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Financial Highlights

At the Heart of Mobile Innovation

Exynos Processors & Modems for LTE/5G Smartphone, IoT and Automotive

Top Image Sensor Supplier for High Resolution Mobile Cameras

Core Display Driver IC for OLED Displays of Rigid, Flexible and Full-front Types

Global Smartphones Featured by ISOCELL Image Sensors

Chinese Smartphones Featured by ISOCELL Image Sensors

Global Mobile Displays Featured by System LSI’s OLED Driver ICs

Revenue Growth
Business Portfolio

Exynos Processor
Modem/RF/Connectivity

ISOCELL
CMOS Image Sensor

Mobile DDI
Touch Controller

NFC/eSE
Fingerprint Sensor

SIM/eSIM
Banking/ID

Power
Management IC

Communication Devices

Internet of Things

Automotive

Consumer Devices
Making 5G a Reality

Dec. 2018
5G Commercial Service Launch with 5G Mobile Hot Spot and Smartphone Prototype

Feb. 2019
Galaxy S10 5G 5G Smartphone Released
Technologies for the Next

AI / Deep Learning
Machine Intelligence on Various Devices

5G Network
High Speed, Low Latency, Massive Number of Connections

Smart Mobility
ADAS Driving Assisted Cars, Drones and more
Intelligence on the Devices

AI/Deep Learning through the Industries

On-device Intelligence combining with 5G, IoT brings the innovation in everyday life and services, which is enabled by advanced semiconductor technologies.
5G Network

The Mass Connected Era
Inspires creativity to all connected dots

Enhanced Mobile Broadband
Ultra Reliable & Low Latency
Massive Machine Type Communication

2018
3GPP 5G NR Phase 1 Standard Release

2019
Commercial Device & Service Release

2020
5G NR Commercialization

5G Mobile Subscriptions to Reach 1 Billion by 2023
(ERICSSON Mobility Report, Nov. 2017)
Enhanced Mobile Cameras

Ultra-high Resolution
More Pixels in a Small Sensor

Small and Slim
Tiny Camera Fit for Full Front Display

Intelligent Camera
Scene-Adaptive HDR Processing, Face Detection/Recognition, Fast AF

Multiple Cameras
Dual, Triple and Quad Cameras for Various User Scenarios

High Light-sensitivity
Bright and Clear Image under Low Light

3D Depth Sensing
DVS, ToF for Game, VR/AR

* DVS: Dynamic Vision Sensor
* ToF: Time-of-Flight
Future Mobility with IC Technology

Innovation in Automotive Industry

Various Semiconductor Components Power Future Driving Experience Including Processors, Connectivity, Electrification and Memory
Enriched Systems in Future Mobility

Cameras, Displays and Security Systems for the Future Mobility

Cameras for ADAS/Autonomous Driving

Displays and Security Systems for Driving, System Control and In-vehicle Entertainment
Strategy for the Growth

Innovation to Bring Ideas to Life

Total Solution
Integrated and Extended Portfolio
- Hardware
- Software

Technical Leadership
Advanced Technologies for Components & Platform
- R&D Investment
- Leading-edge Process
- Reference Platform
- System Design

Leading Market
Collaboration with Ecosystem
- Close Partnership
- Future Market & Technical Research
Solution for Mobile Devices

Samsung’s advanced component solutions for mobile innovation

- ISOCELL Image Sensor
  - CMOS Image Sensor for Multi Cameras in Front / Rear

- Iris Scanning Sensor
- Motion & Depth Sensor

- Exynos Processor
  - Mobile Processor
  - LTE/5G Modern
  - RF IC
  - Connectivity
  - Supply Modulator

- Reference Designs
  - Optimized Platform
    - Designed with Samsung Products

- NFC / Secure Element
  - Mobile Payment / Security

- Touch Controller
  - Low Power, High Sensitive

- OLED Display Driver IC
  - Bezel-less Full Screen

- Fingerprint Sensor
  - Fingerprint Sensor on Display

- Power Management IC
  - PMIC for Mobile Processor, UFS Memory, OLED Display, Wireless Charger, USB Type-C PDIC
Solution for Internet-of-Things

