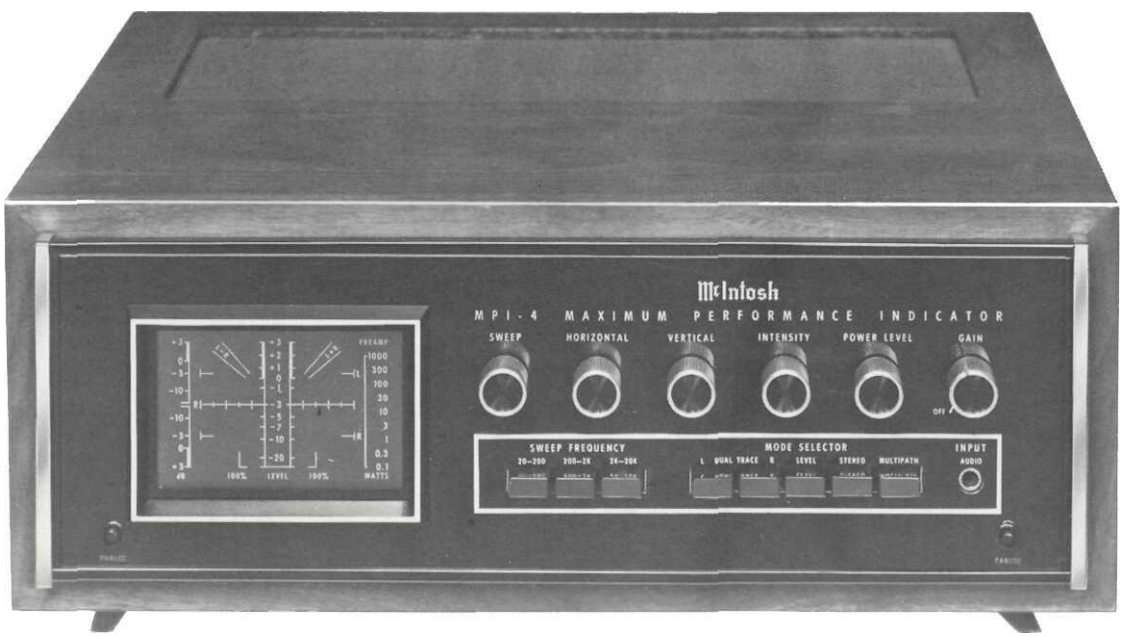
McIntosh
MPI 4

OWNER'S MANUAL

THE McINTOSH MPI 4 MAXIMUM PERFORMANCE INDICATOR



Reading Time 40 Minutes

Price $1.25

Your MPI 4 Maximum Performance Indicator will give you many years of pleasant and satisfactory performance. If you have any questions concerning the operation or maintenance of this instrument, please contact:

CUSTOMER SERVICE

McIntosh Laboratory Inc.
2 Chambers Street
Binghamton, New York 13903
Phone: 607-723-3512

Take Advantage of 3 years of FREE Factory Service . . . Fill in the Application NOW.

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Guarantee

McIntosh Laboratory Incorporated guarantees this instrument to be capable of performance as advertised. We also guarantee the mechanical and electrical workmanship and components to be free of defects for a period of 90 days from date of purchase. If such defects occur, McIntosh Laboratory or one of its authorized agencies will repair the defect at no cost to the purchaser. This guarantee does not extend to components damaged by improper use nor does it extend to transportation to and from the factory or service agency.

THREE YEAR FACTORY SERVICE CONTRACT

An application for a FREE THREE YEAR FACTORY SERVICE CONTRACT is included with this manual. The terms of the contract are:

For Three Years from date of purchase—

1. McIntosh will provide all parts, materials and labor needed to return the measured performance of the instrument to the original performance limits free of any charge. The SERVICE CONTRACT does not cover any shipping costs to and from the authorized service agency or the factory.

2. Any McIntosh authorized service agency will repair all McIntosh instruments at normal service rates. To receive the free service under the terms of the SERVICE CONTRACT, the SERVICE CONTRACT CERTIFICATE must accompany the instrument when taken to the service agency.

3. Always have service done by a McIntosh authorized service agency. If the instrument is modified or damaged, as a result of unauthorized repair the SERVICE CONTRACT will be cancelled. Damage by improper use or mishandling is not covered by the SERVICE CONTRACT.

4. The SERVICE CONTRACT is issued to you as the original purchaser. To protect you from misrepresentation this contract cannot be transferred to a second owner.

5. The SERVICE CONTRACT is given to purchasers who live in the 50 United States or Canada only.

6. For your protection McIntosh selects its dealers carefully. Only one dealer in ten qualifies for a McIntosh franchise, To receive the SERVICE CONTRACT your purchase must be made from a McIntosh franchised dealer.

7. Your completely filled in application for a SERVICE CONTRACT must be postmarked within 30 days of the date of purchase of the instrument.

8. To receive the SERVICE CONTRACT all information on the application must be filled in. The SERVICE CONTRACT will be issued when the completely filled in application is received at McIntosh Laboratory Incorporated in Binghamton, New York, If the application is not received at McIntosh Laboratory, only the service offered under the 90-day guarantee will apply.

General

The MPI 4 is a laboratory-grade instrument. It provides the facility to continuously monitor the quality of the performance of a stereo system. The MPI 4 can sample and display signals from the tuner, preamplifier and power amplifier without reconnecting cables. Signals are displayes on an oscilloscope screen calibrated with scales for tuning, measuring and testing.

As a tuning aid, the instrument is a guide to exact FM station selection and precise tuning. The screen displays FM signal strength, modulation percentage and mulitpath interference. Audio signals may be viewed for stereo balance, strength, phase and channel separation. Output power of the power amplifier can be seen at any instant during program performance, or stored to develop a trend over several minutes.

With the addition of test records, the MPI 4 can show compliance and trackability of a phono pickup, frequency response of the preamplifier and power amplifier, audio distortion and stereo speaker balance.

In one of its operational modes, the MPI 4 becomes a "dual trace" oscilloscope. When operated in the dual trace mode the left and right stereo channels appear simultaneously and separately on the screen for direct comparison. The instrument also has "triggered sweep." It permits the viewer to choose a single tone and lock it on the screen for careful inspection.

installation

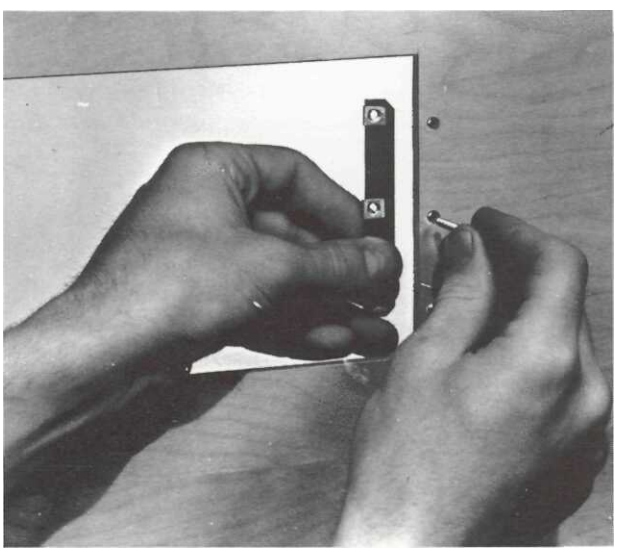
In a search for convenient equipment-mounting technique, McIntosh developed the PANLOC system. Pressing the two PANLOC buttons on the front panel of the MPI 4 releases the unit to slide in or out of its mounting. This allows easy access to cable connections at the rear. It brings top panel controls into view for easy adjustments, adjustments.

Ventilation extends the trouble-free life of an instrument by preventing excessive internal temperature and insulation breakdown. To accomplish this, allow cool air to enter at the bottom of the instrument and warm air to escape at the top. The MPI 4 Maximum Performance Indicator may be mounted in any position. It requires a mounting space 15 inches deep (38.1 cm), 17½ inches wide (44.45 cm), and 6 inches high (15.24 cm).

To mount in the McIntosh cabinet follow the instructions enclosed with the cabinet. For any other installation, remove the instrument, PANLOC brackets, parts bag and mounting template from the carton. Remove the MPI 4 from the plastic bag and place it upside down on the shipping pallet. Then remove the four plastic feet fastened to the bottom of the chassis.

1. POSITION TEMPLATE AND MARK
   Position the plastic mounting template over the area of the cabinet panel where the MPI 4 is to be installed. Be sure that the edges of the equipment marked on the template clears any shelves, partitions or existing equipment located behind the panel. With the template in place mark the six "A" and "B" holes and four smalt holes locating the corners of the cutout. Next, join the four corner marks with pencil lines. The edge of the template is used as a straight edge.

2. DRILL HOLES
   With the drill perpendicular to the panel, drill the six "A" and "B" holes using a 3/16 inch drill. THE SIX HOLES MUST BE DRILLED BEFORE MAKING THE CUTOUT.



3. SAW CUTOUT

Carefully cut the rectangular opening on the inside of the pencilled rectangle.

4. SECURE MOUNTING STRIPS

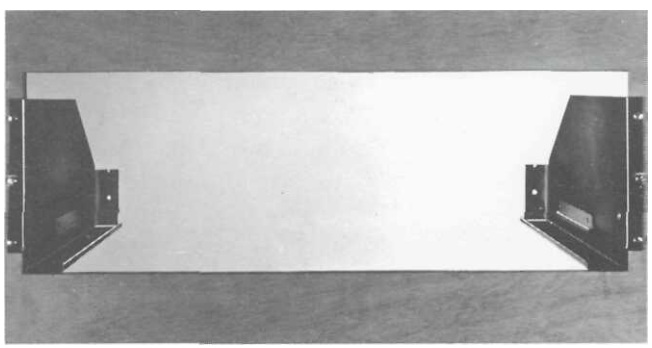
Install the mounting strips (supplied in the hardware package) on the inside of the cabinet panel. Insert two screws (supplied in the hardware package) into the center holes ("B" holes on the template). Use the ¾-inch long screws for panels under ½-inch thick or 1¼-inch screws for panels ½-inch thick or over. Place a mounting strip on the back of the cabinet panel. Align it with the three holes in the panel and tighten the screw. The screw head should pull slightly into the wood panel. Attach the other mounting strip by repeating the procedure.

5. MOUNT THE PANLOC BRACKETS

Attach the PANLOC brackets to the cabinet panel using four screws of the proper length. Place the template over the mounting screws. The screws should be centered on the "A" and "B" holes in the template. If necessary, loosen the screws and push the mounting brackets into alignment then retighten.

6. INSTALL THE UNIT

Thread the power cord through the opening in the cabinet panel. Carefully slide the instrument into the opening so the rails on the bottom of the instrument engage the track on the mounting brackets. Slide the instrument in until it stops at the ad|ust position latches. Press the latches in and continue to slide the instrument until its front panel is flush with the cabinet panel. At the bottom front corners are the PANLOC buttons. Depressing the PANLOC buttons will lock the instrument firmly in the cabinet panel. Pressing the PANLOC buttons a second time will release the instrument You can then slide the instrument forward to the adjust position. Pressing the adjust position latches will allow the instrument to be removed from the cabinet.



How to connect

The MPI 4 may be connected to a stereo receiver (Fig. 1) or to a component system with a separate preamplifier and power amplifier (Fig. 2). Choose which most closely resembles your system.

AUDIO INPUTS

Low Level Audio Input

Use one of the 6-foot shielded cables supplied, to connect the left channel output on your preamplifier to the LEFT AUDIO INPUT on the MPI 4 back panel. Similarly, connect the right channel preamplifier output to the RIGHT AUDIO INPUT.

SPEAKER INPUT

There are four color-coded push connectors on the back panel of the MPI 4. Connect these with two pairs of speaker cables to the left and right output on the power amplifier.

Black Left speaker common terminal
Green Left speaker high terminal
White Right speaker common terminal
Red Right speaker high terminal

Set the SPEAKER IMPEDANCE switch on the MPI 4 back panel to agree with the speaker system impedance: 4W, 8W, or 16W.

TUNER INPUTS

Signal Strength Input

McIntosh tuners and receivers provide signal for the SIGNAL STRENGTH INPUT at a connector marked TP 1 on the back of each tuner. Using the 3-foot low-capacity shielded cable supplied, connect the TP 1 output to the SIGNAL STRENGTH INPUT.

TO PREVENT HIGH FREQUENCY LOSSES, THE SPECIAL 3-FOOT CABLES SUPPLIED MUST BE USED. DO NOT SUBSTITUTE ORDINARY AUDIO CABLE.

For other tuners or receivers which do not provide a signal strength output, consult the manufacturer or their authorized service agency.

Deviation Input

McIntosh tuners and receivers provide signal for the DEVIATION INPUT at a connector marked TP 2 on the back of each tuner. Using the 3-foot low-capacity shielded cable supplied, connect the TP 2 output to the DEVIATION INPUT.

TO PREVENT HIGH FREQUENCY LOSSES, THE SPECIAL 3-FOOT CABLES SUPPLIED MUST BE USED. DO NOT SUBSTITUTE ORDINARY AUDIO CABLE.

For tuners or receivers which do not provide a deviation output, consult the manufacture or their authorized service agency.

