

Section 1

General Information

1.1 General Description.

The TFT EBS System is designed to meet the FCC Two-Tone EBS interstation signaling requirements. It normally consists of three modules—the model 760-04 Two-Tone Generator, the Model 760-01 AM Receiver or the Model 760-02 FM Receiver, and the Model 760-03 Tone Decoder—mounted in a cabinet for installation in a 19-inch relay rack.

An emergency two-tone signal received from the AM or FM station being monitored will be heard on the EBS System speaker after such a tone has been received for at least 8 seconds. The EBS System provides the means for interrupting normal programming and broadcasting the two-tone emergency signal for 23.4 seconds, and for inserting emergency announcements. Normal operation can be restored by operation of two reset switches.

1.2 Specifications.

EBS Cabinet Assembly

Module Capacity

Input Power*

Operating Temperature*

Operating Humidity*

Size

Weight

will accept up to three EBS modules (Models 760-01, -02, -03, -04, and -05). Blank panels are provided when fewer than three modules are in use.

117 VAC \pm 15%, 50/60 Hz, 20 watts maximum.

0° to 50°C.

95% Relative.

3.5" (8.9 cm) high x 19" (48.3 cm) wide x 12" (30.5 cm) deep.

Approx. 10 pounds (4.5 kg)

1.2.1 Model 760-01, Frequency-Synthesized AM Receiver

Frequency Range

Local Oscillator Stability

Tuning Method

Antenna Input

Sensitivity

Image Rejection

AGC

IF Bandwidth, 6dB

Harmonic Distortion

Noise

Audio Outputs, 600 ohms

Carrier-Off Output

540-1620 kHz

\pm 500 Hz per year

Channel frequency digitally set in 10 kHz steps by thumbwheel switches.

75 ohms nominal, unbalanced.

30 μ V for 20 dB S/N at 30% modulation.

50 dB

70 dB

\pm 5 kHz

Less than 3% at 90% modulation.

45 dB or greater below 100% modulation with 10 MV RF

Balanced: +8 dBm. Unbalanced: 1 V rms

Active pullup to 10 V, 10 ma

1.2.2 Model 760-02, Crystal Controlled FM Receiver

Frequency Range

Channel Frequency

Antenna Input

Sensitivity

IF Bandwidth, 6dB

Image Rejection

AGC

Audio Frequency Response

Harmonic Distortion

S/N Ratio

88-108 MHz

Specify frequency, either one or two channel versions available.

75 ohms nominal, unbalanced.

2 μ V for 30 dB of quieting.

\pm 150 kHz

40 dB

80 dB

\pm 1 dB, 50 Hz - 15 kHz

1%

60 dB or greater below 100% modulation at 50 μ V RF input

*Specifications apply to all system modules.

De-emphasis	75 μ sec
Audio Outputs, 600 ohms	Balanced: +8 dBm. Unbalanced: 1 V rms
Carrier-Off Output	Active pullup to 10V, 10ma.
1.2.3 Model 760-03, Two-Tone Decoder	
Input Level Required	100 mV into 600 ohms
*Tone Frequencies**	853 Hz and 960 Hz
Bandwidth**	± 5 Hz
Listen Operate Switch	In Operate mode the loudspeaker is muted until an EBS alert is decoded.
	In Listen mode, the loudspeaker is demuted.
Audio Output	1 Watt, internal loudspeaker
Reset Switch	Resets decoder and mutes loudspeaker
Remote Operation	The RESET switch wiring is brought out to the rear panel.
Time Delay for De-muting**	12 seconds ± 4 seconds
External Alarm Contracts	SPDT relay contacts brought out to rear panel.
1.2.4 Model 760-04, Two-Tone Generator	
Output Frequencies**	853 Hz and 960 Hz
Frequency Accuracy**	± 0.25 Hz, crystal controlled
Output Level	+8 dBm nominal (per tone)
Output Impedance	600 ohms, balanced
Harmonic Distortion**	Less than 2%
Tone Duration**	23.4 seconds, ± 0.15 seconds
Tone Level Adjust**	Front panel pot, -2 dBm to +8 dBm
Program Audio Routing	Rear panel DPDT relay contacts. Balanced input and output. Switchover and latch to EBS programming is automatic.
Emergency Program	
Audio Input	Unbalanced input. Internally inserted into program line.
Test Switch	Connects Generator to Decoder for testing without interrupting program audio.
Tone Switch	Enables one tone at a time for setting level and checking distortion.
Command Switches	2 toggle switches. Must be activated in opposite directions to turn on Generator.
Reset Switch	Releases latch to restore normal program audio.
Remote Operation	The COMMAND and RESET switch wiring is brought to the rear panel.
1.2.5 Model 760-05, Dual-Purpose Decoder	
<i>See Model 760-03, Two-Tone Decoder for Two-Tone Specifications</i>	
<i>Carrier Break/1000 Hz Specifications:</i>	
Input Level Required	100 mV into 600 ohms
Tone Frequency	1000 Hz
Bandwidth	± 50 Hz
Time to mute after start of Carrier Break sequence	23 to 27 sec.
RESET Switch	Resets decoder and mutes loudspeaker.
Listen/Operate Switch	In Operate mode the loudspeaker is muted until an EBS alert is decoded. In Listen mode the loudspeaker is demuted.
Audio Output	1 Watt, internal loudspeaker
Remote Operation	The RESET switch is brought out to the rear panel.
External Alarm Contacts	SPDT relay contacts brought out to rear panel.

Specifications are typical except those identified by ** which are guaranteed.

Section 3

Operation

3.1 General.

After the installation procedures of Section 2 have been carried out, the EBS System is ready for operation. The system is energized whenever the power cord is plugged into an appropriate power receptacle. Figure 3-1, the EBS System front panel, illustrates the controls and indicators referred to in the following paragraphs.

