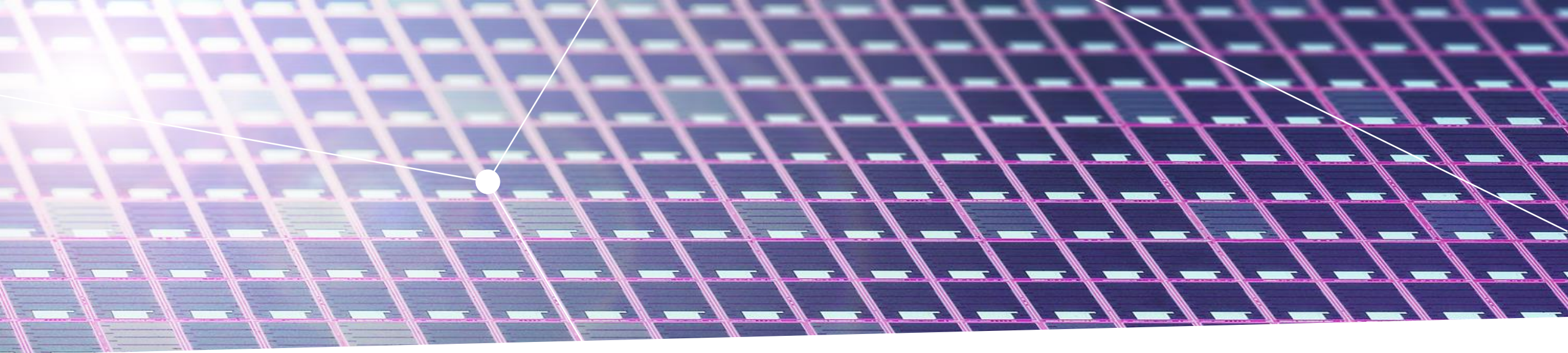


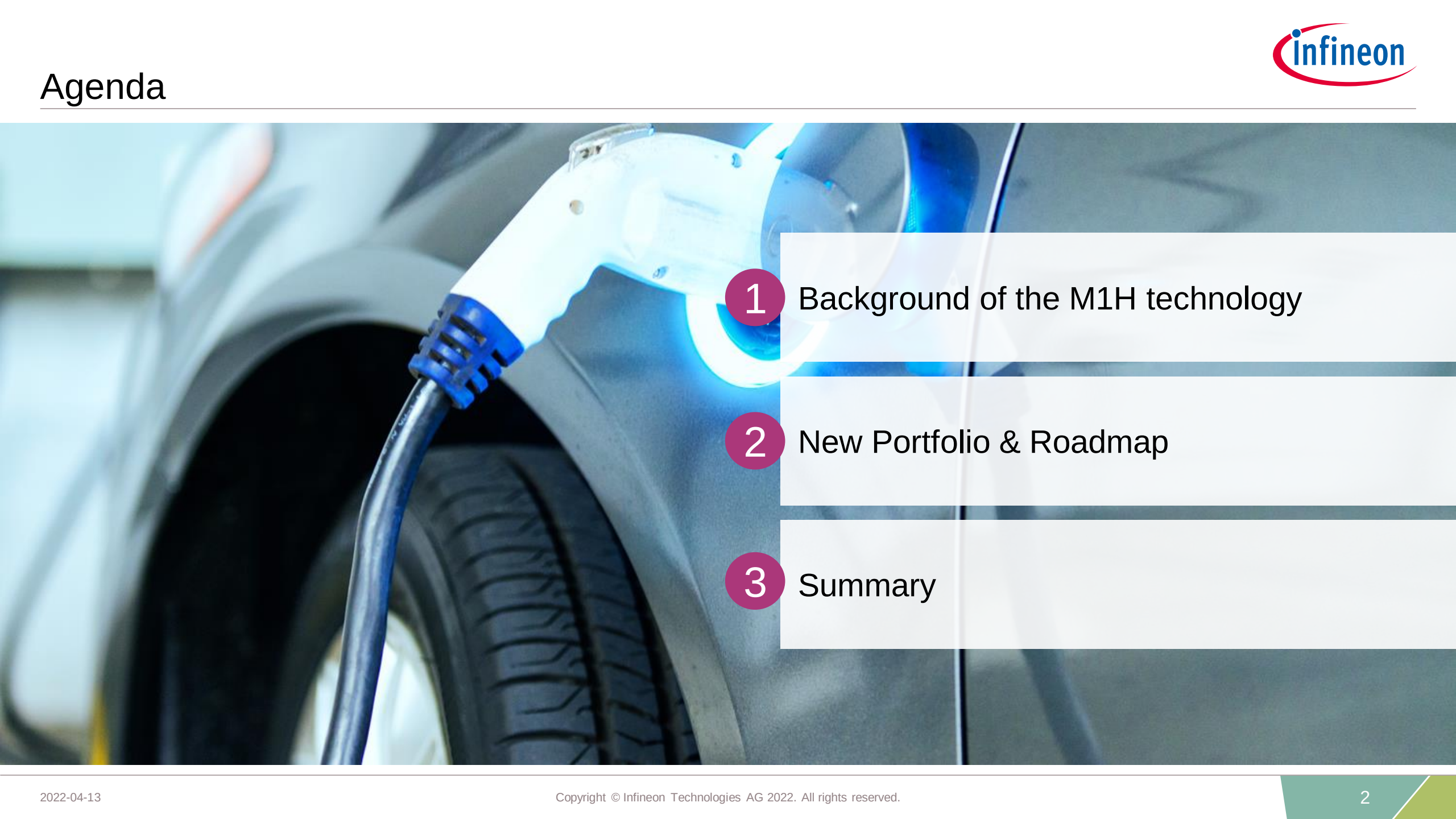


CoolSiC™ MOSFET new product additions in 1200 V M1H technology

Peter Friedrichs, Vice President Silicon Carbide
13 April 2022



Agenda

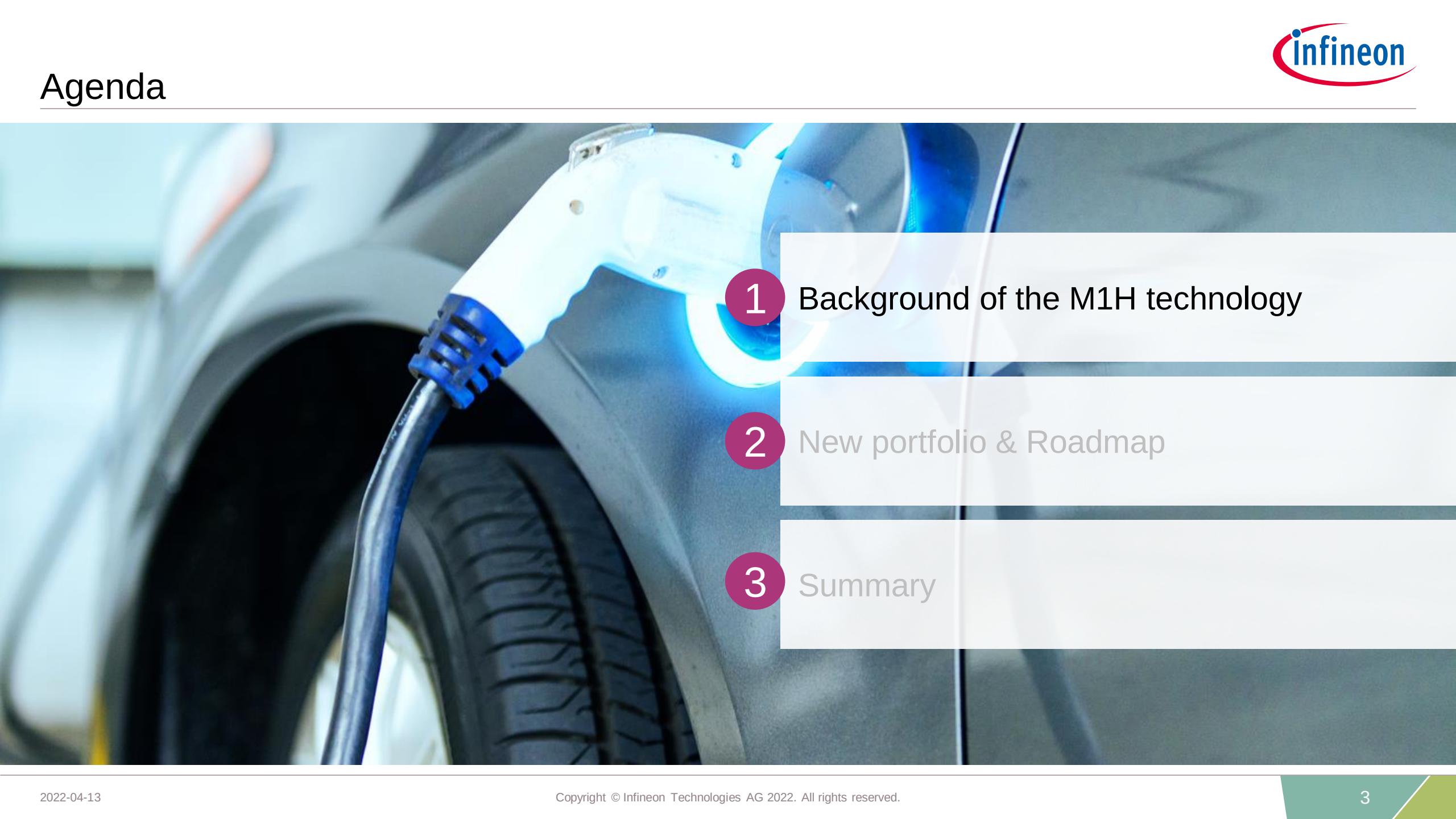
A close-up photograph of a white and blue electric vehicle (EV) charging cable plugged into a charging port on a dark-colored car. The car's body is visible in the background, and a tire is partially seen at the bottom left. The image has a soft, slightly blurred quality.

1 Background of the M1H technology

2 New Portfolio & Roadmap

3 Summary

Agenda

A close-up photograph of a white and blue electric vehicle (EV) charging cable plugged into a charging port on a dark-colored car. The car's tire is visible in the lower left. The image is slightly blurred, focusing on the charging cable and port.

