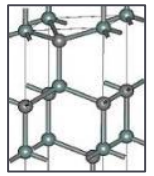
life.augmented

SiC MOSFET portfolio: Building a power revolution

STPOWER

Why silicon carbide?

SiC power devices for performance beyond silicon

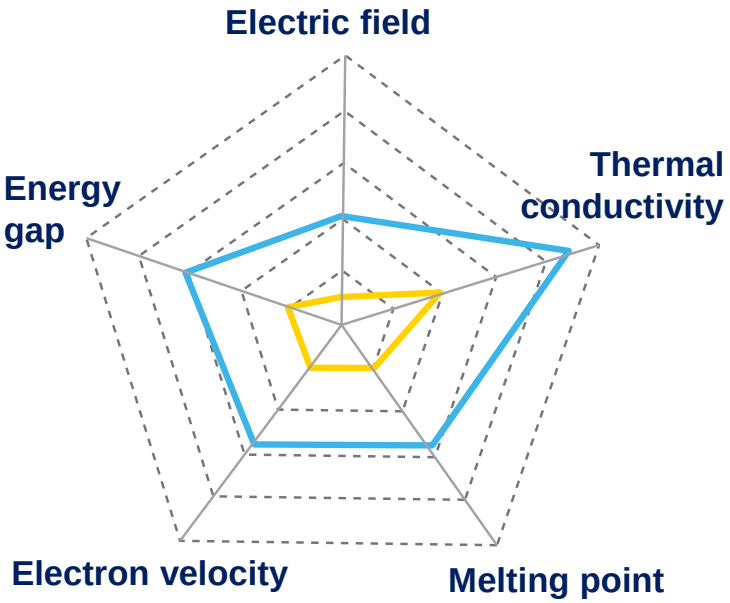


Silicon carbide

Higher breakdown voltage: x10
Lower on-resistance & losses

Higher temperature (operation & endurance)
Reduced cooling requirements

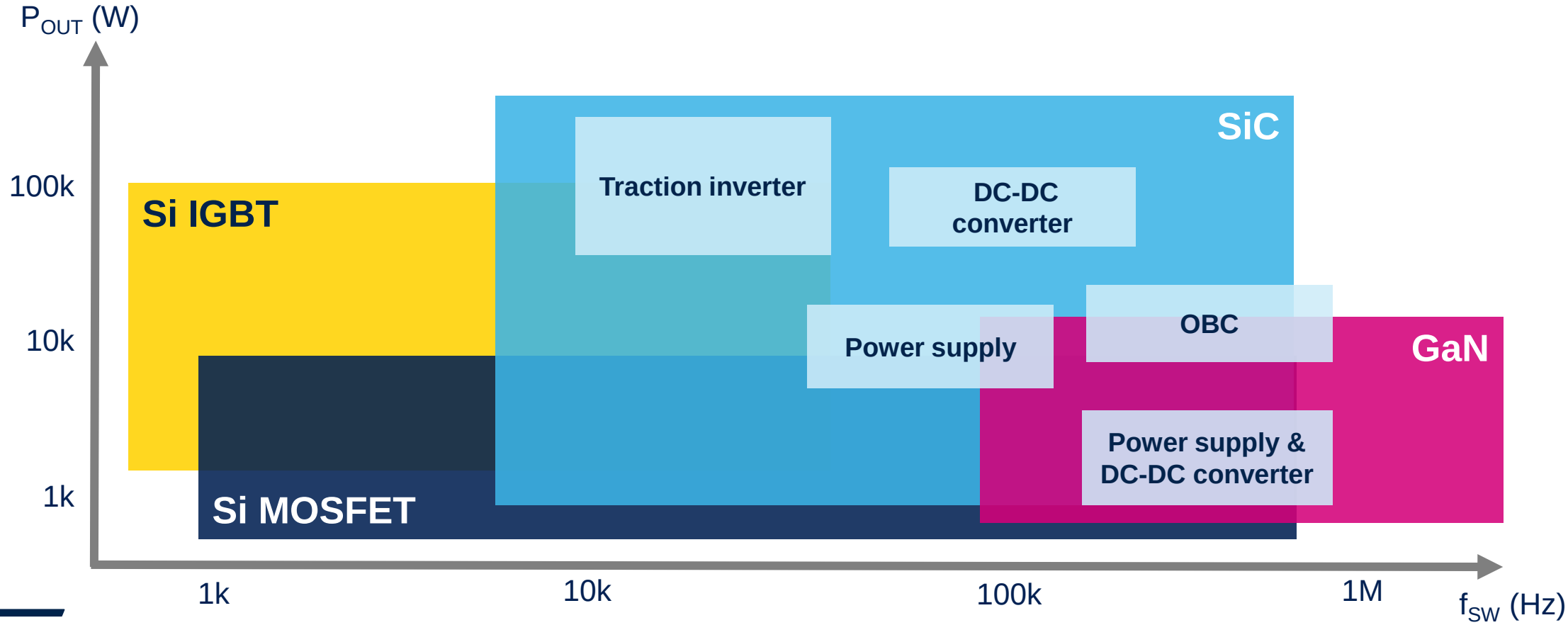
Higher switching frequency
Lower switching losses



life.augmented

Power semiconductors for key applications

SiC MOSFET technology offers the best performance in high voltage, high frequency, and high-power system applications



life.augmented

Automotive and industrial applications

- Global CO2 emission reduction
- Smaller and lighter power unit form factor
- Better inverter efficiency
- Extra mileage/lower battery cost

