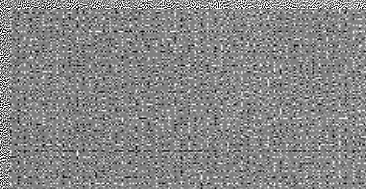


# INSTRUCTION MANUAL

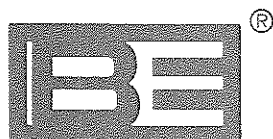


DUAL TONE GENERATOR

JUNE, 1981

IM No. 597-6860

BROADCAST ELECTRONICS, INC.



# **IMPORTANT INFORMATION**

## **EQUIPMENT LOST OR DAMAGED IN TRANSIT**

When delivering the equipment to you, the truck driver or carrier's agent will present a receipt for your signature. Do not sign it until you have (a) inspected the containers for visible signs of damage and (b) counted the containers and compared with the amount shown on the shipping papers. If a shortage or evidence of damage is noted, insist that notation to that effect be made on the shipping papers before you sign them.

Further, after receiving the equipment, unpack it and inspect thoroughly for concealed damage. If concealed damage is discovered, immediately notify the carrier, confirming the notification in writing, and secure an inspection report. This item should be unpacked and inspected for damage **WITHIN 15 DAYS** after receipt. Claims for loss or damage will not be honored without proper notification of inspection by the carrier.

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Technical assistance is available from Broadcast Electronics by letter or prepaid telephone or telegram. Equipment requiring repair or overhaul should be sent by common carrier, prepaid, insured and well protected. Do not mail equipment. We can assume no liability for inbound damage, and necessary repairs become the obligation of the shipper. Prior arrangement is necessary. Contact Customer Service Department for a Return Authorization.

### **FOR TECHNICAL ASSISTANCE**

Phone (217) 224-9600 Customer Service

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Replacement and Warranty Parts may be ordered from the address below. Be sure to include equipment model and serial number and part description and part number.

Broadcast Electronics, Inc.  
4100 N. 24th St., P.O. Box 3606  
Quincy, Illinois 62305  
Tel: (217) 224-9600  
Telex: 25-0142  
Cable: BROADCAST  
Fax: (217) 224-9607

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## **MODIFICATIONS**

Broadcast Electronics, Inc. reserves the right to modify the design and specifications of the equipment in this manual without notice. Any modifications shall not adversely affect performance of the equipment so modified.

# DUAL TONE GENERATOR

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## SECTION I GENERAL INFORMATION

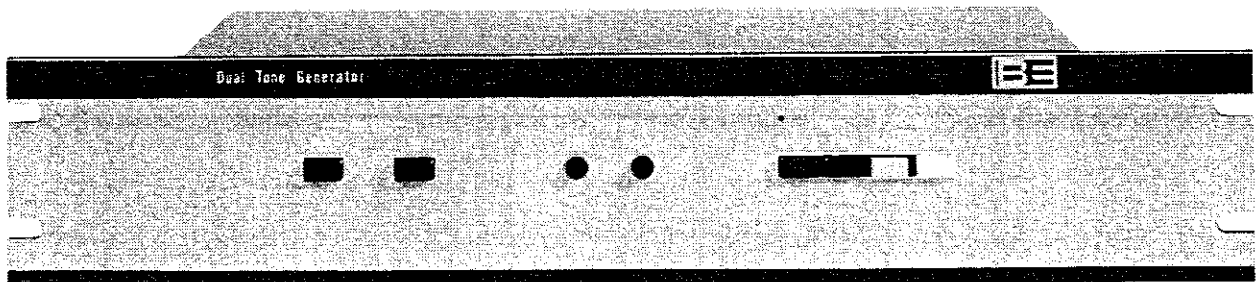
### 1-1. INTRODUCTION

1-2. This section contains a general description of the dual tone generator, provides equipment identification, and lists equipment specifications.

1-3. The Broadcast Electronics Dual Tone Generator is an accessory for use with automation equipment to produce reel-to-reel tapes with 25 Hz end of message (EOM) tones. Besides containing a 25 Hz oscillator, the dual tone generator also includes a 1000 Hz oscillator for recording a level-set tone at the beginning of the tape as well as active filters in both left and right channels to remove program material below 50 Hz (See figure 1-1).

1-4. The 25 Hz sensors detect previously recorded EOM tones, and contain switching and logic circuitry for controlling the stop delay, and left or right channel selection.

1-5. All control functions can be remotely controlled by means of rear panel barrier strip. Through interconnections with peripheral equipment, many applications are possible.



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FIGURE 1-1. DUAL TONE GENERATOR

TABLE 1-1. ELECTRICAL AND PHYSICAL SPECIFICATIONS  
(Sheet 1 of 2)

PARAMETER	SPECIFICATIONS
<u>DETECTORS</u> Input Sensitivity Selectivity	High Impedance Bridging Input Detects 25Hz Tones as low as -17 dBm Rejects Tones outside of the 20 Hz to 30 Hz range at +8 dBm input level.
<u>FILTERS</u> Input Output Output Level Noise Distortion Crosstalk	High Impedance bridging input at 0 dBm Low Impedance capable of driving a 600 Ohm load. 0 dBm output into 600 Ohm with 0 dBm input level. +20 dB output before clipping, -45 dB or more at 25 Hz. 70 dB below 0 dBm output Less than 0.05% THD and IMD at +10 dBm output, 100 Hz to 20 kHz. 60 dB or greater
<u>OSCILLATORS</u> 1 kHz - Frequency Distortion Output Level 25 Hz - Frequency Distortion Output Level	+10 Hz Less than 0.5% Adjustable from -20 to 3 dBm +.25 Hz Less than 0.5% Adjustable from -20 to 0 dBm
Stop Delay 25 Hz Tone Length Operating Temperature Range	Adjustable from 0 to 10 seconds Adjustable from 0.1 to 2 seconds +32° F to +122° F (0° C to +50° C)

TABLE 1-1. ELECTRICAL AND PHYSICAL SPECIFICATIONS  
(Sheet 2 of 2)

PARAMETER	SPECIFICATIONS
Power Requirements	115 V or 230 Vac, 50/60 Hz, 20 Watts maximum
Dimensions	19 inches wide x 3.5 inches high x 8.5 inches deep (48.26 cm x 8.89 cm x 21.59 cm)

## SECTION II INSTALLATION

### 2-1. INTRODUCTION

2-2. This section contains information required for installation and preliminary checkout of the Broadcast Electronics Dual Tone Generator.

2-3. The equipment becomes the property of the customer when the equipment is delivered to the carrier. Carefully unpack the equipment. Perform a visual inspection to determine that no apparent damage has been incurred during shipment. All shipping materials should be retained until it is determined that the unit has not been damaged. Claims for damaged equipment must be filed against the carrier promptly or the carrier may not accept the claim.

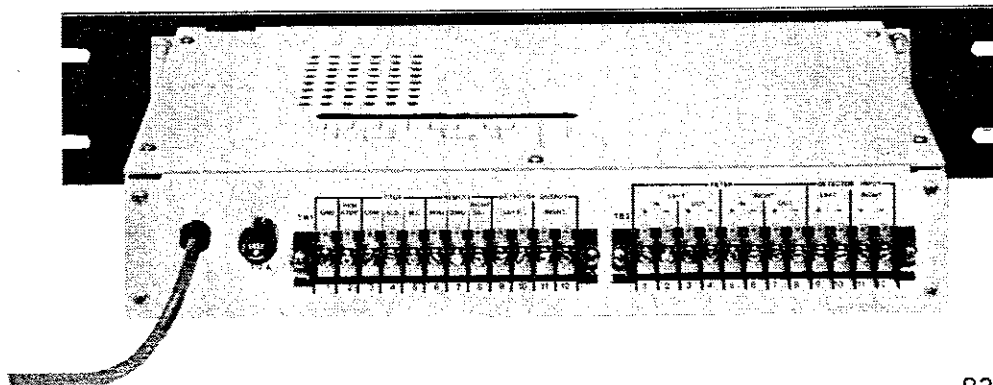
2-4. The contents of the shipment should be as indicated on the packing list. If the contents are incomplete, or if the unit is damaged electrically or mechanically, notify both the carrier and Broadcast Electronics, Inc.

### 2-5. INSTALLATION

#### CAUTION

AVOID MOUNTING THE DUAL TONE GENERATOR NEAR OR ABOVE HEAT GENERATING EQUIPMENT. THIS COULD RESULT IN THE DETERIORATION OF THE GENERATOR PERFORMANCE.

2-6. The mounting area should be as clean and dust free as possible. The generator should be mounted in such a fashion as to allow easy access to the controls mounted on the circuit board accessible through holes in the top cover (See figure 2-1).



839-6860-4

FIGURE 2-1. DUAL TONE GENERATOR (REAR VIEW)

