THINK TANK

By Byron G. Wels, K2AVB

Changing Of The Guard

Over the years, it has given me great pleasure to write this column and share with you the experiences that I've had...to review your circuits, and share your experiences. But alas, as with all things, the old must give way to the new. To paraphrase a biblical passage, "the young are called because they are strong, and the old because they know the way." And so it is with great sadness that I must inform you that I will no longer write this column—my other duties around here have become such that they take up all of my time. So, with this column I pass the helm to my successor. I hope that you'll be as faithful to him as you have been to me.

With the farewells out of the way, let's see what the mailbag has to offer this month.

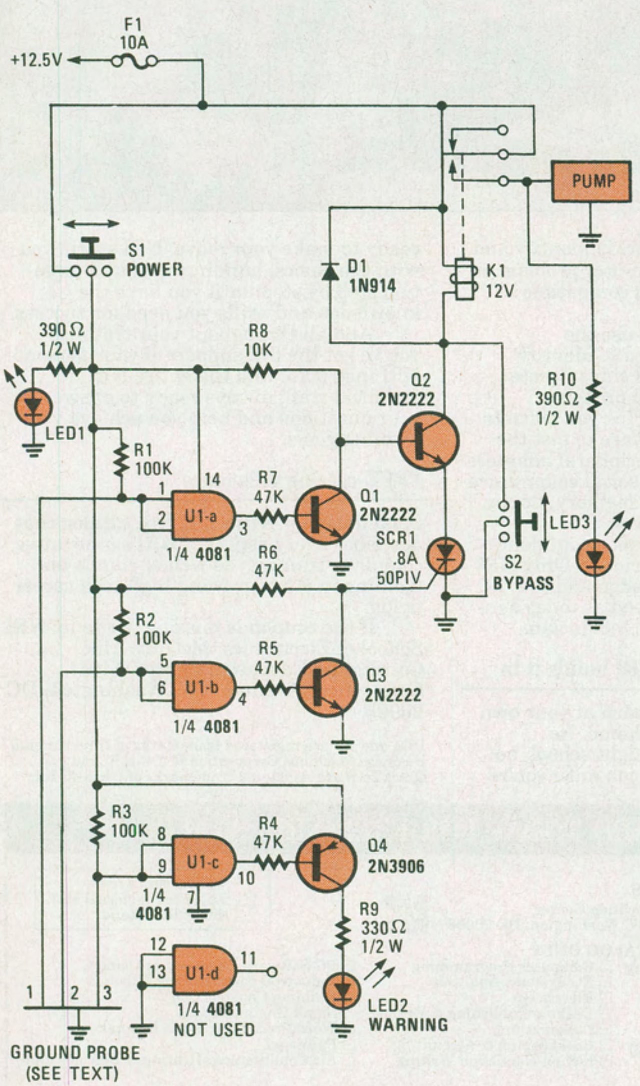

Fig. 1. The water-level control is built around a 4081 quad 2-input AND gate (only three gates of which are used), and a few other readily available components (four transistors, an SCR, a relay, etc.).

WATER-LEVEL CONTROL

I needed a circuit that would power up a water pump when the water reached a predetermined level, and then turn itself off when the water had receded to another predetermined point. So I set about to design just such a circuit. I came up with the circuit in Fig. 1. The circuit is built around a 4081 quad 2-input AND gate (only three gates of which are used), and a few other readily available components (four transistors, an SCR, a relay, etc.).

Gates U1-a through U1-c each have their two inputs tied together, and serve as probes. The probes are then placed at various levels to trigger a particular function at a predetermined time. The ground side of the circuit is placed below the minimum water level. The inputs to each gate are tied high through a 100k resistor connected to the +12.5-volt bus.

As the water level slowly rises to probe 1, the input to U1-a is pulled low by the conduction of current through the water to the ground probe. That turns Q1 off and Q2 on. With Q2 turned on, the circuit is placed in the standby mode, ready to activate the pump when conditions are right.

