

TECHNICAL MANUAL
OPERATOR'S, ORGANIZATIONAL, DIRECT
SUPPORT AND GENERAL SUPPORT
MAINTENANCE MANUAL
FOR
ELECTRONIC MARKER GENERATOR
AN/USM-108A
(NSN 6625-00-628-6515)

HEADQUARTERS, DEPARTMENT OF THE ARMY
AUGUST 1976

WARNING

Dangerously high voltages exist in this equipment. Be very careful when working on or near the power supplies as serious injury or death may result if bodily contact is made with live terminals.

DON'T TAKE CHANCES



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 AND GENERAL SUPPORT
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FOR

ELECTRONIC MARKER GENERATOR AN/ USM-108A

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REPORTING OF ERRORS

You can improve this manual by recommending improvements using DA Form 2028- 2 (Test) located in the back of the manual. Simply tear out the self addressed form, fill it out as shown on the sample, fold it where shown, and drop it in the mail.

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

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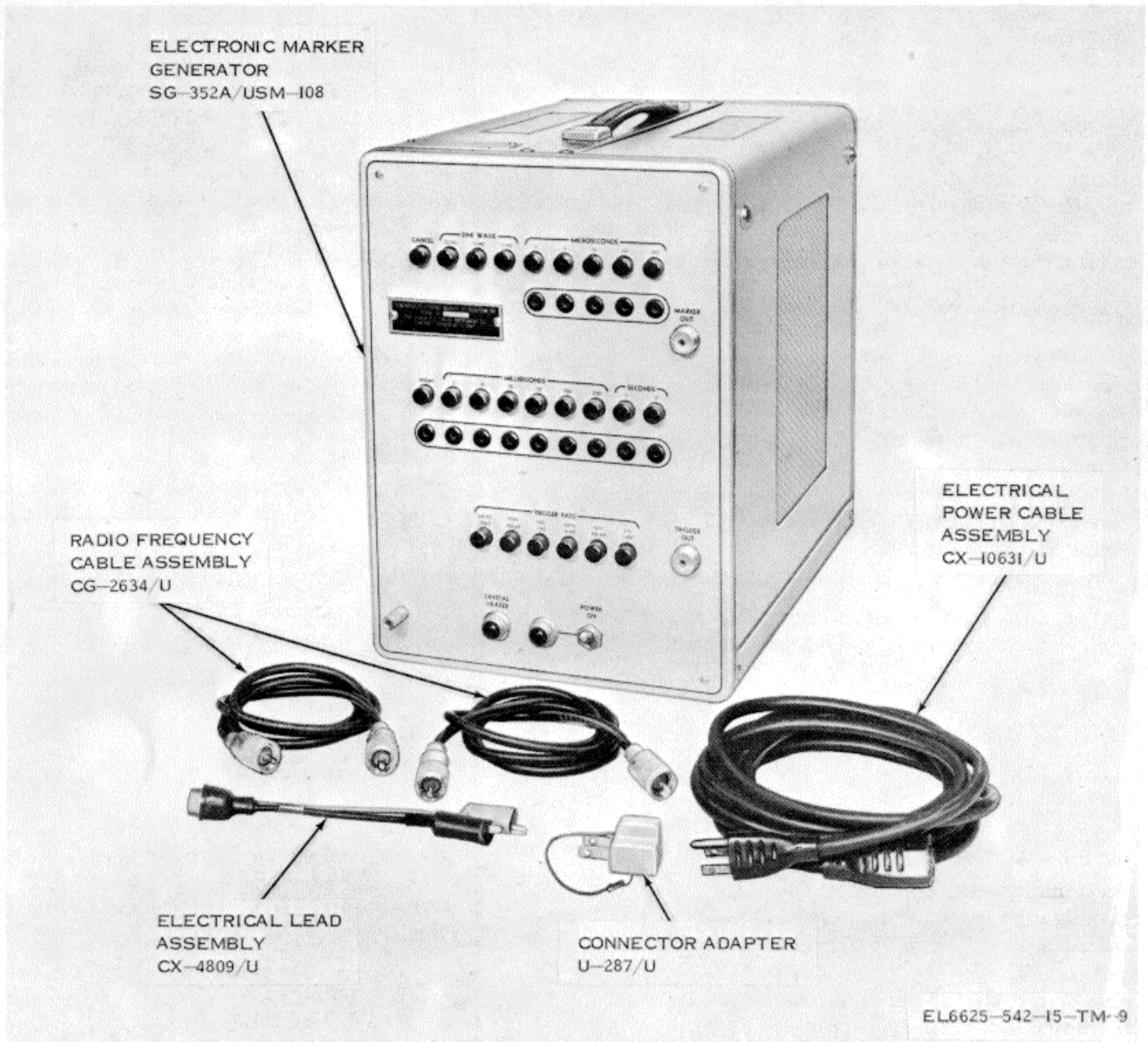


Figure 1-1. Electronic Marker Generator AN/USM-108A.

CHAPTER 1

INTRODUCTION

Section I. GENERAL

1-1. Scope

This manual describes Electronic Marker Generator AN/USM-108A (fig. 1-1) and provides instructions for operation, cleaning, troubleshooting, testing, and repairing the equipment. It also lists tools, materials, and test equipment required for organizational and general support maintenance. No direct support maintenance is authorized for the equipment.

1-2. Indexes of Publications

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

b. 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. Maintenance forms, records, and reports which are to be used by maintenance pertaining to the personnel at all levels are listed in and prescribed by TM

38-750.

b. Report of Packaging and Handling Deficiencies. Fill out and forward DD Form 6 (Packaging Improvement Report) as prescribed in AR 700-58/NAVSUPINST 4030.29/AFR 71-13/MCO P4030.29A, 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 4610.33A/AFR 75-18/MCO P4610.19B, and DSAR 4500.15.

1-4. Administrative Storage

For procedures, forms, and records, and inspections required during administrative storage of this equipment, refer to TM 740-90-1.

1-5. Destruction of Army Materiel

Demolition and destruction of electronic equipment will be under the direction of the commander and in accordance with TM 750-244-2.

Section II. DESCRIPTION AND DATA

1-6. Purpose and Use

Electronic Marker Generator AN/USM-108A is a portable instrument which provides an accurate and stable source of sine waves, trigger pulses and time markers. The wide choice of outputs available permits the use of the generator in a variety of laboratory and calibration applications. It provides a source of calibrating signals for oscilloscope sweep circuits, oscillators and counters. The AN/USM108A can also be used as a source of trigger-rate pulses and as a time measuring device. Markers can be used separately or in combination depending on the desired presentation or application.

1-7. Tabulated Data

a. Output Signals.

- (1) Sine waves of 5MHz, 10MHz, and 50MHz.

- (2) Microsecond markers at intervals of 1, 5, 10, 50, 100 and 500 microseconds.

- (3) Millisecond markers at intervals of 1, 5, 10, 50 and 500 milliseconds.

- (4) One-second and five-second intervals.

- (5) Trigger pulses at rates of 1Hz, 10Hz, 100Hz, 1KHz, 10KHz and 100KHz.

b. Crystal Oscillator.

- (1) Frequency: 1MHz-10Hz.

- (2) Accuracy: approx. 0.001%.

- (3) Stability: within three parts per million per 24 hours.

c. Power Requirements: 105 to 125 volts ac, or 210 to 250 volts ac, 50 to 60 Hz, 240 watts power consumption at 117 volts.

d Output Signal Values.

Output signal	MARKER OUT Connector			Jacks	
	Open circuit voltage	Impedance(at half-voltage)	*Risetime	Open circuit voltage	Impedance
Markers	3 volt minimum	390 Ωmax.	0.07 sec. at 1u sec. to 1.7 sec at 5 seconds	25 volts minimum	390 Ω at 1 sec to 900 Ω at 5 seconds
Trigger Pulses	6 volt minimum	5611 max.	0.08/Asec at 100 Hz to 0.30 sec at 1 Hz		
Sine Waves	3 volt minimum across 52-ohms				

*With output terminated in 53 ohms.

e. Physical Characteristics.

- (1) Ventilation: filtered forced air.
- (2) Finish: anodized, etched front panel, gray enamel case.
- (3) Height: 14 inches.
- (4) Width: 10 inches.
- (5) Depth: 17 inches.
- (6) Weight: 30-1/2 pounds.

f. Output Connections.

- (1) MARKER OUT:
 - (a) Sign Wave; 50MHz, 10MHz, 5MHz.
 - (b) Microseconds; 1, 5, 10, 50, 100 and 500.
 - (c) Milliseconds; 1, 5, 10, 50, 100 and 500.
 - (d) Seconds; 1 and 5.

(2) TRIGGER OUT:

(3) Trigger Rate:

- (a) 100KHz, 10 microseconds.
- (b) 10KHz, 100 microseconds.
- (c) 1KHz, 1 milliseconds.
- (d) 100HZ, 10 milliseconds.
- (e) 10HZ, 100 milliseconds.
- (f) 1 HZ, 1 second.
- g. Electron Tube Compliment: 52 tubes.

1-8. Items Comprising an Operable Equipment

Items comprising an operable AN/USM-108A are Listed in table 1-1.

Table 1-1. Items Comprising an Operable AN/USM-108A

NSN	Qty	Nomenclature	Fig. No.
6625-00-987-9455	1	Electronic Marker Generator SG-352A/USM-108	1-1
	1	Electrical Power Cable Assembly CX-10631/U	1-1
6625-00-801-13211	1	Electrical Lead Assembly CX-4809/U	1-1
	1	Connector Adapter U-287/U	1-1
	2	RF Cable Assembly CG-2634/U	1-1

CHAPTER 2

**SERVICE UPON RECEIPT OF EQUIPMENT
AND INSTALLATION**

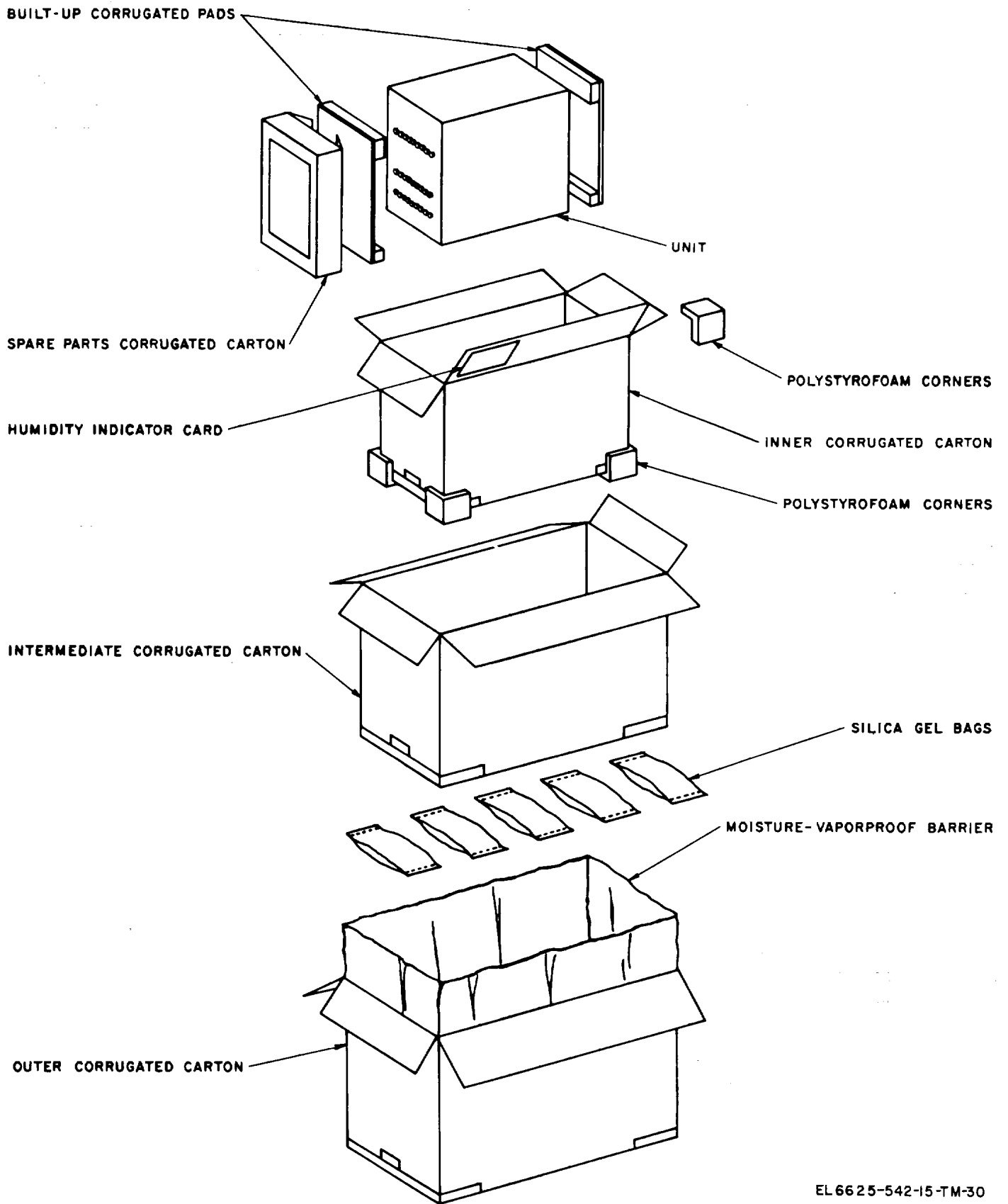
Section I. SERVICE UPON RECEIPT**2-1. Packaging Data**
(fig. 2-1)

a. When packaged for shipment, the AN/USM 108A and spare parts are packed as follows: This AN/USM-108A is placed in an inner corrugate carton and blocked in place with two corrugate pads. The running spares, accessories, and auxiliary items are placed in a sealed plastic bag and stored in the spare parts carton. This carton is placed in this inner corrugated carton as shown in figure 2-1. A sheet of wadding is placed on top of the AN/USM 108A and the spare parts carton. The carton is close and sealed with pressure-sensitive tape.

NOTE

A humidity card is attached to the inner carton which will indicate the presence of excessive moisture by changing from blue to red.

b. Four polystyrafoam corners are placed in the inside corners of the intermediate corrugated carton. The inner corrugated carton is then placed inside the intermediate carton and four more polystyrafoam corners are placed on the four corners of the inner carton. The intermediate carton is then closed and sealed with pressure-sensitive tape. The outer corrugated carton is lined with a moisture-vaporproof barrier and the intermediate carton placed inside. Five silica-gel bags are placed on top of the intermediate carton. The outer carton is then sealed with pressure-sensitive tape.



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Figure 2-1. Packaging diagram.

2-2. Unpacking and Checking

a. Step-by-Step Instructions for Unpacking Shipments (fig. 2-1).

- (1) Place carton on a table or workbench.
- (2) Open outer corrugated carton, moisture-vaporproof barrier, and remove silica-gel bags.
- (3) Remove intermediate corrugated carton.
- (4) Open intermediate carton and remove four polystyrofoam corners.
- (5) Remove inner carton.
- (6) Open inner carton and remove wadding, corrugated pads and spare parts carton.
- (7) Lift AN/USM-108A from inner carton.

b. Checking Unpacked Equipment.

- (1) Inspect the equipment for damage incurred during shipment. If the equipment has been damaged, report the damage on DD form 6.
- (2) See that the equipment is complete as listed on the packing slip. If a packing slip is not available, check the equipment against the data listed in

table

1-1. Report all discrepancies in accordance with paragraph 1-3. Shortage of a minor assembly or part that does not affect proper functioning of the equipment should not prevent use of the equipment.

(3) If the equipment has been used or reconditioned, see whether it has been changed by a modification work order (MWO). If the equipment has been modified, the MWO number will appear on the front panel near the nomenclature plate. If modified, see that any operational instruction changes resulting from the modification have been entered in the equipment manual.

NOTE

Current MWO's applicable to the equipment are listed in DA Pam 310-7.

c. Cleaning New Equipment. After the equipment has been thoroughly checked, clean all items with a soft cloth.

Section II. INSTALLATION

2-3. Cable Connections

The following steps outline the cable connections to the AN/USM-108A.

a. Place Connector Adapter U-287/U into correct power source and attach green grounding terminal to ground.

NOTE

Step a above is not necessary if grounding provisions are already at the power source.

b. Connect Electrical Power Cable Assembly CX-10631/U to rear of AN/USM-108A and power source.

c. Attach RF Cable Assemblies CC-2634/U to TRIGGER OUT and MARKER OUT connector on front panel.

NOTE

Electrical Lead Assembly CX-4809/U may be used in place of either radiofrequency cables depending on application.

2-4. Power Connections

Unless otherwise indicated by the metal plate on the

back of the case, the equipment is wired for operation from an ac power source of 117 volts (range 105 to 125 volts) at a frequency of 50 to 60 Hertz. If operation from a 234 volt source (range 210 to 250 volts) is required, follow the procedures outlined below (fig. 2-2):

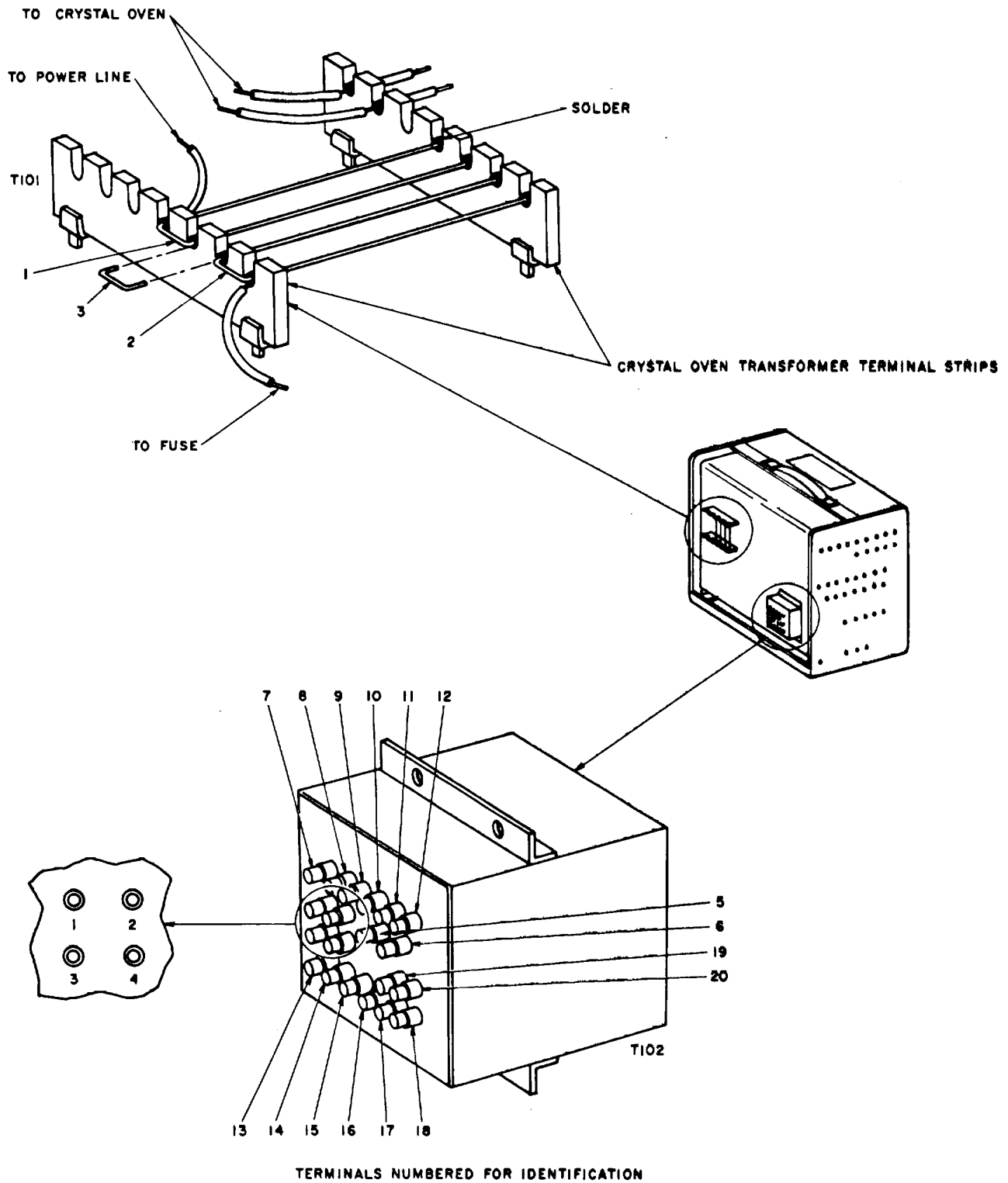
a. Remove the left side panel of the instrument.

b. Remove jumpers between terminals 1 and 2 and terminals 3 and 4 of T101. Connect jumper across terminals 2 and 3. This arrangement places the two primary windings of the power transformer T101 in series for operation on 234 volts input.

c. Remove jumpers (1 and 2) at terminal strip for crystal oven transformer T102. Connect jumper (3) as shown. This arrangement equips transformer T102 operation on 234 volts.

CAUTION

Always change the connections on the crystal oven transformer when changing connections on the power transformer.



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Figure 2-2. Converting from 117 volts to 234 volts operation.

