D E P A R T M E N T O F T H E A R M Y T E C H N I C A L M A N U A L

FIELD AND DEPOT

MAINTENANCE MANUAL

COMMUNICATIONS CENTRALS

AN/TSC-20 AND AN/TSC-20A

This copy is a reprint which includes current pages from Changes 1 and 2.

H E A D Q U A R T E R S , D E P A R T M E N T O F T H E A R M Y

1 1 J A N U A R Y 1 9 6 3

WARNING

DANGEROUS VOLTAGES EXIST IN THIS EQUIPMENT

Be careful when working around the power supply circuits or on the 115-volt ac line connections. Be careful when working around the hf transmitting antenna or the transmitting antenna terminals; high radio frequency voltages exist at these points.

DON'T TAKE CHANCES!

EXTREMELY DANGEROUS VOLTAGES

EXIST IN THE FOLLOWING UNITS:

Generator Set, Electrical Portable, Gasoline Engine Driven Model CE-105-AC/WK8.	**208 volts**
Transmitting Set, Radio AN/FRT-53	**3,000 volts**
Converter, Single Sideband CV-157/URR	**1,000 volts**
Receiver, Radio R-390/URR or R-390A/URR	**570 volts**
Radio Set AN/TRC-47	**345 volts**

VENTILATION IS REQUIRED

The shelter must be ventilated when occupied. Be sure the air-conditioner vents are open, the air-conditioner is operating, or the door of the shelter is open when the equipment is operating.

CAUTION

Refer to paragraph 30 (3) before making resistance measurements on the transistorized dual speaker and amplifier panel.

Changes in force: C 1 and C 2

CHANGE 2
No. 2

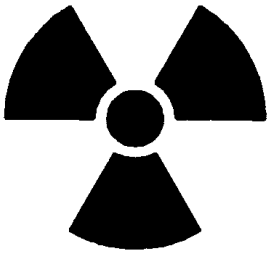
HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., *9 April 1975*

Field and Depot Maintenance Manual
COMMUNICATIONS CENTRALS AN/TSC-20, AN/TSC-20A AND AN/TSC-25

TM 11-5895-288-35, 11 January 1963, is changed as follows:

Inside front cover. Radiation warning is added after existing notices.

WARNING
RADIATION HAZARD



RADIOACTIVE MATERIAL
CONTROLLED DISPOSAL REQUIRED
ACCOUNTABILITY NOT REQUIRED

			STD RW-2
Meter, arbitrary scale	Ra 226	0.22uCi	6625-00-752-7960
Meter	Ra 226	0.69uCi	6625-00-669-0769
Audio level meter	Ra 226	0.40uCi	6625-00-669-0770
Electron Tube	5651		5960-00-262-0286
Raytheon	Co 60	0.2uCi	
Electron Tube	CC3W		5960-00-188-0968
Sylvania	Co 60	1.0uCi	
Electron Tube	0A2WA		5960-00-503-4880
EEVC	U 238	0.1uCi	
CBS Hytron	Ni 63	0.5uCi	
Raytheon	Co 60	0.2uCi	
Electron Tube	5651		5960-00-188-3565
	Co 60	0.2uCi	
Electron Tube	5670		5960-00-188-6584
RCA	Th 232	0.07uCi	
Electron Tube	5671WA		5960-00-262-0286
	Co 60	0.2uCi	
Electron Tube	0A2WA		
EEVC	U 238	0.1uCi	
CBS Hytron	Ni G63	0.5uCi	
Raytheon	Co 60	0.2uCi	
Electron Tube	4CX5000A		5960-00-052-4112
	Th 232	0.0026uCi	

Radiation Hazard Information: The following radiation hazard information must be ideal and understood by all personnel before operating or repairing

Communications Centrals AN/TSC-20, AN/SC-20A, and AN/TSC-25. Hazardous radioactive materials are present in the above listed components of T-593A/TRC, CV-157/URR, SG-15A/PCM, R-390/URR, TS-1194A/U, ME-22A/PCM, 0-330B/FR, 0-672, FR-114/U, TS-505D/U, TS-1060,A,B/GG, PP-1769/U RA, PP-2765/URA, PP-3662/FRT, and 0-672A/URA.

The components are potentially hazardous when broken. See qualified medical personnel and the local Radiological Protection Officer (RPO) immediately, if you are exposed to or cut by broken components. First aid instructions are contained in TB 43-0116, TB 43-0122 and AR 755-15.

NEVER place radioactive components in your pocket.

Use extreme care NOT to break radioactive components while handling them. NEVER remove radioactive components from cartons until you are ready to use them. If any of these components are broken, notify, the local RPO immediately. The RPO will survey the immediate area for radiological contamination and will supervise the removal of broken components.

The above listed radioactive components *will not* be repaired disassembled. Disposal of broken, unserviceable, or unwanted radioactive components will be accomplished in accordance with the instructions in AR 755-15.

By Order of the Secretary of the Army:

FRED C. WEYAND
General United States Army
Chief of Staff

Official:

VERNE L. BOWERS
Major General, United States Army
The Adjutant General

Distribution:

Active Army :
USASA (2)
ACSC-E (2)
Dir of Trans (1)
COE (1)
TSG (1)
USAARENBD (1)
AMC (1)
MICOM (2)
TECOM (2)
TRADOC (2)
ARADCOM (2)
ARADCOM Rgn (2)
OS Maj Comd (4)
LOGCOMD (3)
USACC (4)
MDW
Armies (2)
Corps (2)
HISA (Ft Monmouth) (43)
Fort Gordon (10)
Fort Huachuca (10)
Fort Gillem (10)
Fort Carson (5)
Ft Richardson (ECOM Ofc) (2)
Svc Colleges (1)
USASESS (5)
USAINTCS (3)
USAADS (2)
USAFAS (2)
USAARMS (2)
AD (1) except
SAAD (10)
LBAD (14)
TOAD (14)
USA Dep (2)
Sig Sec USA Dep (2)
Sig Dep (2)
ATS (1)
MAAG (1)
WRAMC (1)
USA RMIS (1)
USAERDAA (1)
USAERDAW(1)
Sig FLDMS (1)
Units org under fol TOE:
11-303 (1)
11-500(AA-AC) (1)

ARNG & USAR: None.
For explanation of abbreviations used, see AR 310-50.

Field and Depot Maintenance Manual

COMMUNICATIONS CENTRALS AN/TSC-20, AN/TSC-20A, AND AN/TSC-25

CHANGE } HEADQUARTERS
No. 1 } DEPARTMENT OF THE ARMY
WASHINGTON, D.C., *22 January 1964*

TM 11-5895-288-35, 11 January 1963, is changed as indicated so that the manual also applies to the following equipment::

Nomenclature	Serial No.
Communications Central AN/TSC-25	1 through 20

Change the title of the manual as shown above.

Page 2, Add the following note below the chapter heading:

Note: Communications Central AN/TSC-25 is similar to Communications Centrals AN/TSC-20 and AN/TSC-20A, with the following major exceptions (par. 2): the external air conditioner has been replaced with an internal air conditioner, the antenna mast has been changed to a hand-cranked collapsible mast, audio patch panels No. 1 and No. 2 have been combined into one audio patch panel, the audio-dc patch panel has been combined with the dc patch panel on the telegraph terminal, and Radio Set AN/TRC-47 and the subscriber packages have been omitted. Information in this manual applies to the AN/TSC-20, AN/TSC-20A, and AN/TSC-25 unless otherwise specified.

Add "(AN/TSC-20(*) only)" in the following places:

Page 2, paragraph 1b:
(10), after "supply."
(12), after "No. 1."
(13), after "No. 2."
(17), after "heater."
(22), after "coupler."
(23), after "coupler."
(24), after "trailer."
(25), after "modified."
Page 5, paragraph 8a, after the heading.
Page 8, figure 2, after the caption.
Page 9, paragraph 8c(3), after the heading.
Page 14, paragraph 13, below the heading.
Figure 6, after the caption.
Page 15, paragraph 14b(1), after the heading.
Page 18, paragraph 16, below the heading.
Page 20, paragraph 19, below the heading.
Page 21, figure 7, after the caption.
Page 25, paragraph 27, below the heading.
Page 26, figure 13, after the caption.
Page 33, paragraph 37b, after the heading.
Page 34, paragraph 37d(2), after the heading.
Page 37, paragraph 41, below the heading.
Page 38, figure 19, after the caption.
Page 39, figure 20, after the caption.
Paragraph 43, below the heading.
Page 48, figure 27, after the caption.
Page 49, figure 30, after the caption.
Page 55, figure 38, after the caption.
Page 56, figure 39, after the caption.
Page 61, figure 45, after the caption.
Page 63, paragraph 58, below the heading.
Page 64, figure 47, after the caption.
Page 77, paragraph 67a(4), after "supply."
Page 78, paragraph 67e, after the heading.
Figure 56, after the caption.
Page 80, paragraph 71, below the heading.
Page 89, figure 62, after the caption.

Change "(fig. 76, TM 11-5895-288-12)" to: (fig. 76, TM 11-5895-288-12, AN/TSC-20(*); fig. 38, TM 11-5895-288-12/1, AN/TSC-25) in the following places:

Page 3, paragraph 4, heading.
Page 4, paragraph 5, heading.
Page 5, paragraphs 6 and 7, headings.
Page 7, paragraph 8b(3), last line.
Paragraph 8c(2), lines 13 and 23.
Page 9, paragraph 8e, heading.
Page 15, paragraph 14b(2) and (3), headings.
Page 16, paragraph 15, heading.
Subparagraph b(1), heading.
Page 18, paragraph 15b(2), (3), and (4), headings.
Page 19, paragraph 17, heading.
Page 20, paragraph 18, heading; and line 13.
Page 23, paragraph 21, heading.
Subparagraphs b, c, and d, headings.
Page 29, paragraph 30c, line 7.
Page 30, paragraph 32e, line 3.
Paragraph 33a, line 11.
Page 31, paragraph 35a, line 10.
Page 40, paragraph 44a, line 7.
Page 77, paragraph 67b, last line.

Page 2, paragraph 1*b*. Make the following changes:

Subparagraph (1). Add after "panel No. 1":

(AN/TSC-20(*)) or security relay panel No. 1 (AN/TSC-25).

Subparagraph (2). Add after "panel No. 2": (AN/TSC-20(*)) or security relay panel No. 2 (AN/TSC-25).

Add subparagraphs (27), (28), and (29) after subparagraph (26): (27) Audio patch panel (AN/TSC 25 only).

(28) MTT-01KW-50U/600B transmitting copuler (AN/TSC-25 only).

(29) MTR-70U-600B/200B receiving copuler (AN/TSC-25 only).

Subparagraph d. Change the last sentence to: The system theory of the AN/TSC-20(*) is covered in TM 11-5895-288-12. The system theory-of the AN/TSC-25 is covered in TM 11-5895-288-12/1.

Delete subparagraphs e, f, and g and substitute:

e. The complete technical manual for the AN/TSC-20(*) includes TM 11-5895-288-12 and the technical manuals and literature listed in appendix I of TM 11-5895-288-12. The complete technical manual for the AN/TSC-25 includes TM 115895-288-12/1 and the technical manuals and literature listed in appendix I of TM 11-5895-288-12/1. The table of components is included in appendix II of TM 11-5895-288 12 and TM 11-5895-288-12/1.

f. The direct reporting, by the individual user, of errors, omissions, and recommendations for improving this manual is authorized and encouraged. DA Form 2028 (Recommended changes to DA technical manual parts lists or supply manual 7, 8 or 9) will be used for reporting these improvements. This form will be completed in triplicate by the use of pencil, pen, or typewriter. The original and one copy will be forwarded direct to Commanding Officer, U. S. Army Electronics Materiel Support Agency, ATTN: SELMS--MP, Fort Monmouth, N. J. 07703. One information copy will be furnished to the individual's immediate supervisor (officer, noncommissioned officer, supervisor, etc.).

g. For applicable forms and records, refer to paragraph 2, TM 11-5895-288-12 or TM 11-5895-288-12/1.

Add paragraph 1.1 after paragraph 1:

1.1. Index of Publications

Refer to the latest issue of DA Pam 310-4 to determine whether there are new editions, changes, or additional publications pertaining to your equipment. DA Pam 310-4 is an index of current technical manuals, technical bulletins, supply manuals (types 4, 6, 7, 8 and 9), supply bulletins, lubrication orders, and modification work orders available through publications supply channels. The index lists the individual parts (-10, -20, -35P, etc.) and the latest changes to and revisions of each equipment publication.

Delete paragraph 2 and substitute:

2. Differences in Models

Maintenance instructions for the components listed below are covered in TM 11-5895-288-12, TM 11-5895-288-12/1, their associated technical manuals, or the literature supplied with the equipment.

Item	AN/TSC-20	AN/TSC-20A	AN/TSC-25
Commercial ac power receptacle (p/o power entrance box).		X	X
Commercial ac power circuit breaker (CB43).		X	X
Dolly assembly	X		
Shelter transporter (Craig model).		X	
Shelter transporter (Gichner model).			X
Signal entrance box binding posts.	20 pairs	25 pairs	25 pairs
Dual-fan housing for AN/FRT-53.		X	
Transmitter exhaust . fan.			X
Transistor Test Set TS-1836/U (model 219B).		X	X
Frequency Meter FR-67/U.	X		
Eput meter, model 7150.		X	
Frequency Meter AN/TSM-16.			X
Hybrid amplifiers		X	X
Receiver, Radio R-390/URR.	X		
Receiver, Radio R-390A/URR.		X	X
Air conditioner, model F-6B-CE.	X	X	
Air conditioner, model CE20VAL6.			X
Dummy Load DA-314/U.			X

Item	AN/TSC-20	AN/TSC-20A	AN/TSC-25
Tone keyer shelf, type 221 model 2.	X	X	
Tone keyer shelf, type 221 model 1.			X
Tone keyer, type 211, model 1.	X	X	
Tone keyer, type 211 model 2.			X
Tone converter shelf, type 222, model 2.	X	X	
Tone converter shelf, type 222, models 4 and 5.			X
Diversity combiner, type 234, model 1.	X	X	
Diversity combiner, type 234, model 2.			X
Line battery power supply, type 228, model 1.	X	X	
Line battery power supply, type 228, model 2.			X
Power supply, type 223, model 1.	X	X	
Power supply, type 223, model 3.			X
Dotter and delay indicator, type 275, model 1.			X
Audio patch panels No. 1 and No. 2.	X	X	
Audio patch panel			X
Audio-dc and de patch panels.	X	X	
Audio-dc patch panel			X
Mast AB-235/G	X	X	
Antenna Support AB 38B/CR.	X	X	
Mast, Assembly AB 746/G.			X
Transmitting antenna coupler TRC-500.	X	X	
Transmitting antenna coupler MTT-01-KW-500 /600B.			X
Receiving antenna coupler RAC-30A.	X	X	
Receiving antenna coupler MTR-70U/ 600B/200B.			X
Power generator, model CE-105-AC/WK8.	X	X	
Power Generator PU-474/M.			X
Subscriber package	X	X	
Radio Set AN/TRC-47.	X	X	

Page 3. Make the following changes:

Paragraph 3, line 5. Add after "AN/TSC-20 (*)": or AN/TSC-25.

Paragraph 4. Make the following changes:

Change the heading to: Control Relay Panel No. 1 (AN/TSC-20(*)) or Security Relay Panel No. 1 (AN/TSC-25).

Subparagraph a, line 6. Change "subscriber package" to: local subscriber.

Page 4, paragraph 5. Delete the heading and substitute: Control Relay Panel No. 2 (AN/TSC-20(*)) or Security Relay Panel No. 2 (AN/TSC-25).

Page 5, paragraph 8. Add subparagraph a.1 after subparagraph a.

a.1. . General (AN/TSC-25). The combined function panel used with the AN/TSC--25 is similar to that used with the AN/TSC-20(*), except that it does not have the eight teletype-writer transmit circuit fuses and has eight additional switches and 5 additional lamps (fig. 17, TM 11-5895-288-12/1). In the AN/TSC-25, the teletypewriter transmit circuit fuses are built into the tone keyers. Eight NORMAL-TEST switches and an associated TEST ALARM lamp are provided for use when making adjustments on the tone converters. Four 4 CHAN REC lamps indicate when the RECEIVE DEMULTIPLEX switch is operated to 4-CHANNEL DIVERSITY.

Page 6, figure 1, notes: Add note 3 after note 2.

3. THE TRANSMIT MULTIPLEX SWITCH CIRCUIT FOR THE AN/TSC-25 IS SIMILAR TO THAT SHOWN FOR THE AN/TSC-20(*), EXCEPT THAT TERMINAL BOARD TB1 IS CHANGED TO TB5 AND ADDITIONAL TERMINAL BOARDS ARE ADDED BETWEEN TERMINAL BOARD TB5 AND THE BLACK PATCH PANEL.

Page 7, paragraph 8c(1). Make the following changes:

Heading. Change "(fig. 2)" to: (fig. 2, AN/TSC-20(*); fig. 2.1, AN/TSC-25).

Delete the fifth sentence and substitute: The combined output from the four tone converters is then routed to the security equipment receiver for decoding.

Page 8, figure 2. Add figure 2.1 after figure 2.

Page 9, paragraph 8. Make the following changes:

Subparagraph c(2), last sentence, line 2. Change "MULTIPLEX" to: DEMULTI-PLEX.

Add subparagraph (4) after subparagraph (3).

(4) *Space and frequency diversity operation* (*AN/TSC-25*). When space and frequency diversity operation is used for message transmission, RECEIVE DE-MULTIPLEX switch S5 (fig. 2.1) is operated to the 4-CHANNEL DIVERSITY position. This operates relay K1 which connects the channel 1 and 2 tone converter pairs in parallel through its contacts. Each tone converter pair will automatically select the proper signal as described in (2) above, with the following exceptions:

(a) Since the same teletypewriter information is transmitted over channels 1 and 2, the inputs to the path A and path B tone converters for channels 1 and 2 will contain identical information, but on a different frequency for each channel.

(b) With switch S5 in the 4-CHANNEL DIVERSITY position, the channel 1 (paths A and B) and channel 2 (paths A and B) tone converter outputs are connected in parallel. The combined output of the channel 1 and 2 tone converters is applied to the security equipment receiver.

Add subparagraph *c.1* after subparagraph c.

c.1. 4 CHAN REC lamps (fig. 38(3), TM 11-5895-288-12/1). Four lamps are associated with the four RECEIVE DEMULTIPLEX switches. When a RECEIVE DEMULTIPLEX switch is operated to 4-CHANNEL DIVERSITY, its associated 4 CHAN REC lamp lights to indicate that the channels are being used for space and frequency diversity operation.

Subparagraph *e(2),* chart, "POWER MONITOR A Lamp" column. After "CONVERTER 1-3", add a reference to footnote "a"; after "CONVERTER 4-6", add a reference to footnote "b"; after "CONVERTER 7-8", add a reference to footnote "c".

Add the following footnotes below the chart:

[a] CONVERTER 1-2 (fig. 38(3), AN/TSC-25).

[b] CONVERTER 3-5 (fig. 38(3), AN/TSC-25).

[c] CONVERTER 6-8 (fig. 38(3), AN/TSC-25).

Page 10, paragraph 8e. Add subparagraph *f* after subparagraph *e*.

f. NORMAL-TEST Switches (fig. 2.1 and 38 (3), TM 11-5895-288-12/1).

(1) *General*. Eight NORMAL-TEST switches (S1 through S8) are provided to enable the tone converters in each pair to be disconnected from each other for testing or maintenance procedures. A TEST ALARM lamp, in parallel with all NORMAL-TEST switches, provides an indication when any switch is operated to the TEST position.

(2) *NORMAL position*. When the NORMAL-TEST switch is operated to the NORMAL position, it connects the outputs of both the path A and path B tone converters of each channel, in parallel, to the output relay circuit in the path A tone converter. This enables the output of the tone converter with the instantaneously stronger signal (selected by the diversity combiner) to apply this signal to the output relay circuit.

(3) *TEST position*. When the NORMAL-TEST switch is operated to the TEST position, it disconnects the output of the path A tone converter from the output of the path B tone converter and connects the output of the path B tone converter to the output relay circuit in the path B tone converter. This enables tests and adjustments to be made on either tone converter individually.

(4) *TEST ALARM lamp*. The TEST ALARM lamp lights when the NORMAL-TEST switch is operated to the TEST position to indicate that the tone converter pair is connected for testing or adjustments and is not connected for space diversity reception (fig. 38(3), TM 11-5895-288-12/'1).

Figure 3. Add the following to the notes:

3. IN THE AN/TSC-25, ANOTHER TERMINAL BOARD IS ADDED BETWEEN TB1 AND THE TRANSFER SWITCH. SEE THE SIGNAL SCHEMATIC DIAGRAM IN TM 11-5895-28812/1.

Page 12, paragraph 12. Make the following changes:

Subparagraph *a*. Add the following after the subparagraph designation:

In the AN/TSC-20(*) only.

Add subparagraph *a.1* after subparagraph *a*.

a.1. In the AN/TSC-25, the alarm unit provides a visual and audible alarm indication when the security equipment in racks 404 and 408 over- heat. The alarm unit consists of four indicator lamps, two crystal diodes, a bell, and two switches.

Subparagraph *c*. Add the following after the subparagraph designation:

In the AN/TSC-20(*) only.

*Page 1*3, figure 5. Add the following to the notes:

5. IN THE AN/TSC-25, VPT-1 NO. 1 AND NO. 2, SUBSCRIBER CALL-1 AND SUBSCRIBER CALL -2 LAMPS DS3 AND DS4, DIODES CR3 AND CR4, AND THE ASSOCIATED WIRING ARE OMITTED; TERMINALS TB1-5, -6, AND -8 ARE NOT USED; TERMINAL TB1-4 IS STRAPPED TO TERMINAL TB1-9; AND THE DESIGNATIONS OF ALARM LAMPS DS5 AND DS6 ARE CHANGED TO DS3 AND DS4, RESPECTIVELY.

*Page 1*5, paragraph 14. Make the following changes :

Subparagraph *a*, line 17. Add the following after "TM 11-5895 288-12":

for the AN/TSC-20(*), or fig. 34, TM 11-5895-288-12/1 for the AN/TSC-25.

Subparagraph *b*. Delete the second sentence and substitute:

In the AN/TSC-20(*), jack circuits 1 through 4 are associated with the send and receive teletypewriter circuits in the subscriber package communications link. In the AN/TSC-25, jack circuits 1 through 4 are provided for teletypewriter communication to a local communications center over landlines.

Subparagraph *b*. Add subparagraph (1.1) after subparagraph (1):

(1.1) Jack circuits I through 4 (fig. 38(1), TM 11-5895-288-12/1 (AN/TSC-25)). Jack circuits 1 through 4 are normalled-through teletypewriter send and receive circuits terminated in the black patch panel. Circuits 1 and 3 are receive circuits, and circuits 2 and 4 are send circuits. Circuits 3 and 4 connect direct to teletypewriter equipment. Circuits 1 and 2 are patched to teletypewriter equipment when required.

*Page 1*6, paragraph 15. Add the following note below heading:

Note

The red patch panel jacks in the AN/TSC-25 perform the same functions as those in the AN/TSC-20(*), except that jack circuits 4 through 9 are used for communication to a local communications center instead of to the subscriber packages.

*Page 1*9, paragraph 16. Add paragraph 16.1 after paragraph 16.

16.1. Audio Patch Panel (AN/TSC-25)

(figs. 35 and 38(1) and (4), TM 11-5895-288-12/1)

The audio patch panel is located in equipment rack 407. It consists of 24 groups of vf jack circuits. Twelve groups of jack circuits are on the top half of the patch panel and 12 are on the bottom half. Each jack circuit consists of six jacks arranged in two adjacent vertical rows, with three jacks in each row. Each jack configuration consists of two LINE jacks, two EQUIP jacks, and two MON jacks. The LINE and EQUIP Jacks are arranged for normalled-through operation. The MON jacks are parallel-connected to the vf circuit. The jack circuits are numbered sequentially from right to left. From the front of the panel, jack circuit 1 is the two adjacent vertical rows of three jacks each, on the extreme upper right; and jack circuit 24 is the two adjacent vertical rows of three jacks each, on the extreme lower left. The three horizontal rows of jacks on the top half and on the bottom half of the patch panel are designated LINE, EQUIP, and MON, reading from top to bottom. Jack circuits 1 through 12 (upper three horizontal rows) are in the receive circuits of the hf communications link between the radio terminal shelter and the distant terminal. Jack circuits 13, 14, 16, and 17 (lower three horizontal rows) are spares. Jack circuits 15 and 18 are connected to telephone TA-43 /PT No. 2 and No. 1, respectively. Jack circuits 19 through 24 are in the transmit circuits of the hf communications link between the radio terminal shelter and the distant terminal. Since the jack circuits operate in an identical manner, a typical jack configuration is described in paragraph 16b.

Paragraph 17. Add the following note below the heading:

Note

In the AN/TSC-20(*), the audio-dc patch panel consists of a single horizontal row of jacks. In the AN/TSC-25, the audio-dc patch panel consists of five horizontal rows of jacks. The upper four rows of jacks perform the same functions as those of the dc patch panel in the AN/TSC-20(*) (TM 11-5859-288-12). The lower row of jacks perform the same functions as described below, except that jack JR5-1 (DOTTER OUT) is connected to the output of the dotter and delay indicator.

Page 20, paragraph 18, Note, line 2. Add after "AN/TSC-20(*)": and the AN/TSC-25.

Page 22, figure 8. Add the following to the notes:

4. IN THE AN/TSC-25, TRANSISTORS Q401, Q402, AND Q403 ARE TYPE 2N301.

Page 23, paragraph 22, lines 3 and 6. After the figure reference in both places, add the following: for the AN,/TSC-20(*) or fig. 29, TM 11-5895-288-12/1 for the AN/TSC-25.

Paragraph *25*. Add the following note below the heading:

Note

In the AN/TSC-25, transmitting antenna

coupler MTT-01KW-50U/500B is used in place of the TRC500 coupler. The MTT-01KW-50U/600B is similar to the TRC 500 and performs the same functions. The circuitry of the MTT-OlKW-50U/600B is similar to that shown in figure 11.

Page 14, paragraph 26. Add the following note below the heading:

Note

In the AN/TSC-25, receiving antenna coupler MTR-70U/200B/600B is used in place of the RAC-30A coupler. The MTR-70U/200B/600B is similar to the RAC-30A and performs the functions given below for the RAC-30A. The circuitry of the MTR-70U/200B/ 600B is similar to that shown in figure 12, except that fuses F1 and F2 are omitted.

Page 28, paragraph 29, line 4. Change "TM 11-5895-288-12)" to:

(TM 11-5895-288-12, AN/TSC-20(*); TM 11-5895-288-12/1, AN/TSC-25).

Paragraph 30a. Delete the second sentence and substitute:

Perform the tests described in paragraphs 85, 86, and 87, TM 11-5895-288-12 for the AN/TSC-20(*), or in paragraphs 67 and 68, TM 11-5895-288-12/1 for the AN/TSC- 25, to sectionalize the fault.

Page 30, paragraph 34, heading. Delete the heading and substitute:

34. Control Relay Panel No. 1 (AN/TSC-20 (*)) or Security Relay Panel No. 1 (AN/TSC-25), Trouble Isolation Procedures

*Page 3*1, paragraph 35, heading. Delete the heading and substitute:

35. Control Relay Panel No. 2 (AN/TSC-20 (*)) or Security Relay Panel No. 2 (AN/TSC-25), Trouble Isolation Procedures

*Page 3*2, figure 15, caption. Delete the caption and substitute:

Control relay panel No. 2 (AN/TSC-20(*)) or security relay panel No. 2 (AN/TSC-25), wiring diagram.

*Page 3*3, figure 16. Reverse the polarities shown on the meters M1 and M2.

Paragraph 37a. Make the following changes:

Line 4. Change "(type 233, model 1)" to: (type 223, model 1, AN/TSC-20(*); type 223, model 3, AN/TSC-25).

Subparagraph (3), line 5. Change "(fig. 62)" to: (fig. 62, AN/TSC(20(*); fig. 62.1, AN/TSC-25).

*Page 3*4, paragraph 37d. Add subparagraph (3) after subparagraph (2).

(3) *Space and frequency diversity operation (AN/TSC 25).* During space and frequency diversity operation, switch S5 is in the 4-CHANNEL DIVERSITY position, operating relay K1. If the teletypewriter signals are continually fading during space and frequency diversity operation, proceed as follows:

(a) Check the signal schematic diagram for circuit operation (fig. 38 (3), TM 11-5895-288-12,/1).

(b) See that NORMAL-TEST switches S1 and S2 are operated to NORMAL.

Check continuity through switch contacts 1-5.

(c) See that relay K1 is operated. Check continuity through relay contacts 6-7, 12-13, 15-16, and 9-10.

(d) Replace defective components (fig. 52).

*Page 3*5, paragraph 39a. Add the following after the last sentence:

Figure 60 is the schematic diagram of the multiple repeat panel.

*Page 3*6, figure 18. Add the following note to the illustration:

6. IN THE AN/TSC-25, LAMP SOCKETS XDS3 AND XDS4, DIODES CR3 AND CR4, AND THE ASSOCIATED WIRING ARE OMITTED; TERMINALS TB1-6, -7, AND -8 ARE NOT USED; TERMINAL TB1-4 IS STRAPPED TO TERMINAL TB1-9; AND THE DESIGNATIONS OF LAMP SOCKETS XDS5 AND XDS6 ARE CHANGED TO XDS3 AND XDS4, RESPECTIVELY.

Page 37, paragraph 40b, heading. Delete the heading and substitute:

b. Alarm Unit, Troubleshooting Chart. Paragraph 41b, heading. Delete the heading and substitute:

b. Subscriber Power Supply Troubleshooting Chart.

Page 43, paragraph 49. Add the following note below the heading:

Note

Transmitting antenna coupler MTT-01KW-50U/600B, used in the AN/TSC-25, is similar to the TRC-500 coupler used with the AN/TSC-20(*).

Paragraph 50. Add the following note below the heading:

Note

Receiving antenna coupler MTR-70U/200B/600B, used in the AN/TSC-25, is similar to the RAC30A coupler used with the AN/TSC-20(*).

Page 44, paragraph 51c, chart. In the "Component" column, after the column heading, add the following: (In the AN/TSC-25, control relay panels are designated security relay panels.)

Page 46, paragraph 52a, line 16. Change "TM 11-5895-288-12" to:

TM 11-5895-288-12 (AN/TSC-20(*)); TM 11-5895-288/12/1 (AN/TSC-25).

Page 48, figure 27. Add figure 27.1 after figure 27.

Figure 29. Change "NOTE" to: NOTES.

Designate the existing note as "1". Add the following:

2. IN THE AN/TSC-25, LAMPS DS3 AND DS4 ARE RELOCATED TO THE POSITIONS SHOWN OCCUPIED BY LAMPS DS5 AND DS6; LAMPS DS5 AND DS6 ARE OMITTED; DIODES CR3 AND CR4 ARE OMITTED.

Paragraph 53, heading. Delete the heading and substitute:

53. Control Relay Panels No. 1 and No. 2 (AN/TSC-20(*)) or Security Relay Panels No. 1 and No. 2 (AN/TSC-25)

Page 50, figure 31. Change " NOTE" to: NOTES.

Designate the existing note as "1". Add the following:

2. IN THE AN/TSC-25, RESISTORS R1 THROUGH R4 ARE OMITTED.

*Page 5*1, figure 32 and 33. Change "NOTE" on each figure to: NOTES.

Designate each existing note as "1". Add the following note to each figure:

2. IN THE AN/TSC-25, THE AUDIO PATCH PANEL CONSISTS OF ONE PANEL WITH SIX HORIZONTAL ROWS OF JACKS WHICH PROVIDE THE SAME FACILITIES AS BOTH AUDIO PATCH PANELS NO. 1 AND NO. 2 IN THE AN/TSC-20(*). JACK AND RESISTOR DESIGNATIONS REMAIN THE SAME.

Figure 33. In the upper left-hand corner of the illustration, change callouts R26 and R27 to R2 and R3, respectively.

Page 52, figure 35. Add the following note to figure 35:

NOTE

IN THE AN/TSC-25, THESE JACKS APPEAR IN THE BOTTOM HORIZONTAL ROW OF THE AUDIO-DC PATCH PANEL AND ARE DESIGNATED JR5-1 THROUGH JR5-23. RESISTOR DESIGNATIONS REMAIN THE SAME.

Page 57, figure 40. Make the following changes:

Delete the caption and substitute:

Control relay panel No. 1 (AN/TSC-20(*)) or security relay panel No. 1 (AN/TSC-25), parts location diagram.

Add the following note to figure 40.

Note

IN THE AN/TSC-25, TERMINAL BOARDS TB1 THROUGH TB6 ARE ARRANGED IN VERTICAL ROWS FROM RIGHT TO LEFT.

*Page 5*8, figure 41. Delete the caption and substitute:

Control relay panel No. 2 (AN/TSC-20(*)) or security relay panel No. 2 (AN/TSC-25), parts location diagram.

Page 77, paragraph 67. Make the following changes:

Subparagraph b. Delete the second sentence and substitute:

To adjust a rheostat to the proper current level, follow the procedures described in paragraph 77c, TM 11-5895-288-12 for the AN/TSC-20(*), or in paragraph 60c, TM 11-5895-288-12/1 for the AN/TSC-25.

Subparagraph c. Delete the third and fourth sentences and substitute:

To adjust one of the KEYER LOOP CURRENT ADJUST CHANNEL rheostats, refer to the procedures given in paragraph 80a, TM 11-5895-288-12 for the AN/TSC20(*), or in paragraph 63b, TM 11-5895-288-12/1 for the AN/TSC-25. To adjust one of the CONVERTER LOOP CURRENT ADJUST rheostats, refer to the procedures given in paragraph 81, TM 11-5895-288-12 for the AN/TSC-20(*), or in paragraph 65a for the AN/TSC-25.

Page 78, paragraph 67d. Delete the third sentence and substitute:

To make the necessary adjustments, follow the procedures given in paragraph 82, TM 11-5895-288-12 for the AN/TSC-20(*) or in paragraph 66 for the AN/TSC-25.

Page 87, figure 61 (foldout). Make the following changes:

Delete the caption and substitute:

Control relay panel No. 1 (AN/TSC-20(*)), or security relay panel No. I (AN/TSC-25), wiring diagram.

Add the following to the notes in the illustration.

4. IN THE AN/TSC-25, TERMINAL BOARDS TB1 THROUGH TB6 ARE ARRANGED IN VERTICAL ROWS FROM RIGHT TO LEFT.

*Page 8*9, figure 62. Add figure 62.1 after figure 62.

*Page 9*3, appendix, introductory statement, after "AN/TSC-20A".

Add: and AN/TSC-25.

Add at bottom of references:

TM 11-5895-288-12/1	Operator and Organizational Maintenance Manual, Communications Central AN/TSC-25.

By Order of the Secretary of the Army:

EARLE G. WHEELER,
General, United States Army,
Chief of Staff.

Official:

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

Distribution:

Active Army:

DASA (3)
USASA (2)
CNGB (1)
OCofSptS (1)
CofEngrs (1)
TSG (1)
CSigO (2)
CofT (1)
USAECDA (1)
USACBRCDA (1)
USACECDA (1)
USACECDA Monmouth Ofc (1)
USAMSCDA (1)
USAOCDA (1)
USAQMCDA (1)
USATCDA (1)
USAADCDA (1)
USAARMCDA (1)
USAAVNCDA (1)
USAARTYCDA (1)
USASWCDA (1)
USCONARC (5)
USAMC (5)
USAECOM (2)
USASMCOM (1)
USASCC (4)
ARADCOM (2)
ARADCOM Rgn (2)
OS Maj Comd (1)
OS Base Comd (1)
LOGCOMD (2)
MDW (1)
Armies (2)
Corps (2)
Carlisle Bks (2)
Instl (2) except
  Ft Monmouth (65)
  Ft Gordon (8)
  Ft Lewis (6)
Ft Huachuca (10)
Ft Hancock (4)
Ft Bragg (2)
Svc Colleges (2)
GENDEP (OS) (2)
Sig Sec, GENDEP (5)
Sig Dep (OS) (6)
Army Dep (1) except
  Lexington (22)
  Sacramento (28)
  Tobyhanna (12)
  Ft Worth (8)
USATC FA (1)
USATC AD (1)
USATC Armor (1)
USATC Engr (1)
USATC inf (1)
USASTC (1)
1st USASA Fld Sta (5)
USA Elct Mat Agcy (10)
Chicago Proc Dist (1)
WRAMC (1)
AMS (1)
USA Mbl Spt Cen (1)
USMR (5)
Sig Fld Maint Shops (1)
USA Elct RD Actv (White Sands) (2)
USA Elct RD Lab, Trp Comd (10)
USA Corps (2)
Units org under fol TOE:
  11-303 (2)

NG: None.
USAR: None.
For explanation of abbreviations used, see AR 320-50.

Technical Manual
No. 11-5895-288-35

HEADQUARTERS,
DEPARTMENT OF THE ARMY
WASHINGTON 25, D.C., *11 January 1963*

COMMUNICATIONS CENTRALS AN/TSC-20

AND AN/TSC-20A

CHAPTER 1

THEORY

Section I. GENERAL

1. Scope

a. This manual covers field and depot maintenance for Communications Centrals AN/TSC-20 and AN/TSC-20A. It includes maintenance instructions appropriate to third, fourth, and fifth echelons for troubleshooting, testing, aligning, and repairing the components listed in b below. It also lists tools, materials, and test equipment for third, fourth, and fifth echelon maintenance. Maintenance instructions for the other major components of the AN/ TSC-20 and the AN/TSC-20A are included in the associated technical manuals or literature supplied with the equipment.

b. The following components of the AN/ TSC-20 and AN/TSC-20A are covered in this manual.

(1) Control relay panel No. 1.
(2) Control relay panel No. 2.
(3) Current limiter panel.
(4) Meter panel.
(5) Combined function panel.
(6) Hybrid unit.
(7) Transfer switch.
(8) Multiple repeat panel.
(9) Alarm unit.
(10) Subscriber power supply.
(11) Black patch panel.
(12) Audio patch panel No. 1.
(13) Audio patch panel No. 2.
(14) Red patch panel.
(15) Audio-dc patch panel.
(16) Antenna patch panel.
(17) Heater.
(18) Dual speaker and amplifier panel.
(19) Blower fan.
(20) RTB-5 terminators.
(21) TDR-002.5 terminators.
(22) TRC-500 coupler.
(23) RAC-30A coupler.
(24) Subscriber package trailer.
(25) Air conditioner, modified.
(26) Reperferator-Transmitter TT178(*)/FG clutch circuit, modified.

c. Official nomenclature followed by (*) is used to indicate all models of the equipment covered in this manual. Thus, Communications Central AN/TSC-20(*) represents Communication Centrals AN/TSC-20 and AN/TSC-20A, Teletypewriter TT-119(*)/FG represents Teletypewriters TT-119/FG and TT-119A/FG, and Reperforator-Transmitter TT-178(*)/FG represents Reperforator-Transmitters TT178/FG and TT-178A/FG.

d. Paragraphs 3 through 28 of this chapter contain detailed circuit theory, where applicable, for the components listed in b above. System theory of the AN/TSC-20(*) is covered in paragraphs 46 through 49 of TM 11-5895-288-12.

e. The complete technical manual for this equipment includes TM 11-5895-288-12. The additional technical manuals and literature required are supplied as part of the AN/TSC-20(*). These manuals are listed in appendix I of TM11-5895-288-12. The table of components is included in appendix II of TM 11-5895-288-12.

f. Forward comments concerning this manual to: Commanding Officer, U.S. Army Electronics Materiel Support Agency, ATTN: SELMS-MP, Fort Monmouth, New Jersey. (DA Form 1598 (Record of Comments on Publications), DA Form 2496 (Disposition Form), or letter may be used).

Note

For applicable forms and records, refer to paragraph 2, TM 11-5895-288-12.

g. Refer to DA Pamphlet 310-4 to determine what Changes to or revisions of this publication are current.

2. Differences in Models

Maintenance instructions for the components listed below are covered in TM 11-5895-288-12, their associated technical manuals, or the literature supplied with the equipment.

Item	AN/TSC-20	AN/TSC-20A
Commercial-ac power receptacle (p/o power entrance box)	Not included	Included
Commercial-ac power circuit breaker (CB43)	Not included	Included
Dolly assembly	Included	Not included
Shelter transporter	Not included	Included
Signal entrance box binding posts	20 pairs	25 pairs
Dual-fan housing for AN/ FRT-43 No. 1 and No. 2	Not included	Included

Item	AN/TSC-20	AN/TSC-20A
Transistor tester, model 219B	Not included	Included
Frequency Meter FR-67/U	Included	Not included
Eput meter, model 7150	Not included	Included
Hybrid amplifiers	Not Included	Included
Receiver, Radio R-390/ URR	Included	Not included
Receiver, Radio R-390A/ URR	Not included	Included

Section II. DETAILED CIRCUIT THEORY

3. General

Paragraphs 4 through 28 describe the theory of operation of all the components listed in paragraph lb. For the theory of operation of all other components of the AN/TSC-20(*), refer to the applicable technical manual or literature supplied with the equipment.

4. Control Relay Panel No. 1

(fig. 76(1) TM 11-5895-288-12)

a. Control relay panel No. 1 is used with Communications S e c u r it y Equipment TSEC/KW-9 to insure that teletypewriter messages from the AN/FGC-25X No. 1 will be encoded before 'transmission to the subscriber package. It also is used to patch test equipment into the security equipment, either directly or through the red patch panel.

b. Control relay panel No. 1 consists of two relays, eight jacks, and four indicators which are associated with the TSEC/KW-9 transmitters and receivers. Since the circuits associated with the TSEC/KW-9 No. 1 transmitter and the TSEC/KW-9 No. 2 receiver are identical (except for reference designations) with the circuits associated with the TSEC/KW-9 No. 3 transmitter and the TSEC/KW-9 No. 4 receiver, only the first two circuits are discussed.

(1) The operating circuit for relay K1 is opened by transmitter TSEC/ KW-9 No. 1 when it is set for clear text. When TSEC/KW-9 No. 1 is set for encrypted text, it closes the operating circuit of relay K1. The circuit to operate relay K1 is from +120 volts direct current (dc) at V-IDF/R terminal 110, through the winding of relay K1, terminal K of P101 of TSEC/KW-9 No. 1, a closed circuit within TSEC/KW-9 No. 1, terminal F of P101 of TSEC/KW-9 No. 1, SET KEYBD jack J1 (break contacts) of control relay panel No.1, to -120 volts dcatV-IDF/Rterminal 116.

(2) Relay K1 operates, closing the path to operate the clutch circuit of the TT-178(*)/FG (AN/FGC25X No. 1) through contacts 1-3. Contacts 4-6 and 7-9 of relay K1 make, closing the send circuit from the TT-178(*)/FG to TSEC/KW-9 No. 1. Contacts 4-5 and 7-8 of relay K1 open after contacts 4-6 and 7-9 make, removing the short-circuit across the send circuit to TSEC/KW-9 No. 1.

(3) When relay K1 is released, the TT-178(*)/FG clutch circuit and the teletypewriter series loop are opened and no signals are routed through the transmitter of TSEC/ KW-9 No. 1. The relay is released either when a switch in the transmitter of TSEC/KW-9 No. 1 is set for clear text or when a plug is inserted into SET KEYBD jack J1, opening the circuit through the relay winding.

(4) The teletypewriter send circuit is normalled-through SET KEYBD jack J1 to the TSEC/KW-9 No. 1 transmitter. KYBD TIE PAIR jack J2 is connected to SET KYBD TIE

PAIR-MISC jack JR6-9 on the red patch panel. By patching SET KEYBD jack J1 to KEYBD TIE PAIR jack J2, test equipment or teletypewriter equipment can be connected from the red patch panel to the TSEC/KW-9 No. 1 transmitter. The SEND INDICATOR lamp, connected across the teletypewriter send circuit at the output of transmitter TSEC/KW-9 No. 1, lights when teletypewriter signals are transmitted th r o ugh TSEC/ KW-9 No. 1.

(5) The output of TSEC/KW-9 No. 2 is normalled-through SET PRINTER jack J4. PRINTER TIE PAIR jack J3 is connected to SET PRINTER TIE PAIR-MISC jack JR6-7 on the red patch panel. Decoded teletypewriter signals are normally routed from the TSEC/KW-9 No. 2 receiver through SET PRINTER jack J4 and the red patch panel to the AN/FGC-25X No. 1 reperforator (TT-178(*)/FG) or page printer (TT-119(*)/FG). If PRINTER TIE PAIR jack J3 is patched to SET PRINTER jack J4, test equipment can be connected from the red patch panel to the TSEC/KW-9 No. 2 receiver. In addition, the 120-voltdc hold battery is connected, through V-IDF/R terminals 111 and 117, through SET PRINTER jack J4, and jacks on the red patch panel, to the receive circuit of AN/FGC-25X No. 1 to prevent it from running open. The REC INDICATOR lamp connected across the receive teletypewriter circuit at the output of TSEC/KW-9 No. 2 lights when teletypewriter signals are being received.

