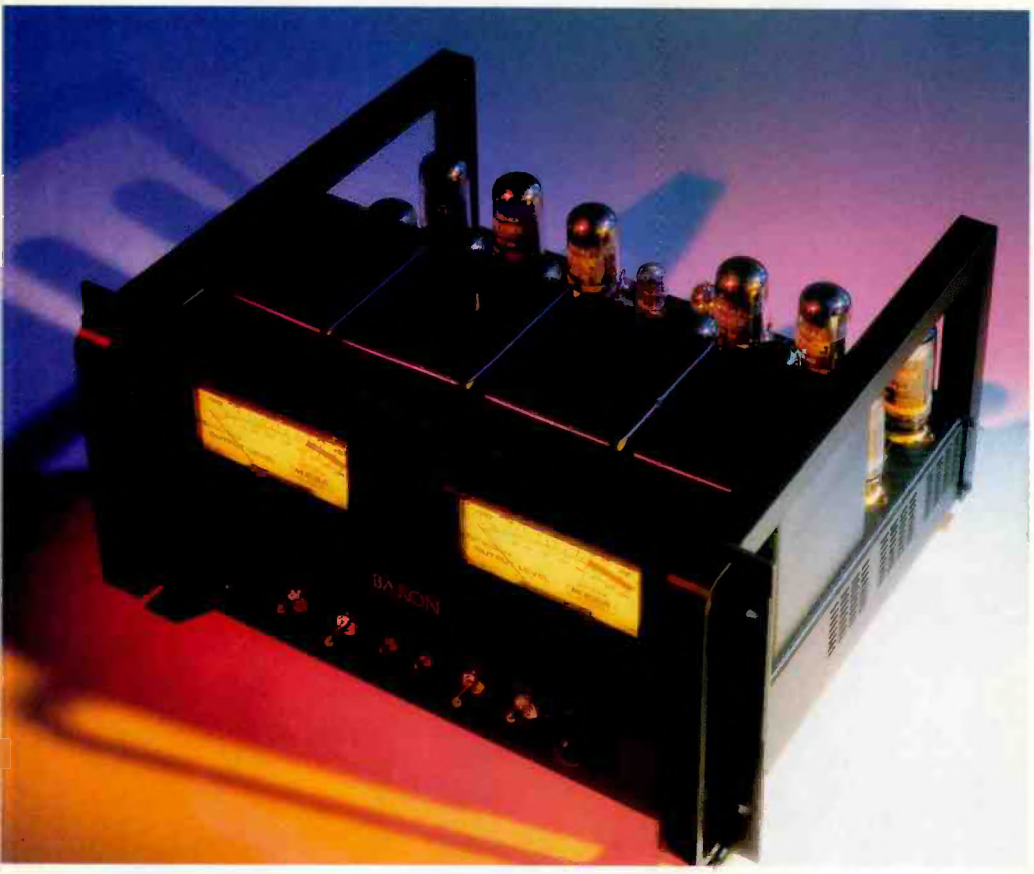
MESA ENGINEERING BARON AMPLIFIER



The Baron tube power amp's heritage stems from Mesa Engineering's success as a maker of musical instrument amplifiers. Randall Smith, the company's president and chief designer, saw a need in the early '80s for a guitar amplifier that could be rack-mounted, so he developed the Mesa M180 and M190 amplifiers. These early models, which found their way into the hi-fi systems of some of Smith's audiophile friends, were so well received that he decided to build a high-end amplifier for use in the home. This led to the introduction of the Baron.

THE MESA BARON'S DESIGN CHOICES WERE BASED ON LISTENING PREFERENCES, NOT MEASUREMENTS.

In designing the Baron, a complex and unusual amp, Smith relied heavily on a listening panel that was fairly evenly divided between musicians and audio enthusiasts. The panelists rejected many design choices that would have given the amplifier better measurements in favor of those they felt would improve its sound. The Baron's design was finalized when its sound character satisfied both the panel and Smith.

