

# Bi-Directional GaN Power ICs open up new possibilities in off-grid applications

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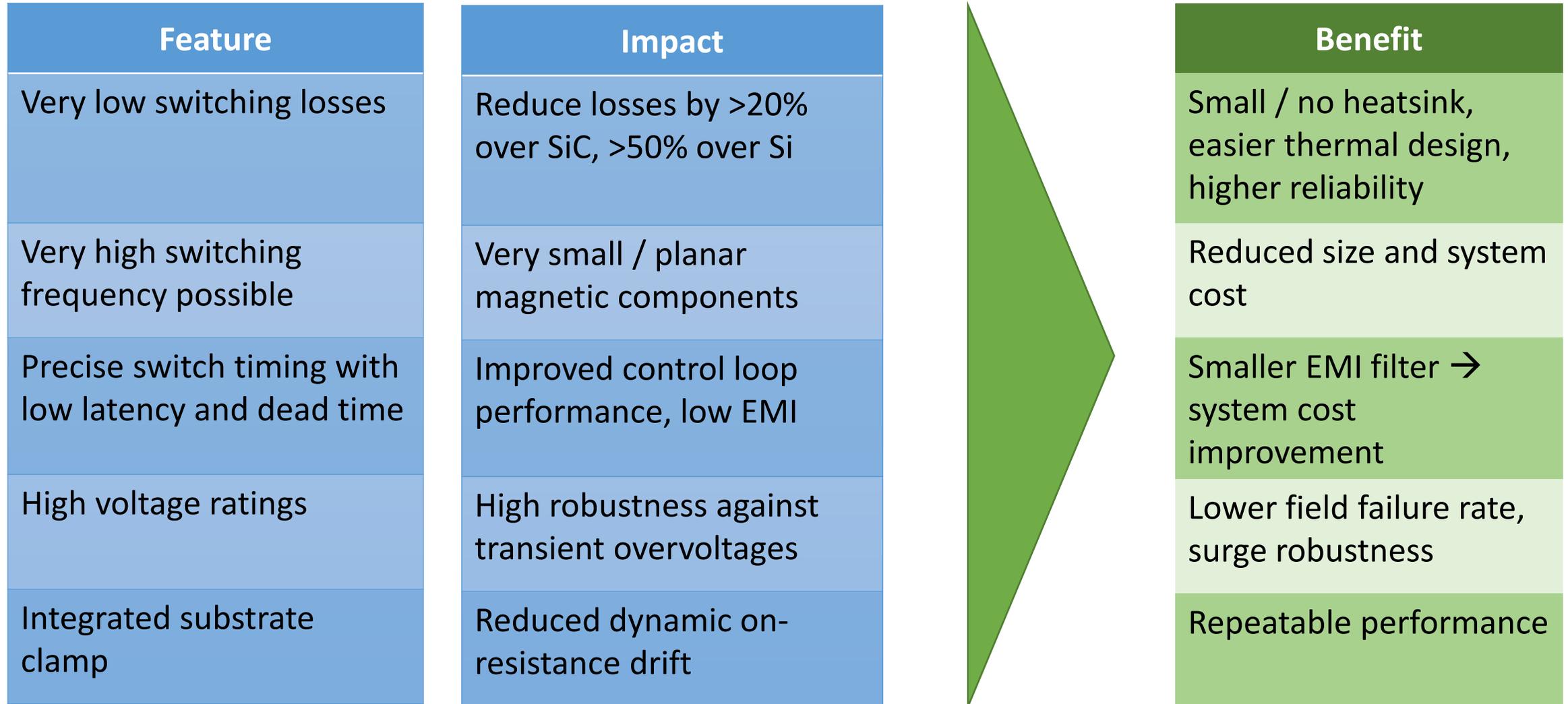


- Bi-Directional power switches in GaN technology
- Technology comparison
- New topologies:
  - Vienna rectifier
  - Current-source inverter
  - Solid state circuit breaker
- Summary



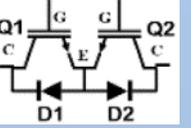
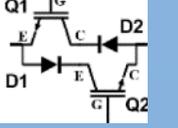
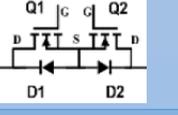
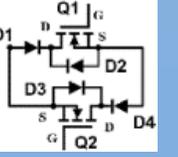
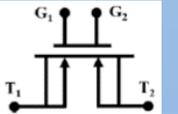
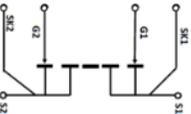
*4x smaller than SiC Bi-Directional FET,  
3x smaller than two Uni-directional GaN,  
9x smaller than Silicon*

