

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

OPERATOR, ORGANIZATIONAL, DS, GS,
AND DEPOT MAINTENANCE MANUAL

REFERENCE TONE GENERATOR
NORTHEAST ELECTRONICS CORPORATION
MODELS TTS-39A AND TTS-39B
AND ACCESSORIES



HEADQUARTERS, DEPARTMENT OF THE ARMY
MARCH 1969

WARNING

THIS EQUIPMENT USES POTENTIALLY DANGEROUS VOLTAGES WHICH CAN BE FATAL IF CONTACTED BY OPERATING PERSONNEL. EXTREME CAUTION SHOULD BE EXERCISED WHEN WORKING WITH THE EQUIPMENT.

CHANGE
NO.

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 31 August 1973

**Operator's Organizational, Direct Support,
General Support, and Depot Maintenance Manual
REFERENCE TONE GENERATOR NORTHEAST ELECTRONICS CORPORATION
MODELS TTS-39A AND TTS-390 AND ACCESSORIES**

TM 11-6625-939-15, 25 March 1969, is changed as follows:

Page 0, paragraph 1.A.1*b*. Delete subparagraph *b*.

Paragraph 1.A.3. Delete paragraph 1.A.3 and substitute:

1.A.3. Forms and Records

a. Reports of Maintenance and Unsatisfactory Equipment. Maintenance forms, records, and reports which are to be used by maintenance personnel at all maintenance levels are listed in and prescribed by TM 38-750.

b. Report of Packaging and Handling Deficiencies. Fill out and forward DD Form 6 (Report of Packaging and Handling Deficiencies) as prescribed in AR 700-58 (Army)/NAVSUP PUB 378 (Navy)/AFR 71-4 (Air Force)/and MCO P4030.29 (Marine Corps).

c. Discrepancy in Shipment Report (DISREP) (SF 361). Fill out and forward Discrepancy in Shipment Report (DISREP) (SF 361) as prescribed in AR 5538 (Army)/NAVSUP PUB 459 (Navy)/AFM 75-34 (Air Force)/and MCO P4610.19 (Marine Corps).

1.A.4. Reporting of Errors

Report of errors, omissions, and recommendations for improving this publication by the individual user is encouraged. Reports should be submitted on DA Form 2028 (Recommended Changes to Publication) and forwarded direct to Commander, US Army Electronics Command, ATTN: AMSEL-MA-C Fort Monmouth, N.J., 07703.

1.A.5. Items Comprising on Operable Equipment

Reference Tone Generators TTS-39A and ITS39B (FSN 6625-883-8324), each comprise an operable end item.

Page B-1. appendix B. Delete appendix B in its entirety.

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SAAD (10)	
TOAD (10)	
LEAD (7)	
USACSA (2)	

NG: None

USAR: None

For explanation of abbreviations used, see AR 310-50.

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TECHNICAL MANUAL

HEADQUARTERS

DEPARTMENT OF THE ARMY

NO. 11-6625-939-15)

WASHINGTON, D. C. , 25 March 1969

REFERENCE TONE GENERATOR, NORTHEAST ELECTRONICS CORPORATION,
MODELS TTS-39A AND TTS-39B AND ACCESSORIES

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1.A. INTRODUCTION

1.A.1. Scope

a. This manual includes installation and operation instructions and covers operator's, organizational, direct support (DS), general support (GS), and depot maintenance. It describes Reference Tone Generator, Northeast Electronics Corporation, Models TTS-39A and TTS-39B Accessories.

b. A basic issue items list (BIIL) for this equipment appears in appendix B.

Note: Appendix B is current as of 29 April 1968.

1.A.2. Indexes of Equipment Publications

a. DA Pam 310-4. Refer to DA Pam 310-4 to determine whether there are new editions, changes, or additional publications pertaining to the equipment.

b. DA Pam 310-7. Refer to DA Pam 310-7 to determine whether there are modification work orders (MWO's) pertaining to the equipment.

1.A.3. Forms and Records

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c. Discrepancy in Shipment Report (DISREP) (SF361). Fill out and forward Discrepancy in Shipment Report (DISREP) (SF361) as prescribed in AR 55-38 (Army), NAVSUP Publication 459 (Navy), AFM 75-34 (Air Force), and MCO P461).19 (Marine Corps).

d. Reporting of Equipment Manual Improvements. Report of errors, omissions, and recommendations for improving this publication by the individual user is encouraged. Reports should be submitted on DA Form 2028 (Recommended Changes to DA Publications) and forwarded direct to Commanding General, U. S. Army Electronics Command, ATTN: AMSEL-ME-NMP-AD, Fort Monmouth, N. J. 07703.

MODEL TTS 39 REFERENCE TONE GENERATOR AND ACCESSORIES OPERATING INSTRUCTIONS

1.0 GENERAL DESCRIPTION

1.01 The Model TTS 39 consists of a basic unit which includes a transistorized oscillator delivering a constant output level. Space is available on the panel to supply up to four independent output modules, designated as Model TTS 39XB; these can be connected for either 600 or 900 ohms output impedance. Each module contains a transistorized amplifier, a DC blocked balanced output transformer, a coarse and fine output level control to permit adjusting the output level between -1 dbm and +2 dbm, a monitoring jack, and space for mounting a hold coil, a gas tube, a relay which may be used as a start relay for starting special functions, a relay for ON HOOK-OFF HOOK cycling, and a transfer relay for special applications. The output stages are completely independent of one another; trouble in one output has no effect on the other outputs. No damage will result if ringing voltage is applied to an output.

1.02 Two versions of the Model TTS 39 are available:

1. The Model TTS 39A includes the basic milliwatt generator and provisions for mounting four output stages.
2. The Model TTS 39B is the same as the Model TTS 39A, but is also equipped with a cycling adapter which provides a ground contact at regular time intervals, such as once in every 10 seconds. This model is used when ON HOOK-OFF HOOK cycling is required for the Model TTS 39XB output modules or when it is desired to provide interruptions in the output signal.

1.03 If more than four output stages are needed, the Model TTS 39D Distribution Amplifier panel is available to mount up to four additional output modules per panel. By adding more TTS 39D panels, a large number of independent output stages can be provided.

1.04 The Model TTS 39 may also be used in combination with the Model TTS 39XF Frequency Cycling Adapter to supply a milliwatt signal at up to ten frequencies which can be automatically cycled in sequence at predetermined time intervals. Unless additional frequencies are ordered, three frequencies are normally supplied in the Model TTS 39XF. If additional frequencies are needed after a unit has been installed, components may be added in the field to include the desired frequencies in the cycling sequence. Any frequency between 300 and 10,000 cps may be used; each output stage is designed to accommodate the full range of frequencies without affecting the output level set for one frequency. Frequencies may be arranged in any sequence, and the time interval for each frequency may be set between 5 and 15 seconds. It may be desirable to use 1000 cps as the first frequency in the cycling sequence and to provide a longer time interval for it than for other frequencies; this will facilitate identifying the start of another sequence of frequencies.

1.05 Both models can accommodate up to four TTS 39XB Output Amplifier Modules, each of which can provide an output impedance

of 600 or 900 ohms. The output impedance is selected by installing the proper straps. Resetting of the output level is necessary when the output is changed from one impedance value to another. The level in each output circuit is independent of the load applied to the other circuit. The output of each circuit is normally 0 dbm, but both coarse and fine adjustments are provided in each channel to permit setting the output level to any desired value from -1.0 dbm to +2.0 dbm.

1.06 Each Model TTS 39XB Output Amplifier Module is provided with a TEST jack to monitor the output level. The insertion of a test cord in these jacks disconnects the output from the connector appearance.

1.07 The TTS 39 group of equipment may be supplied in a TCC 39 Portable Carrying Case.

1.08 The TTS 39 group of equipment is designed to operate from a well filtered 48-volt DC source.

2.0 TRANSMISSION PERFORMANCE

2.01 Because of the basic temperature sensitivity of semiconductors the following specifications are intentionally conservative.

Representative sets show substantially better performance than that specified. In most installations the temperature variations are relatively small; consequently, the variations in performance are very small.

2.02 Specifications

		Frequency Tolerance: $\pm 1\%$
<u>Output Frequencies</u>		
Single Frequency Operation	1000 cps. Other frequencies between 300 and 10,000 cps can be supplied.	Harmonic Distortion: 50° to 110°F $\leq 1\%$
Multifrequency Operation when TTS 39XF is used	Up to 10 frequencies; any group between 300 and 10,000 cps can be supplied. It is suggested that 1000 cps be the first frequency in the sequence.	Output Level: Nominal 0 dbm Maximum +2.0 dbm Minimum -1.0 dbm
Frequency Switching Time When TTS 39XF is Used	Can be supplied to operate at time intervals ranging from 5 seconds to 15 seconds for each Frequency.	Output Level Variations: Temperature: 50° to 110°F ≤ 0.10 db At a given temperature, level is held to better than 0.05 db. Voltage: 42 to 50 volts ≤ 0.05 db Supply Voltage: 48 volts DC will operate between 44 and 54 volts.

Current Drain:	
TTS 39A or B with	MAX 500 MA
four TTS 39XB's	
when used with	MAX 950 MA
the TTS 39XF	
Size:	
TTS 39A or B	5 1/4" x 19"
TTS 39XF	3 1/2" x 19"
TTS 39D	5 1/4" x 19"

3.0 CONTROLS AND ADJUSTMENTS

3.01 The following controls and jacks appear on the front panel of the TTS 39A or B:

1. Power switch and indicator lamp
2. OSC TEST - monitor oscillator
3. TEST jack for TTS 39XB Output Amplifier Modules
4. COARSE level adjustment (locking) for TTS 39XB Output Amplifier Modules
5. FINE level adjustment (locking) for TTS 39XB Output Amplifier Modules

3.02 The TTS 39XF unit contains a HOME + PULSE indicator lamp. This lamp is lighted when the frequency selection switch is in its HOME position and flashes at each change of frequency.

3.03 The following controls and jacks appear on the front of the TTS 39D Distribution Amplifier Panel:

1. Same as 1 under 3.01
2. Same as 3 under 3.01
3. Same as 4 under 3.01
4. Same as 5 under 3.01
5. Input level adj - (optional) - normalizes input level.
6. Input jack - Monitor signal from oscillator
7. Buffer Output jack - Monitor buffer output

3.04 The following controls and jacks appear on the panel of the TCC 39 Carrying Case:

1. 48-volt Jack - Power input
2. Output 1 to 4 - Access to outputs

3. Manual Cycling Switch - Manual cycling start

3.05 It is necessary to allow at least a half hour warm up period before any level adjustments are made. This amount of time is required for the temperature controlled oven containing the level stabilization element to reach its operating temperature. Normal output for units which have been adjusted for 0 dbm output will be in the order of +2.5 dbm when first turned on. This will decrease and stabilize at 0 dbm when the oven reaches its operating temperature. Level adjustments can be made with the COARSE and FINE adjustment, but this adjustment is to be made only after the oven has reached its operating temperature.

4.0 CIRCUIT DESCRIPTION

A. Basic Panel

4.01 The schematic diagram to which the following description applies is shown in Figure 1. A component placement diagram is shown in Figure 1A.

4.02 The TTS 39A or B is a basic panel containing the terminals, wiring, oscillator, and associated circuitry necessary to accommodate up to four TTS 39XB Output Amplifier Modules. Terminals are also provided for the convenient addition of the TTS 39XF Frequency Cycling Adapter and for the Model TTS 39D Distribution Amplifier Panels.

4.03 Common fusing, power switching, and reverse voltage protection for the Models TTS 39 and TTS 39XF are supplied by fuse F-1, power switch S-1 and diode CR-1. A "power on" indication is supplied by pilot lamp PL-1.

4.04 Voltage division for the level stabilizing oven unit is supplied by resistor R-31. Capacitor C-1 provides spark suppression for the thermostat switching contacts located with the oven unit. The DC voltage at pin 3 of the oven should read 24 volts when heating.

