TM 11-2626

WAR DEPARTMENT TECHNICAL MANUAL

TEST UNIT I-176

RESTRICTED. DISSEMINATION OF RESTRICTED MATTER. The information contained in restricted documents and the essential characteristics of restricted materiel may be given to any person known to be in the service of the United States and to persons of undoubted loyalty and discretion who are cooperating in Government work, but will not be communicated to the public or to the press except by authorized military public relations agencies. (See also par. 28, AR 380-5, 15 Mar. 1944.)

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TABLE OF CONTENTS (*Continued*)

LIST OF ILLUSTRATIONS

DESTRUCTION NOTICE

WHY —To prevent the enemy from using or salvaging this equipment for his benefit.

WHEN—When ordered by your commander.

HOW —1. *Smash*—Use sledges, axes, handaxes, pickaxes, hammers, crow-bars, heavy tools.

2. *Cut*—Use axes, handaxes, machetes.

3. *Burn*—Use gasoline, kerosene, oil, flame throwers, incendiary grenades.

4. *Explosives*—Use firearms, grenades, TNT.

5. *Disposal*—Bury in slit trenches, fox holes, other holes. Throw in streams. Scatter.

USE ANYTHING IMMEDIATELY AVAILABLE FOR DESTRUCTION OF THIS EQUIPMENT.

WHAT—1. *Smash*—Meters, controls, panels.

2. *Cut*—Cables and all wiring.

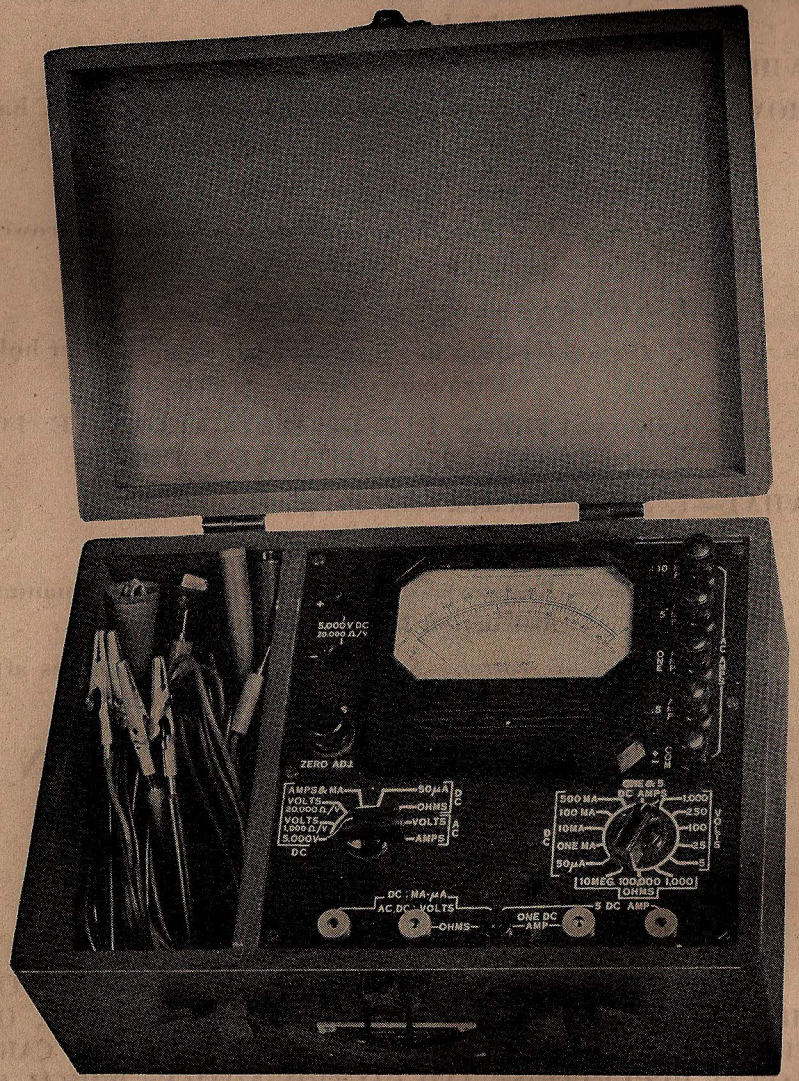
3. *Burn*—Resistors, capacitors, all technical manuals, instruction books, tube charts.

4. *Bury or scatter*—Any or all of the above pieces after destroying their usefulness.

DESTROY EVERYTHING

SAFETY NOTICE

WHEN THIS EQUIPMENT IS USED IN CONNECTION WITH HIGH VOLTAGES WHICH ARE DANGEROUS TO LIFE, OPERATING PERSONNEL MUST EXERCISE EXTREME CARE. SAFETY REGULATIONS AND CAUTION NOTICES WHICH APPEAR THROUGHOUT THIS MANUAL MUST BE OBSERVED AT ALL TIMES. MAKE TESTS EXACTLY AS DIRECTED. PERSONNEL NOT FAMILIAR WITH THE SERVICING OF HIGH-VOLTAGE CIRCUITS SHOULD NEVER MAKE TESTS INVOLVING SUCH CIRCUITS.



TL-14684

Figure 1. Test Unit I-176, with cover raised.

SECTION I

DESCRIPTION

1. PURPOSE. Test Unit I-176 is an instrument designed to measure resistance, alternating current (ac), direct current (dc), and voltage over a wide range of values. The purpose of this manual is to acquaint the repairman with the construction, operating principles, use, and maintenance of this unit.

2. GENERAL DESCRIPTION.

a. This unit is furnished both separately and as a part of Test Set I-56-K. As a part of Test Set I-56-K, it fits into a compartment of Carrying Case CS-130. Weights and dimensions are given below:

Equipment	*Dimensions (in.)*			*Weight (lb.)*
	Height	*Width*	*Depth*	
Test Unit I-176	5½	11½	8½	9
Case CS-130	14¾	20½	9¾	25.6

b. There are five alternating-voltage ranges, covering 0 to 5 volts, 0 to 25 volts, 0 to 100 volts, 0 to 250 volts, and 0 to 1,000 volts; all having a sensitivity of 1,000 ohms per volt.

c. The five direct voltage ranges providing a choice of either 1,000 or 20,000 ohms per volt sensitivity are 0 to 5 volts, 0 to 25 volts, 0 to 100 volts, 0 to 250 volts, and 0 to 1,000 volts. An additional high-voltage range of 0 to 5,000 volts has a sensitivity of 20,000 ohms per volt.

d. Alternating-current (a-c) measurements can be made in four ranges: 0 to 0.5 ampere, 0 to 1 ampere, 0 to 5 amperes, and 0 to 10 amperes.

e. Direct-current (d-c) measurements can be made in seven ranges: 0 to 50 microamperes, 0 to 1 milliampere, 0 to 10 milliamperes, 0 to 100 milliamperes, 0 to 500 milliamperes, 0 to 1 ampere, and 0 to 5 amperes.

f. The three ranges provided for resistance measurements are 0 to 1,000 ohms, 0 to 100,000 ohms, and 0 to 10,000,000 ohms (10 megohms). All ranges employ a constant-resistance ohmmeter circuit, with a 1.5-volt internal battery for the two lower ranges and a 22.5-volt internal battery for the highest range.

g. Two pairs of ordinary test leads, four removable alligator clips, and one pair of special high-voltage multiplier-type leads for the 5,000-volt range are included with the instrument, and are kept in a compartment provided for the purpose in the case of the instrument.

SECTION II

OPERATION

3. PRELIMINARY INSTRUCTIONS. Before handling Test Unit I-176, read the operating instructions carefully. Considerable damage can be caused by mishandling. Pay particular attention to all caution notices.

CAUTION: After completing a measurement, always reset the controls to their off or safety positions as indicated below. Overloads can damage or burn out the meter or other components.

Control	*Safety position*
Left-hand selector switch	5,000 volts
Right-hand selector switch	1,000 volts

4. TEST UNIT I-176 AS D-C VOLTMETER UP TO 1,000 VOLTS.

a. Set the function selector switch (left-hand switch) at VOLTS 1,000 Ω/V for ordinary measurements where meter current drain is unimportant, or at VOLTS 20,000 Ω/V if measuring in a high-resistance circuit where current drawn by the voltmeter must be kept at a minimum.

b. Set the range selector switch (right-hand switch) at the required VOLTS range (5, 25, 100, 250, or 1,000) for the measurement to be made.

c. Plug the short-handled probe of the red test lead into the red jack marked DC VOLTS (at extreme left along bottom of panel).

d. Plug the short-handled probe of the corresponding black test lead into the black jack on the panel (at bottom center).

e. Hold the long-handled probes on the terminals at which the voltage is to be measured, with the red probe on the positive terminal, and read the meter indication on the proper scale. Voltage values obtained with

the 20,000-ohm-per-volt sensitivity may be appreciably higher than those obtained with a 1,000-ohm-per-volt sensitivity if the voltage is being measured through a high resistance.

CAUTION: Be extremely cautious when working with high-voltage circuits. When making measurements on circuits employing 300 volts or more, turn the power off, make meter connections with the alligator clips, and then turn on the power to make the reading. Turn off the power to disconnect the meter. Handling the test prods, leads, or instrument during measurements on circuits involving 300 volts or more is dangerous to human life.

5. TEST UNIT I-176 AS 5,000-VOLT D-C VOLTMETER.

a. Set the function selector switch (left-hand switch) at 5,000 V DC. Here the right-hand range selector switch is out of the circuit and can be in any position.

b. Locate the high-voltage multiplier lead having red ends, and plug the red probe-like end into the 5,000 V DC jack marked +.

c. Locate the high-voltage multiplier lead having black terminations, and plug the black probe-like end into the 5,000 V DC jack marked —.

d. After making sure that the radio set is turned off, connect the clips of the high-voltage leads to the terminals at which the voltage is to be measured, with the red clip on the positive terminal.

e. Turn on the radio set, read the meter on the black 0-50 DCV scale and multiply the reading by 100 to get the voltage value, then turn off the radio set before touching anything else.

CAUTION: When making high-voltage measurements up to 5,000 volts, do not touch the test unit, the high-voltage leads, or any high-voltage terminals while the radio set is turned on and the measurement is being made. Be sure to turn off the radio set and discharge its capacitors before disconnecting the test unit.

6. TEST UNIT I-176 AS A-C VOLTMETER.

a. Set the function selector switch (left-hand switch) to VOLTS AC.

b. Set the range selector switch (right-hand switch) to the required VOLTS range (5, 25, 100, 250, or 1,000) for the measurement to be made. The sensitivity will be 1,000 ohms-per-volt for all a-c voltage measurements.

c. Plug the short-handled probe of the red test lead into the red jack marked AC VOLTS (at extreme left along bottom of panel).

d. Plug the short-handled probe of the corresponding black test lead into the black jack on the panel (at bottom center).

e. Hold the long-handled probes on the terminals at which the voltage is to be measured, and read the meter indication on the proper red scale.

7. TEST UNIT I-176 AS D-C AMMETER.

a. Set the function selector switch (left-hand switch) at 50 μA DC if the 0 to 50 microampere range is to be used, or at AMPS & MA for any of the other current ranges.

b. Set the range selector switch at the required current range. When in doubt, start with a higher range.

c. If the range selector switch is set at a 500 MA or lower range, plug the short-handled probe of the red test lead into the red jack marked DC: MA-μA. If the range selector switch is set at ONE & 5 DC AMPS, plug this probe into the red jack marked ONE DC AMP or 5 DC AMP, depending upon the current range desired.

d. Plug the short-handled probe of the black test lead into the black jack on the panel (at bottom center).

e. Break the circuit in which current is to be measured, and insert the meter into the circuit. Use alligator clips on the long-handled probes, and connect the red probe to the positive side of the circuit. Read the meter indication on the proper black scale.

