Equipment profiles

Hitachi Model SR-2004 Stereo AM/FM Receiver

MANUFACTURER'S SPECIFICATIONS

FM Tuner Section

Usable Sensitivity: Mono, 8.7 dBf (1.5 μV); Stereo, 24 dBf (8.9 μV).
50-dB Quieting: Mono, 12.5 dBf (2.3 μV); Stereo, 36 dBf (34.5 μV).
S/N: Mono, 75 dB; Stereo, 70 dB.
Mono THD: Wide Band, 0.07 per cent @ 1 kHz, 0.15 per cent @ 100 Hz, and 0.2 per cent @ 6 kHz; Narrow Band, 0.1 per cent @ 1 kHz, 0.15 per cent @ 100 Hz, and 0.25 per cent @ 6 kHz.
Stereo THD: Wide Band, 0.1 per cent @ 1 kHz, 0.25 per cent @ 100 Hz, and 0.3 per cent @ 6 kHz; Narrow Band, 0.2 per cent @ 1 kHz, 0.25 per cent @ 100 Hz, and 0.3 per cent @ 6 kHz.
Capture Ratio: 1 dB.
Frequency Response: 30 Hz to 15 kHz, +0.5, -1.0 dB.
Selectivity: Narrow, 85 dB; Wide, 45 dB.
Image and i.f. Rejection: 115 dB.
Spurious Rejection: 120 dB.
AM Suppression: 60 dB.
Stereo Separation: 50 dB @ 1 kHz.
Sub-carrier & SCA Rejection: 70 dB.
Muting Threshold: 28 dBf (14 μV).

Whether you call the circuit "Series E" or "Class G," there's no doubt that Hitachi's proprietary output-stage powering system does result in increased efficiency, less bulky heat-sink requirements, and somewhat smaller overall dimensions for the SR-2004 than might be required with a conventional "Class B" output circuit.

For those not familiar with the "Class G" circuit approach, briefly, the output transistors are powered by low- and high-voltage supplies and four transistors are used for each channel, strung out in series of two. Transistors powered from the lower voltage supply amplify the output signal so long as its amplitude is below a pre-determined value. When amplitudes exceed this value, the higher-powered transistors (operating from the higher voltage supply) turn on while the others turn off. The idea, here, is that each pair of transistors operates over its most efficient region, thereby improving overall efficiency. It follows, of course, that there are now as many as six-transition points in a given a.c. alternation of the signal waveform, as opposed to the two associated with Class B operation, and Hitachi has gone to great lengths (in terms of extra circuitry) to insure against "notch" or switching distortion as these additional switching effects take place.

The Class G scheme also makes possible higher levels of dynamic or "music" power than are usually available with typical class B power output circuits. Interestingly, Hitachi chooses to publish a "music power" rating for the SR-2004 — 400 watts per channel — despite the fact that the FTC discourages the use of such ambiguous wattage notations. In terms of the new IHF amplifier standards, a statement of Dynamic Headroom would be preferable and would, of course, be equal to 3 dB (twice the continuous power rating for short-term signals). In fact, we measured an even greater Dynamic Headroom for this unit, but more on that later.

