• *The introduction of solid-state portable security alarm systems.* Portable, self-contained, fool-proof, and difficult to defeat, which business travelers, tourists, and campers can use to protect a motel or hotel room or, perhaps, even a tent or camper-trailer.

• *The development of a new type of solid-state sensor or transducer.* A number of new devices are needed in this area, for often the measurement or control system is superior in performance to the device used to interface with the rest of the physical world.

• *The development of a new family of logic devices.* For some time, now, TTL has been "King of the Mountain," even though challenged by I^2L, low-power Schottky, and CMOS. The new family may be an adaptation of an existing technology, such as VMOS, or may represent a completely new concept. It's all a bit misty.

• *Dedicated home computers—not kits—in the $200.00 price range.* Regardless of what the optimists believe, I can't visualize home computers as a mass market item unless the programming problem can be solved. Most people — other than hobbyists — look for products which save time, work and effort. And mental work (i.e., programming) is the toughest of all. Therefore, means must be used to greatly simplify or eliminate this task if computers are to achieve widespread public acceptance. . . And, generally, this means a "dedicated" computer—one designed to perform a specific series of tasks with a minimum of input data.

• *The introduction of dual-technology IC's (not BiFET's, which are now available) but devices combining digital and analog (linear) circuits in a single package, if not on a single chip.* There is an increasing need for devices which can operate in both the linear and digital domains without costly A/D and D/A converters. Where there is a need, someone will find a suitable solution.

Reader's Circuit. Searching for an attention-getting display for their popcorn stand, the members of a local Jaycee club in Michigan looked at several ideas. Someone suggested a movie-style marquee with rotating lights. All agreed it was a terrific idea but, unfortunately, too costly for the budget, inasmuch as these displays required a motor-driven, heavy-duty sequential switch to activate the multiple lamp strings in order. Then one of our readers, Jim Harvey, WB8NBS (15026 Sunbury, Livonia, MI 48154), tackled the problem. Applying his ingenuity and doing a little research with Signetics Application Notes, Jim decided he could do the job electronically using solid-state circuitry and a combination of "junk box" and low-cost surplus components. His circuit, capable of flashing up to three strings of lamps, is illustrated in Fig. 1. Jim writes that his total cost (exclusive of lamps) was a fraction of the $75.00 price asked for a motor-driven sequential switch.

Jim's design has a pair of 556 dual timers, *IC1* and *IC2*, three simple opto-couplers, and three medium power Triacs, which serve to switch the (lamp) loads. Dc power is obtained from a simple supply comprising a 12.6-volt step-down transformer, a bridge rectifier, and a 250-µF, 20-volt electrolytic capacitor. The Triacs are isolated from the control circuit by the opto-couplers. Three of the timer IC sections, *IC1B, IC2A,* and *IC2B*, are wired as one-shots, inter-connected through RC differentiating networks so that they trigger each other sequentially. The remaining timer section, *IC1A*, is connected as a free-running multivibrator with about a 4-second period. It is used in one mode to control the sequential circuits for special lighting effects.

Any of several operational modes can be selected by means of three-position switch *S2*. With this switch in its ALL ON position, the one-shot inputs are all grounded, forcing their outputs high and switching all three LED's on, thus activating the Triacs and furnishing line current to all lamp loads continuously. The ALL ON position is used both for general illumination and when the operator wishes to identify any burnt out lamps. In the ALL ROTATE position, *S2* applies V_{CC} to the one-shot trigger inputs, permitting the circuits to cycle on and off sequentially and creating an optical rotation effect as lamp loads "A," "B," and "C" are switched on and off in order. Finally, with *S2* in its ALTERNATE position, the free-running multivibrator (*IC1A*) serves to switch the one-shot trigger inputs alternately between ground and V_{CC}, causing the lamp loads to "rotate" for a half period (about 2 seconds) and then stop for a half period, repeating the cycle over and over.

With cost a critical factor, Jim used inexpensive, readily available components in his design. As indicated earlier, the IC's are type 556, while the Triacs are 200-V, 6-A types; any commercial units with these ratings should be acceptable. The optocouplers are home-made, with each consisting of a "jumbo" red LED, a small CdS photocell, a piece of heat-shrink tubing for assembly, and a dab or two of black paint. Except for the potentiometers, which may be either Trimpots or small volume controls, all resistors are standard ½-watt types. The electrolytic capacitors, identified by a polarity sign, are 20-volt units, while the other capacitors may be either low-voltage ceramics or small tubular paper or plastic film types. The bridge rectifier used in the dc power supply can be either a standard bridge assembly or four diodes with (at least) a 36-PIV rating and minimum 500-mA current handling capacity. Finally, *power* switch *S1* may be a toggle, slide, or rotary spst unit, while *function* switch *S2* is a single-pole, three-position lever or rotary type.

