MODEL TTS-52

LOOP AROUND CONTROL AND MILLIWATT GENERATOR

ISSUE 4

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INSTRUCTION MANUAL

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A Division of Northern Telecom, Inc.

MODEL TTS-52

LOOP AROUND CONTROL AND MILLIWATT GENERATOR

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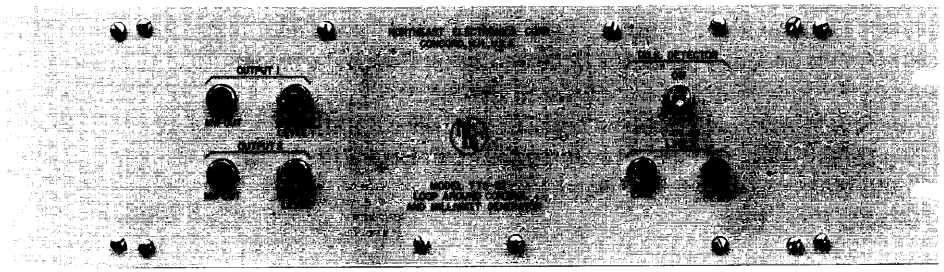

Figure 1—1. Model TTS 52 Loop Around Control and Milliwatt Generator

SECTION 1

DESCRIPTION

1.1 INTRODUCTION.

1.2 The Northeast Electronics Corporation Model TTS 52 series of Loop Around Control and Milliwatt Generators (figure 1-1) permits interconnection of two trunks for the purpose of conducting one-man, two-way transmission measurements. These may be either one-way outgoing dial trunks into a remote office or two-way dial trunks.

1.3 The Model TTS 52 includes loop-around circuitry, an inductor to trip ringing and provide a delayed off-hook condition, delayed application of milliwatt, on-hook and off-hook cycling to ensure release at the end of testing, a combination test line consisting of a milliwatt transmission followed by a balanced termination, a Communications Test jack, an idle termination for use with an external milliwatt and provisions for two internal milliwatt sources. An optional Talk Detector can be installed at a later date if so desired.

1.4 The TTS 52A and TTS 52B Models are identical to a TTS 52 except that a TTS 52A contains one internal milliwatt generator and a TTS 52B contains two. The milliwatt generator contained in a TTS 52A and one of those contained in a TTS 52B eliminates the necessity for an external milliwatt source. The second milliwatt generator in the TTS 52B can be used in conjunction with any office equipment requiring a stable milliwatt source. An output jack and screwdriver adjustment is available on the front panel for each internal milliwatt generator to facilitate fine output level adjustment.

1.5 The Model TTS 52 is relay rack mounted and provides two sets of line terminals that are connected to tip, ring and sleeve conductors of two subscriber numbers assigned to Loop-Around Service. These circuits are referred to as LINE 1 and LINE 2. Test functions assoicated with LINE 1 include a constant milliwatt transmission with on-hook and off-hook cycling, while those associated with LINE 2 include a combination Test Line and a Communications Test jack. Thus, LINE 1 provides proper conditions for one-way transmission measurements while LINE 2 makes possible both level and noise measurement on a single-call basis and is ideally suited for connection appraisal measurement. A lamp indication appears on the front panel and a ground connection is provided to operate an external alarm or other equipment when a connection is made to LINE 2. Loop-around connection is established simply by seizing LINE 1 and LINE 2 simultaneously. Terminals are provided at the rear of the front panel for connection to a 48-volt office battery.

1.6 The Model TTS 50V Talk Detector option for the TTS 52 series of Loop Around Control and Milliwatt Generators bridges the loop-around connection between LINE 1 and LINE 2 and, upon detection of more than one simultaneous frequency, breaks the loop around. This prevents occurance of undesired vcice communication on loop around. Should voice communications become necessary, a switch located on the front panel will disable the Talk Detector.

1.7 Accessories associated with the TTS 52 series of Loop Around Control and Milliwatt Generators are a TTS 50XS and the TTS 50XSD. The TTS 50XS is an adapter unit that can be connected to a TTS 52 to permit selection and looping around of one-way dial trunks originating in a remote office. The TTS 50XSD permits dialing on one-way trunks under test. Some means for dialing remote loop-around equipment and for sending signals into a TTS 50XS unit must be provided. This may be accomplished by use of a TTS 50B (refer to the instruction manual for the TTS 50B Loop Around Control Unit).

SECTION 2

SPECIFICATIONS

2.1 **INTRODUCTION.**

2.2 Table 2-1 lists specifications of the Model TTS 52 series of Loop Around Control and Milliwatt Generators.

Table 2-1. TTS 52A/B Specifications

LINE 1	LINE 2
Off-hook supervision delayed 250 milliseconds. Application of milliwatt delayed an additional 250 milliseconds. Cycles 10 seconds off-hook, 1 second on-hook until release.	Off-hook supervision delayed 250 milliseconds. Application of milliwatt delayed an additional 250 milliseconds. 10 seconds of milliwatt, then continuous balanced termination. Cycles 10 seconds off-hook, 1 second on-hook until release.

Milliwatt Generator

Frequency:	1000 Hz ±1%
Output Level:	0 dBm nominal into 900 ohms
Output Level Range:	−1 dBm to +2 dBm
Accuracy:	±0.05 dB
Output Impedance:	900 ohms

NOTE

900 ohms is the standard output impedance supplied with each milliwatt generator. Other output impedances can be supplied upon request.

Balance Termination	900 ohms +2.0 microfarads
Idle Termination	900 ohms +2.0 microfarads

Power Requirements

Voltage:	48 Volts ±10%
Current Drain:	400 milliamperes maximum

Mechanical

Dimensions:	19 in. w x 5.25 in. h x 7 in. d (483mm w x 132mm h x 192mm d)
Weight (TTS 52A):	8.5 pounds (3.85 kg)
Weight (TTS 52B):	9.0 pounds (4.1 kg)

SECTION 3

OPERATING INSTRUCTIONS

3.1 **INTRODUCTION.**

3.2 Table 3—1 lists functions of all controls, indicators and connectors shown on figure 3—1. Paragraphs 3.3 through 3.11 describe installation while operating features are described in paragraphs 3.12 through 3.26 and operating procedures in paragraphs 3.27 through 3.40.

Table 3—1 Controls,Indicators and Connectors.

Ref Desig	Control, Indicator or Connector	Function
J1	LINE 2 LINE jack	Provides direct connection to LINE 2.
J2	OUTPUT 1 MW-OUT jack	Provides connection to internal milliwatt generator 1 on TTS 52A and TTS 52B for monitor and adjustment.
J3	OUTPUT 2 MW-OUT jack	Provides connection to internal milliwatt generator 2 on TTS 52B for monitor and adjustment.
R22	OUTPUT 1 MW-ADJ LEVEL potentiometer	Adjusts level of internal milliwatt generator 1 on TTS 52A and TTS 52B.
R21	OUTPUT 2 MW-ADJ LEVEL potentiometer	Adjusts level of internal milliwatt generator 2 on TTS 52B.
S1	TALK DETECTOR ON-OFF switch	In OFF position, disables talk detector.

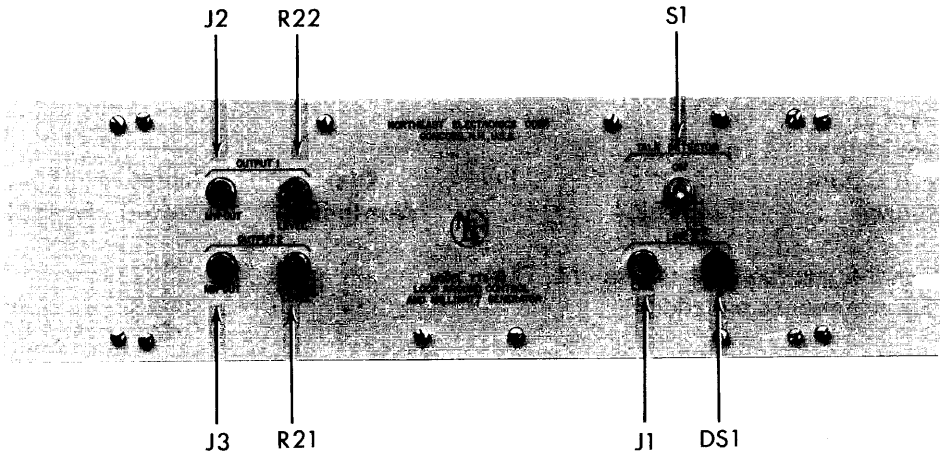

Figure 3—1. TTS 52 Controls, Indicators and connectors.

3.3 **INSTALLATION**.

3.4 The following paragraphs, when used in conjunction with figures 3-2 through 3-4 and 6-1 facilitate installation of TTS 52 series of Loop Around Control and Milliwatt Generators.

3.5 Conversion of a basic TTS 52 to a TTS 52A is accomplished by inserting a milliwatt generator board (E95415) in J2 of the main assembly board (E96039). Refering to figure 3-3, insert board so that the component side is facing toward TB1.

3.6 Conversion of basic TTS 52 to a TTS 52B is accomplished by inserting 2 milliwatt generator boards (E95415), one in J2 and one in J3 of the main assembly board (E96309). Refering to figure 3-3, insert the boards so that the component side is facing toward TB1.

3.7 If the optional Talk Detector board (E95975) is to be included, it should be inserted in J1 (figure 3-3) of the main assembly board (E96039) with the component side facing toward TB2.

3.8 Each TTS 52 is 19—inch relay rack mounted in a space that is 5 1/4 inches (132mm) high by 7 inches (178mm) deep. The following connections should be made (refer to figure 3—2).

Connect	To
LINE 1 Tip	TB1-1
LINE 1 Ring	TB1-2
LINE 1 Sleeve	TB1-4
LINE 2 Tip	TB1-5
LINE 2 Ring	TB1-6
LINE 2 Sleeve	TB1-8
Ext. Alarm Ground Trigger	TB1-9
Office Battery (-48 Volts)	TB1-11
Office Battery (Ground)	TB1-10
Ext. Equipment requiring a 1000 Hz test tone at 0 dBm	TB2-1,TB2-2
Ext. Milliwatt Source	TB2-3,TB2-4

No further connections are required unless the TTS 50XS and TTSXSD accessories are added.

3.9 Figure 3-4 is the installation diagram for the TTS 50XS. All information such as physical dimensions, component location, interwiring connections and installer cabling to trunks to be selected are shown on figure 3-4.

3.10 Table 3—2 shows assignment of trunks versus selector switch positions and numbers that must be dialed to select these trunks.

3.11 Following is a step-by-step installation procedure:

a. Disconnect power to TTS 52 to avoid electrical shock and damage to equipment.

b. On TTS 52, remove strap between terminals 6 and 7 on TB2.

c. If unit is basic TTS 52, an external milliwatt source may be connected directly to TB1 pins 1 and 2 of TTS 50XS with appropriate blocking capacitors as shown on figure 3—4. Strapping from TB2 pins 1 and 2 of TTS 52 to TB1 pins 1 and 2 of TTS 50XS may be omitted if this is done.

CAUTION

When connecting TTS 50XS to TTS 52A or TTS 52B, Internal Milliwatt Generator located in J2 of Main Assembly Board will be damaged if not removed. Milliwatt generator in J2 of a TTS 52A should be removed and may be inserted into J3 of main assembly board. Milliwatt generator in J2 of a TTS 52B must be removed completely.

d. Interconnect wires from TTS 50XS TB1 to TTS 52 TB2 as shown in figure 3-4.

e. Run cable and connect wires from a tip, ring and sleeve appearance of trunks assigned and connect to TB2 of TTS 50XS. See figure 3—4c for terminal assignments and table 3-2 for trunk assignments.

f. Reconnect power to TTS 52 and perform operational tests.

Table 3-2. Trunk Assignments

Dial Number	Trunk Selected	Dial Number	Trunk Selected
1	1	02	11
2	2	03	12
3	3	04	13
4	4	05	14
5	5	06	15
6	6	07	16
7	7	08	17
8	8	09	18
9	9	001	19
01	10	002	20

3.12 OPERATING FEATURES.

3.13 The TTS 52 will work in most telephone offices thus eliminating the need of selecting an option for a particular operation. It is intended to comply with all existing and known future requirements for end office test lines.

3.14 Off hook is delayed 250 ms on both lines. In addition, application of test tone is also delayed 250 ms on both lines preventing accidental seizure of single-frequency detectors.

3.15 LINE 1.

3.16 Upon completing a call to the subscriber number assigned to this line and after a 250 millisecond delay, an off-hook condition, which consists of an inductor is connected across the line. This trips the ringing and provides off-hook supervision. After an additional 250 milliseconds, an internal 1000 Hz test tone is connected to the line. After approximately 10 seconds the inductor is lifted from the line and provides an on-hook condition for 1 second. This will be repeated every 11 seconds until the line is released.

3.17 LINE 2.

3.18 Upon completing a call to the subscriber number assigned to this line and after a 250 millisecond delay, an indicator lamp on the front panel shows the line to be in use. Simultaneously a ground is applied to pin 9 on terminal board 1 to operate an external alarm or other equipment. At this time, an off-hook condition consisting of an inductor is also connected across the line, exactly as described under LINE 1. Again a 250 millisecond delay is experienced before application of a 1000 Hz test tone. After 10 seconds, the inductor is removed from line 1 thus presenting an on—hook condition for 1 second, and then returns to an off—hook condition. This condition remains until the line is released.

3.19 LOOP—AROUND.

3.20 First, one test line is dialed up and held, then a second test line is dialed up and held thus establishing loop-around. Dc blocking is provided to protect the milliwatt supply.

3.21 COMMUNICATION TEST JACK.

3.22 Inserting a test cord into the Communications Test Jack disconnects LINE 1 from the equipment and connects the test man directly to LINE 2 thus permitting use of a talk set or a transmission measuring set.

3.23 INTERNAL MILLIWATT GENERATOR.

3.24 This is a precision-level generator used in the TTS 52A and TTS 52B. It is preset to provide an output of 1000 Hz at 0 dBm into 900 ohms. It is also capable of being pre-tuned to send signals from 300 Hz to 20 kHz.

3.25 OPTIONAL TALK DETECTOR BOARD.

3.26 This is a circuit provided for detection of unwanted voice frequencies that may occur during loop-around. The appearance of unwanted voice frequencies causes the talk detector to operate and remove the loop-around condition. It remains activated until talk detector ON—OFF switch S1 is set to OFF.

3.27 OPERATING PROCEDURES.

3.28 INTRODUCTION.

3.29 Operating procedures for the TTS 52 are listed in the following paragraphs. Operating procedures for TTS 52A and TTS 52B are similar except that they have their own internal milliwatt generators. A TTS 52B has an additional milliwatt generator designed for external use.

3.30 LINE 1.

3.31 This line is used to obtain on-hook/off-hook and milliwatt cycling.

ACTION	RESULT
a. Call subscriber number assigned to line 1.	Line 1 is seized and 250 milliseconds later, off-hook supervision is applied to line 1. 500 milliseconds after seizure, a 1000 Hz test tone is applied to line 1 for 10 seconds.

ACTION	RESULT
a. (Continued)	10 seconds after seizure, the milliwatt is removed from line 1 and an on-hook condition is applied for 1 second. 11 seconds after seizure, a 1000 Hz test tone and an off-hook condition is reapplied to line 1 for 10 seconds. This on-hook/off-hook cycling is repeated until line 1 is released.
b. Release line 1.	Test line is removed and a high-impedance termination is applied to line 1.

3.32 **LINE 2.**

3.33 This line is used to obtain an off-hook condition after one cycle of milliwatt. Balanced termination occurs after the milliwatt test tone and remains until the line is released.

ACTION	RESULT
a. Call subscriber number assigned to line 2.	Line 2 is seized and 250 milliseconds after seizure, off-hook supervision is applied to line 2. IN—USE indicator lamp DS1 lights. Ground is applied to TB1, pin 9. 500 milliseconds after seizure, a 1000 Hz test tone is applied to line 2 for 10 seconds. 10 seconds after seizure, 1000 Hz test tone is removed from line and replaced by a balance termination. 20 milliseconds after seizure, on hook condition is applied to line 2 for 1 second. 21 seconds after seizure, on-hook condition is replaced by off-hook condition. This on-hook/off—hook cycling continues until line 2 is released.
b. Release line 2.	Test line is removed from line 2.

3.34 **LOOP AROUND.**

3.35 Both lines are used together to obtain a loop—around test condition.

ACTION	RESULT
a. Call subscriber number assigned to line 1.	Line is seized and results listed under 3.31a begin.
b. Call subscriber number assigned to line 2.	Line 1 is connected to line 2 and milliwatt supply is disconnected. If optional talk detector circuit is present, it is connected to the loop.

3.36 The talk detector ON—OFF switch is used to disconnect the talk detector circuit from loop—around.

ACTION	RESULT
a. Set talk detector ON-OFF switch S1 to OFF.	Talk detector disconnected and loop-around disabled.
b. Set talk detector ON-OFF switch S1 ON.	Talk detector is enabled and loop-around is reconnected.

3.37 **MW—OUT OUTPUT 1.**

3.38 This procedure is used for adjusting the internal milliwatt generator on a TTS 52A and a TTS 52B.

ACTION	RESULT
a. Connect appropriate measuring equipment to MW—OUT OUTPUT 1 jack J2 using ring and tip 310 cord.	Milliwatt generator is disconnected from test line and output is monitored at J2.
b. Adjust OUTPUT 1 MW—ADJ LEVEL potentiometer R22 to obtain desired level.	Adjusts miliiwatt generator for desired level.
c. Remove cords from J2.	Reconnects milliwatt generator to test line.

3.39 **MW—OUT OUTPUT 2.**

3.40 This procedure is used for adjusting the level of the second internal milliwatt generator on a TTS 52B only.

ACTION	RESULT
a. Connect appropriate measuring equipment to MW—OUT OUTPUT 2 jack J3 using ring and tip 310 cord.	Milliwatt generator is disconnected from attached external devices.
b. Adjust OUTPUT 2 MW—ADJ LEVEL potentiometer R21 to obtain desired level.	Adjusts milliwatt generator for desired output level.
c. Remove cords from J3.	Reconnects internal milliwatt generator to external devices.

