D E P A R T M E N T O F T H E A R M Y T E C H N I C A L M A N U A L

OPERATOR'S, ORGANIZATIONAL, DS, GS, AND

DEPOT MAINTENANCE MANUAL

RANGE CALIBRATOR SET

AN/UPM-11

This copy is a reprint which includes current pages from Change 1.

H E A D Q U A R T E R S, D E P A R T M E N T O F T H E A R M Y

MARCH 1970

CHANGE } HEADQUARTERS
No. 1 DEPARTMENT OF THE ARMY
WASHINGTON, DC, *13 June 1974*

Operator, Organizational, Direct Support, General Support and Depot Maintenance Manual
RANGE CALIBRATOR SET AN/UPM-11

TM 11-6625-310-15-1, 10 March 1970, is changed as follows:
1. A vertical bar appears opposite changed material.
2. Remove and insert pages as indicated in the page list below:

Remove	*Insert*
i	i
1-1 through 14	1-1 through 1-4
B-1 through B-3	B-1

3. File this change sheet in the front of the manual for reference purposes.

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Ft Huachuca (5)	29-134 (1)
Ft Carson (5)	29136 (1)

ARNG: State AG (3)
USAR: None.
For explanation of abbreviations used, see AR 310-50.

TECHNICAL MANUAL
No. 11-6625-310-15-1

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., *10 March 1970*

Operators, Organizational, Direct Support, General Support, and Depot Maintenance Manual RANGE CALIBRATOR SET AN/UPM-11

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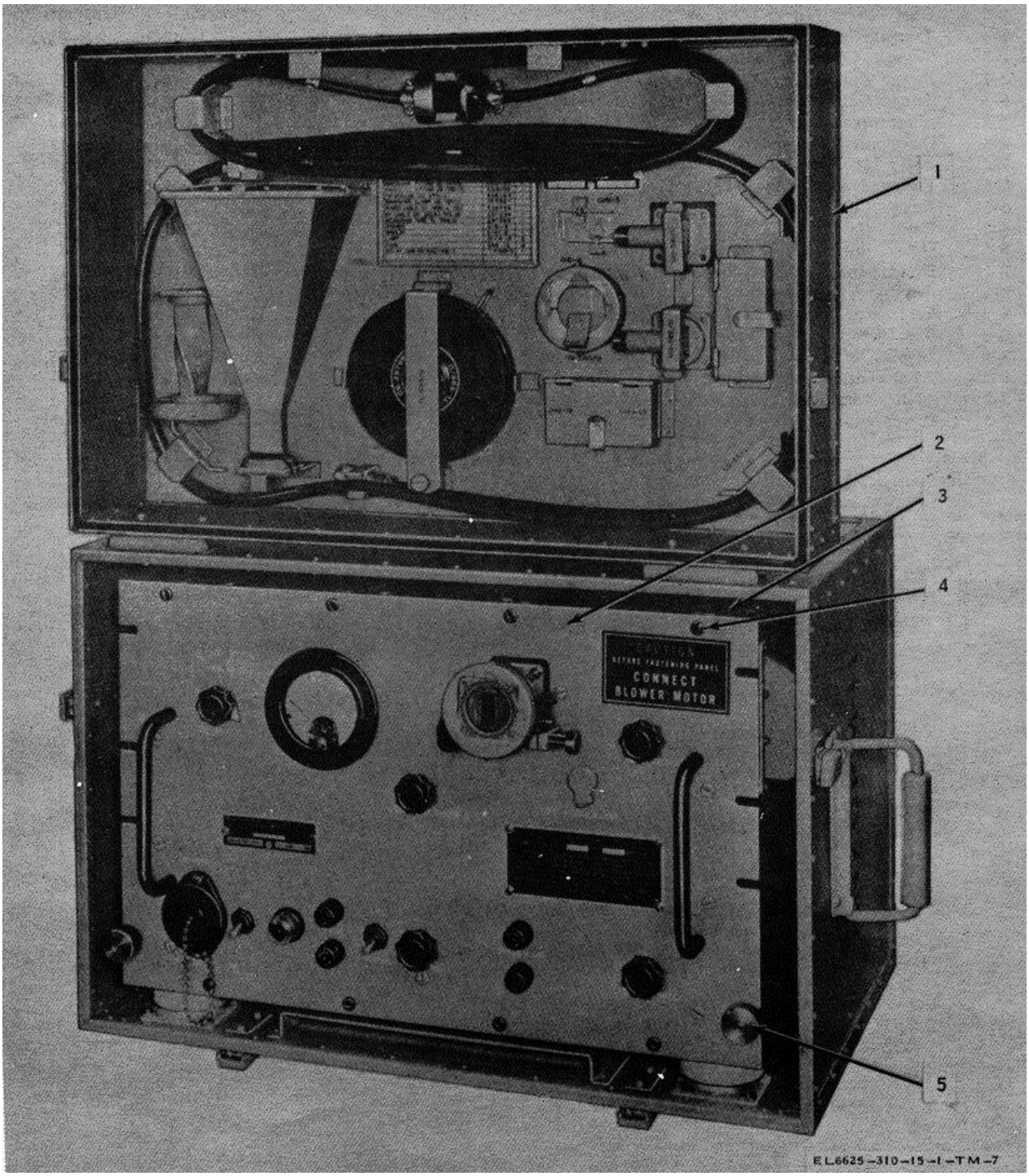


1 Transit Case CY-818/U
2 Range Calibrator TS-696A/UPM-11
3 Dust Cover
4 Captive Retaining screw
5 Swivel bolt with nut

Figure 1-1. Range Calibrator Set AN/UPM-11.

CHAPTER 1
INTRODUCTION AND DESCRIPTION

Section I. GENERAL

1-1. Scope

a. This manual describes Range Calibrator Set AN/UPM-11, and covers its installation and operation and organizational, direct support (DS), general support (GS), and depot maintenance.

b. The basic issue items list is in appendix B and the maintenance allocation chart is in appendix C.

NOTE

Appendix B is current as of 1 February 1974. Appendix C is current as of 21 November 1969.

1-2. Indexes of Publications

a. DA Pam 310-4. Refer to the latest issue of DA Pam 3104 to determine whether there are new editions, changes, or additional publications pertaining to the equipment.

b. DA Pam 310-7. Refer to DA Pam 310-7 to determine whether there are modification work orders (MWO's) pertaining to the equipment.

1-3. Forms and Records

a. Reports of Maintenance and Unsatisfactory Equipment. Use equipment forms and records in accordance with instructions given in TM 38-750.

b. Report and Packaging and Handling Deficiencies. Fill out and forward DD Form 6 (Report of Packaging and Handling deficiencies) as prescribed in AR 700-58/NAVSUP PUB 378/AFR 71-4/MCO P4030.29, and DSAR 4145.8.

c. Discrepancy in Shipment Report (DISREP) (SF 361). Fill out and forward Discrepancy in Shipment Report DISREP) (SF 361) as prescribed in AR 55-38/NAVSUPINST 4610.33/AFM 75-18/MCO P4610.19A, and DSAR 4500.15.

d. Reporting of Equipment Publication Improvements. The reporting of errors, omissions, and recommendations for improving this publication by the individual user is encouraged. Reports should be submitted on DA Form 2028 (Recommended Changes to Publications and Blank Forms) and forwarded direct to Commander, US Army Electronics Command ATTN: AMSEL-MA-S, Fort Monmouth, NJ 07703.

Section II. DESCRIPTION AND DATA

1-4. Purpose and Use

The AN/UPM-11 is an electronic device which provides a means of calibrating accurately the radar range or any X-band radar system. The AN/UPM-11 may also be used with the narrow-beam pickup horn to collimate accurately the antenna axis of a radar system.

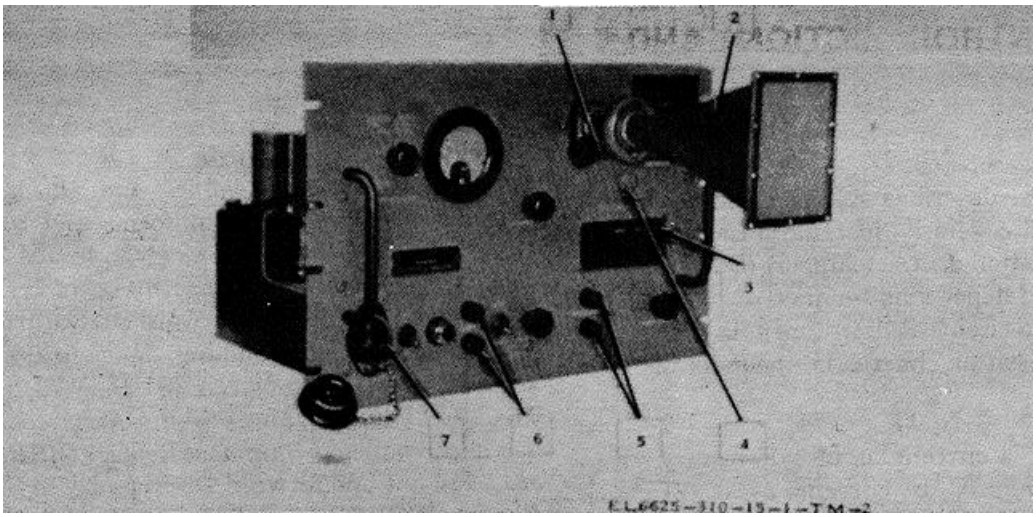
1-5. Description of Range Calibrator Set AN/UPM-11

a. Range Calibrator Set AN/UPM-11 consists of Range Calibrator TS-696/UPM-11 or TS-696A/UPM-11 (fig 1-2), a dust cover (fig. 1-3), and Transit Case CY-818/U (fig. 1-4. Accessory equipment to be used with the AN/UPM-11 is fastened to the cover of the transit case. This equipment is illustrated in figure 1-5.

b. Range Calibrator, TS-696A/UPM-11 (fig. 1-1) contains a 40-megacycle (mc), intermediate frequency (IF) amplifier, fused quartz delay line mounted in a thermostatically controlled oven; balanced mixer assembly; AFC assembly; and a power supply. Each assembly, except the power supply, may be removed easily for servicing or replacement. All operating controls are on the front panel. The calibrator slides into the dust cover (3) and is secured by eight captive retaining screws (4) The calibrator and dust cover are secured to the transit case by two swivel bolts with nuts (5).

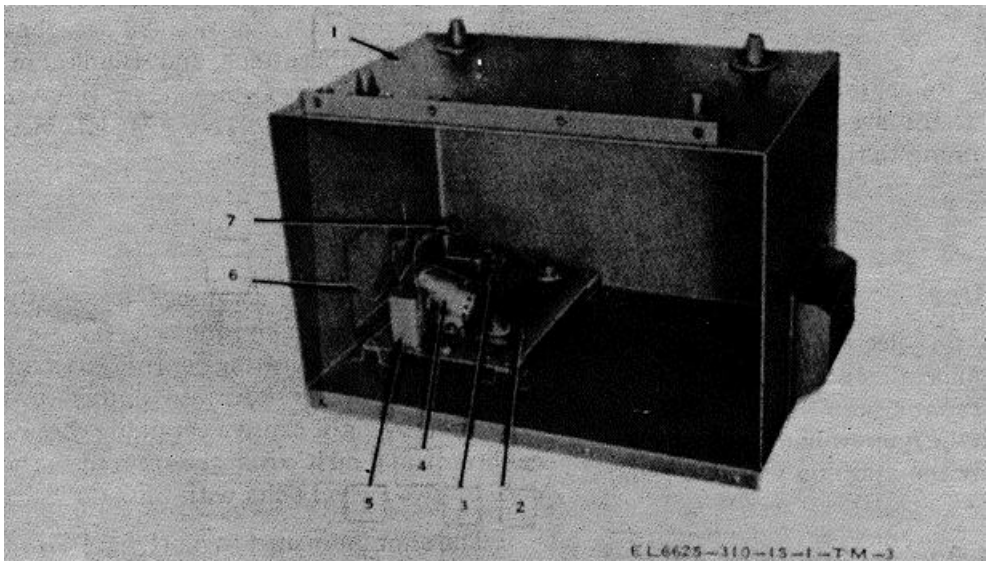
c. The aluminum dust cover (1, fig. 1-3) protects the calibrator chassis. The cover contains standby heater HR-601 (2) and a thermostatically controlled fan and motor assembly (4).

d. Transit Case CY-818/U is an aluminum plymetal case, the exterior and interior surfaces of which are finished in Federal Grey. The case is equipped with an inseparable hinged cover (fig. 1-4) secured by four hinged clamps which fasten over mating brackets attached to the cover. A rubber gasket (2, fig 1-5) is cemented to the edge of the cover to make the case watertight. Two swivel bolts and nuts (10) secure the calibrator and dust cover to a U-shaped mounting rack (13) which is attached to the bottom of the case by four



1 External attenuator
2 Pick-up Horn AT-273/UPM
3 Instruction plate
4 "EXT MODULATION" jack
5 Spare fuse holder
6 Fuse holder
7 "115 VAC" receptacle

Figure 1-2. Range Calibrator TS-696A/UPM-11 pick-up horn attached.



1 Dust cover
2 Standby heater HR-601
3 Thermostat S-601
4 Fan and motor assembly
5 Relay K-601
6 Ventilation louver
7 Plug P-601

Figure 1-3. Dust cover, fan and heater installed.

compartment (12) is provided at the bottom of the case. Accessory retaining clamps are provided in the cover.

1-6. Weight-and dimensions

The weight of the complete Range Calibrator Set 1-2 Change 1 AN/UPM-11 is 80 pounds and the weight of Range Calibrator TS-696A/UPM-11 is 45 pounds. The dimensions in Transit Case CY-818/U are 19 inches wide by 12 inches high by 12 inches deep.

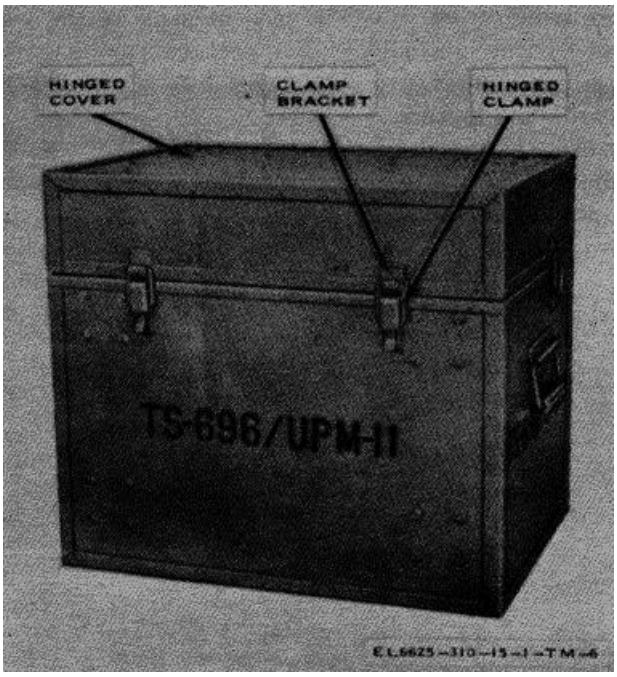


Figure 1-4. Transit Case CY818/U.

1-6.1. Items Comprising an Operable Equipment

FSN	*QTY*	*Nomenclature, part No., and mfr code*	*Fig. No.*
6625-503-0699		Range Calibrator AN/UPM-11: (80058) Consisting of:	
		NOTE The part number is followed by the applicable S-digit Federal supply code for manufacturers (FSCM) identified in SB-70842 and used to identify manufacturer, distributor, or Government agency, etc.	
5985-636-1540	1	Adapter Coaxial to Waveguide: UG591/G; (80058)	1-5
6625-257-2942	1	Adapter Coaxial UG592/U	1-5
6625-305-0001	1	Antenna Horn Pick-Up at 273A/UPM: (80058)	1-5
6625-223-5302	1	Cable Assembly CG 92/U: (80058)	1-5
6625-533-6806	1	Calibrator, Range TS 696/UPM-11: (80058)	1-1
5975-031-1939	2	Clamp Waveguide UG-590/U: (80058)	1-5
5840-545-7371	1	Delay Line: 293828-1;(56232)	1-5
S995-240-4537	1	Power Cable Assembly CX-1.490/U: (80058)	
5905-306-2123	1	Resistor, Thermal: 3H-7;(70563)	
6625-224-2788	1	Waveguide Assembly (Twistguide) CG 673/U: (80058)	

1-7. Additional Equipment Required

a. Pickup Horn AT-273/UPM (17, fig. 1-5) is an aluminum horn, painted grey, with a horizontal and vertical bead width of 20°. The horn is equipped with a Teflon window which covers the horn mouth to make it waterproof.

b. Twistguide CG-673/U (16) intended for use with the pickup horn, converts to the normal H-plane polarization to the E-plane. It is equipped with a quick-disconnect clamp that enables the operator to connect the horn without the use of additional hardware.

c. Two waveguide fittings are included to permit several methods of using the calibrator. Wavequide Fittings UG-591/U (5) terminates in a cover flange, whereas Waveguide Fitting US-592/U(7) terminates in a choke flange.

d. Measuring Tape TL-598/U is used to measure the distance between the pickup horn (when used)

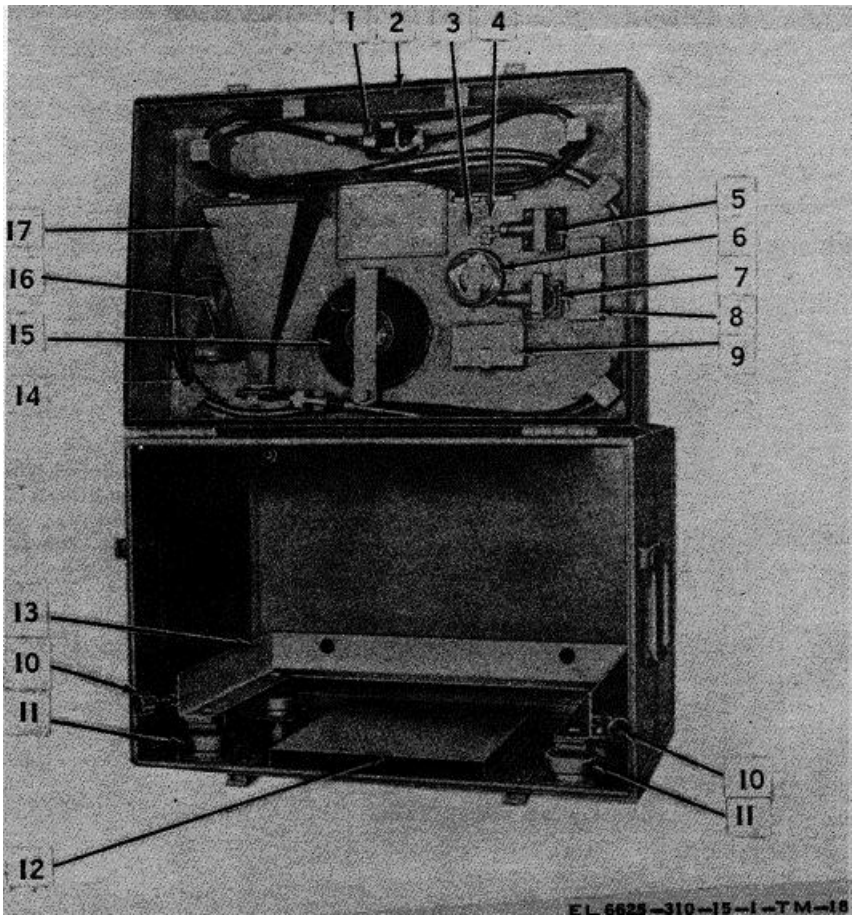
and the radar antenna. The tape is 30 yards long and inclosed in a simulated leather-finish plastic case. Graduation marks are both in yards and meters.

e. Power Cable CX-1490/U (1) is used to connect the calibrator to a power source supplying 250 watts at 115 volts ac, single phase, 50 to 1,000 cps. The power cable is connected to the calibrator at the "115 VAC" receptacle (7, fig. 1-2).

f. R-f Cable CG-252A/rPS-10 (14, fig. 1-5) may be used in place of the pickup horn and, when used, connection is made through the external attenuator (1, fig. 1-2).

