

CORRECTION

I just noticed that in my article, "Isolator Tube Interface to Computers," appearing in the July issue of *audioXpress*, the first four sentences were left out. These sentences contained the name of the software and the company that provides the software, plus the website that it can be downloaded from, so it might be confusing to the reader not to have this information. The website address is: <http://www.nch.com.au/tonegen/index.html>, which will take you directly to the downloading site. The main company web address is: <http://www.nch.com.au/software/index.html>.

Frank Simonsen
fsimonsen@telus.net

TRANNNY TALK

The timing of Larry Lisle's article on the 71A project ("A Minimalist Amplifier Design," March '05 *aX*, p. 16) couldn't have been better! I have all the components to build except the output transformers.

I have a Stancor A3311 (P.P 10,000Ω plates to 500/15/8/4Ω primary DC 70mA max audio power 25W). I know the 8054 is a high-fidelity model. How limited will my results be with these A3311s, whose application may be only for a more lim-

ited bandwidth without the extension at both ends of the frequency response that you must be enjoying? I have 110dB efficient horns. Specifically,

1. What modern equivalent for the 8054 would you recommend?
2. What would you recommend as a SE replacement and how would the audio circuit you show change?
3. Do you know where I might find a pair of 8054s?
4. Do you have a recommendation in NOS (50s vintage) to the 8054?

Thank you for your continuing series of articles over many years of service to the audio industry.

Paul
phat@mountaincable.net

Larry Lisle responds:

Thank you for your letter and kind remarks. Your A3311 was a very successful transformer for Stancor. It was listed in their catalogs from at least 1939 to 1959 for use in radios with push-pull 6F6s or similar output tubes. Therefore, you can count on it to reproduce the audio spectrum of a good-quality AM radio. It's certainly worth a try.

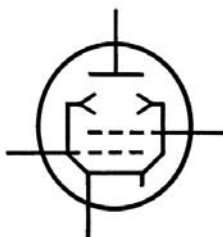
As you pointed out, though, it isn't a high-

fidelity transformer. For comparison, the following prices are from a 1957 Allied Radio parts catalog: Stancor A3311—\$5.94, Stancor A8054—\$13.36, UTC LS-52—\$21.56, Acrosound TO300—\$24.75, Altec-Lansing Peerless S238—\$25.86. These push-pull transformers are approximately equal in power handling ability, and I think the price is a rough guide to their quality.

Whether you can actually perceive the differences among them in your listening environment with real music is something that can only be determined by experiment. I don't believe the small amount of unbalanced direct current in the primary drawn by a single-ended 71A would be enough to seriously degrade the performance of these large transformers, but again, there's no way to be sure without actually trying it.

Where to find these and other transformers from the golden age is a good question. They sometimes turn up at ham or antique radio flea markets, but I've had better luck using the Internet. In any case, be prepared to pay a much higher price than in 1957!

There are many modern transformers, both single-ended and push-pull, that are very good, and I hesitate to flat-out recommend a particular brand. You might check previous issues of *audioXpress* and *Glass Audio* for types that have been used in vari-



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ous projects and then send for a catalog or check specifications on the Internet.

Thank you again for your interest.

REPLACING BATTERIES

I read Charles Hansen's article on the Fluke 8050A DVM (April '05, p. 36) with great interest, especially about the 4.5 digit wide-bandwidth RMS accuracy, the option 01 battery feature, direct dB measurement, and the relative setting which allows you to store a reference measurement to compare against future readings. I acquired one from eBay for \$56 and I am very happy with it. The meter's LCD is in good shape (replacing it costs \$36 + s/h from Fluke!). My meter displays the BT warning when on batteries, although one of the four cells is borderline.

I started researching battery replacement per your article, which brings me to the point of this letter. I found out from the Internet that you should not replace NiCad with NiMH cells unless the charger is specifically designed to do so. This is per a very good battery company (Zbattery) website <http://www.zbattery.com>, which has an excellent FAQ section on this. Their model #NCD3000T is a 3000mAh NiCad C-cell with solder tabs at \$3 each, and is my candidate to use for this project. This obviates the need to install battery holders; you can re-use the existing plastic holders that housed the original cells.

This brings up the question of what it would take to modify the charger circuit, because most of us would prefer to use NiMH cells for their ability to store more power per weight and their lack of memory effect problems. Also, note that the manual containing a schematic and parts list plus an errata update is available as a free download from the Fluke manual support page as a PDF file.

