

# Reverse Costing® CATALOGUE



## REVERSE COSTING®

A complete set of information to understand the technology and cost of the electronic devices on the market. System Plus Consulting Reverse Costing® reports are based on in-house developed methodology and costing tools which ensure their single format. The full collection is regularly updated on our website. These reports can be ordered individually or under our Annual Subscription.

## IMAGING

Ref.	Date Pages	Manufacturer Product	Type of Product	Overview
<b>VISIBLE</b>				
SP20518	2020/2 117	<b>Sony</b>	ToF Sensing Solution	Deep analysis of the rear 3D sensing module with Sony's CIS and Lumentum's flood illuminator.
SP20515	2020/4 114	<b>Omnivision</b> OVM6948	CameraCubeChip	Costs and estimates prices for the OVM6948 CameraCubeChip.
SP20505	2020/8 237	<b>Samsung</b>	Smartphone Camera Module Comparison	Evolution of Samsung's smartphone camera since 2016 with detailed technical and cost analyses of the Galaxy S20 Ultra, Galaxy S10+, Galaxy S9+, Galaxy S8, Galaxy S7
SP20484	2020/1 127	<b>Samsung</b>	3D TOF Depth Sensing Camera Module	Deep analysis of the rear 3D sensing module with Sony's 2nd Generation CIS
SP20470	2020/4 145	<b>Various</b>	Smartphone Camera Module Comparison	Overview of the latest flagship smartphone cameras released in 2019 with detailed technical and cost analyses of the Huawei P30 Pro, Samsung Galaxy S10 5G/S10+ and Apple iPhone 11 Pro
SP18385	2018/5 102	<b>ams</b> AS726X Series	Color Sensor	Full analysis from sensor die to packaging along with a cost analysis and a price estimate for the device.
SP18355	2018/7 115	<b>Hamamatsu</b> C12880MA	C12880MA Micro-spectrometer	Detailed physical analysis with process description and manufacturing cost analysis
<b>INFRARED</b>				
SP20567	2020/9 119	<b>Guide Infrared</b>	17µm Microbolometer Module	Chinese's first low-definition microbolometer for integration into consumer applications
SP20560	2020/8 247	<b>IRay Technology</b>	12µm and 17µm Thermal Sensors	Comparison between 12µm and first and second generation 17µm LWIR microbolometers from Chinese manufacturer IRay Technology's
SP20559	2020/7 115	<b>Hamamatsu</b>	Photodiode and Laser in Livox's Horizon LiDAR	Analysis of the six channels and 905nm pulsed laser and photodiode from Hamamatsu, in Livox's LiDAR for automotive ADAS.
SP20558	2020/5 123	<b>Nirone</b>	Spectral Engines Nirone Sensor X	Insights into technological data, manufacturing cost, and selling price of housing, electronic board, FPI MEMS and InGaAs photodiode
SP20557	2020/6 174	<b>Apple</b>	iPad Pro LiDAR Module	Complete technical analysis of the 3D depth sensing system, this report analyses the cost and estimates the price for the system
SP20531	2020/6 228	<b>Various</b>	Smartphone 3D Sensing Modules Comparison	Technological and economical comparison of five VCSEL dies and six NIR CIS integrated by the major manufacturers.
SP19488	2019/2 140	<b>Valeo</b> SCALA	Valeo SCALA Laser Scanner	Based on a complete teardown analysis of the LiDAR, the report provides the bill-of-material (BOM) and the manufacturing cost of the LiDAR sensor
SP19468	2019/9 147	<b>pmd/Infineon</b>	pmd/Infineon's 3D Indirect Time-of-Flight in LiDAR	Analysis of the complete 3D indirect ToF camera, provided along with cost analysis and price estimation for the module.
SP19456	2019/4 144	<b>ams</b>	Direct ToF Proximity Sensor	Complete analysis of the proximity sensor includes detailed analyses of the SPAD detector and the VCSEL, along with a cost analysis and price estimation for the module.

