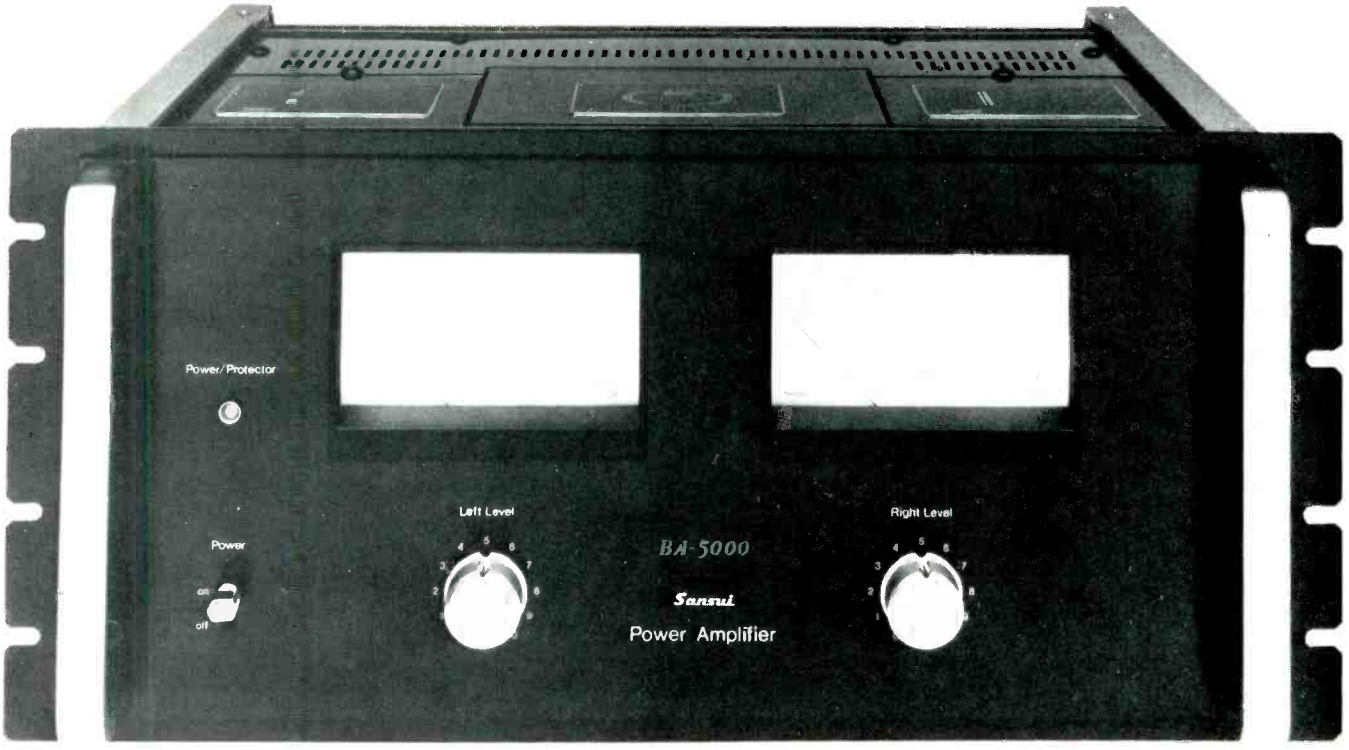
Sansui Model BA-5000 Stereo Power Amplifier



MANUFACTURER'S SPECIFICATIONS

Power Output: Stereo, 300 watts per channel into 2, 4, and 8 ohms, from 20 to 20,000 Hz with no more than 0.1 per cent THD; Mono, 600 watts into 4, 8, and 16 ohms from 20 to 20,000 Hz with no more than 0.1 per cent THD.
Load Impedance: Stereo, 2, 4, or 8 ohms; Mono, 4, 8, or 16 ohms.
Output Voltage: 25 volts stereo, 70 volts mono.
THD: Less than 0.1 per cent.
IM Distortion: Less than 0.1 per cent.
Frequency Response @ 1 watt: 15 to 30,000 Hz, +0, -2 d B.
Damping Factor: Approx. 10 @ 8 ohm load.
Input Sensitivity & Impedance: 700 mV, 50 kilohms.
Power Consumption: 490 watts.

General Dimensions
Dimensions: 19 in. (48.2 cm) W x 8 ¾ in. (22.2 cm) H x 18 11/32 (46.6 cm) D.
Weight: 108 lbs. (49 kg).
Price: $1300.00.