CAUTION: For current measurements, the test unit must always be in series with the circuit. Never connect the test unit across a voltage source or across a circuit when the selector switches are set for current measurements, as this may damage the meter. Be sure to observe polarity for direct current measurements; the red probe always goes to +. Always turn the power off before connecting the test unit to the equipment under test.

8. TEST UNIT I-176 AS A-C AMMETER.

a. Set the function selector switch (left-hand switch) at AMPS AC. The right-hand switch can be in any position as it is out of the circuit.

b. Insert the short-handled probes in the correct pair of AC AMPS binding posts at the right on the panel, one in the ± COM binding post and the other in the .5, ONE, 5 or 10 AMP binding post depending on the current range desired.

c. Break the circuit in which current is to be measured, and insert the meter into the circuit by using alligator clips on the long-handled probes. Polarity does not matter for a-c measurements. Read the meter indication on the proper red scale.

CAUTION: For current measurements, be sure the test unit is always in series with the circuit. If connected across the circuit, the rectifier and meter as well as the current transformer itself may be damaged.

9. TEST UNIT I-176 AS AN OHMMETER. If the instrument is being used for the first time, batteries must be installed in the instrument. Battery installation instructions are given in paragraph 24.

a. Set the function selector switch (left-hand switch) at OHMS DC.

b. Set the range selector switch (right-hand switch) at the required OHMS range (10 MEG., 100,000 OHMS, or 1000 OHMS).

c. Plug the short-handled probe of the red test lead into the red jack marked OHMS.

d. Plug the short-handled probe of the black test lead into the black jack on the panel (at bottom center).

e. Short the long-handled test probes by holding their metal ends together, and rotate the ZERO ADJ. knob until the meter pointer is at zero at the extreme right of the uppermost meter scale. Check this zero adjustment each time the ohmmeter range is changed.

f. Separate the long-handled test probes and connect them to the terminals at which the resistance measurement is to be made.

g. Read the meter indication on the uppermost scale, marked OHMS. For the 1,000-ohm range, use scale readings directly. For the 100,000-ohm range, multiply scale readings by 100. For the 10 MEG. range, divide scale readings by 100 to get the value in megohms, or multiply by 10,000 to get the value in ohms.

CAUTION: Be sure no voltages exist in the circuit in which resistance measurements are to be made. External voltages may burn out the meter. Be sure no metal parts touch the panel during ohmmeter measurements, as the meter is sensitive enough to react to ground currents. When through using the ohmmeter, remove the test leads and return the selector switches to their safety positions. Leaving the ohmmeter connected to an external circuit while the selector switch is in an ohmmeter position will run down the internal batteries.

h. If the meter pointer cannot be brought to zero by rotating the ZERO ADJ. knob, one or both of the internal batteries should be replaced. See battery replacement instructions for Test Unit I-176 in paragraph 24.

10. SERVICING RADIO EQUIPMENT WITH TEST UNIT I-176. Before attempting to service radio sets with Test Set I-56-K, the repairman should be thoroughly familiar with the operation of the components of this test set, as explained in previous paragraphs of this section. The servicing procedure outlined in the following paragraphs is to be considered only as a guide to most effective utilization of the test set.

Detailed servicing instructions for radio equipment will be found in technical manuals dealing with the equipment.

11. PRELIMINARY CHECK OF RADIO EQUIPMENT.

a. Read the instructions included with the equipment to be tested.

b. Inspect all cables, batteries, antennas, antenna leads, grounds and ground leads, microphones, speakers, and headsets for proper connections and good contacts. Look for visible mechanical or electrical defects, such as shorts and defective soldered joints. Points at which wiring passes through metal or around the edges of tube socket contacts are likely places for insulation to be cut or frayed. Tube socket fingers should be examined to make sure they are clean and tight. Be sure there are no shorts between rotor and stator plates of variable capacitors.

c. Check all fuses in the equipment, by inspection or with an ohmmeter.

d. Remove and check all vacuum tubes one at a time for shorts and open filaments. Replace if necessary.

e. Make all possible external continuity checks, and check resistance values against those specified on the circuit diagram for the equipment.

f. Make a resistance test from the high-voltage lead of the equipment to ground. If the reading is zero or very low, indicating a short, the equipment must not be turned on until the trouble is located and corrected.

CAUTION: Many receivers and transmitters contain high voltages that are dangerous. Always turn off the equipment first when making any changes or removing plugs or tubes from sockets.

12. RECEIVER SERVICING PROCEDURE.

a. Check Power Source. For a-c power, measure the line voltage to be sure it is the correct value for the receiver. For battery power, turn on the receiver and adjust for normal operating conditions, then measure the battery voltages. They should be only slightly lower than rated values; if too low, the batteries should be charged or replaced.

b. Check Output Stage. Measure d-c electrode voltages at the output tube socket while the set is turned on. If a voltage chart for the receiver is available (usually given in technical manuals), compare measured values with those on the chart. They should agree within 20 percent if the output stage is operating properly and the plate supply voltage is normal. A click should be heard in the headset or speaker when a voltmeter is connected between the control grid and cathode of the output tube. If an output stage defect is indicated, proceed as follows until the trouble is found:

(1) If the output tube is a pentode and has normal screen-grid voltage but no plate voltage, the output transformer or one of its connections is faulty. Verify this by making continuity tests with an ohmmeter.

(2) If there is no screen or plate voltage, the power supply or one of its connections to the output tube is faulty. Check power supply parts, such as the dynamotor, power transformer, rectifier, vibrator, filter choke, filter capacitors, bleeder resistors, and bypass capacitors for proper performance. Measure the a-c voltage across each winding of the power transformers. Measure the d-c output voltage of the rectifier, and measure the d-c voltage across each section of the filter system until the plate supply voltage to the output tube is reached.

c. Check Audio Stage. When the output stage is operating properly, check the preceding audio stage in a similar manner. If any of the voltage readings are not normal, check each circuit element of the audio stage and the resistors and capacitors immediately connected with that stage until the defective part is located.

d. Check Detector Stage. If the detector is a triode or pentode, voltage checks may be made in the same manner as for the audio and output stages. If the detector is a diode, only the filament voltage can be measured.

e. Check I-f and R-f Amplifier Stages. Proceeding forward from the detector toward the antenna, check voltage in turn for each intermediate-frequency stage, the mixer stage, the r-f oscillator stage, and the r-f amplifier stage.

f. Check Oscillator. If oscillator voltages differ from those given in the voltage chart for the receiver, or if the source of trouble is not located by voltage measurements, check the operation of the oscillator by measuring the d-c voltage drop across the oscillator grid leak. With the test prods, connect the high-resistance d-c voltmeter across the grid leak and measure the d-c voltage. If the tube is oscillating, a readable indication will be obtained. If there is little or no indication, the tube is not oscillating. Check all component parts of the oscillator for open or short circuits, and examine the oscillator coil for open or shorted turns.

g. Check Continuity. If all tube electrode voltages are correct and the oscillator is operating properly but the receiver is still performing unsatisfactorily, turn off the receiver and discharge the capacitors. Check the resistors and capacitors in the automatic volume control circuit with an ohmmeter, then check parts and circuits in a logical order for continuity with the ohmmeter.

h. Check Alignment. If the receiver is out of alignment, the automatic volume control circuit will not function properly and general performance

of the receiver will be unsatisfactory. If a signal generator is available, make an alignment check by following the instructions accompanying the receiver under test.

13. TRANSMITTER SERVICING PROCEDURE.

a. Check External Parts. Examine carefully for defects all cables, plugs, and other external parts directly connected with the transmitter, making continuity tests with an ohmmeter on all suspicious parts.

b. Check Power Supply. Measure the power supply output voltages.

c. Check Oscillator. To determine if the oscillator is operating, measure the oscillator grid current by connecting a d-c milliammeter in series with the oscillator grid leak at the grounded end. Grid current will flow only when the oscillator tuning circuit is resonant at the crystal frequency. If the oscillator is crystal-controlled, either check the crystal by trying it in another transmitter, or replace it with a crystal known to be good. If there is reason to suspect the oscillator, test the oscillator tube, then check all parts associated with the oscillator unit.

d. Test Tubes. Test all tubes that can be handled by Tube Tester I-177, and check remaining tubes by replacing them one at a time with good tubes of the same type and noting the effect on transmitter performance.

e. Make Voltage and Continuity Tests. Following instructions accompanying the transmitter, start with the oscillator unit and check each succeeding r-f stage for correct voltages and continuity.

f. Check Modulator Stage. Measure electrode voltages for the modulator tube, using appropriate high-voltage precautions. If any voltage is lower than normal, turn off the transmitter and check all parts associated with the modulator stage, along with connections to the power supply.

g. Check Modulator Amplifier Stages. Measure voltages for each preceding stage of the modulator amplifier, using available meter jacks or the built-in meters whenever possible. As before, the measured values should be checked against those given in voltage tables in the technical manual accompanying the transmitter. Any deviating more than 20 percent from specified values should be investigated. Other and more specific trouble-shooting suggestions will be found in the manual for the transmitter.

CAUTION: Transmitters contain dangerously high voltages. Before touching any transmitter circuit, particularly rectifier circuits, turn off the power, allow the capacitors at least 10 seconds time to discharge, then short-circuit the high-voltage output with a tool that has a well-

insulated handle. Remove the short-circuit, make connections for the desired measurement, then stand back and turn on the power if making a voltage or current measurement. Read the meter, turn off the power, wait for capacitors to discharge, and again short-circuit the output before removing the test leads. If a d-c high-voltage generator is used as the power source, wait for the armature to stop rotating, and open the field switch before touching the test leads or the test instrument itself.

SECTION III

FUNCTIONING OF PARTS

14. GENERAL DESCRIPTION. Test Unit I-176 is a multirange instrument of high sensitivity. Various circuits are made available at binding posts by two tap switches. The details of these circuits are described in this section.

15. D-C VOLTMETER CIRCUIT, 1,000 OHMS-PER-VOLT (fig. 2). Setting the left-hand selector switch at VOLTS 1,000 Ω/V places 263-ohm shunt resistor 24 across the meter to reduce its sensitivity. The right-hand selector switch then places in series with the meter-shunt combination the correct total multiplier resistance for the VOLTS range to which this switch is set.

16. D-C VOLTMETER CIRCUIT, 20,000 OHMS PER VOLT. Setting the left-hand selector switch at VOLTS 20,000 Ω/V gives the same basic circuit arrangement as in figure 2 but with the shunt removed from the meter and with a different bank of multiplier resistors to be connected by the right-hand selector switch.

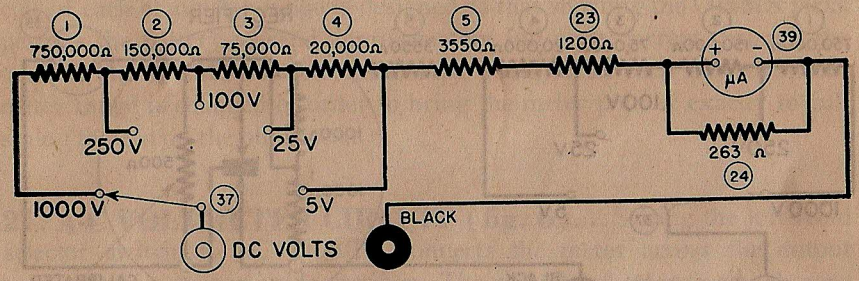


Figure 2. Test Unit I-176, simplified 1,000-ohm-per-volt d-c voltmeter circuit.