CHAPTER 3

OPERATING INSTRUCTIONS

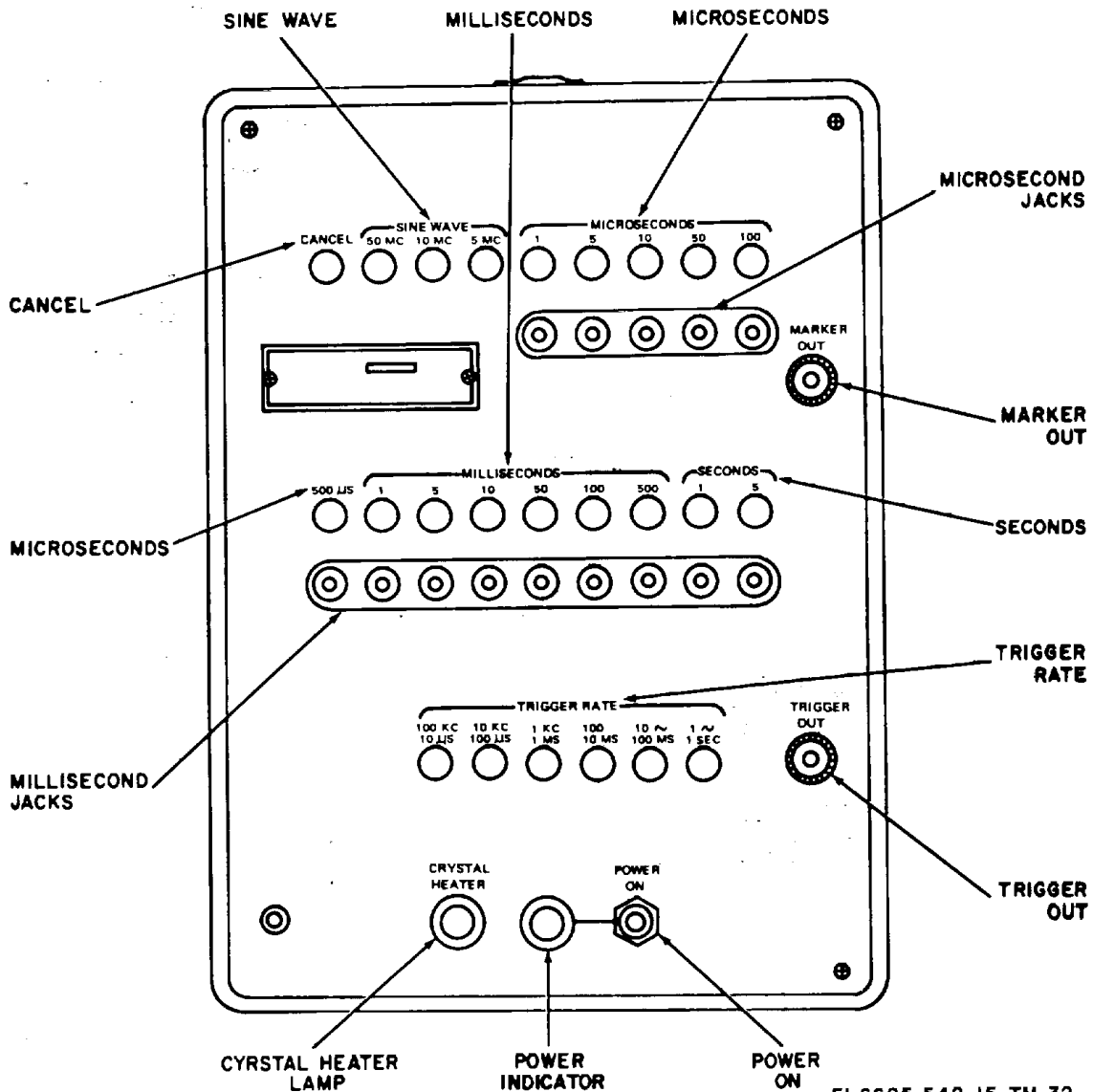
Section I. CONTROLS AND INSTRUMENTS

3-1. General

Haphazard operation or the improper setting of switches and controls can damage the equipment. For this reason, it is essential to know the function of every switch and control on the AN/USM-108A.

3-2. Operator Controls

Table 3-1 lists and describes the function of the controls and indicators of the AN/USM-108A. Figure 3-1 shows the locations of the operator controls and indicators.



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Figure 3-1. Operator controls and indicators.

Table 3-1. Operator Controls and Indicators

Control or indicator	Function
CANCEL pushbutton front panel.	When depressed, will cancel any or all pushbuttons depressed on
SINE WAVE pushbuttons is equal to frequency marked directly over pushbutton.	Depressing any one of three pushbuttons (50MC, 10MC, 5 MC) provides a sine wave signal, at the MARKER OUT connector, that
	NOTE
	Only one signal may be used at any one time, and may only be obtained by MARKER OUT connector.
MICROSECONDS pushbuttons.....	NOTE The sixth marker pushbutton (500 s) is located in the next lower group of pushbuttons. Depressing any one of six pushbuttons provides time-mark signals at MARKER OUT connector, equal to rate marked above each pushbutton.
	NOTE
	More than one pushbutton may be pressed at a given time. In this situation their values will be additive. Example; when 1 MICROSECONDS pushbutton is depressed, time-mark signal at the MARKER OUT connector will be one microsecond. If 5 MICROSECONDS pushbutton is then depressed, time-mark signal at MARKER OUT connector will then be six microseconds.
MICROSECONDS jacks mark signal equal to that of pushbutton directly above it. and any other pushbutton that may be depressed.	Located directly below each pushbutton, these jacks provide a time-Function of these jacks are independent of MARKER OUT connector,
	NOTE
	It is not necessary to depress pushbutton to obtain time-mark pulse.
MARKER OUT connector sine wave signals from sine wave circuits, are MILLISECONDS pushbuttons value marked above each pushbutton.	Point at which time-mark signals, from any or all of time-mark circuits marked microseconds, milliseconds, and second, including obtained. Provides time-mark signals, at MARKER OUT connector, equal to
	NOTE
	More than one pushbutton may be depressed at a given time. In this situation their values will be additive. Example: when 1 MILLISECONDS pushbutton is depressed, time-mark signal will be one millisecond. If 50 MILLISECONDS pushbutton is then depressed, time-mark signal will then be 51 milliseconds.
SECONDS pushbuttons value marked above each pushbutton. When both are	Provides time-mark signals at MARKER OUT connector equal to depressed, their values will be additive.
MILLISECONDS and SECONDS jacks mark signal equal to that of pushbutton directly above it. and any other pushbutton that may be depressed.	Located directly below each pushbutton, these jacks provide a time-Function of these jacks is independent of MARKER OUT connector,
	NOTE
	It is not necessary to depress pushbutton to obtain time-mark pulse.
TRIGGER RATE pushbuttons value marked above each pushbutton.	Provides trigger pulses, at the TRIGGER OUT connector, equal to
	NOTE
	Trigger pulses are available only at TRIGGER OUT connector, and
only one pushbutton may be depressed at a time.	
TRIGGER OUT connector	Point at which trigger pulses are obtained.
POWER ON switch indicated when lamp immediately to the left of POWER	Applies or removes power to AN/USM-108A. Application of power is ON switch is illuminated.

Table 3-1. Operator Controls and Indicators-Continued

Control or indicator CRYSTAL 'EATER lamp is in a heat cycle.	Function When illuminated, indicates crystal oscillator oven is functioning and
--	--

NOTE

This lamp operates independently of POWER ON switch, and will illuminate immediately when power is applied to AN/USM-108A, and will continue to function regardless of position of POWER ON switch.

Section II. OPERATION UNDER USUAL CONDITIONS

3-3. Starting Procedures

- a. Refer to paragraph 2-3 for cable connections.
- b. Refer to paragraph 2-4 and connect to proper ac power source.
- c. Press CANCEL pushbutton.
- d. Set POWER ON switch to ON.
- e. Select proper cable for obtaining signal desired.
- f. Depress pushbutton, or select jack, that will provide desired signals as follows:
 - (1) SINE WAVE (pushbuttons): Depress one of the three sine wave push-buttons to provide a sine wave signal of that frequency at the MARKER OUT connector.
 - (2) Time-marks (pushbuttons): Depress any one of the 14 time-mark push-buttons to provide a time-mark, at the rate selected, at the MARKER OUT

connector. Any combination of the 14 buttons may be depressed to obtain time-marks equal to the arithmetic total of the values depressed.

(3) Time-marks (jacks):

Insert a connector into the jacks to permit individual usage of a particular time-mark, independent of what pushbuttons are depressed. Any or all of the jacks may be utilized at a given time.

(4) TRIGGER RATE (pushbuttons): Depress any one of the six TRIGGER RATE pushbuttons to provide a trigger pulse at the TRIGGER OUT connector. Only one push-button may be depressed at one time.

3-4. Stopping Procedures

- a. Remove all cables and connectors.
- b. Depress CANCEL pushbutton.
- c. Set POWER ON switch to off.

Section III. OPERATION UNDER UNUSUAL CONDITIONS

3-5. Operation in Arctic Climates

Subzero temperatures and climatic conditions associated with cold weather may hamper the efficient operation of electronic equipment. Instructions and precautions for operation under such adverse conditions follow:

- a. Keep the equipment warm and dry. If the equipment is not kept in a heated enclosure, construct an insulated box for its protection.
- b. Make certain the equipment has been warmed up sufficiently before use. This may take from 15 to 30 minutes, depending on the temperature of the surrounding air.
- c. When equipment which has been exposed to the cold is brought into a warm room, it will sweat until it reaches room temperature. When the equipment has reached room temperature, dry it thoroughly.

3-6. Operation in Tropical Climates

In tropical climates, electronic equipment may be installed in tents, huts or, when necessary, in underground dugouts. When equipment is installed below ground, and when it is set up in swamp areas, danger of moisture damage is more acute than normal in the tropics. Ventilation is usually very poor, and the high relative humidity causes condensation on the equipment whenever its temperature becomes lower than the ambient air. To counteract this condition, place lighted electric bulbs under the equipment.

3-7. Operation in Desert Climates

The main problem with electronic equipment in desert areas is the large amount of sand and dust that lodges in the moving parts and mechanical assemblies. Cleaning and servicing intervals should be shortened according to local conditions.

CHAPTER 4

OPERATOR AND ORGANIZATIONAL MAINTENANCE INSTRUCTIONS

Section I. GENERAL

4-1. Scope of Operator and Organizational Maintenance

The maintenance duties assigned to the operator and organizational repairman of Electronic Marker Generator AN/USM-108A are listed below together with a reference to the paragraphs covering the specific maintenance functions.

- a. Operator's daily preventive maintenance checks and services (table 4-1).
- b. Organizational weekly preventive maintenance checks and services (table 4-1).

- c. Organizational monthly preventive maintenance checks and services (table 4-2).
- d. Organizational quarterly preventive maintenance checks and services (table 4-3).
- e. Cleaning (para 4-4).
- f. Rustproofing and painting (para 4-5).
- g. Troubleshooting (table 4-4 and para 4-7).

4-2. Tools and Test Equipment

The tools and test equipment used by the operator and organizational repairman for maintenance of the AN/USM-108A are listed in appendix C.

Section II. PREVENTIVE MAINTENANCE AND TROUBLESHOOTING

4-3. Scope of Preventive Maintenance

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.

a. **Systematic Care.** The procedures given in tables 4-1, 4-2, and 4-3 cover routine systematic care and cleaning essential to proper upkeep and operation of the equipment.

b. **Preventive Maintenance Checks and Services.** The preventive maintenance checks and services tables (tables 4-1, 4-2, and 4-3) outline functions to be performed at specific intervals. These checks and services are to maintain Army electronic equipment in a combat serviceable condition; that is, in good general (physical) condition and in good operating condition. To assist operators in maintaining combat serviceability, the tables indicate what to check, how to check, and the

normal conditions. If the defect cannot be remedied by performing the corrective actions listed, higher category of maintenance or repair is required. Records and reports of these checks and services must be made in accordance with the requirements set forth in TM 38-750.

c. **Preventive Maintenance Checks and Services Periods.** Preventive maintenance checks and services for the AN/USM-108A are required on a daily (table 4-1), weekly (table 4-1), monthly (table 4-2), and a quarterly basis (table 4-3). These checks must be performed during the specified intervals. In addition, the daily checks and services must be performed under the special conditions listed below:

- (1) Initial installation.
- (2) Return from higher category maintenance.
- (3) Once each week, if the equipment is maintained in a standby condition.

Table 4-1. Operator Daily and Weekly Preventive Maintenance Checks and Services

D- Daily
Time required: 0.5

W-Weekly
Time required. 1.6

Interval and sequence No.		Item to be inspected procedure	Work time M/H
D	W		
1		COMPLETENESS: See that equipment is complete (table 1-1).	0.1
2		EXTERIOR SURFACES: Clean exterior surfaces (para 4-4). Check indicator lenses for cracks.	0.1
3		CONNECTORS AND CABLES: Check all connectors and cables for tightness, cracks and overall condition.	0.1
4		CONTROLS AND SWITCHES: Observe that the mechanical action of each pushbutton and switch is smooth and free of external or internal binding, and that there is no excessive looseness.	0.1
5		INDICATOR LAMPS: Set POWER ON switch to ON and observe that POWER ON indicator and CRYSTAL HEATER indicator both illuminate.	0.1
	6	CABLES AND CORDS: Inspect cords, cables and wires for chafed, cracked or frayed insulation. Replace connectors that are broken, arced, stripped or worn excessively.	0.1
	7	HANDLE: Inspect handle for looseness. Replace or tighten as necessary.	0.1
	8	METAL SURFACES: Inspect exposed metal surfaces for rust and corrosion. Touchup paint as required (para 4-5).	0.2

Table 4-2. Organizational Monthly Preventive Maintenance Checks and Services

M- Monthly Time required: 0.11

Sequence No.	Item to inspected procedure	Work time M/H
1	PLUCKOUT ITEMS: Inspect seating of pluckout items. Make certain that tube clamps grip tube bases tightly.	0.2
2	TRANSFORMER TERMINALS: Inspect terminals on power transformer. There should be no evidence of dirt or corrosion.	0.1
3	TERMINAL BLOCKS: Inspect terminal blocks for loose connections and cracked or broken insulation. Be sure silver solder connections are not loose from ceramic backing.	0.1
4	RESISTORS AND CAPACITORS: Inspect resistors and capacitors for cracks, blistering or other detrimental defects.	0.2
5	GASKETS AND INSULATORS: Inspect gaskets, insulators, bushings and sleeves for cracks, chipping and excessive wear.	0.2
6	INTERIOR: Clean interior of chassis and cabinet.	0.1
7	AIR FILTER: Remove and clean air filter (para 4-4).	0.2

Table 4-3. Organizational Quarterly Preventive Maintenance Checks and Services

Q- Quarterly
Time required: 0.3

Sequence No.	Item to be inspected procedure	Work time M/H
1	PUBLICATIONS: See that all publications are complete, serviceable and current. Refer to DA Pam 310-4.	0.1
2	MODIFICATIONS: Check DA Pam 310-7 to determine if new applicable MWO's have been published. All URGENT MWO's must be applied immediately. All NORMAL MWO's must be scheduled.	0.1
3	SPARE PARTS: Check all spare parts (operator and organizational) for general condition and method of storage. There should be no evidence of overstock, and all shortages must be on valid requisitions.	0.1

4-4. Cleaning

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 an open flame converts flame to highly toxic, dangerous fumes.

- b. Remove grease, fungus, and ground-in dirt from the cases; use a cloth dampened (not wet) with trichloroethane.
- c. Remove dust or dirt from output jacks and connectors with a brush.
- d. Remove the air filter and gently tap on a hard surface to dislodge dust and dirt. Agitate the filter in soapy water, rinse thoroughly in clean fresh water and dry.
- e. Clean the front panel and control knobs; use a

soft clean cloth. If necessary, dampen the cloth with water and mild soap.

4-5. Rustproofing and Painting

- a. Rustproofing. When the finish becomes badly scarred or damaged, rust and corrosion can be prevented by touching up the bare surfaces. Use No. 000 sandpaper to clean the surface down to the bare metal. Obtain a bright, smooth finish.

- b. Painting. 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 the applicable cleaning and refinishing practices specified in TB 43-0118.

4-6. Troubleshooting Information

To troubleshoot the equipment, perform all functions of the AN/USM-108A operation until an abnormal condition or result is observed. Note the abnormal condition, or result, and refer to troubleshooting table 4-4 for corrective action. If the corrective measures indicated do not result in correction of the trouble or if no corresponding measure is listed in the troubleshooting table, higher category of maintenance is required.

Table 4-4. Organizational Troubleshooting

Malfunction	Probable cause	Corrective action
POWER indicator lamp does not light.	<ul style="list-style-type: none"> a. Defective ac line cord. b. Defective indicator lamp. c. Defective ac line fuse. 	<ul style="list-style-type: none"> a. Check ac line cord. Replace cord if necessary. b. Check POWER indicator lamp. Replace if necessary. c. Check line fuse (fig. 4-1). NOTE Defective line fuse usually indicates some other trouble. If new fuse blows, higher category of maintenance is required.
OVEN indicator lamp does not light.	<ul style="list-style-type: none"> a. Defective indicator lamp b. Defective crystal oven fuse. 	<ul style="list-style-type: none"> a. Check OVEN indicator lamp. Replace if necessary. b. Check oven fuse (fig. 4-1). NOTE Defective oven fuse usually indicates some other trouble. If new fuse blows, higher category of maintenance is required.

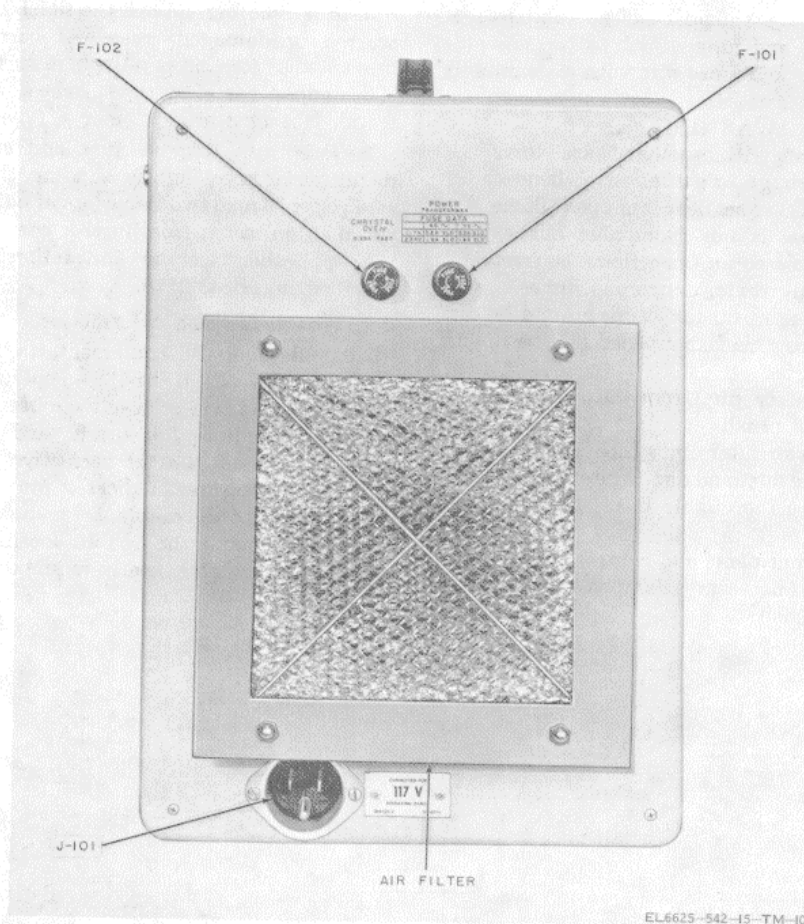


Figure 4-1. Electronic Marker Generator AN/USM-108A, rear view.

CHAPTER 5

FUNCTIONING OF EQUIPMENT

5-1. Block Diagram

(fig. 5-1)

The various circuits described in this chapter are made with reference to figure 5-1, a functional block diagram of the AN/USM-108A, and schematic diagrams (figs. 5-2 through 5-8).

5-2. Power Transformer.

a. The primary winding of power transformer T101 consists of two separate windings. One of the windings is tapped to furnish voltage to the ventilating

fan. Thermal switch K101 is a safety switch connected in series with the primary winding of the power transformer. In instances of fan failure or high ambient room temperature (above 1280F) K101 will open, thus protecting the instrument from damage due to excessive heat. The crystal oven will continue to operate when K101 opens. When the unit cools, K101 closes and power is restored to the unit. Fuse F101 is used as a protective device against electrical overload in the circuit.

Figure 5-1 Functional block diagram.
(Located in back of manual)

Figure 5-2 Power supply, schematic diagram.
(Located in back of manual)

b. The secondary winding of T101 consists of seven separate windings. Three of these windings are connected to selenium rectifier bridges which feed the regulated voltage supplies. Regulated voltages of +350, +225, and -150 are furnished by the supplies. Voltage sources of -8 and -15 volts are derived from the -150 volts supply.

5-3. Crystal Oven Transformer

Transformer T102 is a separate transformer which supplies 6.3 volts ac to a thermostatically controlled crystal oven. Lamp B201 indicates when the oven is on. Transformer T102 is directly fed from the ac powerline. Therefore, the ON-OFF power switch has no effect on the crystal oven control.

5-4. - 150 Volts Regulated Reference Voltage

The -150 volts regulated power supply is fed from the 185 volt secondary winding across terminals 11 and 12 of T101. Gas diode tube V149 acts as a reference voltage source for the -150 volts supply and maintains a fixed potential of -84 volts on the grid of V144 (one-half of a difference-amplifier). The triode section of V144 is connected across voltage divider R141, R142 and R143. The potential on the grid of V144A depends upon the setting of potentiometer R143, the -150 volts adjust

control. When this control is properly adjusted, the output voltage is exactly -150 volts. Capacitor C163 filters the output. Variations in the load which tend to change the output voltage cause the potential on the grid of V144A to change proportionately. An error voltage thus exists between the grids of the difference amplifier. The error voltage is amplified by V144B and fed directly to the grids of V157 and V167. The change in potential at the grid of these tubes causes a corresponding change in voltage at the plates. The voltage at the plates is coupled, in turn, through rectifier CR141 to compensate for variations in the output voltage and to cause it to return to the -150 volts level.

5-5. +225 Volts Supply.

The - 150 volts supply is used as a reference voltage for the +255 volts supply. Resistors R135 and R137 drop the - 150 volts supply to approximately zero on the grid of V124. If the load should change, any tendency of the +225 volts supply to change correspondingly would cause V124 to amplify the change, or error voltage. The output of V124 is directly coupled to cathode follower V107A. Thus, the amplified error voltage appears on the grid of the V107A. Because the cathode of V107A follows the

grid, the output voltage will be returned to its established value of +225 volts. Capacitor C136 is included to improve the response-time of the circuit to sudden changes in output voltage. The screen grid of V124 is connected to the unregulated power source through R121; therefore a small ripple voltage will appear at the screen. This ripple will be amplified through V124 and fed to both the grid and the plate of V107A. Because the grid and plate voltages are 180° out of phase, a cancellation of the ripple voltage occurs at the cathode. Thus, the ripple on the +225 volt bus is reduced to a negligible value.

