3-1

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

DEPARTMENT OF THE AIR FORCE TECHNICAL ORDER

TM 11-2239

TO 16-30TCC14-5

TELEGRAPH–TELEPHONE TERMINAL AN/TCC-14

DEPARTMENTS OF THE ARMY AND THE AIR FORCE

APRIL 1952

AGO 3243A—Apr

C1, TM 11–2239
TO 16–30TCC14–5

DEPARTMENTS OF THE ARMY AND THE AIR FORCE
WASHINGTON 25, D. C., *13 May 1954*

TM 11–2239/TO 16–30TCC14–5, 4 April 1952, is changed as follows:

Reference to figure 39.1 is added to the figure references in the following places in the manual:

Par. 96*a*.	Line 7.
Par. 99*a*.	Line 3.
Par. 102*a*.	Line 3.

Reference to figure 40.1 is added to the figure references in the following places in the manual:

Par. 96*a*.	Line 8.
Par. 96*c*.	Line 2.
Par. 99*a*.	Line 4.
Par. 102*a*.	Line 3.

Reference to figure 41.1 is added to the figure references in the following places in the manual:

Par. 96*a*.	Line 10.
Par. 96*b*.	Line 1.
Par. 98*b*.	Line 6.
Par. 102*a*.	Line 3.

Reference to figure 49.1 is added to the figure references in the following places in the manual:

Par. 22*b*.	Line 4.
Par. 48*a*(1).	Line 22.
Par. 50.	Line 5.
Par. 51.	Line 3.
Par. 52.	Line 1.
Par. 53.	Line 3.
Par. 54.	Line 1.
Par. 56.	Line 4.
Par. 57.	Line 3.
Par. 58.	Line 3.
Par. 60.	Line 2.
Par. 64.	Line 4.
Par. 65.	Line 1.
Par. 66.	Line 3.
Par. 67.	Line 3.
Par. 69.	Line 9.
Par. 70.	Line 1.
Par. 71.	Line 2.
Par. 72.	Line 1.
Par. 74.	Line 2.
Par. 76.	Line 3.
Par. 77.	Line 3.
Par. 78.	Line 1.
Par. 79*a*.	Line 1.
Par. 86*c*.	Line 3.
Par. 95.	Line 10.
Par. 96*a*.	Line 7.
Par. 96*b*.	Line 6.

Reference to figure 50.1 is added to the figure references in the following places in the manual:

Par. 22*b*.	Line 4.
Par. 99*a*.	Line 11.

Section II. DESCRIPTION AND DATA

Note. (Added) Telegraph Terminal TH–5/TG, part of Telegraph-Telephone Terminal AN/TCC–14, procured on the Orders No. 30005–Phila–51, 3289–Phila–52, 3291–Phila–52, and 6438–Phila–51, is essentially the same as Telegraph Terminal TH–5/TG, discussed in TM 11–2239/TO 16–30TCC14–5. All information in the technical manual applies equally to Telegraph-Telephone Terminal AN/TCC–14 procured on the order numbers listed above, except as otherwise specified in this Change.

8. Simultaneous Telegraph-Telephone Service, System Application

Simultaneous telegraph-telephone service * * * operator is needed. **The circuit shown in figure 9 may be operated without the F–98/U associated with the switchboard operator's headset. If the operator's F–98/U is not used, the operator must not answer a telephone call while the teletypewriter circuit is in use (tone is heard in the operator's headset) because the 1,225- and 1,325-cps components of the operator's speech would introduce errors in the teletypewriter message.**

Note. (Added) Only the TP portion of the operator's F–98/U is used in the circuit illustrated in figure 9.

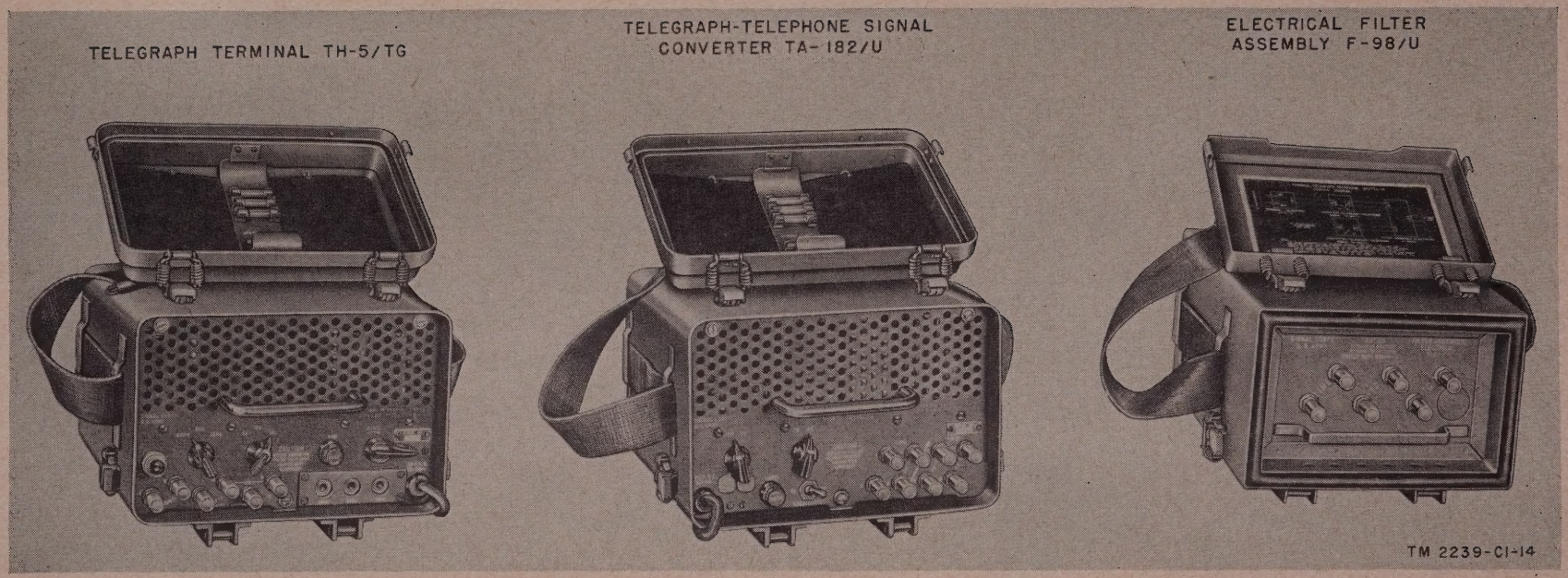


Figure 1. (Superseded) *Telegraph-Telephone Terminal AN/TCC–14.*

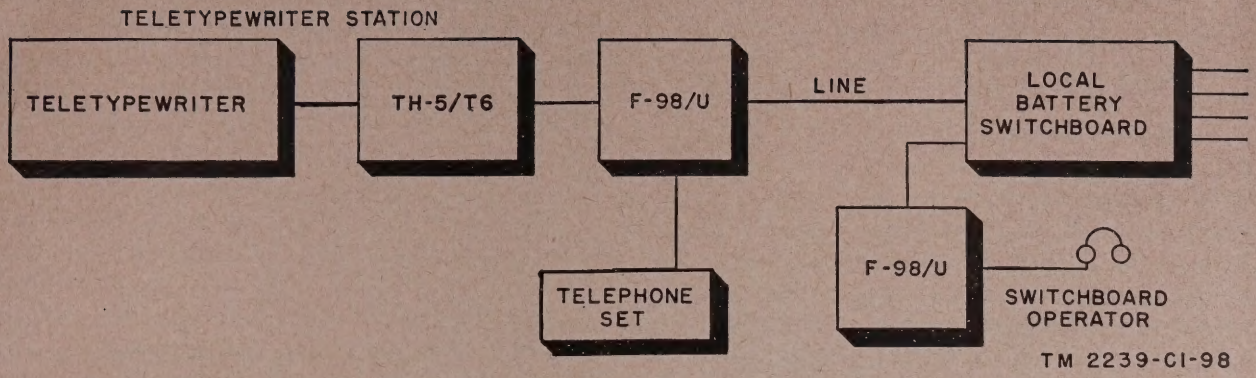


Figure 9. (Superseded) *Switchboard loop circuit using Electrical Filter Assembly F–98/U, simultaneous telegraph-telephone service.*

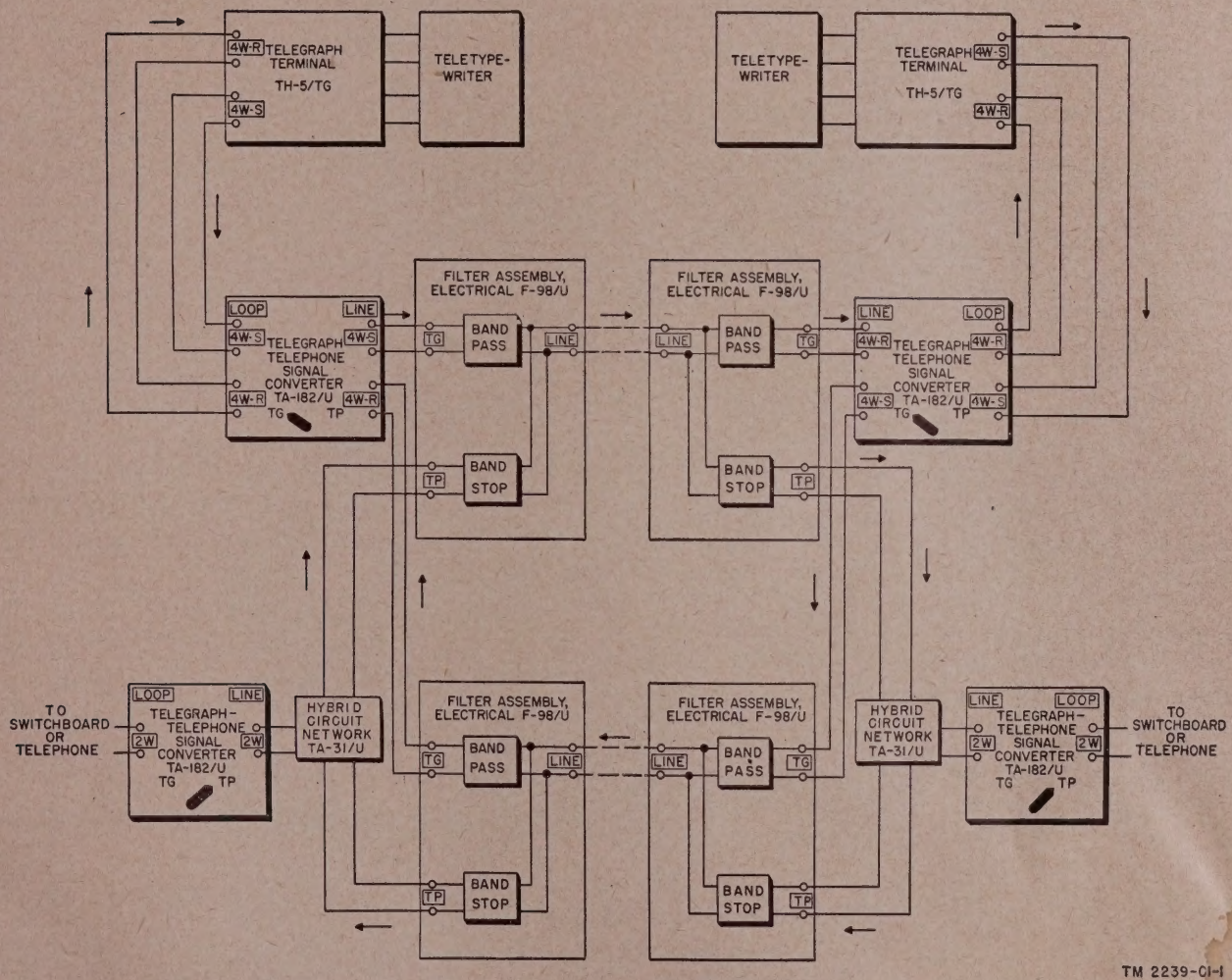


Figure 11. (Superseded) *Four-wire facility, speech plus full-duplex service.*

9. Speech Plus Half-Duplex Service, System Application

Speech plus half-duplex * * * and telephone transmission.

* * * * *

b. Use on 4-Wire Facility. Figure 11 illustrates speech plus **full-duplex** service on a 4-wire facility. Any 4-wire facility * * * the receiving station. In addition, **Hybrid Circuit Network** TA–31/U is required to adapt the 4-wire telephone circuit so that it may be connected to a telephone.

* * * * *

10. Technical Characteristics

Telegraph-Telephone Terminal * * * *a* and *b* below.

a. Telegraph Terminal TH–5/TG.

* * * * *

Receiver sensitivity ---- 0 to —50 dbm.

* * * * *

Power source requirements--115 v ±10%, 50/60 cps.

Ringing generator ---------- 90 v, 20 cps under load.

* * * * *

b. Electrical Filter Assembly F–98/U.

* * * * *

Attenuation ---------- 80 db or greater in stop regions.
4.5 db or less in pass regions.

* * * * *

11. Packaging Data

Note. Telegraph-Telephone Terminal AN/TCC–14 may be packaged in a manner different from that shown, depending on the supply channel.

a. Export. When packaged for * * * wooden export crate. **Views** of the **crates** packed for export **are** shown in *figures* 18 **and 18.1**. The **sizes, weights**, and **volumes** of the **crates are** indicated in the following chart:

Number of crates	Height (in.)	Width (in.)	Depth (in.)	Volume (cu ft)	Weight (lb)
*	*	*		*	*
1 (Orders No. 30005–Phila–51 and 3289–Phila–52).	29¼	17	14¼	4.1	97
1 (Order No. 3291–Phila–52).	26	17	11⅞	2.85	75

b. Domestic. When packaged for * * * separately in cartons. The size, weight, and volume of **the components are** indicated in the **first three rows of the chart below. When packaged for domestic shipment on Order No. 3291–Phila–52, each of the three components of Telegraph-Telephone Terminal AN/TCC–14 is packaged separately in a cardboard case. Each of these three cases contains the same fillers, spare parts, and technical manuals as in export shipment (fig. 18.1) with the exceptions that the case liners and waterproof barriers are not included. The three cases are placed in a single fiberboard carton; the dimensions, weight, and volume of which are shown in the fourth row of the chart below.**

Component	Number of cartons	Height (in.)	Length (in.)	Width (in.)	Volume (cu ft)	When packed with spares (lb)
*	*		*		*	*
F–98/U	1	15	11	7	.66	27.0
AN/TCC–14 (Order No. 3291–Phila–52).	1	25¾	15⅝	11½	2.68	70 (approx)

16. Running Spares

Running spares for components of the Telegraph-Telephone Terminal AN/TCC–14 are listed in *a* through *c* below.

a. (Superseded) *Telegraph Terminal TH–5/TG.* The running spares for the TH–5/TG follow. Spare fuses are stored in holders in the cover (fig. 15).

2 tubes, type 12AX7.
3 tubes, type 12AU7.
2 tubes, type 6AL5.
5 fuses, cartridge, 1.5 amperes.
1 lamp, glow.

* * * * *

19. Uncrating, Unpacking, and Checking New Equipment

Note. For used or reconditioned equipment, refer to paragraph 22.

a. General. Equipment may be * * * domestic packing cases. **The instructions in *d* below apply to equipment bearing Orders No. 3291–Phila–52, 30005–Phila–51, 3289–Phila–52, and**

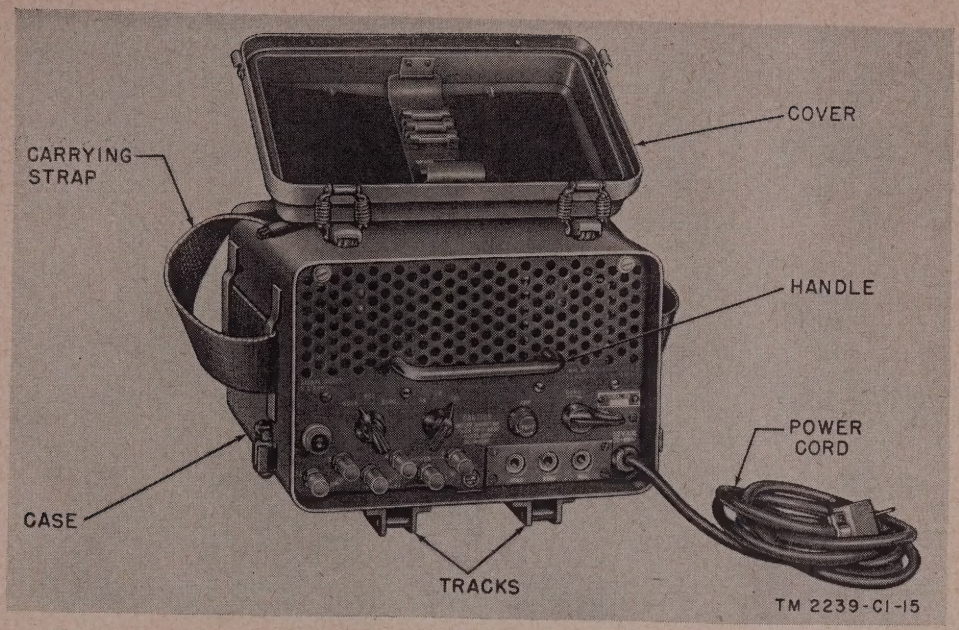


Figure 15. (Superseded) *Telegraph Terminal TH–5/TG, view of front panel.*

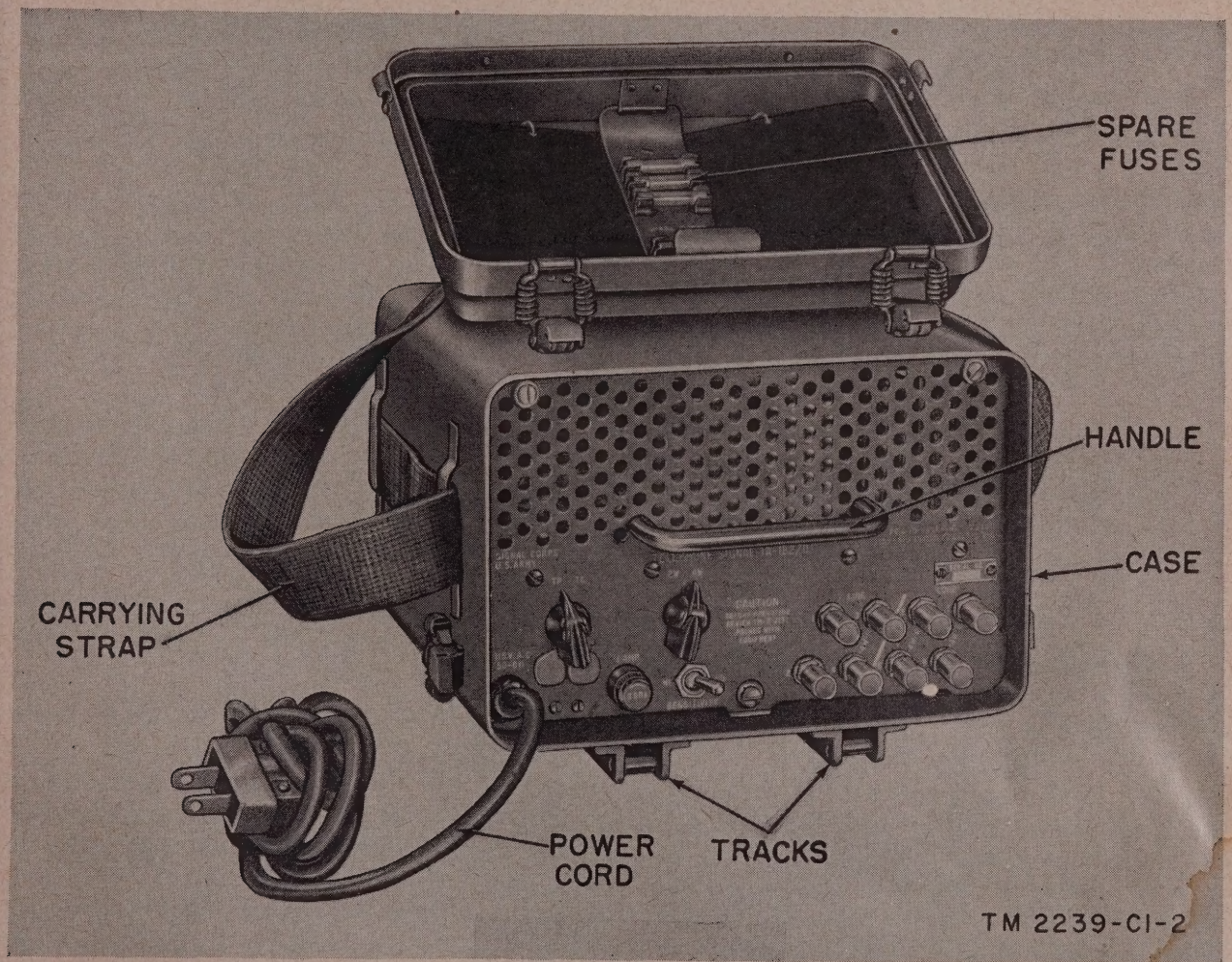


Figure 16. (Superseded) *Telegraph-Telephone Signal Converter TA–182/U, view of front panel.*

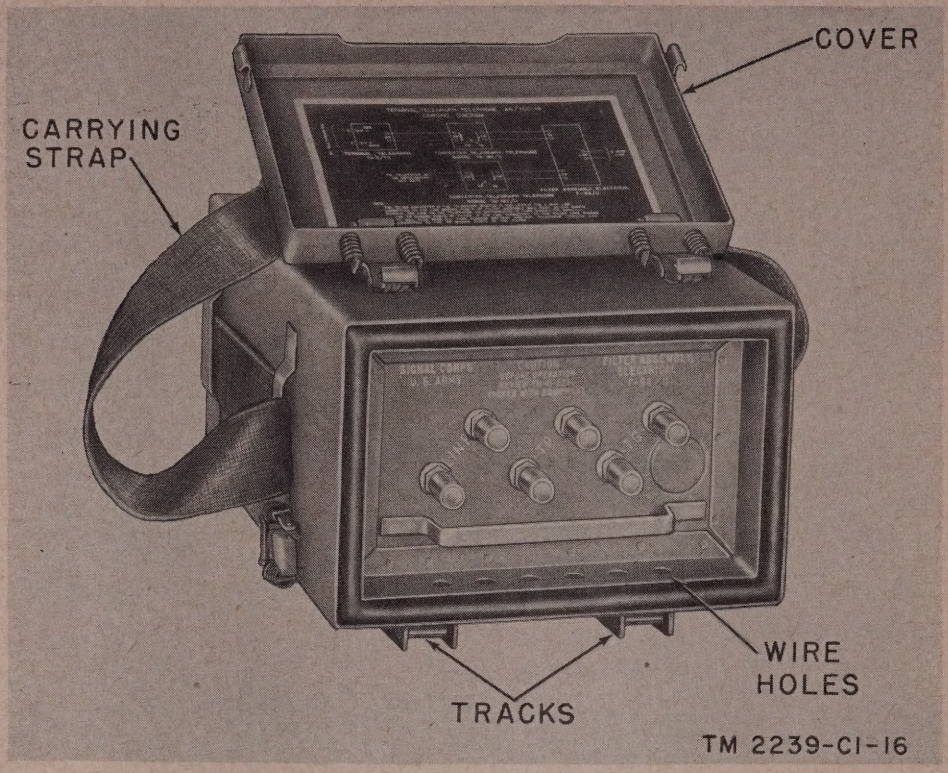


Figure 17. (Superseded) *Electrical Filter Assembly F–98/U, view of front panel.*

6438–Phila–51, shipped in export packing cases. Aside from checking * * * be rendered useless.

b. Step-by-Step Instructions for Uncrating and Unpacking Export Shipments. Figure 18 illustrates * * * cartons as follows:

* * * * *

(9) Remove the TH–5/TG and the TA–182/U chassis from their cases by **loosening the ¾-turn fasteners** on the front panel. The filter is hermetically sealed and should not be removed from its case.

* * * * *

d. (Added) *Uncrating and Unpacking Export and Domestic Shipments (Orders No. 3291–Phila–52, 30005–Phila–51, 3289–Phila–52, and 6438–Phila–51).*

(1) Figure 18.1 illustrates the export packing details of the AN/TCC–14 on Orders No. 3291–Phila–52, 30005–Phila–51, 3289–Phila–52, and 6438–Phila–51. Each component is packaged in an individual case. The component case of Telegraph Terminal TH–5/TG and the component case of Telegraph-Telephone Signal Converter TA–182/U each contains the component, spare parts, applicable technical manual, and fillers. Each technical manual is inclosed in a waterproof barrier. The component case of Electrical Filter Assembly F–98/U contains only the component and fillers. The component cases are packaged in individual case liners, and the three packaged components are packaged together in a lined wooden shipping container. To unpack the crate and cases, follow the procedure outlined below:

(*a*) Cut and fold back the metal straps.

(*b*) Remove the nails from the lid of the wooden shipping container with a nail puller. Do not attempt to pry off the lid; the equipment may be damaged.

(*c*) Open the wooden shipping container and the top of its case liner.

(*d*) Open the top of the case liner and

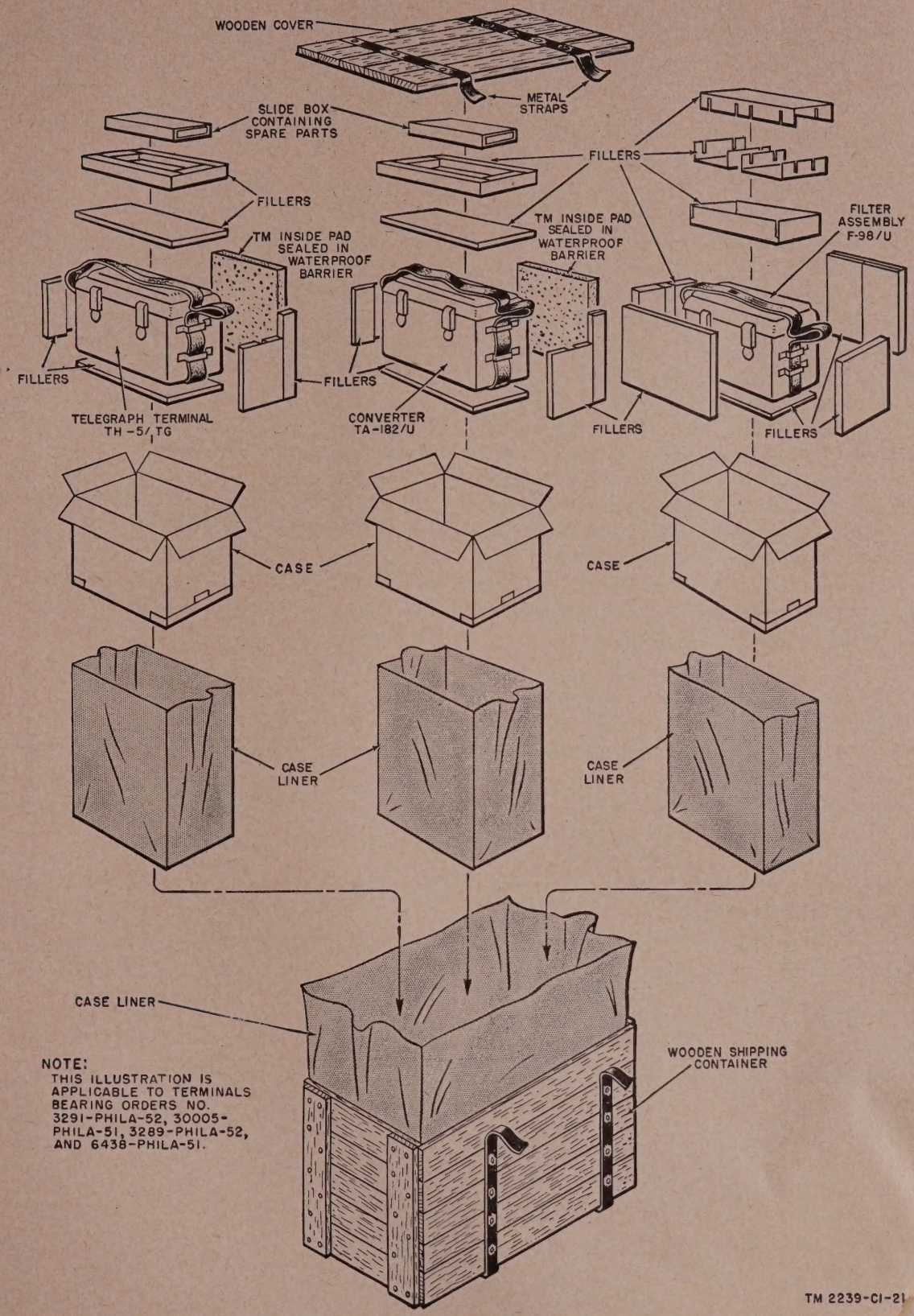


Figure 18.1. (Added) *Telegraph-Telephone Terminal AN/TCC–14, packing and packaging details (see note).*

the case of each of the three component packages.

(*e*) Remove the spare parts boxes.

(*f*) Remove the fillers.

(*g*) Remove the technical manual. The technical manual is sealed inside a waterproof barrier.

(*h*) Lift each of the component units from its packing case.

(*i*) Check the equipment according to the procedures outlined in *b*(6) through (11) above.

(2) On Order No. 3291–Phila–52, domestic shipments are packaged in fiberboard containers. To remove the components, open the cover of the outer fiberboard container and remove the three cases that contain the packaged component units. Open the top of each case, remove the padding and the technical manuals, and remove the component. Check the equipment according to the procedures outlined in *b*(6) through (11) above.

21. Connections

All three components * * * of the TH–5/TG.

* * * * *

b. Operation Over 4-Wire Line. During 4-wire operation * * * as outlined below:

* * * * *

(7) Connect binding posts TP of both the first and the second F–98/U to **Hybrid Circuit Network TA–31/U.**

(8) Connect between **Hybrid Circuit Network TA–31/U** and the 2W LINE binding posts of a **second TA–182/U.** (Note that a * * * Signal Converter TA–182/U.)

* * * * *

Figure 21. The panel marking "1 AMP" is changed to read: **1.5 AMP.**

28. Telegraph-Telephone Signal Converter TA–182/U, Switch Settings

* * * * *

d. Control Settings. The table below describes the control settings on the TH–5/TG for various types of operation.

	TELEGRAPH TERMINAL TH–5/TG, control settings			
Type of operation	4W–2W–TEL switch	NORM-REC-SEND switch	RING switch	Remarks
*	*	*	*	*
2-wire teletype over common battery switchboard.	TEL * * * operation.	NORM _____	Not used _____	See note 2, **figures 49 and 49.1,** for strapping in the holding coil.
*	*	*	*	*
4-wire * * * radio.	4W	SEND * * * receive.	Refer to TM 11–2137.	The CONT * * * transmitter.
4-wire teletype. Full duplex over wire or two-way radio.	4W	NORM * * * radio.	Operate * * * operation. Use TA–182/U for radio.	See note 3, **figures 49 and 49.1,** on schematic **and paragraph 55b** for removal of local copy connection.

42. Visual Inspection

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

* * * * *

c. Rescinded.

* * * * *

48. General

Telegraph Terminal TH–5/TG * * * and *b* below.

a. Major Circuits, General Functioning.

* * * * *

(2) *Receiving circuit.* The receiving circuit * * * to the teletypewriter. The limiter stages of the receiving circuit are designed to present a constant **output at input levels** of between 0 to **—50** dbm (decibels referred to 1 milliwatt in 600 ohms). The output of the discriminator is dependent on the frequency applied to it.

* * * * *

b. Auxiliary Circuits, General Functioning.

* * * * *

(2) *Threshold circuit.* During idle operation * * * on low-level noises. **Absence of an input signal** is indicated by the illumination of the neon lamp on the front panel. The circuit applies * * * are being received.

* * * * *

55. Output Amplifier V8(A)—Marking Interval, Transmitting Circuit

(Superseded)

a. This stage is used to isolate the oscillator from the varying line impedance and to place the signal at the desired level on the line. Tube V8(A) (figs. 24, 49, and 49.1) is a conventional voltage amplifier. Tubes V8(A) and V8(B) use the same cathode bias resistor, resistor R69 (par. 68). The output of the oscillator (par. 54) is fed to tube V8(A) through coupling capacitor C29 and signal voltage-dividing resistors R43, R44, R45, and R86. Resistor R86 may be strapped to raise the output signal level by 4 db, or if strapped, may be unstrapped to lower the output signal level (par. 114*d*). Thus, by the use of resistor R86, the range of output levels of —2 dbm to +6 dbm is compressed within the range of —2 dbm to +2 dbm.

b. The grid of tube V8(A) is biased through the voltage divider consisting of resistors R45 and R46. Resistor R42 and capacitor C27 correct the output impedance of transformer T4. Home copy of the transmitting circuit, on a 4-wire half-duplex facility only, is applied from the output of tube V8(A) to receiving circuit switch S2B (fig. 24). This circuit must be open when the TH–5/TG is used for 4-wire full-duplex applications. Removal of the strap between terminal board connection F2 and D2 will remove the home copy leak. Removal of the home copy leak prevents transmitted signals from interfering with received signals. The home copy strap is not supplied with some terminals. Resistor R28 is an impedance matching resistor used during 2-wire application.

58. Time-Delay Stage V10(A)—Spacing Interval, Transmitting Circuit

The drop in * * * a wave shaping capacitor. Tube V10(A) is biased **to cutoff** because of the voltage divider arrangement of cathode biasing resistors R55 and R56. The drop in plate voltage from tube V10(B) is applied to the grid of tube V10(A); tube V10(A) is cut off, thereby developing a positive rectangular shape across plate load **resistor** R54.

59. Modulator Stage V9(B)—Spacing Interval, Transmitting Circuit

The positive voltage is applied to the plate and grid of tube V9(B) connected as a diode (figs. 24, 49, **and 49.1**). The tube conducts and **returns** capacitors C36 and C37 to ground. Resistors R51 and * * * cathode bypass capacitor.

Figure 26. "R83, 36K" is changed to read: **R83, 24K.**

Figure 27. "T1 –300K" is changed to read: **T1 300K.**

The values of both windings of transformers T2 and T3 are changed from "200 UH" to **"200 MH".**

"TO SWITCH S1" is changed to read: TO SWITCH **S2.**

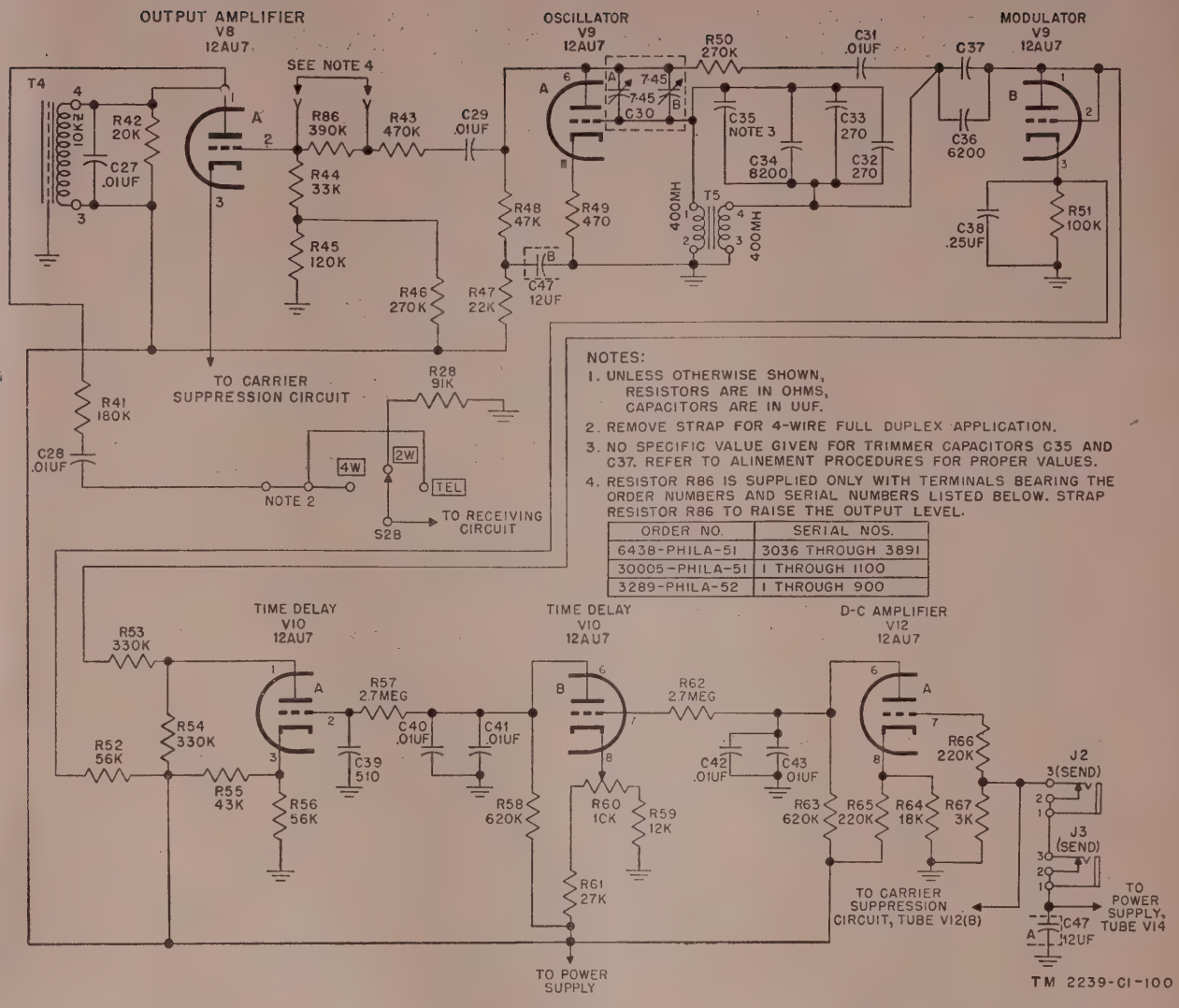


Figure 24. (Superseded) *Telegraph Terminal TH–5/TG transmitting circuit, schematic diagram.*

75. Threshold Circuit, Description

The threshold circuit (fig. 32) is an electronic switching circuit. It maintains the receiving circuit output tube V5 in the marking condition for all signals under the threshold value of —**50** dbm. (The receiving circuit * * * 76 through 79.

77. Rectifier Doubler Stage V6, Threshold Circuit

The a-c (alternating-current) * * * amplification tube V7(A). On the negative half-cycle, tube V6(B) conducts **charging** capacitor C24. **When tube V6(A) again conducts on the following half-cycle, capacitor C25 is charged to a value equal to the d-c potential across capacitor C24 plus the peak value of the a-c voltage. Thus, the voltage developed across capacitor C25 is equal to approximately twice the peak value of the a-c voltage.** Resistor R32 and capacitors C25 and C26 are low-pass filters used to filter out the carrier.

80. Power Supply Circuit

* * * * *

e. Tube V15, filtered * * * and bias supply. **Resistor R40 and capacitor C46A form the filter for the receiving and threshold circuits. Resistor R27 is the current limiting resistor for tube V5.**

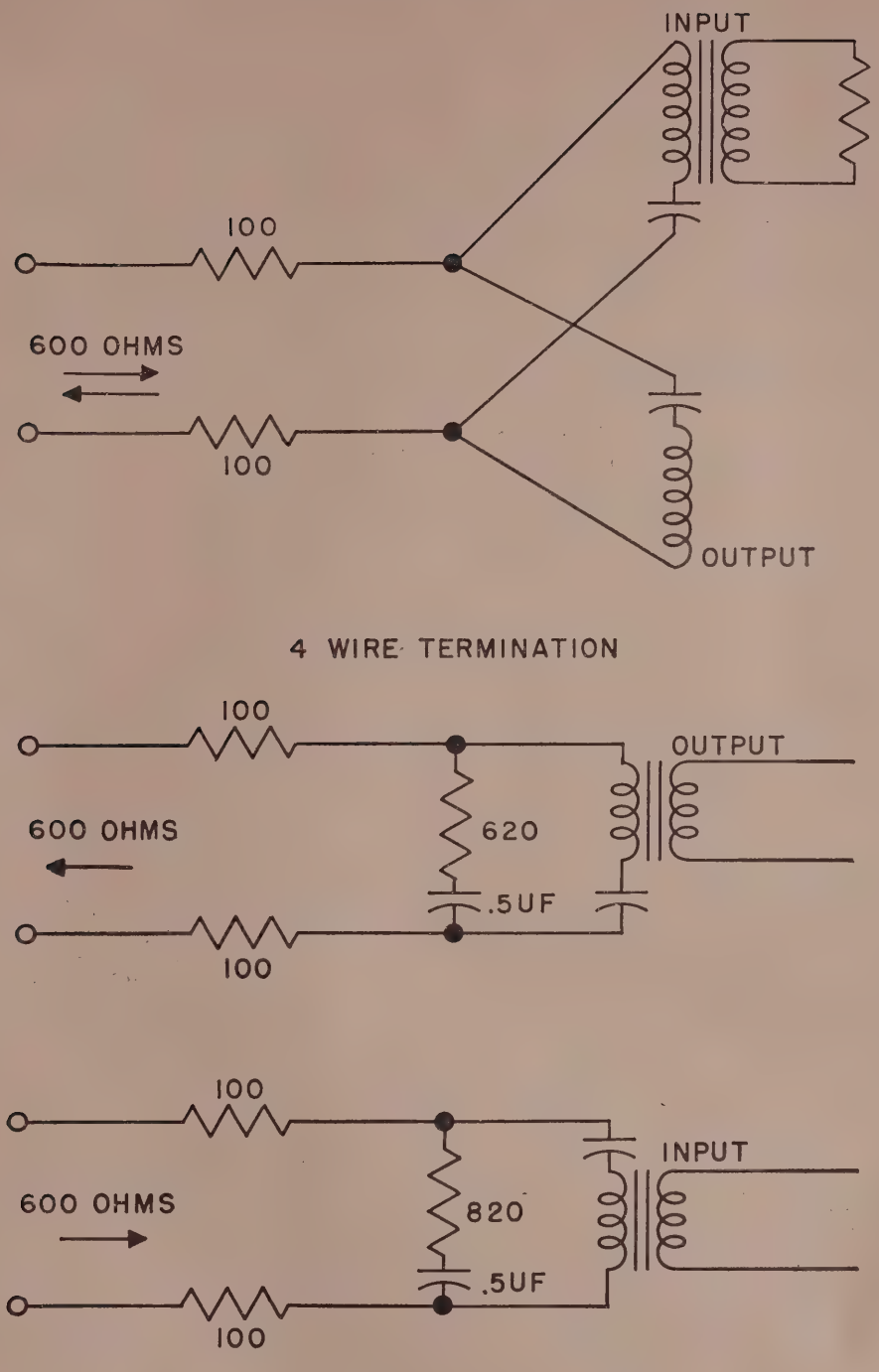


Figure 35. (Superseded) *Schematic showing impedance matching.*

81. Input-Output and Ringing Circuits

* * * * *

c. Functioning of Input-Output and Ringing Circuits. The input-output and ringing circuits function as explained below.

* * * * *

(2) Contacts S1C and * * * E3 and E4. Connection to the proper binding posts is dependent on the position of contact **S2I**. Ballast lamp E7 protects the 20-cps ringing supply circuit against shorts on the line.

* * * * *

81.1. Static Ringing Generator Circuits, General

(Added)

(figs. 36, 36.1, and 36.2)

Figures 36, 36.1, and 36.2 are schematic diagrams of static ringing generator circuits. The three circuits illustrated function similarly, and are electrically and mechanically interchangeable. The circuits shown in figures 36.1 and 36.2 provide improved noise suppression characteristics. A detailed description of the theory of operation of the circuit shown in figure 36 appears in paragraph 82. Subparagraphs *a* and *b* below detail the differences between the circuits shown in figure 36 and those shown in figures 36.1 and 36.2, respectively.

a. Differences Between Circuits Shown in Figures 36 and 36.1.

(1) Reference symbols are assigned to all parts in the circuit shown in figure 36.1. Reference symbols are not used in the circuit shown in figure 36.

(2) The 18K resistor shown in figure 36 corresponds to resistor R101 (39K) in figure 36.1.

(3) The .33μf capacitor in parallel with the relay winding in figure 36 corresponds in function to capacitor C103 and resistor R106 in figure 36.1.

(4) The internal connections to terminals 1 and 2 of the circuit shown in figure 36.1 are interchanged so that the polarity of the voltage applied to the motor contacts in figure 36.1 is the reverse of that applied to the motor contacts in figure 36. Polarity reversal does not affect operation of the circuit.

b. Differences Between Circuits Shown in Figures 36 and 36.2.

(1) Reference symbols are assigned to all parts shown in the circuit in figure 36.2. Reference symbols are not used in the circuit shown in figure 36.

(2) The 18K resistor shown in figure 36 corresponds to resistor R101 (39K) in figure 36.2.

(3) The .01-μf capacitors between ground and terminals 3 and 4 in figure 36 correspond to capacitors C108 and C109 (.05 μf each) in figure 36.2.

(4) Reactors L101 through L104 shown in figure 36.2 are not in the circuit shown in figure 36. These reactors offer high impedance to a-c frequen-

Figure 36. Static ringing generator, circuit No. 1, schematic diagram.

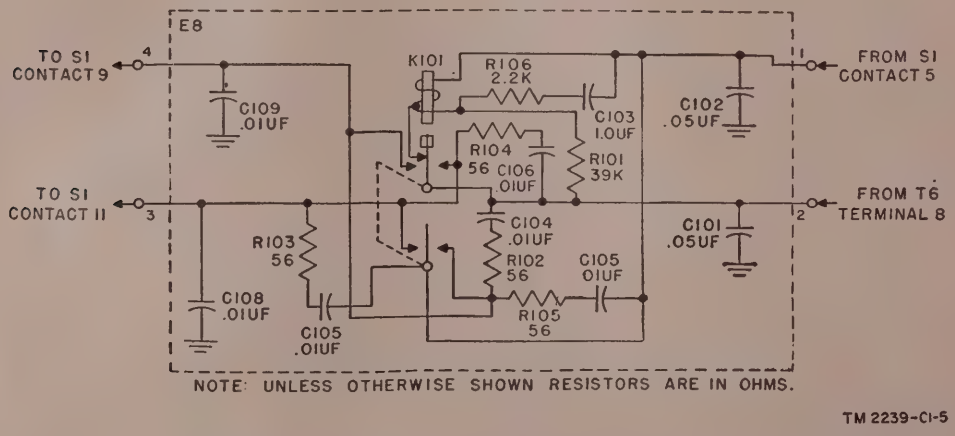


Figure 36.1. (Added) *Static ringing generator, circuit No. 2, schematic diagram.*

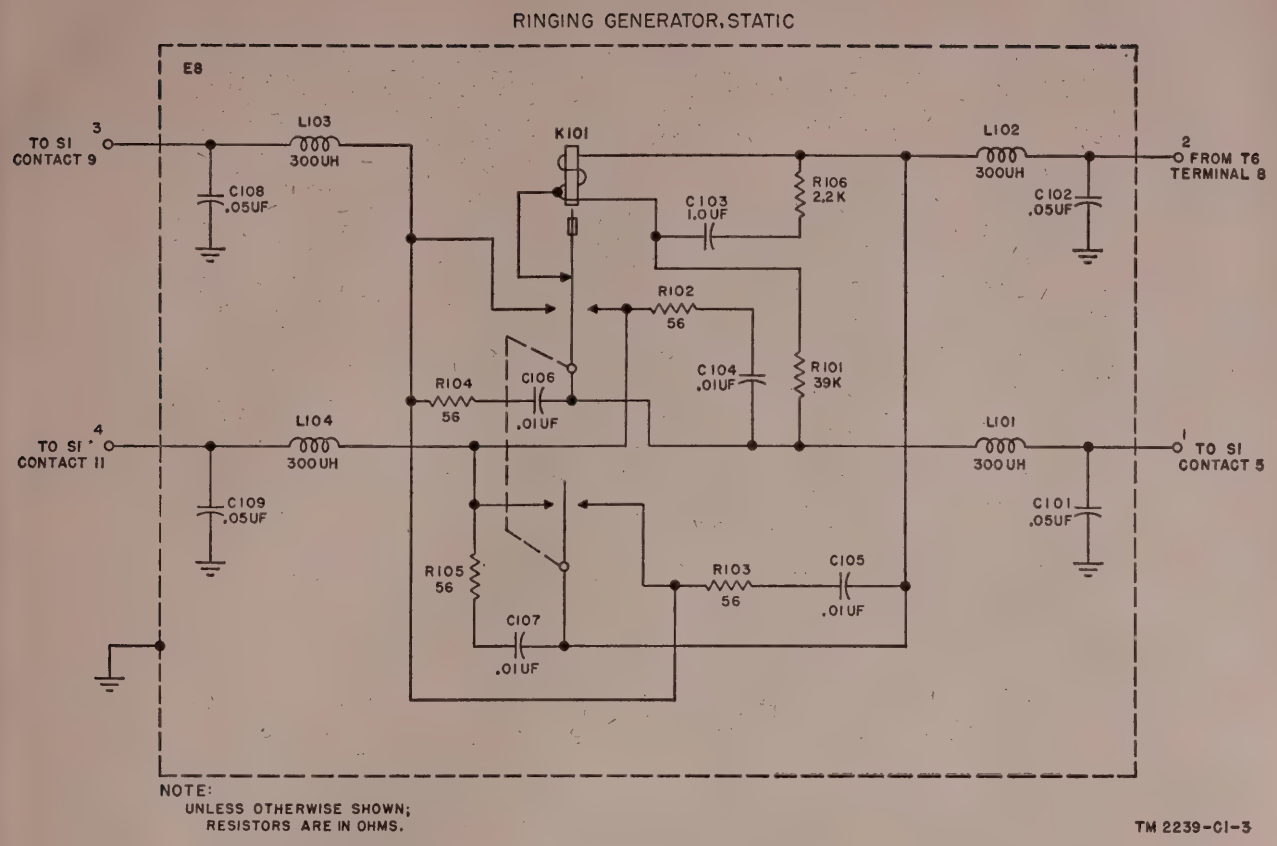


Figure 36.2. (Added) *Static ringing generator, circuit No. 3, schematic diagram.*

cies sufficiently high to introduce noise.

(5) The .33-μf capacitor in parallel with the relay winding in figure 36 corresponds in function to resistor R106 and capacitor C103 in figure 36.2.

(6) The position of the resistor and capacitor in each of the four motor-contact filter-networks (56-ohm resistor in series with a .01-μf capacitor) shown in figure 36 are interchanged in the circuit shown in figure 36.2.

82. Static Ringing Generator Circuit Operation

* * * * *

b. Operation of Static Ringing Generator Vibrator.

(1) The ringing generator * * * the motor contact. When current is first applied to the circuit, **it** flows from tube V15 **and the RING switch** through terminal 1, through the upper armature section to the motor contact, through the relay winding, and returns to tube V15 through terminal 2. The current flow * * * as it vibrates.

* * * * *

90.1. Equipment Differences

(Added)

a. Telegraph Terminal TH–5/TG.

(1) One of three types of static ringing generators (figs. 36, 36.1, and 36.2) is supplied with each terminal. The three types of static ringing generators have similar electrical properties and are electrically and mechanically interchangeable.

(2) Telegraph Terminals TH–5/TG, bearing Orders No. 30005–Phila–51 serial numbers 1 through 1100, 3289–Phila–52 serial numbers 1 through 900, and 6438–Phila–51 serial numbers 3036 through 3891 contain a provision for adjustment of the transmitting-circuit output-level. The adjustment is ac-

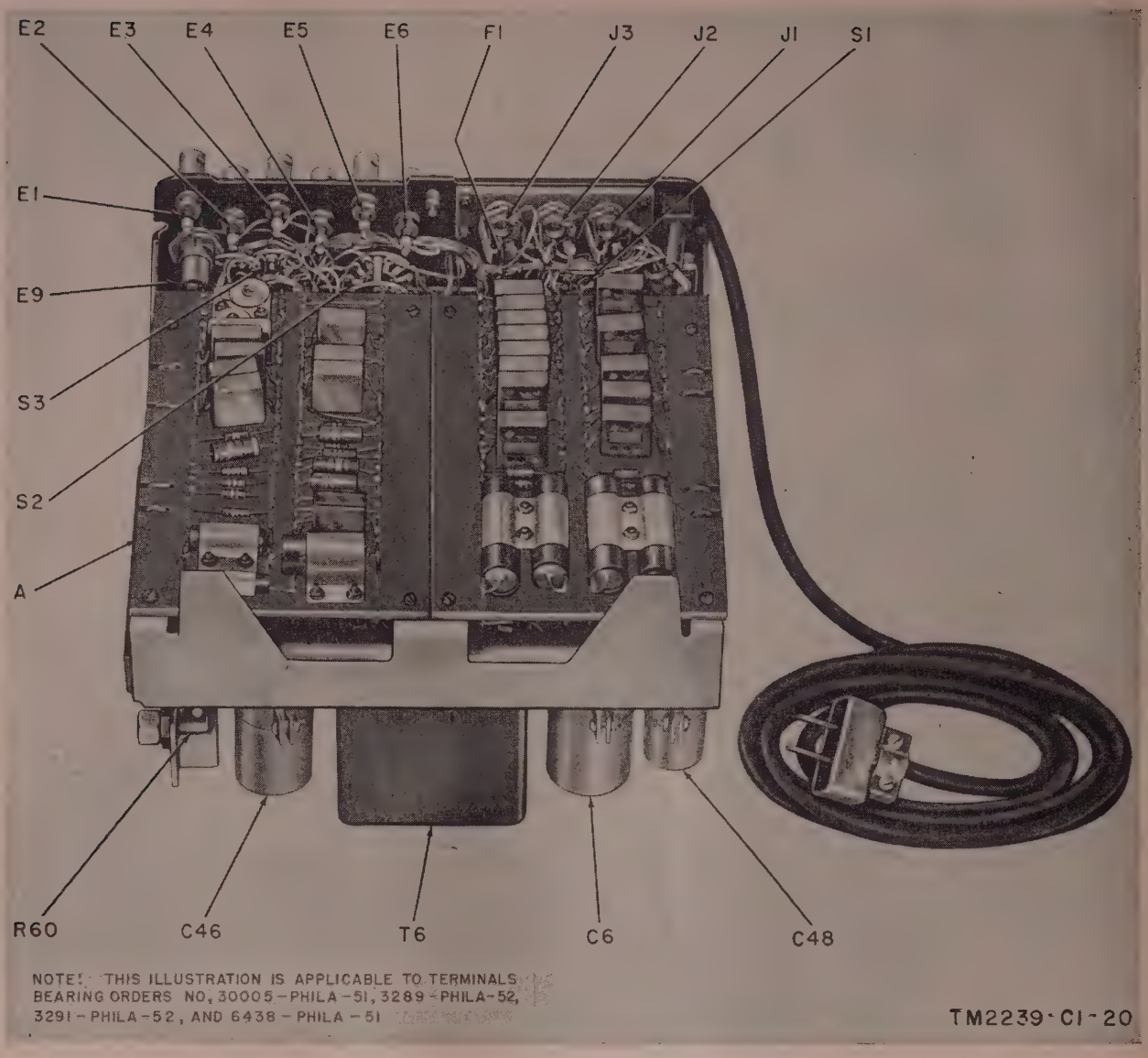


Figure 39.1. (Added) *Bottom view of chassis, showing terminal boards closed (see note).*

complished by strapping or unstrapping resistor R86 (figs. 24.1 and 49.1 and par. 55*a*). No provision for adjustment of the transmitting-circuit output-level is made in terminals not specified above.

b. Telegraph-Telephone Signal Converter TA–182/U. Refer to TM 11–2137 for a discussion of differences in models of Telegraph-Telephone Signal Converter TA–182/U.

91. Troubleshooting Data

The figure references listed below will aid in the rapid location of faults.

Fig. No.	Description
* *	* * *
39 and 39.1	Bottom * * * closed.
40 and 40.1	Bottom * * * open.
41 and 41.1	Location * * * boards.
* *	* * *
49 and 49.1	Telegraph * * * diagram.
* *	* * *

95. Troubleshooting Chart

The chart below * * * refer to TM 11–2137.

