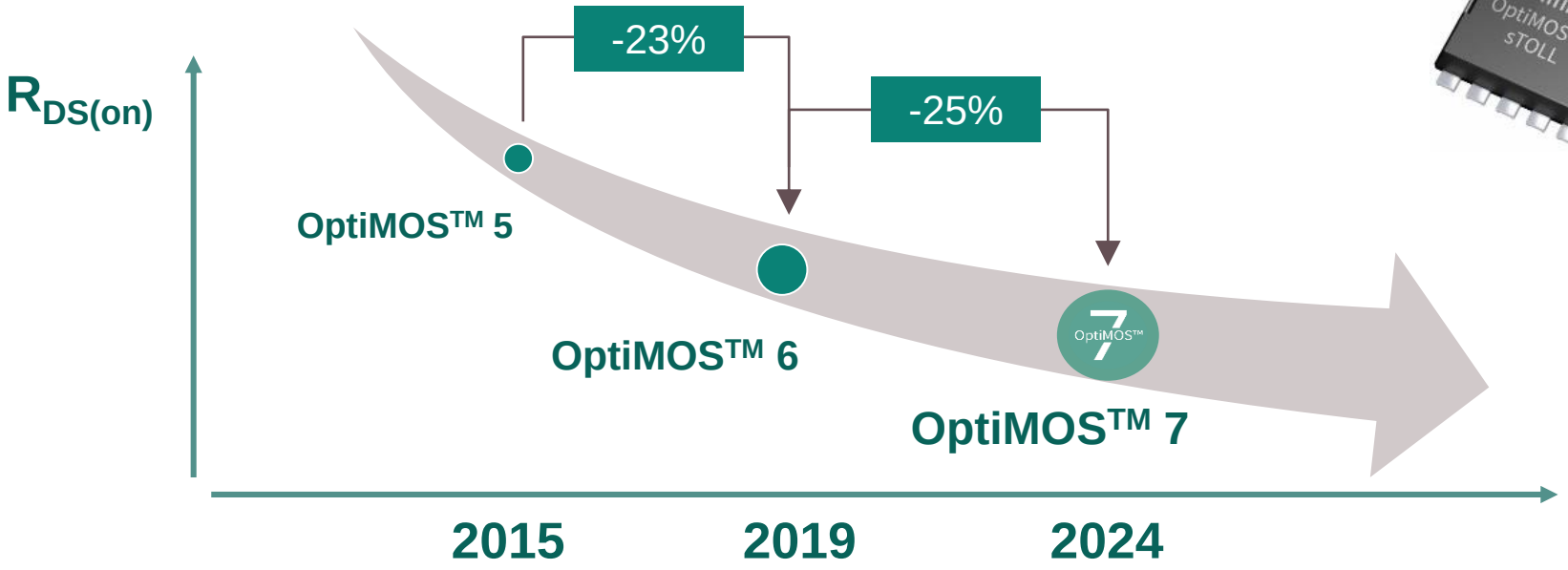
sTOLL 7x8 in OptiMOS 7 ™ 40V

Benchmark Package for Highest Power Density & Efficiency

April 2024

OptiMOS™ 7 40V Overview
IFX's leading MOSFET Technology with BIC Ron*A



OptiMOS™ 7 40V Overview
IFX's leading edge Automotive MOSFET Technology

5th Trench Technology
released by ATV MOSFET

State of the art dual poly trench technology

Leading Edge
300mm
Technology & Production

25% RDS(on) reduction
vs. OptiMOS™ 6 40V

Infineon's **unique copper metallization**
Outstanding electrical and thermal conductivity

Ruggedness improvement
High avalanche current capability

Reduction of Switching losses

OptiMOS™ 7 40V Overview
Automotive Package Portfolio: Innovative & Robust Quality

Infineon Automotive Package Portfolio
Innovative & Robust Quality

S3O8 Single (TSDSON-8) 3x3	SSO8 Dual (TDSON-8) 5x6	SSO8 Half-Bridge (TDSON-8) 5x6	SSO8 Single (TDSON-8) 5x6	SSO10T Single TSC (LHDSO-10) 5x7	sTOLL Single (HSOF-5) 7x8	mTOLG Single (HSOG-4) 8x8	TOLL Single (HSOF-8) 10x12
							

OptiMOS™ 7 40V

OptiMOS™ 7 40V Overview
IFX's leading edge Automotive MOSFET Products

S3O8
10x products
down to 1,2mΩ

Dual SSO8
8x products
down to 1,9mΩ

HB SSO8
6x products
down to 2,3mΩ

Single SSO8
16x products
down to 0,4mΩ

Single SSO10-T
5x products
down to 0,6mΩ

sTOLL
5x products
down to 0,3mΩ

mTOLG with clip
4x products
down to 0,5mΩ

TOLL with clip
3x products
down to 0,2mΩ

OptiMOS™ 7 40V – IFX's leading edge Power MOSFET Technology

Setting industry benchmark in Rdson*A, power-density, current capability, switching performance, chip ruggedness

Available in IFX's famous robust package portfolio of 3x3, 5x6 Dual , 5x6, 7x8, 8x8, 10x12 packages

and extended by top-side cooling 5x7 TSC packages for most efficient Automotive designs

OptiMOS™ 7 40V Overview
Features, Benefits & Applications

Key features

- Very low $R_{DS(on)}$
- High Avalanche capability
- High SOA ruggedness
- Fast switching times (turn on/off)
- Leadless Packages w/ Cu-Clip
- Leading thin wafer Cu-technology
- Leading 300mm in-house production

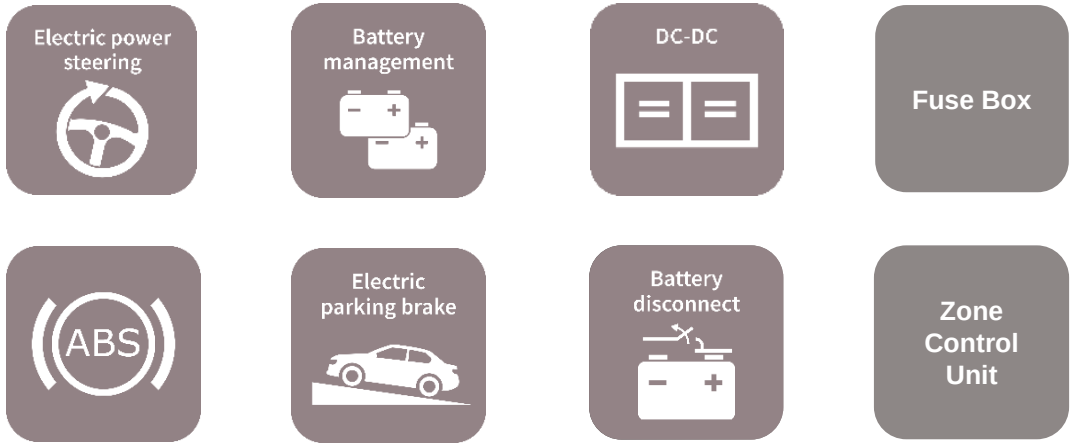
Key benefits

- High power density & efficiency
- Increased current capability
- Improved design ruggedness
- Superior switching performance
- Small footprint & efficient cooling
- Automotive quality product design
- High automotive quality production