- Traditional power semis (MOSFETS, IGBTs) are uni-directional (one-way conduction or isolation)
- Several topologies need bi-directional power flow control – complex and difficult to control
- Bi-directional GaNFast power ICs are the smallest, most efficient, lowest system cost solution
  - Optimized for fast switching, AC voltage applications
  - Enable ‘previously-impractical’ topologies
  - Integrated circuitry ensures reliability
- Applications: Power supplies, Industrial, Solar, Energy storage, Motor drives
- Mass Production Target: 2024



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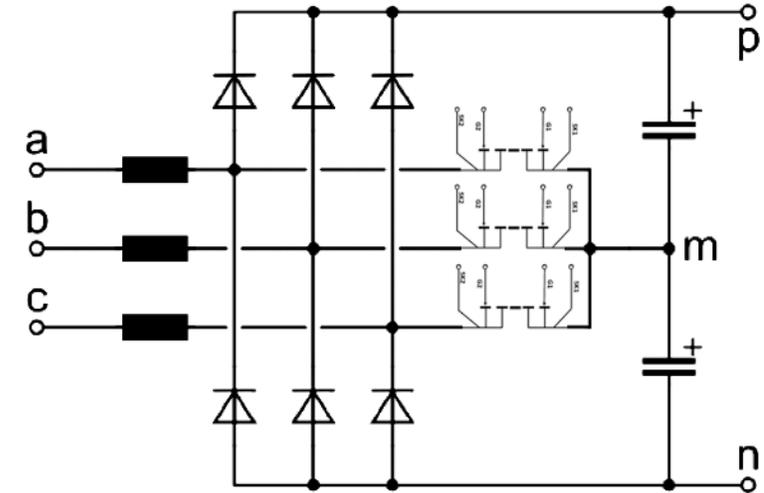
# Extended Technology Comparison\*

Switch Configuration	Description	Chip area / Size / Complexity	Number of Components	ON-state Voltage Drop	Switching Loss	Switching Frequency	Gate Control Complexity
	Diode bridge + asymmetric IGBT	Very high	5	3.5V [2 diodes + 1 IGBT]	High	16kHz	Low
	Asymmetric IGBT + freewheeling diodes	Very high	4	2.5V [1 diode + 1 IGBT]	High	16kHz	Low
	Back-to-back reverse-blocking IGBTs	High	2	2.0V [1 symmetric IGBT]	Very high	8kHz	Medium
	Si power MOSFETs + JBS diodes	High	4	1.25V [1 diode + 1 MOSFET]	Low	60kHz	Low
	Back-to-back SiC power MOSFETs + antiparallel and series JBS diodes	Very high	6	1.25V [1 diode + 1 MOSFET]	Low	100kHz	Medium
	Four-terminal SiC monolithic BiDFET	Medium	1	0.5V [1 BiDFET]	Low	100kHz+	Medium
	Monolithic bi-directional GaN power IC	Lowest	1	0.5V [1 Bi-directional GaN power IC]	Lowest	500kHz+	Medium

\* See "Baliga et.al.: The BiDFET Device and Its Impact on Converters", IEEE Power Electronics Magazine, March 2023