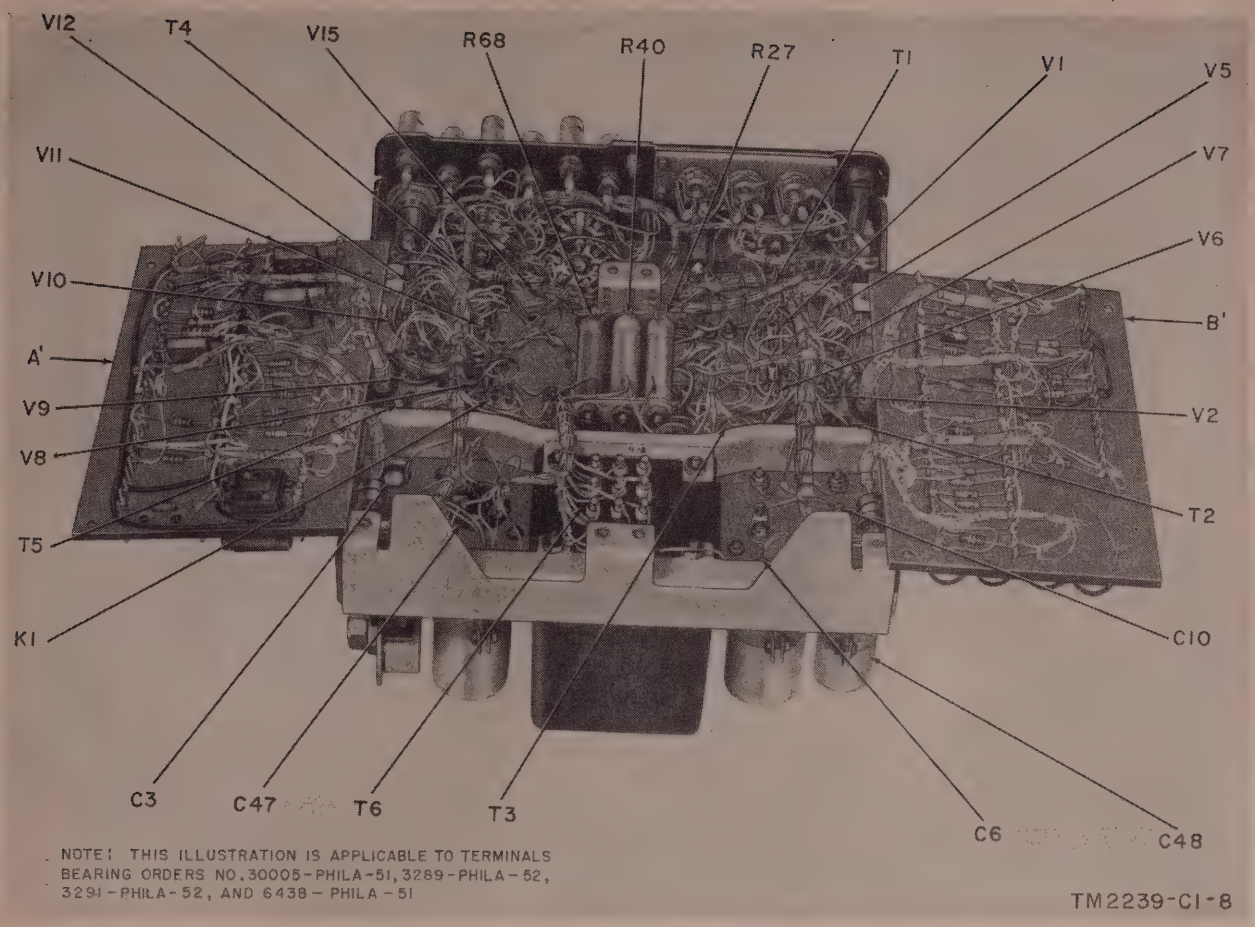


Figure 40.1. (Added) *Bottom view of chassis, showing terminal boards open (see note).*

Symptom	Probable trouble	Corrective action
* * *	* * *	* * *
Transmitted signal distorted . .	Time-delay * * * defective.	Check * * * (par. 62).
Transmitted signal outside 0 dbm ±2 db limits	**Tube V8(A) or associated circuit elements have been replaced.**	**If signal level is too high, remove strap from resistor R86. If signal level is too low, strap resistor R86 (par. 55a).**
* * *	* * *	* * *

Figure 40. The designation V8 and the associated arrow is deleted.

98. Voltage and Resistance Charts

* * * * *

b. Resistor-Capacitor Board, Voltage and Resistance Chart. Figure 42 shows * * * the terminals boards. These voltages duplicate those given in figure **48**. Refer to paragraph * * * the terminal boards.

99. Replacement of Parts

* * * * *

b. To replace any * * * the switch knob. Remove the knob and the metal washer from the switch shaft. Remove the large * * * connections are accessible.

114. Transmitting Circuit Tests

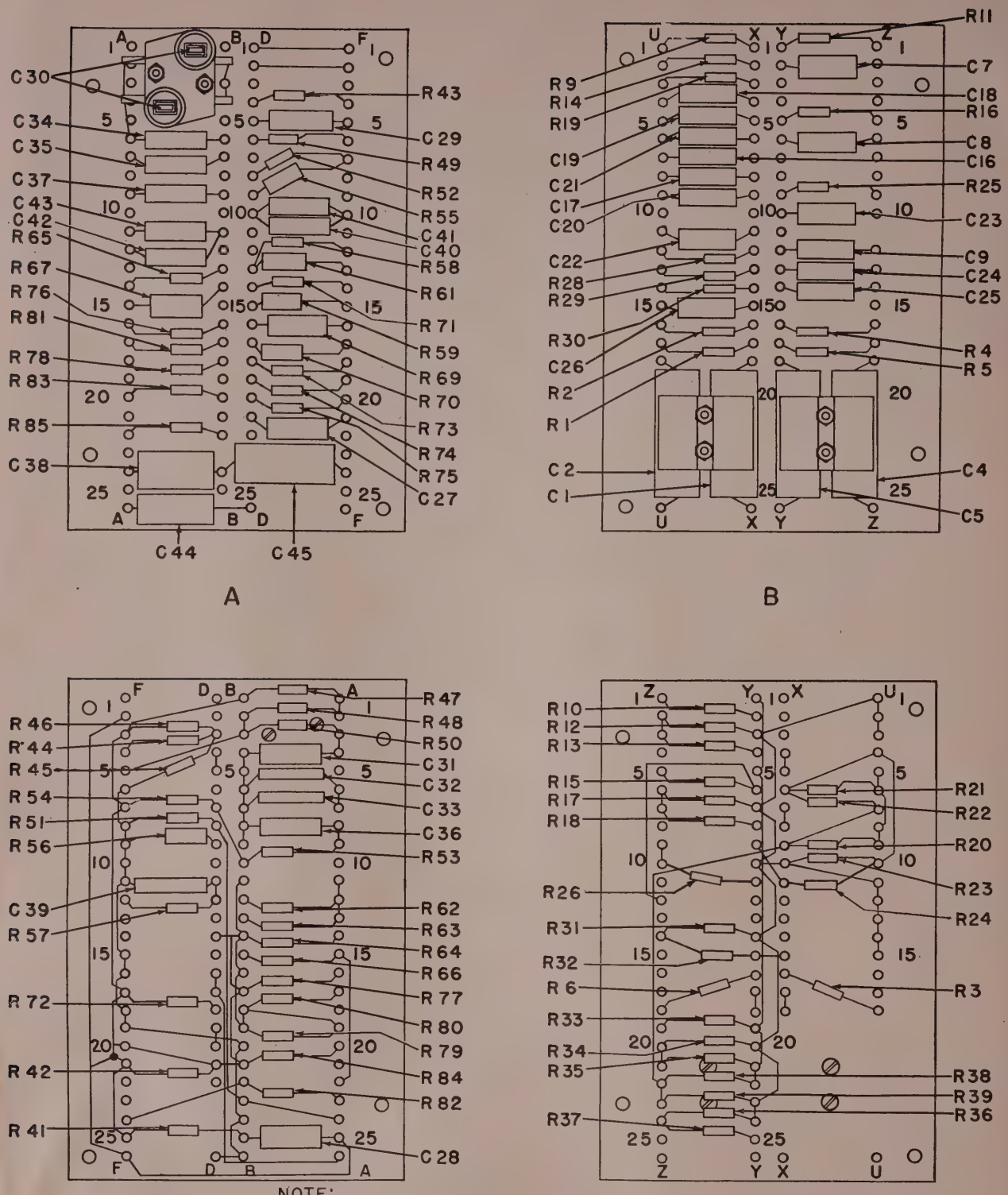
* * * * *

b. Carrier Leakage Test, Carrier Suppression Circuit. To test for carrier leakage in the carrier suppression circuit, proceed as follows:

* * * * *

(2) Connect Electronic Multimeter **ME–6A/U** to the 2W line binding posts.

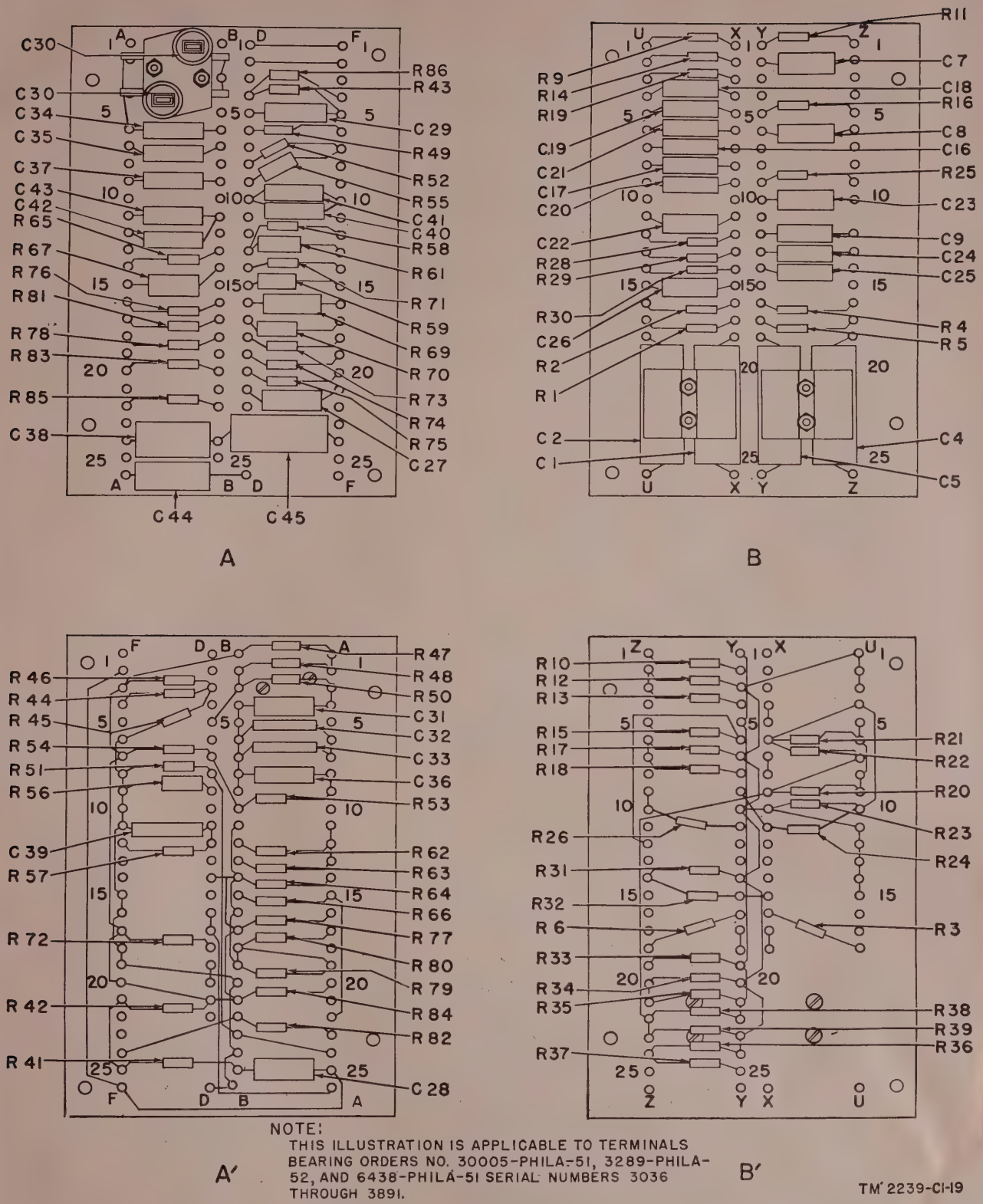
* * * * *



NOTE:
THIS ILLUSTRATION IS APPLICABLE TO TERMINALS BEARING ORDER NOS. 19650-PHILA-50, 3291-PHILA-52, AND 6438-PHILA-51 SERIAL NUMBERS 736 THROUGH 1105 AND 1274 THROUGH 3035.

TM 2239-CI-9

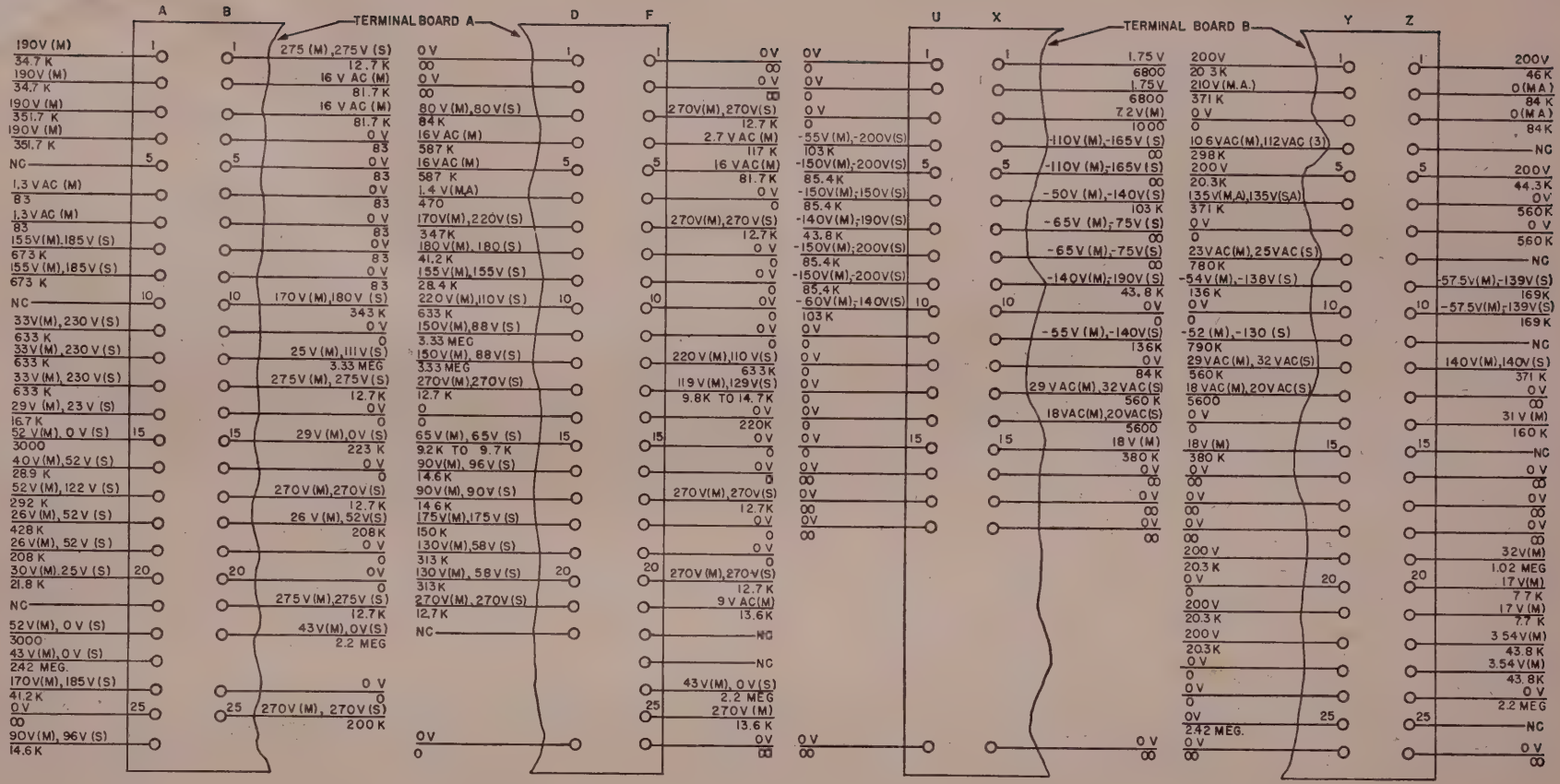
Figure 41. (Superseded) *Location of resistors and capacitors on terminal boards (see note).*



NOTE:
THIS ILLUSTRATION IS APPLICABLE TO TERMINALS BEARING ORDERS NO. 30005-PHILA-51, 3289-PHILA-52, AND 6438-PHILA-51 SERIAL NUMBERS 3036 THROUGH 3891.

TM 2239-CI-19

Figure 41.1. (Added) *Location of resistors and capacitors on terminal boards (see note).*



NOTES

1. 4W-2W-TEL SWITCH IN 2W POSITION
2. NORM-REC-SEND SWITCH IN SEND POSITION
3. S - INSERT DUMMY PLUG IN SEND JACK TO TRANSMIT SPACING SIGNAL.
4. M - REMOVE DUMMY PLUG FROM SEND JACK TO TRANSMIT MARKING SIGNAL
5. A - NORM-REC-SEND SWITCH IN REC POSITION.
6. RESISTANCES MEASURED IN OHMS TO GROUND

TM 2239-C1-41

Figure 42. (Superseded) *Resistor-capacitor terminal board, voltage and resistance chart.*

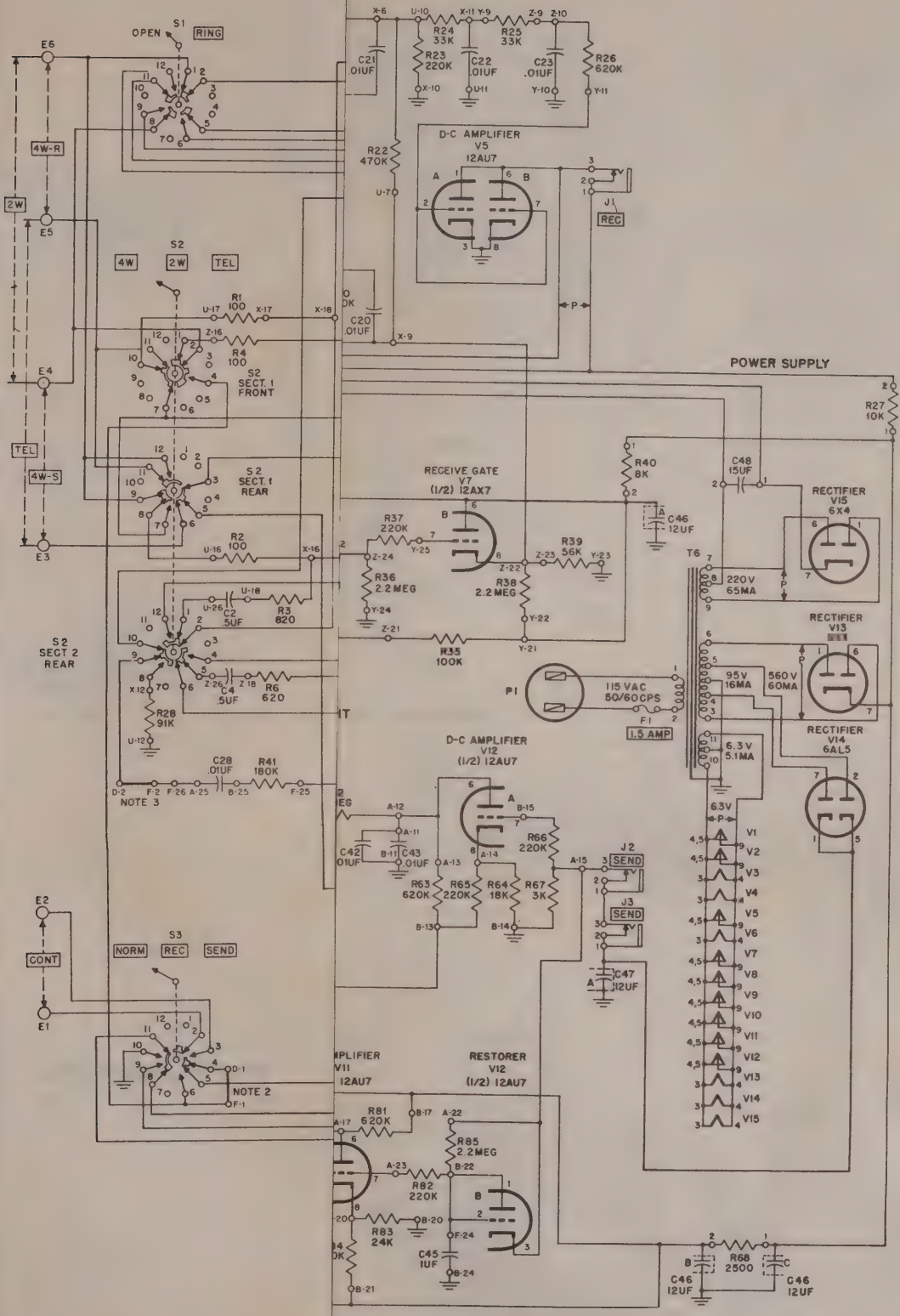
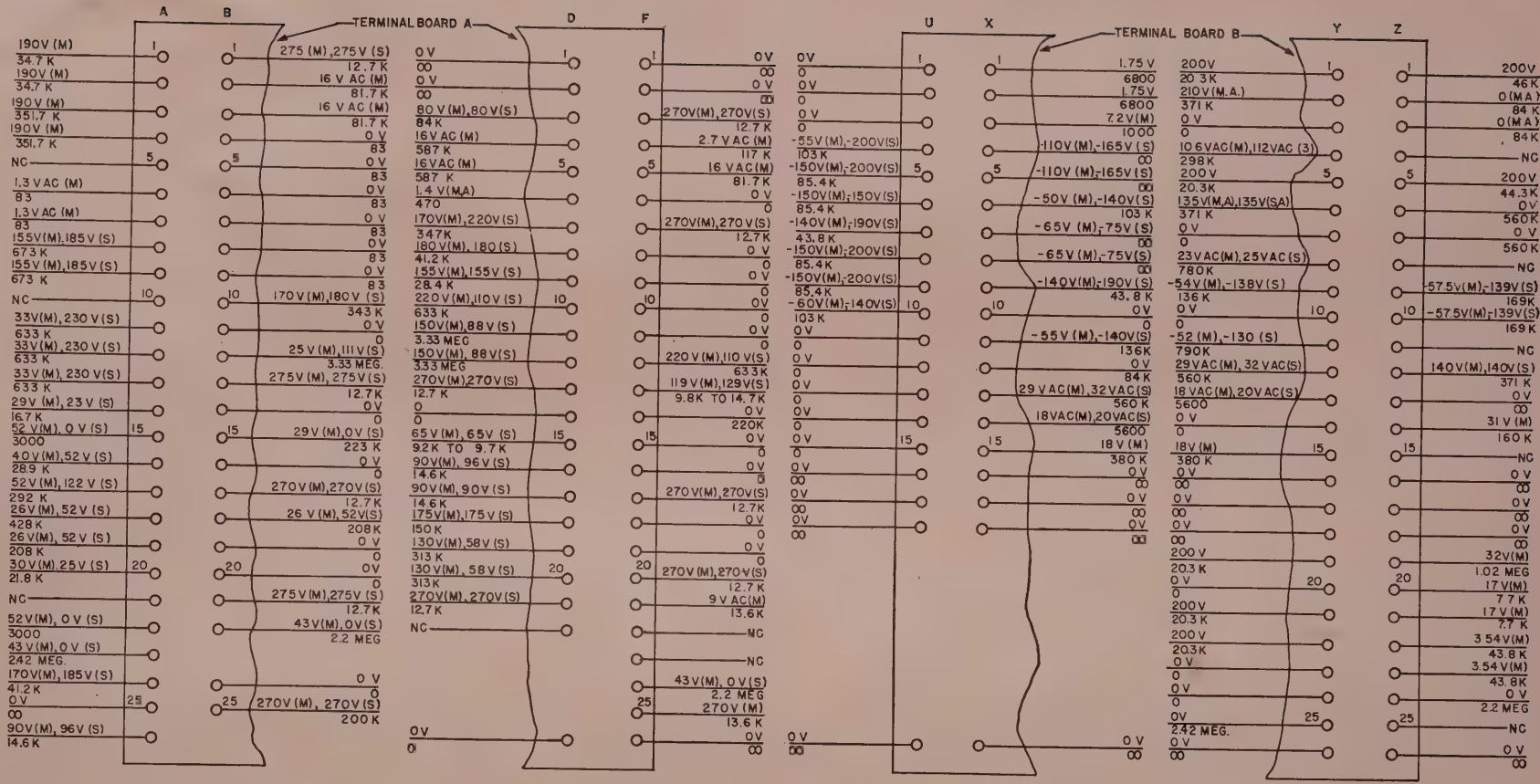


diagram (see note 9).

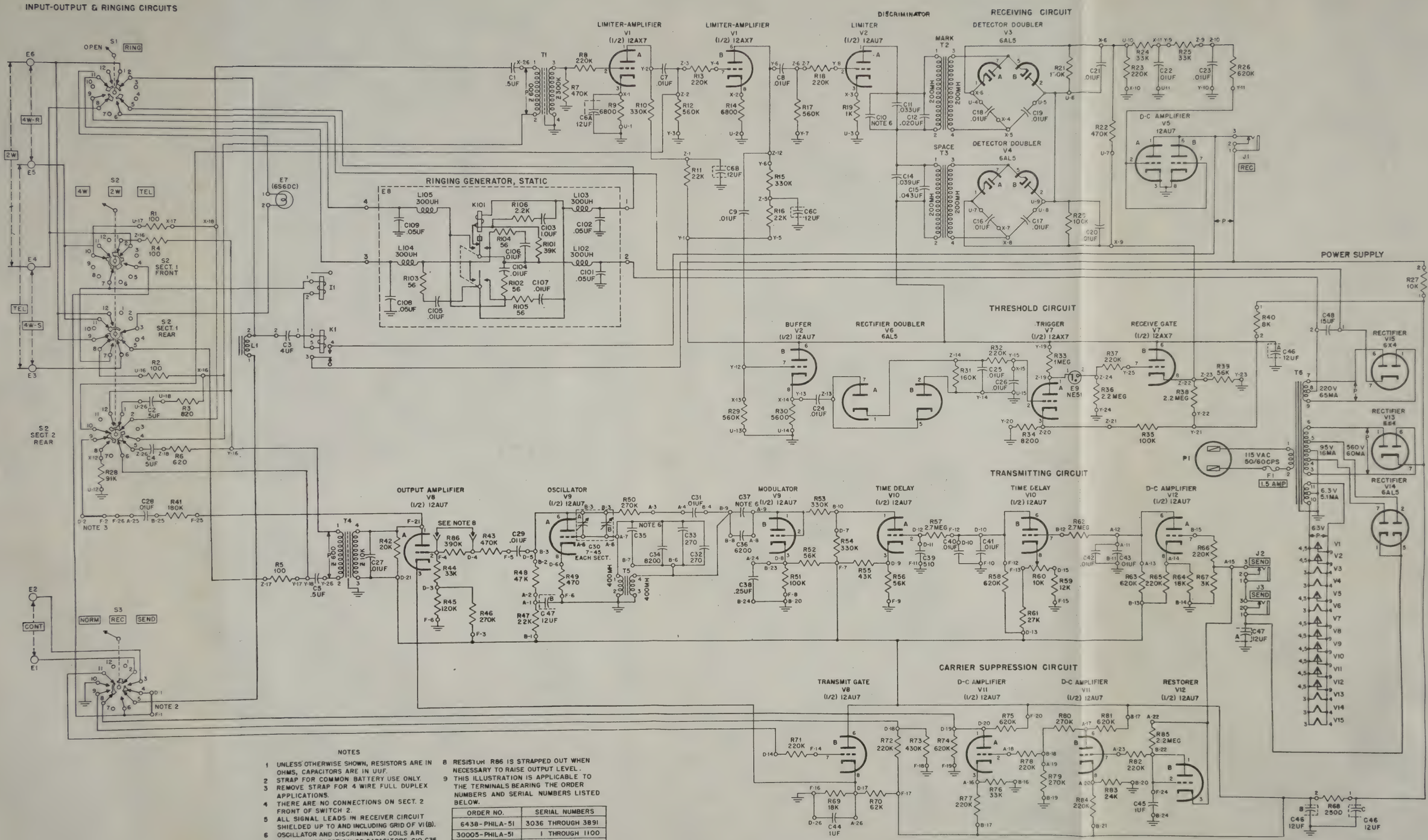
TM 2239-CI-17



NOTES

1. 4W-2W-TEL SWITCH IN 2W POSITION
2. NORM-REC-SEND SWITCH IN SEND POSITION
3. S – INSERT DUMMY PLUG IN SEND JACK TO TRANSMIT SPACING SIGNAL.
4. M – REMOVE DUMMY PLUG FROM SEND JACK TO TRANSMIT MARKING SIGNAL
5. A – NORM-REC-SEND SWITCH IN REC POSITION.
6. RESISTANCES MEASURED IN OHMS TO GROUND

Figure 42. (Superseded) *Resistor-capacitor terminal board, voltage and resistance chart.*



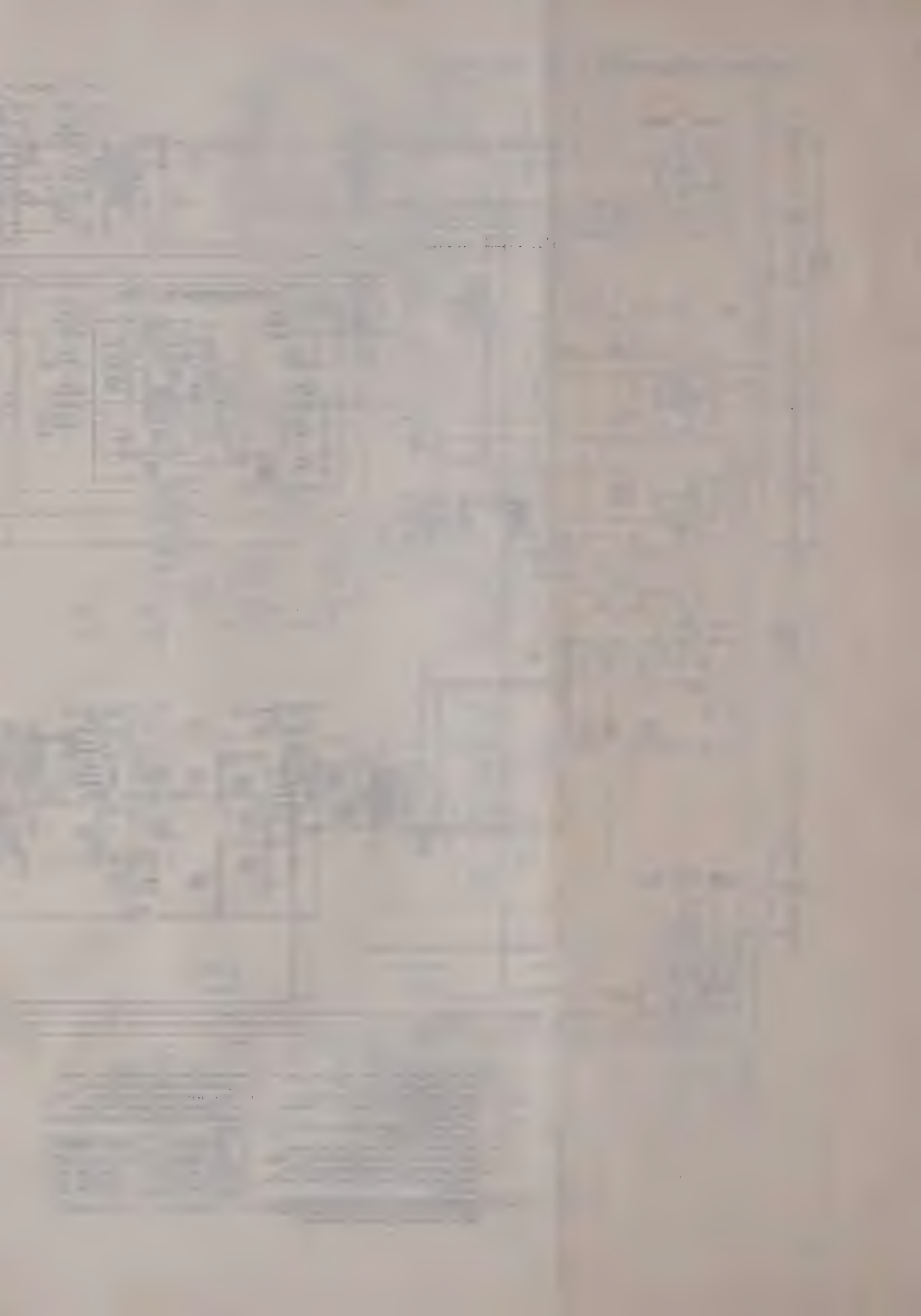
NOTES

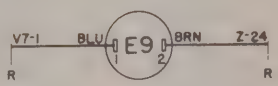
1. UNLESS OTHERWISE SHOWN, RESISTORS ARE IN OHMS, CAPACITORS ARE IN UUF.
2. STRAP FOR COMMON BATTERY USE ONLY.
3. REMOVE STRAP FOR 4 WIRE FULL DUPLEX APPLICATIONS.
4. THERE ARE NO CONNECTIONS ON SECT. 2 FRONT OF SWITCH 2.
5. ALL SIGNAL LEADS IN RECEIVER CIRCUIT SHIELDED UP TO AND INCLUDING GRID OF V1(B).
6. OSCILLATOR AND DISCRIMINATOR COILS ARE TUNED BY SELECTION OF CAPACITORS C10, C35 AND C37.
7. ROTARY SWITCHES ARE VIEWED FROM THE END NEARER TO CONTROL KNOB. SECTION 1 IS THE SECTION CLOSER TO THE KNOB.
8. RESISTOR R86 IS STRAPPED OUT WHEN NECESSARY TO RAISE OUTPUT LEVEL.
9. THIS ILLUSTRATION IS APPLICABLE TO THE TERMINALS BEARING THE ORDER NUMBERS AND SERIAL NUMBERS LISTED BELOW.

ORDER NO.	SERIAL NUMBERS
6438-PHILA-51	3036 THROUGH 3891
30005-PHILA-51	1 THROUGH 1100
3289-PHILA-52	1 THROUGH 900

Figure 49.1. (Added) *Telegraph Terminal TH–5/TG, schematic diagram (see note 9).*

TM 2239-CI-17

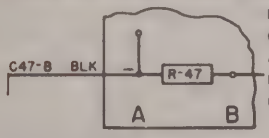




NOTES:

1-COLOR INDICATES COLOR OF TRACERS ON WHITE BASE WIRE.

2-LEGEND FOR AIRLINE WIRING DIAGRAM.



ILLUSTRATES WIRE IN THE "S" CABLE (SEND CABLE) WHICH IS CONNECTED TO TERMINAL A-1 OF TERMINAL BOARD ABCD. THE BLACK WIRE RUNS TO TERMINAL "B" OF CAPACITOR C-47.

3-WIRING CONVENTIONS:

A- BLU DENOTES COLOR CODED WIRE IN CABLE.

B- BRN DENOTES STRAPPING, COLOR CODED, (CHASSIS).

C- ------- DENOTES STRAPPING, BARE, (CHASSIS).

D _____ DENOTES STRAPPING, BARE & INSULATED, (TERMINAL BOARD).

4-STRAPPING ON SEND TERMINAL BOARD:

A- TERMINALS D-1 AND F-1 NORMALLY STRAPPED FOR COMMON BATTERY USE ONLY.

B- TERMINALS D-2 AND F-2 NORMALLY STRAPPED. REMOVE STRAP FOR 4 WIRE FULL DUPLEX OPERATION.

5-CABLE DESIGNATIONS:

"R" RECEIVE CABLE

"S" SEND CABLE

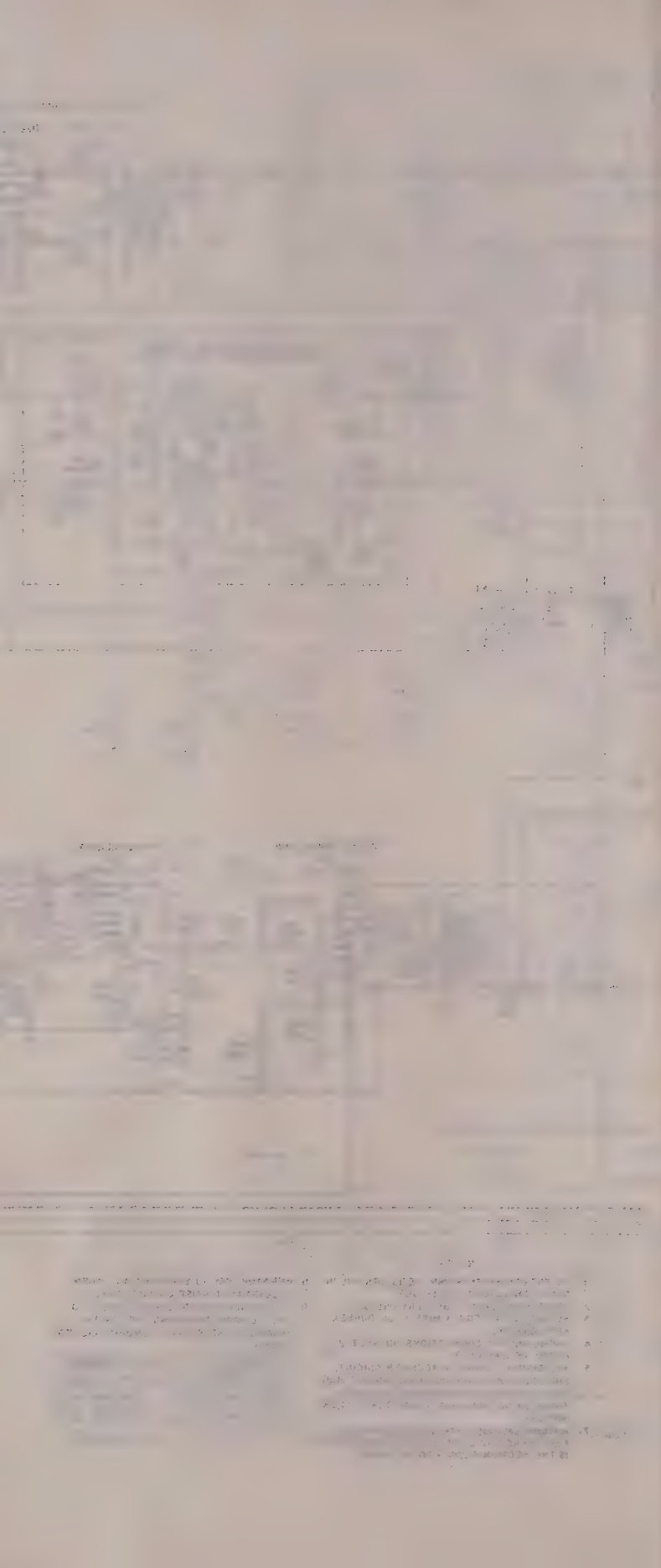
"P" POWER CABLE

6-THIS ILLUSTRATION IS APPLICABLE TO TERMINALS BEARING ORDERS NO. 30005-PHILA-51, 3289-PHILA-52, AND 6438-PHILA-51 SERIAL NUMBERS 3036 THROUGH 3891.

TM 2239-CI-97

3-2

(see note 6).



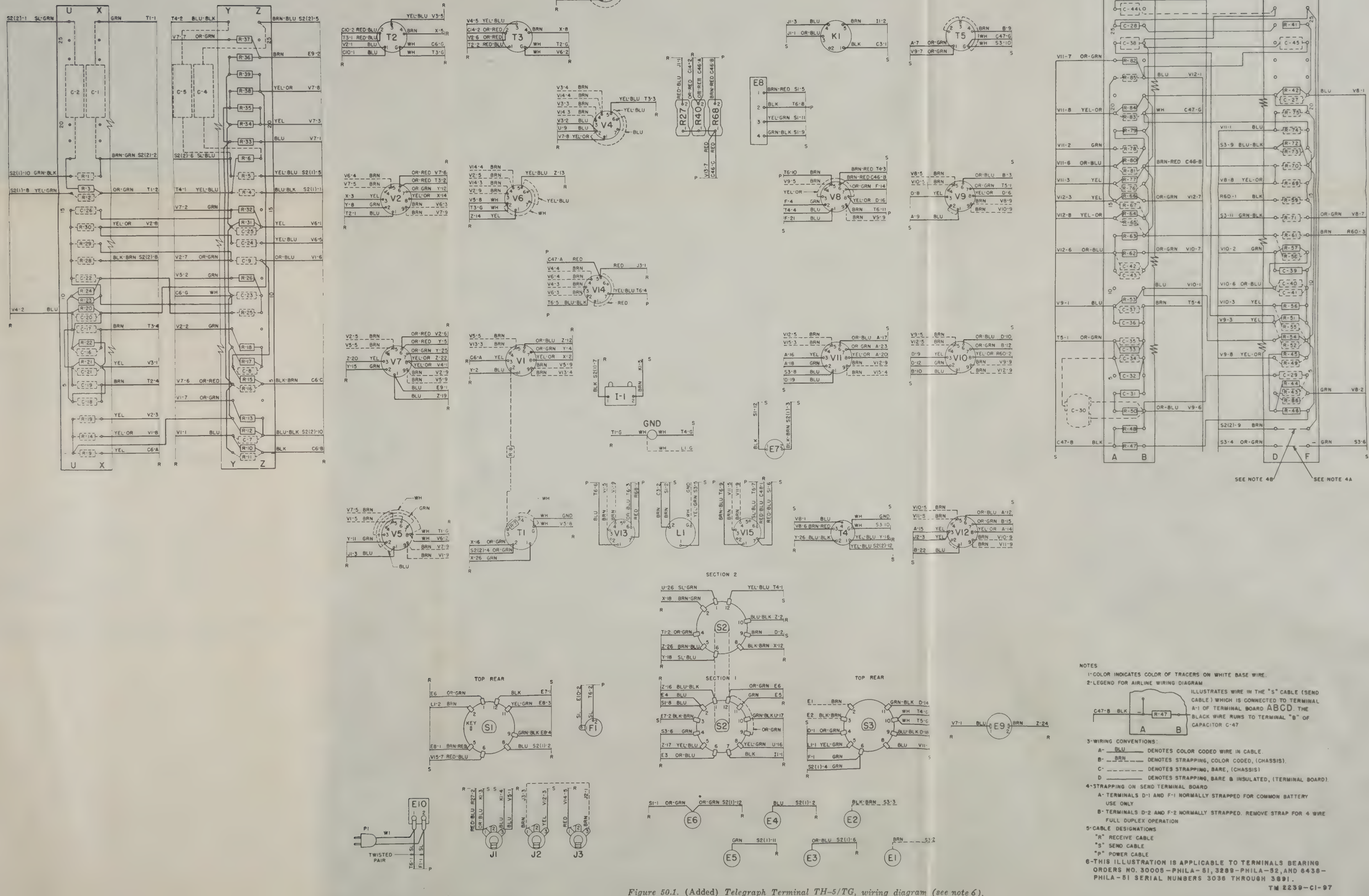


Figure 50.1. (Added) *Telegraph Terminal TH-5/TG, wiring diagram (see note 6).*

NOTES

1-COLOR INDICATES COLOR OF TRACERS ON WHITE BASE WIRE.

2-LEGEND FOR AIRLINE WIRING DIAGRAM.

ILLUSTRATES WIRE IN THE "S" CABLE (SEND CABLE) WHICH IS CONNECTED TO TERMINAL A-1 OF TERMINAL BOARD ABCD. THE BLACK WIRE RUNS TO TERMINAL "B" OF CAPACITOR C-47.

3-WIRING CONVENTIONS:

A- BLU ——— DENOTES COLOR CODED WIRE IN CABLE.

B- BRN — — — DENOTES STRAPPING, COLOR CODED, (CHASSIS).

C- _ _ _ _ _ _ DENOTES STRAPPING, BARE, (CHASSIS)

D ——— DENOTES STRAPPING, BARE & INSULATED, (TERMINAL BOARD).

4-STRAPPING ON SEND TERMINAL BOARD

A- TERMINALS D-1 AND F-1 NORMALLY STRAPPED FOR COMMON BATTERY USE ONLY

B- TERMINALS D-2 AND F-2 NORMALLY STRAPPED. REMOVE STRAP FOR 4 WIRE FULL DUPLEX OPERATION

5-CABLE DESIGNATIONS

"R" RECEIVE CABLE

"S" SEND CABLE

"P" POWER CABLE

6-THIS ILLUSTRATION IS APPLICABLE TO TERMINALS BEARING ORDERS NO. 30005-PHILA-51, 3289-PHILA-52, AND 6438-PHILA-51 SERIAL NUMBERS 3036 THROUGH 3691.

TM 2239-C1-97



d. (Superseded) *Transmitting Circuit Output Level Test.*

(1) Operate the 4W–2W–TEL switch to the 2W position.

(2) Operate the SEND-REC-NORM switch to the SEND position.

(3) Connect Electronic Multimeter ME–6/U to the 2W line binding posts with a 600-ohm resistor across the binding posts.

(4) The ME–6/U should read between .6 volt and 1 volt. If the reading is below .6 volt, strap out resistor R86 (par. 55*a*). If the reading is above 1 volt, unstrap resistor R86.

(5) Insert an open circuit plug into the SEND jack.

(6) The ME–6/U should read within .3 volt of the reading obtained in (4) above.

* * * * *

115. Receiving Circuit Tests

a. Threshold Circuit Check. To test the threshold circuit proceed as follows:

* * * * *

(4) Use the attenuator * * * receives correct copy. The neon lamp should light when the inserted attenuation reduces the signal to a level below —**50 dbm.**

* * * * *

APPENDIX II

IDENTIFICATION TABLE OF PARTS

Rescinded

Figure 49. Telegraph Terminal TH–5/TG, schematic diagram ***(see note 8).***

Figure 49. The following note is added:

8. THIS ILLUSTRATION IS APPLICABLE TO TERMINALS BEARING ORDERS NO. 19650–PHILA–50, 3291–PHILA–52, AND 6438–PHILA–51 SERIAL NUMBERS 736 THROUGH 1105 AND 1274 THROUGH 3035.

Figure 50. At terminal boards UX and YX, cable designations are changed from S to R in four places. A strap is added between terminals Z9 and Z10 on terminal board YZ. At transformer T5 the color designation WH is added to the wire connecting T5(3) and T5(G).

Figure 50. Telegraph Terminal TH–5/TG, wiring diagram ***(Orders No. 19650–Phila–50, 3291–Phila–52, 6438–Phila–51 serial numbers 736 through 1105 and 1274 through 3035.***

[AG 413.4 (26 Mar 54)]

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For explanation of distribution formula, see SR 310–90–1.

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DEPARTMENT OF THE ARMY TECHNICAL MANUAL
DEPARTMENT OF THE AIR FORCE TECHNICAL ORDER

TELEGRAPH-TELEPHONE TERMINAL AN/TCC-14

TM11-2239
TO 31W4-2TCC14-1
CHANGES No. 2

DEPARTMENTS OF THE ARMY AND
THE AIR FORCE
WASHINGTON 25, D. C., *27 September 1955*

TM 11-2239/TO 31W4-2TCC14-1, 4 April 1952, is changed as follows:

10. Technical Characteristics

Telegraph-Telephone Terminal AN/TCC-14 * * * and *b* below.

* * * * *

b. Electrical Filter Assembly F-98/U.

* * * * *

Weight..... 25 lb.
Input power level..... 0 dbm (peaks up to +5 dbm permissible).

43. System Sectionalization

* * * * *

c. Checking Telegraph-Telephone Signal Converter TA-128/U.

* * * * *

(2) Remove the TA-182/U * * * will be possible.

Note. (Added) When the equipment is being operated with a push-to-talk radio, the F-98/U will create a distortion in the telegraph circuit if the input to the F-98/U is over +5 dbm. To prevent this, limit the output of the radio so that the input to the F-98/U is within the 0 dbm to +5 dbm range.

* * * * *

45. Equipment Performance Checklist

* * * * *

c. Electrical Filter Assembly F-98/U. There is no * * * a sealed unit. **To avoid distortion in the telegraph circuit when the telephone circuit is being used with a push-to-talk radio, maintain a 0 dbm to +5 dbm input level to the F-98/U.**

83. General

Electrical Filter Assembly * * * satisfactory telephone circuit.

Note. (Added) Voice frequencies within the telegraph frequency range will interfere with the telegraph signals if the frequency input power is over +5 dbm. This condition may exist when the AN/TCC-14 is operating with a push-to-talk radio transmitting on the telephone circuit. To eliminate this distortion, limit the input to the F-98/U between 0 and +5 dbm.

95. Troubleshooting Chart

The chart below * * * to TM 11-2137.

Symptom	Probable trouble	Corrective action
*	* *	* *
Transmitted signal distorted.	Time-delay * * * defective.	Check * * * (par. 62).
	Power applied to F-98/U too high.	**Lower output of transmitting unit.**
*	* *	* *

APPENDIX I

REFERENCES

Rescinded

[AG 413.4 (15 Aug 55)]

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USMA (5)	8–187R (2)	44–12R (2)
Gen & Br Svc Sch (5) except SigC Sch (25)	8–581R (2)	44–70R (2)
	8–590R (2)	44–101R (2)
Gen Depots (2) except Atlanta Gen Depot (None)	8–667R (2)	44–112R (2)
	9–12R (2)	44–201R (2)
SigC Sec, Gen Depots (10)	10–22R (2)	55–12R (2)
SigC Depots (20)	11–7R (2)	55–16R (2)
POE (2)	11–15R (2)	55–56R (2)
OS Sup Agencies (2)	11–16R (2)	55–202R (2)
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	11–95R (2)	

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USAR: None.
For explanation of abbreviations used, see SR 320–50–1.

U. S. GOVERNMENT PRINTING OFFICE: 1955

TELEGRAPH–TELEPHONE TERMINAL

AN/TCC–14

United States Government Printing Office
Washington: 1952

AGO 3243A

DEPARTMENTS OF THE ARMY AND
THE AIR FORCE

WASHINGTON 25, D. C., *4 April 1952*

TM 11–2239/TO 16–30TCC14–5 is published for the information and guidance of all concerned.

[AG 413.4 (21 Mar 52)]

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CONTENTS

		Paragraphs	Page
CHAPTER 1.	**INTRODUCTION**		
Section I.	General	1, 2	1
II.	Description and data	3–17	1
CHAPTER 2.	**OPERATING INSTRUCTIONS**		
Section I.	Service upon receipt of Telegraph-Telephone Terminal AN/TCC–14	18–22	14
II.	Controls	23–25	18
III.	Operation under usual conditions	26–30	19
IV.	Operation under unusual conditions	31–34	21
CHAPTER 3.	**ORGANIZATIONAL MAINTENANCE INSTRUCTIONS**		
Section I.	Preventive maintenance services	35–38	22
II.	Weatherproofing and painting	39, 40	24
III.	Trouble shooting at organizational maintenance level	41–45	24
CHAPTER 4.	**AUXILIARY EQUIPMENT**	46, 47	27
5.	**THEORY**		
Section I.	Theory of Telegraph Terminal TH–5/TG	48–82	28
II.	Theory of Electrical Filter Assembly F–98/U	83, 84	47
CHAPTER 6.	**FIELD MAINTENANCE INSTRUCTIONS**		
Section I.	Prerepair procedure	85–89	50
II.	Trouble shooting at field maintenance level	90–98	51
III.	Repair	99, 100	57
IV.	Alinement procedures	101–110	58
V.	Final testing	111–117	64
CHAPTER 7.	**SHIPMENT AND LIMITED STORAGE AND DEMOLITION TO PREVENT ENEMY USE**		
Section I.	Shipment and limited storage	118, 119	67
II.	Demolition to prevent enemy use	120, 121	67
APPENDIX I.	**REFERENCES**		68
II.	**IDENTIFICATION TABLE OF PARTS**		70
INDEX			81

WARNING

Heavy currents at moderate potentials are carried in the wiring of this equipment. These currents are dangerous to life.

All operating adjustments of this equipment are made with the power on. Be careful when examining the wiring of the equipment.

When repairing or replacing parts on a particular circuit, remove the power cord to avoid possible electrocution.



First Aid for Electric Shock

RESCUE.

In case of electric shock, shut off the high voltage at once and ground the circuits. If the high voltage cannot be turned off without delay, free the victim from contact with the live conductor as promptly as possible. Avoid direct contact with either the live conductor or the victim's body. Use a dry board, dry clothing, or other nonconductor to free the victim. An ax may be used to cut the high-voltage wire. Use extreme caution to avoid the resulting electric flash.

SYMPTOMS.

a. Breathing stops abruptly in electric shock if the current passes through the breathing center at the base of the brain. If the shock has not been too severe, the breath center recovers after a while and normal breathing is resumed, provided that a sufficient supply of air has been furnished meanwhile by artificial respiration.

b. The victim is usually very white or blue. The pulse is very weak or entirely absent and unconsciousness is complete. Burns are usually present. The victim's body may become rigid or stiff in a very few minutes. This condition is due to the action of electricity and is not to be considered rigor mortis. Artificial respiration must still be given, as several such cases are reported to have recovered. The ordinary and general tests for death should never be accepted.

TREATMENT.

a. Start artificial respiration immediately. At the same time send for a medical officer, if assistance is available. Do not leave the victim unattended. Perform artificial respiration at the scene of the accident, unless the victim's or operator's life is endangered from such action. *In this case only,* remove the victim to another location, but no farther than is necessary for safety. If the new location is more than a few feet away, artificial respiration should be given while the victim is being moved. If the method of transportation prohibits the use of the Shaeffer prone pressure method, other methods of resuscitation may be used. Pressure may be exerted on the front of the victim's diaphragm, or the direct mouth-to-mouth method may be used. Artificial respiration, once started, must be continued, without loss of rhythm.

b. Lay the victim in a prone position, one arm extended directly overhead, and the other arm bent at the elbow so that the back of the hand supports the head. The face should be turned away from the bent elbow so that the nose and mouth are free for breathing.

c. Open the victim's mouth and remove any foreign bodies, such as false teeth, chewing gum, or tobacco. The mouth should remain open, with the tongue extended. Do not permit the victim to draw his tongue back into his mouth or throat.

d. If an assistant is available during resuscitation, he should loosen any tight clothing to permit free circulation of blood and to prevent restriction of breathing. He should see that the victim is kept warm, by applying blankets or other covering, or by applying hot rocks or bricks wrapped in cloth or paper to prevent injury to the victim. The assistant should also be ever watchful to see that the victim does not swallow his tongue. He should continually wipe from the victim's mouth any frothy mucus or saliva that may collect and interfere with respiration.

e. The resuscitating operator should straddle the victim's thighs, or one leg, in such manner that:

(*1*) the operator's arms and thighs will be vertical while applying pressure on the small of the victim's back;

(*2*) the operator's fingers are in a natural position on the victim's back with the little finger lying on the last rib;

(*3*) the heels of the hands rest on either side of the spine as far apart as convenient without allowing the hands to slip off the victim;

(*4*) the operator's elbows are straight and locked.