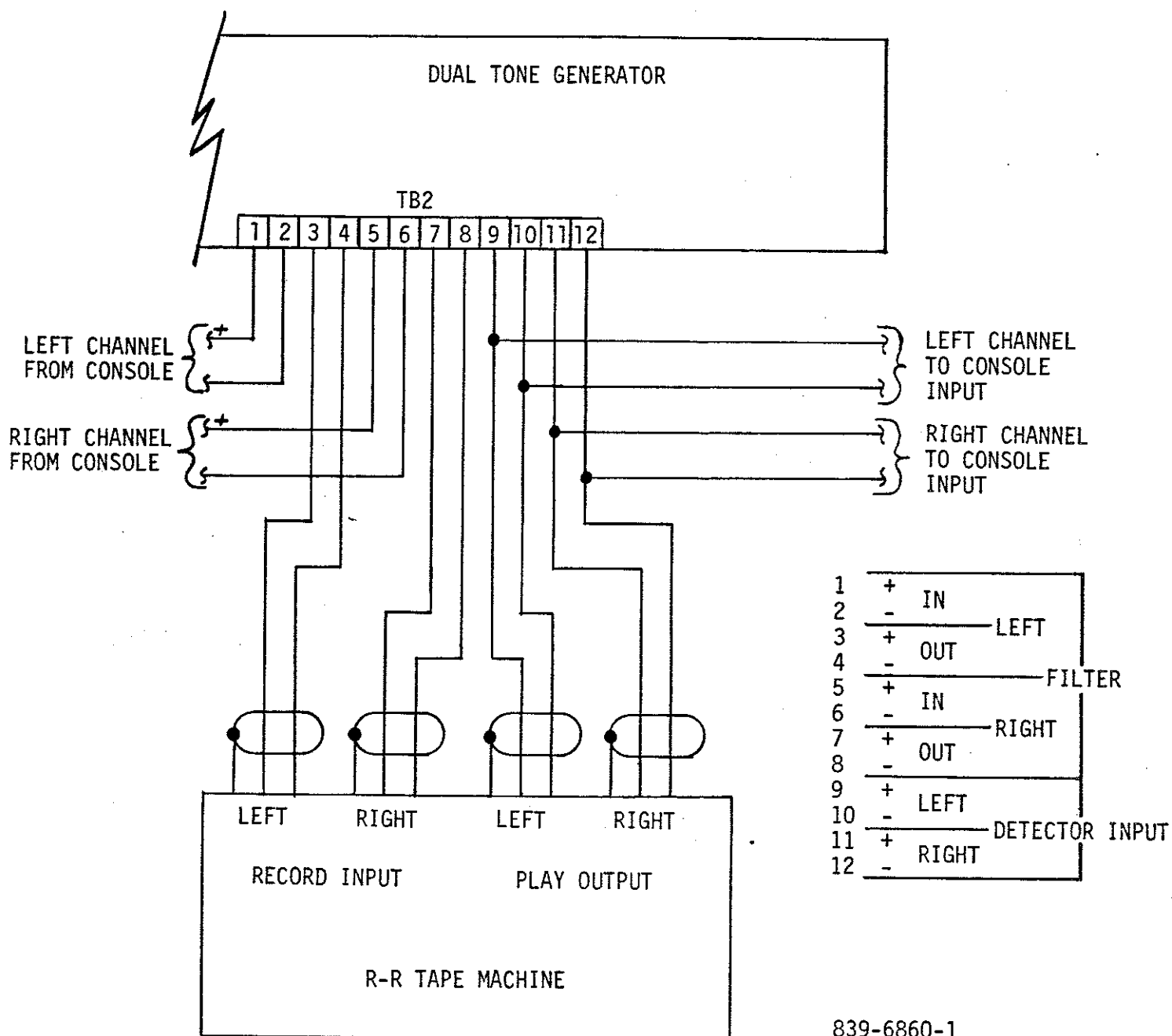


2-7. WIRING

**WARNING**

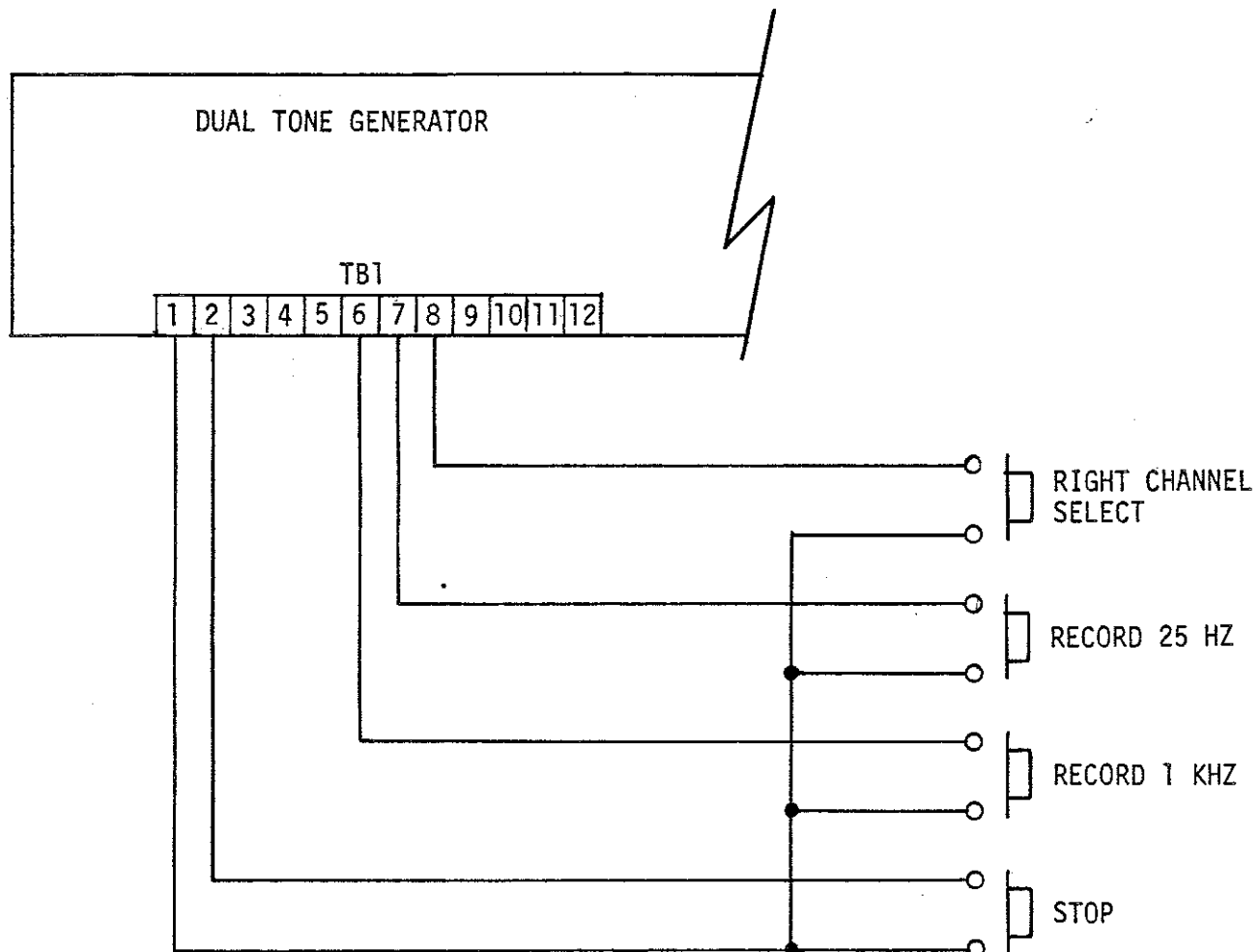
ENSURE PRIMARY AC POWER IS DISCONNECTED  
BEFORE PROCEEDING.

- 2-8. Disconnect primary ac power.
- 2-9. Remove the tone generator top cover and ensure the correct primary voltage range (115V or 230V) is selected by switch S7.
- 2-10. Replace the top cover and connect the ac primary input.
- 2-11. Typical connections for the dual tone generator in an application for producing reel-to-reel tapes is shown in Figure 2-2.
- 2-12. The left and right audio connections from the studio console are connected to the left and right filter inputs of the dual tone generator. The output of the filter sections should then be connected to the left and right inputs of the production reel-to-reel recorder.
- 2-13. Remote connections for the 1K RECORD, RIGHT SELECT, 25HZ RECORD, and MANUAL STOP push switches may be remoted close to the operator for convenience. Normally, open switches should be used with one side of the switch connected to the GND terminal on the rear panel (see Figure 2-3).



839-6860-1

FIGURE 2-2. AUDIO CONNECTIONS



1	GND	
2	REM STOP	
3	COM	
4	N. O.	STOP
5	N. C.	
6	1 KHZ	
7	25 KHZ	REMOTE
8	RIGHT SEL.	
9	LEFT	
10		DETECTOR OUTPUT
11		
12	RIGHT	

839-6860-2

FIGURE 2-3. REMOTE CONTROL CONNECTIONS

## SECTION III OPERATION

### 3-1. INTRODUCTION

3-2. This section provides operating procedures and identifies all controls and indicators associated with the dual tone generator.

### 3-3. CONTROLS AND INDICATORS

3-4. Refer to Figure 3-1 for the location of the controls and indicators associated with the dual tone generator. The function of each control or indicator is described by Table 3-1.

### 3-5. OPERATION

3-6. The dual tone generator will most commonly be used in the production of reel-to-reel tapes used with an automation system. In this configuration, the generator section supplies the 25 Hz end of message (EOM) tone to the recorder and the 25 Hz detector circuitry stops the recorder after a fixed time delay following the end of the 25 Hz tone.

3-7. The output from the station console is fed into the left and right filter section to remove all audio below 50 Hz (See Figure 3-1). This is necessary because any audio that might fall into the passband for the 25 Hz detector circuitry would actuate the circuitry and cause detection of a false EOM signal. Therefore, with all audio below 50 Hz removed by the filters, the only signal detected by the 25 Hz sensors will be the actual 25 Hz tone itself. Since recorded program material contains very little audio in the spectrum below 50 Hz, the quality of the program material will not be degraded.

3-8. To record using the dual tone generator, a blank tape of the desired length must be loaded onto the tape recorder. The recorder is then placed in the record mode and started. The 25 HZ RECORD switch must be depressed and held. If all of the connections have been properly wired, the LEFT DETECTOR will illuminate for the length of time the 25 HZ RECORD switch is depressed. This indicates that the 25 Hz signal has been applied to the tape and is actually being recorded and the tone detector circuitry has detected the tone. After the desired time delay has expired following the end of the EOM tone, the recorder will stop.

3-9. If this test procedure is followed at the beginning of every session when the tape is played back on the automation system, the system will perform as expected. Operator errors or equipment malfunctions will show up immediately during this initial testing.

3-10. After initial testing has been completed, the tape should be thoroughly bulk erased to remove the test tone. Several minutes of tape should be allowed to wind onto the take-up reel as a leader before recording is again started. Alternately a leader tape could be spliced to the head of the tape. After a leader is prepared the recorder must be stopped, placed in the record mode, and started.

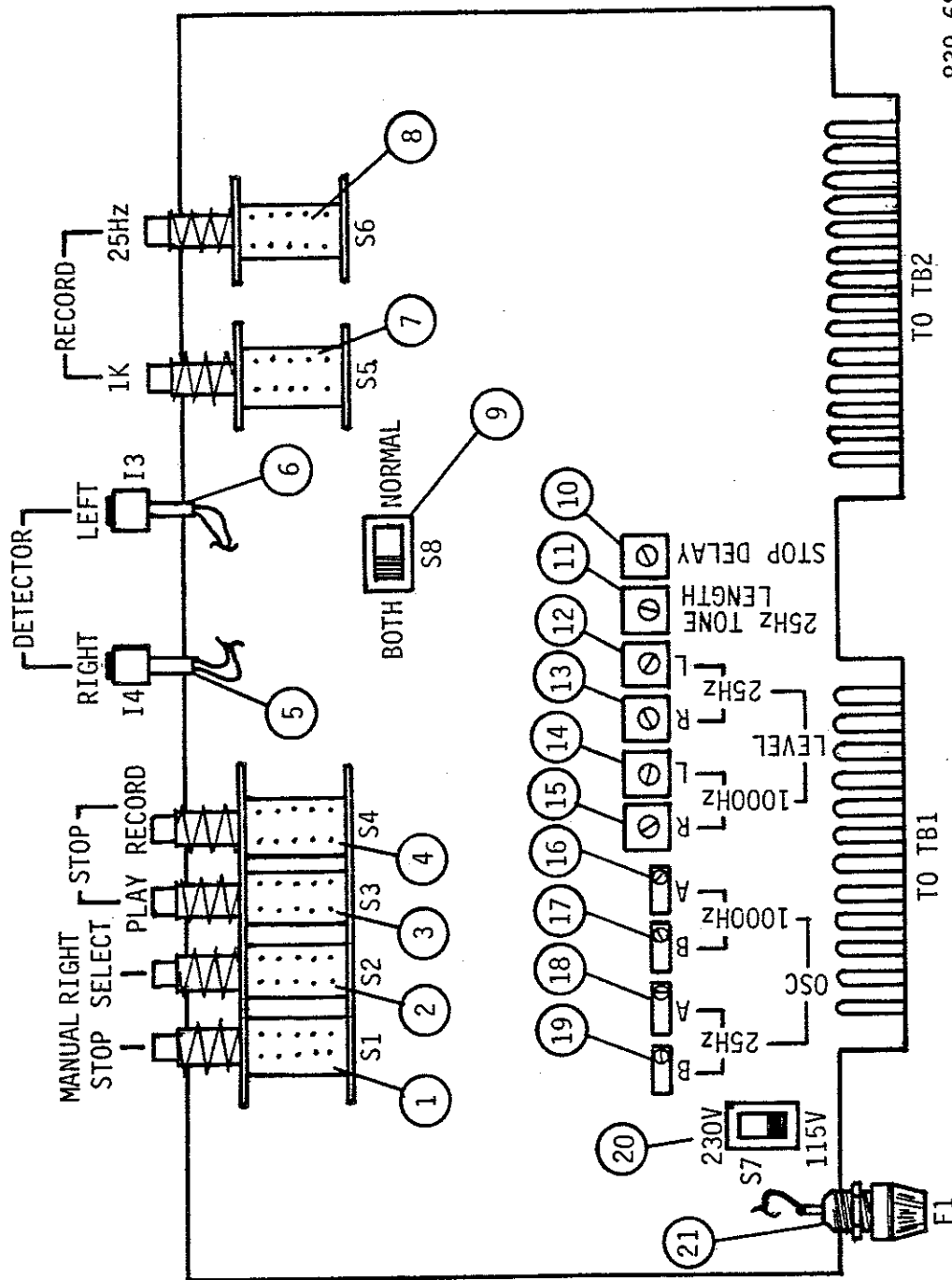


FIGURE 3-1. CONTROLS AND INDICATORS

Table 3-1. Control and Indicator Functions (Sheet 1 of 3)

