SiCPAK™ Product Family

Navitas
Electrify Our World™

GeneSiC™

World's Only Trench-Assisted Planar SiC Technology

April 2025

When failure is not an option

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SiCPAK was developed to withstand harsh environments and extreme operating conditions

for customers who require stable and long-lasting performance in demanding applications

Setting a New Standard for Press-fit Modules

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Unparalleled Reliability and Efficient High-Temperature Performance

✓ **Performance: GeneSiC Trench Assisted Planar SiC MOSFET Technology**

- Up to 20% lower $R_{DS,ON}$ at elevated temperature
- Up to 15% lower switching losses
- Unparalleled reliability under high-voltage/high-temperature/humidity/high-dVdt

✓ **Endurance: Epoxy-resin Potting Technology**

- >10x improved temperature cycling reliability and most-stable thermal resistance
- Protected against moisture ingression in humid environments

✓ **Designed to Address Mission-Profiles of Demanding Applications:**

- EV roadside fast chargers, industrial welding, induction heating, industrial motor drives, solar inverters, and energy storage systems (ESS).

SiCPAK™ : Built for Endurance and Performance

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	SiCPAK F Series *(33.8mmX 62.8mm)*		***SiCPAK G Series*** *(56.7mm X 62.8mm)*		
$R_{DS(ON)}$ *@ V_G = 18V*	**Half-Bridge** (2-Pack / Phase-Leg)	**Full-Bridge** (4-Pack)	**Half-Bridge** (2-Pack / Phase-Leg)	**Full-Bridge** (4-Pack)	**3L-T-NPC**
1200V 4.6 mΩ			**G3F05MT12GB2** **G3F05MT12GB2-T**		
1200V 9.3 mΩ	**G3F09MT12FB2** **G3F09MT12FB2-T**			**G3F09MT12GB4** **G3F09MT12GB4-T**	*Qualification Samples*
1200V 17.0 mΩ	**G3F17MT12FB2** **G3F17MT12FB2-T**				
1200V 18.5mΩ		**G3F18MT12FB4** **G3F18MT12FB4-T**			

- **-T Pre-Applied Thermal Interface Material (Honeywell PTM6000)**
- **All Pin-to-Pin Compatible with Industry Standard Press-fit Modules**
- **Built-in NTC thermistors**

Better Reliability Than Standard Press-Fit Modules

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Reliability Improvements	SiCPAK™ Qualification	Competitor Qualification
Temperature Cycling (-55°C to 150°C)	1000 cycles	<100 cycles
Thermal Shock Test (-40°C to 125°C)	1000 cycles	<100 cycles
Temperature Humidity Bias *(THB / HV-H3TRB)*	1000 hrs 80% V_{DS} THB at module-level 1000 hrs 100% V_{DS} HV-H3TRB die-level	1000 hrs 80% V_{DS} die-level only

Navitas' Epoxy-Potted SiCPAK Modules vs. Competitors' Silicone-Gel Filled Modules after 1000 cycles of Thermal Shock

- Up to 15% thermal resistance increase for epoxy-resin vs. 33%-80% for silicone-gel
- All epoxy-resin potted modules passed isolation tests; all silicone-gel modules failed

Thermal Shock Testing Highlights Epoxy Benefits

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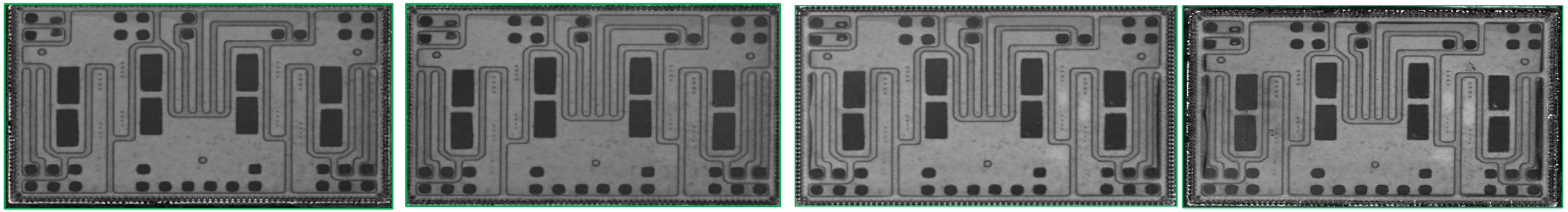
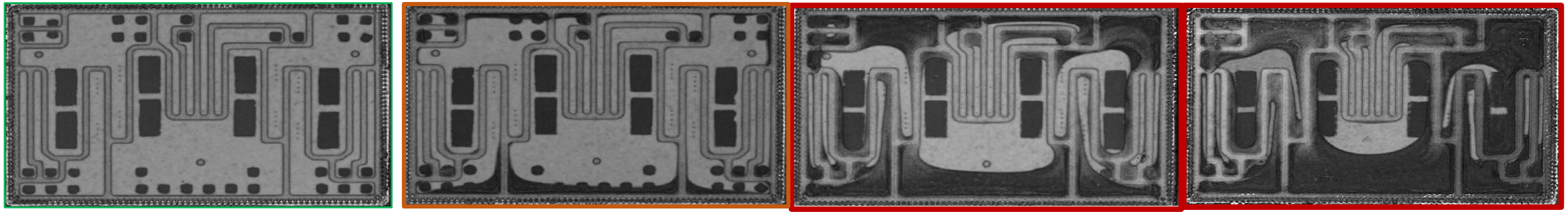
Thermal Shock Testing (-40°C to 125°C)