Car electrification

Traction inverter

On-board charger

DC-DC converter

High-end industrial

Better efficiency

Smaller form factor

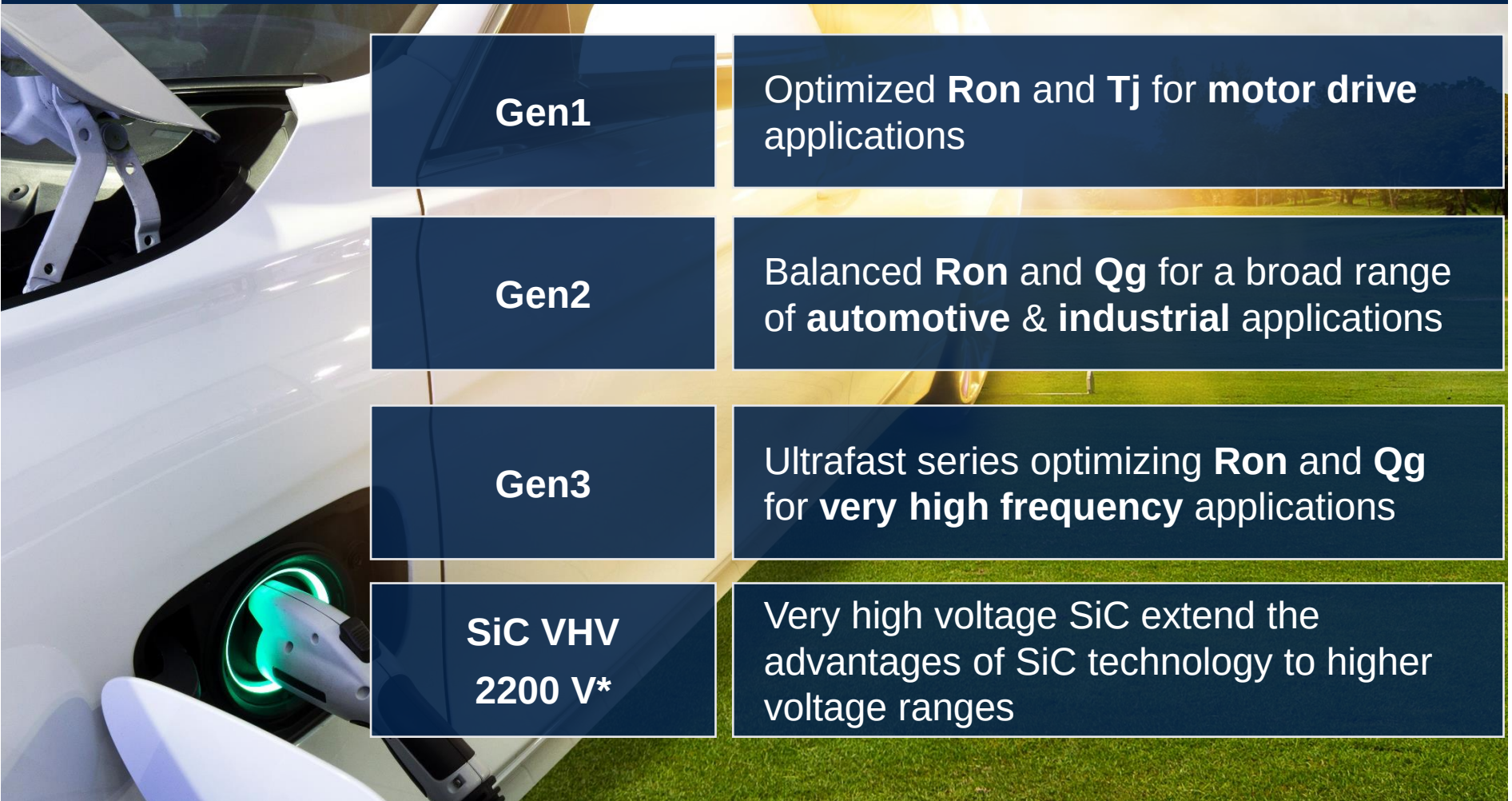
Lower TCO vs. silicon

- Solar inverter
- Energy storage
- Power supply
- Charging station
- Welding
- Drives

life.augmented

SiC MOSFET range

High voltage and fast switching for high density applications

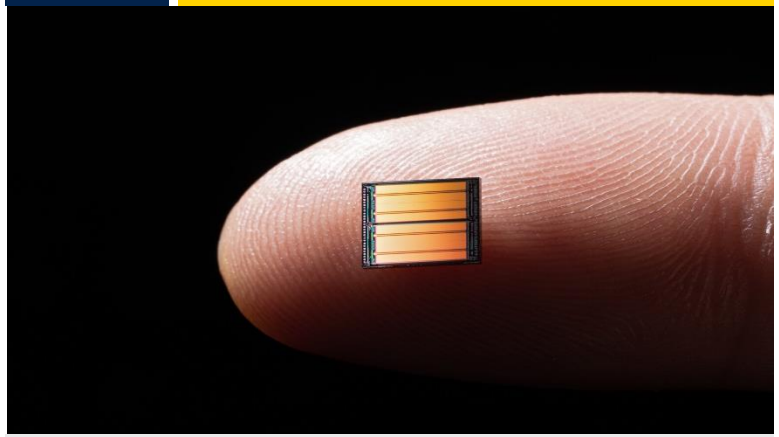


Gen1	Optimized **Ron** and **Tj** for **motor drive** applications	**1200–1700 V**
Gen2	Balanced **Ron** and **Qg** for a broad range of **automotive** & **industrial** applications	**650 V, 1200 V, 2200 V**
Gen3	Ultrafast series optimizing **Ron** and **Qg** for **very high frequency** applications	**650 V, 750 V, 900 V, 1200 V**
SiC VHV 2200 V*	Very high voltage SiC extend the advantages of SiC technology to higher voltage ranges	**2200 V**

*** industrial grade**

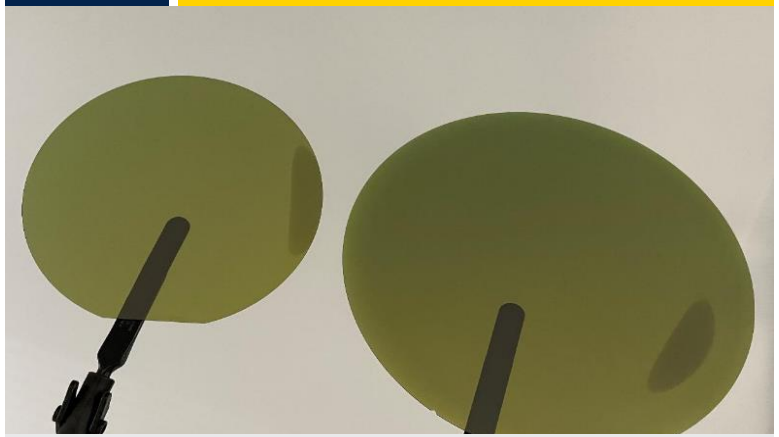
SiC MOSFET range in evolution

Gen3 — Planar technology



- Planar technology
- Ron*A FoM:
  - 750 V (1.8 mΩ*cm²)
  - 1200 V (2.8 mΩ*cm²)
- 650 V, 750 V, 900 V, 1200 V
- Technology qualified
- In full production

Gen4 — Planar technology with pitch reduction



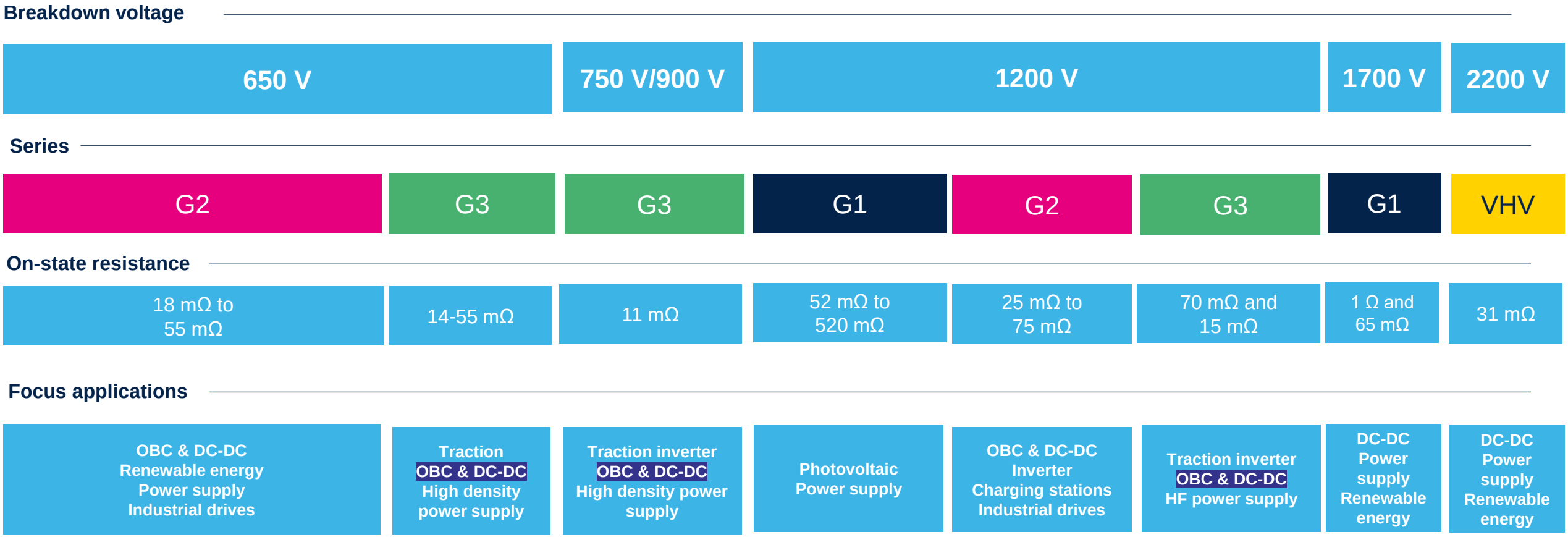
- Ron: lower vs. Gen3
- Integrated Rg, lower driving voltage, possibility for large die, and current and temp. sensors
- Same processes as Gen3
- Commercial maturity by Q3 2024

Gen5 — Planar technology smallest achievable pitch

- Very high-density structure
- 15 V & 18 V driving options
- Further Ron reduction vs Gen4
- Thinner die
- Development to be started at 8”
- Technology qualification by Q2 2025