1-8. Differences in Models

In this manual, the data describes Range Calibrator TS-696A/UPM-11 which differs from earlier model TS696/UPM-11 as follows: TS-696/UPM-11 uses a 30-mc delay line and 30-mc amplifier, and there is no EXT MODULATION jack on the front panel.



1 Power Cable CX-1490/U
2 Rubber gasket
4 Wrench
5 Waveguide Fitting UG-519/U
6 Waveguide Clamp UG-590/U
7 Waveguide Fitting UG-592/U
8 Spare delay line
9 Spare fuse and lamp box
10 Swivel bolt with nut
11 Shock mount
12 Manual storage compartment
13 U-shaped mounting rack
14 R-f cable CG-252A/TPS-10
15 Measuring tape TL-598/U
16 Twistguide Cg-673/U
17 Pickup Horn At-273/UPM

Figure 1-5. Transit Case CY-818/U, location of accessory equipment.

CHAPTER 2
INSTALLATION

2-1. Unpacking

Remove Range Calibrator Set AN/UPM-11 from the shipping container as follows:

a. Remove the outer wrapping of waterproof paper from the corrugated paper carton and open the carton.

b. Open the moistureproof vapor barrier bag and remove the rubberized cushioning material.

c. Remove and examine the humidity indicator.

If the crystals are pink, the AN/UPM-11 should be given a complete inspection. If the crystals are blue, only a thorough visual inspection is necessary.

d. Remove the side cushions, lift the AN/UPM-11 from the carton, remove all paper wrappings, and examine the calibrator for signs of damage due to shipment.

e. The AN/UPM-11 is shipped completely assembled and requires no installation of parts or adjustments.

f. If the calibrator is a reissue and not new, perform the inspection prescribed in paragraph 4-3.

2-2. Power and Space Requirements

Range Calibrator Set AN/UPM-11 requires 250 watts at 115-volt ac, single-phase, 50to 1,000-cps power source. It may be operated in any convenient space while in the transit case. The calibrator chassis has been so designed that the set may be rack-mounted and operated from this position. Bench space required is an area equal to 2 by 3 feet.

2-3. Preparation for Storage

No special storage procedure is required for short-time storage. For long-time storage, place several bags of a dehydrating agent (Silica Gel) on top of the calibrator, wrap in waterproof paper, and seal. The units may be stacked to a reasonable height. If the storage area is very humid and subject to alternate heating and cooling, add a moistureproof vapor barrier bag. Heat-seal the bag.

2-4. Preparation for Shipment Prepare the range calibrator set for shipment as follows:

a. Remove all dirt, dust, grime, and foreign matter from the AN/UPM-11. Wrap in SSM 25-4 Grade "A" paper.

b. Select a corrugated paper carton of such size as to allow for cushioning and packing of a dehydrating agent.

c. Form fit a moistureproof vapor barrier bag to the inside of the carton. Label the vapor barrier bag giving notice that a dehydrating agent is packed with the AN/UPM-11 and that the seal should not be broken until the AN/UPM-11 is ready for use. Also place the packing date on the label.

d. Place rubberized curled animal hair, or equivalent, cushioning material inside the barrier bag to cushion the AN/UPM-11 and place the calibrator in the cushioning material. Place a dehydrator agent (Silica Gel) inside the barrier bag together with a humidity indicator.

e. Exhaust the air by means of a vacuum pump and heat-seal the bag. Seal and label the carton. Wrap the carton with waterproof paper, seal, and label with "FRAGILE" warning labels.

CHAPTER 3

OPERATING INSTRUCTIONS

3-1. Operator's Controls and Indicators

Table 3-1 lists the operating controls and their functions.

Table 3-1. Operating Controls

Switch, control, or Attenuator	*Figure*	*Function*
"METER SELECTOR" switch	3-1 (1)	Selects circuit to be metered and connects volt-milliammeter into circuit.
"L.O. COARSE TUNING" control	3-1 (3)	Provides for manual tuning of local oscillator.
"ON-OFF" power switch	3-1 (12)	Applies external power to TS-696/UPM-11.
"REFLECTOR" control	3-1 (6)	Electrically tunes local oscillator in "MANUAL" position.
"A.F.C.-MANUAL" switch	3-1 (10)	Switches local oscillator tuning from manual to automatic tuning.
"L.O. ATTEN" control	3-1 (9)	Attenuates crystal current to a safe value.
"SWEEP LEVEL" control	3-1 (7)	Sets correct dc level for automatic tuning of local oscillator.
External attenuator	3-1 (4)	Reduces magnitude of incoming radar signals and returned echoes.

3-2. General

a. This section contains the operating instructions for Range Calibrator Set AN/UPM-11.

b. The AN/UPM-11 may be used with the pickup horn (17, fig. 1-5) or with the r-f cable (14). In either case, the procedure is the same; however, the preliminary procedure and the interpretation of results will differ.

c. The AN,/UPM-11 may be operated either in or out of the transit case.

3-3. Preliminary Starting Procedure

a. Open the carrying case and remove Power Cable CX-1490/U (1, fig. 1-5) from the cover. Connect the cable between the "115 VAC" receptacle (13, fig. 3-1) of the calibrator and to a 115volt, ac power source. The power source may be any frequency between 50 and 1,000 cps.

b. If the pickup horn is to be used, proceed as follows:

(1) Attach Pickup Horn AT-273/UPM (17, fig. 1-5) to the output coupler (5, fig. 3-1). Be sure that the radiofrequency polarization of the horn is the same as that of the radar antenna, observe the wide side of the waveguide in both equipment's. These sides should be in the same plane. To change the polarization of the horn, use Twistguide CG-673/U (16, fig. 1-5).

(2) Place the AN/UPM-11 at least 5 yards from the radar antenna.

(3) Measure the distance between the radar antenna the pickup horn using Measuring Tape TL598/U (15, fig. 1-5).

(4) Add this distance to the amplifier delay which is marked on the instruction plate (8, fig. 3-1), and to the delay line delay which is marked on the plate on the delay line oven (fig. 6-3). If extra waveguide is used, an additional delay, equal to 1.5 times the length of the extra waveguide, must be added to this total. Record this total delay for use in paragraph 3-5f (3).

c. If the AN/UPM-11 is to be directly coupled to the radar antenna by the r-f cable, proceed as follows:

(1) Connect Waveguide Fitting UG-591/U (5, fig. 1-5) to the output coupler (5, fig. 3-1).

(2) Fasten R-f Cable CG-252A/TPS-10 (14, fig. 1-5) to the waveguide fitting.

(3) Connect the other end of the r-f cable to a directional coupler located in output of the radar set.

(4) Add the amplifier delay, which is marked on the instruction plate (8, fig. 3-1), to the delay line delay which is marked on the plate on the delay line oven (fig. 6-3). To this total, add the delay of the r-f cable which is equal to 1.5 times the length of the cable. Record this total delay for use in paragraph 3-5f(4).

NOTE

If the r-f cable connected in paragraph 3-3c(3) is not connected directly to the directional coupler in the radar set being calibrated, then the additional r-f cabledelay between the point of connection and the directional coupler must be added to the total computed in paragraph 3-3c(4).

3-4. Starting and Warmup Procedure

Turn the "ON-OFF" power switch (12, fig. 3-1) to "ON". The pilot lamp (11) should light. Allow 10 minutes for the instrument to reach its operating temperature.

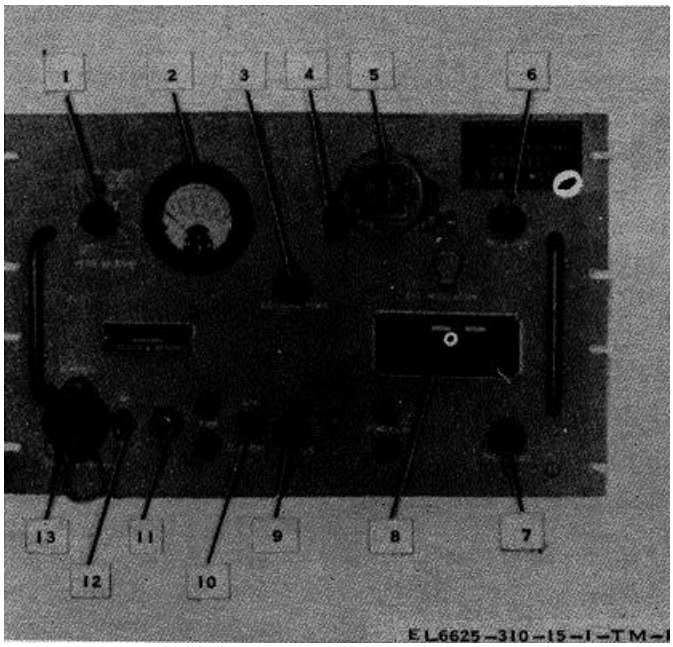
3-5. Operating Procedure

NOTE

The intermediate frequency is 30 mc for the TS-696/UPM-11.

a. General. Operating procedure for Range Calibrator Set AN/UPM-11 consists of tuning the klystron local oscillator to a frequency 40 mc higher than the radiating frequency of the radar transmitter. The frequency of the klystron is dependent on the size of its resonant cavity and the magnitude of the voltage on its reflector plate. The size of the resonant cavity is controlled by the "L.O. COARSE TUNING" control (3, fig. 3-1). The magnitude of the voltage on the reflector plate is dependent on the position of the "A.F.C.-MANUAL" switch (10). In the "MANUAL" position, the operator may vary the voltage on the reflector plate by adjusting the "REFLECTOR" control (6). In the "A.F.C. position," the reflector voltage is controlled by the AFC error voltage in conjunction with the "SWEEP LEVEL" control (7).

b. Lock-On. After the AN/UPM-11 has reached operating temperature, it may be used as a range calibrating or boresighting tool by turning it to "lock-on" to the radar set being checked.



1	"METER SELECTOR" switch	6	"REFLECTOR" control	10	"A.F.C.-MANUAL" switch
2	Volt-milliammeter	7	"SWEEP LEVEL" control	11	Pilot lamp
3	"L.O. COARSE TUNING" control	8	Instruction plate	12	"ON-OFF" power switch
4	External Attenuator control	9	"L.O. ATTEN." Control	13	"115 VAC" receptacle
5	Output coupler				

Figure 3-1. Range Calibrator TS-696A/UPM-11, front panel.

While tuning the local oscillator, the pointer of the volt-milliammeter (2) either will be sweeping or holding steady. "Lock-on" is accomplished when the pointer holds steady.

c. Operation With X-Band Radar. To operate the AN/UPM-11 in conjunction with any X-band radar system, proceed as follows:

(1) Turn the "METER SELECTOR" switch (1) to either "AFC XTAL-1" or "AFC XTAL2".

(2) Set the "A.F.C.-MANUAL" switch (10) to "A.F.C".

(3) Turn on the radar set and tune it for maximum operating efficiency.

(4) Adjust the "SWEEP LEVEL" control (7) for maximum crystal current, as read on the volt-milliammeter (2), while the pointer is sweeping. (Use the complete range of the "SWEEP LEVEL" control.)

(5) Adjust the "L.O. ATTEN." control (9) while performing (4) above to keep the volt-milliammeter pointer on scale.

(6) Turn the "L.O. COARSE TUNING" control (3) counterclockwise to its limit stop.

(7) Very slowly rotate the "L.O. COARSE TUNING" control (3) clockwise, while observing the volt-milliammeter (2), until the "lock-on" position is found. (Pointer of volt-milliammeter stops sweeping and indicates a constant value of crystal current.)

(8) Readjust the "SWEEP LEVEL" control (7) as necessary to keep the crystal current at a maximum while performing (6) and (7) above.

(9) After the "lock-on" position has been found, refine the "L.O. COARSE TUNING" control for maximum crystal current and adjust the "L.O. ATTEN" control (9) until the volt-milliammeter (2) reads 0.8 milliampere (ma).

d. Control of Lock-On. "Lock-on" stability may be checked by moving the "A.F.C.-MANUAL" switch (10) from "A.F.C." to "MANUAL", and then back to the "A.F.C." position. "Lock-on" should occur immediately. If it does not, carefully repeat the procedure outlined in c above.

e. Manual Control. After locking the AN/UPM-11 on to the radar frequency, the AN/UPM-11 may be operated with the "A.F.C.MANUAL" switch (10) in the "MANUAL" position as follows: (1) Turn the "A.F.C-MANUAL" switch (10) to "MANUAL".

(2) Adjust the "REFLECTOR" control (6) TM 116625310-15-1 until the volt-milliammeter registers the exact value of crystal current as that established in c(9) above.

NOTE

The "L.O. COARSE TUNING" control (3) and the "L.O. ATTEN" control (19) should not be moved after switching the "A.F.C.-MANUAL" switch (10) from "A.F.C." to "MANUAL".

f. Interpretation of Results.

(1) With the AN/UPM-11 locked on to the radar frequency, markers will appear on the radar scope. The range circles on the scope (or the range dials) may then be adjusted to read correctly.

(2) The range scale on the radar scope should be set to approximately six or more times the delay of the delay line as indicated on the plate on the delay line oven; for example, if the plate reads 1,500 yards, set the radar scope at approximately 9,000 yards, or more.

(3) If the pickup horn is used, the first marker will appear at a range equal to the total delay computed in paragraph 3-3b(4). The second marker will appear at a range equal to that of the first marker plus twice the amount of the delay of the delay line. Each succeeding marker will appear at a range equal to the range of its preceding marker plus twice the amount of the delay line.

(4) If the r-f cable is used, the first marker will appear at a range equal to the total delay computed in paragraph 3-3c(4). Succeeding markers will appear at ranges equal to the range of the preceding marker plus twice the amount of the delay of the delay line.

g. Boresighting.

(1) The AN/UPM-11 can be used on any radar set (not using a rotating antenna) to collimate (boresight) the radar on-target axis with that of an optical sight. When used in this way, the AN/UPM-11 stimulates a target located at a definite point in space.

(2) Boresight an antenna proceed as follows:

(a) Place the AN/UPM-117 or more yards from the radar antenna.

(b) Connect Pick-up Horn AT-273/UPM directly to the AN/UPM-11. If additional height is desired, use a coaxial cable, or rigid waveguide, to couple the horn to the calibrator.

(c) Place the horn as high above the

ground as is possible. The minimum height is determined by an angle formed by the ground and a line extending from the radar antenna to the horn. This angle must be at least twice the beam width of the radar antenna or the horn, whichever is greater. (The horn has a beam width of 20°.)

(d) Set the radar set for either manual or automatic tracking. Adjust optical sight according to the amount of error present.

(e) Correct for angular error due to parallax between radar antenna, calibrator horn, and the optical sight.

3-6. Stopping Equipment

a. If it is desired to place the set on standby, turn the power switch to "OFF". With the power cord connected, the heater continues to operate, keeping the instrument at the operating temperature.

b. Remove the AN/UPM-1 from service as follows:

(1) Turn the "ON-OFF" power switch (12, fig. 3-1) to "OFF".

(2) Disconnect Power Cable CX-1490/U.

(3) Remove the horn or coaxial cable and connectors from the r-f output coupler.

CHAPTER 4

OPERATOR AND ORGANIZATIONAL MAINTENANCE

4-1. Scope of Organizational Maintenance

The maintenance duties assigned to the operator of the AN/UPM-11 are listed below, together with a reference to the paragraphs covering the specific maintenance function. The duties assigned do not require tools or test equipment other than those issued with the oscilloscope.

a. Daily preventive maintenance checks and services (para 4-3).

b. Weekly preventive maintenance checks and services (para 4-4).

c. Cleaning (para 4-5).

d. Monthly preventive maintenance checks and services (para 4-7).

e. Touchup painting instructions (para 48).

4-2. Organizational Preventive Maintenance

Organizational preventive maintenance is the systematic care, servicing, and inspection of equipment to prevent the occurrence of trouble, to reduce downtime, and to assure that the equipment is serviceable. Preventive maintenance is the responsibility of all categories of maintenance concerned with the equipment, and also includes the testing and repair or replacement of parts that inspection and tests indicate would probably fail before the next scheduled periodic service.

a. Systematic Care. The procedures given in paragraphs 4-3 through 48 cover systematic care essential to proper upkeep and operation of the equipment. The cleaning operations (para 4-5) should be performed once a day. If the equipment is not used daily, however, the cleaning operations must be performed before operation after any extended shutdown, or once a week while the equipment is kept in standby condition. The other items must be checked before the equipment is placed in operation, during operation, or after it is turned off, as specified in the applicable paragraph.

b. Preventive Maintenance Checks and Services. The preventive maintenance checks and service charts (para 4-3, 4-4, and 4-7) outline inspections to be made at specific intervals. These inspections are made to maintain combat serviceability; that is, in good general (physical) condition and in good operating condition. To assist operators in maintaining combat serviceability, the charts indicate what to inspect, how to inspect, and what the normal conditions are. The *References* column lists the paragraphs that contain additional information. If he defect cannot be remedied by the operator, higher category maintenance of repair is required. Records and reports of these inspections must be made in accordance with TM 38750. Paragraph 1-3 contains additional information concerning submission of specific forms.

4-3. Daily Preventive Maintenance Checks and Services Chart

Sequence No.	*Item*	*Procedure*	*References*
1	Exterior surfaces.....	Clean the AN/UPM-11 exterior surfaces and meter glass.	Para 4-5.
2	Cables	Check power and signal cables and connectors for cracks and breaks. Replace cables that have cracks or broken connectors.	SIG 7 & 8 AN/UPM-11.
3	Knobs and switches.....	While making the operating checks (items 5 through 7), observe that the mechanical action of each knob and switch is smooth and free of external or internal binding.	
4	Indicator lamp	While making the operating checks (item 6) observe that the indicator lamp is lighted.	

Sequence No.	Item	Procedure	References
5	Preliminary starting procedures.	Refer to paragraphs 3-3 through 3-4.	Para 3-3 and 34.
6	Operational checks	Refer to paragraphs 3-3 through 3-5. Observe that the range calibrator is operating properly.	Para 3-3, 3-4, and 3-5.
7	Stopping procedures	Refer to paragraph 3-6	Para 3-6.

4-4. Weekly Preventive Maintenance Checks and Services Chart

Sequence No.	Item	Procedure	References
1	Hardware	Inspect all exterior items for loose ness. Tighten handles, latches, and hinges as necessary. Replace miss ing hardware as required.	SIG 7 & 8 AN/UPM11.
2	Metal surfaces	Inspect the exposed metal surfaces for rust and corrosion.	

4-5. Cleaning

Inspect the exterior of the AN/UPM-11. The exterior surfaces should be clean and free of dust, dirt, grease, and fungus.

a. Remove dust and loose dirt with a clean, soft cloth.

WARNING

The fumes of trichloroethane are toxic. Provide thorough ventilation whenever used. DO NOT use near an open flame. Trichloroethane is not flammable, but exposure of fumes to open flame converts fumes to highly toxic, dangerous gases. Avoid contact with the skin; wash off any that spills on the hands.

b. Remove grease, fungus, and ground-in dirt; use a cloth dampened (not wet) with trichloroethane.

c. Clean the front panel and control knobs and case; use a soft, clean cloth. If necessary, use mild soap and water to remove dirt.

4-6. Monthly Maintenance

a. Perform the maintenance functions given in the monthly preventive maintenance checks and service chart (para 4-7) once each month. A month is defined as approximately 30 calendar days of 8-hour-per-day operation. If the equipment is operated 16 hours a day, the monthly maintenance should be performed at 15-day intervals. Adjustment of the maintenance interval must be made to compensate for any unusual operating conditions. Equipment maintained in a standby (ready for immediate operation) condition, must have monthly maintenance performed on it. Equipment in limited storage (requires service before operation) does not require monthly maintenance.

b. Monthly maintenance will be scheduled in accordance with the requirements of TM 38750. If the equipment is part of a vehicular installation, the monthly maintenance should be scheduled concurrently with the periodic service schedule of the carrying vehicle to reduce out-of-service time to a minimum. All deficiencies or shortcomings will be recorded, and those not corrected during the inspection and service will be immediately reported to higher echelon by use of forms and procedures specified in TM 38-750. Equipment that has a deficiency that cannot be corrected at organizational category of maintenance should be deadlined in accordance with TM 38-750. Perform all the services listed in the monthly preventive maintenance checks and services chart (para 4-7) in the sequence listed. Whenever a *normal condition* is not observed, take corrective action in accordance with the paragraph listed under References column.