	T0	100 Cycles	500 Cycles	1000 Cycles
Epoxy				
Silicone				

Significant difference observed in thermal-shock stressed conchoidal fractures between Epoxy and Silicone

Why do Silicon-Gel Press-Fit Modules Fail?

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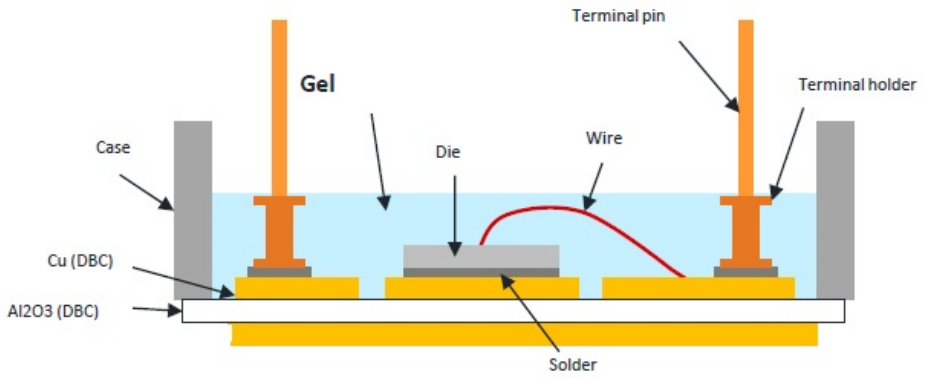
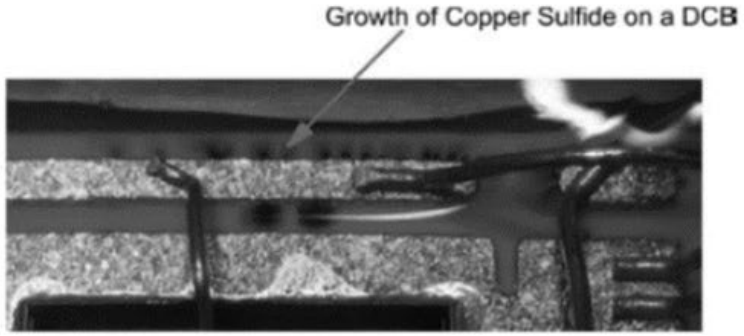
- **Problem: Temperature Cycling**
  - DBC extends and bends with temperature variation, causing conchoidal fractures
- **Problem: Humidity**
  - Silicone gel absorbs moisture and contaminants from the air, leading to short circuit failures

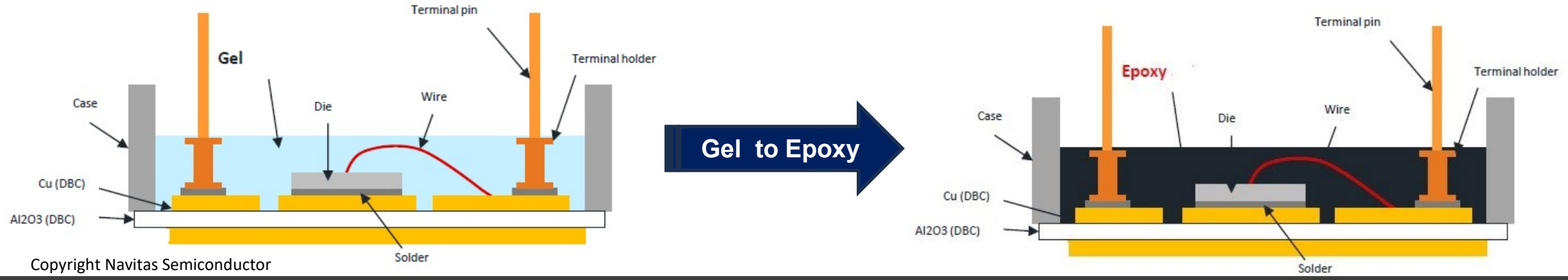




- High temperatures - Moisture and sulphur-containing substances (e.g. hydrogen sulphides) leads to ingression

How Does Epoxy-Resin Solve These Challenges?