1 Background of the M1H technology

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What is behind Infineon's new M1H portfolio

**CoolSiC™
MOSFET
1200 V
M1H**

New package features implemented for discrete devices with enhanced thermal performance

The new technology derivate come with extended operating conditions without compromising the excellent reliability

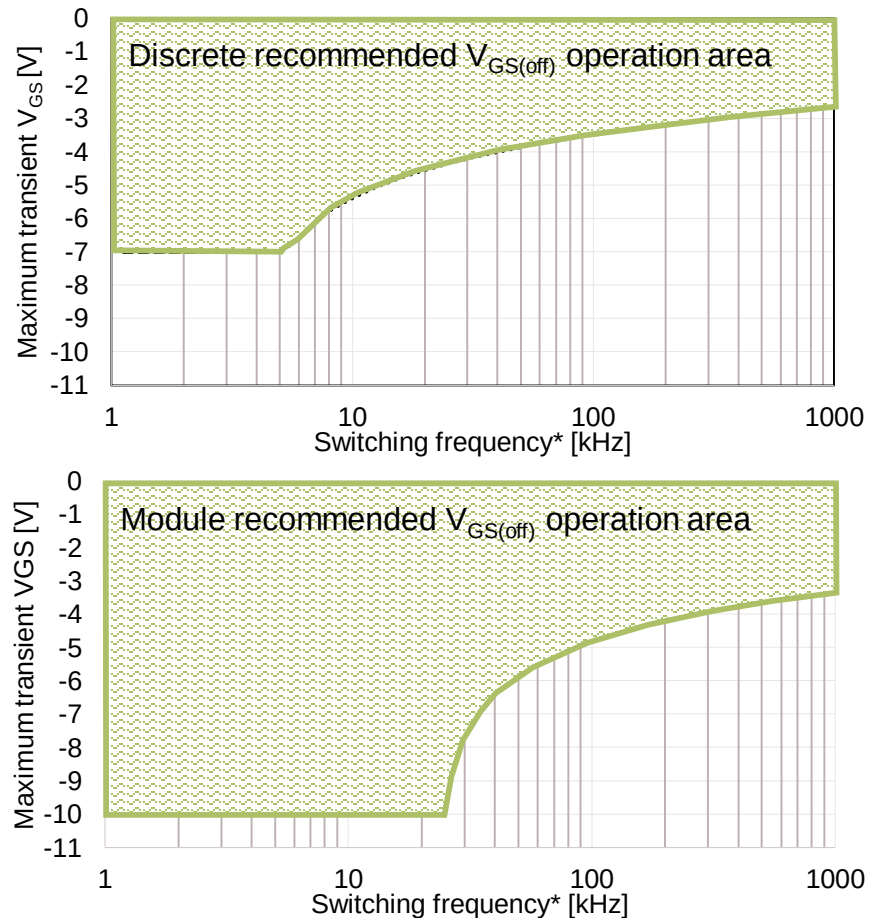
With the roll out of M1H the portfolio sees an significant extension for both, discrete and modules

Extended spectrum of reference boards rolled out with PCIM in May to demonstrate the implementation in real systems- stay tuned !

