Lux Audio MB-3045 Power Amplifier

MANUFACTURER'S SPECIFICATIONS
Power Output: 50 watts average into 8 ohms. (Note: This is a mono unit; a stereo pair was tested.)
THD: 0.3 per cent.
IM Distortion: 0.3 per cent.
Frequency Response: 10 Hz to 40 kHz, −1 dB.
S/N: 95 dB.
Damping Factor: 16 at 1 kHz, 8 ohms.
Input Sensitivity: 0.7 V.
Dimensions: 14½ in. (36.83 cm) W x 9½ in. (24.13 cm) D x 6¾ in. (17.15 cm) H.
Weight: 33.4 lbs. (15.18 kg).
Price: $495.00.

The Lux MB-3045 is a mono tube power amplifier rated at 50 watts into 4, 8, or 16 ohms. Built in the classic vacuum-tube amplifier style, it's apparent that great emphasis has been placed on the sonic and electrical performance.

A strong steel chassis supports all major components (the MB-3045 weighs 33.4 pounds). Viewed from the front of the unit, the unusually massive power and output transformers sit at the right and left rear corners of the chassis. Between them are three large aluminum, electrolytic capacitors and the power supply filter choke. Directly in front is the row of tubes, which consists of two miniature types, two larger size drivers, and the output pair, which are seated in sockets surrounded by a circular ring of vent holes. A sturdy metal cage covers the top of the unit to protect the amplifier and the user from tube breakage and burns, respectively, while maintaining good ventillation. All circuitry, mounted on two printed circuit boards, and wiring is concealed below the chassis. The semi-fixed d.c. bias, balance, and hum balance controls are also mounted below the surface of the chassis which deters excessive tampering with the controls though making adjustments somewhat inconvenient. A power switch, a.c. socket, and fuse post are mounted on the rear panel along with the input and output connectors and the input level control. The only component visible on the front panel is the small, but bright neon pilot light.

