BY BONNIE BAKER

Reach out and touch

As the old AT&T slogan used to say, all you have to do is pick up a phone to "reach out and touch someone." Even for engineers, something as simple as this type of analog conversation can immediately clarify the most confusing details. There are times, however, when a phone conversation isn't enough. In these cases, maybe a picture is worth *more* than 1000 words. Enter the user-friendly touchscreen.

Imagine drawing a picture of your latest circuit creation on the screen, in real time and by hand in the analog domain. Then, immediately electronically send the picture to other interested parties. Although the touchscreen interface may be digital, the human interface is purely analog. With a touchscreen, you are converting the analog human touch into digital code.

Consumer-product designers can choose their touch panel from various technologies. Most available panel technologies use resistive, capacitive, SAW (surface-acoustic-wave), or IR (infrared) techniques. The most popular touchscreen on the market is resistive, because it is inherently stable and affordable.

There are four-, five-, seven-, or eight-wire resistive touchscreens. The most common resistive touchscreen has four wires. The layers of a four-wire resistive-touchscreen panel are a rectangular, flexible top layer; a transparent conductive-coated layer of ITO (indium-tin-oxide) material; air-gap and isolation spacers; another transparent ITO layer; and a stable layer (**Figure 1a**). The panel's flexible top layer (not shown) will flex enough, allowing a depression so that the two conductive layers can touch. Unless you apply pressure, the nearly invisible layer of spacers keeps the two ITO conductive layers apart.

When you touch the flexible top layer with a stylus or a finger, the pressure causes the two ITO layers to connect. While you are touching the panel, you apply power to one of the two ITO layers through the silver-ink conductive bars at opposing ends of that layer. When you power one ITO layer, such as the yellow layer in **Figure 1a**, you use the other ITO layer (green in the **figure**) to probe the location of the stylus by using a high-impedance successive-approximation-register ADC. The ADC converts the voltage that the stylus touch creates from the unpowered layer to a digital value.

For example, if you power the X layer from X+ to X− (yellow) with 2.5V and touch a stylus approximately one-third of the way between the two X-axis conductive bars, the voltage on the Y+ and Y− terminals (green) equals 0.833V. This voltage is proportional to the applied voltage across X+ and X−—a result of the resistive voltage divider of the panel (**Figure 1b**). You sense the Y position when you apply power to opposing conductive bars on the Y layer. You then use the X+ or X− terminals to sense the Y position of the stylus with the ADC.

In this manner, the simple resistive touch panel allows you to reach out and touch across the room or around the world. EDN

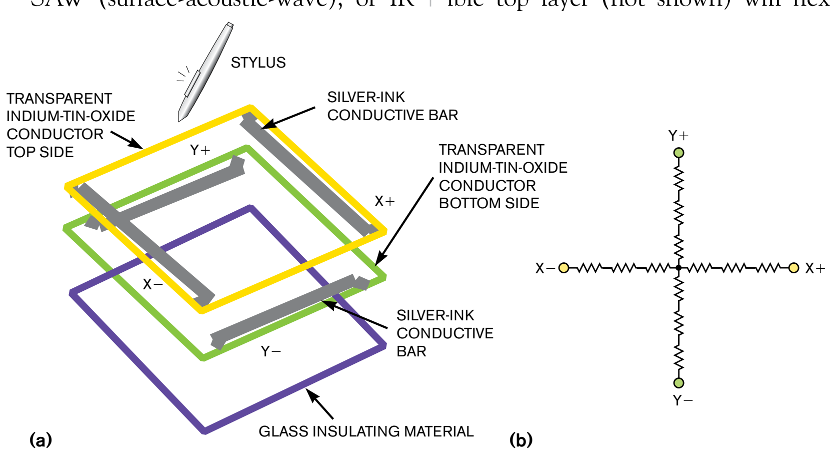

Figure 1 With the four-wire touchscreen panel, the two active areas of the resistive touchscreen sense the X and Y pressure points (a). The equivalent circuit is simply a voltage divider (b).

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