5-6. +350 Volts Supply

The +350 volts supply is fed from a secondary winding across terminals 7 and 8 of T101. This supply functions the same way as the +225 supply. The rectified, filtered output from the 115 volts ac secondary winding is added to the input of the + 225 volts supply to furnish the power required for the +350 volts regulator.

5-7. Bias Voltages

Bias voltages for the electron tubes are derived from the --150 volts supply. A voltage-dividing network consisting of R174 and R176 across the output of the --150 volts supply drops the voltage at the junction of the two resistors to -8 volts. Capacitor C174 filters this output. The --15 volts supply is set by voltage divider R180,

R181. This voltage is then fed through cathode-follower V393A in order to present a low impedance source. Capacitor C170 filters the -15 volts output.

5-8. Oscillator and Multipliers

(fig. 5-3)

The oscillator is a conventional electron-coupled, crystal-controlled oscillator. The oscillator is designed to generate a nonsinusoidal rf voltage at a frequency of 1 megacycle. The crystal is incorporated in the oscillator circuit to maintain a constant frequency within a tolerance of +10 cycles. The crystal is installed in a thermostatically controlled oven to minimize frequency drift. Adjustable capacitor C205, connected across the crystal, permits slight adjustments to be made in oscillator frequency. The output waveform from the plate of V200B is fed to the grid of V204B through C210 and to the grid of V200A through RC network R203, C203. The RC network is incorporated to increase the risetime of the signal on the grid of isolating cathode-follower V200A so there is coincidence of pulses on the grid of V204B and V200A. Conventional voltage amplifier V204B provides a voltage gain of about two and one-half times the input voltage. Inductor L207 is a peaking device incorporated to improve the risetime of the output waveform.

Figure 5-3 Oscillator and multiplier, schematic diagram.

(Located in back of manual)

5-9. Amplifier and Cathode Follower

Triode V204A is biased at cutoff by voltage divider R213 and R214. Coupling capacitor C216, in conjunction with L116, forms a differentiating circuit which shapes the output wave of V204B into sharp pulses on the grid of V204A. The positive pulses are taken from the cathode as 1-microsecond markers. The output is then fed to S710 and to the 5-megacycle sine wave multiplier.

5-10. 5 MC Multiplier

Capacitor C222 and resistor R222 develop a grid-leak bias of -4 volts. This is sufficient to operate V224 as a class C amplifier. The plate tank circuit of V204B resonates at 5 megacycles. Inductors L224 and L227 are the primary and secondary, respectively, of an rf transformer. Inductor L227 resonates at a multiple of the primary frequency (10 megacycles) and is sustained by the primary excitation. The 5-megacycle sine wave developed across the tank circuit of V224 is link-coupled to output switch S710. The 5-megacycle multiplier

operates when any one of the SINE WAVE pushbutton switches is actuated.

5-11. 10 MC Multiplier

The grid circuit of V234 is inductively coupled to the plate tank circuit of the 5-megacycle multiplier through the rf transformer described above. The grid circuit is composed of L227, C227 and C229 and forms a series-resonant circuit tuned to 10 megacycles. This signal is amplified by V234 and fed to the tuned plate circuit. Inductor L234 is the primary of an rf transformer and is tuned to 10 megacycles. Like the 5-megacycle circuit described above, the secondary (L237) of the rf transformer is tuned to a multiple of the primary frequency (in this instance 50 megacycles) and is sustained by it. Like the 5-megacycle signal, the 10-megacycle signal is link-coupled to the output switch. The 10-megacycle multiplier operates only when the 10 MC or 50 MC pushbutton is actuated.

5-12. 50 MC Multiplier

This multiplier is composed of 50 megacycle amplifier V244 and its associated circuit components, and operates the same way as the 5 and 10 megacycle multipliers. The plate tank circuit of this multiplier is tuned to 50 megacycles and is link-coupled to the 50 MC sine wave output switch. Plate voltage for V244 is applied only when the 50 MC pushbutton is actuated.

5-13. Divider Circuits

a. There are 13 divider circuits, each containing a triggered multivibrator circuit (figs. 5-3 and 5-4). The fourteenth marker receives its signal directly from the crystal-controlled oscillator. The 10, 50, 100 and 500 microsecond markers are the high-frequency dividers. The 1, 5, 10 and 50 millisecond markers are the intermediate dividers. The 100 and 500 millisecond and the 1 and 5 second markers are the low-frequency dividers.

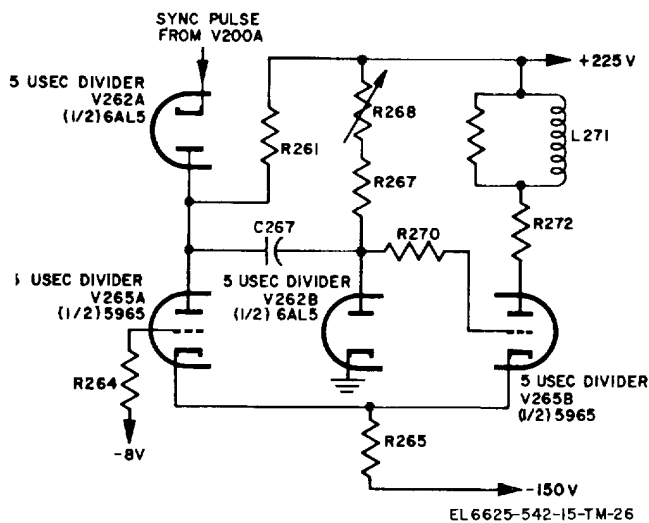


Figure 5-4. Multivibrator circuit, simplified schematic diagram.

b. Operation of each divider circuit is essentially the same. Each circuit consists of a bi-stable multivibrator with diode coupling for triggering pulses. Operation of these circuits is described in the paragraphs that follow. Figure 5-4 is a simplified schematic diagram of a multivibrator circuit and should be referred to during the following description.

5-14. Multivibrator

a. Oscillations of the multivibrator are maintained by the alternate shifting of conduction from V265A to V265B. Once started, each tube would tend to conduct indefinitely if the potential on the tube elements were not

changed periodically by the TM 11-6625-542-14-1 trigger pulses from V200A. The cycle starts in this example with tube V265B at zero bias and V265A at cutoff. Tube V265B is held in conduction by the gridclamping action of diode V262B, while V265A does not conduct because of the fixed grid bias of -8 volts.

b. The trigger pulse which shifts the multivibrator from a quiescent to an unstable state is a negative-going pulse of approximately 50 volts fed to the cathode of V262A. This pulse drives the cathode more negative than the plate causing V262A to conduct. The plate of V262A is coupled to the grid of V265B through C267; therefore the negative pulse breaks the clamping action of V262B and drives the grid of V265B negative. This, in turn, causes the cathode current to decrease. The decreasing cathode current through R265 causes the potential on the cathode of V265A to decrease. When the voltage on the cathode decreases to -8 volts, V265A conducts, causing a further drop in voltage at the plate. This negative-going voltage, like the trigger pulse, is coupled to the grid of V265B through C267 and aids the negative-going trigger pulse in driving V265B to cutoff.

c. As tube V265A conducts, the plate voltage continues to drop until it reaches the same potential as that which is on the plate of V262A (175 volts). At this point, the plate of V262A is more negative than the cathode and subsequent trigger pulses cannot reach the grid of V265B. As the charge across C267 equalizes, the grid of V265B becomes more and more positive until the clamping action of V262B is restored.

d. At this point, the multivibrator begins to revert to its initial state, for as V265B begins to conduct the voltage on the cathode of V265A raises again to cutoff potential. The subsequent drop in current through R261 causes the plate voltage of V265A to increase. As the plate voltage of V265A increases, C267 takes on a charge. The multivibrator is now restored to its quiescent state and, in the absence of further trigger pulses, would remain so. But since more trigger pulses do follow the initial trigger, the multivibrator continues indefinitely to shift conduction from one tube to another as described above. The values of the components in the 5 microsecond divider are selected to provide an elapsed time of 5 microseconds for each complete cycle.

5-15. Cathode Follower

Cathode follower V200A, which couples the 5 megacycle oscillator to the 5 microsecond divider, isolates the divider stage from the oscillator. It also prevents any variations in the divider from affecting the stability of the oscillator.

5-16. 10 A SEC Divider

This circuit operates the same way as the 5-microsecond circuit, except that the time constant components are of

such value that the input diode will pass one pulse for every two pulses at the cathode.

Figure 5-5 Low frequency dividers, schematic.

(Located in back of manual.)

5-17. Other Dividers

The other multivibrator circuits operate in a manner similar to the 5p sec and 10psec dividers previously

described. With the exception of the five second divider, each divider contains a cathode follower in its output circuit.

Figure 5-6 Intermediate frequency dividers, schematic diagram.

(Located in back of manual)

Figure 5-7 High frequency dividers, schematic diagram.

(Located in back of manual)

5-18. Pushbutton Switches

The banana jacks, which are independent of the switches, receive signals directly from the dividers and multipliers. The MARKER OUT connector receives signals selected by the pushbutton switches, through a series isolation resistor for each divider circuit.

5-19. Trigger Out Connector

(fig. 5-8)

The TRIGGER OUT connector receives the individual signals of 10w sec, 100, u sec, 1 msec, 10 msec, 100 msec. These signals are fed to cathode follower V750A and are capacitive-coupled to V750B through C752. The dc level of the signal is a function of the signal repetition

rate due to capacitor C752. To overcome a wide range in the dc level of the signal, diode V760 is incorporated in the grid circuit of V750B. Resistor R756, along with diode V760, holds the grid of V750B at - 7 volts when no signal is present. When a positive-going signal appears, diode V760 ceases conduction, thus allowing the grid and cathode to follow the signal excursion. When the signal passes, diode V760 and its associated circuitry clamp the grid to --7 volts. The pulses at the TRIGGER OUT connector will always start about +6.5 volts. The amplitude of the pulses will depend upon the input signal at the grid of V750A.

Figure 5-8 Trigger cathode follower and switching, schematic diagram.

(Located in back of manual)

CHAPTER 6

GENERAL SUPPORT MAINTENANCE INSTRUCTIONS

Section I. GENERAL TROUBLESHOOTING TECHNIQUES

NOTE

No direct support maintenance is authorized.

WARNING

Voltages as high as 230 volts exist at various points in the equipment. Be careful when servicing the equipment, even when power has been turned off as voltages may still be present in the line power circuitry. Failure to comply may result in serious or fatal injury.

6-1. General Instructions

Troubleshooting at general support includes all the techniques required to isolate a defective part. Section II presents detailed troubleshooting procedures to enable the repairman to localize and isolate a defective component.

6-2. Organization of Troubleshooting Procedures

a. General. The first step in servicing a defective AN/USM-108A is to sectionalize the fault. Sectionalization means tracing the fault to one of the three major sections responsible for the abnormal operation: the power supply section, the oscillator section, and the divider section. The second step is to localize the fault. Localization means tracing the fault to a particular stage or network within one of the three major circuits. The third step is to isolate the fault. Isolation means tracing the fault to the defective part responsible for the abnormal condition. Some faults, such as burned-out resistors, arcing, and shorted transformers, often can be located by sight, smell, and hearing. The majority of faults, however, must be isolated by checking voltages and resistances.

b. Component Sectionalization, Localization, and Isolation. Listed in (1) through (4) below is a group of tests arranged to simplify and to reduce unnecessary work and to aid in tracing a trouble to a specific component. Follow the procedure in the sequence given.

(1) Visual inspection. The purpose of visual inspection is to locate any visible trouble. Through

inspection alone, the repairman frequently may discover the trouble or determine the circuit in which the trouble exists. This inspection is valuable in avoiding additional damage which occurs through improper servicing methods and in forestalling future failures.

(2) *Operational test.* The operational test will usually indicate the general location of trouble and will help in determining the exact nature of the fault. An operational test is given in paragraph 6-5.

(3) *Troubleshooting procedure.* The trouble symptoms listed in this procedure (sec II) will aid greatly in locating trouble.

(4) *Intermittents.* In all these tests, the possibility of intermittent conditions should not be overlooked. If present, this type of trouble often may be made to appear by tapping or jarring the equipment. It is possible that some external connections may cause the trouble. Test wiring for loose connections and moves wires and components with an insulated tool, such as a pencil or fiber rod. This may show where a faulty connection or component is located.

6-3. Test Equipment Required

The items of test equipment required for troubleshooting the AN/USM-108A are listed below. Technical manuals associated with each item are also listed.

Test equipment	Technical Manual
Voltmeter, Electronic AN/USM-98	TM 11-6625-438-15
Variable Transformer CN-16/A	
oscilloscope AN/USM-281A	TM11-6625-1703-15
53-ohm termination connector	
93-ohm termination connector	
Digital Readout Electronic Counter AN/USM-207	TM 11-6625-700-10

Section II. TROUBLESHOOTING PROCEDURES

6-4. Preliminary Setup

a. Determine power source to be used and connect power cable to rear of the AN/USM-108A and to power source. If other than 117 vac power is to be used, refer to paragraph 2-4 for rewiring of the power transformer.

b. Set POWER ON switch to ON and check to see that POWER ON indicator and CRYSTAL HEATER indicator illuminate.

c. Allow equipment to warmup for a minimum of 15 minutes prior to testing.

CAUTION

This is a precision electronic test instrument. As such, it includes factory adjusted controls and specially processed vacuum tube. Unnecessary tube replacement may degrade the performance of the unit. When testing vacuum tubes, replace all good tubes in their original sockets.

6-5. Operational Test

(table 6-1)

a. Microseconds Circuits.

(1) Connect oscilloscope to MARKER OUT connector (refer to section IV for test equipment setup).

(2) Check to see that proper waveshapes and time marks are obtained when MICROSECONDS pushbuttons are depressed.

b. Milliseconds Circuits. Connect oscilloscope to MARKER OUT connector and check to see that proper waveshapes and time marks are obtained when MILLISECONDS pushbuttons are depressed.

c. Second Circuits. Connect oscilloscope to MARKER OUT connector and check to see that proper waveshapes and time marks are obtained when SECONDS pushbuttons are depressed.

d. Trigger Rate Circuits. Connect oscilloscope to TRIGGER OUT connector and check to see that proper waveshapes and time marks are obtained when TRIGGER RATE pushbuttons are depressed.

Table 6-1. Waveshapes

OSCILLOSCOPE TIME/DIV	TYPE 108A OUTPUT		TYPE ADJUSTMENT	DISPLAYED WAVE FORM
	TRIGGER	MARKERS		
1 USEC	100 KC	1 AND 5 MICROSECONDS	5 USEC	
5 USEC	100 KC	5 AND 10 MICROSECONDS	10 USEC	
10 USEC	10 KC	10 AND 50 MICROSECONDS	50 USEC	
50 USEC	10 KC	50 AND 100 MICROSECONDS	100 USEC	
100 USEC	1 KC	100 AND 500 MICROSECONDS	500 USEC	
500 USEC	1 KC	500 MICROSECONDS 1 MILLISECOND	1 MS	
1 MS	100 CYCLES	1 AND 5 MILLISECONDS	5 MS	
5 MS	100 CYCLES	5 AND 10 MILLISECONDS	10 MS	
10 MS	10 CYCLES	10 AND 50 MILLISECONDS	50 MS	
50 MS	10 CYCLES	50 AND 100 MILLISECONDS	100 MS	
100 MS	1 CYCLE	100 AND 500 MILLISECONDS	500 MS	
500 MS	1 CYCLE	500 MILLISECONDS 1 SECOND	1 SEC	
1 SECOND	*	1 AND 5 SECONDS	5 SEC	

* USE INTERNAL WIRING

EL 6625-542-15-TM-27

6-6. Sectionalization Testing

The following procedure describes methods by which troubles may be traced to a particular section. When troubleshooting the AN/USM-108A, investigate the power supply section first, because all other sections are dependent upon it.

a. Power Supply.

(1) Check to see that ac power is connected.

(2) With POWER ON switch in the ON position, indicator lamp should be lighted and cooling fan operating. Check fuse F101 if necessary.

(3) Take a voltage measurement check at the

output of the five voltage supplies. (See test points and voltages in paragraph 7-5.) If voltages are abnormal, check tubes, then components, paying particular attention to the metallic rectifier in the faulty circuit.

b. Oscillator Check.

- (1) Remove tube V262 from socket.

NOTE

This action removes the divider stages from the oscillator and multiplier.

- (2) Place oscilloscope probe into 1 MICROSECOND output jack and check for 1 mc output.

NOTE

If 1 mc output registers on scope, the oscillator and amplifier stages are functioning properly.

- c. Divider Check.

NOTE

Be sure oscillator and amplifier circuits are operating properly before checking the divider stages.

- (1) Check waveforms and test points as described in paragraph 7-10. Any abnormal waveforms indicate a defective stage. Refer to 4 figures 6-1 and 6-2 for pin voltages.

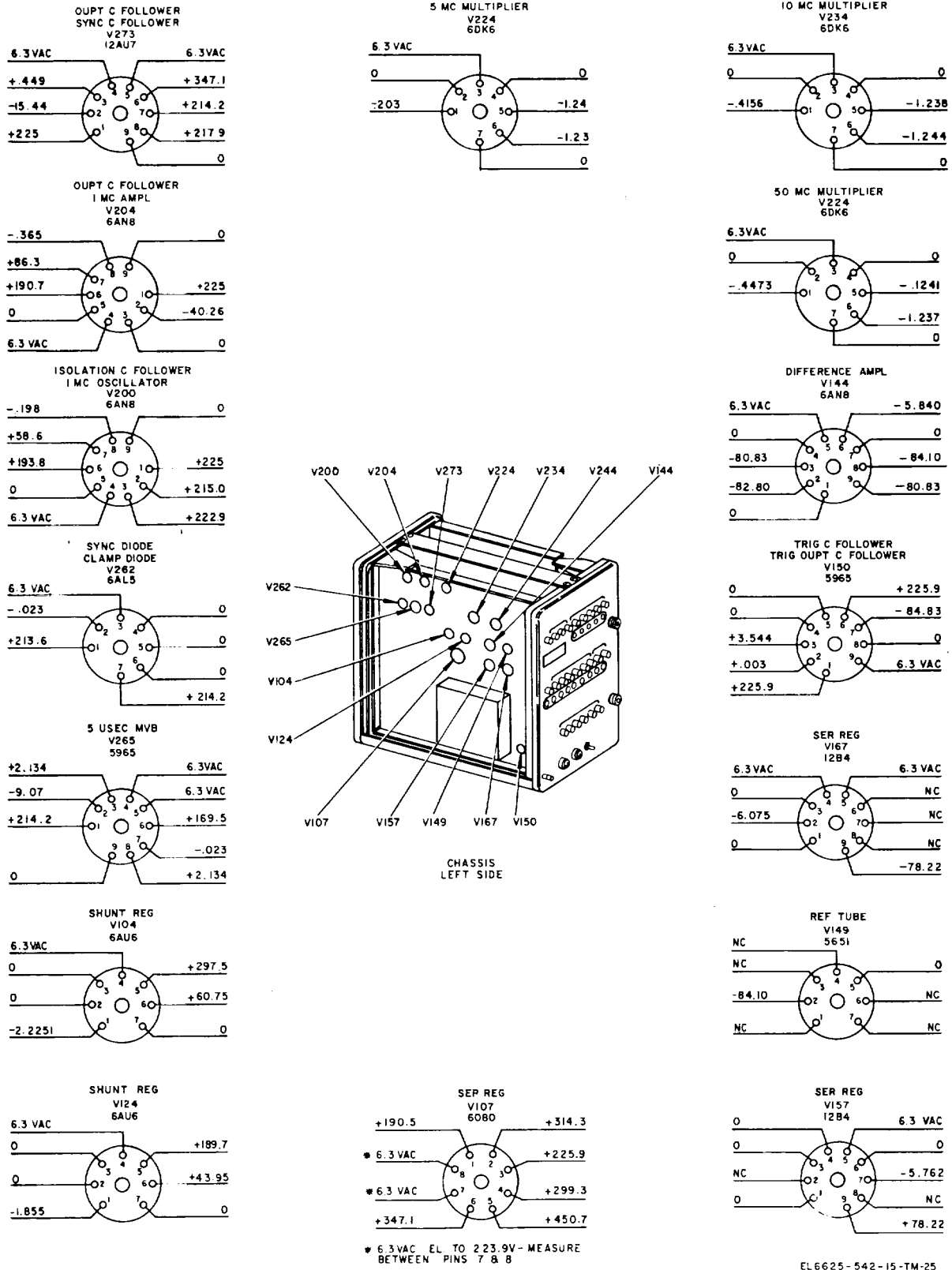


Figure 6-1. Pin voltages, left side.