The most unusual aspect of the Baron's design is its Tandem-State Imaging (patent pending), a system for tailoring the amp's sonic performance to suit different tastes and speakers. Tandem-State Imaging comprises two parts, a rear-panel switch to select any of four negative feedback levels ("0," "I," "II," and "III") and an output-tube setup for pentode or triode operation as well as mixtures of the two.

To accomplish the latter, Mesa partitioned each channel's three pairs of output tubes into two unequal groups. Switches on top of the chassis enable each group to be set for triode or pentode operation. Four modes of operation are available: full pentode, two-thirds pentode and one-third triode, one-third pentode and two-thirds triode, and all-triode.

Power output varies according to the operating mode, with each group of output tubes delivering about 60% less power in triode than in pentode mode. But what matters most, according to Mesa, is the range of sonic choice that Tandem-State Imaging gives you. For example, the Baron's instruction manual states that you might prefer triode operation with little or no negative feedback for "bringing lushness to. . .acoustic instruments in a playback setting," whereas pentode operation might be better "for playing back modern electronic music, where bass fundamentals require considerable—and fast—amplifier power with enough negative feedback to keep speaker motion tight."

The Baron's very attractive front panel has mirror-image symmetry—which is logical, since the Baron is a dual-mono design and has separate AC power cords for each channel. The prominent, illuminated meters normally indicate output level but are

Rated Midband Power at Onset of Clipping, All-Pentode Operation into 8 or 4 Ohms: With Type 5881 output tubes, 135 watts per channel; with Type 6L6 output tubes, 150 watts per channel.
Rated Midband Distortion with No Negative Feedback: Less than 1% THD.
Dimensions: 19 in. W x 8¾ in. H x 14½ in. D (48.3 cm x 22.2 cm x 36.8 cm).
Weight: 75 lbs. (34 kg).
Price: $3,695.
Company Address: 1317 Ross St., Petaluma, Cal. 94954; 707/433-8663; E-mail, audioguy@mesaboogie.com
For literature, circle No. 91

Photos: Michael Groen

Circuit Highlights

The Baron's input circuit is a differential amplifier that uses a 12AX7 dual triode as a phase inverter. One grid is fed from the incoming input signal, the other tied to ground through a resistor that forms the shunt element for the negative feedback. Because of the impedance difference between these grids, the Baron is set up, despite the presence of XLR jacks, for unbalanced signals. In the unit I received, pin 2 of the XLR input connector was tied to the hot lead of the RCA input connector and to the signal input grid; pins 1 and 3 were grounded. Grounding one phase of a balanced input this way could conceivably cause distortion in some preamps. (For that reason, according to Mesa Engineering, Baron amps produced since August of this year have pin 3 grounded through 60 kilohms, to match the input impedance of pin 2 and the RCA connector.) The cathodes of the input tubes are tied together and returned to about –60 volts through a resistor whose value sets the stage's current at the desired level. Output is taken from the plates of the first stage and capacitor-coupled to the next stage through an attenuator that uses one resistor for each signal phase.

The second stage, which also uses a 12AX7 dual triode, is a push-pull amplifier whose cathodes are tied together and connected to ground through a self-biasing resistor. This resistor is bypassed with an electrolytic capacitor. An AC-balance control is incorporated in the plate circuit. (This is a service adjustment and should not be confused with the accessible balance adjustment described below.) A small capacitor is connected from one of the plates to ground; this is just one of many touches that tailor the sound in a way Mesa Engineering considers desirable, although it also increases measured high-frequency distortion. Plate outputs of this stage are capacitor-coupled to the grids of the output tubes.

The plates of the output tubes are fed from a 460-volt supply. The screen grids of the output tubes are fed through a filter choke from this supply and are bypassed through a capacitor to ground. Two adjustable bias-voltage dividers are used to feed the tube grids in each half of the push-pull output stage through individual grid-leak resistors. When the meter switches on the front panel are set for bias adjustment, the meter reads the voltage drop across a common-cathode sampling resistor. This represents the sum of the DC currents in the three output tubes near the Baron's front. When the meter switch is set for balance adjustment, the meter is connected between the sampling resistor and a similar resistor in the cathodes of the other three output tubes. When the amp has been properly balanced, the cathode currents in both halves of the push-pull circuit are equal and the meter reads zero. Global negative feedback is taken back through a switchable series resistor (the four-position feedback switch on the back panel) from the 8-ohm output tap to the aforementioned shunt feedback resistor.

