4 PERFORMANCE TESTS AND CALIBRATION

Performance tests are used to check the operation of the unit. Always execute the performance tests before proceeding to calibration.

4.1 Test Equipment Required

The following equipment is needed for performance tests and calibrations:

1. Variable ac voltage source with isolation transformer, voltmeter, and ammeter
2. Digital voltmeter (DVM)
3. Dual trace oscilloscope with >60-MHz bandwidth
4. Audio band low distortion sine wave generator with a 20-dBm maximum output
5. Harmonic distortion analyzer with level meter
6. Noise meter
7. High-quality music source
8. Lexicon-compatible footswitch and footpedal
9. Headphone amplifier and headphones
10. Cables and dip clips
11. Extender card (Lexicon no. 750-01850)
12. 1.15-ohm, 30-W resistor.

See Figs. 4.2 and 4.3 at the end of this section for interior views of the 224X mainframe.

4.2 System Tests

Diagnostics, nonvolatile storage, and listening tests. When the 224X is turned on or reset, it runs a series of diagnostic programs.

1. Make sure that the unit passes all power-up diagnostics. Repeat the diagnostics several times.
2. Store a control-head setting in a register, then leave the unit off for a while (>1 min). Turn on the unit and make sure that the setting is restored. Check to see that the contents of the register are unchanged by calling the register.
3. Using various signals from signal generators and music sources, listen carefully to all programs and variations. Make sure that there are no excess or unusual noises, birdies, or intermittents.
4. Make sure that moving or gently shaking the control head or mainframe does not affect its output.

Visual Inspection. Inspect the 224X and control head for obvious signs of physical damage. If possible, compare it with a unit operating properly. Remove the front panel of the unit and make the following checks:

1. The protective shield should be in place for the power switch and wiring.

2. The fuse ratings should be as follows:

Primary		
100/120 V	3 AG 3 A slow blow	
220/240 V	3 AG 1.5 A slow blow	
Secondary*		
F1, F2	±15 Vac	2 A slow blow
F3, F4	±12 Vac	3 A slow blow
F5	+10 Vac	2 A slow blow
F6, F7	±5 Vac	15 A slow blow
F8	-5 Vdc	2.5 A slow blow

*Schematic fuse no.

3. The ac voltage changeover switches should be set correctly (see Sec. 1 of Owner's Manual).
4. All jacks, pots, and switches should operate smoothly.
5. XLR connectors should be secure.
6. There should be no loose screws.
7. All ribbon cables and connectors should be secure.
8. All ICs should be securely in their sockets.
9. There should be no parts missing.

4.3 Power Supplies (PS1, PS2, and PS3)

The nominal and operating line voltages for the 224X are as follows:

Nominal (Vac)	Operating (Vac)
100	90-105
120	108-126
220	198-231
240	216-252

Measure all power supplies. Compare voltages to Table 4.1. All power supplies must provide the correct voltage; if they do not, repair and/or calibration is required.

Table 4.1. Test Point Locations for Power Supplies.

Number	Supply (Vdc)	Limits (Vdc)	Location description	Adjustment Location
1	+5	4.85 to 5.15	SBC module; U16, pin 16: left front-most IC; left front IC pin; verify left LED lit on NVS module	R7 on PS3
2	-5	-4.75 to 5.25	SBC module; J72 at the rear and right of U16**	*
3	+12	11.4 to 12.6	SBC module; R8 front lead; 2.7-Kohm, 1/4-W resistor, left of U15; verify center LED lit on NVS module	*
4	-12	-11.4 to 12.6	SBC module; R4 front lead; 270-ohm, 1/2-W resistor, right of U15	*
5	+15	14.75 to 15.25	AIN module; +15 = test point, ground to test point	R6 on PS2
6	-15	-14.75 to 15.25	AIN module; -15 = test point, ground to test point	R5 on PS2
7	+7	6.3 to 7.7	AIN module; +7 = test point, ground to test point	*
8	-7	-6.3 to 7.7	AIN module; -7 = test point, ground to test point	*
9	+7	6.3 to 7.7	AOUT module; +7 = test point, ground to test point	*
10	-7	-6.3 to 7.7	AOUT module; -7 = test point, ground to test point	*
11	10 Vac	8 to 14 Vac	Power molex connector on Transition module	*

*No adjustment.
** To access this test point, turn off the 224X and loosen the SBC module from its backplane connector, connect a test lead to the J72 test point, and then reinsert the SBC module into the backplane.