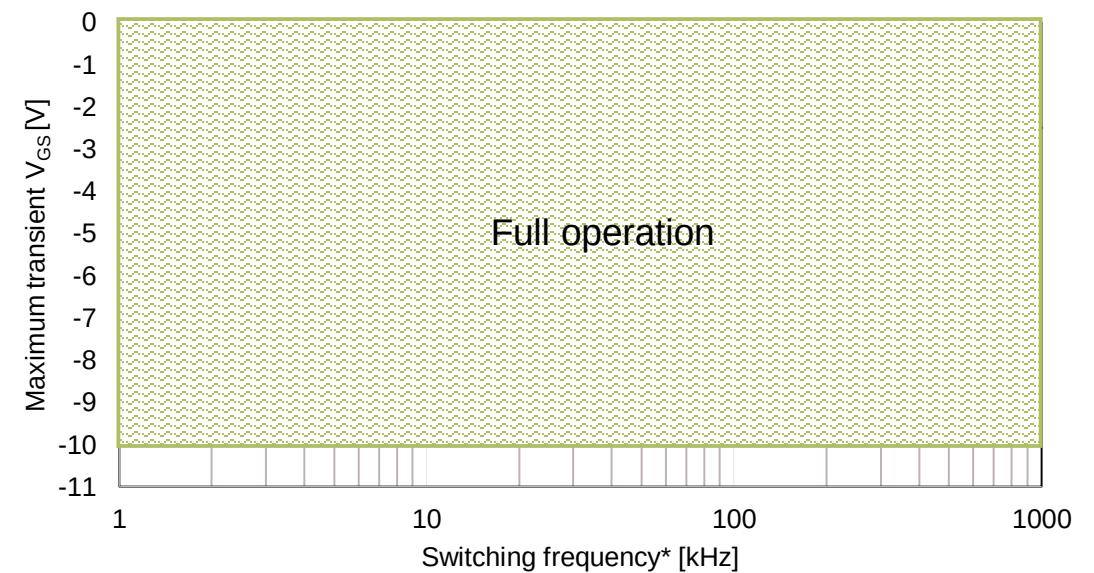
The basic device concept is unchanged, the cell layout and the cell dimensions are not touched → no new generation

The latest CoolSiC™ base technology advancements give you full freedom in choosing the gate voltage

Previous gate voltage recommendation area



New gate voltage recommendation area



Ease of use with maximum negative gate-source voltage down to -10 V

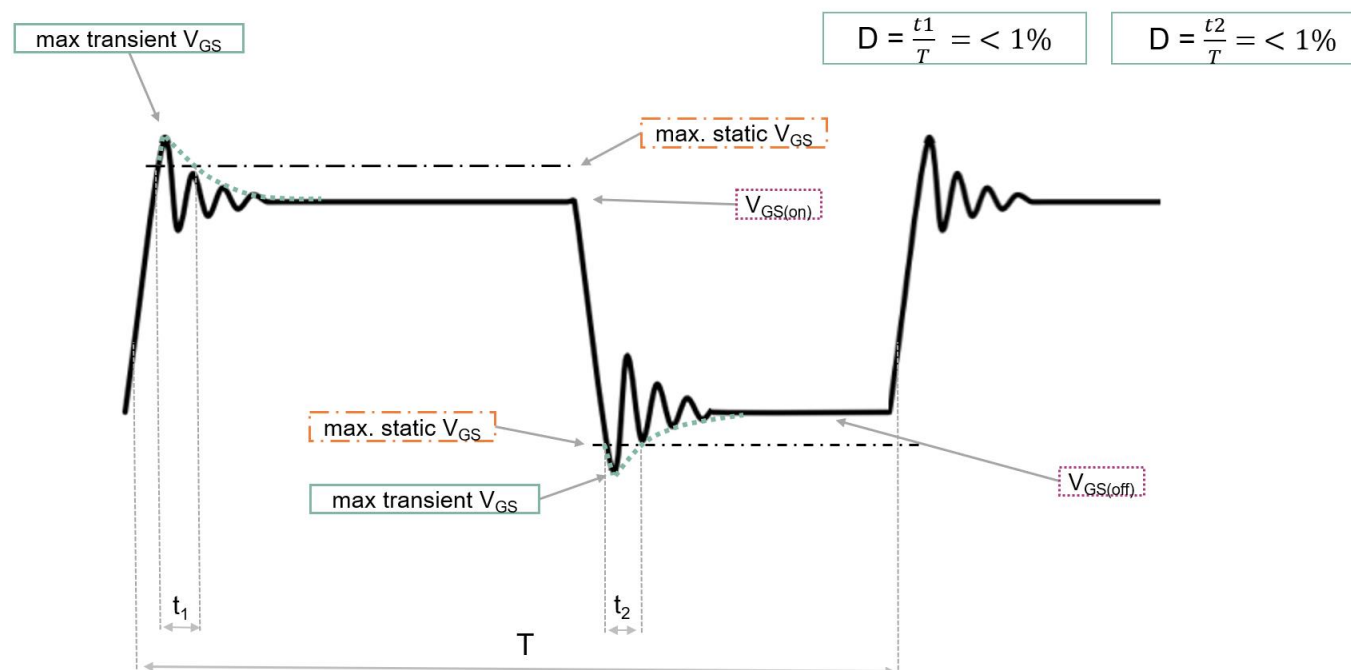
*Assuming 10 years of continuous operation. For more details see Application Note [AN2018-09](#)

Gate-source voltage – more detailed scope covered by datasheet

Gate-source voltage, max. transient voltage	V_{GS}	$D < 0.01$	-10/23	V
Gate-source voltage, max. static voltage	V_{GS}		-7/20	V

Table 4 Recommended values

Parameter	Symbol	Note or test condition	Values	Unit
On-state gate voltage	$V_{GS(on)}$		15 ... 18	V
Off-state gate voltage	$V_{GS(off)}$		0 ... -5	V



