MODEL 4500

Dynamic Presence Equalizer

OPERATING AND MAINTENANCE INSTRUCTIONS

MODEL 4500
Dynamic Presence Equalizer

OPERATING AND MAINTENANCE INSTRUCTIONS

PROFESSIONAL PRODUCTS

CBS LABORATORIES

A Division of Columbia Broadcasting System, Inc.

Stamford, Connecticut 06905

January 1973

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

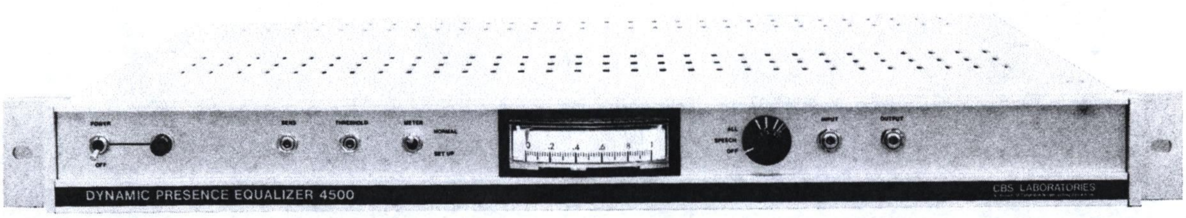


Figure 1-1. Model 4500 Dynamic Presence Equalizer

SECTION I

INTRODUCTION

1-1. GENERAL

This manual provides instructions for the CBS Laboratories Model 4500 Dynamic Presence Equalizer, a high-quality professional broadcasting control unit which greatly improves the quality of poor audio signals.

Though primarily designed to improve poor-quality signals in speech programming, the unit can be used advantageously for all types of audio program material. The user can operate the unit in either a speech-only or a non-discriminatory mode. In the speech-only mode, a speech-music discriminator automatically inhibits the equalizing action during musical passages. When no audio signal corrections are necessary, the equalizing action can be entirely removed, in which case the unit acts as a flat amplifier.

1-2. FUNCTIONAL DESCRIPTION

The Dynamic Presence Equalizer (figure 1-1) improves poor quality speech signals by sampling the program material to determine the proportion of energy in the 2,000-to-4,000 Hz "presence" band, then, when necessary, boosts the amplitudes of presence-band signal components.

A. Audio Signal Transmission Problems

Modern broadcasting stations derive their programs from a wide variety of sources, both from within studios and remote from them. Despite conscientious maintenance, innumerable occasions arise wherein speech quality -- and other audio-signal quality -- is greatly degraded. Some of the reasons for this are azimuth alignment errors in tape recorders, excessive recording levels, incorrect line equalization, poor quality remote equipment, and excessive talker-to-microphone distances. These deficiencies cause attenuation of vital consonant energy in the presence band. As a result, the articulation of the program material is frequently poor.

B. The Presence Band

In speech, most of the energy is required by the vowels which generally produce low-frequency audio signal components from about 100 to 1, 000 Hz; however, most of the information is conveyed by the consonants, which generally produce the higher-frequency audio-signal components of 2, 000 to 4, 000 Hz. Because the high-frequency components of speech are more rapidly attenuated with distance then the low-frequency components, the character of speech heard at close range differs from that heard at a distance. Speech heard at close range, where the high-frequency energy is abundant, is said to have "presence". Hence, the 2-kHz to 4-kHz band is called the presence band.

The sound-energy amplitudes for consonants are naturally 15 to 20 dB below those for vowels. In close proximity, the ear compensates for this, but, when the high-frequency levels are further reduced -- as by audio signal transmission problems -- the ear cannot compensate enough to decipher the consonants and speech is then understood only by redundancy, if at all. By means of equalization techniques, the Dynamic Presence Equalizer compensates for these unwanted reductions in consonant-amplitude levels. Optimum spectral balance is thereby maintained without increasing the program V.I., since the energy in the presence band is generally so much less than the low-frequency energy contributed by the vowels.

1-3. PHYSICAL DESCRIPTION

Designed for easy mounting in a standard 19-inch rack, the Model 4500 Dynamic Presence Equalizer (figure 1-1) is conveniently small and lightweight. Overall height is less than 1-3/4 inches, depth less than 15 inches, and the weight is 8 pounds. All circuits are solid state and are located on one printed circuit board except for the front-panel meter. The front panel meter continuously monitors the main internal voltage used to control the amount of equalization provided except when performing the set-up and alignment procedures at which time the METER switch is placed in the SET-UP position.

A mode switch and a power switch, located on the front panel, are the only operator's controls; hence, once installed and set up, the unit requires no attendance except for occasional meter checks or when desired to change the mode of operation.

The unit can be operated from either a 115-volt or 230-volt single-phase 50 or 60 Hz power source. On delivery, the unit is connected for 115-volt operation. Wiring changes for 230-volt operation are explained in paragraph 2-2.

1-4. WARRANTY

A warranty, with a return postcard is included with your Dynamic Presence Equalizer. Fill out the postcard and return it to CBS Laboratories as soon as possible to validate your warranty.

1-5. FACTORY SERVICE AND REPAIR

If difficulty is experienced in installing or operating the Dynamic Presence Equalizer, please contact your distributor for assistance. If necessary, call CBS Laboratories, Professional Products Department, Stamford, Connecticut, 06905 (Area Code 203, 327-2000).

1-6. SPECIFICATIONS

Dimensions	Fits standard 19-inch rack, 1-3/4 inches high; 15 inches deep
Modes of operation	Equalizes all audio signals, equalizes speech audio signals only, or serves as flat amplifier
Frequency response:	
No control	±0.5 dB, 50 to 15,000 Hz
Control	Maximum boost to 10 dB at 3.4 kHz

Harmonic distortion	Less than 0.5% from 50 to 15,000 Hz
Input level	0 to +23 dBm
Output level (sine wave)	19 dBm
Output level (program)	14 VU
Input and output impedance	600 ohms or 150 ohms balanced or unbalanced
Signal-to-noise ratio	70 dB
Maximum gain	19 dB
Maximum operating temperature	55° C
Power requirements	15 watts, 115/230 volts ac, 50/60 Hz
Shipping weight	18 lb.

SECTION II

INSTALLATION

2-1. UNPACKING

Unpack the Dynamic Presence Equalizer carefully and examine the unit for evidence of possible shipping damage. If the unit is damaged, file a claim immediately with the shipping carrier. If future transportation of the unit is anticipated, save the shipping carton.

2-2. POWER SOURCE (See Figure 2-1.)

The Dynamic Presence Equalizer is equipped with a power transformer which permits selection of either 115-volt or 230-volt operation. When delivered from CBS Laboratories, the Dynamic Presence Equalizer is wired and equipped for 115-volt operation. If 230-volt operation is required, make the following modifications at the terminal strip TB1 at the inside rear of the unit next to the power transformer.

A Remove the black/white lead from terminal 4 of TB1 (figure 7-1).

B Remove the brown lead and the white lead from terminal 3 of TB1.

C Connect the black/white, brown, and white leads to TB1-1.

D Replace the original fuse with a type 3AG-0.125 amp (SLO-BLO).