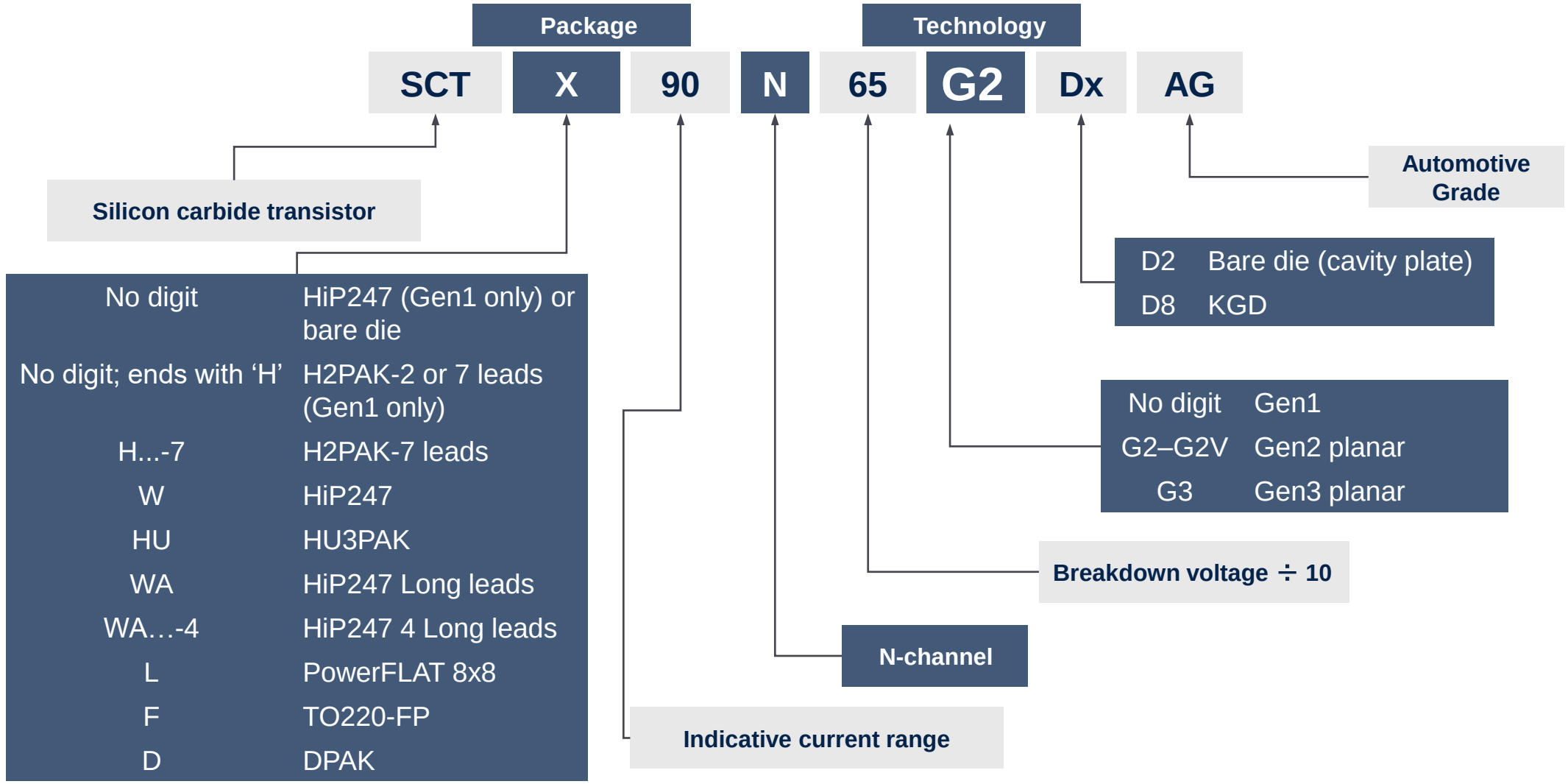
life.augmented

STPOWER SiC MOSFET
Product families and applications



life.augmented

SiC MOSFET Gen1/Gen2 nomenclature



SiC 1200 V Gen1: balanced $R_{DS(on)}$ vs. Tj

Vgs=18 V Industrial grade Automotive-grade	V_{DS} [V]	R_{DS}(on) typ @ 25°C [mΩ]	Id [A]	Package					In mass production
				HiP247	HiP247-LL	HiP247-4LL	H2PAK-2L	H2PAK-7L	
				Tj max= 200°C			Tj max= 175°C		
SCT50N120	1200	52	65	X					
SCTWA50N120					X				
SCTWA50N120-4						X			
SCTH50N120-7								X	
SCT30N120		80	40	X					
SCTWA30N120					X				
SCT30N120H							X		
SCT20N120		169	20	X					
SCTWA20N120					X				
SCT20N120H							X		
SCT20N120AG				X					
SCT10N120		520	12	X					
SCTWA10N120					X				
SCT10N120H							X		
SCT10N120AG				X					

SiC 650 V Gen2: balanced $R_{DS(on)}$ vs. Qg

Vgs=18 V Industrial grade Automotive-grade	V_{DS} [V]	R_{DS}(on) typ @ 25°C [mΩ]	Id [A]	Package				
				HiP247	HiP247-LL	HiP247-4LL	H2PAK-7L	
				Tj max= 200°C			Tj max= 175°C	
SCTW90N65G2V	650	18	119	X				In mass production
SCTWA90N65G2V					X			
SCTWA90N65G2V-4						X		
SCTH90N65G2V-7							X	
SCTW100N65G2AG		20	100	X				
SCTWA100N65G2AG					X			
SCTWA100N65G24AG						X		
SCTH100N65G2-7AG							X	
SCTW35N65G2V		55	45	X				
SCTWA35N65G2V					X			
SCTWA35N65G2V-4						X		
SCTH35N65G2V-7							X	
SCTW35N65G2VAG				X				
SCTWA35N65G2VAG					X			
SCTWA35N65G2V4AG						X		
SCTH35N65G2V-7AG							X	

SiC 1200 V Gen2: balanced $R_{DS(on)}$ vs. Qg

Vgs=18 V	V_{DS} [V]	R_{DS}(on) typ @ 25°C [mΩ]	Id [A]	Package				
Industrial grade				HiP247	HiP247-LL	HiP247-4LL	H2PAK-7L	
Automotive-grade				Tj max= 200°C			Tj max= 175°C	
SCTW70N120G2V	1200	25	80	X				In mass production
SCTWA70N120G2V					X			
SCTWA70N120G2V-4						X		
SCTH70N120G2V-7							X	
SCTW40N120G2V		70	45	X				
SCTWA40N120G2*					X			
SCTWA40N120G2V-4						X		
SCTH40N120G2V-7							X	
SCTW40N120G2VAG		75	35	X				
SCTWA40N120G2AG					X			
SCTWA40N120G24AG *						X		
SCTH40N120G2V7AG							X	

