MODEST MODIFICATIONS OF THE D-I-T-B

(Kalman Rubinson)

OK. Here is the long-promised and, perhaps, long-awaited description of my modifications of the DITB. This text includes a statement of the underlying logic of my approach, a description of each of the modifications, and a list of suggested parts.

Let me warn you that neither I nor Audio Alchemy will take any responsibility for your interventions in the circuitry. These modifications involve removing and replacing devices soldered to a printed circuit board. To accomplish this, without damage to the board or the components, requires some skill and experience. If you are not comfortable with such techniques, don't mess up your DITB. (Fair warning concluded.)

Before describing the modifications of the DITB, it is useful to examine the premises that underly the modifications. First, the DITB is a remarkable value in terms of sound quality per $. Second, it is a remarkable value in terms of parts quality per $. Consequently, extensive upgrading encompassing changes in major active and passive components would not seem to be cost-effective. Further changes, such as to a different circuit topology, would be even more inappropriate. Third, the compact and tidy design is one of the most self-effacing components I've ever seen. It would be a crime to deface it. My approach was to look at, and listen to, the DITB with the intention of enhancing the existing product in ways which are logical but not taken by the manufacturer because of incremental parts cost creep and/or production complexity. That said, I think that the modifications are simple and inexpensive and that they make a significant improvement in what is already an excellent product.

Examination of the schematic reveals a straight-forward implementation of basically excellent devices and examination of the PCB confirms this. Where are the weaknesses? The initial production of the DITB used an AD712 dual opamp for the filter/driver and this has been replaced in current production by the superior OP-275 device. However, whichever device is in your DITB is limited by the fact that it is run from +/-5V supplies! If you examine the Analog Devices spec sheets for the AD712, you will see that the o/p voltage swing is only specified down to a +/-5V supply and that, at that supply, it is capable of about 3 volts -out and a bit more for +out. That's maximum! Now, the usual full scale o/p of the typical DAC is +/-2V and the AD1860 chip used in the DITB puts out 3V f.s. The o/p from a DITB with the AD712 measures 2.25V f.s. Pretty close to the limits, no? So, what about the OP-275? With that op-amp, the DITB puts out 2.49V. The maximum o/p voltage swing from the OP-275 with a +/-5V supply is still specified at 3V but, at least, it appears to be symmetrical. However, since the OP-275 is intended for audio applications, AD also gives us THD against supply voltage and that is even more illuminating: No measurements are even offered below +/-18V! Power-starved devices are probably the basis for much of the criticism of 'inexpensive' audio electronics. Let's ensure that this doesn't happen here.

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What does this tell us to do? First, one should consider swapping the AD712 for the newer OP-275 if your DITB is one of the older ones, as mine was. If you do this, by the way, also change R1 and R22 from 1.5k to 1k for use with the new op-amp. That change is what

accounts for the slightly higher gain with the OP-275. Use a good 1% metal film resistor. Second, one should raise the supply voltage for the OP-275 so that it can really sing. Further examination of the schematic reveals that the analog supply (+/-VA) supplies the dual op-amp and the two AD1860 DAC chips. If one were to separate the supply for the op-amp, one could give it +/-18-20V but that would entail lifting its supply pins from the PCB and finding a quiet and cosmetic way to get the supply lines into the little DITB enclosure. While that probably would give excellent results, I think it would destroy the esthetics and ergonomics of this little delight.

My suggestion is to modify the internal regulators so that VA is now +/-12V and that it is supplied to the op-amp and to the DAC chips. The AD1860s are fully specified at +/-12VA with the VD at +/-5V. AD offers no indications of any performance enhancement, or of compromise, with such a change in supply voltage other than a positive correlation of increasing supply voltage with device power dissipation. However, increased temperature, which undoubtedly goes with the increased dissipation, is associated with slight(!) decreases in THD, as long it's kept within reasonable limits.

Is this effective? It sure is. The sound with the new VA, and the other changes discussed below, raises the performance a distinctive notch. It's still the DITB (that ain't bad!) but with a new air of firmness and assurance in the sound. This is especially notable in the greater sense of space around instruments and voices and in the added fullness and extension in the bass.