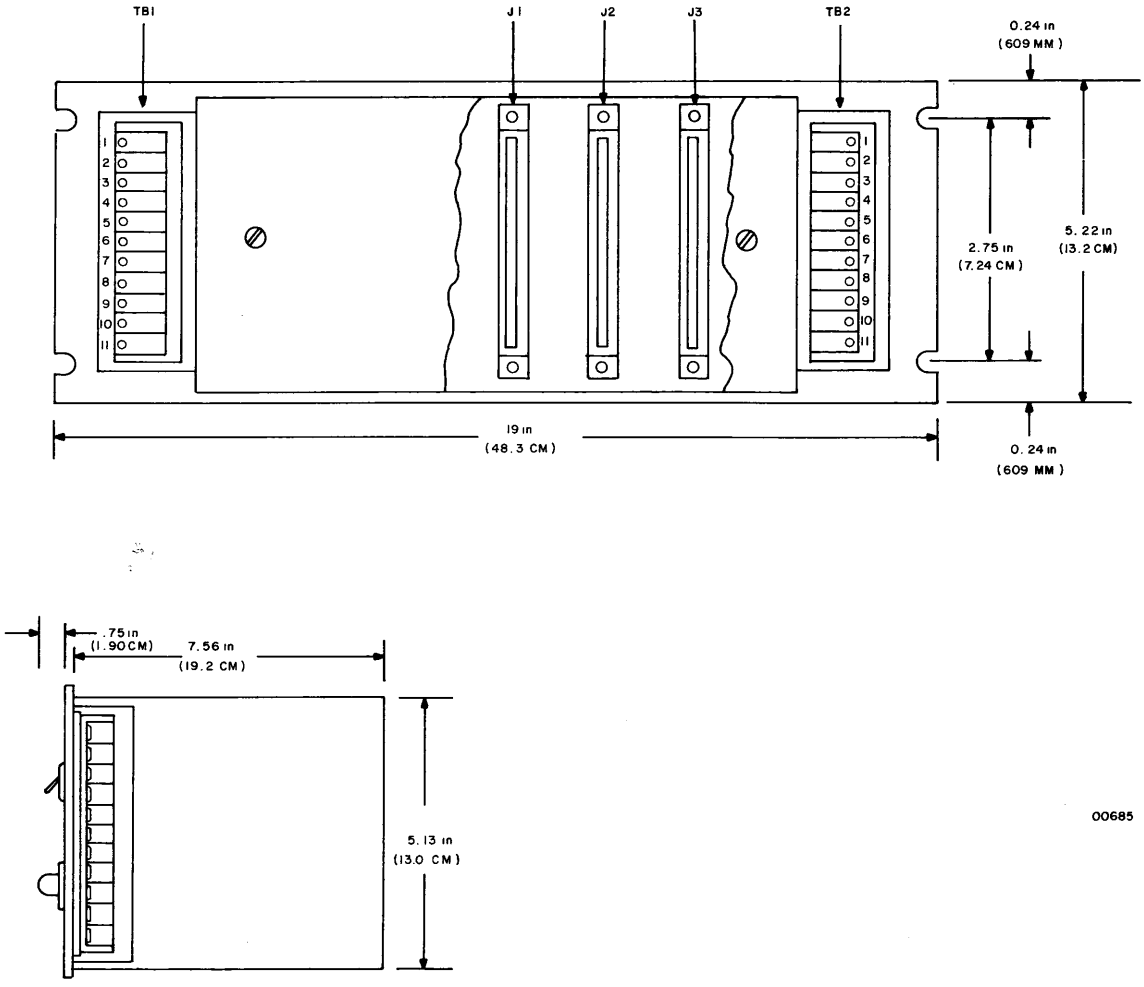

Figure 3—2. TTS 52 Overall Dimensions

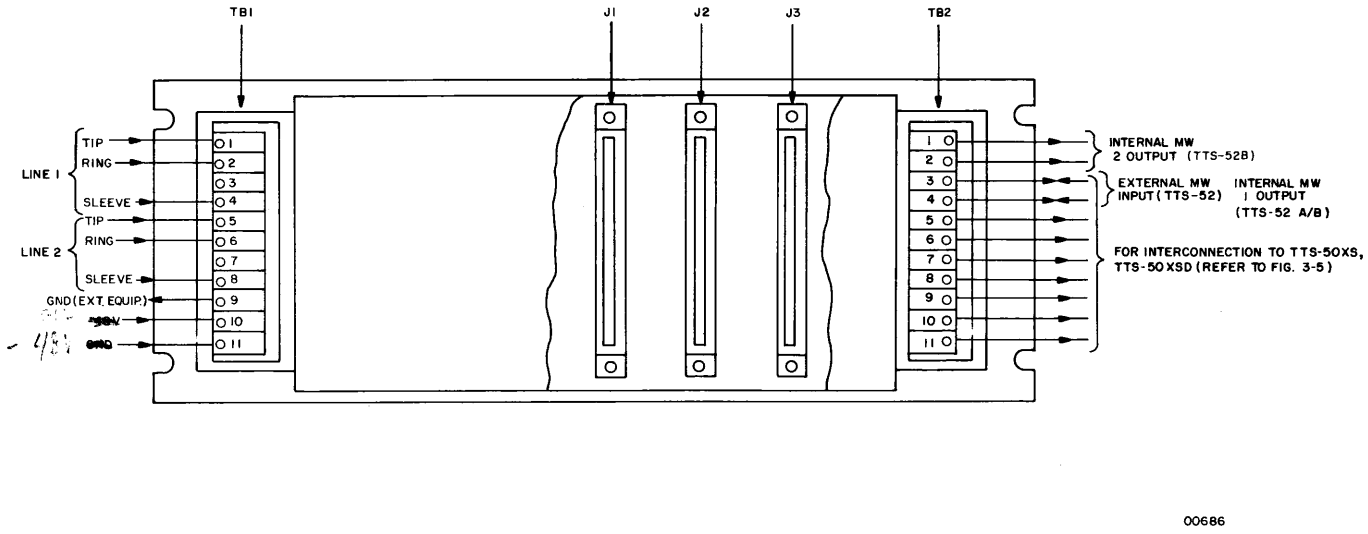

Figure 3—3. TTS 52 Installation Diagram

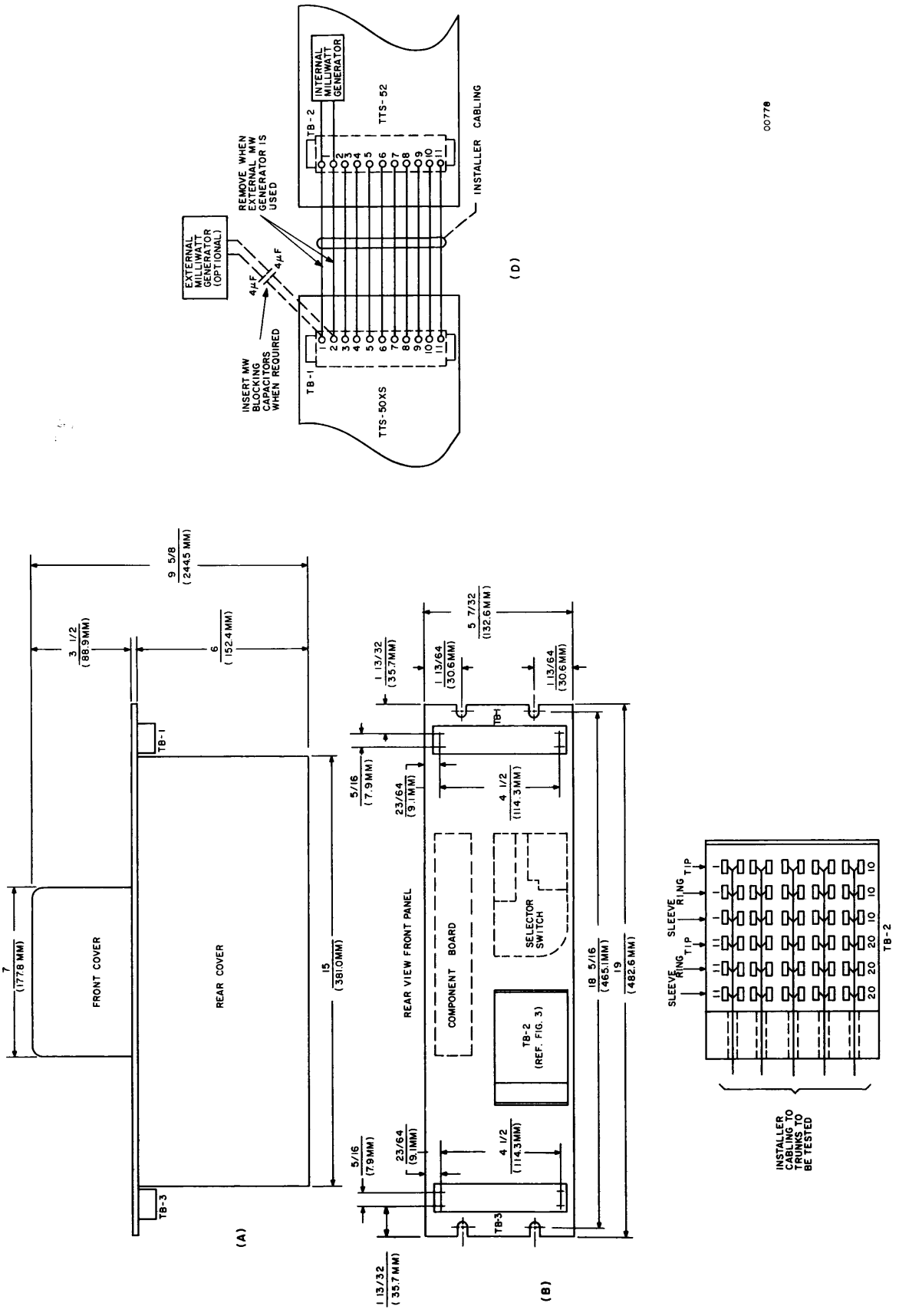

Figure 3—4. TTS 50XS Installation Diagram

SECTION 4

CIRCUIT DESCRIPTION

4.1 INTRODUCTION.

4.2 The following paragraphs when used in conjunction with figures 4−1 through 4−3 and schematics in section 7 describe the circuit employed in TTS 52 Series of Loop Around Test Systems. A unit consists basically of two test lines, switching and cycling circuits, and in the case of TTS 52A and TTS 52B, internal milliwatt generators. An optional Talk Detector circuit may also be included.

4.3 LINE 1.

4.4 Calling in on LINE 1 applies a ground to the sleeve at TB1−4. After a 250 millisecond delay caused by a time constant consisting of R3 and C2, K1 energizes removing R1, a high-impedance load, from the line. Operation of K1 also adds inductor L1 across the line giving an off-hook condition, applies a ground through CR9 to a time constant circuit consisting of R17 and C8, and applies a ground to the time cycle generator. Action of this generator is discussed in paragraph 4.6.

4.5 After a 250 millisecond delay,K8 energizes applying a 1000 Hz test tone from an external milliwatt source attached to TB2−3 and TB2−4 to the line. In the case of a TTS 52A and TTS 52B, the test tone source is internal milliwatt generator board one. After 10 seconds the time cycle generator operates and energizes K4 that in turn operates for the time cycle generator and also removes inductor L1 from LINE 1 presenting an on hook condition. K4 also energizes K5 which serves no purpose on LINE 1. After 1 second the time cycle generator again operates and releases K4 that in turn adds inductor L1 to LINE 1 and returns the milliwatt test tone.

4.6 TIME CYCLE GENERATOR.

4.7 A ground is applied to the positive side of C5 by K1 and C5 begins to charge toward a negative voltage at a rate determined by R7,R8, and C5. Once C5 has attained maximum charge, K3 energizes and Q1 turns on. Relay K3 in turn energizes K4, which provides a discharge path via R9 and R10. Thus K4 operates for 10 seconds and 1 second causing off-hook/on-hook cycling.

4.8 LINE 2.

4.9 Calling on LINE 2 applies a ground to the sleeve connection at TB1−8. After a 250 millisecond delay caused by R14 and C6, K2 energizes and applies inductor L2 across LINE 2. Relay K2 also applies a ground to the time cycle generator and to delay circuit K8 consisting of R17 and C8. In addition, a ground is applied to TB1−9 for use with an external alarm or other equipment and to LINE 2 IN−USE indicator DS1. With K2 energized, a ground is applied through CR4 to K7 that switches the milliwatt line from LINE 1 to LINE 2, and applies a ground to K8. Relay K8 energizes after 250 milliseconds and applies a 1000 Hz test tone to LINE 2. After 10 seconds, the time cycle generator operates as described in paragraph 4.6 and removes inductor L2 from LINE 2. This energizes K5, which locks up, and disables K7 that removes the milliwatt from LINE 2 and applies a 900 ohm, 2 microfarad termination consisting of R19 and C9. The time cycle generator continues to operate until the line is released and supplies off-hook/on-hook supervision through K4.

4.10 LOOP−AROUND.

4.11 Calling first on LINE 1 and then on LINE 2, without releasing LINE 1, energizes both K1 and K2. This provides a path for ground to energize K6 that connects LINE 1 to LINE 2 and removes the milliwatt line and the 900 ohm, 2 microfarad termination. This condition will remain until either of the two lines is released.

4.12 Access to LINE 2 is gained by J1 on the front panel. This removes LINE 1 during loop-around and 900 ohm,2 microfarad line, consisting of R19 and C9.

4.13 MILLIWATT GENERATOR BOARD.

4.14 The oscillator consists of oscillator-amplifier package U902 and a frequency-determining Wien Bridge. The frequency-determining components of the bridge are capacitors C905, C906, and resistors R913, R917,R918. Resistors R912 and R914 are selected to fine tune the frequency and should be within 2% of each other. As they are decreased in value, the frequency increases.

NOTE

The frequency can be changed externally by adding resistors from pin 7 to pin 9 and from pin 9 to pin 22. For frequencies from 300 Hz to 5 kHz, C905 and C906 should be 0.01 microfarad. For frequencies from 5 kHz to 20 kHz, the values should be 0.001 microfarad.

4.15 The positive feedback arm of the bridge consists of R910,R911 and C904 while the negative feedback arm consists of R915 and R916.

4.16 The detector section of the milliwatt generator board consists of an ac amplifier, a bridge, and a dc amplifier. Gain is determined by R927 and R928.

NOTE

The gain can be changed by adding resistors from pin 11 to pin 14.

4.17 The ac amplifier consists of Q903 and Q904. Transistor Q904 and resistor R931 are bootstrapping elements. Diodes CR907 and CR908 and capacitors C915 and C916 make up a bridge detector circuit. Resistor R933 is a feedback resistor for the detector. Intergrated circuit U903 is a dc amplifier that drives the AGC element, which is field-effect transistor Q902.

4.18 The output impedance of the milliwatt generator is normally 900 ohms. One half of the transformer primary is used as a level sense winding and R924 is a load for this winding.

NOTE

Different output impedance may be required (TTS 52B) on second internal milliwatt generator for use with external equipment. Impedance can be changed simply to 600 ohms by bussing from pin 2 to pin 10.

4.19 The milliwatt generator has a precision power supply that provides a stable dc voltage. It makes use of zener diode CR903 as its reference element. The regulator consists of dc amplifier U901 and series pass transistor Q901. The high open-loop gain of U901 provides excellent regulation and ripple rejection. A self-starting circuit consists of R906,R907 and CR904.

4.20 TALK DETECTOR.

4.21 The Talk Detector circuit consists of a detector, a rectifier and a triggering circuit. Impedance matching to the loop-around circuit is provided by T401. The detector consists of ac amplifiers U401 and U402. These amplifiers have a high gain and a wide bandwidth suitable for this application. Resistors R404 and R405 make up the feedback arm of the second amplifier.

4.22 The rectifier bridge consists of CR402 and CR403, which in turn control the triggering circuitry that consists of C408,U403,Q401 and K401. Capacitor C408 is allowed to charge and discharge at a rate determined by R415. When C408 obtains sufficient charge, U403 is enabled and provides a pulse to trigger Q401 which in turn energizes K401. Relay K401 remains energized until Talk Detector On-Off switch S1 is toggled to reset the trigger network.

4.23 A negative 24 volt supply for the integrated circuits is derived from a voltage regulator and divider circuit consisting of Q401, VR401,R418,R419 and C407. Transistor Q402 and VR401 form a regulator section and R418,R419 provide proper biasing.

