TTS 39 SERIES
REFERENCE TONE GENERATOR AND DISTRIBUTION SYSTEM

INSTRUCTION MANUAL

Northeast Electronics Instruction Manual
A0039-10-600 Issue 3 July 1977

northern telecom

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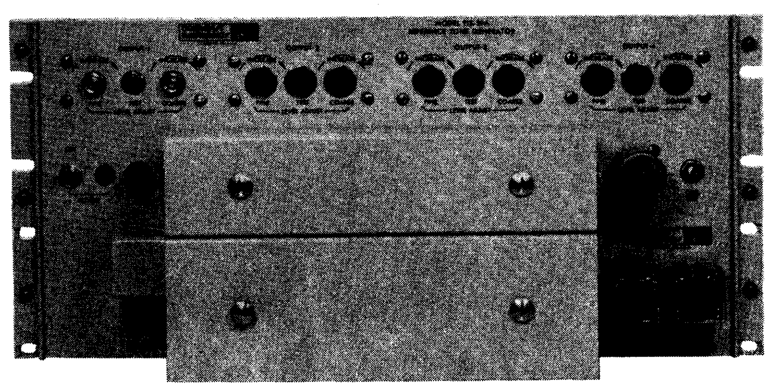

Northeast Electronics Instruction Manual

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SECTION 1

GENERAL DESCRIPTION

1.1 INTRODUCTION.

1.2 The Northeast Electronics TTS 39 series is a family of modular building-block units designed to handle many office milliwatt/tone generator and dialable test line applications. A TTS 39A Reference Tone Generator, a TTS 39D Distribution Amplifier, a TTS 39XB non-dialable Output Module, a TTS 39XC dialable Output Module, and a TTS 39XF Frequency Switching Adapter are the units that can be assembled to form systems.

1.3 TYPICAL SYSTEM.

1.4 As shown on Figure 1—1, both office milliwatt sources and dialable test lines can be simultaneously accommodated by using a single TTS 39A Reference Tone Generator and the appropriate output modules. One TTS 39A can directly drive up to four mixed output modules. Additional output modules can be used by connecting TTS 39D Distribution Amplifiers in tandem.

1.5 Seizure of a dialable TTS 39XC output module is accomplished by the office switching equipment. Variable strapping on the module allows seizure by either ground or battery on the sleeve lead or by any of the three types of E & M signaling schemes. Seizure initiates start of the timing sequence that applies: (1) tone or tones, (2) the quiet termination, and (3) any on-hook/off-hook cycling.

1.6 Frequency switching can also be started by inserting a plug into an office milliwatt jack that has a set of normally-open transfer contacts connected to ground.

1.7 TTS 39A REFERENCE TONE GENERATOR.

1.8 This unit is the basic building block of any TTS 39 system. It contains a precision oscillator and an output amplifier to generate a very stable output level. Normally, the frequency is factory set at 1000 Hz for single-frequency applications. However, it can be set to any desired frequency within the range of 300 Hz to 10 kHz. Sequenced frequencies for gain-slope applications are controlled by the TTS 39XF as described in paragraph 1.19.

1.9 The TTS 39A unit is capable of driving up to four mixed output modules and one additional TTS 39D while still maintaining a stable output level.

1.10 TTS 39D DISTRIBUTION AMPLIFIER.

1.11 This is an expansion unit used to drive up to four additional output modules. It is basically a buffer amplifier that provides a high degree of isolation between the output modules and the preceeding signal source. Each TTS 39D can drive an additional TTS 39D as well as four output modules.

1.12 TTS 39XB OUTPUT MODULE.

1.13 This is a non-dialable output module for use as an office milliwatt/tone generator source at a toll testboard, and in similar applications.

1.14 The module has a buffer amplifier that furnishes a balanced, dc-blocked output. Output impedance is strappable for either 600 or 900 ohms. Normally set to 0 dBm at the factory, the output level can be adjusted at the front panel from −1 to +2 dBm. The amplifier frequency response is flat to enable use of any frequency in the range of 300 Hz to 10 kHz.

1.15 TTS 39XC OUTPUT MODULE.

1.16 This is basically a TTS 39XB output module with added line conditioning that allows it to perform some of the functions of type 100, 102, and 107 test lines. It is normally wired to an assigned telephone number so that it can be dialed up as required.

1.17 Versatile seizure strapping allows the module to be used in many types of offices such as SXS, crossbar X-Y, motorswitch, and ESS. After seizure and a delay, the output goes off-hook to trip any ringing. After an additional delay, tone is applied to the output. In single-frequency applications, the tone is applied for 5.5 seconds after which a quiet termination is applied. (Optional strapping provides for a continuous quiet termination or for continuous cycling between 5.5 seconds of quiet termination and one-second of on-hook.)

1.18 For sequenced frequency applications, the first tone is applied for 10 seconds followed by a one-second on-hook period. Additional frequencies are applied for 5 seconds also followed by one second of on-hook. Either a continuous or a cycled quiet termination is then applied.

1.19 TTS 39XF FREQUENCY SWITCHING ADAPTER.

1.20 The switching adapter controls the frequency of the oscillator located in the TTS 39A. It also determines the length of time that tones are applied. Up to 9 frequencies can be switched.

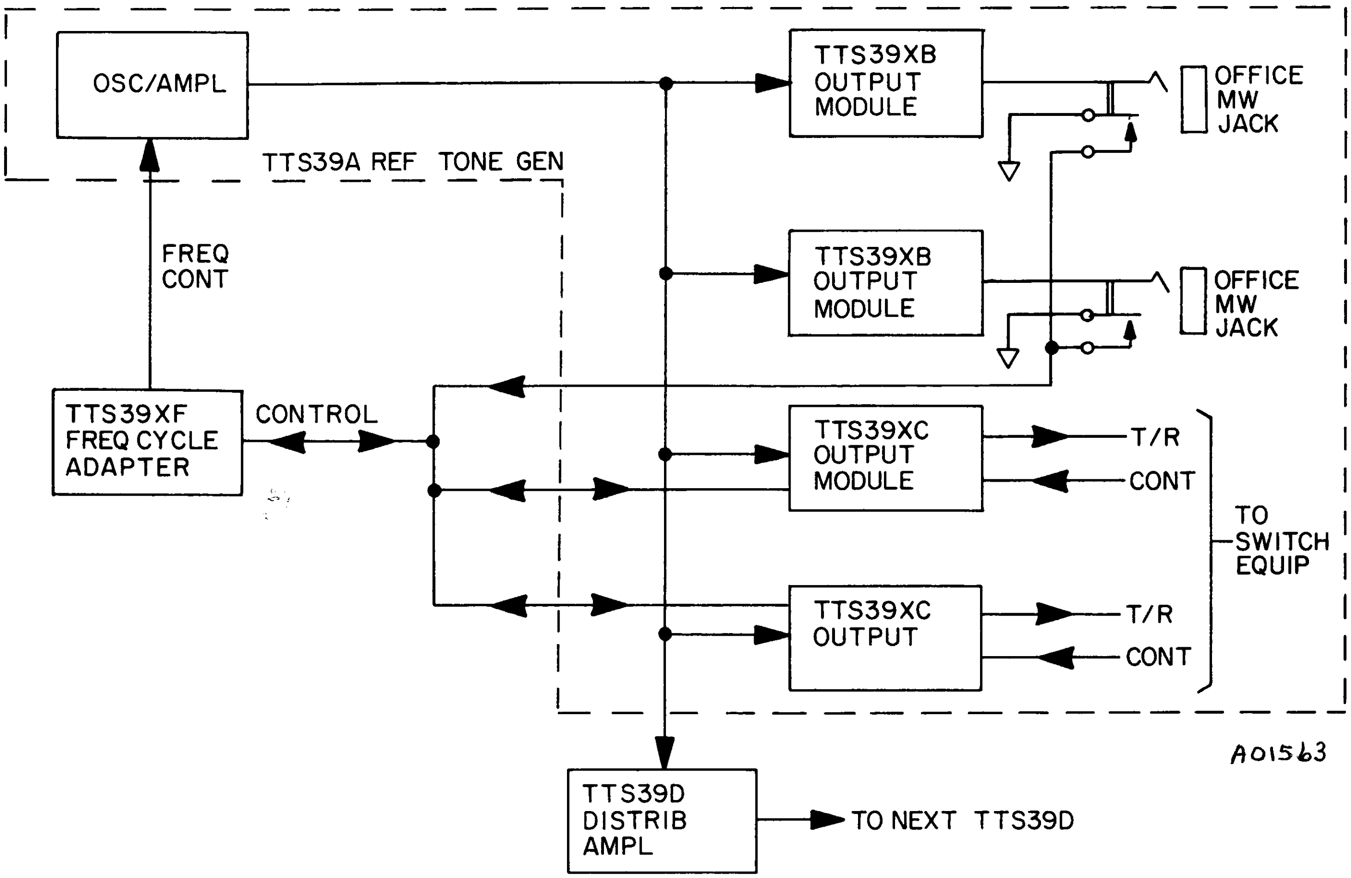


Figure 1—1. Typical TTS 39 Series Office Milliwatt/Test Line System Block Diagram.

SECTION 2

SPECIFICATIONS

2.1 Table 2—1 lists the specifications for the TTS 39A, TTS 39D, TTS 39XF, TTS 39XB, and the TTS 39XC.

Table 2—1. TTS 39 Series Specifications.

OUTPUT FREQUENCY:	
Single-Frequency Applications:	Set to 1000 Hz at the factory. Can be set within the range of 300 Hz to 10 kHz.
Sequenced-Frequency Applications:	Up to 9 frequencies between 300 Hz and 10 kHz when using the TTS 39XF Frequency Switching Adapter.
FREQUENCY TOLERANCE:	Better than ±1%.
OUTPUT LEVEL:	Normally set at 0 dBm; adjustable from −1 to +2 dBm. Each output module independently adjustable.
OUTPUT LEVEL STABILITY:	Better than ±0.05 dB at a given temperature and input voltage; varies less than ±0.1 dB from +10°C to +43°C; varies less than ±0.05 dB from 44 to 50 Vdc input voltage.
OUTPUT LEVEL FLATNESS:	±0.2 dB from 300 Hz to 10 kHz.
HARMONIC DISTORTION:	Less than 1% from +10°C to +43°C.
SUPPLY VOLTAGE REQUIREMENTS:	48 Vdc ±10%.
SIZE:	
TTS 39A:	5¼ in. h x 19 in. w, extends 4½ in. beyond front panel and 7 in. beyond rear panel. (13.3 cm h x 48.3 cm w x 29.2 cm d).
TTS 39D:	5-¼ in. h x 19 in. w x 7 in. d. (13.3 cm h x 48.3 cm w x 17.8 cm d).
TTS 39XF:	3-½ in. h x 19 in. w, extends 4 in. beyond front panel and 2-¾ in. beyond rear panel. (8.9 cm h x 48.3 cm w x 17.2 cm d).
WEIGHT:	
TTS 39A:	15 pounds (6.8 kg) with 4 TTS 39XC output modules.
TTS 39D:	13 pounds (5.9 kg) with 4 TTS 39XC output modules.
TTS 39XF:	11 pounds (5 kg).
TTS 39XB:	1 pound (0.5 kg).
TTS 39XC:	1.5 pounds (0.7 kg).

SECTION 3

INSTALLATION

3.1 INTRODUCTION.

3.2 This section contains the information required to install and make all of the interconnection wiring for the TTS 39 series.

3.3 VISUAL INSPECTION.

3.4 After unpacking the equipment, give it a thorough visual inspection to detect any damage that may have occurred during shipment. If any damage is found, report it immediately to the carrier.

3.5 SERVICE INFORMATION.

3.6 Each instrument manufactured by Northeast Electronics is warranted for a period of one year upon delivery to the original purchaser. Written authorization is required prior to the return of any equipment for factory repairs. Additional service information can be obtained by contacting Northeast Electronics Customer Service Department, P.O. Box 649, Concord, New Hampshire, 03301 or by calling 603-224-6511.

3.7 POWER CONSIDERATIONS.

3.8 The TTS 39 series is designed to operate from a voltage source within the range of 43 to 52 Vdc. The supply used must be well filtered.

3.9 STRAPPING OPTIONS.

3.10 There are several strapping options on the TTS 39XC output module. During final testing at the factory, these straps are positioned using the information normally found on the purchase order. Before installing the equipment, inspect the strapping on the output modules to ensure that the equipment will perform as expected. Table 3—1 provides a summary of the strapping options available. Figures 3—1, 3—2, and 3—3 show the interconnections required for seizure when operating with E&M signaling interfaces.

NOTE

> The output impedance of the output modules cannot be changed without recalibrating the output level. Refer to Section 6 for this information.

Table 3—1. TTS 39XC Line Conditioning Board A2, Strapping Summary.

DESIRED OPERATION/FUNCTION	STRAPPING REQUIRED
Ground sleeve seizure	A to A1 and B to B1
Battery sleeve seizure	A1 to A2 and B to B1
Types I and III E&M seizure	A1 to A2*
Type II E&M seizure	A to A1 and B1 to A2*
No on-hook/off-hook cycling during quiet termination.	C to C1
600-ohm +2 UF quiet termination impedance.	F to F1
5.5 second tone followed by on-hook/off-hook cycling during quiet termination when not using TTS 39XF.	D to D1, E to E1, and 9 to 5 (ground)

* See Figures 3—1, 3—2, and 3—3 for typical applications using Types I, II, and III E&M seizure.

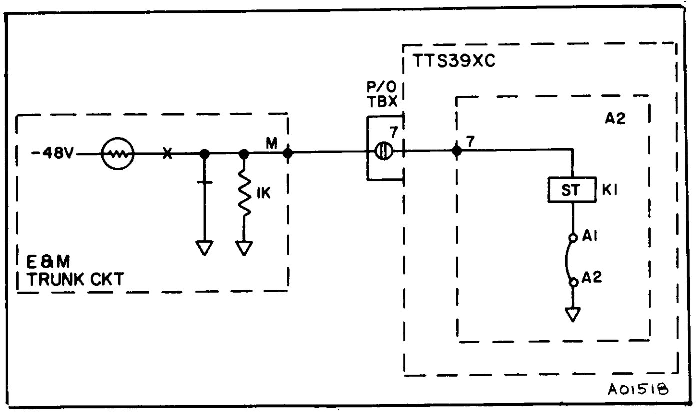


Figure 3—1. Typical Type I E&M Start Control

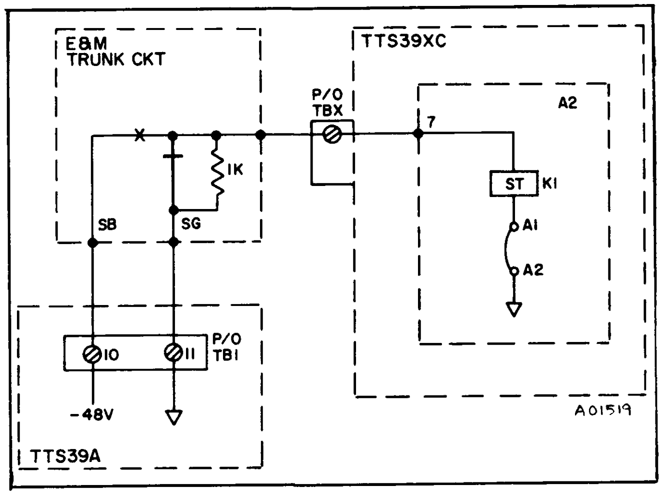


Figure 3—3. Typical Type III E&M Start Control

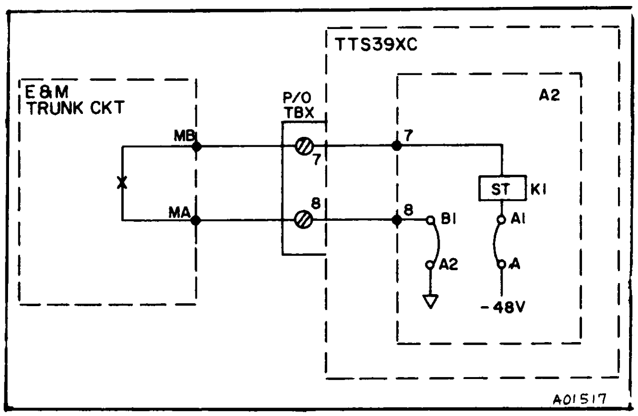


Figure 3—2. Typical Type II E&M Start Control

3.11 **INSTALLATION OF TTS 39A OR TTS 39D WITH TTS 39XB/XC MODULES.**

3.12 To install either a TTS 39A or a TTS 39D, perform the following steps.

1. Install the unit in a standard 19-inch rack. See Figure 3—4 for the rack space requirements.

2. Refer to Table 3—2 for the TTS 39A installation wiring information and Table 3—3 for the TTS 39D.

NOTE

When using the TTS 39XB for an office milliwatt source, it is recommended that only one jack per output module be used. If jacks are multipled, simultaneous access by more than one user at a time must be prevented. Some type of busy light system would be satisfactory.