In the power supply, the B+ voltage for the output stage passes through a solid-state, full-wave rectifier bridge and six 4,700-microfarad, 100-volt filter capacitors in series (an effective filter capacitance of 783 microfarads and 600 volts). Identical resistors across each of the capacitors equalize the voltage distribution in the series string and function as high-voltage bleed resistors when the Baron is turned off. The soft-start position of the AC power switch temporarily places a resistor in series with the power transformer's primary winding, thereby reducing inrush current. This current can be appreciable because the tube heaters have low resistance when cold and the capacitance of the B+ filter is high. Flipping the power switch up to its operating position shorts out the resistor. Simple and effective. *B.H.K.*

also referred to when you adjust the output tubes' bias and balance. A rotary switch below each meter sets the meter to show output level (with a choice of 15 or 150 watts as the 0-dB point), bias, or balance.

Between the two rotary switches are six toggle switches, three per channel. The outermost toggles are unusual, three-position power switches. To turn the Baron on, you should hold each switch all the way down for 2 seconds (its soft-start position), to start the amp without a current surge; then you flip each switch up to its top position. The middle position turns the amp off. The adjacent standby switches also have three positions, for warm-up, standby, and operation. These switches control the high-voltage level fed to the tubes; the tube heaters remain on in all three positions so that the amp can start operating without waiting for the tubes to heat up. The warm-up mode reduces the high voltage by half, which cuts off the output stage, greatly reducing heat and overall power consumption. The standby position cuts the high voltage off completely, reducing heat and power draw even more. However, the Baron attains its characteristic sound faster when you switch on from warm-up than from standby mode. The innermost toggles are used to illuminate each meter, a nice touch.

UNIQUELY, THE BARON OFFERS TRIODE AND PENTODE OPERATION PLUS TWO INTERMEDIATE MODES.

On top of the chassis, near the rear edge, are sets of toggle switches for each amplifier channel. In each set, one switch selects pentode or triode mode for four output tubes, another selects the operating mode for two tubes, and a smaller switch between them selects whether the circuit's common ground is connected to the chassis and power-line ground or isolated from them.

On the Baron's rear panel are, for each channel, three rugged gold-plated binding posts for speaker connections ("Common" flanked by "4 Ohm" and "8 Ohm"), RCA phono and XLR connectors for signal inputs, an AC line fuse, and an IEC power-cord socket. The "Negative Feedback"

Table I—*IHF sensitivity, 8-ohm load on 8-ohm tap.*

	Sensitivity, mV			
	FEEDBACK SETTING			
	0	I	II	III
P/P Mode	34.4	38.0	42.0	48.0
P/T Mode	47.2	50.7	54.8	61.0
T/P Mode	60.7	64.2	68.0	74.2
T/T Mode	73.0	76.4	80.5	87.2