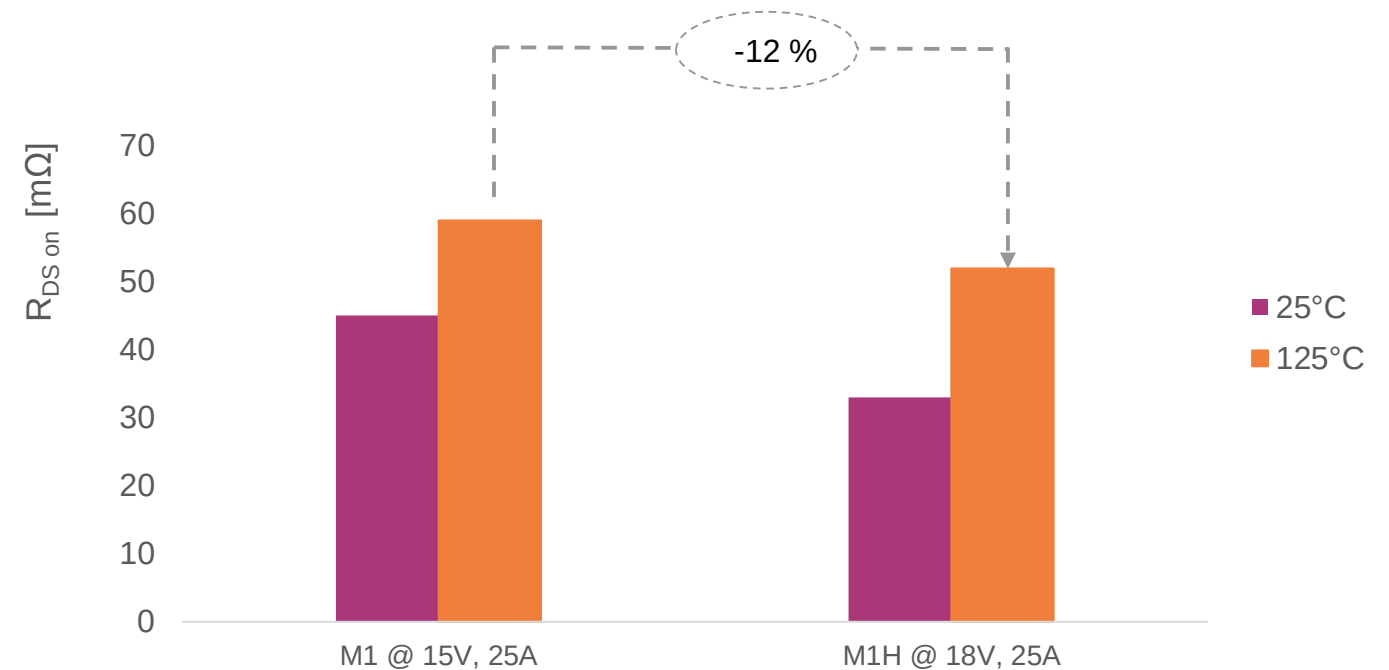
CoolSiC™ MOSFET 1200 V M1H series – Static performance improvement

CoolSiC™
MOSFET
1200 V
M1H

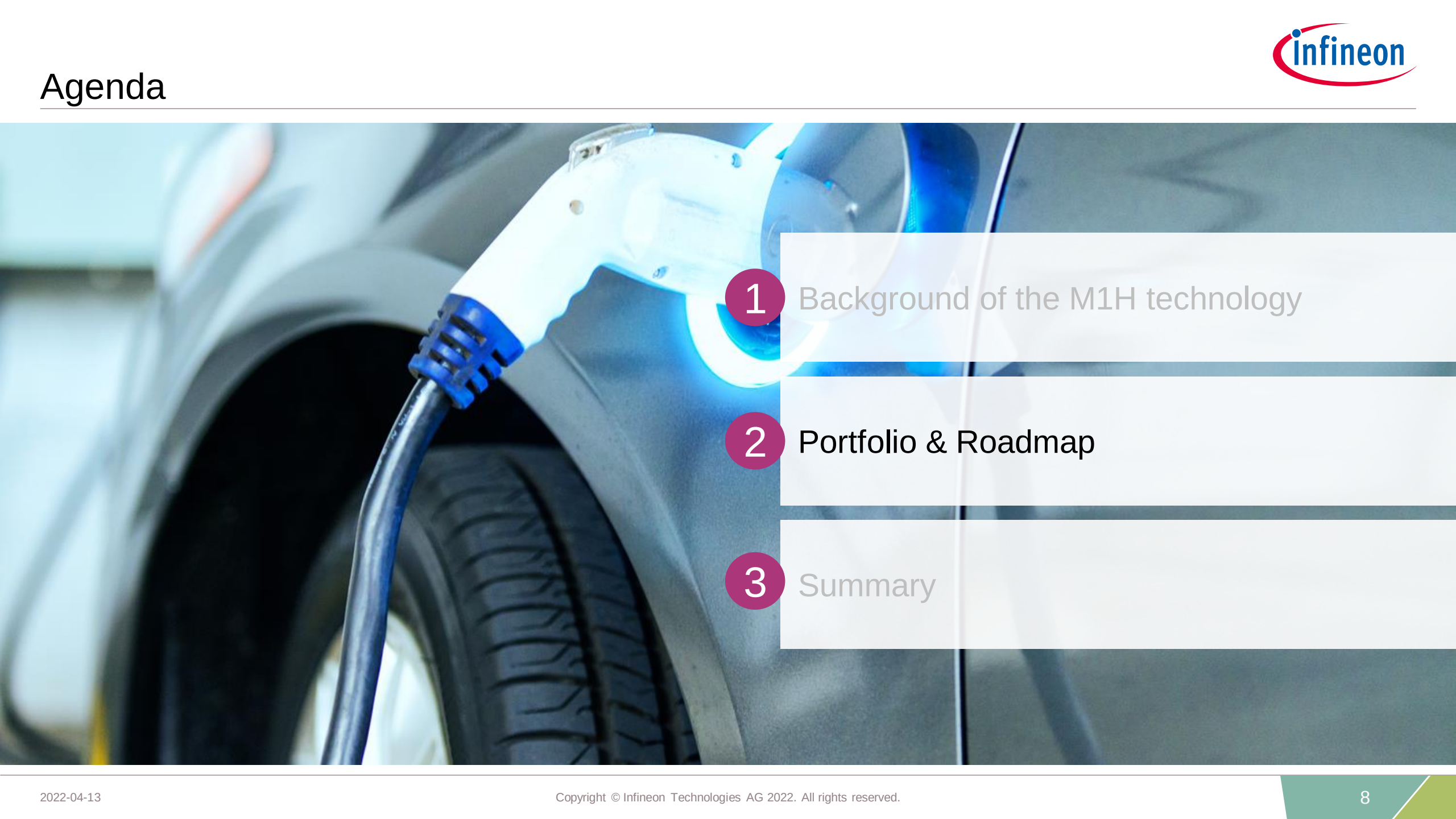
$R_{DS\ on}$ improvement

~12% better at same chip size and application relevant temperatures

Example for similar chip size:



Agenda

A close-up photograph of a white and blue electric vehicle (EV) charging cable plugged into a charging port on a dark-colored car. The car's body is visible in the background, and a tire is partially visible in the lower left. The image is used as a background for the slide.

