New Touch-Screen Controllers Offer Robust Sensing for Portable Displays

By Gareth Finn

Touch-screen displays that sense the occurrence and location of a physical touch on the display area are increasingly being used to replace mechanical buttons in a variety of devices, including smartphones, MP3 players, GPS navigation systems, digital cameras, laptop computers, video games, and laboratory instruments. First generation devices were not very accurate, suffered from false detection, and consumed too much power. Newer touch-screen controllers,[1] such as the AD7879,[2] offer improved accuracy, lower power consumption, and result filtering. They can also sense temperature, supply voltage, and touch pressure, facilitating robust sensing for modern touch-screen displays.

How Does a Touch Screen Work?

First, let's look at how a resistive touch screen operates. Figure 1 shows a basic diagram of the construction and operation of a touch screen.

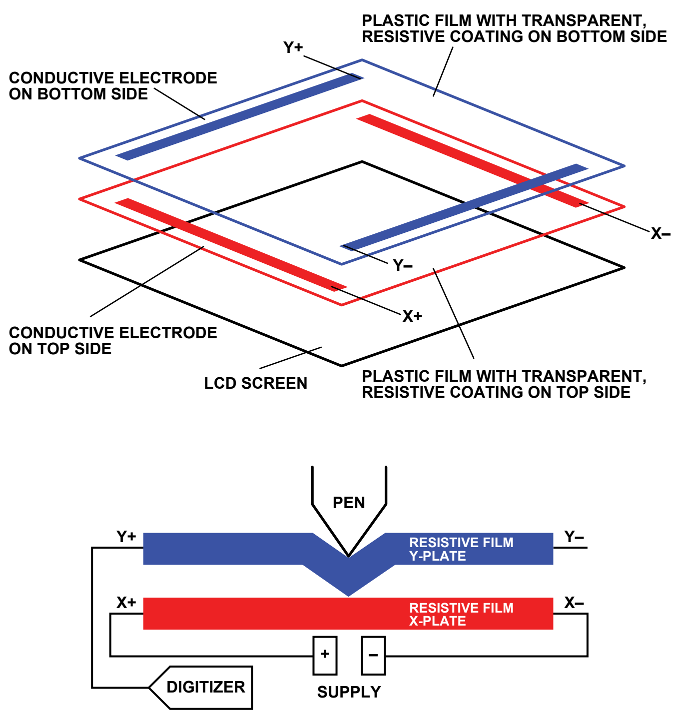

Figure 1. Construction of a resistive touch screen.

The screen is formed by two plastic films, each coated with a conductive layer of metal—usually indium tin oxide (ITO)—that are separated by an air gap. One plate, the X-plate in the diagram above, is excited by the supply voltage. When the screen is touched, the two conductive plates come together, creating a resistor divider along the X-plate. The voltage at the point of contact, which represents the position on the X-plate, is sensed through the Y+ electrode, as shown in Figure 2. The process is then repeated by exciting the Y-plate and sensing the Y position through the X+ electrode.

$$V_{Y+} = V_{REF} \times \frac{R_{X-}}{R_{X(TOTAL)}}$$

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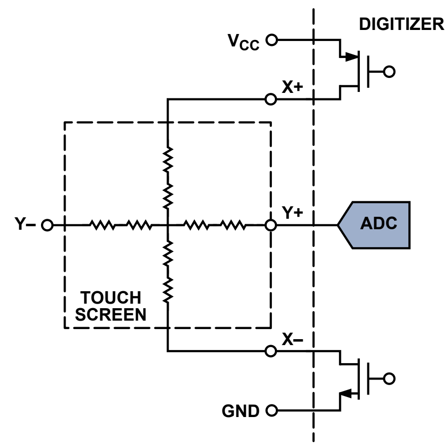

Figure 2. X-position measurement.

Next, the supply is placed across Y+ and X–, and two further screen measurements are made: Z1 is measured as the voltage at X+, and Z2 is measured as the voltage at Y–. These measurements can be used to estimate the touch pressure in one of two ways. If the resistance of the X-plate is known, the touch resistance is given by:

$$R_{TOUCH} = R_X \times \frac{X_{POS}}{2^N} \times \left(\frac{Z2}{Z1} - 1\right)$$

If both X- and Y-plate resistances are known, the touch resistance is given by:

$$R_{TOUCH} = R_X \times \frac{X_{POS}}{2^N} \times \left(\frac{2^N}{Z1} - 1\right) - R_Y \times \left(1 - \frac{Y_{POS}}{2^N}\right)$$

Larger values of touch resistance indicate lighter touch pressure.

