Q & A

READERS' QUESTIONS, EDITORS' ANSWERS

Digital Volume Controls Found

In June, a reader asked about a pushbutton-operated digital volume control. Jim Shand (Aptos, CA), Steven Herbold (via e-mail), and Franklin J. Miller (**Electronics Now's** Audio Editor) wrote to point out that Dallas Semiconductor and Xicor make ICs that do this. Xicor calls them EEPOTs or E²POTs (electrically erasable potentiometers).

Figure 1 shows how to use the simplest chip of this type, the Dallas Semiconductor DS1669. The chip contains a string of resistors, a set of analog switches that connect the output to the tap between any two resistors along the string, and digital support circuitry, including a non-volatile memory. You change taps by pressing the up or down buttons (which auto-repeat if held down more than one second), and the chip remembers its setting if powered off and then on again.

The voltages on all three terminals of the resistor string must be between +5V and ground, or close to that range. You can use ground-referenced audio signals if the amplitude is low (less than 0.4-volt peak-to-peak according to our experiments). Better yet, build the volume control into your circuit at a point that is biased above ground, such as the collector of a transistor, and you'll have no problems.

The DS1669 comes in three versions, with resistances of 10k, 50k, and 100k ohms. You can use it with all kinds of signals, not just audio.

How to use a more sophisticated volume-control chip, the Dallas Semiconductor DS1802, is shown in Fig. 2. That IC provides two stereo channels with log-taper potentiometers. As shown in the figure, the circuit uses separate "up" and "down" pushbutton switches to set the volume for the two channels, but if you ground pin 7, S1 and S2 become balance controls, with S3 and S4 controlling volume to both channels in unison. To prevent pops and crackles, the chip waits until the audio waveform crosses zero before changing position. The DS1802 does not retain its setting when powered off; instead, it sets itself to minimum volume every time it is powered up. Also note that Fig. 2 shows normally-open pushbuttons; those are correct, even though Dallas' data sheet shows them as normally closed.

Why use a digital volume control? Maybe because you like pushbuttons or because you need to control the volume using a microprocessor. But the best reason might be that there's no mechanical wiper to get dirty or wear out. Potentiometers are among the least reliable parts in modern electronic equipment, especially if there's sand, dust, or anything corrosive in the environment; these digital pots aren't bothered by sand or chemicals.

Both the DS1669 and the DS1802 have serial interfaces for microprocessors. You can purchase these chips directly from Dallas Semiconductor by calling 800-336-6933 or 972-371-4000; they take credit cards. Data sheets are available from http://www.dalsemi.com or by writing to Dallas Semiconductor, 4100 Spring Valley Road, Suite 302, Dallas, TX 75244. Similar Xicor products are described on the Web at http://www.xicor.com. You can contact Xicor at 3333 Bowers Avenue, #238, Santa Clara, CA 95054.

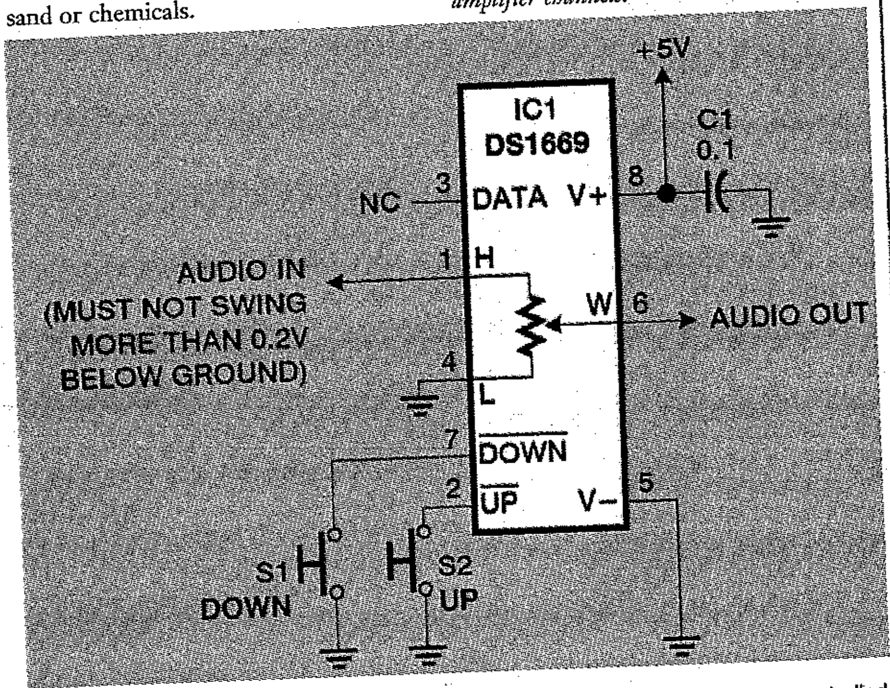

FIG. 1—THE DALLAS SEMICONDUCTOR DS1669 IC acts as a pushbutton-controlled potentiometer. The device comes in 10k, 50k, and 100k versions, and retains its setting when power is removed.