Key applications

- Electric power steering
- Power disconnect switches
- Zone control units & E-fuse box
- DC/DC
- Braking
- BLDC drives in a wide variety
- All automotive applications

OptiMOS™ 7 40V Overview
Focus Applications & Packages



Application / Packages	Drives	Power Distribution Safety Switches	Power Conversion
S3O8 (3x3)	x		x
Dual & HB SSO8 (5x6)	x		x
SSO8 (5x6)	x	x	x
sTOLL (7x8)	x	x	x
mTOLG (8x8)	x		
TOLL (10x12)	x	x	x

https://www.infineon.com/cms/en/product/promopages/OptiMOS7_40V/

OptiMOS™ 7 40V – sTOLL 7x8
Leading Edge Portfolio

Group	Product	max $R_{DS(on)}$ [mΩ]	I_D (DC current) [A]	I_D (chip limitation) [A]	Q_G typ. [nC]	$V_{GS(th)}$ [LL/NL]
1	IAUAN04S7N004 ★	0.39	280	570	144	NL
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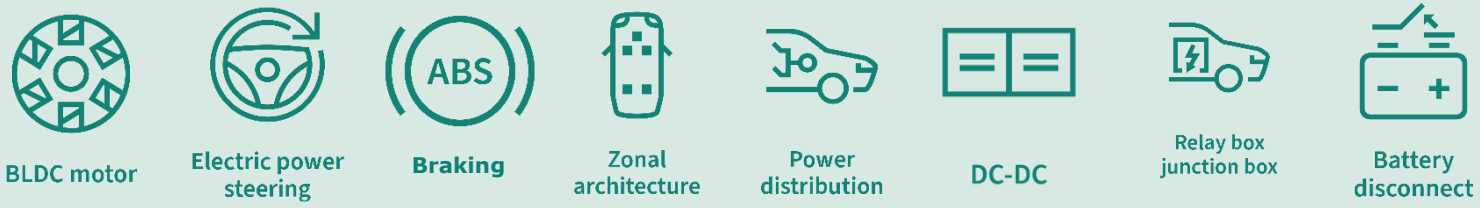
- Super low ohmic Automotive MOSFET package for highest Power Density & Efficiency in 7x8
- Latest OptiMOS™ 7 40V for optimized switching & power losses
- High current capable and proven robust quality package
- Market leading package for EPS, Braking and high power drives
- sTOLL – package JEDEC listed (second source available)
- 25% $R_{DS(on)}$ reduction versus previous generation (BIC product)

Application examples:



sTOLL

NEW!!

L x W x H

7.0 x 8.0 x 2.3 mm³

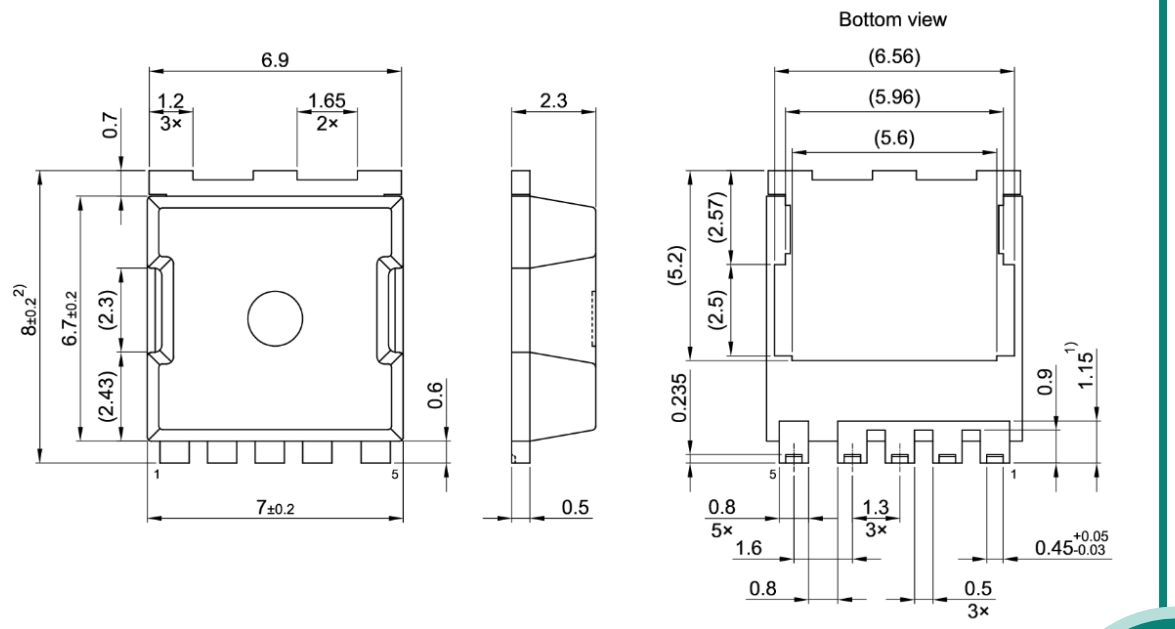
Cu-Clip soldered

In production

OptiMOS™ 7 40V – sTOLL 7x8 -> Improved Moisture Sensitivity Level Rating: MSL2a

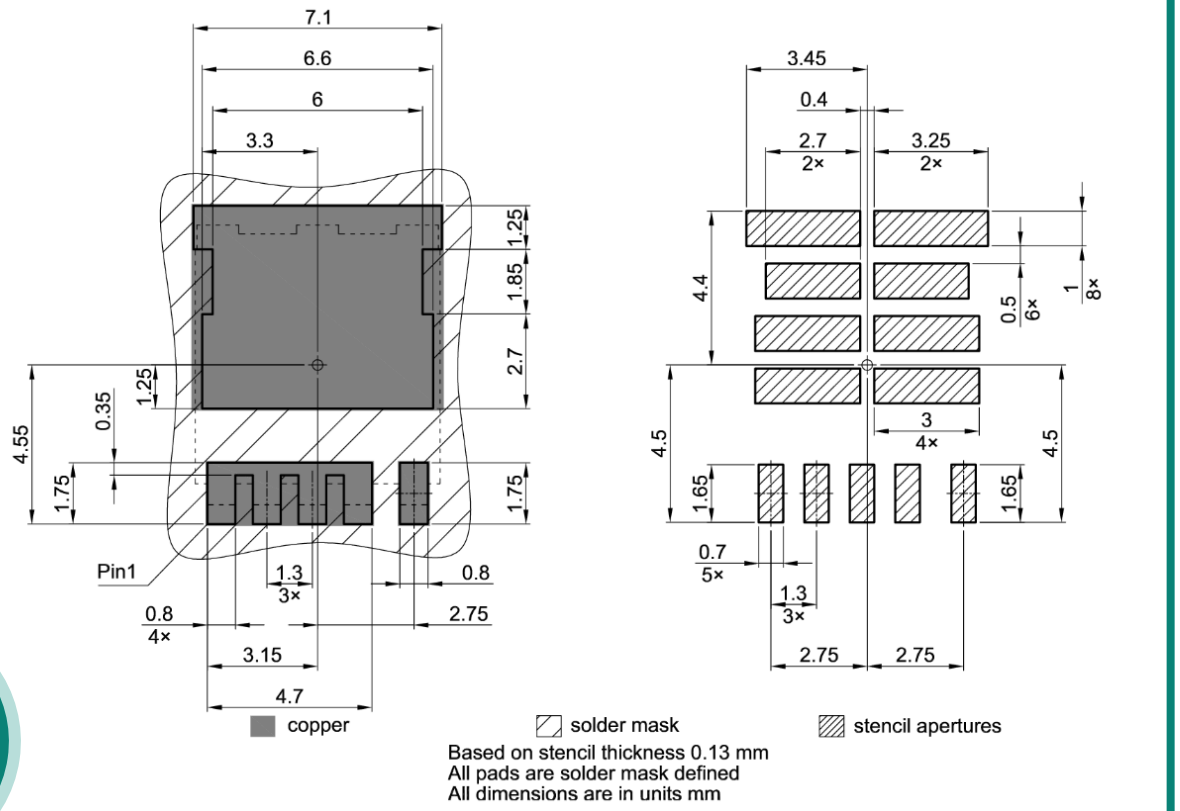
- **OptiMOS™7 sTOLL: MSL2a**
- OptiMOS™6 sTOLL: MSL3