# IMAGING

Ref.	Date Pages	Manufacturer Product	Type of Product	Overview
SP19451	2019/5 143	<b>Panasonic</b> 3D ToF	3D ToF camera with flood illuminator	Physical and economic analysis of the 3D depth sensing camera found in the Vivo Nex Dual Display smartphone.
SP19431	2019/3 300	<b>Various</b> obile CMOS Image Sen	Comparison 2019	Analysis of the CIS dies integrated in rear and front-facing CMOS Camera Modules including main cameras, wide angle, telephoto and near global shutter infrared.
SP19424	2019/2 180	<b>Huawei</b> Mate 20 Pro	3D Depth-Sensing System	Full analysis of the NIR camera module and the dot projector, along with a cost analysis and price estimate for the system
SP19403	2019/3 147	<b>Sony</b> IMX316	3D Time-of-Flight	Complete 3D depth sensing system physical analysis and cost and estimation of the price.
SP18405	2018/8 200	<b>Samsung &amp; Apple</b> Various	ALS & Proximity Sensor	Analysis of the packaging and the sensor die along with a cost analysis calculation for three smartphone generations: Galaxy S7, S8 and S9 and iPhone 7, 8 and X.
SP18404	2018/5 90	<b>Intel</b> RealSense D435	3D Active IR Stereo Depth Camera	Complete teardown analysis of the RealSense D435, with high definition pictures of the vision processor, VCSEL IR projector and image sensor dies and the BOM.
SP18396	2018/4 121	<b>Heimann Sensor</b> HTPA32x32d	32 x 32-array thermopile LWIR	Detailed teardown and cost analysis of the thermopile die, the silicon lens, the EEPROM die, and the packaging.
SP17349	2017/9 170	<b>FIIR</b> Boson	Camera and 12µm microbolometer	Detailed teardown and cost analysis of the microbolometer, lens and WLP. bill-of-material (BOM) of the camera core, and manufacturing cost of the infrared camera.

# INTEGRATED CIRCUITS

Ref.	Date Pages	Manufacturer Product	Type of Product	Overview
<b>OTHER</b>				
SP20556	2020/4 92	<b>Mediatek</b> MT2706	77/79 GHz eWLB/AiP Radar Chipset	Review of the MT2706, including a complete package and die analysis, cost analysis, and price estimate for the component
SP20485	2020/1 367	<b>Various</b>	BCD Technology and Cost Comparison 2020	In-depth comparative study of 31 Bipolar-CMOS-DMOS technologies with a focus on Silicon-on-Insulator high voltage devices from the 15 leading manufacturers
SP19462	2019/4 90	<b>Mobileye</b> EyeQ4	Vision Processor Family	Exhaustive comparison between the EyeQ4®-High and -Mid versions and the previous EyeQ3®, highlighting the improvements, similarities and differences.
SP19429	2019/7 100	<b>Melexis</b> MLX90640	Infrared Thermal Sensor	Detailed teardown & cost analysis of the thermopile die where the memory is directly integrated, along with the silicon lens and the packaging.
<b>MEDICAL</b>				
SP19436	2019/6 163	<b>Apple</b> Apple Watch 4	Apple Watch 4's PPG and ECG Health Sensors	Analysis of the complete health sensor system, including a full analysis of the infrared LED from Epistar, green LEDs from OSRAM and the photodiodes from OSRAM for the PPG.

# MEMORY

Ref.	Date Pages	Manufacturer Product	Type of Product	Overview
<b>OTHER</b>				
SP20565	2020/8 90	<b>Samsung</b> LPDDR5	12GB Mobile Memory	In-depth physical and cost analysis of Samsung's '1y-nm' low power DRAM
SP20551	2020/4 130	<b>Intel</b>	Intel Optane 128GB DIMM	Exhaustive analysis of the main components of the Intel Optane DIMM System, including a full analysis of the 3D XPoint die, Intel Optane Processor and the Micron DRAM DDR4 die
SP20543	2020/6 80	<b>Everspin</b> EMD3D256M	STTMRAM Memory	Analysis of the package and the dies, the MRAM cell, focusing on the layered material that makes up the MRAM cell.
SP19466	2019/11 170	<b>Various</b>	LPDDR4 Memory Comparison 2019	Full teardowns of the packages and LPDDR4 dies to unveil the technology and process employed by each manufacturer.
<b>3D NAND</b>				
SP20562	2020/7 100	<b>YMTC</b>	Technology and cost analysis of YMTC's 64-layer 3D NAND with	Technology and cost analysis of YMTC's 64-layer 3D NAND with hybrid bonding.

