New Possibilities for P-Cap Touch Sensing in Small Format Industrial Displays

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Projected capacitive (p-cap) touchscreens have witnessed overwhelming success in the consumer portable space over the last few years, being specified into highly popular products such as Apple's iPad and iPod Touch, as well as Samsung's Galaxy and Blackberry's Torch smartphones. People are now starting to perceive touch as the only way to interact with technology and this is leading to demands for comparable functionality to be incorporated into the small screen devices used in far more challenging settings. However, there are issues as to how this can be done.

ITO & its widespread proliferation in the consumer sector

Touchscreens based on a mutual capacitive sensing mechanism and utilizing conductive Indium Tin Oxide (ITO) have proved highly attractive for bringing touch functionality to small format displays. This metal compound has several attributes that make it highly suitable for touchscreen manufacture. As well as being both electrically conducting and near optically transparent (with the ability to easily be etched into micro-fine structures that do not inhibit display visibility), in small screens it offers improved durability and performance levels coupled with the economies of scale needed to serve mid/high volume touchscreen designs, while supporting more compelling features, such as multi-touch operation, which allow device manufacturers to create user interfaces that will differentiate their products from the competition.

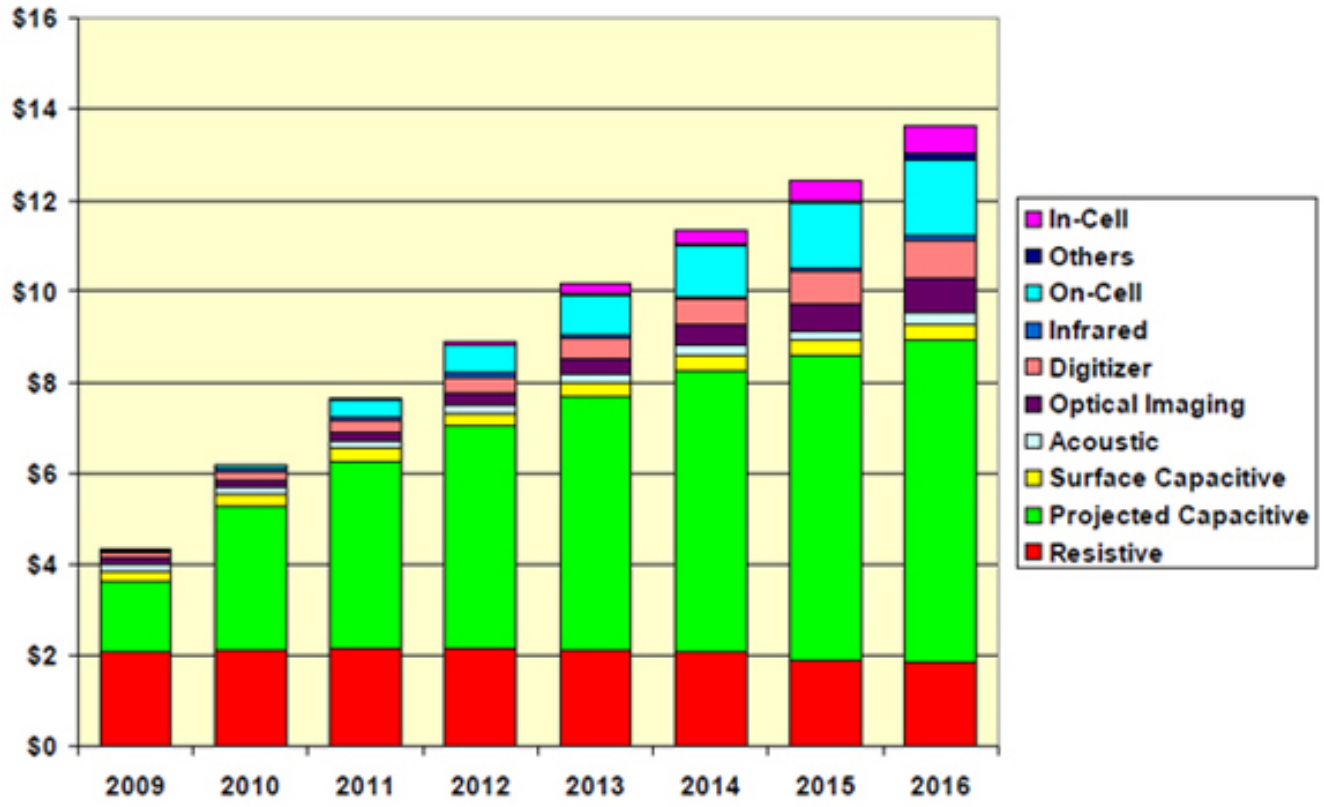

Figure 1. Breakdown on touch sensor market (2009-2016)
[Source: 2010 Touch Market Analysis, DisplaySearch]

The existing widespread use of ITO in several other touch technologies has accelerated the adoption of p-cap touch sensing and has enabled its meteoric growth in the small display consumer sector (<8-Inch diagonals). It now surpasses resistive sensing as the most commonly used touch technology. Furthermore, forecasts by DisplaySearch suggest that, due to the popularity of ITO, p-cap will represent approximately 50% of the expected $14 billion touchscreen market by 2016.