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CoolSiC™ MOSFET 1200 V M1H series for Easy modules

**CoolSiC™
MOSFET
1200 V
M1H**

NEW

Easy 3B

SiC

Easy 1B

Easy 2B

CoolSiC™ MOSFET 1200 V M1H series for Easy modules

CoolSiC™
MOSFET
1200 V
M1H

Roll-out of new chip sizes

maximum flexibility which guarantees broadest industrial portfolio

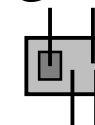
~ 55 mΩ @ 18V, 25°C



~ 33 mΩ @ 18V, 25°C



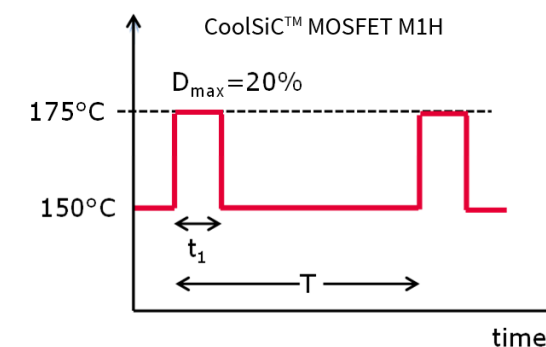
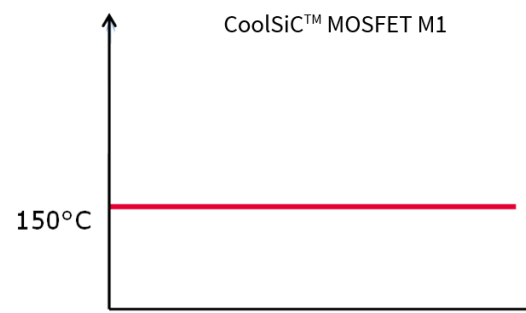
~ 13 mΩ @ 18V, 25°C



Maximum junction temperature $T_{vj,op}$ of 175 °C

overload capability to cover failure events and for higher power density

› Operation at a temperature of $T_{vj,op}=175^{\circ}\text{C}$ under overload condition:



M1 vs. M1H – small adoption of internal R_G for modules, switching behavior slightly optimized

45 m Ω / 1200V M1

- › I_D : 25 A
- › T_{vj} : 25°C
- › V_{dc} : 600 V
- › V_{GS} : +15V/-5V
- › $R_{g,int}$: 4 Ω

VS.

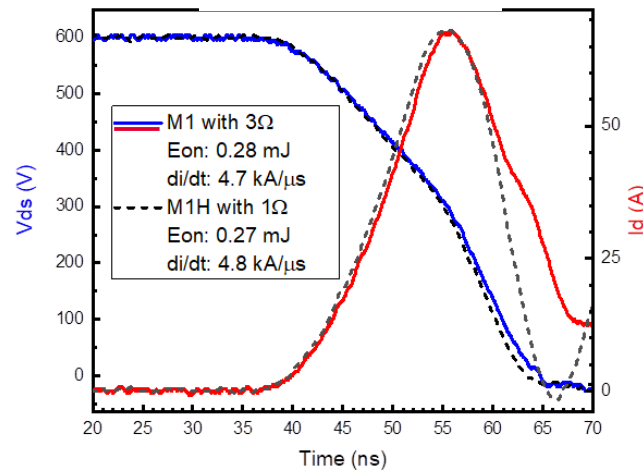
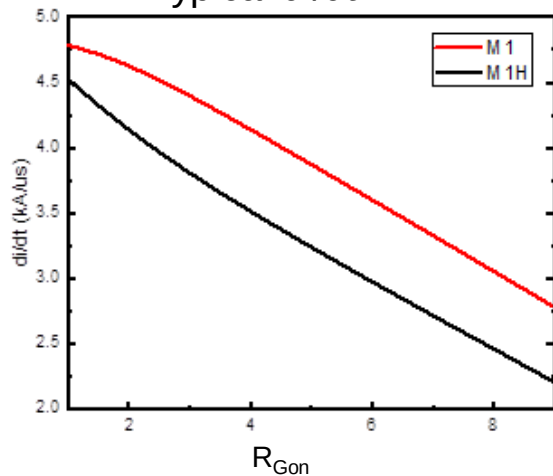
33 m Ω / 1200V M1H

- › I_D : 25 A
- › T_{vj} : 25°C
- › V_{dc} : 600 V
- › V_{GS} : +15V/-5V
- › $R_{g,int}$: 8 Ω

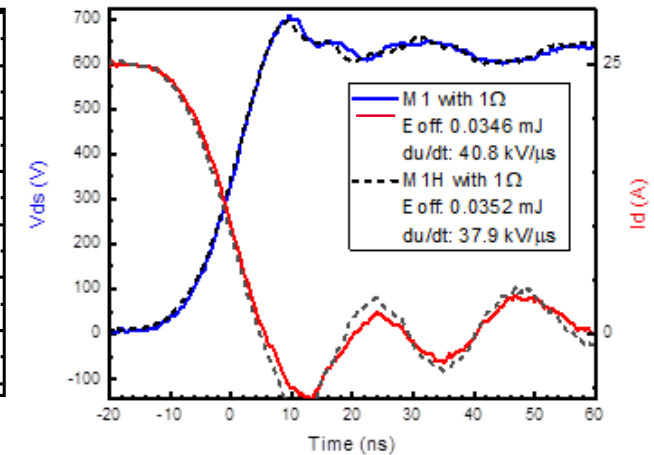
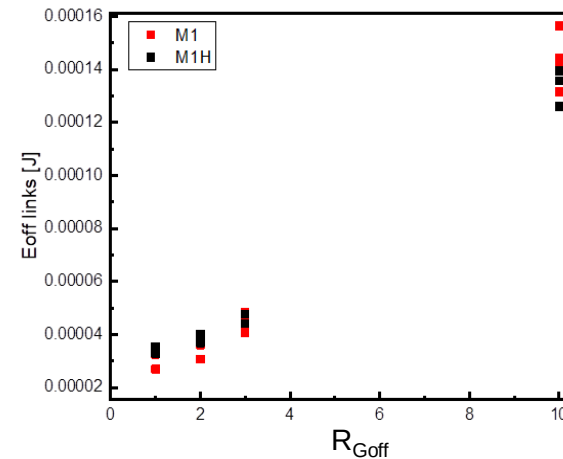
M1 vs. M1H – switching behavior