PG-HSOF-5



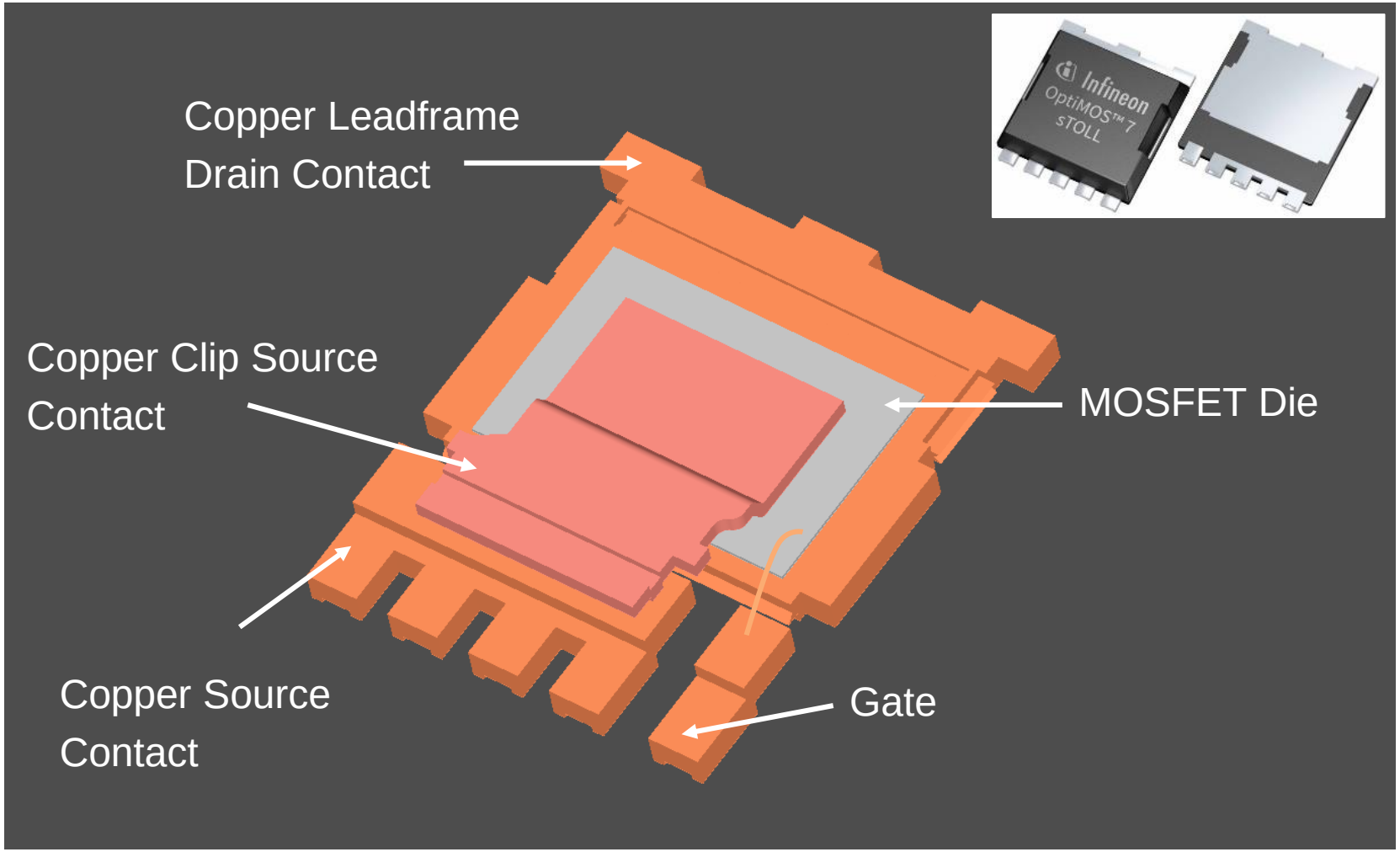
1) Lead length up to anti flash profile; mold flashes excluded.
2) Excluding burr.
All dimensions are in units mm
The drawing is in compliance with ISO 128-30, Projection Method 1 [⊣⊕]
Drawing according to ISO 8015, general tolerances ±0.1;±1°30'

MSL2a!!!!



Based on stencil thickness 0.13 mm
All pads are solder mask defined
All dimensions are in units mm

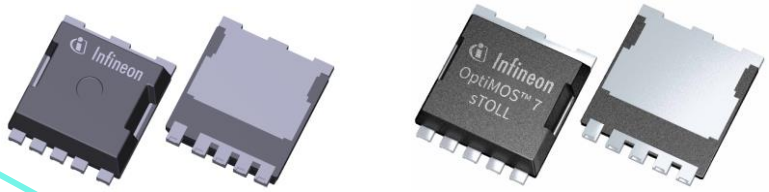
OptiMOS™ 7 40V sTOLL 7x8 -> Leading edge thin wafer Cu-technology + highest power density in relation to footprint



