“Pure-Play,
Next-Generation
Power Semiconductors

Electrify Our World™”

Charles (Yinjie) Zha 查莹杰
VP, GM Navitas Semiconductor China
August 15th, 2022: Navitas Semiconductor, industry-leader in gallium nitride power ICs, acquired GeneSiC Semiconductor, silicon carbide pioneer and industry leader.
$22B ‘Pure-Play’ Market Opportunity

Axes not to scale
1) 2026E potential, Source: Yole, DNV, IRENA, Fraunhofer ISE, IHS, Cisco, Hyperscale, Peer annual reports, Wall Street research.

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Note: Navitas estimate of GaN- & SiC-based power systems compared to silicon in the 2024-2025 timeframe.
The GaN Revolution: Ultimate Integration

GaNFast™

- Autonomous Standby
- Autonomous Protection
- Loss-less Current Sensing
- High Precision
- High Efficiency
- Internal Gate
- Integrated Gate Drive
- dV/dt Immunity
- Layout Insensitive
- 2 kV ESD rating
- Proven Reliability
- Proven Robustness

Si MOSFET

- Old, slow
- High Q_g
- High C_oss
- F_{SW} < 100kHz

Exposed gate
- External gate drive
- dV/dt sensitivity
- Layout sensitivity
- ESD sensitivity
- Unknown reliability
- Unknown robustness

Discrete GaN

200-300 kHz

GaNSense™

- Autonomous Standby Mode
- Integrated HS and LS FETs
- Integrated level-shift isolation
- Shoot-through protection
- Enlarged cooling pads
- Fastest switching
- Highest efficiency

- Autonomous Over-Current Protection
- Over-Temperature Protection

GaNSense plus:

500 kHz

GaNSense Half-Bridge

- Fastest switching
- Highest efficiency

1 MHz

800 Vmax

2kV ESD

Loss-Less Current Sensing

Over-Temperature Protection

Drive Control Sensing Protection Level-Shift

800 Vmax

Autonomous Standby Mode

2kV ESD

Loss-Less Current Sensing

Over-Temperature Protection
October 2022: Over 60,000,000 GaNFast shipped: 
Zero reported GaN-related field failures\(^{(1)}\)
Largest range of SiC FETs & diodes (650 V to 6.5 kV)

Fast Switching
Highest efficiency hard-switch, soft-switch (Lowest $E_{on}$, $E_{off}$, $E_{zvs}$ losses)

Cool Operation
Lowest $R_{DS(on)}$ at high temperature (25% lower than industry typical)

100%-Tested Robust Avalanche
Highest published capability to handle excess energy in fault condition

Long Short-Circuit Withstand Time
World-class survival duration in fault condition

High-Power Paralleling
Matching currents (Stable $V_{th}$)

Based on Navitas testing of 1200V SiC MOSFETs vs. competitor products
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**Best SiC High-Speed, High-Temp Performance**

\[ R_{DS(ON)} \text{ v/s } T_j \]

### In-Circuit, High-Speed Test

- **GeneSiC vs. competitor SiC FET**
  - 1200 V, 20 mΩ, TO-247-4L
  - Higher drain current
  - Lower conduction losses
  - Cooler operation

- **GeneSiC vs. competitor SiC FET**
  - 1200 V, 40 mΩ, D2pak in half-bridge
  - 150 kHz switching = ~10x faster than Si IGBT
  - 30% lower FET loss vs. other SiC
  - 25°C cooler operation = 3x longer lifetime

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High Quality, High Reliability

100%-Tested Avalanche
Highest published capability to handle excess energy in fault condition

Critical in applications like motor drives to withstand unclamped inductive load (UIL) energy dump in situations like motor open-circuit (O.C.)

1200V 20mΩ
$E_{AV} > 2 J$

Competitor products allow threshold voltage to drop under high voltage, creating risk of turn-on error
GeneSiC packaged and bare-die FETs can be paralleled reliably for high-power applications @ 175°C

High Power Paralleling
Matching currents (Stable $V_{TH}$)

Long Short-Circuit Withstand Time
World-class survival duration in fault condition

Critical to prevent failures like motor short circuit where the FET faces full voltage ($V_{DD}$) in ON-state.

GeneSiC

$3x$ Stronger

Competitor

3)

GeneSiC packaged and bare-die FETs can be paralleled reliably for high-power applications @ 175°C

0.5 1 1.5 2 2.5 3
Avalanche Energy (100% Tested, norm.) (2)

GeneSiC

Comp.

GeneSiC

Up to 30% longer

Comp. A

Comp. B

Zero reported GeneSiC-related field failures!

1) As of September '23, per GeneSiC records
2) 1,200 V, 20 mΩ FET
3) Per Navitas Semiconductor
High Capacity, 60% Shorter Lead-times

1) Industry lead-times per Jefferies Equity Research, August '22
2) Majority of parts available immediately from stock. Production lead-times, capacity as of September 2022

- **Navitas**
  - Immediate availability for 1k prototyping
  - **GaNFast:** Power ICs at 6-16 weeks today
    - Committed 3x capacity in 2023
  - **GeneSiC:** Rectifiers at 16 weeks
    - FETs at 26 weeks
    - Committed 5x capacity in 2023
Unique System Design Center Strategy

Increasing Customer Value

System Design Centers
System Innovations

Power Stage
Package Innovation

Power IC
Circuit Innovation

Discrete
Transistor Innovation

Increasing Integration and Innovation

- Assist customers to adopt next-gen GaN and SiC
  - Circuit design
  - High-frequency magnetics
  - Thermal design
  - Advanced packaging / modules

- Advanced performance
  - Higher power density
  - Higher efficiency
  - Lower system cost

- Business advantages
  - Faster time-to-market
  - Maximum ‘first-time-right’ designs
Typically, slow-speed designs have \( \sim 70\% \) of volume used by transformer, capacitors, EMI filter, etc.