5. Control Relay Panel No. 2

(fig. 76(2) and (3), TM 11-5895-288-12)

a. Control relay panel No. 2 is used with the TSEC/KW-26 to insure that teletypewriter messages from AN/FGC-25X No. 2 will be encoded before transmission to the distant radio terminal. It also is used to patch test equipment into the security equipment, either directly or through the red patch panel. Control relay panel No. 2 consists of relay K1, SET KEYBOARD TIE PAIR jack J1, and SET PRINTER TIE PAIR jack J2.

b. The operating circuit for relay K1 is opened by transmitter TSEC/KW-26 No. 1 when it is set for clear text. When TSEC/ KW-26 No. 1 is set for encrypted text, it closes the operating circuit for relay K1. The circuit to operate relay K1 is from +120 volts dc at V-IDF/R terminal 109, through the winding of relay K1, terminal 3 of P1 of TSEC/KW-26 No. 1, through the closed switch contacts within TSEC/KW26 No. 1, terminal 4 of P1 of TSEC/KW26 No. 1, to -120 volts dc at V-IDF/R terminal 115.

c. Relay K1 operates, closing the path to operate the clutch circuit of the TT-178 (*)/ FG (AN/FGC-25X No. 2) through contacts 1-3. Contacts 4-6 and 7-9 of relay K1 make, closing the send circuit from the TT178(*)/FG to TSEC/KW-26 No. 1. Contacts 4-5 and 7-8 of relay K1 open after contacts 4-6 and 7-9 make, removing the short circuit across the send circuit to TSEC/KW26 No. 1.

d. When TSEC/KW-26 No. 1 is set for clear text, relay K1 releases. The contacts of released relay K1 open the send circuit from the TT-178(*)/FG to TSEC/KW-26 No. 1, open the clutch circuit of the TT178(*)/FG, and place a short across the send circuit at the input to TSEC/KW-26 No. 1.

e. SET KEYBOARD TIE PAIR jack J1 is connected to the SET KYBD TIE PAIRMISC jack JR6-15 on the red patch panel. By patching test equipment to the SET KEYBOARD TIE PAIR jack and patching the SET KYBD TIE PAIR-MISC jack to the teletypewriter series transmit loop, outgoing teletypewriter signals from AN/ FGC-25X No. 2 can be checked. SET PRINTER TIE PAIR jack J2 is connected to SET PRINTER TIE PAIR-MISC jack JR6-13 on the red patch panel through TB2-5 and TB2-6. By patching test equipment to the SET PRINTER TIE PAIR jack and patching the SET PRINTER TIE PAIRMISC jack to the teletypewriter series

receive loop, incoming teletypewriter signals from the TSEC/KW-26 No. 2 receiver can be checked.

6. Current Limiter Panel

(fig. 76 (2) and (3), TM 11-5895-288-12)

a. The current limiter panel is used to adjust the current level in the teletypewriter transmit and receive loops. The current limiter panel consists of rheostats R1 through R16.

b. KEYER LOOP CURRENT ADJUST CHANNEL rheostats R1 through R8 are located in the teletypewriter transmit channel loop (1 through 8) between AN/ FGC-25X No. 1 and the tone keyers. The rheostats are used to adjust the loop current to 60 milliamperes.

c. CONVERTER LOOP CURRENT ADJUST CHANNEL rheostats R9 through R16 are located in the teletypewriter receiver loops (9 through 16) between the tone converters and AN/FGC-25X No. 2. The rheostats are used to adjust the loop current to 60 milliamperes.

7. Meter Panel

(fig. 76 (4), TM 11-5895-288-12)

The meter panel is used to check dc current in the teletypewriter transmit and receive loops and to measure audio signal levels in volume units. The meter panel consists of volume unit (vu) meter M1 and milliammeter M2. Vu meter M1 is connected to the VU MTR jacks on the audio-dc patch panel. Audio signals can be patched to the jack for measurements by the vu meter. Milliammeter M2 is connected to the DC MA jack on the audio-dc patch panel. The jack can be used for patching into a teletypewriter loop for measurement of loop current.

8. Combined Function Panel

a. General. The combined function panel is a part of the teletypewriter transmit and receive circuits in the high-frequency (hf) radio communication link. The panel is located on equipment rack 407 in the radio terminal shelter (fig. 4, TM 11-5895-288-12). Eight switches are provided to change from space diversity operation (two-channel diversity) to space and frequency diversity operation (four-channel diversity) when greater reliability of the teletypewriter circuits is required under adverse radio propagation and reception conditions. Eight fuses with integral blown-fuse indicators are mounted on this panel and are used in the teletypewriter transmit circuits to protect the eight tone keyers from damage due to excessive current. Also, the combined function panel contains 14 lamps to indicate that power is being supplied by the power supplies (type 223, model 1) located on the tone keyer, the tone converter, the multiplexer, and the demultiplexer shelves. The functions of the switches, the fuses, and the lamps are described in b through e below.

b. TRANSMIT MULTIPLEX Switches.

(1) *General* (fig. 1). Four TRANSMIT MULTIPLEX switches (S1 through S4) enable the adjacent tone keyer channels (1 and 2, 3 and 4, 5 and 6, or 7 and 8) to be used for either space diversity operation or space and frequency diversity operation. During space diversity operation, up to eight teletypewriter send signals can be applied to the eight separate tone keyers, respectively. During space and frequency diversity operation, the same teletypewriter send signal is applied simultaneously to two adjacent channel tone keyers. Any or all of the four pairs of adjacent tone keyer channels can be used for space and frequency diversity operation. Since the operation of all four switches is identical, only TRANSMIT MULTIPLEX 1-2 switch S1 will be discussed. Switch S1 is associated with tone keyer channels 1 and 2.

(2) *Space diversity operation*. TRANSMIT-MULTIPLEX 1-2 switch S1 (fig. 1) is placed in the 2-CHANNEL DIVERSITY position if only space diversity operation is desired. The encoded teletypewriter send signal from the TSEC/KW-26 No. 1 transmitter is applied to the

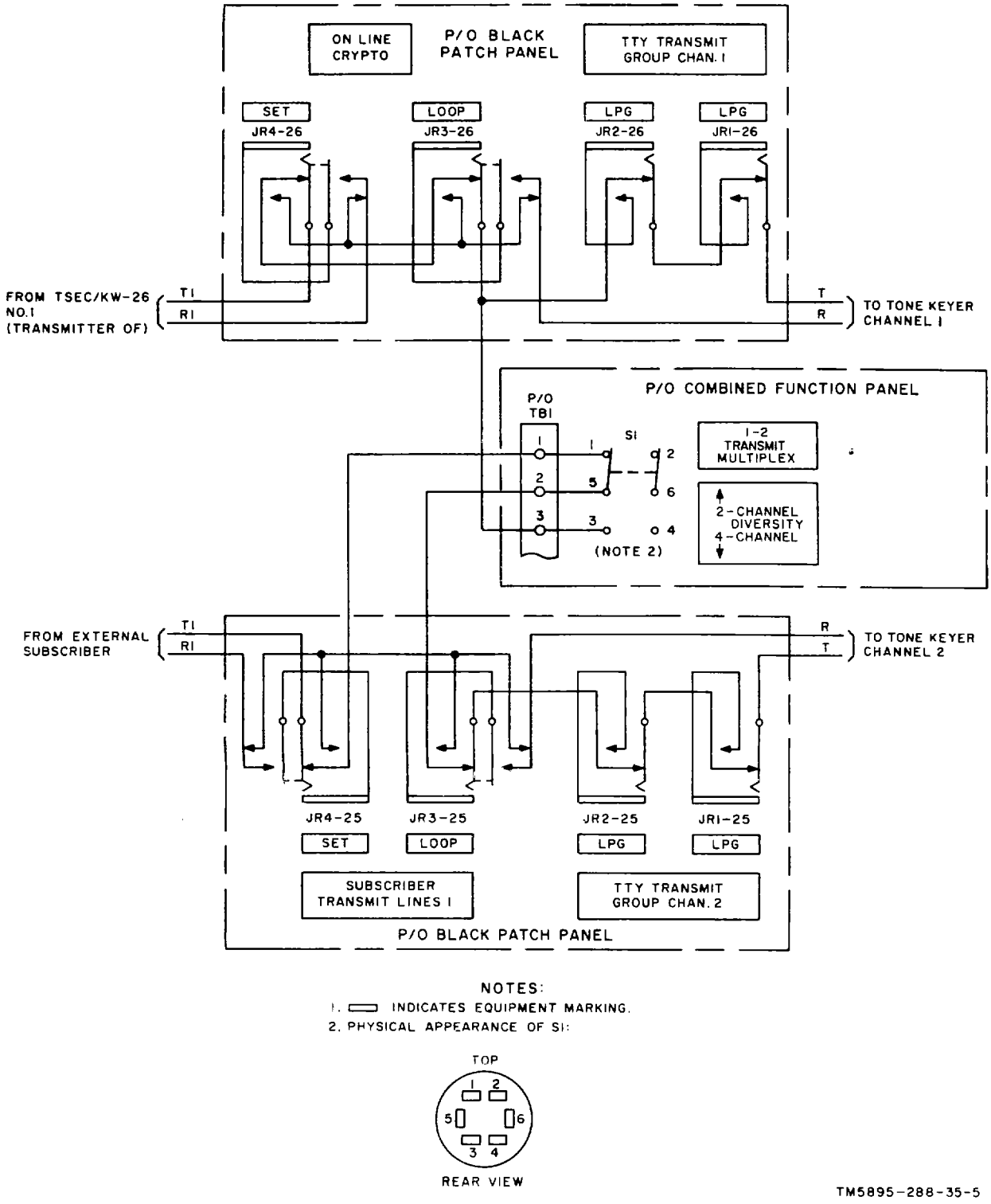


Figure 1. Combined function panel, transmit multiplex switch, schematic diagram.

channel 1 tone keyer through the normalled-through jacks on the black patch panel. The teletypewriter send signal from the external subscriber is applied to the channel 2 tone keyer over a similar route except that TRANSMIT MULTIPLEX 1-2 switch S1 is in the series path of the signal to the channel 2 tone keyer when the switch is in the 2-CHANNEL DIVERSITY position.

(3) *Space and frequency diversity operation*. If the propogation conditions are severe enough to affect the reliability of the transmitted or received teletypewriter messages, space and frequency diversity operation is used. This is accomplished by setting TRANSMIT MULTIPLEX 1-2 switch S1 (fig. 1) to the 4-CHANNEL DIVERSITY POSITION. The encoded teletypewriter send signal from the TSEC/ KW-2 6 No. 1 transmitter is applied to the channel 1 tone keyer over the path described in space diversity operation ((2) above) and simultaneously is applied to the channel 2 tone keyer through closed contacts 3 and 5 of TRANSMIT MULTIPLEX 1-2 switch S1 (in the 4-CHANNEL DIVERSITY position) on the combined function panel. In the 4-CHANNEL DIVERSITY position, switch S1 opens the signal path from the external subscriber on channel 2 to insure that no other signals will be applied to channel 2 during space and frequency diversity operation. The frequency shift keyed outputs from the channel 1 and channel 2 tone keyers are combined and applied to one input channel of multiplexer No. 1. The identical teletypewriter message information is contained in both tone keyer outputs, but indifferent frequency channels (fig. 76 (2), TM 11-5895-288-12).

c. RECEIVE DEMULTIPLEX Switches.

(1) *General* (fig. 2). Four RECEIVE DEMULTIPLEX switches (S5 through S8) enable adjacent tone converter channels (1 and 2, 3 and 4, 5 and 6, or 7 and 8) to be used for either space diversity operation or space and frequency diversity operation. During space diversity operation, each pair of tone converters (one in path A and one in path B) accepts only that portion of the signal associated with a specific teletypewriter channel. The instantaneously larger signal of the two is selected by a diversity combiner and routed to the TSEC/KW-26 receiver for decoding. When both space and frequency diversity operation are used, two adjacent tone converter channels (two pairs of tone converters) accept the same input signal. The combined output from the four tone converters is then routed to the TSEC/KW-9 receiver for decoding. Since the operation of all four switches is identical, only RECEIVE DEMULTIPLEX 1-2 switch S5 will be discussed. Switch S5 is associated with tone converter channels 1 and 2.

(2) *Space diversity operation*. RECEIVE DEMULTIPLEX 1-2 switch is placed in the 2-CHANNEL DIVERSITY position if only spac6 diversity operation is desired. When receiving conditions are good, space diversity operation is normally used. Two antennas receive the same hf radio signal and route it over separate paths (A and B), but identical circuits, to the demultiplexers (fig. 76 (4), TM 11-5895-288-12). Demultiplexer No. 1 is in path A, and demultiplexer No. 3 is in path B. The output from demultiplexer No. 1, which can contain a maximum of eight different frequency-shifted signals, is applied to the path A tone converters, and the output from demultiplexer No. 3 is applied to the path B tone converters (fig. 76 (3), TM 11-5895-288-12). There is a path A and a path B tone converter

associated with each teletypewriter channel. Each tone converter automatically selects the frequency shifted signal associated with its particular teletypewriter channel. In this subparagraph, only the signals transmitted over teletypewriter channels 1 and 2 will be discussed. Since the same signal is routed over receive paths A and B, both tone converters of teletypewriter channel 1 receive identical information. Also, both channel 2 tone converters (path A and path B) receive identical information. Each teletypewriter channel receives different messages. The outputs from the tone converters of

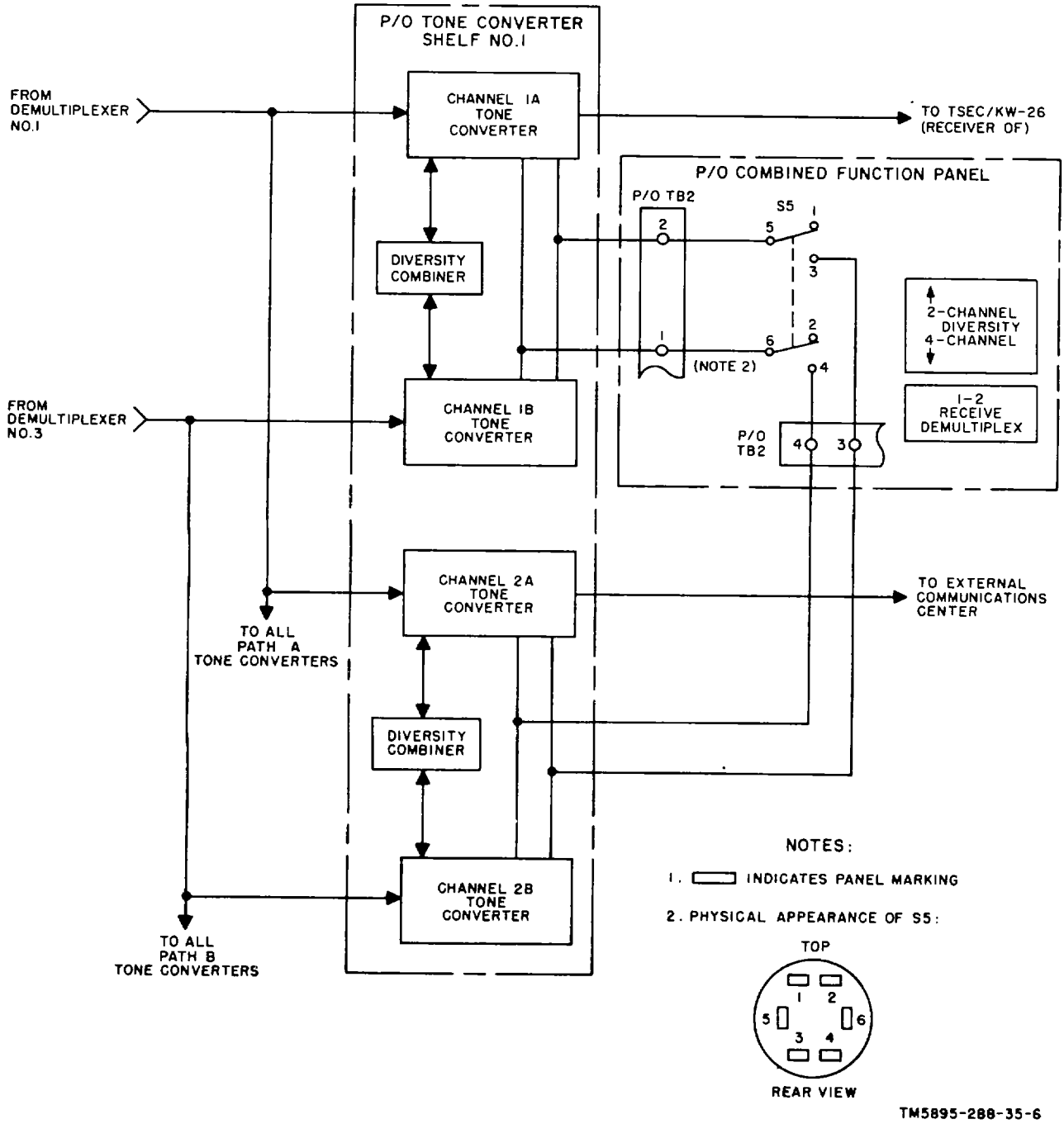


Figure 2. Combined function panel, receive demultiplex switch, schematic diagram.

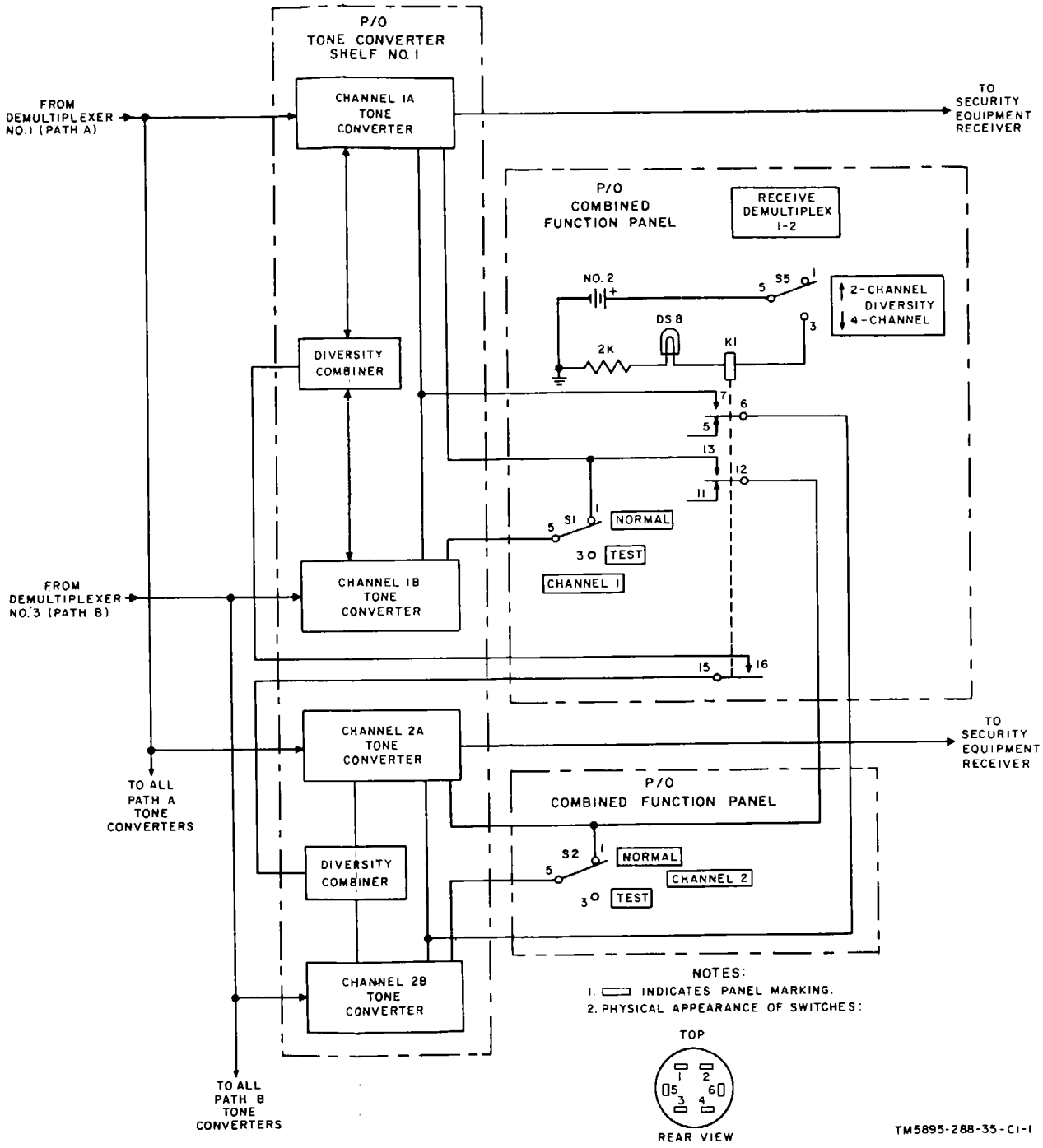


Figure 2.1. Combined function panel, receive demultiplex switch, simplified schematic diagram (AN/TSC-25).

channel 1 are sampled by the channel 1 diversity combiner and the instantaneously stronger signal is applied to the TSEC/KW-26 No. 2 receiver. The instantaneously stronger signal sampled by the channel 2 diversity combiner is applied to the security equipment at an external communications center. There is no path through RECEIVE MULTIPLEX 1-2 switch S5 when the switch is in the 2-CHANNEL DIVERSITY position for space diversity operation.

(3) *Space and frequency diversity*. When space and frequency diversity is used for message transmission, RECEIVE DEMULTIPLEX switch S5 (fig. 2) is placed in the 4-CHANNEL DIVERSITY position. The tone converters automatically select the proper signal, as described in (2) above, with the following exceptions:

(*a*) Since the same teletypewriter information is transmitted over channels 1 and 2, the inputs to the channel A and channel B tone converters for channels 1 and 2 will contain identical information, but on a different frequency for each channel.

(*b*) With switch S5 in the 4-CHANNEL DIVERSITY position, the channel 1 (paths A and B) and channel 2 (paths A and B) tone converter outputs are connected in parallel. The combined output of channels 1 and 2 tone converters are applied to the TSEC/ KW-26 No. 2 receiver.

d. Fuses (fig. 76 (2), TM 11-5895-288-12). Each of the eight teletypewriter transmit channels has a fuse in its circuit to protect the tone keyer. If the current in the teletypewriter send circuit should exceed 125 milliamperes, the fuse will blow and its associated blown-fuse indicator will light. The indicator is in parallel across the fuse and is normally extinguished when the fuse is good. When the fuse blows, the input circuit to the channel 1 tone keyer is opened, preventing any damage to the tone keyer.

e. Power Monitor Lamps (fig. 76 (2) TM 11-5895-288-12).

(1) The 14 power monitor lamps on the combined function panel indicate the presence of power from the power supplies on the tone keyer, the tone converter, the multiplexer, and the demultiplexer shelves. The 14 lamps are grouped in pairs designated POWER MONITOR A and B. The POWER MONITOR A lamp is associated with the main power supply andthe POWER MONITOR B lamp is associated with the alternate or standby power supply. All power monitor lamps are normally lighted to indicate that their associated power supply is available as a power source. When a power supply fails, its associated lamp is extinguished to indicate the failure. The power supply to be used for operation is selected by operating the power supply selector switch S1 on the automatic power supply control at the rear of the associated shelf. This has no effect on the operation of the power monitor lamps.

(2) Listed below are the power monitor lamps, the main or standby power supply being monitored, and the location of the power supply:

POWER MONITOR A lamp	POWER MONITOR B Lamp	Main or standby power supply	Location of power supply
KEYER 1-8	---	Main	Tone keyer shelf.
	1	Standby	Tone keyer shelf.
CONVERTER 1-3 (fig. 76 (3))	---	Main	Tone converter shelf No. 1.
CONVERTER 4-6	---	Main	Tone converter shelf No. 2.
CONVERTER 7-8	---	Main	Tone converter shelf No. 3.
	2	Standby	Tone converter shelf No. 1.
	3	Standby	Tone converter shelf No. 2.
	4	Standby	Tone converter shelf No. 3.

POWER MONITOR A lamp	POWER MONITOR B Lamp	Main or standby power supply	Location of power supply
DEMUX 1-2 (fig. 76 (4))	---	Main	Demultiplexer shelf No. 1.
DEMUX 3-4	---	Main	Demultiplexer shelf No. 3.
	5	Standby	Demultiplexer shelf No. 1.
	6	Standby	Demultiplexer shelf No. 3.
MUX 1-2	---	Main	Multiplexer shelf No. 1.
	7	Standby	Multiplexer shelf No. 1.

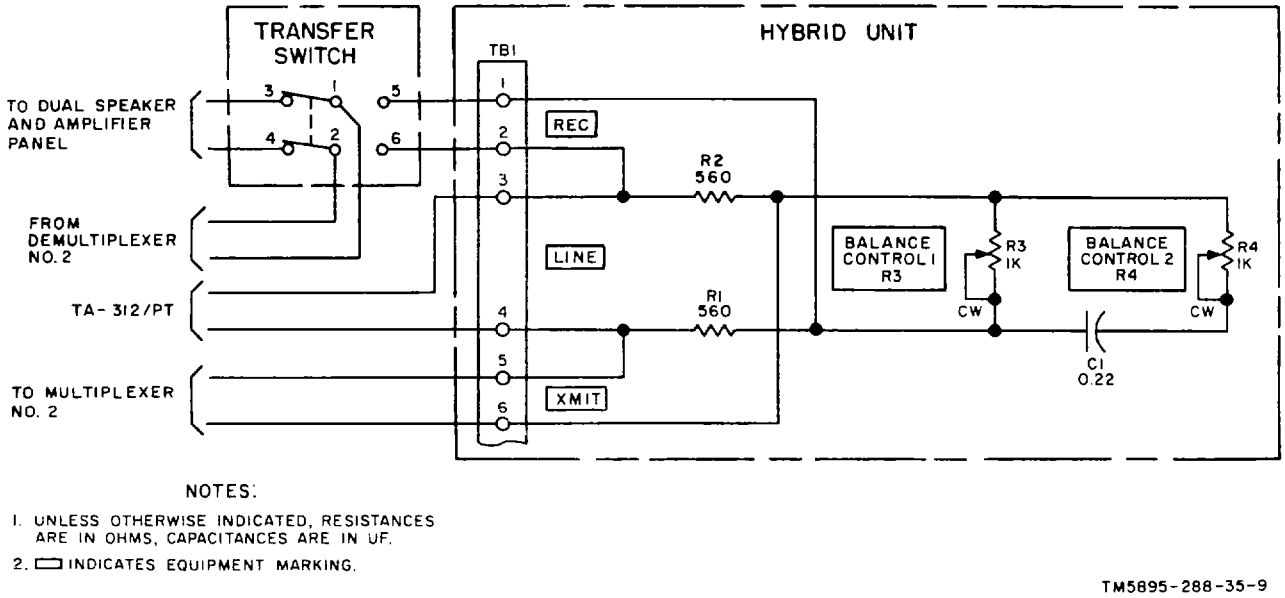


Figure 3. Hybrid unit and transfer switch, schematic diagram.

9. Hybrid Unit

a. The hybrid unit provides two-wire to four-wire operation for the engineer's order-wire circuit and insures that there will be no interference between the transmit and receive signals. The hybrid unit (fig. 3) consists of resistors R1 and R2, BALANCE CONTROL 1 rheostat R3, BALANCE CONTROL 2 rheostat R4, capacitor C1, and terminal board TB1.

b. During operation, resistors R1 and R2, a balancing circuit consisting of rheostats R3 and R4 and capacitor C1, and Telephone Set TA-312/PT function in a bridge circuit (fig. 4). The received voice-frequency (vf) signal path is from demultiplexer No. 2 through TB1-1 (REC) to A (fig. 4) where it splits over two parallel paths to B. One path is through capacitor C1 and rheostats R3 and R4, and resistor R2, to B; the other path is through resistor R1, TB1-4, TA-312/PT, and TBI-3, to B. From B, the vf signal goes through TB1-2 and back to demultiplexer No. 2. The transmitted vf signal path is from multiplexer No. 2 through TB1-6 (XMIT) to D (fig. 4) where it splits over two parallel paths to C. One path is through rheostats R3 and R4 and capacitor C1, and resistor Rlto C; the other path is through resistor 1R2, TB1-3, TA-312/PT, and TB 1-4 to C. From C, the vf signal goes through TB1-5, back to multiplexer No. 2.

c. The balancing circuit (fig. 4) is adjusted to match the impedance of the TA312/PT. Since R1 has the same value as R2, ad equals bc, and ac equals bd. Therefore, when vf signals are received, the potential at D equals the potential at C, and no current flows between TB1-5 andTB1-6. When vf signals are transmitted from the TA-312/PT, the potential at A equals the potential at B, and no current flows between TB1-1 and TB1-2.

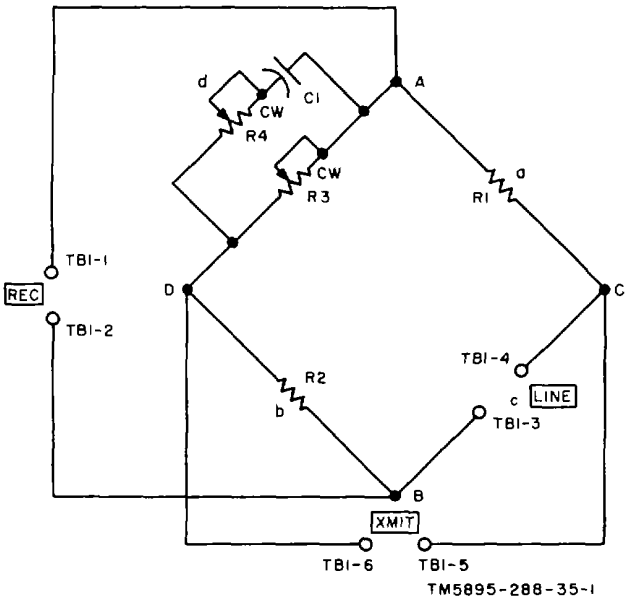


Figure 4. Hybrid unit bridge circuit, simplified schematic diagram.

10. Transfer Switch (fig. 3)

The transfer switch is used to connect the engineer's order-wire receive circuit from demultiplexer No. 2 either to the dual speaker and amplifier panel or to the TA-312/PT through the hybrid unit. When contacts 1-3 and 2-4 are closed, the input signal is applied to the dual speaker and amplifier panel. When contacts 1-5 and 2-6 are closed, the input signal is applied to the hybrid unit REC terminals.

11. Multiple Repeat Panel (fig. 60)

a. During normal operation, the eight teletypewriter loops are completed through the closed contacts of switches SIGNAL 1 through 8 in the multiple repeat panel. The multiple repeat panel is used during testing to key from one to eight teletypewriter channels.

b. The multiple repeat panel contains nine polarized relays (control relay K1 and slave relays K2 through K9), eight SIGNAL switches (S1 through S8), three jacks (OPR J1, SIG J2, and BIAS J3), and three indicator fuses (OPR F3, SIG F2, and BIAS F1). Relay K1 has a signal winding and a bias winding. Relays K2 through K9 have an operate winding and a bias winding. Simplified schematic diagrams showing the operate and bias winding circuits are in B and C, figure 60. Relay K1 controls the operation of slave relays K2 through K9. Current flow through the nine relays is controlled by local battery loop control No. 1.

c. During normal operation, SIGNAL switches S1 through S8 are closed, completing the eight teletypewriter loops through section A of the switches. Dc voltage is applied to the multiple repeat panel from local battery loop control No. 1. The path of the bias current is through TB1-5, current-limiting resistor R18, break contacts of BIAS jack J3, BIAS fuse F1, the bias windings of relays KlthroughK9, and TB1-6. The bias windings are wired so that 30 milliamperes flows through the bias winding of relay K1 (B, fig. 60) and 7.5 milliamperes flows through the bias windings of relays K2 through K9. The path of the signal current which operates master relay K1 is through TB1-3, the break contacts of SIG jack J2, SIG fuse F2,the signal winding of relay K1, and TB1-4. Because 60 milliamperes flows through the signal winding of relay K1 and only 30 milliamperes flows through the bias winding, the relay operates and contacts 4-6 close. Resistor R1 and capacitor C1 suppress sparking at the contacts of the relay.

d. When relay K1 contacts 4-6 close, the operate current path is completed through TB1-1, the break contacts of OPRjackJ1, OPR fuse F3, relay K1 contacts 4-6, the operate windings of relays K2 through K9 in series, and TB1-2. Fifteen milliamperes flows through each operate winding (C, figure 60). Since this current is twice the current flowing through the bias windings, relays K2 through K9 operate, and contacts 4-6 of each relay close. In each case, contacts 4-6 are in parallel with the contacts of section A of the associated SIGNAL switch. Capacitor C2 and resistor R2, capacitor C10 and resistor R3, and the corresponding capacitors and resistors for each of the other slave relays suppress sparking at the contacts of the relays.

e. When the multiple repeat panel is used during testing to key one or more

teletypewriter channels, the SIGNAL switches for the channels to be keyed are opened. The transmitter-distributor of the AN/FGC-25X or the output of Test Set TS2/TG is patched into SIG jackJ2. When the patch cord plug is inserted into the SIG jack, either the transmitter-distributor or the TS-2/TG is connected in series with the signal winding of relay K1. Mark and space signals are applied to the signal winding of relay K1. During a space signal, current is removed because no voltage is applied, and the current through the bias winding of relay K1 causes contacts 4-6 to open. No current flows through the operate windings of relays K2 through K9, and the current through the bias windings of these relays causes contacts 6-7 of each relay to close; this opens the series teletypewriter loop on each channel where the SIGNAL switch is open, and thereby generates a space signal. When a mark signal is applied, current flows through the signal winding of relay K1, which causes contacts 4-6 to close, and applies current to the operate windings of relays K2 through K9. Contacts 4-6 of each of these relays close, and the teletypewriter series loop (for each channel where the SIGNAL switch is open) is completed so that a mark signal is generated.

f. Indicator fuses OPR F3, SIG F2, and BIAS F1 protect the multiple repeat panel relay circuits from overloads. In each case, the indicator lights when the fuse blows.

12. Alarm Unit (fig. 5)

a. The alarm unit provides a visual and an audible indication when the TSEC/KW-9 or TSEC/KW-26 equipment rack overheats, or when a telephone call is received from either of the- subscriber packages. The alarm unit consists of six indicator lamps, four crystal diodes, a bell, and two switches.

b. If the temperature in equipment rack 404 (TSEC/KW-9 equipment) rises above 35° C (95° F), a thermal switch in the rack closes, and 115 volts alternating current (ac) is applied from TB1-2, the thermal switch, and TBl-1, to KW-9 OVERHEAT indicator DS1. Indicator DS1 is connected to the common side of the 115-volt line at TB1-10. The KW-9 OVERHEAT indicator lamp lights. In addition, the 115 volts is applied to diode CR1, which acts as a half wave rectifier and back-biases diodes CR2, CR3, and CR4 so that no current can flow through indicator DS2, DS3, or DS4 unless one of them receives 115 volts ac. The rectified voltage is applied to bell DS7 through closed contacts 5-3 of KW-9 OVERHEAT ALARM STOP switch S1, voltage-dropping resistor R1, and bell DS7 to the common side of the 115-volt line at TB1-10. To disable bell DS7 during troubleshooting, the KW-9 OVERHEAT ALARM STOP switch is operated so that contacts 6-2 are closed, which opens the bell circuit. The bell stops ringing, but the KW-9 OVERHEAT ALARM DISABLED indicator DS5 circuit is completed from TB1-9 through contacts 6-2 of switch S1 and TBl-10. The KW-9 OVERHEAT ALARM DISABLED indicator and the KW-9 OVERHEAT indicator remain lighted until the trouble is corrected. When the thermal switch in equipment rack 404 opens, it extinguishes indicator DS1, by breaking the circuit to the 115 volt ac source. KW-9 OVERHEAT ALARM STOP switch S1 must then be operated to extinguish KW-9 OVERHEAT ALARM DISABLED indicator DS5. The KW-26 OVERHEAT indicator, DS2, diode CR2, KW-26 OVERHEAT ALARM STOP switch S2, and KW-26 OVERHEAT ALARM DISABLED indicator DS6 operate in the same way, but in conjunction with the thermal switch in rack 408.

c. When a telephone call is originated by subscriber package No. 1, a relay in VPT- 1 No. 1 is operated, and 115 volts ac is applied through TB1-6, the closed relay contacts, and TB1-5 to SUBSCRIBER CALL-1 indicator DS3. Indicator DS3 is connected to the common side of the 115-volt line at TB1-10. The SUBSCRIBER CALL-1 indicator lamp lights, showing that a call has been originated. The 115-volt ac is also applied, through half-wave rectifier diode CR3 and voltage-dropping resistor R1, to bell DS7 which is connected to the common side of the 115-volt line at TB1-10. Diode CR3, resistor R1, and bell DS7 perform the

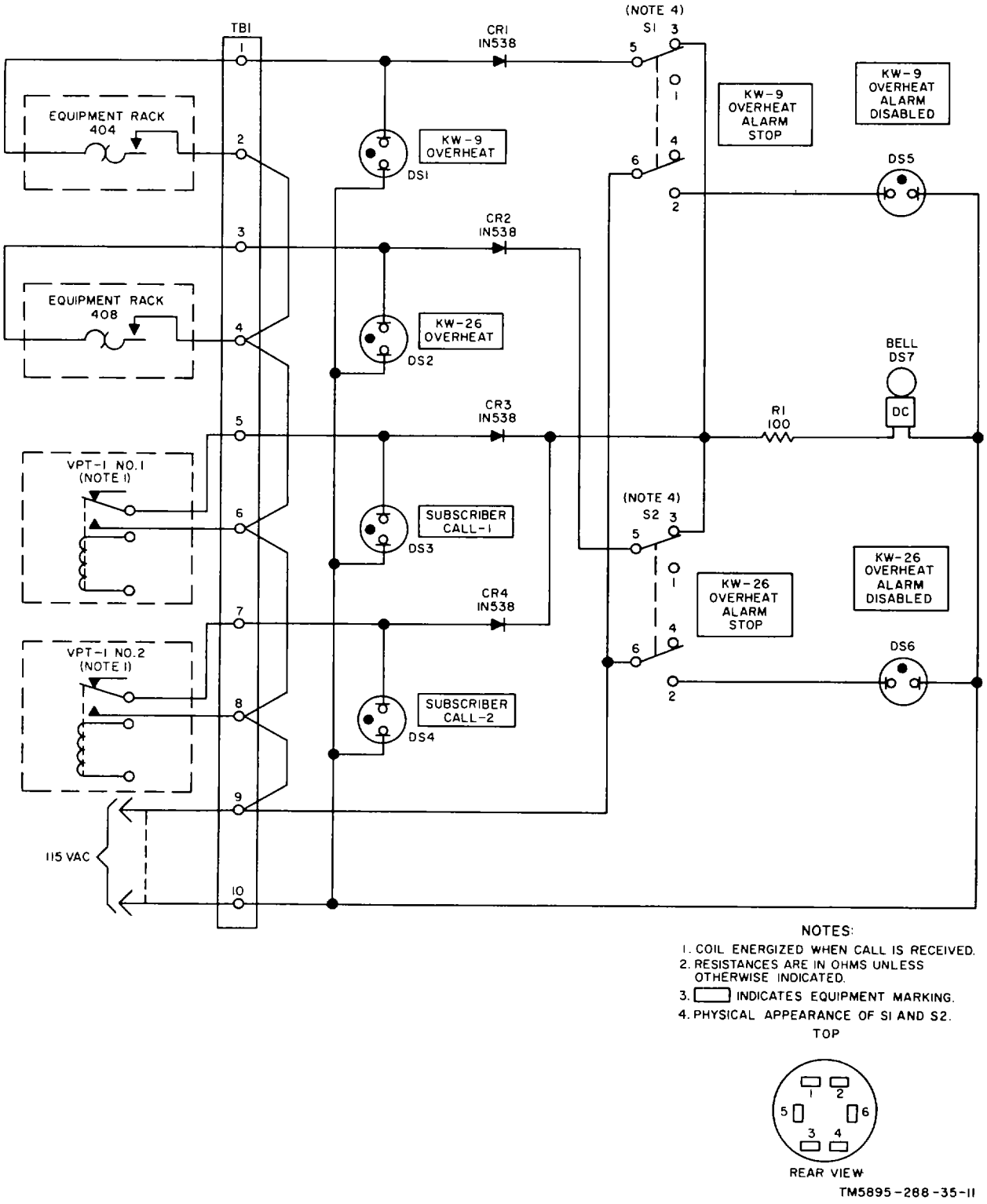


Figure 5. Alarm unit, schematic diagram.

same function as described in b above for the overheat alarm circuits. The bell rings as an audible indication of the incoming call. SUBSCRIBER CALL-2 indicator DS4

and crystal diode CR4 operate in the same way, but in conjunction with a relay in VPT-1 No. 2.

13. Subscriber Power Supply (fig. 6)

a. The subscriber power supply consists of two identical dc power supplies (except for reference designation numbers); therefore, only the first power supply is described. These power supplies are used to supply loop current for the teletypewriter circuits in the subscriber package.

b. The 115-volt ac input is applied at TB1-5 and TB1-6 (common). The primary of transformer T1 is connected to these two terminals. The two power supplies are connected in parallel across the secondary of the transformer. When SUPPLY 1 switch S1 is set to ON, the input voltage is applied to a full-wave rectifier (CR1 through CR4) through SUPPLY 1 AC IN indicator fuse F1, the closed switch contacts, and current-limiting resistors R1 and R2. The dc output of the rectifier is filtered by capacitor C1 and resistor R3 and applied across SUPPLY 1 DC indicator DS1, which lights to show that the power supply is operating. SUPPLY 1 DC ADJ rheostat R5 is in series with the load. The 120-volt dc output appears across TB1-1 and TB1-2. When a portable milliammeter is patched to the

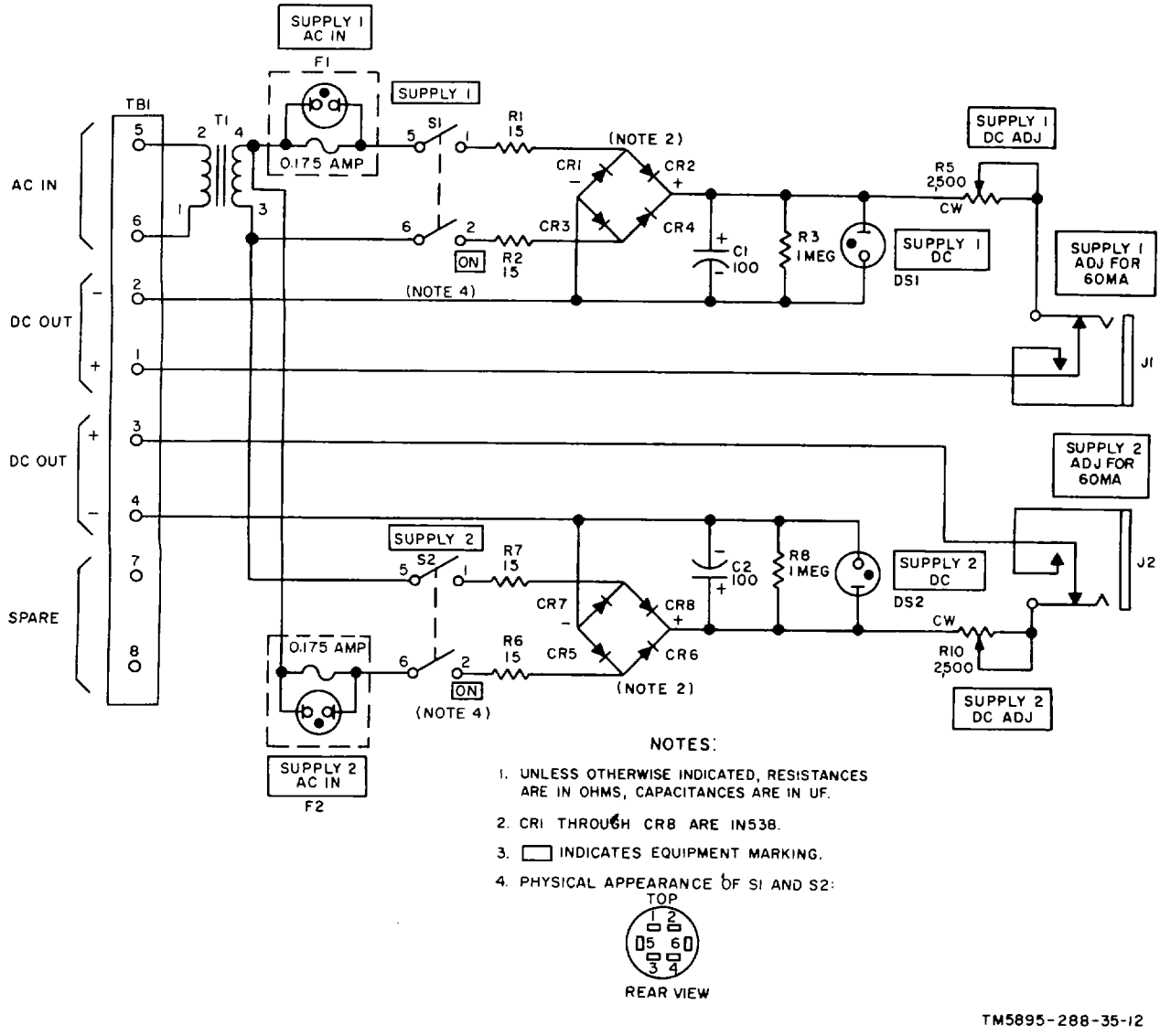


Figure 6. Subscriber power supply, schematic diagram.

SUPPLY 1 ADJ FOR 60 MA jack J1, SUPPLY 1 DC ADJ rheostat R5 can be used to adjust the current output to 60 milliamperes. If an overload should cause SUPPLY 1 AC IN fuse Fl to blow, the fuse indicator lights to show that the power supply is inoperative.

