DEPARTMENT OF THE ARMY TECHNICAL MANUAL

TM 11-5805-246-35

DEPARTMENT OF THE AIR FORCE TECHNICAL ORDER

TO 31W4-2TG-162

FIELD AND DEPOT MAINTENANCE MANUAL

TERMINAL, TELEGRAPH TH-5/TG

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

DEPARTMENTS OF THE **ARMY** *AND THE AIR FORCE*

17 AUGUST 1961

WARNING

HIGH VOLTAGE

is used
in this equipment.

DEATH ON CONTACT

may result if safety precautions
are not observed.

Be careful not to contact high-voltage connections or any power connections when using this equipment. Turn off the power and discharge high-voltage capacitors C46A, C46B, and C46C before making connections or doing any work inside this equipment. Dangerous voltages exist in the following places:

Input circuit	115-vo1ts, 50 to 60 cps
Power supply circuits:	
Power transformer T6	560 volts, 50 to 60 cps
Output voltage	285 volts dc.

DON'T TAKE CHANCES!

DS, GS, and Depot Maintenance Manual

TERMINAL, TELEGRAPH TH-5/TG

CHANGE
No. 1

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., *15 October 1964*

TM 11-5805-246-35, 17 August 1961, is changed as follows:

Page 2, paragraph 1. Make the following changes:

Delete subparagraph *c* and substitute:

c. Forward comments concerning this manual to the Commanding General, U. S. Army Electronics Command, ATTN: AMSEL-MR-MCA, Fort Monmouth, N.J. 07703.

Note. For applicable forms and records, refer to paragraph 2 of TM 11-5805-246-10.

After paragraph 1 add paragraph 1.1.

1.1 Index of Equipment Publications

Refer to the latest issue of DA Pam 310-4 to determine whether there are any new editions, changes, or additional publications pertaining to this publication. DA Pam 310-4 is an index of current technical manuals, technical bulletins, supply manuals, supply bulletins, lubrication orders, and modification work orders that are available through publications supply channels. The index lists the individual parts. (–10, –20, -35P, etc.) and the latest changes to and revisions of each equipment publication.

Page 14, paragraph 26b. Make the following changes:

In the places indicated below, change ((5) below) to ((6) below).

Subparagraph (1), line 3 from end of subparagraph.

Subparagraphs (2) and (3), line 3 from end of subparagraph.

Subparagraph (4), lines 5 and 10 from top of page.

Subparagraphs (1) through (4), last line, change ((6) below) to ((5) below).

Subparagraph (4), line 3 from top of page. Change ((4) below) to ((5) below).

Page 15, paragraph 30, chart, "Manual" column. Opposite Tool Equipment TE-123 add SM 11-4-5180-S07.

Page 16, paragraph 31a (1), last line. Change TM 11-5805-2460-10 to TM 11-5805-246-10.

Page 22, paragraph 35a, note 1, line 6. Change Milliammeter to TS-352 (*)/U.

Page 23, paragraph 37, chart. Make the following changes:

"Tools, test equipment, or material" column, line 2. After ME-22/PCM add (part of Test Set TS-140/PCM).

"Manual" column opposite Tool Equipment TE-123, add SM 11-4-5180-S07.

Page 29, paragraph 40. Delete paragraph 40 and substitute:

40. Tools and Test Equipment Required.

Tools and test equipment	Technical manual
Tool Equipment TE-123	SM 11-4-5180-S07
Frequency Meter AN/TSM-16 or equal.	TM 11-6625-218-12
Impedance Bridge AN/URM-90 or equal.	
Multimeter TS-352(*)/U	TM 11-5527
Test Set I-193-A or equal	TM 11-2513
Rectifier RA-87-A or equal	TM 11-5815-270-15
Distortion Test Set TS-383/GG or equal.	TM 11-2217
Laboratory Standards AN/URM-2	SM 11-4-6625-T01

Paragraph 42b (6). Make the following changes:

Line 5. Change TM 11-5805-246-35 to SM 11-4-6625-T01.

Note, line 2. Change TS-460/U to AN/URM-90.

Page 30, paragraph 43. Make the following changes:

Subparagraph a(2) and (3), line 2, change RA-43-B to RA-87-A.

Paragraph 44a (2) and (4), line 2, change RA-43-B to RA-87-A.

Page 31, paragraph 44b (5). Make the following changes:

Line 5. Change TM 11-5805-246-35 to SM 11-4-6625-T01.

Note. Change TS-460/U to AN/URM-90.

Page 32, paragraph 46. Delete subparagraph *a* and substitute:

a. Test Equipment,

Nomenclature	Federal stock No.	Technical manual
Test Set TS-140/PCM.[a]	6625-243-4888	TM 11-2096
Multimeter TS-352(*)/U.[b]	6625-242-5023	TM 11-5527
Frequency Meter AN/TSM-16.	6625-542-1666	TM 11-6625-218-12
Multimeter ME-26B/U.	6625-542-6407	TM 11-6625-200-12
Distortion Test Set TS-383(*)/GG.[c]	6625-222-1714	TM 11-2217
Test Set I-193-(*).[d]	6625-229-1045	TM 11-2513
Attenuator TS-402(*)/U.[e]	5905-230-5149	TM 11-2044
Light Assembly, Electric MX-1292/PAQ.	6695–537-4470	TM 11-5540
Teletypewriter Set AN/PGC-1.[f]		TM 11-5815-206-12
Telephone Set TA-312/PT.	5805-543-0012	TM 11-2155
Rectifier RA-87-A.	6130-230-7257	TM 11-5815-270-15
Line Unit BE-77-(*).[&]	5805-162-6302	TM 11-359

[a]Test Set TS-140/PCM includes Decibel Meter ME-22/PCM or ME-22A/PCM and Signal Generator SG-15/PCM or SG-15A/PCM.
[b]Indicates Multimeter TS-352/U, TS–352A/U, or TS-352B/U.
[c]Indicates Distortion• Test Set TS-383/GG, TS-383A/GG, or TS-383B/GG.
[d]Indicates Test Set I-193-A, I–193-B, or I-193-C.
[e]Indicates Attenuator TS-402/U or TS-402A/U.
[f]Teletypewriter Set AN/PGC-1 includes Teletypewriter TT-4(*)/TG.
[&]Indicates Line Unit BE-77-A, BE-77-B, or BE-77-C.

Paragraph *47a*, line 4. Change RA-43-(*) to RA-87-A.

Page 34, figure 9. Delete figure 9 and substitute new figure 9.

Page 35, paragraph 50. Make the following changes:

Delete subparagraphs *a* and *b* and substitute:

a. Test Equipment and Materials.

(1) Multimeter ME-26B/U.
(2) Frequency Meter AN/TSM-16.
(3) Rectifier RA-87–A.
(4) Test Set I-193-A.
(5) Resistor, 600 ohms.
(6) Patch cords (para. 47b).
(7) Test Lead Set CX-1331A/U (part of Multimeter TS-352B/U).
(8) Line Unit BE-77-A.

b. Test Connections and Conditions. Connect the TH–5/TG to the test equipment as shown by the solid lines in figure 9. Connect the power cords of the TH–5/TG, AN/TSM-16, RA-87-A, and the ME-26B/U to the 115-volt ac 60-cps power source.

Delete subparagraph *c*.

Subparagraph *d*, chart. Make the following changes:

Change subparagraph heading *"d. Procedure"* to: *c. Procedure.*

"Test equipment control settings" column. Delete lines 1 through 19 and substitute:

AN/TSM-16:
FUNCTION: FREQ. COUNT
MULTIPLY FREQUENCY BY: .1
POWER-OFF-STANDBY: POWER

ME-26/U:
FUNCTION: AC
RANGE: 3V

In the following places, delete TS-505A/U and substitute ME–26B/U.

Step 1, "Test procedure" column, subparagraph *a*.

Subparagraph *c*, last line.

Step 2, "Test procedure" column, subparagraph *b*.

Subparagraph *c*, line 3.

Step 1, "Performance standard" column, subparagraph *c*, line 1.

In the following places, delete FR-67/U and substitute AN/TSM–16.

Step 1, "Test procedure" column, subparagraph *c*, line 2.

Subparagraph *e*, line 1.

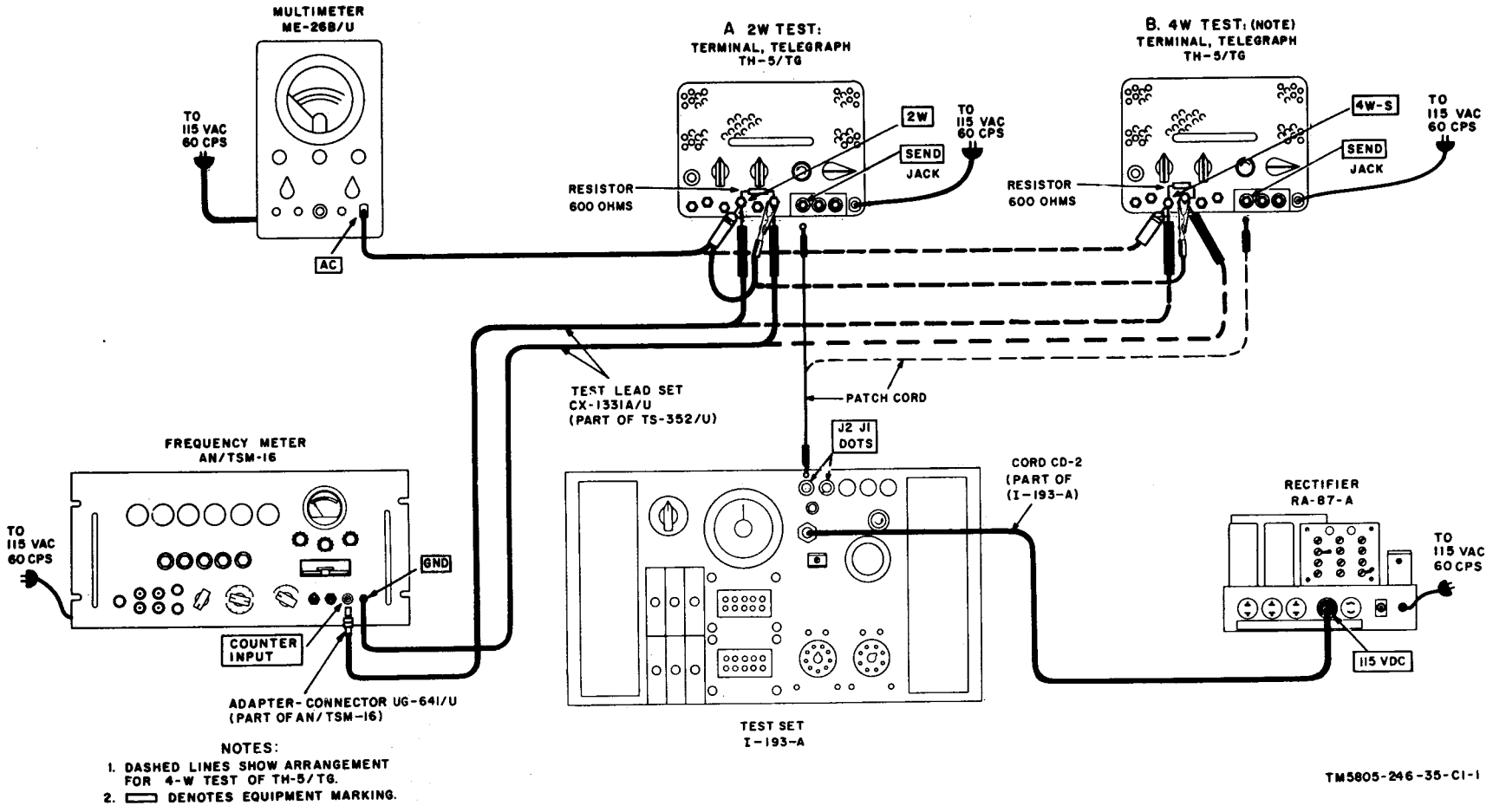

Figure 9. Test setup of sending circuit tests.

Page 47. Delete the appendix and substitute:

APPENDIX

REFERENCES

The following is a list of applicable references which are available to the field and depot maintenance personnel of Terminal, Telegraph TH-5/TG.

AR 320-5	Dictionary of United States Army Terms
AR 320-50	Authorized Abbreviations and Brevity Codes
AR 750-5	Organization, Policies, and Responsibilities for Maintenance Operation
DA Pam 108-1	Index of Army Motion Pictures, Film Strips, Slides, Tapes, and Phono-Recordings
DA Pam 310-4	Index of Technical Manuals, Technical Bulletins, Supply Manuals (Types 4, 6, 7, 8, and 9), Supply Bulletins, Lubrication Orders, and Modification Work Orders
DA Pam 310-21	Index of Supply Manuals; Signal, Types 1, 2, 3, and 10
FM 21-5	Military Training
FM 21-6	Techniques of Military Instruction
FM 21-30	Military Symbols
SM 11-4-5180-S07	Tool Equipment TE-123
SM 11-4-6625-T01	Laboratory Standards AN/URM-2, AN/URM-2A
TA 11-17	Signal Field Maintenance Shops
TA 11-100 (11-17)	Allowances for Signal Corps Expendable Supplies for Signal Field Maintenance Shops
TA 11-101 (11-158)	Allowances of Signal Corps Expendable Supplies for Signal Depot Company
TB SIG 222	Solder and Soldering
TM 11-359	Line Units BE-77, BE-77-A, BE-77-B, and BE-77-C
TM 11-2044	Attenuators TS-402/U and TS-402A/U
TM 11-2096	Test Set TS-140/PCM; Signal Generators SG-15/PCM and SG-15A/PCM; and Decibel Meters ME–22/PCM and ME-22A/PCM
TM 11-2155	Telephone Set TA-312/PT
TM 11-2217	Distortion Test Sets TS-383/GG, TS-383A/GG, and TS-383B/GG
TM 11-2513	Test Sets I-193A, I-193-B, and I-193-C
TM 11-5527	Multimeters TS-352/U, TS-352A/U, and TS-352B/U
TM 11-5540	Electric Light Assembly MX-1292/PAQ
TM 11-5805-246-10	Operators' Manual: Terminal, Telegraph TH-5/TG
TM 11-5805-246-20	Organizational Maintenance Manual: Terminal, Telegraph TH-5/TG
TM 11-5805-246-20P	Organizational Maintenance Repair Parts and Special Tool Lists: Terminal, Telegraph TH-5/TG and TH-5A/TG
TM 11-5805-246-35P	Field and Depot Maintenance Repair Parts and Special Tool Lists: Terminal, Telegraph TH-5/TG and TH-5A/TG
TM 11-5805-250-35	Field and Depot Maintenance Manual: Terminals, Telegraph AN/TCC4 and AN/TCC-20
TM 11-5815-206-12	Operator and Organizational Maintenance Manual: Teletypewriter Set AN/PGC-1 and Teletypewriters TT-4A/TG, TT-4B/TG, TT-4C/TG, and TT-335/TG
TM 11-5815-270-15	Operator, Organizational, Field and Depot Maintenance Manual: Rectifiers RA-87 and RA-87A
TM 11-6625-200-12	Operator and Organizational Maintenance Manual: Multimeters ME-26A/U, ME-26B/U and ME-26C/U

TM 11-6625-203-12	Operator and Organizational Maintenance: Multimeter AN/URM-105, Including Multimeter ME-77/U
TM 11-6625-207-10	Operator's Manual: Teletypewriter Test Set TS-1060/GG, TS-1060A/GG, and TS-1060B/GG
TM 11-6625-218-12	Operation and Organizational Maintenance: Frequency Meter AN/TSM-16
TM 11-6625-274-12	Operator's and Organizational Maintenance Manual: Test Sets, Electron Tube TV-7/U, TV-7A/U, TV-7B/U, and TV-7D/U
TM 11-6625-302-12P	Operator and Organizational Maintenance Repair Parts and Special Tool Lists and Maintenance Allocation Chart: Test Sets TS–190/U and TS-190A/U
TM 11-6625-316-12	Operator and Organizational Maintenance Manual: Test Sets, Electron Tube TV-2/U, TV-2A/U, TV-2B/U, and TV-2C/U

By Order of the Secretary of the Army:

HAROLD K. JOHNSON,
General, United States Army,
Chief Of Staff.

Official:

J. C. LAMBERT,
Major General, United States Army,
The Adjutant General.

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  FTWOAD (8), LEAD (5), CHAD (3)
  SVAD, NAAD (5)
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USACDCCEA (Monmouth Ofc) (1)
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USACDCOA (1)
USACDCQMA (1)
USACDCTA (1)
USACDCADA (1)
USACDCARMA (1)
USACDCAVNA (1)
USACDCARTYA (1)
USACDCSWA (1)
USARSO Sig Agcy (1)
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USATC Armor (2)
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Chicago Proc Dist (1)
AMS (1)
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WSMR (5)

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USATCP (1)
USAERDL (2)
USA Cold Rgn RE Lab (2)
MAAG, China (5)
KMAG (5)
USA Elct RD Fld Sta #1 (5)
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11-500 (AA-AE) (4)
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11-597
11-608

NG: State AG (3); units-same as active Army except allowance is one copy to each unit.

USAR: None.

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

51. Receiving Circuit Tests

(fig 10)

a. Test Equipment and Materials.

(1) Distortion Test Set TS-383/GG.
(2) Multimeter TS-352B/U.
(3) Rectifier RA-87-A.
(4) Test Set I-193-A.
(5) Teletypewriter TT-4 (*)/TG (part of Teletypewriter Set AN/PGC-1).
(6) Power Cable Assembly CX-1202/U (part of Teletypewriter Set AN/PGC-1).
(7) Cable Assembly CX-1201/U (part of Teletypewriter Set AN/PGC-1).
(8) Patch cords (para. 47*b*).
(9) Line Unit BE-77-A.

b. Test Connections and Conditions. Perform adjustments of Distortion Test Set TS-383/GG as indicated in TM 11-2217 to assure proper position of the outer segmented ring in relation to the inner segmented ring so that no distortion exists. Connect the ac power cords of the TH-5/TG, RA-87-A, TS-383/U, and TT-4(*)/TG to the 115-volt ac 60-cps power source. After the ac power has been applied to the equipment, allow a 5-minute warmup period before performing the following procedures.

c. Procedure.

	Control settings		Test procedures	Performance standard
	Test equipment	Equipment under test		
	TS-352B/U: FUNCTION: DC CURRENT Range: 50 MA *TT-4(*)/TG:* MOTOR: ON *I-193-A:* K1: center position K2: center position K3: center position K4: center position K5: center position K6: DOTS HIGH *RA-87-A:* ON-OFF: ON	NORM-REC-SEND: NORM 4W-2W-TEL: 2W	*a.* (and record the TS-352B/U meter ation. *b.* Set the I-193-A K5 key to SEND DOTS. *c.* Observe and record the TS-352B/U meter indication. *d.* Turn off the TT-4(*)/TG. Disconnect the I-193-A and patch cord.	*a.* TS-352B/U meter indicates 20 ma ±2. *b.* None. *c.* TS-352B/U meter indicates one-half of the value recorded in *a* above. *d.* None.
2	*BE-77-A:* RELAY IN CIRCUIT-RELAY OUT OF CIRCUIT: RELAY OUT OF CIRCUIT LOCAL CURRENT SUPPLY-DISTANT CURRENT SUPPLY: LOCAL CURRENT SUPPLY *TT-4(*)/TG:* MOTOR: ON *TS-383/GG:* MOTOR: ON LINE-DIST: LINE VIEW-TRANSMIT: TRANSMIT MARK-ZERO-SPACE: ZERO DISTORTION: center RUN-STOP: RUN Code selecting switch: TEST MESSAGE STOP PULSE: ON INCREASE DISTORTION: Completely clockwise. *RA-87-A:* ON-OFF: ON	NORM-REC-SEND: NORM 4W-2W-TEL: 2W	*Note.* Before performing the following procedures, make certain that a strap is connected between terminals D2 and F2 on terminal board A inside the TH-5/TG (fig. 15). *a.* Connect the equipment as shown in B, figure 10. *b.* Adjust the current control on the BE-77-A. *c.* Make certain that the outer ring of the TS-383/GG is properly positioned for no distortion indication. *d.* Observe and record the TS-352B/U meter indication. *e.* Allow the TT-4(*)/TG to copy at least 10 lines of the test message. Check the copy for errors. *f.* Set the TH-5/TG 4W-2W-TEL switch to 4W. *g.* Allow the TT-4(*)/TG to copy at least 10 lines of the test message. Check the copy for errors. *h.* Remove Test Adapter U-144/U (part of TS-352B/U) from the REC jack on the TH-5/TG.	*a.* None. *b.* BE-77-A meter indicates 20 ma. *c.* None. *d.* TS-352B/U meter indicates 20 ma ±2. *e.* The TT-4(*)/TG copies at least 10 lines free of errors. *f.* None. *g.* Same as *e* above. *h.* None.
3	No changes required except: *TS-383/GG:* Code selecting switch: R	No changes required	*a.* Connect the signal cord of the TS-383/GG to the SEND jack of the TH-5/TG, and the stroboscope cord of the TS-383/GG to the REC jack of the TH-5/TG. *b.* Record the distortion percentage indicated on the TS-383/GG. *c.* Operate all power switches to OFF and remove all power cords from the ac outlets. Disconnect all equipment.	*a.* None. *b.* The TS-383/GG indicates a maximum of 3 percent distortion. *c.* None.