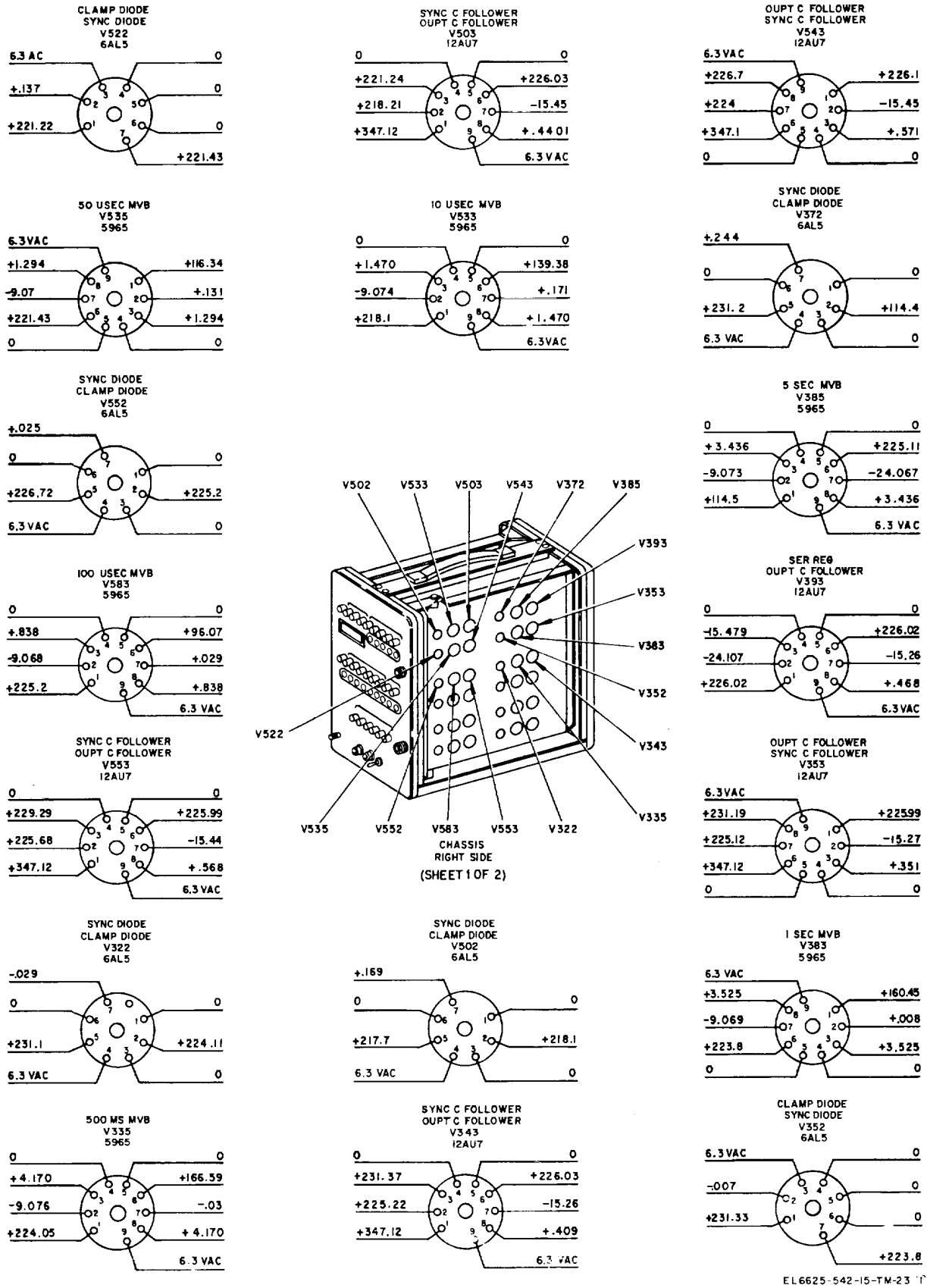


Figure 6-2 (1). Pin voltages, right side (sheet 1 of 2).

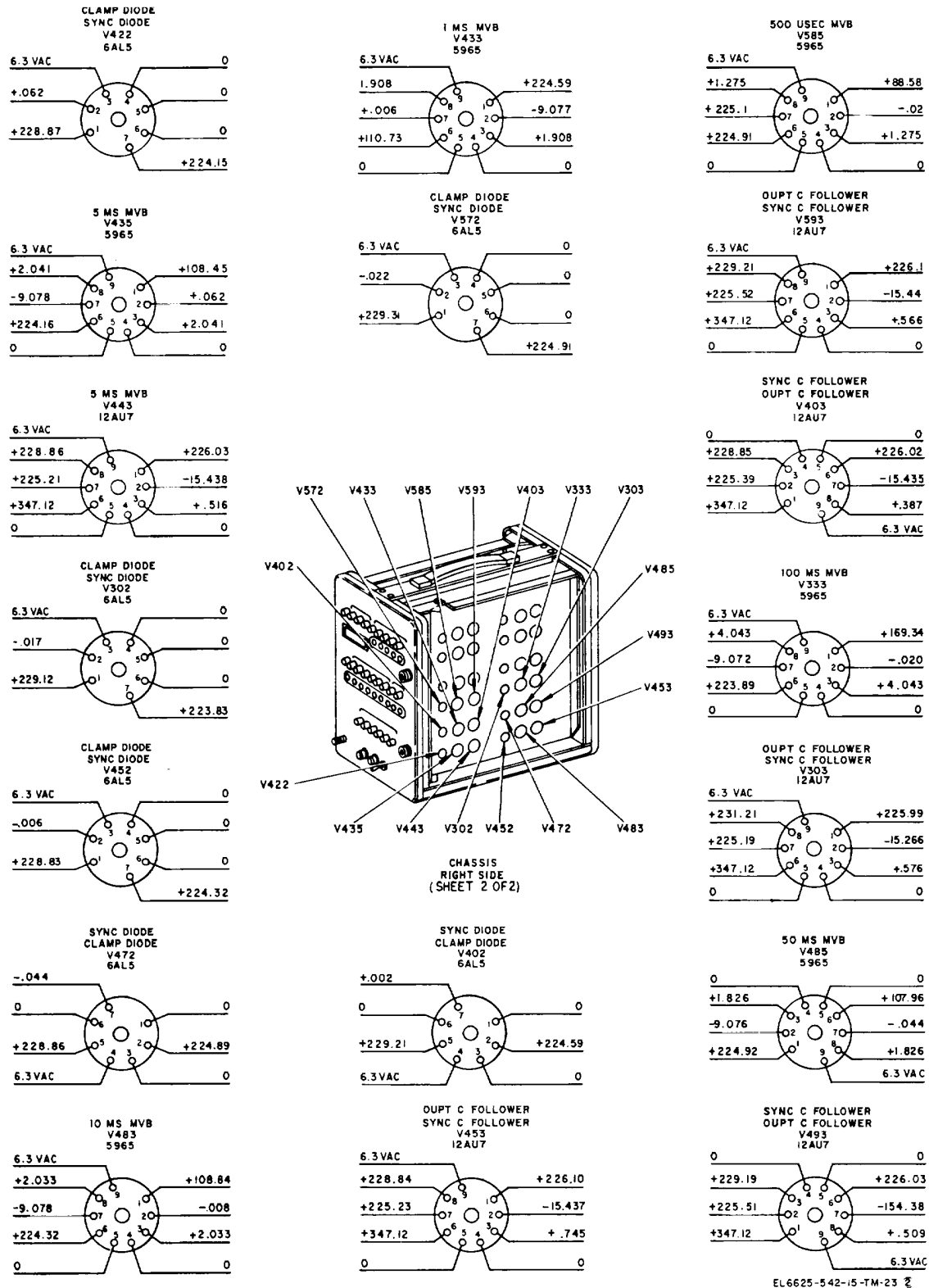


Figure 6-2 (2). Pin voltages, right side (sheet 2 of 2).

(2) Remove diode which couples defective stage to following stages. If the defective stage then functions normally, the trouble is probably due to loading by the stages that follow.

NOTE

Before replacing any components, isolate the trouble by checking the multivibrator with an oscilloscope and voltmeter.

(3) To check multivibrator, check the incoming signal at the grid on one-half of the tube and the output signal. An oscilloscope is used for this test. If desired signals are present and pin voltages are correct, check for signals at the output cathode follower stage. If no signal appears on the cathode, check through switch S710 to the MARKER OUT connector.

(4) If the input signal to the multivibrator registers on the oscilloscope but no signal appears at the output, measure the voltage at multivibrator plate which connects directly to the input diode plate. The voltage reading should be +225 volts. The plate voltage of the other half of the tube should read + 100 volts. The grid voltage on the first half of the tube should read approximately --6 to --8 volts.

d. Multiplier Checks. The multiplier circuits may become faulty due to tube failure. These troubles may be corrected by replacing the faulty tube. Readjustments are sometimes necessary due to aging of components and to variations in characteristics of replacement parts. Refer to section III for adjustments.

Table 6-2. Troubleshooting

Malfunction	Probable cause	Corrective action
1. Improper or loss of time-marks when 1 MICROSECONDS button depressed.	Defective tube V262, V265, V273	Check and replace defective tube.
2. Improper or loss of time-marks when 5 MICROSECONDS button is depressed.	Defective tube V262, V265, V273, V502, V503, or V533.	Check and replace defective tube.
3. Improper or loss of time-marks when 10 MICROSECONDS button is depressed.	Defective tube V502, V503, V533, V522, V543, or V535	Check and replace defective tube.
4. Improper or loss of time-marks when 50 MICROSECONDS button is depressed.	Defective tube V522, V543, V535, V552, V553, or V583.	Check and replace defective tube.
5. Improper or loss of time-marks when 100 MICROSECONDS button is depressed.	Defective tube V552, V553, V533, V572, V593, or V585.	Check and replace defective tube.
6. Improper or loss of time-marks when 500 MICROSECONDS button is depressed	Defective tube V572, V593, V585, V402, V403, or V433.	Check and replace defective tube.
7. Improper or loss of time-marks when 1 MILLISECONDS button is depressed.	Defective tube V402, V403, V433, V422, V443, or V435.	Check and replace defective tube.
8. Improper or loss of time-marks when 5 MILLISECONDS button is depressed.	Defective tube V422, V443, 435, V452, V453, or V483.	Check and replace defective tube.
9. Improper or loss of time-marks when 10 MILLISECONDS button is depressed.	Defective tube V452, V453, V483, V472, V493, or V485.	Check and replace defective tube.
10. Improper or loss of time-marks when 50 MILLISECONDS button is depressed	Defective tube V472, V493, V485, V302, V303, or V333.	Check and replace defective tube.
11. Improper or loss of time-marks when 100MILLISECONDSbutton is depressed.	Defective tube V302, V303, V333, V322, V343, or V335.	Check and replace defective tube.
12. Improper or loss of time-marks when 500MILLISECONDSbutton is depressed.	Defective tube V322, V343, V335, V352, V353, or V383.	Check and replace defective tube.
13. Improper or loss of time-marks when 1 SECONDS button is depressed.	Defective tube V352, V353, V383, V393, V385, or V372.	Check and replace defective tube.
14. Improper or loss of time-marks when 5 SECONDS button is depressed.	Defective tube V393, V385, V372.	
15. Improper or loss of trigger pulses when 100KC-10SCS button is depressed.	Defective tube V262, V273, V265, V502, V503, or V533.	Check and replace defective tube.
16. Improper or loss of trigger pulses when 10 KC-100 S button is depressed.	Defective tube V522, V543, V535, V552, V553, or V583.	Check and replace defective tube.
17. Improper or loss of trigger pulses when 1KC-IMS button is depressed.	Defective tube V572, V593, V585, V402, V403, or V433.	Check and replace defective tube.
18. Improper or loss of trigger pulses when 100 - IOMS button is depressed.	Defective tube V422, V443, V435, V452, V453, or V483.	Check and replace defective tube.
19. Improper or loss of trigger pulses when 10S-IOMS button is depressed.	Defective tube V472, V493, V485, V302, V303, or V333.	Check and replace defective tube.
20. Improper or loss of trigger pulses when 1S-ISEC button is depressed.	Defective tube V322, V343, V335, V352, V353, or V383.	Check and replace defective tube.

6-7. Electron Tube Replacement Techniques

To prevent the discarding of good electron tubes, follow the procedures given in a through j below when troubleshooting the AN/USM-108A. Refer to figures 6-3 and 6-4 for tube locations.

a. Inspect all cabling, connectors, and the general condition of the AN/USM-108A before removing the electron tubes.

b. Isolate the trouble, if possible, to a particular circuit. (Use troubleshooting table 6-2 as a guide.)

c. If a tube tester is available, remove and test one tube at a time. Substitute new tubes only for those that are defective.

d. If a tube tester is not available, troubleshoot by the substitution method.

(1) Replace one of the suspected tubes with a known good tube.

(2) Check to see whether the circuit is operative. If the circuit is operative, discard the original tube. If the circuit is inoperative, remove the new tube and reinsert the original tube.

(3) Continue to check the suspected tubes, using the procedures given in (1) and (2) above, until the circuits become operative or until all the suspected tubes have been checked.

e. If the circuit is inoperative after the procedure outlined in a through d above is completed, continue as follows:

(1) Replace the suspected tubes, one at a time, with known good tubes until the circuit becomes operative or until all the suspected tubes are replaced by new ones. Note the sockets from which the original tubes were removed. If the circuit begins to operate, discard the last tube removed.

(2) Reinsert the remaining original tubes, one at a time, in the original sockets. If the circuit fails to operate at any time during this step, discard the original tube last reinserted. Do not leave a new tube in a socket if the equipment operates satisfactorily with the original tube.

NOTE

If a replacement for a bad tube soon becomes defective, check the adjustment and condition of parts in the tube circuit. Otherwise, continued tube replacement will result in only temporary repair, and more serious troubles may result. f. If the tube substitution does not correct the trouble, reinsert the original tubes in the original sockets before forwarding the defective for higher category repair.

g. Discard tubes when-

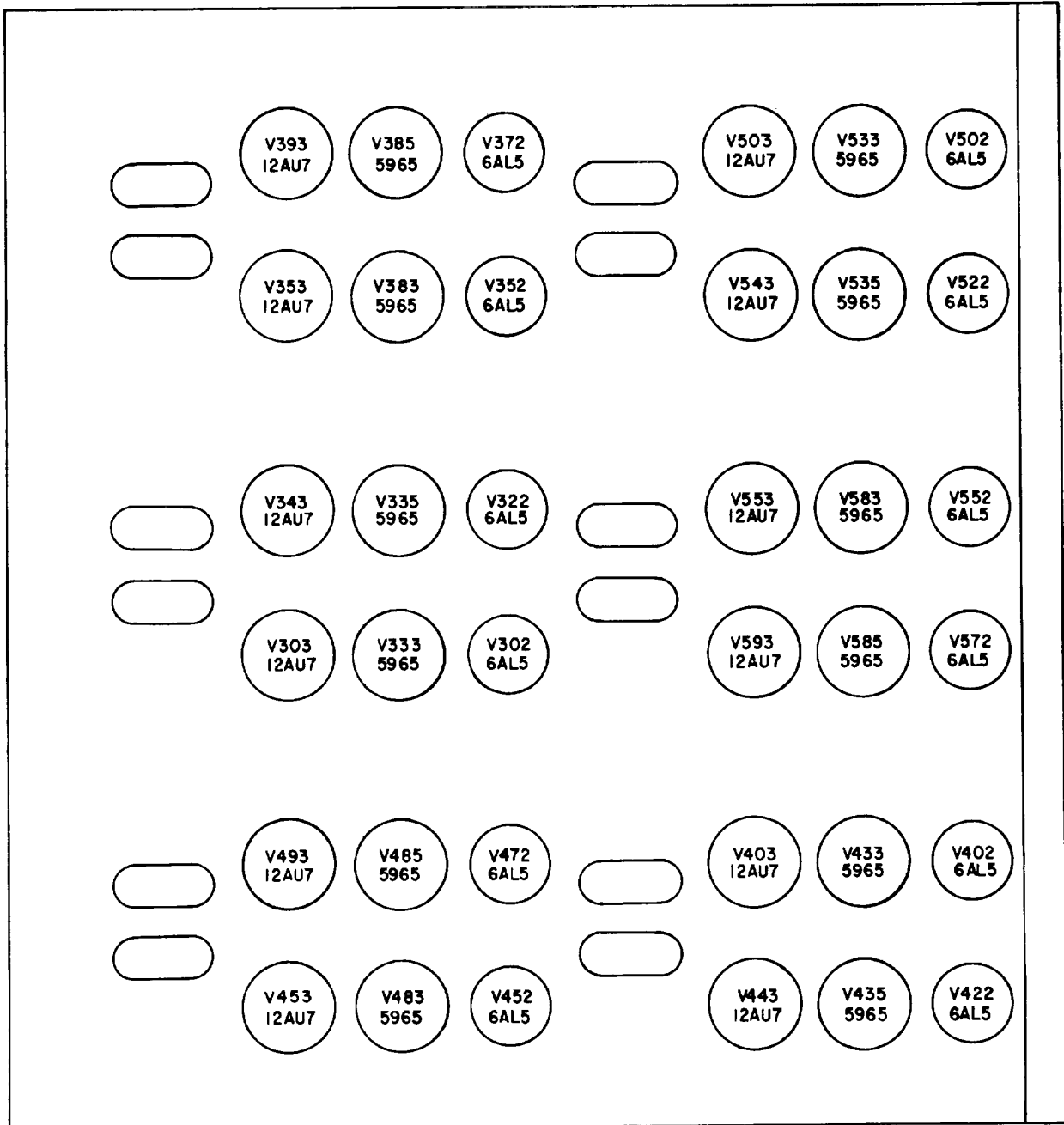
(1) A test by a tube tester or other instrument shows that they are defective.

(2) The tube defect is obvious. For example, the glass envelope is broken or a connecting prong or lead is broken.

h. Do not discard tubes merely because the tubes have been used for a specified length of time. Satisfactory operation in a circuit is the final proof of tube quality. The tube in use may work better than a new one.

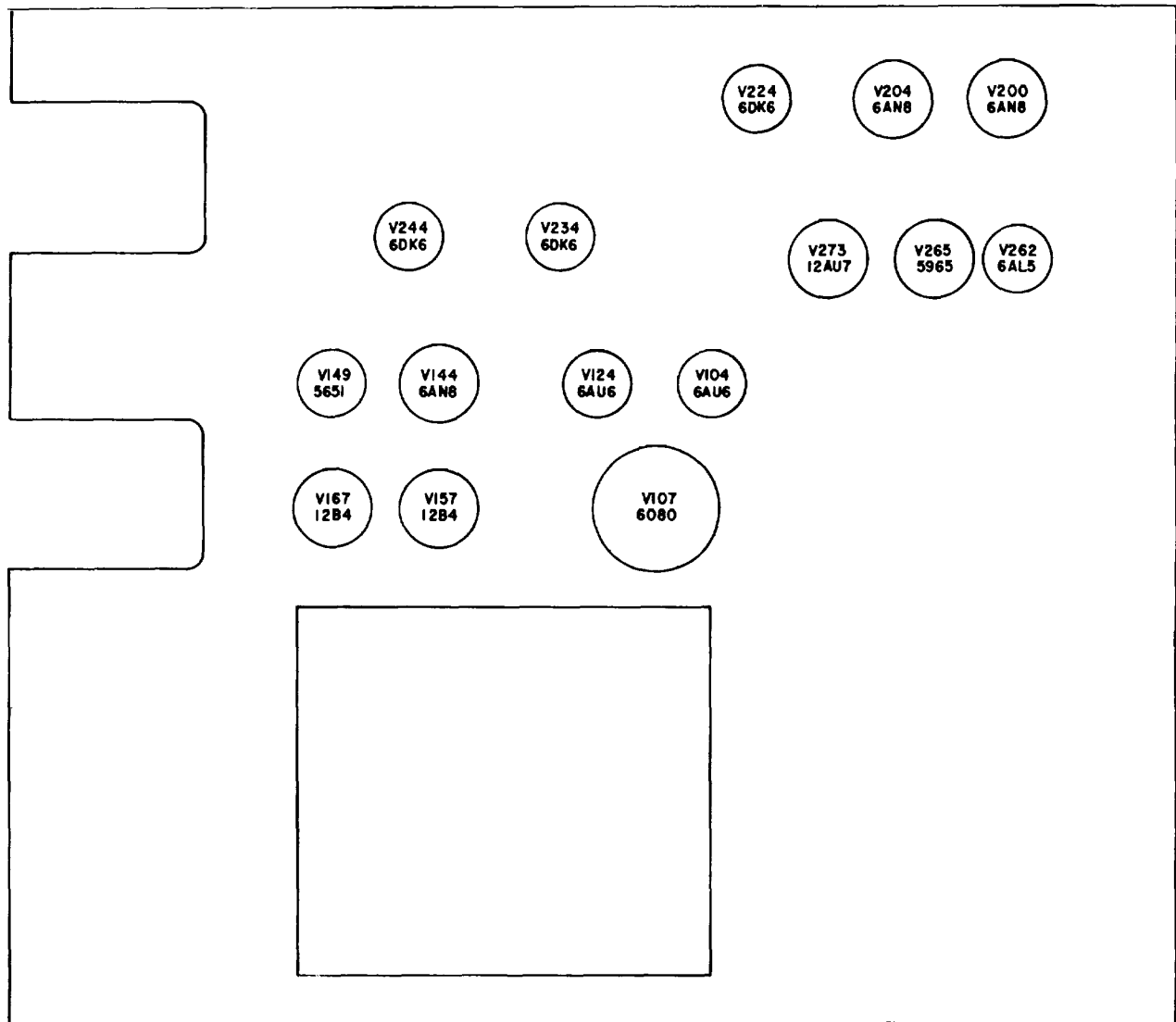
i. Do not discard tubes merely because they fall on, or slightly above, the minimum acceptable value when checked in a tube tester. Some new tubes fall near the low end of the acceptable range; yet these tubes may provide satisfactory performance throughout a long period of operational life at this near limit value.

j. Be careful when withdrawing a miniature tube from its socket. Do not rock or rotate the top when removing it from its socket; pull it straight out. The external pin and the wire lead sealed in the glass base are of two different metals that are butt-welded together where the pin appears to enter the glass. Rocking or rotating the tube causes bending, which tends to break this weld or causes a resistance or intermittent joint to develop.



EL6625-542-15-TM-13

Figure 6-3. Tube locations, right side.



EL6625-542-15-TM-28

Figure 6-4. Tube locations, left side.

Section III. REPAIRS AND ADJUSTMENTS

6-8. General Precautions

Observe the following precautions carefully when servicing the AN/USM-108A:

- a. When servicing the chassis assembly, do not disturb the settings of the variable resistors.
- b. When changing a component that is held by screws, always replace the lockwashers.
- c. Careless replacement of parts often makes new faults inevitable. Note the following points:

- (1) Before a part is unsoldered, note position

of leads. If leads are numerous, tag leads.

- (2) Care must be taken to avoid damage to other leads.

- (3) Use the correct size soldering iron to avoid overheating components and damaging neighboring components.

- (4) Do not allow loose solder to drop into the unit thus avoiding the possibility of a short circuit.

(5) A carelessly soldered connection may create new faults. It is important to make well-soldered joints because a poorly soldered joint is one of the most difficult faults to find.

(6) Replace parts in the circuit in exactly the same position occupied by the original part. A part that has the same electrical value but different physical size may cause trouble. Give particular attention to proper grounding when replacing a part; use the same ground as in the original wiring. Failure to observe these precautions may result in decreased output or parasitic oscillations.

(7) Do not disturb any of the alignment adjustments unless it definitely has been determined that the trouble is caused by an adjustment.

6-9. Replacement of Parts

a. The components of AN/USM-108A are easily reached and replaced if found faulty. The transformer, reactors, and terminal boards are mounted securely to the chassis with hexagonal nuts and machine screws.

b. If any of the switches require replacement, carefully mark the wires connected to the switch with tags to avoid misconnection when the new switch is installed. Follow this practice whenever replacement requires the disconnection of numerous wires.

c. For tube replacement techniques, refer to paragraph 6-7.

d. Refer to figure 6-5 (1) through (11) for location of parts.

