World Leader in Capacitive Proximity Sensing

Use a test finger to set the optimal touch thresholds

By Nicky de Jager and Helgard Muller

Designers have to consider many factors when designing reliable touch interfaces such as the size of the electrodes, the size of the user's finger (child vs. adult) and the thickness and type of overlay. The IQS devices offer auto tuning, high sensitivity, and high SNR, which make the design easier.

This article is intended to help the designer:

- Simulate touch conditions with a test finger
- Calculate the touch SNR (Signal to Noise Ratio)
- Determine touch reliability

An example applying the mentioned principles above using the IQS127 has been added to aid with design.

Conductive Rubber Test Finger

Cylindrical shaped conductive rubber with a length of 150mm and diameter of 10mm can be used as a test finger.

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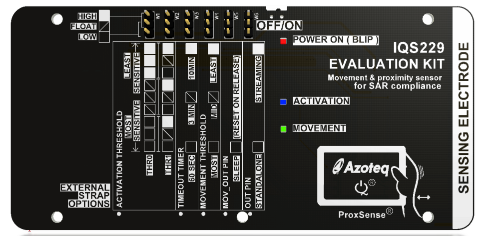
Content

Azoteq enables next generation user interfaces for users to interact naturally with products through capacitive proximity and touch

Quick Guide to the IQS229EV03

The IQS229EV03 Evaluation kit features the IQS229EV01 module PCB. This kit enables the evaluation of the user interface as well as the effect of the 4 resistor strap options:

- 2x Inputs are used to set the activation threshold,
- 1x for the movement sensitivity and
- 1x for choosing a no-movement timeout timer.



The IQS229EV03 allows for easy evaluation of the IC

The IQS229 will work in standalone mode (direct outputs) or streaming mode for evaluation with a GUI using an Azoteq USB streaming device (CT210).

The outputs may be interpreted as follows:

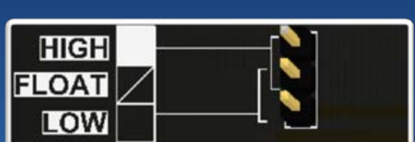
- "ACTIVATION" → normal crossing of the threshold
- "MOVEMENT" → a pulse for every movement detected.

First time power-up

When powering up for the first time, be sure that the "STANDALONE" option is selected by fitting a jumper onto the middle and lower pins.

For the full user guide, please email info@azoteq.com.

External Strap Options for the IQS229EV03



Strap the top two pins together to pull high, bottom two to pull low

The external strap options are only read in:

- Power-on events
- Reset events

Strapping the Options pins to High/Low or Float

When no jumper is placed, a floating input is detected. Otherwise the input can be strapped high or low by placing a jumper.

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The rubber must have resistivity of ρ ≈ 1.0Ω/mm.

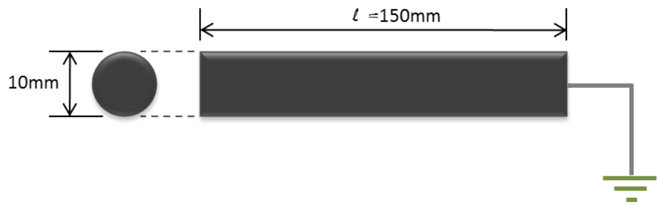

Figure1: Conductive Rubber Test Finger

Simulated Test Finger

A similar shaped object can be used to simulate an adult or child touch. A circular metal touch surface and nonconductive foam at the tip of an insulating handle with a conductor leading to ground can be guided onto the touch surface.

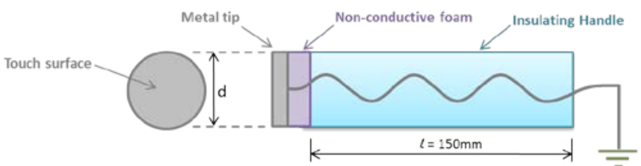

Figure 2: Insulated Metal Tip Test Finger

With reference to Figure 2, the following dimensions are suggested:

- Adult Model: d = 12 mm, l = 150 mm
- Child Model: d = 6 mm, l = 150 mm

Touch area boundaries

Consistent touch generation during testing does not only rely on the touch finger being used. It is also important to consistently generate a touch in the same area of the touch electrode.

The touch boundary specifications are application dependent and it is up to the designer to decide what conditions will ultimately indicate a touch event. The following description is based on a circular touch electrode used on many IQS EV-kits and should be used as a guide when designing touch applications.

The boundaries of the touch area are typically specified around the overlay button graphic and the SNR value specification are determined within the boundary areas. Once again an adult and child model is used as an example.

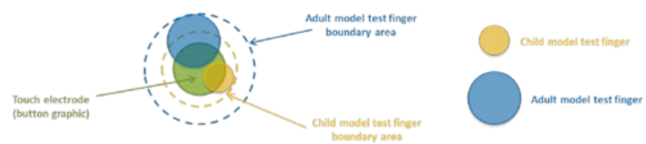

Figure 3: Valid Touch Area Boundries

Touch SNR calculation

Touch Signal-to-Noise Ratio measurements are calculated within the boundary area discussed in the previous section.

