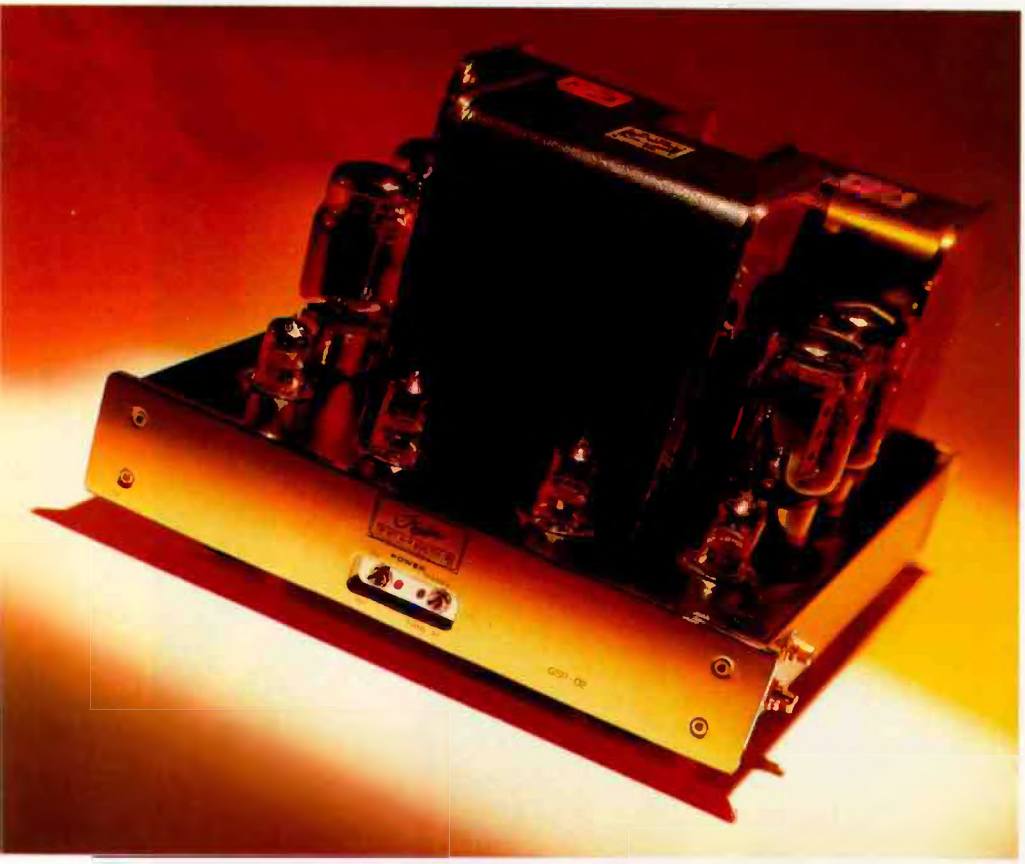
BASCOM H. KING

HOUSTON GSP-02 AMPLIFIER



Rated at 60 watts per channel, the Houston GSP-02 is one of three tube power amplifiers imported into this country by Centasound International. A smaller unit, the GSI-01 integrated amplifier, is rated at 40 watts per channel; Houston's top model is the GSM-260, a mono amp rated at 65 watts. Houston plans to introduce two line-level preamplifiers, a single-ended integrated amplifier, and a single-ended power amplifier in the coming months. Currently, the Houston products are sold direct, with a no-obligation 14-day home trial.

THE HOUSTON GSP-02 IS QUITE ATTRACTIVE AND IS RELATIVELY INEXPENSIVE FOR A TUBE AMP.

