C-MOS touch-switch array controls analog signals

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A few inexpensive complementary-MOS ICs can be used to create a bounceless buttonless touch-switch array. The resulting switching circuit takes advantage of the extremely high input impedance of C-MOS devices to detect the ambient signals (electrostatic charge and power-line hum) present on a person's finger. The circuit's outputs are solid-state switches that are capable of controlling audio or analog signals with negligible distortion and that, in many cases, are compatible with existing circuitry. Light-emitting diodes provide a visual display of the current state of these switches.

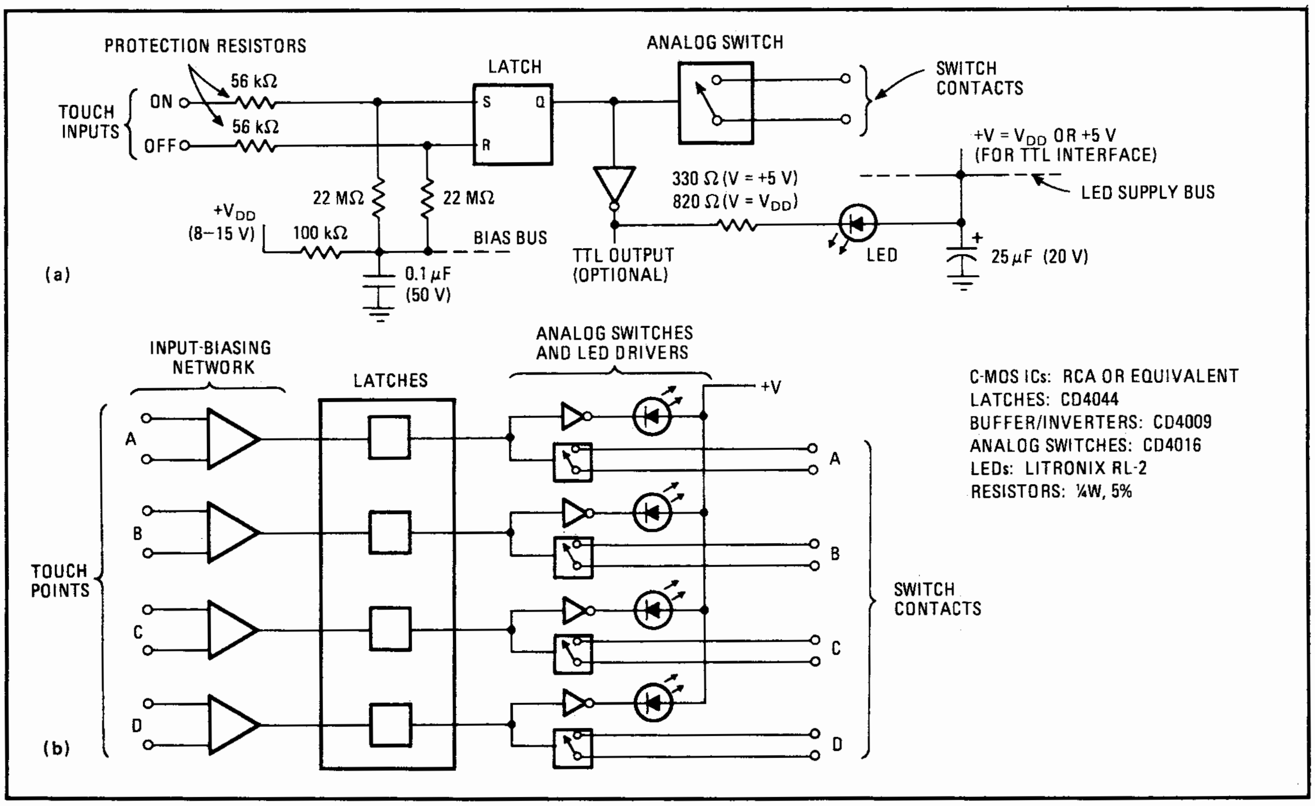
The heart of each touch-switch (a) is a set-reset flip-flop (one-quarter of a quad latch) whose inputs are biased to the V_{DD} supply through 22-megohm resistors. Under normal (resting) conditions, this renders the inputs inactive, and the flip-flop retains its last state. When a finger or large conductive object touches either the on or off input, a noise voltage appears across the bias resistor at that input and is amplified through the regenerative action of the flip-flop. This sets the flip-flop to the desired output state, where it remains until reset by touching the other input.

The flip-flop's output simultaneously controls an analog switch and a buffer/inverter that drives a panel-mounted LED. The output from the buffer can also be used to activate a TTL input, provided that the internal pull-up supply (V_{CC}) is made equal to the TTL power-supply voltage. The 100-kilohm resistor and the 0.1-microfarad capacitor serve to decouple the V_{DD} bias supply so that there is no interaction between the input and display portions of the circuit.

The block diagram (b) shows how a quadruple touch-switch array looks. The touch-sensors should be small metal plates—squares or disks having a side or diameter of 1 to 2 centimeters are best. A substantial increase in plate area results in a proportionate increase in the quiescent hum pickup, and can reduce circuit reliability unless the sensor is mounted very carefully. At the expense of added construction complexity, the LEDs or their mountings can be given a conductive coating, permitting them to serve as the solid-state equivalent of illuminated push-button switches.

Type-CD4016 analog switches work well for noncritical applications, for example, if the circuit is to be used as a source selector for an audio-mixing console. In more critical systems, however, it may be desirable to substitute lower-impedance devices, such as type-CD4066 units. Of course, each flip-flop output can drive many analog switches, and a complex switching arrangement can be created that might be difficult or uneconomical to implement with mechanical devices. Normally closed switching is possible by driving the analog switches with the buffer/inverter outputs, but the cir-

Touch-actuated switching. A simple touch-switch (a) can be built with complementary-MOS ICs. The high input impedance of the C-MOS latch permits the ambient signals of a fingertip to be sensed. The latch's output then controls a C-MOS analog switch, which implements the desired switching function. The LED indicates whether this analog switch is on or off. A quadruple touch-switch array is shown in (b).



cuit's TTL interface must be sacrificed.

In remote locations, where power lines or other major electromagnetic-field sources are not available, it is advisable to install a second contact (at ground potential) on each sensor, so that a slight conduction between the two contacts will assure triggering. Also, to eliminate any chance of damage to the flip-flop inputs from an external power source, the inputs should be protected against excessive current flow with 56-kilohm resistors, as shown. □