Turn-on

› Typical di/dt



Turn-off



New Easy module CoolSiC™ MOSFET M1H portfolio

R _{DS,on} [mΩ]	1200 V half-bridge	1200 V H-Bridge	1200 V SixPACK / PIM	1200 V Booster	1200 V 3-level
55	FF55MR12W1M1H(P)_B11 FF55MR12W1M1H_B70		FS55MR12W1M1H(P)_B11 FS55MR12W1M1H_B70		
33	FF33MR12W1M1H(P)_B11 FF33MR12W1M1H_B70	F4-33MR12W1M1H(P)_B76 F4-33MR12W1M1H_B70	FS33MR12W1M1H(P)_B11 FS33MR12W1M1H_B70		
28			FS28MR12W1M1H(P)_B11 FS28MR12W1M1H_B70		
17	FF17MR12W1M1H(P)_B11 FF17MR12W1M1H(P)_B17 FF17MR12W1M1H(P)_B70	F4-17MR12W1M1H(P)_B76 F4-17MR12W1M1H_B70	FP17MR12W2M1H_B11	DF17MR12W1M1HF_B67 DF17MR12W1M1HF_B68	
13/14			FS13MR12W2M1H(P)_B11 FS13MR12W2M1H_B70	DF14MR12W1M1HF_B67	
11	FF11MR12W2M1HP_B11	F4-11MR12W2M1H(P)_B76 F4-11MR12W2M1H_B70		DF11MR12W1M1HF_B67	F3L11MR12W2M1(P)_B74 F3L11MR12W2M1H(P)_B19
8	FF8MR12W1M1H(P)_B11 FF8MR12W1M1H(P)_B70	F4-8MR12W2M1H(P)_B76 F4-8MR12W2M1H_B70		DF8MR12W1M1HF_B67	F3L8MR12W2M1H(P)_B11
6	FF6MR12W2M1H(P)_B11 FF6MR12W2M1H(P)_B70	F4-6MR12W2M1H(P)_B11 F4-6MR12W2M1H_B70			
4	FF4MR12W2M1H(P)_B11 FF4MR12W2M1H(P)_B70				
2	FF2MR12W3M1H_B11				

Orderable, registerable and available now

In development

Product Idea

B17 = common source

B19 = full SiC

B76 = open source

P = TIM

B11 = PressFIT Pin

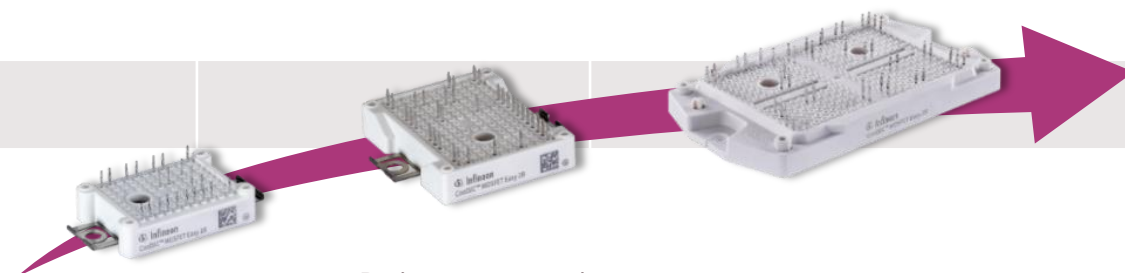
B74 = ANPC

B70 = AlN ceramic

B67 = Booster

B68 = Booster one string

55 mΩ

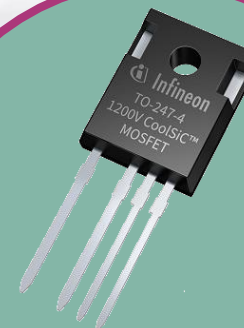


Drain-source on resistance

2 mΩ

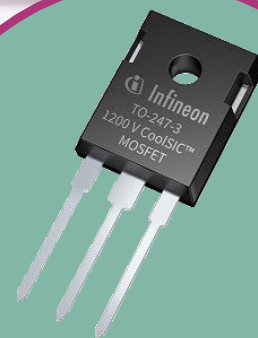
CoolSiC™ MOSFET 1200 V M1H series for discrete packages

NEW
Low-Ohmic
additions with .XT
technology in TO-
footprint



TO247-4

CoolSiC™.XT



TO247-3



D²PAK 7L

CoolSiC™ discrete portfolio

1200 V and 1700 V MOSFETs lineup



	$R_{DS(on)}$ [mΩ]	TO-247-3 	TO-247-4 *Optimized Pin-out 	D ² PAK-7L SMD 	D ² PAK-7L SMD *high creepage 
1200 V	7	IMW120R007M1H	IMZA120R007M1H*		
	14	IMW120R014M1H	IMZA120R014M1H*		
	20	IMW120R020M1H	IMZA120R020M1H*		
	30	IMW120R030M1H	IMZ120R030M1H	IMBG120R030M1H	
	40/45	IMW120R040M1H	IMZA120R040M1H*	IMBG120R045M1H	
	60	IMW120R060M1H	IMZ120R060M1H	IMBG120R060M1H	
	90	IMW120R90M1H	IMZ120R090M1H	IMBG120R090M1H	
	140	IMW120R140M1H	IMZ120R140M1H	IMBG120R140M1H	
	220	IMW120R220M1H	IMZ120R220M1H	IMBG120R220M1H	
	350	IMW120R350M1H	IMZ120R350M1H	IMBG120R350M1H	
1700 V	450				IMBF170R450M1
	650				IMBF170R650M1
	1000				IMBF170R1K0M1



1200 V CoolSiC™ MOSFET

Higher single device power with the **new low-ohmic range**



	AC-DC stage with B6 bridge	DC-DC stage: with LLC, CLLC	DC-DC stage: with DAB
	Uni-directional or bi-directional		
$R_{DS(on)}$ [mΩ]	Typical device power [kW]		
7	~30		
14	15~22		
20			
30	11~15		
40			



New low-ohmic range 7, 14, 20 and 40 mΩ

New features

1	Lowest $R_{DS(on)}$ in TO247 for highest power density
2	Easy to design with maximum gate-source voltage lowered to -10 V
3	Flexible turn-off gate voltage selection -5V~0V
4	.XT interconnection technology improves on thermal dissipation capability up to 30%
5	Enhanced robustness features with avalanche and short-circuit protection

Applications



and more!

