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Masters of Power Solution

1200V Gen1 *e*SiC MOSFET Selection Guide 2024

Advanced Power Master Semiconductor's Silicon Carbide Technology

1200V SiC MOSFET
Target applications & Topologies

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Applications

Solar Inverter

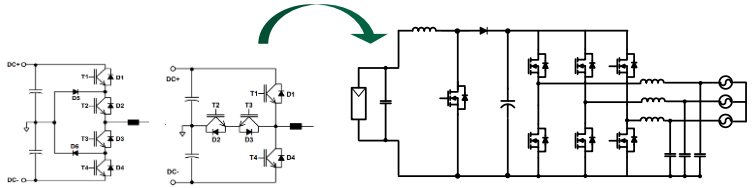
EV Charging Station

OBC

UPS

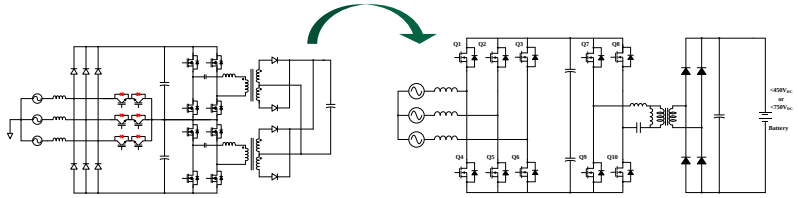
Motor Drives / Traction Inverter

Topology

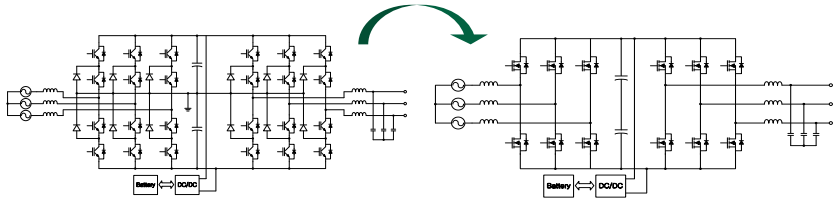


(1) NPC (One leg) (2) TNPC (One leg)

Boost, NPC, TNPC, ANPC



3Φ B6 PFC / FB LLC

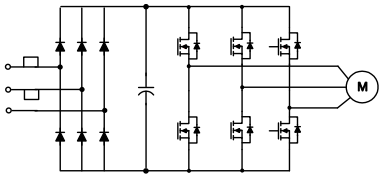


3 phase, 3 level, Diode Clamped Converter

3 phase, 3 level NPC Inverter

3 phase, 2 level, Converter

3 phase, 3 level Inverter



3Φ inverter

Customer needs in target markets

Performance / Accessibility

- Static Behavior : R_{sp} is important
- Dynamic Behavior
  - Switching losses
  - Cap & Charges (Q_G, E_{OSS})
- Good thermal properties

Robustness / Stability

- High UIS Capability
- Robustness against parasitic turn-on effects
- Robust Body diode
- SCWT : > 3μs (for Traction Inverter)

Product Strategy : *e*SiC MOSFET

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650V SiC MOSFET

15 / 22 / 27 / 39 / 45mΩ
G1 - Die : 5 Parts / Package : 14 Parts


Server / Telecom


TV&LED lighting


xEV

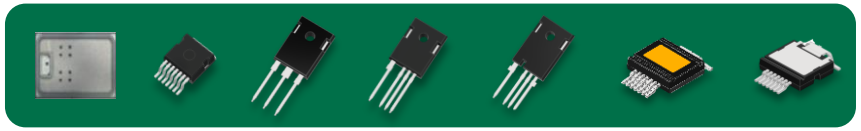

ESS


Solar Inverter


EV Charging Pole


Industrial Motors

1200V SiC MOSFET



10(M3)/ 16(M2)/ 21(M1) /30/40/60/80mΩ
G1 - Die : 3 Parts / Package : 13 Parts


xEV

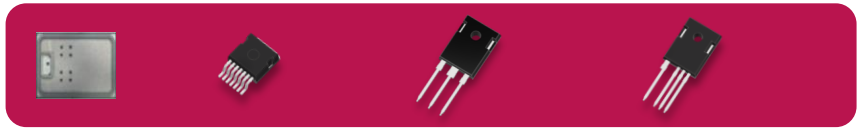

Solar Inverter


EV Charging Pole


UPS


Industrial Motors

1700V SiC MOSFET



24 / 40 / 1000mΩ
G1 - Die : 4 Parts / Package : 14 Parts


Solar Inverter


EV Charging Pole


3phase flyback (smart meter, Aux .Power)

Product Differentiation | High Efficiency (for Non-motor control) | High Ruggedness (for Motor control)

