



Camera Module Comparison 2021 Vol. 2 – Apple iPhone Evolution

Apple's camera design choices from the iPhone 6S Plus to the 12 Pro Max.

Over 1.3B smartphones shipped in 2020, and 15% of those were iPhones. Apple is widely considered an innovation leader, and iPhone cameras are consistently ranked among the best in the industry. Continuing our series of camera module comparison reports, we summarize the results of detailed physical analyses and costing studies to compare the cameras of the iPhone 6S Plus, 7 Plus, 8 Plus, X, XS Max, 11 Pro Max, and 12 Pro Max. This report aims to offer insight into the physical and cost evolution of the camera modules and CMOS image sensors in the last six years of Apple flagship smartphones.

The analysis covers the rear and front-facing RGB camera modules as well as the front-facing Near Infrared (NIR) module. This includes the complete structure, design, and all components of the camera modules. It covers the dimensions, technology nodes and stacking technology in the CMOS image sensors. The rear-facing LiDAR camera in the 12 Pro Max is not covered, but the reader is encouraged to discover the essentially identical LiDAR module in the related report SP20557 - Apple iPad Pro LiDAR Module.

Over the years, the rear camera has evolved with the market trend from a single to dual and finally a triple camera system. The front camera has also evolved

from a single camera to the dual-camera TrueDepth system. The overall design of the AutoFocus/Optical Image Stabilisation (AF/OIS) system has remained very consistent until the introduction of Sensor-shift OIS in the iPhone 12 Pro Max. See our dedicated report SPR21611 - Apple iPhone 12 Pro Max Rear Camera for a deep dive into this technology.

All rear sensors have 12 megapixels (Mp) despite the trend among other leading OEMs to go as high as 108 Mp. This has allowed Apple to sometimes retain image sensors between iPhone generations while improving camera performance from module upgrades and algorithm tweaks.

COMPLETE TEARDOWN WITH

- Detailed photos
- Precise measurements
- Module cross-sections
- Sensor cross-sections
- Sensor measurements
- Manufacturing process flow
- Supply chain evaluation
- Manufacturing cost analysis
- Physical comparisons
- Cost and price comparisons

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AUTHORS



Peter Bonanno, PhD. is a Technology & Cost Analyst, Imaging at System Plus Consulting. With a strong expertise in the field of imaging and optical sensors, Peter performs reverse engineering & costing analyses as well as custom projects.



Véronique Le Troadec has joined System Plus Consulting as a laboratory engineer. Coming from Atmel Nantes, she has extensive knowledge in failure analysis of components and in deprocessing of integrated circuits.



Guillaume Chevalier has joined System Plus Consulting in 2018 to perform physical analyses. He holds a degree in technology of physical measurements and instrumentation technics, and previously worked for four years for chemistry, mechanical and mass-metrology laboratories.

RELATED ANALYSES



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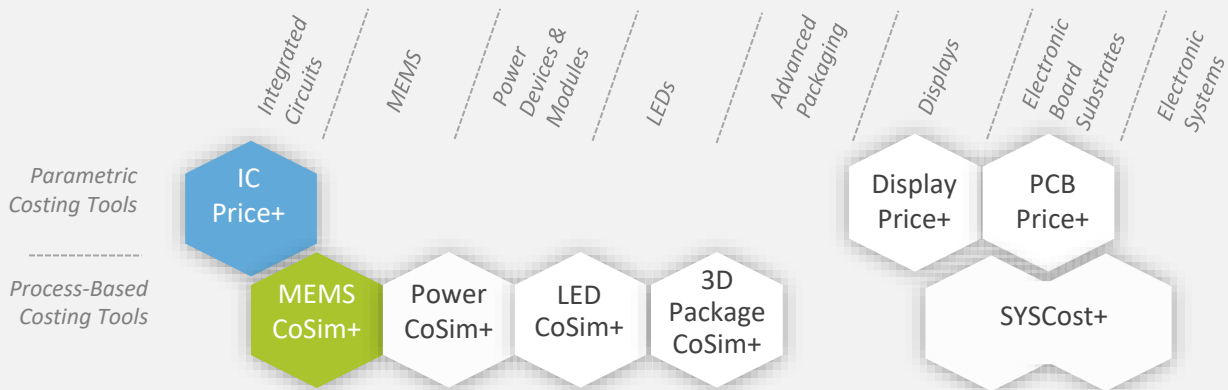


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CONTACTS

Headquarters
22, bd Benoni Goullin
Nantes Biotech
44200 Nantes
France
+33 2 40 18 09 16
sales@systemplus.fr