# MEMORY

Ref.	Date Pages	Manufacturer Product	Type of Product	Overview
SP19489	2019/9 100	<b>Samsung</b>	3D V-NAND 92-Layer Memory	Detailed technology study WITH details of die cross sections and material identification, Dteailed process and manufacturing price estimation also included.
SP19483	2019/12 240	<b>Various</b>	3D NAND Memory Comparison 2019	Detailed study of the latest 96-layer technology from Toshiba and SanDisk, 92-layer technology from Samsung, 72-layer technology from SK Hynix and 96-layer technology from Micron
SP18422	2018/12 245	<b>Various</b> 3D NAND Memory	Leading-edge 3D NAND Memory Comparison	Detailed study of the latest NAND dies and die cross-section and processes. Detailed physical analysis, highlighting the cell design and memory storage type.

# MEMS & SENSOR

Ref.	Date Pages	Manufacturer Product	Type of Product	Overview
<b>PRINTHEADS</b>				
SP18421	2018/9 150	<b>Xaar</b> 1201 GS2p5 PZT	Xaar 1201 GS2p5 PZT Printhead	Insight into technological data, manu-facturing cost, and selling price of the MEMS inkjet manufactured by Ricoh and the 1201 printhead supplied by Xaar
SP18420	2018/9 158	<b>Epson</b> PrecisionCore	Printhead with MicroTFP Inkjet Dies	Insight into technological data,manufacturing cost, and selling price of the microTFP inkjet MEMS and the PrecisionCore printhead by Epson.
<b>PRESSURE SENSOR</b>				
SP18385	2018/5 160	<b>Various</b> MEMS Pressure Senso	MEMS Pressure Sensor Comparison 2018	Multiple comparisons based on physical analyses of 34 MEMS pressure sensor components
<b>PHOTONIC</b>				
SP20544	2020/3 259	<b>Intel</b> QFSP28	Silicon Photonic 100G CWDM4	A deep analysis of the world's first 100G CWDM silicon photonic transceiver, covering new technologies and the main differences from the Intel 100G PSM4.
SP19407	2019/3 200	<b>Intel</b> PSM4 QFSP28	Silicon photonic die	Exhaustive analysis of the main components of the Intel 100G PSM4 connector along with a cost analysis and price estimate.
<b>OTHER</b>				
SP19491	2019/10 88	<b>USound</b> Achelous UT-P 2016	MEMS Speaker	Technology and cost analysis of the UT-P 2016 MEMS Speaker.Envelope Tracker Module
	2019/8 94	<b>HP</b> 746	HP746 HDNA Inkjet Die	Complete physical & cost analysis of the HDNA ihermal inkjet die from HP. A comparison between HP inkjet die with and without HDNA is included.
<b>MICROPHONE</b>				
SP20549	2020/3 112	<b>Infineon</b> XENSIVTM	(SDM) MEMS in Goertek Microphone	Apple's AirPods Pro use the newest MEMS microphone technology from Infineon: Sealed Dual-Membrane XENSIVTM, found in Goertek's microphone.
SP20520	2020/2 113	<b>TDK</b> CH101	Ultrasonic Time of Flight Sensor	The first Piezoelectric Micromachined Ultra-sonic Transducer (PMUT) millimeteraccurate ultra-low power Time of Flight sensor.
SP20458	2020/2 199	<b>Various</b>	Consumer MEMS Microphones	Compare the technology and cost of 19 microphones from Knowles, Goertek, AAC Technologies, STMicroelectronics, TDK-InvenSense, TDK-Epcos, Cirrus Logic and Vesper.
SP19491	2019/10 88	<b>Usound</b> UT-P 2016	MEMS Speaker	Technology and cost analysis of the UT-P 2016 MEMS Speaker
<b>MEDICAL</b>				
SP17346	2017/7 130	<b>Thermo Fisher</b> Ion 520	Sequencing chip	Complete analysis of the Ion 520 chip from Thermo Fisher, featuring chip disassembly and die analyses, processes and cross-sections.
<b>IMU/COMBO</b>				
SP20539	2020/7 131	<b>Sensoror</b> STIM318	Inertial Measurement Unit	Newest IMU with 9-axis detection and gyro bias instability of 0.3°/h from Sensoror.
SP19443	2019/1 102	<b>Honeywell</b> HG1120CA50 9-Axis	MEMS Inertial Sensor	Detailed physical analysis with a process description and manufacturing cost analysis, as well as a full comparison with the Sensoror STIM210 and the ADIS16460.

