

D 101.11:
11-2635 A

TM 11-2635A

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

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GOVERNMENT DOCUMENTS

Q METER TS-617B/U

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pages from Changes 1, 2, 4, and 5.

DEPARTMENT OF THE ARMY • FEBRUARY 1956

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WARNING

DANGEROUS VOLTAGES EXIST IN THIS EQUIPMENT

Be careful when working on the 315-volt plate
and power supply circuits, or on the 115/230-
volt ac line connections.

DON'T TAKE CHANCES!

**EXTREMELY DANGEROUS VOLTAGE
EXISTS IN THE FOLLOWING UNIT:**

Power Supply Section of Q METER TS-617B/U 700-volt circuit



CHANGE }
No. 5 }

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, DC, 20 August 1976

Q METERS TS-617/U, TS-617A/U, TS-617B/U, AND TS-617C/U

TM 11-2635A, 21 February 1956, is changed as indicated below:

Change the title as shown above.

Page 1, chapter 1. Change Note, below title of chapter 1, to read:

NOTE

Q Meters TS-617/U, TS-617A/U, and TS-617C/U are similar to Q Meter TS-617B/U. Information in this manual applies to all models unless otherwise specified; however, where Q Meter TS-617B/U only is specified, this information also applies to Q Meter TS-617C/U.

Paragraph 1.1 is superseded as follows:

1.1. Indexes of Publications

a. *DA Pam 310-4*. 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. *DA Pam 310-7*. Refer to DA Pam 310-7 to determine whether there are modification work orders (MWO's) pertaining to the equipment.

1.2. Reporting Equipment Improvement Recommendations (EIR)

EIR will be prepared using DA Form 2407 (Maintenance Request). Instructions for preparing EIR's are provided in TM 38-750. EIR's should be mailed direct to Commander, US Army Electronics Command, ATTN: DRSEL-MA-Q, Fort Monmouth, NJ 07703. A reply will be furnished directly to you.

Paragraph 2 is superseded as follows:

2. Forms and Records

a. *Reports of Maintenance and Unsatisfactory Equipment*. Maintenance forms, records, and reports which are to be used by maintenance personnel at all maintenance 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.

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

Page 19. Delete paragraph 27.2 and substitute —

27.2. Cleaning

Inspect the exterior of the equipment. The exterior surface should be clean, and free of dust, dirt, grease, and fungus.

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

WARNING

The fumes of trichloroethane are toxic. Provide thorough ventilation whenever used. DO NOT USE NEAR AN OPEN FLAME. Trichloroethane is not flam-

mable, but exposure of the fumes to an open flame or a hot metal surface forms highly toxic phosgene gas.

b. Remove grease, fungus, and ground-in dirt from the cases; use a cloth moistened with trichloroethane.

c. Remove dust or dirt from plugs and jacks with a brush.

CAUTION

Do not press on the meter face (glass) when cleaning; the meter may become damaged.

d. Clean the front panel, meter, and control knobs; use a soft clean cloth. If necessary, dampen the cloth with water; mild soap can be used for more effective cleaning. Wipe dry with a cloth.

Page 26. Paragraph 36.1 is added after paragraph 36.

36.1. Impedance Divider Circuit (TS-617C/U)

(fig. 11.1)

The impedance divider attenuates the oscillator signal output by a constant factor. The injection voltage is produced across 0.03-ohm resistor R16 and its residual inductance at the output of the divider. Resistor R15 has a resistance of 0.75 ohm and is in series with R16. Inductor L10, in series with inductor L11, form an impedance divider with the residual inductance of R16 that results in the same impedance ratio as the resistance ratio; therefore, the injection voltage across R16 is equal to the oscillator output divided by 25. Resistor R14 and variable capacitor C12 form a high frequency correction circuit to equalize the reading of the level vtvm (para 37).

Figure 11.1 is added after figure 11.

Page 37. Figure 19.2 is added after figure 19.1.

Page 41. Paragraph 57a is superseded as follows:

a. *Test Equipment Required for Calibration and Alignment:*

- (1) Frequency Meter AN/URM-79.
- (2) Frequency Meter AN/URM-80.
- (3) Inductance Standard, Fixed MX-2108/G.
- (4) Voltmeter, Electronic AN/URM-145 (voltmeter).
- (5) Generator, Signal AN/URM-127 (audio oscillator).

Page 42. Paragraph 60.3 is added after paragraph 60.2.

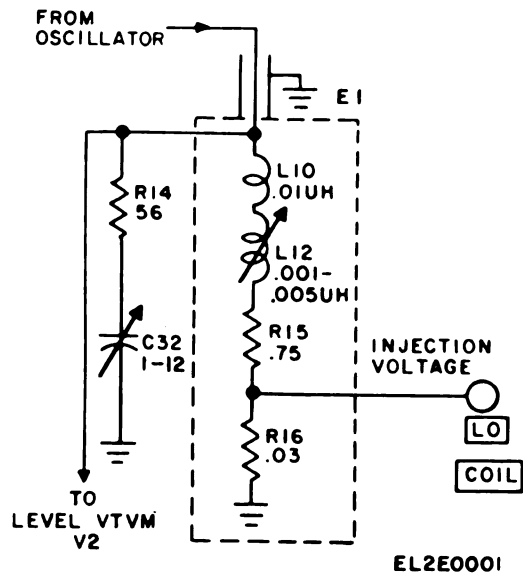
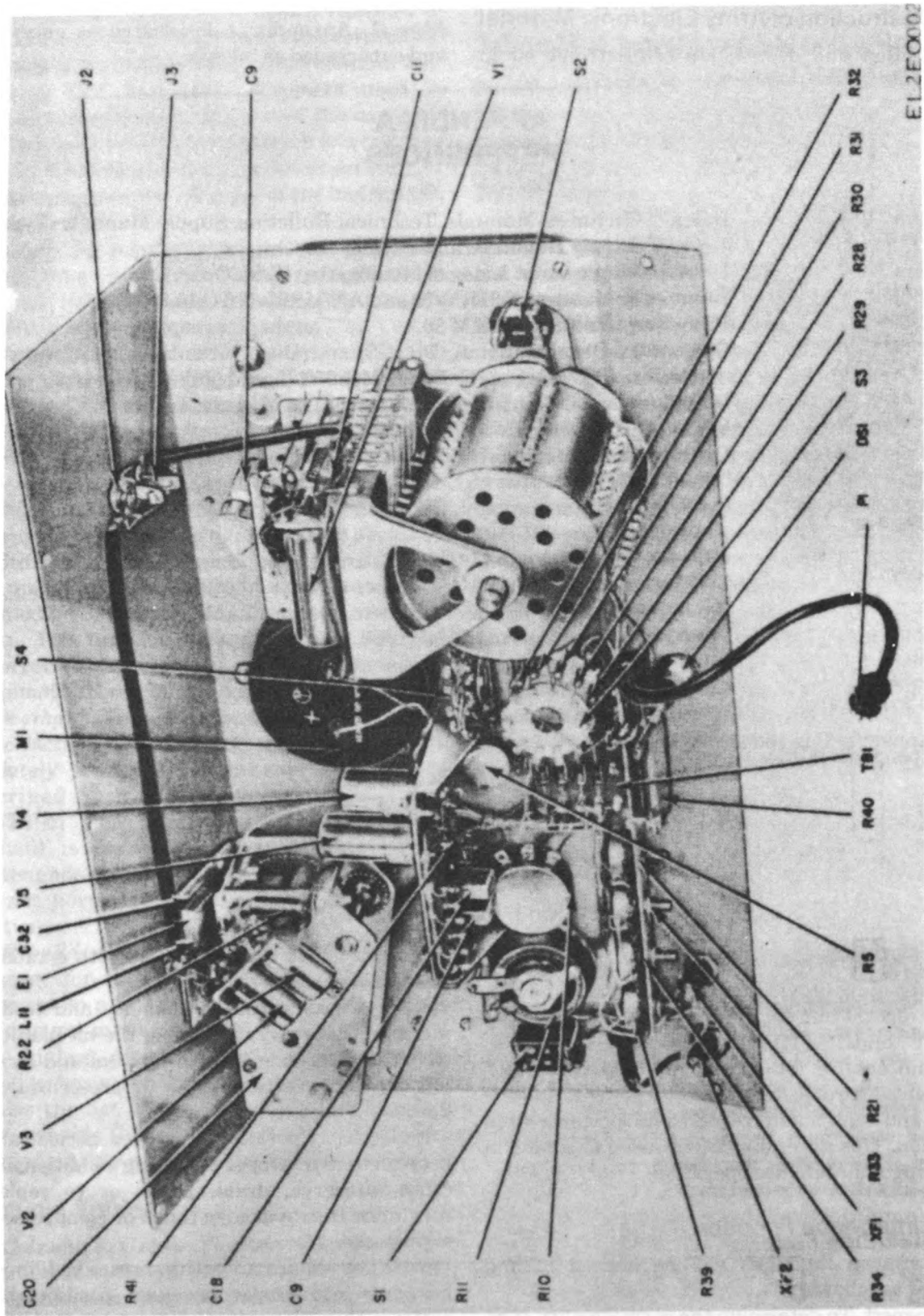


Figure 11.1. Impedance divider, simplified schematic diagram (TS-617C/U).

60.3. Calibration of Injection Voltage (TS-617C/U)

- a. Connect the voltmeter to the COIL LO and GND binding posts.
- b. Set the LEVEL-Q switch to LEVEL.
- c. Turn the range switch to 50-150 KC.
- d. Set the FREQUENCY dial to 100 KC.
- e. Place the RF-ON switch at ON.
- f. Set the SET-LEVEL panel controls for a reading of 20 millivolts on the voltmeter.
- g. Set the RF-ON switch to OFF.
- h. Turn the range switch to 25-50 MC.
- i. Set the FREQUENCY dial to 30 MC.
- j. Set the RF-ON switch to ON.
- k. Adjust L12 (fig. 19.2) for a reading of 20 millivolts on the voltmeter.
- l. Set the RF-ON switch to OFF.
- m. Turn the range switch to 50-75 MC.
- n. Set the FREQUENCY dial to 75 MC.
- o. Set the RF-ON switch to ON.
- p. Adjust C32 (fig. 19.2) for a reading of 20 millivolts on the voltmeter.
- q. Repeat the procedures given in g through p above until the voltmeter reads between 19.6 and 20.4 millivolts for both 30 and 75 mc.



E12E002

Figure 19.2. Q-Meter, rf assembly, location of parts, TS-617CIU.

Page 43. Delete section II and substitute.

65. Destruction of Army Electronic Materiel

Demolition and destruction of electronic equip-

ment will be under the direction of the Commander and in accordance with TM 750-244-2.

Page 44. Appendix is designated as appendix A and superseded as follows:

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	US Army Equipment Index of Modification Work Orders.
TM 11-5094	Frequency Meters AN/URM-79 and AN/URM-82 TO 16-35FR4-6).
TM 11-5095	Frequency Meter AN/URM-80.
TM 11-6625-200-15	Operator's, Organizational, DS, GS, and Depot Maintenance Manual: Multimeters ME-26A/U, ME-26B/U, ME-26C/U, and ME-26D/U.
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 11-6625-366-15	Operator's, Organizational, DS, GS, and Depot Maintenance Manual: Multimeter TS-352B/U.
TM 11-6625-524-14	Operator's, Organizational, DS, GS, and Depot Maintenance Manual: Voltmeter, Electronic AN/URM-145.
TM 11-6625-683-15	Operator, Organizational, DS, GS, and Depot Maintenance Manual: Signal Generator AN/URM-127.
TM 38-750	The Army Maintenance Management System (TAMMS).
TM 43-0139	Painting Instructions for Field Use.
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 B is added after appendix A.

APPENDIX B MAINTENANCE ALLOCATION

Section I. INTRODUCTION

1. General

This appendix provides a summary of the maintenance operations for TS-617/U, TS-617A/U, TS-617B/U, and TS-617C/U. 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.

2. Maintenance Function

Maintenance functions will be limited to and defined as follows:

a. Inspect. To determine the serviceability of an item by comparing its physical, mechanical,

and/or electrical characteristics with established standards through examination.

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

c. Service. Operations required periodically to keep an item in proper operating condition, i.e., to clean, 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, module (component or assembly) for an unserviceable counterpart.

i. Repair. The application of maintenance services (inspect, test, service, adjust, align, calibrate, replace) or other maintenance actions (welding, grinding, riveting, straightening, facing, remachining, or resurfacing) to restore serviceability to an item by correcting specific damage, fault, malfunction, or failure in a part, subassembly, module/component/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 materiel maintenance applied to Army equipment. The rebuild operation includes the act of returning to zero those age measurements (hours, miles, etc.) considered in classifying Army equipment/components.

3. Column Entries

a. Column 1, Group Number. Column 1 lists group numbers, the purpose of which is to identify components, assemblies, subassemblies and module 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 work-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.

4. 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.

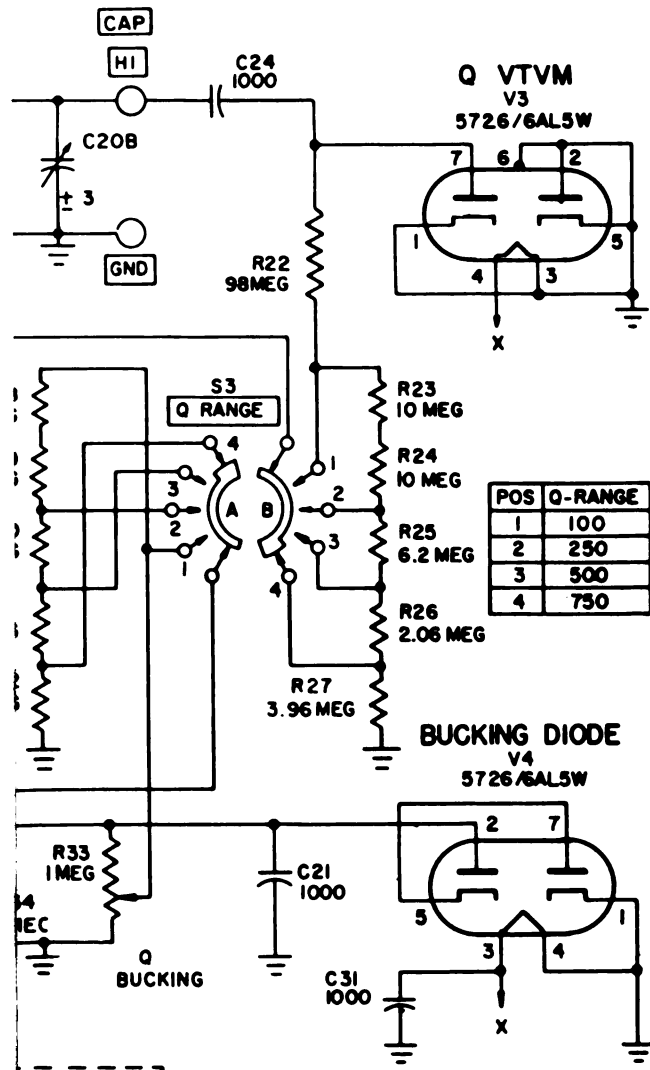
c. Nomenclature. This column lists the noun name and nomenclature of the tools and test equipment required to perform the maintenance functions.

d. National/NATO Stock Number. This column lists the National/NATO stock number of the

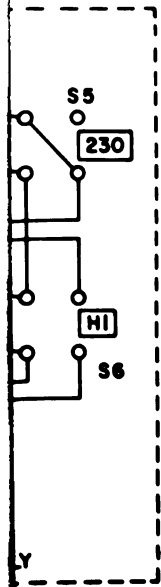
specific tool or test equipment.

e. Tool Number. This column lists the manufacturer's part number of the equipment followed by the Federal Supply Code for manufacturers (five digit) in parentheses.

Page 47. Figure 25.2 is added after figure 25.1.



POS	Q-RANGE
1	100
2	250
3	500
4	750



- NOTES:**
1. UNLESS OTHERWISE SHOWN RESISTORS ARE IN OHMS, CAPACITORS ARE IN UUF.
 2. SWITCH S3 VIEWED FROM THE FRONT, SWITCH S4 VIEWED FROM THE REAR.
 3. WIPER CONTACT 1 OF THE TURRET RANGE SWITCH S7 DOES NOT TOUCH STATIONARY CONTACT 1.

EL2E0003

gram (TS-617CU).

SECTION II MAINTENANCE ALLOCATION CHART
FOR

Q-METERS TS-617/U, TS-617A/U, TS-617B/U, AND TS-617C/U

(1) GROUP NUMBER	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE CATEGORY					(5) TOOLS AND EQUIPMENT
			C	O	F	H	D	
00	Q-METERS TS-617/U, TS-617A/U, TS-617B/U, AND TS-617C/U	Inspect Service Adjust Test Repair Adjust Align Repair Overhaul		0.5 0.5 0.5		1.0 0.5 1.0 2.0	2.0	Visual only 11 11 (operating adjustment only) 1 thru 6,8,9,10 11 7 1 thru 6,8,9,10 7 1 thru 10
01	Q-METER PANEL SUBASSEMBLY	Repair				0.5		7
0101	ALUMINUM CASE	Repair				0.5		7
0102	COVER	Repair				0.5		7
010201	CABLE ASSEMBLY RF C3-1432/U (2 FT)	Repair				0.5		7
02	COIL CASE	Repair				0.5		7
0201	HEATER CORD AND ELEMENT	Repair				0.5		7
0202	COIL TRAY	Repair				0.5		7
0203	COIL CASE BRG	Repair				0.5		7
0214	RF COIL	Replace				0.2		

TABLE 1. TOOL AND TEST EQUIPMENT REQUIREMENTS
FOR

Q-METERS TS-617/U, TS-617A/U, TS-617B/U, AND TS-617C/U

TOOL OR TEST EQUIPMENT REF CODE	MAINTENANCE CATEGORY	NOMENCLATURE	NATIONAL/NATO STOCK NUMBER	TOOL NUMBER
1	H,D	MULTIMETER ME-26D/U	6625-00-913-9781	
2	H,D	TRANSFORMER, VARIABLE POWER CN-16A/U	5950-00-235-2086	
3	D	TEST SET, ELECTRON TUBE TV-2C/U	6625-00-669-0263	
4	H	TEST SET, ELECTRON TUBE TV-7D/U	6625-00-820-0064	
5	H,D	INDUCTANCE STANDARD, FIXED MX-2108/G	6625-00-542-1396	
6	H,D	GENERATOR, SIGNAL AN/URM-127	6625-00-783-5965	
7	H,D	TOOL KIT, ELECTRONIC EQUIPMENT TK-100/G	5180-00-605-0079	
8	H,D	FREQUENCY METER AN/URM-79	6625-00-668-9749	
9	H,D	FREQUENCY METER AN/URM-80	6625-00-649-4286	
10	H,D	VOLTMETER, ELECTRONIC AN/URM-145	6625-00-973-3986	
11	O	TOOLS AND TEST EQUIPMENT AVAILABLE TO THE REPAIRPERSON BECAUSE OF HIS /HER ASSIGNED MISSION		

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MICOM (2)	USAADS (2)
TECOM (2)	USAFAS (2)
TRADOC (2)	USAARMS (2)
LOGCOMD (3)	USAIS (2)
OS Maj Comd (4)	USAES (2)
USACC (4)	MAAG (1)
MDW (1)	USARMIS (1)
Armies (2)	USAERDAA (1)
Corps (2)	USAERDAW (1)
Instl (2) except	Sig FLDMS (1)
Ft Gillem (10)	Units org under fol TOE: -1 ea.
Ft Gordon (10)	11-16
Ft Huachuca (10)	11-17
Ft Carson (5)	11-36
SAAD (30)	11-97
LBAD (14)	11-98
TOAD (14)	11-117
SHAD (3)	11-500(AA-AC)

ARNG & USAR: None.

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

Q METERS TS-617/U, TS-617A/U, AND TS-617B/U

CHANGE }
No. 4 }

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 9 October 1963

TM 11-2635A, 21 February 1956, is changed as follows:

Note. The parenthetical reference to previous changes (example: "page 1 of C2") indicates that pertinent material was published in that change.

Page 1. Add paragraph 1.1 after paragraph 1.

1.1 Index of Publications

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. DA Pam 310-4 is an index of current technical manuals, technical bulletins, supply bulletins, lubrication orders, and modification work orders available through publications supply channels. The index lists the individual parts (-10, -20, -35P, etc.) and the latest changes to and revisions of each equipment publication.

Delete paragraph 2 and substitute —

2. Forms and Records

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

b. Report of Damaged or Improper Shipment. Fill out and forward DD Form 6 (Report of Damaged or Improper Shipment) as prescribed in AR 700-58 (Army), NAVSANDA Publication 378 (Navy), and AFR 71-4 (Air Force).

c. Reporting of Equipment Manual Improvements. The direct reporting of individual user of errors, omissions, and recommendations for improving this manual is authorized and encouraged. DA Form 2028 (Recommended Changes to DA Technical Manual Parts Lists or Supply Manual 7, 8, or 9) will be used for report-

ing these improvements. This form will be completed in triplicate using pencil, pen, or typewriter. The original and one copy will be forwarded direct to Commanding Officer, U.S. Army Electronics Materiel Support Agency, ATTN: SELMS-MP, Fort Monmouth, N.J., 07703. One information copy will be furnished to the individual's immediate supervisor (officer, noncommissioned officer, supervisor, etc.).

Page 9, paragraph 12.1 (page 2 of C2 as changed by C3, 21 March 1961) heading. Change "TC-617/U" to TS-617/U.

Page 13, paragraph 14.3d (page 4 of C2 as changed by C3, 21 March 1961) line 3. Change "9" to Q.

Paragraph 14.8h (page 5 of C2 as changed by C3, 21 March 1961) line 3. Delete the formula and substitute —

$$R_p = \frac{Q_1 Q_2}{2\pi f C_1 (Q_1 - Q_2)} \text{ ohms.}$$

Paragraph 14.9d (page 5 of C2 as changed by C3, 21 March 1961), line 3. Delete the formula and substitute —

$$R_s = \frac{Q_1 - Q_2}{2\pi f C_2 Q_1 Q_2} \text{ ohms.}$$

Line 6. Delete "C₁ = capacitance from paragraph 14.8e in farads."

Paragraph 14.11d (page 6 of C2 as changed by C3, 21 March 1961) line 2. Change

$$\frac{\tau_1}{2} \text{ to } \frac{r_1}{2}$$

Page 15, paragraph 16.1c (page 6 of C2 as changed by C3, 21 March 1961) line 3. Delete the formula and substitute —

$$\text{true } Q = Q_s = \left(\frac{c_1 + c_d}{c_1} \right).$$

* This change supersedes C 3, 21 March 1961.

Paragraph 16.2c (page 7 of C2 as changed by C3, 21 March 1961), line 3. Delete the formula and substitute —

$$L = L_0 \left(\frac{C}{C + C_d} \right).$$

Delete section 1 and substitute —

22. Scope of Maintenance

The maintenance duties assigned to the operator and organizational repairman of the equipment are listed below together with a reference to the paragraphs covering the specific maintenance functions.

- a. Daily preventive maintenance checks and services (par. 25).
- b. Weekly preventive maintenance checks and services (par. 26).
- c. Monthly preventive maintenance checks and services (par. 27).
- d. Quarterly preventive maintenance checks and services (par. 27.1).
- e. Cleaning (par. 27.2).
- f. Touchup painting (par. 27.3).
- g. Troubleshooting (par. 28).

23. 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 paragraphs 25 through 27.3 cover routine sys-

tematic care and cleaning essential to proper upkeep and operation of the equipment.

b. *Preventive Maintenance Checks and Services.* The preventive maintenance checks and services charts (par. 25 through 27.1) 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 chart indicates what to check, how to check, and what the normal conditions are. The *Reference* column lists the illustrations, paragraphs, or manuals that contain detailed repair or replacement procedures. If the defect cannot be remedied by performing the corrective actions listed, higher echelon 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.

24. Preventive Maintenance Checks and Services Periods

Preventive maintenance checks and services of the equipment are required daily, weekly, monthly, and quarterly.

a. Paragraph 25 specifies the checks and services that must be accomplished daily (or at least once each week if the equipment is maintained in standby condition).

b. Paragraphs 26, 27, and 27.1 specify *additional* checks and services that must be performed on a weekly, monthly, and quarterly basis respectively.

25. Daily Preventive Maintenance Checks and Services Chart

Sequence No.	Item	Procedure	References
1	Completeness	See that the equipment is complete (SIG 7 & 8 TS-617/U).	
2	Exterior surfaces	Clean the exterior surfaces, including the panel and meter glasses (par. 27.2). Check the meter glass and indicator lens for cracks.	
3	Connectors	Check the tightness of all connectors.	
4	Controls and indicators.....	While making the operating checks (item 5), observe that the mechanical action of each knob, dial, and switch is smooth and free of external or internal binding, and that there is no excessive looseness. Also, check the meter for sticking or bent pointer.	
5	Operation	Operate the equipment according to par. 32.	Par. 32.

26. Weekly Preventive Maintenance Checks and Services Chart

Sequence No.	Item	Procedure	References
1	Cables	Inspect cord, cables, and wires for chafed, cracked, or frayed insulation. Replace connectors that are broken, arced, or worn excessively.	None.
2	Handles and latches	Inspect handles, latches, and hinges for looseness. Replace or tighten as necessary.	None.
3	Metal surfaces	Inspect exposed metal surfaces for rust and corrosion. Touchup paint as required (par. 27.3).	None.

27. Monthly Preventive Maintenance Checks and Services Chart

Sequence No.	Item	Procedure	References
1	Pluckout items	Inspect seating of pluckout items. Make sure that tube clamps grip tube bases tightly.	None.
2	Jacks	Inspect jacks for snug fit and good contact.	None.
3	Transformer terminals	Inspect the terminals on the power transformer. All nuts must be tight. There should be no evidence of dirt or corrosion.	None.
4	Terminal blocks	Inspect the terminal blocks for loose connections and cracked or broken insulation.	None.
5	Resistors and capacitors	Inspect the resistors and capacitors for cracks, blistering, or other detrimental defects.	None.
6	Gaskets and insulators.....	Inspect insulators and bushings for cracks, chipping, and discoloration.	None.
7	Variable capacitors	Inspect variable capacitors for dirt, corrosion, and deformed plates.	None.
8	Interior	Clean interior of chassis and cabinet.	None.

27.1 Quarterly Preventive Maintenance Checks and Services Chart

Sequence No.	Item	Procedure	References
1	Publications	See that all publications are complete, serviceable, and current.	DA Pam 310-4
2	Modifications	Check DA Pam 310-4 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.	TM 38-750 and DA Pam 310-4.
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.	SIG 7 & 8 TS-617/U.

27.2 Cleaning

Inspect the exterior of the equipment. The exterior surface should be clean, and free of dust, dirt, grease, and fungus.

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

Warning: Cleaning compound is flammable and its fumes are toxic. Provide adequate ventilation. *Do not* use near a flame.

b. Remove grease, fungus, and ground-in dirt from the cases; use a cloth dampened (not wet) with cleaning compound (Federal Stock No. 7930-395-9542).

c. Remove dust or dirt from plugs and jacks with a brush.

Caution: Do not press on the meter face (glass) when cleaning; the meter may become damaged.

d. Clean the front panel, meter, and control knobs; use a soft clean cloth. If necessary, dampen the cloth with water; mild soap may be used for more effective cleaning. Wipe dry with a cloth.

27.3 Touchup Painting Instructions

Remove rust and corrosion from metal surfaces by lightly sanding them with fine sandpaper. Brush two thin coats of paint on the bare metal to protect it from further corrosion. Refer to the applicable cleaning and refinishing practices specified in TM 9-213.

Page 17. Delete fig. 6.

Page 18. Delete fig. 7.

Page 32, paragraph 45, chart, line 3. Change "TM 11-5083" to TM 11-6625-274-12.