4.4 Analog Tests

Apply a 1-kHz, +12-dBm sine wave from the oscillator to both input channels. (This signal is used for standard input tests.) Run the zero-delay test program.

4.4.1 Input sensitivity

Adjust the signal generator output for +8 dBm. Advance input gain adjust pots R1 and R2 until the onset of clipping is reached (the gain pots should be close to their full clockwise rotation). Next, set the signal generator for +18 dBm and rotate the input gain pots counterclockwise (CCW) to just below the clipping level. This should be close to full CCW rotation. Design tolerances allow most machines to operate within a +7- to +22-dBm input range, even though the device is rated at +8 to +18 dBm. Adjust R1 and R2 so that the "0 dB" LED headroom indicator just goes off when the signal generator output is set at +12 dBm.

4.4.2 Output sensitivity

Check each channel for audio output. Make sure that each output can deliver +8- to +18-dBm output into a 600-ohm load by varying the output gain potentiometers; then set each output gain for an output level of +12 dBm.

4.4.3 Frequency response

Check frequency response for each output channel and compare with the frequency response curves in Fig. 4.1. Make sure that the frequency response is within system specification: ±1.5 dB from 20 Hz to 15 kHz; ±0.5 dB from 20 Hz to 12 kHz.

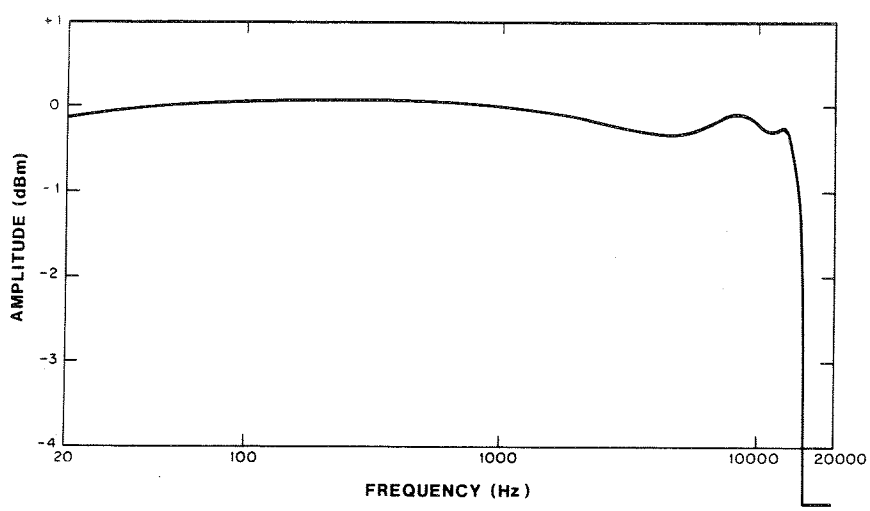

Fig. 4.1. Typical Overall System Frequency Response.

4.4.4 Total harmonic distortion (THD) and noise

THD and noise measured at 1 kHz and 10 kHz should be as follows:

Signal Level (dBm)	Frequency (kHz)	THD and Noise (%)
+12	1	<0.04
0	10	<0.50

4.4.5 Noise floor/signal-to-noise ratio

With 600-ohm loads connected to both inputs and outputs, the noise level at each output should be within the following limits:

	Wide Band (20 Hz to 20 kHz)	A-Weighted
Noise floor	<-68 dBm	<-80 dBm
Ratio relative to +12 dBm	>80 dB	>92 dB

4.4.6 Channel separation

On the left channel input, remove the signal source and connect a 600-ohm load. Apply the standard input test signal to the right channel input. Residual signal measured in output channels A and D should be 60 dB or more below +12 dBm (-48 dBm or below).