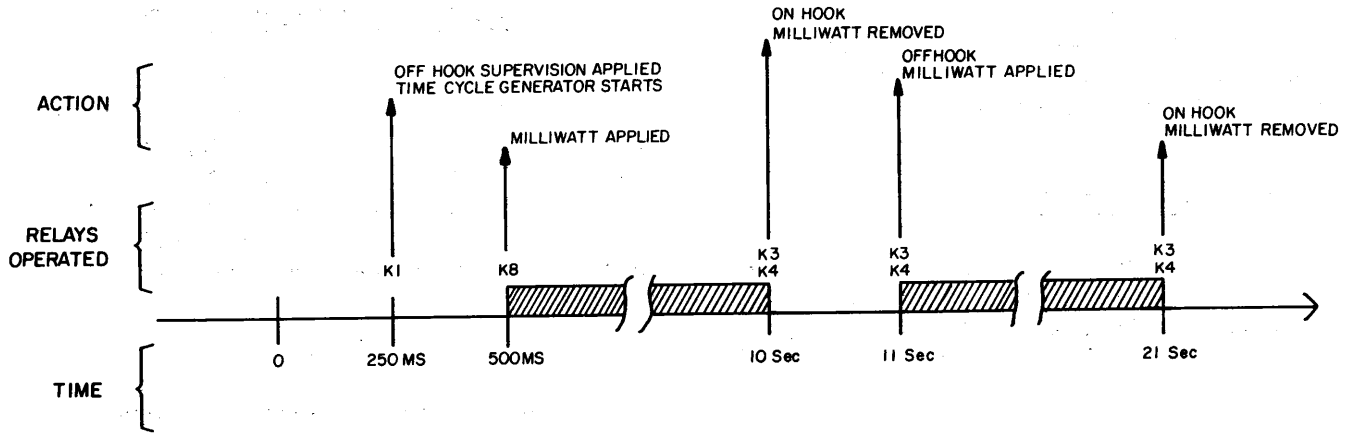

Figure 4—1. TTS 52 Line 1 Timing Diagram

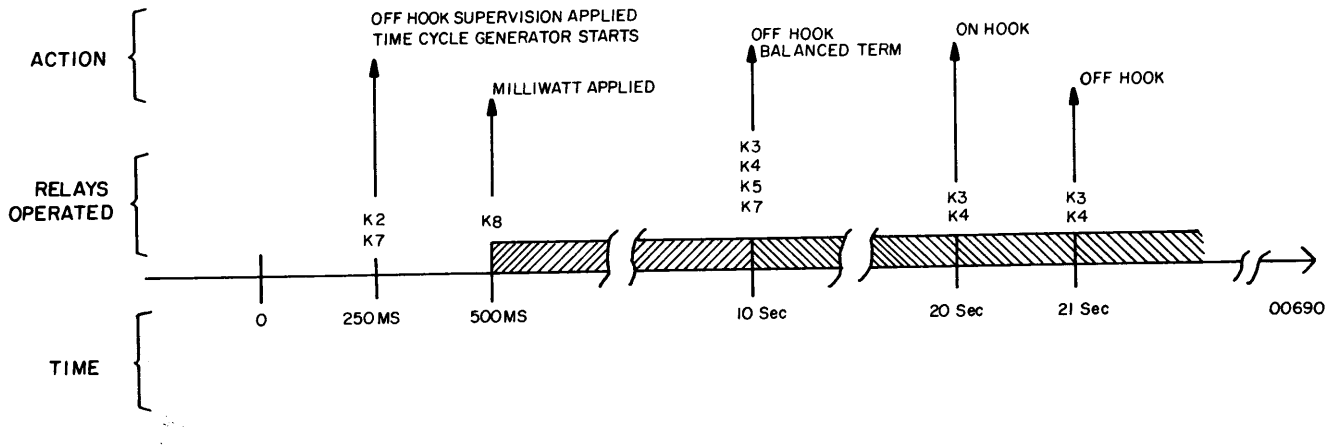

Figure 4—2. TTS 52 Line 2 Timing Diagram

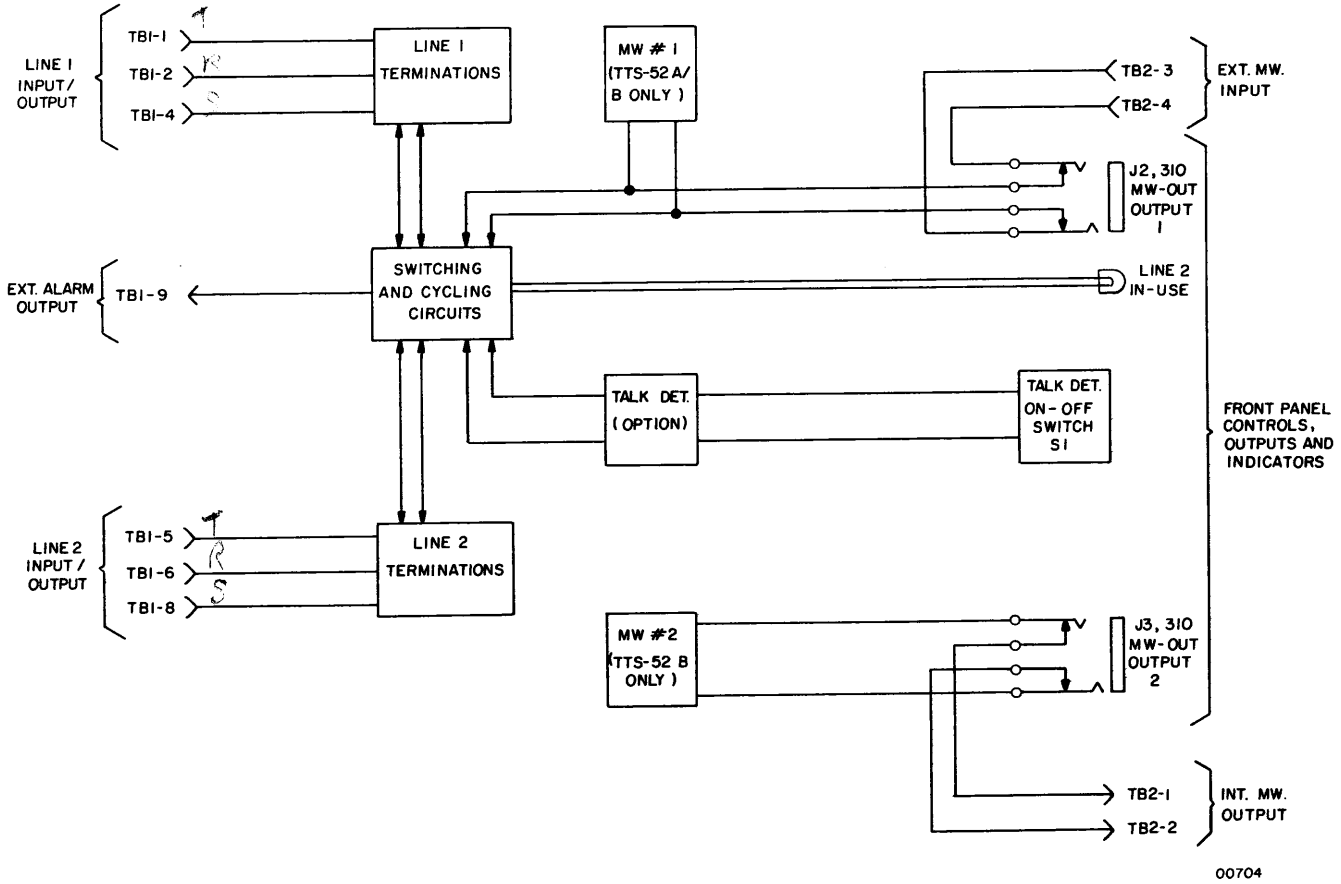

Figure 4—3. TTS 52 Overall Block Diagram

SECTION 5

MAINTENANCE AND CALIBRATION

5.1 **MAINTENANCE.**

5.2 Level setting of the milliwatt generator of a TTS 52A or TTS 52B should be checked periodically by means of a level measuring set that is known to be accurate. Apart from this, a TTS 52 does not require any routine maintenance.

5.3 If abnormal operation of milliwatt generator occurs, it can be easily traced in the following manner (refer to figures 6—2 and 7—2).

a. Using a dc VOM with a scale of at least 50 volts dc, measure voltage between pin 22 (high side of VOM) and case of Q901. This should be approximately 37 volts dc or less.

b. Measure dc voltage between pin 22 and junction of R917 and R921. This should be approximately 12 volts dc or less.

c. Any other readings than those above would indicate a failure in power supply section or 12 volt supply to IC packages.

d. Measure dc voltage between pin 22 and end of R923 (1 megohm) where it joins pin 10 of U903. This should measure approximately 2.5 volts dc. Any large voltage in excess of 3 volts would indicate a problem in AGC section or Q902 in particular.

e. Oscillator problems can be detected by using an oscilloscope to monitor milliwatt signal.

5.4 Calibration of the optional Talk Detector board can be accomplished in the following manner:

a. Turn R411 (50 kohm potentiometer) completely clockwise and operate S1 TALK DETECTOR ON—OFF switch to ON position.

b. Connect a VOM (60 volt dc range) from chassis to pin 4 of U402 (or wiper of R411).

c. Adjust R411 counterclockwise until VOM reads —10 volts dc.

d. Remove VOM.

e. Connect VOM from chassis to wiper of R415. Adjust R415 for —12 volts dc. Remove VOM.

f. Dialing normal loop-around on a TTS 52 and talking into LINE 1 or LINE 2 should cause Loop Around to release. Toggling TALK DETECTOR ON—OFF switch should reset Talk Detector.

SECTION 6

ELECTRONIC PARTS LIST

6.1 **INTRODUCTION.**

6.2 The following pages contain parts list for the TTS 52 Series of Loop Around Test Systems.

6.3 FSCM CODE NUMBERS.

6.4 The Federal Supply Code of Manufacturers for each part and a list of manufacturers is given below:

Table 6—1. List of Manufacturers

Manufacturer	Code No.
01121	Allen Bradley, Milwaukee, Wis.53212
01295	Texas Instruments Inc., Dallas, Texas 75222
02660	Amphenol Corp., Broadview, Ill. 60153
04713	Motorola Inc., Pheonix, Ariz. 85008
05397	Union Carbide Corp., Cleveland, Ohio 44101
12065	Transitron Electronic Corp., Boston, Mass. 02128
12697	Clarostat Mfg., Dover, N.H. 03820
12954	Dickson Electronics Corp., Scottsdale, Ariz. 85252
13606	Sprague Electric. Co., Concord, N.H. 03301
19701	Electra/Midlands, Mineral Wells, Texas 76067
22650	Whale Electronics, Nashville, Tenn. 37204
27735	F—DYNE Electric Co., Fairfield, Conn. 06430
44655	Ohmite Mfg. Co., Skokie, Ill. 60076
49671	RCA Corp., New York, N.Y. 10020
71450	CTS Corp., Elkhart, Ind. 46514
71590	Centralab Electronics, Milwaukee, Wis. 53201
72619	Dialight Corp., Brooklyn, N.Y. 11237
73138	Beckman Instruments, Fullerton, Cal. 47570
77342	AMF Inc. Potter & Brumfield, Princeton, Ind. 47570

Table 6—2. TTS 52 Overall Assembly Parts List

REFERENCE DESIGNATOR	DESCRIPTION	MFGR.	MFGR. PART NO.	N.E.C. PART NO.
DS1		72619	101-8430-0931-201	828000600
J1	JACK,TEL,SWCRFT SCHEM 12	SWDRFT	24B	650200800
J2	SAME AS J1			
J3	SAME AS J1			
L1	4H 00	86632	TN-1274	450200200
L2	SAME AS L1			
R21	5K 2W 10%	12697	CM29064NP	230805020
R22	SAME AS R21			
S1	SPST 6A 00 125V	04009	ST16A	620100200

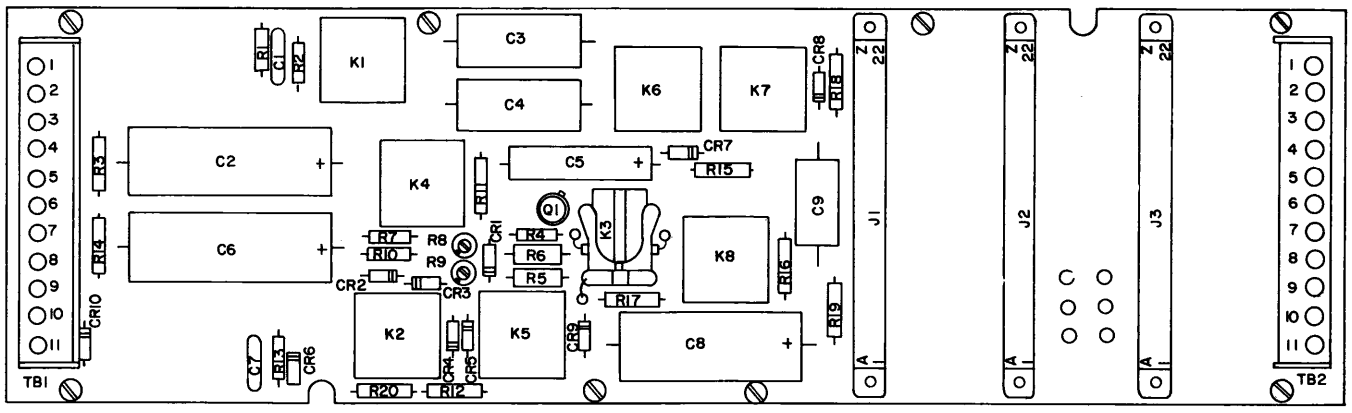

Figure 6—1. TTS 52 Main Assembly Circuit Board, Component Location Diagram

Table 6—3 TTS 52 Main Assembly Circuit Board Parts List

REFERENCE DESIGNATOR	DESCRIPTION				MFGR.	MFGR. PART NO.	N.E.C. PART NO.
C1	.1UF		20%	500V	13606	5GA-P10	330401040
C2	500UF		00	50V	13606	39D507G050GL4	300005071
C3	4UF		10%	150V	27735	MPE11-4.0-150-10	321904050
C4	SAME AS C3						
C5	100UF		00	50V	13606	TE-1309	300201072
C6	SAME AS C2						
C7	SAME AS C1						
C8	SAME AS C2						
C9	2UF		00	200V	27735	D-2.0-200-10	301302050
CR1	DO-7	400MW	20%	27V	12065	1N769	562007690
CR2	D041	3		400V	12065	IN4004	560040040
CR3	SAME AS CR2						
CR4	SAME AS CR2						
CR5	SAME AS CR2						
CR6	SAME AS CR2						
CR7	SAME AS CR2						
CR8	SAME AS CR2						
CR9	SAME AS CR2						
CR10	SAME AS CR2						
J1		5A	00	600V	02660	225-22221-110	651701200
J2	SAME AS J1						
J3	SAME AS J1						
K1			00	24V	AE-NIPPON	PD1400A18-MR11N54	600600400
K2	SAME AS K1						
K3	2.5K		00	24V	77342	RS5D-24	604400300
K4	SAME AS K1						
K5	SAME AS K1						
K6	SAME AS K1						
K7	SAME AS K1						
K8	SAME AS K1						
Q1	TO5AFC	250MW	00	45V	01295	2N1375	553013750
R1	12K	1/2W	10%		01121	TYPE EB	200201236
R2	1K	1/2W	10%		01121	TYPE EB	200201026
R3	750#	3W	5%		44655	4418	210307515
R4	5.6K	1/2W	10%		01121	EB	200205626
R5	1.8K	1W	5%		AB	TYPE GB	200301825
R6	1.2K	1W	10%		01121	TYPE GB	200301226
R7	56K	1/2W	10%		01121	TYPE EB	200205636
R8	100K	1/2W	10%	200V	73138	62P100K	232701046
R9	50K	1/2W	10%	200V	HILIPOT	62P50K	232705036
R10	2.2K	1/2W	10%		01121	TYPE EB	200202226
R11	SAME AS R3						
R12	SAME AS R3						
R13	SAME AS R2						
R14	SAME AS R3						
R15	SAME AS R3						
R16	900#	3W	1%		94322	FL2B	210390001
R17	SAME AS R3						

Table 6—3 (cont)

REFERENCE DESIGNATOR	DESCRIPTION	MFGR.	MFGR. PART NO.	N.E.C. PART NO.
R18	SAME AS R3			
R19	SAME AS R16			
R20	SAME AS R3			
TB1	TERM.BLOCK, 11-CONT.PC	REED DEV.	2PCV-11	850100800
TB2	SAME AS TB1			
XQ1	PC MTG	91662	05-3303	826600100

Table 6—4. TTS 52 Milliwatt Generator Circuit Board Parts List

REFERENCE DESIGNATOR	DESCRIPTION				MFGR.	MFGR. PART NO.	N.E.C. PART NO.
904	8.2UF		10%	15V	05397	T330A825K015AS	310008250
907	SAME AS 904						
908	SAME AS 904						
911	SAME AS 904						
913	SAME AS 904						
916	SAME AS 904						
C901	20UF		00	50V	13606	TE1305	300202061
C905	.01UF		5%	100V	27735	PS11-.01-100-5	321501030
C906	SAME AS C905						
C909	510PF	Z5RTC	10%	1KV	71590	DD-511	330005110
C910	22PF	S2LTC	10%	1KV	71590	DD-220	330002200
C912	50UF		00	75V	22650	JA-13-50-75-8N	301305061
CR901	D041		00	200V	12065	1N4003	560040030
CR902	D035	500MW	00	20V	12065	1N4148	560041480
CR903	DO-7	250MW	5%	6.2V	12954	1N823	563008230
CR904	SAME AS CR902						
CR905	SAME AS CR902						
CR906	SAME AS CR902						
CR907	SAME AS CR902						
CR908	SAME AS CR902						
CR909			10%	30V	MOTOROLA	1N5256A	562052560
Q901	TO5MSS	5W	00	65V	49671	2N4036	552040360
Q902	TO92	2-9MA	00	400V	04713	MPF152 2N5461	555001520
Q903	TO92AFA	310MW	00	25V	04713	MPS6515	550065150
Q904	TO92MSS	310MW	00	40V	04713	2N3905	552039050
R901	1.25K	5W	5%		12697	VC5E	210412515
R902	750#	3W	5%		44655	4418	210307515
R903	1K	1/2W	5%		01121	TYPE EB	200201025
R904	1.8K	1/2W	5%		01121	TYPE EB	200201825
R905	SAME AS R903						
R906	100K	1/2W	5%		01121	TYPE EB	200201045
R907	10K	1/2W	5%		01121	TYPE EB	200201035
R908	10K	1/8W	1%		19701	MF5C	220210021
R909	SAME AS R908						
R910	4.7K	1/2W	5%		01121	TYPE EB	200204725
R911	470-	1/2W	5%		01121	TYPE EB	200204715
R912		1/8W	1%		19701	MF5C	220200000
R913	56.2K	1/8W	1%		19701	MF5C	220256221
R915	46.4K	1/8W	1%		19701	MF5C	220246421

Table 6—4 (cont)

REFERENCE DESIGNATOR	DESCRIPTION	MFGR.	MFGR. PART NO.	N.E.C. PART NO.
R916	10K .25W 00	71450	UPE200RE1-SQ8517	231301030
R917	113K 1/8W 1%	19701	MF5C	220211331
R918	SAME AS R917			
R919	1.5K 1/2W 10%	01121	TYPE EB	200201526
R920	22K 1/2W 5%	01121	TYPE EB	200202235
R921	8.2K 1/2W 5%	01121	TYPE EB	200208225
R922	4.3K 1/2W 5%	01121	TYPE EB	200204325
R923	1M 1/2W 10%	01121	TYPE EB	200201056
R924	825- 1/8W 1%	19701	MF5C	220282501
R925	523- 1/8W 1%	19701	MF5C	220252301
R926	301- 1/8W 1%	19701	MF5C	220230101
R927	.25W 00	71450	UPE200RE1	231300000
R928	SAME AS R912			
R929	2.7K 1/2W 5%	01121	TYPE EB	200202725
R930	SAME AS R906			
R931	SAME AS R903			
R932	SAME AS R907			
R933	1000- 1/8W 1%	19701	MF5C	220210011
R934	SAME AS R913			
R935	SAME AS R913			
R936	6.8K 1/2W 5%	01121	TYPE EB	200206825
R937	SAME AS R936			
T901	P600CT S600SPL AUDIO PC	80223	S0-15P	400300200
U901	14DILP 00	17803	U6E7741393	500007410
U902	14DILP 00	01295	SN72709N14P	500007090
U903	0PT05M 00	49671	CA3000	500030000

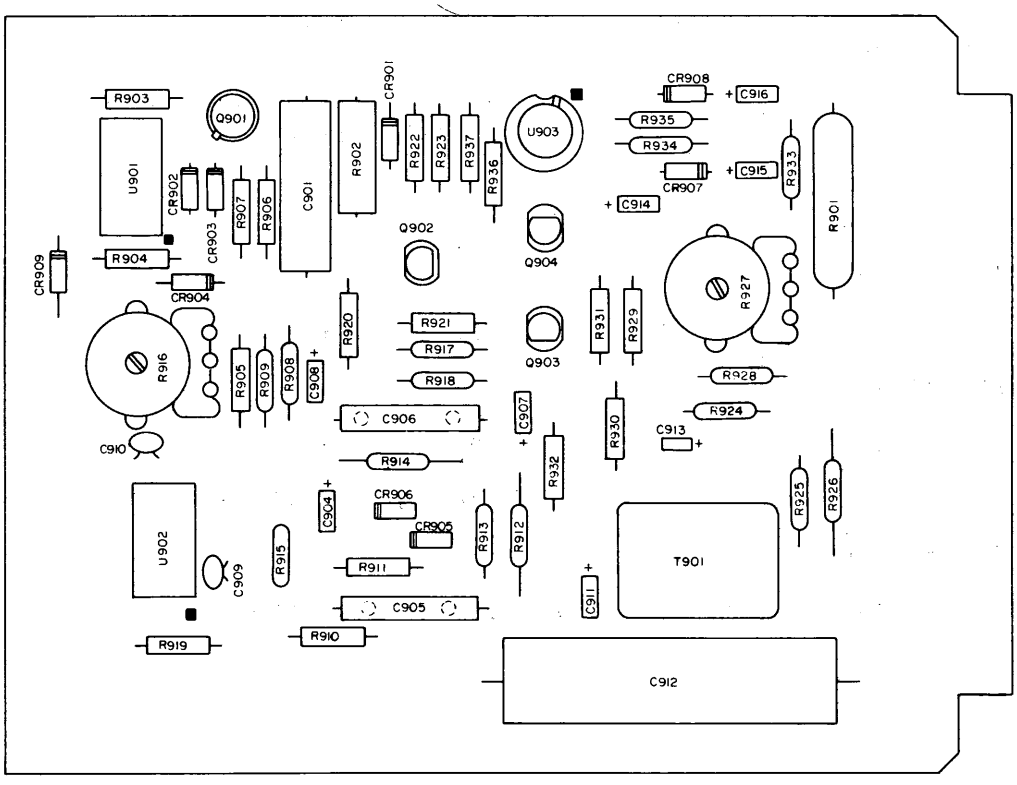

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Figure 6—2. TTS 52 Milliwatt Generator Circuit Board, Component Location Diagram

