EVERYONE JUST WANTS TO GET wade

AN INTERVIEW WITH SOUNDSTREAM'S WADE STEWART

IT'S BEEN TWO AND A HALF YEARS SINCE WE LAST SPOKE WITH WADE STEWART, VP OF ENGINEERING AND MANUFACTURING FOR SOUNDSTREAM TECHNOLOGIES, THE FOLSOM, CALIFORNIA-BASED MANUFACTURER OF PREMIUM CAR AUDIO COMPONENTS. WE FOUND WADE WORKING AT HOME, PURPORTEDLY SUFFERING FROM AN ALLERGY ATTACK. IF SO, YOU'D NEVER KNOW IT! FOUR PHONES WERE RINGING OFF THE HOOK, THE FAX WAS SPEWING ITS GUTS ON THE FLOOR, AND WADE WAS IN HIS USUAL CONSTANT STATE OF MOTION.

SOUNDSTREAM® TECHNOLOGIES

Q. ARE YOU REALLY SICK?

A. Hang on a second.

Q. WADE? WADE?

A. Sorry. That was a courier at the door with a new board sample I've been waiting for. Are you ready?

Q. UH, YEAH. ARE YOU REALLY SICK?

A. Yeah. It's a sick world and I'm a happy guy!

Q. I MEAN, REALLY SICK? WHAT'S WRONG WITH YOU? WHY DON'T YOU TAKE AN ALLERGY PILL?

A. They slow me down ... It's no big deal. With today's technology, anyone who needs me can find me anyway. Let's do it. I've got 100 things to say and only one mouth to say it out of!

Q. OK. SO WHERE'S THE CAR AUDIO INDUSTRY GOING?

A. Ha ha! That's amazing. I just gave an interview last week to a guy who asked me the very same question. But he wanted it in 500 words or less. I tried my best, but he's still got a hell of an editing job ahead of him.

Q. I'VE GOT LOTS OF OPEN PAGES AND AN EDITOR WHO TOLD ME TO GO ASK THE HOTTEST ENGINEER IN THE BUSINESS WHAT WAS HAPPENING. GO FOR IT, WADE. TELL ME WHERE THE CAR AUDIO INDUSTRY IS HEADED.

A. Well, we'll never get to it all here, but one place it's going I can give you in three words – *Towards Higher Efficiency*.

Q. THAT'S IT?

A. No, but it's a major issue. Look, the only reason people buy aftermarket equipment is because they want cleaner, louder sound than they can get with the lousy stuff that comes in cars from the factory.

Q. SO?

A. So, if you want it loud and clean, you've got to have a lot of power reserves – not on the bench in your engineering lab – but in the car! I laugh when I see some company put an amplifier up on the bench three inches away from a lab supply that has mega-amps of current, then runs some tests and says, "Hey, this is a great amp! Look at all the power it pumps out!"

Q. SO WHAT'S WRONG WITH THAT?

A. It's not real, man, it's not real. Lemme tell you a story. When I was a kid, I had an uncle who bought this (for its time) pretty damned powerful outboard engine. What did he do with it? He put it in a big barrel of water. Every night us kids would gather 'round and he'd start up that engine and run her flat out yellin', "Look at her go! Look at her go!" Hell, she wasn't goin' anywhere. Just stirrin' up a lot of water.

The point I'm trying to make is that, I guess he could have instrumented the outboard and measured how many horsepower it was putting out. But so what? It wasn't going anywhere. The test just wasn't real. I don't care how much power the engine was shoving into that tank of water; put it on a boat and see how fast she goes. That's what counts.

Q. SO WHAT DOES THIS HAVE TO DO WITH EFFICIENCY?

A. I'm getting to that. When you test an amplifier on the bench with an unlimited supply of current, efficiency isn't that important – providing you don't torch the amplifier, of course. There's practically no internal impedance in the supply and you're only a couple of inches away from it, so there's almost no loss in the power cable. So, if the amplifier needs to draw a couple more amperes to do its thing, what the hell. It's always there!

Well, it's different in a car. Usually you've got 15 feet or so of cable between the battery and the amplifier, and another 15 feet back on the return path through the chassis. That's a decent amount of resistance! Every unnecessary ampere that's pulled means more IR loss in the power wiring and less voltage at the amplifier. The less voltage at the amplifier, the less power it can put out. It's as simple as that. Ohm's Law. And there's no way around it.

And it's even worse than it seems because output power goes as the square of the voltage. If you lose 10% of the voltage, the maximum output power drops by about 20%. Lose 15% of the voltage and the output drops by almost 30%!

Q. SO YOU JUST DOUBLE THE VOLTAGE LOSS TO GET THE POWER LOSS?

A. No, it's not that simple. That's just how the numbers I picked worked out. Hey,

"THE LESS VOLTAGE AT THE AMPLIFIER, THE LESS POWER IT CAN PUT OUT... AND THERE'S NO WAY AROUND IT."

whoever reads this probably doesn't care about the numbers. That's just for the technical types. What counts is the idea: lose voltage and you lose even more power. So don't lose voltage dummy!

