GaN devices are gaining the confidence of many customers and are penetrating various applications. This is confirmed by the promising market outlook for GaN devices having a compound annual growth rate (CAGR) of 8.1% for the period 2019-2025 according to Yole Développement. This relates to market forces pushing for loss reduction and improved efficiency.

Since their first commercialization in 2010, the performance of GaN devices and the value that they add have been gradually proven. Their price has also become increasingly acceptable to end users. Manufacturers use different approaches for device design, depending on the targeted electrical performance and application.

GaN devices still have some technical and commercial challenges to face. For example, both GaN wafer processing and packaging impact the price and make it the major cost-driver of a GaN device. Other challenges include the complexity of some process steps, mainly epitaxy, which hinder GaN adoption on a large commercial scale.

In this report, System Plus Consulting presents an overview of the state-of-the-art of GaN power devices. It highlights differences in design and manufacturing processes, and their impact on device size and production cost. Overall, it analyses 18 devices from ten of the main suppliers: EPC, GaN Systems, Infineon, Innoscience, Navitas, Nexperia, Panasonic, Power Integrations, Texas Instruments and Transphorm. The report includes optical and SEM pictures of the devices to understand the technological choices at die design and assembling level.

This report includes an estimated manufacturing cost of the analysed GaN devices and their selling prices. It provides physical, technological, and manufacturing cost comparisons between the analysed devices.

**GaN Power Transistor Comparison 2020**

## TABLE OF CONTENTS

**Overview/Introduction**
- Executive Summary
- Reverse Costing Methodology
- Glossary

**Technology and Market**

**Company Profile**

**Physical Analysis**
- Low Voltages
  - EPC: EPC2040, EPC2024, EPC2214
  - Texas Instruments: LMG5200
  - GaN Systems: GS61004B
- Medium Voltages
  - Infineon: IGT40R070D1 E8220, IGOT60R070D1
  - Panasonic: PGA26E198A
  - Texas Instruments: LMG3410R070
  - Transphorm: NTP8206NG/TPH3206PS, TPH3208PS, TP65H035G4WS, TP90H180PS
  - GaN Systems: GS66504B
  - Navitas: NV6115
  - Nexperia: GAN063-650WSA
  - Innoscience: INN650D02
  - Power Integrations: SC1923C

**Technology and Physical Comparison**
- Physical and Technology Comparison
- Performance Comparison

**Manufacturing Process Flow**
- EPC, TI, Infineon, GaN Systems, Transphorm, Navitas, Panasonic, Power Integrations, Nexperia, Innoscience

**Cost and Price Analysis**
- Summary, Yields Explanation and Hypotheses
- Low Voltages
- Medium Voltages
- For Each Analyzed Device:
  - Wafer cost, die cost, packaging cost, component cost and component price

**Cost Comparison**
- Global Comparison – Component Cost
- Low Voltages – Wafer and Ampere Cost Comparison
- Low Voltages – Component Cost Breakdown Comparison
- Medium Voltages – Wafer and Ampere Cost Comparison
- Medium Voltages – Component Cost Breakdown Comparison

**Feedback**

**System Plus Consulting Services**

---

### AUTHORS

**Taha Ayari, PhD** is involved in analyzing compound semiconductor devices within Power Electronics and Compound Semiconductors team. Taha holds a PhD in Electrical and Computer Engineering from Georgia Tech Lorraine.

**Peggy Gallois** joined System Plus Consulting’s laboratory of microelectronics team in July 2019. She has a deep knowledge of metallic materials. She previously worked in the laboratory of metallographic expertise for Dassault Aviation near Paris.

---

### RELATED REPORTS

**Innoscience’s 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.

July 2020 - EUR 3,990*

**Navitas 650V GaNFast Power IC Family**

The first GaN monolithic devices from Navitas for fast charging. October 2019 - EUR 3,990*

**Nexperia’s AEC-Q101 Qualified 650 V GaN-based Power Device**

Deep analysis of the GAN063-650WSA, Nexperia’s first GaN product.

March 2020 - EUR 3,990*
Our analysis is performed with our costing tools Power CoSim+ and IC Price+.
System Plus Consulting offers powerful costing tools to evaluate the production cost and selling price from single chip to complex structures.

**Power CoSim+**
Cost simulation tool to evaluate the cost of any Power Electronics process or device: from single chip to complex structures.

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

**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.

**CONTACTS**

**Headquarters**
22, bd Benoni Goullin
Nantes Biotec
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 LAFFERIERE
Western USA & Canada
+1 310-600-8267
lafferiere@yole.fr
Chris YOUNMAN
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

System Plus Consulting is specialized in the cost analysis of electronics from semiconductor devices to electronic systems.
A complete range of services and costing tools to provide in-depth production cost studies and to estimate the objective selling price of a product is available.

Our services:
• **STRUCTURE & PROCESS ANALYSES**
• **TEARDOWNS**
• **CUSTOM ANALYSES**
• **COSTING SERVICES**
• **COSTING TOOLS**
• **TRAININGS**

www.systemplus.fr
sales@systemplus.fr
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.

2. PRICES
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 are 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.

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

6. DELIVERIES
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.

7. ENTRUSTED GOODS SHIPMENT
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?

9. CONFIDENTIALITY
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. RESPONSIBILITY 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.

11. APPLICABLE LAW
Any dispute that may arise about the interpretation or execution of the current terms and conditions shall be resolved applying the French law.
It the dispute cannot be settled out-of-court, the competent Court will be the Tribunal de Commerce de Nantes.