When an emergency two-tone signal is received from the station to which the receiver is tuned, and when the tone is present for at least 8 seconds, the speaker will be demuted, allowing the two-tone signal to be heard. The operator can then transmit the two-tone emergency signal by moving the handles of the two COMMAND toggle switches in opposite directions. This will interrupt normal programming, transmit the tones for 23.4 seconds, and allow emergency announcements to be transmitted. At any time after operating the COMMAND switches, the operator can resume normal programming by moving the RESET/TEST switch to RESET. He can also mute the speaker by operating the Tone Decoder RESET switch.

Detailed operating instructions for each module are presented in Subsections 3.2 through 3.6.

3.2 AM Receiver.

a. Dial in the desired frequency on the thumb-wheel switches. These switches indicate the frequency in tens of kilohertz.

b. Tune the preselector for the best signal as determined by maximum speaker volume with the Tone Decoder LISTEN/OPERATE switch in the LISTEN position, and by the CARR lamp being lighted.

3.3 FM Receiver.

a. Press the channel selector switch for the desired channel, if ordered with two channels. The single channel receiver is fixed tuned to the specified channel.

b. The CARR lamp must be lighted, indicating sufficiently strong signal for satisfactory operation.

3.4 Two Tone Generator.

3.4.1 Basic Operation.

a. Check that the POWER lamp is lighted, indicating that the Two-Tone Generator is receiving DC power from the Tone Decoder.

b. To transmit an emergency signal, operate the two COMMAND switches in opposite directions as indicated by the arrows on the front panel. The COMMAND lamp should light, indicating that the dual-tone audio signal is being delivered to the transmitter for a period of 23.4 seconds. At the end of the tone period,

emergency announcements can be made on the audio circuit connected to the rear-panel AN INPUT terminal.

c. To restore normal programming, move the RESET/TEST switch to the RESET position.

d. To test the operation of the Two-Tone Generator with the Tone Decoder without interrupting normal programming, move the RESET/TEST switch to the TEST position. The Dual-tone signal should be present at the speaker for 23.4 seconds, with the Decoder in the listen mode.

e. To test the tones separately, move the 853 Hz/OPERATE/960 Hz switch to the desired tone position. The tone should be heard on the speaker as long as the switch is held in the selected position.

f. The GAIN control allows adjustment of the Two-Tone Generators' two-tone audio output to interface with the stations audio system.

3.4.2 Remote Control.

Both the COMMAND and RESET functions can be remotely controlled if the connections described in Subsection 2.3.3e have been made. Operating the remote COMMAND switch performs the same functions described in Subsection 3.4.1a, and operating the remote RESET switch is the same as operating the front-panel RESET switch as described in Subsection 3.4.1b.

NOTE: Pursuant to Section 73.940 (j) of the FCC Rules & Regulations, the remotely located command switch must be guarded such as to prevent accidental operation.

3.4.3 External Audio Switching.

If audio switching is to be accomplished externally by means of circuitry like that of Figure 2-2, move the AM/FM/TV/OPERATE switch to either AM TEST, FM TEST, or TV TEST to test these circuits individually.

3.5 Tone Decoder.

The POWER lamp should be on, indicating that DC power is available from the Tone Decoder power supply.

When the LISTEN/OPERATE switch is set to OPERATE, the speaker circuit will be muted until a dual 853 Hz/960 Hz tone is received for 8 seconds, at which time the speaker circuit will be enabled and the alarm relay will energize. This condition will exist until the RESET switch is operated, at which time the speaker circuit will again be muted and the alarm will de-energize.

When the LISTEN/OPERATE switch is set to LISTEN the speaker is demuted and incoming audio is continuously monitored.

3.6 Dual Purpose Decoder

The POWER lamp should be on, indicating that DC power is available from the Tone Decoder power supply.

When the LISTEN/OPERATE switch is set to

OPERATE, the speaker circuit will be muted until an EBS signal is received. This will enable the speaker circuit and the alarm relay will energize. This condition will exist until the RESET switch is operated, at which time the speaker circuit will again be muted and the alarm relay will be deenergized.

