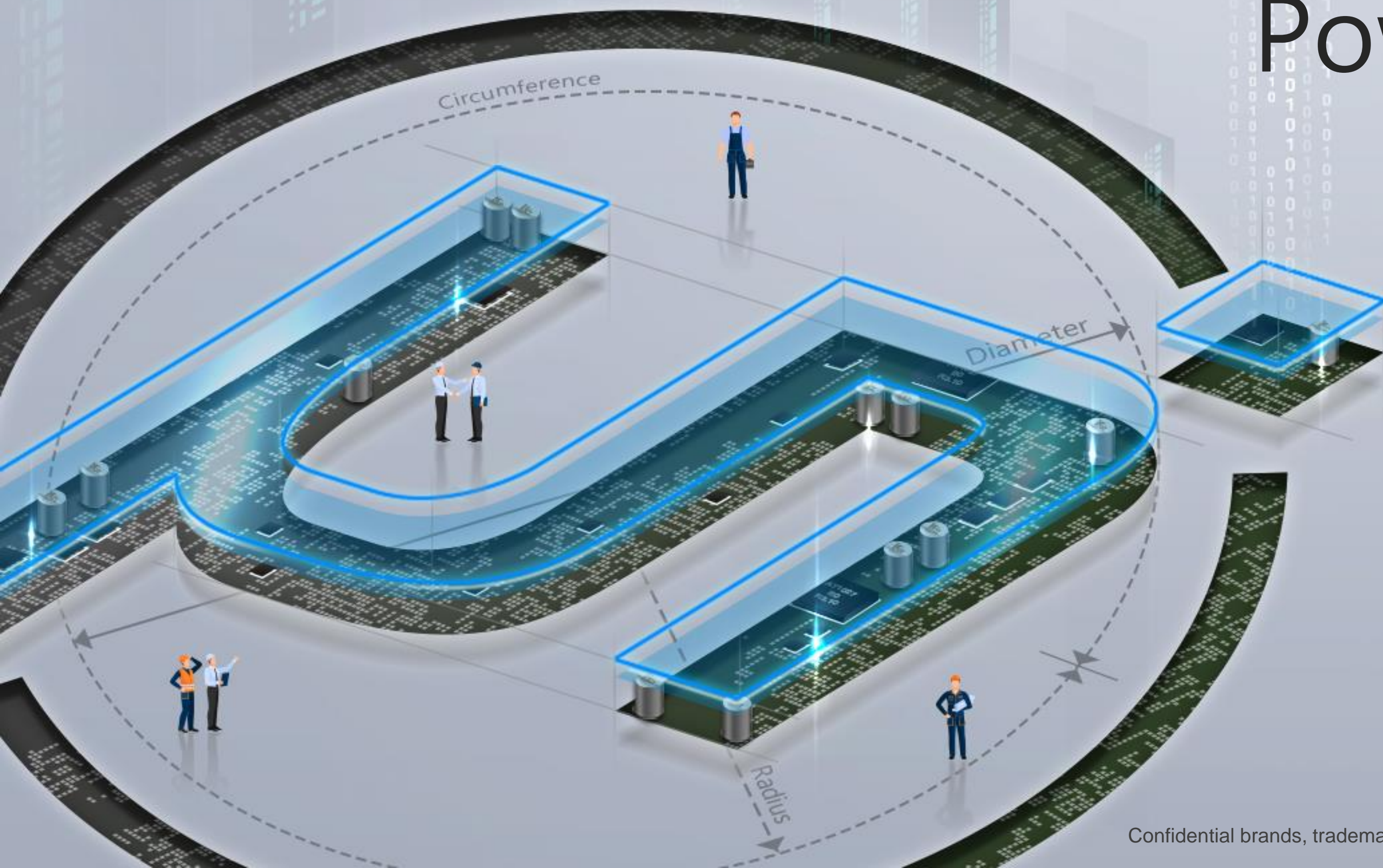
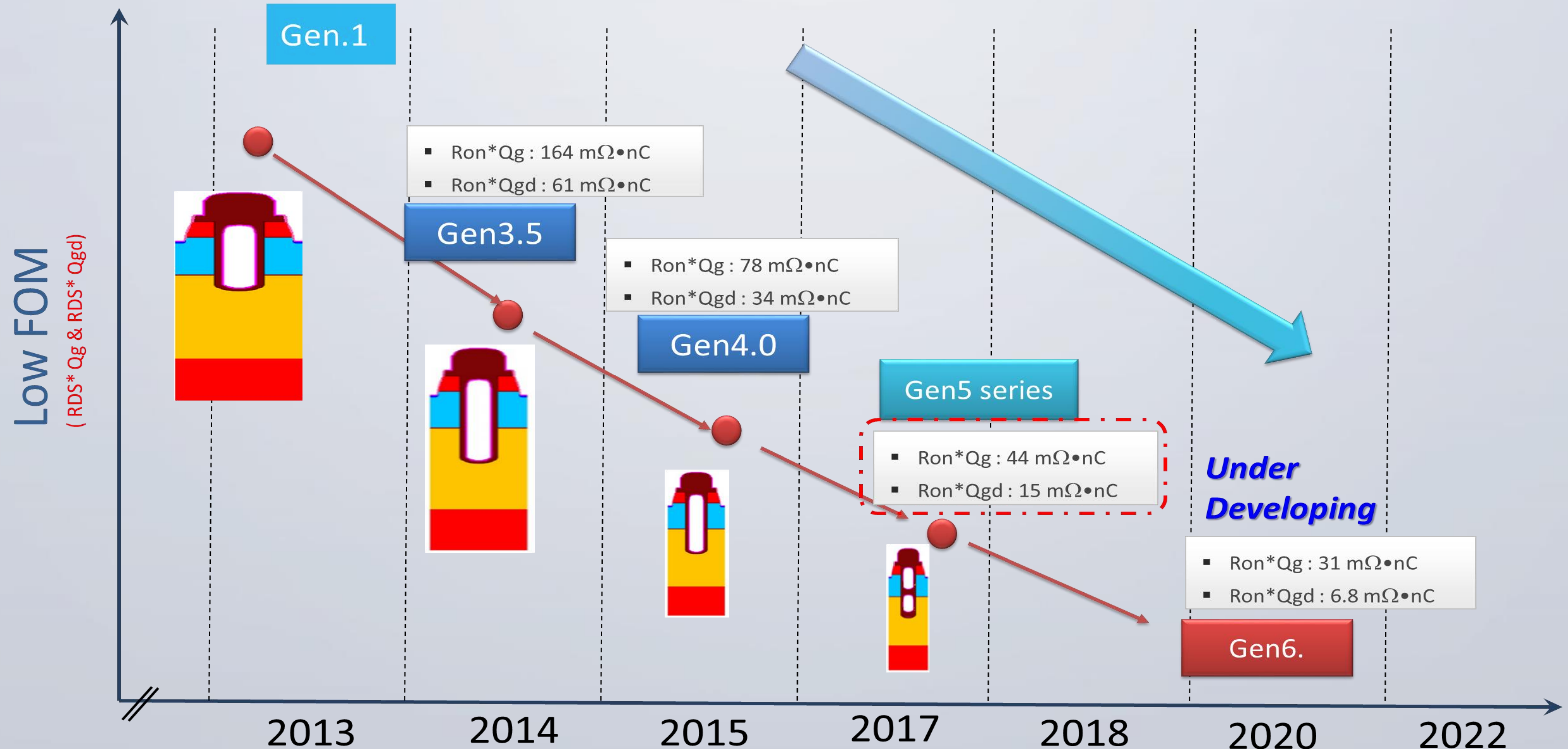


High Density & Precision Power Solution Provider

30th , Sep , 2019



Silicon technology evolution

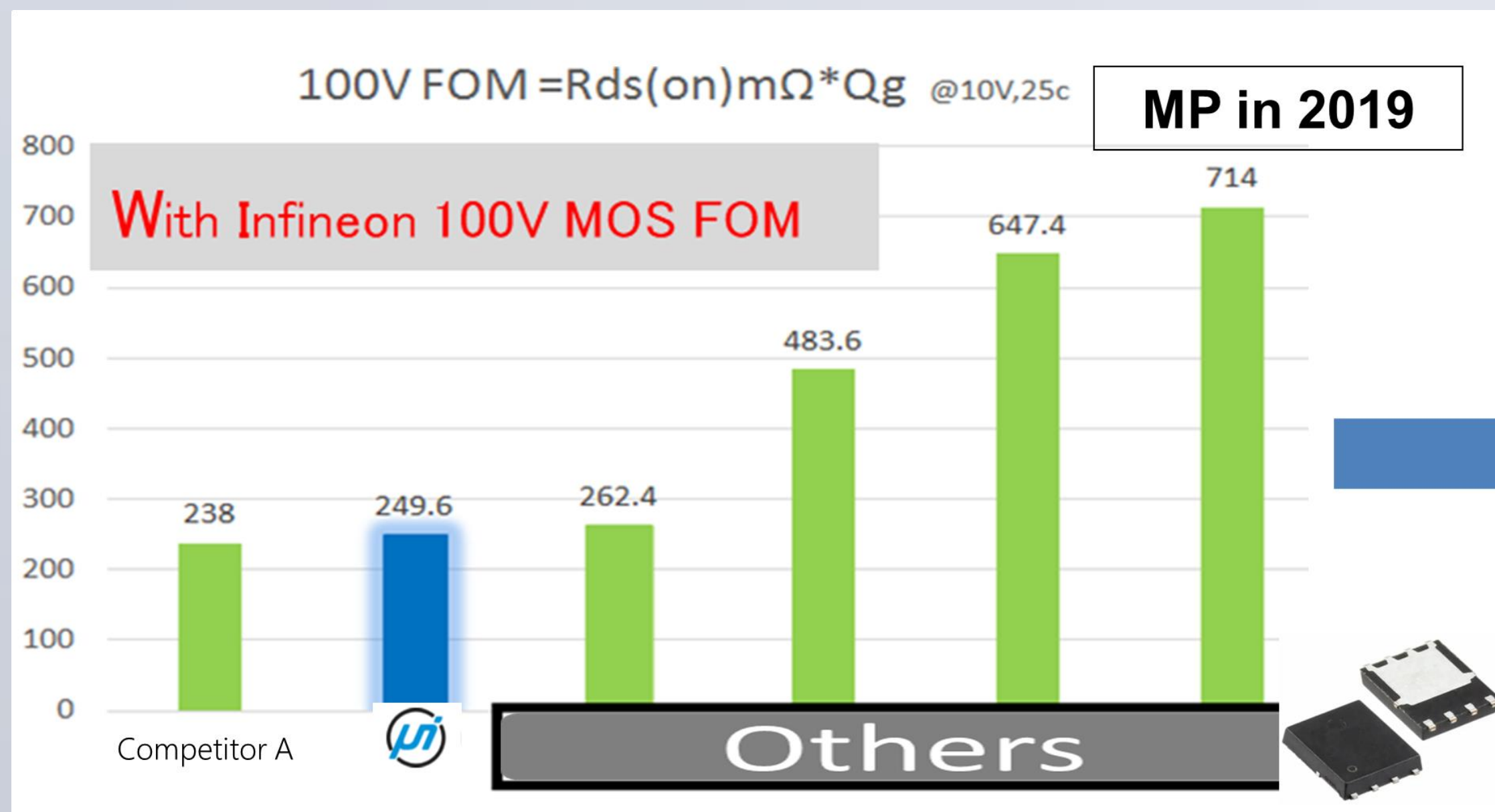


Latest Gen5 series

The Gen5 series incorporates outstanding trench process and packaging technologies to provide the industry's best-in-class performance .

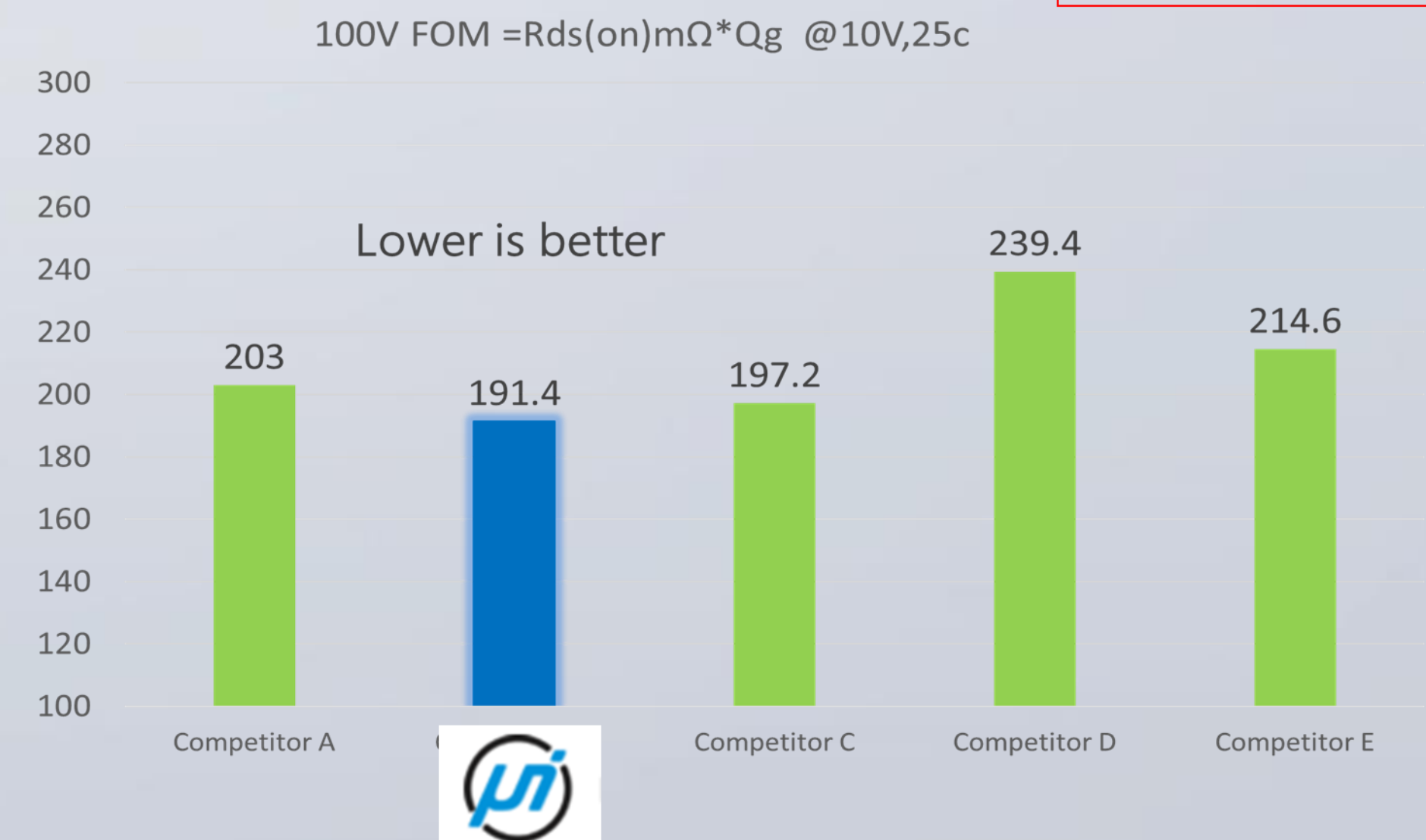
Fabricated with the latest process and the optimized cell structure, the Gen5 series provides a greatly improved trade-off between on-resistance and charge characteristics, which is an important figure of merit for MOSFETs.

