

/ GaN Evolution!

From devices to applications

- History
- Current Technology Overview
- Market Dynamics
- Novel Topologies / Applications



POWERING

/ THE SHIFT



GaN History



/ GaN HEMT History

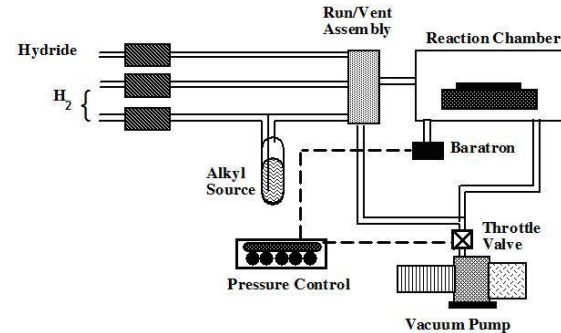
- First HEMT was developed in Japan in 1979.
- Back then it was a GaAs transistor. Since 1985 it was adopted in RF designs
- 1993 was the first GaN HEMT developed (50V 200W applications)
- 2001 University of California presented a GaN on SiC device for >1kV
- Since then, GaN power devices have been investigated further



/ GaN on ...

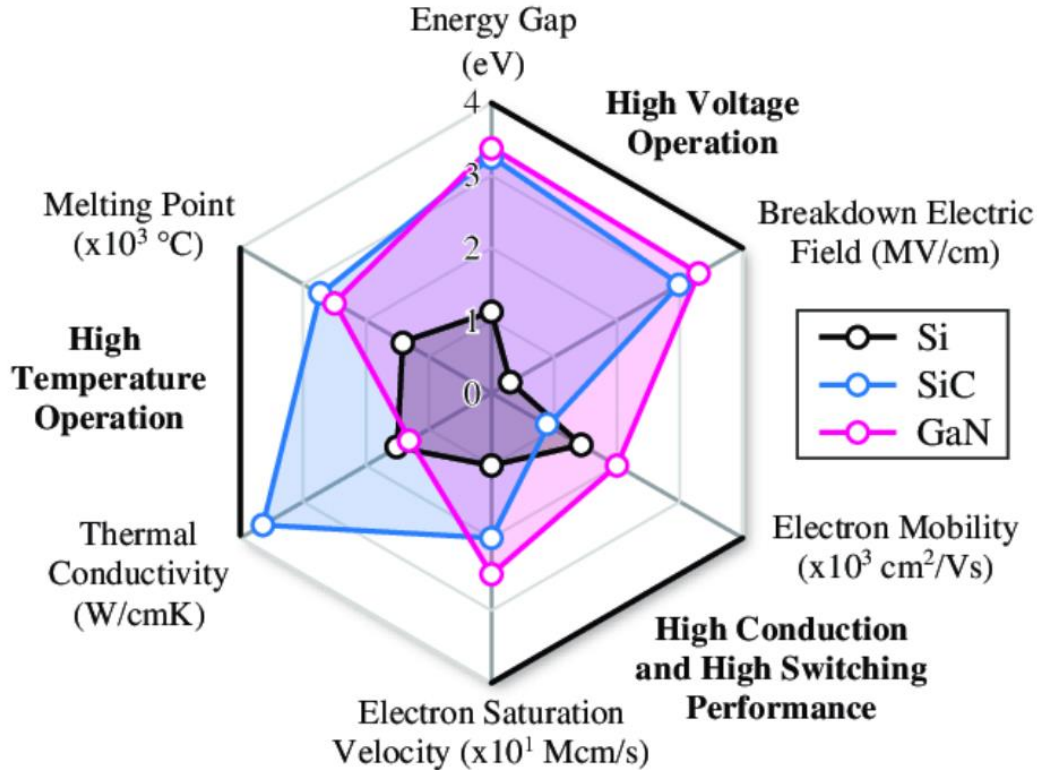
- Pure GaN devices do not exist (until 2025 ...)
- First GaN on SiC approach proven good but SiC was too expensive.
- Si as lowest cost and widely available substrate made its way

- MOCVD process is used to grow GaN on base material.



By Original uploader was Crystalgrower at en.wikipedia - Transferred from en.wikipedia, Public Domain, <https://commons.wikimedia.org/w/index.php?curid=11356348>

/ GaN vs Silicon & SiC

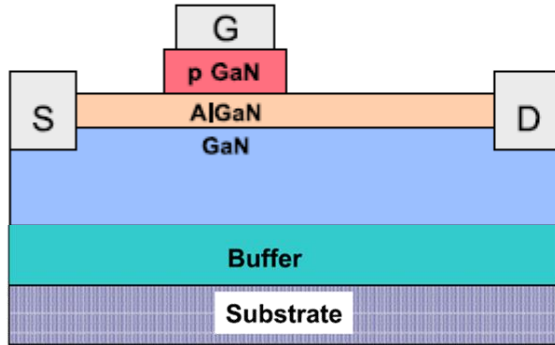




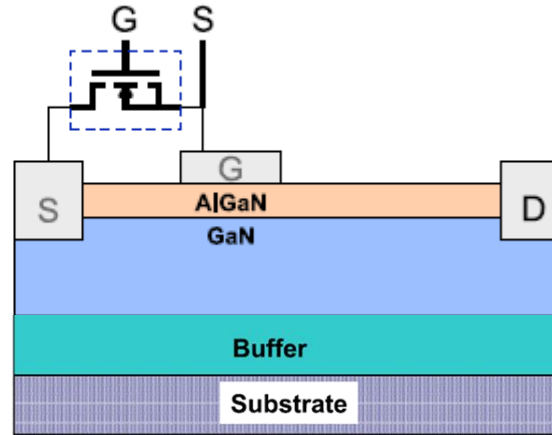
Current Technology Overview



/ GaN HEMT process structures

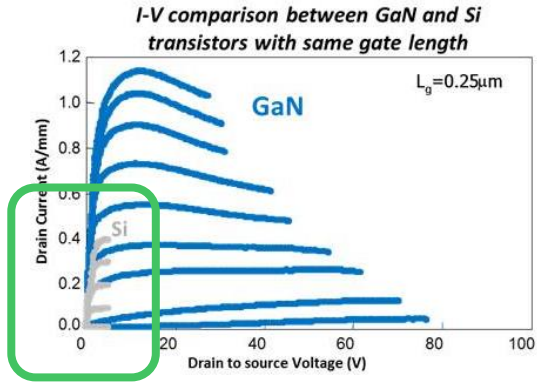


GaN p-GaN gate HEMT



GaN cascode HEMT

/ GaN on Si vs Si – Cost Analysis



- GaN on Si wafer/substrate is the same adopted for Si
- 20Yrs old Si Fab is good enough to manufacture state of the art GaN
- Switch can integrate other functionalities
- GaN LT over last 2Yrs, 16wks (stable)