The increased VA and increased device power dissipation means, of course, that the external unregulated +/-12V, 150ma 'wall wart' supply that comes with the stock DITB is inadequate. While it is +/-16V, unloaded, it becomes loaded down to about 12V under the new load indicating that the new 12v regulators are being starved. The new supply should be capable of at least +/-15V @ 200ma and regulated, if possible.

Along with these changes, C71 and C72, which filter the incoming raw DC voltage, need to be upgraded. As supplied, these are 220uF, 16V electrolytics which are adequate for the stock supply which can only load down from 16V. Even so, this is a bit 'close to the edge.' These should be exchanged for 25V electrolytics of as high a capacity as you can fit in the space. I used a pair of 330uF, 25V MUSE caps which fit as if the space were meant for them. Panasonic Z or HF caps should work as well. Just be certain to insert the caps with the same polarity as the ones you remove. Mark the PCB with a pen before you de-solder the old caps.

If you ever have reason to use the DITB removed from its case, you will undoubtedly note, as I did, that the +5VD 3-terminal regulator runs quite hot. This is true despite the fact that AA used a TO-220 device for this one regulator while they used smaller TO-92 devices for the other three regulators. Prudence dictates, at least to me, that one should upgrade all four regulators to TO-220 devices of, at least, 500ma capability. Remember, with our new and bigger external supply, the i/o differential voltage seen by these regulators will probably be greater and result in still greater heat generation. After carefully removing the regulators and cleaning the PCB, install the new regulators with their heatsinks to the front of the chassis (away from the rear panel). Insert them as far as possible because, even then, you will have to tilt them on their leads so that they will clear the case when you reassemble the DITB.

Speaking of heat, what about the increased power dissipation and heat generation from the DAC chips to which I alluded before? Well, the easiest thing turns out to be just fine. I had envisioned ventilating the DITB box (redundant wording, I know) or even adding a cute miniature brushless DC fan. However, that would be esthetically counterproductive and might even levitate the DITB! What I did was to attach a pair of tiny extrusion heat-sinks to the DAC chips with heat-conductive epoxy and that did the trick.

Finally, at the suggestion of Peter Madnick of Audio Alchemy, I exchanged the 0.1uF power supply bypass caps (C24,C27) at the op-amp for 0.47uF polypropylene film caps. Hey, if the engineer says it's a good idea, let's not scrimp here! However, the PP caps are a bit bulky and you might consider stacked film caps as an alternative. BTW, Audio Alchemy isn't stingy with bypass caps; they're all over the board.

Finally, we come to the external supply and here my job gets real easy. You can build one based on any of the designs offered in the literature. My suggestion is to make it a regulated +/-15V supply, since I am a believer in serial regulation for audio, and to make sure it is quiet, or all you and Audio Alchemy have done will go for nought. The Audio Amateur is a great source for power supply ideas and OCSL will supply the parts for many of them. All you need do is make up a connecting cable with a stereo miniplug for the DITB. Tip is +V, ring is -V and base is ground. However, for the truly ingenious (and lazy) among us, there is an easier route. The manufacturer of the DITB, Audio Alchemy, makes several supplies, which they call 'Power Stations,' that are ideal for both the stock and the modified DITB. The PS1 will give you +/-15v @ 250ma and the PS3 will give +/-18V @ 500ma. However, both of these are unregulated though quite hefty. Go for the biggy: +/-18V @ 2.5 amps, fully regulated! Just don't ask me the price.

PARTS LIST

From Digi-Key
1- AN7905 5V, 1A Neg. Voltage Regulator (U24) for -VD
1- AN7805 5V, 1A Pos. Voltage Regulator (U18) for +VD
1- AN7912 12V, 1A Neg. Voltage Regulator (U23) for -VA
1- AN7812 12V, 1A Pos. Voltage Regulator (U17) for +VA
2- 330uF, 25V electrolytic capacitors, MUSE, Panasonic Z or HF (C71,C72) for ps input filter
2- .47uF Panasonic P-series (PP, 50V) or V-series (SF, 63V) (R24,R27) for ps bypass

From Mouser
2- 14-16 pin heatsinks (33HS016) to mount on DAC chips, U14 and U15
(The thermally-conductive adhesive, unfortunately, is supplied by Mouser in an expensive and larger-than-necessary size. You'll have to scout this out yourself. If you have a better source, let us all know.)

From Audio Alchemy
1- Power Station power supply (or build your own!)