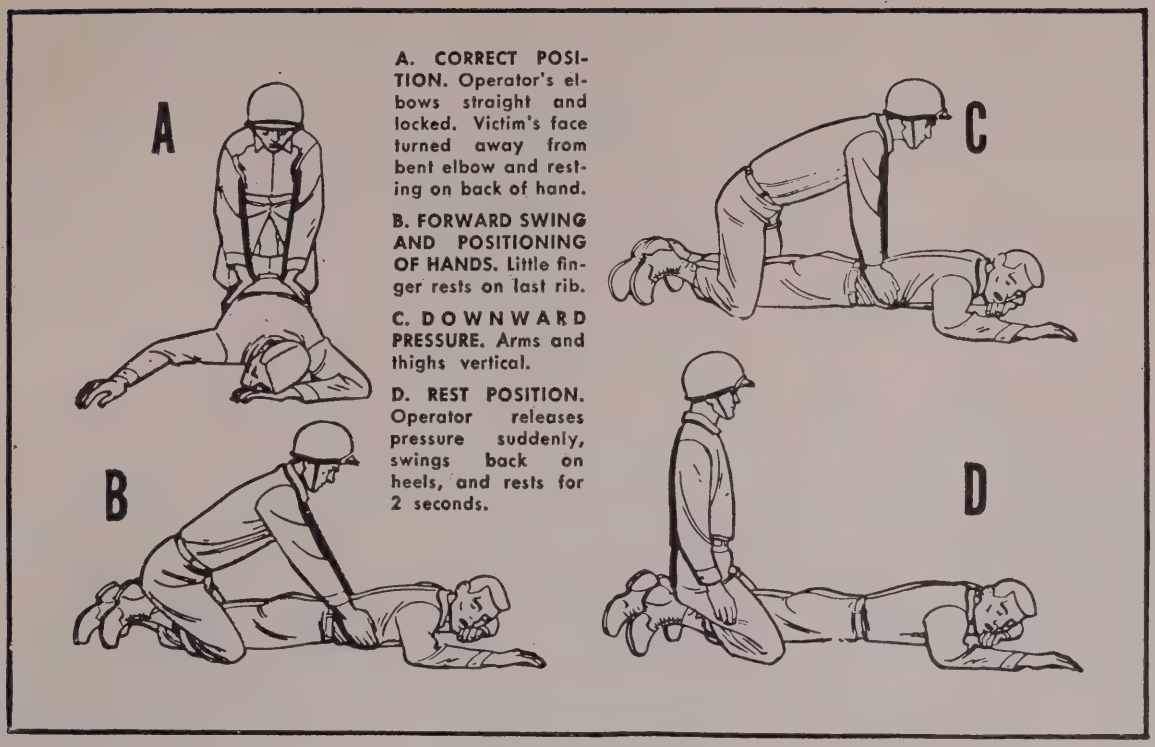
f. The resuscitation procedure is as follows:

(*1*) Exert downward pressure, not exceeding 60 pounds, for 1 second.

(*2*) Swing back, suddenly releasing pressure, and sit up on the heels.

(*3*) After 2 seconds rest, swing forward again, positioning the hands exactly as before, and apply pressure for another second.

g. The forward swing, positioning of the hands, and the downward pressure should be accomplished in one continuous motion, which requires 1 second. The release and backward swing require 1 second. The addition of the 2-second rest makes a total of 4



A. CORRECT POSITION. Operator's elbows straight and locked. Victim's face turned away from bent elbow and resting on back of hand.

B. FORWARD SWING AND POSITIONING OF HANDS. Little finger rests on last rib.

C. DOWNWARD PRESSURE. Arms and thighs vertical.

D. REST POSITION. Operator releases pressure suddenly, swings back on heels, and rests for 2 seconds.

seconds for a complete cycle. Until the operator is thoroughly familiar with the correct cadence of the cycle, he should count the seconds aloud, speaking distinctly and counting evenly in thousands. Example: one thousand and one, one thousand and two, etc.

h. Artificial respiration should be continued until the victim regains normal breathing or is pronounced dead by a medical officer. Since it may be necessary to continue resuscitation for several hours, relief operators should be used if available.

RELIEVING OPERATOR.

The relief operator kneels beside the operator and follows him through several complete cycles. When the relief operator is sure he has the correct rhythm, he places his hands on the operator's hands without applying pressure. This indicates that he is ready to take over. On the backward swing, the operator moves and the relief operator takes his position. The relieved operator follows through several complete cycles to be sure that the new operator has the correct rhythm. He remains alert to take over instantly if the new operator falters or hesitates on the cycle.

STIMULANTS.

a. If an inhalant stimulant is used, such as aromatic spirits of ammonia, the individual administering the stimulant should first test it himself to see how close he can hold the inhalant to his own nostril for comfortable breathing. Be sure that the inhalant is not held any closer to the victim's nostrils, and then for only 1 or 2 seconds every minute.

b. After the victim has regained consciousness, he may be given hot coffee, hot tea, or a glass of water containing ½ teaspoon of aromatic spirits of ammonia. *Do not give any liquids to an unconscious victim.*

CAUTIONS.

a. After the victim revives, keep him LYING QUIETLY. Any injury a person may have received may cause a condition of shock. Shock is present if the victim is pale and has a cold sweat, his pulse is weak and rapid, and his breathing is short and gasping.

b. keep the victim lying flat on his back, with his head lower than the rest of his body and his hips elevated. Be sure that there is no tight clothing to restrict the free circulation of blood or hinder natural breathing. Keep him warm and quiet.

c. A resuscitated victim must be watched carefully as he may suddenly stop breathing. *Never leave a resuscitated person alone until it is CERTAIN that he is fully conscious and breathing normally.*

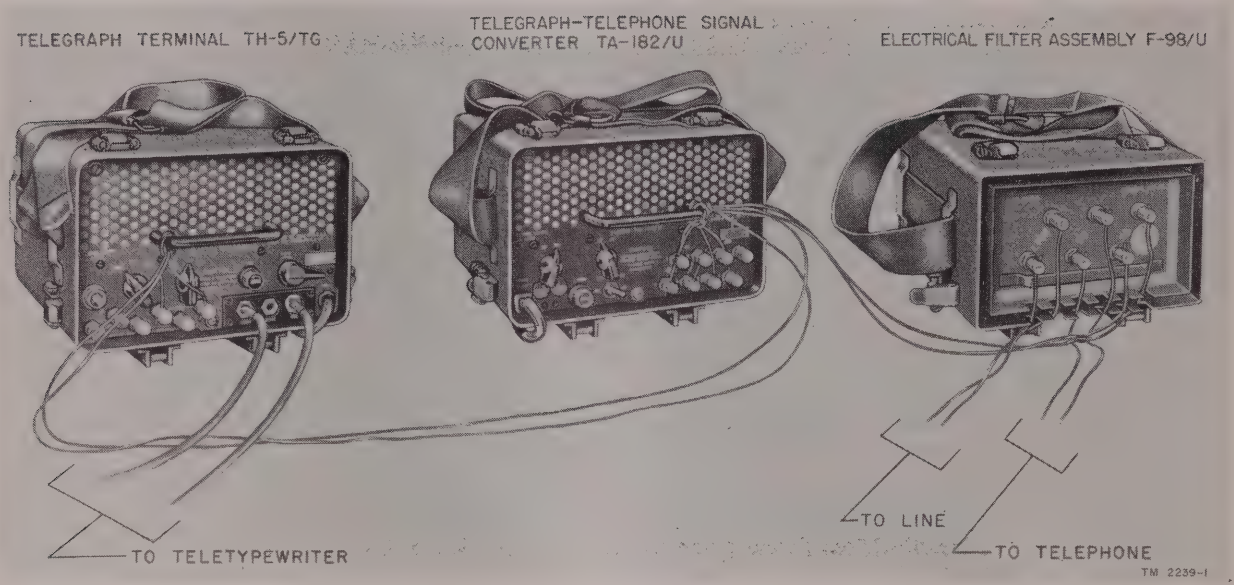


Figure 1. Telegraph-Telephone Terminal AN/TCC-14.

CHAPTER 1

INTRODUCTION

Section I. GENERAL

1. Scope

a. These instructions are published for the information and guidance of the personnel to whom this equipment is issued. They contain information for the installation, operation, maintenance, and repair of Telegraph-Telephone Terminal AN/TCC–14.

b. This manual includes two appendixes. Appendix I covers a list of references. Appendix II contains an identification table of parts.

2. Forms and Records

The following forms will be used for reporting unsatisfactory conditions of Army equipment and in performing preventive maintenance:

a. DD Form 6, Report of Damaged or Improper Shipment, will be filled out and forwarded as prescribed in SR 745–45–5 (Army), and AFR 71–4 (Air Force).

b. 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.

c. AF Form 54, Unsatisfactory Report, will be filled out and forwarded to Commanding General, Air Matériel Command, Wright-Patterson Air Force Base, Dayton, Ohio, as prescribed in SR 700–45–5 and AFR 65–26.

d. DA AGO 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.

e. DA AGO 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.

f. Use other forms and records as authorized.

Section II. DESCRIPTION AND DATA

3. Purpose and Use

a. Purpose. Telegraph-Telephone Terminal AN/TCC–14 (fig. 1) is a combination of three separate components. These components are Telegraph Terminal TH–5/TG; Electrical Filter Assembly F–98/U; and Telegraph-Telephone Signal Converter TA–182/U. This combination permits simultaneous transmission of telegraph pulses and of speech. The telegraph signals utilize a portion of the frequency band used by the telephone channel while permitting the use of the channel for speech transmission.

b. Use. Telegraph-Telephone Terminal AN/TCC–14 may be used in point-to-point systems, network systems, switched systems, and remote control radio systems. These terms are defined in paragraph 4 and explained in paragraphs 6 through 9.

Note. Throughout this manual, reference to AN/TCC–14 will be used to refer to Telegraph-Telephone Terminal AN/TCC–14. Similarly, TH–5/TG will refer to Telegraph Terminal TH–5/TG; F–98/U will refer to Electrical Filter Assembly F–98/U; and TA–182/U will refer to Telegraph-Telephone Signal Converter TA–182/U.

4. Types of Systems

Telegraph-Telephone Terminal AN/TCC–14 may be used in conjunction with four different types of systems. These systems are defined in the following subparagraphs and their applications are explained in paragraphs 6 through 9.

a. Point-to-Point System. A point-to-point system is a system of communication between two fixed teletypewriter stations using Telegraph-Telephone Terminals AN/TCC–14.

b. Network System. A network system is a system of communication between three or more teletypewriter stations. In this system, any station may communicate with any other station by using a prearranged code call.

c. Switched System. A switched system is a system of communication between teletypewriter stations that are connected through a switchboard. The station operator makes contact with the switchboard operator who connects the station to another station.

d. Remote Control Radio System. A remote control radio system is a system of communication that integrates radio and wire facilities. The control devices automatically connect a radio transmitter upon receipt of the proper calling signal and automatically disconnect the transmitter when the calling signal is removed. This type of control is normally used with push-to-talk radio. The term push-to-talk radio is used to describe a radio which transmits and receives on the same frequency. Transmission and reception cannot be carried on simultaneously. Normally, the radio transmitter is disabled and the receiver is functioning (stand-by condition). To transmit, a d-c (direct-current) closure must be provided to turn on the transmitter and disable the receiver. This closure is provided by a remote control unit when operating over a 2-wire circuit, and by a TH–5/TG when operating over a 4-wire circuit.

5. System Applications of Telegraph-Telephone Terminal AN/TCC–14

Telegraph-Telephone Terminal AN/TCC–14 utilizes existing telephone facilities. It does not require a special d-c teletypewriter switchboard; instead, the voice-frequency telegraph loops may be switched through telephone switchboards. The AN/TCC–14 is provided with the necessary components needed to retain normal telephone signaling and supervisory procedures for both local battery and common battery switchboards. Applications of the AN/TCC–14 and its components are discussed in paragraphs 6 through 9.

6. Telegraph Only Service, System Application

Telegraph only service is designed solely for teletypewriter communication. Speech transmission is not involved.

a. Use on Local Battery Switchboard. Figure 2 illustrates a teletypewriter station connected over a loop circuit through a local battery switchboard. The teletypewriter switchboard operator is provided with a monitoring Telegraph Terminal TH–5/TG and a teletypewriter. The teletypewriter station operator may initiate a call by operating the RING switch of the associated TH–5/TG. This operates a drop at the local battery switchboard. The teletypewriter switchboard operator uses the associated teletypewriter to acknowledge the call. The teletypewriter switchboard operator then uses the TH–5/TG to ring the called teletypewriter station. The teletypewriter station operator rings the teletypewriter switchboard operator to signify the end of their communication, and the switchboard operator disconnects the circuit.

b. Use on Common Battery Switchboard. When a common battery switchboard is used in place of a local battery switchboard (*a* above), the following procedure is used: In the common battery application, TH–5/TG switch 4W—2W—TEL (fig. 21) is used to call the teletypewriter switchboard operator. When the 4W—2W—TEL switch is in the TEL position, an open circuit to dc is presented to the line. (This position corresponds to the common battery telephone receiver being on its hookswitch.) To initiate a call, a teletypewriter operator rotates the 4W—2W—TEL switch to the 2W position. (This corresponds to removing the telephone receiver from its hookswitch.) When the 4W—2W—TEL switch is in the 2W position, a holding coil in the TH–5/TG is placed across the 2-wire line. This provides a d-c closure at the switchboard, and the switchboard lamp lights.

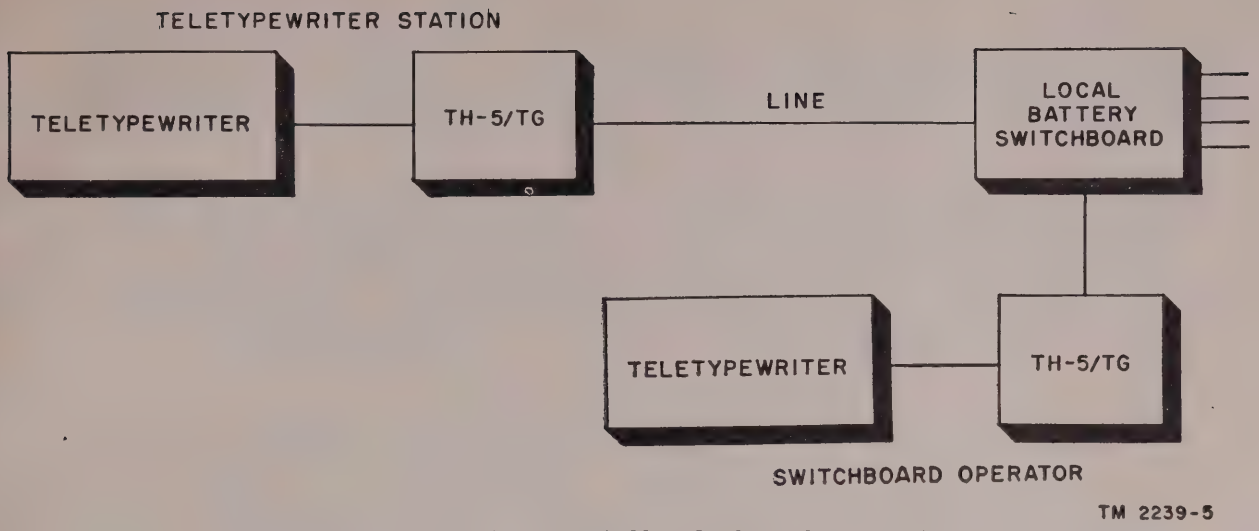


Figure 2. Local battery switchboard, telegraph only service.

The teletypewriter switchboard operator uses an associated teletypewriter to acknowledge the call, and then uses the TH–5/TG at the switchboard to ring the called teletypewriter station. At the termination of the call, the two teletypewriter station operators return the associated 4W—2W—TEL switch to the TEL position. This removes the holding coils from the line and causes the switchboard supervisory lamp to light. The teletypewriter switchboard operator disconnects the circuit.

c. Use on Carrier Telegraph System. Figure 3 illustrates telegraph service over a trunk where the trunk is provided by one of the channels of a carrier system. The loop circuits of Telegraph Terminal AN/TCC–4 are connected to Telegraph-Terminal TH–5/TG.

d. Use on Trunks Not Passing 20-cycle Ringing. Figure 4 illustrates an arrangement in which the trunk facility between the two local (or common) battery switchboards does not pass 20-cps (cycles per second) signal. Telegraph-Telephone Signal Converter TA–182/U is used to obtain a ringing signal. The TA–182/U changes the 20-cps signal to 1,225 cps.

e. Use With Push-to-talk Radio.

(1) *Two-wire basis.* Figure 5 illustrates an arrangement with point-to-point, push-to-talk radio controlled by a remote control unit such as Control Unit RM–39 (main component of Remote Control Equipment RC–289) on a 2-wire basis.

(*a*) *Transmission procedure using a remote control unit.* The teletypewriter operator operates the SEND—REC—NORM switch of the TH–5/TG to the SEND position. Opera-

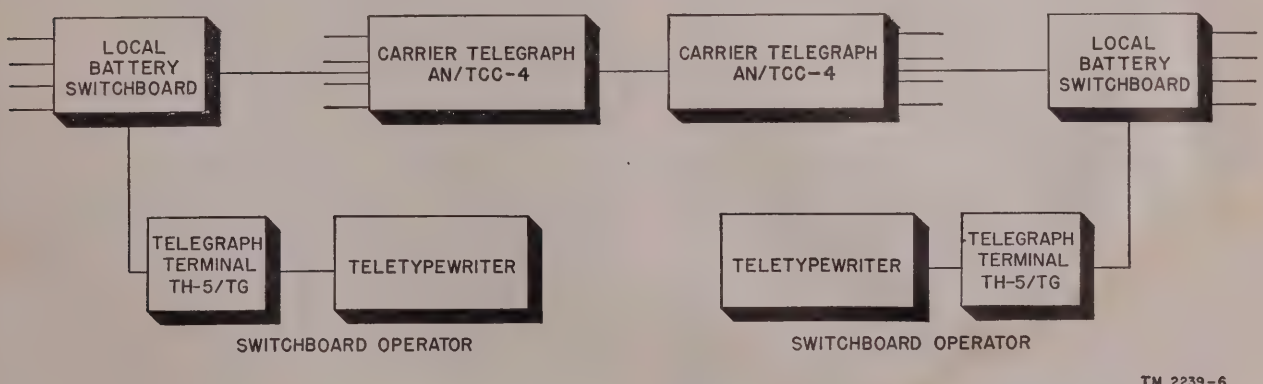


Figure 3. Carrier telegraph system, telegraph only service.

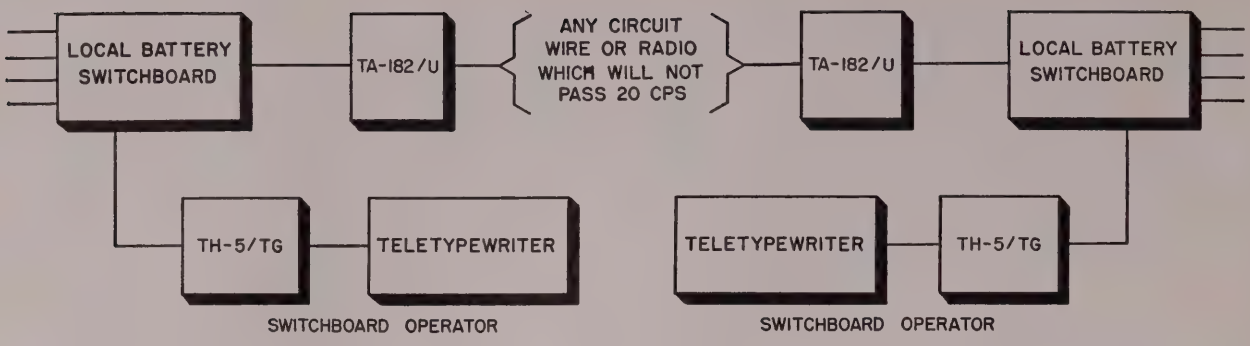


Figure 4. Trunk facility using Telegraph-Telephone Signal Converter TA–182/U, telegraph only service.

tion of the switch puts the holding coil of the TH–5/TG across the line. A d-c closure is provided, and the remote control unit energizes the radio transmitter. The teletypewriter operator may then transmit the message.

(*b*) *Reception procedure using a remote control unit.* The teletypewriter operator operates the SEND—REC—NORM switch of the TH–5/TG to the NORM position. This removes the d-c closure from the line and causes the remote control unit to disable the transmitter and to activate the receiver.

(2) *Four-wire basis.* Figure 6 illustrates an arrangement with point-to-point, push-to-talk radio on a 4-wire basis. A remote control unit is not required. Note that one additional wire must be used to control the radio transmitter in push-to-talk applications on a 4-wire basis. Five wires are used; four for message transmission and reception, and one for transmitter control.

(*a*) *Transmission procedure.* The teletypewriter operator operates the SEND—REC—NORM switch to the SEND position. Operation of the switch provides a d-c closure through the transmitter control wire and one conductor of the transmitting pair. This action energizes the radio transmitter and disables the radio receiver. The teletypewriter operator may then transmit the message.

(*b*) *Reception procedure.* The teletypewriter operator operates the SEND—REC—NORM switch to the NORM position. The equipment is then arranged for reception.

7. Alternate Telegraph-telephone Service, System Application

Alternate telegraph-telephone service is designed to provide a 2-wire voice-frequency channel for either telegraph or telephone use. However, telegraph and telephone service cannot be used at the same time.

a. General. In alternate telegraph-telephone service, when the 4W—2W—TEL switch of the TH–5/TG is in the 2W position, teletypewriter transmission is possible over the 2-wire line. When the 4W—2W—TEL switch is in the TEL position, transmission of speech is possible over the 2-wire line. The 4W—2W—TEL switch is normally in the TEL position.

b. Use on Loops or Trunks Passing 20-cycle Ringing. Figure 7 illustrates alternate telegraph-telephone service on a loop circuit. The teletypewriter station operator telephones the teletypewriter-telephone switchboard operator and requests connection to another teletypewriter station. The two stations, through telephone communication, arrange for teletypewriter operation. Both teletypewriter stations operate the 4W—2W—TEL switch to the 2W

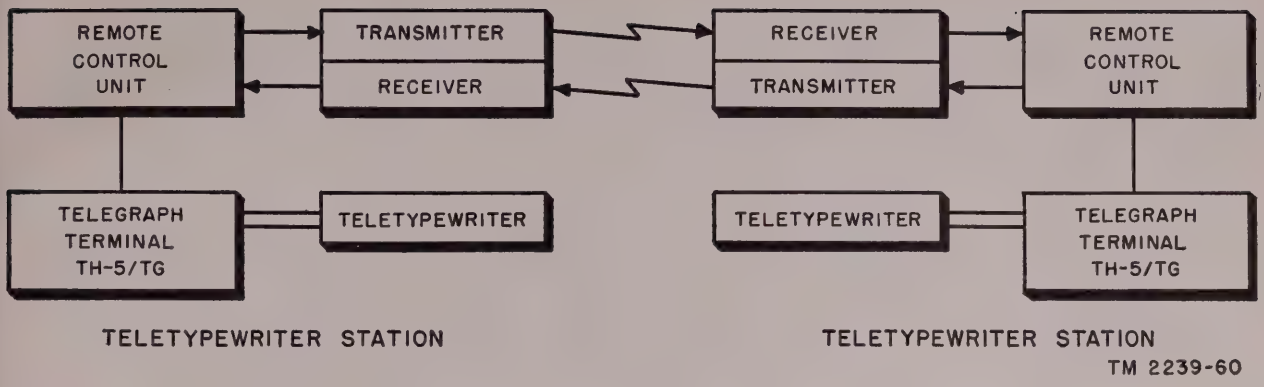


Figure 5. Push-to-talk radio circuit on 2-wire basis using remote control unit, telegraph only service.

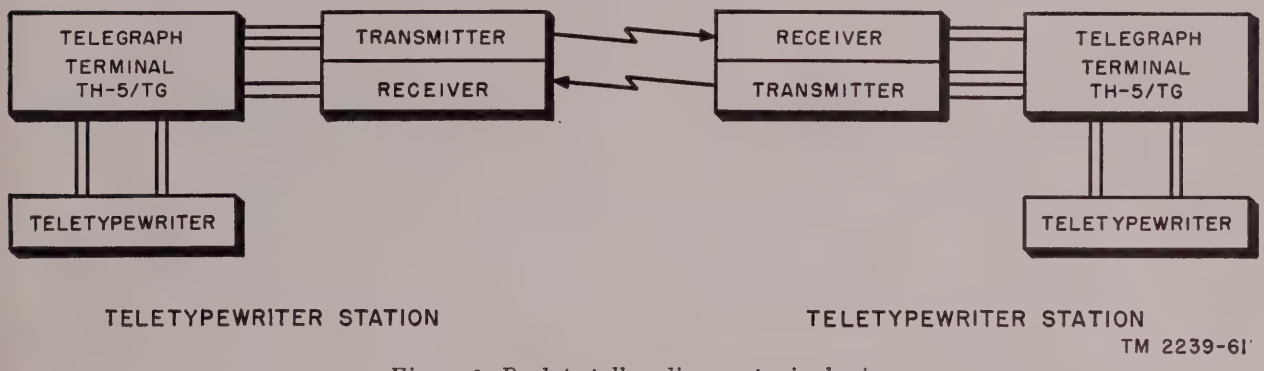


Figure 6. Push-to-talk radio on a 4-wire basis.

position. When teletypewriter communication is completed, the switch is returned to the TEL position. The teletypewriter switchboard operator then disconnects the teletypewriter stations.

c. Use on Loops or Trunks Not Passing 20-cycle Ringing. Figure 8 illustrates alternate telegraph-telephone service on a repeatered loop circuit using Telegraph-Telephone Signal Converter TA–182/U. The circuits function as outlined in *b* above.

8. Simultaneous Telegraph-telephone Service, System Application

Simultaneous telegraph-telephone service is designed to provide a 2-wire voice-frequency channel over which telegraph and telephone transmission may exist at the same time. However, both telegraph and telephone circuits must be switched (or signaled) at the same time. *They cannot be switched (or signaled)*

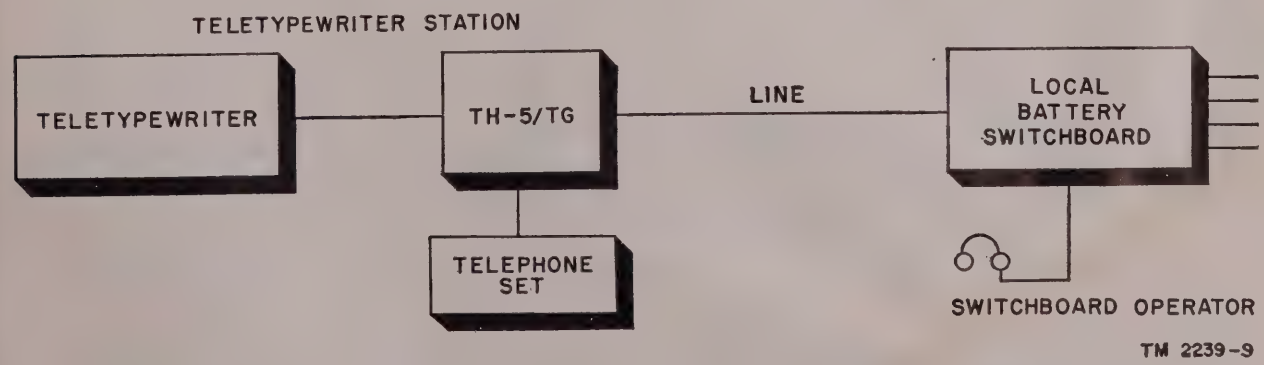


Figure 7. Switchboard loop circuit passing 20-cps. alternate telegraph-telephone service.

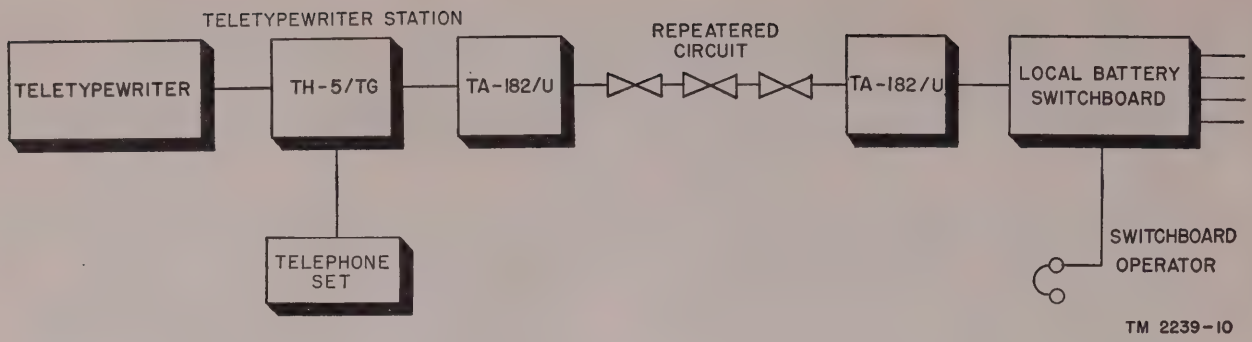


Figure 8. Switchboard loop circuit using Telegraph-Telephone Signal Converter TA–182/U, alternate telegraph-telephone service.

separately. In transmission, Electrical Filter Assembly F–98/U is used to separate teletypewriter and telephone transmission at the terminal. Figure 9 illustrates simultaneous telegraph-telephone service. The circuit used may be either a local or common battery loop. After the two stations are connected by the switchboard operator, simultaneous teletypewriter and speech transmission may take place. For the receiving teletypewriter station to interrupt (break-in) the transmission, the assistance of the switchboard operator is needed.

9. Speech Plus Half-duplex Service, System Application

Speech plus half-duplex service is designed to provide a 2-wire voice-frequency channel over which telegraph and telephone transmission may exist at the same time. *Both telegraph and telephone circuits are completely independent of each other and are switched (or signaled) separately.* Electrical Filter Assembly F–98/U is used to separate teletypewriter and telephone transmission.

a. Use on 2-wire Facility. Figure 10 illustrates speech plus half-duplex service on a 2-wire facility. The telephone and teletypewriter stations may be at the same or different locations. The teletypewriter station must have a TA–182/U and a TH–5/TG associated with it. The components are necessary to permit the teletypewriter station operator to signal the switchboard or the distant terminal on point-to-point circuits. The telephone station requires a TA–182/U only if the line will not pass a 20-cps ringing signal. In switched systems, the teletypewriter circuit and the telephone circuit each uses a different switchboard.

b. Use on 4-wire Facility. Figure 11 illustrates speech plus half-duplex service on a 4-wire facility. Any 4-wire facility may be used including a full-duplex radio operation. Two Electrical Filter Assemblies F–98/U are required at the transmitting station and two at the receiving station. In addition, Voice Frequency Hybrid TA–31/U is required to adapt the 4-wire telephone circuit so that it may be connected to a telephone.

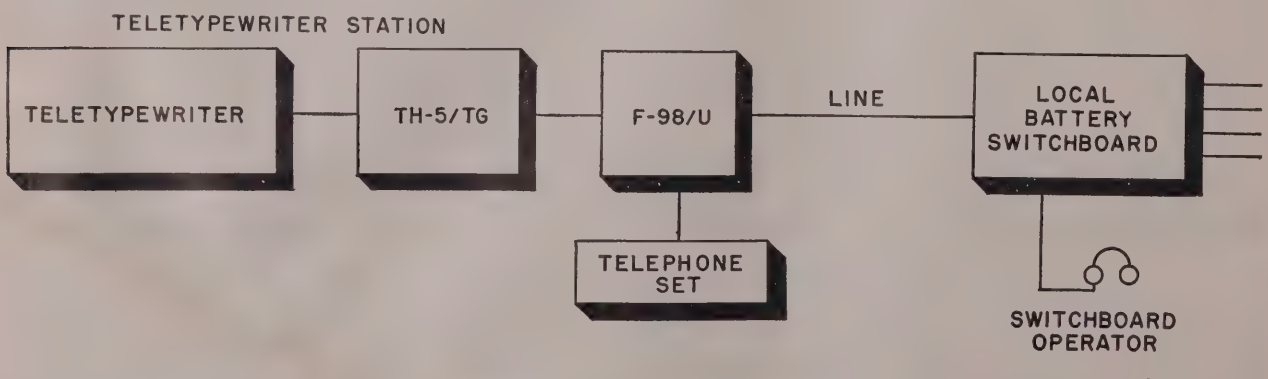


Figure 9. Switchboard loop circuit using Electrical Filter Assembly F–98/U, simultaneous telegraph-telephone service.

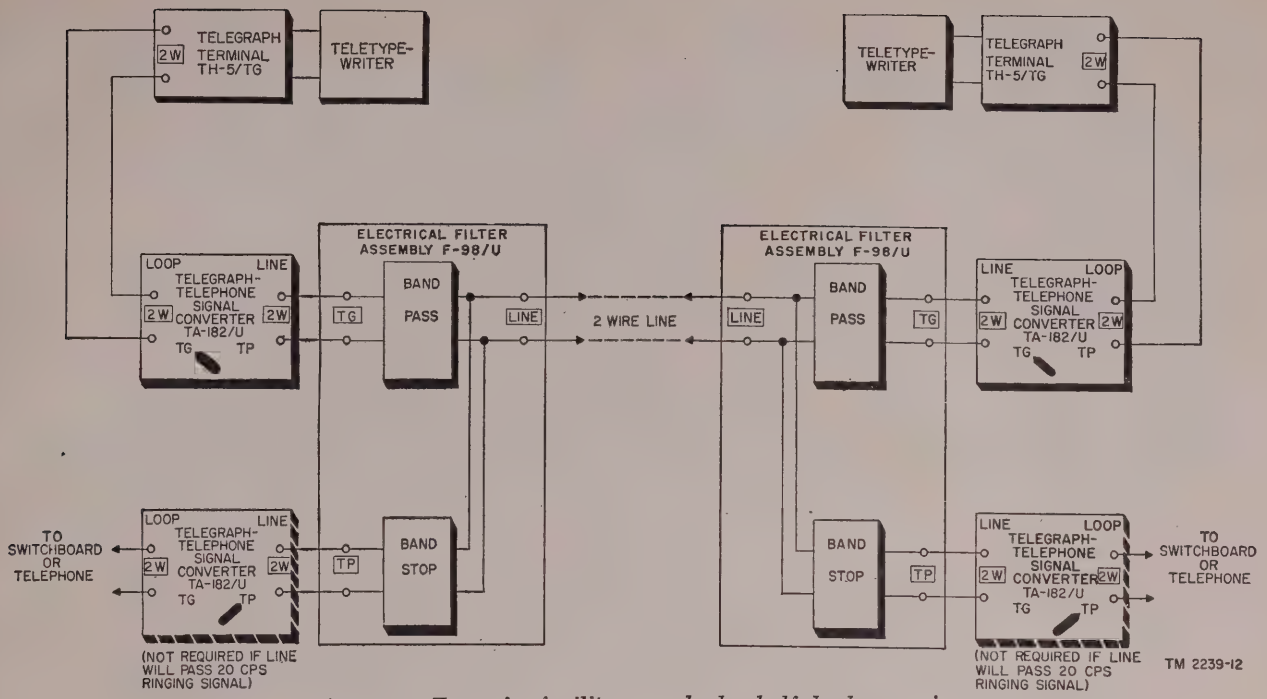


Figure 10. Two-wire facility, speech plus half-duplex service.

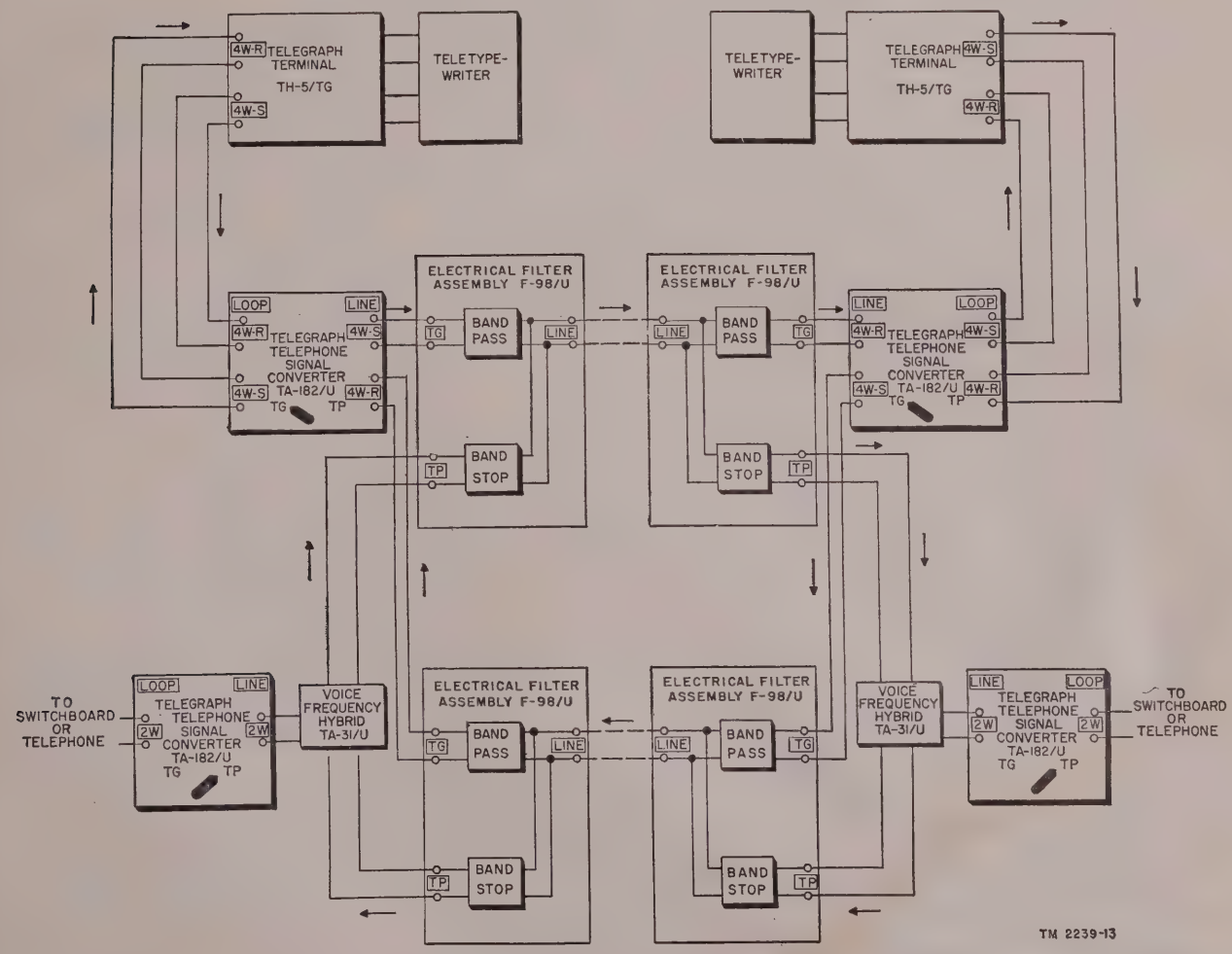


Figure 11. Four-wire facility, speech plus half-duplex service.

c. Use on a Switchboard Loop Circuit. Electrical Filter Assembly F–98/U (fig. 12) shows the separation of teletypewriter and speech communication. Through its action, the F–98/U separates the paths of the teletypewriter and telephone signals. The teletypewriter signal is passed to a local battery switchboard, and the telephone signal is passed to either a common or local battery switchboard. The TA–182/U is used to operate the drop at the teletypewriter switchboard, since the telegraph portion of the F–98/U will not pass 20 cps. The operating procedure for the teletypewriter station operator and the teletypewriter switchboard operator is similar to that outlined in paragraph 6*a*. The telephone switchboard operator uses the normal operating procedure.

d. Use on Trunk Circuit. Figure 13 illustrates the simultaneous use of teletypewriter and telephone circuits over the same trunk facility.

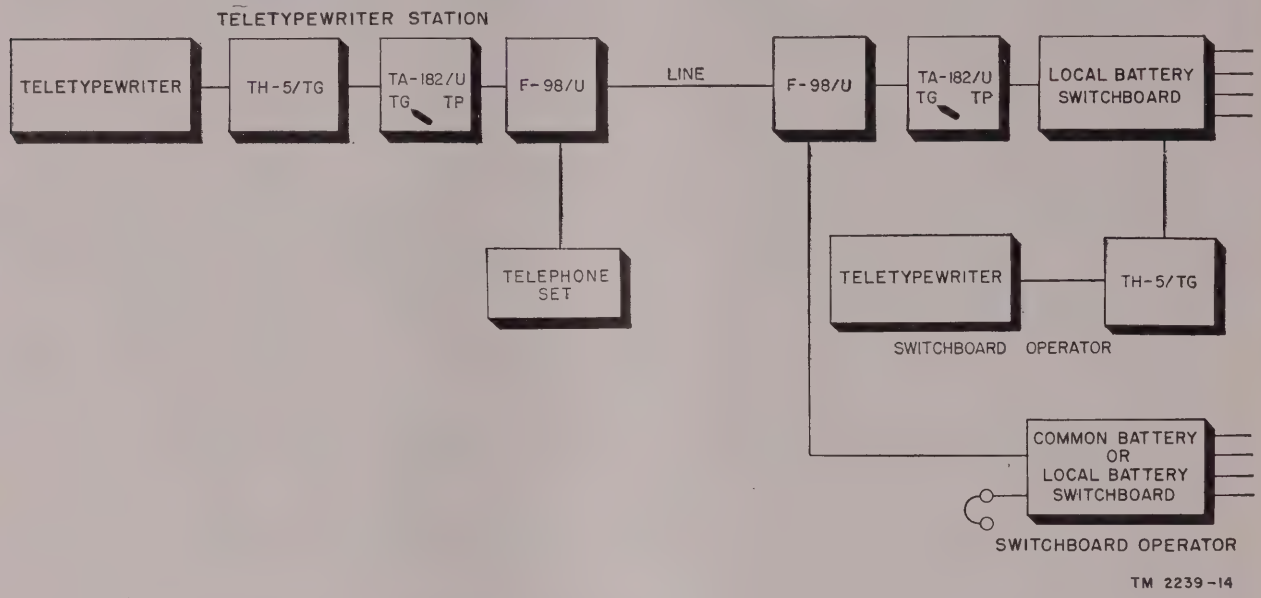


Figure 12. Switchboard loop circuit using Electrical Filter Assembly F–98/U, speech plus half-duplex service

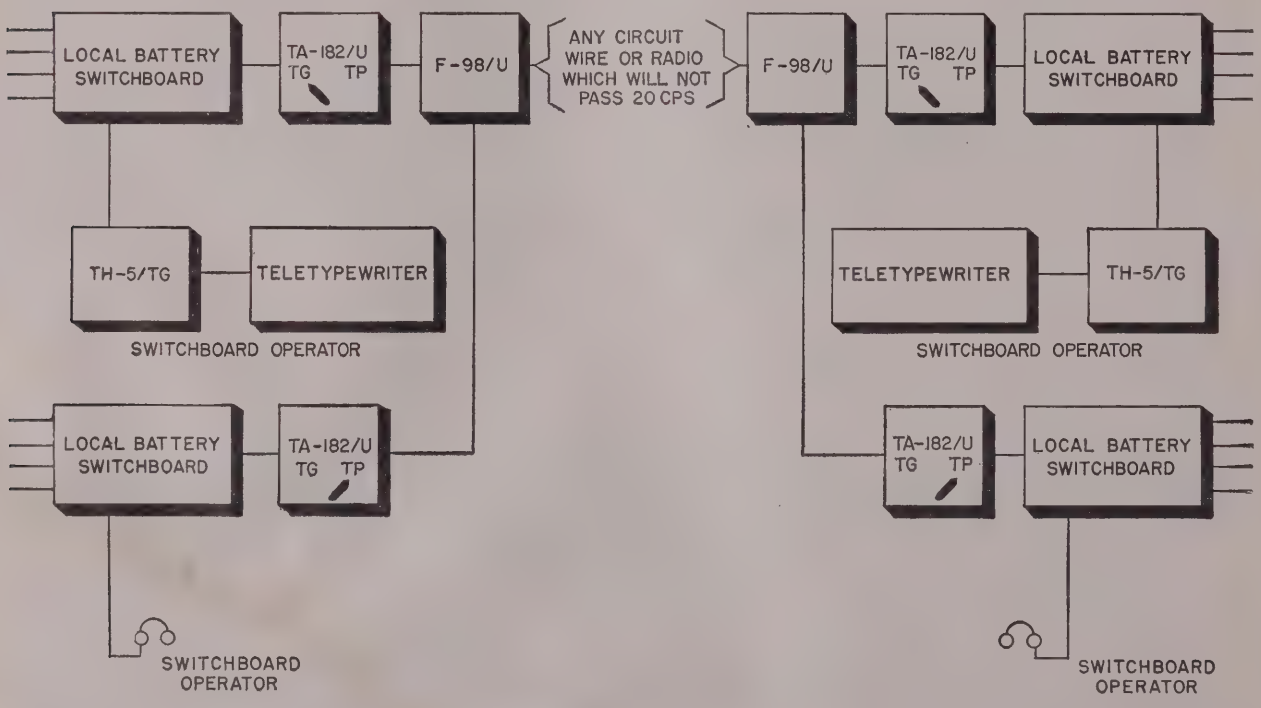


Figure 13. Switchboard trunk circuit using Electrical Filter Assembly F–98/U, speech plus half-duplex service.

Separate local battery teletypewriter and telephone switchboards are used. The teletypewriter and telephone transmission are separated at the switchboard location by means of the F–98/U.

e. Dropping Circuits at Intermediate Points. Figure 14 illustrates speech plus half-duplex service in which the telephone circuit is dropped at an intermediate station while the teletypewriter circuit is continued through to the terminal. In this arrangement, two Electrical Filter Assemblies F–98/U are connected back-to-back. Note that the same arrangement could be used in which the teletypewriter circuit is dropped and the telephone circuit is continued through to the terminal.

a. Telegraph Terminal TH–5/TG.

Mark frequency	1,325 cps.
Space frequency	1,225 cps.
Type of modulation	Frequency shift.
Bandwidth	200 cyc.
Transmission speeds	Normal speeds of 60, 75, and 100 words per minute (based on 7.42 unit code and 6 operations per word).
Number of tubes	15.
Transmitter output level.	0 dbm ±2 db (fixed).
Receiver sensitivity	0 to —45 dbm.

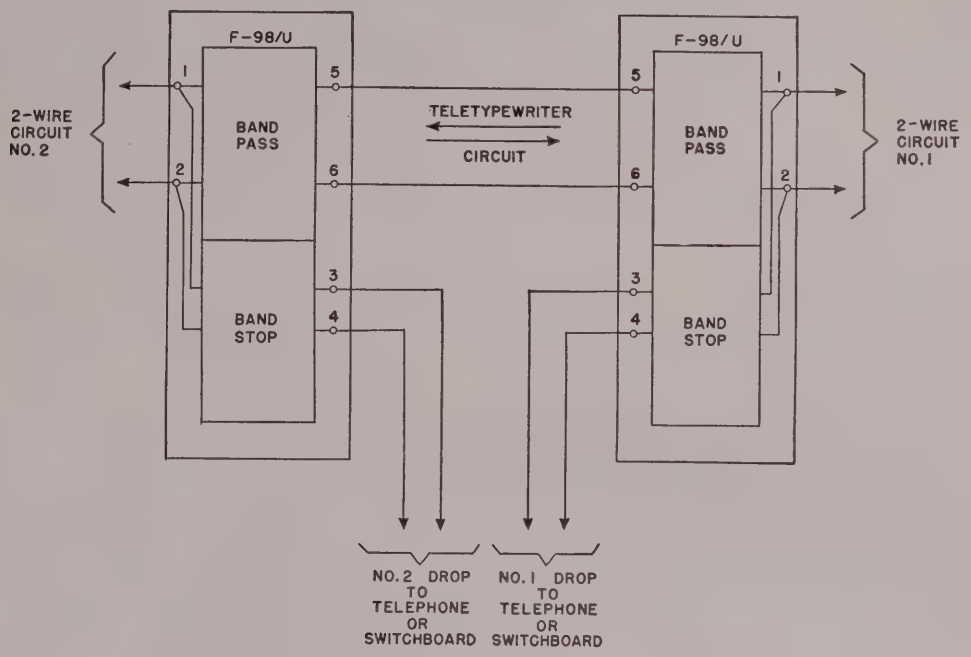


Figure 14. Telephone circuit dropped at intermediate station using Electrical Filter Assembly F–98/U.

10. Technical Characteristics

Telegraph-Telephone Terminal AN/TCC–14 consists of Telegraph Terminal TH–5/TG; Electrical Filter Assembly F–98/U; and Telegraph-Telephone Signal Converter TA–182/U. The technical characteristics of Telegraph-Telephone Signal Converter TA–182/U are covered in TM 11–2137. The technical characteristics of the TH–5/TG and F–98/U are covered in *a* and *b* below.

Terminal impedance	600 ohms ±10%, nominal at 1,000 cps for 2-wire or 4-wire operation.
Receiving direct current (local source).	20 ma (min).
Power drain from a-c source.	60 w.
Power source requirements.	115 v —10%, 50/60 cyc.

Ringing generator ---- 100 v, 20 cyc under load.
Dimensions (over-all including outer case). 6″ x 8½″ x 10″.
Weight ---- 19 lb.

b. Electrical Filter Assembly F–98/U.

Midfrequency operation. 1,275 cps.
Bandwidth ---- 100 to 200 cyc.
Balanced impedance -- 600 ohms input to band stop and to band-pass filter. 600 ohms output with band stop and band pass connected in parallel.
Attenuation ---- 80 db or greater in stop regions. 4 db or less in pass regions.
Supervisory signal ---- 20 cps at 100 ma.
Weight ---- 25 lb.

11. Packaging Data

Note. Telegraph-Telephone Terminal AN/TCC–14 may be packaged in a manner different from that shown, depending on the supply channel.

a. Export. When packaged for export shipment, the components of Telegraph-Telephone Terminal AN/TCC–14 are placed in moisture-vaporproof containers and packed in one wooden export crate. A cutaway view of the crate packed for export is shown in figure 18. The size, weight, and volume of the crate is indicated in the following chart:

Number of crates	Height (in.)	Width (in.)	Depth (in.)	Volume (cu ft)	Weight (lb)
1	25½	16½	12½	3.05	88.5

b. Domestic. When packaged for domestic shipment, the components of Telegraph-Telephone Terminal AN/TCC–14 are packaged separately in cartons. The size, weight, and volume of each component is indicated in the following chart:

Component	Number of cartons	Height (in.)	Length (in.)	Width (in.)	Volume (cu ft)	When packed with spares (lb)
TH–5/TG	1	15	11	8¼	.78	22.5
TA–182/U	1	15	11	8¼	.78	19.0
F–98/U	1	15	11	7	.66	27.0

12. Table of Components
(figs. 15, 16, and 17)

The following table lists all the components required for a complete Telegraph-Telephone Terminal AN/TCC–14 except for the spare parts which are listed in paragraph 16. The table also indicates the required number, dimensions, and weight of those components listed.

13. Description of Telegraph Terminal TH–5/TG

a. Telegraph Terminal TH–5/TG (fig. 15) is a 15-tube, frequency-shift carrier modulator and demodulator. It modulates d-c teletypewriter pulses to 1,225 cps and 1,325 cps. It demodulates 1,225- and 1,325-cps frequencies to d-c teletypewriter pulses. These d-c pulses must be capable of activating a teletypewriter selector magnet which requires a 20-ma (milliampere) current.

b. The TH–5/TG is a compact lightweight unit of miniature construction. The components of the transmitting, receiving, and a-c (alternating-current) operated power supply circuits are mounted on a chassis assembly that is fitted

Component	Required Number	Dimensions (in.)			Weight unpacked (lb)
		Height	Length	Width	
Telegraph Terminal TH–5/TG	1	11	10½	7½	18.5
Telegraph-Telephone Signal Converter TA–182/U	1	11	10½	7½	15.0
Electrical Filter Assembly F–98/U	1	10	8¾	6½	25.5

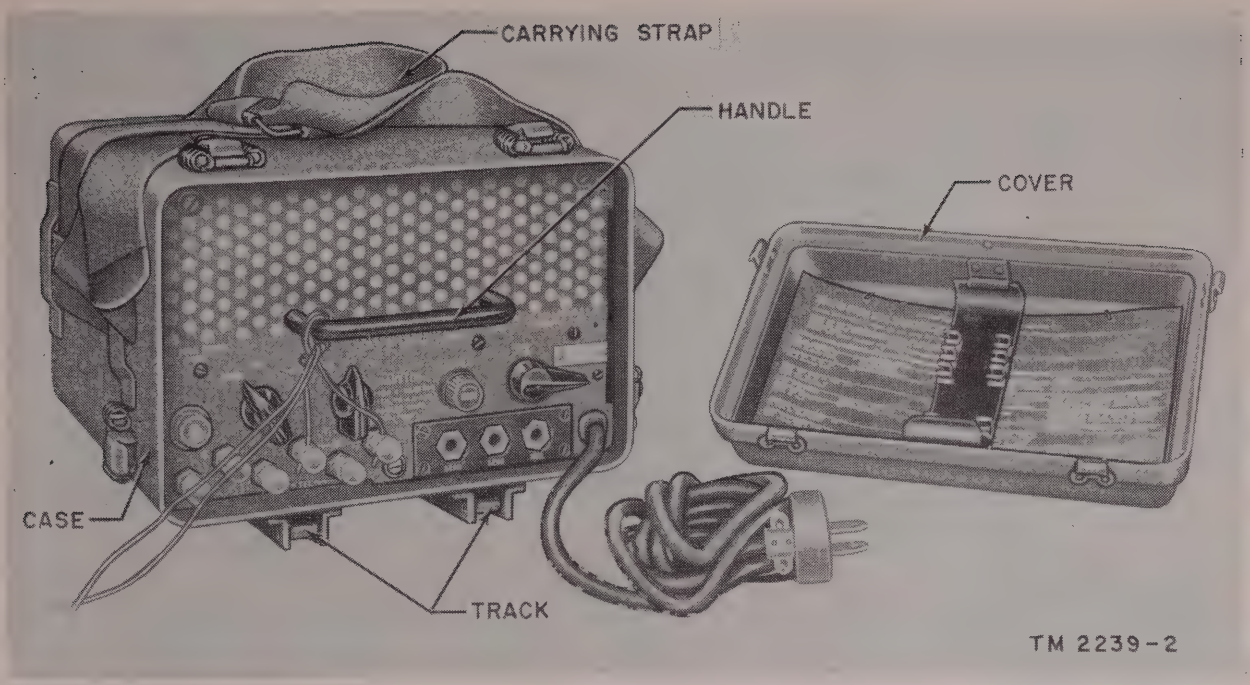


Figure 15. Telegraph Terminal TH–5/TG, view of front panel.

into a waterproof outer case. The panel contains two three-position wafer type switches used to select the type of operation, a nonlocking lever switch used to transmit the 20-cps frequency, three jacks for teletypewriter connections, and six binding posts for connections in 2-wire, 4-wire, and radio-telegraph application.

c. The TH–5/TG provides, in addition, a means for transmitting and receiving a 20-cps frequency. This frequency is used for signaling and breaking purposes.

d. Operation with the use of the TH–5/TG is known generally as *one-way reversible.* That is, only one TH–5/TG may transmit at a time. If both TH–5/TG transmitted at the same time, the transmitted signal in each case would blank out the received signal (par. 48*b*). Therefore, break-in operation is not possible. However, a 20-cps ringing signal may be transmitted by the receiving station to the transmitting station when break-in is desired.

14. Description of Telegraph-Telephone Signal Converter TA–182/U

a. Telegraph-Telephone Signal Converter TA–182/U (fig. 16) is an 8-tube, frequency-shift carrier modulator and demodulator. It modulates 20-cps frequencies to either 1,225 cps for teletypewriter signaling or 1,600 cps for telephone signaling. It demodulates either 1,225 or 1,600 cps to 20 cps to activate the signaling device in the TH–5/TG associated with the switchboard.

b. The panel contains two wafer-type, two-position switches which select the specific type of operation. A toggle switch is used to adjust the sensitivity of the TA–182/U receiving circuit. Eight binding posts on the panel are used for line and loop connections. Refer to TM 11–2137 for a detailed description of Telegraph-Telephone Signal Converter TA–182/U.

15. Description of Electrical Filter Assembly F–98/U

a. Electrical Filter Assembly F–98/U (fig. 17) is a two-section filter. The band-pass section (fig. 37) is used for teletypewriter transmission. The band-stop section is used for telephone transmission. Use of F–98/U permits simultaneous teletypewriter and telephone service; the band-pass and band-stop sections of the F–98/U separate the teletypewriter and telephone signals.