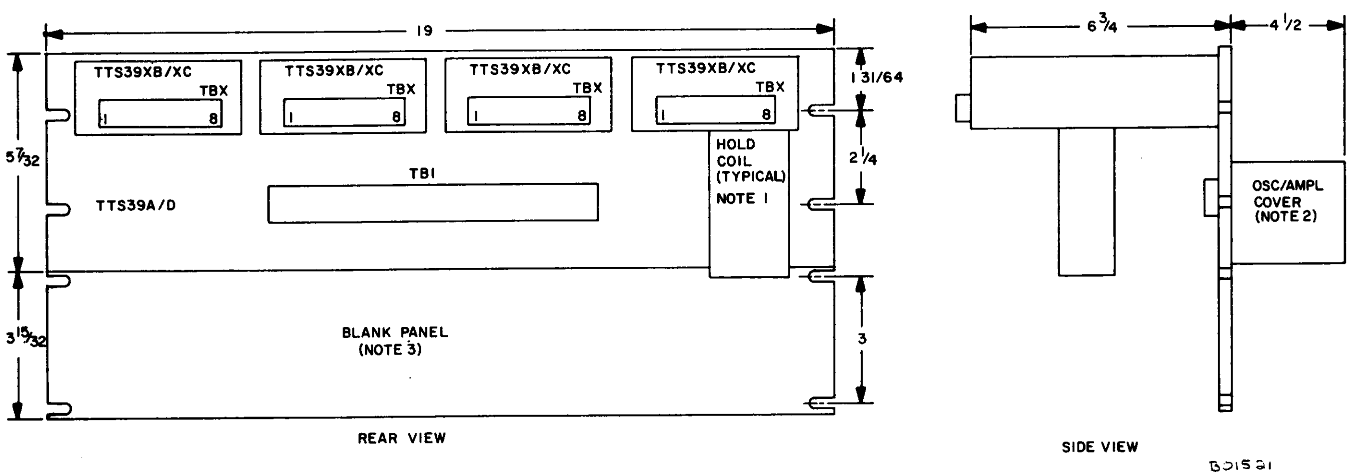
Table 3—2. TTS 39A Installation Wiring.

FROM TTS 39A TB1 PIN	TO	FROM EACH TTS 39XB TBX PIN	TO ASSOCIATED OFFICE MW JACK	FROM EACH TTS 39XC TBX PIN	TO SWITCH EQUIP
1	−48 Vdc	1	tip	3	tip
2	ground	2	ring	4	ring
				8	sleeve if used for start
				↓	
				or	
				7&8	See Figs. 3—1, 3—2, and 3—3

Table 3–3. TTS 39D Installation Wiring.

FROM TTS 39D TB1 PIN	TO	FROM EACH TTS 39XB TBX PIN	TO ASSOCIATED OFFICE MW JACK	FROM EACH TTS 39XC TBX PIN	TO SWITCH EQUIP
–	–48 Vdc	1	tip	3	tip
+	ground	2	ring	4	ring
IN 1	TTS 39A TB1-12*			8 ↓ or 7&8	sleeve if used for start See Figs. 3–1, 3–2, and 3–3

* The first TTS 39D when more than one unit is used. The IN 1 terminal on the second unit connects to the BUFF OUT terminal on the first. Repeat for other units in the chain.



NOTES:
1. HOLD COIL USED ON TTS39XC ONLY
2. OSC/AMPL NOT USED ON TTS39D
3. USED ONLY WHEN ANY TTS39XC ARE USED

Figure 3–4. TTS 39A or TTS 39D with TTS 39XB/XC Output Modules, Outline Drawing

3.13 **INSTALLATION OF TTS 39A AND TTS 39XF.**

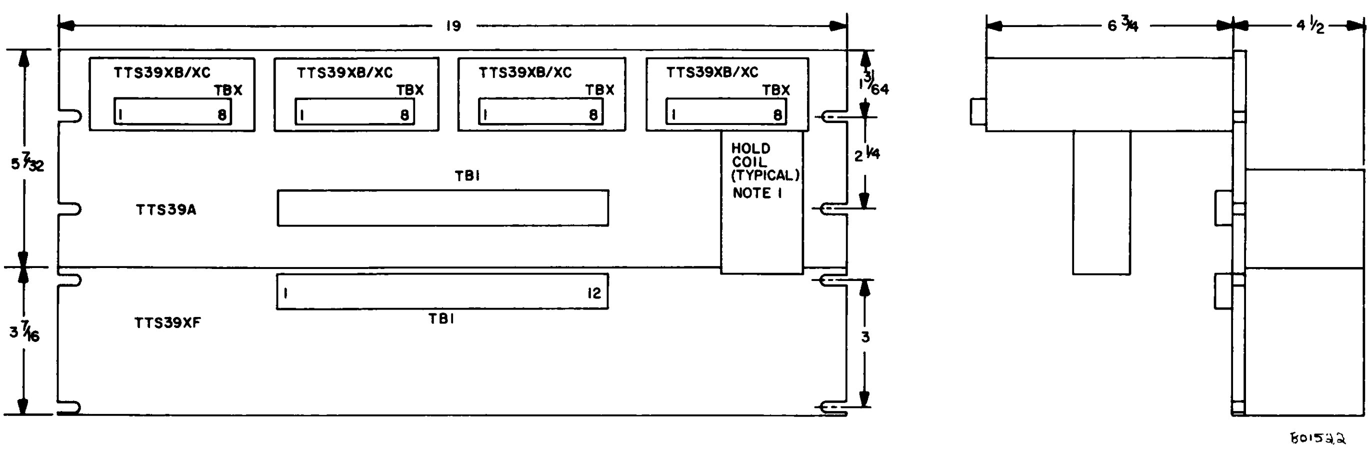
3.14 To install a TTS 39A and TTS 39XF, perform the following steps.

1. Install the unit in a standard 19-inch rack. See Figure 3—5 for the rack space requirements.

2. Refer to Table 3—4 for the wiring information.

Table 3—4. TTS 39A/TTS 39XF Installation Wiring.

FROM TTS 39A TB1 PIN	TO	FROM EACH TTS 39XB TBX PIN	TO ASSOCIATED OFFICE MW JACK	FROM EACH TTS 39XC TBX PIN	TO SWITCH EQUIP
1	—48 Vdc	1	tip	3	tip
2	ground	2	ring	4	ring
		8	N.O. transfer contact	8 ↓	sleeve if used for start
				or 7&8	See Figs. 3—1, 3—2, and 3—3



NOTES:
1. HOLD COIL USED ON TTS39XC ONLY.

Figure 3—5. TTS 39A with TTS 39XB/XC Output Modules, Outline Drawing

3.15 INSTALLATION OF TTS 39XB INTO TTS 39A OR TTS 39D.

3.16 To install a TTS 39XB into either a TTS 39A or a TTS 39D, perform the following steps.

1. Orient the TTS 39XB such that the dust cover is up and insert the potentiometers and access jack through the front panel from the rear.

2. Secure the TTS 39XB with four screws inserted through the front panel.

3. There are three wires twisted together that exit from the TTS 39XB. Solder the red wire to the closest pin A on TB1, the black wire to the closest pin B, and the white/brown wire to the closest pin C.

4. Connect the tip, ring, and sleeve (if required) as instructed in either Table 3—3 or 3—4 as appropriate.

3.17 INSTALLATION OF TTS 39XC INTO TTS 39A OR TTS 39D.

3.18 To install a TTS 39XC into either a TTS 39A or a TTS 39D, perform the following steps.

1. Orient the TTS 39XC such that the circuit board is down and insert the potentiometers and access jack through the front panel from the rear.

2. Secure the TTS 39XC with four screws inserted through the front panel.

3. There is a group of wires connected to stand-off terminals on the edge of circuit board A2. Connect these wires as indicated in Table 3—5.

4. Connect the tip, ring, and control lead(s) from TBX as indicated in Table 3—3 under the TTS 39XC column.

Table 3—5. TTS 39XC Installation Wiring.

FROM TTS 39XC BOARD A2 PIN	TO TTS 39A/D TB1 PIN	FUNCTION
4	10	—48VDC
5	11	GROUND
9	8	PRI START
2	4	XF START
3	9	QUIET TERM
12	3	ON-HK PULSE

SECTION 4

OPERATION

4.1 INTRODUCTION.

4.2 This section contains a description of the controls, indicators, and connectors on the equipment and briet operating instructions.

4.3 CONTROLS, INDICATORS, AND CONNECTORS.

4.4 Tables 4–1, 4–2, and 4–3 describe the controls, indicators, and connectors shown on Figure 4–1.

4.5 OPERATING INSTRUCTIONS.

4.6 With the exception of POWER switches on the TTS 39A and the TTS 39D, the equipment has no operating controls. After all POWER switches have been set to the ON position, the system is ready for operation.

4.7 The TTS 39XB Output Modules cannot be dialed up and are normally accessed by inserting a plug into an associated office milliwatt access jack. Access to the TTS 39XC Output Modules is gained by simply dialing up the assigned telephone number.

Table 4–1. TTS 39A And TTS 39XF Controls, Indicators, And Connectors.

REF DESIG.	CONTROL, INDICATOR OR CONNECTOR	FUNCTION
	ON TTS 39A	
S1	POWER SWITCH	In the ON position applies −48 Vdc to the unit, the output modules, and the TTS 39XF when used.
DS1	POWER indicator	When lighted, indicates that −48 Vdc is applied.
F1	POWER fuse	Provides protection for the −48 Vdc source.
J1	OSC TEST jack	A 310 access jack to the output of the oscillator/amplifier.
	ON TTS 39XF	
DS1	HOME + PULSE indicator	The indicator flashes each time the frequency changes. When continuously lighted, indicates that frequency cycling has been completed.

Table 4–2. TTS 39XB/XC Controls And Connectors.

REF DESIG.	CONTROL, INDICATOR OR CONNECTOR	FUNCTION
J1	TEST jack	A 310 access to observe the tone at the output side of the output amplifier.
R3	COARSE LEVEL ADJUST potentiometer	In conjunction with R17, allows the output to be set within the range of −1 to +2 dBm.
R17	FINE LEVEL ADJUST potentiometer	In conjunction with R3, allows the output to be set within the range of −1 to +2 dBm.

Table 4–3. TTS 39D Controls, Indicators, And Connectors.

REF DESIG	CONTROL, INDICATOR OR CONNECTOR	FUNCTION
S1	POWER switch	In the ON position, applies −48 Vdc to the unit and the output modules.
DS1	POWER indicator	When lighted, indicates that −48 Vdc is applied.
F1	POWER fuse	Provides protection for the −48 Vdc source.
J1	INPUT jack	A 310 access to the input of the buffer amplifier.
J2	BUFFER OUT jack	A 310 access to the output of the buffer amplifier.

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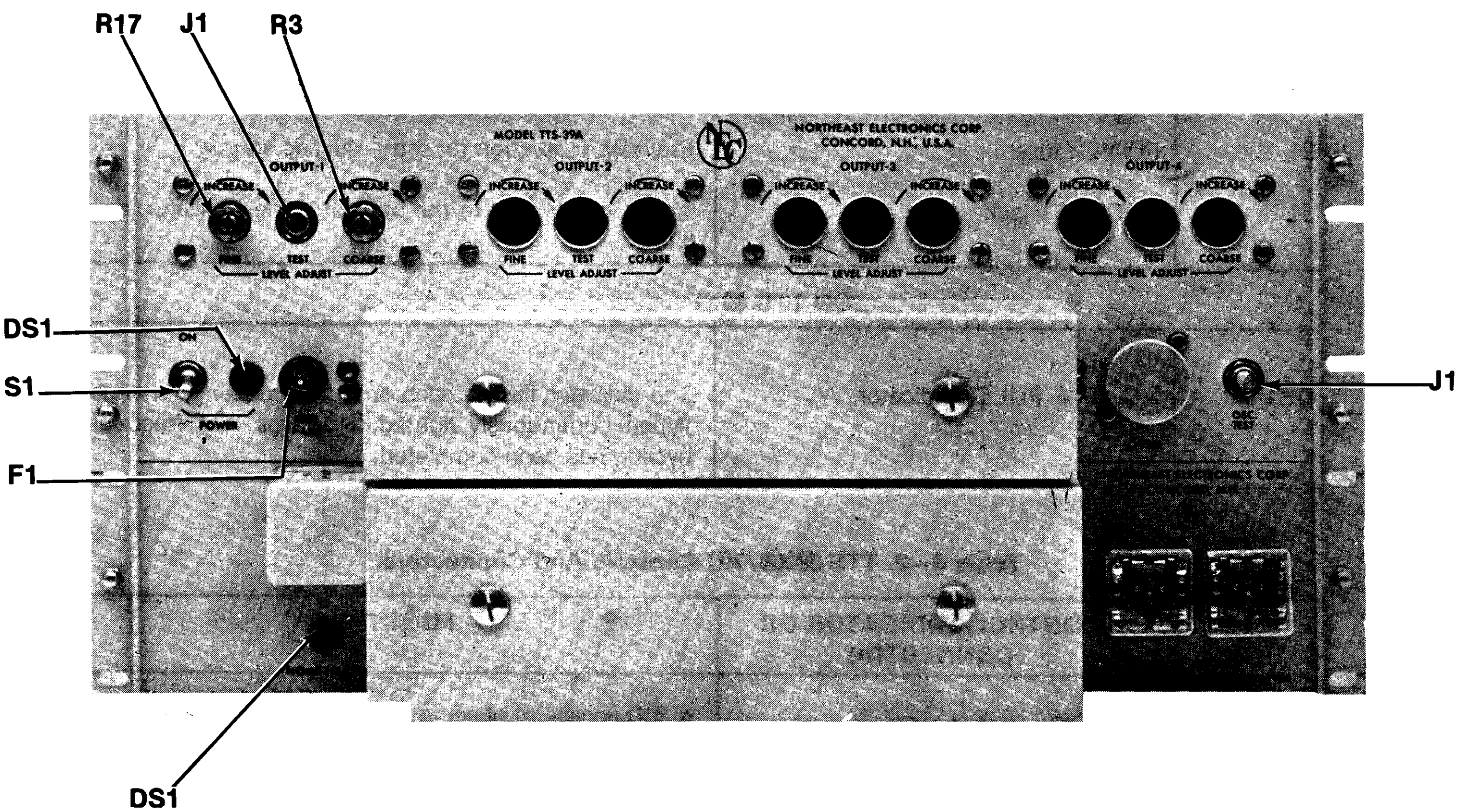

Figure 4–1. TTS 39 Series, Controls, Indicators, And Connectors.

SECTION 5

CIRCUIT DESCRIPTION

5.1 This section provides circuit descriptions for the TTS 39 series of equipment.

5.2 TTS 39A OSCILLATOR/AMPLIFIER CIRCUIT DESCRIPTION.

5.3 See Figure 7—9 for the schematic diagram. Stages Q1 through Q3 and associated components form a bridged-T, R-C oscillator. The frequency-determining circuit is the bridged-T comprised of C4, C5, R34, and R35. Frequency of operation can be varied from 300 Hz to 10 kHz by using different values for R34 and R35.

5.4 Positive feedback is applied from the emitter of Q2 to the emitter of Q1 through thermistors RT1 and RT2. These help stabilize the oscillator output level. The amount of positive feedback used is adjusted by R15. Negative feedback is taken from the emitter of Q3 and applied to the base of Q1. Only at the desired frequency does the positive feedback exceed the negative feedback so that oscillations can occur.

5.5 The output amplifier consists of Q4 through Q6 and the output oven. The oscillator output is taken at the emitter of Q2 through level adjustment R19. Voltage gain is provided by Q4 and current gain by cascaded emitter followers Q5 and Q6. The output impedance is set at 600 ohms by R30. A thermistor located in the oven maintains a very constant output level.

5.6 TTS 39D BUFFER AMPLIFIER CIRCUIT DESCRIPTION.

5.7 As shown on Figure 7—12, the buffer consists of a single emitter follower stage. The collector supply voltage is divided down to approximately —26 volts by R1 and R2 and filtered by C1. The input can be applied through IN 1 terminal on TB1 or via INPUT jack J1. The signal is ac coupled by C3. Output ac coupling is furnished by C2. Distribution to the output modules is made via terminals located on TB1. The buffered output is also available at BUFFER OUTPUT jack J2.

5.8 TTS 39XB CIRCUIT DESCRIPTION.

5.9 See Figure 7—16 for the schematic diagram. The circuit consists of a buffer amplifier and an output transformer. The input signal is applied through fine and coarse adjustments R17 and R3. These are used to calibrate the output level within the range of —1 to +2 dBm. Voltage amplifier Q1 provides the necessary voltage amplification and cascaded emitter followers Q2/Q3 match the output impedance to the low-impedance output transformer. Diodes CR1 and CR2 and R11 protect the buffer from any ringing voltage that may be present on the output line. Transformer T1 provides a balanced output at terminals 1 and 2 on TB1. The output is also available at TEST jack J1. Output impedance is controlled by the strapping associated with R13. Capacitor C4 provides dc blocking.