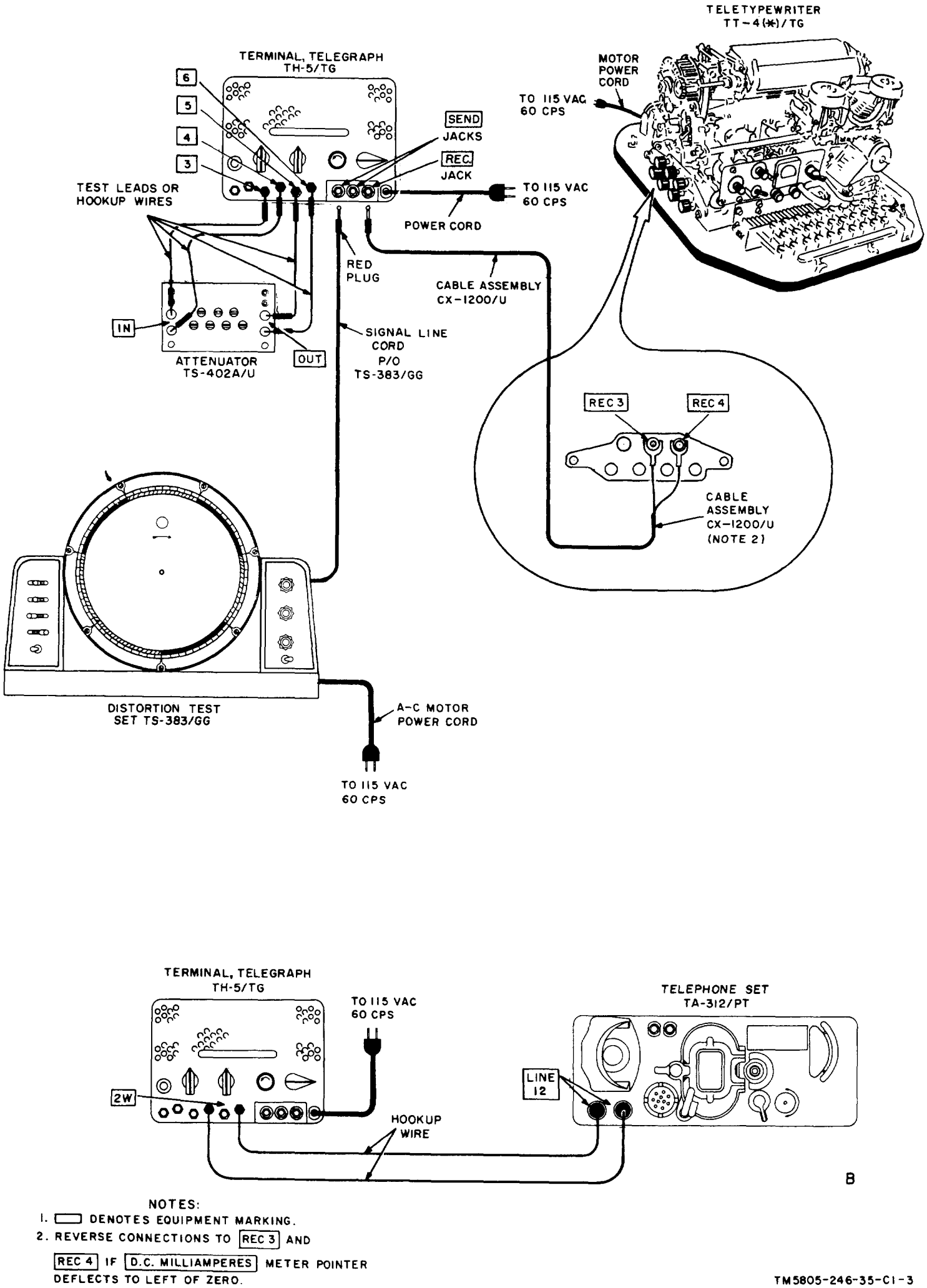

Figure 11. Test setup for sensitivity and operational tests.

52. Sensitivity and Operational Tests

(fig. 11)

a. Test Equipment and Materials.

(1) Attenuator TS–402A/U.
(2) Distortion Test Set TS–383/GG.
(3) Rectifier RA–87–A.
(4) Telephone Set TA–312/PT.
(5) Teletypewriter TT–4(*)/TG (part of Teletypewriter Set AN/PGC–1).
(6) Hookup wire No. 18 AWG (10 ft.).
(7) Line Unit BE–77–A.

b. Test Connections and Conditions. Perform adjustments of Distortion Test Set TS–383/GG as indicated in TM 11–2217 to assure proper position of the outer segmented ring in relation to the inner segmented ring so that no distortion exists. Connect the equipment as shown in A, figure 11. Connect the ac power cords of the TH–5/TG, TS–383/GG, RA–87–A, and TT–4(*)/TG to 115-volt ac 60-cps outlets. Make certain that the strap wire between terminals D2 and F2 on terminal board A inside the TH–5/TG is disconnected (fig. 15).

c. Procedure.

Control settings			Test procedures	Performance standard
Step No.	Test equipment	Equipment under test		
1	*TS–402A/U:* All keys aligned with the white line parallel to the long dimension of the panel (0 db). *TT–4(*)/TG:* MOTOR: ON *TS–383/GG:* MOTOR: OFF LINE-DIST: LINE VIEW-TRANSMIT: TRANSMIT MARK-ZERO-SPACE: ZERO DISTORTION: center RUN-STOP: RUN STOP PULSE: ON	NORM-REC-SEND: NORM 4W–2W–TEL: 4W	*a.* Set the TS–383/GG code selecting switch to TEST MESSAGE and the MOTOR switch to ON. *b.* Allow the TT–4(*)/TG to copy 10 lines of test message. Check the copy for errors. *c.* Turn the TS–402A/U 40-db and 5-db keys clockwise until the white line is aligned with the short dimension of the panel (45 db). *d.* Allow the TT–4(*)/TG to copy 10 lines of the test message. Chcek the copy for errors. *e.* Turn the TS–402A/U 5-db key to align the white line with the long dimension of the panel, and turn the 10-db key to align the white line with the short dimension of the panel (50 db). *f.* Observe the neon lamp on the TH–5/TG panel and the operation of the TT–4(*)/TG for 10 lines of copy. *g.* Turn the TS–402A/U 5-db key to align the white line with the short dimension of the panel, and the 10-db key to align the white line with the long dimension (45 db). *h.* Check the operation of the neon lamp on the front panel of the TH–5/TG. Check the TT–4(*)/TG copy for accuracy. *i.* Remove power from the equipment and disconnect test connections.	*a.* None. *b.* TT–4(*)/TG copies at least 10 lines of the test message without errors. *c.* None. *d.* Same as *b* above. *e.* None. *f.* The TH–5/TG neon lamp glows steadily and the TT–4(*)/TG does not receive copy. *g.* None. *h.* The TH–5/TG neon lamp does not light and the TT–4(*)/TG again receives correct copy. *i.* None.
2	*TA–312/PT:* CB-LB-CBS: LB EXT-INT: INT Buzzer volume control: Mid-position.	NORM-REC-SEND: NORM 4W-2W-TEL: 2W	*a.* Connect the equipment as shown in B, figure 11. Place the TA–312/PT handset firmly in its bracket. *b.* Operate the RING switch on the TH–5/TG and listen for the TA–312/PT to ring. *c.* Turn the handcrank generator on the TA–312/PT at a normal rate (approx. 50 rpm). Listen for the TH–5/TG buzzer to sound. Observe the neon lamp on the TH–5/TG panel. *d.* Remove power from the equipment and disconnect the test connections. *e.* Replace the jumper wire between terminal D2 and F2 on terminal board A on the TH–5/TG (*b* above).	*a.* None. *b.* The TA–312/PT rings as long as the RING switch is operated. *c.* The TH–5/TG buzzer sounds and the neon lamp is lighted when the crank is turned. *d.* None. *e.* None.

Technical Manual No. 11-5805-246-35
Technical Order No. 31W4-2TG-162

DEPARTMENT OF THE ARMY
AND THE AIR FORCE

WASHINGTON 25, D. C., *17 August 1961*

TERMINAL, TELEGRAPH TH-5/TG

*This manual, together with TM 11-5805-246-10, 20 June 1960, and TM 11-5805-246-20, 20 June 1960, supersedes so much of TM 11-2239/TO 16-30TCC-14-5, 4 April 1952, including C1, 13 May 1954, and C3, 14 April 1960. as is applicable to Terminal. Telegraph TH-5/TG.

CHAPTER 1
INTRODUCTION

1. Scope

a. This manual covers field and depot maintenance for Terminal, Telegraph TH-5/TG. It includes theory and instructions appropriate to third, fourth, and fifth echelons for troubleshooting, testing, calibration and repairing the equipment, replacing maintenance parts, and repairing specified maintenance parts.

b. The complete technical manual for this equipment includes TM 11-5805-246-10, TM 11-5805-246-20, TM 11-5805-246-20P. and TM 11-5805-246-35P.

c. Forward comments concerning this manual to the Commanding Officer, U. S. Army Signal Materiel Support Agency, ATTN: SIGMS-PA2d, Fort Monmouth, N.J.

Note. For applicable forms and records, see paragraph 2, TM 11-5805-246-10.

2. Internal Differences in Equipment
(fig. 14 and 15)

a. In equipment bearing Orders No. 19650-P-50, 3291-P-52, and 6438-P-51 (serial numbers 736 through 1105 and 1274 through 3035), resistor R86 is not provided.

b. In equipment bearing Orders No. 19650-P-50, 6438-P-51, 3005-P-51, 3289-P-52, and 3291-P-52, resistor R85 is 2.2 megohms and resistor R83 is 36K ohms.

c. In some equipments, an 11K-ohm resistor (arbitrarily designated as resistor R87) is installed in the cathode circuit of tube V7A (para 30).

CHAPTER 2
THEORY

Section I. SENDING CIRCUIT

3. General
(fig. 14)

The sending circuit converts neutral, direct current (dc), mark and space teletypewriter signals into voice-frequency (vf) frequency-shift teletypewriter signals. The teletypewriter equipment mark and space pulses are formed by closing and opening the loop circuit connected to SEND jacks J2 or J3. The mark and space pulses are amplified by dc amplifier V12A, delayed by space time delay V10B and mark time delay V10A, and applied to modulator V9B. Vf signals (1,325 cycles-per-second (cps) for mark and 1,225 cps for space) are generated in oscillator V9A, amplified in output amplifier V8A, and applied to the line binding posts. When the 4W-2W-TEL switch S2 is in 2W position, the vf signals are applied to the 2W binding posts for transmission to the distant TH-5/TG and to transformer T1 in the receiving circuit for monitoring teletypewriter transmission. When switch S2 is in 4W position, the vf signals are applied to the 4W-S binding posts for transmission to the distant TH-5/TG.

4. Dc Amplifier V12A

The sending loop circuit of the teletypewriter equipment is connected to either SEND jack J2 or J3 (fig. 14) and is opened or closed by the teletypewriter equipment. For a space pulse, the loop circuit is open; for a mark pulse or an idle pulse, the loop circuit is closed. When the loop circuit is closed, the positive output voltage of rectifier V13 is applied across grid resistor R67 and through grid-current limiting resistor R66 to the grid (pin 7) of dc amplifier V12A (A, fig. 1; T0 to T1, T3, to T5, T7 to T9, and T11 to T13). Dc amplifier V12A conducts and the plate voltage decreases (B, fig. 1; T0 to Tl, T3 to T5, T7 to T9, and T11 to T13). Note that the plate voltage decreases rapidly on transitions from space to mark because of capacitors C42 and C43 (fig. 14) discharging through resistor R64 and dc amplifier V12A (B, fig. 1; T3, T7, and T11). When the loop circuit is open, no voltage is applied to the grid of dc amplifier V12A (A, fig. 1; T1 to T3, T5 to T7, and T9 to T11). Dc amplifier V12A cuts off and the plate voltage increases (B, fig. 1; T1 to T3, T5 to T7, and T9 to T11). Note that the plate voltage increases slowly because of the charging of capacitors C42 and C43 through resistor R63 (fig. 14). Resistor R63 is the plate load resistor. Resistors R64 and R65 form a voltage divider network which establishes cathode bias for dc amplifier V12A. Capacitors C42 and C43 and resistor R63 make up a time delay (approximately 5 milliseconds (ms)) network for the space pulses.

5. Space Time Delay V10B

The voltage developed across capacitors C42 and C43 (para 4 and fig. 14) is applied through grid-current limiting resistor R62 to the grid (pin 7) of space time delay V10B. During the mark pulse, the grid voltage of space time delay V10B is very low (B, fig. 1; T0 to T1, T3 to T5, T7 to T9, and T11 to T13). Space time delay V10B is cut off and the plate voltage increases (C, fig. 1; T0 to T2, T3 to T5, T7 to T10, and T11 to T13). During a space pulse, the voltage applied to the grid of space time delay V10B is increasing (B, fig. 1, T1 to T3, T5 to T7, and T9 to T11). When the amplitude of the voltage is sufficient (B, fig. 1; T2, T6, and T10) for space time delay V10B to conduct, the plate voltage for space time delay V10B decreases rapidly (C, fig. 1; T2 to T3, T6 to T7, and T10 to T11) because of the discharging of

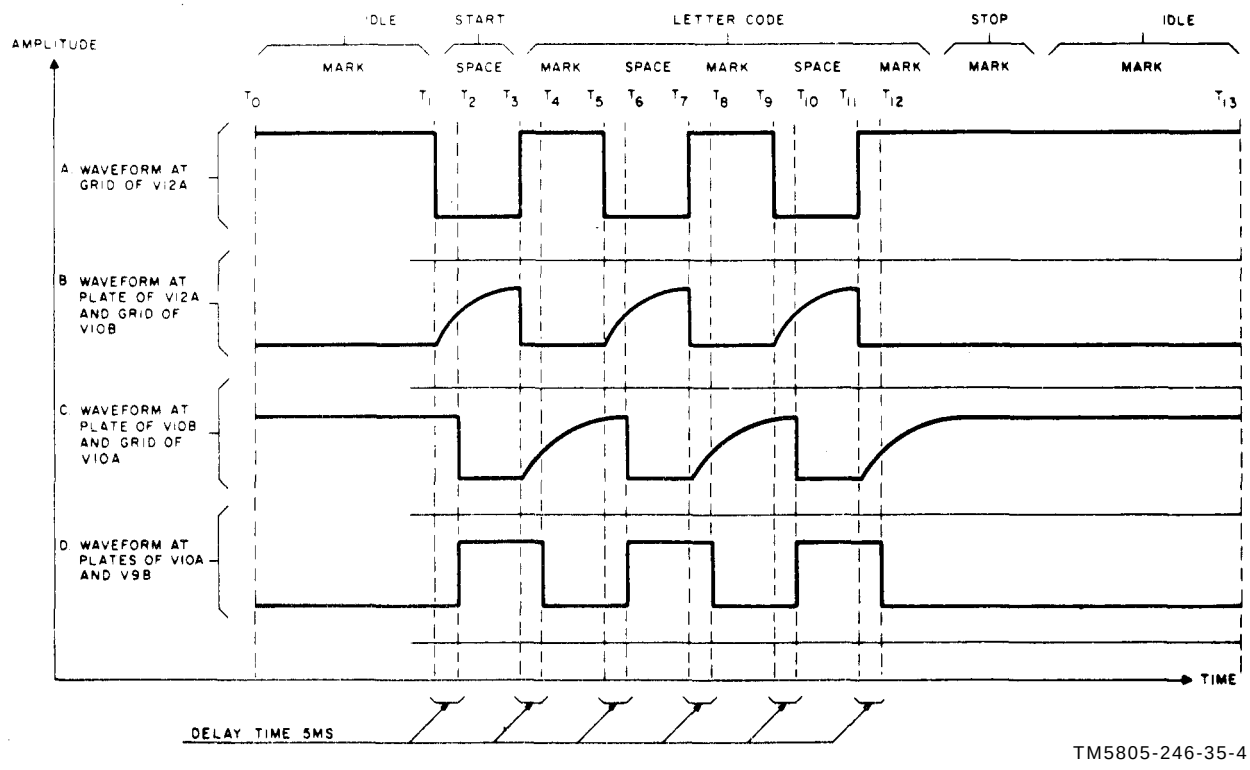

Figure 1. Signal waveforms showing operation of tubes V12A, V10B, V10A, and V9B.

capacitors C40 and C41 (fig. 14) through cathode resistors R59 and R60 and space time delay V10B. Resistor R58 is the plate load resistor. Resistors R59, R60, and R61 form a voltage divider network to establish cathode bias. Variable resistor R60 changes the cathode bias of space time delay V10B. It is adjusted to the point where the time delay period for space signals equals the time delay period for mark signals (mark time delay V10A). Capacitors C40 and C41 and resistor R58 make up a time delay network (approximately 5 ms) for the mark pulses.

6. Mark Time Delay V10A

The voltage developed across capacitors C40 and C41 (para 5 and fig. 14) is applied through grid-current limiting resistor R57 to the grid (pin 2) of mark time delay V10A. During the transition from a space to a mark signal, the voltage applied to the grid of mark time delay V10A is increasing (C; fig. 1, T3 to T6, T7 to T10, and Tll to T13). When the amplitude of the voltage is sufficient (C, fig. 1; T4, T8, and T12), the plate voltage decreases rapidly (D, fig. 1; T4 to T6, T8 to T10, and T12 to T13). During a space signal, the grid voltage of mark time delay V10A (fig. 14) is very low (C, fig. 1, T2 to T3, T6 to T7, and T10 to T11). Mark time delay V10A is cut off and the plate voltage is maximum (D, fig. 1, T2 to T4, T6 to T8, and T10 to T12). Resistor R54 (fig. 14) is the plate load resistor. Capacitor C39 is a waveshaping capacitor. Resistors R55 and R56 make up a voltage divider network to establish cathode bias.

7. Modulator V9B

Modulator V9B (fig. 14) determines whether oscillator V9A (para 8) generates a mark vf signal or a space vf signal. During a mark signal, the plate voltage of mark time delay V10A (para 6) is minimum and modulator V9B is cut off. During a space signal, the plate voltage of mark time delay V10A (para 6) is maximum and modulator

V9B is conducting. Resistor R53 couples the plate voltage of mark time delay V10A to modulator V9B. Resistors R51 and R52 make up a voltage divider to establish cathode bias. Capacitor C38 is the cathode bypass capacitor.

8. Oscillator V9A

Oscillator V9A (fig. 14) generates a mark signal (1,325 cps) when modulator V9B is cut off (para 7), and a space signal (1,225 cps) when modulator V9B is conducting (para 7). During a mark signal, the tuned circuit for oscillator V9A consists of capacitors C32 through C35 and transformer T5. During a space signal, capacitors C36 and C37 are effectively connected in parallel with the tuned circuit to lower the frequency. Capacitor C31 and resistor R50 provide regenerative feedback. The vf signals developed across plate load resistor R48 are applied through coupling capacitor C29 to output amplifier V8A (para 9). Resistor R49 is the cathode resistor. Capacitor C47B and resistor R47 make up a plate decoupling network. Capacitors C30A and C30B provide fine tuning adjustment and reduce the Miller effect.

9. Output Amplifier V8A

a. Vf signals from oscillator V9A (para 8) (fig. 14) are applied through signal limiting resistors R43 and R86 and grid resistors R44 and R45 to the grid (pin 2) of output amplifier V8A. When output amplifier conducts (c below), the vf signals are amplified by output amplifier V8A and applied through plate load transformer T4 to the output circuits (para 10). Capacitor C27 with winding 3 and4 of transformer T4 form a tuned circuit to approximately 1,275 cps. Resistor R42 is a swamping resistor. Resistors R46 and R45 form a voltage divider network to establish bias for the grid.

b. The normal level of the output vf signal is 0 dbm ±2 (decibels (db) referred to 1 milliwatt in 600 ohms). To provide an adjustment of the output signal level, resistor R86 is provided in some equipments (para 2). With the resistor in the circuit, the output signal level is reduced 4 db; with the resistor strapped (shunted with a wire), the output signal level is increased 4 db.

c. Cathode resistor R69 and bypass capacitor C44 are common to output amplifier V8A and transmit gate V8B. When transmit gate V8B conducts (para 14 *a* (1) and *b*, output amplifier V8A is cut off, preventing the vf signal from oscillator V9A from being applied to the output circuits (para 10). When transmit gate V8B is cut off (para 14a(2) and *c)*, output amplifier V8A conducts and the output of oscillator V9A is applied through output amplifier V8A to the output circuits (para 10).

10. Output Circuits for Sending Circuit (fig. 14)

When output amplifier V8A conducts (para 9c), the vf signals developed across transformer T4 are applied to the circuits described in *a* and *b* below, depending on the position of 4W-2W-TEL switch S2.

a. Switch S2 in 4W.

(1) *Output to line.* The vf signals are applied from terminal 2 of transformer T4 through low-frequency (20 cps) blocking capacitor C5, impedance matching resistor R5, contacts 5 and 6 of segment Y on the rear of switch S2A to the 4W-S binding post E3. The vf signals are applied from terminal 1 of transformer T4 through impedance matching resistor R4 and contacts 1 and 2 of segment X on the front of switch S2A to the 4W-S binding post E4. Capacitor C5 and resistor R6 are connected in parallel with winding 1 and 2 of transformer T4 through contacts 6 and 5 of segment Y on the rear of switch S2B to provide the same impedance to transformer T4 as when the transformer is connected to transformer T1 *(b* (2) below) for two-wire operation.

(2) *Output to receiving circuit.* The vf signals are applied from terminal 4 of transformer T4 through signal limiting resistor R41 coupling capacitor C28, the home copy strap,

contacts 9 and 10 of segment Z on the rear of switch S2B to grid resistor R12. The signals developed across resistor R12 are applied to limiter-amplifier V1B (para 17 *b);* thus, home copy is provided for the teletypewriter equipment connected to the REC jack J1.

Note. When switch S2 is operated to TEL, the transmitted signal is applied through the same components as described in (2) above.

b. Switch S2 in 2W.

(1) *Output to line.* The vf signals are applied from terminal 2 of transformer T4 through capacitor C5, contacts 6 and 4 of segment Y on the rear of switch S2B, impedance matching resistor R2 and contacts 8 and 9 of segment Z on the rear of switch S2A to 2W binding post E6. The vf signals are applied through impedance matching resistor R4 and contacts 1 and 2 of segment X on the front of switch S2A to the 2W binding post E4.