- **Low R_{DS(on)}** Reduced I²R losses for high current request .
- **Low Gate charge** Fast Switching and reduced losses in the gate drive circuit .
- **FOM performance** Achieve the best fit between low Ron and low Qg

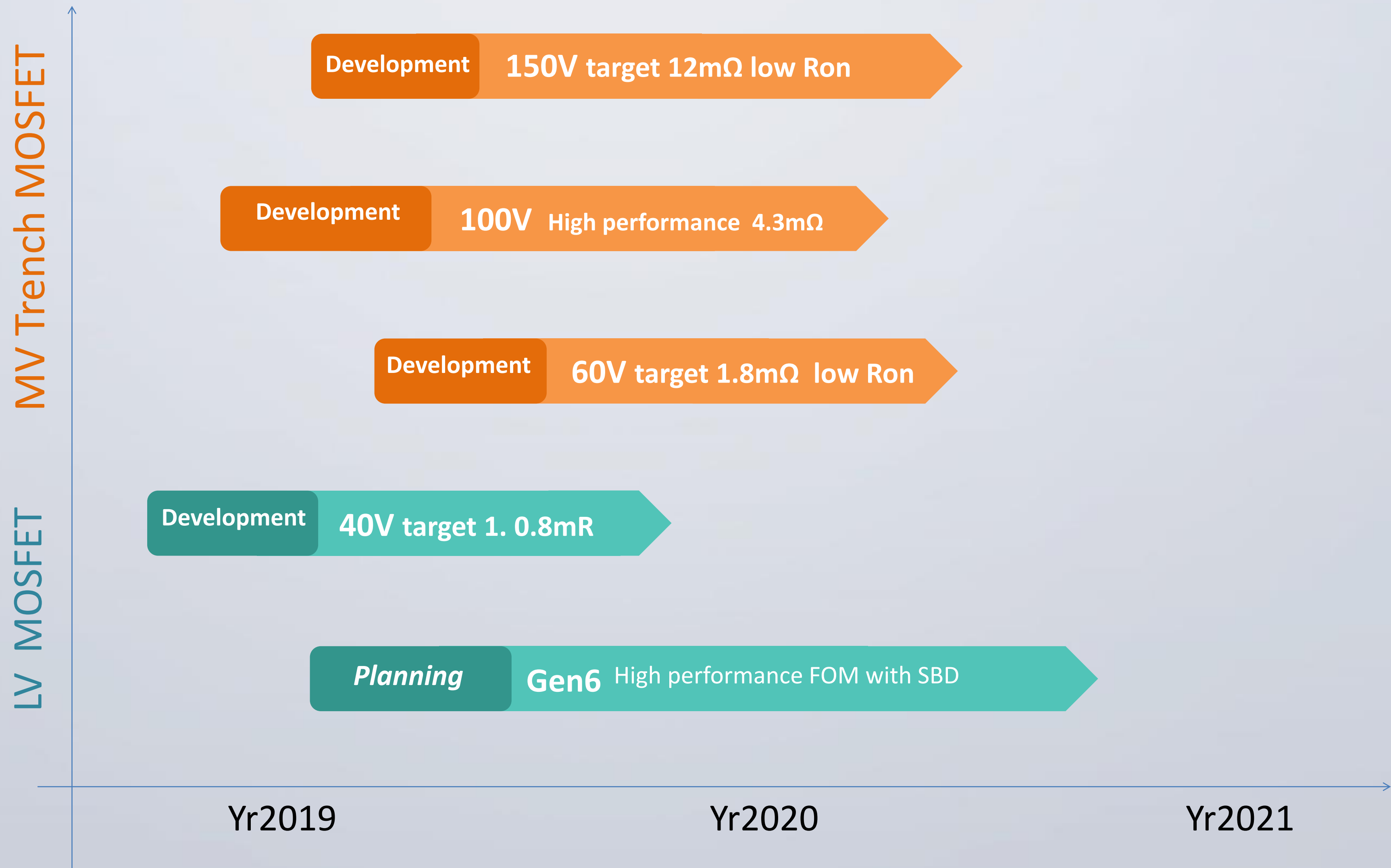


*UPI new 100V platform is low FOM (Ron-typ*Qg)*

MP in 2020



Nch Product Roadmap



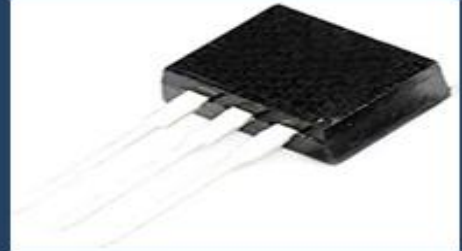
Package evolution

Application

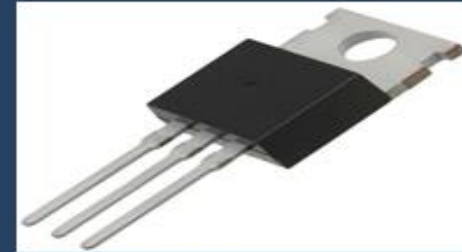
High current



TO-220F



I2PAK



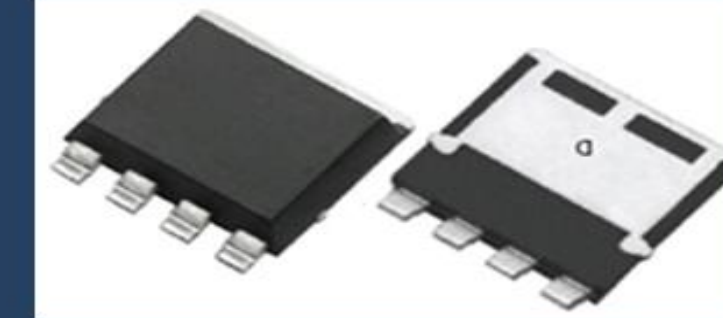
TO-220



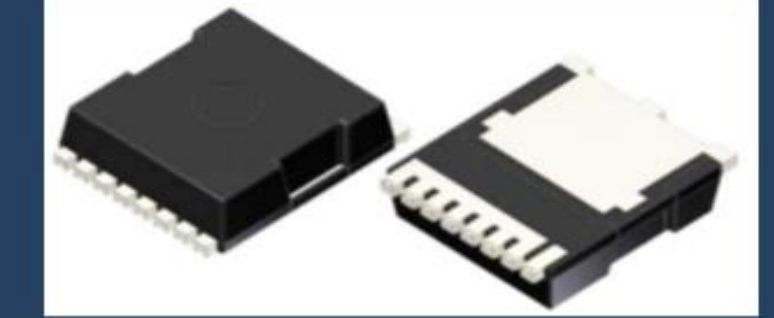
TO-263(D2PAK)



TO263-7 (D2PAK-7)

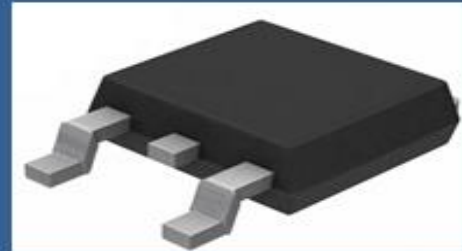


Power Pak 8x8



TOLL leadless

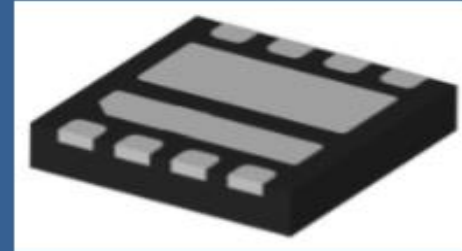
High power density



DPAK



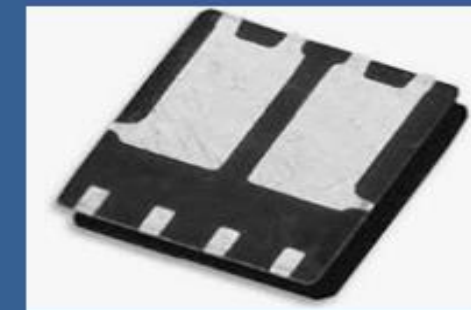
Power 56_33



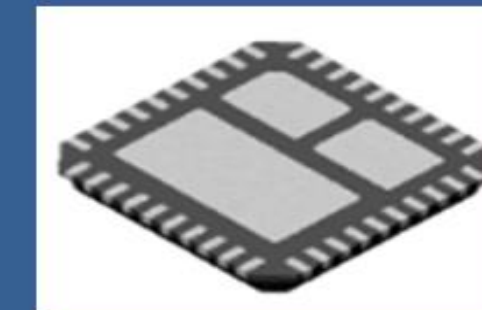
Asym Dual 33



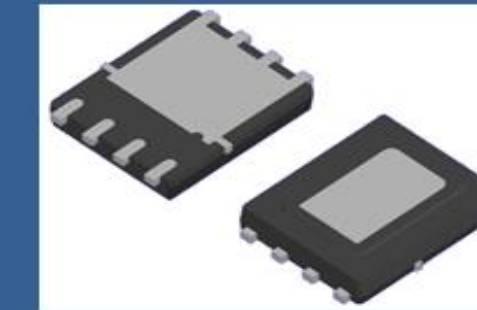
Asym Dual 56



Dual pad 56_33



Dr. MOS



Dual side cooling



Flip type 56

Thin profile



SO8



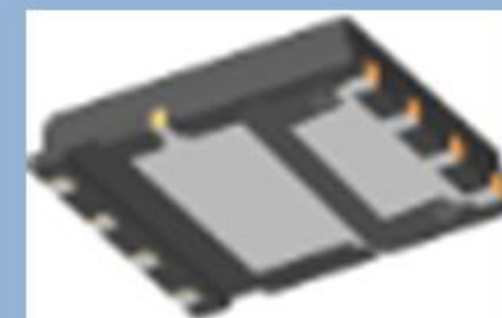
SOT-223



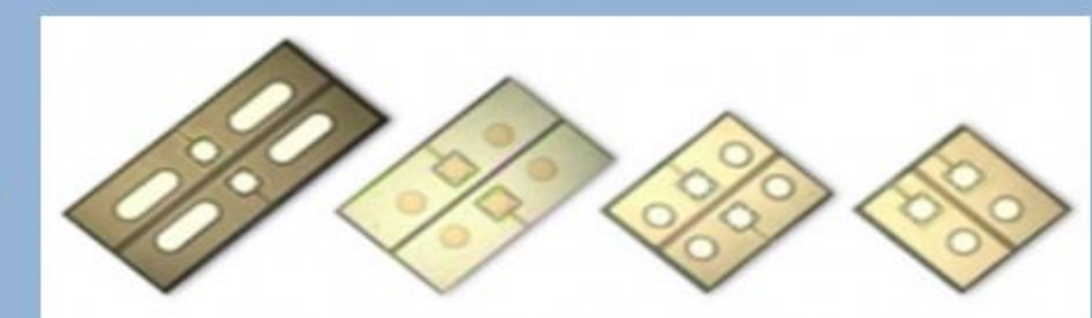
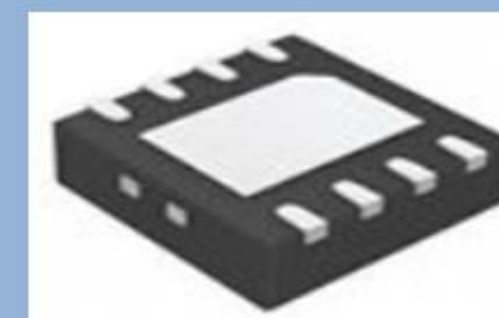
SOT-23



SOT-89



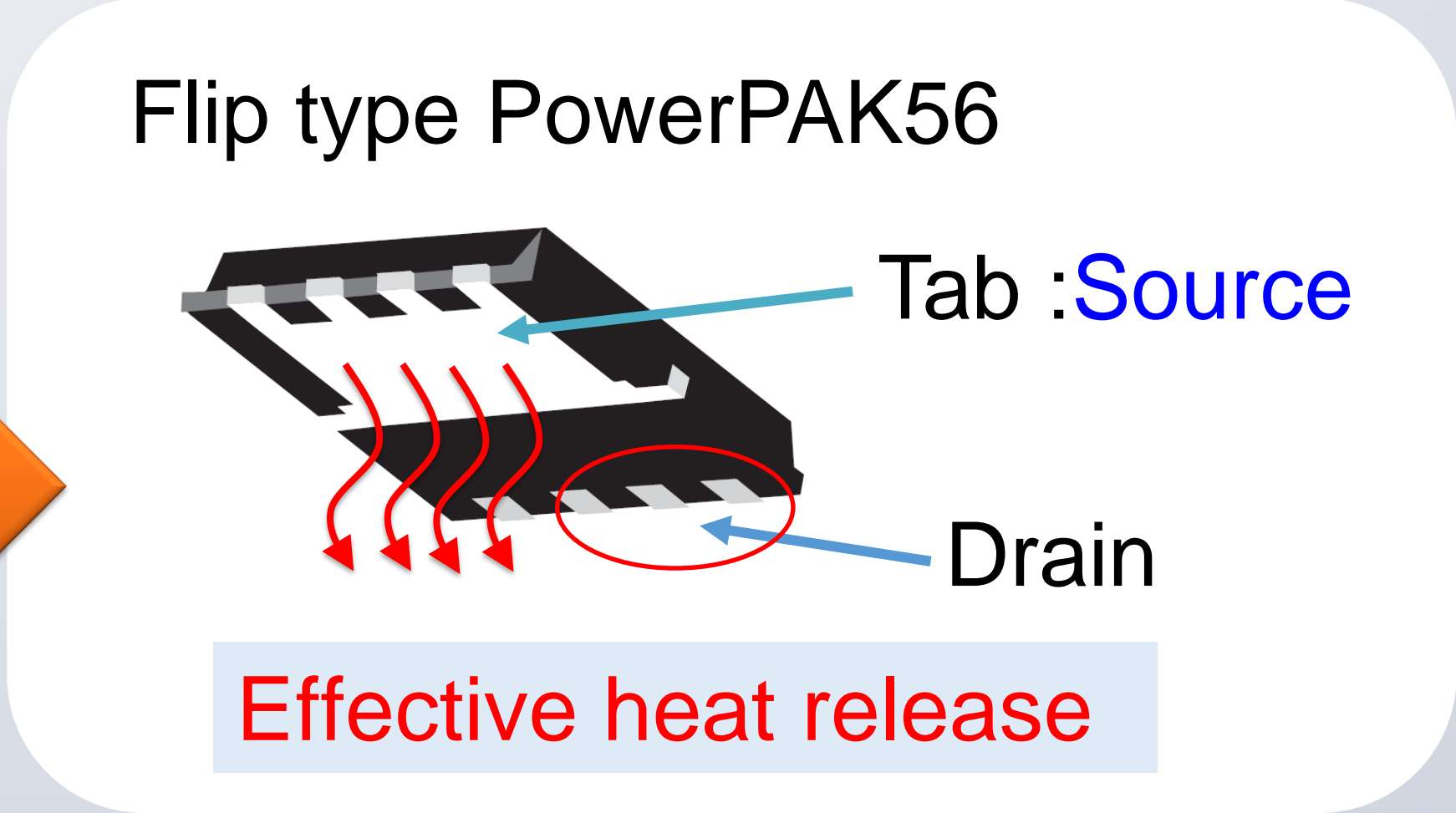
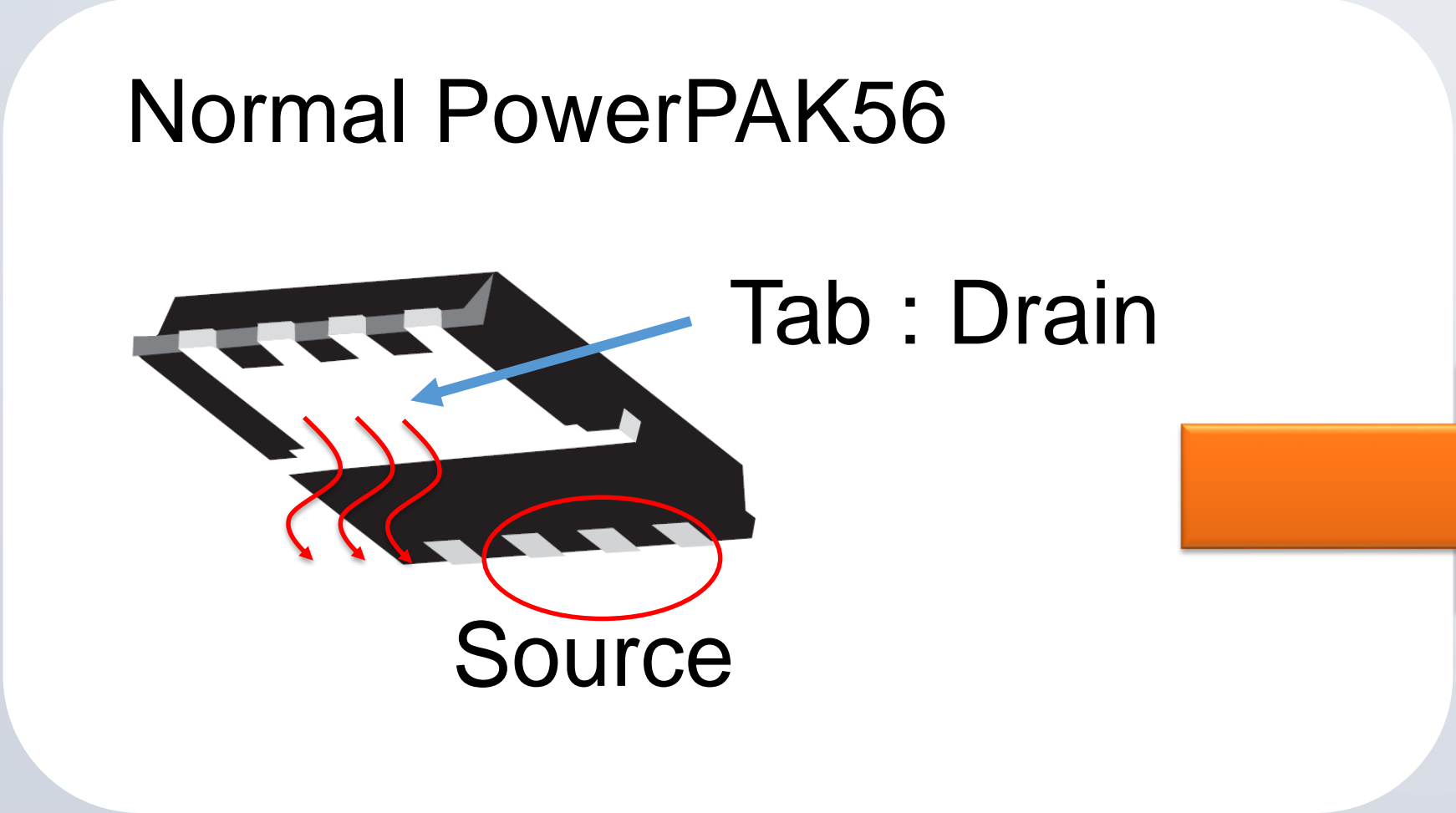
2 in one