4-7. Monthly Preventive Maintenance Checks and Services Chart

Sequence No.	Item	Procedure	References
1	Completeness	Check to see that the AN/UJPM-11 is complete (para 1-6 and 1-7).	
2	Installation.....	See that the range calibrator is properly installed (para 2-1).	
3	Cleanliness	See that the equipment is clean	Para 4-5.

Sequence No.	Item	Procedure	References
4	Preservation	Check all surfaces for evidence of rust and fungus. Remove rust and fungus and spot-paint bare spots.	Para 4-8.
5	Publications	See that all publications are complete, serviceable, and current.	DA Pam 310-4.
6	Modifications	Check DA Pam 310-7 to determine if any new applicable MWO's have been published. All URGENT MWO's must be applied immedi-lately. All ROUTINE MWO's must be scheduled.	DA Pam 310-7.
7	Antenna system	Check to see that the horn and wave-guide assembly is free from dirt, moisture, and physical damage.	
8	Fuses	Inspect fuses for proper value and condition. Fuses in use are of the indicated value and located as follows: Front panel: 2 ea., 5 amperes.	
9	Pluckout items	Inspect clamps and seating of pluck-out items. Check for wrong, bent, or missing parts.	SIG 7 & 8 AN/UPM-11.
10	Resistors and capacitors	Inspect all resistors and capacitors to see that they are free of cracks and blistering. Tighten all mount-ing boards if necessary.	Fig. 6-1 and 6-2.
11	Bushings, gaskets, and insulators	Check to see that these items are free of cracks, chipping, or excessive wear.	SIG 7 & 8 AN/UPM 11.
12	Terminal boards	Inspect terminal boards for loose connections, cracks, or breaks. Tighten if necessary.	
13	Preliminary starting procedures.	Refer to paragraph :-.3.	
14	Operational checks	Refer to paragraphs 3-3, 3-4, and 3-5.	
15	Stopping procedures	Refer to paragraph 3-6.	
16	Spare parts	Check all spare parts for general condition and method of storage. There should be no evidence of overstock, and all shortages must be on valid requisitions.	SIG 7 & 8 AN UPM 11.

Table 4-1. Semiannual Maintenance Inspection

NOTE

A periodic inspection of the range calibrator as outlined in this table should be made at approximately 6-month intervals.

Component	Inspection
Crystals	Remove and check for conversion loss. Replace all crystals having greater than 6-db conversion loss. (Refer to chapter 8.)
Oven	Check continuity of heater between E-701 and E-702. Resistance should be approximately 250 ohms. Check for continuity be-tween input jacks J 701 and J-702, and internal contact.
Heater strip	Check continuity and measure cold resistance Value should be approximately 13o0 ohms.

4-8. Touchup Painting Instructions

Remove rust and corrosion from metal surfaces by lightly sanding them with fine sandpaper. Brush two thin coats of paint on the bare metal to protect it from further corrosion. Refer to applicable cleaning and refinishing practices specified in TB1 74610.

CHAPTER 5

FUNCTIONING

5-1. General

Range Calibrators TS-696/UPM-11 and TS-696A/UPM-11 simulate a series of radar targets which appear on the scope of a radar system at ranges determined by the length of a fused-quartz delay line. The calibrator will provide a minimum of 10 echoes at fixed intervals, dependent on the size of the delay line. The first target echo will appear at a range equal to the delay through the electronic circuits of the calibrator plus the delay through the delay line. Each succeeding target will be delayed an additional amount equal to twice delay of the delay line. Electronic voltage regulation, combined with accurate temperature control, results in a degree of accuracy in the calibrator which is normally higher than that of the radar system being tested; therefore, the range accuracy of the radar set under test may be maintained to a high degree.

5-2. Block Diagram Description for TS-96A/UPM-11

(fig. 5-1)

NOTE

The intermediate frequency is 30 mc for the TS-696/UPM-11.

a. A radar pulse is received from the radar system, either through the pickup horn or by means of the r-f cable. When the pickup horn is used, the radar antenna axis must be aligned with the horn. When the r-f cable is used, the cable must be connected to a directional coupler in the radar antenna system.

b. The received pulse is fed to the balanced mixer assembly through a tee assembly. The portion of the pulse applied to the output leg of the tee assembly is blocked by the action of the TR tube. The portion applied to the input leg of the tee assembly is attenuated by a directional coupler and fed to the afc section of the balanced mixer assembly. This attenuated signal is mixed with the output of the local oscillator assembly which is tuned to a frequency 40 mc higher than the radar frequency. The AFC section contains AFC crystals which, by heterodyne action, produce the intermediate frequency of 40 mc.

c. The 40-mc signal is then fed to the AFC chassis. The exit signal from this chassis is applied to two channels. One of these channels detects any variations in the 40-mc frequency. The variations are converted to error voltages to control the local oscillator reflector-voltage through the "A.F.C.-MANUAL" switch in the power supply, thereby tending to stabilize the intermediate frequency at 40mc. The 40-mc signal leaves the AFC chassis through the second channel and is transmitted to the delay line where it is converted to supersonic energy by the piezoelectric input crystal. This signal is propagated and delayed through a piece of solid-fused quartz. Mechanical vibrations excite a second piezoelectric crystal at the output end of the delay line to produce a 40-mc output signal.

d. The first 40-mc delayed rangemarker produced by the delay line is amplified in a wideband 40-mc amplifier and fed to the signal section of the balanced mixer assembly. The marker signal is then mixed with the output of the local oscillator, producing sideband frequencies 40 mc above or below the local oscillator frequency. The signal is then fed through the TR tube to the output leg of the tee assembly on to the radar antenna by either the r-f cable or the pickup horn. The signal is weak compared to the input pulse from the radar set and consequently is not impeded by the TR tube. A variable external attenuator, attached to the input of the mixer, provides a method of reducing the magnitude of both the incoming radar signal and the returned echo. The delayed microwave signal is then received by the radar and appears on the radar scope as a target at a range determined by the delay in the quartz line plus the delay of the electronic circuits.

e. All of the energy sent through the delay line is not absorbed by the output crystal, but a portion is reflected from the output end of the delay to the input end where it is reflected again to the output end. A second rangemarker is produced at

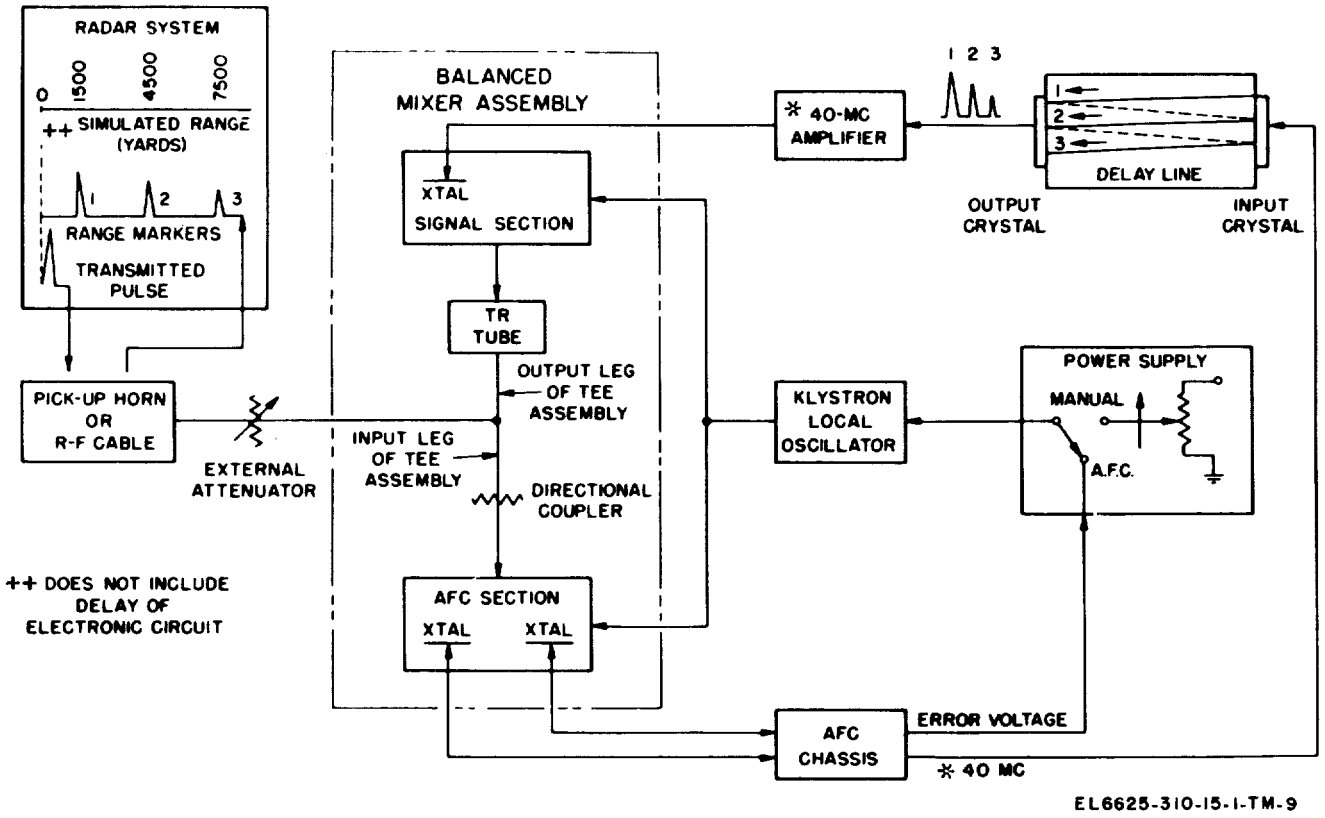


Figure 5-1. Range Calibrator TS-696A/UPM-11, block diagram.

the output end, amplified in the 40-mc amplifier and sent on to the radar to appear on the scope at a range equal to the range of the first marker plus twice the range of the delay line. Reflection of a portion of this energy within the delay line continues, resulting in a third, fourth, and up to a minimum of ten echoes on the radar scope. Each successive echo is at an additional range of twice the value of the delay line. The increasing range of the signals is accompanied by a decrease in amplitude, because of the attenuation through the fused quartz, until they are lost in the noise signal. The next pulse from the radar transmitter starts a new series of echoes.

5-3. Circuit Description

a. Microwave Mixer Circuit.

NOTE

The intermediate frequency is 30 mc for the TS-696/UPM-11.

(1) The microwave mixer circuit (fig. 5-2) mixes the incoming radar signal with the local oscillator signal to produce a 40-mc, IF signal.

(2) The frequency range of the klystron 5-2 local oscillator is from 8,600 to 9,500 mc. The local oscillator may be tuned to oscillate at a frequency 40 mc higher than the radar frequency by the "L.O. COARSE TUNING" control (3, fig.

3-1), and "REFLECTOR" control (6). The local oscillator is coupled to the balanced mixer through a waveguide containing an attenuator (fig. 5-2) which reduces the output of the oscillator.

(3) The incoming radar signal, which is fed to the AFC section through the external attenuator (fig. 5-1) and the directional coupler in the input leg of the tee assembly, is attenuated approximately 30 db. AFC crystals CR-404 and CR-403 (fig. 5-2) produce an intermediate frequency equal to the difference between the local oscillator frequency and the radar frequency. This 40-me signal is coupled out of the mixer by connectors J-404 and J-405 to the AFC chassis.

(4) A portion of the incoming radar signal attempts to enter the signal section of the balanced mixer assembly, but the magnitude of the pulse ionizes the gas in TR tube V-402, creating a high impedance across the input. Any low power signals which pass through the TR tube

and into the signal output channel do not affect operation since they occur prior to the appearance of the output signals.

(5) The 40-mc signals, after passing through the AFC chassis (fig. 5-1), the delay line, and the 40-mc amplifier are fed as range-markers, to signal crystal CR-401 (fig. 5-2) in the signal section of the balanced mixer assembly by connector J-401. These signals are mixed with the local oscillator frequency and combine to produce signals at a frequency equal to the original radar frequency. The TR tube offers no impedance to these output signals since their magnitude is not sufficient to ionize the gas in the TR tube.

(6) Solenoid L-401 controls a waveguide gate which blocks the entrance to the balanced mixer whenever the "ON-OFF" power switch (12, fig. 3-1) is in the "OFF" position. The solenoid is energized with the power switch in the "ON" position and pulls the gate out of the waveguide.

(7) Connector J-402 (fig. 5-2) and crystal CR-402 are included in the balanced mixer assembly to accommodate future modifications.

b. AFC Circuit.

NOTE
The intermediate frequency is 30 mc for the TS-696/UPM-11.

(1) The purpose of the AFC circuit is to maintain the IF signals at exactly 40 mc. The 40mc signals enter the AFC chassis through connectors J-201 and J-202 (fig. 9-1) and are applied to the primary winding of a balanced input transformer T-201. Form the secondary of the transformer, the signals are applied to a two-stage IF amplifier consisting of V-202 and V-203. From here, the signals are applied to discriminator transformer T-202.

(2) The discriminator transformer produces peak outputs at 36.5 and 43.5 me, resulting in a bandwidth of 7 mc, peak to peak. Output transformer T-202 is fed into a subminiature twin diode V-204A and V-204B. A simplified schematic (fig. 5-3) shows the relationship between the components of this stage. The associated components are essentially split into two channels and are so connected that pulses A and B, developed at the outputs of the discriminator detectors V204A and V-204B, will be equal in polarity and amplitude when the IF is 40 mc. After further processing in successive stages, these pulses will produce zero error voltage when applied to local oscillator. As the frequency deviates from 40 mc, the amplitude of the output pulses will change, one increasing and the other decreasing. An increase in frequency will cause the output of detector V-204A to increase and the output of detector V-204B to decrease. A decrease in frequency will have the opposite effect on both tubes.

(3) The outputs of the discriminator stage are amplified in video amplifier V-205 (fig. 9-1) and are then fed into dual diode V-206. Both halves of V-206 operate as peak voltage detectors. The outputs of the peak voltage detectors are combined algebraically in a resistance network consisting of resistors R-219 and R-220. The voltage developed at the junction of this network is the AFC error signal. This voltage, which is always at a negative dc value, will vary above or below its normal value depending on which side of diode V-206 is conducting heavier. When the IF is low, peak voltage detector V-206A will conduct heavier and the increased current flow through R-219 and R-220 will cause the error voltage to rise to a less negative value. When the IF is low, peak voltage detector V-206A will conduct heavier and the increased current flow through R-219 and R-220 will cause the error voltage to rise to a less negative value. When the IF is high, peak voltage detector V-206B will conduct heavier and the decreased current flow through resistors R-219 and R-220 will cause the error voltage to drop to a more negative value. This error voltage is applied to dc amplifier stage V-208B, and then through relay K-201 (energized position) to cathode follower output tube V210B.

(4) Diode V-207A, which is connected across peak voltage detector V-206A, is used as a dc restorer or clamper. Diode V-207B, which is placed across the output of dc amplifier V-208B, is a limiter which controls the positive excursion of the AFC error signal.

(5) From cathode follower V-210B, the error signal is applied to the reflector plate of the klystron local oscillator through a resistance network consisting of resistors R-235, R-238, and R-239 and through the "A.F.C.-MANUAL" switch (10, fig. 3-1) of the power supply. Since any slight change in the dc value of the reflector voltage is reflected in an immediate change of the operating frequency of the local oscillator, the error voltage insures correct operating frequency by adding to, or subtracting form, the normal dc voltage applied to the reflector plate. A "SWEEP LEVEL" control (7) is used to set the operating range of the dc reflector

voltage for proper operation of the local oscillator.

(6) The error signal is applied to cathode follower V-210B (fig. 9-1) through relay K-201 only when the relay is energized ((12) below). In the deenergized position, or when no radar signals are being received, the AFC circuit is searching and cathode follower V-210B is coupled to slow sweep generator V-209B. The klystron sweep voltage is generated by charging capacitor C-226A, which is connected between -150 and + 300 volts through resistor R-232. The grid of generator V-209B is tied to the junction of capacitor C-226A and resistor R-232.

(7) At the start of the charging cycle, generator V-209B is cut off and the voltage applied to the grid rises as capacitor C-226A is charged. When the voltage is sufficient to overcome the bias on generator V-209B, the tube conducts and, since relay K-201 is in the plate circuit of the tube, the relay is energized. One set of contacts connected across capacitor C-226A close and discharge the capacitor when relay K-201 is energized. This action cuts off generator V-209B and reopens relay K-201. The charging cycle then repeats. A sawtooth voltage is thus developed and applied to cathode follower V-210B which, in turn, sweeps the reflector plate of the local oscillator.

(8) The frequency of the local oscillator will swing ± 15 mc from the center value as determined by the "L.O. COARSE TUNING" control (3, fig 3-1) when the "SWEEP LEVEL" control (7) is properly adjusted. While in this condition, the range calibrator is searching. This is indicated by the movement of the volt-milliammeter (2) pointer when the "METER SELECTOR" switch (1) is set to one of the "XTAL" current positions.

(9) When a radar pulse is received, the positive pulses appearing at the plate of video amplifier V-205B (fig. 9-1) are applied through capacitor C-224 to automatic gain control detector V-208A. This tube, operating near cutoff, starts to conduct, producing a negative voltage whose average value is approximately equal to the peak value of the negative output pulse.

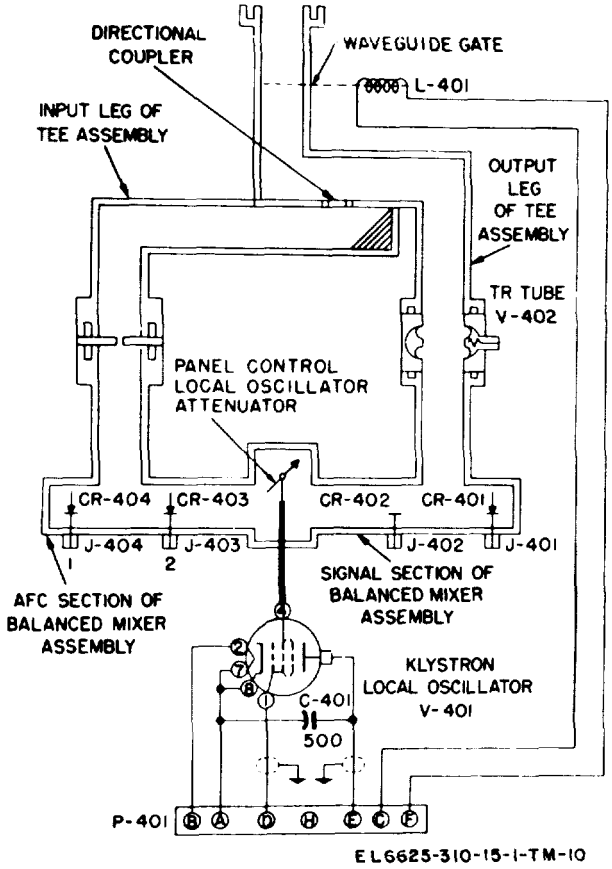


Figure 5-2. Microwave mixer circuit, schematic diagram.

When detector V-208A conducts, capacitor C-228B is charged to the peak negative value of the pulse appearing at the plate of detector V-208A. The capacitor begins to discharge through resistors R-224 and R-227; however, before the charging voltage on capacitor C-228B has dropped an appreciable amount, the next radar pulse arrives and charges capacitor C-228B up to its full value. The process continues as long as radar pulses are received. This results in a continuous automatic gain control voltage output.

(10) This voltage is used to control the grid of first IF stage V-201. Automatic gain control of input stage V-201 is necessary to prevent large changes in AFC signal input from affecting the error signal which controls the local oscillator.

(11) When no signals are present, controller V-209A conducts strongly because of low grid bias. The plate circuit of controller V-209A is tied to the grid of relay holder V-210A through resistor R-229. Relay holder V-210A performs TM 11-6625310-15-1 the function of keeping the sweep voltage for the local oscillator shut off as long as the range calibrator is locked on the radar signal. When there are no signals present, relay holder V-210A is cut off and thus does not affect the operation of the sweep generating circuit.