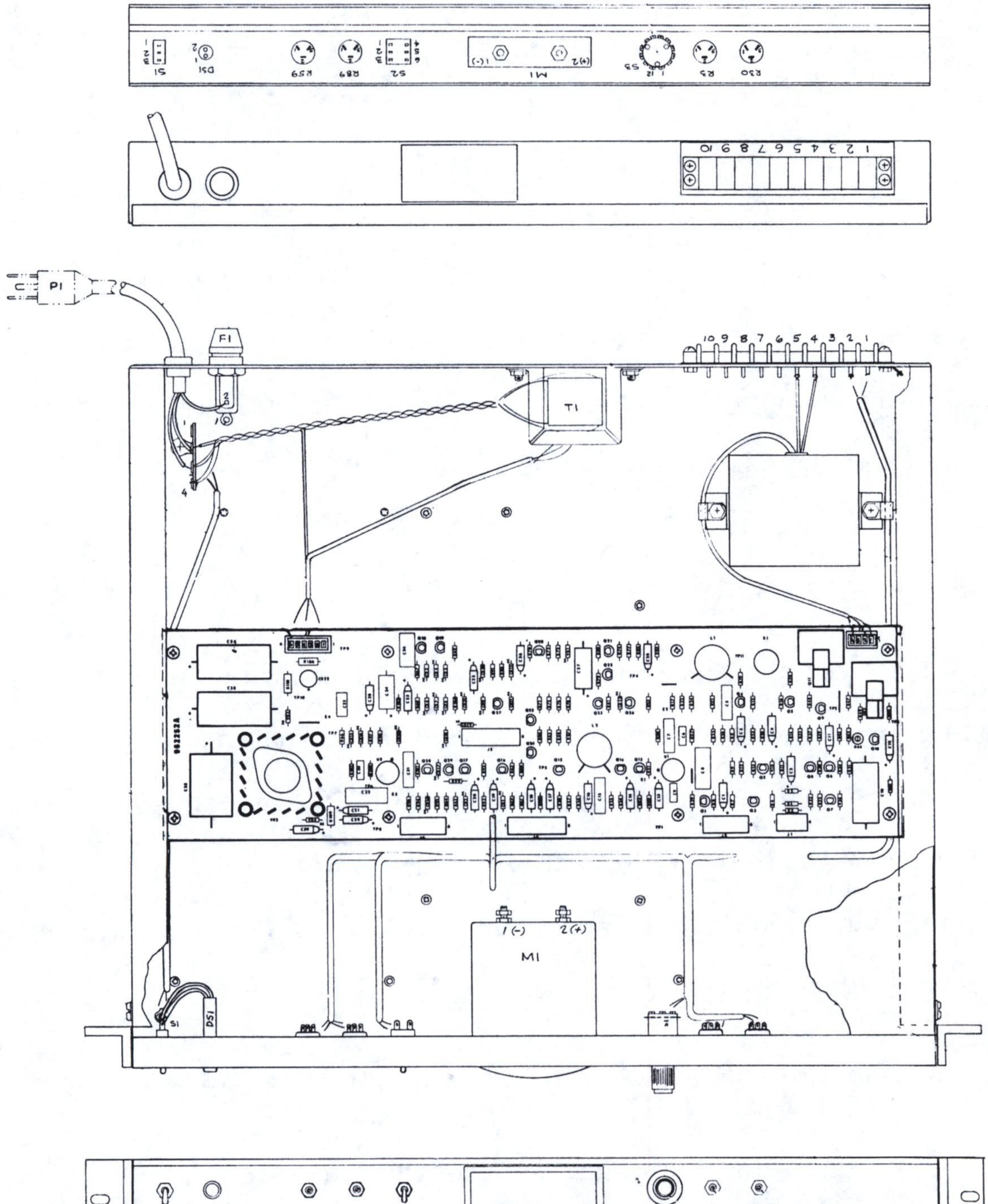


Figure 2-1. Dynamic Presence Equalizer
Outline Drawing

2-3. INSTALLATION

Figures 2-2 shows a system block diagram for a typical Dynamic Presence Equalizer installation.

The Dynamic Presence Equalizer is designed to be mounted in a standard 19-inch-wide electronic equipment rack. It requires 1-3/4 inches of space for the panel height and 15 inches of space behind the front panel. As for all transistorized equipment, the unit must be installed in a reasonably well ventilated position with no high-heat producing equipment beneath it.

CAUTION

Ambient temperature should not exceed 130° F.

The Dynamic Presence Equalizer is designed for use with a well controlled audio level. The use of the CBS Laboratories Audimax automatic level control is highly recommended; however, other similar level controls can be used. It is suggested that the Dynamic Presence Equalizer be connected and placed in the studio immediately following the automatic level control as shown in Figure 2-2.

2-4. ELECTRICAL CONNECTIONS

Connect the power cord to 115v or 230v ac power. (See paragraph 2-2.) The power will light when the POWER switch is placed in the on (upper) position.

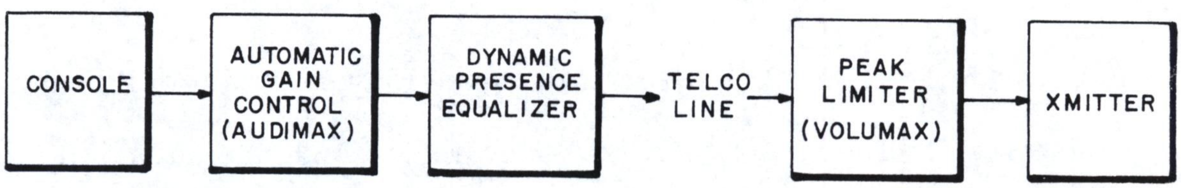
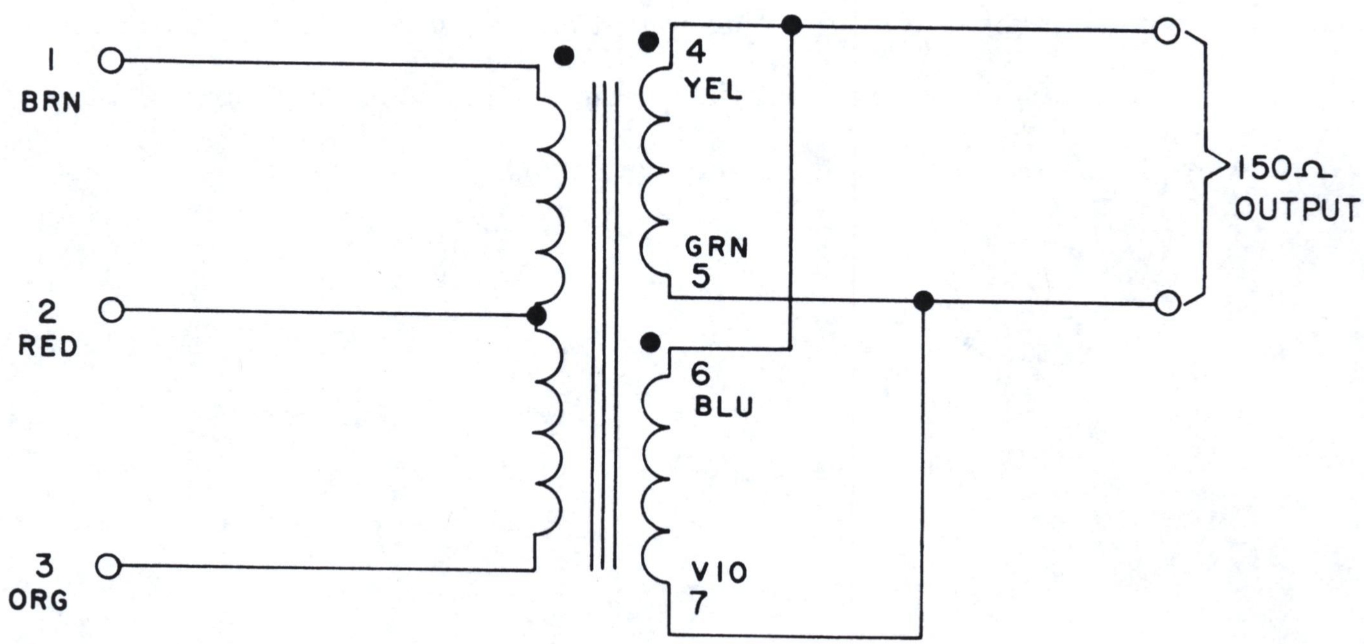


Figure 2-2. Block Diagram - Typical Installation

Connect signal input and output leads to the barrier strip at the rear of the chassis. Use terminals 1 and 2 for input and terminals 4 and 5 for output. Terminals 6 through 10 are not used. As necessary or desirable, the unit may be connected for balanced or unbalanced input and/or output operation. Use terminal 3 (chassis ground) for shield connections.