The GSP-02 is quite attractive, with titanium-plated brass on the front and back panels and the sides of the exposed power and output transformers. Each amp is handmade, using point-to-point wiring. The power and output transformers are hand-wound with high-purity copper wire and are potted. Metallized polypropylene capacitors are used in the signal paths. Input and output connectors are gold-plated. (The input jacks are on one side of the amp; the rear panel is taken up by widely spaced output binding posts, the power-cord socket, and a fuse.) Each channel has a pair of 12AU7 tubes in its front end and a pair of KT-100s, in push-pull, as outputs. (I'm not sure, but I suspect the KT-100 is a more rugged version of the more common KT-88 output tube.) Parts and build quality are reasonably good. The bias adjustment pots could use more support, as they are held in place only by their connecting wires.

Measurements

When I first started to measure the Houston amplifier, I found the onset of visual clipping in the output to be at about 45 watts. Whoa, I sez—this is a 60-watt amp? A call to the importer revealed that the 60-watt rating is at 10% distortion! This is not that unusual for today's single-ended, Class-A tube amplifiers (for example, the Cary CAD-805 mono amp I reviewed in the July 1995 issue attained its rated 50 watts at about 10% distortion), but an amplifier is usually expected to put out its rated power (or more) at the onset of clipping. As will be seen, the GSP-02 does make 60 watts per channel at 10% distortion, which is pretty far into clipping. However, if a company is going to rate its amplifiers' power at high distortion levels, it should say so or else publish more realistic ratings.

My discussions with Centasound about the Houston amp's power rating also led the company to send me a second set of output tubes. Substituting these tubes did not raise the maximum power but did improve some other characteristics of the GSP-02's performance, as noted below. For the rest of my tests, I used the same bias current of 31 milliamperes for the replacement tubes as for the originals. Raising the

Rated Output: 60 watts per channel into 4 or 8 ohms.
Rated Distortion: 10% at 60 watts or 0.15% at 8 watts, 20 Hz to 20 kHz, into 8 ohms.
Dimensions: 12½ in. W x 8¼ in. H x 14¾ in. D (31.8 cm x 21 cm x 37.5 cm).
Weight: 52 lbs. (23.6 kg).
Price: $960.
Company Address: c/o Centasound International, P.O. Box 210337, San Francisco, Cal. 94121; 415/668-9003; fax, 415/668-9638; http://www.centasound.com
For literature, circle No. 92

Photos: Michael Groen

TECHNICAL HIGHLIGHTS

The GSP-02's circuitry is straightforward, with a slight twist. That is, the input stage is a simplified mu follower, but with the plate of the input tube coupled directly to the grid of the stage's second tube and the cathode of that tube going through a single self-biasing resistor to the junction of the first tube's plate and second tube's grid. The stage's output is taken from the cathode of the second tube. This arrangement yields high gain and a low output impedance.

This first stage is directly coupled to the second stage, a long-tailed phase inverter. The phase inverter's plate outputs are capacitor-coupled to the output tube grids, with unequal plate-load resistors to compensate for the inherent imbalance in its push-pull outputs. No AC balance control is provided.

The output stage is an Ultra-Linear design, with the output tubes' screen grids connected to taps on the output transformer's primary. This stage has a negative voltage on each tube's grid and a bias-adjustment pot for each tube under the chassis. The output transformer's secondary has 4- and 8-ohm taps; negative feedback is taken from the 8-ohm tap back to the input stage.

In the power supply, the high-voltage secondary is rectified by a full-wave bridge. It is then filtered by two 1,000-microfarad, 400-volt capacitors in series and fed to the center taps of the output transformers' primary windings. From this point, a 1-kilohm series resistor feeds another pair of 1,000-microfarad, 400-volt capacitors, which in turn feed the plate circuits of the phase inverter tubes. A 22-kilohm decoupling resistor and a 33-microfarad, 450-volt shunt capacitor supply the first stage. All of the GSP-02's tube heaters are AC powered.