(2) *Output to receiving circuit.* The vf signals are applied from terminal 2 of transformer T4 through capacitor C5 and contacts 6 and 4 of segment Y on the rear of switch S2B to terminal 2 of transformer T1; and from terminal 1 of transformer T4 through contacts 12 and 2 of segment X on the rear of switch S2B and capacitor C1 to terminal 1 of transformer T1. With transformer T1 in connected in parallel with transformer T4, the vf signals from the sending circuit are applied to the receiving circuit (para 16 *b);* thus, home copy is provided for the teletypewriter equipment connected to REC jack J1.

(3) *Common battery circuit.* When a common battery telephone line circuit is used for teletypewriter communication, a strap is connected between terminals D1 and F1 on terminal board A (fig. 13). The path of the vf teletypewriter signals is described in (1) and (2) above and paragraph 16 *b* (1). The dc component of the common battery line circuit is from 2W binding post E4 (fig. 14) through contacts 2 and 4 of segment X on the front of switch S2A, segment Y of switch S3 (through the common battery strap and contacts 5 and 4 when the switch is in NORM; and through contacts 6 and 5 when the switch is in SEND), coil L1, and contacts 1 and 2 of segment W of switch S1 to 2W binding post E6. Coil L1 is a holding coil for the common battery telephone equipment.

Section II. CARRIER SUPPRESSION CIRCUIT

11. General

a. The teletypewriter signals applied to dc amplifier V12A (para 4) of the sending circuit is also applied to a time delay network which consists of resistor R85 and capacitor C45 (fig. 14). The time delay network activates the carrier suppression circuit approximately 3 seconds after an idle signal is received. When successive mark and space signals are applied to the time delay network, restorer V12B does not allow the time delay network to activate the carrier suppression circuit. When the carrier suppression circuit is activated, a signal is applied through dc amplifier V11B, dc amplifier V11A, and transmit gate V8B to cut off output amplifier V8A. When the carrier suppression circuit is not activated, no signal is applied through dc amplifier V11B, dc amplifier V11A, and transmit gate V8B; and the carrier suppression circuit has no effect on output amplifier V8A.

b. When the teletypewriter equipment is not generating successive mark and space pulses, the loop circuit is closed (idle condition) and the sending circuit oscillator V9A (para 8) (fig. 14) generates a constant mark vf signal. The carrier suppression

circuit disables the sending circuit output (para 9 *c)* approximately 3 seconds after the idle condition exists. This prevents transmission of a constant mark vf signal to the distant TH-5/TG. The waveform of a typical teletypewriter signal character applied to the sending circuit is illustrated in A, figure 2. The vf signal generated by the oscillator V9A (fig. 14) in the sending circuits is illustrated in B, figure 2. Note that the oscillator generates two distinct vf frequencies: one for a mark pulse and one for a space pulse. A comparison of the waveforms illustrated in A and B of figure 2 indicates a 5-ms delay for oscillator V9A (fig. 14) to change frequencies, because of the space time delay V10B and mark time delay V10A circuits (para 5 and 6). The effect of the carrier suppression circuits on the vf signal applied to the line is illustrated in C, figure 2. Note that a vf signal is applied to the line whenever mark and space pulses are generated by the teletypewriter equipment (A, fig. 2). Three seconds after the loop circuit is in the idle condition, no vf signal is applied to the line (C, fig. 2).

12. Restorer V12B and Dc Amplifier V11B

a. When the carrier suppression is activated, dc amplifier V11B functions as follows: A voltage is developed across grid resistor R67 (fig. 14) and applied through time delay network which consists of resistor R85 and capacitor C45. The voltage developed across capacitor C45 is applied through grid-current limiting resistor R82 to the grid (pin 7) of dc amplifier V11B. Dc amplifier V11B conducts; the plate voltage decreases and is applied to dc amplifier V11A (para 13a). Resistors R84 and R83 form a voltage divider network to establish a fixed bias for the cathode. Resistor R81 is the plate load resistor.

b. When the carrier suppression circuit is not activated, restorer V8B and dc amplifier V11B function as follows.

(1) The first signal of a character applied to the SEND jacks J2 and J3 is a space signal (A, fig. 2). The loop circuit is open and no voltage is developed across resistor R67 (fig. 14). The voltage charge developed across capacitor C45 *(a* above) discharges quickly through resistor V67 and restorer V12B. Dc amplifier V11B cuts off; the plate voltage decreases and is applied to dc amplifier V11A (para 13 *b).*

(2) When a succession of mark and space signals (after the initial space signal ((1) above) are applied to the SEND jacks J2 and J3, capacitor C45 charges slightly during the mark signal *(a* above)

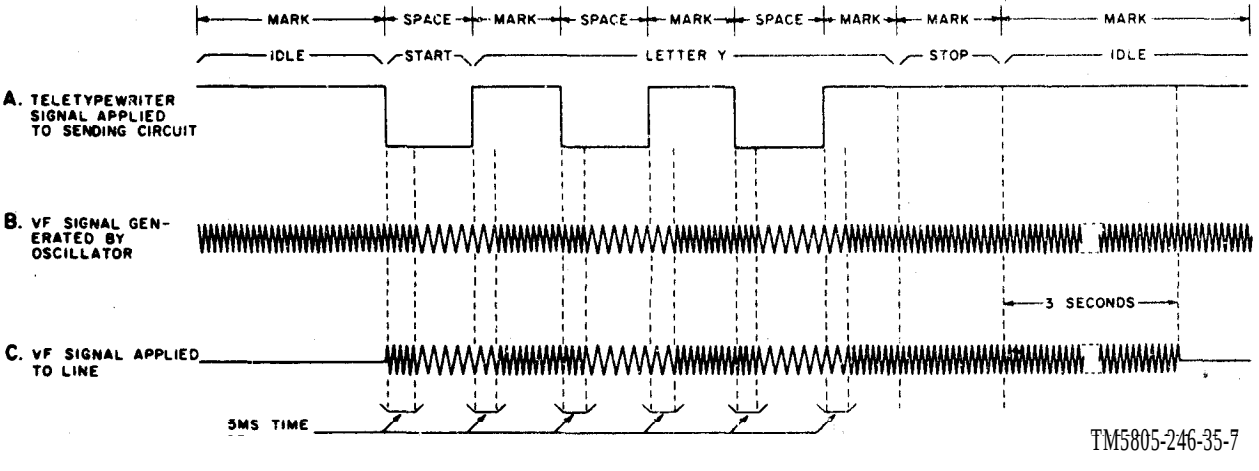

Figure 2. Waveform comparison for sending cticuits of teletypewriter input signal, vf signal generated by oscillator, and vf signal applied to line.

and quickly discharges for the space signal ((1) above). Thus, dc amplifier V11B is continually cut off; the plate voltage rises and is applied to dc amplifier V11A (para 13 *b).*

13. Dc Amplifier V11A

a. When the carrier suppression circuit is activated, dc amplifier V11A (fig. 14) functions as follows: The low plate voltage of dc amplifier V11B (para 12 *a)* is applied through signal limiting resistor R80, grid resistor R79, and grid-current limiting resistor R78 to the grid (pin 2) of dc amplifier V11A. Dc amplifier V11A is cut off; the plate voltage rises and is applied to transmit gate V8B when switch S3 is in NORM (para 14 *a* (1)). Resistors R81, R80, and R79 form a voltage divider network to establish a fixed bias for the grid. Resistors R77 and R76 form a voltage divider network to establish a fixed bias for the cathode. Resistor R75 is the plate load resistor.

b. When the carrier suppression circuit is not activated, dc amplifier V11A functions as follows: The high plate voltage of dc amplifier V11B (para 12 *b)* is applied through resistors R80, R79, and R78 to the grid of dc amplifier V11A, Dc amplifier V11A conducts: the plate voltage decreases and is applied to transmit gate V8B when switch S3 is in NORM (para 14 *a (2)).*

14. Transmit Gate V8B

a. Switch S3 in NORM.

(1) When the carrier suppression circuit is activated, the high plate voltage of dc amplifier V11A (fig. 14) (para 13a) is applied through contacts 8 and 11 of segment Z of switch S3 and grid-current limiting resistor R71 to the grid (pin 7) of transmit gate V8B. Transmit gate V8B conducts; the high voltage developed across cathode resistor R69 is applied to the cathode (pin 3) of output amplifier V8A. Output amplifier V8A is cut off and prevents the output of oscillator V9A from being applied to the output circuits (para 10). Resistors R75 and R74 form a voltage divider to establish a fixed bias for the grid.

(2) When the carrier suppression circuit is not activated, transmit gate V8B functions as follows. The low plate voltage of dc amplifier V11A (para 13b) is applied through contacts 8 and 11 of segment *Z* of switch S3 and resistor R71 to the grid of transmit gate V8B. Transmit V8B is cut off; the low voltage developed across resistor R69 is applied to the cathode of output amplifier V8A. Output amplifier V8A conducts and permits the output of oscillator V9A to be applied to the output circuits (para 10).

b. Switch S2 in REC. Resistors R72 and R73 form a voltage divider network to establish a fixed bias for the grid of transmit gate V8B. The voltage developed across resistor R73 is applied through contacts 9 and 11 of segment Z of switch S3 and resistor R71 to the grid of transmit gate V8B. Transmit gate V8B conducts; the high voltage developed across resistor R69 is applied to the cathode of output amplifier V8A. Output amplifier V8A is cut off and prevents the output of oscillator V9A from being applied to the output circuits (para 10).

C. Switch S3 in SEND. The grid of transmit gate V8B is connected to ground through resistor R71 and contacts 11 and 10 of segment Z of switch S3. Transmit gate V8B is cut off; the low voltage developed across resistor R69 is applied to the cathode of output amplifier V8A. Output amplifier V8A conducts and the output of oscillator V9A is applied to the output circuits (para 10).

Section III. RECEIVING CIRCUITS

15. General
(fig. 14)

The receiving circuits convert vf frequency-shift, teletypewriter signals into neutral, 20-ma dc, teletypewriter signals.

a. When 4W-2W-TEL switch S2 is in 2W, the vf signals are applied to transformer T1 from the 2W binding posts during reception from the distant TH-5/TG or from transformer T4 during transmission in the sending circuit. When switch S2 is in 4W, the vf signals are applied to transformer T1 from the 4W-R binding posts during reception from the distant TH-5/TG or, if the home copy strap is connected, from transformer T4 in the sending circuit to the grid of limiter-amplifier V1B.

b. Vf signals applied to transformer T1 are routed through limiter-amplifier V1A and limiter V2A to the mark and space discriminator and to buffer V2B in the threshold circuit (para 21). Mark signals are converted to dc signals in the mark discriminator and applied through detector double V3 to output amplifier V5 causing it to send a mark dc signal to REC jack J1. Space vf signals are converted to dc signals in the space discriminator and applied through detector doubler V4 to output amplifier V5, causing it to send a space dc signal to REC jack J1.

16. Input Circuits for Receiving Circuit
(fig. 14)

a. Switch S2 in 4W.

(1) *Input from line.* The vf teletypewriter signals are applied from 4W binding post E5 through contacts 10 and 11 of segment Y on the front of switch S2A, impedance matching resistor R1, and low-frequency (20-cps) blocking capacitor C1 to terminal 1 of transformer T1. The vf teletypewriter signals are applied from 4W binding post E6 through contacts 9 and 8 of segment Z on the rear of switch S2A, and impedance matching resistor R2 to terminal 2 of transformer T1. Capacitor C2 and resistor R3 are connected in parallel with winding 1 and 2 of transformer T1 through contacta 1 and 2 of segment X on the rear of switch S2B to provide the same impedance to transformer T1 as when the transformer is connected to transformer T4 *(b* (2) below) for two-wire operation.

(2) *Input from sending circuit.* The vf teletypewriter signals are applied from winding 3 and 4 of transformer T4 through signal limiting resistor R41, blocking capacitor C28, home copy strap, contacts 9 and 10 of segment Z on the rear of switch S2B, and grid resistor R12 to the grid (pin 7) of limiter amplifier V1B (para 17 *b).*

b. Switch S2 in 2W,

(1) *Input signal from line.* The vf teletypewriter signals are applied from 2W binding post E6 through contacts 8 and 9 of segment Z on the rear of switch S2A, and impedance matching resistor R2 to terminal 1 of transformer T1. The vf teletypewriter signals are applied from 2W binding post E4 through contacts 1 and 2 of segment X on the front of switch S2A, impedance matching resistor R4, contacts 2 and 12 of segment X on the rear of switch S2A, and blocking capacitor C1 to terminal 1 of transformer T1.

(2) *Input from sending circuit.* The path of the signals applied to transformer T1 from transformer T4 is described in paragraph 10 *b* (2).

17. Limiter-Amplifiers V1A and V1B and Limiter V2A

Limiter-amplifiers V1A and V1B (fig. 14) amplify and limit vf signals applied to them; limiter V2A limits vf signals applied to it. For signals applied above a certain input signal level, the positive signal peaks are limited by grid current-limiting action

and the negative signal peaks are limited by tube cutoff.

a. Vf teletypewriter signals applied to transformer T1 (para 16) are developed across winding 3 and 4 of transformer T1 and swamping resistor R7 and applied to the grid of limiter-amplifier V1A through grid current-limiting resistor R8. The output of limiter-amplifier V1A is developed across plate load resistor R10 and applied through coupling capacitor C7 to the grid of limiter-amplifier V1B *(b* below). Resistor R9 is the cathode resistor and C6A is the cathode bypass capacitor. Resistor R11 and capacitor C6B provide plate decoupling.

b. The input signal to limiter-amplifier V1B is developed across grid resistor R12 and applied to the grid of limiter-amplifier V1B through grid current-limiting resistor R13. The output of limiter-amplifier V1B is developed across plate load resistor R15 and applied through coupling capacitor C8 to the grid of limiter V2A *(c* below) and to the threshold circuit through capaoitor C9 to the grid of buffer V2B (para 21). Resistor R14 is the cathode resistor. Resistor R16 and capacitor C6C provide plate decoupling.

c. The input signal to limiter V2A is developed across grid resistor R17 and applied to the grid of limiter V2A through grid current-limiting resistor R18. Resistor R19 is the cathode resistor. The output of limiter V2A is developed across the plate load of discriminator transformers T2 and T3 (para 18 *a).* Regardless of the level of the signals applied from the line (between 0 and -50 dbm), limiter V2A applies signals that are square shaped and unchanging in amplitude to the discriminator.

18. Mark and Space Discriminator and Detector Doublers V3 and V4

The discriminator (fig. 14) consists of two tuned circuits; one for mark signals and the other for space signals. Detector doubler V3 and V4 rectify and amplify the signals developed across the associated transformer. The net output voltage of detector doublers V3 and V4 is applied to the grid of output amplifiers V5 (para 19). Since the functions of the tuned circuits and the circuits for detector doublers V3 and V4 are similar, only the circuit functions of mark discriminator T2 and detector doubler V3 will be covered in detail. Where components in the circuit of space discriminator T3 and detector doubler V4 are given in parenthesis, it indicates that the components have a similar function to the component in the circuit of mark discriminator T2 and detector doubler V3.

a. Mark Discriminator (Transformer T2 (T3)). The output from limiter V2A (para 17c) is applied through transformer T2 (T3) to detector doubler V3 (V4). Primary winding 1 and 2 of transformer T2 (T3) is tuned to 1,400 cps (1,210 cps) by capacitors C10, C11, and C12 (C14 and C15). Secondary winding 3 and 4 of transformer T2 (T3) couples the signal to detector doubler V3 (V4).

b. Detector Doubler V3 (V4).

(1) Assume that, during the positive half of an input cycle, terminal 3 of transformer T2 (T3) is positive with respect to terminal 4. Detector doubler V3A (V4A) conducts and charges capacitor C18 (C16). During the negative half of the input cycle, terminal 4 of transformer T2 (T3) becomes positive with respect to terminal 3. Detector doubler V3A (V4A) cuts off and capacitor C18 (C16) begins to discharge through detector doubler V3B (V4B) and resistor R21 (R20). Thus, the capacitor charge time is short and its discharge time is long.

(2) During the negative half of the input cycle ((1) above), capacitor C19 (C17) charges in a similar manner through detector doubler V3B (V4B), and then begins to discharge through detector doubler V3A (4A) and resistor R21 (R20) during the positive half of the input cycle.

(3) The voltages developed across capacitors C18 andC19(C16 and C17) are series aiding, and the effect of twice the amplitude of the input voltage appears as the rectified

output across resistor R21 (R20). Capacitor C21 (C20) filters the rectified output across resistor R21 (R20).

(4) The voltages developed across resistors R21 and R20 are in series opposition and determine the output net voltage (*c* below) of the detector doublers.

c. Output of Detector Doublers V3 and V4.

(1) When a mark vf teletypewriter signal is received (between approximately 1,287 and 1,400 cps), the resonant characteristics of tuned transformers T2 and T3 cause the voltage developed across transformer T2 to be greater than the voltage developed across tramsformer T3. In turn, the voltage developed across load resistor R21 will be greater than the voltage developed across load resistor R20 (*b* above). Thus, the voltage developed across load resistor R22 will be *positive* at the junction of resistors R23 and R24 with respect. to the grounded side of resistor R39 and applied to the grid of output amplifier V5 (para 19b).

(2) When a space vf teletypewriter signal is received (between approximately 1,210 and 1,275 cps), the resonant characteristics of tuned transformers T2 and T3 cause the voltage developed across transformer T3 to be greater than the voltage developed across transformer T2. In turn, the voltage developed across resistor R20 will be greater than the voltage developed across resistor R21 (*b* above). The resultant voltage developed across load resistor R22 will be *negative* at the junction of resistors R23 and R24 with respect to the grounded side of resistor R39 arid applied to the grid of output amplifier V5 (para 19b).

(3) When no signal frequency is applied to the receiving circuit (idle condition), signal voltage is not developed across resistor R22 (para 19a).

19. Output Amplifier V5

Plate voltage for output amplifier V5 (fig. 14) is applied from rectifier V13 through voltage-dropping resistor R27, REC jack J1, and the receive circuit of the teletypewriter equipment connected to the REC jack.

a. During idle condition, no signal voltage is applied from detector doublers V3 and V4 (para 18c(3)). The positive voltage developed across cathode resistor R39 in receive gate V7B (para 24a) is applied to grid resistor R23. The voltage developed across resistor R23 is applied through load resistor R22, wave-shaping resistors R24, R25, and R26 and capacitors C22 and C23 to the grid of output amplifier V5. Output amplifier V5 conducts and applies a mark signal to the REC jack and the receive circuit of the teletypewriter equipment connected to the jack.

b. During reception of successive mark and space signals, the circuit functions as follows:

(1) When a mark signal is received, the positive output voltage of detector doublers V3 and V4 (para 18c(1)) is applied to the grid of output amplifier V5. Output amplifier V5 conducts and the plate current puts the teletypewriter receiving equipment in the closed (marking) condition.

(2) When a space signal is received, the negative output voltage of detector doublers V9 and V4 (para 18 c(2)) is applied to the grid of output amplifier V5. Output amplifier V5 is cut off and the loss of the current puts the teletypewriter receiving equipment in the open (space) condition.

Section IV. THRESHOLD CIRCUIT

20. General
(fig. 14)

a. When no vf teletypewriter signals or vf teletypewriter signals weaker than -50 dbm are applied to the receiving circuit, the threshold circuit provides for an idle (mark) signal to be applied to the loop circuit of the teletypewriter receiving equipment connected to REC jack J1. When vf teletypewriter signals stronger than -50 dbm are applied to the receiving circuit, the threshold circuit is disabled.

b. Vf teletypewriter signals applied to the receiving circuit are routed to the threshold circuit from limiter amplifier V1B. In the threshold circuit, the vf signals are routed through buffer V2B, and rectified by voltage doubler V6. The rectified signals are applied through trigger V7A to receive gate V7B. Receive gate V7B is cut off and output amplifier V5 is controlled by the signals applied from detector doublers V3 and V4.

c. When no vf signals are applied to the receiving circuit, receive gate V7B conducts to keep output amplifier V5 conducting and applying an idle signal to the teletypewriter equipment connected to the REC jack.

21. Buffer V2B

a. During idle condition, no vf signals are applied through coupling capacitor C9 (fig. 14) from limiter-amplifier V1B to buffer V2B (para 17b). No signal voltages are applied from buffer V2B to rectifier doubler V6 (para 22a).

b. When vf teletypewriter signals are applied to limiter-amplifier V1B (para 17b), they are routed through capacitor C9 and grid resistor R29 to the grid (pin 7) of buffer V2B. The signal voltages developed across cathode resistor R30 are applied through coupling capacitor C24 to rectifier doubler V6 (para 22b).

22. Rectifier Doubler V6

a. During idle condition, no signal voltages are applied from buffer V2B (para 21a). No signal voltages are applied from rectifier doubler V6 to trigger V7A (para 23a).

b. When vf teletypewriter signals from buffer V2A (para 21b) are applied to rectifier doubler V6 they are rectified and applied across load resistor R31 to the grid (pin 2) of trigger V7A (para 23b). The dc voltage is approximately double the root-mean-square voltage of the alternating current (ac) of the signal applied from buffer V2B. Capacitor C25 is a filter capacitor.

23. Trigger V7A

a. During idle condition, no signal voltage is applied across resistor R31 (fig. 14) from rectifier doubler V6 (para 22a). Trigger V7A is cut off; the plate voltage increases and is applied to neon lamp E9. Neon lamp E9 lights and the plate voltage of trigger V7A is applied to the grid (pin 7) of receive gate V7B (para 24a). Resistors R35, R34, and R87 form a voltage divider network to establish a fixed cathode bias.

b. When rectifier doubler V6 applies signals to resistor R31 (para 22b), they are applied through grid-current limiting resistor R32 and across wave-shaping capacitor C26 to the grid (pin 2) of trigger V7A. Trigger V7A conducts; the plate voltage decreases and is applied to neon lamp E9. Neon lamp is extinguished and no signal voltage is applied to the grid of receive gate V7B (para 24b).

