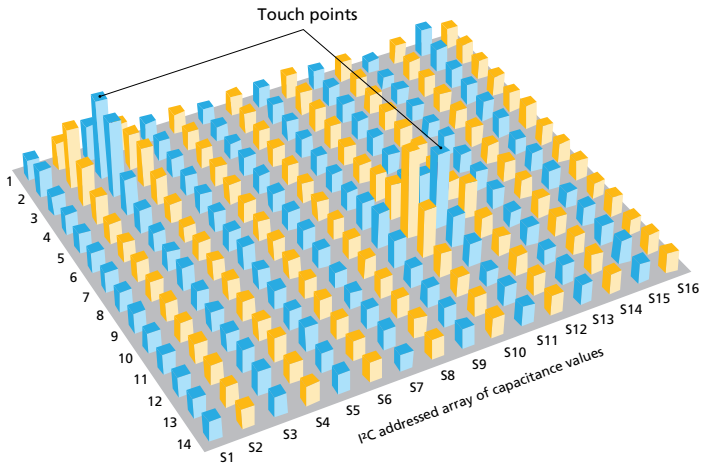
Simplifying the development of low-power interactive devices

MAX IIZ multi-point touch-screen reference design

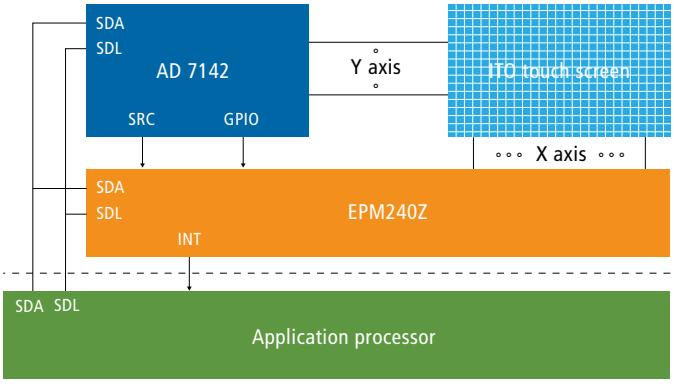
A certain web-enabled multimedia smartphone won consumers over by letting them access an array of applications and scroll through web pages with their fingertips. To develop fluid touch-screen interfaces—without sacrificing time, budget, or power requirements—design with zero-power MAX® IIZ CPLDs.

Unlike ASSPs or other competitive technologies, MAX IIZ CPLDs deliver high I/O counts, ease of use, low power, and flexibility to support product differentiation. These benefits will help you simplify and accelerate the process of creating unique handsets, portable media players, displays, as well as medical, automotive, and industrial applications. Deploy our new multi-point touch-screen reference design on a MAX IIZ EPM240Z device, and you'll have the resources to move quickly from concept to working product.



Customize—or not—and start your design

There are two parts of any touch-screen interface solution: a 2D touch sensor and a computer application that can convert sensor data into a user's intent. Our reference design is a complete sensor and data-gathering system ready for you to customize or use as is, with your indium tin oxide (ITO) screen. The reference design has a simple data interpretation application to demonstrate and test the operation of the multi-touch sensor. The 2D multi-touch reference design is based on a MAX IIZ EPM240Z CPLD and an Analog Devices AD7142 integrated capacitance-to-digital converter (CDC) with on-chip environmental calibration and an ITO capacitive screen.



Multi-touch reference design diagram

The AD7142, which senses capacitance variation, has only 14 capacitance sensor channels. In our reference design, the MAX IIZ CPLD expands the AD7142's capability to handle a two-dimensional ITO glass or film. The application processor uses I²C to access the CDC register file of the AD7142 and sets the MAX IIZ CPLD to drive the SRC signal to the appropriate axle. The MAX IIZ CPLD also generates an interrupt signal when the touch screen first senses a touch after a long pause. The CPLD enhances the AD7142's ability to sense a 1x14 array of capacitive touch points to a 16x14 array of sense points.

ITO touch-screen design

Our reference design is based on a capacitive ITO touch screen with two transparent layers separated by an insulator. The screen has up to 14 Y traces that will connect to the AD7142 and 16 X traces connected to a MAX IIZ CPLD. The CPLD can incorporate more I/Os for better resolution.

Analog Devices AD7142 capacitance-to-digital converter

The AD7142 converter was designed to measure the capacitance and the change in capacitance of a linear array of capacitance sensor pads on a PCB. The converter works by sending a 250-KHz square wave signal through an SRC signal that is a trace near the sense pads. The AD7142 then measures the SRC signal-receive strength on the sensor pads. The capacitance of the touch pad is proportional to the SRC signal-receive strength. As a user's finger approaches a touch pad, the AD7142 detects and quantifies the change in capacitance.

MAX IIZ CPLD transforms linear sensor into 2D sensor

The AD7142 by itself can measure the capacitance of 14 sensors with respect to a single SRC trace. The MAX IIZ CPLD creates a way to have multiple SRC traces. The MAX IIZ device takes the SRC square wave signal from the AD7142 and, under the control of a serial interface, selectively drives one of the touch-screen X traces. Then, the AD7142 can take a capacitance measurement localized to the region adjacent to the active vertical trace. For larger displays of more accuracy, the MAX IIZ CPLD features as many as 80 I/Os in a 5x5mm package.

Saving power, time, and processing effort

Offering provisions for power-down or sleep modes, our reference design is very power efficient. The first level of sleep is obtained by the application processor reducing the sample rate. The application processor can also sample a subset of horizontal and vertical traces, and use the accuracy of the AD7142 to interpolate touches between active traces.

You can save more power by requiring the user to touch the center of the screen to wake the device, limiting the application processor to sampling only one horizontal and one vertical trace. You can save the most power when the application processor and the AD7142 are powered down, and the MAX IIZ CPLD creates a very power-efficient capacitance detection system to sense when the screen is touched. Once the CPLD detects a touch, it can wake the processor using an interrupt signal. Once awake, the system can properly read the touch location.

Want to dig deeper?

For more information about how MAX IIZ CPLDs can solve your touch-screen design challenges, contact your local FAE or sales representative, or visit **www.altera.com/maxiiz** for white papers, application notes, and other literature. For more information on the AD7142, visit **www.analog.com**.

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