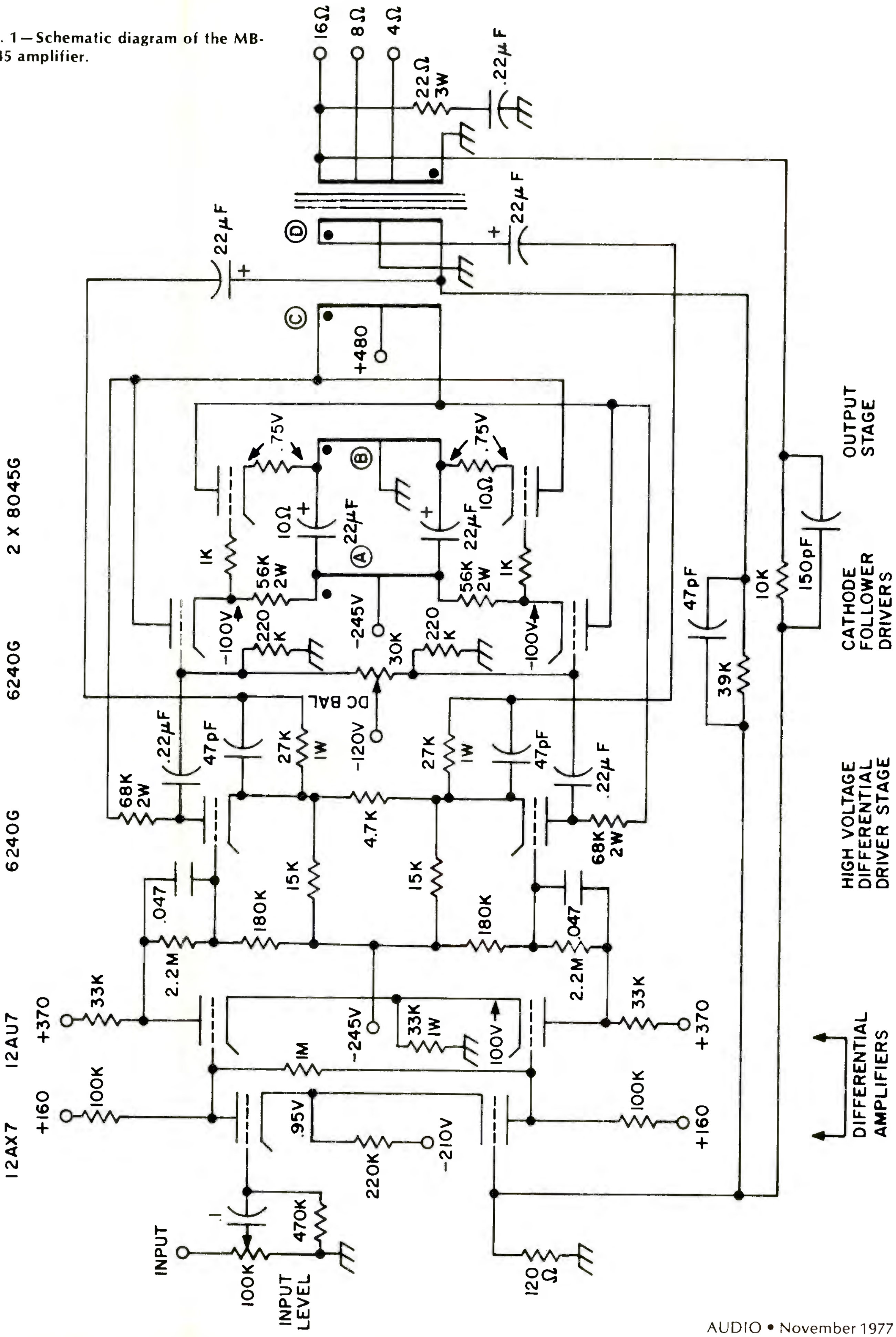
Circuitry

Since the introduction of audio power amplifiers, audiophiles have heard about esoteric tube circuits designed by some high powered engineer for his home system—that surpassed all others. Circuits for such amplifiers seen by this reviewer have tended to use more sophisticated and complicated techniques to allow the designer to simultaneously optimize the greatest number of variables, such as power output, linearity, and response at the extremes of the audio band. However, the Lux MB-3045 appears to be the last word in tube power-amp circuit design, and little expense has been spared to make it so.

Figure 1 shows the circuitry to be fancy indeed. Two stages of differential amplifiers provide a good deal of voltage gain and supply the out-of-phase signals required to drive the output transformer in the usual push-pull fashion. Next, a high voltage differential-driver and cathode-follower stage is employed to provide the very large signal required to drive the grids of the output tubes. (Lux comments that 200 volts, rms, are required at the power tube grids for full power.) The cathode followers are direct coupled to the single pair of output *triodes* that controls virtually all the signal power.

Most engineers familiar with such vacuum-tube design will probably be wondering at this point what sort of triodes Lux has found that are capable of such relatively high power out-

Fig. 1—Schematic diagram of the MB-3045 amplifier.



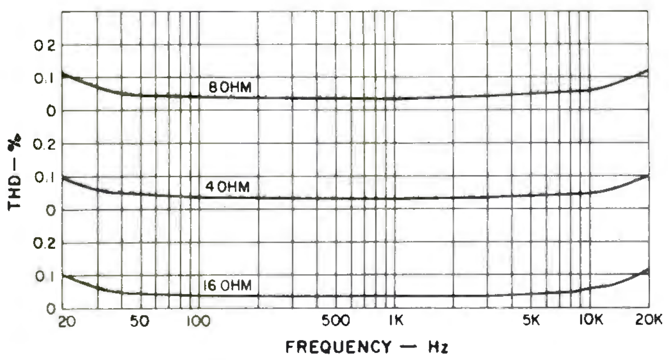


Fig. 2—THD versus frequency for 4-,8-, and 16-ohm loads at 50-watts output.