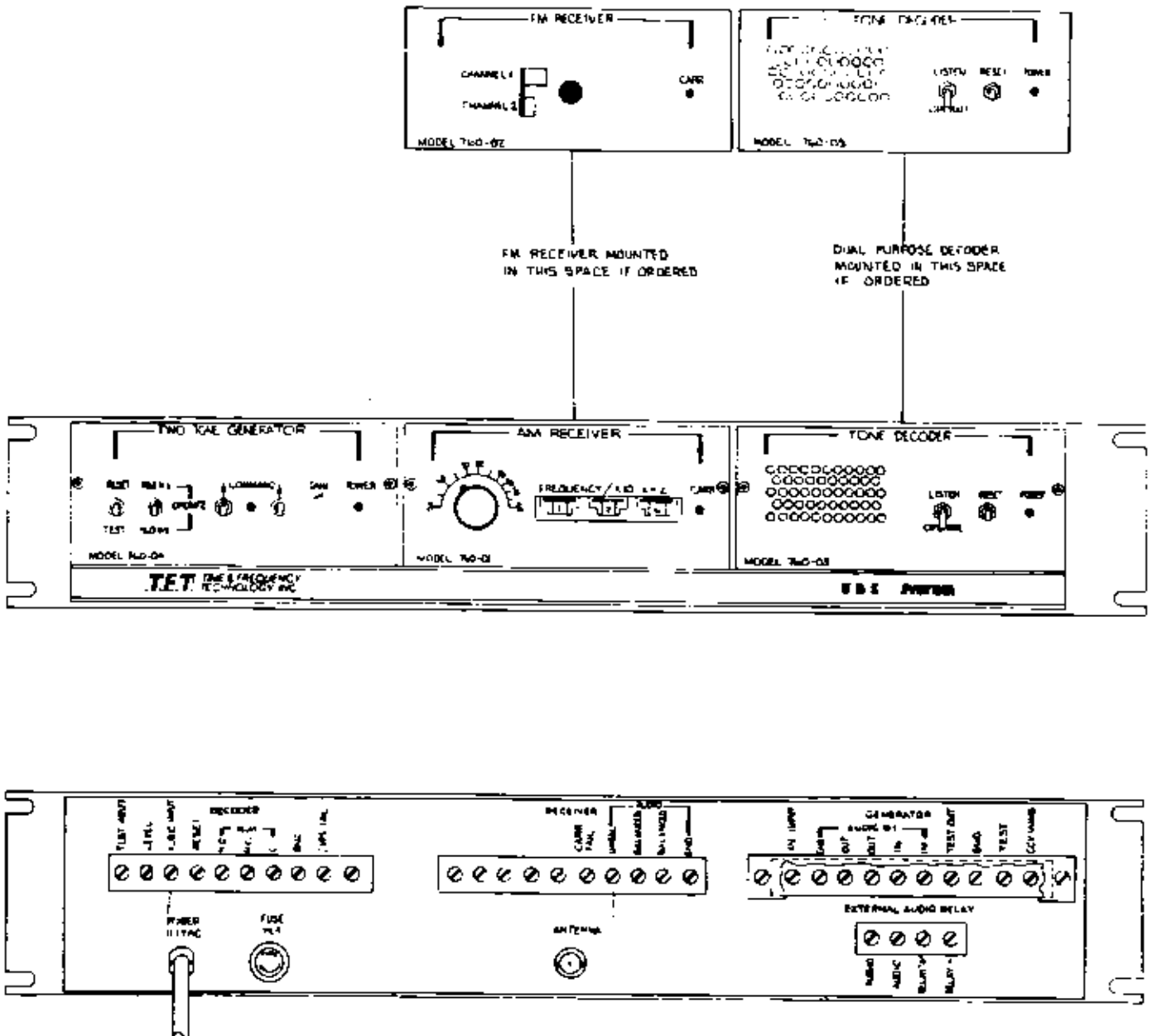


Figure 3-1

Section 4

Theory of Operation

4.1 System.

(Block Diagram: Figure 6-1)

The received signal is demodulated in the AM or FM Receiver, and the resulting audio is applied to the Tone Decoder. If an EBS emergency signal is present (853 Hz and 960 Hz tones present simultaneously for at least 8 seconds), the Tone Decoder demutes its speaker so that the audio can be heard, and energizes a relay to actuate an external alarm. The station's program audio is normally fed through closed relay contacts in the Two-Tone Generator. However, when the COMMAND switches are closed, the program is interrupted, the EBS two-tone signal is placed on the program line to the transmitter for 23.4 seconds, and a local announcement line is activated so that emergency announcements can be made.

The Tone Decoder external alarm circuit and speaker muting can be reset by a front-panel switch or by grounding a remote reset line. The Two Tone Generator can be reset for normal programming by a front panel switch or by grounding a remote reset line. Provisions are made for testing the Two Tone Generator with the Tone Decoder without interrupting the programming, and for separately checking the generation of the two emergency tones, as described in the following paragraphs. Both the AM and FM Receiver furnish an output for a remote carrier-fail alarm.

4.2 AM Receiver Model 760-01.

(Schematic Diagram: Figure 6-2)

This module is a superheterodyne receiver covering the AM broadcast band from 540-1620 kHz in 10 kHz steps. RF amplifier Q1 is tuned by a front-panel control to peak the received signal. Its output is mixed by Q2 with a local-oscillator input from a frequency synthesizer (described in the next paragraph.) The 450-kHz IF signal is amplified by Q4 and Q5, and detected by CR3. The resulting audio signal is amplified by Z16 and fed to the UNBALANCED audio output terminal: it is also fed through transformer T1 to the BALANCED audio output terminals. The output from detector CR3 is also amplified by Q3 and applied as an AGC voltage to RF amplifier Q1 and mixer Q2.

The LO input to the mixer comes from dual retriggerable monostable multivibrator Z11 functioning as a voltage controlled oscillator. The phase-locked loop consists of oscillator Z11, a divide-by-N divider (Z5 through Z10), and a phase detector (Z12). A precision 10 kHz reference signal for the phase detector is obtained from 5 MHz crystal oscillator Q10 by dividing by 500 in Z15, Z14, and Z13. The logic ones and zeroes from the front-panel thumbwheel switches (S1) are decoded by the logic circuitry of gates Z1 through Z4 to cause the divide-by-N divider to divide the output frequency of

oscillator Z11 by the appropriate number to produce a 10-kHz input to pin 1 of phase detector Z12 when the oscillator output is exactly 450 kHz above the frequency indicated by the thumbwheel switches. Any phase difference between the output of the divide-by-N-circuit and this 10-kHz reference is detected in Z12, which produces a voltage to retune the oscillator by means of Q11.

The IF signal at the output of mixer Q2 is detected in Q7/Q8, and used to turn on the CARR LED CR7 to indicate the reception of a carrier. The output of detector Q7/Q8 is also amplified by Q6 and fed to rear-panel connector J3-5 to operate a carrier-fail alarm; this output is +10 volts at 10 ma when a carrier is present, and 0 volts (2000 ohm return to ground) for carrier failure.

4.3 FM Receiver Model 760-02.

(Schematic Diagram: Figure 6-3)

The FM Receiver is capable of receiving any two preselected frequencies within the FM broadcast band of 88 to 108 MHz. The RF amplifier and mixer are each one-half of a MOSFET dual-gate transistor pair. In the RF amplifier the RF input is applied to one gate and AGC to the other. In the Mixer, the RF input is applied to one gate, and the LO signal to the other. The LO is a crystal oscillator (Q2) whose output is tuned to twice the crystal frequency. One crystal is standard, the second optional crystal is selectable by a front-panel switch. This switch also connects an additional tuning capacitor in the crystal oscillator and RF amplifier circuits when the switch is in the position that selects the lower of the two channel frequencies. The LO output frequency is 10.7 MHz above the desired RF signal.

The 10.7 MHz mixer output is fed through two ceramic filters (FL1 and FL2) to provide high selectivity, and into integrated circuit Z2, which functions as an IF amplifier, squelch circuit, detector, AGC, and AFC. The IF amplifier is factory-tuned to 10.7 MHz by L9 and C32.