Page 44. Add APPENDIX after chapter 7.

APPENDIX

REFERENCES

- DA Pam 310-4 Index of Technical Manuals, Technical Bulletins, Supply Bulletins, Lubrication Orders, and Modification Work Orders.
- SIG 7 & 8 TS-617/U Q Meter TS-617/U; TS-617A, B/U.
- TM 9-213 Painting Instructions for Field Use.
- TM 11-5094 Frequency Meters AN/URM-79 and AN/URM-82.
- TM 5095 Frequency Meter AN/URM-80.
- TM 11-5511 Electronic Multimeter TS-505/U.
- TM 11-5527 Multimeters TS-352/U, TS-352A/U, and TS-352B/U.
- TM 11-6625-261-12 Operator's and Organizational Maintenance Manual: Audio Oscillators TS-382A/U, -382B/U, -382D/U, -382E/U, and -382F/U.
- 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 11-6625-320-12 Operator's and Organizational Maintenance Manual: Voltmeter, Meter ME-30A/U and Voltmeters, Electronic ME-30B/U and ME-30C/U.
- TM 38-750 The Army Equipment Record System and Procedures.

By Order of the Secretary of the Army:

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 11-587
 11-592
 11-597

NG: State AG (3).

USAR: None.

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

Q METERS TS-617/U, TS-617A/U, AND TS-617B/U

TM 11-2635A
TO 33A1-6-211-11
CHANGES No. 2

DEPARTMENTS OF THE ARMY
AND THE AIR FORCE
WASHINGTON 25, D. C., 29 July 1960

TM 11-2635A, 21 February 1956, is changed as indicated so that the manual also applies to Q Meter TS-617/U and Q Meter TS-617A/U.

Change the title of the manual to: **Q METERS TS-617/U, TS-617A/U, AND TS-617B/U.**

Note. This manual with C 1, 16 April 1956, and C 2, 29, July 1960, supersedes TM 11-2635, 3 January 1945.

Page 1, chapter 1. Add the following Note below the title of chapter 1.

Note. Q Meters TS-617/U and TS-617A/U are similar to Q Meter TS-617B/U. Information in this manual applies to all models unless otherwise specified.

Change (fig. 1) to (fig. 1 and 5.1) in the following places:

Page 1. Paragraph 1a, line 3.

Paragraph 3a, line 1.

Paragraph 3b, line 1, after "coil case" add: (TS-617A/U and TS-617B/U only).

Add: "(TS-617B/U only)" in the following places:

Page 2. Paragraph 4. Line 17, after Q-range.

Line 22, after Inductance range.

Line 23, after Resistance range.

Line 25, after Power requirements.

Line 28, after Current.

Line 30, after Weight.

Paragraphs 5 and 6, after paragraph headings.

Page 3. Paragraph 7, after heading.

Page 4. Chapter 2, below title to chapter.

Page 8. Paragraph 12, after heading.

Page 9. Paragraphs 13 and 14, after headings.

Page 13. Paragraph 15, after heading.

Page 14. Paragraph 16, after heading.

Page 15. Paragraph 17, after heading.

Page 16. Section I, after heading.

Page 20. Paragraph 31, after heading.

Page 21. Paragraph 32, after heading.

Page 23. Paragraph 34, after heading.

Pages 24-29. Paragraphs 35 - 42, after headings.

Page 31. Paragraph 43b(3), after subparagraph heading.

Paragraph 44, after heading.

Page 32. Paragraph 45, after heading.

Pages 33-38. Paragraphs 47, 48, and 49, after headings.

Page 40. Section II, after heading.

Page 42. Section III, after heading.

Page 43. Section I, after heading.

Page 47/48. After figure caption.

Change " $\mu\mu\text{f}$ " to farads in the following places:

*Page 12. Paragraph 14f(9), formula.
Paragraph 14g(9), formula.*

Page 2, paragraph 4, under "Capacity range" after "460 $\mu\mu\text{f}$ " add: (450 $\mu\mu\text{f}$ in TS-617/U and TS-617A/U).

Under "Q-range" after last item add: (20-625 in TS-617/U and TS-617A/U).

Opposite "Number of tubes" after "6" add: (3 in TS-617/U and TS-617A/U).

* These changes supersede TM 11-2635, 3 January 1945.

Page 8. Add paragraph 6.1.

6.1. Description of Components (TS-617/U and TS-617A/U)

Fourteen plug-in rf coils and a metal carrying case are provided with the TS-617A/U. The rf coils are used as Q meter test coils over the frequency range of 50 kc to 20 mc. Seven plug-in rf coils are provided for the TS-617/U.

Add paragraphs 7.1 and 7.2.

7.2. Differences in Models

Item	Q Meter TS-617B/U	Q Meters TS-617/U, TS-617A/U
Dimensions	11" high by 8" deep by 20" wide	12.5" high by 8.5" deep by 20" wide.
Tubes	5726/6AL5W, 5814A, 5763, 543WGTA	#BRC-102-A, 1659, 5W4GT.
Meters	Q meter 0-100 ua	Q meter 180 ua, Q multiply 1.75 ua.
Rf Coils	14 plug-in coils	7 plug-in coils in TS-617/U, 14 plug-in coils in TS-617A/U.
Switches	Q RANGE, LEVEL-Q	Not included.
Controls	ZERO ADJ LEVEL	Not included.

Page 9. Add paragraph 12.1.

12.1. Controls and Indicators (TC-617/U and TS-617A/U)

The following table lists the controls and indicators of the Q meter (fig. 5.1) and lists their functions:

Control or indicator	Function
ON-OFF switch	Turns Q meter on and off.
Oscillator frequency coarse control.	Used for rapid tuning of the oscillator.
Oscillator frequency fine control.	Used for fine adjustment of the oscillator frequency coarse control.
Oscillator range switch.	Selects frequency band of rf oscillator.
Vtvm zero adjust	This is used to zero-adjust the Q meter.
Oscillator output control coarse.	Limits the output voltage of the oscillator.
Oscillator output control vernier.	Vernier adjustment of oscillator output control.
Q voltmeter	Indicates Q of circuit under test.
Oscillator output	The reading on this meter is used for Q multiplication.
MICRO MICRO FAR-ADS coarse control (Q tuning).	Indicates the amount of capacitance under test.

7.1. Running Spares (TS-617/U and TS-617A/U)

The following is a list of running spares for the Q meter:

- 1 indicator lamp, 2.5-volt, 0.50 amp, type 41.
- 5 fuses, 1.5-amp, 250-volt.
- 1 tube, 1659.
- 1 tube, 5 W4GT.
- 1 tube, #BRC-102-A.

Control or indicator	Function
MICRO MICRO FAR-ADS fine control.	Used for fine adjustment of the MICRO MICRO FAR-ADS coarse control.
MICRO MICRO FAR-ADS vernier control.	Used for vernier adjustments of the MICRO MICRO FAR-ADS coarse control.
Pilot lamp	Indicates when power ON-OFF switch is at ON.
Fuses, 1.5 AMPS	Line fuses (located in line plug).
Dual voltage switch S102 (115-230V) (fig. 19.1).	Selects line voltage of ac power source.
HI-LO switch S102 (fig. 19.1).	For use when the line voltage is above or below rated value of 115 or 230 volts.
Rf jack	Provides oscillator output for use as a signal source. May be used for external oscillator input to Q meter.
COIL LO and COIL HI binding posts.	Provide for connection of rf coils between COIL LO and COIL HI binding posts for test purposes.
CAP HI and GND binding posts.	Provide for the connection of external capacitors between CAP HI and GND binding posts.

Page 9. Add paragraph 13.1.

13.1. Starting Procedure (TS-617/U and TS-617A/U)

a. *Preliminary.* Determine the line voltage available and provide the proper switch conditions (HI-LO and dual voltage switch). Insert the line cord into the ac source.

b. *Starting.*

Caution: Before turning the Q meter on, set the oscillator output control (coarse) (fig. 5.1) to midposition to avoid a possible overload of the thermocouple.

- (1) Throw the OFF-ON switch to ON. The pilot lamp should light.
- (2) Turn the oscillator range switch to the desired frequency range.
- (3) Allow 1 minute for warmup.

Page 13. Add paragraphs 14.1 through 14.11.

14.1. Oscillator Output Voltage Adjustment (TS-617/U and TS-617A/U)

a. Select the oscillator frequency to be used

for a measurement by adjustment of the oscillator range switch and frequency controls (fig. 5.1).

b. Adjust the oscillator output controls for a reading of 1 on the oscillator output voltmeter for Q readings up to 250.

c. Adjust the oscillator output controls for readings of 1.1 to 2.5 for Q values above 250.

Caution: Be careful when changing the oscillator frequency to watch the oscillator output voltmeter and avoid overloading. Excessive oscillator output may result in damage to the thermocouple.

14.2. Q Voltmeter Zero Adjustment (TS-617/U and TS-617A/U)

The Q voltmeter is adjusted to zero with the vtm zero-adjust control located below and to the left of the Q voltmeter (fig. 5.1).

a. Short-circuit or connect a coil between the COIL LO and COIL HI binding posts.

b. Detune the Q circuit by rotating the MICRO MICRO FARADS coarse control (Q

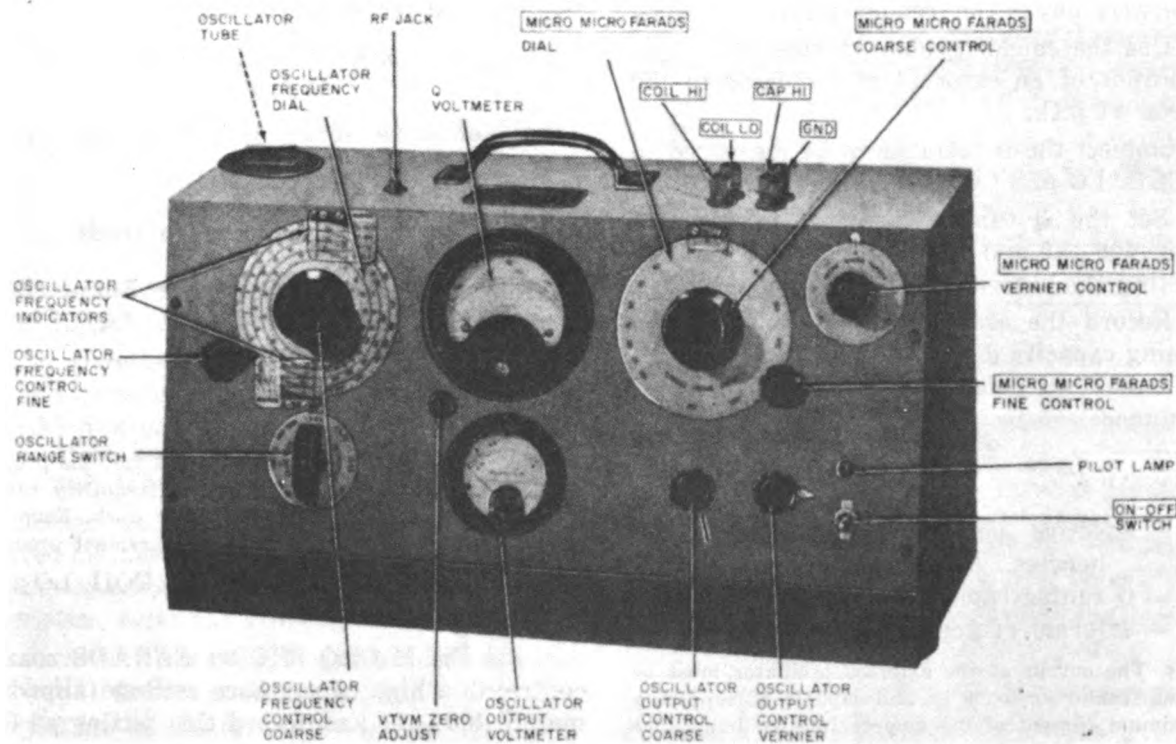


Figure 5.1. (Added) Q Meters TS-617/U and TS-617A/U, controls and indicators.

tuning capacitor) through an appreciable range and observing that no change occurs in the Q voltmeter reading.

c. Adjust the Q voltmeter to zero by means of the vtvm zero-adjust control.

14.3. Measurement Procedure for Q (TS-617/U and TS-617A-U)

a. Estimate roughly the frequency at which the coil to be measured will resonate.

b. Connect the coil to be measured across the COIL LO and COIL HI binding posts.

c. Set the oscillator frequency dial to the resonant frequency of the coil to be measured.

d. Rotate the Q tuning capacitor until a maximum (resonance) is indicated on the Q voltmeter. The Q voltmeter reading at resonance times the oscillator output voltmeter (Q multiplier) reading will directly indicate the Q of the coil under test.

14.4. Inductance Measurement (TS-617/U and TS-617A/U)

a. Disable the rf oscillator by placing the oscillator range switch to a position intermediate between any of the frequency range settings.

b. Use the shielded cable provided to couple the output of an external rf oscillator to the Q meter rf jack.

c. Connect the inductance to be measured to the COIL LO and COIL HI binding posts.

d. Set the Q tuning capacitor to approximately 400 $\mu\mu\text{f}$ and resonate the Q circuit by adjusting the external oscillator frequency.

e. Record the oscillator frequency and the Q tuning capacity dial reading. Use the following formula to determine the effective series inductance.

$$L_s = \frac{2.53 \times 10^{10}}{f^2 C_1}$$

L_s = effective series inductance in microhenries.

C_1 = Q tuning capacitance in $\mu\mu\text{f}$.

f^2 = external rf generator frequency in kc.

Note. The output of the external oscillator must be variable from 1 kc to 60 kc and capable of supplying a maximum current of 0.5 ampere into an impedance of approximately 1 ohm. The inductance measured by the above method varies from two-tenths of a microhenry to two-tenths of a henry with an accuracy of 3 percent.

14.5. Small Inductance in Series with Large Inductance (TS-617/U and TS-617A/U)

a. Choose an rf coil that will resonate at the desired measuring frequency. For rf coil characteristics, refer to paragraph 14.7.

b. Connect the coil between the COIL LO and COIL HI binding posts.

c. Set the oscillator frequency (internal or external) to a value that will permit resonating the Q circuit with the Q tuning capacitor set at 400 $\mu\mu\text{f}$.

d. Resonate the Q circuit by means of the Q tuning capacitor. Record the Q tuning capacitance as C , and the frequency as f .

e. Connect the inductance to be measured in series with one rf coil lug and the COIL LO binding post; be careful that no coupling exists between the coil and the small inductance (coils at right angles).

f. Resonate the Q circuit by means of the Q tuning capacitor. Record the new Q tuning capacitance as C_2 .

g. Use the following formula to determine the effective series inductance:

$$L_s = \frac{2.53 \times 10^{10} (C_1 - C_2)}{f^2 C_1 C_2}$$

L_s = effective series inductance in microhenries.

f = frequency in cps.

C = capacitance in micromicrofarads.

14.6. Measurement of Capacitors Below 430, $\mu\mu\text{f}$ (TS-617/U and TS-617A/U)

a. Select an rf coil that will resonate in the frequency range of the measurement. For rf coil characteristics, refer to paragraph 14.7.

Note. To measure an unknown capacitor, the proper test coil is the one marked with the frequency range in which the capacitor will eventually work. Keep all capacitor leads short during the measurement process.

b. Connect the coil between the COIL LO and COIL HI binding posts.

c. Set the MICRO MICRO FARADS coarse control to a high capacitance setting (approximately 400 $\mu\mu\text{f}$) and record this setting as C_1 .

d. Adjust the oscillator frequency coarse and fine controls for a peak reading on the Q voltmeter (resonance).

e. Connect the capacitor to be tested between CAP HI and GND binding posts.

f. Readjust the MICRO MICRO FARADS coarse control for a peak reading on the Q voltmeter and record the new capacitance reading as C_2 .

g. Compute the value of the unknown capacitor, using the following formula:

$$C = C_1 - C_2$$

where:

C = capacitance of unknown capacitor in μmf .

C_1 = total capacitance required for resonance (c above).

C_2 = difference between known and unknown capacitance required for resonance (f above).

14.7. Characteristics of Rf Coils (TS-617/U and TS-617A/U)

Reference designation	Inductance	Q (approx)	Tuning range
L14	1 uh	180	8-20 mc
L15	2.5 uh	200	5-14 mc
L16	5 uh	200	3.5-10 mc
L17	10 uh	200	2.5-7 mc
L18	25 uh	200	1.5-4.5 mc
L19	50 uh	200	1.1-3 mc
L20	100 uh	200	800-2,000 kc
L21	250 uh	200	500-1,400 kc
L22	500 uh	170	350-1,000 kc
L23	1 mh	170	250-700 kc
L24	2.5 mh	170	150-450 kc
L25	5 mh	160	110-300 kc
L26	10 mh	140	80-200 kc
L27	25 mh	110	50-140 kc

Note. Coils L19, L20, L21, L22, L23, L26, and L27 are not supplied with the TS-617/U.

14.8. High Resistance in Parallel with Q Circuit (TS-617/U and TS-617A/U)

a. Select an rf coil that will resonate at the desired measuring frequency with a convenient tuning capacitance (Q tuning). For rf coil characteristics, refer to paragraph 14.7.

b. Connect the coil between the COIL LO and COIL HI binding posts.

c. Set the oscillator frequency controls to the desired measuring frequency.

d. Set the oscillator output controls for a reading of 250 on the Q voltmeter.

e. Adjust the Q tuning capacitor for a peak reading (resonance) on the Q voltmeter. Record the Q reading as Q_1 and the tuning capacitance as C_1 .

f. Connect the resistor to be measured between the CAP HI and GND binding posts.

g. Readjust the Q tuning capacitor for a new peak reading on the Q voltmeter. Record this reading as Q_2 .

h. Use the following formula to determine the effective parallel resistance.

$$R_p = \frac{Q_1 Q_2}{2 f C_1 (Q_1 - Q_2)} \text{ ohms.}$$

R_p = effective parallel resistance.

f = oscillator frequency in cps.

C_1 = capacitance in farads.

14.9. Low Resistance in Series with Q Circuits (TS-617/U and TS-617A/U)

a. Repeat the procedure outlined in paragraph 14.8a through e.

b. Connect the resistor to be measured in series with one rf coil lug and the COIL LO binding post.

c. Readjust the Q tuning capacitor for a new peak reading on the Q voltmeter. Record this Q reading as Q_2 , and the new Q tuning capacitance as C_2 .

d. Use the following formula to determine the effective series resistance:

$$R_s = \frac{C_1 (Q_1 - Q_2)}{2 f C_2 Q_1 Q_2} \text{ ohms.}$$

R_s = effective series resistance

f = oscillator frequency in cps.

C_1 = capacitance from paragraph 14.8e in farads.

C_2 = capacitance from c above in farads.

14.10. Distributed Capacitance (Accurate Method) (TS-617/U and TS-617A/U)

a. Connect the coil to be tested between the COIL LO and COIL HI binding posts.

b. Set the Q tuning capacitor to approximately 400 μmf . Record the capacitance as C_1 .

c. Adjust the oscillator frequency coarse and fine controls for a peak reading on the Q voltmeter (resonance). Record the frequency as f_1 .

d. Turn the oscillator frequency coarse and fine controls to 10 times f_1 .

e. Replace the coil to be tested with an rf coil that will resonate at approximately 10 f_1 . For rf coil characteristics, see paragraph 14.7.

f. Adjust the Q tuning capacitor for a peak reading on the Q voltmeter.

g. Connect the coil to be tested to the CAP HI and GND binding posts. Be careful to avoid coupling between the two coils.

h. Readjust the Q tuning capacitor for a peak reading on the Q voltmeter.

i. If the Q tuning capacitance reading was increased in *h* above, perform the following:

- (1) Adjust the oscillator frequency controls for an increased dial reading (10 to 20 percent).
- (2) Remove the coil to be tested.
- (3) Repeat *f* through *h* above.

j. If the Q tuning capacitance reading was decreased in *h* above, perform the following:

- (1) Adjust the oscillator frequency controls for a decreased dial reading (10 to 20 percent).
- (2) Remove the coil to be tested.
- (3) Repeat *f* through *h* above.

k. Repeat the steps in *f* through *j* above until the step in *h* above does not require readjustment for a peak reading on the Q voltmeter. Note the oscillator frequency as f_0 .

l. Use the following formula to find the distributed capacitance.

$$Cd = \left(\frac{f_1}{f_0}\right)^2 C_1 \text{ farads.}$$

Cd = distributed capacitance in farads.
 f = frequency in cps.

14.11. Distributed Capacitance, Approximate Method (TS-617/U and TS-617A/U)

a. Connect the coil to be tested between the COIL LO and COIL HI binding posts.

b. Set the Q tuning capacitor to approximately 50 $\mu\mu\text{f}$. Record the capacitance as C_1 .

c. Adjust the oscillator frequency coarse and fine controls for a peak reading on the Q voltmeter (resonance). Record this dial setting as f_1 .

d. Reset the oscillator frequency coarse and fine controls to a lower frequency equal to $\frac{F_1}{2}$.

e. Resonate the Q circuit by means of the Q tuning capacitor. Record the new Q tuning capacitance as C_2 .

f. Use the following formula to determine the distributed capacitance:

$$C_d = \frac{C_2 - 4 C_1}{3} \text{ farads}$$

C_d = distributed capacitance in farads
 f = frequency in cps

Page 15. Add paragraphs 16.1 and 16.2.

16.1. Distributed Capacitance Correction for Q (TS-617/U and TS-617A/U)

The distributed capacitance of a coil results in an effective Q which is less than the true Q. The difference between effective Q and true Q varies with the ratio of the distributed capacitance to the capacitance of the internal resonating capacitor. Find the true Q, as follows:

a. Measure the Q as described in paragraph 14.3. Record the Q tuning capacitance as C_1 and the Q as Q_e .

b. Measure the distributed capacitance of the coil (par. 14.10 or 14.11).

c. Calculate the true Q, using the following formula:

$$\text{true } \left[Q = \left| Q_e \left(\frac{C_1 + C_d}{C_1} \right) \right| \right] \approx \frac{C_3}{C_1}$$

C_1 = internal resonating capacitance (Q tuning) in farads.

C_d = distributed capacitance in farads.

16.2. Distributed Capacitance Correction for Inductance (TS-617/U and TS-617A/U)

Correct the effective inductance of a coil for the effect of the distributed capacitance as follows:

a. Calculate the inductance (par. 14.4 or 14.5). Record the inductance as L_e .

b. Measure the distributed capacitance of the coil (par. 14.10 or 14.11).

c. Calculate the true inductance L , using the following formula:

$$L = L_e \left(\frac{C}{C + C_d} \right)$$

C = internal resonating capacitance (Q tuning) in farads.

C_d = distributed capacitance in farads.

L_e = effective inductance.

Page 15. Add paragraph 17.1.

17.1. Stopping Procedure (TS-617/U and TS-617A/U)

a. Throw the ON-OFF switch to OFF.

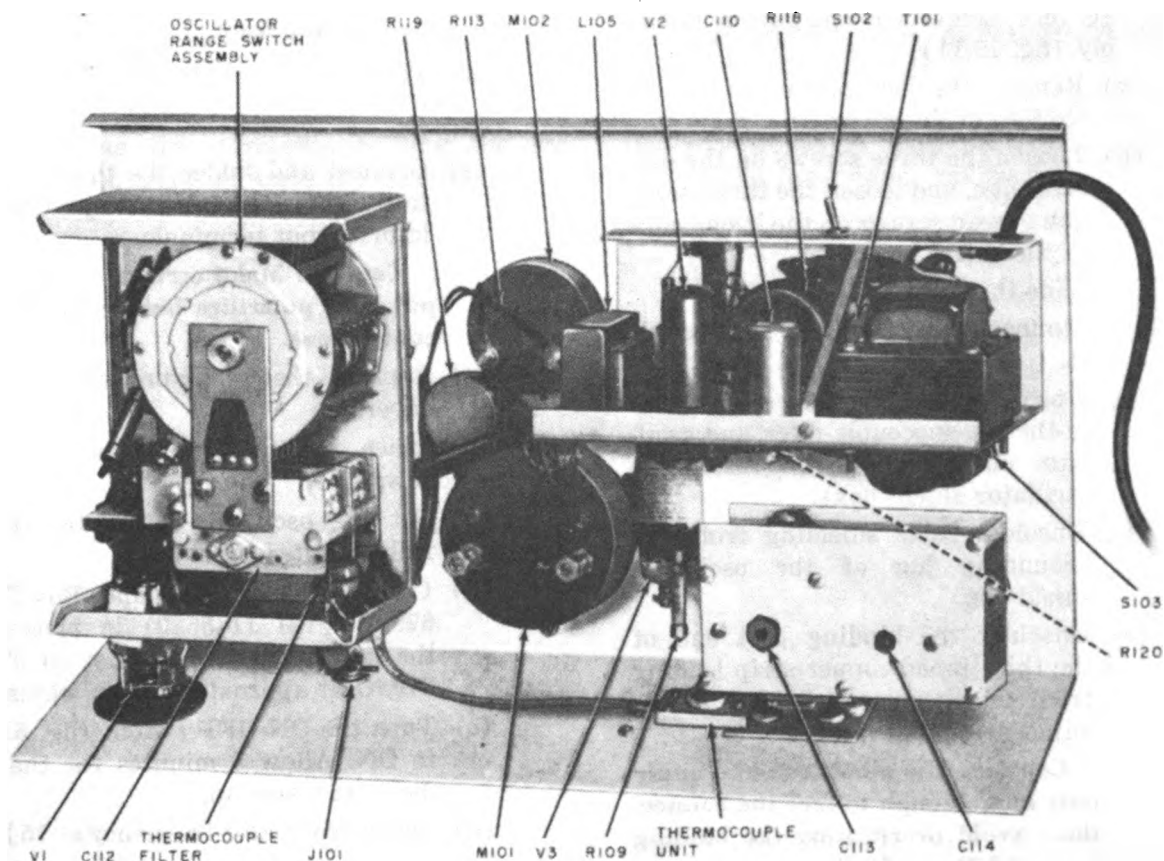
b. Disconnect the line cord from the power outlet.

Page 23, figure 8. Add the following note:

NOTE:
LEVEL VTVM NOT USED IN TS-617/U
OR TS-617A/U.

Page 33, paragraph 46f(7). Add the following to the warning:

Selenium rectifiers are not used in the TS-617/U or TS-617A/U.



TW2635A-C2-2

Figure 19.1. (Added) Q Meters TS-617/U and TS-617A/U, parts location.

Page 42. Add Section II.1.

Section II.1. REPAIRS (TS-617/U AND TS-617A/U)

57.1. Replacement of Thermocouple Unit

a. *General.* The replacement thermocouple unit consists of a shielded thermocouple mount,

a thermocouple, a 0.04-ohm coupling resistor, and a shielded cable, which connects the thermocouple and a 0.04-ohm coupling resistor to the

oscillator. There is also a guard that protects the projecting thin-tinned copper strip, which serves to connect the 0.04-ohm coupling resistor to the Q measuring circuit. The shielded cable also contains the leads that connect the dc output of the thermocouple to the oscillator output voltmeter (Q multiplier) through the rf filter contained in the oscillator shield box.

b. Removal of Thermocouple Unit (fig. 5.1).

- (1) Remove the panel from the Q meter.
 - (a) Remove the screws on the sides and top edge of the panel.
 - (b) Place the panel face down, preferably on some soft material.
- (2) Remove the oscillator shield box cover (covers oscillator range switch assembly (fig. 19.1)).
 - (a) Remove the four screws on the top surface of the cover.
 - (b) Loosen the three screws on the outside edge, and loosen the three hexagonal-head screws on the inside edge of the shield box cover.
 - (c) Slide the cover off.
- (3) Disconnect the defective thermocouple unit.
 - (a) Unsolder the three wires connected to the thermocouple filter and oscillator output terminals (inside the oscillator shield box).
 - (b) Unsolder cable shielding from the grounding lug of the oscillator shield box.
 - (c) Unsolder the binding post end of the thin-tinned copper strip leading from the thermocouple unit to the adjacent binding post.

