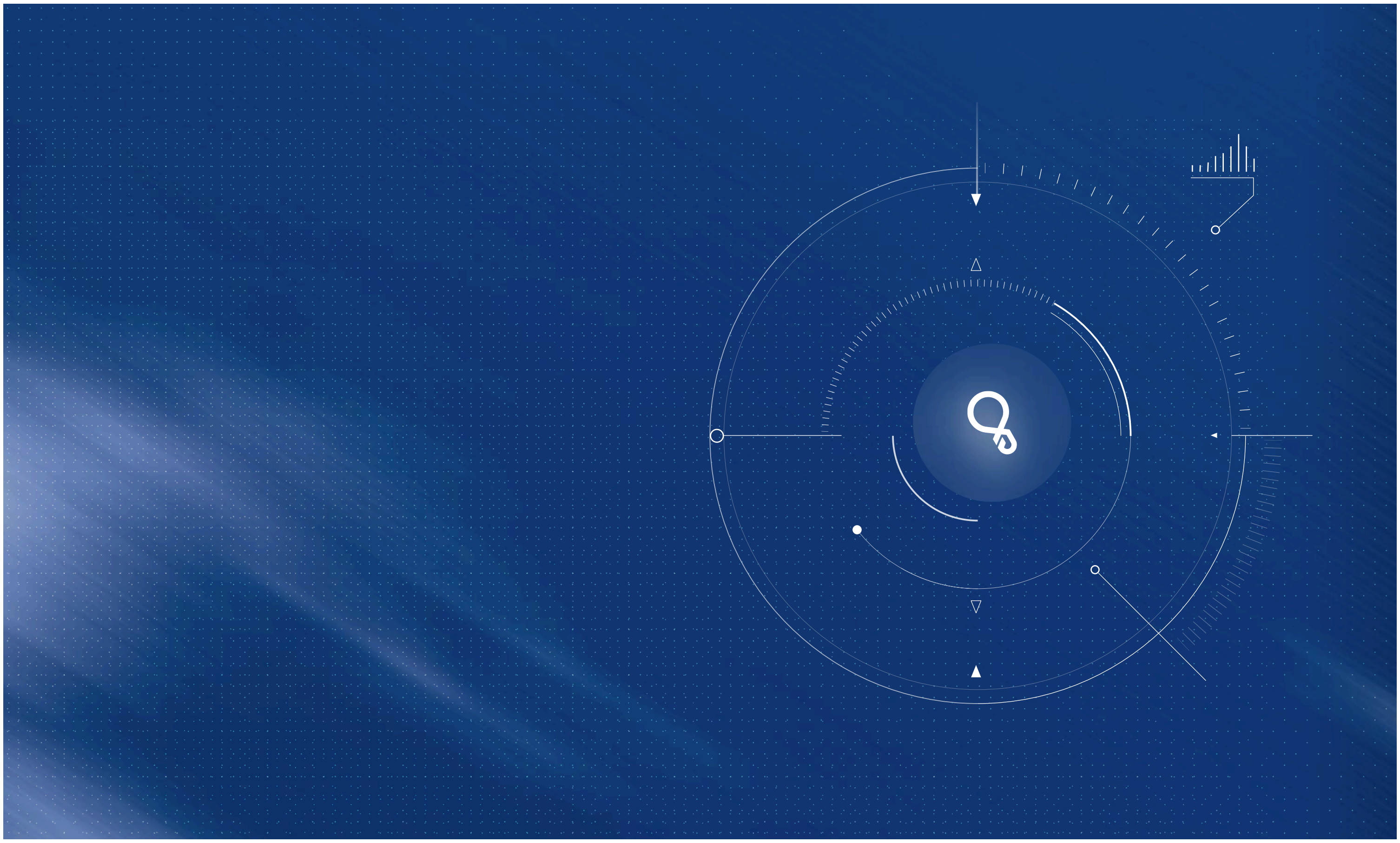
cypris

MARCH 2025



RESEARCH BRIEF

Gallium Nitride (GaN) Technology & Applications Trends

Prepared By

Cypris Team

info@cypris.ai

Cypris Insight Brief | For: Open Access
March 17, 2025

Table of Contents

Executive Summary

This brief provides an analysis of Gallium Nitride (GaN) technology, with a focus on its applications in electronics, including consumer electronics, power electronics, telecommunications, and emerging fields. It examines the competitive landscape, profiling key players in the U.S. GaN market and assessing their technological advancements and market positioning. Additionally, the report explores GaN's advantages and limitations compared to competing technologies, both commercially available and emerging.

