

SemiSouth Laboratories, Inc.

Industrial Update

March 2011

www.semisouth.com



 **SemiSouth**

SemiSouth Labs is a leader in Silicon Carbide Power Semiconductors

1200 V – 1700 V Trench “normally – off” JFETs

1200 V Trench “normally – on” JFETs

1200 V Schottky Diodes

SemiSouth silicon carbide based devices offer higher efficiency, greater power density and higher reliability than comparable silicon-based devices



Solar



Servers



HEV



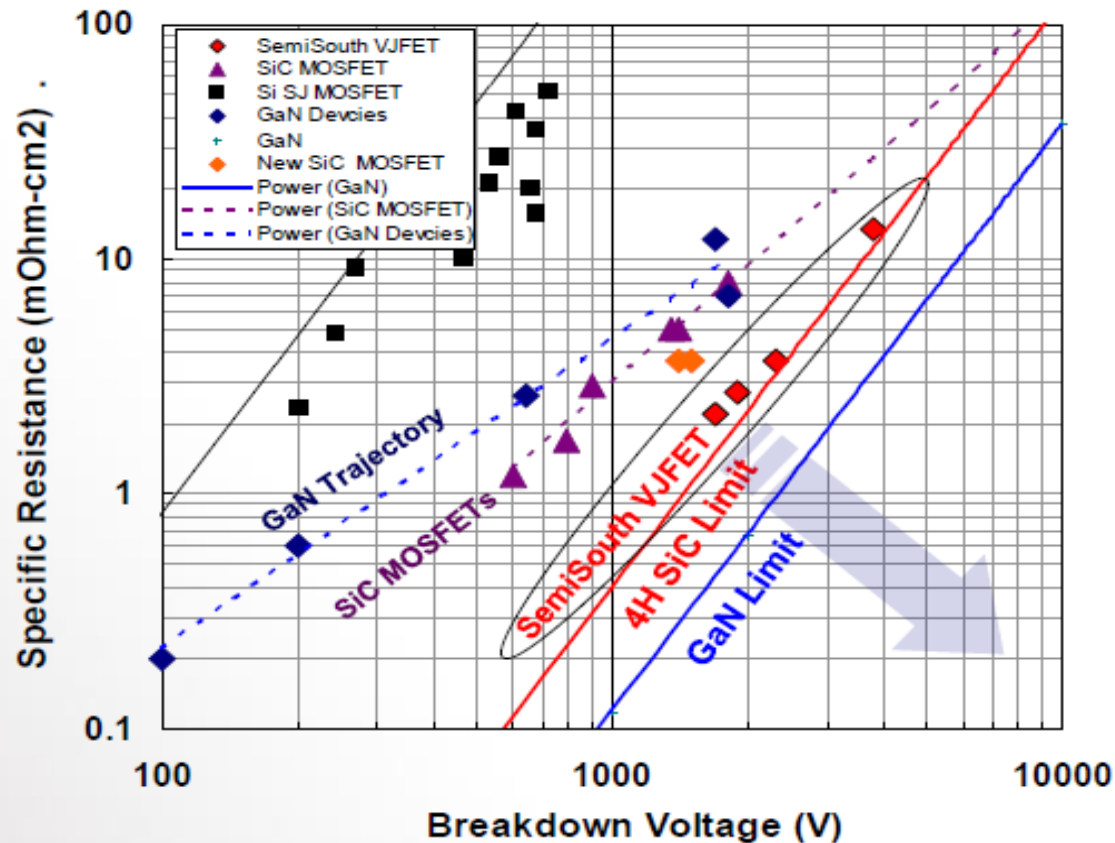
Wind



SiC Wafer

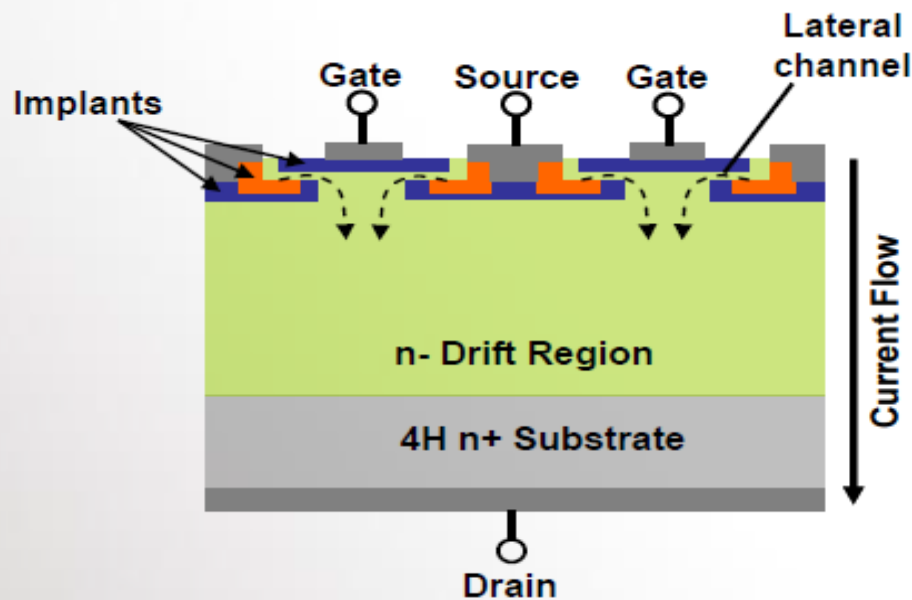


