

ARC AUDIO 4200 SE

Text and Measurements by



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Dave MacKinnon



If you have been around the car audio industry for as long as I have, the name Robert Zeff should be well known to you. The legendary Robert Zeff is responsible for the creation of some of the finest car audio products and brands in the industry. Since the late '90s, Zeff has been enlisted as a lead in-house engineer at Arc Audio for several impressive amplifiers, including their flagship line of Robert Zeff Signature Edition amplifiers. There couldn't be a more fitting name.

I had a quick read through the relatively thick owner's manual for the amp. In it, Zeff purports that this series of amplifiers is 'The best amplifier I have ever designed.' Having previously reviewed many of Zeff's products and having used them in my own vehicle – I could safely suggest that the deal is done, the test report is over, and it's time to go buy these amps! But I have learned the hard way not to jump to conclusions like this, and it won't make for a good read or valid report. So, the Arc Audio 4200 SE is on its way to Frank Cook at Mobile Dynamics East (Toronto) for some testing and measurements before I give it a listen.

POWER SUPPLY

The development, design and manufacture of a true voltage source power supply, one that will facilitate or support a doubling of current output into half-loads, can be an expensive inclusion. To put things in perspective, the power supply section alone could represent hundreds of dollars at the manufacturing level, which in turn translates into several hundreds or even thousands more to consumers.

So how do so many amplifier manufacturers bring such high powered, high value, linear amplifiers to market? The answer: ingenuity, and the right blend of intelligent trade-offs. In Robert's case, he went hi-tech, incorporating an advanced micro-processed power management system, which boasts some useful control and utilization of available resources. As a result, the

4200 SE is able to run loads below 2-Ohms, while maintaining virtually all of the same sonic attributes of higher loads, preserving overall sound quality; simultaneously increasing load flexibility and application usages.

Outside of load management, the 4200 SE is capable of monitoring the temperature of each output stage, adjusting in real-time the operational bias of the bipolar outputs, as the signal exits one and enters another. The targeted outcome of this design approach is to minimize its THD production throughout. Ultimately, all of Robert's design is regulated, which should allow for consistent performance traits from all channels into most loads (1-40hms), regardless of DC Voltage input. Either regulated or unregulated, micro-managed or not, nothing surpasses the performance of an old-fashioned, monstrous, power supply that is capable of delivering linear power to its outputs, regardless of load; or does it?

Even though Robert has designed this amplifier's power supply from the perspective of intelligent efficiencies; this amplifier is not likely to be a testament to his design's virtue, but rather, a testament to his ingenuity and mastery as one of the founding fathers of high-end automotive amplifiers. For the record, traditional hi-end amplifiers claiming the sonic attributes of the 4200 SE would require no less than 28,000mfd's of output capacitance. Robert's smart resource management approach allows him to incorporate as little as 10,000mfd's; passing the savings to consumers.

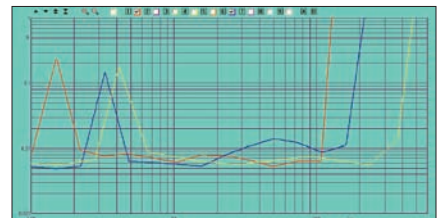
GETTING BENCHED

Okay, from the top! We at Mobile Dynamics only

implement the very best in measurement practices; as this is likely to be a heavily read and scrutinized review, we are going to disclose additional information about our measurement procedures throughout.

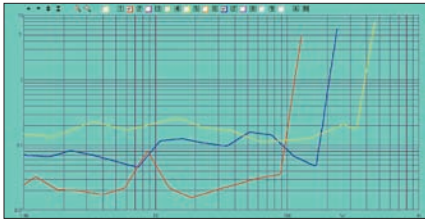
We started by putting the Arc Audio 4200 SE through its paces on our break-in bench, injecting a 1KHz sine wave, while interconnected to a 4-Ohm non-inductive load, producing a 10Volt AC output (25Watts), for a period of 10hours. Before we made our measurements, we calibrated our Audiomatica Clowin7 QC measurement system and audited its final internal frequency, phase, and resistance measurements. Everything was 100%. All preceding measurements were made using either Unsmoothed, 1/48 octave, Sinusoidal sweeps, or Unsmoothed, 256K MLS (Maximum Length Sequence) sweeps, from which FFT and Dual FFT assumptions were made.

THD & WATTAGE



While reviewing the THD qualities (graph above) of the 4200 SE, we noticed that the amplifier produced a mild spike (well below 1%) in THD before 6Watts of output was achieved. Otherwise, it produced smooth curves, deviating less than .1% for over 90% of the Wattage range. Exceptional! ➤

IMD & WATTAGE



We often find IMD measurements more revealing than THD, in that they depict very audible distortions that are the result of accumulative distortions, which occur as the signal passes throughout all of the amplifier's stages.