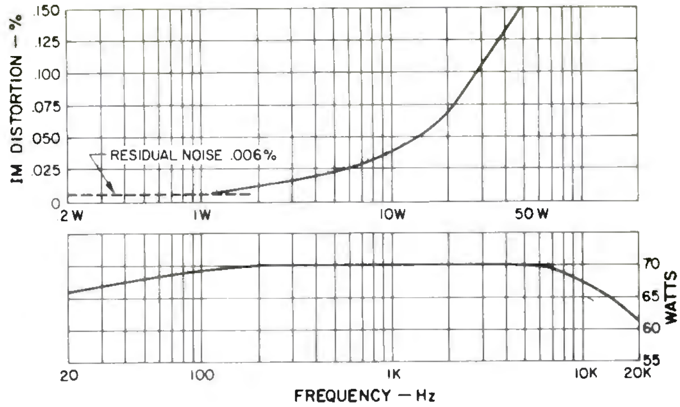


Fig. 3—The MB-3045's power characteristics. Top, SMPTE IM versus output, 8-ohm loads; Bottom, bandwidth for 1.0 per cent THD, 8-ohm loads.

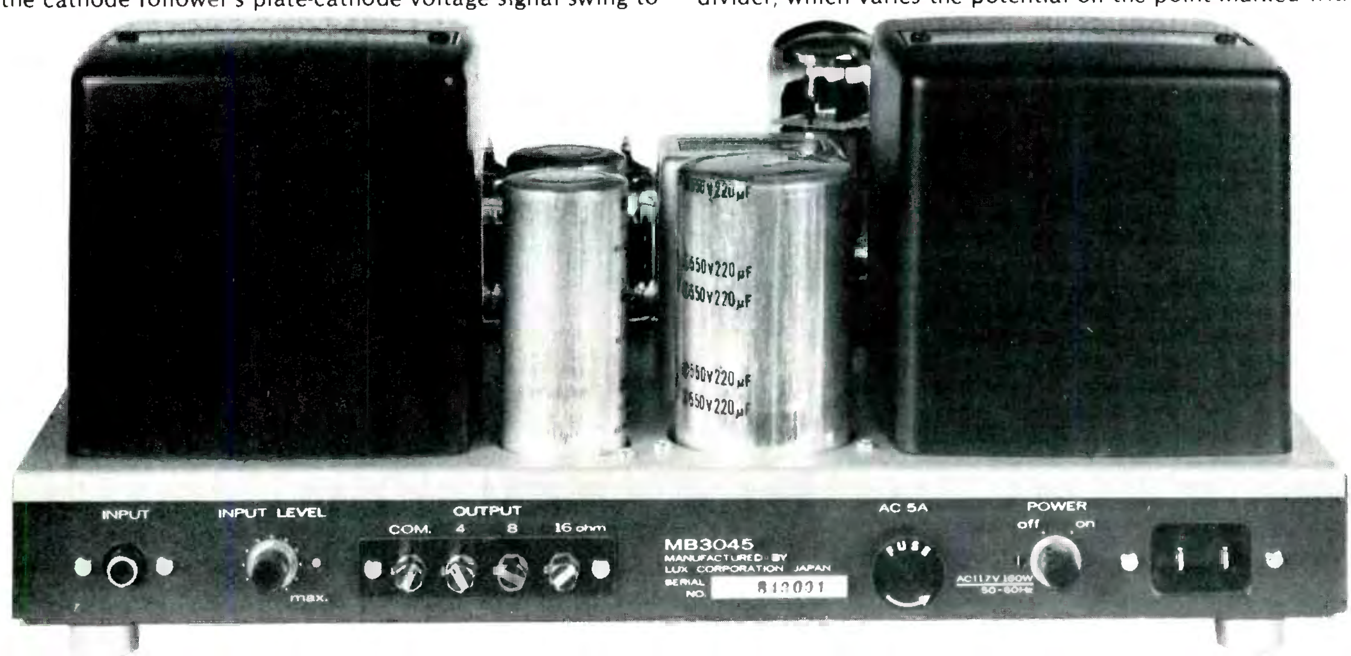
puts with acceptable linearity. In fact, they did not find any, so in cooperation with another Japanese firm (NEC) they designed and manufactured their own 8045G output triode and special 6240G high voltage driver. In addition, a special transformer has been designed to get the best match between the new tubes and the load, which employs amongst other things, quadrafilar wound "primaries."