Caution: Use a hot iron and apply only long enough to free the connection. Avoid overheating the binding post and the 0.04-ohm coupling resistor within the thermocouple unit. Be careful in lifting the tinned copper strip from the binding post. Avoid damage to this strip and the 0.04-ohm resistor.

- (4) Remove the thermocouple unit from the panel by removing the two screws that secure it. These screws are accessible from the top of the panel.

- (5) Remove calibrating resistor R113 (fig. 19.1).
- (6) Install the replacement thermocouple unit.
 - (a) Remove the guardplate from the replacement thermocouple by carefully removing the protective cardboard and the two 6/32 binding-head screws.
 - (b) Secure the thermocouple unit in place in the Q meter with the two securing screws ((4) above).
 - (c) Using a hot iron, solder the tinned copper strip to the binding post.

Caution: Leave a small amount of slack in the lead.

- (d) Solder the cable shield to the grounding lug in the oscillator shield box.
- (e) Connect and solder the three wires to the thermocouple filter and oscillator output terminals.

Caution: Make certain of the output lead polarities before soldering connections.
- (f) Replace the oscillator shield box cover.
- (7) Replace the calibrating resistor as follows:

- (a) Set the oscillator output controls fully counterclockwise.
- (b) Connect Decade Resistance Box TS-679/U (TM 11-5520) in place of the calibrating resistor. Set the TS-679/U at approximately 20 ohms.
- (c) Turn the ON-OFF switch (fig. 5.1) to ON. Allow 5 minutes for the Q meter to warm up.
- (d) Set the oscillator frequency at 75 kc.
- (e) Attach an ac vtm (ME-30A/U or equal) between the COIL LO and GND binding posts of the Q meter.
- (f) Turn the oscillator output controls clockwise *slowly* until 20 mv is indicated on the vtm. Observe the oscillator output voltmeter. If the meter reads full scale before 20 mv is reached, add resistance to the decade box.

- (g) Adjust the decade resistance box for a reading of 1 on the output voltmeter when the vtvm reads 20 mv.

Caution: Do not allow the vtvm reading to exceed 20 mv. At this voltage, the thermocouple is approaching a burnout point.

- (h) Use the value indicated on the decade box for calibrating resistor R113. The resistor should be wound with magnum wire.

57.2. Adjustment of Oscillator Frequency Dial

If the dials or indicators have been removed for any reason, replace as follows:

- a. Turn the oscillator tuning capacitor to the full mesh position.
- b. Loosen the setscrews, holding the frequency dial, and turn until the zero line on the

dial scale coincides with the vertical line of the top indicator.

- c. Secure the dial to the shaft with the setscrews.

Note. The dial should be positioned on the shaft close to the indicator to avoid parallax but should not scrape.

- d. Adjust the upper oscillator frequency indicator (if necessary) to coincide exactly with the zero line on the dial scale.

- e. Adjust the lower oscillator frequency indicator to coincide exactly with the 100 lines on the dial scale.

57.3. Adjustment of MICRO MICRO FARADS Dial (Q Tuning)

- a. Turn the Q tuning capacitor to the maximum clockwise position.
- b. Adjust the dial scale so that the line on the indicator coincides with the line on the dial beyond the capacitance calibration.

BY ORDER OF THE SECRETARIES OF THE ARMY AND THE AIR FORCE:

L. L. LEMNITZER,
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Chief of Staff.

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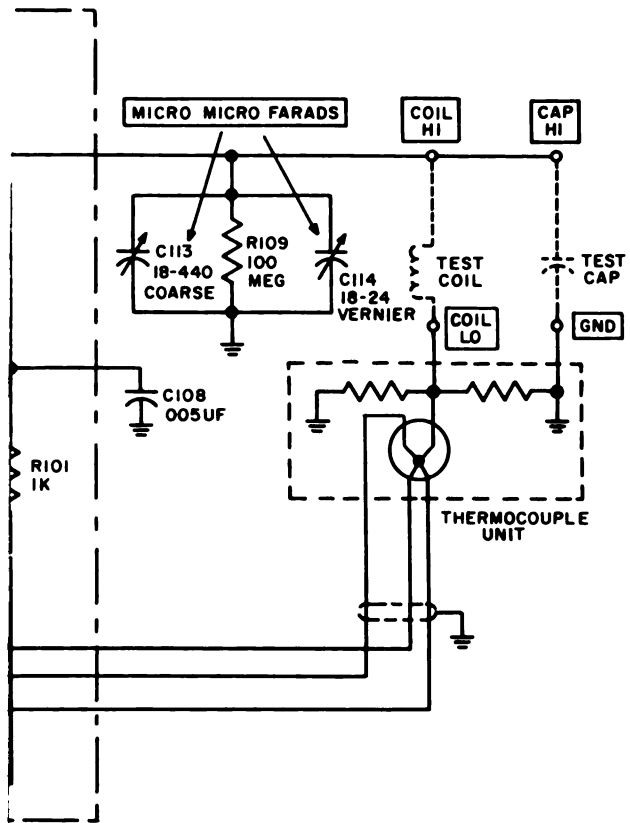
To be distributed in accordance with DA Form 12-7 requirements for TM 11-series (Uncl) plus the following additional formula:

Def Atomic Spt Agcy (5)	JBUSMC (2)
USASA (2)	Units org under fol TOE: (2 copies each)
CNGB (1)	11-7
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EUSA (2)	11-557
Corps (1)	11-587
AFIP (1)	11-592
USA Comm Agcy (3)	11-597
AMS (1)	32-56

NG: None.

USAR: None.

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



TM2635A-C2-3

TECHNICAL MANUAL

Q METER TS-617B/U

TM 11-2635A }
CHANGES No. 1 }

TM 11-2635A, 21 February 1956, is changed as follows:

The following information changes TM 11-2635A so that the manual also applies to the following equipment:

<i>Nomenclature</i>	<i>Order No.</i>	<i>Serial No.</i>
Q METER TS-617B/U	15597-Phila-55	1 through 67

Page 9, paragraph 13a. Line 5. Delete or 230-.

Page 12. Paragraph 14g(9). Change the formula to read as follows:

$$R = \frac{\left(\frac{C_1}{C_2}\right) Q_1 - Q_2}{2\pi f C_1 Q_1 Q_2} \text{ OHMS}$$

Page 13, paragraph 14h(12). Change the formula to read as follows:

$$C_s = \frac{C_1}{\left(\frac{f_0}{f_1}\right)^2 - 1} \text{ farads.}$$

Page 14, paragraph 16b(2). Change the formula to read as follows:

$$Q_s = \frac{Q_1}{1 - \frac{2\pi f C_1 Q_1}{33}}$$

Page 23, paragraph 33. Line 5 from the bottom of the paragraph. Change the formula to read:

$$E = \frac{I}{2\pi f C} = 2\pi f L I.$$

Page 41, paragraph 57. Add the following after a(3):

- (4) Electronic Multimeter ME-30A/U—Common name is multimeter.
- (5) Audio Oscillator TS-382A/U—Common name is audio oscillator.

a.1. *Q-Calibration.* (The procedure must be followed in the sequence given below.)

- (1) Set RF ON switch to the off position.
- (2) Set LEVEL-Q switch to the Q position.
- (3) Set the Q RANGE switch to 100.
- (4) Allow the Q-meter to warm for 10 minutes.

DEPARTMENT OF THE ARMY
WASHINGTON 25, D. C., 16 April 1956

- (5) Place shorting strap between high side of C18 and C19 on terminal board TB2.
 - (6) Adjust ZERO ADJ, Q control for a zero meter reading.
 - (7) Remove shorting strap between C18 and C19.
 - (8) Adjust internal control R33 for zero meter reading.
 - (9) Connect the audio oscillator and the multimeter to the CAP HI and GND binding posts.
 - (10) Set the audio oscillator to 50 kc and 2 volts output as indicated on the multimeter.
 - (11) Adjust internal control R21 for a full scale reading on the meter.
- a.2. *Injection Voltage Calibration.*
- (1) Connect the multimeter to COIL LO and GND binding posts.
 - (2) Set the RF ON switch to the off position.
 - (3) Set the LEVEL-Q switch to the LEVEL position.
 - (4) Allow the Q-meter to warm for 10 minutes.
 - (5) Place shorting strap between high sides of C18 and C19 on terminal board TB2.
 - (6) Adjust ZERO ADJ, LEVEL control for a zero meter reading.
 - (7) Remove shorting strap from C18 and C19.
 - (8) Adjust internal control R34 for a zero meter reading.
 - (9) Set RF ON switch to the ON position.
 - (10) Set the range switch to the 50 kc to the 150 kc range.
 - (11) Adjust the SET LEVEL, COARSE control for a reading of 20 millivolts on the multimeter.
 - (12) Adjust internal control R39 so that pointer reads on red line on meter.
 - (13) Set the RF ON switch to the off position.
 - (14) Readjust internal control R34 for zero meter reading.
 - (15) Set the RF ON switch to the ON position.
 - (16) Readjust internal control R39 so that pointer reads on the red line on the meter.

(17) Repeat (13) through (16) until the meter reads on red line for RF ON position and the meter reads zero when the RF ON switch is in the off position.

Page 41, paragraph 57b. Change the heading to read: **Q-Calibration (Alternate Method).**

Add the following after the heading:

Note. This method cannot be used for Range 1 because the Q-standard does not cover this range.

Page 41, paragraph 57b(4). Change the formula to read as follows:

$$C = \frac{1}{(2\pi f)^2 L} - C_s$$

Page 41, paragraph 57b(5). Add the following after b(5):

Note. If a Q-standard is not available, the coils that come with the Q-meter can be used for calibration but with a lesser degree of accuracy.

(6) If the Q-meter cannot be calibrated by using the alternate method, refer to paragraph 57a.1 and a.2.

60.1. (Added) Calibration of Injection Voltage

a. Connect the multimeter to the COIL LO and GND binding posts.

[AG 418.6 (12 Apr 56)]

By Order of *Wilber M. Brucker*, Secretary of the Army:

Official:

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Major General, United States Army,
The Adjutant General.

MAXWELL D. TAYLOR,
General, United States Army,
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11-57R, Armd Sig Co (2)
11-127R, Sig Rep Co (2)
11-128R, Sig Depot Co (2)
11-500R (AA-AE), Sig Svc Org (2).
11-557C, Abn Sig Co (2)
11-587R, Sig Base Maint Co (2)
11-592R, Hq & Hq Co, Sig Base Depot (2).
11-597R, Sig Base Depot Co (2)

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

USAR: None.

For explanation of abbreviations used, see SR 320-50-1.

- b. Place the RF ON switch to the ON position.
- c. Set the LEVEL-Q switch to the LEVEL position.
- d. Turn range switch to 50-150 kc range.
- e. Set the SET LEVEL panel controls so that the pointer of the meter is on the red line.
- f. The voltmeter should read 20 millivolt ± 2 percent.

60.2. (Added) Calibration of Q VTVM

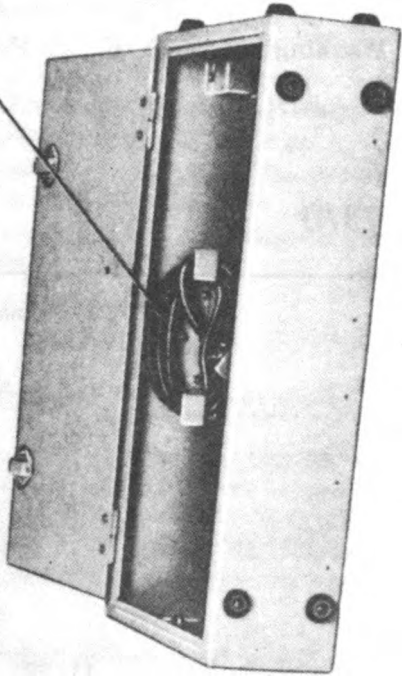
- a. Connect the multimeter and the audio oscillator to the CAP HI and GND binding posts.
- b. Place the RF ON switch to the off position.
- c. Set the LEVEL-Q switch to the Q position.
- d. Set the audio oscillator frequency to 50 kc.
- e. Adjust the audio oscillator output for full scale reading of the meter for all positions of the Q RANGE switch. The multimeter reading should be as follows:

Q range	Multimeter reading for full scale
100.....	2 volts $\pm 2\%$
250.....	5 volts $\pm 2\%$
500.....	10 volts $\pm 2\%$
750.....	15 volts $\pm 2\%$

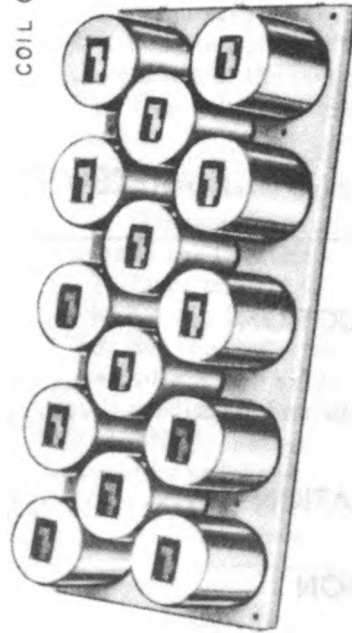
Q METER TS-617B/U

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HEATER CORD

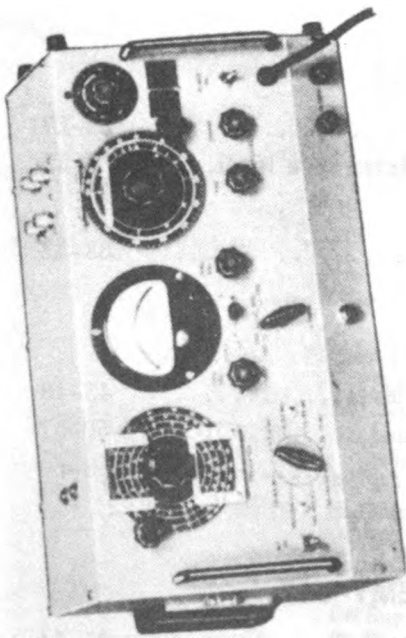


COIL CASE

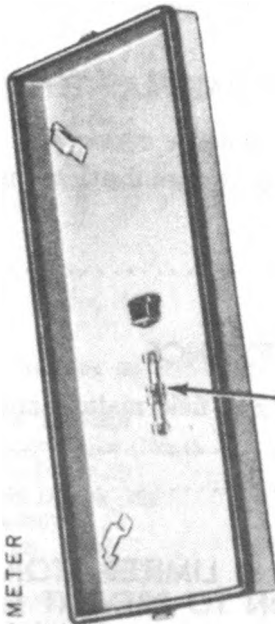


COIL TRAY

LEGS



Q-METER



SPARE FUSES

COVER

RF CABLE ASSEMBLY



TM2635A-2

Figure 1. Q Meter TS-617B/U.

CHAPTER 1

INTRODUCTION

Section I. GENERAL

1. Scope

a. This manual contains instructions for the installation, operation, maintenance, and repair of Q Meter TS-617B/U (fig. 1).

b. The main unit of Q Meter TS-617B/U will be referred to by its common name Q-meter.

c. Forward comments on this manual directly to the Commanding Officer, The Signal Corps Publications Agency, Fort Monmouth, New Jersey.

2. Forms and Records

a. *Unsatisfactory Equipment Reports.*

- (1) DA Form 468, Unsatisfactory Equipment Report, will be filled out and forwarded to the Office of the Chief Signal Officer, as prescribed in SR 700-45-5.
- (2) DD Form 535, Unsatisfactory Report, will be filled out and forwarded to the Commanding General, Air Materiel Command, Wright-Patterson Air

Force Base, Dayton, Ohio, as prescribed in SR 700-45-5 and AF TO 00-35D-54.

b. *Damaged or Improper Shipment.* DD Form 6, Report of Damaged or Improper Shipment, will be filled out and forwarded as prescribed in SR 745-45-5 (Army); Navy Shipping Guide, Article 1850-4 (Navy); and AFR 71-4 (Air Force).

c. *Preventive Maintenance Forms.*

- (1) DA Form 11-238, Operator First Echelon Maintenance Check List for Signal Corps Equipment (Radio Communication, Direction Finding, Carrier, Radar), will be prepared in accordance with instructions on the back of the form (fig. 6).
- (2) DA Form 11-239, Second and Third Echelon Maintenance Check List for Signal Corps Equipment (Radio Communication, Direction Finding, Carrier, Radar), will be prepared in accordance with instructions on the back of the form (fig. 7).

Section II. DESCRIPTION AND DATA

3. Purpose and Use

a. Q Meter TS-617B/U (fig. 1) is an instrument that measures the Q, inductance, capacitance, resistance, and the resonant frequencies of tuned circuits. These measurements can also be made over the frequency range of 50 kilocycles (kc) to 75 megacycles (mc) in eight overlapping bands.

b. A coil case is provided with 14 plug-in

radio-frequency (rf) coils, which cover the frequency range of 50 kc to 20 mc. These coils are used to check the frequency accuracy of the Q-meter and to aid in the measurement of capacitance, Q, and inductance.

4. Technical Characteristics

Frequency range:

- | | | | |
|---------|-------|--------|---------|
| Range 1 | | 50 to | 150 kc. |
| Range 2 | | 150 to | 450 kc. |

- Range 3450 to 1,500 kc.
- Range 4 1.5 to 4.5 mc.
- Range 5 4.5 to 12 mc.
- Range 6 12 to 25 mc.
- Range 7 25 to 50 mc.
- Range 8 50 to 75 mc.
- Range A 1 to 50 kc by means of an external oscillator (not supplied).

Capacity range:

Main tuning capacitor.... 30 to 460 uuf, calibrated in 1 uuf divisions from 30 to 100 uuf and in 5 uuf divisions from 100 to 460 uuf.

Vernier tuning capacitor.... ±3 uuf, calibrated in .1 uuf divisions.

Q-range0 to 750 in four ranges:
 0 — 100
 0 — 250
 0 — 500
 0 — 750

Inductance range09 uh to 130 mh.

Resistance range1 to 1,000 megohms.

Number of tubes 6.

Power requirements .. 100 to 130 or 200 to 260 volts; 49 to 450 cps ac.

Current6 amp at 115V or .3 amp at 230V ac.

Weight66 lb.

6. Description of Components

a. *Q Meter TS-617B/U.* The Q-meter (fig. 1) consists of a panel subassembly which is contained in an aluminum case. The case is equipped with a carrying handle, protective feet on two sides, and ventilating louvers on three sides. All the controls are mounted on the sloping front panel. The jacks and binding posts are mounted on the top of the unit. The power cord is attached to the front panel. Two switches extend through holes in the back of the case to permit operation with various power sources.

b. *Minor Components.* The following minor components are supplied with the Q-meter.

- (1) *Detachable cover.* This cover protects the operating controls when the equipment is not in use. It contains the rf cable assembly and the spare fuses that are supplied with the equipment.
- (2) *Rf assembly.* This cable consists of a 2-foot length of rf cable with plug type PJ055 on one end and two pin plugs on the other end.
- (3) *Coil case.* This case consists of a metal box with a hinged door. It has a removable coil tray. The case contains storage space on the coil tray for 14 plug-in rf coils supplied with the equipment. It also contains a heater element and a heater cord. Two metal

5. Table of Components
(fig. 1)

Component	Reqd No.	Length (in.)	Width (in.)	Height (in.)	Diameter (in.)	Volume (cu ft)	Weight (lb)
Q-Meter	1	8	20	11		1.0	32
Coil case which includes:	1	12	23¼	5		.8	26
Rf cable assembly	1	20					
Heater cord	1	72					.5
Heater element	1						
Legs	2						6
Rf coils	14						
Technical Manual TM 11-2635A	2	¾	7¼	10¼			
Total						1.94	66

Note. This list is for general information only. See appropriate supply publications for information pertaining to requisition of spare parts.

legs, located in the coil case and adjustable in length, are provided for use with the coil tray.

- (4) *Rf coils.* Fourteen plug-in rf coils are provided. These coils are shielded and are stored on the coil tray in the coil case. The rf coils are used as Q-meter test coils over the frequency range of 50 kc to 20 mc.

7. Running Spares

The following is a list of running spares for the Q-meter:

- 1 indicator lamp, 6.3-volt, .25-ampere.
- 5 fuses, 1.5-ampere, type 3AG.
- 1 tube, 5726/6AL5W.
- 1 tube, 5814A.
- 1 tube, 5763.
- 1 tube, 5Y3WGTA.

CHAPTER 2

INSTALLATION

8. Unpacking

a. Packaging Data. When packaged for shipment, the components of Q Meter TS-617B/U are placed in moisture-vaporproof containers and packed in a wooden case. The case is 32 inches high, 28½ inches wide, 22½ inches deep, its volume is 11.87 cubic feet, and its weight is 155 pounds. A view of packaging the Q-meter and coil case for shipment is shown in figure 2.

b. Carton Dimensions and Contents. The following chart indicates the dimensions and contents of each carton:

Carton dimensions (in.)	Contents	Notes
8 x 20 x 11	Q-meter, spare fuses and rf cable assembly	Refer to paragraph 5 for description.
12 x 23¼ x 5	Coil case, rf coils, legs, heater cord and case heating element.	Refer to paragraph 5 for description.

c. Removing Contents.

Caution: Be careful when uncrating, unpacking, and handling equipment; it is easily damaged.

- (1) Cut and fold back the metal straps.
- (2) Remove the nails with a nail puller. Remove the top and one side of the packing case. Do not attempt to pry off the sides and top; the equipment may be damaged.
- (3) Remove the moistureproof barrier and corrugated filler that cover the equipment inside the carton.

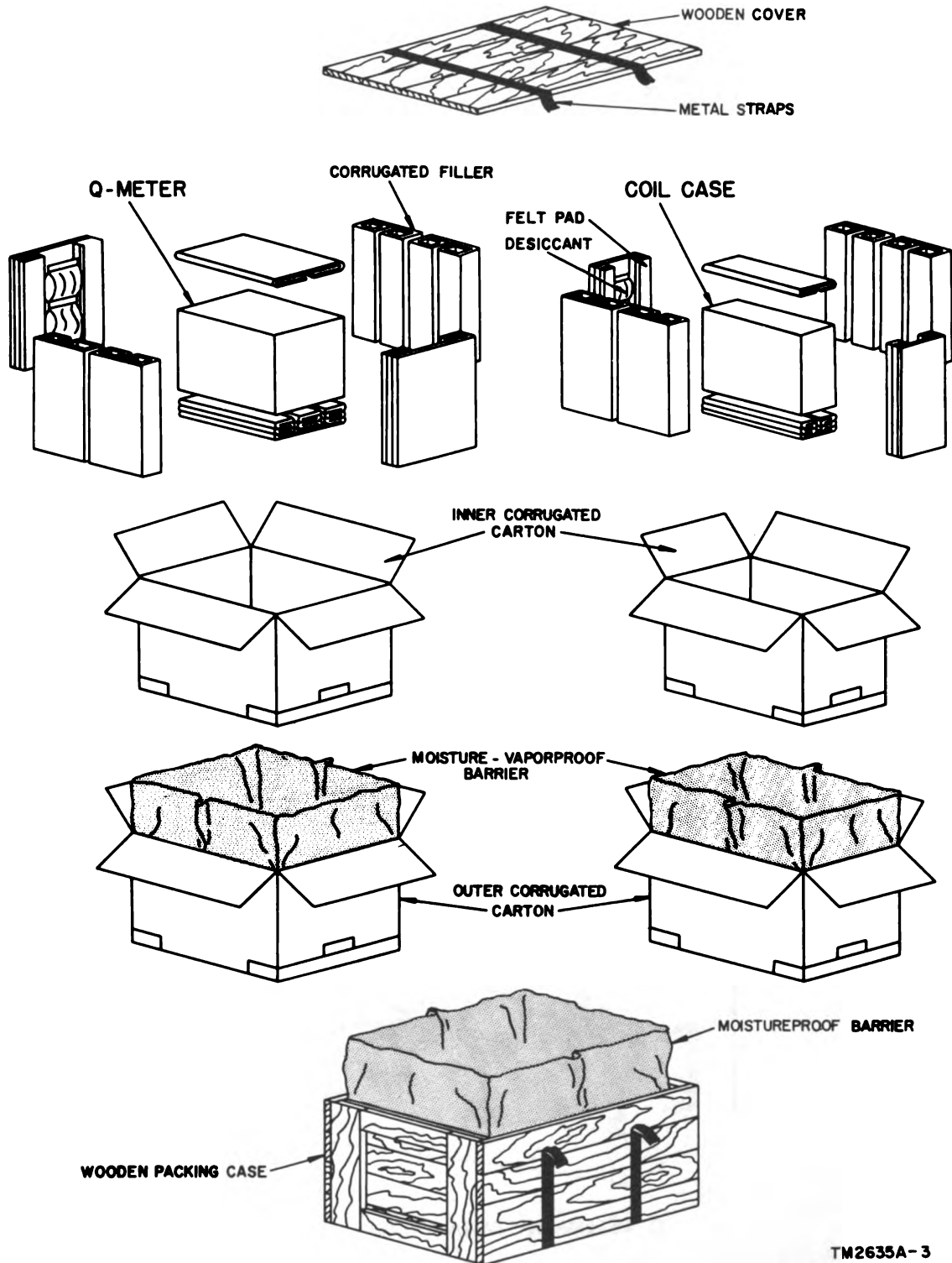
- (4) Remove the equipment from the two cartons.
- (5) Inspect the equipment for possible damage incurred during shipment.
- (6) Check the contents of the packing case against the master packing slip.

9. Installation of Equipment

The Q-meter is shipped with all tubes and fuses in place for operation. Do not open the Q-meter unless it has been damaged in shipment. Instructions on choice of installation and initial adjustment are as follows:

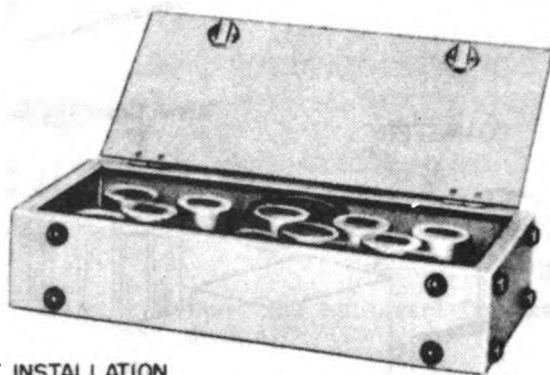
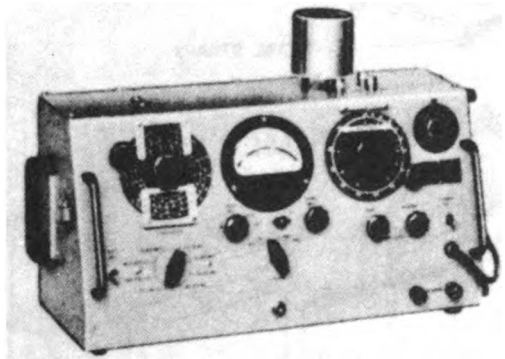
a. Choice of Installation. Three convenient Q Meter TS-617B/U installations are illustrated in figure 3. Choice of installation depends on whether the installation is a permanent, semi-permanent, or temporary type. To set up the permanent installation (fig. 3c), remove the 5 screws on top of the Q-meter. Attach the legs to the coil tray. Line up the holes on the coil tray with those of the Q-meter. Replace the 5 screws. A 115-volt or 230-volt alternating-current (ac) outlet must be within 6 feet of the Q-meter.

b. Initial Adjustment. Determine whether the power source is 115 volts or 230 volts and whether the line voltage is usually above or below the rated value. *Do not connect the power cable to the power source until the following adjustment is made.* Check the position of 115/230-volt switch on the rear of the Q-meter. If necessary, remove the switchplate and set the switch to the correct position for the available power supply voltage (fig. 4). Replace the switchplate.