Portfolio

$R_{DS(on)}$ [mΩ]	TO-247-3 	TO-247-4 
7	IMW120R007M1H	IMZA120R007M1H
14	IMW120R014M1H	IMZA120R014M1H
20	IMW120R020M1H	IMZA120R020M1H
40	IMW120R040M1H	IMZA120R040M1H

1200 V CoolSiC™ MOSFET

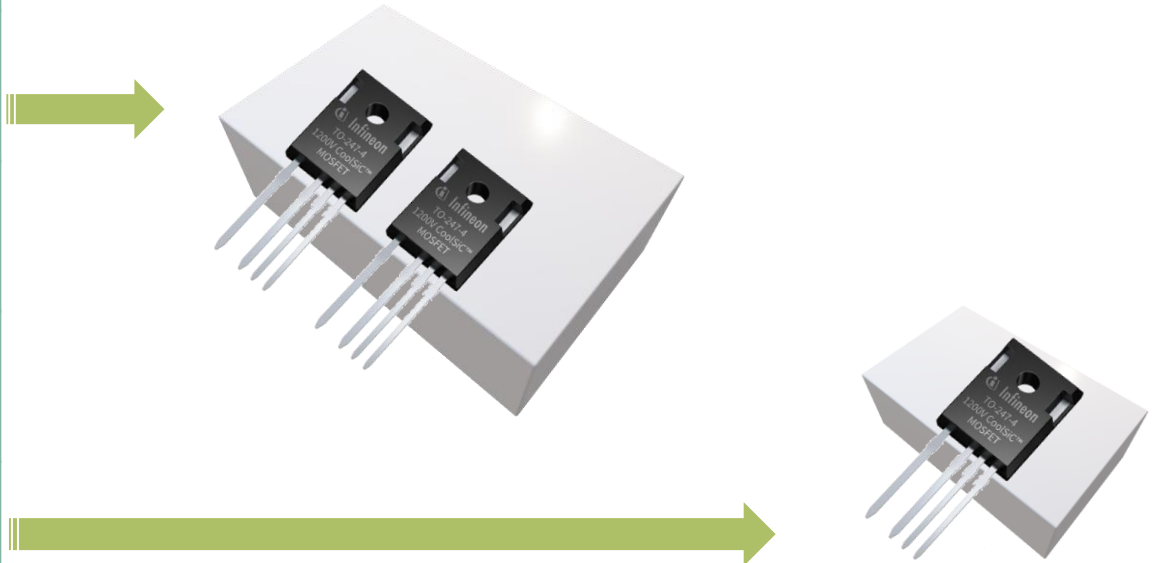
Solar Application – PV Boost



More power, less weight

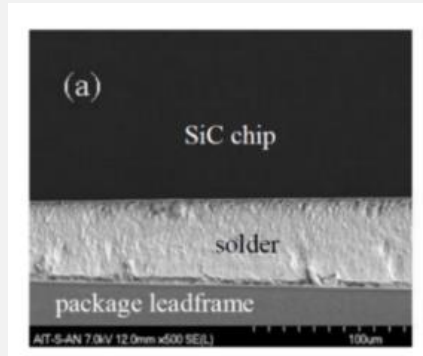
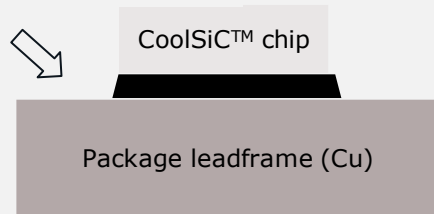
Part number	CoolSiC MOSFET	Example: PV boost power
IMZA120R030M1H	30 mΩ	~15 kW
IMZA120R020M1H	20 mΩ	~20 kW
IMZA120R014M1H	14 mΩ	~25 kW
IMZA120R007M1H	7 mΩ	~30 kW

Power board	Single part	Paralleling parts
System size	✓✓✓	✓
Thermal interface material	✓✓	✓
Power density	✓✓✓	✓



Standard interconnection

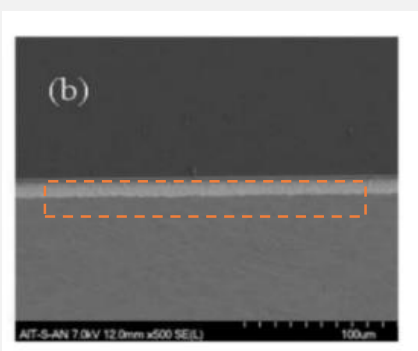
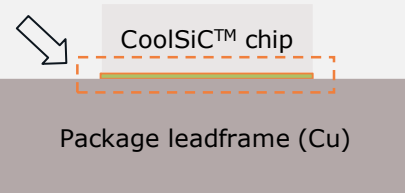
Standard soldering