life.augmented

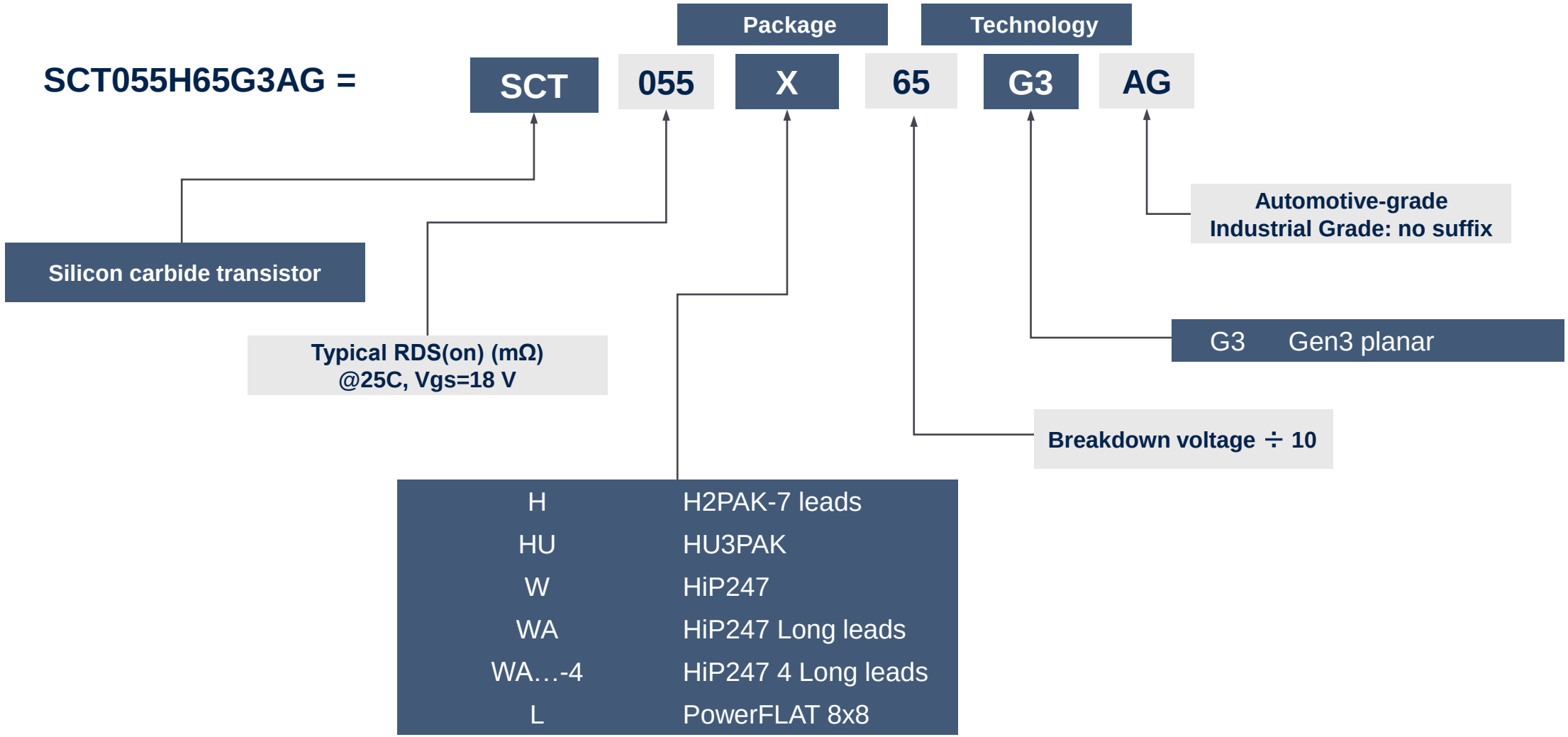
SiC 1200 V Gen2: balanced $R_{DS(on)}$ vs. Qg

Vgs=18 V Industrial grade Automotive-grade	V_{DS} [V]	R_{DS}(on) typ @ 25°C [mΩ]	Id [A]	Package				Mat.30	Entering mass production
				HiP247	HiP247-LL	HiP247-4LL	H2PAK-7L		
				Tj max= 200°C			Tj max= 175°C		
SCTW100N120G2AG	1200 V	30	80	X				OK	
SCTWA100N12G24AG						X		OK	
SCTH100N120G2-AG							X	OK	
SCTW60N120G2		40	60	X				OK	
SCTWA60N120G2-4					X			OK	
SCTH60N120G2-7						X		OK	
SCTW60N120G2AG		45	60	X				OK	
SCTWA60N120G2AG					X			OK	
SCTWA60N12G2-4AG						X		OK	
SCTH60N120G2-7AG							X	OK	

SiC 1700 V
The first very HV automotive & industrial qualified

Vgs=18 V Industrial grade Automotive-grade	V_{DS} [V]	R_{DS}(on) typ @ 25°C [mΩ]	Id [A]	Package					Entering mass production
				HiP247	HiP247-LL	HiP247-4LL	H2PAK-2L	H2PAK-7L	
				Tj max= 200°C			Tj max= 175°C		
SCT1000N170	1700 V	1000	6	X					
SCT1000N170AG				X					
SCTWA1000N170					X				
SCT20N170		64	25	X					
SCT20N170AG				X					
SCTWA20N170					X				

SiC MOSFET Gen3 Nomenclature*



* for discrete packages (not STPAK)

Gen3 SiC MOSFET 650 V discrete

Automotive-grade AECQ 101 compliant	V_{DS} [V]	R_{DS}(on) typ @ 25°C [Ω], *Vgs=18 V	Package	Eng. Samples	Mat.30
SCT055HU65G3AG	650	0.055	HU3PAK	Available	Achieved
SCT055H65G3AG			H2PAK-7L	Available	Achieved
SCT055W65G3AG			HiP247	Available	Q2 2024
SCT055W65G3-4AG			HiP247 4L (LL)	Available	Achieved
SCT040HU65G3AG	650	0.042	HU3PAK	Available	Achieved
SCT040H65G3AG			H2PAK-7L	Available	Achieved
SCT040W65G3AG			HiP247	Available	Q2 2024
SCT027HU65G3AG	650	0.027	HU3PAK	Available	Q2 2024
SCT027H65G3AG			H2PAK-7L	Available	Achieved
SCT027W65G3AG			HiP247	Available	Q2 2024
SCT027W65G3-4AG			HiP247 4L (LL)	Available	Achieved

Gen3 SiC MOSFET 650/750V discrete

Automotive-grade AECQ 101 compliant	V_{DS} [V]	R_{DS}(on) typ @ 25ºC [Ω], *Vgs=18 V	Package	Eng. Samples	Mat.30
SCT018HU65G3AG	650	0.021	HU3PAK	Available	Q2 2024
SCT018H65G3AG			H2PAK-7L	Available	Achieved
SCT018W65G3AG			HiP247	Available	Achieved
SCT018W65G3-4AG			HiP247 4L (LL)	Available	Achieved
SCT014HU65G3AG	650	0.014	HU3PAK	Available	Q2 2024
SCT011HU75G3AG	750	0.011	HU3PAK	Available	Q2 2024
SCT011H75G3AG			H2PAK-7L	Available	Achieved

Gen3 SiC MOSFET product plan 900/1200V discrete

Automotive-grade AECQ 101 compliant	V_{DS} [V]	R_{DS}(on) typ @ 25ºC [Ω], *Vgs=18 V	Package	Eng. Samples	Mat.30
SCT012HU90G3AG	900	0.012	HU3PAK	Available	Q2 2024
SCT012H90G3AG			H2PAK-7L	Available	Achieved
SCT012W90G3AG			HiP247	Available	Achieved
SCT012W90G3-4AG			HiP247-4L	Available	Achieved
SCT070HU120G3AG	1200	0.070	HU3PAK	Available	Achieved
SCT070H120G3AG			H2PAK-7L	Available	Achieved
SCT070W120G3AG			HiP247	Available	Achieved
SCT070W120G3-4AG			HiP247-4L	Available	Achieved
SCT040HU120G3AG	1200	0.040	HU3PAK	Available	Q2 2024
SCT040H120G3AG			H2PAK-7L	Available	Achieved
SCT040W120G3AG			HiP247	Available	Achieved
SCT040W120G3-4AG			HiP247-4L	Available	Achieved

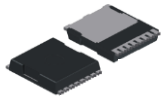
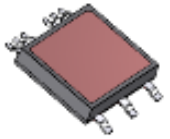
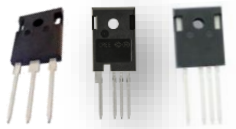
Gen3 SiC MOSFET product plan 1200 V discrete

Automotive-grade AECQ 101 compliant	V_{DS} [V]	R_{DS}(on) typ @ 25°C [Ω], *Vgs=18 V	Package	Eng. Samples	Mat.30
SCT025HU120G3AG	1200	0.027	HU3PAK	Available	Q2 2024
SCT025H120G3AG			H2PAK-7L	Available	Achieved
SCT025W120G3AG			HiP247	Available	Achieved
SCT025W120G3-4AG			HiP247-4L	Available	Achieved
SCT020HU120G3AG	1200	0.020	HU3PAK	Available	Achieved
SCT020H120G3AG			H2PAK-7L	Available	Achieved
SCT016HU120G3AG	1200	0.016	HU3PAK	Available	Q2 2024
SCT016H120G3AG			H2PAK-7L	Available	Q2 2024
SCT015W120G3-4AG	1200	0.015	HiP247-4L	Available	Achieved

SiC package technologies

life.augmented

SiC MOSFET package technologies

PowerFLAT 8x8 STD & DSC	TO-LL	H2PAK-7L	HU3PAK	ACEPACK SMIT	HiP247 (3 ,4, long leads)	STPAK	Bare dice
							
