AUDIO BASICS

A MONTHLY NEWSLETTER OF AUDIO INFORMATION

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The Editorial That Did Not Get Published.

At the Consumer Electronics Show last June, I met Wayne Green, the publisher of *CD Review* magazine. After a short conversation with him regarding our observations that 1-bit CD decoding schemes do not work I volunteered to write an article for *CD Review* regarding our findings. He seemed interested, and mentioned that he had doubts about the Compact Digital Cassette format too. In response to the conversation, I prepared an article about our observations and promptly mailed it to Mr. Green.

It has subsequently disappeared into a black hole.

To keep my efforts from being totally wasted, I am reprinting herein my transmittal letter and the article. You figure out why this information did not even rate an acknowledgment from *CD Review*, the so called consumer orientated audio magazine.

June 13, 1991

Wayne Green
Editor/Publisher
CD Review
Forest Road
Hancock, NH 03449

Dear Mr Green:

In reference to our conversation at the *CD Review* booth at the Consumer Electronics Show, attached is the article I have prepared discussing the resolution limits of 1-bit CD playback technology.

I am hopeful that this information is worth repeating to a wider audience because we are concerned that an industry changeover to bit-stream technology will result in significantly poorer performing CD players for everybody - or - don't throw away that old Philips 16-bit x 4 oversampling machine for newer bells and whistles! Actually I am quite surprised that the subjective reviewers have not noticed the obvious loss of musical resolution with 1-bit players. High frequency transients and string sounds are not right at all.

I have also enclosed the current issue of *Audio Basics*, my monthly newsletter. You may be interested in the last three pages wherein Digital Compact Cassette is analyzed. Its performance potential is even worse than 1-bit CD as DCC is actually a 4-bit system with only one-fourth the data storage capability as a Compact Disc (assuming its hair sized tracks stay in alignment and the heads stay clean). I am not in favor of "progress" in audio engineering that tromps on the music if it gets in the way of the features and the "lifestyle enhancement." You can use this information too if you desire.

Finally, we offered to lend you one of our new power amplifiers (we have some new very fast solid state designs that may be a breakthrough – they actually start to play string sounds, snare drums, and massed voices correctly and do not compress dynamics). The amplifier is available in 120 watt per channel and 200 watt per channel versions. Which would you like to play with? Let us know and we will send you one.

Sincerely,

Frank Van Alstine

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"Bit-stream" CD Players – a Few Numbers to Think About.

Normally one should pay attention to the music, not the numbers. But with "bit-stream" (one-bit) technology CD players it may be possible that the music is taking second place to the numbers. It is important to take a closer look at the numbers to understand what is happening.

A standard 16-bit CD player sampling at 44,000 times per second yields 65,536 discrete amplitude levels or 96 dB of potential dynamic range. A 16-bit CD player with times four oversampling converts the data to 18 bits of information at 176,000 times per second and yields 262,144 discrete amplitude levels and 108 dB of dynamic range.

A one-bit system (with 256 times oversampling) converts the 16-bit x 44 KHz data from the CD to a 1-bit x 11.2 MHz data stream. This yields just 512 amplitude levels per audio frequency cycle at high frequencies, an equivalent resolution of 9-bits or 54 dB of dynamic range. Can this reduce the musical information potential received from the compact disc?

Why bitstream?

Why would many of the CD manufacturers want to invest the money in a new CD technology? One reason is that current 16-bit CD players cannot accurately deliver 16-bit resolution.

The D to A converter in a 16-bit system works by incorporating a series of circuits that each represent a bit of the 16-bit incoming word from the data stream. Each circuit represents a portion of the data starting with 1 unit (the most significant bit) and going down one-half of the size of the proceeding step at a time (1, 1/2, 1/4, 1/8, 1/16, and so on). At the tail end of the 16 bit word (the least significant bit), the data is being represented by a circuit dealing with only 1/65,536 of the information. By the time the last couple of bits are represented, the value of the signal is badly distorted because it is below the tolerance to which the circuit is built. For example, the last bit at 1/65,536 of the most significant bit is only .0015% of the value of the first bit. If the circuit representing the bits were done to 1% accuracy (few are that good) then that would be 1000 times too crude to represent the last bit. The circuit would need to be built to .001% accuracy to do the job.