Probe 2 is placed at the maximum water level. If the water level reaches probe 2, the input of U1-b is brought low, turning Q3 on, which, in turn, causes current to be applied to the gate of SCR1, turning it on. The circuit through K1, Q2, and SCR1 is now complete to ground, and the water pump is now turned on causing the water level to recede. When the water level falls below probe 2, U1-b goes back to logic high. However, due to the latching nature of SCR1, the pump continues to run until the water level falls below probe 1; at that point, the ground circuit opens and de-energizes K1, turning the pump off. The pump will not turn on again until the water level again rises above probe 2.

Probe 3 was added as a warning. Should the water level reach probe 3, LED2 indicates that the pump is not working for some reason. Switch S2 was added as a manual override, while S1 powers the sensing circuit. LED3 is used to indicate that power has been applied to the pump. LED1 is used to indicate that power has been applied to the sensor.

I made the probes out of chrome-plated sewing needles to help resist corrosion. The probes are placed near the pump, while the circuitry is housed in a small remotely located enclosure.

That particular arrangement is used to control a boat's bilge pump, which draws about 7 amps under full load. However, the component values can be changed to accommodate whatever task you have for the circuit.

—Jerry Mercks, Huntsville, AL

Good Jerry, and thank you. I'm sure this circuit could easily be adapted to any sump pump and with a little imagination, to lots of other applications.

PILOT LIGHT

Many electronic circuits need an indication that they're under power; for most AC circuits, a neon lamp is the device of choice (it will operate on anything above 70 volts or so). In this era of semiconductors, it's hard to find the necessary operating voltage for a neon lamp. However, a bidirectional tri-color LED can be used if a capacitor is connected in series with the LED to limit the current through the LED. Refer to see Fig. 2.

The reactance of a capacitor depends on the

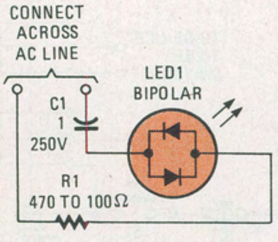

Fig. 2. This simple power-indicator configuration, built around an LED and a capacitor, can take the place of neon pilot lamps in AC circuits.

frequency of the line and the unit's capacitance. We can put a 1-µF, 250-WVDC capacitor, which has a reactance of 2,650 ohms at 60 Hz, in series with an LED to limit the current through the unit to 43 mA. The impedance of the LED is low compared with the reactance of the capacitor, so nearly all the impedance will be due to the capacitor with the added advantage of no energy loss caused by the capacitor.

The power of the LED is 1.175V × 0.43A = 75mW compared to an NE-2 at 58 mW or an NE-2H at 250 mW, which is not so bad! For 230 volts, we can use a 0.47-µF, 400-WVDC capacitor to do the job.

Just remember that you're dealing with a high-voltage circuit and observe the necessary precautions for safety's sake. Since some capacitors can be shorted by line transients, add a 47- to 100-ohm ¼-watt resistor in series as a fuse, just to be on the safe side.

—Juan J. Martinez, Mexico, DF

Thanks, Juan. A handy circuit indeed. We like getting mail from you, as my boss collects stamps. Those Mexican stamps are mighty colorful, too.

SELF-TEST INTERFACE

By, I wanted an interface circuit that would allow me to connect my Franklin 1200 computer to my Ford Bronco II's EEC-IV Self-Test readout. I'm sure that by applying the principles outlined here, other applications will become self evident. See Fig. 3.

The self-test codes are sent via a series of ½-second pulses (+12 volts to 0 volts) to indicate digits with 2 and 4 second delays separating digits and codes. Of course, the Ford service manual is required for any use of this information. Not knowing what's in the Ford "black box" I elected to use a transistor to drive a reed relay, thereby limiting the current draw to 1 mA or less.

The relay contacts simulate pushing a button on the game paddle and a program I wrote deciphers the pulses and prints out the code with a brief description. The LED and S1 activate the self test and indicate the circuit is armed and ready to go when the

