HOBBY CORNER

Multiplexed readouts

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IF YOU EVER INTEND TO BECOME INvolved in repairing, modifying, or building a device that has a readout with several digits, you should have a clear understanding of the principals of multiplexed displays. Consider, for instance, a letter we recently received. One of our readers, Gerry Vrbensky (Nova Scotia, Canada) wants to use larger readouts as an external display for his calculator but is having some problems with his modification. Our guess is that it's the multiplexed circuit that is causing the confusion.

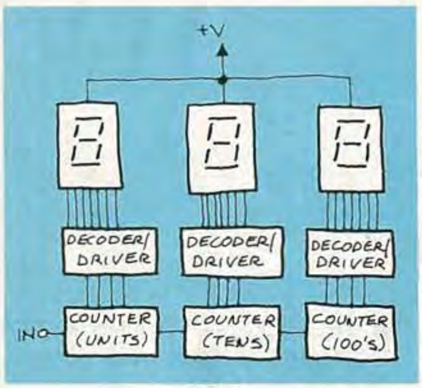

FIG. 1

Figure 1 shows a typical non-multiplexed display. Here, each LED readout has its own decoder/driver. There is no sharing of circuits or components except, of course, the carry-over signal to the next counter IC. That is the type of schematic you will find in most construction articles that involve displays. It is straight-forward and easy to understand.

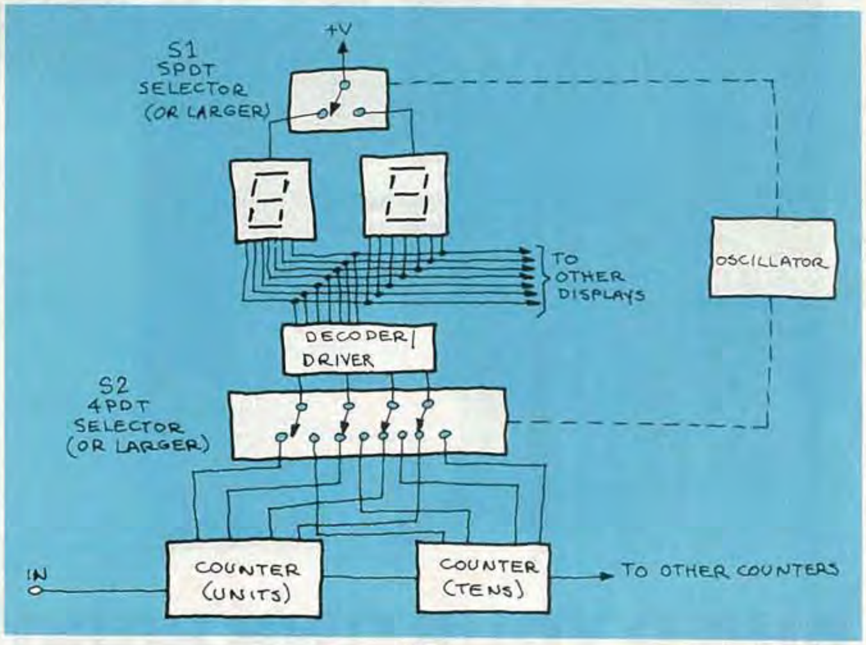

FIG. 2

Figure 2 shows the block diagram of a typical multiplexed display such as the one you might find in a calculator. For clarity, only two readouts are shown. Note that there is only one decoder/driver regardless of the number of readouts used. That's possible because of the multiplexer, shown here as two separate switches and an oscillator.

Let's see how that circuit works. The oscillator serves as both a timing and triggering device. (That is, it synchronizes the switches as well as causing them to open or close.) Switches S1 and S2 simultaneously select one readout and its associated counter. The signal from the selected counter is applied to the decoder/driver, where it is converted and passed on to the appropriate segments of *all* the displays. But only *one* display lights—because only one display is connected to the supply voltage at a time (through S1). Now a second counter and its readout are selected by the switches, the signals are processed in the same manner, and so on. The process continues and all readouts are lighted sequentially. The same sequence is repeated again and again. But you don't see the digits flicker—instead, the readouts appear to be lighted constantly because of the very rapid switching action of the multiplexer circuit.