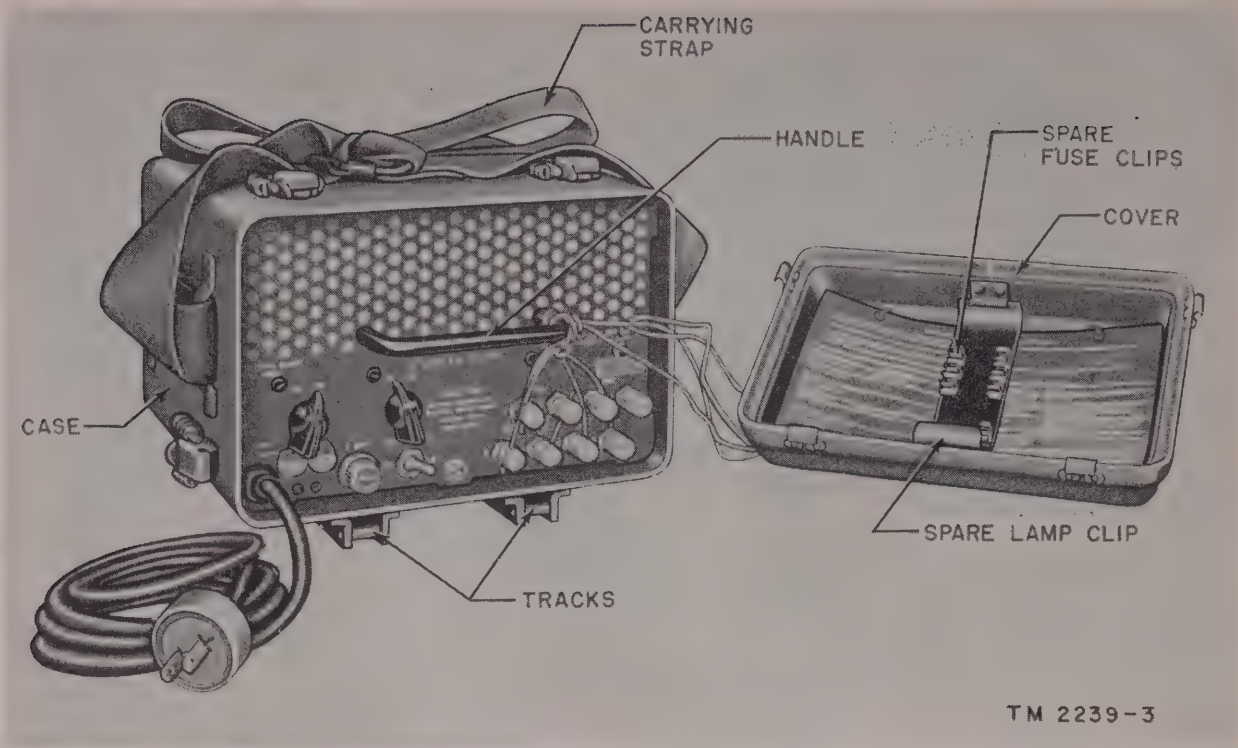


Figure 16. Telegraph-Telephone Signal Converter TA–182/U, view of front panel.

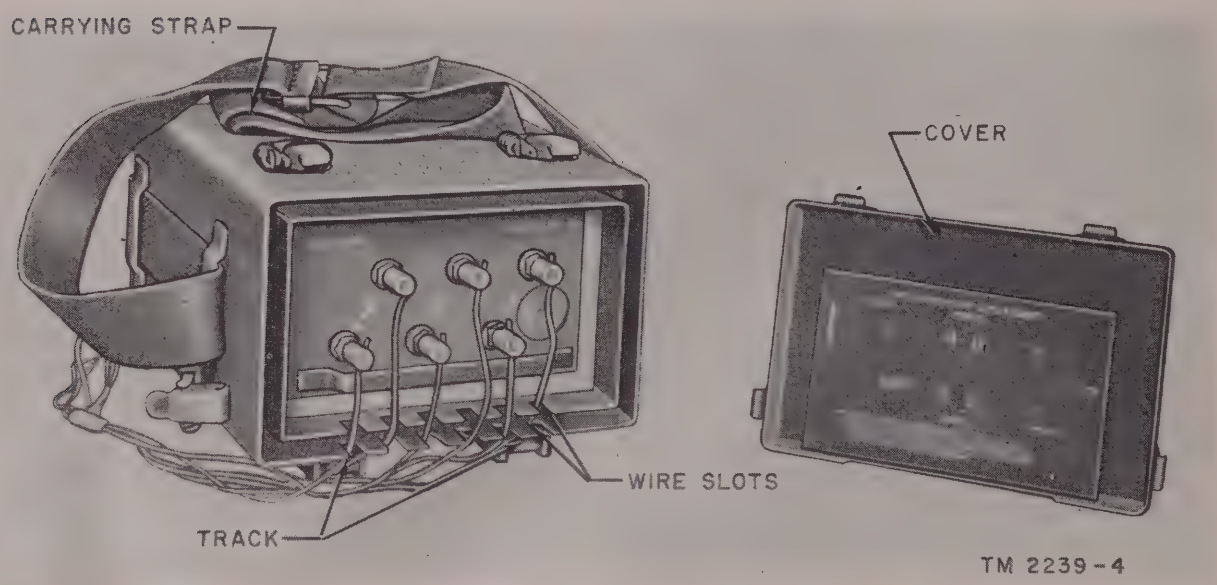


Figure 17. Electrical Filter Assembly F–98/U, view of front panel.

b. The F–98/U is hermetically sealed, requires no adjustment, and has no controls or indicators. The six binding posts located on the face of the panel are for interconnection with the associated equipment and the line.

16. Running Spares

Running spares for components of the Telegraph-Telephone Terminal AN/TCC–14 are listed in *a* through *c* below.

a. Telegraph Terminal TH–5/TG. The running spares for the TH–5/TG follow. The fuses and the incandescent lamp are stored in holders in the cover (fig. 15).

2 tubes, type 12AX7.
3 tubes, type 12AU7.
2 tubes, type 6AL5.
1 tube, 6X4.
7 fuses, cartridge, 1½ amperes.
1 lamp, incandescent.
1 lamp, glow.

b. Electrical Filter Assembly F–98/U. The filter assembly does not contain running spares.

c. Telegraph-telephone Signal Converter TA–182/U. Refer to TM 11–2137 for a list of running spares for Telegraph-Telephone Signal Converter TA–182/U.

17. Additional Equipment Required

A remote control unit such as Control Unit RM–39 (main component of Remote Control Equipment RC–289) is required when Telegraph-Telephone Terminal TH–5/TG is used in push-to-talk radio operation. Refer to paragraph 4*d* for explanation of the basic function of the remote control unit in a push-to-talk radio system. Refer to TM 11–2667 for information concerning Control Unit RM–39.

CHAPTER 2

OPERATING INSTRUCTIONS

Section I. SERVICE UPON RECEIPT OF TELEGRAPH-TELEPHONE TERMINAL AN/TCC–14

18. Siting

The best location for wire equipment depends on local conditions, such as the following: the need to house the equipment where its shelter cannot be seen; the type of housing available; possible installation in a vehicle; the terrain; and the need of easy access to messengers. The choice of location of the TH–5/TG is dependent on the location of the associated equipment. To prevent excessive line (copper) loss, locate the TH–5/TG not more than 6 feet from its associated teletypewriter. Location of either the TA–182/U or the F–98/U is not dependent on the location of the associated equipment. The TA–182/U may use as much as 5 miles of field wire on the loop side.

19. Uncrating, Unpacking, and Checking New Equipment

Note. For used or reconditioned equipment, refer to paragraph 22.

a. General. Equipment may be shipped in oversea or domestic packing cases and, sometimes, in its own carrying cases. When new equipment is received, select a location where the equipment may be unpacked without exposure to the elements, and which is convenient to the permanent or semipermanent installation of the equipment. The instructions in *b* below apply to equipment shipped in export packing cases, and the instructions in *c* below apply to equipment in domestic packing cases. Aside from checking to make sure that all carrying cases are present and that the equipment is undamaged, no special unpacking and uncrating procedures are necessary for equipment shipped in carrying cases.

Caution: Be careful when uncrating, unpacking, and handling the equipment; it is damaged easily. If it becomes damaged or exposed, a complete overhaul may be required or the equipment may be rendered useless.

b. Step-by-step Instructions for Uncrating and Unpacking Export Shipments. Figure 18 illustrates the packing details of the AN/TCC–14. Each component is packaged separately, then the three components are packaged together in a crate. Proceed to unpack the crate and cartons as follows:

(1) Cut and fold back the steel straps.

(2) Remove the nails with a nail puller. Do not attempt to pry off the lid; the equipment may be damaged.

(3) Remove the lid and the packing material.

(4) Remove the components from the packing case and place them on a workbench or other similar object.

(5) Open each carton and remove the components.

(6) Open the snap catches and swing open the covers of each component. This will expose the binding posts and the operating controls. Fold the straps along the side of the case.

(7) Unwind the power cord of the TH–5/TG and the TA–182/U. The power cord is located inside of the cover of these components.

(8) Check the fuses on the front panel of the TH–5/TG and the TA–182/U for correct insertion and for continuity.

(9) Remove the TH–5/TG and the TA–

182/U chassis from their cases by removing the control panel knobs and the screws on the front panel. The filter is hermetically sealed and should not be removed from its case.

(10) Check each tube in the TH–5/TG and the TA–182/U against breakage. Be certain that each tube is in its proper socket. Refer to figure 19 for the TH–5/TG tube locations. Refer to TM 11–2137 for the TA–182/U tube locations.

(11) Check the contents of the packing case against the master packing slip.

c. Unpacking Domestic Packing Cases. Equipment may be received in domestic packing cases. The instructions given in *b* above apply to unpacking domestic shipments.

Note. Save the original packing cases and containers for both export and domestic shipments. They can be used again when the equipment is repacked for storage or shipment.

20. Installation of Telegraph-Telephone Terminal AN/TCC–14

The manner in which Telegraph-Telephone Terminal AN/TCC–14 will be installed will depend on the particular circumstances. The AN/TCC–14 may be installed in either fixed installation or in vehicles. In general, it is necessary to keep the following facts in mind when making the installation.

a. Place the components of the AN/TCC–14 in a part of the building (or area) in which there is not much traffic.

b. If the components cannot be placed on a table or bench, place them on the ground with the control panels right side up and facing the operator.

c. When the equipment is not in use, keep the components covered to minimize their exposure to the elements.

21. Connections

All three components of the Telegraph-Telephone Terminal AN/TCC–14 have binding posts, connections to which are determined by the type of line facility. This facility may be either a 2-wire or 4-wire line. In addition, the TH–5/TG has three jack connections. These jack connections are used for all types of operation. Insert the send (black shell) plug of the teletypewriter into either one of the SEND

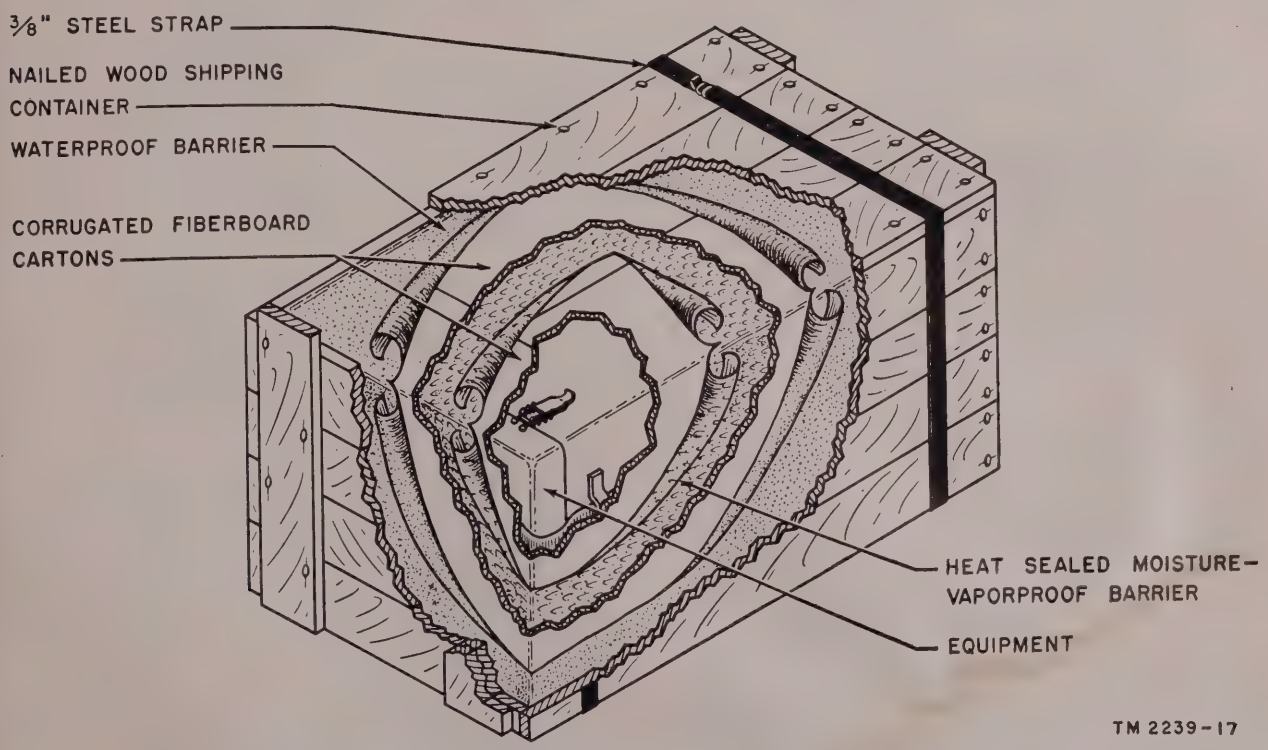


Figure 18. Telegraph-Telephone Terminal AN/TCC–14, packing and packaging details.

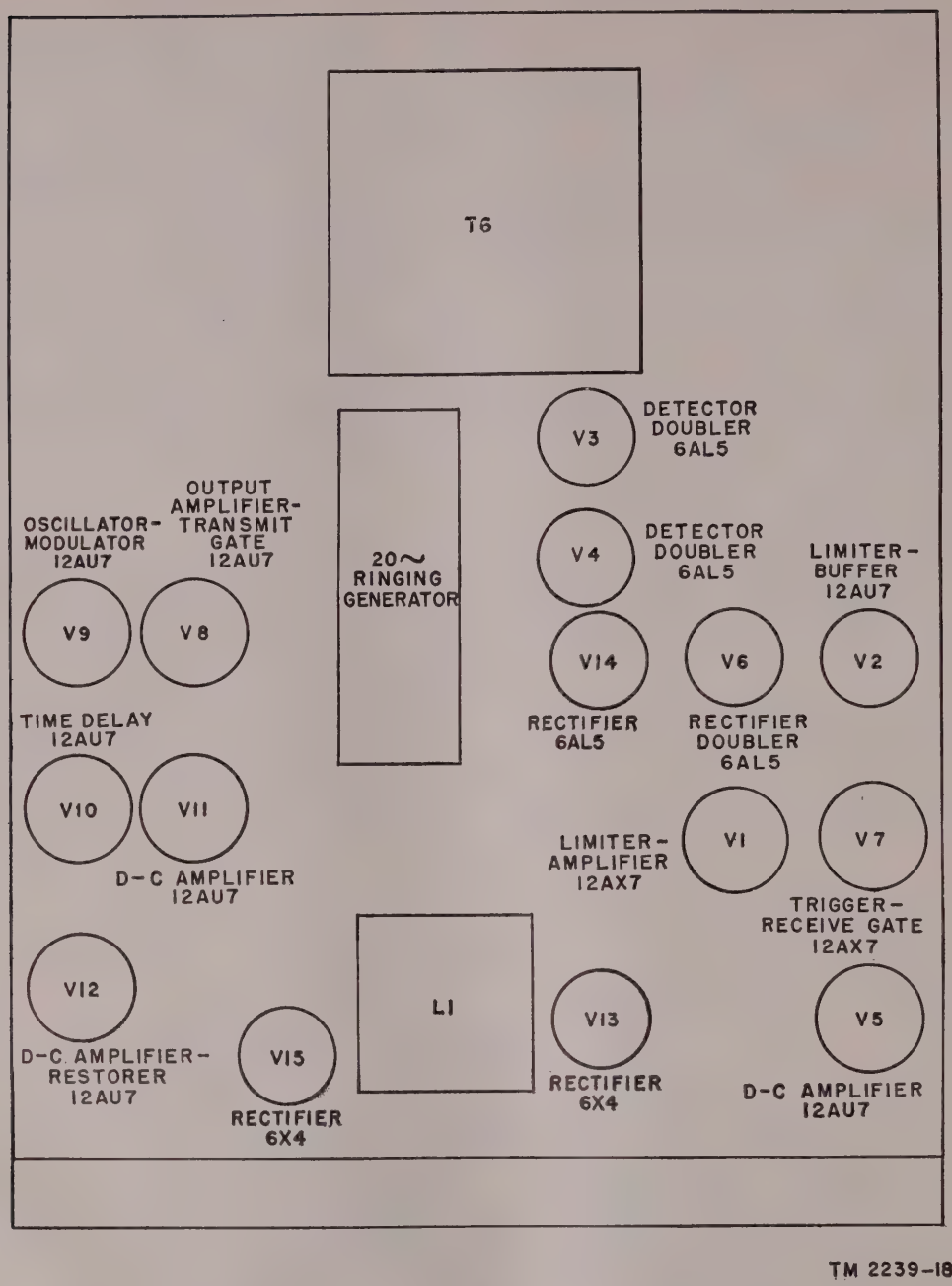


Figure 19. Telegraph Terminal TH–5/TG, tube location.

jacks of the TH–5/TG. Insert the receive (red shell) plug of the teletypewriter into the REC jack of the TH–5/TG.

a. Operation Over 2-wire Line. During 2-wire operation, the AN/TCC–14 uses the same pair of wires for both the transmitting and the receiving circuits. A typical illustration of 2-wire operation is shown in figure 10. Make the connections as outlined below:

(1) Connect between the 2W binding posts of the TH–5/TG and the 2W LOOP binding posts of the TA–182/U.
(2) Connect between the 2W LINE binding posts of the TA–182/U and the TG binding posts on the F–98/U.
(3) Connect between the TP binding posts of F–98/U and a telephone, switchboard, or a second TA–182/U. (Note

that Telegraph-Telephone Terminal AN/TCC–14 contains only one Telegraph-Telephone Signal Converter TA–182/U.)

(4) Connect between the LINE binding posts of the F–98/U and the 2-wire line.

b. Operation Over 4-wire Line. During 4-wire operation, the AN/TCC–14 uses one pair of wire lines for receiving signals from the distant terminal and another pair of wire lines for transmitting signals to the distant terminal. A typical illustration of 4-wire operation is shown in figure 11. Make the connections as outlined below:

(1) Connect between the 4W-R binding posts of the TH–5/TG and the 4W-S LOOP binding posts of the TA–182/U.

(2) Connect between the 4W-S binding posts of the TH–5/TG and the 4W-R LOOP binding posts of the TA–182/U.

(3) Connect between the 4W-S LINE binding posts of the TA–182/U and the TG binding posts on the *first* F–98/U.

(4) Connect between the 4W–R LINE binding posts of the TA–182/U and the TG binding posts on the *second* F–98/U. Note that a Telegraph-Telephone Terminal AN/TCC–14 contains only one Electrical Filter Assembly F–98/U.

(5) Connect the pair of wire lines used in the transmitting circuit to the LINE binding posts of the first F–98/U.

(6) Connect the pair of wire lines used in the receiving circuit to the LINE binding posts of the *second* F–98/U.

(7) Connect binding posts TP of both the first and the second F–98/U to Voice Frequency Hybrid TA–31/U.

(8) Connect between Voice Frequency Hybrid TA–31/U and the 2W LINE binding posts of a *second* TA–128/U. (Note that a Telegraph-Telephone Terminal AN/TCC–14 contains only one Telegraph-Telephone Signal Converter TA–182/U.)

(9) Connect between the 2W LOOP binding posts of the second TA–182/U and a switchboard or telephone.

c. Telephone Operation Using Telegraph Terminal TH–5/TG. To obtain telephone operation when a TH–5/TG (fig. 7) is used, connect a telephone at the TEL binding posts of the TH–5/TG. Ringing signals for the circuit will be supplied from the TH–5/TG.

d. Operation Over 4-wire, Push-to-talk Radio Circuit Using Telegraph Terminal TH–5/TG. When the TH–5/TG is used in conjunction with a push-to-talk radio circuit (fig. 6), the connections are made as outlined below and as shown in figure 20.

(1) Connect between CONT binding post 1 and the relay winding connection point on the radio transmitter.

(2) Connect between CONT binding post 2 and 4W-S binding post 3.

(3) Connect between 4W-S binding post 3 and the talking battery side of the radio transmitter input circuit.

(4) Connect between 4W-S binding post 4 and the other side of the transmitter input circuit.

(5) Connect between 4W-R binding post 5 and one side of the radio receiver output.

(6) Connect between 4W-R binding post 6 and the other side of the radio receiver output.

22. Service Upon Receipt of Used or Reconditioned Equipment

a. Follow the instructions in paragraph 19 for uncrating, unpacking, and checking the equipment.

b. Check the used or reconditioned equipment for tags or other indications pertaining to changes on the wiring of the equipment. Note any wiring changes (figs. 49 and 50).

c. Check the operating controls for ease of rotation.

d. Perform the installation and connection procedures given in paragraphs 20 and 21.

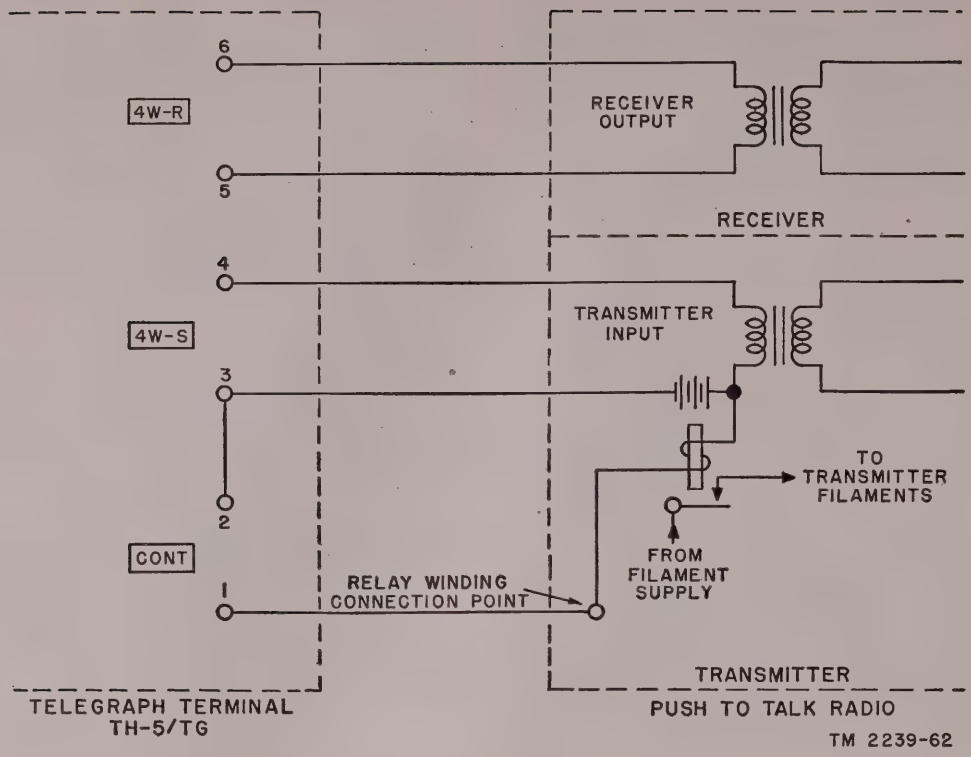


Figure 20. Telegraph Terminal TH–5/TG, connections for 4-wire push-to-talk radio operation.

Section II. CONTROLS

23. Telegraph Terminal TH–5/TG Controls

(fig. 21)

The following table lists the controls and the functions of the TH–5/TG.

Control	Function
RING switch (S1)	Two-position, nonlocking switch; depressed, sends 20-cps ringing signal.
4W—2W—TEL switch (S2).	Three-position locking switch used to arrange the TH–5/TG for type of line facility in either telegraph or telephone operation: 2W position is used on a 2-wire line facility. 4W position is used on a 4-wire line facility. TEL position is used for telephone operation (par. 6*b*).
SEND—REC—NORM switch (S3).	Three-position locking switch used to arrange the TH–5/TG either for wire or for radio operation: NORM position is used when the TH–5/TG is operating over wire lines. SEND position is used when the TH–5/TG is transmitting over radio circuits. REC position is used when the TH–5/TG is receiving over radio circuits.

24. Telegraph-Telephone Signal Converter TA–182/U, Controls

The control panel of the TA–182/U contains the switches that select the different types of operation. Refer to TM 11–2137 for a detailed description of the controls of the TA–182/U.

25. Electrical Filter Assembly F–98/U, Controls

There are no controls on the F–98/U. Use of the F–98/U depends on its connection with the associated TH–5/TG and TA–182/U.

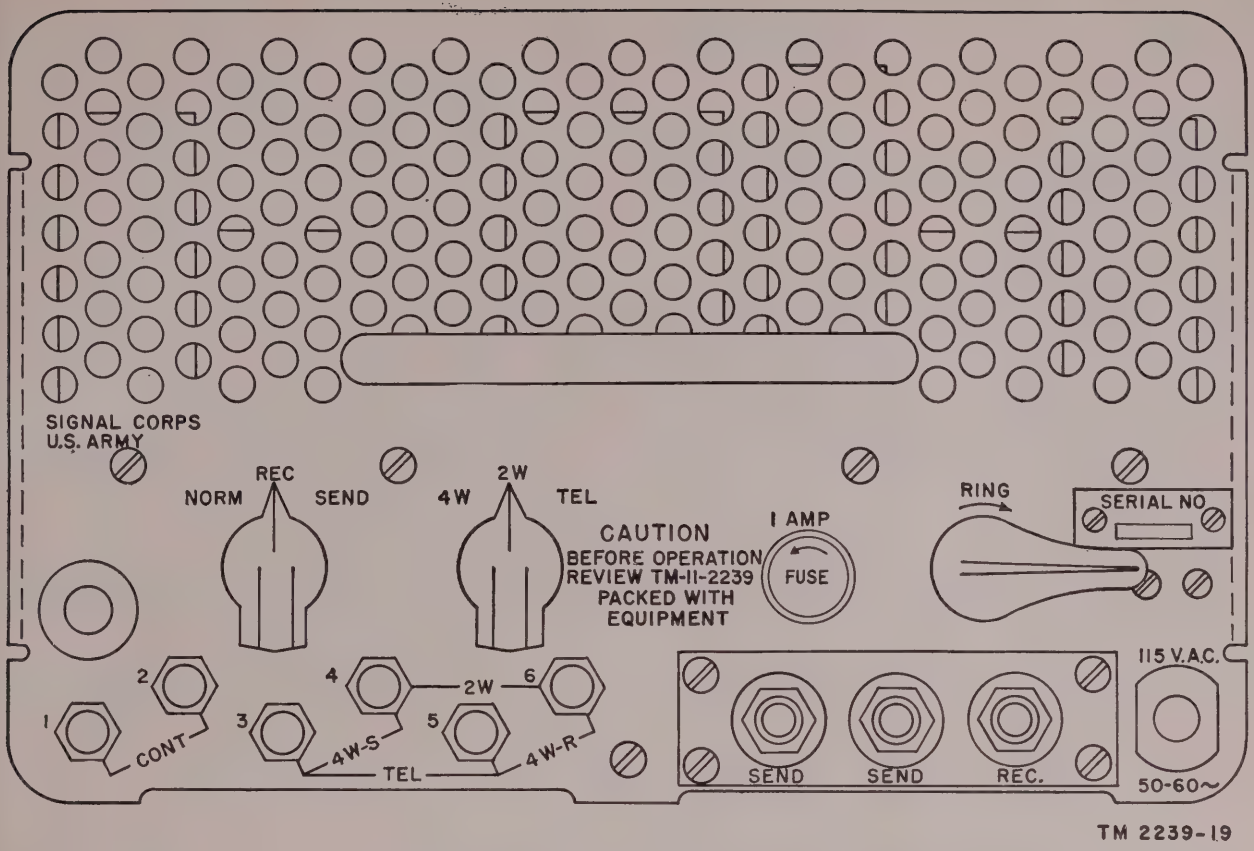


Figure 21. Telegraph Terminal TH–5/TG, front panel.

Section III. OPERATION UNDER USUAL CONDITIONS

26. Preliminary Starting Procedure

The binding post connections of the AN/-TCC–14 are made in accordance with the procedure discussed in paragraph 21. This is the only preliminary starting procedure required. Settings of the switches on the panels of the TH–5/TG and the TA–182/U are discussed in the following paragraphs. The F–98/U has no switches.

27. Telegraph Terminal TH–5/TG, Switch Settings

a. SEND—REC—NORM Switch.

(1) Operate the SEND—REC—NORM switch to the NORM position for all types of wire system operation.

(2) For radio system operations, on a push-to-talk basis, operate the SEND—REC—NORM switch to the SEND position when transmitting and to the REC position when receiving. The use of a remote control unit is required in this application (par. 6*e*).

b. 4W—2W—TEL Switch.

(1) Operate the 4W—2W—TEL switch to the 4W position when the TH–5/TG is connected over a 4-wire line.

(2) Operate the 4W—2W—TEL switch to the 2W position when the TH–5/-TG is connected over a 2-wire line.

(3) Operate the 4W—2W—TEL switch to the TEL position when the TH–5/TG is used for switching a telephone set instead of a teletypewriter in the circuit (par. 6*b*).

c. Ring Switch. Operate the RING switch to transmit a 20-cps ringing signal.

d. SEND and REC Jacks. Insert the red shell (receive) teletypewriter plug in the REC jack and the black shell (transmitting) teletypewriter plug in either of the SEND jacks.

If a transmitter-distributor or a teletypewriter test set is used, connect it to the second SEND jack.

28. Telegraph-Telephone Signal Converter TA–182/U, Switch Settings

a. TP-TG Switch.

(1) Operate the TP—TG switch to the TP position when the TA–182/U is being used in a telephone circuit for signaling purposes.

(2) Operate the TP—TG switch to the TG position when the TA–182/U is being used in a telegraph circuit for signaling purposes.

b. 2W—4W Switch.

(1) Operate the 2W—4W switch to the 2W position to obtain operation over a 2-wire line.

(2) Operate the 2W—4W switch to the 4W position to obtain operation over a 4-wire line.

c. HI—LO Switch.

(1) Operate the HI—LO switch to the LO position for ringing over circuits which have a loss *not* exceeding 25 db (decibels) on the line side.

(2) Operate the HI—LO switch to the HI position for ringing over circuits which have a loss not exceeding 25 db on the line side if fading causes unsatisfactory operation on the LO position.

(3) Operate the HI—LO switch to the HI position for ringing over circuits which have a loss up to 45 db on the line side.

(4) Refer to TM 11–2137 for a detailed discussion of the switch settings of the TA–182/U.

d. Control Settings. The table below describes the control settings on the TH–5/TG for various types of operation.

	TELEGRAPH TERMINAL TH–5/TG, control settings			
Type of operation	4W—2W—TEL switch	NORM—REC—SEND switch	RING switch	Remarks
2-wire telephone. Point-to-point or local battery switchboard.	TEL for talking and magneto ringing; 2W for telegraph terminal ringing.	NORM	Operate for 3 seconds to signal distant terminal.	Telephone operation is not possible on 4-wire circuits.
2-wire teletype. Point-to-point or local battery switchboard.	2W	NORM	Operate for signaling and breaking distant terminal.	When receiving a message, do not start to send until the distant terminal stops transmission. This is indicated by the glow of the neon lamp.
2-wire teletype over push-to-talk radio. Point-to-point or local battery switchboard.	2W	SEND to transmit, NORM to receive.	Not used	In SEND position, a holding coil is placed across line to turn on radio transmitter. A remote control unit is used in this application.
2-wire teletype over common battery switchboard.	TEL in idle condition; 2W for operation.	NORM	Not used	See note 2, figure 49, for strapping in the holding coil.
4-wire teletype. One way reversible on wire.	4W	NORM	Operate for signaling and breaking distant terminal.	

Type of operation	TELEGRAPH TERMINAL TH–5/TG, control settings			Remarks
	4W—2W—TEL switch	NORM—REC—SEND switch	RING switch	
4-wire teletype. One way reversible on push-to-talk radio.	4W	SEND to transmit, REC to receive.	Refer to TM 11–2137	The CONT binding posts provide a d-c closure in SEND position to turn on radio transmitter.
4-wire teletype. Full duplex over wire or two-way radio.	4W	NORM for wire, SEND for radio.	Operate for signaling and breaking distant terminal for wire operation. Use for radio.	See note 3, figure 49, on schematic for removal of local copy connection.

29. Starting Procedure

a. After the switches on the AN/TCC–14 have been positioned properly and the line and loop connections correctly made, connect the power cords of the TH–5/TG and the TA–182/U to a satisfactory power source.

b. Refer to the equipment performance checklist of each component for correct equipment functioning.

30. Stopping Procedure

To remove the AN/TCC–14 from permanent operation, disconnect the power cords from the power source. Replace the covers on the components.

Section IV. OPERATION UNDER UNUSUAL CONDITIONS

31. General

The operation of Telegraph-Telephone Terminal AN/TCC–14 may be impeded where extreme cold, heat, himidity and moisture, or sand conditions prevail. In the paragraphs which follow, procedures are given for minimizing the effects of these unusual operating conditions.

32. Operation in Arctic Climates

a. Keep the equipment warm and dry. Keep the AN/TCC–14 connected to the power source at all times so that the tube filaments remain lighted.

b. When equipment which has been exposed to the cold is brought into a warm room, it will sweat and continue to do so until it reaches room temperature. When the AN/TCC–14 has reached room temperature, dry it thoroughly. Sweating also may arise when equipment warms up during the day after exposure during a cold night.

33. Operation in Tropical Climates

When operated in tropical climates, the AN/TCC–14 may be installed in tents, huts, or, when necessary, in underground dugouts. When the equipment is installed below ground and when it is set up in swamp areas, moisture conditions are more acute than normal. Ventilation is poor, and the high relative humidity causes condensation of moisture on the equipment whenever the temperature becomes lower than that of the ambient air. To minimize this condition, keep the AN/TCC–14 connected to the power source at all times so that the tube filaments remain lighted.

34. Operation in Desert Climates

a. Conditions similar to those in tropical climates often prevail in desert areas. Use the same measures (par. 33) to insure proper operation of the AN/TCC–14.

b. The main problem which arises with operation in desert areas is the large amount of dust which enters the equipment. Place the equipment in as dust-free a location as possible.

c. Never tie power cords or other wiring connections to the inside or outside of tents. Desert areas are subject to sudden wind squalls which may jerk the connections loose or break the lines.

CHAPTER 3

ORGANIZATIONAL MAINTENANCE INSTRUCTIONS

Section I. PREVENTIVE MAINTENANCE SERVICES

35. 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 condition 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. Refer to AR 750–5.

36. General Preventive Maintenance Techniques

a. Use No. 0000 sandpaper to remove corrosion.

b. Use a clean, dry, lint-free cloth or a dry brush for cleaning.

(1) If necessary, except for electrical contacts, moisten the cloth or brush with Solvent, dry cleaning (SD) ; then wipe the parts dry with a cloth.

(2) Clean electrical contacts with a cloth moistened with carbon tetrachloride; then wipe them dry with a dry cloth.

Caution: Repeated contact of carbon tetrachloride with the skin or prolonged breathing of the fumes is dangerous. Make sure adequate ventilation is provided.

c. If available, dry compressed air may be used at a line pressure not exceeding 60 psi (pounds per square inch) to remove dust from inaccessible places; be careful, however, or mechanical damage may result from the air blast.

d. For further information on preventive maintenance techniques, refer to TB SIG 123.

37. Performing Preventive Maintenance

The preventive maintenance operations listed in *a* and *b* below should be performed by organizational personnel at the intervals indicated, unless these intervals are reduced by the local commander.

Caution: Screws, bolts, and nuts should not be tightened carelessly. Fittings tightened beyond the pressure for which they are designed will be damaged or broken.

a. Preventive Maintenance Checklist for Telegraph Terminal TH–5/TG.

Item No.	What to check	When to check[a]	Procedure	Precautions
1	Exterior of case	D	Wipe clean with a dry, lint-free cloth	In humid climates, check to see that water condensed within the case is removed.
2	Control panel	D	Wipe clean with a dry, lint-free cloth.	
3	Chassis	W	Clean all parts of the unit that are easily accessible.	Disconnect all power before removing the TH–5/TG from its case.

Item No.	What to check	When to check[a]	Procedure	Precautions
4	Filter capacitors	W	Inspect filter capacitors C46A, B, C, and C47 for leakage, bulging, and overheating.	
5	Power transformer	W	Wipe clean with a dry, lint-free cloth	Power transformer T6 will run hot.
6	Power cord, plug, and line wire.	W	Inspect power cord and line wire for damaged insulation, especially at connecting points. Look for improper connections which strain the wires or connections. Wipe the power cord, plug, and socket with a clean, dry cloth.	
7	Fuse and fuseholder	W	Inspect fuse cap and fuse ends for burning, charring, and corrosion. Check fuseholder for cleanliness and foreign matter. Brush away all dirt, dust, and foreign matter.	
8	Relay	W	Inspect the dust cover of relay K1. Use a small, soft brush or a clean, dry cloth to clean the outside cover.	
9	Tubes and pins	M	Check tubes and pins for loose contacts, dirt, and corrosion. Check the tubes and, if necessary, replace them.	
10	Binding posts	M	Inspect the binding posts for dirt, dust, rust, and corrosion. Clean the binding posts with a soft-bristled brush.	
11	Capacitors and resistors.	M	Inspect for loose or corroded connections and for cracked or damaged insulation. Loose connections must be resoldered. Wipe off moisture with a clean, dry cloth.	
12	Jacks and switches	M	Inspect the mechanical action of each switch and jack. Note the contact separation and see that contacts close with a slight follow when the switch is operated. Inspect the mechanical action of each jack by inserting a plug. Look for dirt and corrosion on all exposed elements and contacts. Examine the contacts for dirt, pits, and buildups.	
13	Wiring	M	Inspect for cracked, frayed, or torn insulation. Check for loose connections and dirty contacts. Tighten loose screw connections. Resolder loose or broken soldered connections. Clean all connections before reconnecting.	Avoid disconnecting any wires when performing these operations.

[a] D—daily; W—weekly; M—monthly.

b. Preventive Maintenance Checklist for Electrical Filter Assembly F–98/U.

Item No.	What to check	When to check[a]	Procedure
1	Exterior of case	D	Wipe clean with a dry, lint-free cloth.
2	Control panel	D	Wipe clean with a dry, lint-free cloth.
3	Binding posts	M	Inspect the binding posts for dirt, dust, rust, and corrosion. Clean the binding posts with a soft-bristled brush.
4	Line wire	W	Inspect line wires for damaged insulation, especially at connection points. Look for improper connections which strain the wires.

[a] D—daily; W—weekly; M—monthly.

38. Lubrication

The TH–5/TG, the TA–182/U, and the F–98/U require no lubrication. The only moving parts are the switch shafts. These do not require any lubrication.

Section II. WEATHERPROOFING AND PAINTING

39. Weatherproofing

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 moisture-proofing and fungiproofing treatment has been devised, which, if properly applied, provides a reasonable degree of protection. This treatment is explained fully in TB SIG 13 and TB SIG 72.

c. Winter Maintenance. Special precautions necessary to prevent poor performance or total operational failure of equipment in extremely low temperatures are explained fully in TB SIG 66.

d. Desert Maintenance. Special precautions necessary to prevent equipment failure in areas subject to low humidity and excessive sand and dust are explained fully in TB SIG 75.

40. Rustproofing and Painting

a. When the finish on the case has been scarred or damaged badly, rust and corrosion can be prevented by touching up bared surfaces. Use No. 000 or No. 0000 sandpaper to clean the surface down to the bare metal; obtain a bright smooth finish.

Caution: Do not use steel wool. Minute particles frequently enter the case and cause harmful internal shorting or grounding of circuits.

b. When a touchup job is necessary, apply paint with a small brush. Remove rust from the unit by cleaning corroded metal with solvent (SD). In severe cases, it may be necessary to use solvent (SD) to soften the rust and to use sandpaper to complete the preparation for painting. Paint used will be authorized and consistent with existing regulations.

Section III. TROUBLE SHOOTING AT ORGANIZATIONAL MAINTENANCE LEVEL

41. General

a. The trouble shooting and repair work that can be performed at the organizational maintenance level (operators and repairmen) are limited necessarily in scope by the tools, test equipment, and replaceable parts issued and by the existing tactical situation. Accordingly, trouble shooting is based on the performance of the equipment and the use of the senses in determining such troubles as burned-out tubes and cracked insulators.

b. The paragraphs which follow in this section help in determining which of the components, such as the receiving circuit or the transmitting circuit, is at fault and in localizing the fault in that component to the defective stage or item, such as a tube or fuse.

42. Visual Inspection

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

a. Worn, broken, or disconnected cords or plugs.

b. Burned-out fuse.

c. Relay contacts burned due to overload.

d. Wires broken because of excessive vibration.

e. Defective tubes.

43. System Sectionalization

a. General. The quickest and most accurate method to localize trouble in Telegraph-Telephone Terminal AN/TCC–14 is by substituting components known to be in proper working order. Replace the components one at a time and check to see if the AN/TCC–14 is operating properly. If no replacement components are available, the trouble may be localized by removing the components one at a time from the circuit and checking each component. The method for isolating the trouble to a specific component is detailed in *b* and *c* below.

b. Checking Telegraph Terminal TH–5/TG.

(1) Check the TH–5/TG by transmitting from a teletypewriter to which it is connected and examining the home copy. The home copy will indicate the

condition of all the TH–5/TG circuits except the input-output and ringing circuits.

(2) To check the input-output circuit of the TH–5/TG, connect a telephone known to be in proper working condition, across line binding posts 3 and 5. Operate the 4W—2W—TEL switch to the 2W position. Transmit mark and space signals from a teletypewriter. A different tone should be heard in the telephone for the mark and space signals. When the test message stops, the tone should be cut off within 3 seconds.

(3) To check the ringing circuit of the TH–5/TG, connect a telephone known to be in proper working order, across line binding posts 3 and 5. Operate the RING switch (S1) of the TH–5/TG. The telephone should ring.

c. Checking Telegraph-Telephone Signal Converter TA–182/U.

(1) The check performed in *b* above permitted the isolation of trouble either to the TH–5/TG or to the line. If, as a result of this check, it is determined that both the line and the TH–5/TG are not defective, then the trouble must exist either in the TA–182/U or the F–98/U.

(2) Remove the TA–182/U from the circuit. Transmit first from the TH–5/TG and then from the telephone. If the F–98/U is defective, transmission will not be possible over the circuit. If the F–98/U is satisfactory, transmission will be possible.

(3) Replace the TA–182/U in the circuit. Send a ringing signal from the TH–5/TG. Since the TH–5/TG, the line, and the F–98/U are known to be operating satisfactorily, lack of ringing will mean that the TA–182/U is defective.

44. Trouble Shooting by Using Equipment Performance Checklist

The equipment performance checklist (par. 45) is an aid in locating trouble in the equipment. The list gives the item to be checked, the conditions under which the item is checked, the normal indications, and the corrective measures the operator can take. To use this list, follow the items in numerical sequence.

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

b. Normal Indications. The normal indications listed include the visible and audible signs that the operator should note when he checks the items. If the indications are not normal, the operator should apply the recommended corrective measures.

c. 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 chapter 6 indicates that the trouble cannot be corrected during operation and that trouble shooting must be done by an experienced repairman. However, if the situation requires that communication be maintained, and if the AN/TCC–14 is not disabled completely, the operator must maintain the set in operation as long as it is possible.

45. Equipment Performance Checklist

a. Telegraph Terminal TH–5/TG.

	Item No.	Item	Action or condition	Normal indications	Corrective measures
PREPARATORY	1	Teletypewriter	Receive and transmit cords plugged into jacks of the TH–5/TG.		
	2	4W—2W—TEL switch	Set in 2W position.		
	3	SEND—REC—NORM switch.	Set in NORM position.		
	4	2W binding posts	Connect line to 2W binding posts.		

Item No.	Item	Action or condition	Normal indications	Corrective measures
5 START	Power cord	Insert power cord in source of voltage.	Tubes light: teletypewriter selector magnet becomes energized and teletypewrite should run closed.	Check fuse and plug if tubes do not light. Use a tube tester to check any tubes that do not light. Never replace power supply tubes without first checking power supply capacitor. Replace defective part.
6 EQUIPMENT	Teletypewriter keyboard contacts.	Transmits teletypewriter characters.	Local copy received	Check receiver and transmitter circuits. Replace defective parts (ch. 6).
			Tone appears across the line.	Check carrier suppression tubes and circuits. Replace defective parts (ch. 6).
		Transmits mark signal	Teletypewriter runs closed.	Check receiver and transmitter circuits. Replace defective parts (ch. 6).
			Tone disappears from line.	Check carrier suppression tubes and circuits. Replace defective parts (ch. 6).
7 PERFORMANCE	4W—2W—TEL switch	Repeat item 6 with switch thrown to 4W position.	Refer to item 6	Refer to item 6. If local copy is received with switch 4W—2W—TEL in the 4W position but not in the 2W position, the trouble is in the receiver stage of VI(A).
		No signal input	Neon lamp lights	Check threshold tubes and circuits. Replace defective parts. Check receiver circuit (ch. 6).
		Signal input	Neon lamp is extinguished.	Check threshold tubes and circuits. Check receiver circuits VI(A) and VI(B). Replace defective part (ch. 6).
8 STOP	Power cord	Remove power cord	Tubes are extinguished. Teletypewriter selector magnet becomes de-energized.	

b. Telegraph-Telephone Signal Converter TA–182/U. For the equipment performance checklist of the TA–182/U, refer to TM 11–2137.

c. Electrical Filter Assembly F–98/U. There is no equipment performance checklist for the F–98/U since it is a sealed unit.

CHAPTER 4

AUXILIARY EQUIPMENT

46. Mounting MT–791/U and Mounting MT–300/GR

a. Mounting MT–791/U (fig. 22) is provided when the components of Telegraph-Telephone Terminal AN/TCC–14 are to be mounted in a vehicle. The installation of the AN/TCC–14 is explained in paragraph 47.

b. Mounting MT–300/GR may be used in place of Mounting MT–791/U. These mountings are identical except for a junction box which is included on Mounting MT–300/GR. This junction box is not used in the AN/TCC–14 vehicular installations.

47. Installation of Components of Telegraph-Telephone Terminal AN/TCC–14 on Mounting MT–791/U or Mounting MT–300/GR

a. Set the tracks of the component to be mounted into the grooves of the mounting (fig. 22). When the component is firmly in place, pull forward the locking handles located at the front panel of the mounting. Four clamps, set in the grooves of the mounting, engage slots at the end of the tracks when the locking handles are pulled forward.

b. To remove the component from the mounting, push the locking handles backward to disengage the four clamps.

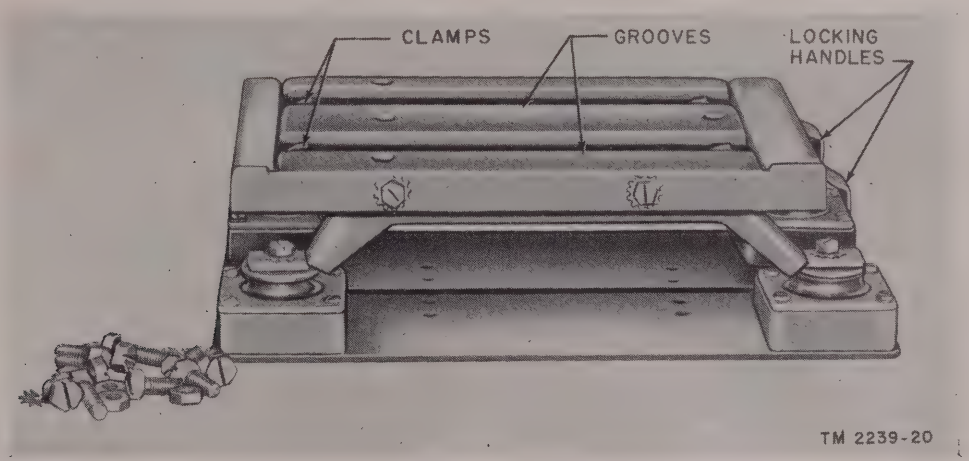


Figure 22. Mounting MT–791/U.

CHAPTER 5

THEORY

Section I. THEORY OF TELEGRAPH TERMINAL TH–5/TG

48. General

Telegraph Terminal TH–5/TG contains three major circuits and six auxiliary circuits. The major circuits, the transmitting, receiving, and power supply circuits, are illustrated in solid block form in figure 23. The six auxiliary circuits were incorporated into the TH–5/TG because of the switching requirements. Five of these circuits, the carrier suppression, threshold, input, output, and ringing circuits, are illustrated in perforated block form in figure 23. The sixth auxiliary circuit, the time-delay circuit, is part of the transmitting circuit (tubes V10(A), V10(B), and V12(A)). The general functioning of the major and the auxiliary circuits is outlined in *a* and *b* below.

a. Major Circuits, General Functioning.

(1) *Transmitting circuit.* The transmitting circuit (fig. 23) uses a modified Hartley oscillator that oscillates continuously at the mark frequency of 1,325 cps. Although the oscillator

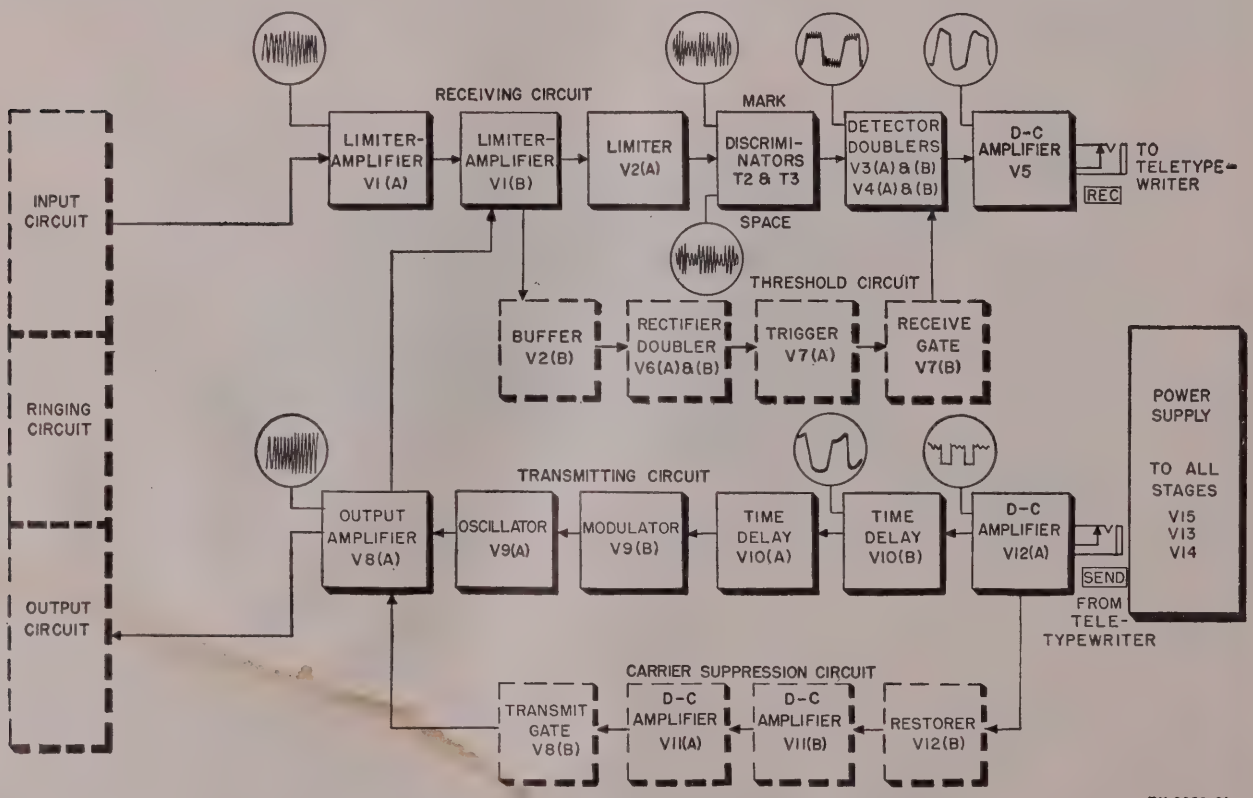


Figure 23. Telegraph Terminal TH–5/TG, block diagram.

oscillates continuously, it does not transmit because of the action of the carrier suppression circuit. The carrier suppression circuit removes the carrier tone from the line when transmission from the teletypewriter has stopped. The modulator of the transmitting circuit is so arranged that the oscillator resonates at its mark frequency of 1,325 cps. During a space pulse, however, the modulator operates to switch additional capacitors into the resonant circuit of the oscillator. This changes the mark frequency of 1,325 cps to the space frequency of 1,225 cps. Refer to figure 49 for the interaction of the transmitting and suppression circuits.

(2) *Receiving circuit.* The receiving circuit (fig. 23) receives the incoming signals (or home copy) from the transmitting circuit, limits and detects the signal, and then applies the resultant d-c pulses to the teletypewriter. The limiter stages of the receiving circuit are designed to present a constant amplitude level of between 0 to —45 dbm (decibels referred to 1 milliwatt in 600 ohms). The output of the discriminator is dependent on the amplitude and the frequency applied to it.

(3) *Power supply circuit.* The power supply circuit (fig. 23) furnishes filament voltage, plate voltage, and bias voltage for the receiving, threshold, transmitting, and suppression circuits. In addition, it supplies a d-c voltage to the 20-cps ringing generator in the ringing circuit.

b. Auxiliary Circuits, General Functioning.

(1) *Carrier suppression circuit.* The carrier suppression circuit (fig. 23) removes the carrier tone from the line approximately 3 seconds after message transmission has stopped. This circuit compensates for the *capture* effect of the limiter: high-level signals override low-level signals. Without the suppression of the home copy tone (pars. 55 and 72) from the transmitting circuit, the incoming low-level signals would be suppressed in the limiter.

(2) *Threshold circuit.* During idle operation, the threshold circuit (fig. 23) prevents false operation of the receiving circuit on low-level noises. The The existence of low-level noise is indicated by the illumination of the neon lamp on the front panel. The circuit applies a bias on the output of the receiver, securing the circuit in the mark condition on signal levels less than —45 dbm. The threshold circuit removes this bias when signals of more than —45 dbm are being received.

(3) *Input and output circuits.* The input and output circuits (fig. 23) have binding posts through which the line is connected to the TH–5/TG. A holding coil is incorporated into these circuits to provide a d-c closure for remote control of push-to-talk radios and common battery switchboards. The input and output circuits contain all the switches used in controlling the operation of the TH–5/TG.

(4) *Ringing circuit.* The ringing circuit contains a ringing generator which transmits a 20-cps signal, and a buzzer that is activated by an incoming 20-cps ringing signal. Relay K1 is wired in series with the buzzer. Operation of the relay causes the teletypewriter to run open.

(5) *Time-delay circuit.* The time-delay circuit (fig. 23) prevents loss of part of the start pulse when the carrier tone is restored to the line. The first space, or starting, pulse that is applied to the TH–5/TG is delayed by the time-delay circuit. This delay permits the immediate transmission of a marking signal. The initial marking signal establishes a steady state condition in the transmission path. This allows for the subsequent transmission of the first undistorted space signal. All other transitions, as well as the first mark-to-space transition, are delayed also.

49. Transmitting Circuit, Description

a. This circuit is used to convert the sequence of opens and closures that make up the teletypewriter code to a voice-frequency signal for transmission over a voice-frequency channel.

b. The circuit (fig. 24) uses a frequency shift type of modulation to obtain signals equivalent to mark and space pulses. When a marking pulse is sent from the teletypewriter, the oscillator resonates at a frequency of 1,325 cps. When a spacing pulse is sent, capacitors C36 and C37 are switched electrically into the oscillator resonant circuit. This changes the transmitted frequency from 1,325 cps to a space frequency of 1,225 cps.

c. The function of the modulator stages is to include capacitors C36 and C37 in the oscillator resonant circuit for space signals and to exclude them for mark signals.

d. The transmitting circuit is explained stage by stage in paragraphs 50 through 62.