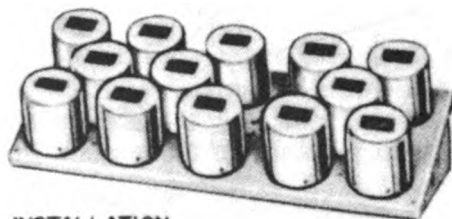
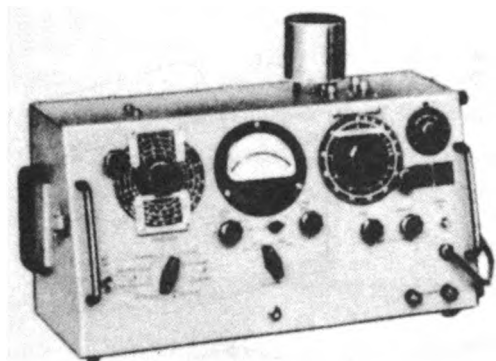


TM2635A-3

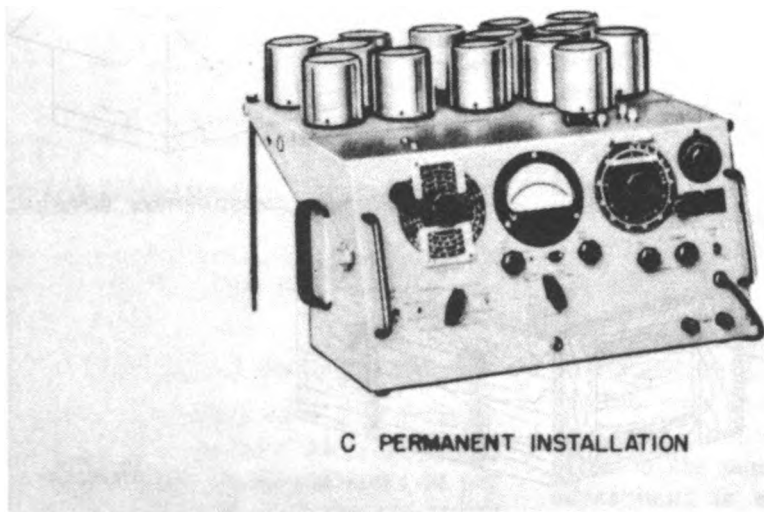
Figure 2. Packaging of Q Meter TS-617B/U.



A TEMPORARY INSTALLATION



B SEMI-PERMANENT INSTALLATION



C PERMANENT INSTALLATION

TM2635A-4

Figure 3. Installation of Q Meter TS-617B/U.



A. 100 TO 115V OPERATION



B. 115 TO 130V OPERATION



C. 200 TO 230V OPERATION



D. 230 TO 260V OPERATION

TM2635A-5

10. Service Upon Receipt of Used or Reconditioned Equipment

a. Follow the instructions in paragraph 8 for uncrating, unpacking, and checking the equipment.

b. Check the used or reconditioned equipment for changes due to Modification Work Orders (MWO). The MWO number will appear on the equipment. If any changes in the wiring have been made, note the change and the MWO number in the manual, preferably on the schematic diagram.

c. Perform the installation given in paragraph 9.

Figure 4. Q Meter, line voltage switch positions.

CHAPTER 3 OPERATION

Section I. CONTROLS AND INSTRUMENTS

11. General

Haphazard operation or improper setting of the controls can cause unsatisfactory performance of the Q-meter. For this reason it is important to know the function of every control and meter on the equipment. The actual operating instructions are contained in Section II of this chapter.

12. Controls and Instruments

The following table lists the controls and instruments of the Q-meter (fig. 5) and indicates their functions:

<i>Control</i>	<i>Function</i>
POWER ON switch	This is used to turn the Q-meter ON and off.
FREQUENCY coarse control	This is a frequency control; it is used to tune rapidly the rf oscillator and indicate its frequency.
FREQUENCY fine control	This is used for fine adjustment of the FREQUENCY coarse control.
Range switch knob	Selects frequency band of rf oscillator.
SET LEVEL COARSE control	Coarse control of the level output voltage as indicated on meter when LEVEL-Q switch is on LEVEL.
SET LEVEL FINE control	Fine adjustment of level output voltage as indicated on meter when LEVEL-Q switch is on LEVEL.
Q RANGE switch	Selects the Q Range that can be read on the meter when LEVEL-Q switch is on Q.
LEVEL-Q switch	In LEVEL position determines the level voltage. In Q position determines the circuit Q of the component under test.

<i>Control</i>	<i>Function</i>
ZERO ADJ LEVEL control	This is used to zero adjust the meter when the LEVEL-Q switch is on LEVEL and the RF ON switch is set to off.
ZERO ADJ Q control	This is used to zero adjust the meter when the LEVEL-Q switch is on Q and the RF ON switch is set to off.
RF ON switch	In ON position turns on rf oscillator and allows adjustment of level output voltage indicated on meter. In off position, the zero adjustment controls can be used to zero adjust the meter.
Meter	Indicates Q of the circuit under test with LEVEL-Q switch on Q. Indicates level output voltage with LEVEL-Q switch on LEVEL. It also has a LEVEL SET red line. Also it will indicate the rf input from an external oscillator.
MICRO MICRO FARADS INDUCTANCE coarse control	This is a capacitor adjustment. The outer scale indicates in uuf the capacitance of the item under test. The inner scale indicates in uh the inductance of the item under test.
MICRO MICRO FARADS INDUCTANCE fine control	This is used for fine adjustment of the MICRO MICRO FARADS INDUCTANCE coarse control.
MICRO MICRO FARADS dial	This is used for vernier adjustment of the MICRO MICRO FARADS INDUCTANCE coarse control.
Pilot light	Indicates power is on when POWER ON switch is in ON position.
1.5 AMPS, fuses	Line fuses.
115V-230V switch (fig. 4)	Selects line voltage of ac power source.

Control	Function
HI-LO switch (fig. 4)	For use when the line voltage is above or below rated value of 115 volts or 230 volts.
RF OUT receptacle	Provides oscillator output for use as a signal source. Insertion of plug disconnects oscillator from injection resistor.
RF IN receptacle	Provides for insertion of external rf power source to extend frequency range of Q-meter.

Control	Function
COIL LO and COIL HI binding posts	Provides for the connection of rf coils between COIL LO and COIL HI binding posts for test purposes.
CAP HI and GND binding posts	Provides for the connection of external capacitors between GND and CAP HI binding posts. Capacitors connected across these binding posts are in parallel with the Q-circuit resonating capacitor.

Section II. OPERATION UNDER USUAL CONDITIONS

13. Starting Procedure

Perform the starting procedure given below before using the operating procedure described in paragraph 14.

a. *Preliminary.* Determine the power sources available and make the adjustments described in paragraph 9. Connect the heater cord to the socket located on the back of the coil case. When the heater cord is plugged into a 115- or 230-volt ac source, the heater element, located inside the coil case, will provide enough heat to keep the rf coils warm and dry. Set the front panel controls (fig. 5) as follows:

Control	Position
POWER ON switch	Off
RF ON switch	Off

b. Starting.

- (1) Throw the POWER ON switch to the ON position. The pilot lamp should glow.
- (2) Turn the range switch knob to the desired frequency range.
- (3) Allow 5 minutes for warm up.
- (4) Throw the LEVEL-Q switch to the LEVEL position and rotate the ZERO ADJ-LEVEL control until the meter reading is zero.
- (5) Throw the LEVEL-Q switch to the Q position and rotate the ZERO ADJ-Q control until the meter reading is zero.

- (6) Turn the FREQUENCY coarse and fine controls to the desired frequency.
- (7) Throw the LEVEL-Q switch to the LEVEL position.
- (8) Throw the RF ON switch to the ON position.
- (9) Adjust the SET LEVEL FINE and COARSE controls until the meter pointer is over the red line on the meter. It may be necessary to readjust the SET LEVEL FINE and COARSE controls when changing frequency to maintain the meter pointer over the red line.
- (10) Throw the LEVEL-Q switch to Q. The equipment is now ready to read Q.

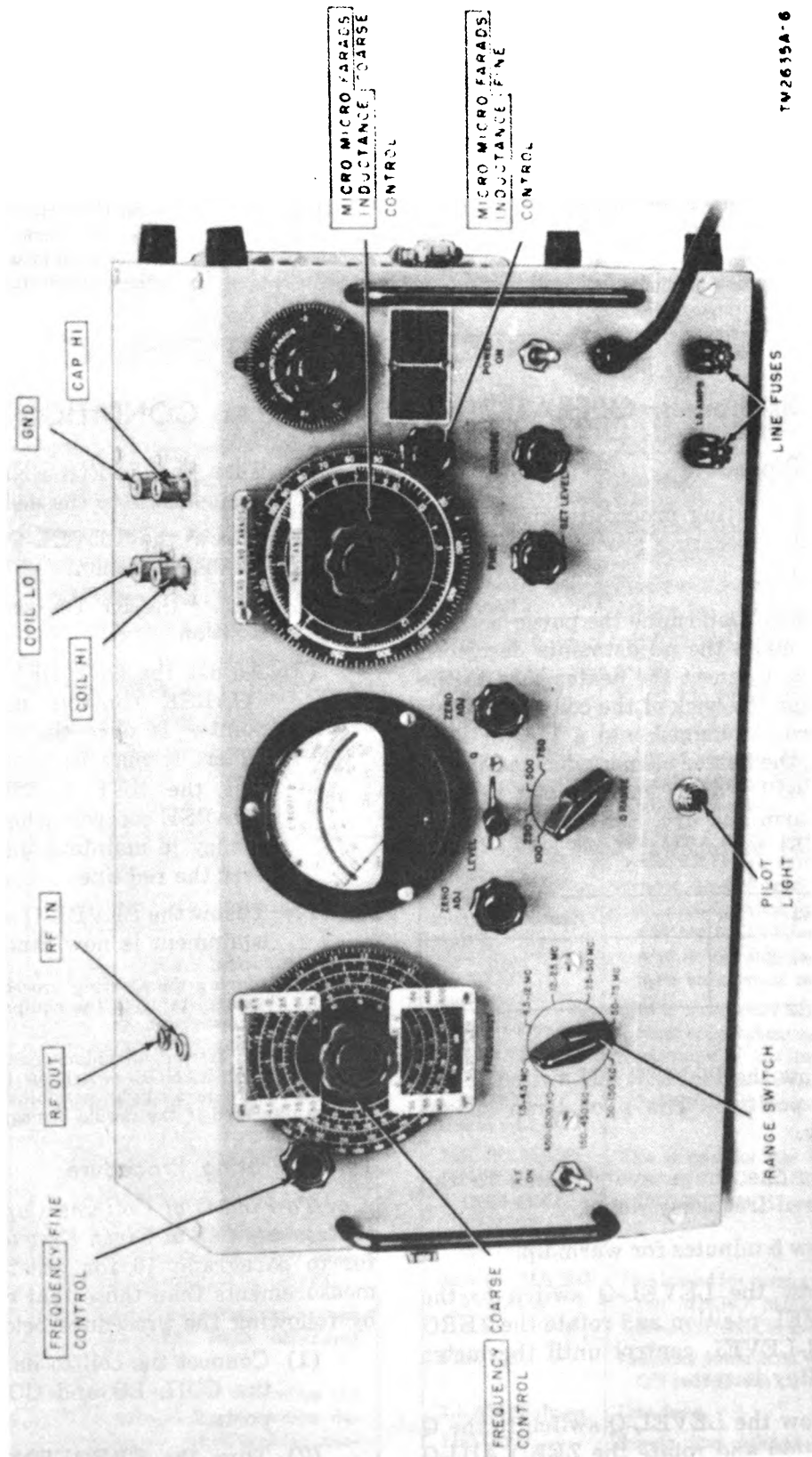
Note. If, during the starting procedure, an abnormal result is obtained, refer to the equipment performance check list in paragraph 32.

Note. When testing an unknown inductor, it is best to place the Q RANGE switch on the highest range initially. There is a slight possibility that the meter may be damaged if the needle is pegged.

14. Operating Procedure

a. *To Find Q of Coil and Capacity Required to Resonate Coil at Given Frequency.* Note: Refer to paragraph 16 for greater accuracy in measurements than those that can be obtained by following the procedure below.

- (1) Connect the coil to be tested between the COIL LO and COIL HI binding posts.
- (2) Turn the FREQUENCY coarse and fine controls to the desired frequency.



TM 2635A-6

Figure 5. Q Meter, controls and instruments.

- (3) Throw the LEVEL-Q switch to the LEVEL position.
- (4) Adjust the SET LEVEL FINE and COARSE controls until the meter pointer is over the red line on the meter.
- (5) Throw the LEVEL-Q switch to the Q position.
- (6) Adjust the MICRO MICRO FARADS INDUCTANCE coarse and fine controls for a peak reading of the meter. Use the MICRO MICRO FARADS dial for vernier adjustment.
- (7) Throw the Q RANGE switch to the range that will give highest on-scale reading.

Results: $Q_1 =$ meter reading
 $C =$ MICRO MICRO FARADS INDUCTANCE dial reading (outer scale) \pm MICRO MICRO FARADS dial reading

b. To Find Q of Coil and Frequency Required to Resonate Coil at Given Capacity.

- (1) Connect the coil to be tested between COIL LO and COIL HI binding posts.
- (2) Turn the MICRO MICRO FARADS INDUCTANCE coarse and fine controls to the desired capacity setting.
- (3) Throw the LEVEL-Q switch to the Q position.
- (4) Adjust the FREQUENCY coarse and fine controls for a peak reading of the meter.
- (5) Throw the LEVEL-Q switch to the LEVEL position.
- (6) Adjust the SET LEVEL FINE and COARSE controls until the meter pointer is over the red line on the meter.
- (7) Throw the LEVEL-Q switch to the Q position.
- (8) Throw the Q RANGE switch to the range that will give highest on-scale meter reading.

Results: $Q_1 =$ meter reading
 $f =$ FREQUENCY control dial reading

c. To Find Inductance of Coil.

- (1) Connect the coil to be tested between COIL LO and COIL HI binding posts.
- (2) Choose the frequency opposite the estimated inductance range as given on the INDUCTANCE-FREQUENCY plate mounted below MICRO MICRO FARADS dial.
- (3) Adjust the FREQUENCY coarse and fine controls to the frequency determined in (2) above.
- (4) Throw the LEVEL-Q switch to the Q position.
- (5) Adjust the MICRO MICRO FARADS INDUCTANCE coarse and fine controls for a peak reading of the meter.

Result: $L =$ MICRO MICRO FARADS INDUCTANCE dial reading (inner scale)

d. Measurement of Capacitors Below 430 Uuf.

- (1) Choose an rf coil that will resonate in the frequency range of the measurement. For characteristics of rf coils supplied, refer to the table in *e* below.
Note. To measure an unknown capacitor, the proper test coil is the one marked with the frequency range in which the capacitor will eventually work. For better grade capacitors with short lead lengths, the measurement will not vary with frequency.
- (2) Plug the coil between COIL LO and COIL HI binding posts.
- (3) Set the MICRO MICRO FARADS INDUCTANCE dial to high capacity setting (approximately 400 micromicrofarads (uuf)), and note setting as C_1 .
- (4) Throw the LEVEL-Q switch to the Q position.
- (5) Adjust the FREQUENCY coarse and fine controls for a peak reading of the meter.
- (6) Connect the capacitor to be tested between CAP HI and GND binding posts.
- (7) Readjust the MICRO MICRO FARADS INDUCTANCE dial for a peak reading of the meter and note the new capacitance setting as C_2 .

Result: $C = C_1 - C_2$ uuf.

e. Characteristics of Rf Coils.

Reference designation	Inductance	Q (approx)	Tuning range
L101	1 uh	180	8-20 mc
L102	2.5 uh	200	5-14 mc
L103	5 uh	200	3.5-10 mc
L104	10 uh	200	2.5-7 mc
L105	25 uh	200	1.5-4.5 mc
L106	50 uh	200	1.1-3 mc
L107	100 uh	200	800-2,000 kc
L108	250 uh	200	500-1,400 kc
L109	500 uh	170	350-1,000 kc
L110	1 mh	170	250-700 kc
L111	2.5 mh	170	150-450 kc
L112	5 mh	160	110-300 kc
L113	10 mh	140	80-200 kc
L114	25 mh	110	50-140 kc

f. Measurement of Large Resistors (10,000 Ohms to 1,000 Megohms).

- (1) Choose an rf coil that will resonate at the desired measuring frequency. For characteristics of rf coils supplied, refer to the table in *e* above.
- (2) Plug the coil between COIL LO and COIL HI binding posts.
- (3) Turn the FREQUENCY coarse and fine controls to the desired frequency.
- (4) Throw the LEVEL-Q switch to the LEVEL position.
- (5) Adjust the SET LEVEL FINE and COARSE controls until the meter pointer is over the red line on the meter.
- (6) Throw the LEVEL-Q switch to the Q position.
- (7) Adjust the MICRO MICRO FARADS INDUCTANCE coarse and fine controls for a peak reading of the meter. Note the Q-reading as Q_1 and MICRO MICRO FARADS INDUCTANCE dial reading as C_1 .
- (8) Connect the resistor to be measured between CAP HI and GND binding posts.
- (9) Readjust the MICRO MICRO FARADS INDUCTANCE coarse and fine controls for a new peak reading of the meter. Note this reading as Q_2 .

$$\text{Result: } R = \frac{Q_1 Q_2}{2\pi f C_1 (Q_1 - Q_2)} \text{ ohms}$$

where f is frequency in cps
and C is capacitance in uuf.

g. Measurement of Small Resistors (1 to 10,000 Ohms).

- (1) Choose an rf coil that will resonate at the desired measuring frequency. For characteristics of rf coils supplied, refer to the table in *e* above.
- (2) Plug the coil between COIL LO and COIL HI binding posts.
- (3) Turn the FREQUENCY coarse and fine controls to the desired frequency.
- (4) Throw the LEVEL-Q switch to the LEVEL position.
- (5) Adjust the SET LEVEL FINE and COARSE controls until the meter pointer is over the red line on the meter.
- (6) Throw the LEVEL-Q switch to the Q-position.
- (7) Adjust the MICRO MICRO FARADS INDUCTANCE coarse and fine controls for a peak reading of the meter. Note this Q-reading as Q_1 and MICRO MICRO FARADS INDUCTANCE dial reading as C_1 .
- (8) Connect the resistor to be measured in series with the rf coil between COIL LO and COIL HI binding posts.
- (9) Readjust the MICRO MICRO FARADS INDUCTANCE coarse and fine controls for a new peak reading of the meter. Note this Q-reading as Q_2 and the MICRO MICRO FARADS INDUCTANCE dial reading as C_2 .

$$\text{Result: } R = \frac{\left(\frac{C_1}{C_2}\right) Q_1 - Q_2}{2\pi f C_1 Q_1 Q_2} \text{ ohms}$$

where f is frequency in cps
 C is capacitance in uuf.

h. To Find Distributed Capacity C_d of Coil (Accurate Method).

- (1) Connect the coil to be tested between the COIL LO and COIL HI binding posts.

- (2) Set the MICRO MICRO FARADS INDUCTANCE coarse and fine controls to a high capacitance setting (approximately 400 uuf). Note the dial reading as C_1 .
- (3) Throw the LEVEL-Q switch to the Q position.
- (4) Adjust the FREQUENCY coarse and fine controls for a peak reading of the meter. Note this dial reading as f_1 .
- (5) Turn the FREQUENCY coarse and fine controls to 10 times f_1 .
- (6) Replace the coil being tested with an rf coil that will resonate at approximately $10f_1$. Note this dial reading as f_0 .
- (7) Adjust the MICRO MICRO FARADS INDUCTANCE coarse and fine controls for a peak reading on the meter.
- (8) Connect the coil to be tested to the CAP HI and GND binding posts.
- (9) Readjust the MICRO MICRO FARADS INDUCTANCE coarse and fine controls for a peak reading on the meter.
- (10) If the MICRO MICRO FARADS INDUCTANCE capacitance reading was increased in (9) above, adjust the FREQUENCY coarse and fine controls for an increased dial reading, remove the coil to be tested, and repeat steps (7) through (9) above.
- (11) If the MICRO MICRO FARADS INDUCTANCE capacitance reading was decreased in (9) above, adjust the FREQUENCY coarse and fine controls for a decreased dial reading, remove the coil to be tested, and repeat the steps in (7) through (9) above.
- (12) Repeat the steps in (7) through (11) above until the step in (9) above does not require readjustment for a peak reading on the meter.

Results: $C_d = \frac{C_1}{2}$ farads.

$$\left(\frac{f_0}{f_1}\right) - 1$$

when f_0 is much greater than f_1

$$C_d = \left(\frac{f_1}{f_0}\right)^2 C_1 \text{ farads.}$$

i. To Find Distributed Capacity, C_d , of Coil (Approximate Method).

- (1) Connect the coil to be tested between the COIL LO and COIL HI binding posts.
- (2) Turn the MICRO MICRO FARADS INDUCTANCE coarse and fine controls to about 50-uuf dial setting. Note this dial reading as C_1 .
- (3) Throw the LEVEL-Q switch to the Q position.
- (4) Adjust the FREQUENCY coarse and fine controls for a peak reading on the meter. Note this dial setting as f_1 .
- (5) Reset the FREQUENCY coarse and fine controls to a lower frequency equal to f_1/n .
- (6) Tune the MICRO MICRO FARADS INDUCTANCE coarse and fine controls for a peak reading on the meter. Note the capacitance reading of this dial as C_2 .

Results: $C_d = \frac{C_2 - n^2 C_1}{n^2 - 1}$ farads.

n can be any number above 1. However, f_1/n must fall within the frequency range of the Q-meter. In most instances, for convenience, n can be the numeral 2 in which case the formula will be:

$$C_d = \frac{C_2 - 2^2 C_1}{2^2 - 1} = \frac{C_2 - 4C_1}{3} \text{ farads.}$$

15. Operating Procedure, Low-frequency Measurements

a. The frequency range of the Q-meter can be extended below 50 kc by the use of auxiliary equipment that is not supplied. For extending the range down to 1 kc, the equipment required follows:

<i>Equipment</i>	<i>Remarks</i>
Audio Oscillator SG-71/FCC	1 kc to 50 kc power oscillator
Rf cable assembly	Supplied with Q-meter
Matching transformer in frequency range of 10 to 50 kc	600 to 1 impedance ratio, .6 ampere secondary

b. Connections for low-frequency operation are made as follows:

- (1) Insert the plug of the rf cable in the RF IN receptacle.
- (2) Connect the pin plugs of the rf cable to the power oscillator.
- (3) Throw the RF ON switch to the off position on the Q-meter.
- (4) Operate the equipment as in paragraph 14 for measurement purposes. Use output and frequency controls of the power oscillator to perform the functions of the SET LEVEL and FREQUENCY controls.

16. Correction Factors

To obtain greater accuracy in the measurements made with the Q-meter it is necessary to correct for the internal errors of the Q-meter and the distributed capacity of the coil used. The uncorrected measurements will be called *indicated* values while the values correcting for the internal errors of the Q-meter will be called *effective* values. When the values are corrected for both the internal errors and the distributed capacity, they will be called *true* values. When more than one correction is required for a measurement, the corrections should be made in the order listed below.

a. *Correction for Q-vtvm VS Conductance.* The loading effect of the Q-vacuum-tube volt-meter (vtvm) circuit is equivalent to 65 megohms, shunting the measuring circuit. To correct the *indicated* Q obtained in paragraph 14a or b for this loading effect, proceed as follows:

- (1) Note the *indicated* Q, the frequency, and the determined capacity value obtained in paragraph 14a or note the *indicated* Q, and the value of the given internal resonating capacity C, and the determined frequencies obtained in paragraph 14b.
- (2) Calculate the *effective* Q_e as

$$Q_e = \frac{Q_i}{1 - \frac{Q_i}{65 \times 10^6 \times 2\pi f C}}$$

where f is the frequency in cycles per second (cps),
C is the capacitance in uuf
and Q_i is the meter reading.

b. *Correction for Injection Resistance.* The injection resistance is in series with the measuring circuit. This resistance, which is .03 ohm, may be safely neglected when the effective series coil resistance is greater than 3 ohms. To correct the *indicated* Q for the injection resistance, proceed as follows:

- (1) Measure the *indicated* Q_i as shown in paragraph 14a or b and note the internal resonating capacity C on the MICRO MICRO FARADS INDUCTANCE dial.
- (2) Calculate the *effective* Q_e as

$$Q_e = \frac{Q_i}{1 - \frac{Q_i}{33}}$$

where f is the frequency in cps
C is the capacitance in uuf.

c. *Correction for Residual Inductance.* The internal residual inductance of .011 microhenry (uh) is in series with the inductance of the coil under measurement. The *indicated* inductance includes the residual inductance and can be ignored for coils greater than .5 uh. To correct the *indicated* inductance for residual inductance, proceed as follows:

- (1) Measure the *indicated* inductance L_i as shown in paragraph 14c.
- (2) Calculate the *effective* inductance L_e as

$$L_e = L_i - .011 \text{ uh.}$$

d. *Distributed Capacity Correction for Q.* The distributed capacity of a coil results in an *effective* Q which is less than the *true* Q. The difference between *effective* Q and *true* Q varies with the ratio of the distributed capacity to the capacity of the internal resonating capacitor. To find the *true* Q, proceed as follows:

- (1) Calculate the *effective* Q_e as in a and b above.
- (2) Measure the distributed capacity C_d of the coil as shown in paragraph 14h or 14i.
- (3) Calculate the *true* Q as

$$\text{true } Q = Q_e \left(\frac{C + C_d}{C} \right)$$

where C = internal resonating capacity.

e. *Distributed Capacity Correction for Inductance.* To correct the *effective* inductance of a coil for the effect of the distributed capacity,

proceed as follows:

- (1) Calculate the *effective* inductance L_e as shown in paragraph 14c.
- (2) Measure the distributed capacity of C_d of the coil as shown in paragraph 14h or 14i.
- (3) Calculate the *true* inductance as

$$\text{true } L = L_e \left(\frac{C}{C + C_d} \right)$$

where C = internal resonating capacity.

17. Stopping Procedure

- a. Throw the POWER ON switch to the off position.
- b. Disconnect the line cord from the power outlet.
- c. Store the line cord and the rf cable assembly in the cover and place the cover on the Q-meter.

Section III. OPERATION UNDER UNUSUAL CONDITIONS

18. General

The operation of the Q-meter may be difficult in regions where extreme cold, heat, humidity and moisture, sand conditions, etc, prevail. Although every precaution is taken in the design of the equipment to maintain its technical characteristics over a wide temperature and humidity range, adverse conditions may cause large errors in measurements unless additional precautions are taken. Paragraphs 19, 20, and 21 provide procedures that minimize the effects of these unusual climatic conditions.

19. Operation in Arctic Climates

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

- a. Keep the equipment warm and dry.
- b. When equipment that has been exposed to the cold is brought into a warm room, moisture will gather on the equipment which may cause

a change in operating characteristics. When the equipment reaches room temperature, dry it thoroughly.

20. Operation in Tropical Climates

Moisture conditions are more acute than normal in the tropics. Ventilation is usually very poor, and the high relative humidity causes condensation of moisture on the equipment whenever the temperature of the equipment becomes lower than the surrounding air. To minimize this condition, provide as good ventilation as possible. Dry the equipment thoroughly before operating it.

21. Operation in Desert Climates

- a. The main problem that arises with equipment operation in desert areas is the large amount of sand, dust, or dirt that enters the moving parts of test equipment.
- b. Be sure to keep the equipment as free from dust as possible. Make frequent preventive maintenance checks.