Next, remove the input signal to the right channel input and connect a 600-ohm load. Apply the standard input test signal to the left channel input. Residual signal measured in output channels B and C should be -48 dBm or below.

4.5 Calibration

Before proceeding with calibration procedures, the performance tests (Secs. 4.1 to 4.4) should be carried out to determine whether adjustments are necessary.

4.5.1 +5-V current foldback adjustment

1. Turn off the 224X and remove the NVS module from its slot (labeled OPT.).
2. Clip a 1.15-ohm 30-W resistor onto pins 1 and 3, and attach a DVM's minus lead to pin 1 and its positive lead to pin 3. Insert the extender board into the OPT. slot.
3. Turn on the unit. Adjust R11 on power supply module 3 until the meter reads approximately 3.00 V (2.8 to 3.2 V).
4. Remove the extender board and replace the NVS module.

Caution: The 1.15-ohm resistor must handle at least 30 W; it may become hot during use.

4.5.2 Phase-lock loop calibration

1. Connect channel 1 of the oscilloscope to U27 pin 3 and synchronize on channel 1.
2. Connect channel 2 of the oscilloscope to U27 pin 8 (clip on the end of R10, 1K resistor).
3. Adjust the variable capacitor C12 for a loop control voltage, U27 pin 8, of about 3.8 V.

4.5.3 Input offset calibration

Power down and carefully remove U23. Connect a jumper from pin 6 of the U23 socket (hook onto CR21 cathode) to a quiet ground (for example, low side of C73). Power up and connect one channel of the oscilloscope to U19 pin 1 (CH1L) and the other channel to U26 pin 21 (MSB of A/D word). Synchronize on CH1L (positive going) and set the oscilloscope to 5 us/DIV and 2 V/DIV on each channel. Offset (R90) should now be adjusted so that the MSB (most-significant bit) dithers between 1 and 0 with equal intensity when viewed on the oscilloscope.

Power down, remove jumper, and replace U23. This procedure ensures that the analog-to-digital converter (ADC) responds with code 1000 0000 0000 or 0111 1111 1111 for a true 0-V input. This will ensure good gain step matching during output conversion.

4.5.4 Output offset calibration

Set up mainframe with the AOUT module on an extender card. Apply a 1-kHz, +12-dBm sine wave from the oscillator to both input channels. Run the zero-delay test program. Adjust the input level potentiometers (R1 and R2) on the AIN module so that the overload indicator in the headroom display is just turned off. Measure the level of the output of Channel A. Adjust the Channel A output level potentiometer (R119) so that the output level is +12 dBm. Measure the distortion of the Channel A output. Adjust R4 for minimum distortion.

4.5.5 Output filter calibration

Each of the four output filters has three null adjustments to compensate for component sensitivity. The nulling procedure is done by removing the signals to the audio inputs and then injecting signals at various frequencies at certain points. The following procedure outlined for channel A should be executed on all four channels.

1. Apply a 22.153-kHz signal with peak amplitude of 0.5 V to the high side of R43 and adjust R19 for a null at node R20/R21.
2. Apply a 19.200-kHz signal with peak amplitude of 0.5 V to node R20/R21 and adjust R25 for a null at node R26/R27.
3. Apply a 35.850-kHz signal with peak amplitude of 0.5 V to node R26/R27 and adjust R31 for a null at node R32/R33.
4. If nulls can't be achieved, carefully examine all component values of the stage in question.

Repeat for channels B, C, and D. Refer to schematics for corresponding test points.