50. D-C Amplifier Stage V12(A)—Marking Interval, Transmitting Circuit

When a marking pulse is sent from the teletypewriter, or during a space-to-mark transition, a positive voltage from the power supply is applied to the grid of amplifier tube V12(A) (figs. 24 and 49). The tube, normally at cutoff,

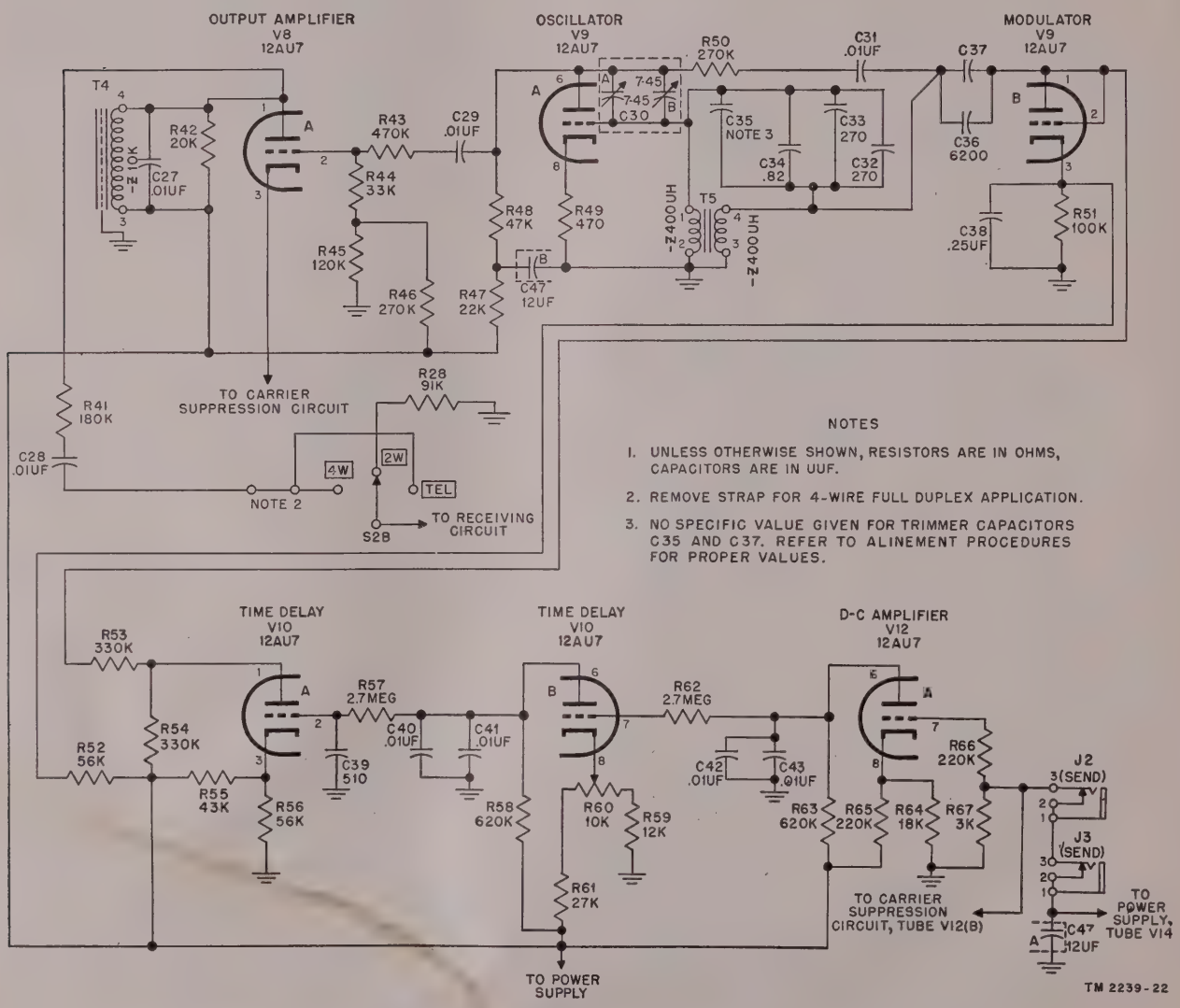


Figure 24. Telegraph Terminal TH–5/TG, transmitting circuit, schematic diagram.

overcomes the bias set by resistors R64 and R65 when the positive voltage is applied to its grid. As the tube conducts, its plate voltage drops because of the voltage drop across load resistor R63. Resistor R66 is the grid current limiting resistor; resistor R67 is the grid leak resistor.

51. Time-Delay Stage V10(B)—Marking Interval, Transmitting Circuit

When tube V12(A) (par. 50) conducts, the potential across current limiting resistor R62 to the grid of tube V10(B) (figs. 24 and 49) is decreased greatly. Without this grid voltage, tube V10(B) is driven to cutoff. At cutoff, its plate voltage rises, applying a higher positive voltage through current limiting resistor R57 to the grid of tube V10(A).

52. Time-Delay Stage V10(A)—Marking Interval, Transmitting Circuit

Tube V10(A) (figs. 24 and 49) conducts when the higher positive voltage is applied to its grid. Because of the voltage drop across load resistor R54, the voltage at the plate of tube V10(A) drops.

53. Modulator Stage V9(B)—Marking Interval, Transmitting Circuit

As tube V10(A) (par. 52) conducts, its plate voltage, applied to the plate and grid of diode V9(B) (figs. 24 and 49), drops. This maintains the tube at cutoff. Since this tube is nonconducting, or effectively open from plate to ground, space frequency capacitors C36 and C37 are removed from the resonant circuit of the oscillator. The oscillator resonates at the mark frequency of 1,325 cps.

54. Oscillator Stage V9(A)—Marking Interval, Transmitting Circuit

The circuit of tube V9(A) (figs. 24 and 49) is a modified Hartley oscillator. The tuned-plate circuit consists of transformer T5 and capacitors C32, C33, C34, and C35. The oscillator signal in the tuned circuit is fed to the grid through terminals 1 and 2 of transformer T5, and capacitor C30. Although capacitor C30 is connected between plate and grid, it varies the interelectrode capacitance between the grid and cathode of the tube (known as the Miller effect). When the tube conducts, there is a regenerative feedback from plate to grid through resistor R50 and blocking capacitor C31. This feedback is of sufficient amplitude to set up oscillations in the resonant circuit. The value of feedback resistor R50 is high; consequently, the grid never draws current. This resistor limits the amplitude of the oscillations. Tube V9(A) operates as a Class A oscillator. Resistor R49 is the cathode bias resistor and biases the tube as a Class A oscillator. Capacitor C30 permits adjustment of the frequency to ±8 cps. This adjustment affects both the mark and space frequencies. Resistor R48 is the plate load resistor. Capacitor C47B and resistor R47 decouple this stage.

55. Output Amplifier V8(A)—Marking Interval, Transmitting Circuit

This stage is used both to isolate the oscillator from the varying line impedance and to place the signal at the desired level on the line. Tube V8(A) (figs. 24 and 49) is a conventional voltage amplifier. Tubes V8(A) and V8(B) use the same cathode bias, resistor R69 (par. 68). The output of the oscillator (par. 54) is fed to tube V8(A) through coupling capacitor C29 and current limiting resistor R43. The grid is biased through resistors R44, R45, and R46. Resistor R42 corrects the output impedance of transformer T4 and its tuned capacitor C27. Home copy of the transmitting circuit, on a 4-wire half-duplex facility only, is applied from the output of tube V8(A) to the receiving circuit switch S2B (fig. 34). This circuit is open when the TH–5/TG is used for 4-wire full-duplex applications. Removal of the strap between terminal board connections F2 and D2 will remove the home copy leak. Removal of the home copy leak will prevent home copy from interfering with received signals. Resistor R28 is an impedance matching resistor used during 2-wire application.

56. D-C Amplifier Stage V12(A)—Spacing Interval, Transmitting Circuit

When a spacing pulse is sent from the teletypewriter, the spacing pulse will remove the positive voltage applied to the grid of tube

V12(A) (figs. 24 and 49) from the power supply. Without this grid voltage, the tube is driven to cutoff. Since there is no plate current, there is no voltage drop across load resistor R63. The voltage on the plate, therefore, rises to the value of its source voltage.

57. Time-Delay Stage V10(B)—Spacing Interval, Transmitting Circuit

The high plate voltage on tube V12(A) (par. 56) is applied to the grid of tube V10(B) (figs. 24 and 49) through current limiting resistor R62. The tube, normally biased at cutoff through cathode resistors R59, R60, and R61, begins to conduct. As the tube conducts, the voltage applied to the plate of V10(B) drops.

58. Time-Delay Stage V10(A)—Spacing Interval, Transmitting Circuit

The drop in voltage on the plate of tube V10(B) (par. 57) is applied to the grid of tube V10(A) (figs. 24 and 49) through current limiting resistor R57. Capacitor C39 is a wave shaping capacitor. Tube V10(A) is biased as a limiter because of the voltage divider arrangement of cathode biasing resistors R55 and R56. The drop in plate voltage from tube V10(B) is applied to the grid of tube V10(A); tube V10(A) is cut off, thereby developing a positive rectangular shape across plate load resistors R53 and R54.

59. Modulator Stage V9(B)—Spacing Interval, Transmitting Circuit

The positive voltage is applied to the plate and grid of tube V9(B) connected as a diode (figs. 24 and 49). The tube conducts and shorts capacitors C36 and C37 to ground. Resistors R51 and R52 are cathode bias resistors. Capacitor C38 is the cathode bypass capacitor.

60. Oscillator Stage V9(A)—Spacing Interval, Transmitting Circuit

The only change in the oscillator circuit (figs. 24 and 49), in the mark-to-space transition, is the inclusion of capacitors C36 and C37 across terminals 3 and 4 of transformer T5. This changes the oscillator frequency from 1,325 cps to 1,225 cps.

61. Output Amplifier Stage V8(A)—Mark-to-space Transition, Transmitting Circuit

This stage functions in the same manner during a mark-to-space transition, as during a space-to-mark transition. Refer to paragraph 55 for an explanation of the circuit functioning, and paragraph 68 for the discussion of the cathode connection.

62. Sequence of Operations in Transmitting Time-Delay Circuit, Transmitting Circuit.

a. To prevent losing part of the first space signal, which is transmitted when the carrier is first restored to the line, a time-delay is incorporated into the transmitting circuit. (Refer to paragraph 68 for the operation of the suppression circuit.)

d. The distortion of the start pulse, which is always a space signal, results when teletypewriter signals are applied to the line through narrow band filters. When a carrier signal is suddenly applied to narrow band filters, a finite time is required for the signal to build up to maximum amplitude. Similarly, it takes time for the signal to build up to a value needed to activate the receiving circuit. This finite time would distort the first space signal were it not for the time-delay arrangement in the transmitting circuit. Refer to figure 25 for the time sequence in the delay circuit.

c. At the beginning of a space signal, or on mark-to-space transitions, tube V12(A) cuts off, and its plate voltage rises to the value of its source voltage. Since capacitors C42 and C43 are charged in series with plate load resistor R63, the voltage rise across the capacitors is slow. This effectively delays the leading edge of the space pulse or the mark-to-space transition applied to the grid of tube V10(B).

d. When a marking signal is transmitted, tube V12(A) conducts and capacitors C42 and C43 discharge rapidly through tube V12(A). Because of the effective plate resistance of that tube, the trailing edge of the space pulse, as applied to the grid of tube V10(B), is also delayed slightly. Although only the time-delay of the first space pulse is of importance,

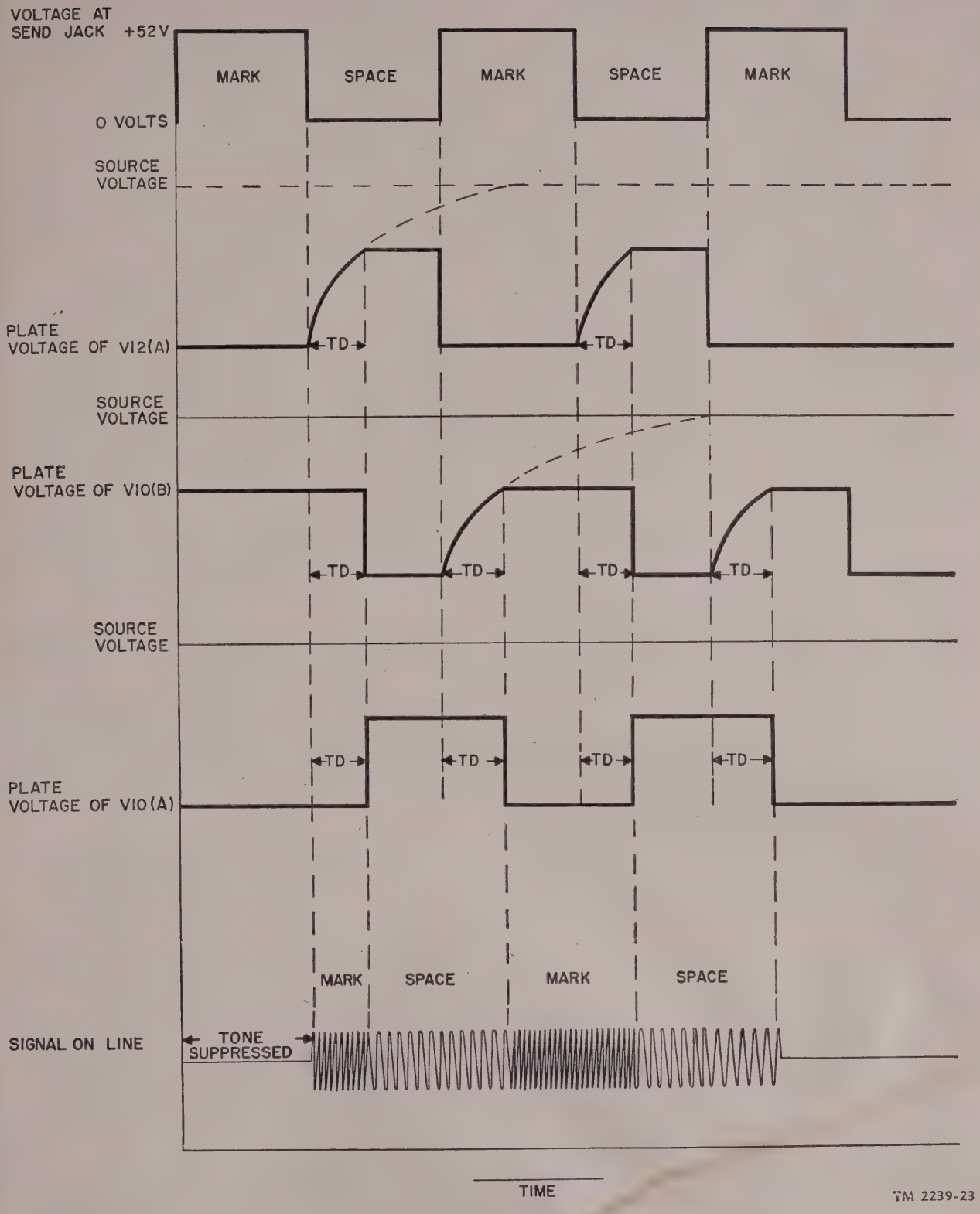


Figure 25. Sequence of operations in the time-delay circuit.

to maintain equal pulse widths all the pulses following must be delayed also. Capacitors C40 and C41 and resistor R58 delay the leading edges of the marking signal on the space-to-mark transitions. This action is similar to the action of the spacing signal time-delay.

e. When a spacing signal first is transmitted, the carrier suppression circuit is deactivated immediately. At the same time, the time-delay in the transmitting circuit delays the signal. This delay allows the space pulse to build up to maximum value and at the same time permits the immediate transmission of a marking signal (par. 68). Figure 25 illustrates the time the spacing signal is delayed. This is equivalent to the first short mark pulse applied to the line. This initial marking carrier current acts to establish a steady state condition in the transmission path. The steady state condition allows the subsequent transmission of the first space signal without any distortion.

f. The function of variable resistor R60 is to maintain equally the time duration of mark and space pulses. Resistor R60 determines the cathode bias on tube V10(B). Thus, it controls the voltage limits to which capacitors C42 and C43 must charge, on mark-to-space transitions, so tube V10(B) may conduct. By referring to the waveform of tube V12(A) (fig. 25), it can be seen that the voltage to which these capacitors charge determines the time-delay for mark-to-space transition. Therefore, by varying the voltage to which the capacitors must charge, the time-delay is varied. To transmit undistorted signals, the original pulse width must be maintained. The time-delay for the space-to-mark transition is fixed. Consequently, only the mark-to-space transition width is varied. The time-delay introduced is approximately 7 milliseconds, or one-third of a pulse at 60 wpm (words per minute).

63. Carrier Suppression Circuit, Description

Since simultaneous message transmission between two stations is not possible, it is necessary to remove the carrier tone (continuous oscillations at the mark frequency) from the line when message transmission stops. The removal of the carrier tone after transmission is terminated is an automatic function of the carrier suppression circuit (fig. 26). The carrier suppression circuit also restores the carrier tone to the line as soon as the first spacing signal is transmitted. The carrier suppression circuit is explained stage by stage in paragraphs 64 through 68.

64. Restorer Stage V12(B), Carrier Suppression Circuit

When no message is being transmitted, the transmitting circuit is in the marking condition. A positive voltage is applied to the plate and cathode of tube V12(B) (figs. 26 and 49). The tube does not conduct, since the cathode is at a

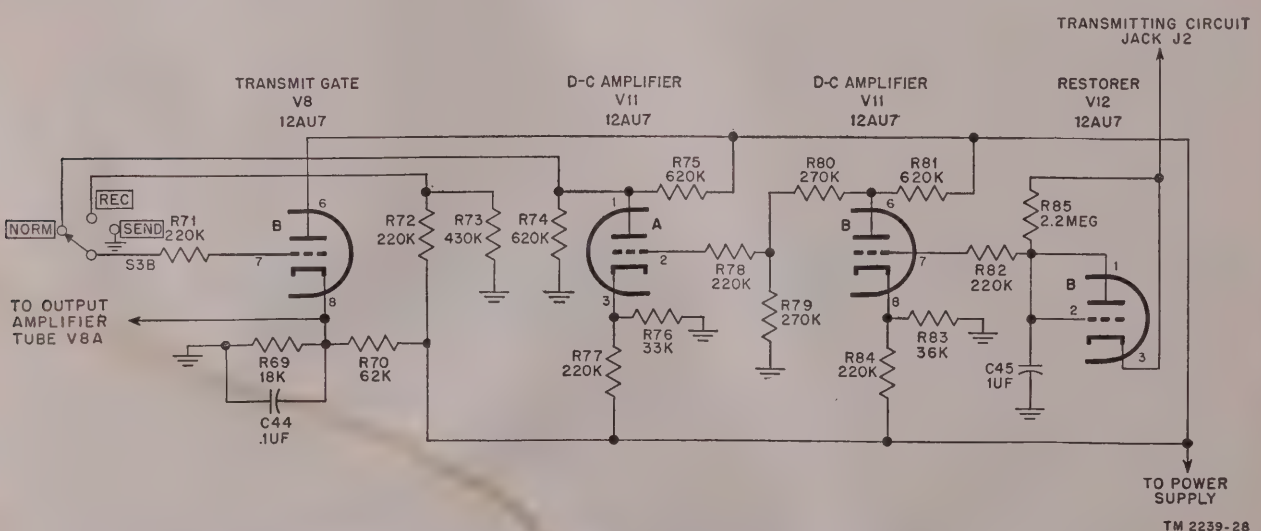


Figure 26. Telegraph Terminal TH–5/TG, carrier suppression circuit, schematic diagram.

higher potential than the plate. The diode presents an open circuit when the cathode is at a higher potential than the plate. Time-delay capacitor C45 charges slowly through resistor R85. The time constant for this time-delay circuit is approximately 3 seconds. The voltage across capacitor C45 is applied to the grid of tube V11(B) through current limiting resistor R82.

65. D-C Amplifier Stage V11(B), Carrier Suppression Circuit

Tube V11(B) (figs. 26 and 49) is normally at cutoff. After 3 seconds, the potential at the grid of the tube is of sufficient value to overcome the bias set by cathode resistors R83 and R84. The tube conducts and its plate voltage drops. R81 is the plate load resistor, and resistors R79 and R80 are voltage dividers.

66. D-C Amplifier Stage V11(A), Carrier Suppression Circuit

Since the plate voltage of tube V11(B) drops (par. 65), the grid voltage of tube V11(A) (figs. 26 and 49) also drops. This voltage applied through current limiting resistor R78 cannot overcome the bias set by resistors R76 and R77. Tube V11(A) is driven to cutoff and the voltage on its plate increases across load resistor R75.

67. Transmit Gate Stage V8(B), Carrier Suppression Circuit

The positive voltage from the plate of amplifier tube V11(A) (par. 66) is applied to the grid of transmit gate tube V8(B) (figs. 26 and 49) through current limiting resistor R71. This voltage causes the tube to conduct. A high positive voltage is developed across cathode resistor R69. This resistor also serves as the cathode resistor for tube V8(A) of the transmitting circuit. The positive bias drives output amplifier tube V8(A) to cutoff and, thereby, removes the carrier tone from the line. The cathode bias resistors of tube V8(B) are resistors R69 and R70. Capacitor C44 is the cathode bypass.

68. Carrier Suppression Circuit—First Spacing Interval

a. When the keyboard contacts are opened for a mark-to-space transition, capacitor C45 rapidly discharges through the low forward resistance of diode V12(B). This is possible since the cathode, during a space pulse, is at zero potential. The potential at the plate is equal to the charge on capacitor C45.

b. With the discharge of the capacitor, tube V11(B) is cut off. Its plate voltage rises, feeding a positive potential to the grid of tube V11(A). The tube conducts and its plate voltage drops. This lesser voltage is applied to the grid of tube V8(B).

c. Tube V8(B) is driven to cutoff and a lesser bias is developed across resistor R69, which permits transmitting circuit output tube V8(A) to conduct, and carrier tone is restored to the line.

d. Since the oscillator resonates continuously at 1,325 cps, a mark tone is transmitted immediately. The primary mark signal is transmitted before the mark-to-space transition has reached modulator tube V9(B). This results from the time-delay circuit (par. 62).

e. During the sending of mark and space signals for message transmission, the charge on capacitor C45 never reaches the critical point at which it will suppress the carrier tone from the line. Reaching the critical point is prevented by the opening of the keyboard contacts for space pulses before 3 seconds have elapsed.

f. When transmission is terminated and the keyboard contacts of the teletypewriter are in the *mark* position for at least 3 seconds, capacitor C45 charges, causing output amplifier tube V8(A) to be cut off. Therefore, it is necessary for the receiving teletypewriter operator to wait for the neon lamp of the TH–5/TG to light before starting transmission. The lighting of the lamp indicates the suppression of the tone from the transmitting terminal.

g. Switch S3B (fig. 26) allows for three different types of suppression action.

(1) In the NORM position, suppression is automatic.

(2) In the REC position, the carrier tone is suppressed continuously. In this position, resistors R72 and R73 provide sufficient bias for tube V8(B) to conduct.

(3) In the SEND position, the carrier tone is transmitted continuously. Tube V8(B) is cut off because the grid is returned to ground.

69. Receiving Circuit, Description

This circuit is used to receive incoming mark and space frequencies, demodulate them, and then apply the resultant d-c pulses to the selector magnet of the teletypewriter. Its further purpose is to receive and demodulate locally transmitted signals to obtain home copy. In 4-wire application, the home copy (locally transmitted signals) is applied to the grid circuit of tube V1(B) (fig. 49). In 2-wire application, both home copy and the incoming signal are applied across the primary of transformer T1. Refer to figure 23 for the waveforms of this circuit. Figure 27 illustrates the receiving circuit, and paragraph 70 through 74 contain a stage-by-stage analysis.

70. Limiter and Amplifier Stage V1(A), Receiving Circuit

Tube V1(A) (figs. 27 and 49) is a conventional voltage amplifier, differing only in that the signal is applied to the grid through series resistor R8 to secure current limiting action on high-level signals. When the tube does draw current, the grid current, being of opposite polarity to the input signal, clips the peaks of the incoming signal. Thus the high-level signal is limited by the grid conduction on the positive half-cycle, and by plate current cutoff on the negative half-cycle. On low-level signals, this stage acts as a Class A amplifier. Resistor R7 provides a resistance-impedance match for transformer winding T1. Capacitor C6A is the bypass for cathode resistor R9. The amplified output is developed across resistor R10, which is in series with decoupling resistor R11 and bypass capacitor C6B.

71. Limiter and Amplifier Stage V1(B), Receiving Circuit

The limiting and amplification functions of tube V1(B) (figs. 27 and 49) are identical to that of the preceding stage (par. 70). Low-level signals, however, which are not clipped by tube V1(A) are clipped by tube V1(B). Home copy on a 4-wire facility is applied directly to the grid of this tube. Capacitor C7 couples tube V1(A) to tube V1(B). Resistor R13 limits the grid current. Grid leak to ground is provided by resistor R12; resistor R14 is the cathode biasing resistor. The amplified output of this stage is developed across resistor R15, which is decoupled by capacitor C6C and resistor R16.

72. Limiter Stage V2(A), Receiving Circuit

The function of tube V2(A) (figs. 27 and 49) is to remove any amplitude modulation that has not been removed by tubes V1(A) and V1(B). The limiter provides the discriminator with a signal of constant amplitude. The input signal to the grid of tube V2(A), being of large amplitude, causes the grid to draw current when the input signal is positive. As the input signal goes positive, capacitor C8 charges across resistor R17, making the grid positive with respect to the cathode. The grid draws current of opposite polarity to the incoming signal; this results in a positive clipped signal in the grid circuit. Limiting is accomplished, in the negative half-cycle, by driving the tube to cutoff. During this period there is no flow of plate current, and, therefore, the negative half-cycle is clipped in the plate circuit. The result is a square wave of constant amplitude. R18 is the grid current limiting resistor. R19 is the cathode bias resistor.

73. Discriminator and Detector Doubler Circuits, Receiving Circuit

a. The primaries, terminals 1 and 2 of transformer T2, are tuned by parallel capacitors C10, C11, and C12 to 1,400 cps, a frequency slightly above the mark frequency. The tuned circuit for the space frequency is the primary of transformer T3 and parallel capacitors C14 and C15. This circuit is resonant at 1,210 cps, a frequency

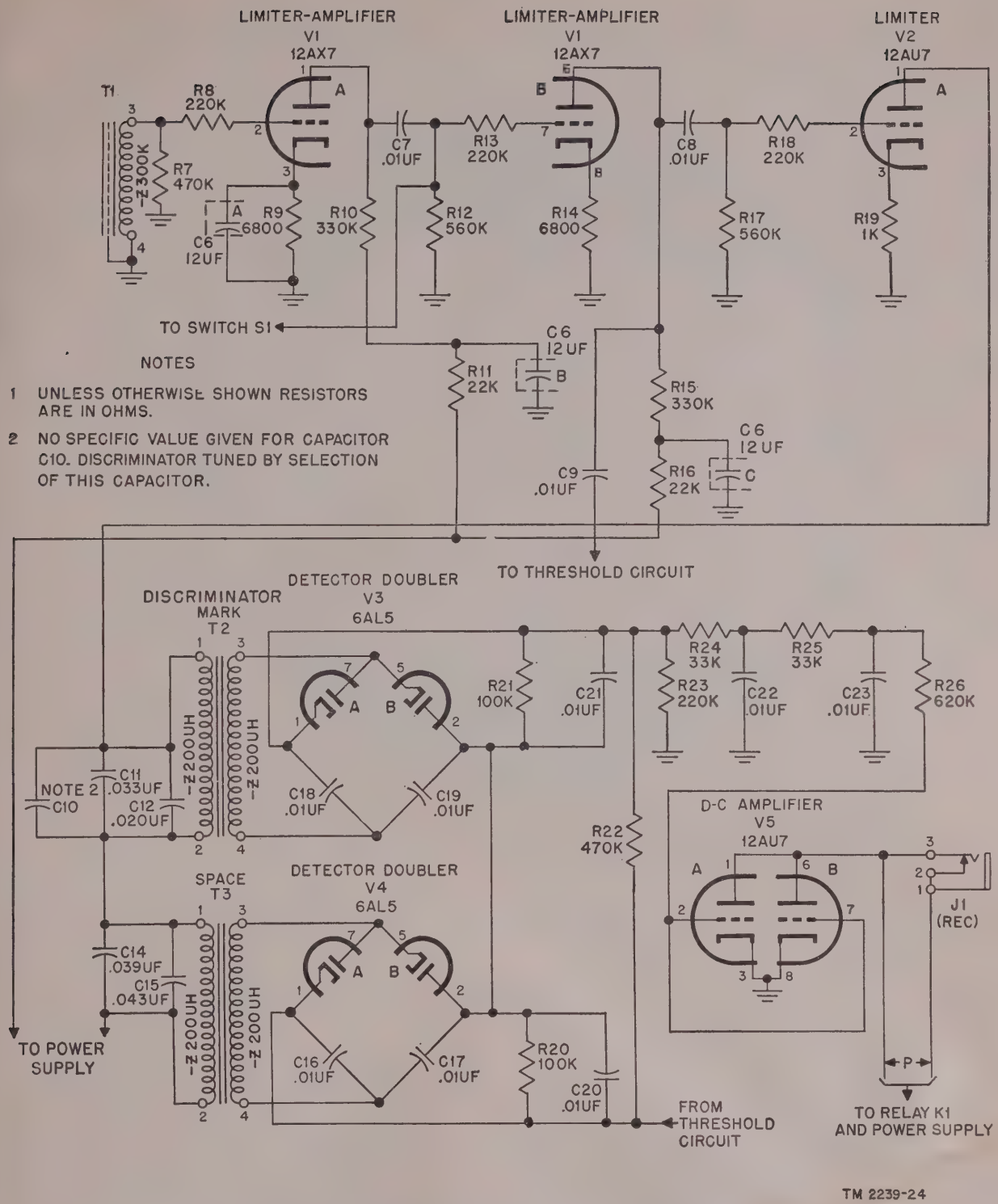


Figure 27. Telegraph Terminal TH–5/TG receiving circuit, schematic diagram.

slightly below the space frequency. The two primary windings are connected in series in the plate circuit of tube V2(A). Since, at resonance, voltage is at a maximum across a parallel tuned circuit, the further the input frequency is from resonance, the lower in amplitude will be the voltage across the tank circuit. Because of the selectivity, the voltage across

the tuned circuit is sinusoidal, although the current pulses are rectangular. Since the input voltage to the discriminator varies in frequency, the voltage output varies in amplitude.

b. Note that in figure 27 there is a voltage across both transformer T2 and transformer T3 for either a mark or a space signal. For a mark interval, however, the amplitude of the signal across transformer T2 is greater than the amplitude of the signal across transformer T3. For spacing intervals, the amplitude of the signal across transformer T3 is greater than the amplitude of the signal across transformer T2. Thus the input signals to the discriminators, being of constant amplitude, but varying frequencies, are converted to signals of varying amplitudes (fig. 28). The amplitude-modulated signals are applied to the detector doubler circuits.

c. Since the action for the mark doubler and the space doubler is identical, only the mark circuit is discussed.

(1) On the carrier half-cycle, when terminal 3 of transformer T2 is more positive than terminal 4, tube V3(A) conducts, since its plate is positive with respect to its cathode. In conducting, it charges capacitor C18. Thus the upper plate of capacitor C18 is positive in relation to the lower plate of the capacitor, by a voltage equal to the peak voltage of the input signal. For this half-cycle, tube V3(B) is cut off, since its cathode is more positive than its plate.

(2) During the next half-cycle, terminal 4 of transformer T3 is positive with respect to terminal 3. Tube V3(A) does not conduct, and capacitor C18 begins to discharge slowly through resistor R21. The time constant of the circuit may be expressed as a rapid charge time and a very slow discharge time. While capacitor C18 is discharging slowly, capacitor C19 charges rapidly through tube V3(B). Since these two capacitors are series aiding, the voltage across them, as it appears across resistor R21, is twice the peak voltage developed across the secondary of transformer T2.

(3) Figure 31 shows an equivalent detector doubler circuit. Although on successive half-cycles the polarities across the input vary; the polarities across the output are constant. The rectified mark and space signals across resistors R21 and R20 are of opposite polarity. The voltage across resistor R21 is always positive; the voltage across resistor R20 is always negative. The net differential or difference between these two voltages appears across resistor R22 (fig. 30). The voltage is positive for a mark signal and negative for a space signal. One side of this resistor is grounded in series with resistor R39, which is a cathode bias in the output of the threshold circuit. The function and action of this resistor are described in the discussion on the threshold circuit (par. 79).

(4) The d-c pulses from tubes V3 and V4 are filtered by capacitors C20, C21, C22, and C23 and resistors R24 and R25. This low-pass filter arrangement bypasses carrier variations to ground. Resistor R23 is a voltage divider.

(5) The signal voltage that appears across the mark tuned circuit of the discriminator during teletypewriter transmission is shown in figure 28. Note that the amplitude of the signal for a mark interval is almost twice the amplitude as for a space interval. The same waveform would appear across the space tuned circuit, except that the signal for a space interval would be twice the amplitude as for a mark interval. The sloping change in amplitude is due to the property of very selective circuits which do not respond instantaneously to a sudden change in frequency.

(6) The detected output of the discriminator is shown in figure 29.

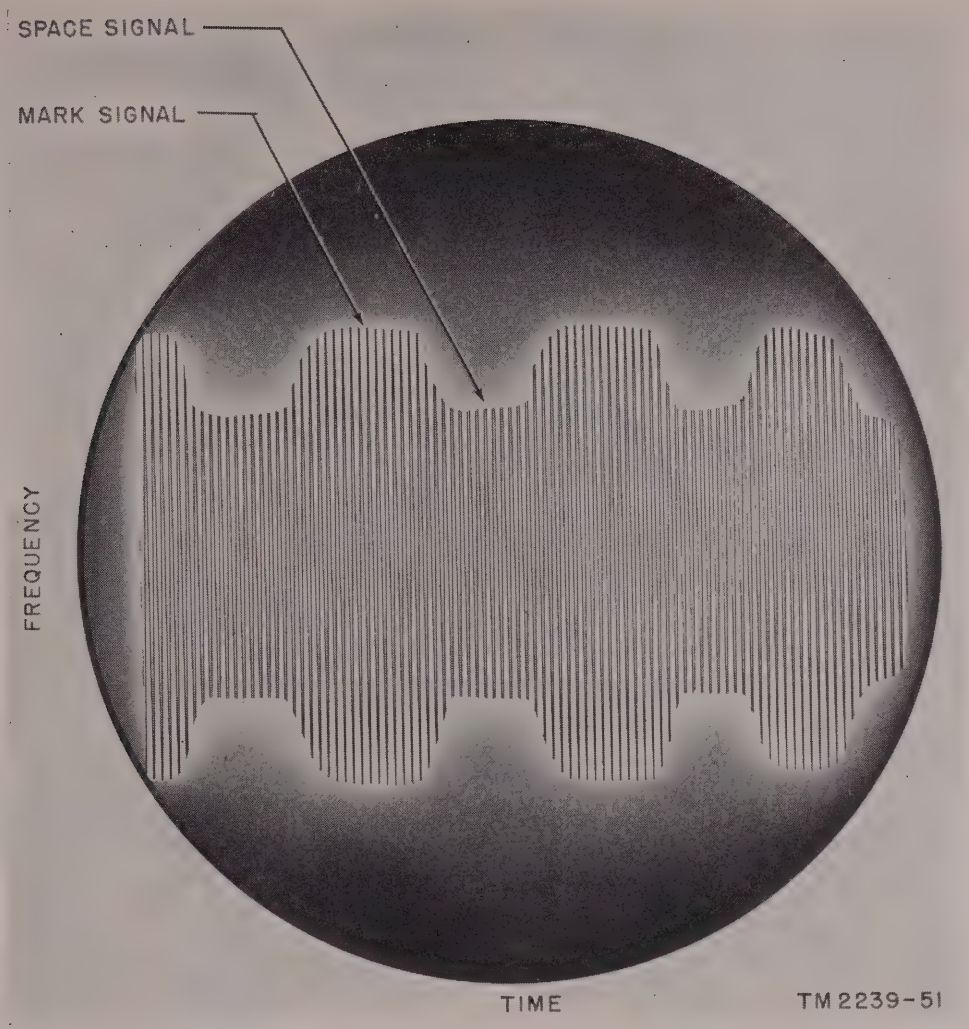


Figure 28. Waveform of signal voltage appearing across mark tuned circuit of discriminator.

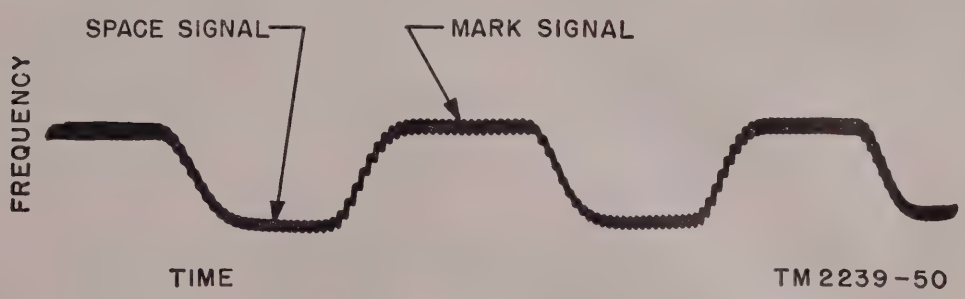


Figure 29. Waveform of voltage output across resistor R22.

74. D-C Amplifier Stage V5, Receiving Circuit

D-c pulses are applied to the grids of V5(A) and V5(B) (figs. 27 and 49) through current limiting resistor R26. The parallel grids of tubes V5(A) and V5(B) are driven positive for a mark pulse and negative for a space pulse. The plate current is a minimum of 20 ma for a mark pulse and 0 ma for a space pulse. Re-

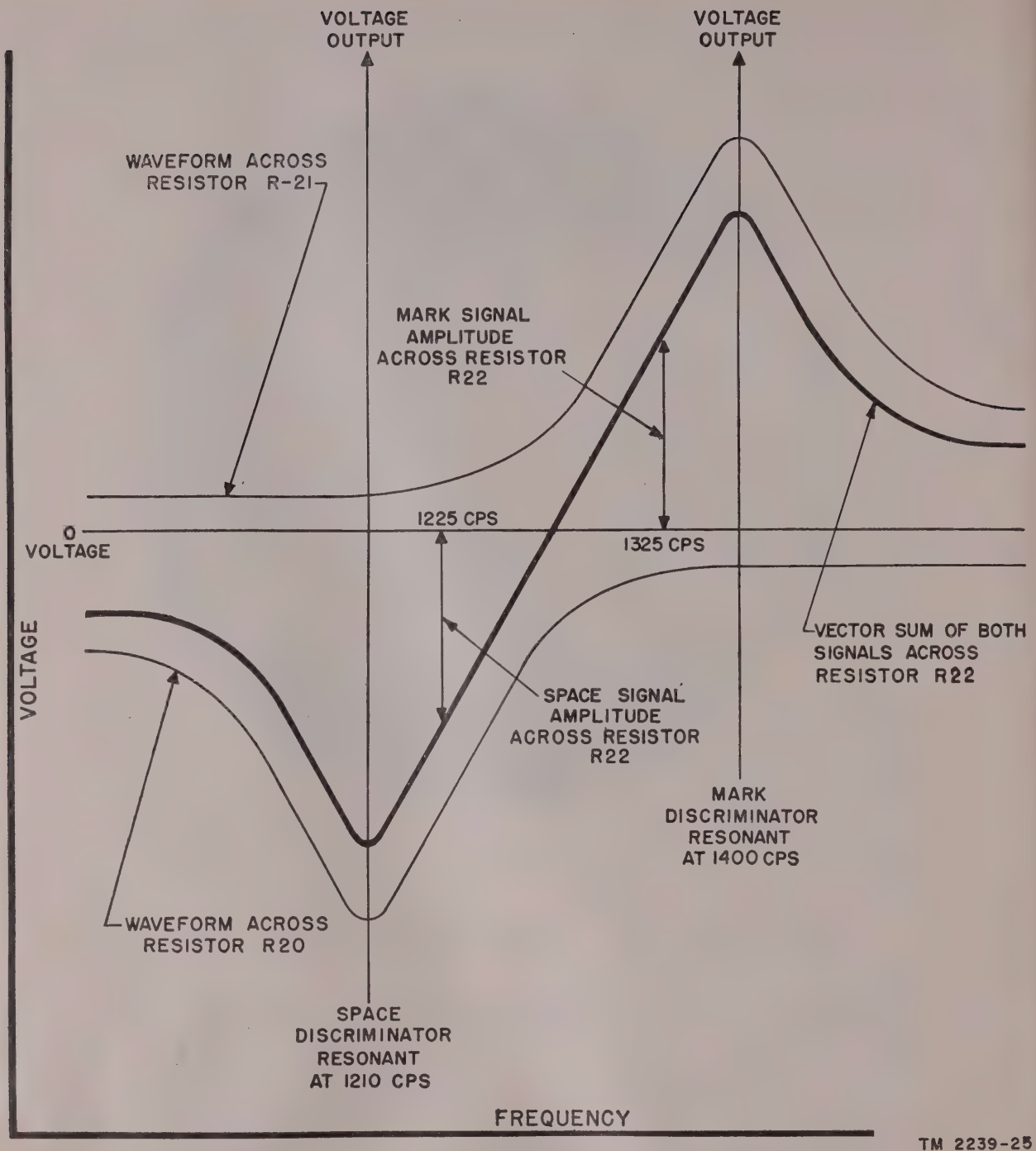


Figure 30. D-c output voltage of detector-doubler, as function of frequency.

sistor R27 limits plate current to 20 ma. A teletypewriter selector magnet, connected in series to the plate circuit through REC jack J1, responds to incoming teletypewriter signals.

75. Threshold Circuit, Description

The threshold circuit (fig. 32) is an electronic switching circuit. It maintains the receiving circuit output tube V5 in the marking

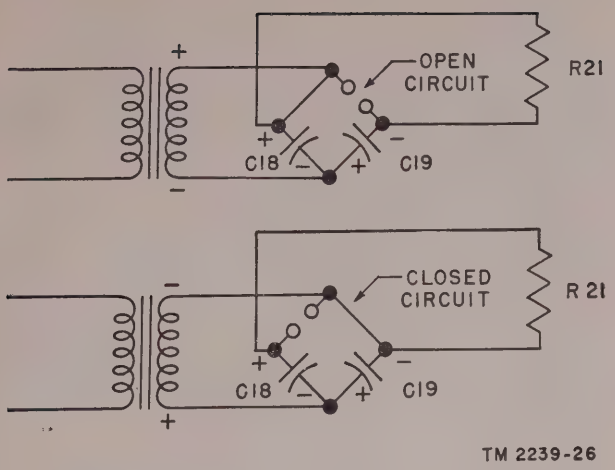


Figure 31. Equivalent detector-doubler circuit.

condition for all signals under the threshold value of —45 dbm. (The receiving circuit sensitivity is rated at 0 to —45 dbm). The threshold circuit prevents false operation of the receiving circuit on low-level noise after transmission has stopped. When a signal of at least —45 dbm is applied to the receiving circuit, the threshold circuit permits the receiving circuit to resume normal operation. The threshold circuit is explained stage-by-stage in paragraphs 76 through 79.

76. Buffer Stage V2(B), Threshold Circuit

The signal from the plate of receiving circuit tube V1(B) is fed to the grid of buffer V2(B) (figs. 32 and 49) through coupling capacitor C9. This signal is applied across grid bias resistor R29. The output of this stage is taken across cathode resistor R30. Since it follows the input signal to the grid, the output is the same polarity as the input. The buffer has a high-impedance input so that it will not shunt the following stages in the receiving circuit. It has a low-impedance output to drive diode tube V6 for maximum rectified voltage in the diode load circuit.

77. Rectifier Doubler Stage V6, Threshold Circuit

The a-c (alternating-current) signal from the buffer (par. 76) is coupled to rectifier-doubler tubes V6(A) and V6(B) (figs. 32 and 49) through coupling capacitor C24. As the signal goes positive, tube V6(A) conducts, charging capacitor C25 across resistor R31. On the next half-cycle, capacitor C25 discharges slowly across resistor R31. This maintains a positive voltage on the grid of the following stage of amplification tube V7(A). On the negative half-cycle, tube V6(B) conducts, offering a low discharge path to ground for capacitor C24. Resistor R32 and capacitors C25 and C26 are low-pass filters used to filter out the carrier.

78. Trigger Stage V7(A), Threshold Circuit

Tube V7(A) (figs. 32 and 49) is biased through cathode resistors R34 and R35. The bias holds plate current at cutoff for signal values from tube V6 (par. 77) that corresponds to intensity strength of less than —45 dbm. When tube V7(A) is at cutoff, its plate potential rises from its initial value of approximately 32 volts toward the value of its source voltage. When this potential reaches 75 volts, neon lamp E9 lights and supplies a closed circuit to ground for the source voltage. This closed circuit con-

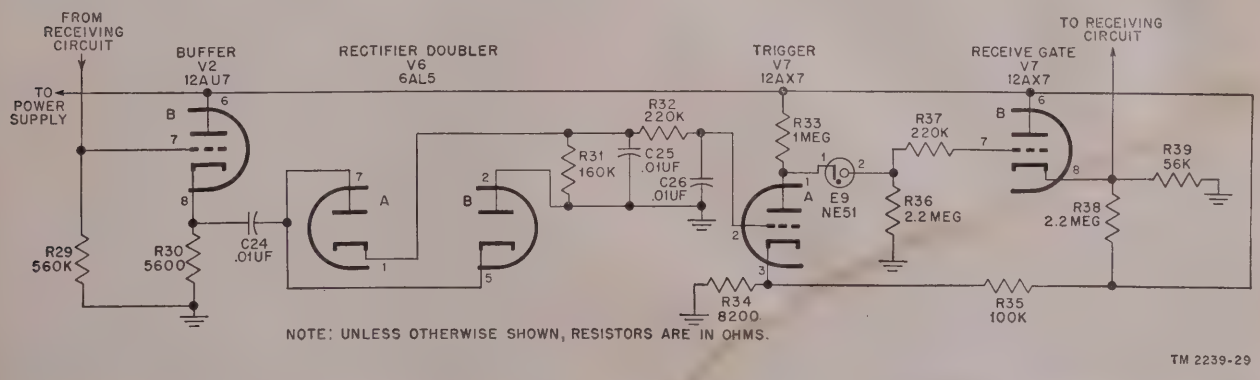


Figure 32. Telegraph Terminal TH–5/TG, threshold circuit, schematic diagram.

sists of plate load resistor R33, neon lamp E9, and grid leak resistor R36. The voltage drop across resistor R36 increases the bias on tube V7(B).

79. Receive Gate Stage V7(B), Threshold Circuit

a. Tube V7(B) (figs. 32 and 49) is connected as a receive gate. When the neon lamp is not lighted, the tube is biased to cutoff by cathode resistors R38 and R39. The voltage drop across resistor R39 is approximately 3.5 volts. This voltage is fed to the receiving circuit, in series with the detected output of the discriminator.

b. When the input signal level to the receiving circuit drops below —45 dbm, the neon lamp lights (par. 78), resulting in a voltage drop across grid leak resistor R36. This voltage is applied to the grid of tube V7(B) through current limiting resistor R37. Tube V7(B) conducts to develop a high positive voltage across resistor R39. This voltage, approximately 82 volts, is applied in series with the discriminator output voltage across resistor R22 of the receiving circuit. This voltage biases the grids of V5(A) and V5(B) positive with respect to their cathodes. The receiving circuit output tubes thus are maintained at the marking condition, and operation of the receiving circuit on random noise is prevented.

c. Since the teletypewriter signals have an intensity of more than —45 dbm, tube V7(A) begins to conduct when the first marking signal is received. When the plate voltage of the tube drops to 32 volts, the neon lamp is extinguished. The grid voltage is removed from tube V7(B) driving the tube to cutoff. The voltage drop across resistor R39 decreases to 3.5 volts. This voltage is applied to the grids of receiving circuit output tubes V5(A) and V5(B). With this lesser grid bias the receiving circuit is free for normal operation.

80. Power Supply Circuit

a. The power supply (fig. 33) consists of three conventional full-wave rectifiers operating from a 110- to 115-volt, 50- to 60-cycle source. The source is supplied by transformer T6. The power supply furnishes d-c voltage for the plate, bias, and ringing supply circuits. In addition, it supplies 6.3 volts ac to the tube filaments.

b. When a mark pulse is transmitted from the teletypewriter, the power supply furnishes a positive voltage which causes d-c amplifier tube V12(A) to conduct.

c. A separate power supply tube (V14) is used for the transmitting circuit input.

d. A low-resistance input is needed to prevent signal distortion. A high-resistance input causes signal distortion because of the use of spark suppression filters across the keyboard contacts of the teletypewriter.

e. Tube V15, filtered by capacitor C48, supplies the 20-cps ringing generator; tube V14, filtered by C47A, supplies the input to the transmitting circuit; and tube V13, filtered by resistor R68 and capacitors C46C and C46B, is the plate and bias supply. R27 and R40 are voltage-dropping resistors in the supply circuit from tube V15 to the receiving and threshold circuits.

81. Input-Output and Ringing Circuits

a. General. Figure 34 is a simplified schematic diagram illustrating switches S1, S2, and S3. This illustration shows them as a series of single-pole, three-position switches. Figure 49 shows them as they actually are, three-position, wafer type switches. In both figures the switches are wired identically. The switch functioning is explained in subparagraph *c* below.

b. Binding Post Connections. The input-output and ringing circuits contain the binding posts through which the TH–5/TG is connected to the line.

(1) In the 2W position of switch S2 (4W—2W—TEL), on a 2-wire facility, binding posts E4 and E6 are used for connecting the transmitting and 20-cps ringing supply circuits to the line. Incoming teletypewriter and 20-cps ringing signals are applied to the TH–5/TG through binding posts E4 and E6.

(2) In the 4W position of switch S2, on a 4-wire facility, the transmitting and 20-cps ringing circuits are connected to the line through binding posts E3

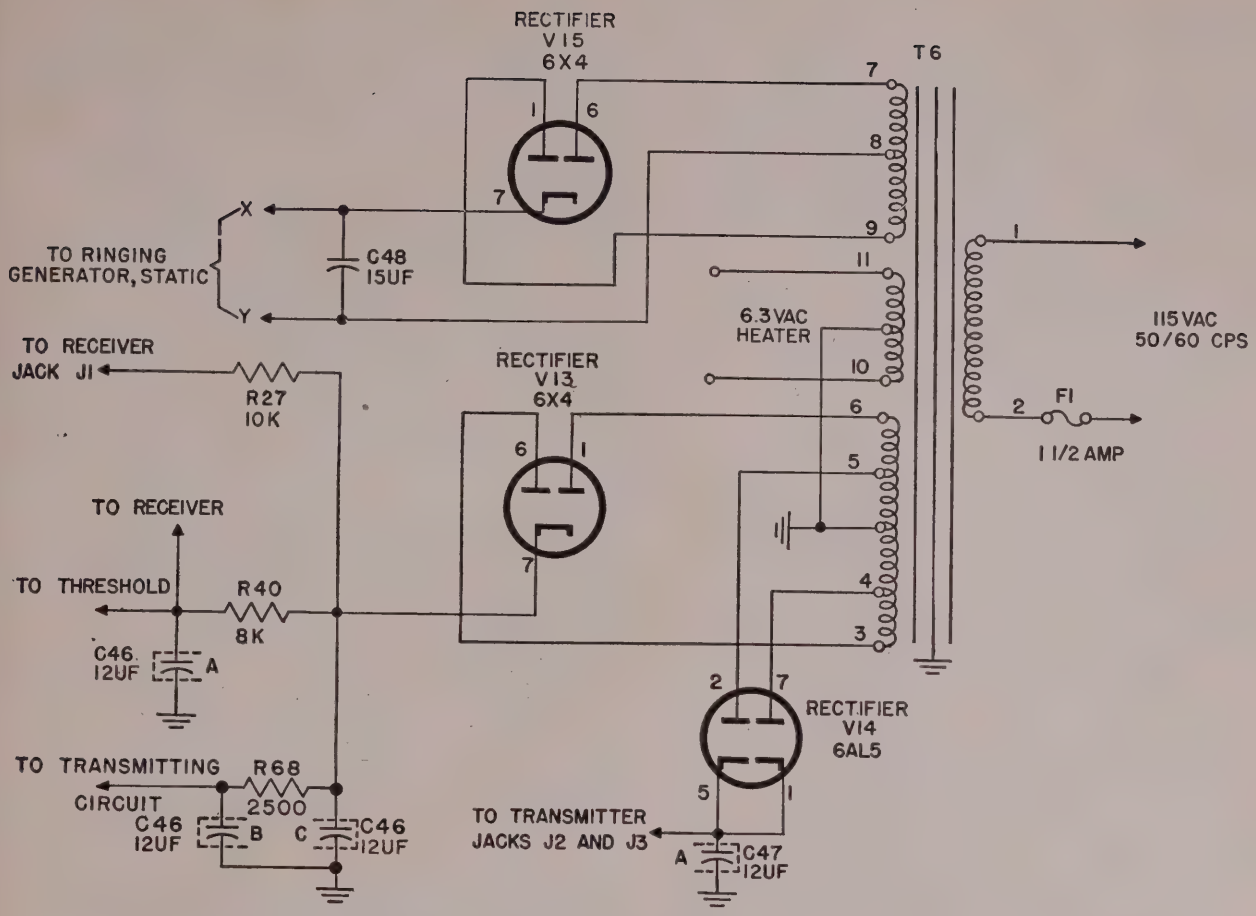


Figure 33. Telegraph Terminal TH–5/TG, power supply circuit, schematic diagram.

and E4. Incoming teletypewriter and 20-cps ringing signals are connected to the TH–5/TG through binding posts E5 and E6.

(3) In the TEL position of switch S2, the telephone set, either common or local battery type, is connected across TEL binding posts E3 and E5. The line connection for the telephone is on a 2-wire facility only, at binding posts E4 and E6.

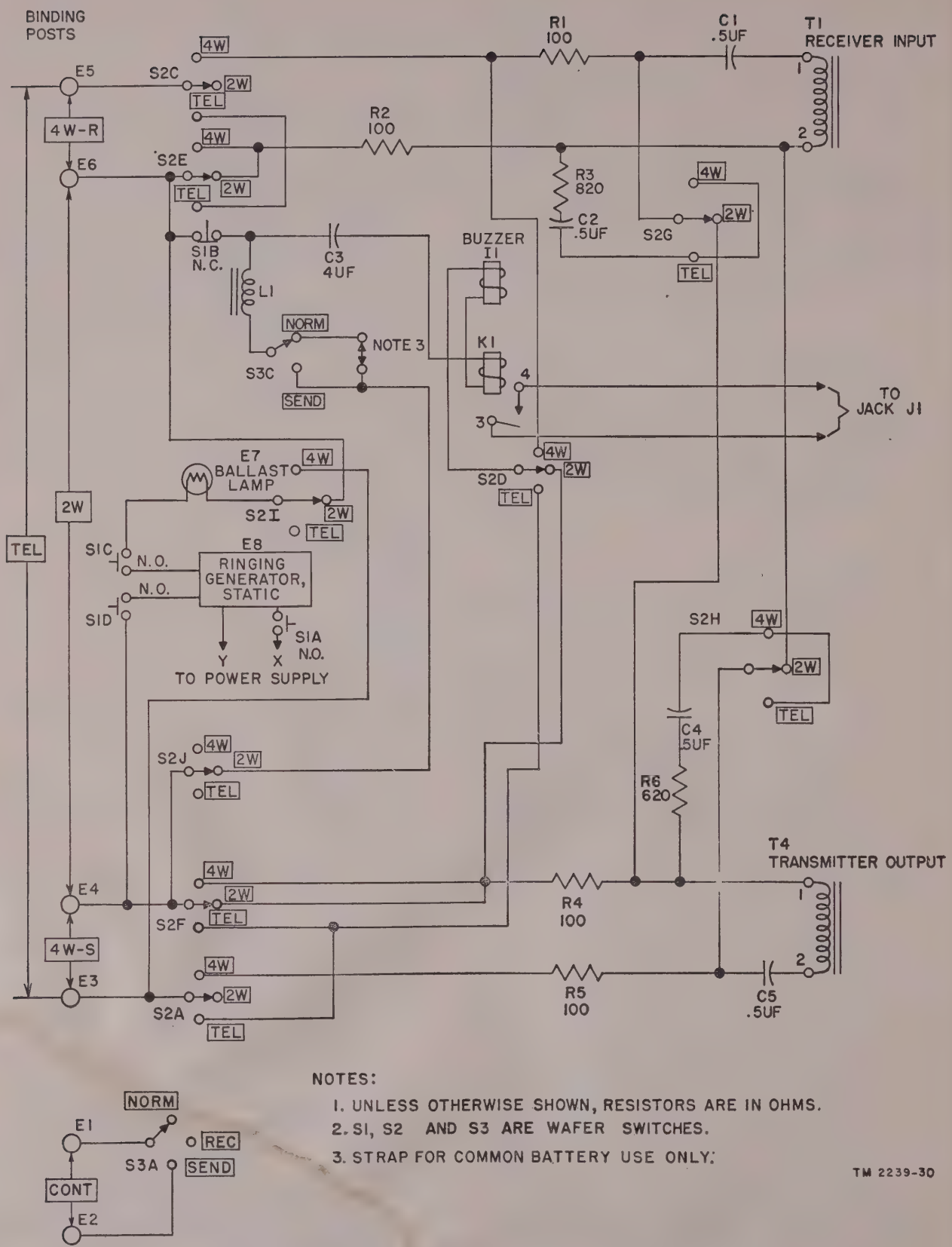
(4) The CONT binding posts provide a d-c closure in the SEND position of SEND — REC — NORM switch S3. Switch S3 is used with associated equipment to activate radio transmitters.

c. Functioning of Input-Output and Ringing Circuits. The input-output and ringing circuits function as explained below.