Thus 16-bit D to A converters really don't have true 16 bit accuracy. They (and their supporting circuits) simply cannot be economically produced with the necessary precision.

With a bitstream converter it is possible to get much better measured linearity, *as long as the signal is averaged over a long enough time period.*

Although 1 bit data with 256 times oversampling resolves only 512 levels, there is a way to get around measuring that limitation *under certain circumstances*. If there are enough repetitive samples of information, or if the error is averaged over a long enough time frame, the measurements look like true 16-bit resolution – measurements even better than for the best mass-produced 16-bit converters.

The secret to good measurements is to build 1-bit systems that allow the test equipment to provide measurements that are better than what is actually happening. This can be done with noise shaping circuits that average the resolution errors over multiple clock cycles and spread the noise and distortion frequencies out so that there are many frequencies of distortion but each at a low enough level that they fall below the noise floor of the test equipment. All

the distortion is still there, however the many small errors cannot be measured within the resolution of the test equipment, while the same distortion, without noise shaping techniques, would be concentrated and measurable. Also by allowing the test equipment to measure many repetitive cycles of the signal, the equipment will show a resolution that really is not there when only signals of short duration are considered.

On a Compact Disc the highest frequency that can be recorded is 22.05 kHz. Given the 11.2896 MHz clock frequency used with current 1-bit systems, this 22.05 kHz signal is represented by only 256 samples on the positive half and 256 samples on the negative half (the maximum 512 samples available at this frequency). However, if there are 256 consecutive cycles of this 22 kHz wave, and each cycle changed by only 1-bit, then on the average one could measure 256 x 256 samples, which equals 65,536 samples, which would yield a measurement of full 16-bit resolution instead of 9-bit. Thus it is possible to get superior measurements from a 1-bit system, even better measurements than are possible with current good 16-bit systems.

But there is a catch!

The great measured resolution will only hold up as long as the signal is measured and averaged over at least 256 cycles of the sine wave at 22.05 kHz. As the measurement of the signal is averaged over fewer and fewer cycles, the resolution of the measurement decreases, showing the inherent 9-bit limitation of the 1-bit 256 times oversampling system.

When the signal is lower in frequency than 11.2896 MHz divided by 65,536 (172 Hz) then there are always 65,536 samples or more per cycle to average, and the resolution of the system will actually be and measure as a true 16-bits. But as the frequency in question rises, then true 16-bit resolution (*defined as actual resolution of a single cycle of a wave form*) becomes impossible. The measured resolution will still appear to be 16-bit if there are enough consecutive cycles of the signal to allow averaging the measurement over 65,536 clock cycles. But if the duration of the signal is short, there are fewer and fewer samples for the test equipment system to work with, and even the measured resolution will fall back to show the limitations of the uncorrected 9-bit base. Meanwhile as the frequency of the signal goes up past 172 Hz, the real resolution of the system goes down, bottoming out at 9 bits at 22 kHz.

A test signal, being completely repetitive, will test perfectly with a 1-bit system. Consecutive samples of an identical frequency are available to average and use to provide measured 16-bit resolution. But with music this consecutive data is not available. The cure of the 1-bit 256 times oversampling system may be worse than the problem it tries to resolve (that 16-bit systems don't really make 16 bits). Which is better, a 16-bit system that makes 14 or 15 bits both measured and on music or a 1-bit system that measures 16-bits on test signals but only makes 9-bits at high frequency with music?

Consider that the true signal to noise ratio of good CD players is actually about 70 dB *as long as all the noise is measured* – if the lows and the highs are not first filtered out before measuring. Note that -70 dB is very quiet – stick your ear in the woofer to tell the system is on. How many bits are necessary to support this level of real resolution? Actually only 12 real, accurate, working, full time bits. This provides 72 dB of dynamic range - better than available from any other source. The 16-bit times 4 oversampling system does better than this so there is better resolution than the real minimum needed even if it doesn't measure as perfectly as 1-bit systems.

The 16-bit times 4 oversampling system works, it reproduces real music at much better resolution than the noise floor of the rest of the audio system, and it is reasonably priced and very reliable. With 1-bit systems there is the ironic possibility that the music may be compromised by the engineering originally meant to improve the measured performance of the system.

Frank Van Alstine

The Super Pas Four Kit is Ready!