HOW to Connect

FIG. 1 CONNECTING THE MPI 4 TO STEREO RECEIVER
(TYPICAL CONNECTIONS)

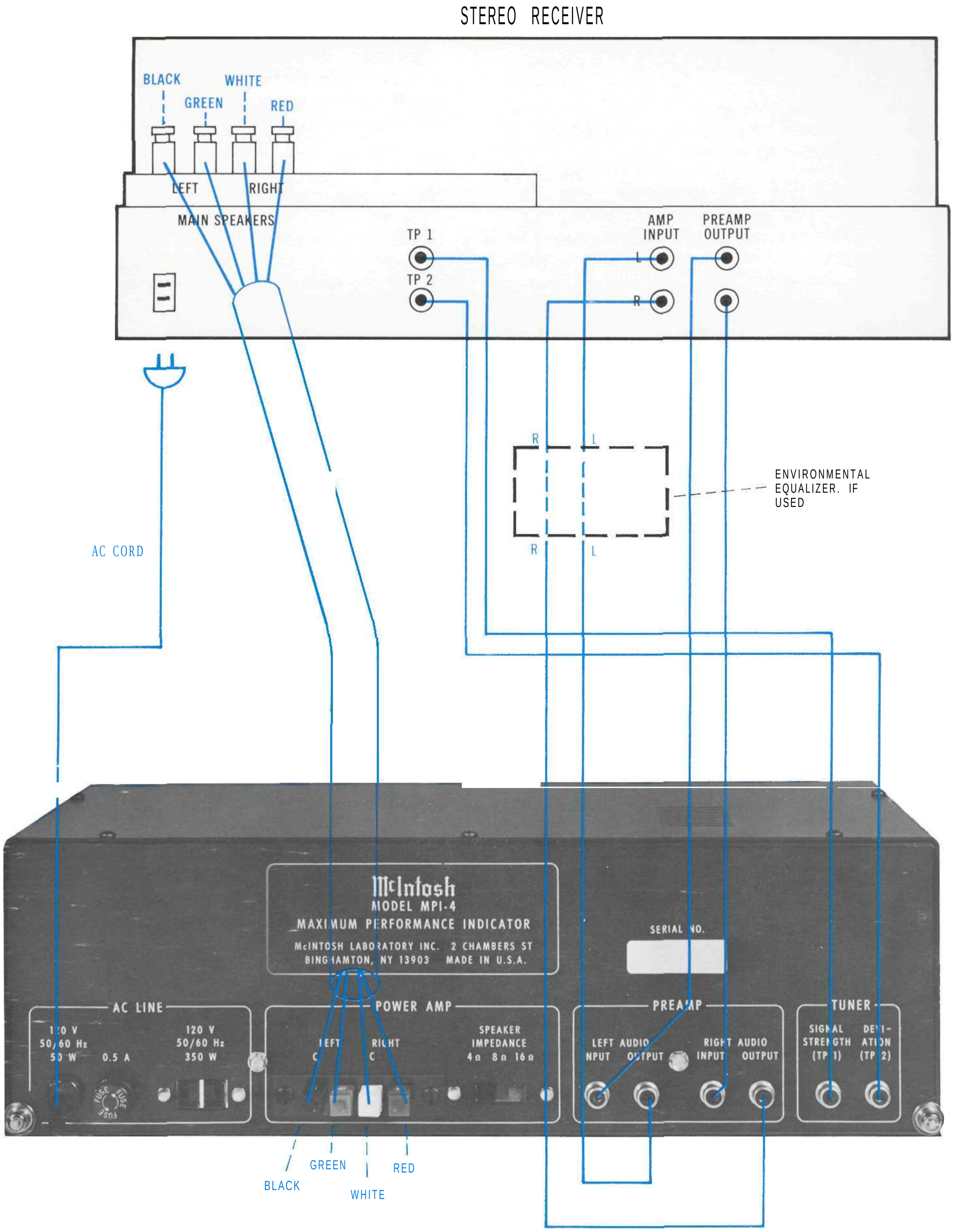
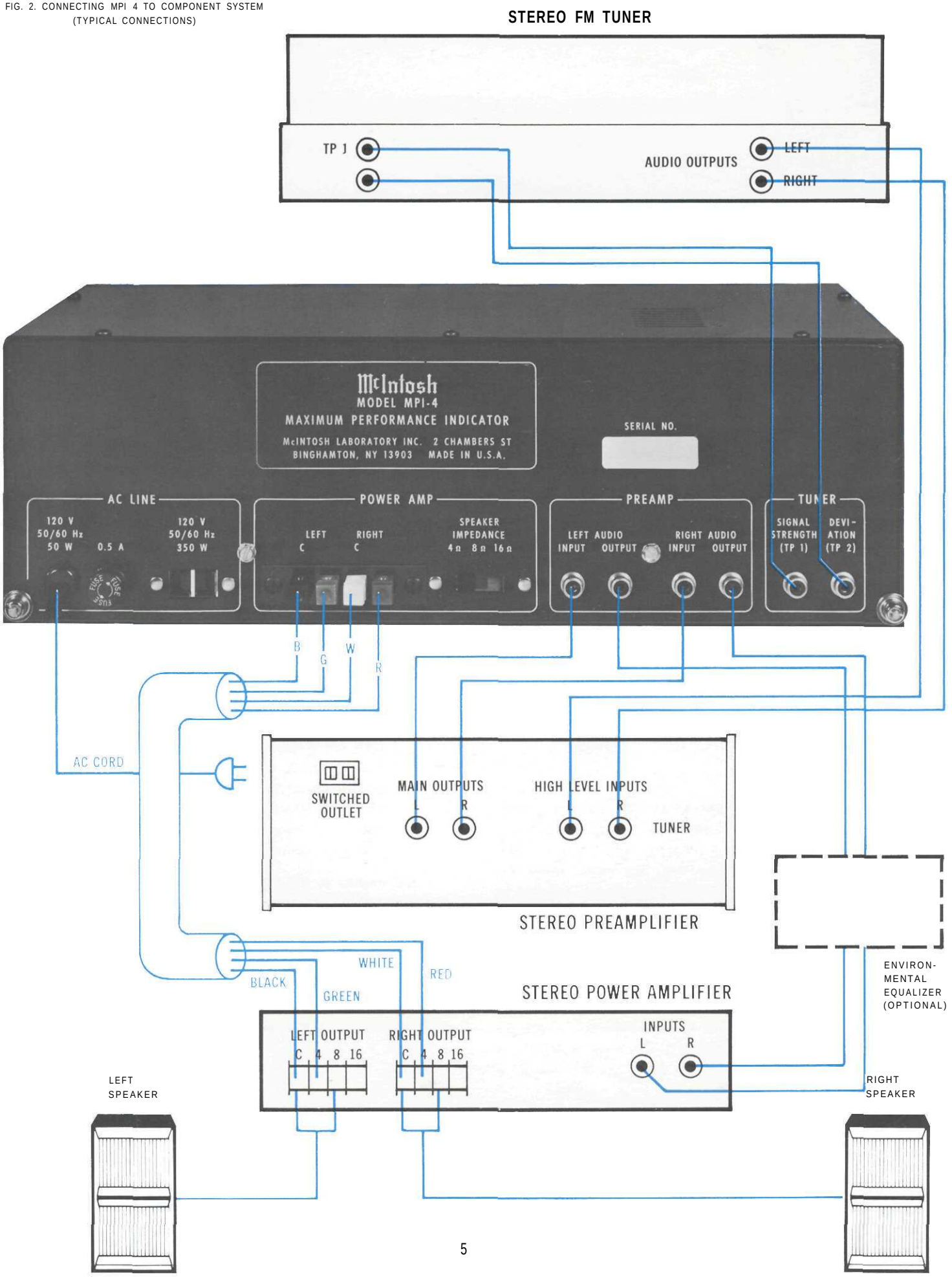


FIG. 2. CONNECTING MPI 4 TO COMPONENT SYSTEM
(TYPICAL CONNECTIONS)



Front Panel information

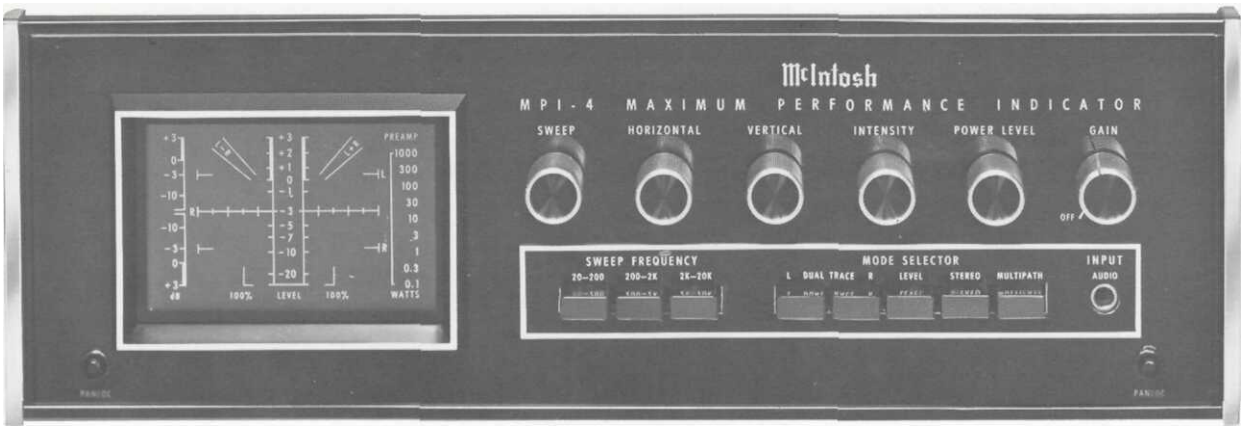


FIG. 3 FRONT PANEL

MODE SELECTOR

The MODE SELECTOR pushbuttons select the type of display seen on the screen of the MPI 4. Each of the five pushbuttons selects a trace—a glowing line of green light—which shows a variety of information about signals from the tuner, preamplifier or power amplifier. To assist the evaluation of each display, the reticle in front of the screen is marked with calibration points which are used to measure signal characteristics. As MODE SELECTOR buttons are pressed, the screen reticle is illuminated in these colors:

Mode	Color
Multipath	Blue
Stereo	Red
Level	Amber
Sweep	Green

MULTIPATH

When properly connected to an FM tuner the MPI 4 will detect and display multipart reception. Multipart reception is the result of a reflected signal arriving at the tuner antenna slightly later than the direct signal. By rotating or repositioning the FM antenna it is possible to reduce multipath reception. The MPI 4 makes it easy to know when the FM antenna is oriented for the best reception of any station.

To show multipart reception the MPI 4 displays instantaneous signal strength versus frequency deviation. Signal strength is shown as vertical deflection of the indicator display beam. Frequency deviation is shown as horizontal deflection. Multipath reception appears as a peak or valley in the display.

Multipath reception degrades FM tuner performance in several ways:

1. Usually there is an increase in background noise level.
2. Distortion is often heard in the program signal
3. Stereo separation may be reduced.
4. The stereo effect may be completely lost.
5. Stereo indicators may fail to function, or function erratically.

To overcome multipart reception it is usually necessary to turn the antenna to receive the FM signal by one predominant path. Rotating a directional antenna is effective at correcting multipath reception. In areas where a simple antenna such as a dipole is used repositioning the antenna can achieve similar results.

In the MULTIPATH mode the MPI 4 is a very effective tuning indicator:

1. Signal strength is shown by the vertical position of the display trace. The higher the position of the trace the greater the signal strength.
2. Correct tuning occurs when the display trace is centered horizontally on the screen. Since the display trace effectively follows the tuner IF response curve, centering the trace tunes the detector to the center of the IF curve.

The display of the signal, when there is no multipath reception affecting the program, appears as a smooth curving line, (Fig. 4). The calibration points are the two 100% marks at the bottom of the screen. As the program material grows louder or softer, the trace expands and contracts. The 100% points indicate the highest modulation percentage normally transmitted by an FM station. (A more detailed description appears in the "How to Use Section.")

STEREO

A stereo program causes a complex display which varies between a circular shape and an elliptical shape. A mono program causes the display to be a slanted line. With an in-phase mono program, the signal falls between the L + R boundaries; in out-of-phase mono program the trace falls along the L — R boundaries.

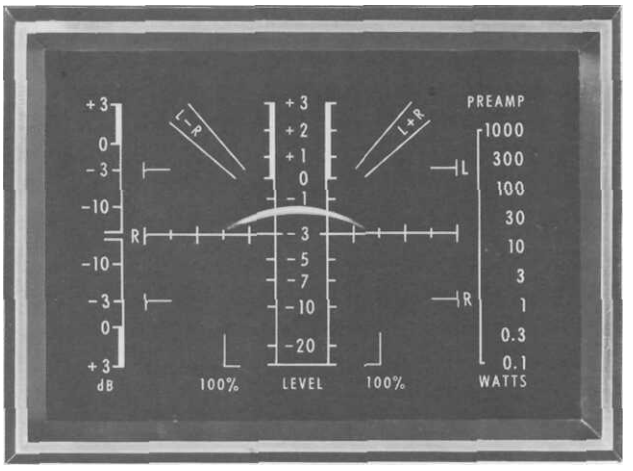


FIG. 4 MULTIPATH DISPLAY

LEVEL

The audio LEVEL of stereo signals is displayed as two vertical columns on the screen (Fig. 5). The height of each column is determined by the power or amplitude of the input signal. The calibration scale between the two columns and the position of the POWER LEVEL knob indicate the actual power of the signal. The nomenclature on the recticle is shown in decibels (dB).