The Dynamic Presence Equalizer is designed for either 600- or 150-ohm line operation. As delivered from CBS Laboratories, it is strapped for 600-ohm operation. For 150-ohm operation, replace R1 (figure 4-5) with a 150-ohm resistor, and re-strap the output transformer T2 (figure 5-1) as shown in the re-strapping diagram, figure 2-3.

OUTPUT TRANSFORMER



INSTRUCTIONS

1. BREAK CONNECTION BETWEEN 5 & 6.
2. STRAP 5 TO 7.
3. STRAP 4 TO 6.

Figure 2-3. Transformer T2 Re-Strapping Connections for 150-Ohm Operation

SECTION III

SET-UP PROCEDURE

3-1. GENERAL

The Dynamic Presence Equalizer is designed to work with well controlled audio input levels. Its POWER switch must be in the on (upper) position for all modes of operation.

3-2. OPERATION WITH CBS LABORATORIES AUDIMAX OUTPUT SIGNALS

On the Dynamic Presence Equalizer, turn the INPUT, OUTPUT, and SENS controls fully counterclockwise. Place the mode switch at ALL and the POWER switch to the on position. Apply a 500-Hz sine wave signal to the Audimax input at sufficient amplitude to drive the Audimax meter reading into the center of the green region with the Audimax output control at approximately mid-position. Then place the Dynamic Presence Equalizer METER switch in the SETUP position and slowly rotate the INPUT control clockwise until the Dynamic Presence Equalizer meter reading is 5. When the METER switch is in the SETUP position, the meter reading is an indication of the signal level. Next, return the METER switch to the NORMAL position and adjust the SENS control for a mid-scale reading on the meter (meter now indicates the equalization control voltage level). Finally, adjust the OUTPUT control for the desired output level.

The unit is now ready for operation. If equalizing action is desired for all program material, leave the mode switch in the ALL position. If equalizing action is desired only for speech, place the mode switch in the SPEECH position. If no equalization is desired, place the mode switch at OFF.

3-3. OPERATION WITH OTHER-THAN-AUDIMAX SIGNALS

On the Dynamic Presence Equalizer, turn the INPUT, OUTPUT and SENS controls fully counterclockwise. Place the mode switch at ALL. Place the POWER switch in the on (upper) position. Apply a 500-Hz signal to the Dynamic Presence Equalizer from a sine-wave oscillator at a level equal to the normal VU level of the program line. Then place the Dynamic Presence Equalizer METER switch in the SETUP position and slowly rotate the INPUT control until the meter reading is 3. When the METER switch is in the SETUP position, the meter reading is an indication of the signal level. Next, return the METER switch to the NORMAL position and adjust the SENS control for a reading of 3 (meter now indicates the equalization control voltage level). Finally, adjust the OUTPUT control for the desired output level.

The unit is now ready for operation. If equalizing action is desired for all program material, the mode switch should be left in the ALL position. If action is desired only for speech programming, place the mode switch in the SPEECH position. If no equalization is desired, place the mode switch at OFF.

3-4. SPEECH-MUSIC DISCRIMINATOR

The speech-music discriminator circuit has been preset at the factory for optimum performance for most applications. In some cases, however, the individual user may wish to adjust it more suitably for his own particular application.

This adjustment is performed with the front panel THRESHOLD control. If this control is turned clockwise, the speech-music discriminator circuit will be biased toward speech; if turned counterclockwise, the speech-music discriminator circuit will be biased toward music. If the resetting of the THRESHOLD control is desired, see paragraph 5-1B.

SECTION IV

THEORY OF OPERATION

4-1. GENERAL

In speech, the acoustic energy representing a vowel is frequently as much as 20 dB greater than the acoustic energy representing the average consonant. This level difference is graphically illustrated in figure 4-1 which shows the long-term acoustic spectrum for male voices. The signal level at 4 kHz, where a still-significant quantity of the important consonant information is contained, is 20 dB lower than the peak low-frequency level in this curve.

Although the consonants are normally transmitted at much lower sound-energy levels than the vowels, our capacity for comprehension of the message is not impaired when in close proximity, because the ear is far more sensitive in the consonant range of the sound spectrum. However, when the talker and listener are connected through the complex interfaces of a typical broadcast system, the chances of severely impairing the message quality by an inadvertant diminution of the high-frequency energy are numerous. There are many causes of consonant information loss in broadcasting. The most prominent is probably incorrect microphone or recording-head azimuth alignment. Others include incorrectly equalized lines, excessive tape recording levels, and remote news pickups with inferior equipment and excessive talker-to-microphone distances.

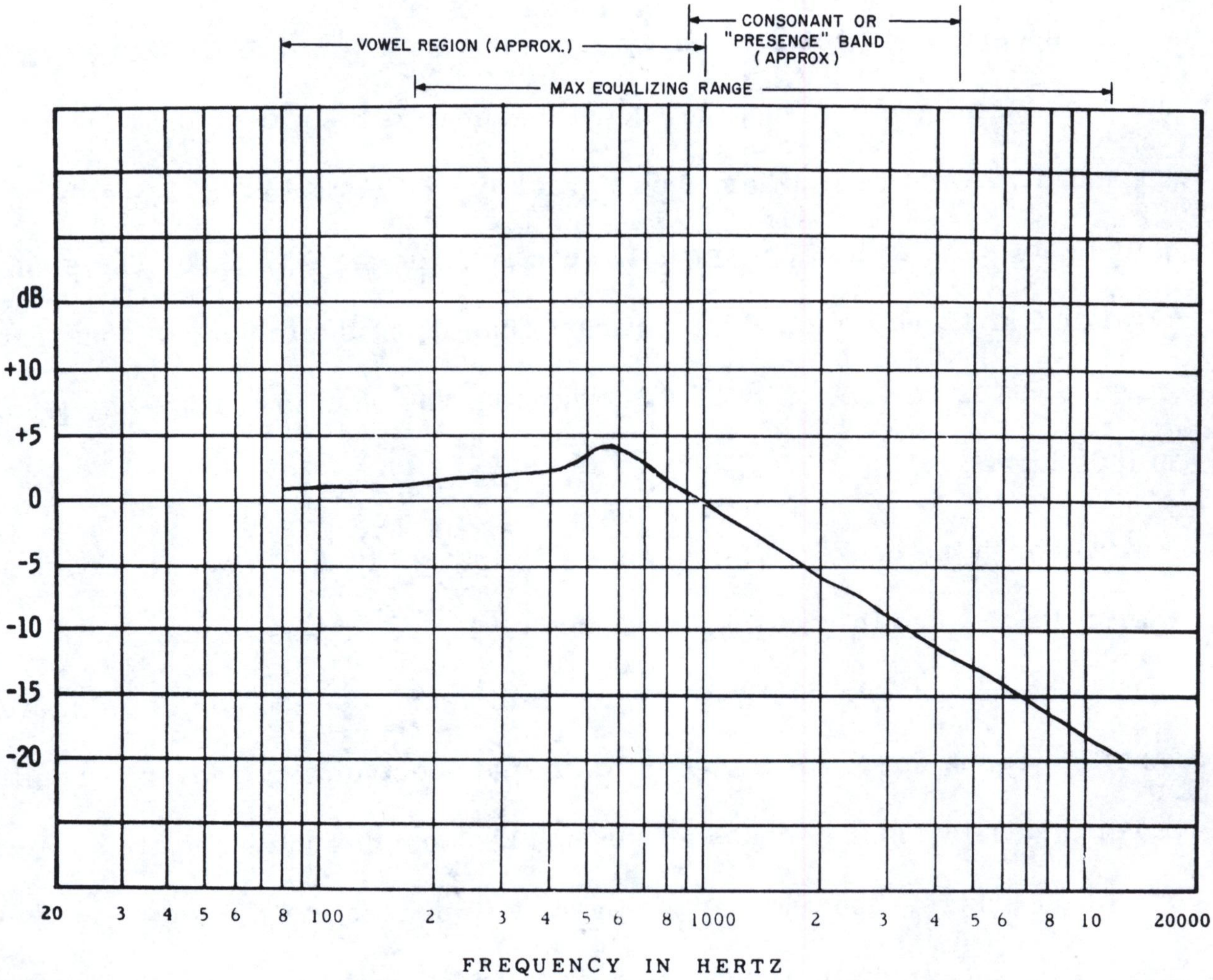


Figure 4-1. Long-Term Acoustic Spectrum for Male Voices

4-2. SPEECH-MUSIC DISCRIMINATION

In the Dynamic Presence Equalizer, a speech-music discriminator is provided to permit automatic inhibition of the action of the Dynamic Presence Equalizer during musical programming if the broadcaster desires. If the front panel mode switch is in the SPEECH position, the Dynamic Presence Equalizer will enhance the presence (consonant) band only during speech; if the switch is in the ALL position, the unit will function with all programming. The decision threshold is adjustable, as explained in paragraph 5-1B.