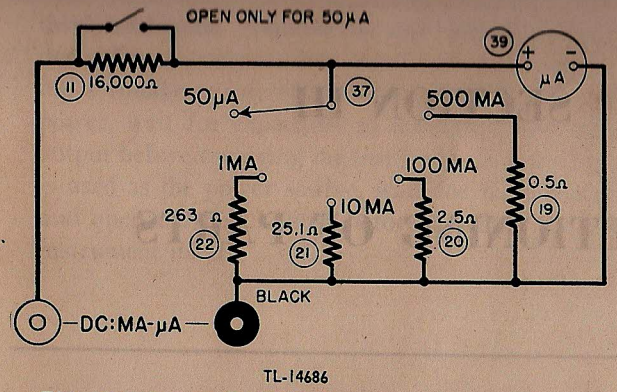


Figure 3. Test Unit I-176, simplified d-c milliammeter circuit.

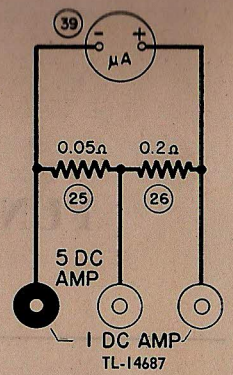


Figure 4. Test Unit I-176, simplified d-c ammeter circuit.

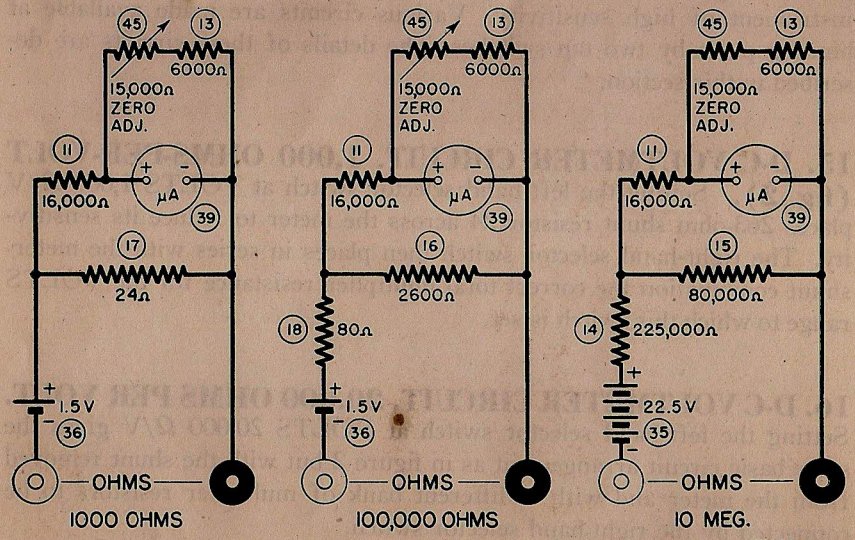


Figure 5. Test Unit I-176, simplified ohmmeter circuits.

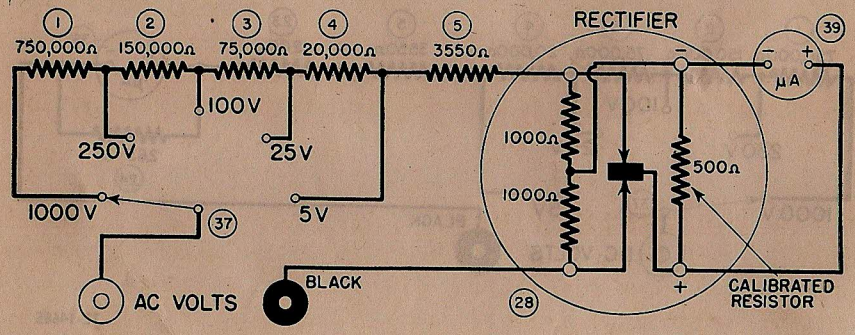


Figure 6. Test Unit I-176, simplified a-c voltmeter circuit.

17. 5,000-VOLT D-C VOLTMETER CIRCUIT. Setting the left-hand selector switch at 5,000 V DC disconnects the meter from all circuits and connects it directly to the two 5,000 V DC jacks located under the panel. Plugging the long-handled insulated connectors of the special high-voltage test leads into these jacks places the correct 100-megohm multiplier resistance in series with the meter, as there are four 12.5-megohm resistors in series inside each long-handled connector.

CAUTION: Do not use any other test leads in these jacks. The use of ordinary test leads, not equipped with multipliers, will destroy the meter.

18. D-C MILLIAMMETER CIRCUIT (fig. 3). Setting the left-hand selector switch at 50 μA connects the meter and 16,000-ohm series resistor 11 between the DC: MA-μA jacks for the 50-microampere range. Setting the left-hand selector switch at AMPS & MA shorts out 16,000-ohm resistor 11 (fig. 3). The right-hand selector switch then connects the correct value of shunt resistance across the meter for the DC MA range at which this switch is set.

19. D-C AMMETER CIRCUIT (fig. 4). Setting the left-hand selector switch at AMPS & MA and setting the right-hand selector switch at ONE & 5 DC AMPS connects the meter to the AMP jacks and to shunt resistors 25 and 26 in such a way that when the test leads are plugged into the pair of jacks for the desired range, the correct shunt resistance value is placed in the circuit.

20. OHMMETER CIRCUITS (fig. 5.) The selector switches arrange the circuits so that for each of the three resistance ranges the proper multiplier and shunt resistance and battery voltage are inserted. The circuit of each ohmmeter range is designed so that shorting the OHMS jacks permits the battery to send approximately full-scale current through the meter. The OHMS ADJ. control must be adjusted each time the ohmmeter range is changed in order to bring the meter pointer exactly to full scale (to zero on the ohms scale).

21. A-C VOLTMETER CIRCUIT (fig. 6). Setting the left-hand selector switch at AC VOLTS connects the meter across the output terminals of a copper-oxide rectifier. The right-hand selector switch connects the input terminals of the rectifier to the AC VOLTS jack through the correct total multiplier resistance for the scale desired. The rectifier

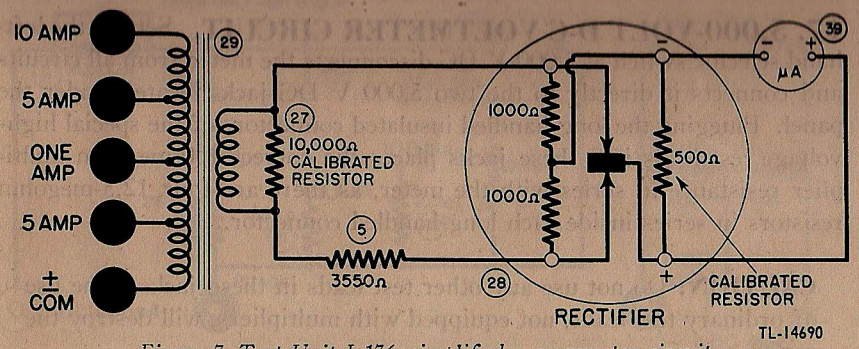


Figure 7. Test Unit I-176, simplified a-c ammeter circuit.

converts alternating current in the measuring circuit to direct current to supply the microammeter. A 500-ohm calibrated output resistor is mounted inside the plug-in rectifier unit. This resistor is adjusted at the factory to match the characteristics of the rectifier, and the complete rectifier unit can be replaced at any time without need for recalibrating the a-c ranges.

22. A-C AMMETER CIRCUIT (fig. 7). Setting the left-hand selector switch at AC AMPS connects the meter across the output of the rectifier unit, and connects the rectifier input to the secondary of a current transformer. The desired current range is obtained by choosing the required pair of AC AMPS binding posts. The right-hand selector switch is out of the circuit. The current transformer primary taps are so positioned that all full-range input currents produce identical a-c input voltages to the rectifier and cause full-scale deflection of the meter pointer.

SECTION IV

MAINTENANCE

NOTE: Failure or unsatisfactory performance of equipment will be reported on W.D., A.G.O. Form No. 468. If this form is not available, see TM 38-250.

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23. GENERAL DESCRIPTION.

a. Test Unit I-176 contains batteries and a plug-in type I-176 rectifier unit which may require replacement. Instructions for making these replacements are contained in the following paragraphs.

CAUTION: Open the test set panel *only* to make necessary battery and rectifier replacements. No other service work should be done on this instrument at any time, except by authorized Signal Corps repair shops or by the manufacturer.

b. To gain access to the batteries and rectifier, remove the eight small screws that hold the panel, then carefully lift the instrument from the case. Since this unit is shipped without batteries it is necessary that they be installed before using the ohmmeter circuits for the first time.

24. BATTERY REPLACEMENT (fig. 8). As the batteries drop in potential because of use or age, the ZERO ADJ. control must be turned farther and farther clockwise for a zero adjustment. If the meter pointer cannot be brought to zero on the ohmmeter scale of the meter during zero adjustment, a battery is very likely in need of replacement. Check battery clips and connecting leads first, however, as a poor battery connection may give the same indication as a bad battery.

a. When the meter pointer cannot be brought to 0 on either the 1,000 or 100,000 OHMS range by adjusting the zero control with the test leads shorted together, the single Battery BA-30 (standard 1½-volt flashlight cell) set between the spring brass terminals should be replaced. Simply pull it out with fingers and push in a new cell, observing the same polarity. (The positive terminal of the cell should be nearest the test lead compartment.)

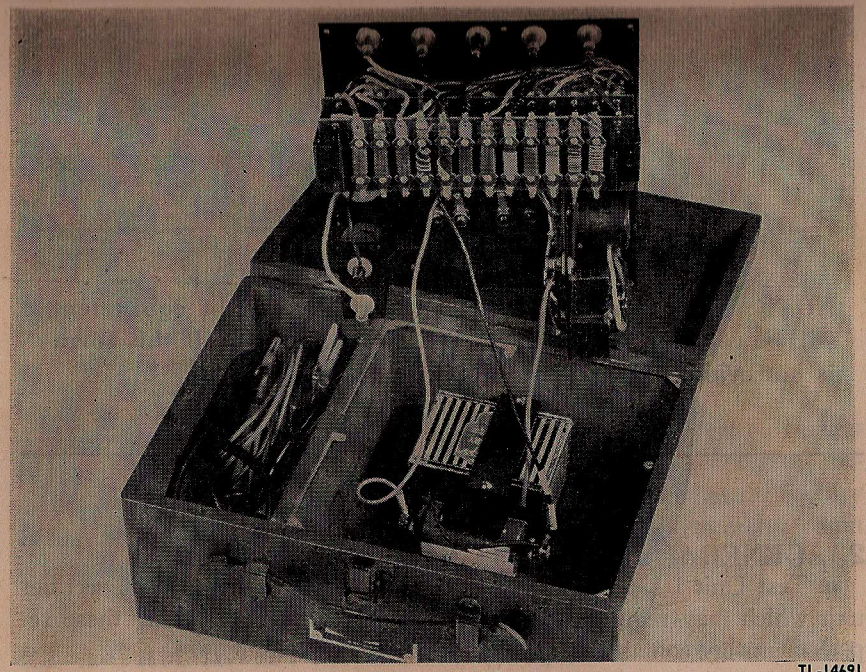

Figure 8. Test Unit I-176, location of batteries.

b. When the meter pointer cannot be brought to 0 on the 10 MEG. range by adjusting the zero control with test leads shorted together, the 22½-volt Battery BA-2, which is clamped to the bottom of the cabinet, should be replaced. Remove the two clamp screws and their lockwashers, lift out the clamping strap and the battery, disconnect the battery leads and connect them to the new battery with the same polarity (red lead to knurled terminal on transformer bracket, and black lead to knurled terminal at negative end of flashlight cell), then put the new battery in the holder. Replace the clamp and screws; make sure all battery lead terminals are tight, then replace the panel assembly in the case and replace the mounting screws.

