INSTRUCTION MANUAL

MODEL 241

"DYNEX" NOISE SUPPRESSOR

JULY 1976

This was our address in 1976. In 1985 we moved to:
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I. GENERAL INFORMATION

The Inovonics DYNEX is a program-controlled filter/expander offering a simple yet effective means of suppressing a certain amount of the residual background noise present in most audio transmission and recording/reproducing systems.

DYNEX is a single-ended device, rather than a full complementary compression/expansion Noise Reduction System, but should not be confused with a simple noise "gate," or program-actuated switch. In its operation, DYNEX first introduces a fixed amount of either frequency-selective or broadband signal loss, and then linearly re-expands program gain to a flat, unity value when energy in the suppressed band exceeds a selected threshold value.

DYNEX uses include:

Reduction of surface noise or rumble in disc playback equipment.

Suppression of magnetic asperity noise (tape hiss) in tape or film reproducing systems.

Quieting of optical film sound channels.

Improving S/N in interface between low grade telephone line and broadcast facilities.

Among the features of DYNEX are:

Choice of operating modes for selective suppression of low frequency, mechanical noises, higher order system noise, or a combination of both, and restoration of program dynamic range by linear broadband expansion.

Variable Threshold adjustment to permit optimum selection of the point of which re-expansion begins.

Visual indication of Threshold coincidence and full expansion.

Availability in a variety of versions for professional or semi-pro requirements.

DYNEX SPECIFICATIONS

Frequency Response: ±0.5dB, 20Hz - 20kHz

Output Noise Level: below -85dBm

Distortion: below 0.1% THD up to +10dBm output
below 0.3% THD up to +23dBm output
(Clipping level above +24dBm)

Noise Suppression Characteristics:

RUMBLE: Choice of two LF rolloff curves (Fig. 1-1; A & B) with restoration to flat response when low frequency energy exceeds preset Threshold.

HISS: Choice of two HF "shelving" curves (Fig. 1-1; C & D) with restoration to flat response when high frequency energy exceeds preset Threshold.

WIDEBAND NOISE: LF + HF rolloff characteristic (Fig. 1-1; E) with restoration to flat response when energy in suppressed band exceeds preset Threshold.

LINEAR EXPAND: 10dB of broadband program attenuation with linear re-expansion to unity gain beginning at Threshold (Fig. 1-2).