6-10. Disassembly and Assembly of Front Panel

a. *Disassembly.* Disassembly of the front panel is necessary if any of the front panel switches are repaired or replaced. Follow the procedure outlined below:

(1) Disconnect power cable from source and from AN/USM-108A.

(2) Disconnect radio frequency cables from front panel.

(3) Remove side covers from AN/USM-108A by turning two locking screws on each side of chassis, disengaging the covers at the bottom of the chassis and removing covers.

(4) Remove six screws from front panel; one in each corner and two securing the nameplate to the front panel.

(5) Remove grounding lug from front panel by removing screw at rear of lug.

(6) Unscrew lenses from indicator lamps on front of panel; note color.

(7) Remove retaining nut from POWER ON switch.

(8) Remove retaining nuts from rear of indicator lamps.

(9) Remove front panel and trim strip.

b. *Assembly.*

(1) Position front panel and trim strip onto chassis.

(2) Position indicator lamps through front panel and secure in place with retaining nuts.

(3) Position POWER ON switch through front panel and secure in place with retaining nut.

(4) Screw proper-colored indicator lenses onto indicator lamps.

(5) Install grounding lug in front panel and secure with nut on rear of panel.

(6) Position nameplate on front panel and secure in place with two screws.

(7) Install four screws in corners of front panel.

(8) Install side covers in position at bottom of chassis and secure in place with two locking screws on each side cover.

(9) Connect cables as required.

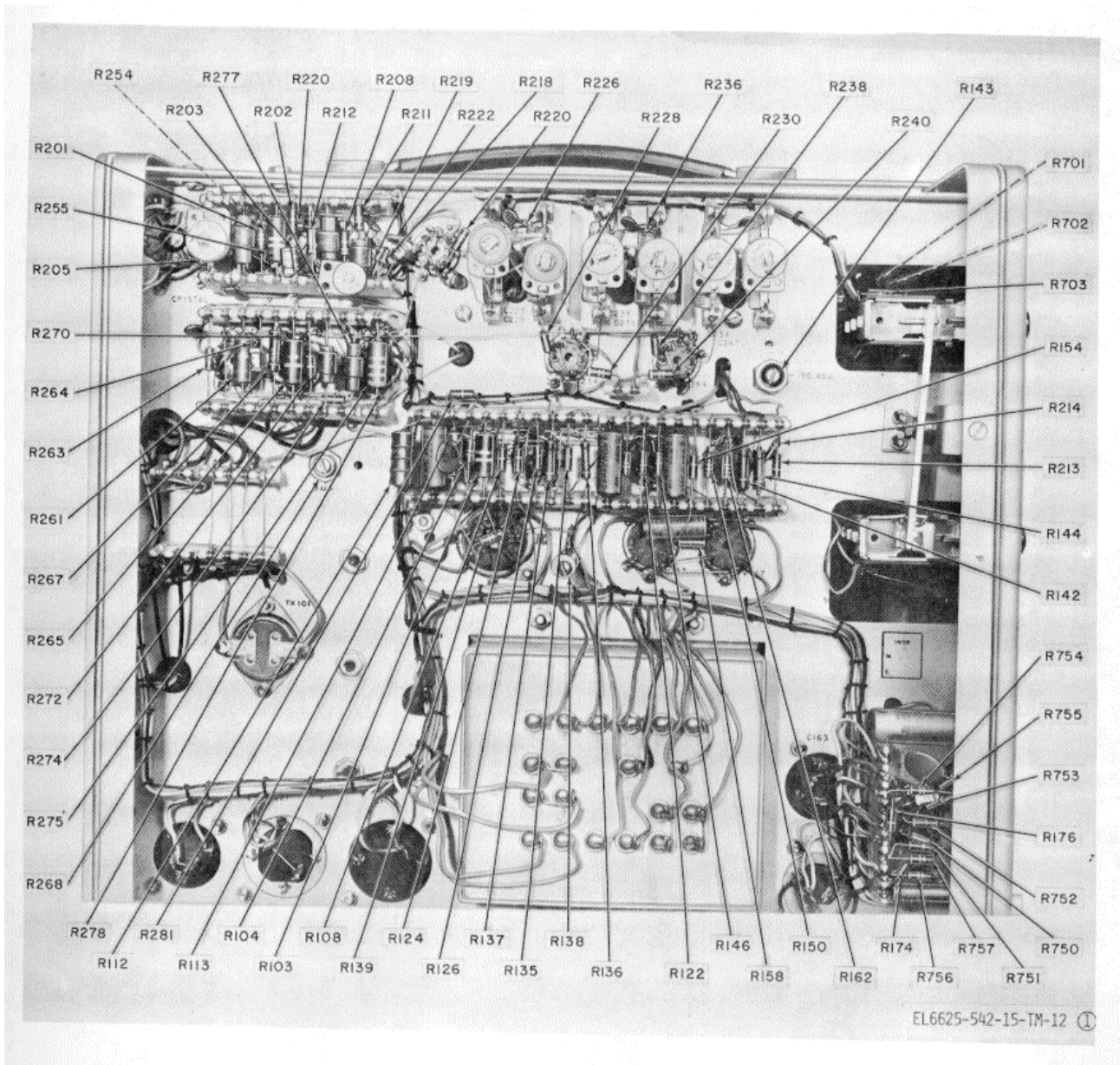


Figure 6-5 (1). Parts identification location (sheet 1 of 1).

Figure 6-5

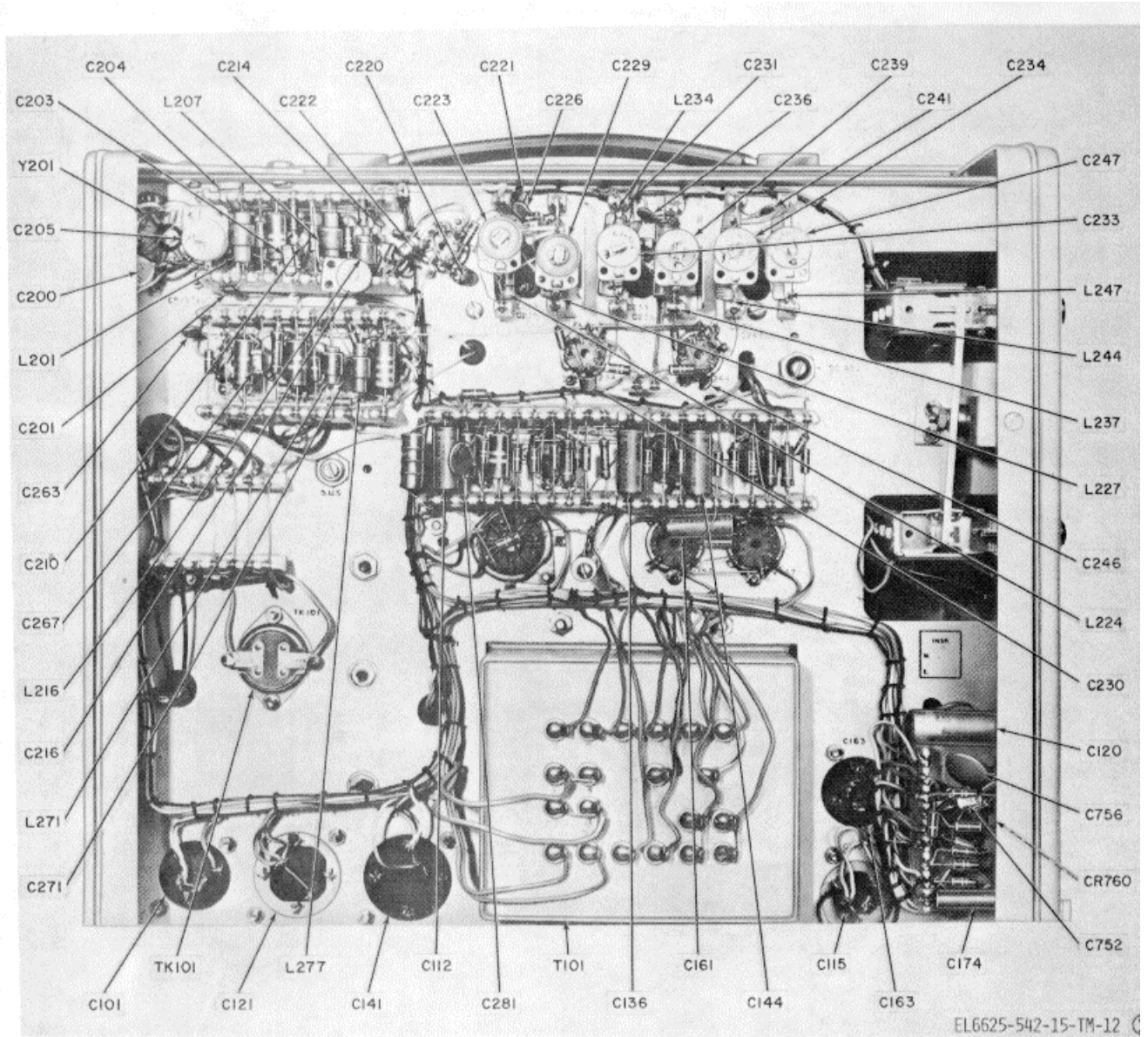


Figure 6-5 (2). Part identification location (sheet 2 of 11).

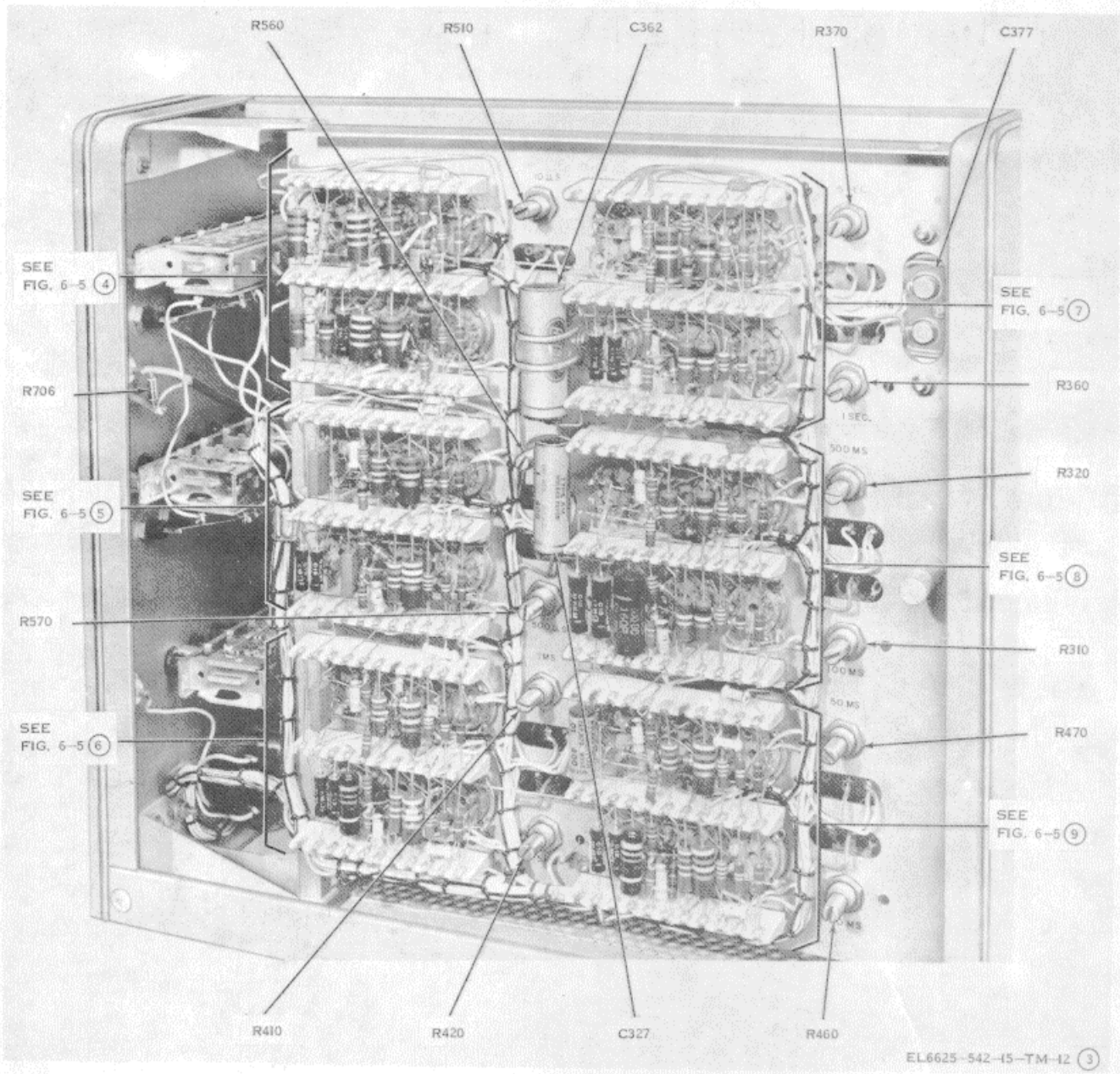


Figure 6-5 (3). Parts identification location (sheet 3 of 11).

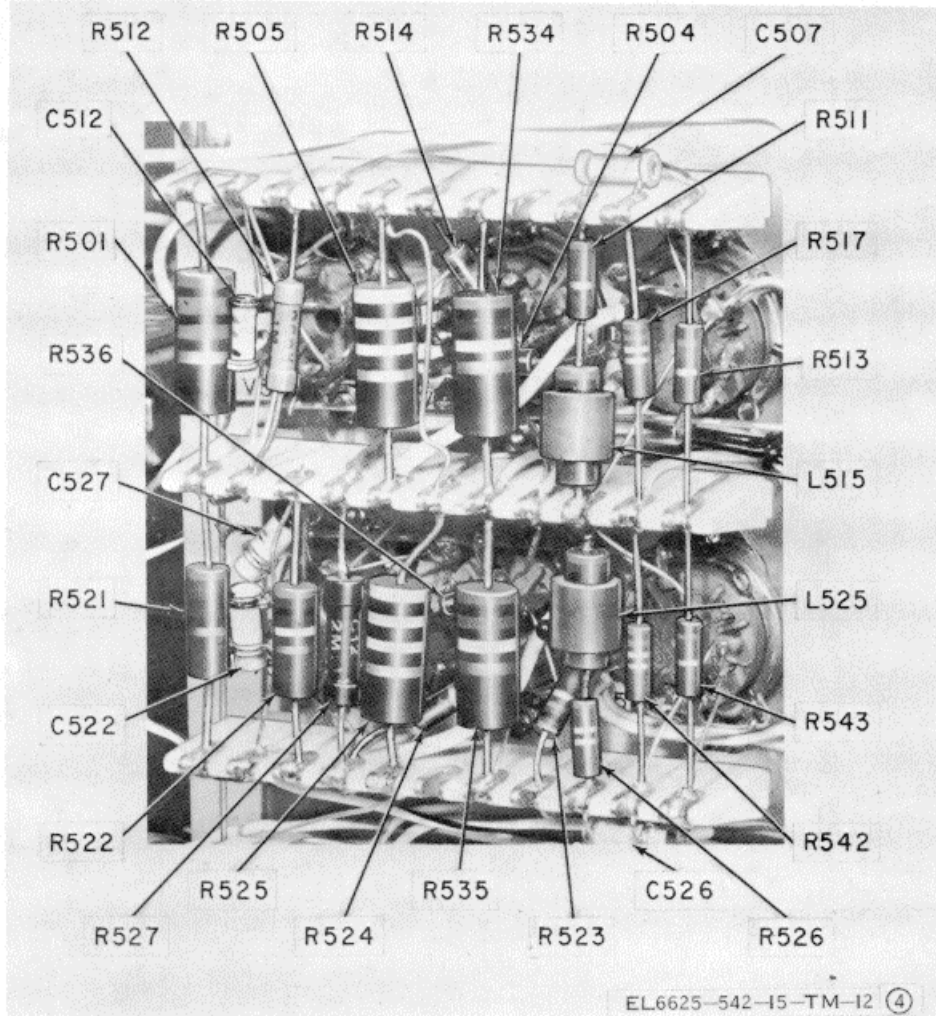


Figure 6-5 (4). Parts identification location (sheet 4 of 11).

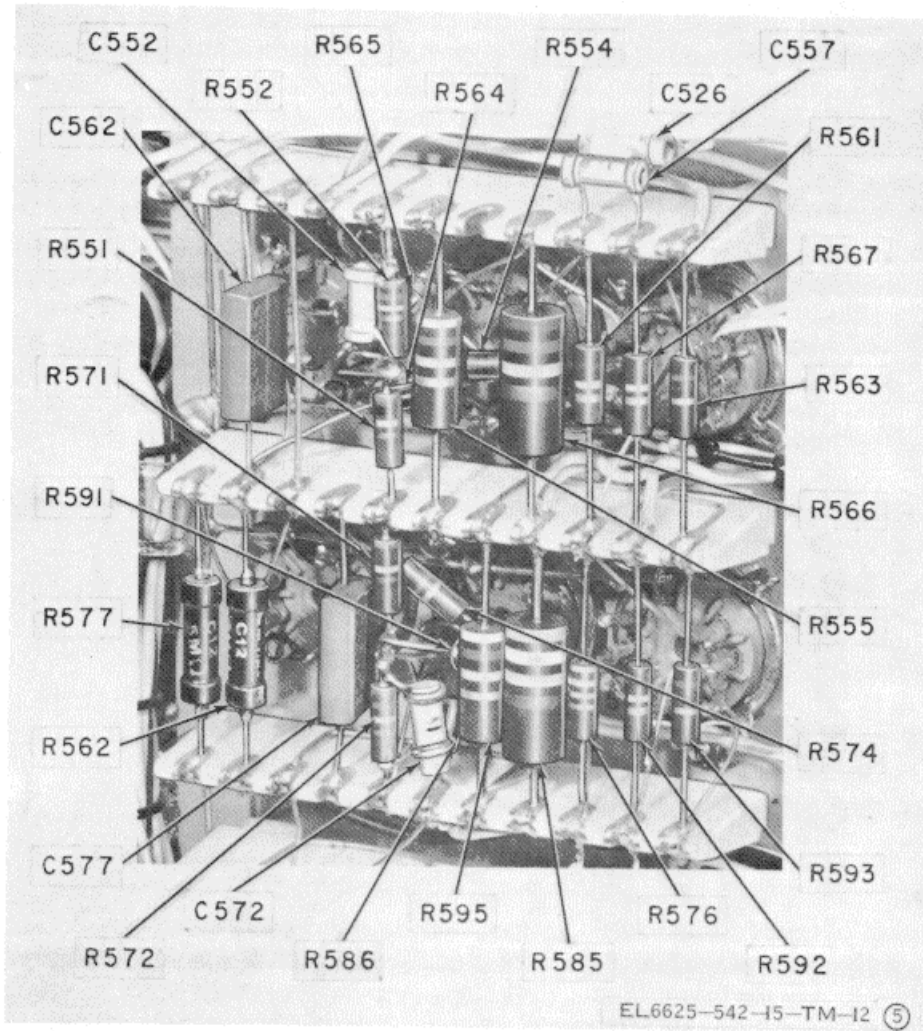


Figure 6-5 (5). Parts identification location (sheet 5 of 11).

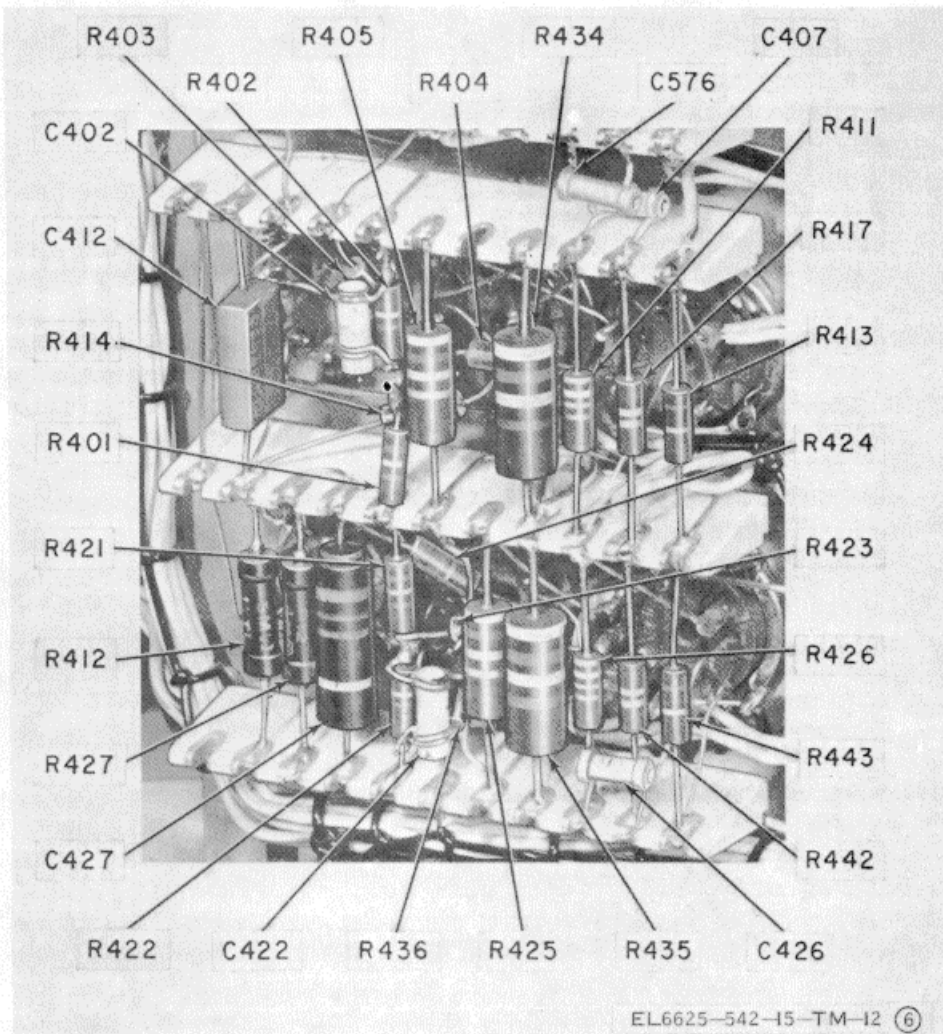


Figure 6-5 (6). Parts identification location (sheet 6 of 11).

