Status of Power IC: Technology, Industry and Trends 2021

Market and Technology Report 2021
GLOSSARIES

AC: Alternative Current
ADAS: Advanced driver-assistance systems
Amp: Ampere
ASIC: Application-Specific Integrated Circuit
ASP: Average Selling Price
BCD: Bipolar–CMOS–DMOS
BMIC: Battery Management Integrated System
CAGR: Compound Annual Growth Rate
EV: Electric vehicle, sometimes called BEV
ECU: Electronic Control unit
EMC: Electromagnetic Compatibility
DTI: Deep Trench Isolation
FDSOI: Fully Depleted Silicon-On-Insulator
FET: Field Effect Transistor
FOX: Field Oxide
GaN: Gallium Nitride
HEV: Hybrid Electric Vehicle
IC: Integrated Circuit
IGBT: Insulated Gate Bipolar Transistor
IoT: Internet of Things
IPM: Intelligent Power Module
JFET: Junction Field Effect Transistor
LDO: Low DropOut
LOCOS: LOCal Oxidation of Silicon
LSI: Large Scale Integrated circuit
MOSFET: Metal-Oxide Field Effect Transistor
OEM: Original Equipment Manufacturer (usually a contract manufacturer)
OSAT: Outsourced Semiconductor Assembly and Test
Ron: On-state Resistance
PFC: Power factor correction
PHEV: Plug-in electric vehicle
PMIC: Power Management Integrated Circuit
PV: Photovoltaics
R&D: Research & Development
SBD: Schottky Barrier Diode
Si: Silicon
SiC: Silicon Carbide
SJ MOSFET: Super Junction MOSFET
SOI: Silicon-On-Insulator
STI: Shallow Trench Isolation
TPMS: Tire-pressure monitoring system
UPS: Uninterrupted Power Supply
USD: United States Dollar
UTTB: Ultra-Thin Box and Body
V: Volt
VA: Volt-Ampere
W: Watt
WBG: Wide Band Gap
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Several types of power ICs exist. The final application requirements define which type of power IC will be used.
SCOPE OF THE REPORT

By application
- Automotive
- Industrial
- Computing
- Consumer
- Telecommunication
- Computing

By device
- Battery management ICs
- Multichannel ICs
- Switching regulators
- Linear regulators
- Other power ICs
  - Voltage references
  - Voltage supervisors
  - Power sequencers
  - Controllers
  - Monolithic Integrated Power Stage
  - Multi-chip Integrated Power Stage

Supply chain
- Major players
- Market shares
- Market dynamics
- Market forecasts
- M&A
- Fab capacity
- 300mm investments
- Focus in China
- COVID19
- Chip shortage
- Focus on top 3 players

Technology
- Integration
- Package
- BCD technology
- Si vs SOI
- PMIC for EV
- BMIC
- GaN IC
- PMIC packaging trends

Yours needs are out of the report’ scope?
Contact us for a custom:
DEFINITIONS

Power Integrated Circuit categories

- **Battery Management Integrated Circuit (BMIC)** – is device used to manage batteries charge and discharge in almost all battery powered applications. It typical includes battery chargers, monitors, gauges, protection, and authentication.

- **Multichannel Power Management IC (PMIC)** – is a specific power IC that combine multiple power conversion ICs in a same package or on a single piece of silicon. Regardless of the number or types (LDO, Switching, controller, battery management) of converters on board, ICs with three or more outputs are classified as Multichannel PMICs.

- **Switching regulator** – replaces variable resistance of a control transistors network with a power switch (FET), which is either fully on or completely off. The output is determined by the topology and the duty cycle of the power switch.
  - AC-DC Switching Regulator – an integrated circuit or system-on-chip product that converts AC voltage to DC voltage.
  - DC-DC Switching Regulator – includes all DC-DC regulator products with internal power switches (FET). It can include both isolated and non-isolated product.
  - Isolated Controller – controller with external FETs and some integrated isolation (level shifter, transformer, or optocoupler).
  - Non-isolated Controller – controller with external FETs but do not contain any form of isolation

- **Linear Regulator** – Linear Regulator is the simplest power IC that uses a non-switching circuit (typically a variable resistor or divider network) to provide voltage conversion. If the input and output voltage differs less than 0.7V, it is classified as Low Drop-Out (LDO) voltage regulator.

- **Monolithic Integrated Power Stage** – is produced by integrating the gate driver and power switch (FET) on a single piece of silicon.

- **Multi-chip Integrated Power Stage** – is produced by integrating two separate pieces of silicon (a gate driver, and a power switch) in the same package.