Europe Sales Office
Lizzie LEVENEZ
Frankfurt am Main
Germany
+49 151 23 54 41 82
llevenez@systemplus.fr

America Sales Office
Steven LAFERRIERE
Western USA & Canada
+1 310-600-8267
laferriere@yole.fr

Chris YOUMAN
Eastern USA & Canada
+1 919-607-9839
chris.youman@yole.fr

Asia Sales Office
Takashi ONOZAWA
Japan & Rest of Asia
+81 80 4371 4887
onozawa@yole.fr

Mavis WANG
Greater China
TW +886 979 336 809
CN +8613661566824
wang@yole.fr

Peter OK
Korea
+82 10 4089 0233
peter.ok@yole.fr

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1.2 This agreement becomes valid and enforceable between the Contracting Parties after clear and non-equivocal consent by any duly authorized person representing the Buyer. For these purposes, the Buyer accepts these conditions of sales when signing the purchase order which mentions "I hereby accept Yole Développement's Terms and Conditions of Sale". This results in acceptance by the Buyer.

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- Within a reasonable time for Products ordered prior to their effective release. In this case, the Seller shall use its best endeavours to inform the Buyer of an indicative release date and the evolution of the work in progress.

2.2 The Seller shall by no means be responsible for any delay in respect of article 2.1 above, and including in cases where a new event or access to new contradictory information would require for the analyst extra time to compute or compare the data in order to enable the Seller to deliver a high quality Products.

2.3 The mailing of the Product will occur only upon payment by the Buyer, in accordance with the conditions contained in article 3.

2.4 The mailing is operated through electronic means either by email via the sales department or automatically online via an email/password. If the Product's electronic delivery format is defective, the Seller undertakes to replace it at no charge to the Buyer provided that it is informed of the defective formatting within 90 days from the date of the original download or receipt of the Product.

2.5 The person receiving the Products on behalf of the Buyer shall immediately verify the quality of the Products and their conformity to the order. Any claim for apparent defects or for non-conformity shall be sent in writing to the Seller within 8 days of receipt of the Products. For this purpose, the Buyer agrees to produce sufficient evidence of such defects.

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3.2 Payments due by the Buyer shall be sent by cheque payable to Yole Développement, credit card or by electronic transfer to the following account:

HSBC, 1 place de la Bourse 69002 Lyon France

Bank code: 30056

Branch code: 00170

Account n°: 0170 200 1565 87

BIC or SWIFT code: CCFRFRPP

IBAN: FR76 3005 6001 7001 7020 0156 587

To ensure the payments, the Seller reserves the right to request down payments from the Buyer. In this case, the need of down payments will be mentioned on the order.

3.4 Payment is due by the Buyer to the Seller within 30 days from invoice date, except in the case of a particular written agreement. If the Buyer fails to pay within this time and fails to contact the Seller, the latter shall be entitled to invoice interest in arrears based on the annual rate Refi of the «BCE» + 7 points, in accordance with article L. 441-6 of the French Commercial Code. Our publications (report, database, tool...) are delivered only after reception of the payment.

3.5 In the event of termination of the contract, or of misconduct, during the contract, the Seller will have the right to invoice at the stage in progress, and to take legal action for damages.

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4.2 The Seller shall only be liable for (i) direct and (ii) foreseeable pecuniary loss, caused by the Products or arising from a material breach of this agreement

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- a) Damages of any kind, including without limitation, incidental or consequential damages (including, but not limited to, damages for loss of profits, business interruption and loss of programs or information) arising out of the use of or inability to use the Seller's website or the Products, or any information provided on the website, or in the Products;
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4.8 The Seller does not make any warranties, express or implied, including, without limitation, those of sale ability and fitness for a particular purpose, with respect to the Products. Although the Seller shall take reasonable steps to screen Products for infection of viruses, worms, Trojan horses or other codes containing contaminating or destructive properties before making the Products available, the Seller cannot guarantee that any Product will be free from infection.

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The Seller shall not be liable for any delay in performance directly or indirectly caused by or resulting from acts of nature, fire, flood, accident, riot, war, government intervention, embargoes, strikes, labour difficulties, equipment failure, late deliveries by suppliers or other difficulties which are beyond the control, and not the fault of the Seller.

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- Posting any Product to any other online service (including bulletin boards or the Internet);
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6.7 As a matter of fact the investor of a company, external consultants, the joint venture done with a third party, and so on cannot access the report and should pay a full license price.

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Any notices under these Terms and Conditions shall be given in writing. They shall be effective upon receipt by the other Party.

The Seller may, from time to time, update these Terms and Conditions and the Buyer, is deemed to have accepted the latest version of these terms and conditions, provided they have been communicated to him in due time.

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