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YAMAHA R-9 RECEIVER

Manufacturer's Specifications

FM Tuner Section

Usable Sensitivity: 8.8 dBf (see text).
50-dB Quieting Sensitivity: Mono, 14.8 dBf; stereo, 37.3 dBf.
S/N Ratio: Mono, 85 dB; stereo, 81 dB.
THD: Mono, 0.05% at 1 kHz, 0.05% at 100 Hz, and 0.1% at 6 kHz; stereo, 0.07% at 1 kHz, 0.07% at 100 Hz, and 0.15% at 6 kHz.
Alternate-Channel Selectivity: 85 dB.
Image Rejection: 40 dB.
I.f. Rejection: 90 dB.
AM Rejection: 55 dB.
Spurious-Response Rejection: 70 dB.
Capture Ratio: "Local," 1.2 dB; "DX," 2.5 dB.
Stereo Separation: 50 dB at 1 kHz, 45 dB at 100 Hz, 45 dB at 10 kHz.
Frequency Response: 30 Hz to 13 kHz, ±0.5 dB.
Output Level: 500 mV for 100% modulation.

AM Tuner Section

Usable Sensitivity: 250 μV/m.
Selectivity: 24 dB.
S/N Ratio: 50 dB.
Image Rejection: 40 dB.
Spurious-Response Rejection: 50 dB.
THD: 0.3% at 400 Hz.
Output Level: 150 mV for 30% modulation.

Amplifier Section

Power Output: 125 watts continuous per channel, 20 Hz to 20 kHz, 8-ohm loads; 145 watts continuous per channel, 20 Hz to 20 kHz, 6-ohm loads.
Rated THD: 0.015% at 8 ohms, 0.03% at 6 ohms.
Dynamic Headroom: 1.58 dB.
Damping Factor: 60 at 8 ohms.
Input Sensitivity: MM phono, 0.22 mV; MC phono, 14 μV; high level, 13.4 mV.
Phono Overload: MM, 110 mV; MC, 8 mV.
Frequency Response: MM phono, RIAA ±0.3 dB; MC phono, RIAA ±0.5 dB; high level, 20 Hz to 20 kHz, +0, −0.3 dB.
S/N Ratio: MM phono, 75 dB; MC phono, 74.5 dB; high level, 80 dB.
Residual Noise: 120 μV.
Subsonic Filter Cutoff: 10 Hz, 12 dB/octave.
Tone Control Range: Bass, ±10 dB at 50 Hz; treble, ±10 dB at 20 kHz; midrange, ±12 dB at 1 kHz.
Loudness Control Range: 40 dB at 1 kHz.

General Specifications

Power Requirements: 120 V, 60 Hz, 500 watts.
Dimensions: 17⅛ in. W × 5-15/16 in. H × 16⅝ in. D (43.5 cm × 15.1 cm × 42.2 cm).
Weight: 26 lbs., 7 oz. (12 kg).
Price: $799.
Company Address: 6660 Orangethorpe Ave., Buena Park, Cal. 90620.
For literature, circle No. 90

Yamaha describes the Model R-9 as an audio/video receiver. I can't deny that it is able to handle and switch signals from two video program sources, including both video and audio (stereo or mono) signals, and to direct those signals to a connected video monitor. Nevertheless, I wish manufacturers would agree on precisely what constitutes an A/V receiver. I've seen some that simply provide a couple of extra inputs for the audio tracks of a VCR or other video program source; at the other extreme are those which switch a variety of video program sources and even have built-in TV audio tuners. The R-9 falls somewhere in between these two extremes.

In terms of its sound capabilities, the R-9 is a superb example of the audio art. Most of the features that have impressed me favorably over the years in earlier Yamaha receivers have been carried over into the R-9. For example, it has a *legitimate* loudness-compensation control; that is, a separate, continuously variable control adjusts the degree of compensation according to the requirements of your actual maximum listening levels, speakers used, etc. Another excellent feature—and one which Yamaha was among the first to introduce—is a separate "Record Out" selector which allows you to record one program source while listening to another. In addition to its high power rating at low distortion levels, its excellent frequency-synthesized tuning system and its 16-station preset capability, the R-9 has a wireless remote control. In some respects, I found that having a remote module for a stereo receiver is even more useful than having one for a TV or a video recorder.