# MEMS & SENSOR

Ref.	Date Pages	Manufacturer Product	Type of Product	Overview
SP19442	2019/1 161	<b>Honeywell</b> HG4930CA51 6-Axis	MEMS Inertial Sensor	Detailed physical analysis with a process description and manufacturing cost analysis, as well as a full comparison with the Sensoron STIM210 and the HG1120CA50.
SP17361	2017/10 175	<b>InvenSense</b> ICM-20789	Pressure Sensor Combo	Detailed technology and cost analysis of the ICM-20789 7-axis motion tracking device. Comparison with the previous generation of combo sensors from InvenSense
<b>GYROSCOPE</b>				
SP18381	2018/1 141	<b>Tronics Microsystems</b> GYPRO3300	Angular Rate Sensor	Analysis of the complete component, including the package, MEMS, and ASIC dies description of the ASIC and MEMS functionalities.
<b>FINGERPRINT</b>				
SP20552	2020/4 107	<b>Goodix</b>	Goodix's Ultra-Thin Optical In-Display Fingerprint	Deep analysis of the latest generation of under-display optical fingerprint
SP19506	2019/10 160	<b>Goodix</b>	Under-Display Optical Fingerprint	Insight into technological data, manufacturing cost, and selling price of the fingerprint sensor supplied by Goodix.
SP19472	2019/9 271	<b>Various</b>	Piezoelectric modules	Physical analysis and a cost estimation of the integration of piezoelectric material in a system or wafer.
SP19465	2019/7 127	<b>Qualcomm</b>	3D Sonic Sensor Fingerprint	Analyses of the sensor die and the ASICs along with a cost analysis and price estimation for the module.
SP18419	2018/7 125	<b>Synaptics and Goodix</b> VIVO X21	Synaptics' Under-Display Fingerprint Scanner Inside the VIVO X21 IMU	Comparison with the latest Huawei FPC1268 fingerprint touch sensor and a physical comparison with the Goodix Version of Vivo's fingerprint scanner
<b>ENVIRONMENT</b>				
SP20513	2019/1 3990	<b>Sensirion</b> SCD30	NDIR CO2 & Humidity Sensor	Technology and cost analysis that includes study of all the main parts of the sensor : the humidity sensor, the other module parts and the assembly
SP20513	2020/1 126	<b>Sensirion</b> SCD30	NDIR CO2 and Humidity Sensor	Technology and cost analysis, all the main parts of the sensor are studied, including the humidity sensor, the other module parts and the assembly.
SP18398	2018/10 150	<b>Various</b>	Miniaturized Gas Sensor	Comparison 2018 : Analysis of the packaging and the sensor die along with a cost analysis for all devices.
SP18372	2018/2 125	<b>Sensirion</b> SGP30	SGP30 Gas Sensor	Analysis of the entire component, including the package, MEMS, and ASIC die. Full description of the ASIC and MEMS functionalities as well as manufacturing processes.
<b>ACCELEROMETER</b>				
SP20568	2020/7 114	<b>Safran &amp; MEMSIC</b> /S1010 & MXA2500M	High-End Accelerometers	Detailed technology and cost analysis of the high-end single-axis and dual-axis accelerometers integrated in the STIM318 IMU.

# PACKAGING

Ref.	Date Pages	Manufacturer Product	Type of Product	Overview
<b>OTHER</b>				
SP18430	2018/11 160	<b>Various</b> Wafer	Wafer to Wafer Permanent Bonding	Analysis of each component's wafer bonding process, including component dimensions, cost and manufacturing approach.
<b>EMBEDDED</b>				
SP19425	2019/11 124	<b>Qualcomm</b> QET5100M	Envelope Tracker Module	In-depth physical analysis of the envelope tracking module, and a complete description of the manufacturing process flow
<b>3D PACKAGING</b>				
SP20555	2020/9 190	<b>Intel Core</b> i5-L16G7	Intel Foveros 3D Packaging Technology	Intel Core i5-L16G7: the first utilisation of Intel's Foveros Technology with Package-on-Package configuration in a consumer product.
SP20471	2020/3 220	<b>Apple</b>	SiP in AirPods Pro	Analysis of Apple's first SiP found in the latest AirPods, featuring a fully integrated SiP for audio codec and Bluetooth connectivity.