The bias supply consists of a full-wave bridge rectifier feeding through a 10-microfarad, 250-volt filter capacitor into the four 100-kilohm bias pots, which are connected in parallel. Each pot's wiper is bypassed to ground via another 10-microfarad, 250-volt capacitor. The schematic shows that these pots, which have no range-limiting resistors, can vary the bias all the way from 0 volts to a voltage negative enough to cut the output tubes off entirely; an unknowing tweaker could inadvertently bias the tubes to destruction.

The schematic doesn't show it, but the main power switch is supplemented by a "Stand By/Operate" switch. The latter connects and disconnects the AC to the power supply's high-voltage rectifier bridge, thus turning the high-voltage DC on and off. *B.H.K.*

plate current to the levels traditionally used for such tubes would decrease the distortion and increase the damping factor but would also shorten tube life.

Except where noted, all measurements were made via the GSP-02's 8-ohm output taps. Voltage gains with 8-ohm loads measured 27.7 dB for the left channel and 26.9 dB for the right channel with the original tubes but matched each other more closely with the replacements. Corresponding IHF sensitivity (millivolts of input for 1 watt output into 8 ohms) was 117.1 millivolts in the left channel and 128.3 millivolts in the right. My other measurements are for the left channel unless otherwise noted.

Note the differences between Fig. 1's frequency response curves for open-circuit, 8-ohm, and 4-ohm loading and for the NHT dummy speaker load, with and without its high-frequency impedance-compensation circuit. The frequency response the Houston GSP-02 delivers to your speakers will depend a lot on their impedance curves. (The 8-ohm tap, used in Fig. 1, has an output impedance of about 10 ohms.) Frequency response should be flatter if your speaker is connected to the GSP-02's 4-ohm taps, whose impedance is about 3.7 ohms. However, if your speaker's impedance is 8 ohms or higher, connecting it to the amp's 4-ohm tap will reduce the amount of power you get. If you buy a GSP-02, experiment to see which output tap yields the best sound with your speakers.

Damping factor, a function of output impedance, measured about 0.85 and 0.75 for the left and right channels, respectively, and was quite uniform over the audio frequency range. Output impedance dropped a bit with the replacement tubes, yielding a damping factor closer to 1. To assess damping factor, I normally feed 1 ampere into the measured channel's output terminals and measure the voltage across that output; the number of volts equals the output's impedance in ohms. But for the GSP-02, I had to reduce my test current to 0.1 ampere in order to prevent output-transformer nonlinearity from causing excessive waveform distortion below 30 Hz.

On square waves, the rise and fall times with 8-ohm loading were 4 microseconds. In the 'scope photo (Fig. 2), square-wave response for an 8-ohm load is quite good, with only minimal overshoot and ringing. Adding a 2-microfarad capacitor in parallel across the 8-ohm resistance increases the rise and fall times, which will definitely dull the high-frequency response, but the waveform is well shaped and behaved. There is considerable tilt in the 40-Hz square wave.

Distortion is plotted against power output in Figs. 3 and 4. The curves in Fig. 3, for

THE HOUSTON AMP CAN SOUND VERY MUSICAL AND SATISFYING WHEN USED WITH THE RIGHT SPEAKERS.

SMPTE IM distortion and total harmonic distortion plus noise (THD + N) at 1 kHz, are for 8-ohm loading. Distortion with the replacement tubes was significantly lower below about 10 watts, but above that, it was pretty much as shown. In Fig. 4, THD + N at 1 kHz is plotted for 4-, 8-, and 16-ohm loads. Like most tube amps, the GSP-02's power and distortion are both lower with 16-ohm loads, while loading a tap with less

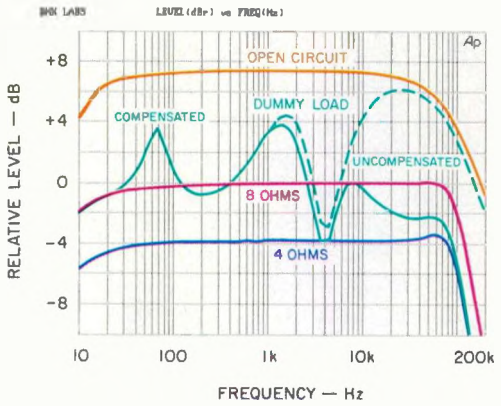


Fig. 1—Frequency response as a function of loading.