14. Black Patch Panel

a. General. The dc jacks on the black patch panel are in the transmit and receive teletypewriter circuits of both the subscriber package communications link and the hf radio communications link. The black patch panel is located in equipment rack 407 in the radio terminal shelter. The panel consists of 26 groups of 4 jacks each. Each group includes two looping (LPG), one LOOP, and one SET normalled-through-type jacks. The four jacks in each group are series connected and are referred to as a jack circuit. The black patch panel consists of 26 jack circuits. The jack circuits are numbered sequentially from right to left. From the front of the panel (fig. 54, TM 11-5895-288-12), jack circuit 1 is the vertical row of four jacks on the extreme right, and jack circuit 26 is the vertical row of jacks on the extreme left. The four horizontal rows of jacks are LPG, LPG, LOOP, and SET, from top to bottom. In b below, the functions of each jack circuit are explained.

b. Jack Circuits. Although the 26 jack circuits are identical with respect to physical configuration, they are functionally divided into three groups. Jack circuits 1 through 4 are associated with the send and receive teletypewriter circuits in the subscriber package communications link. The remaining jack circuits are part of the teletypewriter send and receive circuits in the hf radio communications link; jack circuits 5 through 15 are in the receive group, and jack circuits 16 through 26 are in the transmit group. The two LPG, one LOOP, and one SET jacks in each circuit are used to monitor, reroute, and test the teletypewriter circuits. An explanation of each functional group of jack circuits is given in (1), (2), and (3) below.

Note: All LPG jacks are designated JR1 and JR2; LOOP and SET jacks are designated JR3 and JR4, respectively.

(1) Jack circuits 1 through 4 (fig. 76(1), TM 11-5895-288-12). Jack circuits 1 through 4 are part of the normalled-through teletypewriter s e n d and receive circuits between the subscriber packages and the radio terminal shelter.. Circuits 1 and 2 are part of the teletypewriter receive and send circuits, respectively, in the communications link between subscriber package No. 2 and the radio terminal shelter; circuits 3 and 4 are part of the teletypewriter receive and send circuits in the communications link between subscriber package No. 1 and the radio terminal shelter. A current limiter resistor is connected in series with the tip side of the jack circuit to protect the line battery power supply from current overloads when a plug is inserted into the SET jack.

(2) Jack circuits 5 through 15 (fig. 76 (3) TM 11-5895-288-12). Jack circuits 5 through 15 are assigned to the teletypewriter receive circuits in the hf radio communications link. 'Jack circuits 5, 6, and 7 are spares. The other jack circuits, 8 through 15, are associated with the eight teletypewriter channels. The eight jack circuits operate in an identical manner. However, the channel 1 teletypewriter circuit is connected to the TSEC/KW-26 No. 2 receiver and the other seven teletypewriter circuits are connected to binding posts in the signal entrance box. SUBSCRIBER RECEIVE LINES 11 through 17 (jack circuits 8 through 14) are used for operation with a communications center when proper landline connections are made to the binding posts.

(3) Jack circuits 16 through 26 (fig. 76(2), TM 11-5895-288-12). Jack circuits 16 through26areassigned to the teletypewriter transmit circuits in the hf radio communications link. Jack circuits 16 and 17 are spares. Jack circuit 18, TTY

TRANSMIT GROUP SHORT LINE is also a spare but is terminated in a short and is connected to TTY SUBSCRIBER TRANSMIT LINE 8 binding posts in the signal entrance box. The remaining jack circuits (19 through 26) are associated with the teletypewriter channels. All the jack circuits operate in an identical manner. However, channel 1 jack circuit 26 is connected to the TSEC/KW-26 No. 1 transmitter and jack circuits 19 through 25 (channels 8 through 2) are connected to bindingposts in the signal entrance box. SUBSCRIBER TRANSMIT LINES 1 through 7 are used for operation with a communications center when the proper landline connections are made to the binding posts. To permit operation in space and frequency diversity, adjacent pairs of channels are linked by means of TRANSMIT MULTIPLEX switches located on the combined function panel (para 8b(3)).

15. Red Patch Panel

(fig. 76(1) and (2), TM 11-5895-288-12)

a. General. The dc jacks on the red patch panel are associated with the transmit, control, and receive teletypewriter circuits of the subscriber package communications link and the hf radio communications link. The red patch panel is located between equipment racks 403 and 404 on the curbside wall of the radio terminal shelter. The panel consists of 15 vertical rows of 6 jacks each. Each vertical row is composed of two LOOPING, one LOOP, two SET, and one MISC jacks. For identification purposes, the vertical groups are designated jack circuits 1 through 15, reading from right to left facing the front of the panel. Except for the MISC jack in each vertical group, each jack circuit is part of the normalled-through teletypewriter transmit, control, or receive circuits. The function of each jack circuit is explained in b below.

b. Jack Circuits. Each functional jack circuit consists of two LOOPING, one LOOP, and two SET jacks. These five jacks in each circuit are series connected and are integral parts of the normalled-through teletypewriter transmit, control, and receive circuits. Although there is a MISC jack associated with each jack circuit, it is not electrically connected to the group of five jacks. Five of the jack circuits, including the MISC jacks, are spares and are not connected to any circuits external to the red patch panel. However, each of the spare jack circuits is a series connected, normalled-through circuit identical with those used in normal operation. Jack circuits 1, 2, and 3 are designated SPARE, and jack circuits 10 and 12 are designated SPARE CKT. Jack circuits 4 through 9 are part of the teletypewriter transmit, control, and receive circuits in the subscriber package communications link. Jack circuits 13, 14, and 15 are part of the teletypewriter transmit, control, and receive circuits in the hf communications link. Jack circuit 11 is a series loop. The function of the various jack circuits is discussed below. The horizontal row of MISC jacks is discussed separately at the end of the red patch panel discussion.

(1) Jack circuits 4 through9 (fig. 76(1) TM 11-5895-288-12). Jack circuits 4, 5, and 6 are in the teletypewriter circuits of the communications link between subscribers package No. 2 and the radio terminal shelter. Jack circuits 7, 8, and 9 are in the teletypewriter circuits of the communications link between subscriber package No. 1 and the radio terminal shelter. However, the radio terminal shelter contains only enough teletypewriter equipment to terminate jack circuits 7, 8, and 9 (subscriber 1) in tape-perforating and transmitting equipment. Therefore the subscriber 2 teletypewriter circuits (jack circuits 4, 5, and 6) must be patched to the teletypewriter equipment on jack circuits 7, 8, and 9 to allow teletypewriter communication with subscriber package

No. 2. Since jack circuits 4, 5, and 6 are functionally the same as jack circuits 7, 8, and 9, respectively, only jack circuits 7, 8, and 9 are discussed below.

(a) Jack circuit 7. This group of jacks is in the teletypewriter receive circuit and is connected between control relay panel No. 1 and the reperforator and page printer in AN/FGC-25X No. 1. (The reperforator and the page printer are connected in series across the teletypewriter loop.) When a plug is inserted-into PRINTER SET jack JR4-7, the page printer is disconnected from the teletypewriter loop and is connected to the plug. The signal through the normalled-through jacks goes only to the reperforator. When a plug is inserted into REPERF SET jack JR5-7, the reperforator is disconnected from the teletypewriter loop and is connected to the plug. The signal through the normalled-through jacks goes only to the page printer. A dummy plug may be inserted into either jack equipment associated with the jack from the teletypewriter loop. To use the page printer or reperforator to receive information from the teletypewriter circuit in the subscriber package No. 2 communication link, connect a dc patch cord between LOOP jack JR3-4 in jack circuit 4 and either PRINTER SET jack JR4-7 or REPERFORATOR SET jack JR5-7. Simultaneous reception from both subscriber packages can be achieved in this manner.

(b) Jack circuit 8. This group of jacks is part of the TT-178(*)/ FG clutch control circuit and is connected between control relay panel No. 1 and the transmitter distributor in AN/FGC-25X No. 1. This places the clutch circuit of the transmitter-distributor under control of relay K1 in control relay panel No. 1 (para 4). When a plug is inserted into TD CLUTCH SET jack JR5-8, the jack contacts close and place a short across the T and R leads to the control relay panel. The clutch control circuit is now completed through the tip contact to the external circuit and back through the sleeve contact to the TT-178(*)/FG clutch in the transmitter-distributor. W he n the transmitter-distributor of AN/FGC-25X No. 1 is to be used to send a message to subscriber 1, a dc patch cord connected between TD CLUTCH SET jack JR5-8 and KW-9-3 CONTROL LOOP jack JR3-5 of jack circuit 5, places the clutch circuit of the transmitter-distributor u n d e r control of relay K2 in control relay panel No. 1. SET jackJR48 does not functionally affect the operation of the circuit. If a plug were inserted into JR4-8, the jack would short the external circuit and the path through the other jacks would still be the same as for normalled-through operation. A dummy plug inserted in LOOP jack JR3-8 will place a short across the leads to the clutch circuit of AN/FGC-25X No. 1, operating the clutch.

(c) Jack circuit 9. This group of jacks is in the teletypewriter transmit circuit and is connected between control relay panel No. 1 and the keyboard and transmitter-distributor in AN/FGC-25X No. 1. (The keyboard and transmitter-distributor are connected in series across the teletypewriter loop.) The teletypewriter message can originate either at the keyboard or at the transmitter-distributor. The selection is made by means of a line switch key in AN/FGC-25X No. 1. When a plug is inserted into TD SET jack JR4-9 the transmitter-

distributor is disconnected from the teletypewriter loop and connected to the plug. When a plug is inserted into KYBD SET jack JR5-9, the keyboard is disconnected from the teletypewriter loop and connected to the plug. To use the transmitter-distributor or the keyboard to transmit information to the teletypewriter circuit in the subscriber package No. 2 communications link, connect a dc patch cord between LOOP jack JR3-6 in jack circuit 6 and either the TD SET jack JR4-9 or KYBD SET jackJR5-9. Simultaneous transmission from both subscriber packages can be achieved in this manner.

(2) Jack circuits 13, 14, and 15 (fig. 76(2), TM 11-5895-288-12). Jack circuits 13, 14, and 15 are in the teletypewriter circuits of the hf communications link between the radio terminal shelter and the distant radio terminal. The operation and function of jack circuits 13, 14, and 15 are identical to those of jack circuits 7, 8, and 9, respectively. Jack circuits 13, 14, and 15 are associated with TSEC/KW-26 No. 1 and are connected between control relay panel No. 2 and AN/FGC25X No. 2.

(3) Jack circuit 11 (fig. 76(2), TM 11-5895-288-12). Jack circuit 11 is designated SERIES LOOP. The jacks in this circuit are connected in series and the output lead from the last jack in the group is connected to the input of the first jack to form a series loop. This permits the operator or the maintenance man to construct various test circuits with patch cords.

(4) MISC jacks (fig. 76(1) and (2), TM 11-5895-288-12). The bottom row on the red patch panel consists of three SET KYBD TIE PAIR, three SET PRINTER TIE PAIR, and three BAT dc jacks. The BAT jacks, JR6-5, JR6-8, and JR6-14, are connected to local battery loop control No. 3. Local battery (adjusted by rheostats in local battery loop control No. 3) is available by connecting a dc patch cord to any of the three BAT jacks. The SET KYBD TIE PAIR (para 4b(4) and SET PRINTER TIE PAIR (para 5e) dc jacks provide a means of extending the teletypewriter circuits to control relay panels No. 1 and No. 2.

16. Audio Patch Panels No. 1 and No. 2

(fig. 76(1) and (4), TM 11-5895-288-12)

a. General. The two audio patch panels are located in equipment rack 407, with audio patch panel No. 1 directly above audio patch panel No. 2. Each panel consists of 12 groups of vf jack circuits. Each jack circuit consists of six jacks arranged in two adjacent vertical rows, with three jacks in each row. Each jack configuration consists of two LINE jacks, two EQUIP jacks, and two MON jacks. The LINE and EQUIP jacks are arranged for normalled-through operation. The MON jacks are parallel-connected to the vf circuit. The jack circuits are numbered sequentially from right to left. From the front of the panel, jack circuit 1 is the two adjacent vertical rows of three jacks each, on the extreme right and jack circuit 12 is the two adjacent vertical rows of three jacks each on the extreme left. The three horizontal rows of jacks are designated LINE, EQUIP, and MON respectively, reading from top to bottom. The jack circuits of audio patch panel No. 1 are in the receive circuits of the hf communications link between the radio terminal shelter and the distant terminal. The first six jack circuits of audio patch panel No. 2 are in the transmit and receive circuits of the subscriber package communications link; the last six jack circuits are in the transmit circuits of the hf communications link between the radio terminal shelter and the distant terminal. Since the jack circuits in both patch panels operate in an identical manner, a typical jack configuration is discussed below.

b. Typical Jack Circuit.

(1) Line jacks. When a plug is inserted into the LINE jacks, the normalled-through circuit through the EQUIP jacks is opened and the equipment connected to the LINE jacks is connected to the plug.

(2) EQUIP jacks. When a plug is inserted into the EQUIP jacks, the normalled-through circuit through the LINE jacks is opened and the equipment connected to the EQUIP jacks is connected to the plug.

(3) MON jacks. The MON jacks are used to connect monitor equipment to the circuit. When a plug is inserted into the MON jacks, there is no interruption of the normalled-through circuit. The monitor equipment is connected across the circuit through two 3,300 ohm resistors. The resistors act as loads and are used for current limiting to protect the monitoring equipment from excessive current surges.

17. Audio-Dc Patch Panel

(fig. 76(4), TM 11-5895-288-12)

a. General. The audio-dc patch panel contains nine pairs of vf jacks for use with the audio circuits in the AN/TSC-20(*) and five single jacks for dc circuit application. The panel is located on equipment rack 407 in the radio terminal shelter. Facing the front of the panel, each jack is numbered 1 through 15, starting from the right. An explanation of the circuit associated with the dc and vf jacks is given in b through i below. Jacks JR1-6 and JR1-7 are SPARE MISC vf jacks and jack JR1-1 is a spare dc jack.

b. LOCAL BAT MISC Jacks. The three LOCAL BAT MISC jacks, JR1-2, JR1-3, and JR1-4, are parallel-connected to local battery loop control No. 2 which is associated with line battery power supply panel No. 2. The output from each jack is available as an auxiliary dc source of voltage. When a plug is inserted into a LOCAL BAT MISC jack, current from the negative side of line battery power supply No. 2 is available at the tip of the patch cord plug.

c. DC MA MISC Jack. Jack JR1-5 is designated DC MA MISC and is a do jack connected to do milliammeter M2 on the meter panel. The negative side of the do milliammeter is connected to the tip of the jack. The do milliammeter can be patched into any teletypewriter circuit by use of the DC MAMISC jack and a do patch cord.

d. VUMTR MISC Jacks. The VU MTR MISC jacks, JR1-8 and JR1-9, comprise jack circuit 7. The tip of each vf jack is connected to one side of vu meter M1 located on the meter panel. When a vf patch cord is inserted into jacks JR1-8 and JR1-9, the vu meter connections are extended to the tips of the vf patch cord plug.

e. SG-15A/PCM MISC Jacks. Jack circuit 8 consists of SG-15A/PCM MISC jacks JR1-10 and JR1-11. These jacks are connected to the SG-15A/PCM to permit the signal generator to be patched to any vf jack circuit by means of a vf patch cord.

f. ME-22/PCM MISC Jacks. Jack circuit 9 consists of ME-22/PCM MISC jacks JR1-12 and JR1-13. These vf jacks are connected to Decibel Meter ME-22A/PCM.

An indication of the signal level in any vf circuit may be obtained by means of a vf patch cord between the jack in the circuit under test and the ME-22/PCM MISC jacks.

g. MON AMP IN MISC Jacks. Jack circuit 10 consists of MON AMP IN MISC jacks JR1-14 and JR1-15. These vf jacks are connected to the right-hand speaker of the dual speaker and amplifier panel. An audio indication from any vf circuit may be obtained by means of a vf patch cord between the jack in the circuit under test and the MON AMP IN MISC jacks.

h. XMTR 2 IN LSB and USB MISC Jacks.

Jack circuit 12 consists of XMTR 2 IN LSB MISC jacks JR1-18 and JR1-19. Jack circuit 13 consists of XMTR 2 IN USB MISC jacks JR1-20 and JR1-21. These jack circuits are connected to AN/FRT-53 No. 2. When it is necessary to use the AN/ FRT-53 No. 2, the upper sideband information from multiplexer No. 1 is applied to JR1-20 and JR1-21 by means of a vf patch cord connected to the MUX 1 OUT LINE jacks on audio patch panel No. 2. Similarly, the lower sideband information from

multiplexer No. 2 is applied to JR1-18 and JR1-19 by means of a vf patch cord connected to the MUX 2 OUT LINE jacks on audio patch panel No. 2. The information is applied to the AN/FRT-53 No. 2 through the tips of each jack. A monitoring circuit is in parallel across each pair of jacks.

i. MON MSC Jacks. Jack circuit 11 consists of MON MISC jacks JR1-16 and JR1-17, and jack circuit 14 consists of MON MISC jacks JR1-22 and JR1-23.

There is a 3,300 ohm resistor in series with the tip of each of the four jacks. The resistors are used as load resistors and also to protect the monitor equipment from excessive current surges. Jack circuit 11 is the monitoring circuit for the XMTR 2 IN LSB MISC jacks, and jack circuit 14 is the monitoring circuit for the XMTR 2 IN USB MISC jacks (h above).

18. Antenna Patch Panel

(fig. 76(4), TM 11-5895-288-12) The antenna patch panel is used to connect transmitters AN/FRT-53 No. 1 and AN/FRT-53 No. 2 to the hf transmitting antenna. It also is used to patch the standing wave ratio meter SWR-1K between the transmitter being used and the hf transmitting antenna. Either transmitter may be patched directly to the hf transmitting antenna or through the SWR-1K to the hf transmitting antenna by means of the rf patch cords on the front of the antenna patch panel. The patch connections shown in figure 76(4), TM 11-5895-288-12 are those used for normal operation.

Note: Since only one hf transmitting antenna is supplied with the AN/TSC-20(*), coaxial feed through connector ANT-2 J3 is not normally used.

It may be used if a second transmitting antenna is available.

19. Heater

(fig. 7)

The heater operates from a 208-volt, 3phase, 60 cycle-per-second (cps) power outlet in the radio terminal shelter. Phase A power is applied through one side of thermostat control S1 and safety switch S3 to heaters HR1, HR2, and HR3, which are arranged in a delta configuration. Phase C power is applied through the other side of thermostat control S1 to the heaters. Phase B power is applied through safety switch S4 to the heaters. When thermostat control S1 is set to a HI or LO position, switch contacts 1-2 and 3-4 close, applying power to the heater elements. The heater operates automatically in conjunction with a sensitive element in the thermostat. Whenever there is a change in temperature at the bulb of the sensitive element, the liquid in the bulb expands (when temperature rises) or contracts (when temperature falls); this produces a corresponding movement of the bellows in the thermostat.

This movement opens thermostat switch S1 when the liquid expands and closes S1 when the liquid contracts to predetermined levels. Opening S1 cuts off power to the heater elements. Phase A power is also applied to fan switch S2. Switch S2 closes its contacts when the surrounding temperature reaches a predetermined level. This provides a delay of approximately 1 minute before fan motor B1 operates, which insures that the fan will not blow cold air. When thermostat switch S1 opens the circuit to the heaters, the fan motor will continue to operate until the surrounding temperature drops to a predetermined level; this opens the contacts of fan switch S2, which opens the operating circuit of the fan motor. Safety switches S3 and S4 automatically open the heater circuit if either fan motor B1 fails or if there is a stoppage of air flow through the heater for any other reason. These switches (normally closed) open when the surrounding temperature inside the heater cabinet goes above 90° F (32° C).

20. Dual Speaker and Amplifier Panel

(fig. 8)

a. The dual speaker and amplifier panel contains two identical line amplifiers and speakers. One amplifier and speaker is shown in figure 8 and discussed below. The amplifier is a two-stage, transistorized, audio frequency type that provides up to 2 watts output with a minimum input of -10 decibels (referred to 1 milliwatt) (dbm).

b. The input signal applied to J401-1 and -2 is coupled by line-matching transformer T401 and volume control potentiometer R401 to the base of input amplifier

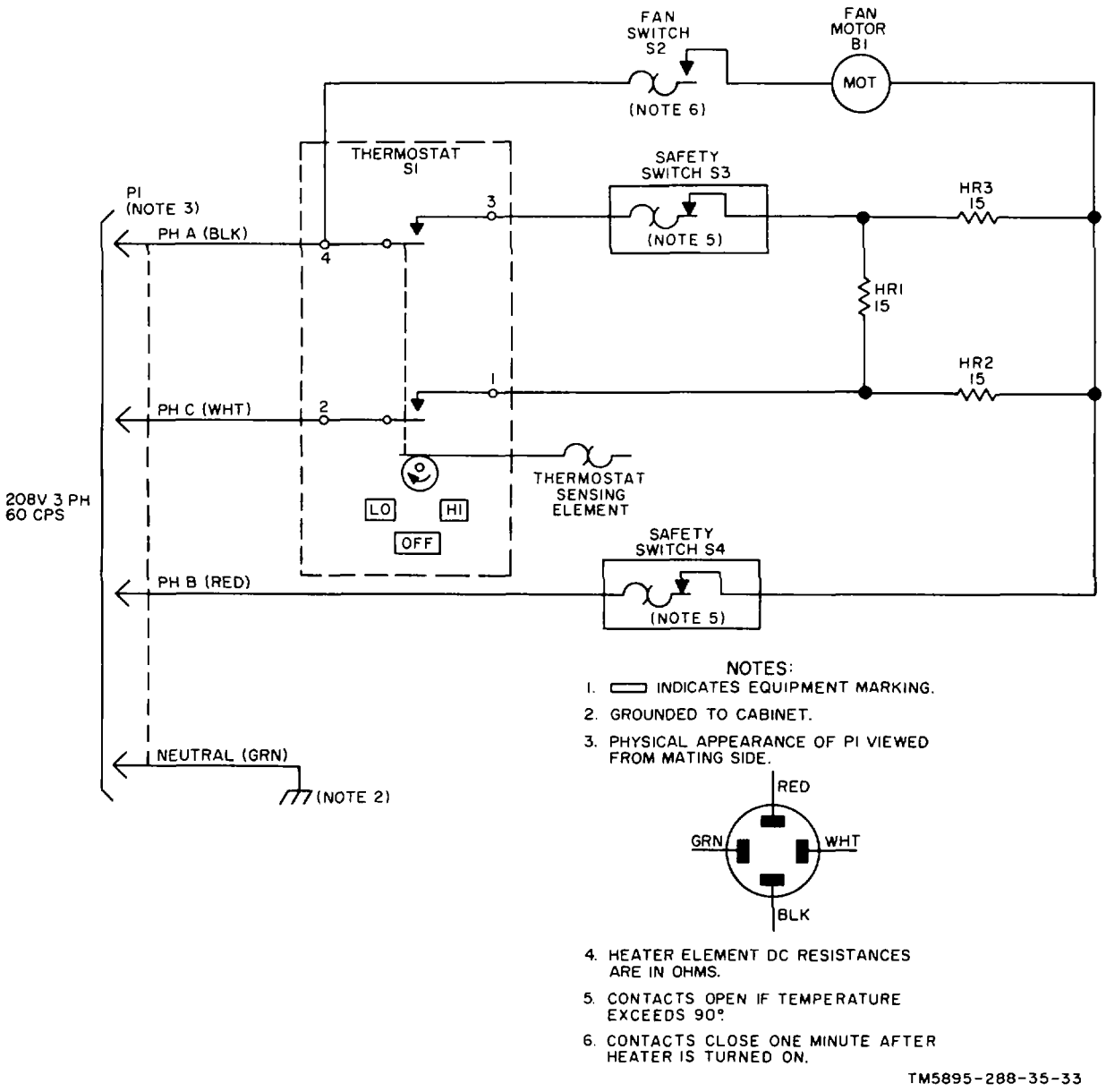
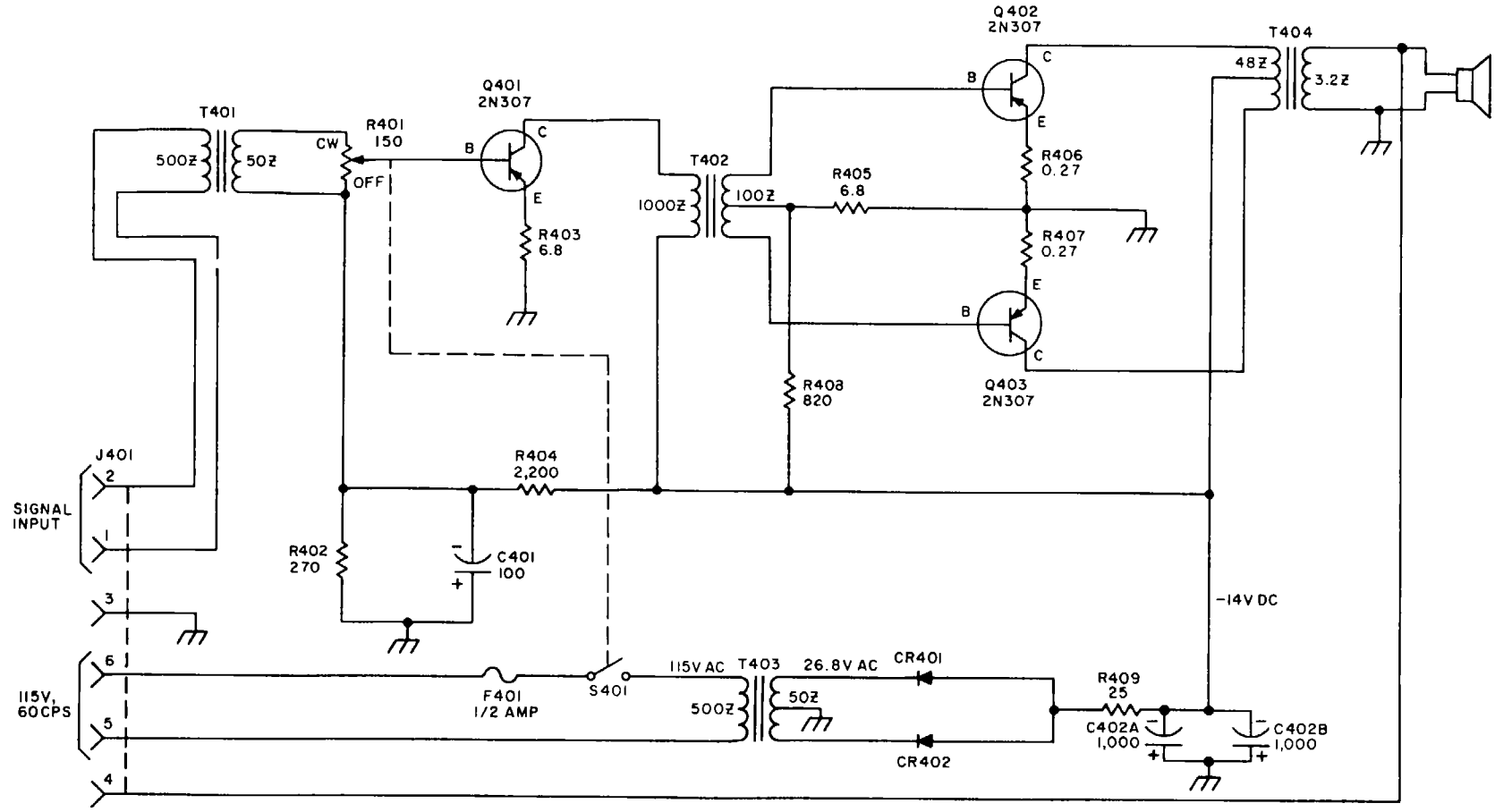


Figure 7. Heater, schematic diagram.

Q401. Volume control potentiometer R401 is returned to the junction of resistors R404 and R402, a voltage-divider network that supplies approximately -0.2 volt forward bias for the base of amplifier Q401. Bypass capacitor C401 maintains the bias supply at ac ground. Emitter-swamping resistor R403 increases the input impedance of the stage and also provides temperature stabilization.

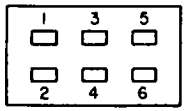
c. The output of amplifier Q401 is transformer-coupled by T402 to the bases of push-pull output amplifiers Q402 and Q403. These amplifiers are base-biased to class B operation by -0.12 volt, which appears at the junction of resistors R408 and R405, a voltage-divider network. Emitter resistors R406 and R407 prevent thermal runaway due to reverse collector currents at high temperatures. The output of amplifiers Q402 and Q403 is transformer-coupled to the speaker by matching transformer T404. This output is also applied to J401-4.

d. The 115-volt ac power connected to J401-5 and -6 is applied to stepdown



NOTES:

1. UNLESS OTHERWISE INDICATED, RESISTANCES ARE IN OHMS, CAPACITANCES ARE IN UF.
2. PHYSICAL APPEARANCE OF J401.



3. CR401 AND CR402 ARE IN1763.

TM5895-288-35-34

Figure 8. Dual speaker and amplifier panels, schematic diagram.

transformer T403 through fuse F401 and on-off switch S401. The 26/8-volt output of transformer T403 is rectified by diodes CR401 and CR402. The output from the diodes is a full-wave, rectified, -14-volt dc collector and bias supply, which is filtered by resistor R409 and capacitor C402.

21. Local Battery Loop Controls No. 1, No. 2, and No. 3

(fig. 76, TM 11-5895-288-12)

a. There are three local battery loop controls in the radio terminal shelter. Local battery loop controls No. 1 and No. 2 are used with line battery power supply panel No. 2. Local battery loop control No. 3 is used with line battery power supply panel No. 1. Each local battery loop control contains three rheostats to adjust the current required for various applications within the system.

b. Local battery loop control No. 1 (fig. 76(2), TM 11-5895-288-12) is used to control the bias, signal, and operating currents used in the multiple repeat panel (para 11). BIAS rheostat R3 is adjusted so that 30 milliamperes flows in the multiple repeat panel control relay bias windings. SIG rheostat R2 is adjusted so that 60 milliamperes flows through the signal winding of the multiple repeat panel control relay. OPR rheostat R1 is adjusted so that 15 milliamperes flows through the operate (line) windings of the slave relays in the multiple repeat panel.

c. Local battery loop control No. 2 (fig. 76(4), TM 11-5895-288-12) is used to control the current available at the LOCAL BAT MISC jacks on the audio-dc patch panel. These jacks are used to provide a dc source for test equipment. Each of the three rheostats in local battery loop control No. 2 is used to adjust the current available at one of the three LOCAL BAT jacks on the patch panel.

d. Local battery loop control No. 3 (fig. 76(1) and (2), TM 11-5895-288-12) is used to control the current available at the three BAT MISC jacks on the red patch panel. These jacks are used to provide a dc source for test equipment. Each of the three rheostats in local battery loop control No. 3 is used to adjust the current available at one of the three BAT MISC jacks on the patch panel.

22. Blower Fans

One blower fan is mounted in a fan housing at the bottom of equipment rack 404 (fig. 7, TM 11-5895-288-12), and one is mounted in a fan housing at the bottom of equipment rack 408 (fig. 8, TM 11-5895-288-12). Each fan motor is connected to a power outlet on the rack. The fans provide cooling air for the security equipment mounted in the racks.

23. RTB-5 Terminator

(fig. 9)

Two RTB-5 terminators are used with each of the two sloping-vee receiving antennas, one RTB-5 to terminate each antenna leg. The terminator impedance is connected between the antenna leg and ground. A built-in lightning arrestor prevents the accumulation of static charges that might damage the associated equipment. The 600-ohm center-tapped termination resistance consists of four 150-ohm resistors in series (R1, R2, R3, and R4).

Only one 300-ohm section is used; the second 300-ohm section is a spare. The antenna input and the ground terminal are on ceramic insulator terminals. Two spark rods, separated from the insulators by a 1/32-inch airgap, are grounded to provide for the dissipation of static charges that might otherwise build up.

24. TDR-002.5 Terminator

(fig. 10)

Two TDR-002.5 terminators are used to terminate the sloping-vee transmitting antenna, one terminator for each leg. The TDR-002.5 consists of two 460-ohm resistors in parallel. Ceramic insulator terminal E1 is used to connect the TDR-002.5 to the antenna leg. Connection to ground is through the terminator case, which is connected to a ground rod.

25. TRC-500 Coupler

(fig. 11)

The TRC-500 coupler is used to couple

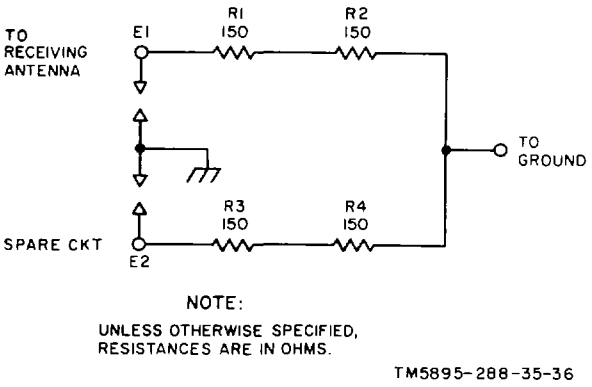


Figure 9. RTB-5 terminator, schematic diagram.

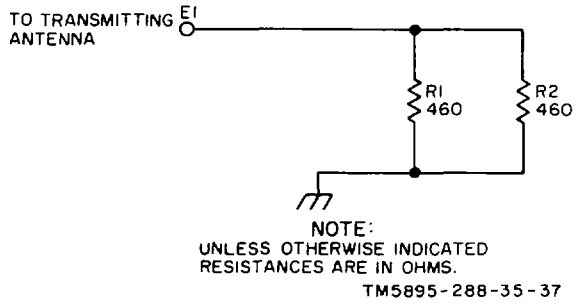


Figure 10. TDR-002.5 terminator, schematic diagram.

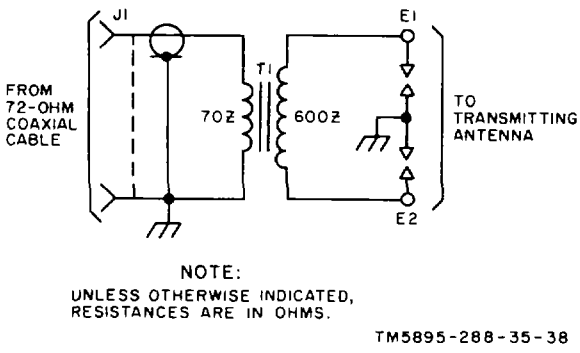


Figure 11. TRC-500 coupler, schematic diagram.

the AN/FRT-53 output to the sloping-vee transmitting antenna. The TRC-500, which matches the 72-ohm unbalanced coaxial cable from the AN/FRT-53to the 600-ohm balanced transmitting antenna, is basically a broadband radio frequency (rf) transformer. The input winding matches the 72ohm coaxial cable input from the AN/FRT53; the output winding matches the 600-ohm antenna impedance. The antenna input terminals are on ceramic insulators. Two spark rods, separated from the insulators by an airgap, are grounded to provide for the dissipation of static charges that might otherwise build up. Coaxial connector J1 is used to connect the TRC-500 to the coaxial cable which comes from the transmitter.

26. RAC-30A Coupler

(fig. 12)

An RAC-30A coupler is used to couple the output of each sloping-vee receiving antenna to the associated R-390/URR in the radio terminal shelter. The RAC-30A, which matches the 600-ohm balanced antenna output to the 72-ohm unbalanced coaxial cable from the receiver input, consists of broadband impedance-matching autotransformer T1, capacitor C1, fuses Fl and F2, and two spark rods. The input from the antenna is connected to ceramic insulator terminals El and E2. Connector J1 is used to connect the RAC-30A to the coaxial cable input to the receiver. Autotransformer T1 is tapped for 200 ohms and 600 ohms. The 600-ohm taps are used to match the receiving antenna impedance.

Capacitor C1 prevents the flow of dc current through the autotransformer windings and permits dc resistance measurements to be made of the antenna termination. Two spark rods, separated from the insulators by an airgap, are grounded to dissipate static charges that might otherwise build

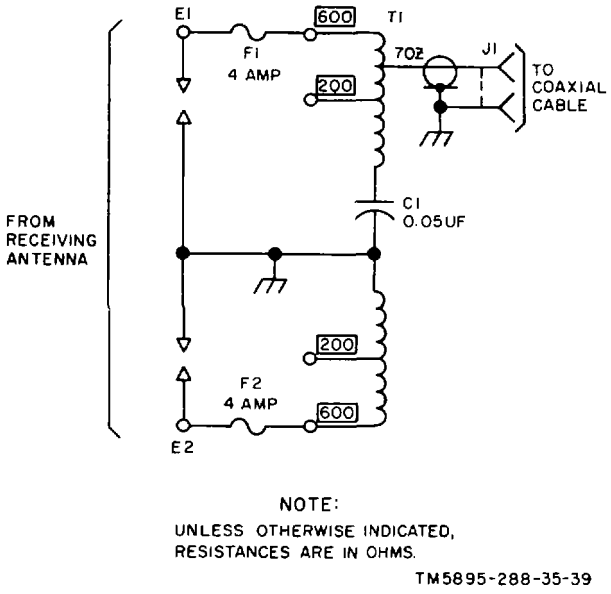


Figure 12. RAC-30A coupler, schematic diagram.

up. Fuses Fl and F2 protect the autotransformer from overload. The RAC-30A is also used to couple the outputs of the double-doublet antennas, in which case the 200-ohm taps are used.

27. Air Conditioner Modification
(fig. 13)

a. General. When one of the two 10kilowatt (kw) generators fails, the radio terminal shelter technical and utility loads must be powered by the other 10-kw generator alone. The air conditioner has been modified so that compressors B103 and B104 are separately controlled. During a generator failure, only the first-stage compressor would be used. Four-pin connector J101 has been replaced by seven pin connector J101, and the internal wiring to the first- and second-stage compressor starters has been changed so that each compressor receives a separate source of 208-volt, 60-cps, 3-phase ac. With this modification, it is possible to operate the air conditioner by using only the firststage compressor, if necessary, to reduce the load on the single 10-kw generator in operation.

b. Wiring Details. Without the modification (A, fig. 13), first- and second-stage compressor starters K101 and K102 are wired in parallel and are operated simultaneously when power is applied. With the modification (B, fig. 13), two circuit breakers (CB9 and CB10) control the application of power to the first- and second stage compressor starters, respectively.

When circuit breaker CB9 is set to the on position, power is applied to terminals L1, L2, and L3 of first-stage compressor starter K101. From K101-L1, phase A power is applied to first-stage compressor B103. In addition, phase A power is applied to evaporator fan motor B104 from terminal K101-L1 through TB103-3. Phase B power is applied to B104 through K101-L2 and TB103-2. When CB10 is set to the on position, three-phase power is applied to terminals L1, L2, and L3 of second-stage compressor starter K102 and follows a similar path.

Caution

If, because of generator failure, only one stage of the air conditioner is to be operated, set circuit breaker CB10 to the off position and leave circuit breaker CB9 in the on position. In this way, the second-stage compressor is shut off and only the first-stage compressor operates.

28. Reperforator-Transmitter TT-178/FG and TT-178A/FG Modification
(fig. 14)

Note

In some models of the equipment, Reperforator-Transmitter TT-178A/FG is used in place of the TT-178/FG.

There are two reperforator-transmitters in the radio terminal shelter, and both have been modified in the same way. In the unmodified reperforator-transmitter, the operation of the clutch magnet was controlled by the STOP-START switch. In the modified reperforator-transmitter a pair of relay contacts in control relay panel No. 1 or No. 2 is in series with the STOP-START switch and the winding of the clutch magnet. When the STOP-START switch is set to START, the associated control relay panel controls the operation of the clutch magnet.

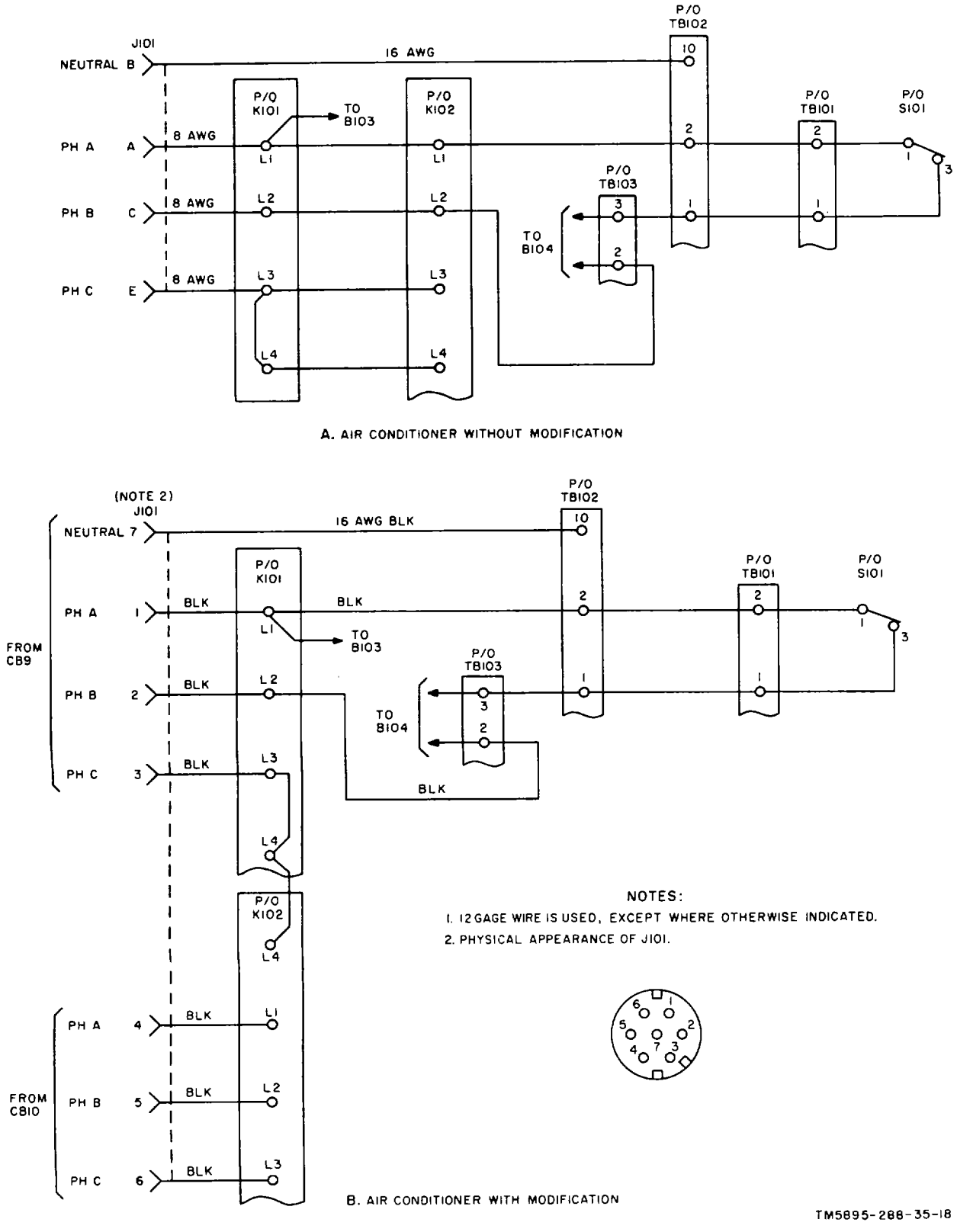


Figure 13. Air conditioner modification, schematic diagram.

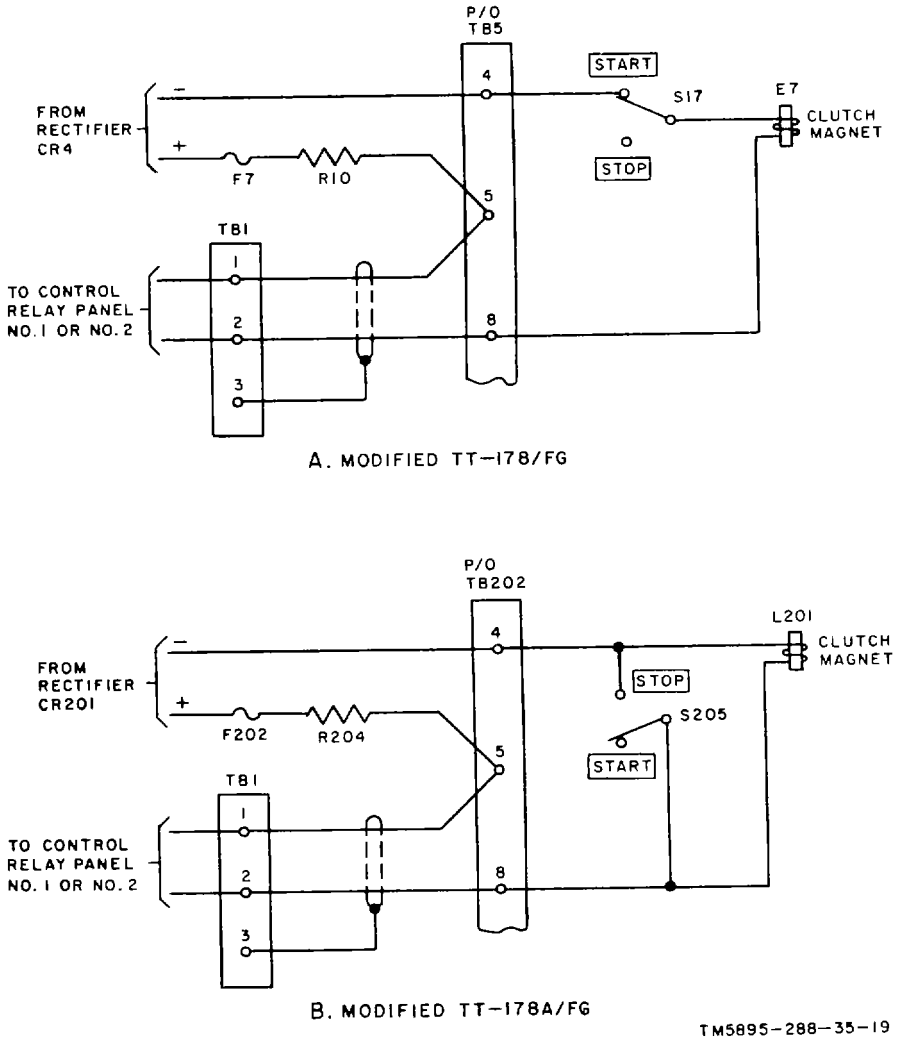


Figure 14. Reperforator-Transmitter TT-178/FG and TT-178A/FG modification, schematic diagram.