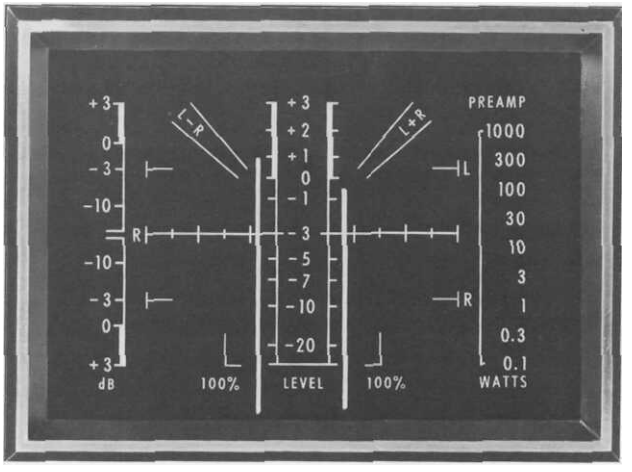


FIG. 5 LEVEL DISPLAY OF L & R CHANNEL

DUAL TRACE

When the DUAL TRACE buttons are pressed, the L (Left) program and the R (Right) programs are seen as separate traces on the screen. The left channel is the upper trace; the right channel is the lower.

If only one button under DUAL TRACE is pressed (L or R), the screen displays only the signal selected.

SWEEP and SWEEP FREQUENCY

Musical program material has many frequencies and it may be displayed as a complex jumble of waves that are difficult to view. By changing the timing, or sweep, of the trace, the MPI 4 can lock onto any portion of the audio spectrum. The result is a clear, easy-to-view wave that remains stable on the screen. Use the SWEEP FREQUENCY pushbuttons to provide a choice of low range frequencies (20-200 Hz), mid-range frequencies (200-2000 Hz) and high-range frequencies (2000-20,000 Hz). Use the SWEEP control for fine tuning of the sweep within any range.

GAIN

The GAIN control operates only when preamplifier signals are being displayed. The GAIN control varies the vertical size of the image in all audio modes of operation. When a signal of unknown strength is to be viewed, start with the GAIN fully counterclockwise, then turn the control until the display reaches comfortable viewing size. When the GAIN control is set to OFF, AC power is removed from the MPI 4.

POWER LEVEL

The POWER LEVEL switch determines the full-scale calibration in watts of signals displayed on the screen. When the switch is turned, a red indicator illuminates the selected power range of the WATTS column along the right side of the screen (Fig. 6). These ranges measure the actual power level of the power amplifier. (How to use these ranges will be described in the next section.) When the red indicator is opposite the topmost marking, PREAMP, the screen displays the amplitude of the preamplifiersignal.

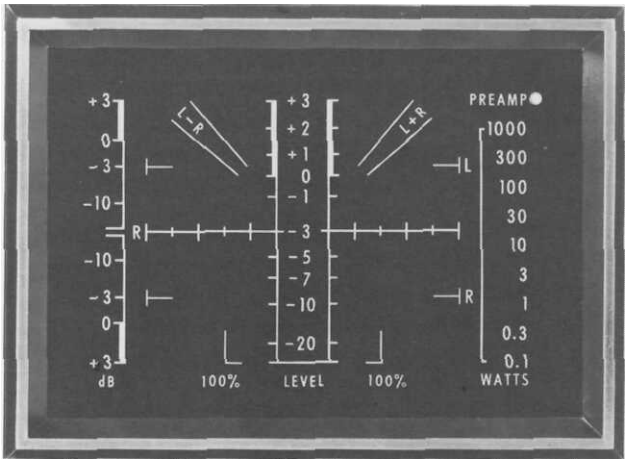


FIG. 6

INTENSITY

The INTENSITY control adjusts brightness of the trace on the screen. For longest screen life, use the minimum, comfortable viewing level.

The trace will disappear when there is no input signal present. For extended cathode ray tube life a built-in automatic intensity control extinguishes the trace during non-signal periods to prevent a stationary spot from burning a permanent mark in the screen surface.

VERTICAL

The VERTICAL control adjusts the up and down location of the trace on the screen.

HORIZONTAL

The HORIZONTAL control adjusts the left to right location of the trace on the screen.

INPUT AUDIO

A microphone, tape recorder, FM tuner or other equipment not normally connected to the rear panel connection of the MPI 4 may be plugged into the INPUT AUDIO jack on the front panel. Signals are displayed on the screen for observation or testing. During this time, the POWER LEVEL selector must be set to the PREAMP position. The size of the display is adjusted by the GAIN control and TRIM controls.

Some microphones may not generate enough signal to drive the display to comfortable viewing levels. This can be corrected by adding a microphone preamplifier between the microphone and AUDIO INPUT jack.

Level set Panel information

AUDIO TRIM LEFT

Adjusts trace height for a left channel preamplifier audio signal.

AUDIO TRIM RIGHT

Adjusts trace width for stereo display or trace height for sweep or level display from a right channel preamplifier audio signal.

SIGNAL STRENGTH

Adjusts trace height above the bottom or base line of the multipath display.

DEVIATION

Adjusts trace width of the multipath display.

MULTIPATHPOLARITY

The MULITPATH POLARITY switch controls polarity of the signal-strength signal. The minus position is used with most tuners.

TRACE SEPARATION

The TRACE SEPARATION control adjusts the distance between the two traces in the DUAL TRACE mode of operation.

SWEEP EXPANSION

The SWEEP EXPANSION control adjusts maximum width of the trace display. SWEEP EXPANSION operates only when one or both of the DUAL TRACE pushbuttons are pressed.

TRIGGER SOURCE

The TRIGGER SOURCE switch selects the signal used to trigger the display sweep. In the DUAL TRACE mode the sweep may be triggered from the left or right channel, or from the 60 hertz line frequency.

FOCUS

The FOCUS control adjusts sharpness of the trace.

LOW PASS FILTER

The LOW PASS FILTER switch inserts or removes a filter that eliminates 19,000 and 38,000 Hz stereo reference signals. These unwanted signals produce fuzzy and indistinct traces on the screen. The most useful position is the IN position. Only in special test procedures is it necessary to switch the filter OUT,

RETICLEILLUMINATION

The RETICLE ILLUMINATION switch turns illumination of the screen scales on or off.

LEVELMODE

In the NORMAL position the two columns rise and fall like VU meters. In the PEAK position the columns indicate the "average" peak level for signals that change continuously in amplitude. The Reset position resets the Peak circuitry and freezes the highest level achieved by the audio.

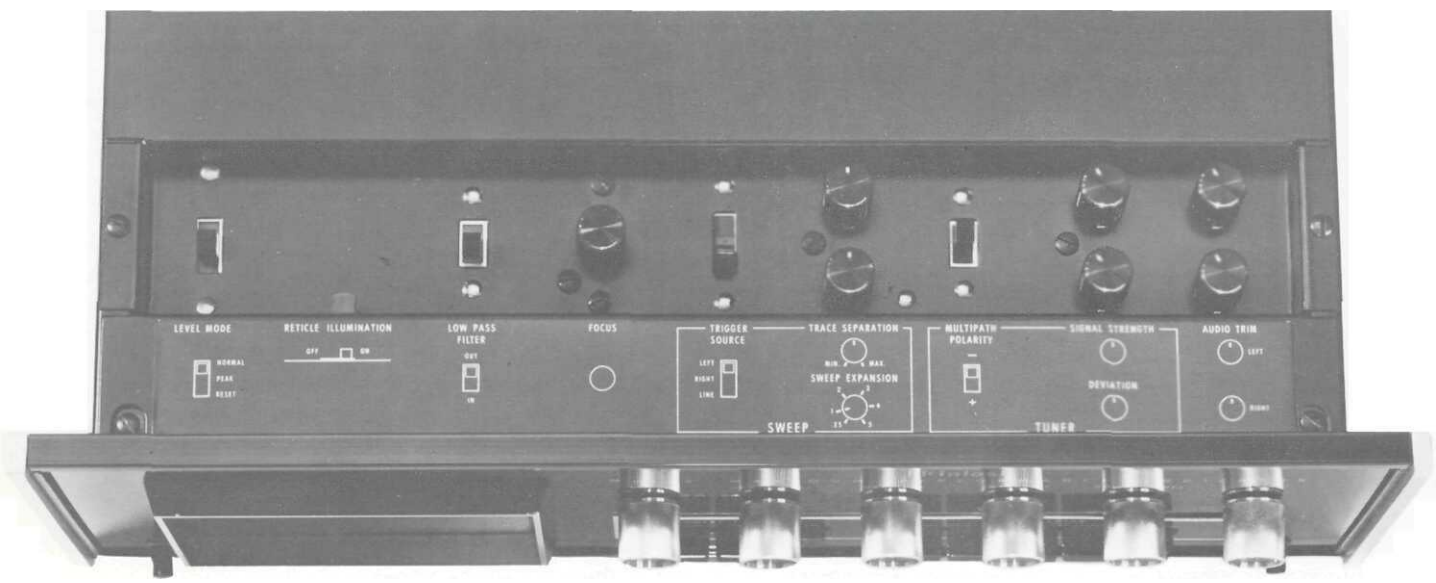


FIG. 7 LEVEL SET PANEL

Rear Panel information

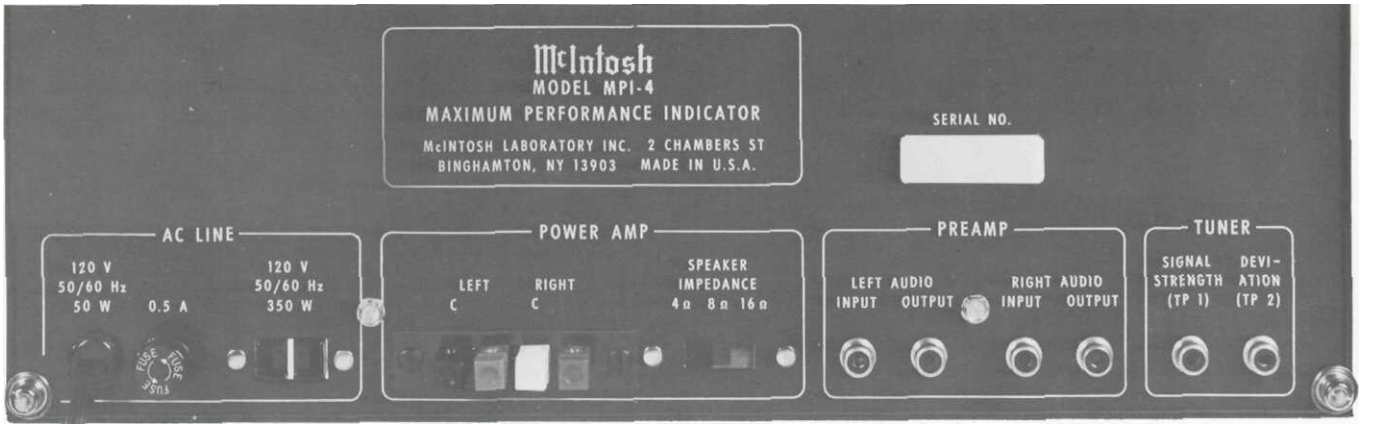


FIG. 8 REAR PANEL

TUNER-SIGNAL STRENGTH (TP 1)

Use the 3 foot low capacity cables provided to connect Test Point No. 1 (TP 1) on a McIntosh tuner to this input.

TO PREVENT HIGH FREQUENCY LOSSES, THE SPECIAL 3-FOOT CABLES SUPPLIED MUST BE USED. DO NOT SUBSTITUTE ORDINARY AUDIO CABLE.

TP 1 supplies the MPI 4 with a voltage which is proportional to the strength of a received FM station. The trace on the screen will move vertically to indicate relative signal strength.

TUNER-DEVIATION INPUT (TP 2)

Use the 3 foot low capacity cable provided to connect Test Point No. 2 (TP 2) on a McIntosh tuner to this input.

TO PREVENT HIGH FREQUENCY LOSSES, THE SPECIAL 3-FOOT CABLES SUPPLIED MUST BE USED. DO NOT SUBSTITUTE ORDINARY AUDIO CABLE.

TP 2 supplies a voltage proportional to the modulation (deviation) of the FM signal. The trace on the screen will expand in a horizontal direction proportional to a station's modulation.

PREAMP-LEFT AUDIO INPUT

The left output of a preamplifier connects to this input. In some modes of MPI 4 operation, the left channel audio signal causes vertical movement of the trace on the screen.

PREAMP-RIGHT AUDIO INPUT

The right output of a preamplifier connects to this input. In the stereo mode of MPI 4 operation, the right channel causes the trace on the screen to move horizontally, in the sweep or level modes the right channel causes the trace to move vertically.