1200V / 40mΩ *e*SiC MOSFET
Key Parameter Comparison

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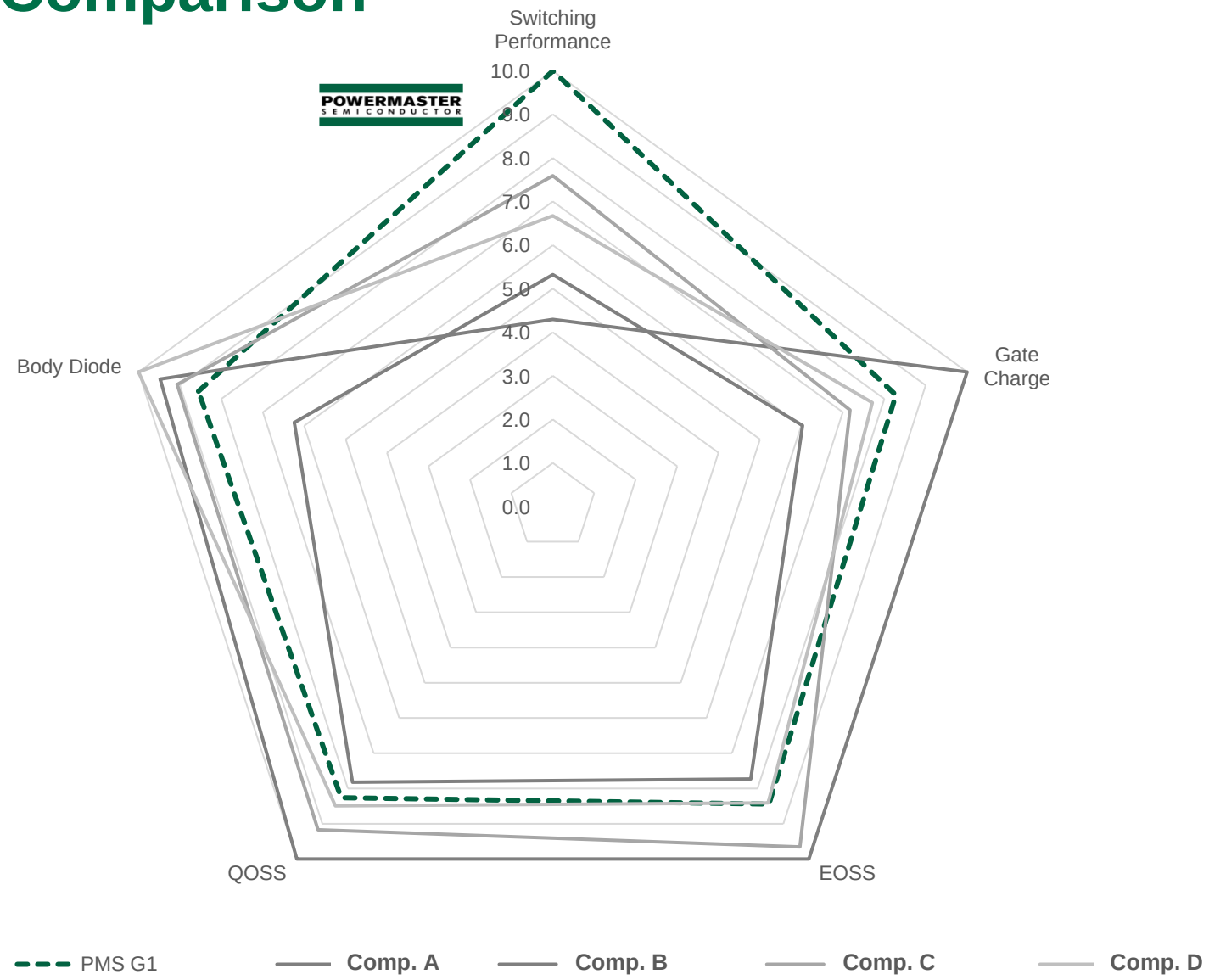

1200V / 40mΩ eSiC MOSFET
Key Parameter Comparison

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Datasheet	PMS G1 PCZ120N40M1	Comp. A	Comp. B	Comp. C	Comp. D
BV_{DSS} [V]	**1200**	1200	1200	1200	1200
I_D [A]	**60**	60	55	70	63
Max V_{GS} [V]	**-10 / 22**	-10 / 22	-10 / 25	-10 / 22	-8 / 21
I_{GSS} [nA]_Max.	**±100** **(-10V / 22V)**	250 (20V)	250 (20V)	200 (18V)	250 (15V)
Recommended v_{GS} [V]	**-5 / 18**	-5 / 20	-5 / 20	-5 / 18	-3 / 15
$R_{DS(on)}$ [mΩ] (typ) / (max)	**40 / 56**	33 / 45	33 / 45	35 / 40	40 / 52
V_{TH} [V]	**2.0 / 3.0 / 4.5**	2.0 / - / 4.0	2.0 / - / 4.0	2.0 / 3.2 / 4.0	1.8 / 2.4 / -
Int. R_G [Ω]	**3.5**	5.0	1.9	2.1	1.3