(12) When radar signals are received, the automatic gain control voltage appearing on the grid of controller V-209A drives the tube toward cutoff and produces a large positive voltage swing in the plate circuits. This positive signal is then applied to the grid of relay holder V-210A, causing the tube to conduct and energize relay K-201. With the relay energized, the sweep voltage is cut off and the error signal voltage is applied to cathode follower V-210B and from there to the local oscillator to keep the oscillator on frequency.

(13) Contacts 8 and 9 on relay K-201 short out the plates of detectors V-206A and V-206B until the radar signal energizes the relay. Thus, no error voltage is developed at the input to dc

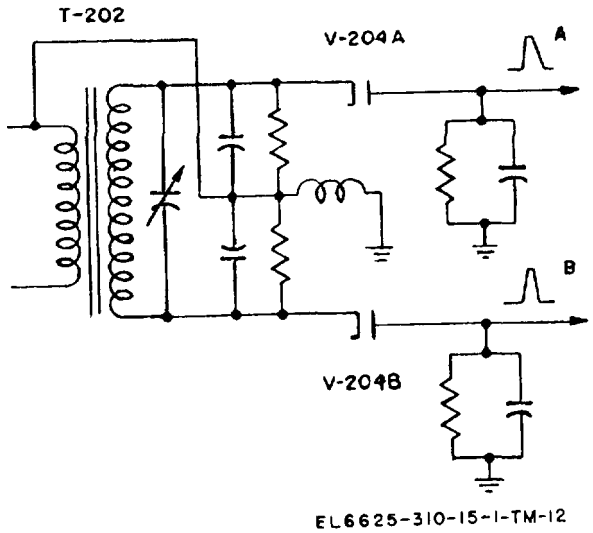


Figure 5-3. Discriminator circuits, simplified schematic diagram.

amplifier V-208B until the range calibrator locks on the radar signal.

c. Delay Line for TS-696A/UPM-11.

NOTE

The intermediate frequency is 30 mc for the TS-696/UPM-11.

(1) The delay line is used to produce a known delay in the transmission of the 40-mc signal. Physically, the line is in the form of a fused-quartz cylinder with a 40-mc crystal attached to each end. The amount of delay is a function of the physical length of fused-quartz line and is kept constant by a thermostatically controlled oven.

(2) The 40-me, IF signal is fed into the delay line through connector J-502 (fig. 5-4) and causes the input crystal to vibrate. This produces a wave of transverse supersonic vibrations which is transmitted through a bar of solid fused quartz. The wave strikes the 40-mc crystal at the input end of the line, whereupon the supersonic energy is converted back to a 40-mec signal. The transmission of the mechanical wave through the fused-quartz dielectric is at the rate of 0.492 inch per microsecond as compared to 946 feet per microsecond for the rate of travel of an electric impulse through copper wire. This causes a delay of the signal which appears on the radar scope.

(3) Some of the energy of the first mechanical wave is reflected at the output end to the input of the delay line where it is again reflected, appearing at the output end crystal as a second output signal. Part of the second signal is reflected toward the input side, re-reflected, and appears as a third output signal. This reflection and re-reflection occurs for each received radar signal. Consequently, there appears at the output of the delay line a series of signals for each received radar signal. The first signal makes one crossing of the delay line; the second, three crossings; the third, five crossings; etc.

(4) Each succeeding signal is of less amplitude than the proceding one. For most radar receivers, at least 10 useful signals are received before the amplitude approaches the receiver noise level. There are approximately 20 to 25 db of attenuation between the amplitude of the first signal and the tenth signal, and 30to 40-db attenuation between the incoming signal and the first delayed signal. The delayed signals appear at connector J-501 and from there are supplied to the input of the 40-mc amplifier.

(5) The delay line oven assembly is supplied with 115-volts ac when the "ON-OFF" power switch (12 fig. 3-1) is in the "ON" position. The voltage is applied across terminals E-501 and E-502 (fig. 53) from the power supply circuit. Thermostat S501 closes the circuit to heater element HR-01 whenever the temperature to the oven drops below 71° C. (160° F.).

d. 40-Mc Amplifier.

NOTE

The intermediate frequency is 30 mc for the TS-696/UPM-11.

(1) The 40-mc delayed signals from the delay line are applied to the amplifier at connector J-301 (fig. 9-2). The amplifier is of conventional design, c o n t a i n i n g four stagger tuned stages to provide the 12-mc bandwidth required. The first stage is a conventional class A amplifier operating with cathode bias obtained by the voltage drop across resistor R-302. The input circuit is tuned by inductor L-02, in the delay line oven assembly, and the capacitance of the connecting coaxial cable. The signal voltage developed across inductor L-303 is capacity-coupled through capacitor C-304 to the grid of first amplifier, V-302 and appears across r e s i s t o r R-303. Resistor R-304 and capacitor C-309 decouple the plate circuit from the power supply. The second and third amplifiers, V-302 and V-303, are identical to amplifier V-301, with the exception of the inductance frequencies and the values of load resistors. The fourth amplifier, V-304, differs from the others in that provisions have been made to introduce an audiofrequency modulation signal to the cathode. The "EXT. MODULATION" jack (4, fig. 1-2) on the front panel of the range calibrator connects to pin E on connector J-303 (fig. 9-2). From this point, the external modulating signal is applied through resistor R-303 to the cathode of amplifier V-304. The output of amplifier V-304 is capacity-coupled through capacitor C-318 to connector J-302, and through a coaxial cable to the signal crystal of the balanced mixer assembly. A four section filter composed of inductors L-309 and L-310 and reactors Z-301 and Z-302, together with capacitors C-319, C-320, and C-321, is also connected to connector J-302. This filter permits measurement of the crystal current in the output leg of the balanced mixer.

NOTE

There is no EXT. MODULATION jack on the TS-696/UPM-11.

(2) The "EXT. MODULATION" jack (4, fig. 1-2) is used to modulate the echo produced by

the calibrator so that it more closely resembles an echo from an actual target. By introducing a suitable noise voltage, the target will appear noisy or, with the proper modulation, it will appear to fade at a predetermined rate. If the proper reference voltage produced by the radar is applied, a will cause an apparent change in the physical location of the horn of the calibrator. The ability of the angle servos of a fire control radar to follow these changes will provide evaluation data for the particular radar being tested.

(3) The +150 volts for the 40-mc amplifier is obtained through a series resistor from the +300 volts in the power supply. This method of obtaining the required B + voltage tends to keep the gain of the amplifier constant, since any aging of the tubes, which may cause them to draw less current, will result in a rise in B + voltage. The tube filaments are wired in a series-parallel arrangement and the filament voltage is controlled by amperite voltage regulator V-108 (fig. 9-3) in the power supply.

e. Power Supply System.

(1) The power supply (fig. 9-3) furnishes all voltages necessary to operate the range calibrator and distributes these voltages as required. The range calibrator can be connected to any 115-volt, a-c, single-phase, 50to 1,000-cps power source.

(2) The power connection is made by means of Power Cable CX-1490/U to connector J-101, the "115 VAC" receptacle. Each side of the line is fused with a 5-ampere fuse, F-101 and F-102. Ac power is applied directly to standby heater HR-601 (fig. 5-5) when power switch S-101 (fig. 9-3) is in the "OFF" position. When switch S-101 is in the "ON" position, power is disconnected from the standby heater and applied directly to power transformer T-101. The output of transformer T-101 is connected to rectifiers V-101 and V-102 and selenium rectifier CR-101.

(3) Rectifier V-101 and its associated filter is a conventional full-wave rectifier power supply. The output from the filter is applied to voltage regulator circuit that regulates the +300-volt dc output. The voltage regulator uses tube V-103, with both halves in parallel, as a series resistance tube. Voltage changes which occur across the regulated output are amplified by amplifier V-104. A reference voltage for the amplifier tube is furnished by the voltage regulator V-105. The +300 volts is adjusted to the proper level by potentiometer R-109.

(4) The +150-volt supply, necessary for the operation of the AFC circuits and the 40-mc amplifier, is developed from the regulated +300 volts dc. The nominal voltage drop across resistor R-129 from the +300-volt supply to terminal P-102 is approximately 150 volts, the required voltage. The same method is used to develop + 150 volts across resistor R-112. This voltage is required by the AFC circuits.

(5) Half-wave rectifier V-102 is conventional and serves a dual function. First, it supplies a -300-volt supply. Second, in conjunction with a selenium rectifier located in a voltage doubling circuit, the rectifier furnishes a -800-volt supply for the keep-alive circuit required to ionize the TR tube. Two VR tubes, V-106 and V-107, regulate the -300-volt supply. Current regulator V-108 is in series with the filament winding of transformer T-101 which supplies a constant voltage to the filaments of the 40-mc amplifier.

f. Fan and Motor Assembly. When the "ONOFF" power switch (12, fig. 3-1) is in the "OFF" position and with the power cable connected, power is applied to standby heater HR-601 (fig. 5-5) through plug P-601 from connector J-103 in the power supply circuit. The purpose of the heater is to keep the unit dry while the calibrator is in a standby status. With the "ON-OFF" switch in the "ON" position, whenever the cabinet temperature reaches 27° C. (80° F.), thermostat S-601 is actuated to operate blower B-601. This reduces the cabinet temperature.

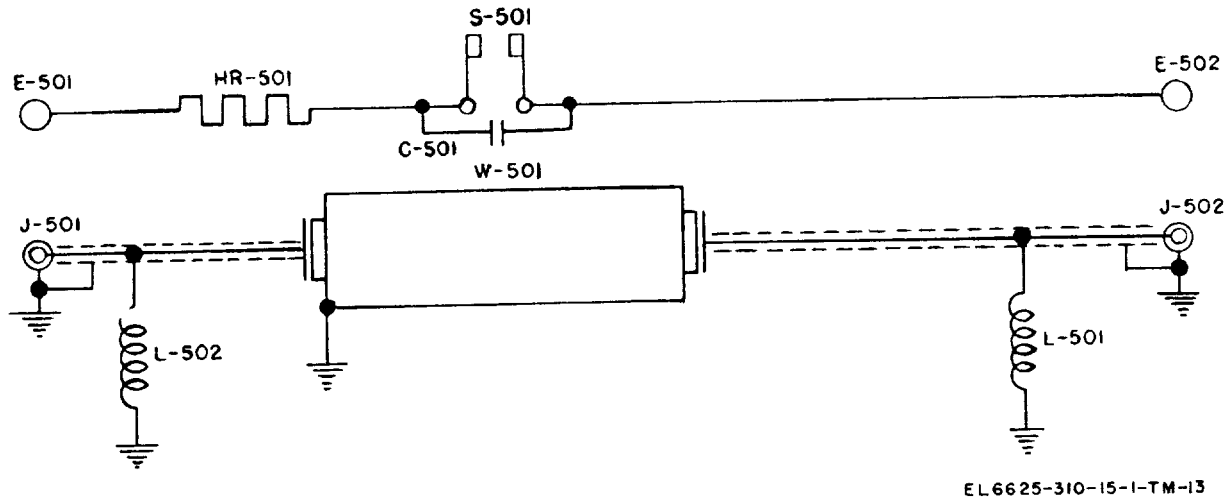


Figure 5-4. Delay line oven assembly, schematic diagram.

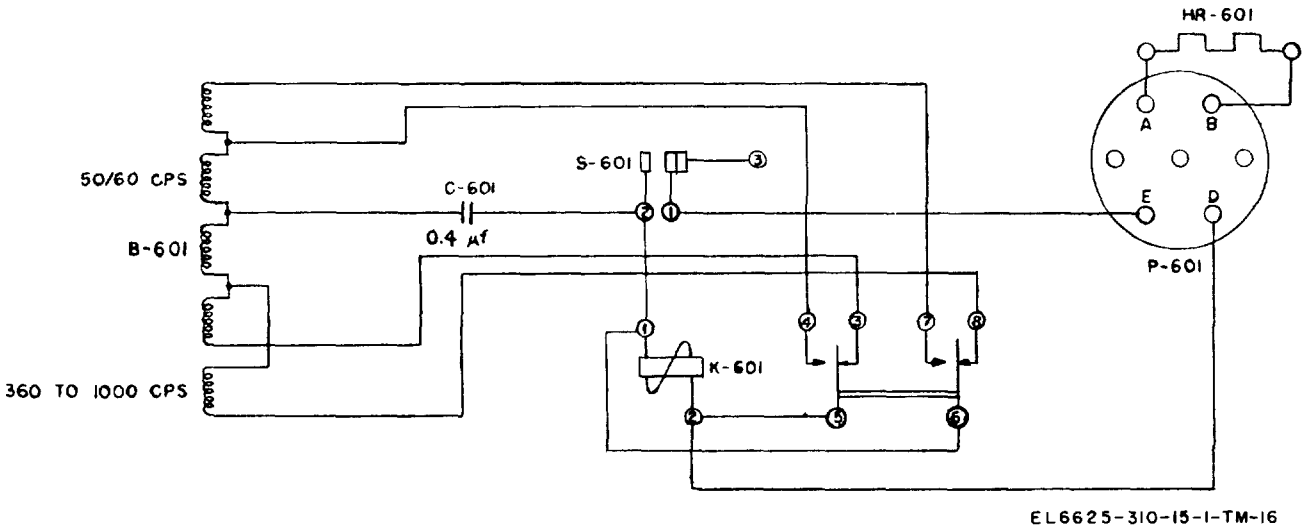


Figure 5-5. Fan and motor assembly, schematic diagram.

CHAPTER 6

TROUBLESHOOTING

6-1. General Troubleshooting Data

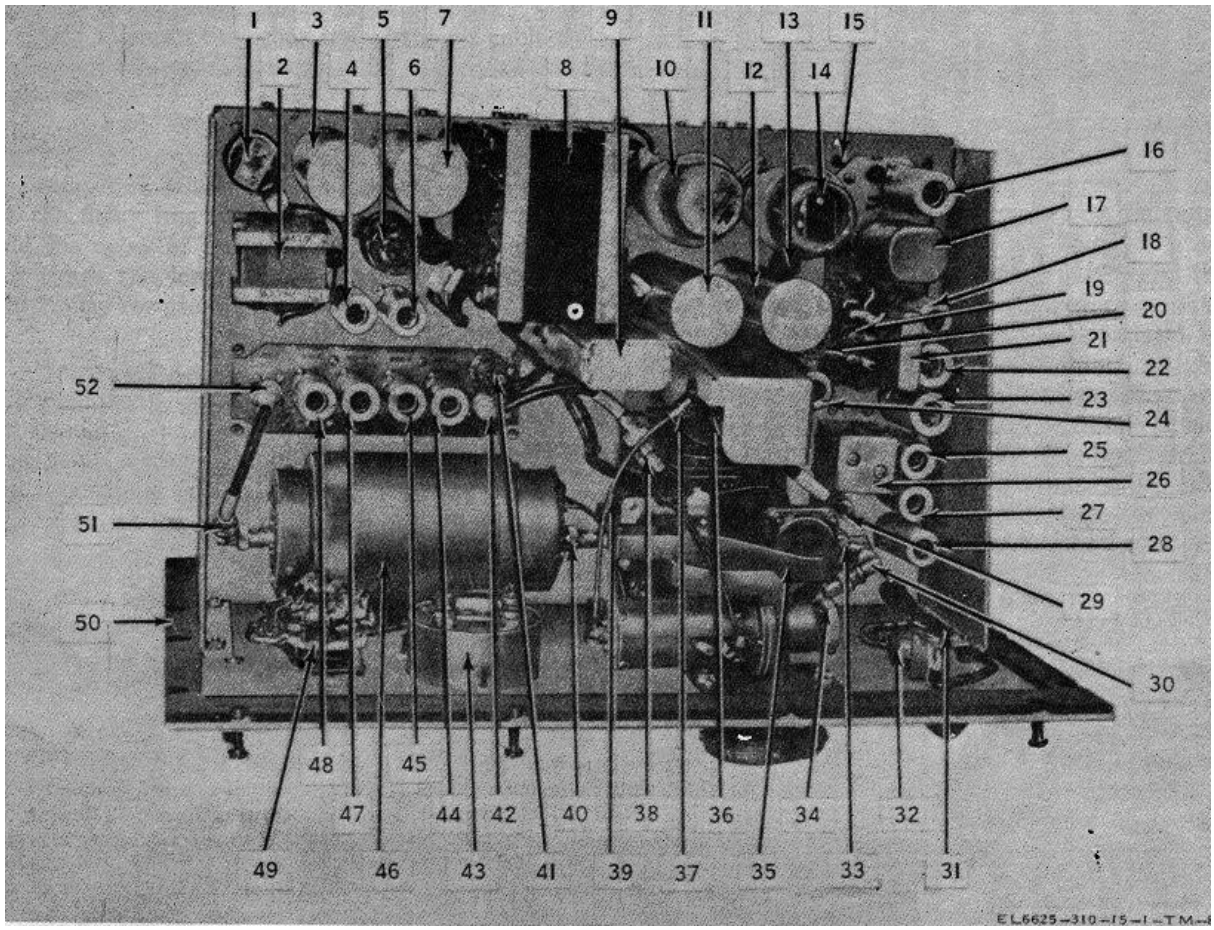
Failures and malfunctions may often be traced to relatively simple causes. Before troubleshooting a malfunctioning unit, check for blown fuses; defective tubes; loose, broken, or frayed wires; poor solder joints; crystal conversion loss; and continuity. Make all checks systematically, since haphazard checking wastes time and may cause further damage. Perform all continuity checks by referring to the electrical schematic diagrams. Parts are located in figures 6-1, 6-2, and 6-3.

6-2. Troubleshooting Chart

Table 6-1 lists the most common troubles which will be encountered. This table also indicates the probable causes of trouble, together with suggested remedies to correct the malfunctioning component.

Table 6-1. Troubleshooting Chart

Trouble Symptom	*Probable cause*	*Checks and corrective measures*
Pilot lamp (11) (fig. 3-1) does not light "ON-OFF" power switch (12) in "ON" position.	No power input	Check power source and receptacle J-101 (fig. 9-3).
	Defective fuses	Replace fuses F-101 and F-102 (fig. 9-3.
	Burned out pilot lamp	Replace lamp L101 (fig. 9-3).
	Defective power switch	Replace switch S-101 (fig. 9-3).
	Transformer filament winding burned out.	Check voltage between terminals 8 and 9 of transformer T-101 (fig. 9-3). Replace transformer if necessary.
	Transformer Primary winding open	Check for continuity between terminals 1 and 3 of transformer T-101 (fig. 9-3). Replace transformer if necessary.
Volt-milliammeter (2, fig. 3-1) does not register with "ON-OFF" power switch (12) in "ON" position, pilot lamp (11) lit, and "METER SELECTOR" switch (1) in any position.	Improperly connected meter	Check connections from volt-milliammeter M-101 to selector switch S-103 (fig. 9-3).
	Defective "METER SELECTOR" switch.	Check selector switch S-103 (fig. 9-3) for continuity at all positions. Replace if necessary.
	Defective vacuum tubes	Check all power supply vacuum tubes. Replace tubes as required.
Calibration rangemarkers on radar scope are weak or missing with range calibrator operative.	Radar antenna not facing calibrator	Align position of calibrator relative to radar antenna if pickup horn is used.
		Check that calibrator and radar are connected if r-f cable is used.
	Defective tubes	Check all 40-mc amplifier tubes. Replace tubes as required.
	Defective crystals	Replace crystals CR-401, CR-403, and CR-404 (fig. 5-2) as required.
	Defective klystron	Replace vacuum tube V-401 (fig. 5-2).
	Trouble in mixer circuit	Check voltages at plus P-401 (fig. 5-2).
	Defective radar indicator or radar set.	Check radar indicator and radar set.
	Defective delay line	Replace delay line (fig. 6-3).