Another interesting innovation, found in the receiver's amplifier section, is its dual mode of operation. At the user's discretion, the amp will operate in true Class A up to around 20 watts per channel, automatically switching to Class AB if signal levels exceed that power output. Of course, in the Class-A mode, power consumption—even with no signal applied—is much higher than in Class B, so you are given the option of having the system operate in Class AB at all times if you feel that the sonic improvement offered by Class A isn't worth the extra power drain.

The tuner has its share of innovative circuitry, too. What Yamaha calls a Computer Servo Lock Tuning System samples incoming signals and determines which of two tuning methods will yield the best and clearest sound. A synthesized, phase-locked-loop tuning circuit is used for weak or noisy stations; for stronger, clearer signals, the R-9 uses an "infinite resolution" FM servo tuning circuit—that is, one which locks onto the station signal rather than the station frequency. "Local" or "DX" settings can be selected manually or automatically, and the new digital fine-tuning arrangement permits you to tune in increments as small as 0.01 MHz in FM or 1 kHz in AM.

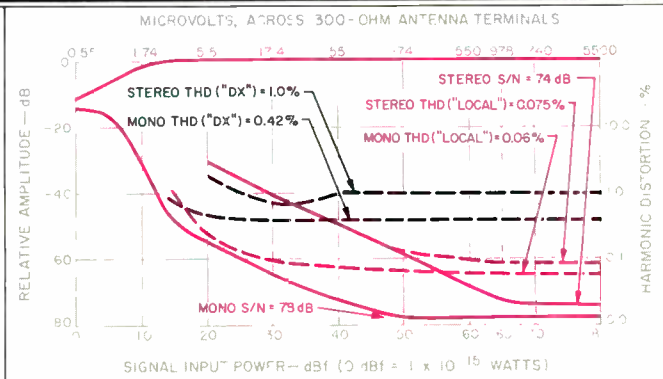


Fig. 1—Mono and stereo quieting characteristics in "Local" (wide-band) mode, and distortion in both "Local" and "DX" (narrow-band) modes, FM section.

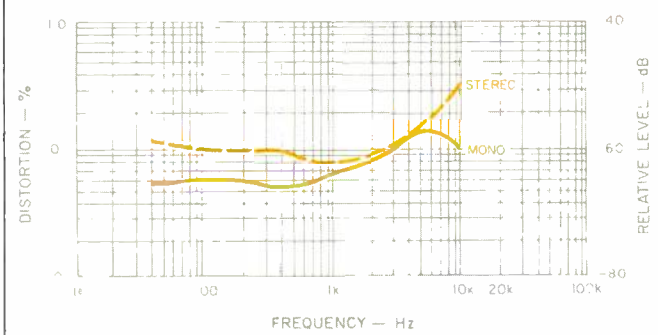


Fig. 2—THD vs. modulating frequency, "Local" mode, FM section.

Control Layout

The R-9 is a rather tall receiver, its front panel standing nearly 6 inches high, which gives it a somewhat heavy look. But the height is needed, if for no other reason than to accommodate the great number of controls and switches on the front panel. Many of the less often-used controls and switches are hidden behind a hinged flap so that the panel doesn't look quite as cluttered as it otherwise might.

Most of the controls that are always in view are pushbuttons. There are buttons for on/off switching, audio and video program selection, audio muting, and activation of the automatic Class-A/Class-AB selector. There is also a row of 15 tuner controls. These include eight preset buttons (plus a shift key for selecting any combination of 16 AM or FM stations), and others which activate the preset "Memory" or select the band (AM or FM), the "Receiving Mode" ("Local," "DX," or automatic switching between them), and the "Tuning Mode" (manual or auto scan). Rockers for regular and fine tuning complete this group. The only rotary controls normally visible are the "Volume" knob and the "Loudness" ring surrounding it. The continuously variable loudness control has a full, 40-dB range, as opposed to the 20-dB range on earlier versions of Yamaha's separate loudness control.

Visible at all times, at the upper left of the front panel, is the digital display for AM or FM frequency and a 10-segment "Signal Quality" bar-graph display. Additional indications in this area show the current tuning and receiving modes and which, if any, of the 16 preset stations is current-

With 2.3 dB of dynamic headroom, the R-9 can deliver more than 200 watts per channel, in short bursts, without clipping!

