
AT11849: QTouch Surface Design Guide

Atmel QTouch

Introduction

User interfaces in consumer products such as wearables, IoT devices, remote controls, and PC/gaming controls are being driven by the massive adoption of touchscreens in smart phones and tablets. The Atmel® QTouch® Surface platform is the ideal solution to support such products requiring a surface solution with low power consumption and high cost optimization.

This document describes the guidelines to develop touch designs for the Atmel QTouch Surface solution. The design guide is an excellent starting point that provides useful guidelines to help in initial selection and construction of touch surface sensors, describes the important software parameters, and their impact.

Features

- Hardware design considerations
- Tuning guidelines
- Software parameters

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1 Overview

The Atmel QTouch Surface platform builds on the market-proven capacitive touch button sensing technology supported by Atmel | SMART MCUs. The solution includes an on-chip peripheral touch controller (PTC), the cornerstone technology that enables higher performance capacitive touch on Atmel MCUs.

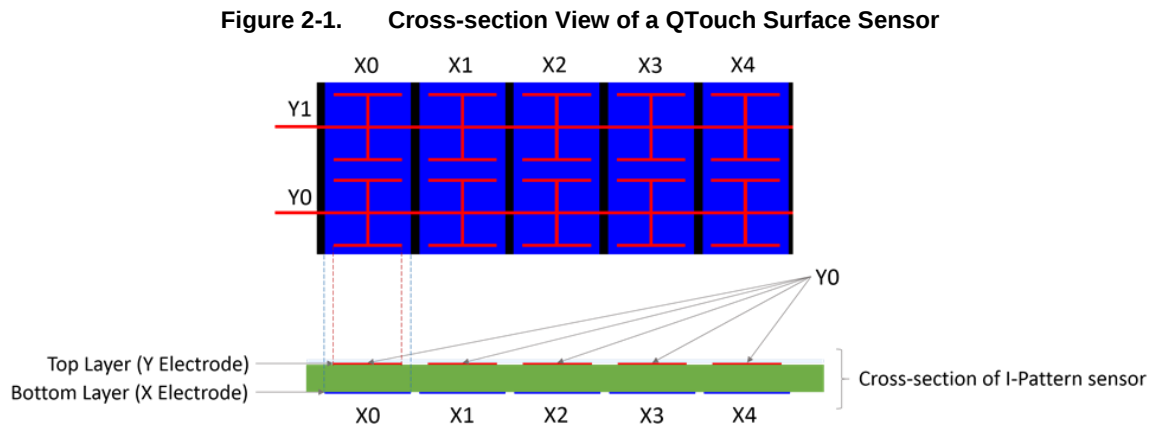
This document provides the essential rules to simplify and ease the development of QTouch Surface designs.

It describes:

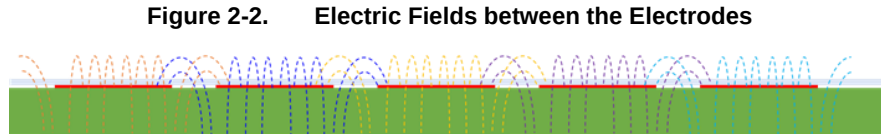
- Different sensors patterns (Z, I, and Diamond)
- Pin selection criteria
- Routing and Layout considerations
- Overlay panel thickness
- Key software parameters
- Tuning guidelines

2 Hardware Design

QTouch Surface sensors make use of the mutual capacitance between the X- and Y-electrodes. [Figure 2-1](#) shows a cross-section view of a QTouch Surface sensor.

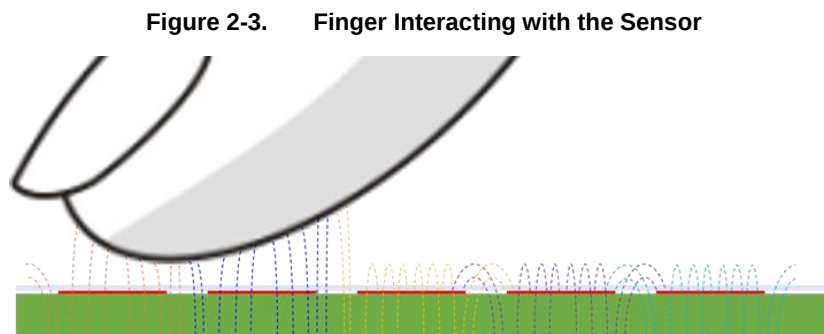


[Figure 2-2](#) depicts the electric fields present between the X- and Y-electrodes of the sensor. When the sensor is scanned, each X-electrode is driven one at a time, in sequence. The field lines are depicted in different colors to indicate the different X-electrodes from which they originate. As shown in the image the field lines from one sensor interact with the sensors adjacent to it. This creates an overlap in the sensitive areas of adjacent sensors. This is known as ‘Spatial Interpolation’. The dimensions and separation between sensor nodes are selected such that the Spatial Interpolation is optimal. This arrangement ensures that there are no discontinuities in the sensitive areas on the Surface.



When a finger is placed over the sensor nodes, it interacts with the field lines and changes the effective capacitance of the sensor nodes. This change in effective capacitance is used to detect a touch.

When the finger moves away from one sensor node and closer to the next, the interaction with the first node progressively decreases and interaction with the second node progressively increases. In this way, the reported position of the finger on the Surface changes progressively. Spatial Interpolation ensures that there are no abrupt discontinuities in the reported position.



The rest of this section discusses the guidelines for designing the sensor electrodes. It also covers other design aspects like routing, pin selection and front panel thickness.

2.2 Sensor Design

Sensor pattern is a very important aspect of designing a QTouch Surface. Linearity, accuracy, and resolution of touch position is greatly dependent on the sensor pattern. The QTouch Surface design consists of a set of sensors nodes arranged in rows and columns to form a matrix. The dimensions of the nodes, along with the number of rows and columns used will determine the total area of the sensor.

This section discusses three patterns that can be used to design a QTouch Surface.

- 'I' Pattern
- 'Z' Pattern
- Diamond Pattern

The 'I' Pattern and the 'Z' Pattern are based on the 'Flooded-X' sensor pattern approach. The Flooded-X two-layer method distributes the X- and Y-electrode cross two layers of a substrate. A useful property of this approach is that the X-electrode completely shields the Y-electrode from behind, making the sensor insensitive to touch from behind. The X- and Y-electrodes overlap each other, with the Y-electrode nearest to touch. The X-electrode must be below the Y-electrode and be larger and a solid fill. Each intersection of X-electrode and Y-electrode forms an individual sensor node. The sensor nodes must be kept small enough to allow the fields to spatially interpolate through the front panel and provide sufficient linearity.