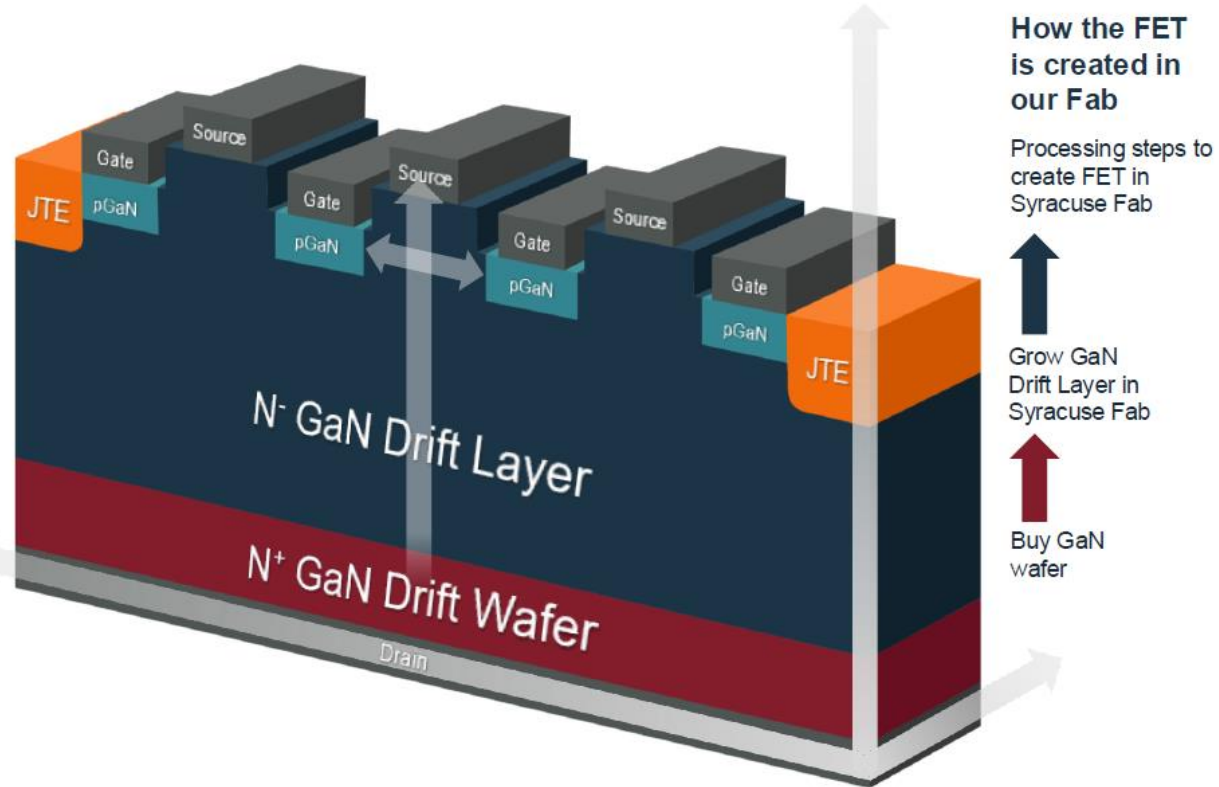
/ Vertical GaN process

Vertical GaN-on-GaN e-JFET

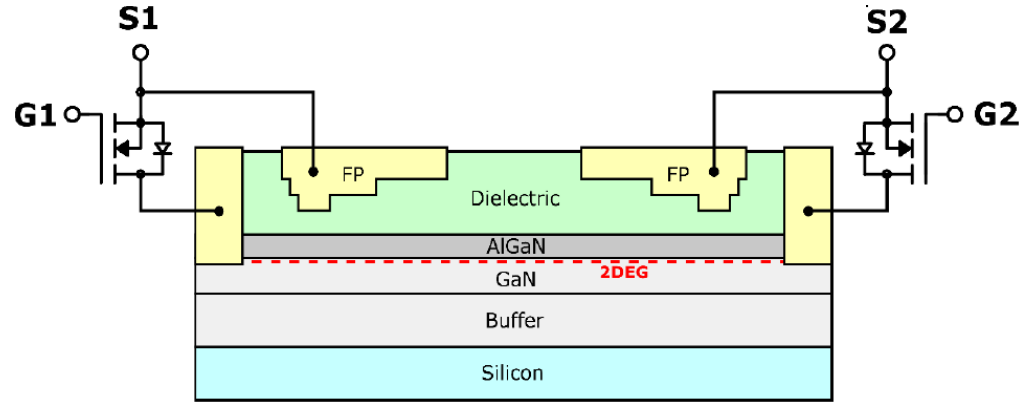
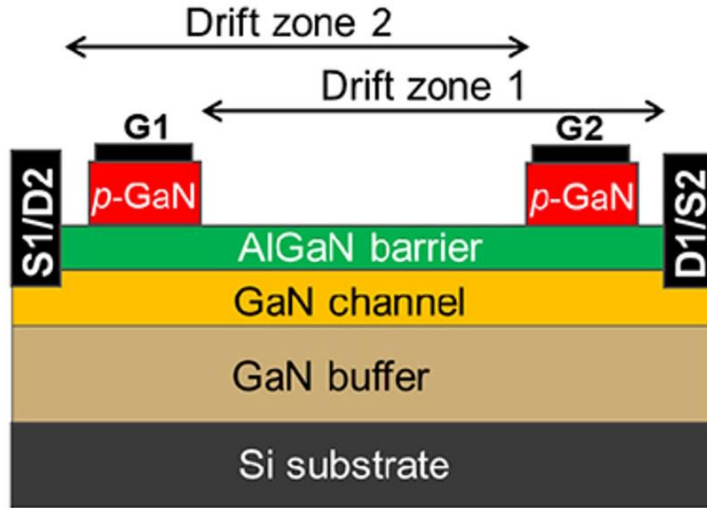
Low overall $R_{DS(ON)}$

