BASCOM H. KING

QUICKSILVER AUDIO SILVER 60 MONO AMP

At first glance, the Quicksilver Audio Silver 60 looks a lot like the Quicksilver V4 amplifier I tested a year ago (February 1998). Internally, however, it's a rather different beast. The Silver 60 is Quicksilver's response to a speaker manufacturer's request for a tube amp that could drive difficult loads and still sound good. But this push-pull design also incorporates lessons that Mike Sanders, Quicksilver's chief designer, learned from low-power, single-ended (SE) triode amplifiers.

Initially, Sanders was skeptical about SE amps because of their generally poor measured performance. Ultimately, he realized that the best models' virtues—amazingly good dynamics and clarity and bass with equally good impact, extension, and definition—justified further research. Much of the improved low bass, he found, came from using oversized output transformers, whose primary windings had high enough inductance for efficient low-frequency coupling to the power tubes. (Low-inductance primary windings cause poor low-frequency performance with demanding speaker loads.)

According to Sanders, further experimentation with tube operating points, circuit topology, component values, and other parameters yielded a more dynamic sound and powerful bass, much like the best SE amplifiers. These changes sacrificed certain measured parameters in order to improve load-driving ability and duplicate some of SE designs' desirable sonic attributes in an amp that retained the higher power of push-pull.

QUICKSILVER AUDIO'S SILVER 60 COMBINES PUSH-PULL POWER WITH SOME SONIC VIRTUES OF SINGLE-ENDED AMPS.

Visually, the Silver 60 has a simple elegance, its black rear cover (which houses the power and output transformers and two filter capacitors) making a pleasing contrast to the chrome chassis. Four output tubes and a small input tube rise from the chassis' projecting apron. The only control features are a large on/off rocker switch and a green LED pilot light on the front of the apron; the output circuit is self-biasing, so no bias adjustment is provided. The rear panel holds a screw-terminal barrier strip for speaker connections (with taps for 1, 4, and 8 ohms), an RCA input jack, an AC line fuse, and an IEC power-cord socket.

Photos: Michael Groen

The Silver 60's construction is simple, elegant, and traditional. The wiring is point-to-point, with Quicksilver's typical neatness, using the chassis as the ground bus. Parts are of a high quality. All in all, a very nicely made amp.

Measurements

Unless otherwise noted, all reported results are for the Silver 60 amplifier I used in the left channel (which was distinguished from the other amp by a white band on its input jack); results for both amps were very similar.

Frequency response at the 8-ohm tap is shown in Fig. 1A, response at the 4-ohm tap in Fig. 1B. In each case, I used the NHT dummy speaker load, an open circuit, a

Rated Output: 60 watts.
Dimensions: 15 in. W x 6½ in. H x 9¾ in. D (38.1 cm x 16.5 cm x 24.8 cm).
Weight: 36 lbs. (16.3 kg).
Price: $2,350 per pair.
Company Address: 5635 Riggins Court, #15, Reno, Nev. 89502; 702/825-1514; www.quicksilveraudio.com.

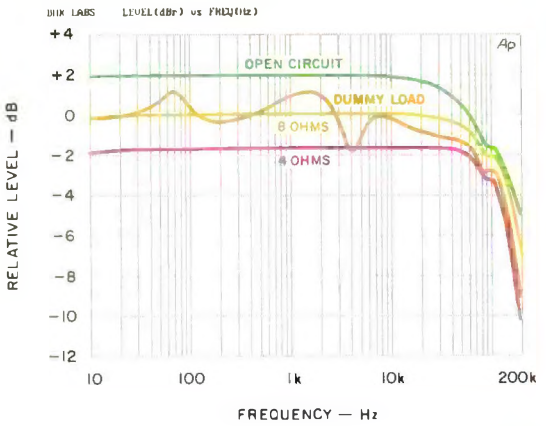

Fig. 1—Frequency response as a function of loading on the 8-ohm tap (A) and 4-ohm tap (B).