4.05 Decoupling between the battery supply and the tone generator is supplied by resistor R-35 and capacitor C-2. Resistors R-32 and R-34 and capacitor C-3 provide voltage division and filtering for the oscillator amplifier unit.

4.06 The OSC TEST jack provides access to the output of the oscillator amplifier unit.

CAUTION: Damage to the thermistor within the oven unit may result should voltage be applied to the OSC TEST jack.

4.07 DC blocking between the output of the oscillator amplifier unit and external Model TTS 39D Distribution Amplifier Panels is provided by capacitor C-4. This circuit is extended to terminal 12 of terminal board TB-1.

4.08 Terminals A through G of terminal board TB-1 provide the internal connections to the Model TTS 39XB Output Amplifier

Modules. These connections include battery, ground, signal input, and control circuits.

4.09 Terminals 3 through 11 are for the addition of a Model TTS 39XF Frequency Cycling Adapter Unit.

B. Oscillator Amplifier Circuit

4.10 The circuit diagram to which the following description applies is shown in Figure 2. A component placement diagram is shown in Figure 2A.

4.11 A bridged-T type of R-C oscillator, consisting of three transistor stages, is used. The first two transistors are directly coupled from the collector of Q-1 to the base of Q-2. The positive feedback path is completed from the emitter of Q2 back through a blocking condenser and a tungsten lamp, utilized for level stabilization, to the emitter of Q-1. A part of the emitter resistance of Q-1 has been made variable to allow setting the correct amount of positive feedback necessary for stable operation.

4.12 A negative feedback which is greater than the positive feedback is supplied to the base of Q-1 through a null selective network and an emitter follower. At its tuned frequency the selective bridged-T null network decreases the negative feedback sufficiently to permit oscillation to occur at the desired frequency, which is determined by the R-C values employed within the network. This frequency determining network consists of two padded capacitances and two selected resistors.

4.13 Amplifier stage Q-4 and the cascaded emitter follower stages Q-5 and Q-6 provide the necessary voltage and current gain required to drive the thermistor Tx, located within the special temperature oven, onto its voltage maximum or "hump." The output level of the amplifier stage driving the thermistor is determined by the setting of potentiometer R-19. Capacitor C-7 provides the DC blocking between the output emitter follower Q-6 and the thermistor.

C. Output Amplifier Circuit

4.14 The Model TTS 39XB Output Amplifier Module consists of a highly stabilized buffer amplifier, a cascaded emitter follower stage, and a ringing voltage protection network mounted individually within a protective enclosure. These units can be arranged in the field for either 600 or 900 ohm operation. Output levels are adjustable over a range from -1 dbm to +2 dbm. The circuit diagram to which the following description applies is shown in Figure 3. A component diagram is shown in Figure 3A.

4.15 The input from the common oscillator unit is coupled to the Q-1 buffer amplifier stage through potentiometers R-3 and R-17. These controls provide the COARSE and FINE adjustment of the output level. Capacitor C-1 provides DC blocking for the base circuit of transistor Q-1. The output of the Q-1 buffer amplifier stage appears across the collector load resistor R-6 and in turn is coupled to the cascaded emitter follower stage through blocking cap.

C-2. The signal voltage appearing across the R-10 emitter load resistor of transistor Q-3 is coupled to output transformer T-1 through DC blocking capacitor C-3. Precision resistors R-12 and R-13 provide the impedance buildout for either 600 or 900 ohm operation. The 600 ohm condition exists when resistor R-13 is strapped out of the circuit over terminals marked Z. The non-polarized, electrolytic capacitor, C-4, provides DC blocking for the output circuit. Diodes CR-1 and CR-2 and resistor R-11 constitute the ringing voltage protection network.

4.16 The output of transformer T-1 is coupled to terminals 1 and 2 of the terminal board located on the rear of the module. This circuit is carried over contacts of the test jack. When plugged into the test jack all external circuits are disconnected by the interrupter springs of the test jack.

4.17 Resistors R-14 and R-15 and capacitor C-5 provide voltage division and filtering for the output amplifier circuit. Resistor R-16 serves as the sleeve resistance to battery for the external circuit connected to the module.

D. Time Cycle Generator

4.18 The Model TTS 39B also contains a time cycle generator as standard equipment. This unit provides the time base for the cycling of ON and OFF HOOK supervision when used in conjunction with one or more output amplifier modules equipped with Option 3. Start ground for the time cycle generator is derived through an isolating diode from the sleeve circuit of the output amplifier modules equipped with Option 3. The above diode is a part of Option 3.

4.19 A schematic diagram of the time cycle generator circuit is shown in Figure 4. A component placement diagram is shown in Figure 4A. The operation of the time cycle generator is as follows:

4.20 When ground is applied to start lead S of the generator circuit, capacitor C-1 in the base circuit of transistor Q-1 will charge over the break contacts of relay K-2 and resistor R-6 to the regulated voltage appearing at the junction of R-1 and zener diode CR-2. Relay K-1, which is in the emitter circuit of Q-1, will operate when the base voltage of Q-1 has risen to approximately 8 volts. The selected value of R-6 determines the rise time and is selected to produce a time constant of 1 second. Relay K-1, when operated, interrupts the ground circuit to terminal G over its make contacts 4 and 5. Terminal C is part of TB-1 of the basic panel shown in Figure 1.

4.21 K-1, operated, also energizes relay K-2. Relay K-2, when operated, interrupts the charging circuit from battery via R-6 to C-1 and establishes a circuit from ground through R-5, its make contacts 3 and 4 to capacitor C-1, which will slowly discharge capacitor C-1. The time required to discharge C-1 is determined by the selected value of R-5. R-5 has been selected to provide a discharging time constant of 10 seconds. After C-1 has discharged sufficiently to allow K-1 to release, ground is again applied to terminal G and the charging circuit for C-1 re-established.

4.22 The above operation is repetitive and will continue as long as ground appears on the start lead. Diode CR-1 provides reverse voltage protection for the protection of the circuitry should battery be inadvertently connected in reverse. Resistors R-2 and R-3 serve as a voltage divider to supply the proper collector voltage to transistor Q-1.

E. TTS 39XF Frequency Cycling Adapter

4.23 The Model TTS 39XF unit contains the time base and the switching to provide the cycling of up to 10 frequencies in sequence. The start ground for the TTS 39XF is derived from the Option 4 circuitry associated with the Output Amplifier Modules assigned for multifrequency operation. A schematic diagram of this unit is shown in Figure 5. A component placement diagram is shown in Figure 5A. The operation of this unit is as follows:

4.24 Ground, when applied to either of the start leads, will operate the START and HOME relay SH. These start leads are brought out to terminals 3 and 4 of terminal board TB-1. Two separate start circuits are employed to allow "X" number of frequencies to be supplied by one Output Amplifier Module and "Y" number by the second, i.e., 3 frequencies for the number 1 and 10 frequencies for the number 2 module. The number of frequencies is determined by the strapping on wiper banks E and F of selector switch RM.

4.25 START and HOME relay, SH, when operated, applies battery to the delay follow relay DF, removes ground from the homing circuit of RM and applies ground to the C wiper of RM. Ground, when applied to the C wiper of RM, will move RM from the home to its first position. The coil circuit of DF is completed by the operation of SH, from battery, the coil of DF, break contacts 2 and 3 of delay relay D to ground through capacitor C-1. As the charging current for C-1 must pass through the coil of DF, DF will operate momentarily until the voltage appearing across C-1 has reached the operating point of relay D. D will then energize, thus interrupting the coil circuit of DF, causing it to release. Relay DF, while operated, supplies a step pulse to RM, causing it to move one step. The next step pulse for RM will be applied upon the release of relay D, which will again operate DF momentarily. This operation is repetitive until the start ground has been removed.

4.26 The C wiper circuit of RM is employed to cause RM, when reaching its home position, to advance to its first position. This circuit prevents the first frequency within the sequence to be transmitted twice for each revolution of RM. Normally, as shown in the schematic, the frequency that is associated with the first position of RM is also associated with the home position (this frequency switching is accomplished over banks A and B of RM). When the TTS 39XF is associated with TTS 39 units employing both multi and single frequency operation, the output modules associated with the single frequency operation will not supply a start ground to the TTS 39XF unit. Thus it can be seen that the frequency transmitted for single frequency operation will be that of the first frequency transmitted in the multifrequency operation. However, in multifrequency operation, this will only be transmitted for one interval during each

revolution of RM, as RM cannot stop in its home position for reasons explained above.

4.27 The function of the D bank of RM is to provide switching to change the time intervals of the frequencies to be transmitted. These time intervals are normally arranged so that approximately 10 seconds will be allowed for the first frequency and approximately 5 seconds for the remaining frequencies. However, other time intervals can be supplied through the selection of the proper value of R-101.

4.28 Pilot lamp PL-1 is controlled by the ONC and RM contacts of RM. When RM is in the home position, the ONC contacts complete a circuit from ground to PL-1 causing it to light. When not in the home position, PL-1 will flash upon the operation of the RM contacts associated with the stepping mechanism. Diodes CR-1 through CR-4 provide isolation between the two start ground circuits.

4.29 When start ground has been removed from the TTS 39XF, stepping switch RM will be driven to its home position by the ground applied to its homing circuit upon the release of relay SH. When reaching its home position, it will not be caused to advance to its first position as ground has been removed from the C wiper circuit by the release of SH.

4.30 The lead connecting from terminal 12 of terminal board TB-1 to the coil circuit of RM is utilized for installations involving automatic programming of these units. The resistors connected to banks A and B, identified as HI-Z and LOW-Z on the schematic, are the resistors associated with the null network of the oscillator unit. Thus, as these resistors are switched by the operation of RM, the frequency generated by the oscillator unit will be switched accordingly.

F. TTS 39D Distribution Amplifier

4.31 The Model TTS 39D Distribution Amplifier panel provides mounting space for up to 4 output modules. This panel also contains a buffer amplifier and battery power control circuits. A schematic diagram of this unit is shown in Figure 6.

4.32 This unit is normally supplied with the Model A buffer amplifier. A component placement diagram is shown in Figure 6A. The purpose of the Model A buffer amplifier is to provide a relatively high impedance input to this unit. This buffer circuit consists of transistor Q-1 and its associated circuitry. Transistor Q-1 is operated as an emitter follower. Capacitor C-2 and C-3 provide DC blocking for the input and output of the buffer circuit. Resistors R-1 and R-2 and capacitor C-1 provide voltage division and filtering. Type 310 jacks marked INPUT and BUFFER OUTPUT have been provided for test purposes.

4.33 Battery fusing for this panel is supplied by fuse F-1, battery power switching is supplied by switch S-1, and reverse voltage protection is provided by diode CR-1. The power ON indication is provided by pilot lamp PL-1.

4.34 The oscillator input from terminal 12 of TB-1 located on the TTS 39 generator unit must be connected to terminal IN-1 of the TTS 39D. For installations requiring more than one distribution amplifier, the IN-1 terminal of the second distribution amplifier is connected to the terminal marked BUFFER OUTPUT of the first distribution amplifier. By connecting in this manner the bridging impedance of only one distribution amplifier will be bridged across the oscillator output of the generator; thus as many of these distribution amplifier units can be operated from a single source as required.

4.35 Distribution amplifiers, when operated in conjunction with multifrequency operation and/or options requiring timed interruptions and start circuits, must be supplied with the appropriate interconnections to the Model TTS 39A or B unit. All options available for use with the TTS 39A or B units may also be applied to the TTS 39D Distribution Amplifier.