PREAMP-LEFT AUDIO OUTPUT

The LEFT AUDIO OUTPUT jack is directly connected to the LEFT AUDIO INPUT jack of the MPI 4. Use the LEFT AUDIO OUTPUT jack to connect the preamplifier output to the left power amplifier input.

PREAMP-RIGHT AUDIO OUTPUT

The RIGHT AUDIO OUTPUT jack is directly connected to the RIGHT AUDIO INPUT jack of the MPI 4. Use the RIGHT AUDIO OUTPUT jack to connect the preamplifier output to the right power amplifier input.

POWER AMP-SPEAKER IMPEDANCE

The POWER AMP-SPEAKER IMPEDANCE selector calibrates the MPI 4 to the speaker impedance in use: 4W, 8W or 16W.

POWER AMP CONNECTIONS

The POWER AMPLIFIER push connections are:

Black Left Amplifier Common
Green Left Amplifier High
White Right Amplifier Common
Red Right Amplifier High

AC POWER OUTLET

The AC power outlet may be used to provide AC to additional equipment drawing up to 350 watts. The outlet is not fused and is on whenever the MPI 4 power cord is connected to an AC power outlet.

FUSE

The 0.5 Ampere fuse protects only the MPI 4. It does not protect additional equipment plugged into the adjacent AC power outlet. For continued protection replace the fuse with like value only.

Initial Setup

After connecting the MPI 4 as described in the previous section, turn on all equipment. Release the PANLOC buttons and slide the MPI 4 out to the adjust position. This allows access to the level set (top panel) controls. Next:

1. Set top panel LEFT AUDIO TRIM and RIGHT AUDIO TRIM fully counterclockwise, the SIGNAL STRENGTH and DEVIATION fully counterclockwise, the MULTIPATH POLARITY to minus, the FOCUS control to mid position, the LOW PASS FILTER to "in", and the LEVEL MODE switch to NORMAL.

2. Set front panel GAIN control fully counterclockwise (but not to Off), the INTENSITY control fully *clockwise,* and the POWER LEVEL switch to PREAMP (fully clockwise).
3- Depress front panel STEREO pushbutton.
4. Using the front panel HORIZONTAL and VERTICAL controls, move the spot of light to the center of the screen, directly behind the 3 in the LEVEL column.
5. Select a mono signal source.
6. Adjust top panel LEFT AUDIO TRIM and RIGHT AUDIO TRIM to the midpoint in their clockwise travel.
7. Adjust front panel GAIN to obtain a 1- to 2-inch pattern, and re-adjust both top panel AUDIO TRIM controls to obtain a pattern similar to Fig. 9.

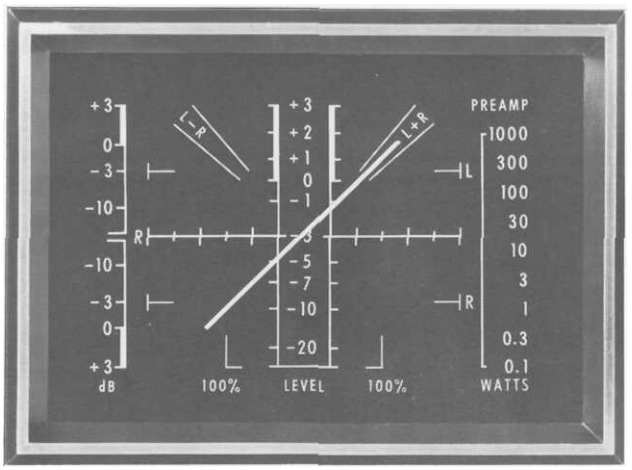


FIG. 9 STEREO DISPLAY OF A MONO SIGNAL

By adjusting the display within the L + R guide, the display is balanced for equal amplitude left and right channels.

8. Adjust intensity control for a comfortable brightness.
9, Adjust top panel FOCUS control for clearest trace.
10- Set the top panel TRIGGER SOURCE switch to LEFT.
11. Depress the front panel L button.
12. Depress the front panel SWEEP FREQUENCY 20-200 button.
13. Adjust the front panel SWEEP control to the approximate midpoint of its range.
14. Adjust the top panel SWEEP EXPANSION control to obtain the pattern shown in Figure 10. The control should position near the 1 marking.

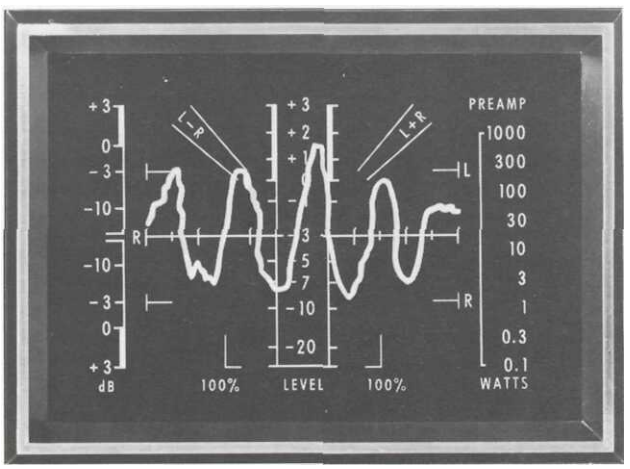


FIG. 10 SINGLE TRACE DISPLAY

15. Depress the front panel R button. Determine that the pattern is similar to that obtained in Fig. 10.
16. Depress *both* front panel L and R buttons.
17. Adjust top panel TRACE SEPARATION to obtain the pattern shown in Figure 11.

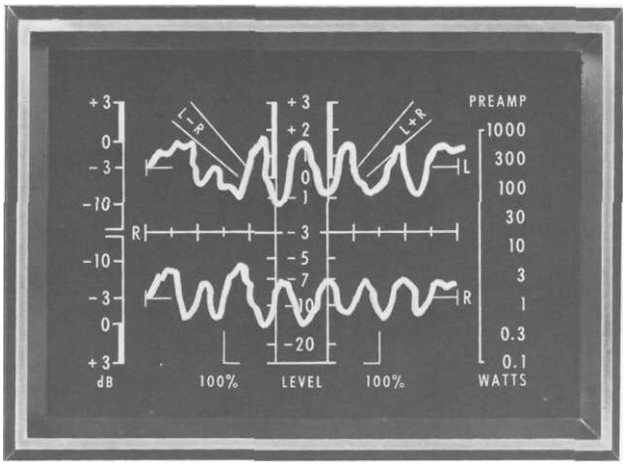


FIG. 11 DUAL TRACE DISPLAY

18. Depress the front panel LEVEL button.
19. Adjust the front panel POWER LEVEL knob to obtain the pattern shown in Figure 12.

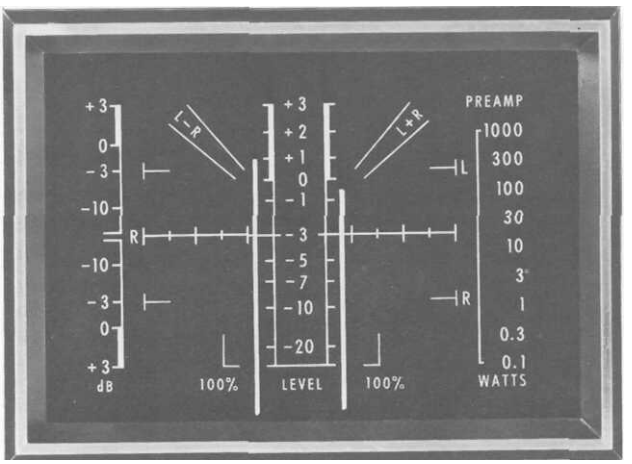


FIG. 12 LEVEL DISPLAY OF L & R CHANNEL

20. Depress the front panel MULTIPATH button.
21. Observe that the spot of light is at the bottom center of the screen.
22. Adjust top panel SIGNAL STRENGTH control to position the spot above the horizontal centerline of the screen: (If the spot of light moves downward as the top panel SIGNAL STRENGTH control is adjusted, set the top panel MULTIPATH POLARITY switch to its opposite setting.)
23. Adjust the top panel DEVIATION control to obtain the pattern shown in Figure 13.

HOW to use the MPI 4

MULTIPATH MODE

Multipath is caused by an FM signal arriving at your antenna by two (or more) paths, a direct one between an FM

station and your antenna, and a reflected path which causes part of the signal to arrive slightly later in time. Such signals usually degrade stereo reception. Typical multipath symptoms include poor channel separation, distortion, noise or buzzing in the program and erratic operation of a tuner's stereo indicator.

Multipath free reception is shown in Figure 13. The trace is formed by a combination of signal strength and modulation (or loudness of the program material). Since signal strength raises the pattern in a vertical direction, the higher the trace, the stronger the station. A powerful local station can be expected to bring the trace to about ½- or ¾-inches below the top of the screen. Weak stations produce lower heights on the screen.

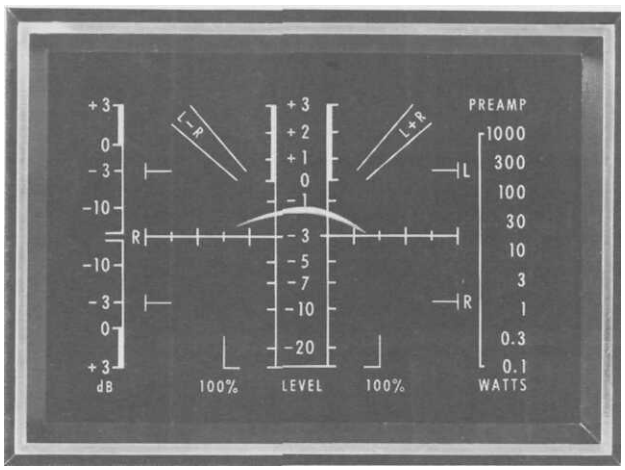


FIG. 13 MULTIPATH FREE DISPLAY

Program modulation causes the trace to expand in a horizontal direction. The pattern, therefore, widens in step with the audio intensity of the program material.

Figure 14 shows a display having multipath. The dips and peaks are the result of a reflected signal arriving at the tuner antenna slightly later than the direct signal.

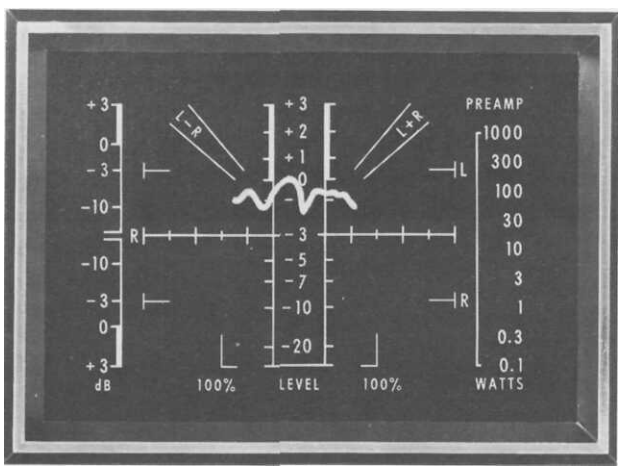


FIG. 14 MULTIPATH INTERFERENCE

By combining displays of strength and modulation, the MPI 4 will not only show multipath, but is, in addition, an accurate tuning indicator Adjust the FM tuning dial until the trace reaches its highest point, while also being centered horizontally on the screen. Centering the trace places the signal at the center of the tuner's IF response curve, the most desirable point. An example of a detuned station is shown in Fig. 15: note how the curve is shifted to the left on the screen. Correct the tuning by adjusting the tuners tuning knob to center the trace.

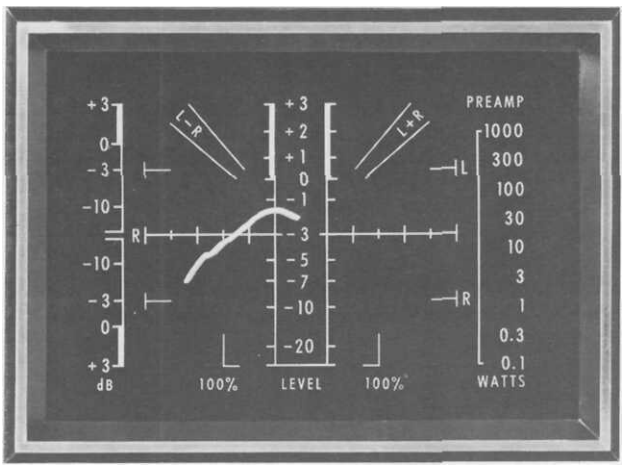


FIG. 15 DETUNED STATION

Multipath produces several visible symptons on the screen. Peaks or valleys may appear on the curve, as shown in Fig. 16. Note, too, how the entire display is shifted

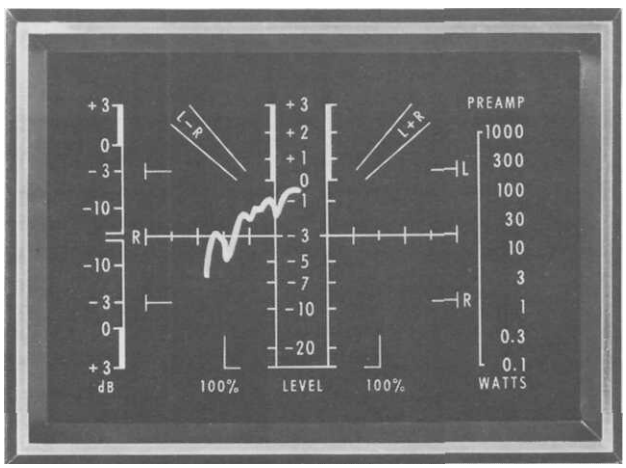


FIG. 16 MULTIPATH & DETUNED

to the left which indicates a combination of both detuning and multipath reception. In general, a trace that is not smooth suffers from multipath contamination. In severe cases, multipath causes considerable fuzziness or blurring of the overall display.