A Dot of A Different Color

Q *I have a rather extensive home theater system that includes nine channels of amplification from three different amplifiers. I'd like to construct a novel VU meter system to display outputs of several of the amplifier channels.*

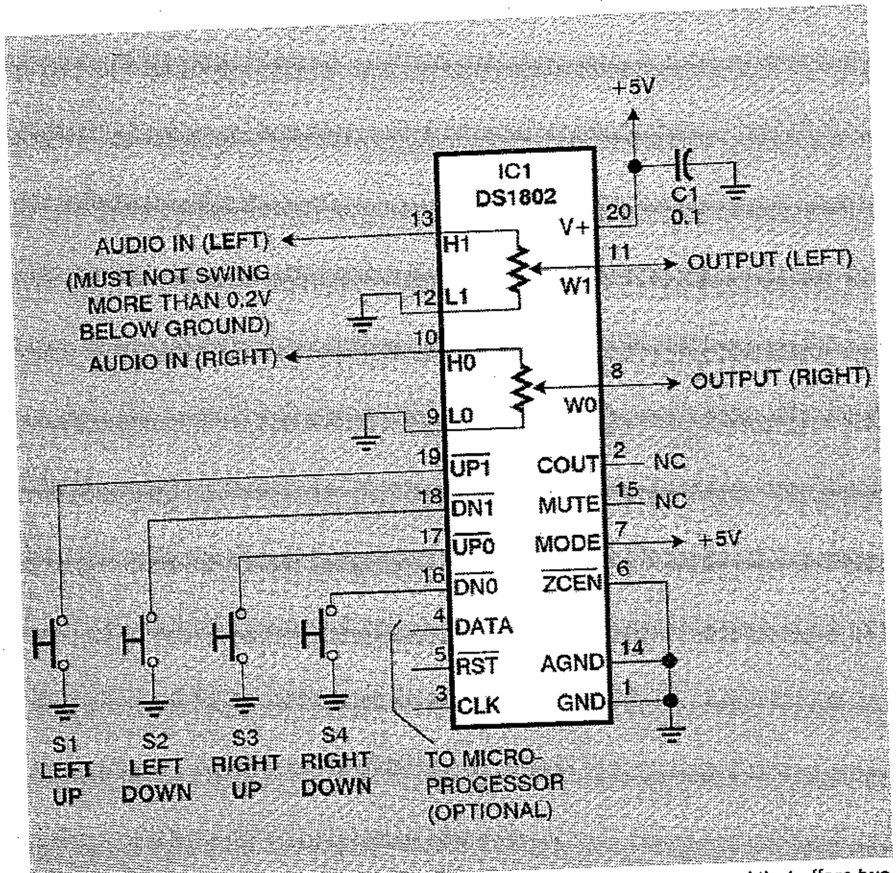

FIG. 2—THE DS1802 IS A HIGHER-PERFORMANCE audio-volume control that offers two channels, log taper, low noise, and zero-crossing detection.