24. Receive Gate V7B

a. During an idle signal, the plate voltage of trigger V7A developed across grid resistor R36 (fig. 14) by the conduction of neon lamp E9 (para 23a). causes receive gate V7B to conduct. The voltage developed across cathode resistor R39 is applied through load resistor R22 (on which no signal voltage is applied from detector doublers V3 and V4 (para 18c(3)) to grid resistor R23 of output amplifier V5. Output amplifier V5 conducts and provides a

marking condition for the teletypewriter equipment connected to the REC jack J1. Resistors R38 and R39 form a voltage divider network to establish a fixed cathode bias.

b. When neon lamp E9 is extinguished, no signal voltage is developed across grid resistor R36 and applied to the grid (pin 7) of receive gate V7B. Receive gate V7B is cut off. The voltage developed across resister R39 and applied through load resistor R22 to the grid (pins 2 and 7) of output amplifier V5 has little effect. The signal voltages applied from voltage doublers V3 and V4 to resistor R22 control the action of output amplifier V5 (para 18c(1) and (2)).

Section V. POWER SUPPLY, SIGNALING AND RINGING, AND TELEPHONE CIRCUITS

25. Power Supply
(fig. 14)

a. Transformer T6. Transformer T6 supplies ac voltages to rectifiers V13, V14, and V15 *(b* through *d* below) and filament voltages to the electron tubes.

b. Rectifier V13. Rectifier V13 provides operating voltages for the electron tubes. Dc is provided through load resistor R68 with filter capacitor C46B for the tube circuits in the sending and carrier suppression circuits, through load resistor R40 with filter capacitor C46A for the tube circuits in the receiving and threshold circuits, and through load resistor R27 with filter capacitor C46C for the plate circuit of dc amplifier V5.

c. Rectifier V14. Rectifier V14 provides operating voltage for the grid of tube V12A through the sending circuit of the teletypewriter equipment connected to SEND jacks J2 or J3. Capacitor C47A provides filtering.

d. Rectifier V15. Rectifier V15 provides operating voltage for ringing generator E8 (para 26a). Capacitor C48 provides filtering.

26. Signaling and Ringing Circuits
(fig. 14)

a. Signaling Circuit

(1) When switch S1 is operated to RING, dc voltage from rectifier V15 (para 25d) is applied from terminal 8 of transformer T6 to terminal 2 of ringing generator E8; and from the cathode (pin 7) of rectifier V15 through contacts 5 and 6 of segment X of RING switch S1 to terminal 1 of ringing generator E8. Ringing generator E8 contains a mechanically resonant vibrator that converts dc to 20 cps ac.

(2) When switch S1 is operated to RING, the 20-cps output of ringing generator E8 is applied to the line binding posts as follows:

(a) When 4W-2W-TEL switch S2 is operated to 4W, the 20-cps signal is applied from terminal 4 of ringing generator E8 through contacts 11 and 12 of segment Z of switch S1, ballast lamp E7, and contacts 3 and 6 of segment Y on the rear of switch S2A to 4W-S binding post E3; and from terminal 3 of ringing generator E8 through contacts 8 and 9 of segment Y of switch S1 to 4W-S binding post E4. Ballast lamp E7 is a variable load for ringing generator E8.

(b) When 4W-2W-TEL switch S2 is operated to 2W, the 20-cps signal is applied from terminal 4 of ringing generator E8 through contacts 11 and 12 of segment Z of switch S1, ballast lamp E7, and contacts 3 and 12 of segment X on the rear of switch S2A to 2W binding post E6; and from terminal 3 of ringing generator E8 through contacts 8 and 9 of segment Y of switch S1 to 2W binding post E4.

b. Ringing Circuit. When a 20-cps ringing signal is received at the line binding posts, it activates buzzer I1 and relay K1.

(1) When 4W-2W-TEL switch S2 is operated to 4W, the 20-cps signal

applied to 4W-R binding post E5 is routed through contacts 11 and 7 of segment Y on the front of switch S2A, terminal 1 of buzzer 11 ((5) below) and through buzzer I1 to terminal 5 of relay K1 ((6) below). The 20-cps signal applied to 4W-R binding post E6 is routed through contacts 1 and 2 of segment W of switch S1, dc blocking capacitor C3, to terminal 1 of relay K1 ((5) below), and through relay K1 to terminal 2 of buzzer I1 ((6) below).

(2) When 4W-2W-TEL switch S2 is operated to 2W, the 20-cps signal applied to 2W binding post E4 is routed through contacts 2 and 7 of segment X on the front of switch S2A to terminal 1 of buzzer I1 ((5) below), and through buzzer I1 to terminal 5 of relay K1 ((6) below). The 20-cps signal applied to 2W binding post E6 is routed through contacts 1 and 2 of segment W of switch S1, and capacitor C3 to terminal 1 of relay K1 ((5) below), and through relay K1 to terminial 2 of buzzer I1 ((6) below).

(3) When 4W-2W-TEL switch S2 is operated to TEL, the 20-cps signal applied to TEL binding post E3 is routed through contacts 6 and 7 of segment Y on the rear of switch S2A to terminal 1 of buzzer I1 ((5) below), and through buzzer I1 to terminal 5 of relay K1 ((6) below). The 20-cps signal applied to TEL binding post E5 is routed through contacts 11 and 9 of segment Z on the rear of switch S2A, contacts 1 and 2 of segment W of switch S1, and capacitor C3 to terminal 1 of relay K1 ((5) below), and through relay K1 to terminal 2 or buzzer I1 ((6) below).

(4) When 4W-2W-TEL switch is operated to TEL, the 20-cps signal applted to 2W binding post E4 is routed through contacts 2 and 7 of segment X on the front of switch S2A, to terminal 1 of buzzer I1 ((4) below), and through buzzer 11 to terminal 5 of relay K1 ((5) below). The 20-cps signal applied to binding post E6 is routed through contacts 1 and 2 of segment W of switch S1, and capacitor C3 to terminal 1 of relay K1 ((5) below), and through relay K1 to buzzer I1 ((6) below).

(5) A 20-cps signal applied through buzzer I1 activates the buzzer and gives an audible indication of the ringing signal.

(6) A 20-cps signal applied through relay K1 causes the relay to operate. Closed contacts 3 and 4 put a short circuit across tip and sleeve contacts of REC jack J1. Shorting out the signal applied from, output amplifier V5 to the REC jack causes the teletypewriter equipment to run open.

27. Telephone Circuit (fig. 14)

When a local or common battery telephone circuit is used for telephone communication by the operator of the TH-5/TG, the telephone lines are connected to the TEL binding posts, and the 4W-2W-TEL switch S2 is operated to TEL.

a. Speech signals between the telephones are routed between the TEL and 2W binding posts as follows. Speech signal applied to TEL binding post E3 is routed through contacts 6 and 7 of segment Y on the rear of switch S2A, and contacts 7 and 2 of segment Y on the front of switch S2A to 2W binding post E4. Speech signal applied to TEL binding post E5 are routed through contacts 11 and 9 of segment Z on the rear of switch S2A to 2W binding post E6.

b. Twenty-cps ringing signals applied to the TEL and 2W binding posts are routed to relay K1 and buzzer I1 as described in paragraph 26b(2) through (6).

CHAPTER 3
THIRD ECHELON MAINTENANCE

Section I. GENERAL TROUBLESHOOTING INFORMATION

Warning: When troubleshooting or making repairs on the TH-5/TG, be extremely careful. Voltages as high as 560 volts ac are present internally.

28. General Instructions

a. Troubleshooting the TH-5/TG at third echelon maintenance level includes all the techniques outlined for organizational maintenance and any special techniques required to isolate a defective part.

b. Troubleshooting may be performed while the TH-5/TG is operating as part of a system or, if necessary, after the TH-5/TG has been removed from service. Usually, when troubleshooting is performed while the TH-5/TG is operating as part of a system, it is done at the organizational level (TM 11-5805-246-20). Troubleshooting at the third echelon level is usually performed with the TH-5/TG removed from the equipment with which it is normally associated.

29. Organization of Troubleshooting Procedures

a. General. The first step in servicing a defective TH-5/TG is to sectionalize the fault. Sectionalization means tracing the fault to either the sending or the receiving circuit or to the power supply (TM 11-5805-246-20). The second step is to localize the fault to a defective stage in the sending or receiving circuit or power supply. The third step, isolation, is to trace the fault to the defective part. Some faults, such as burned-out lamps, fuses, resistors, etc, often may be located by inspection; the majority of the faults, however, must be isolated by making voltage and resistance checks at the individual parts.

b. Sectionalization. After the trouble has been sectionalized, a check of all pluck-out parts and a visual inspection will often lead the repairman directly to the source of trouble; if not, localization and isolation procedures (c and *d* below) will aid in locating the defective part of the circuit.

c. Localization. Use the troubleshooting checklist (para 31) to aid in localizing the trouble to a stage or stages within the sending or receiving circuit or power supply.

d. Isolation. After localization, use voltage, resistance, and continuity measurements to isolate the trouble to the defective part. In all tests, the possibility of intermittent troubles should not be overlooked. If present, this type of trouble may often be made to appear by tapping or jarring the equipment.

30. Tools, Test Equipment, and Material Required

Tools, test equipment, or material	
Tool Equipment TE- 123	
Frequency Meter AN/TSM-16, or equal.	TM 11-6625-218-12
Multimeter TS-352/U, or equal.	TM 11-5527
Test Set, Electron Tube TV-7/U, or equal.	TM 11-6625-247-12
Decibel Meter ME-22/PCM (part of Test Set TS-140/PCM), or equal.	TM 11-2096
Teletypewriter TT-4A/TG, or equal.	TM 11-5815-206-12
Dummy plug[a].	

[a]The dummy plug may be either a tip-sleeve plug (such as Plug, Telephone PJ-055B) or a plastic plug capable of fitting tba SEND and REC jacks of the TH-5/TG and opening their contacts.

Section II. TROUBLESHOOTING PROCEDURES

31. Troubleshooting Checklist

a. Procedure. To isolate a cause of trouble, first use the corrective procedure given in TM 11-5805-246-20; then continue with the corrective measures given in the checklist *(b* below).

(1) When advised to check a particular circuit for continuity or to check the circuit of a particular tube, switch, etc, check for abnormal meter readings. Use the tube socket voltage and resistance diagrams in TM 11-5805-246-20 and the terminal board voltage and resistance diagram given in Figure 3. When an abnormal meter indication is obtained, test each of the parts involved in the particular circuit. Replace any defective part; then test the circuit to see whether the correct voltage or resistance reading is obtained. Finally test the TH-5/TG; use the equipment performance checklist given in TM 11-5805-2460-10.

(2) Use figure 14 for the signal circuitry and figure 15 for wiring and layout of parts on the chassis. Use figures 4 through 7 for location of parts mounted on the chassis.

b. Checklist.

Item No	Symptom	Probable trouble	Corrective measures
1	None of the electron tubes lights when power is applied.	Defective wiring to transformer T6 . .	Check wiring continuity between plug P1 and 1-2 winding of transformer T6.
		Defective transformer T6.	Check for 6.3 volts ac between terminals 10 and 11 transformer T6. Check transformer T6 (para 36).
2	Teletypewriter receives from but cannot transmit to distant terminal.	Defective electron tube circuit V8, V9, V10, V11, V12, or V14.	Check the circuits associated with electron tubes V8 through V12, and V14. If tube V9 or V10 or components associated with these circuits are replaced, check the send bias (para 34).
		Defective output circuit..	Check the continuity between transformer T4 and 4W-S binding posts for four-wire operation and between T4 and 2W binding posts for two-wire operation.
		Defective transformer T4.	Check transformer T4 (para 36).
3	Teletypewriter transmits to but cannot receive from distant terminal.	Defective electron tube circuit V1, V2, V3, V4, V5, V6, or V7.	Check circuits associated with electron tubes V1 through V7, If tubes V3 and V4 or components associated with these tubes or with tube V5 are replaced, check the discriminator (para 35),
		Defective input circuit	Check continuity between 4W-R binding posts and transformer T1 for four-wire operation and between 2W binding posts and tranformer T1 for two-wire operation.
		Defective transformer T1	Check transformer T1 (para 36).
4	Teletypewriter runs open: 4W-2W-TEL switch in all positions and NORM-REC-SEND switch in all positions.	Defective electron tube circuit V13 or V5.	Check circuits associated with electron tubes V5, and V13.
		Defective relay K1.	Check to see that contacts 3 and 4 of relay K1 are not connected. If they are connected, replace the relay.
5	Neon glowlamp lighted and teletypewriter runs open.	Defective electron tube circuit V7E. .	Check circuits associated with electron tube V7B.
6	Distorted copy when telewriter is receiving		
	a. From distant station . .	*a.* Defective electron tube circuit V1, V2, V3, V4, or V5.	*a.* Check circuits associated with electron tubes V1 through V5. If tube V3 or V4 is replaced, check the discriminator (para 35).
	b. Home copy	*b.* Defective electron tube circuits V9 or V8A.	*b.* Check circuits associated with electron tubes V9 and V8A. Check the

Item No.	Symptom	Probable trouble	Corrective measures
			output frequency (para 32a).
		Incorrect send bias adjustment	Check the send bias (para 34).
		Defective electron tube circuits V9B, V10, or V12A.	Check circuits associated with electron tubes V9B, V10, and V12A.
		Defective receiving circuit.	Perform the corrective measures suggested for symptom *a* above.
7	Unable to break transmission from distant terminal or signal local battery switchboard using RING switch.	Defective static ringing generator E8, electron tube V15, switch S1, or switch S2.	Check circuits associated with electron tube V15. Ringing generator E8 should buzz when RING switch is operated. If it does not buzz, check circuits associated with electron tube V15, and continuity of contacts of segment X of switch S1. If dc is present on terminal 1 and 2 of the generator, replace the generator. If the generator buzzes, check the continuity of the circuit from terminals 3 and 4 of the generator to the 2W binding posts.
8	Unable to signal common battery switchboard using 4W-2W-TEL switch in TEL position.	Defective coil L1 or contacts of switches S2 or S3.	Check the continuity of the circuit from coil L1 to the 2W binding posts. Check coil L1 (para 36).
9	Oscillator frequency outside required limits (para 32a) and output signal level is satisfactory (para 33a).	Defective electron tube circuit V8A or V9A.	Check electron tubes V8A and V9A. Check the circuits associated with these tubes. If parts are replaced in these circuits, recheck the output frequency (para 32a).
10	Output signal level outside required limits (para 33a) and oscillator frequency is satisfactory (para 32a).	Defective electron tube circuit V8A or V9A.	*Check* electron tubes V8A and V9A. Check the circuits associated with these tubes. If parts are replaced, in these circuits, recheck the output frequency (para 32a),
	a. Two-wire operation only.	*a.* Defective output circuit	*a.* Check continuity between transformer T4 and 2W binding posts. Check transformers T1 and T4 (para 36).
	b. Four-wire operation only.	*b.* Defective output circuit	*b.* Check continuity between transformer T4 and 4W-S binding posts. Check transformer T4 (para 36).
11	Send bias outside required limits (para 34).	Defective electron tube circuit V9B, V10, or V12A.	Check electron tubes V9B, V10, and V12A. Check the circuits associated with these tubes. If parts in circuits associated with electron tube V9B or V10 are replaced, check the output frequency (para 32a).

32. Output Frequency Test and Adjustment

a. Test Procedure.

(1) *Test setup.*

(a) Operate the *4W-2W-TEL* switch of the TH-5/TG to 4W and the NORM-REC-SEND switch to send.

(b) Connect the AN/TSM-16 to the 4W-S binding posts of the TH-5/TG.

(c) Connect the equipment power cords to the ac power source. Turn on the AN/TSM-16 and allow the equipment to warm up.

(2) Measurement.

(a) Record the AN/TSM-16 indication. The AN/TSM-16 should indicate 1,325 cps ±2.

(b) Insert a dummy plug into a SEND jack of the TH-5/TG. Record the the AN/TSM-16 indication. The AN/TSM-16 should indicat 1,225 cps ±2.

Note. If the output frequency measured *((a)* and *(b)* above) is more than ±8 cps of 1,325 and 1,225 cps, perform the corrective measures given in paragraph 31, item 9, and repeat the procedures in (1) and

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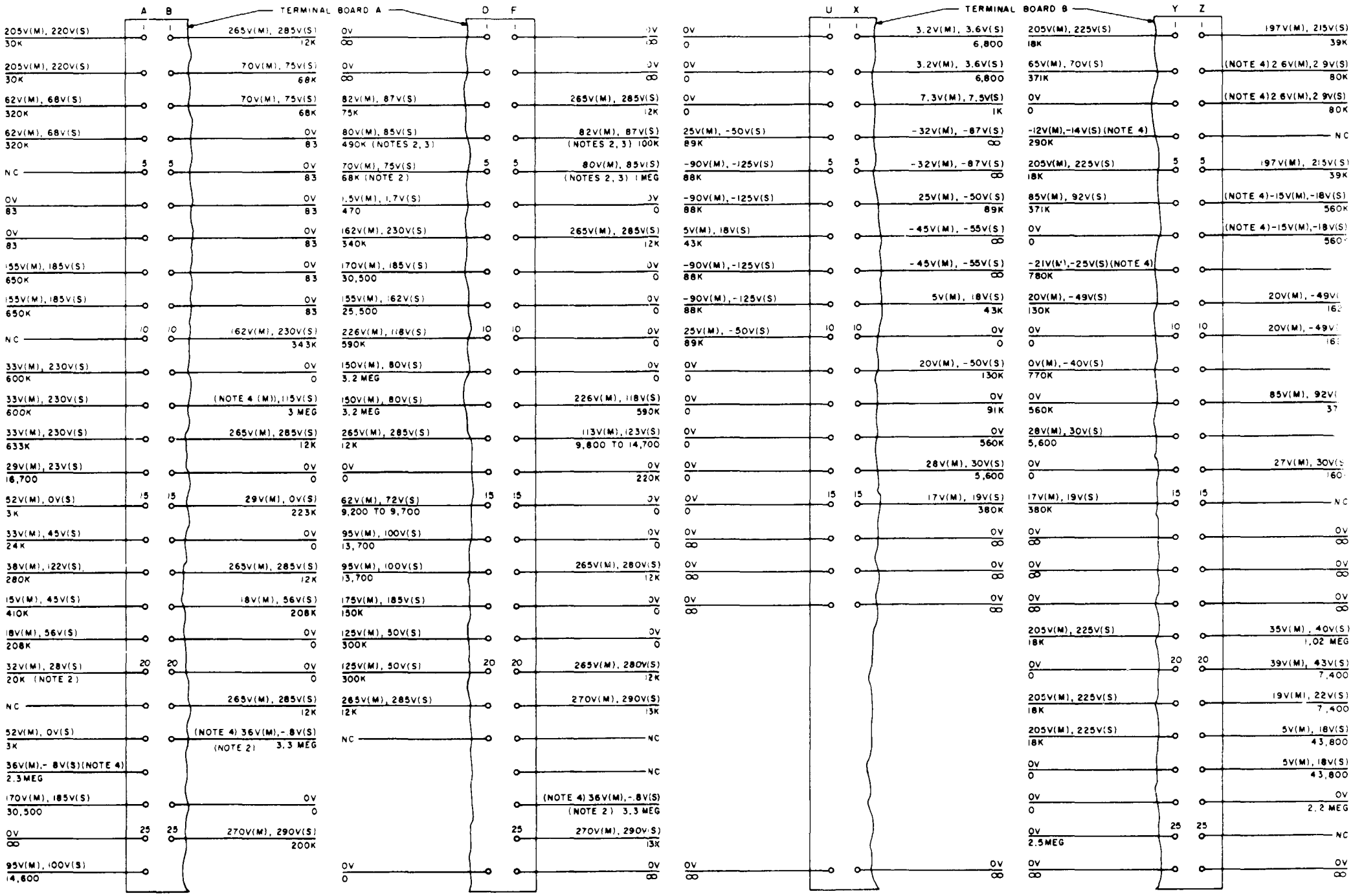


Figure 3. Voltage and resistance diagram for terminal board A and B.

(2) *(a)* and *(b)* above. If the output frequency requirement is still not met, higher echelon maintenance is required to calibrate the oscillator.

(c) Adjust the output frequency of the TH-5/TG *(b* below) when the frequencies measured are less than ±8 cps but more than ±2 cps.

b. Adjustment.

(1) *Test setup.* Use the procedures given in *a* (1) above.

(2) *Procedure.*

(a) Alternately adjust the sections of capacitor C30 (A, fig. 7) with an insulated screwdriver until the AN/TSM-16 indicates 1,325 cps.

(b) Insert a dummy plug into a SEND jack of the TH-5/TG. The AN/TSM-16 should indicate 1,225 cps. Alternately vary the sections of capacitor C30 until the requirement is met.

(c) Repeat the procedures in *(a)* and *(b)* above until the AN/TSM-16 indicates equally within ±2 cps of 1,325 and 1,225 cps.

33. Output Signal Level Test and Adjustment

a. Test Procedures. Perform the output frequency tests (para 32a). Perform the procedures given in (1) and (2) below.

(1) *Test setup.*

(a) Operate the 4W-2W-TEL switch of the TH-5/TG to 4W and the NORM-REC-SEND switch to SEND.

(b) Connect the ME-22/PCM to the 4W-S binding posts of the TH-5/TG. Operate the INPUT IMPEDANCE switch of the ME-22/PCM to 600 OHM.

(c) Connect the equipment power cords to the ac power source, Turn on the ME-22/PCM and allow the equipment to warm up.

(2) *Procedure.*

(a) Record the ME-22/PCM indication. The ME-22/PCM should 0 dbm ±2.

(b) Insert a dummy plug into a SEND jack of the TH-5/TG and record the ME-22/PCM indication. The ME22/PCM should indicate within 0.5 db of the indication obtained in (a) above.

