Keysight Technologies

The Touch Screen Revolution in Test and Measurement

Application Note

KEYSIGHT TECHNOLOGIES

Introduction

Touch screens are slowly but surely creeping into every aspect of people's day to day lives. It is not unlikely for a person to wake up to a cell phone alarm, adjust the room temperature on a thermostat, change the radio station in the car, even start the washing machine using only a touch screen. A decade ago, people would not have used a touch screen for any of these tasks, but today it is commonplace. Touch screens are also working their way into test and measurement equipment. To understand the impact of touch screens on test and measurement equipment, it is important to first know the difference between resistive and capacitive touch screens and the impact smartphones have had on touch screen implementations in devices today.

Touch screens have revolutionized the consumer electronics market, and are working their way into the test and measurement environment. Touch screens have been around for a long time, but there are a few key innovations that have elevated the touch screen from a kludgy gimmick into a slick and natural feeling technology. The main difference between the touch screen that no one used in the 1990's and the touch screen people use constantly on their smart phones today is the type of touch screen technology used on today's consumer devices. Resistive touch screens have been replaced by capacitive touch screens.

Resistive Touch Screens

Resistive touch screens use an inner conductive sheet and an outer resistive sheet with an air gap and spacers between them. The user then presses the two sheets together and a corresponding horizontal and vertical position is calculated for the touch. Resistive touch screens tend to flex slightly when pressed hard, and are often found in grocery stores and ATMs. Resistive touch screens are generally limited to one touch at a time, and are notoriously inaccurate and difficult to use.

Capacitive Touch Screens

Capacitive touch screens are a newer technology, and are found in all higher end tablets and smartphones. Instead of using two conductive layers, capacitive touch screens use a single charged conductive layer with a sensor in each corner of the screen. Contact with something conductive, e.g. a finger, causes a voltage drop that is registered by the sensors. A controller then measures the sensors' values and calculates the horizontal and vertical location of the touch. Capacitive touch screens are significantly more precise than resistive touch screens and have the ability to register multiple touches simultaneously, enabling features like pinch to zoom. Affordable processing, improved battery life, and drop-in parts for manufacturing have made capacitive touch screens the go-to technology for today's devices.

Beginning with the release of a popular line of cellphones in 2007, capacitive touch screens have dominated consumer electronics and the "smartphone revolution" was born. Smartphones debuted in the early 90s, but did not get traction in the marketplace until around 2007. This can be attributed to many different factors like ground breaking smart phones applications, affordable cellular data and better processing power, but the number one reason that smartphones are so prevalent is simple: people are able to use them. With the right user interface there is no need for a stylus; there is no need for a mouse or a keyboard; people only need a finger.

Nearly everything people do with touch screens can be done using a mouse instead. Gestures, zooming and scaling, highlighting, and selecting icons or menu items can all be done with a mouse. So, why do people gravitate towards touch screens? People naturally and natively understand how to use their hands, and capacitive touch screens have become an extension of peoples' hands. Evidence of this is that many toddlers are able to navigate a tablet before they learn how to speak.

A combination of the right hardware with a designed for touch user interface (UI) enables us to use equipment easily and efficiently. Designed for touch UIs are crucial for creating an effective and usable touch screen environment; it is not enough for product designers to simply add a touch screen to an existing UI. Trying to navigate awkward menus and select small icons will quickly cause a user to go back to the mouse and keyboard. It is crucial that menus, icons and movable items are large enough and accessible enough to be controlled via touch screen.

Touch Screens in Test and Measurement Equipment

The number one goal of test and measurement equipment is to be able to identify, isolate, and analyze a system as quickly and efficiently as possible. Having an effective touch screen implementation on test and measurement instruments can reduce the time it takes to configure those instrument and analyze a device's signals.
It is safe to say that test and measurement equipment has more buttons, knobs and menus than most other hardware in its class. Oscilloscopes typically have over a dozen knobs and a few dozen buttons on the front panel. With a good touch screen and a designed-for-touch UI, those knobs and buttons can become unnecessary. Here are a few benefits of having a touchscreen on Keysight oscilloscopes.

Designed-for-touch User Interface and "Touch Mode"

A great example of a touch screen UI can be found on Keysight's Infiniium oscilloscopes. There is a "touch" mode that is designed specifically for use with the built-in capacitive touch screen. When "touch" mode is enabled, the buttons and windows that would normally be difficult to press are enlarged for easier access.
The Keysight InfiniiVision oscilloscopes also have a user interface that is completely designed for use with a touchscreen. Every button or knob on the front panel can be bypassed using the touchscreen.

Pinch to Zoom

Trying to resize a signal on screen using knobs can be a chore. But using the pinch to zoom capability on Keysight's 6000 X-Series oscilloscope to scale the signal horizontally and vertically, the knobs become unnecessary. This is a feature that can only be done by hand, it cannot be replicated by a mouse.

Waveform Zoom

Instead of using pinch to zoom, a user could also just draw a box around the portion of the waveform that they want to zoom in on, and select "waveform zoom."