If this predicted growth is to be fully realized though, then new market opportunities for ITO must be found, both inside and outside established consumer application areas. One such opportunity exists where manufacturers seek to replace traditional mechanical keypads and switches with more intuitive control methods. In order for ITO-based p-cap touchscreens to migrate into these and other demanding industry sectors and applications, such as medical diagnostic tools, domestic appliances, handheld test equipment, warehousing data entry terminals and vehicle telematics, there are certain technical challenges which need to be addressed. These highlight some of the limitations of the “conventional” mutual capacitive sensing mechanism used in consumer electronic devices, and, as we will see, call for a whole new perspective to be taken.

Issues with current ITO touch sensing technology
Mutual capacitive sensing using ITO as the conductive medium is relatively insensitive, and consequently it is difficult to detect touch through more than 1 or 2 mm of glass. This means that although screens can be made which are scratch

resistant, they lack the rigidity necessary to protect the underlying display from moderate to severe impacts thereby reducing operational longevity in many non-consumer applications. However, this issue can be overcome if a self capacitance approach is followed instead. While mutual capacitance touch sensing measures capacitance between two electrodes, self capacitance touch sensing measures capacitance of single electrode to ground, utilizing the field generated from the user to induce minute changes within the sensors field. Through an innovative frequency modulation technique, touch sensor manufacturer Zytronic has been able to develop a sensor series that combines the benefits of enhanced optics and volume manufacturing from ITO processing with a p-cap technology capable of the extreme levels of robustness needed to deal with uncompromising environments.

Self capacitance ITO

Making use of the company's proprietary Projected Capacitive Technology (PCT) this new range of ZYBRID touch sensors has ITO tracks, deposited in a semiconductor-style photolithographic manufacturing process, as its sensing medium, rather than the copper electrodes normally used. The electrodes oscillate at a specific frequency (approximately 1.2 MHz), then when the user's finger approaches the surface of the screen (and thereby in close proximity of the oscillating electrodes underneath it) a change in the oscillation frequency occurs, induced by body capacitance. By measuring the peaks in the frequency change along adjacent X and Y axes electrodes it is possible to accurately determine the position of the touch point.