Robust edge termination for full avalanche capability

Short-circuit $\gg 10\mu s$



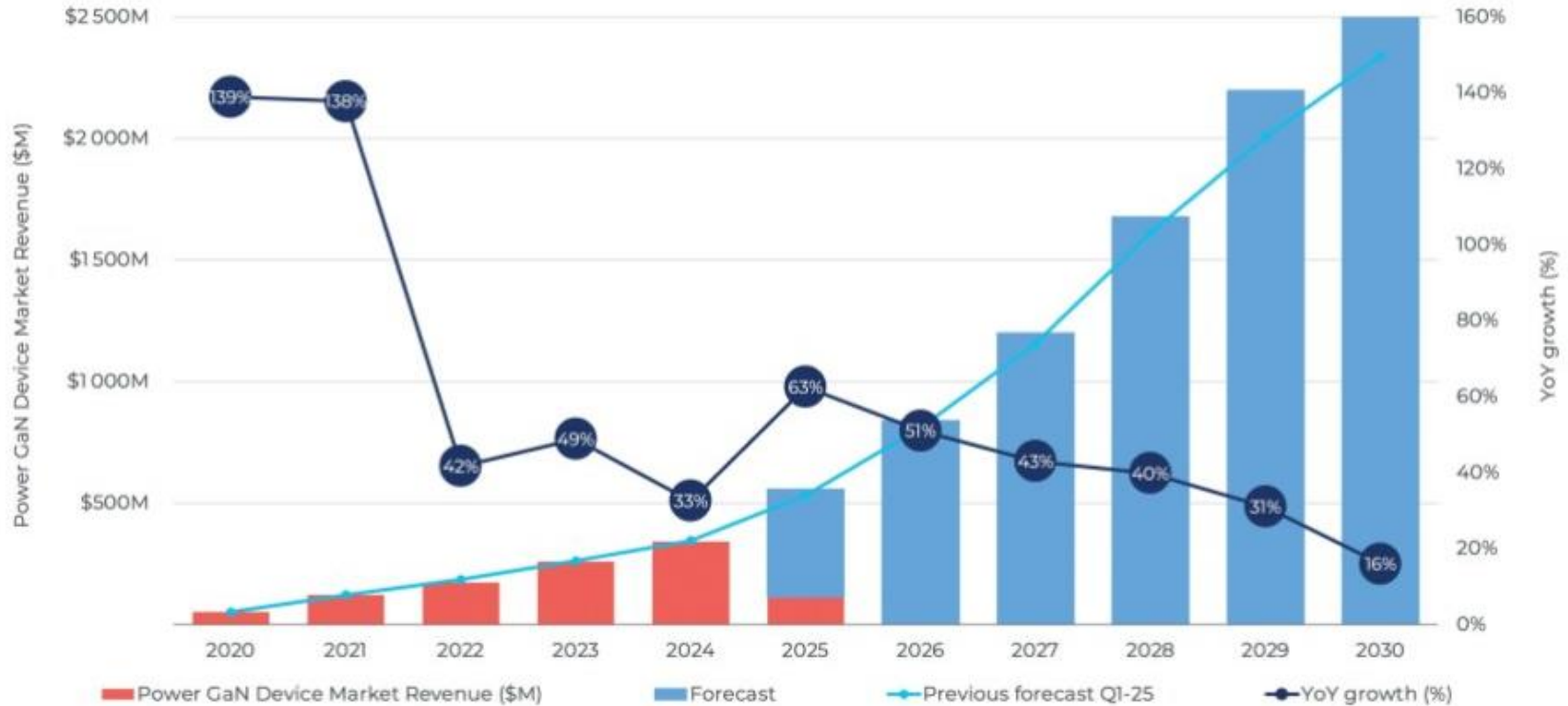
/ Bidirectional GaN





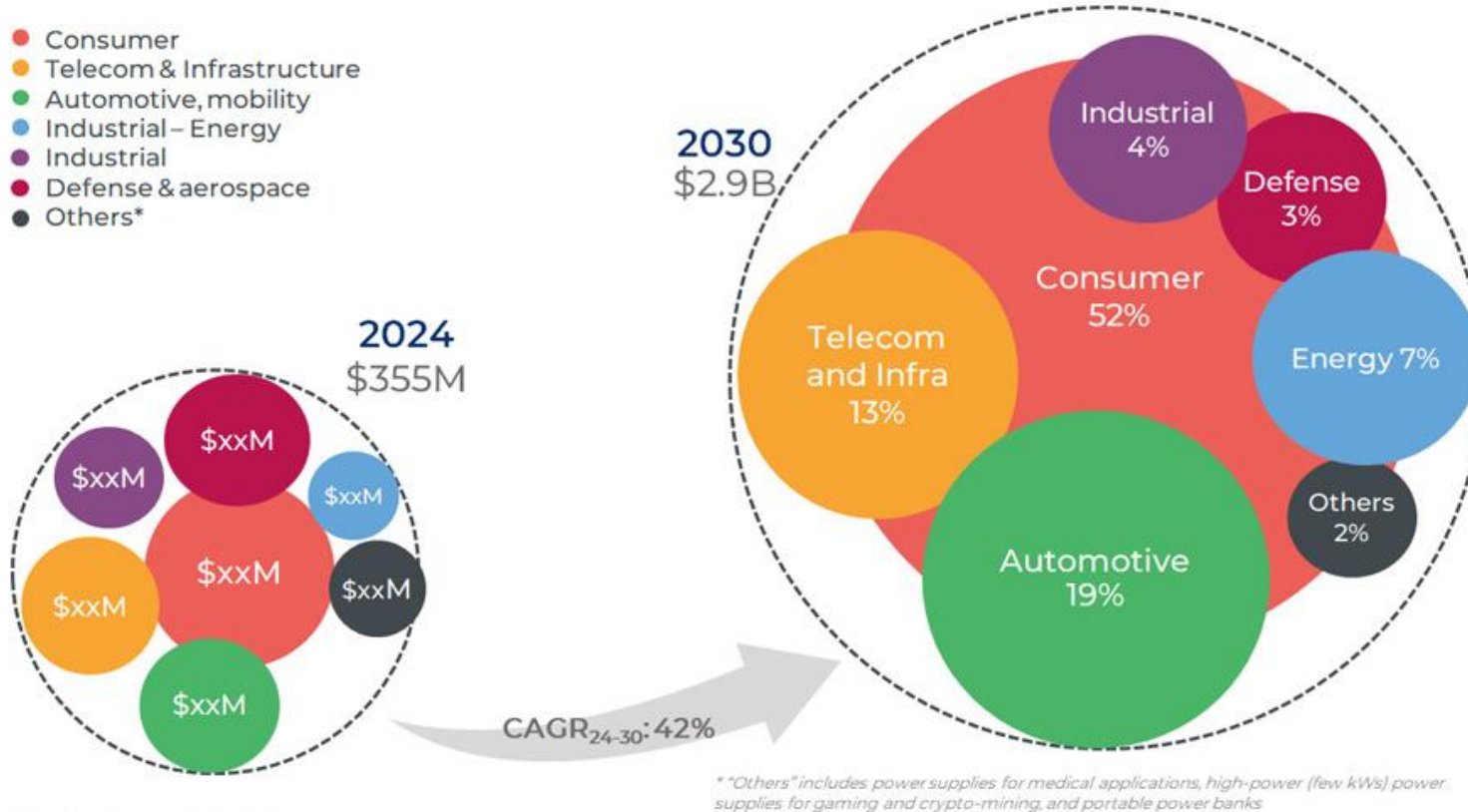
Market Dynamics

/ Power GaN Device Market Forecast



