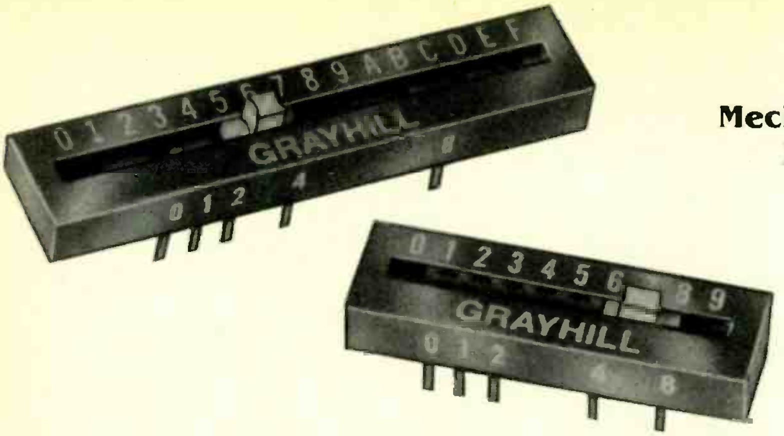


Mechanical slide switches provide 4-bit binary outputs from 0000 to either 1001 or 1111 in a mini-DIP case you can mount on printed-circuit and solderless-circuit boards and test in an active circuit!

By Ed Noll

HEX/BCD Code Switches

A *CODE* SWITCH IS A MECHANICAL DEVICE THAT CAN BE set for a specific 4-bit binary output. Grayhill has two versions of that switch. The first, a BCD type, has ten positions that provide 4-bit binary outputs from 0000 to 1001; the second, a hex type, has 16 positions that provide 4-bit binary outputs from 0000 to 1111. Both devices are slide switches.

The switches are mounted in a mini-dip case convenient for mounting on printed-circuit or solderless-circuit boards. Such binary code DIP switches are convenient for setting up modes of operation in digital circuits, programmable controllers, computer systems and in test equipment used to check out digital systems.

Pinouts and truth tables of the two styles are given in Fig. 1. Four-bit binary logics appear at pins 8, 4, 2, and 1. Switch wiring is such that the output for pin 0 is also active for zero position setting of the switch. Note that the hex switch has 16 positions, and, as shown in its truth table (Fig. 1), sets up the first 16-possible hex combinations. The BCD version has only ten positions, setting up the binary equivalents of decimal 0 through 9. On one side of each type of switch there are a series of pins that are joined internally. Common ground can be established by making connection to any one or more of those pins.

A schematic diagram for a hexadecimal generator and demonstrator is shown in Fig. 2. In the circuit arrangement +6-volts DC is connected to the bus of the hex switch and the 4-bit binary outputs are connected to common ground through individual 10,000-ohm resistors. An LED circuit is connected to the zero-output pin. Whenever the hex switch is positioned at zero setting, a logic 1 appears at that pin and turns on the associated light-emitting diode (LED). The 4-bit binary output is available at outputs D, C, B, and A.

The 4-bit binary signal is also applied to the Motorola 14495 hex-decoder integrated circuit (Fig. 2). The hexadecimal equivalent of the binary switch setting is displayed on the common-cathode, 7-segment LED display (Radio Shack 276-75 or equivalent). When using the 14495 decoder, it is not necessary to use series resistors between the decoder outputs and the segments of the common cathode display. An LED connected to pin 4 turns on whenever hexadecimal A, B, C, D, or F is displayed.

Hook up the switch and decoder system on a solderless breadboard. Check out operation for each switch position. Note that in the transition between any two such switch positions, the logic changes back to 0000. That action is analogous to a rotary non-shorting switch.

Interfacing

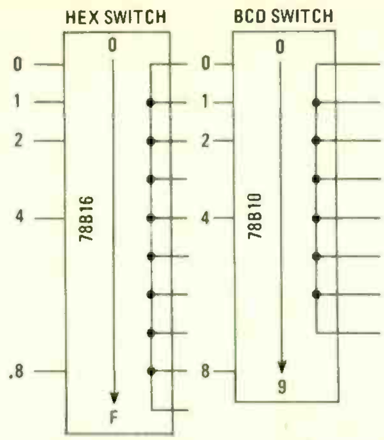
Inverting and non-inverting buffers can be used to interface the 4-bit binary output to digital circuits and/or control systems. The 4049 and 4050 hex buffers are appropriate. When supplied to the non-inverting 4050 integrated circuit (Fig. 3), the output level from the chip is such that additional CMOS circuits or two TTL input circuits can be driven with the 4-bit binary signal. Sensitive relays, as well as opto devices, can be driven from those outputs.