Note. If the output signal level measured *((a)* and *(b)* above) is more than ±6 dbm, perform the corrective measures given in paragraph 31b,item 10, and repeat the procedures in (1) and (2) (a) and *(b)* above.

(c) Adjust the output signal level of the TH-5/TG *(b* below) when the levels measured are less than ±6 dbm but more than ±2 dbm.

b. Adjustment. The following adjustments are performed only with equipment provided with resistor R86 (para 2a, and fig. 15).

(1) Disconnect the TH-5/TG from the ac power source and the ME-22/PCM.

(2) If the ME-22/PCM indication obtained (a(2) above) is between -2 and -6 dbm, connect a strap wire between terminals D4 and F4 on terminal board A (fig. 15).

(3) If the ME-22/PCM indication obtained (a(2) above) is between +2 and +6 dbm, remove the strap wire connected between terminals D4 and F4.

(4) Repeat the procedures given in *a* above.

34. Send Bias Test (fig. 14)

Perform the output frequency test (para 32a) and the output signal level (para 33a) test; then proceed as indicated in *a* and *b* below.

a. Test Setup.

(1) Connect the equipment as described in paragraph 32a(1).

(2) Connect a teletypewriter, such as Teletypewriter TT-4A/TG(TM 11-5815-206-12), send (black) connecting cord to a SEND jack of the TH-5/TG. Connect the ac power cord of the teletypewriter to the ac power source.

b. Procedure. Transmit the letters *R* and *Y* rapidly, rhythmically, and alternately and observe the AN/TSM-16 indication.

The AN/TSM-16 should indicate 1,280 cps ±5.

Note. If the frequency measured does not meet the requirement, perform the corrective measures given in paragraph 31b, item 11, and repeat the procedures given above. If the required frequency is still not met, higher echelon maintenance is required for send bias adjustment.

35. Discriminator Test

Perform the output frequency (para 32a), output signal level (para 33a), and send bias (para 34) tests. Perform the procedures given in *a* and *b* below.

a. Test Setup.

(1) Connect the equipment as described in paragraph 34a, except operate the 4W-2W-TEL switch of the TH-5/TG to 2W.

(2) Arrange a milliammeter (such as the TS-352/U (TM 11-5527), or equal) to measure 50 milliamperes (ma), and connect it to the REC jack of the TH-5/TG.

Notes.

1. If the TS-352/U or TS-352A/U is used, insert the telephone plug of Cord CX-1332/U (part of TS-352/U and TS-352A/U) into the REC jack of the TH-5/TG and insert the black and red test leads into the +DC CURRENT and -DC ±AC OHMS jacks, respectively, of the milliammeter.

2. If the TS-352B/U is used, insert Test Adapter U-144/U (part of TS-352B/U) into the REC jack of the TH-5/TG and insert one end of the test leads (Test Lead Set CX-1331A/U (part of TS-352B/U)) into the U-144/U and the other ends into the +DC CURRENT and -DC+AC OHMS jacks of the milliammeter.

b. Procedure.

(1) Record the milliammeter indication. The milliammeter should indicate 20 ma ±2.

Note. If the meter needle reads off scale to the left, reverse the test lead connections to the milliammeter.

(2) Transmit the letters *R* and *Y*, rapidly, rhythmically, and alternately and observe the milliammeter indication. Record the miliiammeter indication. The milliammeter should indicate within 1 ma, half the current indication obtained in (1) above.

Note. If the milliammeter indication obtained in (2) above is more than 1 ma, higher echelon maintenance is required to perform the discriminator calibration.

36. Dc Resistance of Transformer and Coil Windings

Tranaformer	Point of measurement		Resistance (ohms)
	From	To	
T1	1	2	5.03
	3	4	2,000
T2	1	2	21.4
	3	4	26.6
T3	1	2	21.4
	3	4	26.6
T4	1	2	59
	3	4	880
T5	1	2	83
	3	4	83
T6	9	8	119
	4	Chassis	20
	5	Chassis	20
	3	Chassis	111
	6	Chassis	117
	10	Chassis	2
	11	Chassis	2
	1	2	4.05
	7	8	87
L1	1	2	100
K1	1	5	425
I1	1	2	650

Section III. REPAIRS AND RECEIVING SENSITIVITY ADJUSTMENT

37. Tools, Test Equipment, and Material Required

Tools, test equipment, or material	Manual
Tool Equipment TE-123.	
Decibel Meter ME-22/PCM, or equal.	TM 11-2096
Frequency meter AN/TSM-16, or equal.	TM 11-6625-218-12
Dummy plug [a]	

[a] The dummy plug may be either a tip-sleeve plug (such as Plug, Telephone PJ-055B) or a plastic plug capable of fitting the SEND and REC jacks of the TH-5/TG and opening their contacts.

38. Replacement of Parts

(fig. 4 through 7 and 15)

Note. The parts available for third echelon maintenance are listed in TM 11-5805-246-35P.

a. Front Panel Parts. To replace parts mounted either on the front portion of the chassis or on the front panel, proceed as follows:

(1) Remove the screws that hold the front panel to the chassis.
(2) Separate the front panel from the chassis. Be careful not to break or excessively bend the attached wiring.
(3) After replacing the defective part, seat the front panel on the chassis and replace the screws. Before tightening the screws, make sure that none of the chassis wiring is caught between the front panel and the chassis.

b. Chassis Parts. To replace parts obscured by the terminal boards, proceed as follows:

(1) Remove the mounting screws from the terminal board (A or B).
(2) Invert the terminal board, and secure it to the outside bracket with the mounting screws. Be careful not to break or excessively bend the attached wiring.
(3) After replacing the defective part, reinstall the terminal board on its brackets.

c. Riveted Parts. To replace parts that are riveted to the chassis, proceed as follows:

(1) Tag and remove the leads from the part.
(2) Use a drill or reamer to remove the part from the chassis.
(3) Mount the replacement part with screws, nuts, and washers; use the original mounting holes.
(4) Replace the leads on the replacement part.

39. Receiving Sensitivity Adjustment

When the TH-5/TG is used with a telephone repeater or with a telephone or telegraph carrier terminal insecure telegraph service, hits during idle periods cannot be tolerated. To prevent interference from low level distortion products that originate in the repeaters or the carrier equipment, the receiving sensitivity is reduced from -50 dbm to about -25 dbm by the addition of an 11K resistor (Federal stock No. 5905-279-2667) (arbitrarily designated as R87) connected in series with cathode resistor R34 (tube V7A) (fig. 14).

a. Installation Procedure. Refer to figure 15, detail A. Change the wiring and mount resistor R87 as indicated. Mark the equipment to indicate the addition of resistor R87 in the receiving circuit.

b. Adjustment Procedure. When it is required to restore the sensitivity of the receiving circuit to normal (-50 dbm), connect a strap a cross resistor R87. To reduce the sensitivity to about -25 dbm, remove the strap.

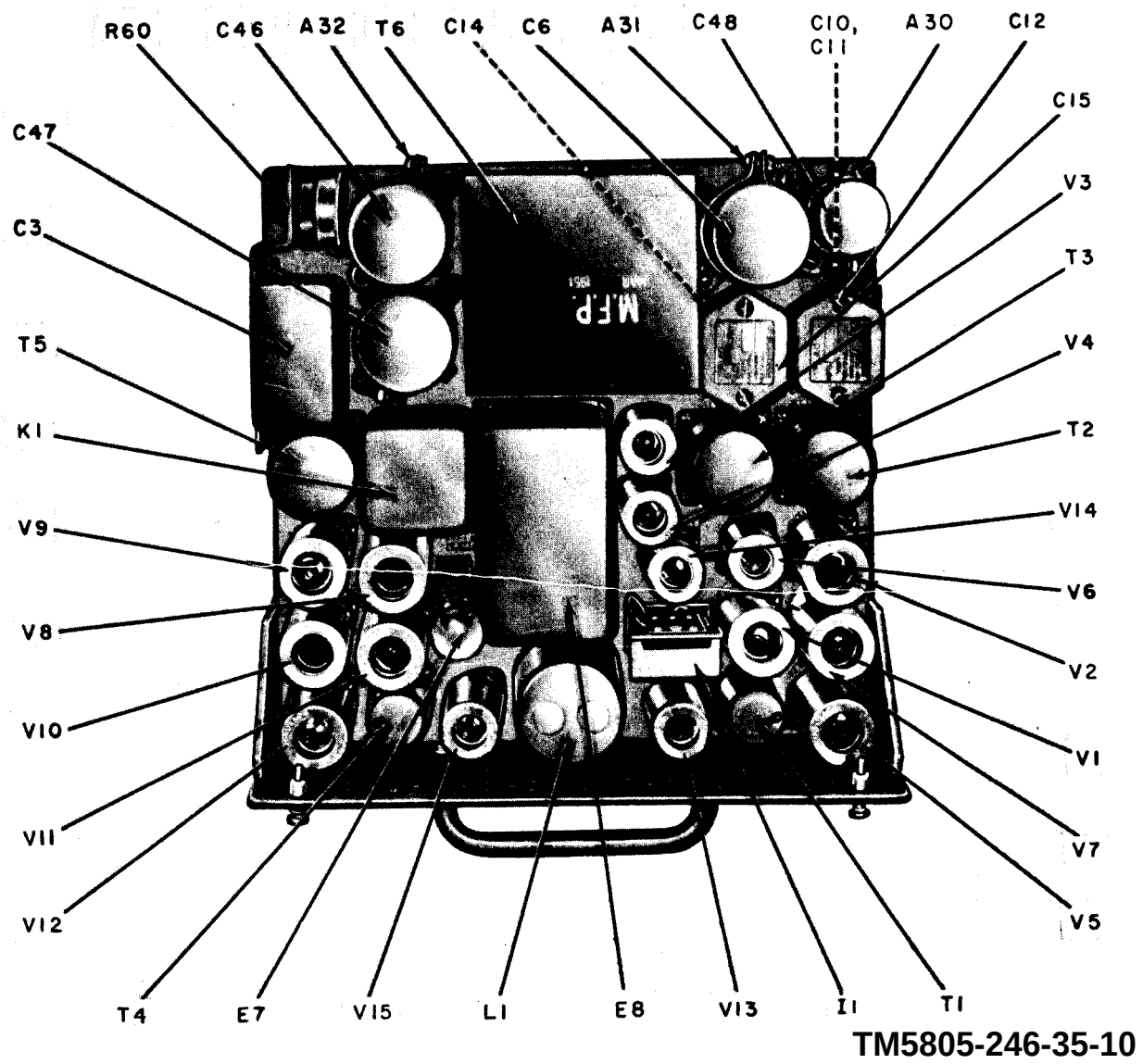


Figure 4. Top view of front panel and chassis assembly, location of parts.

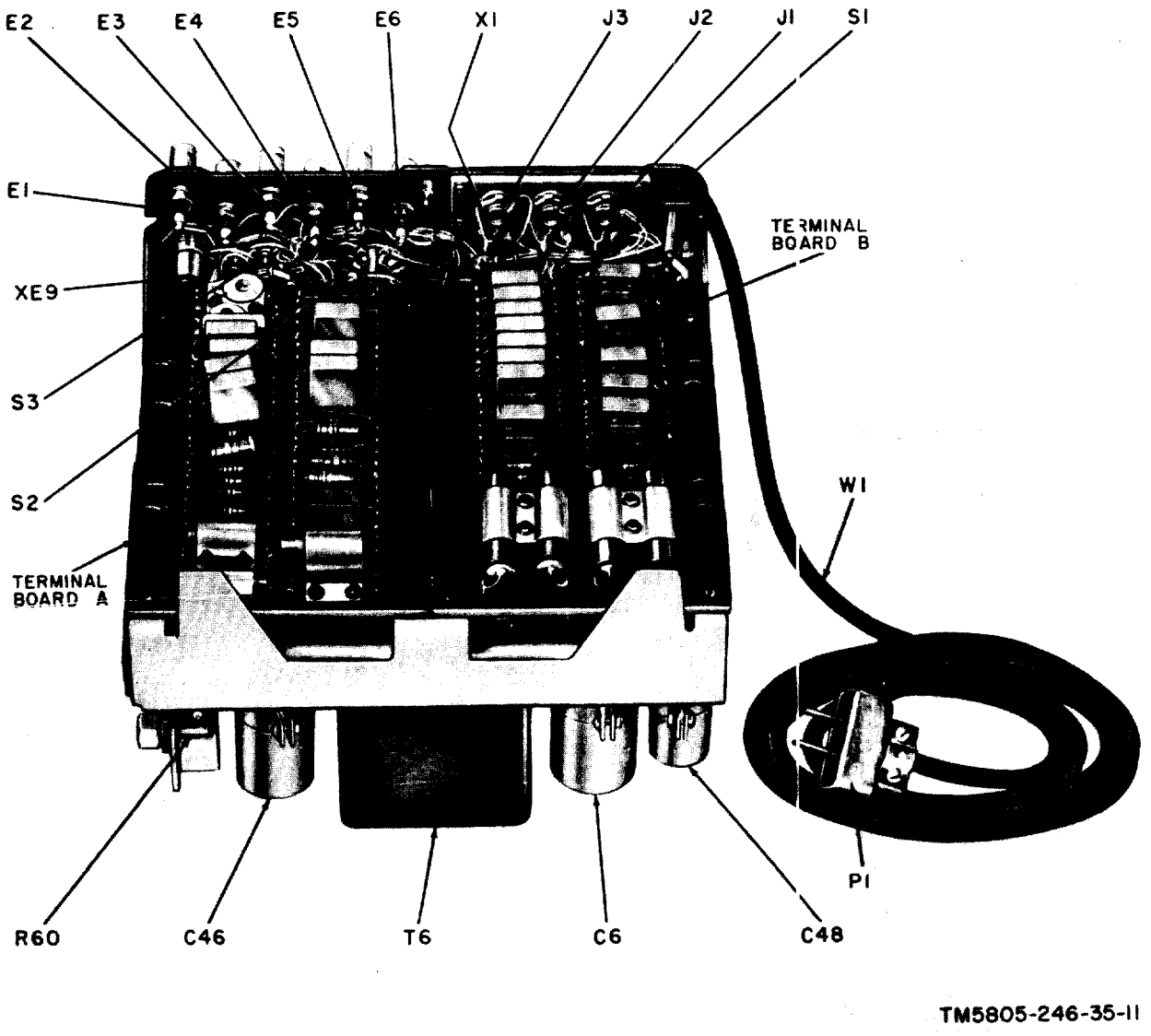


Figure 5. Bottom view of front panel and chassis assembly, location of parts with terminal boards closed.

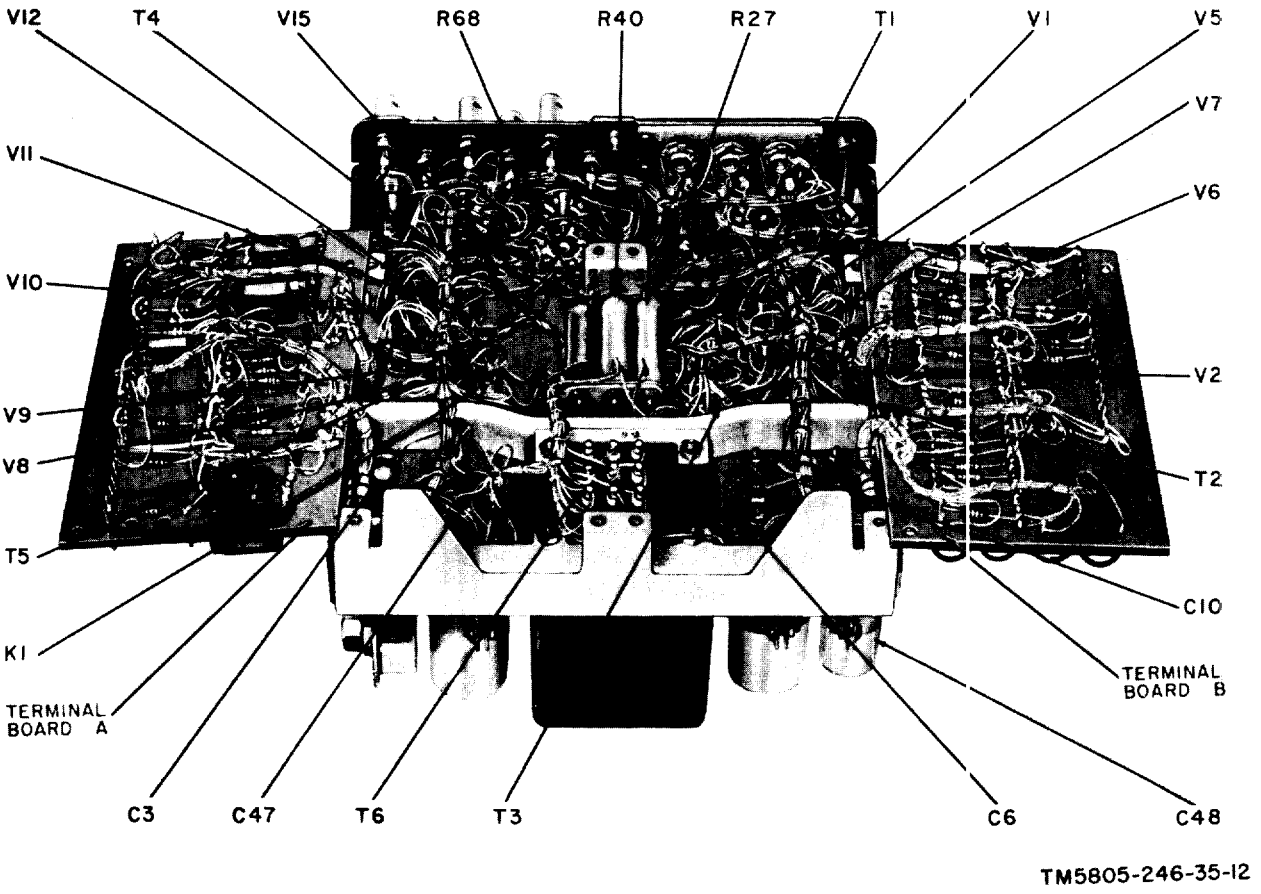
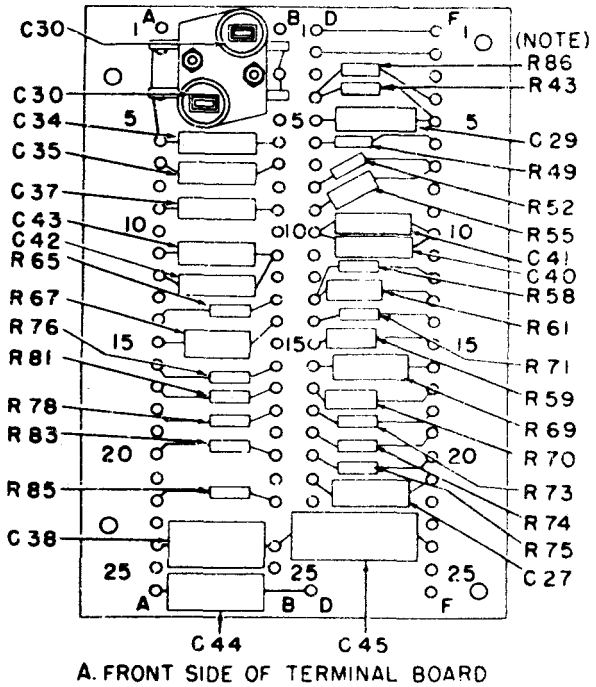
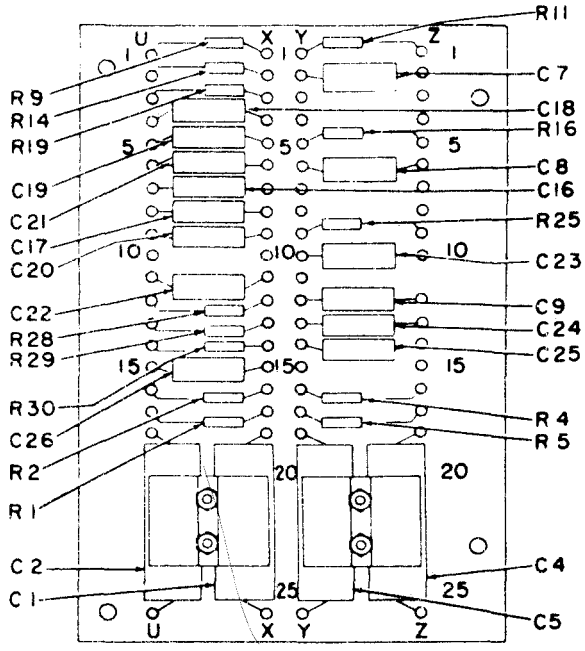


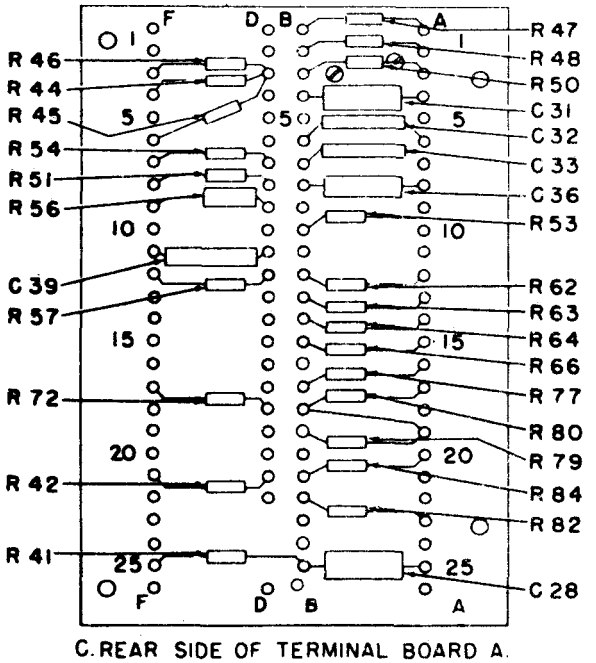
Figure 6. Bottom view of front panel and *chassis assembly, location of parts with terminal boards open.*



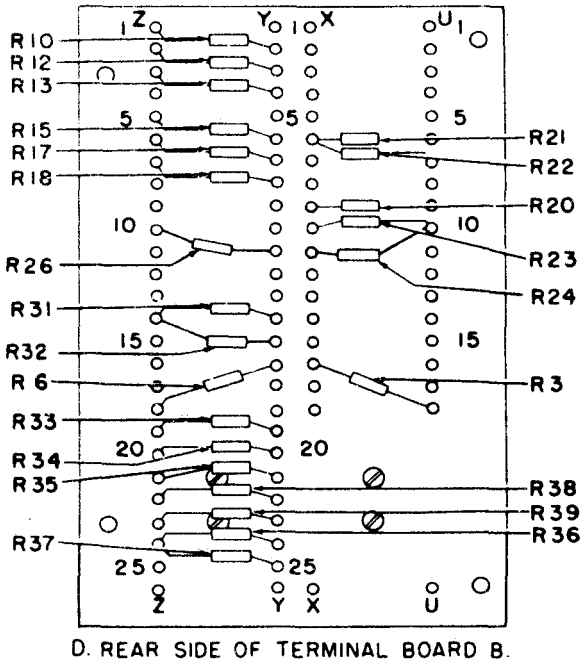
A. FRONT SIDE OF TERMINAL BOARD



B. FRONT SIDE OF TERMINAL BOARD



C. REAR SIDE OF TERMINAL BOARD A.



D. REAR SIDE OF TERMINAL BOARD B.

NOTE:
R86 NOT PROVIDED ON EQUIPMENT BEARING ORDERS NO. 19650-P-50, 3291-P-52, AND 6438-P-51 (SERIAL NO. 736 THROUGH 1105 AND 1274 THROUGH 3035).