4-3. OVERALL SYSTEM DESCRIPTION

A block diagram of the Dynamic Presence Equalizer is shown in figure 4-2 and a schematic in figure 4-5.

A. Dynamic Presence Filter and Output Circuit

The incoming signal is fed through a differential input amplifier Q1, Q2, Q3 (figure 4-5) to emitter followers Q4, Q5 which drive the dynamic presence filter, a novel circuit which serves to boost the presence portion of the spectrum in proportion to an applied control voltage. The operating characteristics of the circuit are illustrated in figure 4-3. With zero control voltage applied, the frequency response is flat. As the control voltage increases, the frequency response becomes progressively more peaked in the presence band and above, reaching a maximum boost of 10 dB at the peak of the curve with an applied control voltage of 10 volts. Distortion-free

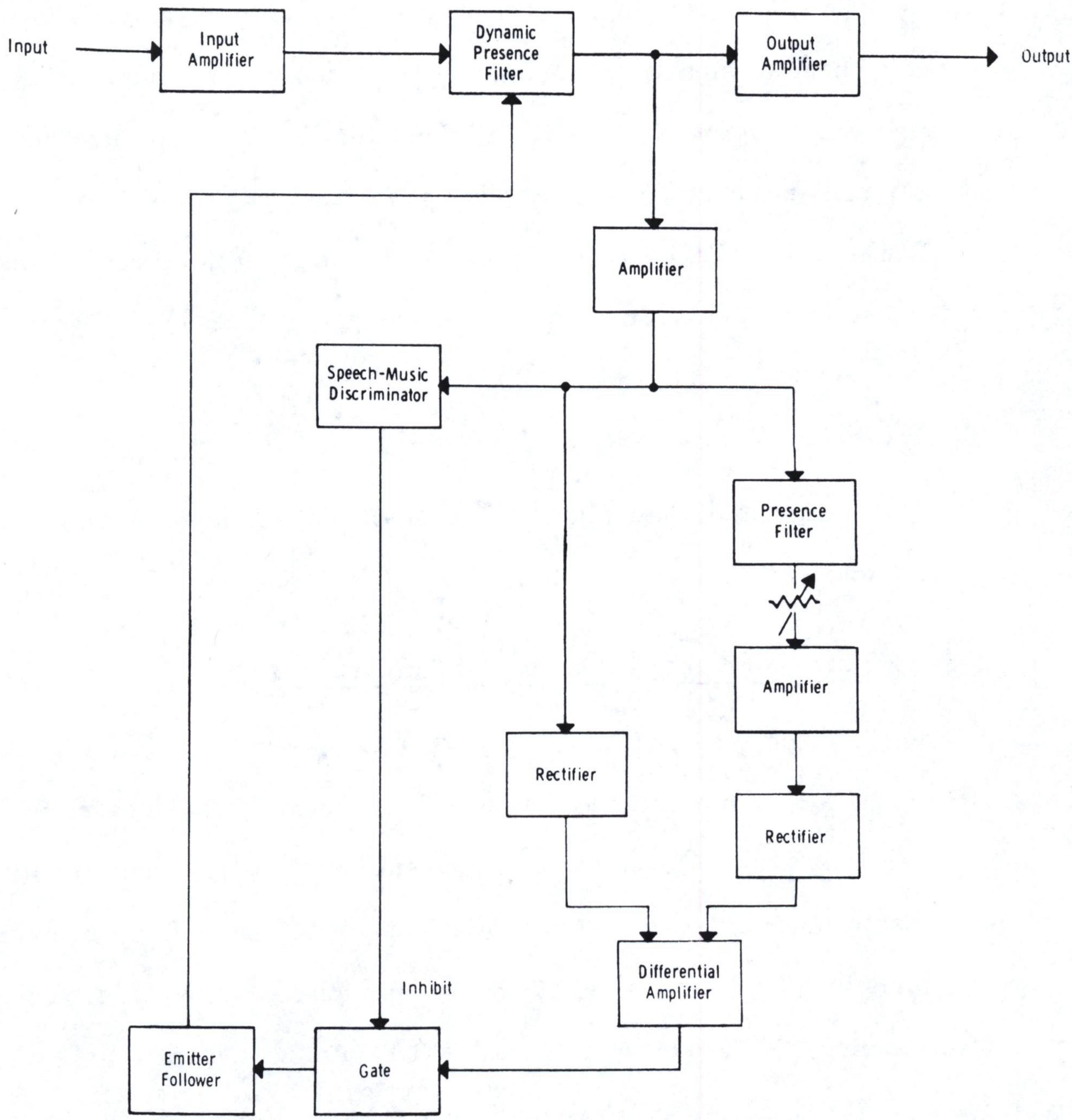


Figure 4-2. Block Diagram of Dynamic Presence Equalizer

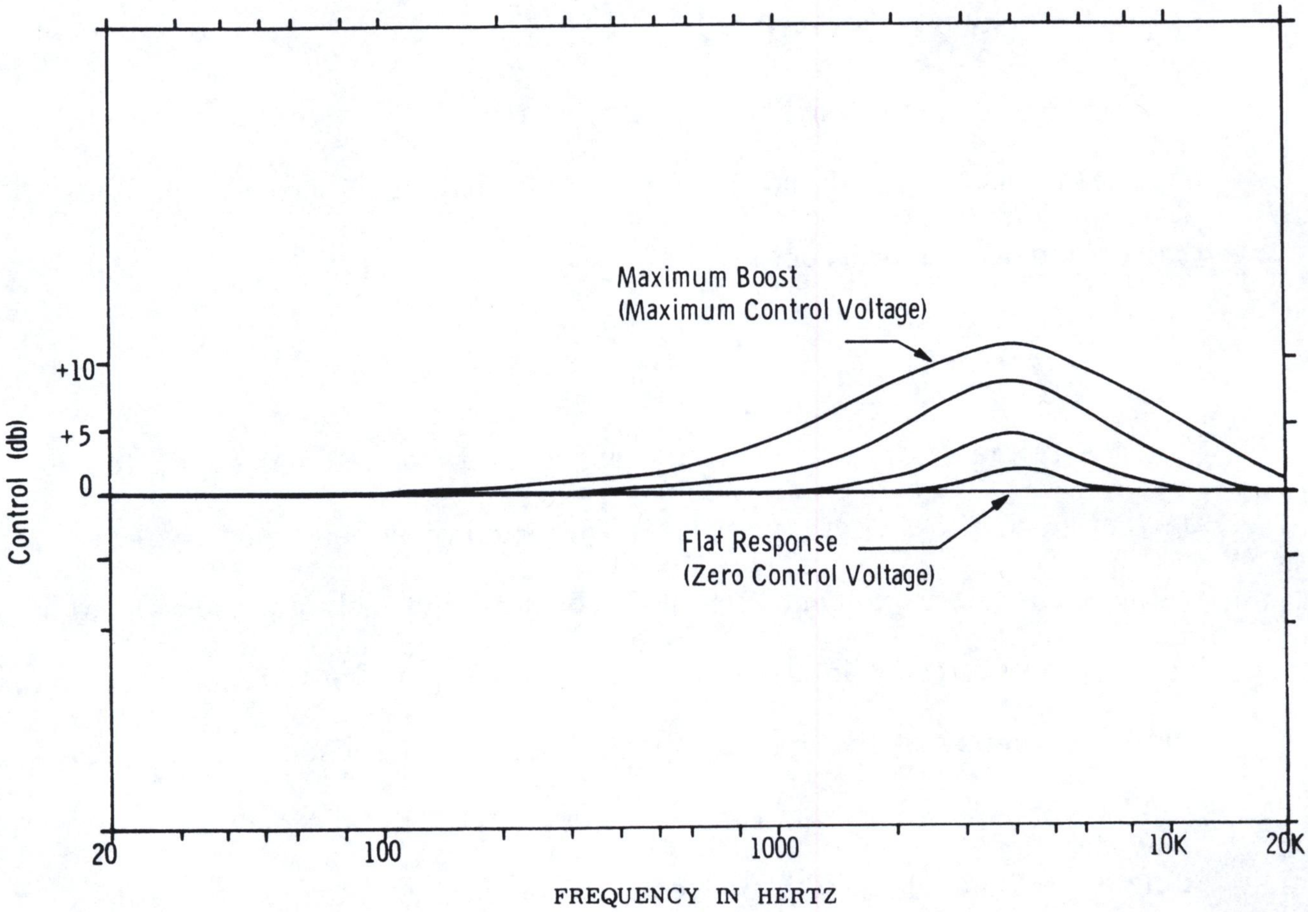


Figure 4-3. Expansion Mode Response

control is achieved through the medium of a balanced light-dependent resistor (LDR) lamp assembly (Z1). At the same time, the high common mode rejection of an integrated-circuit operational amplifier U1 completely eliminates "thump" from the signal line.

Following the dynamic presence filter, the signal is taken through parallel paths to the control circuitry and a balanced output stage (Q6 - Q12) that provides a floating output.

B. Control Section

In the control section, the signal is amplified and split into two paths. One path leads to a rectifier (CR15, 16) which provides a positive-going dc voltage which is representative of the broad-band instantaneous signal amplitude. The other path leads to a bandpass filter, which is tuned to the same center frequency as the dynamic presence filter discussed above. The signal from the bandpass filter is then rectified (CR1, 2), thus providing a positive-going dc voltage which is representative of the instantaneous amplitude of the presence component in the signal being analyzed. These two dc signals are then applied to a differential amplifier U2 which subtracts the presence-representative dc signal from the broad-band-representative dc signal. The resulting error signal is positive if the overall signal is low in presence (i.e., the broad-band signal greater than the amplified presence signal), zero if the dc voltages match, and negative if the amplified presence signal is greater than the broad-band signal. Variation of the gain of the amplifier in the presence-detecting channel -- which consequently varies the amplitude of the presence dc voltage -- is a convenient method of controlling the action of the control section.