5.10 TTS 39XC CIRCUIT DESCRIPTION.

5.11 As shown on the interconnection diagram of Figure 7—17, the TTS 39XC consists of output amplifier A1 and line conditioning A2. The output amplifier is exactly the same as that used in the TTS 39XB and is described in paragraph 5.8.

5.12 TTS 39XC LINE CONDITIONING BOARD A2 CIRCUIT DESCRIPTION.

5.13 See Figure 7—19 for the schematic diagram. In the non-seized condition, all relays are released and an ac impedance consisting of R3 and C2 is connected across the output tip and ring through a set of DOH (Delayed Off Hook) contacts. In the most commonly used arrangement, one side of ST (Start) relay K1 is strapped to —48 volts and the other side is strapped to the sleeve start input at pin 8. When the sleeve is grounded, ST operates immediately. This applies —48 volts through R1 to DOH. After a delay of 200 to 400 milliseconds, DOH will operate provided a ground is present at pin 9.

5.14 When a TTS 39XF is being used, ground will appear at the Priority Start line when the TTS 39XF is in the home position. This ensures that frequency cycling starts at the first tone. When no TTS 39XF is used, pin 9 must be strapped to ground. In both cases, ground is applied to DOH through CR2 and R2. A set of normally-open DOH contacts applies ground through CR1 to latch the relay. Two other sets of DOH contacts remove the ac impedance from the output tip and ring and apply hold coil L1 in its place. This will trip the ringing voltage if present. At the same time, ground is connected to XF Start output pin 2 through sets of DOH and QT contacts and CR3. When a TTS 39XF is being used, the XF Start signal initiates frequency cycling.

5.15 An additional set of normally-open DOH contacts connects —48 volts to a delay network consisting of R7 and C5. After 200 to 400 milliseconds, DMW

(Delayed Milliwatt) relay K5 operates. The tip and ring from the tone generator are now cut through to the output. The length of time that the tone is applied to the output depends on whether or not a TTS 39XF is used. This is described in the following paragraphs.

5.16 When no TTS 39XF is being used, terminal E is strapped to E1. Thus, as soon as DOH operates, ground is applied to R14. This starts timer U1, which is connected as an astable multivibrator. It takes 5.5 seconds for C6 to charge through R9-R12 to the trigger level of U1. When U1 is triggered, the output at pin 3 goes negative and turns on Q1. Ground is now applied through CR8 to QT (Quiet Termination) relay K3, and it operates.

5.17 Operation of K3 connects quiet termination (Comprised of C3 and either R4 or R15) across the output tip and ring. A set of QT contacts latches the relay. Two sets of QT contacts remove the tone by opening the tip and ring paths.

5.18 Transistor Q1 also applies ground through CR6 and a set of DOH contacts to a network consisting of R6, C4, and C5. This allows OH (On Hook) relay K4 to operate for one second. A set of OH contacts opens the output ring line and places the unit on hook. The one second of on-hook (followed by 5.5 seconds of quiet termination) will continue as long as the unit is seized. On-hook cycling can be defeated by strapping C1 to C.

5.19 When a TTS 39XF is used, E-E1 is open and the Quiet Term input at pin 3 is open during all frequency cycling. After each frequency is applied for a period determined by the TTS 39XF, the On-Hook Pulse input at pin 12 momentarily goes to ground. This causes OH to operate for one second and place the unit on hook as described in the preceding paragraph. After the last frequency, the Quiet Term input at pin 3 momentarily goes to ground. Relay QT operates as described in the preceding paragraph. Ground to start U1 is applied through CR9, and on-hook cycling functions as previously described.

5.20 When seizure is removed, all relays release and the unit returns to the idle condition.

5.21 **TTS 39XF CIRCUIT DESCRIPTION.**

5.22 See Figure 7—14 for the schematic diagram of the unit. Assuming that stepping switch RM is in the home position, a ground at XF Start input pin 4 will initiate operation. The ground is applied through CR1 and operates SH. A set of SH contacts applies ground through the home position of S1-D4 and through the normally-closed contacts of RM. This causes RM to step to position 1 and stop (since the normally-closed set of RM contacts opens immediately to remove the ground and mechanically advance the switch).

5.23 A normally-open set of SH contacts and a normally-closed set of D contacts completes the path from −48 volts, through DF, and capacitors C1-C3 to ground. The initial inrush of current to charge the capacitors operates DF. A normally-open set of DF contacts operates RM, but it does not mechanically advance. After approximately 10 seconds, the capacitors have charged to the point where D operates. This breaks the current path of DF, and DF releases. This, in turn, releases RM which then advances to position 2. Resistor R1 reduces the D operate time to approximately 5 seconds for the second and all following tones.

5.24 Resistors R34 ( ) and R35 ( ) are selected by S1-D5 and S1-D6. They are the frequency-determining components for the RC oscillator located in the TTS 39A.

5.25 One side of RM is connected to TB1-3. This is the on-hook pulse that causes the TTS 39XC output module to go on-hook for one second between tones.

5.26 After the last tone, S1-D4 applies ground to TB1-9 for all remaining switch positions. This causes the TTS 39XC to place a quiet termination across the line.

5.27 The next position and all remaining positions of S1-D2 after the last tone apply ground that is available through CR2. This is connected to the stepping switch through sets of ONC and RM contacts. The switch will step to the home position since the RM contacts repeatedly break the ground path.

5.28 If the ground at the XF Start input is removed any time before the switch reaches the home position, SH is released. The normally-closed set of SH contacts now applies ground through the ONC and RM contacts to the switch. This also causes the switch to step to the home position.

5.29 If only TTS 39XB output modules are being used, the XF Start input at TB1—4 is present as long as a user is jacked into an access. This causes the TTS 39XF to continuously cycle as long as the XF Start ground is available. When a TTS 39XC is supplying the XF Start input, the ground is removed as soon as the TTS 39XC applies the quiet termination. In this case the tones are cycled only once, and the stepping switch stops in the home position.

5.30 When only TTS 39XC output modules are being used, the stepping switch cycles only once per seizure and always stops in the home position. Thus S1-D1 furnishes a ground to the Priority Start line at TB1—8. The next TTS 39XC that is seized can start its cycle of operation through use of the Priority Start ground. On the other hand, when TTS 39XB and TTS 39XC output modules are mixed and the TTS 39XB has been siezed, the Priority Start ground duration supplied when S1-D1 passes through the home position, is too short to allow a seized TTS 39XC to interrupt and get started. This problem is overcome by one-shot multivibrator U1 and inverters Q1 and Q2.

5.31 A seized, but not operating TTS 39XC applies −48 volts (through a released relay coil located on the TTS 39XC) to the Priority Start line at TB1-8. Now, when S1-D1 reaches the next position after the last tone, a negative pulse is generated by R1 and R2 to trigger U1. The output of U1 at pin 3 is a positive-going, 500-millisecond pulse. This cuts off Q1, and Q2 is turned on through R4. The Priority Start line at TB1-8 now goes to ground long enough to get the TTS 39XC started. The operation of the TTS 39XF is normal from this point on.

5.32 HOME + PULSE indicator DS1 is pulsed on each time the stepping switch is advanced, and remains lighted in the home position.

SECTION 6

MAINTENANCE AND CALIBRATION

6.1 **INTRODUCTION.**

6.2 This section contains the information necessary to maintain and calibrate all units in the TTS 39 series.

6.3 **TEST EQUIPMENT REQUIRED.**

6.4 The test equipment required to calibrate the TTS 39 series are a frequency counter capable of counting from 300 Hz to 10 kHz, an ac voltmeter with at least a 10 megohm input impedance, and a stop watch or an electronic timer.

Table 6—1. TTS 39A Oscillator Frequency-Determining Resistors.

FREQ (HZ)	HI Z (R34)	LOW Z (R35)
300	145.5k	14.134k
400	118.82k	11k
500	113k	7.5k
600	87.499k	6.3515k
800	75k	5.23k
1000	57.39k	3.809k
1200	48.7k	3.16k
1300	45.31k	2.923k
1500	42.2k	2.563k
1600	37.965k	2.3755k
1700	35.721k	2.26k
1800	34.175k	2.1122k
2000	30.75k	1.97k
2200	28.4k	1.7283k
2300	27.4k	1.69k
2400	26.192k	1.584k
2500	24.98k	1.525k
2600	24.208k	1.4626k
2700	23.5k	1.4134k
2800	22.795k	1.355k
3000	21.1k	1.27k
3200	22.554k	1.18k
3400	19.69k	1.15k
3500	18.08k	1.0845k
3800	16.9k	1k
4000	16.361k	953
10,000	6.49k	365

6.5 **CALIBRATION.**

6.6 Paragraphs 6.7 through 6.24 provide calibration instructions for the TTS 39A, TTS 39XF, TTS 39XB, and the TTS 39XC.

6.7 TTS 39A CALIBRATION.

6.8 When the TTS 39 system is used in single-frequency applications (i.e., no associated TTS 39XF is used), the frequency-determining components for the oscillator are located in the TTS 39A. Normally, the frequency is set to 1000 Hz at the factory unless otherwise indicated at the time of order input. The other adjustable parameter in the TTS 39A is the output level.

6.9 **TTS 39A Single-Frequency Calibration.** To change the single-frequency output of the TTS 39A, perform the following steps.

1. Loosen two screws that secure protective cover on front panel of TTS 39A and remove cover.

2. Select desired frequency from Table 6—1 and determine values of the two resistors to use in oscillator. If exact frequency is not listed, use next lowest frequency.

3. On oscillator board, remove old R34 and R35. See Figure 7—8.

4. Install new values for R34 and R35.

5. On TTS 39A, set POWER switch to ON.

6. Connect frequency counter to OSC TEST jack.

7. Normally, the frequency observed will be higher than the desired frequency. To bring the frequency down to the desired frequency, pad C4 and/or C5.

8. Perform output level calibration procedure presented in paragraph 6.10.

6.10 **TTS 39A Output Level Calibration.** To calibrate the TTS 39A output level, perform the following steps.

1. Loosen two screws that secure protective cover and remove.

2. Connect ac voltmeter between emitter of Q2 and ground. This is at junction of C2 and C3. See Figure 7—8.

3. Set POWER switch to ON. Allow a warm up time of at least 30 minutes to stabilize oven temperature.

4. Adjust R15 to obtain an indication of 1.5 Vrms on ac voltmeter.

5. Connect ac voltmeter to emitter of Q6. This is at the negative end of C7. See Figure 7—8.

6. Adjust R19 to obtain an indication of 4.6 Vrms on ac voltmeter.

7. To secure adjustments, apply a drop of glyptol cement to R15 and R19.

6.11 TTS 39XF CALIBRATION.

6.12 When the TTS 39XF is used, the frequency-determining resistors for the TTS 39A oscillator are located in the TTS 39XF. Normally three frequencies are cycled by the TTS 39XF. The first frequency is usually applied for 10 seconds and the others for 5 seconds each. The following procedure can be used to change, add, or delete frequencies and to change the cycling time.

6.13 **Changing, Adding, and Deleting TTS 39XF Frequencies.** The following procedure can be used to change, add, or delete frequencies.

1. On front of TTS 39XF, remove two screws that secure protective cover and remove cover.

2. On TTS 39A, set POWER switch to ON.

3. If any frequency cycling is in process, let it go to completion. This is indicated when HOME+PULSE indicator is continuously lighted.

4. To delete a frequency or frequencies at the end of a sequence, simply remove associated resitors R34 ( ) (HI-Z) and R35( ) (LO-Z) (Figure 7—13). On deck D2 of stepping switch S1, extend strapping one switch position toward wiper position for each frequency deleted. See Figure 6—1.

5. To delete a frequency or frequencies other than at the end of the sequence, remove associated resistors and move up all of the following resistors toward the wiper position to fill the vacant spaces. On deck D2 of S1, extend strapping one switch position toward the wiper position for each frequency deleted.

6. When adding frequencies, first remove some of the strapping on deck D2 of S1 as follows. Moving toward the home position, remove strapping at one switch position for each frequency being added. When simply changing frequencies, this step can be omitted.

7. On front of TTS 39A, connect frequency counter to OSC TEST jack.

8. The TTS 39XF must be cycled to the position of interest so that the oscillator in the TTS 39A will operate properly. When the stepping switch is in the home position, the oscillator output frequency is the same as when in position 1. To activate stepping switch, connect ground to TB1—4 on rear of TTS 39XF. The first time the switch advances, it will be in position 1. When the switch gets to the desired position, quickly remove the D relay from its socket. This will halt the switch so that continuous testing at a given frequency can be accomplished.

9. In Table 6—1, select desired frequency and determine the values of the resistors to use. If the exact frequency is not listed, use next lowest frequency.

10. If necessary, remove old values of R34( ) (HI-Z) and R35( ) (LO-Z) and then install new ones.

11. At this point, the measured frequency should be lower than the desired frequency. If it is, proceed to step 12. If the frequency is too high, R34 ( ) and/or R35 ( ) must be replaced with larger values until the measured frequency is lower than the desired frequency.

12. To raise the frequency, add padding resistors in parallel with R34( ) and/or R35( ) until desired frequency is obtained.

13. Repeat steps 8 through 12 for the remaining frequencies. To reactivate the stepping switch, simply plug D relay into its socket. Remove it again when the stepping switch has reached the desired position.

14. Cycle the unit until it is in the position that corresponds to the frequency that is to be used as the reference. This is normally 1000 Hz.

15. Perform TTS 39A output level calibration procedure presented in paragraph 6.10.

16. On TTS 39A, connect ac VTVM to OSC TEST jack.

17. Observe and record output level at the reference frequency.

18. Cycle unit through all active frequencies and record output level of each. It must be the same as the reference level ± 0.2 dB. If the level is too low, remove associated padding resistors and repad using only low Z resistor R35( ). This should allow the correct frequency to be set and increase the output level at the same time. If the level is too high, remove the associated padding resistor and repad using only the high Z resistor R34( ). This should allow the correct frequency to be set and lower the output level at the same time.

19. Remove the ground at TB1—4.

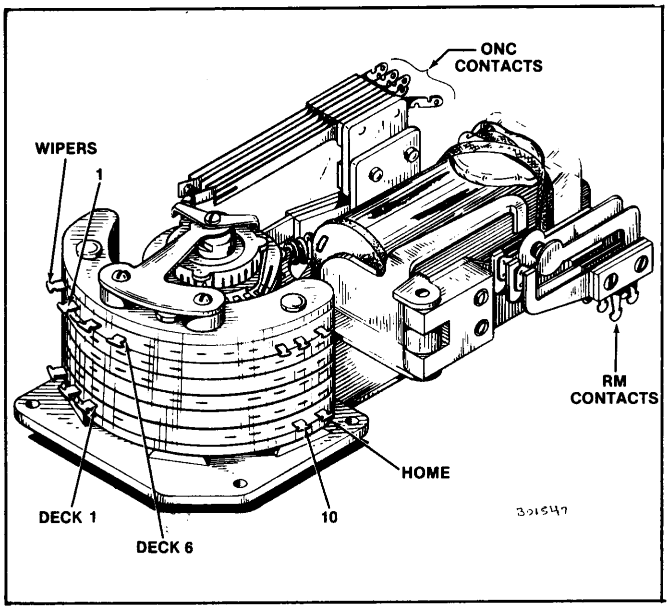

Figure 6—1. TTS 39XF Stepping Switch Pin Identification

6.14 **Changing TTS 39XF Cycle Time.** Normally the first frequency is applied for 10 seconds and the others for 5 seconds each. Other commonly used combinations are 15 seconds for the first frequency and 10 seconds for the rest, or 5 seconds for all frequencies. Procedures for these combinations are presented in the following steps.

1. On TTS 39XF front panel, remove two screws that secure cover and remove cover.

2. At rear of TTS 39A, connect −48 Vdc to TB1−1 and ground to TB1−2.

3. To change cycle time of first frequency to 15 seconds, add a 200 microfarad, 50 Vdc capacitor in parallel with the two capacitors that should already be installed on CB1 in the TTS 39XF. See Figure 7−13.

4. To change cycle time of all frequencies to 5 seconds, remove one of the 200 microfarad capacitors mounted on CB1 in TTS 39XF. Also remove all strapping wire from deck D3 on stepping switch S1. See Figure 6−1.

5. On the D relay, first check to ensure that the normally-open contact adjusting screw is backed out enough so that the contacts do not make when the relay is energized. See Figure 6−2.

6. On the D relay, adjust the normally-closed contact adjusting screw counterclockwise to increase the time and clockwise to decrease the time. Replace D relay.

7. Connect a ground to TB1−4. Frequency cycling will start.

8. Using a stop watch or any type of electronic timing device, start timing when the stepping switch cycles to the home position to measure the time of the first frequency. Stop timing at the next step of the switch. To time the other frequencies, measure the time between steps of the switch.

9. Continue to adjust relay D1, if required, until the desired time is obtained. The adjustment of D can be made during the time between steps.