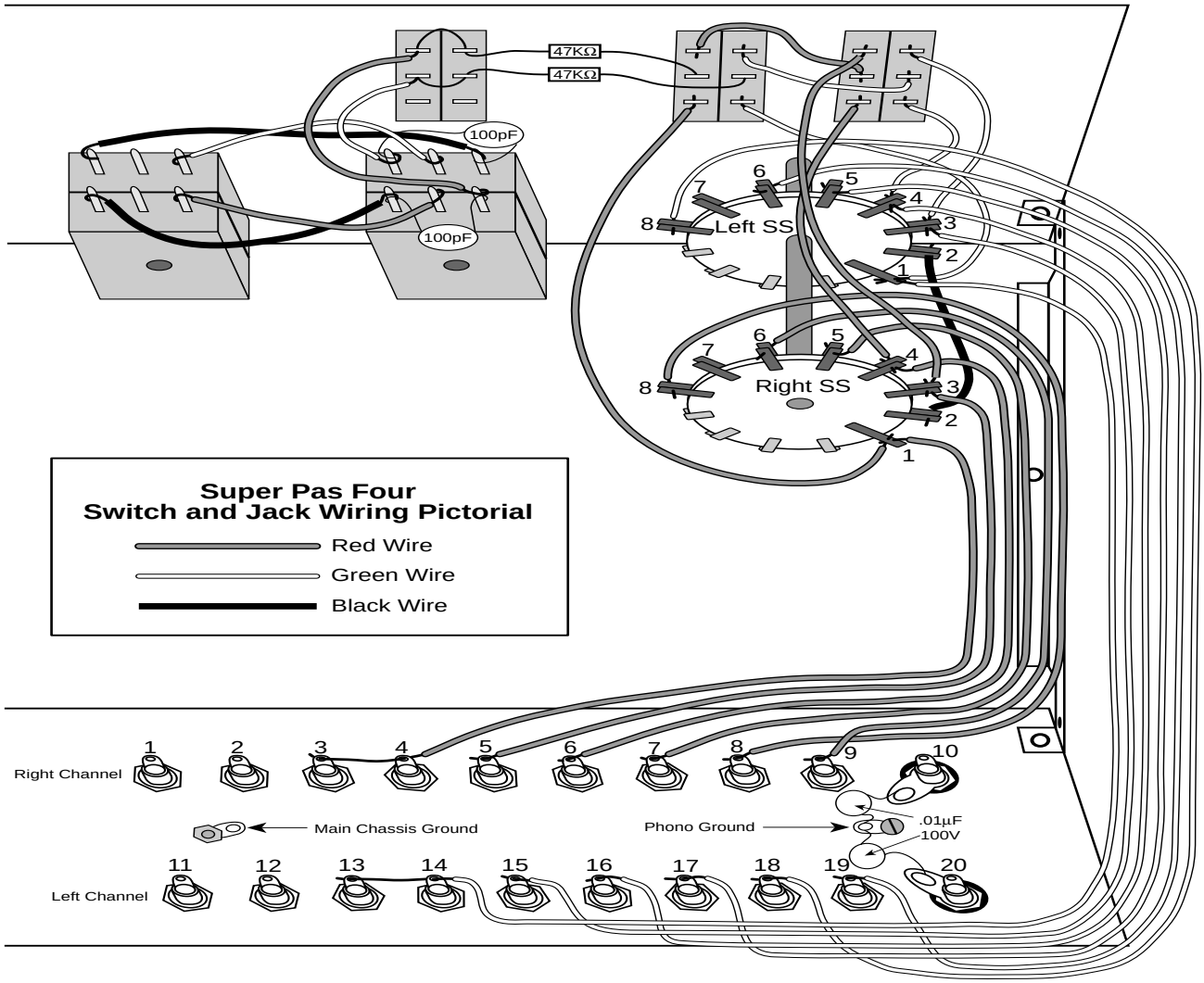
Last month we announced our complete new hybrid vacuum tube preamplifier, the Super Pas Four.