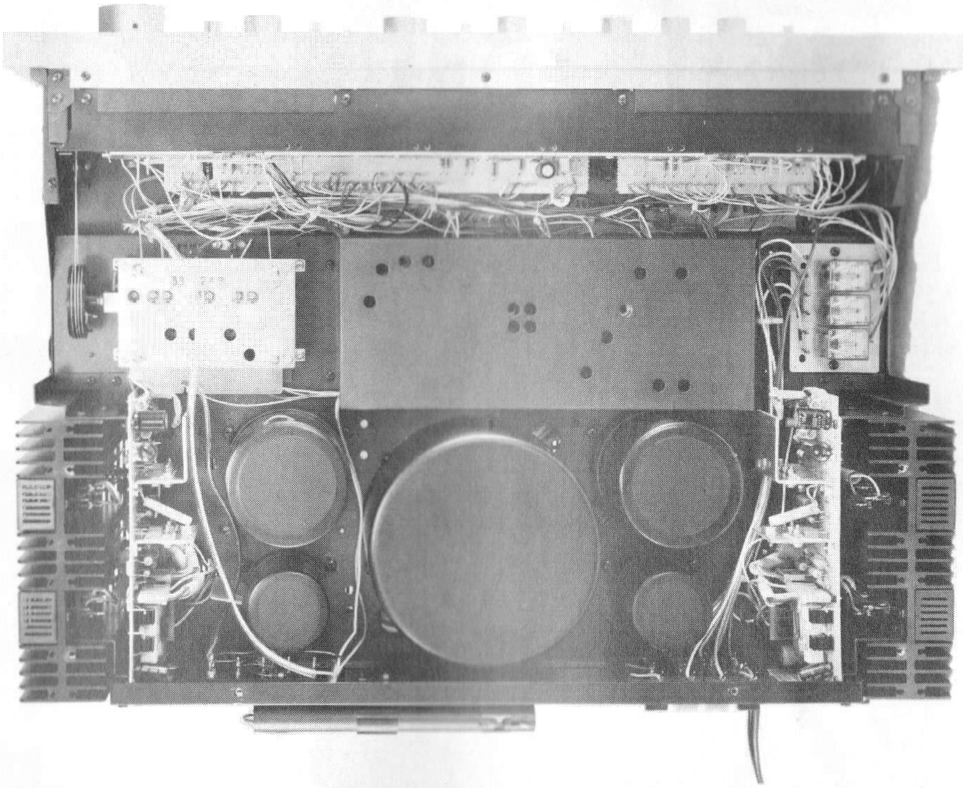
As for the front-panel layout, the easy-to-read, light-colored dial scale area is flanked by a pair of power output meters at the left and signal strength and center-of-channel tuning meters at the right. FM frequencies are linearly calibrated and above the scale are program source indicator lights, a stereo light, and an auto-lock light which illuminates when you let go of the tuning knob after tuning to the signal of your choice. The auto-lock feature is a refined form of AFC which is disabled by the capacitive switch that is relay-activated when you touch the tuning knob.

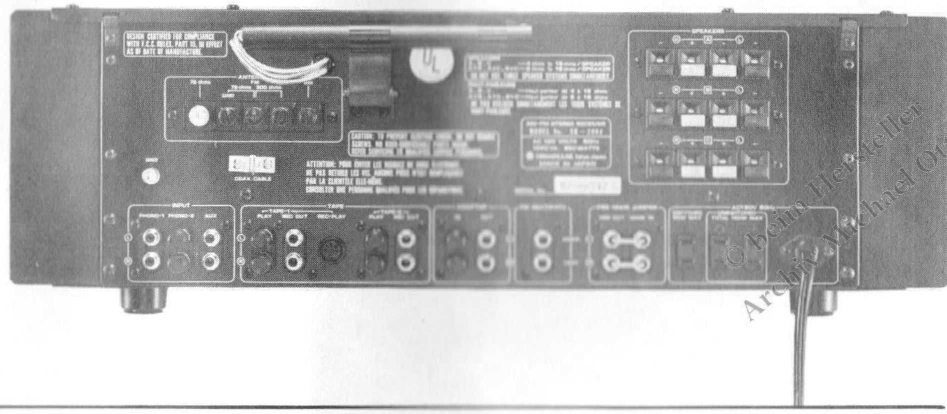
A protection-circuit indicator light is located just below the power output meters and, in line with it, are four clusters of oval shaped pushbuttons. The first three of these select speakers. Low- and high-cut filter switches are next, followed by an MPX noise filter switch, an FM-mute defeat switch (which also cancels the auto-lock feature), an i.f. bandwidth switch, and an FM multipath switch which converts the signal-strength meter to a multipath indicator. The remaining three pushbuttons are a *Mono/Stereo* mode switch, *Loud-*

AM Tuner Section
Sensitivity: 370 µV/M, internal antenna; 20 µV, external.
Image Rejection: 70 dB.
I.f. Rejection: 90 dB.
Selectivity: 40 dB.
S/N: 50 dB.

Amplifier Section
Continuous Power Output: 200W/channel, 8 ohm loads, 20 Hz to 20 kHz.
Rated THD: 0.08 per cent.
Music Power: 400 W per channel into 8 ohms.
Rated IMD: 0.08 per cent.
Input Sensitivity: Phono, 2.5 mV; High Level, 150 mV; Mike, 3 mV.
Max. Phono Input Level: 500 mV.
S/N ("A" Weighted, referenced to full output): Phono, 75 dB; High Level, 90 dB.
Damping Factor: 75.
Frequency Response: Phono, RIAA, ±0.2 dB; High Level, 10 Hz to 40 kHz, ±1.5 dB.
Bass Control Range: ±10 dB @ 50 or 100 Hz (depending upon turnover selected.)
Treble Control Range: ±10 dB @ 10 or 20 kHz.
Midrange Control: ±6 dB @ 1 kHz.
High-Cut Filter: -10 dB @ 10 kHz.
Low-Cut Filter: -10 dB @ 50 Hz.