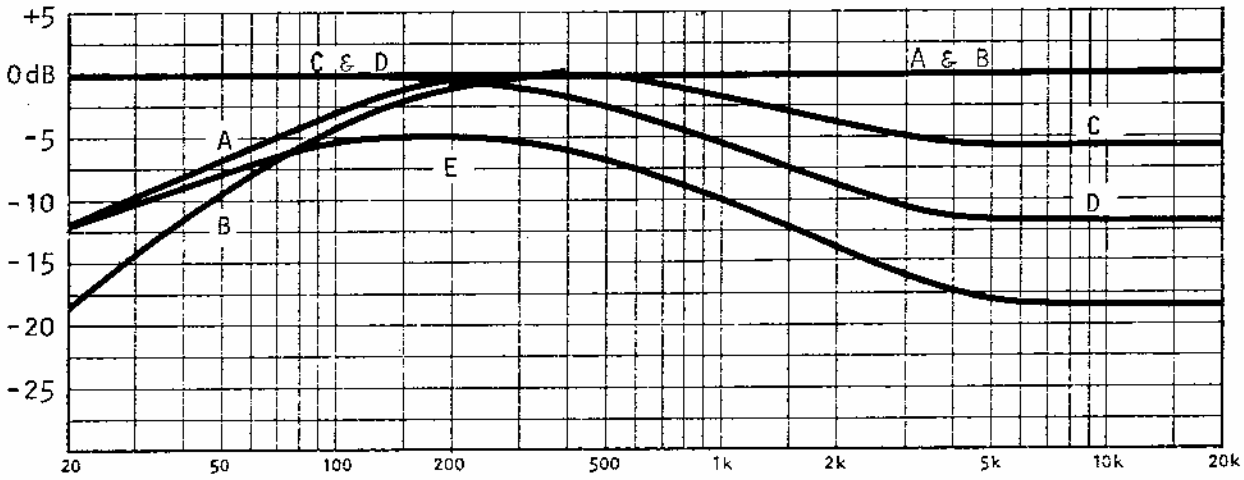


Fig. 1-1

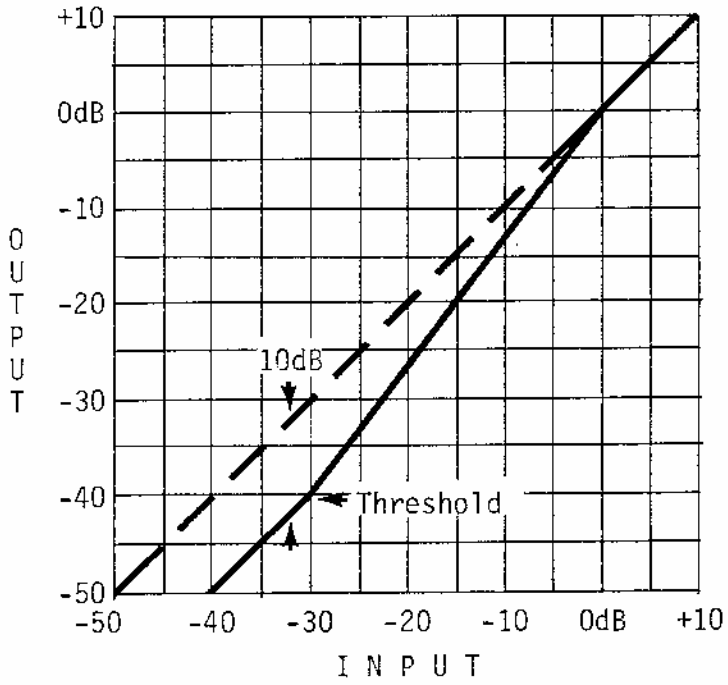


Fig. 1-2

Input: 100K unbalanced (transformer optional) for nominal studio line levels of +4 or +8dBm. -03 version accepts unbalanced inputs between -10 and 0dBm.

Output: Feeds 600 ohm lines or bridging inputs at nominal line levels. Clipping level in excess of +24dBm.

Power Requirement: 105 - 130VAC (230V available), 50/60Hz; 0.1A.

Size and Weight: 1-7/8" X 8-1/2" X 6-1/2"; 4 lbs.

II. INSTALLATION

Upon receipt of the equipment, inspect at once for shipping damage. Should any such damage be observed, notify the carrier immediately; if not, proceed as outlined below. It is suggested that the original shipping carton and materials be retained should future re-shipment become necessary.

Mounting

The Inovonics DYNEX is in a compact "half-rack" package. Optional mounting hardware permits either a single unit or a pair of units to be mounted in a standard 19-inch equipment rack. Alternately, the DYNEX can be custom-fitted by the user to a particular mounting situation.

In/Out Connection

-00, -01 and -02 option units have a screw-terminal barrier strip for input and output connection. The "semi-pro" -03 version is outfitted with RCA-type "phono" connectors for lower level, unbalanced lines.

Line Considerations

-00, -01 and -02 units are meant to interface with nominal studio line levels of +4 or +8dBm. No output line termination is necessary, as the low source impedance of the unit obviates any shift in characteristics, whether or not the output is terminated in 600 ohms. Should the equipment which feeds the DYNEX require output loading, an external 600 ohm resistor should be connected across the input terminals; otherwise the input is "bridging".

The "semi-pro" -03 version DYNEX is designed to interface with line levels of -10 to 0dBm (unbalanced) as commonly encountered in less professional or consumer grade equipment.

III. OPERATION AND FUNCTIONAL DESCRIPTION

Everyday use of the DYNEX is meant to be a simple, straightforward operation, and all panel controls are marked with least confusing, best descriptions of their functions. As unnecessary as it thus may seem to give detailed operating instructions, a basic understanding of audio noise and methods for its reduction is important, as is awareness of the various limitations of the DYNEX and similar noise-suppressing devices.

Noise Reduction Systems

Background noise in audio reproducing systems has always been a source of annoyance to all but casual listeners. Over the years, advances in the art have improved the signal-to-noise ratio of the various transmission or recording methods, generally as the second-order effect of a change in materials and procedures. Contributions have been either dramatic, as in the changeover from shellac to vinyl pressings, or less evident on the listener level, as in improvement in magnetic oxide formulations.

With appreciable improvements in other aspects of audio reproduction quality, noise has remained a single, seemingly increasing irritation. Recently, therefore, special steps have been taken in a specific attempt to substantially reduce residual noise.

Noise Reduction Systems which employ complementary dynamic range compression and re-expansion have been utilized in telephone and other communications equipment for several decades. This same technique has only recently been applied to high quality audio reproduction, however, most notably the Dolby and dbx Noise Reduction Systems. These systems are very effective in improving S/N, as the audio signal is "encoded" prior to introduction of the major noise component, and "decoded" to recover the audio less noise.

In those numerous cases when a complementary system is not employed or when noise is subsequently introduced, that class of device generally referred to as a "Program-Controlled Filter" or "Single-Ended Noise Reducer" can be used to suppress some of the residual noise with negligible effect on the legitimate program material. Again, the concept is not a new one. Devices of this type enjoyed a brief popularity during the late Forties and early Fifties when consumer audio system technology fell out of step with that which was embodied in professional gear.

For effectiveness in operation, "Single-Ended" devices depend to a large degree upon the steady-state nature of residual noise; for as

program material is made up of harmonically-related components with similarly varying dynamics, the greatest distraction and annoyance comes from the omnipresent residual elements which are related to the program neither in harmonic nor dynamic qualities.

DYNEX Operation

Since noise is fairly well masked by higher energy program material, it is possible to suppress that noise to some degree by reducing system gain at low program levels, either on a broadband basis or in those portions of the spectrum which contain insignificant program energy, and then restoring gain to full value or flat response when program amplitude increases sufficiently to mask noise. It is by this mechanism that the DYNEX and similar devices operate.