ITEM	NOMENCLATURE	FUNCTION
1	MANUAL STOP switch (S1)	Controls the stop relay within the dual tone generator. If depressed, will energize the stop relay to stop the recorder.
2	RIGHT SELECT switch (S2)	Selects the right channel recording and stop circuitry rather than the left channel circuitry.
3	STOP PLAY switch (S3)	Enables the dual tone generator stop circuits in the play mode. If depressed, stops the recorder after a delay preset by the STOP DELAY control expires, beginning at the end of the 25 Hz stop tone.
4	STOP RECORD switch (S4)	Enables the dual tone generator stop circuitry in the record mode. If depressed, stops the recorder after a delay preset by the STOP DELAY control expires beginning at the end of the 25 Hz stop tone.
5	RIGHT DETECTOR indicator (I4)	Illuminates when the presence of a 25Hz tone applied to the dual tone generator right detector input is sensed. The indicator will illuminate for the duration of the tone only.
6	LEFT DETECTOR indicator (I3)	Illuminates when the presence of a 25Hz tone applied to the dual tone generator left detector input is sensed. The indicator will illuminate for the duration of the tone only.
7	RECORD 1K switch (S5)	Causes a 1kHz tone to be mixed with the signal applied to the left and right filter input sections of the dual tone generator. The tone is enabled the length of time the RECORD 1K switch is held depressed. The 1kHz tone will be recorded on both the left and right channels of the tape.

Table 3-1. Control and Indicator Functions (Sheet 2 of 3)

ITEM	NOMENCLATURE	FUNCTION
8	RECORD 25 HZ switch (S6)	Causes a 25 Hz tone to be mixed with the signal applied to the left filter input section only of the dual tone generator. If the RIGHT SELECT switch is depressed the 25 Hz tone will be mixed with the signal applied to the right filter input section only of the dual tone generator.
9	BOTH/NORMAL switch	Selects recording of the 25 Hz stop tone on the left channel only, right channel only, or both channels. If the BOTH/NORMAL switch is set to either position, the 25 Hz stop tone will be recorded on the left channel only. If the BOTH/NORMAL switch is set to NORMAL and the RIGHT SELECT switch is depressed, the 25 Hz stop tone will be recorded on the right channel only. If the BOTH/NORMAL switch is set to BOTH and the RIGHT SELECT switch is depressed, the 25 Hz stop tone will be recorded on both channels simultaneously. The tone is enabled the length of time the RECORD 25 Hz switch is held depressed.
10	STOP DELAY control (R32)	Adjusts a delay which stops the associated recorder, beginning at the end of the 25 Hz tone.
11	25HZ TONE LENGTH control (R31)	Sets minimum 25 Hz tone length.
12	LEVEL 25 HZ L control (R30)	Adjusts the left channel 25 Hz tone output level.
13	LEVEL 25 HZ R control (R29)	Adjust the right channel 25 Hz tone output level.

Table 3-1. Control and Indicator Functions (Sheet 3 of 3)

ITEM	NOMENCLATURE	FUNCTION
14	LEVEL 1000HZ L control (R28)	Adjusts the left channel 1000 Hz tone output level
15	LEVEL 1000HZ R control (R27)	Adjusts the right channel 1000 Hz tone output level
16	OSC 1000 HZ A control (R6)	Adjusts frequency and distortion of the 1000 Hz tone.
17	OSC 1000 HZ B control (R5)	Adjusts frequency and distortion of the 1000 Hz tone.
18	OSC 25 HZ A control (R4)	Adjusts frequency and distortion of the 25 Hz tone.
19	OSC 25 HZ B control (R3)	Adjusts frequency and distortion of the 25 Hz tone.
20	115V/230V switch (S7)	Allows selection of 115V or 230V primary ac potential.
21	FUSE (F1)	Provides overload protection for the dual tone generator circuitry.



The 1K RECORD switch must be depressed and held for at least 30 seconds to apply a level set tone for operator use in setting playback levels when cueing the tape on an automation system. After the 1kHz tone has been recorded, several seconds of tape should be allowed to run. The 25 HZ RECORD switch must next be depressed, held for a few seconds, and then released to apply the 25 Hz tone to the beginning of the tape to cause the playback deck in the automation system to stop at the beginning of the first selection. After the preset time delay has passed following the release of the 25 HZ RECORD switch and if the RECORD STOP switch is depressed, the recorder will automatically stop and will be ready for the first selection to be recorded.

3-11. To record the first cut on the tape, the record or master tape must first be cued to the proper point, and the recorder placed in the record mode again. Then, both the source and the recorder must be started at the same time. A single start switch could be wired in parallel with the START switches of both machines to perform this function with minimal operator effort. Of course, normal recording procedures should be followed with respect to recording levels, etc.

3-12. When the end of the selection approaches, the operator must insert the EOM tone at the proper point by pressing the 25 HZ RECORD switch. A quick push and release action will result in the EOM tone being recorded with a length determined by the setting of the tone length control on the circuit board. If the 25 HZ RECORD switch is pressed and held, however, the tone length will be determined by the length of time that the switch is depressed.

### 3-13. SPECIAL APPLICATIONS

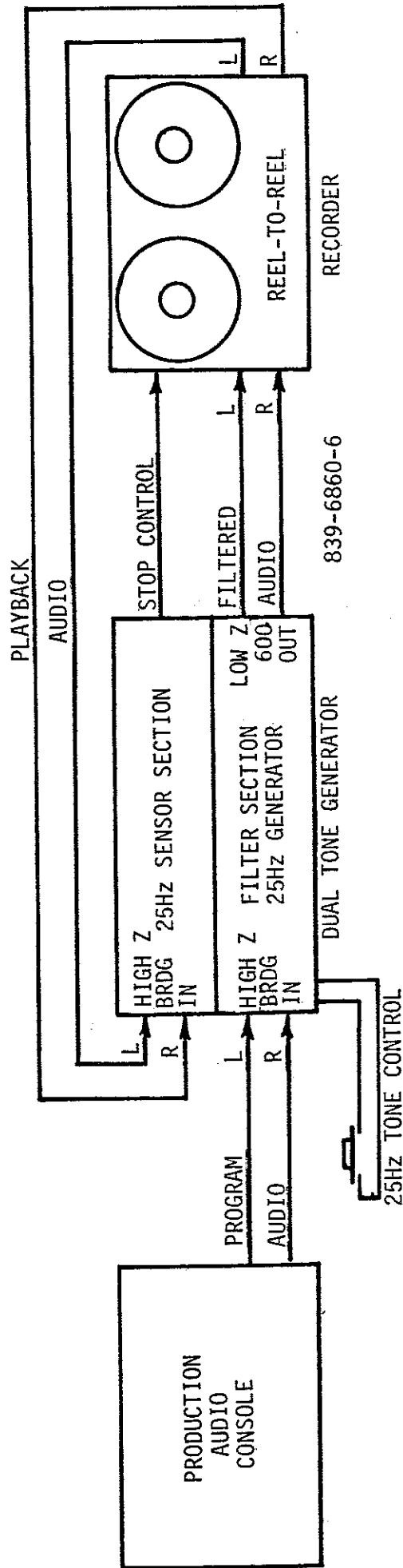
3-14. DUBBING CARTRIDGES FROM A MASTER REEL-TO-REEL TAPE. Many automated stations use reel-to-reel machines for their basic music library, but prefer the convenience of cartridges for current music. This allows much greater flexibility in the rotation of current hits than can be obtained with reel-to-reel equipment. However, dubbing the music from reel-to-cart equipment is a tedious task, especially considering the addition of EOM tones (150 Hz signal on the cue track as opposed to the 25 Hz signal for reel-to-reel). This is one application where the dual tone generator can be a real time saver (See Figure 3-3).

3-15. Audio from the reel-to-reel playback is fed to both the filter section of the tone generator and to the 25 Hz sensor section to detect the EOM tone on the master tape. The output of the 25 Hz detector circuitry controls the cartridge recorder so that the 25 Hz tone on the master tape will trigger placement of the 150 Hz EOM tone on the cartridge. Filtered audio from the dual tone generator feeds the audio input to the cart recorder. As this program material was filtered in the production of the master tape, no further attenuation of the low frequencies is effected by the filter circuitry and the audio is basically routed straight through, except for the removal of the 25 Hz tones.

3-16. Stop control from the dual tone generator can be connected to both the cart recorder and the reel-to-reel deck so that both equipments stop automatically after the EOM tone on the master tape. This would leave the reel-to-reel machine positioned at the beginning of the next cut, and the recorded cartridge could be removed and the next one inserted in preparation for the next recording. The recorded cartridge must be cued to the beginning before use.

3-17. USE OF THE DUAL TONE GENERATOR AS A 25 HZ SENSOR. Some older automation systems require the reel-to-reel playback machines to provide the EOM signal to the controller. The 25 Hz detection circuitry of the dual tone generator provides just such a function and may be used to interface an additional reel-to-reel playback deck to the older automation system (See Figure 3-4).

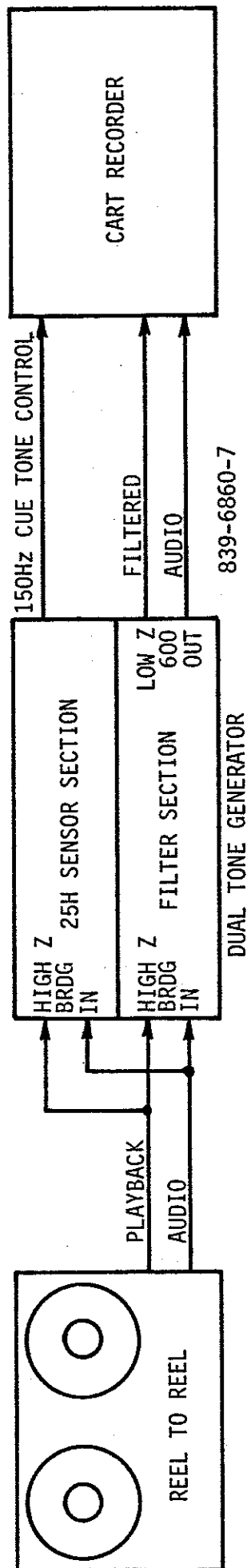
3-18. Audio from the playback deck is fed to both the filter section and the 25 Hz detector circuitry. The filter section provides filtered audio applied directly to the system. The 25 Hz detector senses the EOM tone on the tape, converts it to a relay closure, and feeds this signal to the EOM input of the automation system for that particular source. In addition, the stop control is connected from the dual tone generator to the playback deck to stop the deck between cuts. The start control from the system is brought to the deck to allow the deck to be started on command.