General Specifications
Power Consumption: 850 watts, 120 V, 60 Hz.
Dimensions: 22¾ in. (57.8 cm) W x 7½ in. (19 cm) H x 17½ in. (44.5 cm) D.
Weight: 56.2 lbs. (25.5 kg).
Price: $950.00





ness switch, and an *Adaptor* switch which creates a "circuit-break" for insertion of accessory devices such as Dolby decoders; equalizers, etc.

Controls along the lower section of the panel include a power *On/Off* switch, phone jack, three-position bass and treble turnover switches, *bass, mid-range, and treble* tone controls, *Balance* control, muting lever switch (with -20 and -40 dB positions), master volume control, tape copy and tape monitor lever switches, program selector switch, mike mixing level control, microphone input jack, and a large tuning knob coupled to an effective flywheel tuning arrangement.

In addition to three sets of spring-loaded speaker terminals, the rear panel is equipped with three a.c. receptacles (two unswitched, one switched), preamp-out/main-amp in jacks, horizontal and vertical output jacks for connection to an oscilloscope (for observation of multipath effects), and

Fig. 1—Mono and stereo quieting and distortion characteristics in the wide-band setting.

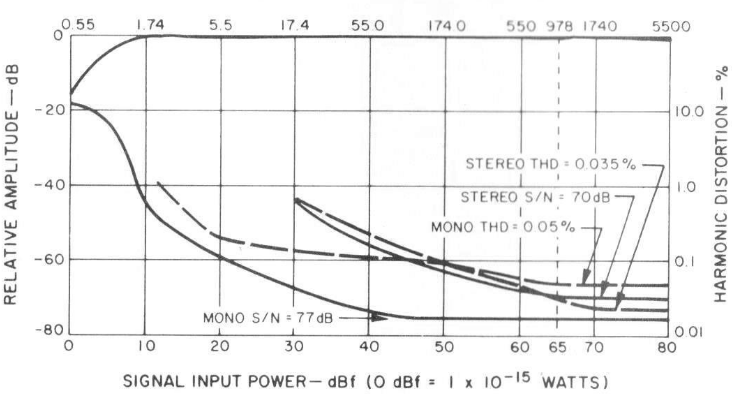
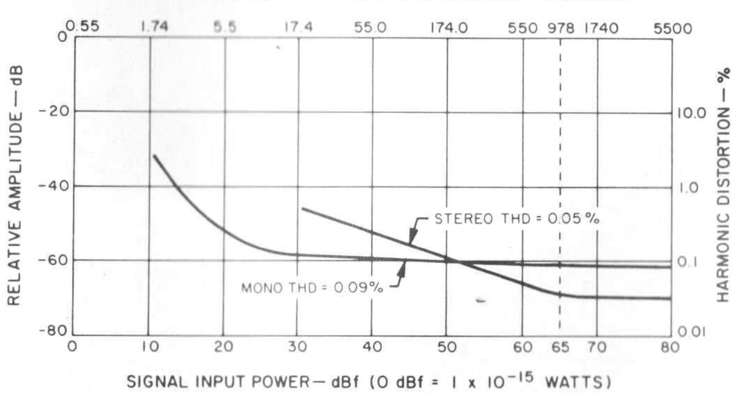


Fig. 2—Mono and stereo distortion characteristics in the narrow-band setting.



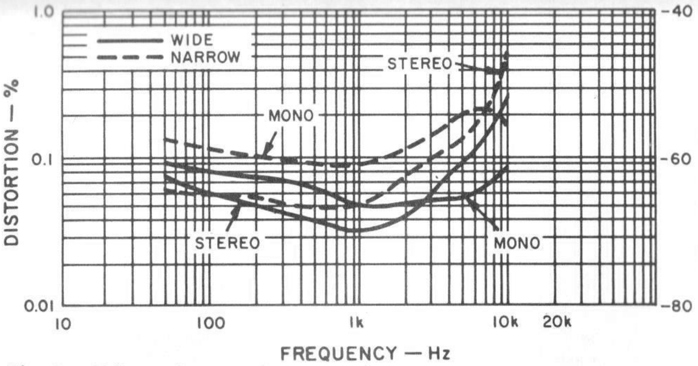


Fig. 3—Distortion vs. frequency in the wide- and narrow-band settings.

the usual array of tape-out/tape-in jacks, AUX input jacks, and two pairs of phono input jacks. An extra set of jacks is provided for the adaptor or accessory connection controlled from the front panel. Antenna terminals include AM, 300-ohm FM, and 75-ohm coaxial connector, and a chassis ground terminal is located adjacent to the phono inputs. A ferrite-bar AM antenna swings away from the rear panel for improved AM reception.