Safely connecting the wireless world

Exynos i
IoT Processors with On-chip Security Solution and Connectivity

ISOCELL
Image Sensor Solution for Sensing and Recognition
Dynamic Vision Sensor

Security
NFCs, Secure Elements for Data Protection
Secure Storage of Key & Credentials,
Authentication and Crypto Operation
Transforming the Driving Experience with IC Technologies

ADAS, Infotainment System, Telematics and Autonomous Driving Solutions

Solution for Mobility

**ExynosAuto**
Processors and NPUs for IVI, Cluster, ADAS System
Modems for Telematics System

**ISOCELL**
High Sensitive and High Resolution Image Sensors with Embedded Security

**Security**
Safe and Reliable Security Solutions for Automotive Systems and Personal Information

**Display**
Display Driver ICs, Touch Controllers

* C-V2X: Cellular Vehicle-to-Everything
Path of Innovation

2011 Exynos 4412
2013 Exynos 5410
2014 Exynos 5430
2015 Exynos 7420
2016 Exynos 8890
2017 Exynos 8895
2018 Exynos 9810
2019 Exynos 9820

32nm 28nm 20nm 14nm 10nm
HKMG Process 3D FinFET

2009 CMC220
World 1st Commercial LTE
Exynos Modem 300/303 LTE-A 300Mbps Carrier Aggregation
Exynos Modem 333 LTE-A 450Mbps 3CA

2015 Exynos 8890
Exynos 7872

2016 Exynos 8890
3rd Gen Custom CPU Intelligence with DL Gigabit LTE Modem LTE-A 300Mbps, 3CA

2017 Exynos 8895
Supports 6-mode Including CDMA

2018 Exynos 9810
Exynos 9610

2019 Exynos 9820

7/8nm
5G Exynos Modem 5100
3GPP Rel-15 5G NR
Multi-mode single chip

Exynos Processor
Exynos for Device Intelligence

An Intelligent Powerhouse

Neural Processing Unit

High Performance, Low Power Processing

Flexible and Scalable Architecture

Android NN API, Caffe2, Tensorflow-lite

Intelligent Image Processing

Face/Object/Voice Recognition

IoT/Machine Learning

Smart Mobility

* NNE (Neural Network Engine)
Exynos Modem for 5G Era

600 million+
Exynos Modems Has Commercialized
in 150 Countries

2009
Released World 1st
Commercial LTE
Modem

2014
300Mbps
Carrier Aggregation

2017
1Gbps
LTE Cat.16

2018
1.2Gbps
LTE Cat.18

2019
2Gbps
LTE Cat.18

2020
5G New Radio
2Gbps (Sub-6GHz), 6Gbps (mmWave)

Exynos LTE Advanced
Exynos Modem 300/303
Exynos 8895
Exynos Modem 359
Exynos 9810
Exynos Modem 359
Exynos 9810
Supporting CDMA

Exynos LTE Advanced Pro
Exynos 9820
Exynos Modem 5100
5G NR Rel.15 Compliant
Multi-mode Single Chip Modem

Exynos Modems Has Commercialized in 150 Countries

600 million+
Exynos Modems Has Commercialized
in 150 Countries
Milestone to Bring 5G

- Exynos Modem Chipset for 5G Rel-16
- Released Exynos Modem Chipset
- Succeeded OTA 5G NR Data Call
- 5G NR Commercialization
- NSA 5G NR Rel-15
- SA

Exynos Modem 5100

- Compatibility: Compliant with 3GPP 5G NR Rel-15
- Global Bands: Sub-6GHz 2GHz, mmWave 6GHz
- Multi-mode: Single Modem for Every Network
- 5G Chipset: Modem with RF IC, ET, PMIC

Exynos Modem for 5G Era

Network & Equipment Manufacturers

Mobile Operators

Device Manufacturers

Interoperability Test

Commercial Device Development
Exynos i Series for IoT

Integrated IoT Solutions
Enhanced Performance
Ultimate Power Efficiency
On-chip Security Sub-system & PUF