Table 6—5. TTS 52 Talk Detector Circuit Board Parts List

REFERENCE DESIGNATOR	DESCRIPTION	MFGR.	MFGR. PART NO.	N.E.C. PART NO.
C401	.1UF 10% 100V	13606	225P10491WD3	320001040
C402	SAME AS C401			
C403	SAME AS C401			
C404	.0047UF 10% 100V	13606	225P47291WD3	320004720
C405	.0082UF 10% 100V	13606	225P82291WD3	320008220
C406	SAME AS C401			
C407	50UF 00 50V	13606	TE1307	300205063
C408	2.2UF Y5V TC 20% 50V	72982	8141-050-651-225M	330802250
CR401	DO35 500MW 00 20V	12065	1N4148	560041480
CR402	SAME AS CR401			
CR403	SAME AS CR401			
CR404	SAME AS CR401			
CR405	DO41 00 200V	12065	1N4003	560040030
K401	24V	04221	181-12C200	604102200
Q401	TO92HSS 310MW 00 40V	04713	2N3903	550039030
Q402	TO5MSS 5W 00 65V	49671	2N4036	552040360
R401	10K 1/2W 10%	01121	TYPE EB	200201036
R402	SAME AS R401			
R403	SAME AS R401			
R404	1M 1/2W 10%	01121	TYPE EB	200201056
R405	3M 1/2W 5%	01121	TYPE EB	200203055
R406	1K 1/2W 10%	01121	TYPE EB	200201026
R407	SAME AS R406			
R408	100K 1/2W 10%	01121	TYPE EB	200201046
R409	SAME AS R404			
R410	SAME AS R408			
R411	50K .25W 00	71450	UEP200RE1-SQ8519	231305030
R412	22K 1/2W 10%	01121	TYPE EB	200202236
R413	SAME AS R412			
R414	1.2M 1/2W 10%	01121	TYPE EB	200201256
R415	SAME AS R411			
R416	1.5K 1/2W 10%	01121	TYPE EB	200201526
R417	SAME AS R406			
R418	300# 3W 5%	13606	TYPE 3X	210303015
R419	4.7K 1/2W 10%	01121	TYPE EB	200204726
R420	EL.VAL. 1/2W	01121	EB	200200000
R421	SAME AS R401			
T401	P.C. MTND 5-58X	80223	5702A	400300300
U401	14DILP 00	17803	U6E7741393	500007410
U402	SAME AS U401			
U403	SAME AS U401			
VR401	A31A 1W 5% 24V	12954	1N3029B	562030292

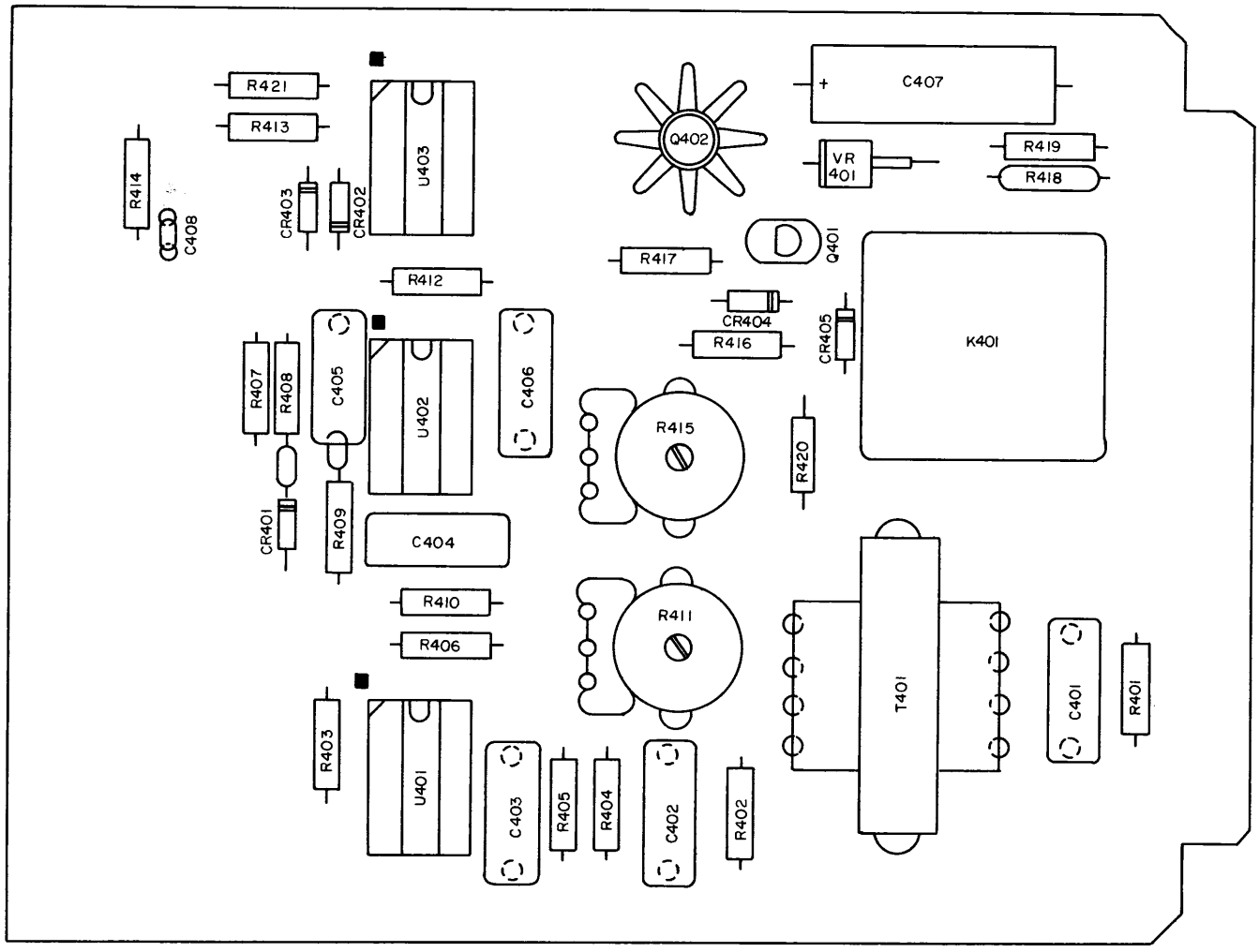


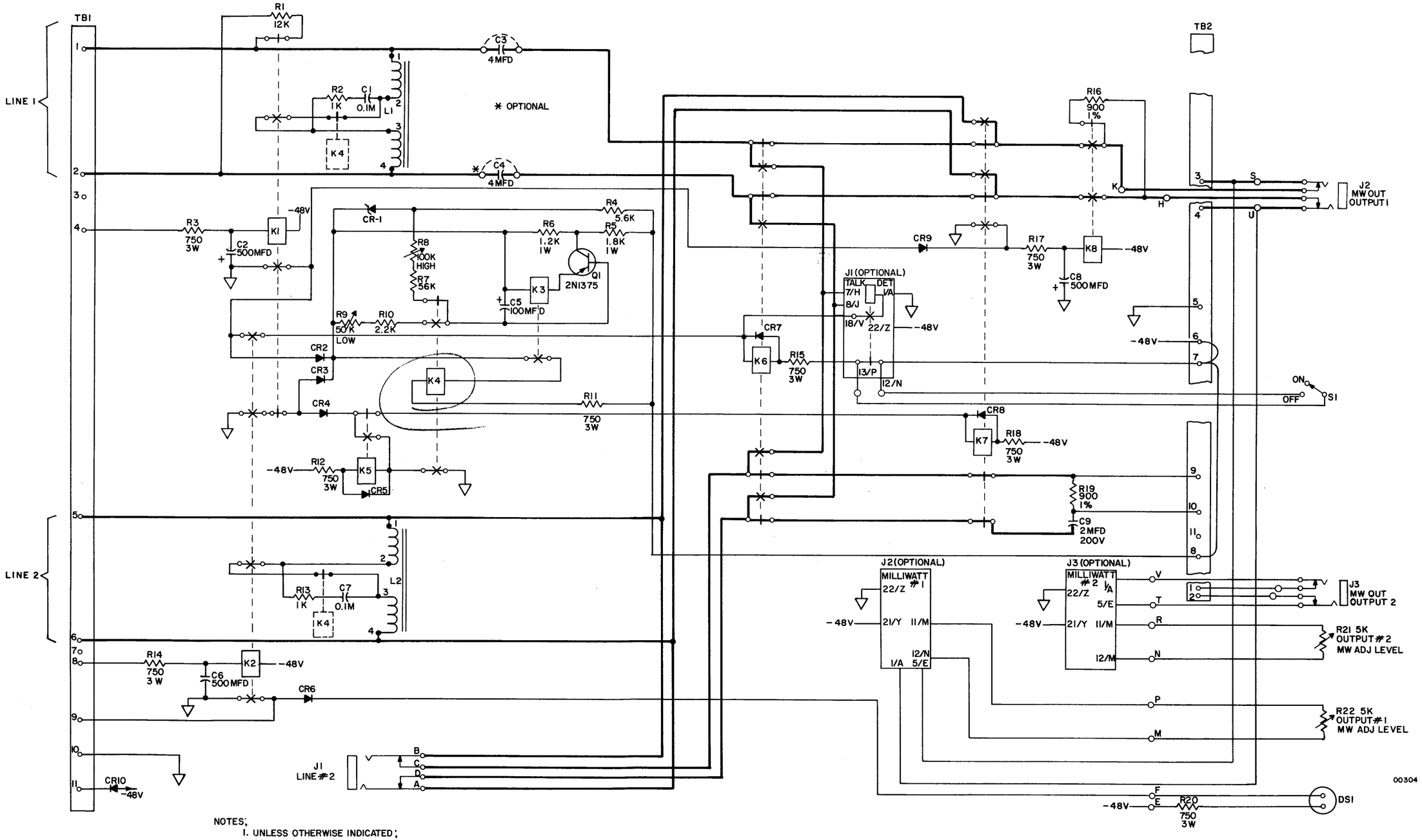
Figure 6—3. TTS 52 Talk Detector Circuit Board, Component Location Diagram

SECTION 7

SCHEMATIC DIAGRAMS

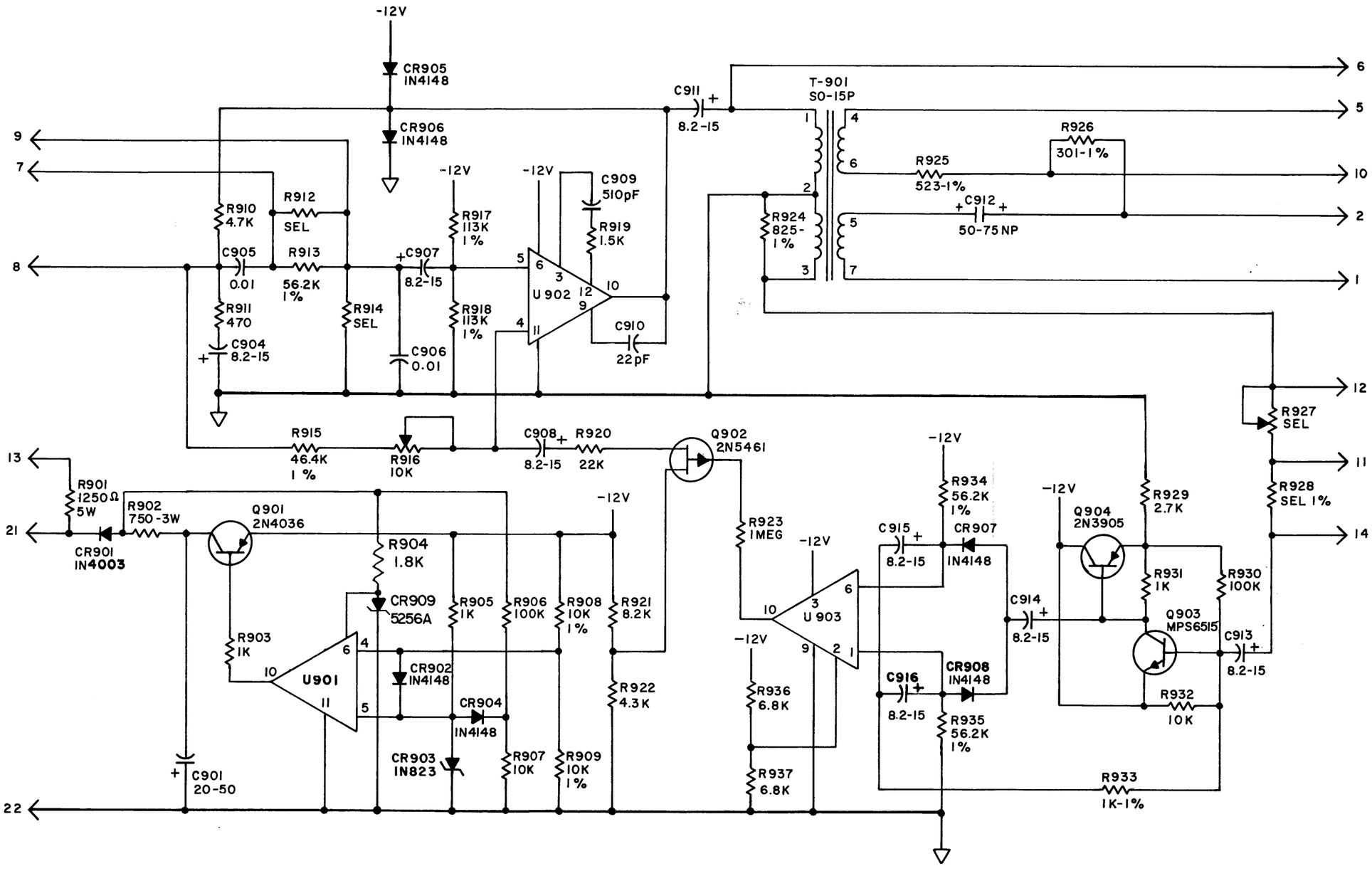
7.1 **INTRODUCTION.**

7.2 This section provides the schematic diagrams, figures 7−1, 7−2 and 7−3 for the TTS 52 Loop Around Control and Milliwatt Generator.



NOTES;
1. UNLESS OTHERWISE INDICATED;
   CR2 THRU CR10 ARE IN4003.
   ALL RESISTORS ARE 1/4 WATT.
   ALL RESISTORS ARE IN OHMS.
   CAPACITOR VALUES ARE IN MICROFARADS.

Figure 7—1. TTS 52 Overall Schematic Diagram



NOTES:

1. **UNLESS OTHERWISE INDICATED:**
   RESISTOR VALUES ARE IN OHMS.
   CAPACITOR VALUES ARE IN MICROFARADS.
   INDUCTANCE VALUES ARE IN MILLIHENRYS.
2. **U901 = U6E7741393, U902 = SN72709N, U903 = CA3000.**

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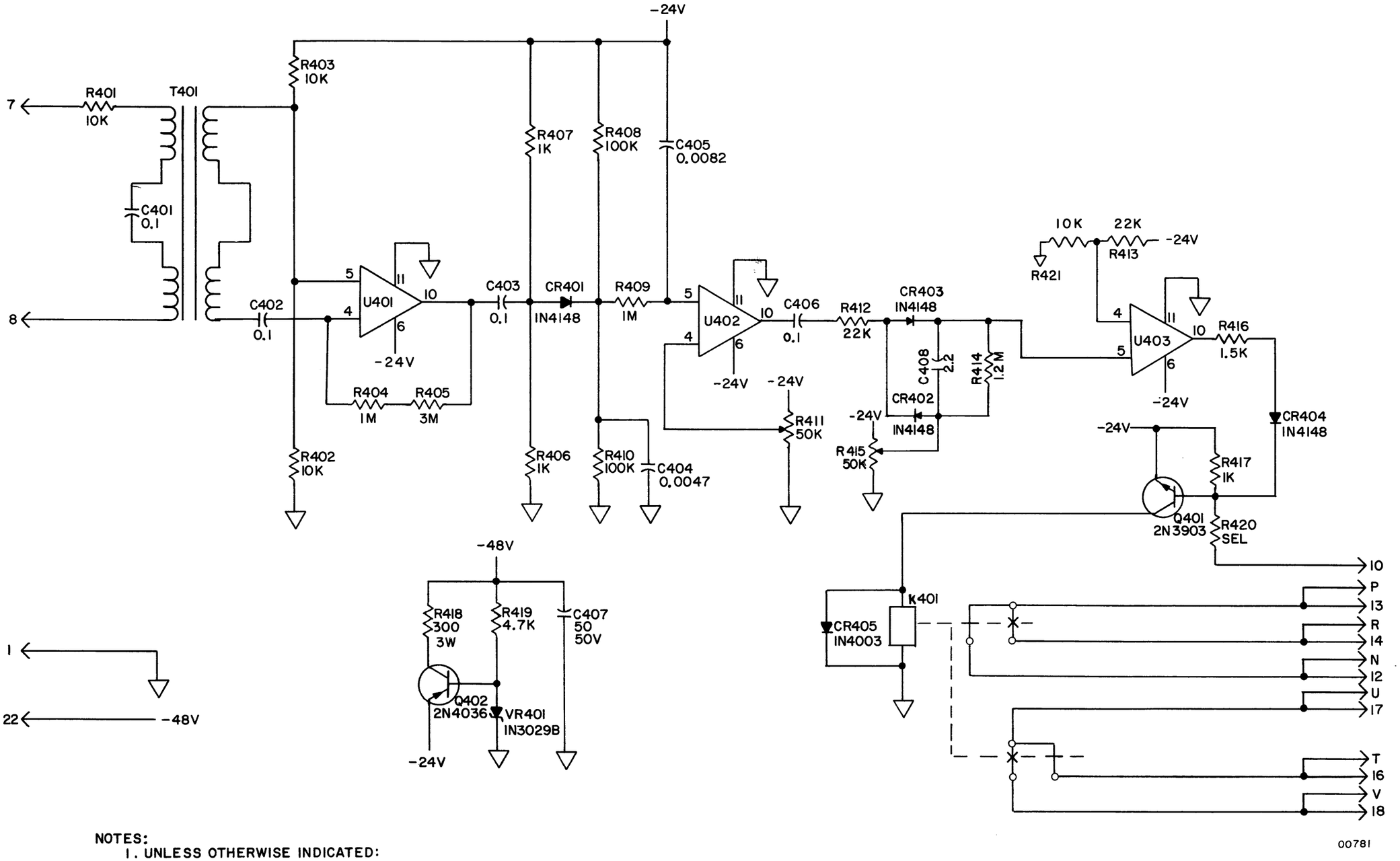
SCHEMATIC M-5003
MILLIWATT GENERATOR
E95415

Figure 7—2. TTS 52 Milliwatt Generator, Schematic Diagram



NOTES:
1. UNLESS OTHERWISE INDICATED:
   RESISTOR VALUES ARE IN OHMS.
   CAPACITOR VALUES ARE IN MICROFARADS.
   INDUCTANCE VALUES ARE IN MILLIHENRYS.
2. U401-403 ARE U6E7741393.

Figure 7—3. TTS 52 Talk Detector, Schematic Diagram

SECTION 8

ACCESSORIES

8.1 INTRODUCTION.

8.2 The TTS 50XS Trunk Selecting Adapter and optional TTS 50XSD Dial Thru Adapter are accessories to the TTS 52 series of Loop Around Control and Milliwatt Generators.

8.3 DESCRIPTION.

8.4 The TTS 50XS Trunk Selecting Adapter is a unit designed to permit selection and looping around of one-way trunks originating in a remote office, thereby facilitating one-man, two-way transmission measurements on such trunks. It is supplied with an internal selector switch that has the capacity to access 20 one-way trunks. Selection of one-way trunks is under control of tone signalling generated by a control unit located at the test control center. This unit could be a TTS 50B Loop Around Control Unit or a TTS 20B or TTS 30B. These tones are extended to the TTS 50XS via an additional trunk connected to LINE 2 of a TTS 52. The one-way trunk selected by the TTS 50XS is extended to a trunk connected to the LINE 1 appearance of the above loop-around circuit, thus establishing a loop-around condition.

8.5 An optional TTS 50XSD Dial Thru Adapter can be used with a TTS 50XS. This permits dialing directly through a loop-around system to reach the toll test board, thus eliminating the necessity for accessing individual trunk circuits at the toll center.

8.6 SPECIFICATIONS.

POWER REQUIREMENTS

Voltage:	48 Volts dc
Current Drain:	1 Ampere maximum

MECHANICAL:

Dimensions:	19 in. w x 5 1/4 in. h x 9 5/8 in. d

8.7 INSTALLATION AND OPERATING INSTRUCTIONS.

8.8 Refer to paragraph 3.3 of this manual for installation instructions.

8.9 FRONT PANEL CONTROLS.

8.10 Figure 8—2 and table 8—1 show front panel controls and describe their use on the TTS 50XS.

8.11 OPERATION.

8.12 To obtain access to circuits in the TTS 50XS, one trunk at the control office is used to dial the LINE 2 input circuit of the TTS 52, while the LINE 1 circuit is idle. In

Table 8—1. Controls,Indicators and Connectors.