Touch Handles

Another Keysight innovation is the implementation of touch handles. Touch handles are enlarged sections of a cursor or marker that allow the user to easily select and move the desired cursor, waveform, or window. Using a knob to select each cursor and move it into place can be a chore. With touch handles, it is easy to simply drag and drop the cursors using a finger. Figure 1 shows the different touch handles on a Keysight Infiniium oscilloscope. Simply dragging the different arrows will re-position the cursors. Grabbing the FFT touch handle and moving it up and down will move the signal up and down on screen, enabling the user to position the waveform in precisely the right place. This capability is especially helpful for making quick measurements or for doing cursor-gated measurements.

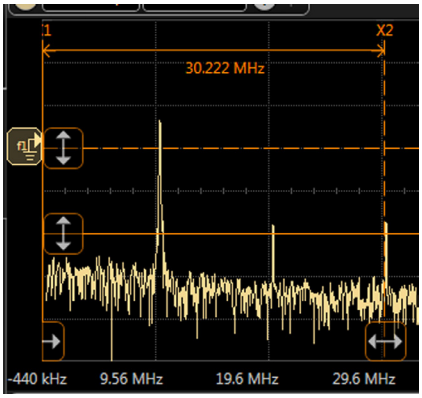

Figure 1: Touch Handles on a Keysight Oscilloscope

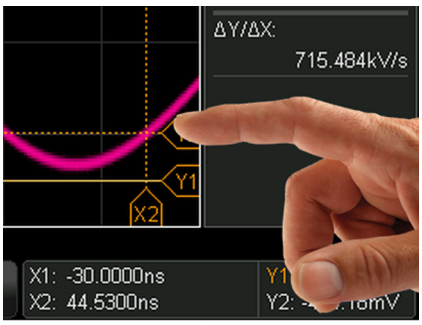

Figure 2 shows an alternate form of touch handle used on Keysight's InfiniiVision oscilloscopes.

Zone Triggering

The touch screen has also opened up new possibilities for making signals easier to isolate on an oscilloscope. Figure 3 shows a signal with an infrequent glitch. Most oscilloscope users would have a very difficult time setting up a trigger to isolate this glitch, likely using a trial and error method. A simple edge trigger will not isolate the signal, and a runt pulse trigger will not work, because the signal does eventually make it all the way to the top. On traditional oscilloscopes, the user would have to set up a very precise rise time trigger to isolate the glitch. However, using a zone trigger the user only has to use their finger to draw a box intersecting the part of the signal they are trying to isolate. Instead of having to set up a complicated trigger, likely through a trial and error method, a user can quickly and easily isolate and analyze the pertinent portion of the signal with a quick touch of the screen. In Figure 4, we see the glitch isolated using zone trigger.

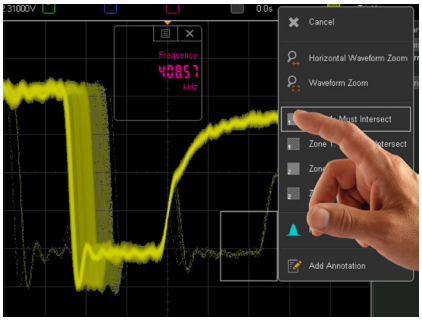

Figure 3: Signal with Infrequent Glitch.

Annotations

Adding annotations is also very quick and simple on the InfiniiVision oscilloscopes. Typically, users will not use a keyboard with this type of oscilloscope, so typing is usually done using knobs to select one letter at a time. With Keysight InfiniiVision oscilloscopes, all the user has to do to add an annotation is draw a box where they want the annotation and select “Add Annotation.” Then, a keyboard appears on screen and the user can type as if they were using a tablet or phone keyboard.

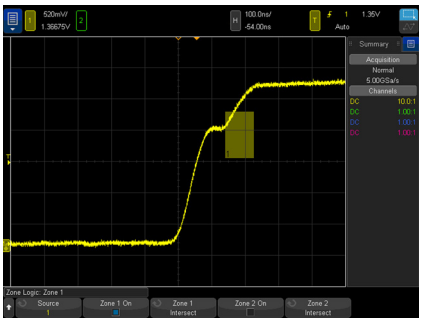

Figure 4: Glitch Isolated with Zone Trigger.

Floating Windows

The Keysight InfiniiVision oscilloscopes also allow the user to drag and drop windows from the sidebar to the screen. This is especially helpful for simultaneously documenting multiple items. Figure 5 shows a 1 MHz clock, measurements of the clock signal, an FFT of the clock, a list of the FFT peaks, a system summary, and an annotation all on the screen at the same time.

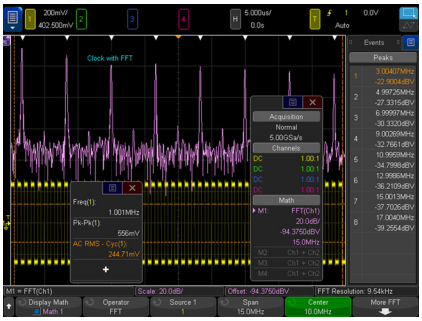

Figure 5: Floating Windows and Annotations.

Capacitive touch screens and designed-for-touch user interfaces are everywhere in consumer devices, but they are just starting to make their debut in the test and measurement world. Innovations by Keysight such as touch handles, zone touch trigger, and pinch to zoom are the just first in what will be a long list of time saving features in test and measurement equipment. It is clear that touch screens and new user interfaces will improve test and measurement equipment’s ease of use and analysis capabilities, ultimately reducing the time to market of systems and devices. What innovation comes next? Only time will tell, but it is clear that touchscreens are here to stay.

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