1200V / 40mΩ eSiC MOSFET
Gate Charge(Q_G), E_{OSS} & Q_{OSS}

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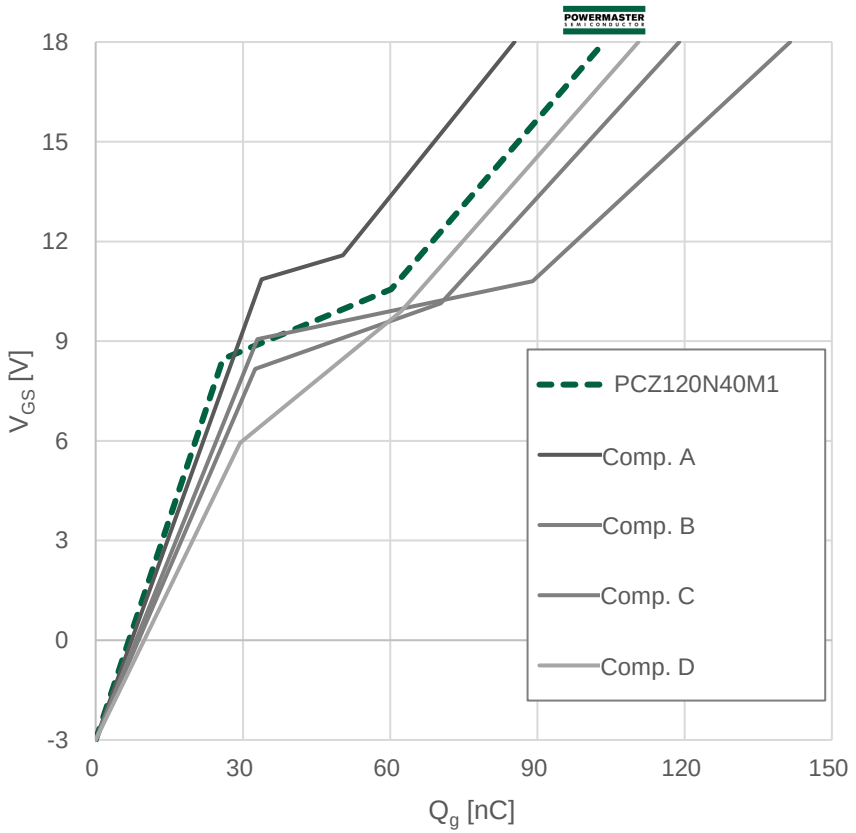
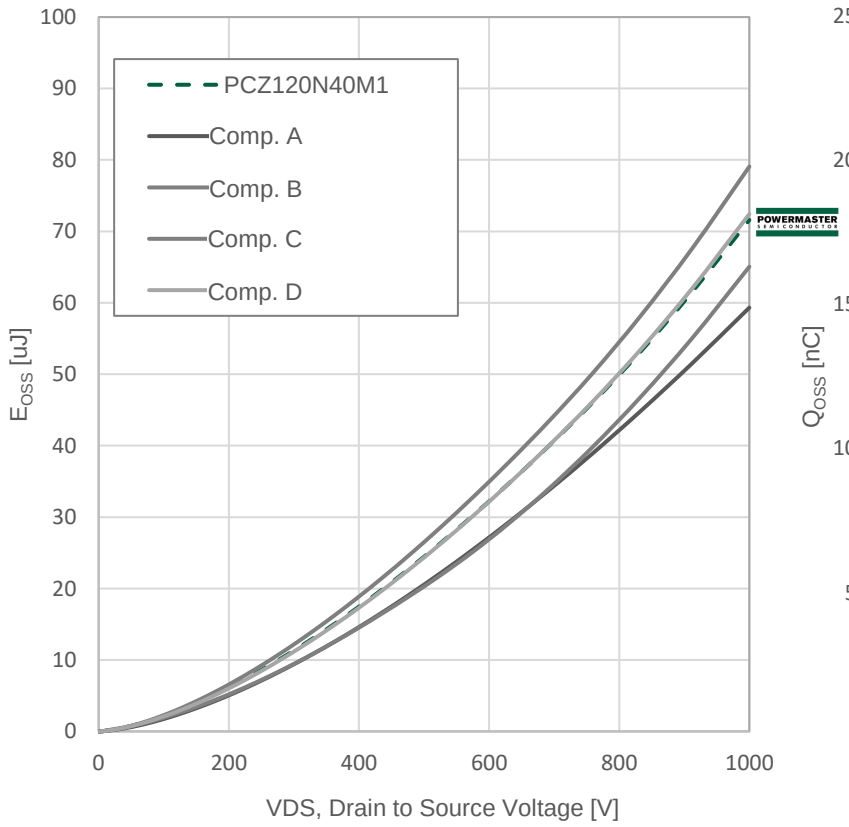
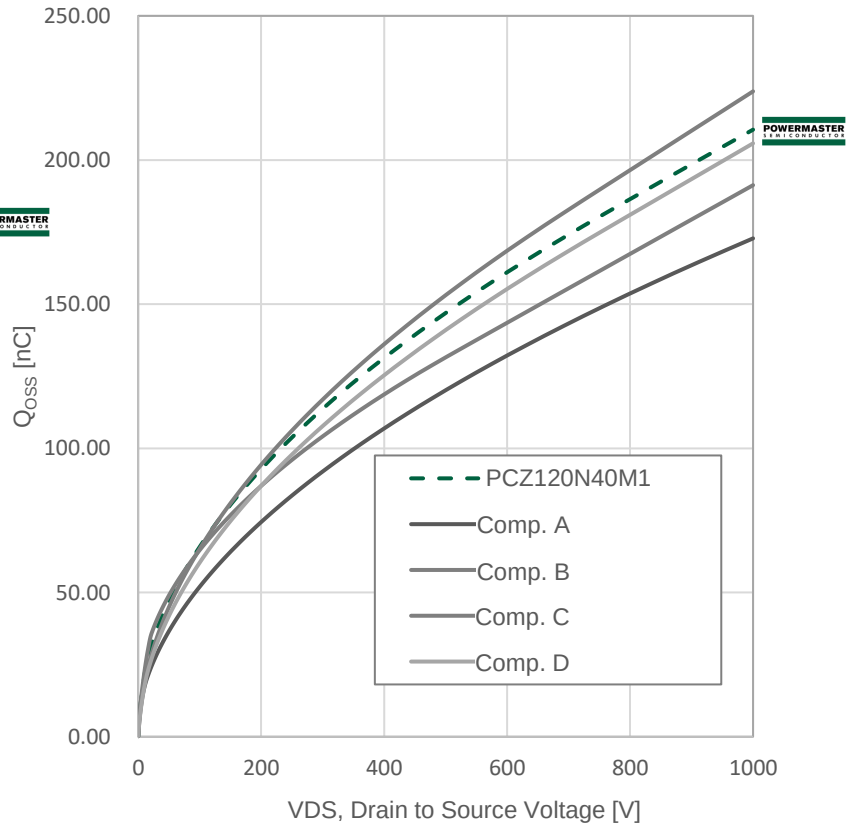
- Gate Charge(Q_G) Comparison