Smart Lighting
Smart Home Appliance
Smart Speaker
Wearable Devices
Smart Metering
Mobile Tracker
Smart Bike
Infrastructure Control

Communication Range
Data Speed

Short
Low
ZigBee
BLE
Thread

Medium
Medium ~ High
Wi-Fi 802.11n

Long
Medium ~ High
GNSS
NB-IoT
LTE

Power Efficiency
On-chip Security Sub-system & PUF

Exynos i T100
Exynos i T200
Exynos i S111
Exynos Auto Series for Mobility

Integrated Mobility Solutions

<table>
<thead>
<tr>
<th>In-vehicle Infotainment</th>
<th>ADAS System</th>
<th>Telematics</th>
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</thead>
<tbody>
<tr>
<td>Exynos Auto V</td>
<td>Exynos Auto A</td>
<td>Exynos Auto T</td>
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<tr>
<td>Powerful Processors for Intelligent Multi-screen Infotainment Platform</td>
<td>Intelligent Processor for ADAS System</td>
<td>LTE &amp; 5G Modems for Telematics System Low Latency, C-V2X</td>
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Exynos Auto V9
A Processor to Power the Next Generation In-vehicle Infotainment System

- Displays
- Cameras
- Tri-cluster GPU
- NPU
- Safety
SAMSUNG ISOCELL
Image Sensors Capturing Moments Anytime through Unique Pixel Technologies

- Bright
  - Tetracell Smart WDR
- Fast
  - DUAL PIXEL Fast Readout Sensor
- Slim
  - Sub-micron Small Pixel
- Multi
  - Multi Camera Solutions for Zoom, Depth Sensing, LLS

* WDR (Wide Dynamic Range), LLS (Low Light Shooting)
ISOCELL Image Sensor

Technologies that Redefine Mobile Camera

**ISOCELL Plus**
Upgraded Pixel Isolation Technology
Better Low Light Sensitivity, Higher Color Fidelity
Fit for Realizing High-resolution in Sub-micron Pixel

**Sub-micron Small Pixel**
0.8um 64Mega Pixel
Small and Super Resolution Sensor

**Hybrid Pixel Conversion**
Tetracell – Remosaic Technology
Clear and Bright Images Any Time

**Multi Camera Solution**
Total Solution for Out-focus, Low Light Shooting

SAMSUNG ISOCELL
Advanced Image Sensor Technologies

Sub-micron Pixel

Less Size, More Pixels
Super Resolution within a Tiny Sensor
Powered by ISOCELL Plus Pixel Technology

Tetracell Technology

Hybrid Pixel Merging & Remosaic Algorithm
Super Resolution Ensures High Quality Images
after Pixel-merging Algorithm

ISOCELL

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| 2013   | 2014  | 2017  | 2019  |

ISOCELL PLUS

Less Size, More Pixels
Super Resolution within a Tiny Sensor
Powered by ISOCELL Plus Pixel Technology
Multi Camera Solution

Mix and Match Multi Camera Solutions

Various sensor combinations in Dual, Triple and Quad Cameras which enable DSLR-like photo experiences such as greater light sensitivity, depth effects and sharper brightness in all conditions.

Out Focus  LLS  Optical Zoom  High Resolution  Depth Sensing

* LLS : Low Light Shooting
Stunning Mobile Images with ISOCELL

Advanced Node
28nm based Image Sensors

ISOCELL Pixel Technology
Superior Image Quality with Small Pixel Unique Pixel Technologies

Design Service
Hardware and Software Integrated Solution Custom Sensor Design
Samsung has maintained the position as a key supplier of mobile processors, image sensors and display driver ICs.

Innovations in semiconductor technologies will be the key driver in various new applications that adopts AI/Deep Learning, 5G NR network, and smart mobility.

Samsung System LSI is a provider of integrated total solution for mobile. On top of that, System LSI is now on the path to be a key player for 5G and autonomous mobility, and is investing for future device intelligence.
Possibilities Beyond Components

Integrated Solutions

Silicon Technologies