Q. AND THAT MEANS?

A. Three things. One, make the amplifier efficient so you don't draw any more current than you have to. Two, have a local source of current for handling peaks and, three, minimize the resistance of all power handling components.

Q. WHAT DOES THAT MEAN AS FAR AS SOUNDSTREAM AMPS ARE CONCERNED?

A. Thought you'd never ask! As far as the amplifier circuitry goes, it means matching the output characteristics to the load impedance. Strange as it may sound, the key to doing that lies in the power supply, not in the audio circuitry. The output stage

of a modern solid-state amplifier can be designed to drive almost any load if it's supplied with the right operating voltages. The trick is to supply the right voltages.

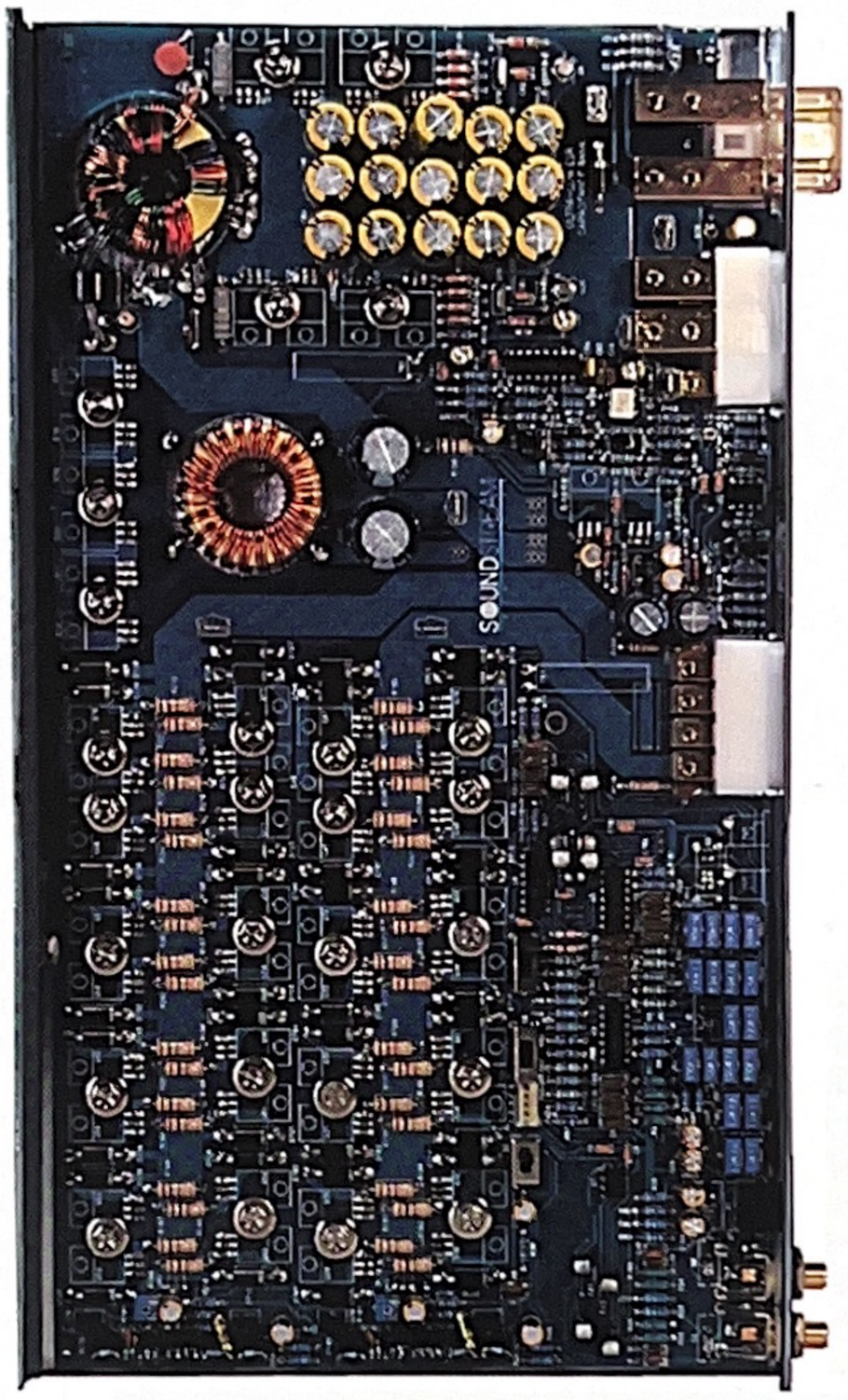
Remember the last time you interviewed me, we talked about some companies who were selling amps that were designed for "high current" and others that were designed for "high power"? I told you then I thought that was a big crock. It's not a matter of "high power" or "high current", it's a matter of load impedance. You need more current to drive the same amount of power into a low-impedance load, and you need more voltage to drive it into a high-impedance load. People began calling this "high current" and "high power", but it would have been better to call it "high current" and "high voltage" because you always want "high power"!