Rumble Suppression

Figs. 3-1 and 3-2 graph the two DYNEX low frequency suppression/restoration characteristics. These are effective in reducing AC line hum, turntable rumble, studio air conditioner noises and other low pitch, mechanically-generated disturbances. Restoration to flat response occurrs only when low frequency program energy increases sufficiently above the noise level to provide masking. The THRESHOLD control facilitates setting the unit's restoration sensitivity to discriminate between residual noise and legitimate program.

Since the ear is not particularly pitch-discriminating in the low frequency range, noise in this part of the spectrum is easily masked by even a small amount of legitimate low frequency program component. The re-expansion ratio in the Rumble Suppression modes can thus afford to be quite steep, restoring response fully to flat once Threshold has been exceeded.

Hiss Suppression

Two Hiss Suppression characteristics are provided, and are graphed in Figs. 3-3 and 3-4. This mode is particularly effective in reducing the apparent level of tape hiss, record surface effects, optical sound track noise and higher-order electronic annoyances. As in the case of Rumble Suppression, the two Hiss Suppression modes reduce gain at higher frequencies, and re-expand to flat response when high frequency program energy is present in sufficient magnitude to mask noise.

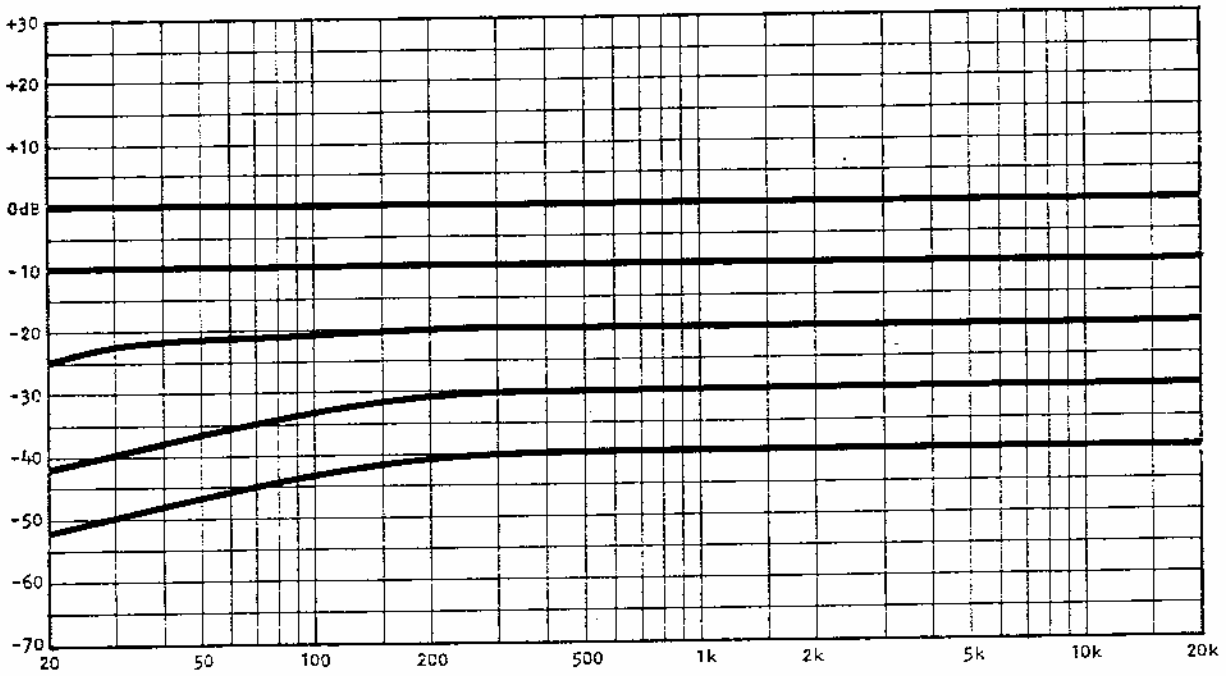


Fig. 3-1, RUMBLE - 12dB

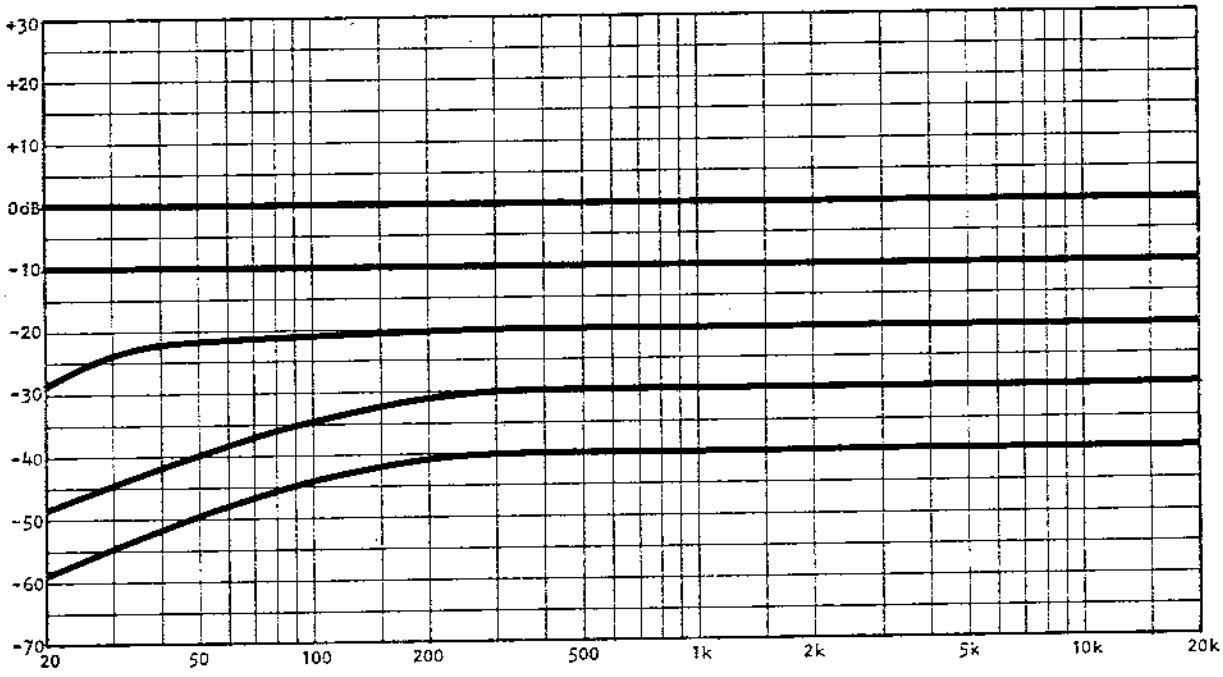


Fig. 3-2, RUMBLE - 18dB

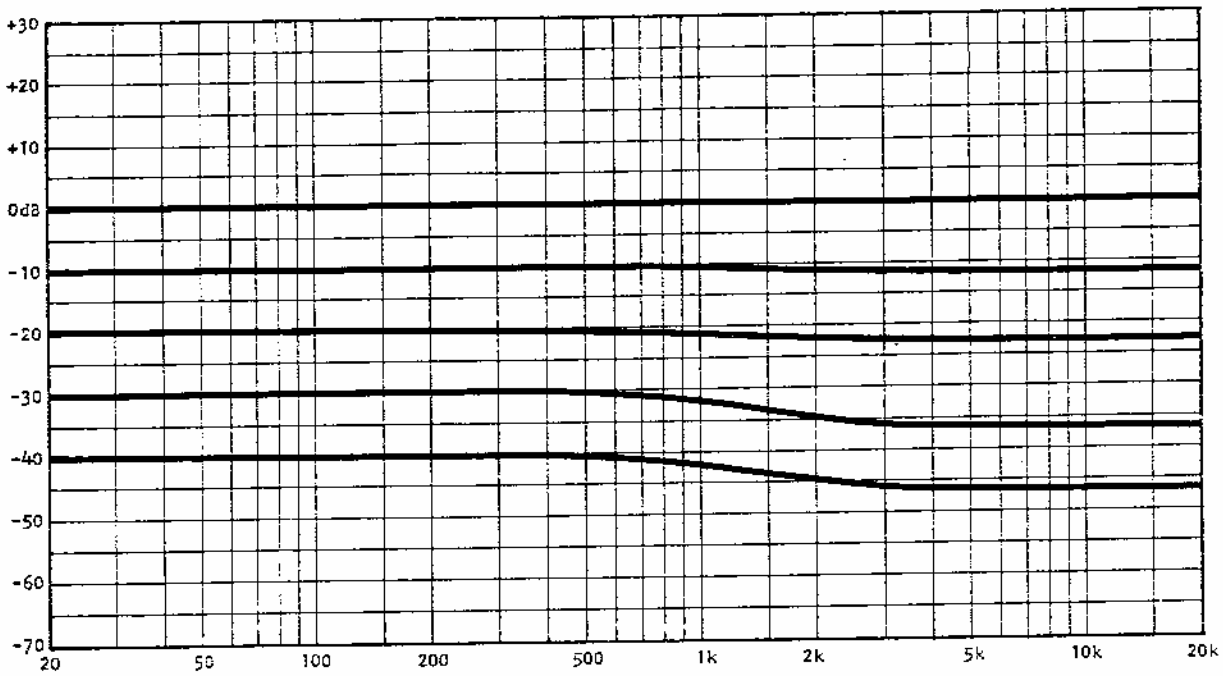


Fig. 3-3, HISS - 6dB

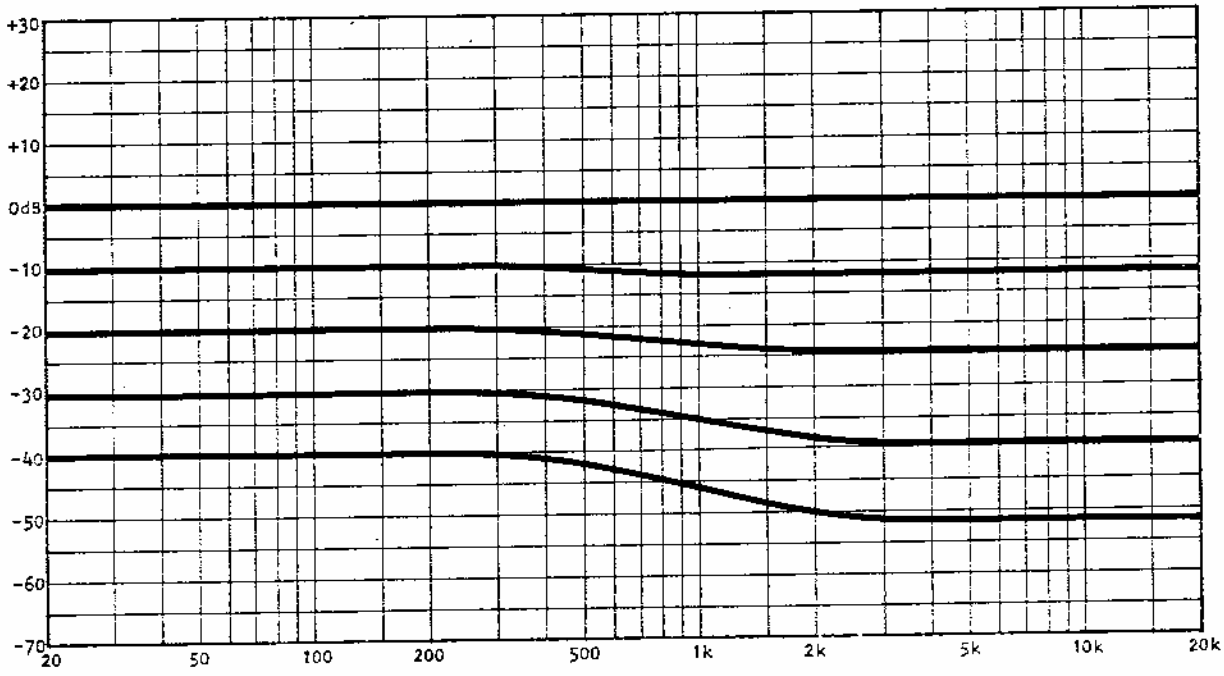


Fig. 3-4, HISS - 12dB

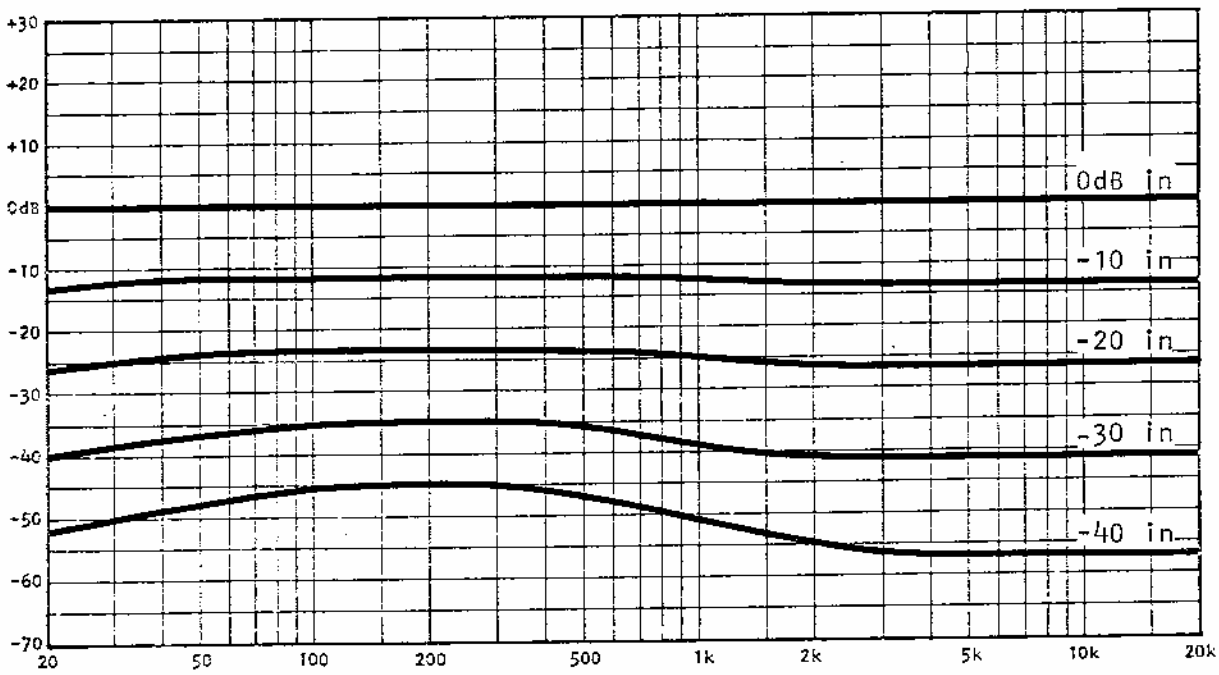


Fig. 3-5, WIDEBAND NOISE

Since an additional degree of high frequency program energy is required to mask hiss than low frequency energy to mask rumble, the re-expansion ratio for the HISS - 12dB Suppression mode is a more gentle, linear function which restores response fully to flat only after high frequency energy is well above the Threshold value (Fig. 3-4).

