NEW IDEAS

Add-on scope multiplexer

HAVING A DUAL-TRACE SCOPE IS A LUXury that many of us, unfortunately, must do without. However, with the simple circuit we'll describe, you can add dual-trace capability to your single-trace scope at a cost of less than $5. Unfortunately, the device has one major "drawback," it only monitors logic levels (TTL and CMOS); but at that price, who cares!

How it works

Figure 1 shows the multiplexing circuit that lets you view two traces simultaneously. The operation of the unit revolves around three IC's: a 4093 quad NAND Schmitt-trigger, 4066 quad analog-switch, and a 7555 timer (that is used to gate IC2-b and IC2-c on or off.)

The device can be powered from a supply ranging of from 4.5 to 15 volts, and draws less than 2 mA. With a supply of 5 volts, the unit may be used to monitor TTL or CMOS logic-levels. At higher supply voltages (15 volts), it may be used to check only CMOS logic signals.

To make the operation of the unit a little easier to understand, we'll first look at the two input circuits separately and then see how the switching action of the circuit is handled.

When a high is fed to PROBE 1 IN, it is inverted by IC1-a and once again by IC1-b, so that the input to IC2-a is high. That high causes the "switch contacts" in IC2-a to close. With the "contacts" closed, a high-level output is presented to the input of IC2-b.

Meanwhile, let's suppose that a high is fed to PROBE 2 IN. That signal is then inverted by IC1-d and routed to IC2-d, causing its "contacts" to open and the unit to output a logic-level high. The output of IC2-d is then fed to IC2-c.

Unless a gating pulse is presented to both IC2-c and IC2-d,

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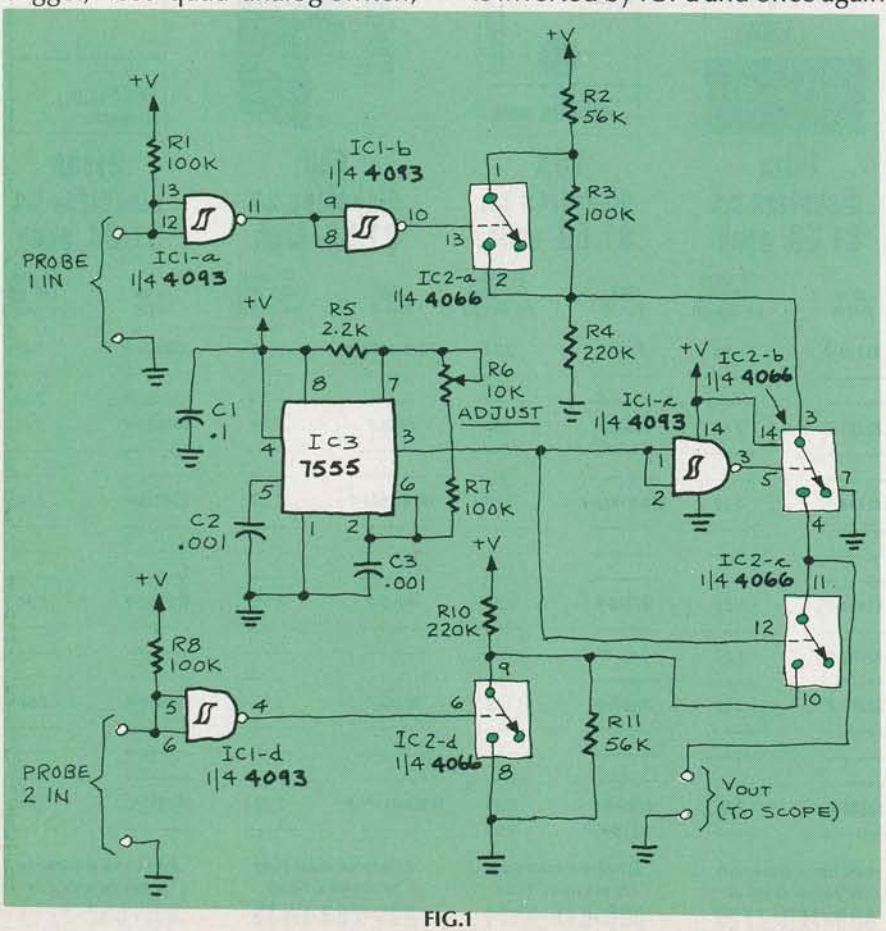

FIG.1

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power-supply rejection ratio (PSRR) is 30 dB.

Figure 4 shows how the ULN-3784B is used as an amplifier with bass and treble controls.

Additional information on both devices is available on request from **Sprague Electric Company**, Semiconductor Division, 115 Northeast Cutoff, Worcester, MA 01606. Refer to Engineering Bulletin 21717.12 for the ULN-3784B and to Engineering Bulletin 21717.23 for the ULN-3705M low-voltage amplifier. **R-E**

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their "contacts" will remain open and no signal will appear at the output. We use the output from pin 3 of IC3 (a 7555 timer) to gate IC2-b and IC2-c. Note that the signal from IC3 is inverted before it is fed to IC2-b but not before it is sent to IC2-c. Thus, the pulsing output from IC3 will alternately switch the display between probes

Two voltage-divider networks determine the position that the trace is to be shown on the screen. Because we want to display both signals at the same time, the high and low levels for one probe must be different from the high and low levels for the other probe. For INPUT 1, the divider is made up of resistors R2, R3, and R4, and for the other, R10 and R11.

The addition of R3 in the first voltage-divider circuit increases the voltage level of both the high-level and low-level inputs from probe 1. Thus, the probe-1 signals will be displayed at the top of the signals from probe 2. The probe-1 trace is displayed between the 3- and 4-volt mark, while the probe-2 trace is shown between zero and one-volt. That can be shown by the following formulas, which assume a high level of +5-volts.

Probe 1:

$$\text{High} \cong \frac{R4}{R2+R4}(V) = \frac{220K}{56K+220K}(5V) \cong 4V$$

$$\text{Low} \cong \frac{R4}{R2+R3+R4}(V) = \frac{220K}{56K+100K+220K}(5V) \cong 3V$$

Probe 2:

$$\text{High} \cong \frac{R11}{R10+R11}(V) = \frac{56K}{220K+56K}(5V) \cong 1V$$

$$\text{Low} \cong 0V$$

With the scope set to trigger on one input, signals up to 50 kHz can be monitored. That makes the circuit ideal for low to medium speed logic-level inputs. Certain frequencies can cause garbage (harmonics of the sampling frequency) to be displayed; however, adjusting potentiometer R6 will correct that.—*Jeff Verive*