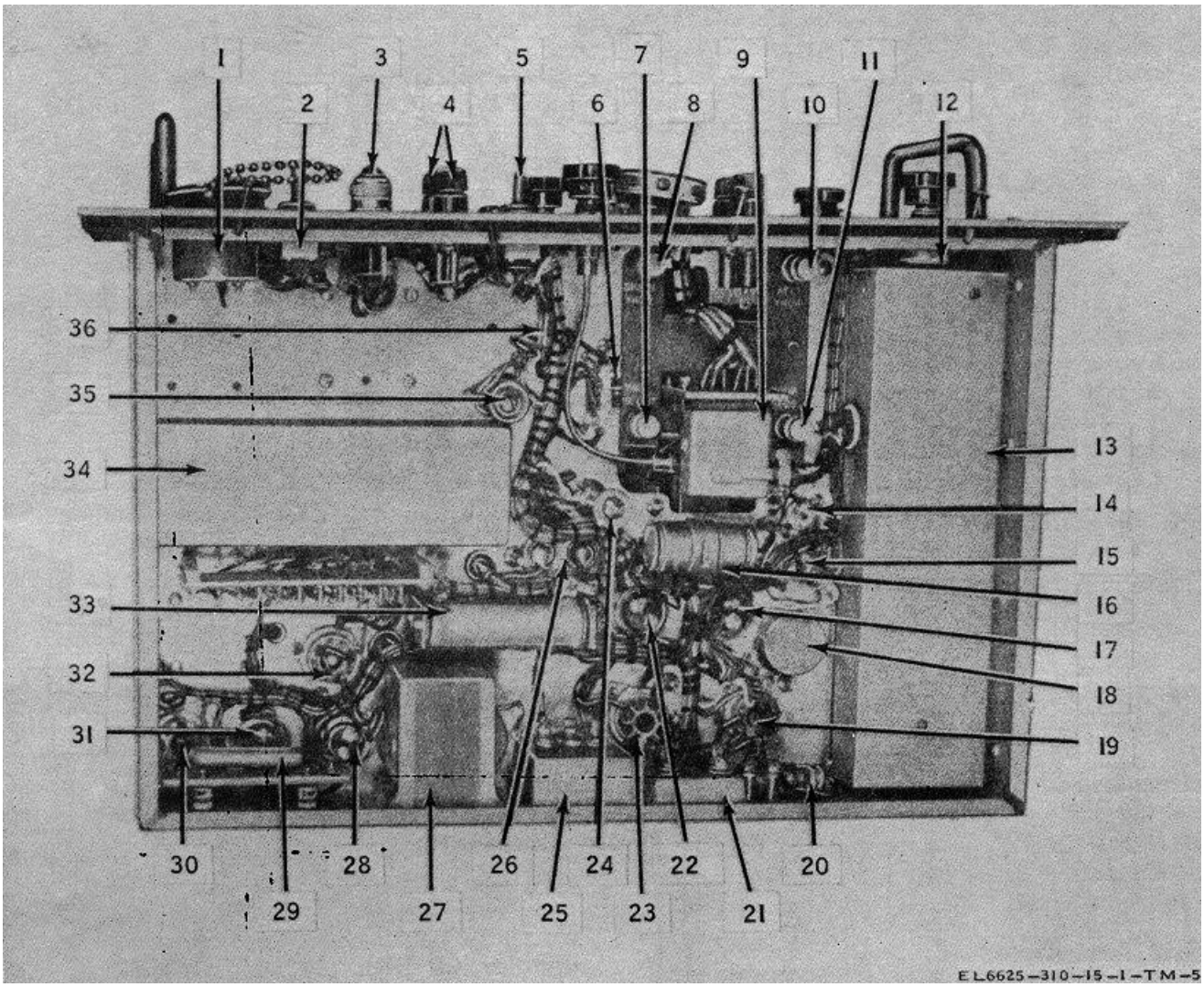


1 Tube V-102
2 Choke L-102
3 Capacitor C-104
4 Tube V-106
5 Tube V-108
6 Tube V-107
7 Capacitor C-103
8 Transformer T-101
9 Capacitor C-103
10 Tube V-101
11 Capacitor C-101
12 Capacitor C-102
13 Resistor R-109
14 Tube V-103
15 Connector J-205
16 Tube V210
17 Relay K-201
18 Tube V-209
19 Capacitor C-228
20 Tube V-104
21 Capacitor C-226
22 Tube V-208
23 Tube V-205
24 Tube V-105
25 Tube V-203
26 Transformer T-202
27 Tube V-202
28 Tube V-201
29 Connector J-201
30 Connector J-203
31 Connector J-103
32 Resistor R-118
33 Connector J-202
34 Spare crystals (4)
35 Mixer assembly
36 Tube V-401
37 Manual tuning strut
38 Connector J-502
39 Connector J-303
40 Connector J-302
41 Connector J-303
42 Connector J-302
43 Meter M-101
44 Tube V-304
45 Tube V-303
46 Delay line oven assembly
47 Tube V-302
48 Tube V-301
49 switch S-103
50 Rubber gasket
51 Connector J-501
52 Connector J-301

Figure 6-1. Range Calibrator TS-696A/UPM-11, top view.

6-3. Voltage Measurements

If the malfunctioning component cannot be isolated by the general checks prescribed in 6-2, or if the necessary information is not included in the Troubleshooting Chart (table 6-1), it will be necessary to perform a point-to-point check of voltages. Table 6-2 lists these voltages for the components of the power supply section, IF amplifier, and AFC chassis. It should be noted that voltages are not included for tubes V-204, V-205, and V-206 in the AFC chassis because of the inaccessibility of these components.



1 Connector J-101
2 Switch S-101
3 Lamp I-101
4 Fuse F-101, F-102
5 Switch S-102
6 Resistor R-103
7 Crystal Y-401
8 Crystal Y-402
9 Connector J-204
10 Crystal Y-404
11 Crystal Y-403
12 Resistor R-118
13 AFC assembly
14 Tube socket X-105
15 Tube socket X-104
16 Capacitor C-110
17 Capacitor C-102
18 Resistor R-109
19 Tube socket X-103
20 Capacitor C-108
21 Capacitor C-107
22 Capacitor C-101
23 Tube socket X-103
24 Resistor R-117
25 Capacitor C-109
26 Capacitor C-103
27 Choke L-101
28 Capacitor C-105
29 Selenium rectifier CR-101
30 Tube socket X-102
31 Capacitor C-104
32 Tube socket X-108
33 Resistor R-203
34 40-mc amplifier assembly
35 Resistor R-129
36 Resistor R-111

Figure 6-2. Range Calibrator TS-696A/UPM-11, bottom view.

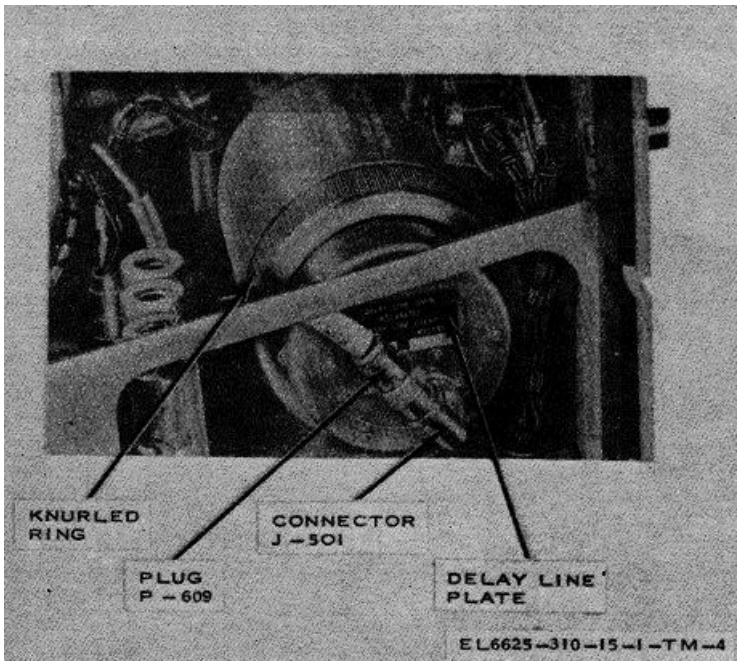


Figure 6-3. Delay line oven assembly.

Table 6-2. Voltage Measurements

NOTE

Before making measurements, check that the line voltage is 115 volts, 60 cps. Place the "A.F.C.-MANUAL" switch in the "MANUAL" position. Place all potentiometer controls in a counter clockwise position. Do not set R-109 (13, fig. 6-1). Use tube adapter when making measurements to avoid disturbing circuits.

POWER SUPPLY SECTION

Meter scale	Location	Between pin(s)	Voltage	Remarks
--	X-103	1 and gnd	0	
1000 volts dc	(23, fig. 6-2)	2 and gnd	430	
--		3 and gnd	0	
1000 volts ac		4 and gnd	400 ac	
--		5 and gnd	0	
1000 volts ac		6 and gnd	400 ac	
--		7 and gnd	0	
1000 volts dc		8 and gnd	430	
10 volts ac		2 and 8	5.1 ac	
--	X-102	1 and gnd	0	
1000 volts ac	(30, fig. 6-2)	2 and gnd	400 ac	
--		3 and gnd	0	
1000 volts dc		4 and gnd	-490	
--		5 and gnd	0	
1000 volts dc		6 and gnd	-490	
--		7 and gnd	0	
1000 volts ac		8 and gnd	400 ac	
10 volts ac		2 and 8	5 ac	
1000 volts dc	X-103	1 and gnd	240	
1000 volts dc	(19, fig. 6-2)	2 and gnd	400	
1000 volts dc		3 and gnd	287	
1000 volts dc		4 and gnd	240	
1000 volts dc		5 and gnd	400	
1000 volts dc		6 and gnd	287	
250 volts dc		7 and gnd	140	
250 volts dc		8 and gnd	140	
10 volts ac		7 and 8	6.25 ac	
250 volts dc	X-104	1 and gnd	140	
250 volts dc	(15, fig. 6-2)	2 and gnd	143	
250 volts dc		3 and gnd	143	
250 volts dc		4 and gnd	143	
1000 volts dc		5 and gnd	245	
1000 volts dc		6 and gnd	300	
250 volts dc		7 and gnd	143	
10 volts ac		3 and 4	6.25 ac	

Meter scale	Location	Between pin(s)	Voltage	Remarks
250 volts dc 250 volts dc	X-105 (14, fig. 6-2)	1 and gnd 5 and gnd 2, 3, 4, 6, 7 each to gnd	140 140 0	
250 volts dc 250 volts dc 250 volts dc --	V-106 (4, fig. 6-1)	2 and gnd 4 and gnd 7 and gnd 1, 3, 5, 6 each to gnd	-145 -145 -145 0	
250 volts dc 1000 volts dc 250 volts dc 1000 volts dc 250 volts dc 250 volts dc 1000 volts dc	V-107 (6, fig. 6-1)	1 and gnd 2 and gnd 3 and gnd 4 and gnd 5 and gnd 6 and gnd 7 and gnd	-145 -300 -105 -300 -145 -105 -300	
-- 50 volts ac -- -- 50 volts ac -- 50 volts ac 50 volts ac 10 volts ac	X-108 (32, fig. 6-2)	1 and gnd 2 and gnd 3 and gnd 4 and gnd 5 and gnd 6 and gnd 7 and gnd 8 and gnd 7 and 8	0 12.7 ac 0 0 12.7 ac 0 17.8 ac 12.7 ac 4.8 ac	 Drop across ballast.

IF AMPLIFIER

NOTE

NO signal input to IF amplifier.

Meter scale	Location	Between pin(s)	Voltage	Remarks
-- 5 volts dc 15 volts ac -- 500 volts dc 500 volts dc --	-V-301 (48, fig. 6-1)	1 and gnd 2 and gnd 3 and gnd 4 and gnd 5 and gnd 6 and gnd 7 and gnd	0 2.6 6.2 ac 0 160 160 No connection	
-- 5 volts dc 15 volts ac 15 volts ac	V-302 (47, fig. 6-1)	1 and gnd 2 and gnd 3 and gnd 4 and gnd	0 2.4 6.2 ac 12.4 ac	

500 volts dc		5 and gnd	160	
500 volts dc		6 and gnd	160	
--		7 and gnd	No connection	
--	V-303	1 and gnd	0	
5 volts dc(45, fig. 6-1)		2 and gnd	2.6	
15 volts ac		3 and gnd	12.4 ac	
15 volts ac		4 and gnd	6.2 ac	
500 volts dc		5 and gnd	160	
500 volts dc		6 and gnd	160	
--		7 and gnd	No connection	
--	V-304	1 and gnd	0	
5 volts dc	(44, fig. 6-1)	2 and gnd	2.5	
15 volts ac		3 and gnd	6.2 ac	
--		4 and gnd	0	
500 volts dc		5 and gnd	160	
500 volts dc		6 and gnd	160	
5 volts dc		7 and gnd	2.5	

AFC CHASSIS

NOTE

No signal input to AFC chassis. Range potentiometer set for -150 volt de at T-205.

Meter scale	Location	Between pin(s)	Voltage	Remarks
150 volts dc	V-201	1 and gnd	140	
1.5 volts dc	(28, fig. 6-1)	2 and gnd	0.5	
15 volts ac		3 and gnd	5.5 ac	
1.5 volts ac		4 and gnd	0.3 ac	
1.5 volts dc		5 and gnd	0.52	
--		6 and gnd	0	
1.5 volts dc		7 and gnd	0.5	
1.5 volts dc	V-202	1 and gnd	-0.31	
5 volts dc	(27, fig. 6-1)	2 and gnd	2	
--		3 and gnd	0	
15 volts ac		4 and gnd	6.1 ac	
150 volts dc		5 and gnd	137	
150 volts dc		6 and gnd	137	
5 volts de		7 and gnd	2	
--	V-203	1 and gnd	0	
5 volts de	(25, fig. 6-1)	2 and gnd	2	
--		3 and gnd	0	
15 volts ac		4 and gnd	6.3 ac	
150 volts dc		5 and gnd	145	
150 volts dc		6 and gnd	145	
5 volts dc		7 and gnd	2	

Meter scale	Location	Between pin(s)	Voltage	Remarks
150 volts dc	V-205	1 and gnd	97	
01.5 volts dc	(23, fig. 6-1)	2 and gnd	-0.6	
--		3 and gnd	0	
500 volts dc		4 and gnd	-300	
500 volts dc		5 and gnd	-300	
150 volts dc		6 and gnd	97	
--		7 and gnd	-0.66	
1.5 volts dc		8 and gnd	0	
500 volts dc		9 and gnd	-300	
15 volts ac		4 and 9	6.3 ac	
15 volts ac		5 and 9	6.3 ac	
1.5 volts dc	V-208	1 and gnd	-.33	
500 volts dc	(22, fig. 6-1)	2 and gnd	-155	
150 volts dc		3 and gnd	-145	
500 volts dc		4 and gnd	-300	
500 volts dc		5 and gnd	-300	
500 volts dc		6 and gnd	-170	
500 volts dc		7 and gnd	-300	
500 volts dc		8 and gnd	-300	
500 volts dc		9 and gnd	-300	
15 volts ac		4 and 9	6.3 ac	
15 volts ac		5 and 9	6.3 ac	
50 volts dc	V-209	1 and gnd	27	
500 volts de	(18, fig. 6-1)	2 and gnd	290 to 300	AFC sweeping.
15 volts ac		3 and gnd	6.3 ac	
--		4 and gnd	0	
150 volts dc		5 and gnd	-20 to -100	AFC sweeping.
1.5 volts dc		6 and gnd	-0.33	
--		7 and gnd	0	
500 volts dc	V-210	1 and gnd	290 to 300	AFC sweeping.
50 volts dc	(16, fig. 6-1)		2 and gnd	-37
		3 and gnd	0	
500 volts dc		4 and gnd	-300	
500 volts dc		5 and gnd	-300	
		6 and gnd	0	
150 volts dc		7 and gnd	-138 to -150	AFC sweeping.
500 volts dc		8 and gnd	-150 to -170	AFC sweeping.
500 volts dc		9 and gnd	-300	
15 volts ac		4 and 9	6.3 ac	
15 volts ac		5 and 9	6.3 ac	
	V-204 V-206 V-207			Measurements cannot be taken on these tubes without disturbing circuit.

CHAPTER 7
GENERAL SUPPORT AND DEPOT MAINTENANCE INSTRUCTIONS

Section I. REPAIRS

7-1. General Repair Instructions

The following procedures are given to facilitate the removal and replacement of faulty components.

7-2. Removal and Replacement of Toggle Switches

Remove and replace the "ON-OFF" power toggle switch (37, fig. 7-7) and the "AF.C.-MANUAL" toggle switch as follows:

a. Remove seal nut (38) from the front panel (40).

b. Tag and unsolder all leads.

c. Replace defective switch with new switch and resolder all leads.

d. Install seal nut (38) to secure switch in position.

7-3. Removal and Replacement of Variable Resistors

Remove and replace the "REFLECTOR" variable resistor (33, fig. 7-1) and the "SWEEP LEVEL" variable resistor as follows:

a. Remove knurled knob (6) and seal nut from variable resistor shaft.

b. Tag and unsolder all leads.

c. Replace defective variable resistors with new variable resistor and resolder all leads.

d. Install seal nut (34), and knob (6) to secure variable resistor in position.

7-4. Removal and Replacement of Fuse Holders

Remove and replace fuseholders (27, fig. 7-1) as follows:

a. Remove cap from fuseholder.

b. Remove fuse (26) from fuseholder.

c. Remove locknut and washer at rear of panel.

d. Tag and unsolder all leads.

e. Replace defective fuseholder with new fuseholder and resolder all leads.

f. Install locknut and washer at rear of panel.

g. Install fuse (26) and fuseholder cap.

7-5. Removal and Replacement of Pilot Lamp

To remove and replace the pilot lamp (24, fig. 7-1) unscrew the lamp jewel and remove defective lamp. Replace with a new lamp and install lamp jewel.

7-6. Removal and Replacement of Light Indicator

Remove and replace the light indicator (25, fig. 7-1) as follows:

a. Remove the locknut and fiber washer at rear of panel.

b. Tag and unsolder all leads.

c. Replace defective light indicator with new light indicator and resolder all leads.

d. Install locknut and fiber washer at rear of panel.

7-7. Removal and Replacement of "115 VAC" Receptacle

Remove and replace the "115 VAC" receptacle (19, fig. 7-1) as follows:

a. Unscrew cover and chain assembly (17) from receptacle (19).

b. Remove two screws (20 and 21) and lockwashers (22) which attach receptacle to panel.

c. Tag and disconnect two leads from the receptacle.

d. Replace defective receptacle with a new receptacle and reconnect leads

e. Attach receptacle (19) and cover chain assembly (17) to front panel using two screws (20 and 21) and two lockwashers (22).

f. Screw cover and chain assembly onto receptacle.

7-8. Removal and Replacement of Volt-Milliammeter

Remove and replace the volt-milliammeter (2, fig. 1-7) as follows:

a. Remove three screws and nuts.

b. Tag and disconnect leads.

c. Replace defective meter with new meter and reconnect leads.

d. Install three retaining screws and nuts.

7-9. Removal and Replacement of Rotary Switch

Remove and replace the "METER SELECTOR" rotary switch (31, fig. 7'-1) as follows:

a. Remove knurled knob (1) from switch shaft.

b. Remove seal nut (32) from shaft.

c. Tag and unsolder all leads.

d. Replace defective switch with new switch and resolder leads.

e. Install seal nut (32) and knurled knob (1) on switch shaft.

7-10. Removal and Replacement of Delay Line

Remove and replace the delay line as follows:

a. Remove the knurled ring (fig. 6-3) which secures the delay line to the oven and remove the delay line.

b. Insert the new delay line and align it by inserting the pin on the delay line into the pin recess on the oven housing.

c. Remove the delay line plate from the oven and place it with the delay line that was re- moved. Install the new plate on the oven housing and install knurled ring.

7-11. Removal and Replacement of Fixed Resistors

Remove and replace fixed resistors as follows:

a. Tag and unsolder leads.

b. Replace defective resistor with new resistor.

c. Resolder leads.

7-12. Removal and Replacement of Capacitors

a. Remove and replace mica capacitor as follows:

(1) Tag and unsolder leads.

(2) Replace defective capacitor with new capacitor.

(3) Resolder leads.

b. Remove and replace paper capacitor as follows:

(1) Remove nuts and clamp.

(2) Tag and unsolder leads.

(3) Replace defective capacitor with new capacitor.