Lately we have seen several examples of high powered amplifiers geared for the professional market. Sansui has entered that market with their BA 5000 stereo amplifier which promises to be an exceptionally strong contender. The Japanese have an advanced machine tool industry that allows them to build elegant packages with lots of parts at modest prices and this amplifier is an example of that. It is a superb package, very well engineered, and extremely rugged. The internal partitions are all of girder-type construction. The metal parts all have a lot of mass to them—front panels nearly ½ in. thick, side rub-rails that are so heavy they appear to be cast, very heavy-duty heat sinks, and all well braced. The front panel is well laid out with excellent level controls for each channel, two heavy-duty rack handles, and two power meters. These peak responding meters, which are rather good looking, have their own driver amplifiers, and are accurate from 20 Hz to 15 kHz.

There is a massive heat-sink extrusion near the back of the amplifier that is fan cooled; the fan blows into the extrusion at the center and exhausts out the sides, providing excellent heat dissipation ability. The back, which holds the cooling fans, folds down after the removal of four machine screws, making the output transistors easily accessible. The output transistors are all mounted on sockets, so in case one did blow it would be easy to replace. We would like to praise the manufacturers for their use of the heavy-duty banana-jack type terminals for the output connection. However, we prefer the standard telephone jacks for input use rather than the RCA pin-jacks that are supplied with the amp.

The actual printed circuit cards that hold the first stages mount in holders for easy removal. The cards themselves show the addition of small capacitors after assembly, probably for stabilization (more about this later) and these capacitors are not up to the over-all quality of the rest of the amplifier. The whole unit is just incredible from a mechanical point of view, probably the most rugged amplifier package I have ever seen. The output stage differs from most consumer amps in that it has auto-formers in the output. This allows the amp to deliver its rated power into various load impedances. In most transistor amplifiers, the power output increases as the load impedance decreases. The BA-5000 is basically a two-ohm amplifier, and because of the auto-former it will deliver its rated output power into 2, 4, or 8 ohms; and, if you bridge both amplifiers in the "mono" configuration, it will deliver twice the power into 4, 8, or 16 ohms. When you use the two-ohm tap, you direct couple the load to the output devices.

The power supply furnishes regulated power for everything except the output and driver devices—very hip. It is a superb power supply, well laid out, and all the wiring is done to big terminal strips. It has a massive torroidal power transformer with a very low external magnetic field and very low internal resistance, helping to make the power supply very stiff. This is important to the sound of an amplifier be-

cause it allows the amplifier to be driven into overload without a severe voltage drop. The power transformer case appears to be well potted and heremetically sealed. Large high quality electrolytic capacitors are used—very low internal impedance. The electrolytic capacitors are connected by copper bus-bars. This improves their high frequency performance. The power supply is so good it's just outrageous!

Circuit Description

The Japanese semi-conductor industry has for some time been putting a lot of R & D into developing output transistors with a greater safe operating area. The output transistors Sansui uses in this amplifier are very strong—large safe areas and also fairly fast. They are regular transistors, but these are some of the strongest transistors I've seen. Eight output devices and two drivers per channel; the rail voltages measured plus and minus 53 volts.

The circuit itself is a complementary amplifier. First, there is an input and buffer amplifier consisting of a differential pair direct coupled into a common-emitter amplifier—its function is to allow the main amplifier to be hooked up in bridge configuration (i.e., you can get both in-phase and out-of-phase outputs from the buffer amplifier). It also supplies a little voltage gain and a higher input impedance. (However, it's my opinion that the amplifier would sound better without this amplifier; this is an added circuit which obviously is going to detract from the sound to some degree.) The buffer amplifier is coupled to a "P" type differential amplifier, which is direct coupled to an "N" type differential amplifier. This shifts the d.c. level of the signal back to "0." One side of the "N" type differential amplifier is tied to ground; the other side goes through a bias regulator with a current source as its load. This current source drives a pair of pre-driver transistors separated by the bias regulator which are "Darlingtoned" onto the driver transistors. These devices drive the output stage which is a complementary output stage acting as followers. All three devices—the pre-drivers, the drivers, and the output stage—are hooked up in the uni-follower configuration. There are some current-limiting transistors that clamp the bases of the driver transistors if it ever becomes necessary to limit the current flowing through them because of some overload condition. A fairly simple circuit, but in my opinion, the amplifier is not well stabilized; when you drive it into clipping, it oscillates. I believe this is due to the fact that the second differential amplifier's and the pre-drivers' f_t's occur at the same frequency which produces a phase shift in the open loop response of the amplifier and makes it difficult to stabilize. However, it is not bad and doesn't seem to have any noticeable effect on the sound.