Ref. Desig.	Control,Indicator and Connectors	Function
S1	POWER ON—OFF Toggle switch	Turn power to unit ON or OFF.
J1	REC INPUT Telephone jack	Monitor input and test on LINE 2.
PL1	OUTPUT Indicator lamp	Lights when tip and ring circuit has been completed to trunk selected.
PL2	HOME HOLD Indicator lamp	Lights when selector switch is in HOME or HOLD position.
PL3	P Indicator Lamp	Lights when selective detector FP is operated.
PL4	Q Indicator Lamp	Lights when selective detector FQ is operated.

this case, the LINE 2 circuit is extended to selective detectors in the TTS 50XS. After seizure of the TTS 52 LINE 2 input, tone FQ is applied at the control office. This operates a relay in the TTS 50XS which breaks the homing circuit of the selector switch in the TTS52. As a result, normal loop-around switching of the TTS 52 will not take place when LINE 1 is subsequently dialed.

NOTE

FQ tone can be derived from a special control unit such as a TTS 50B Loop Around Control Unit. Other units that can be used are a TTS 20B or a TTS 30B control unit.

8.13 Subsequently, another trunk circuit is used to establish a connection to LINE 1 of the TTS 52. After this connection has been established, the desired trunk number is dialed in the control unit (see Section 3, Table 3—2), that remains connected to the circuit over which the connection of LINE 2 in TTS 52 is maintained. Dialing pulses the FP tone in the control unit and a relay in the TTS 50XS. If the desired trunk is free, the TTS 50XS will switch through to it. Thus the loss of milliwatt tone indicates that the selected trunk has been reached and is free. If the desired trunk is busy the milliwatt tone will remain on LINE 1. The testman in the control office can now dial an additional number in the control unit, thereby removing the TTS 50XS selector by a corresponding number of steps. If the desired trunk is busy, it is possible to park on it and seize it when it does become free. Loss of milliwatt tone will alert the testman at the control office when the trunk is free and the TTS 50XS has switched through. At the control office, the incoming end of the selected trunk can now be connected to the transmission measuring equipment. A loop-around circuit now exists over circuit that provides connection to the TTS 52 LINE 1 input and the selected trunk. Two-way transmission losses of the trunk used to reach the LINE 1 input can now be measured. Together with loop-around transmission losses, this permits computation of near-to-far and far-to-near losses of the selected trunk.

CAUTION

The control unit must be left connected to LINE 2 and control tone FQ must remain on LINE 2 during loop-around measurement.

8.14 After testing of the selected trunk has been completed, the remote selector switch can be reset to it's home position by transmission of an FP tone on the TTS 52 LINE 2. Removal of both FQ and FP tones on LINE 2 will also reset the selector.

8.15. **CIRCUIT DESCRIPTION.**

8.16 The schematic diagram applicable to this description is figure 8—7. A description of the selective detectors used in this unit begins with paragraph 8—29.

8.17 Assume that frequency FQ has been applied to the trunk connected to the LINE 2 input of a TTS 52 and that the TTS 52 LINE 1 circuit has not been seized. Relay FQ in the selective detector tuned to frequency FQ operates upon reception of this tone. Transformer T1 and capacitors C3 and C4 provide coupling between the selective dectors and LINE 2 of the TTS 52. Relay FQ, when operated:

a. Interrupts the battery circuit to relay K6 in TTS 52 unit. Thus when LINE 1 of the TTS 52 is subsequently dialed, a normal loop-around will not be established. The above battery circuit to relays FQ and K6 is derived through the solenoid winding of stepping switch RM and the normally closed contact of FQ. Current drawn by relays FQ and K6 is not sufficient to operate RM.

b. Prepares a circuit for the pulsing of RM.

8.18 Relay FQ, when released, breaks the homing circuit to RM and lights the Q Lamp to provide a visual indication that the FQ selective detector has operated. Stepping pulses can now be applied to RM.

8.19 Relay FP in the selective detector tuned to frequency FP will follow received FP pulses. When operated, relay FP energizes pulse-following relay PF, which in turn, completes a circuit from ground to the coil of RM. Relay FP also lights the P Lamp to provide a visual indication that selective detector FP has operated. RM is positioned by the number of operations of selective detector relay PF.

8.20 In the normal or home position of the stepping switch, a ground is applied by contact ONC1 to slow release relay B, which is normally operated when RM is in its home position. After RM has taken its first step, ground to B relay through ONC1 is removed. Relay B, however, will remain operated by ground pulses supplied through operation of the RM1 contacts while RM is stepping.

8.21 When dialing positions 0 and 00, relay Z operates. Contacts of Z are in parallel with the RM1 contacts, thus the ground circuit to the relay B coil is maintained by operation of Z to allow dialing the next digit. Shortly after the end of a dial pulse train, relay B releases to close a circuit for relay C. If the selector switch has come to reset on a busy trunk, ground will appear on the sleeve to short the winding of the C relay and prevent its operation. If no ground appears on the sleeve, relay C will operate. When operated, it applies ground to the sleeve of the desired trunk and interrupts

the connection between the sleeve and its own winding. Relay C thus remains energized until relay H is operated.

8.22. Relay C, when operated, completes a circuit for relay D. This consists of a ground through a make contact of relay C, a make contact of ONC1 and the winding of relay D to battery. When relay D operates, it switches the tip and ring of the trunk connected to the TTS 52 LINE 1 input from the milliwatt generator to the tip and ring arms of the selector switch and thus to the tip and ring of the selected trunk. When this circuit is switched through, the milliwatt generator tone disappears from the trunk connected to LINE 1. If the selector switch has reached a busy trunk, it is possible to park on the selected trunk. When the trunk becomes free, the unit will switch through to it. Loss of the milliwatt tone will alert the testman at the test control center of this condition.

8.23 Returning selector switch RM to its home position prior to selection of the next trunk to be tested is accomplished by transmitting an FP tone. Reception of FP by the TTS 50XS, after B relay has released, operates homing relay H by completing a circuit from ground through a make contact of PF, a break contact of B, to the battery through the coil of H.

8.24 Relay H, when operated, breaks the ground circuit, to the coil of relay C causing it to release, which in turn releases the D relay, to remove the tip and ring circuit from the selected trunk. Relay H when operated, also establishes a circuit from ground to the coil of RM. This ground is carried over a break contact of B, RM2 and the ONC2 contacts of RM. Thus RM will self-step to its home position.

8.25 When RM has returned to its home position, the ONC1 contacts transfer a ground circuit to the coil of relay B. This re-energizes relay B and returns all other circuits to their normal home postions.

8.26 Removal of the FQ tone will also return all circuits to their home positions. This homing circuit is established by QF when it operates upon release of selective detector FQ. Relay QF, when operated, extends ground to RM through its homing contacts, thus returning all circuits to their home positions as described above.

8.27 The HOME—HOLD lamp provides a visual indication that the selector switch is in its HOME position or when a 0 has been dialed, thus placing it in a HOLD position prior to further dialing.

8.28 The OUTPUT lamp provides a visual indication that the D relay has switched the tip and ring through to the selected trunk.

8.29 SELECTIVE DETECTOR.

8.30 Individual selective detector units consist of four transistor stages each. Input stage Q1 is a conventional emitter follower utilized to maintain a reasonably high input impedance. Stage 2 is a conventional common emitter amplifier used to achieve voltage gain. Q3 is an emitter follower used to provide high-impedance coupling between output stage Q4 and amplifier stage Q2. Output stage Q4 drives the relay in its collector circuit according to control signals received at the input of the selective detector.

8.31 The input is coupled to the base of Q1 through sensitivity control R16, capacitor C1 and resistor R1. The output of Q1 is taken from the emitter and coupled through C2 to the base of Q2. The amplified signal at the collector of Q2 is coupled directly to the base of Q3. The output is taken from the emitter of Q3 and applied to a voltage doubling rectifier circuit. Simultaneously, this output is coupled through R17 and C5 to a frequency-selective network consisting of L1,C3,C4,R7, R8,R15 and TH1. The output of this network is applied directly to the base of Q1 completing a negative feedback loop. Values of R7,C3,C4 are selected to set the frequency response of the detector.

8.32 The bridged—T frequency-selective network has a characteristic that passes all frequencies except a narrow band centered about the specific frequency to which it is tuned. Therefore, off-frequency signals are coupled back to the base of Q1 and the gain of amplifier stages Q1 and Q2 is reduced to a level far below that required to operate the relay in the output stages. When the input frequency falls within a narrow band approaching the tuned frequency, the network reduces the feedback level proportionately until such time as the frequency is exactly correct. At this point the feedback is completely removed and the gain of Q1 and Q2 rises to a maximum.

8.33 At some point, Q3 will provide an output signal to the voltage-doubling rectifier circuit consisting of C6,CR1,CR2 and C7. This is sufficient to cause Q4 to conduct, energizing the relay in its collector circuit (FP or FQ). The value of C7 has been selected to provide a certain amount of storage for the signal applied to the base of Q4 and yet allow this stage to follow dial pulses. Other values should not be substituted for this capacitor.

8.34 The operating voltage for the selective detector units is obtained from the 48 Volt station battery through a voltage divider circuit and filter networks consisting of R13,C9 and R14. One such voltage divider and filter is located on each selective detector unit.

8.35 **CALIBRATION.**

8.36 **SENSITIVITY ADJUSTMENT.**

8.37 Selective detectors in the TTS 50XS have been factory adjusted to operate from input levels in the range of 0 dBm to −15 dBm. These detectors can be adjusted in the field to operate within the range of +5 dBm to −10 dBm. This sensitivity adjustment is determined by the setting of input gain controls (R16) located on the individual detectors. These controls are accessed by removing the front protective cover from the TTS 50XS. Proper level adjustment for the selective detectors is accomplished as follows:

a. Determine maximum line attenuation that will be encountered for circuits used between test control center and TTS 50XS equipment.

b. To results of above step, add approximately 3 dB and insert an attenuator of this value between control unit and LINE 2 of associated TTS 52.

c. Position gain controls on selective detectors to maximum clockwise position (minimum sensitivity).

d. Apply frequency FQ and rotate gain control on FQ selective detector to a point where FQ indicator lamp just operates.

e. While dialing a series of zeros, rotate gain control on FP selective detector to a point where smooth stepping of selector switch is observed. A visual indication of pulsing is provided by P lamp.

f. Return LINE 2 circuit of TTS 52 to normal and replace protective front cover on TTS 50XS. The unit is now ready for operation.

8.38 **TTS 50XSD DESCRIPTION.**

8.39 The TTS 50XSD Dial Thru Adapter extends the functions of a TTS 50XS to allow dialing out on a circuit selected by the TTS 50XS on a dc basis (see figures 8−1 and 8−2). The only functional difference, as far as control signals are concerned, is that the remote selector switch is returned to its home position prior to selection of the next circuit by removal of frequency FQ rather that the application of frequency FP.

8.40 **SPECIFICATIONS.**

POWER REQUIREMENTS

Voltage:	48Volts dc
Current Drain:	400mA maximum

Mechanical:

Dimensions:	19in.w x 3 1/2in.h x 6in.d (483mm w x 89mm h x 153mm d)

8.41 **INSTALLATION AND OPERATING INSTRUCTIONS.**

8.42 Addition of a TTS 50XSD unit requires several modifications to circuitry. For the most part, these modifications are accomplished by removing straps provided on terminal boards. The TTS 50XSD requires 3 1/2 inches (89mm) of standard rack space and is powered from the same 48 folt dc source as the TTS 50XS.

8.43 **INSTALLATION.**

8.44 If a TTS 50XSD has been previously attached to a modified TTS 50XS and shipped as one unit, refer to figure 8−9 for interconnection to a TTS 52. The following steps are provided for installation:

a. Disconnect power to TTS 52 to avoid electrical shock and damage to equipment.

b. On TTS 52, remove strap between terminals TB2−6 and TB2−7.

c. If unit is a basic TTS 52, an external milliwatt source can be connected directly to TB1−1 and TB1−2 of TTS 50XS with appropriate blocking capacitors installed as shown in figure 8−9. Strapping from TB2−1 and TB2−2 of TTS 52 to TB1−1 and TB1−2 of TTS 50XS can be omitted if this is done.

CAUTION

When installing a TTS 50XS to a TTS 52A or a TTS 52B, the internal milliwatt generator located in J2 of the main assembly board will be damaged if not removed. In the case of a TTS 52A, the milliwatt generator in J2 should be removed and inserted in J3 of the main assembly board. The milliwatt generator in J2 of a TTS 52B must be removed completely.

d. Interconnect wires from TTS 50XS TB1 and TTS 50XSD TB1 to TTS 52 as shown on figure 8−10. TTS 50XS should already be connected to TTS 50XSD.

e. Run cable and connect wires from a tip, ring and sleeve appearance of trunks assigned and

connect to TB2 of TTS 50XS. See section 3, table 3—2 and diagram 3—4c for trunk and terminal assignments.

f. Reconnect power to TTS 52 and perform operational tests.

8.45 If a TTS 50XSD has been ordered separately and has to be attached to a TTS 50XS, a kit is provided to facilitate this operation. Location and quantity of the following parts should be checked:

Table 8—2. Kit for TTS 50XS Modification and TTS 50XSD Installation.

DESCRIPTION	QUANTITY	NEC NUMBER
6/32 x 3/8 F.H.S.	6 each	— —
6/32 Flat Washer	6 each	— —
6/32 Capnut	6 each	— —
22 ga. White/Orange Wire	2 feet	— —
22 ga. White/Slate Wire	2 feet	— —
22 ga. Red Wire	1 foot	— —
Solder	2 feet	— —
#20 Teflon Tubing	6 inches	— —
Shrink Tubing	1 inch	— —
10 Ohm 3W Resistor	1 each	2103—01005
500 Ohm 3W Resistor	1 each	2103—05016
750 Ohm 3W Resistor	1 each	2103—07516
20 mF 50V Capacitor	1 each	3002—02061
Sheetmetal Rail	1 each	B0039—10—109
Sheetmetal Rail	1 each	B0039—10—123
Interconnection Harness	1 each	A0050—51—038

8.46 The following steps are provided for installation of a TTS 50XSD to a TTS 50XS and TTS 52:

a. Remove power to TTS 52 and TTS 50XS to avoid electrical shock and damage to equipment.

b. Remove all interconnections between TTS 52 and TTS 50XS.

c. Refer to figure 8—10 and make following modifications to TTS 50XS:

1. Remove strap located on PF relay between pins 5 and 6.
2. Remove black wire from PF relay pin 6 and attach to PF relay pin 5.

3. Connect a short length of red wire to PF relay pin 6 and attach other end to B relay pin 2.

4. Unsolder two white/orange wires from P pilot lamp PL3.

5. Unsolder two white/orange wires from PF relay pin 2.

6. Determine which white/orange wire runs from P pilot lamp PL3 to PF relay and mark.

7. Reconnect lead found in step 6, one end to P pilot lamp PL3 and other end to PF relay pin 8. There should be a white/green wire already connected to PF relay pin 8.

8. Splice a long length of white/orange wire to remaining lead at P pilot lamp PL3. Connect other end to PF relay pin 2. Remaining white/orange lead at PF relay is reconnected to pin 2 of PF relay.

9. Remove dust cover on front panel. Remove 3 screws holding down P module. This is module next to four relays. Remove six Amp—lug connections to TB4 of P module (refer to figure 8—11).

10. Reverse connections on TB4—4 and TB4—5 so that ground is now on TB4—5.

11. Connect 10 Ohm 3W resistor between TB4—4 and TB4—7. Use Teflon on leads. Do not solder in place yet.

12. Connect negative end of 20 mF 50WVDC electrolytic capacitor to TB4—7 and positive

end to TB4—5. Use Teflon on leads. Solder both resistor and capacitor in place.

13. Replace P module with Amp—lug wires to TB4 as follows:

TB4—1	Green	TB4—2	Black
TB4—3	White	TB4—4	Slate
TB4—5	Blue	TB4—6	Violet

14. Check for continuity between following points:

FROM	TO
TB3—6	B Relay pin 5
TB3—5	PF Relay pin 7
TB3—4	TB4—14
TB3—2	One side of OUTPUT Lamp PL1
TB3—3	PF Relay pin 8
TB3—1	D Relay pin 2

15. Check R2 on main assembly board (E95050) for correct value of 750 Ohms. If not, install 750 ohm 3W resistor.

16. Run a white/slate wire from TB3—6 to junction of CR5 and CR6 on main assembly board (E95050).

17. Remove R4 and replace with 500 ohm 3W resistor. R4 previously was 600 ohm 3W resistor.

d. Attach TTS 50XSD to TTS 50XS using 6/32 x 3/8 flat-head screws, 6/32 flat washers, 6/32 capnuts and sheetmetal rails as shown on figure 8—1.

e. Remove jumpers located on TTS 50XS TB3—1 through TB3—6.

f. Using harness provided and referring to figure 8—9, connect the following:

TTS 50XSD TB1	COLOR	TO TTS 50XS
TB1—1	Green	PF Relay pin 6
TB1—2	Red	TB1—5
TB1—3	Yellow	TB1—3
TB1—4	Orange	TB1—4
TB1—16	Brown	TB1—7
TB1—9	White	TB3—1
TB1—10	Slate	TB3—2
TB1—11	Purple	TB3—4
TB1—12	Blue	TB3—3

g. Reconnect TTS 50XS/TTS 50XSD to TTS 52 as shown in figure 8—9.

h. Reconnect power to TTS 52 and perform operational test.

8.47 CIRCUIT DESCRIPTION.

4.48 A schematic diagram of the TTS 50XS and TTS 50XSD circuitry is shown on figure 8—12. Operation of a TTS50XSD used in conjunction with a TTS50XS, is as follows. Connection to LINE 2 circuit of a TTS 52 is made and frequency FQ is applied in the normal manner. Connection to LINE 1 of the TTS 52 is then established by the testman. Application of frequency FQ removes battery from loop around relay K6 of TTS 52, thus preventing normal loop around of the TTS 52 when connecting to LINE 1. Pulses at frequency FP are applied by the test man to position the selector switch in the TTS 50XS. At the end of the pulse train, the B relay releases, setting up the C relay to check for a busy on the sleeve. If free, the C relay will energize, operating relays D and DF. Relay D, when operated, switches LINE 1 from the milliwatt generator and connects it to the selected circuit in a normal manner. Relay DF prepares a circuit via which subsequent dial pulses will be applied to relay PO. Relay DF, when operated, also completes a circuit thus causing relay LD to energize.

8.49 Relay LD, when operated, interrupts the battery path to the loop-around relay in the TTS 52, thus preventing it from operating upon removal of frequency FQ. Should frequency FQ be removed for an extended period of time (more than 10 seconds) relay LD will release. This restores the TTS 52 circuits to a normal condition.

8.50 Dial pulses at frequency FP will now cause dc interruptions on the circuit selected. Thus, dialing on this circuit is accomplished. Removal of frequency FQ operates relay QF, which in turn operates the homing relay to return the selector switch to its home position. Removal of frequency FQ, this time, cannot reenergize loop-around relay K6 in the TTS 52 because of the previous operation of relay LD.

8.51 Return of the selector switch to its home position again operates relay B, in turn allowing relays C,D and DF to release. The release of DF, however, will not immediately cause LD to release, as the capacitor in its coil circuit has retained sufficient energy to hold LD for approximately 10 seconds. The make contact of relay LD has been backed off to allow the armature to close against the pole with no air gap. This is necessary to provide the above time constant with a reasonable size capatitor.