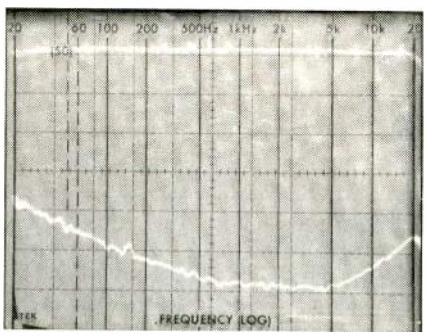
ly selected. Lights to the right of the display show the status of the "DNC" (Dynamic Noise Canceller) and "Simulated Stereo" circuits. In addition, tiny indicator lights illuminate above the program selectors when each is activated.

Opening the hinged flap on the lower section of the R-9's front panel reveals a headphone jack; three speaker-selector pushbuttons; a "Tone Bypass" switch; bass, midrange, and treble rotary tone controls with detented center positions; a balance control; pushbuttons for "DNC" (a single-ended dynamic filter along the lines of the more familiar DNR), "Simulated Stereo," "Stereo/Mono," and "MM/MC" phono, plus a rotary record-out selector.

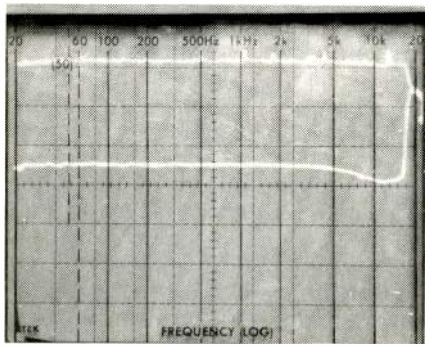
Functions of the wireless remote control are limited to input selection, power on/off, selection of any one of the 16 preset AM or FM stations, audio muting, and volume adjustment. These functions are the ones you would most likely want to control from the comfort of your listening position.

A diagram in the owner's manual, depicting how various external components would be connected to the R-9, gives some idea of just how much of a "control center" this receiver really is. Shown are a pair of videocassette recorders (one of which could just as easily be a videodisc player), a TV monitor (which must have a video input jack; connection via the antenna input will not do), a Compact Disc player, a turntable equipped with either a moving-magnet or a moving-coil cartridge, two audio tape decks, and *three* sets of loudspeakers.

Few amplifiers or receivers have three sets of speaker outputs, because the net load impedance could fall dangerously low if all three were connected across the amplifier's outputs at once. Yamaha gets around this by connecting the "B" and "C" speaker terminals in series, to maintain a reasonably high net impedance across the amplifier output during use with three sets of speakers. Operating speakers in series will, of course, seriously compromise the amplifier's effective damping factor, and should be done only for casual listening in secondary locations. When either the "B" or "C" speakers are used alone or in combination with the "A" speakers, the impedance problem does not arise.



A



B

Fig. 3—Frequency response (upper traces) and separation vs. frequency (lower traces) in "Local" (A) and "DX" (B) modes, FM section.

Tuner Measurements

In testing the R-9's FM tuner section, I quickly established that the major difference between the "Local" and "DX" tuning modes was not so much in sensitivity as in selectivity. In other words, the "Local" setting corresponds primarily to a wide i.f. bandwidth setting on other tuners and receivers; the "DX" setting provides higher alternate-channel selectivity, useful for zeroing in on weaker stations that might otherwise be interfered with by strong stations broadcasting at frequencies near the desired signal's.

Figure 1 shows mono and stereo quieting characteristics in the "Local" mode. It also shows harmonic distortion for a 1-kHz modulating signal, in mono and stereo, for both the "Local" and "DX" modes. With the tuning set to "Local" (wide) mode, best S/N ratio in mono was 78 dB; in stereo, it was 74 dB. Usable sensitivity measured 12 dBf, improving somewhat to 10.8 dBf when I switched to the "DX" position. Yamaha's claim of 8.8-dBf usable sensitivity in mono is measured for a 30-dB signal-to-*noise* ratio. The IHF standard usable-sensitivity measurement is for a 30-dB ratio of signal to *noise plus distortion*. Hence the apparent discrepancy between my reading and Yamaha's. Our testing methods were obviously the same when it came to 50-dB quieting sensitivity, however. I measured exactly 14.5 dBf in mono and 37.0 dBf in stereo, close enough to Yamaha's published figures.