6.15 TTS 39XB CALIBRATION.

6.16 The only parameters on the TTS 39XB that can be adjusted are the output impedance and the output level.

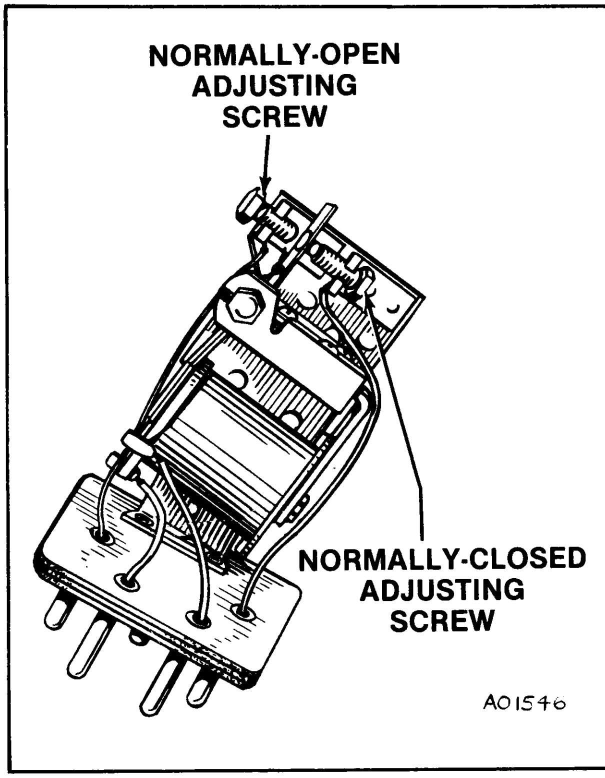

Figure 6—2. TTS 39XF D Relay Adjustments

6.17 **Changing TTS 39XB Output Impedance.** Unless otherwise indicated, the output impedance is set to 900 ohms. To change it to 600 ohms, perform the following steps.

1. On TTS 39XB of interest, remove protective cover.

2. On circuit board, locate R13. See Figure 7−15. If there is no strap across this resistor, the output impedance is 900 ohms. To change the impedance to 600 ohms, install a strap across R13.

3. Install protective cover and perform output level calibration as instructed in paragraph 6−18.

6.18 **TTS 39XB Output Level Calibration.** The TTS 39XB output level can be set within the range of −1 to +2 dBm. To set the output level within this range, perform the following steps.

1. Connect an ac voltmeter to associated TTS 39XB TEST jack.

2. Depending on the output impedance of the TTS 39XB, connect either a 600 or 900 ohm precision resistor across ac voltmeter input terminals.

3. On TTS 39A, set POWER switch to ON. If a TTS 39D is being used, set its POWER switch to ON.

4. On TTS 39XB, adjust FINE potentiometer to mid range.

5. Adjust COARSE potentiometer to obtain desired indication on ac voltmeter.

6.19 TTS 39XC CALIBRATION.

6.20 The variable parameters of the TTS 39XC are the output impedance, the output level, the quiet termination impedance, and the on-hook/quiet term cycle time.

6.21 **Changing TTS 39XC Output Impedance.** To change the TTS 39XC output impedance, perform the following steps.

1. On TTS 39XC of interest, remove protective cover.

2. On circuit board A1, locate R13. See Figure 7—15. If there is no strap across this resistor, the output impedance is 900 ohms. To change impedance to 600 ohms, install a strap across R13.

3. Replace protective cover.

4. Calibrate output level as instructed in paragraph 6.22.

6.22 **TTS 39XC Output Level Calibration.** The TTS 39XC output level can be set within the range of −1 to +2 dBm into either 600 or 900 ohms. To adjust the output level within this range, perform the following steps.

1. Connect ac voltmeter to TTS 39XC TEST jack.

2. Depending on output impedance of TTS 39XC, connect either a 600 or 900 ohm precision resistor across input terminals of ac voltmeter.

3. On TTS 39A, set POWER switch to ON. If a TTS 39D is being used, also set its POWER switch to ON.

4. On TTS 39XC to be calibrated, adjust FINE potentiometer to mid range.

5. Adjust COARSE potentiometer to obtain desired output level indication on ac voltmeter.

6.23 **Changing TTS 39XC Quiet Termination Impedance.** The quiet termination impedance is normally set to 900 ohms unless otherwise indicated. To change the quiet termination impedance, perform the following steps.

1. On circuit board A2 (Figure 7—18) locate R4. If there is no strap across this resistor, the quiet termination impedance is 900 ohms. To change the impedance to 600 ohms, install a strap across R4 (terminals F and F1).

6.24 **Changing TTS 39XC Single-Frequency Tone Duration.** Normally, when no TTS 39XF is used, the single-frequency tone is applied for 5.5 seconds. The timer in the TTS 39XC may be set to deliver a 10 second tone. If this is the case, perform the following step to obtain a 5.5 second tone.

1. On line conditioning board A2, place a jumper across terminals D-D1. This sets the timer for a 5.5 second operation cycle.

SECTION 7

DIAGRAMS

7.1 INTRODUCTION.

7.2 Figures 7–1 through 7–19 are the functional, component location, and the schematic diagrams for the TTS 39A, TTS 39D, TTS 39XF, TTS 39XB, and the TTS 39XC.

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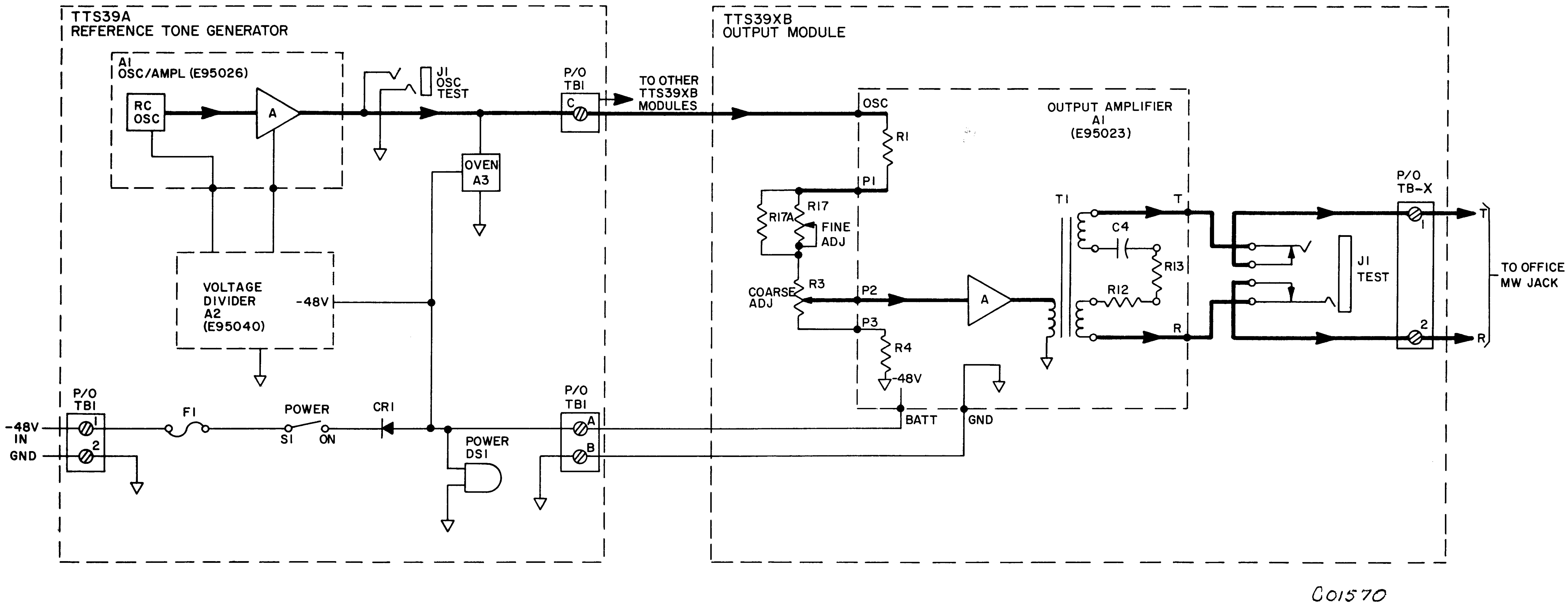

Figure 7—1. TTS 39A Reference Tone Generator Used With TTS 39XB Output Modules, Functional Diagram.

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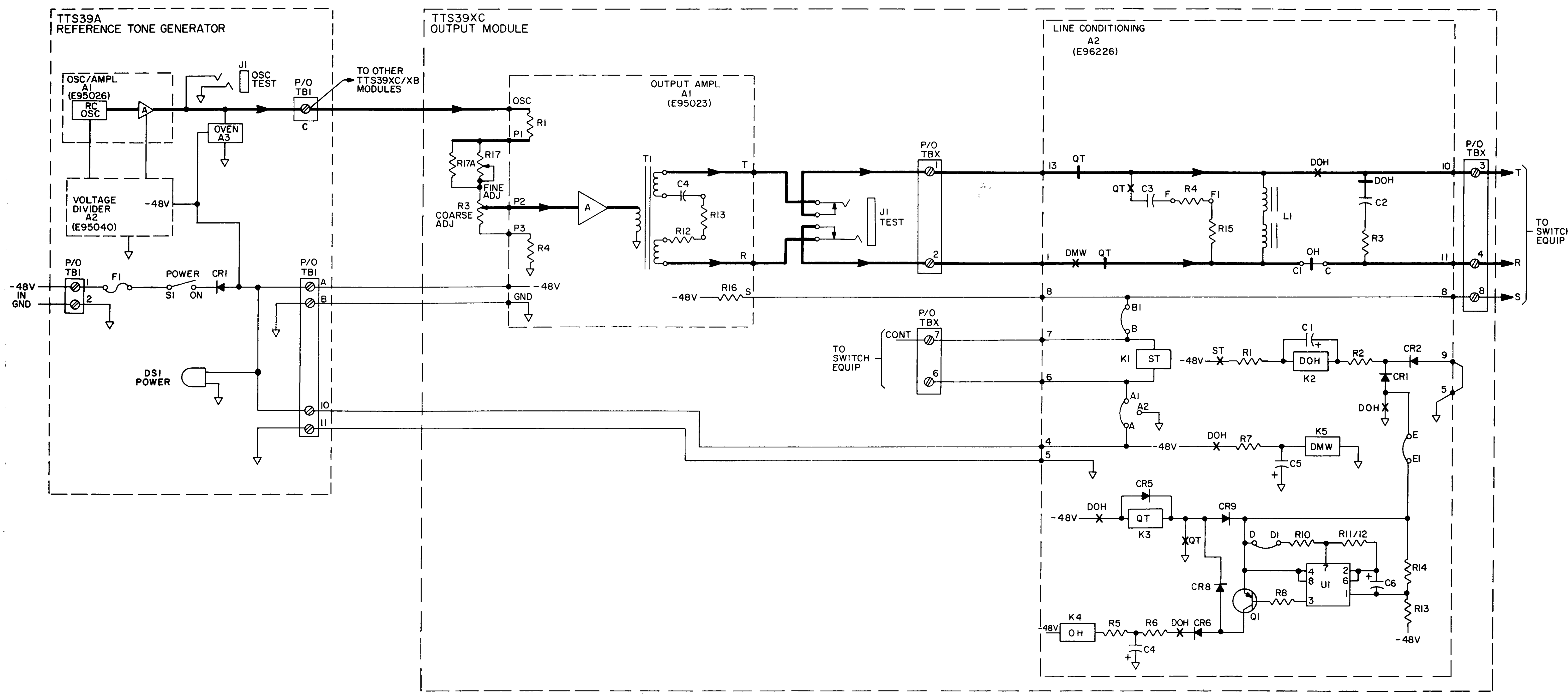

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Figure 7—2. TTS 39A Reference Tone Generator Used With TTS 39XC Output Modules, Functional Diagram.

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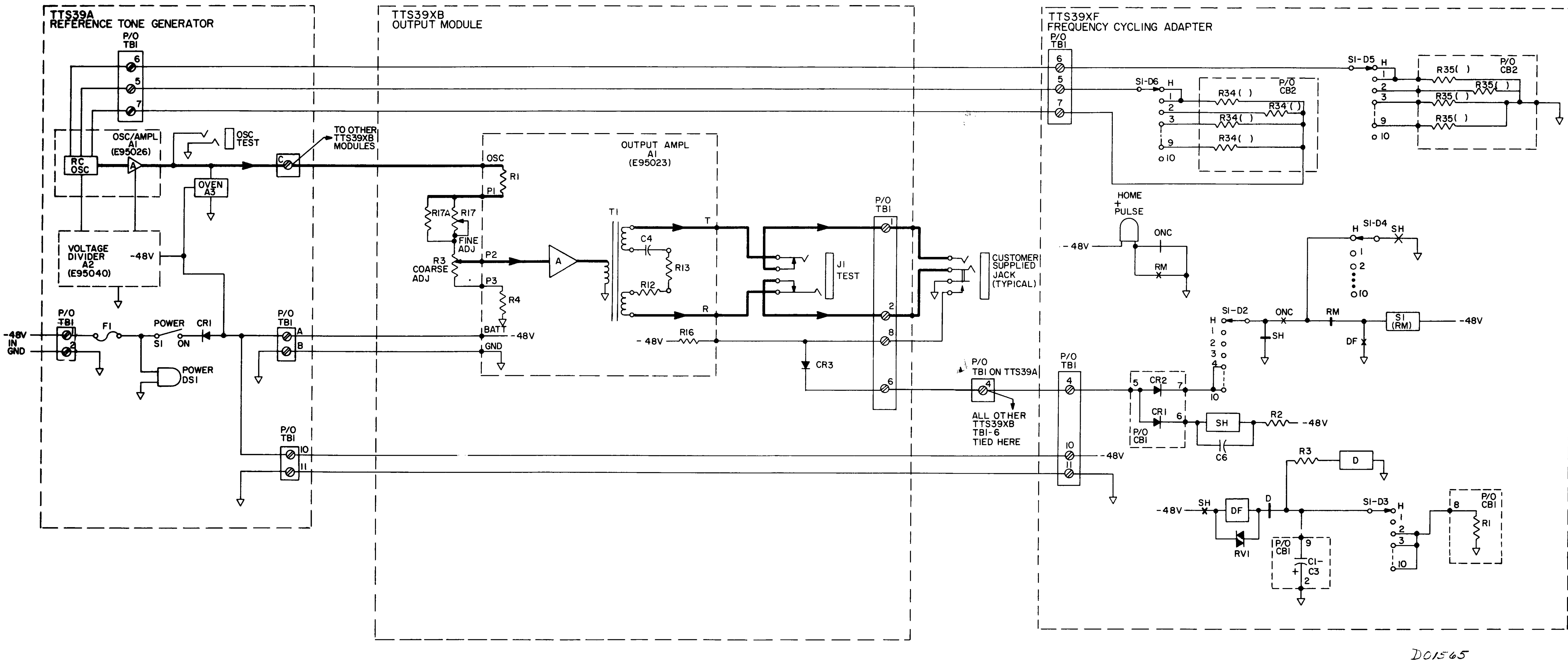

Figure 7—3. TTS 39A Reference Tone Generator Used With TTS 39XB Output Modules And TTS 39XF Frequency Switching Adapter, Functional Diagram.

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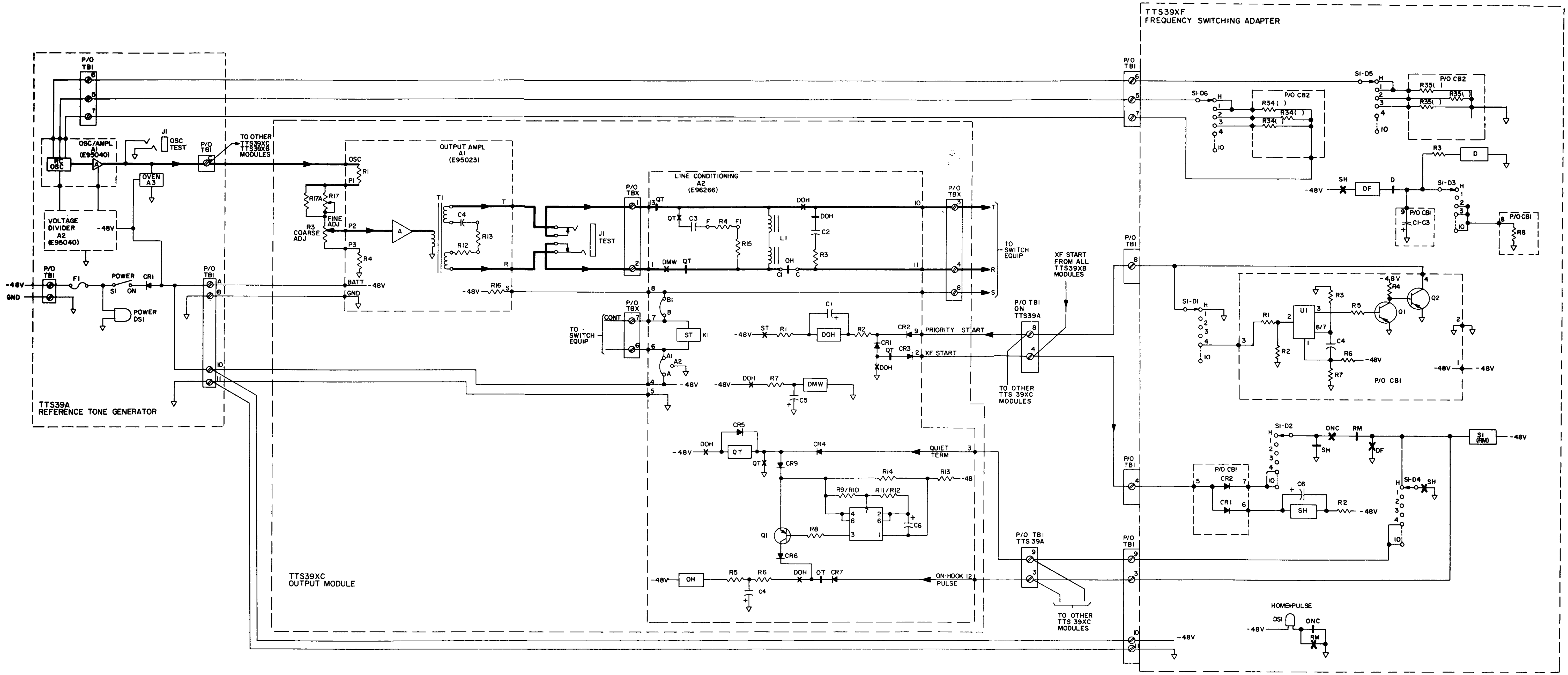

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Figure 7—4. TTS 39A Reference Tone Generator Used With TTS 39XC/XB Output Modules And TTS 39XF Frequency Switching Adapter, Functional Diagram.