THIS APPLICATION PROVIDES FILTERING FOR THE PROGRAM MATERIAL, RECORDING THE 25 HZ EOM CUE TONE AND STOPPING THE REEL-TO-REEL RECORDER AFTER THE PROPER STOP DELAY TIME.

THE FILTER SECTION IS WIRED BETWEEN THE CONSOLE OUTPUT AND THE REEL-TO-REEL RECORDER INPUT. THE OUTPUT OF THE RECORDER PLAYBACK SECTION IS WIRED AS THE SENSOR INPUT. THE STOP CONTROL OUTPUT OF THE SENSOR SECTION IS WIRED TO THE REMOTE STOP PROVISION OF THE REEL-TO-REEL RECORDER.

FIGURE 3-2. DUAL TONE GENERATOR TYPICAL INSTALLATION-MUSIC TAPE PRODUCTION

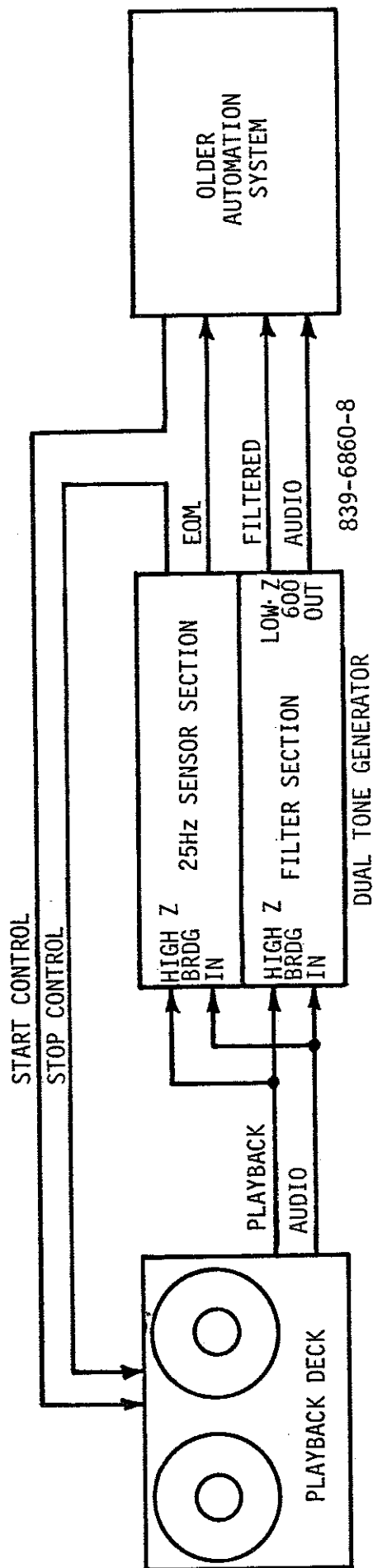


THE MASTER REEL-TO-REEL MUSIC TAPE INCLUDES THE 25 HZ CUE TONES WHICH TRIGGER THE PRECISE PLACEMENT OF THE 150 HZ TONES ON THE "MUSIC CARTS".

THE FILTER SECTION IS WRIED BETWEEN THE REEL-TO-REEL PLAYBACK DECK AND THE CARTRIGE RECORDER TO ENSURE ALL THE 25 HZ TONE IS REMOVED FROM THE AUDIO PRIOR TO RECORDING THE CARTRIGE.

THE INPUT TO THE SENSOR SECTION IS WIRED IN PARALLEL WITH THE FILTER SECTION INPUT. THE OUTPUT OF THE SENSOR SECTION IS WIRED TO THE REMOTE 150 HZ (SECONDARY) CUE TONE RECORD PROVISION WITH THE SENSING OF THE 25 HZ TONE ON THE REEL-TO-REEL TAPE.

FIGURE 3-3. DUAL TONE GENERATOR TYPICAL INSTALLATION-DUBBING FROM MUSIC TAPE TO CART



OLDER AUTOMATION SYSTEMS REQUIRE SEPERATE 25 HZ CUE TONE SENSING TO PRODUCE THE EOM SIGNAL TO THE AUTOMATION CONTROL UNIT. THE DUAL TONE GENERATOR STOPS THE REEL-TO-REEL DECK AND FILTERS THE 25 HZ CUE TONE OUT OF THE AUDIO TO THE AUTOMATION CONTROL UNIT.

THE FILTER SECTION IS WIRED BETWEEN THE PLAYBACK DECK AND THE SOURCE INPUT OF THE AUTOMATION SYSTEM. THE SENSOR SECTION INPUT IS WIRED IN PARALLEL WITH THE FILTER SECTION INPUT. THE SENSOR OUTPUT IS WIRED TO THE EOM INPUT FOR THE SOURCE ON THE AUTOMATION CONTROL UNIT. THE STOP CONTROL IS WIRED TO THE REMOTE STOP OF THE PLAYBACK DECK. THE AUTOMATION START CIRCUIT IS WIRED TO THE REMOTE START OF THE PLAYBACK DECK.

FIGURE 3-4. DUAL TONE GENERATOR TYPICAL INSTALLATION-OLDER AUTOMATION SYSTEMS

## SECTION IV THEORY OF OPERATION

### 4-1. INTRODUCTION

4-2. This section contains theory of operation for the dual tone generator. For purposes of explanation, the circuitry is divided into functional circuits. Refer to figure 4-1 and the schematic diagram as required for the following text.

### 4-3. THEORY OF OPERATION

#### 4-4. POWER SUPPLY

4-5. The tone generator is powered from a primary ac input of 115V or 230 V, 50 or 60 Hz. Operation from the correct potential is selected by the position of the 230V/115V switch (S7) mounted to the tone generator internal circuit board. Overload protection is provided by fuse F1.

4-6. Transformer T1 produces an output of 24 volts which is half-wave rectified into positive and negative 24 volt dc potentials. The +24 volt potential is regulated into a +15 volt source by U1 and the -24 volt potential is regulated into a -15 volt source by U2. Diodes connected across each regulator provide protection for the regulators from faults occurring on the input side of the regulators. A +24 volt filtered output from the supply provides a potential to operate the internal 24 volt relay circuitry.

#### 4-7. AUDIO INPUT

4-8. Balanced audio enters the dual tone generator at the filter inputs (TB2) on the equipment rear panel. Pins 1 and 2 are the inputs for the left channel and pins 5 and 6 are the right channel inputs. As right channel operation is identical to left channel operation, only the left channel will be discussed.

4-9. Audio is ac coupled to amplifier U11A and is then applied to an active six-pole Chebishev high-pass filter comprising U11B, U10A, and U10B. The filter removes essentially all program material from the input audio below 50 Hz to prevent possible interference with the 25 Hz tone to be recorded. Filtered audio is output through R56 and mixed with signal from the 25Hz and 1KHz tone oscillators through R19. Amplifiers U9A and U9B provide a balanced output to the record electronics of the associated recorder.

#### 4-10. CONTROL LOGIC

4-11. After the input audio is filtered, signal from the tone generator is added to the audio signal. Depressing the 25 Hz RECORD switch (S6) causes a LOW to appear on the trigger input of U5. A HIGH from the Q output of U5 is coupled through diodes D8 and D9 to inverters U7D and U7E.

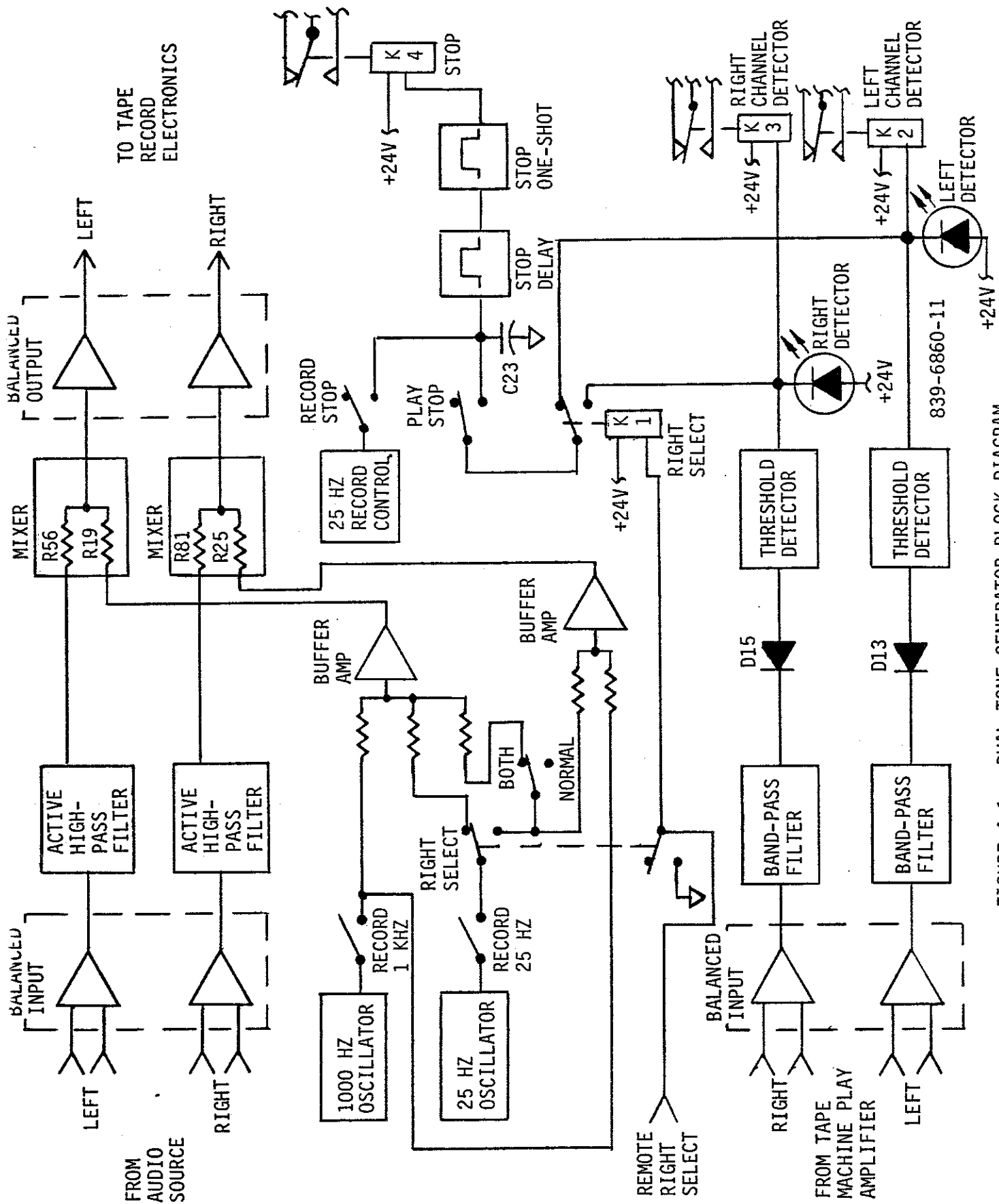


FIGURE 4-1. DUAL TONE GENERATOR BLOCK DIAGRAM

4-12. If the RIGHT SELECT switch is open, the input to inverter U7E will go HIGH whenever the Q output of U5 goes HIGH. If the RIGHT SELECT switch is closed, the input to U7C will be LOW and the output of U7C will be HIGH so that when the Q output of U5 goes HIGH, the input to U7D will also go HIGH. When the input to U7D or U7E goes HIGH, the corresponding output will go LOW to enable FET switch Q2 (left channel) or Q4 (right channel) to mix a 25 Hz tone with the program audio. The left channel buffer stage (U4A) buffers the 25Hz audio tone from Q2 into mixing resistor R19.