Surface mounting					**Through-hole**	**Special package solutions**	
Very thin (<1 mm) Well accepted in power conversion Dual side cooling option Leadless **Industrial domain**	**2.4 mm** (max) thickness Good Rthj-a performance Leadless **Industrial domain** **Kelvin source** for optimized driving Good thermal dissipation	**AG qualified at 175°C** Kelvin source for optimized driving High runner for automotive customers	**AG qualified at 175°C** **Top side cooling** Kelvin source for optimized driving Very good thermal dissipation	AG qualified at 175°C Isolated top side cooling Suitable for different configurations (HB, dual die, etc.) High power Modular approach	**AG qualified at 200°C** **Very common industry standard** Kelvin source option for optimized driving High creepage version (1700 V) in development	**Unique solution for traction inverter** **AG qualified at 200°C** **Very high thermal dissipation efficiency** Sense pin for optimized driving Multisintered package	**WLBI & KGD** **T&R or RWF options** **Compliant with the most stringent automotive quality requirements**

life.augmented

Multisintering STPAK*

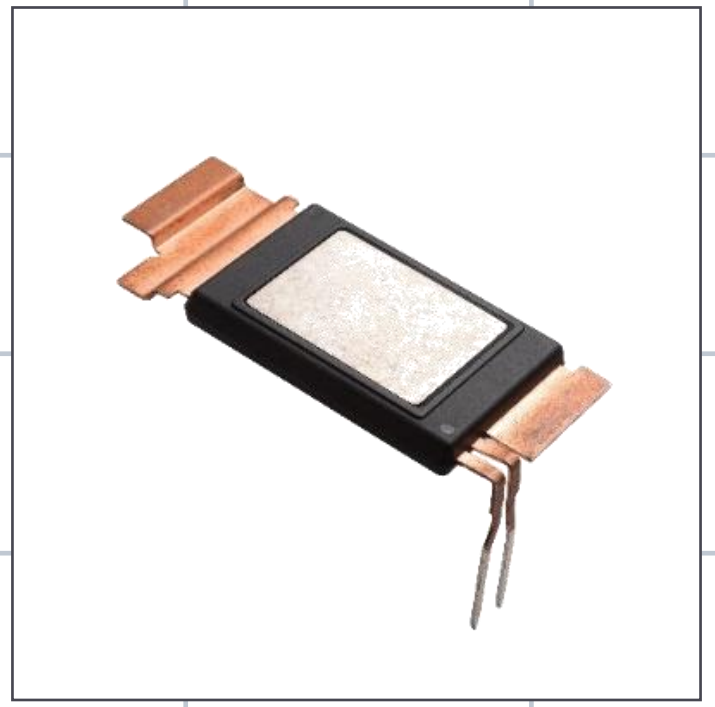
Automotive quality standards
AEC-Q101 qualified

High temperature capability
Tj (max)= 200°C

High voltage rated
650 V / 1200 V

Mechanical reliability
Improved thermal performance due to bottom direct sintering to heatsink

Control
Sense pin for enhanced control



System compactness
High power density

Flexibility
Modular design approach

High efficiency
Gen3 SiC MOSFET embedded

Robustness
Internal clip design

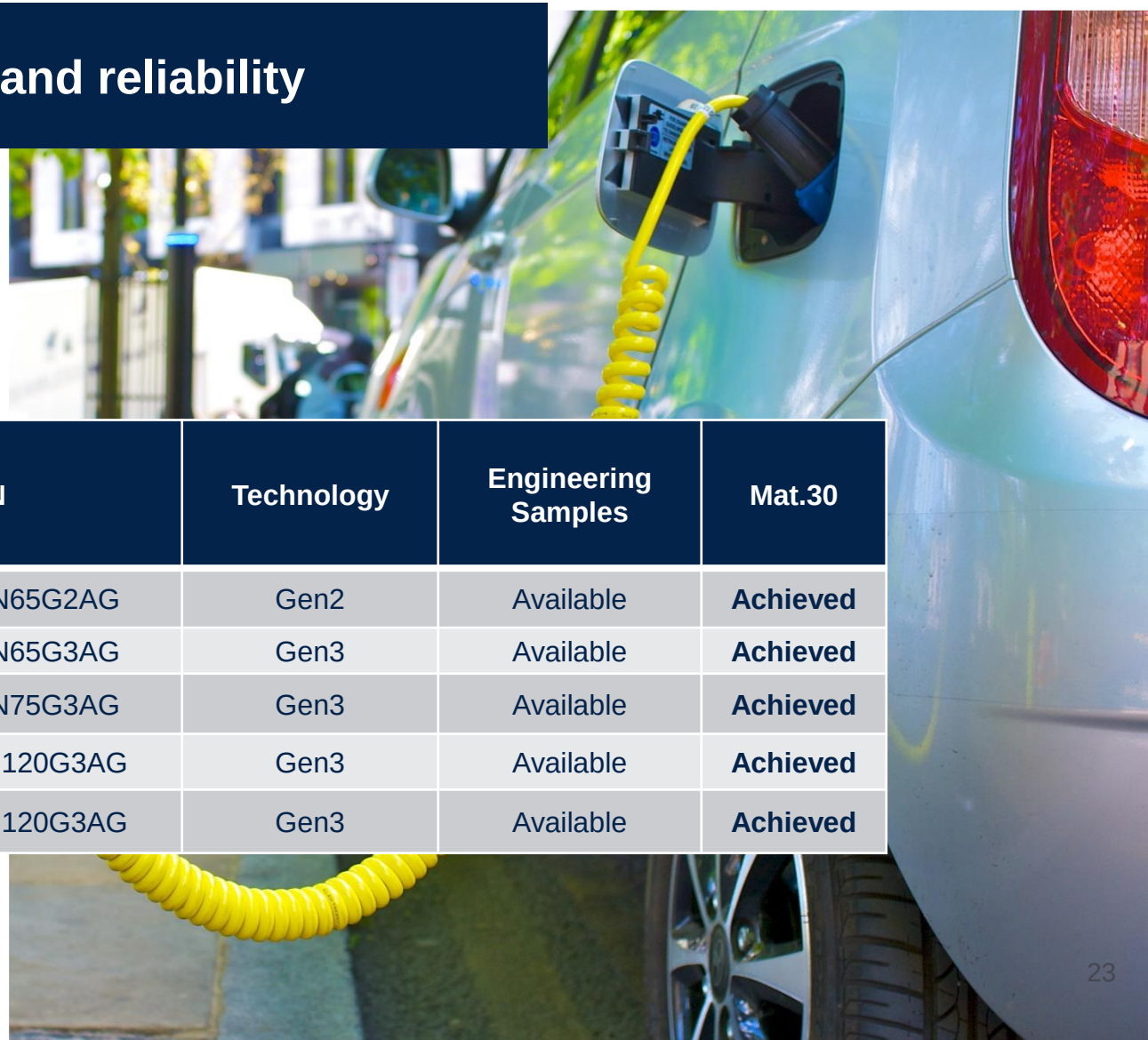
Cooling system reduction
Very good thermal dissipation

life.augmented

SiC MOSFET in STPAK

Multisintering solution for higher performance and reliability

Automotive-grade



V_{DS} [V]	$R_{DS(on)}$ typ. @ 18 V, 25°C [mΩ]	I_D [A] @ 25°C	P/N	Technology	Engineering Samples	Mat.30
650	8	250	SCTHS250N65G2AG	Gen2	Available	**Achieved**
650	6.7	230	SCTHS250N65G3AG	Gen3	Available	**Achieved**
750	5.5	300	SCTHS300N75G3AG	Gen3	Available	**Achieved**
1200	10	180	SCTHS200N120G3AG	Gen3	Available	**Achieved**
1200	8	250	SCTHS250N120G3AG	Gen3	Available	**Achieved**

life.augmented

ACEPACK* SMIT

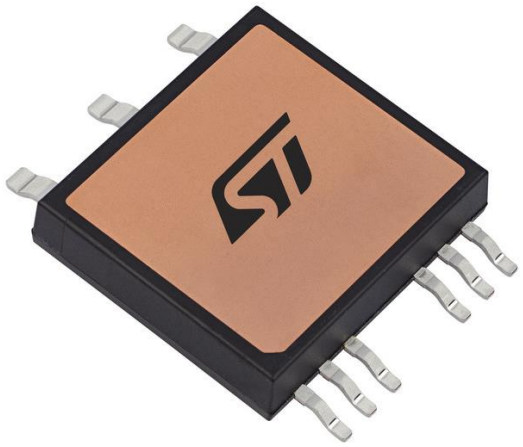
Flexible
Suitable for several applications