Source: Power SiC and GaN Compound Semiconductor Market Monitor, Q2 2025, Yole Group

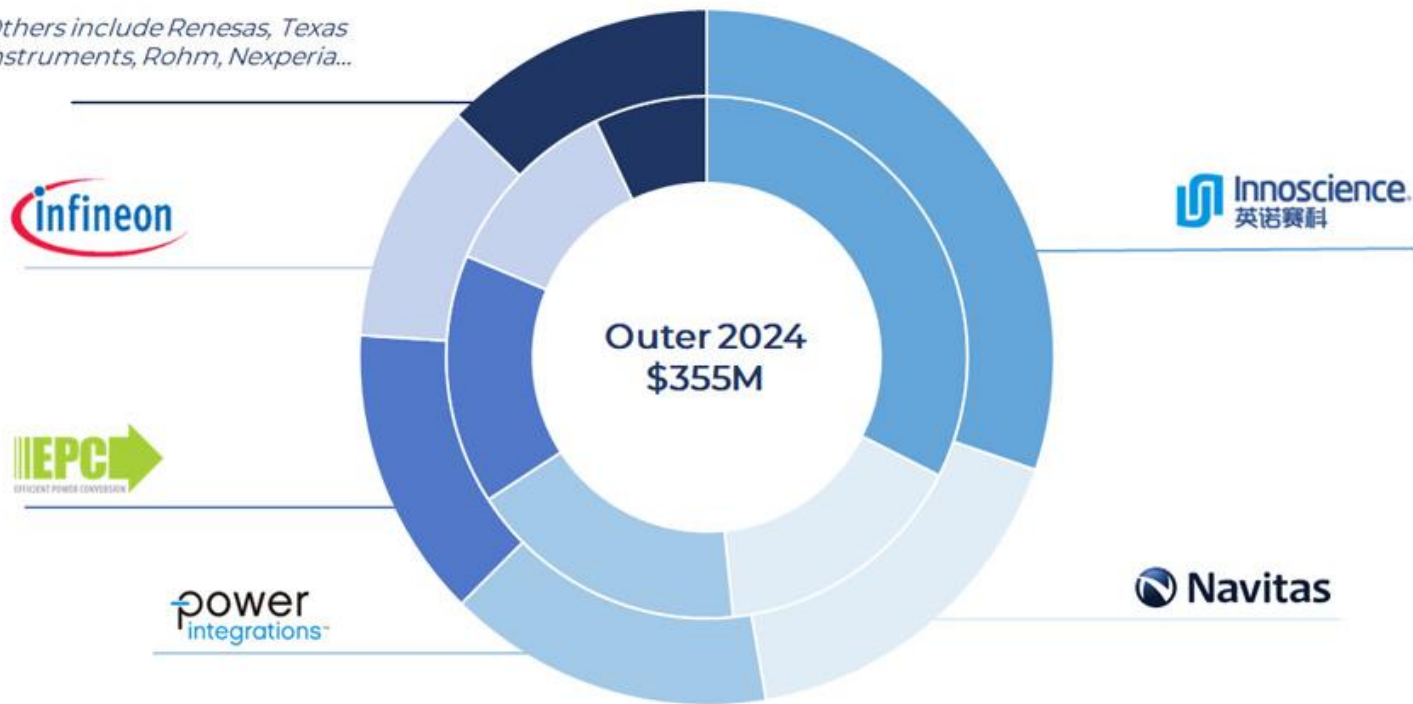
/ Power GaN Device Market by End-Markets



Source: Power GaN 2025, Yole Group, October 2025

/ Power GaN Device Market share 2023-2024

Others include Renesas, Texas instruments, Rohm, Nexperia...