TM5805-246-35-5

Figure 7. Terminal boards, location of parts.

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CHAPTER 4

FOURTH ECHELON MAINTENANCE

Section I. REPAIRS AND ALIGNMENT

40. Tools and Test Equipment Required

Tools or test equipment	Manual
Tool Equipment TE-123 . .	
Frequency Meter AN/TSM-16, or equal.	TM 11-6625-218-12
Impedance Bridge TS-460/U, or equal.	TM 11-2634
Multimeter TS-352/U, or equal.	TM 11-5527
Test Set I-193-A, or equal.	TM 11-2513
Rectifier RA-43-B, or equal.	
Distortion Test Set T8-383/GG, or equal.	TM 11-2217
Laboratory Standards AN/URM-2	

41. Repairs

Note. The parts available for fourth echelon maintenance of the TH-5/TG are listed in TM 11-5805-246-35P.

Fourth echelon repair of the TH-5/TG consists of any repair of the case and cover assembly, including the replacement of the luggage catches and spring lock fasteners, Replacement of the capacitors required in calibrating the oscillator (para 42) and the discriminator (para 44) is also performed at fourth echelon.

42. Oscillator V8A Alignment Procedures

Use the following procedures *(a* through *c* below) when the oscillator frequency measurement (para 32) is not within 3 cps of 1,325 and 1,225 cps. Use the procedures in *a* and *b* below for the mark frequency alignment and in *a* and *c* below for space frequency alignment.

Note. Capacitor C30 affects both the mark and space frequency. When capacitor C30 is adjusted, check the mark and space frequency to be sure that both are within the required limits.

a. Test Setup. Use the following test setup for the procedures in *b* and *c* below.

(1) Remove the panel and chassis assembly of the TH-5/TG from its case.

(2) Perform the steps outlined in paragraph 32a.

Warning: **Before removing or installing the tuning capacitors in the following procedures, disconnect the ac power cord connector of the TH-5/TG from the ac power source.**

b. Mark Frequency.

(1) Set each section of capacitor C30 (fig. 7) in the center of its range.

(2) Remove capacitor C35 and connect the capacitance unit of the AN/URM-2 in place of capacitor C35.

(3) Connect the ac power cord connector of the TH-5/TG to the ac power source.

(4) Adjust the capacitance unit of the AN/URM-2 until the AN/TSM-16 indicates 1,325 cps.

(5) Record the capacitance unit indication and disconnect the capacitance unit.

(6) Select a capacitor, or a group of capacitors connected in parallel or in series, to obtain the indicated capacitance value ((5) above) from those listed in TM 11-5805-246-35 for tuning the oscillator.

Note. Measure the selected capacitor (or capacitors) value with the TS-460/U.

(7) Solder the selected capacitor (or capacitors) in place. The AN/TSM-16 should indicate 1,325 cps ±2. If the AN/TSM-16 does not provide the proper indication, repeat the procedures in (2) through (6) above.

(8) Insert a dummy plug in a SEND jack and adjust capacitor C30 until the

AN/TSM-16 indication is 1,225 cps ±1.

(9) Remove the dummy plug and readjust capacitor C30 until the AN/TSM-16 indicates 1,325 cps +1,

(10) Repeat the procedures in (8) and (9) above until the requirements are met.

(11) If the space frequency does not require tuning *(c* below), disconnect the equipment and replace the panel and chassis assembly of the TH-5/TG in its case.

c. Space Frequency.

(1) Adjust capacitor C30 (fig. 7) until the AN/TSM-16 indicates 1,325 cps.

(2) Insert a dummy plug in a SEND jack.

(3) Remove capacitor C37 (fig. 7) and replace it by the same method used for capacitor C35 *(b(2)* through (6) above), until the AN/TSM-16 indicates 1,225 cps ±2.

(4) Remove the dummy plug from the SEND jack. The AN/TSM-16 should indicate 1,325 cps ±3.

(5) Readjust capacitor C30 until the AN/TSM-16 indicates 1,325 cps ±1.

(6) Insert the dummy plug into a SEND jack and readjust capacitor C30 until the AN/TSM-16 indicates 1,225 cps ±1.

(7) Repeat the procedures in (5) and (6) above until the requirements are met.

(8) Disconnect the equipment and replace the front panel and chassis assembly of the TH-5/TG in its case.

43. Send Bias Alignment

Send bias alignment is performed when the send bias requirement (para 34) is not met. The alignment is also performed when parts have been replaced in the modulator V9B and the time delay V10 circuits. Perform the following procedures after the oscillator frequencies (para 32) and the output signal level (para 33) requirements are met.

a. Test Setup.

(1) Remove the panel and chassis assembly of the TH-5/TG from its case; set the 4W-2W-TEL switch to 4W and the NORM-REC-SEND switch to SEND.

(2) Refer to figure 10 and connect the I-193-A to the RA-43-B and the TH-5/TG; connect the AN/TSM-16 to the 4W-S binding posts on the TH-5/TG.

(3) Connect the power cords of the TH-5/TG, AN/TSM-16, and RA-43-B to the ac power source.

b. Procedure.

(1) Adjust the dotting speed of the I-193-A for DOTS HIGH.

(2) Adjust send bias resistor R60 (fig. 4) until the AN/TSM-16 indicates 1,275 cps.

(3) Disconnect the equipment and replace the panel and chassis assembly of the TH-5/TG in its case.

44. Discriminator Alignment

Alignment of the discriminator is performed when the discriminator output requirement (para 35) is not met. The alignment is also performed when parts either in the discriminator or detector doubler V3 or V4 circuits have been replaced, Perform the following procedures after the oscillator frequencies (para 32), output signal level (para 33), and the send bias (para 43) requirements are met.

a. Test Setup.

(1) Remove the panel and chassis assembly of TH-5/TG from its case. Set the NORM-REC-SEND switch to SEND and the 4W-2W-TEL switch to 2W.

(2) Refer to A, figure 9 and connect the I-193-A to the RA-43-B and the TH-5/TG.

(3) Connect the stroboscope cord of the TS-383/GG to the REC jack. Adjust the TS-383/GG to receive test signals.

(4) Connect the power cords of the TH-5/TG, RA-43-B, and TS-383/GG to the ac power source.

(5) Adjust the dotting speed of the I-193-A for DOTS HIGH.

(6) If the TS-383/GG is set for 100-word-per-rninute operation, it should indicate not more than 5-percent distortion. If it is set for 60-word-per-minute operation, the maximum distortion allowed is 3 percent.

b. Procedure.

Warning: Before removing or installing capacitor C10 in the following procedure, disconnect the ac power cord of the TH-5/TG from the ac power source.

(1) Remove capacitor C10 (fig. 4 and 6) and connect the capacitance unit of the AN/URM-2 in place of capacitor C10.
(2) Connect the ac power cord connector of the TH-5/TG to the ac power source.
(3) Perform the procedures given in *a* (5) and (6) above and adjust the capacitance unit of the AN/URM-2 until the requirement is met.
(4) Record the capacitance unit indication and disconnect the capacitance unit.
(5) Select a capacitor, or a group of capacitors connected in series or parallel, to obtain the indicated capacitance value ((4) above) from those listed in TM 11-5805-246-35 for tuning the discriminator.

Note. Measure the selected capacitor (or capacitors) value with the TS-460/U.

(6) Solder the selected capacitor (or capacitors) in place and repeat the procedures given in a (5) and (6) above.

Note. If the TS-383\GG does not provide the proper indication, repeat the procedures in (1) through (6) above.

(7) Disconnect the equipment and replace the panel and chassis assembly of the TH-5/TG in its case.

Section II. FOURTH ECHELON TESTING PROCEDURES

45. General

a. Testing procedures are prepared for use by Signal Field Maintenance Shops and Signal Service Organizations responsible for fourth echelon maintenance to determine the acceptability of a repaired TH-5/TG. These testing procedures are also used for *final testing* a TH-5/TG. These procedures set forth specific requirements that repaired signal equipment *must* meet before it is returned to the using organization. The testing procedures may also be used as a guide for testing equipment at third echelon if the proper tools and test equipment are available. A summary of the performance standards is given in paragraph 53.

b. Each test depends on the preceding one for certain operating procedures and, where applicable, for test equipment calibrations. Comply with the instructions preceding each chart before proceeding to the chart. Perform each test in sequence. *Do not vary the sequence.* For each step, perform all actions required in the *Test equipment control settings* and *Equipment under test control settings* columns; then perform each specific test procedure and verify it against its performance standard.

46. Test Equipment, Other Equipment, and Materials Required

All test equipment, other equipment, and materials required to perform the testing procedures given in this section are listed in the following charts and are authorized under TA-11-17 and TA 11-100(11-17) except as noted. Specific models of equipment were used to perform the test procedures described in paragraphs 50 through 52. If these test procedures are performed with other models of equipment, an allowance must be made for any test connections or test results that may differ from those given in these procedures.

a. Test Equipment.

Nomenclature	Federal stock No.	Technical manual
Electronic Multimeter TS-505(*)/U.[a]	6625-243-0563	TM 11-5511 or TM 11-5511A
Test Set TS-140/PCM.	6625-243-4888	TM 11-2096
Multimeter TS-352(*)/	6625-242-5023	TM 11-5527
Frequency Meter FR-67/U.[b]	6625-356-0256	TM 11-2698
Distortion Test Set TS-383(*)/GG.[c]	6625-222-1714	TM 11-2217
Test Set I-193-(*).[d]	6625-229-1045	TM 11-2513
Attenuator T -402(*)/U.[e]	5905-230-5149	TM 11-2044
Light Assembly, Electric MX- 1292/PAQ.	6695-537-4470	TM 11-5540
Line Unit BE-77-(*).[f]	5805-162-6302	TM 11-359
Printer TG-7-A or Teletypewriter TG-7-B.	5815-198-9029	TM 11-352
Telephone Set TA-312/PT.	5805-543-0012	TM 11-2155
Rectifier RA-43-(*).[g]	6130-230-7294	TM 11-954

[a]Indicates Electronic Multimeter TS-505/U, TS-505A/U, TS-505B/U, or Multlmeter TS-505C/U, TS-505D/U.

[b]Indicates Multimeter TS-352/U, TS-352A/U, or TS-352B/U.

[c]Indicates Distortion Test Set TS-383/GG, TS-383A/GG, or TS-383B/GG.

[d]Indicates Test Set I-193-A, 1-193-B, or I-193-C.

[e]Indicates Attenuator TS-402/U or TS-402A/U.

[f]Indicates Line Unit BE-77-A, BE-77-B, or BE-77-C.

[g]Indicates Rectifier RA-43-A or RA-43-B.

[h]Multimeter AN/URM-105 and Frequency Motor AN/TSM-16, authorized under TA 11-17, were purposely omitted in favor of Multimeter TS-352(*)/U and Frequency Meter FR-67/U which are more likely to be available. However, Multimeter AN/URM-105 and Frequency Meter AN/TSM-16 may be used if available.

b. Materials.

Nomenclature	Federal stock No.	Lenght (approx)
Resistor, fixed, composition, 620 ohms.[a]	5905-117-4313	
Hookup wire, #20 gage (or larger).		6 ft
Cable Assembly, Special Purpose, Electrical, Cord CD-307A.	5995-196-9564	3 ft
Plug, Telephone PJ-055.[b]	5935-192-4760	

[a]A 600-ohm noninductive rasistor is required In certain tests for purposes of Impedance matching. The 620-ohm resistor listed, which is a repair part item of the TH-5/TG (TM 11-5805-246-35P), or any other 600-ohm resistor available may be used.

[b]Not required when the two-conductor patch cord described in paragraph 47b is available.

47. Special Instructions

a. Test Set I-193-(*) and Distortion Test Set TS-383(*)/GG require a source of dc power capable of supplying 60 milliamperes at 130 volts. Rectifier RA-43-(*) meets these requirements. However, any available source of dc power that meets the above requirements may be used.

b. A two-conductor patch cord is required to make the connections between certain equipment. If a patch cord similar to that illustrated in figure 8 is not available, fabricate the cord; use the illustration as a guide.

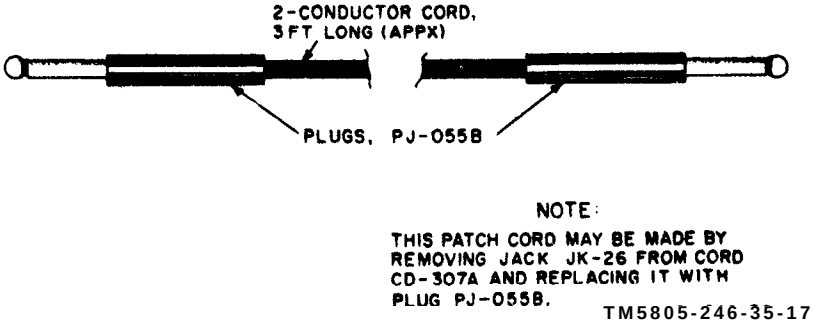


Figure 8. Patch cord fabrication diagram.

48. Modification Work Orders

The performance standards given in the tests (para 40-43) assume that all modification work orders (MWO) for the TH-5/TG being tested have been performed. A listing of current MWO's will be found in DA Pamphlet 310-4.

49. Physical Test and Inspection

a. Test Equipment. Light Assembly, Electric MX-1292/PAQ.

b. Test Connections and Conditions. Prepare the light assembly for use by installing the wide transmission filter in the mercury vapor lamp assembly and connecting the lamp to the 245 V. FOR M. V. LAMP receptacle on the longwave unit. Connect power to the longwave unit. No connection to the unit under test is required. Remove the panel and chassis assembly of the TH-5/TG from its case (fig. 5). Remove the screws on terminal boards A and B, and expose the bottom of the chassis (fig. 6).

c. Procedure.

Step No.	Test equipment control settings	Equipment under test control settings	Test procedure	Performance standard
1	N/A	Controls may be in any position.	*a.* Inspect front panel and exterior of case. Look for damaged, loose, or missing screws, knobs, or other parts. Check the condition of the finish. *Note.* Touchup painting is recommended instead of refinishing whenever practicable. Do not polish with abrasives or paint screwheads, binding posts, and plated fasteners. *b.* Operate each switch to all positions.... *c.* Inspect fuseholder; look for burns, breaks, and sufficient spring tension. Check fuse rating. *d.* Inspect power cord insulation and connector; look for cracks, abrasions, and indication of excessive wear.	*a.* No evidence of damaged, loose, or missing screws, knobs, or parts. External surfaces intended to be painted should not show bare metal. *b.* Switches operate smoothly without binding to each position indicated on the panel. *c.* Fuseholder must not be burned or broken, and spring tension must be strong. A 1-1/2-ampere, 250-volt fuse must be installed. *d.* Power cord and connector must be in good condition, free of cracks, abrasions, and evidence of excessive wear.
2	*MX-1292/PAQ* Longwave unit: 245 V. FOR M.V. LAMP: ON.	Controls may be in any position.	*a.* Expose to the direct rays of the mercury vapor lamp the portion of the equipment that has been repaired and disturbed. *Note.* There will be no moistureproofing or fungiproofing varnish on switch contacts. *b.* Turn off lamp.	*a.* All electronic components, wiring, and chassis surfaces are covered with moisture-proofing and fungiproofing varnish. *Note.* MFP varnish glows grayish-green under the lamp. *b.* None.
3	N/A	N/A	Check equipment for applicable MWO (para 48).	

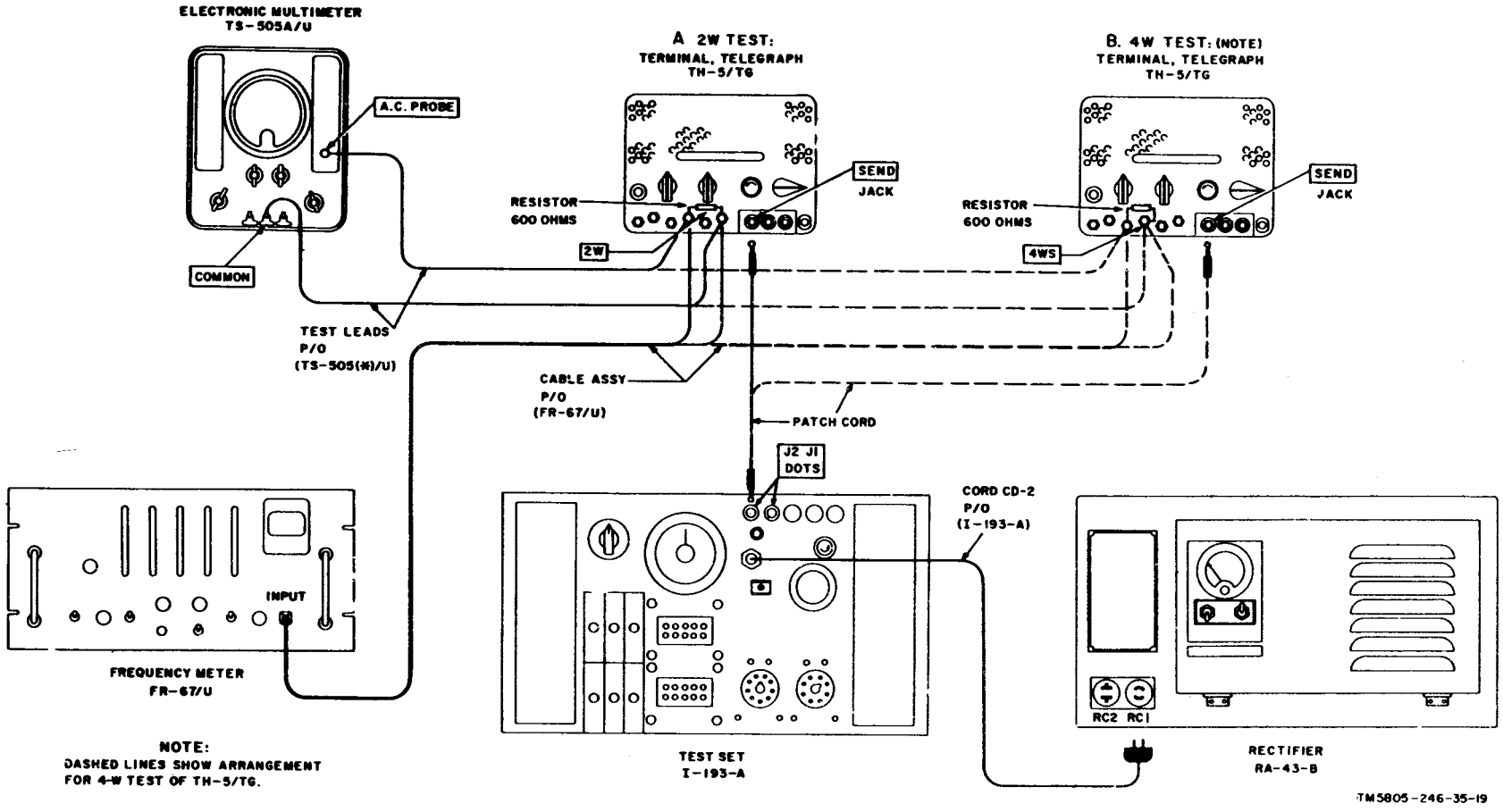


Figure 9. Test setups for sending circuit tests.

50. Sending Circuit Tests

a. Test Equipment and Materials.

(1) Electronic Multimeter TS-505A/U. (See *b* below.)
(2) Frequency Meter FR-67/U.
(3) Rectifier RA-43-B.
(4) Test Set I-193-A.
(5) Resistor, 600 ohms.
(6) Patch cord (para 47*b*).

b. Zeroing TS-505A/U. Before connecting the TS-505A/U in the test setup, zero the TS-505A/U for ac voltage as follows:

(1) Connect the ac power cord to the ac power source.
(2) Set the RANGE switch to 2.5 V.
(3) Connect the A. C. PROBE to the COMMON probe.
(4) Adjust the ZERO ADJ. control for zero indication on the meter.

c. Test Connections and Conditions. Connect the TH-5/TG to the test equipment as shown by solid lines in figure 9. Connect the power cords of the TH-5/TG, FR-67/U, and RA-43-B to the ac power source.

d. Procedure.