Anyway, the major difference between the two designs is in their power supplies, not in their amplifier topologies. Or, at least it should be. Put it this way: Soundstream has no problem designing <u>one</u> amplifier that can drive either high or low impedances (a.k.a. "High Power" or "High Current"), and then optimizing its efficiency by choosing the power supply rails appropriately. In our old Reference Series, we did that with a switch, eliminating the need for a second product in the same power category. The practical result was that a consumer could buy one Soundstream amp and use it with <u>any</u> set of speakers just by setting the switch properly.

Well, it didn't take long for somebody to put one of our amps on the bench and find that it delivered more power into 2-ohm ("low impedance") resistors when the switch was in the "High Power" position than when it was in the "High Current" position. Then they'd try the same thing in the car and call up and say, "Hey, this amp doesn't play as loud as it should." So I'd tell them to put the switch in the "High Current" position and listen again. They'd argue that they'd measured the amp on a bench and got less power that way than in the "High Power" position.

They missed the point. When they tried what I told them to do, the amp was tremendous.

That's the difference between bench testing and real-world operation. Sure our amps could drive more power into 1 or 2 ohms on the bench with the high power setting. They're rugged enough to do so. But they're not operating efficiently that way. They have all the current they could ever need on a bench. Put 'em in the car where efficiency becomes important, and they'll deliver more power when you follow our suggestions.



Q. WOW, THAT'S COOL. JUST SET THE SWITCH AND MAXIMIZE POWER OUTPUT?

A. Yeah, well, it is cool. But it's also not quite that simple. If you set the switch correctly, you get maximum power. The problem is you can't always be sure where to set the switch because you can't be sure what the <u>real</u> load impedance is.

"SOUNDSTREAM HAS NO PROBLEM DESIGNING <u>ONE</u> AMPLIFIER THAT CAN DRIVE EITHER HIGH OR LOW IMPEDANCES. . ."

Q. WHAT DO YOU MEAN? SPEAKERS ARE SPEC'D WITH THEIR IMPEDANCE.

A. Yeah, they probably hit that impedance at some frequency, but the real impedance changes with frequency and every speaker is different. Even the same speaker ends up with a different impedance around resonance, depending on how it's boxed. That's why we developed Auto High Current™.

Q. WHAT'S THAT?

A. Well, it's sort of an analog computer that figures out what kind of a load the amp is driving and sets up the power supply for optimum efficiency.

Q. YOU MEAN THERE'S A COMPUTER IN EVERY SOUNDSTREAM AMP?

A. Hey, it doesn't figure your taxes, but yes, there is! It's a very specialized circuit that monitors the current through the output stage of each channel, combines that information with the output voltage, and figures out what the load impedance is. The theory is pretty straightforward. Implementation is something else. But it works! You get optimum operation from the amplifier automatically.

For example, with some loads a competitor's amp might draw 80 amperes of current while a Soundstream amp gets by with 60. That's a big difference in efficiency. And, like I said, every ampere you save means less voltage loss in the wiring, more voltage at the amplifier, and more output power. What's more, with Auto High Current you don't have to rely on the speaker manufacturer's spec. The amp figures out what the speaker impedance really is – as installed – not what a manufacturer says the raw driver impedance is.

The results can be quite spectacular in real world applications.

Q. IS THAT POINT ONE?

A. Yeah, in a nutshell.

Q. AND POINT TWO WAS?

A. Having a local source of current for handling peaks.

Q. YOU MEAN LIKE A "STIFFENING CAP"?

A. Well, sort of like a stiffening cap, only we think we've done it in a better way. There's nothing wrong with a stiffening cap except that on most the ESR is too high, and it's placed too far from the supply.

Q. WHAT DO YOU MEAN? WHAT'S ESR?

A. ESR stands for "Equivalent Series Re-

sistance". It's a sort of "quality factor" for capacitors. You know, there's no such thing as an ideal capacitor – except in school books – and engineers keep forgetting that. Every capacitor has internal resistance and inductance that limit how fast it can be charged and – more importantly – discharged. If you're using a capacitor for local storage and you want to get a quick slug of current out of it, you need one with low internal resistance and inductance – in other words, one with a very low ESR. Otherwise it might as well not be there. That's even more true when you're using a switching power supply which every up-scale car amp does.

ESR depends on how the capacitor is made, the kind of electrolyte it uses, the foil area and thickness, how the foil is "tabbed" and that sort of thing. In general, small caps have lower ESR in relation to their capacitance than big electrolytes, so you're better off connecting a lot of small caps in parallel than using one humongous one. That's what we do in our amps. We call it Power Grid™.