Multipath is most often overcome by changes in antenna direction. For outdoor antennas with a rotator, aiming the antenna in a different direction usually helps. Indoor dipoles or similar antenna may also be repositioned. In all cases, best results are clearly indicated on the MPI 4 screen.

Make sure that the MPI 4 is property set up.

1. Turn the POWER LEVEL switch to the PREAMP position.
2. Set the GAIN control fully counterclockwise (but *not* to OFF), and the INTENSITY control fully clockwise.

3. Depress the STEREO button and check if the spot of light is in the center of the screen. If not, use the HORIZONTAL and VERTICAL controls to center the spot.

To operate the MPI 4 in the MULTIPATH mode:

4. Depress the MULTIPATH button and set the FM tuner to the desired station. Adjust the INTENSITY control for desired brightness.
5. Alternately adjust antenna direction and FM tuning to obtain the highest signal strength and least multipath, as shown in the illustrations.

STEREO

In this mode, the MPI 4 displays signals sampled from the preamplifier or power amplifier output. The Left channel signals cause the trace to deflect in a vertical direction. Right channel signals extend the trace along a horizontal line. Randomly phased stereo signals will produce a pattern on the screen appearing like "a ball of twine." (Fig. 23) If left and right signals are present in equal amounts and equal phase, the display is a diagonal line along the screen's L + R line (Fig. 17).

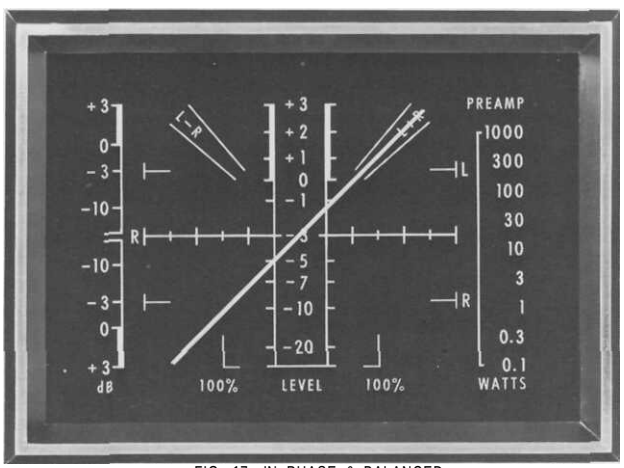


FIG. 17 IN PHASE & BALANCED

This display also appears when the FM tuner or other program source is delivering a mono program since right and left channels are equal.

If only a left channel is present, the trace will extend only in the vertical direction. If only a right channel is present the trace will extend only in the horizontal direction. With these indications, you can set the precise balance of a stereo system.

BALANCE AND PHASE CHECK

Make sure the spot is properly centered (Steps 1, 2 and 3 on pages 11, 12). Then:

1. Depress the STEREO pushbutton.
2. Set the preamplifier or other program source to deliver a mono signal.
3. Adjust the GAIN control to obtain approximately a 2-inch display.
4. Balance the program source by making the trace on the screen fall precisely along the L + R line. This is done by adjusting the left and right gain (or balance) controls on the preamplifier. If the screen produces a trace like that of Figure 17, electrical balance and phase are correct. If the trace is reversed, (Figure 18) the channels are electrically balanced, but out of phase.

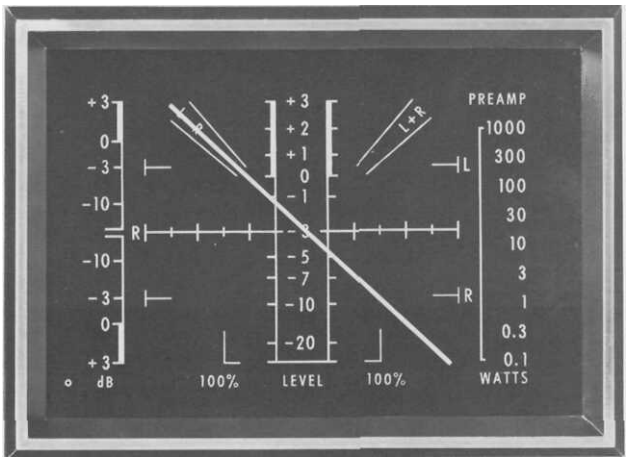


FIG. 18 BALANCED BUT OUT OF PHASE

Consider other possible traces and variations which may appear during this test. In Figs. 19 and 20 for example, both traces are tilted toward the right which indicates the two channels are correctly in phase. But since the traces fail to line up with the diagonal screen L + R calibration they are not equal in electrical strength. In Fig. 19 the right channel has greater amplitude than the left channel, and causes the trace to tilt toward the horizontal. In Fig.20, the high vertical tilt of the trace indicates excessive left channel strength. The correct L + R angle appears when the amplifier gain controls are adjusted for proper balance. Figs. 21 and 22 show the same effects of electrical unbalance, as well as an out-of-phase condition.

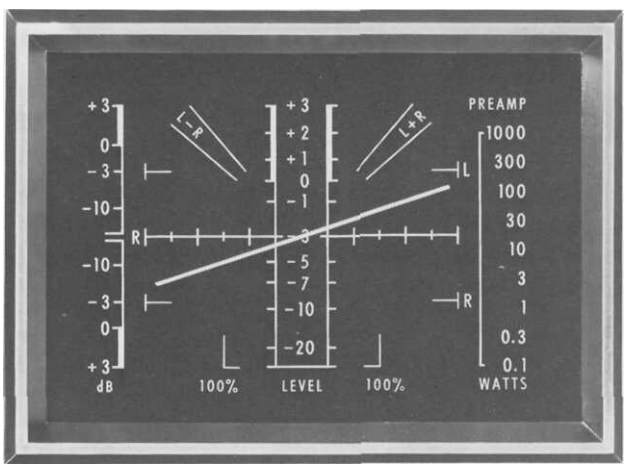


FIG 19 PHASE BUT UNBALANCED

The acoustical balance of the stereo system is affected by many things including room acoustics, furniture placement, room shape, small differences in loudspeakers, etc. Electrical balance and acoustical balance may not agree.

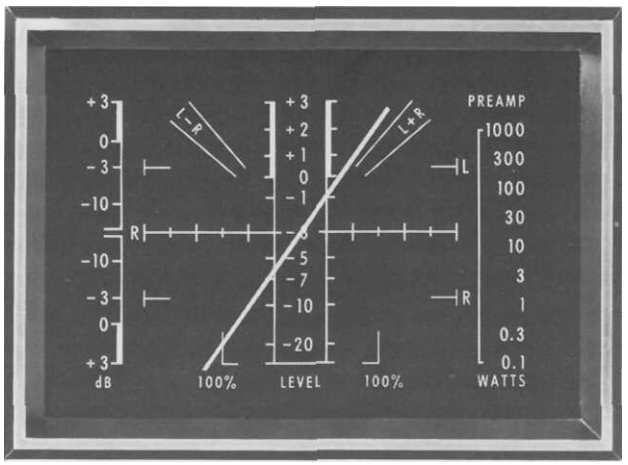


FIG. 20 IN PHASE BUT UNBALANCED

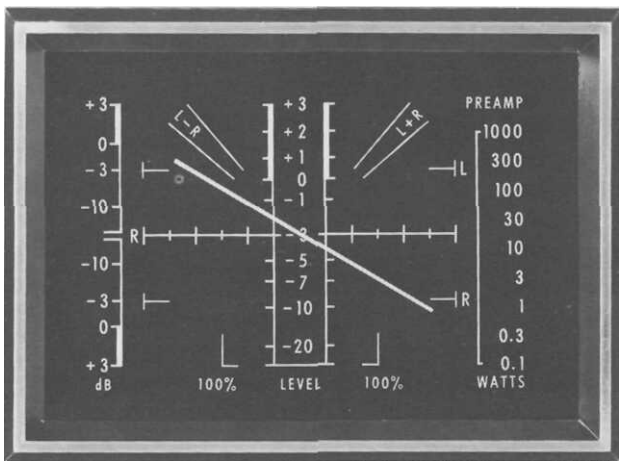


FIG. 21 OUT OF PHASE & UNBALANCED

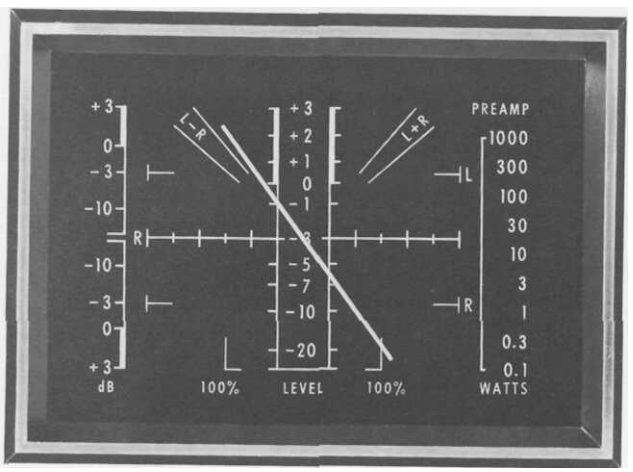


FIG. 22 OUT OF PHASE AND UNBALANCED

SEPARATION CHECK

A stereo program creates an image on the screen which vanes between an elliptical and circular pattern. Although the pattern is irregular and changing, it is possible to judge the approximate amount of separation between channels. To make this check make sure the spot is properly centered, then:

1. Depress the STEREO button.
2. Set the preamplifier or other program source to the stereo mode.
3. Adjust the GAIN control to obtain approximately a 2-inch display.

Stereo separation is usually dictated by the program source. As you view the screen and listen to a stereo program the pattern may follow several trends. When it extends outward in every direction and approximates a circle, it is indicating excellent stereo separation between channels. An example is shown in Fig. 23.

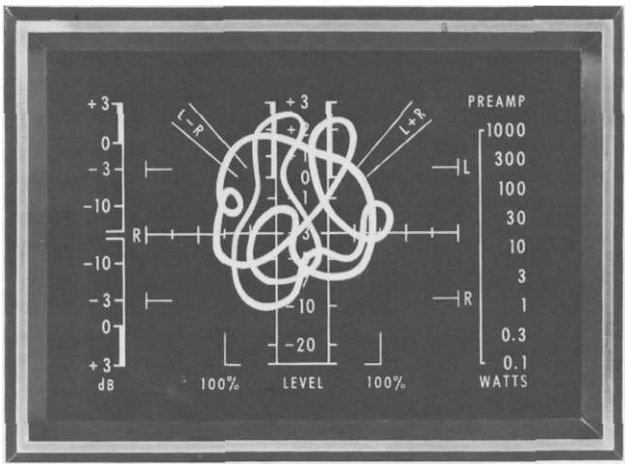


FIG. 23 STEREO DISPLAY

If the pattern tends toward an elliptical shape, as in Fig. 24, stereo separation is less than optimum.

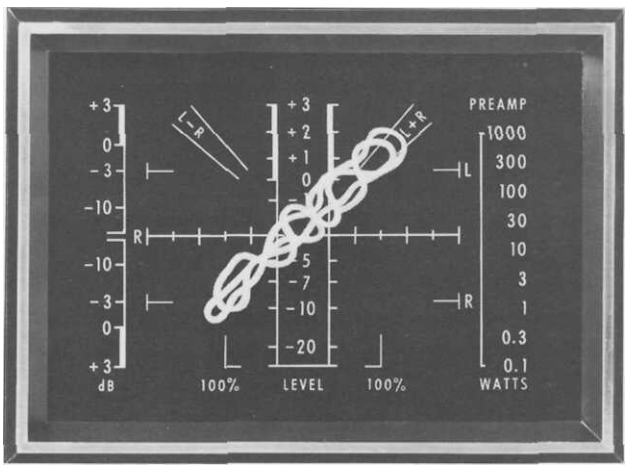


FIG. 24 REDUCED SEPARATION

A pattern which tilts toward the left, as in Fig. 25 not only suggests reduced stereo separation, but indicates an out-of-phase condition in the program material In judging any of the patterns just described, allow the program material to play for enough time for a trend to develop in the display.

LEVEL MODE

In the LEVEL mode of operation the left channel appears as a left vertical column on the screen, while the right channel appears as a right vertical column. Depress the LEVEL pushbutton and the display should agree with the one shown in Fig. 26 during a stereo program.