The AGC voltage at pin 15 of Z2 controls the gain of the RF amplifier. The squelch voltage at pin 12 of Z2 is amplified by Z3 and used to light CARR LED CR1 when received carrier develops sufficient squelch voltage. The squelch is also further amplified by Q3 to drive an external carrier alarm circuit through rear-panel terminal 5; this output is +10 volts at 10 ma when a carrier is present and 0 volts (2000 ohm return to ground.) for carrier failure.

4.4 Tone Decoder Model 760-03.

(Schematic Diagram: Figure 6-5)

This module detects the presence of the 853 Hz and 960 Hz tones in the receiver audio output. If both tones are present simultaneously for at least 8 seconds,

Section 5

Maintenance

5.1 General.

Since the Model 760 is a solid-state instrument and its power requirements are low, no maintenance problems due to high temperature should be encountered, provided the instrument is installed well away from vacuum-tube and other heat-generating equipment. Likewise, because the operating voltages are low, excessive dust accumulation associated with high-voltage devices should not occur.

5.2 Periodic Maintenance.

The only periodic maintenance required is cleaning. Once a year, or more often in dusty locations, take off the top cover and blow off the dust with compressed air.

5.3 Performance Checks.

The following procedures will enable the technician to determine whether the instrument is operating properly. If the tests indicate substandard operation, it is recommended that the instrument be returned to the factory for adjustment or repair. Internal adjustments are not recommended to be made in the field.

5.3.1 AM Receiver, Model 760-01

a. Sensitivity

1. Connect a Signal Generator (HP8640B or equivalent) to the ANTENNA input on the rear panel with its frequency at 540kHz and AM modulation set to 50%, 1kHz. Set output level at $10\mu\text{V}$.
2. Connect a general purpose oscilloscope to the UNBAL and GND terminals on the rear panel.
3. Dial in 540kHz on thumb wheel switches of 760-01 and tune the pre-selector for maximum signal on the oscilloscope.
4. Slowly increase the level of the Signal Generator until the CARR LED comes on — this should occur at approximately $30\mu\text{V}$. At the time the CARR LED comes on the voltage at the CARR FAIL terminal on the rear panel should change from 0 volts to 10V DC.

b. AGC Range

1. Increase the Signal Generator level to 30mV and the 1kHz sinewave on the oscilloscope should remain undistorted.
2. Repeat steps for 1030kHz and 1600kHz input signal.

5.3.2 FM Receiver, Model 760-02

a. Sensitivity

1. Connect a Signal Generator (HP8640B

or equivalent) to the ANTENNA input on the rear panel with its frequency at the receiver's channel frequency and its frequency deviation set for 75kHz at a 1kHz rate. Set output level at $1\mu\text{V}$.

2. Connect a general purpose oscilloscope to the UNBAL and GND terminals on the rear panel.

3. Slowly increase the level of the Signal Generator until the CARR LED comes on — this should occur at approximately $2\mu\text{V}$. At the time the CARR LED comes on the voltage at CARR FAIL terminal on the rear panel should change from 0 volts to 10V DC.

b. AGC Range

1. Increase the Signal Generator level to 20mV and the 1kHz sinewave on the oscilloscope should remain undistorted.
2. If receiver is a dual-channel version, repeat procedure for alternate channel.