AD7879 Touch-Screen Controller

The AD7879 touch-screen controller is designed to interface with 4-wire resistive touch screens. In addition to sensing touch, it also measures temperature and the voltage on an auxiliary input. All four touch measurements—along with temperature, battery, and auxiliary voltage measurements—can be programmed into its on-chip sequencer. Its wide supply voltage range (1.6 V to 3.6 V), small size (12-ball, 1.6 mm × 2 mm WLCSP; or 16-lead, 4 mm × 4 mm LFCSP), and low power dissipation (480 µA while converting, 0.5 µA in shutdown mode) make it flexible for use in a wide range of products.

Wake Up on Touch

The AD7879 can be configured to start up and convert when the screen is touched and to power down after release. This can be useful for battery-powered devices where power conservation is important. After each conversion sequence, the AD7879 delivers an interrupt to the host microcontroller, waking it from its low-power mode to process the data. Thus, the microcontroller also draws little power until the screen is touched. Figure 3 shows the setup for the wake-up-on-touch function.

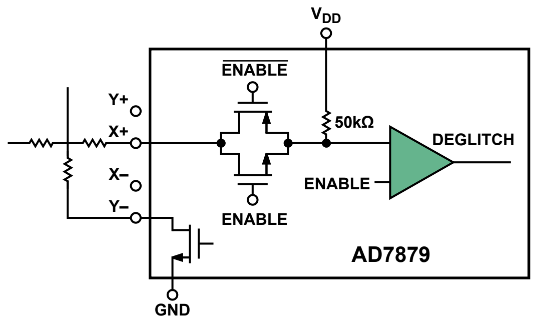

Figure 3. Wake-up-on-touch setup.

When the screen is touched, the X- and Y-plates connect, pulling the deglitch input low and waking the AD7879, which then starts converting. An interrupt is sent to the host at the end of the conversion.

Result Filtering

In a typical display, the resistive plates are placed on top of a liquid-crystal display (LCD), which contributes a lot of noise to the position measurement. This noise is a combination of impulse noise and Gaussian noise. The AD7879 offers median and averaging filters to reduce this noise. Instead of taking a single sample for position measurement, the sequencer can be programmed to take two, four, eight, or 16 samples. These samples are sorted, median filtered, and averaged to give a lower noise, more accurate result. The principle is illustrated more clearly in Figure 4. Sixteen position measurements are taken and are then ranked from lowest to highest. The four biggest and four smallest measurements are discarded to eliminate impulse noise; the remaining eight samples are averaged to reduce Gaussian noise. This has the added benefit of reducing the required amount of host processing and host-to-touch-screen controller communication.

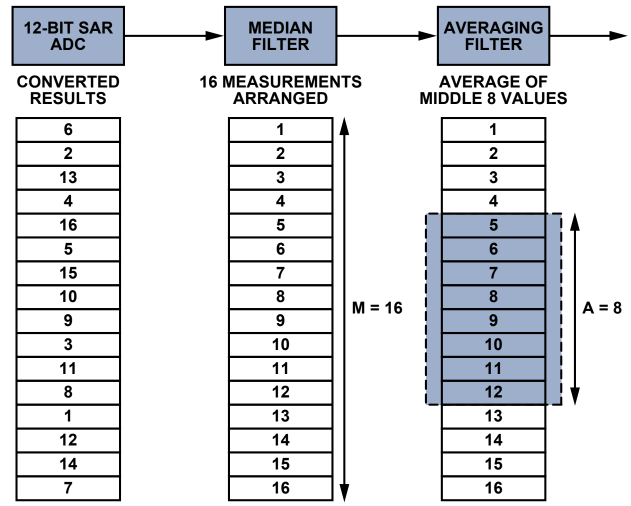

Figure 4. Median and average filtering.

References

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Author

Gareth Finn [gareth.finn@analog.com] currently works as a staff analog design engineer with the Integrated Portable Products Group in Limerick, Ireland. After graduating from University College Cork with a BE (Elec) in 1999, he spent five years as a designer with the Consumer Products Group at S3 in Cork, Ireland and two years as a designer in the Mixed-Signal Automotive Group at TI in Munich, Germany. Gareth joined the Transmit Signal Processing Group at ADI in October 2006.