4.36 Options

- Option 1 - Provides a gas tube for tripping the ringing when the TTS 39A is used. No hold is included. A mounting space has been provided on the individual module units for the addition of gas tubes.
- Option 2 - Includes a hold coil for tripping the ringing and providing a hold on the line when the TTS 39A is used. Mounting space has been provided on the module for the addition of hold coils.
- Option 3 - Provides hold circuits and relays required to provide ON HOOK-OFF HOOK cycling; the hold coil also trips the ringing. This option is normally used only in conjunction with the TTS 39B; if an external source of interruptions is available, Option 3 may also be used with the TTS 39A. The start circuits contained in Option 3 may also be used to start frequency cycling when the TTS 39XF is used with the ITS 39B. A schematic of this circuitry is shown in Figure 8. Mounting holes are provided on individual modules for the mounting of component boards containing the above circuitry.
- Option 4 - Provides start circuits for initiating frequency cycling when the TTS 39XF is used in combination with the TTS 39A or the TTS 39B. This option is not required when Option 3 is provided. A schematic diagram of this option is shown in Figure 8. Mounting holes have been provided on the individual modules for the mounting of component boards containing the above circuitry.
- Option 5 - Combination of Options 1 and 4 for use with the TTS 39A.

Option 6 - Combination of Options 2 and 4 for use with the TTS 39A.

Other options are available such as standard terminations, call party release, and other terminations, etc. As these other various options are normally individually tailored to customer specifications, specific details have not been included within this manual.

4.37 Frequency Cycling

The start circuitry for the TTS 39XF Frequency Cycling Adapter is shown in Figure 7. For output modules to be associated with single frequency operations this circuitry is omitted. If this circuitry has been supplied, it can be disabled by lifting the lead connecting the contact of relay K-1 to terminal D of TB-1.

4.38 Cross Busy

For installations employing both cycling and non-cycling output circuits it may be desired to cross busy the output circuits to guard against frequency cycling appearing on an output assigned to single frequency operation. A typical example of this circuitry is shown on the next page. Ground, when applied to the sleeve of either or both outputs 1 or 2, will operate relay CB-1 which in turn busies outputs 3 and 4. The operation of CB-2 is identical to that of CB-1. Mounting space has been provided on the output modules for these components.

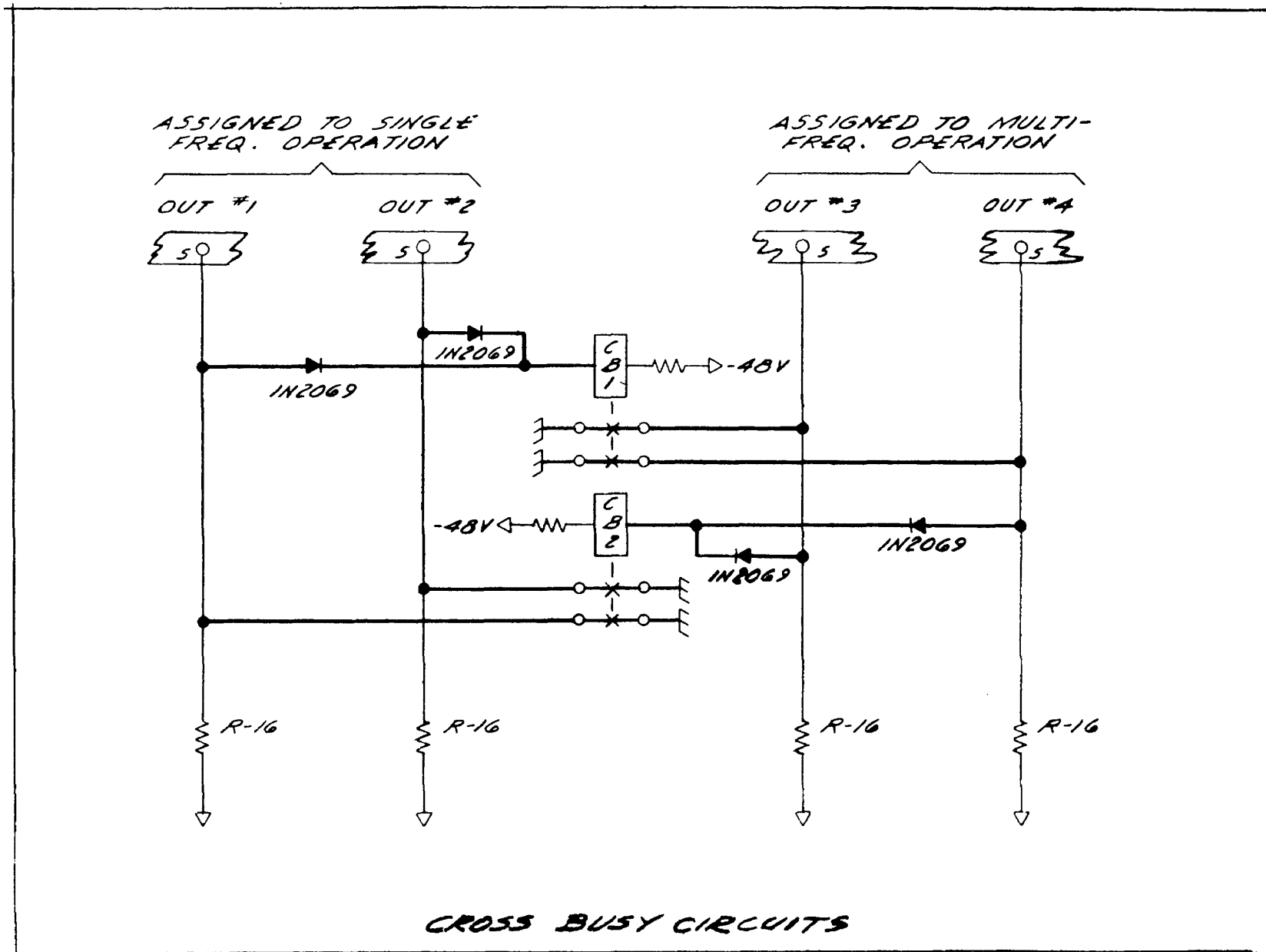


Figure A

5.0 MAINTENANCE AND TROUBLE SHOOTING

General

5.01 Apart from occasional checks on the output levels, the TTS 39A and TTS 39B units do not require any routine maintenance.

5.02 If any abnormal operation occurs, it can easily be traced to one of the three groups of circuits. These circuits are as follows:

1. Oscillator and thermistor driving circuit.
2. Output amplifier circuits.
3. Time cycle generator circuit (TTS 39B).

5.03 When there is no output at any of the output amplifiers, the trouble is most likely to be located in the oscillator and thermistor driving circuits and trouble shooting should be conducted as follows:

1. Referring to Figure 2A, connect the high side of a VTVM to point A and the low side to the low side of resistor R-90 (ground) on the oscillator board. The voltage should be 1.5 volts RMS at these points. If it is not, adjust R-15 for this level. Turning R-15 with a screwdriver clockwise increases the positive feedback and therefore increases the output level appearing at point A. There should be no fluctuation of the signal level at this point once the level is adjusted to 1.5 volts RMS.
2. If there is no voltage between point A and ground (with R-15 in maximum clockwise position), check the filament of the tungsten lamp for continuity. Replace if faulty. If the lamp is good, replace the transistors, starting with Q-1 and ending up with Q-3. If trouble still prevails, check for proper DC voltage as indicated on the schematic diagram of the circuit. These voltages should be within $\pm 10\%$ as indicated.
3. When the preceding steps fail to produce an output at point A, check other components contained in the oscillator circuit, such as resistors, capacitors, and the frequency switching relays. It is important after correction of the trouble to readjust the voltage appearing at point A and ground to 1.5 volts RMS.

5.04 With the oscillator operating properly, check the RMS voltage appearing between pins 2 and 7-8 of the oven. This voltage should be in the order of 1.1 volts RMS; the exact voltage depends upon the characteristics of the individual thermistor within the oven itself. The oven must be at normal operating temperature for this measurement. If no voltage appears at pin 2 of the oven, check the thermistor driving portion of the circuit. This circuit consists

of transistors Q-4, Q-5, Q-6, and their associated circuitry. After this circuit has been restored to normal operating condition, check the operating point of the thermistor. This is covered under Thermistor Operating Level Adjustment.

5.05 If the voltage appearing across the thermistor (between pins 2 and 7 of the oven) is found to be excessive, check the thermistor for continuity as this indicates an open thermistor. If the thermistor is found to be defective, installation of a new oven unit is recommended.

Thermistor Operating Level Adjustment

5.06 The thermistor driving voltage has been factory adjusted and should require further adjustment only when replacement of the oven unit has become necessary. For this adjustment the oven must be at its normal operating temperature and the oscillator voltage appearing at the emitter of Q-2 should be 1.5 volts RMS. Refer to Figure 2A for the preceding component locations.

5.07 To perform the thermistor level adjustment, remove the protective front cover and connect the high side of a VTVM to the emitter of Q-6 (2N1136A) and the low side to ground. Connect an output level meter such as a Model TTS 4AN or equivalent into one end of the test jacks. Advance adjustable resistor R-19 (located on the oscillator board) to a full clockwise position. Observe the output level and very slowly rotate R-19 in a counter clockwise direction to a point where the output level no longer continues to rise as R-19 is turned. If necessary, repeat the preceding operation in order to definitely establish this point. The thermistor is now being driven to the beginning of its so-called "hump." Observe the VTVM which should now show a reading of approximately 4 to 5 volts RMS (the exact voltage depends on the characteristics of the individual thermistor), and further rotate R-19 to a position that increases the VTVM reading by 1 volt.

Output Amplifier

5.08 When one output circuit is inoperative and the others are functioning normally, it can be assumed that the preceding oscillator and thermistor driving circuit is operating satisfactorily. Trouble shooting should be conducted on the inoperative output stage as follows:

1. With reference to Figure 3A, substitute transistors Q-1, Q-2, and Q-3, then recheck for output. If trouble still exists, advance both output level controls (COARSE and FINE) to their full clockwise positions. With the unit on, check the DC voltage at the negative end of capacitor C-5; it should read 24 volts DC $\pm 10\%$. Connect the high side of a VTVM to the junction of R-2 and R-5 (base of Q-1) and the low side to ground. The AC signal voltage at this point should be in the order of .5 volts RMS. If it is not, trouble will probably be found in the output level adjustment controls or the DC blocking capacitor C-1. Excessive output level is an indication of an open resistor or defective oven unit.

2. If the signal voltage measured at the base of Q-1 is found to be normal, measure the signal voltages appearing at the collector of Q-1 and the emitters of Q-2 and Q-3. The AC signal voltages at these points should be in the order of 2.8 volts RMS. If these voltages are found to be normal connect the high side of the VTVM to terminal 4 (green lead) of transformer T-1 and the low side to terminal 1 (black and white lead) of transformer T-1. The AC signal voltage should read in the order of 2.8 volts RMS (no load on output). If no signal appears at this point, check DC blocking capacitor C-4 and transformer T-1 for an open circuit. If the signal voltage measured is low and capacitor C-4 is found to be normal, check transformer T-1 for shorted turns by measuring the DC resistance of the windings. With the transformer in the circuit (power removed from the unit), the following resistances should be realized; if they are not, replace the transformer.

Terminal 5 to Terminal 8	40-60 ohms
Terminal 1 to Terminal 2	20-30 ohms
Terminal 3 to Terminal 4	20-30 ohms

The above readings are approximate and will vary with individual transformers.

3. Should the signal voltage measured at terminals 1 and 4 of T-1 be normal, then capacitor C-4 and resistors R-12 and R-13 should be checked. Contacts of test jack J-1 must make a good connection in order for the signal to reach the ring and tip contacts on the terminal board. No signal should appear on the terminal board when a plug is inserted into the test jack.
4. After trouble has been corrected, readjust the COARSE and FINE adjustment controls to the desired output level. Oven must be at normal operating temperature for this adjustment.
5. To check the ringing voltage protection network, consisting of diodes CR-1 and CR-2 and resistor R-11, disable the oscillator by removing transistor Q-1. Apply ringing voltage to output ring and tip terminals. Measure the DC emitter voltage of Q-3. This voltage should be within 2 volts of the collector voltage of Q-3; if it is not, locate and replace the defective component within this network. It is important that this network be in proper operating order, as this supplies the ringing voltage protection to transistors Q-2 and Q-3, and capacitor C-3.