CHAPTER 4

ORGANIZATIONAL MAINTENANCE

Section I. PREVENTIVE MAINTENANCE SERVICES

22. Definition of Preventive Maintenance

Preventive maintenance is work performed on equipment (usually when the equipment is not in use) to keep it in good working order so that breakdowns and needless interruptions in service will be kept to a minimum. Preventive maintenance differs from trouble shooting and repair since its object is to prevent certain troubles from occurring.

23. Tools and Materials

Tools and materials used with Q Meter TS-617B/U for preventive maintenance, but not supplied, are listed in *a* and *b* below.

a. Tools.

- 1 Pliers
- 1 Screw driver
- 1 Allen wrench No. 6

b. Materials.

- Cheesecloth, bleached, lint-free
- Paper, sand, flint #000
- Cleaning Compound (Federal stock No. 7930-395-9542)

24. General Preventive Maintenance Techniques

a. Use #000 sandpaper to remove corrosion.

b. Use a clean, dry, lint-free cloth or dry brush for cleaning. If necessary, moisten the cloth or brush with Cleaning Compound. After cleaning, wipe the parts dry with a cloth.

Warning: Prolonged breathing of Cleaning Compound fumes is dangerous. Make certain that adequate ventilation is provided. Cleaning Compound is flammable; do not use near a flame.

c. For further information on preventive maintenance techniques, refer to TB SIG 178, Preventive Maintenance Guide for Radio Communication Equipment.

25. Use of Preventive Maintenance Forms

a. DA Form 11-238 (fig. 6) and DA Form 11-239 (fig. 7) are to be used as preventive maintenance check lists. Instructions for the use of each form appear on the back of the form.

b. Items not applicable to Q Meter TS-617B/U have been lined out. Reference to the ITEM column are to paragraphs in this manual that contain additional maintenance information for the particular item.

26. Performing Preventive Maintenance

Caution: Tighten screws, bolts, and nuts carefully. Fittings tightened beyond the pressure for which they are designed will be damaged or broken.

a. Daily Items (Operators maintenance).

- (1) Check for completeness and general condition of the test set. The components of the Q-meter are listed in paragraph 5.
- (2) Clean dirt and moisture from the case, front panel and binding posts.
- (3) Inspect the seating of fuses F1 and F2 and pilot lamp DS1 (fig. 5).
- (4) Inspect the controls for binding, scraping, excessive looseness, and for positive action.
- (5) Check the Q-meter for normal operation (par. 13 and 14). If there is any

OPERATOR FIRST ECHELON MAINTENANCE CHECK LIST FOR SIGNAL CORPS EQUIPMENT
RADIO COMMUNICATION, DIRECTION FINDING, CARRIER, RADAR

INSTRUCTIONS: See other side

EQUIPMENT NOMENCLATURE _____ EQUIPMENT SERIAL NO. _____

LEGEND FOR MARKING CONDITIONS: ✓ Satisfactory; X Adjustment, repair or replacement required; ⊕ Defect corrected.
 NOTE: Strike out items not applicable.

DAILY

NO.	ITEM	CONDITION						
		S	M	T	W	T	F	S
1	COMPLETENESS AND GENERAL CONDITION OF EQUIPMENT (woodwork, commutation, carrying cases, wire and cable, microphones, tubes, spare parts, technical manuals and accessories). PAR 26 a (1)							
2	LOCATION AND INSTALLATION SUITABLE FOR NORMAL OPERATION.							
3	CLEAN DIRT AND MOISTURE FROM ANTENNA, MICROPHONE, HEADSETS, CHECKSETS, KEYS, JACKS, PLUGS, TELEPHONES, BATTERY BAGS, COMPONENT PANELS. PAR 26 a (2)							
4	INSPECT SEATING OF READILY ACCESSIBLE "PLUCK-OUT" ITEMS: SWITCHES, CAPS, CRACKERS, FUSES, CONNECTORS, WIRING, PLUG-IN COILS AND RESISTORS . PAR 26 a (3)							
5	INSPECT CONTROLS FOR BINDING, SCRAPING, EXCESSIVE LOOSENESS, WORN OR SHIPPED GEARS , MISALIGNMENT, POSITIVE ACTION. PAR 26 a (4)							
6	CHECK FOR NORMAL OPERATION. PAR 26 a (5)							

WEEKLY

NO.	ITEM	COURT-CLIM	NO.	ITEM	COURT-CLIM
8	INSPECT CASES, MOUNTINGS, ANTENNAS, TOWERS, AND EXPOSED METAL SURFACES, FOR RUST, CORROSION, AND MOISTURE. PAR 26 b (1)		14	CLEAN AIR FILTERS, BRASS NAME PLATES, DIAL AND METER WINDOWS, WELT ASSEMBLIES.	
9	INSPECT CORD, CABLE, WIRE, AND SHOCK MOUNTS FOR CUTS, BREAKS, PRAYING, DETERIORATION, KINKS, AND STRAIN. PAR 26 b (2)		15	INSPECT METERS FOR DAMAGED GLASS AND CASES. PAR 26 b (4)	
10	INSPECT ANTENNA FOR ECCENTRICITIES, CORROSION, LOOSE FIT, DAMAGED INSULATORS AND REFLECTORS.		16	INSPECT SHELTERS AND COVERS FOR ADEQUACY OF WEATHER-PROOFING.	
11	INSPECT CANVAS ITEMS, LEATHER, AND CABLING FOR WILDER, TEARS, AND PRAYING.		17	CHECK ANTENNA GUY WIRES FOR LOOSENESS AND PROPER TENSION.	
12	INSPECT FOR LOOSENESS OF ACCESSIBLE ITEMS: SWITCHES, KNOBS, JACKS, CONNECTORS, CONDENSERS, TRANSFORMERS, POWER CORDS, RELAYS, BELONGS, MOTORS, DIODES, CAPACITORS, SCRIBATORS, AND PILOT LIGHT ASSEMBLIES . PAR 26 b (3)		18	CHECK TERMINAL BOX COVERS FOR CRACKS, LEAKS, DAMAGED GASKETS, DIRT AND GRATE.	

19 IF DEFICIENCIES NOTED ARE NOT CORRECTED DURING INSPECTION, INDICATE ACTION TAKEN FOR CORRECTION.

DA FORM 11-238
 1 MAY 51

REPLACES DA AGO FORM 419, 1 DEC 50, WHICH IS OBSOLETE.

TM2635A-7

Figure 6. DA Form 11-238.

SECOND AND THIRD ECHELON MAINTENANCE CHECK LIST FOR SIGNAL CORPS EQUIPMENT
RADIO COMMUNICATION, DIRECTION FINDING, CARRIER, RADAR

INSTRUCTIONS: See other side

EQUIPMENT NOMENCLATURE _____ EQUIPMENT SERIAL NO. _____

LEGEND FOR MARKING CONDITIONS: ✓ Satisfactory; X Adjustment, repair or replacement required; ⊕ Defect corrected.
 NOTE: Scribe out items not applicable.

NO.	ITEM	NO.	ITEM
1	COMPLETENESS AND GENERAL CONDITION OF EQUIPMENT (including accessories carrying cases, wire and cables, miscellaneous tubes, spare parts, technical manuals and accessories). PAR 26 G (1)	19	INSPECT FOR LEAKS, BUBBLES, AND DISCOLORATION.
2	LOCATION AND INSTALLATION SUITABLE FOR NORMAL OPERATION.	20	INSPECT VARIABLE CAPACITORS FOR BIRT, MOISTURE, CRACKS, AND LOOSE MOUNTINGS.
3	CLEAN DIRT AND MOISTURE FROM SWITCHES, JACKS, PLUGS, HEADPHONES, MICROPHONES, AND ACCESSORIES. PAR 26 G (2)	21	INSPECT FIXED CAPACITORS FOR LEAKS, BUBBLES, AND DISCOLORATION. PAR 26 C (2)
4	INSPECT SEATING OF READILY ACCESSIBLE "PLUG-IN" ITEMS: TUBES, LAMPS, RESISTORS, FUSES, CONNECTORS, COILS, AND RESISTORS. PAR 26 G (3)	22	INSPECT VARIABLE CAPACITORS FOR BIRT, MOISTURE, CRACKS, AND LOOSE MOUNTINGS. PAR 26 C (3)
5	INSPECT CONTROLS FOR BINDING, SCRAPPING, EXCESSIVE LOOSENESS, WORN OR CHIPPED GEARS, MISALIGNMENT, POSITIVE ACTION. PAR 26 G (4)	23	INSPECT RESISTORS, BUSHINGS, AND INSULATORS, FOR CRACKS, CRIPPING, BLISTERING, DISCOLORATION AND MOISTURE. PAR 26 C (4)
6	CHECK FOR NORMAL OPERATION. PAR 26 G (5)	24	CLEAN AND TIGHTEN SWITCHES, CONTROLS, KEYS, AND INTERIORS OF CHASSIS AND CABINETS NOT READILY ACCESSIBLE. PAR 26 C (5)
7	CLEAN AND TIGHTEN EXTENSION OF COMPONENTS AND CASES, FACE MOUNTS, HEADPHONES, MICROPHONES, EARPHONES, AND CABLE CONNECTIONS. PAR 26 G (6)	25	INSPECT TERMINALS OF LAMP-BASED CIRCUITS AND CONNECTIONS OF CABLES AND WIRING. PAR 26 C (6)
8	INSPECT CASES, MOUNTINGS, CONTROLS, KEYS, AND EXPOSED METAL SURFACES, FOR RUST, CORROSION, AND MOISTURE. PAR 26 D (1)	26	CLEAN AND TIGHTEN CONNECTIONS AND MOUNTINGS FOR TRANSFORMERS, CHOKES, POTENTIOMETERS, AND RHEOSTATS. PAR 26 C (7)
9	INSPECT CORD, CABLE, WIRE, AND HEADPHONES FOR CUTS, BREAKS, FRAYING, DETERIORATION, KINKS, AND STRAIN. PAR 26 D (2)	27	INSPECT TRANSFORMERS, CHOKES, POTENTIOMETERS, AND RHEOSTATS FOR OVERHEATING AND OIL-LEAKAGE. PAR 26 C (8)
10	INSPECT HEADPHONES FOR CRACKS, BUBBLES, AND DISCOLORATION.	28	INSPECT METER GLASS AND CASES.
11	INSPECT MICROPHONES FOR CRACKS, BUBBLES, AND DISCOLORATION.	29	INSPECT HEADPHONES FOR CRACKS, BUBBLES, AND DISCOLORATION.
12	INSPECT FOR LOOSENESS OF ACCESSIBLE ITEMS: SWITCHES, KEYS, JACKS, CONNECTORS, ELECTRICAL TRANSFORMERS, COILS, AND PILOT LIGHT ASSEMBLIES. PAR 26 D (3)	30	INSPECT HEADPHONES FOR CRACKS, BUBBLES, AND DISCOLORATION.
13	INSPECT HEADPHONES FOR CRACKS, BUBBLES, AND DISCOLORATION.	31	CLEAN AND TIGHTEN CONNECTIONS AND MOUNTINGS FOR TRANSFORMERS, CHOKES, POTENTIOMETERS, AND RHEOSTATS. PAR 26 C (5)
14	INSPECT HEADPHONES FOR CRACKS, BUBBLES, AND DISCOLORATION.	32	INSPECT TRANSFORMERS, CHOKES, POTENTIOMETERS, AND RHEOSTATS FOR OVERHEATING AND OIL-LEAKAGE. PAR 26 C (8)
15	INSPECT METERS FOR DAMAGED GLASS AND CASES. PAR 26 D (4)	33	INSPECT HEADPHONES FOR CRACKS, BUBBLES, AND DISCOLORATION.
16	INSPECT HEADPHONES FOR CRACKS, BUBBLES, AND DISCOLORATION.	34	INSPECT HEADPHONES FOR CRACKS, BUBBLES, AND DISCOLORATION.
17	INSPECT HEADPHONES FOR CRACKS, BUBBLES, AND DISCOLORATION.	35	INSPECT HEADPHONES FOR CRACKS, BUBBLES, AND DISCOLORATION.
18	INSPECT HEADPHONES FOR CRACKS, BUBBLES, AND DISCOLORATION.	36	INSPECT FOR LEAKING WATERPROOF CASES, KEYS, AND CONTROLS. PAR 26 C (7)
		37	MOISTURE AND FUNGIPROOF.

38 IF DEFICIENCIES NOTED ARE NOT CORRECTED DURING INSPECTION, INDICATE ACTION TAKEN FOR CORRECTION.

DA FORM 11-239
1 MAY 51

REPLACES DA 460 FORM 439, 1 DEC 50, WHICH IS OBSOLETE.

16-50-239-1

TM2635A-8

Figure 7. DA Form 11-239.

doubt about the performance of the Q-meter after testing for normal operation, refer to the equipment performance check list (par. 32).

b. Weekly Items (Operators maintenance).

- (1) Inspect the exposed metal surfaces of the case for rust and corrosion.
- (2) Inspect the power cord for breaks, deterioration, and loose connector.
- (3) Inspect for looseness of accessible items, such as dials, switch knobs, and lock nuts, on jacks J2 and J3.
- (4) Inspect meter M1 for damaged glass or case.

Caution: Disconnect all power from the test set before performing the following operations. Upon completion, reconnect the power and check for satisfactory operation of the Q-meter.

c. Monthly Items (Organizational repairman).

- (1) Inspect fixed capacitors C22 and C23 (fig. 18) for leaks or bulging.
- (2) Inspect variable capacitors C9 and C20 for dirt (fig. 19).

Caution: Do not touch or bend the plates of capacitors C9 and C20. To do so will result in loss of frequency calibration of the Q-meter.

- (3) Inspect resistors for cracks, chipping, and discoloration.
- (4) Clean and tighten the mounting for transformer T9 and choke L9 (fig. 18).
- (5) Inspect transformer T9, choke L9, and resistors R11 and R12 (fig. 18 and 19) for signs of overheating.

- (6) Check moistureproof and fungiproof varnish for cracks and chipping.

27. Weatherproofing Procedures and Precautions

a. General. Signal Corps equipment, when operated under severe climatic conditions such as prevail in tropical, arctic, and desert regions, requires special treatment and maintenance. Fungus growth, insects, dust, corrosion, salt spray, excessive moisture, and extreme temperatures are harmful to most materials.

b. Tropical Maintenance. A special moistureproofing and fungiproofing treatment has been devised which, if properly applied, provides a reasonable degree of protection. This treatment is explained in TB SIG 13, Moistureproofing and Fungiproofing Signal Corps Equipment, and TB SIG 72, Tropical Maintenance of Ground Signal Equipment. The equipment is given the moistureproofing and fungiproofing treatment at the factory and it is necessary to use this treatment only when parts are replaced or repaired.

c. Winter Maintenance. Special precautions necessary to prevent poor performance or total operational failure of equipment in extremely low temperatures are explained in TB SIG 66, Winter Maintenance of Signal Equipment, and TB SIG 219, Operation of Signal Equipment at Low Temperatures.

d. Desert Maintenance. Special precautions necessary to prevent equipment failure in areas subject to extremely high temperature, low humidity, and excessive sand and dust are explained in TB SIG 75, Desert Maintenance of Ground Signal Equipment.

Section II. TROUBLE SHOOTING AT ORGANIZATIONAL MAINTENANCE LEVEL

28. General

a. The trouble shooting and repair work that can be performed at the organizational maintenance level (operators and repairmen) is necessarily limited in scope by the tools, test equipment and replaceable parts issued. Accordingly, trouble shooting is based on the performance of the equipment and the use of the senses in determining such troubles as burned-out fuses, broken cords, and electron tubes with open filaments.

b. The paragraphs which follow in this section help in determining which of the circuits is at fault and in localizing the fault in the circuit to the defective stage or item, such as a tube or fuse. If the fault can be determined through organizational maintenance procedures, corrective measures are indicated. If the fault cannot be determined through organizational maintenance procedures, reference is made to the necessary field maintenance instructions.

29. Electron Tube Testing Techniques

a. Inspect all interior cables, connections, and the general condition of the equipment before removing the electron tubes.

b. Isolate the trouble to a particular stage of the Q-meter.

c. If Electron Tube Test Set TV-7/U or equivalent is available, remove and test one tube at a time. Substitute new tubes only for those that are defective. Tubes that are shorted or contain heater-to-cathode leakage should be discarded immediately, because these conditions can upset any stage in the Q-meter, as well as other Q-meter functions, and produce misleading test results.

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

- (1) Substitute a new tube for an original tube. If no change occurs in the operation of the Q-meter, replace the new tube with the original. Similarly, check each original tube, in turn, until the equipment becomes operative or until all suspected tubes have been tested and the need for further trouble shooting is indicated.
- (2) Some circuits, for example oscillator circuit V1, may function with one tube and not another, even though both tubes are new. Keep any removed tube until its condition is checked by a tube tester.
- (3) *Do not leave a new tube in a socket if the Q-meter operates properly with the original tube.*
- (4) If a replacement tube soon becomes defective, further trouble shooting is necessary. The section that contains the tube should be tested for defective component parts.
- (5) If tube substitution does not correct the trouble, *reinsert the original tubes in the original sockets before forwarding the defective equipment for higher echelon repair.*

e. As a general rule, discard tubes only in the cases given in (1) and (2) below. Do not dis-

card them merely because they fall on or slightly above the lowest acceptable value when tested in a tube tester. Do not discard tubes merely because they have been used for some time. Satisfactory operation in a circuit is the final proof of tube quality. The tube in use may work better than a new tube.

- (1) Discard the tubes when a test in a tube tester or other instrument shows that the tube is defective.

- (2) Discard the tubes when the defect can be plainly seen, such as a broken glass envelope or a broken connecting prong.

f. Be careful when withdrawing a miniature tube from its socket. Do not rock or turn it; pull it straight out. Be sure to replace all shields. Straighten the pins with the proper pin straightener, if one is available, before replacing tubes in the Q-meter.

30. Visual Inspection

a. Failure of this equipment to operate properly usually will be caused by one or more of the following faults:

- (1) Worn, broken, or disconnected cords or plugs.
- (2) Burned-out fuses.
- (3) Wires broken because of excessive vibration.
- (4) Defective tubes.

b. When failure is encountered and the cause is not immediately apparent, check as many of these items as practicable before starting a detailed examination of the component parts of the systems. If possible, obtain information from the operator of the equipment regarding performance at the time trouble occurred.

31. Trouble Shooting by Using Equipment Performance Check List

a. *General.* The equipment performance check list (par. 32) will help the operator to locate trouble in the equipment. The list gives the item to be checked, the conditions under which the item is checked, the normal indications and tolerances of correct operation, and

the corrective measures the operator can take. To use this list, follow the items in numerical sequence.

b. *Action or Condition.* For some items, the information given in the *Action or condition* column consists of various switch and control settings under which the item is to be checked. For other items it represents an action that must be taken to check the normal indication given in the *Normal indications* column.

c. *Normal Indications.* The normal indications listed include the visible and audible signs that the operator should perceive when he

checks the items. If the indications are not normal, the operator should apply the recommended corrective measures.

d. *Corrective Measures.* The corrective measures listed are those the operator can make without turning in the equipment for repairs. A reference in the table to paragraph 48 indicates that the trouble cannot be corrected during operation and that trouble shooting by an experienced repairman is necessary. If the set is completely inoperative or if the recommended corrective measures do not yield results, turn the equipment in for repairs.

32. Equipment Performance Check List

Item No.	Item	Action or condition	Normal indications	Corrective measures
P R E P A R A T O R Y S T A R T	1 115V-230V switch (S5)	Proper voltage shown on switch plate.		
	HI-LO switch (S6)	Proper position shown on switch plate.		
	Fuses (F1, F2)	Correct size.		
	2 Range switch (S7)	Set to desired frequency range.		
	3 FREQUENCY dial	Set to desired frequency.		
	4 LEVEL-Q switch (S4)	Set to LEVEL position.		
	5 RF ON switch (S2)	Set to off position.		
	6 POWER ON switch (S1)	Turn to ON position.	Pilot lamp lighted (DS1). Meter swings below and above zero during warm-up.	Check fuses F1 and F2. Check line cord and plug. Check 115V-230V switch. Replace panel lamp.
	7 ZERO ADJ-LEVEL control (R5)	Zero adjust meter.	Meter reads zero.	If unable to zero, refer to paragraph 48. If no activity, check LEVEL-Q switch.
8 LEVEL-Q switch (S4)	Set to Q.			
9 ZERO ADJ-Q control (R6)	Zero adjust meter.	Meter reads zero.	If unable to zero, refer to paragraph 48. If no activity, check LEVEL-Q switch.	

	<i>Item No.</i>	<i>Item</i>	<i>Action or condition</i>	<i>Normal indications</i>	<i>Corrective measures</i>
E Q U I P M E N T P E R F O R M A N C E S T O P	10	LEVEL-Q switch (S4)	Set to LEVEL position.		
	11	RF ON switch (S2)	Set to ON position.		
	12	SET LEVEL COARSE control (R11)	Turn clockwise.	Meter reads level.	Check RF ON switch (S2). Refer to paragraph 48.
	13	SET LEVEL FINE control (R10)	Turn clockwise.	Meter reads level.	Check RF ON switch (S2). Refer to paragraph 46.
	14	Plug rf coil at COIL binding posts			
	15	LEVEL-Q switch (S4)	Set to Q position.		
	16	FREQUENCY dial	Set to frequency in range of rf coil.		
	17	MICRO MICRO FARADS INDUC-TANCE dial	Tune for peak meter reading.	Meter reads Q.	Check Q RANGE switch (S3). Refer to paragraph 48.
	18	Q RANGE switch (S1)	Set to each position.	Meter reads Q on each scale.	Check Q RANGE switch (S3). Refer to paragraph 48.
	19	POWER ON switch (S1)	Turn to off position.	Pilot light will go out.	

CHAPTER 5

THEORY

33. General Q-meter Theory (fig. 8)

In the Q-meter a small voltage is introduced in series with the tuned circuit (consisting of R_s , L and C) across the injection resistor R_i . When the circuit is tuned to resonance by means of the tuning capacitor C or the oscillator frequency is adjusted to the resonant frequency of the circuit, the current I is limited solely by the series resistance of the coil R_s and the injection resistor R_i . Thus

$$I = \frac{e}{R_s + R_i}$$

where e is the voltage across R_i .

The voltage developed across the tuning capacitor C is

$$E = \frac{I}{2\pi f C} = I^2 \pi^2 L.$$

The ratio $\frac{E}{e}$ is the circuit Q

where E is the voltage across the capacitor f is the frequency in cps and C is the capacitance in uuf.

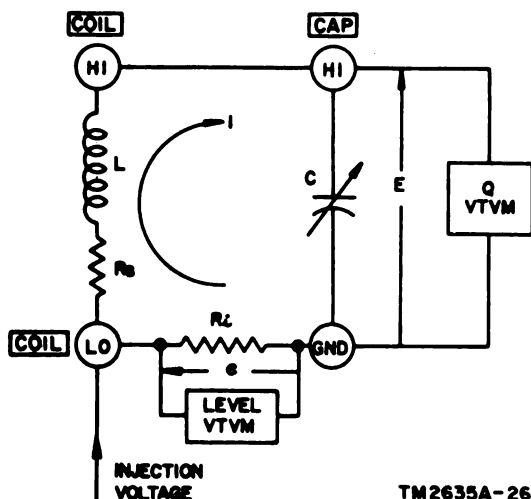


Figure 8. Q-Meter, basic circuit.

34. Block Diagram (fig. 9)

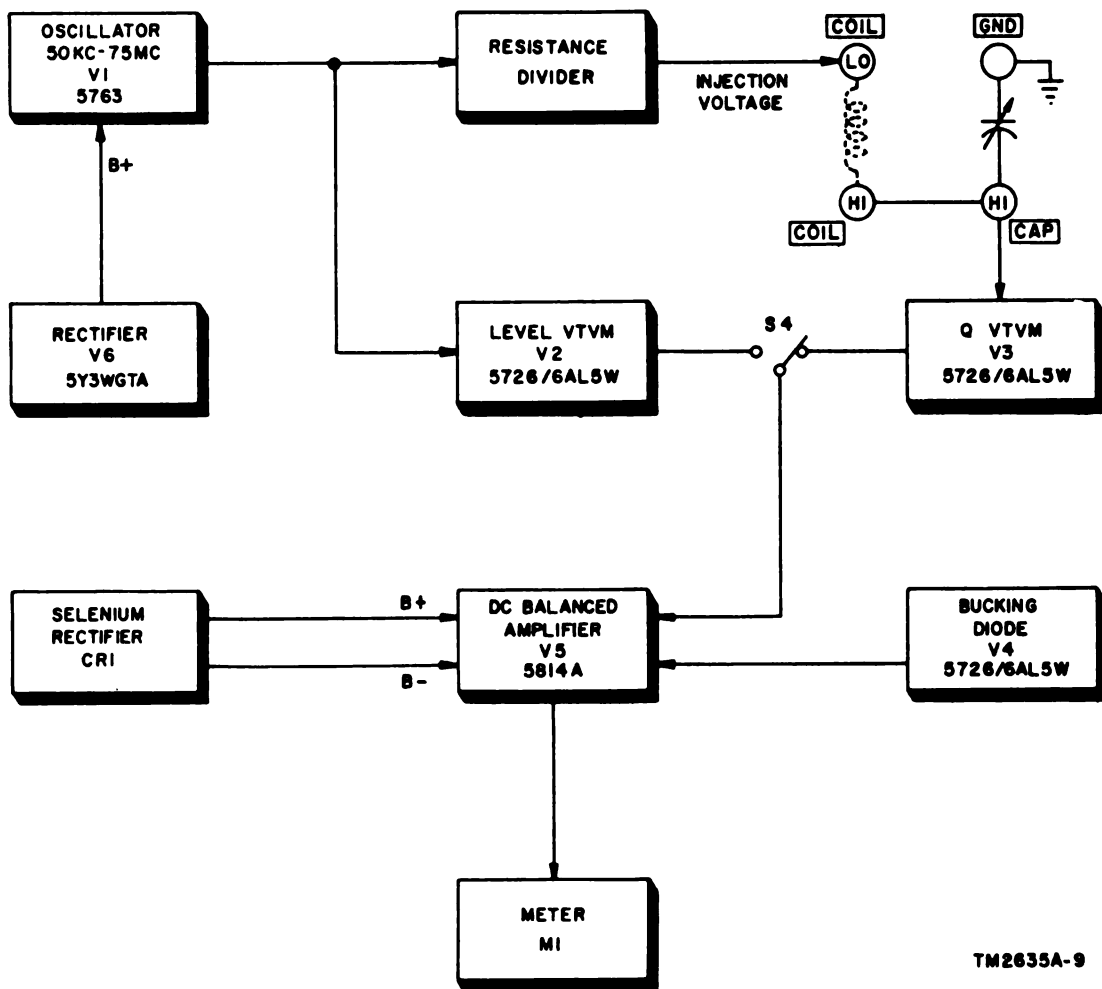
The block diagram for the Q-meter is shown in figure 7. For more detailed over-all circuit information refer to figure 25. A description of the Q-meter circuits represented by the blocks follows:

a. *Oscillator.* The oscillator stage is an eight band tunable oscillator and operates over the frequency range of 50 kc to 75 mc. Oscillator tube V1 is a beam power pentode, 5763, operated as a triode with plate and screen tied together. The output that is developed in this stage is fed to the resistance divider stage.

b. *Resistance Divider.* The resistance divider stage takes the rf signal at a fixed level from the oscillator as monitored by the level vtvm stage, V2. The resistance divider stage reduces the input signal level by a constant factor of approximately 30 at the output. The low level output of this stage, .02 volt, is the injection voltage that series feeds the COIL HI and COIL LO binding posts of the unit.

c. *Level Vtvm.* Level vtvm stage V2 monitors the input signal level to the resistance divider. The tube used for this purpose is a dual-diode 5726/6AL5W connected as a voltage doubler. The direct-current (dc) output of this stage feeds the dc amplifier stage through switch S4.

d. *Q-vtvm.* The voltage developed at resonance across the tuned circuit, formed by the coil under test and the internal resonating capacitor, is a direct function of the injection voltage and the circuit Q. The Q-vtvm stage, V3, monitors the voltage developed across the tuned circuit. The Q-vtvm stage consists of a dual-diode with one section connected as a peak reading rectifier. Because the injection voltage is kept constant by monitoring the level vtvm stage, the output of the Q-vtvm stage is directly related to circuit Q.