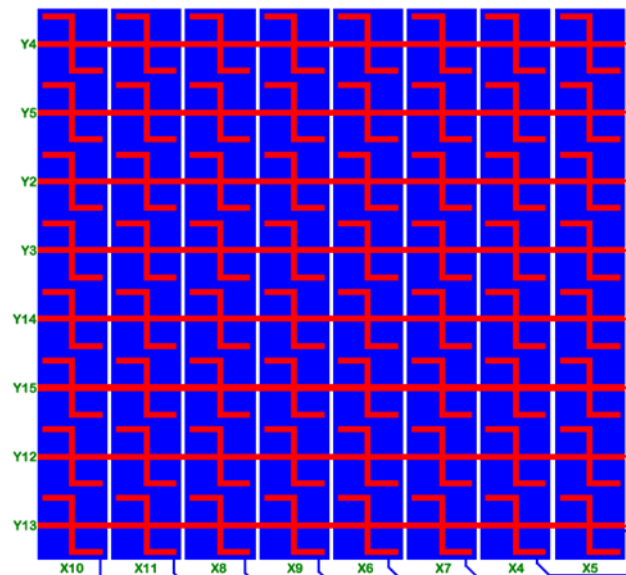
The Diamond Pattern does not have the X- and Y-electrodes overlapping each other. Instead the gap between the edges of the X-electrode and Y-electrode form an individual sensor node.

Note: A QTouch Surface sensor can only be designed using the Mutual Capacitance method.

2.2.1 'Z' Pattern

This pattern consists of a 'Flooded – X' arrangement with a Y-electrode in the shape of letter 'Z'.

Figure 2-4. Sensor Design - 'Z' Pattern

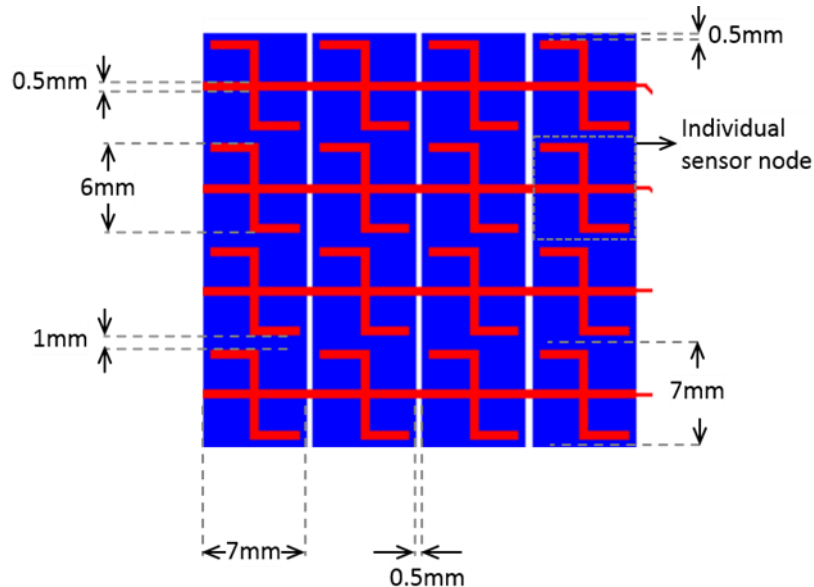


The sensor surface is designed as follows:

- A square shaped solid flood is used to form the X-electrode
- An 'Z' shaped pattern is used to form the Y-electrode
- Minimum number of rows / columns that can be used is limited to three
- Maximum number of rows / columns that can be used is limited to 16
 - Total number of resulting nodes is limited to 100

- E.g. Rows = 10, Columns = 10, Nodes = 10 X 10 = 100
- E.g. Row = 16, Column = 6, Nodes = 16 X 6 = 96
- The number of rows and columns are chosen appropriately to achieve the desired area

Figure 2-5. 'Z' Pattern – Dimensions



The dimensions and separation guidelines are indicated in [Figure 2-5](#).

- Size of each sensor node should be between 5mm to 7mm for an optimum balance between resolution and sensitivity
- Y-electrode thickness should be between 0.2mm and 0.5mm
- An X-flood can be used for sensors along each column, since they use the same X-line
- Separation between X-flood columns should be 0.5mm

The 'Z' pattern has good sensitivity, low noise levels and good linearity along both axes.

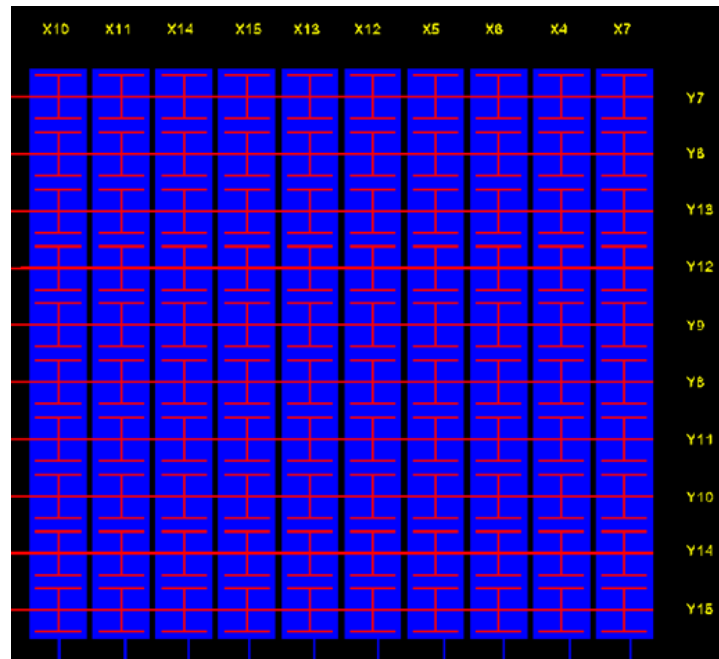
Smaller nodes give better resolution and larger nodes give better sensitivity. The 'Z' pattern:

- Supports 4 to 7 bit position resolution
- Supports 2mm edge-to-edge finger separation
- 5mm sensors will yield a DPI (Dots Per Inch) of 162 and 7mm sensors will yield a DPI of 232

2.2.2 'I' Pattern

This pattern consists of a 'Flooded – X' arrangement with a Y-electrode in the shape of a letter 'I'. Since the 'I' pattern increases the overall area of the Y-electrode, the linearity along the diagonal of the QTouch Surface will be better.

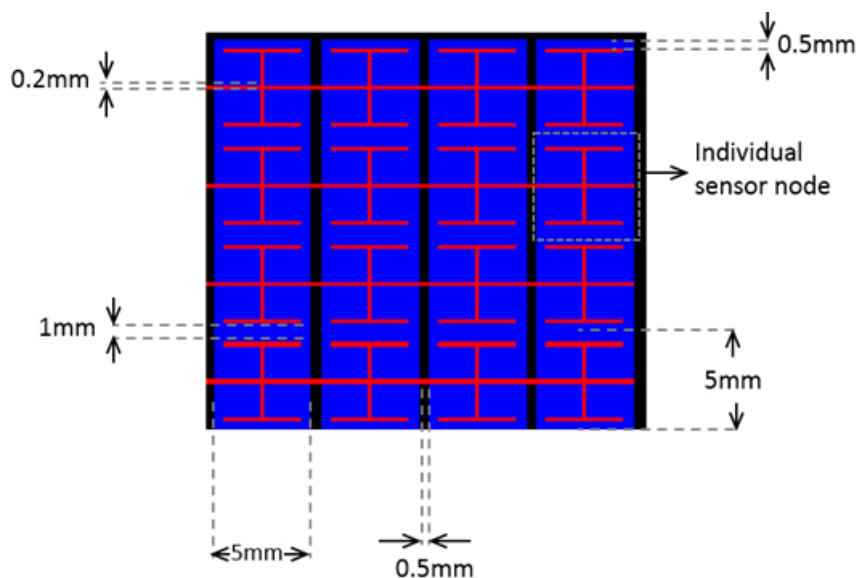
Figure 2-6. Sensor Design - 'I' Pattern



The sensor surface is designed as follows:

- A square shaped solid flood is used to form the X-electrode
- An 'I' shaped pattern is used to form the Y-electrode
- Minimum number of rows / columns that can be used is limited to three
- Maximum number of rows / columns that can be used is limited to 16
 - Total number of resulting nodes is limited to 100
 - E.g. Rows = 10, Columns = 10, Nodes = 10 X 10 = 100
 - E.g. Row = 16, Column = 6, Nodes = 16 X 6 = 96
- The number of rows and columns are chosen appropriately to achieve the desired area

Figure 2-7. 'I' Pattern – Dimensions



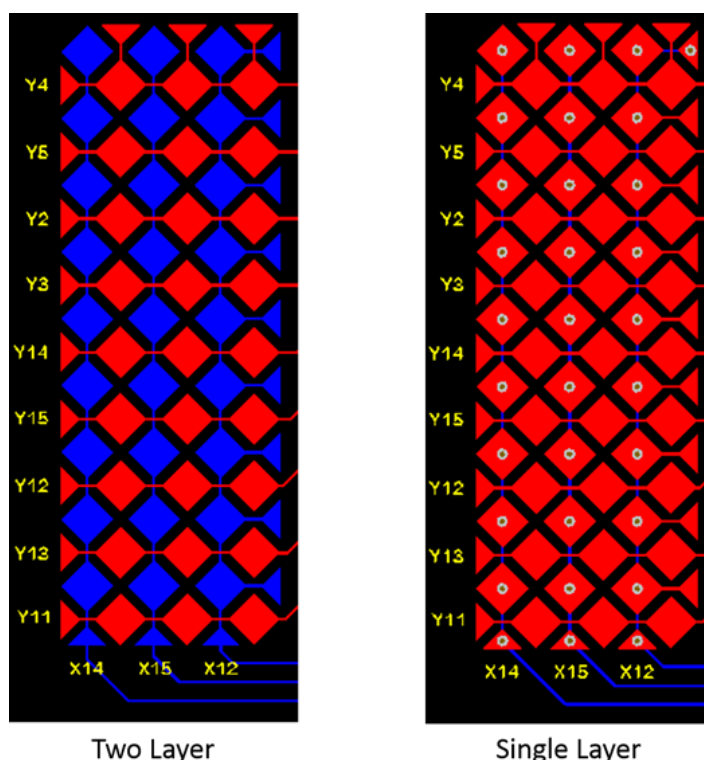
The dimensions and separation guidelines are indicated in [Figure 2-7](#).

- Size of each sensor node should be between 5mm to 7mm
- Y-electrode thickness should be 0.2mm and 0.5mm
- An X-flood can be used for sensors along each column, since they use the same X-line
- Separation between X-flood columns should be 0.5mm

2.2.3 Diamond Pattern

The following section describes a QTouch Surface design using the 'Diamond Pattern' approach. The sensor nodes are formed by rhombus shaped electrodes. The Y-electrodes are arranged among rows on the top layer and X-electrodes are arranged along columns on the bottom layer or top layers.

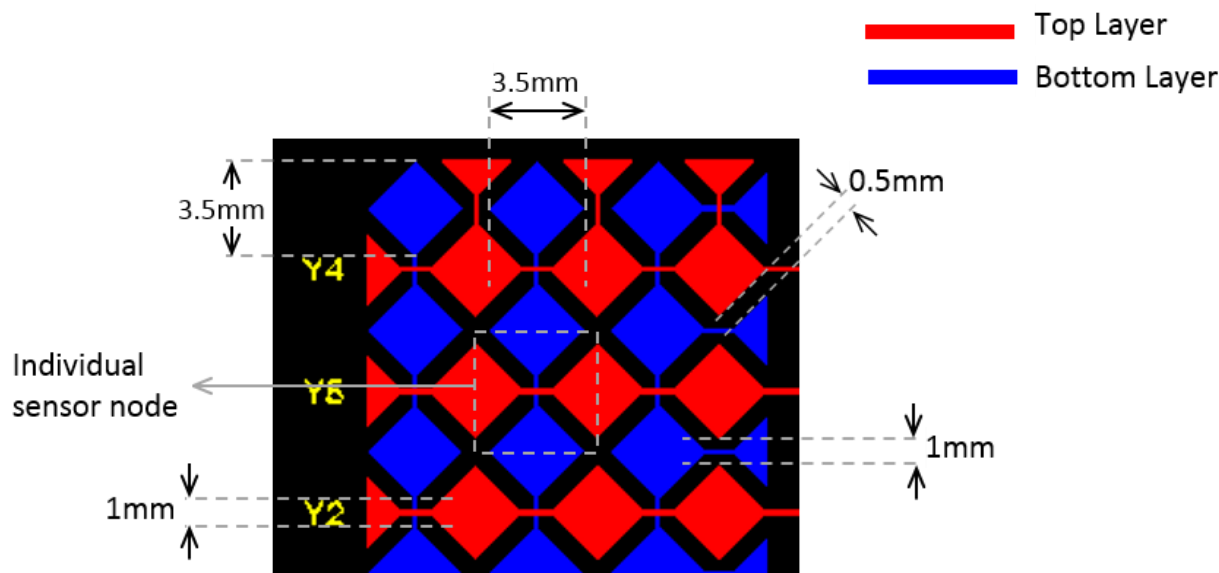
Figure 2-8. Sensor Design - Diamond Pattern



The sensor surface is designed as follows:

- Rhombus shaped electrodes are used to form X-electrode sensor nodes along each column
- Rhombus shaped electrodes are used to form Y-electrode sensor nodes along each row
- Y-electrode should be on the top layer
- X-electrode can be on the top layer or bottom layer
- An individual sensor node is formed by the region between the edges of the X- and Y-electrodes
- Minimum number of rows / columns that can be used is limited to three
- Maximum number of rows / columns that can be used is limited to 16
 - Total number of resulting nodes is limited to 100
 - E.g. Rows = 10, Columns = 10, Nodes = 10 X 10 = 100
 - E.g. Row = 16, Column = 6, Nodes = 16 X 6 = 96
- The number of rows and columns are chosen appropriately to achieve the desired area

Figure 2-9. Sensor Design - Diamond Pattern



The dimensions and separation guidelines are indicated in Figure 2-8.

- Separation between X-flood columns should be 1mm
- The length along each diagonal of the rhombus is 3.5mm
- Y-electrode thickness should be 0.2mm and 0.5mm

As indicated above, another way to setup the diamond pattern sensor is to place both the X- and Y-electrodes on the same layer. This leads to improved sensitivity and the bottom layer will be available for placing ground shield layer if required. The dimensions and separation guidelines are the same for both two layer and single layer designs.

2.2.4 Key Parameters

This section describes the various parameters that can be used to describe the performance of the sensor.