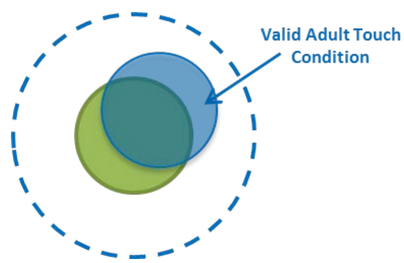

Figure 4: Adult Touch Condition

Furthermore, 250 samples were used and the average counts were recorded for a touch and untouched signal respectively:

- SU-AVG = Numerical Average of untouched signal count for 250 samples
- ST-AVG = Numerical Average of touched signal count for 250 samples
- ∆touch- AVG = SU-AVG - ST-AVG (for 250 samples)

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The ∆touch-AVG value is calculated by subtracting the ST-AVG value from the SU-AVG value because we are working in surface mode*.
*Surface mode meaning capacitance is measured between the electrode and earth i.e. self-capacitance. Refer to Application note AZD008.

For the touch samples the SNR is calculated as follows:

$$SNRdb = 20\log\left(\frac{\Delta touch}{NRMS}\right)$$

Where NRMS is

$$\sqrt{\frac{\sum_{n=0}^{249} Signal(n) - SU\_AVG}{250}}$$

The NRMS value is the Root-Mean-Square Noise value of 250 samples using SU-AVG as baseline.

Typical design specification dictates that:

$$SNRdB > 20dB$$

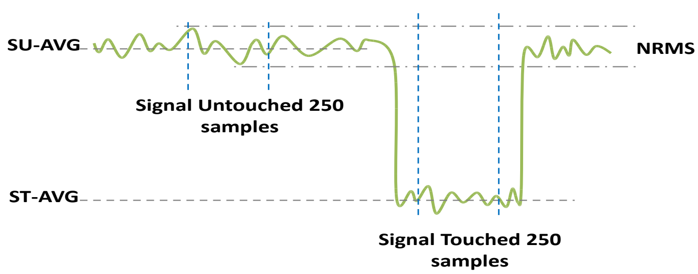


Figure 5: SNR Calculation

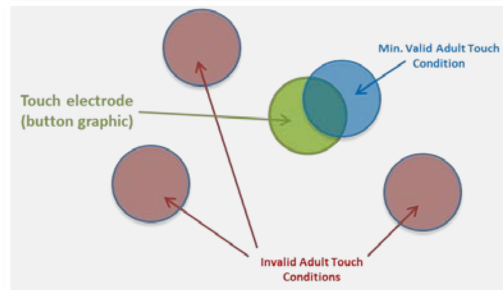
Touch Accuracy Calculation

Touch accuracy can be expressed as a ratio of average touch strength measured within boundary with lowest ∆touch value over average touch strength measured anywhere outside boundary with highest ∆touch value.

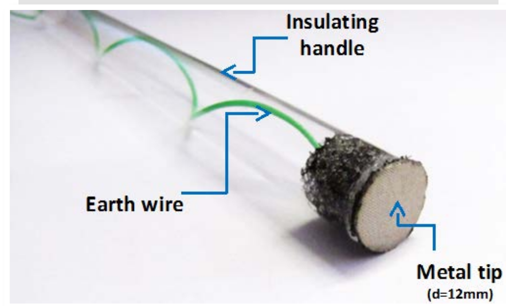
$$Touch\ accuracy = \frac{Av.lowest\ \Delta touch\ within\ boundary}{Av.highest\ \Delta touch\ outside\ boundary} = \frac{S\Delta\min\_valid}{S\Delta\max\_invalid}$$

Typical design specification dictates that:

$$Touch\ accuracy > 4$$



Valid and Invalid Touch Conditions



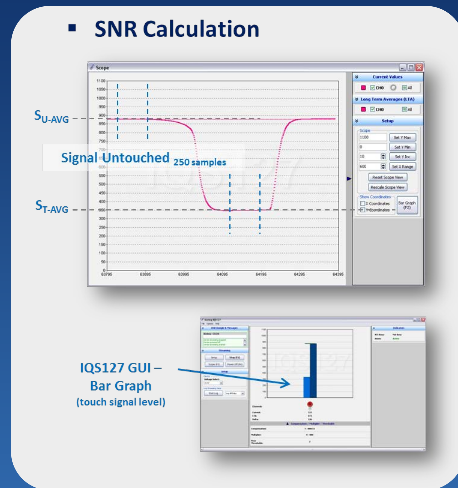
Adult Model Test Finger

For the full article, please email info@azoteq.com.

Determining Touch Thresholds

While there are different options available to determine Touch and Proximity values, the GUI is a great visual representation of what is happening during test cases. Other options include:

- Stand-alone threshold settings
- Percentage difference between the Counts and LTA
- Set Delta Threshold(LTA – Counts)



Using the GUI to determine touch values

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