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Figure 9. Q-meter, block diagram.

e. *Dc Balanced Amplifier.* The dc balanced amplifier stage, V5, amplifies the low level direct-current signals from the vtvm stages. Sufficient amplification is available to drive meter M1 in the plate circuit. This stage consists of a dual-triode type 5814A tube.

f. *Bucking Diode.* The bucking diode stage consists of V4, a 5726/6AL5W tube, connected to develop a contact potential, which is used to buck out the contact potential of the level vtvm, V2, and Q-vtvm, V3.

g. *Rectifier.* The rectifier is a full-wave type with choke input. The tube, V6, is a 5Y3WGTA.

The filtered high voltage is the plate supply for oscillator stage V1.

h. *Selenium Rectifier.* This is a low-current plate supply for dc balanced amplifier V5. Rectifier CR1 is connected in a half-wave circuit. At the output, a positive voltage is supplied for the plates and a negative voltage for the cathodes of V5.

35. Oscillator Circuit (fig. 10)

Tube V1 is connected as a tuned-grid, triode oscillator. The range from 50 kc to 75 mc is

covered in eight bands. Figure 9 is the simplified schematic diagram of the oscillator for the 50 kc to 150 kc range. The operation of other ranges is similar (fig. 25).

a. Frequency. The frequency of oscillation is determined by the inductance of L1 and the capacity setting of tuning capacitors C9A and C9B. For the lower ranges, capacitor C9A and C9B are connected in parallel by means of the jumper between pins 5 and 8 of the range switch. The three highest ranges do not have this jumper and, therefore, only capacitor C9A is used in the tuned circuit. Initial adjustment of the frequency range is accomplished by means of trimmer C1 and the tuning core of L1.

b. Feedback. The grid of V1 is connected to a tap on L1 through grid coupling capacitor C8 and level stabilizing resistor R1. Resistor R7 is the grid-leak for the tube. The coil connected between pins 2 and 3 of the range switch

is in series with the plate of V1 and is inductively coupled to L1. The polarity of this coupling is such that positive feedback is applied to the grid from the plate circuit to produce oscillations. Capacitor C8 is an rf bypass for the plate coupling coil.

c. Output. The output of the oscillator is obtained from the output coupling coil connected between pin 6 of the range switch and ground and fed through a shielded cable to the RF OUT jack, J2, and RF IN jack, J3. Oscillator output can be obtained from J2 by means of a phone plug and connecting cable. External rf signals may be fed to the resistance divider circuit by means of a phone plug inserted in J3. When neither jack is used, the oscillator output is fed through a shielded cable to the resistance divider.

d. Output Level Control. The output level of the oscillator is controlled by varying the plate

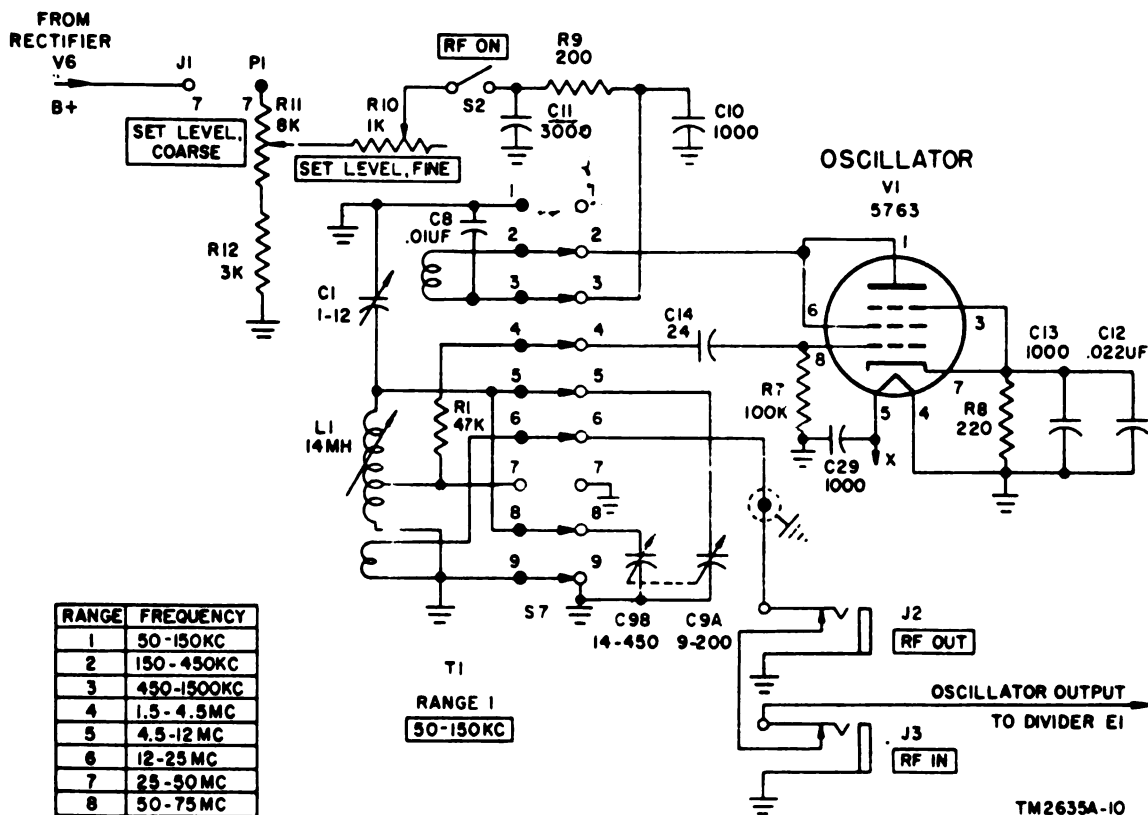


Figure 10. Oscillator, simplified schematic diagram.

voltage of V1. The supply voltage available on pin 7 of P1 is applied to a voltage divider network which consists of R11 and R12. Large variations in plate voltage and oscillator output are obtainable by the SET LEVEL COARSE control, R11. Variable resistor R10 is connected to the slider arm of resistor R11 and is in series with the plate of V1. Fine adjustment of oscillator output is obtained by adjustment of R11. Switch S2 controls the application of plate voltage to V1 and capacitors C10 and C11 and resistor R9 form an rf filter circuit.

e. Other Components. Resistor R8 is the cathode resistor for V1 and prevents excessive plate current flow if V1 fails to oscillate. Capacitors C12 and C13 are rf bypass capacitors for the cathode. The heater of V1 is bypassed by capacitor C29.

36. Resistance Divider Circuit (fig. 11)

The resistance divider attenuates the oscillator signal output by a constant factor. The injection voltage is produced across .03-ohm resistor R16 at the output of the divider. Resistors R13, R14, and R15 are in parallel and form .9 ohm of resistance in series with R16. The injection voltage across R16, therefore, is equal to the oscillator output divided by 30.

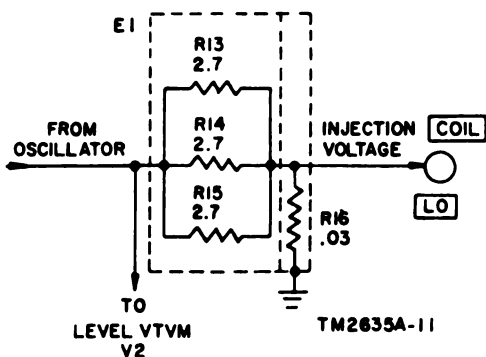


Figure 11. Resistance divider, simplified schematic diagram.

37. Level Vtvm (fig. 12)

The level vtvm is a voltage doubling peak-to-peak reading rectifier. The rectifying action of

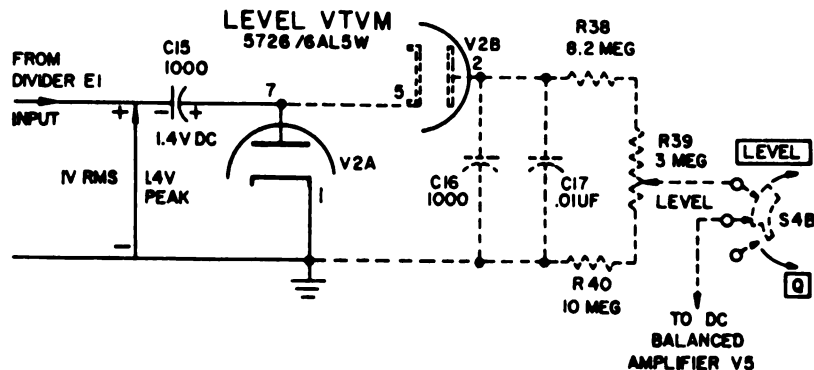
V2 is illustrated in A and B, figure 12, where it is assumed that the voltage being measured is 1 volt root mean square (rms). This corresponds to a peak voltage in both positive and negative directions of 1.4 volts peak. In A, figure 12, it is assumed that the voltage is positive with respect to ground and only one-half the dual-diode, V2A, conducts. During this half-cycle, capacitor C15 is charged to the peak value of 1.4 volts as illustrated in A, figure 12. It is assumed the voltage on capacitor C15 remains at 1.4 volts during the next half-cycle that is illustrated in B, figure 12. During this half-cycle in which the applied voltage to the diode is negative with respect to ground, the applied 1.4 peak volts is additive to the 1.4 volts that appear on capacitor C15, causing capacitors C16 and C17 to become charged to a total of 2.8 volts through V2B. The output dc voltage is developed across the voltage dividing network, which consists of resistors R38, R39, and R40. Resistor R39 is a variable control and permits calibration of the level. The output voltage is fed to the dc amplifier stage through switch S4.

38. Q-vtvm (fig. 13)

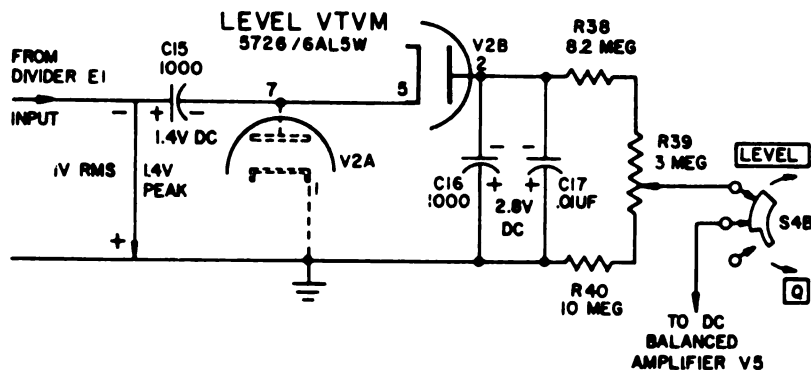
The Q-vtvm circuit consists of one section of V3 connected as a peak rectifier. The diode is connected in shunt with load resistors R22 through R27. The time constant of the coupling capacitor C24 and the total load resistance is great enough to give peak rectification for all frequencies of operation. The input consists of the rf resonant voltage that appears across the circuit under test at the CAP HI and GND binding posts. Capacitors C20A and C20B are the sections of the internal resonating capacitor. Switch S3B provides for tapping the total load resistance to obtain the various Q-ranges of the instrument. The dc output of this stage is fed to the dc balanced amplifier through switch S4B.

39. Bucking Diode (fig. 14)

Compensation for the contact potential of diodes V2 and V3 is provided by bucking diode V4. The dual-diode sections are connected in series for greater contact potential output into a load that consists of variable resistors R33



A. ELECTRICAL CIRCUIT POSITIVE WITH RESPECT TO GROUND



B. ELECTRICAL CIRCUIT NEGATIVE WITH RESPECT TO GROUND

NOTE:
SWITCH SECTIONS SHOWN
IN **LEVEL** POSITION.

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Figure 12. Level vtvm, simplified schematic diagram.

and R34 in parallel. Capacitors C21 and C31 are rf bypass capacitors. Resistor R33 is the internal adjustment for cancellation of the Q-vtvm contact potential; resistor R34 adjustment serves the same purpose for the level vtvm contact potential. The voltage from resistor R34 is fed to the dc balanced amplifier through switch S4B. The voltage from resistor R34 is connected to the divider, which consists of resistors R28 through R32. The resistors form a divider equivalent to that of figure 14. Therefore, contact potential compensation is obtained for all settings of the Q RANGE switch. The output from switch S3A is fed to the dc balanced amplifier through switch S4B.

40. Dc Balanced Amplifier (fig. 15)

The dc balanced amplifier stage consists of a dual-triode, V5, connected for balanced operation to drive meter M1. The stage analysis follows:

a. Tube V5 is operated so that with no dc signal on either grid the stage is balanced and no difference in potential exists between the plates of the tube. Therefore, in the absence of signal, the meter current is zero. If a negative dc voltage is applied to the grid pin 7 of V5, less current will flow in its section than in the section represented by the other grid, pin 2.

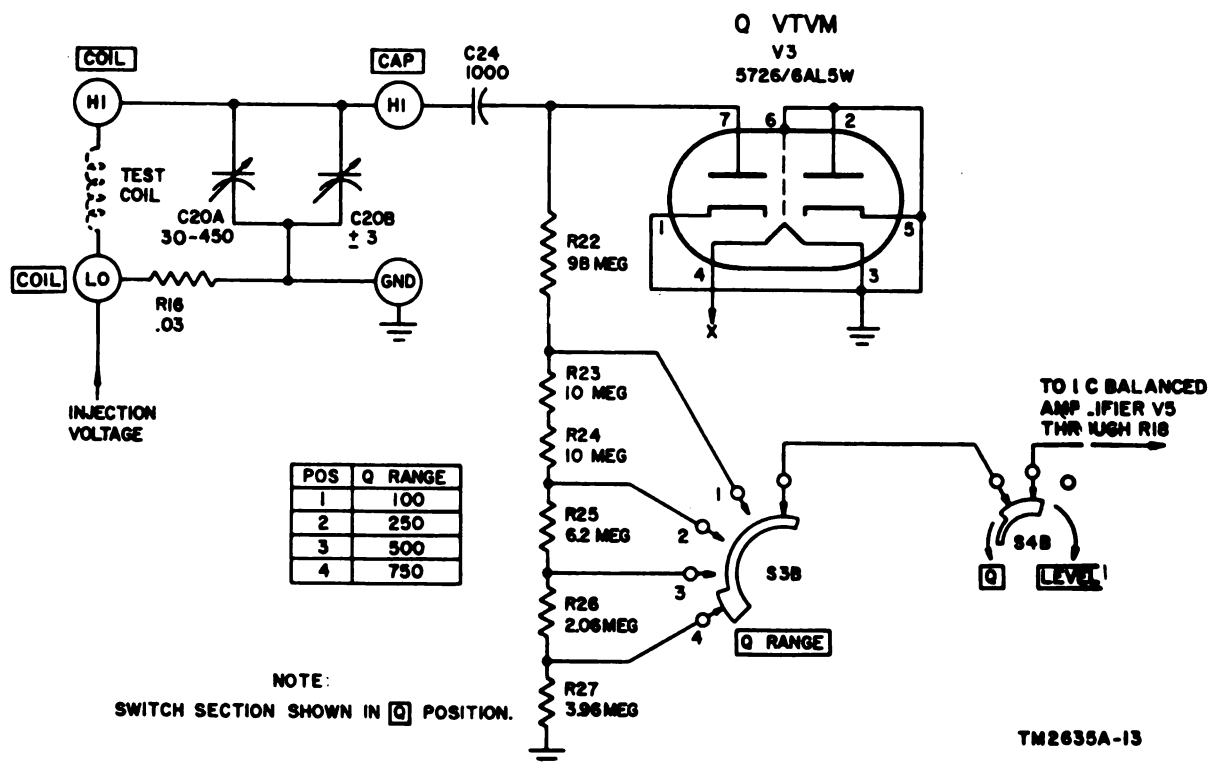


Figure 13. Q-vtm, simplified schematic diagram.

Subsequently the voltage drop across resistor R20 is reduced, and the potential of the plate, pin 1. As a result, current will flow through meter M1. The current flow through the meter is controlled by variable resistor R21, which is the internal sensitivity adjustment.

b. To zero the meter in actual operation of the unit, two independent controls are provided. These variable resistors, R5 and R6, are connected to the high-potential end of the plate load resistors, R19 and R20, through switch S4A. Resistor R5 is connected in the LEVEL position of S4A and resistor R6 is connected in the Q position of switch S4A. The B+ supply voltage is fed to the taps on these variable resistors. Variation of the panel control setting of the variable resistor in the circuit will vary the plate voltage of each section of the dual-triode sufficiently to zero meter M1.

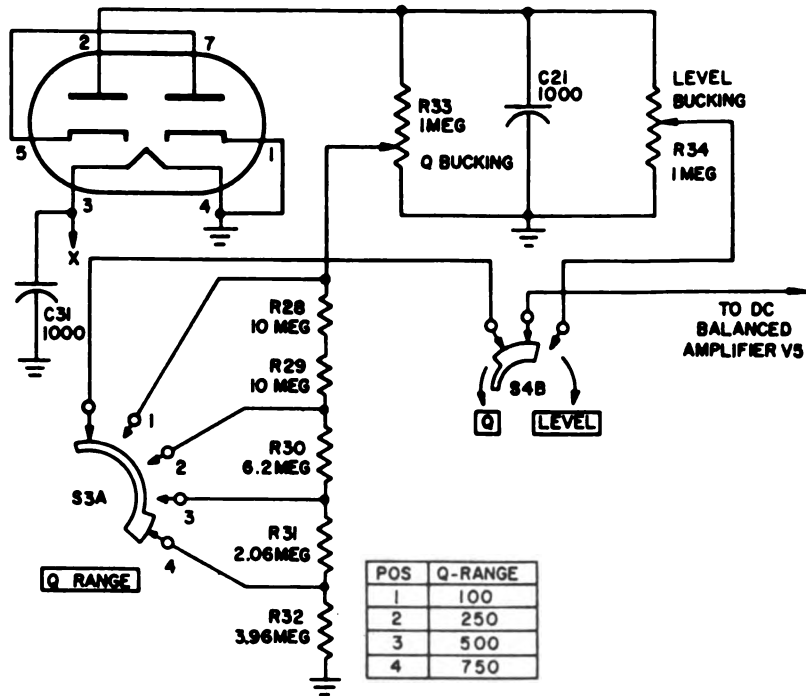
c. The rectified output voltage of Q-vtm

stage V3 is fed to a grid, pin 7 of V5, with switch S4B in the Q position. When switch S4B is in the LEVEL position, the signal applied to the same grid, pin 7 of V5, is in the rectified output of level vtm stage V2.

d. The other grid, pin 2 of V5, is used to compensate for the contact potential of Q-vtm stage V3 and level vtm stage V2. The output of bucking diode stage V4 is taken from resistor R33, passed through the divider formed by switch S3A, and applied to pin 2 of V5 with switch S4B in the Q position. When switch S4B is in the LEVEL position, the bucking potential existing on the tap of resistor R34 is applied to the grid, pin 2.

e. Resistors R17 and R18 are parasitic suppressors and C18 and C19 are grid bypass capacitors. The cathode circuit consists of four resistors, R41, R42, R43, and R44, connected to give balanced operation of the two sections of tube V5. The B- potential for the tube is sup-

BUCKING DIODE
V4
5726/6AL5W



NOTE:
SWITCH S4B SHOWN IN **Q** POSITION

TM2635A-14

Figure 14. Bucking diode, simplified schematic diagram.

plied to the low-potential end of resistor R44.

41. Power Supply (fig. 25)

The power supply section provides for operation from 115- and 230-volt line voltage. For 115-volt operation, switch S5 connects both primaries in parallel while for 230-volt operation, the primaries are connected in series. For conditions of low line voltage, switch S6 applies the input voltage to taps, pins 2 and 5, on the primary windings. The input voltage is applied to the full primary winding by means of switch S6 when the line voltage is higher than rated.

a. Rectifier V6 is connected in a full-wave rectifier circuit. This stage has a choke input filter that consists of choke L9 and capacitor C22. The output of the stage is fed to the oscillator section of the Q-meter through pin 7 of jack J1.

b. The selenium rectifier is connected in a

half-wave rectifier circuit. Resistor R35 is a current-limiting resistor and the filter for this stage consists of capacitor C23 and resistors R36 and R37. Since the ground for this stage is at the junction of R36 and R37, the B+ output is across R36 and the B- output appears across R37. The B+ output is fed to the dc balanced amplifier through pin 4 of jack J1 and the B- output is applied to this same stage through pin 3 of jack J1.

42. Sources of Error

For many measurements, the effect of the internal errors of the Q-meter is sufficiently small so that all internal errors may be ignored. However, where the internal errors cannot be ignored, the corrections indicated in paragraph 16 must be made to insure greater accuracy. The internal errors are as follows:

a. Q-vtvm Loading Effect (fig. 13). The load

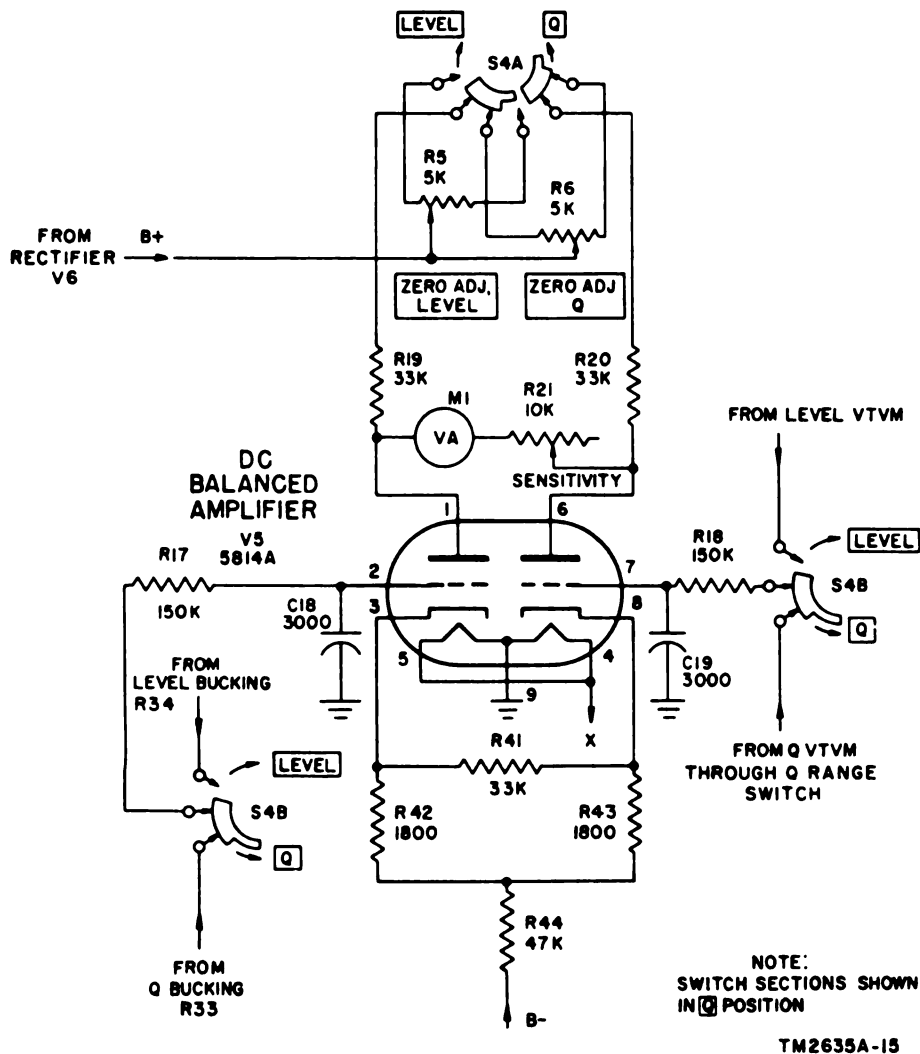


Figure 15. Dc balanced amplifier, simplified schematic diagram.

resistance for the Q-vtvm circuit consists of series resistors R22 through R27 to form a 130-megohm load. Since the Q-vtvm circuit is a peak reading voltmeter, the loading effect is half the resistance load (65 megohms). The correction to be made to Q-measurements for the loading effect is given in paragraph 16a.

b. *Injection Resistor* (fig. 13). Injection resistor R16 is in series with the resonant circuit. When the effective series resistance of the coil under test is less than 3 ohms, the resistance of R16 (.03 ohm) will introduce an appreciable

error in the Q-readings. If, however, the effective resistance of the coil under test is greater than 3 ohms, the effect of the injection resistor can be safely ignored. Correction for the injection resistance is given in paragraph 16b.

c. *Residual Inductance*. A residual inductance of .011 uh is present between the COIL LO and COIL HI binding posts. This inductance consists of the wiring inductance and cannot be reduced. For greater accuracy in inductance measurements of small value coils, the correction of paragraph 16c should be applied.

CHAPTER 6

FIELD MAINTENANCE

Section I. TROUBLE SHOOTING AT FIELD MAINTENANCE LEVEL

Warning: Certain points located throughout the chassis of the Q-meter operate at voltages above 250 volts. Do not touch these points while power is being applied to the Q-meter. Be very careful when handling or testing any part of the Q-meter while it is connected to the power source.

43. Trouble-shooting Procedures

a. General. The first step in servicing a defective Q-meter is to sectionalize the fault. Sectionalization means tracing the fault to the major component or circuit responsible for the abnormal operation of the Q-meter. The second step is to localize the fault. Localization 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 localized by checking voltages and resistances.

b. Component Sectionalization and Localization. Listed below is a group of tests arranged to simplify and reduce unnecessary work and in tracing a trouble to a specific component. The simple tests are used first. Those that follow are more complex. Follow the procedure in the sequence given. In general, the trouble is traced to a section of the Q-meter, and the faulty component in that section is located; then the trouble is remedied. The service procedure is summarized as follows:

- (1) *Visual inspection.* The purpose of visual inspection is to locate burned resistors, leaky capacitors, and broken connections. Through inspection alone, the repairman may discover the trouble or determine the circuit in which

the trouble exists. The inspection is valuable in avoiding additional damage to the Q-meter which might occur through improper servicing methods and in forestalling future failures.

- (2) *Input resistance measurements.* These measurements prevent further damage to the Q-meter from possible short circuits. Since this test gives an indication of the condition of the filter circuits, its function is more than preventive.
- (3) *Operational test.* The operational test (par. 32) is important because it frequently indicates the general location of trouble. In many instances, the information gained will determine the exact nature of the fault. To utilize the information fully, all symptoms must be interpreted in relation to one another.
- (4) *Intermittent troubles.* In all these tests, 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 connection may cause the trouble. Test the wiring for loose connections and move the 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.

44. Trouble-shooting Data

Caution: Always check the circuit label, located on the back inside the Q-meter case, since the schematic diagram in the manual may

not include circuit changes made during equipment production. The material supplied in this manual will help in rapid location of faults. Consult the following trouble-shooting data :

<i>Fig. or par. No.</i>	<i>Title</i>
Fig. 17	Q-meter, top view of power supply, location of parts.
Fig. 18	Q-meter, bottom view of power supply, location of parts.
Fig. 19	Q-meter, rf assembly, location of parts.
Fig. 20	Q-meter, turret assembly, location of rf transformers.
Fig. 21	Tube socket and terminal boards, voltage and resistance diagram.
Fig. 25	Q-meter, schematic diagram.
Par. 49	Dc resistance of transformers and coils.