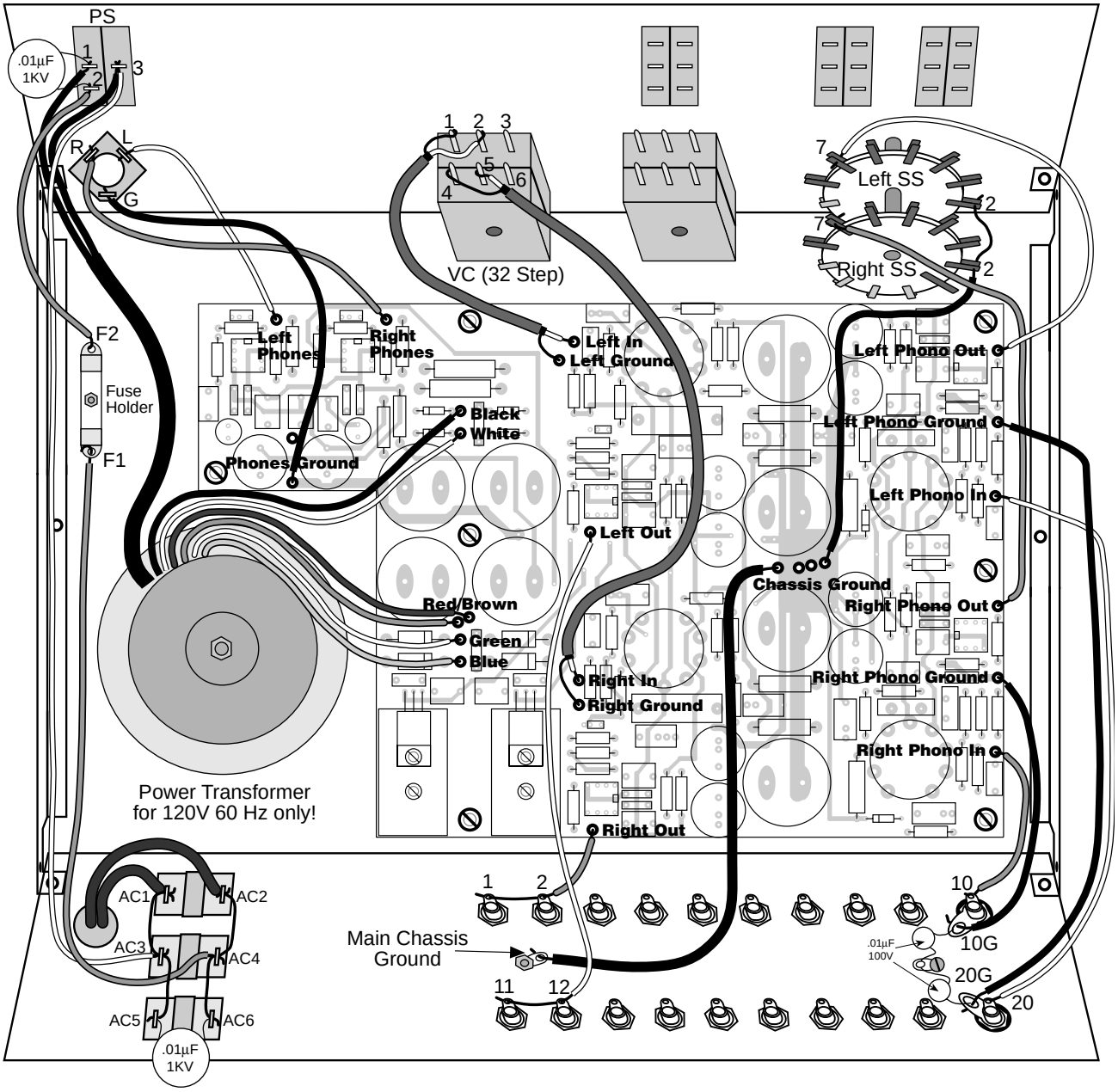
Now we are pleased to inform you that the complete do-it-yourself kit is ready to ship to you.

The Super Pas Four kit is a complete new preamplifier, chassis and all! It is the only state of the art preamplifier available as a complete do-it-yourself kit. It is the only low priced hybrid vacuum tube preamp. It is the only vacuum tube preamp with a built in headphone amplifier. It is the preamplifier that audiophiles on a budget have been waiting for. It has the sound that music lovers have been looking for - but never quite finding. Our first customers are ecstatic.