CSP

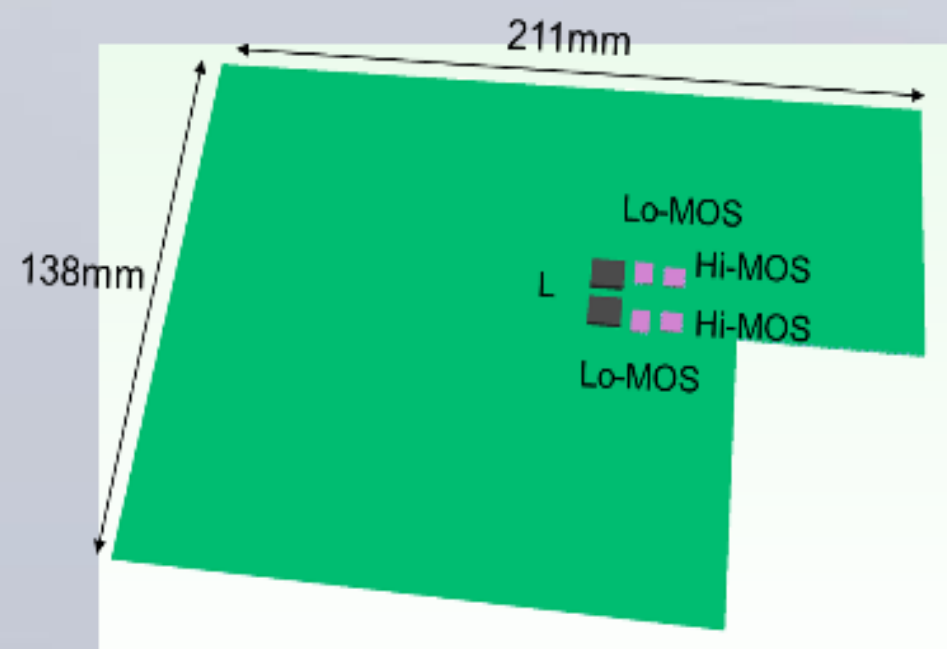
Flip Type PowerPAK 56

Developing

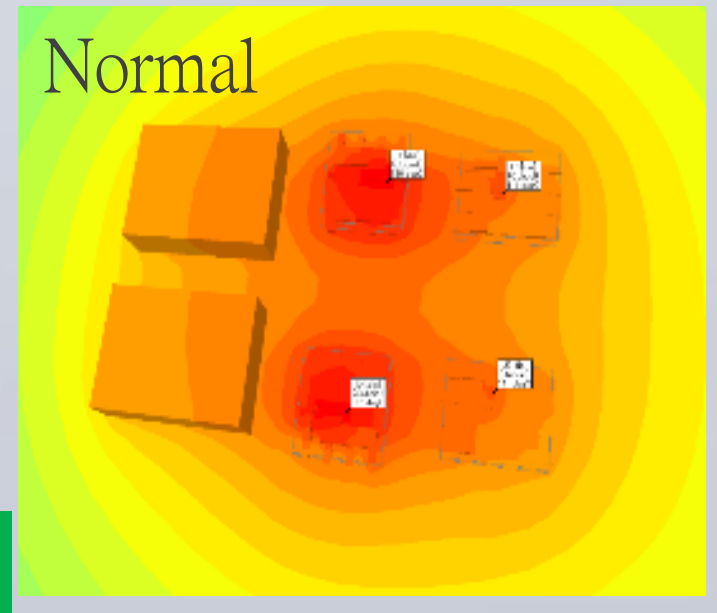
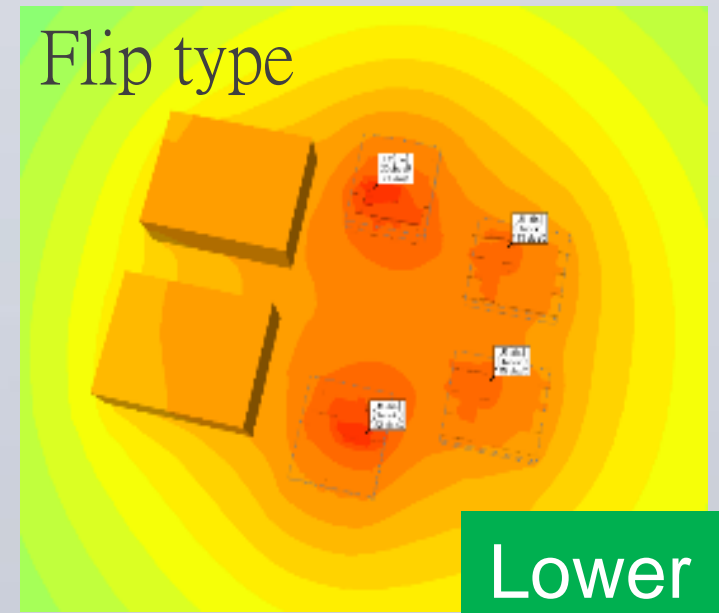


Thermal simulation result

@without air flow



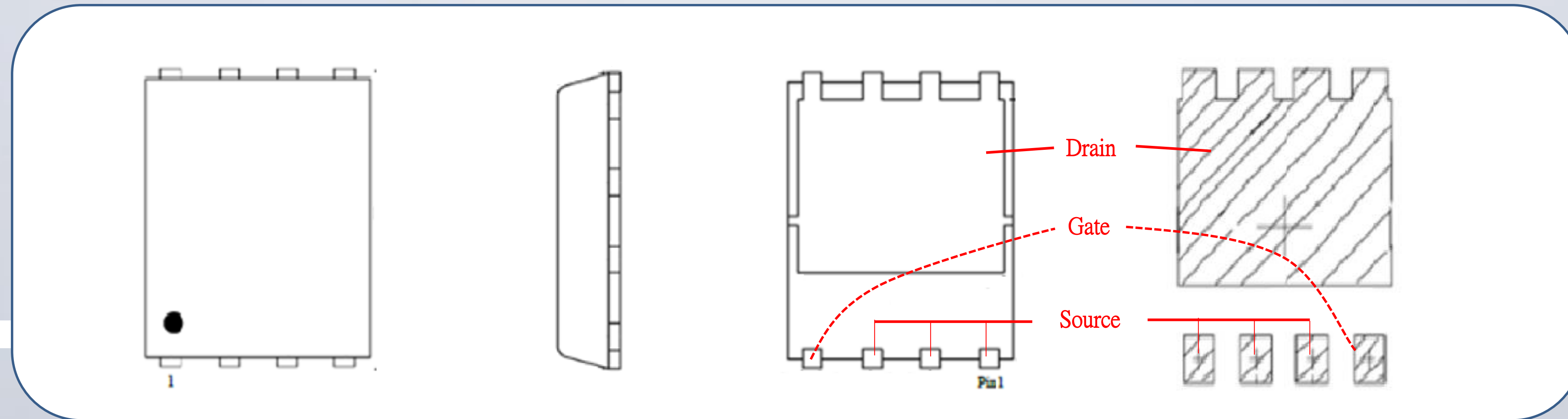
- Model Condition -
- PCB Thickness 1.66mm
- Layer : 8
- Cu Thickness : 1oz
- Thermal via : 0.3mmΦ (Cu)
- DCDC BUCK 2phases
- Hi-side 1.5W x2
- Lo-side 3.0W x2
- L 0.9W x2



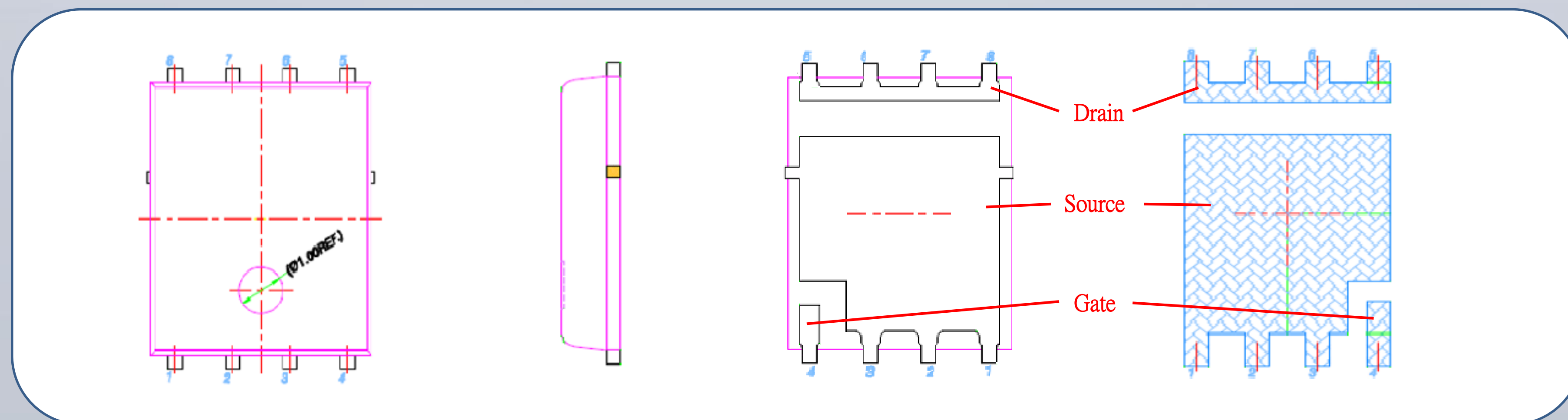
	Hi-1	Hi-2	Lo-1	Lo-2
Flip type	113	113	124	123
Normal 5x6	111	111	136	135

Outline and Footprint

Normal PowerPAK56

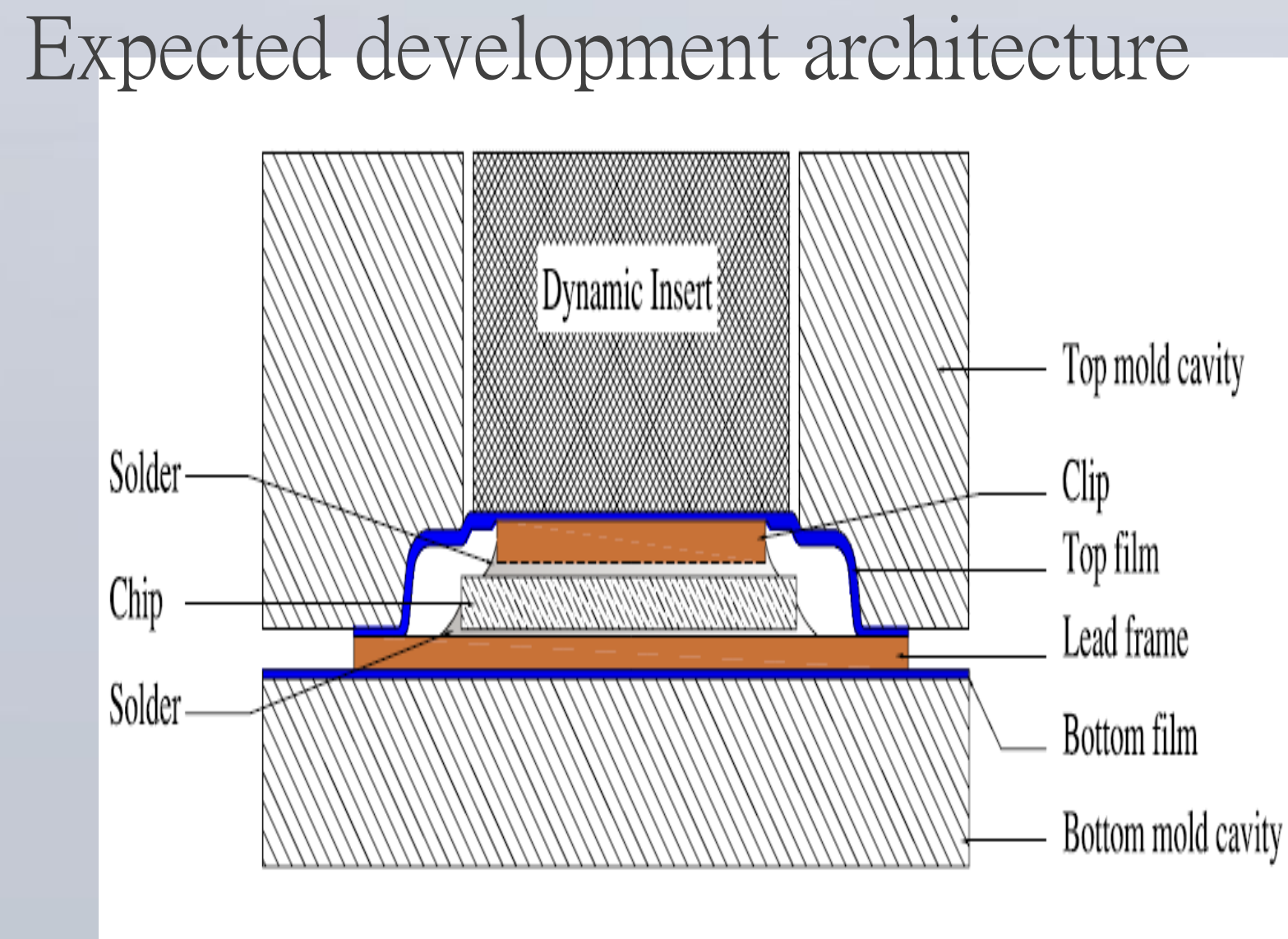
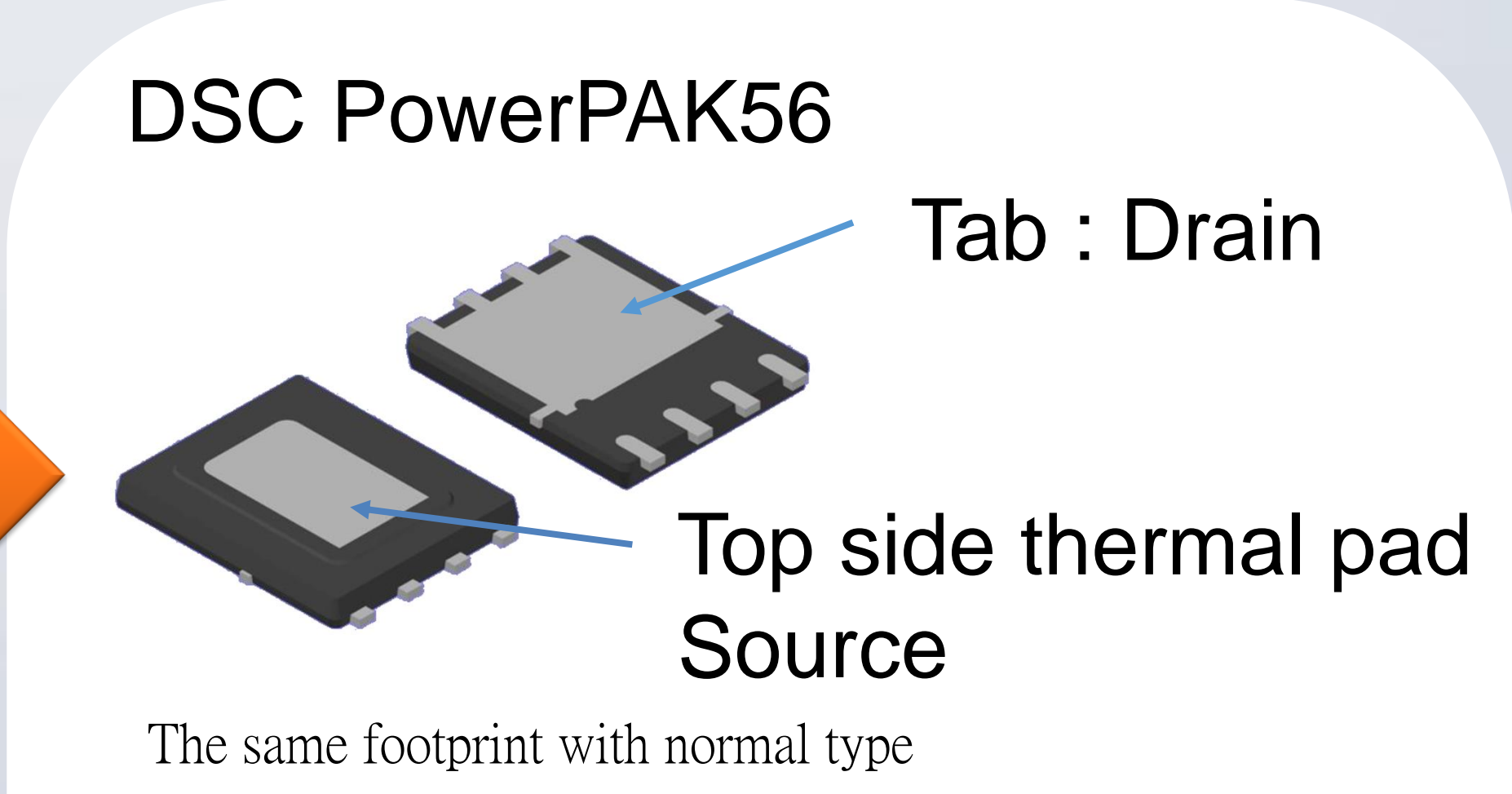
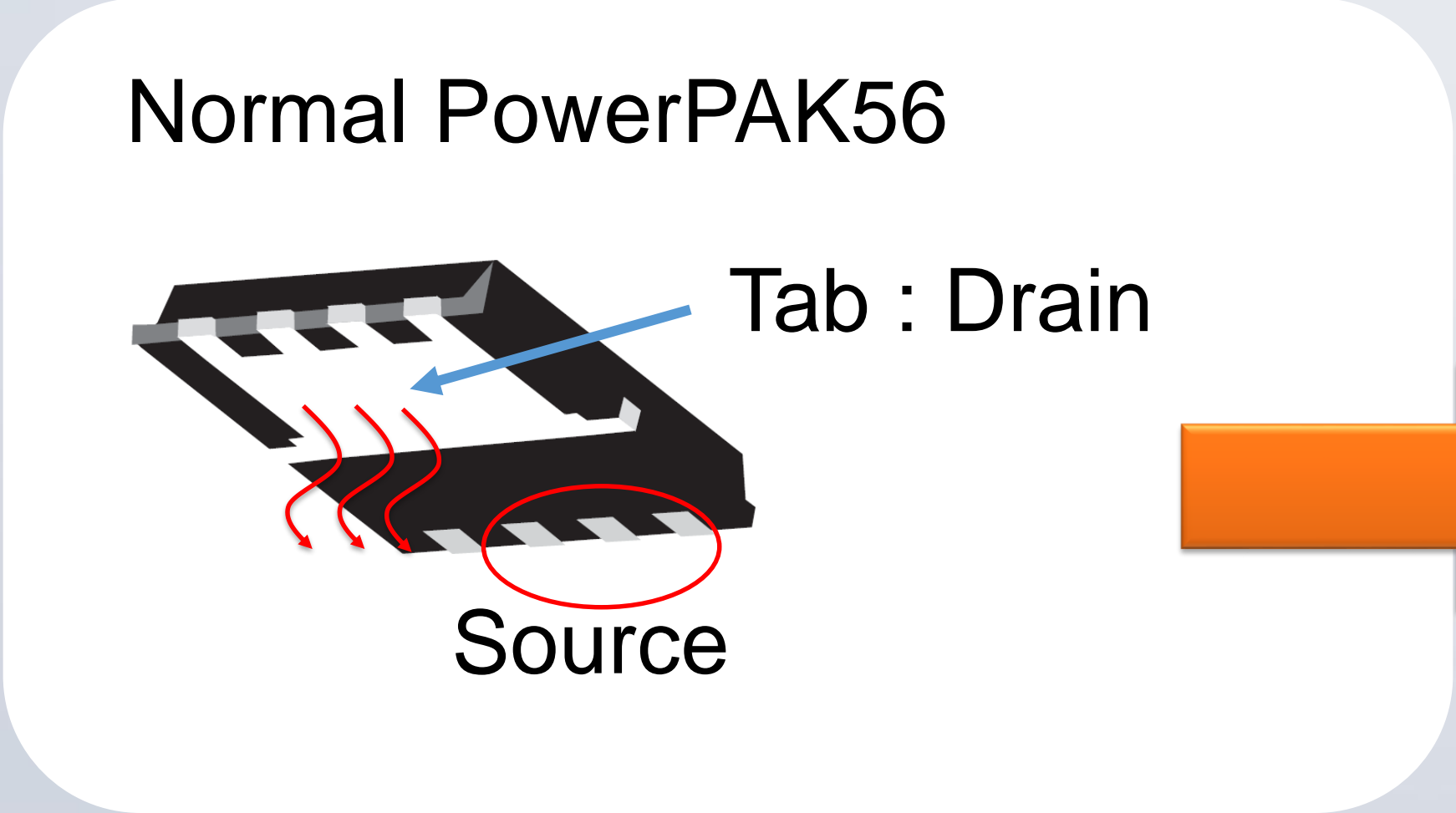