The 4200 SE measured very well; outputting under 3/10th of a percent for more than 90% of the usable range (graph above); at different intervals on one channel, we did note some irregular performances with regards to channel uniformity and overall percentage levels, but again, overall the amplifier performed very well.

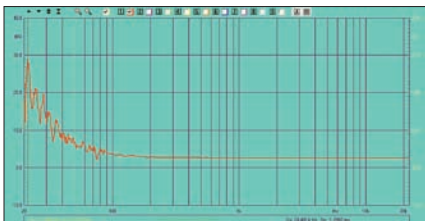
LINEARITY

Linearity is a strong measurement of an amplifier's ability to faithfully track and reproduce an input signal. The 4200 SE produced virtually identical results from each channel, measuring only the slightest deviation, each less than .5dB. Note: Essentially Perfect!

FREQUENCY RESPONSE & PHASE

Frequency response is a critical amplifier measurement. Just as important and perhaps more is phase response. The frequency response of the 4200 SE was virtually ruler flat from 20Hz to 20KHz, measuring +/- .5dB. The phase qualities were equally impressive, gently shifting to a maximum of +14.1 degrees on the bottom end (from 70 down to 20Hz) and to a maximum of -23.35 degrees on the top end (from 8KHz up to 20KHz), remaining virtually flat between 70Hz to 8KHz; this performance is again excellent!

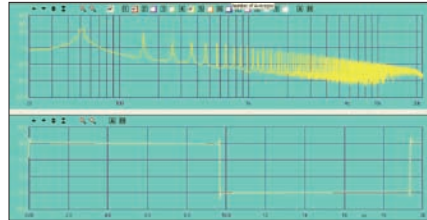
IMPULSE



Impulse measurements are useful at determining the speed of an electrical circuit. The graph above depicts the amount of time it takes the 4200 SE to produce frequencies between 20Hz to 20KHz. The amplifier remained linear and fast down to approximately 100Hz at which time it starts to slow (as do most amplifiers) represented by the rise in the red line. At 50 Hz, it measured a latency of .3305ms, producing its slowest results at 21.7Hz, showing 1.735ms. These results

depict this amplifier as being "faster than many we have tested," and are well below the 10ms threshold, indicative of hi-end design and manufacturing.

SLEW MEASUREMENTS



Slew measurements can reveal a lot about an amplifier's power supply, calibration, and potential stereo qualities. However, Slew measurements can be misleading if they're not utilized and interpreted in the right context. In the case of the 4200 SE, it reproduced the injected square wave with recognizable form (note the graph above). With regards to voltage biasing, we notice a very slight imbalance in the voltage delivery between the power rails. We averaged the imbalances and noted the following: Positive Rail: 31.455VAC/ microsecond, Negative Rail: -29.262 VAC/ microsecond, creating a deviation of approximately 2.19 VAC. From these scores we determined that the 4200 SE is cable of slewing 30.36 VAC on average with a 50Hz square wave injection.

At first, we noted this as being a very respectable performance for such a low frequency. But then we realized that Robert passively limited (via a capacitor) the Voltage rise time at the front end of the amplifier, so that it can never come close to the slew rate limit via active components. We then viewed the performance as exceptional!

SUMMARY MEASUREMENTS

Amplifier measurement can be an arduous task; interpreting the measurements can be even more challenging. The ARC Audio 4200 SE took these challenges to new levels, as it is quite possibly the representation of a new breed of mobile amplification, one with extremely managed and filtered resources throughout all stages. Robert's new design offerings may very well facilitate a need for the creation of new measurement standards.

We at Mobile Dynamics are pleased to have been a part of this potential paradigm shift and the fact that we are amongst the first to chart it. For your benefit, we have provided an extensive quick reference report, containing the most audited amplifier specifications. We caution you, however, to be careful when utilizing specifications in making your buying decision, as there is literally as many specifications as there are frequencies in sound. It is therefore impossible to judge a product by the limited amount of specs provided by the manufacturer or independent test reports.

However, some specifications allow us to place, or categorize products, for the purpose of consideration, based on certain output performance expectations, general application and budget.