(4) Install clamp nuts and resolder leads.

c. Remove and replace electrolytic capacitors as follows:

(1) Tag and unsolder leads.

(2) Remove hexagonal nut and lockwasher from bottom of chassis.

(3) Replace defective capacitor with new capacitor.

(4) Install hexagonal nut and lockwasher and resolder leads.

7-13. Removal and Replacement of Tube Sockets

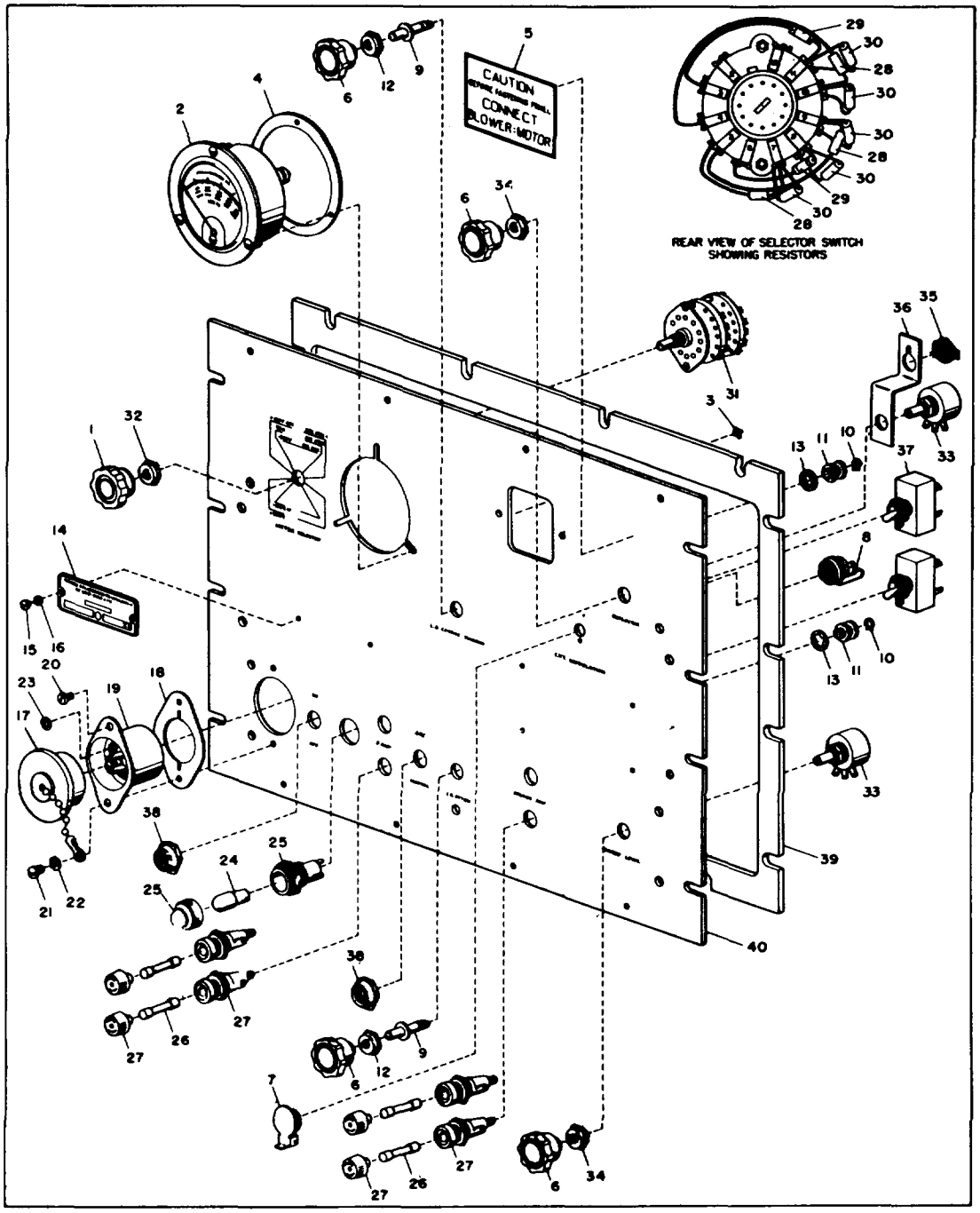
Remove and replace tube sockets as follows:

a. Remove tube shield, vacuum tube, and chassis shield as required.

b. Tag and unsolder all leads.

c. Remove two retaining screws.

d. Unsolder (if necessary) and remove mounting strap.



1	Knurled knob	14	Name plate	28	Fixer resistor
2	Volt-milliammeter	15	Binding-head screw	29	Fixed resistor
3	External-tooth lock washer	16	Internal-tooth lockwasher	30	Fixed resistor
4	Gasket	17	Cover and chain	31	Rotary switch
5	Decalcomania	18	Gasket	32	Seal nut
6	Knurled knob	19	Male contact receptacle	33	Variable resistor
7	Jack cover	20	Binding-head screw	34	Seal nut
8	*Telephone jack*	21	*Binding-head screw*	35	Female contact connector
9	Shaft	22	External-tooth lockwasher	36	Connector bracket
10	Retaining ring	23	Internal-tooth lockwasher	37	Toggle switch
11	Shaft bushing	24	Incandescent lamp	38	Seal nut
12	Seal nut	25	Light indicator	39	Gasket
13	Internal-tooth lock washer	26	5-Ampere fuse	40	Front panel
		27	Fuse holder		

Figure 7-1. Front panel, exploded drawing.

e. Replace defective socket with new socket and resolder leads.

f. Install mounting strap and retaining screws.

g. Install chassis shield, vacuum tube, and tube shield as required.

7-14. Removal and Replacement of Transformer

Remove and replace transformer T-101 (8, fig. 6-1) as follows:

a. Remove four retaining screws through bottom of chassis.

b. Tag and unsolder all leads.

c. Replace defective transformer with new transformer. Resolder leads and install retaining screws.

7-15. Removal and Replacement of Choke

Remove and replace choke L101 (27, fig. 6-2) and L-102 (2, fig. 6-1) as follows:

a. Remove four retaining screws through bottom of chassis for L-101, and from back of chassis for I102.

b. Tag and unsolder two leads.

c. Replace defective choke with new choke, resolder leads, and install retaining screws.

7-16. Removal and Replacement of Klystron Tube

Remove and replace klystron local oscillator V-401 (36, fig. 6-1) as follows:

a. Remove two nuts from under side of the chassis and remove tube shield.

b. Remove screw from coupling in tuning cable.

c. Unscrew knurled ring.

d. Remove cap and pull tube out.

e. Replace defective tube with new tube and install tuner coupling, cap, tube shield, and nuts.

7-17. Removal of AFC Assembly or 40-Mc Amplifier Assembly (30 Mc for TS-96/UPM-1 1)

Remove the AFC assembly (13, fig. 62) or the 40-mc amplifier assembly (34) as follows:

a. Remove cable connections from top of assembly.

b. Remove four nuts from bottom of assembly.

c. Remove assembly.

Section II. CALIBRATION

7-18. General Calibration Information

Refer to TB 11-6625310-35/1 for calibration procedures. Range Calibrator Set AN/UPM-11 is similar to a primary standard. The extreme accuracy of the instrument precludes its calibration in the field or repair shop. When the accuracy of the instrument is in doubt, change the delay line and check the calibrator against one that is known to be accurate. Proceed as follows:

a. Set up a AN/UPM-11 known to be accurate and calibrate a radar scope or, if available, the range servo dial.

b. Place the doubtful AN/UPM-11 adjacent to the AN/UPM-11 of known accuracy and check the calibration of the radar scope or range servo dial.

c. The second calibration should check with the first calibration: however, it should be noted that the markers will not coincide unless the amplifier delay and the delay line delay of both range calibrators are exactly equal.

7-19. Special Tools Required

There are no special tools required to operate or service Range Calibrator Set AN/UPM-11. Standard test equipment is used for checks and measurements made during checking and maintenance procedures.

CHAPTER 8
DEPOT OVERHAUL STANDARDS

8-1. Applicability of Depot Overhaul Standards

The tests outlined in this section are designed to measure the performance capability of repaired equipment. Equipment that is to be returned to stock should meet the standards given in these tests.

8-2. Applicable References

a. Repair Standards. Applicable procedures of the depots performing these tests and the general standards for repaired electronic equipment given in TB SIG 355-1, TB SIG 355-2, and TB SIG 3 form a part of the requirements for testing this equipment.

b. Technical Publications. The technical publications listed below are needed to meet the requirements of this overhaul standard. In cases where commercial test equipment is required, and where authenticated commercial publications are not available, use the manufacturer's maintenance publication.

Title	*Number*
Operator's Manual: Signal Generators AN/USM-44 and AN/USM-44A.	TM 11-6625-508-10
Operator, Organizational, DS, GS, and Depot Maintenance Manual: Frequency Comparator CM-77A/USM.	TM 11-6625-493-15
Operator and Organizational Maintenance Manual: Voltmeter, Meter ME-30A/U and Voltmeters, Electronic ME-30B/U, ME-30C/U, and ME-30E/U.	TM 11-6625-320-12
Operator, Organizational, DS, GS, and Depot Maintenance Manual: Multimeters ME-26B/U, ME-26C/U, and ME-26D/U.	TM 11-6625-200-15

8-3. Test Facilities Required

The following equipment, or suitable equivalents, will be used in determining compliance with this specific standard.

a. Test Equipment.

Equipment	*Federal stock number*	*Quantity required*	*References*
Oscilloscope, Tektronix 545A	.....	1 ea	Commercial
Signal Generator AN/USM-44	6625-669-4031	1 ea	TM 11-6625-508-10
Signal Generator HP-6201 ea	.....		Commercial
X-Band Amplifier HP-495A	.....	1 ea	Commercial
Frequency Comparator CM-774/USM	6625-080-7204	1 ea	TM-11-6625-493-15
Voltmeter, Electronic ME-30B/U	6625-643-1670	1 ea	TM 11-6625-320-12
Variable Attenuator HP-X382A	.....	1 ea	Commercial
Crystal Detector HP-420A ,	.....	2 ea	Commercial
Multimeter ME-26D/U6625-542-6407	.....	1 ea	TM 11-6625-200-15
Frequency Meter HP-X530A	.....	1 ea	Commercial
Attenuator, Fixed CN-797/U	5985-644-7996	1 ea	

Equipment	*Quantity required*
BNC coaxial jacks UG-290A/U	3 ea
N type coaxial "T" UG-274B/U.....	1 ea
Impedance Network DA-121/U	1 ea
N-type adapter UG-349B/U	1 ea
Cable Assembly CG-92G/U (8' 4" RG-6/U)	2 ea

NOTE

Equivalent substitutes for the above equipments may be used provided the equipment under test is not subject to excessive crystal currents during tests.

8-4. General Test Requirements

a. Input power to the equipment shall be 115 volts ac ±10 %o, 60 cycles, unless otherwise stated.

b. Allow a 30-minute warmup period for all test equipments before proceeding with the procedures.

c. Refer to applicable publications on test

equipments prior to their use for necessary operating instructions and precautions.

d. Use absorption-type F r e q u e n c y Meter HP-X530A, or equivalent, to check frequency setting of Signal Generator HP-620 prior to making the tests.

e. The use of Impedance Network DA-121/U prevents excessive signal crystal currents in the AN/UPM-11 when the AN/USM-44 is used to develop the video s i g n a l for the tests. The CN-797/U is used as an isolator between the HP-495A X-band RF amplifier and the input to the AN/UPM-11. The rated attenuation is 9 db. Suitable substitutes may be used down to a 6-db level provided the proper impedance match is maintained. Corrections to the HP-620 attenuator may have to be made if this attenuator is changed.

f. The lengths of the interconnection cables are specified in the interconnection diagram (fig. 8-2). These cable lengths are important if the waveform will be as illustrated in figure 8-4. Changing the cable lengths may alter the waveform display, but this may still be useful for the tests.

g. Before proceeding with the tests, determine whether the AN/UPM-11 uses the TS-696/UPM-11 (30 mc IF) or the TS-696A/ UPM-11 (40 mc IF).

8-5. Crystal Sensitivity Test

The following test checks conversion loss in the crystals of the balanced mixer to the requirements specified in preceding paragraphs of this ,manual. The loss is specified at -6 db and should be checked in circuit. The crystals in the balanced mixer should be in matched pairs; thus, the results of these tests should be similar for both crystals of the balanced mixer.

a. Preliminary Adjustments and Tests.

(1) Connect the test equipment as indicated in figure 8-3.

(2) Adjust the test equipment as follows:

(a) Signal Generator HP-620.

1.	FREQUENCY:	9,310 mc (check with HP-X530A).
2.	MOD SELECTOR:	CW.
3.	OUTPUT ATTENUATOR:	0 dbm.
4.	POWER SET:	0 dbm.

(b) Variable Attenuator HP-X382A. Set the attenuation control to MAX (on dial).

(c) Frequency Comparator CM-77A/USM.

1.	LO Freq control:	Maximum clockwise (do not actuate control switch at max position).
2.	HI Freq control:	Maximum clockwise.
3.	Gain control:	Maximum clockwise.

(d) Range Calibrator AN/UPM-11.

1.	AFC-MANUAL switch:	MANUAL.
2.	L. O. COURSE tuning:	As required.
3.	REFLECTOR control:	As required.
4.	ATTENUATOR control:	6 on panel meter for SIG XTAL position.

(e) Voltmeter, Electronic ME-30B/U. Set the RANGE SELECTOR switch to .01 -40 db.

b. Sensitivity Check of CR404 and CR403.

(1) With test equipment interconnected as - shown in figure 8-3, remove P404 from J404 and connect MIXER OUT lead on signal comparator to J404. Remove P403 from J403 and terminate with 50-ohm coaxial resistor.

(2) Adjust L.O. COURSE TUNING control on AN/UPM-11 for peak indication on Voltmeter, Electronic ME-30B/U.

(3) Adjust REFLECTOR control on AN/UPM-11 for peak indication on Voltmeter, Electronic ME-30B/U.

(4) Note and record noise level reading on scale of the ME-30B/U. (This reading is crystal noise plug video amplifier noise.)

(5) Adjust ATTENUATION control on Variable Attenuator HP-X382A until the ME-30B/U reads double the noise reading (corresponds to 6 db).

(6) Note and record the attenuator dial reading. Add attenuation of cable CG-92B/U (2.6 db) to the attenuator dial reading.

(7) Consult curve on graph in figure 8-1 for typical attenuation values for 1N23B crystals at 9.31 mc. A tolerance of + 10 db is acceptable.

(8) Perform (1) through (7) about at signal generator frequencies of 8 and 11 mc.

(9) Remove signal comparator MIXER OUT cable from J404, remove 50-ohm termination and connect to J404, connect MIXER OUT cable connector to J403. Perform (1) through (7) above for crystal CR403.

(10) The tests of CR403 and CR404 shall indicate a matched pair of crystals.

(11) Remove coaxial termination and MIXER OUT cable from J404 and J403. Reconnect P404 and P403 to J404 and J403.

c. Sensitivity Check of CR1ol and CR402.

(1) Perform the procedures outlined in b above, except make connections to J402 and J401.

(2) The test results shall indicate matched crystals.

8-6. Delay Line and 40-Mc Amplifier Delay Measurement

a. Preliminary Procedure.

(1) Connect test equipment as indicated in figure 8-2. This equipment arrangement substitutes for the use of a piece of radar equipment. The X-Band RF amplifier increases the power level of the HP-620 to that normally found at the radar directional coupler. To achieve AFC lock-in on the AN/UPM-11, the HP-620 output attenuator should be set to approximately -7 db with the HP-495A amplifier output set to maximum output. (See commercial instruction manual for details on setting the amplifier.) Once lock-in is achieved, the Signal Generator HP-620 attenuator may be changed to -10 dbm without unlocking the AFC circuit.

(2) Adjust the test equipment as follows:

(a) Signal Generator HP-620.

1.	FREQUENCY:	9,310 me (check with HP-X530A).
2.	MOD SELECTOR:	INT.
3.	PULSE RATE:	4 kc.
4.	PULSE WIDTH:	1 μsec.
5.	OUTPUT ATTENUATOR:	-5 dbm
6.	POWER SET:	Set to zero with MOD SELECTOR at CW and restore MOD SELECTOR to INT.
7.	PULSE DELAY:	Fully ccw.

(b) X-Band Amplifier HP-495A.

1.	ON-STBY-OFF switch:	STDBY.
2.	RF GAIN:	Initially fully ccw.

(c) Signal Generator AN/USM-44.

1.	FREQUENCY B. RANGE:	
2.	OUTPUT LEVEL:	Fully cw.
3.	FREQUENCY:	40 mc (TS-696A/ UPM-11). 30 me (TS-696/UPM-1l1).
4.	MOD SELECTOR:	CW.
5.	Output attenuator:	+ 4db.
6.	MOD LEVEL:	Fully ccw.

(d) Frequency Comparator CM-77A/USM.

1.	L. O. FREQUENCY control:	Maximum clockwise (do not operate control switch at this point).
2.	HI FREQUENCY control:	Maximum clockwise.
3.	GAIN control:	Maximum clockwise.

(e) Oscilloscope Tektronix 545A.

1.	STABILITY "A":	Fully cw.
2.	TRIGGERING MODE "A":	AC LF REJECT.
3.	TRIGGER SLOPE:	INT-.
4.	TIME/CM "A":	5 ,sec.
5.	VARIABLE:	CALIBRATED.
6.	HORIZONTAL DISPLAY:	"A" DEL'D BY "B".
7.	5X MAG:	OFF.
8.	TRIGGER MODE "B":	AC.
9.	TRIGGER SLOPE "B":	EXT-.
10.	TRIGGER LEVEL & STABILITY:	As required for stable display.
11.	TIME/CM or DELAY TIME:	2 μsec.
12.	LENGTH:	Fully clockwise.
13.	DELAY TIME MULTIPLIER:	1.00.
14.	MODE:	A CHANNEL.
15.	AC-DC switch:	DC.
16.	VOLTS/CM:	As required.
17.	VARIABLE:	Fully clockwise.
18.	EXT TRIGGER "B" switch:	-.

(f) Range Calibration AN/UPM-11.

1.	AFC-Manual switch:	AFC.
2.	Meter Selector switch:	SIG XTAL.
3.	Panel attenuator (if provided):	Minimum attenuator.

(g) Multimeter ME-26D/U:

1. FUNCTION switch: --.
2. RANGE switch: 300 v.

b. Measurement of Delay Time.

(1) Adjust AN/UPM-11 L.O. FREQUENCY control and SWEEP LEVEL control until the AFC indicates lock-in (a steady indication on panel crystal current meter, or a steady reading on the ME-26D/U). Should lock-in fail, check settings on AN/USM-44 and % modulation monitor meter.

(2) Adjust TRIGGER LEVEL "B" and TRIGGER SLOPE "B" controls on oscilloscope for a stable display (fig. 8-4).

NOTE

If trace leading edge indicates a large amplitude pulse with sloping trailing edge, adjust the CM-77/USM LO FREQ control until baseline on scope is level at beginning of trace.

(3) If trace is not closely similar to figure 8-4, set TIME/CM "A" oscilloscope control until display is nearly similar.

(4) Adjust VOLTS/CM switch for best display of pulse amplitude. Set polarity switch for positive-going display on crt.

(5) Adjust DELAY TIME MULTIPLIER until bottom of pulse leading edge is at beginning of horizontal trace.

(6) Multiply the reading on DELAY TIME MULTIPLIER dial by the setting on TIME/CM or DELAY TIME switch (2 μsec in this case).

(7) Multiply this value by 164 to obtain the total delay of the DELAY LINE PULSE AMPLIFIER in yards.

(8) Restore DELAY TIME MULTIPLIER to 1.00.

c. Measurement of Amplifier Delay Time.

(1) With HORIZONTAL POSITION control on oscilloscope, adjust sweep position until leading edge of the first pulse is against the nearest vertical reticle on crt scale. Record the number of centimeter marks between the first pulse and leading edge of the second.

NOTE

The second pulse leading edge may not line up with a CM line; therefore, some interpolation is necessary.

(2) In this case, each centimeter mark is equal to 5 µsec. Record the number of microseconds from first to second pulse in whole number of centimeters per microsecond.