- **Reduces variation of plastic strain of bond wires**
  - Epoxy reduces stress between DBC and bond-wires
- **Reduces expansion stresses due to higher thermal conductivity**
  - Epoxy provides ~10x higher thermal conductivity over gel, quickly spreading heat
- **Limits extension and bending of overall structure**
  - Epoxy limits extension and bending of DBC
- **Reduces moisture ingression**
  - Gel absorbs water moisture & contaminants



Qualification Tests : Beyond Industry Norms

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Test	Reference	Test Conditions	Duration	Devices	Result
HTRB	JESD22-A108	High-Temperature Reverse Bias: Tj = 175°C, VDS = 1200V	1000hrs	≥ 77 dies	PASS
HTRB	JESD22-A108	High-Temperature Reverse Bias: Tj = 175°C, VDS = 1200V	1000hrs	≥ 6 modules	PASS
HTGB	JESD22-A108	High Temperature Gate Bias: Tj = 175°C, VGS = +22V	1000hrs	≥ 77 dies	PASS
HTGBR	JESD22-A108	High Temperature Gate Bias: Tj = 175°C, VGS = -10V	1000hrs	≥ 77 dies	PASS
HV-H3TRB	JESD22 A-101	High Humidity High-Temperature Bias: 85°C, 85%RH, VDS = 960V	1000hrs	≥ 77 dies	PASS
HV-H3TRB (THB)	JESD22 A-101	High Humidity High-Temperature Bias: 85°C, 85%RH, VDS = 960V	1000hrs	≥ 6 modules	PASS
TC	JESD22-A104	Temperature Cycle: -55°C / 150°C	1000 cyc	≥ 6 modules	PASS
HTSL	JESD22-A103	High-Temperature Storage Life: Ta = 175°C	1000hrs	≥ 6 modules	PASS
PC	IEC 60749-34	Power Cycling (sec) : ΔTj = 80°C, Tj max = 150 °C	25,000 cycles	≥ 6 modules	PASS
VIB	IEC 60068-2-6	Vibration (25-500Hz/15min, 10G, each 2 hours X, Y, Z)	N/A	≥ 6 modules	PASS
UIS	AEC Q101-004	Unclamped Inductive Switching	N/A	≥ 3 modules	PASS