25. RECTIFIER REPLACEMENT. If the a-c voltage or current ranges fail to operate properly but other ranges are satisfactory, replacement of the type I-176 plug-in rectifier unit will usually clear the trouble. Remove the panel assembly from the case and turn it over. Pull out the old plug-in rectifier unit and plug the new one into the rectifier socket. The standard four-prong socket makes it impossible to insert the rectifier incorrectly.

NOTE: If replacement of the battery or rectifier, or both, does not restore correct operation or if the test unit does not function on any of

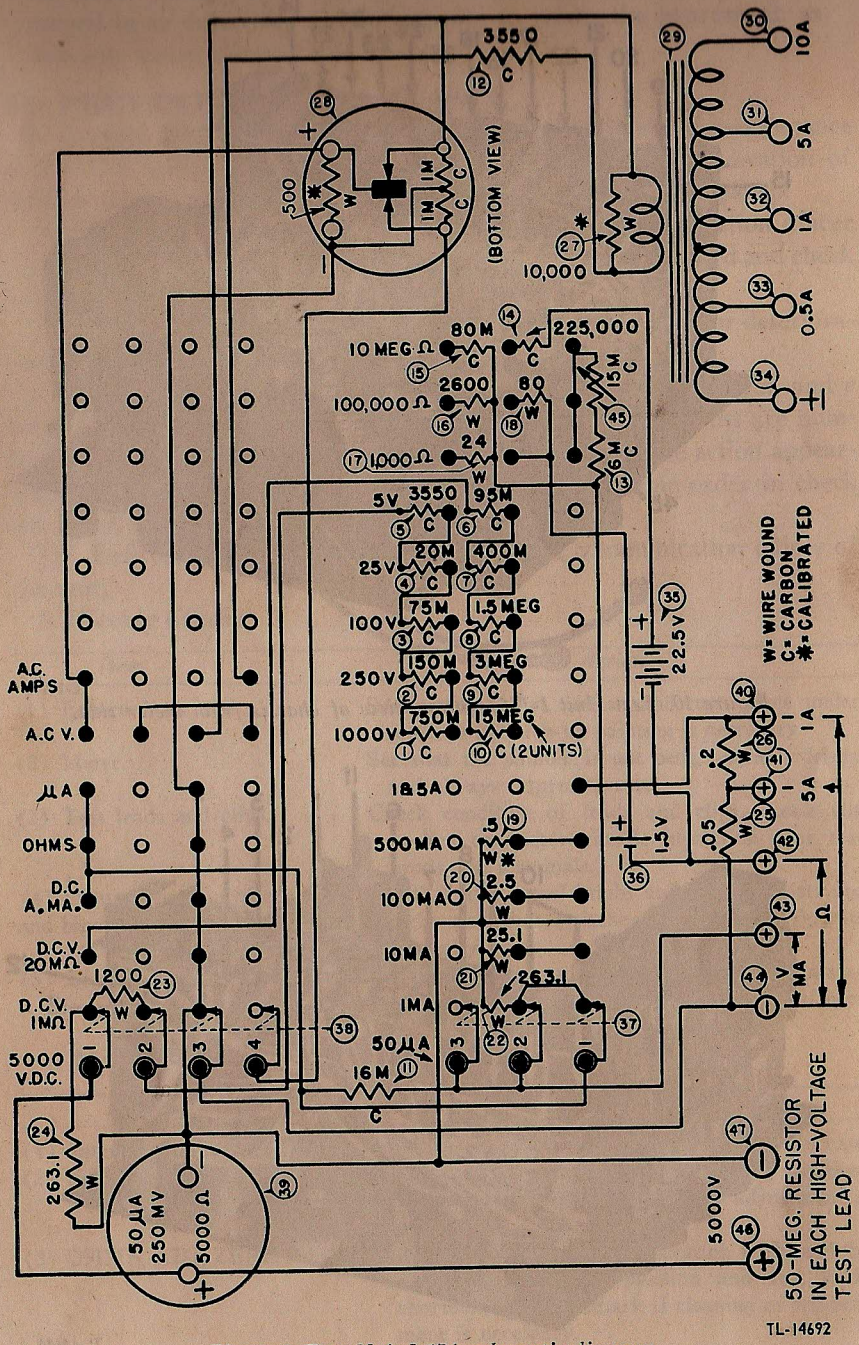

Figure 9. Test Unit I-176, schematic diagram.

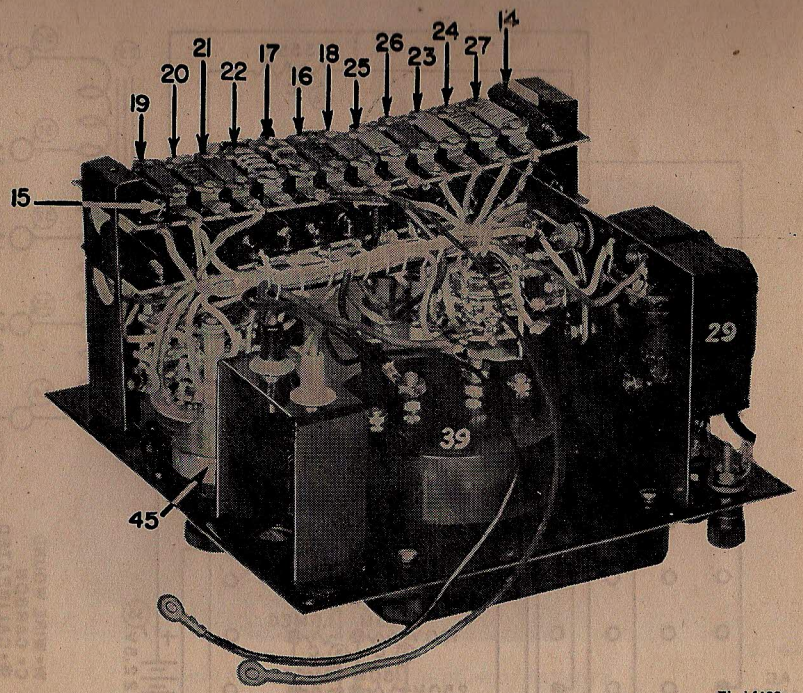

Figure 10. Test Unit I-176, bottom view of chassis from meter side.

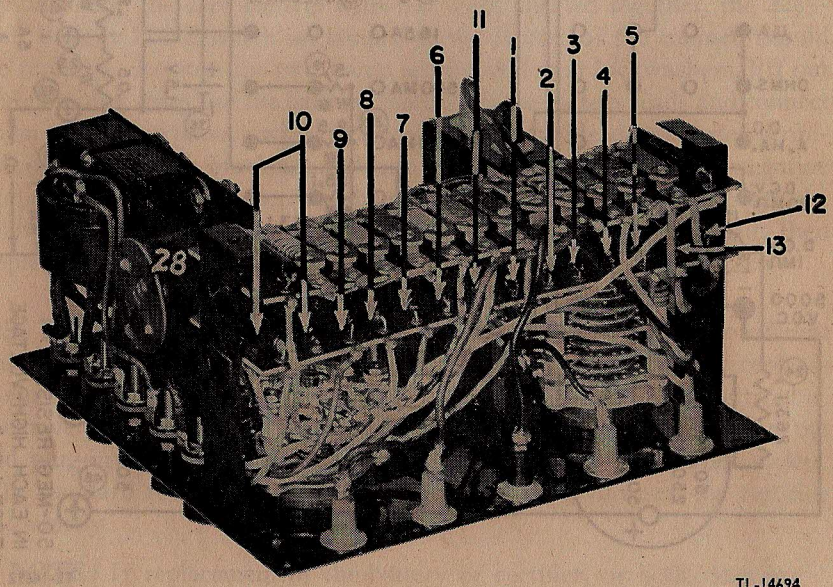

Figure 11. Test Unit I-176, bottom view of chassis from switch side.

its direct voltage or direct current ranges, the test unit should be turned in as defective. Do not attempt to repair the instrument, as this may cause considerable damage.

26. PREVENTIVE MAINTENANCE.

a. General Instructions. The performance of the items of maintenance outlined in these paragraphs will provide, periodically, an indication of the operational condition of this test unit and assure proper upkeep.

(1) A definite time should be scheduled by the communication officer for these checks. The operator should take the readings indicated and check in the appropriate columns in the check sheets.

(2) Equipment not in use should be checked once a month for deterioration, rust, broken parts, and general operation.

(3) The maintenance items are listed in subparagraphs *b*, *c*, *d*, and *e* below. In subparagraphs *b* and *c* below, the maintenance items are numbered consecutively with an explanation of the appropriate action appearing opposite each item. The items, arranged in the same order in check list form, appear in subparagraphs *d* and *e* below.

(4) Deficiencies noted will be reported to the communication officer of the unit.

b. Weekly Checks.

Item	*Action*
(1) External surface.	Remove dust, dirt, grease, and rust. Note under remarks if touch-up painting is necessary.
(2) Meter.	See that the pointer is not bent, operates freely and always returns to zero.
(3) Test leads and clips.	Check condition of leads and clips. Look for broken conductors inside insulation near test prods and terminals.
(4) Control knobs, switches, and binding posts.	See that all control knobs and binding posts are tight and that switches and controls operate normally.
(5) Batteries.	Check zero ohms adjustment as described in section IV paragraph 24. Replace batteries if necessary and note under remarks.

c. Monthly Checks.

Item	*Action*
(1) Interior surfaces.	Remove all dust and foreign matter in the case.
(2) Selector switches.	Check operation of set for each switch position. Note under remarks if repair or adjustment is necessary.
(3) OHMS, ADJ. ZERO control.	Check for smoothness of operation with selector switches in OHMS position and test leads shorted. Enter a remark if cleaning or replacement is necessary.
(4) Case.	Repaint or repair if needed. Note in remarks.

d. Weekly Check List.

PREVENTIVE MAINTENANCE—FIELD TEST EQUIPMENT

Test Unit I-176 Serial No. .....

Enter a check in the form below if the item has been found satisfactory.

ITEM	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
(1) External Surfaces.															
(2) Meter.															
(3) Test leads and clips.															
(4) Control knobs, switches.															
(5) Batteries.															

Enter a check in the form below if the action has been completed.

ITEM	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
(6) Unsatisfactory items brought to attention of communication officer.															
(7) Previously reported unsatisfactory items completed.															

REMARKS:

Date ..... Through ..... Signature .....

Rating .....

e. Monthly Check List.

PREVENTIVE MAINTENANCE—FIELD TEST EQUIPMENT

Test Unit I-176 Serial No. .....

Enter a check in the form below if the item has been found satisfactory.

ITEM	1	2	3	4	5	6
(1) Interior surfaces.						
(2) Selector switches.						
(3) OHMS, ADJ. ZERO control.						
(4) Case.						

Enter a check in the form below if the action has been completed.

ITEM	1	2	3	4	5	6
(5) Unsatisfactory items brought to attention of communication officer.						
(6) Previously reported unsatisfactory items corrected.						

REMARKS:

Date ..... Through ..... Signature .....

Rating .....

27. MOISTUREPROOFING AND FUNGIPROOFING.

a. General. Communication failures commonly occur when Signal Corps equipment is operated in tropical areas where temperature and humidity are extremely high. The following problems are typical:

(1) Resistors and capacitors fail.

(2) Electrolytic action takes place in coils, chokes, transformer windings, etc., causing eventual break-down.

(3) Hook-up wire and coil insulation break down. Fungus growth accelerates deterioration.

(4) Moisture forms electrical leakage paths on terminal boards and insulating strips, causing flash-overs and crosstalk.

