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WALL WARTS—PROS AND CONS

I'd like to add another reason to Paul Stamler's list ("In Praise of Wall Warts," Jan. '08 *aX*, p. 24) of why to use wall warts—hum.

Physical separation of the power transformer from low-level audio circuitry is the best safeguard from magnetic pickup from the power transformer. I've battled this problem on many audio projects, once even resorting to mu-metal shielding of the internally mounted power transformer to solve a pesky hum problem. Using a wall wart is the easier solution. This is especially important for low-level circuits most susceptible to hum, such as preamps.

Yet another benefit of wall warts is ease of replacement. Power transformers are prone to failure by power line overvoltage conditions or by power supply circuitry faults (shorted regulator, dried up lytics, and so on). It's much easier to debug and replace a wall wart than an internal transformer.

The circuit in Fig. 1 is a voltage doubler, but is properly used as a single-ended doubler, not a dual-output doubler. By using the pin labeled V- as ground, the pin labeled V+ is double the voltage of a half-wave rectifier circuit. Alternately, by using the common node of the two filter caps as ground, V+ and V- provide a dual-output (but not doubled) supply. Here's a good link on this: www.play-hookey.com/ac_theory/ps_v_multipliers.html.

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Much as I agree with Paul Stamler's enthusiasm for the good points of wall warts, I believe that he failed to mention a few negatives.

First, wall warts have a habit of multiplying. As anyone who works with computer equipment lately has probably noticed, all of a sudden you have *lots* of wall warts and a shortage of properly spaced outlets to plug them into. There are neat products that help a lot, including wide-spaced outlet strips and "squid plugs"—you can guess how they work—but you still end up with a little area dedicated to wall warts that looks sort of like the "tank farm" section of an oil refinery. If your preamp used two wall warts, it would probably occupy most of the area on a standard narrow six-outlet power strip. Avoiding this is one of the benefits of equipment with *internal* power supplies and simple (and usually standard and interchangeable) line cords.

Second, there can be important safety issues with certain configurations. Most wall warts deliver their voltage on one of those small concentric plugs, which have quite tight spacing (especially internally), and a thin and thinly insulated wire. If, for example, you float that filament supply on +160V to center it, that +160V is now being applied to that thin wire and small connecter—and the internal wiring of the wart itself—all of which were only intended to see 16 or 24V. Even if the transformer *in* the wart is rated safe for that breakdown voltage, I doubt that the interconnect wire they use is rated for it. Even if it is, I would not trust the wire typically used in terms of mechanical safety; I wouldn't want dangerous voltage on a wire that could be so easily damaged if you step on it or set something on it.

Third, and last, most wall warts are not "green." Most of them limit their safe current by virtue of having relatively high winding impedance and low efficiency—if shorted they simply don't draw enough power to burn. This is one of the reasons they are so very safe. Unfortunately, the same considerations lead to a transformer that tends to draw a lot of idle current and have low efficiency when operating (some as low as 50%).

Because the wall wart is always connected, even when the equipment it powers is switched off, a large collection of them will tend to draw quite a bit of extra power. Admittedly, it's probably not significant in terms of your electric bill, but those with a green inclination might object. You should also note that some wall warts do not appreciate having their

ventilation blocked by being buried under carpet or stray clutter; even some without vents require free air flow around the case for cooling, so some care may be required in that direction as well.

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CROSS-REFERENCES

I recently read an article by Charles Hansen which he wrote last year. In it he stated that it was difficult to cross-reference Heathkit and other old part numbers. ECG has a master replacement guide for semiconductors that does a great job of this. He mentioned an MPSU45. That's an ECG272, for instance. It has many Heath numbers cross-referenced to ECG numbers. The copy that I have was printed in 1989. I am assuming that ECG is still in business, of course.

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Charles Hansen responds:
Mr. Davis is correct, but note that ECG was purchased by NTE a number of years ago (www.nteinc.com). I use the NTE cross-reference all the time. I also have the 1992 SK Cross-Reference book (from Thomson Consumer Electronics), but SK is now TCE/RCA and to my knowledge they have yet to provide an updated cross-reference.

There is also a nice cross-reference for Tektronix and HP test equipment semiconductors at www.sphere.bc.ca/test/tekequiv.html, www.sphere.bc.ca/test/hpparts.html.