- **Sensitivity**
Sensitivity refers to the magnitude of the touch delta for a finger touch on the sensor. Sensitivity depends on the geometry of the sensor pattern and Gain setting used.
- **Jitter**
Jitter is the variation in the reported touch position when a stationary finger touch is present on the sensor. It represents the overall noise in the system. Jitter can be reduced by increasing the Filter Level setting.
- **Cross-talk**
Cross-talk refers to the delta change caused in the nodes adjoining a touched node. The amount of cross-talk present depends on the geometry of the sensor pattern.
- **Linearity Error**
Linearity Error refers to the deviation between the reported touch position and actual touch position as the finger slides over the sensor.
- **Resolution**
Resolution refers to the number of distinct touch positions reported when a finger traverses in a straight line along the horizontal or vertical axis of the sensor. Resolution is specified in DPI.

- **Touch Separation**

Touch separation is the minimum distance required between the edges of two fingers for the sensor to recognize them as two distinct touches. The Touch Separation that can be supported depends on the geometry of the sensor pattern.

Table 2-1 shows a comparison of the performance parameters of the sensor patterns described in Chapter 2. The designs compared have a node size of 5mm.

Table 2-1. Comparison of Performance Parameters

	'Z' Pattern	'I' Pattern	Diamond Pattern
Total Area	25mm ²	25mm ²	25mm ²
Jitter	0.3mm	0.3mm	1.2mm
Sensitivity (Touch Delta)	95	100	40
Linearity Error	2.6mm	1.6mm	1.3mm
Resolution	162 DPI	162 DPI	162 DPI
Finger Separation	2mm	2mm	2mm

Note: Data has been collected through manual testing. These values approximately indicate the expected performance.

2.2.5 Pin Selection

All the X-lines should be connected to pins that are close to each other. Similarly, all the Y-lines should be connected to pins that are close to each other. This will ensure that the routing is optimal and crossing of sense traces is avoided.

2.2.6 Layout Considerations

The following considerations need to be made while designing a PCB for a QTouch Surface design.

Enough Space on Edges

Avoid placing touch sensors close to the edges of the PCB. It is recommended to provide enough clearance between the PCB edge and the sensor electrode. Sense lines and electrodes that are too close to the edge will be more susceptible to radiated noise.

Shorter Sensor Traces

Traces from the microcontroller pins to the sensor electrode should be as short as possible. Making long traces increases loading on the sense line. In practice, using protection mechanism (say ground shielding) is easy to make in short traces comparing to that of longer traces.

Uniform Trace Lengths

The trace lengths for the X- and Y-lines should be kept uniform in order to make sensitivity tuning easier.

Thinner Traces

To prevent false touches over sensor traces keep trace width between 0.1mm and 0.5mm. The sensor traces should be routed on the non-touch side and should be connected to the sensor electrode preferably through a PCB via. This makes the sense traces insensitive to finger touch.

Nearby Traces

- Any traces that are closer than twice the trace thickness are considered nearby traces
- Sense traces should not be placed near other traces and components, as this may cause loading and interference. Longer sense traces will load the sensor and reduce the sensitivity. Traces with switching signals that are placed close to the sense traces can cause noise in sensors.
- GND traces should not be placed near sense traces. This will load the sensor and reduce the sensitivity. To reduce loading the sense traces and GND traces should cross at 90° on separate layers. If shielding from noise sources is necessary a thin meshed ground may be used behind electrodes (<40% copper). Meshed ground can also be helpful in increasing SNR.

X- and Y-traces

For mutual-capacitance, PTC X- and Y-lines should not be routed for longer length. Combination of that X and Y forms a channel and trace area becomes sensitive to touch. It is better to group the X-traces together and Y-traces together and route them physically separated on the PCB.

Figure 2-10 shows an example of incorrect X- and Y-traces routing.

- Sufficient gap is not provided between X- and Y-traces
- X- and Y-traces are not grouped together

Figure 2-10. Incorrect X- and Y-traces Routing

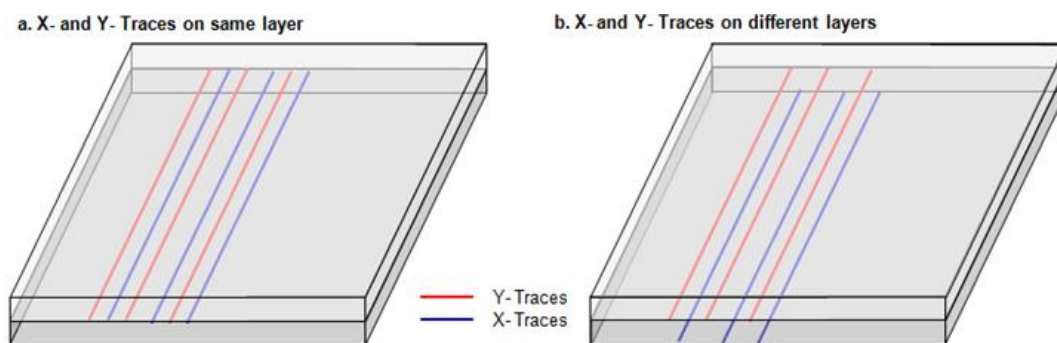


Figure 2-11 shows an example of correct X- and Y-traces routing.

- X- and Y-traces are grouped together
- Sufficient gap is provided between X- and Y-trace groups

Figure 2-11. Correct X- and Y-traces Routing – Example 1

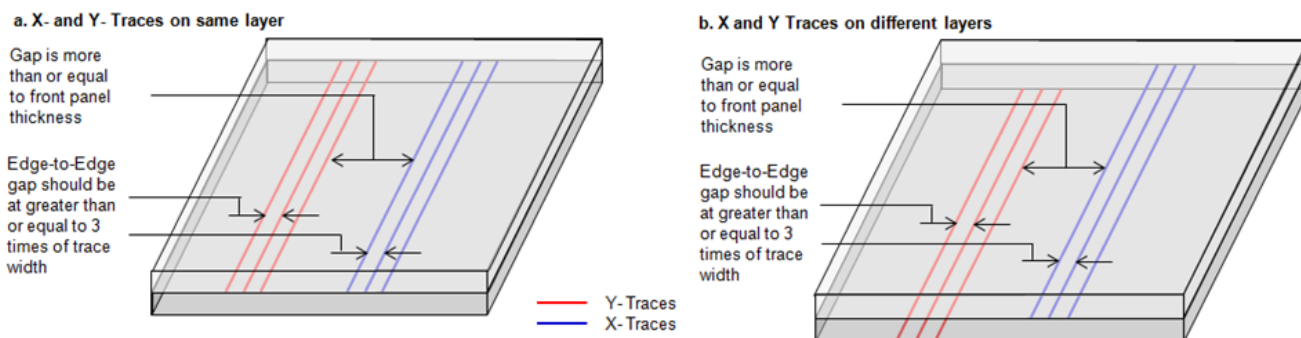
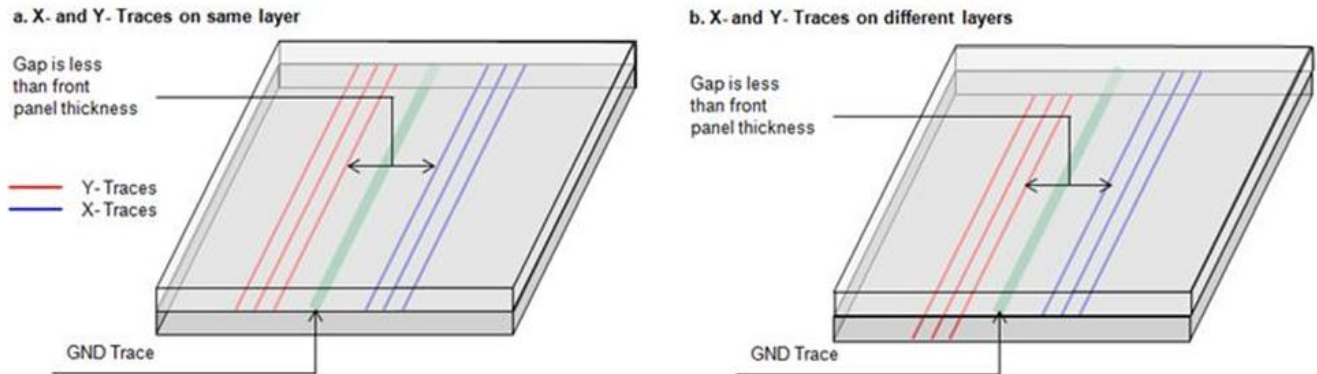