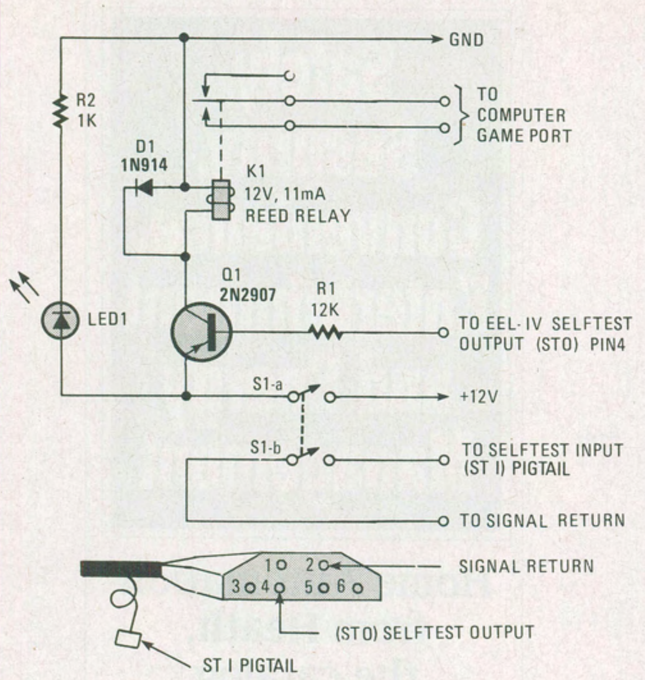

Fig. 3. This circuit when placed between the vehicle's EEC-IV Self-Test read-out and a Franklin 1200 computer acts as an interface.

Bronco key is turned on. Diode D1 protects Q1 from any inductive kick caused by the relay.

I prepared a wiring harness—consisting of ¼-inch male push connectors and alligator clips for battery connections—to mate with the connector on the Bronco.

Rather than open the computer each time to use the DIP plug as with the game paddle, I cut the paddle cable and inserted 8-pin DIN jack and plugs.

—*Bob Lovdahl, Anchorage, AK*

Good shot, Bob! And readers, if you have a use for an interface such as this, check the service manual for your own car and see if you can adapt Bob's circuit.

MORE MAGIC

I saw the magic light box in your November, 1990 column, and it brought back a rush of memories. I made a few of those things for my own use.

Starting with all switches off or open (see Fig. 4), explain that only one switch will light the light. Show (by pressing the switch) that the left-most switch won't do it, nor will the right-most switch turn on the light. It's always the center button. Press it and the light will turn on.

You can now press the center button several times, showing that it turns the light on and off. The left and right buttons do nothing. Press them to turn the light off, and hand the box to a friend. He'll press the center button, to no avail. Tell them they now have a 50/50 chance with one of the other buttons. They'll press one, again, no help! Take the box back and show that it's the *other* button that lights the light. You press it, and Bingo!

Okay, now that I let the bunny out of the bag, I'm lying low to escape all the people who couldn't light the light!

—*Christopher Dunn, Chicago, IL*

Chris, score one for our side! I'm sure our readers are going to have lots of fun with this one.

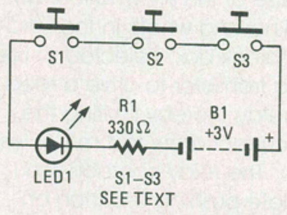

Fig. 4. The magic light circuit is nothing more than three push-to-make, push-to-break switches, an LED, and two AA batteries connected in series. All three switches must be on in order to light the LED.

RELAY ACTUATOR

I've seen relay actuators using a single, normally-open pushbutton switch and a 4069 hex inverter, but here's an even simpler circuit (see Fig. 5).

Switch S1 is a normally-open pushbutton switch (ON), while S2 is a normally-closed pushbutton switch (OFF or reset). Pressing S1 completes the circuit to activate and latch the relay. The only way to de-actuate the relay is to press switch S2.

Because the normally-open contacts of the relay are being used, the relay should be a double-pole, double-throw type.

—*Ian Skinner, Victoria, B.C., Canada.*

Sometimes, Ian, we electronics types do things the hard way. I like your circuit for its simplicity and obvious low cost. ■

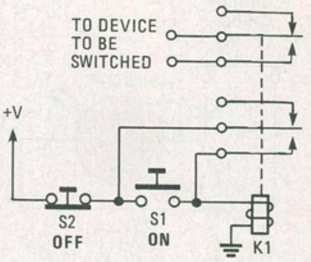

Fig. 5. Using two switches (one a normally-open pushbutton and the other a normally-closed pushbutton), this simple circuit can be used to replace others that use more complicated and expensive hardware.