(1) When switch S1 is depressed, contact S1A closes, and power is applied to the ringing generator.

(2) Contacts S1C and S1D close to connect the 20-cps signal to the line either at binding posts E4 and E6 or binding posts E3 and E4. Connection to the proper binding posts is dependent on the position of contact S21. Ballast lamp E7 protects the 20-cps ringing supply circuit against shorts on the line.

(3) Contact S1B opens during the transmission of the ringing signals to prevent energizing relay K1 and buzzer I1. For incoming buzzer signals, contact S1B remains closed, offering a path for the signal to relay K1 and buzzer I1.



NOTES:

1. UNLESS OTHERWISE SHOWN, RESISTORS ARE IN OHMS.
2. S1, S2 AND S3 ARE WAFER SWITCHES.
3. STRAP FOR COMMON BATTERY USE ONLY.

TM 2239-30

Figure 34. Input-output and ringing circuits, schematic diagram.

(4) When relay K1 is energized, the teletypewriter runs open since the closing of contacts 3 and 4 of the relay shorts out the REC jack.

(5) The buzzer circuit is completed either through binding post E5 and E6 or E4 and E6. This action depends on the position of switch S2D. Capacitor C3 is a blocking capacitor in this circuit.

(6) When switch S2 is in the 4-wire position, the transmitting circuit is connected to the line through binding posts E3 and E4. The signal is coupled to the secondary of transformer T4 and passes through low-frequency blocking capacitor C5. The signal then is fed through impedance correcting resistors R4 and R5, contacts S2A and S2F, to binding posts E3 and E4. When the signal is being received, it feeds to the TH–5/TG through binding posts E5 and E6. The signal then goes to the receiving circuit through impedance matching resistors R1, R2, and low-frequency blocking capacitor C1.

(7) The action in the circuit is similar on a 2-wire facility. The received and transmitted signals are applied through binding posts E4 and E6. Resistors R2 and R4 correct the impedance for both the transmitting and receiving circuits. The line winding of the input and output transformers are in parallel.

(8) For home copy, on 2-wire application, the transmitting circuit output feeds to the receiving circuit input through contacts S2H and S2G. The connection between the line windings of the input and output transformer is removed during both the 4-wire and the telephone applications. To maintain the same nominal line impedance in both 4-wire and in 2-wire circuit applications, during 4-wire applications, resistor R6 and capacitor C4 are connected across the output of transformer T4, and capacitor C2 and resistor R3 are connected across the input of transformer T1. Capacitors C2 and C4 offer high reactance to the 20-cps ringing signal.

(9) In the TEL position of switch S2, voice communication passes across the binding posts from the line to the telephone through contacts S2A, S2F, and contacts S2C and S2E.

(10) In alternate telegraph-telephone service, with the 4W—2W—TEL switch in the TEL position, the incoming ringing signal will operate the buzzer. It will not ring the bell of the telephone set.

(11) Contact S3A is open in the REC and NORM positions. In the SEND position switch S3A provides a d-c closure to activate the transmitter of associated radio equipment. Note that the switch *must remain* in the SEND position during transmission over push-to-talk radio.

(12) Contact S3B (fig. 26) maintains automatic carrier tone suppression in the NORM position. In the REC position the carrier tone is suppressed continuously. In the SEND position the carrier tone is transmitted continuously.

(13) Contact S3C (fig. 34) provides a d-c closure through holding coil L1 for the common battery current from the switchboard. The coil is included in the circuit when switch 4W—2W—TEL is in the 2W position. Coil L1 is used in *telegraph only* service when a telephone switchboard serves as a teletypewriter switchboard.

(14) The strap between the NORM and SEND contacts of switch S3C provides a closed path for the common battery current and is connected only during this application. In addition, holding coil L1 is in the circuit for the remote operation of a remote control unit. The SEND — REC — NORM switch must be in the SEND position.

(15) Figure 35 is a simplified diagram showing line terminations on a 2-wire and a 4-wire facility. The TH–5/TG will present a nominal 600-ohm im-

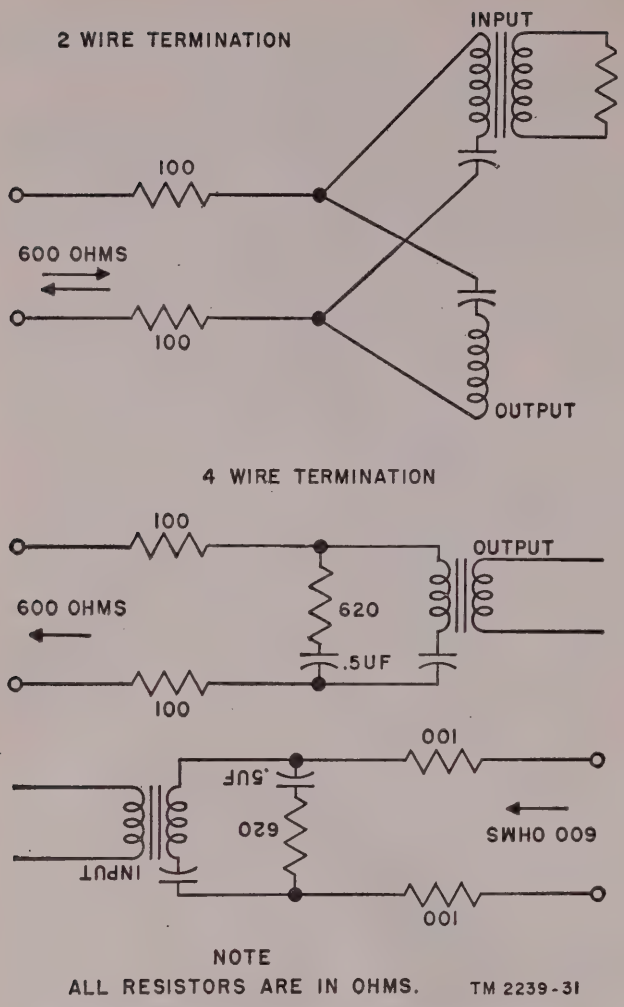


Figure 35. Schematic showing impedance matching.

pedance to the line in both 2-wire and 4-wire applications.

82. Static Ringing Generator Circuit

a. Function of Static Ringing Generator Circuit. The function of the ringing generator circuit (fig. 36) is to supply a 20-cps telephone ringing signal in telephone applications, or a 20-cps break signal to activate the buzzer at a teletypewriter station. To accomplish this, a vibrator, a mechanical resonant electrical device, is to change a continuous direct current into a pulsating direct current. A suppression filter, included in the ringing generator circuit, eliminates radio frequencies that cause interference in the TH–5/TG and associated equipment.

b. Operation of Static Ringing Generator Vibrator.

(1) The ringing generator vibrator has five contacts. The upper left contact is the *motor* contact. The remaining four contacts are the *voltage* contacts. When no current is applied to the relay, the armature is at rest midway between the voltage contacts with the motor (upper left) contact closed (fig. 36). In this condition the 18K resistor is shorted out of the circuit by the upper armature section and the motor contact. When current is first

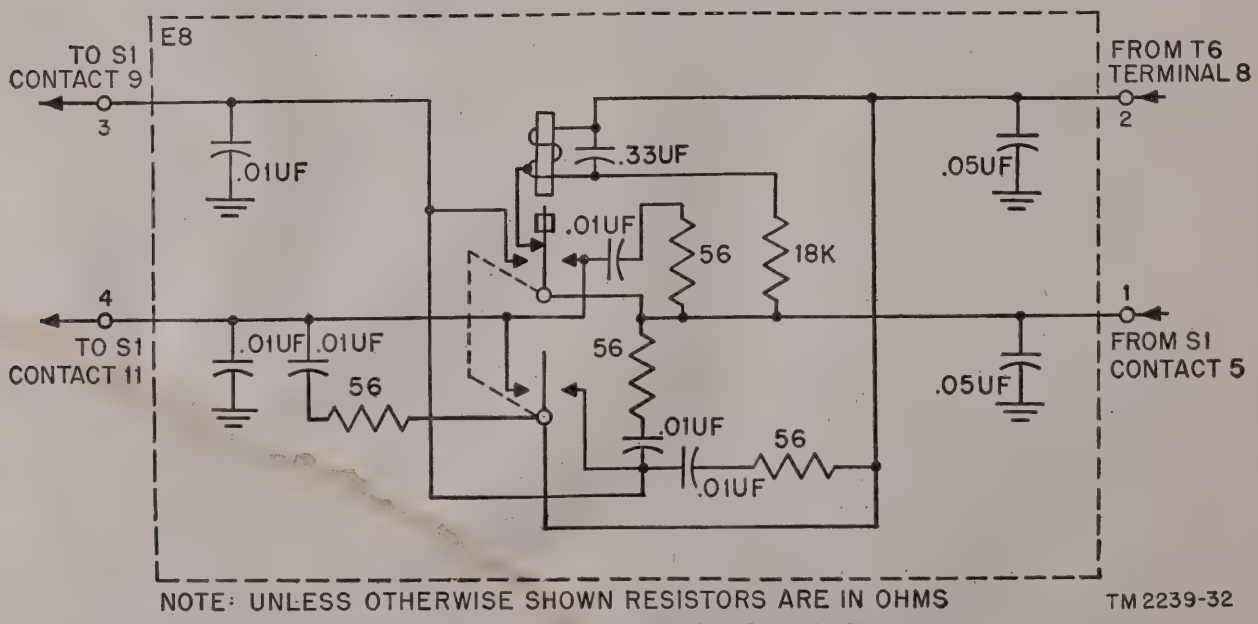


Figure 36. Ringing generator, static, schematic diagram.

applied to the circuit, current flows from tube V15 through terminal 1, through the upper armature section to the motor contact, through the relay winding, and returns to tube V15 through terminal 2 and the RING switch. The current flow through the relay winding energizes the winding. Since the core of the winding is bent slightly to the right (not shown in figure 36) the magnetic field pulls the armature to the right. This motion breaks the motor contact, placing the 18K resistor in the circuit. With this added resistance in the circuit, the current flow decreases, causing the collapse of the magnetic field and permitting the armature to move back toward its rest position. Inertia carries the armature past its rest position. As the armature passes the rest position, the motor contact closes and the winding re-energizes. This applies a force to move the armature back to the right, breaking the motor contact. In this manner, oscillations build up until the armature closes and opens the voltage contacts as it vibrates.

(2) When the armature closes the left set of voltage contacts, the path from the negative side of rectifier tube V15 is from terminal 2 through the lower armature section and contact to terminal 4. The positive path is from terminal 1 through the upper armature section and contact to terminal 3. When the armature closes the right set of voltage contacts, the negative path is from terminal 2 to terminal 3, and the positive path is from terminal 1 to terminal 4. Since the armature is mechanically resonant at a 20-cps rate, the polarity of terminals 3 and 4 will change at a 20-cps rate, effectively producing a 20-cps alternating current.

(3) Current surges are prevented because a closed circuit (through the relay winding) is offered continuously to the current flow from the power supply. The .33-μf (microfarad) capacitor in parallel with the relay winding decreases the time required for the armature to build up vibrations of sufficient amplitude to make and break the voltage contacts.

c. Operation of Static Ringing Generator Filter. The generator circuit includes a suppression filter to prevent interference caused by sparking at the contact points. The series resistors and capacitors which form the filter, attenuate the undesired frequencies which might interfere with the operation of the converter and with associated equipment. A sealed metal shield houses the entire ringing generator, to eliminate radiation of undesired frequencies.

Section II. THEORY OF ELECTRICAL FILTER ASSEMBLY F–98/U

83. General

Electrical Filter Assembly F–98/U is used to derive a telegraph channel from a portion of the frequency band which a telephone channel uses while retaining the telephone channel for speech transmission. This operation is possible because only a small portion of the normal voice band is required for a telegraph channel. That part of the band which remains after subtraction of the small band required for telegraph provides a satisfactory telephone circuit.

84. Functioning of Electrical Filter Assembly F–98/U

a. Electrical Filter Assembly F–98/U (fig. 37) consists of a band-pass and band-stop section.

(1) The band-pass section contains a series-resonant circuit that offers very low attenuation to the frequencies used by the telegraph channel. The band-pass section offers very high attenuation to all other frequencies.

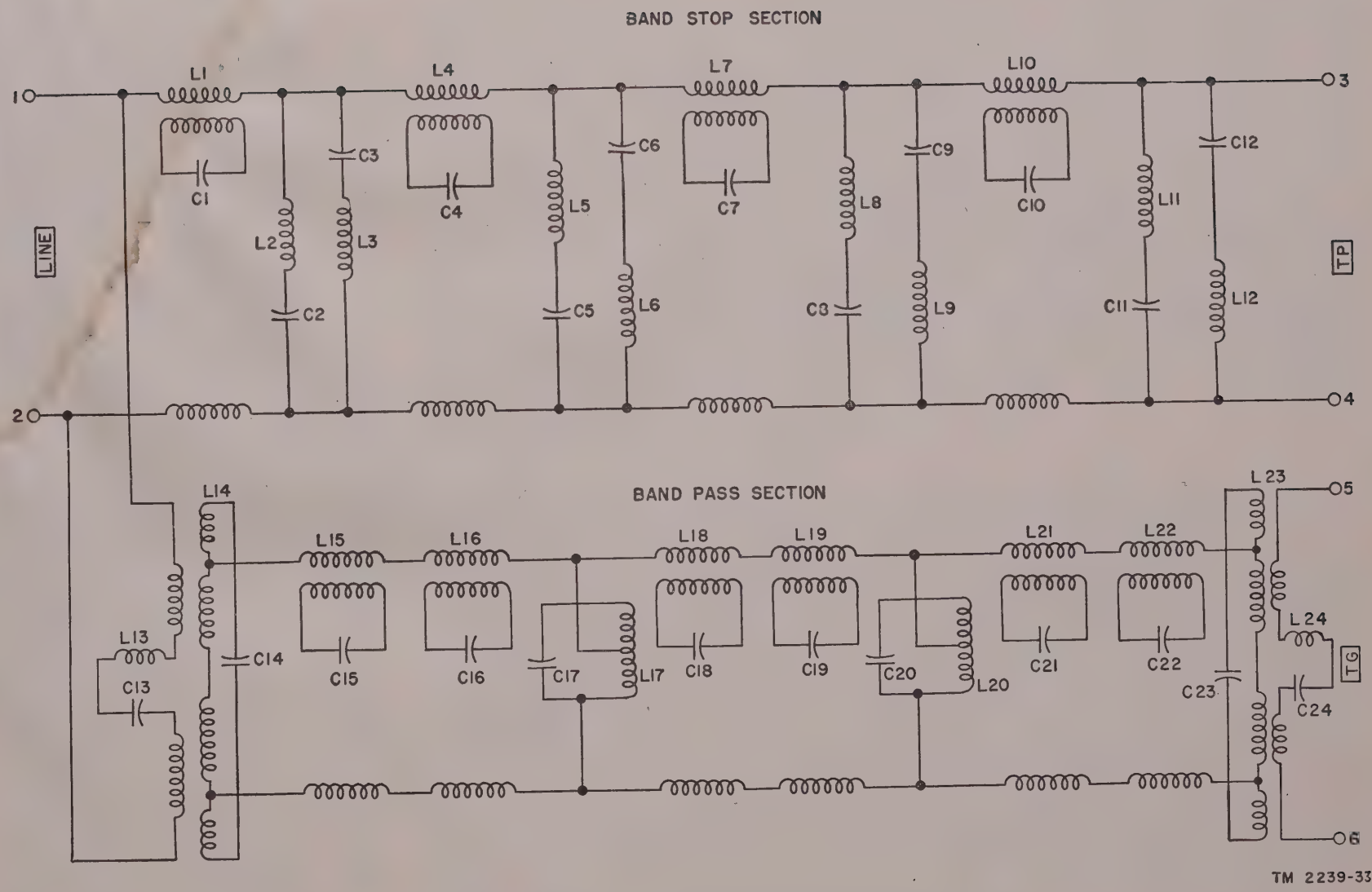


Figure 37. Electrical Filter Assembly F–98/U, schematic diagram.

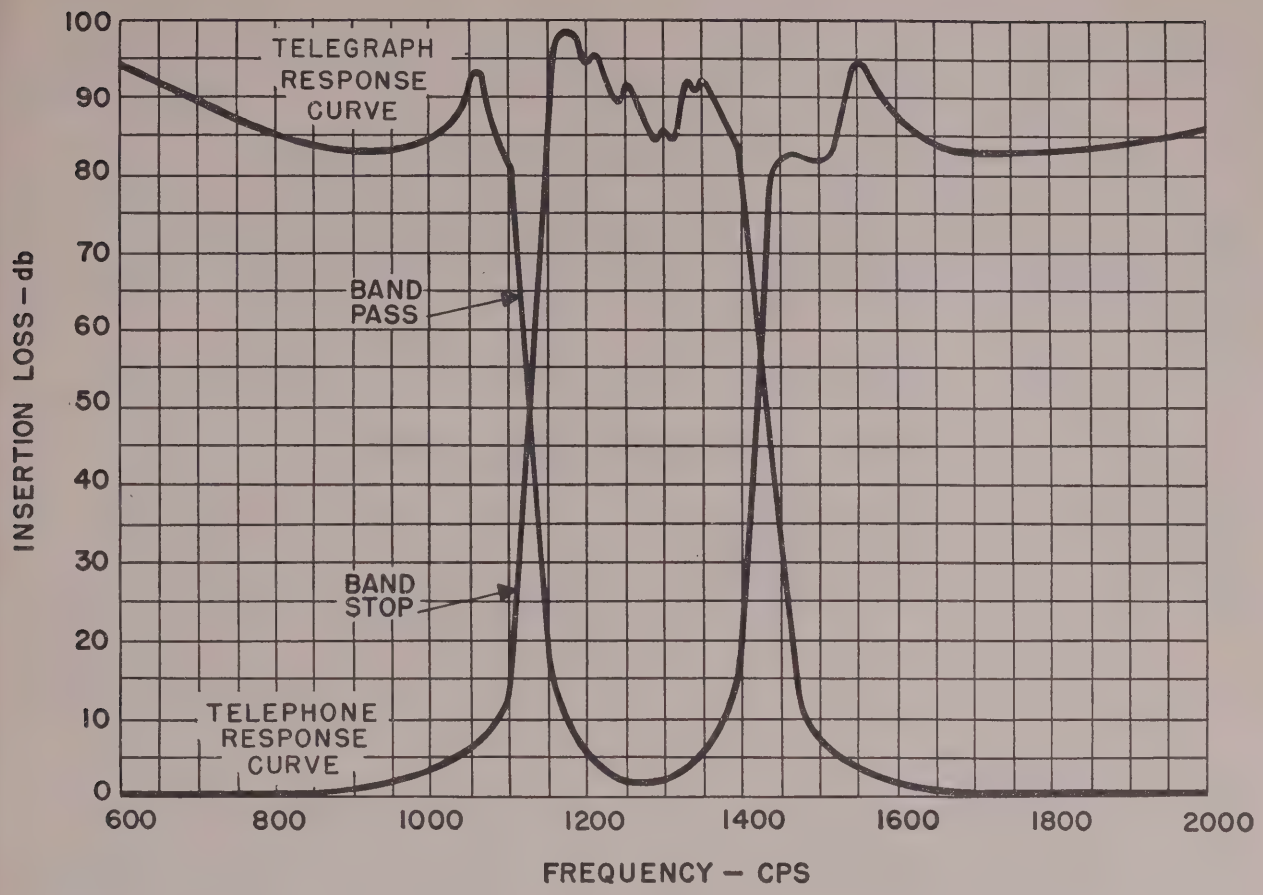


Figure 38. Electrical Filter Assembly F–98/U, frequency characteristics.

(2) The band-stop section contains a parallel tuned circuit. The band-stop section will pass all frequencies used by the telephone channel except the portion that the telegraph channel requires. The band-pass section is connected in parallel with the band-stop section on the line side.

b. Figure 38 illustrates the frequency response curves of the telephone and telegraph signals applied to the line.

(1) The lower curve shows the high loss of the band-stop section. Note that telephone signals are cut off at points between 1,125 cps and 1,400 cps.

(2) The upper curve shows the band-pass section. Note that high losses are offered to the telegraph signals at frequency points where the band-stop losses to the telephone signals are low.

c. The audio-frequency band width is approximately from 0 to 2,800 cps. The telegraph signals use approximately 200 cycles of the audio-frequency band width.

d. Ringing signals of 20 cps will pass through the band-stop section of the F–98/U but not through the band-pass section.

CHAPTER 6

FIELD MAINTENANCE INSTRUCTIONS

Note. This chapter contains information for field maintenance of Telegraph Terminal TH–5/TG. Information for field maintenance of Telegraph-Telephone Signal Converter TA–182/U is contained in TM 11–2137. There is no field maintenance performed on the Electrical Filter Assembly F–98/U. The extent of repair which any field maintenance unit undertakes is limited only by the tools and test equipment available and by the degree of skill of assigned personnel.

Section I. PREREPAIR PROCEDURE

85. Tools, Material, and Test Equipment

The tools, materials, and test equipment needed for performing the prerepair procedures in this section are—

Tool Equipment TE–113
Solvent (SD)
Tube Tester I–177
Multimeter TS–352/U.

86. Removal of Pluck-Out Parts

Remove Telegraph Terminal TH–5/TG chassis from its case prior to the removal of pluck-out parts.

a. Removing Tubes. After the tubes (fig. 19) have cooled sufficiently, pull up the tube with the fingers. Do not rock the tube or jiggle it excessively in its socket; it can be extracted by a direct, upward pull. Rock it gently if it does not release easily. Jiggling a tube in its socket during removal spreads the contacts. Label each tube as soon as it is removed so that it can be replaced in its proper socket.

b. Removing Fuse. Fuse F1 is located within the front panel (fig. 21). Turn the fuseholder counterclockwise and extract the fuse from its holding sleeve.

c. Removing Neon Lamp. Unscrew the neon lampholder, and remove the bayonet-base lamp (E9) (fig. 49) by pushing down and turning counterclockwise.

87. Cleaning, Inspecting, and Testing Removed Parts

a. Cleaning.

(1) Clean the tubes with a cloth moistened with solvent (SD); if necessary, clean the prongs with crocus cloth.

(2) Clean the ends of fuse F1 with an emery cloth and wipe with a clean cloth.

b. Inspecting.

(1) Inspect the tubes for cracks in the glass and base and for bent and broken prongs.

(2) Inspect fuse ends for evidence of burning, corrosion, and looseness.

c. Testing.

(1) Test the tubes for proper emission, leakage, and short circuits; use a tube tester or place doubtful tubes in a TH–5/TG known to be operating normally.

(2) Test the fuse for continuity.

(3) Test the lamp.

88. Cleaning and Inspecting Chassis

a. Cleaning. Thorough cleaning of the TH–5/TG is necessary to insure optimum performance by preventing corrosion, rust, and dust from damaging parts or causing arc-over or low-resistance leakage between h-v points and ground. Remove loose dust and dirt with a brush or blower. Remove dirt and grease which adhere to the chassis and parts with a brush or cloth moistened with solvent (SD). Clean the switches with a small brush or pipe cleaner moistened with solvent (SD).

b. Inspecting. After a component has been cleaned thoroughly and carefully, make a visual inspection of parts and wiring for rust, corrosion, loose connections, frayed and burned insulation, loose screws, and burned and charred resistors and coils. Carefully inspect

tube sockets for broken contacts, switches for loose and bent contacts and broken insulation, and terminal boards for broken lugs and signs of burning. Inspect and tighten all loose setscrews and knobs.

89. Replacing Pluck-Out Parts

Replace the tubes, fuse, and neon lamp in the TH–5/TG. Be sure that the tubes are replaced in the correct sockets (fig. 19).

Section II. TROUBLE SHOOTING AT FIELD MAINTENANCE LEVEL

Warning: When servicing Telegraph Terminal TH–5/TG, be extremely careful because of the high voltages exposed. Keep one hand in a pocket when measuring socket voltages with a probe. Before touching any part of the equipment after the voltage is turned off, short the part to ground.

90. Trouble-Shooting Procedures

The first step in servicing a defective component is to sectionalize the fault, which means tracing the fault to the *major component or circuit* responsible for the abnormal operation of the set. The second step is to localize the fault, which means tracing the fault to the defective *part* responsible for the abnormal condition. Some faults, such as burned-out resistors and shorted transformers, often can be located by sight, smell, or hearing. The majority of faults, however, must be localized by *checking voltages and resistances.*

91. Trouble-Shooting Data

The figure references listed below will aid in the rapid location of faults.

Fig. No.	Description
19	Tube location.
39	Bottom view of chassis showing terminal boards closed.
40	Bottom view of chassis showing terminal boards open.
41	Location of resistors and capacitors on terminal boards.
42	Resistor-capactior terminal board, voltage and resistance chart.
43	Top view of chassis showing location of parts.
44	Voltage and frequency curves for the discriminator mark-tuned circuit.
45	Resistor color codes.
46	Capacitor color codes.
47	Tube-socket voltage and resistance chart, SEND—REC—NORM switch in SEND position.
48	Tube-socket voltage and resistance chart, SEND—REC—NORM switch in REC or NORM position.
49	Telegraph Terminal TH–5/TG, schematic diagram.
50	Telegraph Terminal TH–5/TG, wiring diagram.

92. Test Equipment Required for Trouble Shooting

The test equipment required for trouble shooting and the associated technical manuals are listed below.

Test equipment	*Technical manual*
Tube Tester I–177 or equal	TM 11–2627
Multimeter TS–352/U	TM 11–5527

93. General Precautions

Observe the following precautions carefully whenever Telegraph Terminal TH–5/TG is serviced.

a. Be careful when the unit is exposed; high voltages are present.

b. 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 transformer, has a number of connections, tag each lead.

(2) Be careful not to damage other leads when pulling or pushing them out of the way.

(3) Do not allow drops of solder to fall into the equipment; they may cause short circuits.

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

94. Operational Test

If the TH–5/TG is in normal operation, operate the equipment as described in the equipment performance checklist (par. 45). This checklist is important because it frequently indicates the general location of trouble. Listen

for crackling or buzzing noises which indicate high-voltage arcing. Check the TH–5/TG for smoke and the odor of burned or overheated parts. Transformer T6 will run hot; this is not an indication of defective operation.

95. Trouble-Shooting Chart

The chart below is furnished as an aid in locating trouble in the TH–5/TG and lists the symptoms which the repairman can observe, either by sight or by sound, while making a few simple tests. Once the trouble has been localized to a stage or circuit, a tube check and voltage and resistance measurements of this stage or circuit ordinarily should be sufficient to isolate the defective part. Refer to figures 42, 44, 47, 48, and 49 in performing the checks outlined below. There is no trouble-shooting chart for the F–98/U since it is a hermetically-sealed unit that requires replacement when it becomes inoperative. For the trouble-shooting chart of the TA–182/U, refer to TM 11–2137.

Symptom	Probable trouble	Corrective action
Unit fails to operate and tubes do not light when power is applied.	Open fuse in power circuit	Replace fuse F1. If the new fuse opens, check filter capacitors C46, C47, and C48 and replace defective capacitor.
	Defective connection in power cord or plug.	Repair connections.
	Defective power transformer	Replace transformer T6 (par. 97).
Receiving circuit inoperative (see note 1).	Defective power supply	Test tube V15, check capacitors C46B, C46C, and resistor R68. Replace defective part (par. 80).
	Defective receiving circuit stages.	Test tubes V1(A), V1(B), V2(A), V5(A), and V5(B), and check the circuits of these tubes. Replace defective part (pars. 69 through 74).
No space signal received	Defective space discriminator circuit.	Test tubes V4(A) and V4(B), and check capacitors C14, C15, C16, and C17. Replace defective part (par. 73).
No mark signal received	Defective mark discriminator circuit.	Test tubes V3(A) and V3(B), and check capacitors C10, C11, C12, C18, and C19 (par. 73).
Transmitting circuit inoperative. No home copy on either 2-wire or 4-wire facility.	Defective power supply	Test tube V15, check capacitors C46B, C46C, and resistor R68. Replace defective part (par. 80).
	Oscillator inoperative	Test tube V9(A), and check the circuit of this tube. Replace defective part (par. 60).
	Defective voice-frequency amplifier.	Test tube V8(A), and check the circuit of this tube. Replace defective tube (par. 61).
	Defective suppression circuit	Test tube V11(A), and check the circuit of this tube. Replace defective part (par. 66).
Transmitting circuit sends only marking signal.	Defective modulator stage	Test tubes V9(B), V10(A), V10(B), and V12(A). Check the circuits of these tubes (pars. 56 through 59).
	Defective oscillator stage	Check capacitors C36 and C37 for an open or short circuit. Replace defective part (par. 60).
Transmitting circuit sends only spacing signal.	Defective modulator stage	Test tubes V9(B), V10(A), V10(B), and V12(A). Check the circuits of these tubes (par. 59).
	Defective power supply	Test tube V14 and capacitor C47. Replace defective part (par. 80).
Carrier tone transmitted continuously.	Defective suppression circuit stage.	Test tubes V8(B) and V11(B). Check the circuits of these tubes. Replace defective part (pars. 65 and 67).
	Short circuit in the time-delay circuit of suppressor.	Replace capacitor C45 (par. 64).
Carrier tone suppressed continuously. Neon lamp lights.	Defective suppression circuit stage.	Test tubes V11(A) and V11(B). Check the circuits of these tubes. Replace defective parts (pars. 65 and 67).

Symptom	Probable trouble	Corrective action
No reception. Neon lamp lights (see note 2).	Defective threshold circuit stage	Test tubes V2(B), V6(A), V6(B), and V7(A). Check the circuits of these tubes. Replace defective parts (pars. 76 through 78).
	Defective receiving circuit_____	Test tubes V1(A) and V1(B). Check the circuits of these tubes. Replace defective parts (pars. 70 and 71).
Premature suppressor action___	Time-delay circuit of suppressor is open.	Replace capacitor C45 (par. 64).
Transmitted signal distorted___	Time-delay capacitors of the transmitting circuit are defective.	Check capacitors C40, C41, C42, and C43. Replace defective parts (par. 62).
Receiving circuit responds to low-level random noise when idle.	Defective threshold circuit stage	Test tube V7(B) and neon lamp. Check the circuits of these stages (par. 79).
No output of the 20-cps ringing supply.	Defective power supply_____	Test tube V15. Check capacitor C48. Replace defective part (par. 80).
	Defective static ringing generator.	Replace ringing generator (par. 82).
	Defective RING switch_____	Replace switch.

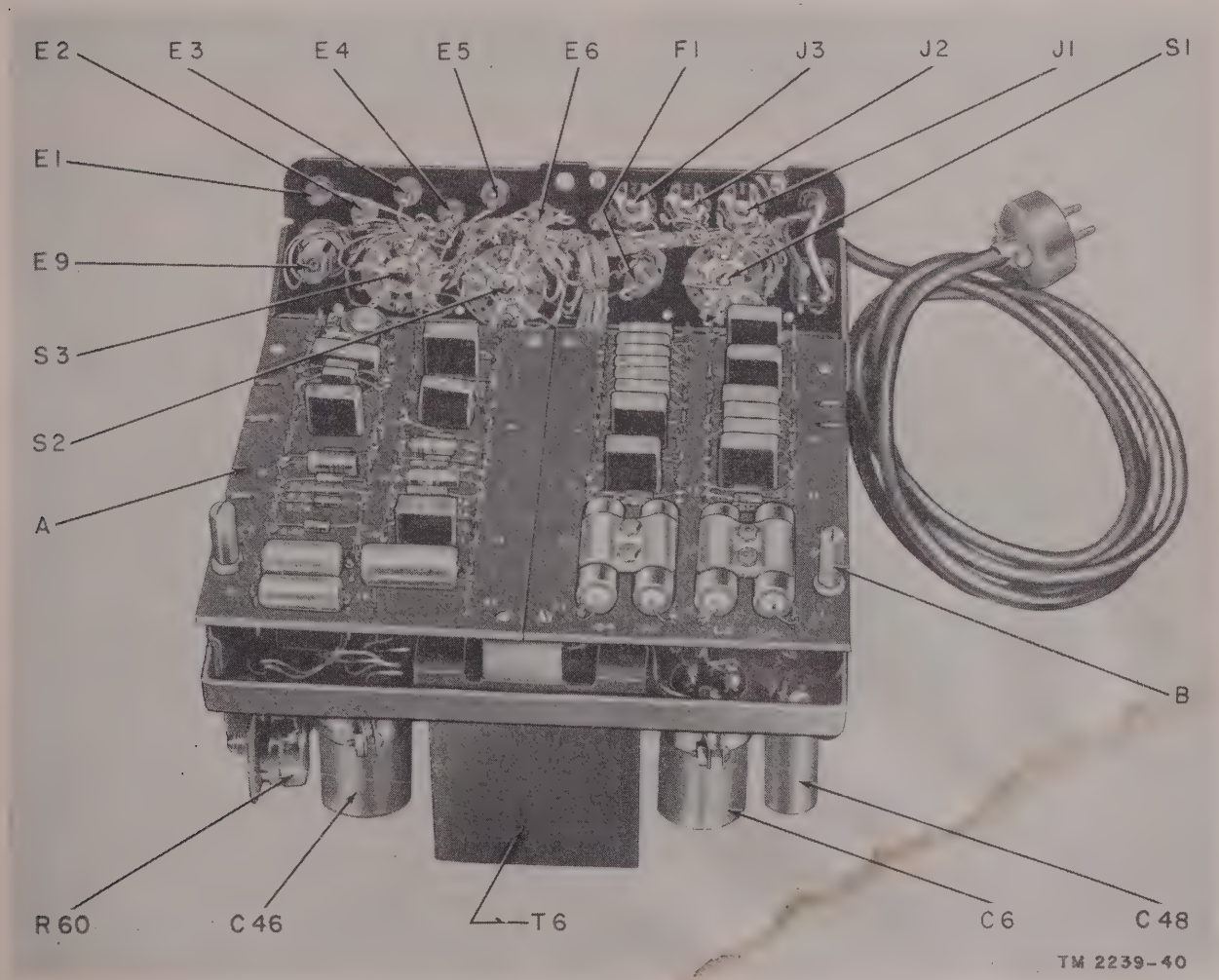


Figure 39. Bottom view of chassis, showing terminal boards closed.

Note 1. Whenever the receiving circuit is inoperative, check the circuits through home copy connections. On a 2-wire facility, home copy is applied across transformer T1. On a 4-wire facility, home copy is applied to the grid of tube V1(B). If home copy is received on the 4-wire facility but not on 2-wire, the trouble is immediately localized to the stage of tube V1(A).

Note 2. Lighting of the neon lamp is not necessarily a sign of proper threshold action. The neon lamp lights if tube V7(A) of the threshold circuit is cut off. The lamp also may light as a result of improper tone suppression.

96. Location of TH–5/TG Components on Terminal Boards

a. Although Telegraph Terminal TH–5/TG is a compact unit, trouble shooting has been simplified because of the arrangement of the component parts. These components are clearly marked with symbol numbers which correspond to symbol numbers shown on the schematic diagram (fig. 49). Figure 39 shows terminal boards A and B in a closed position. Figure 40 shows the terminal boards opened and labeled A′ and B′. Figure 41 illustrates the front and rear positions of the terminal boards showing the location of resistors and capacitors on each side of each board.

b. In figure 41, letters of the alphabet appear across the top and bottom of each board, and numbering is arranged from top to bottom. Assume the repairman wants to check capacitor C26, which is located in the threshold circuit. Figure 49 shows capacitor C26 to be connected across contacts X15 and U15. The repairman then has only to refer to figure 41, select the terminal board on which the alphabet letters X and U appear, then count down to 15. These contacts will be across capacitor C26.

c. To open the terminal boards (A′ and B′, fig. 40), remove the four mounting screws on each board. Invert the terminal boards and replace the mounting screws. The back of the front panel is exposed by loosening the setscrew on each side of the panel. Pull the panel forward and tighten the screws. The unit is now ready for checking.

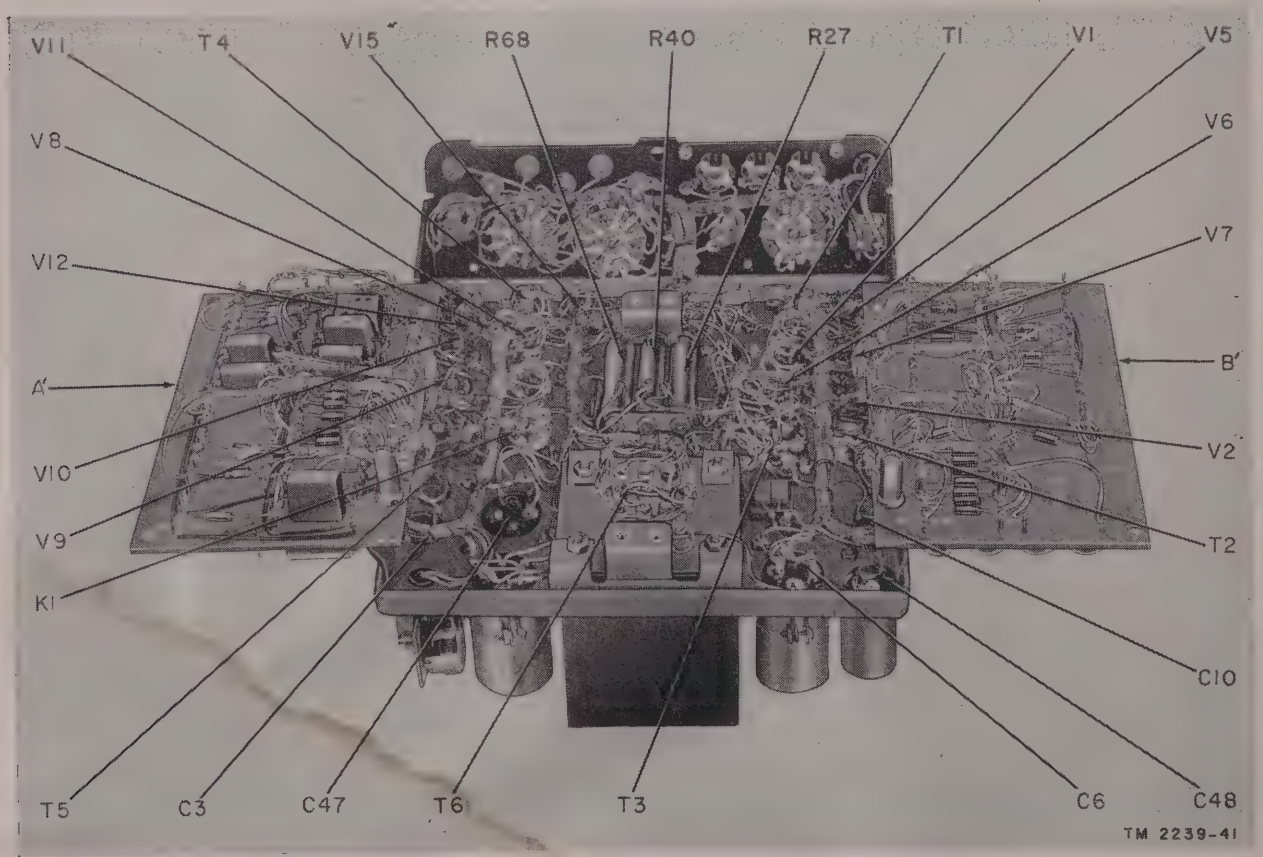
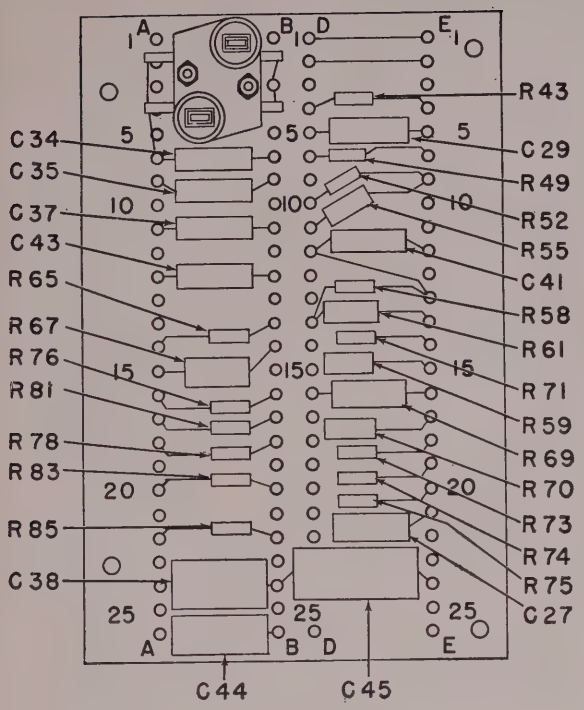
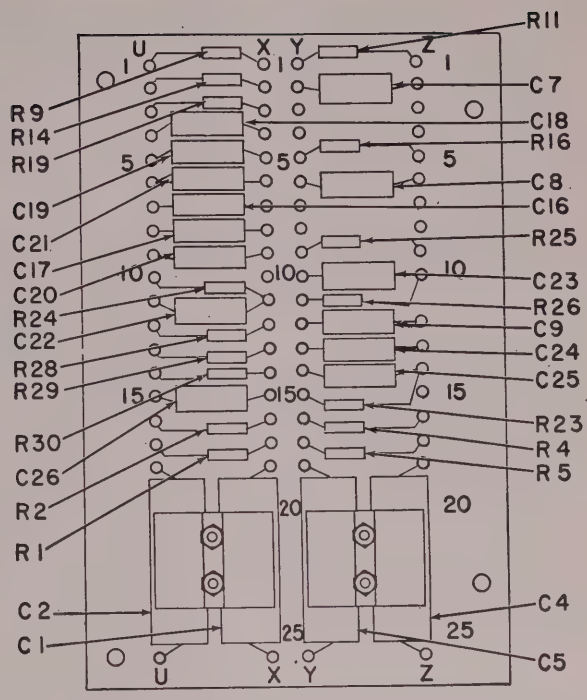


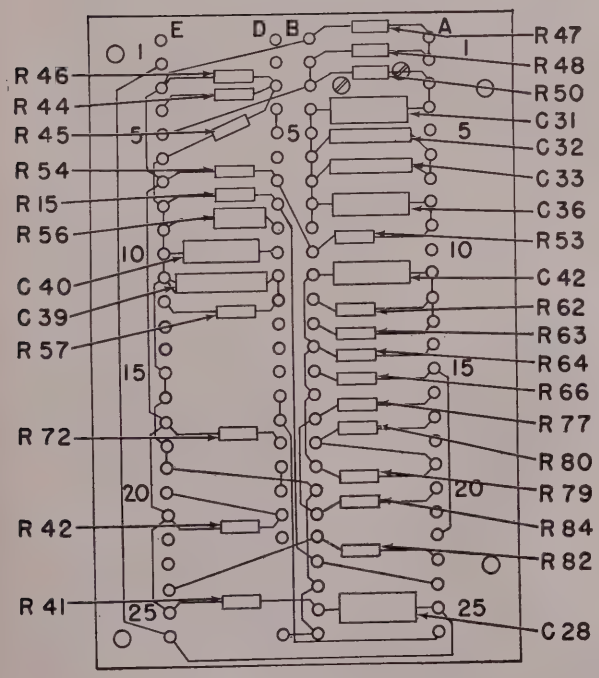
Figure 40. Bottom view of chassis, showing terminal boards open.



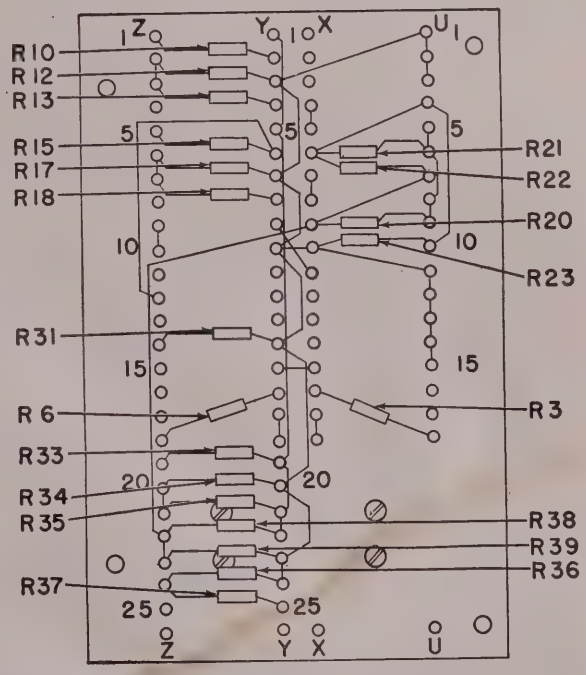
A



B



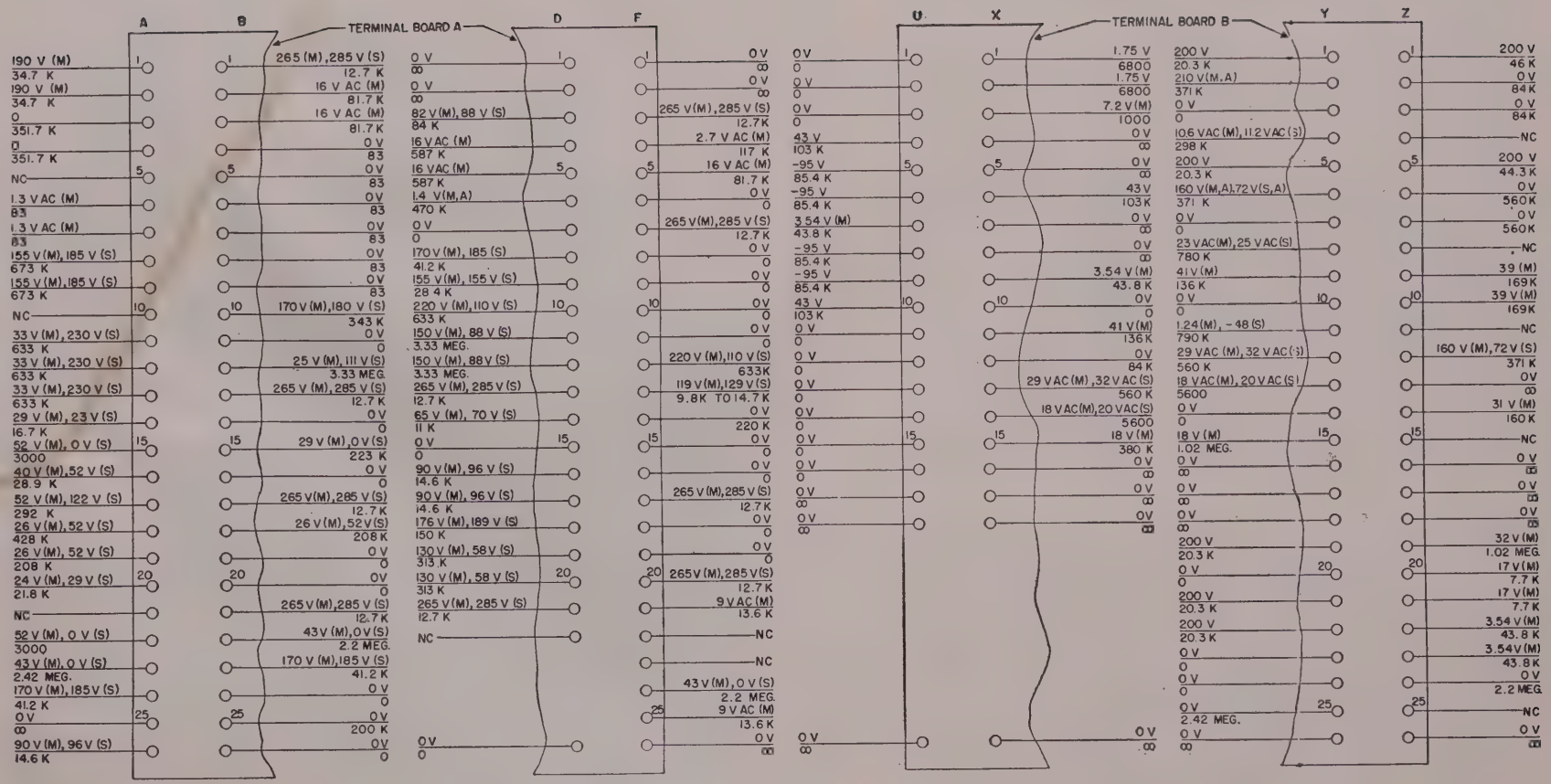
A′



B′

TM 2239-37

Figure 41. Location of resistors and capacitors on terminal boards.



NOTES:

1. 4W-2W-TEL SWITCH IN 2W POSITION.
2. NORM-REC-SEND SWITCH IN SEND POSITION.
3. S - INSERT DUMMY PLUG IN SEND JACK TO TRANSMIT SPACING SIGNAL.
4. M - REMOVE DUMMY PLUG FROM SEND JACK TO TRANSMIT MARKING SIGNAL.
5. A - NORM-REC-SEND SWITCH IN REC POSITION.
6. RESISTANCES MEASURED IN OHMS TO GROUND.

Figure 42. Resistor-capacitor terminal board, voltage and resistance chart.

97. D-C Resistances of Transformers and Coils

The d-c resistances of the coil and transformer windings in the TH–5/TG are listed in the chart below. Make all measurements with a d-c ohmmeter (Multimeter TS–352/U). Before taking measurements check to see that power is not being supplied to the TH–5/TG. Operate the 4W—2W—TEL switch to the 2W position and the SEND—REC—NORM switch to the SEND position.

Transformer	Terminals	Ohms
T–1	1–2	5.03
T–1	3–4	2,000
T–2	1–2	21.4
T–2	3–4	26.6
T–3	1–2	21.4
T–3	3–4	26.6
T–4	1–2	59
T–4	3–4	880
T–5	1–2	83
T–5	3–4	83
T–6	9–8	119
T–6	4–G	20
T–6	5–G	20
T–6	3–G	111
T–6	6–G	117
T–6	10–G	0
T–6	11–G	0
T–6	1–2	4.05
T–6	7–8	87
L–1	1–2	100

98. Voltage and Resistance Charts

a. Tube-Socket Voltage and Resistance Charts.

(1) Figure 47 shows the voltage and resistance readings between the pins of the TH–5/TG tubes and ground. Refer to TM 11–2137 for the voltage and resistance readings of the TA–182/U. There are no tubes in the F–98/U.

(2) Figure 48 shows the changes in the voltages with different settings of the SEND—REC—NORM switch.

b. Resistor-Capacitor Board, Voltage and Resistance Chart. Figure 42 shows the voltage and resistance readings at the terminal boards. These voltages duplicate those given in figure 42. Refer to paragraph 96 for the discussion on how these readings may be taken. Figure 41 shows the location of capacitors and resistors on the terminal boards.

Section III. REPAIR

99. Replacement of Parts

a. Most of the parts in Telegraph Terminal TH–5/TG are readily accessible and are replaced easily if found to be faulty. Figures 39, 40, and 43 show the location of parts in the TH–5/TG. If a switch requires replacement, mark the wire connected to the switch carefully with tags or other devices to avoid misconnection when the new switch is installed. Follow this practice whenever replacement requires the disconnection of numerous wires. Refer to figure 50.

b. To replace any switch, loosen the setscrew in the switch knob. Remove the knob, the felt washers, and the metal washer from the switch shaft. Remove the large nut which holds the switch to the receiver panel; use a hollow-shank socket wrench or a pair of long-nosed pliers. Move the switch back from the receiver panel and lift the switch up to a position where all connections are accessible.

100. Refinishing

Instructions for refinishing badly marred panels on exterior cabinets are given in TM 9–2851. Refer to paragraph 40 for rustproofing and painting the equipment.

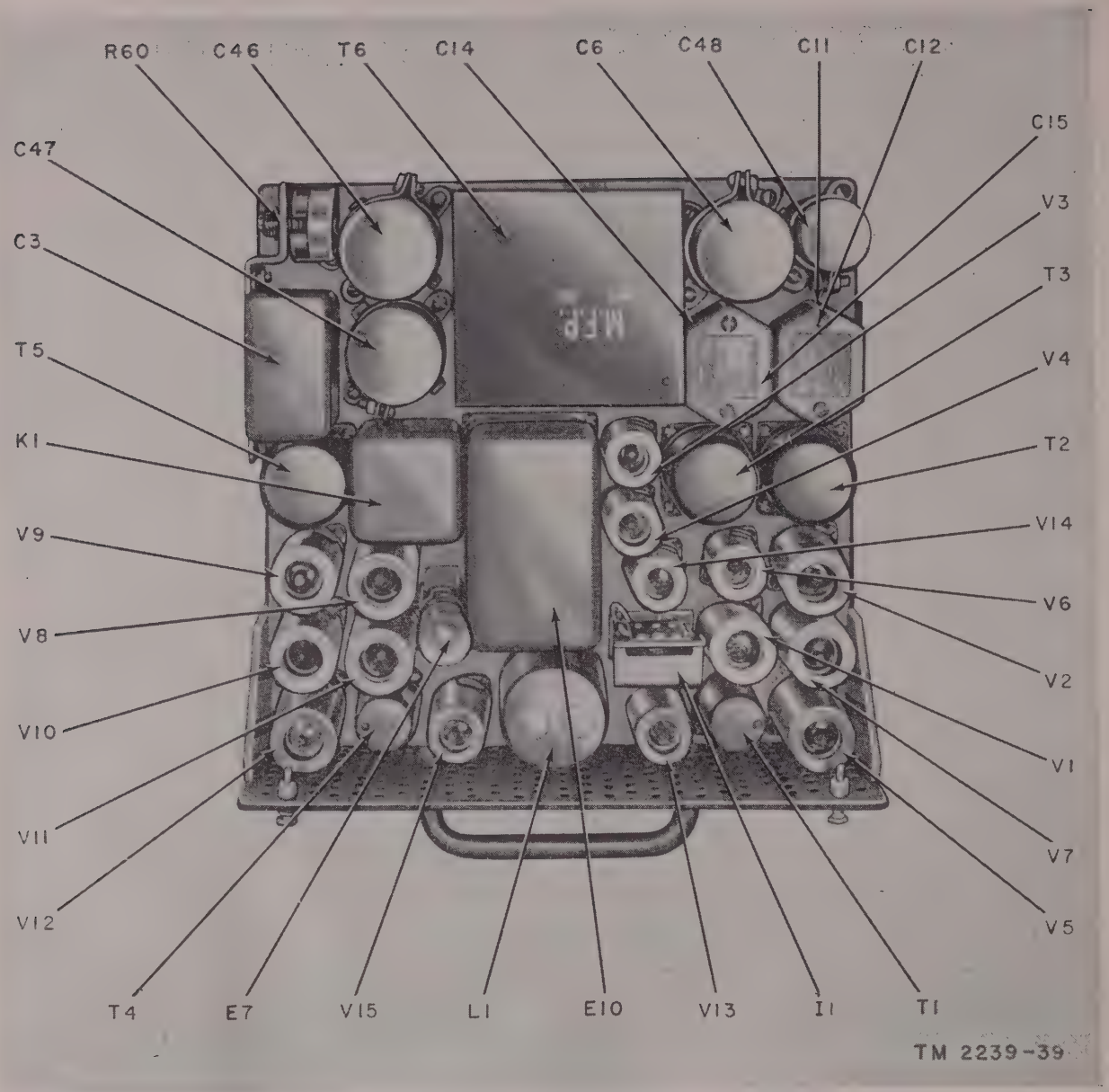


Figure 43. Top view of chassis showing location of parts.