CHAPTER 2

TROUBLESHOOTING

Section I. GENERAL TROUBLESHOOTING INFORMATION

Warning

Be very careful when troubleshooting or making repairs on this equipment. Voltages as high as 3,000 volts are present internally.

29. General Instructions

a. Troubleshooting at the field and depot maintenance level includes all the techniques outlined for organizational maintenance (TM 11-5895-288-12) and any special or additional techniques required to localize and isolate a defective part. The field and depot maintenance procedures are not complete in themselves, but supplement the procedures described in organizational maintenance. Paragraphs 32 through 51 provide troubleshooting procedures to be performed by field and depot maintenance facilities for the components listed in paragraph 1/b.

b. Troubleshooting may be performed while the equipment is operating as part of the system or, if necessary, after the equipment (or parts thereof) has been removed from service. Paragraphs 33 through 51 describe the steps to be followed in a systematic procedure that will enable the repairman to isolate the cause of trouble and correct the fault.

30. Organization of Troubleshooting Procedures

a. General. The first step in servicing a defective equipment is to sectionalize the fault. Sectionalization means tracing the fault to a defective equipment. Perform the tests described in paragraphs 85 through 87, TM 11-5895-288-12 to sectionalize the fault. The second step is to localize the fault. Localization means tracing the fault to the defective component. The third step, isolation, means tracing the fault to the defective part. Some faults, such as burned out fuses, resistors, or relay coils, may be located by sight or smell. The majority of faults, however, must be isolated by checking voltages and resistances. Before following the detailed troubleshooting procedures, check the fuse indicators. If any fuse indicator is lighted, replace the associated fuse. If the replacement fuse blows, there must be a short somewhere within the component. Replace any lamp that should light but does not. If the replacement lamp does not light, the trouble is elsewhere within the associated circuit.

b. Localization. The procedures listed below will aid in localizing the trouble.

(1) *Signal tracing*. Signal tracing (para 32a) will help localize the fault to a specific component.

(2) *Signal substitution*. Signal substitution (para 32b) helps the repairman to localize a trouble quickly to a component or stage.

(3) *Voltage and resistance measurements*. The dual speaker and amplifier panel is transistorized. Observe all precautions to prevent transistor damage. Make voltage and resistance measurements (fig. 24) only as specified. When measuring voltages, use tape or sleeving to insulate the entire test prodexcept the extreme tip. A momentary short circuit can ruin a transistor. (For example, if the bias is shorted out, excessive current between the emitter and base would burn out the transistor.) Use the resistor and capacitor color codes (fig. 58 and 59) to find the values. Use the schematic diagrams (fig. 1 through 14 and 60) and the resistance tables (para 51b and c) to determine normal readings, and compare them with the readings taken.

(4) *Intermittent troubles*. The

possibility of intermittent troubles should not be overlooked. An intermittent trouble will often become apparent if the component is tapped or jarred. If a trouble is intermittent, be sure to check all associated wiring and connections.

c. Isolation. To isolate trouble to a specific part, use the troubleshooting instructions (para 34 through 50). The schematic diagrams (fig. 1 through 14 and 60), the wiring diagrams (fig. 15 through 23 and 61 through 63), the signal schematic diagram (fig. 76, TM 11-5895-288-12), and the resistance tables (para 51*b* and *c*) will also assist the repairman in isolating trouble.

31. Test Equipment Required

The following chart lists the test equipment required for troubleshooting, with the associated technical manuals and the assigned common names.

Test equipment	Technical manual	Common name
Signal Generator SG-15A/PCM	TM 11-2096	Signal generator
Teletypewriter Test Set TS-1060/GG	TM 11-6625-207-10	Teletypewriter test set
Electron Tube Test Set TV-7/U	TM 11-6625-274-12	Tube tester
Multimeter TS-352/U	TM 11-5527	Multimeter
Electronic Multimeter TS-505/U	TM 11-5511	Vtvm
Oscilloscope 0S-8C/U	TM 11-1214A	Oscilloscope
Decibel Meter ME-22/PCM	TM 11-2096	Db meter

Section II. TROUBLESHOOTING PROCEDURES

32. Localization Tests

a. Signal Tracing. Signal tracing is used to localize the trouble to a specific component. When a component includes several stages (the dual speaker and amplifier panel, for example) signal tracing may be used to localize the trouble to a particular stage within the component. When using signal tracing to localize trouble to a specific component, use the appropriate test equipment (para 31) to check the signal output of each suspected equipment in the signal path from point of origin to destination. When the test equipment indicates no output, or improper output, the component under test is at fault. Signal tracing within components is covered in the trouble isolation procedures (para 34 through 50).

b. Signal Substitution. Signal substitution is essentially the same as signal tracing, except that an external signal is used instead of the normal input signal. When this procedure is used, the signal is injected at the signal input of the component and measured at the output. If there is no output, or if the output is unsatisfactory, the component under test is defective.

c. Continuity Checks. When signal tracing and signal substitution tests indicate that the trouble is between components instead of within a component, check continuity of the wiring and normalled-through jack circuits that connect the two components. If the trouble is localized to a patch panel, check continuity from jack to jack in the normalled-through path (para 42) for the circuit under test until the defective jack is isolated. Whenever a part within a component seems to be defective, check the wiring to the part before repairing or replacing the part.

d. Trouble on All Teletypewriter Channels. When all teletypewriter channels malfunction, the trouble may be quickly localized because of the limited number of components involved. If all teletypewriter receive channels are defective, the trouble must be in a component that is common to all teletypewriter receive channels. Check the two hf receiving antennas, the two RAC-30A's, R-390A/URR No. 1 and No. 2, CV-157/URR No. 1 and No. 2, demultiplexers No. 1 and No. 3, and the isolation units in tone converter

shelves No. 2 and No. 3. If all teletypewriter transmit channels are defective, the trouble must be in a component that is common to all teletypewriter transmit channels. Check the isolation unit in the tone keyer shelf, multiplexer No. 1, AN/ FRT-53 No. 1, the SWR-1K, the TRC-500, and the hf transmitting antenna.

e. Trouble on More Than One Vf Channel.

When more than one vf channel malfunctions, refer to figure 76, sheet 4, TM 115895-288-12 to determine the components c o mm o n to the channels involved, and check these components from the hf antenna through the demultiplexer for a receive path or from the multiplexer to the hf antenna for a transmit path.

33. Isolating Troubles

a. General. The troubleshooting charts and isolation procedures in paragraphs 34 through 51 give instructions for isolating trouble to a defective part in a malfunctioning component. These charts and procedures should be used in conjunction with the schematic diagrams (fig. 1 through 14 and 60), the wiring diagrams (fig. 15 through 23 and 61 through 63), the signal schematic diagram (fig. 76, TM 11-5895288-12), and the resistance tables (para 51b and c). Whenever possible, use rackmounted test equipment so that the malfunctioning component will not have to be removed for testing.

b. Use of Troubleshooting Charts. Each troubleshooting chart contains three columns*: Symptom, Probable trouble, and Correction*. The *Symptom* column lists the various symptoms of trouble that may be encountered during operation or testing.

The Probable trouble column indicates malfunctions that may be the cause of the trouble. The Correction column contains instructions for correcting the trouble.

34. Control Relay Panel No. 1, Trouble Isolation Procedures

a. General. Control relay panel No. 1 is located in equipment rack 404. Relay K1 is associated with the transmitter of TSEC/ KW-9 No. 1 and relay K2 is associated with the transmitter of TSEC/KW-9 No. 3.

Jacks J4 and J8 are part of the normalled-through teletypewriter receive circuits associated with the receiver of TSEC/KW9 No. 2 and the receiver of TSEC/KW-9 No. 4, respectively. Since both relay circuits and both jack circuits are identical, only relay K1 and jack J4 circuits are referred to in the troubleshooting chart. The information in the troubleshooting chart is applicable to both relay circuits and both jack circuits, depending on which TSEC/KW-9 is used. The symptoms in the troubleshooting chart are predicted on the condition that the receivers of TSEC/KW-9 are set for decoding the teletypewriter messages; the transmitters of TSEC/KW9 are set for encoding the teletypewriter messages; and that all equipment is turned on. Figure 61 is the wiring diagram of control relay panel No. 1.

Note

Jacks J2 and J3 are extensions of jacks on the red patch panel and can be checked by a continuity test (para 32*c*).

b. Control Relay Panel No. 1, Troubleshooting Chart.

SYMPTOM	PROBABLE CAUSE	Correction
1. No teletypewriter messages are transmitted:		
Relay K1 does not operate	Defective contacts on jack J1	Clean (para 64), adjust (para 66), or replace (para 52) jack J1.
	Defective relay K1	Adjust (para 63) or replace (para 53) relay K1.
	Defective circuit wiring	Repair wiring.
	Defective TSEC/KW-9 No. 1	Repair TSEC/KW-9 No. 1.
Relay K1 operates	Open contacts 5 and 7 of jack J1	Clean (para 64), adjust (para 66), or replace (para 52) jack J1.
	Defective TSEC/KW-9 No. 1	Repair TSEC/KW-9 No. 1.
	Open contacts 4-6 or 7-9 of relay K1	Clean (para 61) or adjust (paras 63) contacts on relay K1.
	Defective circuit wiring	Repair wiring.

SYMPTOM	PROBABLE CAUSE	Correction
Transmitter-distributor clutch does not operate.	Open contacts 1-3 of relay K1	Clean (para 61) or adjust (para 63) contacts on relay K1.
2. Page printer and reperforator of AN/FGS-25X do not operate on incoming messages.	Defective contacts on jack J4	Clean (para 64), adjust (para 66), or replace (paras 52) jack J4.

35. Control Relay Panel No. 2, Trouble Isolation Procedures

a. General. Control relay panel No. 2 is used in the teletypewriter loop in conjunction with the TSEC/KW-26. The symptoms in the following troubleshooting chart assume that the transmitter of TSEC/KW26 No. 1 is set for encoding teletypewriter messages and that all equipment is turned on. Figure 15 is a wiring diagram of control relay panel No. 2. Figure 76 (2) and (3), TM 11-5895-288-12, show the schematic diagram of control relay panel No. 2.

Note

SET KEYBOARD TIE PAIR jack J1 is an extension of the SET KYBD TIE PAIR-MISC jack on the red patch panel, and SET PRINTER TIE PAIR jackJ2 is an extension of the SET PRINTER TIE PAIR-MISC jack on the red patch panel. These jacks can be tested by continuity checks (para 32*c*).

b. Control Relay Panel No. 2, Troubleshooting Chart.

SYMPTOM	PROBABLE CAUSE	Correction
No teletypewriter messages can be transmitted, or transmitted messages are garbled.		
Relay K1 does not operate.	Defective TSEC/KW-26 No. 1.	Repair TSEC/KW-26 No. 1.
	Defective relay K1 or associated wiring.	Adjust (para 63) or replace (para 53) relay K1, or repair wiring.
	Defective power supply or associated wiring.	Repair power supply or associated wiring.
Relay K1 operates.	Open contacts 46 or 7-9 on relay K1.	Clean (para 61) or adjust (para 63) contacts on relay K1.
Transmitter-distributor clutch of AN/FGC-25X does not operate.	Open contacts 1-3 on relay K1.	Clean (para 61) or adjust (paras 63) contacts on relay K1.

36. Meter Panel, Trouble Isolation Procedures

a. Vu Meter. Check the vu meter as described below.

(1) Calibrate the SG-15A/PCM as instructed in the operating procedures for the SG-15A/PCM in TM 11-2096.

(2) Perform the preliminary and starting procedures for calibrating both the SG-15A/PCM and the ME22A/PCM as instructed in the operating instructions for the TS140/PCM in TM 11-2096.

(3) Connect the SG-15A/PCM OUTPUT terminals to the ME-22A/PCM INPUT terminals with a wire pair. Make the necessary adjustments as instructed in the final adjustments for the TS-140/PCM in TM 11-2096. Do not disconnect the two equipments.

(4) Patch the vu meter to the ME-22A/ PCM INPUT jacks. The vu meter should indicate 0 vu.

(5) If the vu meter does not indicate 0 vu, check the meter panel wiring and patch panel jacks. If the wiring and jacks are good, replace the vu meter (para 52). Figure 16 is the wiring diagram of the meter panel.

b. Dc Milliammeter. Check the dc milliammeter as described below.

(1) Use a known good dc milliammeter to check the current in the teletypewriter loop through the KW9-1

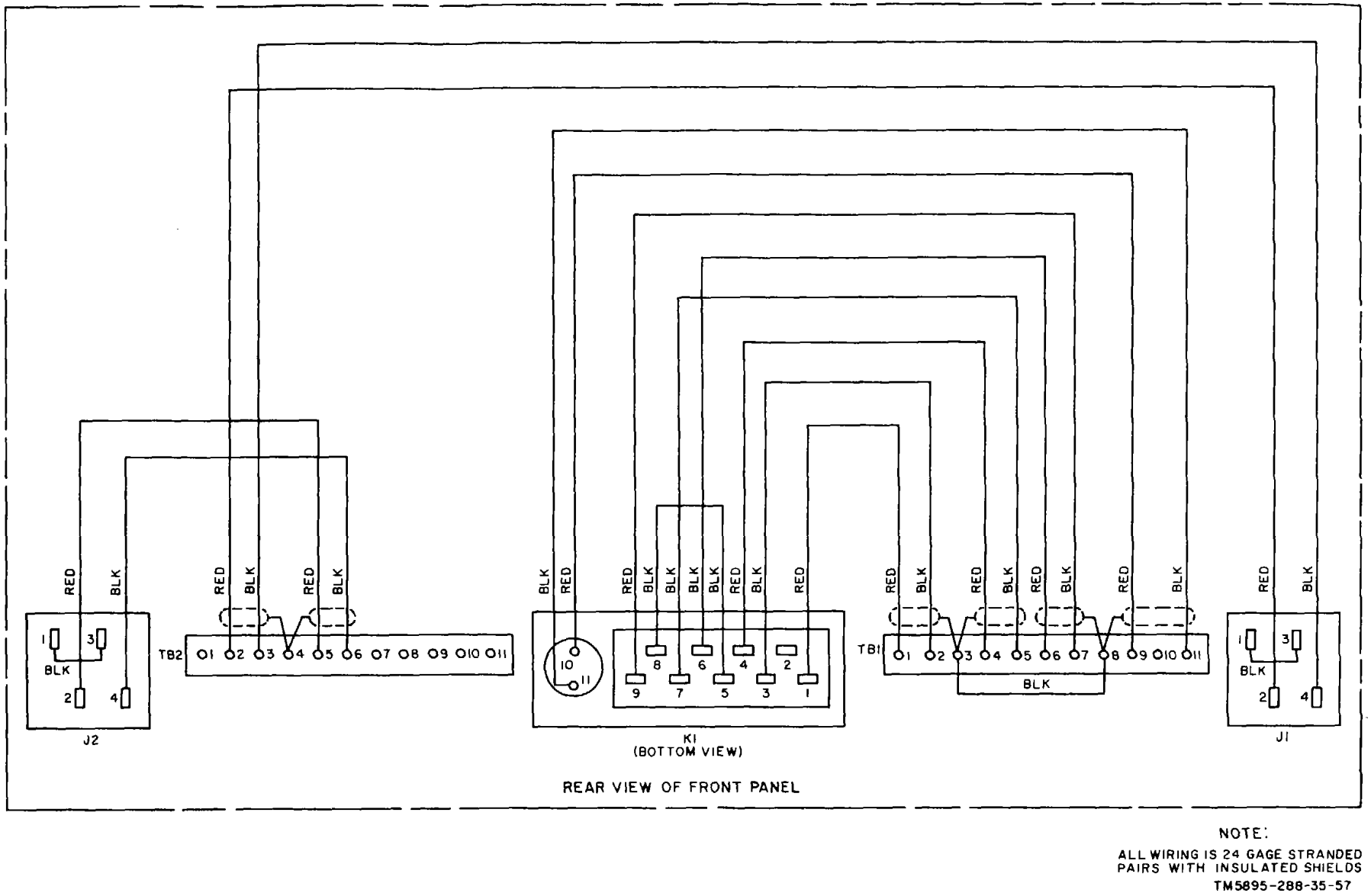


Figure 15. Control relay panel No. 2, wiring diagram.

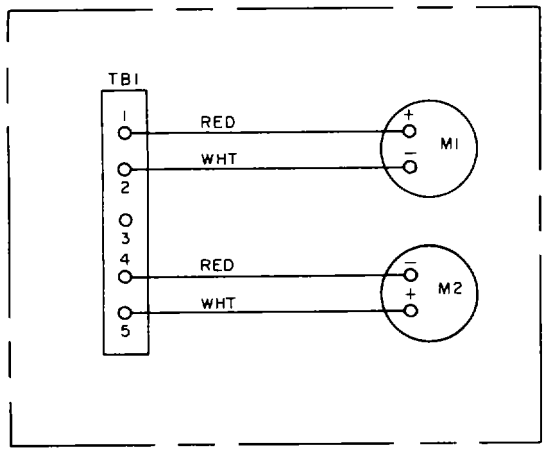


Figure 16. Meter panel, wiring diagram.

SEND LOOPING jack on the red patch panel. Be sure that the AN/ FGC-25X No. 1 keyboard SENDLOCK switch is set to LOCK to insure the presence of a continuous mark signal in the loop.

(2) The milliammeter should indicate 60 milliamperes.

(3) Patch the DC MA jack on the audio dc patch panel to the KW9-1 SEND LOOPING jack on the red patch panel. The dc milliammeter should indicate the same reading as the known good milliammeter ((2) above).

(4) If the dc milliammeter does not indicate 60 milliamperes, check the meter panel wiring and patch panel jacks. If the wiring and jacks are good, replace the dc milliammeter (para 52).

37. Combined Function Panel, Trouble Isolation Procedures

a. Power Monitor Lamps. During normal operation, the power monitor lamps light to indicate that the main and standby power supplies (type 233, model 1) in the tone keyer, the three tone converter, the two demultiplexer, and the multiplexer shelves are operating. If either the main or standby power monitor lamp is extinguished, proceed as follows:

(1) Check the shelf POWER switch to see if it has been turned on.

(2) Check to see that shelf FUSE 1 and FUSE 2 are not blown.

(3) Use Multimeter TS-352/U tocheck for the presence of 13volts dc ±1.5 across the terminals associated with the particular lamp in question (fig. 62).

(4) If the correct voltage is present, replace the defective lamp.

b. Keyer Fuses. If a keyer fuse blows, its associated integral blown-fuse indicator lights. Replace the blown-fuse indicator assembly. If the fuse blows and the indicator does not light, check the wiring to the fuse (fig. 62). If the wiring is good, c he c k the fuse indicator assembly for mechanical defects.

c. TRANSMIT MULTIPLEX Switches. Since the four TRANSMIT MULTIPLEX switches are identical, TRANSMIT MULTIPLEX 1-2 switch S1 is used as an example. The isolation procedures are also applicable to switches S2, S3, and S4.

(1) *Space diversity position*. With switch S1 in the 2-CHANNEL DIVERSITY position, the channel 1 and channel 2 tone keyers should be receiving different teletypewriter information. If the channel 2 tone keyer is not receiving a teletypewriter signal, proceed in the following manner.

(a) Send a test message over channel 2.

(b) Patch the DC MA jack on the audio-dc patch panel to the TTY TRANSMIT GROUP CHAN2 LPG jack.

(c) The dc milliammeter should fluctuate in response to the mark and space signals of the test message.

(d) If the dc milliammeter does not respond to the test message, check the continuity of contacts 1-5 of switch S1. Replace s-witch S1 if defective.

(2) *Space and frequency diversity position*. With switch S1 in the

4-CHANNEL DIVERSITY position, the channel 1 and channel 2 tone keyers receive the same teletypewriter signal. If continually fading signals are being received at the distant radio terminal, proceed in the following manner.

(a) Send a test message over channel 1.

(b) Patch the DC MA jack on the audio-dc patch panel to the TTY TRANSMIT GROUP CHAN 1 LPG jack.

(c) The dc milliammeter should fluctuate in response to the mark and space signals of the test message. Note the minimum and maximum readings.

(d) Move the patch cord from the TTY TRANSMIT GROUP CHAN 1 LPG jack to the TTY TRANSMIT GROUP CHAN 2 LPG jack.

(e) The dc milliammeter should fluctuate and indicate the same minimum and maximum readings noted in (c) above.

(f) If the meter indications are not present or the indications differ from those in (e) above, check the continuity of contacts 3-5 of switch S1. Replace switch S1, if defective.

d. RECEIVE DEMULTIPLEX Switches. Since the four RECEIVE DEMULTIPLEX switches are identical, only RECEIVE DEMULTIPLEX 1-2 switch S5 is examined. The isolation procedures are also applicable to switches S6, S7, and S8.

(1) *Space diversity operation*. During normal operation, switch S5 is in the 2-CHANNEL DIVERSITY position and is not in the receive circuit path of the incoming signal. If there is a malfunction in the receive circuit or the incoming signal is abnormal, switch S5 requires no troubleshooting.

(2) Space and frequency diversity operation. During space and frequency diversity operation, switch S5 is in the 4-CHANNEL DIVERSITY position and is in the receive circuit path of the incoming signal. If the teletypewriter signals received are continually fading during space and frequency diversity operation, proceed as follows:

(a) Check the signal schematic diagram for circuit operation (fig. 76 (3), TM 11-5895-288-12).

(b) Check the wiring of the switch (fig. 62).

(c) Check the switch.

(d) Replace the switch, if defective (para 52).

38. Hybrid Unit, Trouble Isolation Procedures

a. General. The hybrid unit operates in conjunction with the engineering order wire. The following troubleshooting chart is used to isolate a defective part in the hybrid unit. The symptoms in the troubleshooting chart will be encountered when the engineering order-wire circuit is in use. Figure 17 is the wiring diagram of the hybrid unit. Figure 3 is the schematic diagram.

b. Hybrid Unit Troubleshooting Chart.

SYMPTOM	PROBABLE CAUSE	Correction
1. No transmission over engineer's order-wire circuit from TA-312/PT.	Resistor R2 defective.	Replace R2 (para 52).
2. No reception over engineer's order-wire circuit by TA-312/Pr.	Resistor R1 defective.	Replace R1 (para 52).
3. Excessive singing on transmit side of engineer's order-wire circuit.	Balancing circuit improperly adjusted or defective.	Readjust balancing network (para 67c). If singing still exists, check potentiometers R3 and R4 and capacitor C1 and replace defective part.

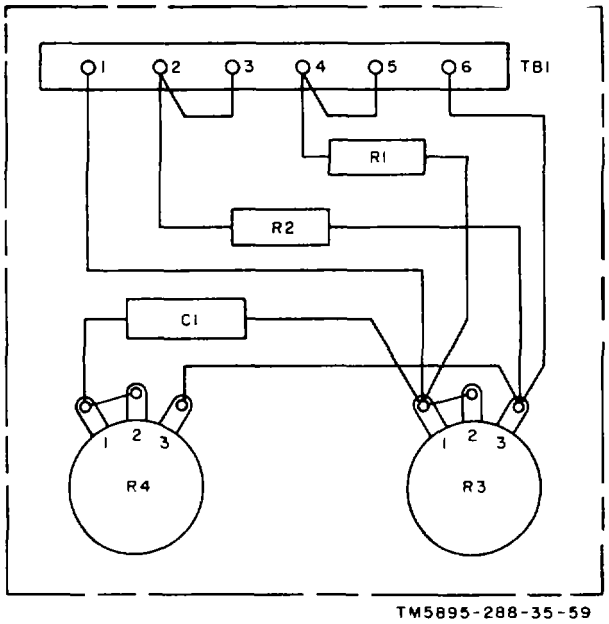


Figure 17. Hybrid unit, wiring diagram.

39. Multiple Repeat Panel, Trouble Isolation Procedures

a. General. The multiple repeat panel is used during testing to simultaneously repeat a test message on two or more (up to eight) teletypewriter channels. During normal operation, the eight SIGNAL switches are closed to complete the series paths for the eight teletypewriter channels. The following troubleshooting chart is used to isolate a defective part in the multiple repeat panel. Figure 63 is a wiring diagram of the multiple repeat panel.

Note
If any fuse indicator glows, replace the associated fuse.

b. *Multiple Repeat Panel, Troubleshooting Chart*.

SYMPTOM	PROBABLE CAUSE	Correction
1. No input teletypewriter signal to channel tone keyer (with SIGNAL switch closed).	SIGNAL switch defective	Replace switch (para 52).
2. No teletypewriter channel can be keyed with multiple repeat panel:		
Relay K1 operates; relays K2 through K9 do not operate.	Defective contacts 6-4 on relay Kl	Clean (para 61) or adjust (para 63a(2)) contacts on relay K1.
Relay K1 does not operate.	Defective OPR jack J1	Clean (para 64) or adjust (para 66) contacts on jack J1.
	Defective local battery loop control circuit.	Repair local battery loop control circuit.
	Defective line battery power supply	Repair line battery power supply.
	Defective local battery loop control circuit.	Repair local battery loop control circuit.
	Defective SIG jack J2 or BIAS jack J3.	Clean (para 64), adjust (para 66), or replace (para 52) jack J2 or J3.
	Defective circuit wiring.	Repair circuit wiring.
	Defective resistor R18	Replace resistor R18 (para 52).
	Defective bias coil of relay K1	Replace relay K1 (para 54).
3. Only one channel cannot be keyed	Defective operate or bias coil of relay associated with unkeyed channel.	Replace relay (para 54).
	Defective contacts 4-6 of relay associated with unkeyed channel.	Clean (para 61) or adjust (para 63a(2)) contacts or replace relay K1 (para 54) as necessary. Note: If contacts are excessively pitted, check resistors and capacitors in arc suppression networks and replace defective part.
4. Channel is still keyed with its associated SIGNAL switch in closed position.	SIGNAL switch defective	Check switch and replace if necessary (para 52).

40. Alarm Unit, Trouble Isolation Procedures

a. General. Figure 18 is a wiring diagram of the alarm unit. Figure 5 is the schematic diagram. Before using the troubleshooting chart (b below), set KW-9 OVERHEAT ALARM STOP switch S1 and

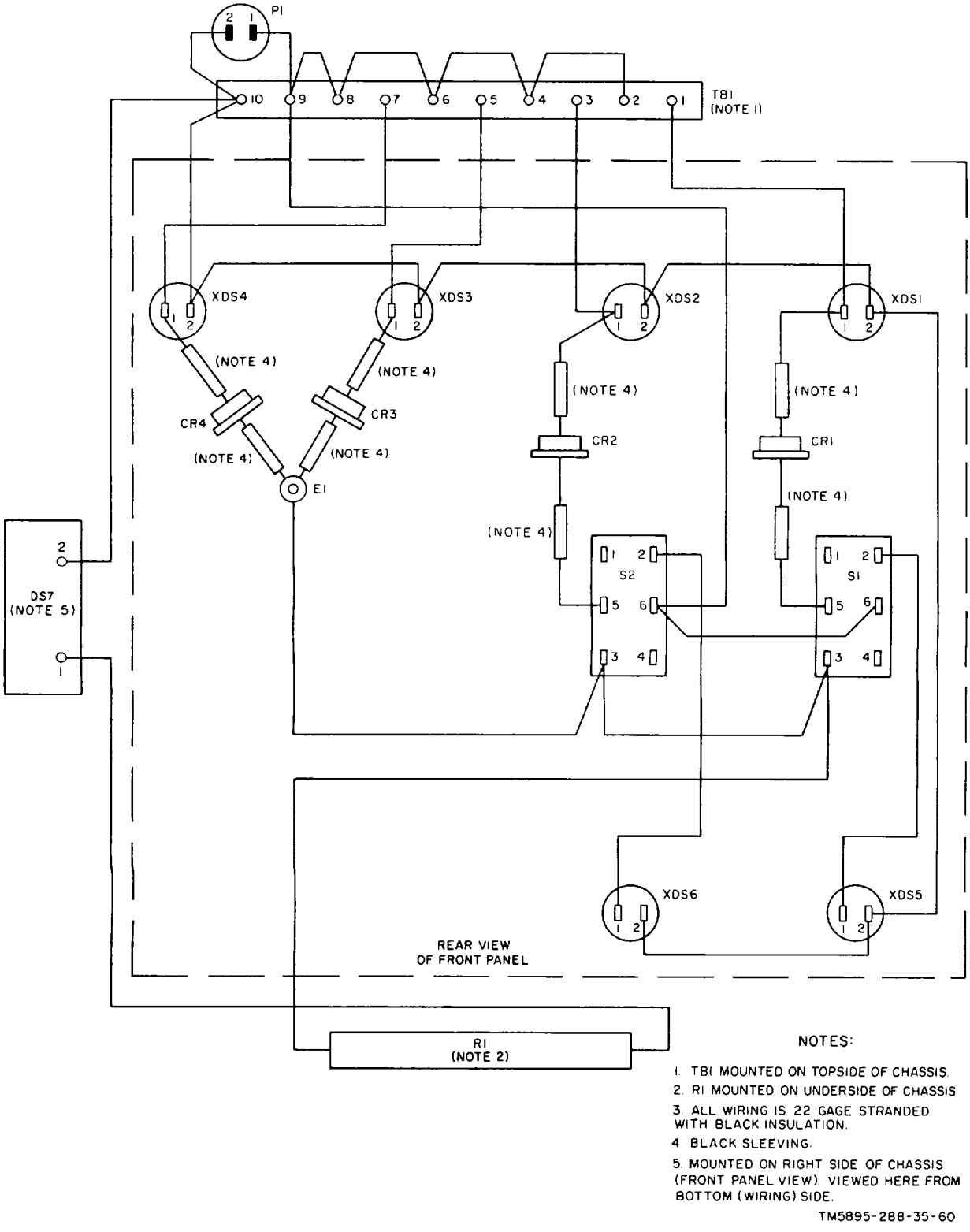


Figure 18. Alarm unit, wiring diagram.

KW-26 OVERHEAT ALARM STOP switch S2 to the up position.

b. Subscriber Power Supply, Troubleshooting Chart.

ITEM	SYMPTOM	PROBABLE CAUSE	Correction
1	Audible alarm does not sound for any overheat condition nor for incoming call.	Resistor R1 defective.	Check R1 and replace, if necessary (para 52).
		Bell defective.	Check bell coil and replace, if necessary (para 52).
		Open circuit in 115-volt ac leads.	Repair wiring.
2	With overheat condition in TSEC-KW-9 equipment, KW-9 OVERHEAT indicator lamp DS1 lights, but bell does not ring.	Crystal diode CR1 defective.	Check CR1 and replace, if necessary (para 52).
		Switch S1 defective.	Check continuity of S1 and replace, if necessary (para 52).
3	With overheat condition in TSEC-KW-26 equipment, KW-26 OVERHEAT indicator lamp DS2 lights, but bell does not ring.	Crystal diode CR2 defective.	Check CR2 and replace, if necessary (para 52).
		Switch S2 defective.	Check continuity of S2 and replace, if necessary (para 52).
4	With call on subscriber call 1 circuit, SUBSCRIBER CALL-1 indicator lamp DS3 lights, but bell does not ring.	Crystal diode CR3 defective.	Check CR3 and replace, if necessary (para 52).
5	With call on subscriber call-2 circuit, SUBSCRIBER CALL-2 indicator lamp DS4 lights, but bell does not ring.	Crystal diode CR4 defective.	Check CR4 and replace, if necessary (para 52).
6	KW-9 OVERHEAT ALARM DISABLED lamp DS5 does not light with KW-9 OVERHEAT ALARM STOP switch S1 in down position and overheat condition in TSEC/KW-9 equipment.	KW-9 OVERHEAT ALARM STOP switch S1 defective.	Check continuity of S1 and replace, if necessary (para 52).
7	KW-26 OVERHEAT ALARM DIEABLED lamp DS6 does not light with KW-26 OVERHEAT ALARM STOP switch S2 in down position and overheat condition in TSEC/KW-26 equipment.	KW-26 OVERHEAT ALARM STOP switch S2 is defective.	Check continuity of S2 and replace, if necessary (para 52).

41. Subscriber Power Supply, Trouble Isolation Procedures

a. General. Two identical power supplies are contained in the subscriber power supply. The following troubleshooting chart is applicable to both power supplies. Figure 19 is a wiring diagram of the subscriber power supply. Figure 6 is the schematic diagram.

b. Alarm Unit, Troubleshooting Chart.

ITEM	SYMPTOM	PROBABLE CAUSE	Correction
1	Fuse F1 continues to blow.	Shorted or leaking C1.	Check C1 and replace, if necessary (para 52).
2	No output voltage.	Open circuit.	Look at neon indicator DS1. If it is on, check variable resistor R5 and jack J1 for an open circuit. If indicator is off, check resistors R1 and R2, switch S1, and bridge rectifiers CR1 through CR4 (para 51) for open circuit.
3	Low output voltage.	High resistance circuit.	Same as for no output voltage above except check for higher-than-normal resistance instead of open circuit.
4	Excessive ripple.	Open filter circuit.	Replace capacitor C1 (para 52).

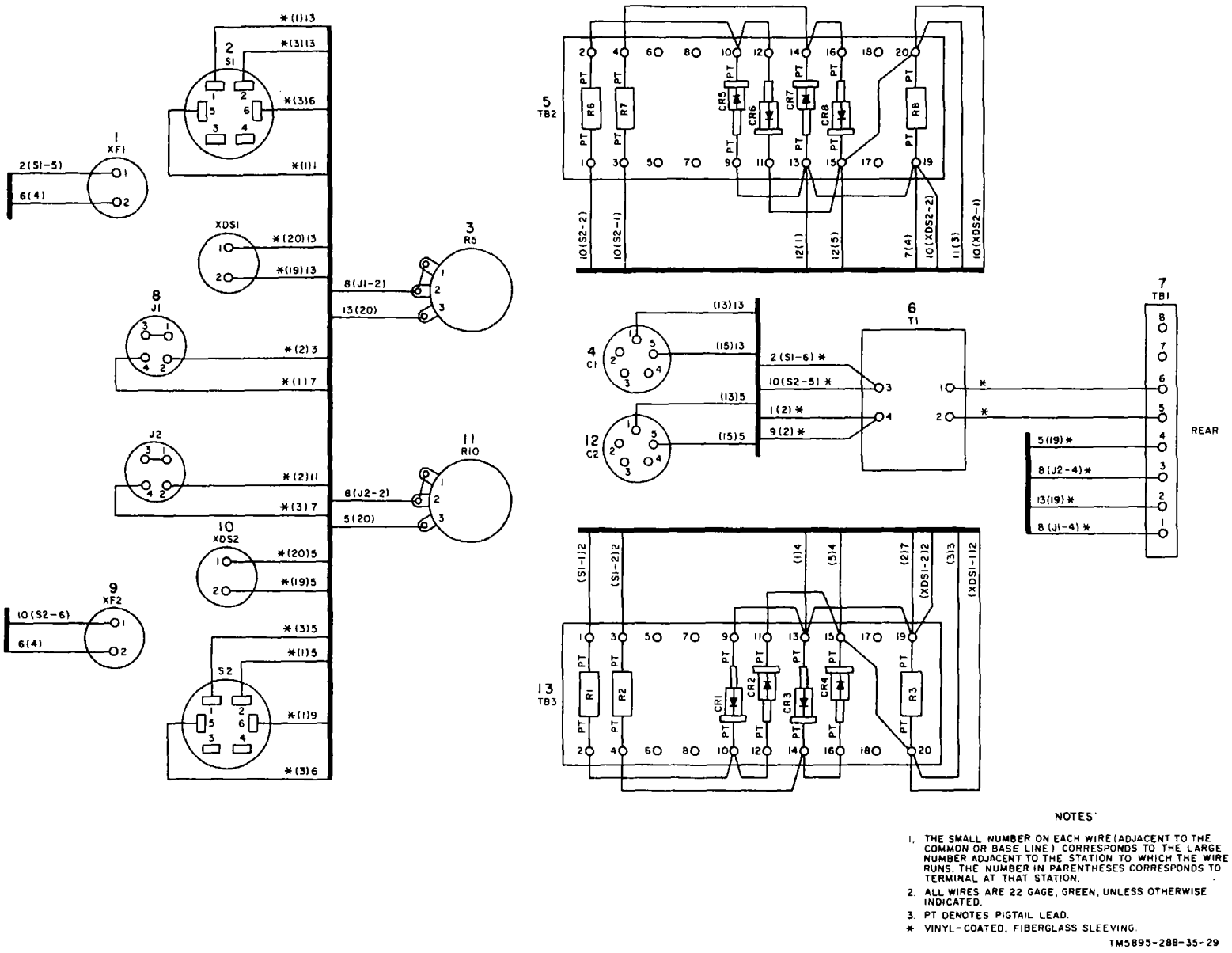


Figure 19. Subscriber power supply, wiring diagram.

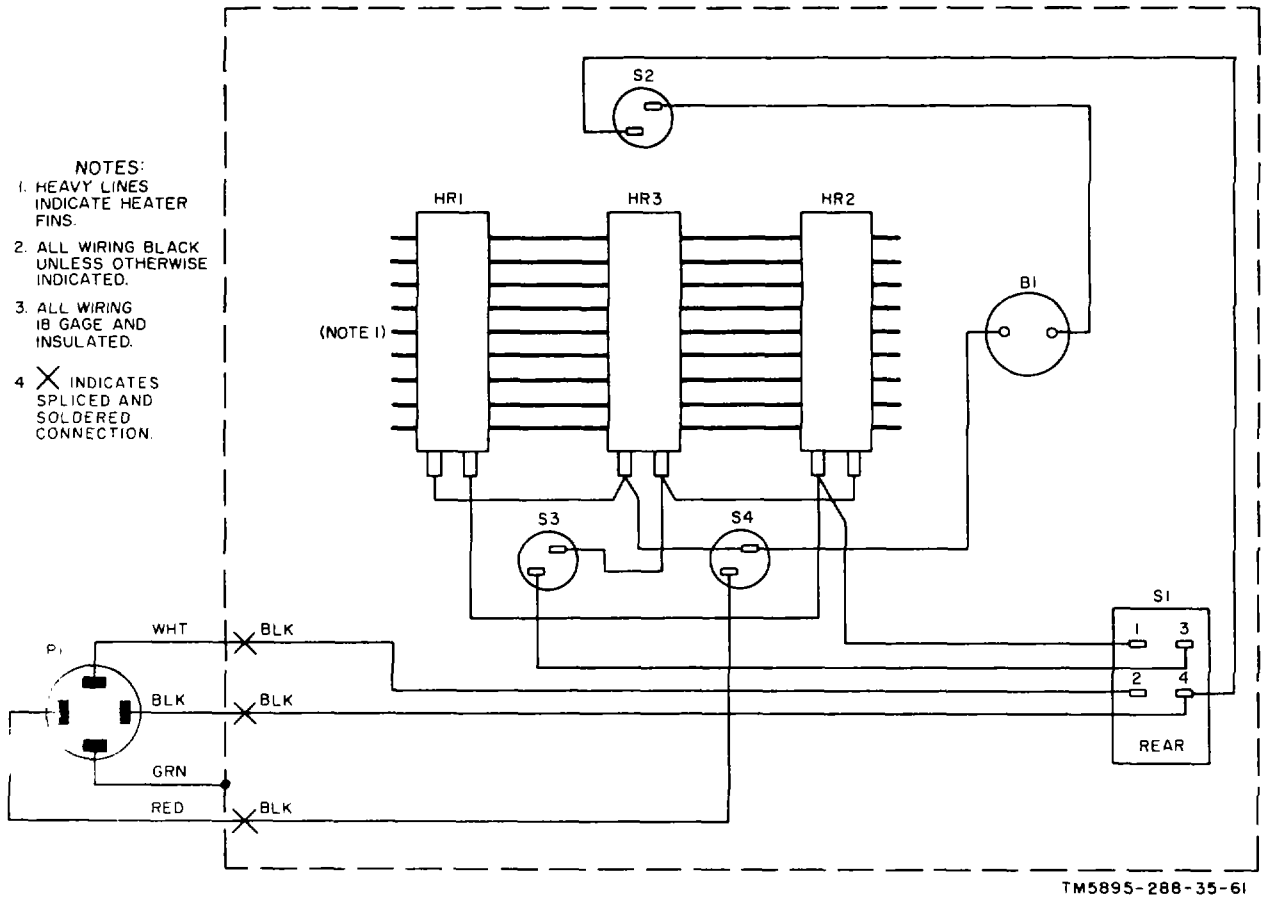


Figure 20. Heater, wiring diagram.

42. Patch Panels

Trouble in a patch panel is isolated by checking continuity (para 32c). When there is trouble in a normalled-through path in a patch panel, the trouble can normally be localized to a particular jack by checking for signals at the various jacks in the normal-through path to determine where the signal is being lost. When this method is not applicable, perform a continuity test on both the tip and ring paths through the jacks in the patch panel to determine where the open circuit is located. When the trouble is isolated to a particular jack, adjust the jack contacts (para 66) or replace the jack.

43. Heater, Trouble Isolation Procedures (fig. 7)

a. General. Paragraph b below gives the troubleshooting procedures for the heater. Figure 20 is a wiring diagram of the heater.

b. Heater, Troubleshooting Chart.

ITEM	SYMPTOM	PROBABLE CAUSE	Correction
1	Fan motor B1 does not start. All heater elements hot.	Fan switch S2 defective	Check continuity of S2 with ac test lamp (power applied) and replace, if necessary (para 56*b*).
		Fan motor B1 defective	Replace defective fan motor (para 56*e*).
		Thermostat control S1 or thermostat sensing element defective.	Check continuity of S1 with ac test lamp and replace, if necessary (para 56a).

ITEM	SYMPTOM	PROBABLE CAUSE	Correction
	All heater elements cold	Thermostat control S1 or thermostat sensing element defective.	Check continuity of S1 with ac test lamp and replace, if necessary (para 56*a*).
		Safety switch S4 defective	With power removed from heater, check continuity of S4 and replace, if necessary (para 56*c*).
	All heater elements do not get hot	Safety switch S3 defective	With power removed from heater, check continuity of S3 and replace, if necessary (para 56*c*).
		Heater element defective	Replace defective heater element (para 56*d*).
		Thermostat control S1 defective	Check continuity of S1 and replace, if necessary (para 56*a*).
2	Heater element HR1 only:	Heater element HR1 defective	Replace heater element HR1 (para 56*d*).
	Remains cold	Thermostat control S1 defective	Check continuity of S1 and replace, if necessary (para 56*a*).
	Becomes warm	Safety switch S3 defective	With power removed from heater, check continuity of S3 and replace, if necessary (para 56*c*).
3	Heater element HR2 only:		
	Remains cold	Heater element HR2 defective	Replace defective heater element HR2 (para56d).
	Becomes warm	Thermostat control S1 defective	Check continuity of S1 and replace, if necessary (para 56d).
4	Heater element HR3 only:		
	Remains cold	Heater element HR3 defective	Replace defective heater element HR3 (para 560). ***Note*: The dc resistance of each heater element is 15 ohms.**
	Becomes warm	Safety switch S3 defective	With power removed from heater, check continuity of S3 and replace, if necessary (para 56c).
		Thermostat control S1 defective	Check continuity of S1 and replace, if necessary (para 56a).

44. Dual Speaker and Amplifier Panel, Trouble Isolation Procedures

a. General. The dual speaker and amplifier panel contains two identical amplifiers and speakers. The left amplifier and speaker is used with the engineer's order wire, and the right is connected to the audio-dc patch panel for use when testing (fig. 76 (4), TM 11-5895-288-12). Figure 21 is a wiring diagram of one amplifier. Figure 8 is the schematic diagram. When troubleshooting (b below), the amplifier is energized.

b. Dual Speaker and Amplifier Panel Troubleshooting Chart.

ITEM	SYMPTOM	PROBABLE CAUSE	Correction
1	Fuse F401 blows continually	Leaky capacitor C402	Check C402, and replace if necessary (para 52).
		Transformer T403 shorted to ground.	Replace T403.
		***Note*: For 2 through 5 below, no signal is applied.**	
2	No output. No voltage at junction of R409 and C402.	Defective fuse F401	Replace F401 (para 52).
		Defective switch S401	Check S401 for continuity. Replace, if necessary (para 52).
3	No output. Voltage at junction of R409 and C402 is not approximately -14 volts do.	Defective resistor R409	Replace R409 (para 52).
		Defective capacitor C402	Replace C402 (para 52).
		Defective diode CR401 or CR402	Check diodes. Replace if necessary (para 52).
		Defective transformer T403	Replace T403.
4	No output. Voltage at junction of	Defective driver or push-pull out-	Proceed to item 5.

ITEM	SYMPTOM	PROBABLE CAUSE	Correction
	R409 and C402 is approximately 14 volts dc.	put stage.	
5	No output. Audio signal, 3,000 cycles at 0 dbm, injected between bases of Q402 and Q403 is not audible in speaker.	Defective push-pull output stage	Check T404, R405, R408, and T402. Replace defective part (para 52).
	***Note*: For items S through 9, use audio signal generator set for 3,000 cycles at -27 dbm.**		
6	No output. Audio signal injected between base of Q401 and ground is audible in speaker.	Defective transformer T401, resistor R401, R402, or R404, or capacitor C401.	Check T401, R401, R402, R404, and C401. Replace defective parts (para 52).
7	No output. Audio signal injected between base of Q401 and ground is not audible in speaker.	Defective driver stage	Check driver Q401 and associated parts. Replace defective parts (para 52).
8	Distorted output. With amplifier volume control fully clockwise and audio signal across primary of T401, voltages from base, emitter, and collector of Q402 and Q403 to ground are not as indicated in figure 24.	Defective push-pull output stage	Replace defective part (para 57).
9	Output very low. With amplifier volume control fully clockwise and audio signal across primary of T401, voltage and resistance for push-pull output stage are not as shown in figures 8 and 24.	Push-pull output stage defective. Driver stage defective	Replace defective part (para 57). Check R402, R403, R404, and C401 Replace defective part (para 52).