- **Supervisor and Controllers** – General Purpose Analog ICs that source or sink power specifically over physical medium/interfaces and include Hot Swap controllers, USB Power ICs, and Power-over-Ethernet (PoE) power source and sink ICs. These devices may also include circuitry to supervise, control and sequence power to these interfaces.
  - Power-Over-Ethernet Controller – includes controllers used in both the Powered Devices (PDs) and the Power Sourcing Equipment (PSEs) regardless of the configuration.
  - Hot-swap controllers – include both hot-swap controllers and hot-swap converters for use in hot plugging systems.

- **Voltage reference** – IC that provides a constant voltage within a system irrespective of variations in output current or input voltage.
WHO SHOULD BE INTERESTED IN THIS REPORT?

**IDMs, Foundries and Fabless companies:**
- Understand the Power IC market and Technology Evolution
- Understand the power IC market drivers
- Define new strategies regarding the market evolution
- Evaluate the market potential of future technologies and products for new applicative markets
- Understand new technical challenges in power IC products
- Screen potential new applications for the introduction of new disruptive technologies
- Position your company in the ever-changing power management value chain

**Equipment & material suppliers:**
- Understand power IC evolution and ecosystem dynamics
- Anticipate the power IC players needs
- Adapt the services to what the market needs
- Discern the differentiated value of your products and technologies in this market
- Identify new business opportunities and prospects

**Assembly and test service companies:**
- Understand the strategy of top power IC players

**Financial & strategic investors:**
- See the potential of new IC technologies
- To know about the latest M&As
- To get a list of power IC players and their activities
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Abdoulaye LY is a Technology & Market Analyst specializing in Power Electronic Systems at Yole Développement. As part of the Power Electronics & Wireless division at Yole, Abdoulaye’s expertise is focused on power management, power electronics systems, electric motors, EV charging stations, renewable energies and electric grids.

Prior to Yole, Abdoulaye served as an electrical engineer and power electronics system engineer at Centum Adetel Transportation Solution for 3 years, where he oversaw converter design. He also performed simulations for catenary free tramways, tested qualifying auxiliary power supplies (APS) for railway applications and managed a team developing a new battery cooling system.

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In addition, she actively supports and assists in developing a dedicated collection of market & technology reports and custom consulting projects.

Prior to Yole, Ana was involved in a high added-value collaboration within the CNM research center and ON Semiconductor, a leading power electronics company. During that partnership and two years as a Silicon Development Engineer, Dr. Villamor has acquired extensive technical expertise and in-depth knowledge of the power electronics industry.

Ana has authored and co-authored several papers, as well as a patent. Ana holds a Ph.D. in electronics and an Electronics Engineering degree and a master's degree in Micro and Nano Electronics from the Universitat Autonoma de Barcelona (Spain).

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COMPANIES CITED IN THIS REPORT

All products need power management to convert, control, monitor, or distribute power.
MARKET FORECAST

Power IC market drivers

The power IC market follows the trends of the power electronics market but also the megatrends for other types of components, such as MEMS and sensors, since power IC is required for all these components.

The power IC market is mainly driving by the trends:

- Automotive electrification
- Autonomous driving
- Factory and building automation
- 5G rollout
- Internet of Things
- More and more online services demand
- Cordless tools – “Batteryfication”

In the following slides, one can find the market forecasts by segment and by power IC product.
Key market and technology trends consist of more integration and reducing the cost.

**Market trends**
- Automotive electrification
- Autonomous driving
- Factory and building automation
- 5G penetration
- Internet of Things
- More and more online services demand
- Cordless tools – Batteryfication
- Smart grid
- Reduction of air pollution & energy consumption
- Distributed energy sources (PV, wind…)

**Technology trends**
- Increase specific power IC functionalities
- Several voltage-rail requirements
- Increase in power
- Downsizing
- Cost reduction
MARKET FORECAST

Power IC market dynamic

- Mobile & Consumer
- Industrial
- Automotive
- Computing
- Telecom
- Medical

SUPPLY CHAIN AND MARKET SHARE

POWER IC SUPPLY CHAIN AND PLAYERS ANALYSIS
Power IC players’ business model 1/2

POWER IC SUPPLY CHAIN AND PLAYERS ANALYSIS
Power IC players’ business model 2/2

MARKET SHARE
Global Top Power IC Suppliers

The top five power IC vendors include:
- Texas Instruments
- Infineon Technologies
- NXP Semiconductors
- Qualcomm
- Renesas

These companies dominate the global market share.

MARKET SHARE EXECUTIVE SUMMARY
Global Top Power IC Suppliers 2018 vs. 2020

The market share of the top power IC suppliers has significantly changed over the years.