Since layout and lead dress are not overly critical, the flasher circuit may be assembled on perf board using point-to-point wiring or on a suitable pc board, at the builder's option. Heat sinks should be provided for the Triacs if they are to be loaded to near maximum ratings. All dc polarities must be observed, or course, and the assembled circuit should be double-checked for accidental shorts, opens, and wiring errors *before* power is applied. When connecting the load lamps, which are wired in parallel within each string, make sure that Triac maximum ratings are observed. While the 6-A Triacs can handle almost any standard 120-V incandescent lamp, the greater the number of lamps, the better the overall optical effect, hence low-wattage bulbs (7½-W units or even 120-V Christmas tree strings) are preferred to permit a maximum number of lights within each string without overload. Naturally, the lamps in each load string should be arranged in alternate patterns to achieve the desired effect . . . A-B-C-A-B-C-A-B-C, and so on. Jim offers the following hints to insure optimum performance:

(1) Since the one-shots require an initial trigger to begin cycling, the circuit may not operate if *S2* is in its ALL ROTATE position initially. In this case, switch *S2* to the ALL ON or ALTERNATE position momentarily before switching back to the ALL ROTATE position.

(2) Once the display is operating in the ALL ROTATE mode, "tweak" each one-shot's potentiometer until equal *on* times are achieved for each load string . . . or simply until the effect is pleasing when viewed from a distance.

(3) Finally, switch *S2* to the ALTERNATE mode and adjust *IC1A*'s potentiometer for the most eye-catching display. ◇

Experimenter's Corner

By Forrest M. Mims

READ/WRITE MEMORIES (RAM's), PART 2

IN LAST month's column we discussed the 7489 RAM, a TTL chip that can store up to sixteen 4-bit words. This month we'll complete our experiments with the 7489 and get to know the 74193 4-bit counter.

First, let's cover a few facts about the 7489 we didn't have room for last month. We already know that the 7489 is a RAM, that is, a random access, read/write memory. But did you know you can also think of the 7489 as a string of sixteen 4-bit latches? Each storage element in a 7489 is a latch flip-flop, so it's a perfectly valid way of describing the 7489.

Thinking of the 7489 as a string of 4-bit latches is a good way to better appreciate this important TTL memory chip. How would you like to make your own 7489 from a handful of 4-bit latches? I don't think you would. Besides the latches, you would need a decoder chip and some gates.

RAM Demonstration Circuit. Did you build the RAM demonstrator described in last month's column? If so, you've probably learned a fair amount about working with bipolar (TTL) RAM's. If not, you might want to consider retrieving last month's POPULAR ELECTRONICS and collecting the necessary parts. You can buy 7489's for as little as a couple of dollars or so from suppliers who advertise in this magazine.

Programming. Let's discuss programming procedures for the RAM demonstrator. Programming is semi-automatic since the 7490 address pointer (see Figure 4 in last month's column) will advance to the next address if you apply a single clock pulse. The best way to do this is to slow down the clock to about one pulse per second by adjusting the one-megohm potentiometer and disconnecting the clock input from pin 14 of the 7490. To advance the pointer to the next address, simply touch the clock lead to pin 14 of the 7490 long enough for the clock LED to flash one time.

After you learn to advance the 7490 in single address increments, you're ready to load data into the RAM. Set up the data by grounding the input pins that are to be at logic 0 and leave floating the inputs that are to be at logic 1. You can use switches or jumpers to load data.

Momentarily grounding the 7489's WE input (pin 3) will load the data word into the selected address slot. The word that was previously in the selected address will be lost. After the word is loaded, you're ready to move on to the next address. Remember, you're using a 7490 *decade* counter for an address pointer. That means you can select only the first ten (0000 through 1001) of the RAM's sixteen addresses.

If you want an easy way of knowing

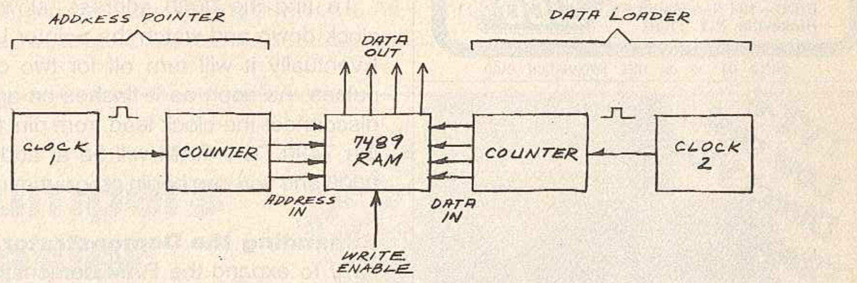

Fig. 2. Block diagram of pseudo-random data loader.