OptiMOS™ 7 40V sTOLL 7x8 -> Highest Avalanche Current Rating + Lowest R_{DSON}

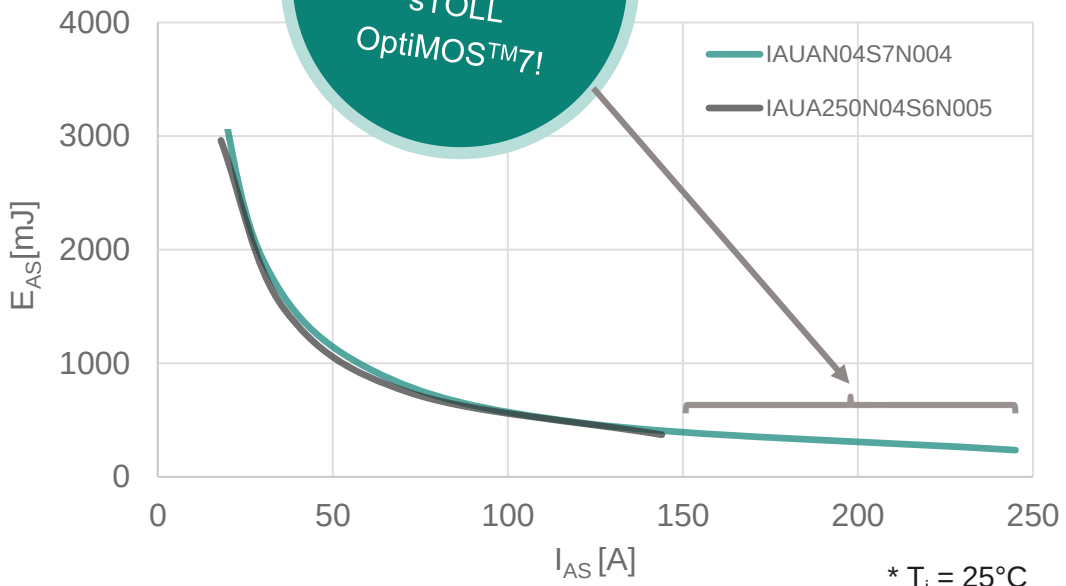
Highest avalanche current rating ever in a Trench FET technology
Perfect fit for Safety Switches + Power Distribution applications

~up to 70% higher avalanche currents!



	IAUA250N04S6N005 ★	IAUAN04S7N004 ★
RDSON max. 10V	0.55mOhm	0.39mOhm
I_{AS}	145A	245A
E_{AS} @ 72A	740mJ	820mJ
R_{thJC}	0.60K/W	0.63K/W

No current destruction for sTOLL OptiMOS™7!

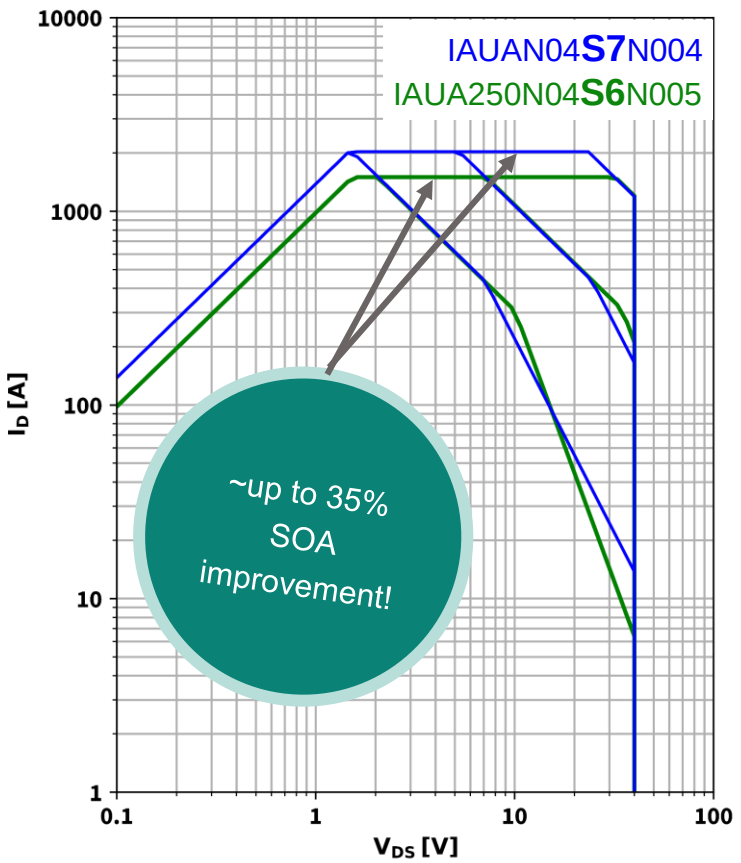


* T_j = 25°C

OptiMOS™ 7 40V sTOLL 7x8 ->
Up to 35% better SOA ruggedness + highest current capability

- **35% SOA improvement compared to OptiMOS™6 + 5**
- **Reduction of steady on losses plus higher current capability**

$I_D = f(V_{DS})$; $T_C = 25$ °C; $D = 0$; parameter: t_p



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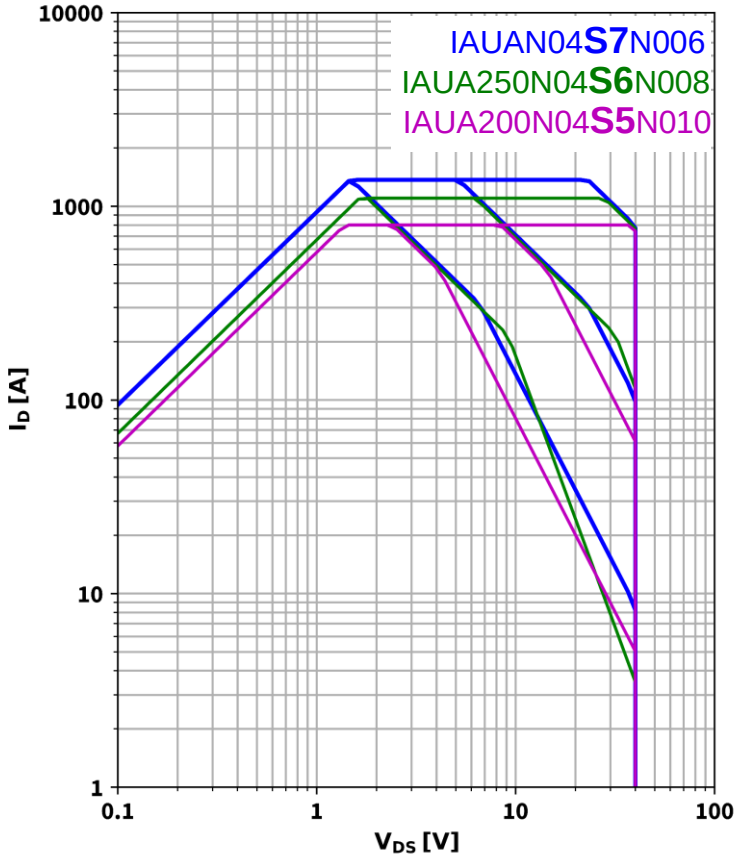
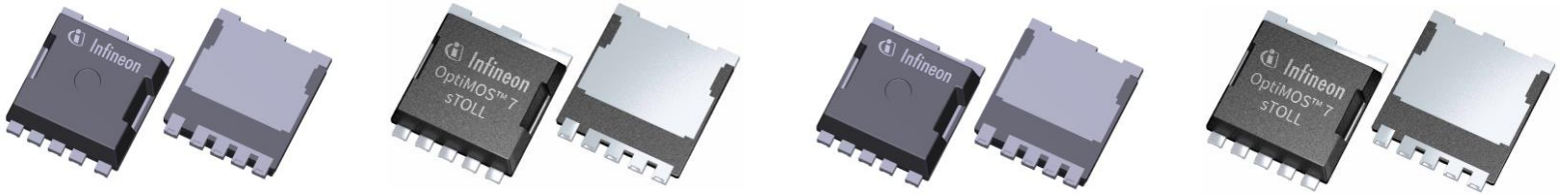