# PACKAGING

Ref.	Date Pages	Manufacturer Product	Type of Product	Overview
SP19439	2019/1 200	<b>Apple</b> Series 4	Apple Watch	Complete analysis of the SiP, featuring die analyses, packaging processes and cross-sections.
SP18444	2018/11 127	<b>Samsung</b> Exynos 9110	Samsung Exynos 9110 with Eplp	Complete analysis of the SiP FO-PLP, featuring die analyses, processes and package cross-sections.
SP18417	2018/10 160	<b>Intel</b>	EMIB	Complete physical analysis of the packaging process, with details of all technical choices regarding processes, equipment and materials.
SP18406	2018/6 130	<b>Samsung, Qualcomm</b>	Samsung's Galaxy S9 + Processor Packages	Review of the Exynos 9810 and the Snapdragon 845, including a complete package analysis, cost analysis, and price estimate for the chips.
SP18393	2018/7 157	<b>Qualcomm</b> WiGig Chips	Qualcomm WiGig Chipset Smartphone	Full investigation of the system, featuring a detailed study of the SiPs and the antenna board including die analyses, processes and board cross-sections
SP18373	2018/2 140	<b>TSMC</b> Apple A11 inFO PoP	inFO Packaging in iPhone X	Analysis of the packaging from the DRAM memory to the LSC developed by TSMC. Comprehensive cost analysis and price estimation of the device.
SP17360	2017/11 130	<b>AMD</b> Radeon Vega	SPIL CoW last – Samsung HBM2	Complete physical analysis of the packaging process. Comparison with NVIDIA's Tesla P100 and AMD's Fury X.
SP17352	2017/10 300	<b>Various</b> MEMS Packaging	Mems Packaging	Multiple comparisons based on physical analyses of over 100 MEMS components.

# PASSIVE

Ref.	Date Pages	Manufacturer Product	Type of Product	Overview
<b>OTHER</b>				
SP17344	2017/9 140	<b>Various</b> Silicon Capacitor	Silicon Capacitor	Details on the manufacturing process and materials used, component design, and die size. Comparison of the components' sizes, materials and characteristics.

# POWER

Ref.	Date Pages	Manufacturer Product	Type of Product	Overview
<b>SiC</b>				
SP20536	2020/8 202	<b>Various</b>	SiC Diode Comparison 2020	Comparison of the technology and cost of 11 SiC diodes from Infineon, Wolfspeed, Rohm, STMicroelectronics, ON Semiconductor, Microsemi, UnitedSiC
SP19494	2019/10 154	<b>Wolfspeed</b> CAB450M12XM3	SiC Module	Estimated manufacturing cost of all the module's components and selling price analysis
SP19467	2019/8 200	<b>UnitedSiC</b>	UnitedSiC Cascode JFET 650V Family	Detailed manufacturing cost analysis of the JFET, the MOSFET and the package as well as the estimated selling price of each one of 5 five cascode components
SP19449	2019/5 289	<b>Various</b> SiC MOSFET	Comparison 2019	Estimated manufacturing cost of the MOSFET devices & analysis of their selling prices. Technological & manufacturing cost comparisons between the analyzed MOSFETs.
SP18428	2018/8 95	<b>Rohm</b> Gen3 Trench	Rohm SiC MOSFET Gen3 Trench Design Family	Analysis of the Gen3 trench MOSFETs at 650V and 1200V, with optical and scanning electron microscope (SEM) images of the complex SiC trench structure.
SP18413	2018/6 100	<b>STMicroelectronics</b> Tesla Model 3	Tesla Model 3 Inverter with SiC Power Module	Estimation of the production cost of the SiC MOSFET and package. Technical and cost comparison with the Mitsubishi J-Series TP-M power module.
<b>OTHER</b>				
SP20474	2020/5 165	<b>Various</b>	Industrial Power Module Packaging Comparison 2020	Insight into several packaging technologies to analyze their structures, processes and costs
SP18399	2018/7 110	<b>Various</b>	Automotive Power Module Packaging	Comparison 2018 of the structures and costs of the different technological choices made by key manufacturers of the automotive industry
SP18359	2018/5 115	<b>Various</b>	Power Discrete Packaging	Comparison 2018 : Summary of the state of the art of packaging power semiconductors at a discrete level. Comparison of 20 types of packages.