Figure 2-12 shows an example of correct X- and Y-traces routing.

- X- and Y- traces are grouped together
- Not able to provide sufficient gap between X- and Y-trace groups. So, a ground trace is routed between X- and Y-trace groups

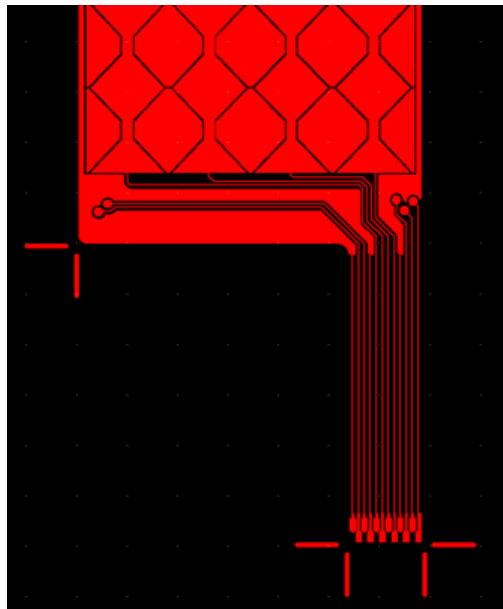
Figure 2-12. Correct X- and Y-Traces Routing – Example 2



Nearby Ground

In all layers GND trace/plane should surround all other signal traces. This can be achieved by placing thick ground trace on the edges of the PCB on all layers. Alternatively copper pour can be used in empty space of the PCB and can be connected to GND. The GND trace acts as a barrier between noise and the signal. Using “stitching vias” located closer to each other on the edge of the PCB helps in reducing the effect of noise even from the sides of the PCB. Proper GND placement is indicated in [Figure 2-13](#).

Figure 2-13. GND Surrounding Sensor and Traces



Floating Metal

Any floating metal placed close to the sensor can couple with the field generated by the sensor and re-radiate it. This can increase the noise in the system. It can also cause unintended touch sensitivity in other regions of the PCB. Any floating metal should be grounded to prevent these effects.

2.2.7 Front Panel Thickness

Sensor nodes that are 5mm to 7mm in size can support front panel of 0.5mm to 2mm in thickness. The front panel should have a sufficiently high dielectric constant. The dielectric constants of some common materials are shown in [Table 2-2](#).

Table 2-2. Dielectric Constants of Common Materials

Material	Dielectric Constant
Air	1
Common glass	7.8
Pyrex Glass	4.8
Lexan	2.9
Polyethylene	2.3
Polystyrene	2.6
FR-4	5.2
Plexiglas	2.8
PVC, rigid	2.9
Mylar	3
Nylon	3.2
Teflon	2.1

3 Library Parameters

This section describes the library parameters available for configuring a QTouch Surface design.

3.1 Lumped Sensors

The library is designed to save power by using an optimized touch acquisition algorithm. The algorithm groups a number of individual sensor nodes and treats them as a single sensor. This is known as a 'Lumped Node'. The touch acquisition is performed in four stages. Each stage uses a different sensor grouping scheme to form the Lumped Sensors. The grouping is designed such that the location of the finger touch is precisely identified, while performing the fewest acquisitions necessary.

The four acquisition stages are Sleep Stage (S0), Sub-Segment Stage (S1), Row and Columns Stage (S2), and Individual Sensor Stage (S3). The user only needs to configure the Lumped Sensors for the S0 stage. The remaining stages are handled by the library.

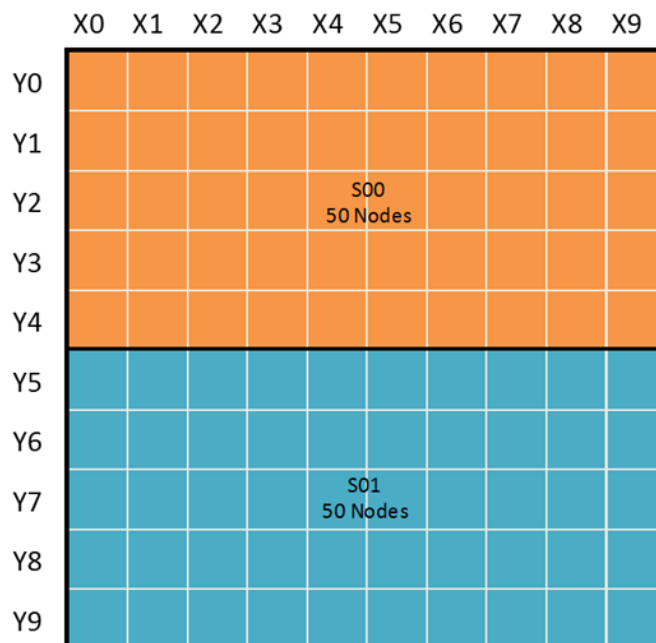
3.1.1 Sleep Stage (S0)

In this stage the Lumped Sensors are formed by grouping a certain number of rows or columns. The maximum number of sensors that can be grouped is limited by the internal Compensation Capacitance. The number of sensors should be selected such that the Compensation Capacitance does not get saturated. This value is configured using the Lump Node Size (`DEF_MAX_LUMP_SIZE`) parameter. The library will automatically select a number of rows or columns such that the number of sensors is less than the Lump Node Size.

A typical example of Lumped Sensor configuration for a 10 X 10 Surface is shown in [Figure 3-1](#). In this example the Lumped Sensors (S00, S01, S02, and S03) are formed by grouping rows. The Lumped Sensors can be formed by grouping columns as well. This Library automatically selects the grouping scheme based on the Lump Node Size and number of X- / Y-lines available.