Source: Power GaN 2025, Yole Group, October 2025

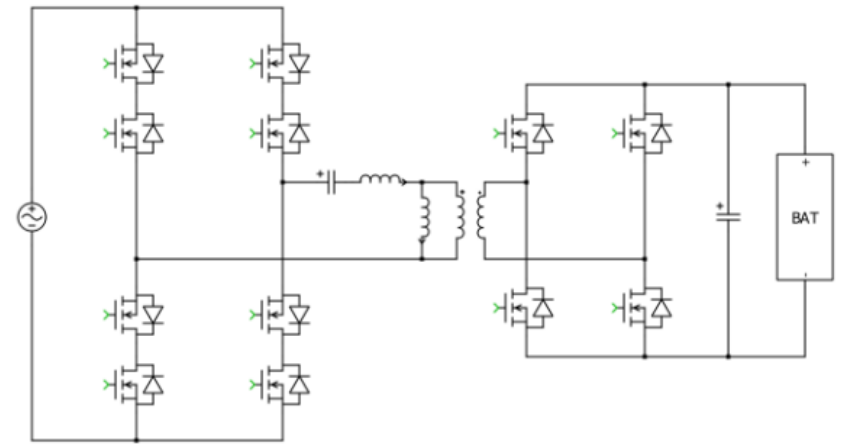
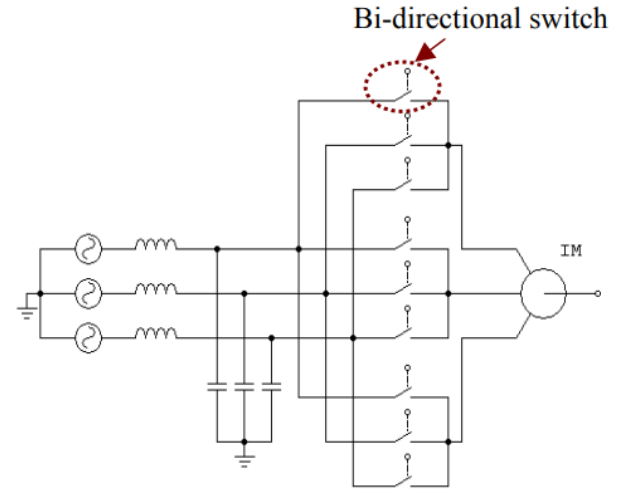
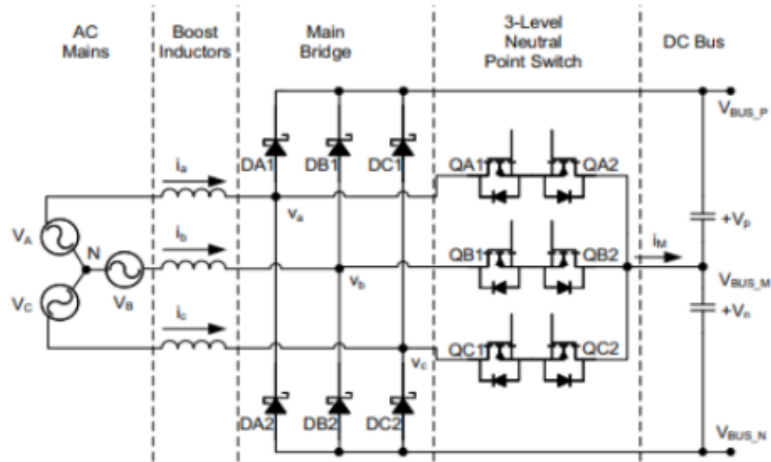
/ GaN Supplier Overview





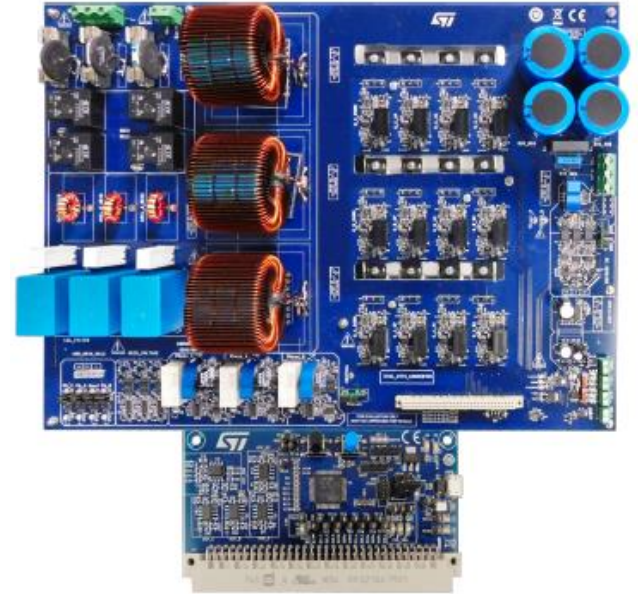
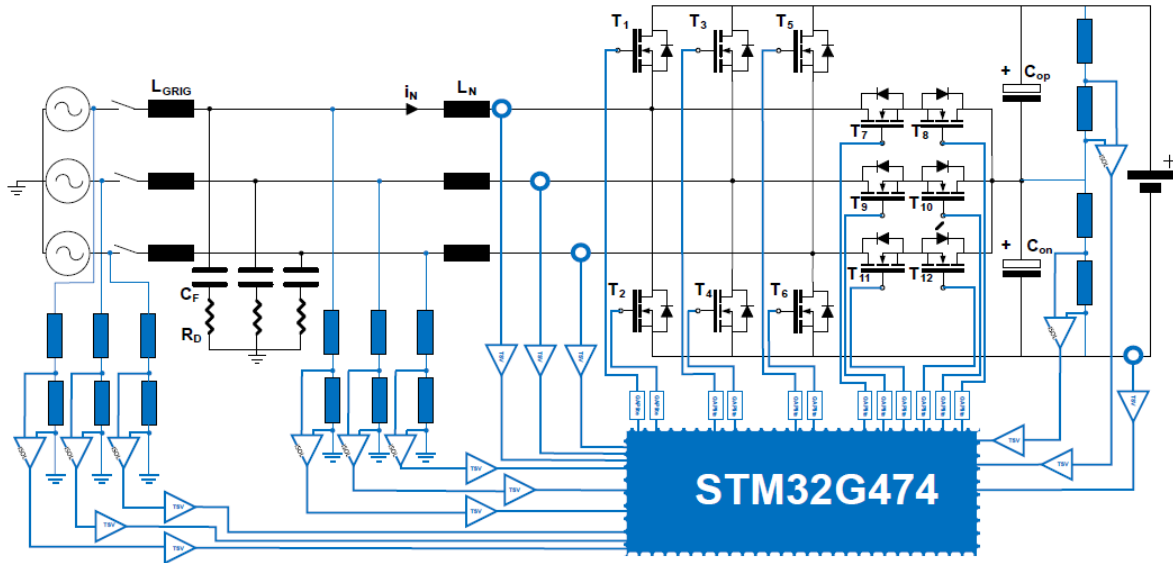
Applications