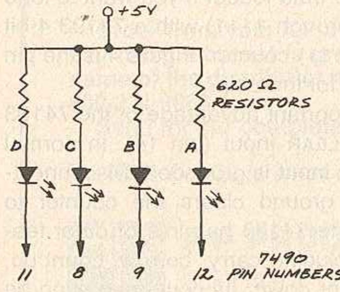

Fig. 1. Circuit indicates address pointer output.

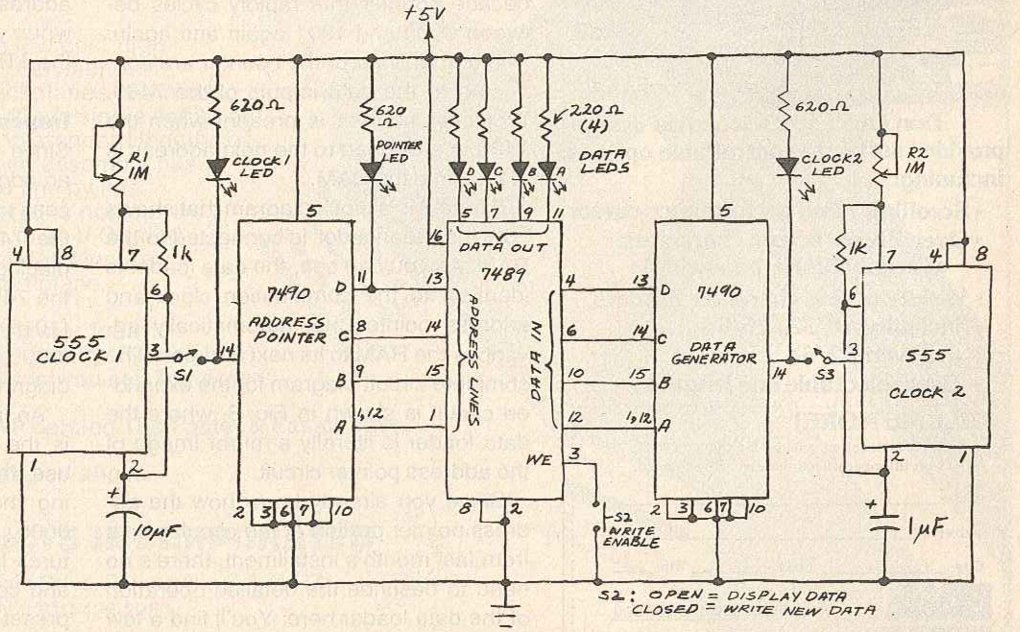

Fig. 3. Automated RAM demonstrator with pseudo-random data generator.

exactly what address the 7490 is pointing to, connect LED's and 620-ohm series resistors between the four 7490 outputs (pins 11, 8, 9, and 12) and plus 5 volts. Be sure to arrange the LED's in the proper sequence (Fig. 1).

You don't really need to know to which address the 7490 is pointing if you let it recycle to address 0000. Then you can simply load ten words, one at a time, using the programming procedure outlined above.

How do you know when the 7490 is pointing to 0000? The pointer LED is on when the D bit in the address is logic 0 and off when it is logic 1, as shown:

Decimal count	Address pointer (7490 output)				Pointer LED
	D	C	B	A	
0	0	0	0	0	On
1	0	0	0	1	On
.	.	.	.	.	.
.	.	.	.	.	.
.	.	.	.	.	.
8	1	0	0	0	Off
9	1	0	0	1	Off

To find the 0000 address, slow the clock down and watch the pointer LED. Eventually it will turn off for two clock pulses. As soon as it flashes on again, disconnect the clock lead from pin 14 of the 7490. The RAM will be at address 0000 and you can begin programming.

Expanding the Demonstrator. It's easy to expand the RAM demonstrator by adding an automatic, pseudo-random data loader. The data loader is merely a decade counter that rapidly cycles between 0000 and 1001 again and again. The output lines of the counter are connected to the data imputs of the 7489. Whatever number is present when the 7489 is advanced to the next address is loaded into the RAM.