Proprietary Compact design leads to ultra-low specific on-resistance in power JFET (normally-on or normally-off versions available)



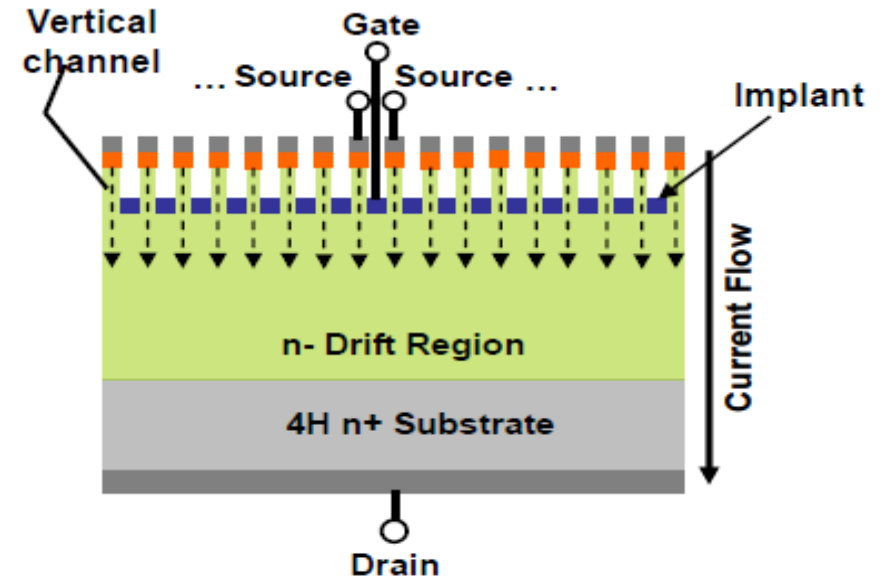
SemiSouth *Patented Vertical-Channel JFET*

Competitor's Lateral-Channel JFET



- (-) 12 mask layers
- (-) Cell pitch > 15 μm
- (-) 3 implants
- (-) Epi re-growth
- (-) $R_{(on)sp} \approx 8 \text{ m}\Omega \cdot \text{cm}^2$

SemiSouth Vertical-Channel JFET*



- (+) 6 mask layers
- (+) Cell pitch < 4 μm
- (+) 1 implant
- (+) No epi re-growth
- (+) $R_{(on)sp} \approx 2 \text{ m}\Omega \cdot \text{cm}^2$