Analyst Opinion

Gallium Nitride is at an inflection point, where its adoption is shaped not just by performance but by cost dynamics and application-specific advantages. While GaN offers superior efficiency and power density, its benefits extend beyond a simple comparison to Silicon Carbide (SiC). SiC's packaging compatibility in industries such as EVs and grid infrastructure favors its use, while GaN's higher switching speeds and compactness make it ideal for sectors such as AI data centers and high-frequency power supplies. Rather than being direct competitors, GaN and SiC are developing along distinct but overlapping trajectories, each optimized for specific system architectures. Transitioning to the latest GaN wafer technologies, such as 300 mm, could significantly lower costs and expand adoption in power conversion applications up to 700V and beyond.

A major bottleneck for GaN is its supply chain concentration. China's 98% control of low-purity gallium poses geopolitical risk, as recent export restrictions demonstrate. While the CHIPS Act is primarily aimed at bolstering silicon-based semiconductor manufacturing, it indirectly strengthens the broader U.S. semiconductor ecosystem, providing an opportunity for GaN players to align with domestic manufacturing initiatives. However, the CHIPS Act itself faces uncertainty due to the shifting policy landscape in the U.S., raising concerns about its long-term impact. Companies that proactively secure diversified supply chains will gain a strategic advantage, mitigating the risk of future material shortages.

GaN's role in high-power applications such as AI data centers, 5G infrastructure, and EV power systems is often underappreciated. Its efficiency gains are not just about performance but also about reducing operational costs, particularly in cooling and power management. With AI workloads pushing data center energy consumption to unprecedented levels, GaN's ability to improve power conversion efficiency and reduce thermal loads makes it a valuable technology for next-generation computing. Similarly, as EVs transition to higher power onboard chargers (20kW+ systems), GaN's power density will play a key role in enabling more compact and efficient designs.

GaN's adoption is shaped by vendor-specific integration strategies that optimize for distinct applications. Unlike SiC, which can often replace silicon Insulated Gate Bipolar Transistors (IGBTs) with minimal redesign, GaN's advantages, higher switching speeds, efficiency, and compact form factor require a system-level re-architecture to unlock their full potential. This makes vendor alignment critical, as companies such as Infineon, Navitas, and EPC differentiate through tailored toolchains that streamline implementation. While early adoption required significant engineering effort, the ecosystem is evolving, from robotics evaluation kits to integrated microcontroller ecosystems, to reduce barriers. The companies that recognize these shifts, viewing GaN not as a simple component swap but as an opportunity for system-wide optimization, will be best positioned to leverage its full capabilities in next-generation power designs.

Ultra-wide bandgap (UWBG) semiconductors such as gallium oxide (Ga_2O_3), diamond, and cubic boron nitride (c-BN) are gaining attention for their potential in ultra-high-voltage power electronics and extreme-performance RF applications due to their superior breakdown fields and thermal conductivity. However, challenges in material synthesis, doping, and large-scale fabrication currently limit their commercialization, making GaN the more practical choice. As research progresses, UWBG materials could complement or, in niche cases, compete with GaN, particularly in next-generation high-power and high-frequency systems.

Research Methodology

In our research, we used the Cypris platform and broader internet searches to gather relevant data. Additionally, we incorporated secondary sources, including industry articles, company websites, and recent market news. Throughout this process, we refined our approach by adapting our keywords to synonyms and related terms to ensure comprehensive data collection. For our foundational queries, we used Cypris' Boolean search functionality with the following search terms '[Gallium Nitride Electronics]'.