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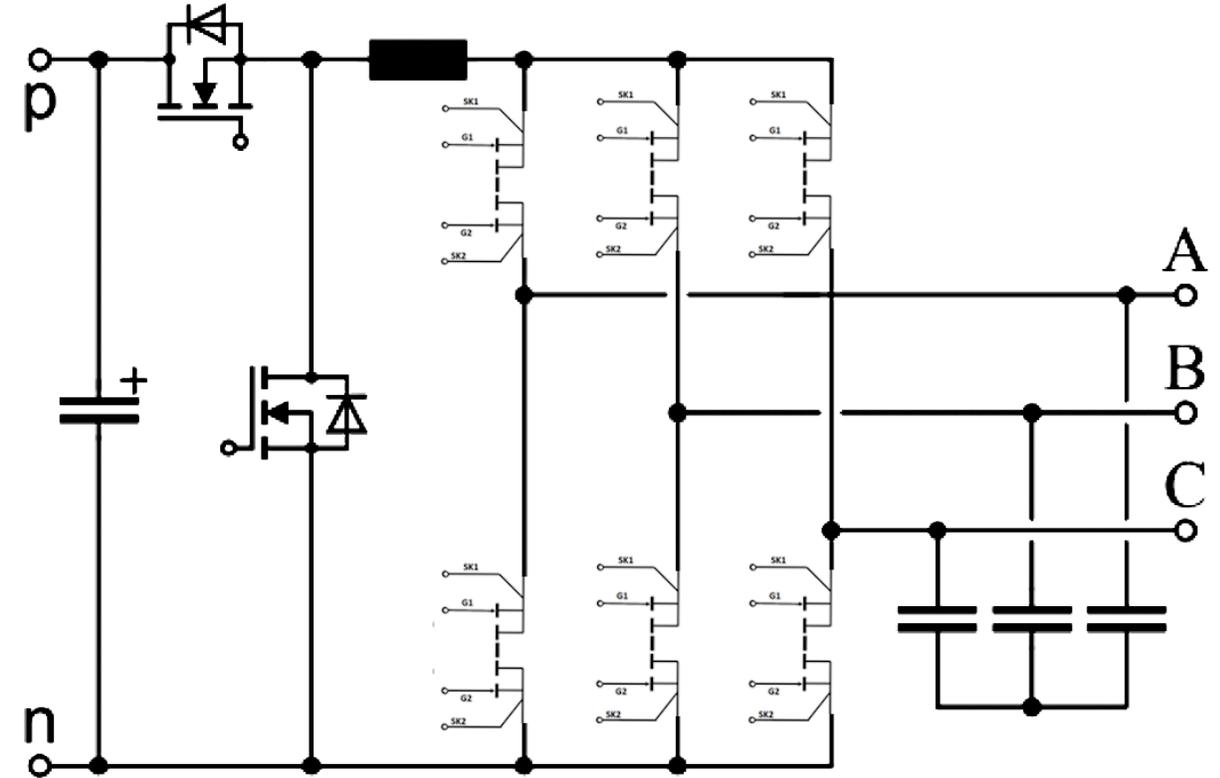
- Input: Universal AC, output: 800V (+/- 400 V)
- Switching frequency: 100 kHz
- Using GaNFast™ Bi-directional GaN in TOLT
- Very high efficiency and low complexity



\* See "Huber, Kolar: Monolithic bi-directional power transistors", IEEE Power Electronics Magazine, March 2023

# Bi-Directional GaNFast™ Power IC in Current Source Inverter

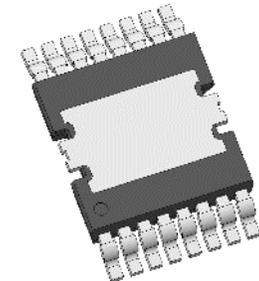
- Inherently sinusoidal output
- Very high switching frequency possible through further reduction of the switching losses
- Bi-directional power flow
- Potential to optimize motor size and cost, through lower inductance



- Replacing electromechanical switches with a solid-state switch

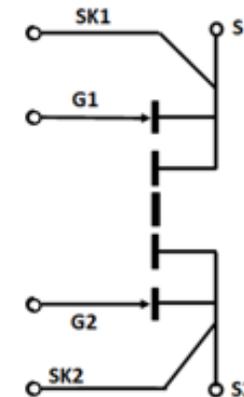
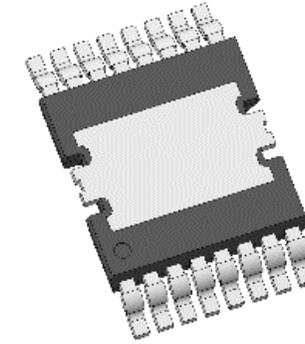
## Significant advantages for critical applications:

- No arcing
- No degradation from vibration or shock
- Much smaller size and weight
- Fast response time
- No moving parts → better reliability, switch cycles
- Handles AC or DC
- Low power remote control



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**Navitas' GaNFast™ Bi-directional offers convincing solutions to enable new topologies for better performance and system cost savings**

Discover more at  
[navitassemi.com](https://navitassemi.com)

