PY Touch PCB Design Guide

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The following table:

1. Touch Trace Rules

Traces between the touch MCU and touch buttons will increase the parasitic capacitance of the touch channel, thereby reducing touch sensitivity. In addition, touch traces can introduce external noise, affecting the signal-to-noise ratio and anti-interference performance of the touch channel. Therefore, good touch tracing is particularly important for touch control systems.

The spacing between touch channel traces should be at least 30mil.

Touch channel traces should be as thin as possible.

▶ There should be no touch traces under the touch buttons.

It is best not to route touch traces parallel to communication signal lines or periodic signal lines. These signal lines should be kept perpendicular to the touch traces as much as possible. If objective conditions require these signal lines to be parallel to the touch traces, the spacing between these signal lines and the touch traces should be increased, and the length of parallel traces should be shortened. It is best to design these signal lines and touch traces on different layers.

Touch traces should be as short as possible, which helps to improve button sensitivity and reduce system noise. To improve overall button sensitivity and ensure consistency, it is best to place the touch chip at the center of each button, which can minimize and maximize the length of each channel trace.

A resistor should be placed in series with the touch trace. The recommended resistance value is 4.3K. The resistor must be placed close to the MCU pin, and the distance from the chip pin should be less than 10mm.

2. Ground Plane Design

In touch applications, ground plane can shield external noise sources and stabilize the inherent capacitance of touch lines. A good ground plane can effectively improve the signal-to-noise ratio and anti-interference performance of touch. However, the ground plane will also increase the parasitic capacitance of the touch channel and reduce touch sensitivity. Therefore, the ground plane must follow certain rules to improve signal-to-noise ratio and anti-interference while ensuring sensitivity meets application requirements.

In touch applications, the ground plane should be a mesh ground instead of a solid ground. Compared with solid ground, mesh ground can achieve similar shielding effects while not excessively increasing the parasitic capacitance of the touch channel. The recommended mesh ground trace width is 8mil, and the spacing is 30mil.

Generally, in touch sensor devices, the blank area on the same layer can be filled with mesh ground.

In applications with high electromagnetic interference (such as walkie-talkie interference), the entire back layer of touch sensor devices can be filled with mesh ground.

The distance between the ground and touch channel traces should be at least 30mil.

Note: Touch sensor devices refer to capacitive sensing devices connected to the end of touch traces, such as metal PADs, flat springs, conductive cotton, etc.

3. **Button Design**

Buttons can be designed in various shapes, such as square, round, and triangular. The design principle for button shape and size is to maximize space utilization to achieve optimal sensitivity with the smallest button area. From this perspective, round buttons are best, followed by square ones. If PCB space allows, for round buttons, the recommended diameter is not less than 10mm. Except for special applications, the button size should not be too large. An excessively large size will not increase sensitivity but will introduce more external noise. Generally, the diameter of round buttons should not be greater than 15mm, and the side length of square buttons should not be greater than 15mm.

A certain spacing should be maintained between buttons. When a finger touches a button, adjacent buttons will also sense a certain capacitance. If the button spacing is too small, adjacent buttons may be accidentally touched when a finger touches a button. Usually, buttons should maintain a spacing of at least 10mm, and this spacing is also related to the covering material on the upper layer of the button. The thicker the covering material, the greater the button spacing should be.

In touch design, a covering layer is placed on the button. The covering layer can protect the touch sensor from external influences and prevent fingers from directly touching the metal sensor. The material and thickness of the covering layer will affect the sensitivity of the button. The formula for finger sensing capacitance is:

CF=E0Er A/D

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In the formula, E0 is the vacuum dielectric constant, Er is the relative dielectric constant of the covering material, A is the sensing area between the finger and the touch sensor, and D is the thickness of the covering material.

From the formula, it can be seen that button sensitivity is inversely proportional to the thickness of the covering material and directly proportional to the relative dielectric constant of the material.