Philip Cooper
picooper@optonline.net

Charles Hansen responds:

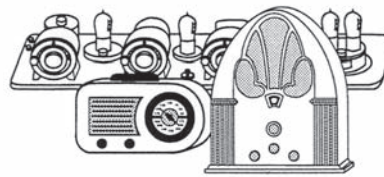
I'm glad that Mr. Cooper is happy with his Fluke 8050A DMM. His concern over the charging requirements for NiMH batteries is well founded in the case of fast charge times, such as the chargers used for power tool batteries where rapid cycling is needed to maintain productivity on the job. I have two identical Makita cordless drills. The older one came with NiCad batteries, and

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I won't charge NiMH batteries with it because the charge current is too high and the charger does not have the necessary "smarts" to prevent damage. The newer charger will handle both battery types, although a NiCad will take a bit longer to charge.

With regard to low (trickle) charging rates, however, you will not damage a NiMH battery using a charge circuit originally designed for NiCad batteries. As long as the charge current is 10% of the cell AH rating, either type of battery can remain on charge indefinitely without damage. The 8050A manual (Table 1-4) states that the full charge time for a new uncharged battery is 14 hours. We have been using NiMH batteries in four Fluke 8050A and 8010 DMMs at work for two years without any problems. I don't think it is necessary to modify the Fluke charging circuitry.

If you do not regularly use the DMM, NiCad batteries might be a better choice because of their lower self-discharge rate. Otherwise, the higher energy density characteristics of NiMH will deliver more continuous operating hours, assuming the same physical battery size.

Mr. Cooper's information on the solder-

tabbed Zbattery is useful for those not wishing to modify their Fluke with new holders.

E-LATED

Pete Millett really hit a home run with his E-Linear single-ended pentode amp (April '05, p. 6). It's amazing the kind of performance you can get with a few parts and some thoughtful engineering. I'm building this one, for sure!

I do have a few suggestions, as well as a concern that I'd like to share:

1. You can substitute the 7-pin miniature 0A2 for the octal 0D3 regulator. This little guy has better regulation but a lower current rating than its big brother, so you'll need to increase the value of R1 to about 9100Ω. Whatever you do, don't change the value of C2—you'll ruin the tube!

You can get the basing info from a neat little program called "Tube Data Sheet Locator (TDSL-PE)," downloadable for free from <http://www.duncanamps.com/tdslpe/download.html>.

2. I agree with Pete that ordinary capacitor clamps are pretty ugly, but you don't need to machine fancy ones. Simply turn the clamps upside-down and mount them beneath the chassis. Just be sure to lay out the clamps from the underside, or the holes may not end up where you want them.
3. The ASC 40μF polypropylene motor-start capacitors Pete recommends are economical and really sound great, but higher values do not sound as good. This is definitely a case of bigger not being better.
4. I'm concerned about the heater-to-cathode voltage applied to the rectifiers. Design-maximum rating for these tubes is no more than 100V continuous, or 300V peak.

Although these tubes are on their own separate heater winding, the winding is grounded. This places the entire 425V supply across the heater-cathode insulation.

It is far better to just let the heater winding float. Heater-cathode leakage will then develop a positive bias on the winding, which is actually desirable.

CAUTION—it is potentially hazardous to power any other tube from the rectifier heater winding!

5. It used to be standard practice with pentodes to put a small capacitor across the plate winding of the out-



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put transformer. This maintained transformer loading at the higher frequencies, where the speaker had given up.

I believe that such a capacitor may reduce the slight ringing noticeable in the square waves, and it might allow compensation capacitor C9 to be reduced or eliminated.

Just a small capacitor would be needed—I guesstimate about 1nF (1000pF)—but the voltage rating should be around three times plate voltage. Since this capacitor handles only ultrasonic frequencies, silver mica or ceramic will work fine, and are readily available at these voltages.

Bob McIntyre
musitronix@yahoo.com

Pete Millett responds:

Thanks for the comments.