It is most likely that Lux has chosen to use the triode output tubes for two reasons. Not necessarily in order of importance, they are 1) inherently lower output impedance than pentodes, and 2) inherently better linearity than pentodes. By realizing these two goals, the amplifier will then by nature drive complicated loads such as speakers more gracefully and generate less distortion, with all other things being equal.

The ratios employed in the output transformer were not measured, but if it can be assumed that all four primaries are in a 1:1:1:1 ratio from the knowledge that all four primaries were quadrafilar wound, then perhaps some insight can be had on the operation of the output and driver stages. The first conclusion from this assumption is that the entire output stage is operated near unity voltage gain due to the localized feedback through winding B. Winding A then provides a d.c. current path for the cathode followers and simultaneously operates them closer to constant current operation. Meanwhile, the appropriate phase of winding C tends to maintain the cathode follower's plate-cathode voltage signal swing to a minimum. Reducing the signal modulation of both current and voltage then should result in improved linearity in this stage. However, the entire 200-volt signal must still be provided by the first 6240G. By bootstrapping the 68-kilohm plate-load resistor from this stage to winding C again, the tube's operating current change with signal is reduced. In this case, the connection to the C winding yields better large signal linearity and increased voltage gain.

The input stages are straightforward differential amplifiers similar to those used in other tube power amplifiers. One noticeable distinction is the use of winding D to apply local differential feedback to the second stage cathodes through the 27-kilohm resistors and the 47-pF capacitors. A summation of signals from winding D and the 16-ohm tap are used for the overall loop feedback, which when divided down by the 120 ohm resistor, is conveniently applied to the inverting input of the first stage differential amplifier. No a.c. balance control was deemed necessary in this circuit, as the inherent balance in the differential amplifiers and the various local feedback loops serve to maintain symmetrical drive to the output transformer.

D.c. bias and balance are provided by the usual voltage divider arrangements, but in this amplifier bias voltage must be applied to the grids of the driver tubes instead of the output tube grids. Within the power supply is the bias voltage divider, which varies the potential on the point marked with



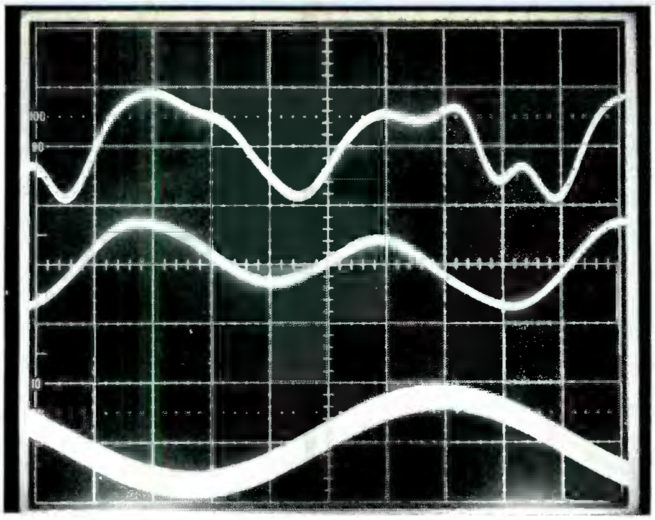


Fig. 4—MB-3045's SMPTE IM residual at 50 watts, Top; and 15.8 watts, Center; with input at bottom.