Circuit Highlights

The FM front end of the Hitachi SR-2004 employs three dual-gate MOS-FETs and a five-gang variable capacitor. In the wide-band setting of the i.f. system, a "saw"-filter including a four-pole LC linear-phase arrangement is employed, while for the narrow, higher selectivity setting, two linear-phase ceramic filters are employed. The i.f. amplifier is a six-stage differential type and utilizes three ICs. Quadrature detection is used to recover the composite FM stereo signal which is decoded by means of a phase-lock-loop circuit contained in the MPX IC.

A ceramic filter is employed in the AM section of the receiver, along with a three-gang tuning capacitor.

The Class G output circuit has already been described and in the SR-2004 it is combined with an electronic protection circuit which disconnects speakers in the event of a circuit fault or amplifier current overload.

FM Performance Measurements

While ultimate signal to noise measured the same for both the narrow and wide i.f. settings (77 dB in mono, 70 dB in stereo), there were, as might be expected, signficant differences in the distortion observed when using the two available i.f. bandwidths. Figure 1 shows the mono and stereo quieting and distortion characteristics using the wide band setting. Harmonic distortion in mono was an incredibly low 0.05 per cent and 0.035 per cent in stereo. We suspect here that such low readings are partly the result of distortion inherent in our test equipment serving to cancel the minute distortion actually generated by the tuner circuits, since we would not normally expect to read lower THD figures in stereo than we do in mono.

Figure 2 is a plot of harmonic distortion versus signal input level, this time with the tuner section switched to the "narrow" setting. Despite the high selectivity achieved with this setting, distortion figures were still very low, with readings of 0.09 per cent in mono and 0.05 per cent in stereo for a 1-kHz test signal. In Fig. 3 we have plotted distortion versus test frequency for mono and stereo for both the wide-band and narrow-band settings. Even under the very worst conditions (6 kHz), stereo distortion was still a low 0.6 per cent. While frequency response was not at all affected by choice of bandwidth settings (see Figs. 4 & 5), separation did decrease slightly when the narrow-band setting was used.

In the narrow-band mode, separation measured 48 dB at 1 kHz, 44 dB at 100 Hz, and 34 dB at 10 kHz, while in the wide-band mode the separation increased to 58 dB at mid frequencies, 44 dB at 100 Hz, and 52 dB at 10 kHz.

Capture ratio measured 1.2 dB, and selectivity was 88 dB in the narrow mode and 43 dB in the wide mode. All forms of rejection were better than 100 dB below 100 per cent modulation and AM suppression measured 60 dB, exactly as claimed. Both muting and stereo threshold were on the high side of where we prefer to see them, with readings of 15 μV (28.7 dBf) and 18 μV (30.3 dBf) respectively. Sub-carrier output products were buried beneath the residual noise level in stereo which, itself, was 70 dB below full modulation.

The response of the AM section of the receiver is plotted in Fig. 6. Vertical divisions in all of the 'scope photos of this report are calibrated to 10 dB each, so that the AM response was down some 20 dB at 5 kHz, referenced to the output at 1 kHz.

Amplifier Section Measurements

Continuous power output per channel, with an input test signal of 1 kHz, was 252 watts per channel for the rated THD figure of 0.08 per cent. At 200 watts per channel output, using 8-ohm loads, THD measured only 0.01 per cent while IM distortion measured 0.04 per cent. With power bandwidth (at the 200-watt level) extending from a low 9 Hz to 44 kHz, actual FTC rated power within the stated power band from 20 Hz to 20 kHz was 222.6 watts as opposed to the 200 watts claimed. Dynamic headroom was higher than that of any receiver we have measured since we began testing for this new specification. It measured just under 4.0 dB, substantiating Hitachi's claim that the receiver can deliver far more power under short-term musical signal conditions than might be suggested by its continuous power rating. Harmonic distortion plus noise is plotted as a function of continuous power output per channel for this receiver in Fig. 7, while in Fig. 8 we have shown the THD plus noise at all frequencies within the audio band for rated (200 watts per channel) output. Damping factor, measured at 50 Hz, was 86.

Fig. 4—Frequency response and stereo separation in the wide-band setting.