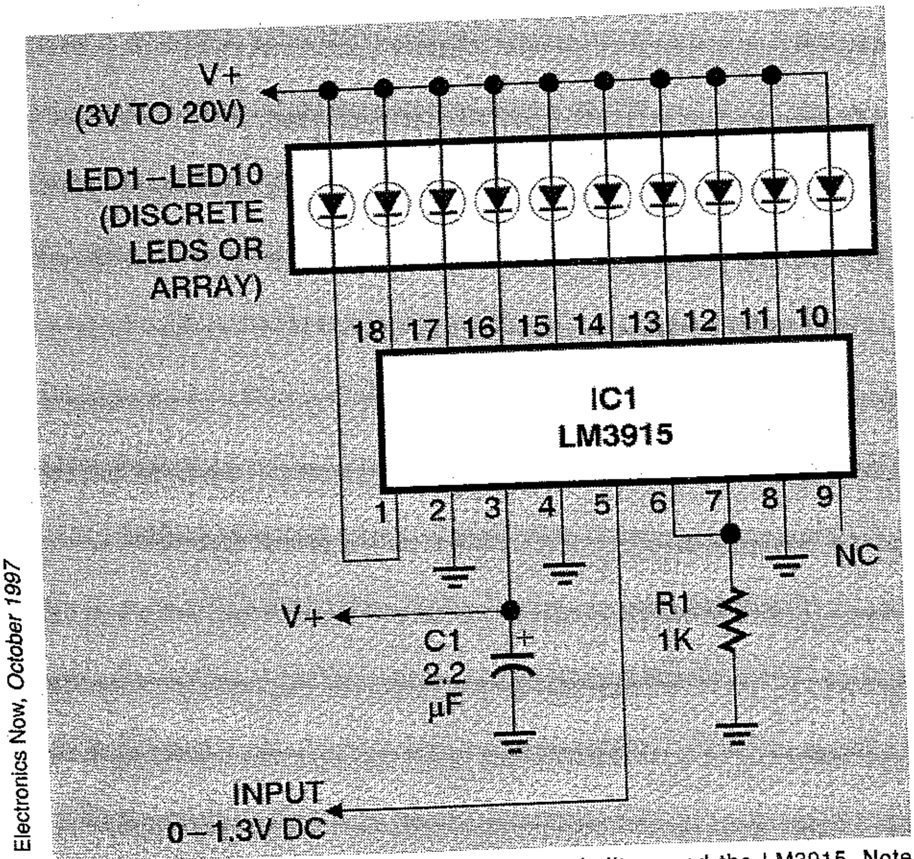

FIG. 3—HERE'S A BASIC MOVING-DOT display built around the LM3915. Note that grounding pin 9 provides a bargraph display.

Can you tell me how to use the National Semiconductor LM3915 integrated circuit in a "moving dot" display using two-color LEDs? My desire is to have a moving red dot on a green background to display amplifier output. — P. D., Portsmouth, NH

A The LM3914, 3915, and 3916 ICs let you use a row of LEDs as a meter, either in moving-dot or in bargraph mode. The LM3914 is linear; the LM3915 is logarithmic (hence good for audio work); and the LM3916 more closely matches the behavior of a VU meter.

Figure 3 shows the basic circuit. National Semiconductor's data sheets, available from http://www.natsemi.com, tell you in detail how to supply the input, which can be taken across a speaker through a resistor network.

Your idea of a moving red dot on a green background is a good one, but because green LEDs look brighter than red ones, you might want to do it the other way around, as a moving green dot on red.

Figures 4 and 5 will help you to implement your idea. As Fig. 4 shows, the LM3915 contains a switching transistor and current limiter for each LED. By putting a 10k resistor in place of the LED, you can obtain a logic-level output, which you can then feed to a pair of CMOS inverters, as shown in Fig. 5. The polarity across the LED reverses depending on the logic level, making it switch from one color to the other. Which color is "high" and which color is "low" depends on which way the two-color LED is inserted, of course. If it alternates rapidly between green and red, it will look yellow. Note that while Fig. 5 specifies a 74HC04 CMOS hex inverter, you could also use a 74HCU04, 74HCT04, or, for a wider range of supply voltages, 4049.

Disk Drives and Flybacks

Q *In April, a reader asked how to use a 16-bit IDE disk drive in an 8-bit PC XT. A suitable adapter, with onboard BIOS, is available as part #10268 from Jameco Electronics, 1355 Shoreway Road, Belmont, CA 94002 (Tel.: 800-831-4242) for about $55.*

Now for my question: Where can I get schematics and parts such as flybacks for older TTL computer monitors? I've tried many places and no one has been able to help. — Steve Fuesting, Effingham, IL

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shown, R1 is 1.2 megohms so that a 100-μF capacitor gives a 120-second delay, accurate to five or ten percent. Aging of C1 will be the main source of inaccuracy; use a tantalum capacitor for best results.

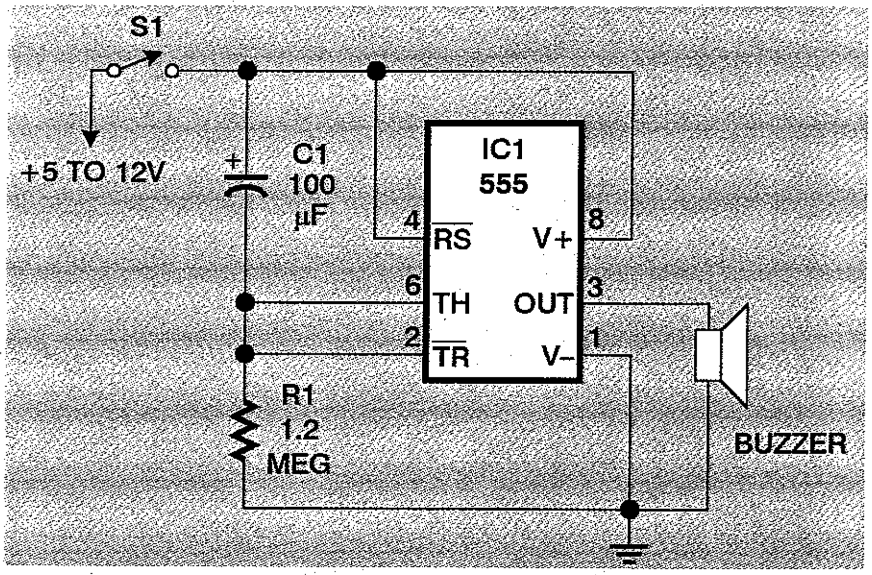

FIG. 3—HERE'S HOW TO CONFIGURE A 555 timer IC to sound a buzzer after a two-minute delay. Different delays can be set by changing the values for R1 and C1.