(5) Moisture provides leakage paths between battery terminals.

b. Treatment. A moistureproofing and fungiproofing treatment has been devised, which, if properly applied, provides a reasonable degree of protection against fungus growth, insects, corrosion, salt spray, and moisture. The treatment involves the use of a moisture- and fungi-resistant varnish applied with a spray gun. A brief description of the method of application follows:

(1) All repairs and adjustments necessary for the proper operation of the equipment are made.

(2) Equipment to be processed is thoroughly cleaned of all dirt, dust, rust, fungus, oil, grease, etc.

(3) Equipment is partially disassembled and certain parts, such as relay contacts, open switches, air capacitors, sockets, bearings, etc., are covered with masking tape.

(4) Equipment is baked to expel moisture which the circuit elements have absorbed.

(5) All circuit elements and all parts of the equipment are sprayed or painted with three coats of moistureproofing and fungiproofing varnish.

(6) The equipment is given a final operational check.

c. Step-by-step Instructions.

(1) DISASSEMBLY.

(*a*) Remove cover by disengaging hinges.

(*b*) Remove eight screws holding front panel to case and remove panel assembly.

(*c*) Remove battery leads from battery.

(*d*) Remove battery from case.

(*e*) Remove four screws and lockwashers holding battery bracket to case; remove bracket.

(2) MASKING. Cover the following components with masking tape as shown in figures 12 and 13.

(*a*) Complete selector switch, item A, figure 12.

(*b*) Complete selector switch, item B, figure 12.

(*c*) Contacts on high-voltage pin jacks, item C, figure 12.

(*d*) Lugs on battery leads, item D, figure 12.

(*e*) Five (5) pin jacks on front panel, item A, figure 13.

(*f*) Contacts on battery bracket, (not photographed).

(3) PREPARATION. Thoroughly clean all equipment to be treated by removing all oil, dirt, rust, or fungus adhering to components.

(4) DRYING.

(*a*) Place components to be treated in heat chamber.

(*b*) Bake for 2 or 3 hours at 160° F. *Do not exceed 160° F.*

(*c*) If wax should begin to melt on any of the components, decrease temperature and increase baking time approximately 1 hour for each 10° drop in temperature.

(5) VARNISHING.

(*a*) Apply three (3) coats of moisture and fungiproofing varnish to all equipment to be treated, including inside of cases, allowing a 15 to 20 minute drying period after each coat.

(*b*) Using a brush, apply varnish to those portions not reached by spray gun, making sure that all components are adequately protected by varnish.

(6) REASSEMBLY.

(*a*) Remove all masking tape.

(*b*) Reassemble unit by following instructions for disassembly in reverse order.

(*c*) Mark cases MFP with date of treatment.

(*d*) Check over-all performance of equipment.

CAUTION: Varnish spray may have toxic effects. Use respirator if available. Otherwise fasten cheesecloth or other cloth material over nose and mouth.

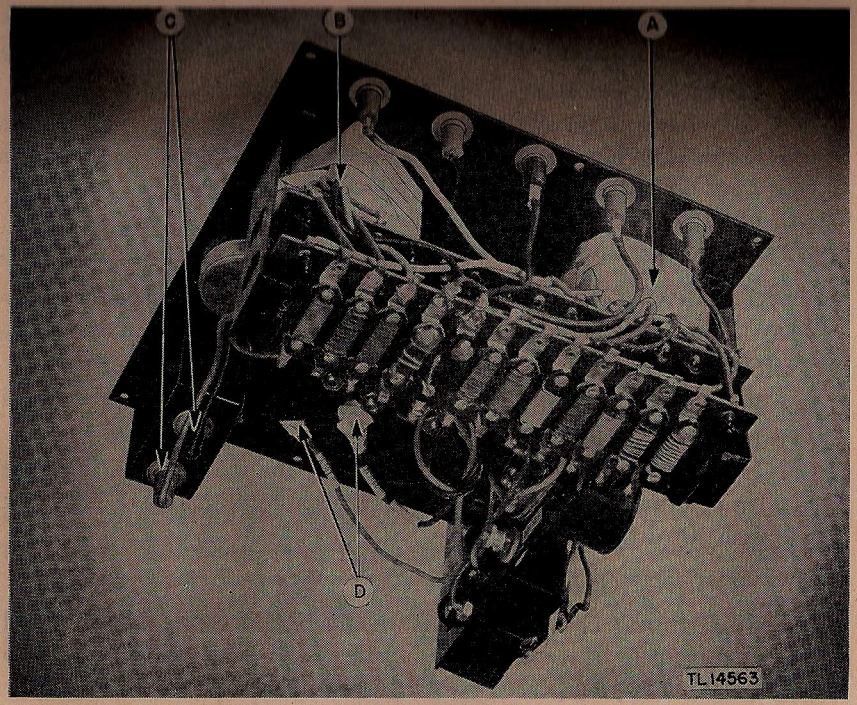

Figure 12. Test Unit I-176, bottom view, masking of components.

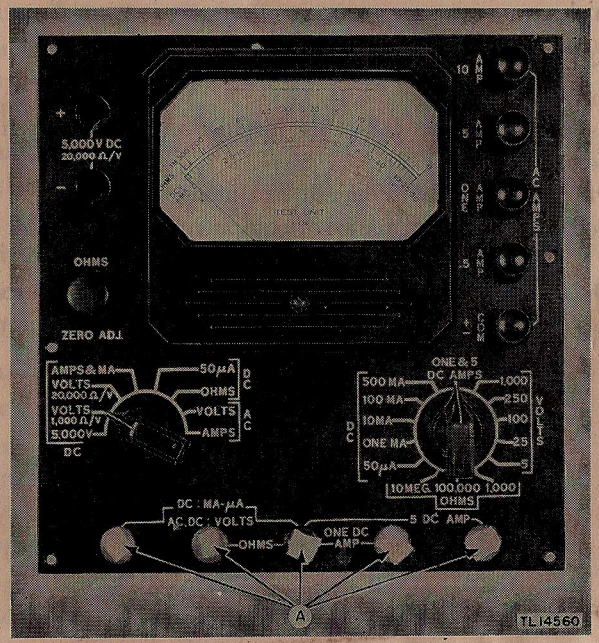

Figure 13. Test Unit I-176, top view, masking on front panel.

SECTION V

SUPPLEMENTARY DATA

28. TUBE-BASE CHART FOR SIGNAL CORPS AND COMMERCIAL TUBES.

a. Signal Corps Tubes. (See tube-base diagrams in figure 14.)

Tube	*Base*	*Tube*	*Base*	*Tube*	*Base*	*Tube*	*Base*
VT-7	4D	VT-54	4M	VT-88	7V	VT-115	7AC
VT-24	4D	VT-56	5A	VT-88-A	7V	VT-115-A	7AC
VT-25	4D	VT-57	6F	VT-89	6F	VT-116	8N
VT-25-A	4D	VT-58	6F	VT-90	7Q	VT-116-B	8N
VT-26	4K	VT-62	4D	VT-91	7R	VT-117	8N
VT-27	4D	VT-63	5C	VT-91-A	7R	VT-119	4AB
VT-28	5E	VT-65	6Q	VT-92	7V	VT-120	5BB
VT-29	5A	VT-66	7S	VT-92-A	7V	VT-121	5BC
VT-30	4D	VT-67	4D	VT-93	8E	VT-124	6X
VT-31	4D	VT-68	7D	VT-94	6Q	VT-125	6X
VT-33	5K	VT-69	6F	VT-94-A	6Q	VT-126	6S
VT-35	5E	VT-70	7E	VT-94-D	6Q	VT-126-A	6S
VT-36	5E	VT-72	4D	VT-95	4D	VT-126-B	6S
VT-37	5A	VT-73	5A	VT-96	8B	VT-131	8N
VT-38	5F	VT-74	5L	VT-97	5T	VT-132	8K
VT-40	4D	VT-75	6G	VT-98	6R	VT-133	8Q
VT-41	4K	VT-76	5A	VT-99	8G	VT-134	7AC
VT-44	4K	VT-77	6F	VT-100	5AW	VT-135	6Q
VT-45	4D	VT-78	6F	VT-101	6BM	VT-135-A	6Q
VT-46	4P	VT-80	4C	VT-103	8Q	VT-136	5AZ
VT-46-A	4P	VT-83	4C	VT-104	8Q	VT-137	6Q
VT-47	5B	VT-84	5D	VT-105	8S	VT-138	7AL
VT-48	6B	VT-86	7R	VT-107	7AC	VT-139	4AJ
VT-49	5F	VT-86-A	7R	VT-107-A	7AC	VT-145	4C
VT-50	4D	VT-86-B	7R	VT-107-B	7AC	VT-146	5Y
VT-51	4D	VT-87	7T	VT-112	8N	VT-147	7E
VT-52	4D	VT-87-A	7T	VT-114	5T	VT-148	8AJ

Tube	Base	Tube	Base	Tube	Base	Tube	Base
VT-149	8AS	VT-177	5AG	VT-201	7AC	VT-229	8BD
VT-150	8R	VT-178	7AK	VT-201-C	7AC	VT-231	8BD
VT-151	8A	VT-179	7AO	VT-202	7BS	VT-233	8Q
VT-151-B	8A	VT-180	6BB	VT-203	7BD	VT-234	2T
VT-152	7S	VT-181	5AB	VT-205	8Q	VT-235	3P
VT-153	8E	VT-182	7BE	VT-206-A	5L	VT-237	5BD
VT-161	8R	VT-183	4AH	VT-207	8BE	VT-238	5BB
VT-162	8N	VT-184	4AJ	VT-208	8X	VT-239	4AA
VT-163	8G	VT-185	6BB	VT-209	8BK	VT-241	8BN
VT-167	8K	VT-188	8W	VT-210	7AV	VT-242	4AH
VT-168	7AC	VT-189	8AC	VT-211	8BK	VT-255	5T
VT-168-A	7AC	VT-190	8V	VT-212	5BD	VT-245	8BA
VT-169	8E	VT-192	5AC	VT-213-A	6Q	VT-247	8Y
VT-170	5Y	VT-193	8V	VT-214	7Q	VT-260	4AJ
VT-171	7AT	VT-194	8AR	VT-215	6R	VT-264	7BA
VT-171-A	7AT	VT-195	5AQ	VT-216	4P	VT-266	4P
VT-172	6AU	VT-196	6S	VT-221	7AP	VT-268	8S
VT-173	6AR	VT-197-A	5T	VT-223	5Z	VT-269	8BK
VT-174	7BA	VT-198-A	7S	VT-224	7BL	VT-288	8BK
VT-175	7S	VT-199	8N	VT-225	5J	VT-289	8BD
VT-176	8N	VT-200	4AJ	VT-227	6BO		

b. Commercial Tubes. (See tube-base connection diagrams in figure 14.)

