

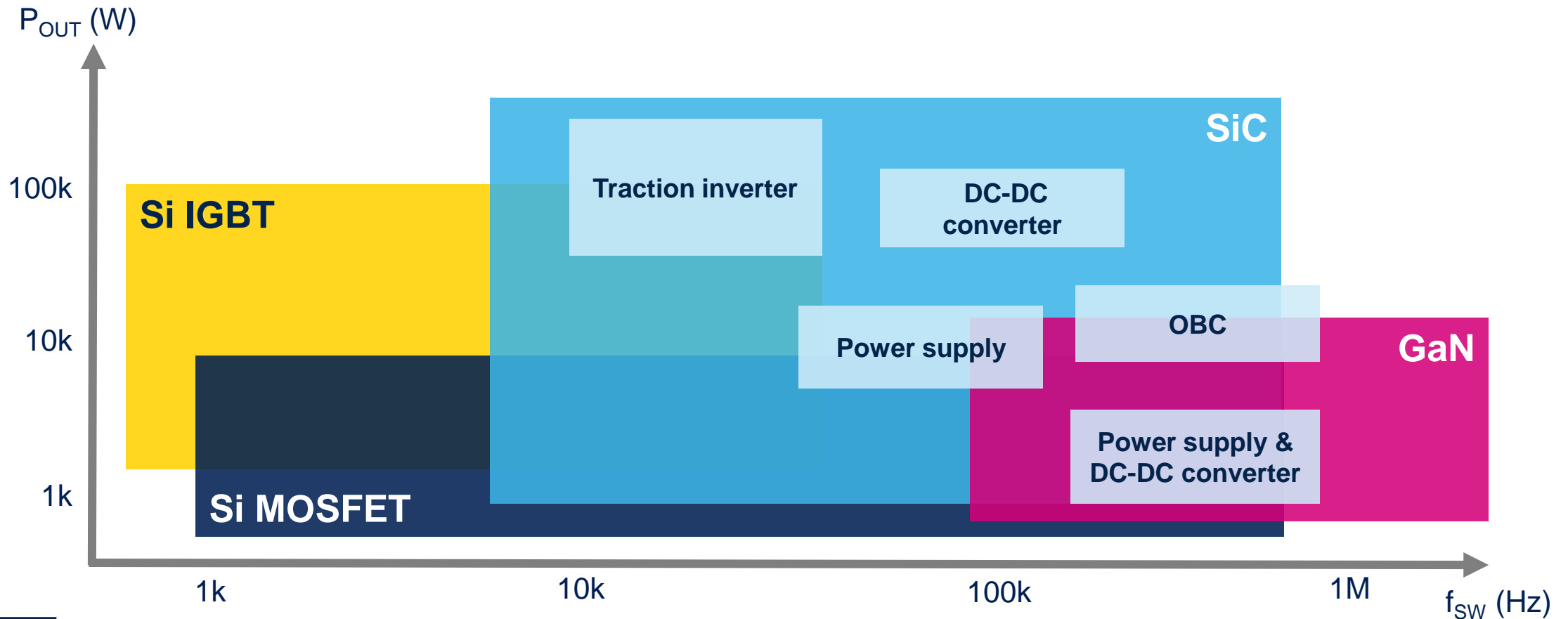


Introduction of ST SiC and HV MOFETs products

Elisa Chiang
Technical Marketing
Power & Discrete MKT and Applications
Taiwan, APeC Region

Power semiconductors for key applications

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



ST SiC MOSFET Solutions for Automotive



SiC MOSFET driving the next generation of energy solutions

Electric vehicle



On-board chargers
DC-DC converters
Traction inverters and E-compressor

Charging station



Industrial chargers
EV DC fast chargers
EV wireless chargers

Renewable energy



Solar inverters
Energy storage systems
Wind power

Power supplies



AC-DC server power supplies
Telecom AC-DC rectifiers
UPS

Available technologies:

1st Gen
1200V and 1700V

2nd Gen
650V, 1200V, 1700V

3rd Gen
650V, 1200V

4th Gen
750V, 1200V*

* Technology maturity by Q4/25

STPOWER SiC MOSFET families

The best high-voltage and high-frequency switches for high-density applications



Gen1
1200V-1700V

Very good **Ron vs. Tj** behavior: very suitable for motor drive applications

Gen2
650V, 1200V

Very Good Ron vs. Qg trade-off : highly suitable for a broad range of automotive and industrial **applications**

Gen3
650V, 750V, 900V, 1200V

An ultrafast series with the **best Ron vs. Qg trade off**: highly suitable for very high frequency applications & AG qualified

SiC VHV
2200V*

Very High Voltage SiC extends the advantages of SiC technology to higher voltage ranges

* industrial grade

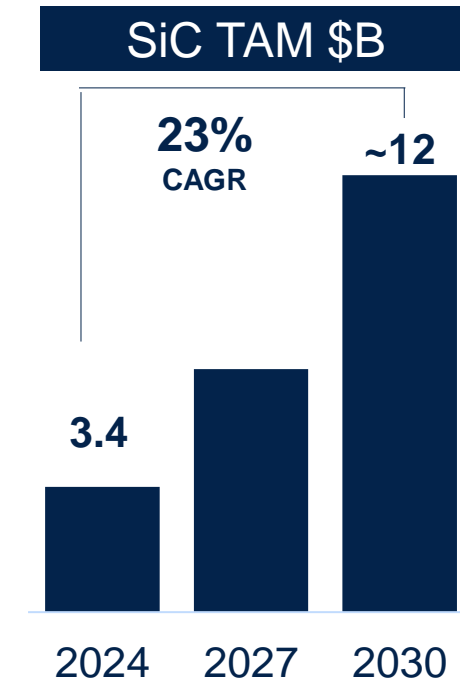


SiC MOSFET: the true R-evolution for high voltage power switches

ST is a pioneer and leader in silicon carbide

25+ years experience
Fourth generation of technology ramping

Gen1	Optimized Ron and Tj for motor drive applications
Gen2	Balanced Ron and Qg for industrial and automotive
Gen3	Lower Ron vs. Gen2 maximizes the driving range of EVs
Gen4	Reduced Ron vs. Gen3 tailored for traction inverter and high-Power Industrial applications
Gen5 (In R&D)	Innovative very high-power density technology for automotive and industrial



Integrated manufacturing model

Full vertical integration – from powder to module
Catania SiC Campus and ST-Sanan JV
Accelerating transition to 200 mm

Source: Omdia, Yole, ST

*including dice sales to other module makers

STPOWER SiC MOSFET

Product families and applications

Breakdown voltage

650 V

750 V/900 V

1200 V

1700 V

2200 V

Series

G2

G3

G3

G1

G2

G3

G1

VHV

On-state resistance

18 mΩ to
67 mΩ

14-55 mΩ

11 mΩ

52 mΩ to
520 mΩ

25 mΩ to
75 mΩ

15 mΩ to
70 mΩ

1 Ω and
65 mΩ

31 mΩ

Focus applications

OBC & DC-DC
Renewable energy
Power supply
Industrial drives

Traction
OBC & DC-DC
High density
power supply

Traction inverter
OBC & DC-DC
High density power
supply

Photovoltaic
Power supply

OBC & DC-DC
Inverter
Charging stations
Industrial drives

Traction inverter
OBC & DC-DC
HF power supply

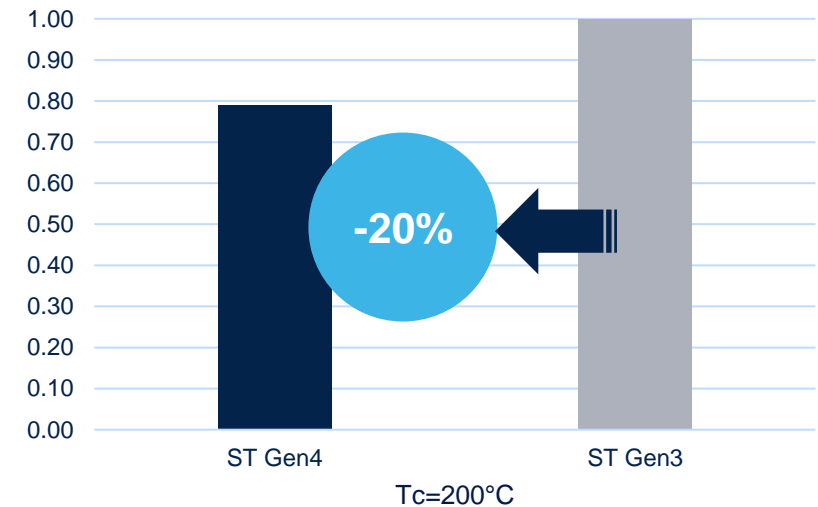
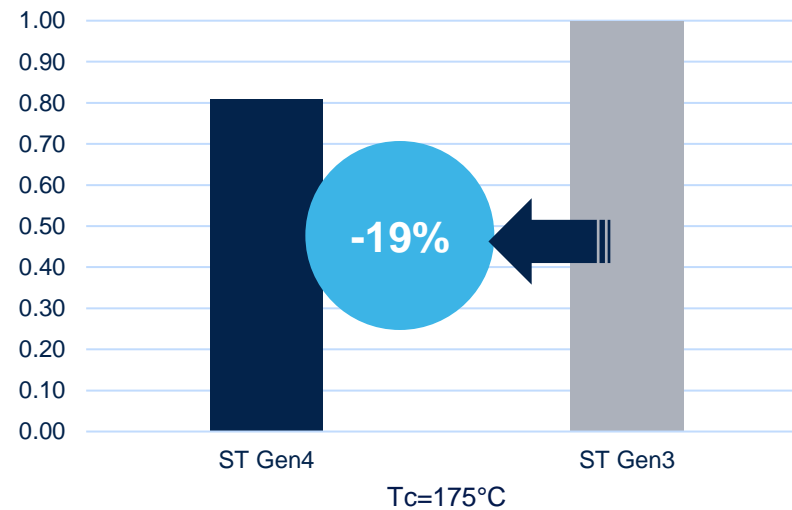
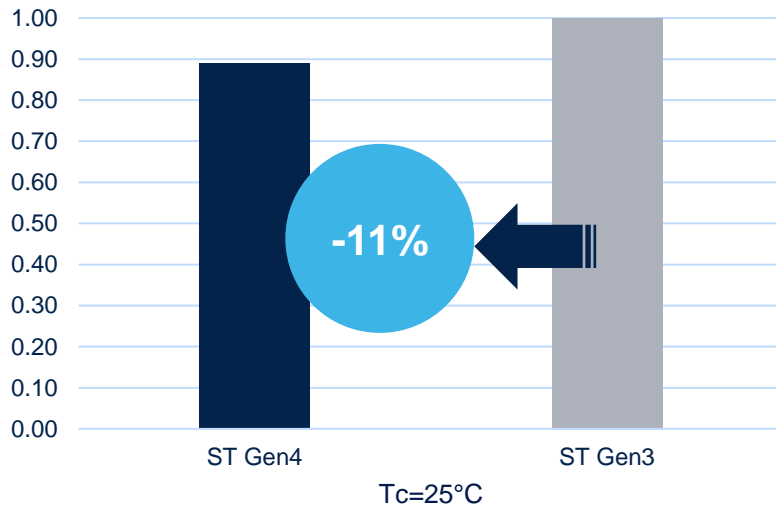
DC-DC
Power
supply
Renewable
energy