The positive-going control voltage is then passed through an appropriate time-constant shaping network (C34, R103) to a Darlington emitter follower (Q28, 29) which, in turn, completes a feedback loop by driving the lamp of the LDR module in the dynamic presence filter. An inhibiting gate (CR21) is located between the differential amplifier and the emitter follower to provide a means for inhibiting the action of the device when the appropriate gate control signal is received from the speech-music discriminator.

C. Speech-Music Discriminator

The speech-music discriminator is a circuit which, as its name implies, supplies a binary output: +10 volts when speech is present, 0 volts when music is present thereby controlling the inhibit gate in the control section. It is recognized that one can easily distinguish between a crisp news delivery speech and symphony music; however, a large number of intermediate types of programming exist -- such as singing commercials, opera, patter-songs, etc. -- which tend to make the classification much more difficult. The speech-music discriminator recognizes speech by its staccato nature, and any musical accompaniment or background will result in a music decision.

(1) Logarithmic Amplifier, Rectifier, and Comparator. A more detailed block diagram of the speech-music discriminator is seen in figure 4-4. This circuit relies for its decisions upon the facts that speech is staccato in nature and also possesses a short-term wide dynamic range. The logarithmic amplifiers (Q18, 19) and rectifier (CR9 - 12) exploit the large difference in short-term dynamic range between speech and music. By logging, the peak-to-valley ratio of the envelope of speech is exaggerated in comparison with that of music. The envelope is then inverted and dc-amplified, (Q20, 21). As a result, the speech envelope thereupon encompasses a range of approximately 10 volts, varying from almost zero at speech peaks to nearly 10 volts in the troughs. A musical envelope tends to peak at 0 volts but, on the other hand, only rarely rises above 5 volts in the troughs. A Schmitt trigger (Q22, Q23) is used as a voltage comparator which is set for triggering at nearly 6 volts. Thus the Schmitt trigger is only actuated by speech signals and provides a series of pulses at the syllabic rate.

(2) Integrator and Comparator. This pulse stream is subsequently integrated by means of a peak detector (CR13, C28, R82), and the integrator output is thus a smoothly varying dc signal whose amplitude represents the "speechiness" of the program.

The peak-detected signal varies with the rate of speech of the talker and with the precision of his delivery, but seldom drops below 5 volts. Musical programming, on the other hand, only rarely results in an amplitude greater than 1 volt. Consequently, by passing this voltage to another Schmitt

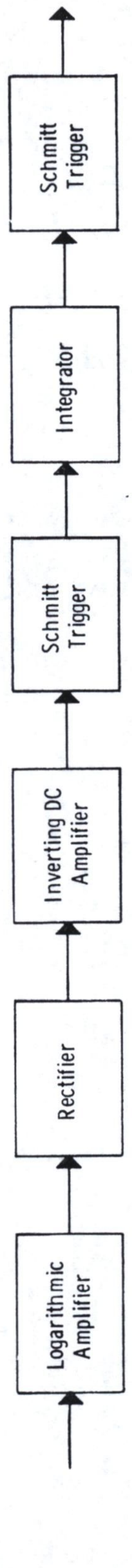
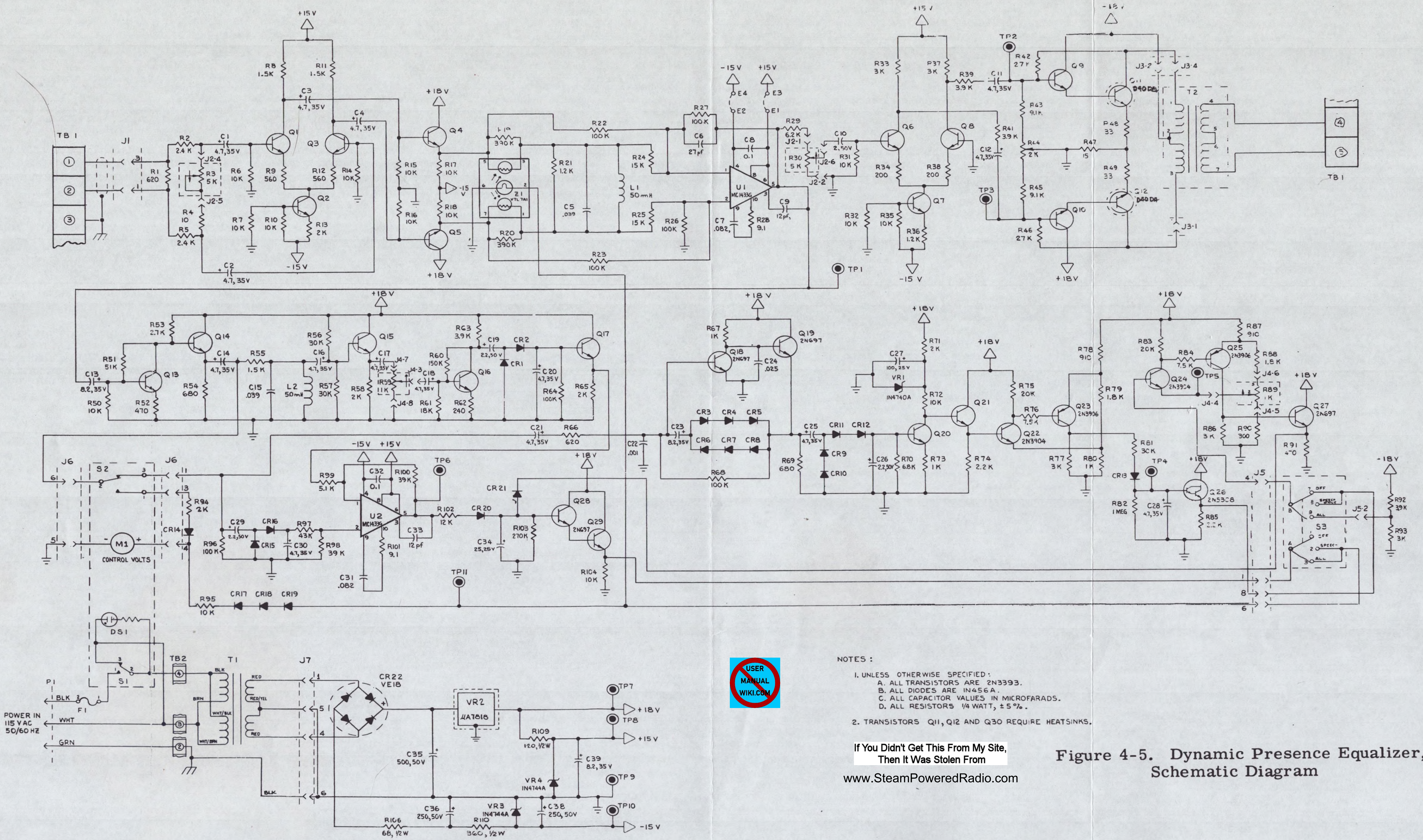


