Subject: Re: Feedback
Posted by metasonix on Sun, 06 Jun 2004 23:51:34 GMT
View Forum Message <> Reply to Message

The most experienced engineers I've ever known--guys with experience going back 50 years or more--all seem to say the same thing: the best performance can be had with push-pull low-mu triodes, with about 10 dB of loop negative feedback. This is exactly what you see in early-30s professional PA amplifiers like the Western Electric 86 (300Bs), and most PA amps made by Thordarson/Lafayette/UTC/ etc. (usually had 2A3s or 45s).One occasionally saw 6B5 type class-B amps, but those were in the minority. Class AB low-mu triodes in push-pull were pretty close to being universal.The 6L6 killed all this off pretty quickly in 1936. It came down to a battle of fidelity vs. power/dollar. And the 6L6 won those kinds of battles. It was the Depression. Another thing to disappear in the late '30s was the driver transformer. You want the best possible phase inverter/driver? There is still nothing like a good transformer. Unfortunately, electronic-type phase inverters became the norm--because they were cheaper than a good transformer. Not better. If carefully designed and run from a high plate voltage, a phase inverter is capable of great performance. (Until the tube starts to get weak, that is.)Yet another thing you saw in the best amps (and still do) is fixed grid biasing (negative grid voltage). Cathode bias resistors were cost-cutting measures. They did have one other advantage: they offered better reliability than a negative bias supply (which sometimes fails, usually killing all the output tubes and maybe the transformer). Those old WE theater amps usually had cathode bias for this reason.Look in any old data sheet for an audio output tube--triode or pentode or whatever. The ratings for fixed bias always show lower distortion than similar cathode bias ratings.(Remember, WE didn't sell this stuff, they LEASED it. IBM copied this trick later. You wanna make money producing exotic electronics, you sell it. You REALLY wanna make money, you lease the stuff. Microsoft is such a money-making powerhouse for only one reason: they don't sell outright contracts for ownership of commercial software, they force big businesses to pay big, fat license fees on a yearly basis. They don't actually own the software, they are only allowed to use it on a license-fee basis. That's how to make a lot of money very quickly.)The SE thing is pretty much a freak of the 1990s. Oldtimers look at this trend VERY askance. In the 30s, SE meant simply a low-cost amplifier for low-power applications. The infamous WE 91A was a fluke--it was WE's theater amp for small-town movie houses who didn't make a lot of money. Everything after that you can chalk up to obsessive Japanese guys, who influenced Japanophiles like Arthur Loesch and Joe Roberts. This is very much like the anime world, which is now huge outside Japan because the Japanese anime producers were taking artistic risks in the 1980s, at a time when American animators were producing garbage like "He-Man and the Masters of the Universe". The fact that most anime is also junk doesn't matter. They seized young eyeballs early on, and now they've got those eyeballs for life.With push-pull triode amps, you don't NEED a lot of feedback. So you don't use it. A major problem with a typical feedback loop is that it includes the output transformer--the FB resistor goes from the speaker terminal back to the input stage, usually. This can magnify any tendency the transformer has toward ringing, peaking, phase-margin stability problems etc. So before WWII, one often saw feedback going only from an output tube's plate back to the input. Better output transformer winding techniques solved this.Look at the Harmon-Kardon Citation II. It had a LOT of feedback. All over the place. But it also used a very special transformer, carefully wound to prevent peaking and provide excellent, FLAT high frequency response. A stock Citation can go out to past 100 kHz routinely--this was thought to be impossible in the 30s.The same was true of old Dynaco tube amps. Their transformers weren't quite that good, but they were well-behaved in

the audio passband. So 20-25 dB of feedback didn't result in instability. (They needed that feedback too. 6550s are ok, but EL34s have a LOT of distortion. And those simple 7199 driver circuits are barely adequate for the job. Dynaco amps were masterpieces of minimal design.)The free advice is: 1) push-pull low mu triodes, running near the limit of plate dissipation for lowest distortion. 2) driver transformer, NOT a phase inverter.3) get decent transformers.I'd watch out for some of the crazy, exotic circuits being pushed nowadays. I disagree with many of the hard-ass high-end audio designers, who feel that perfection is only possible with differential amp circuits stolen from old Tektronix oscilloscopes, plus heavy power supply regulation. If you want to see that philosophy in action, go to any high-end salon and look inside the monster push-pull 6550 amps they all sell.