AD 4G	0A4 4V	1B1 4A	1F5-G 6X
AF 4C	0Z3 5N	1B4 4M	1F6 6W
AG 4C	0Z4 4R	1B5/25S 6M	1F7-G, GH, GV 7AD
AX 4Q	01 4D	1B7-G 7Z	
B 4E	01A 4D	1B8 8AW	1G1 4A
BA 4J	01AA 4D	1C1 4A	1G4-G 5S
BH 4J	01B 4D	1C5-G 6X	1G5-G 6X
BR 4H	D-½ 4B	1C6 6L	1G6-G 7AB
BX 4D	1 4G	1C7 7Z	1H4-G 5S
DE 4D	D-1 4C	1C21 4V	1H4-G 5Z
E 4D	KR-1 4G	1D1 4A	1H6-G 7AA
G 4D	RA-1 4Q	1D5, 1D5-GR 5Y	1J1 4A
GA 5B	RE-1 4C	1D5-GT 5R	1J5-G 6X
H 4D	SO-1 4Q	1D7-G 7Z	1J6-G 7AB
LA 5B	1A1 4A	1D8-GT 8AJ	1K1 4A
PZ 5B	1A3 5AP	1E1 4A	1L1 4T
PZH 5B	1A4-P 4M	1E4-G 5S	1L4 6AR
Wnd A 6N	1A4-T 4K	1E5-G 5R	1LA4 5AD
XXD 8AC	1A5-G 6X	1E5-GP 5Y	1LA6 7AK
XXL 5AC	1A6-GT 6L	1E7-G 8C	1LB4 5AD
00 4D	1A6-S 6L	1F1 4A	1LB6 8AX
00A 4D	1A7-G 7Z	1F4 5K	1LC5 7AO

Tube	Base	Tube	Base	Tube	Base	Tube	Base
1LC6	7AK	2C22	4AM	5R4-GY	5T	6B6-G	7V
1LD5	6AX	2C34/RK34	7BL	5T4	5T	6B7	7D
1LE3	4AA	2E5	6R	5U4-G	5T	6B8	8E
1LH4	5AG	2E22	5J	5V4-G	5L	6C4	6BG
1LN5	7AO	2G5	6R	5W4	5T	6C5	6Q
1N1	4T	2S/4S	5D	5X3	4C	6C5-G	6Q
1N5-G	5Y	2V3-G	4Y	5X4G	5Q	6C6	6F
1N6-G	7AM	2W3	4X	5Y3-G	5T	6C7	7G
1P1	4T	2X2/879	4AB	5Y4-G	5Q	6C8-G	8G
1P5-G	5Y	2X3	4E	5Z3	4C	6D5	6Q
1Q1	4T	2Y2	4AB	5Z4	5L	6D6	6F
1Q5-GT	6AF	2Y3	4C	6	4A	6D7	7H
1R1-G	4T	2Y4	5D	A (6)	6N	6D8-G	8A
1R4/1294	4AH	2Z2	4B	6A3	4D	6E5	6R
1R5	7AT	3	4A	6A4/LA	5B	6E6	7B
1S1G	4T	OA3/VR75	4AJ	6A5-G	6T	6E7	7H
1S4	7AV	OB3/VR90	4AJ	6A6	7B	6F5	5M
1S5	6AU	OC3/VR105	4AJ	6AB5	6R	6F5-G	5M
1SA6	6BD	OD3/VR150	4AJ	6AB6	7AU	6F6	7S
1SB6	6BE	3A4	7BB	6AB7/1853	8N	6F7	7E
1T1-G	4T	3A5	7BC	6AC5-G	6Q	6F7-S	7E
1T4	6AR	3A8-GT	8AS	6AC6-G	7W	6F8-G	8G
1T5	6AF	3B5-GT	7AP	6AC7/1852	8N	6G5	6R
1T5-GT	6X	3B7/1291	7BE	6AD5-G	6Q	6G6-G	7S
1-V	4G	3B21	4C	6AD6-G	7AG	6G7	7N
1V1	4A	3B22	4C	6AD7-G	8AY	6G7-S	7N
1Y1	4A	3B23/RK22	4AN	6AE5-GT	6Q	6H4-GT	5AF
1Z1	4A	3C5-GT	7AQ	6AE6-G	7AH	6H5	6R
2	4A	3D6/1299	6BB	6AE7-GT	7AX	6H6	7Q
G-2	5D	3LE4	6BA	6AF5-G	6Q	6H7	7P
G-2S	5D	3LF4	6BB	6AF6-G	7AG	6H7-S	7P
KR-2	4G	3Q4	7BA	6AF7	8AG	6H8	8F
RE-2	4B	3Q5-GT	7AP	6AG5	7BD	6J5	6Q
SO-2	4D	3S4	7BA	6AG7	8Y	6J6	7BF
2A3	4D	4	4A	6AH5-G	6AP	6J7	7R
2A3-H	4Q	G-4	5D	6AH7-GT	8BE	6J7-G	7R
2A4-G	5S	G-4S	5D	6AK5	6BD	6J7-GT	7R
2A5	6B	4A6-G	8L	6AK6	7BK	6J8-G	8H
2A6	6G	4B24	4C	6AL6-G	6AM	6K5-G	5U
2A7	7C	4B25	4C	6A7	7C	6K6-G	7S
2B4	5A	4S	5D	6A7-M	8A	6K7	7R
2B6	7J	5	4A	6A7-S	7C	6K8	8K
2B7	7D	A (5)	5H	6A8	8A	6L5-G	6Q
2C4	5AS	KR5	5B	6B4-G	5S	6L6	7AC
2C21/RK33	7BH	IN5-GT	5Y	6B5	6AS	6L6-GX	7S

Tube	Base
6L7	7T
6N5	6R
6N6-G	7AU
6N7	8B
6P5-G	6Q
6P7-G	7U
6Q5	6Q
6Q6-G	6Y
6Q7	7V
6R6-G	6AW
6R7	7V
6S6-GT	5AK
6S7-G	7R
6SA7	8R
6SA7-GT	8AD
6SC7	8S
6SD7-GT	8N
6SE7-GT	8N
6SF5	6AB
6SF7	7AZ
6SG7	8BK
6SH7	8BK
6SJ7	8N
6SK7	8N
6SL7-GT	8BD
6SN7-GT	8BD
6SQ7	8Q
6SR7	8Q
6SS7	8N
6ST7	8Q
6T5	6R
6T7-G	7V
6U5/6G5	6R
6U6-GT	7AC
6U7-G	7R
6V4	5D
6V6	7AC
6V7-G	7V
6W5-G	6S
6W6-GT	7AC
6W7-G	7R
6X5	6S
6X6	7AL
6Y3	4AC
6Y5	6J
6Y6-G	7AC
6Y7-G	8B
6Z3	4G
6Z4	5D
6Z5	6K
6Z6	7Q
6Z7-G	8B
6ZY5-G	6S
7	4A
7A4	5AC
7A5	6AA
7A6	7AJ
7A7-LM	8V
7A8	8U
7B4	5AC
7B5	6AE
7B6	8W
7B7	8V
7B8	8X
7C4/1203A	4AH
7C5	6AA
7C6	8W
7C7	8V
7E5/1201	8BN
7E6	8W
7E7	8AE
7F7	8AC
7G7	8V
7H7	8V
7J7	8AR
7K7	8BF
7L7	8V
7N7	8AC
7P7	8V
7Q7	8AL
7R7	8AE
7S7	8BL
7T7	8V
7V7	8V
7W7	8BJ
7Y4	5AB
7Z4	5AB
8	4A
9	4A
10	4D
WX-12	4D
12A	4D
12A5	7F
12A6	7AC
12A7	7K
12A8-GT	8A
12AH7-GT	8BE
12B6	6Y
12B7	8V
12B8-GT	8T
12C8	8E
12E5-GT	6Q
12F5-GT	5M
12G7	7V
12H6	7Q
12J5-GT	6Q
12J7-GT	7R
12K7-GT	7R
12K8	8K
12L8-GT	8BU
12Q7-GT	7V
12SA7	8R
12SA7-GT	8AD
12SC7	8S
12SF5	6AB
12SF7	7AZ
12SG7	8BK
12SH7	8BK
12SJ7	8N
12SK7	8N
12SL7-GT	8BD
12SN7-GT	8BD
12SQ7	8Q
12SR7	8Q
12Z3	4G
12Z5	6K
14	5E
14A4	5AC
14A5	6AA
14A7	8V
14AF7	8AC
14B6	8W
14B8	8X
14C5	6AA
14C7	8V
14E6	8W
14E7	8AE
14F7	8AC
14H7	8V
14J7	8AR
14N7	8AC
14Q7	8AL
14R7	8AE
14S7	8BL
14W7	8BJ
14Y4	5AB
14Z3	4G
15	5F
17	5A
18	6B
19	6C
RK19	4AN
20	4D
KR20	6N
RK21	4AB
22	4K
A-22	4D
AC22	5E
KR22	6N
RK22/3B23	4AN
K24	5E
RK24	4D
24A	5E
24S	5E
25	6M
KR25	6B
25A6	7S
25A7-G	8F
25AC5-GT	6Q
25B5	6D
25B6-G	7S
25B8-GT	8T
25C6-G	7AC
25D8-GT	8AF
25L6	7AC
25N6-G	7W
25S	6M
25X6-GT	7Q
25Y4-GT	5AA
25Y5	6E

Tube	Base
25Z3	4G
25Z4	5AA
25Z5	6E
25Z6	7Q
26	4D
A26	4D
27	5A
27HM	5A
27S	5A
K27	5A
A28	4D
29	6N
30	4D
A-30	4Q
R-30	4D
31	4D
KR31	4G
32	4K
A32	4Q
32L7-GT	8Z
33	5K
RK33/2C21	7BH
34	4M
RK34/2C34	7BL
35	5E
35A5-LT	6AA
35L6-GT	7AC
35Y4	5AL
35Z3-LT	4Z
35Z4-GT	5AA
35Z5-GT	6AD
35Z6-G	7Q
36	5E
37	5A
38	5F
39/44	5F
RK-39	5AW
40	4D
A40	4Q
40Z5	6AD
41	6B
41M	7S
42	6B
42A2	3S
42B2	3S
43	6B
43-MG	7S
44	5F
45	4D
45 special	4D
45Z3	5AM
45Z5-GT	6AD
46	5C
46A1	2S
46B1	2S
47	5B
RK47	5J
48	6A
A48	4Q
50	4D
VR50	4W
50A5	6AA
50C6-G	7AC
50L6-GT	7AC
50Y6-GT	7Q
50Z6-G	7Q
50Z7-G	8AN
51	5E
52	5C
53	7B
55	6G
56	5A
56AS	5A
56S	5A
57	6F
57AS	6F
57S	6F
58	6F
58AS	6F
58S	6F
59	7A
59A	7A
59S	7A
HY61/807	5AW
RK62	4D
64	5E
65	5E
67	5A
68	5E
69	5E
70	6N
70A7-GT	8AB
70L7-GT	8AA
71A	4D
75	6G
75 M	7V
75S	6G
VR75-30	4AJ
76	5A
77	6F
77M	7R
78	6F
78S	6F
79	6H
80	4C
81	4B
82	4C
82V	4L
83	4C
83V	4L
84/6Z4	5D
G-84	5D
85	6G
85AS	6G
85L7	8AB
85M	7V
85S	6G
86M	6Q
87S	6F
88	4C
88M	7R
88S	6F
89	6F
89RS	7N
VR105-30	4AJ
112A	4D
113HY	5K
HY-114B	2T
115HY	5K
117L7-GT	8A0
117M7-GT	8A0
117N7-GT	8AV
117P7-GT	3AV
117Z4-GT	54AA
117Z6-GT	7Q
125HY	5K
VR150-30	4AJ
165R	4A
165R4	4A
165R8	4A
181	4D
182A	4D
182B	4D
183/483	4D
185R	4A
185R4	4A
185R8	4A
210T	4D
213, 213B	4C
216, 216B	4B
231D, WE 213D	4D
239A	4G
242C	4D
244A	5A
245A	4D
249B	4AU
252A	4D
257	5B
257A, WE 257A	3Q
259A	5E
264	4D
271A	5A
274-A	4C
274-B	5T
275-A	4D
282-A	4AR
283-A	5A
287A	5AU
291	5G
293	5G
295	5G
WE 300A	4D
WE 300B	4D
301A	4C
307A, WE 307-A	5J
310	4D
310A	6F
311A	5F

