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YAMAHA M-70 POWER AMPLIFIER

Manufacturer's Specifications

Power Output: 200 watts per channel, 8-ohm loads, 20 Hz to 20 kHz.
Rated THD: 0.002%.
Clipping Power, 4 Ohms: 250 watts per channel.
IM Distortion, at Half Rated Power: 0.002%.
Damping Factor, 8 Ohms, 1 kHz: 200.
Frequency Response: D.c. to 100 kHz, +0, −0.5 dB.
Input Sensitivity, for Half Rated Power: 1.41 volts.
S/N, re: Rated Power Output: 124 dB.
Slew Rate: 200 V/μS.
Power Consumption: 600 watts, 1,200 VA.

Dimensions: 17⅛ in. (43.5 cm) W × 5¼ in. (13.3 cm) H × 15 in. (38 cm) D.
Weight: 30.1 lbs. (13.7 kg).
Price: $950.00.
Company Address: 6600 Orangethorpe Ave., Buena Park, Cal. 90620.
For literature, circle No. 92

The Far Eastern penchant for naming special circuits with descriptive slogans, initials and acronyms reaches its pinnacle with the Yamaha M-70, which is actually a perfectly good amplifier that meets virtually all of its specifications and delivers in excess of 200 watts per channel into 8-ohm speaker loads. Just consider the following: The Yamaha M-70 is a "Natural Sound" stereo power amplifier. It uses "ZDR" (Zero Distortion Rule), not to mention a High-Efficiency Yamaha "X" Power Supply and and "X" Amplifier Circuitry. All this and it amplifies audio signals, too! Joking aside, I promise to decode all of these phrases shortly; first let's take a look at the physical layout of the amplifier itself.

A square power on/off pushbutton and a "Protection" indicator light are located at the left end of the front panel of the M-70. The indicator glows for a few seconds after turn-on (during which time speakers are muted) or whenever else the protection circuitry mutes the amplifier. The center portion of the panel is occupied by a pair of logarithmically compressed bar-graph meters, calibrated from 0.02 to 300 watts. "Meter Off," "Peak Hold" and "Range" buttons are located to the left of the meters. When the "Range" switch is depressed, it multiplies the sensitivity of the metering system by a factor of 10 (a reading of 20 watts then means 2 watts, for example). When this range multiplication is selected, an indicator located between the two bar graphs lights up to denote the fact.

The right section of the panel is given over to speaker-selection and input-level controls. Here, Yamaha has come up with a simple but much appreciated innovation. The switches which select speakers "A" or "B" simultaneously select separate pairs of left and right input-level controls. If you have one pair of speakers in one room and a different pair, with very different efficiency, in a second room, you can adjust the level controls so that volume levels will be the same when you switch from the first pair of speakers to the second pair. (Only one pair of speakers can be selected at one time, however.) A third pushbutton switch allows you to temporarily turn off the signal being fed to either speaker pair, since the "A" and "B" switches are interlocked (one or the other must always be depressed).

The rear panel of the M-70 is equipped with a pair of input terminals, a chassis ground terminal, an unswitched convenience a.c. receptacle, and two sets of stereo speaker-cable connection terminals. These connectors are extremely easy to use, requiring only that the stripped end of a speaker wire be inserted in a small hole at the front of each connector, following which the connector housing is simply rotated one-half turn to lock the speaker wire firmly in place.

Circuit Highlights

And now, for a translation of all those circuit acronyms and abbreviations. Let's take ZDR first. It consits of a distortion detector and summing circuit (see Fig. 1). A bridge detector and comparison amplifier monitor input voltage, output voltage, and output current of the final stage and detect any harmonic distortion, changes in output, or impending instabilities. The bridge elements are pure resistances, and the circuit is designed so that variations in load impedance have no effect upon the detector. The distortion detector compares the power stage's output waveform with the stage's input waveform, generating a distortion waveform that is 180° out of phase with the distortion in the output signal. This signal is fed back to the input of the power stage in the correct proportion to cancel virtually all distortion. Even undesired signals generated by the back EMF of the speakers are dealt with by the ZDR circuit, according to Yamaha.

The difference between this and negative feedback is that only the distortion products are returned to the input. In theory, at least, ZDR can be used to totally eliminate distortion (hence the name); with regular feedback, the only way to eliminate distortion completely would be to feed back enough of the amplifier's output to totally eliminate all gain, as well. ZDR should also eliminate the instability problems which high feedback can cause.

The X power supply and X power amplifier turn out to be a single system, not unlike several other two-level power-supply arrangements which have been appearing from various amplifier manufacturers in recent years. Elements of the X power system are reminiscent of the Carver Magnetic Field amplifier, and, in fact, part of the circuitry used in the Yamaha M-70 is licensed from Carver Corp. The X power supply provides two d.c. power lines to the X amplifier stages—low power and high power. Circuitry in the X power amplifier stage then selects the appropriate supply line, according to the input-signal requirements. During amplification of average-power music signals, only the low-power line is utilized, reducing heat dissipation and increasing efficiency. When high-level music peaks come along, the amplifier switches to the high-power line.

