# Application Note: AZD0021
# Using a Resistor Network Touch Sensor

## 1 Introduction

This document describes the effect that the linearising network resistors have on the output of the IQS410, when used with a linear coated ITO glass sensor.

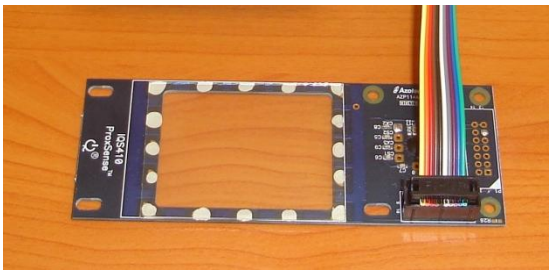

**Figure 1: IQS410 Demo with Resistive Network Sensor**

In the sections that follow, the output is examined with different network resistor configurations. For each of these, a square pattern is drawn on the ITO sensor, and the output from the IQS410 is compared with this input. The pattern drawn on the ITO sensor is similar to the shape drawn in Figure 2 below. Note: the pattern is drawn 'roughly' by hand and those outputs are displayed further down.

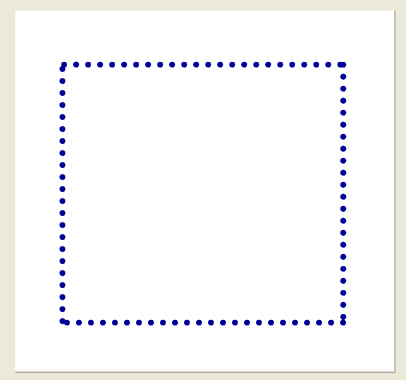

**Figure 2: Touch input**

The ITO glass used for these experiments has dimensions as follows: 50mm x 40mm, and the resistance measured from edge to edge across the length and width of the glass is 4.7k x 4.2k Ohm. 5 connections on each edge are used to connect the network resistors to the ITO glass sensor. Thus the glass has 20 connections, 5 on each edge. The configuration is illustrated in Figure 3 below