Many of the semiconductor manufacturers provide cross-references to their competitors' part numbers. For instance, Texas Instruments provides their cross-reference at http://focus.ti.com/logic/docs/crossreference.tsp?sectionId=451&familyId=1.

MIKE PERFORMANCE

In George Danavaras' article on the Panasonic Mike Cartridge (*aX* 12/07, p. 28), there are many errors and misrepresentations, and at least some clarifications as to the measurement techniques used.

First, a few comments about Bruel & Kjaer microphones. In general, their performance far exceeds their specifications. The microphone used as a reference microphone (standard on the Type 2230 SLM pictured) is a Type 4155—a model that is no longer available. More important, this microphone is not primarily designed for electroacoustic work, but instead is designed for general product and environmental noise measurements. For loudspeaker testing, a 4191 mike (comparable to our older Type 4133) should be used because of its higher cutoff frequency and reduced distortion. Also, the 2230 body will have an effect on the microphone responses; normally only a microphone and its preamplifier body would be used near the tested loudspeaker driver.

I fully understand that the basis for many of the tests made were based on live comparative frequency response measurements using the 4155 microphone on the 2230 sound meter and the DUT microphone taped to its side. Still, the effects of the 2230 and the adjacent microphone will have an effect that

could change—especially at higher frequencies—by a slight shift in position or orientation. Ideally, these measurements should be made with a superposition technique—not taping the microphones side-by-side.

Figure 1 seems to show the response of the tweeter, as measured with the mikes, not the response of the microphones, as described. I know this because the B&K mike response is much flatter than this. This should be made clear in the measurement.

Similarly, the distortion measurement parameters are the distortion values of the drivers and perhaps the Panasonic microphones. It does a disservice to our company to promote those measurements as those of our microphone. The correct technique to evaluate microphone distortion is to use two drivers individually driven by separate frequencies that are not harmonically related. Then, you look at the difference frequency values and measure the spectral parameters not present at the two driven frequencies and their harmonics. This allows you to ignore the loudspeaker nonlinearity.

The author commented that an anechoic environment is required for distortion measurements. This is, in fact, an error. While frequency response measurements can easily be affected significantly by the room acoustics, the near field distortion measurements are practically immune to variation, as long as the room is not a highly reverberant room, or by the unlucky chance the specific frequency chosen is at the room standing wave modes.

Again, in Fig. 5, the author presents a frequency response graph that is of the loudspeaker—not the microphones—yet is described as "response of the microphone."

A comment about the Panasonic microphones: While cheap, they are pressure response microphones and exhibit the rising high frequency response shown in Figs. 3 and 6. This rise in response is not really due to the microphone, but is due to the sound pressure buildup of high frequencies as the wavelength of sound approaches the diameter of the microphone. The B&K microphone is designed to have a high frequency rolloff in its pressure response to compensate for this pressure buildup.

CONTRIBUTORS

Bjørn Kolbrek ("Horn Theory: An Introduction, Part 1," p. 6) is an electronics engineer in Norway, and works as an R&D engineer for Scana Mar-El designing remote control systems for ships. His hobbies include building horn loudspeakers, amplifiers, and amateur radio gear. For the last four and a half years, he has studied horn loudspeaker technology–both theoretical–and practical–with Thomas Dunker.

A specialist in a practical approach to electronics, **John Laughlin** ("Amp6," p. 18) has spent 25 years in the electronic industry, and 25 years as a college instructor. He has a first-class radiotelephone license, and is a member of the Brazos Valley Amateur Radio Club. He has written for several publications, including *Popular Electronics*, *Ham Radio Magazine*, and *QEX*. Besides electronics design, he enjoys making custom billiard cues, sailing, and he has walked across the Grand Canyon three times.

Jack Walton ("The Noise (Analysis) Machine," p. 30) was a chemistry major in college (Fordham in NYC), doing much work in physics where he routinely broke equipment, particularly the diamond saw blades used to cut copper-gold alloys. This was at the dawn of the super-conducting era. He received his first-hand experience with vacuum tubes in instrumentation building low-noise amplifiers for the solid-state lab, repairing instrumentation, and playing with liquid nitrogen. He was also very active in ham radio at the time, building VHF tube equipment.