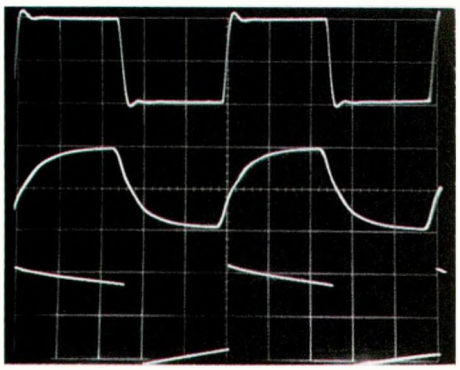


Fig. 2—Square-wave response for 10 kHz into 8-ohm load (top), 10 kHz into 8 ohms paralleled by 2 µF (middle), and 40 Hz into 8 ohms (bottom).

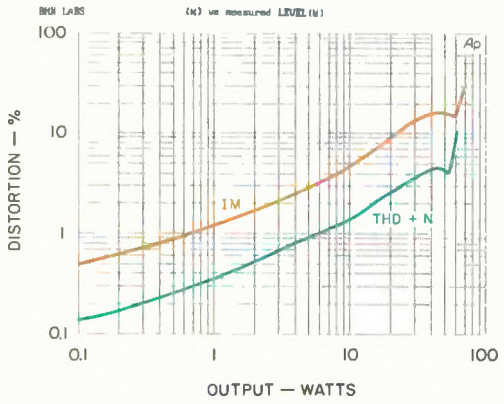


Fig. 3—THD + N at 1 kHz and SMPTE IM distortion vs. power output, for 8-ohm loads on the 8-ohm tap.

than its nominal impedance (here, 4 ohms on the 8-ohm tap) raises distortion a bit without affecting power output. In the curves of THD + N versus frequency at various power levels (Fig. 5), there's only a moderate rise in distortion at high frequencies, which is desirable, but distortion rises more steeply below 50 Hz. Houston may have sacrificed some low-frequency power capability in the output transformers to keep distortion low at high frequencies. The harmonic-distortion residue of a 10-watt, 1-kHz signal, with 8-ohm loading, is analyzed in Fig. 6.

Channel separation was 75 dB or greater above 300 Hz and was greater than 82 dB from 1 to 20 kHz. Crosstalk was greatest at low frequencies, which is unusual; this was probably because of common coupling between the channels in the power supply.

Output noise levels for the Houston amplifier's right (worse) channel were 2,287 microvolts wideband, 2,280 microvolts from 22 Hz to 22 kHz, 273 microvolts from 400 Hz to 22 kHz, and 444 microvolts, A-weighted. However, the left channel's noise was only about 36% of the right channel's in the first two measurements; the higher noise in the right channel was due to power-supply hum. In the last two measurements, which de-emphasize the low bass, both channels' noise levels were lower and the difference between them was smaller.

Dynamic power attainable was 58 watts into 8-ohm loads, which corresponds to dynamic headroom of –0.15 dB relative to rated power. As previously mentioned, the power at visual onset of clipping was about 45 watts, for a clipping headroom of –1.2 dB relative to the rated 60 watts. The GSP-02 drew 0.52 ampere in standby mode and 1.3 amperes in operating mode when idling.

Not surprisingly, in view of its low damping factor, this amplifier doesn't have much overall negative feedback. I checked this by opening the feedback loop. At 1 kHz, with 8-ohm loading, the resulting change in gain was only about 2.5 dB.