DC-DC
Power
supply
Renewable
energy

Gen4 vs Gen3 RDS(on) comparison

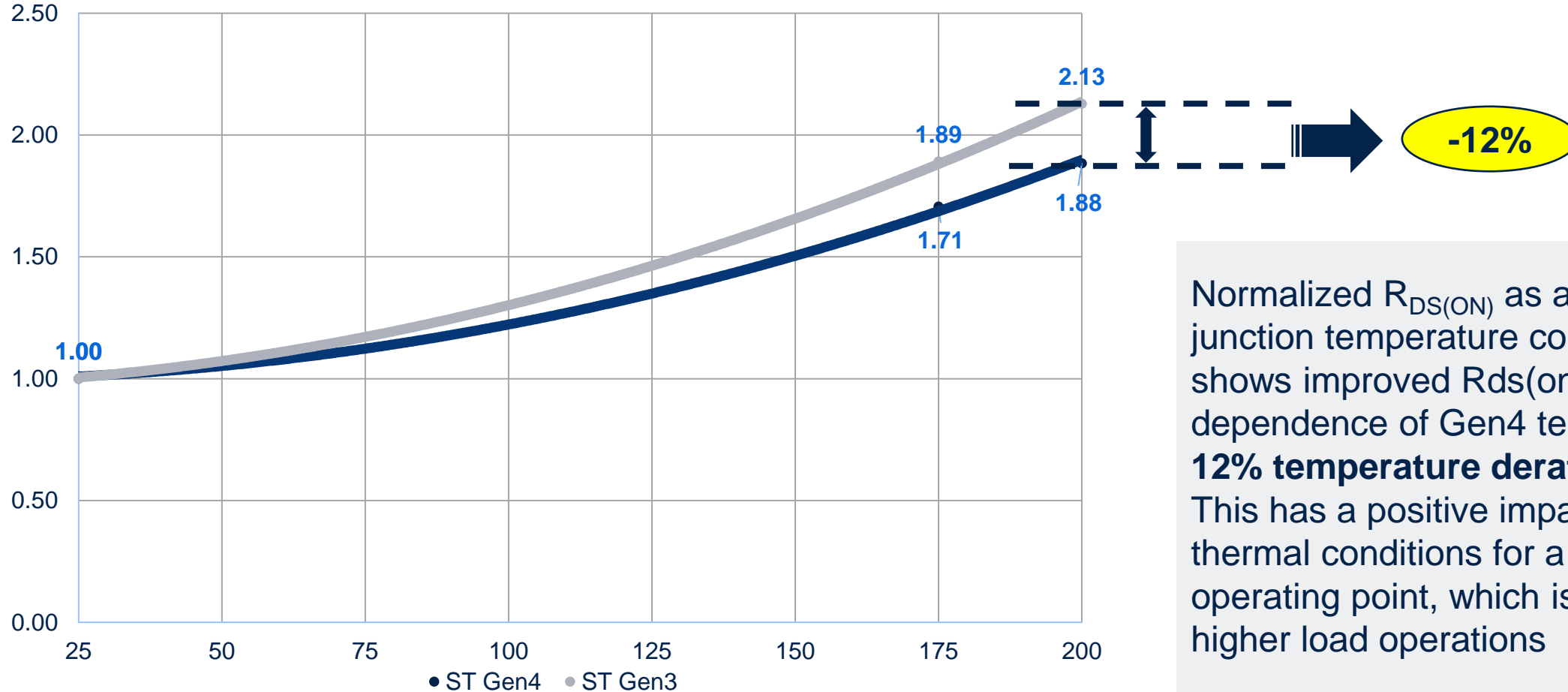
$R_{DS(on)}$ comparison based on same die size and layout (1200 V Gen4 19.6 mm² test vehicle)

Normalized $R_{DS(on)}$



RDS(ON) Comparison Trend over temperature ST Gen4 vs Gen3

$R_{DS(ON)}$ Temperature Trend, $V_{gs}=18V$

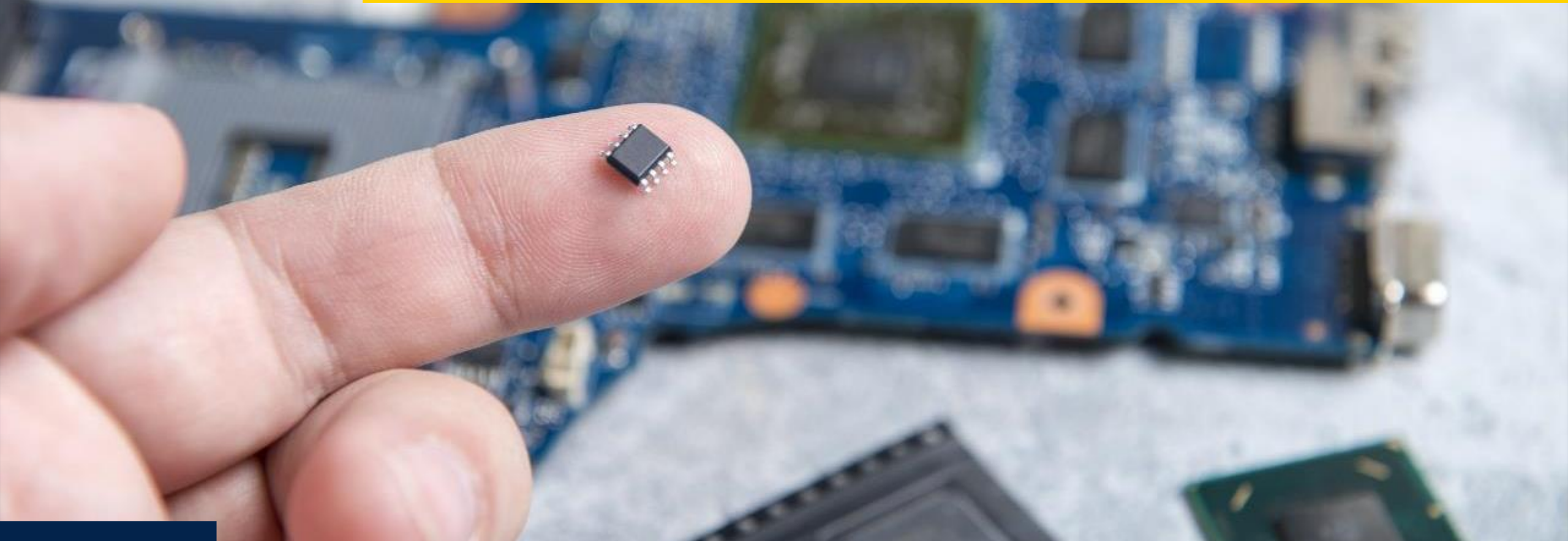


Normalized $R_{DS(ON)}$ as a function of junction temperature comparison shows improved $R_{ds(on)}$ temperature dependence of Gen4 technology: **-12% temperature derating @200°C**
This has a positive impact to the thermal conditions for a worst-case operating point, which is typically at higher load operations


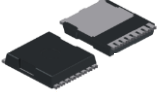








(1200V Gen4 19.6 mm² Test Vehicle)

SiC MOSFET packages

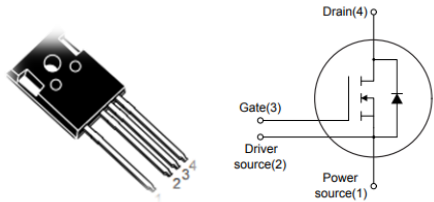


SiC MOSFET package technologies

Packages	PowerFLAT 8x8 STD & DSC	TO-LL	H2PAK-7L	HU3PAK	ACEPACK SMIT	HiP247 (3,4, long leads)	STPAK	Bare dice
								
Characteristics	Surface mounting					Through-hole	Special package solutions	
	<ul style="list-style-type: none"> Very thin (<1 mm) Well accepted in power conversion Dual side cooling option Leadless Industrial domain 	<ul style="list-style-type: none"> 2.4 mm (max) thickness Good Rthj-a performance Leadless Kelvin source for optimized driving Good thermal dissipation Industrial domain 	<ul style="list-style-type: none"> AG qualified at 175°C Kelvin source for optimized driving High runner for automotive customers High Creepage version under feasibility study 	<ul style="list-style-type: none"> AG qualified at 175°C Top side cooling Kelvin source for optimized driving Very good thermal dissipation High Creepage version under qualification 	<ul style="list-style-type: none"> AG qualified at 175°C Isolated top side cooling Suitable for different configurations (HB, dual die, etc.) High power Modular approach 	<ul style="list-style-type: none"> AG qualified at 200°C Kelvin source option for optimized driving High creepage version (1700 V) in development Very common industry standard 	<ul style="list-style-type: none"> Unique solution for traction inverter AG qualified at 200°C Very high thermal dissipation efficiency Sense pin for optimized driving Multisintered package 	<ul style="list-style-type: none"> WLBI & KGD T&R or RWF options Compliant with the most stringent automotive quality requirements

ST solution for SMPS and Server

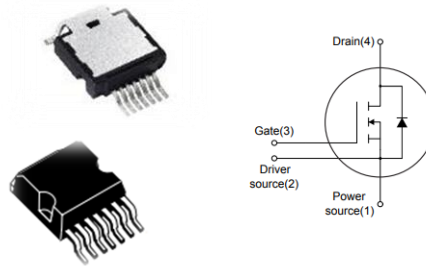
Increased power density through advanced package technologies



HiP247 3L & 4L
Wire bonding
technology

For DC-DC
converters

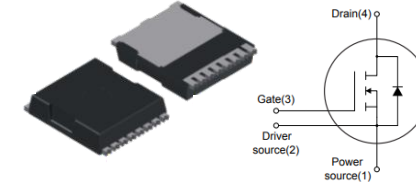
- AEC-Q101 qualified, T_j (max)=200 °C
- 650V / 1700V Voltage rated
- Product spec range from 15mΩ to 63 mΩ
- Sense pin for enhanced control



H2PAK 7L & HU3PAK
Bottom side and top
side cooling SMD
packages

AC/DC & DC-DC
converters

- AEC-Q101 qualified, T_j (max)=175 °C
- 650V / 1200V Voltage rated
- Product spec range from 11mΩ to 63 mΩ
- Sense pin for enhanced control



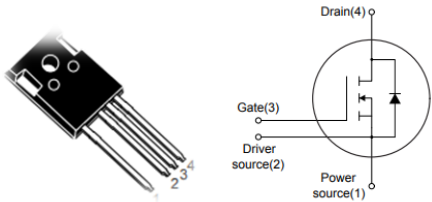
TOLL
Bottom side cooling
SMD packages

Totem Pole PFC
and SMPS

- Improved thermal performances
- Sense pin for enhanced control
- 650V Voltage rated
- Product spec range from 15 mΩ to 55 mΩ
- Configuration flexibility