The Linear Transfer Complementary SEPP circuit in Fig. 1 is the power output stage. The "SEPP" stands for "single-ended push-pull," a design much favored by Japanese manufacturers. This sounds like a contradiction in terms, but actually denotes a push-pull circuit which looks single-ended to the d.c. power supply, so that its mid-voltage point is 0 volts. This prevents d.c. from reaching the speakers, without the use of blocking capacitors.

Another circuit found in the Yamaha M-70 is called Linear-Transfer Bias Circuitry (not shown in Fig. 1). It biases the bipolar transistors so that their operating points are slightly staggered, converting their total transfer characteristics to an ideal "square" characteristic in the low-current region. Overall effect is to reduce crossover distortion to negligible or unmeasurable levels.

Measurements

The extremely low rated distortion quoted for the Yamaha M-70 made it almost impossible for me to verify the quoted figures, since my test signal source contains approximately 0.002% harmonic distortion to begin with. Furthermore, trying to measure distortion levels of 0.002% or lower with reference to power output levels of 1 watt or less (as required by the FTC) invariably involves one in measuring the residual noise floor rather than pure distortion. This is true even if spectrum analysis is used, since even when restricting bandwidth of measurement, *some* noise is still present in the reading. After all, 0.002% corresponds to −94 dB! Nevertheless, I can confirm that at a power output level of 200 watts per channel, both channels operating, using 8-

Transient response of the M-70 was excellent, and bass reproduction very good, with no muddiness or overhang.

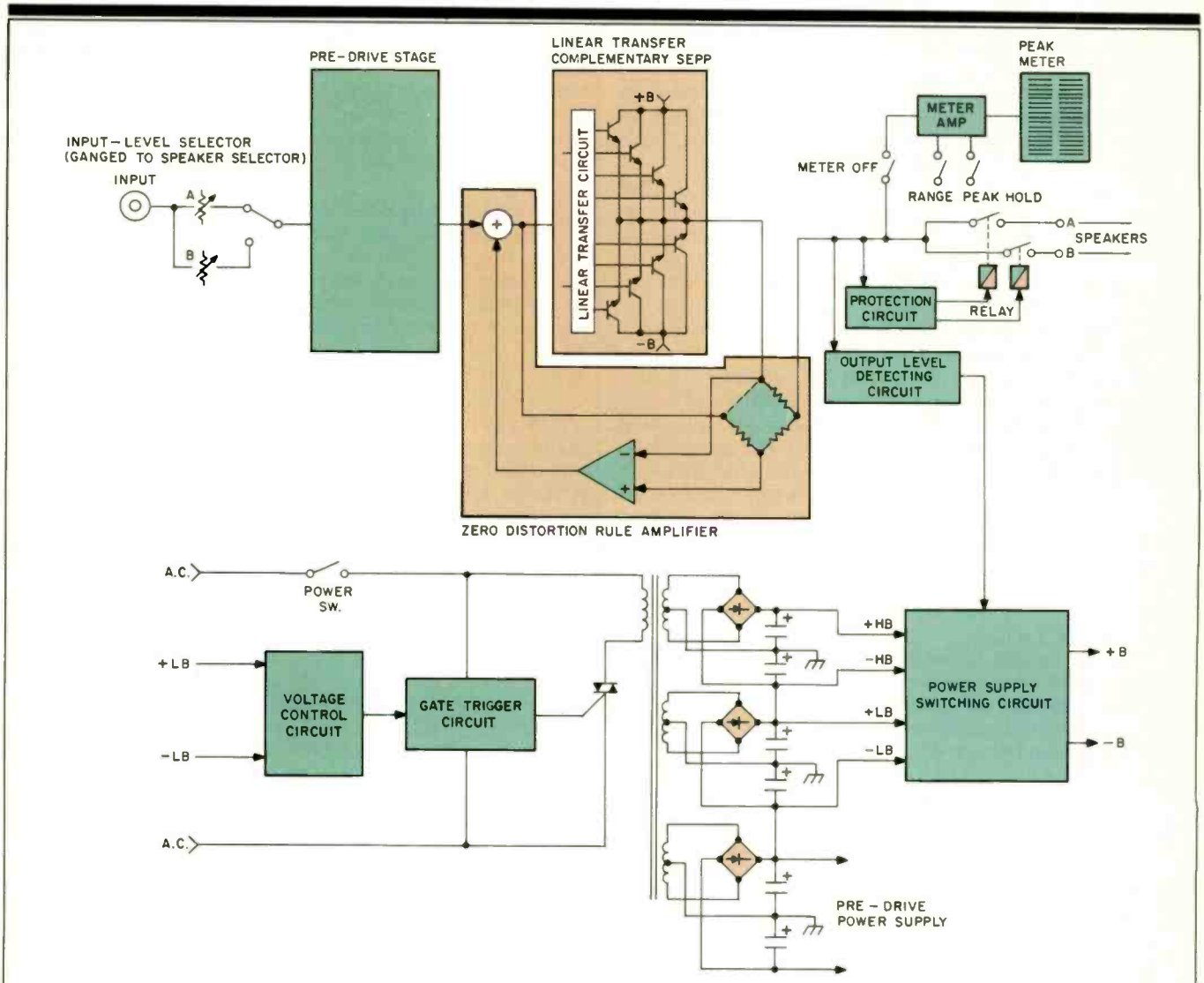

Fig. 1—Partial block diagram of the M-70.