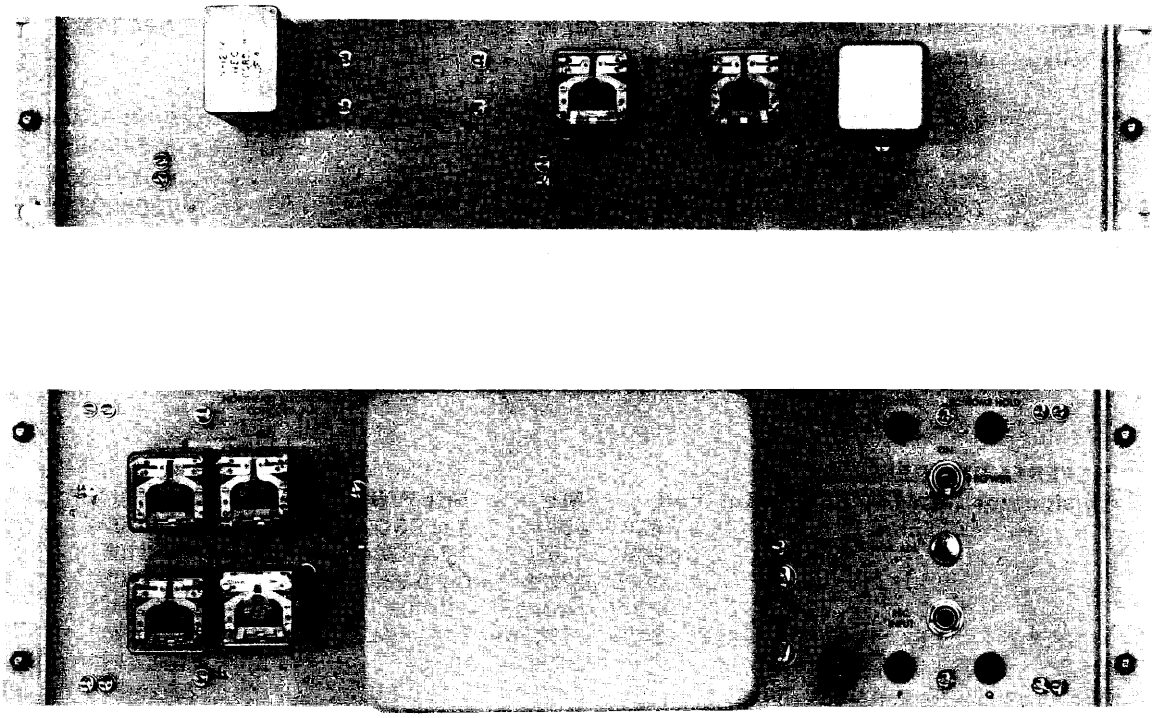


Figure 8—1. TTS 50XS Trunk Selecting Adapter and TTS 50XSD Dial Thru Adapter

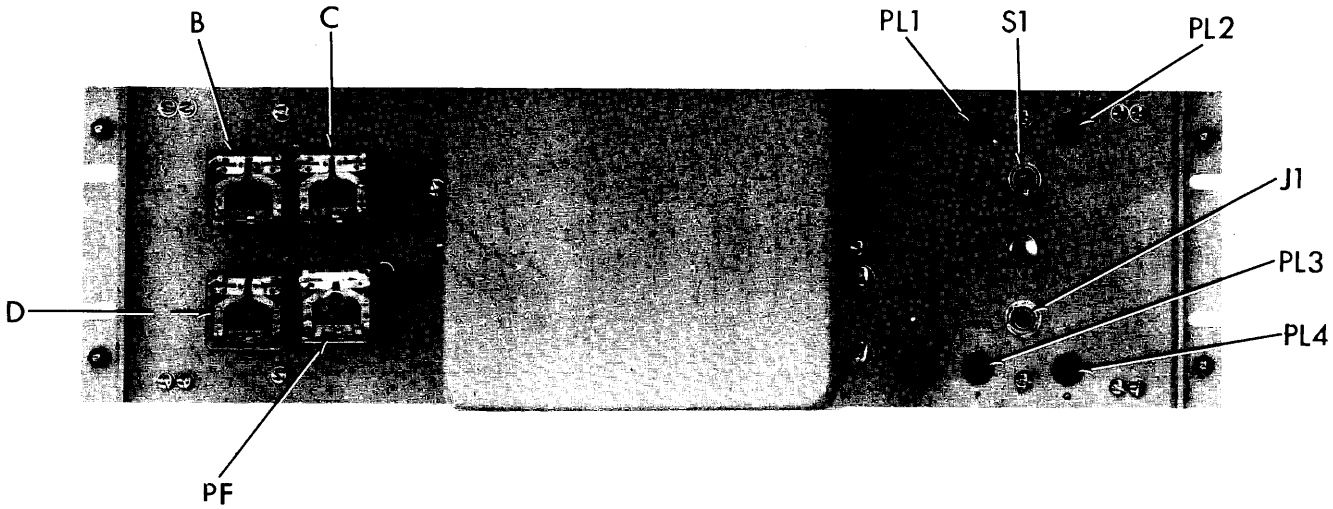


Figure 8—2. TTS 50XS Controls, Connectors and Indicators

Table 8—3. TTS 50XS Overall Assembly Board, Parts List

REFERENCE DESIGNATOR	DESCRIPTION VALUES POWER TOL VOLT	MFR	MFR P/N	NEC P/N
B,C,D,PF	0.5K 20 mA	78277	42R0500SIL	604600100
F1	fuse 3AG	75915	3AG	863100400
J1	jack, TEL, swcrft schem 4	82389	L12B	650100300
PL1—PL4	T-2 slide base	80368	60A	730000200
RM	sw step 6-deck, 11 step		PW-163405GAJA	615100100
S1	spst 6A 00 125V	31356	ST12A	620100100
TB1,TB3	11 conctact	71785	H-140 ¾ W	850000800
TB2,TB4	14 contact	71785	14-140 ¾W	850001100

Table 8—4. TTS 50XS Main Circuit Board Parts List

REFERENCE DESCRIPTION Designator	Values Power Tol Volt	Mfr	Mfr P/N	NEC P/N
C1	200UF 50V	05844	9-65PSD20050-S	301402070
C2	2UF 50V	13606	TVA-1304	300401061
C3,4	10UF 200V	27735	0-2.0-200-10	301302050
CR1—6	D041 200V	Horizon	1N4003	560040030
H,QF,X,Z	2.5K 24V	77342	RS5D-24	604400300
R1,2	1.2K 3W 10%	06486	PW3	210301226
R3	47— 1/2W 10%	01121	TYPE EB	200204706
R4	600 3W 10%	06486	PW3	210306016
R5	2.2K 1/2W 5%	01121	TYPE EB	200202225
R6	1.2K 3W 10%	06486	PW3	210301226
R7	2.2K 1/2W 5%	01121	TYPE EB	200202225
R8	900 3W 10%	06486	PW3	210309016
R10	2.2K 3W 5%	01121	TYPE EB	200202225
T1	P600-150 S600-150	81095	S-58X	400100100

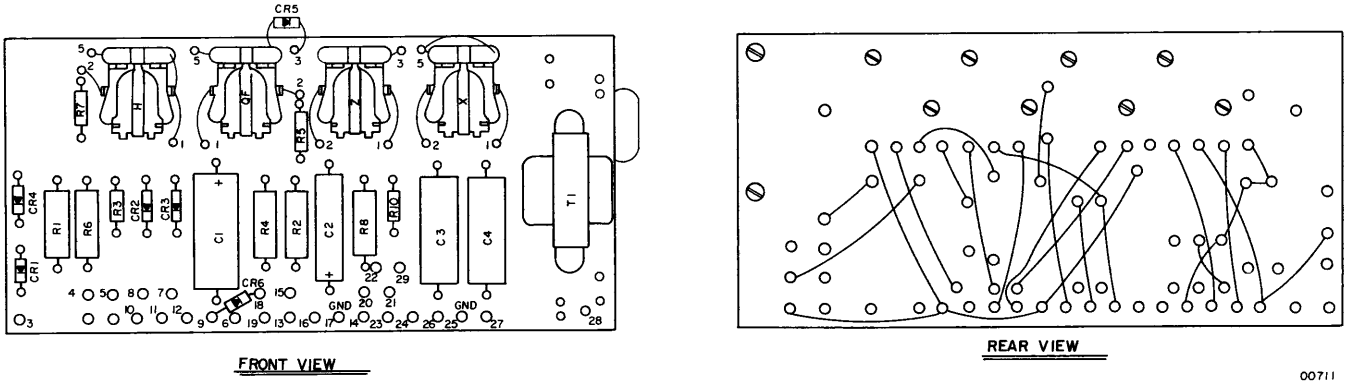


Figure 8—3. TTS 50XS Main Circuit Board, Component Location Diagram

Table 8—5. TTS 50XS FQ Selective Detector Overall Parts List

REFERENCE DESIGNATOR	DESCRIPTION VALUES POWER TOL VOLT	MFR	MFR P/N	NEC P/N
	E95033 PC Brd			B005051032
	Q Module Brd lower E95034			B005051033
QF	2.5K 00 24V	77342	RS5D-24	604400300

Table 8—6. TTS 50XS FQ Selective Detector Top Circuit Board Parts List

Reference Designator	Description ValuesPower Tol	Volt	MFR	MFR P/N	NEC P/N
C1	20UF	50V	13606	TE1305	300202061
C2	0.47UF 10%	50V	13606	192P479R8	321104740
C3,4	0.24UF 10%	100V	13606	225P20491XDS3	320002040
C5	0.56UF 10%	100V	13606	225P5649R75YD3	320005641
L1	inductor 250-500 MH		Artted	AC8163	455100400
Q1—3	TO5AFC 250MW	45V	01295	2N1375	553013750
R1	33K 1/2W	5%	01121	TYPE EB	200203335
R2	220K 1/2W 10%		01121	TYPE EB	200202246
R3	3.3K 1/2W 10%		01121	TYPE EB	200203326
R4	200K 1/2W 5%		01121	TYPE EB	200202045
R5	3.3K 1/2W 10%		01121	TYPE EB	200203326
R6	110 1/2W 5%		01121	TYPE EB	200201115
R8	47 1/2W 10%		01121	TYPE EB	200204706
R9	10K 1/2W 10%		01121	TYPE EB	200201036
R15	5K 3W 20%		12697	U-39-5000	230305020
R16	75K 5W 10%		12697	A47-75K-S	231007530
R17	10K 1/2W 10%		01121	TYPE EB	200201036
TH1	10		00124	11E-2	290101000

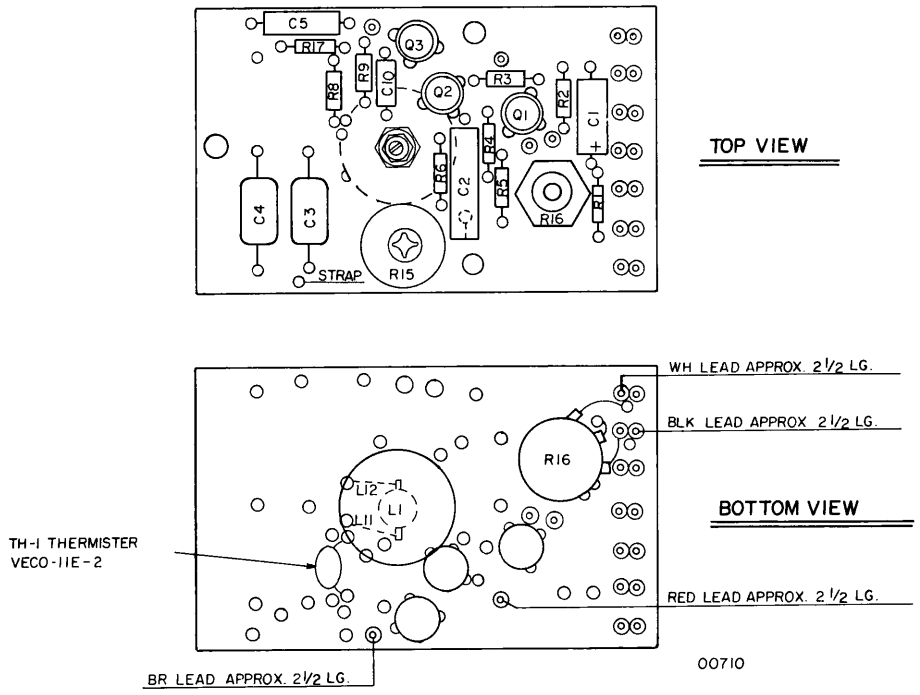


Figure 8—4. TTS 50XS FQ Selective Detector, Component Location Diagram (1 of 2)

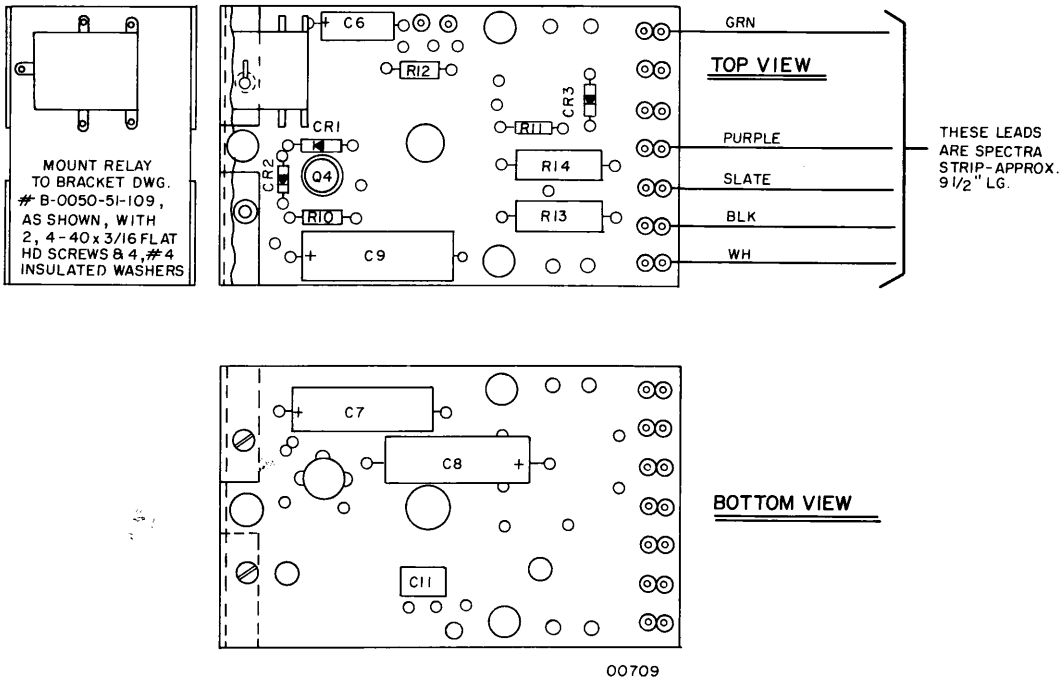


Figure 8—4. TTS 50XS FQ Selective Detector, Component Location Diagram (2 of 2)

Table 8—7. TTS 50XS FQ Selective Detector Bottom Circuit Board Parts List

REFERENCE DESIGNATOR	DESCRIPTION VALUES	POWER	TOL	VOLT	MFR	MFR P/N	NEC P/N
C6	20UF		00	50V	13606	TE1305	300202061
C7	1MF (P) 5MF (Q)			200V	27735	MPE11-1.0-200-10	321901050
C8	200UF		00	20V	09653	APD115	300902071
C9	100UF		00	50V	09653	APD127	300901072
C11	0.47UF Y5V TC		20%	100V	72982	B131-100-651-474M	330804741
CR1,CR2	A21 80mw		00	80V	12065	1N198	561001980
CR3	D041		00	200V	Horizon	1N4003	560040030
Q4	T05AFC 250mw		00	45V	01295	2N1375	553013750
R10	4.7K	½W	10%		01121	TYPE EB	200204726
R11	7.5K	½W	5%		01121	TYPE EB	200207525
R12	1K	½W	10%		01121	TYPE EB	200201026
R13	1.2K	3W	10%		06486	PW3	210301226
R14	600	3W	10%		06486	PW3	210306016

Table 8—8. TTS 50XS FP Selective Detector Overall Parts List

REFERENCE DESIGNATOR	DESCRIPTION VALUES POWER TOL VOLT	MFR	MFR P/N	NEC P/N
	E95033			B00505103C
	E95034 PC Brd			B005051031
PF	2.5K 00 24V	77342	RS5D-24	604400300

Table 8—9. TTS 50XS FQ Selective Detector Top Circuit Board Parts List

Reference Designator	Description Value Power Tol Volt	MFR	MFR P/N	NEC P/N
C1	20UF 50V	13606	192P4749R75YD3	321104740
C3,4	0.047UF 10% 100V	13606	225P40391WD3	320004030
C5	0.56UF 10% 100V	13606	225P5649R75YD3	320005641
C10	820PF 5% 100V	72136	CM15E821J	335008210
L1	inductor var 250-500MH	Artted	AC8163	455100400
Q1—3	T05AFC 250MW 45V	01295	2N1375	553013750
R1	33K 1/2W 5%	01121	TYPE EB	200203335
R2	220K 1/2W 10%	01121	TYPE EB	200202246
R3	3.3K 10%	01121	TYPE EB	200203326
R4	200K 1/2W 5%	01121	TYPE EB	200202045
R5	3.3K 1/2W 10%	01121	TYPE EB	200203326
R6	110 1/2W 5%	01121	TYPE EB	200201115
R7	11K 1/2W 5%	01121	TYPE EB	200201135
R8	47 1/2W 10%	01121	TYPE EB	200204706
R9	10K 1/2W 10%	01121	TYPE EB	200201036
R15	5K 3W 20%	12697	U-39-5000	230305020
R16	75K 1/2W 10%	12697	A47-75K-S	231007530
R17	10K 1/2W 10%	01121	TYPE EB	200201036
TH1	10	00124	11E-2	290101000

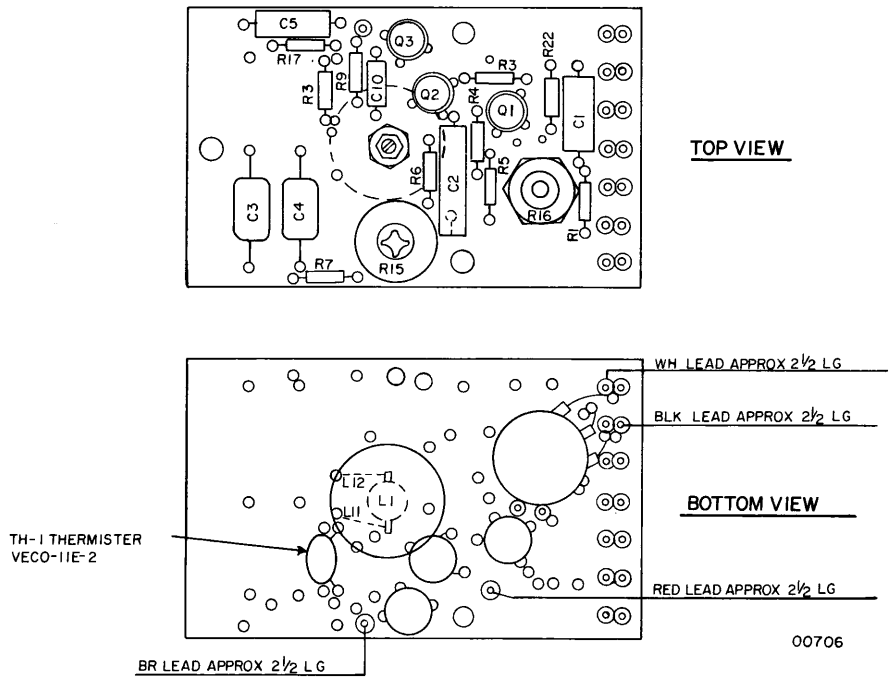


Figure 8—5. TTS 50XS FP Selective Dector, Component Location Diagram (1 of 2)