ST SiC Gen3 solution for OBC & DC-DC

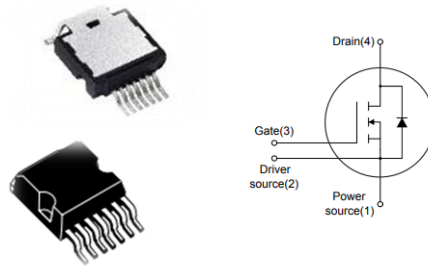
Increased power density through advanced package technologies



HiP247 3L & 4L
Wire bonding
technology

For DC-DC
converters

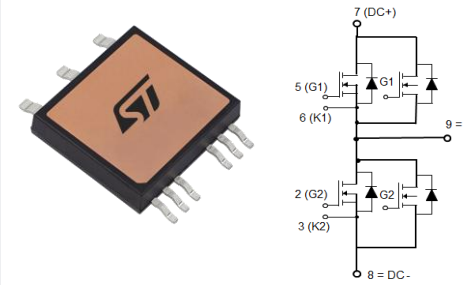
- AEC-Q101 qualified, T_j (max)=200 °C
- 650V / 1700V Voltage rated
- Product spec range from 15mΩ to 63 mΩ
- Sense pin for enhanced control



H2PAK 7L & HU3PAK
Bottom side and top
side cooling SMD
packages

OBC and DC-DC

- AEC-Q101 qualified, T_j (max)=175 °C
- 650V / 1200V Voltage rated
- Product spec range from 11mΩ to 63 mΩ
- Sense pin for enhanced control



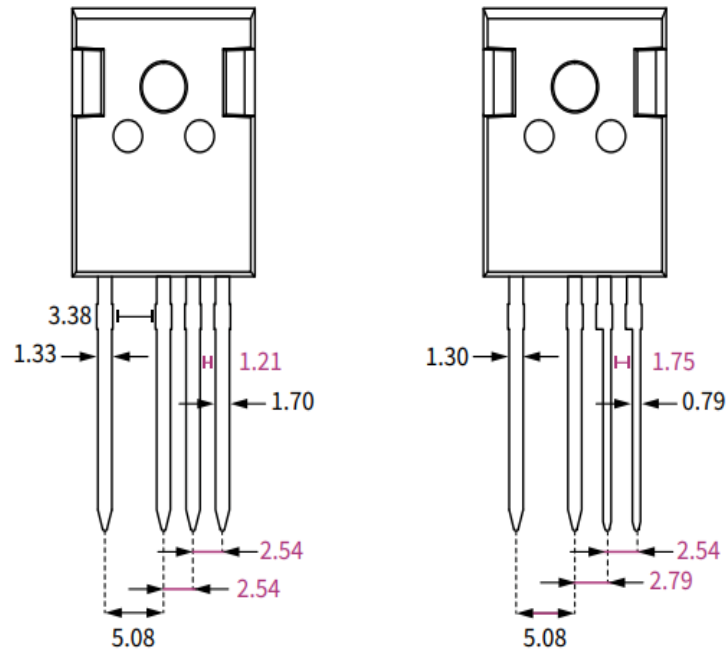
SMIT
Top side cooling SMD
package

OBC and DC-DC

- Improved thermal performances
- Sense pin for enhanced control
- 650V / 1200V Voltage rated
- Product spec range from 20 mΩ to 63 mΩ
- Configuration flexibility
- Insulation Voltage: 3.4 kVrms
- SMD with Isolated Top Side Cooling

TO247-4 Narrow Leads

Package option



TO247-4L NL

For Energy
management

- Improved version of the standard TO-247 4pin package to avoid Tin bridge when wave soldering.
- The TO-247 4pin with asymmetric leads comes with 0.54 mm increased creepage distance between the critical leads and enables smoother wave soldering and reduced board yield loss.
- ST is development two products for TO247-4 HC NL (11mΩ 1200V and 19mΩ 1200V)



ST package investigation/development

Increased power density through advanced package technologies



MAX247 HCC

For Very High Voltage range

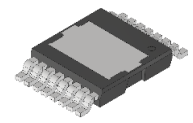
- 1700V / 2200V Voltage rated
- Sense pin for enhanced control
- High Creepage version
- Industrial Market



HU3PAK HC

OBC and DC-DC

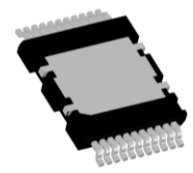
- 1700V Voltage rated
- Sense pin for enhanced control
- High Creepage version
- AEC-Q101 qualified, Tj (max)=175 °C



TOLT

Server and SMPS

- 650V Voltage rated
- Top side cooled
- Sense pin for enhanced control
- Creepage: 4.0mm
- 650 Vrms insulation in PD2

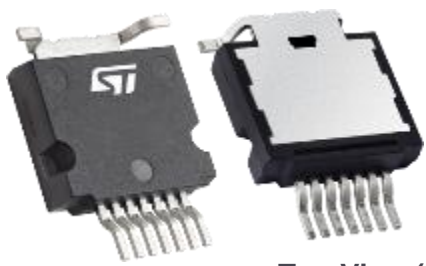


QDPAK

AI Server OBC and DC/DC

- 650V / 1200V Voltage rated
- Top side cooled
- Sense pin for enhanced control
- AEC-Q101 Rev.E





Top View (Heatsink Side)

HU3PAK

Innovative top-side cooling solution

High temperature capability
 $T_j(\text{max}) = 175^\circ \text{C}$

Improved Thermal Performances

Avoiding thermal conduction through PCB
 Optimizing heatsink form factor and efficiency

Improved thermal dissipation
 Top side cooling

Higher Efficiency enabler

A better T_j management permits to rise up system efficiency

Kelvin source pin
 SMD package

Enables higher efficiency

Enables more compact systems

Higher creepage distance

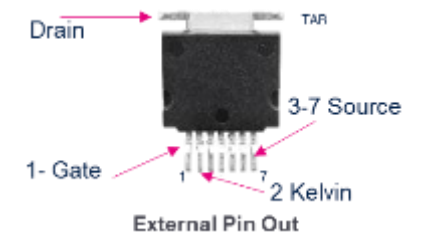
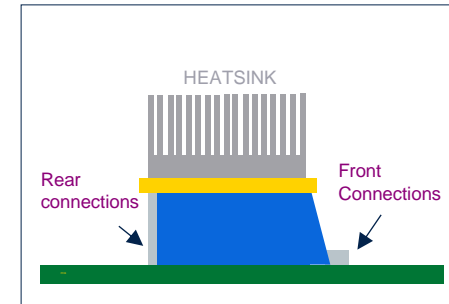
Electric arc prevention

Better isolation to pass safety regulations

Adopting a planar and simple heatsink

BOM Cost Reduction

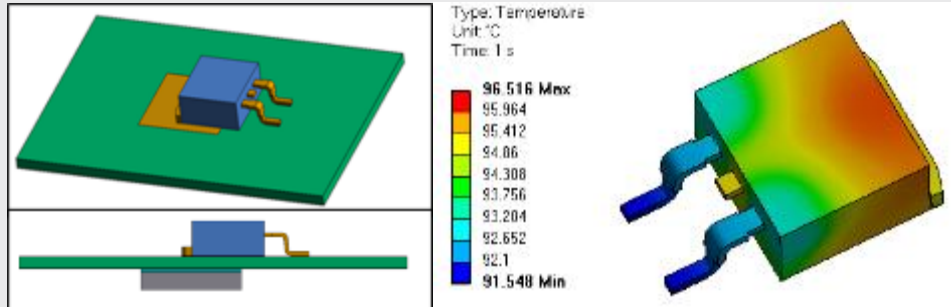
Using a simple FR-4 PCB instead of an expensive IMS one



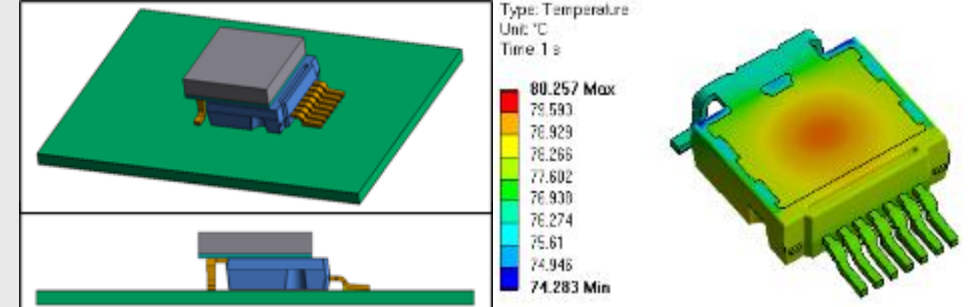
Outperforming alternative to D2PAK / H2PAK-7

Thermal map @ full load

D²PAK bottom cooling



HU3PAK top-side cooling



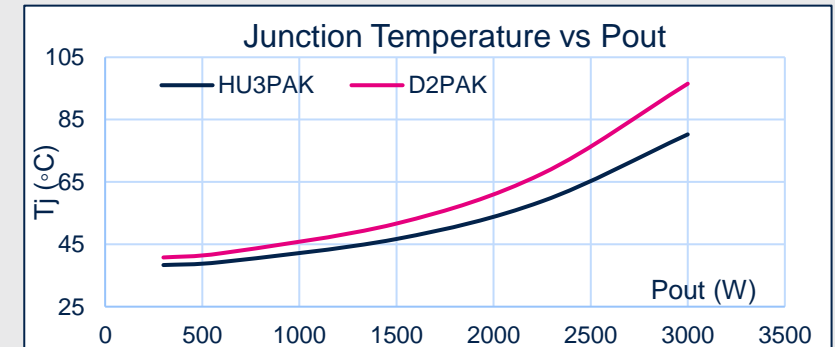
Same heatsink positioned on

- D²PAK bottom side of the PCB trough thermal vias
- HU3PAK directly on the top exposed copper frame

	HU3PAK	D ² PAK	
$R_{th(J-H)}$ (°C/W)	8.91	10.47	-15%
$R_{package}$ (mΩ)	80	80	//



Losses in 3kW FB LLC			
	D ² PAK	HU3PAK	
P_{die} (W)	0.578	0.568	@ Pout 300 W
T_j (°C)	40.7	38.4	- 2.3°C
P_{die} (W)	5.908	5.275	@ Pout 3 kW
T_j (°C)	96.52	80.26	-16.26°C



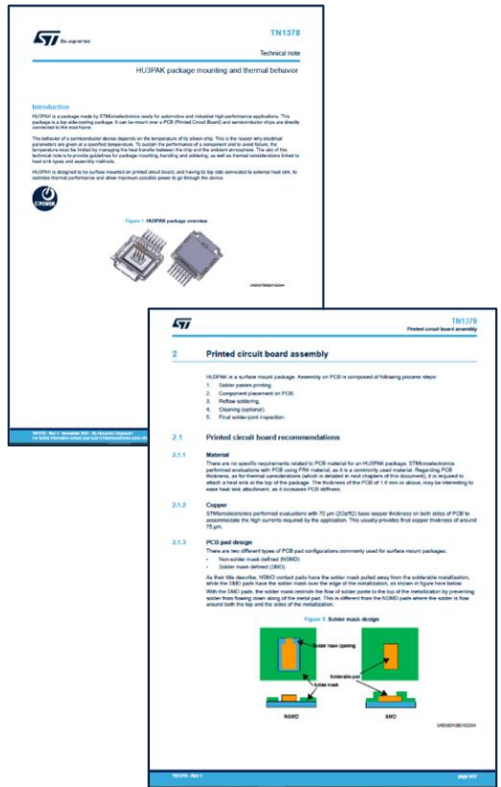
Top-side cooling solution improves heat dissipation capability keeping the same heat sink and PCB, allowing lower T_j .

