c. Turn on the radar automatic frequency control and rotate the radar antenna.

d. Examine the ringtime pattern on the PPI indicator.

2-38. ANALYSIS OF RESULTS. If the ringtime is now good on the azimuth on which the echobox was returned, the AFC is in operation on that azimuth and the local oscillator is following the frequency pulling of the transmitter. The ringtime may now have decreased on those azimuths where it was originally good as illustrated in figure 2-7B. If the AFC does not follow, the frequency pulling may be excessive or the AFC may be defective.

NOTE

If the ringtime is considerably decreased at certain azimuths and the AFC does not follow, the radar must be considered inoperative at those azimuths and should be so reported until repaired.

2-39. CHECK FOR AUTOMATIC FREQUENCY CONTROL LOCKING. The following procedure will show whether the AFC is locking on the proper frequency.

a. Stop the radar antenna and tune the echo box with the TUNING control for maximum output indication on the echo box output meter.

b. Turn off the AFC at the radar receiver and manually tune the local oscillator for maximum ringtime. This puts the receiver local oscillator in proper tune.

c. After the local oscillator has been manually tuned, turn the AFC switch on.

2-40. ANALYSIS OF RESULTS. If the ringtime decreases even slightly when the AFC switch is turned to the on position, it is an indication that the AFC is locking on the wrong frequency or failing to lock at all. Refer to the appropriate radar manual for information to correct the condition.

2-41. RECEIVER AND T-R BOX RECOVERY TIME CHECKS.

2-42. PROCEDURE FOR T-R BOX CHECK. This test procedure requires the use of an A type indicator or a synchroscope such as TS-239/UP if the radar system does not contain an A-scope.

a. Stop the radar antenna and tune the echo box for maximum deflection on the output meter to obtain a good ringtime pattern such as curve E in figure 2-8.

b. Gradually reduce the radar receiver gain or detune the echo box if echoes do not interfere.

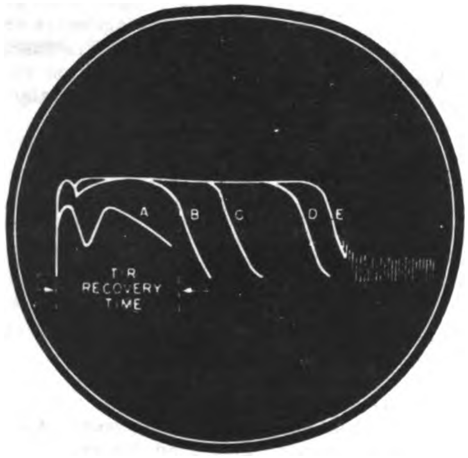


Figure 2-8. Measurement of T-R Recovery Time

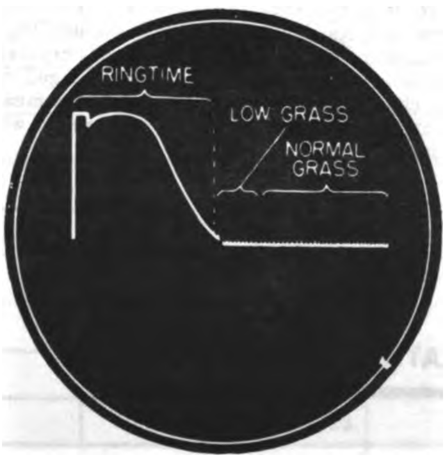
c. A pattern such as curve D in figure 2-8 having the same relative shape as E will result. Further slight reduction in gain will produce a curve similar to curve C which will once again have the same shape as curve E.

d. Continue reducing gain (or detuning the echo box) until a change occurs in the slope of the curve as shown in curve B.

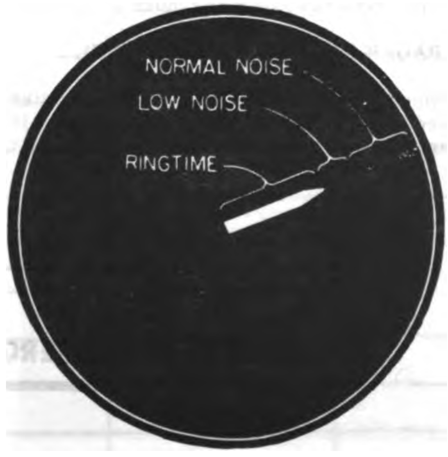
e. This point of change marks the T-R box recovery time of the radar set. For proper operation the T-R box recovery time should be 1500 yards or less. For recovery time of the particular radar being tested, refer to the appropriate radar handbook.

f. If the gain control is reduced still further (or echo box detuned further), a greater distorted pattern should appear such as curve A of figure 2-8.

g. When the above procedure does not produce a



A-SCOPE



PPI

Figure 2-9. Measurement of Receiver Recovery Time series of curves similar to those in figure 2-8, giving a T-R box recovery point, and if the ringtime is short, it is possible that the T-R recovery time is much too high (greater than ringtime). If this condition exists, check the T-R box in accordance with appropriate radar manual.