Table 8—10. TTS 50XS FQ Selective Detector Bottom Circuit Board Parts List

REFERENCE DESIGNATOR	DESCRIPTION VALUES POWER TOL VOLT		MFR	MFR P/N	NEC P/N
C6	20UF	00 50V	13606	TE1305	300202061
C7	5UF	00 50V	13606	TE1303	300205051
C8	200UF	00 20V	09653	APD115	300902071
C9	100UF	00 50V	09653	APD127	300901072
C11	0.47UF Y5 TC	20% 100V	72982	8131-100-651-474M	330804741
CR1,CR2	AZ1 80mw	00 80V	12065	1N198	561001980
CR3	D041	00 200V	Horizon	1N4003	560040030
Q4	T05AFC 250mw	00 45V	01295	2N1375	553013750
R10	4.7K ½W	10%	01121	TYPE EB	200204726
R11	7.5K ½W	5%	01121	TYPE EB	200207525
R12	1K ½W	10%	01121	TYPE EB	200201026
R13	1.2K 3W	10%	06486	PW3	210301226
R14	600 3W	10%	06486	PW3	210306016

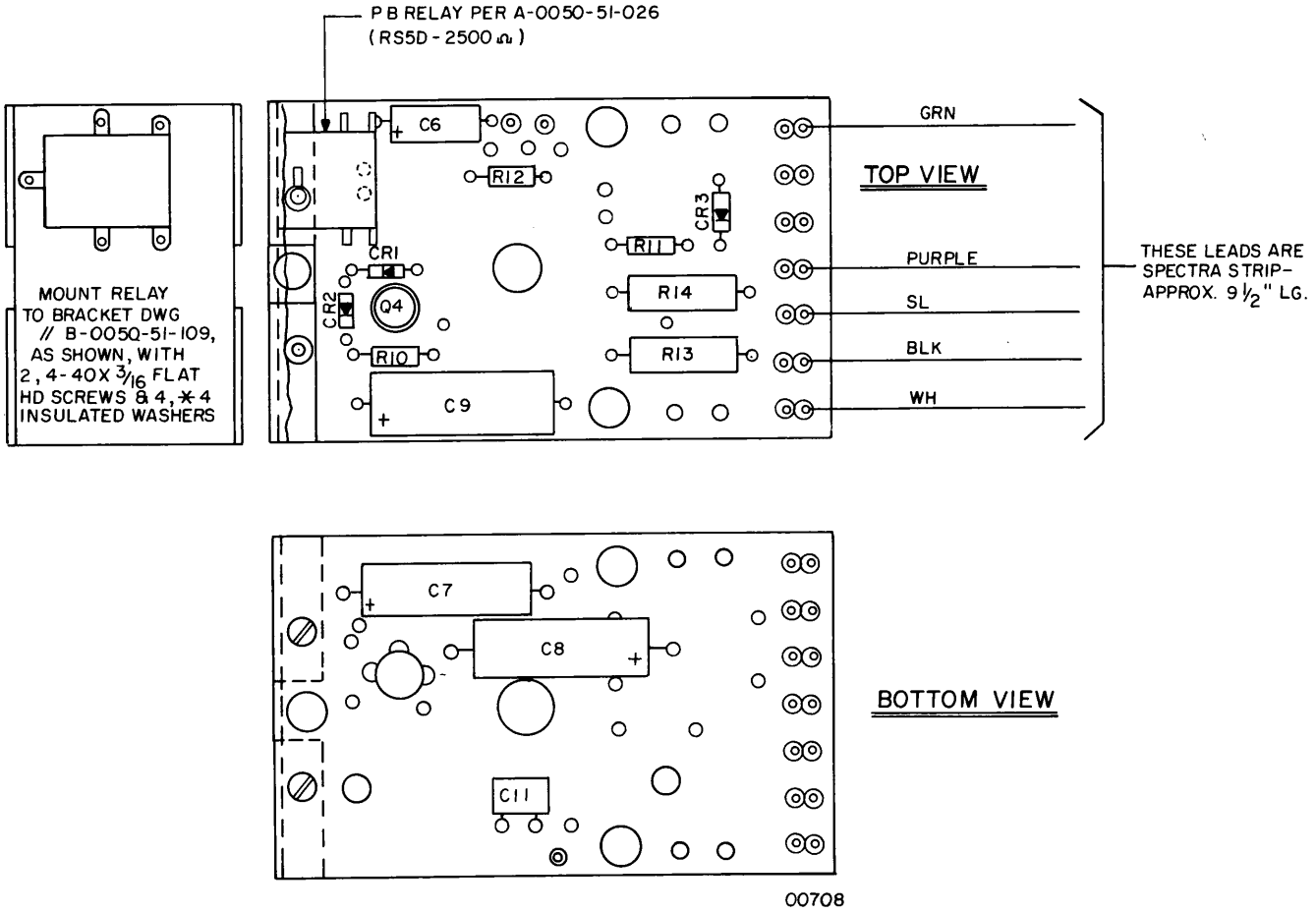


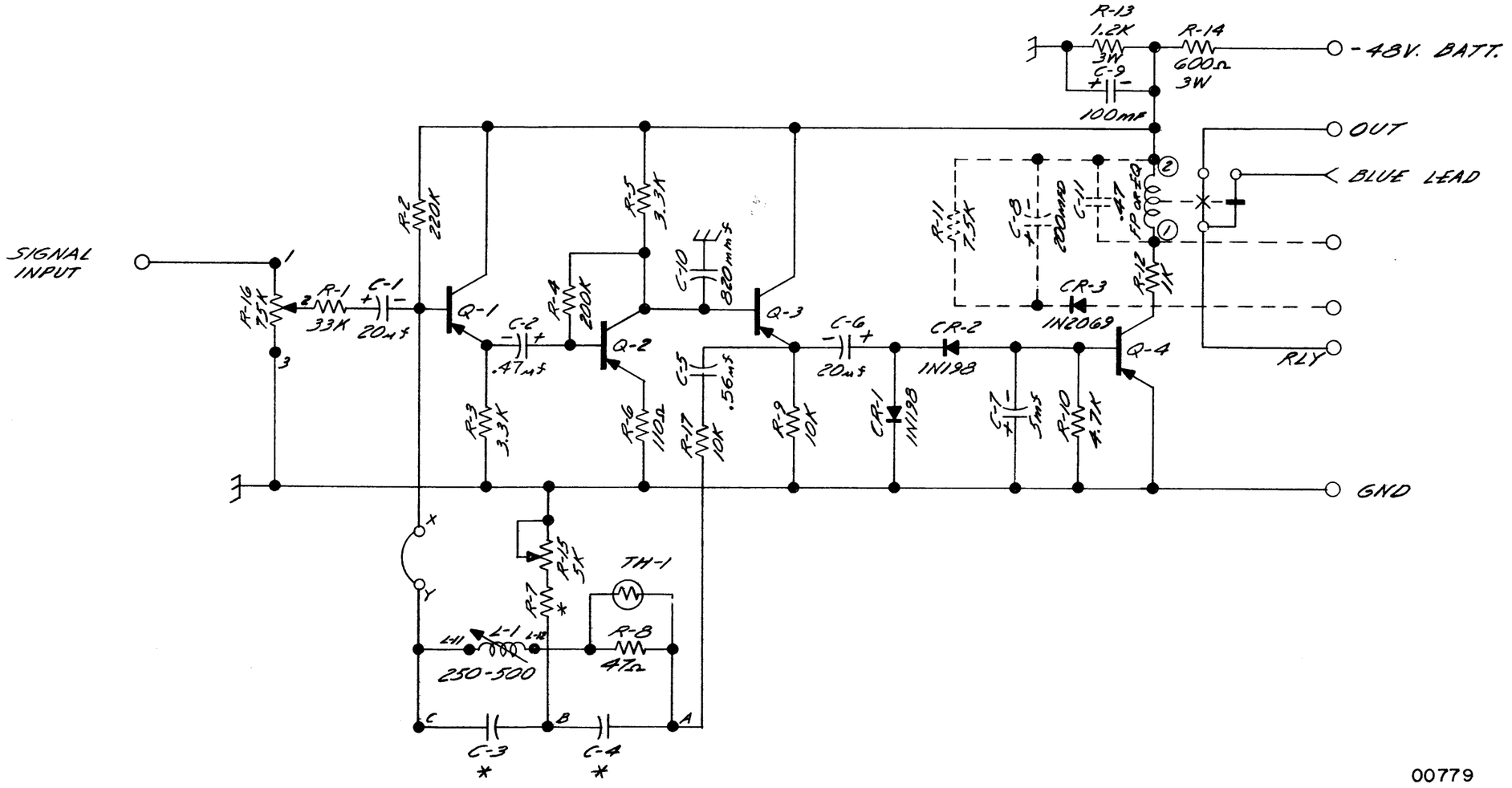
Figure 8—5. TTS 50XS FP Selective Detector, Component Location Diagram (2 of 2)

Table 8—11. TTS 50XS Buffer Circuit Board Parts List

REFERENCE DESIGNATOR	DESCRIPTION	MFGR.	MFGR. PART NO.	N.E.C. PART NO.
C1	100UF 00 50V	13606	TE-1309	300201072
C2	.1UF 10% 100V	13606	225P10491WD3	320001040
C3	SAME AS C2			
Q1	TO5AFC 250MW 00 45V	01295	2N1375	553013750
R1	2K 3W 5%	13606	TYPE 3X	210302025
R2	2.5K 3W 5%	13606	TYPE 3X	210302525
R3	10K .25W 00	71450	UPE200RE1-SQ8517	231301030
R4	300K 1/2W 5%	01121	TYPE EB	200203045
R5	10K 1/2W 10%	01121	TYPE EB	200201036
R6	12K 1/2W 10%	01121	TYPE EB	200201236
R7	270- 1/2W 10%	01121	TYPE EB	200202716
T1	P20-30K S800-1200 AUDIO P	80223	SO-7P	400300100

Table 8—12. TTS 50XSD Parts List

REFERENCE DESIGNATOR	DESCRIPTION VALUES POWER TOL VOLT	MFR	MFR P/N	NEC P/N
C1	250UF 00 50V	13606	TVA1312	300402570
C2,C3	4UF 00 200V	27735	D-4.0-200-10	301304050
CR1	0041 00 200V	Horizon	1N4003	560040030
DF	0.5K 20ma	78277	42R0500GSIL	604600100
LD	12K 1.2ma	78277	4R12000LG-SIL	604500100
L1	4H	86632	TN-1274	450200200
R1	4.3K ½W 5%	01121	TYPE EB	200204325
R2	100 ½W 5%	01121	TYPE EB	200201015
R3	1.2K 3W 5%	W.Leonard	TYPE 3X	210301225
TB1	16 contact	71785	16-140 ¾W	850001300



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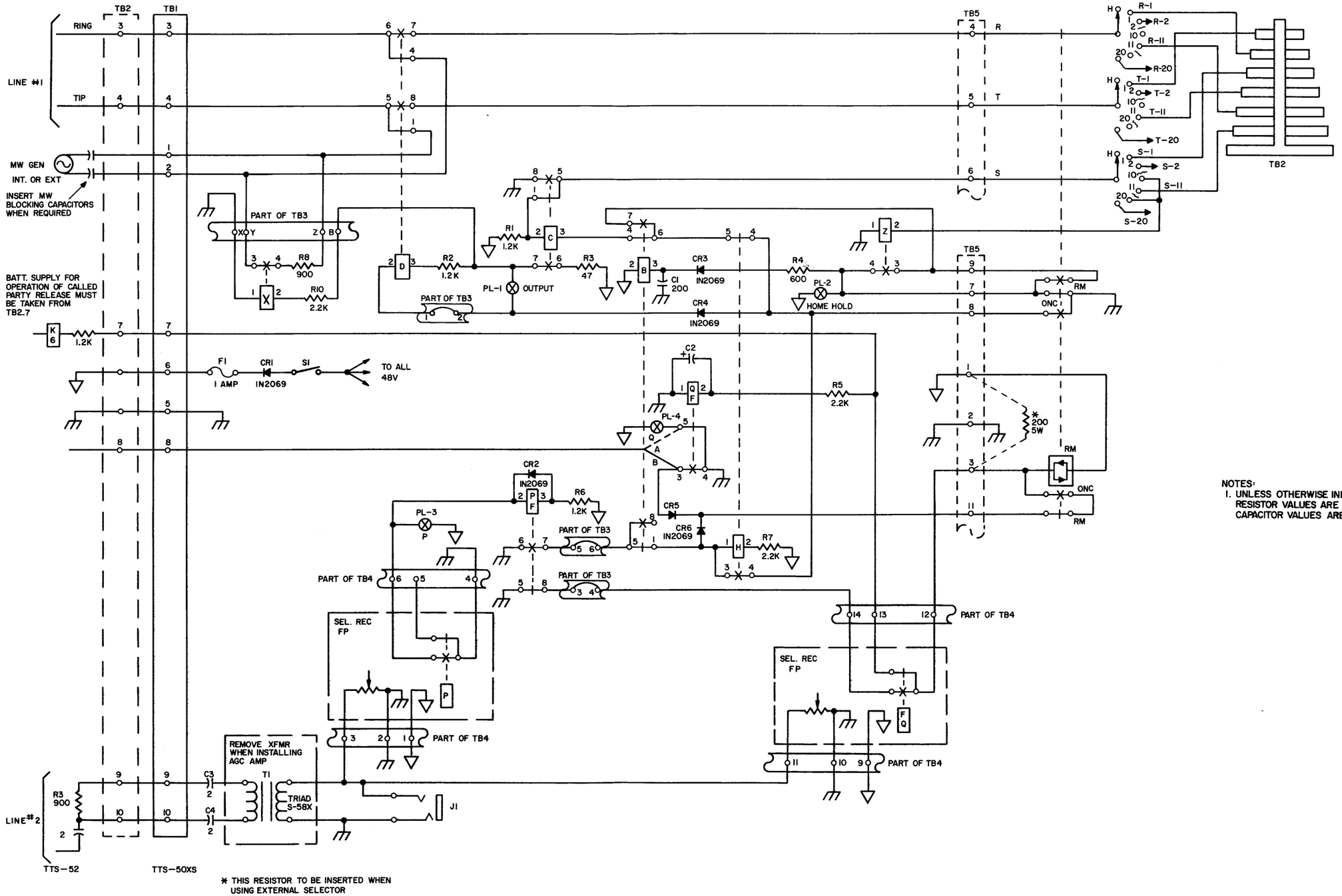
NOTES:
1- TRANSISTORS ARE 2N1375 (TI).
2- * = SELECTED VALUES.

Figure 8—6. TTS 50XS Selective Detector, Schematic Diagram



NOTES:
1. UNLESS OTHERWISE INDICATED:
   RESISTOR VALUES ARE IN OHMS
   CAPACITOR VALUES ARE IN MICROFARADS

00780

Figure 8—7. TTS 50XS Overall Schematic Diagram

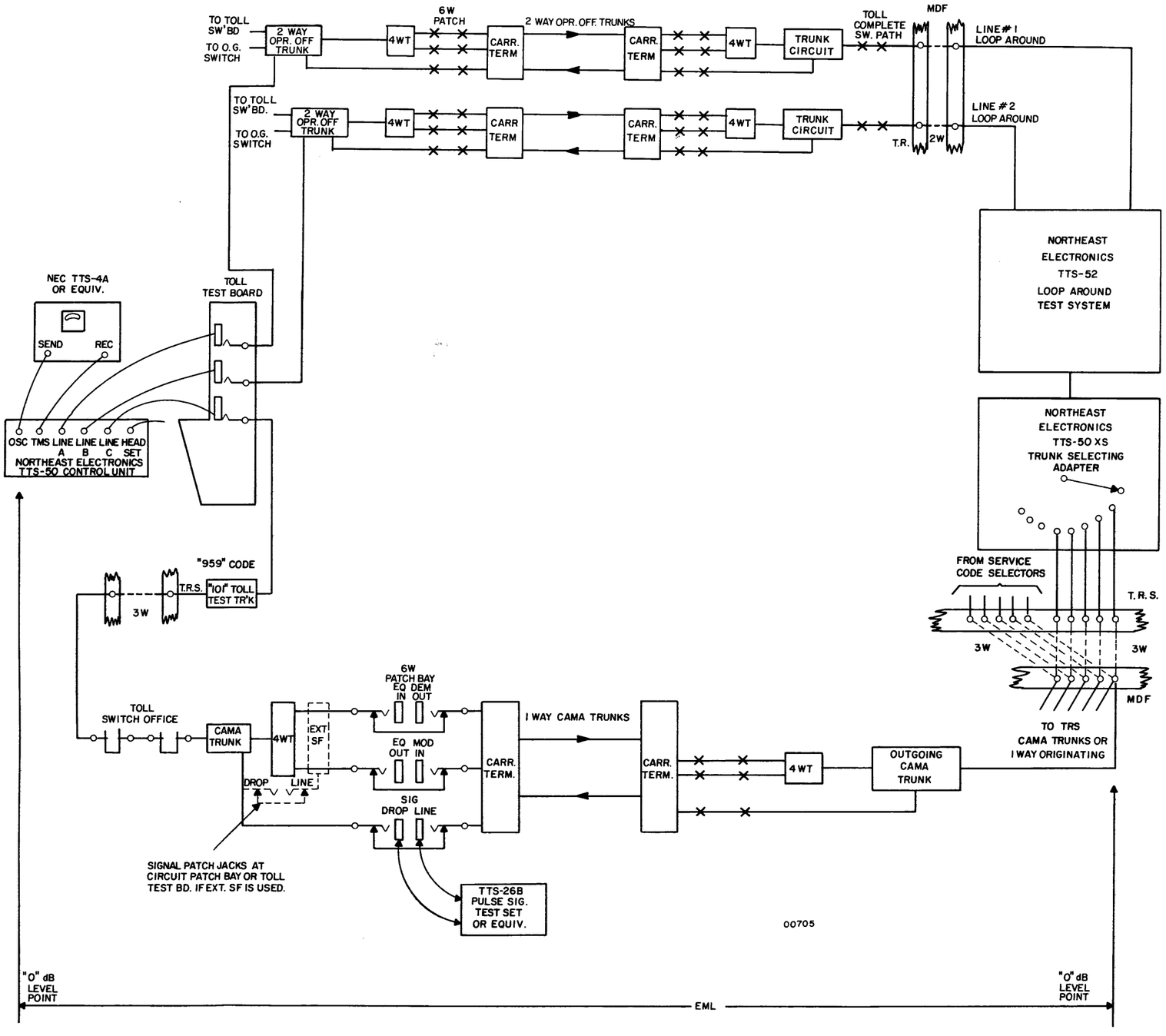


Figure 8—8. Transmission Testing on One-Way CAMA Trunks Using TTS 52 and TTS 50XS