4-13. The BOTH/NORMAL switch has no effect if the RIGHT SELECT switch is open. If the RIGHT SELECT switch is closed and the BOTH/NORMAL switch is in NORMAL, a 25 Hz tone will be output on the right channel only. If the RIGHT SELECT switch is closed and the BOTH/NORMAL switch is in BOTH, a 25 Hz tone will be output on both channels.

4-14. If the 1K RECORD switch (S5) is depressed, a LOW will appear on the gate of both Q1 and Q3, enabling both FET switches for the duration of the switch closure. Depressing the RECORD STOP switch (S4) couples the Q output of U5 through inverter U7F to the trigger and threshold inputs of U6.

4-15. Whenever the Q output of U5 goes HIGH, U7F will discharge capacitor C24. At the end of the HIGH from U5, C24 will charge through R32 and R34. When capacitor C24 charges to 2/3 of the power supply voltage, the Q output of U6 will go LOW. This discharge and charging of C24 forces the output of U6 HIGH when the 25 Hz record signal is initiated and LOW after an adjustable delay set by R32 after the tone ends.

4-16. When the Q output of U6 goes back LOW, it triggers one-shot U8 set for approximately 1/2 second which pulses stop relay K4 at the end of the stop delay. Depressing the PLAY STOP switch (S3) enables the same type of action, except in response to detected 25 Hz tones routed through contacts of relay K1. Switch S1 is the MANUAL STOP switch which simply grounds the low side of coil K4 to energize the stop relay.

4-17. Relay K1 selects whether the trigger and threshold inputs to U6 are connected to the left channel or the right channel detector when switch S3 is closed. Right channel select relay K1 is energized by depressing the RIGHT SELECT switch (S2). When S2 is depressed, the stop delay circuitry is connected to the right channel. When S2 is open, the stop delay circuitry is connected to the left channel. In either case, the stop delay circuitry is not connected to either detector unless the PLAY STOP switch (S3) is depressed.

4-18. TONE DETECTORS



4-19. Each 25 Hz sensor has a high-impedance ac-coupled bridging input fed to an input amplifier stage. As right channel operation is identical to left channel operation, only the left channel will be discussed.

4-20. The output of amplifier U17A is applied to a four-pole 25 Hz band-pass filter comprising U15A and U15D. The 25 Hz output of the filter is rectified by diode D13 and applied to U15B. When a tone is detected the output of U15B will change from a LOW to a HIGH. A HIGH at the output of U15B applied to inverter U7B will energize relay K2 and illuminate LEFT DETECTOR indicator to signify that a 25 Hz tone has been detected on the left channel. Assuming that relay K1 is not energized and the PLAY STOP switch (S3) is depressed, U7B will discharge capacitor C24 and the stop delay circuit will operate to stop the associated recorder.

## SECTION V MAINTENANCE

### 5-1. INTRODUCTION

5-2. This section provides mechanical and electrical maintenance procedures and adjustments.

### 5-3. MAINTENANCE

5-4. Maintenance of the dual tone generator is basically limited to preventive maintenance. This includes keeping the unit clean and dust free, away from major heat-generating components, and in a vibration-free environment as much as possible.

5-5. Should problems develop, refer to the diagrams. All components mount on or connect to a single printed circuit board. Troubleshooting consists of isolating a problem down to a suspected area in the circuitry, locating the defective part, and replacing the part.

5-6. The dual tone generator is a solid state device utilizing integrated circuits and transistors. Usually, if a component failure occurs, it will be an active component. All IC's are mounted in sockets for ease of replacement.

### 5-7. ADJUSTMENTS

5-8. As shipped from the factory, the dual tone generator has been adjusted for proper signal level, frequency, and distortion. However, there are some controls that the user may wish to adjust differently from the factory-set parameters.

5-9. STOP DELAY. The STOP DELAY potentiometer (R32) is mounted on the dual tone generator circuit board and is accessible through the top panel cutout. Adjustment of this control determines the delay after the EOM tone (either detected or recorded) that the stop relay will actuate. This time period is adjustable between 0 and 10 seconds and is factory preset at approximately 2 seconds.

5-10. To adjust this control, depress the STOP/RECORD switch for several seconds and measure the length of time from the moment the 25 HZ RECORD switch is released until the stop relay actuates (indicated by the click of a relay inside of the unit). Adjust the STOP DELAY control and repeat the above procedure until the desired delay is obtained.

5-11. 25 HZ TONE LENGTH. The 25 HZ TONE LENGTH control (R31) is mounted on the dual tone generator circuit board. This control provides adjustment of the minimum 25 Hz tone length. As set at the factory, this length is approximately one second.

5-12. To adjust the 25 Hz tone length, temporarily connect the detector inputs and filter output as shown in figure 5-1.

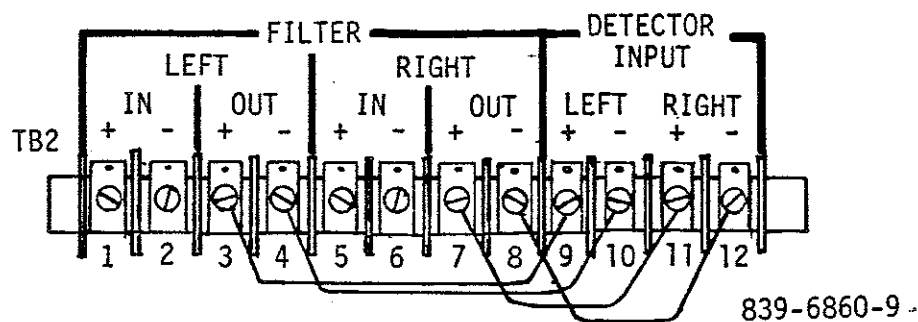


FIGURE 5-1. 25 HZ TONE LENGTH ADJUSTMENT

5-13. Ensure the front panel RIGHT SELECT switch is not depressed. Depress the 25 HZ RECORD switch momentarily and measure the time the LEFT DETECTOR indicator illuminates. Adjust the 25 HZ TONE LENGTH control to obtain the desired length.

5-14. Remove the temporary jumpers from the detector inputs and filter outputs.

5-15. 1000 HZ TONE LEVEL AND 25 HZ TONE LEVEL. The 1000 Hz tone level is factory preset to 0 dBm and the 25 Hz level is factory preset to -7 dBm. These levels are adequate for most purposes, but if desired may be readjusted as follows.

5-16. Connect a 600 Ohm load across the + and - LEFT OUT FILTER terminals on TB2. Connect a 600 Ohm load across the + and - RIGHT OUT FILTER terminals on TB2. Connect an audio voltmeter or a calibrated oscilloscope across the left channel load.

5-17. Depress the front panel 1K RECORD switch and adjust the 1000 HZ L LEVEL control (R28) to obtain the correct level. Repeat the procedure for the right channel, adjusting the 1000 HZ R LEVEL control (R27).

5-18. Depress the front panel 25 HZ switch and adjust the 25 HZ R LEVEL control (R29) to obtain the correct level. Repeat the procedure for the left channel, adjusting the 25 HZ L LEVEL control (R30).

5-19. Remove all test equipment.

5-20. FREQUENCY AND DISTORTION CONTROLS. The 25 HZ and 1000 HZ OSC A and B controls are adjusted to optimum during factory final test and will not normally require readjustment. If adjustment is required, proceed as follows. As both controls interact and affect frequency and distortion, the controls must be adjusted together in pairs.

5-21. Required Test Equipment. The following test equipment is required to adjust the dual tone generator frequency and distortion controls:

- A. Dual Trace Oscilloscope
- B. Audio Distortion Meter (Sound Technology Model 1701A or equivalent).

## WARNING

DISCONNECT PRIMARY AC POWER BEFORE PROCEEDING.

5-22. Preliminary Procedure. Ensure primary ac power is disconnected and connect the test equipment as shown in figure 5-2.

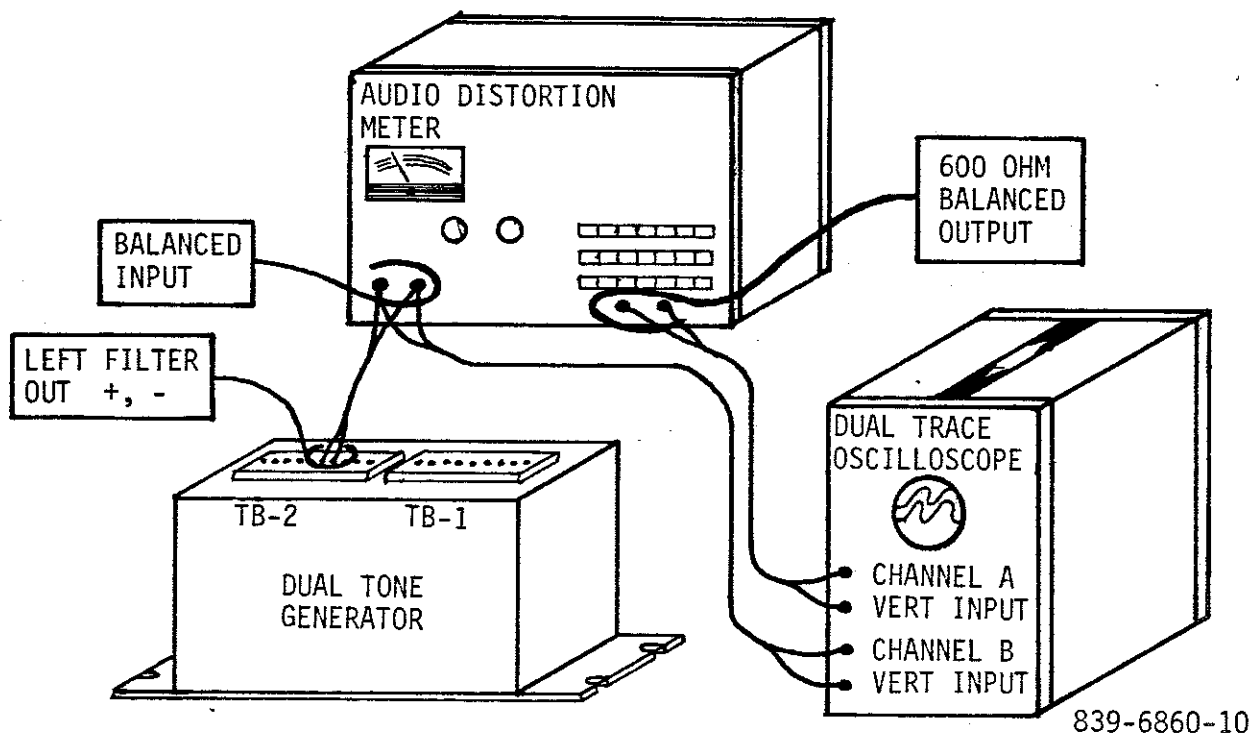


FIGURE 5-2. FREQUENCY AND DISTORTION TEST.