- E_{OSS} Comparison



- Q_{OSS} Comparison



1200V / 40mΩ eSiC MOSFET
Hysteresis Loss in Output Capacitance

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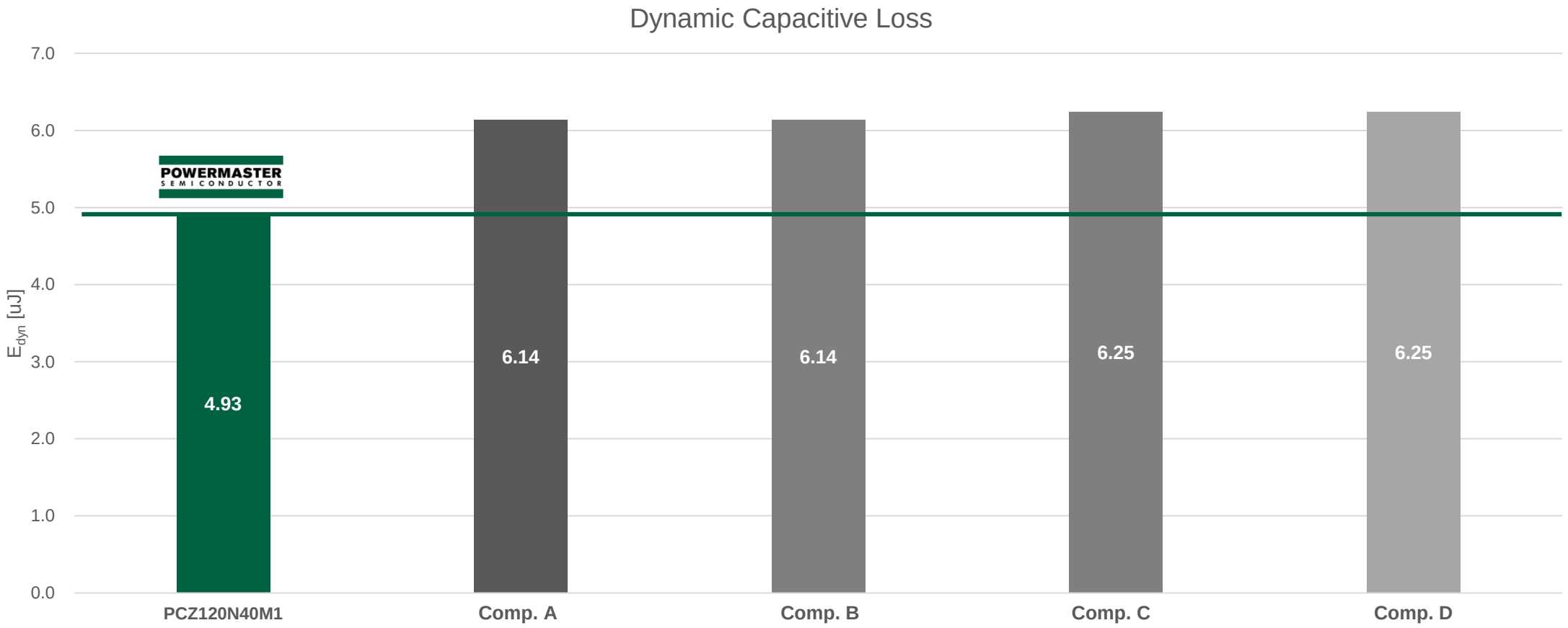