Coldest device works with lower $R_{DS(on)}$ lowering the conduction losses



HU3PAK mounting instructions & thermal management

Title	Type	Icon
TN1378: HU3PAK package mounting and thermal behavior	Technical Note	PDF

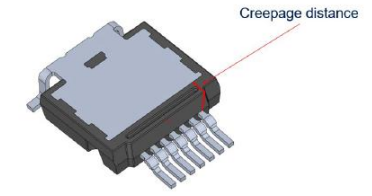
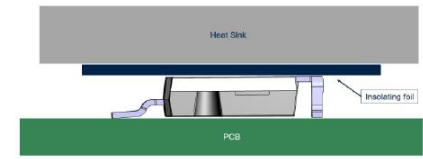


Top side cooling can best be mounted with soft gap filler or liquid gap filler for optimal performances

Gap filler comes with different thermal conductivity that play an important role on Rth and thermal management

Many thermal compounds are available on the market that may provide good results:

Figure 17. Creepage distance in HU3PAK on uncemented insulating foil

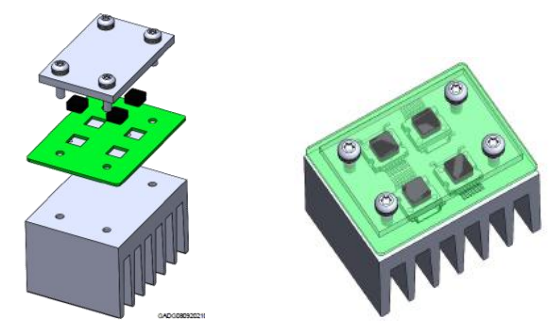


GAD0021120211341

Depending on the pollution degree and the material group of the resin, the maximum rms voltage that can be withstood by the package is defined in the table below:

Table 4. Maximum rms voltage capability with a creepage distance of 3.7 mm

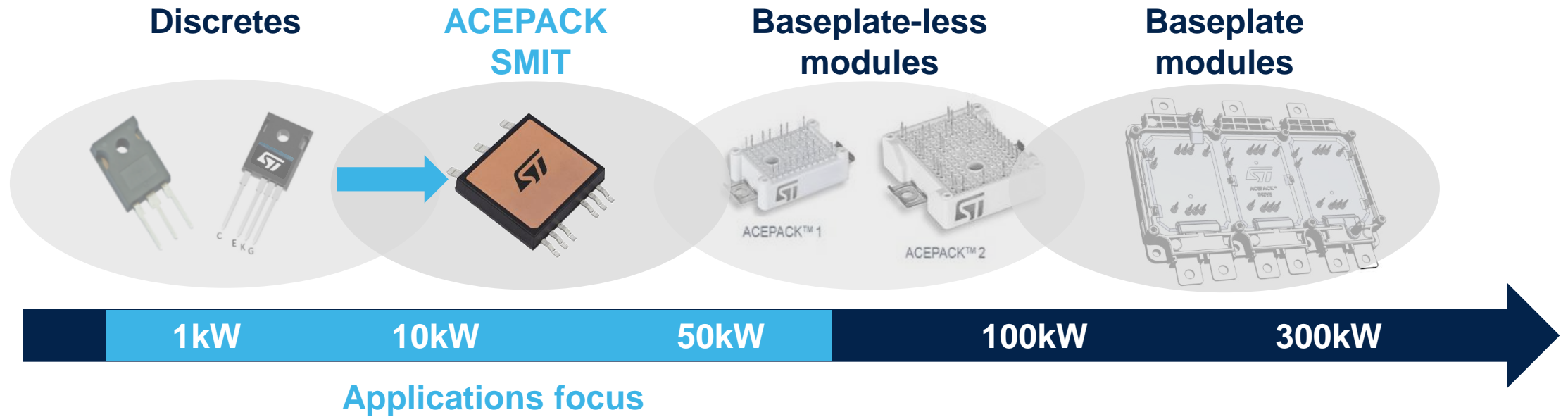
Pollution degree	Material group	Max rms voltage
1	I and II	1070 V
2	II	515 V



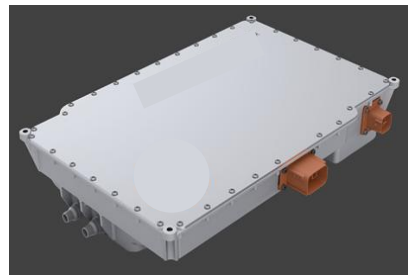
Example of heat sink assembly with counter plate



Innovation in power conversion



Data center power



Onboard charger



EV charger

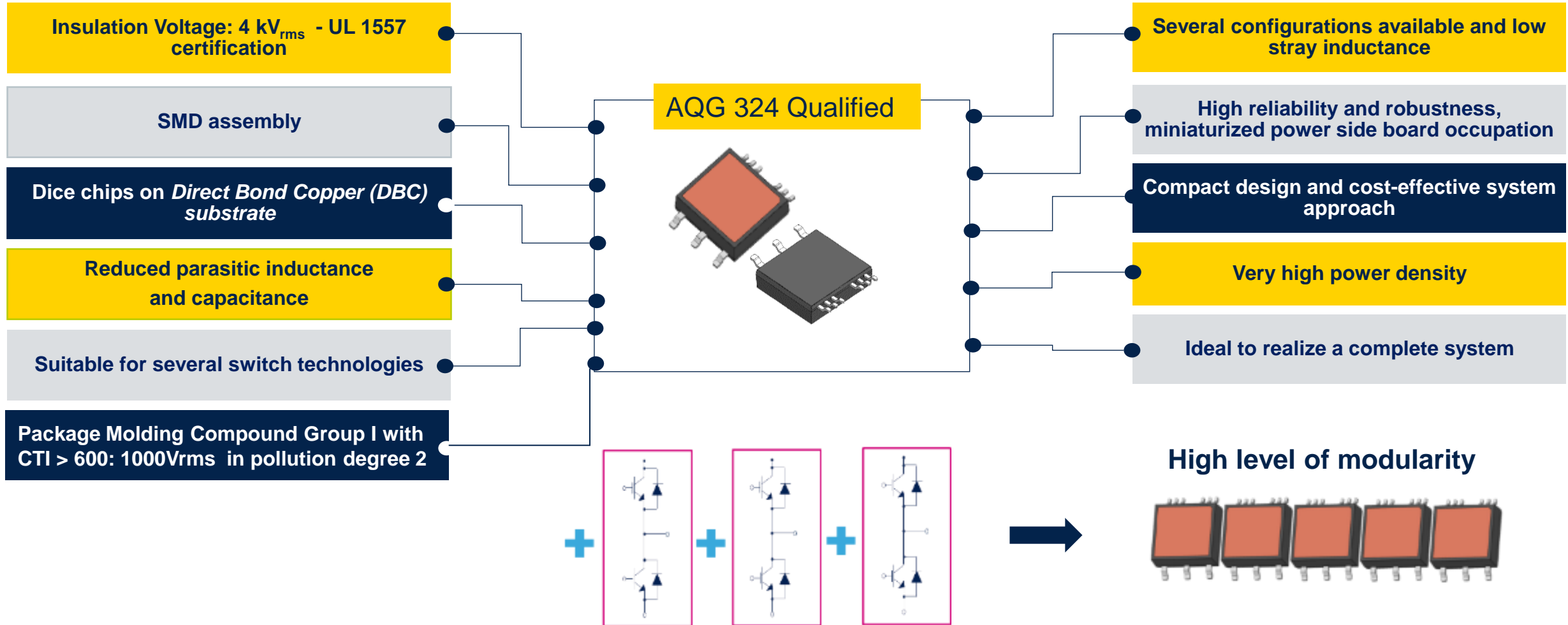


Electric storage



Solar energy

Why ACEPACK SMIT?

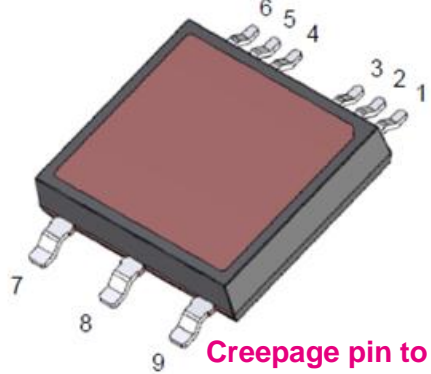


Why SMIT?

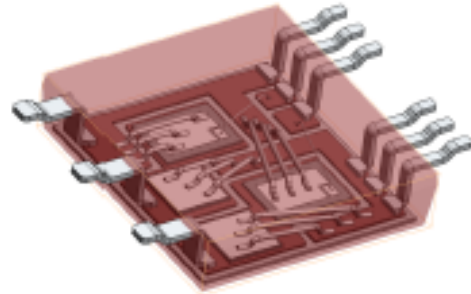
Surface-mounted isolated top-side cooled package

It looks like a discrete... But it is a module!