***Competition* : No THB**

***Competition* : <100 cycles**

Trench-Assisted Planar = Superior Performance

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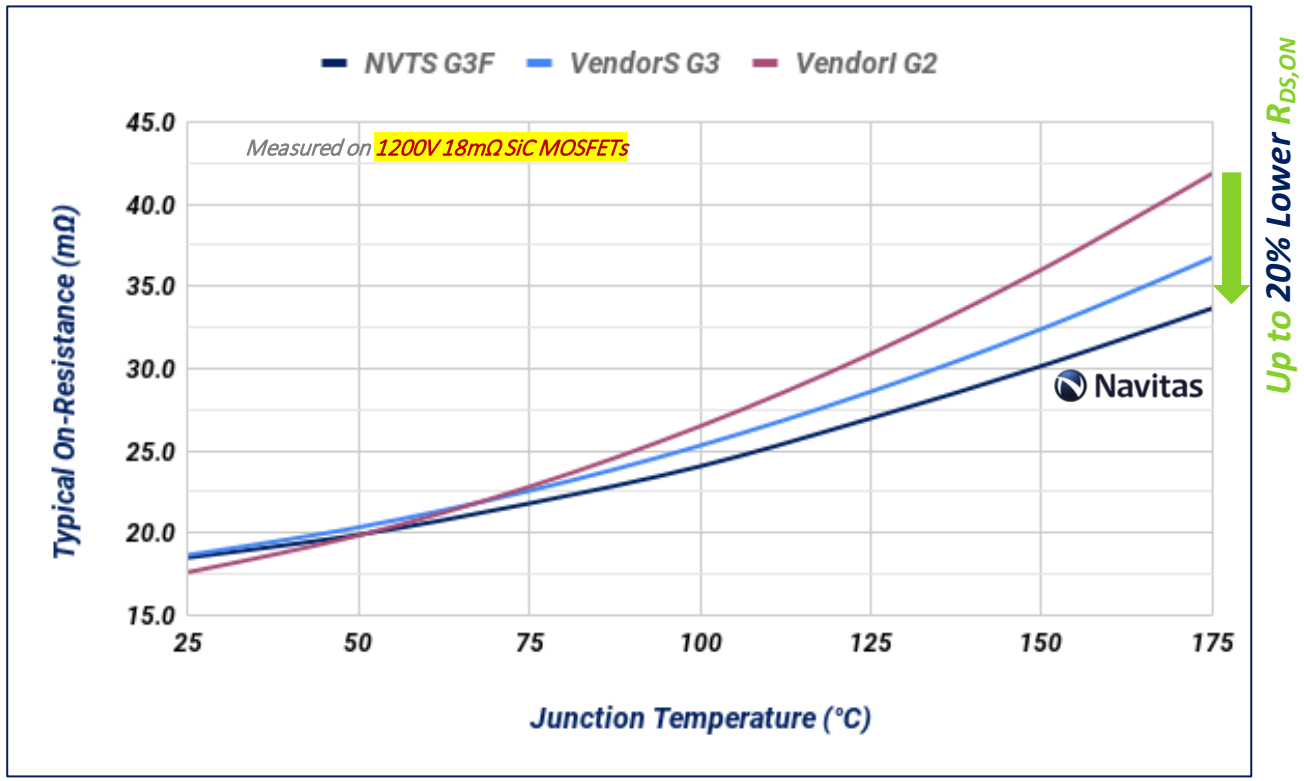
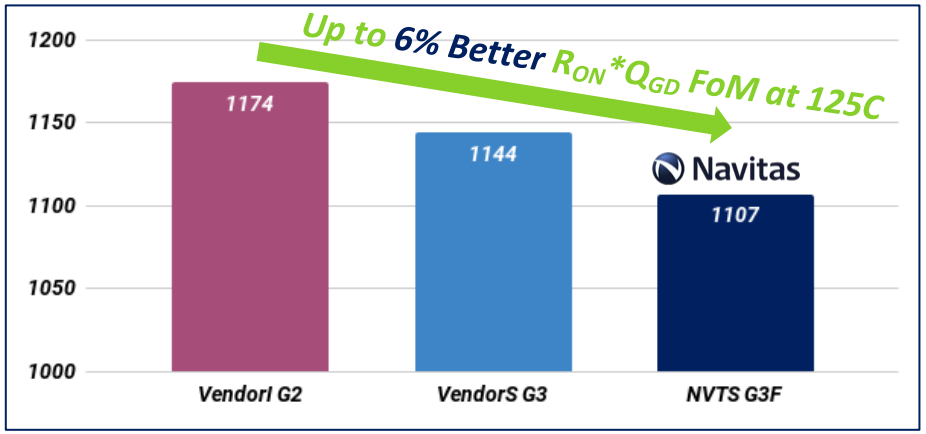
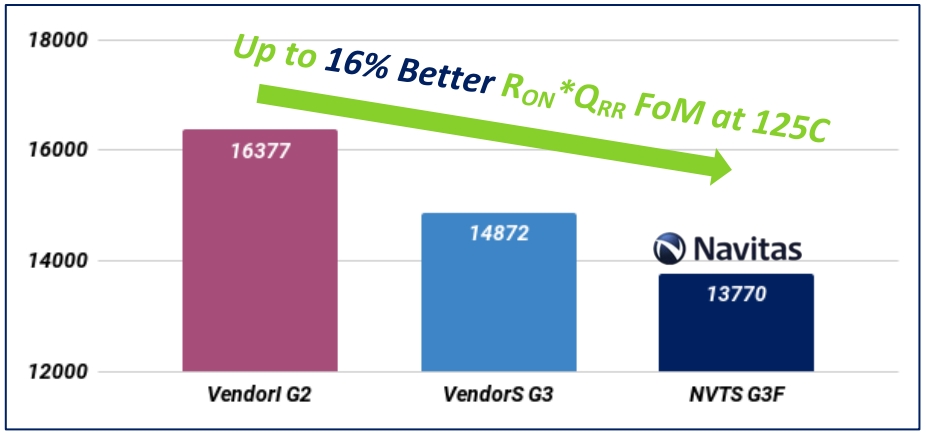
5% - 20% Lower $R_{DS,ON}$ at 100°C – 175°C







Industry-Leading Performance Enabled by Proprietary Trench-Assisted Planar SiC MOSFET Technology

Richardson Electronics
POWER & MICROWAVE TECHNOLOGIES

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Thank you!

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