DUTs	PCZ120N40M1	Comp. A	Comp. B	Comp. C	Comp. D
E_{dyn} [uJ] @ 800V	4.93	6.14	6.14	6.25	6.25

1200V / 40mΩ eSiC MOSFET Performance Benchmark

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- **AC Parameter's Comparison Table under Same test condition**

	Best				Worst
Q_g [nC]	Comp. A 85.3	PCZ120N40M1 103	Comp. D 110.6	Comp. C 118.9	Comp. B 141.5
E_{dyn} [uJ]	PCZ120N40M1 4.93	Comp. A 6.14	Comp. B 6.14	Comp. D 6.25	Comp. C 6.25
E_{oss} [uJ]	Comp. A 42.2	Comp. C 43.69	PCZ120N40M1 49.99	Comp. D 50.2	Comp. B 54.59
Q_{oss} [nC]	Comp. A 153.68	Comp. C 167.45	Comp. D 181	PCZ120N40M1 186.43	Comp. B 196.51
T_{rr} [ns]	Comp. D 15.2	Comp. C 16.2	PCZ120N40M1 17.1	Comp. A 17.3	Comp. B 20.2

- **Ruggedness Comparison Table @ UIS (unclamped inductive switching test)**

	Best			Worst
I_{AS} [A]	Comp. B 59.1	Comp. D 54.5	PCZ120N40M1 48.7	Comp. C 39

1200V / 40mΩ eSiC MOSFET
Switching Performance Benchmark

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- **Switching Performance Comparison @ Same test condition**

I_D=40A	Best				Worst
Turn-on Loss	PCZ120N40M1	Comp. C	Comp. D	Comp. B	Comp. A
[uJ]	374	461	593	690	1013
Turn-off Loss	PCZ120N40M1	Comp. D	Comp. C	Comp. A	Comp. B
[uJ]	178	234	266	272	346
Total SW Loss	PCZ120N40M1	Comp. C	Comp. D	Comp. B	Comp. A
[uJ]	552	727	827	1037	1285
Peak Vds	Comp. B	Comp. D	Comp. C	PCZ120N40M1	Comp. A
[V]	995	1021	1033	1040	1057
Negative Vgs	Comp. B	PCZ120N40M1	Comp. D	Comp. C	Comp. A
[V]	-3.8	-4.0	-4.0	-5.8	-6.0