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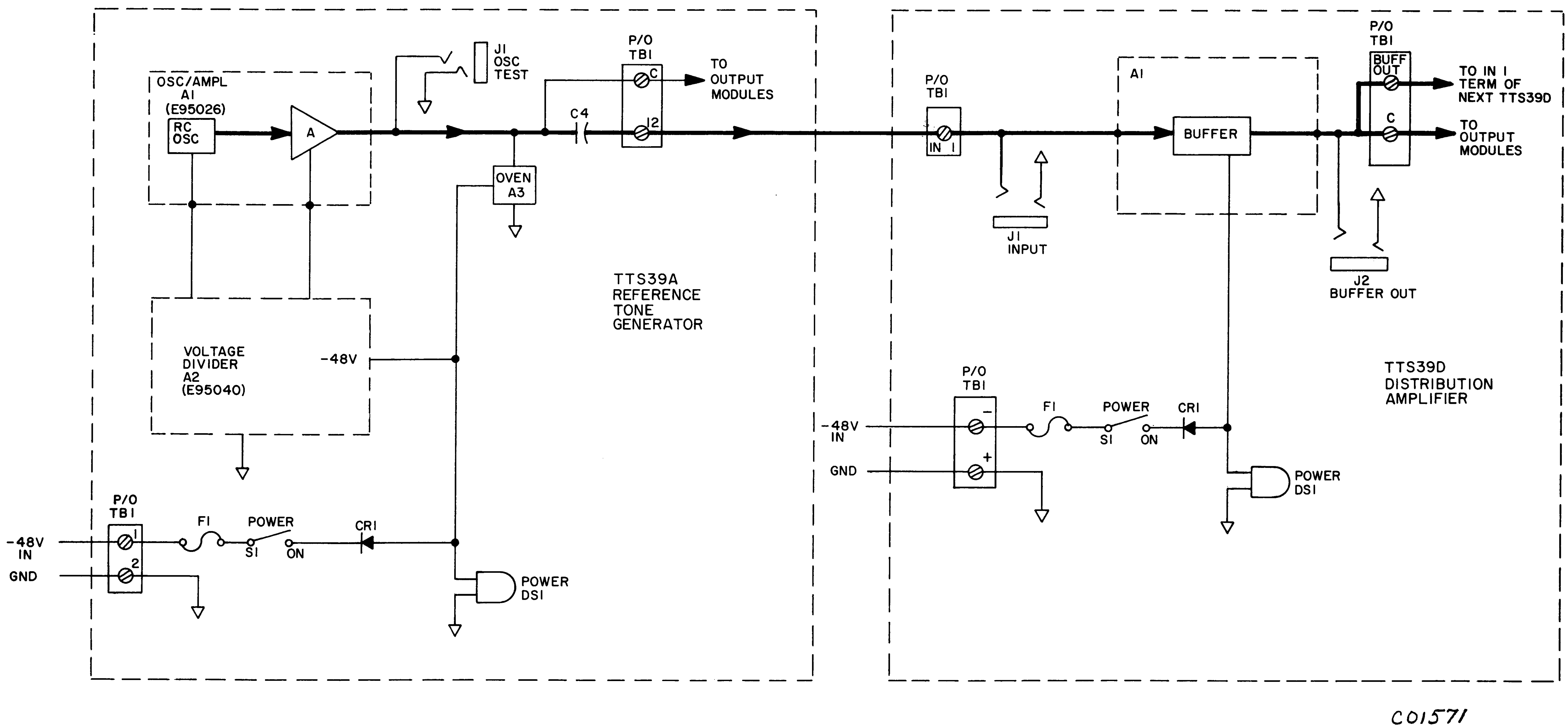


Figure 7—5. TTS 39A Reference Tone Generator Used With TTS 39D Distribution Amplifier And Output Modules, Functional Diagram.

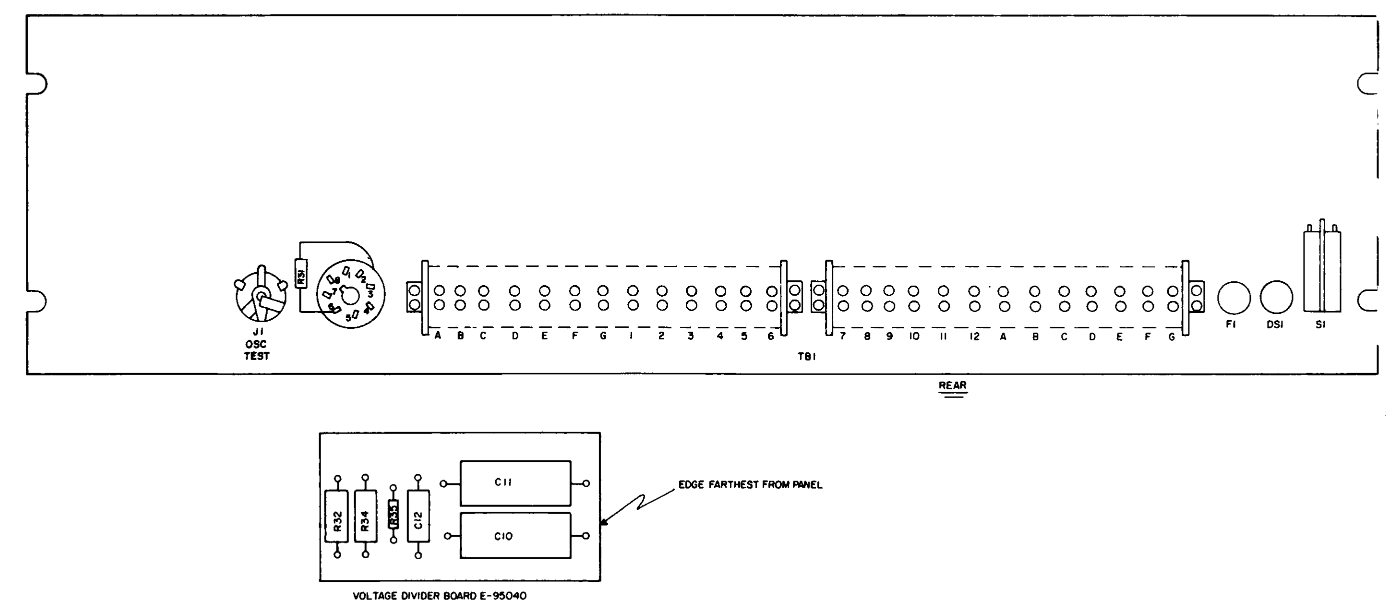
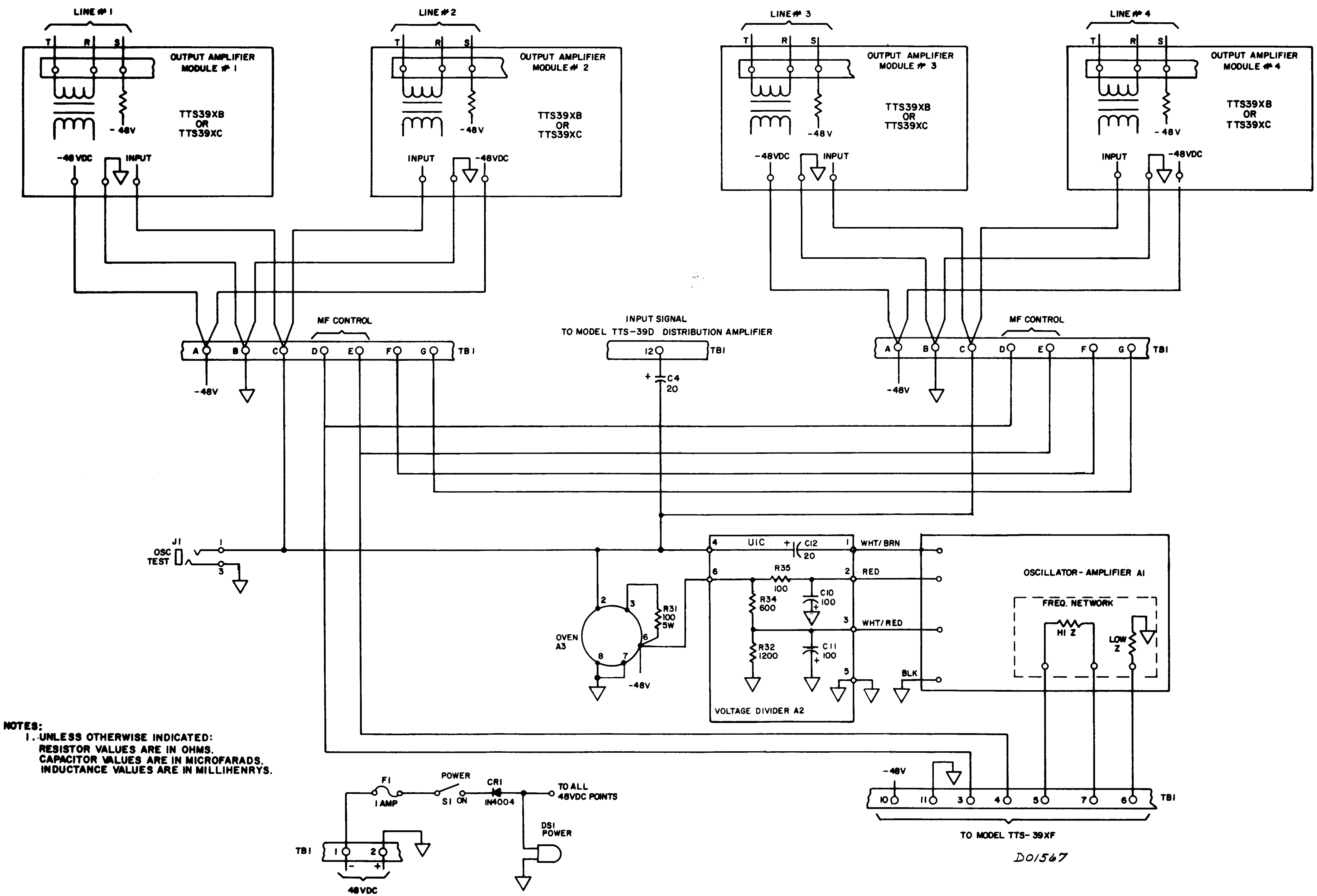


Figure 7—6. TTS 39A Front Panel And Voltage Divider Board Component Location.



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

Figure 7—7. TTS 39A Reference Tone Generator Interconnection Diagram.

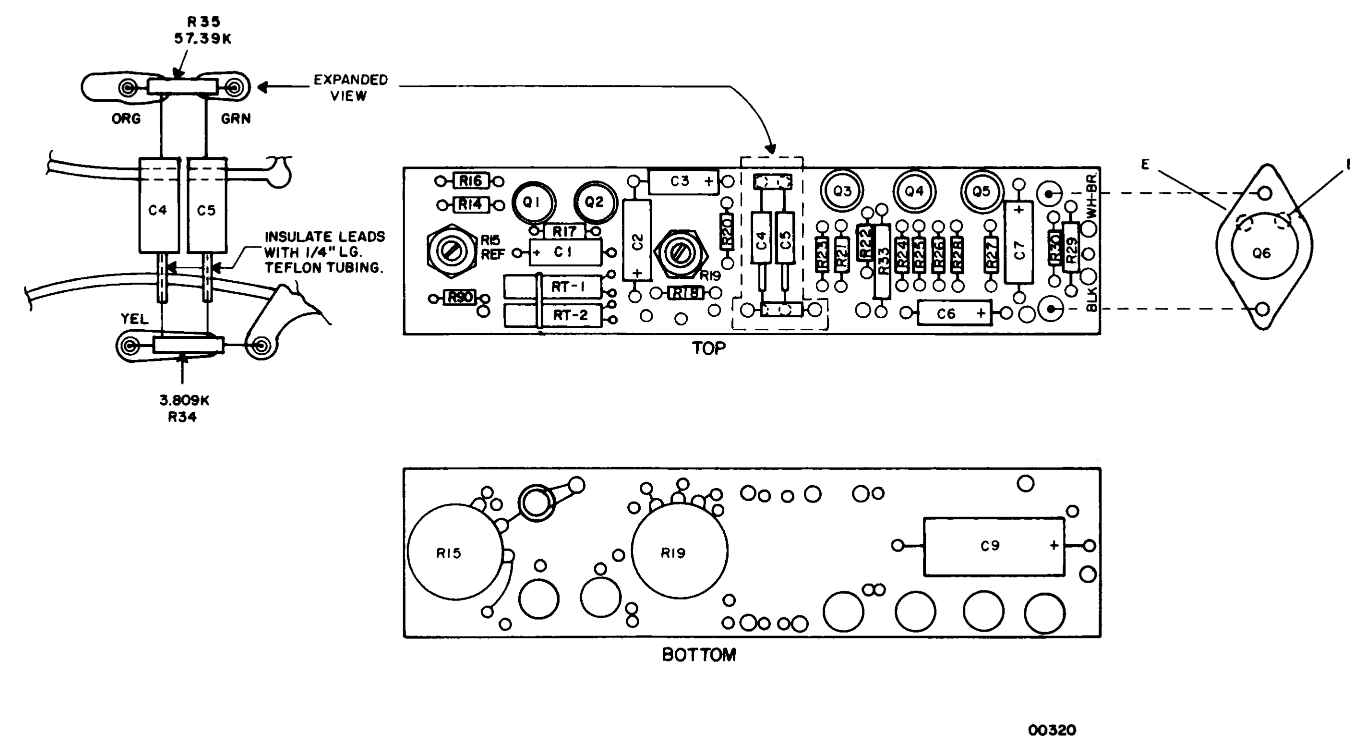
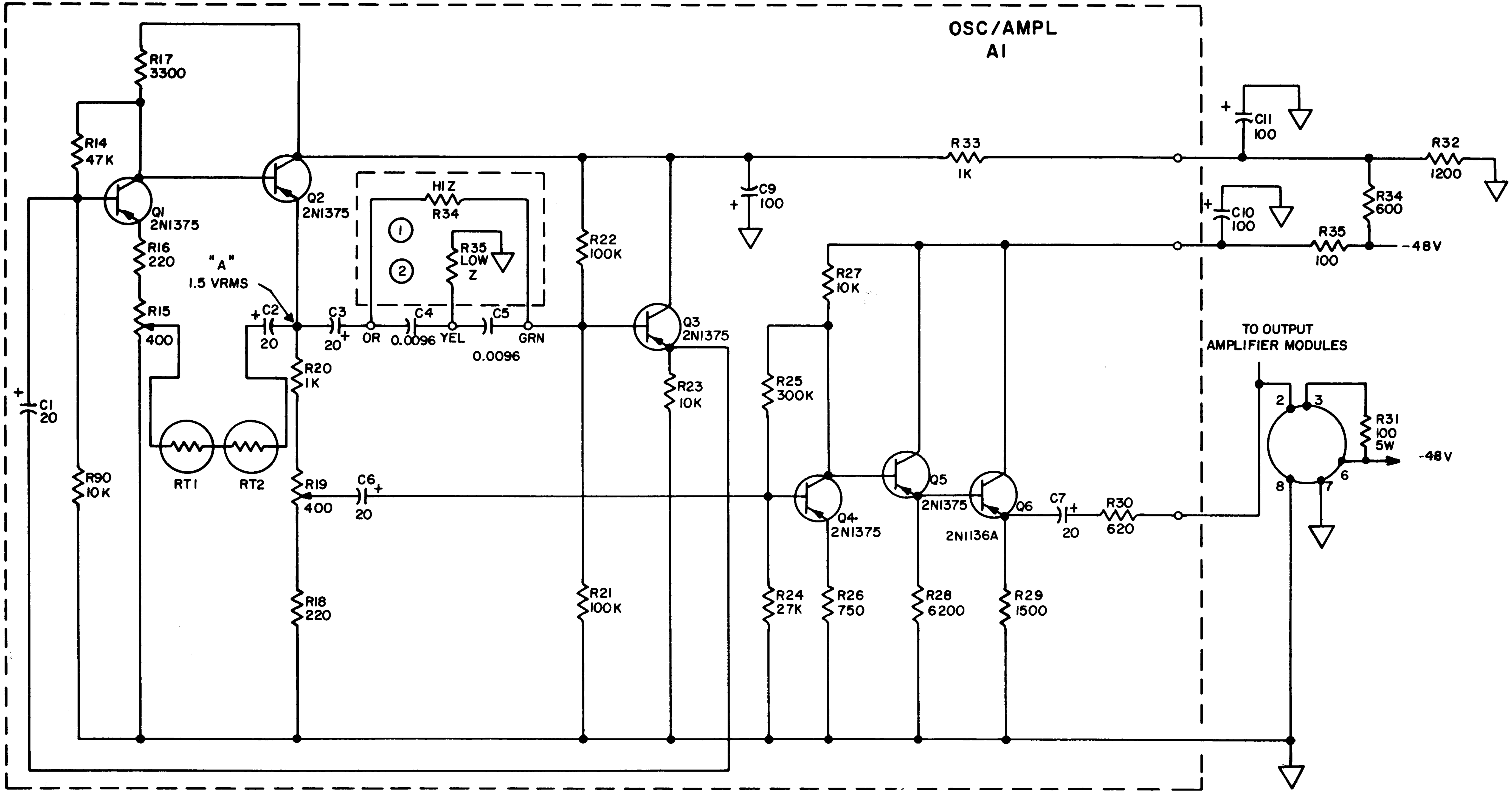


Figure 7—8. TTS 39A Oscillator/Amplifier Board Component Location.