ohm loads, I measured 0.0024% THD for a 1-kHz test signal, 0.0015% for a 20-Hz test signal, and 0.0023% for a 20-kHz input signal. SMPTE IM at rated output measured an insignificant 0.0033%, while at the half-power point quoted in the manufacturer's specifications, SMPTE IM was, indeed, exactly 0.002% as claimed. Damping factor came close to the 200 figure claimed by Yamaha; my slightly lower reading of 175 might be due to either the slight series resistance of the short connecting cables between the amplifier's output terminals and the test instruments, or the fact that I measure damping factor relative to a 50-Hz signal (in accordance with EIA Amplifier Measurement Standards) whereas Yamaha quoted damping factor relative to a mid-frequency signal of 1 kHz.

Frequency response extended from below 4 Hz to 115 kHz for a −1 dB roll-off and up to 215 kHz for a −3 dB roll-off. CCIF-IM distortion, using twin-tone input signals set 1 kHz apart and measuring any 1-kHz signal component at the output, was a minute 0.0035%. IHF-IM distortion, using the same twin-tone input signals, was below the limits of the test instrumentation, or less than 0.03%. Input sensitivity for 1-watt output was 100 mV, while S/N (relative to 1-watt output, with 0.5-V input) measured 92 dB, A-weighted.

It was not possible to measure dynamic headroom using the standard tone-burst test signal normally used for that test. The tone-burst signal caused the protection circuit of the amplifier to operate when the clipping level was approached. This is not in and of itself a bad thing, since it suggests that the protection circuitry of the M-70 is extremely reliable and is not likely to allow any damaging types of

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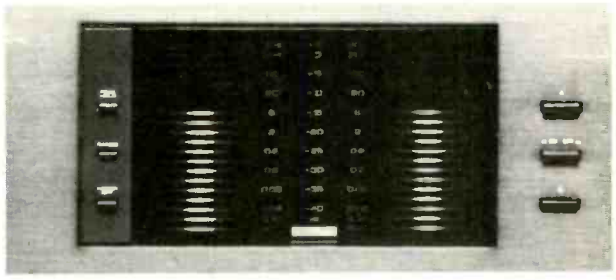
outputs to pass through the final stages of the amplifier; it simply prevented me from measuring dynamic headroom. It is interesting to note that in their published specifications, Yamaha lists a series of harmonic distortion numbers for a variety of frequencies from 20 Hz to 100 kHz. In all these listings, however, power output is at *half* rated power rather than at full rated power. The same holds true for IM distortion. It would appear that Yamaha, too, avoids running the amplifier at full rated power for extended periods of time. From a practical point of view, half-power is, after all, just 3 dB below full power and I can understand their wanting to brag about the fact that at the half-power level, THD at 1 kHz is an incredibly low 0.0005%, while even at 20 kHz, THD for this output is only 0.001%!

Use and Listening Tests

I have to say that the Yamaha M-70 is an extremely clean-sounding amplifier, though I would be hard-pressed to state that it is any cleaner sounding than a host of other amplifiers of approximately the same power ratings I have tested in recent months. The M-70 supplied enough power to drive my relatively low-efficiency reference speakers to adequate sound levels, even when I played some of my more dynamically recorded Compact Discs. Transient response was excellent and bass reproduction was very good, with no evidence of muddiness or overhang. The low internal impedance of this amplifier seemed to work ideally with my reference speakers and at least two other sets of high-quality loudspeaker systems that I hooked up to it.

Altogether, though, I get the feeling that the Yamaha M-70 is too close to being "overprotected" by its admittedly efficient protection circuitry. This circuitry almost seems to work too quickly, not allowing for even momentary peak clipping—a condition which is likely to occur more often than not, now that CDs, with their awesome peaks, are with us to stay. Whether this is a characteristic of dual-level-supply designs in general (I noticed the same quality some years ago when I first tested the Carver M400), or whether it's just peculiar to this unit or model amplifier, I really can't say. I suppose it really doesn't matter, since the muting that does occur when the amp is severely overdriven seems to cause it no permanent damage, and its sound is quickly restored once the overload is removed. Even with medium-efficiency speakers, overdriving of this amplifier is most unlikely, no matter what types of discs or source material you use, so I suppose my concern is more academic than practical.

Getting back to the sound quality of the amplifier (which is, and should be, the first and most important consideration), I must repeat that I liked its tight overall sound. I'm fairly well convinced that this sound quality has little or nothing to do with ZDR, X power supply or X amplifier design, but if it makes the Yamaha folks (and their customers) happy to believe that these are the circuits that are responsible for the good dynamic sound qualities of the M-70, who am I to argue! *Leonard Feldman*



Twenty red LED bars per channel show peak power, from 0.02 to 300 watts—plenty, as the protection circuits limit headroom above the rated 200 watts.