# POWER

Ref.	Date Pages	Manufacturer Product	Type of Product	Overview
<b>IGBT</b>				
SP20541	2020/3 100	<b>StarPower</b> GD820HTX75P6H	Tri-Pack IGBT Module	Tri-Pack power module from StarPower with direct liquid cooling pin-fin structure.
SP20516	2020/1 127	<b>Hitachi</b> Audi e-tron's Inverter	Double-Side Cooling Power Module	Discover Hitachi's power module and its innovative assembling technology of integrated double-side cooling structure.
SP19492	2019/10 163	<b>Infineon</b> PrimePACK™2	1200V Power Module with IGBT5 and EC5 Diode	Full teardown of the module's components and housing, as well as stimated manufacturing cost of all the module's components and a selling price analysis
SP19455	2019/3 140	<b>ABB</b> 5SNG 1000X170300	Power Module	Insights into the structure, technical choices, design, processes, and supply chain positions. Manufacturing cost of the module's components and analyses its selling price.
<b>GaN</b>				
SP20563	2020/7 78	<b>Innoscence</b>	650V GaN-on-Si Transistor	The first 100% Chinese GaN-on-Si power device found in Rock's fast charger, manufactured on an 8-inch platform.
SP20550	2020/3 101	<b>Nexperia</b> GAN063-650WSA	GaNbased Power Device	Deep analysis of the GAN063-650WSA, Nexperia's first GaN product
SP20547	2020/2 127	<b>OPPO</b>	GaN-based in-box fast charger	Competitive analysis of Power Integrations' GaN and silicon technology used in OPPO's high power chargers.
SP19493	2019/10 108	<b>Macom</b> NPA1008	RF Power Amplifier with GaN-on-Si HEMT	Estimation of the production costs of the HEMT, the passive die, and the package as well as the estimated selling price of the component.
SP19480	2019/7 156	<b>Anker</b> SC1933C	GaN-on-Sapphire HEMT Power IC	Teardown analysis of the SC1933C .Estimation of the production costs of the ICs, the HEMT & the package as well as the estimated selling price of the component.
SP19464	2019/5 112	<b>Navitas</b> NV6115 & NV6252	GaNFast Power IC Family	Insights into the HEMT tructure, the epitaxy, technical choices, design, processes, and supply chain positions.
SP19453	2019/7 169	<b>Various</b>	GaN-Based Wall Charger Comparison 2019	Detailed BOM and manufacturing analysis for all the chargers' devices and packages. Different supply chains and the technical choices made by the manufacturers.
SP19415	2019/9 86	<b>EPC</b> EPC2112	HEMT with Monolithic Optimized Gate Driver	Complete teardown analysis and detailed manufacturing cost analysis of the die and the package as well as the estimated selling price of the device,
SP18411	2018/10 110	<b>Qorvo</b> QPF4006 39GHZ	Qorvo QPF4006 39GHz GaN MMIC	Detailed analysis of the packaging and the GaN on SiC transistor with optical SEM Pictures as well as a cost analysis.
SP18391	2018/6 97	<b>GaN Systems</b> GS61004B	100V GaN HEMT	Estimated production cost for the epitaxy and the package. Comparison of the standard 100V Si MOSFETs and low-voltage GaN on Si HEMT.
	2019/11 260	<b>Various</b>	GaN-on-Si HEMT vs Superjunction MOSFET Comparison 2019	Detailed pictures of device structures, details on manufacturing processes and materials, comparison of electrical performance, and cost breakdown analysis of the process.
	2019/6 97	<b>Infineon</b> 600V	CoolGaN Transistor	Complete teardown analysis including optical and SEM pictures of metal layers, delayering of the GaN, cross-section of the HEMT part and the diode part of the die.

# RF

Ref.	Date Pages	Manufacturer Product	Type of Product	Overview
<b>RF MODULE</b>				
SP20522	2020/4 304	<b>Various</b>	RF Front-End Module Comparison 2020 V2	Insights into technology and cost data for FEMs and several other components found in ten smartphones.
SP20504	2020/1 266	<b>various</b>	RF Front-End Module Comparison 2020 – V1	Technical and cost overview of the latest Radio Frequency Front-End module technologies, with deep analysis of the Apple iPhone 11 Pro, Samsung Galaxy Note 10+ and OnePlus 7 Pro 5G.
SP19478	2019/10 162	<b>Qorvo</b> QM76018	RFFEM	Complete analysis of the FEM SiP, including the LNA, the filtering dies, the internal and external EMI shielding and the Power Amplifier.
SP19445	2019/2 167	<b>Broadcom</b> AFEM-8092	Apple iPhone Xs/Xr Series	Complete analysis of the FEM SiP, including an analysis of the matching IC, the filtering dies, the internal and external EMI shielding and the Power Amplifier.