4-OHM MEASUREMENTS

4-Ohm Summary @ 50 Hertz						
	Ch. 1	Ch. 2	Ch. 3	Ch. 4		
Wattage	127	122	126	124	▲ H.I.B.	
THD %	1.0	1.0	1.0	1.0	▼ L.I.B.	
IMD %	.84	2.7	.93	.8	▼ L.I.B.	
S/N dB	97.5	101	99	101	▼ L.I.B.	
Damping Factor	404	417	406	434	▲ H.I.B.	
Slew Rate Volts	33.2	32	31.6	28.9	▲ H.I.B.	
Separation dB	72.9	72.9	73.3	73.3	▼ L.I.B.	
Linearity +/- dB	.48	.45	.52	.5	▼ L.I.B.	
Channel Error dB	N/A		N/A		▼ L.I.B.	
Impulse ms	.33	.3	.32	.32	▼ L.I.B.	
DC Volts	14.6	14.6	14.6	14.6	▲ H.I.B.	
Current Amps	16.1	15.4	15.8	15.7	▼ L.I.B.	
Efficiency %	54	54.1	54.8	54.2	▼ L.I.B.	
Idle Current	2.1	A. Current	45.5	M. Current	63	▼ L.I.B.

H.I.B. = Higher Is Better / L.I.B. = Lower Is Better

Into 4-Ohm non-inductive loads the 4200 SE produced an average output of 124.75 Watts at 1% THD, exceeding the manufacturer's specification by 13.5%. Overall, the 4200 SE spec'd out very well (into 4-Ohm loads) in the majority of our measurements.

We particularly liked the Phase Response, Damping Factor, Slew Rate, and Impulse scores as they strongly suggest that this amplifier will produce quick, controlled and accurate transients. As well, it had excellent signal noise scores, averaging 99.62 dB/ Octave from 20Hz-20KHz, 20dB above what most would consider adequate.

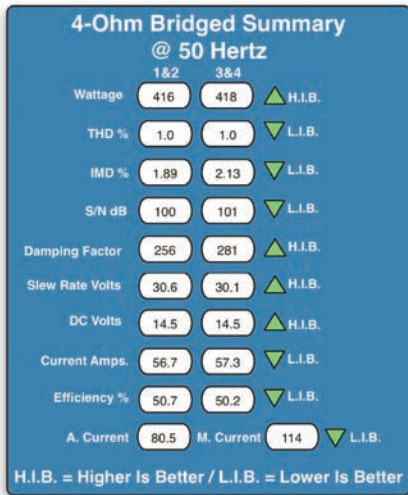
2-OHM MEASUREMENTS

2-Ohm Summary @ 50 Hertz						
	Ch. 1	Ch. 2	Ch. 3	Ch. 4		
Wattage	215	212	215	216	▲ H.I.B.	
THD %	1.0	1.0	1.0	1.0	▼ L.I.B.	
IMD %	1.79	3.4	.411	1.15	▼ L.I.B.	
S/N dB	101	102	101	100	▼ L.I.B.	
Damping Factor	253	268	257	262	▲ H.I.B.	
Slew Rate Volts	29.9	30.2	30	26.8	▲ H.I.B.	
Separation dB	N/A	N/A	N/A	N/A	▼ L.I.B.	
Linearity +/- dB	.51	.63	.532	.546	▼ L.I.B.	
Channel Error dB	N/A		N/A		▼ L.I.B.	
Impulse ms	N/A	N/A	N/A	N/A	▼ L.I.B.	
DC Volts	14.6	14.6	14.6	14.6	▲ H.I.B.	
Current Amps	27.6	27	28	28	▼ L.I.B.	
Efficiency %	53.4	53.8	52.5	52.8	▼ L.I.B.	
Idle Current	2.1	A. Current	78	M. Current	111	▼ L.I.B.

H.I.B. = Higher Is Better / L.I.B. = Lower Is Better

The 4200 SE also exceeded manufacturer specifications into 2-Ohm non-inductive loads by an average of 7.25%. This amplifier has also established itself as being stable and linear into half-loads, doubling its power from 4-Ohms to 2-Ohms, as promised by ARC Audio. Traditionally, most amplifiers weaken significantly, as nominal resistive loads fall below 4-Ohms; however, the 4200 SE retained its composure, varying ever so slightly in performance and in some instances, actually improved.

4-OHM BRIDGED MEASUREMENTS



When it comes to mono power ratings, most people think only of bass applications as the power output levels climb well above what most full range speaker systems can tolerate. As well, there is significant evidence that in most transistor amplifiers output increased levels of various distortions while in bridged modes. While the 4200 SE outputs more than enough power for any sensible subwoofer application, it also retains more than enough composure for utilization in full range applications: THD, Damping, Slew Rate and Signal/Noise specs all remained excellent and the phase qualities of the amplifier shifted much less than expected. Ultimately, this amplifier exceeded its depicted mono performance, outputting 834 Watts

RMS into 4-Ohm non-inductive loads. We chose not to test the 4200 SE into lower loads, as we completely believe that the supplied performance depictions from ARC Audio will be met!