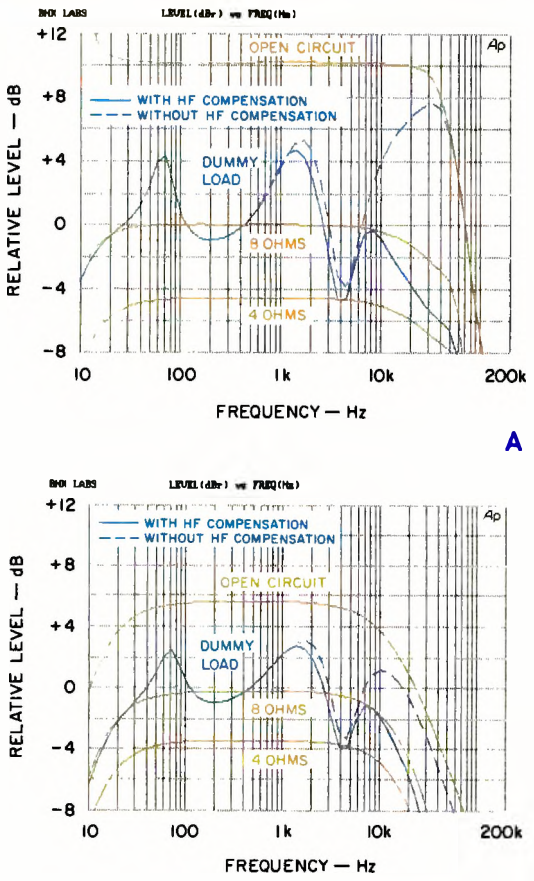


Fig. 1—Frequency response in all-pentode (P/P) mode with maximum feedback (A) and in all-triode (T/T) mode with zero feedback (B).

switch, in the center, is common to both channels.

The Baron's chassis is fairly conventional and is divided into three zones. First is the front panel, with a cover for the meters extending about 2 inches behind it. Next are the power and output transformers. Behind them are the tubes, the switches for operating mode and ground selection, and access holes for the bias and balance adjustment pots. Ample slots in the sides and top allow plenty of air to flow into the chassis and up past the tubes. Metal bars on each side connect the top of the front panel with the back corners of the chassis; these bars will help you lift the amp and enable you to turn it over without damaging the tubes. All metalwork is aluminum, even the transformer covers. The inside of the chassis is mostly occupied by printed circuit boards for each channel's audio circuitry and power supply. The Baron is very well built, with high-quality parts.

Measurements

To simplify references to the Baron's four operating modes, I'll abbreviate them as P/P (all-pentode), P/T (two-thirds pentode, one-third triode), T/P (two-thirds triode, one-third pentode), and T/T (all-triode). Data presented is for the left channel, which had higher distortion than the right. Input signals were applied to the RCA connectors in all cases.

The Baron's voltage gain varied somewhat, depending on the operating modes of its output tubes and the feedback setting. The amount of negative feedback was small, ranging from about 1 to 8 dB according to the load and, again, the output mode and feedback setting. The Baron's gain was greatest in P/P mode (38.31 dB with zero feedback), decreasing as I switched through the P/T, T/P, and T/T modes (minimum gain was 30.22 dB). As I switched through them, I found it interesting that over most of the audio range each mode's gain and frequency response under load with maximum feedback was very similar to the next mode's gain and response with zero feedback. Table I presents IHF sensitivity for each combination of output mode and feedback level when an 8-ohm load was connected to the 8-ohm output tap. With 4-ohm loading on the 4-ohm output tap, gain was lower by about 70%, or about 3.1 dB, and sensitivity was correspondingly higher. Channel balance was excellent, within a few tenths of a dB.

The Baron's frequency response is shown in Fig. 1 for various loading conditions. The dummy speaker load, built for me by NHT under Ken Kantor's direction, was designed to mimic the load presented by a real speaker. It has an RC high-frequency impedance-compensation network, whose effects can also be seen. Figure 1A shows operation in P/P mode with maximum feedback; Fig. 1B is for T/T mode with zero feedback. Note the variations in response when the Baron feeds the simulated speaker load: They are caused by interaction between the amp's high output impedance and the load's impedance variations. Needless to say, this will affect the sound and will vary according to the impedance characteristics of the speakers you use. The variation is greater in pentode than in triode mode; this would be even more evident if I had used a lower feedback setting for Fig. 1A. Similarly, the response with the dummy load in Fig. 1B would have been smoother had I used maximum feedback.

OUTPUT-MODE SELECTION IS PARTLY A TRADE-OFF OF BANDWIDTH VERSUS LOAD TOLERANCE.

The low-frequency peak with open-circuit loading seen in Fig. 1A occurs only in P/P mode (where the amp's open-loop gain is highest) when maximum feedback is used. This peak might cause output-transformer saturation and consequent intermodulation distortion, but only in the unlikely event that you play material containing a lot of infrasonic energy at high levels into speakers whose impedance at low frequencies is high.