# RF

Ref.	Date Pages	Manufacturer Product	Type of Product	Overview
SP19433	2019/5 81	<b>Accoener</b> A111 60 GHz	Pulsed Coherent Radar	Review of the A111, including a complete die analysis, cost analysis, and price estimate for the chips. Physical and technical comparison with Texas Instruments' IWR6843AoP
SP19400	2019/1 159	<b>Ainstein &amp; Calterah</b>	Ainstein K-77 & Calterah CAL77A2T4R	BOM and the manufacturing cost of the radar sensor and review of the CAL77A2T4R transceiver, with a complete die analysis, cost analysis, and price estimate of the chips.
SP19392	2019/4 121	<b>Analog Devices</b> ADI ADGM 304/1004	RF MEMS Switch	Detailed physical description of the Analog Devices ADGM1304 along with a cost analysis. physical and cost comparison with the ADGM1001.
SP18379	2018/2 160	<b>Broadcom</b> AFEM-8072	Mid&High Band LTE FEM	Analysis of the full FEM SiP, including the RF IC and its IPDs, the filtering dies and the internal and external EMI shielding.
SP18368	2018/10 397	<b>Various</b> Automotive Radar	Automotive Radar	Comparison 2018 : Description of each component and statistical analyses for most radar systems focusing on the RF board.
SP17364	2017/11 140	<b>Various</b>	RF SiPs	Description of each component and important data, including type of substrate, proportion of silicon in the module and line spacing.

## RF IC

SP20521	2020/3 205	<b>Broadcom</b> AFEM-8100	SiP in the Apple iPhone 11 Series	Cost effective third generation of mid/high band Front-End Module with advanced and innovative packaging.
SP20519	2020/4 173	<b>Infineon &amp; Knowles</b> T60TR13C & DSP IA85	Google Pixel 4XL Gesture Recognition Chipset	Deep dive into the first Human Machine Interaction (HMI) system with Infineon's 60 GHz Radar On-Chip AoP BGT60TR13C and Knowles' DSP IA8508.
SP20517	2020/5 216	<b>Qualcomm</b>	2nd Generation 5G mmWave Chipset, from Modem to Antenna	Full investigation of the system, featuring a detailed study of the SiPs, including die analyses, processes and board cross-sections
SP19482	2019/9 194	<b>Qualcomm</b> SDX50M & QTM052	Qualcomm's First 5G mmWave Chipset	Full investigation of the system, with detailed study of the SiPs, including die analyses, processes and board cross-sections. Complete cost analysis & selling price estimation. System
SP19481	2019/8 100	<b>Texas intruments</b> AWR1843AoP	77/79 GHz Radar Chipset	Complete package and die analysis, cost analysis, and price estimate for the component.
SP18418	2018/8 150	<b>Peraso</b> X710	Peraso X710 Chipset 60GHz	Full investigation of the system, with a detailed study of the baseband processor, the RFIC and the antenna board including die analyses, processes and board cross-sections.

## RF FILTER

SP20546	2020/7 100	<b>Skyworks</b> SKY78221	FBAR-BAW Filter Technology in 28/16nm BAWID	First High-Volume Manufacturing (HVM) BAW filter on the market from Skyworks, integrated in the Apple iPhone 11 Pro Max and iPad Pro second generation.
SP20490	2020/6 201	<b>Various</b>	SAW Filter Comparison 2020	Description of each process flow for the thirteen SAW technologies on the market. It also contains a complete cost analysis of each process and tries to explain OEM choices.
SP19454	2019/10 100	<b>Murata</b> IHP	SAW Filter	Complete analysis of the IHP SAW component including analyses of the filter die and the CSP, along with cost analysis and price estimation for the component.

