RF Front-End Module & Components Comparison

Apple iPhone X, Apple iPhone 8 Plus, Apple Watch Series 3, Samsung Galaxy S8, Huawei P10, Xiaomi Mi6, ASUS Zenfone 4 Pro, Sony Xperia XZs

RF report by Stéphane ELISABETH
April 2018 – version 1
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Executive Summary

This comparative technology study has been conducted to provide insight on technology data for RF Front-End modules in Smartphones and a new Smartwatch. The report includes the study of at least 40 Front-End Modules and several components found in eight flagship smartphones: Apple Watch Series 3, Apple iPhone 8 Plus, Apple iPhone X (US vs. Japanese version), Samsung Galaxy S8 Edge (US vs. European version), Huawei P10, Asus Zenfone 5 Pro, Sony Xperia XZs and Xiaomi Mi6.

With teardowns of a large variety of smartphones and one smartwatch, the main RF Modules have been extracted and physically analyzed. Sizes and technologies are studied to provide a large panel of OEM technical and economical choices and an overview of the market. Skyworks is now a major player along with Broadcom/Avago but several other players like Qorvo, Murata, Epcos/TDK also exist and have been analyzed.

The report includes a description of each component and statistical analyses for most of front-end modules. It also tries to explain the OEMs choice and the supplier tendencies.

Note: Wifi and Bluetooth Module analyses are not included in this report
Apple Smartphone History & RF Major Players

Apple try and succeed to developed one processor each year in order to improve the last series or to propose a new series. Using two different modem, the RFFE suppliers are different.

<table>
<thead>
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<th>2016</th>
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<th>Q4 2017</th>
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Apple iPhone X Teardown

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Apple iPhone X RF Components Summary

<table>
<thead>
<tr>
<th>RF Components (Marking)</th>
<th>Manufacturer</th>
<th>Type</th>
<th>Dimensions</th>
<th>Area</th>
<th>RF Board Proportion</th>
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<td>Low-Band PAMID</td>
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<td>Quintplexer</td>
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Total

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<th>RF Components (Marking)</th>
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<th>Area</th>
<th>RF Board Proportion</th>
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<td>FEMiD</td>
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<td>Broadcom</td>
<td>Quintplexer</td>
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</tbody>
</table>

Total
Smartphone Comparison – Area Distribution per Supplier

Area Repartition

- Broadcom
- Qorvo
- TDK-Epcos
- Skyworks
- Murata
- Total

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Apple - iPhone X - A1902
Apple - iPhone X - A1901
Apple - Watch Series 3
Samsung Galaxy S8 - SM950F
Samsung Galaxy S8 - SM950U1
Huawei P10
Sony Xperia XZs
Asus ZenFone 4 Pro
Xiaomi Mi6

RF Board Area:

Market Analysis
- Apple iPhone X Physical Analysis
- Apple Watch Physical Analysis
- Samsung Galaxy S8 Physical Analysis
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RFFE report 2017 vs. 2018 – Apple iPhone Series

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RF Components Market Forecast

![RF Components Market 2015-2022 (in $M)](image)

*Courtesy of Yole Development*

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  - Band History
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- [Xiaomi Mi6 Physical Analysis](#)
- [Feedbacks](#)
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AFEM-8072 – Package View & Dimensions

- Package Type:
- Dimensions:
- Pin Pitch:

Marking: <Logo Avago>
8072JD284
738
KM

Package Top View – Optical View
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Package Side View – Optical View
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AFEM-8072 – Package Opening

- SMD components
- Flip-Chip Die
- Bare Die
- Wire bonding
- Package Top View – Optical View

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AFEM-8072 – EMI Shielding

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Apple iPhone X Physical Analysis
  - Synthesis
    - A1902
      - AFEM-8072
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      - SKY77366
      - SKY13760
      - SKY13762
    - A1901
      - AFEM-8056
      - AFEM-8066
      - QM76041
      - DS353
      - SKY13764
      - SKY13767
      - N
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AFEM-8072 – Active devices – Power Amplifier

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      - AFEM-8072
      - SKY78140
      - SKY77366
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      - QM76041
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      - SKY13764
      - SKY13767
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    - SKY77366
    - SKY13760
    - SKY13762
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    - SKY113764
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- A1901

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AFEM-8072 – Active devices – SPxT Switch

Package Top View – Optical View
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Switch Top View – Optical View
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- Die Area:
- Die Marking:
- Die Substrate:
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- Synthesis
  - A1902
    - AFEM-8072
    - SKY78140
    - SKY77366
    - SKY13760
    - SKY13762
  - A1901
    - AFEM-8056
    - AFEM-8066
    - QM76041
    - DS353
    - SKY13764
    - SKY13767
    - N

Apple Watch Physical Analysis

Samsung Galaxy S8 Physical Analysis

Huawei P10 Physical Analysis

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- A1902
  - AFEM-8072
  - SKY78140
  - SKY77366
  - SKY13760
  - SKY13762

- A1901
  - AFEM-8056
  - AFEM-8066
  - QM76041
  - DS535
  - SKY13764
  - SKY13767
  - N

Matching IC Top View – Optical View
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Package Top View – Optical View
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• Die Area:

• Die Marking:

• Die Substrate:
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- Synthesis
  - A1902
    - AFEM-8072
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  - AFEM-8056
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Apple Watch Physical Analysis

Samsung Galaxy S8 Physical Analysis

Huawei P10 Physical Analysis

Sony Xperia XZs Physical Analysis

Asus ZenFone 4 Pro Physical Analysis

Xiaomi Mi6 Physical Analysis

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    - SKY77366
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  - SKY13764
  - SKY13767
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Apple Watch Physical Analysis
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Huawei P10 Physical Analysis
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Xiaomi Mi6 Physical Analysis
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Die Number Repartition

Die Area Repartition
### Apple iPhone X Physical Data Summary – A1902

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*NB. For Die/Component number*
Related Reports

REVERSE COSTING ANALYSES - SYSTEM PLUS CONSULTING

RF
- Broadcom AFEM-8072 – Mid and High Band LTE RF Front-End Module (FEM)
- Advanced RF SiPs for Cell Phones: Reverse Costing Overview

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RF
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- RF Front End Modules and Components for Cellphones
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