TTS 39XF Frequency Cycling Adapter

5.09 Trouble shooting of this unit can, for the most part, be accomplished by substituting relays Sh, DF, and D. Should this fail to correct the trouble, other components C-1 and diodes CR-1

through CR-4 should be checked. Resistors identified as HI-Z and LOW-Z are the frequency determining resistors for the oscillator section of the TTS 39 and have no effect on the switching or timing of this unit.

5.10 It should be noted that relay D has been provided with a special adjustment. This adjustment consists of turning the break contact out to eliminate the air gap between the armature and the pole piece of the relay when operated. This delays the release, thus providing a much longer time constant than would otherwise be realized.

Time Cycle Generator

5.11 Should the Time Cycle Generator unit fail to operate after applying ground to the start (S) terminal, the trouble will most likely be traced to dirty relay contacts. If the unit does not operate after cleaning the contacts of K-1 and K-2, other components such as Q-1, C-1, 6R-1, and R-1 through R-6 should be checked.

5.12 The value of resistor R-6 determines the charge time of C-1 and the value of resistor R-5 determines the discharge time of 10 seconds. Any change in the values of C-1, R-5 or R-6 will change the timing of the unit.

6.0 INSTALLATION INSTRUCTIONS

6.01 Before attempting to connect and operate the Model TTS 39A or B Reference Tone Generator, perform a visual inspection of the unit to insure that damage has not been caused during shipment, such as components being pushed together, etc.

6.02 Installers wiring and interconnection is shown in Installation Diagram Figure 9.

6.03 Connect a well filtered 48-volt DC source to terminals 1 and 2 of terminal board TB-1, located on the rear of the unit. Positive (+) is to be connected to terminal 2, and negative (-) to terminal 1. If polarity is reversed, the unit will not operate.

6.04 The unit is designed to operate over a voltage range of 44 to 52 volts at terminals 1 and 2. A direct line to the DC buss should be provided. If this is not feasible, thorough tests must be made to insure that the supply voltage at terminals 1 and 2 will always be within this range regardless of the other loads which may be connected to or disconnected from the common supply line.

6.05 Each of the TTS 39XB Input Amplifier Modules of the TTS 39A or B is normally connected to an especially assigned subscriber number in the dial equipment. The line circuits normally associated with these subscriber appearances must be disconnected. This is necessary to avoid a permanent off-hook condition in the line circuit, and to remove all DC voltages from the R-T leads when the TTS 39A or B is in the idle condition.

6.06 The tip ring and sleeve of each subscriber number assigned to the TTS 391 or B should be connected to terminals 1, 2, and 8 respectively on each TTS 39XB Output Amplifier Module.

6.07 Each TTS 39XB Output Amplifier Module can be arranged for either 600 or 900 ohm output impedance. Installation Diagram Figure 9 shows the correct strap to be added or deleted for the different impedance.

6.08 Should the impedance of a TTS 39XB be changed in the field, the level should be readjusted to meet the correct requirements.

6.09 Before attempting the above level adjustments it is important to allow a half hour warm up period, as this period of time is required for the temperature controlled oven to reach operating temperature.

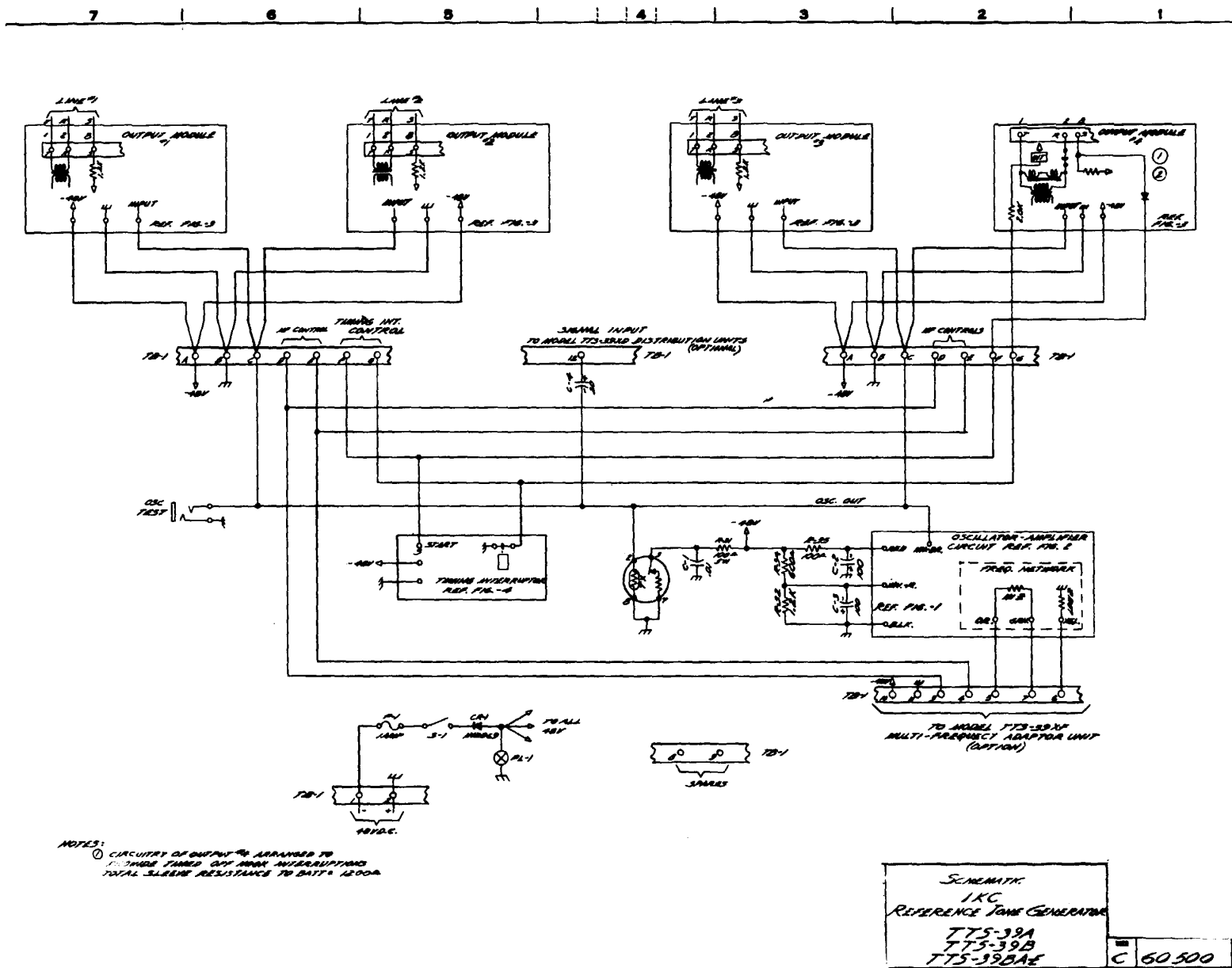


Figure 1

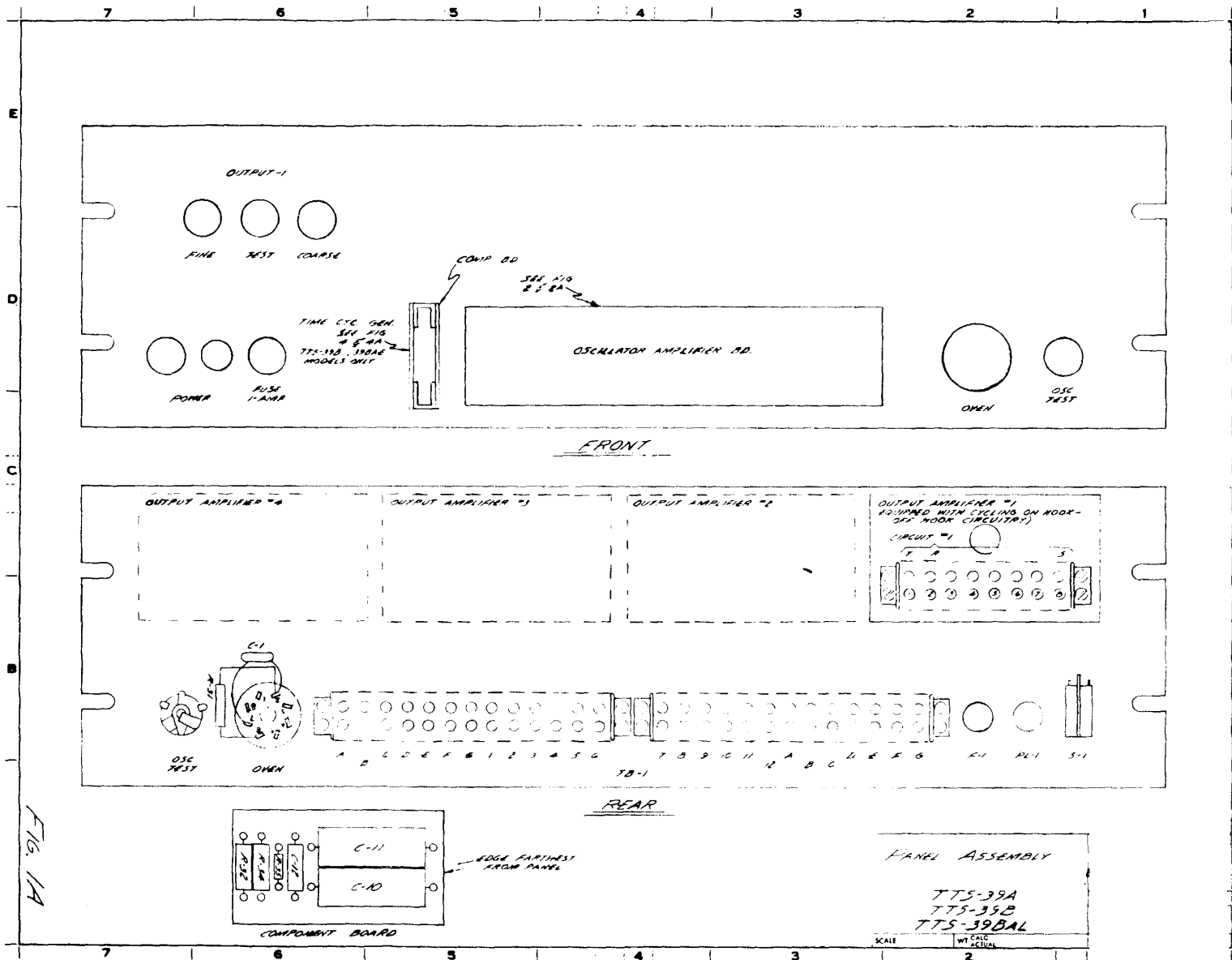
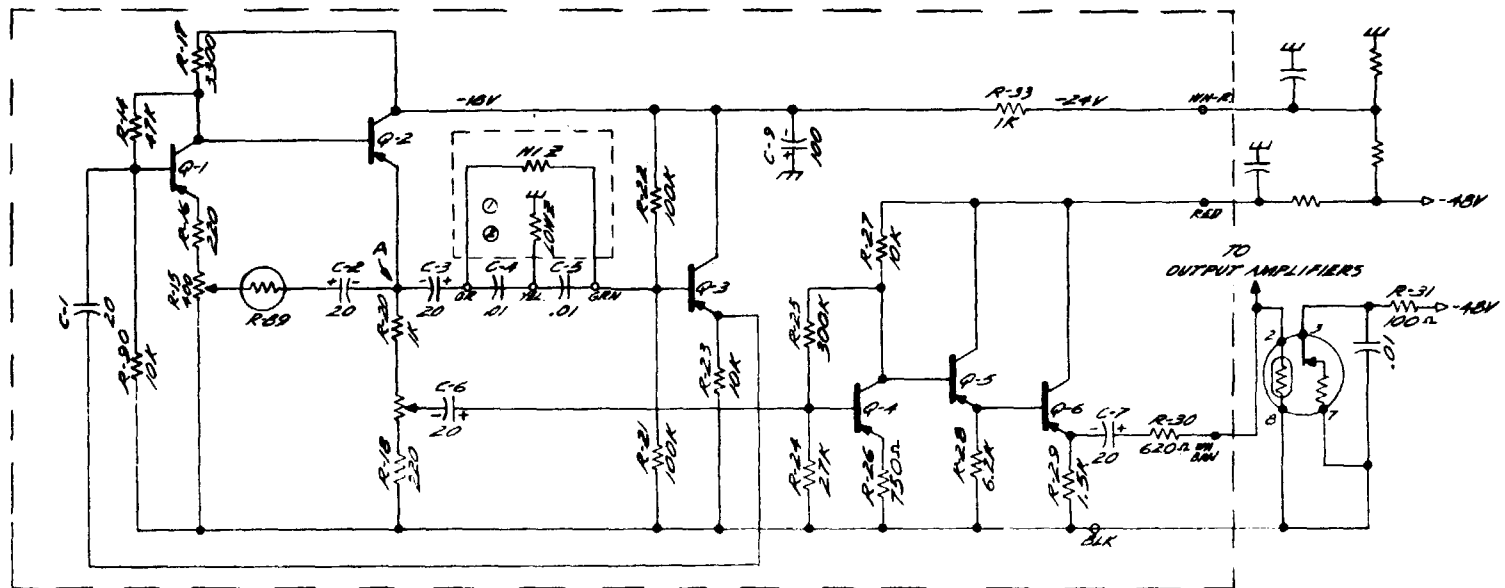


