Capacitive Fingerprint Sensors

Technology and Patent Infringement Risk Analysis

Component A
iPhone 5S

Component B
Ascend Mate 7

Component C
Galaxy S5

Component D
Galaxy S6
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INTRODUCTION
Scope of the Study

This report provides a technology and patent infringement risk analysis of 4 capacitive fingerprint sensors designed by X, Company Y and Company Z and included in smartphones: Apple iPhone 5S, Huawei Ascend Mate7 and Samsung Galaxy S5 and S6.

Component A
(Company X)

Component B
(Company Y)

Component C
(Company Z)

Component B
(Company Z)

iPhone 5S

Ascend Mate 7

Galaxy S5

Galaxy S6

This report is focused on some aspects presenting similar features between the 4 selected products and revealed by the reverse engineering performed by System Plus Consulting. These product features are only related to the fingerprint sensor die, design and packaging. They are not related to the ASIC. They are not related to the electrical circuit of the sensing area nor the signal process as those features are not accessible by a tear down of the device.

Disclaimer: This report does not provide detailed claim charts and legal opinions regarding patent infringements. The risks of patent infringement highlighted in this report require more in-depth legal assessments to be confirmed.
Fingerprint sensors using capacitive technology represent a fast growing market, and it can be linked to the development of smartphone and other electronic devices. The fingerprint sensor vendor Idex forecasts an increase of 360% of the number of fingerprint sensor units in mobile devices and of the fingerprint sensor market between 2014 and 2017 (Source: N+1 Singer, Idex, 2014).

Various devices (external fingerprint scanners, cars, phones, computers, keyboards and the like,...) integrating a capacitive fingerprint sensor have been available on the market since the late 90's. However, those sensors lacked efficiency and were difficult to use.

But a new generation of capacitive fingerprint sensors has emerged in the last few years. More efficient and easy to use, less expansive, they have been incorporated in the last generations of smartphones of companies like Apple, Samsung or Huawei. This market growth is supported by a new phase of IP development, revealed by an increase in the number of new patents related to capacitive fingerprint sensor published since 2012 (Source: Knowmade, 2015).

AuthenTec, now part of Apple, is the 1st provider of fingerprint sensors for smartphone manufacturers (Fujitsu, Motorola, Philips, Apple,...). In 2013, for the 1st time, Apple included a fingerprint sensor in one of its devices, the iPhone 5S, following the acquisition of AuthenTec. In the last couple of years, other manufacturers relied upon others fingerprint sensors companies. In particular, the smartphone world leader Samsung choose a technology developed by Synaptics (Validity) and began to incorporate fingerprint scanners in its Galaxy products, including the Galaxy S5, in 2014. Launched in 2015, Samsung’s Galaxy S6 also included such a fingerprint sensor but slightly different from the 1st generation. For its part Huawei choose the Swedish company Fingerprint Cards to equip its Ascend Mate 7 released in 2015.

The fingerprint sensors found in the Apple iPhone 5S (AuthenTec), Huawei Ascend Mate 7 (Fingerprint Cards) and Samsung Galaxy S5 and S6 (Synaptics) represent 3 different technological choices but sharing common characteristics. Moreover, AuthenTec, Fingerprint Cards and Synaptics are the main actors in capacitive fingerprint sensing solutions for electronic devices. Thus the comparison of each fingerprint sensor with the technology developed by the two other companies would provide a deeper insight in the capacitive fingerprint sensor domain.
INTRODUCTION
Key Features of the Report

- This report provides a deep insight on technology data and manufacturing processes (teardown analysis) of Component A, Component B, Component C and Component D components, and comparative studies of product features.
- It provides patents related to the target product features and held by Apple, Fingerprint Cards and Synaptics.
- It provides discussions on the potential patent infringement risks by comparing relevant patent claim elements to the target product features and manufacturing processes.
- This report also provides an extensive Excel database with all patents analyzed in this study (26 patent families including more than 100 patents). This database allows multi-criteria searches:
  - Patent publication number
  - Hyperlinks to the original documents
  - Priority date
  - Title
  - Abstract
  - Patent Assignees
  - Legal status of the patent

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INTRODUCTION
Objectives of the Report

• Provide an overview of technology data and manufacturing process of Component A, Component B, Component C and Component D components supplied by Apple (AuthenTec), Fingerprint Cards, Validity and Synaptics.