*t_p: 1us, 10us, 100us

OptiMOS™ 7 40V sTOLL 7x8 -> Low Gate Charge for high Frequency Switching and efficient Drives and Power Conversion

- Small gate charge for lowest gate drive currents
- Higher efficiency due to less switching and conduction losses for gate driver
- Optimized for efficient drives and power conversion



Electric power steering

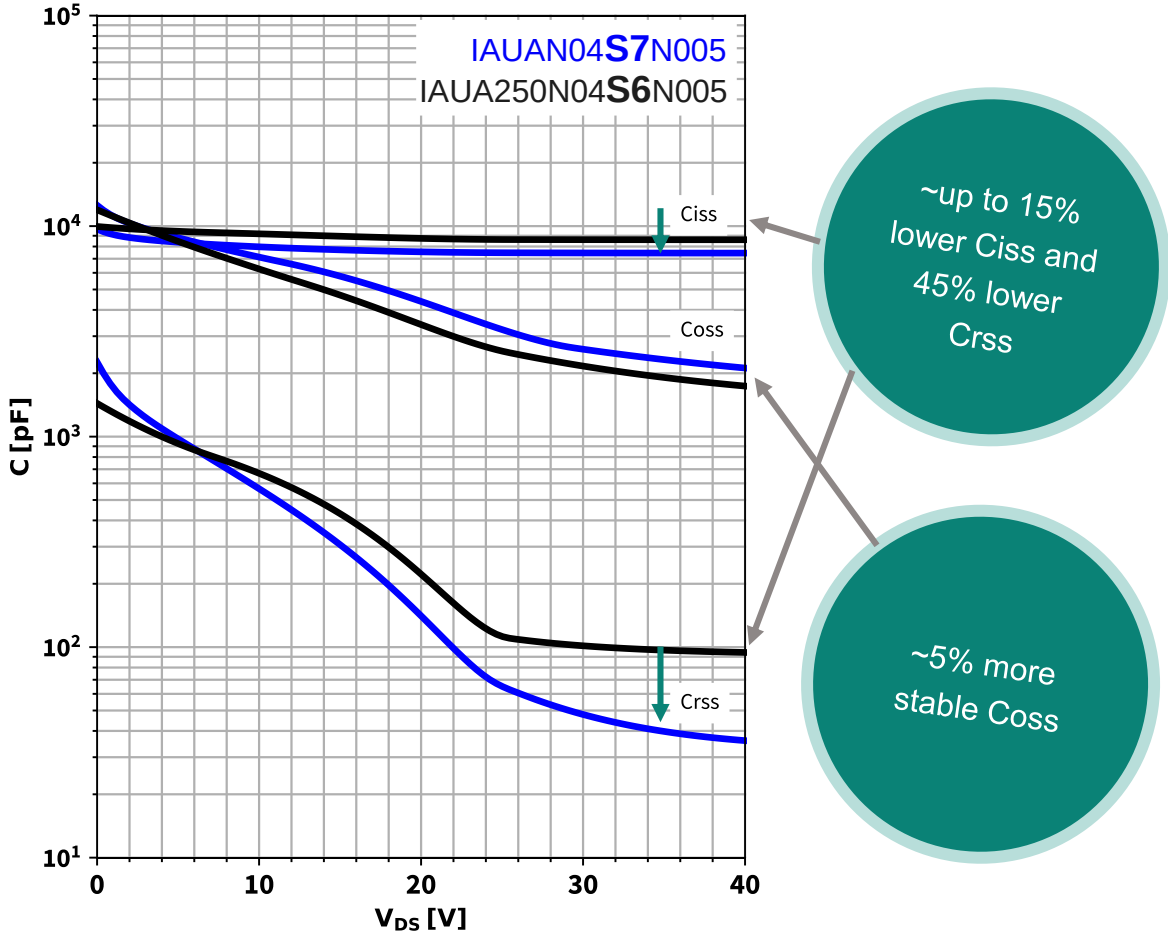
DC-DC

	IAUA250S6N005	IAUAN04S7N005	IAUA250S6N008	IAUAN04S7N008
Q_{gtot}	170 nC	150 nC	109 nC	78 nC
Q_{gs}	46 nC	40 nC	30 nC	22 nC
Q_{gd}	37 nC	30 nC	25 nC	18 nC

OptiMOS™ 7 40V sTOLL 7x8 -> Optimized input & output capacitances for improved switching behavior

- Reduced input and reverse transfer capacitances (C_{iss}, C_{rss})
- Improved stability of output capacitance (C_{oss})
- More stable C_{oss} and lower C_{rss} for less gate coupling and ringing

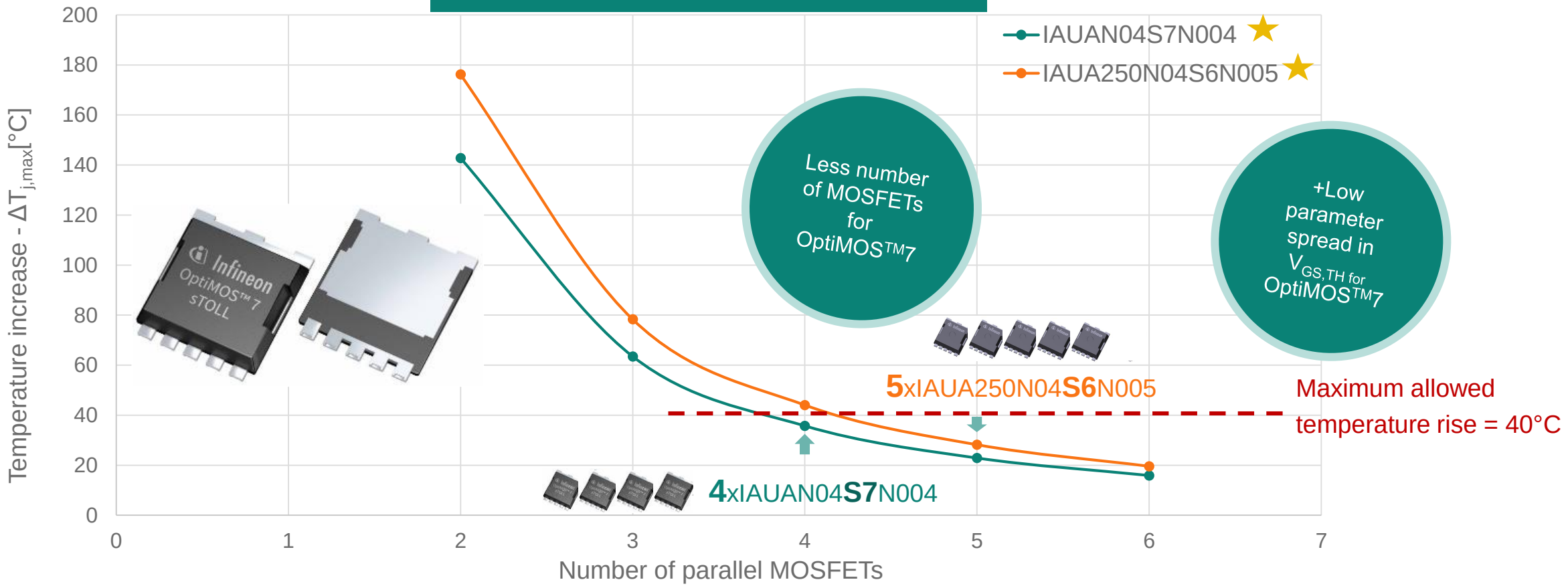
$C = f(V_{DS})$; $V_{GS} = 0$ V; $f = 1$ MHz