Applications



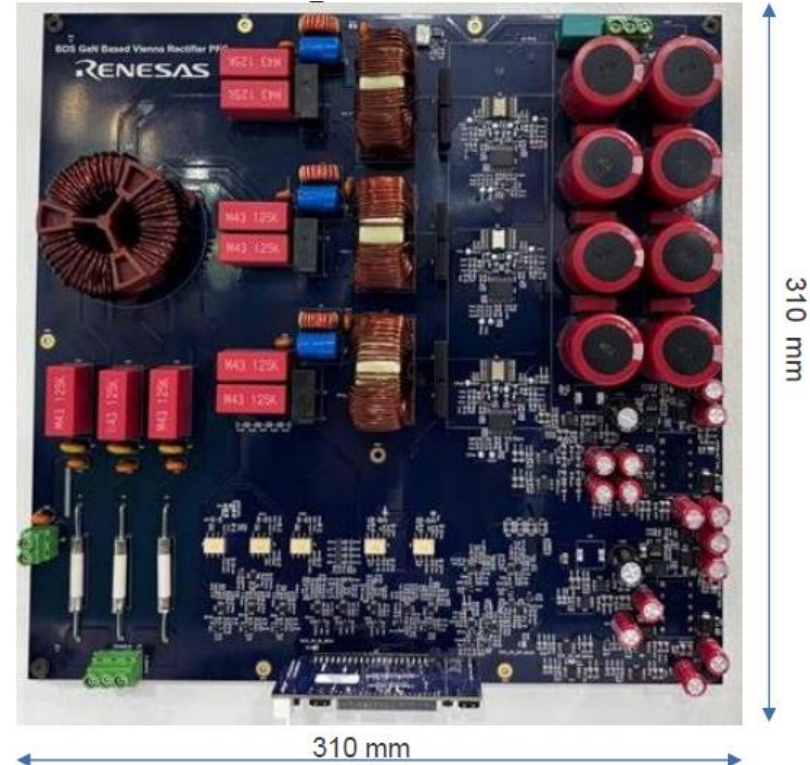
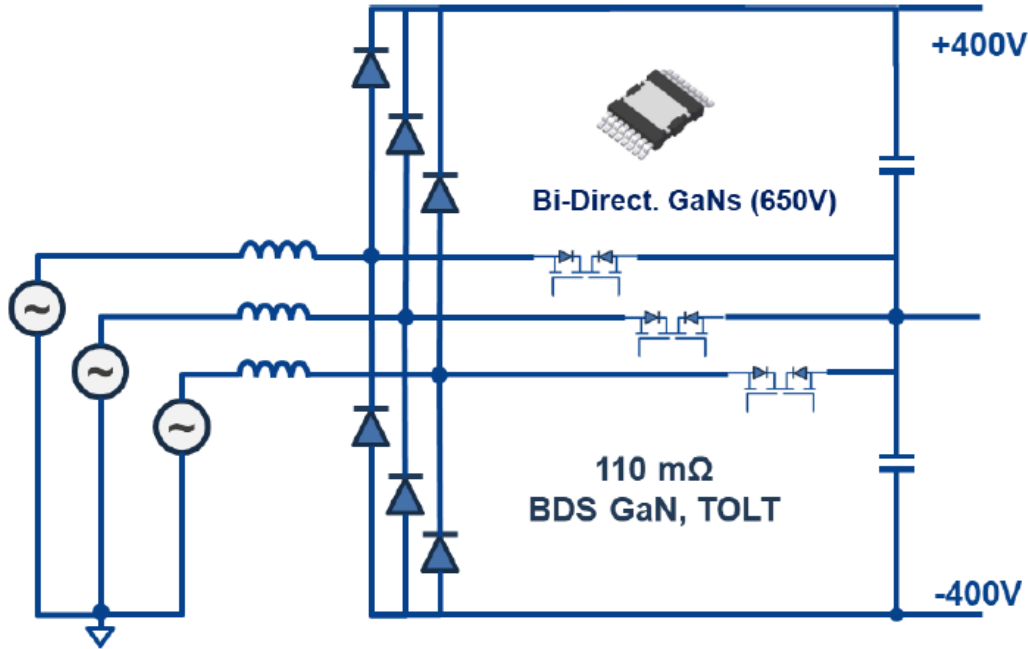
/ Vienna Rectifier

3-phase, 3-level AFE bidirectional converter



/ Bidi GaN Vienna Rectifier

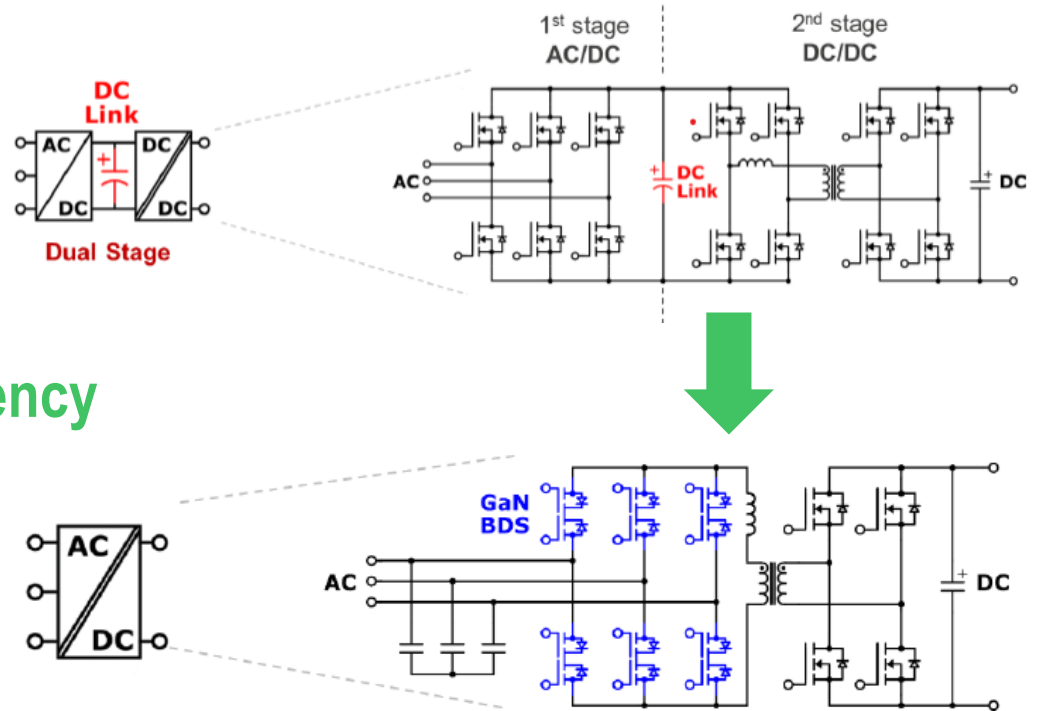
Bi-Directional GaN replacing back-to-back switches