Creepage pin to top : 5mm



Creepage pin to pin: 7 mm



- is molded
- has a leadframe
- is an SMD
- is available in T&R*

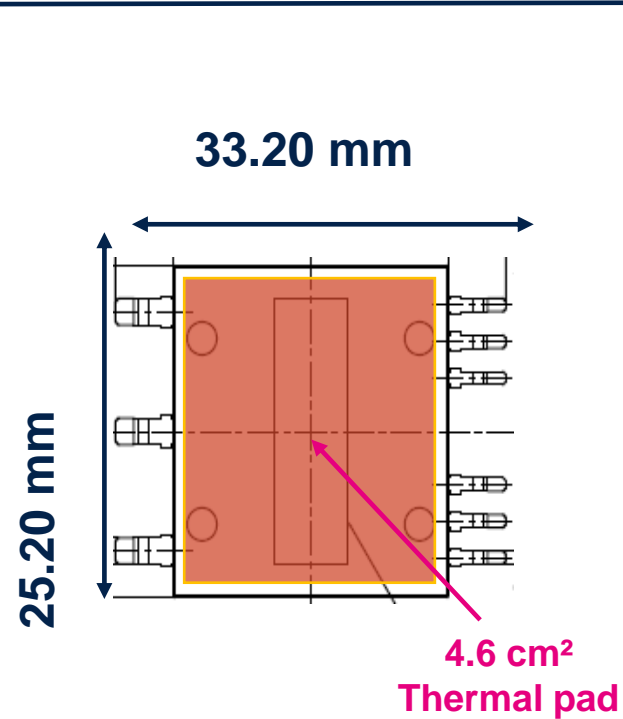
- contains a DBC**
- has integrated dice forming simple topologies
- has an isolated thermal pad

* Tape and reel

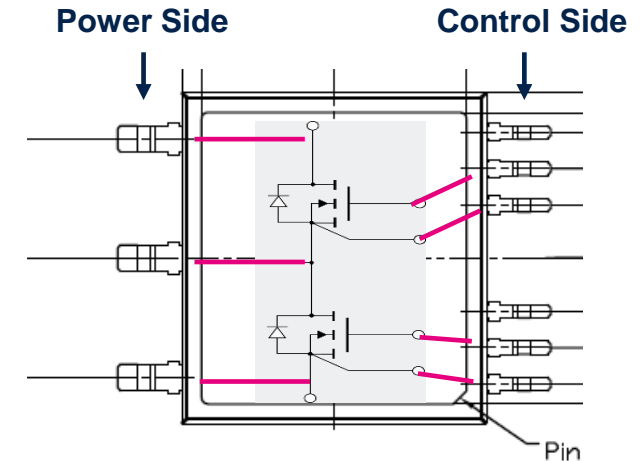
** Direct Bond Copper



Dimensions

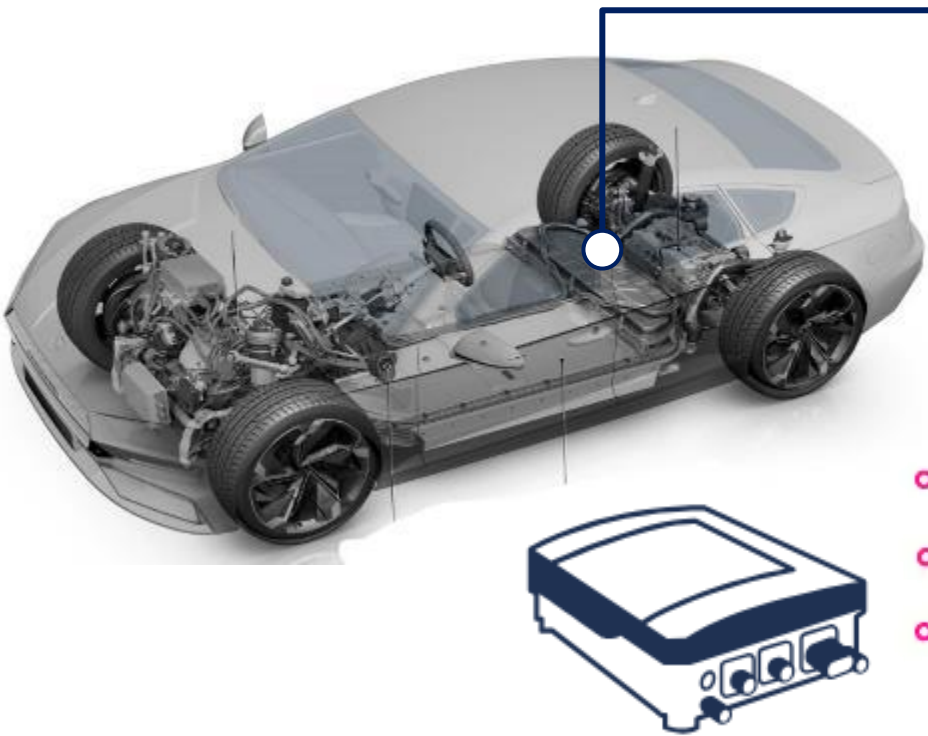


Pin-out

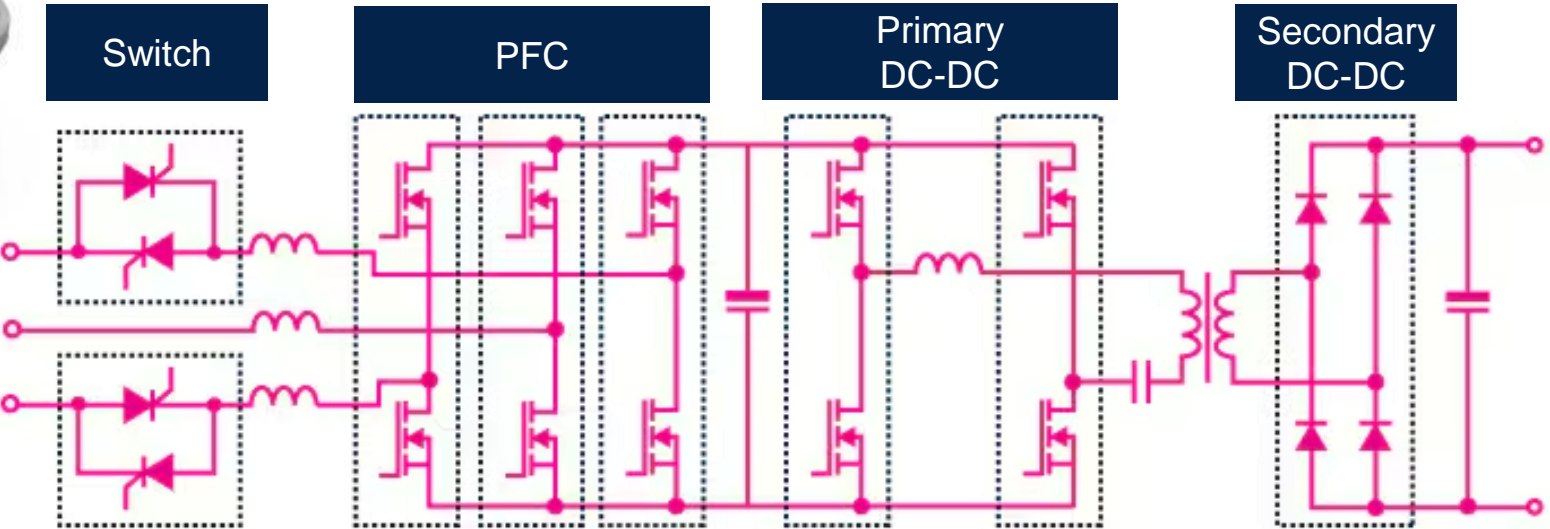


- This assembly is merely illustrative. Pin connections in real products may differ
- In rectifiers the control pins might also be used for power

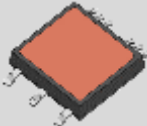
Full ACEPACK SMIT solution for OBC platforms

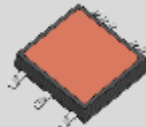


Onboard charger Typical application schematic

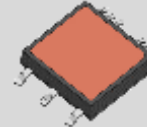


400 V battery platform

- 2x 

STTN6050H-12M1Y
- 3x 

STGSH80HB65DAG
- 2x 

SH68N65DM6AG
- 1x 

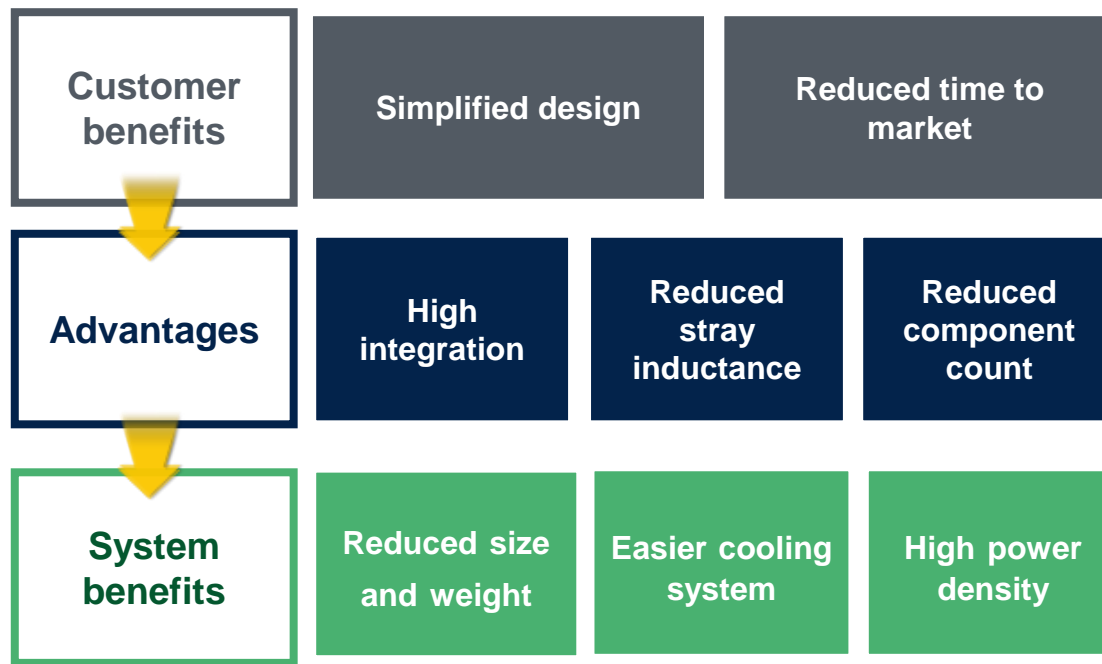
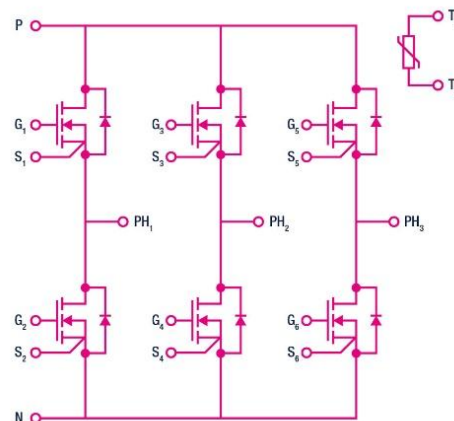
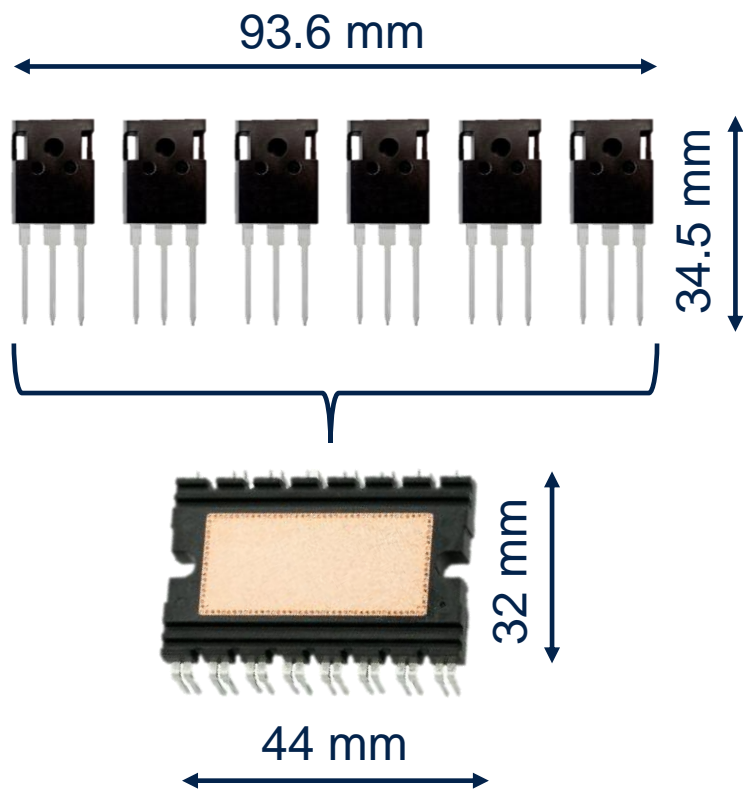
STTH60RQ06-M2Y