OptiMOS™ 7 40V sTOLL 7x8 ->
Significant advantages for paralleling MOSFETs

Condition: $I_{D,peak}$ = 900A for t_s =150ms, JEDEC 2s2p board with natural convection, $\Delta T_{j,max}$ = 40°C

$$\Delta T_{j,max} = (I_{nom,FET})^2 * R_{DS(on)@110°C} * Z_{th,JA-2s2p}$$



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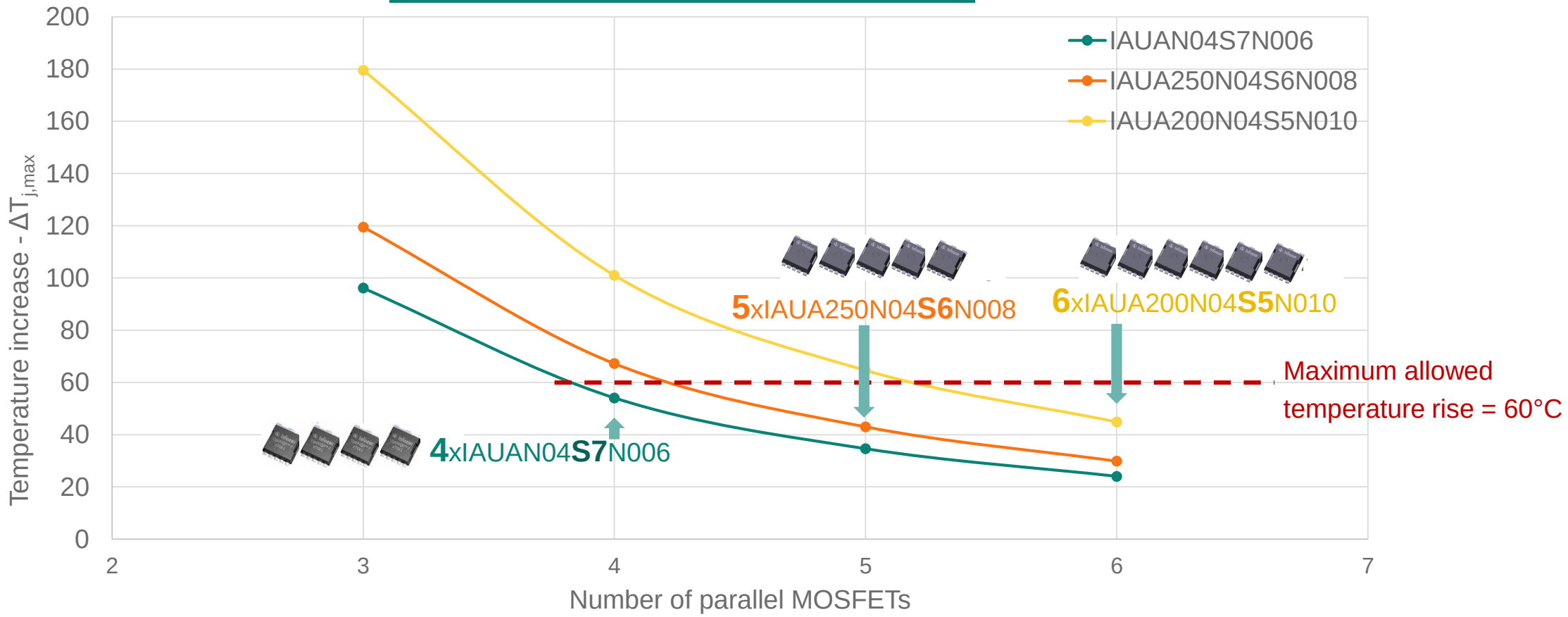
Significant advantages for paralleling MOSFETs

Condition: $I_{D,peak}$ = 900A for t_s =150ms, JEDEC 2s2p board with natural convection, $\Delta T_{j,max}$ = 60°C

$$\Delta T_{j,max} = (I_{nom,FET})^2 * R_{DS(on)@110°C} * Z_{th,JA-2s2p}$$

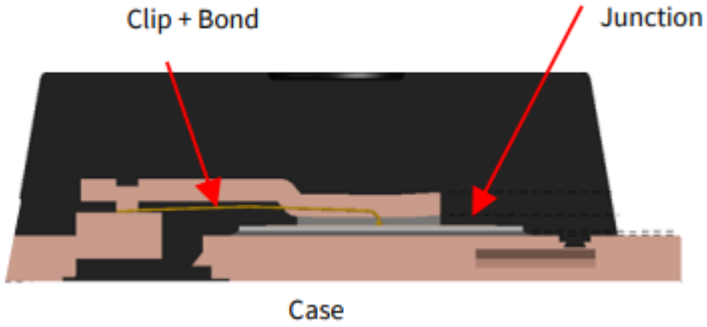


OptiMOS™ 7 40V sTOLL 7x8 -> Thermal Resistance - Definition

Thermal Characteristics[2)]

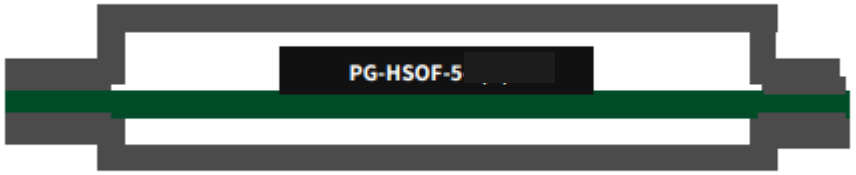
Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	
Thermal resistance, junction - case	R_{thJC}	–	–	–	0.63	K/W
Thermal resistance, junction - ambient[3)]	R_{thJA}	–	–	23.1	–	

