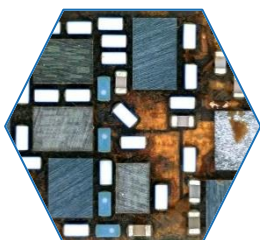
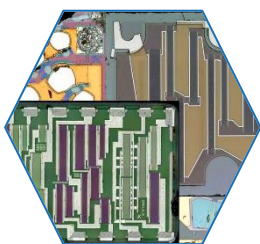
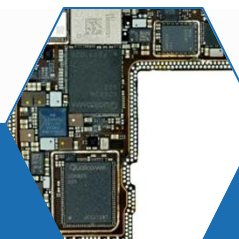




## RF Front-End Module Comparison 2021 – Vol. 1 – Focus on Apple

*Technical and cost overview of the evolution of the radio frequency front-end module technologies integrated in the Apple iPhone series from 2016 - 2020.*



Last year, System Plus opened hundreds of front-end modules (FEMs) and components to provide an overview of the radio frequency (RF) FEM market in select flagship smartphones. The information was gathered in four reports, ranging from player's evolution to World Area Analysis. This provided an excellent means of tracking this technology market's evolution.

This year, System Plus Consulting will again offer different volumes of technical and cost comparisons of smartphone RFFEMs. Each comparison report will focus on a specific subject – for example, a player's evolution, a specific technology, or a comparison of flagship devices.

In this first volume of 2021, we provide insights into technology and cost data for FEMs and several components found in 18 smartphones from the Apple iPhone series since 2016. This includes a comprehensive overview of the RFFEM architectures on the market that compare available smartphones from these companies. Apple's dependency on specific component manufacturers is revealed, along with the different choices for integration of communication technology, even millimeter wavelength (mmWave) signal support in the latest generation. We also reveal how the company maintains its leadership on the premium market.

Through these smartphone teardowns, the main RF modules and components have been extracted and physically analyzed, from the output of the

transceiver to the antenna. Packaging, sizes, and technologies are studied as well, providing a large panel of technical and economic choices and an overview of the market.

Every component has been analyzed to understand the manufacturing process cost.

This report also includes a technical and cost comparison of the modules and seeks to explain the smartphone makers' choices and supplier tendencies. All RFFEM are integrated in this report, from baseband to antenna tuner, on 5G, 4G, Wifi, BT, GPS, and UWB.

### COMPLETE TEARDOWN WITH

- Detailed photos
- Precise measurements
- Module opening
- Die measurements
- Detailed technical and cost analysis of 45 components
- Complete bills-of-materials (boms) for the modules
- Comparison between suppliers
- Comparison between oems
- Cost comparisons

**Title:** RF Front-End Module Comparison 2021 – Vol. 1 – Focus on Apple

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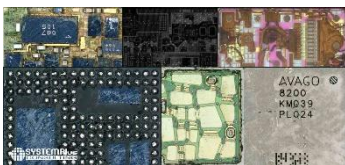


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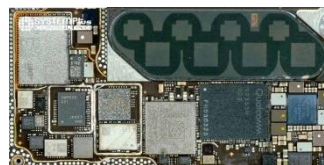
## RELATED ANALYSES



### Broadcom AFEM-8200 PAMiD in the Apple iPhone 12 Series

*Deep dive analysis of the fourth generation of mid/high band front-end module for 4G and 5G from Broadcom.*

February 2021 - EUR 3,990\*



### Apple iPhone 12 series mmWave 5G Chipset and Antenna

*A study of the complete first generation of the 5G millimeter-wave chipset for Apple's phones including custom antenna, FEM and antenna-on-package.*

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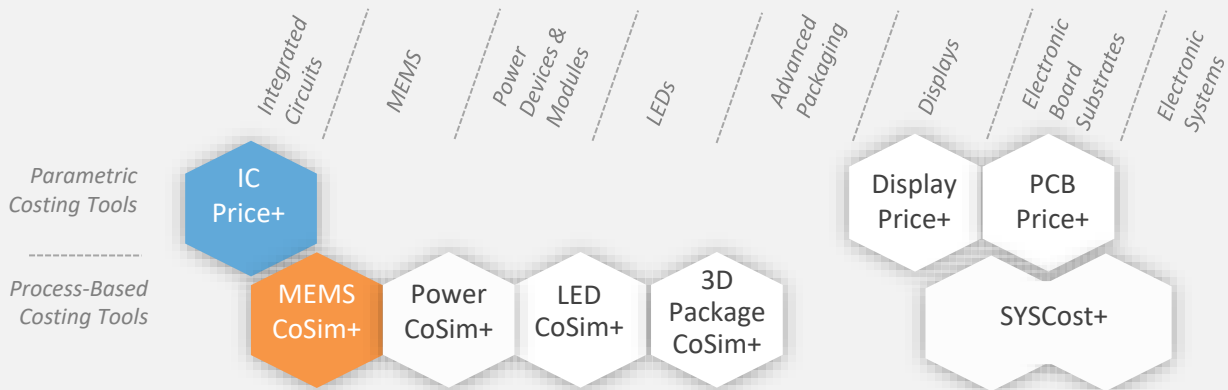