Figure 1 also shows how distortion rises when tuning is switched to the "DX" (narrow) i.f. mode. In the "Local" mode, harmonic distortion decreased to a low of 0.06% in mono and an almost equally low 0.075% in stereo. Using the "DX" setting, I measured 0.42% THD in mono at all signal levels above about 40 dBf, and stereo THD rose to around 1.0%. Figure 2 shows how THD varied with frequency, for mono and stereo, again in the "Local" or low-distortion mode. Even at 6 kHz, in stereo, THD was only 0.17%.

Tuning mode ("Local" versus "DX") had a great effect upon FM stereo separation, too, as you can see by looking at Figs. 3A and 3B. Both of these spectrum analyses were made for strong-signal conditions and cover the range from 20 Hz to 20 kHz in a logarithmic sweep. The top trace in each case represents desired output from the modulated (left) channel, and therefore constitutes a frequency response plot over the stated frequency range. Deviation from flat response was never greater than 0.3 dB in the "Local" mode (Fig. 3A) and was down 1.5 dB at 15 kHz for the "DX" mode (Fig. 3B). Separation was superb in the "Local" mode (bottom trace of Fig. 3A). It was 58.5 dB at mid-frequencies, nearly 50 dB at 100 Hz, and in excess of 40 dB at 10 kHz. In the "DX" mode, with its higher selectivity but more restricted bandwidth, separation decreased to less than 30 dB across the entire audio spectum (bottom trace of Fig. 3B)—still

The 82-dB S/N ratio on phono would be very good for a separate preamp. When you consider all the possible noise sources in a receiver, it's remarkable.

adequate for good stereo imaging, but nowhere near as high as with the "Local" setting.

Figure 4 shows output products observed from the unmodulated channel's output when the opposite channel is fully modulated by a 5-kHz signal. The sweep extends linearly from 0 Hz to 50 kHz, and the tall spike at the left is the desired 5-kHz signal (the shorter one within it represents the crosstalk at the opposite channel's output). A rather high-amplitude, 19-kHz subcarrier product can be seen to the right of these spikes. Still further to the right is a short spike representing residual 38-kHz output, surrounded by sidebands which are 5 kHz above and below 38 kHz.

I measured a capture ratio of 1.1 dB in the "Local" mode; in the "DX" mode, capture ratio increased to 2.5 dB, as claimed by Yamaha. Both i.f. and spurious-response rejection were 90 dB, AM rejection was 57 dB, and alternate-channel selectivity (measured in the "DX" mode) was 87 dB, a bit higher than the published spec of 85 dB.

AM frequency response, plotted in Fig. 5, extends from around 50 Hz to 4 kHz for the −6 dB points. Best signal-to-noise ratio in AM was exactly 50 dB, as claimed, while harmonic distortion at 30% modulation measured 0.35% for a 1-kHz modulating signal.

Amplifier Measurements

In the "Auto Class A" mode, the R-9's power amplifier section operated in Class A until output power into 8-ohm loads exceeded 20 watts, at which point it smoothly made the transition to Class-AB operation. Maximum output for rated THD was 144 watts per channel into 8-ohm loads for most of the audio spectrum, decreasing to 136 watts per channel at 20 Hz and 139 watts per channel at 20 kHz. The receiver's rating of 125 watts per channel is, therefore, very conservative. In fact, at rated output of 125 watts per channel, THD at mid-frequencies was a mere 0.0028%, and at the frequency extremes of 20 Hz and 20 kHz, THD measured only 0.009% and 0.007%, respectively. Distortion as a function of power output and frequency is shown in the three-dimensional plot of Fig. 6.

Damping factor of the power amplifier section was 79, referred to 8 ohms, using a standard 50-Hz test signal. Dynamic headroom was very high, measuring 2.3 dB above the rated continuous power level of 125 watts per channel. This means that for short, music-like bursts of signal, the R-9 can deliver in excess of 200 watts per channel without significant clipping! Twin-tone or CCIF distortion was no more than 0.0026% at rated output power.