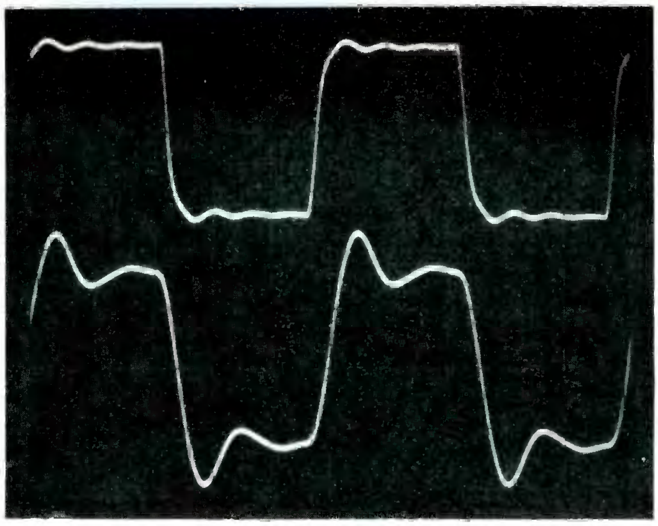


Fig. 6—Response of the MB-3045 to a 10 kHz square wave into an 8 ohm load (Top), and into an 8 ohm load paralleled by 2 μF. Scale is 10V/div.

an asterisk; it is nominally -120 volts. The 30-kilohm balance pot gives the necessary range of adjustment to compensate for the variations in tubes and resistors so the unbalanced d.c. current in the output transformer can be reduced to a minimum. Due to the two stages (cathode follower and output tube) and the miniscule degeneration from the 10-ohm cathode resistors, this design has less bias stability than most other tube power amplifiers. Lux recommends that the bias and balance be adjusted whenever replacing output tubes. In the opinion of this reviewer, the best performance will be obtained if they are occasionally adjusted as the tubes age (perhaps every 1000 hours) and also in the unlikely event that the 6240G (V4) tube must be replaced singly.

Measurements

THD measurements are shown in Fig. 2 for 50 watts into 4, 8, and 16 ohm resistive loads. As can be seen from the curves, distortion was almost independent of load resistance. SMPTE IM distortion is shown in Fig. 3 as a function of output power for the 8 ohm load. The Lux curves for this measurement show a gradual rise below 0.3 watt, which was not detected in either unit tested. At powers above 50 watts, distortion rose gradually until clipping occured. For a 50 watt output, Lux claims a blanket 0.3% maximum THD or IM, and the amplifiers had no trouble staying well below this figure even after many hours use.

Figure 4 is an oscilloscope photo of the IM distortion residual at 50 and 15.8 watts, with the input signal for reference, on the top, center, and bottom traces, respectively. Keeping in mind the delay in the distortion analyzer, the negative going peaks in the residual correspond to the negative and positive signal peaks, which can be considered third harmonic distortion. The center trace also shows some evidence of circuit imbalance or second harmonic. Although the distortion gets more complicated at higher power levels, this general sort of residual does not show any strong discontinuity in the behavior, as crossover distortion might cause.

The lower curve in Fig. 3 shows the power bandwidth capabilities of the amplifier. Notice that the roll off at the low frequency end is quite gradual. The 1- and 50-watt frequency responses in Fig. 5 show that this unit actually put out 50 watts at 12 Hz with only modest distortion visible on the 'scope. This is outstanding performance for a tube amplifier and could only be achieved by using a very good output transformer with lots of muscle behind it. At the 1-watt power level, the response is within +0, −0.5 dB from 8 to 20 kHz.

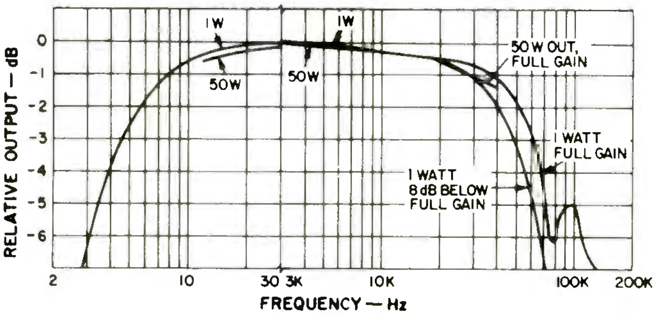
These tests are performed with a high quality function generator having a constant 50-ohm output impedance. With this low impedance source and with the input level control full up, 1 dB peaking is apparent at 100 kHz. Since only a handful of preamps present a power amplifier a source impedance this low at 100 kHz, this peak will probably never be excited in normal use. However, all types of behavior such as this should be kept in mind if any problems arise.