Flip type PowerPAK56

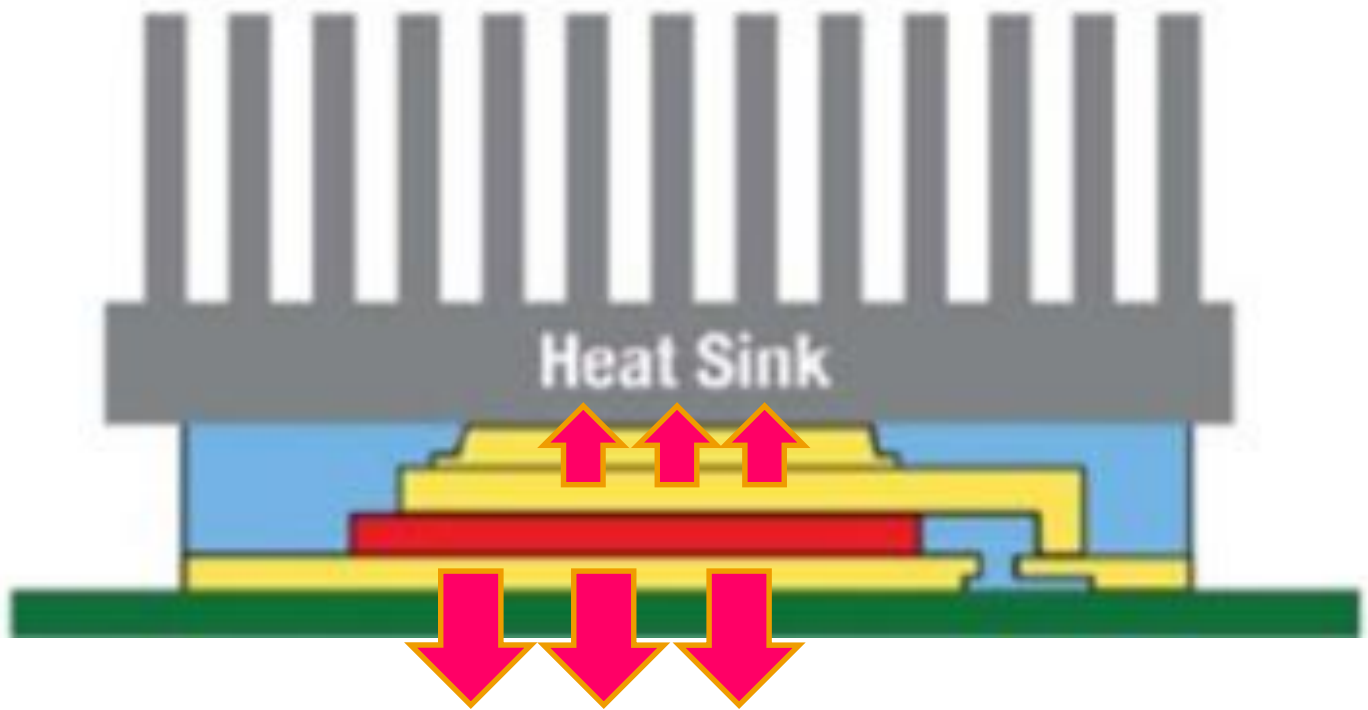


Dual Side Cooling PowerPAK 56

Developing

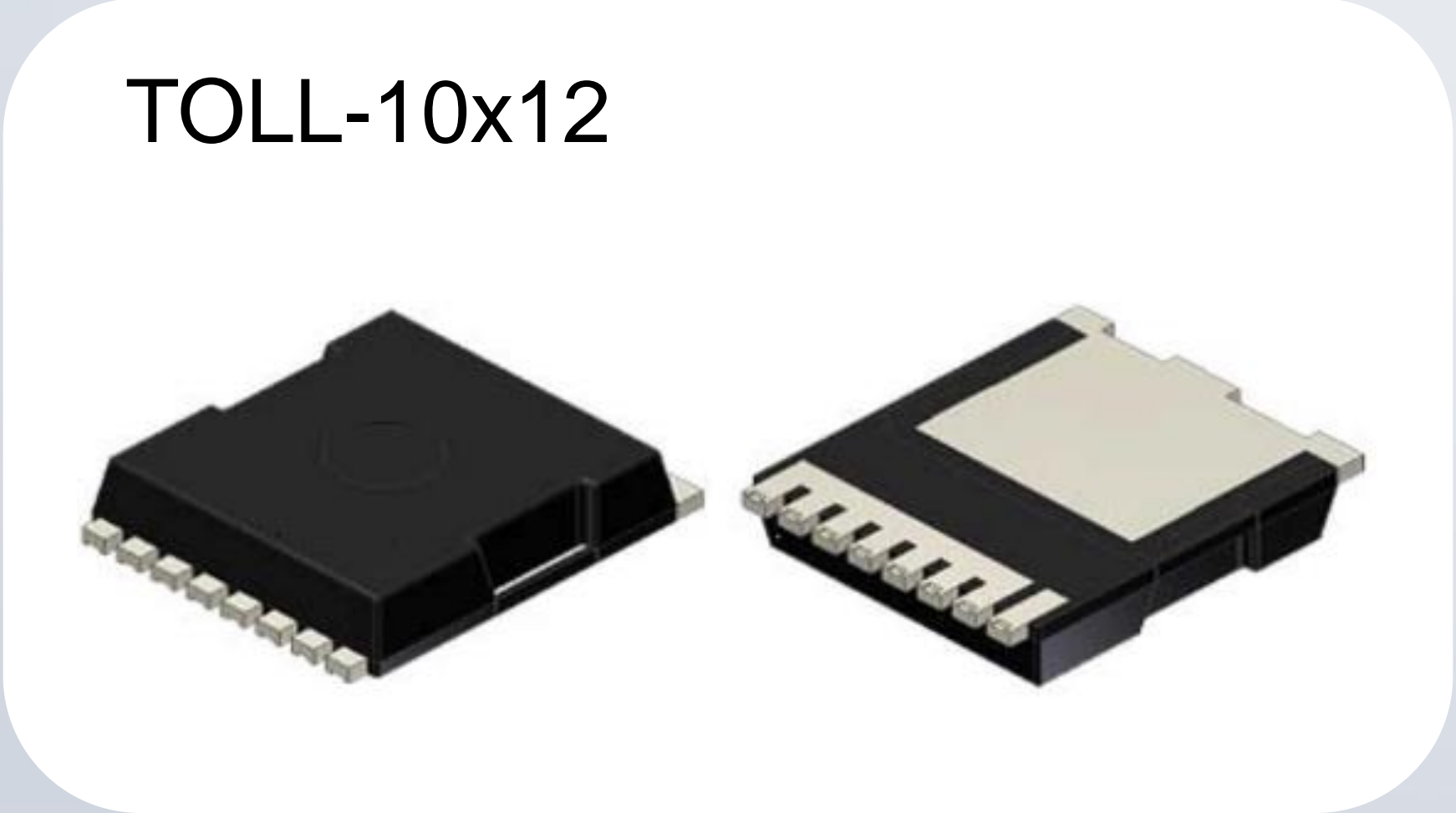


On Top with heatsink to quick release heat



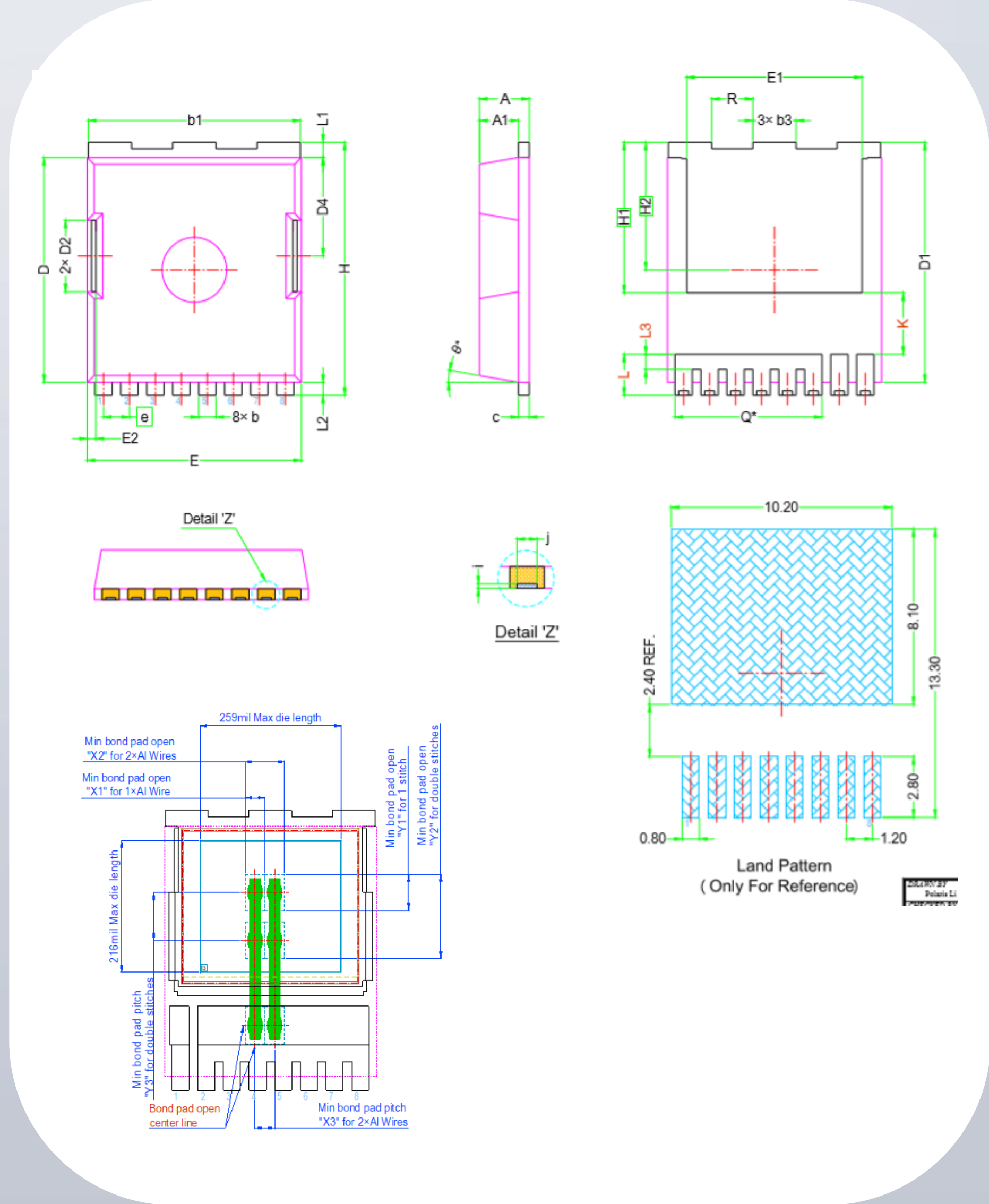
High current package - TOLL

Developing



Key features

- ✓ Highest current capability per footprint up to **300A**
- ✓ Ultra low RDS(on)



Battery – Powered Motor



MOSFET solution of Powered Motor

•Stronger :