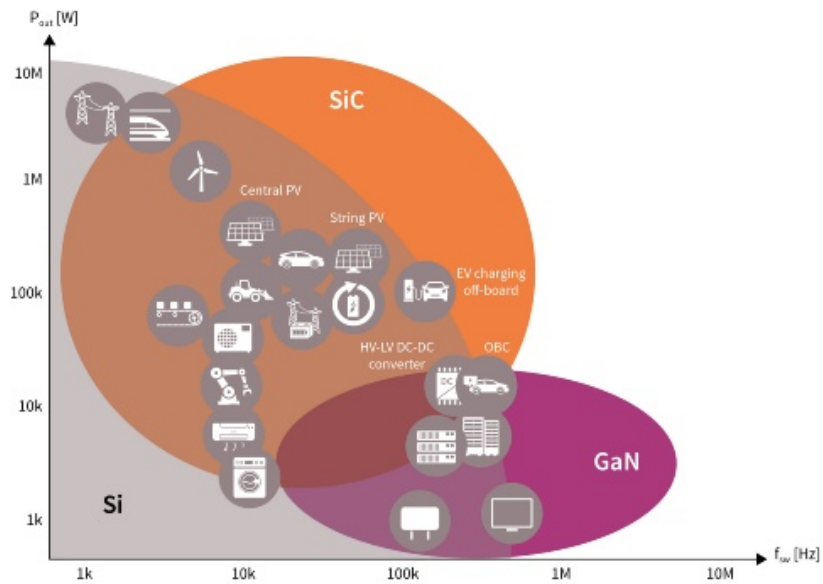
Background

Gallium Nitride

Gallium Nitride (GaN) has transformed from a niche semiconductor material into a critical enabler of high-performance electronic systems across multiple industries. GaN's fundamental material properties, including higher electron mobility, wide bandgap, and superior switching characteristics, make it an ideal material for applications demanding higher efficiency, reduced system size, and enhanced thermal performance.

Wide Bandgap Semiconductors

GaN belongs to a class of materials known as Wide Bandgap Semiconductors (WBG). Several materials including boron nitride, silicon dioxide, and diamond are defined as WBG materials. However, the most prevalent WBG semiconductors today are those based on gallium nitride (GaN) and silicon carbide (SiC).[1] Compared to traditional silicon semiconductors, WBG materials can handle higher power at higher voltages and operate at higher frequencies, as shown in the image below. Wide bandgap semiconductor devices also offer significant power efficiency to a variety of applications, also show in the image.



Wide Bandgap Semiconductor Applications. Image Source: Infineon.

However, GaN and SiC devices present unique design challenges. Their gates are more difficult to drive than those of conventional silicon devices, often requiring expertise from specialist power engineers.

[1] Introduction to Wide Band-Gap Semiconductors

This complexity has slowed adoption. To address this, manufacturers now offer GaN devices with gate drivers specifically designed for individual SiC components. Additionally, integrating the SiC device and its driver into a single package simplifies implementation while saving board space and reducing weight.[2]

Ultra-Wide Bandgap Semiconductors

Beyond GaN and SiC, several ultra-wide bandgap (UWBG) semiconductors are emerging as potential competitors in high-performance electronic applications. Materials such as gallium oxide (Ga_2O_3), aluminum nitride (AlN), diamond, and cubic boron nitride (c-BN) exhibit exceptional properties, including larger bandgaps, enhanced thermal stability, and superior carrier mobility. These characteristics position them as promising candidates for next-generation high-power and high-frequency devices.[3]

For instance, Ga_2O_3 offers a high breakdown field, making it suitable for ultra-high-voltage applications.[4] Diamond and c-BN possess exceptional thermal conductivity and electrical properties, making them ideal for applications requiring efficient heat dissipation and high-power handling.[5] However, challenges such as material synthesis, doping difficulties (including the unavailability of complementary dopants), poor ohmic contacts, low carrier mobility, and integration with existing technologies currently limit their widespread adoption.[6]

Current and Emerging Applications of GaN

The table below summarizes GaN technology applications, outlining key use cases, competing technologies, advantages, and limitations. Additional details are provided after the table.

Application	Example Use Cases	Competing Technologies	GaN Advantages	GaN Limitations
Consumer Electronics	Smartphones & laptop chargers, wireless charging systems	Silicon MOSFETs, Silicon Carbide, Gallium Oxide	Higher efficiency (95% vs 87% for silicon), smaller size, lower heat output	Manufacturing costs, long-term reliability testing
Power Electronics	Data center power supplies, AI computing, renewable energy inverters, EV power conversion	Silicon MOSFETs, Silicon Carbide, Gallium Oxide, Diamond, Cubic Boron Nitride	Higher switching speed, reduced cooling requirements, smaller and lighter components	Thermal management at high power levels, cost competitiveness against SiC in high-voltage applications
Telecommuni-cations & RF Electronics	5G/6G base stations, satellite communications, radar systems	LDMOS, Gallium Arsenide, Indium Phosphide (InP), Gallium Nitride on Silicon Carbide (GaN-on-SiC), Diamond	Better power handling and efficiency in mmWave frequencies, higher voltage operation, smaller RF front-end modules	Higher cost and manufacturing complexity, requires advanced packaging for thermal management

[2] The Evolution of GaN in Consumer Electronics: Key Insights
[3] Ultra-wide-bandgap semiconductors: opportunities and challenges
[4] An Overview of the Ultrawide Bandgap Ga2O3 Semiconductor-Based Schottky Barrier Diode for Power Electronics Application
[5] A Review of Diamond Materials and Applications in Power Semiconductor Devices
[6] Ultrawide Bandgap Semiconductor Devices and Monolithic Circuits