If your application requires complementary outputs, the inverting 4049 hex buffer can be used. That manner of operation might be attractive when the binary logic 1 is to operate relays using a high sink current.

The hex switch itself can be wired to provide a complementary output. The basic circuit is given in Fig. 4. In that application the bus line is connected to common ground, while each of the individual 4-bit binary outputs are connected to the plus voltage through 10,000-ohm resistors. In that case, the output logic at DCBA will be 1111 when the switch is set to hex 0. Complementary logics decline with switch setting reaching a DCBA value of 0000 when the switch is set to hex F.

Adding a Storage Latch

In your application it might be advisable that the 4-bit



POS	HEX CODE 0	1	2	4	8
0	•				
1		•			
2			•		
3		•	•		
4				•	
5		•		•	
6			•	•	
7		•	•	•	
8					•
9		•			•
A			•		•
B		•	•		•
C				•	•
D		•		•	•
E			•	•	•
F		•	•	•	•

POS	BCD CODE 0	1	2	4	8
0	•				
1		•			
2			•		
3		•	•		
4				•	
5		•		•	
6			•	•	
7		•	•	•	
8					•
9		•			•

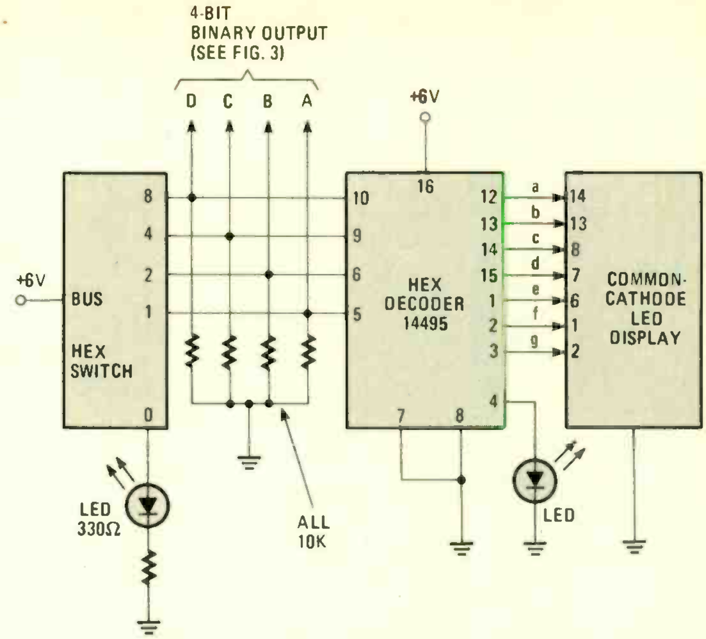
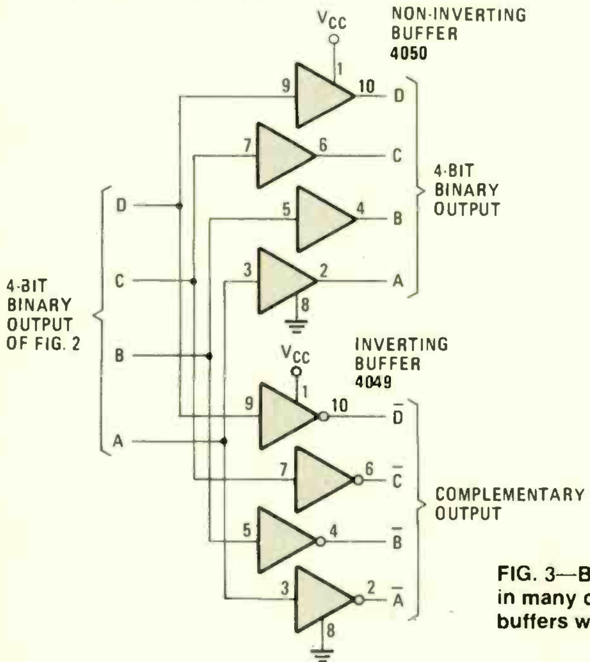


FIG. 2—WITH A LITTLE BIT of simple circuitry, the hex-code switch can control the display of an LED numerical indicator via a hex decoder. The 14495 used requires current-limiting resistors at its outputs.