Associated Equipment Used

Equipment used in the listening tests for this review consisted of:

CD Transports: Sonic Frontiers SFT-1 and PS Audio Lambda Two Special

CD Electronics: Genesis Technologies Digital Lens anti-jitter device and Sonic Frontiers SFD-2 MkII and Classé Audio DAC-1 D/A converters

Phono Equipment: Oracle turntable, Well Tempered Arm, Accuphase AC-2 moving-coil cartridge, Vendetta Research SCP-2C phono preamp, and phono stage of Anthem Pre 1 preamp

Additional Signal Sources: Nakamichi ST-7 FM tuner, Nakamichi 250 cassette deck, and Technics 1500 open-reel recorder

Preamplifiers: Sonic Frontiers Line-3 and Forssell balanced tube line driver

Power Amplifiers: Sonic Frontiers Power-3 mono tube amplifiers, Sumo Gold Class-A amplifier (updated by its designer, Jim Bongiorno), Quicksilver M135 mono tube amps, and Arnoux 7B digital switching amp

Loudspeakers: Audiostatic ES-500s and Genesis Technologies Genesis Vs

Cables: Digital interconnects, Illuminati DX-50 (AES/EBU balanced); analog interconnects, Transparent Cable MusicLink Reference (balanced) and Tara Labs Master and Music and Sound (unbalanced); speaker cables, Transparent Cable MusicWave Reference and Tara Labs RSC Master Generation 2

Use and Listening tests

When I received the Houston GSP-02, I had a pair of Audiostatic ES-500 speakers set up in my listening room. I was dissatisfied with their response; the midbass was a bit weak and the upper midrange a bit too prominent. When I replaced my original amp with the GSP-02, the frequency balance seemed to improve. I learned why when I measured the Houston amp's performance and discovered its rather high output impedance. The impedance of the ES-500 speakers has a broad maximum at about 100 Hz and is lower in the upper midrange and at high frequencies. Since the voltage delivered by the GSP-02 varies with the load

impedance, the interaction between the Audiostatics and the Houston amp had fortuitously equalized the speakers in a way that improved their sound in my room. The overall sound was quite good indeed, with great resolution and detail. On some material, I thought I might have heard some distortion that I could attribute to low idling current in the amp's output stages. With the replacement output tubes, the sound improved and was absolutely first-rate on much of the music I played.

I frequently use B&W 801 Matrix Series 3 speakers in my tests, but I did not feel that using them with the GSP-02 would be entirely appropriate. The B&Ws' impedance curve varies like that of the dummy test load, whose effect on frequency response can be seen in Fig. 1; the response aberrations I could expect if I used them with this amp would obscure other aspects of the amplifier's sound. Instead, I set up the Genesis Technologies Genesis Vs, whose impedance curve is more uniform than the B&Ws' over most of the range that the amplifier has to drive. Since this impedance is 3 ohms or less, I used the 4-ohm output taps on the GSP-02. Using the Houston amp to drive the Genesis Vs, I got very good sound, with excellent space, dimension, and detail.

Tonal balance was more or less what I usually get from the Genesis speakers except for slightly increased output in the upper bass and lower midrange. This was caused by the speaker's rising impedance below about 150 Hz, which enabled the amplifier to deliver a higher output voltage; when an amp's damping factor is as low as the GSP-02's, its output at any frequency will vary with the speaker's impedance at that frequency. When the amp has a more normal damping factor—i.e., moderate to high—its electrical frequency response is more invariant with impedance.

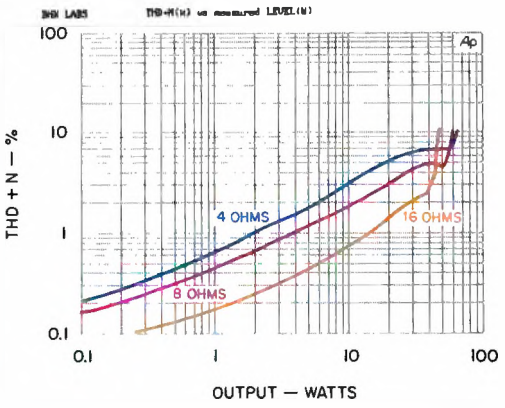


Fig. 4—THD + N at 1 kHz vs. power output and load impedance.