/ Single-Stage Converters

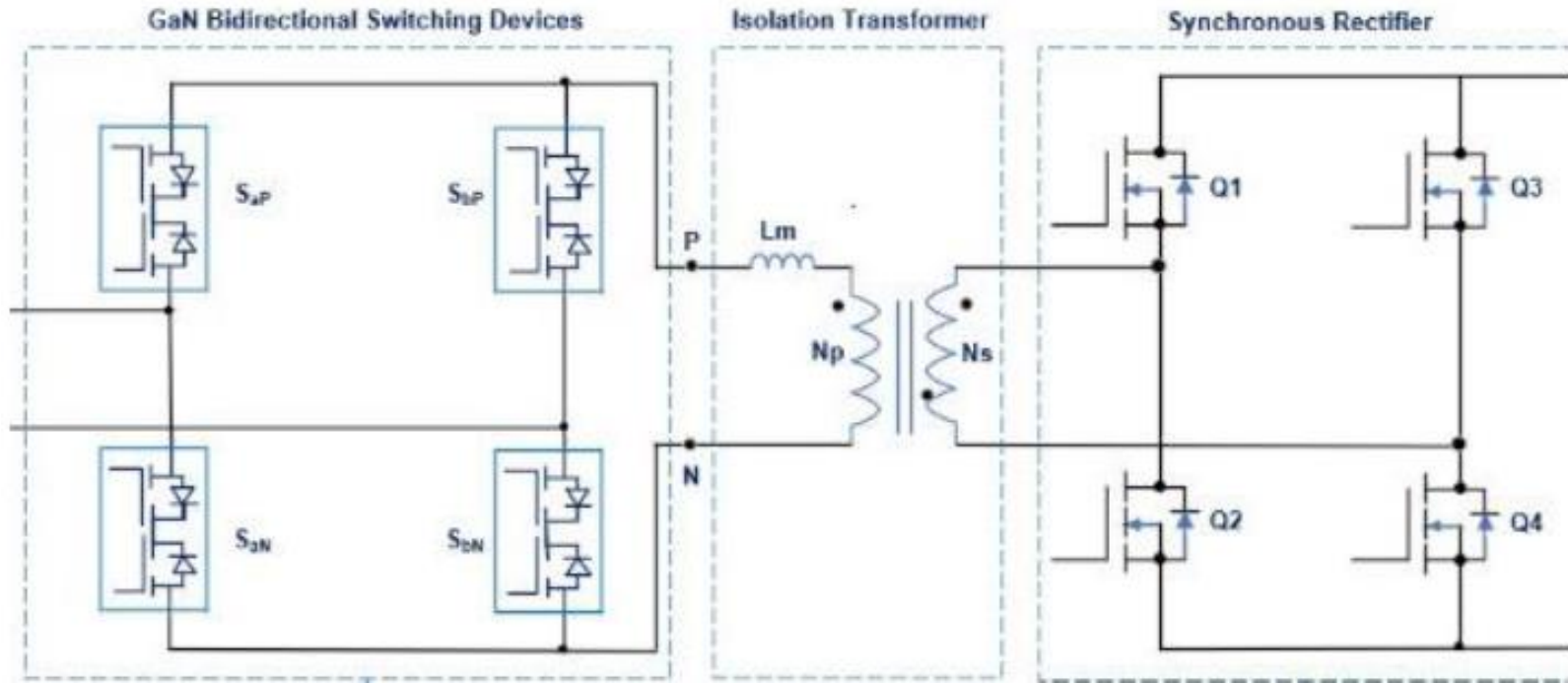
Bi-Directional GaN enables Cost Reduction

- Reduced System Cost
- Smaller size and weight
- Higher Conversion Efficiency
- No DC-Link capacitor