1. The 0A2 can be used in place of the 0D3 if desired. I like the 0D3/VR150 largely for its looks!
2. You can use regular capacitor clamps inside the chassis to hold the large can capacitors, as Bob suggests. It does require quite a bit of space under the chassis, though. With the clamps I have, the terminals of the caps would wind up 2" below the chassis, so you'd need about a 2-1/2" deep chassis to provide some clearance. One benefit of mounting them the way I did is that you can use a pretty shallow chassis.
3. I haven't played with larger polypropylene-in-oil motor run caps. The parasitics (inductance and so on) do increase with size, so it's entirely possible the larger ones wouldn't sound as good.
4. I think Bob picked the wrong rating off the data sheet for the rectifier tubes. The heater-cathode rating of the 6CJ3 and 6CL3 is only 100V if the heater is *positive* with respect to the cathode. The rating for having the heater *negative* with respect to the cathode is 900V continuous, 5500V peak—and with the heater grounded and cathode at B+, the heater is negative with respect to the cathode.

In television damper diode service, which is what these tubes were designed for, the heater is normally run off the same (grounded) filament supply as other tubes in the set, and the cathode is at high voltage (typically the same DC voltage as the plate of the horizontal output tube, 200–800V), so it is perfectly safe to use them this way.

If desired, assuming you have a separate filament winding, you could connect it to the cathode; but I'd be as worried about the isolation of the filament transformer as the heater-cathode insulation of a damper diode tube. Floating the winding will work OK as well—I've done it—but in general I don't like to have floating heater windings.

5. I didn't try a capacitor across the output transformer. It's possible it might allow the capacitor on the driver plate to be eliminated, but I suspect it is still desirable to have the capacitor on the driver. The driver pentode has such

high Gm that any parasitic inductance in the plate circuit causes an increase in gain, possibly at hundreds of megahertz, which is undesirable in and of itself. The ringing in the square wave output is pretty inconsequential—the amplitude is very small, and the square wave response looks much better than most amplifiers that I have looked at. You can increase the value of the capacitor on the driver plate if desired to eliminate it, but I chose a capacitor value that provided close to critical damping. Sweeping a sine wave up to

A poster for the 119th AES Convention. The background is a blue and orange gradient with a grid pattern and musical notes. The text is white and yellow. At the top right, it says 'JACOB K. JAVITS CONVENTION CENTER NEW YORK, NY, USA'. In the center, '119th AES Convention' is written in large letters, with 'October 7-10, 2005' below it. To the right of the main title is the Audio Engineering Society logo. Below the title, it says 'where audio comes alive!' and 'register online now @ www.aes.org'. At the bottom, there is a list of activities: 'exhibitor seminars', 'technical papers', 'educational events', 'tutorials • special events', and 'workshops • exhibits • tours'.

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over 100kHz didn't show any significant peaks at high frequency, another indication that it is adequately damped.

PERSONAL USE ONLY

I just scanned the latest edition (April '05) of *audioXpress* that I received in the mail today. At the end of Erno Borbely's article (p. 25), there's a box containing a statement regarding intellectual property. I'm sorry to hear that this sort of thing is an ongoing problem that has a direct effect on Mr. Borbely.

Thank you for so generously sharing your knowledge over the years with the DIY audio community. I have learned quite a bit recently by reading (and re-reading) your series on designing with JFETs from a few years ago. Given the problem with people using your designs for commercial purposes, it's truly wonderful that you remain willing to provide this information to us amateurs. Obviously something motivates you beyond the simple desire to make money and a living, and I hope that you get a few of these from time to time that encourage you to continue to contribute.

It's great, and we like it!

Vince Harris
Philadelphia, Pa.

CABLE CONNECTIONS

I am perplexed by Richard Honeycutt's response to John Volanski's book review critique (April '05, *Xpress Mail*, p. 48). Without consulting many references on signal cable construction, but relying on memory, I don't understand Mr. Honeycutt's comment on "one way" cables. Of course, he recognizes the reason for marking them, but, I think, confuses the two types of signal cables and the way the shield is used.

In balanced cable, there are two conductors and a shield. Neither conductor is (or should be) connected to ground at either end. The shield is the only wire connected to ground, and can be connected at both ends without concern for ground loops.

In unbalanced lines, there are two conductors and a shield, but one of the conductors is connected to ground at both ends. If the shield is connected to ground at both ends, a ground loop will exist. This may or may not cause noise, hum, and/or EMI interference depending on the design and circumstances, so it has become common to leave the shield unconnected at

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one end. I have made up all of my signal cables from Mogami cable in this configuration and have zero noise, hum, and so on. Contrary to Mr. Honeycutt's remark, I connect the grounded end of the shield to the output jack of the source component, not the destination end.