Signals to be viewed are selected by the POWER LEVEL switch. If the switch is in the PREAMP position, the pre-

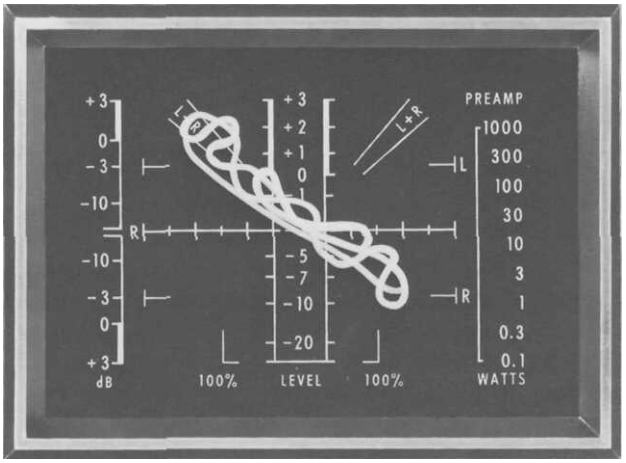


FIG. 25 OUT OF PHASE

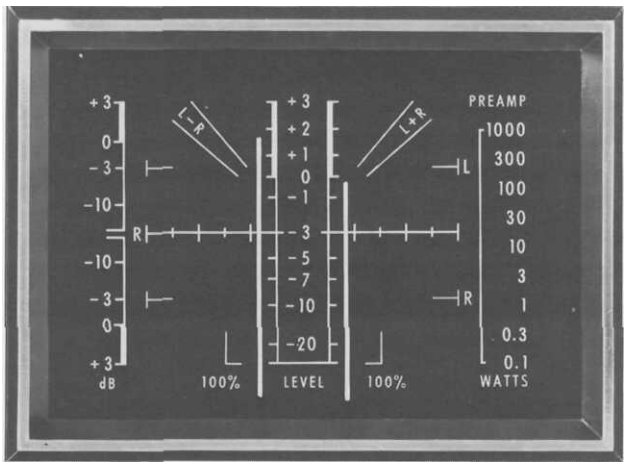


FIG. 26 LEVEL DISPLAY

amplifier outputs are displayed, and their heights can be adjusted by the GAIN control. For other positions of the POWER LEVEL selector, the GAIN control is disabled and power output from the power amplifier is indicated on the scale in ranges from 100 watts to 0.1 watt. The level columns respond to the peak voltage present in the supplied power amplifier signal. The power calibration is in average watts for sine wave signals. Each step of the POWER LEVEL switch indicates a difference of 5 dB in power output. Turn the POWER LEVEL switch until you discover a position which completely contains the peaks of the program material. To convert the display readings to actual power amplifier output in watts, use the Power Table, Fig. 31.

Example: Assume the POWER LEVEL control is set so the red indicator is opposite "10" on the WATTS scale. While playing program material, assume the trace reaches a height of "+1" on the LEVEL SCALE (center of the screen). Consult the POWER TABLE and find "+1" in the LEVEL SCALE column at left. Next, read to the right until you reach the "10" column headed under the WATTS heading. The figure given there is the exact wattage output of the power amplifier. In this example 6.3 watts.

LEVEL MODE

The top panel LEVEL mode is activated when the MPI-4 LEVEL button is pressed. With the LEVEL mode switch in the NORMAL position the height of the two columns, as read on the center dB scale, is an indication of the audio level. The vertical lines on the screen rise and fall in step with the program material. The columns rise very quickly, (250ms rise time) but decay somewhat slowly (½ sec. decay rate).

With the LEVEL mode switch in the PEAK mode the two columns indicate the "average" peak value of the audio waveform. The two columns rise slower (approx. ½ sec.) than in the NORMAL mode and they also fall slower (25 sec. decay rate). For sound that continuously changes in amplitude this mode will give an indication of the "average" peak level. For a sine wave (a continuous tone) the NORMAL and the PEAK will give the same dB reading.

The RESET position of the LEVEL mode switch quickly discharges the "average" Peak timing circuit for making another "average" Peak measurement.

In some instances, it is desirable to stop the action and observe the highest point achieved by the audio signal over a period of time. This permits close comparison between the highest levels attained by left and right channels and simplifies their measurement against the scales on the screen. This may be done by placing the LEVEL MODE switch in the RESET position. This allows the changing signal to build up and display its highest, or peak indication. If a higher peak comes along, while the switch is still held, the two columns will go up to the higher value. If the power level switch is in a watt position the two columns will indicate the "equivalent peak average power" being delivered to the loudspeakers.

The decay time for "Peak" readings while in the RESET position is 100 seconds. (For a sine wave the peak value as read in the RESET position will be slightly greater than in the NORMAL and PEAK positions.)

Return the switch to NORMAL for conventional display.

SWEEP MODE

In the SWEEP mode the MPI 4 operates as a standard audio oscilloscope. In this mode it is possible to view individual audio cycles in the program. Since most program material consists of many tones, the MPI 4 may be adjusted to "trigger" at nearly any frequency in the audio spectrum. This provides a clear display of the range of interest. If you wish to view tones in the lower end of the audio range, press the 20-200 pushbutton on the front panel. Also press the L or R button under the MODE SELECTOR. As the program plays, you should be able to freeze one or more cycles on the screen by further adjustment of the SWEEP control (which acts as a fine tuning control). A single trace display is shown in Fig. 27.

It is also possible to roughly estimate the frequency of the audio tone displayed on the screen. Assume the SWEEP FREQUENCY button is set to 20-200 and the SWEEP control is turned fully counterclockwise. At this time, the screen is "sweeping" 20 times per second. If one audio

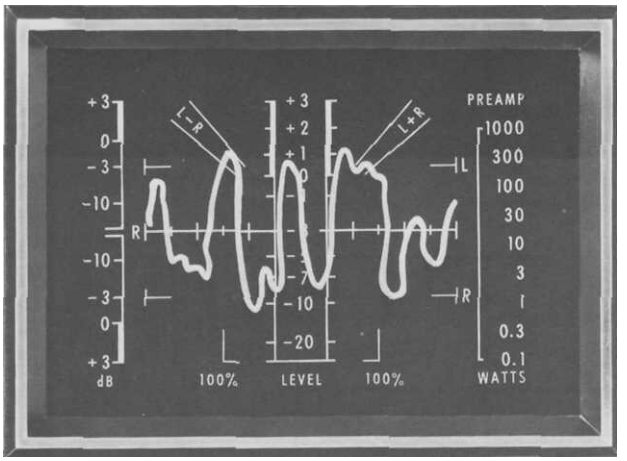


FIG. 27 SINGLE TRACE SWEEP

cycle appears stationary on the screen, it is a 20 Hz tone. If 10 cycles appear on the screen at the same settings, the tone is 200 Hz.

To examine audio tones in the mid-range, press the 200-2,000 button. Further adjustment of the SWEEP control should lock the waveform on the screen. Again, an estimate of frequency may be made. If the SWEEP is set fully counterclockwise, the trace is sweeping at the rate of 200 Hz. Count the number of cycles on the screen, multiply by 200, and the result is the audio frequency.

Tones in the highest range are observed with the SWEEP FREQUENCY button in the 2,000-20,000 band. If the SWEEP control is set fully counterclockwise, (a 2000 Hz sweep), two cycles on the screen represent a 4000 Hz tone; three cycles are a 6000 Hz tone, etc.

The screen can simultaneously display left and right stereo channels as a dual trace, as shown in Fig. 28. To view both signals, depress L and R pushbuttons of the DUAL TRACE MODE SELECTOR.

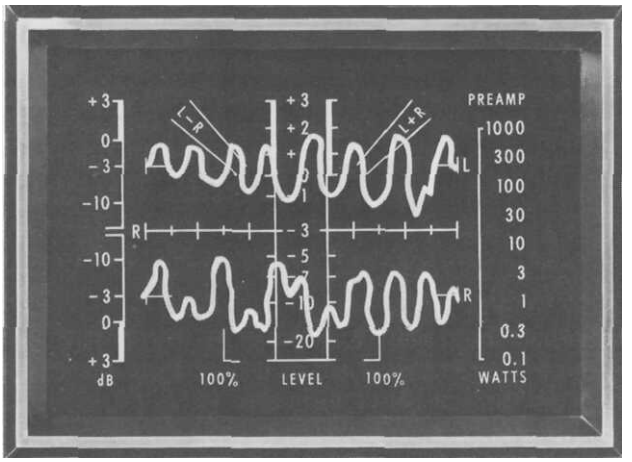


FIG. 28 DUAL TRACE DISPLAY

It is possible to magnify the display for closer viewing by adjusting the SWEEP EXPANSION control on the top panel as desired.

PHONO PICKUP COMPLIANCE AND TRACKING CHECK

With the aid of a test record, compliance and tracking of a pickup may be checked. Follow the instructions on the test record jacket and make certain the spot on the MPI 4 is properly centered, then:

1. Depress the STEREO button.
2. Start the phono turntable and set the pickup on the appropriate test band.
3. Adjust the GAIN control to obtain approximately a 2-inch display. Figure 29 shows good compliance and tracking, while Figure 30 shows distortion due to improper tracking.

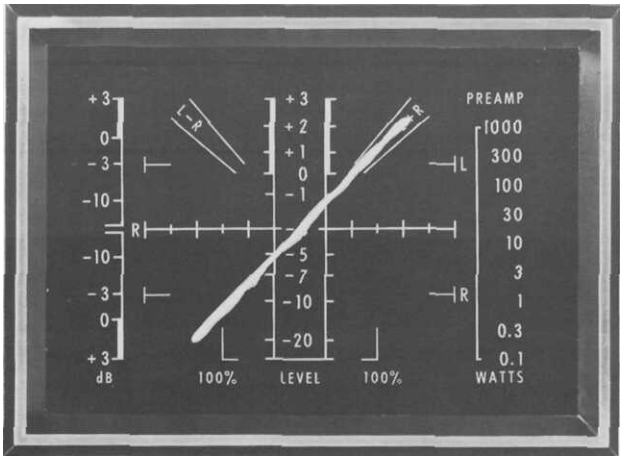


FIG. 29 GOOD TRACKING

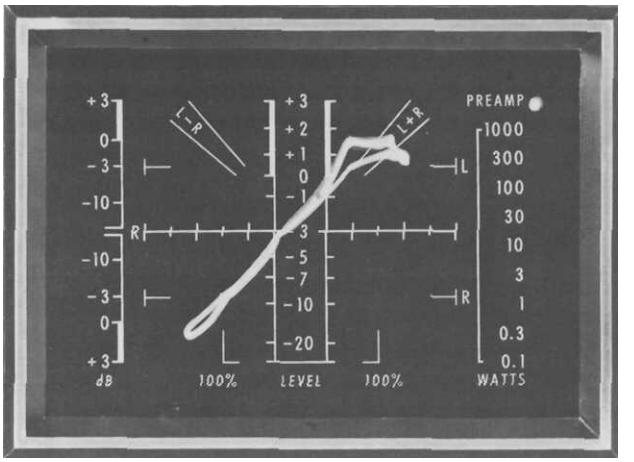


FIG. 30 IMPROPER TRACKING

FREQUENCY RESPONSE CHECK

Check the frequency response of your system with the aid of a test record. The graph in Fig. 31 shows an ideal RIAA curve using the CBS STR 100 test record. Make this test and all single frequency tests at low acoustic levels to prevent potential loudspeaker damage. To perform a frequency response check:

1. Play the 1000 Hz test tone on the phonograph.
2. Adjust the preamplifier volume control for an adequate sound level. Be cautious. The use of loud single frequency program material can overload loudspeaker systems.
3. Set the POWER LEVEL selector to a setting which provides column heights closest to the 0 dB mark on the level scale.
4. Adjust your preamplifier volume controls to obtain precise 0 dB readings for both columns using the

1000 Hz test tone.

5. Play the other tones on the test record and write down the column indications for each frequency played on the test record.
6. Transfer the readings obtained in Step 5 to the graph in Figure 33. Compare your curve with the curve on the graph. A deviation of 3 dB is acceptable.

LEVEL SCALE	POWER LEVEL SWITCH SETTING (WATTS)								
(dB)	1000	300	100	30	10	3	1	3	.1
+3	1000	300	100	30	10	3	1.0	.3	.1
+2	800	240	80	24	8	2.4	.8	.24	.08
+1	630	190	63	19	6.3	1.9	.63	.19	.063
0	500	150	50	15	5	1.5	.5	.15	.05
-1	312	93	31.2	9.3	3.12		.93	.312	.093 0312
-3	250	75	25	7.5	2.5		.75	.25	.075 .025
-5	126	38	12.6	3.8	1.26		.38	.126	.038 0126
-7	100	30	10	3.0	1.0		.3	.1	.030 .01
-10	50	15	5	1.5	.5		.15	.05	.015 .005
-20	5	1.5	0.5	.15	.05		.015	.005	.0015 0005

FIG. 31 POWER TABLE

PHONO CHANNEL SEPARATION CHECK

Check channel separation of your system with the aid of a test record (such as the CBS STR 100).

Make this test and all single frequency tests at low acoustic levels to prevent potential loudspeaker damage.