Emerging Electronics Applications	Micro-LED displays, quantum computing, advanced sensing technologies	OLED, Mini-LED, Diamond, Boron Nitride, Gallium Oxide, Aluminum Nitride	Higher brightness and lifespan in displays. Potential for quantum computing scalability. Superior thermal and optoelectronic properties	Manufacturing complexity in micro-LEDs, high costs

Consumer Electronics

Consumer electronics represent a rapidly advancing application sector for GaN technology, with significant commercial adoption evident in power adapters and charging devices. Leading manufacturers have used GaN's high switching speeds to design smaller, more efficient chargers for smartphones, laptops, and other devices. Because consumer devices operate at lower voltages and power levels, typically below 100V, GaN solutions must be optimized for compact designs with lower thermal output, while also being cost-effective enough for mass-market adoption. Compared to traditional silicon-based chargers, GaN-based power adapters achieve approximately 95% efficiency versus silicon's 87%, drastically reducing waste heat and energy loss.[7] In recent years, Gallium Oxide (Ga_2O_3) has emerged as a potential alternative to GaN in compact power conversion applications, as it offers an even higher breakdown field and lower manufacturing costs due to its availability in bulk wafers. However, its lower thermal conductivity remains a significant challenge compared to GaN.[8]

Wireless charging systems have also benefited from GaN's superior power conversion characteristics. By operating efficiently at higher frequencies, GaN devices reduce energy losses and heat buildup during wireless power transfer. Given the constraints of portable consumer devices, GaN enables manufacturers to minimize size and weight while ensuring sufficient power delivery without overheating, a critical advantage over silicon-based solutions. This improvement not only enhances charging efficiency but also allows for more compact and thermally optimized designs compared to silicon-based systems.[9]

While silicon-based metal-oxide-semiconductor field-effect transistor (MOSFETs) have traditionally dominated consumer power electronics, GaN's advantages in efficiency, thermal performance, and size reduction make it the preferred choice for next-generation high-power adapters and wireless charging systems. Gallium Oxide (Ga_2O_3), with its ultra-wide bandgap, could provide a lower-cost alternative for high-efficiency chargers, especially in applications where thermal management is less of a concern. Unlike industrial or automotive markets, consumer electronics require rapid commercialization, high-volume manufacturing, and aggressive cost reduction strategies to stay competitive, making scalability a key factor in GaN's widespread adoption. However, challenges remain in reducing manufacturing costs and conducting long-term reliability testing under real-world consumer use conditions to ensure durability.

[7] Gallium Nitride: The Secret Behind Future Chargers
[8] Gallium Oxide Power Electronics: The Key Semiconductor for Realizing Energy Sustainable Future
[9] Exploring Advanced GaN Technology: The Driving Force Behind the Future of Electronics

Power Electronics

Power electronics is a foundational application area for GaN technology, with increasing adoption in data center power supplies, AI computing infrastructure, renewable energy systems, and electric vehicle (EV) power conversion. These applications demand high efficiency, compact designs, and thermal performance, all which GaN excels at due to its higher switching speeds and lower conduction losses compared to traditional silicon-based power devices.

- In data centers and AI servers, GaN enables power supplies with efficiency levels of 98%, reducing energy waste, cooling costs, and system footprint, making it a key component in hyperscale computing infrastructure.[10]
- In renewable energy systems, GaN's ability to operate at high frequencies allows for more efficient and compact solar inverters, improving the energy conversion process while minimizing thermal losses.
- In EVs and mobility applications, GaN plays a crucial role in on-board chargers (OBCs), DC-DC converters, and auxiliary power management systems, helping reduce vehicle weight and improve overall efficiency.

Competing technologies in power electronics include silicon MOSFETs, silicon carbide, gallium oxide, diamond, and cubic boron nitride, all of which offer distinct advantages in certain segments. SiC dominates in high-power applications exceeding 800V, such as EV traction inverters and grid-scale renewable energy storage, due to its superior thermal conductivity and higher breakdown voltage.[11] However, GaN is better suited for low to mid-voltage applications, typically in the 48V–650V range, where it offers advantages in efficiency, switching speed, and power density over traditional silicon-based solutions.[12] Compared to silicon superjunction MOSFETs, GaN offers lower switching losses and higher frequency operation, allowing for smaller magnetics and reduced cooling requirements, which are particularly beneficial in data center and AI server power architectures. Gallium Oxide (Ga_2O_3), with its ultra-wide bandgap and extremely high breakdown field, is emerging as a competitor in ultra-high-voltage applications such as solid-state transformers and grid power electronics. Its ability to support voltages beyond GaN and SiC makes it an attractive material for next-generation power infrastructure, though its lower thermal conductivity poses challenges in heat dissipation.[13]