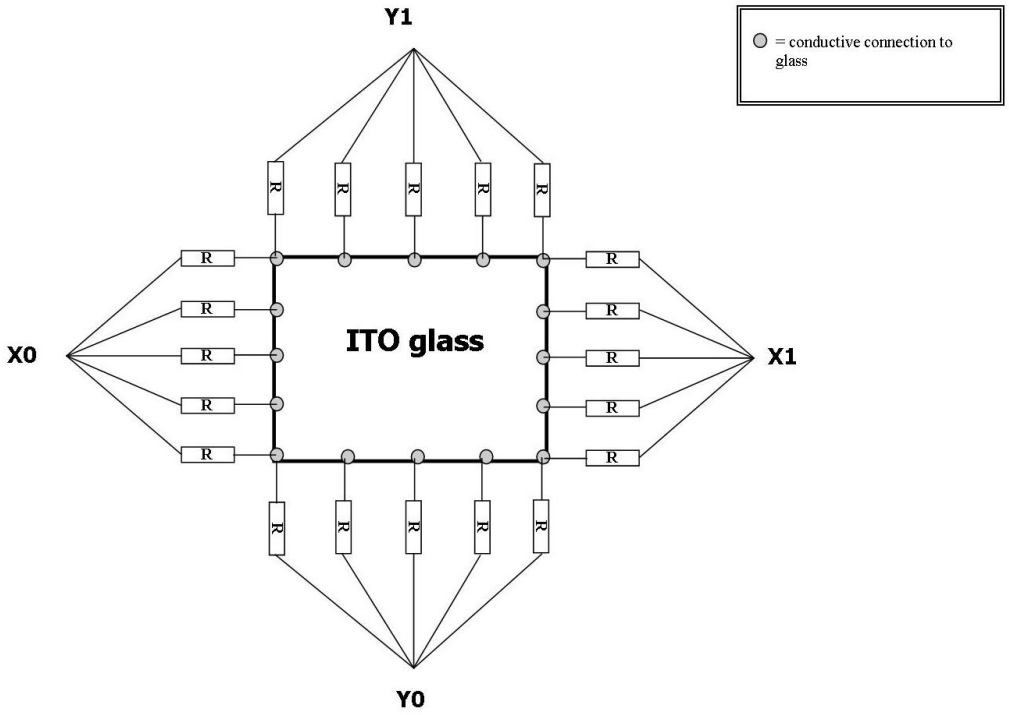


**Figure 3: Network Resistance Configuration**

# 2 Network Resistance Values

## *2.1 No Network Resistors*

If each of the 4 sensing lines are connected from the IQS410 to the centre of each edge of a rectangular ITO coated glass panel, a very non-linear (rounded) output is seen. This is illustrated in Figure 4 below. It is clear that the output is only accurate close to the centre of each edge of the sensor, which is where the sensing lines are connected in this case. The corners of the square are non-existent.

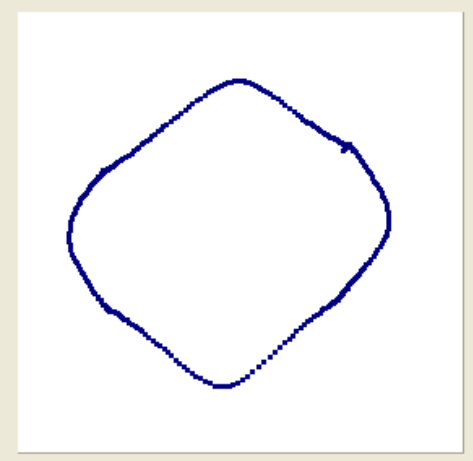

**Figure 4: No network resistors**

## *2.2 Network Resistors – To small*

Here 1k Ohm network resistors are used. It is seen that the corners are still 'rounded' on the output. This indicates that the network resistors are too small relative to the ITO resistance, and the linearising effect is not optimal.

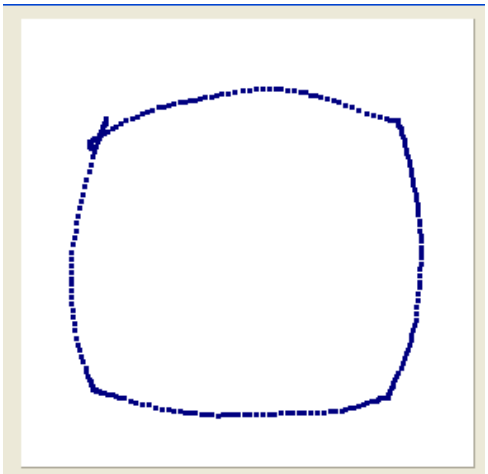

**Figure 5: Small network resistors**

## *2.3 Acceptable network resistors*

In Figure 6, resistors with a value equal to that of roughly the total resistance across the touch panel were used. In this case 4.7k Ohm resistors were used. The result is that the corners are much more defined than any of the previous configurations.

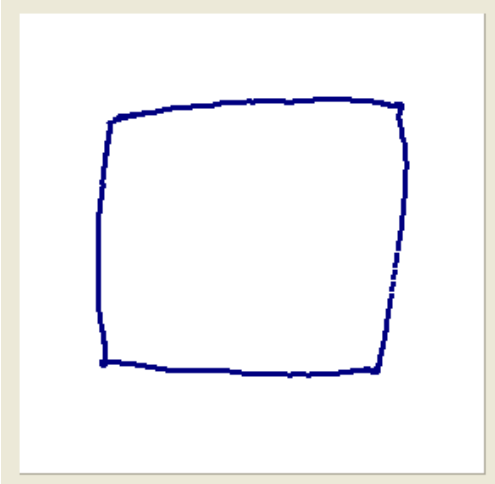

**Figure 6: Acceptable configuration**

In Figure 7, network resistance of roughly twice the total resistance across the ITO sensor is used. Here the corners are very well defined, and a very acceptable response is achieved.