Figure 1A



- NOTES:
1. SELECTED VALUES TO PROVIDE DESIRED FREQUENCY
 2. OMIT FOR MULTI-FREQUENCY OPERATION

FIG. 2

Schematic
 Oscillator Amplifier
 Printed Circuit

REF. NO.	
SIZE	B 40477

Figure 2

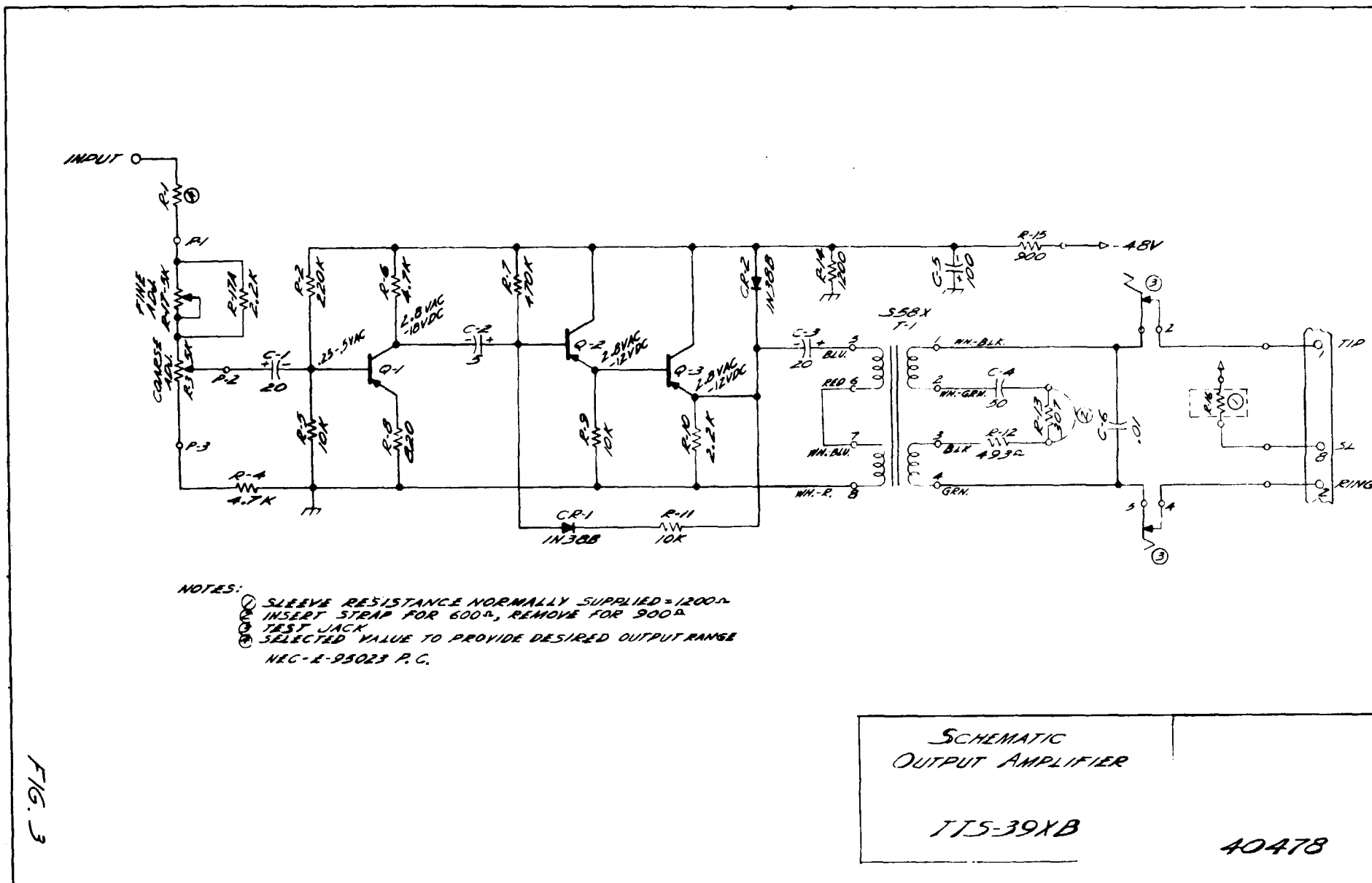


Figure 3

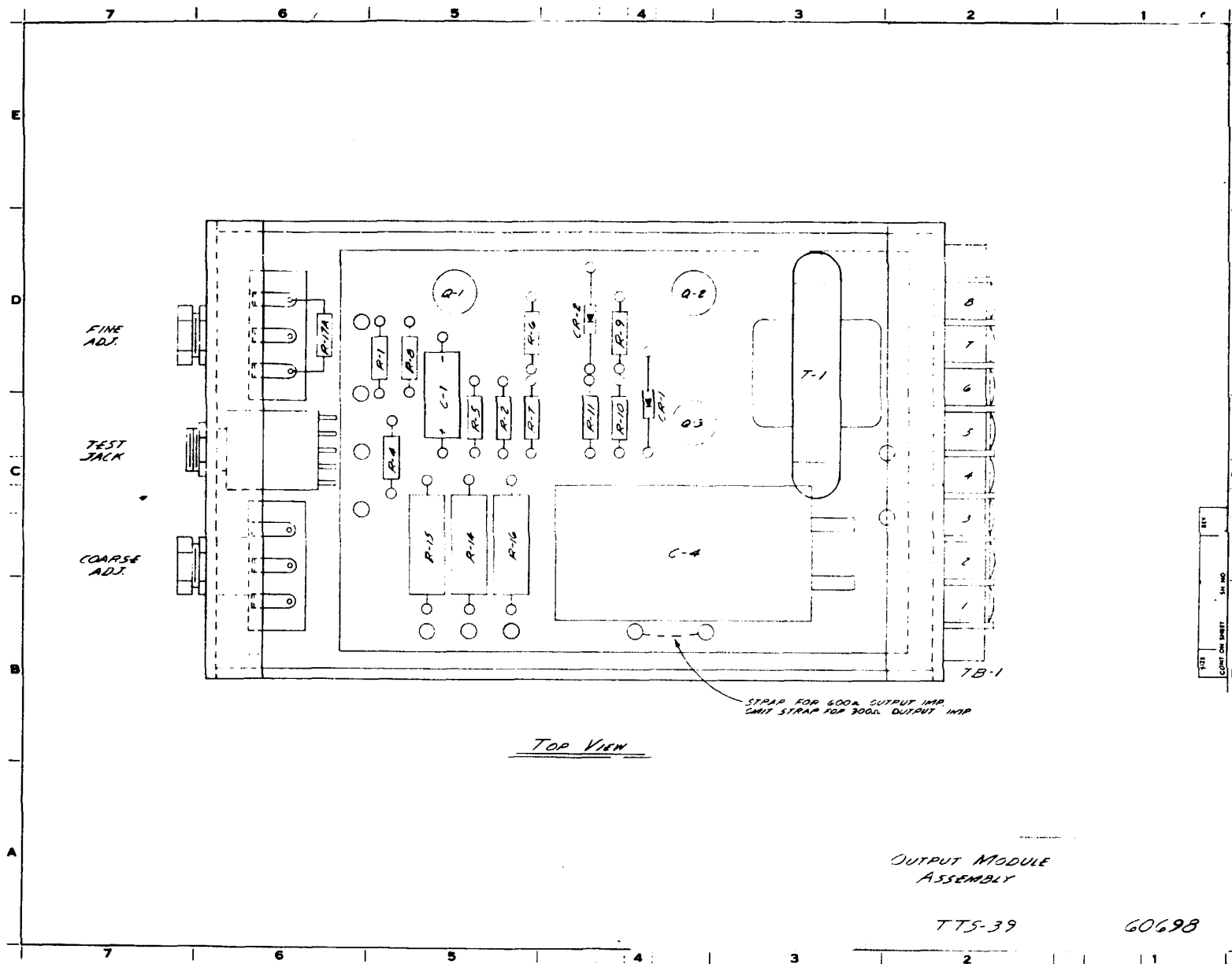
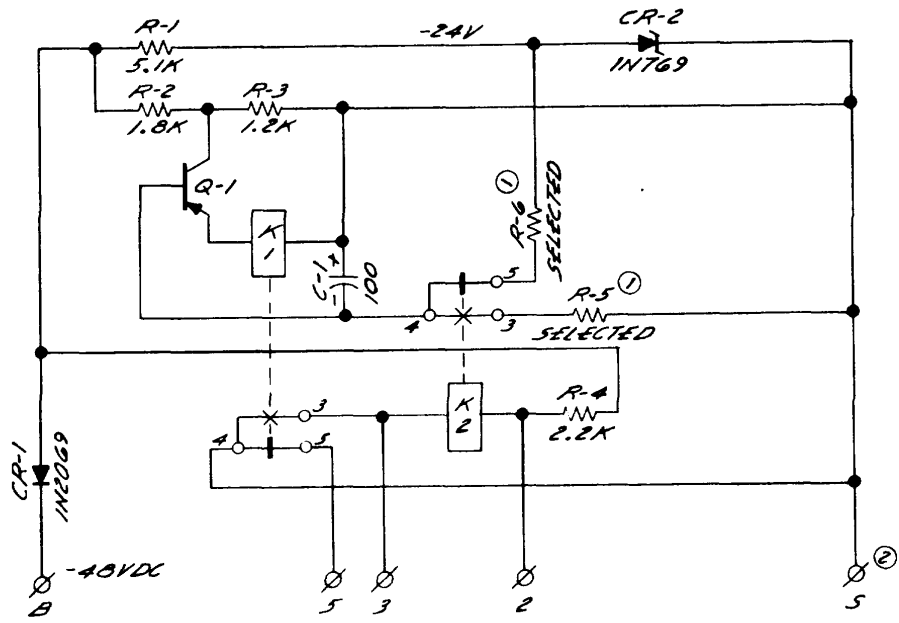


Figure 3A

NOTE:

- ① SELECTED TO PROVIDE DESIRED TIMING.
- ② TO START APPLY GROUND TO TERM. "5"