This configuration has been recommended by many designers over the years, and it has worked for me for more than ten years.

*Frank S. Thomas III
Ballwin, Mo.*

Richard Honeycutt responds:

Thank you for your comment. Your letter leaves me with the impression that you believe that there is a difference between the "low" side of the signal and "ground" in unbalanced equipment. This is very rarely the case. Therefore, whether the shield is connected at both ends makes no difference, because the "low" side of the signal pair already connects the grounds in the "source" and "destination" equipment.

Your letter also assumes that unbalanced cables use two-conductor shielded cabling. Normally this is not the case either: single-conductor shielded cable is most common. Your solution certainly would help if you were connecting unbalanced equipment with isolated grounds.

Thank you for identifying my error in recommending grounding at the destination end: you are correct in that for balanced circuits and isolated unbalanced circuits, the shield should be grounded at the source end. Further information on grounding can be found in Davis's *Sound System Engineering*, Ballou's *Handbook for Sound Engineers* (available from Old Colony Sound Lab), and in several books by Ralph Morrison.

PCB PICTURES

I read with great interest Erno Borbely's two JFET Preamp articles (June and July '05 aX). Unless I missed it, though, neither installment contains pictures of the PCB traces. This makes them little more than a two-installment advertisement in my opinion. Yes, the schematics are there, complete with difficult-to-find-except-from-Borbely devices, but I'd be far more likely to patronize your advertisers for this one if you could make my life a little easier, like providing PC artwork. Most of your other authors seem capable of this task.

Thanks for letting me vent.

*Steve
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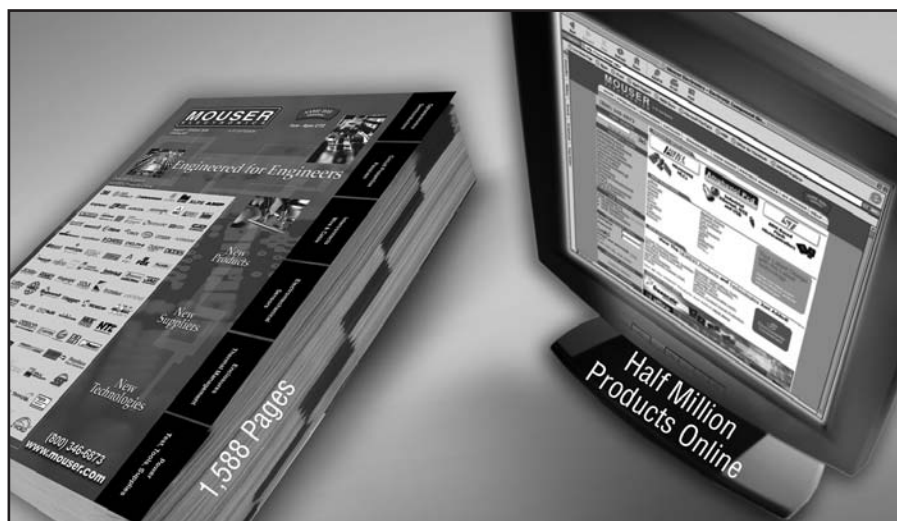
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Erno Borbely responds:

There is no question of being "capable of this task," but reproducing PC artwork 1:1 in the magazine is not easy. I send my manuscript in Word and/or PDF format, both of which change the size of my originals. Limited space in the mag might also dictate size reduction or even omission.

The original size of the boards is: 105 × 145 and 210 × 145. You can find .pdf versions of the line amp and phono preamp on the aX website www.audioXpress.com. For hard copies, please send a self-addressed stamped envelope to audioXpress, PO Box 876, Peterborough, NH 03458. Good luck with your JFET projects.

CAP TYPES

As Paul Stamler points out in "Capacitor Bypass: Proceed Carefully" (aX 5/05), bypassing can be counter-productive if not done with a perception into the interaction between capacitor types. Analog Devices has some very good application notes on grounding and bypassing on their website (www.analog.com), as do many of the capacitor manufacturers.

I'd like to add to his comments under "Raw Results" on page 60. Comments 1 and 2 concern the expected relationship between ESR and ESL in aluminum filter caps. Low ESR requires a large plate area that minimizes the electrode resistance, and closely spaced electrodes.