Thus, you can replace all but one decoder/driver in a non-multiplexed display circuit with one oscillator and two switching arrays. Say, for example, you are building a display that is to have 12 digits in the readout. Using the non-multiplexed method, 12 decoder/drivers would be needed. But if that same circuitry is multiplexed, the number of decoder/drivers can be reduced to four. That's a substantial savings when you're trying to cut costs in order to be competitive and/or make a smaller device.

Also, don't be confused if you find far fewer IC's in your calculator (or clock) than you expect. Very often, the oscillator, selectors, and decoder/driver are built right into one IC package. So, if you understand Fig. 2 and are able to trace out the wiring to the digits, you can easily determine what is going on in the circuit. That information should enable you to attach that larger readout to your calculator, or at least get you on the right track. Good luck, Gerry.

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AN INVITATION

To better meet your needs, "Hobby Corner" has undergone a change in direction. It has been changed to a question-and-answer form. You are invited to send us questions about general electronics and its applications. We'll do what we can to come up with an answer or, at least, suggest where you might find one.

If you need a basic circuit for some purpose, or want to know how or why one works, let us know. We'll print those of greatest interest here in ""Hobby Corner." Please keep in mind that we cannot become a circuit-design service for esoteric applications; circuits must be as general and as simple as possible. Please address your correspondence to:

Hobby Corner
Radio-Electronics
200 Park Ave. South
New York, NY 10003

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Tilt switch

Donald Wendel (TX) is looking for a device to detect a tilt from the vertical. Unfortunately he didn't mention the intended application, so we don't know if a simple switching arrangement will suffice—or if the device is to be used to determine the degree of tilt. So we'll take a look at both.

Let's consider the switching device first since it's the simpler of the two. The easiest approach would be to use a mercury switch such as the "position-determining" type available from Radio Shack. If you can't get those, several standard mercury switches can be arranged so that the contacts close whenever they are moved from the horizontal.

A second possible switching arrangement is one that you can build. It consists of a hanging metal wire (braided for flexibility) with a weight on the free end. The wire hangs through a metal ring, as shown in Fig. 3, and completes a circuit when it touches the ring. The size of the ring and its distance from the supported end of the wire can be adjusted to increase or decrease the sensitivity of the device.

If the device is to show the degree of

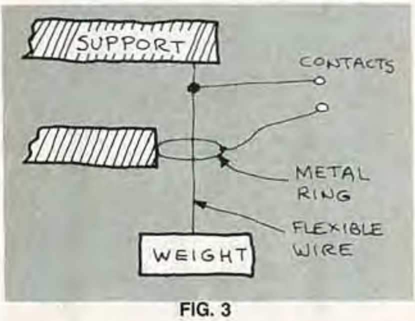

FIG. 3

tilt, that complicates matters considerably. One method that comes to mind uses a joystick (the kind that use potentiometers, not the ones that contain switches). The joystick is supported upside down and a suitable weight is attached to the handle. When the joystick (or the device it's attached to) is tilted in any direction, the resistance of its potentiometer (which you can read on an ohmmeter) will change. That reading will be in direct proportion to the degree of tilt. One supplier of the type of joystick mentioned above is Jameco Electronics (1355 Shoreway Road Belmont, CA 94002). Check the ads in the back of this magazine for other sources.

Perhaps another reader will come up with a better idea. If not, those suggestions should get you going in the right direction.

DC to AC converter

It must have been the summer storms—we have received several inquiries lately about building converters. The letters came from all over, including Puerto Rico and the Philippines.

The gist of those requests is for a converter circuit that will produce 115 volts AC from a square-wave generator. The writers want to power everything from refrigerators to computers. Among the various square-wave generators suggested are the 555 oscillator and the 5369 crystal oscillator.