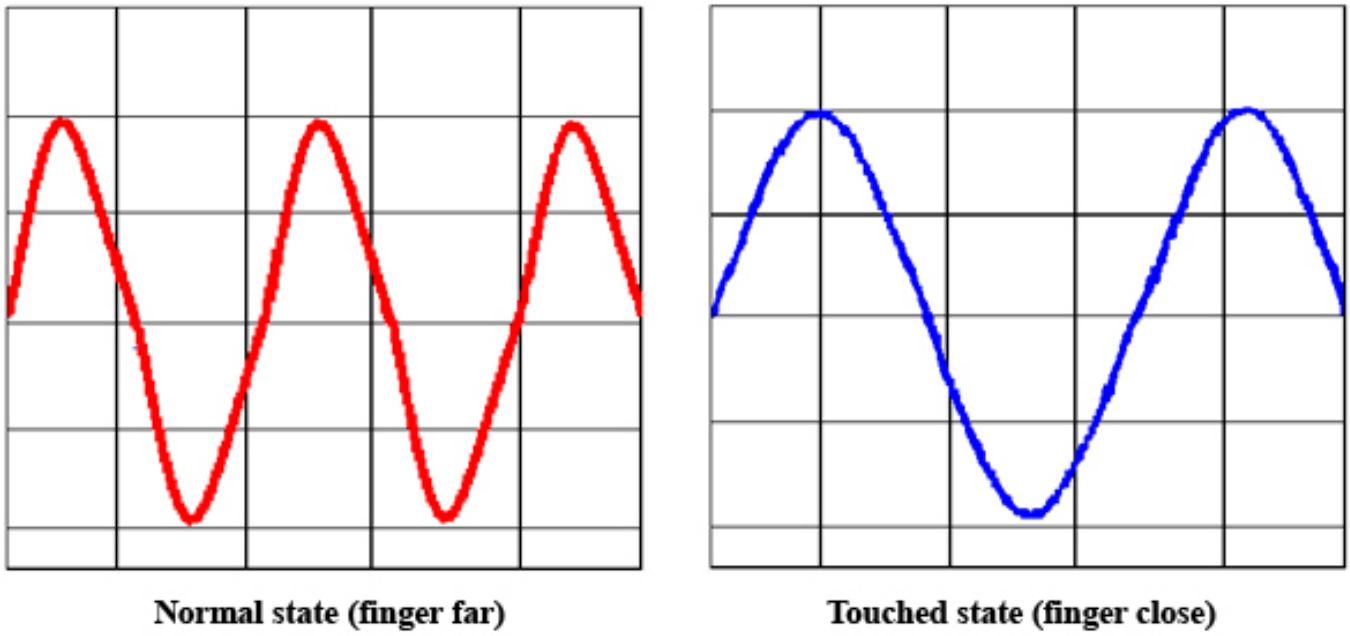

Figure 2. Frequency modulation technique used by PCT touch sensors

The stronger Z-axis sensitivity that the self capacitance ITO-based p-cap sensors are capable of allows them to be used with a wider range of protective overlay thicknesses and overlay materials, up to around 6 mm thick. This increases the touchscreen's resistance to physical stresses, such as heavy impacts, deep scratches and harsh chemicals, all of which are commonplace in the industrial or

outdoor use. Utilized in conjunction with the company's high performance touch controller solution, responsiveness can be defined by the designer, with native Windows 7 gesture recognition and dual touch functionality supported.

The PCT-based ITO sensors are able to deliver significant design advantages over the current breed of ITO sensors founded on the principles of mutual capacitance. The improved sensitivity also enables gloved hand operation (something that is not typically possible with conventional mutual capacitive p-cap sensing solutions) and therefore it offers clear advantages in industrial, medical and outdoor applications.

ITO continues to be the dominant conductive medium used in the manufacture of touch sensors, most notably in the now dominant p-cap technology. However, mainstream p-cap products based around the combination of ITO and mutual capacitance techniques restrict use in more rugged user interfaces. The development of new ITO p-cap touchscreens, based on a self capacitance sensing mechanism, allow these touch sensors to break into a host of new application areas.

These sensors are able to maximize design flexibility and add greater levels of functionality to user interfaces for industrial and public-use, ensuring their long term operation. This technological advance results in a p-cap offering that is highly optimized for small format, heavy duty touch-enabled devices and means the sort of user experiences that have become commonplace in the consumer space can finally migrate into non-consumer sectors.