Bi-Directional GaNFast™ Switches Open Doors for New High-Performance Topologies

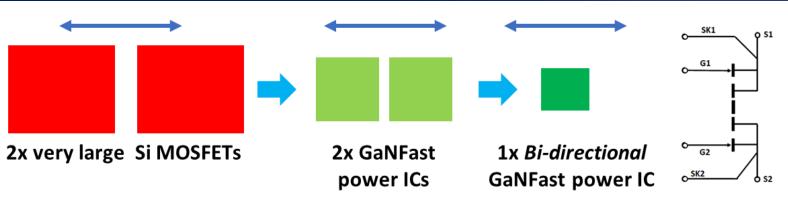
Alfred Hesener, Senior Director Industrial & Consumer, Navitas Semiconductor

Bodo's
Wide Bandgap
Event 2024
Making WBG Designs Happen

GaN

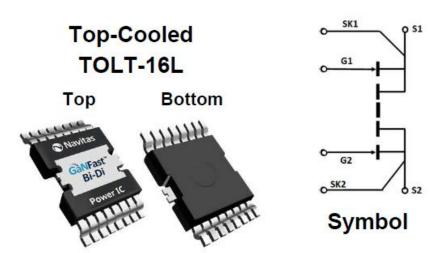
#### World's First Bi-Directional GaNFast™ Power IC





4x smaller than SiC, bi-directional FET, 3x smaller than two uni-directional GaN, 9x smaller than silicon

- Multiple topologies benefit from bi-directional power flow 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



# **Bi-Directional GaNFast™ Power IC Unlock the Next Level of Performance**



#### **Feature**

Very low switching losses

Very high switching frequency possible

Precise switch timing with low latency and dead time

High voltage ratings

Integrated substrate clamp

#### **Impact**

Reduce losses by >20% over SiC, >50% over Si

Very small / planar magnetic components

Improved control loop performance, low EMI

High robustness against transient overvoltages

Reduced dynamic onresistance drift

#### Benefit

Small / no heatsink, easier thermal design, higher reliability

Reduced size and system cost

Smaller EMI filter →
system cost
improvement

Lower field failure rate, surge robustness

Repeatable performance

## **Extended technology comparison \***

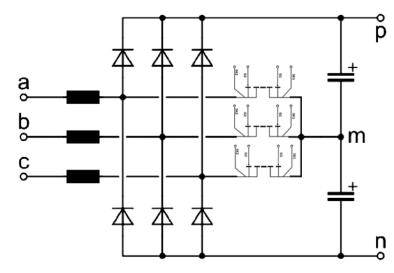


Switch configuration	Description	Chip area / Size / Complexity	Number of components	ON-state voltage drop	Switching loss	Switching frequency	Gate control complexity
D1 D3 D3 D4	Diode bridge + asymmetric IGBT	Very high	5	3.5V [2 diodes + 1 IGBT]	High	16kHz	Low
	Asymmetric IGBT + freewheeling diodes	Very high	4	2.5V [1 diode + 1 IGBT]	High	16kHz	Low
$ \begin{array}{c c} Q1 & G \\ E & C \end{array} $ $ \begin{array}{c c} D2 \\ C & G \end{array} $ $ \begin{array}{c c} Q2 \end{array} $	Back-to-back reverse- blocking IGBTs	High	2	2.0V [1 symmetric IGBT]	Very high	8kHz	Medium
Q1 G Q2 D TAT S TAT D D1 D2	Si power MOSFETs + JBS diodes	High	4	1.25V [1 diode + 1 MOSFET]	Low	60kHz	Low
D1 D1 G D2 D3 D4 G Q2	Back-to-back SiC power MOSFETs + antiparallel and series JBS diodes	Very high	6	1.25V [1 diode + 1 MOSFET]	Low	100kHz	Medium
$\begin{array}{c c} G_1 & & G_2 \\ \hline T_1 & & & T_2 \end{array}$	Four-terminal SiC monolithic BiDFET	Medium	1	0.5V [1 BiDFET]	Low	100kHz+	Medium
	Monolithic bidirectional GaN power IC	Lowest	1	0.5V [1 Bidirectional GaN power IC]	Lowest	500kHz+	Medium

#### Bi-Directional GaNFast™ Power IC in Vienna Converter



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

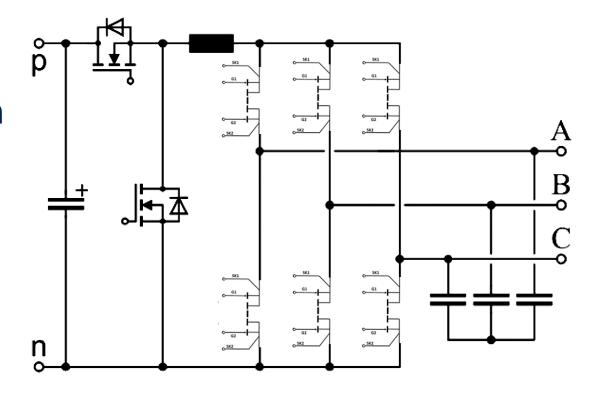




# **Bi-Directional GaNFast™ Power IC in Current Source Inverter**



- 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



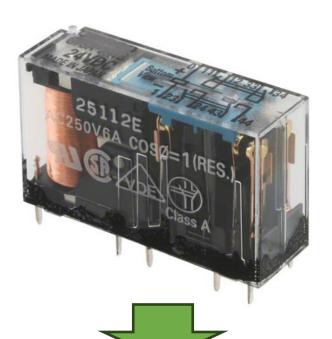
#### Bi-Directional GaNFast™ Power IC in Circuit Breakers

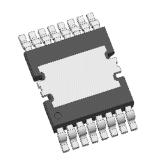


Replacing electromechanical switches with a solid-state switch

### Significant advantages for <u>critical</u> 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

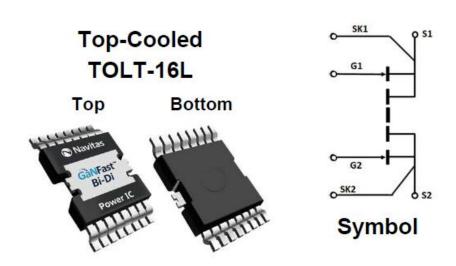




## Bi-Directional GaNFast™ Power IC : Summary



- 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



Navitas' GaNFast™ Bidirectional offers convincing solutions to enable new topologies for better performance and system cost savings

# Discover more at navitassemi.com