As a special for *Audio Basics* subscribers, we will provide and pay for two day air shipping in the continental USA on Super Pas Four orders received by December 15th. You pay only the $595 basic kit price. Order now (and pay with a money order so we don't have to wait for your personal check to clear) and we will have your Super Pas Four kit delivered to you in the continental USA in time for Christmas.

Here are a few samples of kit manual drawings *(in the kit the drawings are provided at a much larger size to be easy to read).*





Buy B&W CM-1s and Get the B&W Acoustitune Sub-Woofer Free!

Because B&W is giving us a special price right now, we can make you a very special offer: When you order a set of B&W CM-1 mini-matrix speakers (black only) from us at the $800/pair retail price, we will throw in the $350.00 list price B&W Acoustitune sub-woofer at no extra charge and pay shipping to you in the continental USA. The Acoustitune is a perfect match for the CM-1s, the result is 801 like performance in a small space - the combination I am using myself right now in my video system (along with a Super Pas Four preamp, an Ωmega 150 power amplifier, and a Hughes SRS system).

Hurry, the supplies are limited.

If you don't need the sub-woofer (and the CM-1s are very impressive all by themselves) then take $250 off the price – you pay $550 for the CM-1s alone – the best price we have ever had on them. Call us about them now.

Gift Certificates

Again this year Darlene will prepare a personalized card and gift certificate for any of you that are in need of a last minute Christmas gift idea. We can print an Audio by Van Alstine gift certificate in whatever amount you choose (and pay for) and make sure the card and letter gets to your honored recipient as promptly as possible. Darlene reminds me to tell you that an *Audio Basics* subscription (still $16.00 per year in the USA and $24.00 foreign) makes a pretty good gift itself and it lasts for a whole year.

Please get your order for a gift certificate to us as soon as possible to give us and the post office time to make that Christmas deadline.

The Grado SR-200 Headphones Deserve Another Mention

One of my pleased Grado clients (and a B&W 801 owner) just called me with the most thoughtful and descriptive review of the superb Grado headphones yet. He said the Grado phones sound like the B&W Matrix 801 loudspeakers - if the speakers were located in a perfect room. What more do you need to know? They are still $169 including shipping in the continental USA and will make the best present of all for any serious audiophile.

No Used Equipment Right Now But Don't Give Up, Call Us Anyway!

Many months, equipment received early in the month is sold before *Audio Basics* is ever written. There is equipment available, but it is gone before it has a chance to get listed.

If you want a great value on used factory guaranteed A.V.A. equipment, call us about mid-month. There is a very good chance that then we may have something for you. The best values turn over very quickly.

Remember too if you are interested in trading up, we have sold every single piece of

Its Time To Renew *Audio Basics*

Check your mailing label. There is a very good chance the four digit number to the right of your name reads 9111, 9112, or 9201. If so your subscription to *Audio Basics* is running out.

We are holding the price to $16.00 US, $20.00 Canada, and $24.00 Foreign for another year as the post office has not increased rates yet. (Annual back issues are still available for $15.00 per year in the US – add $4.00 per year for back issue sets to foreign countries).

Thanks for your continued support. We will try and make *Audio Basics* informative and interesting again for you in 1992.

A Note on The Giveaway Contest.

We have heard from a few disgruntled readers pointing out that the winning letter was much too sophisticated to have been written by a 12 year old. Right! Read again - the "12 year old" B. D. was Mr. Krol's Connoisseur turntable. I suspect B. D. got some help and that is one of the reasons he won – he fooled Darlene and me too the first time through.

We have another great giveaway for you coming up early in 1992. Keep a lookout for it and keep those letters coming.

Its Been an Interesting Year.

Here and there we have been noticed. *The Absolute Sound* finally printed their very complimentary Mos-Fet 120 power amplifier review. *Stereophile* put the Super Pas Three on their recommended component list again and published our information regarding the 801 Matrix crossover upgrade early in the year. Julian Hirsch gave us an unsolicited plug in his Tech Talk column in *Stereo Review* regarding our engineering expertise with the Dyna St-70 upgrade. *Sensible Sound* reviewed several of our components (they are getting back on their printing schedule with a new editor) with mostly favorable comments. Our kind clients and readers have given us continuing support. All in all we couldn't ask for more and we will keep on trying to retain your support with the best engineering and values we can do.

Frank and Darlene Van Alstine
Dave Umeda Aado Perandi