He decided to pursue an MBA at the University of Chicago and worked in finance at several investment banks before he started his own investment management firm. He is deeply involved in the specialty chemicals business at the moment.

He has moved to sand-state and does much work looking at noise and interference issues with audio equipment. He collects Hallicrafters ham radio equipment, sings tenor in choir and has three grown sons. His wife is a molecular biologist, who has variously worked on cancer stem cells and opioid receptors.

Aren van Waarde ("The G40EP: A Flea-Powered Headphone Amp," p. 36) is a Dutch biochemist working in the field of medical imaging (positron emission tomography.) He has worked as a Ph.D. student and a postdoc at several universities (including Leiden and Yale Universities) before accepting tenure at the University of Groningen. His passion for audio started on his ninth birthday when his parents gave him a Philips kit. Most of his current audio equipment (loudspeakers, radios, tuners, pre- and power amps, both tube and solid-state) is homemade.

Ed Simon ("Soldering: A Tutorial," p. 42) received his B.S.E.E. at Carnegie-Mellon University. He has installed over 500 sound systems at venues including Jacob's Field, Cleveland, Ohio; MCI Center, Washington D.C.; Museum of Modern Art Restaurants, New York; The Coliseum, Nashville, Tenn.; The Forum, Los Angeles; Fisher Cats Stadium, Manchester, N.H.

David J. Weinberg ("AES Multi-Tracks in New York 2007, Pt. 2," p. 46) is an engineering consultant and technical journalist on audio, video, and film technology. He provides audio and home theater engineering consultation and professional on-location digital audio recording services to companies, radio stations, and individuals. He brings to his work an MSEE, a First Class Radiotelephone license, and over 40 years of continued study and active involvement in the audio, video, and computer industries. He is Vice Chairman of the Audio Engineering Society's DC section, a manager in the Society of Motion Picture and Television Engineers' DC section, and membership officer of the Boston Audio Society (www.BostonAudioSociety.org).

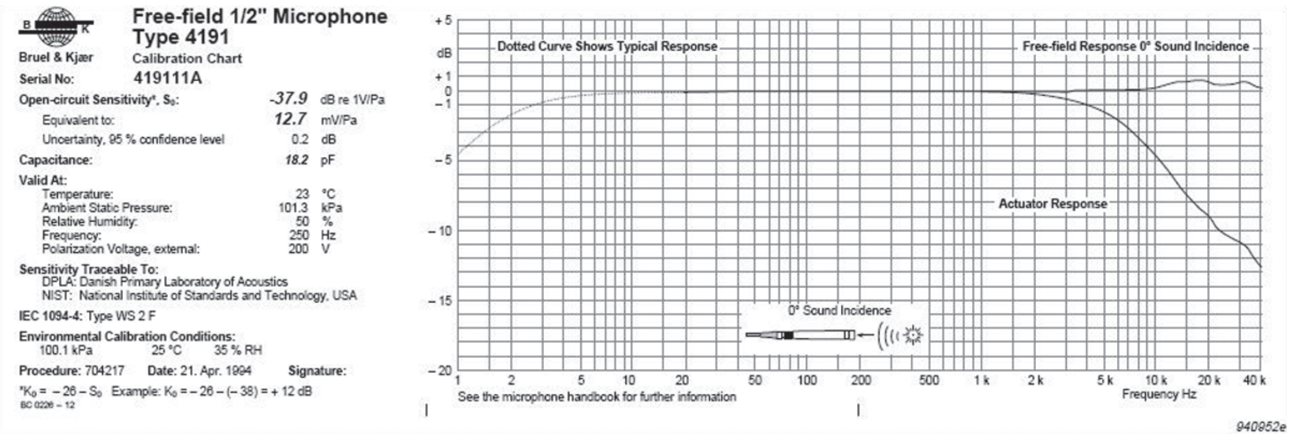

FIGURE 1: Calibration chart supplied with a free-field ½″ microphone type 4191

Figure 1 shows both the pressure (actuator) and free field response on the curves for the 4191 microphone mentioned earlier.

The Panasonic microphones response is severely affected by temperature and humidity variations. This is not too much of a problem in loudspeaker testing that is usually performed indoors and with a controlled environment. Of course, a B&K microphone cannot be affected by external variables, as it is most commonly used outdoors or on factory floors with no control of the environment.