5.3.3 Tone Decoder, Model 760-03

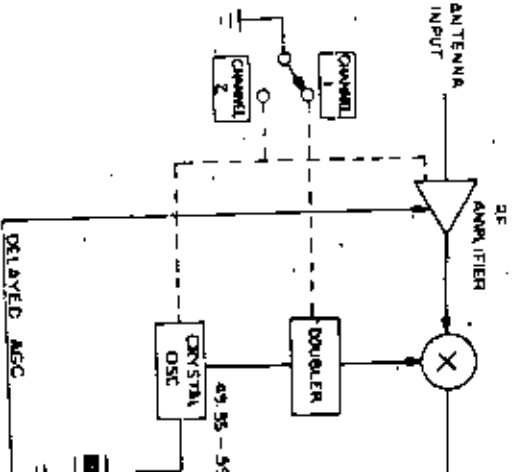
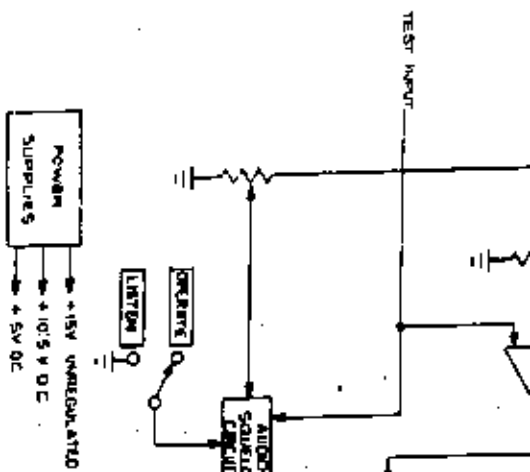
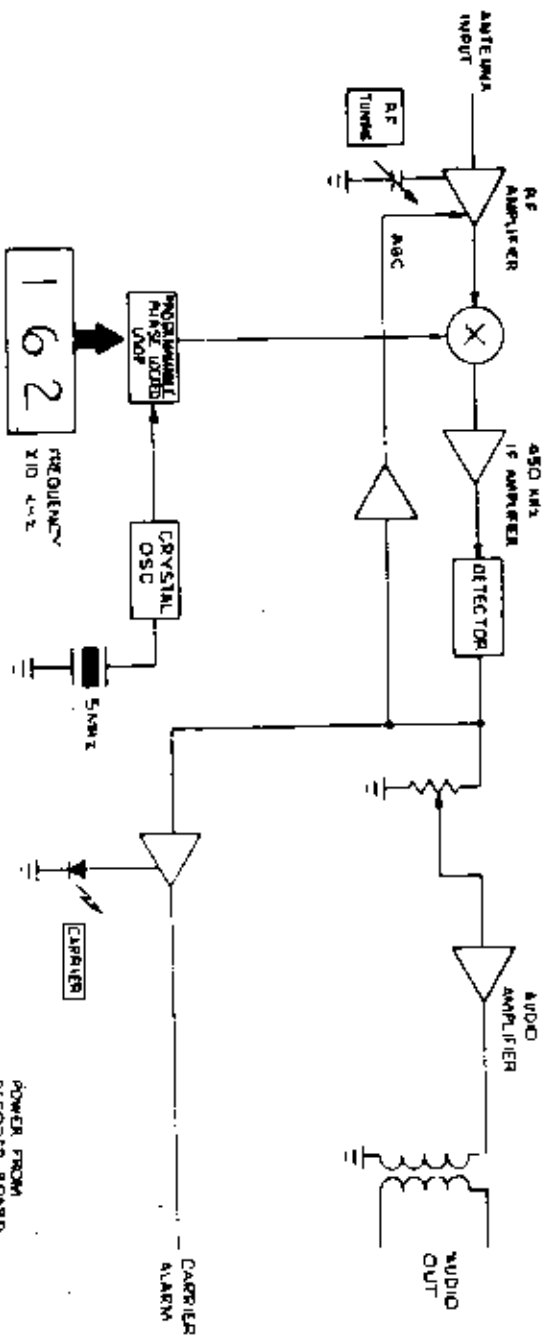
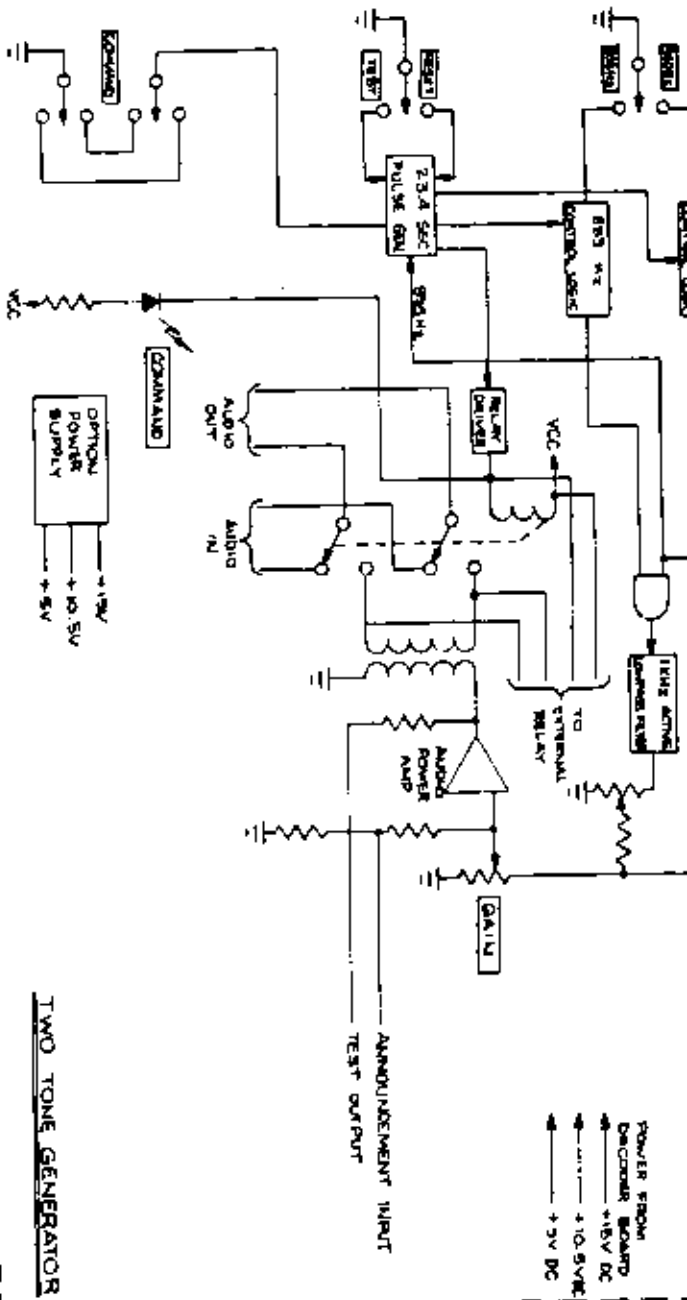
- a. Connect a jumper wire between rear panel terminals TEST INPUT on the Decoder and TEST OUT on the Generator. If a receiver is available connect its UNBAL output to the AUDIO INPUT terminal and tune the receiver to a local channel. With the LISTEN / OPERATE switch on the Decoder in the LISTEN position audio should be heard on the speaker. Switch to the OPERATE position and the audio should no longer be audible.

- b. Activate the COMMAND switch on the Generator and check that LED's CR3 and CR4 go out, indicating that the two tones are being received. 8 to 12 seconds after the initiation of the COMMAND switch, the speaker should demute and the two tones should be audible for another 12 to 16 seconds. When demuting the speaker the Decoder RELAY contacts should switch. The speaker will remain in the demuted mode and the relay will stay switched until reset by the Decoder RESET switch.