5-23. Remove the top cover of the tone generator and connect a jumper across the RECORD 1K switch contacts. Replace the top cover.

5-24. Ensure the RIGHT SELECT switch is not depressed.

5-25. Adjust the R and L 1000 HZ LEVEL controls (R27 and R28) and the R and L 25 HZ LEVEL controls (R29 and R30) to the center of their range.

5-26. Adjust the generator output to 1 kHz.

5-27. Apply primary power to the dual tone generator.

5-28. While triggering on one trace, observe the second trace as an indicator of frequency and adjust the 1000 HZ OSC A and B controls to obtain the correct frequency.

5-29. Observe distortion on the analyzer adjust the 1000 HZ A control a slight amount in the direction which reduces distortion.

5-30. Adjust the 1000 HZ B control in the opposite direction to correct the frequency.

5-31. Repeat the procedure until the distortion is less than 0.5% and the oscillator is on frequency.

### **WARNING**

DISCONNECT PRIMARY AC POWER BEFORE PROCEEDING.

5-32. Disconnect primary ac power.

5-33. Open the top cover. Remove the jumper across the RECORD 1K switch and connect the jumper across the RECORD 25 HZ switch contacts. Replace the top cover.

5-34. Adjust the generator output to 25 Hz.

5-35. Adjust the 25 HZ OSC A and the 25 HZ OSC B controls in the same manner as the 1000 HZ OSC A and B controls.

### **WARNING**

DISCONNECT PRIMARY AC POWER BEFORE PROCEEDING.

5-36. Disconnect primary ac power. Open the top cover. Remove the jumper across the RECORD 25 HZ switch contacts. Replace the top cover.

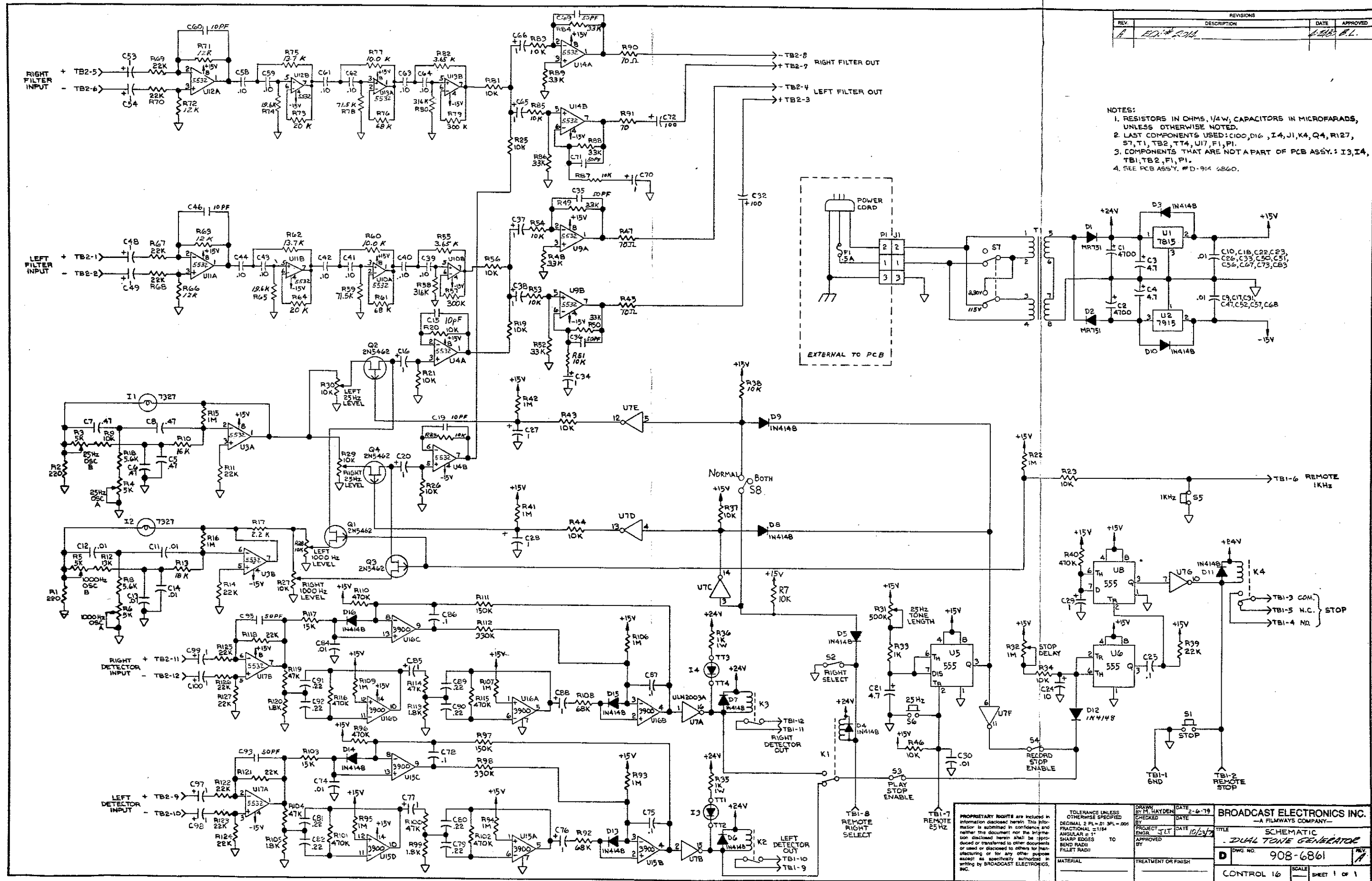
5-37. Adjust the tone level controls per paragraphs 5-15 through 5-19 and remove all test equipment.

5-38. DIAGRAMS

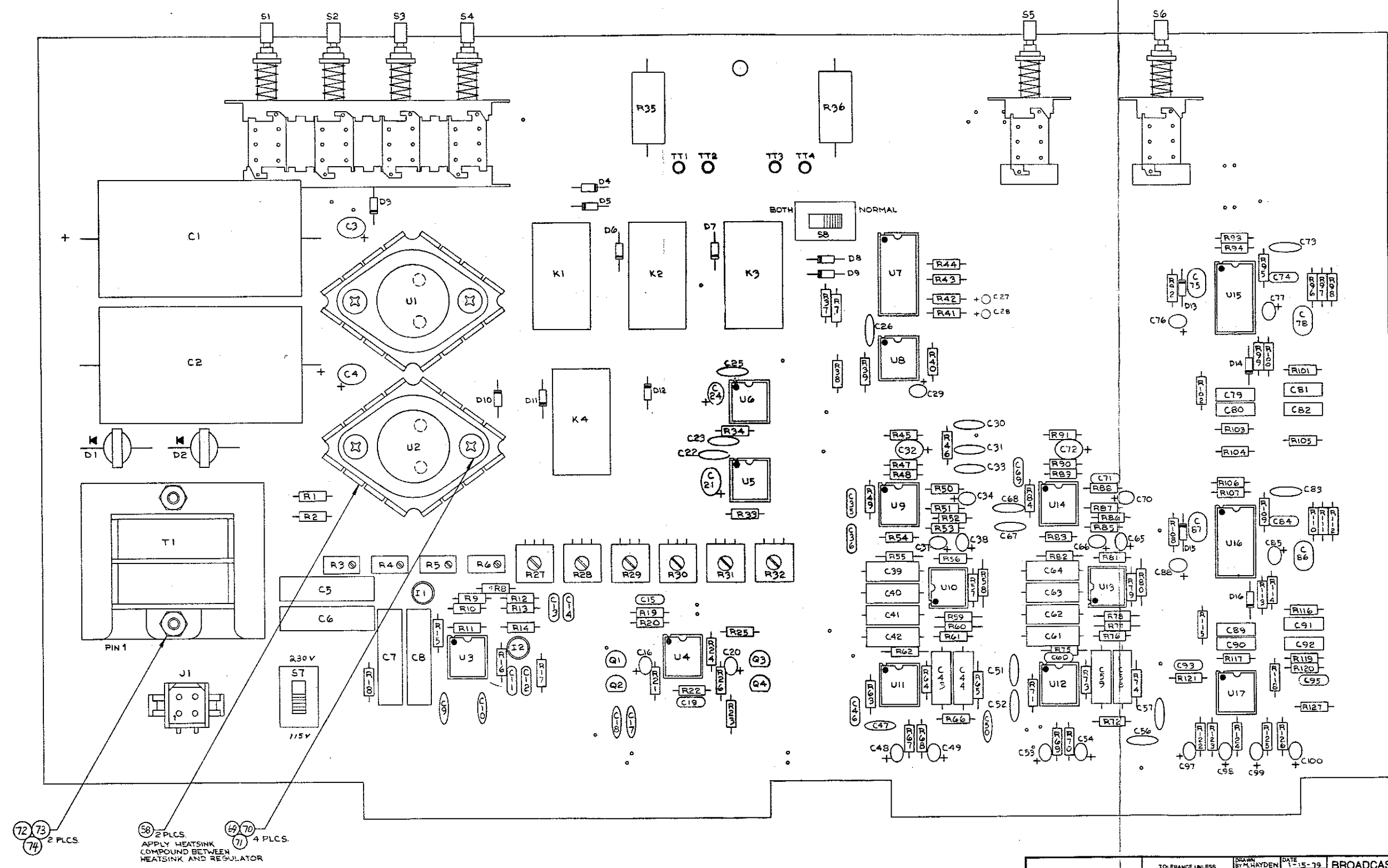
5-39. The following diagrams are contained in this section as aids to maintenance:

Figure 5-3 Dual Tone Generator Schematic Diagram D908-6860

Figure 5-4 Dual Tone Generator Assembly Diagram D914-6860



REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED
A	CHANGED U1 TO U17	1-2-80	JH
B	PER ECN 2014	4-24-80	JH
C	PER ECN 2633	4-1-81	CRF



SEE B/M NO. 914-6860  
SEE SCHEMATIC NO. D-908-6861

72 73 74 2 PLCS.  
58 2 PLCS.  
44 70 71 4 PLCS.  
APPLY HEATSINK COMPOUND BETWEEN HEATSINK AND REGULATOR

PROPRIETARY RIGHTS are included in information disclosed herein. This information is submitted in confidence and neither this document nor the information disclosed herein shall be reproduced or transmitted to other documents or used or disclosed to others for manufacturing or for any other purpose except as specifically authorized in writing by BROADCAST ELECTRONICS, INC.		TOLERANCE UNLESS OTHERWISE SPECIFIED DECIMAL 2 PL = 01 3PL = .005 FRACTIONAL ± 1/16 ANGULAR ± 1° SHARP EDGES REND RADI FILLET RADI	DRAWN BY M. HAYDEN CHECKED BY PROJECT ENGR TO APPROVED BY	DATE 1-5-79 DATE 10/23/77	BROADCAST ELECTRONICS INC. —A FILMWAYS COMPANY— TITLE PCB ASSEMBLY DUAL TONE GENERATOR DWG NO. 914-6860 SCALE 2/1 SHEET 1 of 1
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5-7/5-8

FIGURE 5-4  
DUAL TONE GENERATOR ASSEMBLY DIAGRAM

## SECTION VI PARTS LIST

### 6-1. INTRODUCTION

6-2. This section provides descriptions and part numbers of parts and assemblies required for maintenance of the Broadcast Electronics Dual Tone Generator. Each table entry in this section is indexed by the reference designators on the schematic diagrams.