Section IV. ALINEMENT PROCEDURES

101. General

a. Alinement of the transmitting and receiving circuits of Telegraph Terminal TH–5/TG is discussed in this section. Paragraphs 103 through 106, which describe the transmitting circuit, include a preferred and two alternate alinement procedures and a send-bias adjustment procedure. Paragraphs 109 and 110 which describe the receiving circuits, contain a preferred and an alternate alinement procedure for the discriminator.

b. The alternate alinement procedures are emergency methods to be used only when the equipment necessary for the preferred alinement procedures is not available.

c. The transmitting circuit should be alined before the receiving circuit is alined.

102. Test Equipment Required for Alinement of Telegraph Terminal TH–5/TG

a. General. Parts which require alinement are located on the top and bottom of the TH–5/TG chassis (figs. 39, 40, 41, and 43).

b. Frequency Meter. The frequency meter should be an accurately calibrated instrument to test properly the two frequencies of the TH–5/TG. Frequency Meter FR–67/U is recommended.

c. Signal Generator. The signal generator should be an accurately calibrated instrument capable of producing audio-frequency signals. Signal Generator SG–15/PCM, which is a part of Test Set TS–140/PCM, is recommended. Audio Oscillator TS–379/U may be used in place of Signal Generator SG–15/PCM. Before the signal generators are used, they must be calibrated by using Frequency Meter FR–67/U.

d. Milliammeter. The milliammeter should have a 20-ma full-scale reading to permit checking the output of the receiving circuit output. Multimeter TS–352/U is satisfactory for this purpose.

e. Oscilloscope. Oscilloscope BC–1060–A is a suitable oscilloscope. Use the oscilloscope only as an emergency alternate when Frequency Meter FR–67/U is not available.

f. Transmitter-Distributor. The transmitter-distributor (teletypewriter) used must be capable of transmitting 60 or 100 words per minute. The tape used with the transmitter-distributor must be perforated with alternate R and Y signals. Test Set I–193–C may be used in place of the transmitter-distributor. Sending dots from Test Set I–193–C is the equivalent of transmitting alternate mark and space.

g. Spare Telegraph Terminal TH–5/TG. The TH–5/TG used as a model should have been alined and adjusted as outlined in paragraph 104.

h. Teletypewriter Distortion Test Set. Teletypewriter Test Set TS–611/FG is the only test equipment that may be used in the preferred method (par. 109) of alining the receiving circuit of the TH–5/TG.

i. Rectifier. Any 130-volt d-c source will do.

j. Headset. Any standard headset may be used when checking the transmitting circuit. The headset method should be used only when the comparison (spare) TH–5/TG has been alined and adjusted as outlined in the preferred methods (pars. 104 and 109).

k. Impedance Bridge. Use Impedance Bridge TS–460/U or equivalent when selecting the trimmer capacitors listed in appendix II. The impedance bridge must be accurate within 2 percent.

103. Transmitting Circuit Alinement, General

Note. Whenever Capacitor C32, C33, C34, or C36 is replaced, it will be necessary to realine the oscillator.

a. Alinement of the oscillator circuit is critical because the TH–5/TG will not operate properly if the space or mark frequencies vary more than 3 cps from their assigned frequencies.

b. Alinement of the oscillator usually is accomplished by adjustment of variable trimmer capacitor C30. If it is impossible to accomplish the oscillator alinement by varying capacitor C30, it will be necessary to replace fixed trimmer capacitors C35 and C37.

c. Replacement for either fixed trimmer capacitor C35 or C37 may consist of one or a combination of two capacitors selected from the list given in appendix II.

d. When alining the oscillator, adjust the mark frequency before adjusting the space frequency.

e. Resistor (potentiometer) R60 is adjusted to maintain equal duration of the space and mark pulses. Do not adjust resistor R60 until the oscillator frequencies have been checked and are known to be correct.

104. Oscillator Alinement, Preferred Method

a. Mark Frequency Check.

(1) Operate the SEND—REC—NORM switch to the SEND position.

(2) Operate the 4W—2W—TEL switch to the 2W position.

(3) Connect the 2W binding posts to the input of the frequency meter.

(4) Obtain at least three readings of the mark frequency on the frequency me-

ter. The readings should be 1,325 cps ±3 cps.

(5) If the readings show less than 3 cps variation from 1,325 cps, no further alinement of the mark frequency is necessary. If more than 3 cps but less than 8 cps variation from 1,325 cps is found, follow the procedures of *b*(1) and (2) below. If the variation from 1,325 cps is greater than 8 cps, follow the procedure of *b*(2) through (4) below.

b. Mark Frequency Alinement Procedure.

(1) If the mark frequency varies from 1,325 cps by between 3 cps and 8 cps, adjust variable trimmer capacitor C30 until the frequency meter reads 1,325 cps ±3 cps.

Note. Capacitor C30 contains two adjusting screws. Both must be adjusted to provide the full range of ±8 cps.

(2) If the mark frequency shows a greater than 8-cps variation from 1,325 cps, or if the frequency cannot be brought to within 3 cps of 1,325 cps by adjustment of capacitor C30, set both adjustments of capacitor C30 in the center of their ranges and remove fixed trimmer capacitor C35.

(3) Replace fixed trimmer capacitor C35 with a capacitor selected from the list in appendix II. Select a capacitor of larger value than the removed capacitor if the frequency shown on the meter in *a*(4) above is greater than 1,325 cps. Select a capacitor of smaller value if the frequency shown on the meter is less than 1,325 cps. It may be necessary to use a combination of two capacitors to obtain the desired value.

(4) Adjust variable trimmer capacitor C30 to obtain 1,325 cps ±1 cps.

c. Space Frequency Check.

(1) Repeat the procedure given in *a*(1) through (3) above.

(2) Insert an open-circuit plug or a dummy plug into the SEND jack. This will shift the transmitter to the space frequency.

(3) Obtain at least three readings of the space frequency on the frequency meter. The readings should be 1,225 cps ±3 cps.

(4) If the readings show less than 3-cps variation from 1,225 cps, the oscillator alinement is complete. If more than 3 cps but less than 8 cps variation from 1,225 cps was found, follow the procedure of *d*(1) and (2) below. If the variation from 1,225 cps was greater than 8 cps, follow the procedure of *d*(2) and (3) below.

d. Space Frequency Alinement Procedure.

(1) If the space frequency shows between 3 cps and 8 cps variation from 1,225 cps, adjust the space frequency to within 3 cps of 1,225 cps by means of capacitor C30 without causing a variation of more than 3 cps from 1,325 cps in the mark frequency. If this cannot be accomplished, set the mark frequency at 1,325 cps and remove capacitor C37.

(2) Replace fixed trimmer capacitor C37 with a capacitor selected from the list in appendix II. Select a capacitor of larger value than the removed capacitor if the frequency shown on the meter in *c*(4) above is greater than 1,225 cps. Select a capacitor of smaller value if the frequency shown on the meter is less than 1,225 cps. It may be necessary to use a combination of two capacitors to obtain the desired value.

(3) Adjust capacitor C30 to obtain 1,225 cps ±1 cps when space signals are transmitted and 1,325 cps ±1 cps when mark signals are transmitted.

105. Oscillator Alinement, Alternate Methods

a. First Alternate Method.

(1) *Mark frequency check.*

(*a*) Operate the 4W—2W—TEL switch to the 2W position on both the TH–5/TG under test and on the TG–5/TG being used as the frequency standard.

(*b*) Operate the SEND—REC—NORM switch to the SEND position on both the TH–5/TG under test and

on the TH–5/TG used as the frequency standard.

(*c*) Connect the vertical plates of the oscilloscope to the 2W binding posts of the TH–5/TG used as the frequency standard.

(*d*) Connect the horizontal plates of the oscilloscope to the 2W binding posts of the TH–5/TG under test.

(*e*) If a circle or ellipse is obtained on the oscilloscope screen, the mark frequency is adjusted properly. If a circle or ellipse is not obtained on the oscilloscope, follow the procedure given in (2) below.

(2) *Mark frequency alinement procedure.*

(*a*) Adjust capacitor C30 until a circle or ellipse is obtained on the oscilloscope.

Note. The variable trimmer capacitor contains two adjusting screws, both of which must be adjusted to obtain the full range of ±8 cps.

(*b*) If adjustment of variable trimmer capacitor C30 does not produce a circle or ellipse on the oscilloscope, set both adjustments at the centers of their ranges and replace capacitor C35.

(*c*) Replace capacitor C35 from the list of capacitors in appendix II. Select a capacitor from the list which produces a circle or ellipse on the oscilloscope when substituted for capacitor C35.

(3) *Space frequency check.*

(*a*) Follow the procedure given in (1) (*a*) through (*d*) above.

(*b*) Insert an open-circuit or dummy plug into the SEND jack of both the TH–5/TG under test and the TG–5/TG used as the frequency standard.

(*c*) If a circle or ellipse is obtained on the oscilloscope screen, no further adjustment of the oscillator is required.

(*d*) If a circle or ellipse is not obtained on the oscilloscope, follow the procedure given in (4) below.

(4) *Space frequency alinement procedure.*

(*a*) Adjust capacitor C30 until a circle or an ellipse is obtained on the oscilloscope. Recheck the mark frequency. If both space and mark frequencies are correct, no further alinement is necessary.

(*b*) If a circle or an ellipse cannot be obtained on the oscilloscope, or if adjustment of the space frequency misalined the mark frequency, realine the mark frequency. Remove capacitor C37.

(*c*) Replace fixed trimmer capacitor C37 with a capacitor selected from the list in appendix II. Choose a capacitor from the list which produces a circle or an ellipse when substituted for capacitor C37.

b. Second Alternate Alinement Method.

(1) The second alternate alinement method differs from the first alternate alinement method (*a* above) only in the method of comparing the frequencies of the TH–5/TG under test with the frequency standard. In the second alternate alinement method, the output of the TH–5/TG under test and the standard frequencies are applied simultaneously to a headphone set. The zero-beat method of frequency comparison is used to determine the difference in frequencies between the standard frequency and the output frequency of the TH–5/TG.

(2) When checking the output frequencies of the TH–5/TG under test, a difference of 3 cps from the standard frequency is the maximum acceptable deviation.

(3) When replacing any of the fixed trimmer capacitors, adjust the output frequencies of the TH–5/TG to within 1 cps of the standard frequency.

106. Send-Bias Adjustment, Preferred Method

a. General.

(1) The send-bias must be adjusted only after ascertaining that the oscillator frequencies are correct. (Refer to paragraphs 101 through 105).

(2) The send-bias rarely needs adjustment in normal operation. Replacement of parts in the modulator time-delay circuit may, however, necessitate readjustment of the send-bias control.

b. Send-Bias Adjustment Procedure.

(1) Operate the SEND—REC—NORM switch to the SEND position.

(2) Operate the 4W—2W—TEL switch to the 2W position.

(3) Connect the input of the frequency meter to the 2W binding posts.

(4) Apply signals to the SEND jack from one of the following sources:

(*a*) Send alternate mark and space pulses from a transmitter-distributor at either 60 or 100 words per minute. Use a tape with alternate R and Y signals to produce the alternate mark and space pulses in the transmitter-distributor.

(*b*) Send dots from Test Set I–193–C.

(5) Adjust the send-bias control (resistor R60) until the frequency meter reads 1,275 cps.

107. Send-Bias Adjustment, Alternate Method

a. Connect the distortion test set in series with Rectifier RA–87 and a teletypewriter that responds to 20-ma current. (Sufficient resistance should be inserted in series with the rectifier line to obtain 20 ma).

b. Check the orientation range of the teletypewriter and set the range at its center.

c. Disconnect the teletypewriter from the 20-ma current circuit.

d. Connect the teletypewriter to a TH–5/TG known to be adjusted by the preferred send-bias adjustment method (par. 106).

e. Connect the 2W binding posts of the TH–5/TG to be adjusted to the 2W binding posts of the TH–5/TG known to be adjusted properly.

f. Connect the output of the distortion test set to the SEND jack of the TH–5/TG to be adjusted.

g. Send alternate R and Y signals from the distortion test set.

h. Set the send-bias control, resistor R60, at the center of its rotation and note the orientation range of the teletypewriter.

i. Adjust resistor R60 on the TH–5/TG under test so that the orientation range of the teletypewriter is closest to the range obtained in *b* above.

108. Receiving Circuit Alinement, General

a. The receiving circuit must be alined properly to operate on the correct (standard) input frequencies. Improper alinement of the receiving circuit will result in garbled message reception or no reception at all.

b. Aline the receiving circuit by adjusting the capacitance designated C10. Capacitor C10 is a capacitor or a combination of two capacitors chosen from the list in appendix II.

c. Capacitance trimming in both the space and mark discriminator tuned circuits is accomplished by the proper selection of capacitor C10; therefore, whenever a change is made in either space- or mark-tuned circuits, a change in the value of fixed trimmer capacitor C10 probably is necessary.

d. The replacement of either transformer T2 or T3 requires realinement of the discriminator circuit.

109. Receiving Circuit, Preferred Alinement Procedure

a. Checking Discriminator Alinement.

(1) Plug the multimeter into the TH–5/TG REC jacks. Set the multimeter on the 0-to 50-ma scale.

(2) Plug a transmitter-distributor or Test Set I–193–C into the SEND jack.

(3) Determine the precise current reading on the multimeter when a continuous mark signal is sent from the transmitter-distributor or test set.

(4) Send alternate R and Y signals if a transmitter-distributor is used. Send dots if Test Set I–193–C is used.

(5) Determine the precise current reading when dots or alternate R and Y signals are transmitted.

(6) The current for a steady mark signal should be between 20 and 22 mils. The current for dots or R and Y signals should be exactly half of the current for a steady mark. If the current

reading for dots or alternate R and Y signals is less than half the current for steady mark signals, the value of capacitor C10 must be reduced. If the current reading for dots or alternate R and Y signal is more than half the reading for marks, the value of capacitor C10 must be increased. The method of selecting the capacitance to use for capacitor C10 is described in *b* below.

b. Discriminator Alinement Procedure.

(1) Connect the 2W binding posts of the TH–5/TG transmitting section which has been alined by the preferred procedure described in paragraph 104 to the 2W binding posts of the TH–5-/TG under test.

(2) Set the SEND — REC — NORM switches of both TH–5/TG units to the NORM position.

(3) Set the 4W—2W—TEL switches of both Telegraph Terminal TH–5/TG to the 2W position.

(4) Connect the input of Teletypewriter Test Set TS–611/FG to the REC jack of the TH–5/TG under test.

(5) Key the adjusted TH–5/TG transmitting section with a 100-word-per-minute test message. If 100-word-per-minute equipment is not available, refer to (7) below.

(6) Select a capacitor from the list in appendix II to be used as capacitor C10. Teletypewriter Test Set TS–611/FG will show a distortion of less

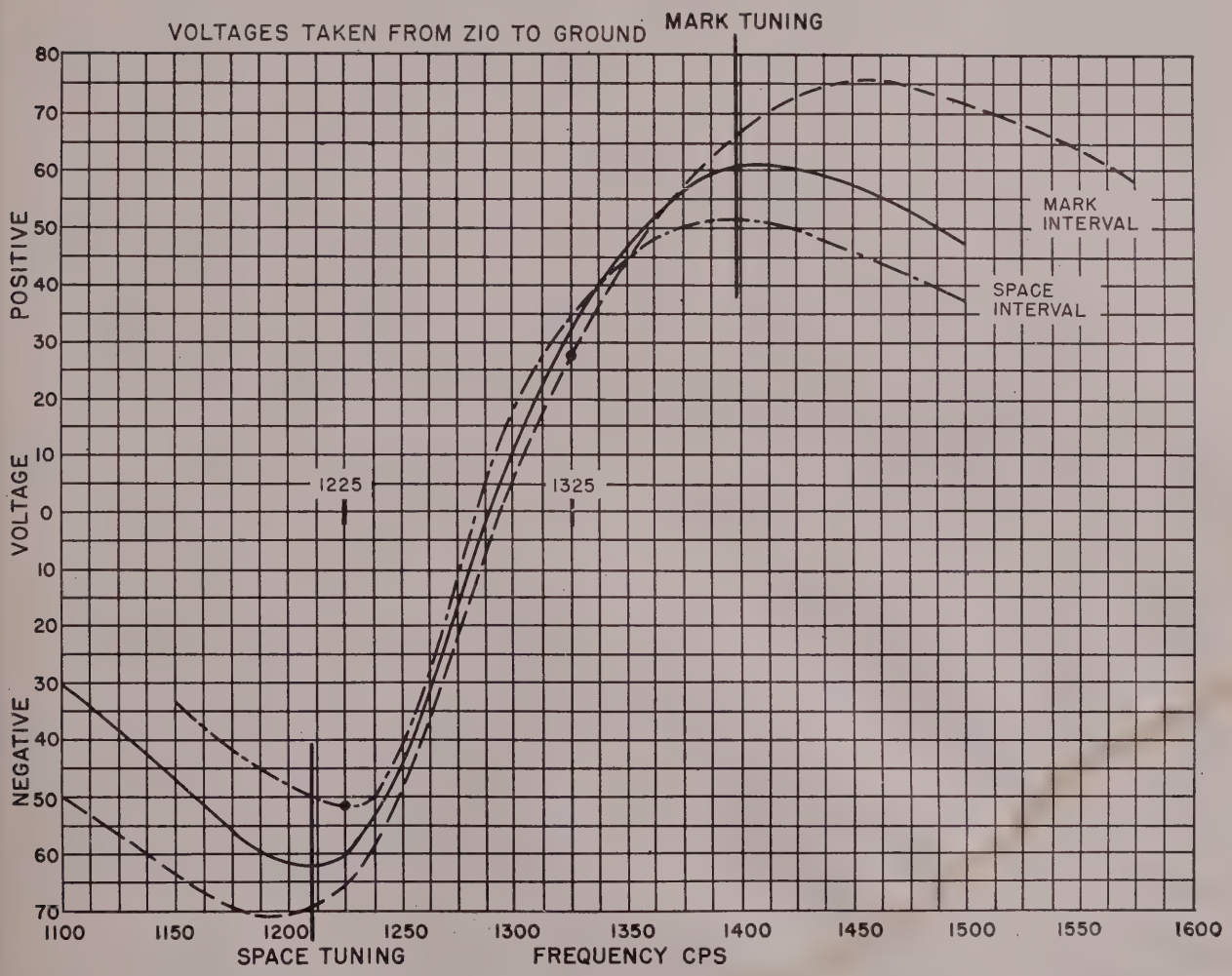


Figure 44. Voltage and frequency curves for the discriminator mark-tuned circuit.

than 5 percent when a capacitor of proper value is used as capacitor C10.

(7) If 100-word-per-minute equipment is not available ((5) above), use 60-word-per-minute equipment and obtain a 3-percent distortion ((6) above).

110. Receiving Circuit, Alternate Alinement—Using Signal Generator SG–15/PCM

Note. The alinement of the discriminator mark-tuned circuit is critical; therefore check the calibration of the signal generator using Frequency Meter FR–67/U.

a. Connect the signal generator to the frequency meter.

b. Adjust the signal generator until a reading of 1,287 cps is obtained on the frequency meter.

c. Disconnect the frequency meter.

d. Use a .039-μf and a .043-μf capacitor for C14 and C15, respectively.

e. Connect Multimeter TS–352/U across capacitor C23. Set the multimeter on the d-c scale.

f. Connect the signal generator to the 2-W binding post of the TH–5/TG. Operate the SEND—REC—NORM switch to the NORM position and the 4W—2W—TEL switch to the 2W position.

g. The reading on the multimeter scale should be zero volts. If it is not, refer to figure 44 to determine whether capacitance should be added or subtracted. The solid line in figure 44 illustrates the voltage range across capacitor C23 for a range of frequencies when the sum of C14 and C15 is exactly .082 μf. The perforated lines show the effect of $\pm$5-percent tolerance of capacitors C14 and C15.

h. Select capacitor C10 of a value which produces a reading of zero volts on the multimeter (par. 108*b* and *g* above).

Section V. FINAL TESTING

111. General

This section is intended as a guide to be used in determining the quality of a repaired Telegraph Terminal TH–5/TG. The minimum test requirement outlined in paragraphs 113 through 117 may be performed by maintenance personnel with adequate test equipment and the necesary skills. Repaired equipment meeting these requirements will furnish uniformly satisfactory operation.

112. Test Equipment for Final Testing

The test equipment used in the alinement of the TH–5/TG (par. 102) is used also in the final testing. In addition, the following equipment is required:

a. Teletypewriter. Any standard type teletypewriter may be used for the operational test.

b. Bias Meter. The bias meter of Line Unit BE–77–C may be used to adjust resistor R60.

c. Vacuum-Tube Voltmeter. A vacuum-tube voltmeter which has a flat response in the audio range is required. Electronic Multimeter TS–505/U is suitable for this purpose.

d. Output Meter. An output meter which has an adequate response to the audio-frequency range is required. Decibel Meter ME–22/PCM may be used; however, an output meter that can measure —60 dbm (decibels referred to 1 milliwatt in 600 ohms) is more desirable. The low range of the output meter eliminates the necessity of computing the carrier leakage.

113. Power Supply Circuit Test

To test the plate voltage supply, proceed as follows:

a. Operate the 4W—2W—TEL switch to either the 4W or 2W position.

b. Operate the SEND—REC—NORM switch to the NORM position.

c. Connect Multimeter TS–352/U to REC jack of the TH–5/TG.

d. The milliammeter scale of the multimeter should indicate a current flow of approximately 20 ma.

114. Transmitting Circuit Tests

a. Carrier Suppression Circuit Tests. To test

the carrier suppression circuit, proceed as follows:

(1) Operate the 4W—2W—TEL switch to the 2W position.

(2) Connect Decibel Meter ME–22/PCM to the 2W line binding posts.

(3) Insert a dummy plug into one of the SEND jacks.

(4) The reading on the decibel meter should be 0 dbm ±2 db.

(5) Remove the dummy plug from the SEND jack. The reading on the decibel meter should remain at 0 dbm ±2 db for about 3 seconds, depending on the time delay of the suppression circuit. At the end of this interval, the db should show no signal reading.

(6) Operate the 4W—2W—TEL switch to the 4W position.

(7) Connect the decibel meter to the 4W—S binding posts.

(8) Insert the dummy plug into one of the SEND jacks.

(9) The reading on the decibel meter should be 0 dbm ±2 db.

(10) Remove the dummy plug from the SEND jack. The reading on the decibel meter should remain at 0 dbm ±2 db for approximately 3 seconds.

b. Carrier Leakage Test, Carrier Suppression Circuit. To test for carrier leakage in the carrier suppression circuit, proceed as follows:

(1) Insert the dummy plug into one of the SEND jacks.

(2) Connect Electronic Multimeter TS–505/U to the 2W line binding posts.

(3) Shunt the 2W line binding posts with a 600-ohm resistor.

(4) Remove the dummy plug from the SEND jack.

(5) Allow at least 3 seconds for the suppression circuit to remove the carrier signal from the line, and then read the meter. The value of the carrier leakage should not be greater than —60 dbm.

c. Oscillator Frequency Test. To test the frequency of the transmitting circuit, proceed as outlined in paragraph 104.

d. Transmitting Circuit Output Level Test. To test the transmitting circuit output level, proceed as follows:

(1) Operate the 4W—2W—TEL switch to the 2W position.

(2) Operate the SEND—REC—NORM switch to the NORM position.

(3) Plug Multimeter TS–352/U into the REC jacks.

(4) Insert a dummy (open) plug into one of the SEND jacks.

(5) The meter reading should be zero (0).

(6) Remove the dummy plug from the SEND jack.

(7) The reading of the meter should be 20 ma.

(8) If the meter reading is zero when the dummy plug is inserted and 20 ma when the dummy plug is removed, the transmitting and receiving circuits will respond to mark and space signals.

(9) To check the 2W home copy circuit, operate the 4W—2W—TEL switch to the 2W position and perform the steps given in (1) through (8) above. To check the 4W home copy circuit, operate the 4W—2W—TEL switch to the 4W position and perform the steps given in (1) through (8) above.

e. Time-Delay Circuit Test. To test the time-delay circuit, proceed as follows:

(1) Connect the output of Distortion Test Set TS–383/GG to Line Unit BE–77–C.

(2) Adjust the bias to read zero on the line unit.

(3) Disconnect the distortion test set from the line unit.

(4) Connect the distortion test set to one of the SEND jacks of the TH–5/TG under test.

(5) Connect a second TH–5/TG (one that is known to be in excellent working condition) in series with Line Unit BE–77–C. Connect this arrangement across the output of the TH–5/TG that is under test. The TH–5/TG is used in series with the line unit to supply the line unit with a d-c input.

(6) Adjust resistor (potentiometer) R60 to obtain 0 bias ±3 percent on the line unit.

115. Receiving Circuit Tests

a. Threshold Circuit Check. To test the threshold circuit, proceed as follows:

(1) Connect Attenuator TS–402/U between the TH–5/TG under test and a second TH–5/TG.

(2) Connect a teletypewriter to each TH–5/TG.

(3) Transmit a test message.

(4) Use the attenuator to add attenuation until the receiving teletypewriter no longer receives correct copy. The neon lamp should light when the inserted attenuation reduces the signal to a level below —45 dbm.

b. Receiving Circuit Checks. To test the receiving circuit, proceed as outlined in paragraphs 108 and 109.

116. Input-Output and Ringing Circuit Tests

The input-output and ringing circuits may be tested while performing an over-all circuit test. Refer to paragraph 117 for the method of performing this test.

117. Operational Test

a. To test the TH–5/TG for over-all circuit operation, proceed as follows:

(1) Connect a teletypewriter or transmitter-distributor to one of the SEND jacks of the TH–5/TG.

(2) Connect a receiving teletypewriter to the REC jack.

(3) Operate the 4W—2W—TEL switch on the TH–5/TG to the 2W position.

(4) Operate the SEND—REC—NORM switch to the NORM position.

(5) Transmit a test message from the teletypewriter.

(6) Operate the 4W—2W—TEL switch to the 4W position.

(7) Transmit a test message from the teletypewriter. In either the 2W or the 4W position of the 4W—2W—TEL switch, home copy without errors should be obtained.

b. To test the ringing circuit, connect two telegraph terminals (TH–5/TG) in the circuit and proceed as outlined in *a* above.

CHAPTER 7

SHIPMENT AND LIMITED STORAGE AND DEMOLITION TO PREVENT ENEMY USE

Section I. SHIPMENT AND LIMITED STORAGE

118. Disassembly

The following instructions are recommended as a guide for preparing Telegraph-Telephone Terminal AN/TCC–14 for transportation or storage. To disassemble the equipment, reverse the procedure for setting up the components (par. 20).

a. Disconnect the power plugs.

b. Disconnect all communication wires from the binding posts.

c. Remove the components from Mounting MT–791/U.

119. Repacking for Shipment or Limited Storage

a. The exact procedure for repacking for shipment or limited storage depends on the material available and the conditions under which the equipment is to be shipped or stored. Reverse the instructions given in paragraph 19.

b. Whenever practicable, place a dehydrating agent, such as silica gel, inside the packing case. Protect the case with a waterproof paper barrier. Seal the seams of the paper with waterproof sealing compound or tape.

Section II. DEMOLITION TO PREVENT ENEMY USE

120. Methods of Demolition

a. Smash. Use sledges, axes, handaxes, pickaxes, hammers, crowbars, heavy tools.

b. Cut. Use axes, handaxes, machetes.

c. Burn. Use gasoline, kerosene, oil, flame throwers, incendiary grenades.

d. Explode. Use firearms, grenades, TNT.

e. Dispose. Bury in slit trenches, fox holes, other holes. Throw in streams. Scatter.

Note. Use anything immediately available for destruction of this equipment.

121. Destruction of Components

When ordered by your commander, destroy all equipment to prevent its being used or salvaged by the enemy.

a. Smash (par. 120*a*) the controls, tubes, coils, switches, capacitors, transformers, and headsets.

b. Cut (par. 120*b*) cords, headsets, and wiring.

c. Burn (par. 120*c*) cords, resistors, capacitors, coils, wiring, and technical manuals.

d. Bury or scatter (par. 120*e*) all of the above parts after they have been rendered useless.

e. Destroy Everything.

APPENDIX I

REFERENCES

Note. For availability of items listed, check SR 310–20–3 for field manuals. Check SR 310–20–4 for technical manuals, technical bulletins, and supply bulletins. Check SR 310–20–5 for Army regulations and special regulations.

1. Regulations

a. Army.

AR 380–5	Military Security (Safeguarding Military Information).
AR 750–5	Maintenance of Supplies and Equipment (Maintenance Responsibilities and Shop Operation).

b. Special.

SR 310–20–3	Index of Training Publications (Field Manuals, Training Circulars, Firing Tables and Charts, Army Training Programs, Army Training Tests, Graphic Training Aids, Joint Army-Navy Air Force Publications, Combined Communications Board Publications and Allied Communications Publications).
SR 310–20–4	Index of Technical Manuals, Technical Regulations, Technical Bulletins, Supply Bulletins, Lubrication Orders, Modification Work Orders, Tables of Organization and Equipment, Reduction Tables, Tables of Allowances, Tables of Organization, and Tables of Equipment.
SR 310–20–5	Index of Administrative Publications (Army Regulations, Special Regulations, Joint Army-Air Force Adjustment Regulations, General Orders, Bulletins, Circulars, Commercial Traffic Bulletins, Army Procurement Circulars, Department of the Army Pamphlets, and ASF Manuals).
SR 700–45–5	Unsatisfactory Equipment Report (Reports Control Symbol CSGLD–247).
SR 745–45–5 AFR 71–4	Report of Damaged or Improper Shipment (Reports Control Symbols CSGLD–66 (Army), and AF–MC–U2 (Air Force)).

2. Supply Publications

SB 11–47	Preparation and Submission of Requisitions for Signal Corps Supplies.

3. Technical Manuals on Auxiliary Equipment and Test Equipment

TM 11–359	Line Unit BE–77, BE–77–A, BE–77–B, & BE–77–C.
TM 11–2039	Audio Oscillators TS–379/U, TS–379A/U, and TS–379B/U.
TM 11–2044	Attenuators TS–402/U and TS–402A/U.
TM 11–2137	Telegraph-Telephone Signal Converter TA–182/U.
TM 11–2217	Distortion Test Set TS–383/GG and TS–383A/GG.
TM 11–2513	Test Sets I–193–A, I–193–B, and I–193–C.

TM 11–2526	Oscilloscope BC–1060–A.
TM 11–2627	Tube Tester I–177 and I–177–A.
TM 11–2634	Impedance Bridges TS–460/U, TS–460A/U and TS–460B/U.
TM 11–2667	Remote Control Equipment RC–289.
TM 11–5511	Electronic Multimeter TS–505/U.
TM 11–5527	Multimeter TS–352/U.

4. Painting, Preserving, Maintenance, and Lubrication

TB SIG 13	Moistureproofing and Fungiproofing Signal Corps Equipment.
TB SIG 66	Winter Maintenance of Signal Equipment.
TB SIG 72	Tropical Maintenance of Ground Signal Equipment.
TB SIG 75	Desert Maintenance of Ground Signal Equipment.
TB SIG 123	Preventive Maintenance Practices for Ground Signal Equipment.
TM 9–2851	Painting Instructions for Field Use.

5. Decontamination

TM 3–220	Decontamination.

6. Demolition

FM 5–25	Explosives and Demolitions.

7. Packaging and Packing Information

a. Military (JAN) Specifications.

JAN–D–169(4)	Desiccants (Activated).
JAN–P–100	Packaging and Packing for Overseas Shipment—General Specification.
JAN–P–106A	Packaging and Packing for Overseas Shipment—Boxes; Wood, Nailed (For weight of contents not in excess of 1,000 pounds).
JAN–P–116(2)	Packaging and Packing for Overseas Shipment—Preservation, Methods of.
JAN–P–125(1)	Packaging and Packing for Overseas Shipment—Barrier-Materials, Waterproof, Flexible.
JAN–P–131(3)	Barrier-Material; Moisture-Vaporproof, Flexible.

b. U. S. Army Specification.

100–2E	Marking Shipments by Contractors, Standard Specifications.

c. Signal Corps Instructions.

720–7	Standard Pack.
726–15	Marking of Interior Containers (for Signal Corps Equipment).

8. Other Publications

NAV SHIPS	Teletypewriter Test Set TS–611/FG.
TB SIG 219	Operation of Signal Equipment at Low Temperatures.
TM 11–453	Shop Work.
TM 11–455	Radio Fundamentals.
TM 11–483	Suppression of Radio Noises.

APPENDIX II

IDENTIFICATION TABLE OF PARTS

Note. The fact that a part is listed in this table is not sufficient basis for requisitioning the item. Requisitions must cite an authorized basis, such as a specific T/O&E, T/A, SIG 7 & 8, SIG 7–8–10, SIG 10, list of allowances of expendable material, or another authorized supply basis. The Department of the Army Supply Catalog applicable to the equipment covered in this manual is SIG 7 & 8 AN/TCC–14. For an index of available supply catalogs in the Signal Portion of the Department of the Army Supply Catalog, see the latest issue of SIG–1.

1. Telegraph-Telephone Terminal AN/TCC–14 (Sig C stock No. 4A2895–3)

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
	Telegraph Terminal TH–5/TG. (See par. 2, app II for parts.)	Changes d-c teletypewriter pulses into shift frequency modulated carrier signals for transmission over a voice-frequency channel.	4A2895–5
	Telegraph-Telephone Signal Converter TA–182/U*.	Converts 20-cps ringing signals to either 1,600 cps or 1,225 signaling frequency.	4F350–182
	Filter Assembly, Electrical F–98/U. (See par. 3, app II for parts.)	Provides band separation of signals to allow simultaneous telephone and telegraph communication.	3Z1899–98

* The identification table of parts for Telegraph-Telephone Signal Converter TA–182/U is contained in TM 11–2137.

2. Telegraph Terminal TH–5/TG

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
I–1	BUZZER, signal: ac; 8.5–42 v, 20 cps.	Provides audible call signal.	4Z3041
	CABLE, power: electrical; 2 cond; 16 strands #30 AWG.	Conducts 115-volt, 60-cycle a-c power from power lines to equipment.	1B3018–2.28
C1, C2, C4, C5	CAPACITOR, fixed: paper; 500,000 $\mu\mu$f ±20%; 400 vdcw.	C1, C5—Blocking capacitor. C2, C4—Impedance-matching capacitors.	3DA500–813
C3	CAPACITOR, fixed: paper; 4μf ±20%; 400 vdcw.	Blocking capacitor.	3DB4–382
C6A, C6B, C6C, C46A, C46B, C46C,	CAPACITOR, fixed: electrolytic; 3 sect., 12 μf per sect.; 300 vdcw.	C6A, C6B, C6C—Decoupling. C46A, C46B, C46C, C47A, C47B—Power supply filter. C47C—Not used.	3DB12–45

C47A, C47B, C47C			
C7, C8, C9, C22, C23, C24, C25, C26, C27, C28, C29, C31	CAPACITOR, fixed: paper; 10,000 μμf ±20%; 600 vdcw.	C7, C8, C24, C29—Coupling. C9—Threshold coupling. C22, C23—Discriminator filter. C25, C26—Threshold circuit filter. C27—Tuned circuit primary of transformer T4. C28—D-c blocking capacitor. C31—Oscillator tuned circuit.	3DA10–367
C10	CAPACITOR. (See par. 4 of this app.)	Mark discriminator tuning.	
C11	CAPACITOR, fixed: mica; 33,000 μμf ±5%; 600 vdcw; JAN type CM56D333J.	Mark discriminator tuning.	3K5633342
C12	CAPACITOR, fixed: mica; 20,000 μμf ±5%; 600 vdcw; JAN type CM56D203J.	Mark discriminator tuning.	3K5620342
C14	CAPACITOR, fixed: mica; 39,000 μμf ±5%; 600 vdcw; JAN type CM61D393J.	Space discriminator tuning.	3K6139342
C15	CAPACITOR, fixed: mica; 43,000 μμf ±5%; 600 vdcw; JAN type CM61D433J.	Space discriminator tuning.	3K6143342
C16, C17, C18, C19, C20, C21, C40, C41, C42, C43	CAPACITOR, fixed: mica; 10,000 μμf ±5%; 300 vdcw; JAN type CM35D103J.	C16, C17, C18, C19—Discriminator voltage doubler. C20, C21—Discriminator filter. C40, C41, C42, C43—Delay circuit time constant.	3K3510342
C30	CAPACITOR, variable: ceramic; 2 sect., 7 to 45 μμf per sect.; 500 vdcw; JAN type CV21C450.	Oscillator tuning.	3D9045V–17
C32, C33	CAPACITOR, fixed: ceramic; 270 μμf ±5%; 500 vdcw; JAN type CC32UJ271J.	Oscillator tuned circuit.	3D9270–21
C34	CAPACITOR, fixed: mica; 8,200 μμf ±5%; 500 vdcw; JAN type CM40D822J.	Oscillator tuned circuit.	3K4082242
C35	CAPACITOR. (See par. 4 of this app.)	Oscillator tuned circuit.	
C36	CAPACITOR, fixed: mica; 6,200 μμf ±5%; 500 vdcw; JAN type CM35D622J.	Oscillator space frequency tuning.	3K3562242
C37	CAPACITOR. (See par. 4 of this app.)	Oscillator space frequency tuning.	
C38	CAPACITOR, fixed: paper; 250,000 μμf ±20%; 400 vdcw.	Cathode bypass for tube V9B.	3DA250–596
C39	CAPACITOR, fixed: mica; 510 μμf ±5%; 500 vdcw; JAN type CM20D511J.	Waveform shaping.	3K2051142
C44	CAPACITOR, fixed: paper; 100,000 μμf ±20%; 400 vdcw.	Cathode bypass for tube V8B.	3DA100–1098
C45	CAPACITOR, fixed: paper; 1.0 μf ±10%; 200 vdcw.	Carrier suppression time constant.	3DB1–383
C48	CAPACITOR, fixed: electrolytic; 15 μf; 250 vdcw; JAN type CE31C150M.	Power supply filter.	3DB15–70
	CONNECTOR, plug: 2 cont male.	Connector plug for a-c power cord.	6Z1727
	FASTENER, spring-lock.	Retains panel and chassis in case.	6Z3810–16.15
F1	FUSE, cartridge: 1½ amp, 250 v.	Overcurrent safety device.	3Z2601.5
	GASKET: case seal.	Provides immersionproof seal between cover and case.	2Z4868.977

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
E8	GENERATOR, static ringing: vibrator type; hermetically sealed; 110 v dc, .065 amp output; 65 v rms, 20 cyc, .05 amp input.	Supplies 20 cps for ringing purposes.	4F2318
	GROMMET: .355" max dia of cable.	Strain relief and insulating bushing.	6Z4865–1
	HOLDER, fuse: extractor post type.	Supports cartridge fuse and provides electrical connection between fuse link and adjacent circuit.	3Z3282–42.9
J1, J2, J3	JACK, telephone: for 2 cont plug; JAN type JJ-089.	J1—Receiving circuit output jack. J2, J3—Transmitting circuit input jacks.	2Z5598A–89
	KNOB: pear shaped.	Provides mechanical advantage to operate spring return switch.	2Z5821–50
	KNOB: modified, round.	Provides mechanical advantage and visual index for control shafts.	2Z5786.47
	LAMP, incandescent: 115–125 v, 6 w, .050 amp.	Ballast lamp for 20-cycle static ringing generator.	6Z6810–6
E7	LAMP, glow: 1/25 w, 75 v dc, neon.	Provides visual signal and constant voltage drop.	2Z5888–5
	LAMPHOLDER.	Supports incandescent lamp and provides electrical connection between lamp filament and adjacent circuit.	6Z8335–4
	LATCH, fastener.	Attaches cover to case with spring-locking action.	6Z6918–23
	LIGHT, indicator: w/lens.	Supports glow lamp and provides electrical connection between lamp electrodes and adjacent circuit.	2Z5991–230
E1, E2, E3, E4, E5, E6	POST, binding.	Provide mechanical and electrical tie-points for wiring.	3Z741–39
L1	REACTOR: 1 sect. 2.4 h o/a inductance; 100 ohms ±10% d-c resistance.	Line d-c return.	3C573–49
K1	RELAY, armature: ac, 7 v, 20 cps.	Receiver disabling during ring-down.	2Z7599A–335
R1, R2, R4, R5	RESISTOR, fixed: composition; 100 ohms ±10%; ½ w; JAN type RC20BF101K.	Impedance matching.	3RC20BF101K
R3	RESISTOR, fixed: composition; 820 ohms ±5%; ½ w; JAN type RC20BF821J.	Impedance matching.	3RC20BF821J
R6	RESISTOR, fixed: composition; 620 ohms ±5%; ½ w; JAN type RC20BF621J.	Impedance matching.	3RC20BF621J
R7, R22, R43	RESISTOR, fixed: composition; 470,000 ohms ±10%; ½ w; JAN type RC20BF474K.	R7—Impedance matching of secondary winding T1. R22—Discriminator filter. R43—Oscillator attenuator.	3RC20BF474K
R8, R13, R18, R23, R32, R37,	RESISTOR, fixed: composition; 220,000 ohms ±10%; ½ w; JAN type RC20BF224K.	R8—Grid current limiting for tube V1A. R13—Grid current limiting for tube V1B. R18—Grid current limiting for tube V2A.	3RC20BF224K

R66, R71, R72, R78, R82		R23, R32—Threshold circuit filter. R37—Grid current limiting for tube V7B. R66—Grid current limiting for tube V12A R71, R72—Grid bias for tube V8B. R78—Grid current limiting for tube V11A R82—Grid current limiting for tube V11B.	
R9, R14	RESISTOR, fixed: composition; 6800 ohms ±10%; ½ w; JAN type RC20BF682K.	R9—Cathode bias for tube V1A. R14—Cathode bias for tube V1B.	3RC20BF682K
R10, R15, R53, R54	RESISTOR, fixed: composition; 330,000 ohms ±10%; ½ w; JAN type RC20BF334K.	R10, R15, R54—Plate load for tube V1A. R53—Isolating resistor.	3RC20BF334K
R11, R16, R47	RESISTOR, fixed: composition; 22,000 ohms ±10%; ½ w; JAN type RC20BF223K.	R11—Decoupling for tube V1A. R16—Decoupling for tube V1B. R47—Decoupling for tube V9A.	3RC20BF223K
R12, R17, R29	RESISTOR, fixed: composition; 560,000 ohms ±10%; ½ w; JAN type RC20BF564K.	R12—Grid leak for tube V1B. R17—Grid leak for tube V2A. R29—Grid leak for tube V2B.	3RC20BF564K
R19	RESISTOR, fixed: composition; 1000 ohms ±10%; JAN type RC20BF102K.	Cathode bias for tube V2A.	3RC20BF102K
R20, R21	RESISTOR, fixed: composition; 100,000 ohms ±10%; ½ w; JAN type RC20BF104K.	Discriminator filter.	3RC20BF104K
R24, R25, R44, R76	RESISTOR, fixed: ceramic; 33,000 ohms ±10%; ½ w; JAN type RC20BF333K.	R24, R25—Discriminator filter and grid current limiting for tube V5. R44—Oscillator attenuator. R76—Cathode bias for tube V11A.	3RC20BF333K
R26, R58, R63, R74 R75, R81	RESISTOR, fixed: composition; 620,000 ohms ±15%; JAN RC20BF624J.	R26—Grid current limiting for tube V5. R58, R63—Delay circuit time constant and plate load. R74—Grid leak for tube V8B normal operation. R75—Plate load for tube V11A. R81—Plate load for tube V11B.	3RC20BF624J
R27	RESISTOR, fixed: WW; 10,000 ohms ±5%.	Output current limiting.	3Z6610-343
R28	RESISTOR, fixed: composition; 91,000 ohms ±5%; JAN type RC20BF913J.	Impedance match for 2-wire operation.	3RC20BF913J
R30	RESISTOR, fixed: composition; 5600 ohms ±10%; JAN type RC20BF562K.	Cathode bias for tube V2B.	3RC20BF562K
R31	RESISTOR, fixed: composition; 160,000 ohms ±5%; JAN type RC20BF164J.	Threshold circuit rectifier load.	3RC20BF164J
R33	RESISTOR, fixed: composition; 1 megohm ±10%; JAN type RC20BF105K.	Plate load for tube V7A.	3RC20BF105K
R34	RESISTOR, fixed: composition; 8200 ohms ±5%; JAN type RC20BF822J.	Cathode bias for tube V7A.	3RC20BF822J
R35, R51	RESISTOR, fixed: composition; 100,000 ohms ±5%; JAN type RC20BF104J.	R35—Cathode bias for tube V7A. R51—Cathode bias for tube V9B.	3RC20BF104J

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
R36, R38, R85	RESISTOR, fixed: composition; 2.2 megohms ±10%; JAN type RC20BF225K.	R36—Grid leak for tube V7B. R38—Cathode bias, threshold circuit, tube V7B. R85—Tone suppression time constant.	3RC20BF225K
R39	RESISTOR, fixed: composition; 56,000 ohms ±10%; JAN type RC20BF563K.	Threshold circuit cathode bias.	3RC20BF563K
R40	RESISTOR, fixed: WW; 8000 ohms ±5%.	Power supply filter.	3Z6580–51
R41	RESISTOR, fixed: composition; 180,000 ohms ±10%; JAN type RC20BF184K.	Coupling for local copy.	3RC20BF184K
R42	RESISTOR, fixed: composition; 20,000 ohms ±5%; JAN type RC20BF203J.	Impedance matching.	3RC20BF203J
R45	RESISTOR, fixed: composition; 120,000 ohms ±5%; JAN type RC20BF124J.	Grid bias for tube V8A.	3RC20BF124J
R46, R79, R80	RESISTOR, fixed: composition; 270,000 ohms ±5%; JAN type RC20BF274J.	Voltage dividers.	3RC20BF274J
R48	RESISTOR, fixed: composition; 47,000 ohms ±10%; JAN type RC20BF473K.	Plate load for tube V9A.	3RC20BF473K
R49	RESISTOR, fixed: composition; 470 ohms ±10%; JAN type RC20BF471K.	Cathode bias.	3RC20BF471K
R50	RESISTOR, fixed: composition; 270,000 ohms ±10%; JAN type RC20BF274K.	Oscillator feedback for tube V9A.	3RC20BF274K
R52	RESISTOR, fixed: composition; 56,000 ohms ±5%; JAN type RC20BF563J.	Cathode bias for tube V9B.	3RC20BF563J
R55	RESISTOR, fixed: composition; 43,000 ohms ±5%; JAN type RC30BF433J.	Cathode bias for tube V10A.	3RC30BF433J
R56	RESISTOR, fixed: composition; 56,000 ohms ±5%; JAN type RC20BF563J.	Cathode bias for tube V10A.	3RC30BF563J
R57, R62	RESISTOR, fixed: composition; 2.7 megohms ±10%; JAN type RC20BF275K.	R57—Grid current limiting for tube V10A. R62—Grid current limiting for tube V10B.	3RC20BF275K
R59	RESISTOR, fixed: composition; 12,000 ohms ±10%; JAN type RC30BF123K.	Cathode bias voltage divider for tube V10B.	3RC30BF123K
R60	RESISTOR, variable: WW, rotating brush type, 1 sect.; 10,000 ohms ±10%.	Cathode bias adjusting for tube V10B.	3RA7515
R61	RESISTOR, fixed: composition; 27,000 ohms ±10%; JAN type RC30BF273K.	Cathode bias voltage divider for tube V10B.	3RC20BF273K
R64	RESISTOR, fixed: composition; 18,000 ohms ±5%; JAN type RC20BF183J.	Cathode bias for tube V12A.	3RC20BF183J
R65, R77, R84	RESISTOR, fixed: composition; 220,000 ohms ±5%; JAN type RC20BF224J.	R65—Cathode bias voltage divider for tube V12A. R77, R84—Cathode bias for tube V11.	3RC20BF224J
R67	RESISTOR, fixed: composition; 3000 ohms ±5%; JAN type RC42BF302J.	Grid leak for tube V12A.	3RC42BF302J
R68	RESISTOR, fixed: WW; 2500 ohms ±5%; JAN type RW32G252.	Power supply filter.	3RW26707

R69	RESISTOR, fixed: composition; 18,000 ohms ±5%; JAN type RC42BF183J.	Cathode load for tube V8B.	3RC42BE183J
R70	RESISTOR, fixed: composition; 62,000 ohms ±5%; JAN type RC30BF623J.	Cathode bias for tube V8B.	3RC30BF623J
R73	RESISTOR, fixed: composition; 430,000 ohms ±5%; JAN type RC20BF434J.	Grid bias for tube V8B.	3RC20BF434J
R83	RESISTOR, fixed: composition; 24,000 ohms ±5%; JAN type RC20BF243J.	Cathode bias for tube V11B.	3RC20BF243J
	SHIELD, tube: JAN type TS102U03.	Tube retention and circuit isolation.	2Z8304.277
	SHIELD, tube: JAN type TS102U01.	Tube retention and circuit isolation.	2Z8304.274
	SHIELD, tube: JAN type TS103U02.	Tube retention and circuit isolation.	2Z8304.275
	SOCKET, tube: 7 cont; miniature size; JAN type TS102P01.	Supports electron tube and provides electrical connection between tube elements and adjacent circuits.	2Z8677.171
	SOCKET, tube: 9 cont; miniature size; JAN type TS103P01.	Supports electron tube and provides electrical connection between tube elements and adjacent circuits.	2Z8679.37
	STRAP, carrying.	Carrying strap for case.	6Z8448-28
S1	SWITCH, rotary: 1 sect.; 2 positions; 4 poles, 2 throws.	20-cycle ringing switch.	3Z9825-62.640
S2	SWITCH, rotary: 2 sect.; 3 positions; 10 poles, 3 throws.	2-wire, 4-wire, and telephone operation.	3Z9825-62.641
S3	SWITCH, rotary: 1 sect.; 3 positions; 3 poles, 3 throws.	Radio-link control switch.	3Z9825-62.642
T1	TRANSFORMER, AF: input type; 600 ohms pri, 300,000 ohms secd.	Line to grid impedance matching.	3Z9631.432
T2, T3	TRANSFORMER, discriminator: plate coupling type; pri—21.4 ohms dc resistance; secd—26.6 ohms dc resistance.	T2—Mark frequency discriminator transformer. T3—Space frequency discriminator transformer.	2Z9632.668
T4	TRANSFORMER, AF: plate coupling type; pri—920 ohms dc resistance, 4.5 h ±15%; secd—59 ohms dc resistance.	Plate to line impedance matching.	2Z9632.666
T5	TRANSFORMER, AF: plate coupling type; pri—83 ohms dc resistance, 400 mh ±2%; secd—83 ohms dc resistance, 400 mh ±2%.	Plate to grid coupling, audio oscillator.	2Z9632.667
T6	TRANSFORMER, power: step-down and step-up; 115 v ac, 50–60 cycles, single-phase; 3 output windings—#1 secd 560 v dc, #2 secd 220 v dc, #3 secd 6.3 v ac.	Filament and d-c power supply.	2Z9621-234
V1, V7	TUBE: JAN type 12AX7.	V1—Carrier voltage amplifier and limiter. V7—D-c amplifier in threshold circuit.	2J12AX7
V2, V5, V8, V9, V10, V11, V12	TUBE: twin triode, JAN type 12AU7.	V2—Limiter buffer. V5—D-c amplifier in receiving circuit. V8—Section A, amplifier; section B, transmit gate. V9—Section A, carrier oscillator; section B, electronic switch, diode connected. V10—D-c amplifier in output of transmitting circuit.	2J12AU7

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
V3, V4, V6, V14	TUBE: twin diode, JAN type 2J5726 (preferred) or JAN type 6AL5.	V11—D-c amplifier in carrier suppression circuit. V12—Section A, d-c amplifier in input of transmitting circuit; Section B, restorer. V3—Discriminator, mark frequency. V4—Discriminator, space frequency. V6—Rectifier and voltage doubler, threshold circuit. V14—Rectifier, transmitting circuit plate supply.	2J5726/6AL5W
V13, V15	TUBE: twin diode, common cathode; JAN type 6X4W or 6X4.	V13—Rectifier, power supply. V15—Rectifier, ringer power supply.	2J6X4W

3. Electrical Filter Assembly F–98/U

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
	GASKET: cover seal.	Provides rainproof seal between cover and case.	2Z4868.980
	LATCH, fastener.	Attaches cover to case with spring-locking action.	6Z6918–23

4. Oscillator and Discriminator Capacitor Selection

Capacitors designated C10, C35, and C37 in paragraph 2 of this appendix will consist of one or two of the trimmer capacitors listed in *a* and *b* below. Refer to chapter 6 for the selection procedure.