Q. So the way the capacitor's made is important?

A. Absolutely! You pay more for a low ESR cap because of the multiple internal tabs and high-purity foil, but it's worth it in performance. We just found some caps with over twice the capacitance we had been using at the same ESR, so we're using them in our new amps. That let us boost the amount of storage without slowing down the response time. And, since the storage is right at the power supply rather than outside the amp, you get quicker reaction than with an external stiffening cap. I have no objection to using an outside cap for longer term storage, but it doesn't solve the instantaneous peak problems that musical transients pose.

Q. And point three?

A. Point three should be obvious.

Q. Well...

A. Just a joke. I wanted to see if you were paying attention. Point three is only obvious when you think about it, which I do every damn day. You see, you can't get audio power out of an amp if you can't get battery power into it. Simple as that. No exceptions to the rule. An amp is just a precision valve that controls output power in response to the input signal. It doesn't "make" power; it just converts battery power to audio power. So you can't get more out than you put in. That's why you can't cut corners inside an amplifier on power wiring, connectors and that sort of thing the way some people do.

We've always used solid-brass connectors plated with 24-karat gold while others use gold-plated "white metal". Theirs may look like ours, but they're not the same. Ours are custom designed and made only for us. The gold plating on connectors is there to avoid corrosion; nothing else.

Don't get me started on gold's value as an electrical conductor, it's better than white metal, but brass is best. Besides, the gold plating on any connector is only on the outside and is too thin to carry much current. The bulk of the current goes through the body of the connector, and brass is a hell of a lot better conductor than "white metal". That's the stuff you make bowling trophies out of, not power connectors.

Anyway, in our new amps, we've increased the contact area between the board traces and the power connector and doubled the number of mounting screws. That cuts down on the resistance and gives us just a bit more efficiency. I'm a firm believer that power connectors should be

"I HAVE NO OBJECTION TO USING AN OUTSIDE CAP FOR LONGER TERM STORAGE, BUT IT DOESN'T SOLVE THE INSTANTANEOUS PEAK PROBLEMS THAT MUSICAL TRANSIENTS POSE."

mounted directly on the PC board, not wired to it with jumpers. It makes no sense to me to come from the battery with 4-gauge cable and then jump over to the board with a tiny piece of wire. But people do it! Amazing!

Needless to say, we still drill our connectors to accept 4-gauge cable, not 8-gauge like others do. Remember, you need to get current from the battery to the amplifier. To do it right, you need at least 4-gauge wire.

We've also gone to plating our PC boards to four times the normal copper thickness. It's kind of expensive but it does quarter the resistance of the traces and gives us thicker side-to-side plate troughs on double-sided boards. Among other things, that makes our boards a lot more reliable than others.

Q. With all that, it sounds like you ought to come out pretty well on the PowerCube test.

A. Nope! I'm told we don't. Can't say I give a damn though. That thing is nothing but a "straw man", and the guys who tout it the most don't seem to know an ohm from an amp. I'm sure they don't, if their training manual gives us any insight into the matter. I've never seen such a collection of technical mistakes in my life. But I digress.

Q. What's a "straw man"?

A. You know ... you put up an hypothesis that you don't justify. Then you test against the bogie, and cut the other guy down so you can say: "See, I told you so!"

Who says there's any particular virtue in coming out "cubic" on the PowerCube? What does that have to do with anything? All it means is that you've got a tightly regulated power supply, and that you don't current-limit the output stage. Well, we don't current-limit the output stage, but some tests we've run on their products suggest that they do! And, like I told you last time, I think over-regulating the power supply just cheats the customer out of power he could have. Why not take advantage of the extra power available when you start your car. After all, this is about making as much loud, clean power as possible!

Q. So you don't think much of the PowerCube?

A. Not the way they're using it. If I wanted to design an amplifier that came out "cubic", all I'd have to do is increase the amount of feedback in the regulator. No sweat. I could even concoct a power supply that made the amp put out more voltage into low impedances than into higher impedances so the measured cube turned up and got bigger than the "ideal" cube. I guess that would make it "better than ideal." Actually, the Quad Factor™ circuit in our new Reference Class A amps does something like that.

"I CALLED THE GUY WHO CHAIRED THE COMMITTEE THAT WROTE THAT STANDARD, AND HE SAID THAT THE POWERCUBE HAD NO CONNECTION WHATSOEVER WITH THE IHF AMPLIFIER STANDARD OR THE IHF TONEBURST."

Q. What's Quad Factor?

A. Oh, it's a new power supply that lets our Class A amps deliver four times more power when you halve the impedance. The theoretical ideal is to double the power when you halve the impedance; these amps quadruple it. The Reference Class A 10.0, for example, delivers 25 x 2 into 4 ohms and 100 x 2 into 2 ohms. Then it doubles or better down to 1/2 ohm – 250 x 2 into 1 ohm and 500 x 2 into 1/2 ohm – and it's rated down to 1/4 ohm.