NOTES:

1. UNLESS OTHERWISE INDICATED:
   RESISTOR VALUES ARE IN OHMS.
   CAPACITOR VALUES ARE IN MICROFARADS.
   INDUCTANCE VALUES ARE IN MILLIHENRYS.
   SELECTED VALUES TO PROVIDE DESIRED FREQUENCY

2. OMIT FOR MUTI-FREQUENCY OPERATION

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Figure 7—9. TTS 39A Oscillator/Amplifier Board Schematic Diagram.

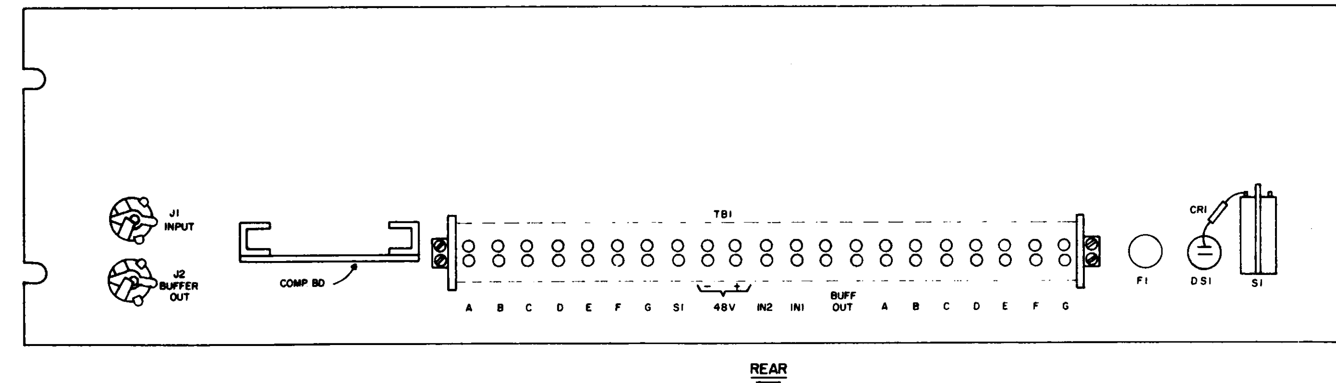

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Figure 7—10. TTS 39D Front Panel Component Location.

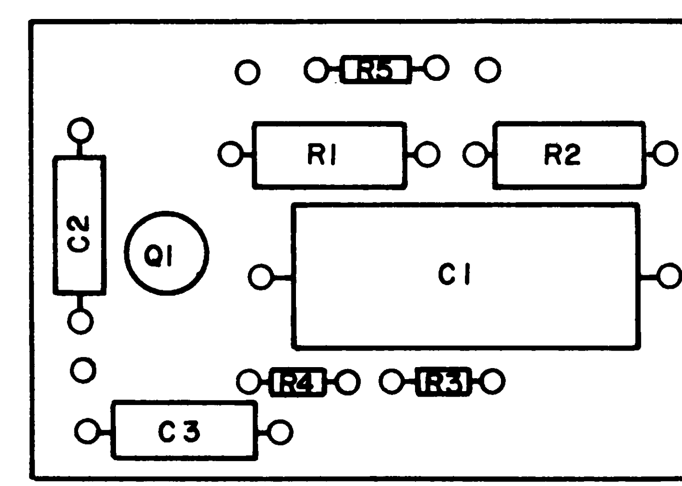

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Figure 7—11. TTS 39D Buffer Amplifier Board Component Location.

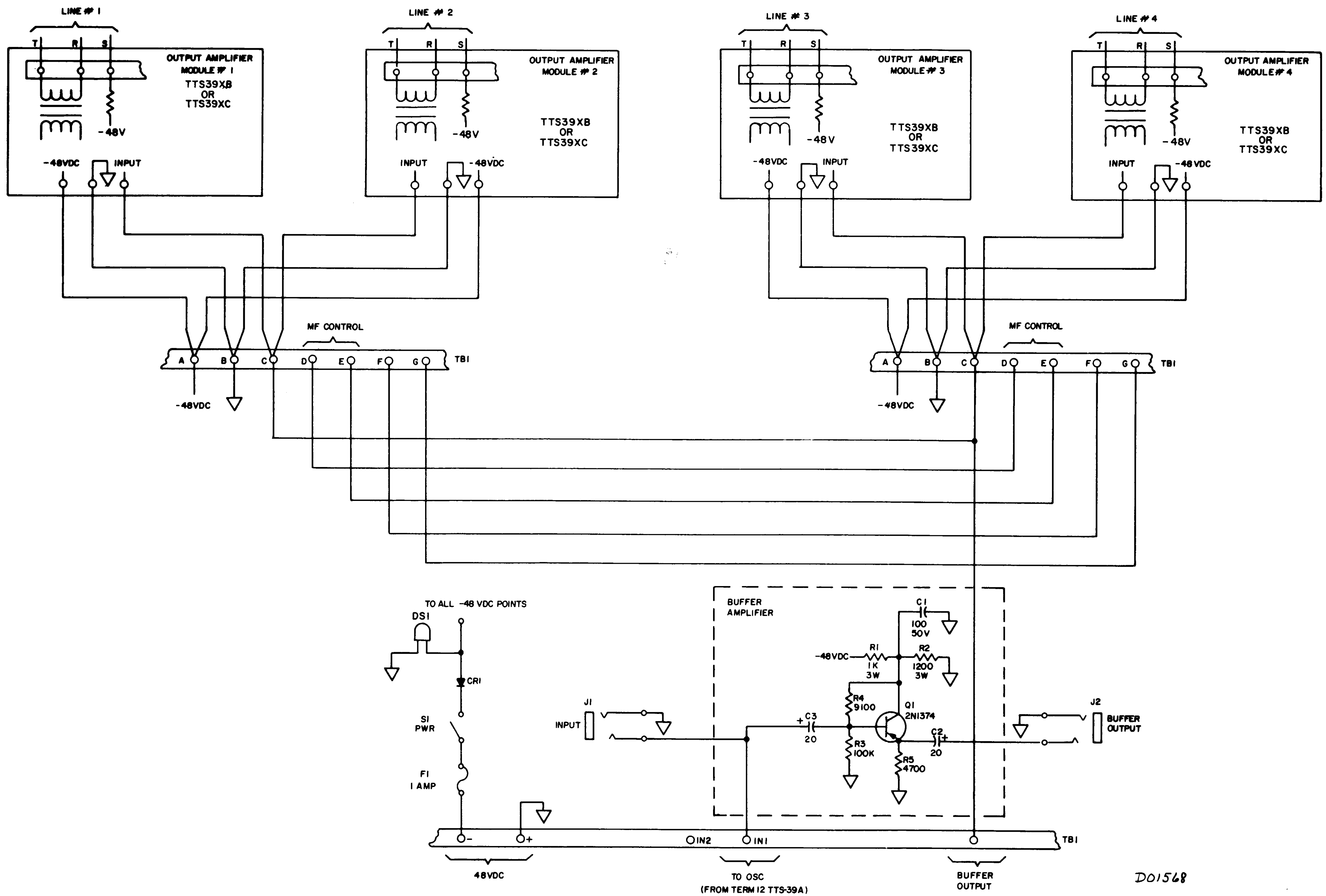


Figure 7—12. TTS 39D Interconnection Diagram.

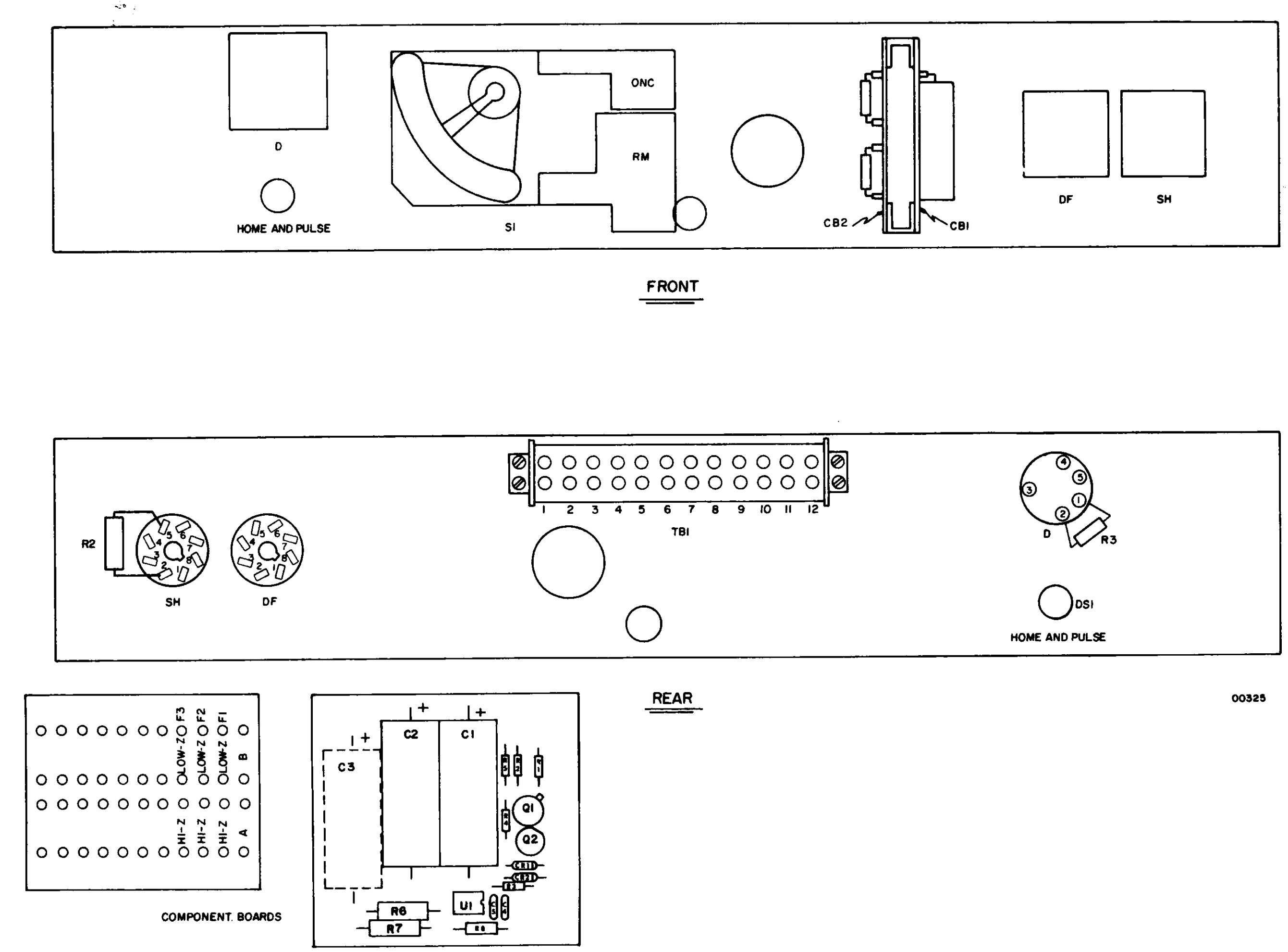
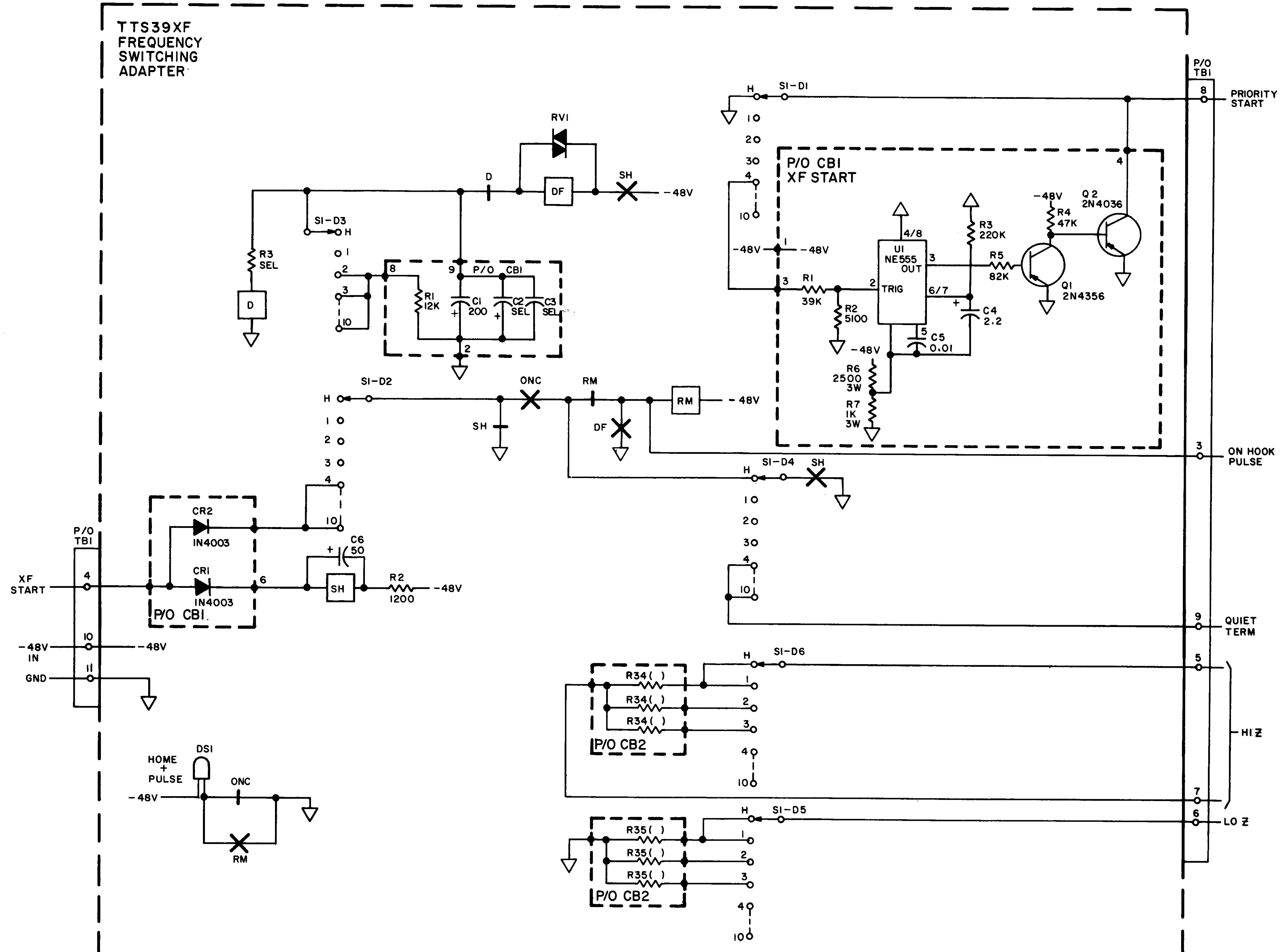


Figure 7—13. TTS 39XF Overall Component Location.