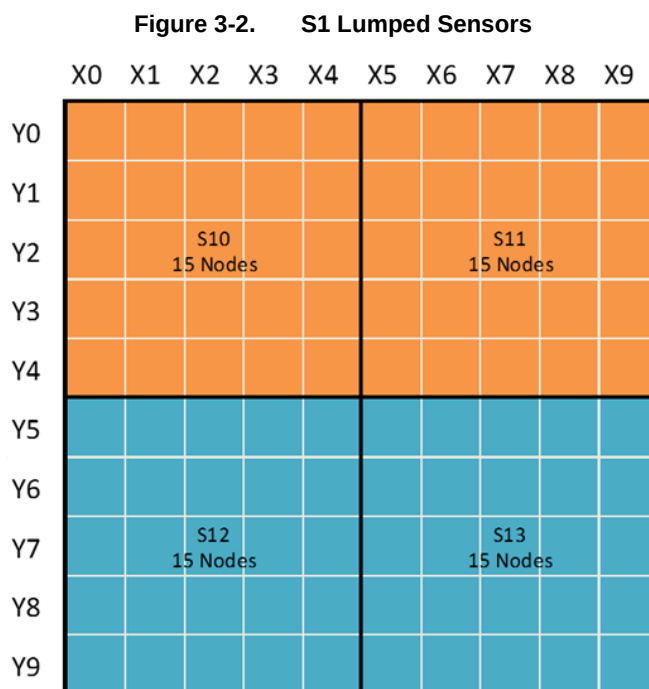
Note: In an actual design the number of Lumped Sensors formed and the Lump Node Size that can be supported may vary based on the capacitance of the electrodes.

Figure 3-1. S0 Lumped Sensors with Lump Node Size = 30



3.1.2 Sub-segment Stage (S1)

The Lumped Sensors for this stage are formed by splitting the S0 Lumped Sensors along the other grouping axis. For example: If S0 grouping is along the Y-axis, then the Lumped Sensors will be split along the X-axis to form S1 Lumped Sensors. This is done automatically by the library.



3.1.3 Row-column Stage (S2)

The Lumped Sensors for this stage are formed by grouping each row and each column. This is not dependent on the grouping in the previous stage.

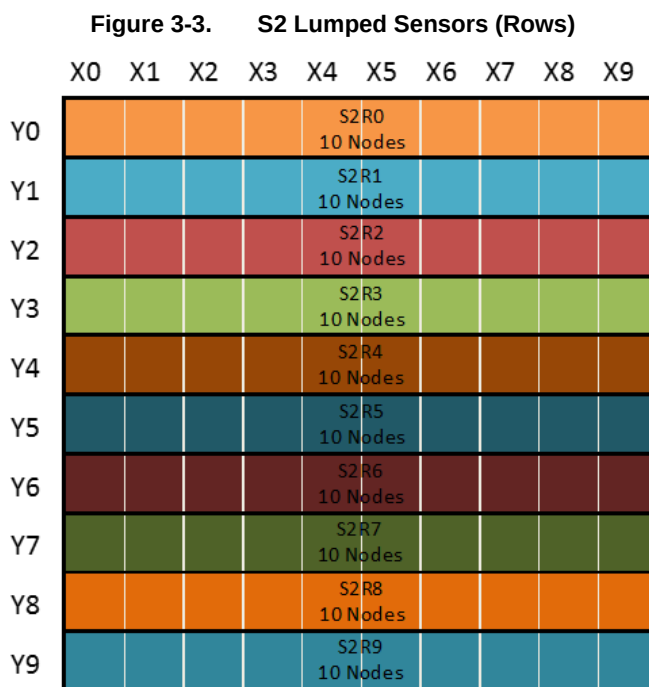
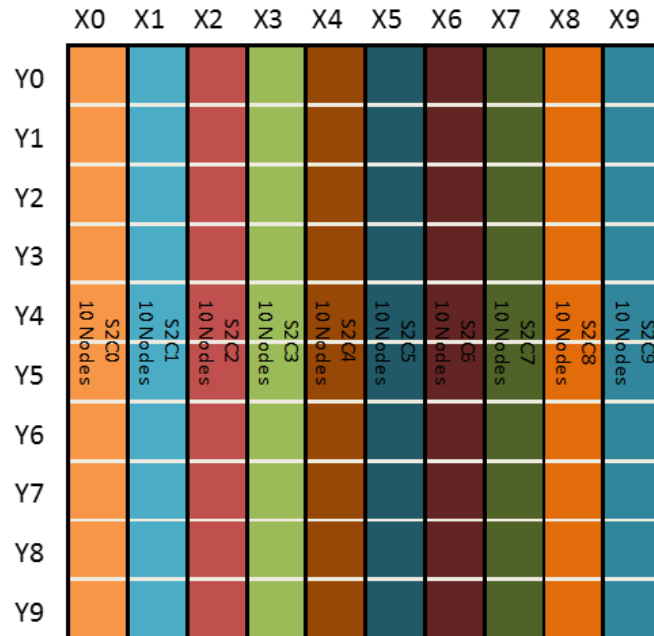


Figure 3-4. S2 Lumped Sensors (Columns)



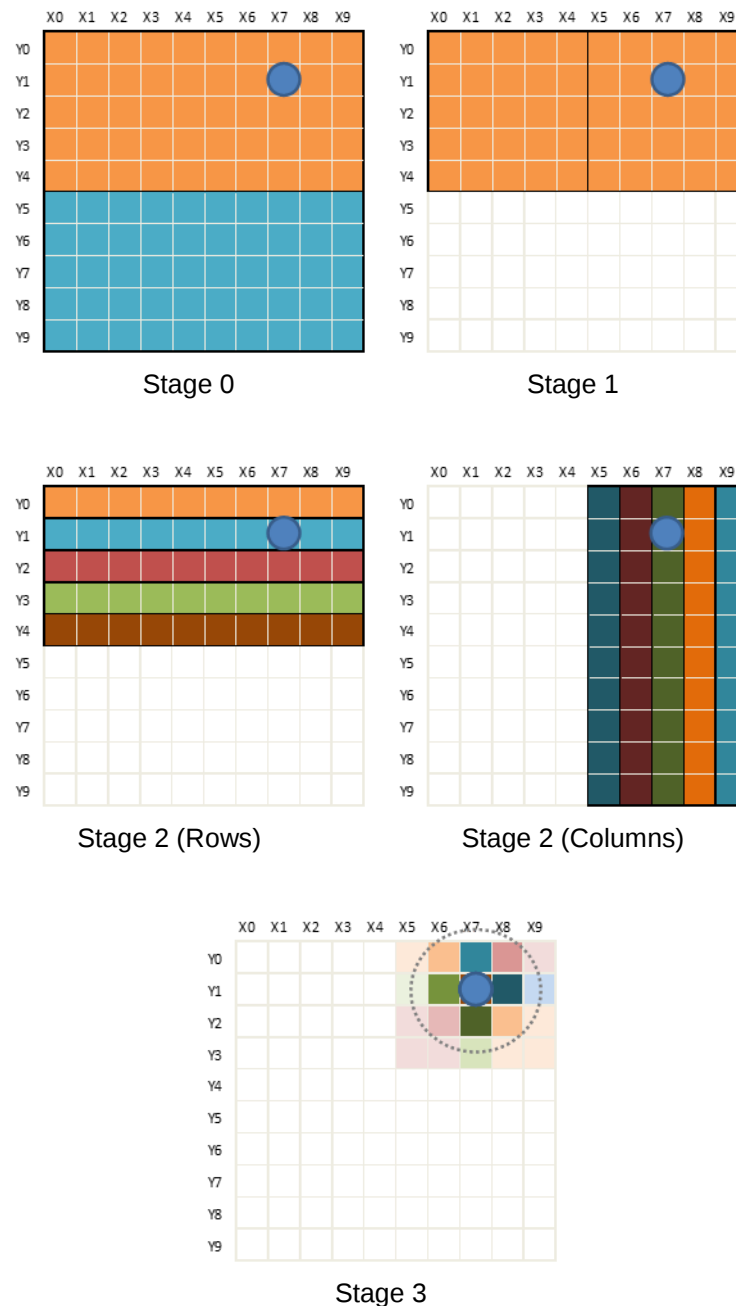
3.1.4 Individual Nodes (S3)

In this stage the individual nodes are measured. The specific nodes that are burst will depend on touch detection on the Lumped Sensors of the previous stages.