Sorry fellows, but there's no way those oscillators can output enough wattage to operate those devices. That is, you cannot get both more voltage and current out than you put in. Electronics is no exception to the rule of life that says "You never get something for nothing."

Many people mistakenly believe that some electronic circuits manufacture power. That's probably because they see circuits where you put a couple of volts in and get 5000 volts out. Or, perhaps, a circuit that outputs ten amps when the input is only 500 milliamps. But that doesn't indicate a change in *power*. Power is equal to the product of voltage and current.

So those devices that you might *think* are creating power are not. (Don't take our word for it, though. Take any device and compare the product of the input voltage and current and the product of the output voltage and current. We *guarantee* that at best you'll wind up with equal numbers. You'll actually get *less* power out than you put in. That's because the circuit itself will use up some portion of the input power.)

Low power oscillators (such as those mentioned) cannot handle the kind of power necessary to produce 500 watts at 115 volts (even though that's only 4.4 amps). Remember—what we are dealing with are milliwatt devices.

There are two types of devices that are commercially available and can provide emergency power. One device attaches to the alternator of your car and reportedly produces 110 volts AC for operating radios, drills, and so on. As to whether or not they would be satisfactory for powering TV's or a moderate size refrigerator, we have no idea. And it's likely that the output will be to noisy for a computer. Because we have not had first-hand any experience with those units, we can't recommend them.

The other device that can produce the needed power is 12-volt DC to 110-volt AC converter or inverter. That device can produce an output of a couple hundred watts. But if more power is needed, you can simply use more than one unit. If you decide to go that route, expense will be a major factor. A device of that type—in kit form with an output of 175 watts—is available from the Heath Company (Benton Harbor, MI 49022) for about $55. Several years ago we mounted a Heath unit in my car and used it successfully for a variety of purposes, including a ham transceiver (but not a computer).

Transformer direction

Steve Pearson (WA) attempted to build the high-voltage generator shown in "Hobby Corner" last February. His project was unsuccessful, apparently because of the transformer used. Let's see if we can lend a hand and help clear up some of the confusion.

Any transformer can be used as a step-up or step-down transformer (provided that the primary and secondary have an unequal number of turns of wire in them). If the transformer has a small number of turns at its input (primary) and a large number of turns at its the output (secondary), it is a step-up transformer. On the other hand, if you apply the input to the high-turns side, you have a step-down transformer. (The relationship between the number of turns of wire in a transformer's primary and secondary is referred to as the *turns ratio*.)

For example, take the case of a 110-volt to 12-volt transformer. If you apply 110 volts to one side and get 12 volts out the other, you are stepping-down the voltage. However, you can just as easily reverse the transformer so that the input side is now the output. A transformer can step up or step down the voltage that is applied to it depending on which side is used as the primary.

As far as the high-voltage generator is concerned, what you need is a transformer with very high turns ratio. A filament transformer, such as the one you used, doesn't step-up the voltage enough because it doesn't have a sufficiently high turns-ratio.

In these days of low-impedance transistor circuits, it has become increasingly more difficult to purchase transformers with a high turns-ratio. As pointed out last February, your best bet is an audio-output transformer designed for a tube receiver. Perhaps you can take on from an old radio or even a tube-type TV. If you do find such a transformer, apply the input to the side that was connected to the speaker and you should get a sufficiently high voltage from the other side.

Control-voltage source

Very often the solution to a problem is just a matter of using a circuit in a slightly different way. That's our advice to H.B. Armstrong (OH), who is looking for a way to control a relay with a signal from a tape recorder.

If you-look back at the July "Hobby Corner" you'll see a circuit that used the audio signal from a radio to turn a device on and off. That circuit can be used to turn on a light, activate a relay, or do almost anything when an audio signal is fed to it. Now, if we understood your problem correctly, all you have to do is to connect the same device across the audio output of your recorder. **R-E**