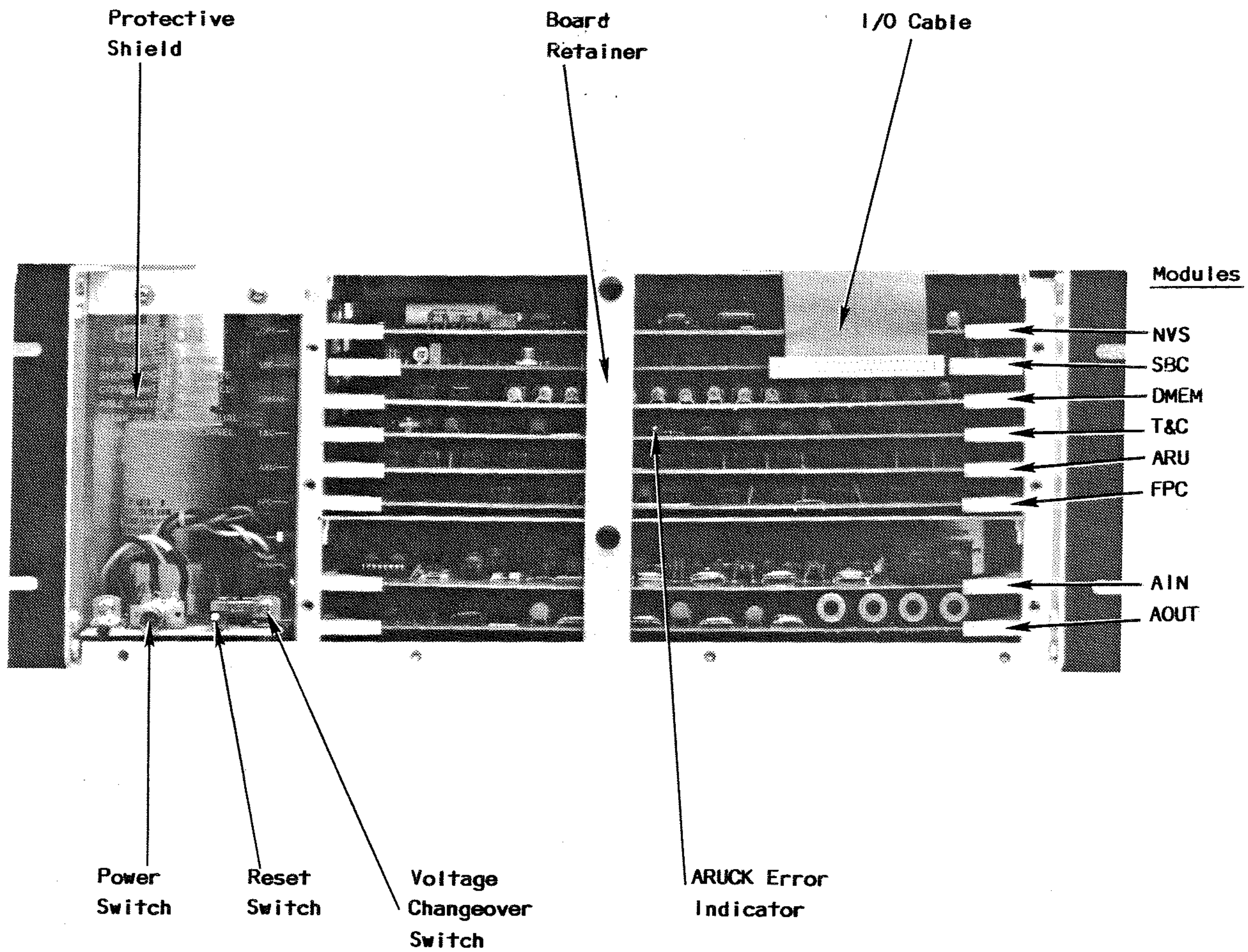

Fig. 4.2. 224X Mainframe Interior -- Front View.