3.1.5 Optimized Bursting Illustration

Figure 3-5 illustrates the bursting pattern when a touch is present on node X7-Y1.

Figure 3-5. Optimized Bursting Illustration



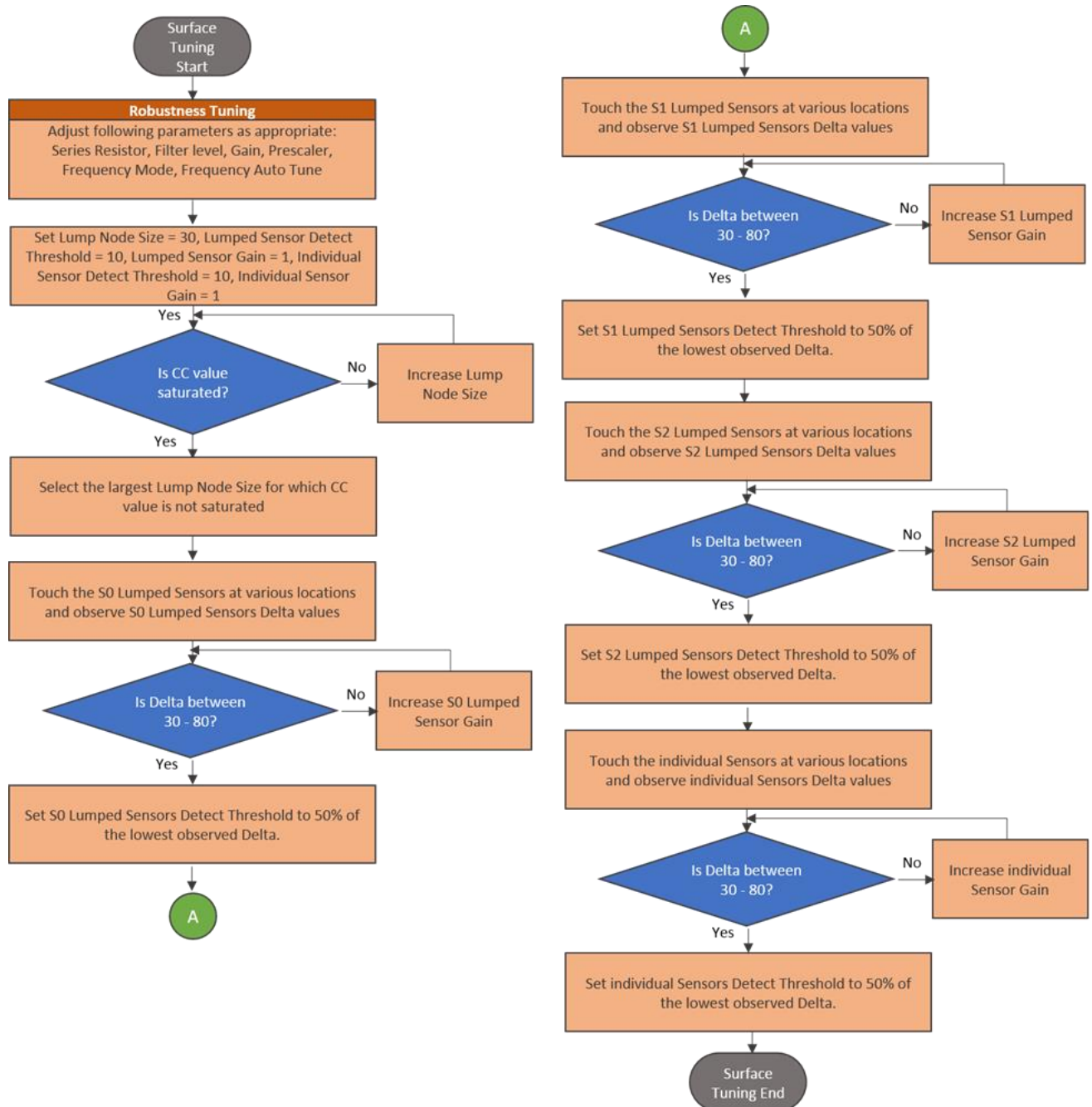
Bursting Steps:

1. When 'time_to_measure_touch' is 1, S0 bursting occurs on Lumped Sensors S00 and S01– A touch is detected on S00.
2. S1 bursting occurs on Lumped Sensors S10, S11 – Touch is detected on S11.
3. S2 bursting occurs on Lumped Sensors S2R0, S2R1, S2R2, S2R3, S2R4, S2C5, S2C6, S2C7, S2C8, S2C9 – Touch is detected on S2R1 and S2C7. X7-Y1 is identified as the touched node.
4. S3 bursting is done on X7-Y1 and surrounding individual nodes.

3.2 Tuning Procedure

Figure 3-6 shows the high level steps required to tune the QTouch Surface Library parameters to ensure optimal performance. Refer to [3] [PTC Robustness Design Guide](#) for details on tuning the robustness parameters.

Figure 3-6. Typical Tuning Flow



3.2.1 Lump Node Size

Select maximum number of channels that can be combined to form a Lumped Sensor. Increasing this will reduce power consumption. But if the parameter is too large, sensor CC value will be saturated.

Steps:

1. Set the Lumped Node size to a nominal value (e.g. 30).
2. Observe the CC value for the Lumped Node.
 - a. The CC value for each node is stored in 'p_cc_calibration_vals' array, in the p_mutlcap_measure_data structure.
3. If the CC value is not saturated ($< 0x3C00$), increase the Lumped Node Size.
4. If the CC value is saturated ($\geq 0x3C00$), decrease the Lumped Node Size.
 - a. Select the largest node size for which the CC value of all S0 channels is not saturated.

3.2.2 Gain and Detect Threshold for Individual Sensors

The Detect Threshold needs to be set for all the individual nodes in the 'touch_mutlcap_sensor_config()' function.

Steps:

1. Set the Detect Threshold to a nominal value (e.g. 10).
2. Set the Gain to a minimum value (GAIN_1).
3. Touch the Surface at various locations. Ensure that the Surface is touched directly on the node, between two adjacent nodes and between four adjacent nodes. Observe the Delta value for all the touches.
4. The touch Delta should be between 30 – 80 counts. If the value is below this, increase the Gain setting and repeat step 3.
5. Set the Detect Threshold to 50% of the lowest observed Delta.

3.2.3 Gain and Detect Threshold for Lumped Sensors

The Detect Threshold needs to be set for all the Lumped Sensors formed in the S0, S1, and S2 acquisition stages. This needs to be done in the 'touch_mutlcap_sensor_config()' function.