## OTHER

SP20561	2020/9 105	<b>Vayyar</b> VYYR2401	4D UWB Radar Imaging SoC	Deep dive analysis of Vayyar's 4D UWB Radar Imaging System-on-Chip from the Walabot Home Fall Detection System
SP17328	2017/12 300	<b>Various</b> RF IPD	RF Integrated Passive Devices	Description of each component, its major characteristics (substrate type (GaAs, silicon, glass), passivation layers, passive integration, etc.) and a comparison of all devices.

# SOLID STATE LIGHTING

Ref.	Date Pages	Manufacturer Product	Type of Product	Overview
<b>VCSEL</b>				
SP19426	2019/4 190	<b>Various</b> VCSEL	Comparison 2019	Complete cost analysis and a cost estimate of the VCSEL
<b>OTHER</b>				
SP20545	2020/4 105	<b>Butterfly Network</b>	CMUT Sensor	Focus on the analysis of the CMUT semiconductor. It includes an ultrasonic MEMS transducer and the ASIC die developed by Butterfly Network.

# SYSTEM

Ref.	Date Pages	Manufacturer Product	Type of Product	Overview
<b>OTHER</b>				
SP19460	2019/8 142	<b>Freebox</b>	Freebox Delta Server	Detailed BOM, the manufacturing cost of the server, optical module and security module and estimation of final manufacturer price
SP19460	2019/8 142	<b>Devialet</b>	Free Devialet Player	Complete teardown analysis including printed circuit board (PCB) cross-sections, PCB antenna X-rays and main integrated circuit (IC) die photos.
SP19446	2019/9 85	<b>Various</b>	Particle Sensor	Technical & cost analysis of 7 particle sensors, it includes block diagrams.
<b>CONSUMER</b>				
SP20542	2020/10 200	<b>Intel RealSense L515</b>	MEMS-Based Solid-State LiDAR Camera	A high-resolution LiDAR sensor featuring a bi-axial MEMS mirror scanner associated with an infrared laser and a RGB camera.
<b>AUTOMOTIVE</b>				
SP20512	2020/2 115	<b>Audi-Bosch FPK</b>	Instrument Cluster	Latest Audi Q3 instrument cluster with immobilizer: Structural and cost analysis
SP20509	2020/1 80	<b>Tesla Model 3</b>	Triple Forward Camera from Tesla Model 3	Complete analysis of the main sensing part of the Tesla's autopilot system
SP20507	2020/1 87	<b>Denso Toyota Alphard</b>	Monocular Forward ADAS Camera	Denso has developed a new monocular forward camera for improved night vision, using Sony's high-sensitivity 1.27M-pixel image sensor and Toshiba's new advanced image recognition processor.
SP20501	2020/1 67	<b>Aptiv 4N0907217A</b>	Aptiv's Lane Assist Front Camera for Audi A8	Complete teardown analysis of the Audi A8 Front Camera with BOM and manufacturing cost of the camera.
SP19514	2019/12 110	<b>Nvidia Tegra K1</b>	Visual Computing Module	Complete analysis of the module, featuring deep IC and Memories die analyses, packaging processes and cross-sections
SP19510	2019/12 89	<b>Aptiv R3TR</b>	76GHz Short Range Radar	Complete teardown analysis with BOM and the manufacturing cost of the radar sensor
SP19508	2019/12 72	<b>Mando MRR20</b>	77GHz Mid-Range Radar	Complete teardown analysis with BOM and the manufacturing cost of the radar sensor
SP19502	2019/12 87	<b>Aptiv Zfas</b>	Audi A8 zFAS ADAS Platform	Complete teardown analysis with BOM and the manufacturing cost of the control unit
SP19500	2019/12 76	<b>Denso DNSRR004</b>	Short Range Radar	Complete teardown analysis with BOM and the manufacturing cost of the radar sensor
SP19499	2019/12 94	<b>Denso DNMWR009</b>	Cruise Control Radar Distance Sensor	BOM and manufacturing cost of the radar sensor. It also so includes a physical analysis of the MCU, a complete cost analysis and selling price estimation
SP19498	2019/11 77	<b>Bose</b>	Automotive Audio Amplifier	Complete teardown analysis of Bose Audio Amplifier from the Renault Talisman. Complete physical analysis and manufacturing cost estimate for every part. Frames
SP19476	2019/9 69	<b>Ford SYNC 3</b>	Silverbox	Complete teardown analysis along with BOM and cost analysis.

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