Step No.	Test equipment control settings	Equipment under test control settings	Test procedure	Performance standard
1	*FR-67/U* AUTO-MANUAL: AUTO DISPLAY TIME: mid-position EXT. START-INT. START: INT. START MULTIPLY FREQUENCY BY: 1 POWER: ON MEASURE-CHECK: MEASURE SENSITIVITY: Set for meter indication within the green portion of the meter scale. *TS-505A/U* FUNCTION: A. C. RANGE: 2.5 V *I-193-A* K1: center K2: center K3: center K4: center K5: center K6: DOTS HIGH	NORM-REC-SEND: SEND 4W-2W-TEL: 2W	*a.* Record the TS-505A/U meter indications. *b.* Allow the frequency meter to count the signal frequency 3 times. Compute and record the average count. *c.* Remove the plug from the DOTS J2 jack of I-193-A and allow the FR-67/U to count the signal frequency 3 times. Note and record the average frequency count and the TS-505A/U indication. *d.* Reconnect the plug to the DOTS J2 jack of I-193-A and set the K5 key to SEND DOTS. e. Allow the FR-67/U to count the signal frequency 3 times. Compute and record the average count.	*a.* Meter indicates between 0.6 and 1.2 volts. *b.* Average count is 1,325 cps ±2. c. Average count is 1,225 cps ±2. TS-505A/U indicates same as that recorded in *a* above ±0.1 volt. *d.* None. e. Average count is 1,275 cps ±2.
2	Same as in step No. 1.	NORM-REC-SEND: NORM 4W-2W-TEL: 2W	*a.* Disconnect the I-193-A. Insert a dummy plug into the TH-5/TG SEND jack. *b.* Record the TS-505A/U meter indication. *c.* Remove the dummy plug from the TH-5/TG SEND jack and observe the indication on the TS-505A/U meter for 3 to 5 seconds after the plug is removed.	*a.* None. *b.* Meter indicates between 0.6 and 1.2 volts. *c.* Between 3 and 5 seconds after the plug is removed, the meter indication drops to zero.
3	Same as in step No. 1.	No change from step No. 2 except: 4W-2W-TEL: 4W	*a.* Connect the TH-5/TG to the test equipment as shown in dashed lines in figure 9. *b.* Repeat *a* through *c* of step No. 2. *c.* Turn off the power and disconnect the test equipment.	*a.* None. *b.* Same as in step No. 2. *c.* None.

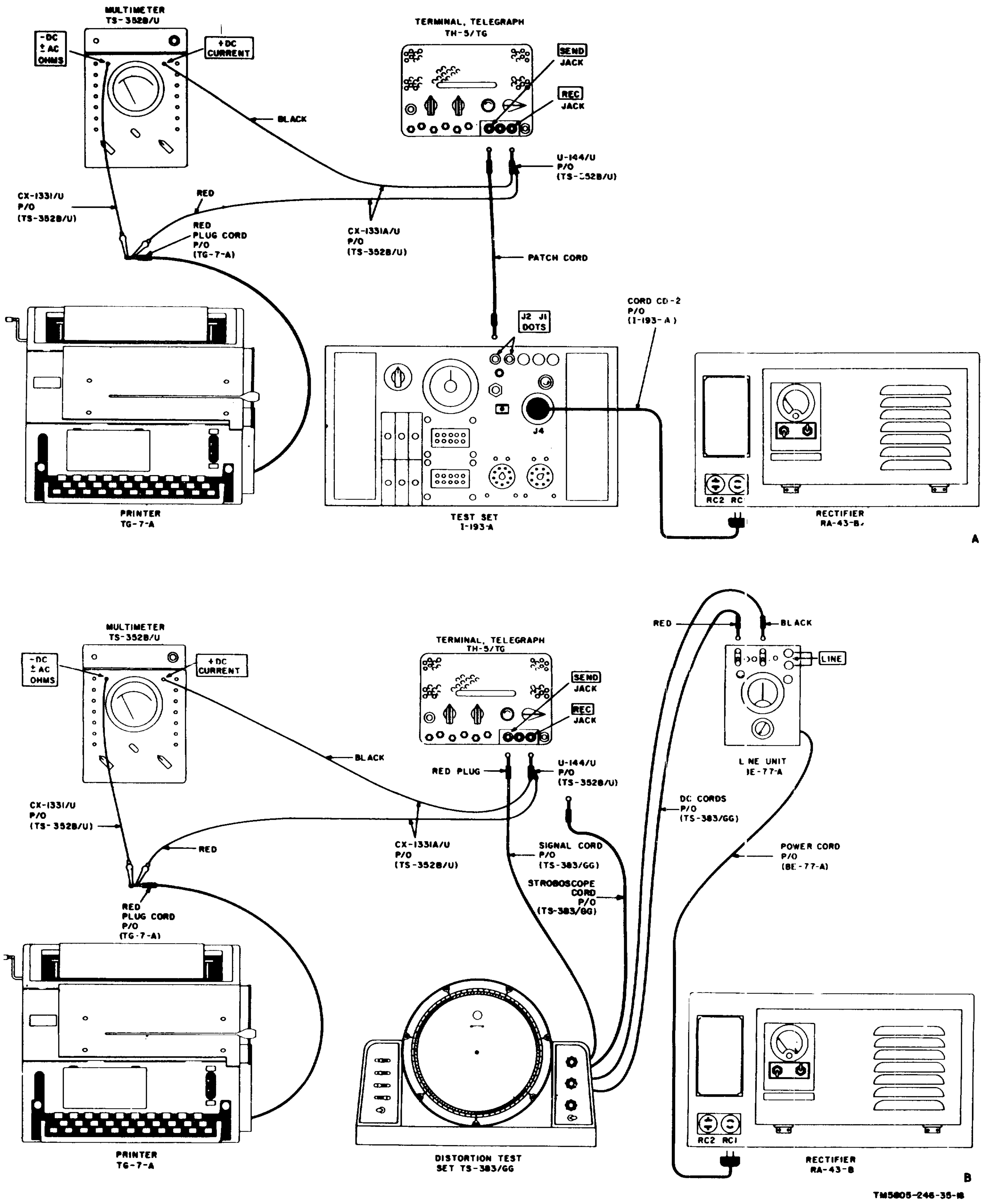


Figure 10. Test setups for receiving circuit tests.

51. Receiving Circuit Tests

(fig. 10)

a. Test Equipment and Material.

(1) Distortion Test Set TS-383/GG.
(2) Line Unit BE-77-A.
(3) Multimeter TS-352B/U.
(4) Rectifier RA-43-B.
(5) Printer TG-7-A.
(6) Test Set I-193-A.
(7) Patch cord (para 47*b*).

b. Test Connections and Conditions. Connect the test and other equipment as shown in A, figure 10. Connect the power cords of the TH-5/TG, RA-43-B, and TG-7-A to the ac power source. Check the RA-43-B to see that it is adjusted for operation on the ac line power being used. After power has been applied to the equipment, allow a 5-minute warmup before performing the tests.

c. Procedure.

Step No.	Test equipment control settings	Equipment under test control settings	Test procedure	Performance standard
1	*TS-352B/U* FUNCTION: DC CURRENT. Range: 50 MA *TG-7-A* MOTOR: ON *I-193-A* K1: center K2: center K3: center K4: center K5: center K6: DOTS HIGH *RA-43-B* POWER: ON	NORM-REC-SEND: NORM 4W-2W-TEL: 2W	*a.* Record the indication on the TS-352B/U. *b.* Set the I-193-A K5 key to SEND DOTS. *c.* Record the TS-352B/U meter indication. *d.* Turn off the TG-7-A; disconnect the I-193-A and the patch cord.	*a.* TS-352B/U indicates 20 ma ±2. *b.* None. *c.* TS-352B/U indicates one-half the value recorded in above. *d.* None.
2	*BE-77-A* RELAY IN CIRCUIT-RELAY OUT OF CIRCUIT: RELAY OUT OF CIRCUIT. LOCAL CURRENT SUPPLY-DISTANT CURRENT SUPPLY: LOCAL CURRENT SUPPLY. *TG-7-A* MOTOR: ON *TS-383/GG* MOTOR: ON LINE-DIST: LINE VIEW-TRANSMIT: TRANSMIT MARK-ZERO-SPACE: ZERO DISTORTION: center RUN-STOP: RUN Code selecting switch: TEST MESSAGE STOP PULSE: ON *RA-43-B* POWER: ON	NORM-REC-SEND: NORM 4W-2W-TEL: 2W	*a.* Connect the equipment as shown in B, figure 10. Connect the power cord of the TS-383/GG to ac power source. *b.* Adjust the current control on the BE-77-A. *c.* Allow the TG-7-A to copy at least 10 lines of the test messager. Check the copy for errors. *d.* Set the TH-5/TG 4W-2W-TEL switch to 4W. *Note.* Check to see that a strap exists between terminals D2-F2 on terminal board A inside the TH-5/TG (fig. 15). *e.* Allow the TG-7-A to copy at least 10 lines of the test message. Check the copy for errors. *f.* Remove the U-144/U from the REC jack of the TH-5/TG.	*a.* None. *b.* BE-77-A meter indicates 20 ma. *c.* The teletypewriter copies at least 10 lines free of errors. *d.* None. *e.* Same as in above. *f.* None.
3	Same as step No. 2 except: *TS-383/GG* Code selecting switch: R	Same as step No. 2.	*a.* Connect the RA-43-B, BE-77-A, and TS-383/GG as shown in B, figure 10. Connect the signal cord of the TS-383/GG to the SEND jack of the TH-5/TG and the stroboscope cord to the REC jack. *b.* Record the distortion percentage indicated on the TS-383/GG.	*a.* None. *b.* The TS-383/GG indicates a maximum of 3 percent distortion.

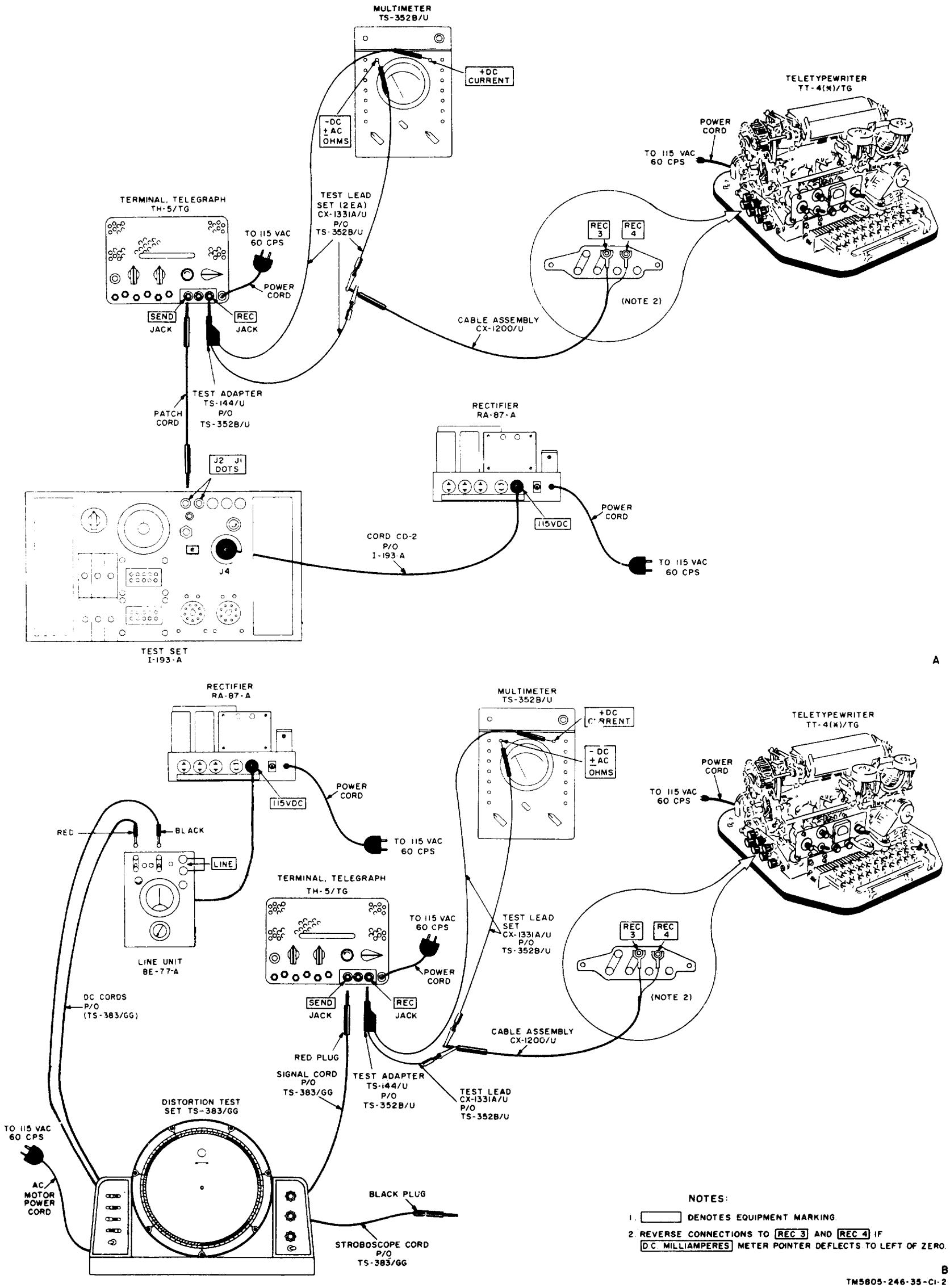


Figure 10. Test setups for receiving circuit tests.

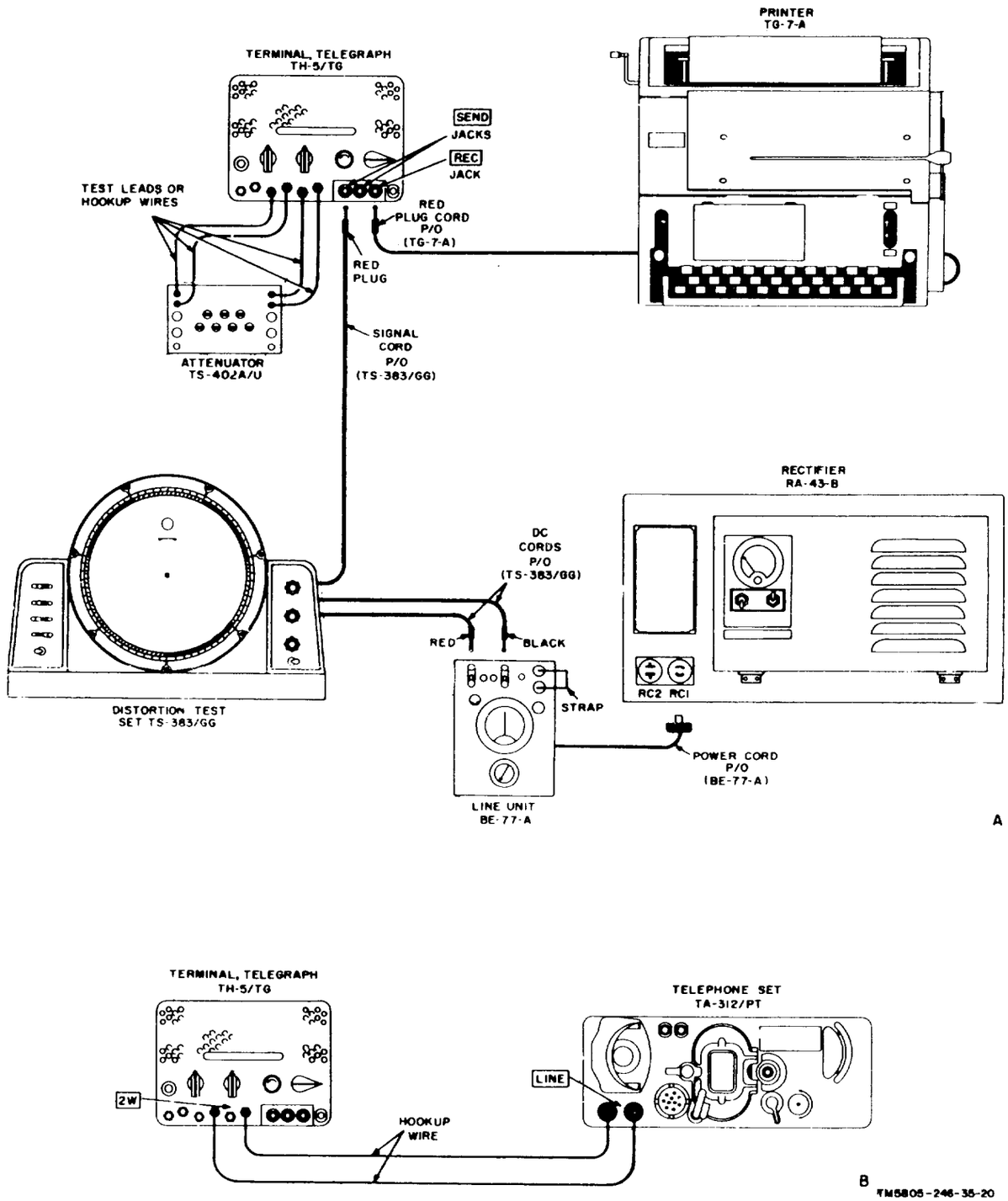


Figure 11. Test setups for sensitivity and operational tests.

52. Sensitivity and Operational Tests
(fig. 11)

a. Test Equipment and Material.
(1) Attenuator TS-402A/U.
(2) Distortion Test Set TS-383/GG.
(3) Line Unit BE-77-A.
(4) Rectifier RA-43-B.
(5) Telephone Set TA-312/PT.
(6) Printer TG-7-A.
(7) Hookup wire.

b. Test Connections and Conditions. Connect the test equipment as shown in A, figure 11. Connect the power cords of the TH-5/TG, TG-7-A, TS-383/GG, and RA-43-B to the ac power source. Disconnect the strap wire between terminals D2 and F2 on terminal board A inside the TH-5/TG (fig. 15).

c. Procedure.

1	*TS-402A/U* All keys aligned with the white line parallel to the long dimension of the panel (0 db). *BE-77-A* RELAY IN CIRCUIT-RELAY OUT OF CIRCUIT: RELAY OUT OF CIRCUIT. LOCAL CURRENT SUPPLY-DISTANT CURRENT SUPPLY: LOCAL CURRENT SUPPLY. LINE RHEOSTAT: Maximum counterclockwise. *TG-7-A* MOTOR: ON *TS-383/GG* MOTOR: OFF LINE-DIST: LINE VIEW-TRANSMIT: TRANSMIT MARK-ZERO-SPACE: ZERO DISTORTION: center RUN-STOP: RUN STOP PULSE: ON	NORM-REC-SEND: NORM 4W-2W-TEL: 4W	*a.* Adjust the BE-77-A LINE RHEOSTAT for 20-ma indication on its meter. *b.* Set the TS-383/GG code selecting switch to TEST MESSAGE and the MOTOR switch to ON. *c.* Allow the TG-7-A to copy 10 lines of the test message. Check the copy for errors. *d.* Turn the TS-402A/U 40-db and 5-db keys clockwise until the white line is aligned with the short dimension of the panel (45 db). *e.* Allow the TG-7-A to copy at least 10 lines of the test message. Check the copy for errors. *f.* Turn the 5-db key to align the white line with the long dimension of the panel, and turn the 10-db key to align the white line with the short dimension of the panel (50 db). *g.* Observe the neon lamp on the TH-5/TG panel and the operation of the TG-7-A for 10 lines of copy. *h.* Turn the 5-db key to align the white line with the short dimension of the panel and the 10-db key to align the white line with the long dimension (45 db). *i.* Check the operation of the neon lamp on the TH-5/TG panel. Check the TG-7-A copy for accuracy. *j.* Turn off the equipment and disconnect it.	*a.* None. *b.* None. *c.* TG-7-A copies at least 10 lines of the test message without errors. *d.* None *e.* Same as *c* above. *f.* None. *g.* The TH-5/TG neon lamp glows steadily and the TG-7-A does not receive copy. *h.* None. *i.* The TH-5/TG neon lamp does not light and the TG-7-A again receives correct copy. *j.* None.
2	*TA-312/PT* CB-LB-CBS: LB EXT-INT: INT Buzzer volume control: midposition.	NORM-REC-SEND: NORM 4W-2W-TEL: 2W	*a.* Connect the equipment as shown in B, figure 11. Place the TA-312/PT handset firmly in its retaining brackets. *b.* Operate the RING switch on the TH-5/TG and listen for the TA-312/PT to ring. *c.* Turn the handcrank generator on the TA-312/PT at a normal rate of speed (approximately 50 rpm). Listen for the TH-5/TG buzzer to operate and observe the neon lamp on the panel. *d.* Replace the jumper between terminals D2 and F2 on terminal board A on the TH-5/TG (*b* above). *e.* Turn off the equipment and disconnect it.	*a.* None. *b.* The TA-312/PT rings as long as the switch is operated. *c.* The TH-5/TG buzzer is audible and the neon lamp lights when the crank is turned. *d.* None. *e.* None.

53. Test Data Summary

Personnel may find it convenient to arrange a checklist similar to that shown below:

Test	Performance standard	Equipment performance
1. SENDING CIRCUIT TESTS		
a. Output voltage (mark)	0.6 to 1.2 volts ac.	
b. Output frequency (mark)	1,325 cps ±2.	
c. Output voltage (space)	Within 0.1 volt of indication recorded for a above.	
d. Output frequency (space)	1,225 cps ±2.	
e. Bias	1,275 cps ±2.	
f. Carrier suppression	No indication after 3 seconds.	
2. RECEIVING CIRCUIT TESTS		
a. Power output	20 ma ±2.	
b. Bias	One-half the value recorded for *a* above.	
c. Local copy (2W)	10 lines of error-free copy.	
d. Local copy (4W)	10 lines of error-free copy.	
e. Distortion percentage	3 percent distortion, maximum.	
3. SENSITIVITY AND OPERATIONAL TESTS		
a. Operation with no attenuation.	10 lines of error-free copy.	
b. Operation with 45-db attenuation.	10 lines of error-free copy.	
c. Operation with 50-db attenuation.	No copy; neon lamp lights.	
d. Operation reset to 45-db attenuation.	10 lines of error-free copy.	
e. Ringing output	Telephone bell rings.	
f. Signaling output	Buzzer is audible; neon lamp lights.	