Wideband Noise Suppression

This DYNEX mode, graphed in Fig. 3-5, is most effective in "problem" noise situations, such as noisy location-recording or broadcast environments, salvaging of early, noisy phonograph records and broadcast or recording of voice-channel telephone or shortwave radio communications links. As shown in Fig. 3-5, this mode employs LF rolloff, HF reduction and broadband attenuation, with restoration of circuit gain to a flat, unity value beginning as energy in the suppressed area exceeds the Threshold level.

Broadband Expansion

In this fourth DYNEX operating mode, broadband gain is reduced by a fixed 10dB, and linearly re-expanded to unity beginning at the Threshold setting. Although the Broadband Expansion mode is useful in the suppression of many forms of noise, the primary utility of this mode is the restoration of dynamic range to previously compressed program material. The expansion curve is shown under DYNEX Specifications in Fig. 1-2.

Panel Indicators

A red LED indicator signals Threshold coincidence, visually indicating that the DYNEX is active in restoring gain to a unity, flat value. A green FULL EXPANSION indicator lights when gain is fully restored.

DYNEX Operation - SUGGESTED INITIAL CONTROL SETTINGS

Select either a frequency-selective suppression mode for specific noises, or the LINEAR EXPAND mode for restoration of program dynamics. Use only the degree of frequency-selective suppression necessary to reduce annoyance to a tolerable level.

Set the THRESHOLD control at a point which will cause the associated red LED to remain on fairly constantly when program material is present, but not advanced to the point that will cause the indicator to light solely on noise in the absence of legitimate program. The green LED indicates FULL EXPANSION, and may or may not flash on program peaks, depending on the dynamic range of the input program. The PRESET position of the THRESHOLD control is a generally acceptable Threshold setting for most operations.

IV. CIRCUIT DESCRIPTION

Referring to the DYNEX schematic, input signals are first fed to a unity-gain buffer amplifier, IC4. The low output impedance of IC4 drives the five low and high frequency pre-emphasis networks associated with the frequency-selective noise suppression modes. These networks comprise C1/R2, RUMBLE-12dB; C2/R3, RUMBLE-18dB; C3/R4, HISS-6dB; C4/R5, HISS-12dB; R6, 41, 42, 43/C5, 19, BROADBAND NOISE. Mode switch S1 selects the pre-emphasized output of these various networks, or, in the case of LINEAR EXPAND, a flat signal via R1.

The signal selected by S1 is fed to the variable gain stage consisting of IC2 and its associated components, including the two FET's, Q1 and 2. This circuit configuration, known as the Santana Circuit, utilizes FET Q1 as an active variable resistor across the inverting input of operational amplifier IC2. A similar "dummy" FET, Q2, across the non-inverting amplifier input, serves to cancel the channel non-linearities of Q1 and permit gain control at audio signal levels which would ordinarily be above the normal, low distortion working range of the FET's.

IC3 is a summing and output amplifier stage. The associated transistors, Q4 and 5, are current gain stages to provide adequate output for low impedance loads and long cables. These stages are protected from output short-circuits by diodes CR5 and 6.

In its function as a summing amplifier, IC3 receives signals both from the variable gain stage, through R23, and directly from the input buffer amplifier, through R24. With the variable gain stage, IC2, at maximum attenuation, the DYNEX is a flat, unity-gain amplifier with the ouput signal identical to what is being fed to the input. With IC2 at minimum attenuation (unity-gain, inverting), the pre-emphasized or flat signal selected by S1 is fed out-of-phase with the buffered input signal to IC3, and the DYNEX output assumes a low and/or high frequency rolloff, or broadband attenuated characteristic. It is thus between these two extremes, or within the active operating region of IC2, that the DYNEX functions to reduce residual noise.

As described in Section III, one of two expansion ratios is selected to restore flat, unity gain, depending on the suppression mode selected. These characteristics are generated by sampling either the input or the output signal of the variable gain stage to derive the DC control voltage to reduce the gain of that stage. When the output signal is sampled, as is the case of the LINEAR EXPAND and HISS-12dB or WIDEBAND NOISE modes, re-expansion is a gentle, linear function. Other modes derive control by sampling the input signal, generating a steeper curve. The optimum re-expansion ratio is determined when the suppression mode is selected.

The selected signal is fed through the front panel THRESHOLD control, R44 to amplifier IC1. Transistor Q3 yields a differential output to permit full wave rectification by diodes CR2 and 3. The cathodes of these two diodes are set to the Q1 pinchoff voltage by R17, and rectified control voltage drives this point positive to reduce gain of IC2. R21 and C6 filter the rectified control signal, with R22 also selectively switched in to extend the time constant in the RUMBLE modes.

IC5, a dual op-amp, is connected as a differential comparator, sampling the DC control signal and illuminating either the THRESHOLD (coincidence) for FULL EXPANSION panel indicators as required.

The 18-volt bipolar power supply comprises rectifier diodes CR8-11, filter capacitors C15 and 16, and regulator IC's 6 and 7.

V. ALIGNMENT AND CALIBRATION

Equipment Required

VOLT-OHMMETER
AUDIO OSCILLATOR - H.P. 200 CD or equiv.
AC VOLTMETER - H.P. 400 E or equiv.

Procedure

NOTE: All alignment steps are done in the LINEAR EXPAND mode, and with the DYNEX "IN".