$R_{th\text{-}JC}$



– Backside of the exposed pad is fixed to $T_{ambient}$ =25°C

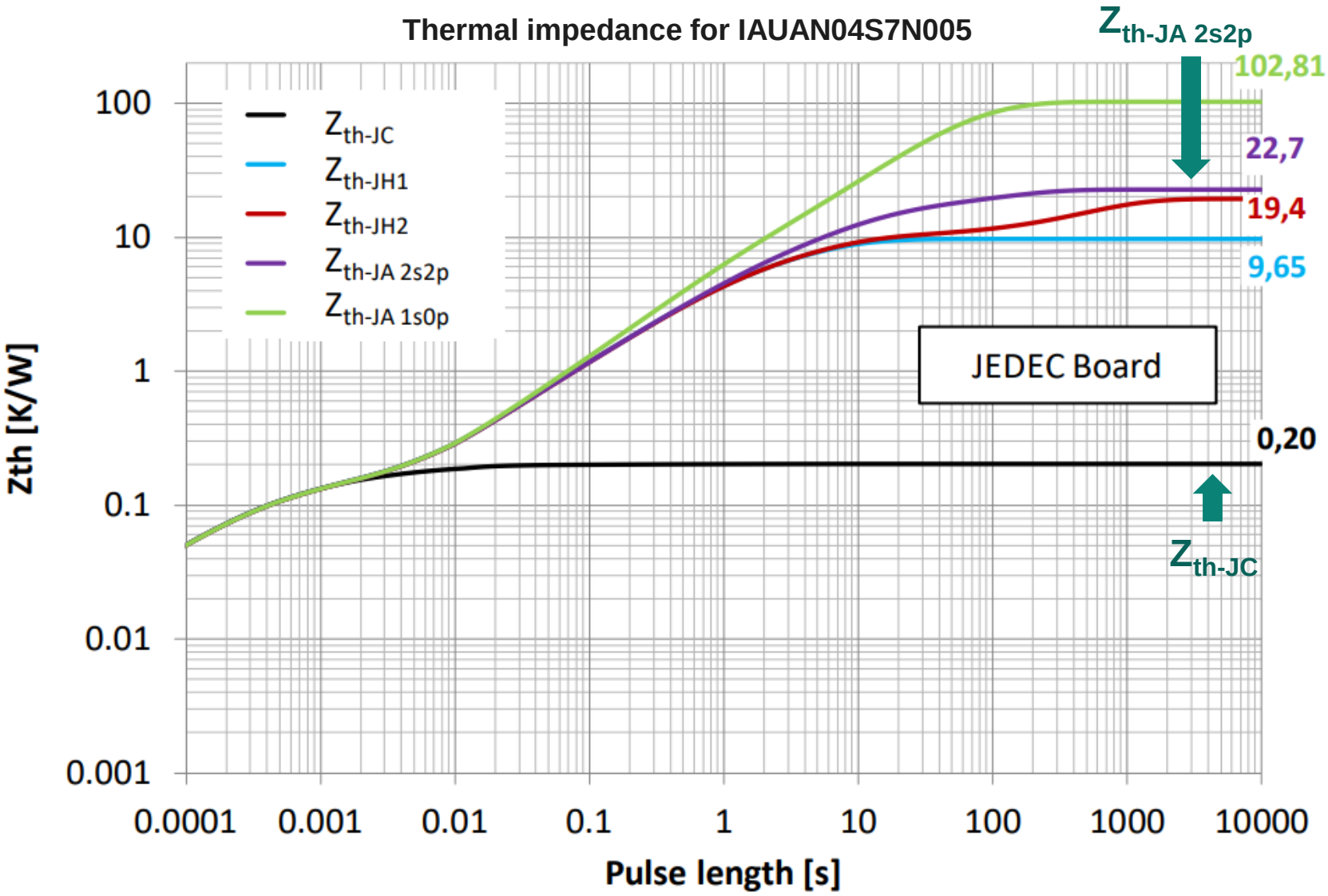
$R_{th\text{-}JA}$



– PCB: JEDEC standard 2s2p
– plastic housing and natural convection by air

$$R_{th\text{-}JA} = R_{th\text{-}JC} + R_{th\text{-}CA}$$

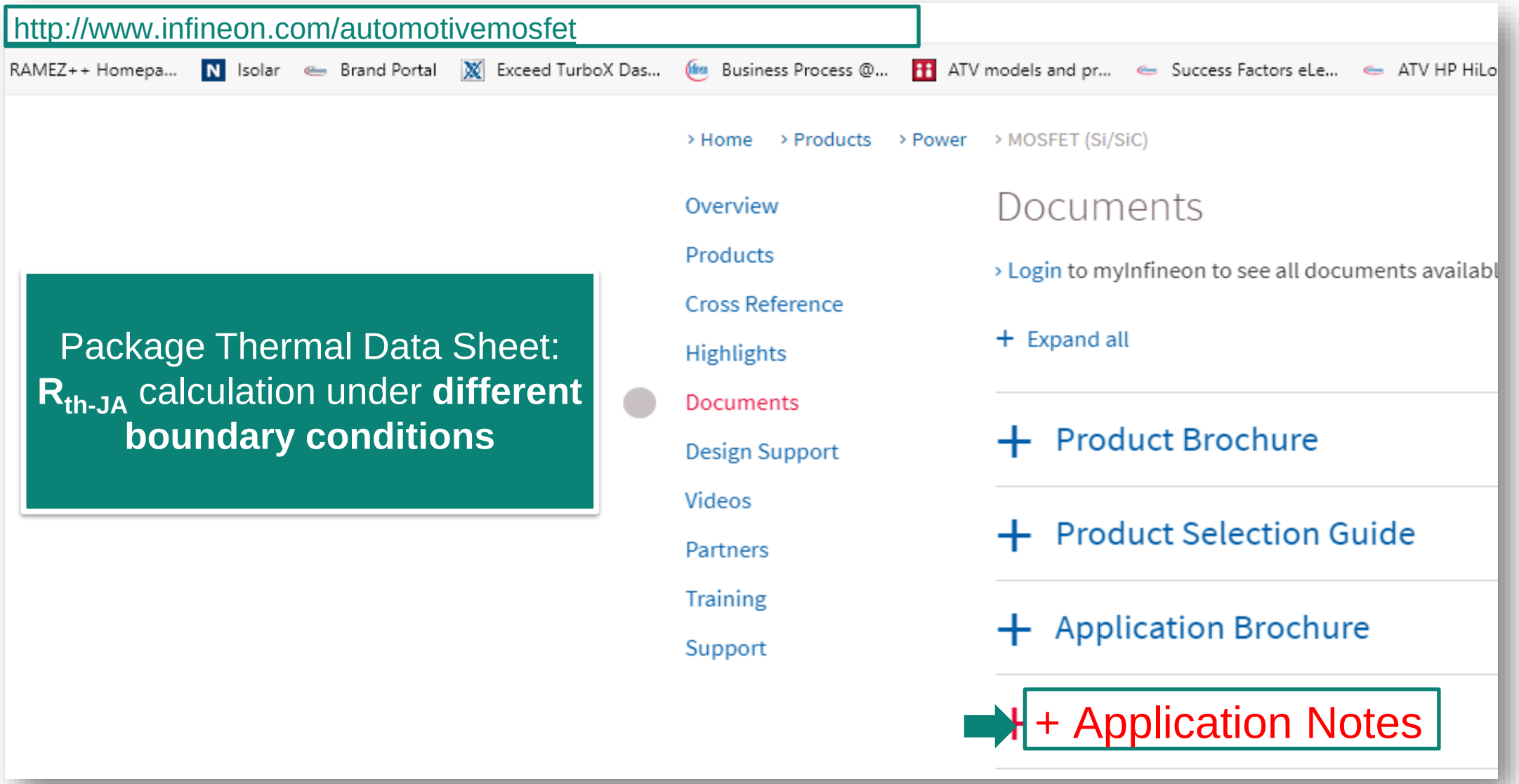
OptiMOS™ 7 40V sTOLL 7x8 -> Example - PG-HSOF-5-1



- $Z_{th\text{-}JA}$ increases with increasing pulse length
- $Z_{th\text{-}CA}$ decisive with increasing pulse length for $R_{th\text{-}JA}$
- $Z_{th\text{-}CA}$ can be improved using Al metal housing (red line) + fixed ambient temperature (blue line)