Phono input sensitivity for 1 watt output was 0.23 mV for the MM phono input and 15 μV for the MC input; 15 mV of input signal was required for the high-level inputs to produce 1 watt of output. Phono overload measured 145 mV for the MM cartridge input and 14 mV for the MC pre-preamplifier input. Frequency response for the high-level inputs was flat within 1 dB from 20 Hz to 50 kHz. Yamaha has opted to use a nondefeatable, subsonic filter with a nominal cutoff point of 10 Hz. This accounts for the slight drop at the extreme low end, which, in the sample I tested, reached the −3 dB point at 12 Hz. High-frequency cutoff (the −3 dB point) occurred at 100 kHz. All of these measurements were made with the tone-control circuits defeated. The range of the three tone controls is shown in the multiple-sweep spectrum analysis of Fig. 7.

Signal-to-noise ratio for the MM phono inputs was 82 dB, A-weighted, referred to a 5-mV input signal and 1 watt output. That would be a very good S/N ratio even for a separate, high-priced preamplifier. When you consider all of the possible noise- and hum-generating circuits in a receiver as complex and comprehensive as this one, 82 dB seems all the more remarkable. The MC phono input did almost as well, with a measured S/N of 76 dB referred to a 0.5-mV input and 1 watt output. This figure, too, is excellent and compares favorably with results obtained for the very best separate preamplifiers having MC inputs. Signal-to-noise ratio for all of the high-level inputs measured 83 dB, referred to 1 watt output and 0.5 V input. Translated to rated output, this means that if a 2.0-V maximum signal (typical of CD player outputs) were fed to the high-level inputs and the volume-control setting were increased to produce 125 watts, the effective S/N would be about 33 dB higher, or 116 dB. Clearly, this receiver is not going to impose any limitations on the dynamic range or signal-to-noise ratio achieved by even the very best CD players.

RIAA equalization was accurate to within −0.4 dB from 30 Hz to 20 kHz. At 20 Hz, response was off by 1.0 dB, but that can be attributed to the presence of the subsonic filter, which is in-circuit at all times.

Figure 8 shows the action of the separate, continuously variable loudness control at several settings. The control attenuates the midrange, rather than boosting bass and treble. In use, the listener first sets the "Loudness" ring—which surrounds the "Volume" knob—to its maximum (flat)

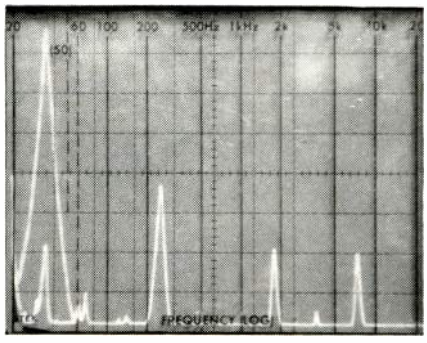


Fig. 4—Crosstalk and distortion components for a 5-kHz, FM modulating signal.

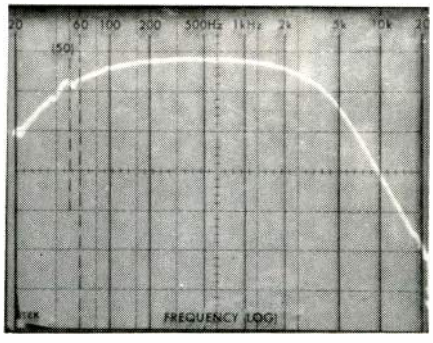


Fig. 5—AM frequency response.

The R-9 is, without a doubt, one of the most flexible, well-thought-out central audio components I have encountered.