A. Power Supply Check

Apply primary power to the DYNEX and check that both supplies are within 1 volt of 18 volts. Pins 7 and 4 of any type 748 IC are convenient monitor points.

B. Variable Gain Stage Balance

1. Ground the gate of Q1 with a clip lead to chassis. The bare jumper wire marked TEST, and located behind the Threshold control is a convenient connection to Q1's gate.

2. Apply a nominal line level signal of 500Hz to the DYNEX input and monitor the output of IC2 with the AC voltmeter. A convenient monitor point is the end of R23 nearest IC2.

3. Adjust R8 for minimum reading (null).

4. Remove the ground lead.

C. FET Pinchoff Adjustment

1. Rotate the THRESHOLD control fully counterclockwise, but not into its PRESET position.

2. Apply a 500Hz signal to the DYNEX input at a level roughly 30dB below nominal line level, and monitor the unit's output with the AC voltmeter.

3. Rotate R17 slowly clockwise from full CCW, setting it for a 1/4dB output increase from minimum.

D. Indicator Calibration

1. Apply a 500Hz signal to the DYNEX input at a level approximately 30dB below nominal line level. Monitor the unit's output with the AC voltmeter.

2. Advance the front panel THRESHOLD control slowly clockwise from the full CCW position. At some point the DYNEX output will begin to increase. Adjust the THRESHOLD control for an increase of 1dB. At this THRESHOLD setting, adjust R33 so that the red LED just comes on. Make sure that when the THRESHOLD control is rotated counterclockwise the LED turns off and the monitored output drops by 1dB.

3. Increase the oscillator amplitude to nominal line level.

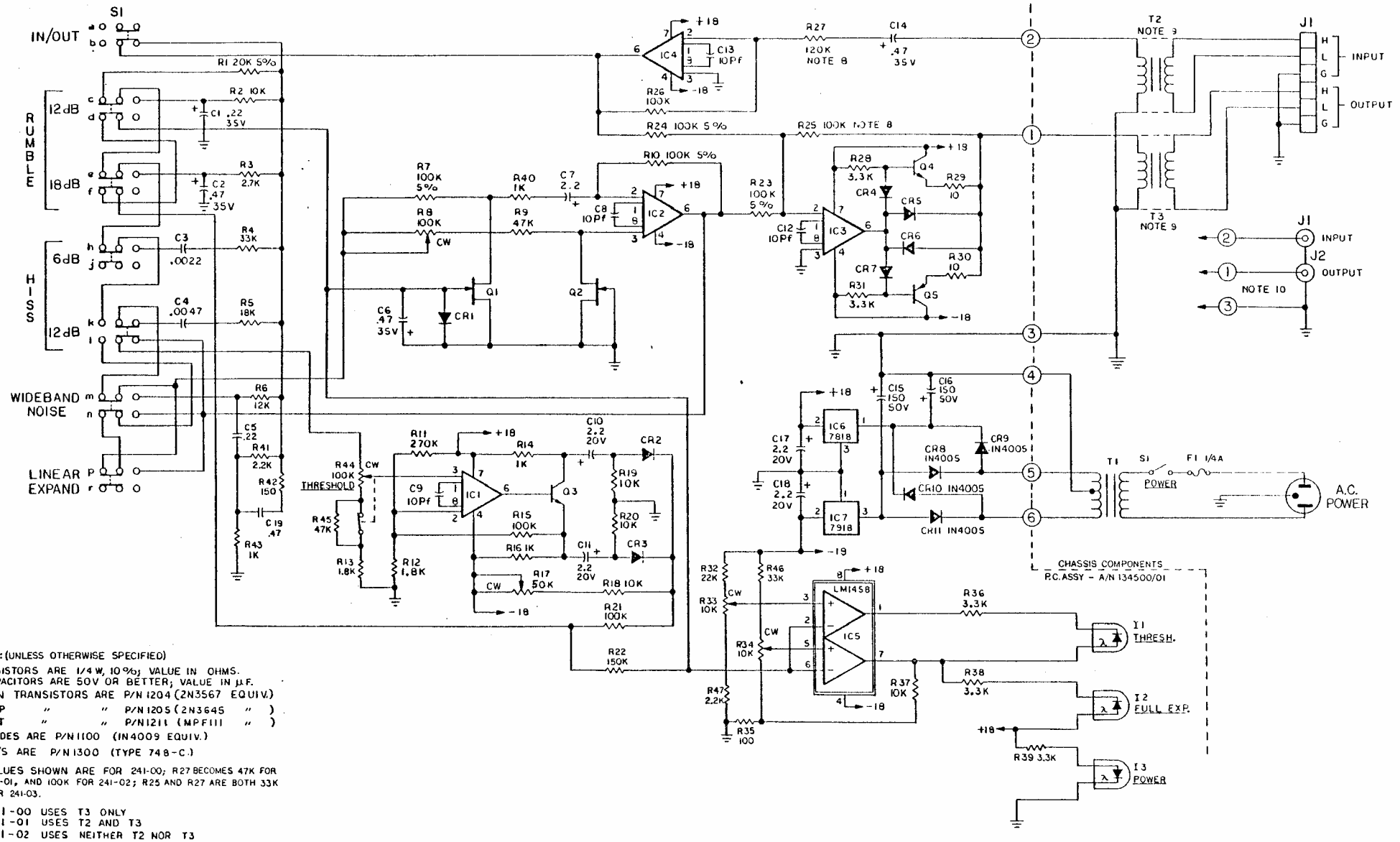
4. Rotate the THRESHOLD control fully clockwise and note the monitored output reading; then slowly turn the control counterclockwise until the signal drops 1dB from the maximum value. At this point adjust R34 so that the green LED just comes on. Check that the green indicator turns off as the THRESHOLD control is rotated further counterclockwise and the monitored signal level drops.