45. Tools and Test Equipment Required for Trouble Shooting

The items of test equipment required for trouble shooting the Q-meter are listed below. Technical manuals associated with each item are also listed. The required tools are contained in Tool Equipment TE-113.

<i>Test equipment</i>	<i>Technical manual</i>
Multimeter TS-352/U	TM 11-5527
Electronic Multimeter TS-505/U	TM 11-5511
Electron Tube Test Set TV-7/U	TM 11-5083

46. General Precautions

Observe the following precautions very carefully whenever servicing the Q-meter.

a. Be careful when the Q-meter is removed from the case; dangerous voltages are exposed.

b. If the Q-meter has been operating for some time, use a cloth when removing the metal tube shields and a tube puller to remove tubes to prevent burning the hand or fingers.

α. When servicing the oscillator assembly and the internal resonating capacitor assembly, do

not disturb the placement of parts and be careful not to bend the tuning capacitor plates. This could cause a short circuit or a change of calibration.

d. Do not overtighten screws when assembling mechanical couplings.

e. When replacing a component that is held by screws, always replace the lock washers.

f. Careless replacement of parts often makes new faults inevitable. Note the following points:

- (1) Before a part is unsoldered, note the position of the leads. If the part, such as a power transformer, has a number of connections, tag each lead.
- (2) Be careful not to damage other leads by pushing or pulling them out of the way.
- (3) Do not use a large soldering iron when soldering small resistors or ceramic capacitors. Overheating of the small parts may ruin or change the value of the component.
- (4) Do not allow drops of solder to fall into parts of the chassis because they may cause short circuits.
- (5) A carelessly soldered connection may create new faults. It is very important to make well-soldered joints because a poorly soldered joint is one of the most difficult faults to find.
- (6) When a part is replaced in a high-frequency circuit, it must be placed in exactly the position occupied by the original part. A part which has the same electrical value but different physical size may cause trouble in high-frequency circuits. 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.

Warning: The failure of selenium rectifiers can result in the liberation of poisonous fumes and the deposit of poisonous selenium compounds. If a rectifier burns out or arcs over, the odor is strong. Provide adequate ventilation immediately. Avoid inhaling the fumes and do not handle the damaged rectifier until it has cooled.

47. Checking B Circuits for Shorts (fig. 16)

a. One B+ line leaves the filter circuit of the power supply and supplies plate voltage for V1 through switch S2. If the B+ voltage is low or there is no B+ voltage, it is likely that the trouble lies in the power supply circuit. This may be caused by a faulty rectifier tube, V6, or an open

filter choke, or a shorted filter capacitor.

b. The power supply output from the selenium rectifier consists of a B— line, which supplies the potential for the cathodes of V5, and B+ line, which supplies the plate voltages for V5. If the B voltages are low or if no B voltages exist, the trouble probably lies in selenium rectifier CR1 or filter capacitor C23.

c. Refer to figure 16, which is a simplified diagram of the B voltage distribution throughout the Q-meter, and note the possible paths that could offer short circuits. By using this diagram in conjunction with the voltage and resistance measurements found in figure 21 the typical causes for trouble can be checked easily.

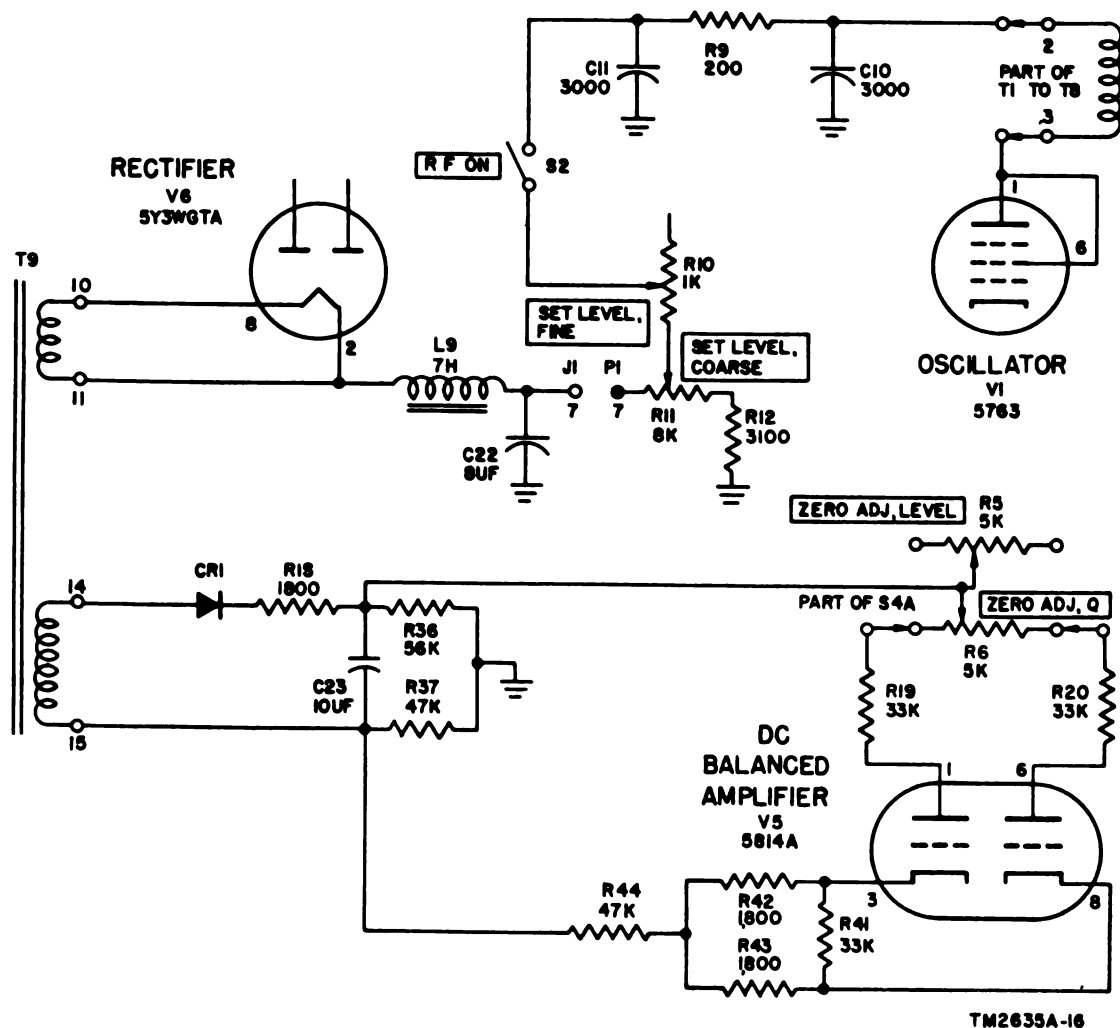


Figure 16. Q-meter, B voltage distribution.

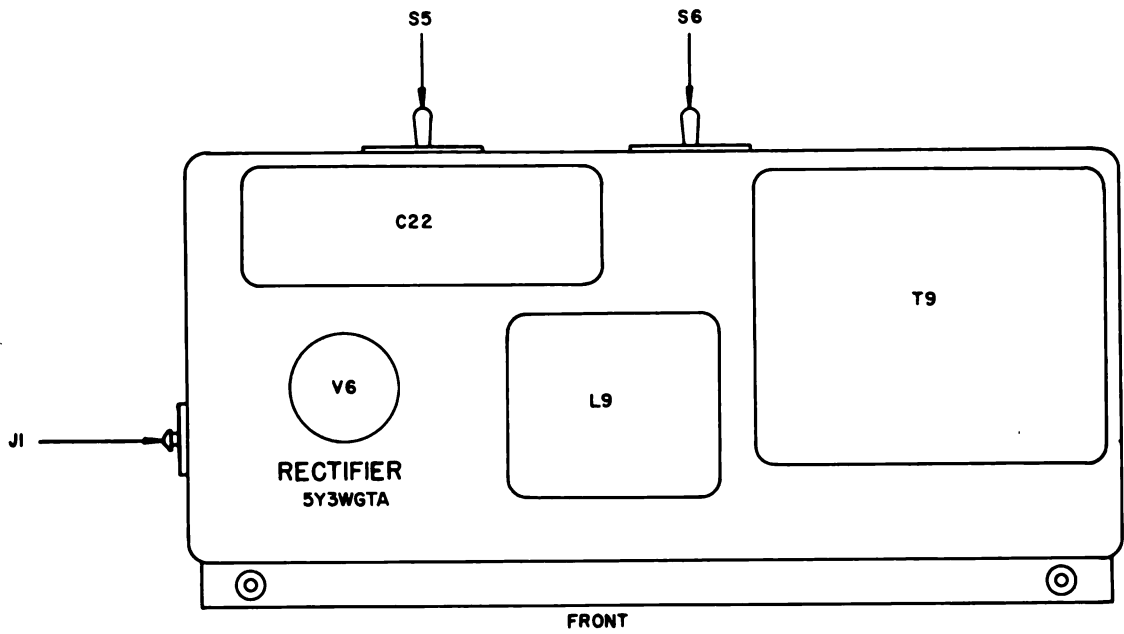
48. Trouble Shooting by Using Trouble-shooting Chart

The following chart is supplied as an aid in locating trouble in the Q-meter. It lists the symptoms that the repairman observes, either visually or audibly, while making a few simple tests. The chart also indicates how to localize

trouble quickly to the different stages of the Q-meter. After the trouble has been localized to a stage or circuit, a tube check and voltage and resistance measurement of this stage or circuit ordinarily should be sufficient to isolate the defective parts. Normal voltage and resistance readings are given in figure 21.

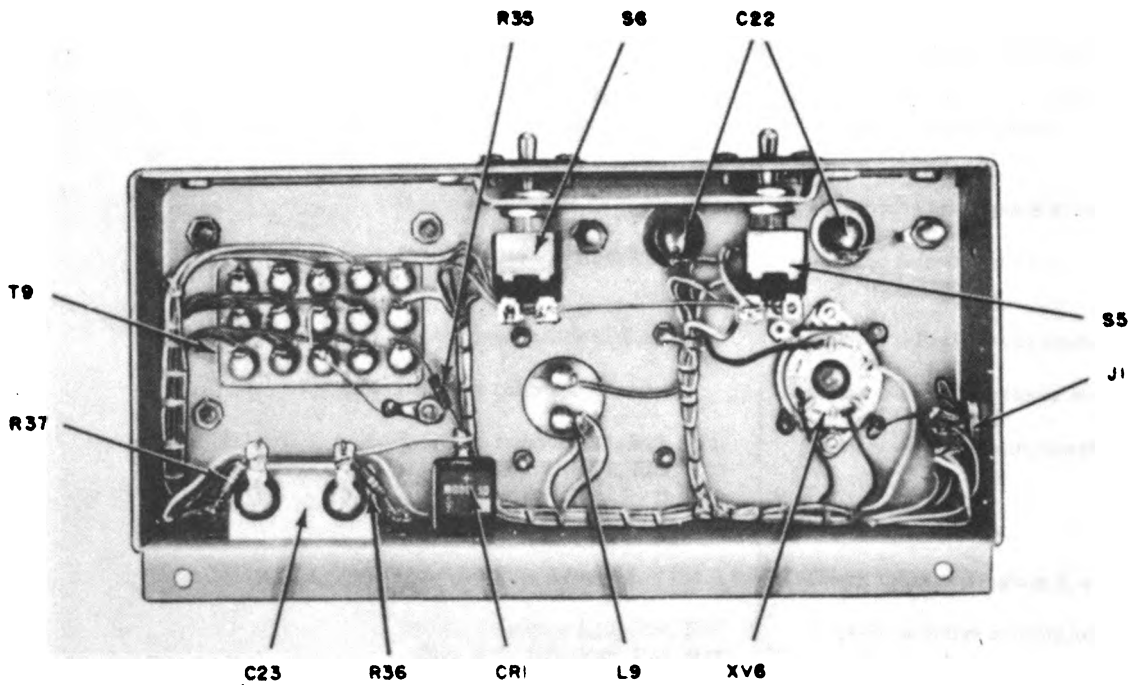
<i>Symptom</i>	<i>Probable trouble</i>	<i>Correction</i>
1. POWER ON switch is in ON position. Pilot lamp does not light.	1. Blown fuse F1 and/or F2. Defective pilot lamp.	1. Replace blown fuse with spare fuse. Replace lamp.
2. Fuse F1 and/or F2 blows when POWER ON switch is thrown to ON position. RF ON switch is in off position.	2. Shorted filter capacitor. Defective rectifier tube V6.	2. Check capacitors C22 and C23. Make resistance check and replace defective capacitors. Check tube and replace if defective.
3. Fuse F1 and/or F2 blows when RF ON switch is moved to ON position.	3. Shorted rf filter capacitor.	3. Check capacitors C10 and C11. Make resistance check and replace defective capacitors.
4. Symptoms are similar to those in item 3. However, this occurs only in one range.	4. Section of turret is defective in inoperative range.	4. Check turret section for defective component and replace.
5. RF ON in off position. LEVEL-Q switch in LEVEL position. Meter does not zero with ZERO ADJ-LEVEL control. LEVEL-Q switch in Q position. Meter ZERO ADJ Q control.	5. Defective tube V2. Defective resistor R34, R38, R39, or R40. Defective capacitor C16 or C17.	5. Check tube and replace if weak. Replace defective component. Replace defective component.
6. RF ON in off position. LEVEL-Q switch in LEVEL position. Meter zeros with ZERO ADJ-LEVEL control. LEVEL-Q switch in Q position. Meter does not zero with ZERO ADJ-Q.	6. Defective tube V3. Defective resistor R22, R23, R24, R25, R26, R27, R28, R29, R30, R31, R32, or R33.	6. Check tube and replace if weak. Replace defective component.
7. RF ON in off position. Meter does not zero in either position of LEVEL-Q switch.	7. Defective tube V4 or V5. Defective resistor R19, R20, R17, R18, R40, R41, R42, R43, R44, R36, or R37. Defective capacitor C23, C18, C19, or C21. Defective rectifier CR1.	7. Check tubes and replace if weak. Replace defective component. Replace defective component. Replace defective component.

<i>Symptom</i>	<i>Probable trouble</i>	<i>Correction</i>
8. RF ON in ON position. LEVEL-Q switch in LEVEL position. Insufficient or no level reading on meter.	8. Defective tube V1 or V2. Defective switch contacts on jacks J2 and J3. Defective resistor R9, R10, R38, or R39. Defective capacitor C10, C11, C15, C16, or C17.	8. Check tubes and replace if weak. Replace if defective. Replace defective component. Replace defective component.
9. Symptoms are similar to those in item 8. However, this occurs only in one range.	9. Section of turret is defective in inoperative range.	9. Check turret section for defective component and replace.
10. RF ON in ON position. LEVEL-Q switch in Q position. No reading of meter as work coil is tuned through resonance.	10. Defective tube V3. Defective resistance divider E1. Defective resistor R22, R23, R24, R25, R26, or R27. Defective capacitor C24.	10. Check tube and replace if weak. Replace defective component. Replace defective component. Replace defective component.



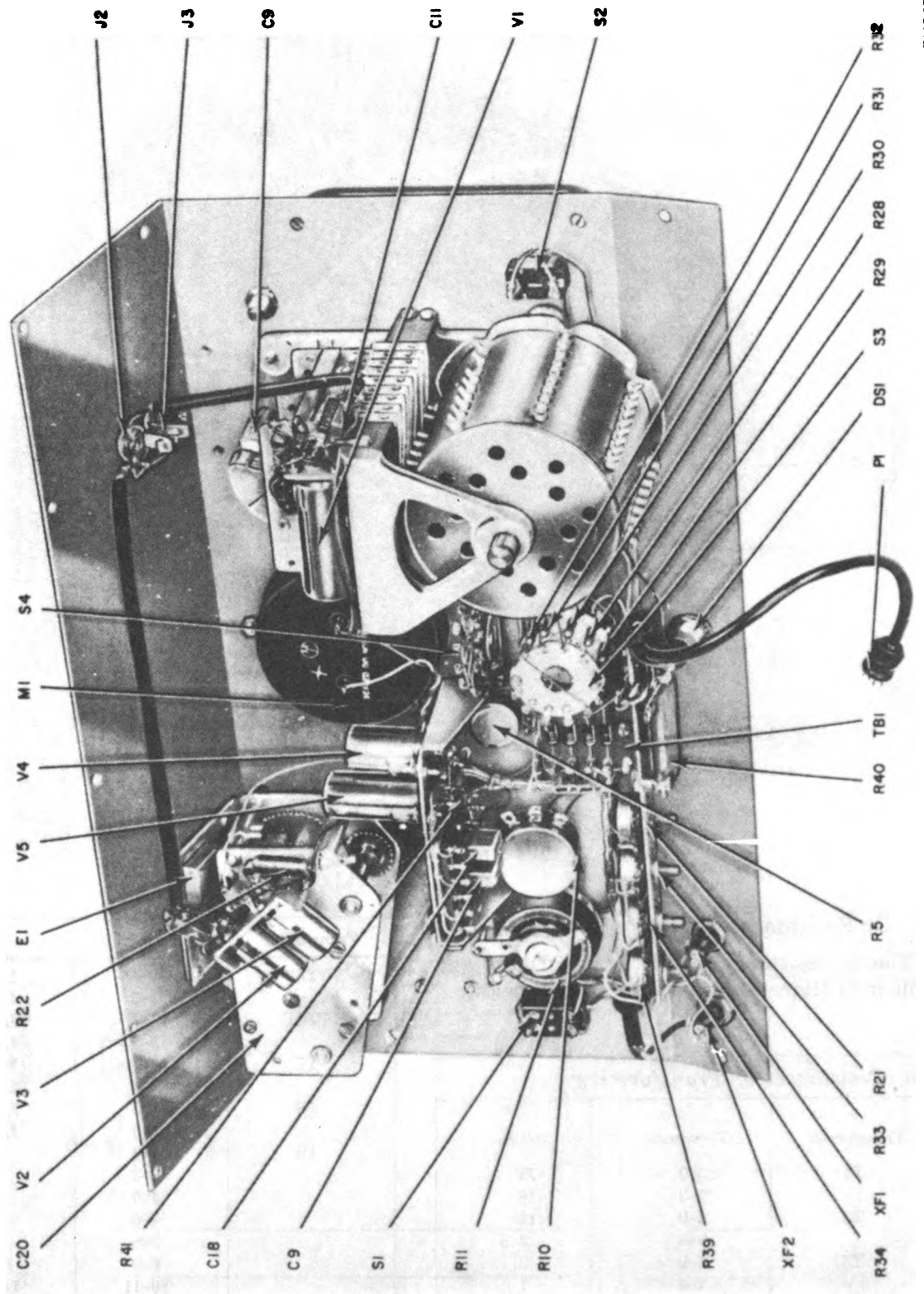
TM2635A-17

Figure 17. Q-meter, top view of power supply, location of parts.



TM2635A-18

Figure 18. Q-meter, bottom view of power supply, location of parts.



TM2635A-19

Figure 19. Q-meter, rf assembly, location of parts

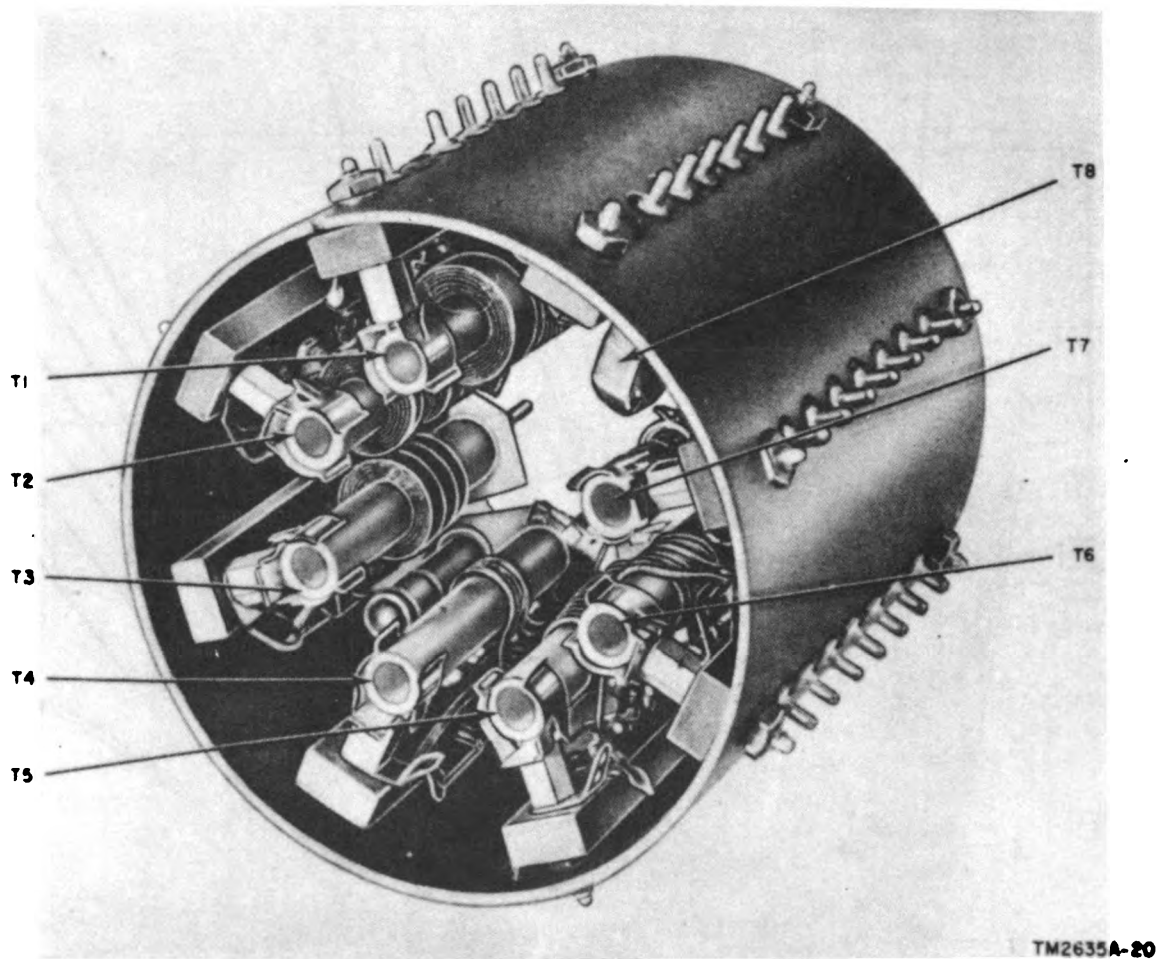


Figure 20. Q-meter, turret assembly, location of rf transformers.

49. Dc Resistances of Transformers and Coils

The dc resistances of the transformers and coils in Q Meter TS-617B/U are listed below.

<i>a. Resistances of Transformers</i>		
<i>Transformer</i>	<i>Terminals</i>	<i>Ohms</i>
T1	5-9	72
	2-3	18
T2	5-9	14
	2-3	3.5
T3	5-9	3
	2-3	1
T4	5-9	1
	2-3	.5

<i>Transformer</i>	<i>Terminals</i>	<i>Ohms</i>
T5	5-7	Less than 1
	2-3	Less than 1
T6	5-7	Less than 1
	2-3	Less than 1
T7	5-7	Less than 1
	2-3	Less than 1
T8	1-5	Less than 1
	2-3	Less than 1
T9	1-2	9
	1-3	10
	4-5	9
	4-6	10
	7-8	180
T9	8-9	180
	10-11	Less than 1
	12-13	Less than 1
T9	14-15	130

b. Resistances of Coils.

Coils	Ohms
L101	.02
L102	.03
L103	.04
L104	.1
L105	.24
L106	1.3
L107	1.5

Coils	Ohms
L108	2.8
L109	5
L110	5
L111	8
L112	11
L113	25
L114	58
L9	200

Section II. REPAIRS

50. Replacement of Parts

Note. Several parts used in the Q-meter have closer tolerances than used in most radio equipments. Resistors R22 through R32 are precision parts. If these parts require replacement, use the *exact* value and tolerance rating of the part removed. If even slightly different values are used, the calibration of the Q-readings will be inaccurate on one or more positions of the Q RANGE switch.

a. The components of the Q-meter are readily accessible and are replaced easily if found faulty. The sockets, capacitors, filter choke and power transformer are mounted with hexagonal nuts and pan-head screws. The nuts can be removed easily with socket wrenches. The dial knobs and control knobs are removed with Allen wrenches.

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.

51. Removal of Oscillator Turret

(fig. 19)

To remove the oscillator turret from the oscillator assembly, proceed as follows:

a. Place the range switch S7 between range positions. If this is not done, damage may be caused to the wiper contacts.

b. Loosen the Allen set screw on the rear bushing sufficiently to remove the rear bearing.

c. Carefully slide the turret assembly off the detent plate and away from the support casting.

d. Replacement is made in a similar manner in reverse order. Make sure the locating pin on the detent plate is placed in the notch provided

at the lip of the turret. Before tightening the Allen screw on the rear bushing, push the turret and bearing toward the panel to eliminate end-play.

52. Removal of Resistance Divider E1 (fig. 19)

To remove resistance divider E1, proceed as follows:

a. Unsolder capacitor C15 and the shielded cable from the terminal mounted on the resistance divider assembly.

b. Loosen slightly the screw, which is located inside the COIL LO binding post.

c. Loosen slightly the four screws that are located symmetrically around the COIL LO binding post.

d. Remove the screw located in the COIL LO binding post.

e. Hold E1 firmly with one hand and remove the four screws loosened (c above).

f. Do not damage internal resonating capacitor C20 as E1 is removed from the unit.

g. When installing resistance divider E1, be sure to replace all grounds as in the original installation and tighten all screws securely.

53. Refinishing

Instructions for refinishing badly marred panels or exterior cabinets are given in TM 9-2851, Painting Instructions for Field Use.

54. Adjustment of Frequency Dial

The frequency dial indicates the frequency of the oscillator. If the frequency dial is not placed

in proper position on tuning capacitor C9 shaft, the frequency indication will be in error. To check and adjust the dial, proceed as follows:

a. Tune the oscillator to the stop at the low-frequency end of the range.

b. The hairlines on the MEGACYCLES and KILOCYCLES masks should fall on 100 and 0 of the linear scale of the dial. To adjust, proceed as follows:

- (1) For slight adjustments, loosen the two screws that hold each mask and move the masks into position.
- (2) For large adjustments, loosen the Allen set screws in the dial knob and rotate the dial to the proper position. Tighten the set screw.

55. Adjustment of MICRO MICRO FARADS INDUCTANCE Dial

If the MICRO MICRO FARADS INDUCTANCE dial is not set correctly on its shaft, errors will be introduced in all measurements. To check the setting, rotate the dial to the stop at the high capacity end. The hairline of the mask should fall on the two dial markings terminated in dots. To adjust, proceed as follows:

a. For slight adjustments, loosen the two screws that hold the dial mask and move the hairline into position; then tighten the screws.

b. For large adjustments, loosen the Allen set screw in the dial knob and rotate the dial into position. Tighten the set screw.

56. Adjustment of MICRO MICRO FARADS Dial

The MICRO MICRO FARADS dial is properly adjusted when it can be turned in a clockwise direction past the +3 mark to the stop, the same distance as when it is turned in a counterclockwise direction past the -3 mark to the stop. If the overtravel at each end is not equal then adjust as follows:

a. Loosen the set screws on the dial knob and rotate the dial to assumed proper position.

b. Tighten the set screws on the dial knob and check the rotation for equal overtravel at each end of dial.

c. Repeat the steps in a and b above if necessary.