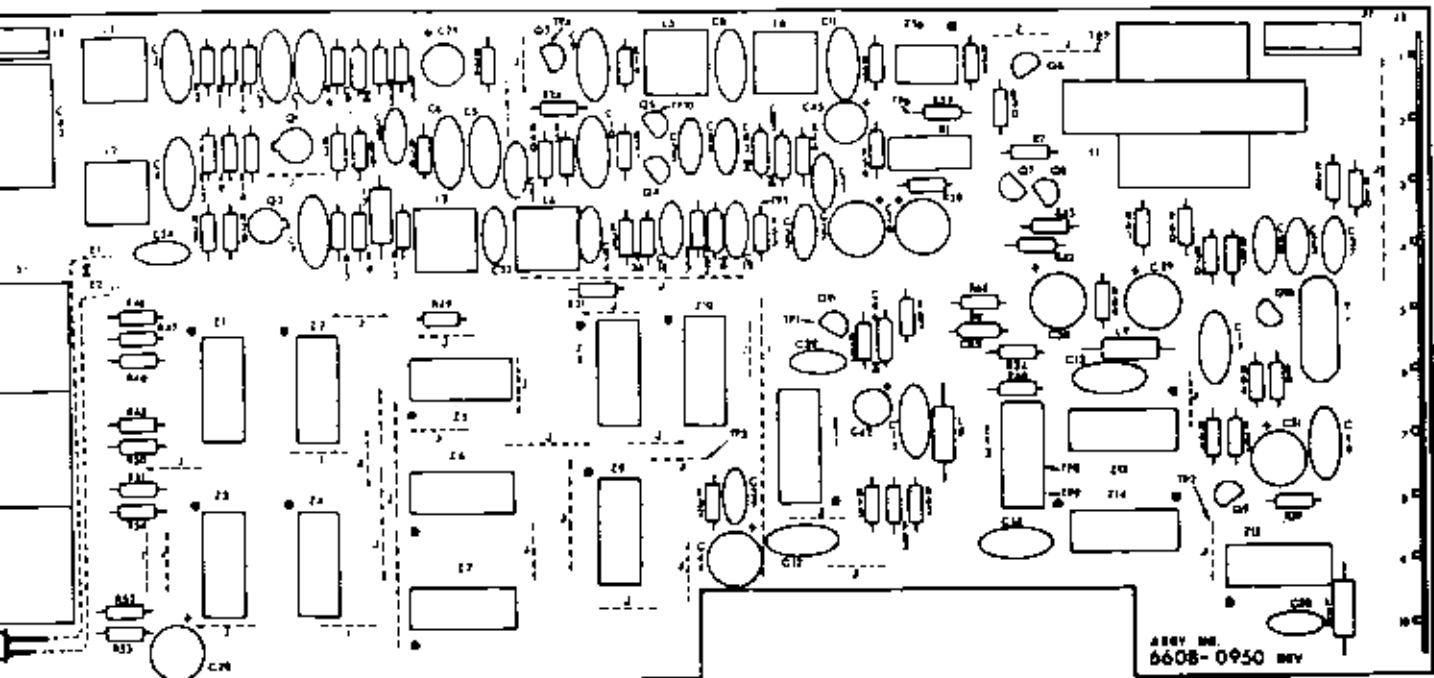
5.3.4 Two-Tone Generator, Model 760-04

- a. Connect a voltmeter and a counter at the TEST OUT terminal at the rear panel of the Two-Tone Generator.

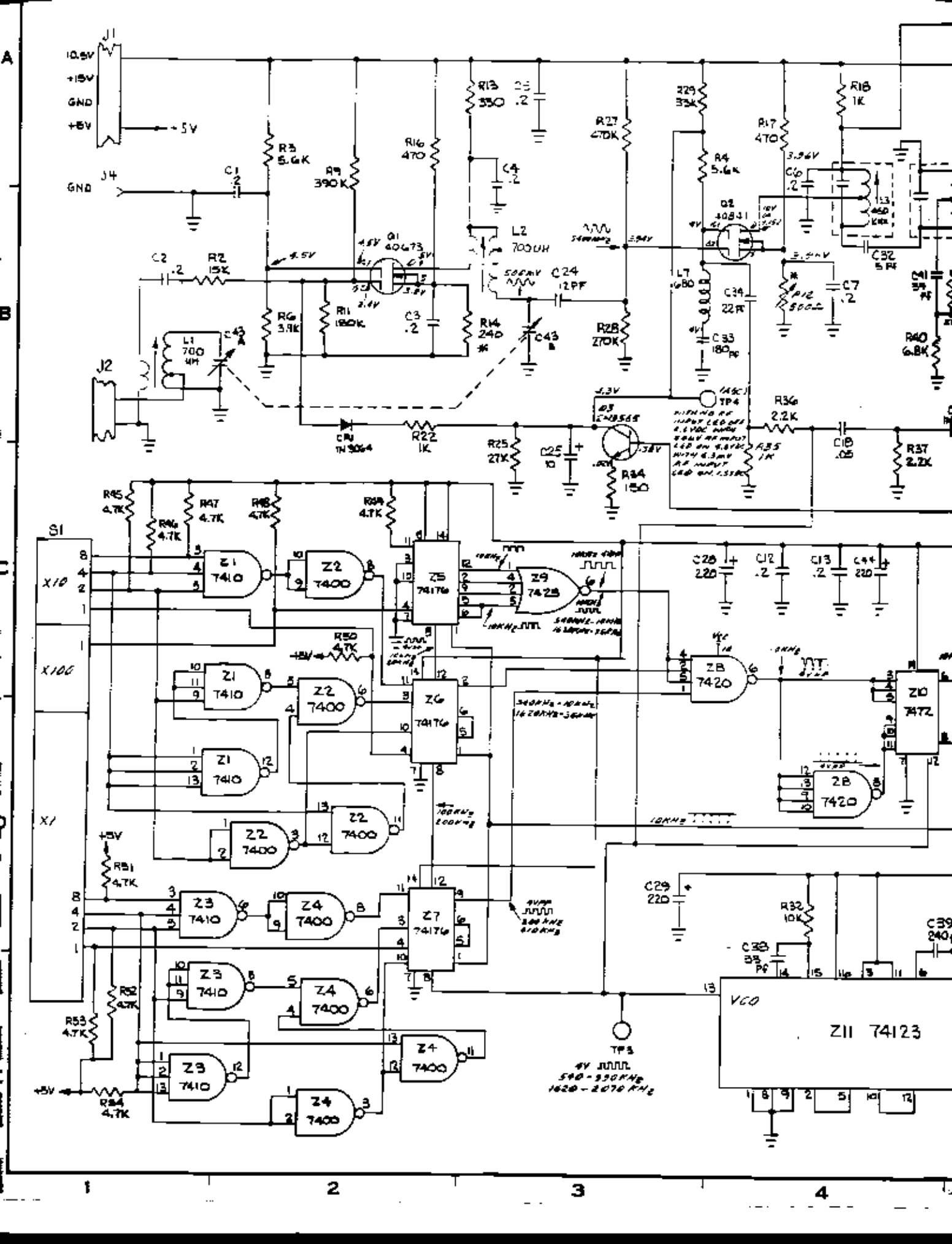
- b. Activate the 853Hz tone by placing the 853Hz/OPERATE/960Hz switch in the 853Hz position. The voltage (unloaded) should be approximately 4V r.m.s. (This voltage may be adjusted with the front panel GAIN control)