OBJECTIVE SUMMARY

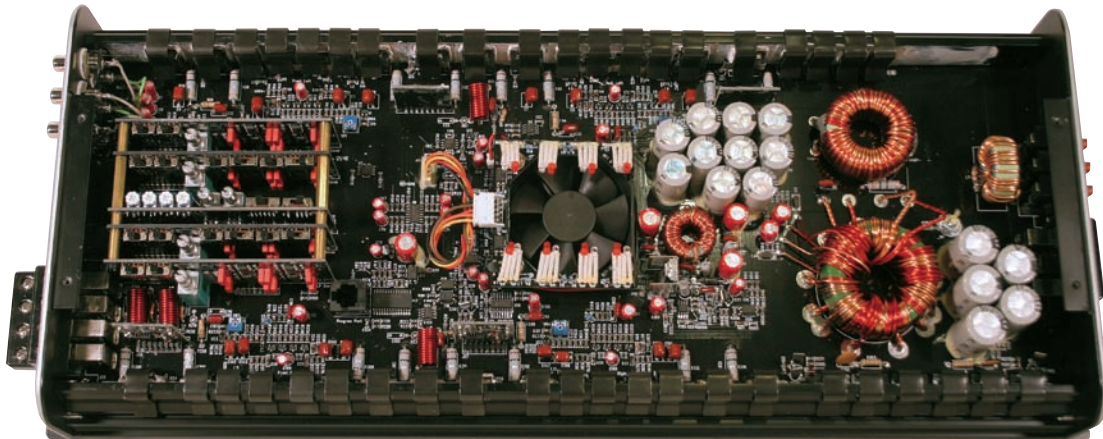
The ARC Audio 4200 SE measured excellently; producing clean transients with amazing linearity, minimal phase shifts, and extremely low latencies, with good channel separation, even into lower frequencies and loads; while being efficient enough for most, if not all stock electrical systems to support. It measured so well, in fact, that if we hadn't opened up the amplifier, we would have assumed that a more traditional, over-built power supply and output stage resided inside; as the disclosed measurements are more indicative of larger, more expensive designs. I can't help but feel some premature praise is due here (because Dave hasn't listened to it), as ARC Audio has packed a lot of performance and value into a relatively small foot-print (19.5- x 8- x 2.5 inches). Kudos to ARC and Mr. Zeff. From my perspective, you have raised the bar by placing truly hi-fi potentials in reach of the many, rather than the few! Final word: specs are cool, but hearing-is-believing; so listen up to golden ears Dave MacKinnon of Of Sound Mind Labs for his expert subjective impressions of the ARC Audio 4200 SE. Visit www.mobiledynamics.ca/pasmag for more information on amplifier design.

DESIGN FEATURES

A look inside the amp reveals that it is equipped with some of the best components and designs available. A microprocessor-controlled power supply sets the tone for the rest of the design. The power supply CPU oversees circuit protection, the cooling fan and load optimization extend power production and reliability. The Arc Audio 4200 SE should not only prove to be a great-sounding amp, but a robust one as well. Arc Audio rates the amp as being capable of driving 1Ω loads when operating in four-channel mode, making it bridgeable into 2Ω loads. As previously mentioned, at the heart of this amp is a potent power supply, capable

of self adjustment and prodigious amounts of current delivery – a solid foundation. From a user standpoint, this is a thoughtfully designed unit in all regards. The left side panel houses six sets of RCA jacks and two balanced signal connections. Two of the RCAs provide a connection to the head unit and the third is an audio output to pass on to a subwoofer amp (for example). The balanced inputs use RJ45 computer jacks and standard EIA/TIA 568B colour scheme wiring that is common to most off-the-shelf network cables. This means that, using the supplied instructions, you can connect the output of most factory (or aftermarket) source units directly to the inputs of this amplifier. The third jack is for the supplied digital remote level control. A two-tiered speaker terminal block will easily accept 10awg cables. On the opposite end of the amp are the fuses and power connections. The power blocks will allow for 4awg cables and the amp is protected by three 40A fuses – proof that this monster is ready to make some real power. However, should you decide to load the amp down to 1Ω per channel in stereo or 2Ω bridged, you will be able to pop these fuses when listening to test tones. That being said, music isn't test tones and they are rated quite appropriately.