Transient phenomena in the MB-3045 tended to be somewhat trying to measure since the observed effects could not be easily isolated. For example, the amp did not exhibit a well-defined slew-rate limitation. Without applying an input signal of larger magnitude than that required to clip the amplifier at 1 kHz, increasing the test frequency to the point of slew-like distortion showed a slew rate of 6-10 volts/microsec. However, the 10 kHz square wave response shown in the upper trace of Fig. 6 shows the output signal exceeding 25 volts/microsec! There should, therefore, be no obvious problem with musical program material.

The lower curve in Fig. 6 shows the same 10 kHz square-wave test, but with the additional load of 2 microfarads in parallel with the 8-ohm load resistor. This ringing is similar to that observed under the same conditions with most transistor amps, but in this case is probably caused by some tuning with the leakage inductance of the output transformer.

Clipping into resistive loads was graceful, like most tube amplifiers. However, the manner in which this amplifier clipped into reactive loads was really outstanding. The waveform took the appearance of very soft peak compression and limiting, and only with very large input overloads did any asymmetry occur.

Fig. 5—MB-3045's frequency response at 1 and 50 watts. (Note break in curves at 30 Hz and 3 kHz.)



For the record, the damping factor was measured to be an even 30, which held up surprisingly well through the audio midrange. Gain at 1 kHz was found to be exactly 27.5X or 28.8 dB. This is slightly higher than most amplifiers in this power range and may be useful in some systems.

Listening Tests

A ten-year-old trend in speaker manufacturing, trading efficiency for other improvements such as size and price, has been matched by the large increases in amplifier power ratings. With only one exception, the wave of amplifiers over 100 watts per channel has been limited exclusively to transistor designs by financial considerations and consumer acceptance. It would be natural to expect that for this reason alone the MB-3045 would be rather disadvantaged in the modern audio environment. It is a pleasure to report that this is not so.

Driving a pair of low-efficiency, 8-ohm loudspeakers in a small- to medium-size room actually gave the impression of power. Classical recordings with good dynamic range and rock records were regularly and cleanly reproduced at high volume. One transistor amplifier capable of 100 watts/channel into 8 ohms was incapable of achieving the same subjective levels. But there is obviously more to sound reproduction than just power.

Articulation and depth of imaging from a pair of these Lux amps was very good. Very complicated symphonic passages could be torn apart instrument by instrument from the listener's seat with surprising ease.

The pleasing but unrealistic bass often associated with tube power amplifiers has been replaced in these units with the extended and commanding low end that one has come to expect only from the modern "super" transistor power amps. But the upper midrange and high end silkiness of some older tube units has remained. Reproduction of music is accomplished with the best of both worlds.

Conclusion

Over some months of operation, the initial irritation from the bulk and inconvenience of two separate, heavy power amps has faded into fascination and respect; they will be missed when they are returned to Lux at the conclusion of this test. But these amps are not for everyone. Their price, at $495 each, is high for their power. Tube replacement will set one back another $45 every 3,000 to 5,000 hours (figures supplied by Lux). In addition, there may be the service charge of the technician required to reset the adjustments, and the inconvenience of obtaining the driver and output tubes from the single source—Lux Audio in New York.

Of course, tubes are more rugged than their transistor counterparts when overloaded electrically, but the tubes have other disadvantages too. Much more heat is generated and this requires just as much or more free air to keep temperatures down and component longevity up. As the amplifiers warmed, a slight odor of phenolic arose which may be a little objectionable. And finally, there will always be the old bugaboo of gradual deterioration in performance after the first few hours are put on the tubes.

For the readers thinking about buying a pair of MB-3045s, there is one last item to consider: speaker impedances. Electrostatic (capacitive load!) or 16-ohm dynamic loudspeakers will sway some toward the Lux pair, while others may need the extra power available in transistor jobs when driving 4-ohm loads.

In any case, those who listen to the MB-3045 pair (highly recommended) and appreciate the reproduction, will probably not be able to find a transistor amplifier yet that has all the desireable sonic qualities that these do. *George Pontis.*