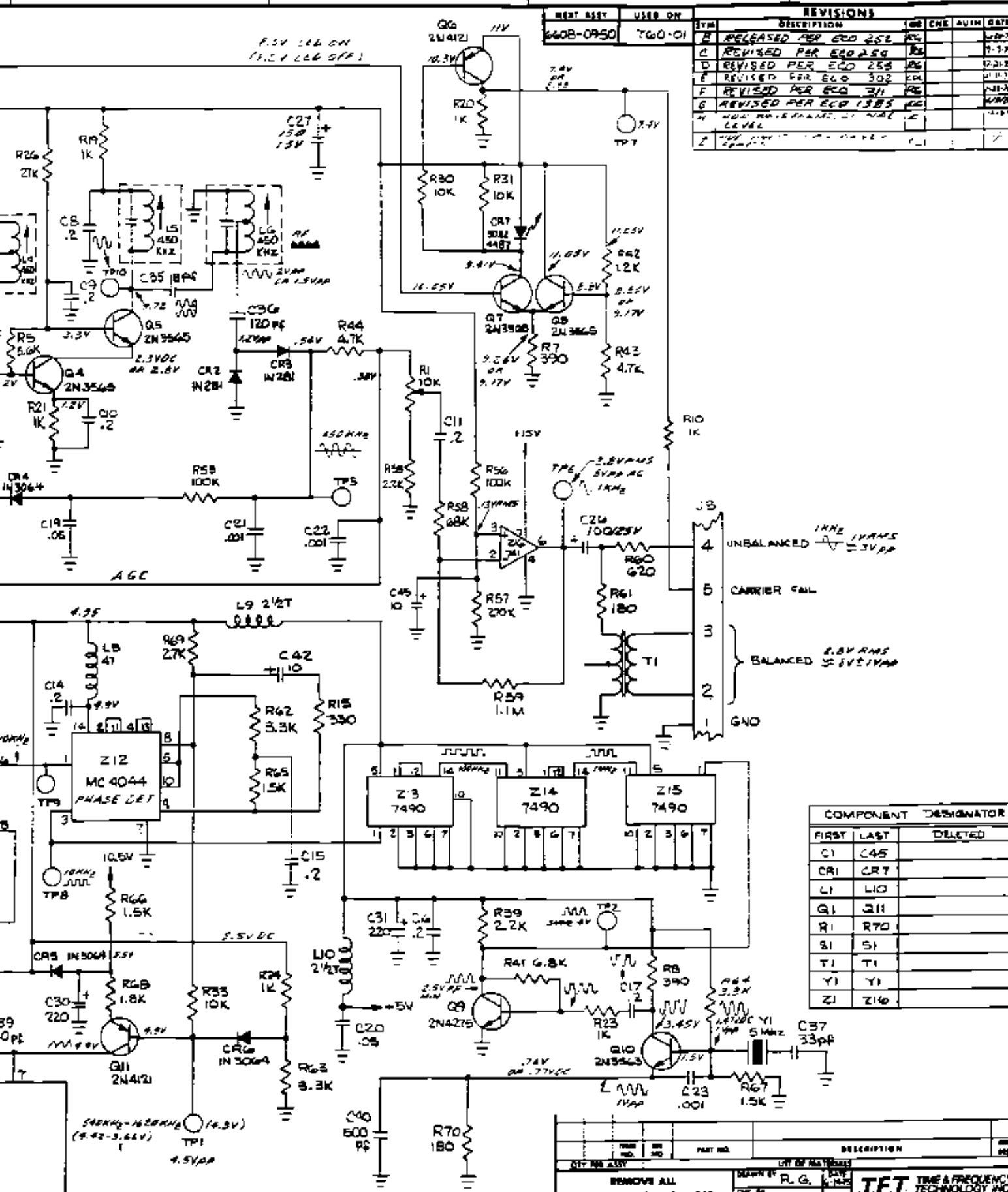


1 2 3 4 5



AM RECEIVER





BEST ASST	USED ON
6608-0950	760-01

REVISIONS					
SYM	DESCRIPTION	BY	CHE	AVIM	DATE
A	RELEASED PER ECO 252	RG			1-20-52
B	REVISED PER ECO 259	RG			7-17-52
C	REVISED PER ECO 258	RG			7-21-52
D	REVISED PER ECO 302	EP			11-11-52
E	REVISED PER ECO 311	RG			1-21-53
F	REVISED PER ECO 1385	RG			11-20-53
G	ADD R44, R45, R46, R47, R48, R49, R50, R51, R52, R53, R54, R55, R56, R57, R58, R59, R60, R61, R62, R63, R64, R65, R66, R67, R68, R69, R70, R71, R72, R73, R74, R75, R76, R77, R78, R79, R80, R81, R82, R83, R84, R85, R86, R87, R88, R89, R90, R91, R92, R93, R94, R95, R96, R97, R98, R99, R100, R101, R102, R103, R104, R105, R106, R107, R108, R109, R110, R111, R112, R113, R114, R115, R116, R117, R118, R119, R120, R121, R122, R123, R124, R125, R126, R127, R128, R129, R130, R131, R132, R133, R134, R135, R136, R137, R138, R139, R140, R141, R142, R143, R144, R145, R146, R147, R148, R149, R150, R151, R152, R153, R154, R155, R156, R157, R158, R159, R160, R161, R162, R163, R164, R165, R166, R167, R168, R169, R170, R171, R172, R173, R174, R175, R176, R177, R178, R179, R180, R181, R182, R183, R184, R185, R186, R187, R188, R189, R190, R191, R192, R193, R194, R195, R196, R197, R198, R199, R200, R201, R202, R203, R204, R205, R206, R207, R208, R209, R210, R211, R212, R213, R214, R215, R216, R217, R218, 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UNBALANCED
1KHZ 1V RMS
= 3V PP