Additionally, diamond and cubic boron nitride (c-BN) are being researched for their exceptional thermal conductivity, ultra-wide bandgaps, and high breakdown fields, making them promising candidates for high-frequency and high-power applications. Diamond, with its unmatched ability to dissipate heat, is particularly suited for power electronics where efficiency and thermal management are critical. Similarly, c-BN's high electrical resistivity and high breakdown voltage position it as a strong contender for next-generation power-switching devices. However, both materials face significant fabrication and doping challenges, particularly in achieving efficient n-type doping and mobile carrier activation, which currently limit their commercial scalability.[14]

[10] Revolutionizing Power Electronics: Next-Gen GaN and SiC Technologies Unveiled in Atlanta
[11] EVs Need 800 V and 800 V Needs Silicon Carbide
[12] Mid-Voltage Systems Turn to GaN Devices to Achieve the Highest Power Density
[13] Ultra-wide bandgap semiconductor Ga2O3 power diodes
[14] Electronic properties of c-BN/diamond heterostructures for high-frequency high-power applications

While GaN provides significant advantages in efficiency, size reduction, and system-level cost savings, challenges remain in scalability, thermal management at higher power levels, and cost competitiveness against SiC in high-voltage applications. Additionally, GaN devices require advanced packaging and gate drive optimization to fully realize their performance potential, adding complexity to system integration. Unlike consumer electronics, where GaN adoption is driven by fast product cycles and miniaturization, power electronics markets require rigorous reliability testing, long-term performance validation, and regulatory compliance, making the transition slower but highly impactful once adopted.[15] As GaN manufacturing matures and costs decline, its role in power-intensive applications across data centers, renewables, and EVs is expected to expand, though competition from SiC, Ga_2O_3, and other emerging UWBG materials will continue to shape the industry.

Telecommunications & RF Electronics

GaN is revolutionizing telecommunications and Radio Frequency (RF) electronics, enabling higher performance particularly in 5G and emerging 6G wireless infrastructure, satellite communications, and radar systems. As wireless networks evolve, the demand for higher frequency operation, greater power efficiency, and improved thermal performance has driven the shift from legacy RF semiconductor technologies to GaN-based solutions. GaN's high electron mobility, wide bandgap, and superior power density make it ideal for high-frequency RF amplifiers in 5G base stations, satellite communications, and military radar systems, where efficiency, signal integrity, and reliability are paramount.[16]

Traditional RF power amplifiers have relied on metal-oxide semiconductors (LDMOS) and gallium arsenide (GaAs), which have historically dominated sub-3 GHz cellular infrastructure.[17] However, as 5G and future 6G networks push into higher frequency bands, particularly in mmWave (24 GHz and above), LDMOS and GaAs increasingly struggle with efficiency and power density limitations above 3 GHz. GaN offers better mmWave performance, higher power handling, and improved thermal stability, enabling smaller, more efficient RF front-end modules. GaN's ability to operate at higher voltages than LDMOS allows for more compact base stations with fewer cooling requirements, reducing total infrastructure costs, and improving energy efficiency for telecom providers.

Silicon Carbide is also gaining attention in RF applications, primarily as a substrate for Gallium Nitride (GaN) devices in high-power, high-frequency radar and satellite systems. SiC's excellent thermal conductivity and high breakdown voltage provide advantages over traditional GaAs and LDMOS solutions.[18] However, SiC itself is not typically used as the active material in RF amplifiers due to its lower electron mobility compared to GaN. Instead, GaN-on-SiC technology is being adopted for high-power RF applications, leveraging SiC's thermal properties and GaN's superior electron mobility

Despite its advantages, GaN adoption in RF applications still faces barriers related to cost and manufacturing complexity. GaAs remains cost-competitive in low-power, high-frequency applications, such as smartphone RF front ends, due to its established manufacturing base and lower cost at scale. Additionally, indium phosphide (InP) dominates specialized extremely high-frequency applications (100+ GHz), such as advanced satellite communications and high-speed optical networks, where GaN may not

[15] Addressed main challenges related to GaN adoption: discover the GaNext PENTA Project impact summary!
[16] RF GaN: A World of Potential, But at a Critical Crossword
[17] Application Note AN-007: A Comparative Review of GaN, LDMOS, and GaAs for RF and Microwave Applications
[18] Silicon Carbide Electronics and Sensors Benefits

yet offer the required performance.[19] Diamond is being investigated as a substrate material for gallium nitride (GaN) in RF applications, rather than as a direct alternative to GaN itself. GaN-on-diamond technology offers superior thermal management due to diamond's unmatched thermal conductivity, enabling up to 3 times improvement in RF power density and a 3-fold reduction in thermal resistance compared to GaN-on-SiC devices.[20] However, challenges in fabrication, including difficulties in bonding GaN to diamond with thermally conductive interfaces and managing stress at the interface, as well as high production costs, currently limit the widespread adoption of this technology in commercial RF applications.[21] GaN RF technology also demands optimized packaging and thermal management solutions to leverage its high-power density without performance degradation.