MARKET SHARE EXECUTIVE SUMMARY
Global Top Power IC Suppliers market share if M&A are considered

The market share of the top power IC suppliers would have been different if M&A were considered.
FOCUS ON CHINESE MARKET

CHINESE POWER IC MARKET DYNAMICS

- Chinese power IC market is expanding rapidly.
- Several power IC players have emerged in China, gaining market share.
- Apart from market size, China is also the world's largest power IC consumer.
- The Chinese government has been promoting the development of power ICs through various measures.
- The Chinese government supports local enterprises in the power IC industry, including through financial support and research funding.
- China is actively participating in international power IC standards and cooperation.
- The Chinese government is investing in education and training to develop a skilled workforce in the power IC sector.

MARKET DRIVING FORCES

- The increase in demand for high-efficiency power ICs in various applications, including smart grids and renewable energy systems.
- The development of new technologies and innovations in power ICs.
- The need for power ICs in electric vehicle applications.
- The growing importance of energy efficiency in various sectors.
- The increasing interest in sustainable energy solutions.

MEASURES OF MICROELECTRONICS PROMOTION

- The Chinese government has implemented a series of measures to promote the microelectronics industry, including investments in research and development.
- The government has established special economic zones for the microelectronics industry.
- The government has introduced tax incentives and subsidies for microelectronics companies.
- The Chinese government supports the establishment of microelectronics clusters.
- The government has initiated projects to promote the localization of microelectronics components.

IPOS AND EXPANSION OF PRODUCTION CAPACITY IN CHINA

- Several Chinese companies have undergone IPOs in recent years, raising funds for expansion.
- The Chinese government has supported the expansion of production capacity in the power IC sector.
- Local power IC companies have invested in new facilities to meet growing demand.
- The Chinese government has facilitated international partnerships for technology transfer and capacity building.

LOCAL POWER IC SUPPLY CHAIN

- The Chinese local power IC supply chain includes players such as fabless (design), foundry, fablelite, and IDM.
- The Chinese government has been working to strengthen the local supply chain by promoting local production and reducing dependency on imports.
- The Chinese government has been attracting investment and talent in the power IC sector to develop a local supply chain.
- The Chinese government is also investing in research and development to enhance the capabilities of local power IC companies.
FAB CAPACITY INCREASE

FAB INCREASE DEVELOPMENT TIMELINE
Main power players investing in 300mm fabs

MERGERS AND ACQUISITION
Fab acquisitions

DIVESTMENT / INVESTMENT
Overview

NEW FABS TO SOLVE THE CHIP SHORTAGE?

FABS CAPACITY – OVERVIEW
Texas Instruments

FABS CAPACITY – 2021
Texas Instruments

INVESTMENT ON 300MM WAFER FAB
Why are Power IC players investing on 300mm wafer fab!
TECHNOLOGY TRENDS

STANDARD POWER IC vs. SPECIFIC POWER IC

WHAT DOES BCD TECHNOLOGY OFFER?

BCD CHALLENGES

TECHNOLOGY CHOICE

MANY DESIGN CHOICES: NEED TO FIND A TRADE OFF

BCD EVOLUTION FOR POWER MANAGEMENT

Technology evolution: 4 main axes

NEW CHALLENGES WITH HIGHER INTEGRATION

Integration also means moving closer to semiconductor hotspots
TECHNOLOGY TRENDS

TECHNOLOGY EVOLUTION OF INTEGRATED POWER DEVICE ARCHITECTURE

Evolution of isolation structures

ISOLATION STRUCTURES

Highlights

OTHER ISOLATION METHODS

Compound materials

ISOLATION STRUCTURES

Summary

LOCOS | STI | DTI | SOI | GaN-on-XX
--- | --- | --- | --- | ---
Main voltage levels | Main applications | Main players | Advantages | Limitations | Cost | Use in Power IC manufacturing (estimation)

OTHERS: GALVANIC ISOLATION

Mandatory for HV systems like in automotive

PACKAGING FOR MIDDLE-AND HIGH-POWER APPLICATIONS

From TO to BGA or embedded solutions
TECHNOLOGY TRENDS
HOW TO USE OUR DATA?

The Yole Group of Companies, including Yole Développement, System Plus Consulting, and PISEO are pleased to provide you a glimpse of our accumulated knowledge.

Feel free to share our data with your own network, within your presentations, press releases, dedicated articles, and more. But before doing so, contact our Public Relations department to make sure you get up-to-date, licensed materials.

We will be more than happy to give you our latest results and appropriate formats of our approved content.

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