But, let me get back to the "cube". What is funny to me is that these guys try to dress up the "straw man" and make him sound official by talking about the IHF test standard and the IHF toneburst and all of that. Well, I called the guy who chaired the committee that wrote that standard, and he said that the PowerCube had no connection whatsoever with the IHF Amplifier Standard or the IHF toneburst.

Q. I'm sure your competition will be glad to hear that you've told the world that.

A. Ha ha! Yeah. I think they have some explaining to do. Anyway, let's get off the competition. I'd rather talk about something that doesn't suck – Soundstream.

Q. Okay. What's this new *AIR*BASS™ the industry is buzzing about?

A. So you want to know about our little technological coup. Okay, but you better hold on. This is just the kind of stuff that turns-on today's car audio consumer. It's a plug-in board we sell as an accessory for most new Reference amplifiers that lets you adjust the subwoofer volume by remote control. No wires, no infrared that gets wiped out in the sun, none of that stuff. We use a low-power, 300 MHz RF transmitter to run the system. From a technical standpoint, when you install the board in a new Reference series amplifier

it routes the signal through the low-pass section of the electronic crossover.

Q. THE CROSSOVER IS BUILT-IN?

A. Yeah. Most Soundstream amps have adjustable electronic crossovers built-in and they've got buffered line outputs, so you don't need to buy anything else. And they all bridge to mono also, so you can use any of them to drive a sub.

But to get back to *AIR*BASS™, the board has a resistor-ladder level control that's operated by an 8-bit digital switch. That's what controls the subwoofer volume. We don't use a VCA (Voltage Controlled Amplifier) because they have too much distortion and noise and the bandwidth changes with the gain. A resistor ladder is much cleaner sounding.

But that's the technical explanation. What's really cool is the application. From the remote, the user can increase or decrease the subwoofer's volume, mute it, or hit a single button and get *maximum bass!*

Touch a button and WHAM, be prepared to get knocked back in your seat!

Q. THAT SOUNDS GREAT, WADE. THE CUSTOMERS ARE PROBABLY ALREADY LINING UP. WHO ELSE HAS IT?

A. Nobody. But I'm sure they'll copy it. Most of our ideas get copied sooner or later.

Q. HAS MUCH BEEN CARRIED OVER FROM THE OLD LINE TO THE NEW?

A. Sure. We haven't taken *anything* away. Just added new goodies. LSE.Q is still on the Reference1000s, the Reference705s, and the Reference Class A 10.0.

Q. LSE.Q BOOSTS THE BASS OUTPUT OF A SUBWOOFER?

A. In a big way! But it's much more than just a bass boost. It also helps contribute to the amplifiers efficiency, at least in a practical application way. First, it's a variable frequency (30 to 60 Hz), variable level bass boost. That allows the user to get an extra "bump" in their bass. At the same time, it's also a really sharp subsonic filter that strips off signals you can't hear. If the subwoofer enclosure in a particular application will only reproduce frequencies down to 35 Hz, why send it information below that frequency. It only robs power. And signal waves at low frequencies are extremely long and take a lot of energy (power) to reproduce. If you eliminate that information by using the LSE.Q's subsonic filter, you in effect redirect the power that was being wasted at those unusable frequencies into the area of the spectrum where they can be used. So the subwoofer can put out more of the deep bass you can hear. That's especially important when you're using a vented sub. A vented sub is completely uncontrolled below resonance and can get in "a world of hurt" if you hit it with a lot of subsonic energy.

"THAT MEANS HIGHER RELIABILITY WHEN DRIVING A NEAR SHORT – AND, BELIEVE ME, A QUARTER-OHM IS A NEAR SHORT."

Q. WHAT DO YOU MEAN BY "A WORLD OF HURT"?

A. To start with, the speaker blows up!

Q. I SEE! WHAT ELSE HAS BEEN CARRIED OVER TO THE NEW REFERENCE AMPLIFIERS?

A. Well, the basic designs that earned Soundstream power amps multiple international awards and the reputation they have for reliability and sound quality.

Q. EXAMPLES?

A. Darlington output stages. Nothing beats them for sound, and they're much better matched than Mosfets or other kinds of output devices, so you can parallel a bunch of them and get a super-wide "safe operating area". That means higher reliability when driving a near short – and, believe me, a quarter-ohm is a near short.

We also continue to design our amps for three-way operation – Coherent Stereo™, Mixed-Mono and Bridged Mono – and, for high reliability, we still use our Smart Thermal Rollback™ power supply and Chassisink™ construction. They can't be beat.

Q. REFRESH MY MEMORY.

A. Well, you know what Mixed-Mono is – running one channel as a non-inverting amp and the other as an inverting amp, so you can hang a subwoofer across the hot terminals and have one stereo amp serve to power both the main left/right speakers and a sub. We see the marketing need so we provide the function, but we don't like the idea of unbalancing the amplifiers, that is, operating one non-inverting and the other inverting.