CHAPTER 5
FIFTH ECHELON MAINTENANCE

54. General

Fifth echelon maintenance consists of rebuilding the TH-5/TG, including the case and cover assembly (TM 11-5805-246-12P). Final tests for a rebuilt TH-5/TG are the same as for fourth echelon (para 45 through 52). Parts available for fifth echelon maintenance of the TH-5/TG are listed in TM 11-5805-246-

55. Tools and Test Equipment Required

The equipment required at fifth echelon maintenance is listed in paragraphs 40 and 46. In addition, Test Set, Electron Tube TV-2/U, or equal, is substituted for Test Set, Electron Tube TV-7/U, or equal.

APPENDIX

REFERENCES

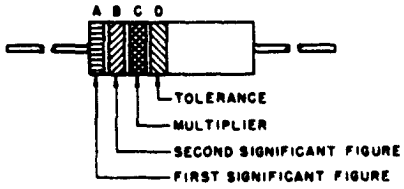
Following is a list of applicable references which are available to the field and depot maintenance personnel of Terminal, Telegraph TH-5/TG.

AR 320-5	Dictionary of United States Army Terms
AR 320-50	Authorized Abbreviations and Brevity Codes
AR 700-38	Unsatisfactory Equipment Report (Reports Control Symbol CSGLD-247(R2))
AR 700-58	Report of Damaged or Improper Shipment (Reports Control Symbol (CSGLD-66 (Army), BuSandA 4600-6 (Navy), Reports Control Symbol 4600-3 (Marine Corps), Air Force Exempt under par 7 (3), AFR 174-1))
DA Pamphlet 108-1	Index of Army Motion Pictures, Film Strips, Slides and Phono Recordings
DA Pamphlet 310-4	Military Publications: Index of Technical Manuals, Technical Bulletins, Supply Bulletins, Lubrication Orders, and Modification Work Orders
DA Pamphlet 310-21	Military Publications: Index of Supply Manuals; Signal Corps
FM 21-5	Military Training
FM 21-6	Techniques of Military Instruction
FM 21-30	Military Symbols
TA 11-17	Signal Field Maintenance Shops
TA 11-100(11-17)	Allowances of Signal Corps Expendable Supplies for Signal Field Maintenance Shops
TB SIG 213-25	Digest of Field Reports for Signal Corps Equipment
TM 11-352	Printer TG-7-A and Teletypewriters TG-7-B and TG-37-B
TM 11-359	Line Units BE-77, BE-77-A, BE-77-B, and BE-77-C
TM 11-954	Rectifiers RA-43-A and RA-43-B
TM 11-2044	Attenuators, TS-402/U and TS-402A/U
TM 11-2096	Test Set TS-140/PCM; Signal Generators SG-15/PCM and SG-15A/PCM; and Decibel Meters ME-22-PCM and ME-22A/PCM
TM 11-2155	Telephone Set TA-312/PT
TM 11-2217	Distortion Test Sets TS-383/GG, TS-383A/GG, and TS-383B/GG
TM 11-2513	Test Sets I-193-A, I-193-B, and I-193-C
TM 11-2634	Impedance Bridges TS-460/U, TS-460A/U, and TS-460B/U
TM 11-2661	Electron Tube Test Sets TV-2/U, TV-2A/U, and TV-2B/U
TM 11-2698	Frequency Meter FR-67/U
TM 11-5511	Electronic Multimeter TS-505/U
TM 11-5511A	Electronic Multimeter TS-505A/U and TS-505B/U and Multimeters TS-505C/U and TS-505D/U
TM 11-5527	Multimeters TS-352/U, TS-352A/U, and TS-352B/U
TM 11-5540	Electric Light Assembly MX-1292/PAQ
TM 11-5805-246-10	Operator's Manual: Terminal, Telegraph TH=5/TG
TM 11-5805-246-20	Organizational Maintenance Manual: Terminal, Telegraph TH-5/TG
TM 11-5805-246-20P	organizational Maintenance Repair Parts and Special Tools List: Terminal, Telegraph TH-5/TG

TM 11-5805-246-35P	Field and Depot Maintenance Repair Parts and Special Tools List: Terminal, Telegraph TH-5/TG
TM 11-5805-250-35	Field and Depot Maintenance: Terminals, Telegraph AN/TCC-4 and AN/TCC-20
TM 11-5815-206-12	Operation and Organizational Maintenance: Teletypewriter Set AN/PGC-1 and Teletypewriters TT-4A/TG and TT-4B/TG
TM 11-6625-218-12	Operation and Organizational Maintenance: Frequency Meter AN/TSM-16.
TM 11-6625-274-12	Operator's and Organizational Maintenance Manual, Test Sets, Electron Tube TV-7/U, TV-7A/U, TV-7B/U, and TV-7D/U

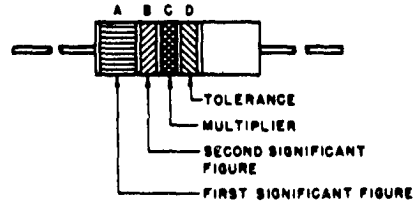
COLOR CODE MARKING FOR MILITARY STANDARD RESISTORS

COMPOSITION-TYPE RESISTORS



BAND A— Equal Width Band Signifies Composition-Type

WIREWOUND-TYPE RESISTORS

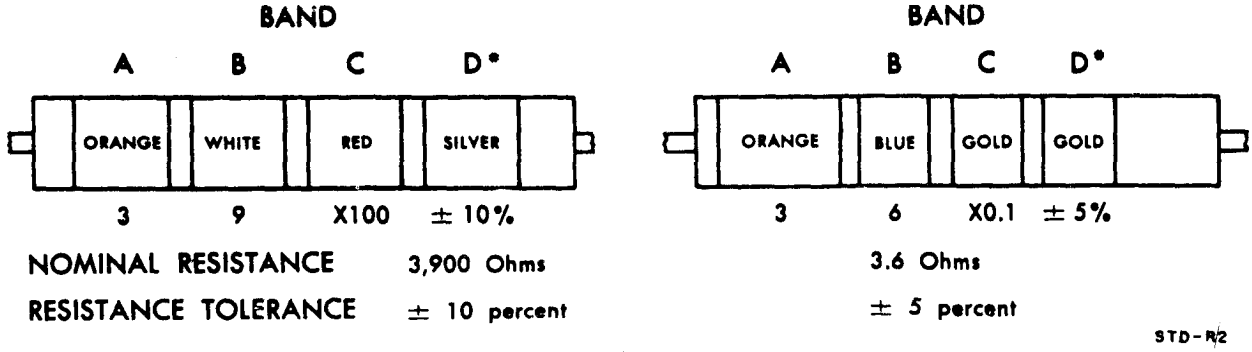


BAND A— Double Width Signifies Wire-wound Resistor

COLOR CODE TABLE

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

EXAMPLES OF COLOR CODING



*If Band D is omitted, the resistor tolerance is ±20%, and the resistor is not Mil-Std.

Figure 12. MIL-STD resistor color code marking.

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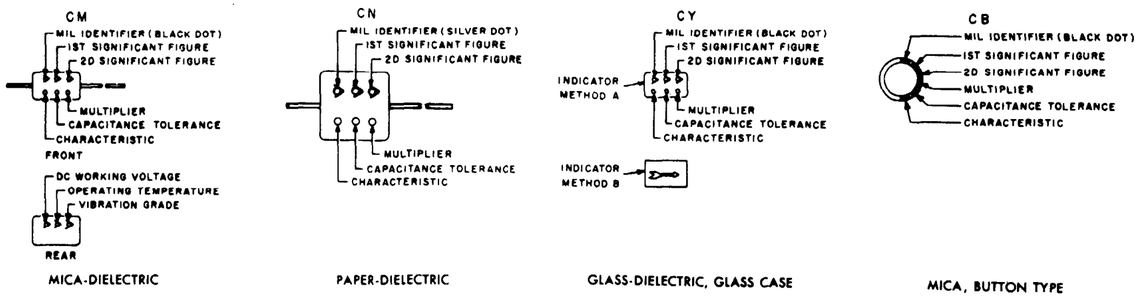
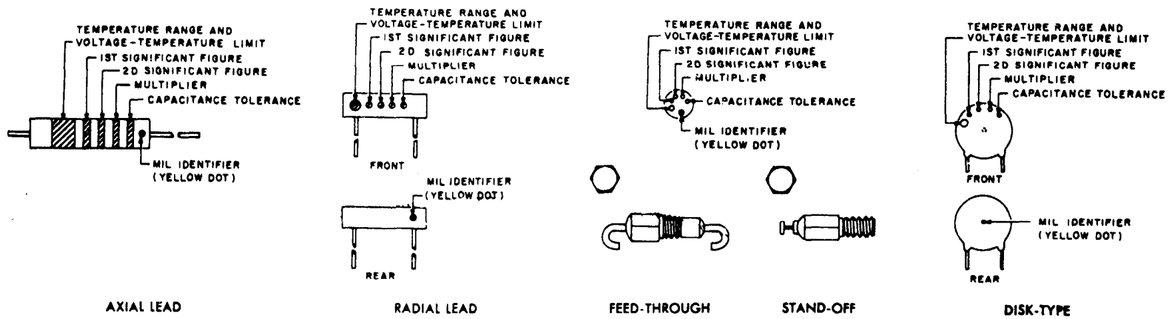
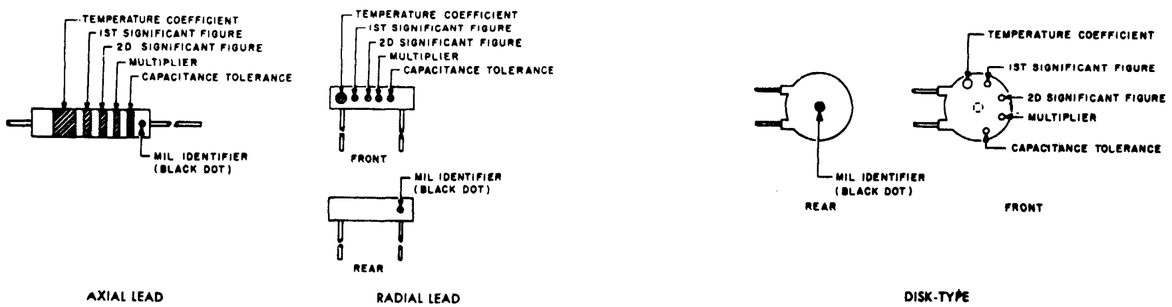
GROUP I



GROUP II Capacitors, Fixed Ceramic-Dielectric (General Purpose) Style CK



GROUP III Capacitors, Fixed, Ceramic-Dieletric (Temperature Compensating) Style CC



COLOR CODE TABLES

TABLE I – For use with Group I, Styles CM, CN, CY and CB

COLOR	MIL ID	1st SIG FIG	2nd SIG FIG	MULTIPLIER[1]	CAPACITANCE TOLERANCE				CHARACTERISTIC[2]				DC WORKING VOLTAGE	OPERATING TEMP. RANGE	VIBRATION GRADE
					CM	CN	CY	CB	CM	CN	CY	CB	CM	CM	CM
BLACK	CM, CY CB	0	0	1			± 20%	± 20%		A				−55° to +70°C	10–55 cps
BROWN		1	1	10					B	E		B			
RED		2	2	100	± 2%		± 2%	± 2%	C		C			−55° to +85°C	
ORANGE		3	3	1,000		± 30%			D			D	300		
YELLOW		4	4	10,000					E					−55° to +125°C	10–2,000 cps
GREEN		5	5		± 5%				F				500		
BLUE		6	6											−55° to +150°C	
PURPLE (VIOLET)		7	7												
GREY		8	8												
WHITE		9	9												
GOLD				0.1			± 5%	± 5%							
SILVER	CN				± 10%	± 10%	± 10%	± 10%							

TABLE II – For use with Group II, General Purpose, Style CK

COLOR	TEMP. RANGE AND VOLTAGE – TEMP. LIMITS[3]	1st SIG FIG	2nd SIG FIG	MU[illegible]R[1]	CAP TC [illegible]CE	MIL ID
BLACK		0	0	1	± 20%	
BROWN	AW	1	1	10	± 10%	
RED	AX	2	2	100		
ORANGE	BX	3	3	1,000		
YELLOW	AV	4	4	10,000		CK
GREEN	CZ	5	5			
BLUE	BV	6	6			
PURPLE (VIOLET)		7	7			
GREY		8	8			
WHITE		9	9			
GOLD						
SILVER						

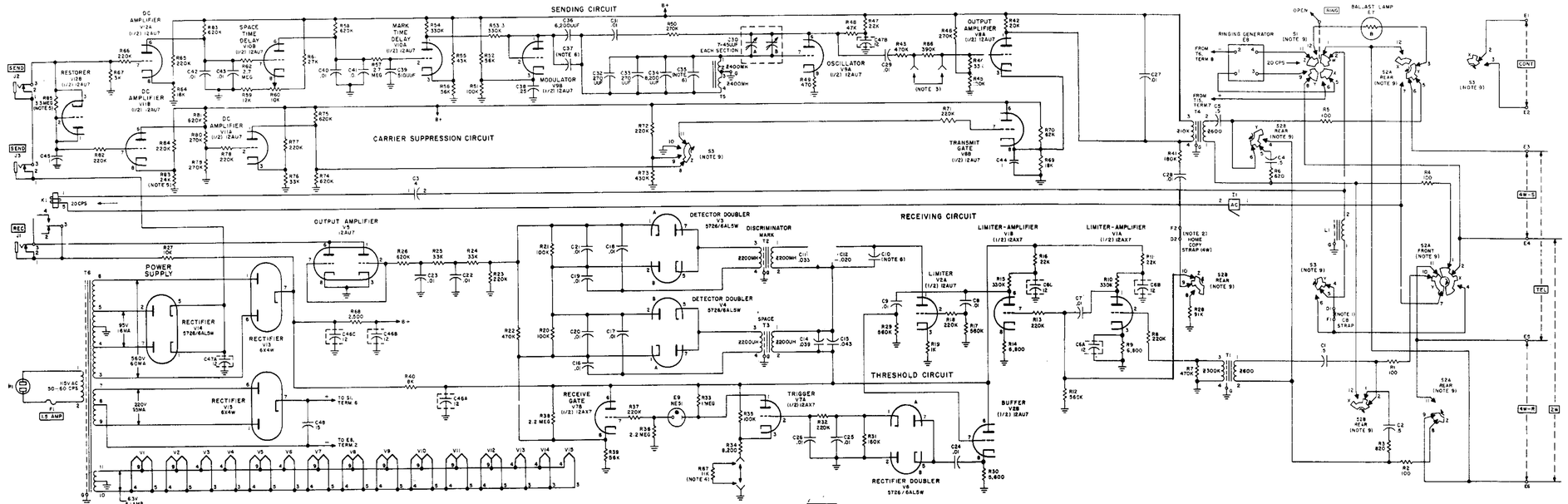
TABLE III – For use with Group III, Temperature Compensating, Style CC

COLOR	TEMPERATURE COEFFICIENT[4]	1st SIG FIG	2nd SIG FIG	MULTIPLIER[1]	CAPACITANCE TOLERANCE		MIL ID
					Capacitances over 10uuf	Capacitances 10uuf or less	
BLACK	0	0	0	1		± 2.0uuf	CC
BROWN	−30	1	1	10	± 1%		
RED	−80	2	2	100	± 2%	± 0.25uuf	
ORANGE	−150	3	3	1,000			
YELLOW	−220	4	4				
GREEN	−330	5	5		± 5%	± 0.5uuf	
BLUE	−470	6	6				
PURPLE (VIOLET)	−750	7	7				
GREY		8	8	0.01			
WHITE		9	9	0.1	± 10%		
GOLD	+100					± 1.0uuf	
SILVER							

1. The multiplier is the number by which the two significant (SIG) figures are multiplied to obtain the capacitance in uuf.
2. Letters indicate the Characteristics designated in applicable specifications: MIL–C–5, MIL–C–91, MIL–C–11272, and MIL–C–10950 respectively.
3. Letters indicate the temperature range and voltage-temperature limits designated in MIL–C–11015.
4. Temperature coefficient in parts per million per degree centigrade.

STD–CE

Figure 13. MIL-STD capaciter color code marking.



NOTES

1. STRAP CONNECTED AS SHOWN ONLY WHEN TH-5/TG IS CONNECTED TO A COMMON BATTERY TELEPHONE EQUIPMENT WITH SWITCH S2 IN 2W POSITION.
2. STRAP CONNECTED AS SHOWN FOR FOUR-WIRE HALF-DUPLEX OPERATION
3. RESISTOR R86 IS NOT PROVIDED IN EQUIPMENTS BEARING ORDERS NO 19650-P-50, 329I-P-52, AND 6438-P-51 (SERIAL NO 736 THROUGH HOH AND 1274 THROUGH 30583).
4. RESISTOR R87 (REFERENCE DESIGNATION ARBITRARILY ASSIGNED) IS NOT PROVIDED ON ALL EQUIPMENTS.
5. RESISTOR R85 IS 2.2 MEG AND RESISTOR R83 IS 36K IN EQUIPMENT BEARING ORDERS NO 19650-P-50, 6438-P-51, 30005-P-51, 3289-P-52, AND 3291-P-52.
6. VALUE FOR CAPACITORS C10, C35, AND C37 ARE DETERMINED DURING CALIBRATION. CAPACITORS REPRESENTED BY THESE REFERENCE DESIGNATIONS MAY CONSIST OF MORE THAN ONE CAPACITOR.
7. UNLESS OTHERWISE SHOWN RESISTANCES IN OHMS AND CAPACITANCES IN uf
8. ▭ INDICATES EQUIPMENT MARKING
9. LETTERS A, B, C, ETC ARE ARBITRARY DESIGNATIONS FOR SWITCH SEGMENTS. SWITCHES ARE SHOWN VIEWED FROM THE KNOB END. SWITCHES S2 AND S3 ARE IN POSITIONS SHOWN BELOW.

Figure 14. Terminal, Telegraph TH-5/TG, schematic diagram.

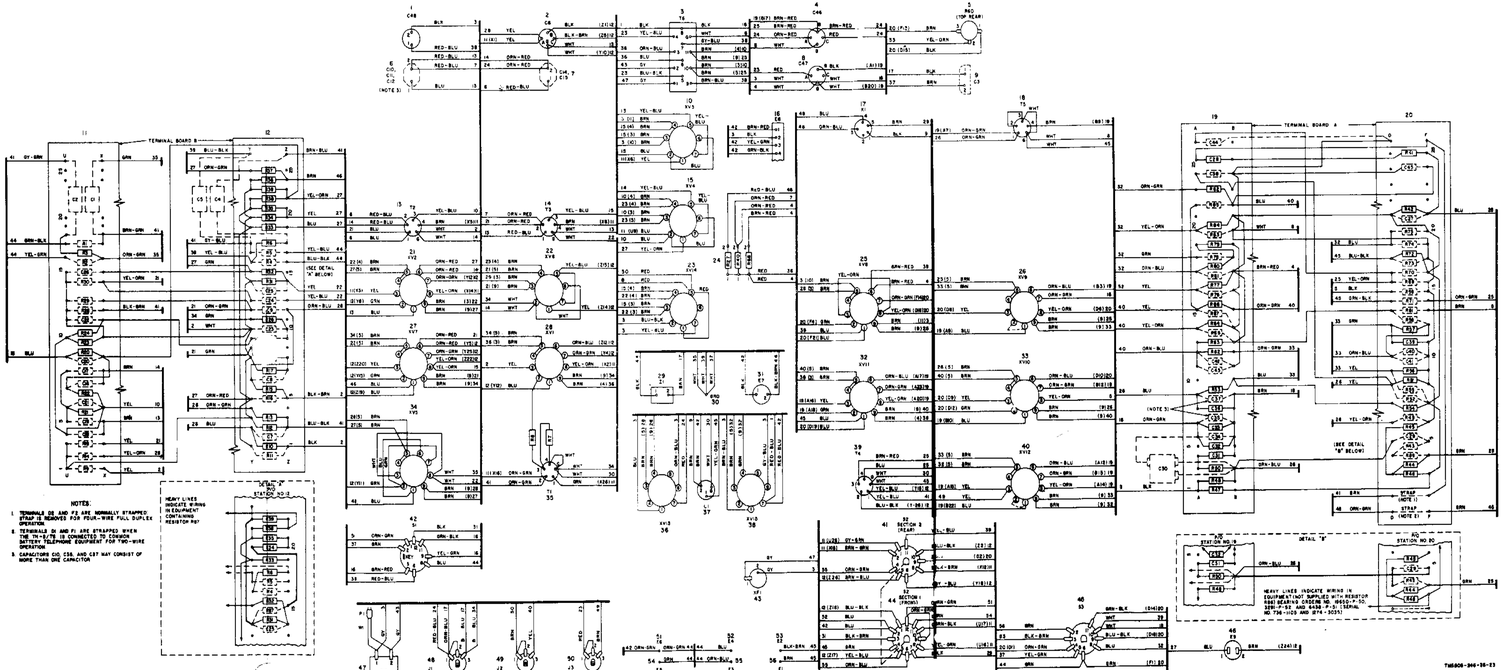


Figure 16. Terminal, Telegraph TH-6/TG, wiring diagram.

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11-587 (2)
11-592 (2)
11-597 (2)
29-56 (2)

NC: State AG (3); Units—-Same as Active Army except allowance is one copy to each unit,
USAR: None.
For explanation of abbreviations used, see AR 320-50.

* U.S. GOVERNMENT PRINTINC OFFICE : 1992 O - 311–831 (44703)