DESIGNER'S NOTEBOOK

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A simple solution to power-supply ripple

ONE COMMON PROBLEM THAT PLAGUES everybody who plays around with electronics hardware is power-supply noise. How critical that problem is depends entirely on the sort of circuit you want to power. Some circuits will "laugh off" ripple as high as ten percent of the supply voltage, while others will go "belly up" if any ripple at all is present.

Of course, there are several different kinds of power-supply noise—AC ripple and RF are two. How you go about dealing with the problem depends on the kind of noise you have. With all due respect to Einstein and his *Unified Field* theory, curing RFI is a lot different then dealing with poor regulation.

Probably the most common cause of noise is poor regulation in the supply. The 60-Hz that surrounds us has a nasty habit of finding its way into the output stages of even the most carefully regulated supply. That means when you put that plug into the wall socket, you usually get problems along with power!

Reducing ripple is a matter of careful power-supply design—proper shielding, and a whole host of other things we've all dealt with a million times. And if we had to point a finger at the single most important component in the elimination of ripple, it would have to be the filter capacitor that sits right on the output of the power supply.

More noise problems have been cured by increasing the size of that capacitor than by any other single means that I can think of. Unfortunately, finding huge capacitors is a practical problem and fitting them on the board is often a physical problem. However, there is a better way!

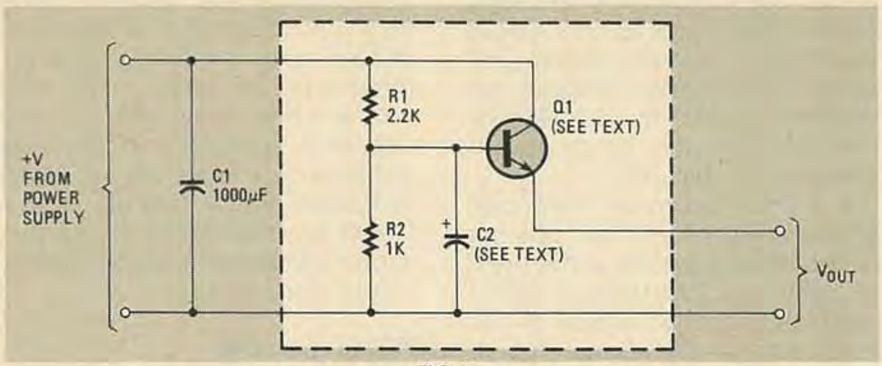

FIG. 1

This month's "brainsaver" can go a long way toward solving the problem of unacceptable amounts of ripple. It's a very simple capacitance multiplier that works along with and helps the filter capacitor you put on the back end of your supply. If you use it intelligently, you'll be amazed at how quiet (ripple free) the DC can be.

The operation of the circuit is virtually foolproof and it will easily stand up to a lot of experimenting. The basic design is flexible enough to operate with a wide range of component values. Figure 1 shows a schematic of the capacitance multiplier. The part values shown are a good starting point, and you should have no trouble getting the circuit to operate successfully.

How it works

The transistor is set up as a high-gain amplifier that effectively amplifies C2, the capacitor connected to its base. Capacitor C1 is the regular filter capacitor you should have in the circuit to start off with. Since the circuit is in parallel with the filter capacitor, the net capacitance will be the sum of C1 and the "phony" capacitance of the multiplier.

The actual effective capacitance you can produce with that circuit depends on the value of C2 and the gain of transistor Q1. If you pick your values carefully for those two components, you can get a simulated capacitance of over 1 farad at the output and that's enough to quiet even the noisiest supply. (Yes, I said 1 farad, the equivalent of 1 million microfarads!)

As with any circuit, there are trade-offs—the thing that data books usually refer to euphemistically as *design considerations*. One glance at the circuit will show you that all the load current has to pass through the collector-emitter junction of the transistor. Therefore, you'd better make sure to pick a transistor for Q1 that can handle the current you're going to draw from the supply.

There's also going to be a voltage

drop for the same reason, so make sure you feed the capacitance multiplier with a voltage that's about a volt or so higher than the value you want at the output. The effective capacitance of the circuit will be roughly the product of C2 and the gain of the transistor.

Since a good rule of thumb is that a transistor's gain decreases as its power handling capacity increases, you'll have to decide for yourself where the break-even point is for your application. If you really have a noise problem, and you want to handle large amounts of current, you might consider using a Darlington. Either the store-bought variety, or a homemade one put together from two transistors and some resistors will do the job. The key here is experimentation.

As with all the circuits that appear here, the schematic (Fig. 1)is only the starting point. What saves the day in one application will undoubtedly blow up in another. I'm sorry I can't give you exact values and part numbers for all the components, but the circuit's parts values are dictated by its use. The best advice I can give you is to breadboard the thing and start off with relatively small values. Use a 500-μF capacitor for C2, a 2N2222 for the transistor and see how the circuit operates.

Since you're dealing with a circuit that can emulate big capacitors, it pays to *exercise more than a bit of caution*! You'll be storing plenty of energy in a small place, and any circuit that can melt the tip of a screwdriver deserves to be treated with respect.

The voltage ratings of the capacitors should match up with the output of your supply—the higher the voltage rating of the capacitors the better. If you decide on the right components, the circuit can go a long way toward reducing hum in audio, and all the other nasties that ripple can produce. Just be careful; remember, you'll be dealing with increased amounts of energy.

A correction

November's "Designer's Notebook" had an error in Fig. 1: Power to IC1 is supplied to pin 1 (not to pin 16 as shown). **R-E**