FIG. 1—TWO CODE SWITCHES are diagrammed here, presenting the pinouts and the truth tables for each. The 0 pinout is high at zero and all other settings are low. You may want to tie an LED indicator to the zero output, should that be the home position of a circuit you are designing.



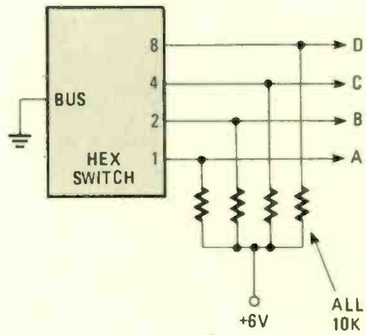


FIG. 4—CONNECTIONS for obtaining a complementary hex output from a binary code DIP switch. Here, the resistors connect the switch's output to a high until the switch grounds the outputs via the bus input.

FIG. 3—BUFFERS provide the circuit isolation required in many circuits. Shown here are the 4050 and 4049 Hex buffers with the latter providing inverting buffering.

binary output be placed on hold for a specific application. Two advantages are offered by that arrangement. First, the 4-bit binary output logic will not change as the switch is moved to another position. Second, the switch can be pre-set to the next position to be used and held there. Operations will continue as per the previous setting, and at an appropriate time a fast changeover can be made simply by depressing a pushbutton switch.

That mode of operation can be established using a 4175 storage register chip as shown in Fig. 5. The 4-bit output of the circuit of Fig. 2 is supplied to appropriate DCBA pins of the 4175. A pushbutton switch is connected to storage pin 9 of the 4175. New DCBA outputs are applied to your 14495 decoder. In addition complementary outputs as may be re-

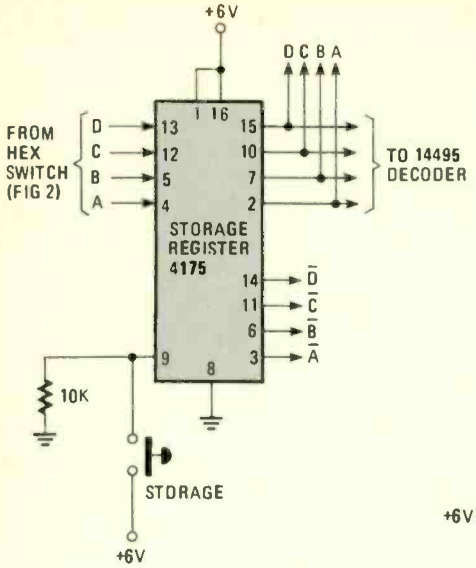


FIG. 5—**STORING THE OUTPUT** from the hex switch is a useful idea. Actually, a similar circuit is used in displaying telemetered data presentations. For example, your weight on an electronic scale is constantly changing, due to your shifting weight, breathing, etc. So, a pulse generator closes the storage switch circuit every two seconds (typical) and the data is displayed without the rapid flashing that makes the last digit so hard to read.