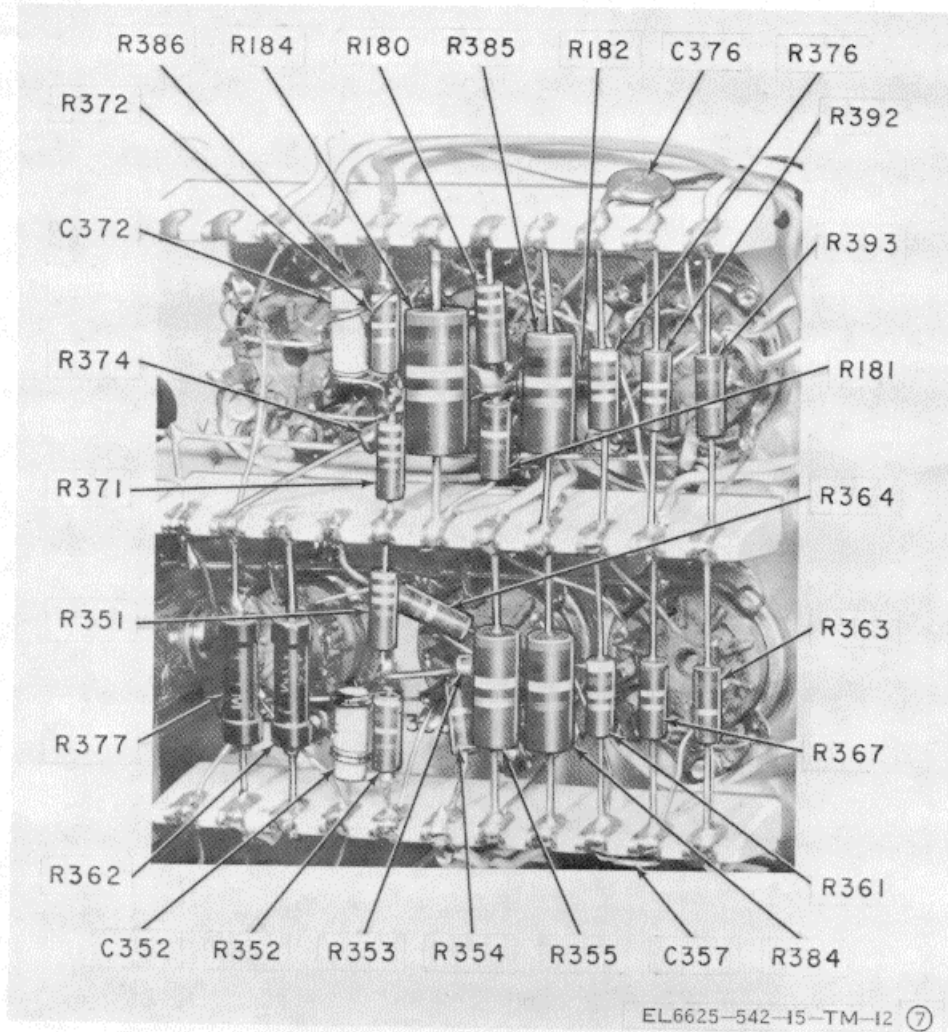


Figure 6-5 (7). Parts identification location (sheet 7 of 11).

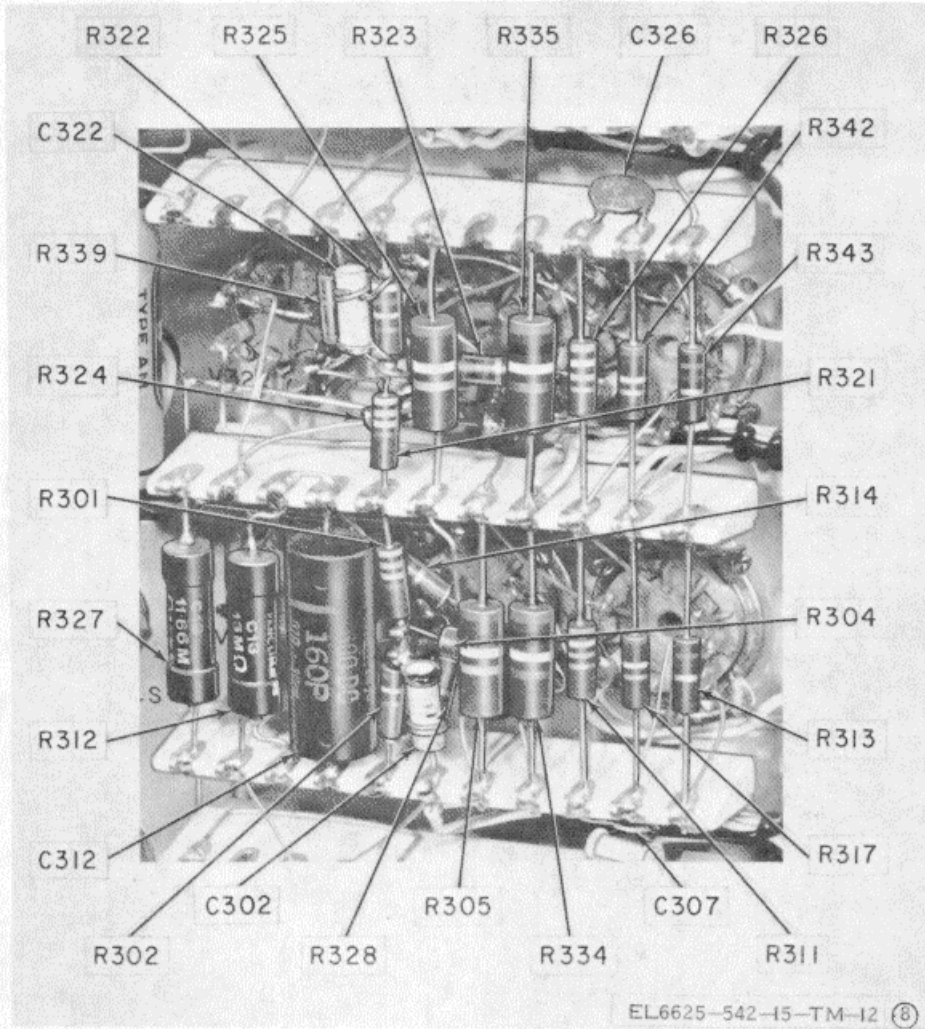


Figure 6-5 (8). Parts identification location (sheet 8 of 11).

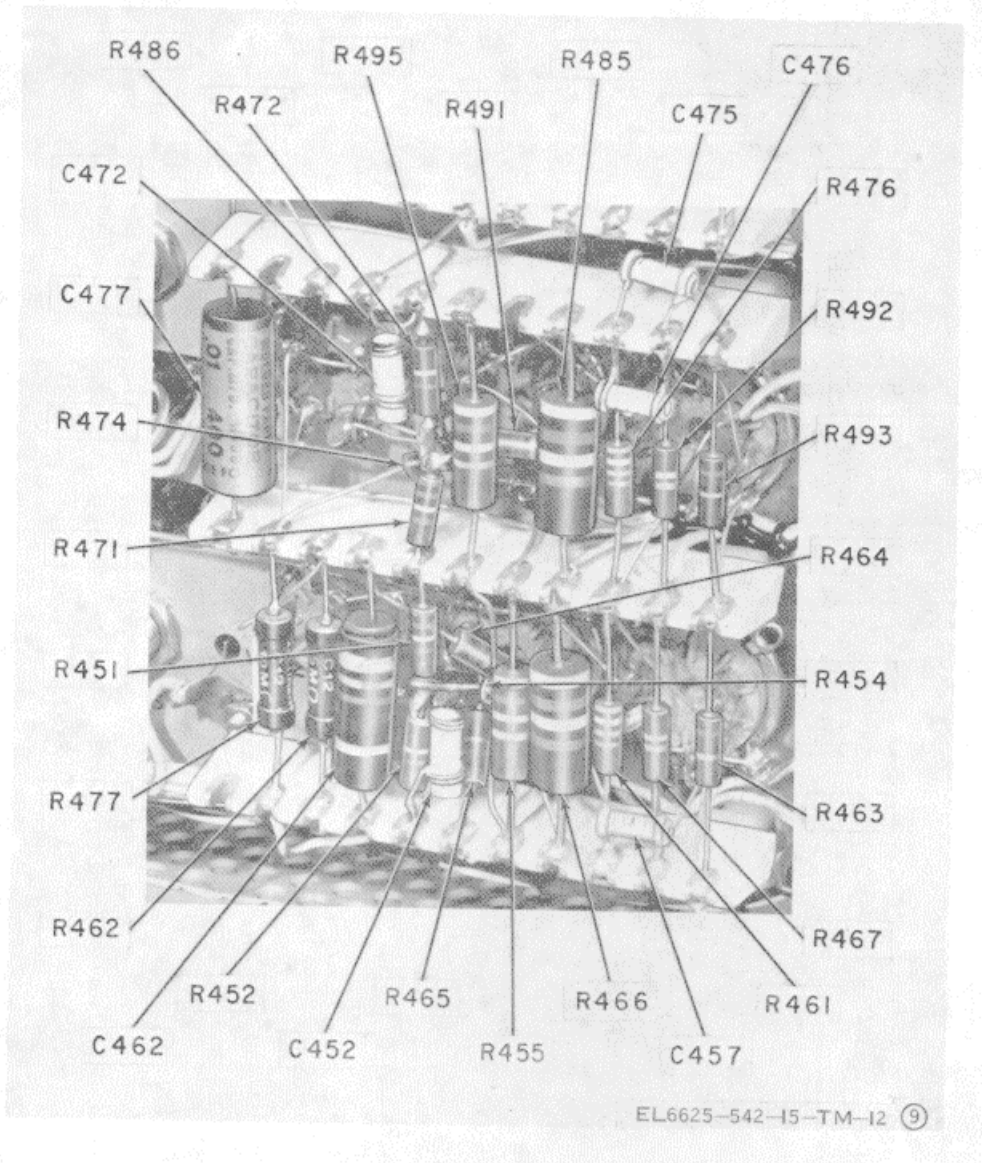


Figure 6-5 (9). Parts identification location (sheet 9 of 11).

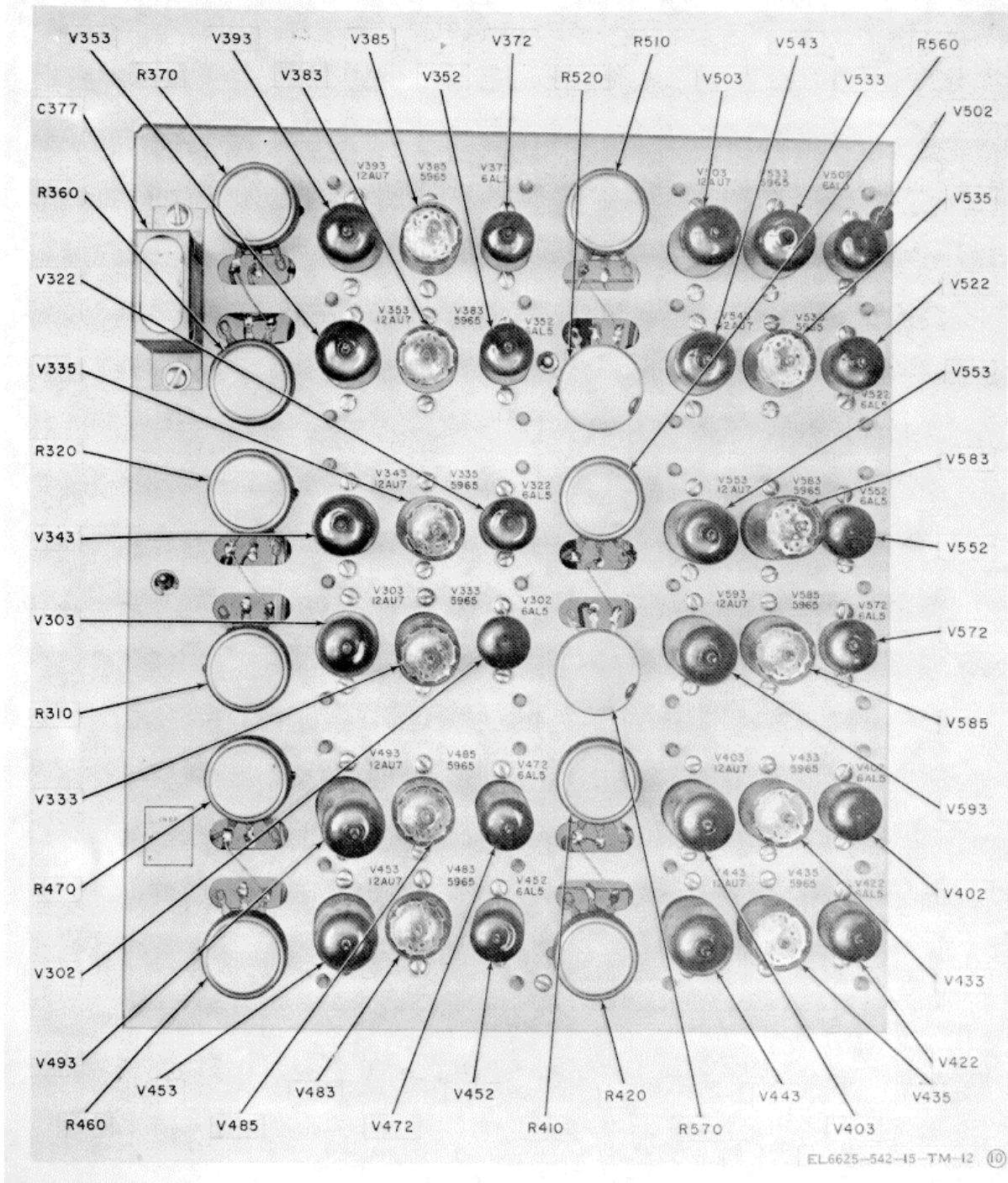


Figure 6-5 (10). Parts identification location (sheet 10 of 11).

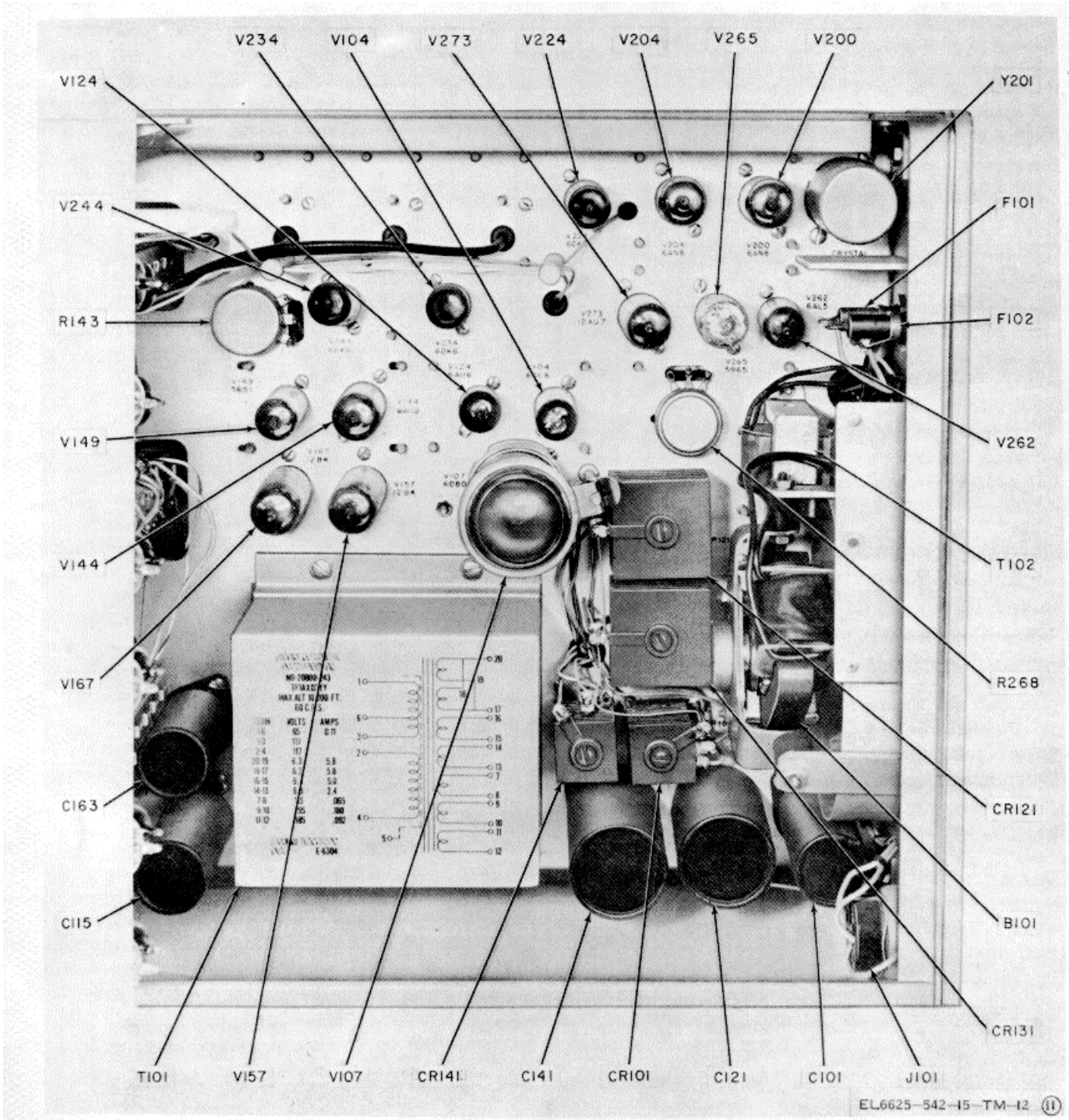


Figure 6-5 (11). Parts identification location (sheet 11 of 11).

6-11. Adjustments

a. The following adjustments should be performed as necessary to insure the reliability of the AN/TTSM-108A.

b. When performing specific test procedures, refer to the General Support Testing Procedures for test equipment setup and exact locations for obtaining the required voltages or waveforms.

6-12. Test Equipment and Materials Required

- a. Oscilloscope AN/USM-281A.
- b. Voltmeter, Electronic AN/USM-98.
- c. Variable Transformer CN-16/A.
- d. Coaxial cable RG-62A/U, 42 inches long with 93-ohm termination.
- e. Coaxial cable RG-58C/U, 42 inches long with 59-ohm termination.
- f. Electronic Counter AN/USM-207.

6-13. Voltage Measurements

The --150 volts regulated supply can be varied and is used as a reference voltage for the +225 volts, +350 volts, -8 volts and --15 volts supply voltages.

- a. *-150 Volts Supply.*
 - (1) Remove cover from AN/USM-108A (para 6-10).
 - (2) Connect variable transformer to correct power source.
 - (3) Connect AN/USM-108A to variable transformer.
 - (4) Turn on variable transformer and set at 117 volts.
 - (5) Turn on AN/USM-108A and allow 15 minute warmup.
 - (6) Connect positive lead of voltmeter to junction of R150 and C144.
 - (7) Connect negative lead to chassis ground.
 - (8) Adjust -150 control (R143) for exactly -150 volts.
- b. *+255 Volts Supply.*
 - (1) Connect positive lead of voltmeter to pin 3 of V107.
 - (2) Connect negative lead to chassis ground.
 - (3) Voltage should +225 +4.5 volts.

NOTE

Since all voltages are a derivative of the -150 volts supply, it is only necessary to check the remaining supply voltages. If the parameters given are not obtained, it will be necessary to service the AN/USM-108A.

- c. *+350 Volts Supply.*
 - (1) Connect positive lead of voltmeter to pin 6 of V107.
 - (2) Connect negative lead to ground.
 - (3) Voltage should be +350 +7 volts.
- d. *-15 Volts Supply.*
 - (1) Connect positive lead of voltmeter to pin 3 of V393.
 - (2) Connect negative lead to ground.
 - (3) Voltage should be --15 11 volt.
- e. *-8 Volts Supply.*
 - (1) Connect positive lead of voltmeter to junction of R174 and R176.

- (2) Connect negative lead to ground.

- (3) Voltage should be -8 +1 volt.

6-14. Ripple Voltage Measurements

The following checks should be performed to check the ripple level at each of the supply level points. Since there are no controls for varying the ripple rate, it will be necessary to service the AN/USM-108A if the parameters listed are exceeded.

- a. *-150 Volts Supply.*
 - (1) Connect oscilloscope to variable transformer.
 - (2) Either remove 1 mc crystal Y201 from socket, or place a jumper across crystal socket pins 4 and 6.
- (3) Set up oscilloscope as follows:
 - (a) Polarity as required.
 - (b) Vernier sensitivity to 0.2 calibrated.
 - (c) Horizontal sweep to internal, X5.
 - (d) Sweep mode to normal.
 - (e) Sweep time to 1 millisecond.
 - (f) Trigger slope to +.
 - (g) Trigger source to internal.
- (4) Connect negative lead of oscilloscope to ground.
- (5) Connect positive lead to junction of R150 and C144.
- (6) Ripple should not be greater than 5 millivolts, as viewed on oscilloscope.
- b. *+225 Volts Supply.*
 - (1) Repeat a (1) through (4) above.
 - (2) Connect positive lead of oscilloscope to pin 3 of V107.
 - (3) The ripple should not be greater than 30 millivolts, as viewed on oscilloscope.
- c. *+350 Volts Supply.*
 - (1) Repeat a (1) through (4) above.
 - (2) Connect positive lead of oscilloscope to pin 6 of V107.
 - (3) The ripple should not be greater than 30 millivolts, as viewed on oscilloscope.
 - (4) Reinsert 1 mc crystal Y201, or remove jumper wire from crystal socket, pins 4 and 6.

6-15. 1 MC Oscillator Adjustment

- a. Connect input of frequency counter to AN/USM-108A MARKER OUT connector through terminating resistor.
- b. Set controls of frequency counter to measure a frequency of 1 mc.
- c. Adjust C205 for 1 mc output +10 cycles.

6-16. Divider Circuit Adjustments

Potentiometers are incorporated in the cathode-coupled multivibrator circuits to adjust the dividing rate of the stage under test. These are adjusted in the following manner.