Tube	Base
312A	6BK
323A	5AU
328	6F
348A	7R
349A	7S
350A, WE 350A	5AW
350B	7S
351A	6S
383A	5AT
385A	6BL
482A, 482B	4D
483	4D
484	5A
485	5A
486	5S
WL578/8020	4P
585	4D
586	4D
HY-615B	3P
713, 713A, WE-713A	8BK
717, 717A, WE-717A	8BK
801, 801A	4D
802	6BM
803	5J
804	5J
807	5AW
811	30
812	30
813	5BA
814	5J
816	4P
837	6BM
840	5J
841	4D
842	4D
843	5A
864	4D
865	4AR
866, 866A	4P
874	4S
878	4AU
879	4AB
884	6Q
885	5A
941	4D
942	4D
950	5K
951	4K
954	5BB
955	5BC
956	5BB
957	5BD
958	5BD
959	5BE
985	5D
986	4C
1005, CK1005	5AQ
1201/7E5	8BN
1203	4AH
1203A/7C4	4AH
1204	8B0
1221	6F
1223	7R
1231	8V
1232	8V
1284	8V
1291/3B7	7BE
1293	4AA
1294	4AH
1299/3D6	6BB
1602	4D
1603	6F
1608	4D
1609	5K
1610	5B
1612	7T
1613	7S
1614	7AC
1616	4P
1619	7AC
1620	7R
1621	7S
1622	7AC
1625	5AZ
1626	6Q
1629	7AL
1631	7AC
1632	7AC
1633	8BD
1634	8S
1635	8B
1642	7BH
1851	7R
1852	8N
1853	8N
2050	8BA
7184, KR7184	6B0
8005	30
8013A	4P
8020/WL578	4P
9001	7BD
9002	7BS
9003	7BD
9004	4BJ
9005	5BG
9006	6BH

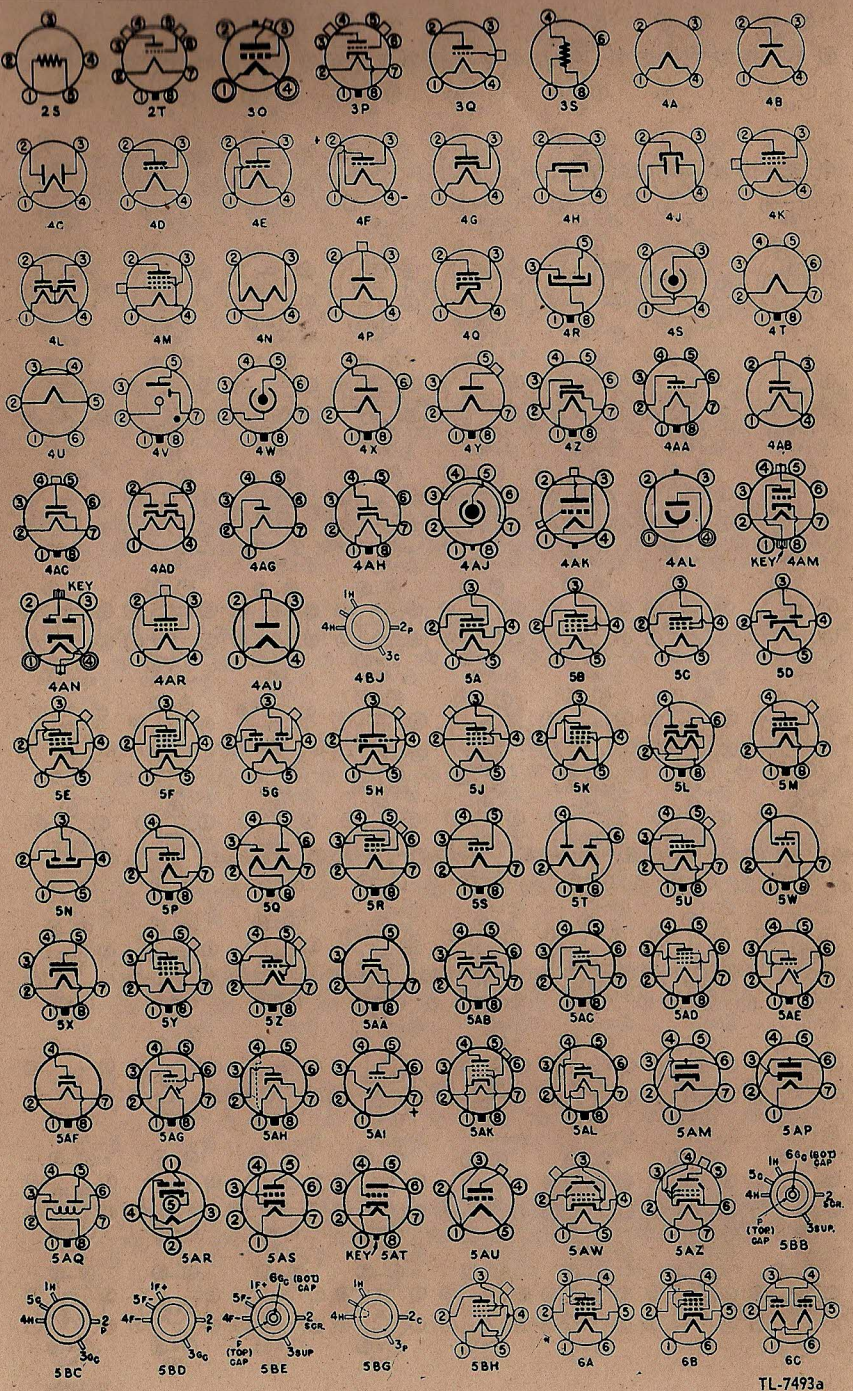

Figure 14.1. Tube base diagrams, 2S to 6C.

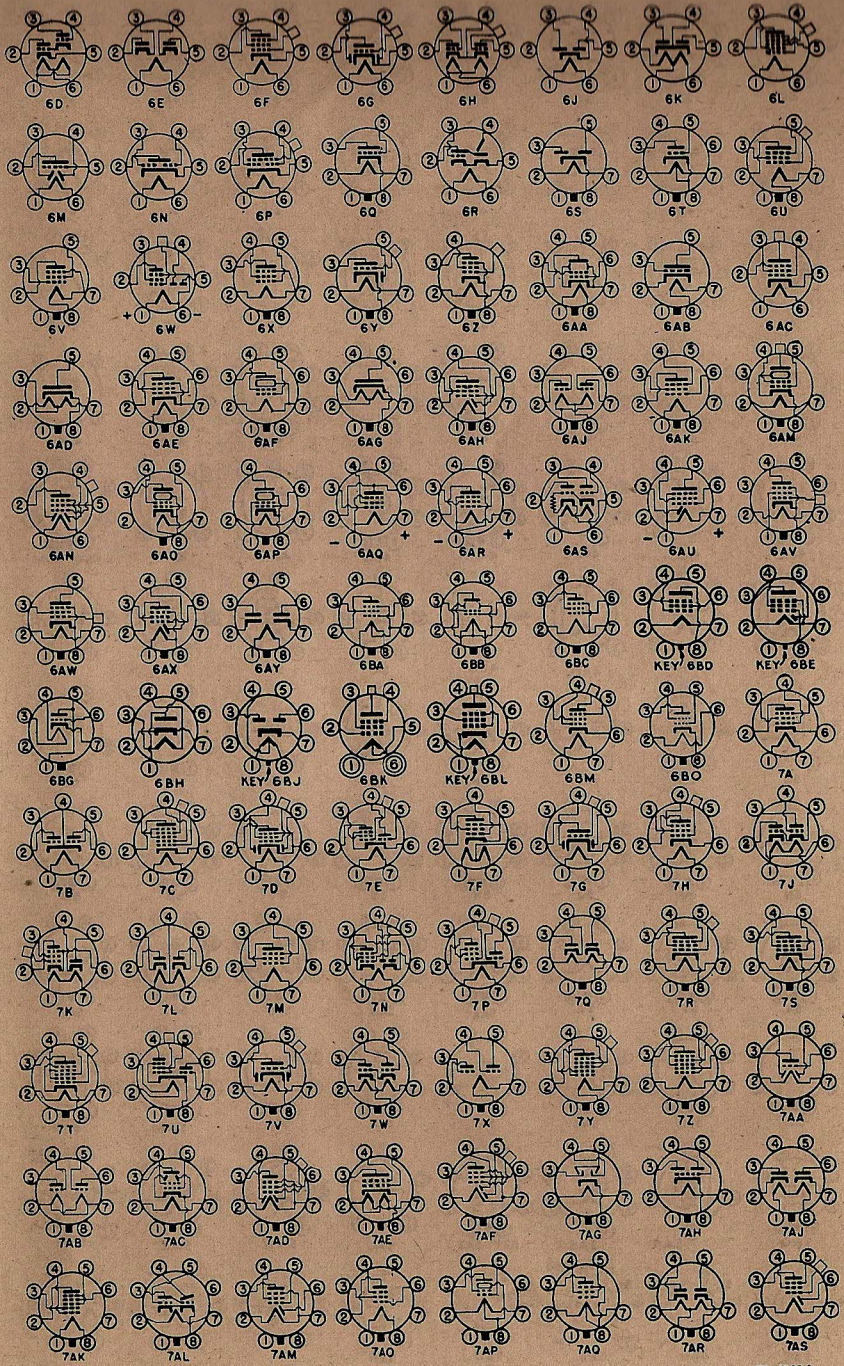

Figure 14.2. Tube base diagrams, 6D to 7AS.

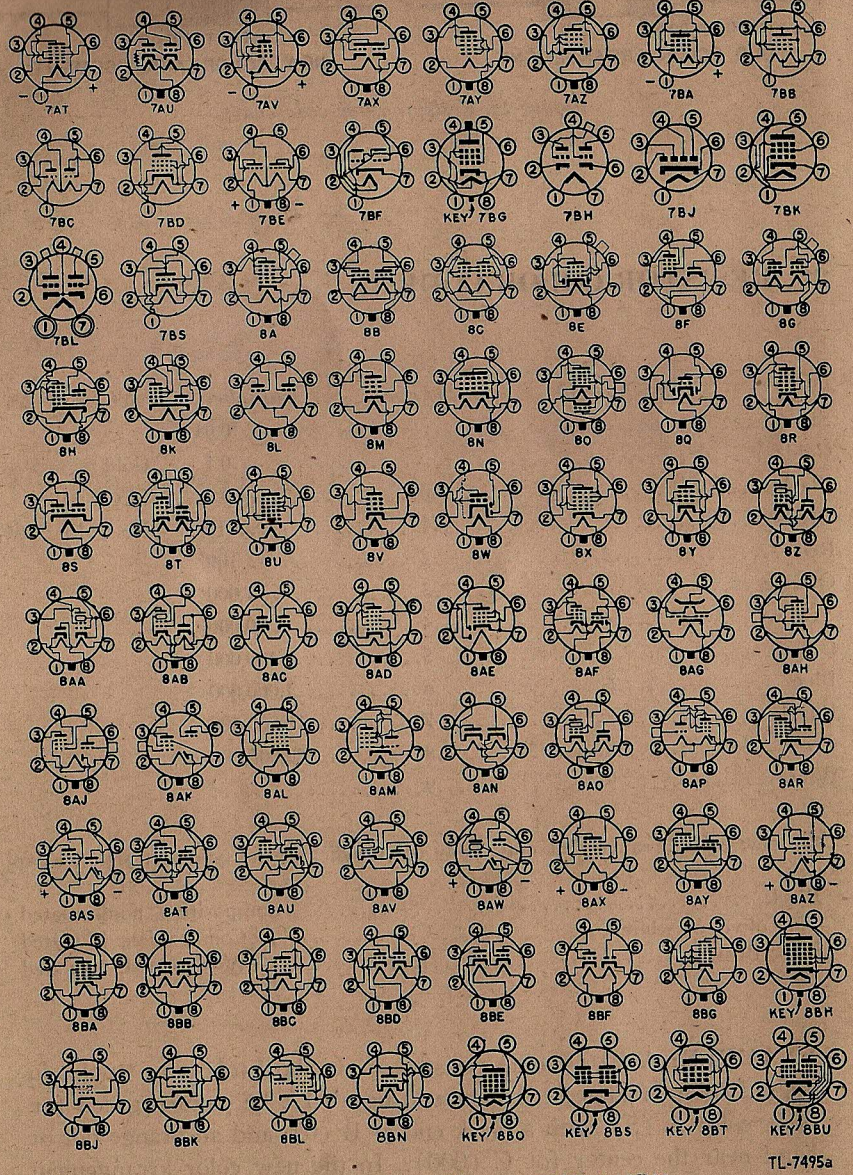

Figure 14.3. Tube base diagrams, 7AT to 8BU.