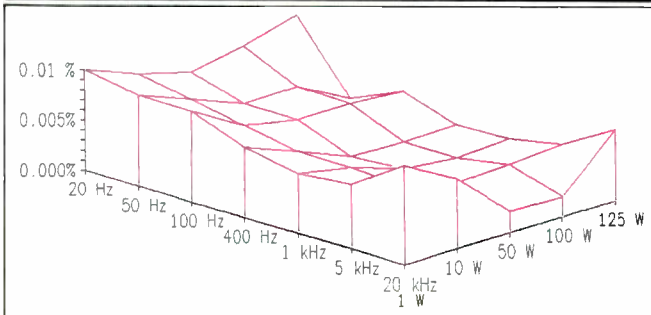


Fig. 6—Power output vs. frequency vs. THD. Perspective exaggerates the corner point representing 125 watts at 20 Hz, where distortion is only 0.009%. The R-9's distortion remains below its rated 0.015% until above 135 watts (see text).

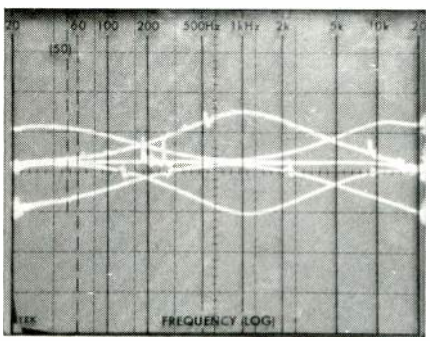


Fig. 7—Tone control range.

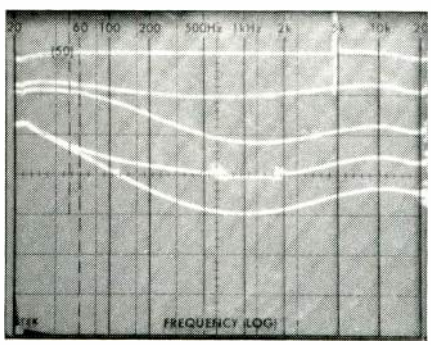


Fig. 8—Loudness contour curves for several settings of the continuously variable loudness control.

setting, adjusts the knob for realistic, live-performance listening levels, and then uses the ring to lower the sound to levels more comfortable for home listening. This calibrates the loudness compensation setting to match the sensitivity of your speakers and the acoustics of your room. At the ring's minimum position, mid-frequency levels are attenuated by around 40 dB regardless of the volume-control setting; this would be suitable for background listening.

Use and Listening Tests

I have already commented on the excellent performance of the R-9's FM tuner section. The choices of tuning and reception modes made by the tuner's microprocessor were almost always the same ones I would have made myself. The tuner section rarely switched into the "DX" mode in my listening location, so I benefited from the extremely low distortion and the excellent stereo separation afforded by the wide-band "Local" mode.

I used a variety of audio and video program sources with the R-9, and found that it served as an excellent multi-media control center. Even when playing CDs selected for their wide dynamic range, the R-9 never ran out of power when driving low-efficiency reference speakers. I did try using the "Auto Class A" mode at lower listening levels and, frankly, could detect no difference between sound quality in Class A and Class AB at those levels. I'd like to think that this speaks well for the low-distortion circuitry of Yamaha's Class-AB amplifier rather than implying a lack of critical perception on my part.

The stereo synthesizer circuit did wonders for some of my video home movies which have only monophonic soundtracks. This circuit, like many others of its type, utilizes a comb filter to convert a monaural signal into simulated stereo. Of course, if you listen carefully, you know that the results are not true stereo, but the spread of sound is pleasing and effective nevertheless.

The Dynamic Noise Canceller circuit is similar in principle to the DNR circuit widely used in car stereos, tape decks, and videodisc players. Essentially, DNC is a sliding low-pass filter which follows the upper-frequency limit of program content and removes noise above that frequency.

The three tone controls provided just about all of the tonal compensation I would ever need. For those who feel that a narrower band multi-control equalizer is needed, the R-9 even has an accessory output loop to which an equalizer or other signal-processing component can be connected. This effectively puts the additional accessory in series with the signals passing through the R-9; the accessory loop acts as a third tape monitor loop but is not switchable.

The Yamaha R-9 is, without a doubt, one of the most flexible and well-thought-out central audio components I have enountered. My only fear is that for some, perhaps, it may actually turn out to be *too* flexible. People assembling an audio system for the first time may not need all of its features. On the other hand, audio and video enthusiasts who like to plan ahead may well find that, even though they may not use all of the R-9's extensive facilities at first, more and more of the rear-panel jacks will be occupied as their involvement in audio and video increases.

Leonard Feldman