(3) Adjust, if necessary, the DELAY TIME MULTIPLIER until the leading edge of the second pulse is flush with the nearest centimeter mark of crt scale.

(4) Multiply the DELAY TIME MULTIPLIER reading by 2 (µsec) and add this value to the value obtained in (2) above.

(5) Multiply the value obtained in (4) above by 164 and divide by 2 to obtain the delay line delay time.

(6) To obtain the total amplifier delay time, subtract the value obtained in (5) above from the value recorded in step b(7) above.

(7) Record the amplifier delay time.

d. Voltage Calibration.

(1) With the AN/UPM-11 AFC locked in, set the METER SELECTION switch to the positions listed in the Range column of table 8-1.

(2) The test instrument AN/UPM-11 meter must indicate within values listed in Limits column of table 8-1.

Table 8-1. Metering voltages of AN/UPM-11

	Range (volts)	*Limit (volts)*
+300 V	.....	295 to 305
+150 IF	.....	140 to 160
+150 AFC	.....	140 to 160
TR-V	.....	--850 to -950
-300 V	.....	--290 to -310

e. AFC Control Check for TS-696A/UPM-11.

(1) Use the same test setup shown in figure 8-2.

(2) Add Frequency Meter HP-X530A, or equivalent, to the waveguide fitting between panel and UG-591/U.

(3) Carefully tune the HP-620 to 9,312 mc. Readjust attenuator on HP-620, if necessary, prior to making the tests.

(4) Multimeter ME-26B/U shall not indicate an increase in voltage. The AN/UPM-11 shall remain locked in.

(5) Carefully tune the HP-620 to a frequency of 9,308 mc.

(6) Multimeter ME-26B/U shall indicate an increase in voltage. The AN/UPM-11 shall re- main locked in.

(7) The above check will check the ability of the AFC circuit to control the local oscillator frequency through the intermediate frequencies of 38 to 42 mc. The AN/UPM-11 will break lock in at 9,307 me corresponding to an if. of 37 mc.

f. AFC Control Check for TS-696/UPM-11. Proceed as outlined in e above, except the intermediate frequencies (e(7) above) will center around 30 me (29 to 32 mc).

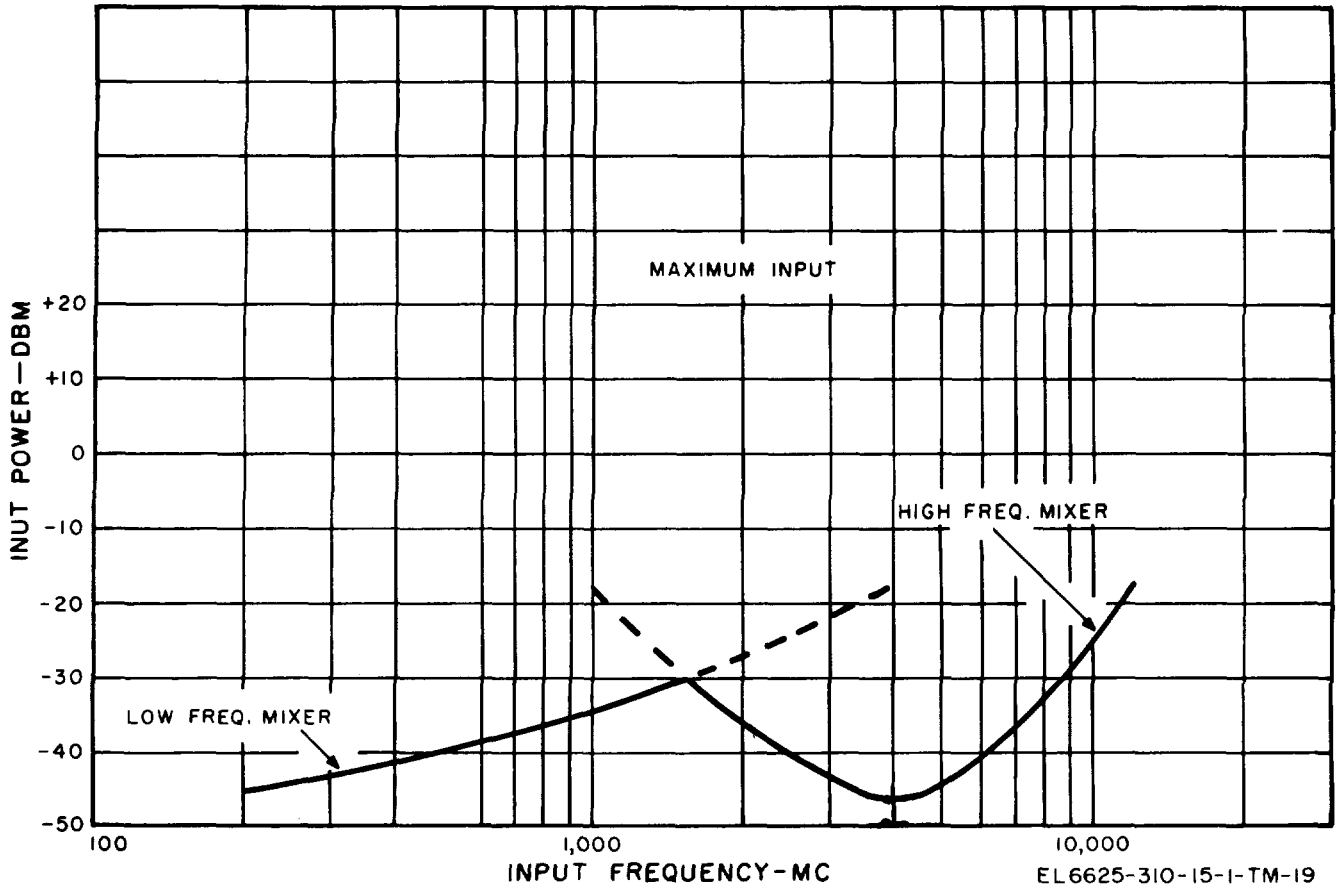


Figure 8-1. Graph, crystal sensitivity cheek.

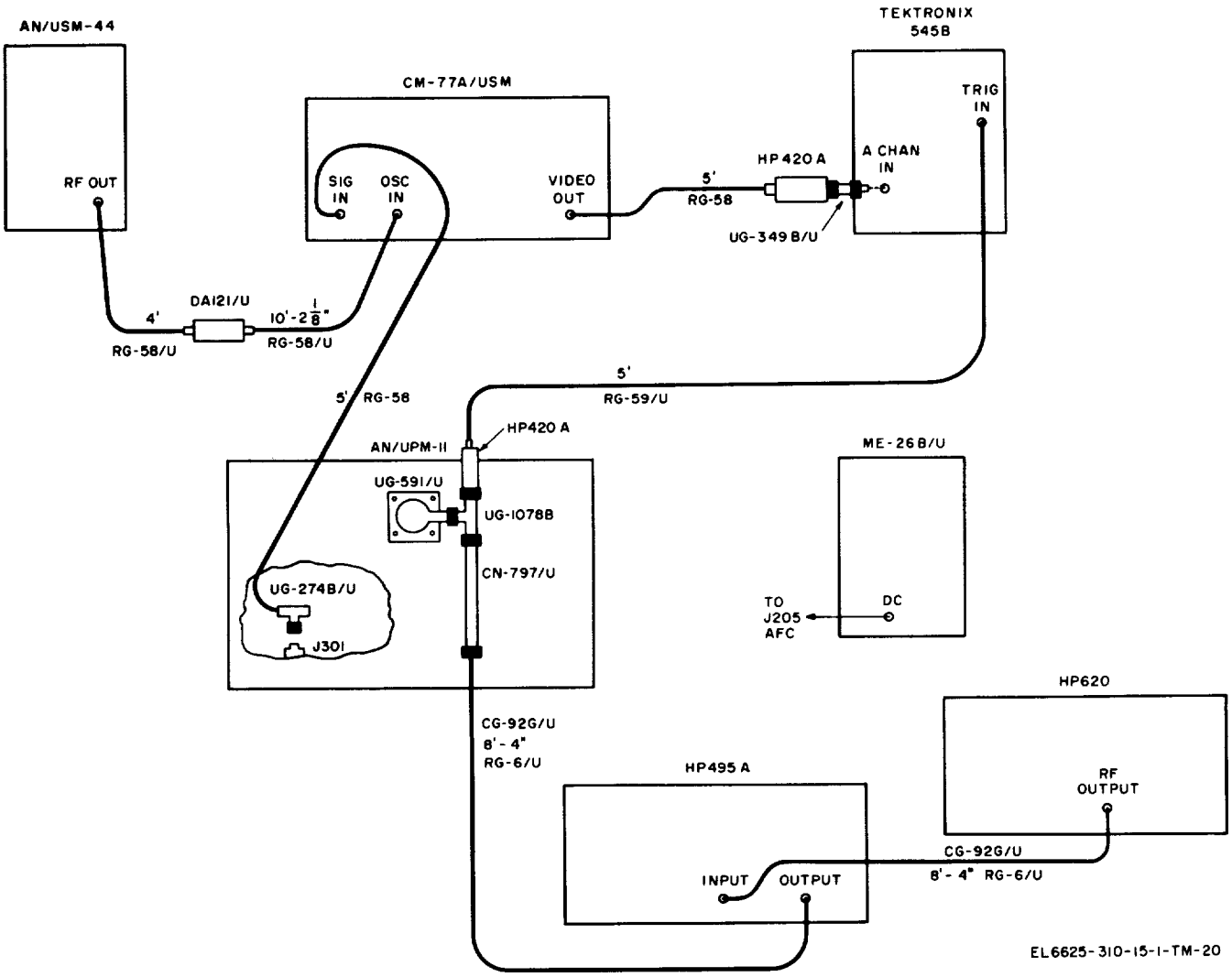


Figure 8-2. Test setup, delay line delay and AFC measurements.

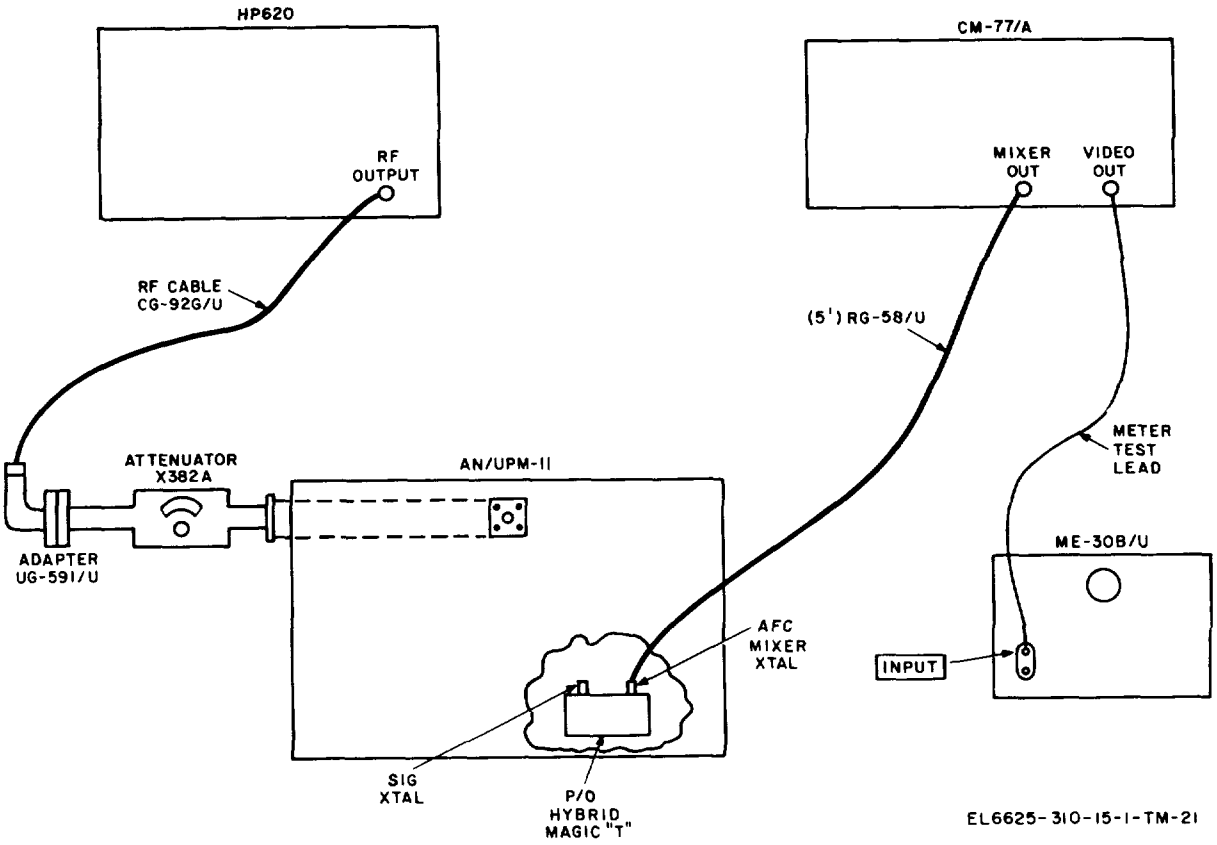


Figure 8-3. Test setup, crystal sensitivity test.

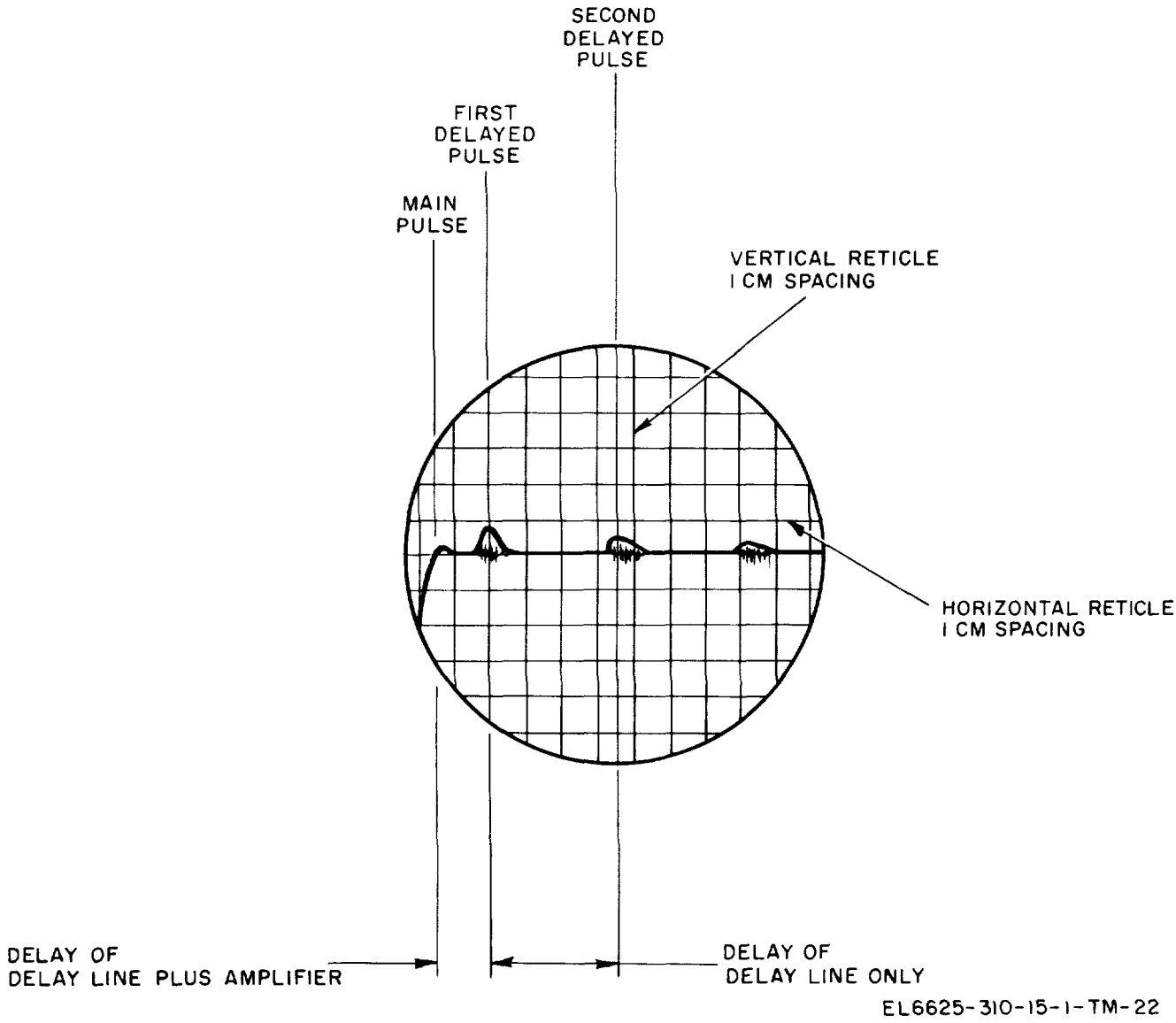


Figure 8-4. Display of pulses, pulse delay measurements.

CHAPTER 9
SHIPMENT AND LIMITED STORAGE AND DEMOLITION TO PREVENT ENEMY USE

Section I. SHIPMENT AND LIMITED STORAGE

9-1. Disassembly of Equipment

Disassembly of the AN/UPM-11 consists of removing the power cord and accessory cables and the pickup horn and placing them in their holders in the lid of the transit case.

9-2. Repacking for Shipment or Limited Storage

The exact procedure for repackaging depends on the material available and the conditions under which the equipment is to be shipped or stored.

a. Materials Required. The following materials are required for packaging the AN/UPM-11. For stock numbers of the materials, consult SB 38-100.

Material	*Quantity*
Filler material	4 lb
Corrugated cardboard	27 sq ft.
Gummed tape	17 ft
Gummed waterproof tape	20 ft
Waterproof paper	25 sq ft

b. Packaging. Package the AN/UPM-11 as follows:

(1) Cushion the AN/UPM-11 on all surfaces with pads of filler material.

(2) Place the cushioned unit within a wrap of corrugated cardboard.

(3) Secure the wrap with gummed tape.

(4) Protect the corrugated cardboard wrap with a waterproof paper barrier.

(5) Seal the seams of the paper barrier with waterproof tape.

c. Packing.

(1) Place the package containing the AN/UPM-11 into a wooden box.

(2) Nail a wooden lid on the box.

Section II. DEMOLITION OF MATERIEL TO PREVENT ENEMY USE

9-3. Authority for Demolition

The demolition procedures given in paragraph 9-4 will be used to prevent the enemy from using or salvaging this equipment. Demolition of the equipment will be accomplished only upon the order of the commander.

9-4. Methods of Destruction

Any and or all of the methods of destruction given below may be used. The time available will be the major determining factor for the methods to be used in most instances when destruction of equipment is undertaken. The tactical situation also will determine how the destruction order will be carried out. In most cases, it is preferable to completely demolish some portions of the equipment rather than to partially destroy all the equipment parts.

a. Smash. Remove the AN/UPM-11 from its installation. Smash with sledges, axes, machetes, hammers, or crowbars, or any other heavy tools available.

b. Cut. Cut the cables, cords, and wires; use axes, machetes, and similar tools.