Figure 15. Resistor color-code chart.

29. RESISTOR COLOR CODE.

Color	*A 1st digit*	*B 2nd digit*	*C Multiplier*	*Tolerance code*
Silver			0.01	
Gold			0.1	Gold: 5%
Black	0	0	0.1	Silver: 10%
Brown	1	1	10	No Color: 20%
Red	2	2	100	
Orange	3	3	1,000	
Yellow	4	4	10,000	
Green	5	5	100,000	
Blue	6	6	1,000,000	
Purple	7	7	10,000,000	
Gray	8	8	100,000,000	
White	9	9		

On new color arrangement only, body color indicates the type of resistor, as follows:

Black	Composition, noninsulated
Tan, olive, or white	Composition, insulated
Dark Brown	Wire-wound, insulated

EXAMPLE: A 50,000-ohm resistor of standard tolerance would, in the old color arrangement shown in figure 15, be painted green for body color A (5), with a black end at B (0), and an orange dot or band near the center for C (000). In the new color arrangement shown in figure 15, band A would be green (5), band B would be black (0), and band C would be orange (000). In both arrangements, band D would be missing.

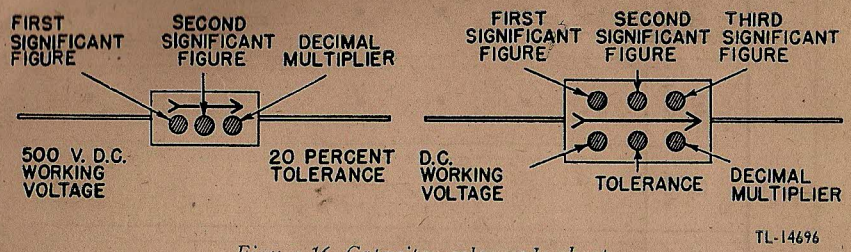

Figure 16. Capacitor color-code chart.

30. CAPACITOR COLOR CODE.

Color	*Numerical*	*Volts*	*Multiplier*	*Tolerance*
Black	0		1	
Brown	1	100	10	1%
Red	2	200	100	2%
Orange	3	300	1,000	3%
Yellow	4	400	10,000	4%
Green	5	500	100,000	5%
Blue	6	600	1,000,000	6%
Violet	7	700	10,000,000	7%
Gray	8	800	100,000,000	8%
White	9	900	1,000,000,000	9%
Gold		1000	0.1	5%
Silver		2000	0.01	10%
No Color		500		20%

EXAMPLE: A 56,300-mmf (0.0563 mf) capacitor with 10% tolerance and rated at 500 volts would be identified by a green dot (5), a blue dot (6), and an orange dot (3) on the top row, and with a red dot (00), a silver dot (10% tolerance), and a green dot (500 volts) on the bottom row, arranged in the order shown in figure 16. All capacitance values are given in micromicrofarads (mmf) by the color code. Small capacitors often use the 3-dot code shown in figure 16.

31. MAINTENANCE PARTS LIST FOR TEST UNIT I-176

NOTE: Order maintenance parts by stock number, name, and description.
Only maintenance parts can be requisitioned.

Ref. symbol	*Signal Corps stock No.*	*Name of part and description*	*Quan. per unit*	*Running spares*	*Orgn. stock*	*3d ech.*	*4th ech.*	*5th ech.*	*Depot stock*
	3F4470-176	TEST UNIT I-176.							*
30, 31, 32, 33, 34	3Z737-23	BINDING POST: screw type.	5				*	*	*
51	3Z1087	CLIPS: alligator; push-on type.	4		*	*	*	*	*
44	2Z5581-4	JACK ASSEMBLY: pin; black bakelite; (consisting of beryllium copper contact, bakelite casting, cold-rolled steel lock ring retaining washer).	1				*	*	*
40, 41, 42, 43	2Z5581-5	JACK ASSEMBLY: pin; red bakelite; (same as 44).	4				*	*	*
47	2Z5581-10	JACK ASSEMBLY: special; black bakelite; insert; (with steel lock ring).	1				*	*	*
46	2Z5581-9	JACK ASSEMBLY: special; red bakelite; tip insert; (with steel lock ring).	1				*	*	*
53	2Z5821-5	KNOB: bar; moulded black bakelite with white index line; 1¼".	2		*	*	*	*	*
54	2Z5821-4	KNOB: round; small; standard; for ¼" hole.	1		*	*	*	*	*
39	3F4470-176/M1	METER: 0-50-μa microammeter; resistance 5,000 ohms; full-scale deflection 250 mv.	1				*	*	*
45	2Z7270.31	POTENTIOMETER: carbon; 15,000-ohm ± 20%; ½-watt; (shaft ¼" diam. with ⅜" bushing).					*	*	*
28	3F4470-176/R1	RECTIFIER UNIT: 4-pin plug-in special; complete with resistance-matching network and shunt.	1			*	*	*	*
25	3Z5970-1	RESISTOR: fixed; wire-wound; 0.05-ohm ± 1%; 1-watt.	1				*	*	*
26	3Z5972-4	RESISTOR: fixed; wire-wound; 0.2-ohm ± 1%; 1-watt.	1				*	*	*
19, 20	3Z5992-21	RESISTOR: fixed; wire-wound; 0.5-ohm ± 1%; 1-watt; special.	2				*	*	*

*Indicates stock available.

31. MAINTENANCE PARTS LIST FOR TEST UNIT I-176 *(continued)*

Ref. symbol	*Signal Corps stock No.*	*Name of part and description*	*Quan. per unit*	*Running spares*	*Orgn. stock*	*3d ech.*	*4th ech.*	*5th ech.*	*Depot stock*
17	3Z6002D4-2	RESISTOR: fixed; wire-wound; 24-ohm ± 1%; 1-watt; special.	1				*	*	*
21	3Z6002E5-32	RESISTOR: fixed; wire-wound; 25.1-ohm ± 1%; 1-watt; special.	1				*	*	*
18	3Z6008-6	RESISTOR: fixed; wire-wound; 80-ohm ± 1%; 1-watt; special.	1				*	*	*
22, 24	3Z6026C3	RESISTOR: fixed; wire-wound; 263.1-ohm ± 1%; 1-watt; special.	2				*	*	*
23	3Z6120-17	RESISTOR: fixed; wire-wound; 1,200-ohm ± 1%; 1-watt; special.	1				*	*	*
16	3Z6260-3	RESISTOR: fixed; wire-wound; 2,600-ohm ± 1%; 1-watt; special.	1				*	*	*
5, 12	3Z6355	RESISTOR: fixed; carbon; 3,550-ohm + ½% — 1½%; 1-watt; check at 800 μa.	2				*	*	*
13	3Z6560-23	RESISTOR: fixed; carbon; 6,000-ohm + ½% — 1½%; 1-watt; check at 800 μa.	1				*	*	*
28	3Z6610-139	RESISTOR: fixed; wire-wound; 10,000-ohm ± 1%; 1-watt; special.	1				*	*	*
12	3Z6616-8	RESISTOR: fixed; carbon; 16,000-ohm + ½% — 1½%; 1-watt; check at 800 μa.	1				*	*	*
4	3Z6620-96	RESISTOR: fixed; carbon; 20,000-ohm + ½% — 1½%; 1-watt; check at 800 μa.	1				*	*	*
3	3Z6675-31	RESISTOR: fixed; carbon; 75,000-ohm + ½% — 1½%; 1-watt; check at 800 μa.	1				*	*	*
15	3Z6680-10	RESISTOR: fixed; carbon; 80,000-ohm + ½% — 1½%; 1-watt; check at 800 μa.	1				*	*	*
6	3Z6695	RESISTOR: fixed; carbon; 95,000-ohm + ½% — 1½%; 1-watt; check at 40 μa.	1				*	*	*
2	3Z6715-45	RESISTOR: fixed; carbon; 150,000-ohm + ½% — 1½%; 1-watt; check at 800 μa.	1				*	*	*
14	3Z6722E5-1	RESISTOR: fixed; carbon; 225,000-ohm + ½% — 1½%; 1-watt; check at 800 μa.	1				*	*	*
7	2Z9900.5	RESISTOR: carbon; 400,000-ohm + ½% — 1½%; 1-watt; check at 40 μa.	1				*	*	*
1	3Z6775-12	RESISTOR: carbon; 750,000-ohm + ½ — 1½%; 1-watt; check at 800 μa.	1				*	*	*
8	3Z6801A5-16	RESISTOR: carbon; 1.5-meg. + ½ — 1½%; 1-watt; check at 40 μa.	1				*	*	*

* Indicates stock available.

31. MAINTENANCE PARTS LIST FOR TEST UNIT I-176 *(continued)*

Ref. symbol	*Signal Corps stock No.*	*Name of part and description*	*Quan. per unit*	*Running spares*	*Orgn. stock*	*3d ech.*	*4th ech.*	*5th ech.*	*Depot stock*
9	3Z6803-9	RESISTOR: carbon; 3-meg. + ½% — 1½%; 1-watt; check at 40 μa.	1				*	*	*
10	3Z6960-6	RESISTOR: carbon; 15-meg. + ½ — 1½%; 1-watt; check at 40 μa (in 2 series units each 7.5 meg.).	1				*	*	*
48	2Z8674.89	SOCKET: wafer; 4-pin standard.	1				*	*	*
37	3Z9825-56.7	SWITCH: selector; rotary; (3-deck, 14-position).	1				*	*	*
38	3Z9825-56.8	SWITCH: selector; rotary; (4-deck; 14-position).	1				*	*	*
50	3F3153	TEST LEAD SET: rubber-covered; 1 red and 1 black, No. 42; 4′ long; prod at each end.	2		*	*	*	*	*
52	3E7170-3	TEST LEAD SET: high-voltage; with 50-meg. multiplier resistance in each lead.	1		*	*	*	*	*
29	2Z9900.5	TRANSFORMER: current; (primary tapped, 0.5 amp; 1 amp; 5 amp; 10 amp; single-sec. 1.5 μa at 6 volts; over-all dimensions, 2¼″ × 1⅞″ × 2″ thick; color coded; wire leads).	1			*		*	*
35	3A2	BATTERY BA-2: 22½v.	1		*	*	*	*	*
36	3A30	BATTERY BA-30: 1½v.	1		*	*	*	*	*

* Indicates stock available.

Order Nos. 6397-Phila-44, 24475-Phila-44, 24530-Phila-44 and 27612-Phila-44; 28,000; August 1944.

GOLD 5% SILVER 10% N. COLOR 20%

BAD BLACK 0

Boys Brown 1

RAPE RED 2

OUR ORANGE 3

YOUNG YELLOW 4

GIRLS GREEN 5

BEHIND BLUE 6

VICTORY VIOLET 7

GARDEN GRAY 8

WALLS WHITE 9