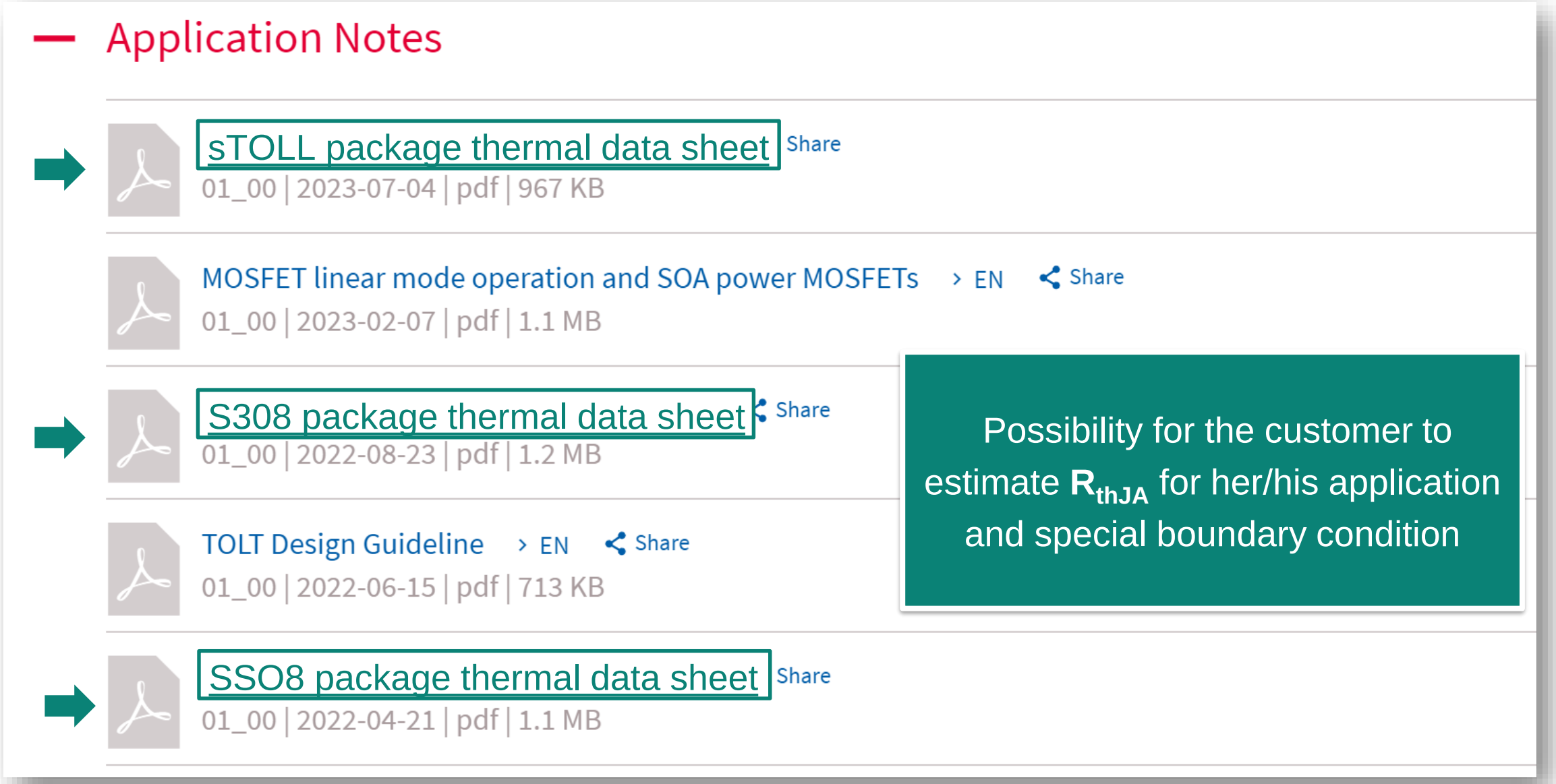
OptiMOS™ 7 40V sTOLL 7x8 -> Package Thermal Data Sheet – Where to find?

http://www.infineon.com/automotivemosfet



Package Thermal Data Sheet: $R_{th\text{-}JA}$ calculation under **different boundary conditions**

OptiMOS™ 7 40V sTOLL 7x8 ->
Package Thermal Data Sheet – Which is available?



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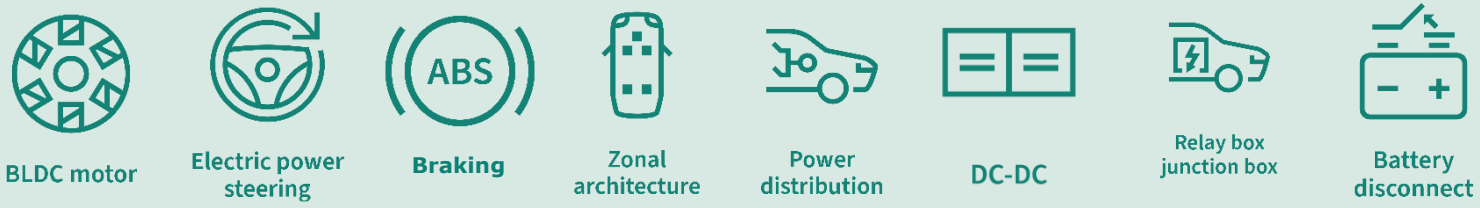

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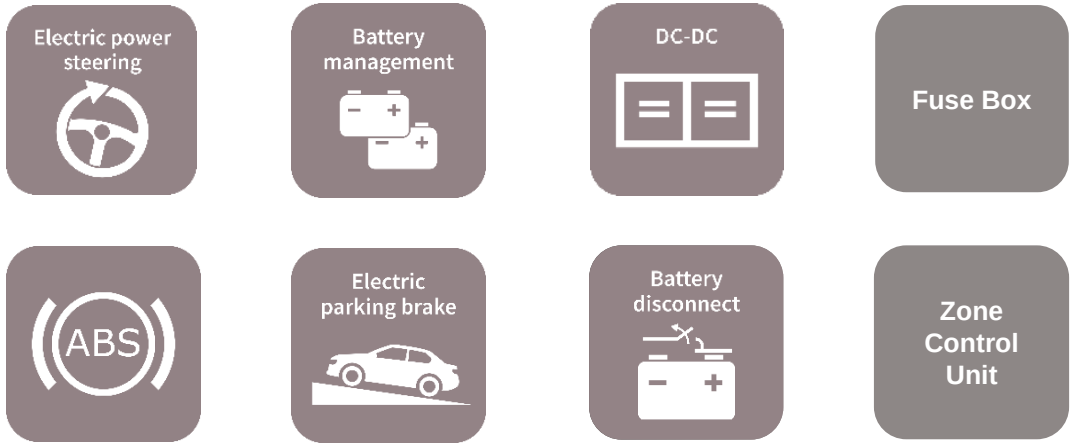

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sTOLL (7x8)	x	x	x
mTOLG (8x8)	x		
TOLL (10x12)	x	x	x

https://www.infineon.com/cms/en/product/promopages/OptiMOS7_40V/


Infineon