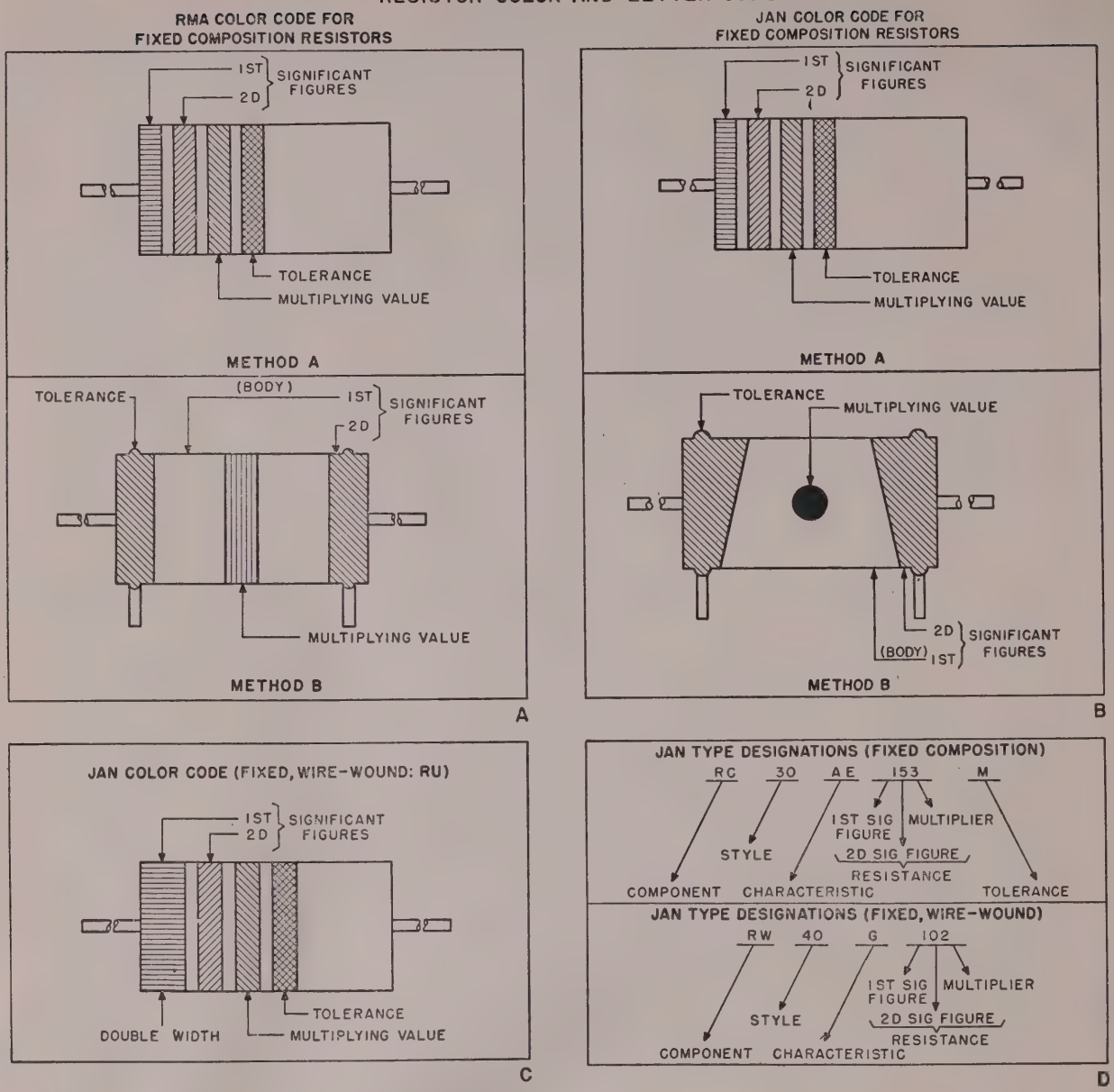
a. Trimmer capacitors used in the alinement of the oscillator circuit are listed below:

Name of part and description	Signal Corps stock No.
CAPACITOR, fixed: silver mica; 470 μμf ±10%; 500 v dc; JAN CM20D471K.	3K2047141
CAPACITOR, fixed: mica; 1000 μμf ±5%; 500 v dc; JAN CM30D102J.	3K3010241
CAPACITOR, fixed: mica; 2000 μμf ±5%; 500 v dc; JAN CM30D202J.	3K3020242
CAPACITOR, fixed: mica; 3900 μμf ±5%; 500 v dc; JAN CM35D392J.	3K3539242
CAPACITOR, fixed: mica; 3000 μμf ±5%; 500 v dc; JAN CM30D302J.	3K3030242
CAPACITOR, fixed: mica; 5100 μμf ±5%; 500 v dc; JAN CM35D512J.	3K3551242
CAPACITOR, fixed: mica; 6200 μμf ±5%; 500 v dc; JAN CM35D622J.	3K3562242
CAPACITOR, fixed: silver mica; 7500 μμf ±5%; 300 v dc; JAN CM35D752J.	3K3575242
CAPACITOR, fixed: mica; 8200 μμf ±5%; 500 v dc; JAN CM40D822J.	3K4082242
CAPACITOR, fixed: silver mica; 10,000 μμf ±5%; 300 v dc; JAN CM40D103J.	3K4010342

b. Trimmer capacitors used in alinement of the mark tuned discriminator circuit are listed below:

Name of part and description	Signal Corps stock No.
CAPACITOR, fixed: silver mica; 47 μμf ±10%; 500 v dc; JAN CM20C470K.	3K2047031
CAPACITOR, fixed: mica; 100 μμf ±10%; 500 v dc; JAN CM20C101K.	3K2010131
CAPACITOR, fixed: mica; 200 μμf ±5%; 500 v dc; JAN CM20D201J.	3K2020142
CAPACITOR, fixed: mica; 300 μμf ±5%; 500 v dc; JAN CM20D301J.	3K2030142
CAPACITOR, fixed: mica; 390 μμf ±5%; 500 v dc; JAN CM20D391J.	3K2039142
CAPACITOR, fixed: mica; 510 μμf ±5%; 500 v dc; JAN CM20D511J.	3K2051142
CAPACITOR, fixed: mica; 620 μμf ±5%; 500 v dc; JAN CM30D621J.	3K3062142
CAPACITOR, fixed: mica; 750 μμf ±5%; 300 v dc; JAN CM30D751J.	3K3075142
CAPACITOR, fixed: mica; 910 μμf ±5%; 500 v dc; JAN CM30D911J.	3K3091142
CAPACITOR, fixed: mica; 1000 μμf ±5%; 500 v dc; JAN CM30D102J.	3K3010242
CAPACITOR, fixed: mica; 1100 μμf ±5%; 500 v dc; JAN CM30D112J.	3K3011242
CAPACITOR, fixed: mica; 1200 μμf ±5%; 500 v dc; JAN CM30D122J.	3K3012242

RESISTOR COLOR AND LETTER CODE



STANDARDS				
COLOR	SIGNIFICANT FIGURE	MULTIPLYING VALUE	TOLERANCE (%)	JAN LETTER TOLERANCE
BLACK	0	1	—	—
BROWN	1	10	± 1	F
RED	2	100	± 2	G
ORANGE	3	1,000	± 3	—
YELLOW	4	10,000	± 4	—
GREEN	5	100,000	± 5	—
BLUE	6	1,000,000	± 6	—
VIOLET	7	10,000,000	± 7	—
GRAY	8	100,000,000	± 8	—
WHITE	9	1,000,000,000	± 9	—
GOLD	—	0.1	± 5	J
SILVER	—	0.01	±10	K
NO COLOR	—	—	±20	M

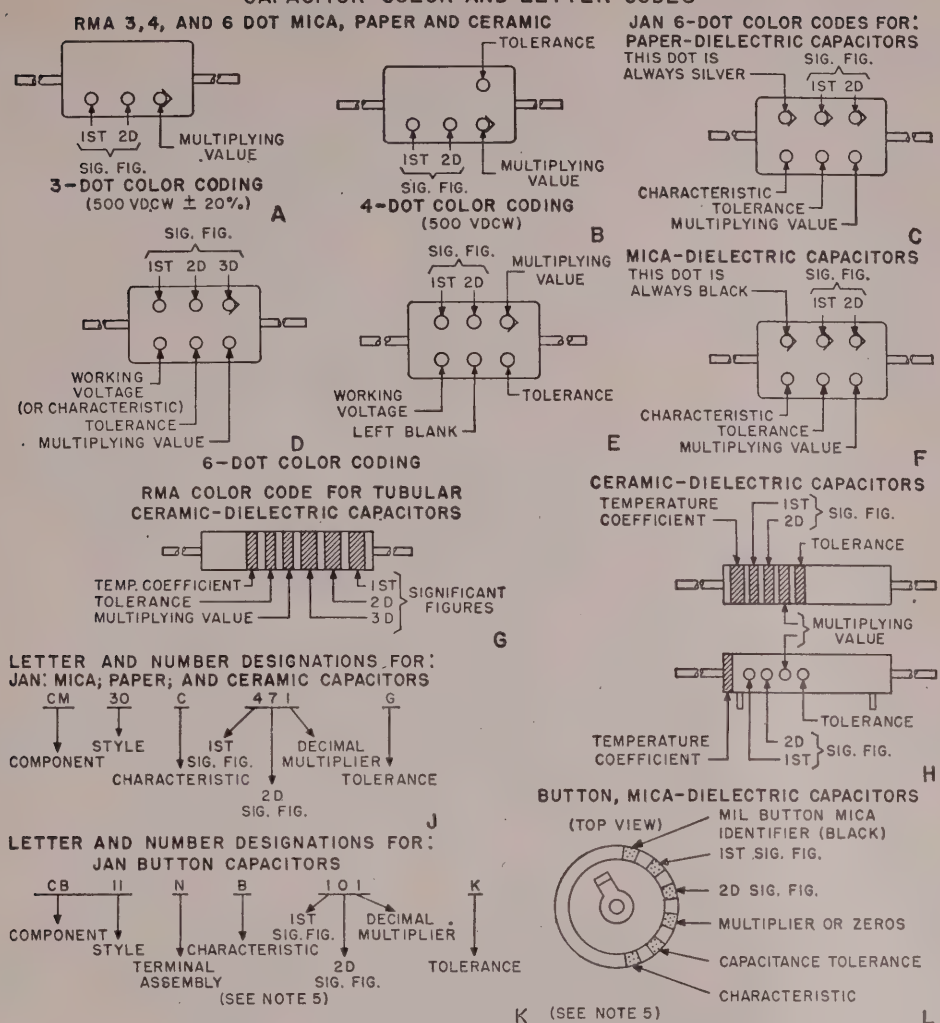
NOTES:

1. RESISTORS WITH AXIAL LEADS ARE INSULATED. RESISTORS WITH RADIAL LEADS ARE NON-INSULATED.
2. RMA: RADIO MANUFACTURERS ASSOCIATION.
3. JAN: JOINT ARMY-NAVY.
4. THESE COLOR AND NUMBER CODES GIVE ALL RESISTANCE VALUES IN OHMS.
5. RESISTIVE COMPONENTS USED FOR LETTER TOLERANCES ARE: RC, RN, AND RU.
6. WATTAGE FOR RW TYPES IS FOUND IN THE JAN SPECIFICATIONS UNDER CHARACTERISTICS.

TM RC

Figure 45. Resistor color codes.

CAPACITOR COLOR AND LETTER CODES



- STANDARDS -					JAN MICA-CM		JAN PAPER-CM		JAN CERAMIC-CC					
									CAP. TOL. FOR MORE THAN 10 UUF			CAP. TOL. FOR 10 UUF OR LESS		
COLOR	SIG. FIG.	DECIMAL MULTIPLIER	% TOL.	VDCW	LETTER TOL.	CHARAC-TERISTIC	LETTER TOL.	CHARAC-TERISTIC	DEC. MULT.	%	LETTER DESIG-NATION	UUF	LETTER DESIG-NATION	CHARAC-TERISTIC
BLACK	0	1	±20	500	M	A	M	A	1	±20	M	±2.0	G	C
BROWN	1	10	± 1	100	-	B	-	E	10	± 1	F	-	-	H
RED	2	100	± 2	200	G	C	-	H	100	± 2	G	-	-	L
ORANGE	3	1,000	± 3	300	-	D	N*	J	1,000	-	-	-	-	P
YELLOW	4	10,000	± 4	400	-	E	-	P	-	-	-	-	-	R
GREEN	5	100,000	± 5	500	-	F	-	R	-	± 5	J	±0.5	D	S
BLUE	6	1,000,000	± 6	600	-	G	-	S	-	-	-	-	-	T
VIOLET	7	10,000,000	± 7	700	-	-	-	T	-	-	-	-	-	U
GRAY	8	100,000,000	± 8	800	-	-	-	-	0.01	-	-	±0.25	C	B
WHITE	9	1,000,000,000	± 9	900	-	-	-	-	0.1	± 10	K	±1.0	F	SL
GOLD	-	0.1	± 5	1,000	J	-	-	-	-	-	-	-	-	A
SILVER	-	0.01	±10	2,000	K	-	K	-	-	-	-	-	-	-
NO COLOR	-	-	±20	500	-	-	-	-	-	-	-	-	-	-
* THE TOLERANCE OF THIS CAPACITOR IS ±30%, NOT ±3%														

NOTES

JAN: JOINT ARMY-NAVY
RMA: RADIO MANUFACTURERS ASSOCIATION

1. THESE COLOR AND LETTER CODES GIVE CAPACITANCES IN MICROMICROFARADS
2. THIS TABLE IS ADAPTED FOR JAN AND RMA COLOR AND JAN LETTER TYPE DESIGNATIONS
3. CERAMIC AND MICA CAPACITORS, BOTH JAN AND RMA, ARE GENERALLY 500 VDCW
4. BUTTON CAPACITORS ARE GENERALLY 300 VDCW
5. READ BUTTON CAPACITOR TOLERANCE UNDER CERAMICS OF MORE THAN 10 UUF
6. CHARACTERISTICS ARE AVAILABLE IN JAN CAPACITOR SPECIFICATION MANUALS
7. THE COMPONENTS USED ABOVE FOR JAN LETTER TYPE DESIGNATIONS ARE:
   CB MICA BUTTON; *CC* CERAMIC; *CM* MICA MOULDED; *CN* PAPER MOULDED

TM CC

Figure 46. Capacitor color codes.

NOTES:-
1. (B) NORM-REC-SEND SWITCH IN NORM POSITION.
2. (C) WAIT UNTIL NEON LAMP LIGHTS.
3. (D) REMOVE V5 FROM SOCKET TURN ON POWER 10 MINUTES BEFORE TAKING MEASUREMENT.
4. (S) INSERT DUMMY PLUG FOR SPACE CONDITION.
5. (M) REMOVE DUMMY PLUG FOR MARK CONDITION.
6. 4W-2W-TEL SWITCH IN 2W POSITION UNLESS OTHERWISE SPECIFIED.
7. NORM-REC-SEND SWITCH IN REC POSITION UNLESS OTHERWISE SPECIFIED.
8. ALL VOLTAGES DC UNLESS OTHERWISE SHOWN.
9. ALL RESISTANCES MEASURED IN OHMS TO GROUND.
10. ALL DC VOLTAGES MEASURED TO GROUND. USE VOLTMETER WITH 20,000 OHMS-PER-VOLT SENSITIVITY.

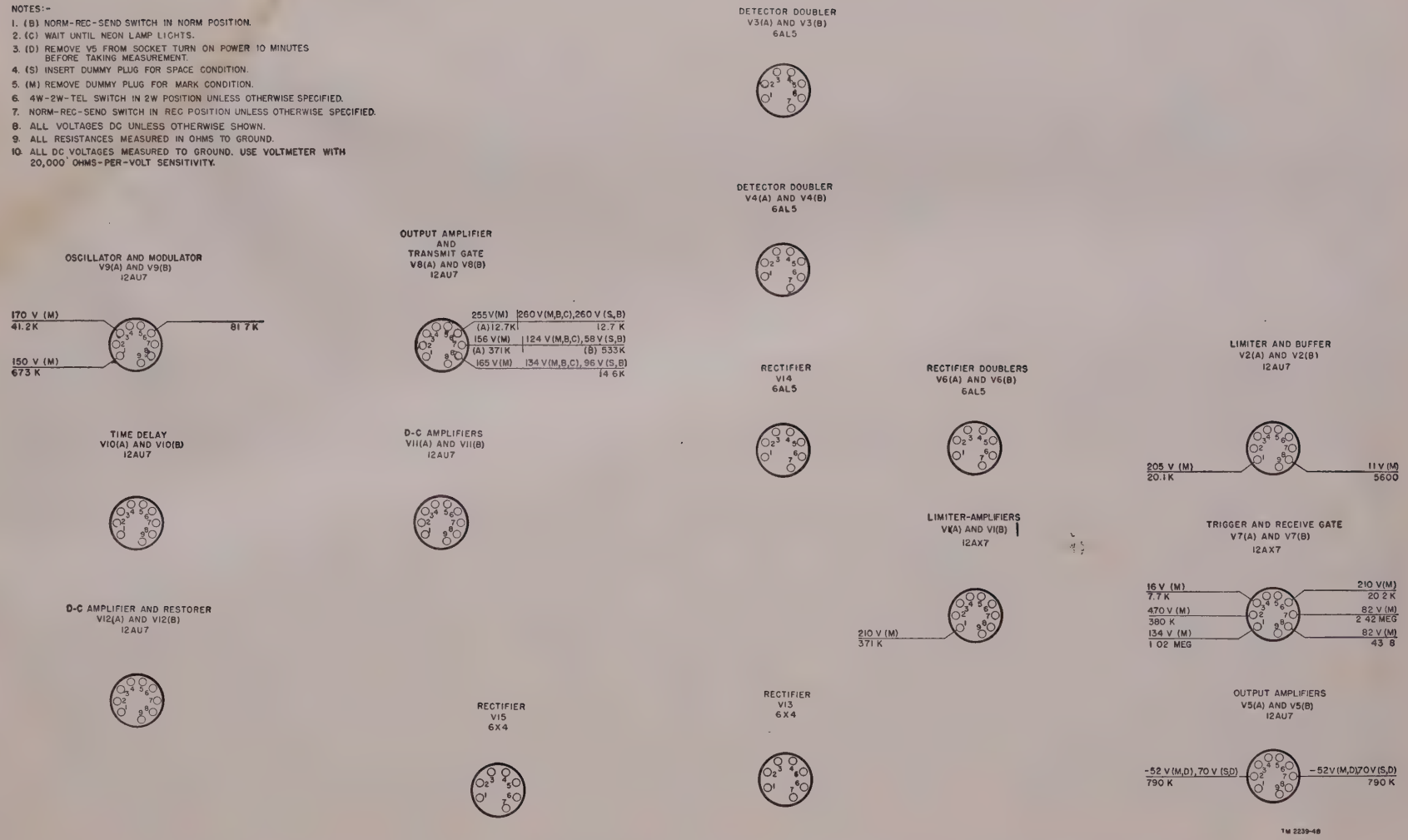


Figure 48. Tube-socket voltage and resistance chart, SEND-REC-NORM switch in REC or NORM positions.

NOTES :-

1. 4W - 2W - TEL SWITCH IN 2W POSITION UNLESS OTHERWISE SPECIFIED.
2. NORM - REG - SEND SWITCH IN SEND POSITION UNLESS OTHERWISE SPECIFIED.
3. (S) INSERT DUMMY PLUG FOR SPACE CONDITION.
4. (M) REMOVE DUMMY PLUG FOR MARK CONDITION.
5. (A) NORM - REG - SEND SWITCH IN REC POSITION.
6. NC MEANS NO CONNECTION.
7. ALL VOLTAGES DC UNLESS OTHERWISE SHOWN.
8. ALL RESISTANCES MEASURED IN OHMS TO GROUND.
9. ALL DC VOLTAGES MEASURED TO GROUND USE VOLTMETER WITH 20,000 OHMS - PER - VOLT SENSITIVITY.

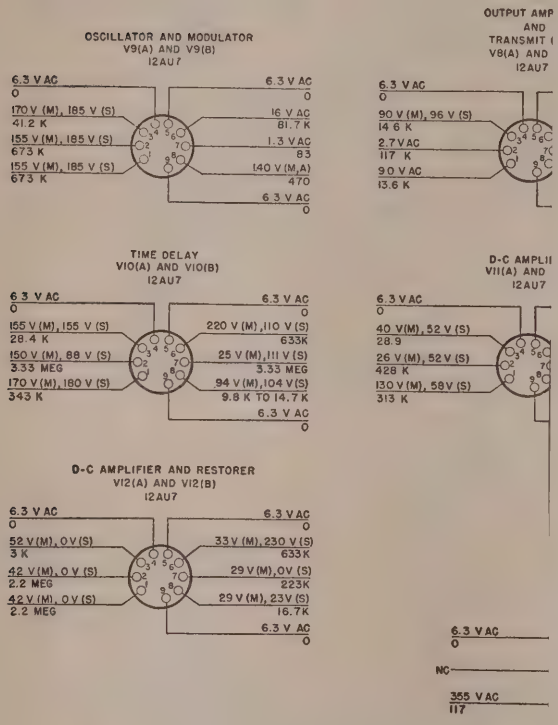


Figure 47. Tube

NOTES:-

1. (B) NORM-REC-SEND SWITCH IN NORM POSITION.
2. (C) WAIT UNTIL NEON LAMP LIGHTS.
3. (D) REMOVE V5 FROM SOCKET TURN ON POWER 10 MINUTES BEFORE TAKING MEASUREMENT.
4. (S) INSERT DUMMY PLUG FOR SPACE CONDITION.
5. (M) REMOVE DUMMY PLUG FOR MARK CONDITION.
6. 4W-2W-TEL SWITCH IN 2W POSITION UNLESS OTHERWISE SPECIFIED.
7. NORM-REC-SEND SWITCH IN REC POSITION UNLESS OTHERWISE SPECIFIED.
8. ALL VOLTAGES DC UNLESS OTHERWISE SHOWN.
9. ALL RESISTANCES MEASURED IN OHMS TO GROUND.
10. ALL DC VOLTAGES MEASURED TO GROUND. USE VOLTMETER WITH 20,000 OHMS-PER-VOLT SENSITIVITY.

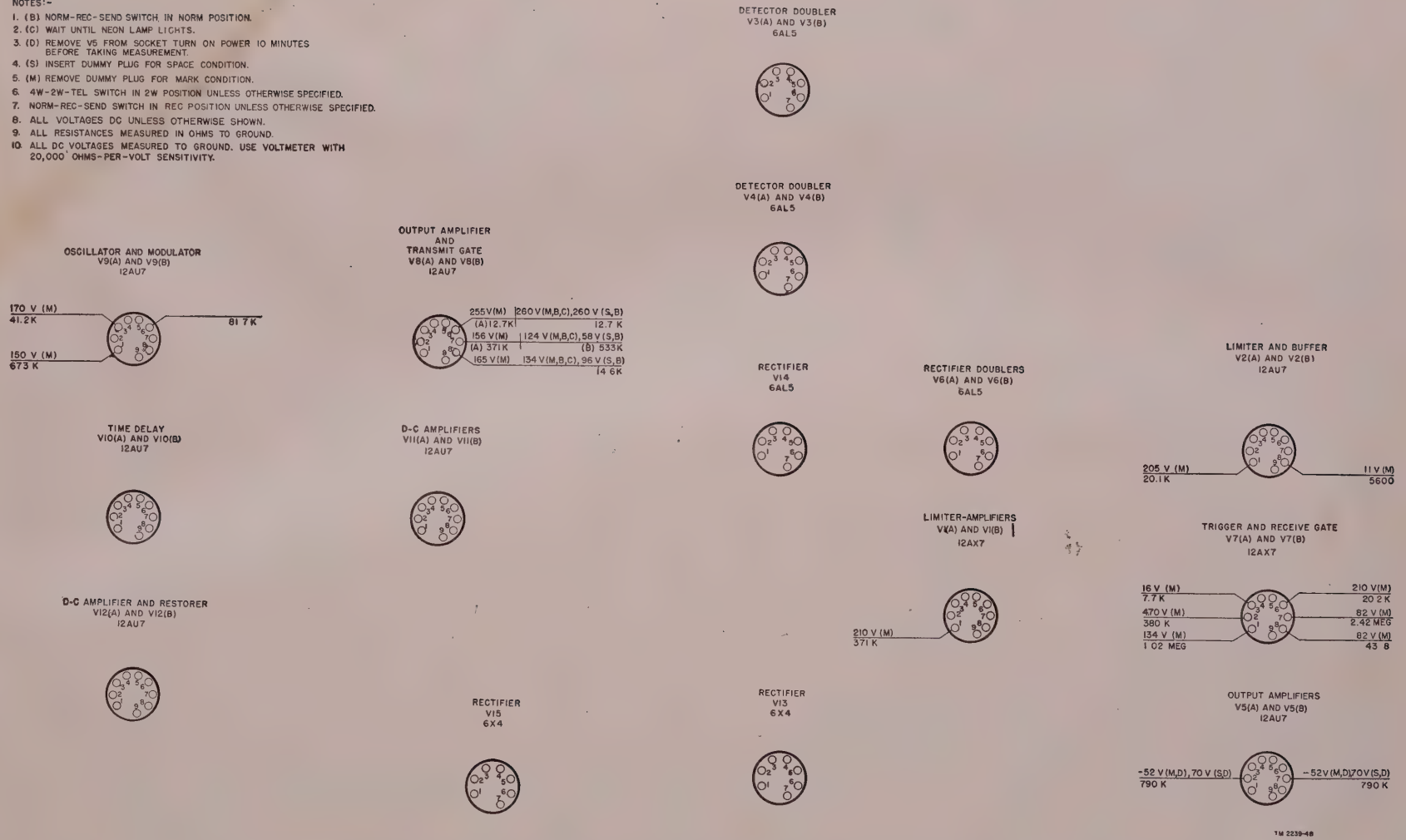
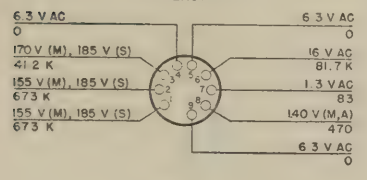
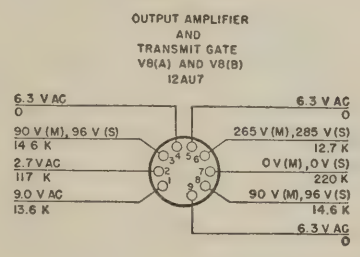


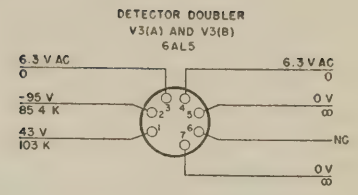
Figure 48. Tube-socket voltage and resistance chart, SEND-REC-NORM switch in REC or NORM positions.

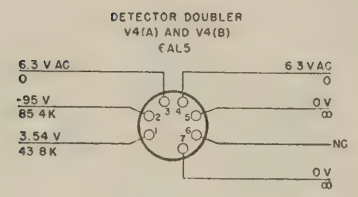
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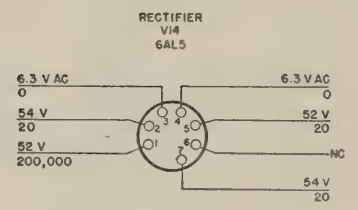
1. 4W - 2W-TEL SWITCH IN 2W POSITION UNLESS OTHERWISE SPECIFIED.
2. NORM-REG-SEND SWITCH IN SEND POSITION UNLESS OTHERWISE SPECIFIED.
3. (S) INSERT DUMMY PLUG FOR SPACE CONDITION.
4. (M) REMOVE DUMMY PLUG FOR MARK CONDITION.
5. (A) NORM-REG-SEND SWITCH IN REG POSITION.
6. NC MEANS NO CONNECTION.
7. ALL VOLTAGES DC UNLESS OTHERWISE SHOWN.
8. ALL RESISTANCES MEASURED IN OHMS TO GROUND.
9. ALL DC VOLTAGES MEASURED TO GROUND USE VOLTMETER WITH 20,000 OHMS-PER-VOLT SENSITIVITY.

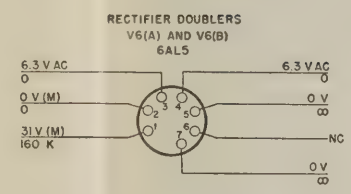


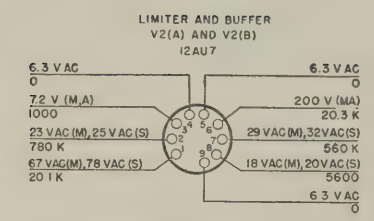


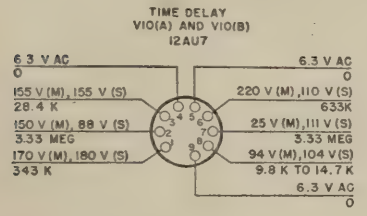


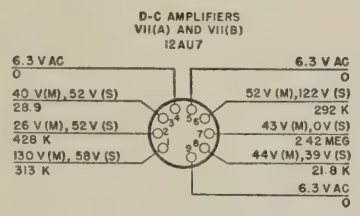


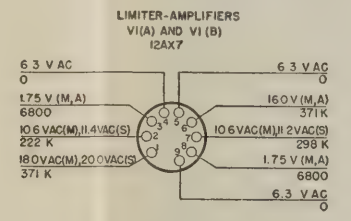


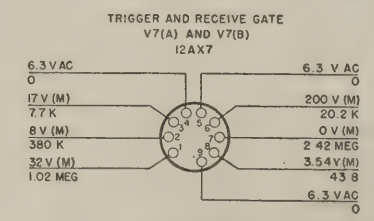


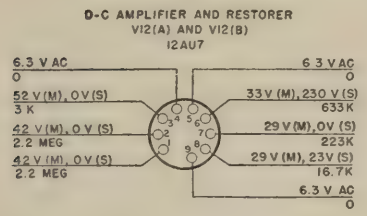


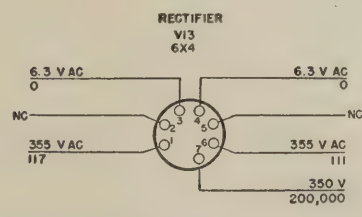


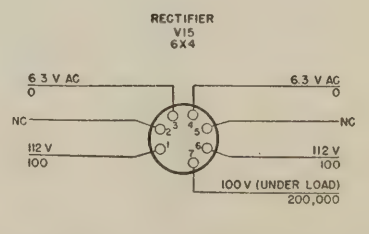












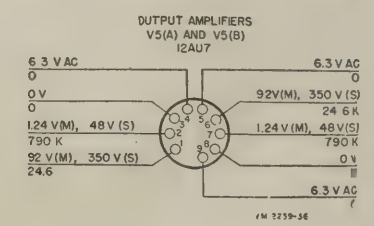
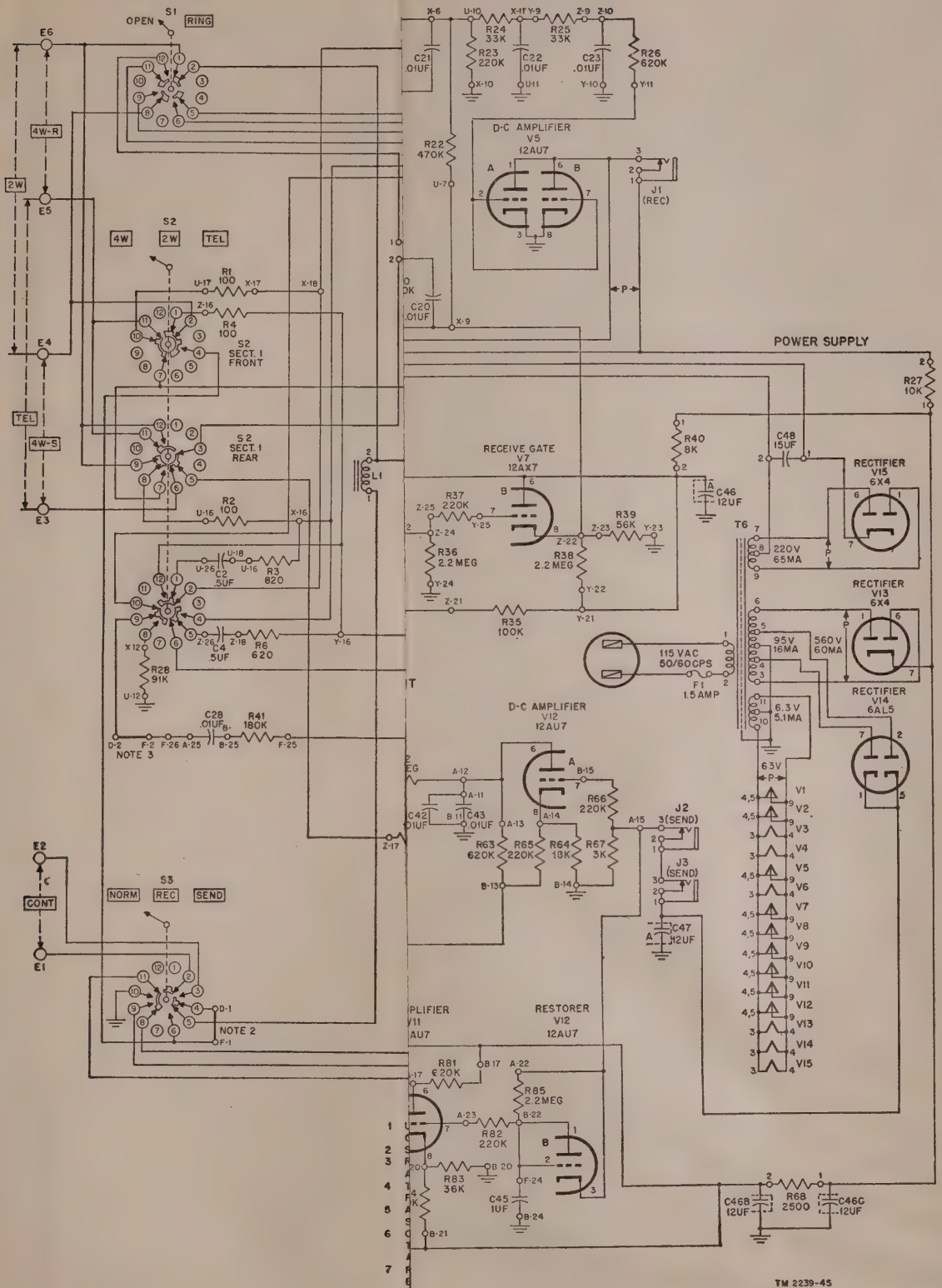


Figure 47. Tube-socket voltage and resistance chart, SEND-REC-NORM switch in SEND position.

INPUT-OUTPUT & RINGING CIRCUITS



INPUT-OUTPUT & RINGING CIRCUITS

RINGING GENERATOR, STATIC

LIMITER-AMPLIFIER V1 12AX7

LIMITER-AMPLIFIER V1 12AX7

DISCRIMINATOR

LIMITER V2 12AU7

MARK T2

RECEIVING CIRCUIT

DETECTOR DOUBLER V3 6AL5

SPACE T3

DETECTOR DOUBLER V4 6AL5

D-C AMPLIFIER V5 12AU7

POWER SUPPLY

THRESHOLD CIRCUIT

BUFFER V2 12AU7

RECTIFIER DOUBLER V6 6AL5

TRIGGER V7 12AX7

RECEIVE GATE V7 12AX7

TRANSMITTING CIRCUIT

OUTPUT AMPLIFIER V8 12AU7

OSCILLATOR V9 12AU7

MODULATOR V9 12AU7

TIME DELAY V10 12AU7

TIME DELAY V10 12AU7

D-C AMPLIFIER V12 12AU7

CARRIER SUPPRESSION CIRCUIT

TRANSMIT GATE V8 12AU7

D-C AMPLIFIER V11 12AU7

D-C AMPLIFIER V11 12AU7

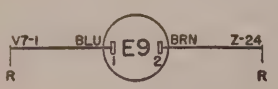
RESTORER V12 12AU7

NOTES

1 UNLESS OTHERWISE SHOWN, RESISTORS ARE IN OHMS, CAPACITORS ARE IN UUF.
2 STRAP FOR COMMON BATTERY USE ONLY.
3 REMOVE STRAP FOR 4 WIRE FULL DUPLEX APPLICATIONS.
4 THERE ARE NO CONNECTIONS ON SECT. 2 FRONT OF SWITCH 2.
5 ALL SIGNAL LEADS IN RECEIVER CIRCUIT SHIELDED UP TO & INCLUDING GRID OF V1(B).
6 OSCILLATOR AND DISCRIMINATOR COILS ARE TUNED BY SELECTION OF CAPACITORS C10, C35 AND C37.
7 ROTARY SWITCHES ARE VIEWED FROM THE END NEARER TO CONTROL KNOB.

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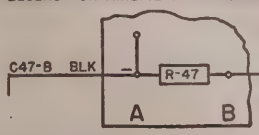
Figure 49. Telegraph Terminal TH–5/TG, schematic diagram.



NOTES:

1-COLOR INDICATES COLOR OF TRACERS ON WHITE BASE WIRE.

2-LEGEND FOR AIRLINE WIRING DIAGRAM.



ILLUSTRATES WIRE IN THE "S" CABLE (SEND CABLE) WHICH IS CONNECTED TO TERMINAL A-1 OF TERMINAL BOARD ABCD. THE BLACK WIRE RUNS TO TERMINAL "B" OF CAPACITOR C-47.

3-WIRING CONVENTIONS:

A- BLU DENOTES COLOR CODED WIRE IN CABLE.

B- BRN DENOTES STRAPPING, COLOR CODED, (CHASSIS).

C- ------- DENOTES STRAPPING, BARE, (CHASSIS)

D _____ DENOTES STRAPPING, BARE & INSULATED, (TERMINAL BOARD).

4-STRAPPING ON SEND TERMINAL BOARD:

A- TERMINALS D-1 AND F-1 NORMALLY STRAPPED FOR COMMON BATTERY USE ONLY.

B- TERMINALS D-2 AND F-2 NORMALLY STRAPPED. REMOVE STRAP FOR 4 WIRE FULL DUPLEX OPERATION.

5-CABLE DESIGNATIONS:

"R" RECEIVE CABLE

"S" SEND CABLE

"P" POWER CABLE

TM2239-55

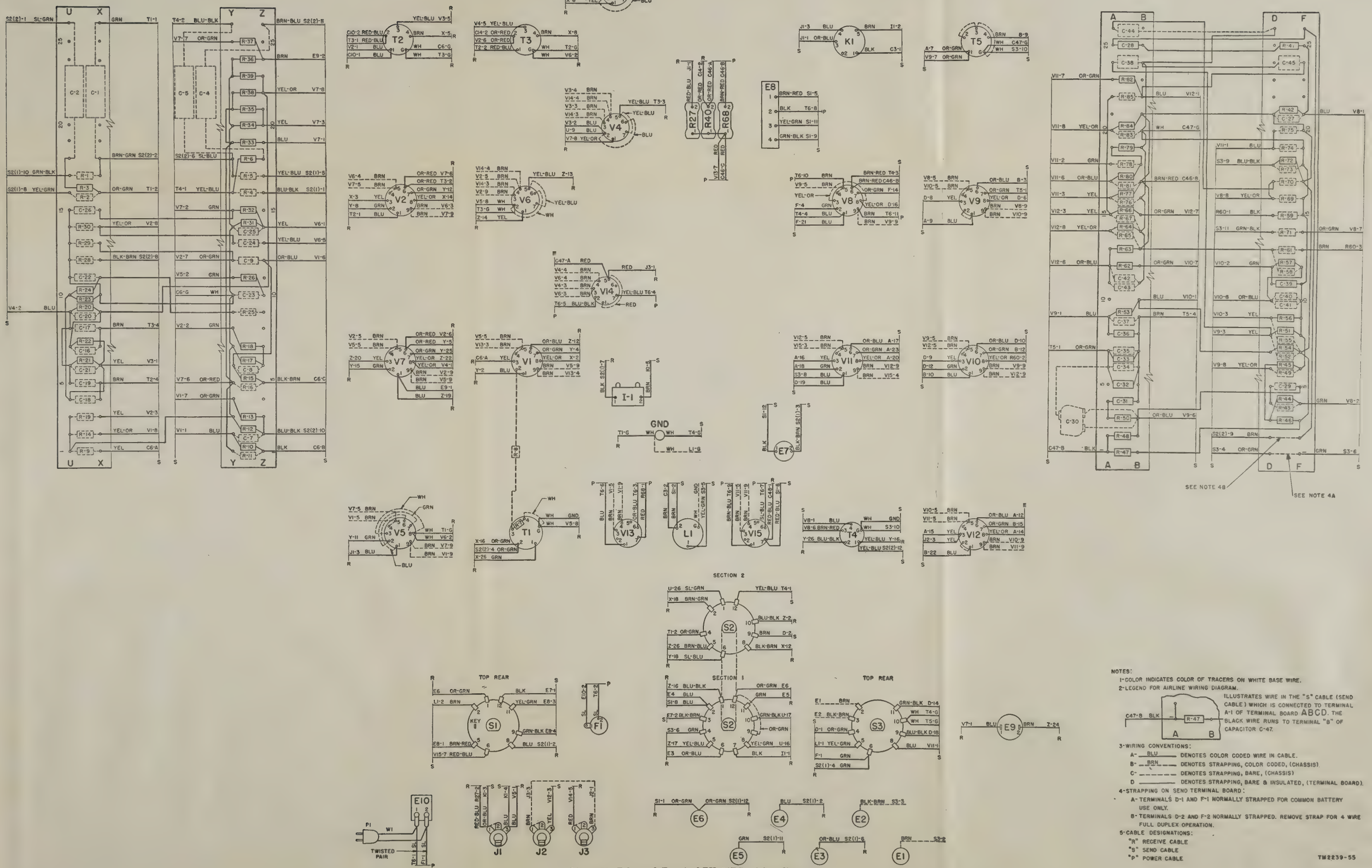


Figure 50. Telegraph Terminal TH-5/TG, wiring diagram.

NOTES:

1-COLOR INDICATES COLOR OF TRACERS ON WHITE BASE WIRE.

2-LEGEND FOR AIRLINE WIRING DIAGRAM.

ILLUSTRATES WIRE IN THE "S" CABLE (SEND CABLE) WHICH IS CONNECTED TO TERMINAL A-1 OF TERMINAL BOARD ABCD. THE BLACK WIRE RUNS TO TERMINAL "B" OF CAPACITOR C-47.

3-WIRING CONVENTIONS:

A- BLU ——— DENOTES COLOR CODED WIRE IN CABLE.

B- BRN ——— DENOTES STRAPPING, COLOR CODED, (CHASSIS).

C- ——— DENOTES STRAPPING, BARE, (CHASSIS)

D ——— DENOTES STRAPPING, BARE & INSULATED, (TERMINAL BOARD).

4-STRAPPING ON SEND TERMINAL BOARD:

A- TERMINALS D-1 AND F-1 NORMALLY STRAPPED FOR COMMON BATTERY USE ONLY.

B- TERMINALS D-2 AND F-2 NORMALLY STRAPPED. REMOVE STRAP FOR 4 WIRE FULL DUPLEX OPERATION.

5-CABLE DESIGNATIONS:

"R" RECEIVE CABLE

"S" SEND CABLE

"P" POWER CABLE

TM2239-55

INDEX

	Paragraphs	Page
Additional equpiment required for AN/TCC–14	17	13
Alinement:		
Alternate method	105, 110	60, 64
General	101	58
Preferred method	104	59
Procedures	10, 105	9, 60
Receiving circuit, methods:		
General	108	62
Preferred	109	62
Test equipment required	102	59
Alternate telegraph-telephone service:		
General	7*a*	4
System application	7	4
Use on loops or trunks:		
Not passing 20-cps ringing	7*c*	5
Passing 20-cps ringing	7*b*	4
Amplifier:		
And limiter stage V1, functioning	70, 71	36
Output, stage V8, mark-to-space transition	61	32
Amplifier, d-c, stage:		
V11, functioning	65, 66	35
V5, functioning	74	39
V12(A), marking interval	50	30
V12(A), spacing interval	56	31
Auxiliary:		
Circuits, general functioning	48*b*	29
Equipment	46	27
Ballast lamp, use	81*c*	43
Band-pass section, Electrical Filter Assembly F–98/U	84	47
Binding post connections, TH–5/TG	81*b*	42
Buffer stage V2(B)	76	41
Buzzer circuit, input-output and ringing circuit, functioning	81*c*	43
Carrier suppression circuit:		
Carrier leakage test	114	64
D-c amplifier stage V11	65, 66	35
Description	63	34
First spacing interval	68	35
General functioning	48*b*(1)	29
Restorer stage V12(B)	64	34
Transmit gate stage V8(B)	67	35
Charts:		
Trouble-shooting	95	52
Voltage and resistance	98	57
Chassis, cleaning and inspecting	88	50
Checking:		
Filter F–98/U	43*c*	25
Telegraph Terminal TH–5/TG	43*b*	24
Telegraph-Telephone Signal Converter TA–182/U	43*c*	25

	Paragraphs	Page
Checklist:		
Equipment performance:		
Telegraph Terminal TH–5/TG	45*a*	25
Telegraph-Telephone Signal Converter TA–182/U	45*b*	26
Filter F–98/U	45*c*	26
Preventive maintenance:		
Filter F–98/U	37*b*	23
Telegraph Terminal TH–5/TG	37*a*	22
Circuits, dropping at intermediate points	9*e*	9
Cleaning, inspecting, and testing removed parts	87	50
Cleaning and inspecting chassis	88	50
Components:		
Destruction	121	67
Table	12	10
Connections:		
Operation:		
Over 4-wire line	21*b*	17
Over push-to-talk radio circuit using Telegraph Terminal TH–5/TG	21*d*	17
Over 2-wire line	21*a*	16
Telephone operation using Telegraph Terminal TH–5/TG	21*c*	17
CONT binding post	81*b*(4)	43
Controls:		
Filter F–98/U	25	18
Telegraph Terminal TH–5/TG	23	18
Telegraph-Telephone Signal Converter TA–182/U	24	18
Control Unit RM–39	6*e*(1), 17	3, 13
D-c amplifier stage:		
V11 functioning	65, 66	35
V5 functioning	74	39
V12(A), marking interval	50	30
V12(A), spacing interval	56	31
D-c resistance of transformers and coils	97	57
Definition of preventive maintenance	35	22
Demolition methods	120	67
Description:		
Filter F–98/U	15	11
Telegraph Terminal TH–5/TG	13	10
Telegraph-Telephone Signal Converter TA–182/U	14	11
Desert maintenance	39*d*	24
Destruction of components	121	67
Disassembly	118	67
Discrimination and detector doubler circuits	73	36
Domestic shipment, uncrating and unpacking	19	14
Dropping circuits at intermediate points	9*c*	8
Electrical Filter Assembly F–98/U. (*See* Filter F–98/U).		
Electronic switching circuit	75	40
Equipment:		
Auxiliary	46	27
Performance checklist:		
Filter F–98/U	45*c*	26
Telegraph-Telephone Signal Converter TA–182/U	45*b*	26
Telegraph Terminal TH–5/TG	45*a*	25
Equivalent detector doubler circuit	73*c*(3)	38
Export shipment	11*a*	10
Filter, static ringing generator, operation	82*c*	47
Filter F–98/U:		
Band-pass section	84	47
Band-stop section	84	47
Checking	43*c*	25

	Paragraphs	Page
Filter F–98/U—Continued		
Checklist:		
Equipment performance	45*c*	26
Preventive maintenance	37*b*	23
Connections	21	15
Controls	25	18
Description	15	11
Dropping circuits at intermediate points	9*e*	9
Frequency response curve	84	47
Functioning	84	47
Running spares	16*b*	13
Theory	83	47
Final testing:		
First spacing interval	68	35
Forms and records	2	1
General	111	64
Test equipment	112	64
Four-wire line, connection	21*b*	17
Frequency:		
Oscillator, test	114*c*	65
Response curve, Filter F–98/U	84	47
Functioning:		
Input-output and ringing circuit	81*c*	43
Filter F–98/U	84	47
Resistor R60	62*f*	34
Static ringing generator circuit	82	45
General functioning, auxiliary circuit:		
Carrier suppression	48*b*(1)	29
Input-output	48*b*(3)	29
Ringing	48*b*(4)	29
Threshold	48*b*(2)	29
Time-delay	48*b*(5)	29
General preventive maintenance techniques	36	22
Hybrid, voice frequency (TA–31/U), use	9*b*	6
Impedance matching, line	81*c*(15)	45
Input circuit test	116	66
Input-output and ringing circuits:		
Auxiliary circuit, general functioning	48*b*(3), *b*(4)	29
Ballast lamp, use	81*c*	43
Binding post connections	81*b*	42
4W—2W—TEL switch, use	81*b*(1)	42
Functioning	81*c*	43
General	81*a*	42
Relay K1, functioning	81*c*	43
Switch, use:		
S1	81*c*(1)	41
S2	81*b*(1)	42
S3	81*c*(10)	45
Installation of Mounting MT–791/U	47*a*	27
Interval, first spacing	68	35
Jacks, SEND and REC, use	27*d*	19
Lamp, ballast, use	81*c*	43
Limiter:		
And amplifier stage V1, functioning	70, 71	36
Limited storage	119	67
Stage V2(A), functioning	72	36
Line, impedance matching	81*c*(15)	45
Locating Telegraph-Telephone Terminal AN/TCC–14	18	14
Locating of TH–5/TG component of terminal board	96	54

	Paragraphs	Page
Lubrication of AN/TCC–14	38	23
Maintenance:		
Desert	39*d*	24
Preventive. (*See* Preventive maintenance.)		
Tropical	39*b*	24
Winter	39*c*	24
Mark doubler circuit, functioning	73	36
Mark-tuned circuit, functioning	73	36
Method of demolition	120	67
Miller effect	54	31
Modulator stage V9(B):		
Marking interval	53	31
Spacing interval	59	32
Mounting MT–791/U, installation	47*a*	27
Network system	4*b*	2
One-way reversible	13*d*	11
Operation:		
Static ringing generator:		
Filter	82*c*	47
Vibrator	82*b*	46
Under unusual conditions:		
Arctic	32	21
Desert	34	21
General	31	21
Tropical	33	21
Under usual conditions:		
4-wire line, connections	21*b*	17
Push-to-talk radio circuit, connections	21*d*	17
Telegraph Terminal TH–5/TG	13*d*	11
2-wire line, connections	21*a*	16
Operational tests	94, 117	51, 66
Oscillator alinement	105	60
Frequency test	114*c*	65
Method:		
Alternate	105	60
Preferred	104	59
Oscillator stage V9(A) spacing interval	60	32
Output:		
Amplifier stage V8(A) mark-to-space transition	61	32
Circuit tests	116	66
Level test, transmitting circuit	114*d*	65
Painting	40	24
Parts, replacement	99	57
Performing preventive maintenance	37	22
Pluck-out parts:		
Removal:		
Fuse	86*b*	50
Neon lamp	86*c*	50
Tubes	86*a*	50
Replacement	89	51
Point-to-point system	4*a*	2
Power supply circuits:		
Functioning	48*a*(3), 8	29, 5
Test	113	64
Precautions, general, trouble-shooting	94	51
Preliminary starting procedure	26	19
Preventive maintenance:		
Checklist:		
Filter F–98/U	37*b*	23
Telegraph Terminal TH–5/TG	37*a*	22

	Paragraphs	Page
Preventive maintenance—Continued		
Service:		
Definition	35	22
General techniques	36	22
Performing preventive maintenance	37	22
Procedures:		
Preliminary starting	26–28	19–20
Starting	29	21
Stopping	30	21
Purpose and use	3	1
Push-to-talk radio	4*d*, 6*e*	2, 3
REC jacks, use	27*d*	19
Receiving circuits:		
Alinement, general	108	62
Alternate alinement, using Signal Generator SG–15/PCM	110	64
D-c amplifier stage V5, functioning	74	39
Description	69	36
Discriminator and detector doubler circuits	73	36
General, functioning	48*a*	28
Limiter and amplifier stage V1, functioning	70, 71	36
Limiter stage V2(A), functioning	72	36
Preferred alinement procedure	109	62
Sensitivity	75	40
Tests	115	66
Receiving gate stage V7(B), functioning	79	42
Rectifier doubler stage V6, functioning	77	41
Refinishing	100	57
Relay K1, functioning	81*c*	43
Remote Control Equipment RC–289	6*e*(1), 17	3, 13
Remote control radio system	4*d*	2
On 2-wire basis	6*e*(1)	3
On 4-wire basis	6*e*(2)	4
Removal of pluck-out parts	86	50
Fuse	86*b*	50
Neon lamps	86*c*	50
Tubes	86*a*	50
Repacking for shipment and limited storage	119	67
Replacement of parts	99	57
Replacing pluck-out parts	89	51
Resistance charts, voltage and	98	57
Resistor R60, functioning	62*f*	34
Restorer stage V12(B), functioning	64	34
Ring switch, use	27*c*	19
Ringing circuit:		
Function	81*c*	43
General functioning	48*b*(4)	29
Tests	116	66
Ringing generator:		
Circuit static, functioning	82	45
Filter operation	82*b*	46
Vibrator operation	82*b*	46
Running spares	16	12
Rustproofing and painting	40	24
Scope	1	1
Send-bias adjustment:		
Alternate method	107	62
Preferred method	106	62
SEND jacks, use	27*d*	19
Sensitivity, receiving circuit	75	40
Sequence of operations in transmitting time-delay circuit	62	32

	Paragraphs	Page
Services, telegraph-telephone:		
Alternate	7	4
Simultaneous	8	5
Speech plus half-duplex	9	6
Telegraph only	6	2
Upon receipt of used or reconditioned equipment	22	17
Shipment:		
Domestic	11*b*	10
Export	11*a*	10
Repacking for	119	
Signal Generator SG–15/PCM, using, receiving circuit, alternate alinement	110	64
Simultaneous telegraph-telephone service system application	8	5
Siting	18	14
Space:		
Doubler circuit, functioning	73	36
Tuned circuit, functioning	73	36
Speech plus half-duplex:		
Dropping circuits at intermediate points	90	51
Filter F–98/U	9*c*	8
System application	9	6
Use of—		
4-wire facility	9*b*	6
Switchboard loop circuit	9*c*	8
Trunk circuit	9*d*	8
2-wire facility	9*a*	6
Starting procedure	29	21
Static ringing generator circuit, functioning	82	45
Step-by-step instructions for uncrating and unpacking export equipment	19*b*	14
Stopping procedure	30	21
Suppression circuit	48*b*(1), 63	29, 34
Carrier leakage test	114*b*	65
Suppression filter	82	45
Switching circuit electrical	75	40
Switch:		
2W—4W	28*b*	20
4W—2W—TEL	27*b*, 81*b*(1)	19, 42
HI—LO	28*c*	20
RING	27*c*	19
SEND—REC—NORM	27*a*, 68*g*	19, 35
S1, use	81*c*	43
S2, use	81*b*(1)	42
S3, use	81*b*(4)	43
TP—TG	28*a*	20
Switch ring	27*c*	19
Switched systems	4*c*	2
System application	7	4
Alternate telegraph-telephone service	7	4
Simultaneous telegraph-telephone service	8	5
Speech plus half-duplex	9	6
Telegraph only service	6	2
Telegraph-Telephone Terminal AN/TCC–14	5	2
System sectionalization:		
Checking Telegraph-Telephone Signal Converter TA–182/U	43*c*	25
Checking Telegraph Terminal TH–5/TG	43*b*	24
General	43*a*	24
Table of components	12	10
Technical characteristics:		
Electrical Filter Assembly F–98/U	10*b*	10
Telegraph-Telephone Terminal AN/TCC–14	10	9
Telegraph Terminal TH–5/TG	10*a*	9

	Paragraphs	Page
Telegraph only service, system application:		
Use on—		
Carrier telegraph system	6c	3
Common battery switchboard	6b	2
Local battery switchboard	6a	2
Trunks passing 20-cps ringing signal	6c	3
Push-to-talk radio	6e	3
Telegraph-telephone service:		
Alternate	7	4
Simultaneous	8	5
Telegraph-Telephone Signal Converter TA–182/U:		
Controls	24	18
Checking	43c	25
Checklist, equipment performance	45b	26
Connections	21	15
Description	14	11
Equipment performance checklist	45b	26
Running spares	16b	13
Switch TP—TG, use	28a	20
Use on trunks not passing 20-cps ringing signals	6d	3
Telegraph-Telephone Terminal AN/TCC–14:		
Connections	21	15
Installation	20	15
Lubrication	38	23
Packaging data	11	10
Running spares	16	12
Siting	18	14
Use on carrier telegraph system	6c	3
Telegraph Terminal TH–5/TG:		
Alinement	102	59
Binding post connections	81b	42
Checking	43b	24
Connections for various types of operations	21	15
Controls	23	18
Description	13	10
Equipment performance checklist	45a	25
Location of resistors and capacitors on terminal board	96	54
Major circuits, general functioning	48a	28
Power supply circuit, general functioning	48a(3)	29
Receiving circuit, general functioning	48a(2)	29
RING switch, use	27c	19
SEND and REC jacks, use	27d	19
Switch 4W—2W—TEL, use	27b	19
Technical characteristics	10a	9
Test equipment required for alinement	102	59
Theory, general	48	28
Transmitting circuit, general functioning	7	4
Test equipment:		
Alinement of Telegraph Terminal TH–5/TG	102	59
Equipment used	85	50
Final testing	112	64
Trouble shooting	92	51
Tests:		
Carrier leakage	114b	65
Circuit:		
Input	115	66
Output	116	66
Output level, transmitting	114c	65
Power supply	113	64
Receiving	115	66
Ringing	116	66

	Paragraphs	Pages
Tests—Continued		
Current—Continued		
Threshold	115*a*	66
Time-delay	114*e*	65
Transmitting	114*a*	64
Final, general	112	64
Operational	117	66
Oscillator frequency	114*c*	65
Theory, Filter F–98/U	83	47
Threshold circuit:		
Buffer stage V2(B), functioning	76	41
Description	75	40
General functioning	48*b*(2)	29
Receiver gate stage V7(B), functioning	79	42
Rectifier doubler stage V6, functioning	72	36
Trigger stage V7(A), functioning	78	41
Time-delay circuit:		
General functioning	48*b*(5)	29
Sequence of operation	62	32
Stage V10(A & B):		
Marking interval	51	31
Spacing interval	57, 58	32
Tests	114*e*	65
Tools, materials, and test equipment	85	50
Transformer T6, use	80	42
Transmit gate stage V8(B), functioning	67	35
Transmitting circuit:		
Alinement, general	103	59
D-c amplifier V12(A):		
Marking interval	50	30
Spacing interval	56	31
Description	49	30
Miller effect	54	31
Modulator stage V9(B):		
Marking interval	53	31
Spacing interval	59	32
Oscillator stage V9(A):		
Marking interval	54	31
Spacing interval	60	32
Output:		
Amplifier stage V8(A):		
Mark-to-space transition	61	32
Marking interval	55	31
Level test	114*d*	65
Time-delay stage V10 (A & B):		
Marking interval	51	31
Spacing interval	51–58	31–32
Trigger stage V7(A), functioning	78	41
Trouble shooting at field maintenance level:		
Charts	95	52
Data	91	51
D-c resistance of transformers and coils	97	57
General precautions	93	51
Operational test	94	51
Test equipment required	92	51
Procedures	90	51
Voltage and resistance charts	98	57
2-wire line, connections	21*a*	16
Uncrating, unpacking, and checking new equipment	19	14
Unpacking domestic packing cases	19*c*	15
Use	3	1

	Paragraphs	Page
Vehicular installation	46	27
Vibrator, static ringing generator operation	82*b*	46
Visual inspection, trouble shooting	42	24
Voice frequency, hybrid connections	21*b*	17
Voice Frequency Hybrid TA–31/U, use	9*b*	6
Voltage and resistance charts	98	57
Weatherproofing, maintenance:		
Desert	39*d*	24
General	39*a*	24
Tropical	39*b*	24
Winter	39*c*	24

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