Square-wave response is shown in Fig. 2. The pairs of traces at the top and in the middle are for a 10-kHz signal; the faster (squarer) trace in each pair is for an 8-ohm load on the 8-ohm tap, while the slower (more rounded) trace shows the effect of 8 ohms paralleled with a 2-microfarad capacitance. The mode in the top traces is P/P with maximum feedback; the middle traces are for T/T mode and maximum feedback. The Baron's P/P mode has the greater bandwidth (because of decreased damping of the output transformer's resonance at

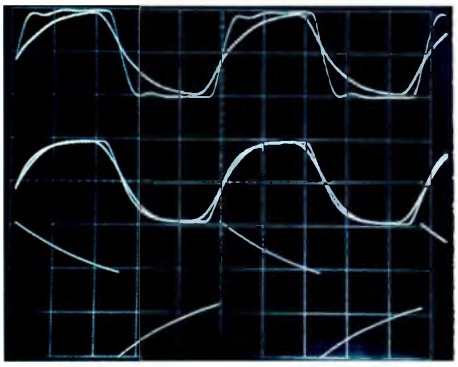


Fig. 2—Square-wave response for 10 kHz in P/P mode (top) and T/T mode (middle) and for 40 Hz in T/T mode (bottom). The overlaid 10-kHz traces show effects of 8-ohm loading and of 8-ohm loads paralleled by 2 µF (see text); the 40-Hz curve is for 8-ohm loading.

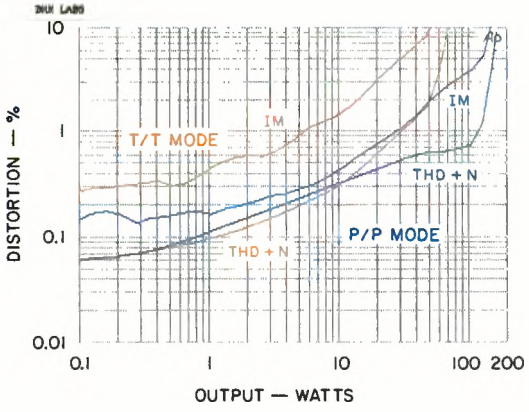


Fig. 3—Distortion vs. power for all-pentode and all-triode modes.

about 50 to 60 kHz) but is more affected by load; T/T mode is slower but has greater load tolerance. In the bottom trace, a 40-Hz waveform with the Baron in T/T mode, the pronounced tilt is caused by the rolled-off low-frequency response seen in Fig. 1.

Figure 3 shows distortion for P/P and T/T modes with maximum feedback. The SMPTE intermodulation (IM) distortion is considerably higher in T/T mode because of power-supply ripple modulation that seemed to occur mostly in this mode.

Figure 4 shows 1-kHz total harmonic distortion plus noise (THD + N) versus power in P/P mode with maximum feedback (Fig. 4A) and in T/T mode with zero feedback (Fig. 4B) for various loads on the 8-ohm tap. Some of the well-known differences between pentode and triode operation are clearly seen here. Specifically, the triode mode is, again, more load-tolerant; the distortion near full power stays more constant with changing load. In pentode mode, however, the attainable power and the distortion at specific power levels vary more with load. The Baron's load matching is typical for a tube amplifier: There is little change in power when an output tap is loaded with half its rated impedance (e.g., 4 ohms on the 8-ohm tap), but when the load is twice the rated impedance, power output drops appreciably.

Figure 5 shows how the Baron's THD + N varies with frequency at several power levels in P/P mode with maximum feedback. This push-pull amplifier's performance here is entirely in keeping with its small amount of feedback and is as good as (or better than) the distortion of some of the single-ended tube amplifiers that are popular these days.

The Baron's dynamic power in P/P mode was 150 watts at the beginning of the 20-millisecond tone burst and 144 watts at the end of the burst. Mesa Engineering does not provide conventional specifications for the Baron's power output and distortion, but the company does give (in a document titled "Mesa Baron Technical Update") power output of 55, 85, 120, and 150 watts per channel for the T/T, T/P, P/T, and P/P modes, respectively. If you take 150 watts as a reference, dynamic headroom would be 0 dB. Based on the data for Fig. 5, the power levels attainable at clipping (2% THD + N) for the four output modes were, respectively, 49, 76, 116, and 134 watts at 300 to 400 Hz (where the amp's distortion at most power levels is lowest).