1200V / 40mΩ eSiC MOSFET
PCZ120N40M1 Switching Loss

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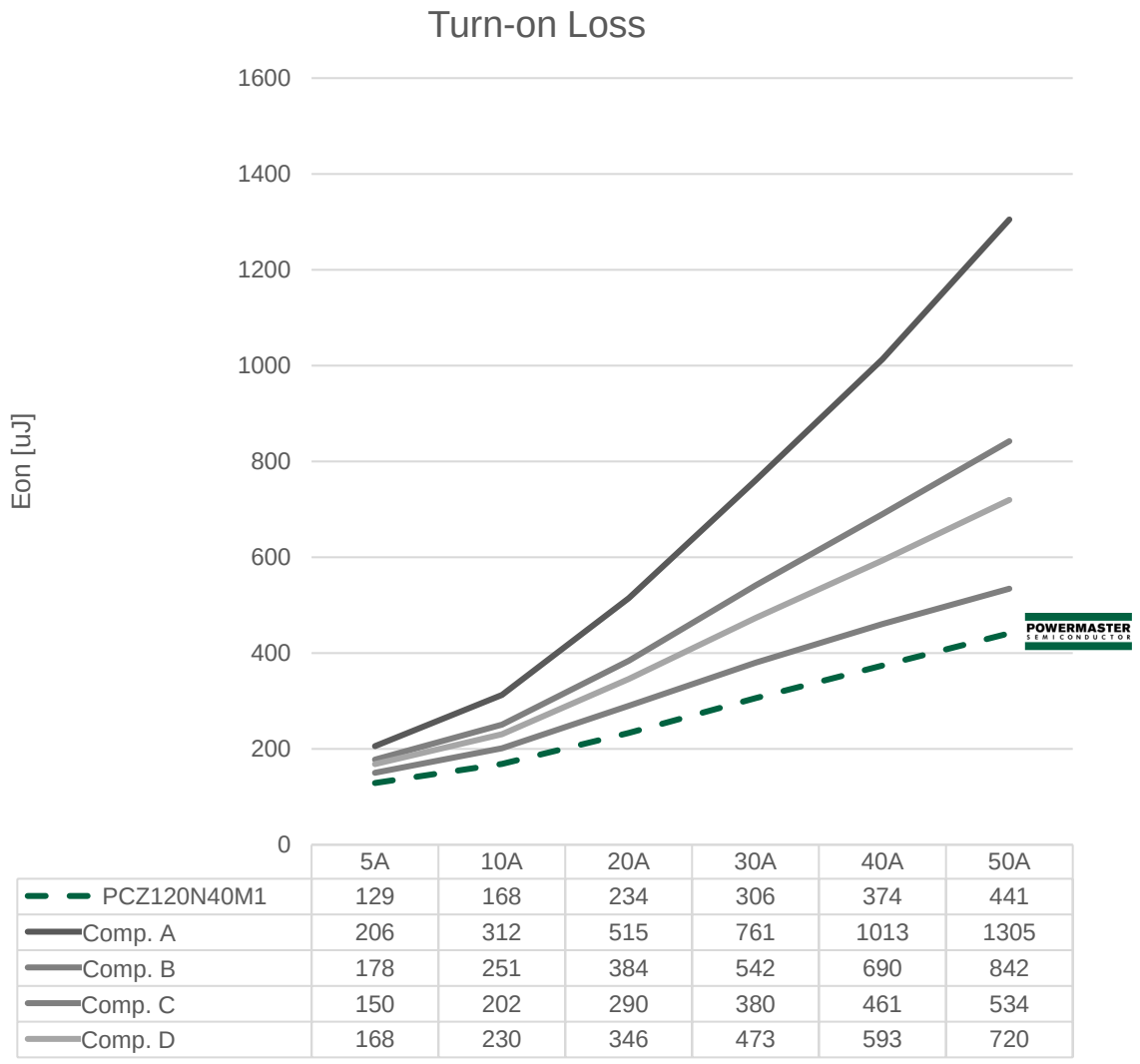

	5A	10A	20A	30A	40A	50A
PCZ120N40M1	129	168	234	306	374	441
Comp. A	206	312	515	761	1013	1305
Comp. B	178	251	384	542	690	842
Comp. C	150	202	290	380	461	534
Comp. D	168	230	346	473	593	720

	5A	10A	20A	30A	40A	50A
PCZ120N40M1	54	58	65	115	178	258
Comp. A	31	32	33	53	94	150
Comp. B	47	55	87	175	272	384
Comp. C	60	72	128	232	346	477
Comp. D	48	54	81	169	266	386

V_{DD}=800V, V_{GS}=-3V/+18V, Ext Rg=4.7Ω, FWD=PCH120S20D1

1200V / 40mΩ eSiC MOSFET
PCZ120N40M1 Switching Loss

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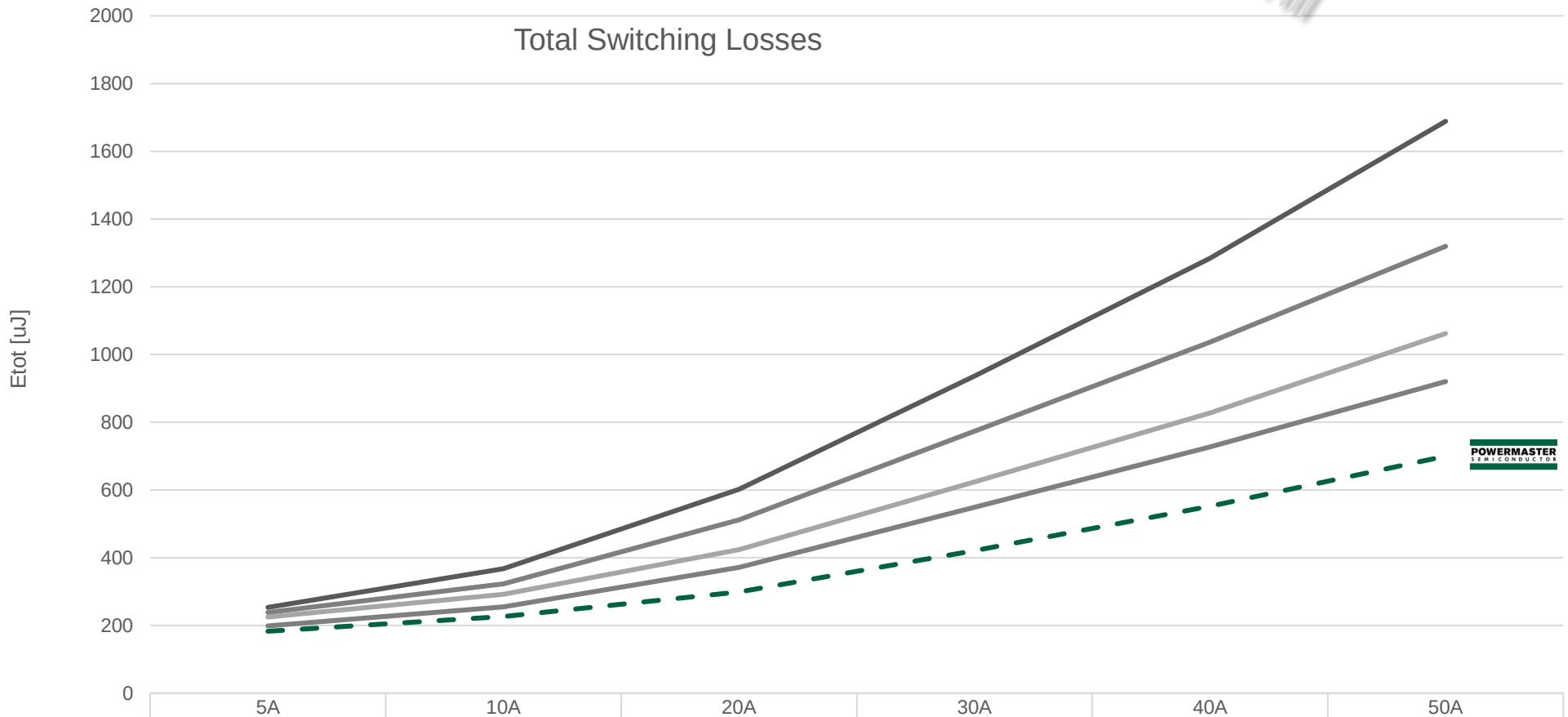