The top panel of the amp has a removable aluminum plate that covers the amp's adjustments. I am not going to cover each and every control on the top - suffice it to say that you can configure this amp to do almost anything you want. For example, 2, 3 or 4-channel operation, stereo/mono, low-pass, band-pass or high-pass operation, bass boost and crossover slope adjustments are just some of the many options. What's more important is that I can't think of any feature that was missing. A feature that truly stands out as being noteworthy is that the amp has individual gain controls for each channel. This means that you will need to use a test tone and quality voltmeter or oscilloscope to perfectly align the output of each channel – or an extremely well-trained ear (though the meter is much easier). It also means that channel imbalance is a thing of the past. You can make this amp sound, dare I say, perfect every time. I wish more amplifiers at this level had this feature. >>





Arc Audio goes so far as to include instructions on how to customize the removable top panel with paint. The ARC logo illuminates in red when the amp is in protection and blue when operating properly. The customization instructions show how to retain the operation of the glowing logo to boot. Also worth noting: the cool blue Arc Audio logo will illuminate in red when it first fires up, or when the cooling fan comes on to chill things out. Arc Audio also informed us of the 4200 SE's unique lighting behaviour at high temperatures, as the illumination throbbing was designed to increase in speed as the amplifier gets hotter. It also flashes differently for other forms of protection, either thermal, over-voltage or short. You can even change the Blue default colour to over 200 shades between blue and red, perfect for matching a custom install or personal taste.

LISTEN UP

The Arc Audio 4200 SE was promptly inserted into our reference system (Polk Audio LSi9 loudspeakers and Clarion DRZ9255 source unit – all wired with Audioquest cables). I chose to audition the front channels of the amp in full-range stereo, though I could have also run the amp as a two-channel with its 1Ω stereo and 2Ω mono capabilities. I started with the 2001 IASCA competition CD, knowing it provides a challenge of frequency, dynamics and tonal balance. I confirmed left and right channel configuration and phase before listening – something that should be done any time an amp is installed. Right out of the box, it was clear that this amp had impressive capabilities and extended frequency limits. The lows seemed lower and the highs clearer and more natural than with most amplifiers – even some really expensive ones. I decided to measure the frequency response limits to confirm the manufacturers' claim of 4Hz to 100kHz – I saw 4.17Hz to 108kHz at -3dB and 8.2Hz to 47.9kHz at -1dB. That's ruler flat. It also means that any significant phase shift caused by these frequency limits is well outside of the normal audible range of 20Hz to 20kHz. Frank Cook's measurements at Mobile Dynamics echo these findings perfectly. The all-important midrange was perfectly balanced. No emphasis, brightness or harshness – just silky-smooth reproduction across the board. Bass and midbass was tight, controlled and crisp with good speaker control, even with the woofers in my LSi9s finding themselves in vented enclosures. Frequency response performance is one thing – but what really gets me wound up when re-

viewing an amplifier are its special characteristics. The Arc Audio 4200 SE not only offered some of the most pinpoint-accurate instrument and voice placement of any amp I have reviewed, but managed to convey a sense of depth to the performance as well as allowing the soundstage to extend almost two feet beyond the boundaries set by my speakers – absolutely stunning in all regards. What stood out as truly impressive was the sense of clarity of each instrument. There was a clear sense of space around each one – making them easy to pinpoint and locate on the soundstage.

As important as all the power, frequency and distortion measurements are – they just can't convey what an amplifier sounds like. The Arc Audio 4200 SE sounds absolutely stunning in all regards. I chose to open the amp for a quick inspection of Zeff's latest creation before sending it back to the crew at Arc Audio. The design is quite ingenious in terms of thermal control. The power supply and output devices are configured vertically along the main board of the amp – that is to say – they stand straight up. The bottom chassis component of the amp is U-shaped in profile and these devices are clamped with spring-loaded clips. Where the creativity comes into play is in the amplifier's shroud – the aluminum top cover of the amp. Along the long edges of shroud are a series of holes. Air is drawn in through these holes, up and over the outside of the bottom chassis (which will be heated by the switching devices) and then to a centrally located fan. Air is exhausted out the short ends of the amp beneath the main circuit board. This is not only efficient, but also buries the fan deep within the amp to keep it quiet when in operation and more importantly creates forced induction cooling.

CONCLUSION

As mentioned, it came as no surprise that this amplifier was going to sound fantastic. Over the years, I have reviewed a few products that have been designed by Zeff and each one has offered a similar sonic balance to the impressive Arc Audio 4200 SE amplifier. The talented team at Arc Audio has created an exciting product that sounds absolutely great! The Arc Audio 4200 SE is easily one of the best-sounding amplifiers (of any number of channels and at any price) I have ever had the honour to audition. Congrats to Arc Audio and Robert Zeff for producing a product that puts the focus where it matters – sound quality! **PAS**