High-speed GaN IC designs shrink ‘passive’ components by \( \sim 50\% \)\(^{(1)} \)

Half-Bridge IC delivers \( \sim 2x \) the power, or \( \sim 2x \) faster charging in the same size\(^{(1)} \)

\(^{(1)} \) Sep’22 Navitas survey of 20 publicly-available Navitas and MCM example chargers and reference designs 65W - 200W. Nominal 100 cc charger size selected, power capability determines charging speed
100% Tier 1 Mobile OEMs Adopting Navitas

Tier 1 OEMs

- Samsung
- LG Electronics
- Motorola
- Oppo
- Lenovo Legion
- Dell
- Xiaomi
- iQOO
- Redmi
- Realme

225+ GaN Chargers Mass Production

290+ GaN Chargers In Development

100% Mobile OEMs Designing With Navitas GaN ICs

60M+ GaN ICs Shipped

Zero GaN Field Failures

(1) As of June 30th, 2022. (2) Based on Navitas shipment data and no customer-reported consumer failures for production shipments through October 2022.

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European Data Center power supplies must meet ‘Titanium’ efficiency (>96% peak) from Jan 1st, 2023\(^{(1)}\)

Design Center: 4 platforms, 8 customer projects: 1.3 kW, 1.6 kW, 2.7 kW, 3.2 kW CRPS

GaN ICs can reduce electricity use by up to 10%, save >15 TWh or $1.9B in annual electricity costs\(^{(2)}\)

Silicon AC-DC 3,200W

- 47 kHz
- 325 x 107 x 41 mm
- 2.2 W/cc

GaNFast AC-DC 2,700W

- >2x higher power density
- >30% reduction in energy loss

- 300-500 kHz
- 185 x 73.5 x 39 mm
- 5.1 W/cc

“GaN is a breakthrough new technology that is enabling dramatic reductions in size, energy savings and power density”

“Navitas is an excellent partner with industry-leading GaN ICs”

Robin Cheng, VP R&D


\(^{(2)}\) Navitas est. based on a) Navitas server/datacom forecast & AAAS data, b) $0.12/kWhr, c) Si vs. GaN $/W and d) data-center loading profile. Estimated based on known existing Si-based solutions to deliver >500A next-generation data processors to Navitas targets for new GaN-based AC/DC and DC/DC for these same next-generation data processors.
$12B/yr Potential for GaN/SiC by 2030\(^{(1)}\)

- OBC > $38
- DC-DC > $12
- Traction drive > $286

Total: > $330 per EV = $10.1B

...and > $1.9B in road-side chargers

Note: Assumes 150 kW traction inverter, 100 kWh battery, $100/kWh battery cost and typical 230 mile range.

\(^{(1)}\) Estimate 2030, 30M EV/yr, based on DNV and Navitas analysis

Shanghai: EV Center

Dedicated EV System Design Center

- 3 platforms
  - 400V 6.6 kW W bi-directional charger (2-in-1)
  - 800V 6.6 kW bi-directional charger and DC-DC (3-in-1)
  - 22 kW wall charger to 400V, 800V

Synergistic & Engaged Customers
System Design Center Accelerates Customer Revenue

- Navitas’ Shanghai EV System Design Center:
  - Optimized Magnetic designs, higher $F_{SW}$
  - Optimized system and component thermal design
- Achieves:
  - Higher efficiency -
  - Higher power density
  - Lower weight
  - Faster time-to-market
GaN + SiC for Solar & Energy Storage

Synergistic & Engaged Customers

Market Potential for GaN/SiC(2)

- 5-10kW Residential  >$1.40B
- 1kW residential (micro)  >$1.00B
- Energy Storage  >$1.25B (50% attach rate)
- Commercial (string)  >$1.00B
-  >$4.65B

(1) Navitas est. 6.2 kW residential installation with silicon inverter at 97.5%, GaN at 98.5% efficiency.
(2) Market estimates for 2030, based on DNV and Navitas analysis.
Legacy Si-Based GE Brush-less DC (BLDC) Motor & Inverter for Washing Machine (~80% efficiency)

Navitas 300W 3-phase Platform for Inverter-Motor Integration

- 2x higher frequency
- >60% fewer components, PCB area
- 95-97% efficiency
- 80% energy savings vs Silicon BLDC
- 90% energy savings vs AC motors
- High reliability
- Fast time to market

(1) Navitas estimate 50-300W motors, including circulators, hydronic pumps, aircon IDU/ODU fans, HVAC, air purifiers, hair dryers, refrigerator compressors, dishwashers, washing machines.
Energy sources and uses are being electrified...

...creating a $40B GaN + SiC opportunity by 2050
Leader in Sustainability

February ’22 First GaN sustainability report based on global standards.

Every GaNFast™ IC saves\(^{(3)}\)

4 kg CO\(_2\)

- **4x-10x lower component CO\(_2\) footprint than silicon\(^{(1)}\)**
- **28% lower lifetime CO\(_2\) footprint for chargers / adapters\(^{(2)}\)**
- **Accelerates transition from ICE to EV by 3 years, saving 20%/yr of road-sector emissions by 2050** \(^{(4)}\)
- **GaN saves up to 2.6 Gton / year by 2050** \(^{(5)}\)

May ’22 World’s first semiconductor company CarbonNeutral® certified

August ’22 First 100,000 tons CO\(_2\) saved

October ’22 Recognized for industry-leading sustainability reporting

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“全面专注下一代功率半导体，共同 Electrify Our World™”

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