NOTES:
1. RESISTORS IN OHMS AND CAPACITORS IN MICROFARADS.
2. ALL RELAYS SHOWN NON-OPERATED.
3. ONC CONTACTS SHOWN IN HOME POSITION.
4. SI-DI, D2 AND D6 STRAPPING STARTS AT POSITION AFTER LAST TONE POSITION.

D01564

Figure 7—14. TTS 39XF Schematic Diagram.

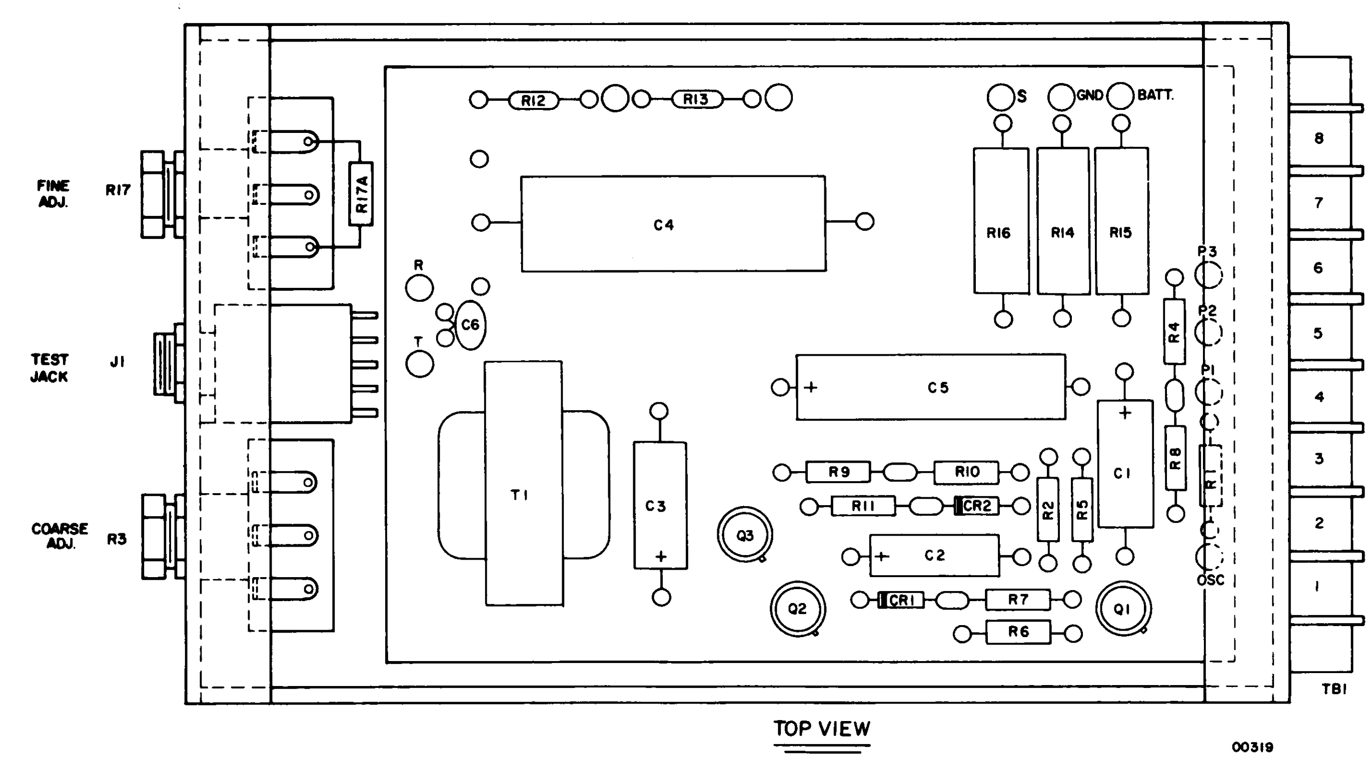
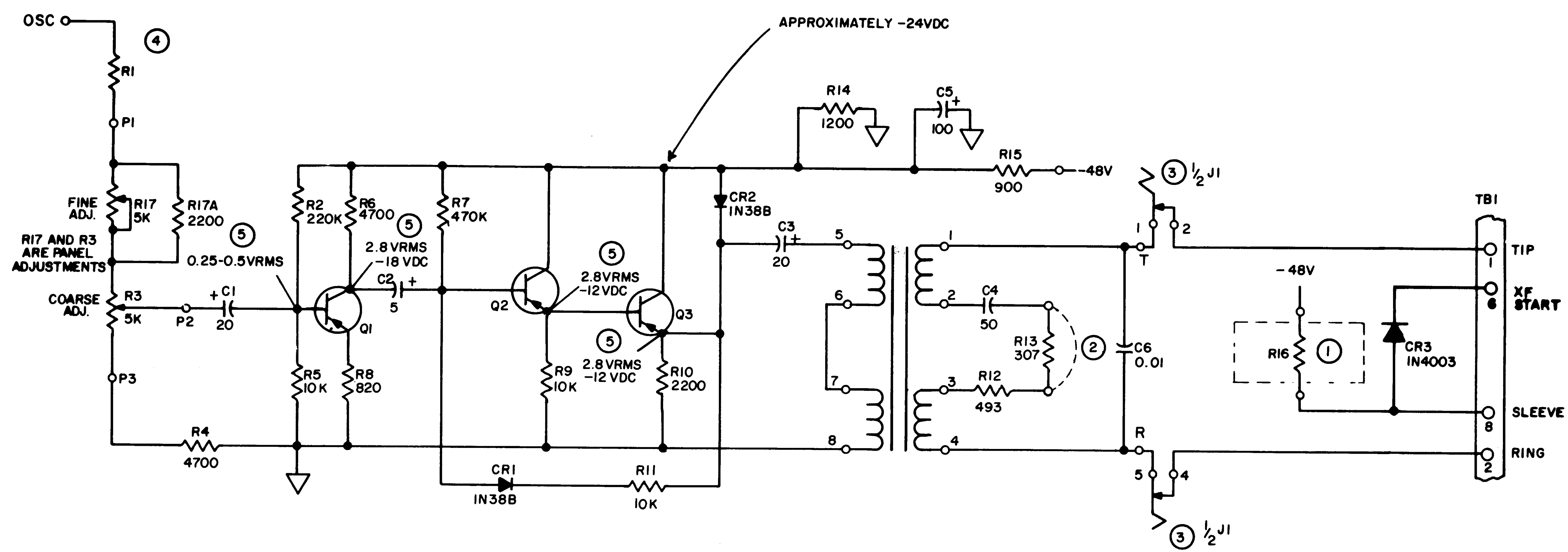


Figure 7—15. TTS 39XB/XC Output Amplifier Board Component Location.



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APPROXIMATE D.C. RESISTANCES OF T1

TERM. 5 TO TERM. 8	40Ω-60Ω
TERM. 1 TO TERM. 2	20Ω-30Ω
TERM. 3 TO TERM. 4	20Ω-30Ω

TROUBLE SHOOTING AID

NOTES:

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

(1) SLEEVE RESISTANCE NORMALLY SUPPLIED = 1200Ω

(2) INSERT STRAP FOR 600Ω, REMOVE FOR 900Ω

(3) TEST JACK

(4) SELECTED VALUE TO PROVIDE DESIRED OUTPUT RANGE

(5) RMS VOLTAGES MEASURED WITHOUT FINAL OUTPUT LOADED

Figure 7—16. TTS 39XB Schematic Diagram.

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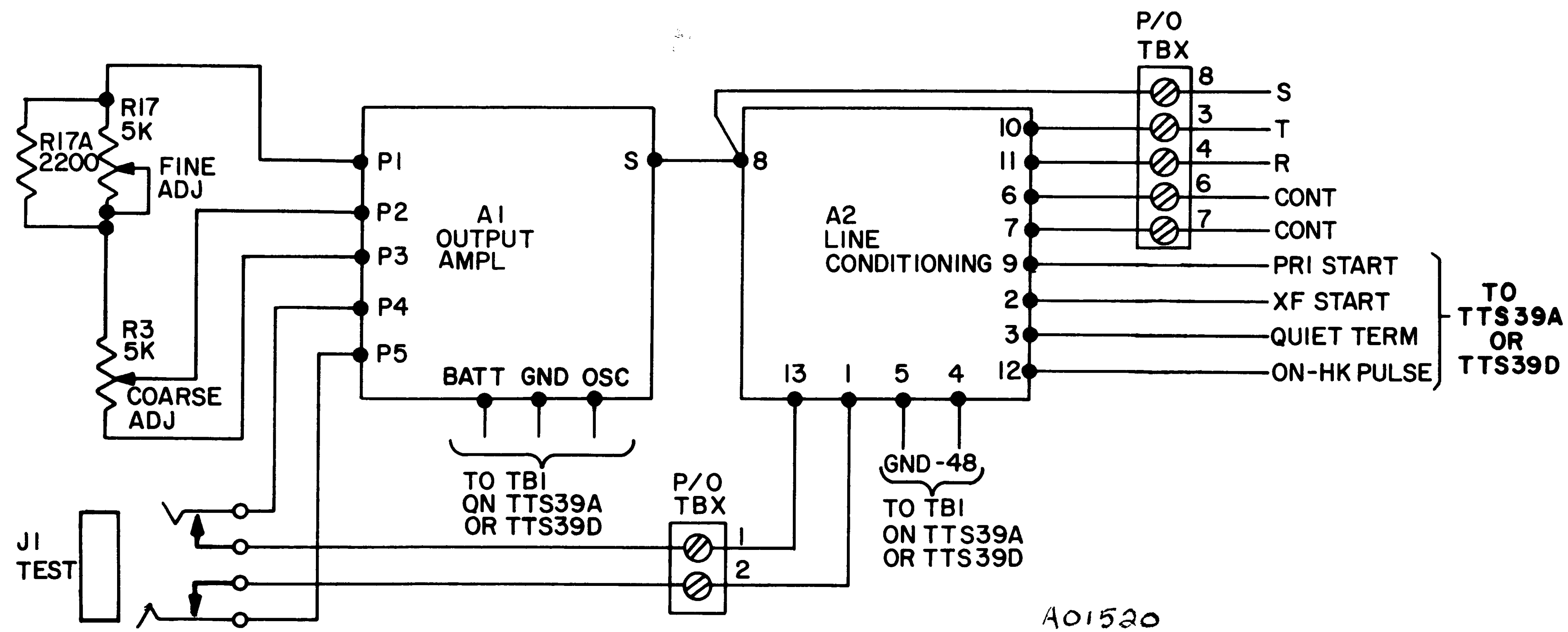


Figure 7—17. TTS 39XC Interconnection Diagram.

B-1-A-2-+
A1-A-−

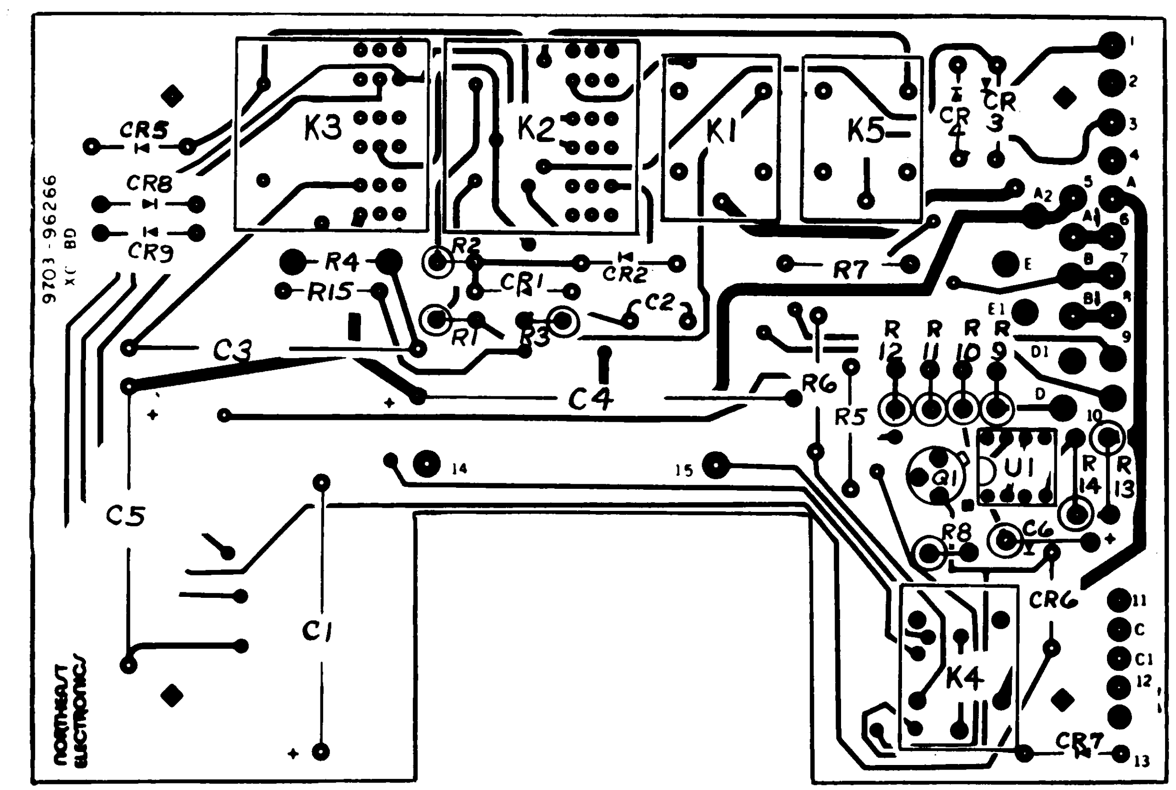
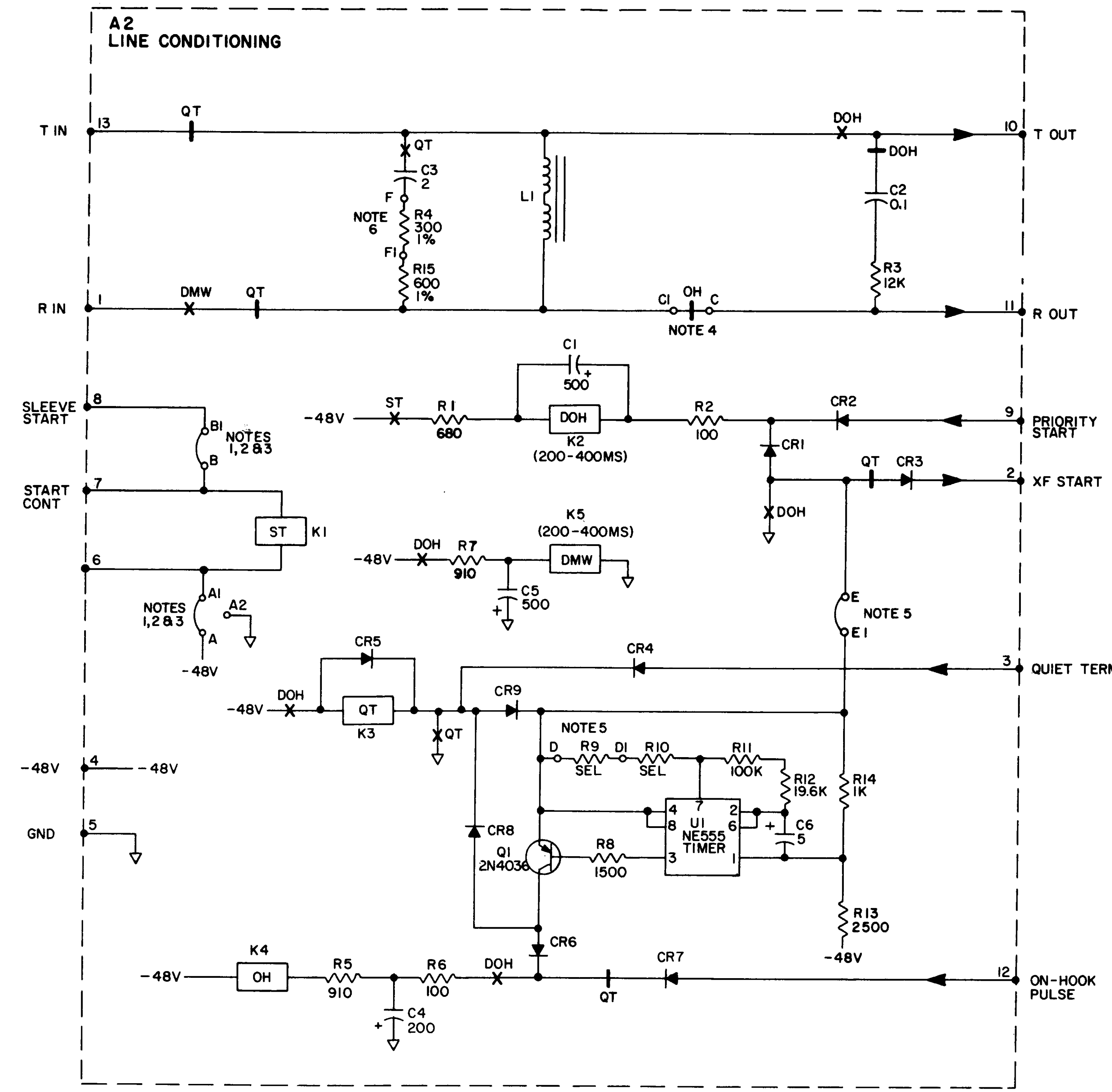


Figure 7—18. TTS 39XC Line Conditioning Board A2 Component Location.