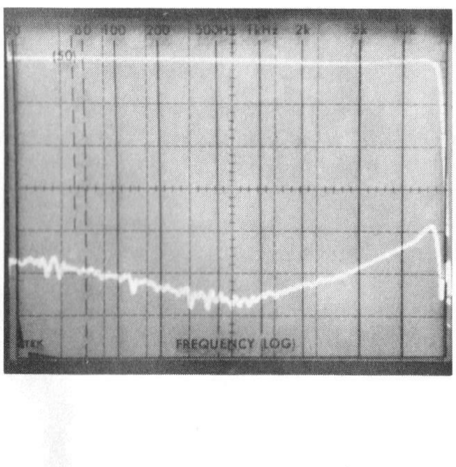


Fig. 5—Frequency response and stereo separation in the narrow-band setting.

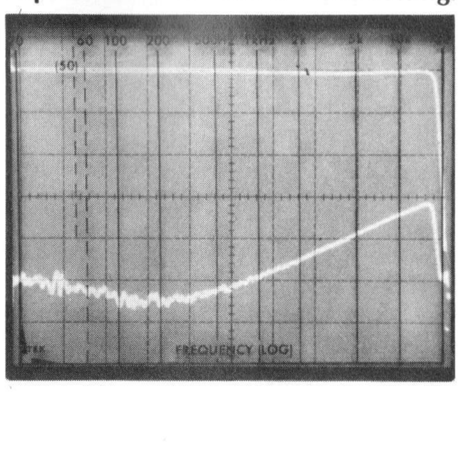
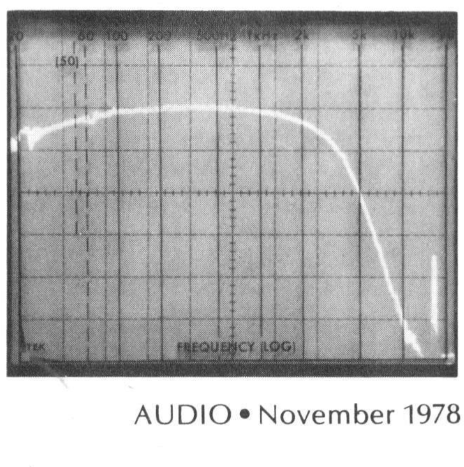


Fig. 6—AM frequency response.



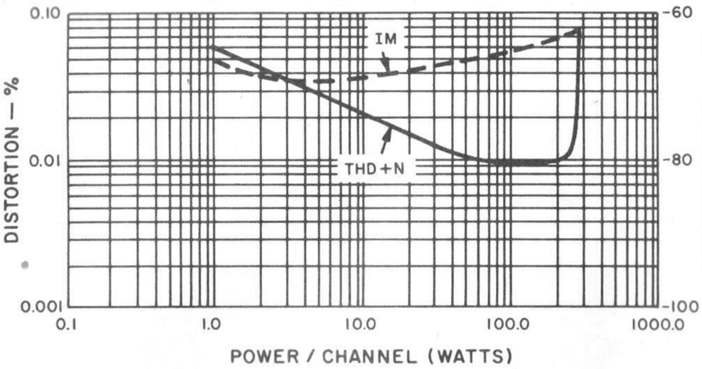


Fig. 7—THD and noise vs. power output.

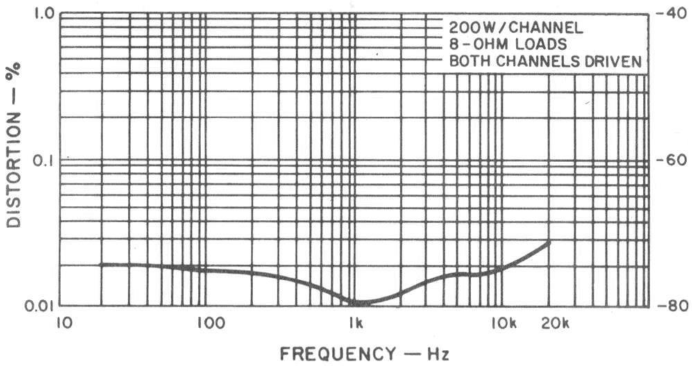


Fig. 8—THD and noise vs. frequency.

The phono sections had an input sensitivity for rated output of 2.6 millivolts which, translated to the new IHF standards, works out to an input sensitivity of 0.18 millivolts for 1-watt output. Phono overload with a 1-kHz input signal occurred at 640 millivolts, while phono S/N measured 74 dB referred to full output. Measured in accordance with the new IHF specs, phono S/N was 63 dB, while high-level S/N was 64 dB. RIAA equalization was accurate to within 1.0 dB from 20 Hz to 20 kHz, while high-level frequency response was flat to within 1.5 dB from 10 Hz to above 30 kHz, measured via the AUX inputs.