/ Onboard Charger Single-Stage 3.7kW

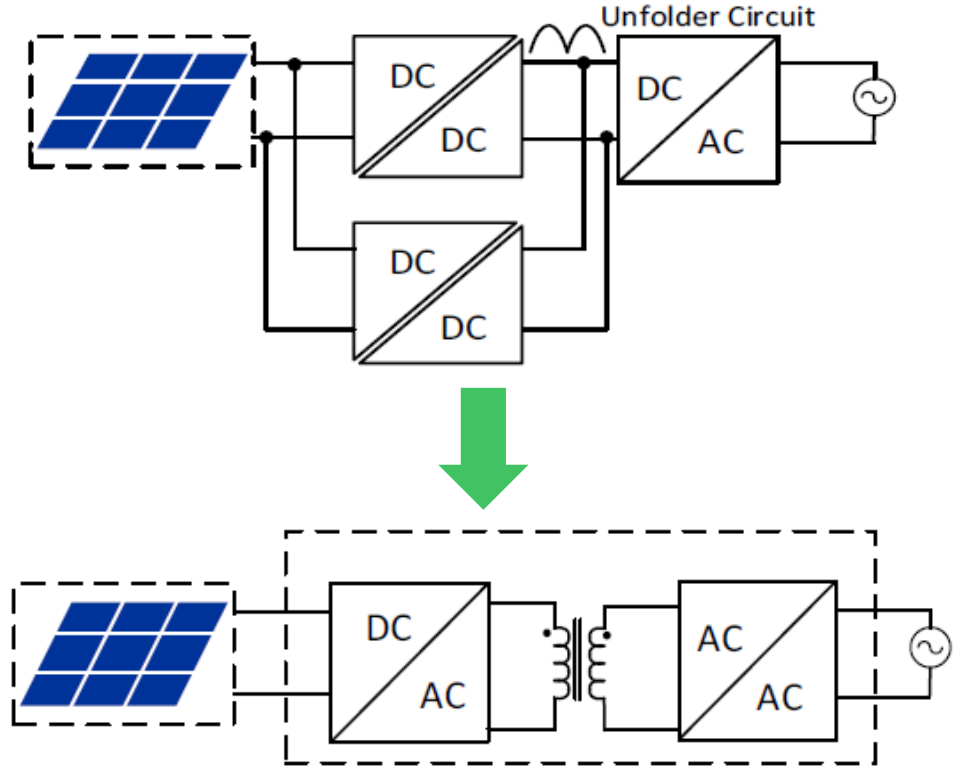
Size & Cost Reduction



/ Microinverter

Bi-Directional GaN enables AC/AC converter stage

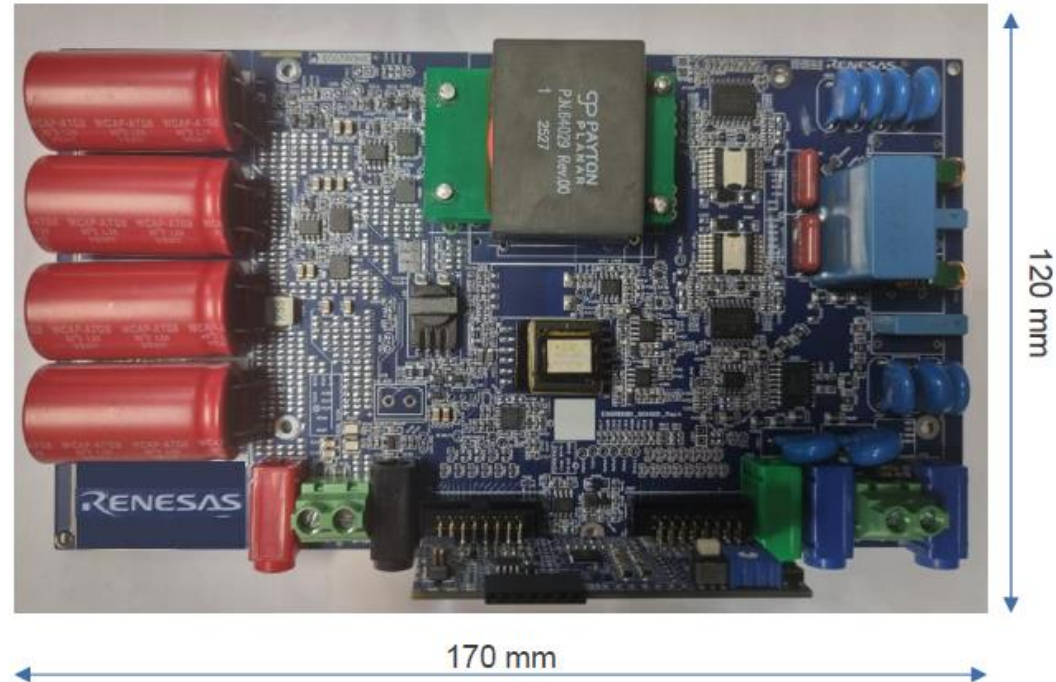
- Reduced BOM with DC-AC stage followed by AC-AC converter stage
- Higher Efficiency and high power density
- Bi-Di GaN on AC/AC bridge



/ 500W Microinverter

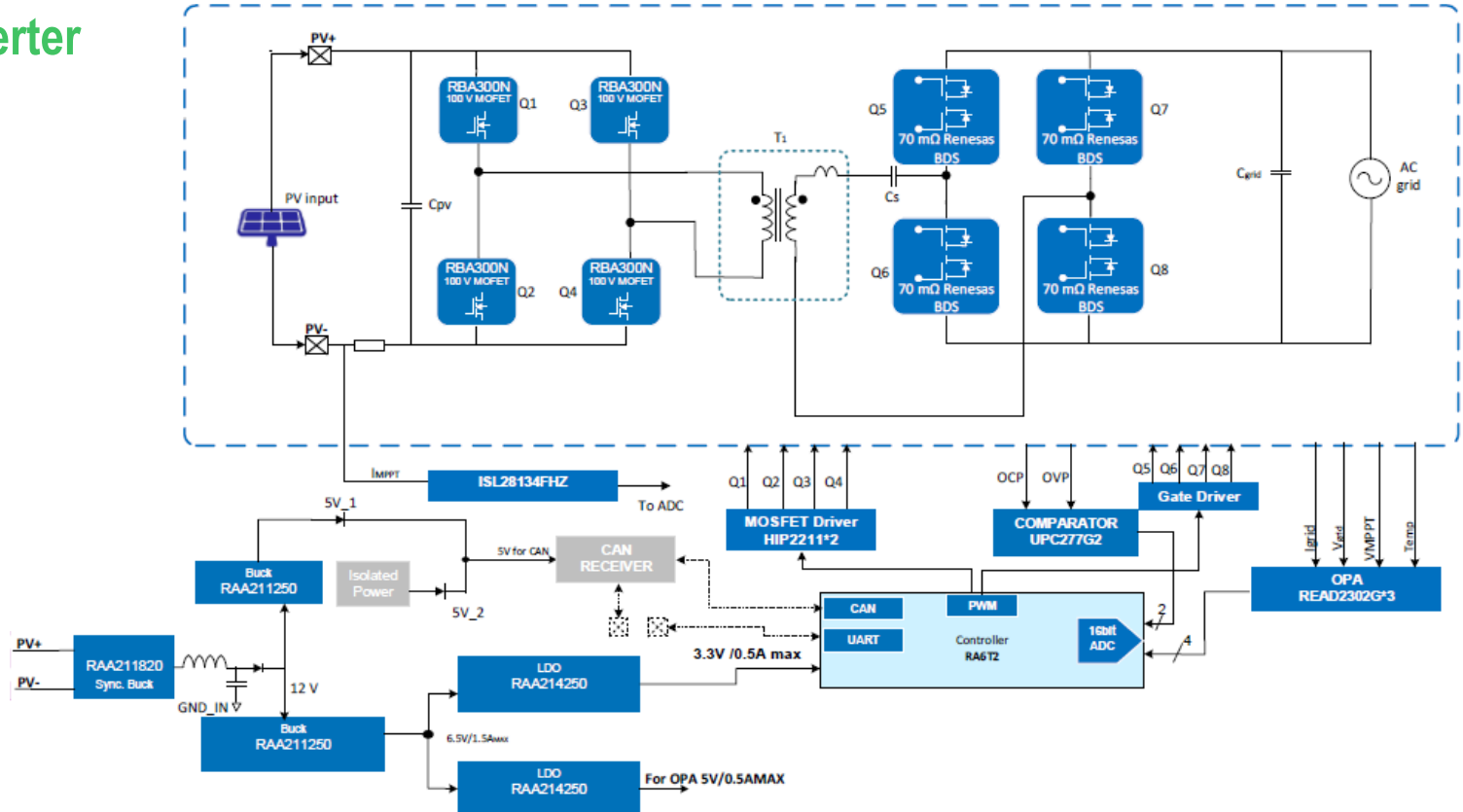
DAB-based topology

- Single stage power conversion
- Peak Efficiency 97%
- 400kHz to 800kHz
- Compact Magnetics
- ZVS



System Block Diagram

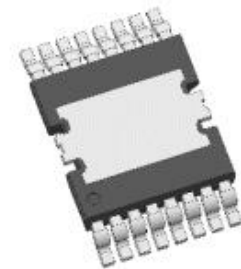
Microinverter



/ Circuit Protection

Replacing electromechanical switches

- No arcing
- No degradation from vibration or shock
- Smaller size and weight
- Fast response time



/ Ready to get started?



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