Robust
2500 Vrms electrical isolation

Easy
SMD assembly

Thermal performance
Dice chips on direct bonded copper (DBC) substrate

Fast in switching
Reduced parasitic inductance and capacitance



Ideal
For building a complete system

Configurable
Several configurations available and low stray inductance

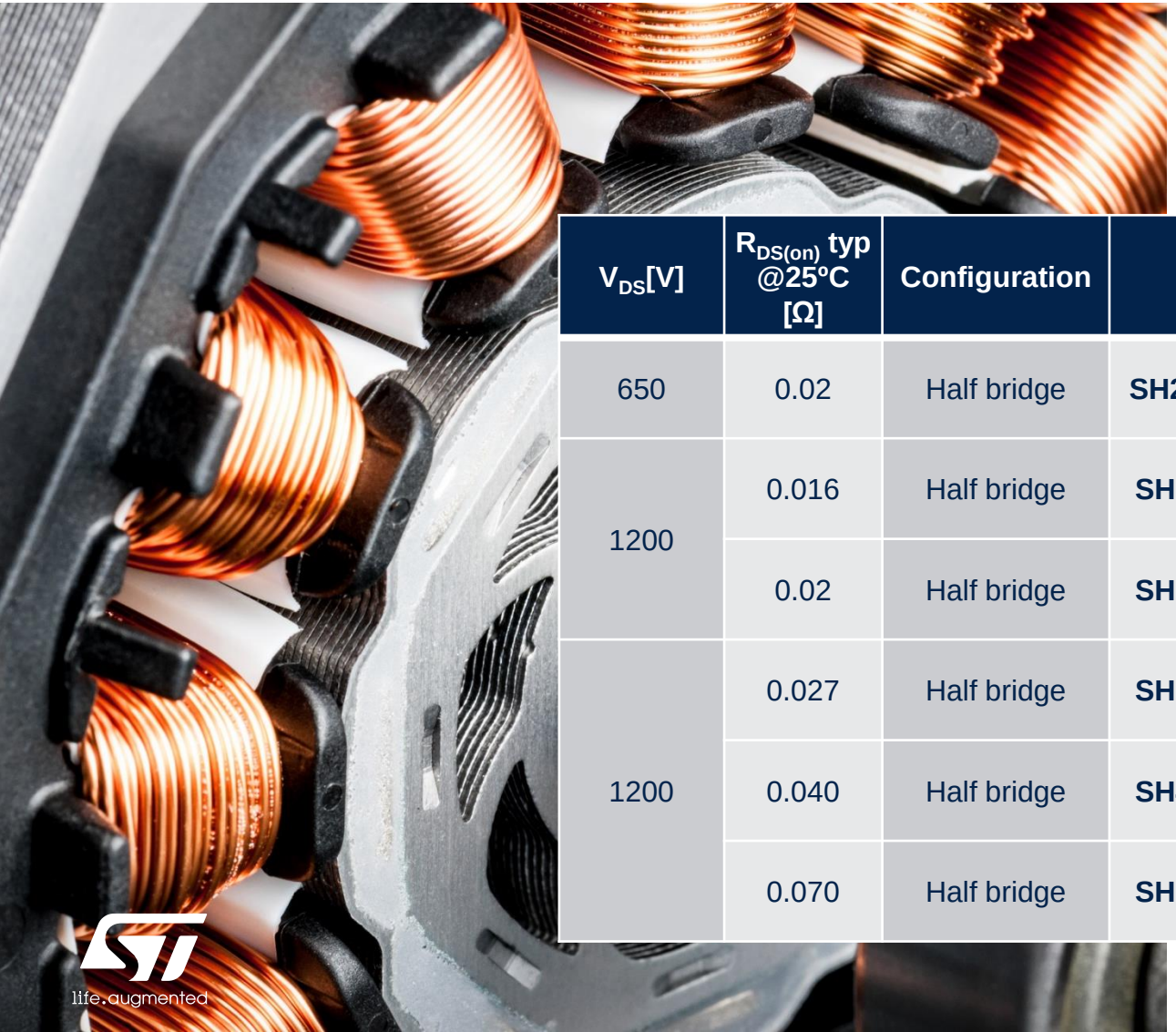
Reliable
High reliability and robustness, miniaturized power sideboard

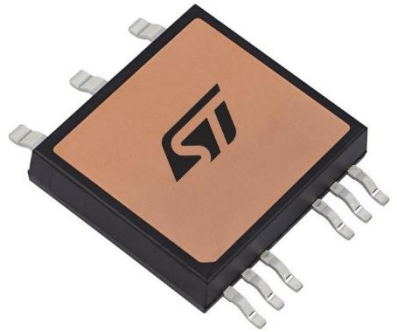
Cost-effective
Cost-effective system approach

Compact
Compact design and very high power density

life.augmented

SiC MOSFET products in ACEPACK SMIT





V_{DS}[V]	$R_{DS(on)}$ typ @25°C [Ω]	Configuration	P/N	Samples	MP
650	0.02	Half bridge	**SH20M65W3AG***	Available	Q4 2024
1200	0.016	Half bridge	**SH16M12W3AG**	Available	Q2 2024
	0.02	Half bridge	**SH20M12W3AG**	Available	Q3 2024
1200	0.027	Half bridge	**SH25M12W3AG**	Available	Q3 2024
	0.040	Half bridge	**SH40M12W3AG**	Available	Q4 2024
	0.070	Half bridge	**SH70M12W3AG**	Available	Q1 2024