- a. Connect a probe from oscilloscope input A to MARKER OUT connector of AN/USM-108A.
- b. Set up oscilloscope as follows:
 - (1) Polarity as required.
 - (2) Vernier sensitivity to 0.1.
 - (3) Horizontal sweep to internal, X5.
 - (4) Sweep time to 1 microsecond.
 - (5) Sweep mode to normal.
 - (6) Trigger source of external.
 - (7) Trigger slope to +.
- c. Connect TRIGGER OUT of AN/USM-108A to oscilloscope trigger input.
- d. Allow sufficient time for warmup.
- e. Depress 1 MICROSECONDS pushbutton on AN/USM-108A.
- f. Adjust triggering level of oscilloscope for stable trace.
- g. Refer to table 6-1.

NOTE

Table 6-1 is separated into five columns. Column 1 indicates the position of the TIME/DIV control on the oscilloscope. Columns 2 and 3 indicate the pushbuttons that should be depressed for the circuit under test. Column 4 indicates the correct potentiometer to be adjusted for the circuit under test. Column 5 illustrates the correct waveform as displayed on the oscilloscope.

- h. Proceed with all steps indicated in table 6-1.

6-17. Sine Wave Adjustments

- a. *5 MC Adjust.*
 - (1) Connect 53 ohm termination connector to MARKER OUT connector of AN/USM-108A.
 - (2) Insert tip of probe into terminating resistor.

- (3) Connect lead from probe to A input of oscilloscope.
- (4) Connect TRIGGER OUT of AN/USM-108A to oscilloscope trigger input.
- (5) Set up oscilloscope as follows:-
 - (a) Polarity as required.
 - (b) Vernier sensitivity to 0.1.
 - (c) Horizontal sweep to internal, X5.
 - (d) Sweep time to 1 microsecond.
 - (e) Sweep mode to normal.
 - (f) Trigger source to external.
 - (g) Trigger slope to +.
- (6) Depress 5 MC SINE WAVE pushbutton on AN/USM-108A.
- (7) Adjust capacitors C229 and C223 one-cycle-per-centimeter, two volts peak-to-peak on oscilloscope.

b. 10 MC Adjust.

- (1) Repeat a (1) through (4) above.
- (2) Depress 10 MC SINE WAVE pushbutton on AN/USM-108A.
- (3) Change TIME/DIV on oscilloscope to 0.1 microsecond.
- (4) Adjust capacitors C233 and C239 for one-cycle-per-centimeter, with maximum amplitude.

c. 50 MC Adjust.

- (1) Set oscilloscope as in 10 mc adjust, but set magnifier to X5.
- (2) Depress 50 MC SINE WAVE pushbutton on AN/USM-108A.
- (3) Adjust capacitors C243 and C247 for one-cycle-per-centimeter with an amplitude of approximately 1.2 centimeters.

**CHAPTER 7
GENERAL SUPPORT TESTING PROCEDURES**

7-1. General

a. Testing procedures are prepared for use by electronics field maintenance shops and electronic service organizations responsible for general support of electronic repaired equipment to determine the acceptability of repaired equipment. These procedures set forth specific requirements that repaired equipment must meet before it is returned to the using organization. These procedures may also be used as a guide for testing equipment that has been repaired at general support maintenance if the proper tools and test equipments are available.

b. Comply with the instructions preceding each table. Perform each step in sequence. Do not vary the sequence. For each step, perform each specific procedure and verify it against its performance standard.

7-2. Test Equipment and Material Requirements

All the test equipment required to perform the

testing procedures given in this chapter are listed below.

- a. Electronic Voltmeter AN/USM-98.
- b. Variable Transformer CN-16/A.
- c. Oscilloscope AN/USM-281A.
- d. 53-ohm termination connector.
- e. Digital Readout Electronic Counter AN/USM-207.

7-3. Modification Work Orders

The performance standards listed in the tests tables 7-1 through 7-7 are based on the assumption that all modifications have been performed. A listing of current modification work orders will be found in DA Pam 310-7.

7-4. Physical Tests and Inspection

- a. *Test Equipment and Materials Required.* None.
- b. *Test Connections and Conditions.* None.

Table 7-1. Physical Tests and Inspection

Step No.	Control Settings		Test procedure	Performance standard
	Test equipment	Equipment under test		
1	None	Any position.....	<ul style="list-style-type: none"> a. Inspect case and chassis for damage, missing parts and condition of paint. b. Inspect all controls and mechanical assemblies for missing screws, bolts and nuts. c. Inspect all connectors, sockets, receptacles for looseness, damage, or missing parts. 	<ul style="list-style-type: none"> a. There should be no evidence of damage or parts missing. External painted surfaces should not show bare metal. Panel lettering will be legible. b. Screws, bolts and nuts will be tight-none missing. c. No loose parts or damage; no missing parts.
2	None	Any position.....	<ul style="list-style-type: none"> a. Depress all front panel push buttons. b. Inspect all front panel jacks. 	<ul style="list-style-type: none"> a. All pushbuttons should be capable of depressing and releasing freely without restriction. b. All jacks should be free of any obstruction that would restrict the normal insertion of the proper plug.

7-5. Power Supply Voltage Measurements

a. *Test Equipment and Materials Required.* Electronic Voltmeter AN/USM-98.

b. *Test Connections and Conditions.* Calibrate

the AN/USM-98 as indicated in TM 11-6625-438-15 prior to using.

Table 7-2. Power Supply Voltage Measurements

Control Settings

Step No.	Test equipment	Equipment under test	Test procedure	Performance standard
1	Volts range: 500 Null: 1. A, B, C, D, E: adjust for null.	POWER: ON All pushbuttons ejected.	a. Connect positive lead of AN/ USM-98 to ground and negative lead to top of R150(18K resistor). b. Set --150 ADJ control of AN/ USM-108A to read --150 volts	a. None. b. Reading must be exactly-150 volts.
2	Same as 1.....	Same as 1	Connect positive lead of AN/ USM-98 to pin 3 of V107 and negative lead to ground.	Voltage reading should be+225 +4.5 volts.
3	Same as 1.....	Same as 1	Connect positive lead of AN/ Volts range: 50.USM-98 to pin 6 of V107 and negative lead to ground.	Voltage reading should be+350 +7 volts.
4	Same as3.....	Same as 1a. Connect negative lead of AN/ USM-98 to cathode, pin 3 of V393. Connect positive lead to ground. b. Place negative lead of AN/USM-98 to junction of R174and R176 (junction is at the top of R176).	a. Voltage reading should be-15 +_ 1 volt. b. Voltage reading should be-8 + 1 volt.

7-6. Ripple Voltage Measurements

a. Test Equipment and Materials Required

(1) Oscilloscope AN/USM-281A.

(2) Variable Transformer CN-16A/U.

(1) Calibrate the AN/USM-281A as indicated in TM 11-6625-1703-15 prior to using.

(2) On the AN/USM-108A, place a jumper across pins 4 and 6 of 1 MC crystal oscillator Y201.

Table 7-3. Ripple Voltage measurements

Control Settings

Step No.	Test equipment	Equipment under test	Test procedure	Performance standard
1	AN/USM-218A Vernier sensitivity: .02, calibrated. Horiz sweep: internal, X5. Sweeptime: 1ms. Sweep mode: normal. Trigger slope: +. Trigger source: internal CN-16A/U 117 volts	POWER: ON All pushbuttons ejected.	a. Connect negative lead of AN/ USM-281A to ground and positive lead to junction (top) of R150 (18K-ohm) and C144. b Vary CN-16A/U from 105 to125 volts	a. None. b. Ripple viewed on oscilloscope should not exceed 5 millivolts.
2	Same as 1	Same as 1	a. Connect positive lead of AN/ USM-281A to pin 3 of V107 Connect negative lead to ground. b. Vary CN-16A/U from 105 volts to 125 volts.	a. None b. Ripple viewed on oscilloscope should not be greater than 30 millivolts.
3	Same as 1	Same as 1	a. Connect positive lead of AN/ USM-281A to pin 6 of V107. Connect negative lead to ground. b. Vary CN-16A/U from 105 volts to 125 volts. c. Remove jumper wire	a. None b. Ripple viewed on oscilloscope should not be greater than30 millivolts. c. None

7-7. Divider Circuits Measurements

- a. *Test Equipment and Materials Required.*
Oscilloscope AN/USM-281A
- b. *Test Connections and Conditions.*
(1) Connect probe from input A of

oscilloscope to MARKER OUT of AN/USM-108A.
(2) Connect lead from TRIGGER OUT of AN/USM-108A to oscilloscope trigger input.

Table 7-4. Divider Circuits Measurements

Control Settings

<i>Step No.</i>	<i>Test equipment</i>	<i>Equipment under test</i>	<i>Test procedure</i>	<i>Performance standard</i>
	Vernier sensitivity: .1, calibrated. Horiz. sweep: internal, X5. Sweep time: 1 p.s Sweep mode: normal. Trigger slope: +. Trigger source: external.	POWER: ON1 MICROSECONDS: depressed. All other pushbuttons ejected.	a. Adjust trigger level control on oscilloscope for stable trace. b. Depress pushbuttons on AN/ USM-108A as indicated in table6-1 in the prescribed sequence.	a. Stable waveform. b. As shown in table 6-1 NOTE. Table 6-1 consists of 5 columns. Column 1 gives proper oscilloscope settings. Columns 2 and 3 give the correct settings for the AN/USM-108A. Column 4 lists the adjustment control for circuit being tested. Column 5 illustrates the correct waveform displayed on the oscilloscope.

7-8. Sine Wave Output Circuits Measurements

- a. *Test Equipment and Materials Required.*
(1) Oscilloscope AN/USM-281A.
(2) 53-ohm termination connector.
- b. *Test Connections and Conditions.*
(1) Connect 53-ohm termination connector to

MARKER OUT connector of AN/USM-108A.
(2) Insert probe tip into termination connector and connect probe lead to A input of oscilloscope.
(3) Connect TRIGGER OUT of AN/USM-108A to oscilloscope trigger input.

Table 7-5. Sine Wave Output Circuits Measurements

Control Settings

<i>Step No.</i>	<i>Test equipment</i>	<i>Equipment under test</i>	<i>Test procedure</i>	<i>Performance standard</i>
1	Vernier sensitivity: 0.1. Horizontal sweep: internal, X5. Sweep time: 1 p.s. Sweep mode: normal. Trigger source: external	POWER: ON. 5 MC SINE WAVE: depressed. All other pushbuttons ejected.-	Observe oscilloscope	Waveform displayed on oscilloscope should be one cycle per centimeter with an amplitude of two volts or more.
2	Same as 1 except sweep time: 1 p.s.	10 MC SINE WAVE: depressed. All other pushbuttons ejected.	Observe oscilloscope	Waveform displayed should be one cycle per centimeter.
3	Same as 2	50 MC SINE WAVE: depressed. All other pushbuttons ejected.	Observe oscilloscope	Waveform displayed should be one cycle per centimeter with an amplitude of approximately 1.2 centimeters or greater.

7-9. 1 MC Oscillator Test

- a. *Test Equipment and Materials Required.*
Electronic Counter AN/USM-207.
- b. *Test Connections and Conditions.*
(1) Calibrate the AN/USM-207 as indicated in

TM 11-6625-700-10 prior to using.
(2) Connect probe to marker out of AN/USM-108A to input of AN/USM-207.

Table 7-6. 1 MC Oscillator Test

Control Settings

<i>Step No.</i>	<i>Test equipment</i>	<i>Equipment under test</i>	<i>Test procedure</i>	<i>Performance standard</i>
	As required to measure 1 mc.	POWER: ON 1 MICROSECONDS: depressed. All other push buttons ejected	Observe frequency counter	Counter should read 1 mc '10 cycles.

7-10. Waveforms Check

- a. *Test Equipment and Materials Required.*
Oscilloscope AN/USM-281A.

b. *Test Connections and Conditions.* See table 7-7

Table 7-7. Waueforms Check

Control Settings

<i>Step No.</i>	<i>Test equipment</i>	<i>Equipment under test</i>	<i>Test procedure</i>	<i>Performance standard</i>
	Trigger slope: + Sweep mode: normal. Trigger source: internal. Refer to table 7-8 for variable control settings.	POWER: ON. All pushbuttons ejected.	Connect input A of oscilloscope to test point locations as indicated in table 7-8.	Waveshapes should appear as shown in table 7-8.

TEST POINT LOCATION	SCOPE SETTING			WAVE SHAPE	TEST POINT LOCATION	SCOPE SETTING			WAVE SHAPE
	VERNIER SENSITIVITY VOLTS/DIV	HORIZ SWEEP	VERNIER SWEEP TIME			VERNIER SENSITIVITY VOLTS/DIV	HORIZ SWEEP	VERNIER SWEEP TIME	
PIN 6 OF Y201	2	X5	0.1 USEC		PIN 6 OF V433	5	X5	100 USEC	
JUNCTION PIN 3 OF V204 AND R218	2	X5	0.1 USEC		JUNCTION PIN 6 OF V435 AND C427	5	X2	1 MS	
PIN 7 OF V262	2	X2	1 USEC		PIN 3 OF V443	1	X1	1 MS	
JUNCTION Y201 AND C205	0.2	X1	0.1 USEC		PIN 8 OF V493	1	X1	10 MS	
AT JUNCTION OF 10MC SINE WAVE BUTTON AND PUSHBUTTON SWITCH (UNDER SWITCH)	0.2	X1	0.1 USEC		JUNCTION PIN 1 OF V485 AND C477	5	X1	10 MS	
AT JUNCTION OF 50MC SINE WAVE BUTTON AND PUSHBUTTON SWITCH (UNDER SWITCH)	0.2	X1	0.1 USEC		PIN 3 OF V453	1	X2	1 MS	
PIN 6 OF V533	2	X5	1 USEC		PIN 1 OF V333	1	X5	10 MS	
PIN 3 OF V543	2	X5	10 USEC		JUNCTION PIN 1 OF V335 AND C327	5	X2	100 MS	
PIN 3 OF V593	2	X5	100 USEC		PIN 8 OF V343	1	X2	100 MS	
JUNCTION PIN 6 OF V585 AND C577	2	X1	100 USEC		PIN 8 OF V393	1	X5	1 SEC	
PIN 8 OF V553	2	X1	100 USEC		JUNCTION PIN 1 OF V385 AND C377	1	X5	1 SEC	
JUNCTION PIN 6 OF V535 AND C527	2	X1	10 USEC		PIN 3 OF V353	1	X5	1 SEC	

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Table 7-8. Required Waveshapes 7-5

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 TB 43-0118	US Army Equipment Index of Modification Work Orders. Field Instructions for Painting and Preserving Electronics Command Equipment Including Camouflage Pattern Painting of Electrical Equipment Shelters.
TM 11-6625-274-12	Operator's and Organizational Maintenance Manual: Test Sets, Electron Tube TV-7/U, TV-7A/U, TV-7B/U, and TV-7D/U.
TM 11-6625-316-12	Operator's and Organizational Maintenance Manual: Test Sets, Electron Tube TV-2/U, TV-2A/U, TV-2B/U, and TV-2C/U.
TM 11-6625-537-14-1	Organizational, Direct Support, General Support, and Depot Maintenance Manual: Electronic Voltmeter ME-202A/U (NSN 6625-00-709-0288) and ME-202B/U (NSN 6625-00-972-4046).
TM 11-6625-700-14-1	Operator, Organizational, Direct Support, and General Support Maintenance Manual Including Repair Parts and Special Tools List (Including Depot Maintenance Repair Parts and Special Tools): Digital Readout Electronic Counter AN/USM-207A (Serial Nos. 1A through 1100A).
TM 11-6625-1703-15	Operator, Organizational, DS, GS, and Depot Maintenance Manual Including Repair Parts and Special Tool Lists: Oscilloscope AN/USM-281A.
TM 38-750	The Army Maintenance Management System (TAMMS).
TM 740-90-1	Administrative Storage of Equipment.
TM 750-244-2	Procedures for Destruction of Electronics Materiel to Prevent Enemy Use (Electronics Command).

APPENDIX C

MAINTENANCE ALLOCATION

Section I. INTRODUCTION

C-1. General

This appendix provides a summary of the maintenance operations for AN/USM-108A. 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 Function

Maintenance functions will be limited to and defined as follows:

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

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

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

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

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

f. Calibrate. To determine and cause corrections to be made or to be adjusted on instruments or test measuring and diagnostic equipment used in precision 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.

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

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

i. Repair. The application of maintenance services (inspect, test, service, adjust, align, calibrate, replace) or other maintenance actions (welding, grinding, riveting, straightening, facing, remachining, or resurfacing) to restore serviceability to an item by correcting specific damage, fault, malfunction, or failure in a part, subassembly, module/component/assembly, end item or system. This function does not include the trial and error replacement of running spare type items such as fuses, lamps, or electron tubes.

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

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

C-3. Column Entries

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

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

c. Column 3, Maintenance Functions. Column 3 lists the functions to be performed on the item listed in column 2. When items are listed without maintenance functions, it is solely for purpose of having

the group numbers in the MAC and RPSTL coincide.

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

- C--Operator/crew
- O- Organizational
- F--Direct support
- H--General support
- D-Depot

e. *Column 5, Tools and Equipment.* Column 5

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

C4. Tool and Test Equipment Requirements (Table 1)

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

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

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

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

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

**Section II. MAINTENANCE ALLOCATION CHART
FOR
ELECTRONIC MARKER GENERATOR AB/USM-108A**

(1) GROUP NUMBER	(2) COMPONENT ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE CATEGORY					(5) TOOLS AND EQUIPMENT	(6) REMARKS
			C	O	F	H	D		
00	ELECTRONIC MARKER GENERATOR AN/USM-108A	Inspect Test Service Adjust Repair Repair Rebuild		0.1 0.3 0.2		0.5 0.5 0.7		8 1 thru 5, 7 1 thru 4, 6, 7 D	

TABLE 1. TOOL AND TEST EQUIPMENT REQUIREMENTS
FOR
ELECTRONIC MARKER GENERATOR AN/USM-08A

TOOL OR TEST EQUIPMENT REF CODE	MAINTENANCE CATEGORY	NOMENCLATURE	NATIONAL/NATO STOCK NUMBER	TOOL NUMBER
1	H, D	COUNTER ELECTRONIC, DIGITAL READOUT AN/USM-207A		6625-00-044-3228
2	H, D	MULTIMETER AN/USM-223	6625-00-999-7465	
3	H, D	OSCILLOSCOPE AN/USM281A	6625-00-228-2201	
4	H	TEST SET, ELECTRON TUBE TV-7D/U	6625-00-820-0064	
5	D	TEST SET, ELECTRON TUBE TV-2/U	6625-00-669-0263	
6	H, D	VOLENITUN, ELECTRONIC ME-2023/U	6625-00-972-4046	
7	H, D	TOOL KIT, ELECTRONIC EQUIPMENT TK-100/G	5180-00-65-007T9	
8	o	Tools and test equipment available to the organizational repairman because of his assigned mission		

