

FIG. 3—THIS TWIN-T FILTER gives a better notch and is cheaper to build than the circuit in Fig. 2, though you should use precision components for best results.

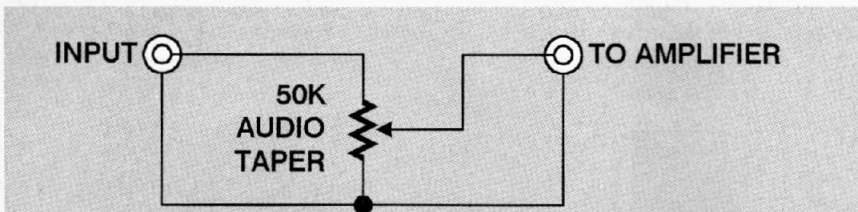


FIG. 4—HERE'S THE RIGHT WAY to hook up a volume control. For two channels, use a dual-gang potentiometer.

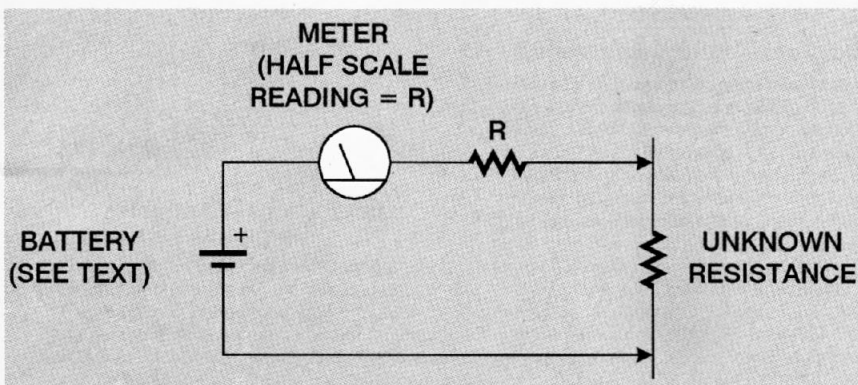


FIG. 5—HERE'S HOW TO BUILD AN OHMMETER. To compensate for battery aging, make R adjustable.

especially good notch, because any coil with an inductance of 5 henrys is going to have enough resistance to impair its performance.

Modern distortion analyzers use the twin-T network shown in Fig. 3. It gives a very sharp notch at a fixed frequency, and the components are cheap—just three resistors and three capacitors. Use 1% precision components and make one of them adjustable, so you can compensate for small errors in the values. For 1 kHz, R can be 1.6K, in which case R/2 is 800 ohms, C is 0.1 μ F, and 2C is 0.2 μ F. Better yet, instead of the 800-ohm resistor, use a 680-ohm resistor and a 200-ohm trimmer. For best performance, put the filter between two op-amp buffers as shown in the diagram.

A disadvantage of the twin-T network is that the frequency isn't variable. If you

need multiple frequencies, build several networks and choose between them with a selector switch. For more about filters, see *The Art of Electronics*, by Paul Horowitz and Winfield Hill, Chapter 5 (more information on that book can be found in the box titled "How to Get Information on Electronics").

Finding Discontinued ICs

Q I have a Heathkit digital multimeter that has served me well. The problem is finding replacement RTL logic chips to replace the original ones. Do you know of any vendor who deals in discontinued RTL ICs? — E. H. S., Clarendon Hills, IL

A Discontinued ICs are the specialty of Rochester Electronics, 10 Malcolm

Hoyt Dr., Newburyport, MA 01950 (Tel: 508-462-9332; email sales@rocelec.com). But it may be easier to find a used multimeter like yours at a hamfest or by advertising on rec.radio.swap, and salvage it for parts.

Add A Volume Control

Q I recently acquired several Dynaco power amplifiers for almost nothing at a yard sale. How do I go about installing a volume control on these things? I've thought about putting a dual-ganged potentiometer in series with the input jacks—is this the proper way to do it? — J. R., Middletown, RI

A Not quite; you'd probably get some hum, and the volume wouldn't go all the way down to zero because even a large series resistance can't block all of the signal. Instead, a volume control should be connected as a voltage divider in front of the amplifier input, as shown in Fig. 4. One channel is shown; you can use a dual-gang potentiometer and wire both channels the same way.

For best control at low volumes, use an audio-taper potentiometer. "Audio taper" means that when the potentiometer is set to half-scale, you'll get considerably less than half of the full signal; that's desirable because most audio systems operate far below maximum volume most of the time, and because the ear perceives loudness logarithmically.

Build An Ohmmeter

Q The surplus dealers are offering beautiful 50-mA meters with ready-made ohms scales (full scale = zero ohms). What battery and resistance do I put with the meter in order to make an ohmmeter? — J. K., Clackamas, OR

A Regardless of the meter characteristics, zero ohms will be full scale and infinity will be the other end of the scale. What you need to know is that the meter reads at half scale. That will tell you what resistance to put in series with it (see Fig. 5). Then you have to find a battery voltage that will make it read correctly. That's easy; you already know that it takes 50 microamperes to deflect it to full scale, so the battery voltage will be $0.0005 \times R$. It will probably turn out to be a standard battery voltage, per-

continued on page 16