Table 6-1. Dual Tone Generator - 908-6860

REF. DES.	DESCRIPTION	PART NO.	QUANTITY
F1	Fuse, 3 AG, 1/2 Amp, 250 V	330-0050	1
J1	Receptacle, 4-Pin	418-0240	1
I3, I4	Indicator, LED, Red, 14 V at 20 mA	323-3331	2
TB1, TB2	Barrier Strip, 12 Terminals	412-0112	2
XF1	Fuse Holder, 3 AG	415-2012	1
---	Pins (For J1)	417-0053	3
---	Switch Cap (White)	343-6400	1
---	Switch Cap (Black)	343-6401	4
---	Switch Cap (Gray)	343-6402	1
---	Front Panel Overlay	506-6860	1
---	Clip, Mounting, I3, I4	430-0051	2
---	Connector, 2-Pin, (For I3 and I4)	417-0010	2
---	Printed Circuit Board	914-6860	1

Table 6-2. Dual Tone Generator Circuit Board Assembly - 914-6860  
(Sheet 1 of 9)

REF. DES.	DESCRIPTION	PART NO.	QUANTITY
C1, C2	Capacitor, Electrolytic, 4700 uF, 35 V	014-4794	2
C3, C4	Capacitor, Tantalum, Dipped, 4.7 uF 35 V	064-4763	2
C5 THRU C8	Capacitor, Mylar Film, 0.47 uF, 100V	030-4753	4
C9, C10	Capacitor, Ceramic Disc, 0.01 uF, 25 V	000-1044	2
C11 THRU C14	Capacitor, Mylar Film, 0.01 uF, 100V	030-1043	4
C15	Capacitor, Ceramic Disc, 10pF <u>+10%</u> , 1 KV, NPO	001-1014	1
C16	Capacitor, Tantalum Dipped, 1 uF, 35 V	064-1063	1
C17, C18	Capacitor, Ceramic Disc, 0.01 uF, 25 V	000-1044	2
C19	Capacitor, Ceramic Disc, 10 pF <u>+10%</u> , 1 KV, NPO	001-1014	1
C20	Capacitor, Tantalum, Dipped, 1 uF, 35 V	064-1063	1
C21	Capacitor, Tantalum, Dipped, 4.7 uF, 35 V	064-4763	1
C22, C23	Capacitor, Ceramic Disc, 0.01 uF, 25 V	000-1044	2
C24	Capacitor, Tantalum Dipped, 10 uF, 25 V	063-1074	1
C25	Capacitor, Mylar Film, 0.1 uF, 100 V	030-1053	1
C26	Capacitor, Ceramic Disc, 0.01 uF, 25 V	100-1044	1
C27, C28	Capacitor, Electrolytic, 1 uF, 50 V	024-1064	2

Table 6-2. Dual Tone Generator Circuit Board Assembly - 914-6860  
(Sheet 2 of 9)

REF. DES.	DESCRIPTION	PART NO.	QUANTITY
C29	Capacitor, Tantalum, Dipped, 1 uF, 35 V	064-1063	1
C30, C31	Capacitor, Ceramic Disc, 0.01 uF, 25 V	000-1044	2
C32	Capacitor, Tantalum, Dipped, 100 uF, 25 V	023-1083	1
C33	Capacitor, Ceramic Disc, 0.01 uF, 25 V	001-1044	1
C34	Capacitor, Tantalum, Dipped, 1 uF, 35 V	064-1063	1
C35, C36	Capacitor, Mica, 50 pF, 50 V	040-5013	2
C37, C38	Capacitor, Tantalum, Dipped, 1 uF, 35 V	064-1063	2
C39 THRU C44	Capacitor, Polycarbonate, 0.1 uF <u>+2%</u> , 100 V	037-1055	6
C46	Capacitor, Ceramic Disc, 10 pF <u>+10%</u> 1 KV	001-1014	1
C47	Capacitor, Ceramic Disc, 0.01 uF, 25 V	000-1044	1
C48, C49	Capacitor, Tantalum, Dipped, 1 uF, 35 V	064-1063	2
C50 THRU C52	Capacitor, Ceramic Disc, 0.01 uF, 25 V	000-1044	3
C53, C54	Capacitor, Tantalum Dipped, 1 uF, 35 V	064-1063	2
C56, C57	Capacitor Ceramic Disc, 0.01 uF, 25 V	000-1044	2
C58, C59	Capacitor Polycarbonate, 0.1 uF <u>+2%</u> 100 V	037-1055	2

Table 6-2. Dual Tone Generator Circuit Board Assembly - 914-6860  
(Sheet 3 of 9)

REF. DES.	DESCRIPTION	PART NO.	QUANTITY
C60	Capacitor, Ceramic Disc, 10pF $\pm 10\%$ , 1 KV	001-1014	1
C61 THRU C64	Capacitor, Polycarbonate, 0.1 uF $\pm 2\%$ , 100 V	037-1055	4
C65, C66	Capacitor, Tantalum, Dipped, 1 uF, 35 V	064-1063	2
C67, C68	Capacitor, Ceramic Disc, 0.01 uF, 25 V	000-1044	2
C69	Capacitor, Mica, 50 pF, 50 V	040-5013	1
C70	Capacitor, Tantalum, Dipped, 1 uF, 35 V	064-1063	1
C71	Capacitor, Mica, 50 pF, 50 V	040-5013	1
C72	Capacitor, Tantalum, Dipped, 100uF, 25 V	023-1083	1
C73	Capacitor, Ceramic Disc, 0.01 uF, 25 V	000-1044	1
C74	Capacitor, Mylar Film, 0.01 uF, 100 V	030-1043	1
C75	Capacitor, Mylar Film, 0.1 uF, 100V	030-1053	1
C76, C77	Capacitor, Tantalum, Dipped, 1 uF, 35 V	064-1063	2
C78	Capacitor, Mylar Film, 0.1 uF, 100 V	030-1053	1
C79 THRU C82	Capacitor, Polycarbonate, 0.22 uF $\pm 5\%$ , 50 V	037-2254	4
C83	Capacitor, Ceramic Disc, 0.01 uF, 25 V	000-1044	1
C84	Capacitor, Mylar Film, 0.01 uF,	030-1043	1
C85	Capacitor, Tantalum, Dipped, 1 uF, 35 V	064-1063	1

Table 6-2. Dual Tone Generator Circuit Board Assembly - 914-6860  
(Sheet 4 of 9)

REF. DES.	DESCRIPTION	PART NO	QUANTITY
C86, C87	Capacitor, Mylar Film, 0.1 uF, 100V	030-1053	2
C88	Capacitor, Tantalum, Dipped, 1 uF, 35 V	064-1063	1
C89 THRU C92	Capacitor, Polycarbonate, 0.22 uF +5%, 50 V	037-2254	4
C93, C95	Capacitor, Mica, 50 pF, 50 V	040-5013	2
C97 THRU C100	Capacitor, Tantalum, Dipped, 1 uF, 35 V	064-1063	4
D1, D2	Diode, Silicon, MR751, 6 A, 100 V	202-0751	2
D3 THRU D16	Diode, Silicon, Fast-Switching, IN4148, 100 V, 10 mA	203-4148	14
I1, I2	Lamp, 28 V, 0.04 A, Bi-Pin, No.7327	321-7327	2
J1	Connector, 4-Pin	418-0255	1
K1 THRU K4	Relay: Coil; 24 Vdc, 950 Ohm Resistance Contacts; 2 A @ 28 Vdc or 1 A @ 120 Vac, Resistive Load	270-0024	4
Q1 THRU Q4	Transistor, JFET, 2N5462, P-Channel	212-5462	4
R1, R2	Resistor, 220 Ohm +5%, 1/4 W	100-2233	2
R3 THRU R6	Potentiometer, 5K Ohm +10%, 1/2 W	178-5045	4
R7	Resistor, 10K Ohm +5%, 1/4 W	100-1053	1
R8	Resistor, 5.6K Ohm +5%, 1/4 W	100-5643	1
R9	Resistor, 10K Ohm +5%, 1/4 W	100-1053	1
R10	Resistor, 16K Ohm +5%, 1/4 W	100-1653	1
R11	Resistor, 22K Ohm +5%, 1/4 W	100-2253	1
R12	Resistor, 13K Ohm +5%, 1/4 W	100-1353	1

Table 6-2. Dual Tone Generator Circuit Board Assembly - 914-6860  
(Sheet 5 of 9)

REF. DES.	DESCRIPTION	PART NO.	QUANTITY
R13	Resistor, 18K Ohm $\pm 5\%$ , 1/4 W	100-1853	1
R14	Resistor, 22K Ohm $\pm 5\%$ , 1/4 W	100-2253	1
R15, R16	Resistor, 1 Meg Ohm $\pm 5\%$ , 1/4 W	100-1073	2
R17	Resistor, 2.2K Ohm $\pm 5\%$ , 1/4 W	100-2243	1
R18	Resistor, 5.6K Ohm $\pm 5\%$ , 1/4 W	100-5643	1
R19 THRU R21	Resistor, 10K Ohm $\pm 5\%$ , 1/4 W	100-1053	3
R22	Resistor, 1 Meg Ohm $\pm 5\%$ , 1/4 W	100-1073	1
R23 THRU R26	Resistor, 10K Ohm $\pm 5\%$ , 1/4 W	100-1053	4
R27 THRU R30	Potentiometer, 10K Ohm $\pm 10\%$ , 1/2 W	178-1054	4
R31	Potentiometer, 500K Ohm $\pm 20\%$ , 1/2 W	178-5064	1
R32	Potentiometer, 1 Meg Ohm $\pm 10\%$ , 1/2W	178-1074	1
R33	Resistor, 1K Ohm $\pm 5\%$ , 1/4 W	100-1043	1
R34	Resistor, 10K Ohm $\pm 5\%$ , 1/4 W	100-1053	1
R35, R36	Resistor, 1K Ohm $\pm 5\%$ , 1 W	120-1043	2
R37, R38	Resistor, 10K Ohm $\pm 5\%$ , 1/4 W	100-1053	2
R39	Resistor, 22K Ohm $\pm 5\%$ , 1/4 W	100-2253	1
R40	Resistor, 470K Ohm $\pm 5\%$ , 1/4 W	100-4763	1
R41, R42	Resistor, 1 Meg Ohm $\pm 5\%$ , 1/4 W	100-1073	2
R43, R44	Resistor, 10K Ohm $\pm 5\%$ , 1/4 W	100-1053	2
R45	Resistor, 10 Ohm $\pm 5\%$ , 1/4 W	100-1023	1
R46	Resistor, 10K Ohm $\pm 5\%$ , 1/4 W	100-1053	1
R47	Resistor, 10 Ohm $\pm 5\%$ , 1/4 W	100-1023	1
R48 THRU R50	Resistor, 33K Ohm $\pm 5\%$ , 1/4 W	100-3353	3