To observe the results follow the instructions furnished with the test record and:

1. Depress the LEVEL button.
2. Play the left channel spot frequency band on the record.
3. Set the POWER LEVEL selector to a position that yields approximately 0 dB deflection on the left column.
4. You should obtain a display like that shown in Figure 32. The difference in height between left column and right column indicates left to right channel separation in dB. The POWER LEVEL switch may be advanced to increase the level of the right volume if necessary. Each step of the POWER LEVEL switch adds 5 dB. (20 dB is generally considered fair, 30 dB good and 40 dB excellent.

   Repeat steps 2, 3 and 4 but play the right channel for right to left channel separation measurements.

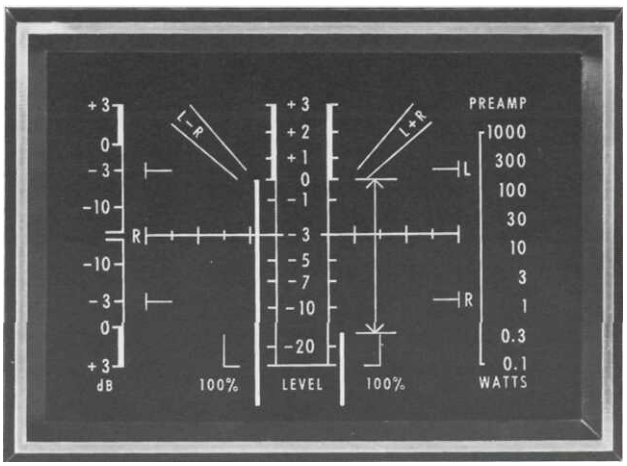


FIG. 32 CHANNEL SEPARATION (Approx 15dB)

AMPLIFIER LINEARITY CHECK

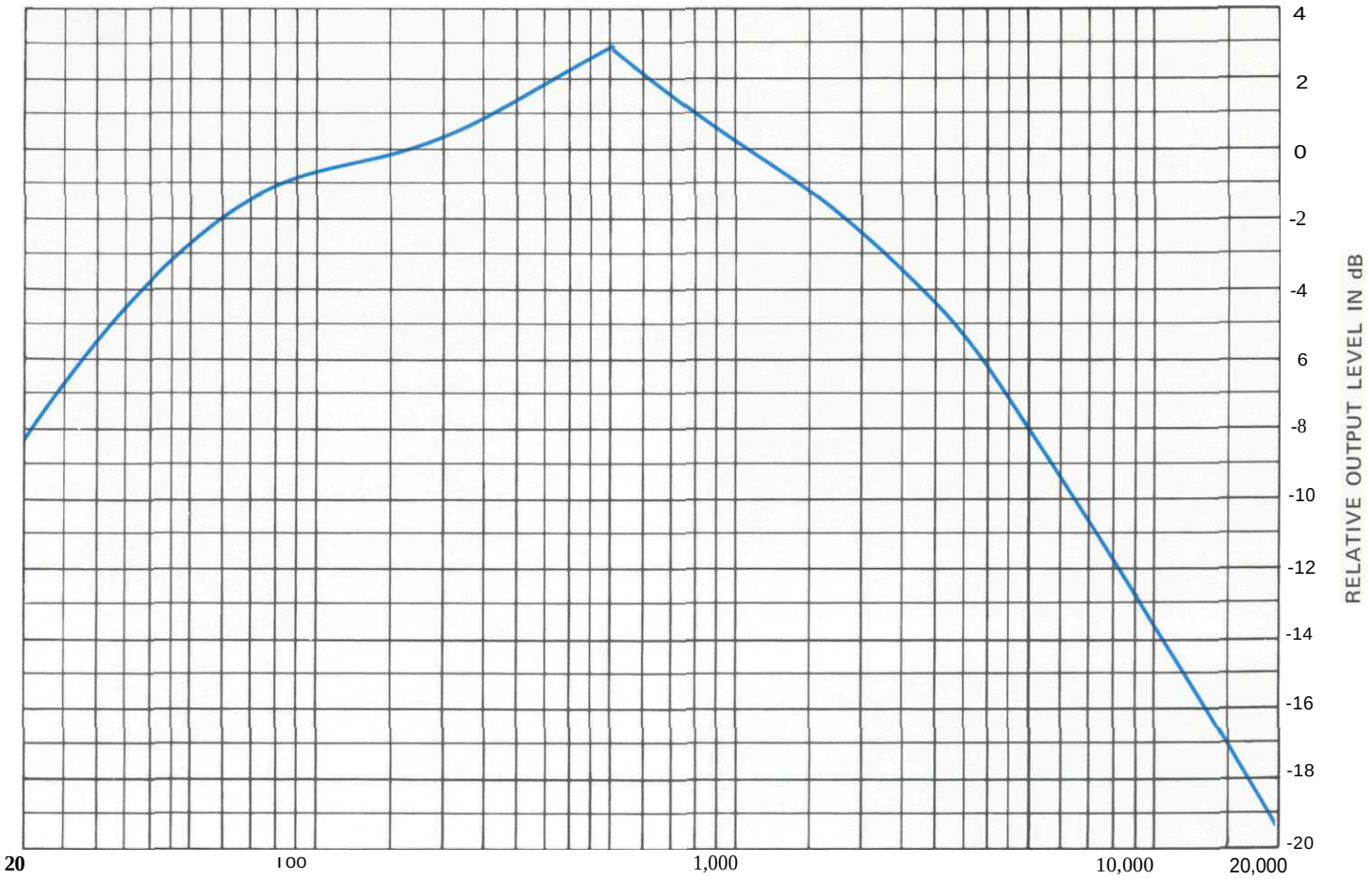
With the aid of a test record you may perform an amplifier linearity check.

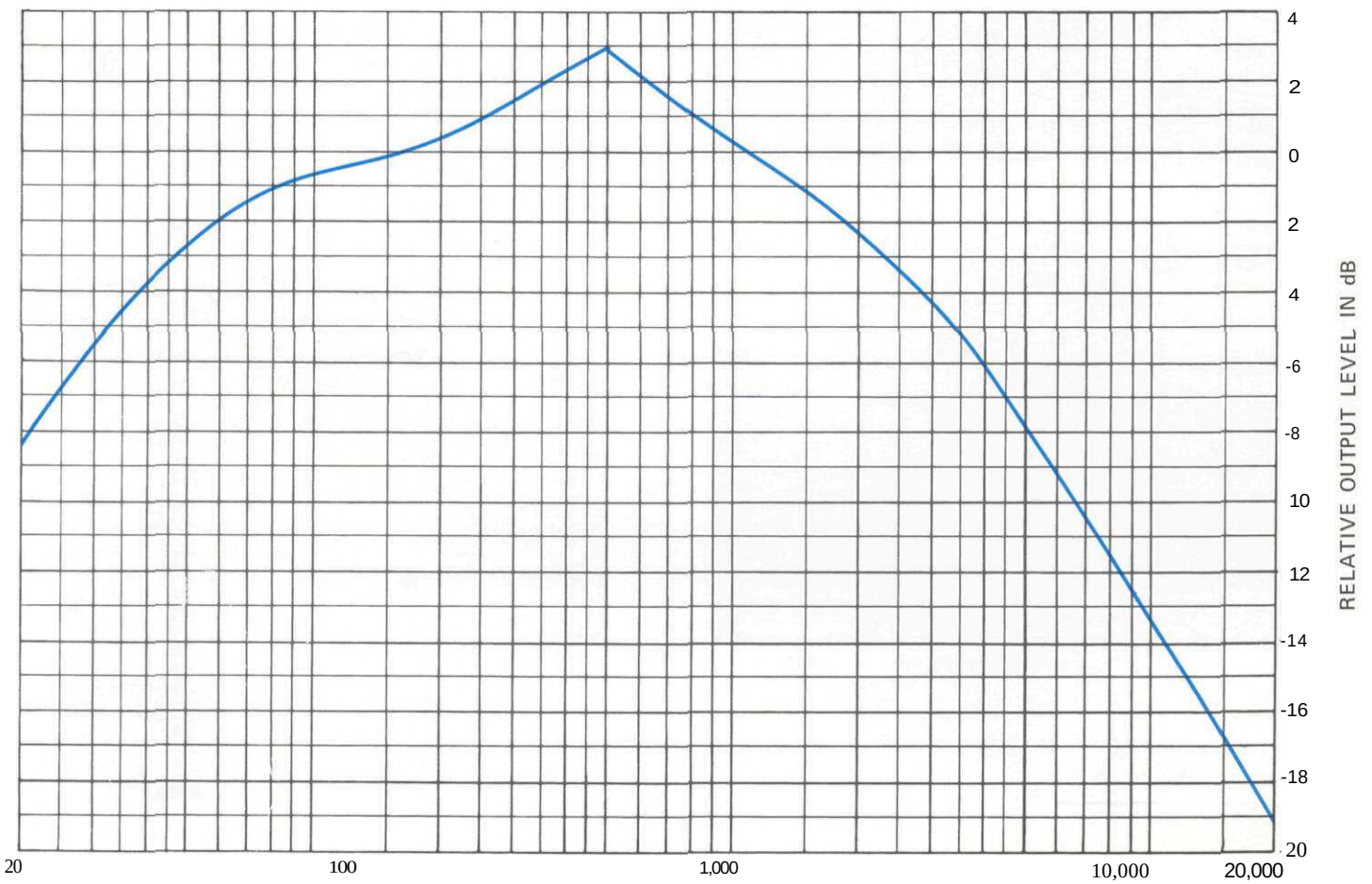
Make this test and all single frequency tests at low acoustic levels to prevent potential loudspeaker damage.

High intensity single frequency program material can overheat the loudspeakers voice coil and cause burn out. To perform this check:

1. Depress the L button.
2. Play the 1000 Hz test tone on the record.
3. Set the POWER LEVEL selector switch to a setting that produces an adequate display between 1000 and 0.1 watt.
4. Depress the 200-2,000 SWEEP FREQUENCY button and adjust the SWEEP control to obtain a few cycle waveform.
5. Referring to Figure 34: waveform A is sinusoidal and

IDEAL RIAA SYSTEM RESPONSE USING CBS STR 100 TEST RECORD





FREQUENCY IN Hz

FIG. 33

indicates the amplifier has low or little distortion: waveform B indicates poor linearity and clipping: while waveform C indicates crossover distortion.

6. Depress button R and observe the right channel waveform.

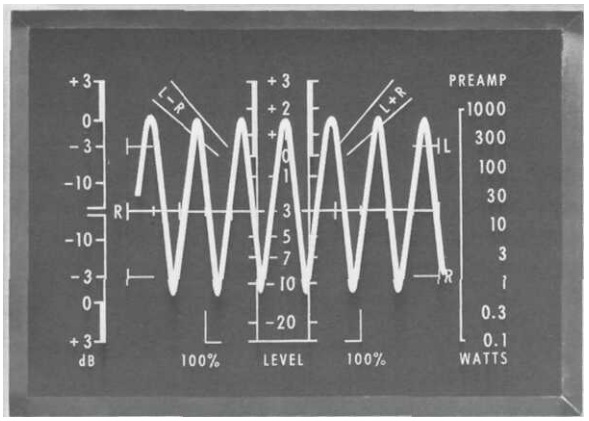
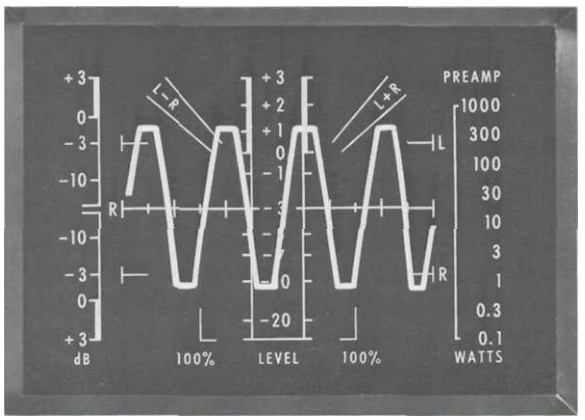
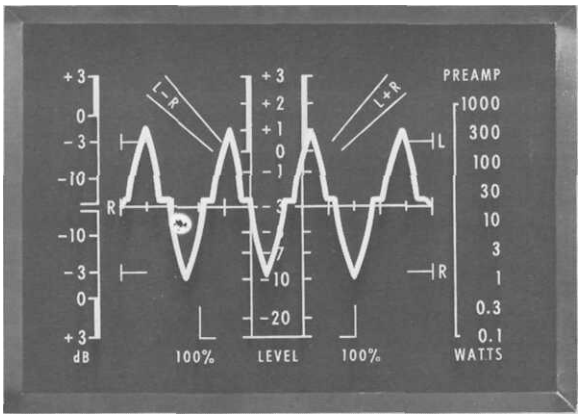


FIG. 34 (a) NORMAL



(b) CLIPPING



(c) CROSS OVER DISTORTION

Performance Limits

All ratings are nominal

MULTIPATH MODE OF OPERATION

Sensitivity: l00mV/cm
Frequency Response: DC to 50kHz (-3dB)
Input Impedance: 250,000 W
Signal Strength Polarity: Selectable positive or negative

STEREO MODE OF OPERATION

Sensitivity - L (Vertical Amp.): 1.75mV rms/cm (5mV P-P/cm)
Sensitivity - R (Horizontal Amp.): 1 75mV rms/cm (5mV P-P/cm)
Frequency Response: 5Hz to 50kHz (-3dB)
Input Impedance: 250,000W

POWER LEVEL MODE OF OPERATION

Sensitivity 0.1 to 1000 average watts for lull scale indication (+3dB) in 9 calibrated steps.
Frequency Response: 5Hz to 100kHz (-3dB)
Input Impedance: 75,000 W
Calibration: For bridging 4,8 or 16 ohm speaker loads

PREAMP LEVEL MODE OF OPERATION

Sensitivity: 15mV rms for +3dB indication
Frequency Response: 5Hz to 50kHz
Input Impedance: 250,000 W

SWEEP MODE OF OPERATION

Display modes: Left, right, or both (dual trace)
Sensitivity: 1.6mV rms/cm (4 5mV P-P/cm)
Frequency Response: 5Hz to 50kHz (- 3dB)
Input Impedance. 250,000 W
Sweep Frequency: 20Hz to 20,000 Hz in 3 Decade ranges
Sweep Expansion: 0.25X to 5X
Sweep I rigger: The sweep is triggered only in the presence of an input signal.