Even though the Baron is dual mono, with separate power supplies and such, the two channels, otherwise completely independent, have sensitive leads in close proximity at the feedback switch. Crosstalk was less than –80 dB below 1 kHz but increased above that frequency; by 20 kHz, it was between –65 and –75 dB—depending on the direction of measurement, whether or not the amp was grounded to my Audio Precision test system's chassis ground, and how I set the amp's ground-isolation switches.

Like most characteristics I measured, output noise varied with the Baron's operating mode and feedback level. The absolute value of the noise in the band from 22 Hz to 22 kHz was about 1 millivolt with the feedback set to zero—except in T/T mode, where it dropped to 0.5 millivolt. The major contributions to these readings came from power-supply hum components. The IHF signal-to-noise ratio (A-weighted noise relative to 1 watt into 8 ohms) varied with operating mode and feedback; it was 81 dB in P/P mode with zero feedback and 88 dB in T/T mode with maximum feedback.

THE MESA BARON'S DISTORTION IS IN KEEPING WITH THE LOW AMOUNT OF FEEDBACK IT USES.

Damping factor was only about 1 for most conditions; it dropped to 0.5 or less in P/P mode at all feedback levels. The damping factor was relatively flat with frequency between 100 Hz and 20 kHz but decreased below 100 Hz, varying with mode and feedback level.

The Baron's current draw from the AC line was 1.7 amperes in the standby and warm-up modes and 4 amperes at idle in all operating modes.

Use and Listening Tests

During the review period, I used a Sonic Frontiers SFT-1 or a Counterpoint DA-11A CD transport to drive a Genesis Technologies Digital Lens jitter-reduction device. The output of the Digital Lens drove a Sonic Frontiers SFD-2 MKII, a Classé Audio DAC-1, a Dodson Audio DA-217, or a Manley Reference D/A converter. Phono source was an Oracle turntable fitted with a Well Tempered Arm and an Accuphase AC-2 moving-coil cartridge used with a Vendetta Research SCP-2C phono preamp. I also used a Nakamichi ST-7 FM tuner, a Nakamichi 250 cassette recorder, and a Technics 1500 open-reel recorder. The preamplifiers in my system were an Audio Re-

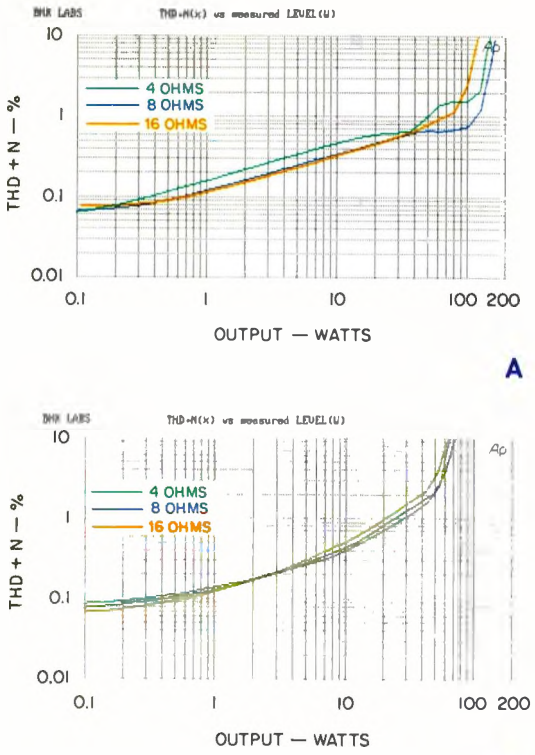


Fig. 4—THD + N vs. output for different loads on 8-ohm tap in P/P mode with maximum feedback (A) and in T/T mode with zero feedback (B).