45. Current Limiter Panel and Local Battery Loop Control Rheostats, Trouble Isolation Procedures

If there is either no current, or the current in a particular circuit cannot be adjusted to the required level by means of the rheostat in the circuit, the rheostat may be defective. The suspected rheostat may be checked with Multimeter TS-352/U set to the RX100 scale. The multimeter should indicate between 0 and 2,500 ohms as the rheostat is varied from zero to maximum resistance. If the multimeter indicates any dead spots, replace the rheostat (para 52). Figure 22 is the wiring diagram of the local battery loop controls.

46. Blower Fan, Trouble Isolation Procedures

The blower fan in equipment rack 404 or 408 receives power from the rack power strip. If all the components within the equipment rack, except the blower fan, are operating normally, check the blower fan power connector and power cord for continuity (para 32*c*). If there is no continuity, repair or replace the power cable and connector. If there is continuity, the trouble is in the fan motor. Replace the entire fan housing (para 52).

47. RTB-5 Terminator, Trouble Isolation Procedures

If excessive noise is noted in the receive circuit, check the two resistors being used in the RTB-5 terminator. Use Multimeter TS-352/U set to the RX10 scale to test each resistor. The value of each resistor should be approximately 150 ohms. If a resistor is found to be defective, remove the resistor and replace it with the spare resistor mounted on the inside left of the RTB-5 case.

48. TDR-002.5 Terminator, Trouble Isolation Procedures

Warning

Dangerous voltages exist at antenna terminals. Be sure transmitter is turned off before working on terminators.

Each leg of the sloping-vee transmitting antenna is terminated in a TDR-002.5 terminator. If the terminator is good, the antenna transmission line is properly terminated and no voltage standing waves

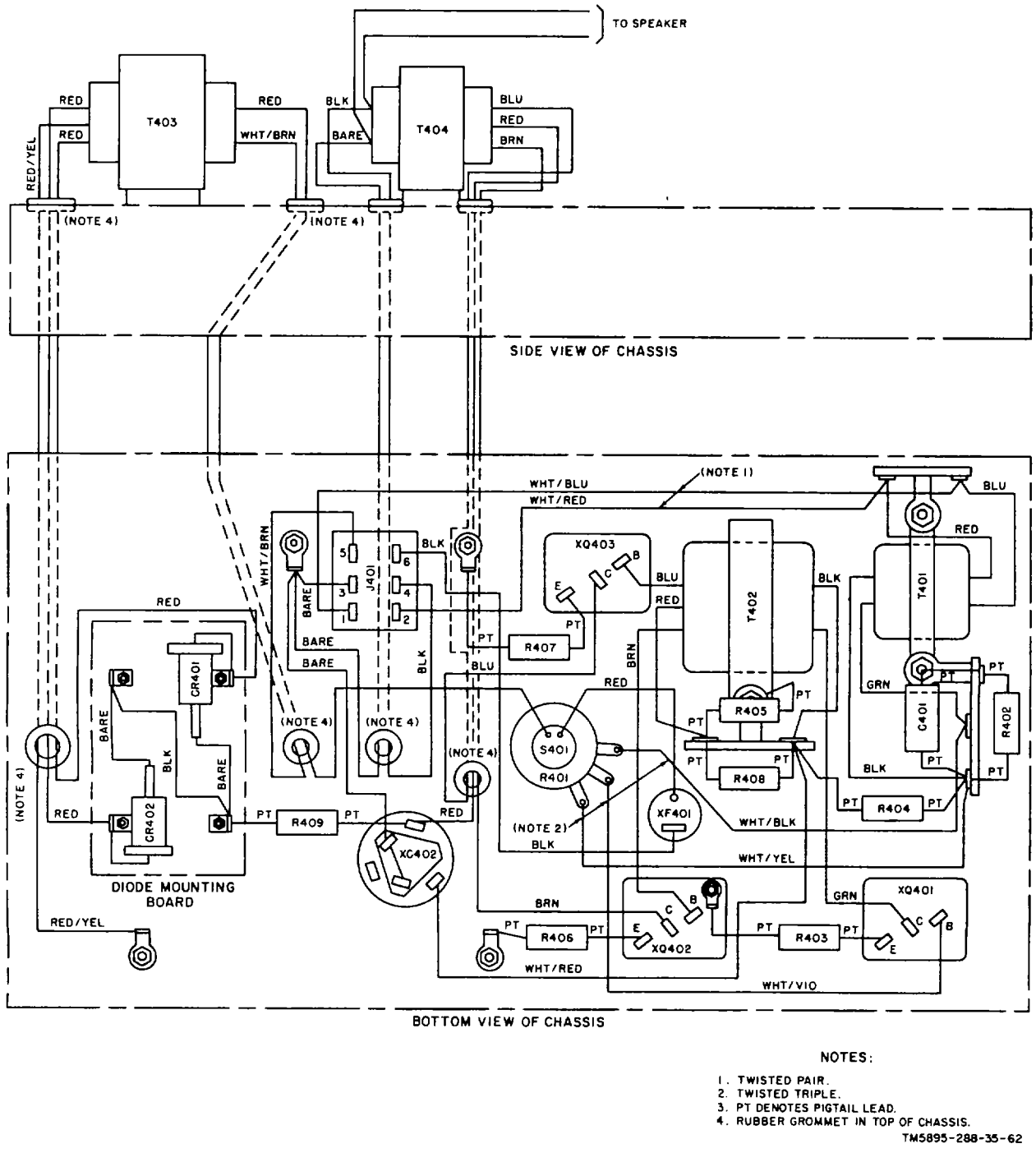


Figure 21. Dual speaker and amplifier panel, wiring diagram.

exist. If the standing wave ratio meter SWR-1K indicates that excessive standing waves exist, check the two resistors in the TDR-002.5 terminator. The resistors are tested with Multimeter TS-352/U set to the RX10 scale. A reading of approximately 460 ohms should be obtained for each resistor. If the proper resistance value is not obtained, replace the defective resistor (para 52).

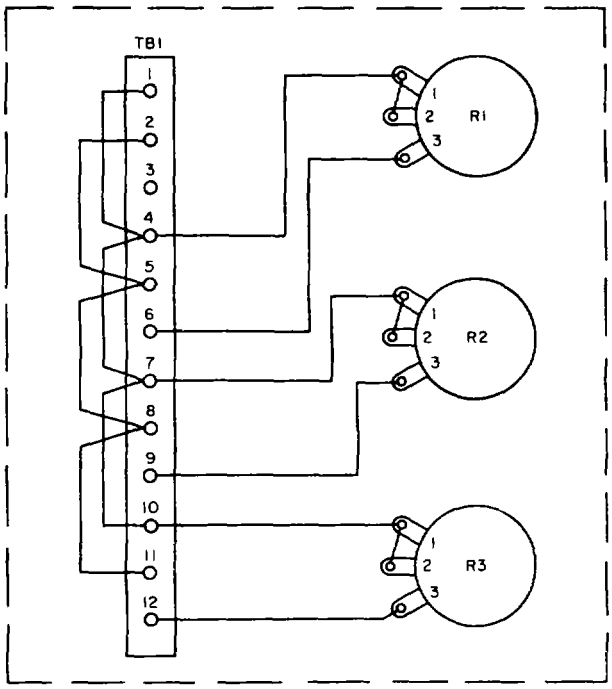


Figure 22. Local battery loop controls No. 1, No. 2, and No. 3, wiring diagram.

49. TRC-500 Coupler, Trouble Isolation Procedures

Warning

Dangerous voltages exist at antenna terminals. Be sure transmitter is turned off before working on coupler.

Check the primary and secondary windings of the TRC-500 transformer. If an open circuit is indicated in either winding, replace the TRC-500 coupler (para 52). Since the TRC-500 transformer is hermetically sealed and potted in a special compound, no maintenance is required.

50. RAC-30A Coupler, Trouble Isolation Procedures (fig. 23)

If a trouble is localized to the RAC-30A coupler, check fuses F1 and F2. If there is a blown fuse, replace the defective fuse (para 52). If both fuses are good, test the RAC-30A coupler in the following manner:

a. Disconnect the coaxial cable input to the receiver from connector J1.

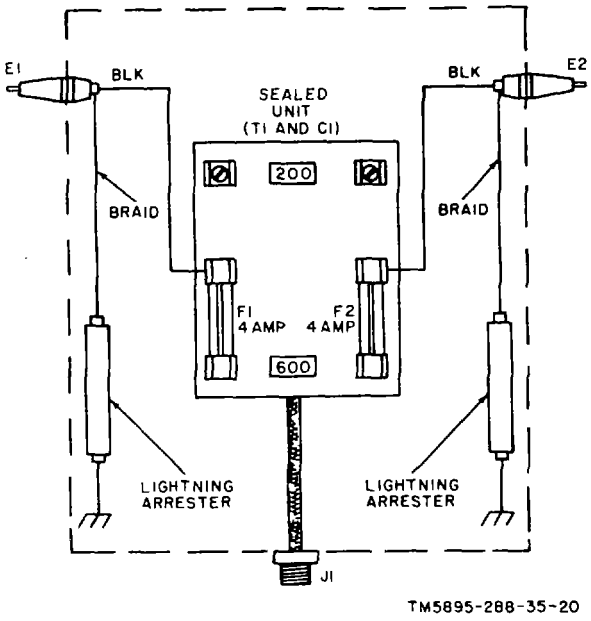


Figure 23. RAC-30A coupler, wiring diagram.

b. Set Multimeter TS-352/U to the RX1 scale and connect the multimeter across the 70-ohm terminals. The multimeter should record essentially the antenna termination resistance of 600 ohms.

c. Disconnect the antenna from insulator terminal El and E2. The multimeter should read very high or almost an open circuit.

d. Short terminals El and E2. The multimeter should read zero.

e. If any or all of the readings in b, c, and d above are not obtained, replace the RAC-30A coupler (para 52).

51. Additional Troubleshooting Data

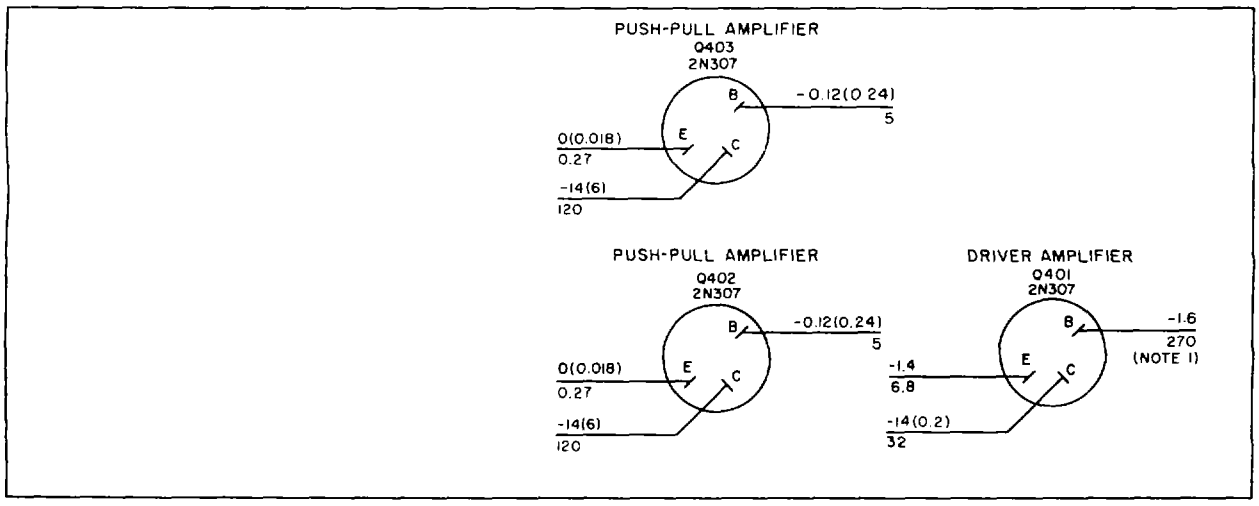
a. General. The following paragraphs contain information to supplement the isolation procedures g iv e n in the troubleshooting charts. The additional information consists of procedures to check the forward and backward resistances of diodes and rectifiers, dc resistance values for all relays, coils, and transformers, and voltage and resistance measurements.

b. Diodes and Bridge Rectifiers, Resistance Check. The forward and backward resistance of the diodes in the alarm unit, subscriber power supply, and dual speaker and amplifier panel are listed below.

Component	Diode	Type	Resistance (ohms)	
			Forward	Backward
Alarm unit	CR1 through CR4	1N538	less than 1	4 meg (nom)
Subscriber power supply	CR1 through CR8	1N538	less than 1	4 meg (nom)
Dual speaker ad amplifier panel	CR401 and CR402	1N1763	less than 1	4 meg (nom)

c. Transformer Winding and Relay Coil Data. The dc resistances of the transformer windings and relay coils in the components listed in paragraph 1b are shown below.

Component	Relay or transformer	Winding	Terminals	Ohms
Control relay panel No. 1	K1, K2		10-11	5,000 (nom)
Control relay panel No. 2	K1		10-11	5,000 (nom)
Multiple repeat panel	K1	Signal	2-3	160 (nom)
		Bias	1-8	160 (nom)
	K2 through K9	Operating	2-3	160 (nom)
		Bias	1-8	160 (nom)
Dual speaker and amplifier panel	T401	Primary		18
		Secondary		4
	T402	Primary		120
		Secondary (full)		10
		Secondary (center tap)		5
	T403	Primary		28
		Secondary (full)	2.5	
		Secondary (center tap)		1.25
	T404	Primary (full)		1.1
		Primary (center tap)		Less than 1 ohm
		Secondary		Less than 1 ohm



NOTES:

1. R401 FULLY CLOCKWISE.
2. ALL RESISTANCE MEASUREMENTS ARE MADE WITH THE POSITIVE LEAD OF THE OHMMETER GROUNDED.
3. FIRST VOLTAGE FIGURES ARE DC WITH NO SIGNAL APPLIED.
4. ALL VOLTAGES IN PARENTHESES ARE AUDIO WITH -27DBM INPUT AND R401 SET FULLY CLOCKWISE.

TM5895-288-35-50

Figure 24. Dual speaker and amplifier panel, voltage and resistance diagram.

d. Voltage and Resistance Data. Figure 24 shows the voltages measured at the terminals of transistors Q401, Q402, and Q403 in the dual speaker and amplifier panel. The voltages are measured during normal operation, but with no signal input. The resistance values shown in figure 24 are taken between the transistor terminals and ground. Use Electronic Multimeter TS-505/U to make the voltage and resistance measurements.

CHAPTER 3

REPAIRS AND ADJUSTMENTS

Section I. REMOVAL AND REPLACEMENT OF PARTS

52. General Parts Replacement Techniques

a. General. Most of the parts in the components listed in paragraph 1*b* can be easily reached and replaced when the component is removed from the rack. Replacement procedures that are obvious are not covered. Replacement procedures for parts that are common to more than one component are covered in *c* below. Precautions that must be observed when replacing parts are covered in *b* below. Paragraphs 53 through 58 describe replacement procedures for component parts that are not covered in the standard replacement procedures. Replace the blower fan using the replacement procedures described in TM 11-5895-288-12. Figures 25 through 47 are parts location illustrations for the components listed in paragraph 1*b*. Use standard replacement procedures when replacing parts in the components listed below.

(1) Current limiter panel (fig. 25).
(2) Meter panel (fig. 26).
(3) Combined function panel (fig. 27).
(4) Hybrid unit (fig. 28).
(5) Transfer switch (fig. 3).
(6) Alarm unit (fig. 29).
(7) Subscriber power supply (fig. 30).
(8) Patch panels (fig. 31 through 35).
(9) Terminators and couplers (fig. 36 through 39).

b. Precautions. Observe the following precautions when replacing parts.

(1) Note the position of the part and placement of wiring before removal.
(2) Before removal, carefully tag the wires leading from the part to avoid wiring errors during replacement.
(3) Prior to unsoldering a part, make sure that the soldering iron tip is clean and tinned. When removing wiring, do not keep the soldering iron on the solder joint too long; excessive heat may damage surrounding parts attached to the same joint. Clean the terminals before soldering a new part to them to avoid cold-solder joints. Make connection leads as short as possible.
(4) When removing a diode or transistor, use a dc source with the soldering iron. If a dc source is not available, use an isolating transformer between the soldering iron and the ac source.
(5) When replacing a diode or transistor, use a pencil-type soldering iron with a 25-watt maximum capacity. Solder quickly; use a heat sink (such as long-nose pliers) between the solder joint and the diode or transistor.
(6) Use approximately the original length and dress of diode or transistor leads.
(7) Be sure that replacement diodes are oriented in the same manner as the original diodes.

c. Standard Replacement Procedures. Use the procedures given below to replace parts in the components listed in *b* above.

(1) *Jacks*. Tag and disconnect all leads connected to the jack. Remove the screws that hold the jack to the insulator block or panel, and remove the jack. Make sure that the replacement jack is the same type as the original jack.
(2) *Lamp housings*. Tag and disconnect the leads connected to the lamp. Remove the nut that holds the lamp housing to the front panel and remove the lamp housing. Make sure the replacement lamp housing is the same type as the original lamp housing.

(3) *Toggle switches*. Tag and disconnect all leads connected to the switch. Remove the nut that holds the switch to the front panel and remove the switch. Make sure that the replacement switch is the same type as the original switch.

(4) *Fuseholders*. Tag and disconnect all leads connected to the fuseholder. Remove the nut that holds the fuseholder to the front panel and remove the fuseholder. Make sure that the replacement fuseholder is the same type as the original fuseholder.

(5) *Resistors and capacitors*. Use the resistor and capacitor color code markings (fig. 58 and 59) and the schematic diagrams to determine the value of the resistor or capacitor being replaced. Replace the defective part with one having the same value. A replacement resistor must have a wattage rating equal to or higher than that on the resistor being replaced. A capacitor must have a working voltage equal to or higher than that on the capacitor being replaced.

(6) *Potentiometers and rheostats*. Tag and disconnect all leads connected to the part. Remove the nut that holds the part to the chassis or front panel. Remove the control knob if necessary and remove the part. Make sure the replacement part is the same type as the original part.

(7) *Terminal boards*. Tag and disconnect all leads connected to the terminal board. Remove the screws that hold the terminal board to the chassis or panel and remove the terminal board. Make sure that the replacement terminal board is the same type as the original terminal board.

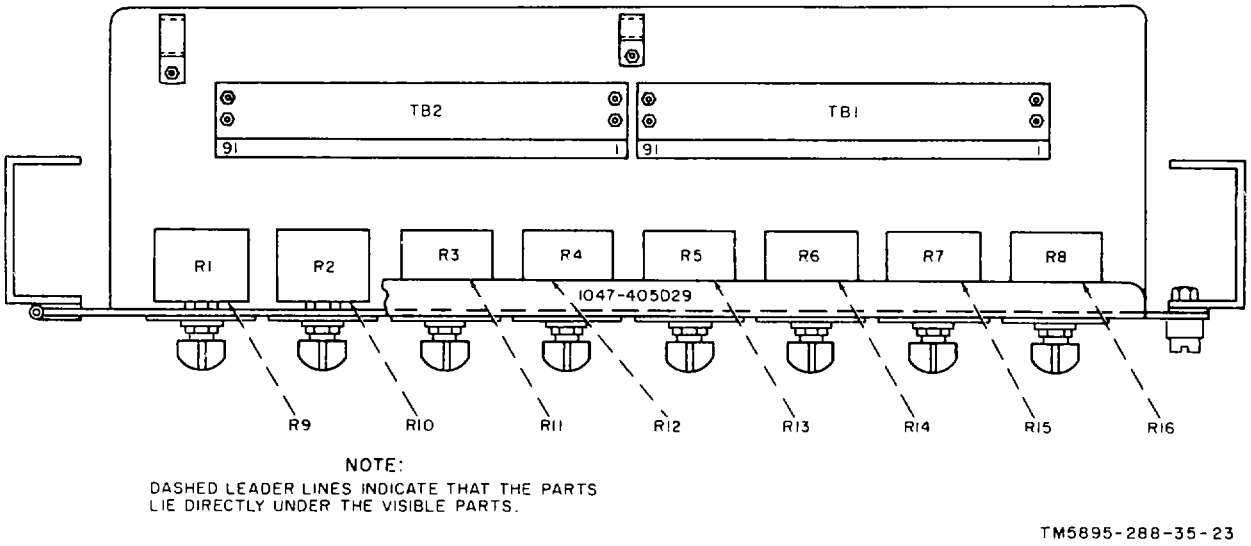


Figure 25. Current limiter panel, parts location diagram.

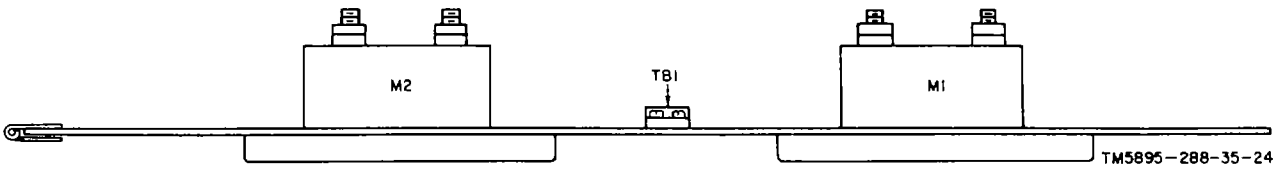


Figure 26. Meter panel, parts location diagram.

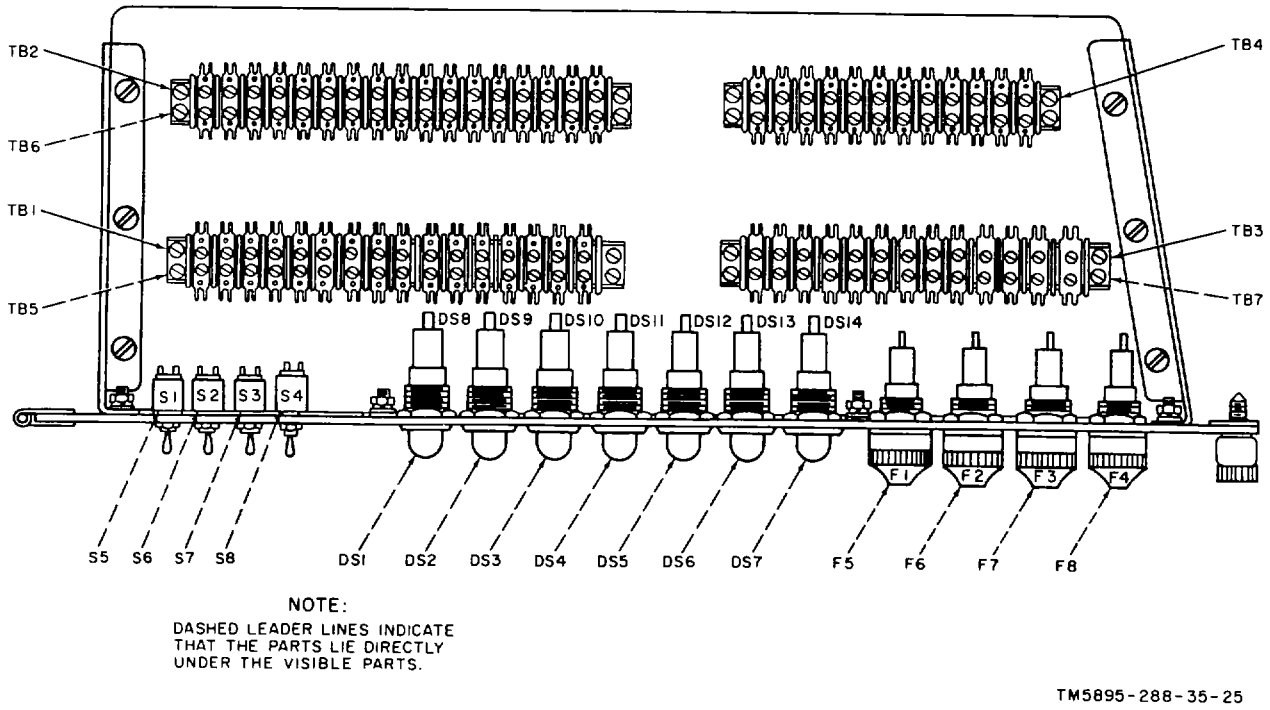


Figure 27. Combined function panel, parts location diagram.

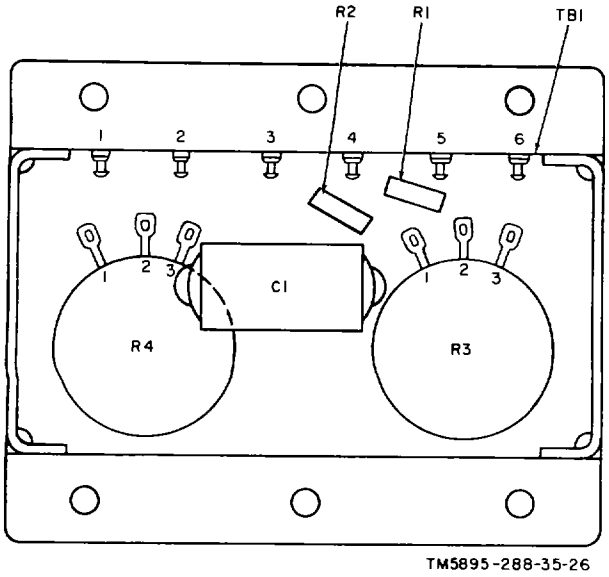


Figure 28. Hybrid unit, parts location diagram.

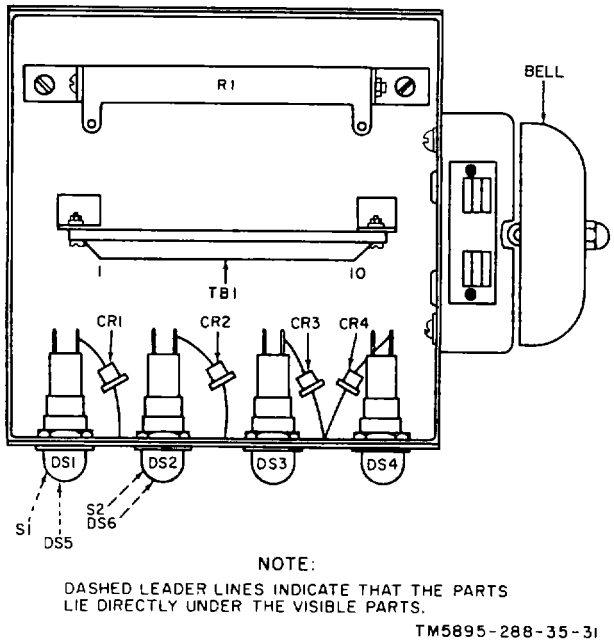


Figure 29. Alarm unit, parts location diagram.

53. Control Relay Panels No. 1 and No. 2 (fig. 40 and 41)

Control relay panels No. 1 and No. 2 contain jacks, lamps and lamp housings, terminal boards, and relays. The jacks, lamp housings, and terminal boards can be replaced by using standard removal and

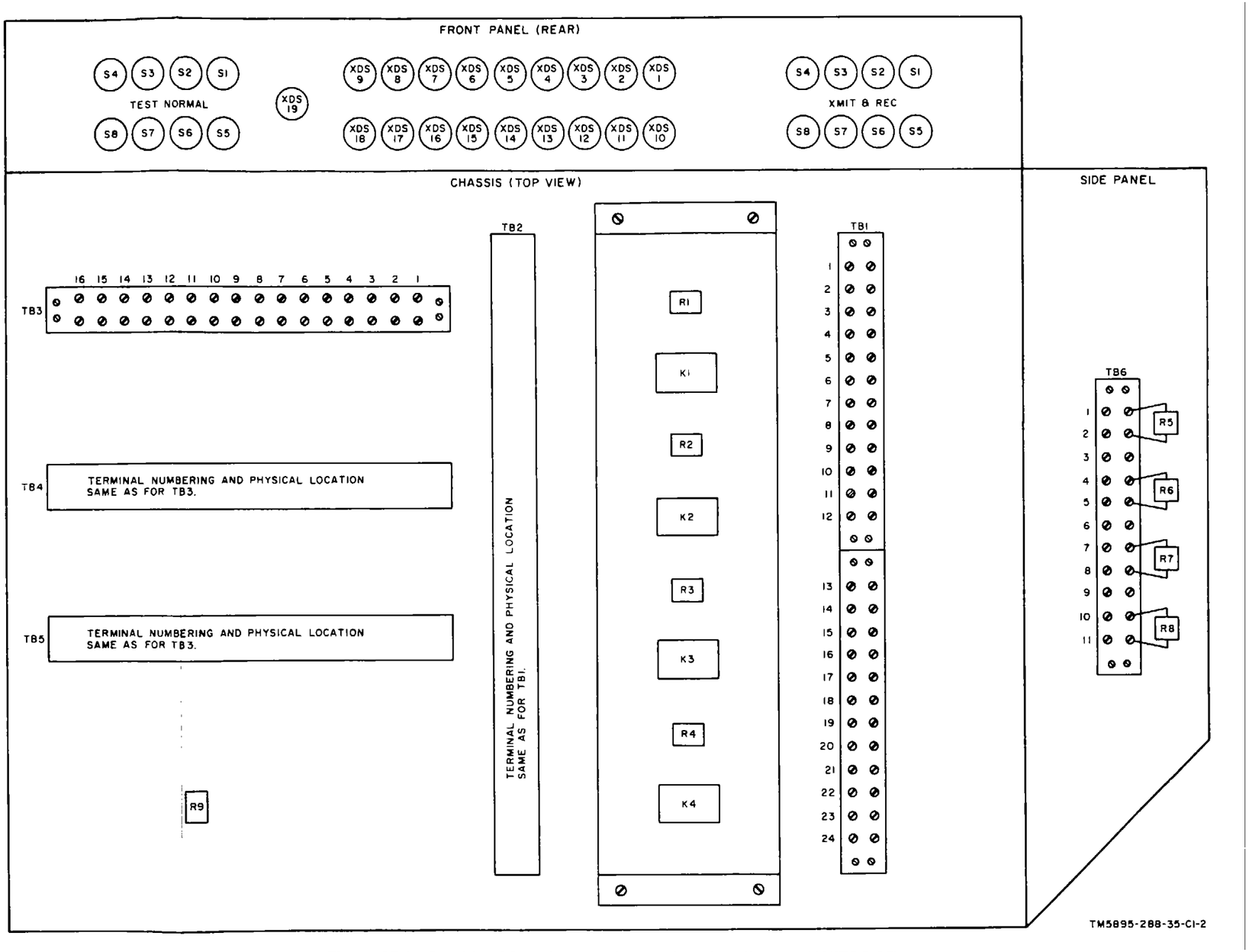


Figure 27.1. Combined function panel, parts location diagram (AN/TSC-25).

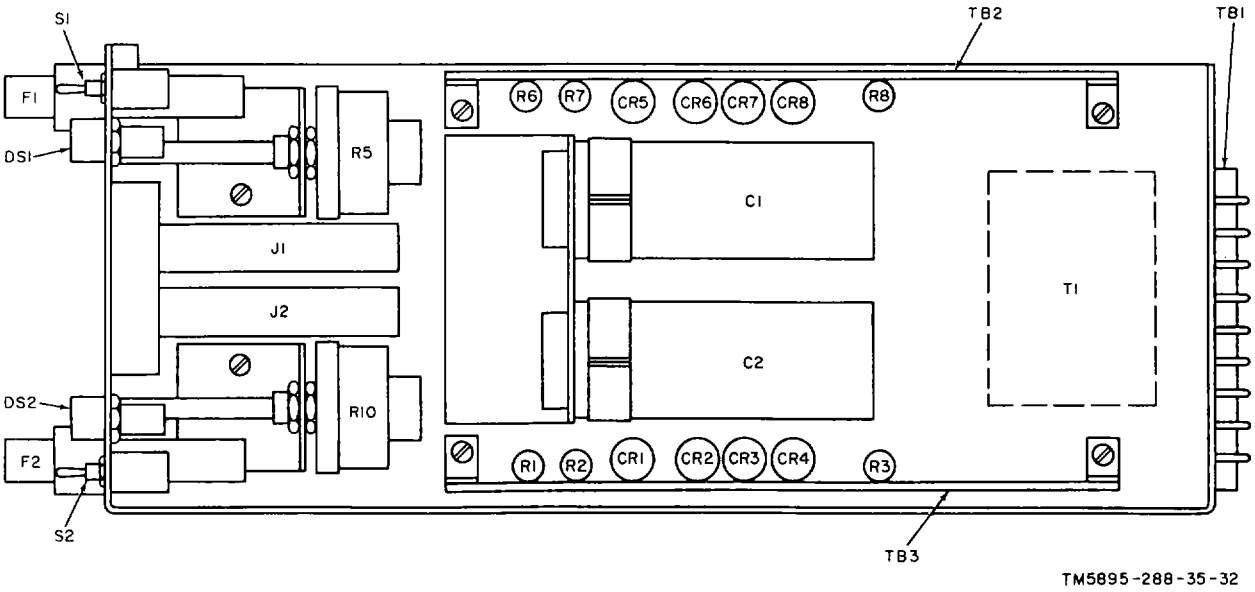


Figure 30. Subscriber power supply, parts location diagram.

replacement techniques (para 52c). To remove a relay, proceed as follows:

a. Remove the screw at the bottom of the dust cover and remove the dust cover.

b. Tag and unsolder all leads to the relay.

c. Remove the four screws that hold the relay bracket to the front panel. Keep the relay bracket as close to the front panel as possible when the screws are removed to avoid breaking the wires passing through the relay bracket.

d. Remove the four screws that hold the relay to the relay bracket.

e. Align the replacement relay on the relay bracket and secure it with the four screws.

f. Secure the relay bracket to the front panel; use the four screws.

g. Reconnect all leads to the terminals on the relay.

h. Replace the dust cover and secure it with the screw.

54. Multiple Repeat Panel (fig. 42)

a. General. The multiple repeat panel contains jacks, toggle switches, fuseholders, resistors, capacitors, terminal boards, and relays. Any jack toggle switch, fuseholder, or terminal board may be replaced by following the standard replacement procedures (para 52c). The procedures for replacing a relay contact or relay armature are given in b below.

Note:
Normally, both the contacts and the armature are replaced at the same time.

b. Replacement of Relay Contact and Armature. The relay contacts are on the ends of the contact screws (fig. 43). Remove the contacts by removing the contact screws. To remove the armature, proceed as follows:

(1) Loosen the armature clamp screw (A, fig. 43); use a jeweler's screwdriver with a 1/16-inch blade. One turn of the screw should be sufficient.

(2) Remove the armature (B, fig. 43) from the front of the relay by gently pulling it out with a pair of tweezers or by pushing it from the rear with a small sharp instrument. If a slight pressure does not dislodge the armature, gently work it up and down, maintaining a slight, steady pressure until it comes free.

Caution:
Under no circumstances should excessive pressure be used to drive out the armature, because the entire force is placed on the hinge spring.

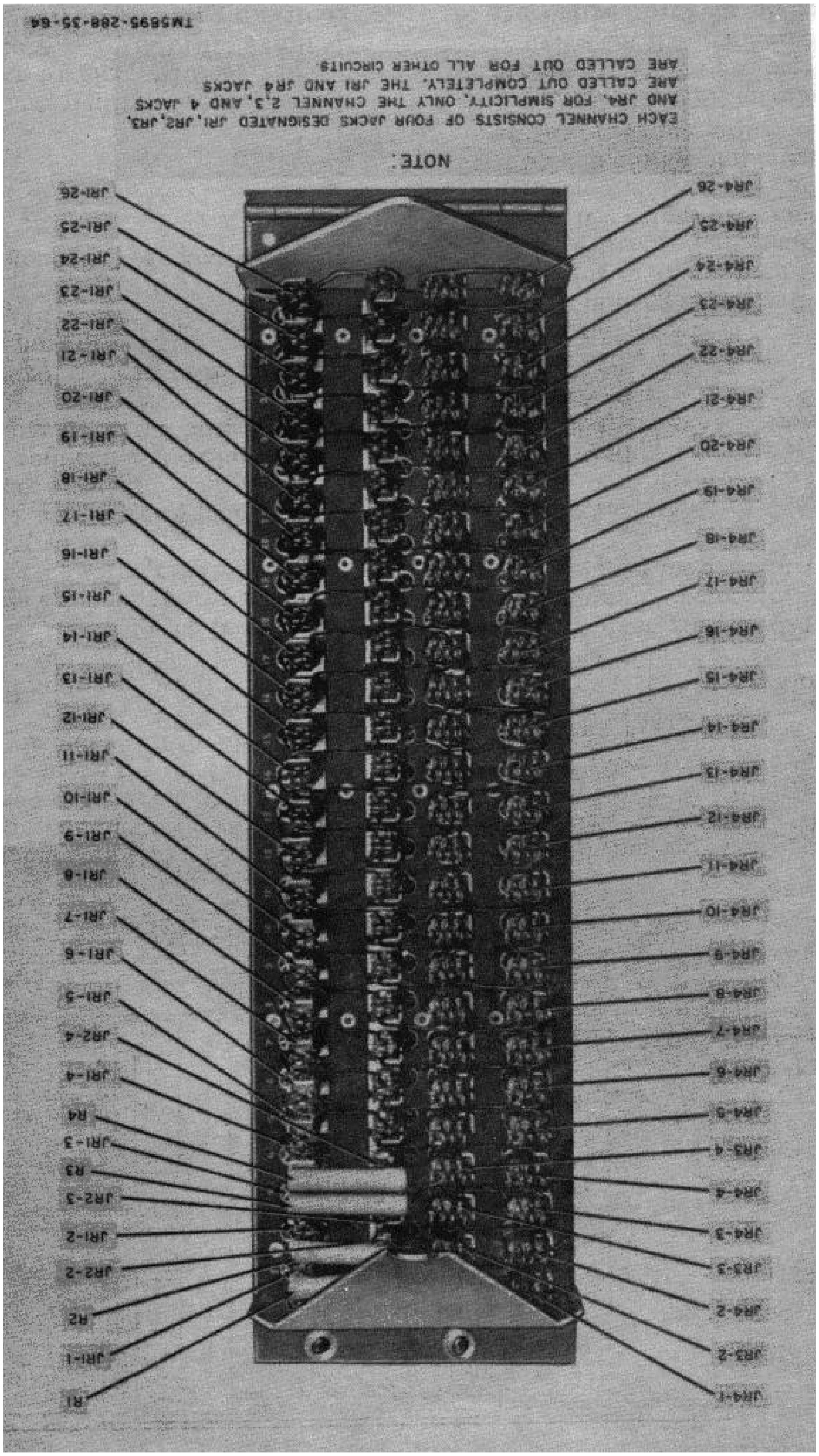


Figure 31. Black patch panel, parts location diagram.

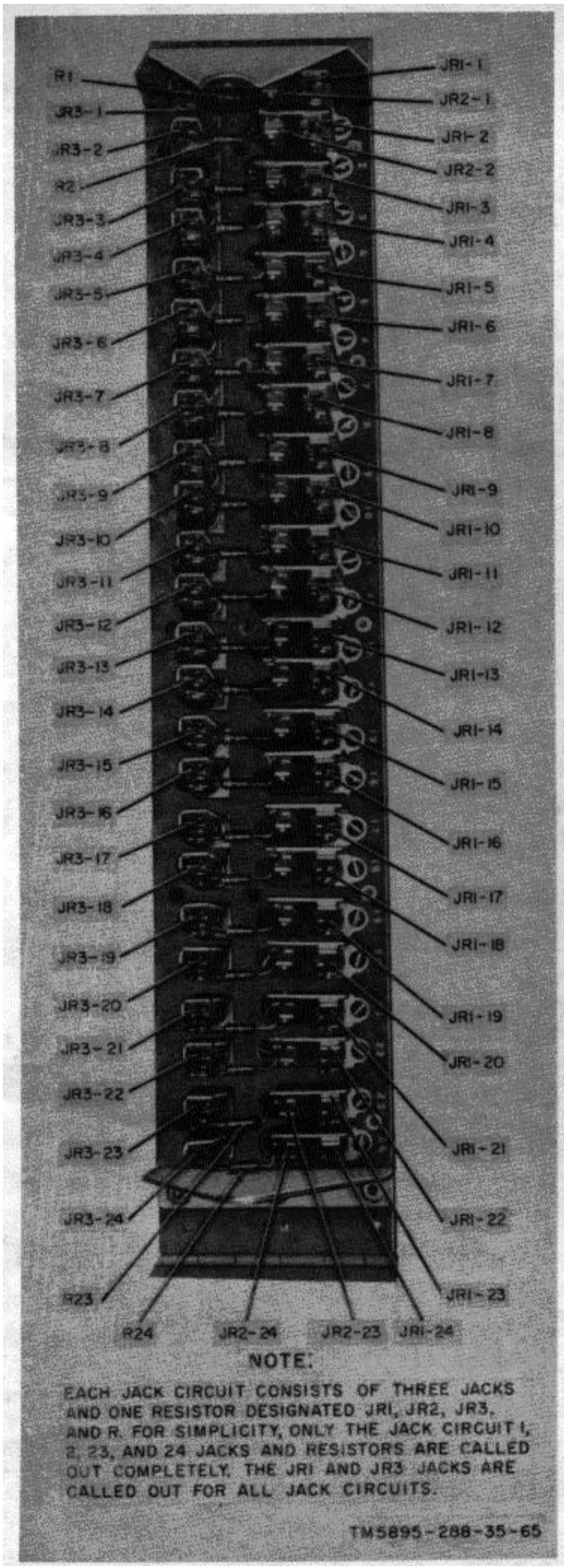


Figure 32. Audio patch panel No. 1, parts location diagram.

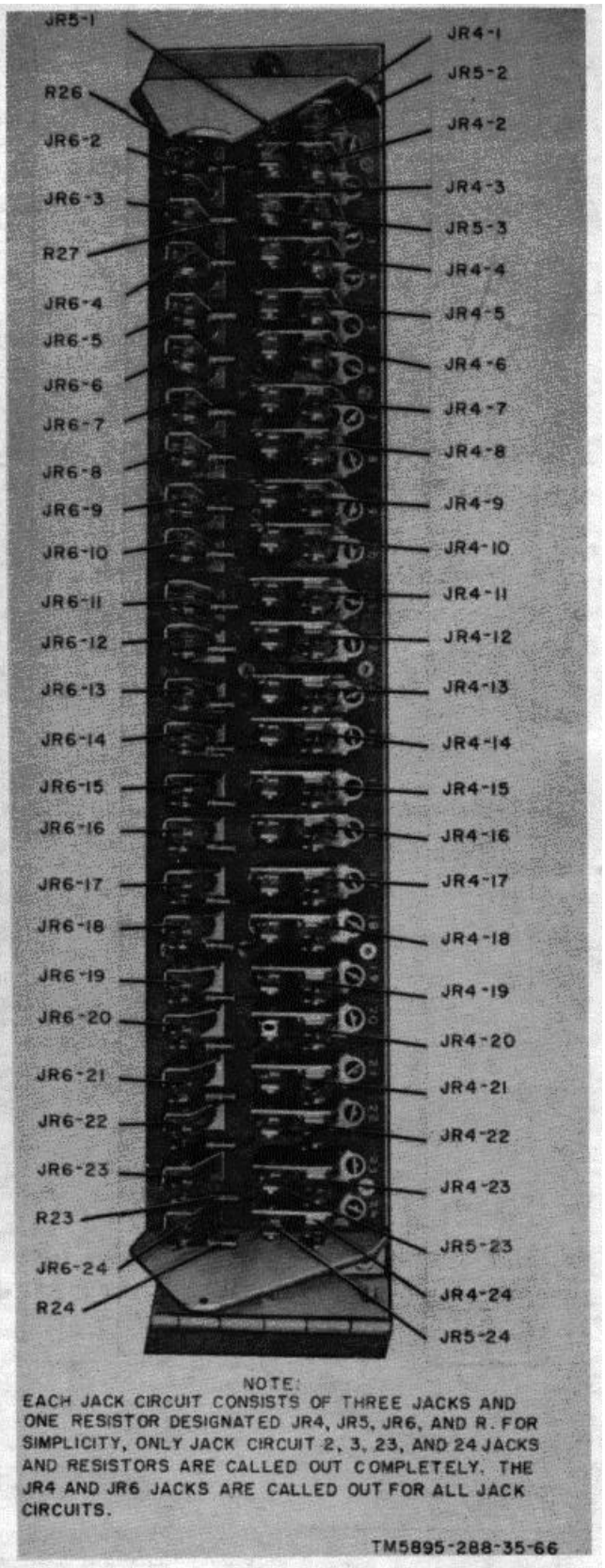


Figure 33. Audio patch panel No. 2, parts Location diagram.