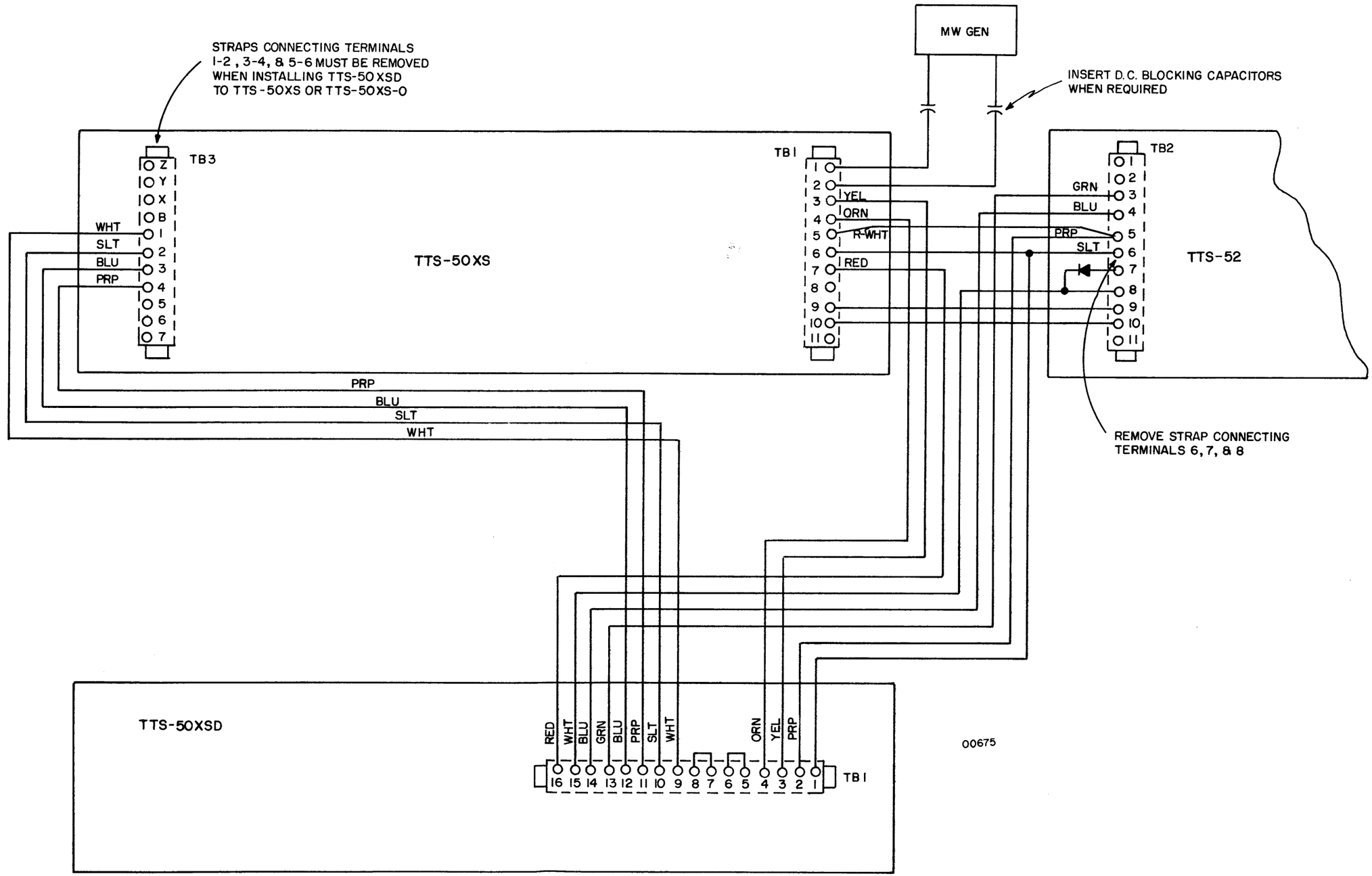
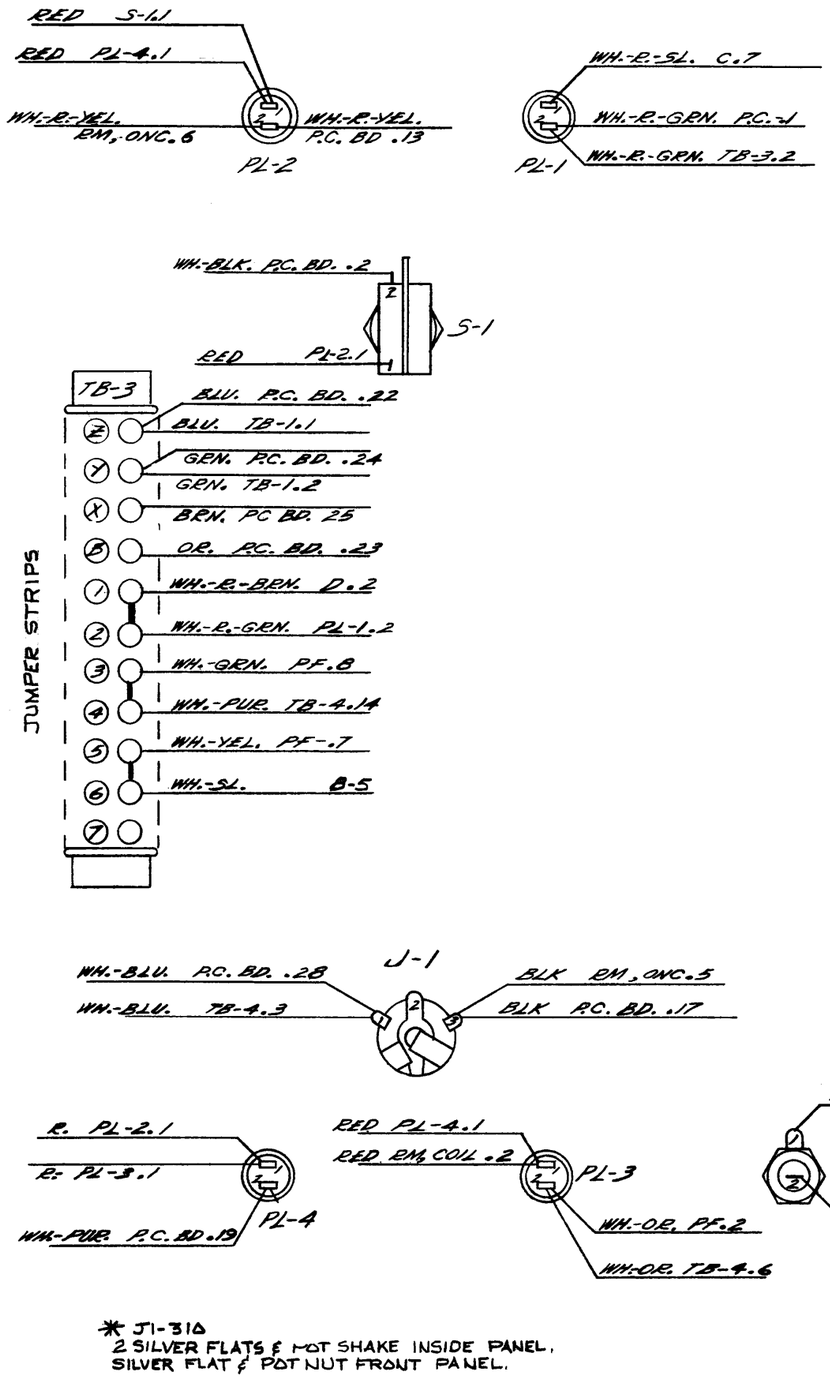
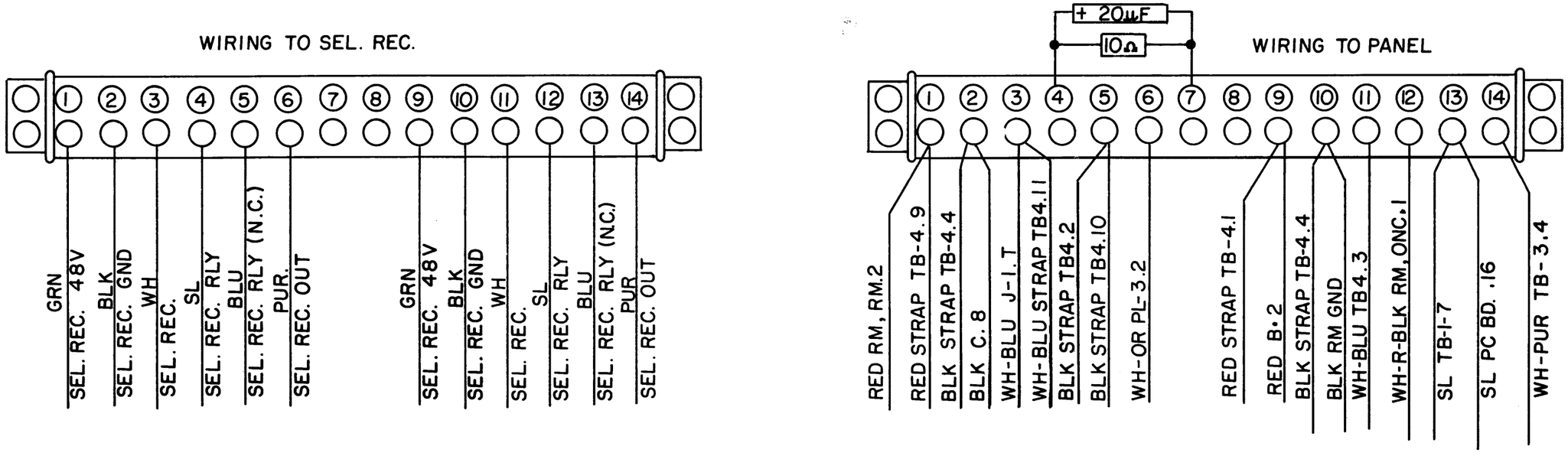


Figure 8—9. TTs to TTS 50XS and TTS 50XSD, Installation Diagram



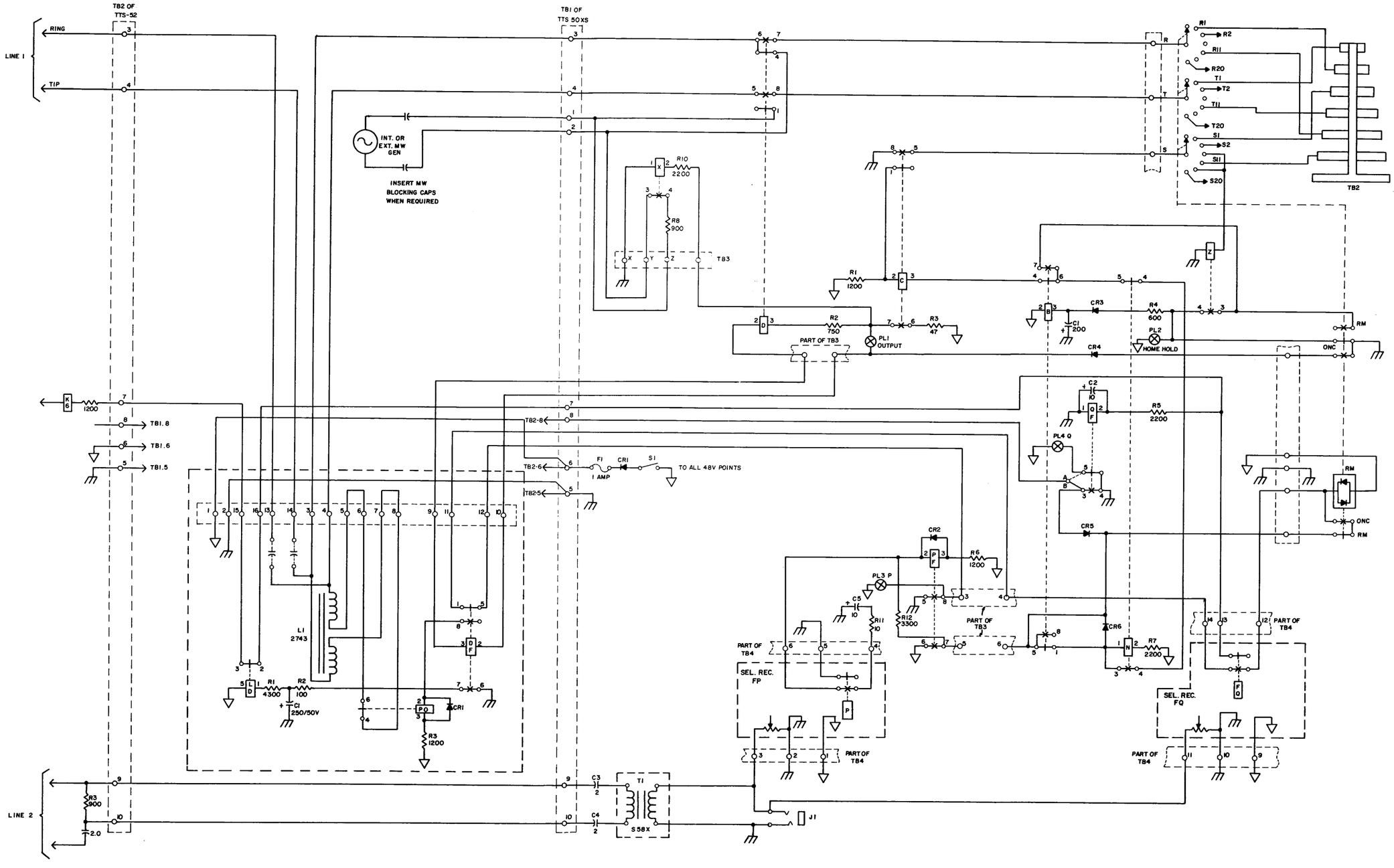
✱ J1-31Δ
2 SILVER FLATS & NOT SHAKE INSIDE PANEL, SILVER FLAT & POT NUT FRONT PANEL.

Figure 8—10. TTS 50XS Modification Diagram



00707

Figure 8—11. TTS 50XS Selective Detector Modification Diagram



NOTES:
1. UNLESS OTHERWISE INDICATED:
   RESISTOR VALUES ARE IN OHMS.
   CAPACITOR VALUES ARE IN MICROFARADS.
   ALL DIODES ARE IN4004

Figure 8—12. TTS 50XS and TTS 50XSD Overall, Schematic Diagram

MODEL TTS 52 ERRATA

CORRECTION TO SECTION 2

Specifications (page 2—1)
Change: Milliwatt Generator
Accuracy: ±0.05b
To: Accuracy: ±0.05dB

CORRECTION TO SECTION 3

Paragraph 3.29 (page 3—3)
Change last sentence of paragraph to read:
A TTS 52B has an additional milliwatt generator designed for external use.

CORRECTIONS TO SECTION 8

Paragraph 8.17a (page 8—2)

Change last sentence of paragraph to read:
Current drawn by relays FQ and K6 is not sufficient to operate RM.

Paragraph 8.19 (page 8—2)
Change paragraph to read:
Relay FP in the selective detector tuned to frequency FP will follow received FP pulses. When operated, relay FP energizes pulse-following relay PF, which in turn, completes a circuit from ground to the coil of RM. Relay FP also lights the P lamp to provide a visual indication that selective detector FP has operated. RM is positioned by the number of operations of selective detector relay PF.

Table 8—3 (page 8—8)
Change MFR P/N for reference designators TB1,TB3
From: H—140 3/4W
To: 11—140 3/4W

Table 8—8 (page 8—11)
Change entry: P2.5K 00 24V 77342 5D—24 604400300
To read: PF 2.5K 00 24V 77342 RS5D—24 604400300

Table 8—12 (page 8—13)
Change MFR P/N for reference designator LD
From: eR12000LGSIL
To: 4R—12000LG—SIL

MODEL TTS 52 ERRATA

CORRECTION TO SECTION 2

Specifications (page 2–1)
Change: Milliwatt Generator
Accuracy: ±0.05b
To: Accuracy: ±0.05dB

CORRECTION TO SECTION 3

Paragraph 3.29 (page 3–3)
Change last sentence of paragraph to read:
A TTS 52B has an additional milliwatt generator designed for external use.

CORRECTIONS TO SECTION 8

Paragraph 8.17a (page 8–2)

Change last sentence of paragraph to read:
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Paragraph 8.19 (page 8–2)
Change paragraph to read:
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To read: PF 2.5K 00 24V 77342 RS5D–24 604400300

Table 8–12 (page 8–13)
Change MFR P/N for reference designator LD
From: eR12000LGSIL
To: 4R–12000LG–SIL

CORRECTION TO SECTION 3

Figure 3—4 (D), page 3—7

Delete (D) and add in it's place the

drawing below:

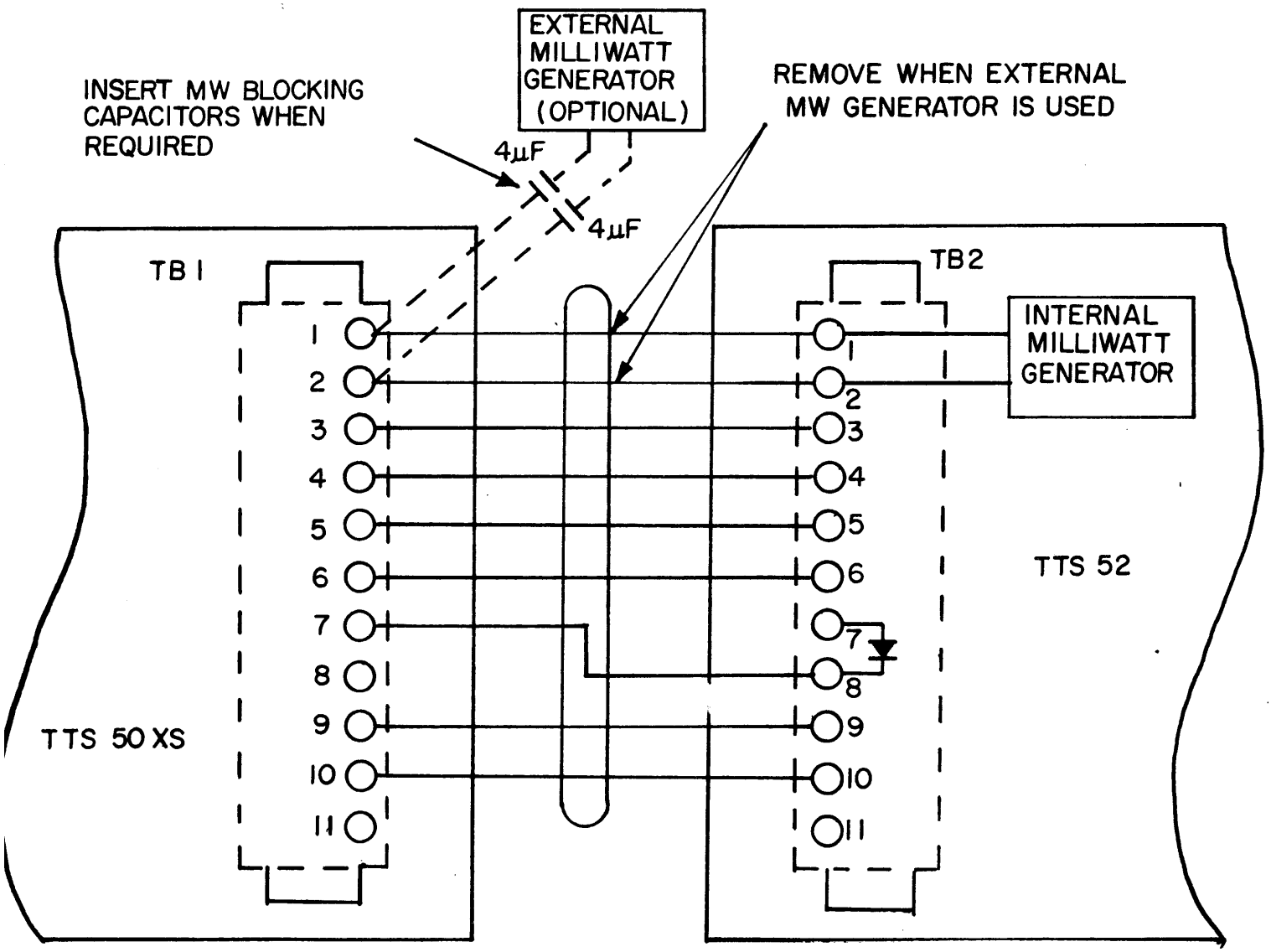

FIGURE 3-4 (D)