Emerging Electronics Applications

As GaN technology continues to evolve, its impact is extending beyond traditional power and RF applications into emerging electronics fields, such as micro-LED displays, quantum computing, and advanced sensing technologies. These applications take advantage of GaN's unique optoelectronic properties, wide bandgap, high electron mobility, and thermal stability, making it an essential material for next-generation electronic devices. While GaN's role in power conversion and telecommunications is well-established, its adoption in high-resolution displays, quantum devices, and ultra-sensitive sensors represents a rapidly growing frontier in semiconductor innovation. Competing ultra-wide bandgap materials such as diamond, boron nitride (BN), gallium oxide (Ga_2O_3), aluminum nitride (AlN), and boron arsenide (BAs) are also being explored for these next-generation applications, particularly where extreme thermal performance, quantum stability, or advanced optoelectronics are required.

One of the most promising emerging applications is micro-LED display technology, where GaN is the fundamental material for red, green, and blue (RGB) pixel emitters. Unlike organic light-emitting diodes (OLEDs), which suffer from burn-in and shorter lifespans, GaN-based micro-LEDs offer higher brightness, better energy efficiency, and longer operational stability. Additionally, micro-LEDs are more resistant to environmental degradation, making them ideal for high-durability applications such as augmented reality (AR), virtual reality (VR), and automotive heads-up displays (HUDs). [22] However, despite these advantages, manufacturing micro-LEDs remains a significant challenge due to mass transfer difficulties, pixel defect rates, and high production costs, preventing widespread commercialization. Competing technologies like OLED and mini-LED (an advanced form of backlit LCD) remain dominant in consumer markets due to their lower production complexity and cost-effectiveness. Additionally, aluminum nitride (AlN) is being explored for deep-UV LED and optoelectronic applications,[23] while boron nitride (BN) is gaining interest for its potential in high-performance, stable, and high-temperature electronic displays.[24]

Beyond displays, GaN is also being explored for quantum computing, where its low noise characteristics and superior thermal conductivity make it a strong candidate for next-generation qubits and quantum processors. Currently, superconducting qubits are based on niobium and aluminum circuits, and trapped ion qubits dominate quantum computing research, but GaN's potential for supporting scalable, stable, and high-coherence qubit designs is actively being investigated. Its high-frequency performance may

---

[19] Exploring the Future Prospects of InP Wafers
[20] Qorvo's GaN-on-Diamond Achieves Breakthrough Results for DARPA
[21] Diamond/GaN HEMTs: Where from and Where to?
[22] Ultra-high brightness Micro-LEDs with wafer-scale uniform GaN-on-silicon epilayers
[23] Aluminum Nitride Ultraviolet Light-Emitting Device Excited via Carbon Nanotube Field-Emission Electron Beam
[24] Cubic Boron Nitride and Its Applications

also contribute to quantum microwave communication systems, further expanding its role in cutting-edge computing architectures.[25] Diamond, with its ultra-high thermal conductivity and extreme quantum coherence properties, is also being researched as a candidate for quantum computing, particularly for nitrogen-vacancy (NV) center-based qubits.[26]

Competitive Landscape

The Gallium Nitride (GaN) semiconductor market in the United States is shaped by a mix of established semiconductor firms, specialized GaN-focused companies, and emerging startups. This section profiles key U.S. companies driving GaN innovation, analyzing their market positioning, technological advancements, and strategic focus. Organizations were selected based on technological innovation, market influence, and strategic positioning within the GaN ecosystem, highlighting the industry's competitive landscape and potential future leaders.