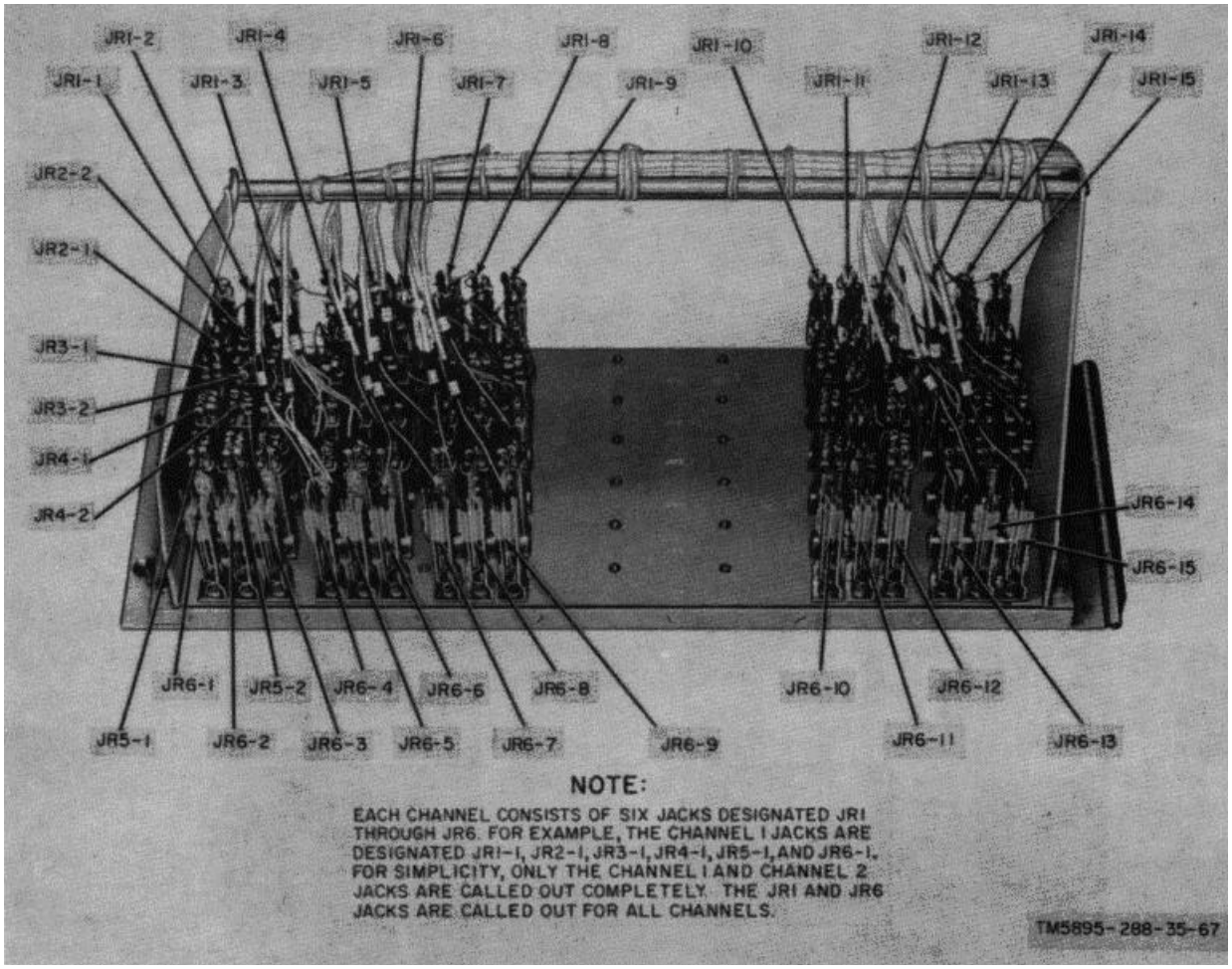


Figure 34. Red patch panel, parts location diagram.

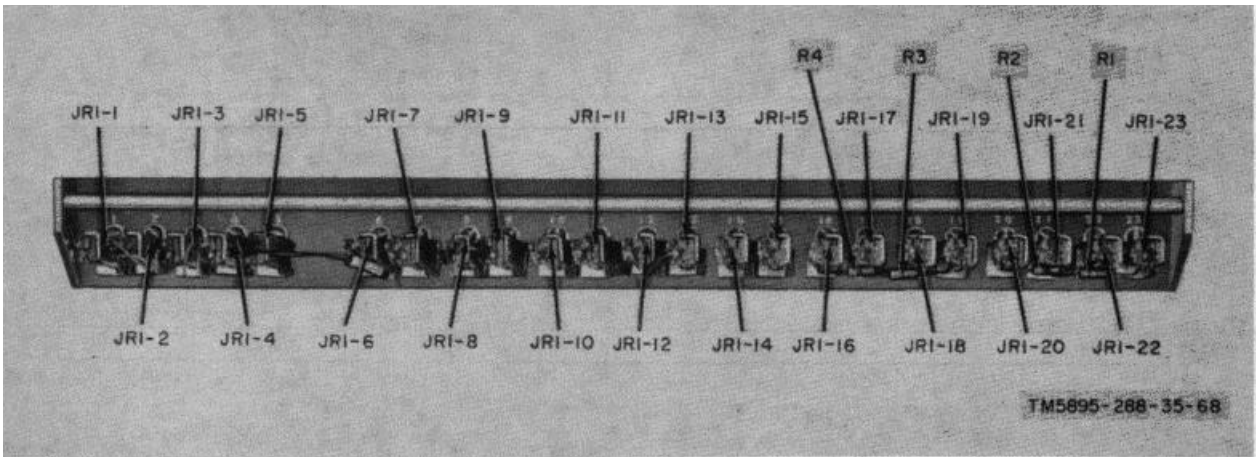


Figure 35. Audio-dc patch panel, parts location diagram.

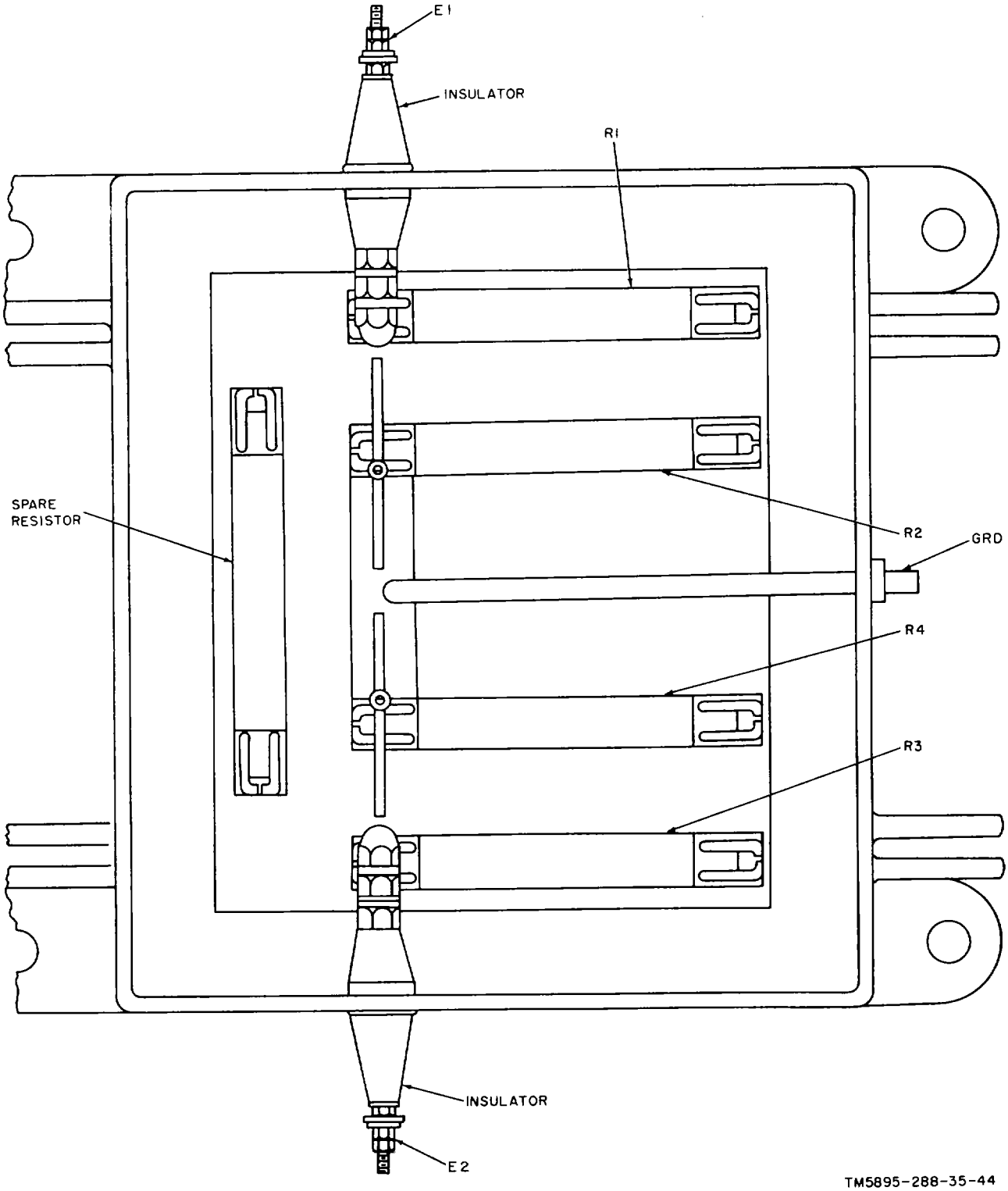


Figure 36. Terminator RTB-5, parts location diagram.

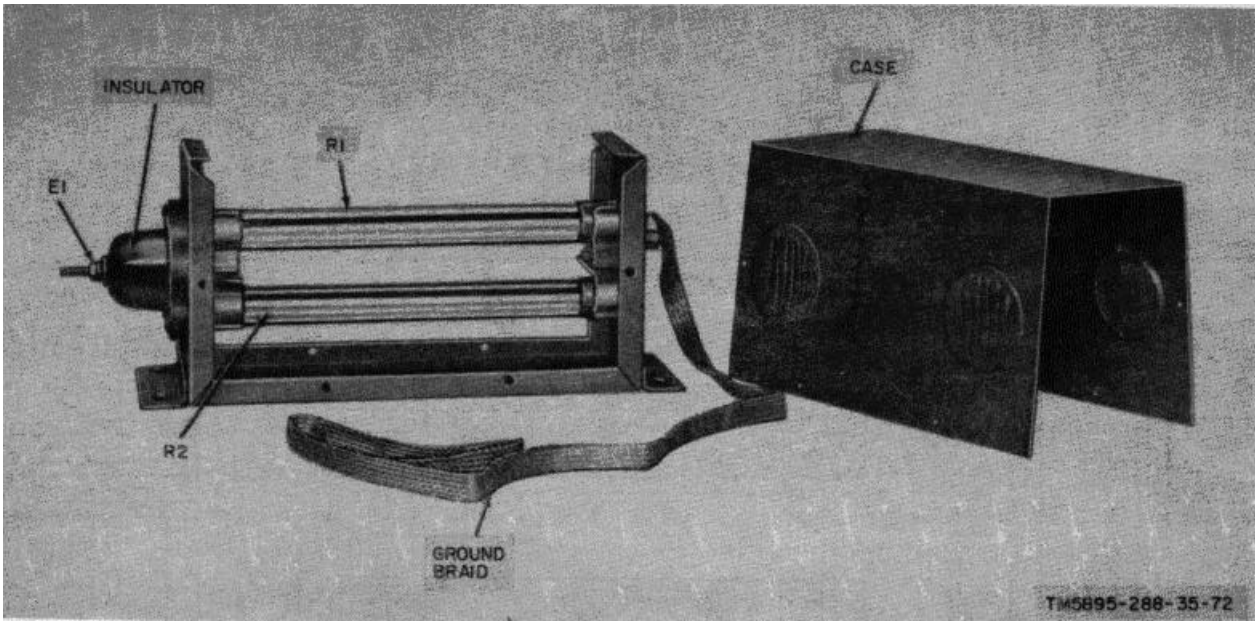


Figure 37. Terminator TDR-002.5, parts location diagram.

(3) Open the repair kit containing a new armature and two contact screws.

Caution:
When opening the repair kit be careful not to drop the contact screws accidentally. Dropped contact screws may not remain within their specified limits and must not be used again until tested for accuracy.

(4) Insert the new armature from the rear of the relay, contact end first. While inserting the new armature, look through the clamp from the front of the relay to make sure the armature clears the armature clamp screw. Ease the armature in until the back end is flush with the pole pieces. If the armature is loose in the clamp, tighten the armature clamp screw enough to prevent the armature from falling out but still allow movement for aligning the contact screws.

(5) Install one contact screw by inserting the narrow part of the screw sideways into the gap, engaging the contact screw threads. This will prevent damage to the damper spring (C, fig. 43) due to accidental snagging on the threads of the contact bracket.

(6) Screw the contact screw in far enough to secure it but not far enough to place pressure on the damper spring.

(7) Install the other contact screw in the same manner as described in (5) and (6) above.

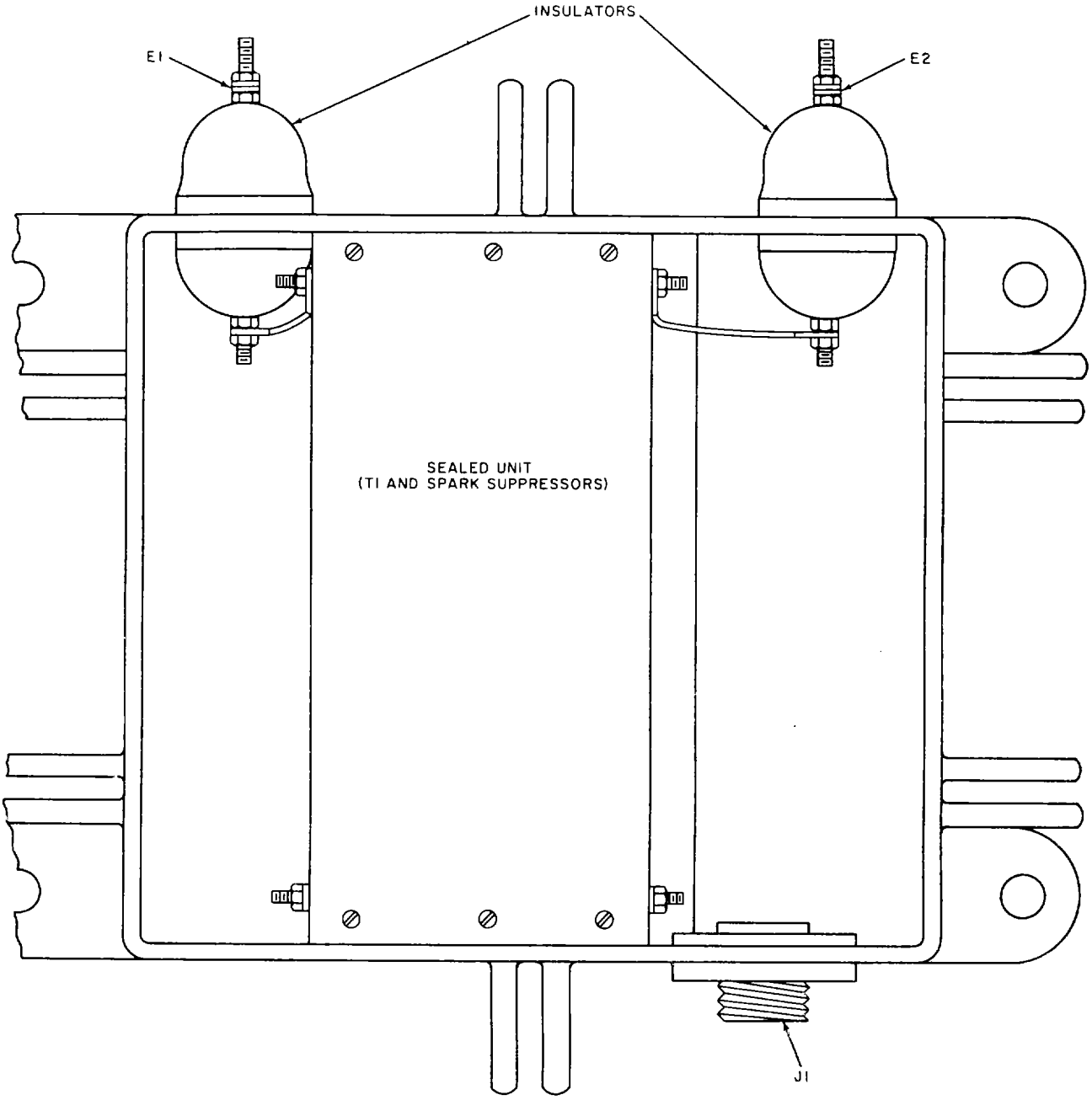
(8) Move the armature until the armature contacts are in alignment with the contact screws. Secure the armature in position by tightening the armature clamp screw (A, fig. 43).

Caution:
Do not overtighten the clamp screws; the threads are aluminum and may be easily stripped.

(9) Adjust the relay contact screws and armature (para 14, TM 11-6625-362-12).

55. Antenna Patch Panel
(fig. 44)

The antenna patch panel contains coaxial feedthrough connectors. To remove any coaxial feedthrough connector, first re-



TM 5895-288-35-46

Figure 38. Coupler TRC-500, parts location diagram.

move the cables from the connector; then remove the connector by removing the hexagonal nuts holding it to the panel.

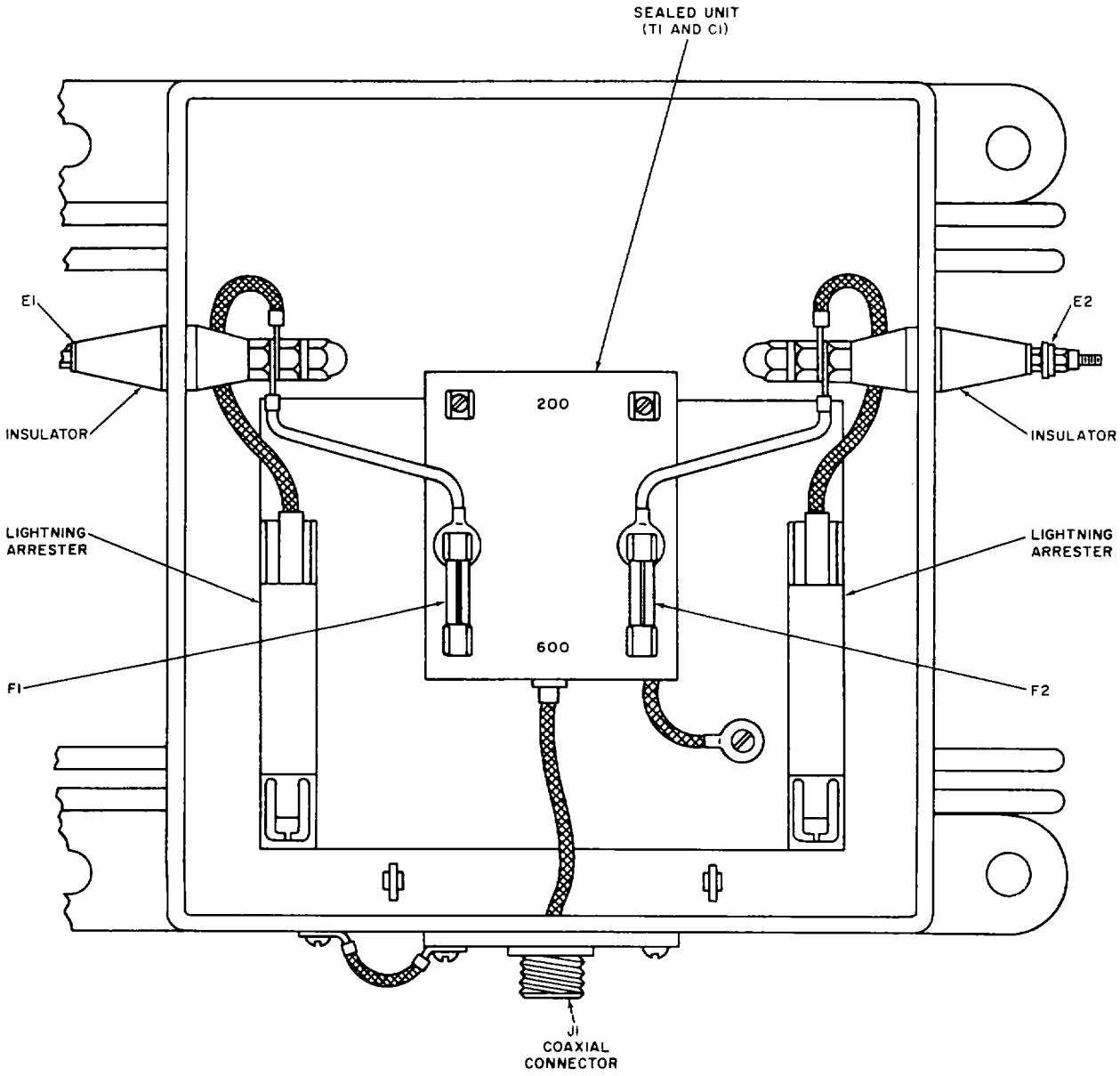
56. Heater

(fig. 45)

The heater contains fan switch S2, thermostat S1, safety switches S3 and S4, heater elements HR1, HR2, and HR3, and fan motor B1. The following paragraphs describe the procedures for removing these parts from the heater housing.

a. Replacement of Thermostat S1. Thermostat S1 includes a bellows unit and an on-off switch. To replace the bellows, proceed as follows:

(1) Remove the four screws that attach the bellows unit to the on-off switch.



TM 5895-288-35-47

Figure 39. Coupler RAC-30A, parts location diagram.

(2) Remove the four screws that secure the fan motor bracket to the heater housing.

(3) Raise the fan motor bracket and slide the thermostat sensing element out from the sensing element mounting bracket.

(4) Slide the replacement thermostat sensing element into the sensing element mounting bracket.

(5) Secure the fan motor bracket to the heater housing with the four screws.

(6) Secure the replacement bellows unit to the on-off switch with the four screws.

b. Replacement of Thermostat On-Off Switch. To replace the thermostat on-off switch, proceed as follows:

(1) Remove the control knob by loosening the setscrew on the control knob.

(2) Tag and remove all wires to the on-off switch.

(3) Remove the four screws that secure the thermostat bellows to the on-off

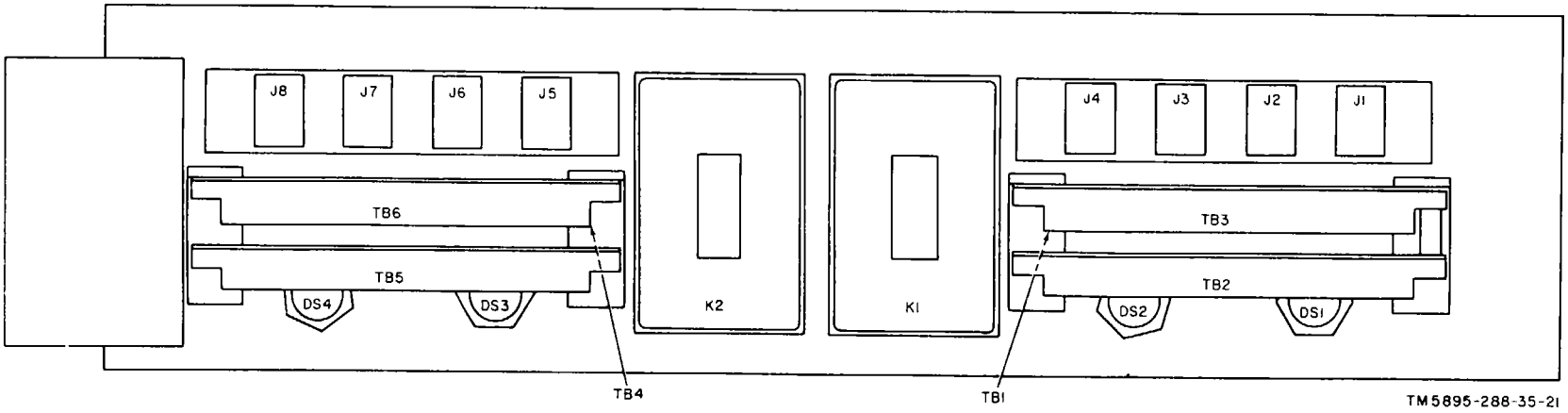


Figure 40. Control relay panel No. 1, parts location diagram.

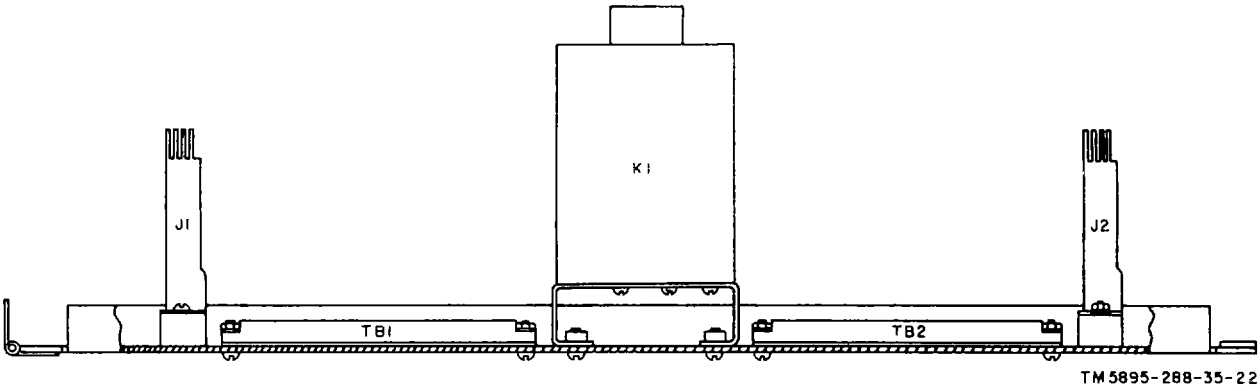


Figure 41. Control relay panel No. 2, parts location diagram.

switch, and gently pull the bellows unit away from the switch.

(4) Remove the two screws that secure the on-off switch to the frame.

(5) Remove the on-off switch.

(6) Secure a replacement on-off switch to the frame; use the two screws.

(7) Reconnect all wires to the on-off switch.

(8) Secure the thermostat bellows unit to the on-off switch; use the four screws.

(9) Replace the control knob.

c. Replacement of Safety Switch S3 or S4. To replace either safety switch, proceed as follows:

(1) Tag and remove the wires from the safety switch.

(2) Remove the two screws that secure the safety switch to the heater housing, and remove the safety switch.

(3) Attach the replacement safety switch to the heater housing; use the two screws.

(4) Reconnect the wires to the safety switch.

d. Replacement of Heater Elements. To replace the heater elements, proceed as follows:

(1) Tag and disconnect the six power lead lugs.

(2) Remove the two screws that secure the heater element to the bottom of the heater housing.

(3) Remove the four screws that secure the fan motor bracket to the heater housing and remove the fan motor bracket and the fan motor.

(4) Remove the four screws that secure the front grill to the frame, and remove the grill.

(5) Remove the screw from the top center of the heater element, and remove the heater element.

(6) Secure the replacement heater elements to the heater housing, use the screw at top center of the heater element and the two screws at the bottom of the heater element.

(7) Secure the front grill to the frame; use the four screws.

(8) Secure the fan motor bracket to the heater housing; use the four screws.

e. Replacement of Fan Motor B1. To replace the fan motor, proceed as follows:

(1) Remove the four screws that secure the fan motor mounting bracket to the heater housing, and remove the fan motor bracket with the fan motor attached.

(2) Tag and disconnect the wires to the fan motor.

(3) Remove the four screws that secure the fan motor to the fan motor bracket and remove the fan motor.

(4) Secure the replacement fan motor to the fan motor bracket; use the four screws.

(5) Reconnect the wires to the fan motor.

(6) Secure the fan motor bracket to the heater housing; use the four screws.

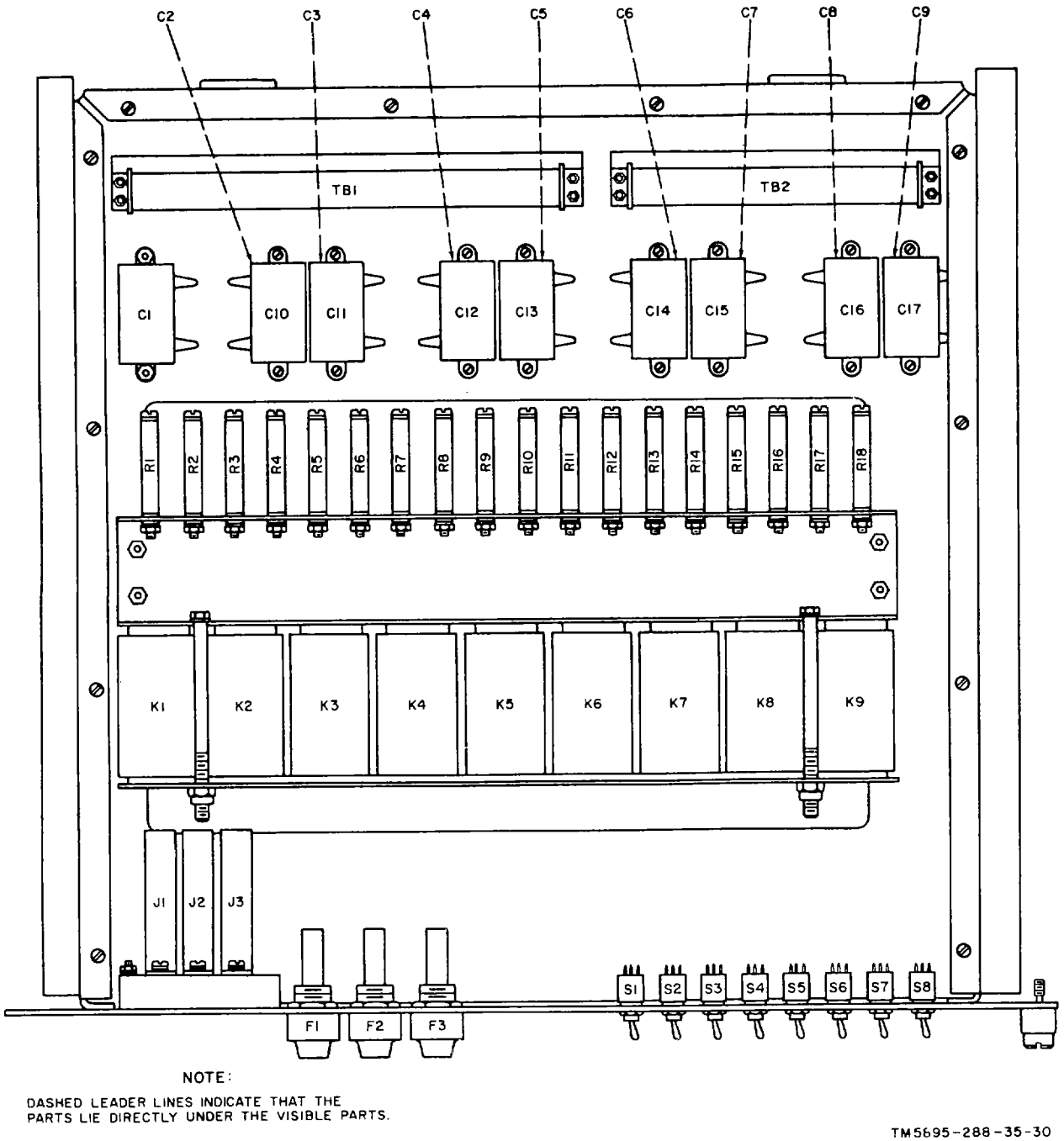


Figure 42. Multiple repeat panel, parts location diagram.

57. Dual Speaker and Amplifier Panel

(fig. 46)

a. General. The dual speaker and amplifier panel contains two speakers and two amplifiers mounted on a single panel. Each speaker is mounted directly on the front panel, and each amplifier is mounted on a separate chassis behind the front panel. To remove the speaker or any part of an amplifier, remove the associated amplifier chassis from the front panel. The following paragraphs contain procedures for replacing a speaker, removing an amplifier chassis, and replacing certain parts in the

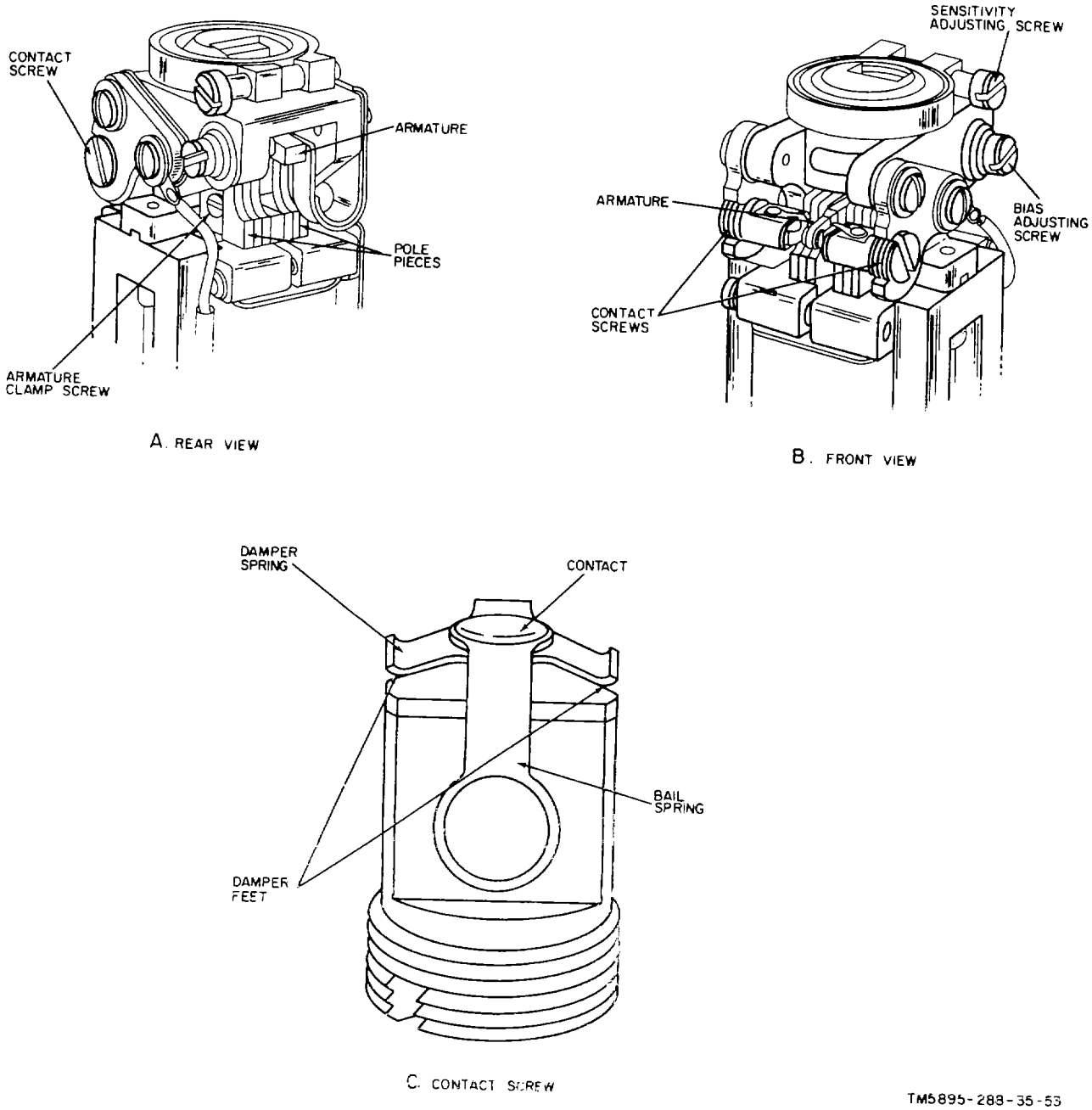


Figure 43. Polarized relay, armature and contact removed.

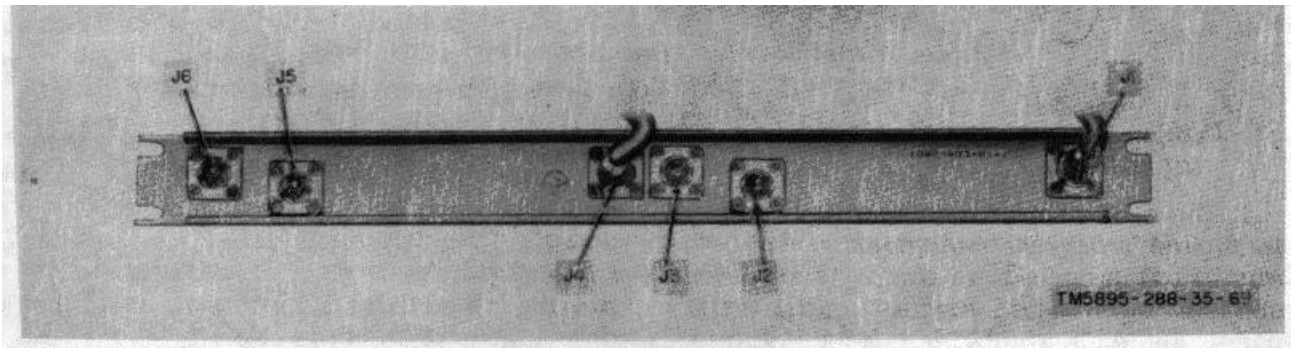


Figure 44. Antenna patch panel, parts location diagram.

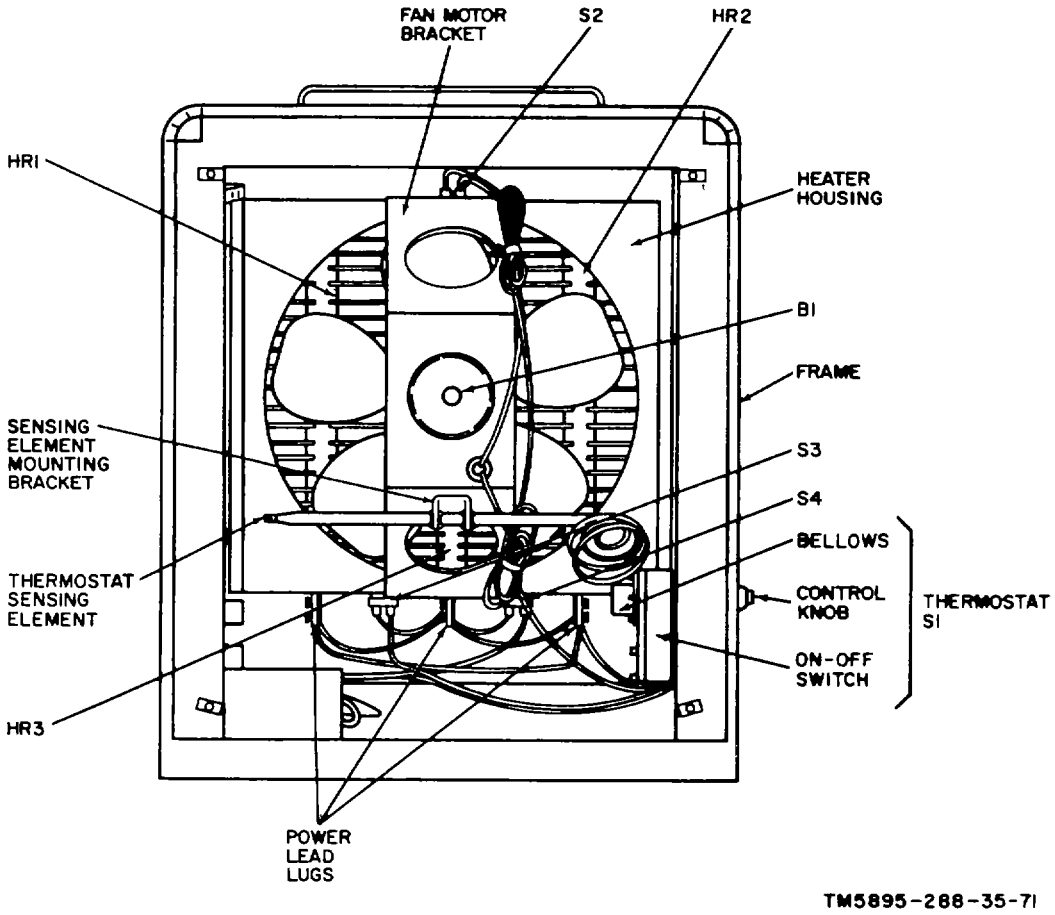


Figure 45. Heater, parts replacement diagram.

amplifier. Replacement of parts on the amplifier chassis that are not described in the following paragraphs can be accomplished with standard replacement procedures (para 52c).

b. Removal of Amplifier Chassis. To remove an amplifier chassis from the front panel, proceed as follows:

(1) Remove control knob from the volume control by loosening the setscrew.

(2) Loosen the two captive screws and swing the panel out from the rack.

(3) Remove the plug from the amplifier chassis.

(4) Remove the four screws that hold the amplifier chassis to the front panel, and remove the amplifier chassis.

(5) Remove the four screws that secure the chassis mounting plate to the amplifier chassis and remove the chassis mounting plate.

c. Replacement of Potentiometer R401. To replace the potentiometer, proceed as follows:

(1) Remove the amplifier chassis from the front panel and remove the chassis mounting plate from the amplifier chassis (*b* above).

(2) Tag and unsolder all leads to the potentiometer.

(3) Remove the two screws that secure the potentiometer mounting bracket to the amplifier chassis.

(4) Note the potentiometer orientation, and remove it from the potentiometer mounting bracket by removing the hexagonal nut.

(5) Secure the replacement potentiometer on the potentiometer

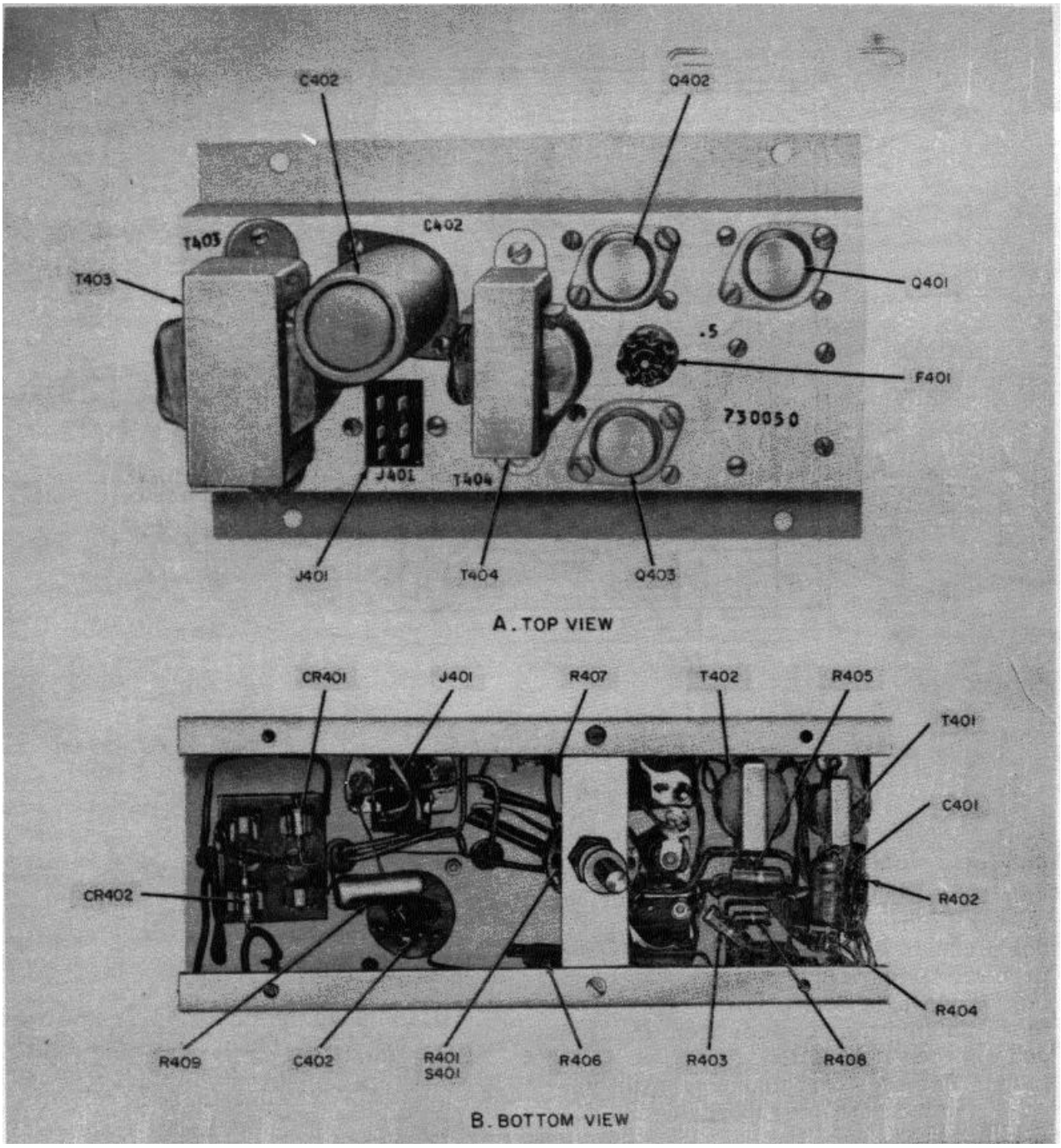


Figure 46. Dual speaker and amplifier panel, parts location diagram.

mounting bracket; make sure that it is properly oriented.

(6) Replace the potentiometer mounting bracket on the amplifier chassis and resolder all leads.

(7) Secure the amplifier chassis to the front panel (*f* below).

d. Replacement of Transistors. To replace a transistor (para 52*b*), proceed as follows:

(1) Remove the amplifier chassis from the front panel and remove the chassis mounting plate from the amplifier chassis (*b* above).