If you're not going to use the amplifier for mixed-mono, you shouldn't have to put up with that unbalance. You would never use a Brand X amplifier on the right channel and a Brand Y on the left, but that's what most amplifiers who are mixed-mono capable are asking you to do by using one inverting and one non inverting channel. So we have Coherent Stereo for people who want the best sound and perfect balance between channels. In Coherent Stereo mode, both channels are identical (neither is inverted) and sound quality is maximized.

But we still give everyone the option of Mixed-Mono. That lets them buy a Soundstream stereo amp, start off by using it in Mixed-Mono, and then grow into Coherent Stereo.

And Bridged Mono is, of course, a way to use the amp in mono, as a single channel. This is popular in subwoofer applications. Power doubles to the output, and the user can direct both channels to a single subwoofer.

Q. AND THERMAL ROLLBACK?

A. Thermal Rollback is our way of protecting Soundstream amps from overheating without shutting them off completely. The easy way to protect an amp from heat is simply to mount a thermal switch on the heatsink and turn off the signal or the power supply (either way works) when the heatsink temperature exceeds a safe level, say 95° C. That's fine. We do that too. But only as a safety valve that, to my knowledge, has never triggered. I guess that says something about the effectiveness of Thermal Rollback. It's our primary line of defense.

But we go one step further. We use *two*

"TOUCH A BUTTON AND WHAM, BE PREPARED TO GET KNOCKED BACK IN YOUR SEAT!"

thermostats on the sink, one set at 95°C. – the safety valve – and the other at 85°C. When the sink hits 85°C, we narrow the pulse width in the switching power supply. This limits the continuous current that's available and, in a sense, throttles the amp down until it cools off. That's what we mean by Thermal Rollback. The interesting thing is that it has very little affect on the sound. You see, music is dynamic, not continuous. While Thermal Rollback limits the maximum ***continuous*** power the amp can put-out when the protection kicks in, it has little effect on ***dynamic*** power because we reduce the pulse ***width***, not the pulse ***voltage***. That way the supply bounces back and handles each peak, even though, (until the heatsink cools off) it can't deliver continuous sinewaves.

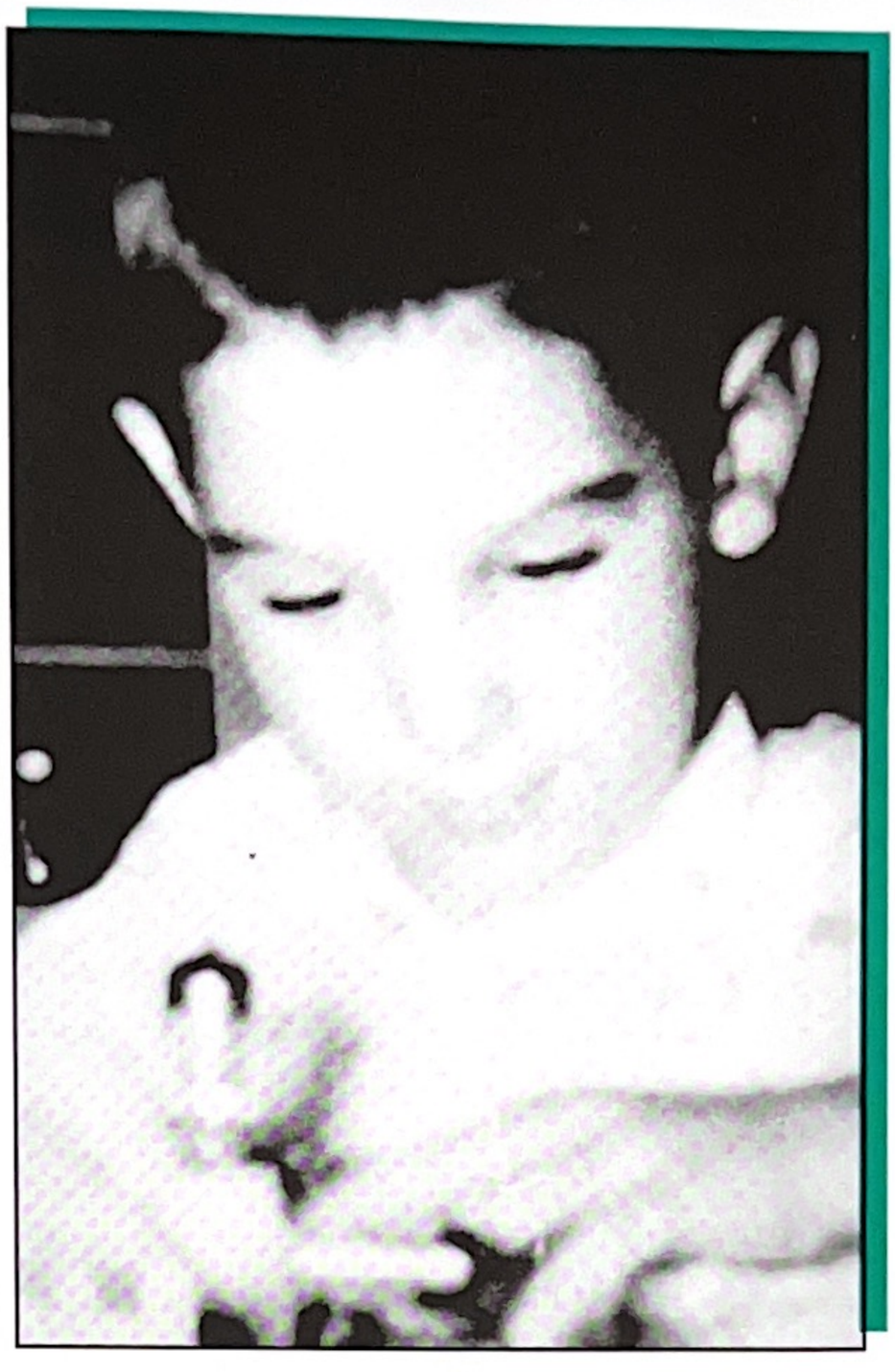
Q. Unique to Soundstream?