life.augmented

Top-side cooling package: HU3PAK*

Automotive quality standards
AEC-Q101 qualified

High temperature capability
Tj (max)= 175°C

High voltage rated
Up to 1200 V

Improved thermal dissipation
Top side cooling

Efficient
Kelvin source pin enables higher efficiency

Electric arc prevention
Higher creepage distance for a better isolation

Compactness
SMD package for more compact systems

Smaller form factor
Direct top side connection to heatsink

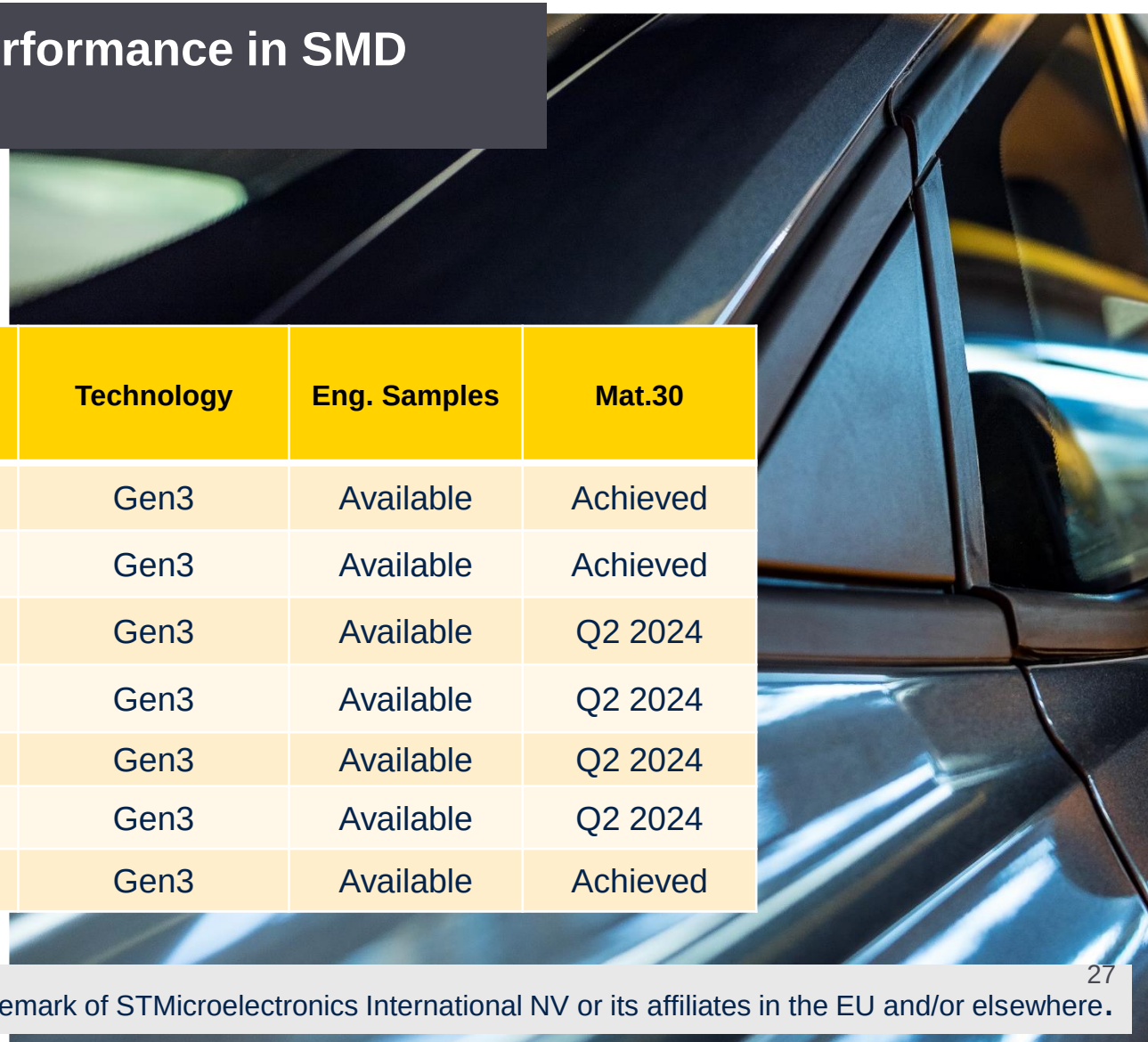
life.augmented

SiC MOSFET in top-side cooling HU3PAK*

Enabling heatsink adoption for best thermal performance in SMD designs

Automotive-grade

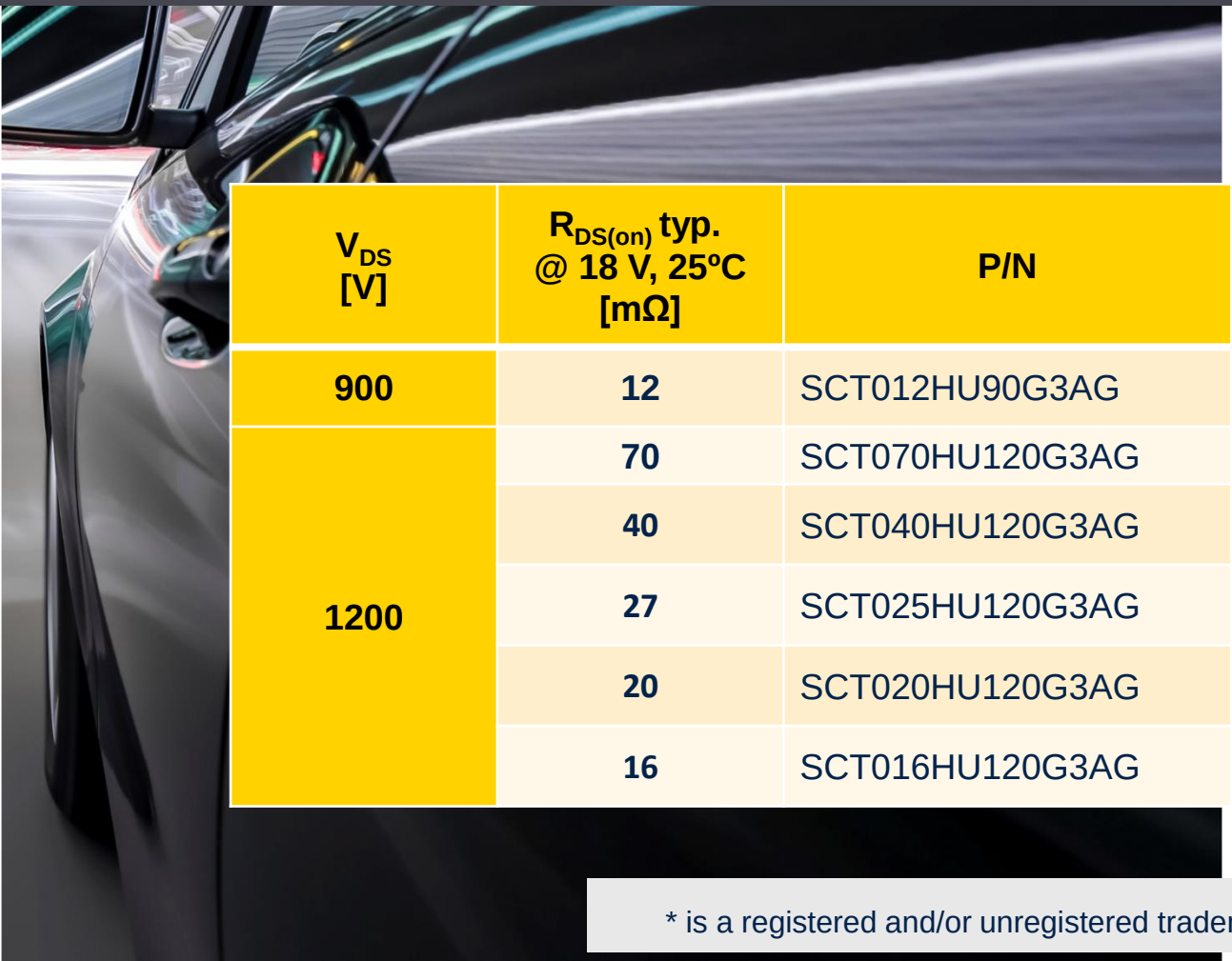
V_{DS} [V]	$R_{DS(on)}$ typ. @ 18 V, 25°C [mΩ]	P/N	Technology	Eng. Samples	Mat.30
650	**55**	SCT055HU65G3AG	Gen3	Available	Achieved
650	**42**	SCT040HU65G3AG	Gen3	Available	Achieved
650	**27**	SCT027HU65G3AG	Gen3	Available	Q2 2024
650	**21**	SCT018HU65G3AG	Gen3	Available	Q2 2024
650	**14**	SCT014HU65G3AG	Gen3	Available	Q2 2024
750	11	SCT011HU75G3AG	Gen3	Available	Q2 2024
750	60	SCT060HU75G3AG	Gen3	Available	Achieved