This Completes Calibration.

SCHEMATIC REF. NO.	PART NUMBER	DESCRIPTION	MFG.	MANUFACTURER PART NUMBER
		CIRCUIT BOARD COMPONENTS		
C1, 5	1065	CAPACITOR, .22uF, 35V	Matsuo	DTSA-3502-224M
C2, 6, 14, 19	1066	" .47uF "	Matsuo	DTSA-3502-474M
C3	0854	" .0022uF, 100V	Sprague	225P 22291
C4	0858	" .0047uF "	Sprague	225P 47291
C7,10,11,17,18	1053	" 2.2uF, 20V	Matsuo	DTSA-2002-225M
C8, 9, 12, 13	0801	" 10pF	Arco	DM15-100J
C15, 16	0918	" 150uF, 50V	Sprague	TVA 1311
CR1-7	1100	DIODE, 1N4009	Fairchild	
CR8-11	1125	" 1N4005	Fairchild	
I1	2014	LED INDICATOR, Red	Litronix	RL 4850
I2	2015	" " Green	Monsanto	MV 5253
I3	2013	" " Yellow	Litronix	YL 4850

SCHEMATIC REF. NO.	PART NUMBER	DESCRIPTION	MFG.	MANUFACTURER PART NUMBER
IC1-4	1300	INTEGRATED CIRCUIT, type 748-C	Signetics	N5748V
IC5	1310	" " " 1458	National	LM1458
IC6	1311	" " " 7818-C	National	LM7818C
IC7	1312	" " " 7918-C	National	LM7918C
Q1, 2	1211	TRANSISTOR, MPF 111	National	
Q3, 4	1204	" 2N 3567	"	
Q5	1205	" 2N 3645	"	
R8	0563	RESISTOR, 100K Variable	Beckman	91AR100K
R17	0562	" 50K "	"	91AR20K
R33, 34	0559	" 10K "	"	91AR10K
R44	0614	" 100K " with switch	Allen Bradley	70K4N040S104U
		All fixed resistors are 1/4w carbon, value and tolerance per schematic.		
S1	1824	SWITCH, 7-Station Pushbutton		

SCHEMATIC REF. NO.	PART NUMBER	DESCRIPTION	MFG.	MANUFACTURER PART NUMBER
		CHASSIS COMPONENTS		
F1	2701	FUSE, 1/4 A	Littlefuse	3AG
S1	1804	SWITCH, SPST Min. Toggle	C & K	7101
T1	135800	TRANSFORMER, Power	Inovonics	
T2	1502	" Input (optional)	Microtran	MT 11A
T3	109000	" Output	Inovonics	
	1503	Shield for T2	Microtran	M-90



NOTES: (UNLESS OTHERWISE SPECIFIED)

1. RESISTORS ARE 1/4 W, 10%; VALUE IN OHMS.
2. CAPACITORS ARE 50V OR BETTER; VALUE IN µF.
3. NPN TRANSISTORS ARE P/N 1204 (2N3567 EQUIV.)
4. PNP " " P/N 1205 (2N3645 ")
5. FET " " P/N 1211 (MPF111 ")
6. DIODES ARE P/N 1100 (IN4009 EQUIV.)
7. IC'S ARE P/N 1300 (TYPE 748-C.)
8. VALUES SHOWN ARE FOR 241-00; R27 BECOMES 47K FOR 241-01, AND 100K FOR 241-02; R25 AND R27 ARE BOTH 33K FOR 241-03.
9. 241-00 USES T3 ONLY
   241-01 USES T2 AND T3
   241-02 USES NEITHER T2 NOR T3
10. 241-03 EMPLOYS ALTERNATE IN/OUT CONNECTIONS.

241	AZTEC 6-9-76 JBW 6-10-76	SCHEMATIC, MODEL 241 - "DYNEX"
		135600 D

INOVONICS WARRANTY

Inovonics, Inc. products are warranted to be free from defects in material and workmanship. Any discrepancies noted within 90 days of the date of purchase will be repaired free of charge. Additionally, parts for repairs required between 90 days and one year from the date of purchase will be supplied free of charge, with installation billed at normal rates. It will be the responsibility of the purchaser to return equipment for warranty service to the dealer from whom it was originally purchased unless prior arrangement is made with the dealer to inspect or repair at the user's location.

This warranty is subject to the following conditions:

1. Warranty card supplied with the equipment must be completed and returned to the factory within 10 days of purchase.

2. Warranty is void if unauthorized attempts at repair or modification have been made, or if serial identification has been defaced, removed, or altered.

3. Warranty does not apply to damage caused by misuse, abuse, or accident.

4. Warranty valid only to original purchaser.

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