Figure 4-4. Block Diagram of
Speech-Music Discriminator

trigger (Q24, 25) which has a trigger level of +4 volts, a binary function is obtained. A +10-volt output is obtained for speech, and a 0-volt output is obtained for music. The application of the 0-volt level to the inhibit gate, previously discussed, prevents a control voltage from being developed. Conversely, the application of the +10-volt level permits a control voltage of up to 10 volts to develop, and, thus, additionally provides the means for limiting the maximum correction to 10 dB at the peak of the curve.

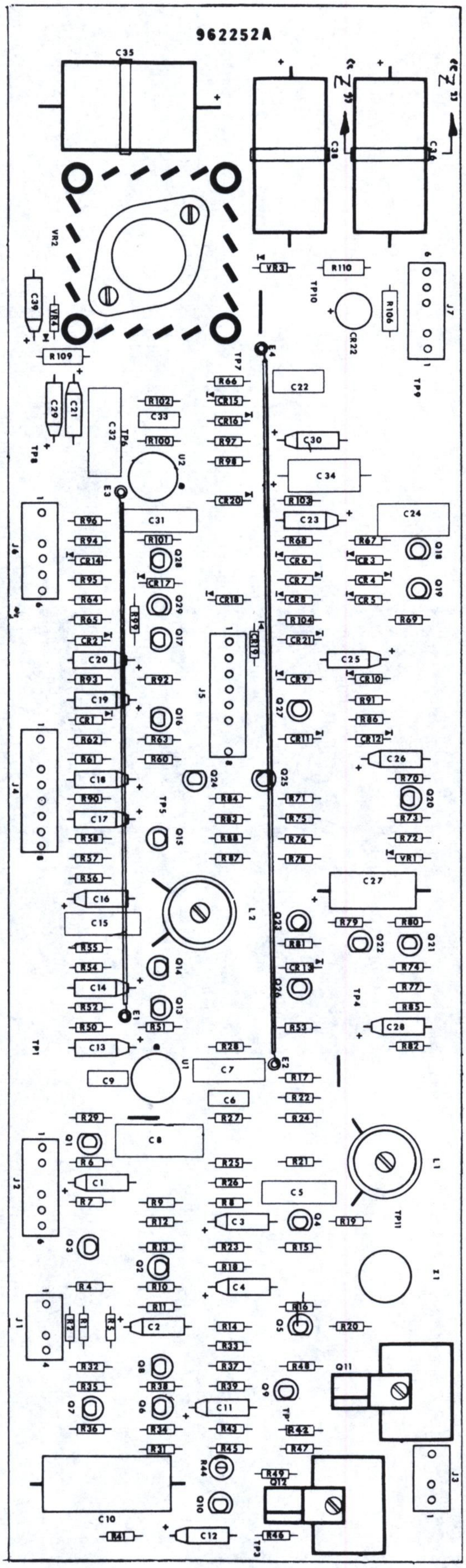
(3) Mode Switch. A mode switch is provided which enables the operator to select the SPEECH-only mode, an ALL mode, or an OFF switch condition that converts the unit to a flat amplifier by disconnecting the control voltage line.



NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   A. ALL TRANSISTORS ARE 2N3393.
   B. ALL DIODES ARE IN456A.
   C. ALL CAPACITOR VALUES IN MICROFARADS.
   D. ALL RESISTORS 1/4 WATT, ±5%.
2. TRANSISTORS Q11, Q12 AND Q30 REQUIRE HEATSINKS.

Figure 4-5. Dynamic Presence Equalizer, Schematic Diagram


962252A
C35
C38
C36
VR2
VR3
R110
TP10
R106
CR22
J7
TP9
C39
VR4
R109
C29
C21
TP8
C32
TP6
R102
C33
R100
U2
R66
CR15
CR16
R97
R98
C22
C30
C34
E3
E4
TP7
CR20
R103
C31
C23
C24
J6
R96
R94
CR14
R95
R64
R65
CR2
R101
Q28
CR17
Q29
R99
Q17
CR18
R68
CR6
CR7
CR8
R104
CR21
R67
CR3
CR4
CR5
Q18
Q19
R69
C20
R93
C19
CR1
R62
R61
C18
R90
C17
R58
R57
R56
C16
C15
R55
R54
C14
R52
R50
C13
TP1
J4
J5
R92
Q16
R63
R60
Q24
TP5
Q15
R84
R83
R88
R87
CR19
CR9
Q27
CR11
Q25
R71
R75
R76
R78
C25
CR10
R91
R86
CR12
C26
R70
Q20
R73
R72
VR1
C27
L2
Q23
R79
R81
CR13
Q26
R53
Q22
R80
Q21
R74
R77
R85
TP4
C28
R82
Q14
Q13
E1
R51
U1
C9
C7
R28
E2
C6
R27
R17
R22
R24
R29
Q1
C8
J2
R6
C1
R7
R25
R26
R8
R21
L1
C5
R9
R12
C3
Q4
R19
TP11
Q3
R13
R23
R15
Q2
R18
R10
C4
Z1
R4
R11
J1
R2
R1
R3
C2
R14
R16
Q5
R20
R33
R32
Q8
R37
R48
Q11
R35
R38
R39
Q9
Q7
Q6
C11
R36
R34
R43
R42
R31
R45
R47
R44
R49
Q12
J3
C10
Q10
R41
C12
TP3
R46