A. Used to be, but "me-too" companies copy good things. We just think we do it best, and we generate ideas at a rate that keeps us a few steps ahead of everybody else anyway. Kinda hard to catch up by copying our old ideas, don't you think?

Q. Sure doesn't seem likely to me. What was the other item?

A. Chassisink – that's our name for the idea of using the whole chassis as a heatsink. Other people say they do the same thing, but they really don't. For Chassisink to work the way it should, the power transistors have to be distributed around the chassis, not piled up in the corner somewhere. That's one difference between our design and the competition. We distribute the heat.

We also mount our power devices differently than other people do. Most bolt them to the chassis through the mounting tab. Obviously, that's what the tab's for, but it's not the best way to get the heat out of the "die", the actual transistor that's buried inside the case. When you tighten the tab, it can distort and lift the hot spot of the transistor – down at the die under the plastic case – out of contact with the chassis. So we don't use the tab. We mount the power transistors on the PC board and tie the board to the chassis with a pair of bolts, one on each side of each power transistor. That presses the hot spot against the chassis. The tab goes along for the ride. We're speaking of very small dimensions here and the PC board can flex as needed to keep each individual transistor in contact with the sink. Furthermore, we "jitterbug" the inner surface of our chassis to ensure ideal contact with all power devices. The result is that the transistors make more contact with the heatsink allowing it to be more efficient at dispersing heat.



Q. Anything else new you'd like to mention?

A. Well, some things don't show but they have an effect. We've redesigned the gain blocks on our new Reference series to improve the S/N ratio about 10 dB. The overall gain is the same, but we managed to eke out a bit better sound this way.

"KINDA HARD TO CATCH UP BY COPYING OUR OLD IDEAS, DON'T YOU THINK?"

Another thing we haven't talked about is the new balanced inputs. We've incorporated balanced line to our amplifiers in quite a different way than anyone else.

Q. Really? There are differences?

A. There sure are. Other people use an "op amp" input stage. An "op amp" – or "operational amplifier" to get technical – is an IC gain block with a differential input. It seems like the right component to use for a balanced input but it's not. For one thing, the "Common Mode Rejection Ratio" is uncontrolled.

Q. What's "Common Mode Rejection Ratio"?

A. It's called CMRR for short, and it's a measure of how well a balanced input rejects noise on the line. That's the whole reason for using balanced inputs – to reject "common mode" noise, that is, noise that's picked up on both wires – so it's the most important aspect of balanced-input design.

Anyway, to get back to the issue, the other weakness with an op-amp input is that the volume control usually comes after the amplifier stage. That means it's possible to overload the op amp and not know it. Furthermore, putting the control after the op amp means that the noise varies with the volume setting, which is also undesirable.

In the Reference series, we use a discrete matched pair of transistors in the input circuit. The volume control is in the emitter circuit of the discrete pair. It's really a feedback type volume control that prevents overload and doesn't affect noise level. And, we end up with better than 80dB of common mode rejection. That ain't bad! It's at least 20dB better than you can do with an op amp!

This circuit was designed specifically for the new Reference series. It's based on an old trick used in mixing consoles.

Q. Mixing consoles?

A. Yeah, those $100,000+ jobbies used by recording studios. They've got a similar noise problem and this is the way I solved it when I used to design them. I thought it would be a good idea for the car, too. Another thing from my recording days is overload indicators. We added them to the balanced input stage so they're on the new products too.