The phase response measurements (Figs. 4 and 7) have me puzzled. Though you did not show the response of the B&K mike, I assume, then, that you are showing the comparative phase of the Panasonic mikes relative to the B&K mike. Because all these have a diaphragm resonance at somewhere around 15kHz, the actual phase variation relative to their low frequency will be at –90° at that resonance. The key is to have the resonance well damped—and all these show a well-damped resonance. This relatively low resonance point is another reason to not use these microphones for high frequency analysis of tweeters. At B&K we recommend 1/4 or 1/8″ diameter microphones with diaphragm resonance frequencies of at least 70kHz for this application.

Also, I would like to mention that to purchase one of our high-quality microphones or sound meters such as our Type 2250, you could spend several thousands of dollars, but we make these products available for rental at prices that would be attractive to an audio club or individual audio enthusiast.

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George Danavaras responds:

I would like to thank Mr. Weir for his letter and the opportunity to make some additional clarifications concerning my article. I agree with Mr. Weir that the 4191 mike would be more accurate for loudspeaker testing than the 4155 mike I used for my tests. I would be happy if I could use the 4191 mike, but I had access only to the 4155 microphone and the 2230 Sound Level meter (SLM).

Concerning the testing method, as I described in the article, I used an acoustic source and I measured the amplitude and the phase response of the source first with the B&K mike and then with the Panasonic mikes. The purpose was to compare the measurements of the acoustic source that were taken with the B&K mike with the measurements of the same acoustic

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source that were taken with the Panasonic mikes. Then, considering as reference the response taken with the B&K microphone, the response of the Panasonic microphones could be extracted.

The same method applies also for the distortion measurements. I measured the distortion of the acoustic source first with the B&K mike and then with the Panasonic mikes. The distortion figures that are given in Tables 1, 2, and 3 of the article are the distortion of the acoustic source as measured by the B&K mike and the Panasonic mikes.

I think that Mr. Weir misunderstood the meaning of Fig. 1. As I describe in the article, not only does the body of the 2230 SLM have an effect on the microphone response, but also the placement of the Panasonic mike close to the body of the B&K mike also has an effect.

This effect is shown in Fig. 1 of the article. In this figure two amplitude responses of the same acoustic source are shown. Both responses were taken with the B&K mike. One was taken with the B&K alone and the other with the Panasonic mike on the B&K body. The differences in the two responses describe the effect of the placement of the Panasonic mike on the body of the B&K mike.

Due to this effect and some other reasons described in the article, I conclude that the accuracy of the testing method was about ±1dB. Anyway, I believe that most of the misunderstanding comes from the incorrect description of Figs. 1, 2, and 5 and Tables 1, 2, and 3 which should be modified as follows:

Figure 1: Two frequency responses of the same acoustic source are shown. One was taken with the B&K mike alone and the other was taken again with the B&K mike having the Panasonic mike attached on the body. The difference in the responses is due to the proximity of the Panasonic microphone.

Figure 2: The low frequency response of the acoustic source as measured by the B&K mike and the standard Panasonic mikes.

Figure 5: The low frequency response of the acoustic source as measured by the B&K mike and the modified Panasonic mikes.

Table 1: Distortion of the acoustic source at 115 dBSPL peak as measured by the B&K mike and the standard Panasonics.

Table 2: Distortion of the acoustic source at 125 dBSPL peak as measured by the B&K mike and the Linkwitz modified Panasonics.

Table 3: Distortion of the acoustic source at 130 dBSPL peak as measured by the B&K mike and the Linkwitz modified Panasonics.

Mr. Weir notes that I commented that an anechoic enviroment is required for distortion measurements and considers this an error. What I mentioned in the article is that because I don't have an anechoic chamber available, the only solution is the near-field measurement. I don't think that this is an error. Additionally, I don't have any measurements about how the Panasonic mike response is affected due to temperature or humidity. All my measurements were taken indoors at a room temperature about 24° C and humidity 55%.

Finally, I would like to add that the Bruel & Kjaer Company is a world leading manufacturer and its products are the industry reference. If there was any misunderstanding or omission in the article concerning the characteristics of the B&K mike, this was not my intention. aX

ARTICLES WANTED

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