• Find the technical and manufacturing process similarities and differences of Component A, Component B, Component C and Component D components.

• Identify key patents held by Apple (AuthenTec), Fingerprint Cards and Synaptics (Validity), and related to the target product features and manufacturing processes.

• Find the link between patented technological solutions and marketed products.

• Identify the potential infringing parties, and help to find evidence of use.

• Identify potential risks of patent infringement, and identify the patents which require a more in depth legal assessment.
INTRODUCTION

Methodology

Teardown Analysis
- Package is analyzed and measured.
- The dies are extracted in order to get overall data: dimensions, main blocks, pad number and pin out, die marking.
- Setup of the manufacturing process.

Comparative Study
- The similarities and differences of target of products are identified (product features and manufacturing processes).
- A set of product features and manufacturing processes is selected regarding their interest in terms of IP study.

Patent Search
- Patents are extracted from Questel-Orbit worldwide patent database by using keyword-based queries.
- The selection of relevant patents is done manually by expert review of the subject-matter of inventions.
- The patents are manually categorized regarding the selected product features.

Infringement Risks
- The links between the patented technologies and the target product features are established.
- The potential infringing parties of the target product are identified, and the potential risks of patent infringements are discussed.
INTRODUCTION

Methodology

• The data were extracted from the FamPat worldwide database (Questel-ORBIT) which provides 90+ million patent documents from 95 offices.
• The patents search was performed in September 2015, hence patents published after this date will not be available in this report.
• The patent selection was done manually.

**Number of selected patent families for capacitive fingerprint sensor technologies IP Investigation:**
26 over a number of returned results > 900

• The statistical analysis was performed with Questel Orbit IP Business Intelligence software.
• The patents were manually categorized using keyword analysis of patent title, abstract and claims, in conjunction with expert review of the subject-matter of inventions.
• The patents were organized according to FamPat’s family rules (variation of EPO strict family): A Patent Family comprises patents linked by exactly same priority numbers (strict family), plus comparison of priority and application numbers, specific rules by country and information gathered from other sources (national files, legal status ...).

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### Patent Search Strategy

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<tr>
<th>Step</th>
<th>Search Equation</th>
<th>Results</th>
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<td><strong>Patent Related to Capacitive Fingerprint Sensor</strong></td>
<td>(XXX OR XXX)/BI/CLMS/DESC AND (XXX OR XXX OR XXX)/BI/CLMS/DESC AND (AUTHENTEC OR APPLE OR FINGERPRINT CARDS OR SYNAPTICS OR VALIDITY)/PA.FLD</td>
<td>&gt;900</td>
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<tr>
<td><strong>Manual Selection</strong></td>
<td><strong>SELECTED PATENT FAMILIES</strong></td>
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- **+** Truncation replacing any number of characters
- **?** Truncation replacing zero or one character
- **#** Truncation replacing one character
- **_** Truncation for word that may have a space (ex: semiconductor, semi conductor)
- **OR** Finds references containing at least one of the words
- **AND** Finds references containing all words
- **S** Finds references containing the terms in the same sentence
- **nD** Finds references containing adjacent terms, regardless of the order, and may be separated by a maximum of n words
- **nW** Finds references containing adjacent terms, in the order specified, and may be separated by a maximum of n words
- **( )** Parentheses are necessary to combine different operators
- **/TI/OTI** Search in Title
- **/BI** Search in Title and Abstract
- **/CLMS** Search in Claims
- **/DESC/ODES** Search in Description
- **/PA.FLD** Search in Patent Assignees
- **/IC** Search in International Patent Classification (IPC)
The **Component A** fingerprint sensor from **Company A** is integrated in the home button of the **Apple iPhone 5S**. The iPhone 5S was launched in 2013. The sensor features a square shape with a resolution of xx pixels and pixel density of xx ppi. It uses a capacitive touch technology. The sensor array is composed of XXX capacitor plates mounted on a XXX substrate and covered by a protective XXX. The sensor die is XXX to a XXX substrate.