In the single trace mode it is triggered by the displayed waveform.

In the dual trace mode the trigger is selectable: left channel, right channel, or line frequency.

LEVEL INDICATION MODE

Normal 250 *m* s rise time
500ms fall time

Peak: 500ms rise time
25sec fall time

Reset. 250 *m* s rise time
l00sec fall time

LOW PASS FILTER

16,000 Hz L.F. Filter for stereo and sweep modes.

19,000 Hz and 38,000 Hz rejected by at least 30dB

RETICLE LIGHTING

Selectable: On-Off

CRT

3 inch round tube, calibrated 5 x 6cm

1,000 Volt accelerating potential

Automatic Intensity Control: In the absence of a horizontal signal, the intensity is reduced to prevent phosphordamage.

SEMICONDUCTOR COMPLEMENT:

2 integrated circuits
23 Transistors
10 Light emitting diodes
29 Diodes

POWER SUPPLES

All are regulated to give equivalent performance tor line voltages of 100 to 135 volts.

POWER REQUIREMENTS: 120 volts 50/60Hz 50 watts

SIZE:

Front panel measures 16 inches wide (40.65 cm) by 5-7/16 inches high (13.8 cm). Chassis measures 15 inches wide (38.1 cm) by 5 inches high (12.7 cm) by 13 inches deep (33.1 cm) including PANLOC mounting brackets and back panel connectors. Knob clearance required is 1½ inches (3.85 cm) in front of the mounting panel.

FINISH:

Front panel is anodized gold and black with special gold/teal nomenclature illumination. Chassis is black.

MOUNTING:

Exclusive Mclntosh developed professional PANLOC.

WEIGHT:

21 pounds (9.55 kg) net, 33 poinds (15 kg) in shipping carton.

Technical Description

INPUT SWITCHING AND DISPLAY

The MPI 4 has four inputs: tuner, preamplifier, power amplifier and front panel jack. The first three are permanently connected to the MPI 4, while the front panel jack provides the flexibility to observe additional signals.

Tuner signals are connected directly to the MODE SELECTOR-MULTIPATH pushbutton. The preamplifier, front panel jack and power amplifier signals are routed to the POWER LEVEL selector switch and then to the MODE SELECTOR pushbuttons. By setting the POWER LEVEL switch to PREAMP, preamplifier signals are selected for display. Whenever a plug is inserted into the front panel jack, the preamplifier connections at the rear of the MPI 4 are disconnected and the front panel jack signals are displayed instead. By setting the POWER LEVEL switch to a position other than PREAMP, power amplifier signals are displayed.

SIGNAL PROCESSING

Preamplifier signals and front panel signals are applied through LEFT and RIGHT AUDIO TRIM controls, the GAIN control and the POWER LEVEL switch to left and right preamplifiers. Power amplifier signals are routed through the IMPEDANCE MATCHING NETWORK, POWER LEVEL ATTENUATOR selector and POWER LEVEL switch to left and right signal amplifier.

Each of the signal amplifiers comprises one-half of a dual high-gain operational amplifier operating in a non-inverting mode. These amplifiers amplify the input signals to the level necessary to drive the peak detectors. Each peak detector consists of a diode and a capacitor which stores the peak level of the audio signal. Decay time is controlled by a resistor selected by the LEVEL MODE switch with Normal, Peak and Reset positions. The outputs of the signal amplifiers are also applied to a trigger source switch and the MODE SELECTOR switch.

The MODE SELECTOR switch routes tuner, preamplifier and peak detector output signals as follows:

1. In the MULTIPATH mode signal strength and deviation signals are applied to vertical and horizontal amplifiers, respectively.
2. In the STEREO mode left and right preamplifier signals are applied to the vertical and horizontal amplifiers.
3. In the LEVEL mode peak detector outputs are applied to a switching amplifier.
4. In the DUAL TRACE and SINGLE TRACE mode preamplifier signals are applied to a switching amplifier after going through or around the LOW PASS FILTER. The filter removes 19,000 and 38,000 Hz signals which interfere with the display.

The switching amplifier is a unity gain DC amplifier which alternately selects left and right channels. In the dual

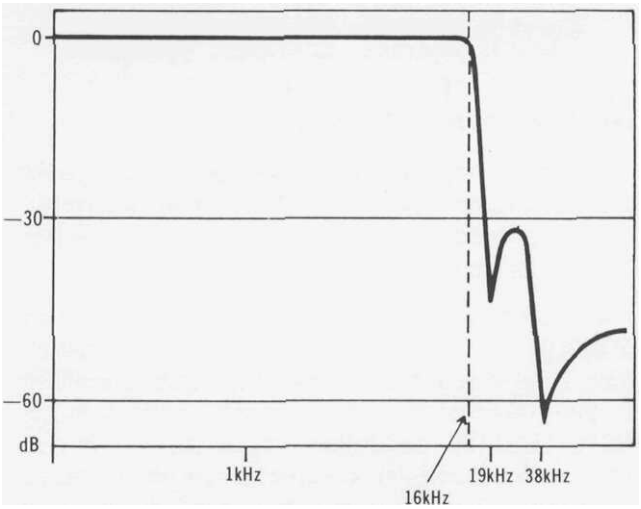


FIG. 34 LOW PASS FILTER RESPONSE

trace mode the right channel is offset from the left channel by an amount determined by the TRACE SEPARATION control. In the single trace mode the switching amplifier passes the desired channel (left or right) to the vertical amplifier.

Vertical and horizontal amplifiers are identical wide band DC coupled amplifiers. Each consists of two cascaded differential pairs. The input pair is a Darlington configuration for high input impedance. The second pair comprises high-voltage transistors that drive the deflection plates of the cathode ray tube.

AUTOMATIC INTENSITY CONTROL

An automatic intensity control circuit is connected to the output of the horizontal amplifier and senses the AC component of the horizontal output. The circuit works with the INTENSITY control; when modulation is not present intensity is reduced to avoid burning the phosphor on the face of the cathode ray tube. At all but full intensity settings the spot is extinguished. At full intensity the spot does not extinguish so it may be located and adjusted for position on the screen.

TRIGGER AMPLIFIER

The trigger amplifier operates in single and dual trace modes. Depending on the TRIGGER SOURCE switch setting, it uses left or right preamplifier outputs, or line frequency signals, to provide a steady presentation of small vertical deflection signals on the cathode ray tube. The trigger amplifier is a two-transistor high gain amplifier whose output voltage is compatible with the digital IC in the sweep generator.

SWEEP GENERATOR

When the sweep is triggered a linear ramp is generated by an R-C network consisting of a high-voltage source charging a capacitor through a high-value resistor. The resistor value is set by the SWEEP control, while the capacitor value is selected by SWEEP FREQUENCY push-buttons. The high-value resistor and high voltage effectively serve as a current source.

The linear ramp is fed into an emitter follower which provides the time base output and also drives a differential pair. The amplitude of the time base output is controlled by the SWEEP EXPANSION. The differential pair senses when the ramp has reached a certain voltage level. In single and dual trace modes this level is a fixed voltage and it determines when the sweep terminates. In the level mode this voltage corresponds to alternate outputs from the two peak detectors and determines the height of the two columns. When this voltage is reached, the differential pair generates a trigger hold-off pulse long enough to discharge the capacitor in the R-C network. During the hold-off period the sweep cannot be restarted and the cathode ray tube is blanked.

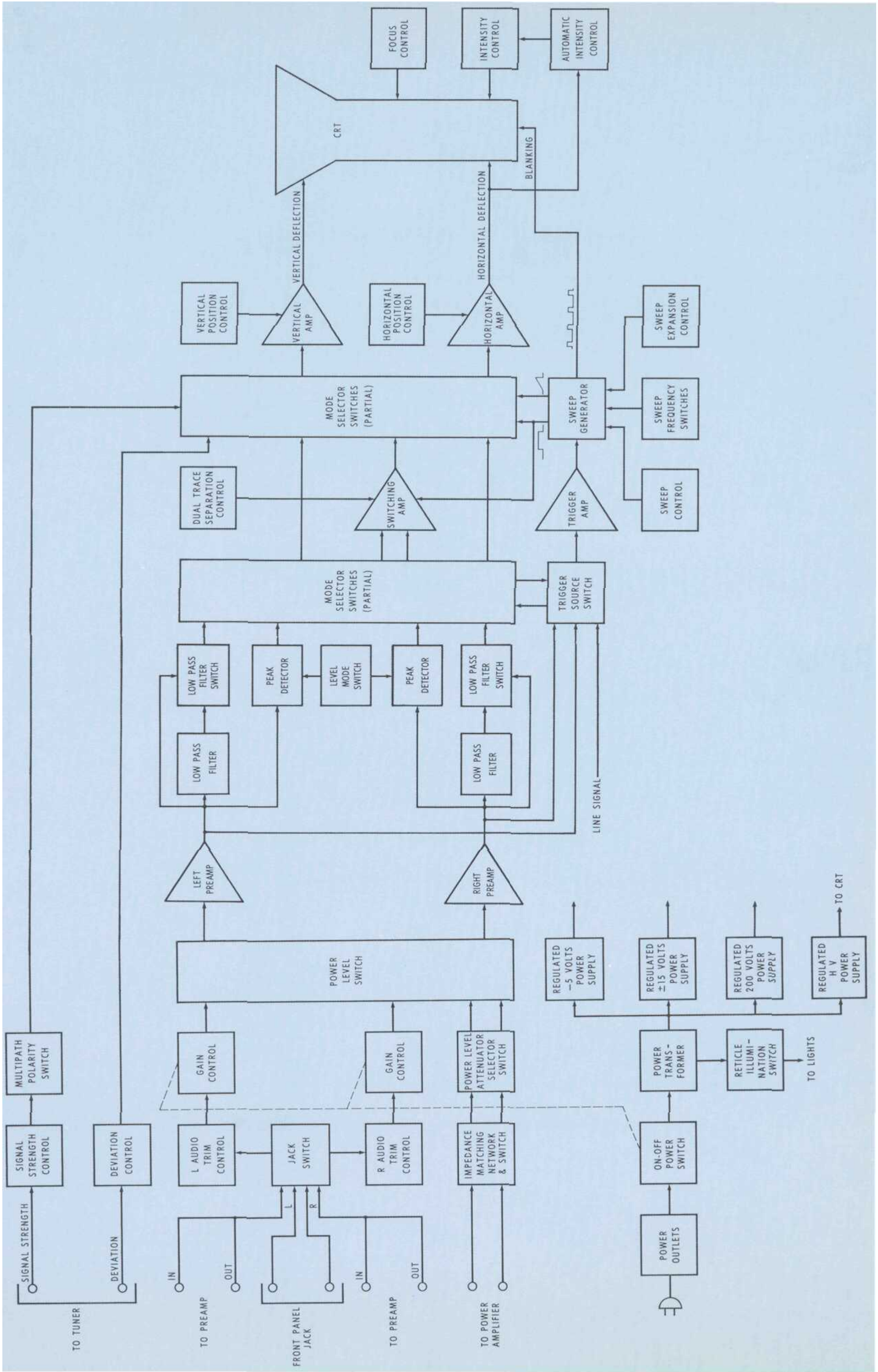
The hold-off pulse feeds one-half of a dual type D flip-flop and sets the flip-flop. When the hold-off pulse terminates, the flip-flop allows the capacitor to charge again after it receives a signal from the trigger amplifier. The other half of the flip-flop switches each time the ramp terminates the sweep. This half generates a square wave signal that drives the Left-Right switching amplifier. During the LEVEL mode the square wave alternates the column position to the left and right for a two column display.

POWER SUPPLIES

There are five power supplies in the MPI 4: -5 volts; + and -- 15 volts; 200 volts; and -1000 volts. Each is regulated to assure that the calibrated display does not change due to line voltage variations.

The - 5 and - 15 volt supplies are derived from a full-wave rectifier and are regulated by zener diodes. The 200 volt supply is derived from a half-wave rectifier and is regulated by an active voltage regulator. The -1000 volts supply, which provides cathode ray tube anode acceleration voltage, is obtained from a zener-regulated voltage doubler.

Block Diagram



BLOCK DIAGRAM

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