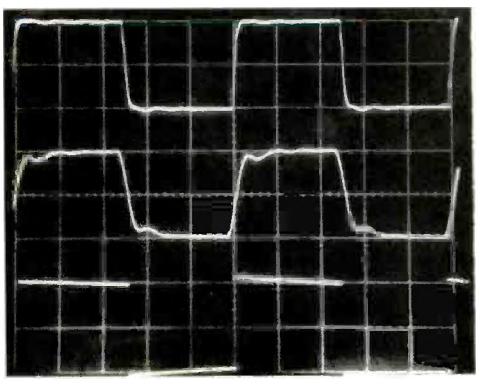

Fig. 2—Square-wave response for 10 kHz into 8-ohm load (top), 10 kHz into 8 ohms paralleled by 2 µF (middle), and 40 Hz into 8 ohms (bottom); all tests made at 8-ohm tap.

matching load (8 ohms on the 8-ohm tap, 4 ohms on the 4-ohm), and a resistance of half that load (4 and 2 ohms, respectively). The curves for the 4-ohm tap are a bit closer together, signifying slightly better output regulation with load and a slightly higher damping factor at that tap. (This is because the turns ratios of many output transformers, including the Silver 60's, yield 9- and 4-ohm taps rather than 8- and 4-ohm.)

The Quicksilver's square-wave response (Fig. 2) is fairly good at 10 kHz into an 8-ohm resistive load on the 8-ohm tap, and the absence of the usual overshoot, ringing, and increased rise time when a 2-microfarad capacitor is paralleled across the load is commendable. (Thus, the Silver 60s would be a good choice for driving electrostatic speakers.) The amp's excellent low-frequency response can be gleaned from the small amount of tilt in the 40-Hz trace. Rise and fall times for a ±5-volt output into an 8-ohm load on the 8-ohm tap were 2.8 microseconds; with a 4-ohm load on the 4-ohm tap and the same input drive level, the results were 3.1 microseconds.

Figures 3, 4, 5, and 6 show several aspects of distortion, all measured at the 8-ohm tap. Figure 3 plots two types of distortion versus power, total harmonic distortion plus noise (THD + N) at 1 kHz for various loads and SMPTE IM distortion for an 8-ohm load. In Fig. 4, THD + N versus frequency at several power levels, there's a commendably small increase in distortion at each end of the audio spectrum. Figure 5 reveals that the second and third harmonics are dominant through most of the output range and that the fourth and fifth harmonics are essentially out of the picture until

Associated Equipment Used

Equipment used during the listening test sessions for this review consisted of:

CD Equipment: Classé Audio DAC-1 and Sonic Frontiers Processor 3 D/A converters, PS Audio Lambda Two Special and Sonic Frontiers Transport 3 CD transports, Sony CDP-707ESD CD player, Panasonic DVD-A310 DVD player, and Genesis Technologies Digital Lens anti-jitter device

Phono Equipment: Kenwood KD-500 turntable, Infinity Black Widow arm, Win Research SMC-10 moving-coil cartridge, and Vendetta Research SCP2-C phono preamplifier

Additional Signal Sources: Nakamichi ST-7 FM tuner, Nakamichi 1000 cassette deck, and Technics 1500 open-reel recorder

Preamplifiers: Sonic Frontiers Line-3 and First Sound Reference II passive, modified Quicksilver Audio LS, and Dynaco PAS-2

Amplifiers: Arnoux Seven-B stereo switching amp, Quicksilver Audio M135 mono tube amps, Manley Labs Stingray stereo tube amp, de-Havilland Electric Company Aries single-ended mono tube amps, E.A.R. V20 integrated tube amp, and Sumo Polaris solid-state stereo amp

Loudspeakers: Dunlavy Audio Labs SC-IIIs and Tannoy Churchills

Cables: Digital interconnects, Illuminati DX-50 (AES/EBU balanced); analog interconnects, Vampire Wire CCC/II and Tice Audio IC-1A; speaker cables, Kimber Kable BiFocal-XL and Madrigal Audio Laboratories HF2.5C

THE SILVER 60'S CIRCUIT IS AS MINIMAL AS IT CAN GET AND STILL BE PRACTICAL.

TECHNICAL HIGHLIGHTS

The circuit of the Quicksilver Audio Silver 60 is as close to minimal as it can get and still be practical. Signal input is applied to the common-cathode first stage, using half of a 12AT7 twin triode. That stage's plate output is directly coupled to the grid of the second stage, a split-load phase inverter, which uses the other half. The phase inverter's outputs are capacitor-coupled to the control grids of the output tubes.