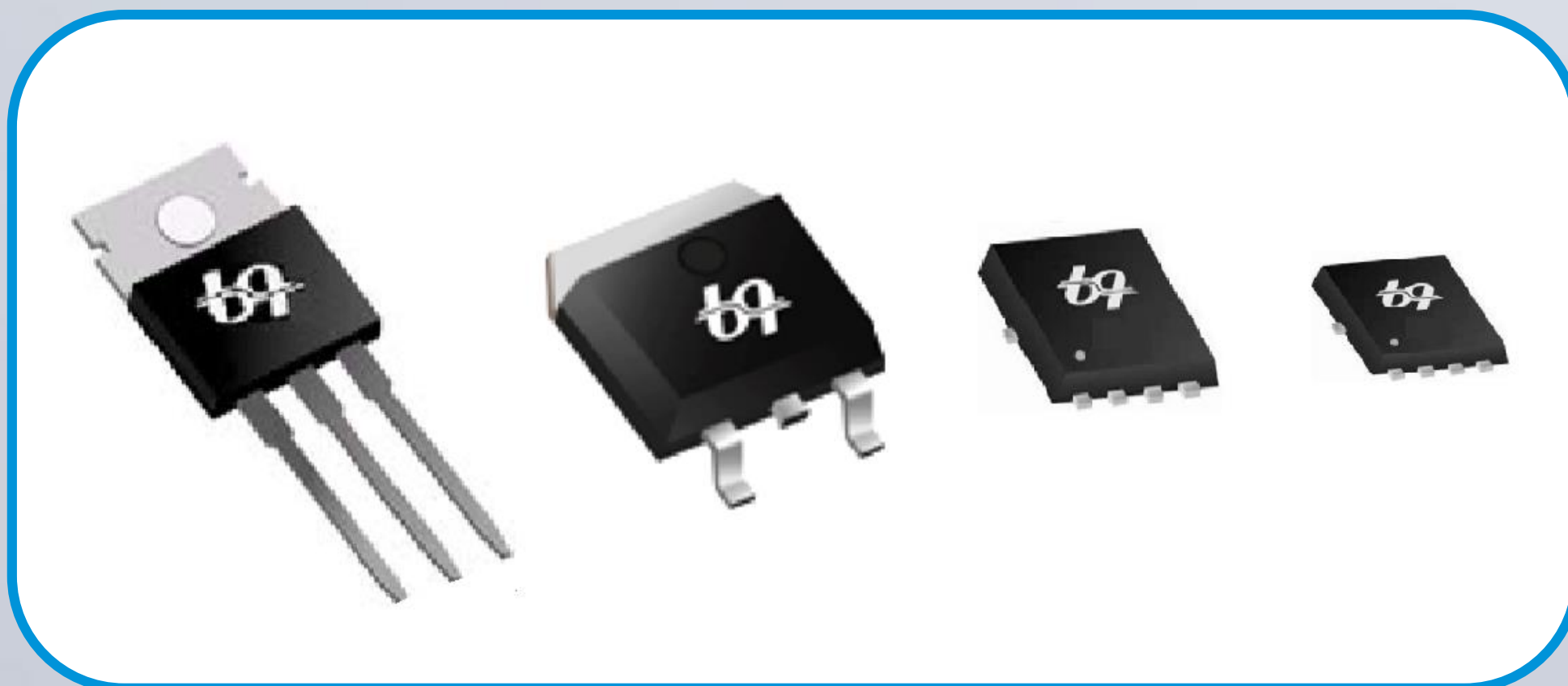
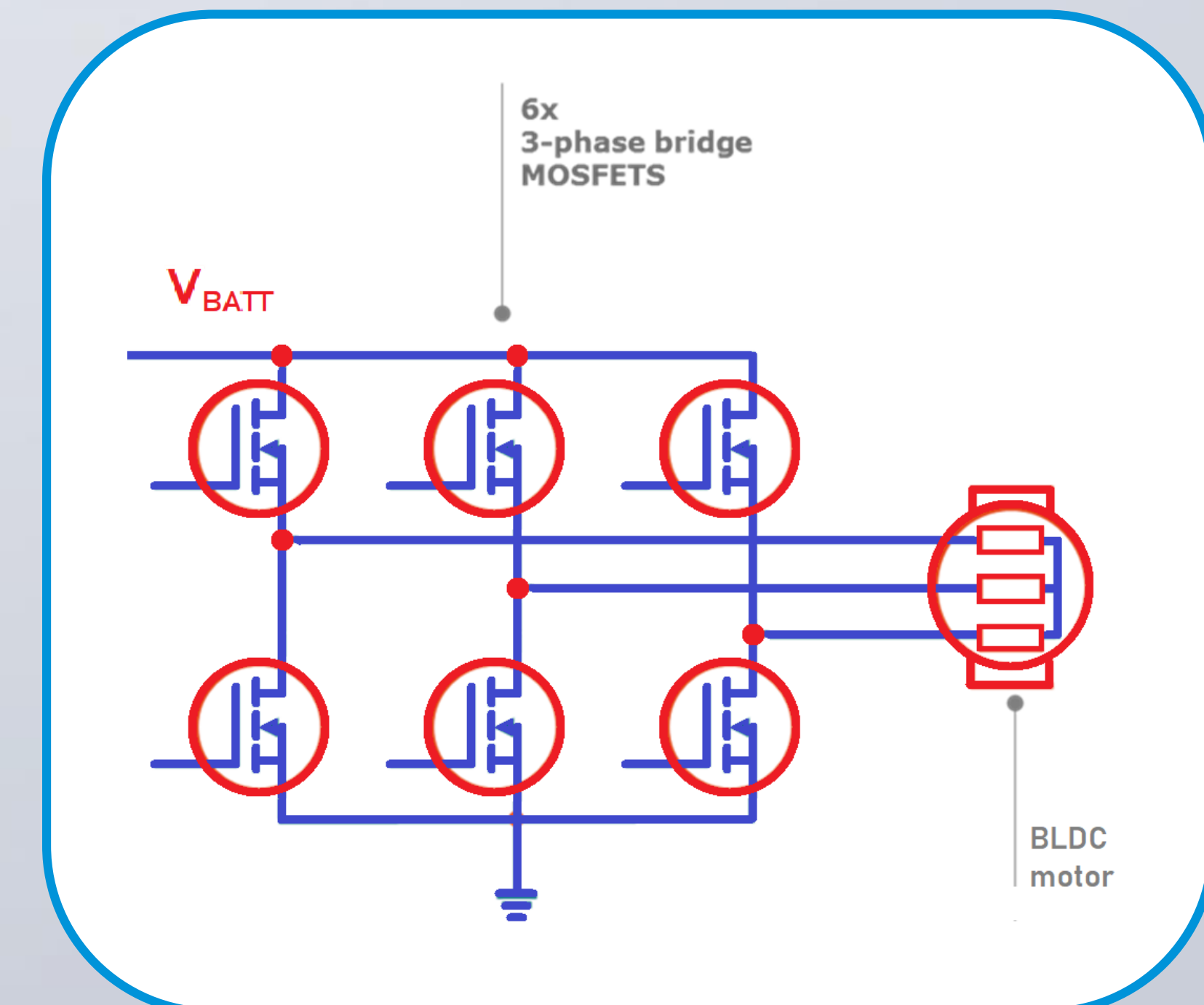
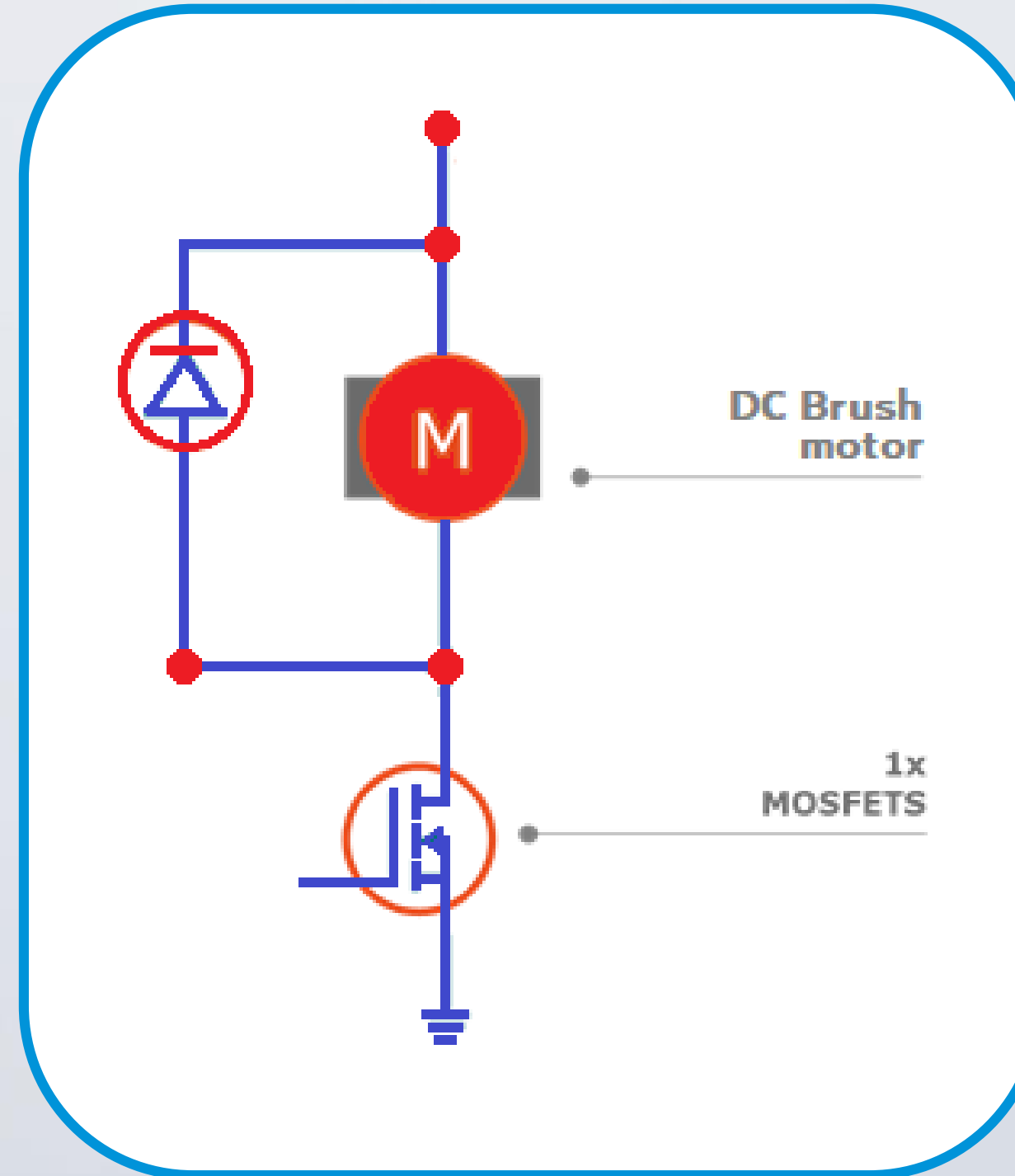
- ✓ E_{av} - Higher Avalanche Rating
- ✓ SOA - Wide Safe Operating Area
- ✓ I_d - High current capability .

•Performances :

- ✓ $R_{ds(on)}$ - Lower Conduction Power Loss
- ✓ Q_{rr} - Fast Reverse Recovery Time

•Reliable :,

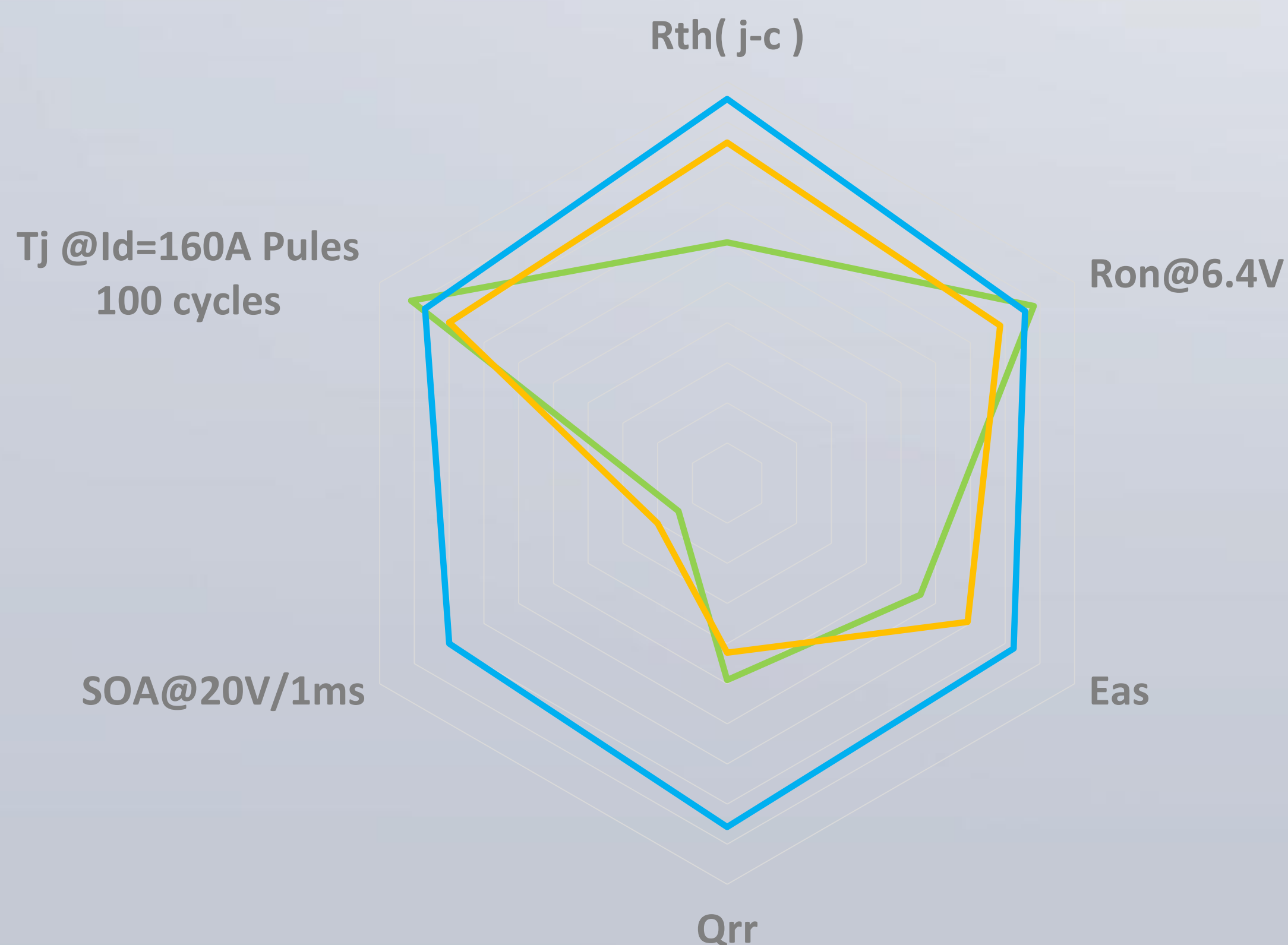
- ✓ $R_{th(j-c)}$, Quick to Release the high temperature
- ✓ **Package** , Advance Clip Bonding , Good Board Level .



Benchmark Result of PRPAK56

QM3100M6

- ✓ Effective heat release due **lower Rth(j-c)**
- ✓ Stronger due **higher Eas** and **wider SOA**
- ✓ Meet high current application requirement in power cycling

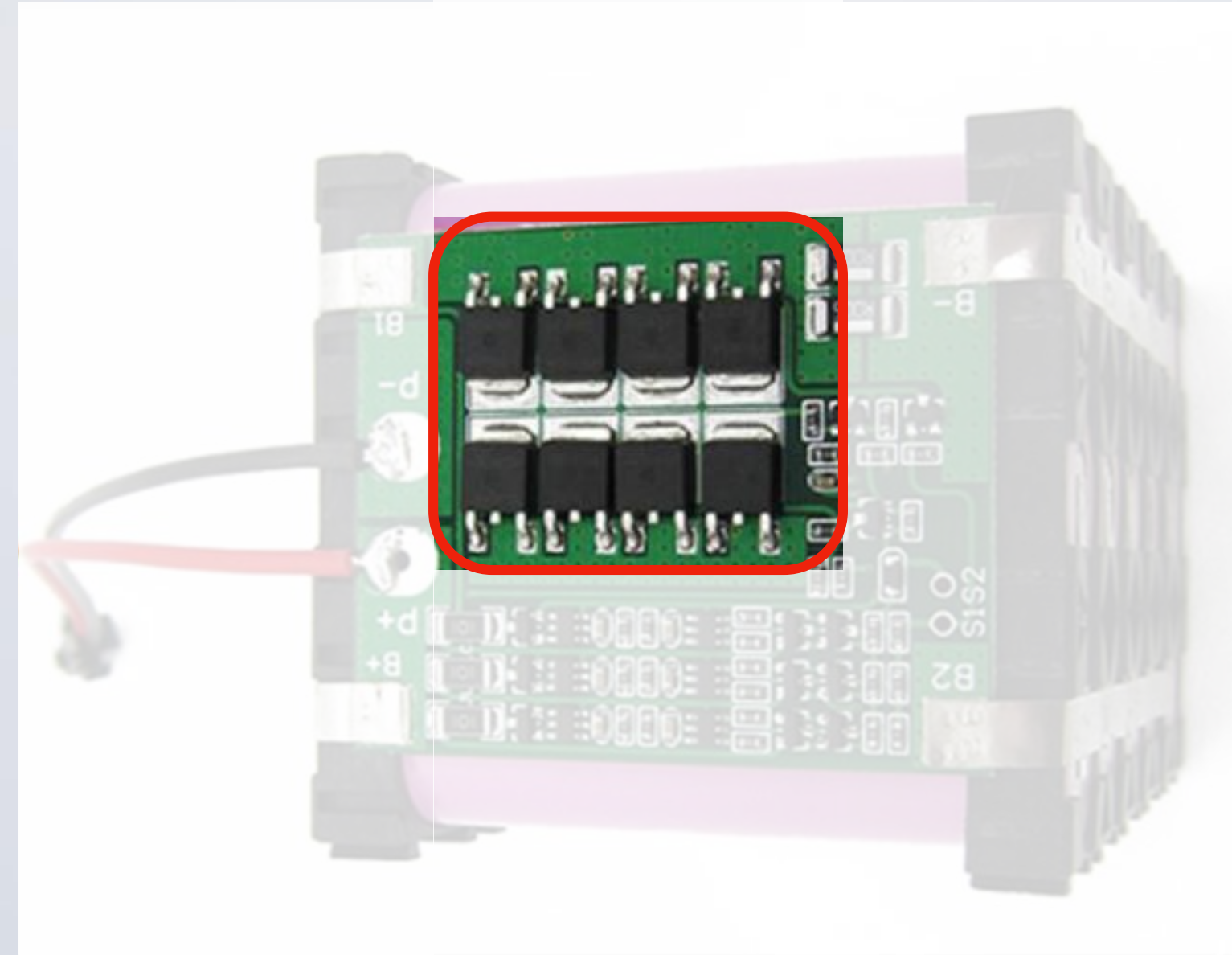
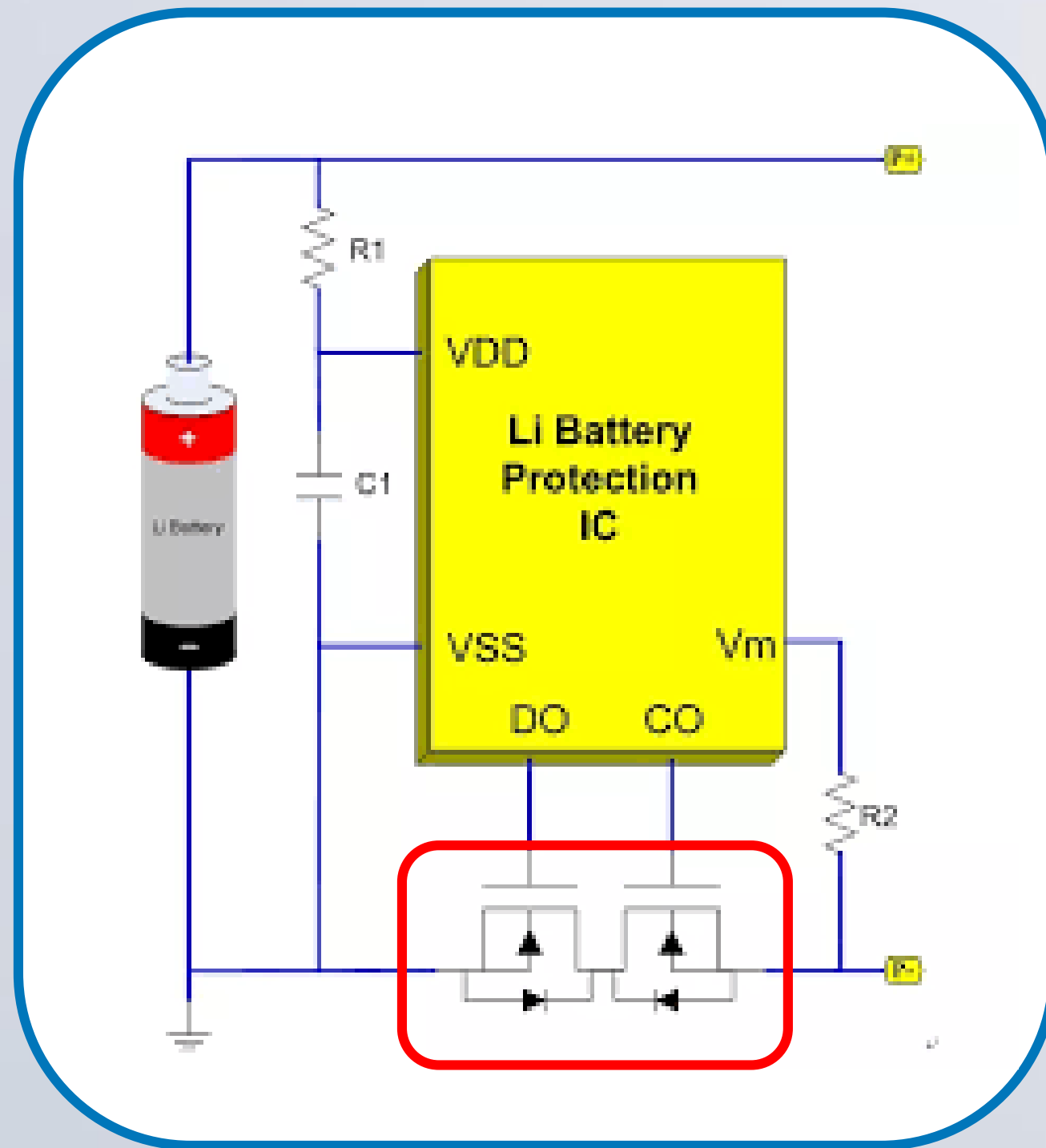


Key parameter	Competitor A	Competitor B	UPI QM3100M6
Rth(j-c) (c/w)	0.752	0.791	0.722
Ron@6.4V (mR)	1.7	1.91	1.75
Eas (mJ)	278.3	346.1	412.2
Qrr (nc)	50.93	59.105	29.159
SOA@20V/1ms (A)	7	10	40
Tj @Id=160A Pules 100 cycles (c)	110	125	112

Battery Protection



MOSFET solution Battery Protection



• Stronger :

- ✓ Eav - Higher Avalanche Rating
- ✓ SOA - Wide Safe Operating Area
- ✓ Id - High current capability .