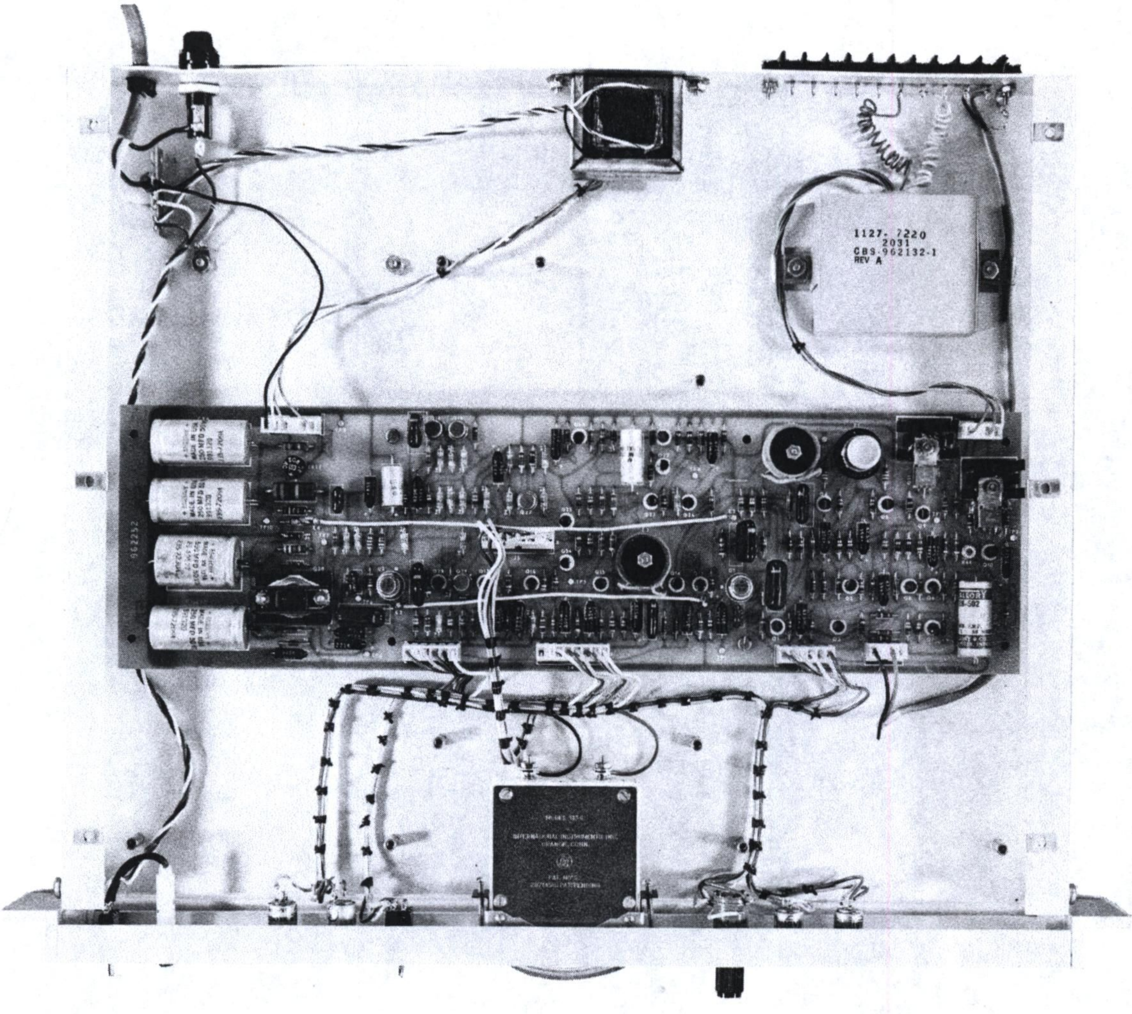


Figure 5-1. Dynamic Presence Equalizer with Top Cover Removed

SECTION V

MAINTENANCE

5-1. ALIGNMENT PROCEDURE

A. Adjustment of Balance Control

Distortion in the Dynamic Presence Equalizer is properly minimized by the correct adjustment of the balance control R44 on the circuit board (figure 5-1). The balance adjustment seldom requires attention, but if either output transistor Q10 or Q11 is replaced, this control should be reset by the following procedure.

CAUTION

Be sure the test oscillator has a distortion figure of less than 0.1% so that the oscillator signals will not influence the result.

Place the METER switch in the SETUP position and apply a 50-Hz sine wave tone to the Dynamic Presence Equalizer. Use sufficient amplitude to deflect the Dynamic Presence Equalizer meter to half-scale. Monitor the output with a distortion analyzer, and adjust the balance control R44 for minimum distortion. This should be less than 0.5%.

B. Adjustment of THRESHOLD Control

The threshold setting can be monitored at the threshold bias test point TP5 on the circuit board.

(1) Apply a sine wave to the Dynamic Presence Equalizer at the calibration level described in paragraph 3-2 or paragraph 3-3.

(2) Place the mode switch in the SPEECH position.

(3) Monitor TP5 with either a voltmeter or an oscilloscope. The factory-setting amplitude of the signal at this test point is 3.5 volts.

5-2. TROUBLESHOOTING SUGGESTIONS

A. Power Supply Checks

Troubleshooting of any apparent malfunction of the Dynamic Presence Equalizer should begin with a check of the Power supply. The measured dc voltages indicated should fall within five percent of those indicated at the test points on the schematic diagram, figure 4-5. Ripple measurements should be less than 10 mv peak-to-peak. In the event of excessive 120-Hz hum, check for open filter capacitors in the power supply. If the power supply board is functioning correctly, proceed with the following checks.

B. Input Section

The input section has approximately unity gain. A 1-kHz input signal at 0 dBm should result in a 0-dBm level at the output with R1 completely clockwise. Check this at test point TP1. If this result is not obtained, the operational amplifier U1 may be at fault or one of the input transistors. Check the emitter followers with an oscilloscope by observing the signals at their emitters; these signals should be equal but of opposite phase.

C. Output Section

If the input section is functioning normally but no output appears, the output section is at fault. Check the operation of the differential amplifier Q6-8 by examining the drive voltages at test points TP2 and TP3. When the OUTPUT control is fully clockwise, the level at each test point should be -5 dBm and the signals should be out of phase with each other. If the correct signals are present here, the fault lies in the output stage -- probably one of the transistors Q9-12.

D. Control Section

To test the control section, place the METER switch in the SETUP position and apply a 1-kHz input signal of sufficient amplitude to cause a mid-scale reading on the meter. (This meter gives signal-strength rather than control-voltage indications when the METER switch is placed in the SETUP position.) Then place the mode switch in the ALL position and return the METER switch to NORMAL. (Meter now indicates control voltage.) Adjust the SENS control to obtain a mid-scale meter reading. Raise the input signal frequency and observe that the control voltage drops to zero at about 1, 300 Hz.

If these tests indicate that something is wrong, check the voltage at the emitter of Q17. This is the output of the presence extraction circuitry. With the above input of 1 kHz, the Q17 emitter potential should be approximately +5 volts. If not, a malfunction exists in the Q13-17 amplifier chain.

If Q16 checks out correctly, check the control voltage test point TP6 for a reading of approximately +10 volts. Raise the input signal frequency from 1 kHz to 3 kHz and observe that this voltage drops to approximately -14 volts.

If this does not occur, check U2 and/or the program rectifier circuitry C29, CR15, CR16, C30. If these tests are satisfactory, the emitter follower Q28, 29 is probably at fault.

E. Speech-Music Discriminator Section

The speech-music discriminator can be similarly checked. Use the same test signal setup as outlined for the control section, subparagraph D above. With a 1 kHz sine-wave signal applied and the mode switch set at ALL, adjust the SENS control for a mid-scale meter reading. Place the mode switch in the SPEECH position and place the METER switch momentarily in the SETUP position. Then return the mode switch to NORMAL. The control voltage should drop to zero in approximately 5 seconds.

Monitoring of the speech-music discriminator section is performed most effectively with program material. Set up the Dynamic Presence Equalizer as explained in paragraph 3-2 or 3-3 and apply speech programming to the unit. Monitor test point TP4 with an oscilloscope or VTVM. The test-point reading should be approximately +6-8 volts. Then apply smooth musical programming; the voltage should drop to less than 1 volt. If this happens, the speech-music discriminator is working correctly and the threshold can be set as outlined in paragraph 5-1B. If not, the circuit should be checked by the signal-trace process as follows.

With speech program input, as outlined immediately above, check the waveform at the emitter of Q19. This waveform should appear as a heavily limited wave at an amplitude of approximately 4 volts p-p. Next check the signal at the base of Q20. This should be a varying positive dc voltage of approximately 2 volts peak amplitude. Next, check the signal at the emitter of Q21. This should be an amplified and inverted version of the signal monitored at the base of Q20. The signal at the emitter of Q21 should vary from +10 volts at speech pauses to +1 volt at speech peaks.