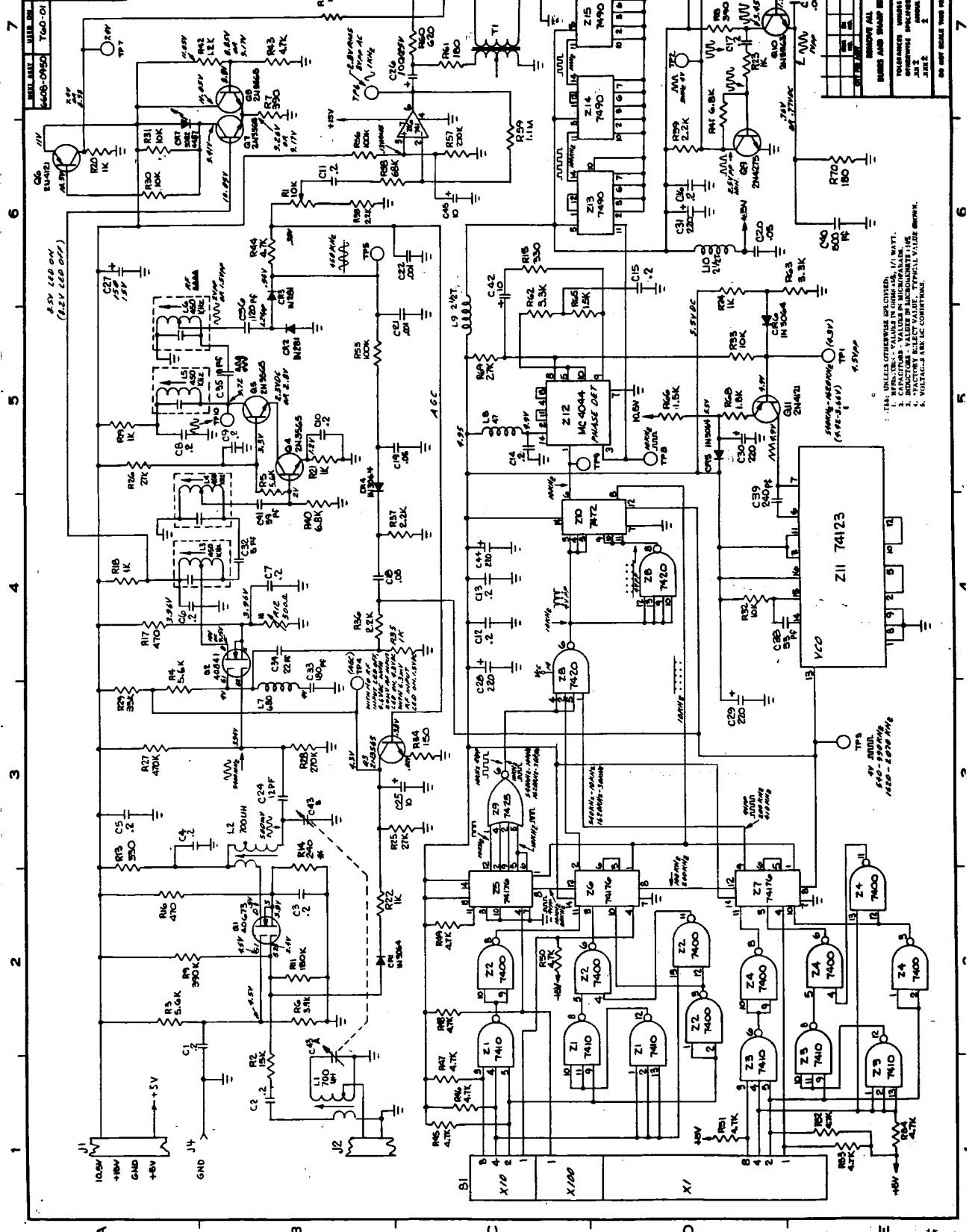
BALANCED
2.8V RMS
5.5V PP

COMPONENT DESIGNATOR		
FIRST	LAST	DELETED
C1	C45	
CR1	CR7	
L1	L10	
Q1	Q11	
R1	R70	
S1	S1	
T1	T1	
Y1	Y1	
Z1	Z10	

1. UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN MILLIMETERS.
2. CAPACITORS - VALUES IN MICROFARADS.
3. INDUCTORS - VALUES IN MICROHENRIES.
4. FACTORY SUPPLIED VALUE. TYPICAL VALUE.
5. METRIC TAGS ARE TO BE OBTAINED FROM THE MANUFACTURER.

<p>REMOVE ALL BURS AND SHARP EDGES</p> <p>TOLERANCES UNLESS OTHERWISE SPECIFIED</p> <p>XX ± ANGULAR</p> <p>XXX ±</p> <p>DO NOT SCALE THIS PRINT</p>	<p>DRAWN BY R.G.</p> <p>CHE BY C.B. LITTLE</p> <p>DATE 6-28-52</p> <p>REV. NO.</p> <p>QTY</p> <p>ISS</p> <p>100 NO</p>	<p>DESCRIPTION</p> <p>AM RECEIVER</p> <p>FIGURE G-2</p> <p>6601-1450</p>
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REV	DESCRIPTION	BY	DATE
1	PRELIMINARY
2	REVISED FOR...
3	REVISED FOR...
4	REVISED FOR...
5	REVISED FOR...
6	REVISED FOR...
7	REVISED FOR...
8	REVISED FOR...



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