	5A	10A	20A	30A	40A	50A
PCZ120N40M1	183	226	299	421	552	700
Comp. A	253	367	602	936	1285	1689
Comp. B	238	323	512	774	1037	1319
Comp. C	198	255	372	549	727	920
Comp. D	225	292	423	624	827	1062

V_{DD}=800V, V_{GS}=-3V/+18V, Ext Rg=4.7Ω, FWD=PCH120S20D1

1200V / 40mΩ eSiC MOSFET
PCW120N401M1 Switching Performance

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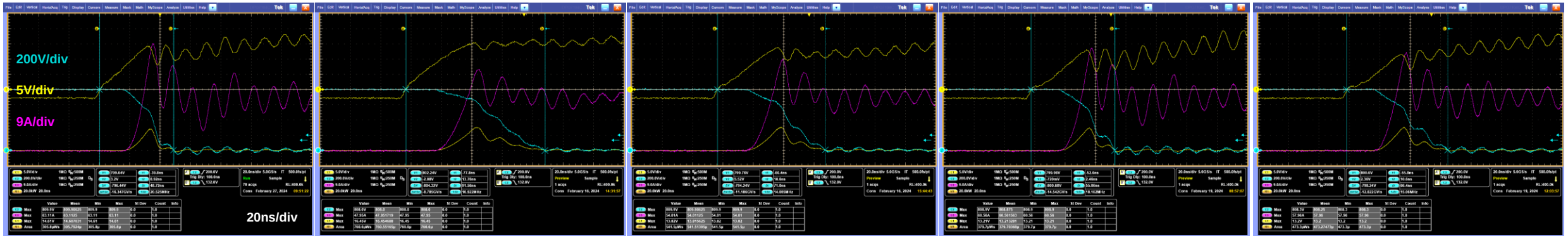
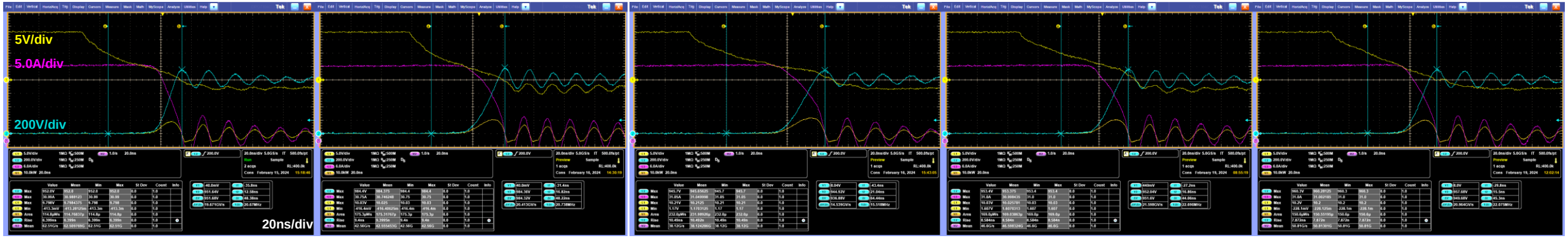
Turn-on @ I_D=30A