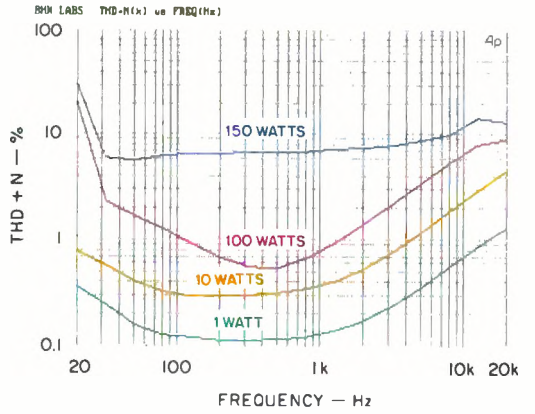


Fig. 5—THD + N vs. frequency, P/P mode with maximum feedback and 8-ohm loading on 8-ohm tap.

search LS22, a Pass Labs Aleph-P, and my custom-made Forssell balanced tube line driver. For comparison with the Baron, I used a pair of Sonic Frontiers Power 3 mono tube amps, a pair of Quicksilver M135 mono tube amps with Svetlana 6550C output tubes, and a Spectron 1KW digital switching amplifier. The loudspeakers were Genesis Technologies Vs and B&W 801 Matrix Series 3s; the B&Ws were augmented from 20 to 50 Hz by subwoofers, placed against the wall behind each 801. Speaker and interconnect cables were from MIT and Transparent Audio. Digital interconnects were Audient Technologies Datrix AES/EBU Reference active cabling, in conjunction with Audient's Tactic and Audit cable driver and receiver, and AES/EBU balanced Illuminati DX-50s.

I first listened to the Baron on the Genesis V speakers. I was surprised to find that the sound was not as affected by the speaker's impedance variations as I had expected. The sound was laid-back, with a softened high end. The speaker's low-frequency impedance rise below about 150 Hz (stemming from the high-pass crossover between its powered woofer and passive midbass driver) generally caused the Baron no problems with overall blend and balance in the bass and lower midrange. I did notice some mild boominess from 100 to 200 Hz on some music when the Baron was in all-pentode mode. Some of my favorite pop CDs sounded fun and involving. Yet some other music sounded more irritating and distorted with the Baron than with the other amps in my system. On classical pieces, there was a better sense of "thereness" with the other amps; the Baron sounded more closed in and not as airy and spacious. But I must say it did put out power: Even in all-triode mode, it would play most music louder than I wanted.

I liked the sound of the Baron better with the B&W 801s than with the Genesis Vs, despite the 801s' greater impedance variations in the midrange. (The 801s' maximum and minimum impedances are similar to those of the NHT dummy load.) I played quite a variety of music and generally enjoyed the experience. More than once I found myself thinking that this amp really sounded pretty damn good. The Baron sounded best to me in its all-triode mode with full feedback. As I switched in more and more pentode operation, the sound got harder and the frequency response aberrations became too noticeable. Surprisingly, considering the results of my measurements, the Baron's bass was anything but flabby and undamped. I thought it was quite tuneful and not too dissimilar from the bass of other amplifiers I've used with the 801s.

Operation of the Mesa Baron, both in the lab and in my listening room, was straightforward. One surprise, however, was a small blap from the speakers when I unplugged an input lead to the amp just after I'd placed the Baron in standby mode. Clearly, the filter capacitors still held enough of a charge to amplify for a short while. Solution: wait just a few seconds longer!

EVEN IN TRIODE MODE, THE BARON PUT OUT ENOUGH POWER TO PLAY MOST MUSIC LOUDER THAN I WANTED.

I thought that the power transformers got a bit too hot after several hours of operation on a hot day. It would be wise to follow the operating manual's recommendations regarding fan cooling.

The Baron is an interesting design. Its basic design concept is valid, but its sound (for me, at least) was undercut by its high output impedance and the variations in frequency response this caused when it drove real speaker loads. Yet it does represent a good value in terms of power and features per dollar and gives you unique ways to tailor your system's sound. If you like a warm, full sound and enjoy equipment that you can play with in ways that make a sonic difference, you may find that it's your cup of tea, even if it isn't entirely mine. A