*SCHEMATIC
TIME CYCLE GENERATOR*

*FIG.-4
A-10635*

Figure 4

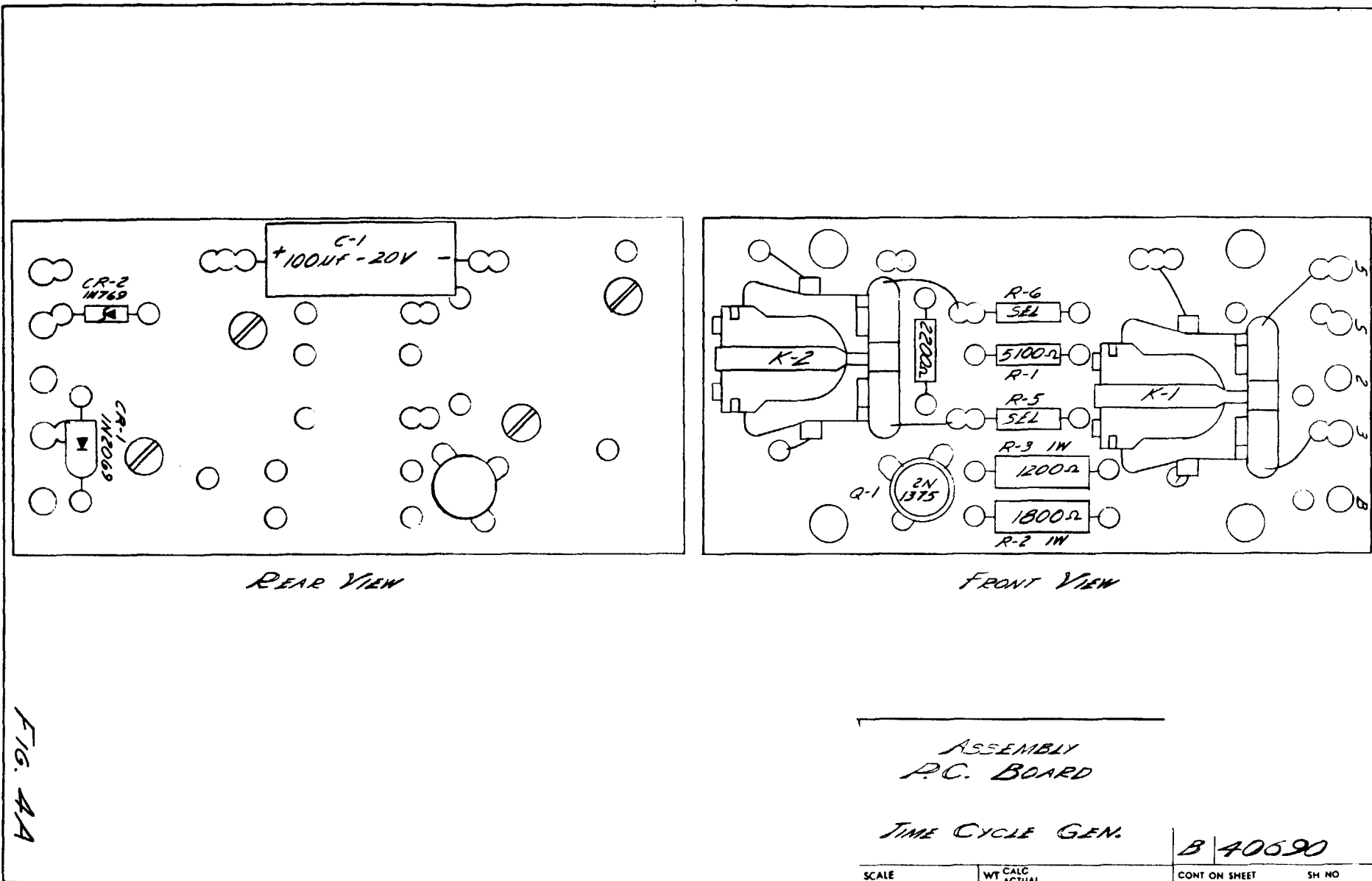


FIG. 4A

Figure 4A

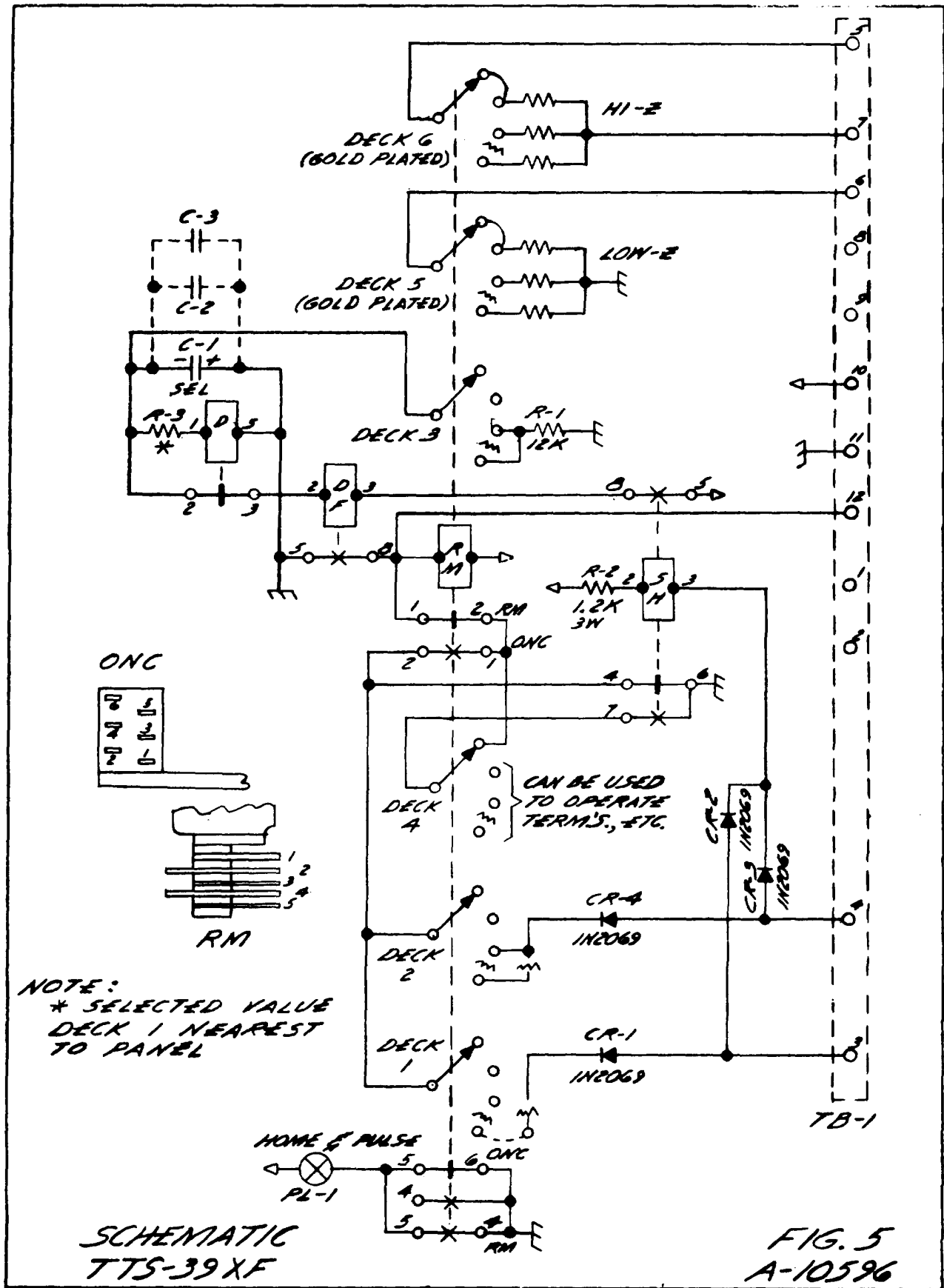


Figure 5