The relative dielectric constants of covering layer materials are shown in the table below:

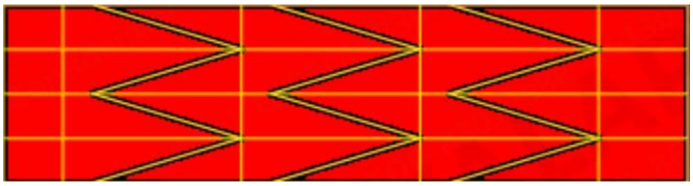
Material	ε_r (Relative Permittivity)
Air	1.0
Formica	4.6 – 4.9
Glass (standard)	7.6 – 8.0
Glass (ceramic)	6.0
PET film (Mylar®)	3.2
Polycarbonate (Lexan®)	2.9 – 3.0
Acrylic (Plexiglas®)	2.8
ABS	2.4 – 4.1
Wood and desktop	1.2 – 2.5
Slate (Stone plate)	2.5 – 6.0

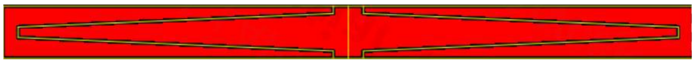
4. Slider/Wheel Design

The slider/wheel sensing PAD on the PCB is best designed as equally spaced and connected electrode blocks.
To ensure the resolution of the slider/wheel output position, the width of each sensing PAD should not exceed the width of a finger (7mm–15mm), and there should be a certain gap (0.5mm–1mm) between adjacent sensing areas.

4.1 Slider PCB Design

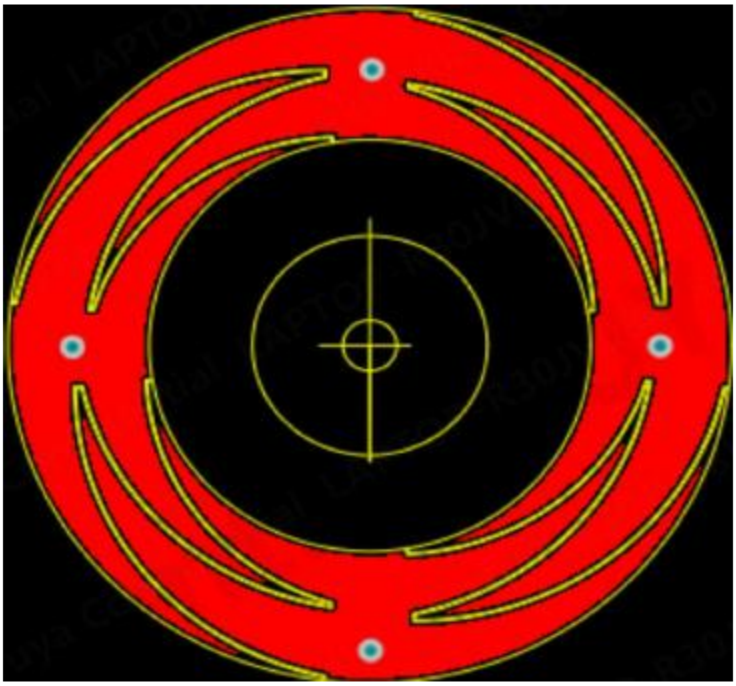
- The total length of the slider is determined based on the actual length of the sensing area. The total length usually needs to connect to 1 TK channel per 10–20 mm.
  The TK channel is used to drive the sensing PAD for signal transmission and detection. In a typical layout, each PAD is connected to a separate TK channel, and the number of PADs is usually N+1.
  Once the length is determined, the number of channels and the pitch between PADs can be determined accordingly.
- The transition area between the slider and wheel sensing PADs should not have excessive electrode width changes, to ensure smooth signal transitions between the front and rear ends of the finger.
  The width of the transition area should not be less than half the width of the normal sensing PAD.


4.1.1 "Slider model with a tooth pitch ratio of 2:3"


4.1.2"Slider model with a tooth pitch ratio of 1:2"

4.2 Wheel PCB Design

- The wheel can be implemented with a minimum of **3 channels**, but the most commonly used is **4 channels**.
- The wheel sensing **PADs** are interleaved in a circular pattern, and each sensing **PAD** should have the same shape.



4.2 – Wheel model using 4 channels