Figure 2 is a block diagram that shows how the data loader is connected to the RAM. As you can see, the data loader is identical to the combination clock and address pointer that automatically advances the RAM to its next address. The complete circuit diagram for the expanded circuit is shown in Fig. 3, where the data loader is literally a mirror image of the address pointer circuit.

Since you already know how the address pointer portion of the circuit works from last month's installment, there's no need to describe the detailed operation of the data loader here. You'll find a few operating tips helpful, however.

First, the RAM will accept (write) new data from the data loader when *S2* (WRITE ENABLE) is closed. Otherwise, the RAM will continue to store any existing data. Second, both *S1* and *S3* should be closed when you want to load pseudo-random data, unless you want all the RAM addresses to contain the same number. (In that case, leave *S3* off after the data loader reaches the number you want to store in each address.)

Third, remember to turn *S2* off when you want to read out the contents of the 7489 with the help of the four output LED's. The LED's will be blanked (off) when *S2* is on and data is being loaded. Finally, be sure to experiment with the settings of both *R1* and *R2*. Decreasing the effective resistance of *R2* increases the count rate of the 7490, and this will

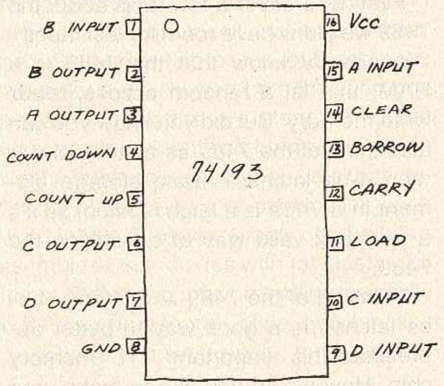

Fig. 4. 74193 pin diagram.

improve the "randomness" of the data loaded into the RAM. Similarly, lowering the resistance of *R1* will speed up the address pointer and let you load new data in a fraction of a second.

Incidentally, be sure to slow down the address pointer with the help of *R1* when you want to read out the data with the LED's.

Improving the Demonstrator. Since we're using a decade counter as an address pointer, we can only gain access to ten of the sixteen storage slots in the 7489. You can remedy this by replacing the 7490 address pointer (and the 7490 data loader if you want to load (1010 through 1111) with a 74193 4-bit (0000-1111) counter. Figure 4 is the pin diagram for this chip.

An important advantage of the 74193 is the CLEAR input (pin 14). In normal use, this input is grounded. Disconnecting the ground clears the counter to 0000. The 74193 has lots of other features including carry, borrow, count up, and count down. Its count can even be preset to any desired value between 0000 and 1111. ◇

Hobby Scene Q&A

By John McVeigh

RECEIVER OVERLOAD

***Q.** A CB'er about a half mile away from my house uses a beam antenna and a power mike. When he transmits, he puts out a very strong signal (about 30 over on my S meter), and his audio is superb—no distortion at all. However, he causes interference to all the other channels. Sometimes, the signals on the other channels drop in strength (the S meter drops several S units) and my receiver gets very quiet. Why does this happen, and is there anything I can do to my radio to help stop the interference?—Andy Gill, Carrollton, KY.*

A. You mention that the CB'er is putting out clean-sounding audio. This seems to imply that he is not overmodulating his transmitter—which often occurs when a power mike is abused. If there was severe overmodulation, "splatter" would appear on many channels. But the situation sounds more like a case of receiver overload. If his signal is very strong, it can cause distortion and/or override the selective circuits in the receiver i-f and cause the automatic gain control to cut back on receiver gain. The net result is a reduction in signal strength on the channel you're tuned to.

There's no practical filter that could be inserted in the transmission line and would be sharp enough to attenuate the undesired signal but not affect the desired one. If your rig has an r-f gain control, you could try backing down on it. An attenuator in the feedline to the receiver might help if you had separates, rather than a transceiver. You might try asking the CB'er to back off on the modulation, or perhaps turn his beam so that you're off its side!

SOUND VIA POWER LINE

***Q.** Instead of running extension speaker wires, I'd like to build a unit that would sense the audio signal over the ac wiring in my house. Another unit would pick up the signal at the wall socket and feed the signal to a speaker. Do you know where I can find suitable schematic diagrams?—David Mast, Holland, MI.*

A. The January 1976 issue of POPULAR ELECTRONICS contains a construction project that does exactly what you're interested in. If you can't find that issue, you can order a back issue for $1.50 (includes postage and handling) from the Ziff-Davis Consumer Service Division, 595 Broadway, New York, NY 10012. Readers outside the U.S. can order back issues for $2.00. Copies are available for magazines from April 1974 through the present issue.