Competitiveness against IGBTs

Fairchild



***NPT IGBT
FGL40N***

***VJFET
SJEP120R063***

***Performance
Improvement***

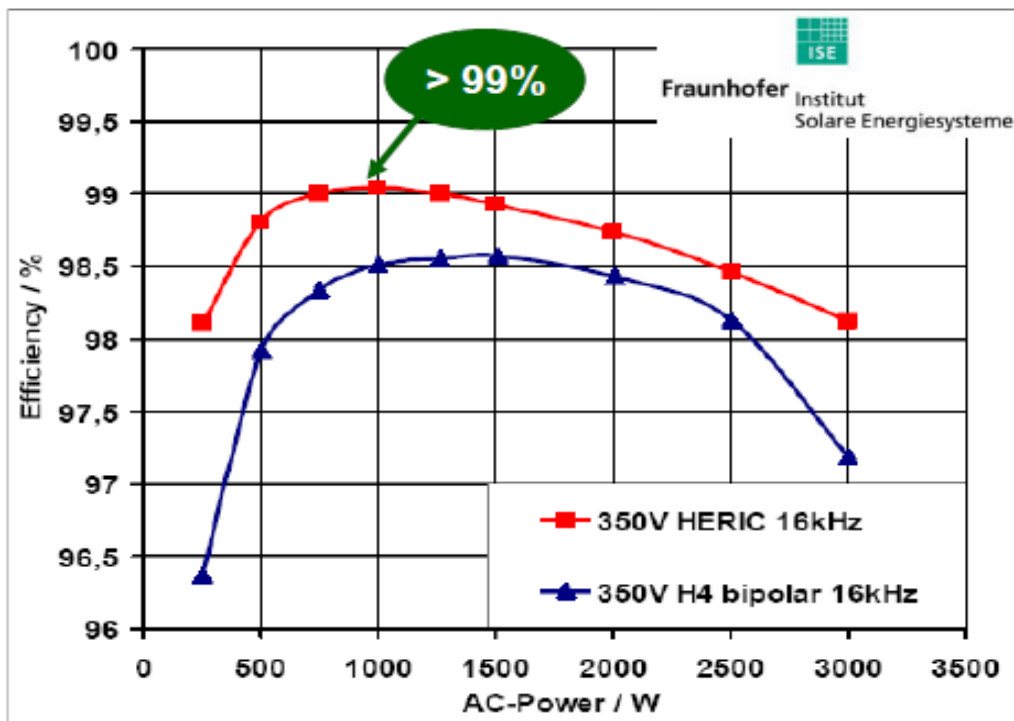
Critical Parameter

<i>Technology</i>		Silicon – IGBT	Silicon Carbide	
<i>Breakdown Voltage</i>	V_{DS}	1200V	1400V	Higher breakdown margin
<i>On Voltage (conduction)</i>	V_{on}	2.5V	Unipolar	Reduced losses at low I ...higher light load Efficiency
<i>Input Capacitance</i>	C_{iss}	1700 pF.	1220pF	Reduced Gate Power Loss
<i>Effective Output Cap Energy Related</i>	$C_{O(ER)}$	260 pF	100 pF	2.5X Lower Switching Losses
<i>Operating Temperature</i>	T_j	-55°C to 150°C	-55°C to 175°C	Safe Operation at higher Temp
<i>Thermal Impedance</i>	R_{thj-c}	0.25K/W	0.6K/W	X2 worse but offset by overall lower dissipation losses
<i>Turn-On Losses</i>		550uJ	131uJ	
<i>Turn-Off Losses</i>	Joules	1000uJ	94uJ	X7-X10 Lower Switching Energy
<i>Total Losses</i>		1550uJ	225uJ	