• Performances :

- ✓ Rds(on) - Lower Conduction Power Loss


• Reliable :,

- ✓ Rth(j-c) , Quick to Release the high temperature
- ✓ Package , Advance Clip Bonding , Good Board Level .


Vsss or Vds (V)	Application	Cell number	Voltage (V)
12~24	Cell phone / Tablet / Power Bank	1	3.7~4.2
30~40	Laptop , BBU , power tools	2~5	7.4~21
60~80	Ebike , Lighting , Power tools	8~10	29.6~37
100~150	BBU , E-bike , E-scooter	11~13	40.6~ 54.6
>150	BBU , E-bike , E-scooter	>14	>60

Mosfets solution

- TO-220 & PRPAK56

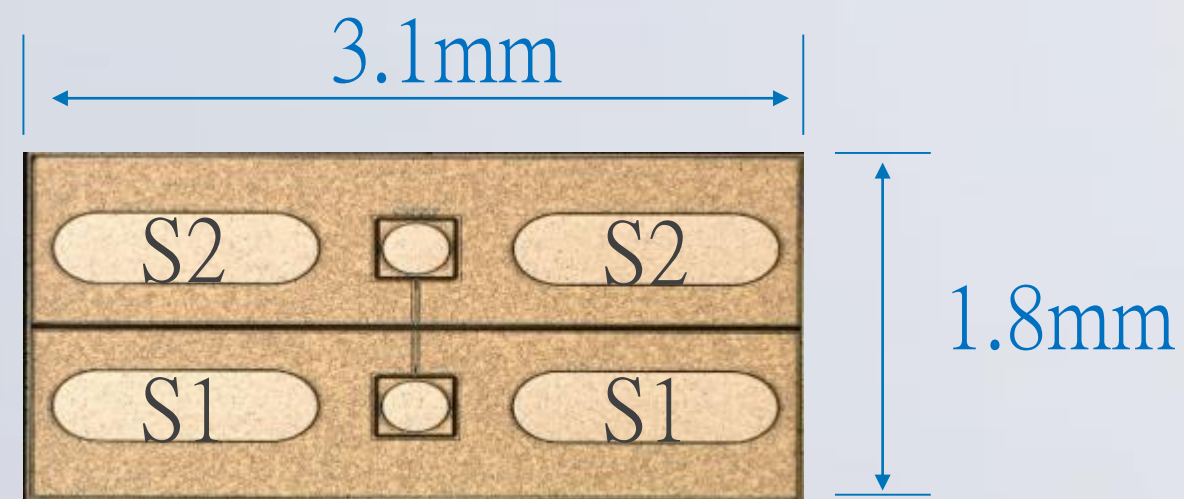


	TO-220	$R_{DS(on)}$ ($V_{GS}=10V$)	I_D [max]
30V	QM3020P	1.8m Ω	290A
	QM3018P	3.0m Ω	140A
	QM3016P	4.0m Ω	110A
40V	QM4020AP	3.0m Ω	220A
	QM4016P	6.5m Ω	90A
60V	QM6020P	2.8m Ω	198A
	QM6020AP	3.8m Ω	242A
	QM6018AP	8.2m Ω	130A
80V	QM8020AP	5.2m Ω	98A
100V	QM0020P	5.7m Ω	163A
	QM0020AP	8.5m Ω	128A



	PRPAK56	$R_{DS(on)}$ ($V_{GS}=10V$)	I_D [max]
30V	QN3100M6N	1.1m Ω	189A
	QN3109M6N	1.6m Ω	145A
	QM3100M6	2.0m Ω	173A
40V	QN4104M6N	1.1m Ω	224A
	QN4103M6N	1.4m Ω	200A
	QN4101M6N	2.3m Ω	136A
60V	QN6101M6N	2.8m Ω	111A
	QN6102M6N	5.8m Ω	66A
100V	QN0102M6N	6.0m Ω	96A
	QN0101M6N	10.0m Ω	51A

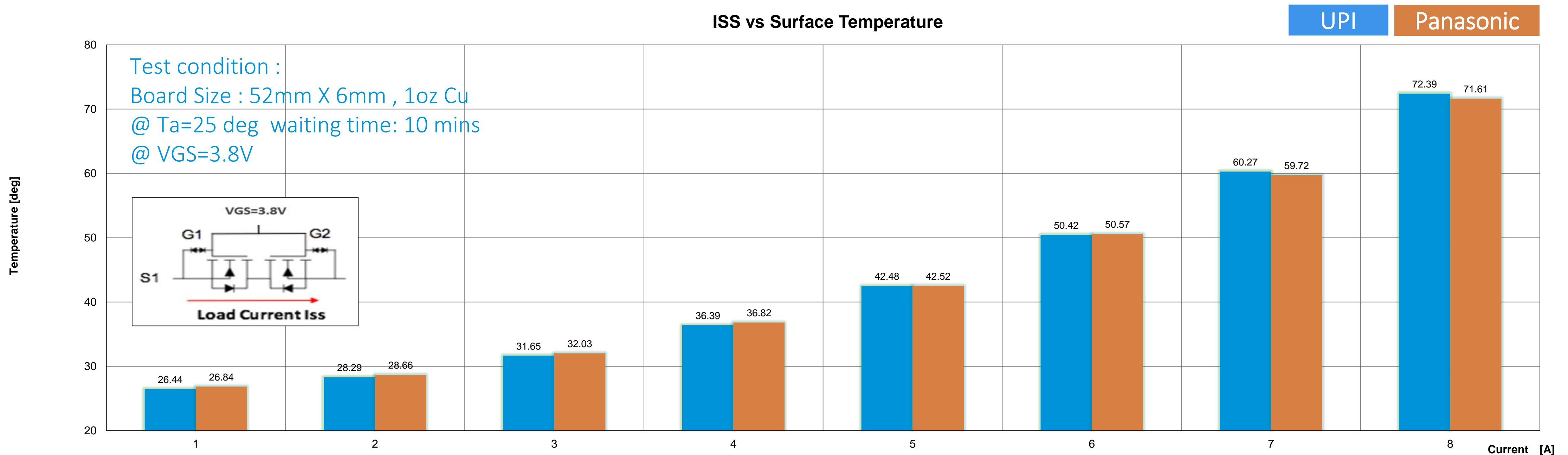
Temperature Comparison in CSP



CSP 6PE

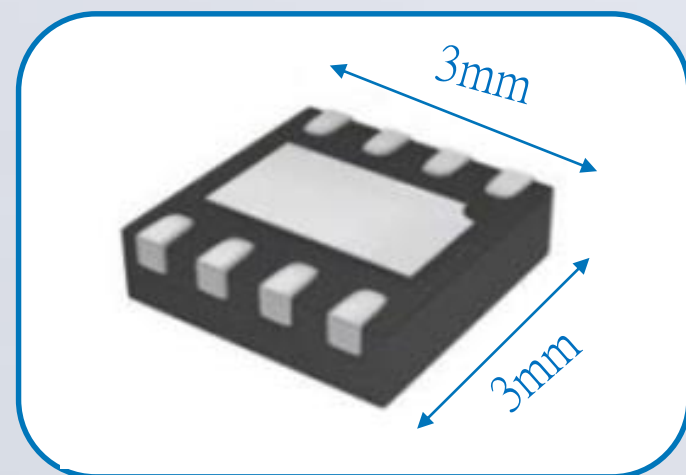
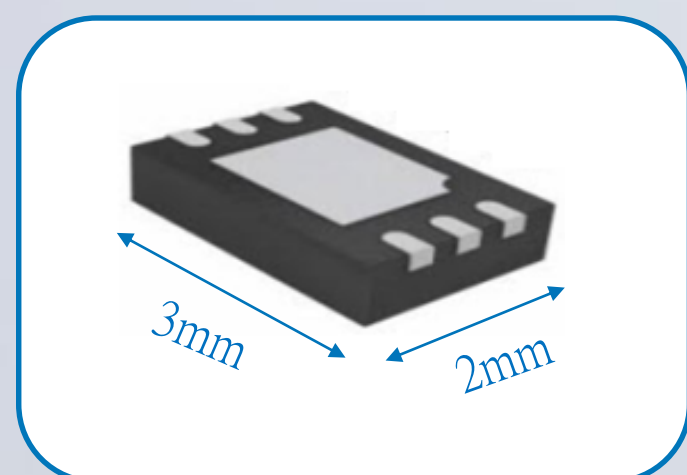
RSS(on)	UBIQ QN1003R6E Actual parameter	Panasonic FCAB21350L Actual parameter	Data sheet			Unit
			Min	Typ	Max	
R _{ss(on)} (V _{GS} =4.5V)	2.25	2.12	1.55	2.1	2.75	mohm
R _{ss(on)} (V _{GS} =3.8V)	2.32	2.21	1.6	2.2	2.85	mohm
R _{ss(on)} (V _{GS} =3.1V)	2.35	2.23	1.65	2.4	3.95	mohm
R _{ss(on)} (V _{GS} =2.5V)	2.54	2.50	1.9	3.1	6.1	mohm

ISS vs Surface Temperature



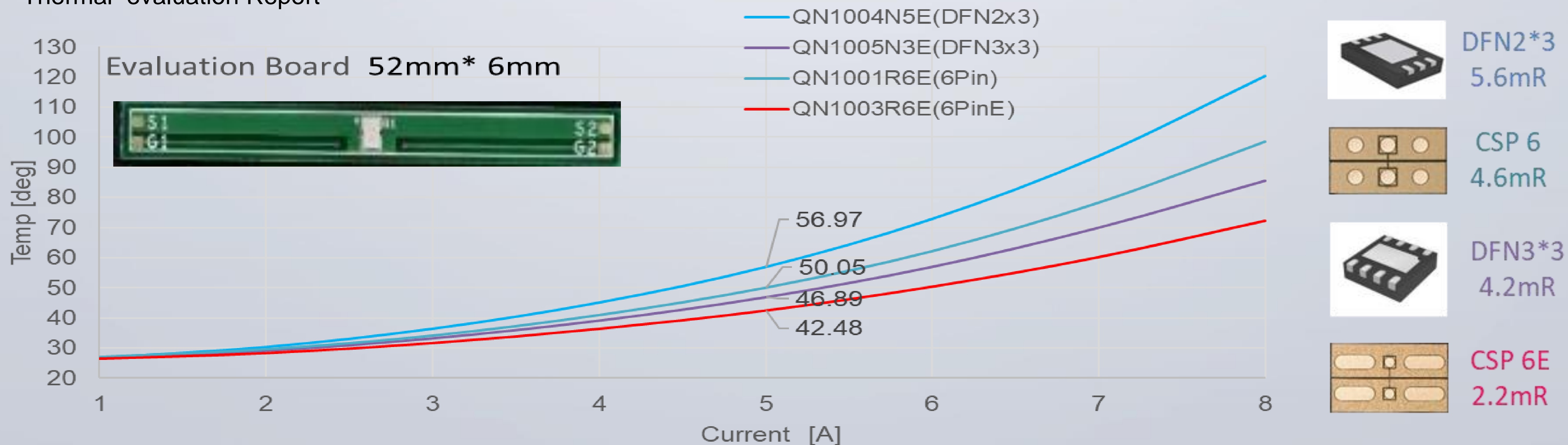
New Products with DFN Package

Easier layout, easier repair, lower SMT cost



Product Name	Package	VSS (V)	VGS (V)	R _{ss(ON)} (mΩ) Typ			Engineering Sample
				VGS=4.5V	VGS=3.8V	VGS=2.5V	
QN1004N5E	DFN2x3	12	±8	2.9	3	3.6	Q2'19
QN1005N3E	DFN3x3	12	±8	1.9	2	2.3	Q1'19
QN2xxxN5E	DFN2x3	20/24	±12	4.7	4.9	5.8	H2'19

Thermal evaluation Report



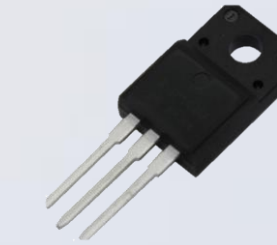
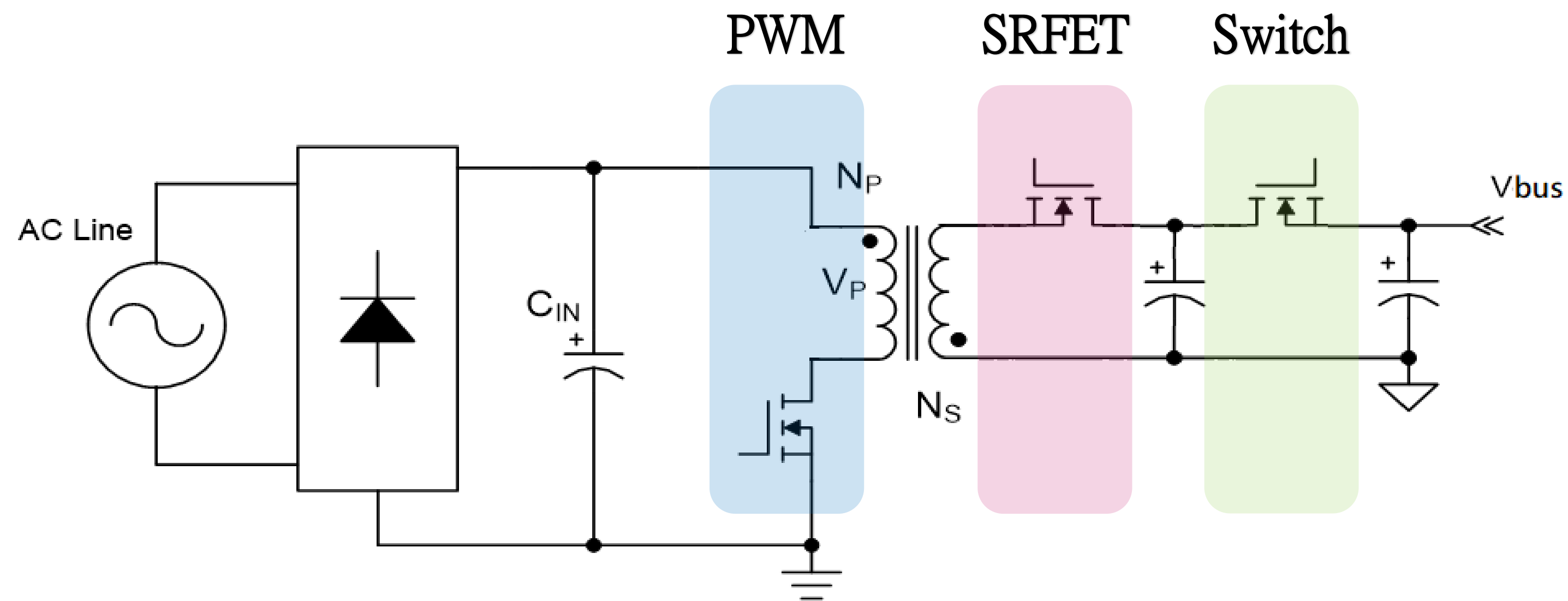
Single-cell Battery MOSFET Lineup

