Xs

a new series from Pass Labs.

Introduction

It seems like yesterday, and so it is a little surprising to note the Pass Labs SuperSymmetry design is 18 years old, and the patent expires at the end of 2011. In the last few years we have recognized that design must move forward; that there are still improvements to be made in amplifiers. SuperSymmetry serves as a good start, but *plus ultra*, there is more beyond.

Technical excellence is a virtue by itself, but it will be the *sound* that determines the long term success of a new design after the novelty has worn off. The audio marketplace is littered with products that measured spectacularly well but which did not go down as "classics" because they lacked the subjective qualities that kept listeners happy beyond the initial excitement.

With this uppermost in mind we set out to create a new generation of amplifiers that measure well, but in a manner that only serves the subjective perception of listeners. Oscilloscopes and distortion analyzers are excellent tools, but they make lousy customers. Our real customers care most about the experience they get when they sit down to listen to their music.

We want our products to invite you to listen. We want you to enjoy the experience so much that you go through your entire record collection - again and again. We want customers for the long haul.

The Role of Distortion Numbers

A simple survey of really successful audio amplifiers shows that distortion numbers by themselves are not that important. Obviously there is some level at which harmonic distortion is subjectively intrusive – we could probably stipulate that 10% distortion is too much, and would probably accept that 1% would be quite audible.

Conversely, we should accept that distortion becomes inaudible below some arbitrary level. Is it at 0.1%? 0.01%? 0.001%? We actually don't know, because there has to be a much larger context of performance to which a single number only alludes.

So while we measure all the things we can as part of the development process, it is the listening experience which has to be the deciding factor. Objective measurements are helpful, and they certainly are important to insure conformity in the manufacturing process, but all this only serves the

customer's listening experience, which is primarily subjective. Similarly with all the other objective characteristics of the amplifier – they are subservient to the customer's experience.

The Process

We began the work with a group of listeners and upgraded the uniformity of their playback systems with components chosen for the ability to reveal differences between amplifiers. We did not do AB or ABX testing – people lived with prototypes as long as they liked in their own system, and the only changes made were to the amplifiers themselves.
We built sets of modular prototypes which allowed us to alter any given part of the amplifier – the heaviest parts, the heat sinks and transformers and such, stayed relatively static so that one person could easily make the changes.

At the same time we began an examination of the characteristics and sound of some other types of gain devices (tubes and SITs) and also alternative versions of the Jfets and Mosfets which comprise our current products.

The process took about three years. In the first year we had settled on most of the power supply design and the physical chassis and heat sinks, and in the second year we finalized the basic power output stage and front end. In this last year we have been tweaking the front end circuits and the biasing arrangements and values of the output stage.

Harmonic Structure

We paid a good deal of attention to the harmonic structure of the amplifier's transfer curve. It is well understood that the relative amounts of the various harmonics in distortion characteristic contribute to the perception of audibility. It is generally agreed that concentration of this distortion into the second and third harmonics is best and the reduction or elimination of higher order harmonics is also desired. What is not so clear is the best relative second and third harmonic amplitude and phase.

It turns out that these relations are some importance and that their perception is also dependent on absolute amplitude, the topology of the circuit, the bias of the circuit, the types of devices, the feedback which might be employed, and of course, everything else. However, for a given design, these things can be successfully tweaked into a state which is subjectively preferred by our listeners, and we came to unanimity on the result.

Emphasis on Output Stage

While every part of the amplifier is important, playing with developmental tube and SIT designs, we concluded that it is the character of the power output stage itself which is most influential in shaping the sound of the amplifier. This is not a radically new idea – the output stage does the most work, generally has the most distortion, and is the interface to the complex variable and reactive load which is a loudspeaker.

In the end, we found that adjusting the values for push-pull Class A biasing and also the amount of single-ended bias in the output stage gave us a major improvement. Pass Labs started with single-ended Class A bias in 1991 and current product still uses some of these techniques, but the new design increases the value of single-ended bias by an order of magnitude over the XA series of amplifiers. This bias is supplied by newer, improved constant current sources with tightly regulated values and very high dynamic impedances.

Most importantly, we can adjust this output stage for a particular subjective character. It is helpful that the output stage transistors have an aggregate capacity well over 10 KW, and that the massive heat sink assemblies are capable of 2 KW all day long. No cute little heatsinks here ;)

The Front End

Initially we designed a new front end that could be tweaked to produce arbitrary ratios of low order harmonics, and while this worked fine, after we finished working with the output stage portion of the design we found that it worked better to have the front end simply complement the output stage in a largely neutral manner.

The new front end is not more complex than the previous design. It still uses cascoded matched Toshiba Jfets (NOS from our large cache) for the input devices which drive complementary Mosfets.

However we have increased the heat sinking so that this stage can be biased with 2.5 times more current and brought in higher quality Toshiba Mosfets (also NOS). This dramatically increases the linearity and bandwidth of the front end, and with the proper adjustment of each part of each stage and balancing degeneration with loading gives us an amplifier front end which by itself has low distortion, a 100 Khz bandwidth and a fairly low output impedance – all without a feedback loop.

Also, the new front end has a 200 Kohm input impedance (balanced) with very small capacitance. Anything will drive it.

Feedback is not essential for this front end, but we have left it with enough open loop gain to allow some feedback around the output stage. This is strictly in service of the sound of the output stage – it already has decent specs.

In Conclusion

X*s* 300 – 300 Watt Mono - $85,000 / pr
X*s* 150 – 150 Watt Mono - $65,000 / pr

PASS

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