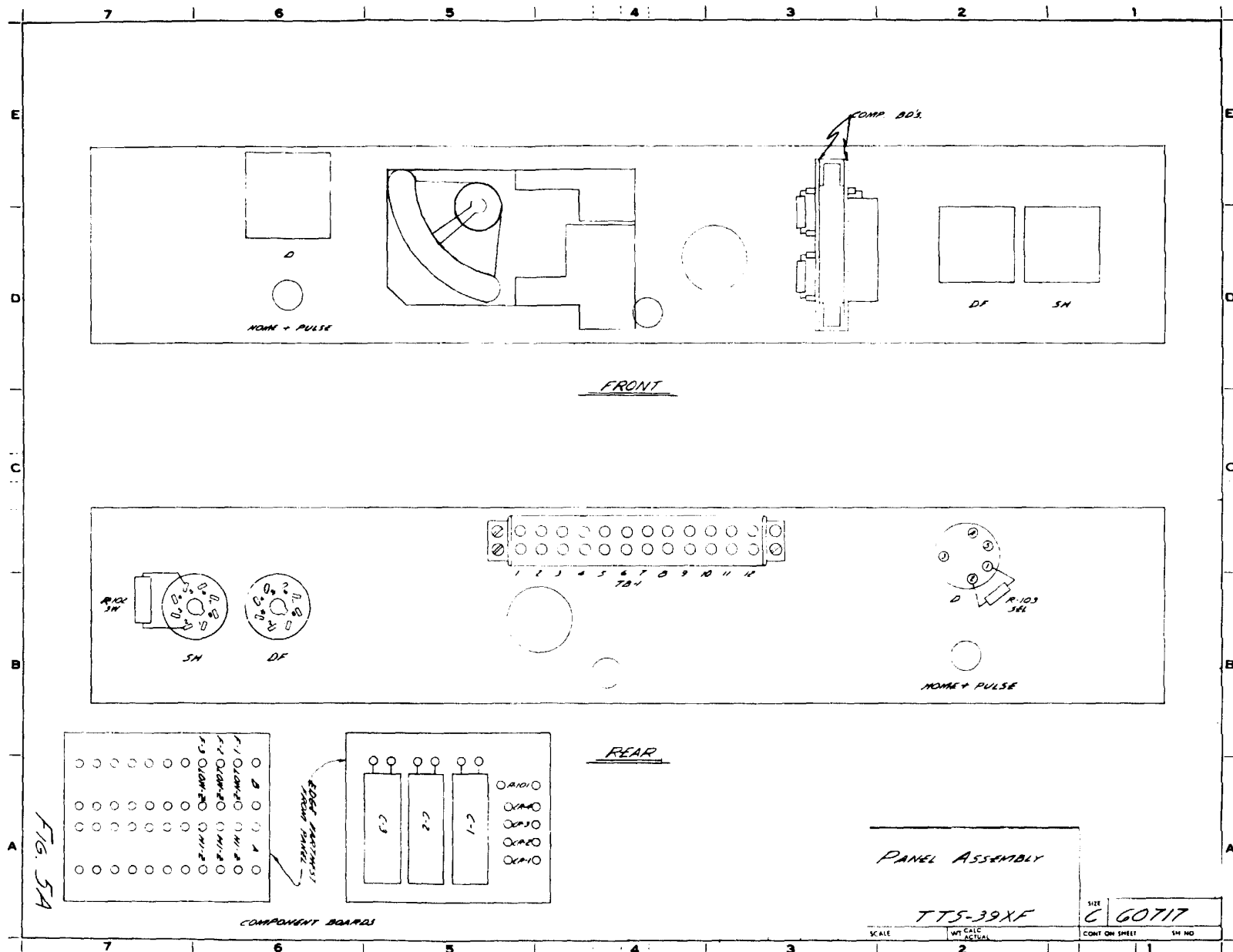


Figure 5A

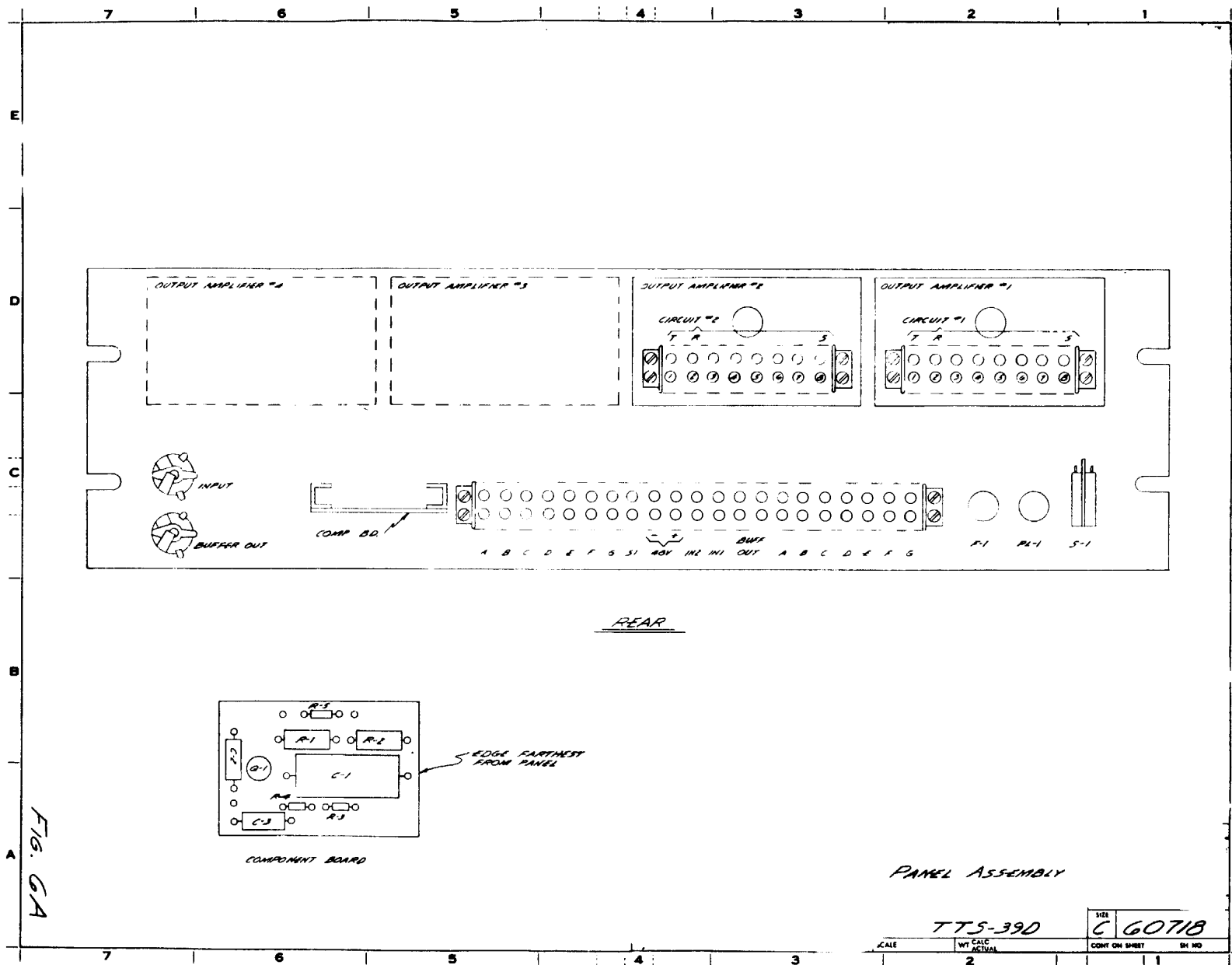


FIG. 6A

Figure 6A

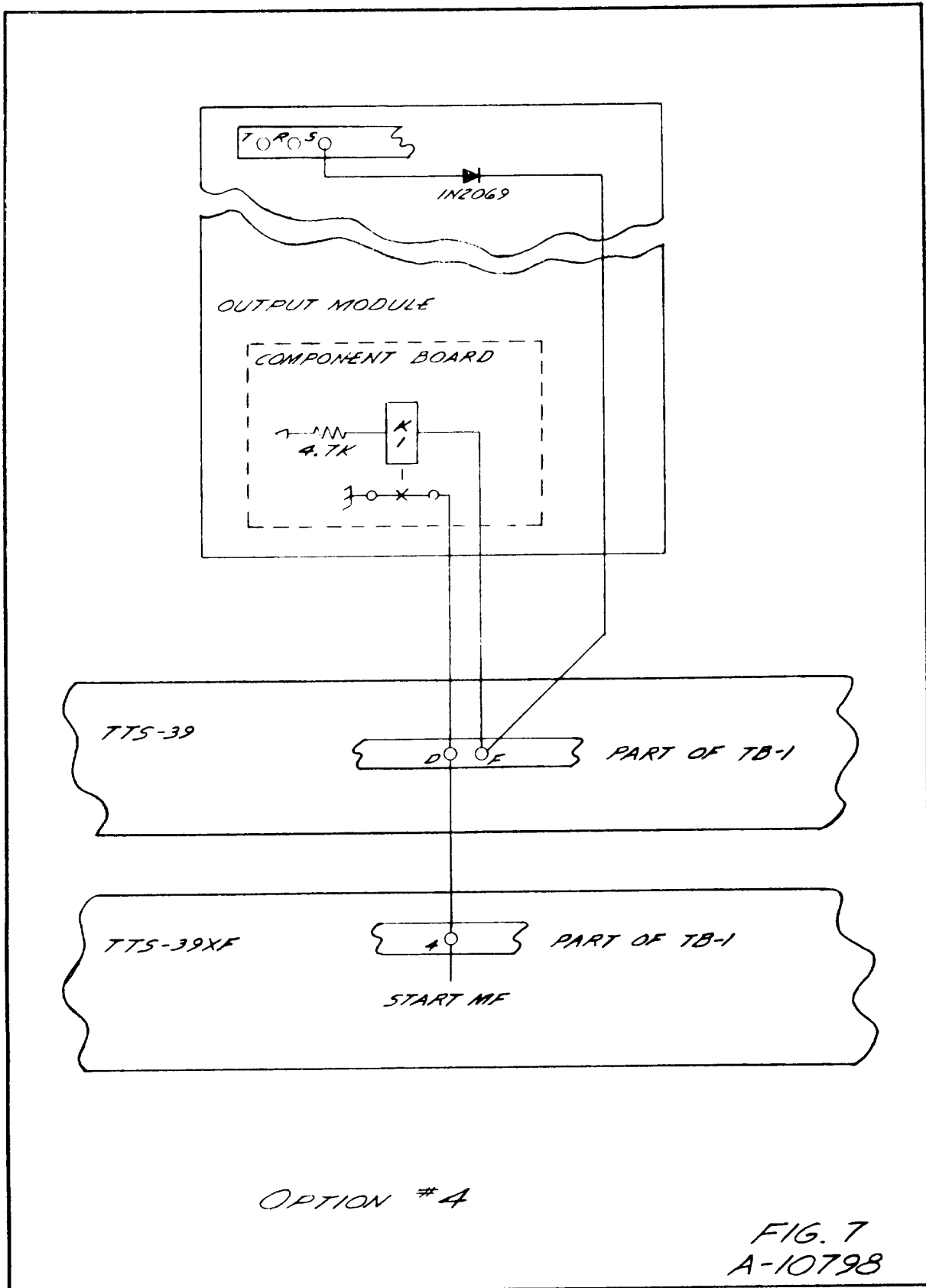
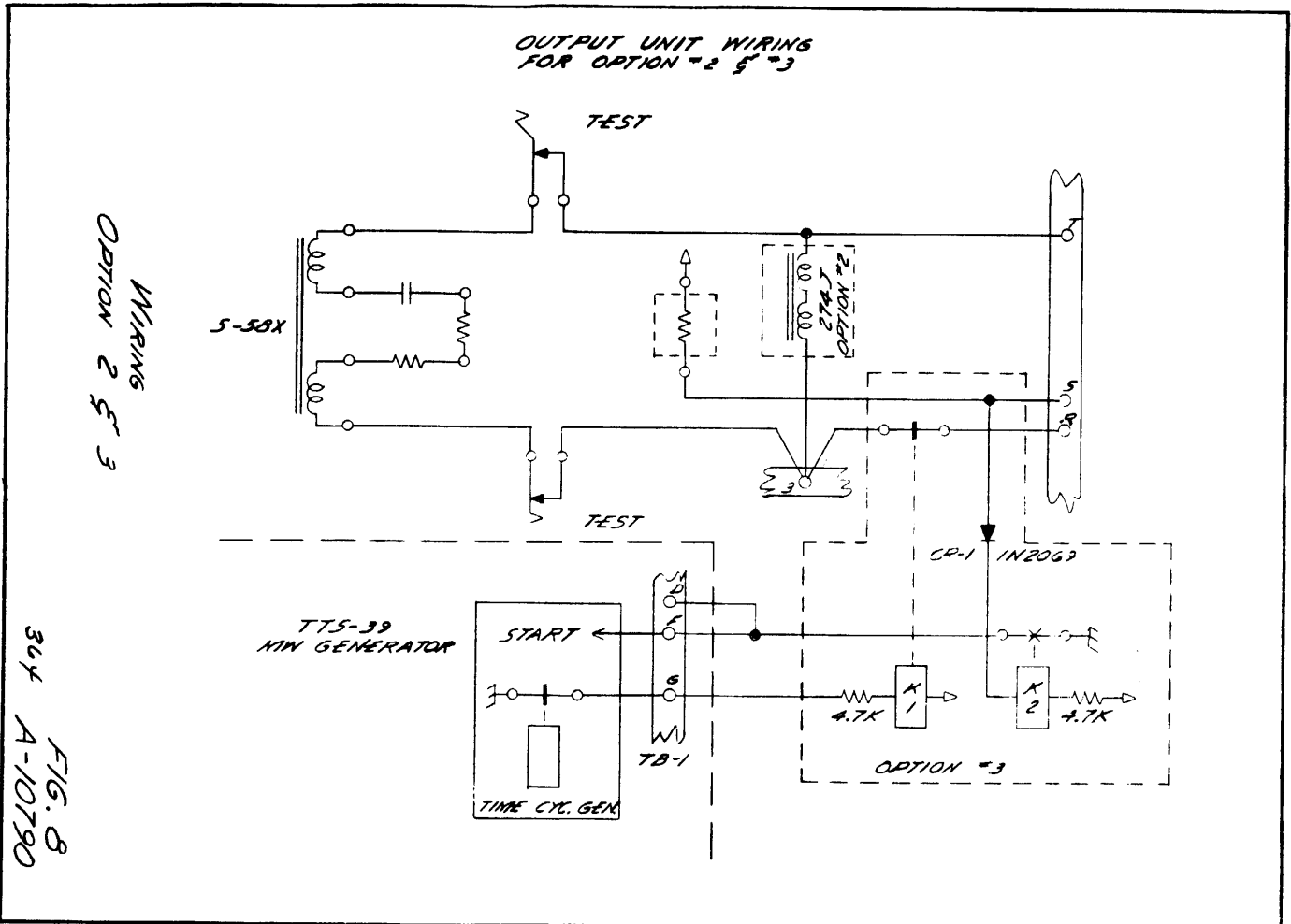