Two paralleled push-pull pairs of output tubes are used, in an Ultra-Linear circuit configuration. These tubes should have a long useful life, as four of them are used even though power output is relatively low. A common cathode resistor, bypassed with a capacitor, provides self-biasing (cathode bias). The Silver 60 comes with EL34 output tubes, though other types (such as KT88s, 6550s, or 6L6s) can be used. The plate-to-cathode voltage is somewhat lower than is the norm nowadays, on the order of +385 volts. Current draw, while not terribly high, is higher than Quicksilver's norm: With EL34s, it's around 55 milliamperes per tube, for output stage dissipation of some 84 watts at idle. Setting the output circuit's operating points for lower voltage and higher current than customary was part of the amplifier's voicing. Overall feedback is taken from the 8-ohm connection on the output transformer back to the cathode circuit of the first stage. *B.H.K.*

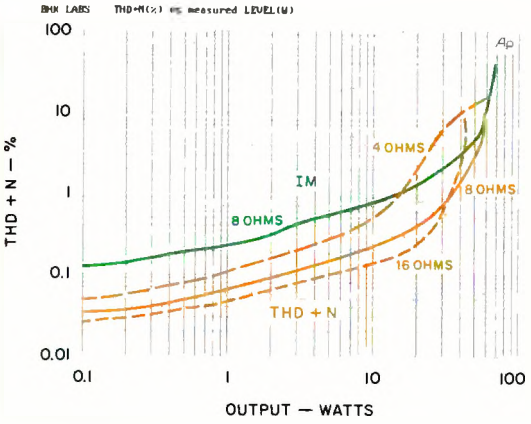

Fig. 3—Distortion vs. power output, at 8-ohm tap.

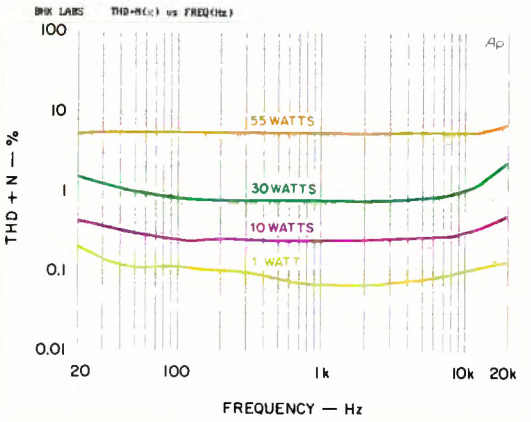

Fig. 4—THD + N vs. frequency, 8-ohm load on 8-ohm tap.

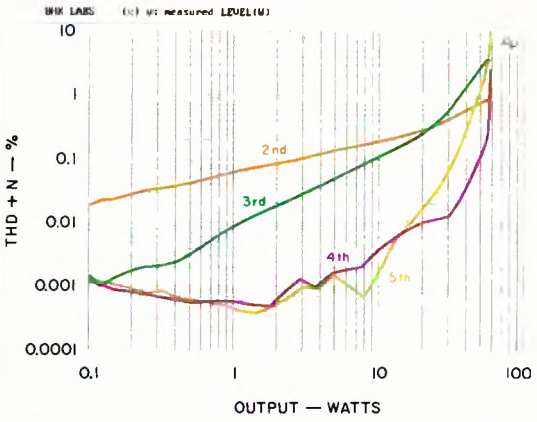

Fig. 5—Second through fifth harmonics vs. output at 1 kHz, 8-ohm load on 8-ohm tap.

about 20 watts. Except for the sixth harmonic, which attains almost the same level as the fourth at 10 watts out (Fig. 6), the higher harmonics drop fairly rapidly to very low levels. The Silver 60's overall measured distortion was not as low as that of some past Quicksilver amps. This is primarily because of the newer circuit's simplicity, the small amount of global feedback, and the designer's optimization of circuit operating points for best sonic performance rather than lowest measured distortion.

SQUARE-WAVE TRACES AND DAMPING FACTOR REFLECT THIS AMP'S EXCELLENT BASS PERFORMANCE.