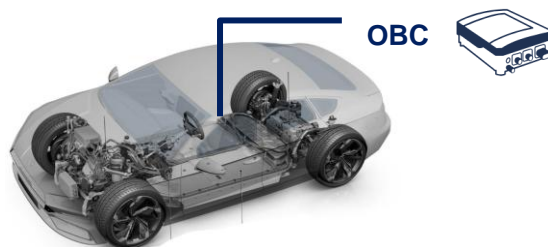
8 ACEPACK SMITs replacing 18 discrete devices

ACEPACK DMT-32 power modules features & benefits

Sixpack configuration

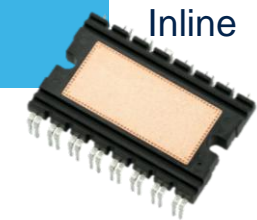


Power modules offer very high-power capability and customized solution

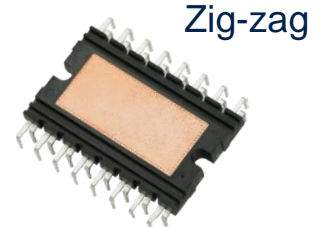


ACEPACK DMT-32

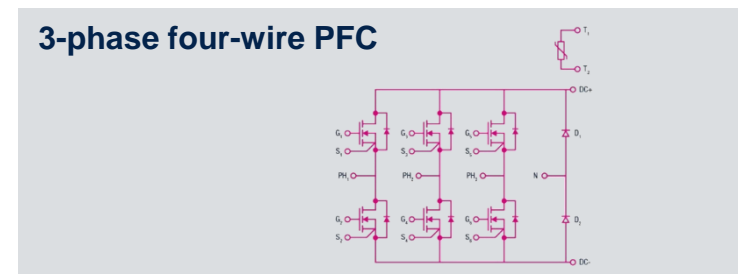
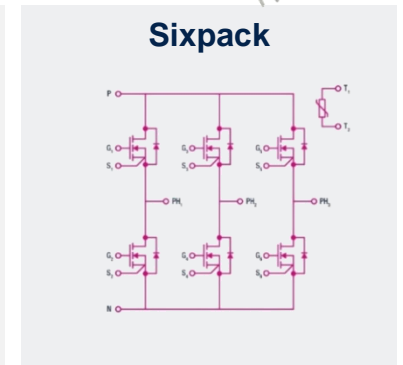
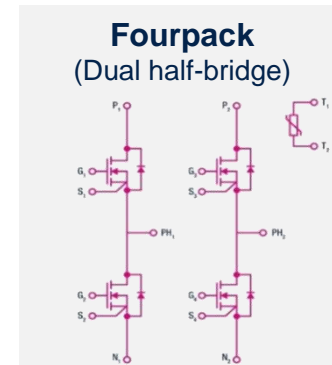
Power modules with 1200 V SiC Gen2 and Si-based bridge diode rectifier



Inline



Zig-zag



Topology	Part number	Dice	Pin option	$R_{DS(on)}$ typ (per switch)	DBC	ES	QS ⁽¹⁾	SOP
Fourpack (Dual half bridge)	M1F80M12W2-1LA	SiC	Inline	80 mΩ	AIN	-	-	MP
	M1F45M12W2-1LA	SiC	Inline	45 mΩ	AIN	-	-	MP
3-phase four-wire PFC	M1TP80M12W2-2LA	SiC & Si(*)	Inline	80 mΩ	AIN	-	-	MP
	M2TP80M12W2-2LA	SiC & Si(*)	Zig-zag	80 mΩ	AIN	-	-	MP
Sixpack	M1P45M12W2-1LA	SiC	Inline	45 mΩ	AIN	-	-	MP
	M2P45M12W2-1LA	SiC	Zig-zag	45 mΩ	AIN	-	-	MP

ACEPACK DMT-32 SiC Gen3 based power modules

BV	Topology	Part Number	Pin option	$R_{DS(on)}$ typ (per switch)	DBC	ES ^(1,2)	QS ⁽²⁾	SOP
1200V	Four-Pack (Full-Bridge)	M2F40M12W3-2LA	Zig-Zag	40mΩ	AIN	Sep '26 ^(*)	Nov '26	Dec '26
		M2F30M12W3-2LA	Zig-Zag	27,5mΩ	AIN	Sep '26 ^(*)	Nov '26	Dec '26
	Six-Pack	M2P70M12W3-1LA	Zig-Zag	70mΩ	AIN	Now	Jan '26	Feb '26
		M2P40M12W3-1LA	Zig-Zag	40mΩ	AIN	Oct '25	Jan '26	Mar '26
	Four-Pack + Half-Bridge	M2FH32M12W3-1LA	Zig-Zag	4x30 + 2x20mΩ	AIN	Sep '26	Nov '26	Dec '26

(*): Contact division for early ES

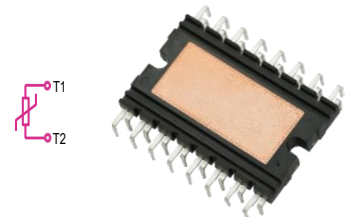
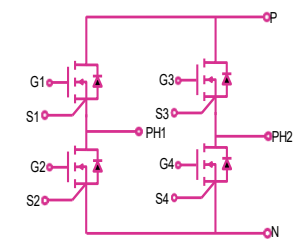
BV	Topology	Part Number	Pin option	$R_{DS(on)}$ typ (per switch)	DBC	ES ^(1,2)	QS ⁽²⁾	SOP
650V	Six-Pack	M2P20M65W3-1LA	Zig-Zag	20mΩ	AIN	Aug '26 ^(*)	Sep '26	Oct '26

(*): Contact division for early ES

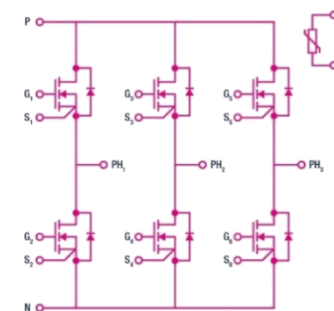
- 1) Limited qty
- 2) Lead Time applies

Zig-zag

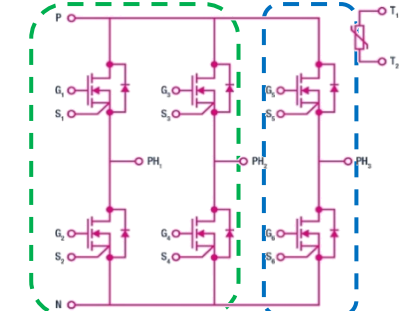
Four-Pack (Full Bridge)



Six-Pack



FourPack + Half-Bridge



ST HV Solutions for automotive



Design trends OBC, DC-DC converters, and batteries



On-board charger (OBC)

- Increased power options: 3-phase 11 kW/22 kW and single phase 7 kW
- Increased power density
- Bidirectional for V2G, V2L, V2H, V2V
- Maximized efficiency to reduce charging time



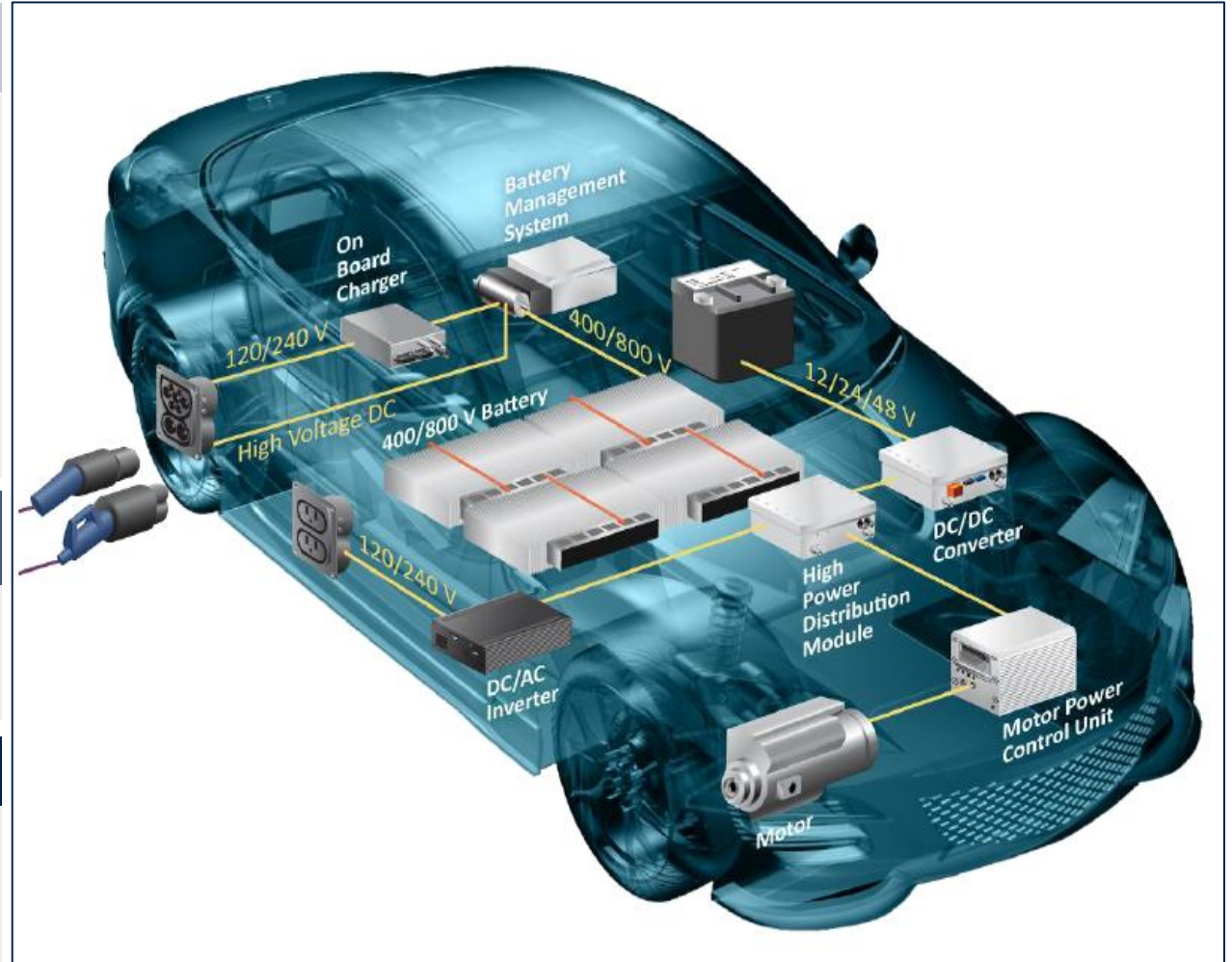
DC-DC converter

- Higher efficiency conversion
- Combination of DC-DC and OBC in one box



Battery

- HV options 400V and 800V
- LV options 12V, 24V and 48V





HV Si MOSFETs for car electrification



Onboard chargers

- MDmesh M5/M2/M6 (600, 650 V)
- MDmesh DM2/DM6/**DM9** (600, 650 V)