The supply chain of Gallium Nitride (GaN) devices consists of three main stages:

- Wafer fabrication
- Chip manufacturing
- Integration into end-products

Wafer fabrication involves the production of GaN-on-Silicon, GaN-on-Silicon Carbide (SiC), or GaN-on-Sapphire substrates using epitaxy techniques such as Metal-Organic Chemical Vapor Deposition (MOCVD).[27] Chip manufacturing is led by Integrated Device Manufacturers (IDMs) that design, process, and package GaN semiconductors for power electronics and radio frequency (RF) applications. Finally, GaN devices are integrated into end-products such as wireless chargers, data centers, and other applications mentioned earlier. The companies shaping this supply chain specialize in different stages, from producing GaN wafers to developing fully integrated solutions for high-growth markets.

The table below summarizes some of the leading U.S. companies developing GaN technologies, categorizing them by their roles in the supply chain, key application areas, and notable advancements, highlighting their impact on the GaN semiconductor market. Further details on each company and market position are provided after the table.

[25] Emerging GaN technologies for power, RF, digital and quantum computing applications: recent advances and prospects
[26] P1 Center Electron Spin Clusters Are Prevalent in Type Ib Diamonds
[27] Guide: Semiconductor wafer with gallium nitride (GaN) – the manufacturing processes

Company	Supply Chain Categories	Key Applications	Notable Advancements
Efficient Power Conversion (EPC)	Chip Manufacturing (IDM), Integration into End-Products	DC-DC converters, Motor drives, Consumer electronics	Chip-scale packaging for high-speed, high-efficiency power devices
Infineon	Wafer Fabrication, Chip Manufacturing (IDM)- Integration into End-Products	Consumer electronics- Automotive and eMobility, Residential solar, AI data centers, Telecom	First to produce GaN chips on 300mm wafers (2024). Acquired GaN Systems, strengthening GaN portfolio
Navitas Semiconductor	Chip Manufacturing (IDM), Integration into End-Products	Fast chargers, Data centers, Electric vehicle power systems	World's first 8.5 kW AI data center power supply achieving 98% efficiency
MACOM	Wafer Fabrication, Chip Manufacturing (IDM)	RF and microwave (Telecom, 5G)- Industrial & Defense, Data centers	Selected by DoD to develop advanced GaN-on-SiC processes under the CHIPS Act
Qorvo	Wafer Fabrication, Chip Manufacturing (IDM)	Radar systems, Wireless communications (5G)	Leadership in the STARRY NITE program for 90nm GaN-on-SiC.
Renesas (Transphorm)	Wafer Fabrication, Chip Manufacturing (IDM), Integration into End-Products	Electric vehicles (EVs), Renewable energy, Data centers	Seamless integration of GaN with SiC and silicon for hybrid power solutions
Texas Instruments (TI)	Chip Manufacturing (IDM), Integration into End-Products	Industrial automation- Automotive, consumer electronics, Communications equipment	TI expanded its 200mm GaN manufacturing capacity in 2024, aiming to produce >95% of its GaN chips internally by 2030
NXP	Chip Manufacturing (IDM), Integration into End-Products	5G infrastructure, Electric vehicles (EVs), Industrial automation	Expanding GaN use in automotive power conversion and ADAS; Developing high-reliability GaN for industrial automation and smart energy grids

Efficient Power Conversion

Efficient Power Conversion Corporation (EPC) is a technology company dedicated to advancing the field of power electronics through the development and commercialization of gallium nitride (GaN)-based power devices. Their products are used in a wide range of applications, from consumer electronics and automotive to renewable energy and space. EPC specializes in enhancement mode gallium nitride (eGaN) based power management. eGaN FETs and integrated circuits provide performance many times greater than silicon power MOSFETs in applications such as DC-DC converters, remote sensing technology (lidar), motor drives for eMobility, robotics, and drones, and low-cost satellites.[28]

Infineon

Infineon Technologies is a global semiconductor company that specializes in power systems and IoT. I In September 2024, the company became the first to produce GaN chips on 300 mm wafers, increasing

[28] EPC Announces 4th Edition of 'GaN Power Devices for Efficient Power Conversion' Book

chip output by 2.3 times compared to 200 mm wafers.[29] This breakthrough lowers production costs and brings GaN closer to cost parity with silicon-based counterparts. Infineon's acquisition of GaN Systems in 2024 further solidified its commitment to the GaN market. The company is focusing on applications across various industries, including consumer electronics, mobility, residential solar, telecommunications, and AI data centers.