life.augmented

SiC MOSFET in top-side cooling HU3PAK*

Enabling heatsink adoption for best thermal performance in SMD designs

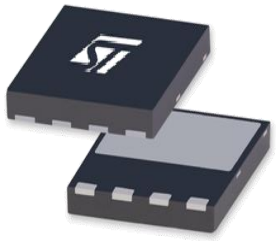


Automotive-grade

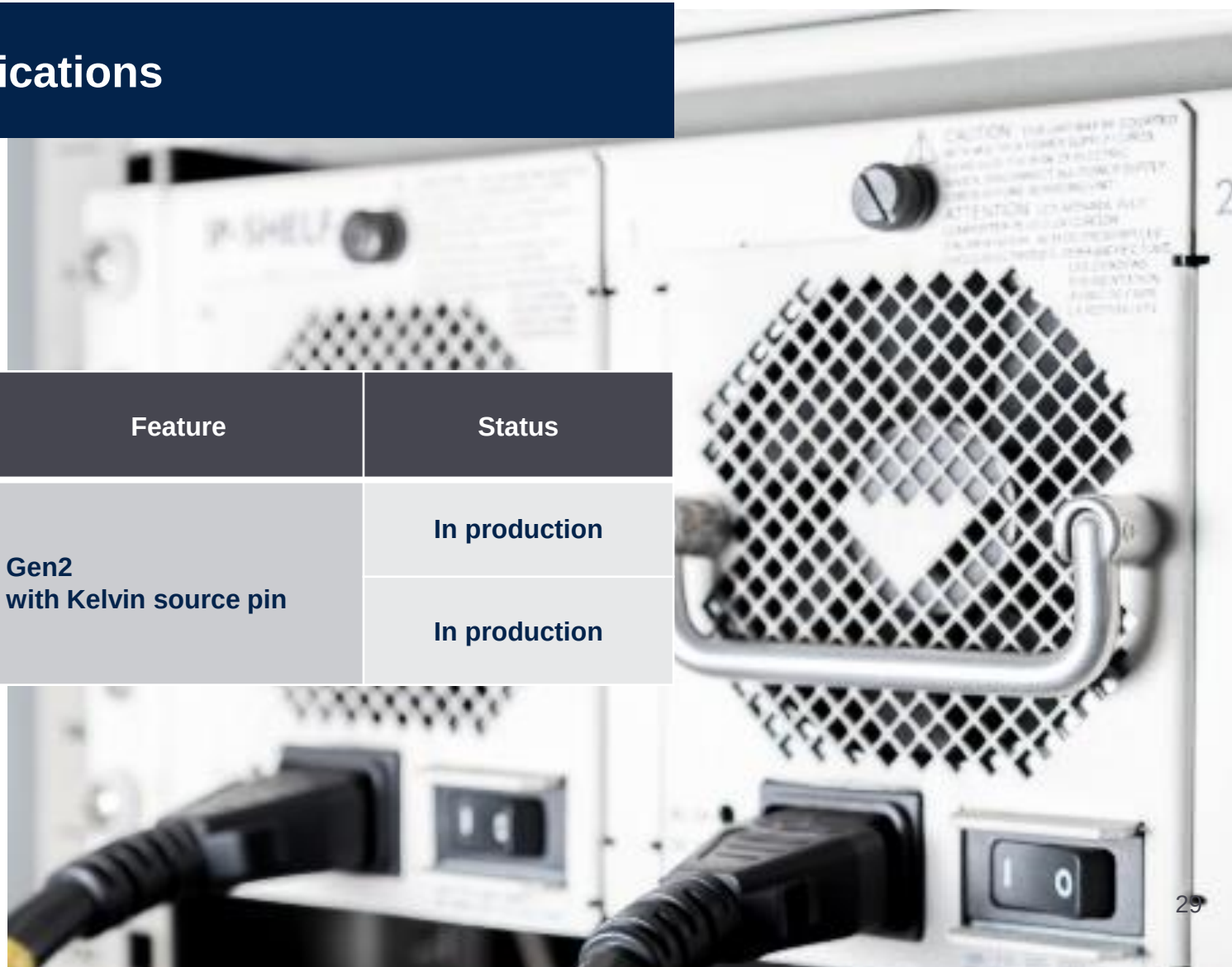
V_{DS} [V]	$R_{DS(on)}$ typ. @ 18 V, 25°C [mΩ]	P/N	Technology	Eng. Samples	Mat.30
900	**12**	SCT012HU90G3AG	Gen3	Available	Q2 2024
1200	**70**	SCT070HU120G3AG	Gen3	Available	Achieved
	40	SCT040HU120G3AG	Gen3	Available	Q2 2024
	27	SCT025HU120G3AG	Gen3	Available	Q2 2024
	20	SCT020HU120G3AG	Gen3	Available	Achieved
	16	SCT016HU120G3AG	Gen3	Available	Q2 2024

SiC MOSFET in PowerFLAT 8x8

Ideal for high frequency industrial applications



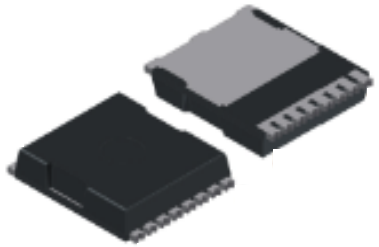
V_{DS}[V]	R_{DS}(on) typ @ 25°C [Ω]	P/N	Feature	Status
650 V Vgs=18 V	0.055	SCTL35N65G2V	Gen2 with Kelvin source pin	In production
	0.018	SCTL90N65G2V		In production



life.augmented

SiC MOSFET in TO-LL

Designed for high-speed phase, high power, and more efficient server and telecom power systems



V_{DS}[V]	R_{DS}(on) typ @ 25°C [Ω], Vgs=18 V	Package	P/N	Eng. Samples	MAT 30
650 V	0.040	TO-LL	SCT040TO65G3	Available	Q2 2024
	0.055	TO-LL	SCT055TO65G3	Available	Q2 2024
	0.027	TO-LL	SCT027TO65G3	Available	Q2 2024
	0.014	TO-LL	SCT014TO65G3	Available	Q2 2024

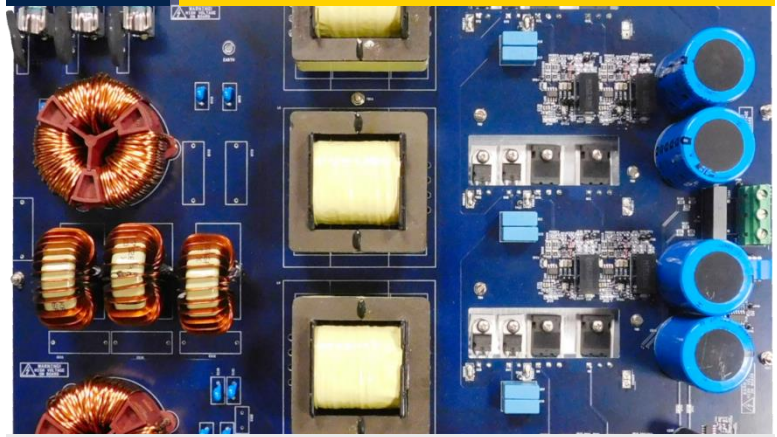
With Kelvin source

Suitable to be driven at Vgs=15 V

life.augmented

SiC reference designs

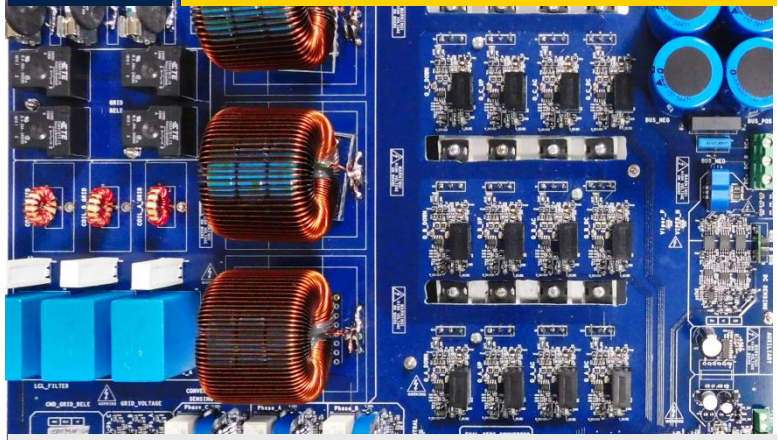
1 15 kW 3-phase Vienna rectifier



STDES-VIENNARECT
(Available on request)

For power factor correction based on SiC MOSFETS and the STNRG388A digital controller.

2 Industrial and EV fast charging



STDES-PFCBIDIR
(Available on request)

For three-phase AC/DC and DC/AC applications based on SiC MOSFETS and the STM32G474 MCU.

3 3.6 kW bridgeless totem pole boost

STEVAL-DPSTPFC1
(Available on direct order)

Achieves digital power factor correction (PFC) with inrush current limiter (ICL).

life.augmented

SiC reference designs

4 30 kW Vienna PFC rectifier

STDES-30KWVRECT
(Available on request)

For high-power three-phase active front-end (AFE) rectifier based on SiC MOSFETs and the STPSC40H12C.

5 7 kW bidirectional AC-DC converter

STEVAL-7BIDIRCB
(Available on request)

7 kW full SiC-based bidirectional totem pole PFC + CLLC converter.

6 Testing platform of SiC MOSFETs in HiP247-4

STDES-SICGP4
(Available on direct order)

Allows evaluating the switching and thermal performance of SiC power MOSFETs in HiP247-4 package.

life.augmented

Our technology starts with You

Find out more at www.st.com/stpower

life.augmented