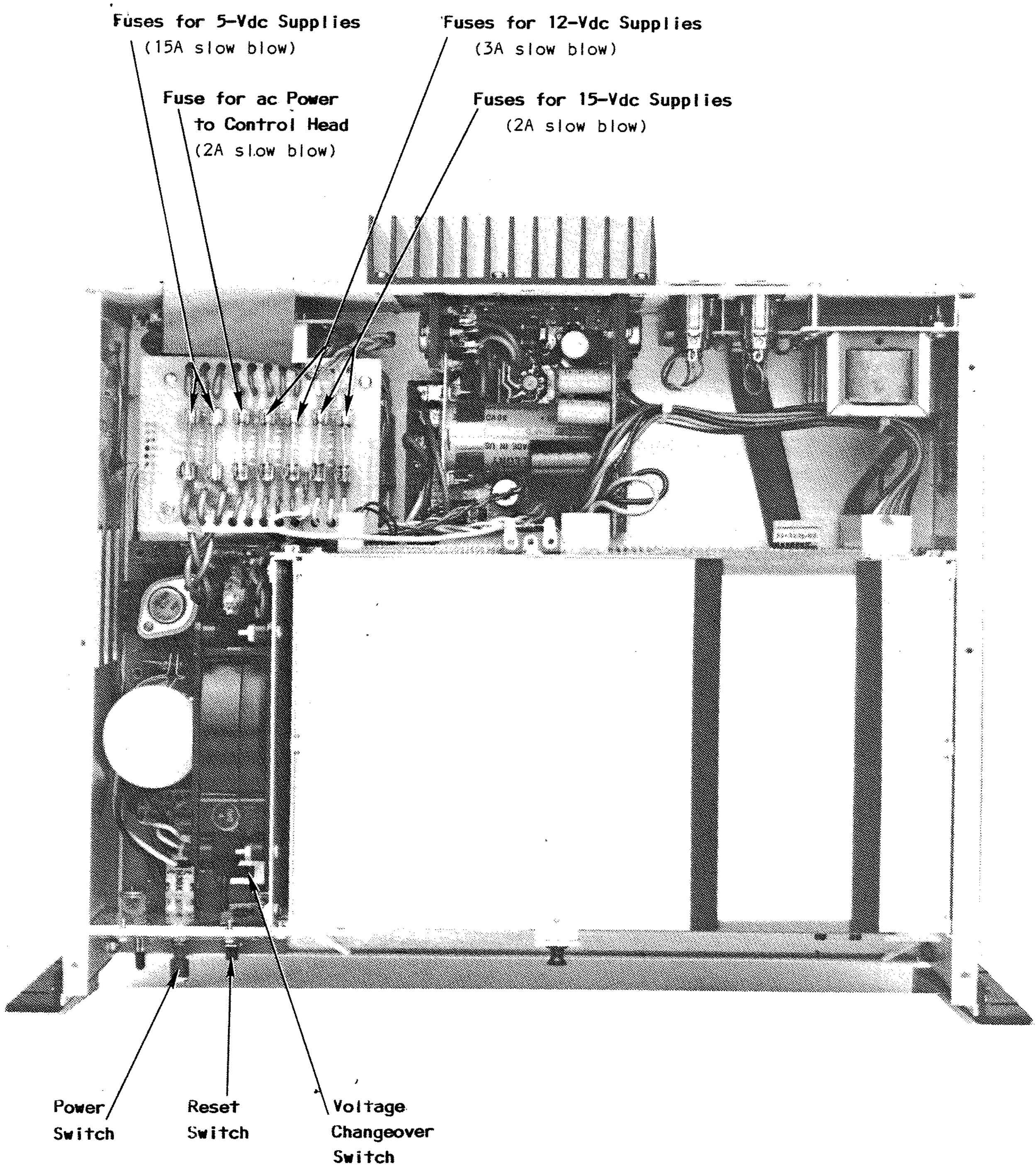

Fig. 4.3. 224X Mainframe Interior -- Top View.