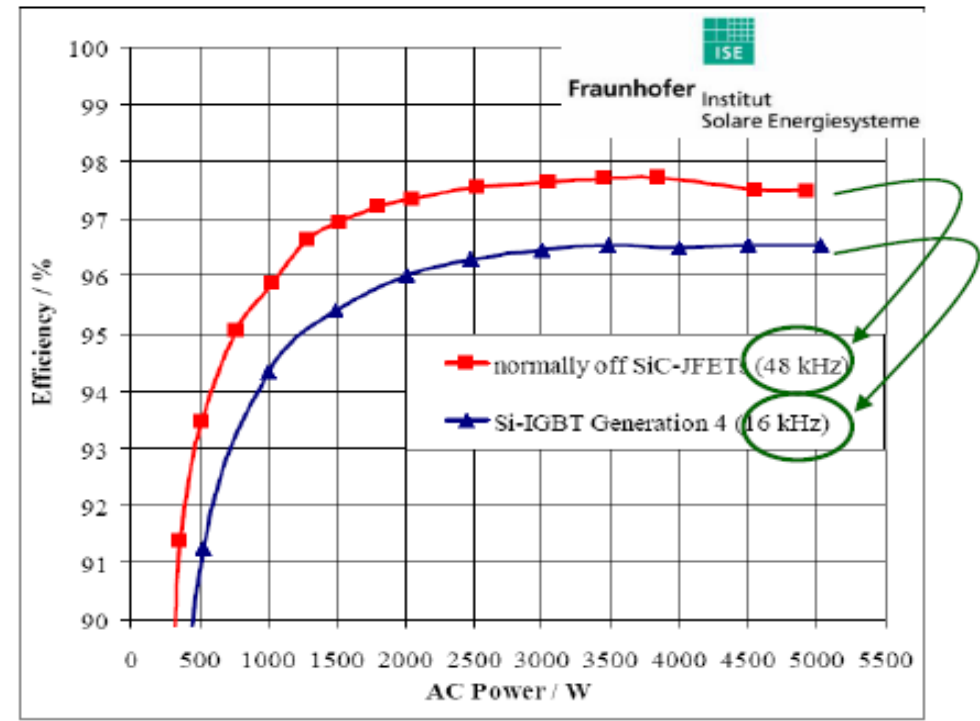
SS JFETs HAVE 50% LOWER LOSSES

“We now use junction field-effect transistors (JFETs) made of silicon carbide (SiC) manufactured by SemiSouth Laboratories Inc.. This is the main reason for the improvement”, - Prof. Bruno Burger, leader of the Power Electronics Group at Fraunhofer ISE, July 2009 press release.

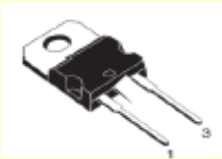
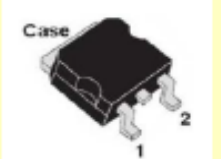
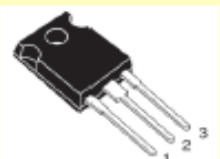
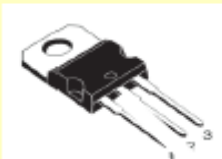
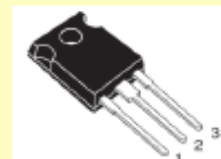

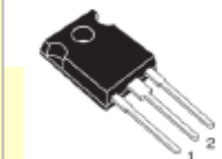
- Single phase Heric®
- Commercial inverters @ 98%
- SemiSouth's JFET lowers losses ~ 50%



- Three phase full bridge inverter
- SemiSouth JFET boosts efficiency 1.2%
- SemiSouth JFET operates 3X higher freq.




* Bruno Burger, Dirk Kranzer, “Extreme High Efficiency PV-Power Converters,” EPE, Barcelona, Spain, 8-10 September 2009

Part	SDA05S120	SDB05S120	SDP10S120D	SDA10S120	SDP20S120D	SDP30S120	SDP60S120D
Package	 2L TO-220	 DPAK (TO-252)	 3L TO-247	 2L TO-220	 3L TO-247	 2L TO-247	 3L TO-247
BV (V)	1200	1200	1200	1200	1200	1200	1200
I _F (A)	5A	5A	10A (2 x 5A)	10A	20A (2 x 10A)	30A	60A (2 x 30A)
V _{Fmin} (V) V _{Fmax} (V)	1.6 1.8	1.6 1.8	1.6 1.8	1.6 1.8	1.6 1.8	1.6 1.8	1.6 1.8
Samples	2008	2011	2008	2008	2008	2009	2011
Production	2008	EQ2/2011	2008	2008	2008	2009	EQ3/2011

Latest Datasheets at


<http://www.semisouth.com/products/products.html>

 Accepting Sample and Production orders

SemiSouth 2008-11 Vertical JFET Products

Normally-ON

Normally-OFF

Part	SJDP120R085	SJDP120R045	SJEP120R100	SJEP120R063	SJEC120R050	SJEP170R550
Package	 3L TO-247	 Bare Die Only	 3L TO-247	 3L TO-247	 Bare Die Only	 3L TO-247
Voltage	1200 V	1200 V	1200 V	1200 V	1200 V	1700V
Rds(on)	85 mΩ	45 mΩ	100 mΩ	63 mΩ	50 mΩ	550 mΩ
Ciss Tr/Tf Die size	670 pF 12 / 30 (ns) 4.5 mm ²	1420 pF 20 / 40 (ns) 9 mm ²	670 pF 12 / 30 (ns) 4.5 mm ²	2 x 670 pF 15 / 35 (ns) 2 x 4.5 mm ²	1420 pF 20 / 40 (ns) 9 mm ²	167 pF 15 / 30 (ns) 2 mm ²
Samples	2009	2011	2008	2009	2010	2009
Production	2009	TBD	2008	2009	TBD	2009

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Accepting Sample and Production orders