Q. You used to design mixing consoles for recording studios?

A. Yeah, in a past life. We made a few other changes too.

Q. Like?

A. Well, we've always used a Class-A drive stage, but now we've doubled the amount of drive current that's available. That helps

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us goose the output devices into putting out all they've got into low-impedance loads. You know, it's one thing to be stable into low impedance loads – others have done it with varying degrees of success – and another to be able to drive them adequately. The current gain of the output transistors starts to fall off at very high currents, so you need an extra shot of drive capability to counteract the fall off. You can hear the difference in the tightness of the bass.

Q. I WAS TALKING TO A DEALER THE OTHER DAY WHO WAS REALLY EXCITED ABOUT A NEW CLASS A AMPLIFIER SOUNDSTREAM CALLED PICASSO. WHAT IS SO SPECIAL ABOUT PICASSO THAT IT DESERVED A NAME THAT SET IT APART FROM THE REST OF THE LINE?

A. Picasso is the extreme, a no-holds-barred design for the guy who wants the absolute ultimate in sound quality. And it was great fun for our engineers. We took all the cool stuff we put into the new Reference amplifiers, then tweaked it a bit more. We used components selected for sound quality and a really cool variation of our new power supply. And, it's direct-coupled except for two specially chosen polypropylene capacitors in the power amp stage. The idea was for Picasso to be the pre-eminent amplifier for driving satellites.

Of course, it has the new shiny heatsink. It looks like chrome but it's not; chrome doesn't do well for heat sinking. It's really aluminum that goes through a unique four-step process that reproduces the effect of chrome while retaining the thermal effectiveness of aluminium. I think it looks pretty damn good.

"I'D DIE IN TWO MINUTES DESIGNING COMPUTERS. THEY HAVE NO SOUL."

Q. YOU ALSO HAVE A NEW LINE OF AMPLIFIERS CALLED SOUNDSTREAM USA. WHERE DO THEY FIT IN?

A. The USA line is a more affordable version of the Reference series but, you know, the two have an awful lot in common. The USAs have built-in crossovers, line outputs for daisy chaining, balanced inputs, etc. They even use the same output devices as the Reference amps, they're just not rated to drive as low an impedance. And the differential balanced input circuits are just like the ones we used to use in the original Reference rather than the new ones.

Q. THIS IS BEGINNING TO SOUND REDUNDANT, BUT ANYTHING ELSE NEW?

A. Sure. There's other stuff, but we've covered most of the important topics. Besides, I'm knee deep in fax paper and my answering machine is beeping like a wounded pelican. We're going to have to call it good for this session.

Q. OKAY, TWO MORE THINGS. PEOPLE IN THE INDUSTRY I'VE TALKED TO ABOUT YOU SAY YOU'VE GOT QUITE A DIVERSE BACKGROUND. ONE RUMOR EVEN HAS IT THAT YOU DESIGNED YOUR FIRST AMPLIFIER AT 5 YEARS OLD. CAN THAT BE TRUE?

A. Yeah, and it went up on Apollo 6. No, that's stretching it a bit but you can see how stories start. Actually, I have been into electronics since about that time. In my office hangs a picture of me as a young ram, no, I'm getting off track again. In my office I have a picture of me at about 5 years old holding a vacuum tube. I look like I was fascinated. I guess my interest in electronics can be traced at least that far back. Wow, that was a while ago. I'll tell you another story from about that time. I remember when I conducted my first scientific experiment – I made a magnet out of a hacksaw blade. You heat it up over a stove and when it cools, it becomes a bar magnet. Then if you whack it on a table, it turns back into a hacksaw blade. Try that when your parents aren't home, kids!

Q. SO THERE IS SOME TRUTH TO THE STORY. YOU'VE ALWAYS LOVED ELECTRONICS?

A. Actually, I've always loved music. So my involvement in electronics is an offshoot of that. I remember in the seventies when I was in a band called Greyhound. We were happening for a while. We played the Whisky in Hollywood and did the LA club scene, but five nights a week playing clubs wasn't my destiny. That could have been slightly influenced by the kinds of bands who were also working the clubs, looking for a record deal. I remember one of them you might have heard of, a little four piece band called Van Halen.

But I wound up engineering electronics, and I wouldn't change a thing. As I see it, my job is one with heart. I'd die in two minutes designing computers. They have no soul. What I do has the ability to reach people and effect them in ways that bring happiness to their lives. It has some redeeming value because music can effect emotions and reproducing it in a quality way which gives people more happiness and me great satisfaction. Every time a kid at a grocery store hauls my stuff outside and freaks when he sees what's in my trunk, I get a buzz.

Q. FINAL QUESTION. I HEARD THE SONG YOU SANG ON THE SOUNDSTREAM CHRISTMAS ALBUM "FRUITCAKE" AND IT WAS GREAT. ANY PLANS FOR ANOTHER GO AT THE PERFORMING SIDE OF THE BUSINESS?

A. Ha ha! Well, you never know. If this company is dedicated to anything else besides building the absolute best car audio products in the world, it's to having as much fun as we possibly can while we're doing it. If the marketing department comes calling, I'm available.

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