Interestingly, the tall, smaller diameter caps tend to have lower ESR than short, larger diameter caps of the same capacitance and voltage ratings. This may be because the taller caps have foil lengths and widths that are closer to square, which maximizes the foil area. Etching the foil further increases the available surface area. Capacitors with thinner oxide layers and separators produce higher capacitance and lower ESR, but at the cost of reduced voltage ratings.

You might think the close plate spacing that produces low ESR would also result in lower ESL, because the loop area available to produce a magnetic field is reduced. This would be true if the aluminum capacitor foils were laid flat, but they are instead wound into a cylinder (this is also true of wound film-foil and metallized-film caps, comment 6). Think of them as being similar to

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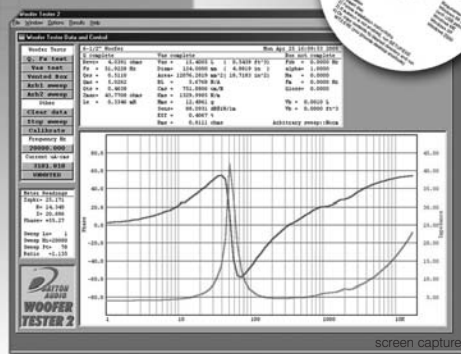
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air-core inductors, so their inductance is essentially independent of frequency. The terminal leads also add a small amount of additional inductance.

Tan theta (comment 3) is the ratio of capacitive reactance to ESR, and is a frequency-dependent term. For low loss capacitors, tan theta is essentially equal to dissipation factor (DF).

I would think the higher number of turns in short, larger diameter capacitors of the same voltage and capacitance as tall, small diameter caps should increase the ESL, not decrease it (also comment 3).

The multi-layer parallel-plate ceramic disc (comment 7) is indeed the lowest ESL capacitor type, if you can put up with the variations in capacitance with temperature, age, applied voltage (AC and DC), and frequency. The high-K X5U types might vary as much as -55% with all these combined effects.

While solid tantalum capacitors are generally superior to aluminums in terms of ESL, they are not as good as the disc ceramics. They also have inrush current limitations and thus cannot be used

as the main reservoir filter capacitor. A combination of aluminum, tantalum, and ceramic types may give the best results.

*Charles Hansen
Ocean, N.J.*

TUBE SAFETY

Kudos to Larry Lisle for his excellent article "Reducing Filamentary Triode Amp Distortion" (aX May '05, p. 35). This is truly groundbreaking work. But I am curious about the stated precautions on too-low filament voltages: What harm could this cause?

We know for incandescent light bulb filaments that life is inversely proportional to a high exponent of the operating voltage, such that a small reduction in voltage causes a large life extension (at the loss of much light emission, alas). It would seem that in the triode, lower filament voltages should result in less material loss from the filament with any given plate voltage. Is there some other effect going on here?

Also, with regard to reducing the space charge, is there any reason this technique could not be employed with separate-cathode tubes? Or does the high electron

emissivity of the cathode coating make this concept too voltage-sensitive to be practical?

Many thanks for a fine and thought-provoking article!

*Bob Masta
audio@daqarta.com*

Larry Lisle responds:

Thank you for your comments. As to your questions—in writing for publication I think it's best to err on the side of caution. While I haven't experienced any apparent shortening in tube life by reducing filament voltage to values above the critical point where the space charge disappears, I don't have enough evidence to make a categorical statement that there couldn't be any danger with any filamentary tube under any conditions. I'd hate to be responsible for a reader blowing away some expensive tubes without being aware that there may be risks.

To your second question, I have noticed distortion reduction with separate cathode tubes, but to eliminate a variable I did most of my research on filamentary types. If you choose to experiment, be sure to allow enough time for the emission from the cathode to stabilize after changing the heater voltage. *ax*



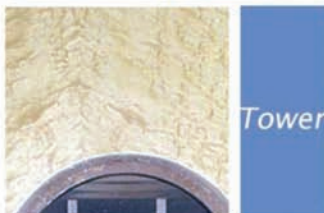
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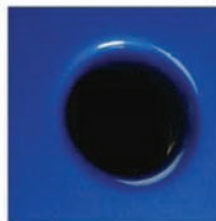
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