What's a MOV?

Q *In every surge suppressor there are MOVs (metal oxide varistors). Just what is that device, how does it work, and how are they rated? Could you furnish a typical schematic? — B. B., Ft. White, FL*

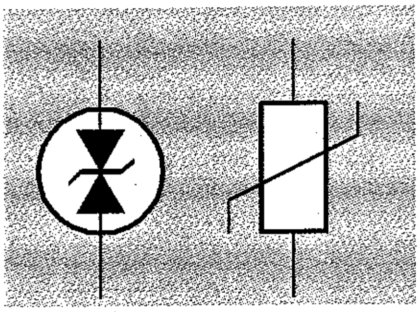

FIG. 1—HERE ARE THE TWO SYMBOLS that are most often used to indicated a voltage-variable resistor (or varistor) in a schematic diagram.

A A varistor, or voltage-variable resistor, is a component that has high resistance at low voltages, but when the voltage exceeds a certain limit, the resistance suddenly becomes much lower. Varistors work rather like Zener diodes, but the internal principles are different, and varistors are not sensitive to polarity; thus they can be used in AC circuits. Fig. 1 shows the schematic symbol.

Metal-oxide varistors are made of substances such as zinc oxide. Their most common function is to absorb spikes or surges of excess voltage across the power line. Figure 2 shows how they're used. Surges usually come from nearby lightning strikes or from electric motors shutting off and suddenly converting their magnetic energy back into electricity. Of course a varistor can't do anything about momentary voltage drops or power failures; for that you need a UPS (uninterruptible power supply).

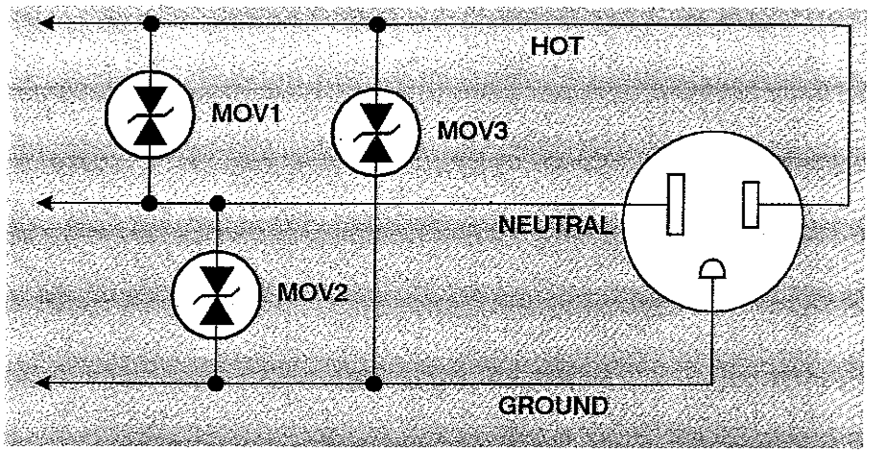

FIG. 2—ALTHOUGH MOV1 DOES MOST OF THE WORK, completely protecting an AC outlet requires the use of 3 MOVs configured as shown.

A varistor is rated for its breakdown voltage (which should be slightly higher than the highest voltage that will ever normally be present) and its energy-absorbing capacity in joules (where one joule is equivalent to one watt for one second, or 1000 watts for 1/1000 second, and so on). After a few years of hard work, a varistor stops absorbing surges and should be replaced.

Recording Sound Digitally

Q *I'm currently working on a sound recorder using integrated circuits. I would like to get a chip that can record up to 30 minutes and use it in a radio to record music. Currently, I can only find 20-second recording chips, but I see phone answering machines that can do 30 minutes of recording. Are there any suppliers of these parts, and could this technology replace CDs? — T. J., Prairie Grove, IL*

A Taking your last question first, we're still a few years away from replacing CDs with memory chips. Half an hour of high-fidelity music requires half a CD, *i.e.*, 300 megabytes of memory. That's the equivalent of thousands of dollars' worth of RAM, and the power requirements are appreciable.

Telephone answering machines record 14 minutes of speech in one megabyte of flash EPROM by compressing the data heavily, taking advantage of known limits on the shape of speech waveforms. In effect, they analyze the speech and then synthesize it back. If you record