2-43. RECEIVER RECOVERY TIME CHECK.

NOTE

The T-R box must be working properly during the following test procedure.

a. Detune the echo box so that it has no effect on the radar equipment.

b. Adjust the radar receiver gain so that about one-quarter inch of grass is showing on the A-scope or, if a PPI indicator is being used, the receiver gain should be adjusted so that the noise trace is low.

c. Stop the radar antenna and tune the echo box to resonance while observing the indicator screen.

2-44. ANALYSIS OF RESULTS. If the receiver recovery time is normal, the noise or grass will appear immediately after the end of the ringtime trace. The amplitude of the noise should be equal to that observed when the echo box was detuned. If the receiver recovery is slow, the noise will be weak and will not appear for some time after the end of the ringtime track as shown in figure 2-9. In extreme cases of receiver non-recovery, the normal background noise may not reappear on the indicator at all. Slow receiver recovery is usually an i-f or video defect and will make the radar receiver susceptible to jamming. If slow T-R box recovery or slow receiver recovery is found, adjustment or repair of the radar set is necessary. Consult the appropriate radar maintenance handbook for detailed instructions.

SECTION III
OPERATING CHECKS AND ADJUSTMENTS

3-1. CALIBRATION OF ECHO BOX.

3-2. In order to establish the ringtime that may be expected of each echo box, perform the tests described in paragraph 2-7 on any radar with which the echo box is to be used and which is regarded to be in normal operating conditions as determined by tests made with Radar Test Set TS-147/UP or equivalent. The echo box then becomes a convenient standard with which performance checks can be made quickly.

3-3. RADAR PERFORMANCE RECORD.

3-4. Since the echo box is used for comparative tests, it is necessary to keep a permanent record of the performance of every radar installation showing the results of each test performed. Such a record serves as a life history of the radar system and tends to show up any progressive deterioration in performance. The record becomes a useful guide in locating defective apparatus or improper adjustments in the radar system. Figure 3-1 is a sample of such a record.

3-5. The performance of individual echo box test sets will vary both in ringtime and power readings. Once a record of measurements has been made with the echo box and its accessories, keep the unit together. If any parts such as the pick-up antenna, crystal rectifier, connecting cord, etc. are interchanged or replaced, check the echo box against previous measurements and, if necessary, make a new record with the new combination.

SECTION IV
EMERGENCY OPERATION

4-1. There are no provisions for emergency operation of the echo box due to equipment failure.

RADAR PERFORMANCE CHECK SHEET

Radar Model ____________ Serial __________________ Location ______________

Test Set Serial _______________________ Orignal ringtime on this radar under measured conditions _________ yds.

DATE	TIME	OBSERVED RINGTIME	RADAR PERFORMANCE	ECHO BOX METERS		CHECKED BY
				METER READING	METER SENSITIVITY DB	
		yds.	db. down			
		yds.	db. down			
		yds.	db. down			
		yds.	db. down			
		yds.	db. down			
		yds.	db. down			
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		yds.	db. down			

Figure 3-1. Sample Radar Performance Check Sheet

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General, United States Army,
Chief of Staff.

Official:
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USA White Sands Sig Agcy (13)
Yuma Test Sta (2)
USA Elct PG (1)
Sig Fld Maint Shops (3)
Sig Lab (5)
Mil Dist (1)
USA Corps (Res) (1)
Sectors, USA Corps (Res) (1)
JBUSMC (2)
Units org under fol TOE:
  11-7 (2)
  11-16 (2)
  11-57 (2)
  11-127 (2)
  11-128 (2)
  11-500 (AA-AE) (2)
  11-557 (2)
  11-587 (2)
  11-592 (2)
  11-597 (2)

NG: State AG (6); units—same as Active Army except allowance is one copy to each unit.

USAR: None.

For explanation of abbreviations used, see AR 320-50.

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TM 11-6625-220-10 ECHO BOX TS-488A/UP — 1958