The next two transistors (Q22, 23) form a Schmitt trigger circuit which is set to operate at approximately +7 volts. The output, at the collector of Q23, should be a series of positive-going pulses of 10 volts amplitude. Since these pulses are integrated in the next stage, the dc voltage at test point 4 should be a positive-going dc voltage indicative of the "speechiness" of the program material.

SECTION VI

PARTS LIST

6-1. GENERAL

This section contains parts lists for the complete Dynamic Presence Equalizer. Each list gives the circuit designation of the part, an electrical description, a reference to the manufacturer where applicable, and the manufacturer's part number. In all cases, we recommend the use of original manufacturer's parts for any necessary replacements. If the part cannot be obtained directly, contact the Professional Products Department at CBS Laboratories to obtain it.

6-2. RESISTORS

Unless otherwise indicated in the parts list, all resistors used in the image Enhancer are carbon composition, 1/4 watt, plus or minus 5%.

6-3. TRANSISTORS AND DIODES

When replacing transistors and diodes called out in the parts list with 1N and 2N standard numbers, replace them with the manufacturing brand of transistor or diode as removed, when possible. If the parts list indicates a specific manufacturer and part number, that part should only be replaced by the component thus indicated.

6-4. MANUFACTURERS' NAME ABBREVIATIONS

AO	-	Allen Organ Co.
AB	-	Allen Brady
ALCO	-	Alco Electronic Products, Inc.
AU	-	Augat
CBS	-	CBS Laboratories
CFM	-	Cinch Manufacturing
EL	-	Elmenco
HHS	-	H. H. Smith
IND	-	Industiral Devices
LF	-	Littlefuse
MA	-	Mallory
MO	-	Motorola
MOL	-	Molex
RCL	-	RCL Electronics
VAC	-	Vactec

6-5. MAIN ASSEMBLY (DPE 4500)

Ref	Description	Mfr	Part No.
	Inseparable chassis assembly	CBS	962156
	Printed circuit board (see para. 6-6)	CBS	962253
	Nameplate	CBS	962199-6
	Wiring harness, Branched A	CBS	962255-1
	Wiring harness, Branched B	CBS	962255-2
	Wiring harness, Branched C	CBS	962255-3
	Accessory kit and assembly	CBS	962163-3
DS1	Lamp, red	IND	2150A1
F1	Fuse, 0.25 amp	LF	312.250
J3	Connector, 4 pin	MOL	2139-4
J7	Connector, 6 pin	MOL	2139-6
M1	Meter	CBS	962260
R3, R30	Variable resistor, 5 kilohms	AB	WA4N020S502AA
R59,R89	Variable resistor, 1 kilohm	AB	WA4N020S102UA
S1, S2	Switch, SPDT	ALCO	MST-105D
S3	Switch, DPTP	RCL	12CCB-3
TB1	Terminal block, Y type	CFM	353-18-10-001
TB2, TB3	Terminal strip, 4 PT	HHS	850
T1	Power transformer	CBS	
T2	Audio transformer	CBS	962132-1
XF1	Fuse holder	LF	342012

6-6. PRINTED CIRCUIT BOARD ASSEMBLY

Ref	Description	Mfr	Part No.
	RESISTORS		
R1, R66	620 ohms		
R2, R5	2.4 kilohms		
R4	10 ohms		
R6, R7, R10, R14 thru R18, R31, R32, R35, R50, R72, R95, R104	10 kilohms		
R8, R11, R55	1.5 kilohms		
R9, R12	560 ohms		
R13, R58, R65, R71, R94	2 kilohms		
R19, R20	390 kilohms		
R21, R36	1.2 kilohms		
R22, R23, R26 R27, R64, R68 R96	100 kilohms		
R24, R25	15 kilohms		
R28, R101	9.1 ohms		
R29	6.2 kilohms		
R33, R37, R77, R86, R93	3 kilohms		
R34, R38	200 ohms		
R39, R41, R63 R92	3.9 kilohms		
R40	Not used.		
R42, R46, R56, R57, R81	30 kilohms		
R43, R45	9.1 kilohms		

6-6. PRINTED CIRCUIT BOARD ASSEMBLY (Cont)

Ref	Description	Mfr	Part No.
	RESISTORS (cont)		
R44	Variable to 2 kilohms	CBS	991314
R47	15 ohms		
R48, R49	33 ohms		
R51	51 kilohms		
R52, R91	470 ohms		
R53	2.7 kilohms		
R54, R69	680 ohms		
R60	150 kilohms		
R61	18 kilohms		
R62	240 ohms		
R67, R73, R80	1 kilohm		
R70	6.8 kilohms		
R74, R85	2.2 kilohms		
R75, R83	20 kilohms		
R76, R84	7.5 kilohms		
R78, R87	910 ohms		
R79, R88	1.8 kilohms		
R82	1 megohm		
R90	300 ohms		
R97	43 kilohms		
R98, R100	39 kilohms		
R99	5.1 kilohms		
R102	12 kilohms		
R103	270 kilohms		
R105, R94	Not used		
R106	68 ohms, 1/2 w		

6-6. PRINTED CIRCUIT BOARD ASSEMBLY (Cont)

Ref	Description	Mfr	Part No.
	RESISTORS (cont)		
R107	Not used		
R108	Not used		
R109	120 ohms, 1/2 w		
R110	680 ohms, 1/2 w		
	CAPACITORS		
C1 thru C4, C11, C12, C14, C16, C17, C18, C20, C21, C25, C28, C30	4.7 μf, 35v	MA	TAC475MO35P04
C5, C15	0.039 μf	EL	IMDF-2-393J
C6	27 pf	EL	DM10C270J0500-WV4CR
C7, C31	0.082 μf	EL	IMDF-3-823J
C8, C32	0.1 μf	EL	IDP-2-104J
C9, C33	12 pf	EL	DM10C120J0500-WV4CR
C10	2 μf, 50v, non-polar	MA	TCN 502
C13, C23, C39	8.2 μf, 35v	MA	TAC825K035P04
C19, C26, C29	2.2 μf, 50v	MA	TAC225M050P04
C22	0.001 μf	EL	DM15C102J0100-WV4CR
C24	0.025 μf	EL	1DP-1-253J
C27	100 μf, 25v	MA	TT25X100A
C34	25 μf, 25v	MA	TT25X25A
C35	500 μf, 50v	MA	TCW501N050-LIF3I
C36, C38	250 μf, 50v	MA	TCW250N050P1J
C37	Not used		

6-6. PRINTED CIRCUIT BOARD ASSEMBLY (Cont)

Ref	Description	Mfr	Part No.
	SEMICONDUCTORS		
CR1 thru CR21	Diodes		1N456A
CR22	Full-wave bridge	VA	VE18
Q1 thru Q10, Q13 thru Q17, Q20, Q21, Q28	Transistor		2N3393
Q18, Q19, Q27, Q29	Transistor		2N697
Q11, Q12	Transistor		
Q22, Q24	Transistor		2N3904
Q23, Q25	Transistor		2N3906
Q26	Transistor		2N5308
VR1	Diode, zener		1N4740A
VR2	Regulator, voltage	CBS	991609
VR3, VR4	Diode, zener		1N4744A
	MISCELLANEOUS		
J1, J3	Wafer, pin (4 pin)	MOL	A-2183-4A
J2, J6, J7	Wafer, pin (6 pin)	MOL	A-2183-6A
J4, J5	Wafer, pin (8 pin)	MOL	A-2183-8A
L1, L2	Coil, Toroidal, 50 mhy (no center tap)	CBS	990554
U1, U2	Integrated circuit	MO	MC1433G
XU1, XU2	Socket, integrated circuit (10 pin)	AU	805B-24G1R
XZ1	Socket, miniature	CBS	991107
Z1	Control element	VAC	VTL7A1