Figure 7



344
FIG. 8
A-10790

Figure 8
30

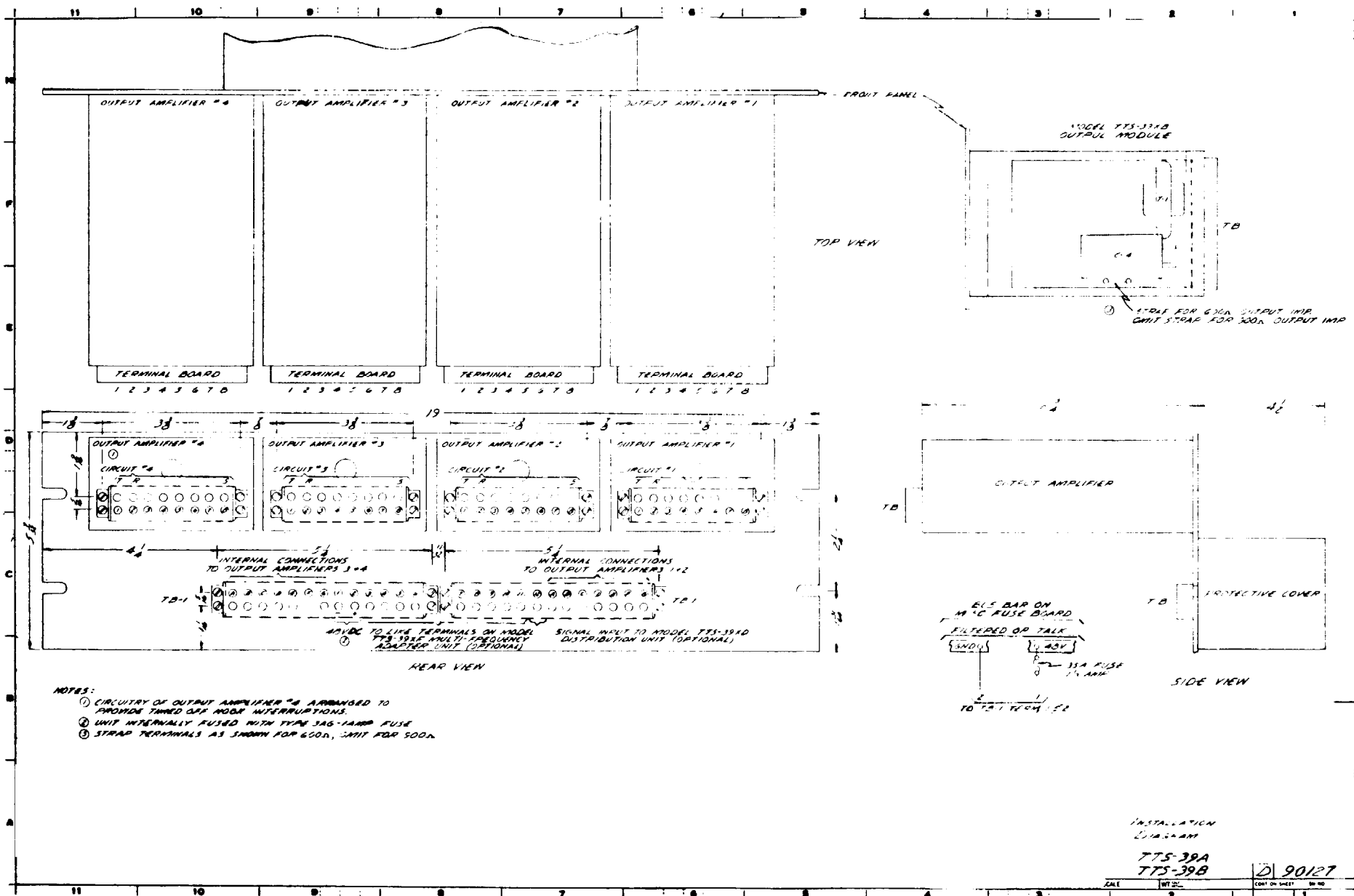


Figure 9

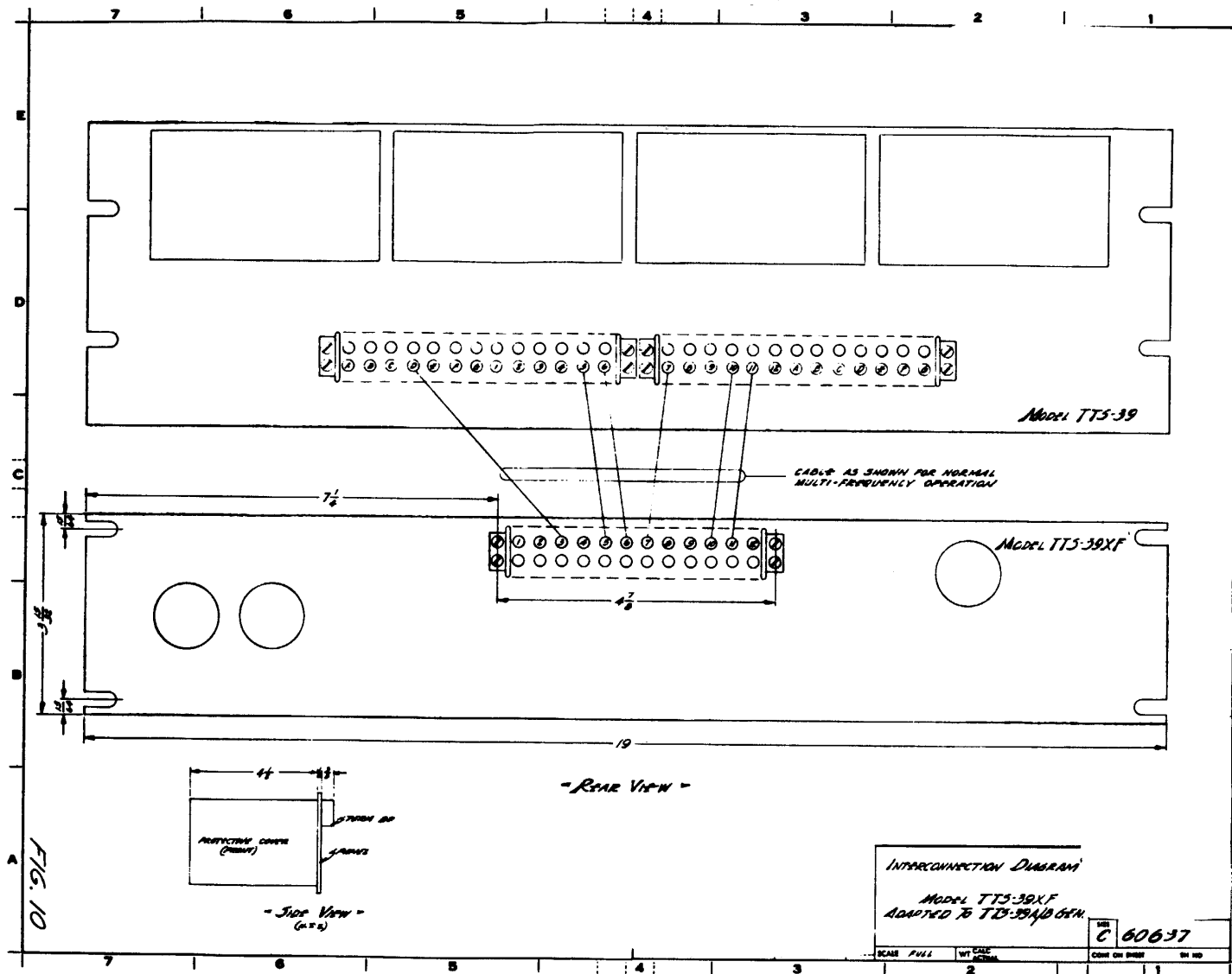


Figure 10

APPENDIX A

REFERENCES

Following is a list of publications available to the operator and maintenance personnel of Reference Tone Generator, Northeast Electronics Corporation, Models TTS-39A and TTS-39B.

DA Pam 310-4	Index of Technical Manuals, Technical Bulletins, Supply Manuals (types 7, 8, and 9), Supply Bulletins, and Lubrication Orders.
DA Pam 310-7	U. S. Army Equipment Index of Modification Work Orders.
TB SIG 355-1	Depot Inspection Standard for Repaired Signal Equipment.
TB SIG 355-2	Depot Inspection Standard for Refinishing Repaired Signal Equipment.
TB SIG 355-3	Depot Inspection Standard for Moisture and Fungus Resistant Treatment.
TM 9-213	Painting Instructions for Field Use.
TM 38-750	Army Equipment Record Procedures.

APPENDIX B

BASIC ISSUE ITEMS

Section I. INTRODUCTION

B-1. Scope

The equipment described in this appendix is for Reference Tone Generator, TTS-39A and TTS-39B. There are no items required for installation, operation or operator's maintenance.

E-2. Explanation of Columns

The following is a list of explanations of columns in section II.

a. Source Maintenance and Recoverability Codes (SMR) Column. Not used.

b. Federal Stock Number Column. This column indicates the Federal stock number for the item.

c. Description Column. This column includes the Federal item name and any additional description of the item which may be required. A part number or other reference number is followed by the applicable five-digit Federal supply code for manufacturers. Usable on code column is not used.

d. Unit of Measure Column. The unit used as a basis of measure (e.g., ea, pr, ft, yd, etc.) is given in this column.

e. Quantity Incorporated in Unit Column. The total quantity of the item used in the equipment is given in this column.

f. Quantity Furnished with Equipment Column. This column lists the quantity of the item supplied for initial operation of the equipment and/or the quantities authorized to be kept on hand by the operator for maintenance of the equipment.

g. Illustrations Column.

(1) *Figure number (a).* The number of the illustration in which the item is shown is indicated in this column.

(2) *Item No. or reference designation (b).* Not used.

B-3. Federal Supply Codes

This paragraph lists the Federal supply code with the associated manufacturer's name.

<i>Code</i>	<i>Manufacturer</i>
06819.....	Northeast Electronics Corp.

(1) SMR CODE	(2) FEDERAL STOCK NUMBER	(3) DESCRIPTION	(4) UNIT OF MEAS	(5) QTY INC IN UNIT	(6) QTY FURN WITH EQUIP	(7) ILLUSTRATON	
						(a) FIGURE NO.	(b) ITEM NO.
	6625-883-8324	<p>REFERENCE TONE GENERATOR: TTS-39A and TTS-39B; 06819 (This item is nonexpendable)</p> <p>TECHNICAL MANUAL TM 11-6625-939-15</p> <p>Requisition through pinpoint account number if assigned; otherwise through nearest Adjutant General facility.</p> <p>NOTE: For technical manuals the quantity indicates the maxim number of copies authorized for packing (or issue) with the equipment. Where a number of these equipments are concentrated in a small area, the quantity on hand may be reduced to minimum actual requirements as determined by the commanding officer of the unit.</p> <p>NO PARTS AUTHORIZED OPERATOR/CREW</p> <p>NO ACCESSORIES, TOOLS, OR TESS EQUIPMENT ARE TO BE ISSUED WITH THIS EQUIPMENT</p> <p>NO BASIC ISSUE STEMS ARE MOUNTED IN OR ON THIS EQUIPMENT</p>	ea	2	2	1A	

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USACDCCEA Ft Huachuca (1)

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USAR: None.

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GRAPH

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The Metric System and Equivalents

Linear Measure

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

Weights

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

Liquid Measure

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

Square Measure

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

Cubic Measure

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

Approximate Conversion Factors

<i>To change</i>	<i>To</i>	<i>Multiply by</i>	<i>To change</i>	<i>To</i>	<i>Multiply by</i>
inches	centimeters	2.540	ounce-inches	newton-meters	.007062
feet	meters	.305	centimeters	inches	.394
yards	meters	.914	meters	feet	3.280
miles	kilometers	1.609	meters	yards	1.094
square inches	square centimeters	6.451	kilometers	miles	.621
square feet	square meters	.093	square centimeters	square inches	.155
square yards	square meters	.836	square meters	square feet	10.764
square miles	square kilometers	2.590	square meters	square yards	1.196
acres	square hectometers	.405	square kilometers	square miles	.386
cubic feet	cubic meters	.028	square hectometers	acres	2.471
cubic yards	cubic meters	.765	cubic meters	cubic feet	35.315
fluid ounces	milliliters	29.573	cubic meters	cubic yards	1.308
pints	liters	.473	milliliters	fluid ounces	.034
quarts	liters	.946	liters	pints	2.113
gallons	liters	3.785	liters	quarts	1.057
ounces	grams	28.349	liters	gallons	.264
pounds	kilograms	.454	grams	ounces	.035
short tons	metric tons	.907	kilograms	pounds	2.205
pound-foot	newton-meters	1.365	metric tons	short tons	1.102
pound-inches	newton-meters	.11375			

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

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