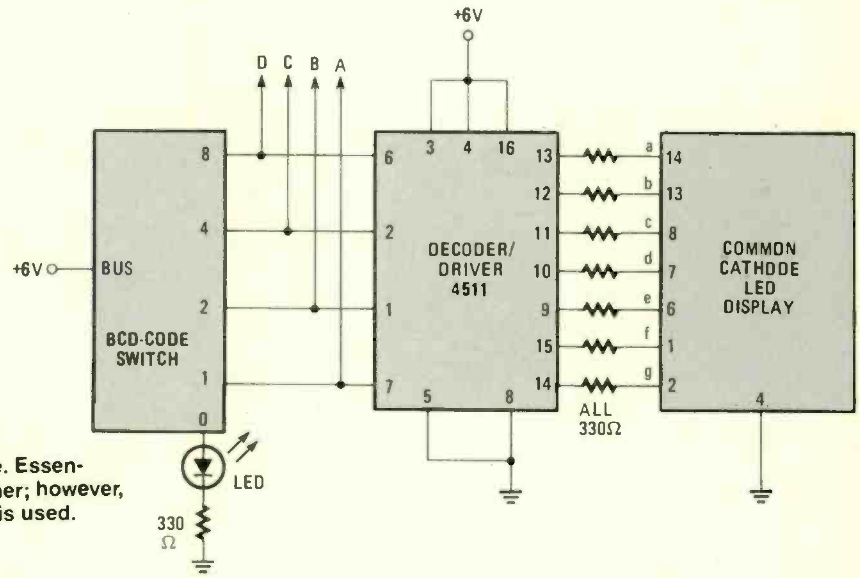


Fig. 6—**A VARIATION** of Fig. 2 is shown here. Essentially, the circuit performs in the same manner; however, an inexpensive decoder/driver, CMOS 4511, is used.

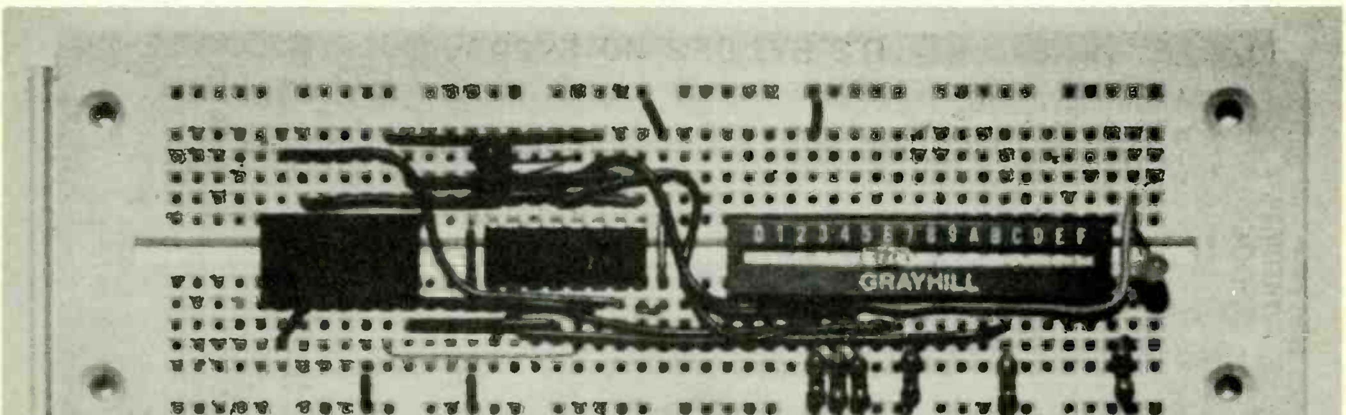
quired are made available at pins 14, 11, 6, and 3.

Add the storage latch to your basic circuit. Set the code switch to hex 8. Momentarily depress the store pushbutton. The 4-bit binary equivalent of hex 8 will appear at the DCBA outputs of the 4175. Now move the hex decode switch to different positions above and below hex 8. Observe that the output is latched on hex 8. Set the switch to hex C. Now depress the store pushbutton, noting that the output switches over to the 4-bit binary equivalent of hex C and holds.

The previous procedures demonstrate two advantages of using a storage latch circuit in generating a 4-bit binary signal for test use or other applications.

The circuit of Fig. 6 shows how the BCD code switch can be used to generate the BCD 4-bit binary signal. The switch circuit is identical to that of Fig. 2. However, the less expensive 4511 BCD decoder/driver is used. Any 4-bit binary number above decade 9—namely, 1010 to 1111—will not be displayed. In using the 4511, current-limiting resistors must be connected in the path between each decoder output and its 7-segment input. Wire the circuit and check out operation.

You may find the mechanical code switch useful in a variety of practical and educational applications. A most favorable attribute is the ability to mount it on printed-circuit and solderless-circuit boards. ■



THE SOLDERLESS-CIRCUIT BOARD has been wired to duplicate the schamatic drawing illustrated in Fig. 2. The Grayhill switch is a HEX-code type set to HEX 6. The HEX decoder chip (center) drives the common-cathode LED display at the left.