Navitas [Navitas Semiconductor](#)

Navitas Semiconductor specializes in high-efficiency power semiconductors. The company focuses on GaN power integrated circuits (ICs) that combine power, drive, and control functions into a single package, enabling higher efficiency, faster switching speeds, and reduced system size compared to traditional silicon solutions. While Navitas initially gained traction in consumer fast-charging applications, it has expanded into high-power sectors as well, where GaN's efficiency advantages lead to smaller, more efficient power conversion systems across multiple industries.[30] Navitas announced plans to showcase significant advancements in GaN and silicon carbide (SiC) technologies at APEC 2025, including the world's first 8.5 kW AI data center power supply achieving 98% efficiency, highlighting the company's commitment to innovation across various high-growth markets.[31]

MACOM [MACOM](#)

MACOM Technology Solutions Inc. focuses on both GaN-on-Silicon Carbide (SiC) and GaN-on-Silicon (Si) technologies for the Telecommunications, Industrial and Defense, and Data Center industries. The company is developing advanced GaN processes for radio frequency (RF) and microwave applications, particularly in high-voltage and millimeter-wave frequencies. In November 2024, MACOM was selected to spearhead a U.S. Department of Defense-funded (DoD) project under the CHIPS Act to develop advanced GaN-on-Silicon Carbide (SiC) semiconductor processes for radio frequency (RF) and microwave applications. This initiative focuses on high-voltage, millimeter-wave solutions and builds on prior collaborations with the DoD, including contracts to improve heat dissipation and refine GaN technologies for high-frequency applications.[32]

qorvo [Qorvo](#)

Qorvo specializes in high-performance RF GaN solutions, including GaN-on-Silicon Carbide technology, which is critical for advanced radar systems, wireless communications, and satellite applications. Qorvo's technological focus centers on innovative RF and semiconductor solutions for a wide range of applications. In addition, the company has a leadership role in the U.S. Department of Defense's STARRY NITE program. This initiative aims to develop 90nm GaN-on-Silicon Carbide (SiC) foundry processes for high-performance RF applications up to 100 GHz, addressing both military and commercial needs. By

[29] Infineon pioneers world's first 300 mm power gallium nitride (GaN) technology – an industry game-changer
[30] Navitas Semiconductor Announces Fourth Quarter and Full Year 2024 Financial Results
[31] Navitas Semiconductor to Showcase Latest GaN and SiC Innovations at APEC 2025
[32] MACOM Selected to Lead Advanced GaN-on-SiC Semiconductor Technology Development Project

focusing on advanced packaging and integration, this program enhances device performance and scalability while supporting domestic semiconductor supply chains.[33]

Renesas

Renesas and Transphorm have become a unified force in the gallium nitride (GaN) market following Renesas' acquisition of Transphorm completed on June 20, 2024.[34] Transphorm, known for its high-reliability GaN solutions for high-voltage power conversion, specializes in efficient, compact, and durable GaN devices across applications such as electric vehicles, renewable energy, and data centers. Its acquisition by Renesas has integrated Transphorm's advanced GaN technology into Renesas' broad power portfolio, enabling comprehensive solutions that combine GaN with silicon carbide (SiC) and silicon technologies. Together, they address growing demands for wide bandgap semiconductors with products offering higher efficiency, faster switching frequencies, and smaller footprints.

Texas Instruments

Texas Instruments (TI) designs, manufactures, tests and sells analog and embedded semiconductors in markets that include industrial, automotive, personal electronics, communications equipment, and enterprise systems. The company integrates GaN technology with advanced packaging and control solutions, differentiating itself with reliable, easy-to-use designs that accelerate adoption across various industries. TI's GaN Field-Effect Transistors with integrated drivers enable fast switching speeds of 150V/ns, reducing losses and improving efficiency while minimizing system size and cost through higher switching frequencies over 500kHz. Designed for reliability with extensive testing and protection features, TI also provides dedicated design tools and resources to accelerate development and adoption in high-voltage applications.[35] Additionally, TI expanded its 200mm GaN manufacturing capacity in 2024, aiming to produce >95% of its GaN chips internally by 2030.[36]

NXP

NXP Semiconductors is a semiconductor company specializing in radio frequency (RF) power solutions, focusing on automotive, industrial, and smart home applications. The company delivers energy-efficient, high-performance components. Its GaN-on-SiC transistors, optimized for 4G/5G cellular specifications, emphasize high power density and compact designs, enabling smaller, lighter radio units for telecom operators. With over 20 years of GaN development expertise, NXP accelerates 5G deployments through rapid prototyping, pin-compatible modules, and advanced packaging.[37]

[33] Qorvo® Awarded Department of Defense Advanced RF Gallium Nitride Program
[34] Renesas Completes Acquisition of Transphorm
[35] GaN: Pushing the limits of power density & efficiency
[36] Texas Instruments expands internal manufacturing for gallium nitride (GaN) semiconductors, quadrupling capacity
[37] NXP Advances 5G with New Gallium Nitride Fab in Arizona