Another possible problem is that the circuit uses 100 per cent d.c. feedback. The reason this is necessary is that there is an auto-former in the output and any small d.c. off-set may cause excessive current to flow through the auto-former because the auto-former has a very low resistance at d.c. and saturates its core. The 100 per cent feedback requires the use of a blocking capacitor in the shunt leg of the feedback loop. When you impress a non-symmetrical, unidirectional signal across the blocking capacitor, it develops a

Table I—THD with both channels operating at 300 watts into 4-ohm load.

Freq., Hz.	Left, %	Right, %
20	0.037	0.04
50	0.029	0.025
1k	0.032	0.0225
10k	0.04	0.0285
20k	0.06	0.02

Table II—Harmonics of 1 kHz, in percent, measured with wave analyzer.

Harmonic	Left, %	Right, %
2nd	0.031	0.019
3rd	0.0042	0.0022
5th	0.0004	0.0022
6th	0.00058	0.0023
7th	0.0002	0.0013
9th	0.00018	0.0008
13th	0.0002	0.00014

Table III—IM distortion of 60 Hz and 6 kHz; total of right channel is 0.056 per cent, left channel is 0.11 per cent.

IM Product	Left Ch.	Right Ch.
2nd	0.11	0.064
3rd	0.02	0.027
4th	0.0026	0.0064
5th	0.00028	0.001
6th	0.004	0.004
7th	0.0024	0.002
8th	0.0009	0.0005
9th	0.0007	0.001
10th		0.0007
11th		0.00015
13th		0.00004

charge. When this happens, it pulls the input of the negative side of that differential amplifier to ground, causing the output of the amplifier to swing positive. Every time this happens, the feedback tries to catch it, and this causes a pulse inside the amplifier. The bias points are no longer fixed but wander around. Only totally direct-coupled amplifiers are free from this. But that's pretty esoteric.

Table IV—Power output vs. frequency, one channel at a time just before clipping, 4-ohm load and 4-ohm amp tap, a.c. 120 volts.

Freq., Hz	L Ch. Watts/Volts	R Ch. Watts/Volts
10	38/361	342/37
20	380.25/39	361/38
1K	400/40	400/40
20k	342/37	333.06/36.5

Both channels operating, 4-ohm load and 4-ohm tap; both measured:

Freq., Hz	Watts/Volts
20	351.56/37.5
1K	380.25/39
10K	351.56/37.5
20K	324.00/36

We took lots of distortion measurements on this amplifier (for those of you who are interested in distortion measurements). The author believes that distortion measurements have little meaning below a 0.5 per cent or so. But it's interesting to note that the distortion residuals contained mostly simple even-order harmonics except at the extreme low frequencies where the transfer characteristic of the autoformer was visible. There is no noticeable cross-over distortion present, as this amplifier has very low cross-over distortion. We have included the distortion harmonics for those of you who are interested. These may possibly have more meaning than straight total distortion, but nobody's been able to supply a correlation between measurements and sound quality yet, but we keep hoping.

On the back of the amplifier is a switch which converts the amplifier from stereo to monaural. When in the monaural mode, the amplifier delivered in excess of 700 watts continuously without any strain. The superb heat sink in this amplifier requires special mention. During the testing procedure, the amplifier was subjected to long periods of time at full power output. The fan came on rarely, and the amplifier itself never over-heated.

Evaluation

From using the Sansui BA 5000 amplifiers on many sound jobs, I would say they are rock-stable as far as overload, power, and all that, but they are a little more sensitive to grounds because of the way they are stabilized. In every other respect, you can turn them on and forget them. They have never given me *any* problems in the field; they work flawlessly. They are very versatile; they are *the* industrial amps for anyone who needs a combination of high power and high quality. When listening to them, you will find the mid-range is very articulate but lacks space; the high end is more open, also very articulate; the bass is good, slightly exaggerated. They definitely have a transistor sound, but probably one of the least offensive of the present high-powered transistor amplifiers; however, they are not as good as some of the very best home hi-fi amplifiers. Supreme reliability, superb packaging, and beauty are the BA-5000's strong points For a band, recording studio or wherever you need a high quality heavy-duty industrial amplifier, it is *the* amplifier. It will deliver the goods with no regrets.

Geoffrey T. Cook

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