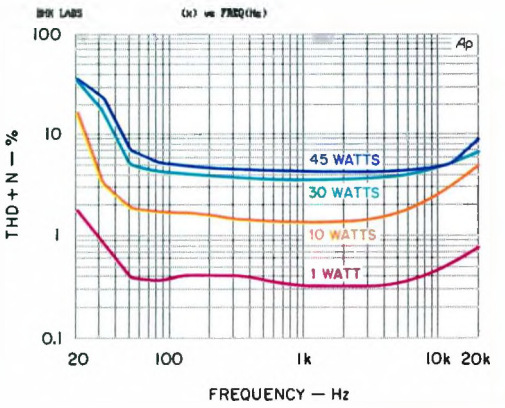


Fig. 5—THD + N vs. frequency.

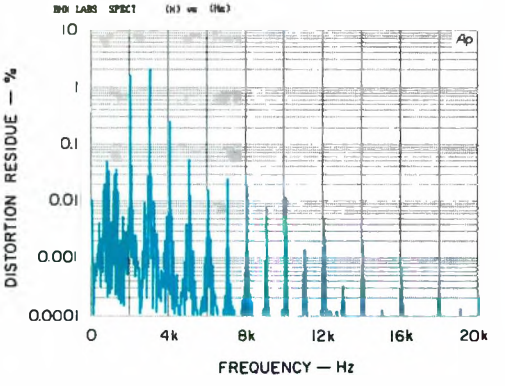


Fig. 6—Spectrum of harmonic-distortion residue for a 1-kHz signal at 10 watts out into 8 ohms.

Although the Houston GSP-02 did not sound quite as good or realistic as some of the amplifiers that I use for reference, it gave a good and musically enjoyable account of itself on the Genesis Vs—especially for a stereo tube power amp priced at less than $1,000. While somewhat sensitive to its speaker load, it can deliver very musical and satisfying sound when paired with the right speakers. A

ROTEL, *continued from page 46*

center-channel levels except through the setup routine, so reestablishing these settings each time would be a chore. Further, because the channel levels have no memory backup, they require resetting if the unit is unplugged or your electricity fails.

Operationally, the Rotel pair's simplicity makes for a direct and intuitive interface. But simplicity can be a double-edged sword, and these components do present a few inconveniences. Foremost is that you must manually select the 5.1-channel input at the RSP-980's front panel; you can't do it from the remote, nor does this preamp/processor automatically select that input when a signal is presented to it. (You can't use the remote to select the RDA-980's dynamic range modes, either.) Similarly, you can select mono, stereo, or a surround mode only by sequencing up or down through the eight possible modes via two keys on the remote. More seriously, there is no way at all to select or change surround modes or to adjust center/surround balance from the front panel. If you misplace the remote or accidentally step on it or run it through the Maytag (don't laugh, someone I know *real* well has done this), you're flat out of luck until you get another. (Unplugging and replugging the RSP-980 at least resets it to THX mode, but it erases all channel-level settings.) The RSP-980 lacks a headphone jack and front-panel A/V inputs for a camcorder. And, finally, both units deserve far better owner's manuals.

DOLBY PRO LOGIC PERFORMANCE WAS TRULY FIRST-CLASS, AND DOLBY DIGITAL SOUNDED EVEN BETTER.

For ascetics bred to the rigors of true audiophilia, these are, of course, mere quibbles. And in all fairness, I found the Rotel duo to be smooth, straightforward, and pleasant to use—pleasanter, in several ways, than some more elaborate and technologically burdened competitors. Rotel has done a very nice job of striking a balance between value, sonics-centered engineering, and extensive home theater features. A