PCZ120N40M1 | Comp. A | Comp. B | Comp. C | Comp. D



Turn-off @ I_D=30A

PCZ120N40M1 | Comp. A | Comp. B | Comp. C | Comp. D



V_{DD}=800V, V_{GS}=-3V/+18V, Ext Rg=2Ω, FWD=PCH120S20D1

1200V *e*SiC MOSFET Gen1. Portfolio

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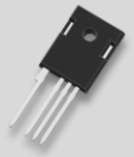
Solar | UPS | EV(OBC) | EV Charger

Available now
Coming Soon

Package / $R_{DS(ON)\_typ}$	Grade	Bare Die	D2PAK-7L	TO-247-3L	TO-247-4L
					
21mΩ	Indus.	PCO120N21M1		PCW120N21M1	PCZ120N21M1
	Auto.				
40mΩ	Indus.	PCO120N40M1	PCBF120N40M1	PCW120N40M1	PCZ120N40M1
	Auto.				PCZ120N40M1A
80mΩ	Indus.	PCO120N80M1	PCBF120N80M1	PCW120N80M1	PCZ120N80M1
	Auto.		PCBF120N80M1A		PCZ120N80M1A

Ordering System (SiC MOSFET)

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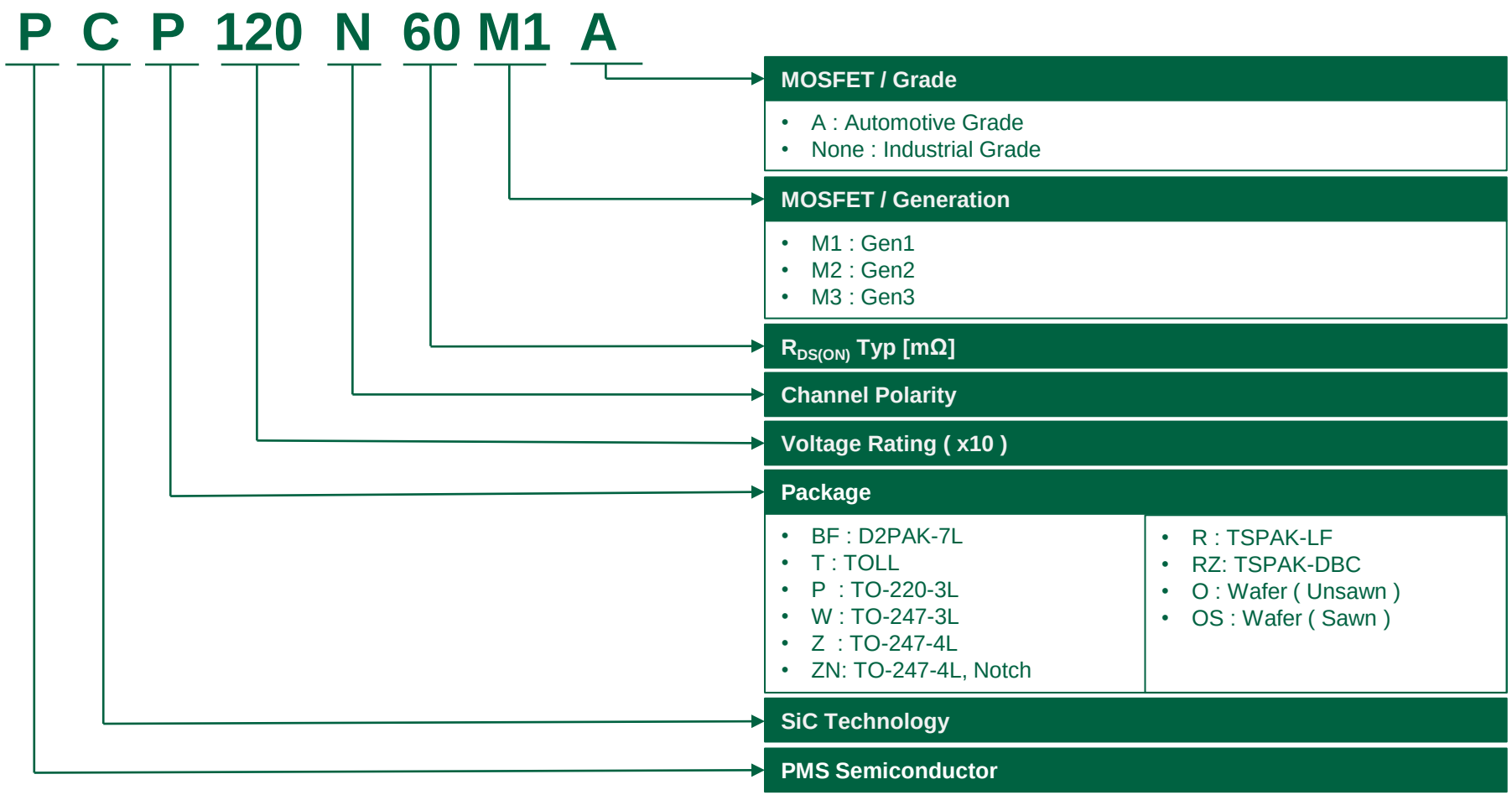

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