### 5G's Impact on RF Front-End and Connectivity for Cellphones 2020

*An intensifying US-China competition for RF technology supremacy.*

September 2020 - EUR 6,490\*

## COSTING TOOLS



Our analysis is performed with our costing tools IC Price+ and MEMS CoSim+.

System Plus Consulting offers powerful costing tools to evaluate the production cost and selling price from single chip to complex structures.

### IC Price+

The tool performs the necessary cost simulation of any Integrated Circuit: ASICs, microcontrollers, memories, DSP, smartpower...

### MEMS CoSim+

The costing tool is process-based to evaluate the manufacturing cost per wafer using your own inputs or using the pre-defined parameters included in the tool.

## ABOUT SYSTEM PLUS CONSULTING

## WHAT IS A REVERSE COSTING®?

Reverse Costing® is the process of disassembling a device (or a system) in order to identify its technology and calculate its manufacturing cost, using in-house models and tools.



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System Plus Consulting is specialized in the cost analysis of electronics from semiconductor devices to electronic systems.

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# TERMS AND CONDITIONS OF SALES

## 1. INTRODUCTION

The present terms and conditions apply to the offers, sales and deliveries of services managed by System Plus Consulting except in the case of a particular written agreement.

Buyer must note that placing an order means an agreement without any restriction with these terms and conditions.

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Prices of the purchased services are those which are in force on the date the order is placed. Prices are in Euros and worked out without taxes. Consequently, the taxes and possible added costs agreed when the order is placed will be charged on these initial prices.

System Plus Consulting may change its prices whenever the company thinks it necessary. However, the company commits itself in invoicing at the prices in force on the date the order is placed.

## 3. REBATES and DISCOUNTS

The quoted prices already include the rebates and discounts that System Plus Consulting could have granted according to the number of orders placed by the Buyer, or other specific conditions. No discount is granted in case of early payment.

## 4. TERMS OF PAYMENT

System Plus Consulting delivered services are to be paid within 30 days end of month by bank transfer except in the case of a particular written agreement.

If the payment does not reach System Plus Consulting on the deadline, the Buyer has to pay System Plus Consulting a penalty for late payment the amount of which is three times the legal interest rate. The legal interest rate is the current one on the delivery date. This penalty is worked out on the unpaid invoice amount, starting from the invoice deadline. This penalty is sent without previous notice.

When payment terms are over 30 days end of month, the Buyer has to pay a deposit which amount is 10% of the total invoice amount when placing his order.

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System Plus Consulting remains sole owner of the delivered services until total payment of the invoice.

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The delivery schedule on the purchase order is given for information only and cannot be strictly guaranteed. Consequently any reasonable delay in the delivery of services will not allow the buyer to claim for damages or to cancel the order.

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The transport costs and risks are fully born by the Buyer. Should the customer wish to ensure the goods against lost or damage on the base of their real value, he must imperatively point it out to System Plus Consulting when the shipment takes place. Without any specific requirement, insurance terms for the return of goods will be the carrier current ones (reimbursement based on good weight instead of the real value).

## 8. FORCE MAJEURE

System Plus Consulting responsibility will not be involved in non execution or late delivery of one of its duties described in the current terms and conditions if these are the result of a force majeure case. Therefore, the force majeure includes all external event unpredictable and irresistible as defined by the article 1148 of the French Code Civil?

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As a rule, all information handed by customers to system Plus Consulting are considered as strictly confidential. A non-disclosure agreement can be signed on demand.

## 10. RESPONSABILITY LIMITATION

The Buyer is responsible for the use and interpretations he makes of the reports delivered by System Plus Consulting. Consequently, System Plus Consulting responsibility can in no case be called into question for any direct or indirect damage, financial or otherwise, that may result from the use of the results of our analysis or results obtained using one of our costing tools.

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Any dispute that may arise about the interpretation or execution of the current terms and conditions shall be resolved applying the French law.

If the dispute cannot be settled out-of-court, the competent Court will be the Tribunal de Commerce de Nantes.