**Source:** System Plus
TEAR DOWN
Physical Analysis Methodology

This report is focused on some aspects presenting similar features between the 4 selected products and revealed by the reverse engineering performed by System Plus Consulting. These product features are only related to the fingerprint sensor die, design and packaging. They are not related to the ASIC.

- **Step 1**: Package is analyzed and measured
- **Step 2**: The dies are extracted in order to get overall data: dimensions, main blocks, pad number and pin out, die marking
- **Step 3**: Setup of the manufacturing process
TEAR DOWN

Packaging

**Component A**  
*Company X*
- Capacitive touchscreen
- Metal cover ring
- Casing with integrated ESD shield
- Backing sheet plate

**Component B**  
*Company Y*
- LCP package and encapsulation materials
- Aluminum ring
- Marantec motor ring
- Wiring for connection to integrated PCB and bonded to a thin PCB by solder paste
- Pressure sensitive

**Component C**  
*Company Z*
- Plastic rubber seal, Aluminum ring
- Sealing site is nominated to the AIC, after the component performed and to be adhered to the substrate
- AIC side is implemented byAIC paste
- Pressure sensitive gasket

**Component D**  
*Company Z*
- Plastic rubber seal, Aluminum ring
- Sealing site is nominated to the AIC, after the component bonded to the substrate, and is to be adhered to the substrate
- AIC side is implemented by pressure sensitive adhesive and thin PCB
- Pressure sensitive gasket
In this technology and patent infringement risk analysis, we have chosen the 3 following levels for characterizing the potential risk of patent infringement.

- **Unlikely infringement**: The product features being investigated do not reproduce any elements of the patent’s claims.
- **Likely infringement**: The product features being investigated reproduced at least partly one element of the patent’s claims.
- **Highly likely infringement**: The product features being investigated reproduced at least one element of the patent’s claims.
**PATENT ANALYSIS**
Component A – Patent Identification

**TEARDOWN**

- iPhone 5S home button assembly

**IDENTIFIED PATENT FAMILIES**

- **US**

  - (2013) - Environmental

  - An environmental

  - The button assembly 500 includes

  - Patent pending in the USA
PATENT ANALYSIS
Component A – Patent Infringement Risk

Component A Features
Company X

The sensing elements are covered with a layer of

The sensing surface is covered with an

Intellectual Property Rights
Company Y

Pending application: WO 2015/00001
Title: Method of
Scope of the main claim:
A fingerprint sensing device comprising:

Fig. 2b
PATENT ANALYSIS
Component A – Patent Infringement Risk

Component A Features
Company X

The fingerprint sensor is included in

The sensor is placed

The sensor comprises:

home button – cross section

home button assembly with gasket and tactile
switch removed (top) and flex circuit unfolded (bottom)

Highly Likely
Infringement

Intellectual Property Rights
Company Z

Granted patent: US
Pending applications: GB, DE, IT, JP, KR, SE, TW

Title: Fingerprint sensor
Scope of the main claim:
An electronic device user interface comprising:

Scope of dependent claims:
claims 3 and 4: flexible circuit
claim 6:
claim 7:
claim 8:
claim 10:
CONCLUSIONS

SUMMARY OF PATENT INFRINGEMENT RISK

The fingerprint sensor Component A shows a high risk of infringement regarding 3 patents owned by Company Z and a medium risk of infringement regarding 1 patent belonging to Company Y.

The sensor Component B has a risk of infringement towards 4 patents owned by Company X and a medium risk for a patent of Company Z.

Both sensors Component C & D show a risk of infringement regarding 3 patents belonging to Company X portfolio.
26 patent families composed of more than 100 patents.
This database allows multi-criteria searches and includes patent publication number, hyperlinks to the original documents, priority date, title, abstract, patent assignees, legal status for each member of the patent family.
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  - Non-Volatile Memory

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  - Infrared Imaging

- Patent Investigation (crossed analysis based on Knowmade & Yole Développement expertise)
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  - MEMS Gyroscope
  - 6-axis & 9-axis Inertial MEMS IMUs
  - Microbatteries
  - Embedded Active & Passive Packages
  - Interposer
  - Phosphors for LED

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