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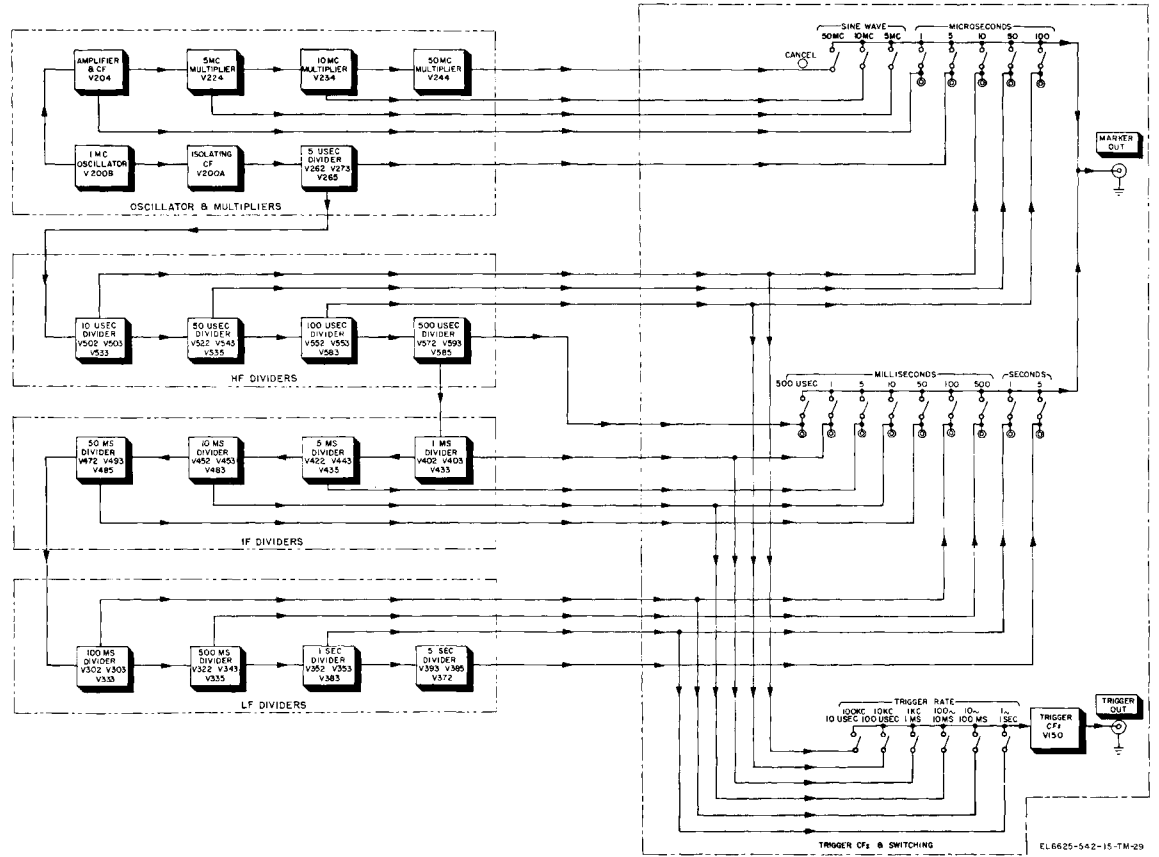
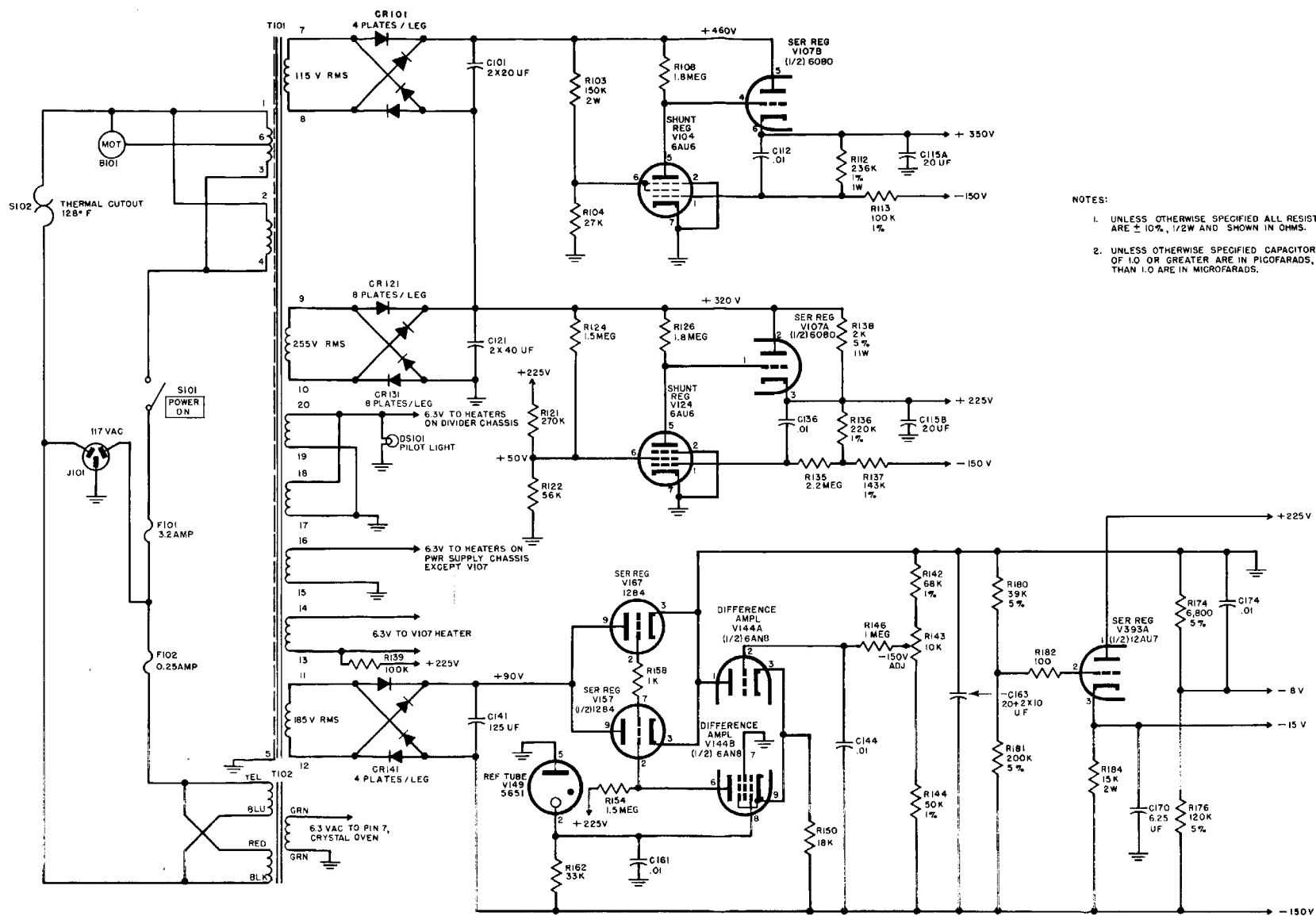


Figure 5-1. Functional block diagram.



- NOTES:
1. UNLESS OTHERWISE SPECIFIED ALL RESISTORS ARE $\pm 10\%$, 1/2W AND SHOWN IN OHMS.
 2. UNLESS OTHERWISE SPECIFIED CAPACITORS WITH VALUES OF 1.0 OR GREATER ARE IN PICOFARADS, VALUES LESS THAN 1.0 ARE IN MICROFARADS.

Figure 5-2. Power supply schematic diagram.

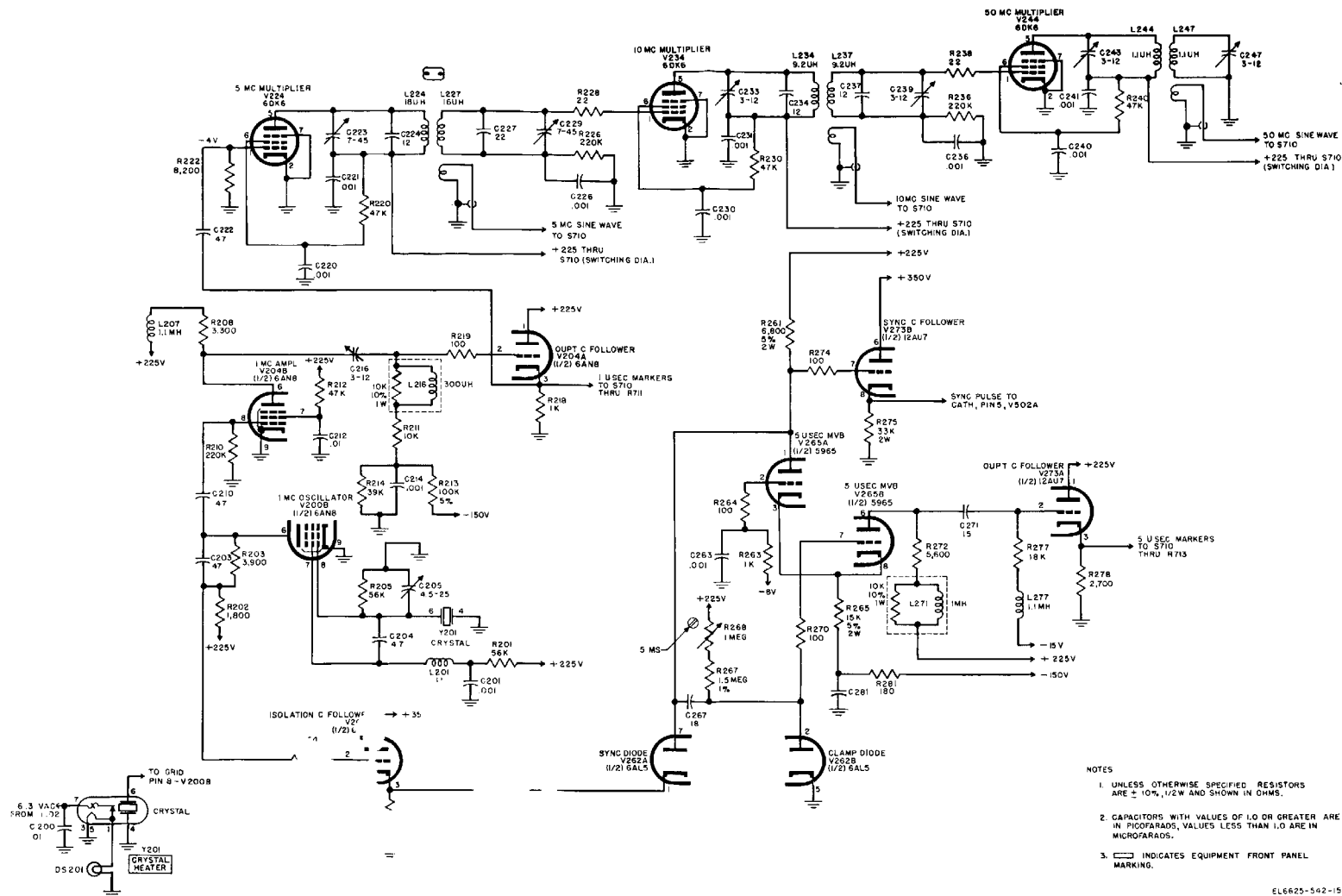
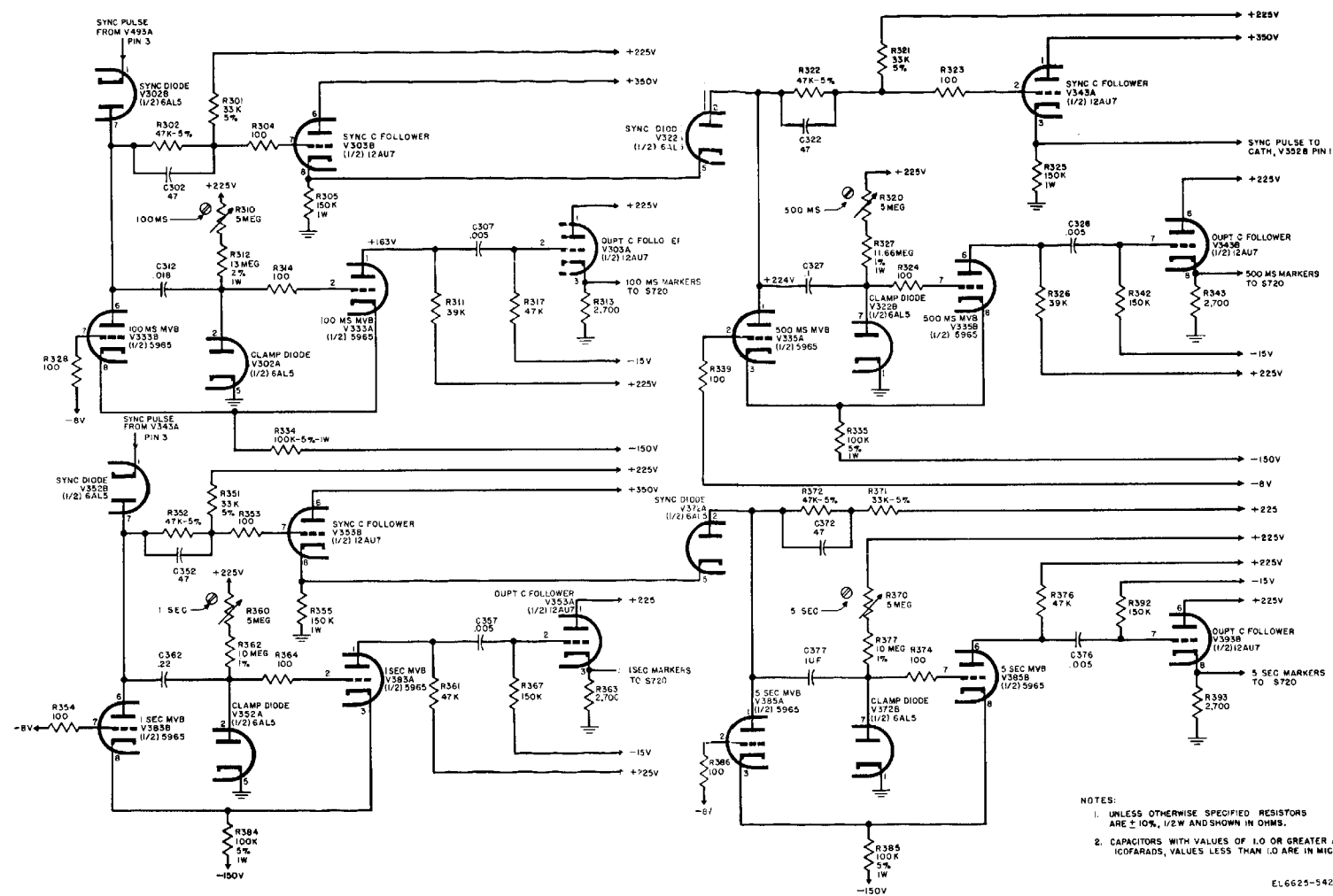


Figure 5-3. Oscillator and multiplier, schematic diagram.



NOTES:
 1. UNLESS OTHERWISE SPECIFIED RESISTORS ARE ± 10%, 1/2W AND SHOWN IN OHMS.
 2. CAPACITORS WITH VALUES OF 1.0 OR GREATER ARE IN MICROFARADS, VALUES LESS THAN 1.0 ARE IN MICROFARADS.

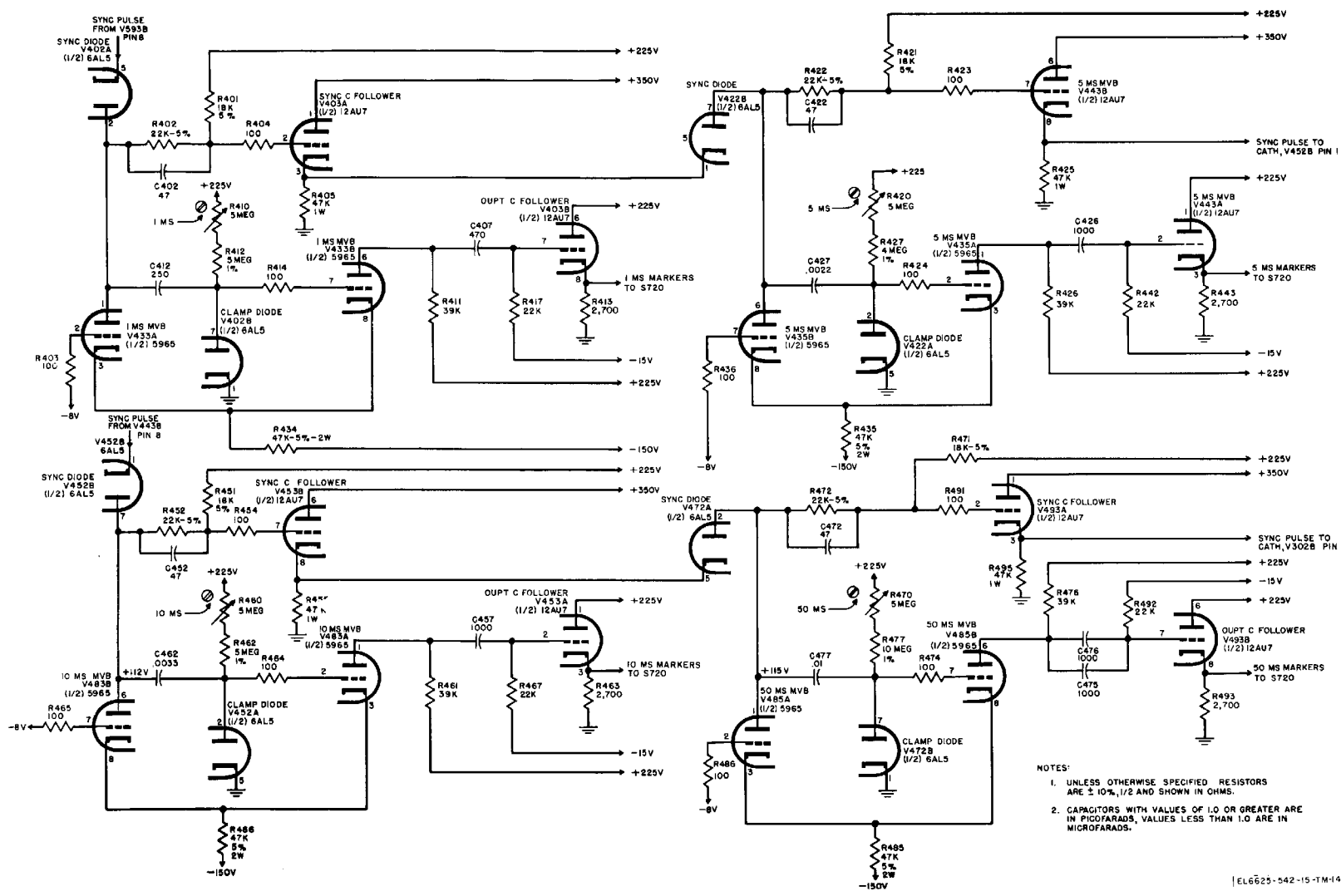


Figure 5-6. Intermediate frequency dividers, schematic diagram.

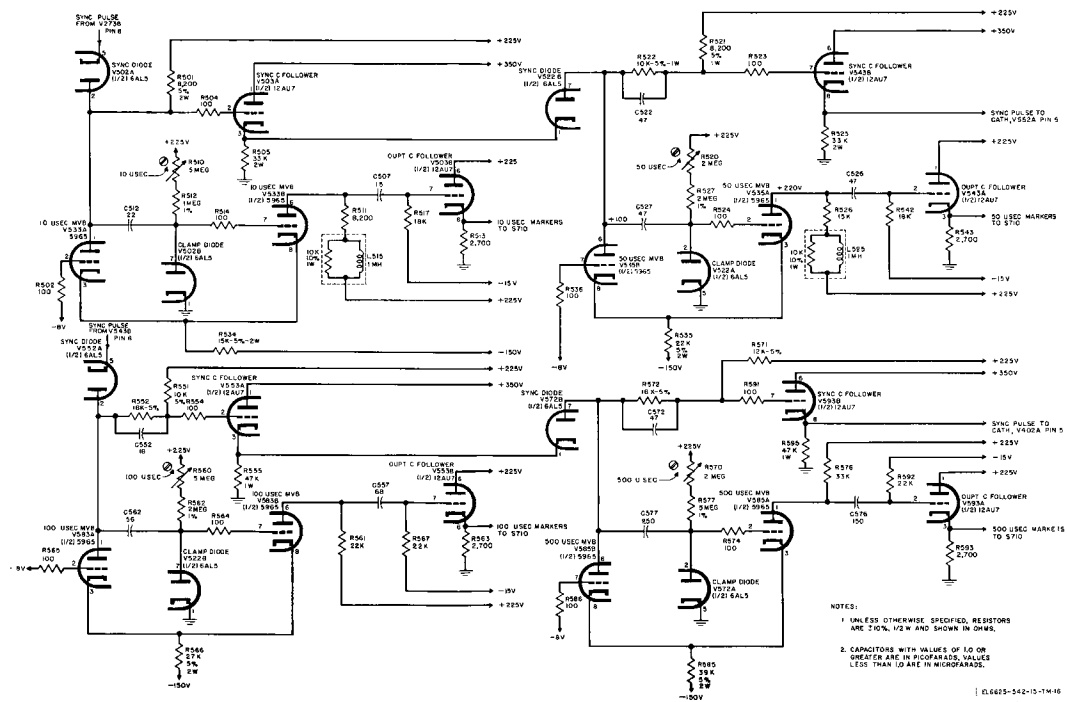


Figure 5-7. High frequency dividers, schematic diagram.

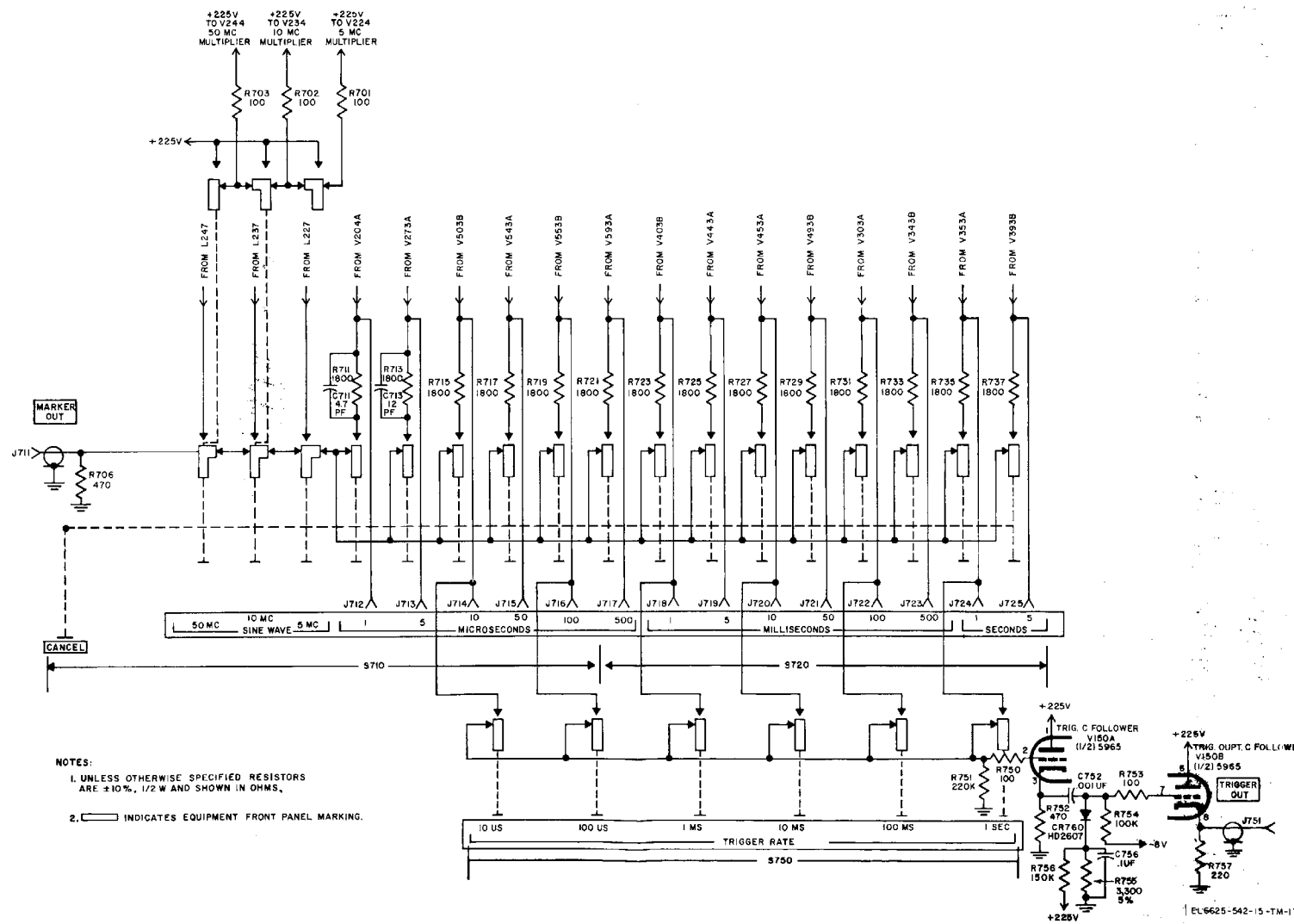


Figure 5-8. Trigger cathode follower and switching, schematic diagram.

Figure 5-8. Trigger cathode follower and switching, schematic diagram.

600

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