Table 6-2. Dual Tone Generator Circuit Board Assembly - 914-6860  
(Sheet 6 of 9)

REF. DES.	DESCRIPTION	PART NO.	QUANTITY
R51	Resistor, 10K Ohm $\pm 5\%$ , 1/4 W	100-1053	1
R52	Resistor, 33K Ohm $\pm 5\%$ , 1/4 W	100-3353	1
R53, R54	Resistor, 10K Ohm $\pm 5\%$ , 1/4 W	100-1053	2
R55	Resistor, 3.65K Ohm $\pm 1\%$ , 1/4 W	100-3611	1
R56	Resistor, 10K Ohm $\pm 5\%$ , 1/4 W	100-1053	1
R57	Resistor, 300K Ohm $\pm 5\%$ , 1/4 W	100-3063	1
R58	Resistor, 316K Ohm $\pm 1\%$ , 1/4 W	100-3131	1
R59	Resistor, 71.5K Ohm $\pm 1\%$ , 1/4 W	100-7131	1
R60	Resistor, 10.0K Ohm $\pm 1\%$ , 1/4 W	100-1001	1
R61	Resistor, 68K Ohm $\pm 5\%$ , 1/4 W	100-6853	1
R62	Resistor, 13.7K Ohm $\pm 1\%$ , 1/4 W	100-1371	1
R63	Resistor, 12K Ohm $\pm 5\%$ , 1/4 W	100-1253	1
R64	Resistor, 20K Ohm $\pm 5\%$ , 1/4 W	100-2053	1
R65	Resistor, 19.6K Ohm $\pm 1\%$ , 1/4 W	100-1961	1
R66	Resistor, 12K Ohm $\pm 5\%$ , 1/4 W	100-1253	1
R67 THRU R70	Resistor, 22K Ohm $\pm 5\%$ , 1/4 W	100-2253	4
R71, R72	Resistor, 12K Ohm $\pm 5\%$ , 1/4 W	100-1253	2
R73	Resistor, 20K Ohm $\pm 5\%$ , 1/4 W	100-2053	1
R74	Resistor, 19.6K Ohm $\pm 1\%$ , 1/4 W	100-1961	1
R75	Resistor, 13.7K Ohm $\pm 1\%$ , 1/4 W	100-1371	1
R76	Resistor, 68K Ohm $\pm 5\%$ , 1/4 W	100-6853	1
R77	Resistor, 10.0K Ohm $\pm 1\%$ , 1/4 W	100-1001	1

Table 6-2. Dual Tone Generator Circuit Board Assembly - 914-6860  
(Sheet 7 of 9)

REF. DES.	DESCRIPTION	PART NO.	QUANTITY
R78	Resistor, 71.5K Ohm $\pm 1\%$ , 1/4 W	100-7131	1
R79	Resistor, 300K Ohm $\pm 5\%$ , 1/4 W	100-3063	1
R80	Resistor, 316K Ohm $\pm 1\%$ , 1/4 W	100-3131	1
R81	Resistor, 10K Ohm $\pm 5\%$ , 1/4 W	100-1053	1
R82	Resistor, 3.65K Ohm $\pm 1\%$ , 1/4 W	100-3611	1
R83	Resistor, 10K Ohm $\pm 5\%$ , 1/4 W	100-1053	1
R84	Resistor, 33K Ohm $\pm 5\%$ , 1/4 W	100-3353	1
R85	Resistor, 10K Ohm $\pm 5\%$ , 1/4 W	100-1053	1
R86	Resistor, 33K Ohm $\pm 5\%$ , 1/4 W	100-3353	1
R87	Resistor, 10K Ohm $\pm 5\%$ , 1/4 W	100-1053	1
R88, R89	Resistor, 33K Ohm $\pm 5\%$ , 1/4 W	100-3353	2
R90, R91	Resistor, 10 Ohm $\pm 5\%$ , 1/4 W	100-1023	2
R92	Resistor, 68K Ohm $\pm 5\%$ , 1/4 W	100-6853	1
R93 THRU R95	Resistor, 1 Meg Ohm $\pm 5\%$ , 1/4 W	100-1073	3
R96	Resistor, 470K Ohm $\pm 5\%$ , 1/4 W	100-4763	1
R97	Resistor, 150K Ohm $\pm 5\%$ , 1/4 W	100-1563	1
R98	Resistor, 330K Ohm $\pm 5\%$ , 1/4 W	100-3363	1
R99	Resistor, 1.8K Ohm $\pm 5\%$ , 1/4 W	100-1843	1
R100	Resistor, 47K Ohm $\pm 5\%$ , 1/4 W	100-4753	1
R101, R102	Resistor, 470K Ohm $\pm 5\%$ , 1/4 W	100-4763	2
R103	Resistor, 15K Ohm $\pm 5\%$ , 1/4 W	100-1553	1
R104	Resistor, 47K Ohm $\pm 5\%$ , 1/4 W	100-4753	1
R105	Resistor, 1.8K Ohm $\pm 5\%$ , 1/4 W	100-1843	1



Table 6-2. Dual Tone Generator Circuit Board Assembly - 914-6860  
(Sheet 8 of 9)

REF. DES.	DESCRIPTION	PART NO.	QUANTITY
R106, R107	Resistor, 1 Meg Ohm $\pm 5\%$ , 1/4 W	100-1073	2
R108	Resistor, 68K Ohm $\pm 5\%$ , 1/4 W	100-6853	1
R109	Resistor, 1 Meg Ohm $\pm 5\%$ , 1/4 W	100-1073	1
R110	Resistor, 470K Ohm $\pm 5\%$ , 1/4 W	100-4763	1
R111	Resistor, 150K Ohm $\pm 5\%$ , 1/4 W	100-1563	1
R112	Resistor, 330K Ohm $\pm 5\%$ , 1/4 W	100-3363	1
R113	Resistor, 1.8K Ohm $\pm 5\%$ , 1/4 W	100-1843	1
R114	Resistor, 47K Ohm $\pm 5\%$ , 1/4 W	100-4753	1
R115, R116	Resistor, 470K Ohm $\pm 5\%$ , 1/4 W	100-4763	2
R117	Resistor, 15K Ohm $\pm 5\%$ , 1/4 W	100-1553	1
R118	Resistor, 22K Ohm $\pm 5\%$ , 1/4 W	100-2253	1
R119	Resistor, 47K Ohm $\pm 5\%$ , 1/4 W	100-4753	1
R120	Resistor, 1.8K Ohm $\pm 5\%$ , 1/4 W	100-1843	1
R121 THRU R127	Resistor, 22K Ohm $\pm 5\%$ , 1/4 W	100-2253	7
S1 THRU S4	Switch, Pushbutton, 4 section, DPDT Interlocked	343-1011	4
S5, S6	Switch, Pushbutton, DPDT, Momentary	343-1012	2
S7, S8	Switch, Slide, DPDT, 0.5A, 125 V	345-0863	2
T1	Transformer: Split Primary: 115/230 Vac, 50/60 Hz Dual Secondary: 12V @ 0.5 A	376-0524	1
U1	Integrated Circuit, Fixed Positive, Voltage Regulator, MC7815C, +15V, 1.5A TO-3 Case	227-7815A	1

Table 6-2. Dual Tone Generator Circuit Board Assembly - 914-6860  
(Sheet 9 of 9)

REF. DES.	DESCRIPTION	PART NO.	QUANTITY
U2	Integrated Circuit, Fixed Negative Voltage Regulator, MC7915C, -15V, 1.5A, TO-3 Case	227-7915A	1
U3, U4	Integrated Circuit, 10 mHz Dual Operational Amplifier, 16-Pin DIP	221-5532	2
U5, U6	Integrated Circuit, Timer, NE555, 8-Pin DIP	229-0555	2
U7	Integrated Circuit, 7-Channel Driver, 16-Pin DIP	229-2003	1
U8	Integrated Circuit, Timer, NE555, 8-Pin DIP	229-0555	1
U9 THRU U14	Integrated Circuit, 10 mHz Dual Operational Amplifier, 16-Pin DIP	221-5532	6
U15, U16	Integrated Circuit, Quad-Linear Operational Amplifier, 14-Pin DIP	221-3900	2
U17	Integrated Circuit, 10 mHz Dual Operational Amplifier, 16-Pin DIP	221-5532	1
XU3 THRU XU6	Socket, Integrated Circuit, 8-Pin DIP	417-0800	4
XU7	Socket, Integrated Circuit, 16-Pin DIP	417-1601	1
XU8 THRU XU14	Socket, Integrated Circuit, 8-Pin DIP	417-0800	7
XU15, XU16	Socket, Integrated Circuit, 14-Pin DIP	417-1400	2
XU17	Socket, Integrated Circuit, 8-Pin DIP	417-0800	1
----	Blank Printed Wiring Board	514-6860	1

## PRODUCT WARRANTY

LIMITED ONE YEAR

While this warranty gives you specific legal rights, which terminate one (1) year (6 months on turntable motors) from the date of shipment, you may also have other rights which vary from state to state.

Broadcast Electronics, Inc. ("BE"), 4100 North 24th Street, P. O. Box 3606, Quincy, Illinois 62305, hereby warrants cartridge machines, consoles, transmitters and other new Equipment manufactured by BE against any defects in material or workmanship at the time of delivery thereof, that develop under normal use within a period of one (1) year (6 months for turntable motors) from the date of shipment. Other manufacturers' Equipment, if any, shall carry only such manufacturers' standard warranty. This warranty extends to the original user and any subsequent purchaser during the warranty period. BE's sole responsibility with respect to any Equipment or parts not conforming to this warranty is to replace such equipment or parts upon the return thereof F.O.B. BE's factory or authorized repair depot within the period aforesaid.

In the event of replacement pursuant to the foregoing warranty, only the unexpired portion of the warranty from the time of the original purchase will remain in effect for any such replacement. However, the warranty period will be extended for the length of time that the original user is without the services of the Equipment due to its being serviced pursuant to this warranty. The terms of the foregoing warranty shall be null and void if the Equipment has been altered or repaired without specific written authorization of BE, or if Equipment is operated under environmental conditions or circumstances other than those specifically described in BE's product literature or instruction manual which accompany the Equipment purchased. BE shall not be liable for any expense of any nature whatsoever incurred by the original user without prior written consent of BE.

BE shall not be liable to the original user for any and all incidental or consequential damages for breach of either expressed or implied warranties. However, some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you. All express and implied warranties shall terminate at the conclusion of the period set forth herein.

Except as set forth herein, and except as to title, there are no warranties, or any affirmations of fact or promises by BE, with reference to the Equipment, or to merchantability, fitness for a particular application, signal coverage, infringement, or otherwise, which extend beyond the description of the Equipment in BE's product literature or instruction manual which accompany the Equipment. Any card which is enclosed with the Equipment will be used by BE for survey purposes only.

### **BROADCAST ELECTRONICS, INC.**

4100 North 24th Street, P. O. Box 3606, Quincy, Illinois 62305