As you can see in Fig. 7, the Silver 60's damping factor is relatively constant over the frequency range, even in the low bass, at the 8-ohm tap. Although the 4-ohm curve's shape was very similar, overall damping factor was a bit higher, about 4, because of the improved output regulation at that tap.

Dynamic power at the start of the 20-millisecond IHF tone burst was 68 watts, yielding dynamic headroom of 1.1 dB, but dropped to 64 watts by the end of the burst. With a 1-kHz tone, the amps started to clip at about 58 watts, yielding clipping headroom of –0.3 dB. Voltage gain into 8-ohm loads on the 8-ohm tap was 24.79 dB for the amp I used for the left channel and 24.88 dB for the amp I used for the right; corresponding IHF sensitivity for 1 watt into 8 ohms was 163 and 161.3 millivolts, respectively.

Output noise for the left-channel amp was 537.2 microvolts wideband and 99.8 microvolts A-weighted; for the other amp, the results were 873.9 and 126.6 microvolts. The IHF signal-to-noise ratio was 89 dB for the left channel and 87 dB for the right. The AC line current was 1.44 amperes at idle, increasing to 1.7 amperes at 58 watts into 8 ohms on the 8-ohm tap.

Use and Listening Tests

For my initial listening, I used the Quicksilver Silver 60 amplifiers to drive a pair of Dunlavy Audio Labs SC-III loudspeakers

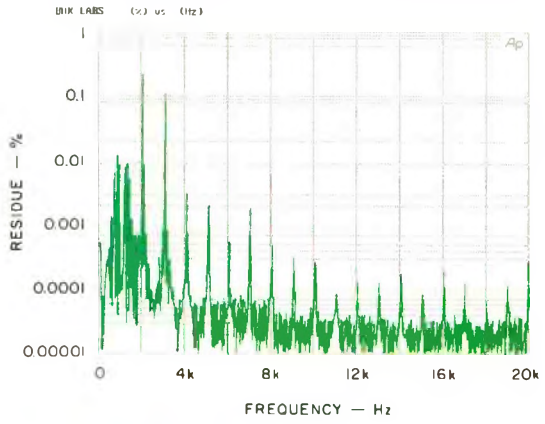

Fig. 6—Spectrum of harmonic-distortion residue for a 1-kHz signal at 10 watts out into 8 ohms on 8-ohm tap.

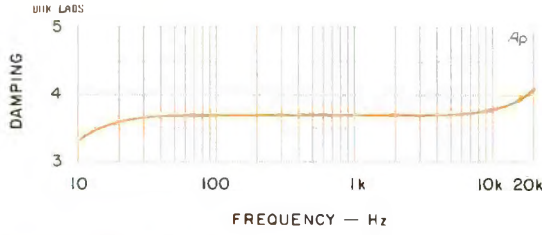

Fig. 7—Damping factor at 8-ohm tap.

(which I reviewed in the July 1998 issue), augmented by a pair of Tannoy Churchill speakers used as subwoofers; the Churchills were driven by a Sumo Polaris stereo power amp via a custom low-pass filter whose input was the output from the Quicksilvers. My preamp for this setup was the First Sound Reference II.

When I received the Silver 60s, they were quite new, with virtually no playing time on them. They sounded good right out of the box, but I knew they would sound a bit better with more hours on them. And indeed, when I set them up for further listening after I'd made my measurements, they sounded even better.

I was quite impressed with the Silver 60s. Their transparency, space, air, and dimension were right up there with the best. Bass quality, impact, definition, and extension were also quite impressive. The Quicksilvers drove the Dunlavy SC-IIIs with enough power to play most of my favorite music at considerably higher volume levels than those I use for normal listening. And when I replaced the SC-IIIs with the Churchills, which are 4 dB more sensitive, the Silver 60s made these Tannoy speakers really stand up and shout!

I WAS IMPRESSED BY THE QUICKSILVERS' TRANSPARENCY, SPACE, AND BASS IMPACT AND EXTENSION.

Whether I used the Dunlavy/Tannoy setup or the pair of Tannoys alone, the Quicksilvers sounded amazingly natural and convincing.

The Quicksilver Silver 60s did their thing most competently and without problems. My only surprise was at how good these little amps were. I liked them a lot, enjoyed a lot of music with them, and most definitely recommend your giving them a listen. A