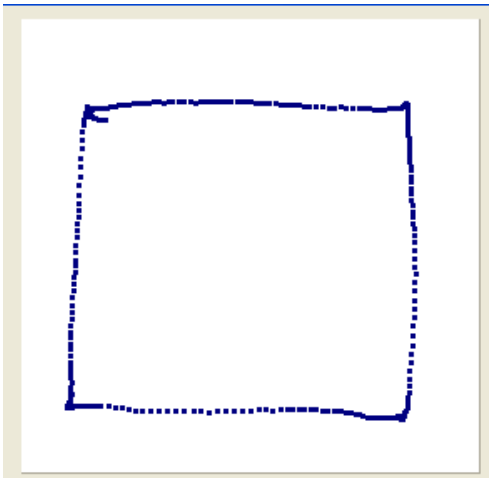

**Figure 7: Optimal configuration**

### 2.4 Network resistors – Too big

If the network resistors are chosen too big, then the edges of the square are still well defined, but then the system loses resolution. This can be seen in the figure below. Too much resistance is added to the sensing circuit, with the resistive ITO making up a small percentage of the total, and thus the system has lower resolution across the sensor.

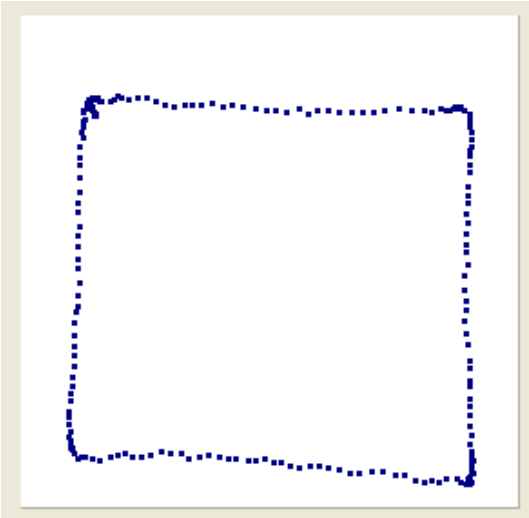

**Figure 8: Large network resistors**

# 3 Amount of network resistors per side

In the above section, the size of the network resistors was covered. In these examples, there were 5 resistors per side, and the output was linear near the edges.

If too few resistors are used, then the output is not linear near the edges, and what is known as a 'pin-cushion' effect is seen. This can be seen in Figure 9 below, where only 3 resistors were used per side, one to the centre, and two to the corners, per side. It can be clearly seen that the output is not linear near the edges.

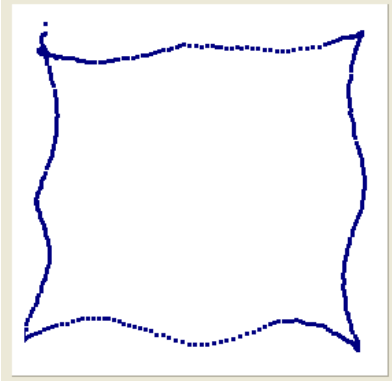

**Figure 9: Too Few Network Resistors**

# 4 Conclusion

Selecting the network resistors is a crucial step in the design of the touch sensor. Increase the values of the resistance until the corners of the output are acceptable to the application, and then use these values. As the values become larger, the output will begin to deteriorate (lower the resolution of the system), thus always select the smallest values that are acceptable.

Regarding the number of resistors per side, use enough resistors to prevent the 'pin-cushion' effect on the edges of the touch sensor.

The concepts illustrated in this document are to be used as a guideline when designing the network resistance touch sensor. If the resistance of the ITO varies greatly from that used in this document, the optimal network resistors could be of a different proportion to that of the ITO, compared to those found in the scope of this document.