P/N	PKG	Size	BVDSS [V]	VGSS [V]	R _{ss(on)} typ [mohm]	
					VGS = 4.5V	VGS = 3.8V
QN1006R4E	CSP 4Pin (0.5 Ball pitch)	0.9x0.9mm	12	±8	22	24
QN1001R6E /QS1B01	CSP 6Pin	1.4x2.4mm	12	±8	4.4	4.7
QN1003R6E	CSP 6Pin-E	1.8x3.0mm	12	±8	2.1	2.2
QN1007RAE	CSP 10Pin-E	1.8x3.6mm	12	±8	1.5	1.6
QN1002RAE	CSP 10Pin-E	1.5x3.0mm	12	±8	2.5	2.6
QN1004N5E	DFN2X3	2.0x3.0mm	12	±8	5.8 (2.9)	6.0 (3.0)
QN1005N3E	DFN3X3	3.0x3.0mm	12	±8	3.8 (1.9)	4.0 (2.0)
QM2580R4	CSP 4Pin (0.65 ball pitch)	1.3x1.4mm	20	±12	19.5	20.8
QM2588R4	CSP 4Pin (0.65 ball pitch)	1.05x1.08mm	24	±12	39	TBD
QM2586R4	CSP 4Pin (0.65 ball pitch)	1.23x1.23mm	24	±12	24	TBD
QM2582R4	CSP 4Pin (0.65 ball pitch)	2.0x2.1mm	24	±12	11.5	12.0
QM2540N5	DFN2X3	2.0x3.0mm	20	±12	26(13)	27.6(13.8)
QM2542N5	DFN2X3	2.0x3.0mm	20	±12	18.4(9.2)	29.2(9.6)
QM2544N5	DFN2X3	2.0x3.0mm	20	±12	13.8(6.9)	14.8(7.4)
QM2538N3	DFN3X3	3.0x3.0mm	20	±8	7.8(3.9)	8.0(4.0)
QM2530M7	DFN3X3	2.8x2.9mm	20	±12	20(10)	21.8(10.9)

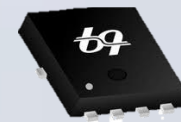
Battery – Fast Charger



Fast Charger

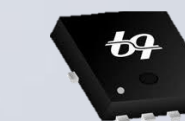


PWM	
650V 4A	QM04N65F
650V 6A	QM06N65F
650V 8A	QM08N65F
650V 10A	QM10N65F
650V 12A	QM12N65F
650V 14A	QM14N65F
700V 12A	QM12N70F
800V 8A	QM08N80F



Switch	
30V 6mR	QN3102M6N
30V 5mR	QN3103M6N
30V 4.1mR	QN3104M6N
30V 3mR	QN3106M6N
30V 2.1mR	QN3107M6N
30V 4.7mR	QN3102M3N
30V 3.6mR	QN3103M3N
30V 2.4mR	QN3120M3N

* M6N - PRPAK56
 M3N - PRPAK33



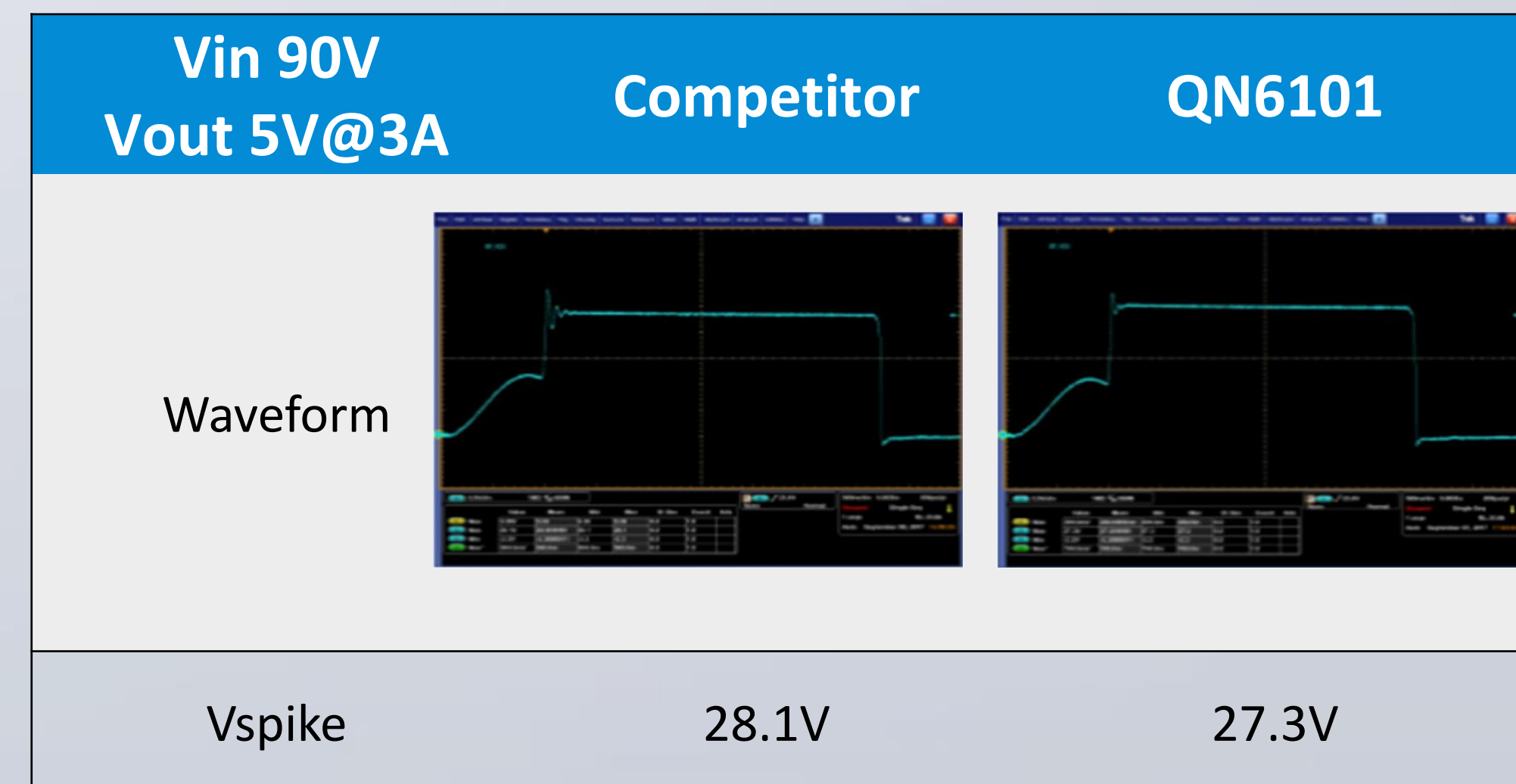
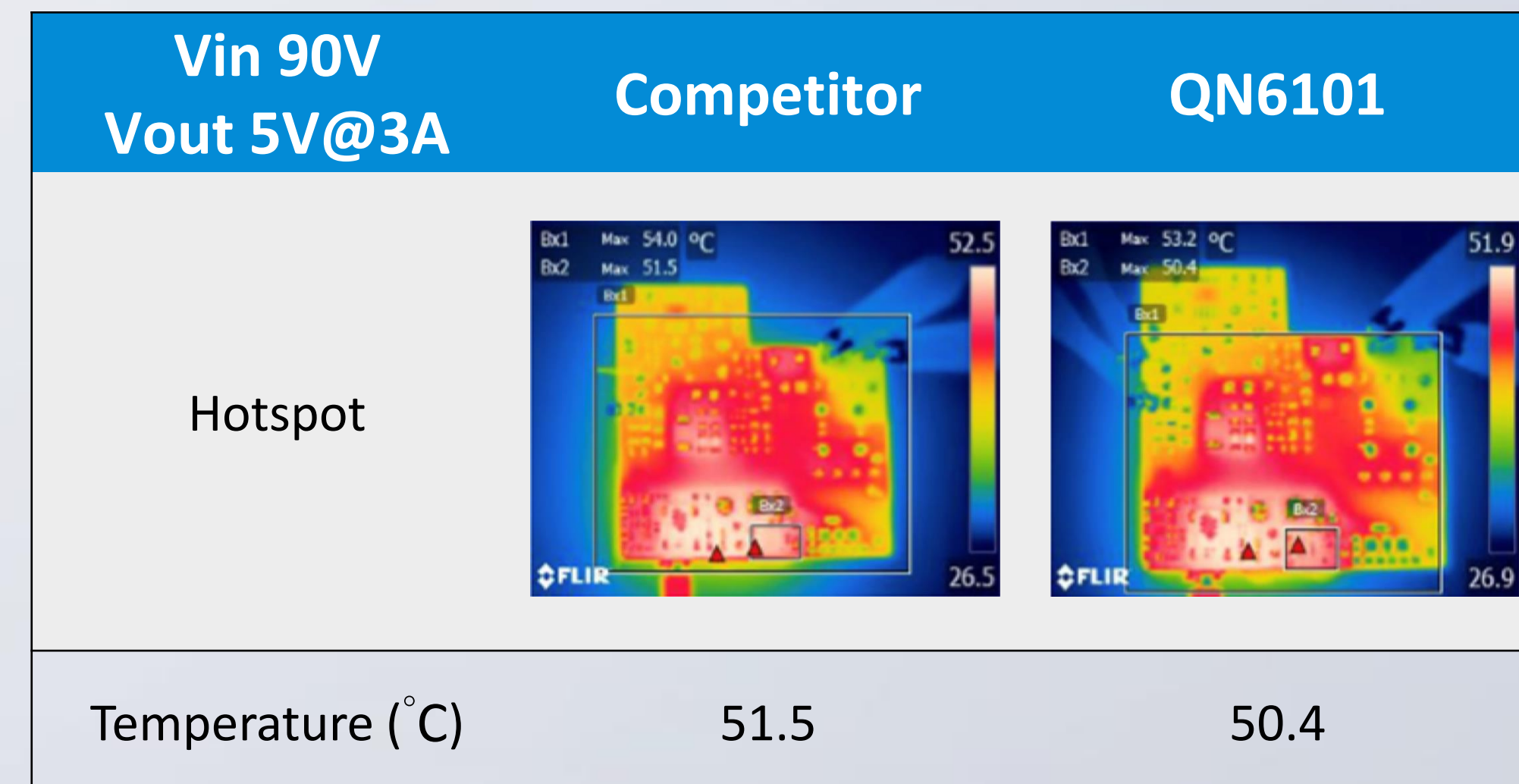
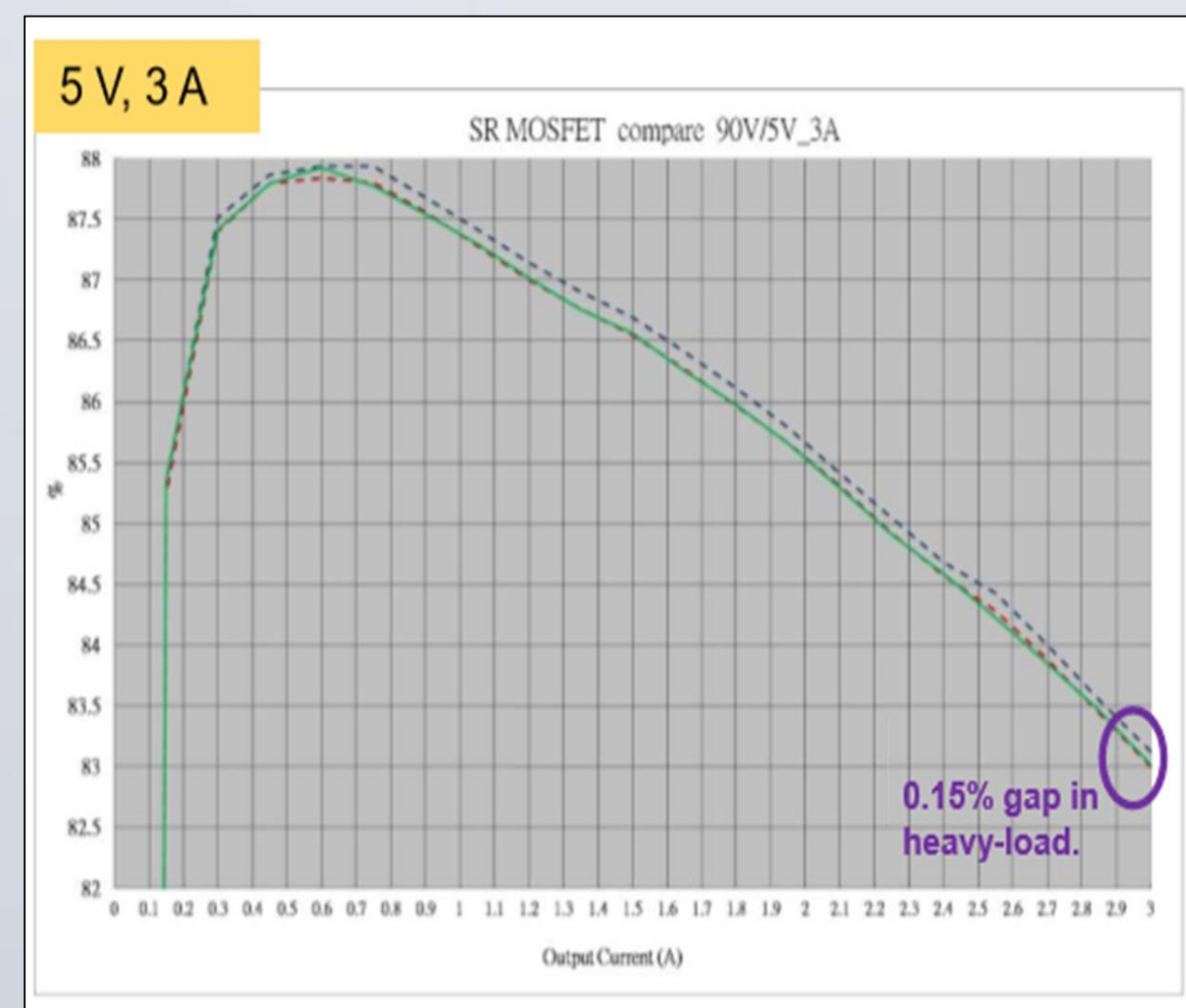
SRFET	
60V 2.2mR	QN6101M6N
60V 4.6mR	QN6102M6N
100V 4.8mR	QN0102M6N
100V 8mR	QN0101M6N

Competitor Benchmark in 60V

60V for SRFET in QC Charger

- ▶ Low Ron and Qgd – Higher efficiency
- ▶ Lower **Qrr** and **Trr** – Lower Vspike and EMI
- ▶ Lower Power Loss – Good thermal performance

Product	Competitor	QN6101M6N
Vth (V)	1.2~2.2	1.2~2.5
Ron 10V @ 20A (mΩ)	2.1 (typ.) 2.5 (max.)	2.2 (typ.) 2.8 (max.)
Ron 4.5V @ 20A	2.7 (typ.) 3.4 (max.)	3.1 (typ.) 4.0 (max.)
Ciss 30V (pF)	4288	4727
Coss 30V (pF)	1177	757
Crss 30V (pF)	101	80
Rg (Ω)	0.72	1.0
Qgd 4.5V (nC)	12.89	9.1
Qgs 4.5V (nC)	10.2	13
Qrr (di/dt = 100A/ms)	70.2	28
Trr (di/dt = 100A/ms)	53.1	42



Gen5 – Power MOSFETs

Gen5 Power MOSFETs achieve highest performance at MV

Key Applications

- ▶ AC / DC power supply – ATX, Server
- ▶ PD & quick charger
- ▶ Telecom and networking
- ▶ Power tool

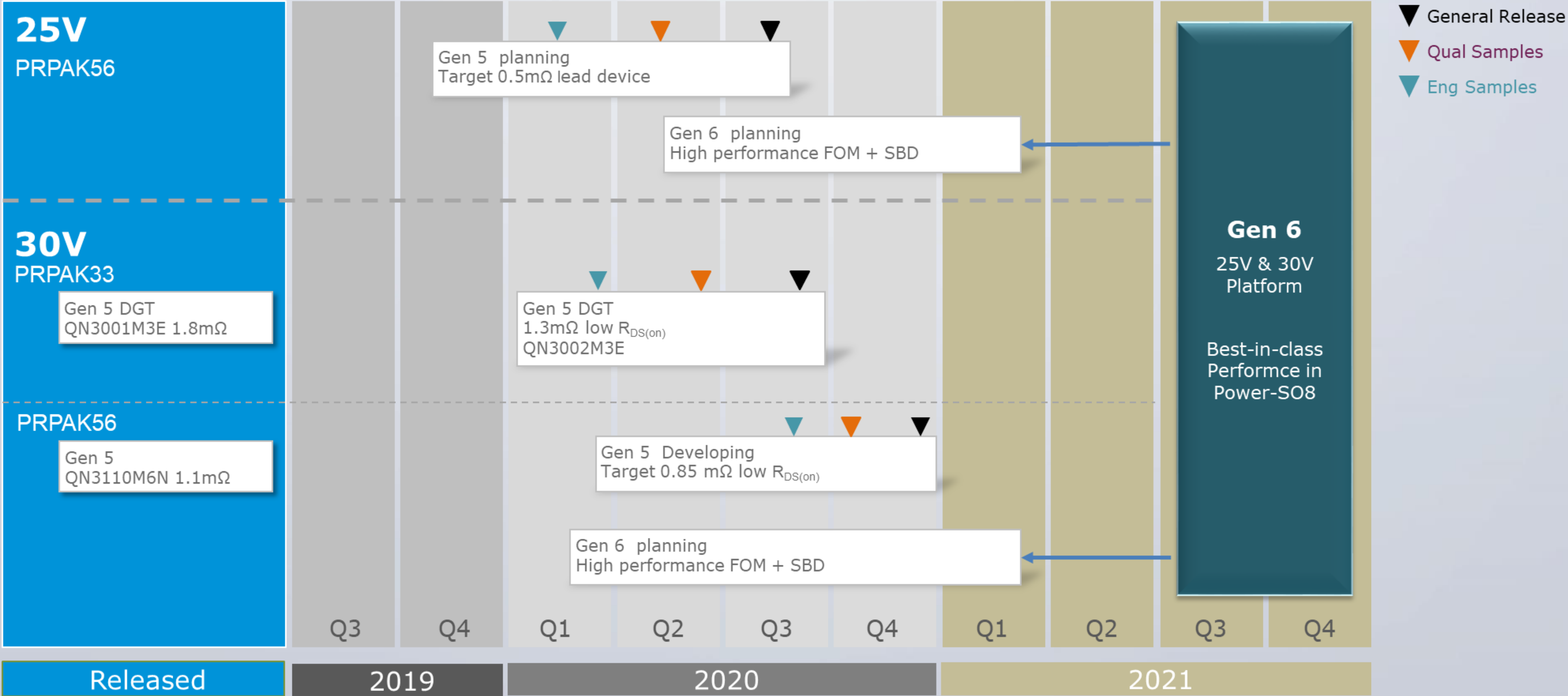
Key Features

- ▶ Reduced I^2R losses for SYNC FET application
- ▶ Low COSS for reduced output losses
- ▶ Low QGD for reduced switching losses
- ▶ Achieves the best balance between low R_{on} and low Q_g