NOTES:
1. FOR GROUND SLEEVE SEIZURE STRAP A-A1 & B-B1.
2. FOR BATTERY SLEEVE SEIZURE STRAP A1-A2 & B-B1.
3. FOR TYPES I & III E&M, STRAP A1-A2.
   FOR TYPE II E&M, STRAP A-A1 & B1-A2.
4. FOR NO ON HK/OFF HK CYCLING STRAP C-C1.
5. WHEN NOT USING TTS39XF, STRAP D-D1 FOR 5.5 SEC TONE AND STRAP E-E1 FOR ON HK/OFF HK CYCLING AFTER TONE. ALSO STRAP 9 TO 5 (GND).
6. FOR 600 OHMS STRAP F-F1. OMIT FOR 900 OHMS.
7. RESISTORS ARE IN OHMS & CAPACITORS IN MICROFARADS.
8. ALL DIODES ARE 1N4003.

REF DES	A2
P/N	C003970011
I.D. NO.	96266

D01510

Figure 7—19. TTS 39XC Line Conditioning Board A2 Schematic Diagram.

SECTION 8

PARTS LIST

8.1 INTRODUCTION.

8.2 Tables 8—1 through 8—11 are the electronic parts list for the TTS 39 series.

Table 8—1. TTS 39A Reference Tone Generator Overall Parts List.

REFERENCE DESIGNATOR	DESCRIPTION VALUE	POWER	TOL	VOLTS	MFGR.	MFGR. PART NO.	N.E. PART NO.
CR1	D041		3	400V	EDAL	IN4004	560040040
DS1	T-2 SLIDE BASE				SYL	60A	730000200
F1	FUSE 3AG				LITTELFUSE	3AG	863100400
J1	JACK,TEL,SWCRFT SCHEM 4				SWCRFT	L12B	650100300
R31	100#	5W	5%		W LEONARD	TYPE 5XM	210401015
S1	SPST	6A		125V	J-B-T	ST12A	620100100
TB1	13 CONTACT				CINCH	13-140 3/4W	850001000
XDS1	LAMP HOLDER,GREEN				DIALCO	105-4428-0722-200	828000200
XF1	FUSEHOLDER,3AG PANEL				BUSSMAN	HKP	863000100

Table 8—2. TTS 39A Oscillator/Amplifier Circuit Board A1 Parts List.

REFERENCE DESIGNATOR	DESCRIPTION VALUE	POWER	TOL	VOLTS	MFGR.	MFGR. PART NO.	N.E. PART NO.
C1	20UF			25V	C. DUBILIE	NLW-20-25	300902060
C2	20UF			25V	C. DUBILIE	NLW-20-25	300902060
C3	20UF			25V	C. DUBILIE	NLW-20-25	300902060
C4	.0096UF		5%	100V	F-DYNE	PS11-.0096-100-5	321509620
C5	.0096UF		5%	100V	F-DYNE	PS11-.0096-100-5	321509620
C6	20UF			25V	C. DUBILIE	NLW-20-25	300902060
C7	20UF			50V	SPRAGUE	TE1305	300202061
C9	100UF			50V	C. DUBILIE	NLW-100-50	300901072
Q1	TO5AFC	250MW		45V	TI	2N1375	553013750
Q2	TO5AFC	250MW		45V	TI	2N1375	553013750
Q3	TO5AFC	250MW		45V	TI	2N1375	553013750
Q4	TO5AFC	250MW		45V	TI	2N1375	553013750
Q5	TO5AFC	250MW		45V	TI	2N1375	553013750
Q6	TO3LPA	106W		50V	BENDIX	2N1136A	553011361
R14	47K	1/2W	10%		AB	TYPE EB	200204736
R15	400#	2W	10%		CLAROSTAT	CM22425NP	230804010
R16	220-	1/2W	10%		AB	TYPE EB	200202216
R17	3.3K	1/2W	5%		AB	TYPE EB	200203325
R18	220-	1/2W	10%		AB	TYPE EB	200202216
R19	400#	2W	10%		CLAROSTAT	CM22425NP	230804010
R20	1K	1/2W	10%		AB	TYPE EB	200201026
R21	100K	1/2W	10%		AB	TYPE EB	200201046
R22	100K	1/2W	10%		AB	TYPE EB	200201046
R23	10K	1/2W	10%		AB	TYPE EB	200201036
R24	27K	1/2W	10%		AB	TYPE EB	200202736
R25	300K	1/2W	5%		AB	TYPE EB	200203045
R26	750-	1/2W	5%		AB	TYPE EB	200207515
R27	10K	1/2W	10%		AB	TYPE EB	200201036
R28	6.2K	1/2W	5%		AB	TYPE EB	200206225
R29	1.5K	1W	10%		AB	TYPE GB	200301526
R30	620-	1/2W	5%		AB	TYPE EB	200206215
R33	1K	1W	10%		AB	TYPE GB	200301026
R34-35	SELVAL	1/8W	.5%		ELECTRA	RN55 SIZE 100 PPM	220300000
R90	10K	1/2W	10%		AB	TYPE EB	200201036
RT1	LAMP,WEIN BRIDGE				SYLVANIA	SEE DWG	730100301
RT2	LAMP,WEIN BRIDGE				SYLVANIA	SEE DWG	730100301

Table 8—3. TTS 39A Voltage Divider Circuit Board A2 Parts List.

REFERENCE DESIGNATOR	DESCRIPTION VALUE	POWER	TOL	VOLTS	MFGR.	MFGR. PART NO.	N.E. PART NO.
C10-11	100UF			75V	SPRAGUE	39D107G075EL4	300001070
C12	20UF			25V	C. DUBILIE	NLW-20-25	300902060
R32	1.2K	3W	10%		IRC	PW3	210301226
R34	600#	3W	10%		IRC	PW3	210306016
R35	100-	1/2W	10%		AB	TYPE EB	200201016

Table 8—4. TTS 39D Distribution Amplifier Overall Parts List.

REFERENCE DESIGNATOR	DESCRIPTION VALUE	POWER	TOL	VOLTS	MFGR.	MFGR. PART NO.	N.E. PART NO.
CR1	D041	3		400V	EDAL	IN4004	560040040
DS1	T-2 SLIDE BASE				SYL	60A	730000200
F1	FUSE 3AG				LITTELFUSE	3AG	863100400
J1	JACK,TEL,SWCRFT SCHEM 4				SWCRFT	12B	650101000
J2	JACK,TEL,SWCRFT SCHEM 4				SWCRFT	12B	650101000
S1	SPST	6A		125V	J-B-T	ST12A	620100100
TB1	21 CONTACT				CINCH	21-140 3/4W	850001700
XDS1	LAMP HOLDER,GREEN				DIALCO	105-4428-0722-200	828000200

Table 8—5. TTS 39D Buffer Amplifier Circuit Board A1 Parts List.

REFERENCE DESIGNATOR	DESCRIPTION VALUE	POWER	TOL	VOLTS	MFGR.	MFGR. PART NO.	N.E. PART NO.
C1	100UF			50V	SPRAGUE	TVA1310	300401070
C2	20UF			25V	C. DUBILIE	NLW-20-25	300902060
C3	20UF			25V	C. DUBILIE	NLW-20-25	300902060
Q1	TO5AFC	250MW		25V	TI	2N1374	553013740
R1	1K	3W	10%		IRC	PW3	210301026
R2	1.2K	3W	10%		IRC	PW3	210301226
R3	100K	1/2W	10%		AB	TYPE EB	200201046
R4	9.1K	1/2W	5%		AB	TYPE EB	200209125
R5	4.7K	1/2W	10%		AB	TYPE EB	200204726

Table 8—6. TTS 39XF Frequency Switching Adapter Overall Parts List.

REFERENCE DESIGNATOR	DESCRIPTION VALUE	POWER	TOL	VOLTS	MFGR.	MFGR. PART NO.	N.E. PART NO.
C6	50UF			50V	SPRAGUE	TE1307	300205063
D	12K	1.2MA			SIGMA	4R-12000LG-SIL	604500100
DF	.5K	20MA			SIGMA	42R0500GSIL	604600100
DS1		50MA		48V	SYL	60A	730000200
R2	1.2K	3W	10%		IRC	PW3	210301226
R3	SEL.VAL.	1/2W			AB	TYPE EB	200200000
RV-1	SILICON				AE	RY-57	565557000
S1	6 DECK 10 STEP				AE	PW-56778-1	615100200
SH	.5K	20MA			SIGMA	42R0500GSIL	604600100
TB1	12 CONTACT				CINCH	12-140 3/4W	850000900
XDS1	LAMP HOLDER,GREEN				DIALCO	-105-4428-0722-200	828000200

Table 8—7. TTS 39XF Component Board CB2 Parts List.

REFERENCE DESIGNATOR	D E S C R I P T I O N VALUE	POWER	TOL	VOLTS	MFGR.	MFGR. PART NO.	N.E. PART NO.
C1	200UF			50V	IEI	PC200LR50L	301002070
C2	200UF			50V	IEI	PC200LR50L	301002070
CR3-4	D041	3		400V	EDAL	1N4004	560040040
R1	12K	1/2W	10%		AB	TYPE EB	200201236

Table 8—8. TTS 39XF Component Board CB1 Parts List.

REFERENCE DESIGNATOR	D E S C R I P T I O N VALUE	POWER	TOL	VOLTS	MFGR.	MFGR. PART NO.	N.E. PART NO.
C1-2	200 UF			50V	SPRAGUE	39D207G050J4	300002071
C4	2.2UF	Y5V TC	20%	50V	ERIE	8141-050-651-225M	330802250
C5	.01UF	Z5UTC	GMV	1KV	CENTRALAB	DD-103	330101030
CR1-2	D041	1A	SI	200V	EDAL	1N4003	560040030
Q1	T0105	350MW TC	PNP	80V	FAIRCHILD	2N4356	552043560
Q2	T05	7W TA	PNP	65V	RCA	2N4036	552040360
R1	39K	1/8W	10%		AB	TYPE BB	200003936
R2	4.7K	1/8W	10%		AB	TYPE BB	200004726
R3	220K	1/8W	10%		AB	TYPE BB	200002246
R4	47K	1/8W	10%		AB	TYPE BB	200004736
R5	82K	1/8W	10%		AB	TYPE BB	200008236
R6	2.5K	3W	5%		W LEONARD	TYPE 3X	210302525
R7	1K	3W	5%		W LEONARD	TYPE 3X	210301025
R8	12K	1/2W	10%		AB	TYPE EB	200201236
U1	8DIP-P			LM	SIGNETICS	NE 555V	510005550

Table 8—9. TTS 39XB Output Module Parts List.

REFERENCE DESIGNATOR	D E S C R I P T I O N VALUE	POWER	TOL	VOLTS	MFGR.	MFGR. PART NO.	N.E. PART NO.
CR3	D041			200V	EDAL	1N4003	560040030
J1	JACK,WE-310 ACCEPTANCE				SWCRFT	C-54B	650200400
PC1	PC BD E95023						A003951003
R3	5K	2W	10%		CLAROSTAT	CM29064NP	230805020
R17	5K	2W	10%		CLAROSTAT	CM29064NP	230805020
R17A	2.2K	1/2W	5%		AB	TYPE EB	200202225

Table 8—10. TTS 39XB And TTS 39XC Output Amplifier Circuit Board A1 Parts List.

REFERENCE DESIGNATOR	DESCRIPTION VALUE	POWER	TOL	VOLTS	MFGR.	MFGR. PART NO.	N.E. PART NO.
C1	20UF			25V	C. DUBILIE	NLW-20-25	300902060
C2	5UF			50V	SPRAGUE	TE1303	300205051
C3	20UF			25V	C. DUBILIE	NLW-20-25	300902060
C4	50UF			75V	TSI	PA50LR75NP	301305061
C5	100UF			50V	C. DUBILIE	NLW-100-50	300901072
C6	.001UF		20%	1KV	SPRAGUE	5GA-D10	330401020
CR1	D041	1A	SI	400V	EDAL	IN4004	560040040
CR2	D041	1A	SI	400V	EDAL	IN4004	560040040
Q1	T05	250MW	TC PNP	45V	TI	2N1375	553013750
Q2	T05	250MW	TC PNP	45V	TI	2N1375	553013750
Q3	T05	250MW	TC PNP	45V	TI	2N1375	553013750
R1	3.9K	1/2W	5%		AB	TYPE EB	200203925
R2	220K	1/2W	10%		AB	TYPE EB	200202246
R4	4.7K	1/2W	5%		AB	TYPE EB	200204725
R5	10K	1/2W	5%		AB	TYPE EB	200201035
R6	4.7K	1/2W	5%		AB	TYPE EB	200204725
R7	470K	1/2W	10%		AB	TYPE EB	200204746
R8	820-	1/2W	10%		AB	TYPE EB	200208216
R9	10K	1/2W	5%		AB	TYPE EB	200201035
R10	2.2K	1/2W	5%		AB	TYPE EB	200202225
R11	10K	1/2W	5%		AB	TYPE EB	200201035
R12	493-	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220249301
R13	307-	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220230701
R14	1.2K	3W	10%		IRC	PW3	210301226
R15	900-	3W	10%		IRC	PW3	210309016
R16	1.2K	3W	10%		IRC	PW3	210301226
T1	600/600	1 WATT	10%		UTRAD	5702A	400300300

Table 8—11. TTS 39XC Output Module Parts List.

REFERENCE DESIGNATOR	DESCRIPTION VALUE	POWER	TOL	VOLTS	MFGR.	MFGR. PART NO.	N.E. PART NO.
A1	PC BD E95023						A003951003
A2	TTS 39 LINE CONDITIONING						A003970011
J1	JACK,WE-310 ACCEPTANCE				SWCRFT	C-54B	650200400
L1	HOLD COIL				BERKSHIRE	11415	450200201
R3	5K	2W	10%		CLAROSTAT	CM29064NP	230805020
R17	5K	2W	10%		CLAROSTAT	CM29064NP	230805020
R17A	2.2K	1/2W	5%		AB	TYPE EB	200202225
TBX	8 CONTACT				CINCH	8-140 3/4W	850000600

Table 8—12. TTS 39XC Line Conditioning Circuit Board Parts List.

REFERENCE DESIGNATOR	DESCRIPTION VALUE	POWER	TOL	VOLTS	MFGR.	MFGR. PART NO.	N.E. PART NO.
C1	500UF			25V	SPRAGUE	39D507G025HE4	300005070
C2	.1UF		20%	500V	SPRAGUE	5GA-P10	330401040
C3	2UF			200V	F-DYNE	MPE11-2.0-200-10	301302050
C4	200UF			25V	SPRAGUE	39D207G025EJ4	300002070
C5	500UF			25V	SPRAGUE	39D507G025HE4	300005070
C6	5UF			16V	SPRAGUE	TE1152	300205050
CR1-9	D041	1A	SI	200V	EDAL	1N4003	560040030
K1	3.3K	14.5MA		48V	MIDTEX	210-11D100	604800400
K2	6C PC TYPE H				AE-NIPPON	PD1400A18-MR11N54	600600400
K3	6C PC TYPE H				AE-NIPPON	PD1400A22-MR11N58	600600500
K4-5	830-	29MA		24V	MIDTEX	210-11C100	604800300
Q1	TO5	7W	TA PNP	65V	RCA	2N4036	552040360
R1	680-	1/2W	5%		AB	TYPE EB	200206815
R2	100-	1/2W	10%		AB	TYPE EB	200201016
R3	12K	1/2W	10%		AB	TYPE EB	200201236
R4	300-	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220230001
R5	910-	1/2W	5%		AB	TYPE EB	200209115
R6	100-	1/2W	10%		AB	TYPE EB	200201016
R7	910-	1/2W	5%		AB	TYPE EB	200209115
R8	1.5K	1/2W	10%		AB	TYPE EB	200201526
R9-10	SEL.VAL.	1/2W			AB	TYPE EB	200200000
R11	100K	1/2W	10%		AB	TYPE EB	200201046
R12	19.6K	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220219621
R13	2.5K	3W	5%		W LEONARD	TYPE 3X	210302525
R14	1K	1W	10%		AB	TYPE GB	200301026
R15	600-	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220260001
U1	8DIP-P			LM	SIGNETICS	NE 555V	510005550
XK1	COVER DUST 210 RELAY				MIDTEX	Z10-11	810300300
XK4-5	COVER DUST 210 RELAY				MIDTEX	Z10-11	810300300