57. Calibration and Alignment of Q Meter TS-617B/U

a. *Test Equipment Required for Calibration and Alignment.*

- (1) Frequency Meter AN/URM-79
- (2) Frequency Meter AN/URM-80
- (3) Q-standard, Type 513A (Boonton Radio Corp.)

b. *Q-calibration.*

- (1) The calibration of frequency on all ranges can be accomplished with the use of Frequency Meters AN/URM-79 and AN/URM-80.
- (2) The calibration of Q on all four ranges is made by comparison with the value of Q stamped on the name plate of the Q-standard (Type 513A, Boonton Radio Corp.) at .5, 1.0, and 1.5 megacycles (mc). This eliminates the need for measuring injection voltage.
- (3) The calibration of inductance is made at the same time Q is measured by direct comparison with the name plate value of L stamped on the Q-standard.
- (4) The calibration of capacitance is made at the same time that Q and L are measured by computation from the formula

$$C = \frac{1}{2\pi f^2 L} - C_d$$

where f is the frequency in cps, L and C_d are name plate values stamped on the Q-standard.

- (5) It is only necessary to insert the Q-standard in the coil terminals of the Q-meter and resonate the meter at .5, 1.0, and 1.5 mc in turn to perform the above tests.

c. *Alignment of Oscillator* (fig. 22). All ranges of the oscillator except the highest frequency range of 50 mc to 75 mc can be aligned by adjustment of the coil cores and trimmers.

The range from 50 to 75 mc needs no adjustment.

- (1) Connect the crystal calibrator or frequency meter between the COIL LO and GND binding posts.
- (2) Place the RF ON switch in the ON position.
- (3) Set the LEVEL-Q switch to LEVEL.
- (4) Turn the range switch to the lowest frequency range.
- (5) Adjust the SET LEVEL COARSE control so that the pointer of the meter reads on the red line.
- (6) Set the crystal calibrator for an output at 50 kc.
- (7) Tune the oscillator so that the frequency dial indicates 50 kc.
- (8) Adjust the core for coil L1 to zero beat with the crystal calibrator.
- (9) Set the crystal calibrator for an output at 150 kc.
- (10) Tune the oscillator so that the frequency dial indicates 150 kc.
- (11) Adjust trimmer C1 for zero beat with the crystal calibrator.
- (12) Repeat the steps in (6) through (11) above until the adjustment of either core or trimmer requires no further adjustment of the other.
- (13) Adjust all other ranges except the highest frequency range as in the steps in

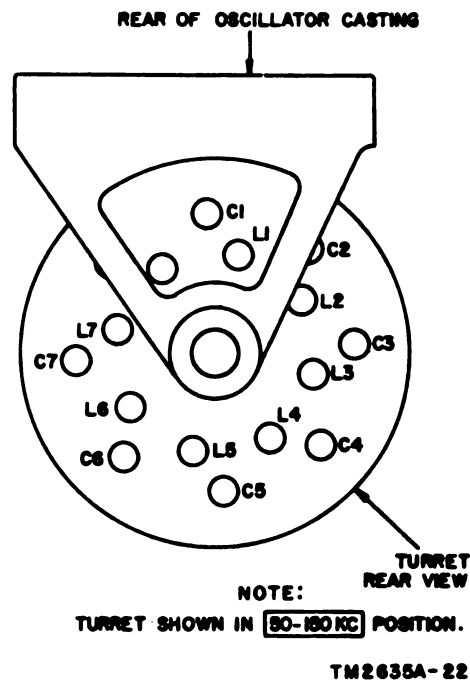


Figure 22. Q-meter, location of oscillator adjustments.

(1) through (12) above. Adjust the coil cores at the low-frequency end of each range. Adjust the trimmers at the high-frequency end as marked on the dial masks. For example, the trimmer for the range marked 12 mc to 25 mc should be adjusted at 25 mc.

Section III. FINAL TESTING

58. General

This section is intended as a guide to be used in determining the quality of a repaired Q-meter. The minimum test requirements outlined in paragraph 60 may be performed by maintenance personnel with adequate test equipment and the necessary skills. Repaired equipment meeting these requirements will furnish uniformly satisfactory operation.

59. Test Equipment Required for Final Testing

Items of test equipment required for final testing are listed in paragraph 57a.

60. Frequency Calibration

- a. Connect the crystal calibrator or frequency meter to the COIL LO and GND binding posts.
- b. Set the RF GN switch to ON.
- c. Set LEVEL-Q switch to LEVEL position.
- d. Make measurements with SET LEVEL panel controls set so that the pointer of the meter is on the red line.
- e. The frequency accuracy should be as follows:

Frequency	Accuracy
50 kc to 50 mc	±1%
50 mc to 75 mc	±3%

CHAPTER 7

SHIPMENT AND LIMITED STORAGE AND DEMOLITION TO PREVENT ENEMY USE

Section I. SHIPMENT AND LIMITED STORAGE

61. Disassembly

The following instructions are recommended as a general guide for preparing Q Meter TS-617B/U for transportation or storage.

- a. Remove any leads or coils connected to the binding posts.
- b. Place the rf coils in the carrying case provided.
- c. Wrap the line cord in the cover.
- d. Fasten the cover of the Q-meter to the case.
- e. Check the equipment against the table of components (par. 5).

62. Field Repackaging Data

a. *Materials Required.* The following chart lists the estimated amount of materials required to prepare the Q-meter for shipment:

Materials	Amount
Waterproof barrier	65 sq ft
Pressure-sensitive tape	15 ft
Single-faced, flexible, corrugated paper	45 sq ft
Gummed paper tape	25 ft
Flat steel strapping	20 ft
Wooden shipping box	1 ea

b. *Box Size.* The dimensions of the shipping box required for the Q-meter are given in the chart below.

Box No.	Inner dimensions			Board ft	Volume (cu ft)	Packed weight (lb)
	Height (in.)	Width (in.)	Depth (in.)			
1 of 1	32	28½	22½	31	11.87	155

63. Repackaging Q Meter TS-617B/U

- a. *Technical Manuals.* Wrap the manuals in waterproof-barrier material. Seal all the seams and folds with pressure-sensitive tape.
- b. *Tubes.* Wrap the tubes individually in flexible, single-faced corrugated paper. Secure the wrapping with gummed paper tape.
- c. *Lamps, Fuses.* Cushion each lamp by wrapping individually within flexible corrugated paper. Secure cushioning with gummed paper tape. Fuses require no packaging.
- d. *Cables.* Wind each cable into a coil of convenient dimensions. Tie at three places with suitable tape, securing the terminals to the coil with the ties.
- e. *Stowage.* Stow all the components of Q Meter TS-617B/U within the designated compartment of the Q-meter case cover and the coil case. Fill all voids with single-faced, flexible corrugated paper to prevent movement. Close the case covers and secure all fastenings. Cushion each case on all surfaces with pads fabricated of single-faced, flexible corrugated paper, designed to absorb the shock of impact normally encountered in handling and transit. Secure cushioning with gummed paper tape. Inclose each cushioned case within a wrap of single-faced, flexible corrugated paper and secure with gummed paper tape. Place in cartons. Seal moisture-vaporproof barriers with pressure-sensitive tape and seal cartons with gummed paper tape.

64. Field Repacking, Strapping, and Marking

a. *Repacking* (fig. 2).

(1) Place one each, packaged Q-meter carton with contents, and one each packaged coil case carton with contents, together within a nailed wooden box lined with a sealed waterproof case liner.

(2) Secure technical literature between contents and lid of box.

(3) Fill all voids with pads fabricated of single-faced, flexible corrugated paper to prevent movement.

(4) Seal waterproof liner with pressure-sensitive tape.

(5) Nail lid to wooden box.

b. *Strapping*. Strap the shipping box.

c. *Marking*. Mark the shipping container in accordance with the requirements of SR 55-720-1, Section II, Transportation and Travel, Preparation for Oversea Movement of Units (POM).

Section II. DEMOLITION OF MATERIEL TO PREVENT ENEMY USE

65. General

The demolition procedures outlined in paragraph 66 will be used to prevent the enemy from using or salvaging this equipment. Demolition of the equipment will be accomplished only under order of the commander.

66. Methods of Destruction

Use any or all of the following methods to destroy the equipment.

a. *Smash*. Smash the controls, tubes, coils, switches, capacitors, transformers, and meter;

use sledges, handaxes, pickaxes, hammers, crowbars, or heavy tools.

b. *Cut*. Cut the power cord and slash the wiring; use axes, handaxes, or machetes.

c. *Burn*. Burn cords and manuals; use gasoline, kerosene, oil, flame throwers, or incendiary grenades.

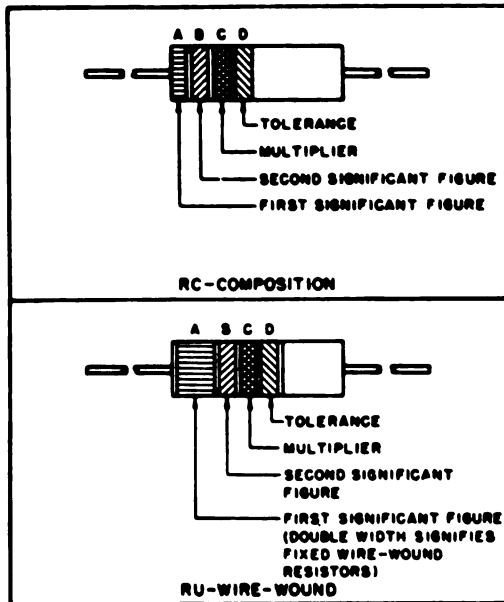
d. *Bend*. Bend panel and cabinet.

e. *Explosives*. If explosives are necessary, use firearms, grenades, or TNT.

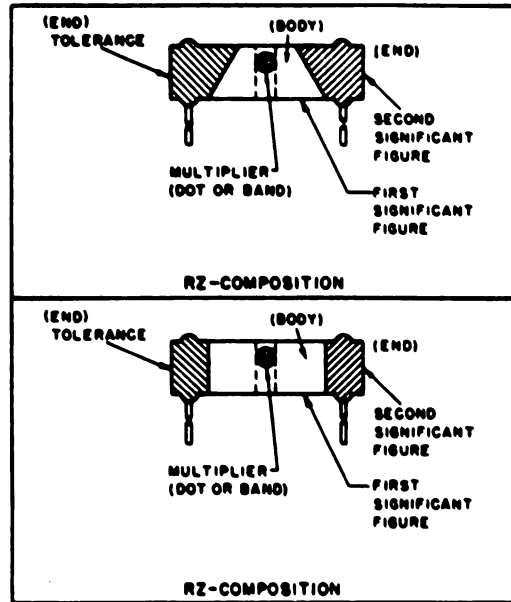
f. *Disposal*. Bury or scatter the destroyed parts in slit trenches, fox holes, or throw them into streams.

RESISTOR COLOR CODE MARKING (MIL-STD RESISTORS)

AXIAL-LEAD RESISTORS (INSULATED)



RADIAL-LEAD RESISTORS (UNINSULATED)



RESISTOR COLOR CODE

BAND A OR BODY*		BAND B OR END*		BAND C OR DOT OR BAND*		BAND D OR END*	
COLOR	FIRST SIGNIFICANT FIGURE	COLOR	SECOND SIGNIFICANT FIGURE	COLOR	MULTIPLIER	COLOR	RESISTANCE TOLERANCE (PERCENT)
BLACK	0	BLACK	0	BLACK	1	BODY	± 20
BROWN	1	BROWN	1	BROWN	10	SILVER	± 10
RED	2	RED	2	RED	100	GOLD	± 5
ORANGE	3	ORANGE	3	ORANGE	1,000		
YELLOW	4	YELLOW	4	YELLOW	10,000		
GREEN	5	GREEN	5	GREEN	100,000		
BLUE	6	BLUE	6	BLUE	1,000,000		
PURPLE (VIOLET)	7	PURPLE (VIOLET)	7				
GRAY	8	GRAY	8	GOLD	0.1		
WHITE	9	WHITE	9	SILVER	0.01		

* FOR WIRE-WOUND-TYPE RESISTORS, BAND A SHALL BE DOUBLE-WIDTH WHEN BODY COLOR IS THE SAME AS THE DOT (OR BAND) OR END COLOR, THE COLORS ARE DIFFERENTIATED BY SHADE, GLOSS, OR OTHER MEANS.

EXAMPLES (BAND MARKING):

10 OHMS ± 20 PERCENT: BROWN BAND A; BLACK BAND B; BLACK BAND C; NO BAND D.
4.7 OHMS ± 5 PERCENT: YELLOW BAND A; PURPLE BAND B; GOLD BAND C; GOLD BAND D.

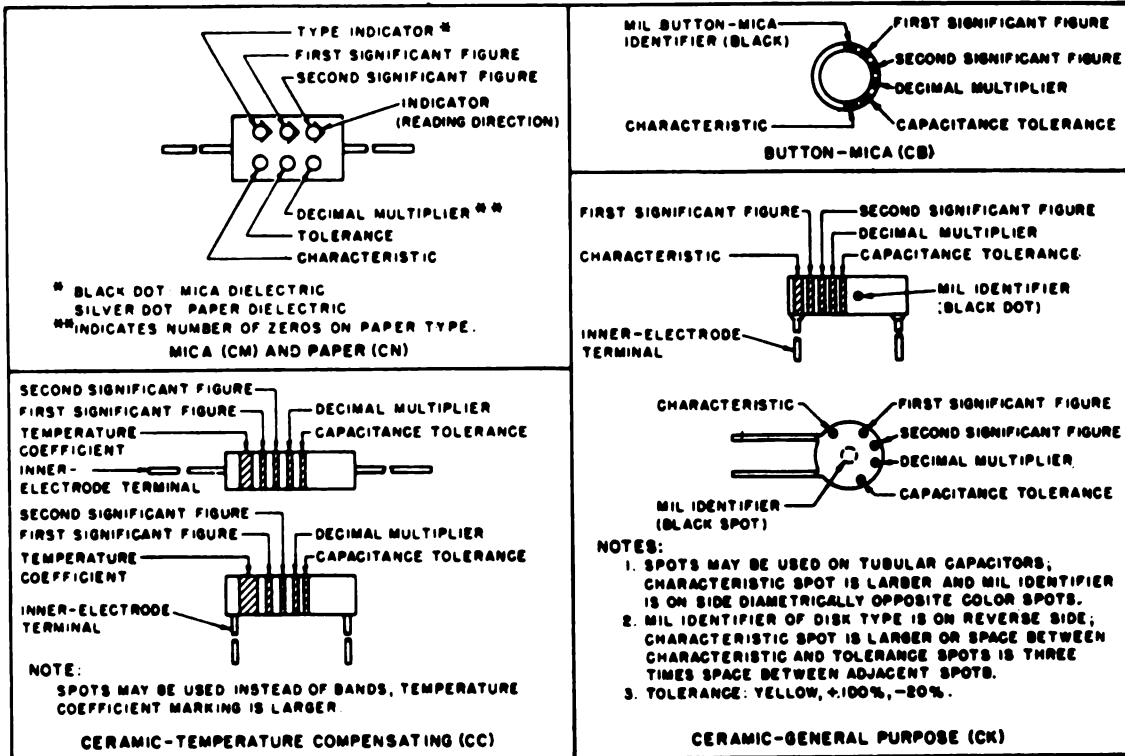
EXAMPLES (BODY MARKING):

10 OHMS ± 20 PERCENT: BROWN BODY, BLACK END; BLACK DOT OR BAND, BODY COLOR ON TOLERANCE END.
3,000 OHMS ± 10 PERCENT: ORANGE BODY, BLACK END, RED DOT OR BAND; SILVER END.

STD-R1

Figure 23. MIL-STD resistor color codes.

CAPACITOR COLOR CODE MARKING (MIL-STD CAPACITORS)



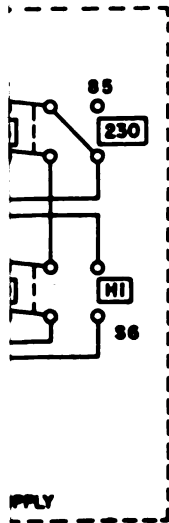
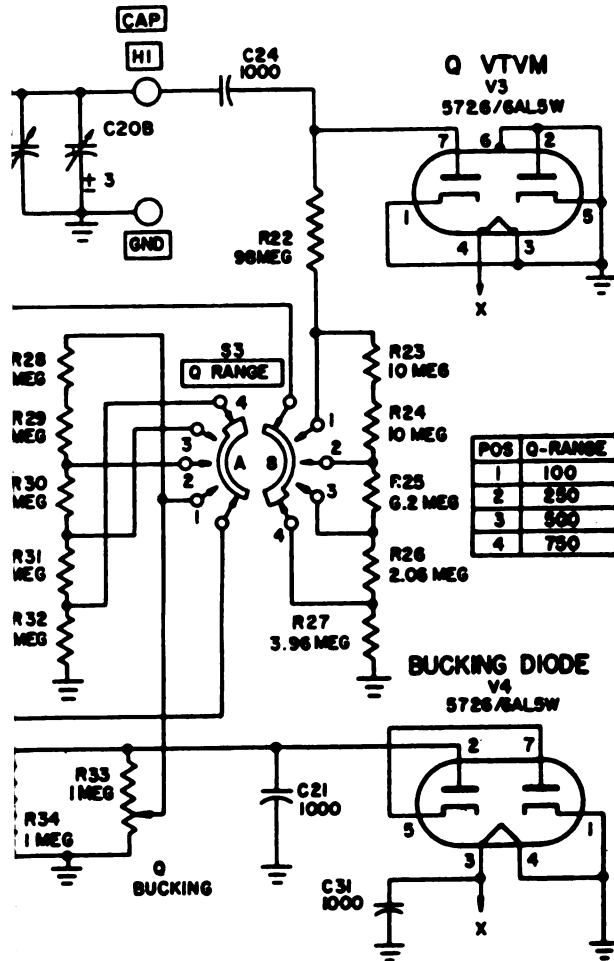
CAPACITOR COLOR CODE

COLOR	SIG FIG.	MULTIPLIER		CHARACTERISTIC				TOLERANCE ²					TEMPERATURE COEFFICIENT (UUF/UF/°C)
		DECIMAL	NUMBER OF ZEROS	CM	CN	CB	CK	CM	CN	CB	CC		
											OVER 10UUF	10UUF OR LESS	
BLACK	0	1	NONE		A			20	20	20	20	2	ZERO
BROWN	1	10	1	B	E	B	W					1	-30
RED	2	100	2	C	H		X	2		2	2		-80
ORANGE	3	1,000	3	D	J	D			30				-150
YELLOW	4	10,000	4	E	P								-220
GREEN	5		5	F	R						5	0.5	-330
BLUE	6		6		S								-470
PURPLE (VIOLET)	7		7		T	W							-750
GRAY	8		8			X						0.25	+30
WHITE	9		9								10	1	-330 (±500) ³
GOLD		0.1						5		5			+100
SILVER		0.01						10	10	10			

¹ LETTERS ARE IN TYPE DESIGNATIONS GIVEN IN MIL-C SPECIFICATIONS.
² IN PERCENT, EXCEPT IN UUF FOR CC-TYPE CAPACITORS OF 10UUF OR LESS.
³ INTENDED FOR USE IN CIRCUITS NOT REQUIRING COMPENSATION.

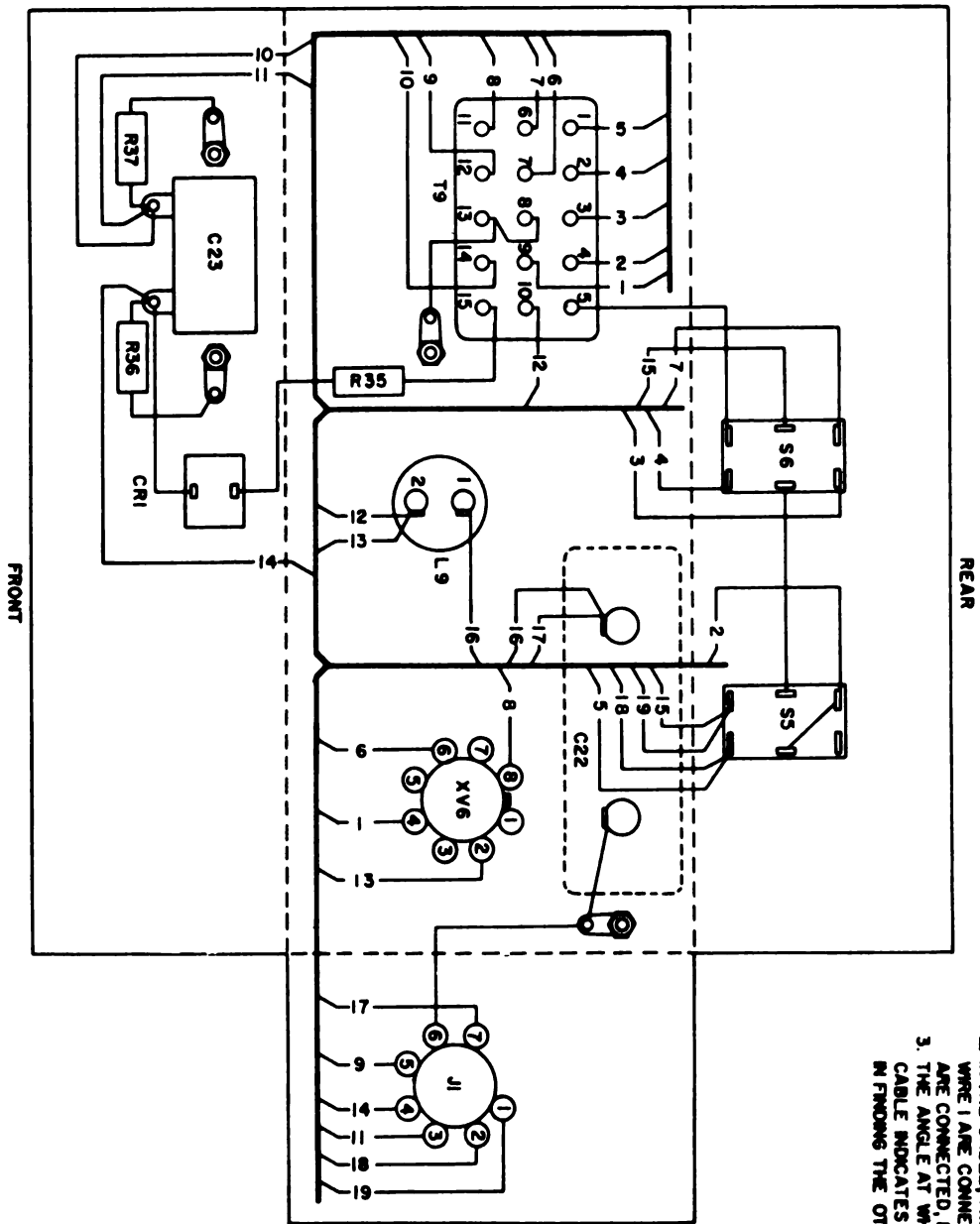
STD-C1

Figure 24. MIL-STD capacitor color codes.



- NOTES:**
1. UNLESS OTHERWISE SHOWN RESISTORS ARE IN OHMS, CAPACITORS ARE IN UF.
 2. SWITCH S3 VIEWED FROM THE FRONT, SWITCH S4 VIEWED FROM THE REAR
 3. WIPER CONTACT 1 OF THE TURRET RANGE SWITCH S7 DOES NOT TOUCH STATIONARY CONTACT 1.

TN2638A-23



- NOTES:
1. THE WIRES OF THE CABLE ARE NUMBERED CONSECUTIVELY, THE NUMBERS START WITH NO.1.
 2. IN THE CABLE, THE TWO POINTS INDICATED BY WIRE 1 ARE CONNECTED, THOSE TIED TO WIRE 2 ARE CONNECTED, ETC.
 3. THE ANGLE AT WHICH A SPECIFIC WIRE ENTERS A CABLE INDICATES THE DIRECTION TO FOLLOW IN FINDING THE OTHER END OF THE WIRE.

Figure 26. Q-meter, power supply wiring diagram.

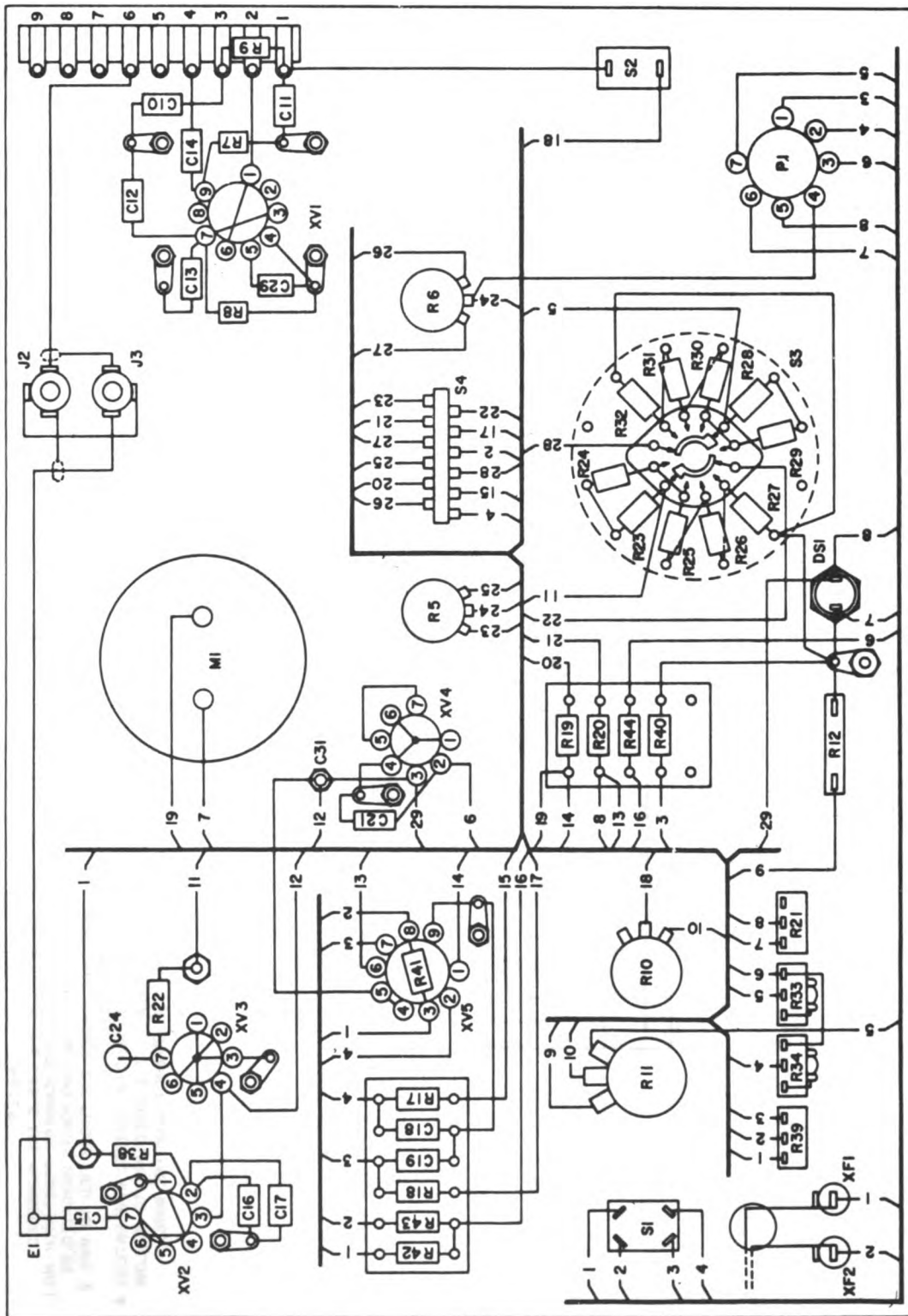


Figure 27. Q-meter, rf assembly wiring diagram.

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DEPARTMENT OF THE ARMY
WASHINGTON 25, D. C., 21 February 1956

TM 11-2635A is published for the use of all concerned.

AG 413.6 (15 Feb 56)

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