Standard soldering

.XT interconnection

Diffusion soldering



Elimination of solder joint through diffusion soldering

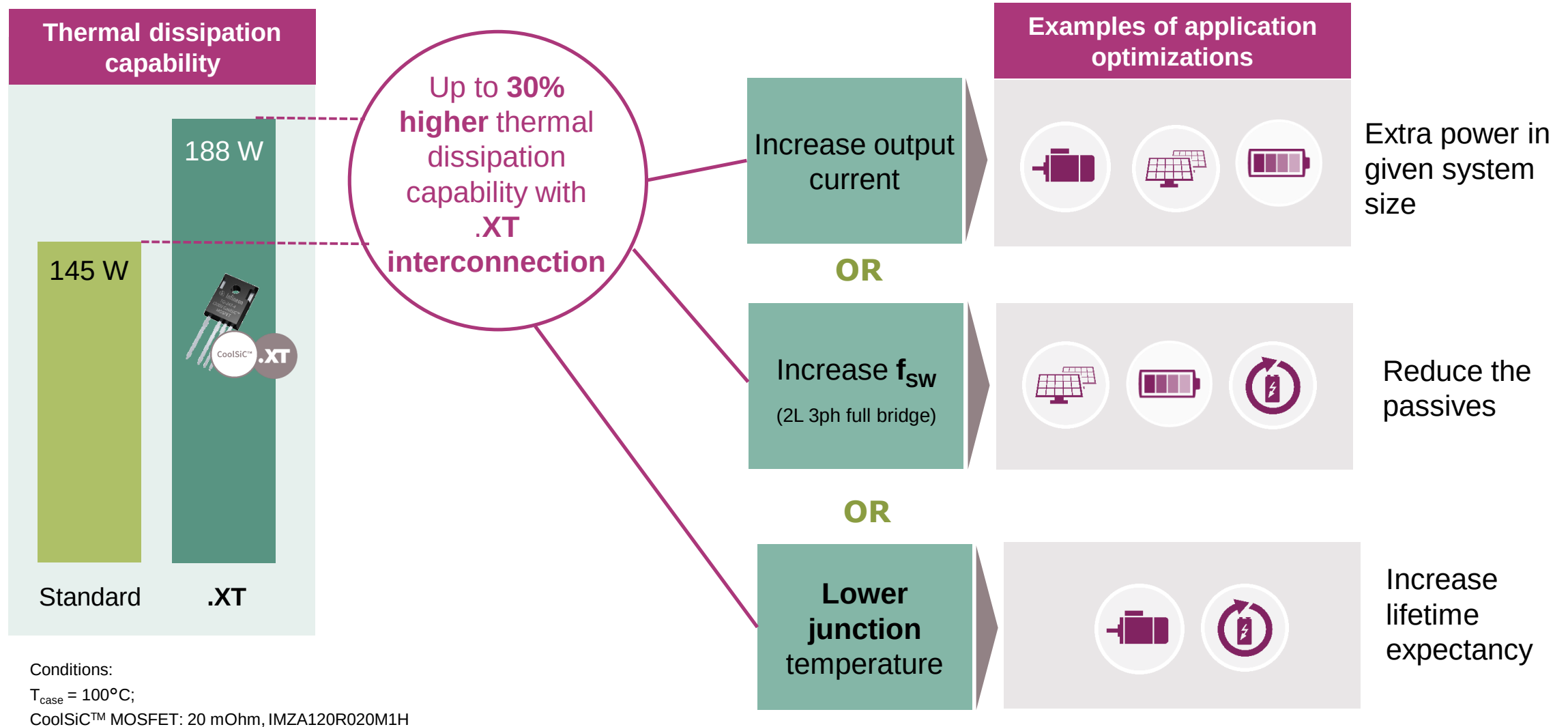
.XT technology benefits



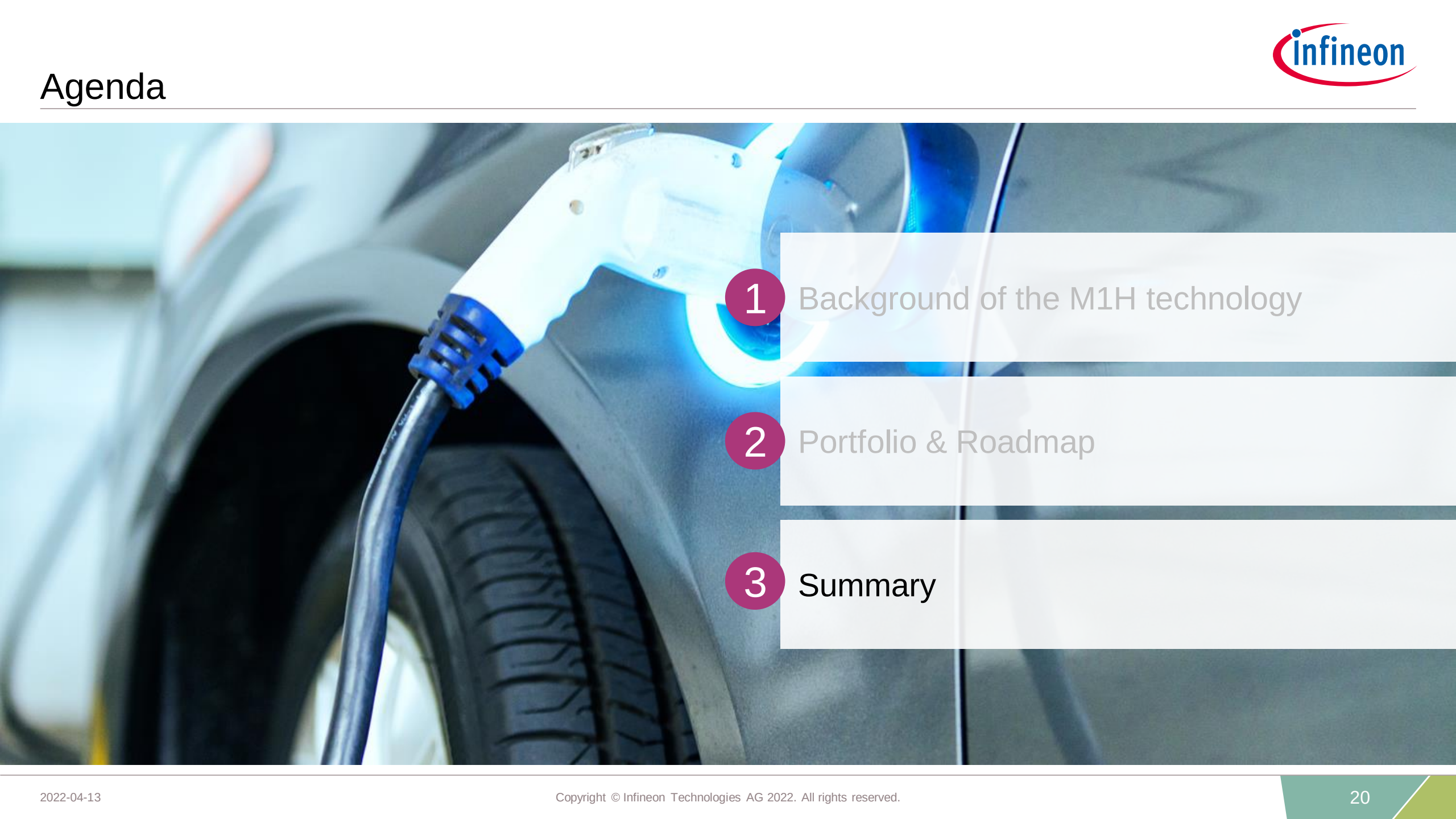
- › Enhances the thermal dissipation capabilities with **>15% improvement** on thermal conductivity.
- › **>25% reduction** on junction-to-case thermal resistance (R_{thjc})
- › **>45% reduction** on junction-to-case thermal impedance (Z_{thjc})
- › **Reduce thermo-mechanical stress**; increase power cycling capabilities.

1200 V CoolSiC™ MOSFET

.XT enhances optimization potential even further for SiC based designs



Agenda

A close-up photograph of a white and blue electric vehicle charging cable plugged into a car's charging port. The car is dark-colored, and a tire is visible in the background. The image has a blue tint.

1 Background of the M1H technology

2 Portfolio & Roadmap

3 Summary

+SiC Silicon Carbide

- › Introduction of a new 1200 V SiC MOSFET chip upgrade called M1H with added features and wide range of control possibilities
- › Extended chip & package portfolio for highest flexibility and power density
- › Product introduction of Easy 3B using 1200 V CoolSiC™ MOSFET and .XT in low-ohmic TO247 portfolio



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