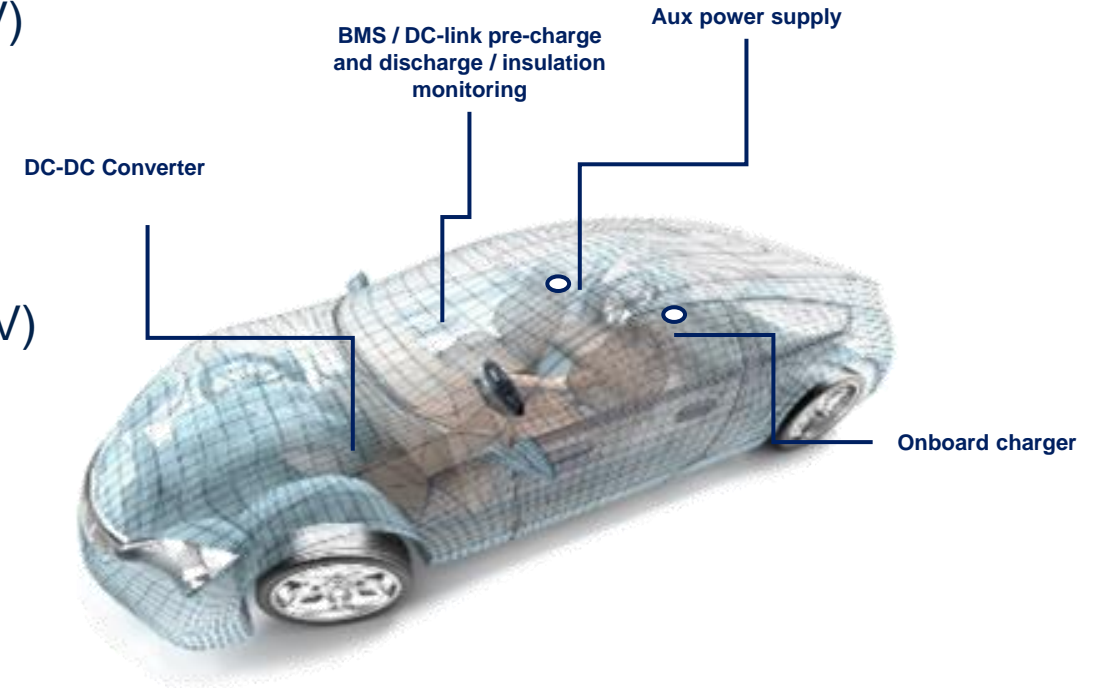
DC-DC converters

- MDmesh DM2/DM6/**DM9** (600, 650 V)

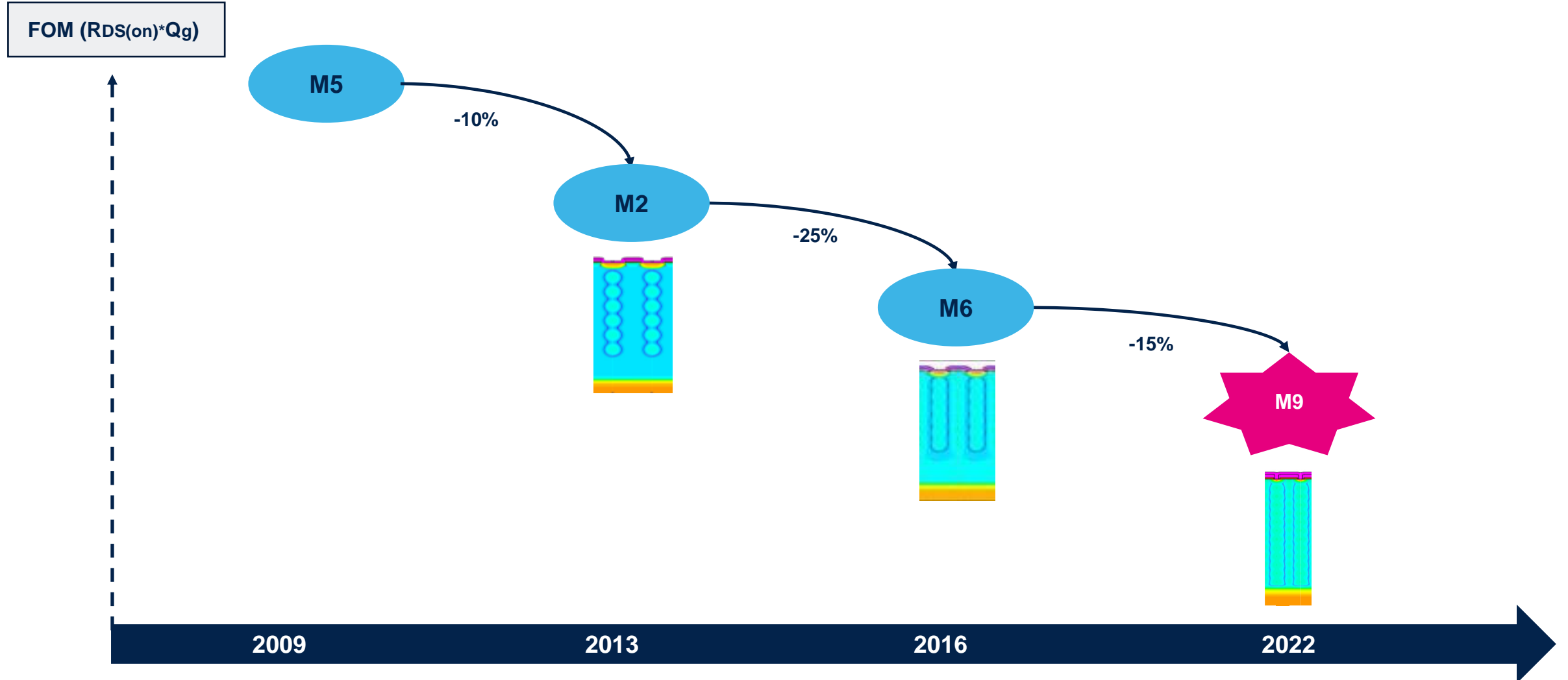


BMS / auxiliaries

MDmesh K5 (800, 950, 1200 V)



Automotive high-voltage ($\leq 650\text{V}$) MOSFETs Superjunction Technology FoM evolution



From DM2 & DM6 to DM9 AG

Comparison of Best RDS(on) (600/650 V tech)



DM2 = 93 mΩ



DM6 = 80 mΩ



DM9 = 46 mΩ

Best R_{DS(on)} (*)

(*) BVDSS=600V



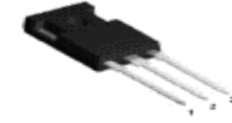
DM6 = 97 mΩ



DM9 = 50 mΩ

Best R_{DS(on)} (**)

(**) BVDSS=650V



DM2 = 50 mΩ



DM6 = 39 mΩ



DM9 = 23 mΩ

Best R_{DS(on)} (**)

(**) BVDSS=650V



Automotive-grade high voltage MDmesh DM6/DM9 600V/650V OBC and DC-DC

High-voltage MDmesh DM9 & DM6 series with embedded fast diode

600 V
STB47N60DM6AG
 $R_{DS(on)} = 0.080 \Omega$

650 V
STW68N65DM6-4AG
 $R_{DS(on)} = 0.039 \Omega$

650 V
STB30N65DM6AG
 $R_{DS(on)} = 0.110 \Omega$

650 V
STHU32N65DM6AG
 $R_{DS(on)} = 0.097 \Omega$

650 V
SH68N65DM6AG
 $R_{DS(on)} = 0.041 \Omega$
2 MOSFETs in HB configurations

600 V
STH60N099DM9-2AG
 $R_{DS(on)} = 0.099 \Omega$

600/650 V
STHU60N046DM9AG
 $R_{DS(on)} = 0.046 \Omega$

600/650 V
STHU65N050DM9AG
 $R_{DS(on)} = 0.050 \Omega$

600/650 V
STHU65N110DM9AG
 $R_{DS(on)} = 0.110 \Omega$

600/650 V
STH65N050DM9-7AG
 $R_{DS(on)} = 0.050 \Omega$

650 V
*STH65N110DM9-7AG
 $R_{DS(on)} = 0.110 \Omega$
*under development

New in production!

New In Production!

DC-DC converter

Onboard charger

The most complete series: 600 & 650 V

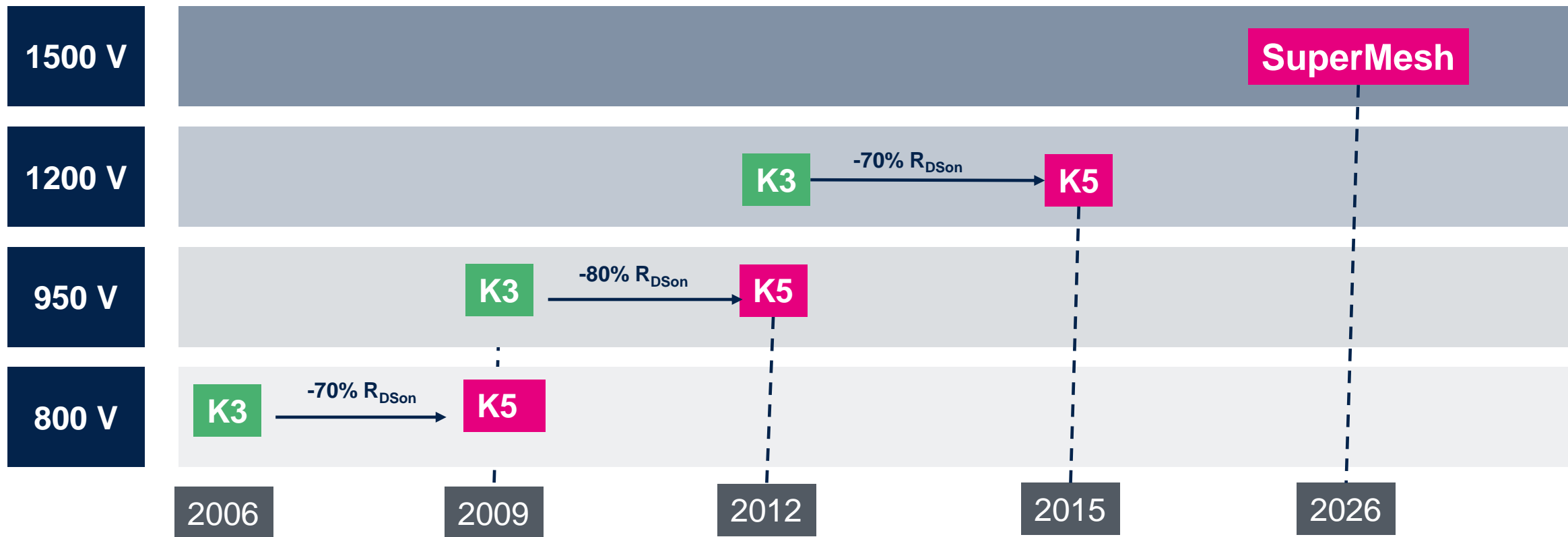
Targeting higher power density and compactness in OBC and DC-DC converters

Automotive-grade qualified

Die selling on request



Very high voltage ($\geq 800\text{V}$) automotive MOSFETs BV and $R_{\text{DS(on)}}$ evolution





VHV automotive-grade MDmesh MOSFETs for BMS, aux traction inv, & DC Link



Leader in very-high-voltage MOSFETs with MDmesh K5 series

650V
PowerFLAT 5x6

STL7LN65K5AG
 $R_{DS(on)} = 1.15 \Omega$

950V

STW22N95K5
 $R_{DS(on)} = 0.330 \Omega$

950V

STD7N95K5AG
 $R_{DS(on)} = 1.25 \Omega$

1200V

STH2N120K5-2AG
 $R_{DS(on)} = 10 \Omega$

1200V

STH13N120K5-2AG
 $R_{DS(on)} = 0.690 \Omega$

1200V

STH8N120K5-2AG
 $R_{DS(on)} = 2.0 \Omega$

BMS

New In Production!