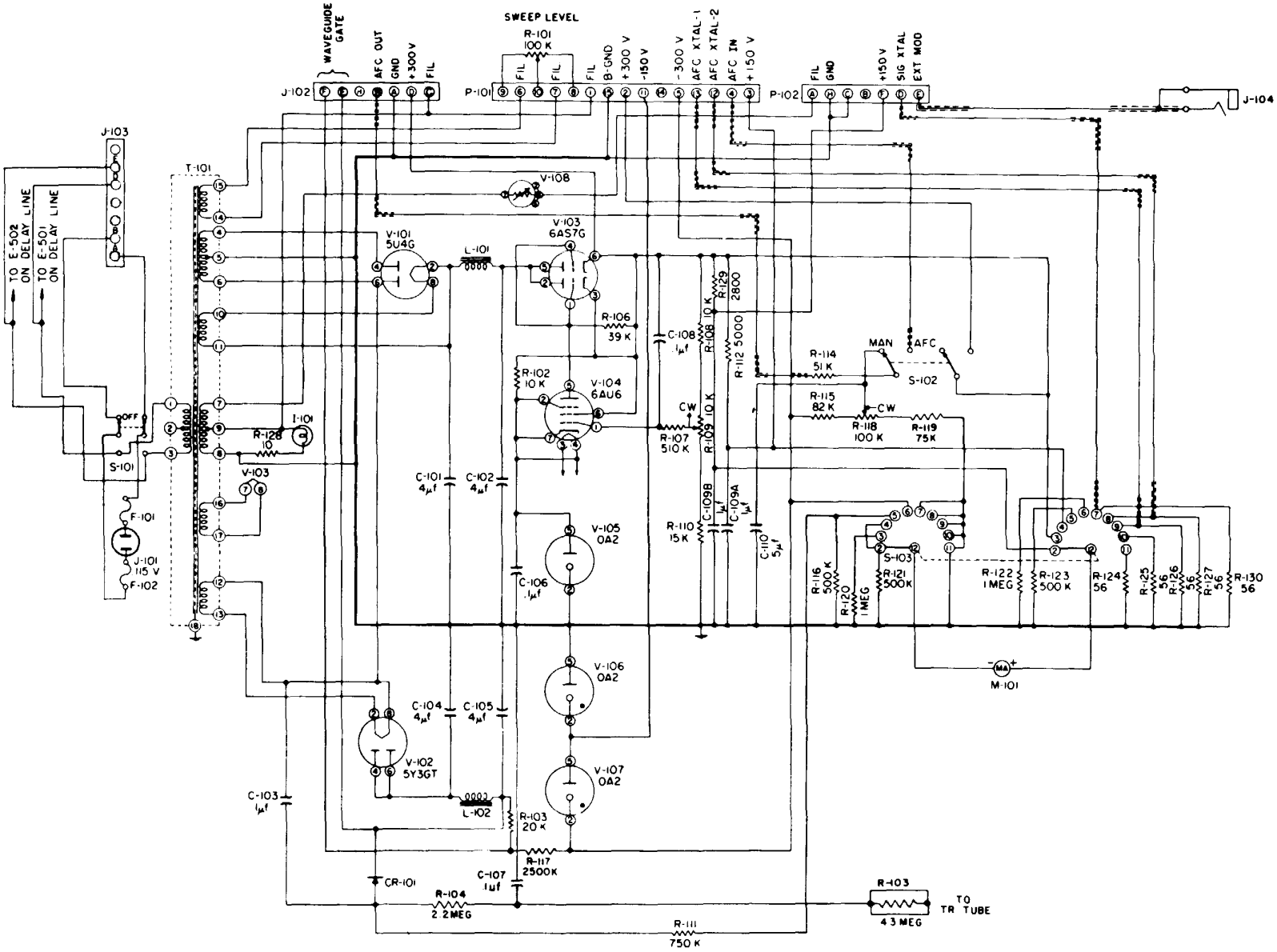
WARNING

Be extremely careful with explosives and incendiary devices. Use these items only when the need is urgent.

c. Burn. Burn the technical manuals first. Use gasoline, kerosene, flame-throwers, or incendiary grenades to complete the destruction of the set.

d. Explode. If explosives are necessary, use firearms, grenades, powder charges, or explosives to demolish the equipment where feasible.

e. Dispose. Scatter or bury the destroyed parts, or throw them into waterways. This is particularly important if a number of parts have not been completely destroyed.



EL6625-310-15-1-TM-15

Figure 9-3. Power supply, schematic diagram.

APPENDIX A
REFERENCES

DA Pam 310-4	Index of Technical Manuals, Technical Bulletins, Supply Manuals (types 7, 8, and 9), Supply Bulletins, and Lubrication Orders.
DA Pam 310-7	U.S. Army Equipment Index of Modification Work Orders.
SIG 7 & 8 AN/UPM-11	Range Calibrator Set AN/UPM-11 and AN/UPM-11A.
TB SIG 355-1	Depot Inspection Standard for Repaired Signal Equipment.
TB SIG 355-2	Depot Inspection Standard for Refinishing Repaired Signal Equipment.
TB SIG 3553	Depot Inspection Standard for Moisture and Fungus Resistant Treatment.
TB 11-6625-310-35/1	Calibration Procedure For: Range Calibrator Sets AN/UPM-11 and AN/UPM-11A.
TB 746-10	Field Instructions for Painting and Preserving Electronics Command Equipment.
TM 11-2678	Operator, Organizational, Field and Depot Maintenance Manual. Pulse Generator AN/PPM-1 and AN/PPM-1A.
TM	11-6625-219-12 Organizational Maintenance Manual: Oscilloscope AN/USM-81.
TM	11-6625-310-15 Operation and Maintenance: Range Calibrator Set AN/UPM-11A.
TM 11-6625-366-15	Organizational, DS, GS, and Depot Maintenance Manual: Multimeter TS-352B/U.
TM 11-6625-508-10	Operator's Manual: Signal Generators AN/USM-44 and AN/USM-44A.
TM 38-750	Army Equipment Record Procedures.

APPENDIX B
BASIC ISSUE ITEMS LIST (BIIL) AND ITEMS TROOP INSTALLED OR AUTHORIZED LIST (ITIAL)

Section I. INTRODUCTION

B-1. Scope

This appendix lists basic issue items and items troop installed or authorized required by the crew/operator for installation, operation, and maintenance of the Terminal Set, Telephone ANITCC-61.

B-2. General

This Basic Issue Items and Items Troop Installed or Authorized List is divided into the following sections:

a. Basic Issue Items List -Section II. A list, in alphabetical sequence, of items which are furnished with, and which must be turned in with the end item.

b. Items. Troop Installed or Authorized List - Section III. A list, in alphabetical sequence of items which, at the discretion of the unit commander, may accompany the end item, but are not subject to be turned in with the end item.

B-3. Explanation of Columns

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

a. Illustration. Not applicable.

b. Federal Stock Number. Indicates the Federal stock number assigned to the item and will be used for requisitioning purposes.

c. Part Number. Indicates the primary number used by the manufacturer (individual, company, firm, corporation, or Government activity), which controls the design and characteristics of the item by means of its engineering drawings, specifications standards, and inspection requirements, to identify an item or range of items.

d. Federal Supply Code for Manufacturer (FSCM). The FSCM is a 5-digit numeric code used to identify the manufacturer, distributor, or Government agency, etc, and is identified in SB 708-42.

e. Description. Indicates the Federal item name and a minimum description required to identify the item.

f. Unit of Measure (U/M). Indicates the standard of basic quantity of the listed item as used in performing the actual maintenance function. This measure is expressed by a two-character alphabetical abbreviation, (e.g., ea, in., pr, etc.). When the unit of measure differs from the unit of issue, the lowest unit of issue that will satisfy the required units of measure will be requisitioned.

g. Quantity Furnished with Equipment (Basic Issue Items Only). Indicates the quantity of the basic issue item furnished with the equipment.

h. Quantity Authorized (Items Troop Installed or0 Authorized Only). Indicates the quantity of the item authorized to be used with the equipment.

Section II. BASIC ISSUE ITEMS LIST

(1) Illustration		(2)	(3)	(4)	(5)	(6)	(7)
(A) Fig. No.	(B) Item No.	Federal stock number	Part number	FSCM	Description Usable on code	Unit of meas	Qty furn with equip
1-5		66256634626	CY-818/U	80058	CASE, TRANSIT	EA	1

Section III. ITEMS TROOP INSTALLED OR AUTHORIZED LIST

(1) Federal stock number	(2) Part number	(3) FSCM	(4) Description Usable on code	(5) Unit of meas	(6) Qty Qty
6675244-7761	TL-598/U	80058	ACCESSORIES TOOLS & TEST EQUIPMENT TAPE, MEASURING	EA	1
5120-224-2504	4260-104-103	80213	WRENCH, SOCKET HEAD SCREW	EA	1
5120-198-5398	TL-567/U	80058	WRENCH, SOCKET HEAD SCREW	EA	1

APPENDIX C
MAINTENANCE ALLOCATION

Section I. INTRODUCTION

C-1. General

This appendix provides a summary of the maintenance operations covered in the equipment literature for AN/UPM-11. 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.

C-2. Maintenance Functions

Maintenance functions will be limited to and de- fined as follows:

a. Inspect. To determine serviceability of an item by comparing its physical, mechanical, and electrical characteristics with established standards.

b. Test. To verify serviceability and to detect incipient electrical or mechanical failure by use of special equipment such as gages, meters, etc. This is accomplished with external test equipment and does not include operation of the equipment and operator type tests using internal meters or indicating devices.

c. Service. To clean, to preserve, to charge, and to add fuel, lubricants, cooling agents, and air. If it is desired that elements, such as painting and lubricating, be defined separately, they may be so listed.

d. Adjust. To rectify to the extent necessary to bring into proper operating range.

e. Align. To adjust two or more components or assemblies of an electrical or mechanical system so that their functions are properly synchronized. This does not include setting the frequency control knob of radio receivers or transmitters to the desired frequency.

f. Calibrate. To determine the corrections to be made in the readings of instruments or test equipment used in precise measurement. Consists of the comparison 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 with the certified standard.

g. Install. To set up for use in an operational environment such as an encampment, site, or vehicle.

h. Replace. To replace unserviceable items with serviceable like items.

i. Repair. To restore an item to serviceable condition through correction of a specific failure or unserviceable condition. This function includes, but is not limited to welding, grinding, riveting, straightening, and replacement of parts other than the trial and error replacement of running spare type items such as fuses, lamps, or electron tubes.

j. Overhaul. Normally, the highest degree of maintenance performed by the Army in order to minimize time work in process is consistent with quality and economy of operation. It consists of that maintenance necessary to restore an item to completely serviceable condition as prescribed by maintenance standards in technical publications for each item of equipment. Overhaul normally does not return an item to like new, zero mileage, or zero hour condition.

k. Rebuild. The highest degree of materiel maintenance. It consists of restoring equipment as nearly as possible to new condition in accordance with original manufacturing standards. Rebuild is performed only when required by operational considerations or other paramount factors and then only at the depot maintenance category. Rebuild reduces to zero the hours or miles the equipment, or component thereof, has been in use.

l. Symbols. The uppercase letter placed in the appropriate column indicates the lowest level at

which that particular maintenance function is to be performed.

C-3. Explanation of Format

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 Nomenclature. Column 2 lists the noun names of components, assemblies, subassemblies and modules on which maintenance is authorized.

c. Column 3, Maintenance Functions. Column 3 lists the maintenance category at which performance of the specific maintenance function is authorized. Authorization to perform a function at any category also includes authorization to perform that function at higher categories. The codes used represent the various maintenance categories as follows:

Code	*Maintenance category*
C	Operator/Crew
0	Organizational maintenance
F	Direct support maintenance
H	General support maintenance
D	Depot maintenance

d. Column 4, Tools and Test Equipment. Column 4 specifies, by code, those tools and test equipment required to perform the designated function. The numbers appearing in this column refer to specific tools and test equipment which are identified in section III.

e. Column 5, Remarks. Self-explanatory.

C-4. Explanation of Format of Section III, Tool and Test Equipment Requirements

The columns in Section III, Tool and Test Equipment Requirements, are as follows:

a. Tools and Equipment. The numbers in this column coincide with the numbers used in the tools and equipment column of the Maintenance Allocation Chart. The numbers indicate the applicable tool for the maintenance function.

b. Maintenance Category. The codes in this column indicate the maintenance category normally allocated the facility.

c. Nomenclature. This column lists tools, test, and maintenance equipment required to perform the maintenance functions.

d. Federal Stock Number. This column lists the Federal stock number of the specific tool or test equipment.

e. Tool Number. Not used.

SECTION II. MAINTENANCE ALLOCATION CHART

MAINTENANCE ALLOCATION CHART

GROUP NUMBER	COMPONENT ASSEMBLY NOMENCLATURE	MAINTENANCE FUNCTIONS											TOOLS AND EQUIPMENT	REMARKS
	T	INSPECT	TEST	SERVICE	ADJUST	ALIGN	CALIBRATE	INSTALL	REPLACL	REPAIE	OVERHAUR	REBUILD		
1	RANGE CALIBRATOR SET AN/UPM-11	H												Visual
			H											
				H									1,3	Preventive Maintenance
					H								7,8,9	
						H							7,8,9	
							D							Depot facilities
								H					9	
									H					
										H			9	Shop facilities
											H		9	Shop facilities
												D	9	Depot facilities
1a	ADAPTER COAXIAL UG-591/G and UG-592/G	H												Visual
								H					9	Shop facilities
									H				9	Depot facilities
1b	CABLE ASSEMBLY	H												Visual
			H										1	
				H										
								H					9	Preventive maintenance
									H				9	
										H			9	
											H		9	
												D	9	

MAINTENANCE ALLOCATION CHART

GROUP NUMBER	COMPONENT ASSEMBLY NOMENCLATURE	MAINTENANCE FUNCTIONS											TOOLS AND EQUIPMENT	REMARKS
		INSPECT	TEST	SERVICE	ADJUST	ALIGN	CALIBRATE	INSTALL	REPLACE	REPAIR	OVERHAUL	REBUILD		
1c	CIAMP, WAVEGUIDE UG-590/U	H		H				H	H	H			7,8 9 9	Visual Preventive Maintenance
1d	DELAY LINE	H	H	2,4,9	Shop facilities			H D	H D				9 9 9 9	Visual Shop facilities Shop facilities Depot facilities Depot facilities
1e	HORN, PICK UP AT-273/UPM	H	H	H					H D	H D			9 9 9 9	Visual Preventive Maintenance Shop facilities Depot facilities Shop facilities Depot facilities

MAINTENANCE ALLOCATION CHART

GROUP NUMBER	COMPONENT ASSEMBLY NOMENCLATURE	MAINTENANCE FUNCTIONS											TOOLS AND EQUIPMENT	REMARKS
	T	INSPECT	TEST	SERVICE	ADJUST	ALIGN	CALIBRATE	INSTALL	REPLACL	REPAIE	OVERHAUR	REBUILD		
1f	WAVE GUIDE ASSEMBLY CG-673/U	H												Visual
			H										7,8	
				H									9	Preventive Maintenance
									H				9	Shop facilities
									D				9	Depot facilities
2	CASE CY-818/U	H												Visual
				H										Preventive Maintenance
									H				9	
										H			9	Shop facilities
											H		9	Shop facilities
											D		9	Depot facilities
2a	COVER DUST	H												Visual
				H										Preventive Maintenance
									H				9	Shop facilities
										H			9	Shop facilities
											H		9	Shop facilities
											D		9	Depot facilities

MAINTENANCE ALLOCATION CHART

GROUP NUMBER	COMPONENT ASSEMBLY NOMENCLATURE	MAINTENANCE FUNCTIONS											TOOLS AND EQUIPMENT	REMARKS
		INSPECT	TEST	SERVICE	ADJUST	ALIGN	CALIBRATE	INSTALL	REPLACL	REPAIE	OVERHAUR	REBUILD		
2b	FAN AND MOTOR ASSEMBLY	H												Visual
			H											Preventive Maintenance
				H									9	Shop facilities
					H								9	Shop facilities
								H					9	Shop facilities
									H				9	Shop facilities
										D			9	Depot facilities
											D		9	Depot facilities
3	RANGE CALIBRATOR TS-696/UPM-ll or TS-696A/UPM-ll	H											1 thru 6	Visual
			H										1 thru 6	
				H										Preventive Maintenance
					H								1,3,9	
						H							3	
							H						9	Shop facilities
								H					9	
									H				9	
										H			9	Shop facilities
										D			9	Depot facilities
											H		9	Shop facilities
												D	9	Depot facilities

SECTION III. TOOL AND TEST EQUIPMENT REQUIREMENTS

TOOL AND TEST EQUIPMENT REQUIREMENTS

TOOLS AND EQUIPMENT	MAINTENANCE CATEGORY	NOMENCLATURE	FEDERAL STOCK NUMBER	TOOL NUMBER
		RANGE CALIBRATOR SET AN/UPM-11		
1	H,D	MULTIMETER TS-352B/U	6625-242-5023	
2	H,D	PULSE GENERATOR AN/PPM-1 or 1A	6625-503-0661	
3	H,D	OSCILLOSCOPE, AN/USM-140	6625-987-6603	
4	H,D	SIGNAL GENERATOR, AN/USM-44	6625-669-4031	
5	H,D	TEST SET, ELECTRON TUBE, TV-7/U	6625-820-oo64	
6	H,D	TAPE MEASURING. TL-598/U (ISSUED W/EQUIENT)	6675-244-7761	
7	H,D	WRENCH ALLEN, 1/16" wd TL-567/U (ISSUED W/EQUIPENT)	5120-198-5398	
8	H,D	WRENCH ALLEN. /64" wd (ISSUED W/EQUIPMENT)	5120-224-2504	
9	H,D	TOOL KIT TK-87/U (ISSUED W/EQUIPMENT)	5180-690-4452	

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NG: State AG (3).

USAR: None.

For explanation of abbreviations used, see AR 310-50.

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The Metric System and Equivalents

Linear Measure

1 centimeter = 10 millimeters = .39 inch
1 decimeter = 10 centimeters = 3.94 inches
1 meter = 10 decimeters = 39.37 inches
1 dekameter = 10 meters = 32.8 feet
1 hectometer = 10 dekameters = 328.08 feet
1 kilometer = 10 hectometers = 3,280.8 feet

Weights

1 centigram = 10 milligrams = .15 grain
1 decigram = 10 centigrams = 1.54 grains
1 gram = 10 decigram = .035 ounce
1 decagram = 10 grams = .35 ounce
1 hectogram = 10 decagrams = 3.52 ounces
1 kilogram = 10 hectograms = 2.2 pounds
1 quintal = 100 kilograms = 220.46 pounds
1 metric ton = 10 quintals = 1.1 short tons

Liquid Measure

1 centiliter = 10 milliters = .34 fl. ounce
1 deciliter = 10 centiliters = 3.38 fl. ounces
1 liter = 10 deciliters = 33.81 fl. ounces
1 dekaliter = 10 liters = 2.64 gallons
1 hectoliter = 10 dekaliters = 26.42 gallons
1 kiloliter = 10 hectoliters = 264.18 gallons

Square Measure

1 sq. centimeter = 100 sq. millimeters = .155 sq. inch
1 sq. decimeter = 100 sq. centimeters = 15.5 sq. inches
1 sq. meter (centare) = 100 sq. decimeters = 10.76 sq. feet
1 sq. dekameter (are) = 100 sq. meters = 1,076.4 sq. feet
1 sq. hectometer (hectare) = 100 sq. dekameters = 2.47 acres
1 sq. kilometer = 100 sq. hectometers = .386 sq. mile

Cubic Measure

1 cu. centimeter = 1000 cu. millimeters = .06 cu. inch
1 cu. decimeter = 1000 cu. centimeters = 61.02 cu. inches
1 cu. meter = 1000 cu. decimeters = 35.31 cu. feet

Approximate Conversion Factors

To change	*To*	*Multiply by*	*To change*	*To*	*Multiply by*
inches	centimeters	2.540	ounce-inches	Newton-meters	.007062
feet	meters	.305	centimeters	inches	.394
yards	meters	.914	meters	feet	3.280
miles	kilometers	1.609	meters	yards	1.094
square inches	square centimeters	6.451	kilometers	miles	.621
square feet	square meters	.093	square centimeters	square inches	.155
square yards	square meters	.836	square meters	square feet	10.764
square miles	square kilometers	2.590	square meters	square yards	1.196
acres	square hectometers	.405	square kilometers	square miles	.386
cubic feet	cubic meters	.028	square hectometers	acres	2.471
cubic yards	cubic meters	.765	cubic meters	cubic feet	35.315
fluid ounces	milliliters	29,573	cubic meters	cubic yards	1.308
pints	liters	.473	milliliters	fluid ounces	.034
quarts	liters	.946	liters	pints	2.113
gallons	liters	3.785	liters	quarts	1.057
ounces	grams	28.349	liters	gallons	.264
pounds	kilograms	.454	grams	ounces	.035
short tons	metric tons	.907	kilograms	pounds	2.205
pound-feet	Newton-meters	1.356	metric tons	short tons	1.102
pound-inches	Newton-meters	.11296			

Temperature (Exact)

°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

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