Voltage	Package	Device	Max $R_{DS(on)}$ mΩ (10V)	Max $R_{DS(on)}$ mΩ (4.5V)
40V	PRPAK5*6	QN4104M6N	1.1	1.5
		QN4103M6N	1.4	2.0
		QN4101M6N	2.3	2.9
60V	PRPAK5*6	QN6101M6N	2.8	4.0
		QN6102M6N	5.8	8.8
	TO-263	QN6101B3N	3.3	4.7
	SO8	QN6102S8N	7.0	10.4
100V	PRPAK5*6	QN0104M6N	4.35	-
		QN0108M6D	5.3	-
		QN0102M6N	6.0	9.5
		QN0107M6D	7.5	-
		QN0106M6D	7.5	12.0
		QN0101M6N	12.5	15.0
		QN0103M6N	16.0	22.0
	TO-251	QN0101U3N	11.3	15.8
	PRPAK3*3	QN0103M3N	16.0	22.0
	PRPAK5*6D	QN0105M6N	18.0	-
TO-263	QN0104B3N	4.8	-	
150V	PRPAK5*6	QN02N15M6	12.0	-
	TO-220	QN01N15P	7.5	-

Product Roadmap

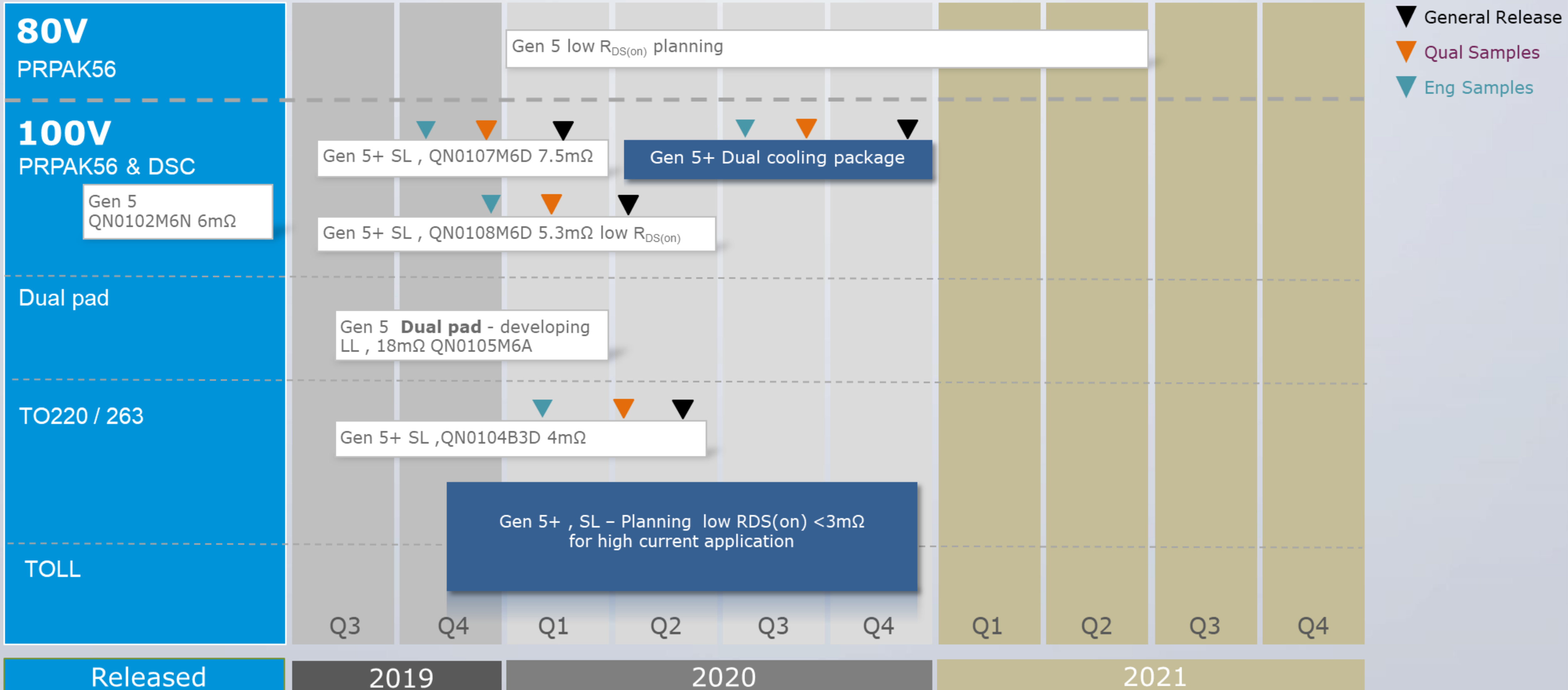
25V-30V Platforms



40V-60V Platforms



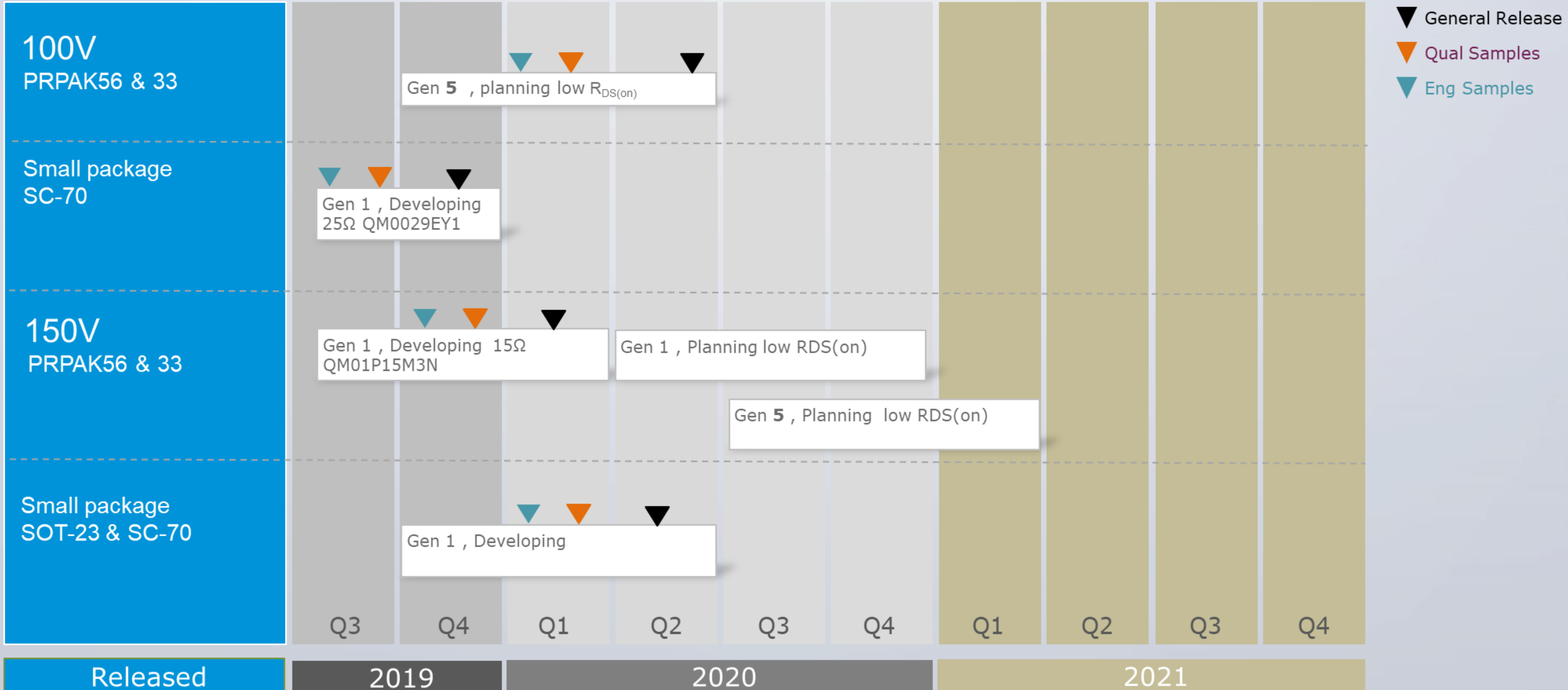
80V-100V Platforms



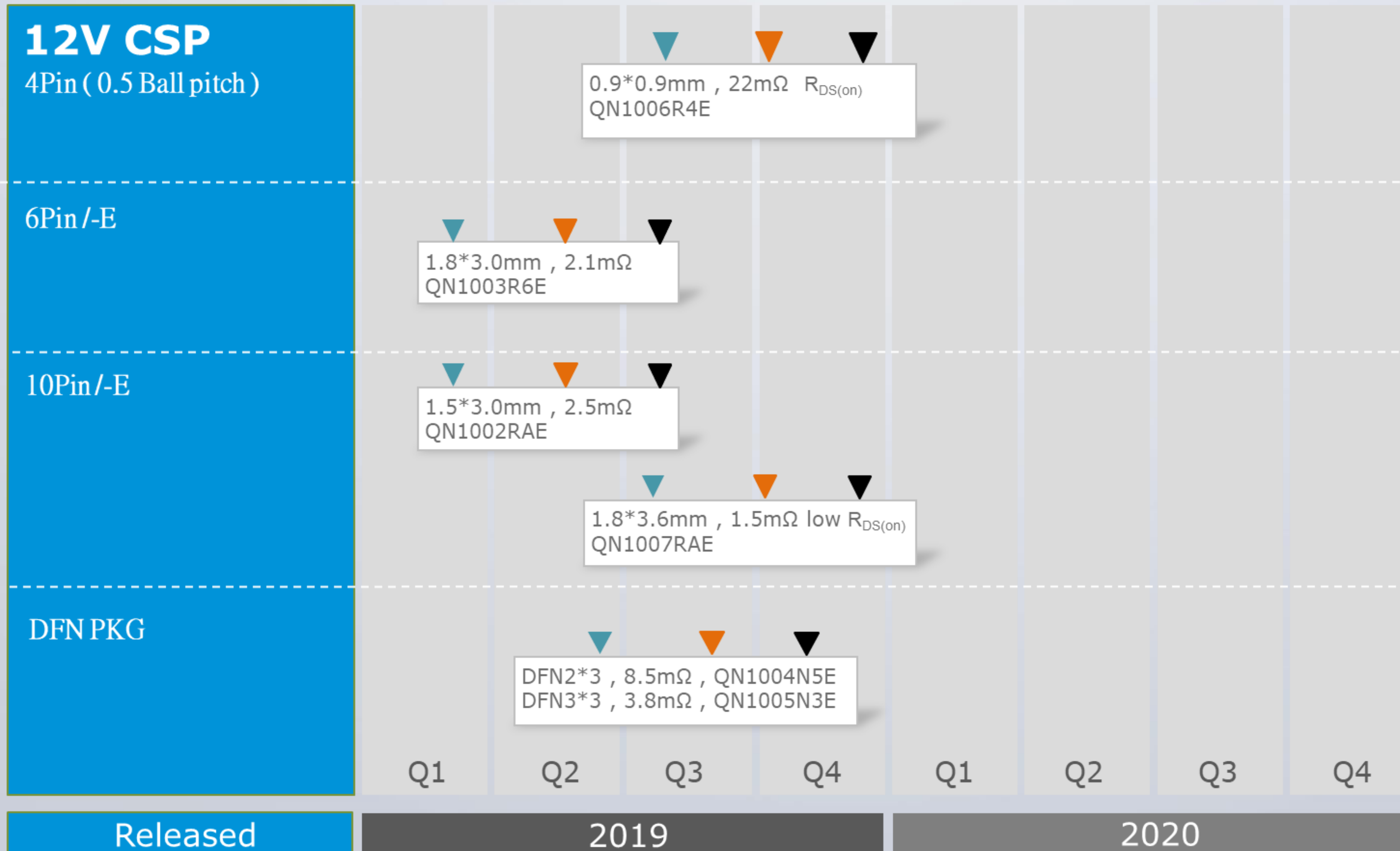
150V Platforms






P-ch Platforms



12V Battery Application



-  General Release
-  Qual Samples
-  Eng Samples

Released

2019

2020

20V-24V Battery Application

20V CSP
4Pin (0.65 Ball pitch)

1.3*1.4mm , 19.5mΩ
QM2580R4

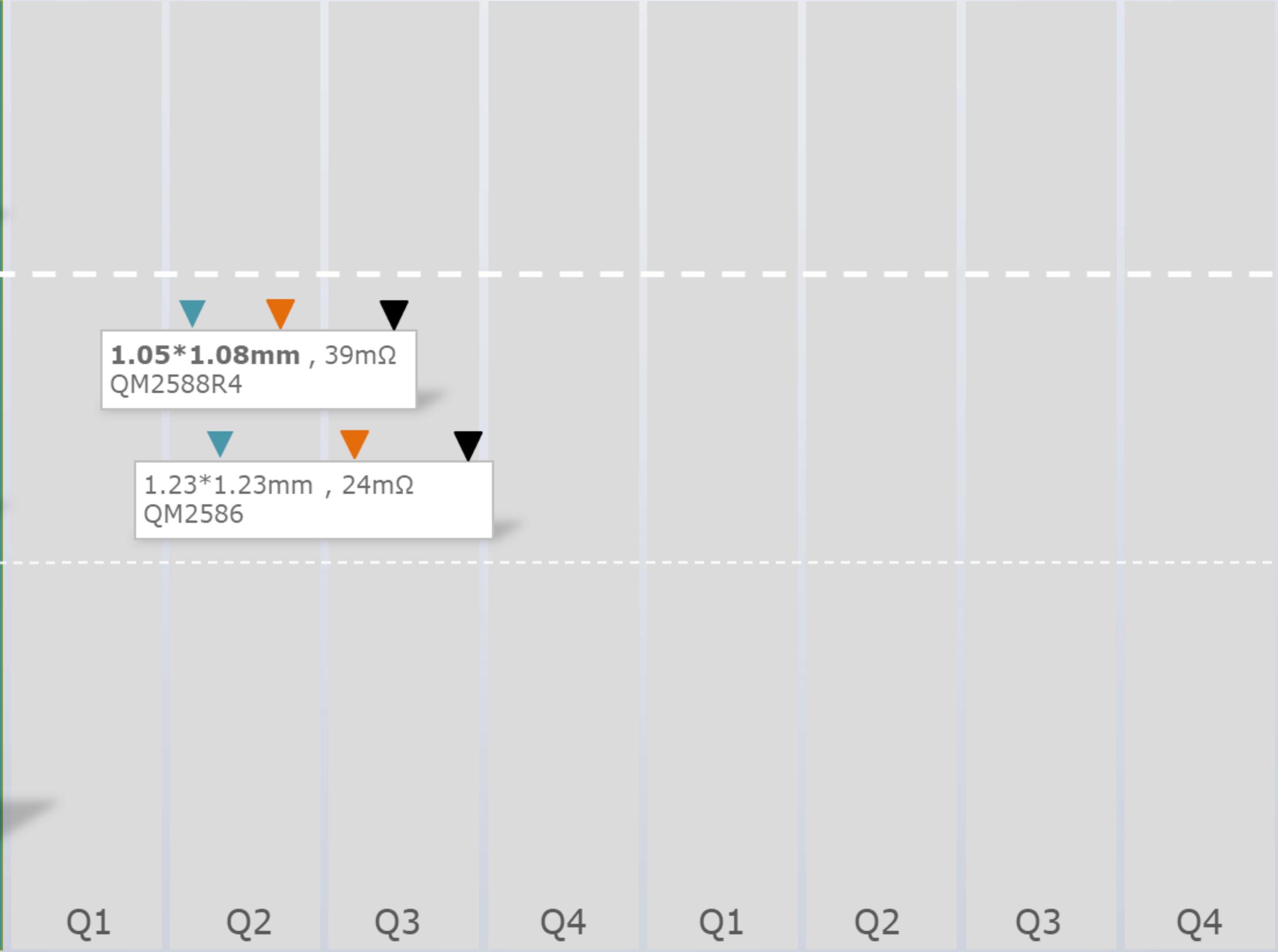
24V CSP
4Pin (0.65 Ball pitch)




2.0*2.1mm , 11.5mΩ
QM2582R4

DFN PKG

DFN2*3 , 13.8mΩ
QM25442N4.

DFN3*3 , 7.8mΩ
QM2538N3



-  General Release
-  Qual Samples
-  Eng Samples

Released

2019

2020



Thank You!
Power Solutions for Today & **TOMORROW**