Figure 9 is a composite sweep-frequency plot of bass and treble control range when the 100-Hz and 3-kHz turnover points are selected. These frequency designations are actually erroneous, since the 3-dB turnover points of the tone controls using these settings turn out to be more like 200 Hz and 2 kHz. The same thing applies to the alternate turnover settings, the control range of which is plotted in the 'scope photo of Fig. 10 and upon which has been superimposed the control range of the mid-range tone control. Loudness control action is plotted for various settings of the volume control in Fig. 11.

Listening and Use Tests

During the brief time in which we have been using and listening to the Hitachi SR-2004, we have been particularly impressed with its ability to deliver high levels of short-term transient musical signals to our reference speaker systems. Normally, when driving these speakers to exceptionally loud levels, we are able to perceive a certain amount of raggedness in the high-frequency region as clipping levels are approached. This was not the least bit in evidence in the case of the SR-2004, and the reason becomes clear if one monitors output signals on a calibrated 'scope. Some of the transient peaks we observed were actually more than 4 dB greater in amplitude than the continuous power output reference lines on the 'scope (adjusted for the equivalent of 200 watts per channel) and yet there was no evidence of either compression or clipping. Sustained listening at such levels did not induce the kind of listening fatigue which normally occurs when repeated short-term overload takes place. Nor were we able to detect any switching distortion caused by the novel Class G circuit (and to which we were particularly sensitive, since we suspected that such distortion might be audible).

While in theory (and on the bench) we heartily subscribe to the "wide band" FM alternative provided by the FM tuner section of this receiver, we were unable to detect any difference in overall tonal quality when switching from the wide to the narrow mode. This bodes well for the SR-2004 if it is to be used in areas where use of the wideband setting is impossible because of station crowding on the dial.

Phono reproducton was impressive, with no evidence of poor transient overload recovery and tight, unmuddied overall response. "Transmitting" the same recorded material via our FM generator and picking up the signal on FM made for a good comparison between FM reception qualities of the tuner and direct listening via the preamp/amplifier section and, aside from a slight increase in residual noise level (our radiated signal, though close to the receiver, does not quite deliver 65 dBf of signal strength at the antenna terminals and we prefer to make this test without direct connection from signal generator to antenna terminals).

The Hitachi SR-2004 offers a classic example of a receiver that delivers "louder" sound without distortion than other similarly rated units. The new IHF Dynamic Headroom specification permits Hitachi to properly boast about this achievement without resorting to obsolete "music power" wattage ratings, and we would hope that the company will quickly avail themselves of this new and important specification in future representations of Class G products. The receiver is fairly priced for the performance it delivers and, thanks to its high efficiency, saves a bit of power in the process, not to mention the fact that it's a bit easier to cart home than most others in the same power category. *Leonard Feldman*

Fig. 9—Bass and treble control range with 100 Hz and 3 kHz turnover settings.

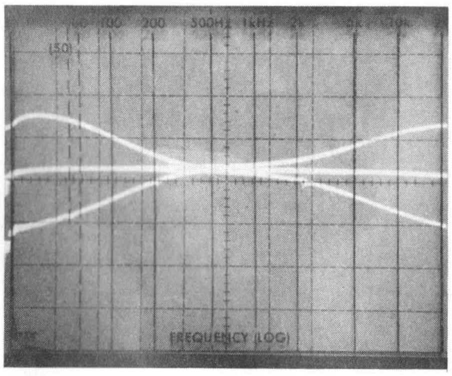


Fig. 10—Bass and treble, plus midrange control range, with 50 Hz and 6 kHz turnover settings.

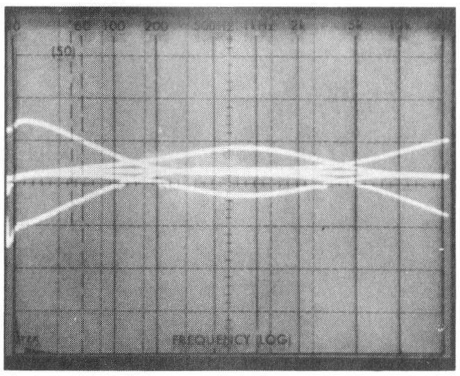


Fig. 11—Loudness control characteristics.