1200V

STH8N120K5-2AG
 $R_{DS(on)} = 2.0 \Omega$

H2PAK High Creepage version

1200V

***ST2H8N120K5AG**
 $R_{DS(on)} = 2.0 \Omega$

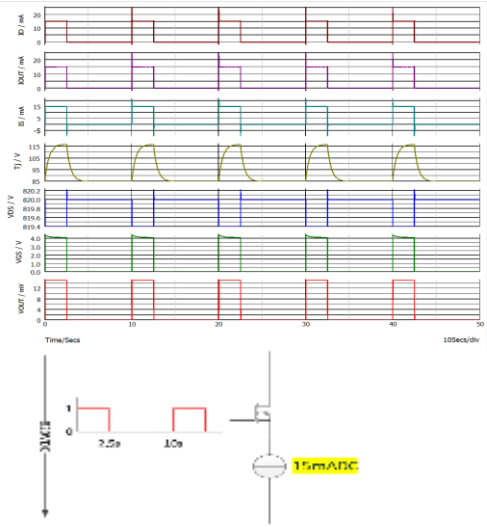
1500V

***STH4N150-2AG**
 $R_{DS(on)} = 10 \Omega$

✓ **The most complete series for VHV MOSFET (from 650 up to 1200 V)**

✓ **Targeted for Flyback topologies**

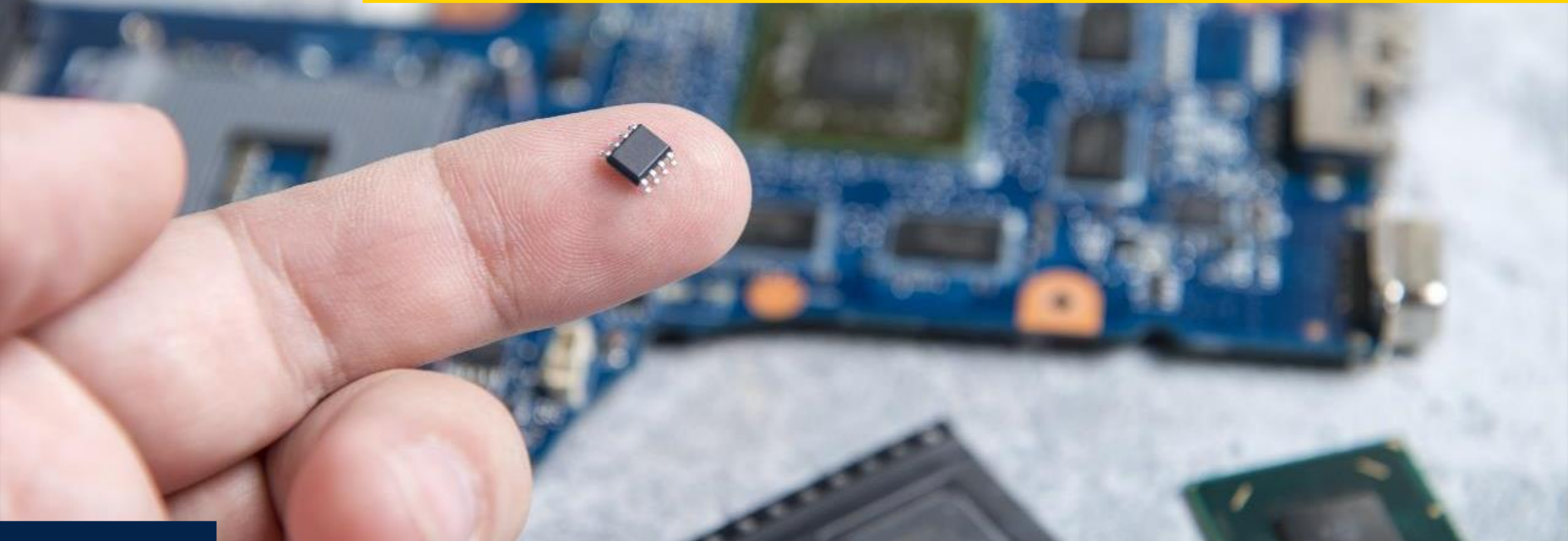
- **Linear-Mode safe operation**
 - Accurate electro-thermal SPICE models
 - Verified with dedicated tests on application
 - Detailed "customer support" for dedicated application needs



ST Confidential

*under development

ST HV MOSFET packages



High-voltage automotive power MOSFET packages

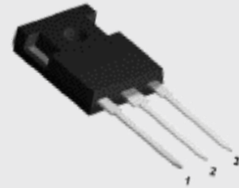
Through-hole



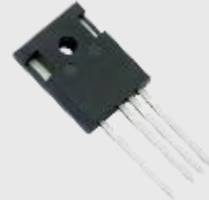
TO-220



TO-247



TO-247 LL



TO247-4L

SMD



D²PAK



H2PAK-2L



DPAK



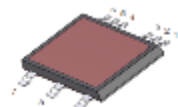
H2PAK-7L



H2PAK-2
high creepage



5x6 VHV

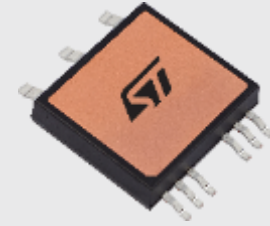


ACEPACK SMIT

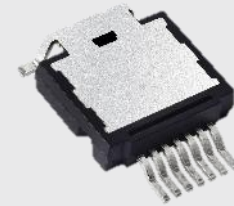


HU3PAK

ACEPACK SMIT package



HU3PAK package



H2PAK-2L high creepage (on development)



STPOWER MOSFET HU3PAK TSC product portfolio and plan



600V, 650V MDmesh HU3PAK- Automotive

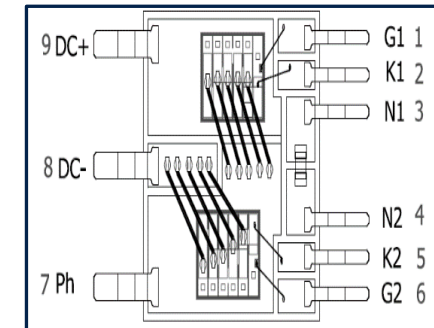
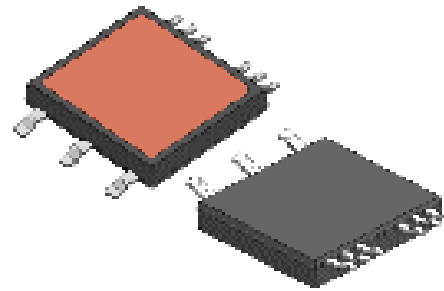


$BV_{DSS}[V]$	Max $R_{DS}[\Omega]$	Max $I_D[A]$	Qg[nC]	Sales type	Technology	Samples available	Production
600	0.099	29	46	STHU36N60DM6AG	MDmesh DM6	Available	Production
	0.080	36	55	STHU47N60DM6AG	MDmesh DM6	Available	Production
	0.046	54	94	STHU60N046DM9AG	MDmesh DM9	Available	Production
650	0.110	26	46	STHU65N110DM9AG	MDmesh DM9	Available	Production
	0.097	37	55	STHU32N65DM6AG	MDmesh DM6	Available	Production
	0.050	51	100	STHU65N050DM9AG	MDmesh DM9	Available	Production



STPOWER MOSFET SMIT Package product portfolio and plan

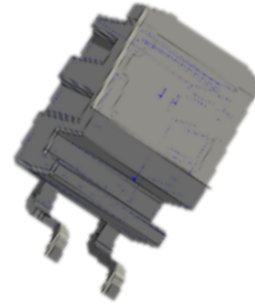
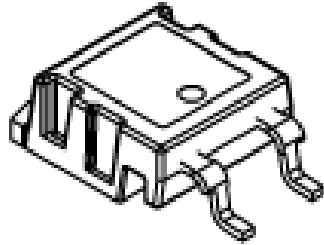
MDmesh ACEPACK SMIT for Automotive						
BV_{DSS} [V]	$R_{DS(on)}$ [Ω]	I_d max [A]	Techno	Sales Type	Samples	Production
650	0.097	32	MDmesh DM6	SH32N65DM6AG	Available	Production
	0.064	53	MDmesh DM6	SH63N65DM6AG	Available	Production
	0.041	64	MDmesh DM6	SH68N65DM6AG	Available	Production



Two MOSFETs connected in half-bridge topology

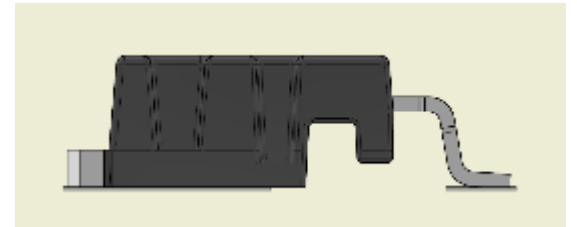
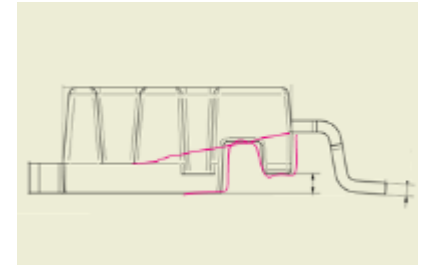


AG 1200V SJ K5 in H2PAK-2L Standard & high-creepage packages



ST2H8N120K5AG

- ES available
- Full Production in Jan 2026



Benefits

- Increased creepage and clearance by new design
 - ✓ Creepage = 7.8 mm (latest release) will allow insulation up to 1500V by group 1 resin
- No need of coating/potting additional step



ST Plan to enlarge HC portfolio also with 1500V BV_{DSS} solution.

Our technology starts with You



Find out more at www.st.com

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