(2) Remove the two mounting screws that secure the transistor to the amplifier chassis.

(3) Gently pull the transistor directly up from the chassis. Be careful not to damage the mica insulator.

(4) Plug in the replacement transistor; make sure that the mica insulator is placed between the transistor and the chassis.

(5) Secure the transistor to the chassis with the two mounting screws. Make sure that the transistor seats firmly against the chassis; the chassis serves as a heat sink for the transistor.

(6) Secure the amplifier chassis to the front panel (*f* below).

e. Replacement of Diodes. To replace a diode (para 52*b*), proceed as follows:

(1) Remove the amplifier chassis from the front panel and remove the chassis mounting plate from the amplifier chassis (*b* above).

(2) Unsolder the single wire to the diode.

(3) Remove the diode from the mounting clip.

Note:

The mounting clip serves as an electrical connection for the diode and must be inspected to make sure it is clean.

(4) Place a new diode in the clip. Be sure it seats firmly.

(5) Resolder the diode lead to the connection from which it was removed.

(6) Secure the amplifier chassis to the front panel (*f* below).

f. Replacement of Amplifier Chassis. To replace the amplifier chassis, proceed as follows:

(1) Secure the chassis mounting plate to the amplifier chassis; use the tour screws.

(2) Secure the amplifier chassis to the front panel; use the four screws.

(3) Reconnect the plug.

(4) Secure the panel to the rack by tightening the two captive screws.

(5) Secure the control knob to the volume control by tightening the setscrew.

58. Disassembly of Subscriber Package Caster Assembly

(fig. 47)

a. Disassembly. The only item of the subscriber package enclosure to be disassembled is the caster assembly. To remove ,and disassemble the caster assembly, proceed as follows:

(1) Remove the mounting plate bolts (1), the lockwashers (2), and the washers (3) and remove the caster assembly (4) from the subscriber package enclosure (18).

(2) Remove the castellated axle nut (5), the axle washer (6), and the axle bolt (7) and remove the caster spacers (8) and the caster (9).

(3) Remove the castellated bearing nut (10) and the bearing bolt (11) from the caster assembly (4) while holding the caster mounting plate (12) and the bearing mounting plate (14) in position.

(4) While holding the bearing mounting plate (14) in position, remove the caster mounting plate (12), and remove the 25 caster ball bearings (13).

(5) While holding the bearing mounting plate (14) in position, turn the caster frame (16) until the bearing mounting plate (14) is facing upward.

(6) Remove the bearing mounting plate (14) and remove the 17 ball bearings (15).

Note:

Keep these ball bearings apart from the ball bearings removed in (4) above.

(7) Unscrew the grease fitting (17).

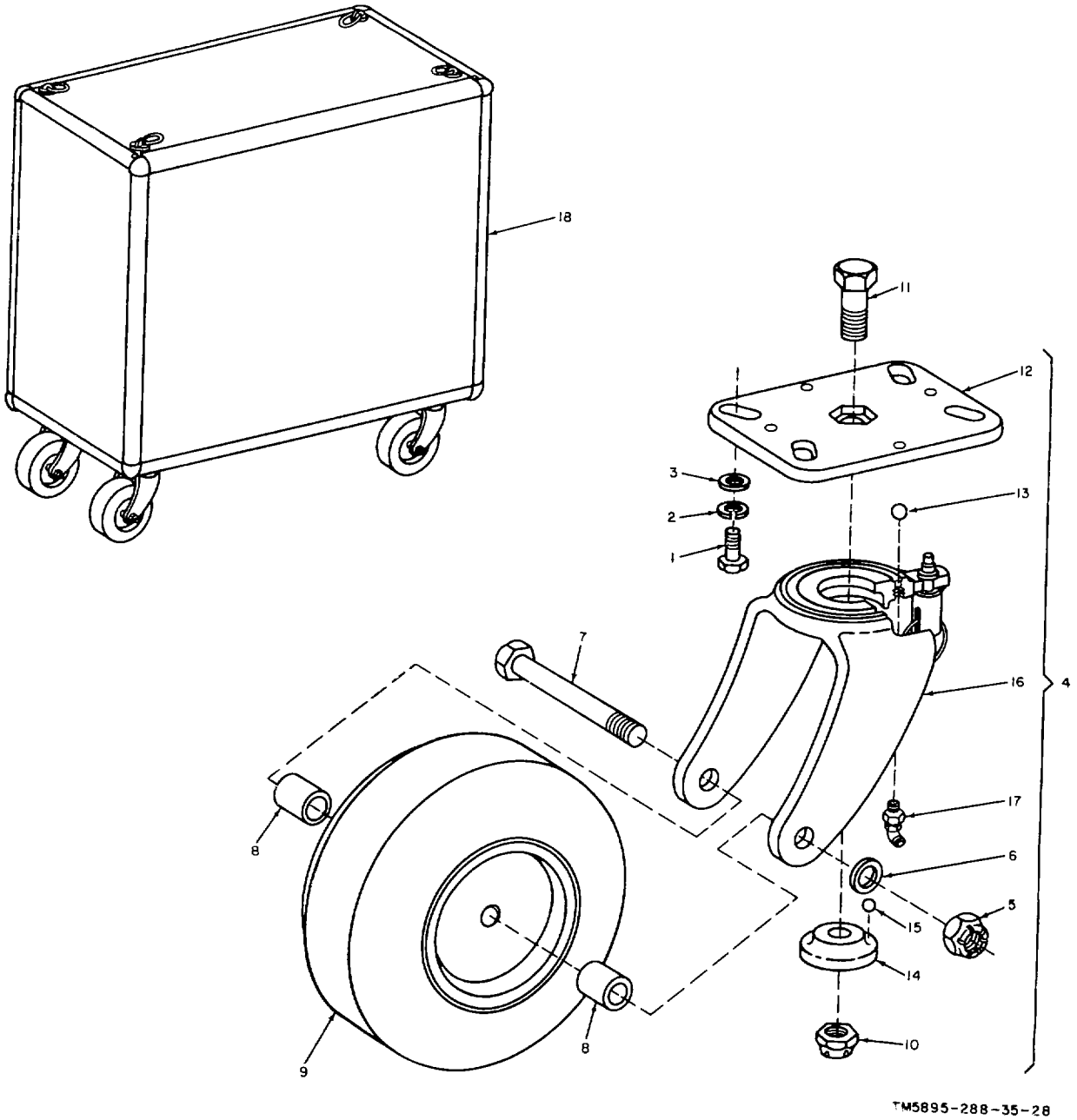
Note:

Be sure to clean all parts thoroughly before reassembly.

b. Reassembly. To reassemble the caster assembly and install it on the subscriber package enclosure. proceed as follows:

(1) Screw the grease fitting (17) on the caster frame (16).

(2) Turn the caster frame (16) upside down and place the 17 ball bearings (15) in the groove on the underside of the caster frame (16). Place the bearing mounting plate (14) in position over the ball bearings (15).



1 Mounting plate bolt (4 ea)
2 Lockwasher (4 ea)
3 Washer (4 ea)
4 Caster assembly
5 Castellated axle nut
6 Axle washer
7 Axle bolt
8 Caster spacer (2 ea)
9 Caster
10 Castellated bearing nut
11 Bearing bolt
12 Caster mounting plate
13 Caster ball bearing (25 ea)
14 Bearing mounting plate
15 Ball bearing (17 ea)
16 Caster frame
17 Grease fitting
18 Subscriber package enclosure

Figure 47. Subscriber package caster assembly, exploded view.

(3) While holding the bearing mounting plate (14) in position, turn the caster frame (16) right side up.

(4) Place the 25 caster ball bearings (13) in the groove on the upper side of the caster frame (16). Place the caster mounting plate (12) in position over the caster ball bearings (13).

(5) Secure the bearing mounting plate (14) and the caster mounting plate (12) in position; use the bearing bolt (11) and castellated bearing nut (10). Tighten the bolt and nut securely.

(6) Secure the caster (9) and the caster spacers (8) to the caster frame (16); use the axle bolt (7), the axle washer (6), and the castellated axle nut (5).

(7) Secure the caster assembly (4) to the subscriber package enclosure (17); use the washers (3),the lock-washers (2), and the mounting plate bolts (1).

Section II. ADJUSTMENTS

59. General

a. This section contains information for adjusting the relays and jacks in the components listed in paragraph lb as well as the adjustments required after replacing a part in one of the components. Frequent adjustment of relays and jacks is not required. However, continual use over a long period of time causes contact wear, loss of spring tension, and other conditions which make adjustments necessary. Replacing a rheostat, for example, would necessitate adjustment of the rheostat to establish the proper circuit operating condition.

b. Before adjusting any relay, be sure that it is clean. Adjust the relay to meet the mechanical requirements given in the standard and specific procedures. The adjustment procedures must be performed in the sequence given to avoid the possibility of having to readjust the relay. After the adjustment is completed, perform the appropriate tests. Follow the same precautions when adjusting the jacks.

60. Test Equipment, Tools, and Materials Required

The following test equipment, tools, and materials are required for cleaning and adjusting the relays and jacks and for component adjustments.

a. Test Equipment.

(1) Test Set, Relay TS-1194A/U (TM 11-6625-362-12).

(2) Multimeter TS-352/U (TM 11-5527).

(3) Portable dc milliammeter.

b. Tools.

(1) Hand contact burnisher.

(2) Wire burnisher.

(3) Sleeve limiting gage.

(4) Spring adjuster.

(5) Tool Kit TE-50.

(6) Tool Kit TK-87/U.

(7) Tool Kit TK-88/U.

c. Materials.

(1) 5-watt variac.

(2) 200-ohm, 25-watt resistor.

(3) Cleaning Compound (FSN 7930-395-9542).

(4) Heavy bond paper.

(5) Paper shim, 0.004-inch thick, 1/8 inch wide.

(6) Toothpicks.

(7) Orangestick.

61. Relay Cleaning

a. General.

(1) If a circuit fails to function properly, the cause is often dirty contacts or dirty or gummy parts. It is essential that contacts and parts be kept clean. Relay covers are provided to reduce the accumulation of dust on the working parts of the relay. The inside of the relay covers must be kept free of dust and not left off the relay any longer than absolutely necessary.

(2) Be sure that the surfaces of the pole pieces and armature are clean at all points where they may touch each other. Insert a clean piece of bond paper between the armature and pole piece. Manually press the armature toward the pole piece so that the paper is held with a slight pressure between these parts; then withdraw the paper. If the paper shows evidence of dirt, use a clean piece of paper each time and repeat the operation until the paper shows no evidence of dirt when it is removed.

b. Contact Wear.

(1) Pitted or built-up contacts are not necessarily an indication that the end of the useful life of the relay has been reached or that the relay is defective. Do not replace relays because of contact erosion unless contact erosion on one of the contacts of the mating pair has reached the point where contact is made with the base metal to which the contact is welded.

(2) Buildups and pits on relay contacts result from the action of electric current when the contacts make and break. Buildups assume various forms. Sharp-pointed buildups may result in mechanical locking of the contacts in the operated or closed positions. Contacts that are not worn through to the base metal can be reconditioned by removing buildups and cleaning pits. First inspect the contacts to determine whether or not buildups and pits are present. If the inspection indicates that contact erosion is so advanced that buildup removal or pit cleaning would not be in order, replace the relay.

c. Cleaning Nonpitted Contacts.

(1) If a visual inspection reveals that there is dirt on the relay contacts or it is suspected that an insulating film is preventing good contact, use cleaning compound to clean the contacts. Dip the flat end of a clean toothpick about 1/2 inch into the cleaning compound. Deposit the cleaning compound on the contacts. Do not rub. If the contacts are normally closed, hold them slightly separated with an orangestick inserted between the flexible contact springs, but not far enough to bend the springs. Dip the, flat end of another clean toothpick into the cleaning compound and again deposit the cleaning compound on the contacts without rubbing. This action should flush away the dirt loosened by the first application. Be careful that the cleaning compound does not come in contact with the relay coil or insulator. When the contacts are thoroughly dry, burnish them as described in (2) below to remove any deposit or residue remaining on the contacts.

Warning:

Cleaning compound is flammable and its fumes are toxic. Do not use near a flame; provide adequate ventilation.

(2) Contacts that fail in service may normally be cleaned by burnishing to remove any foreign material. Clean the blade of the burnisher before and after use by wiping with a clean dry cloth. When burnishing normally open contacts, place the blade of the burnisher between the contacts and either press them together with the orangestick or operate the relay manually, giving a slight pressure against the blade of the burnisher. At the same time, move the blade back and forth two or three times. Repeat the process between all normally open contacts. To burnish normally closed contacts, manually operate the relay with the orangestick. Insert the burnisher blade between the contacts and release the relay. Burnish the contacts as described above. Repeat the process for all normally closed contacts. Do not use abrasives other than the burnisher blade. After burnishing, check the contact separation. Repeated burnishing tends to remove

some contact material thereby increasing the contact separation.

d. Reconditioning Contacts Having Buildups or Pits.

(1) If the contacts are built up, remove the buildup with a buildup remover or file. Separate the contacts with an orangestick (*c* (2) above). Place the blade of the buildup remover over the built up contact. Avoid applying pressure that may force the contact off the spring. Hold the buildup remover so that the blade is parallel to the centerline of the spring. After properly positioning the buildup remover, exert a slight pressure toward the contact. Move the buildup remover back and forth, parallel to the contact spring, to remove the buildup. When filing normally open contacts, place the buildup remover blade between the contacts. Press the contacts toward the blade with the orangestick or manually Operate the relay to give a slight pressure against the blade. Then move the blade back and forth. After two or three strokes, remove the buildup remover and visually inspect the contact surface. Use only enough strokes with the buildup remover to remove the buildup as determined by visual inspection. After the buildup has been removed, burnish the contacts (*c*(2) above). If necessary, recondition the pit in the mating contact as described in (2) below.

(2) Burnish the contacts to be cleaned with the flat blade of the contact burnisher. Do not attempt to remove the pit from the contact, but burnish only enough to insure that the flat contacting surface surrounding the pit is cleaned. Burnish the pit with the wire burnisher. To do this, place the ball point of the wire burnisher in the pit. If the pit is small, rotate the barrel of the tool between the thumb and forefinger and at the same time apply a slight pressure toward the contact. Apply this pressure with the tool itself, since the burnisher wire is sufficiently rigid to transmit the necessary pressure. Inspect the contact and repeat the operation, if necessary, with the burnisher held at various angles until the entire surface of the pithas been cleaned. If the pit is large, the cleaning operation may be accomplished by moving the ball point of the wire burnisher over the surface of the pit with a circular motion. After cleaning the pit, again burnish by using the flat blade of the burnisher.

62. Relay Contact and Winding Designations

a. Telephone Relays (fig. 48). The relays in control relay panels No. 1 and No. 2 are telephone type relays. Figure 48 shows a telephone relay and the terminal numbers of the relay coil and contacts.

b. Polarized Relays (fig. 43). The polarized relay used in the multiple repeat panel has two windings. One is the signal winding (K1) or the operate winding (K2 through K9); the other is the bias winding. Figure 60 shows the coil and contact arrangement. All leads from the contacts and coil are wired to an octal base. The signal or operate winding is connected between pins 2 and 3 on the octal base. The bias winding is connected between pins 1 and 8 of the octal base. Pins 4 and 7 of the octal base are connected to the two stationary relay contacts. The relay armature is connected to pin 6.

63. Relay Adjustment Procedures

a. General Instructions.

(1) *Telephone-type relays*. Telephone-type relays should be adjusted when they fail to meet the electrical test requirements or if the equipment is being reconditioned. The adjustment procedures given in c and d below must be performed in the sequence given when adjusting a relay. If this sequence is not followed, some adjustments will cancel adjustments already made. The tools required for adjusting these relays are given in b below.

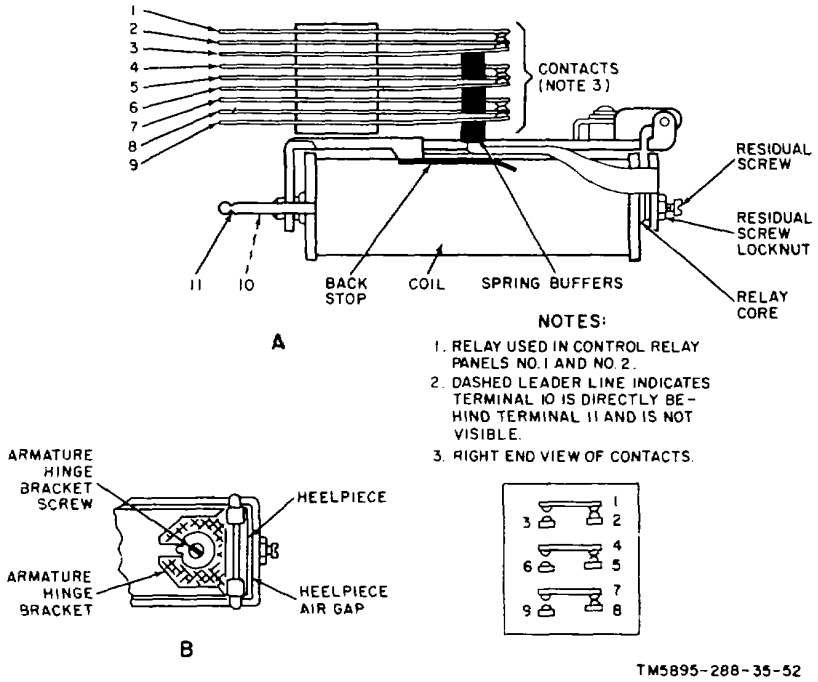


Figure 48. Telephone relay, contact and winding designations.

(2) *Polarized relays*. Polarized relay adjustments should not be made unnecessarily. If it is necessary to adjust a polarized relay, use Relay Test Set TS-1194A/U. For adjustment procedures, refer to paragraph 14, TM 11-6625-362-12.

b. Relay Adjusting Tools. The tools required for adjusting the telephone relays are listed in the chart below. The manufacturer's part number is given for identification purposes only since each tool has this part number stamped on it.

Tool	AECo part No.	Used for adjusting	Federal stock No.
S-wrench----------	H-7062	Residual screw locknut ----------	5120-293-0355
Armature arm bender---------	H-14768	Relay armature arm ----------	5120-240-7641
Backstop adjuster ----------	H-14769	Relay backstop ----------	5120-263-1137
Pliers, duckbill (TL-369/U).	----------	Spring alignment----------	5120-256-2150
Gages, thickness ----------	H-46795-1	Residual and heelpiece airgap and gaging springs.	5120-223-9214
Spring adjuster----------	H-20777	Relay springs ----------	5120-230-7900
Spring adjuster----------	H-42873	Relay springs ----------	5120-255-3237
Spring adjuster----------	H-7066	Relay springs ----------	5120-372-5025

c. Mechanical Adjustments. The adjustments given below must be performed before any electrical adjustments are made. These adjustments apply to all the telephone-type relays. Refer to figure 48 for relay parts location. Perform the adjustments in the sequence given below.

Note:

***Unless otherwise instructed*, the relay is operated electrically; use Test Set I-181 or the alternate test setup described in *d*(2) below, and the operating values given in *d* below.**

(1) Preliminary requirements.

(a) Relays must be fastened securely to the mounting plate. Gage by eye and feel.

(b) There should be 1/32-inch clearance between the contact springs, armature, heelpiece, and

any other adjacent parts. Gage by eye.

(c) Mating contacts must not be out of alignment with each other by more than one-third of their base diameter (A, fig. 49). Gage by eye. If this requirement is not met, attempt to align the contacts by applying pressure to the ends of the contact springs. If this does not correct the condition, attempt to loosen the contact spring assembly clamping screws and then shift the springs as required. Remove the relay from the mounting plate for this adjustment. Tighten the clamping screws securely when the alignment is completed.

Caution:

The clamping screws are tightened under pressure at the factory, then baked and clipped; this makes removal difficult. Do not attempt to loosen the spring assembly except in cases of emergency.

(d) The armature must move freely in its bearings, but the sideplay must not exceed 0.020 inch. If the armature binds, or if the sideplay is excessive, the armature should be replaced.

(e) Relay springs should not have any sharp bends or kinks. A gradual bow in the free length of a spring is permissible if it does not exceed 0.025 inch. Remove sharp kinks or excessive bows in contact springs with the duckbill pliers or the proper spring adjuster. Stroke the tool along the contact spring while applying pressure in the opposite direction of the bow. Do not bend the spring.

Caution:

If a spring adjuster is used to stroke a contact spring, be careful that the

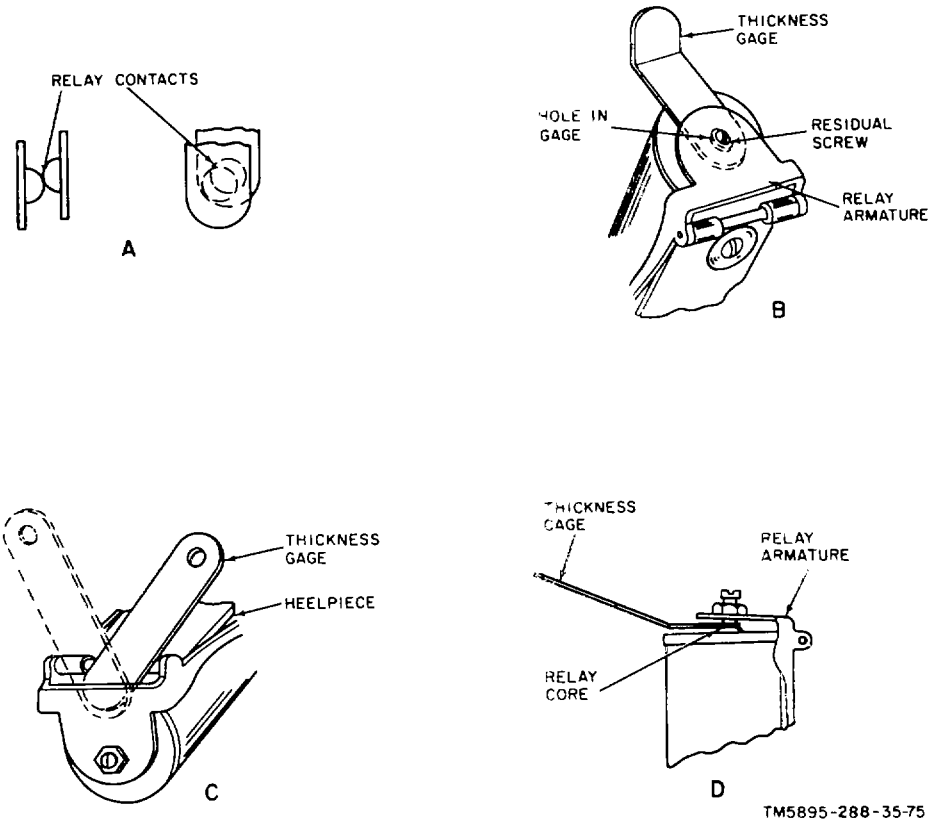


Figure 49. Telephone-type relay adjustments.

sharp edge of the slot in the spring adjuster does not peel a small shaving from the spring. Shavings may cause a short circuit between the contact springs which is an extremely difficult trouble to locate.

(2) *Residual airgap*. All the telephone-type relays have adjustable residual screws. The purpose of the residual airgap. is to prevent the residual magnetism in the core from holding the armature operated after the current to the relay winding is removed. A special keyring-type thickness gage assembly, which consists of nine gages mounted on a ringholder, is required for checking the residual airgap, since each gage has a hole at one end. Remove the gages from the holder before using. If this type of gage is not available, use the standard type thickness gage until the keyring-type thickness gage is obtained. Checking and adjusting residual airgaps with the standard type thickness gage, however, is difficult and not reliable.

(a) Residual airgap inspection. The inspection requirements are that the armature must not touch the core, or be farther from the core than 0.004 inch, with the relay fully operated (residual screw touching the core).

1. Insert a 0.0015-inch thickness gage between the armature and the relay core (B, fig. 49) in such a manner that there residual screw passes through the center of the hole in the thickness gage. Operate the armature manually. The gage should be loose. If the gage is tight, remove the gage and check the gap by eye. If there is a perceptibie clearance between the armature and the core, with the residual screw pressed against the core, the gap is satisfactory. If there is no clearance, adjust the residual airgap (*(b)* below).

2. If the gage (*1* above) was loose, insert a 0.004-inch gage in the same manner as instructed in *1* above. The gage should be tight. If the 0.004-inch gage is loose, adjust the residual airgap (*(b)* below).

(b) Residual airgap adjustment. The adjustment requirements are that the armature must not touch the core or be farther from the core than 0.003 inch with the relay fully operated (residual screw touching the core).

1. Loosen the residual screw locknut (A, fig. 48); use the S-wrench. Insert a 0.002-inch gage between the armature and the core and manually operate the relay armature. Turn the residual screw with a screwdriver until the gage is snugly held between the armature and the core when the armature is pressed against the core. Tighten the residual screw locknut while holding the residual screw with a screwdriver.

2. Recheck the adjustment by inserting a 0.0015-inch gage between the armature and core and manually operating the armature. The gage should be loosely held by the armature. Substitute a 0.003-inch gage for the 0.0015-inch gage and manually operate the armature. The 0.003-inch gage should be fight. If either of the above checks are not satisfactory, readjust the residual airgap (*1* above).

(3) *Heelpiece airgap*. The heelpiece airgap must be large enough to keep the armature from striking or binding against the heelpiece (B, fig. 48), but as small as possible in order to obtain the maximum magnetic strength. The heelpiece airgap is specified as 0.0015 inch for all telephone-type relays.

(a) Heelpiece airgap inspection. The inspection requirements are that the armature must not touch the heelpiece or be farther from the heelpiece than 0.005 inch with the relay operated.

1. The minimum limit of clearance is satisfactorily met if light may be observed between the inner surface of the armature and the heelpiece, over its entire width, when the armature is operated manually. Gage by eye.

2. If the relay is oriented in the equipment so that this light test cannot be made, check the minimum limit with the 0.0015-inch gage, inserted between the armature and the heelpiece. To check the gap over the entire width of the heelpiece, hold the gage in two positions (C, fig. 49), while operating the armature manually. If the gage is tight at any point, adjust the gap (*(b)* below).

3. If the gage is loose, check the maximum limit with the 0.005-inch gage inserted between the armature and the heelpiece (C, fig. 49). If the 0.005-inch gage is loose at any point, adjust the airgap (*(b)* below).

(b) Heelpiece airgap adjustment. The adjustment requirements are that the armature must not touch the relay core or be farther from the relay core than 0.003 inch, with the relay operated. When adjusting the heelpiece airgap, keep the gap to a minimum.

1. Loosen the armature hinge bracket screw (B, fig. 48), and insert the 0.0015-inch gage between the armature and the heelpiece. Center the gage between the hinge pins. Hold the armature firmly against the gage, and then tighten the hinge bracket screw securely. Check to see that the gap is the same on each side of the armature by holding the gage in the two positions (C, fig. 49). Repeat the heelpiece airgap adjustment if the armature is not parallel to the heelpiece, as gaged by the eye.

2. After adjusting the heelpiece airgap, recheck the residual airgap ((2) above). Both these gaps must be within the specified limits before proceeding to the adjustments that follow.

(4) *Armature arm.* Check the armature arm after the residual and heelpiece airgaps have been checked ((2) and (3) above). Check to see that all springs are straight and that the stationary contact spring closest to the heelpiece in each spring assembly is parallel to the heelpiece. If this requirement is not met, adjust this spring parallel to the heelpiece.

Note:

The spring assembly of a relay is an arrangement of all the springs operated by the armature. Stationary springs of a relay are the springs that are not pushed by the armature arm. Armature springs are the springs that are pushed by the armature arm.

(*a*) Insert a 0.007-inch gage between the tip of the residual screw and the relay core (D, fig. 49).

Note:

When particular gage is specified and its value does not appear on one gage, place two gages together to obtain the required value. For example, 0.007 inch is obtained by placing a 0.004-inch gage and a 0.003-inch gage together.

(*b*) Operate the relay. All make contacts should just make (close).

(*c*) If the contacts do not make, adjust the armature arm (with the armature arm bender) away from the spring assembly until the contacts just make, with the relay operated on the gage (*(b)* above).

(*d*) If the contacts make, substitute a 0.002-inch larger gage (0.009) in *(a)* above and operate the relay. The contacts should not make.

(*e*) If the contacts make, adjust the armature arm away from the

heelpiece while holding the armature operated with your thumb.

Note:

Be very careful when making this adjustment. It is only necessary to bend the armature slightly. Do not bend it too far or it will become necessary to bend it in the opposite direction. Apply a slight pressure on the armature arm with the armature arm bender, then recheck to see if it meets the requirement (*(b)* or *(d)* above).

(f) Recheck the gaging requirements (*(a)* through *(e)* above) if an adjustment (*(c)* or *(e)* above) was required. If necessary, readjust the armature arm until the requirement is met.

(5) *Spring gaging*. Gage the relay springs after the armature arm requirements have been met. Spring gaging values establish the correct sequence of operation of the relay springs. Relay springs are identified by numbers in this equipment.

Note:

Armature springs are not adjusted during the gaging adjustment. They should be straight and should have sufficient tension against the armature arm to hold the armature in the nonoperate position. On twin contact relays, both contacts must meet the specified requirements

(*a*) Insert a 0.004-inch gage between the tip of the residual screw and the relay core (D, fig. 49).

(*b*) Operate the relay. All break contacts should just break (open).

(*c*) If the break contacts do not break, adjust the stationary spring with the applicable spring adjuster. Apply pressure to the spring, at the clamping assembly and toward the heelpiece, until the contact just opens with the relay operated.

Note:

A slight pressure is all that is required to correctly position the spring. Do not bend the springs,

(d) If the contacts (*(b)* above) break, substitute a 0.002-inch larger gage (0.006) in *(a)* above and operate the relay. The contacts should not break.

(e) If the contacts break, apply pressure to the stationary spring, with the applicable spring adjuster, away from the heelpiece, until the contacts remain closed with the relay operated.

(f) Recheck the gaging requirements (*(a)* through *(e)* above) if an adjustment (*(c)* or *(e)* above) was required.

(6) *Armature travel*. Armature travel (stroke) is specified for relays which have a make set of contacts as the first contacts (closest to the heelpiece) in a spring assembly. Adjust the armature travel to 0.013 inch ±0.001.

(a) Insert a 0.012-inch gage between the residual screw and the core.

(b) Operate the relay. The armature arm should just leave the backstop. *Check to be sure that the make contacts do not close*.

(c) If the armature arm does not leave the backstop, adjust the backstop for a slight gap, between the armature arm and the backstop, with the relay operated on the 0.012-inch gage. Use the duckbill pliers or the backstop adjuster for this adjustment.

(d) If the armature arm leaves the backstop (*(b)* above), attempt to insert a 0.002-inch larger gage (0.014) between the residual screw and the core. The requirement is met if either of the conditions given below exist.

1. The gage will not enter the gap between the residual screw and the core.

2. The gage enters the gap between the residual screw and the core, but the armature arm does not leave the backstop when the relay is operated.

(e) If the requirements in *(d)* above are not met, adjust the backstop toward the spring assembly and recheck the adjustments given in *(a)* through *(d)* above.

d. Electrical Adjustments. The electrical adjustments are made after all mechanical adjustments have been made and checked. Electrical adjustments consist of applying the correct tension to the

armature springs so that the relay will operate on its specified operating current (7.62 milliampere (ma)) and will not operate on its specified nonoperate current (2.30 ma). A 120 volt dc power source is applied to Test Set 1-181 ((1) below) or used as a power source with the alternate test setup ((2) below). If the relay does not meet the test requirements, it must be completely readjusted, both mechanically (*c* above) and electrically ((1) or (2) below). On relay springs with twin contacts, both contacts must open or close, within the tolerances given, to meet the requirements.

(1) *Use of Test Set I-181*. Connect Test Set I-181 to the relay being electrically adjusted, and proceed as follows:

(a) Adjust Test Set I-181; use path 1 for the operate value and path 2 for the nonoperate value.

(b) Apply the operate value of current (7.62 ma) to the relay by depressing switch SOAK-1 to the 1 position. The relay should operate.

Note:

A relay is considered operated when all break contacts are open and all make contacts are Closed

(c) If the relay does not operate, remove tension from the armature springs by applying a slight pressure with the applicable spring adjuster away from the armature arm stud.

Note:

Place the spring adjuster over the spring at the point where the spring comes out of the clamping assembly Apply only a slight pressure at a time since ;, is very easy to apply too much pressure

(d) If the relay operates (*(b)* above), apply the nonoperate value of current (2.30 ma) to the relay by depressing switch 2-2 on Test Set I-181. The relay should not operate.

Note:

A relay is considered nonoperate if no break contacts open and no make contacts close.

(e) If the relay operates during the nonoperate test, add tension to, the armature springs by applying a slight pressure with the applicable spring adjuster toward the armature arm stud. Distribute the tension equally among all armature springs.

(f) If the relay requires a tensioning adjustment (*(c)* or *(e)* above), it will be necessary to recheck the spring gaging requirements (*c*(5)*(a)* through *(e)* above), since spring tensioning affects the gaging adjustment. If any adjustments are required during the check of the spring gaging requirements, it will be necessary to recheck the electrical requirements, since each of these adjustments affects the other.

(2) *Use of alternate test setup*. If Test Set I-181 is not available, connect a milliammeter, a decade box, and a 120-volt dc power supply (in that order) in series with the positive side of the relay coil, and connect a single-pole, single-throw switch in series with the negative side of the relay coil and the negative side of the power source. Leave the switch open. Then proceed as follows:

(a) Set the decade box for maximum resistance, and then close the switch. Decrease the decade box resistance until the millimeter indicates 7.62 ma. The relay should operate.

Note:

A relay is considered operated when all break contacts are open and all make contacts are closed.

(b) If the relay does not operate, follow the procedure described in (1)*(c)* above.

(c) If the relay operates (*(a)* above), open the switch. The relay will release. Then set the decade box for maximum resistance again, and close the switch. Decrease the resistance until the milliammeter indicates 2.30 ma. The relay should not operate.

Note:

A relay is considered nonoperated when no break contacts -pen and no make contacts close

(d) If the relay operates during the nonoperate test, follow the

procedure described in (1)(e) above.

(e) If the relay requires a tensioning adjustment, refer to (1)(f) above.

64. Jack Cleaning

a. General.

(1) Since the failure of a circuit to function properly is often the result of dirty contacts, it is essential that jack contacts be kept clean. Because there is no panel cover enclosing the jacks, it is particularly important to keep the jack contacts clean.

(2) When it becomes necessary to clean a jack, use compressed air and an airhose to blow away any dust or foreign material that may have accumulated between the jack contacts and on the jack surface. Take a piece of clean bond paper and place the paper between the open jack contacts. Insert a dummy plug into the jack to close the contacts, sandwiching the paper between the contacts. Withdraw the paper. If the paper shows evidence of dirt, repeat the operation several times; use clean paper each time, until there is no longer any dirt deposited on the paper. With the plug still inserted, take another clean piece of paper and insert it between the normally closed contacts that are now open because of the inserted plug. Remove the plug. Withdraw the paper. Repeat this operation several times until dirt is no longer deposited on the paper.

b. Contact Wear.

(1) Jacks do not normally require replacement because of pitted or built-up contacts. Replace a jack only when the contact is worn down to the base material to which it is welded. When necessary, recondition the contacts that are not excessively worn by removing buildups and cleaning pits. If it is necessary to remove a jack in order to gain access to the contacts, it may be economically advisable to replace the jack instead of cleaning the contacts, especially if the contacts are pitted.

(2) Buildups and pits on the jack contacts are caused by arcing as the jack contacts make and break the electrical circuit. Remove buildups with a contact burnisher. If the buildups cannot be removed, replace the jack (para 52).

c. Cleaning Nonpitted Contacts.

(1) If, by visual inspection, it is seen that there is dirt on the jack contacts, use cleaning compound to clean the contacts. Follow the procedure used to clean relay contacts with the cleaning compound (para 61*c*(1)). Normally closed contacts are opened by inserting a dummy plug into the jack.

(2) Contacts that fail in service may be cleaned with a hand contact burnisher to remove foreign material. Keep the blade of the contact burnisher clean and avoid touching or rubbing the blade with the fingers. Wipe the blade with a clean dry cloth before placing the burnisher blade between the contacts. To burnish normally open contacts on jacks, place the burnisher blade between the contacts and either press the contacts against the blade with the orangestick or partially insert a dummy plug into the jack to give a slight pressure on the blade. Move the burnisher blade back and forth between the contacts three or four times. In some instances, additional strokes of the blade may be required to clean the contacts. In the case of normally closed contacts on jacks, either insert a plug into the jack or open the contacts with the orangestick and then place the burnisher blade between the contacts. Withdraw the plug or orangestick from the jack and burnish the contacts as described above. After burnishing, note whether or not the contact follow and contact separation

requirements are met. If necessary, adjust in accordance with the procedures in paragraph 66.

d. Cleaning Pitted Contacts. The procedures for cleaning pitted jack contacts and removing buildups are the same as for relays (para 61*d*). In the case of normally closed jack contacts, either insert a plug into the jack or use the orangestick to open the contacts.

65. Jack Contact Designations

Three different jack types are used in the components listed in paragraph 1*b*. The following table lists the components containing the jacks, the jack designations, and a figure reference to the illustration showing the contact designations of the jack.

Component	Jack designation	Fig. No.
Control relay panel No. 1.	J1, J4, J5, and J8	50
	J2, J3, J6, and J7	51
Control relay panel No. 2.	J1 and J2 ----------	51
Multiple repeat panel.	J1, J2, and J3	51
Audio patch panels No. 1 and No. 2	All LINE and EQUIP jacks.	52
	All MON jacks -------	51
Audio-dc patch panel.	All jacks	51
Black patch panel-----	All LPG jacks	51
	All LOOP and SET jacks.	50
Red patch panel	All LOOPING and MISC jacks.	51
	All LOOP and SET jacks except jack circuit 11[a]	50
.		
Subscriber power supply.	J1 and J2 ----------	51

[a]LOOP and SET jacks for jack circuit 11 are type 303A (fig. 51).

66. Jack Adjustment Procedures

a. General. To adjust a jack, standard jack adjustment techniques should be used. If a contact is sprung, it maybe necessary to bend the associated spring sufficiently to restore the contact to its normal position (either open or closed). If a spring is badly bent out of shape, replace the jack (para 52) instead of attempting to straighten out the spring. Once the spring adjustment is made, insert a plug into the jack to make sure that the jack contacts are functioning properly.

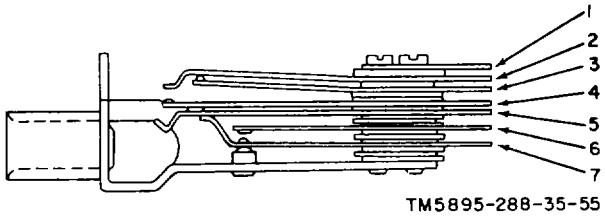


Figure 50. Jack type 438C, contact spring arrangement and numbering.

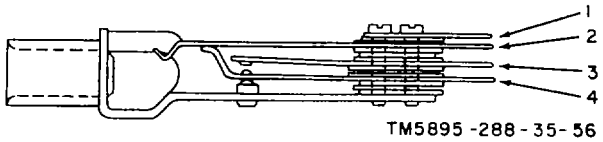


Figure 51. Jack type 303A, contact spring arrangement and numbering.

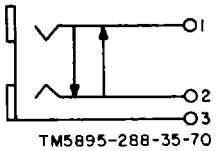


Figure 52. Jack type 410A, contact spring arrangement and numbering.

b. Requirements. This paragraph contains the inspection requirements to check before performing any jack adjustments. These requirements are applicable to all the jacks, except where otherwise specified.

(1) *Sleeve wear*. Use a sleeve limiting gage. The gage should not fully enter the sleeve in any rotated position of the gage. If the sleeve wear requirements cannot be met, reassign the jack circuit to one of the spare jack circuits.

(2) *Assembly screw tightness*. Assembly screws should be sufficiently tight to hold the springs securely in position. Gage by feel. This requirement need not be checked if the jack is not accessible or if the jack must be removed in order to be checked.

(3) *Cleaning*. Jacks should be kept reasonably free of dirt and dust. If necessary, clean the jacks (para 64).

(4) *Contact alignment* (fig. 53). The contacts should line up so that the point of contact falls wholly within the boundary of the

opposing contact at all times during contact. Gage by eye.

(5) *Spring position*. The tip spring should be positioned so that the bottom of the crimp is 0.005 inch maximum below the centerline of the jack sleeve. Adjust the spring if necessary.

(6) *Contact separation*. The separation of normally open contacts should be 0.012 inch minimum. Gage by eye. Insert a plug into the jack and rotate the plug through 1 complete revolution. The normally closed contacts should remain open and the normally open contacts should remain closed. Gage by eye.

(7) *Spring tension*. The pressure of the tip spring on the tip of the to 1,400-gram gage should be 1,200 grams maximum with a plug fully inserted into the jack. The tension of the tip spring should be sufficient to hold the spring, which makes contact with it, against the stud in the frame or against the insulators between the spring and the frame. Gage by eye and feel.

(8) *Contact pressure*. With a plug fully inserted into the jack, the contact pressure of the normally open contacts should be 65 grams minimum measured at the crimp. The contact pressure between the normally closed contacts should also be 65 grams minimum (with the plug removed from the jack).

(9) *Butt*. It should be possible to fully insert a plug into the jack. However, the pressure applied should not exceed that which can be exerted with the plug held between the thumb and the index finger.

(10) *Contact sequence*. This requirement is applicable to the type 438C jack only. When the tip spring is operated, all normally open contacts should make before any normally closed contact breaks. In effect a momentary condition exists whereby all contacts are closed. Gage by eye.

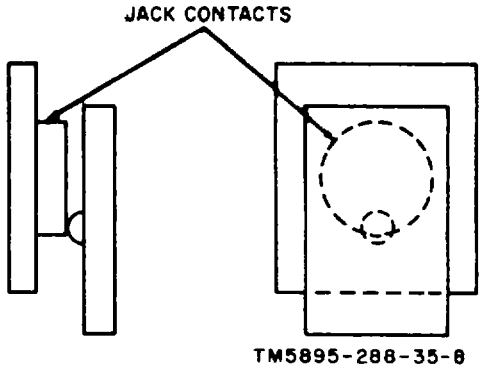


Figure 53. Contact alignment.

c. Adjustment Procedures. If any of the requirements in *b* above cannot be met, follow the applicable procedure given in this paragraph. It is important that the procedures be carefully followed because by performing one adjustment, other jack adjustments may be affected.

Note:

Whenever removing any wires from the jacks. tag all the wires before unsoldering.

(1) *Sleeve wear*. The sleeve limiting gage should not enter the jack up to the stop shoulder. If the gage does enter up to the stop shoulder, replace the jack (para 52).

(2) *Assembly screw tightness*. Tighten loose assembly screws with a regular screwdriver. If the spring pileup is still not clamped securely, remove the assembly screws and add a fiber insulator underneath the top terminal or clamping plate. Replace the assembly screws and tighten securely.

(3) *Cleaning*. Clean the contacts as outlined in paragraph 64. When necessary to disassemble the spring assembly, wipe off all parts with a clean cloth.

(4) *Contact alignment*. Loosen the spring assembly screws and attempt to line up the contacts by shifting the springs until each contact point lies wholly within the opposing contact point, as near the center as possible. Tighten the assembly screws securely. After aligning the contacts, check that the requirements are met for spring position, contact separation, spring

tension, contact pressure, butt, and contact sequence (for type 438C jacks only). If the contacts cannot be lined up in this manner, replace the jack (para 52).

(5) *Spring position*. If the position of the spring does not meet the requirement (b(5) above), use the spring adjuster to adjust the position of the tip spring as required. Exert pressure gradually to avoid kinking the tip spring.

(6) *Contact separation* (fig. 54).Adjust the separation between the tip spring and the tip front contact spring by applying the spring adjuster to the front of the spring just behind the crook in the spring. Bend the spring up or down as required. Adjust contact springs for contact separation at the rear of the spring where it leaves the insulators.

(7) *Spring tension* (fig. 55). Adjust the springs with the spring adjuster applied at the rear of the spring where it leaves the insulators.

(8) *Contact pressure*. To adjust the contact pressure, follow the instructions given in (7) above. Contact pressure is adjusted by adjusting the spring tension.

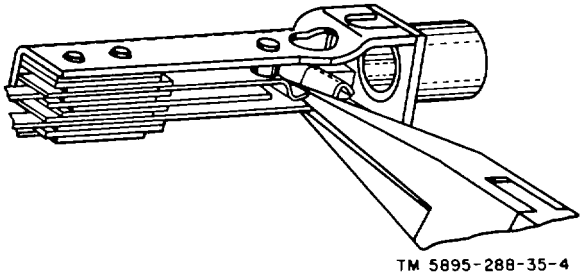


Figure 54. Method of adjusting for contact separation.

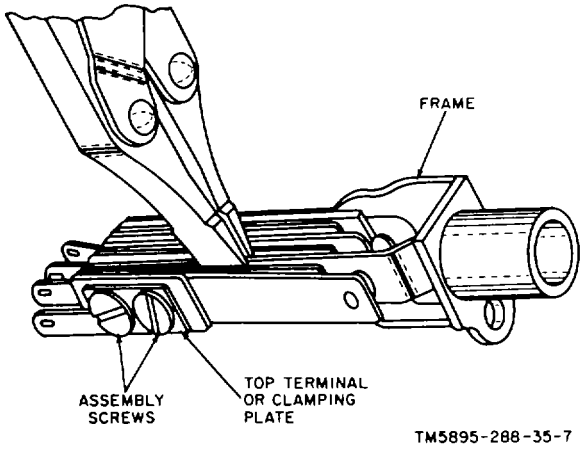


Figure 55. Method of adjusting spring tension and contact pressure.