Steps:

1. Set the Detect Threshold to a nominal value (e.g. 10).
2. Set the Gain to a minimum value (GAIN_1).
3. Touch the Surface at various locations. Ensure that all the Lumped Sensors are touched. Observe the Delta value for all the touches.
4. The touch Delta should be between 30 – 80 counts. If the value is below this, increase the Gain setting and repeat step 3.
5. Set the Detect Threshold to 50% of the lowest observed Delta.

3.3 Library Parameter Configuration

Apart from the Gain and Detect Threshold the QTouch Surface Library provides various parameters for optimizing touch performance, power consumption and response time.

Table 3-1. QTouch Surface Library Parameters

Feature	Parameter	Range	Typical	Recommendations
Maximum Touches	DEF_SURF_MAX_TCH	1 – 2	1	- Setting the maximum touches to two will increase the response times and power consumption - Set to one if the use-case for multiple touches can be ignored
Lump Node Size	DEF_MAX_LUMP_SIZE	10 – 100	30	- Increasing Lump Node Size will allow fewer Sleep Channels and decrease power consumption - If the parameter is too large, sensor CC value will be saturated - Optimal Lump Node Size needs to be configured manually
Sleep Channels	DEF_SURF_NUM_SLEEP_CHANNELS	1 – 32	4	- Fewer sleep channels will decrease power consumption - This parameter is not editable by the user and will be set automatically based on the Lump Node Size
Sleep Channels Detect Threshold ⁽¹⁾	SURF_SLEEP_CHANNELS_DT	1-255	80	Common Detect Threshold for all the sleep channels (S0)
Segment Channels Detect Threshold ⁽¹⁾	SURF_SEGMENTS_DT	1-255	50	Common Detect Threshold for all the segment channels (S1)
Row Line Channels Detect Threshold ⁽¹⁾	SURF_ROW_LINE_DT	1-255	40	Common Detect Threshold for all the nodes along a row (S2)
Column Line Channels Detect Threshold ⁽¹⁾	SURF_COL_LINE_DT	1-255	40	Common Detect Threshold for all the nodes along a column (S2)
Individual sensor Detect Threshold ⁽¹⁾	SURF_IND_SEN_DT	1-255	20	Common Detect Threshold for all individual sensors (S3)
Detect Integration	DEF_SURF_DI	0 – 255	0	- Higher values will provide better immunity against noise spikes - Set this to the lowest value that provides sufficient spike filtering
Max On Duration	DEF_SURF_MAX_ON_DURATION	0 – 255	0	- This should be kept at the typical value - This can be changed if special circumstances need to be addressed
Towards Touch Drift Period	DEF_SURF_TCH_DRIFT_PERIOD	1 – 127	20	Reference value will be adjusted by one count for every unit of the drift period. Unit: 200ms.
Away From Touch Drift Period	DEF_SURF_ATCH_DRIFT_PERIOD	1 – 127	5	- Reference value will be adjusted by one count for every unit of drift period - Unit: 200ms
Measurement time (ms)	SURF_ACTIVE_TCH_SCAN_RATE_MS	0-1000	20	Scan Rate when touch is present
Off measurement period (ms)	SURF_NO_TCH_SCAN_RATE_MS	0-10000	100	Scan Rate when there is no touch

Feature	Parameter	Range	Typical	Recommendations
Low Power trigger wait time (ms)	<code>NO_ACTIVITY_TRIGGER_TIME</code>	0-50000	5000	Delay before low power mode is triggered when touch is present on the surface. This is applicable only when Low Power Mode is enabled.
DPI X Axis	<code>DEF_SURF_DPI_X</code>	50-160	160	- Dots per inch on X-axis - Number of position per inch displayed along X-axis
DPI Y Axis	<code>DEF_SURF_SIZE_IN_Y</code>	50-160	160	- Dots per inch on Y-axis - Number of position per inch displayed along Y-axis
Surface Size in X Axis (mm)	<code>DEF_SURF_SIZE_IN_X</code>	20-120	50	Total Surface Size along X-axis
Surface Size in Y Axis (mm)	<code>DEF_SURF_SIZE_IN_Y</code>	20-120	50	Total Surface Size along Y-axis
Surface Node Size in X Axis (mm) ⁽²⁾	<code>DEF_SURF_SENSOR_SIZE_IN_X</code>	4-10	5	Surface Node Size along X-axis. This is based on total surface size along X-axis. This will be calculated internally.
Surface Node Size in Y Axis (mm) ⁽²⁾	<code>DEF_SURF_SENSOR_SIZE_IN_Y</code>	4-10	5	Surface Node Size along Y-axis. This is based on total surface size along Y-axis. This will be calculated internally.
Total Position Resolution along X Axis ⁽²⁾	<code>DEF_SURF_TOT_RES_X</code>	0-319	50	- Number of positions displayed along X-axis for the whole surface. This is based on total surface size along X-axis. - This will be calculated internally
Total Position Resolution along Y Axis ⁽²⁾	<code>DEF_SURF_TOT_RES_Y</code>	0-319	50	- Number of positions displayed along Y-axis for the whole surface. This is based on total surface size along Y-axis. - This will be calculated internally

Notes: 1. Separate Detect Threshold can be set in source files.
2. These parameters are internally calculated based on DPI and Surface Size of X- and Y-axis. If any of these inter-related parameters are manually modified, the other parameters must also be modified appropriately.

3.4 Noise Robustness

The QTouch Surface Library provides the same robustness features that are available in the PTC library. The noise robustness of the system can be improved by adjusting the Filter Level, Auto Oversampling, Prescaler, and Sense Resistor.

Apart from these, the acquisition frequency can be configured by selecting among three available modes, namely Fixed Mode, Spread Mode, and Hop Mode. In Fixed Mode (`FREQ_MODE_NONE`), the fastest frequency is used to perform the acquisition. In Spread Mode (`FREQ_MODE_SPREAD`), the delay between acquisition pulses is varied in order to spread the acquisition frequency spectrum. In Hop Mode (`FREQ_MODE_HOP`), the library cycles through three pre-selected acquisition frequencies. In Hop Mode, if 'Frequency Auto-tune' is enabled, the acquisition frequency is dynamically changed depending on the amplitude and frequency of noise in the system.

Refer to [\[3\] PTC Robustness Design Guide](#) for more details about configuring the robustness features of the library.

4 Reference

- [1] QTouch Surface Library User Guide
http://www.atmel.com/Images/Atmel-42406-QTouch-Surface-Library-Peripheral-Touch-Controller_User-Guide.pdf
- [2] QTAN0079 Buttons, Sliders and Wheels - Sensor Design Guide
<http://www.atmel.com/Images/doc10752.pdf>
- [3] PTC Robustness Design Guide
http://www.atmel.com/Images/atmel-42360-ptc-robustness-design-guide_applicationnote_at09363.pdf
- [4] QTouch Library Peripheral Touch Controller - User Guide
http://www.atmel.com/Images/Atmel-42195-Qtouch-Library-Peripheral-Touch-Controller_User-Guide.pdf

5 Revision History

Doc Rev.	Date	Comments
42442A	04/2015	Initial document release.



Atmel Corporation 1600 Technology Drive, San Jose, CA 95110 USA T: (+1)(408) 441.0311 F: (+1)(408) 436.4200 | www.atmel.com

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