67. Component Adjustments

a. General. Of the components listed in paragraph 1*b*, only certain components require adjustments after a part is replaced. The following subparagraphs describe the adjustment procedures required after replacing a part in one of the components listed below.

(1) Local battery loop controls No. 1, No. 2, and No. 3.

(2) Current limiter panel.

(3) Hybrid unit.

(4) Subscriber power supply.

b. Local Battery Loop Controls No. 1, No. 2, and No. 3. If one of the rheostats is replaced in local battery loop control No. 1, the rheostat must be adjusted for the proper operating signal or for bias current in the associated circuit of the multiple repeat panel. To adjust a rheostat to the proper current level, follow the procedures in paragraph 77*c*, TM 115895-288-12. If a rheostat is replaced in local battery loop control No. 2 or No. 3, the rheostat must be adjusted in accordance with the current required for the required application at the patch panel jack with which the rheostat is associated (fig. 76 (1), (2), and (4), TM 11-5895-288-12).

c. Current Limiter Panel Adjustment. After a rheostat is replaced on the current limiter panel, the loop current associated with the particular channel must be readjusted. The adjustment is made with the current limiter panel installed in the equipment rack and correctly wired. To adjust one of the KEYER LOOP CURRENT ADJUST CHANNEL rheostats, refer to the procedures given in paragraph 80*a*, TM 11-5895-288-12. To adjust one of the CONVERTER LOOP CURRENT ADJUST CHANNEL rheostats, refer to the

procedures given in paragraph 81 , TM 11-5895-288-12).

d. Hybrid Unit Adjustments. After a part is replaced in the hybrid unit, the BALANCE controls must be readjusted. The adjustments are made with the hybrid unit installed and correctly wired. To make the necessary adjustments, follow the procedures as outlined in paragraph 82, TM 11-5895-288-12.

e. Subscriber Power Supply Adjustment. The subscriber power supply may be adjusted when installed in the subscriber package under load or on a test bench. To adjust this power supply when it is installed in the subscriber package, patch the portable dc milliammeter into the SUPPLY 1 ADJ 60 MA or SUPPLY 2 ADJ 60 MA jack (depending on which power supply is to be adjusted). Adjust the SUPPLY 1 DC ADJ or SUPPLY 2 DC ADJ control for 60 milliamperes on the portable dc milliammeter. To adjust the subscriber power supply on the test bench, proceed as follows:

Note:

Make sure that both SUPPLY 1 and SUPPLY 2 power switches are in their off (down) position.

(1) Connect a variac between TB5-5 and TB5-6 of the subscriber power supply (fig. 56).

(2) Connect the TS-352/U to TB5-5 and TB5-6. Set the TS-352/U to the 250-volt ac scale.

(3) Operate the variac to the 0-volt position.

(4) Connect the input of the variac to 115-volt ac power source. The TS-352/U should indicate 0 volts ac.

(5) Patch the portable dc milliammeter into the SUPPLY 1 ADJ for 60 MA jack on the subscriber power supply.

(6) Connect a 200-ohm, 25-watt load resistor between TB5-1 and TB5-2.

(7) Operate the SUPPLY 1 power switch to ON.

(8) Adjust the variac until the TS352/U indicates 115 volts ac.

(9) Adjust the SUPPLY 1 DC ADJ control on the front panel of the subscriber power supply with a screwdriver until the portable dc milliammeter indicates 60 milliamperes ±5.

(10) Operate the variac to the 0-volt position.

(11) Operate the SUPPLY 1 power switch to the off (down) position.

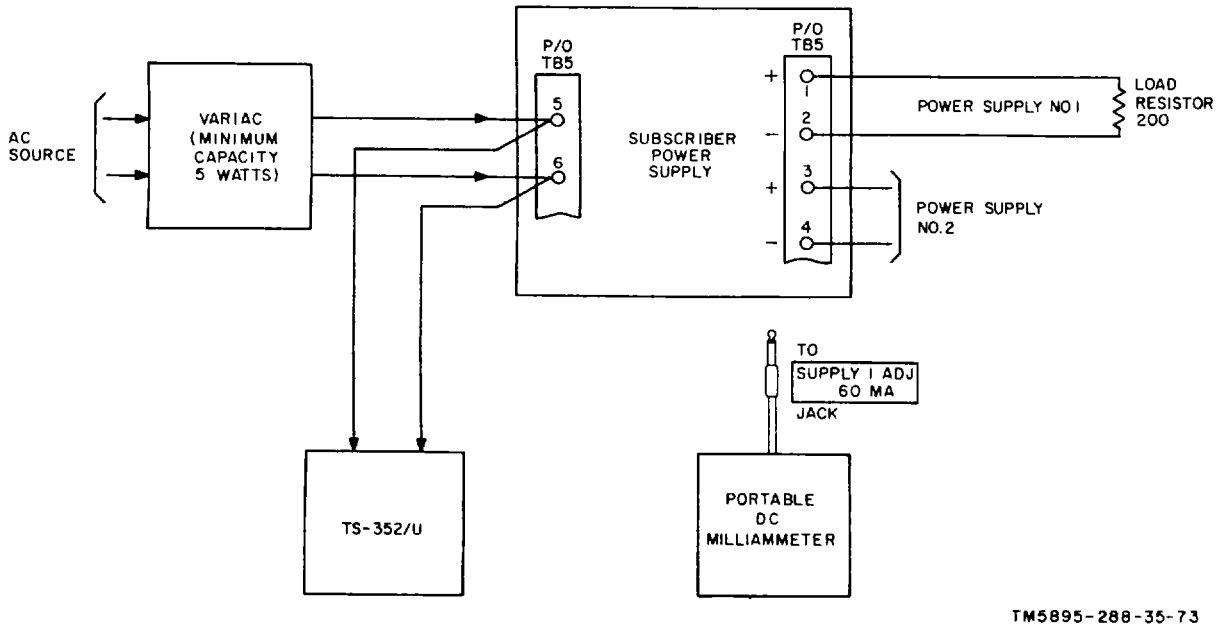


Figure 56. Test setup for adjusting subscriber power supply.

(12) Remove the load resistor from between TB1-1 and TB1-2.

Warning:

Do not touch the load resistor with bare fingers because it can become hot enough, after minutes of operation, to burn the skin.

(13) Connect the load resistor between TB5-3 and TB5-4.

(14) Patch the portable dc milliammeter into the SUPPLY 2 ADJ for 60 MA jack.

(15) Operate the SUPPLY 2 power switch to ON.

(16) Operate the variac until the TS-352/U indicates 115 volts ac.

(17) Adjust the SUPPLY 2 DC ADJ control with a screwdriver until the portable dc milliammeter indicates 60 milliamperes ±5.

(18) Remove the test equipment and load resistor.

CHAPTER 4

FINAL TESTING

68. Purpose of Final Testing

The tests outlined in this chapter are designed to measure the performance capability of the dual speaker and amplifier panel, the subscriber power supply, the hybrid unit, and the RAC-30A coupler after repairs have been performed. None of the other components listed in paragraph 1*b* require final testing.

69. Test Equipment Required for Final Testing

The following test equipment is required for final testing.

a. Test Set, Relay TS-1194A/U (TM 11-6625-362-12).

b. Signal Generator SG-15A/PCM (TM 11-2096).

c. Electronic Multimeter TS-505A/U (TM 11-6625-239-12).

d. Spectrum Analyzer TS-723A/U (TM 11-5097).

e. Resistor, 3.2 ohm, 2 watt.

70. Final Testing Dual Speaker and Amplifier Panel (fig. 57)

The procedures for final testing each of the two amplifiers in the dual speaker and amplifier panel are identical. Follow the procedures below to test either amplifier.

a. Connect the 3.2-ohm, 2-watt resistor between pins 3 and 4 of connector J401.

b. Connect the test leads from the electronic multimeter across the 3.2-ohm resistor.

c. Connect the test leads from the SG-15A/PCM to pins 1 and 2 of connector J401.

d. Connect the 115-volt ac power source to pins 5 and 6 of connector J401.

e. Turn the amplifier on by rotating the volume control clockwise.

f. Adjust the SG-15A/PCM for an output frequency of 1,000 cycles at a level of -10 dbm.

g. Adjust the amplifier volume control until the electronic multimeter indicates 2.5 volts.

h. Vary the SG-15A/PCM frequency output from 300 to 3,000 cycles. The electronic multimeter reading should not deviate more than ±3 decibels (db).

i. Disconnect the electronic multimeter test leads from across the 3.2-ohm resistor.

j. Connect the TS-723A/U across the 3.2-ohm resistor.

k. Vary the SG-15A/PCM frequency output from 300 to 3,000 cycles. The reading on the TS-723A/U should be less than 5 percent (about 3 percent).

l. Rotate the volume control fully counter-clockwise.

m. Remove all the test leads and the 3.2ohm resistor from connector J401.

n. Repeat steps *a* through *m* above to test the other amplifier.

71. Final Testing Subscriber Power Supply

When testing the subscriber power supply, it is necessary to determine that each power supply section is capable of delivering 60 milliamperes under load. This can be done by performing the adjustment procedures in paragraph 67*e*.

72. Final Testing Hybrid Unit

Follow the procedures outlined below to test the hybrid unit.

a. Lift the TA-312/PT handset from the cradle switch.

b. Set the SG-15A/PCM for 1 kc, and patch the 1-kc signal to the DEMUX 2 OUT CHAN 3A jack on audio patch panel No. 2.

c. Operate the transfer switch to the hybrid position.

d. Patch the ME-22A/PCM to MUX 2 IN CHAN 3 jack on audio patch panel No. 2.

e. Adjust the ME-22A/PCM for a 600 ohm input and adjust the SG-15A/PCM for a 0-dbm output.

f. Sweep the SG-15A/PCM from 300 cps

through 3 kilocycles (kc). Observe the attenuation as indicated by the ME-22A/ PCM. At no point during the frequency excursion should the ME-22A/PCM indicate above -25 dbm.

g. Remove the patch cords and the test equipment and replace the TA-312/PT handset on the cradle switch.

73. Final Testing RAC-30A Coupler

After repairs have been made or the RAC-30A coupler is replaced by a new one, it is necessary to test the coupler before installing it in the system. This can be done by performing the test in paragraph 50.

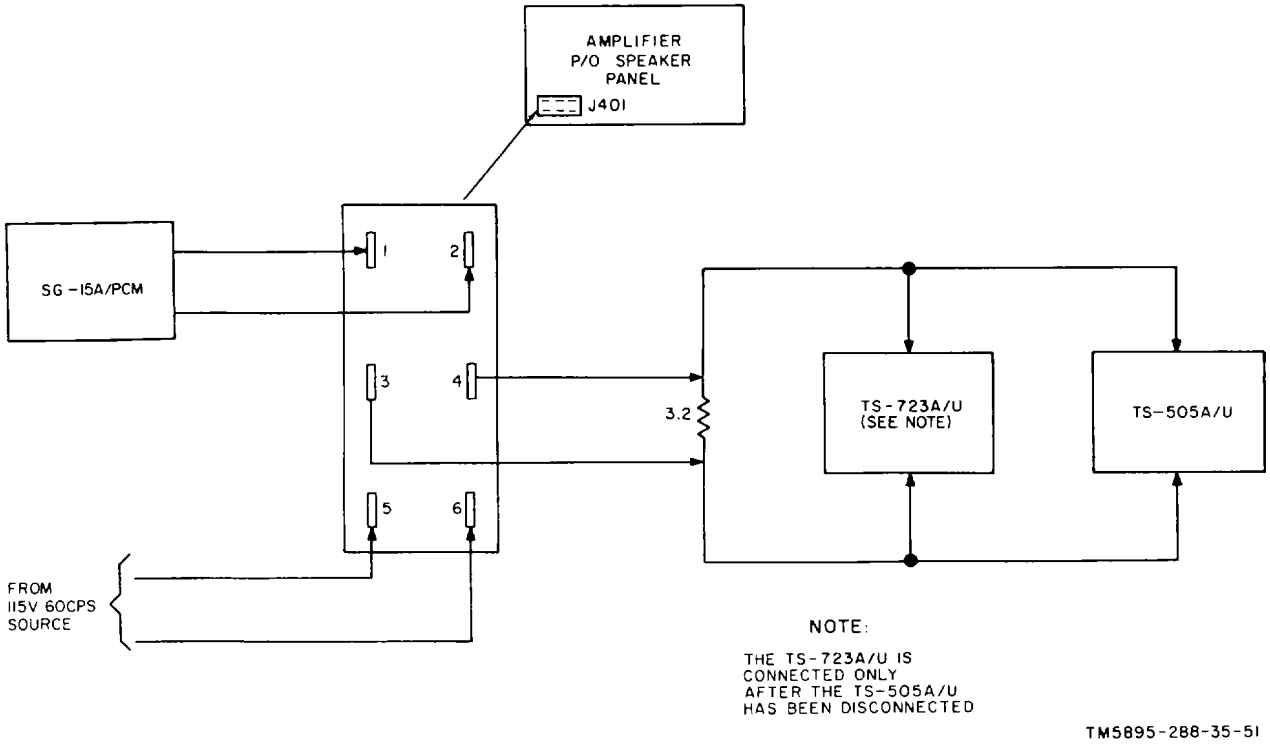
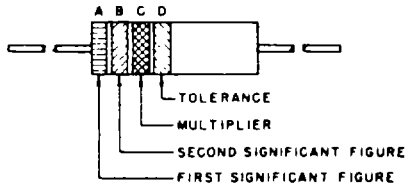


Figure 57. Test setup for testing dual speaker and amplifier panel.

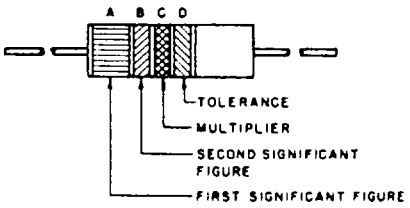
COLOR CODE MARKING FOR MILITARY STANDARD RESISTORS

COMPOSITION-TYPE RESISTORS



BAND A— Equal Width Band Signifies Composition-Type

WIREWOUND-TYPE RESISTORS

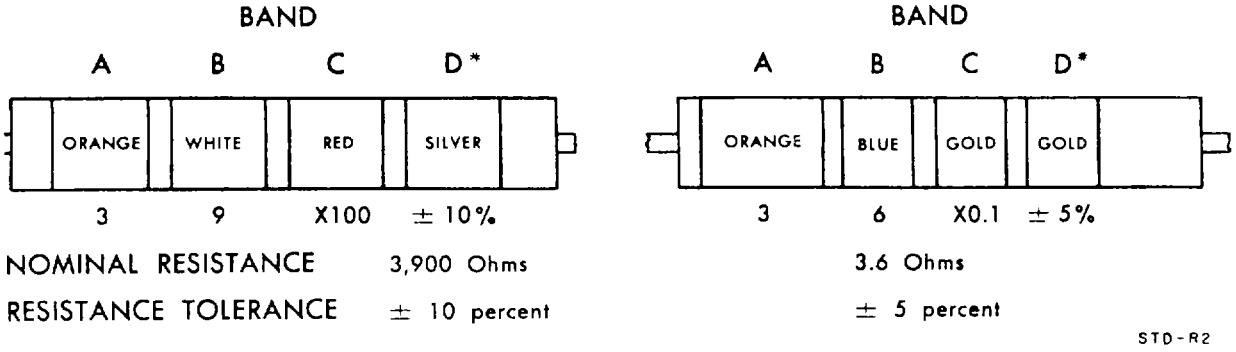


BAND A— Double Width Signifies Wire-wound Resistor

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

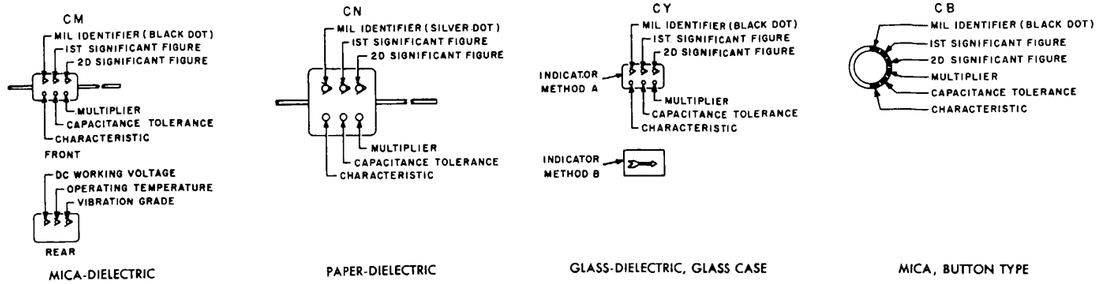


*If Band D is omitted, the resistor tolerance is ±20%, and the resistor is not Mil-Std.

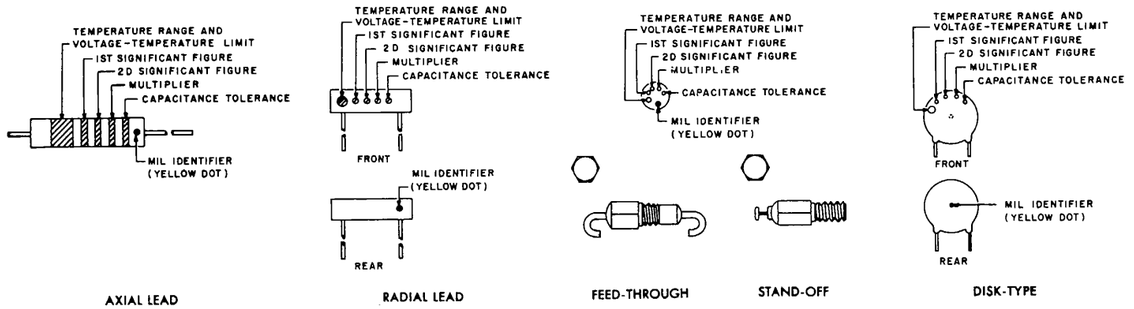
Figure 58. Color code marking for MIL-STD resistors.

COLOR CODE MARKING FOR MILITARY STANDARD CAPACITORS

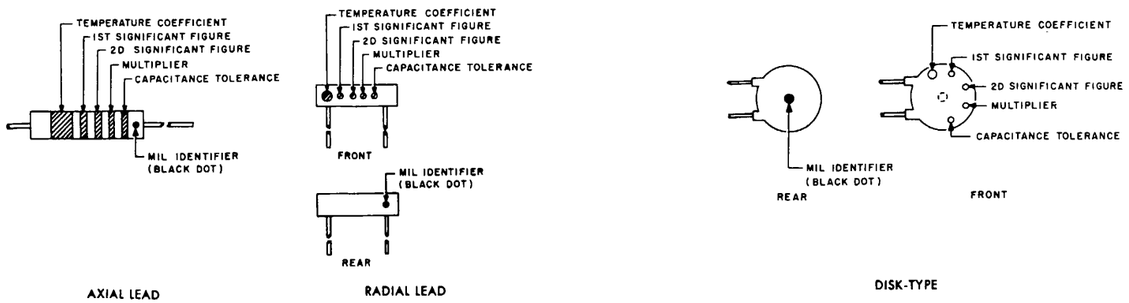
GROUP I Capacitors, Fixed, Various-Dielectrics, Styles CM, CN, CY, and CB



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	MULTIPLIER[1]	CAPACITANCE TOLERANCE	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–C2

Figure 59. Color code marking for MIL-STD capacitors.

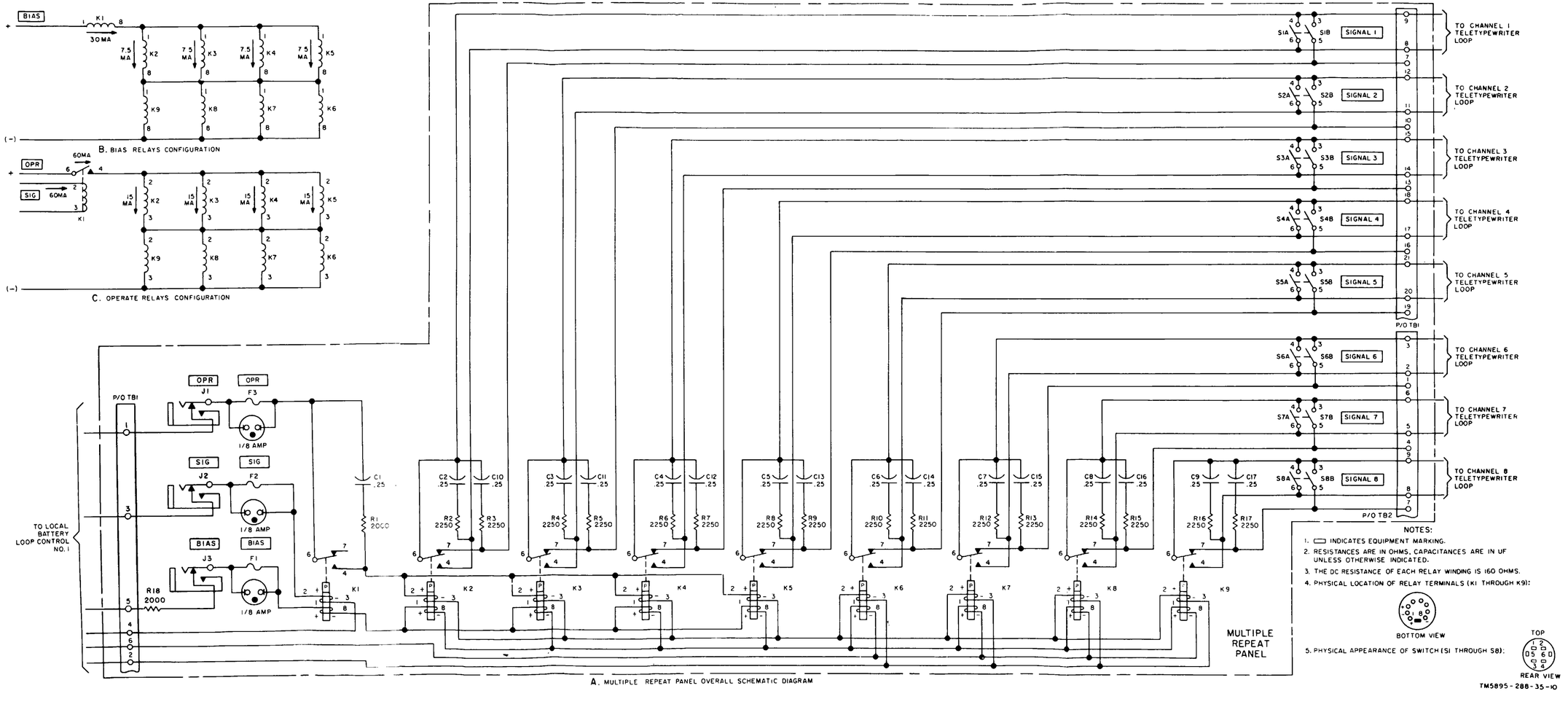
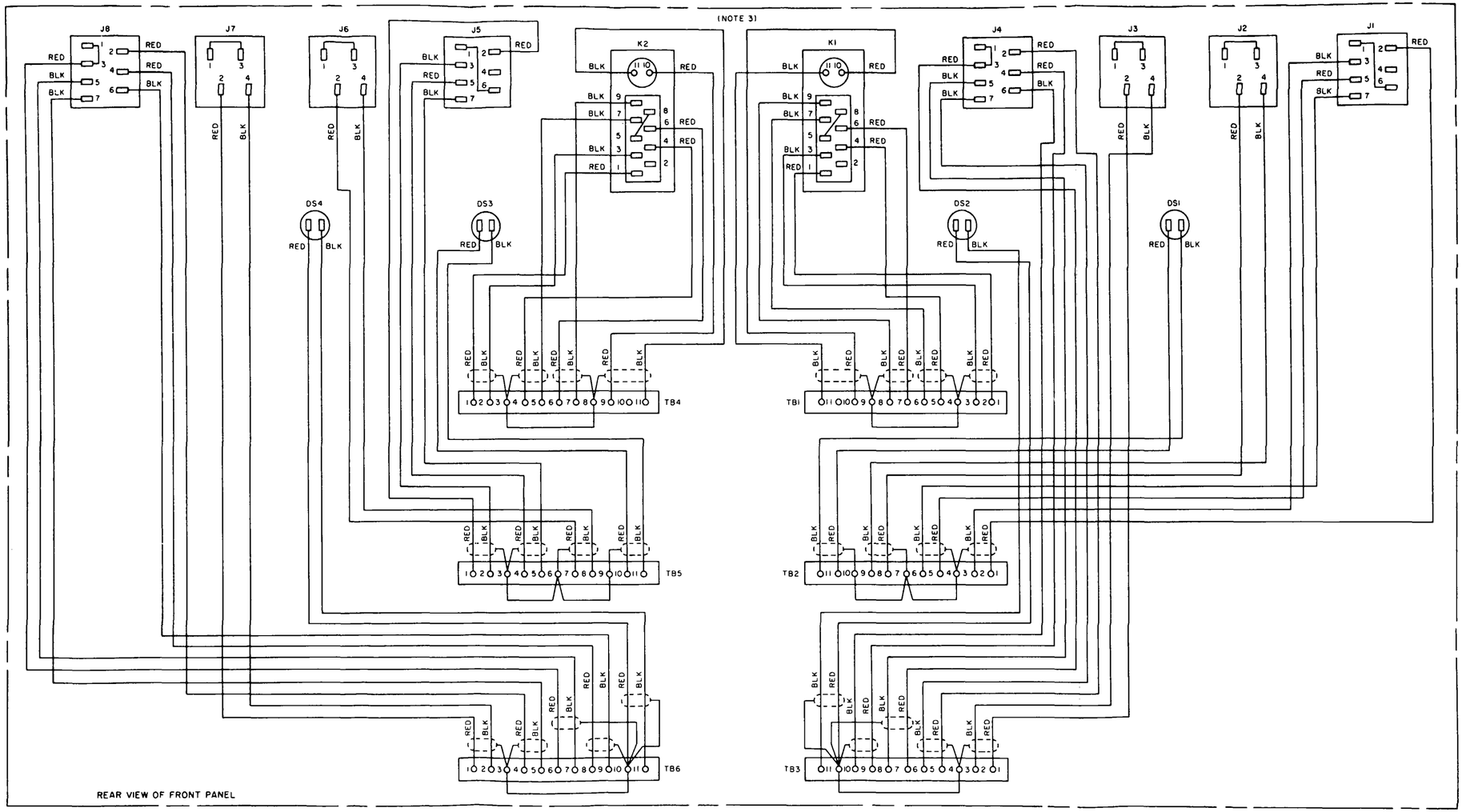


Figure 60. Multiple repeat panel, schematic diagram.



NOTES:

1. ALL WIRING IS 24 GAGE STRANDED PAIRS WITH INSULATED SHIELD.
2. ALL RELAY, JACK, AND TERMINAL BOARD JUMPERS ARE BLACK.
3. RELAYS K1 AND K2 ARE SHOWN AS VIEWED FROM FRONT OF PANEL.

TM5895-288-35-54

Figure 61. Control relay panel No. 1, wiring diagram.

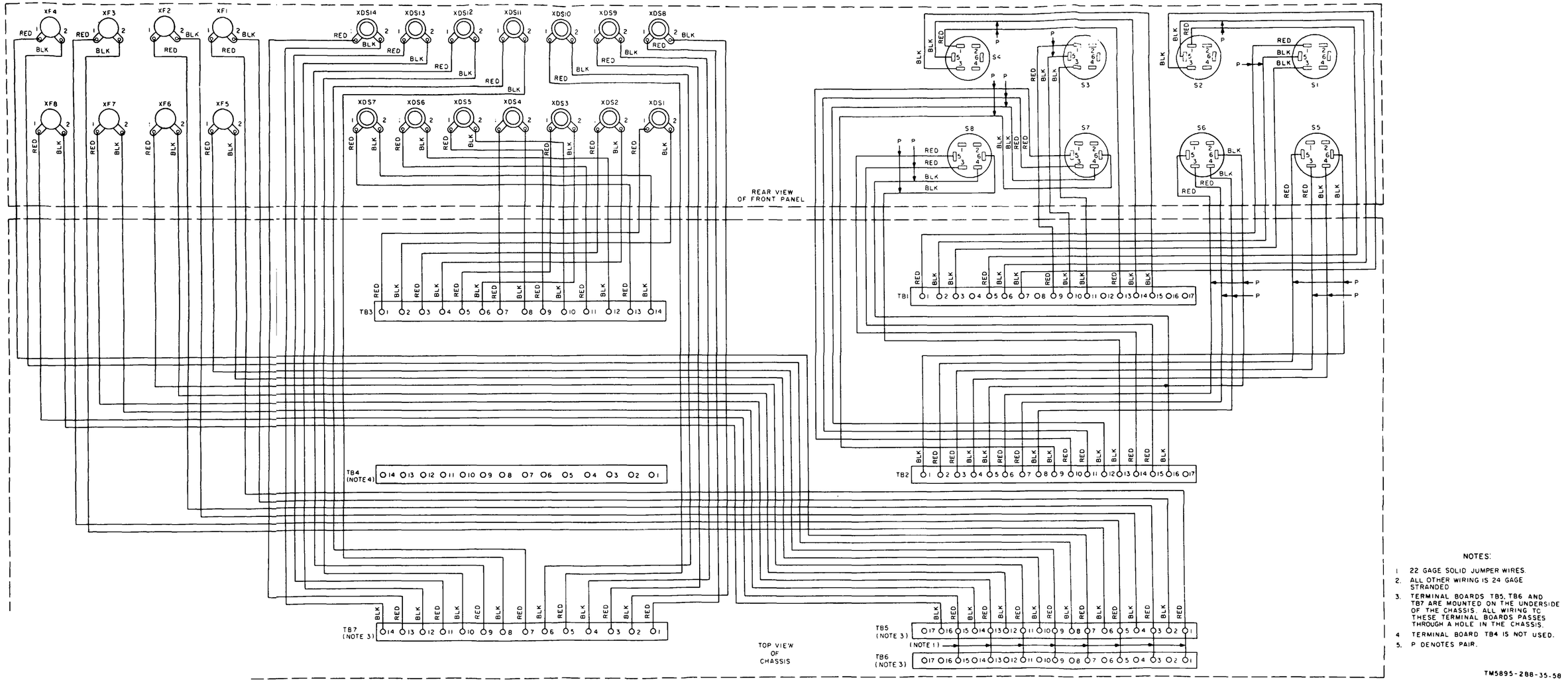


Figure 62. Combined function panel, wiring diagram.

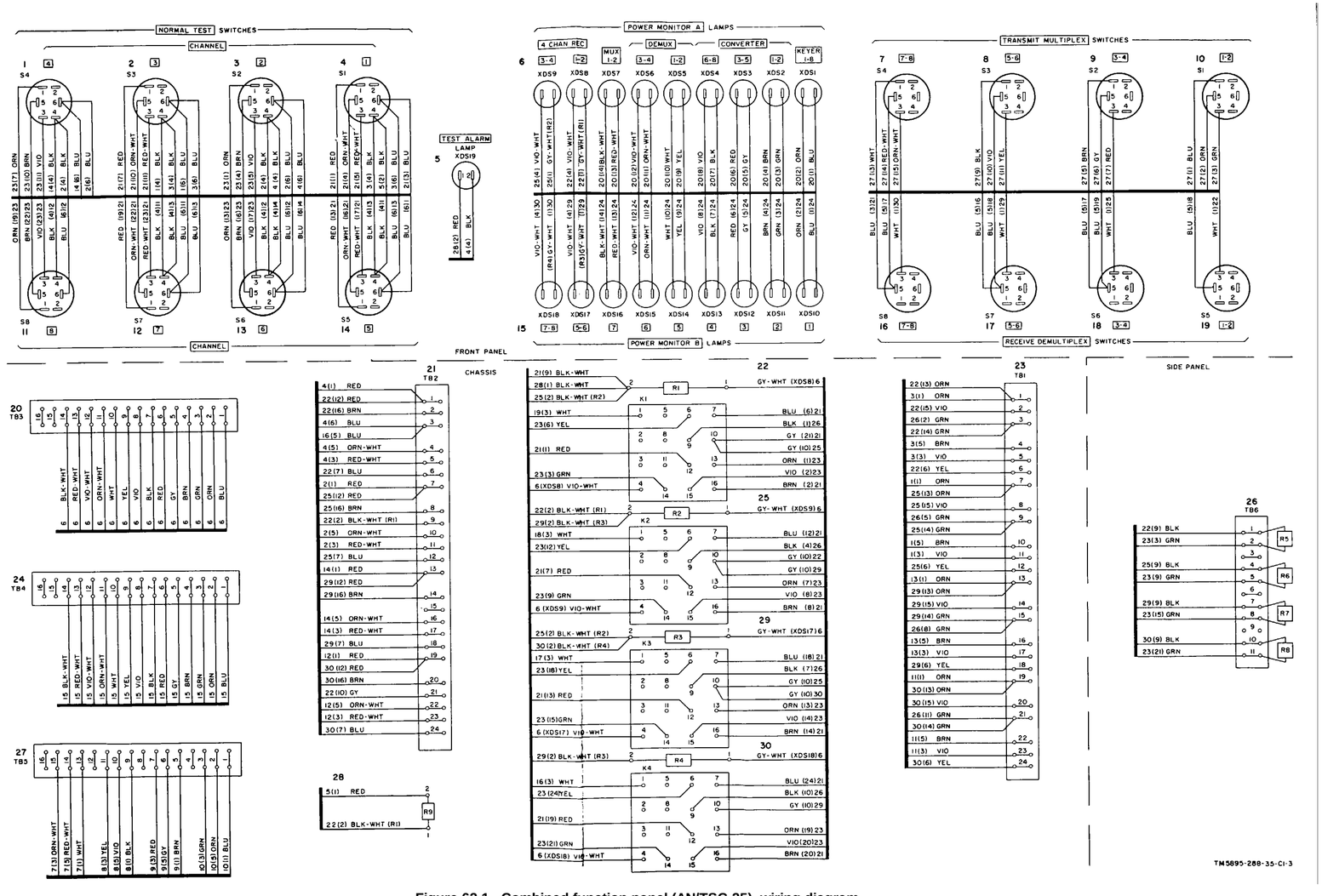


Figure 62.1. Combined function panel (AN/TSC-25), wiring diagram.

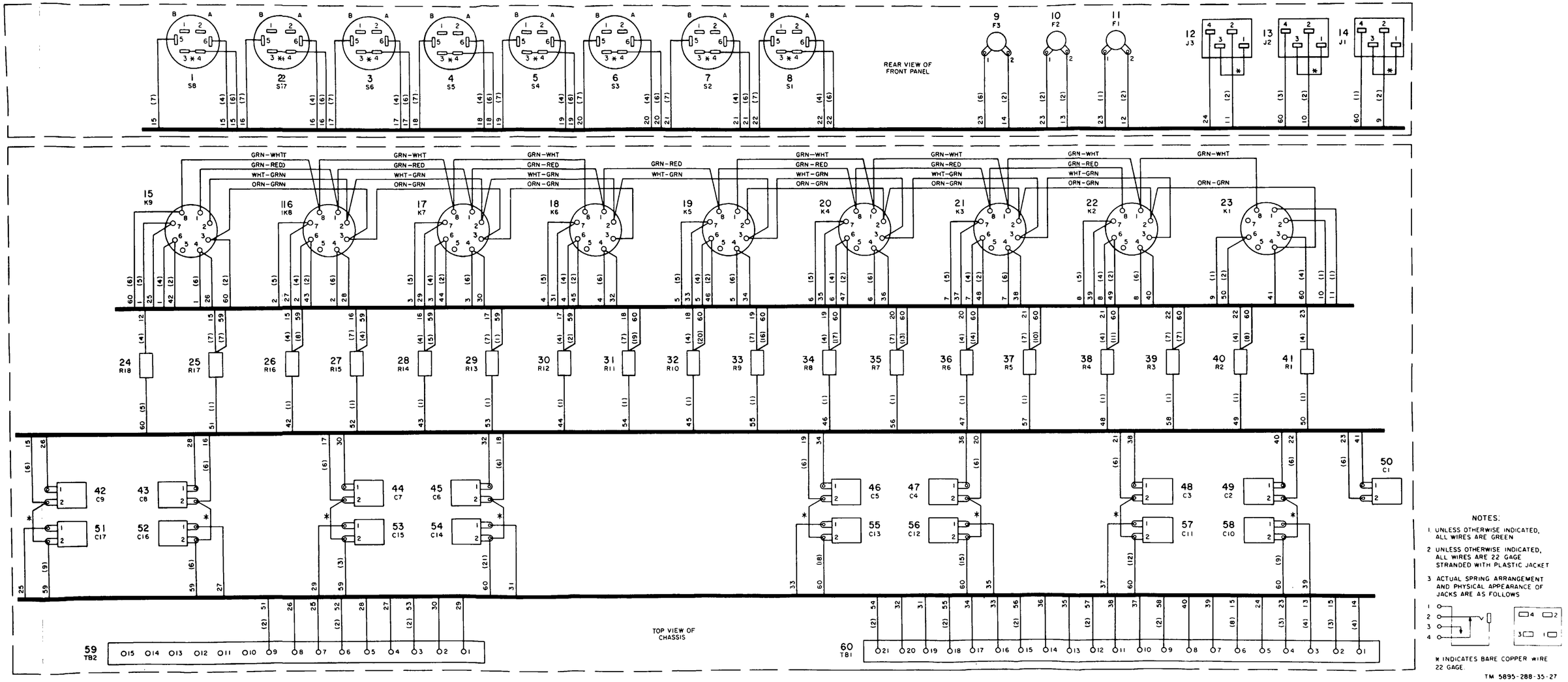


Figure 63. Multiple repeat panel, wiring diagram.

APPENDIX
REFERENCES

Following is a list of applicable references available to the field and depot maintenance repairmen of Communications Centrals AN/TSC-20 and AN/TSC-20A.

DA Pamphlet 310-4	Index of Technical Manuals, Technical Bulletins, Supply Bulletins, Lubrication Orders, and Modification Work Orders.
TM 11-1214A	Oscilloscope OS-8C/U.
TM 11-2096	Test Set TS-140/PCM; Signal Generator SG-15/PCM and SG15A/PCM; and Decibel Meters ME-22/PCM and ME-22A/ PCM.
TM 11-2208	Test Sets TS-2/TG, TS-2A/TG, and TS-2B/TG.
TM 11-5097	Spectrum Analyzers TS-723A/U, TS-723B/U, and TS-723C/U.
TM 11-5511	Electronic Multimeter TS-505/U.
TM 11-5527	Multimeters TS-352/U, TS-352A/U, and TS-352B/U.
TM 11-5895-288-12	Operator and Organizational Maintenance Manual: Communications Central AN/TSC-20.
TM 11-6625-207-10	Operator's Manual: Teletypewriter Test Set TS-1060/GG.
TM 11-6625-239-12	Operator's and Organizational Maintenance Manual: Electronic Multimeters TS-505A/U and TS-505B/U and Multimeters TS505C/U and TS-505D/U.
TM 11-6625-274-12	Operator's and Organizational Maintenance Manual: Test Sets, Electron Tube TV-7/U, TV-7A/U, TV-7B/U, and TV-7D/U.
TM 11-6625-362-12	Operator's and Organizational Maintenance Manual: Test Set, Relay TS-1194A/U.
TB SIG 354	Maintenance and Repair Procedures for Lightweight Field and Mobile Shelters of Aluminum Stressed Skin Foam-Core Construction (Covering S-141/G and S-144/G Type Shelters).

INDEX

By Order of Secretary of the Army:

EARLE G. WHEELER,
General, United States Army,
Chief of Staff.

Official:

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

Distribution:

Active Army:

USASA (2)
DASA (6)
CNGB (1)
CSigO (7)
CofT (1)
CofEngrs (1)
TSG (1)
AMC (5)
USCONARC (5)
ARADCOM (2)
ARADCOM Rgn (2)
OS Maj Comd (3)
OS Base Comd (2)
LOGCOMD (2)
MDW (1)
Corps (2)
USA Corps (3)
USA CD Agcy (1)
USA Tng Cen (2)
USA Elct Comd (5)
USA Msl Comd (3)
Svc Colleges (2)
Br Svc Sch (2)
Army Dep (2) except Lexington,
Tobyhanna (12) Sacramento (17)
Ft Worth (8)
En Dep (OS) (2)
Sig Sec, En Dep (5)
Sig Dep (OS) (12)
WVRAMC (1)
USA Trans Tml Comd (1)
Def Log Svc Cen (1)
Army Tml (1)
POE (1)
OSA (1)
AFIP (1)
AMS (I)
Army Pictorial Cen (2)
USA Mobility Spt Cen (1)
Yuma Test Station (2)
USACARIB Sig Agcy (1)
Sig Fld Maint Shops (3)
JBUSMC (2)
Instl (2) except Ft Monmouth (63)
USA Elct Mat Agcy (25)
Chicago Proc Dist (1)
USA Elct R&D Activity (15)
USA Strat Comm Comd (4)
Units org under fol
TOE: (2 ea UNOINDC)
11-7
11-16
11-57
11-97
11-98
11-117
11-155
11-157
11-500 AA-AE (4)
11-557
11-587
11-592
11-597

NG: State AG (3).
USAR: None.
For explanation of abbreviations used, see AR 320-50.

☆U.S. GOVERNMENT PRINTING OFFICE: 1986-491-421-40571

RECOMMENDED CHANGES TO EQUIPMENT TECHNICAL PUBLICATIONS

THEN...JOT DOWN THE DOPE ABOUT IT ON THIS FORM. CAREFULLY TEAR IT OUT, FOLD IT AND DROP IT IN THE MAIL.

SOMETHING WRONG WITH PUBLICATION

FROM: (PRINT YOUR UNIT'S COMPLETE ADDRESS)

DATE SENT

PUBLICATION NUMBER	PUBLICATION DATE	PUBLICATION TITLE

BE EXACT PIN-POINT WHERE IT IS

PAGE NO.	PARA-GRAPH	FIGURE NO.	TABLE NO.

IN THIS SPACE, TELL WHAT IS WRONG AND WHAT SHOULD BE DONE ABOUT IT.

PRINTED NAME, GRADE OR TITLE AND TELEPHONE NUMBER	SIGN HERE

DA FORM 1 JUL 79 2028-2

PREVIOUS EDITIONS ARE OBSOLETE.

P.S.--IF YOUR OUTFIT WANTS TO KNOW ABOUT YOUR RECOMMENDATION MAKE A CARBON COPY OF THIS AND GIVE IT TO YOUR HEADQUARTERS.

The Metric System and Equivalents

Linear Measure

1 centimeter = 10 millimeters = .39 inch
1 decimeter = 10 centimeters = 3.94 inches
1 meter = 10 decimeters = 39.37 inches
1 dekameter = 10 meters = 32.8 feet
1 hectometer = 10 dekameters = 328.08 feet
1 kilometer = 10 hectometers = 3,280.8 feet

Weights

1 centigram = 10 milligrams = .15 grain
1 decigram = 10 centigrams = 1.54 grains
1 gram = 10 decigram = .035 ounce
1 decagram = 10 grams = .35 ounce
1 hectogram = 10 decagrams = 3.52 ounces
1 kilogram = 10 hectograms = 2.2 pounds
1 quintal = 100 kilograms = 220.46 pounds
1 metric ton = 10 quintals = 1.1 short tons

Liquid Measure

1 centiliter = 10 milliters = .34 fl. ounce
1 deciliter = 10 centiliters = 3.38 fl. ounces
1 liter = 10 deciliters = 33.81 fl. ounces
1 dekaliter = 10 liters = 2.64 gallons
1 hectoliter = 10 dekaliters = 26.42 gallons
1 kiloliter = 10 hectoliters = 264.18 gallons

Square Measure

1 sq. centimeter = 100 sq. millimeters = .155 sq. inch
1 sq. decimeter = 100 sq. centimeters = 15.5 sq. inches
1 sq. meter (centare) = 100 sq. decimeters = 10.76 sq. feet
1 sq. dekameter (are) = 100 sq. meters = 1,076.4 sq. feet
1 sq. hectometer (hectare) = 100 sq. dekameters = 2.47 acres
1 sq. kilometer = 100 sq. hectometers = .386 sq. mile

Cubic Measure

1 cu. centimeter = 1000 cu. millimeters = .06 cu. inch
1 cu. decimeter = 1000 cu. centimeters = 61.02 cu. inches
1 cu. meter = 1000 cu. decimeters = 35.31 cu. feet

Approximate Conversion Factors

To change	*To*	*Multiply by*	*To change*	*To*	*Multiply by*
inches	centimeters	2.540	ounce-inches	Newton-meters	.007062
feet	meters	.305	centimeters	inches	.394
yards	meters	.914	meters	feet	3.280
miles	kilometers	1.609	meters	yards	1.094
square inches	square centimeters	6.451	kilometers	miles	.621
square feet	square meters	.093	square centimeters	square inches	.155
square yards	square meters	.836	square meters	square feet	10.764
square miles	square kilometers	2.590	square meters	square yards	1.196
acres	square hectometers	.405	square kilometers	square miles	.386
cubic feet	cubic meters	.028	square hectometers	acres	2.471
cubic yards	cubic meters	.765	cubic meters	cubic feet	35.315
fluid ounces	milliliters	29,573	cubic meters	cubic yards	1.308
pints	liters	.473	milliliters	fluid ounces	.034
quarts	liters	.946	liters	pints	2.113
gallons	liters	3.785	liters	quarts	1.057
ounces	grams	28.349	liters	gallons	.264
pounds	kilograms	.454	grams	ounces	.035
short tons	metric tons	.907	kilograms	pounds	2.205
pound-feet	Newton-meters	1.356	metric tons	short tons	1.102
pound-inches	Newton-meters	.11296			

Temperature (Exact)

°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

PIN: 023064-000