

算力电源之东芝功率芯片

TOSHIBA

Toshiba Devices & Storage (Shanghai) Co., Ltd.

2026.08.27 PCIM @ShenZhen

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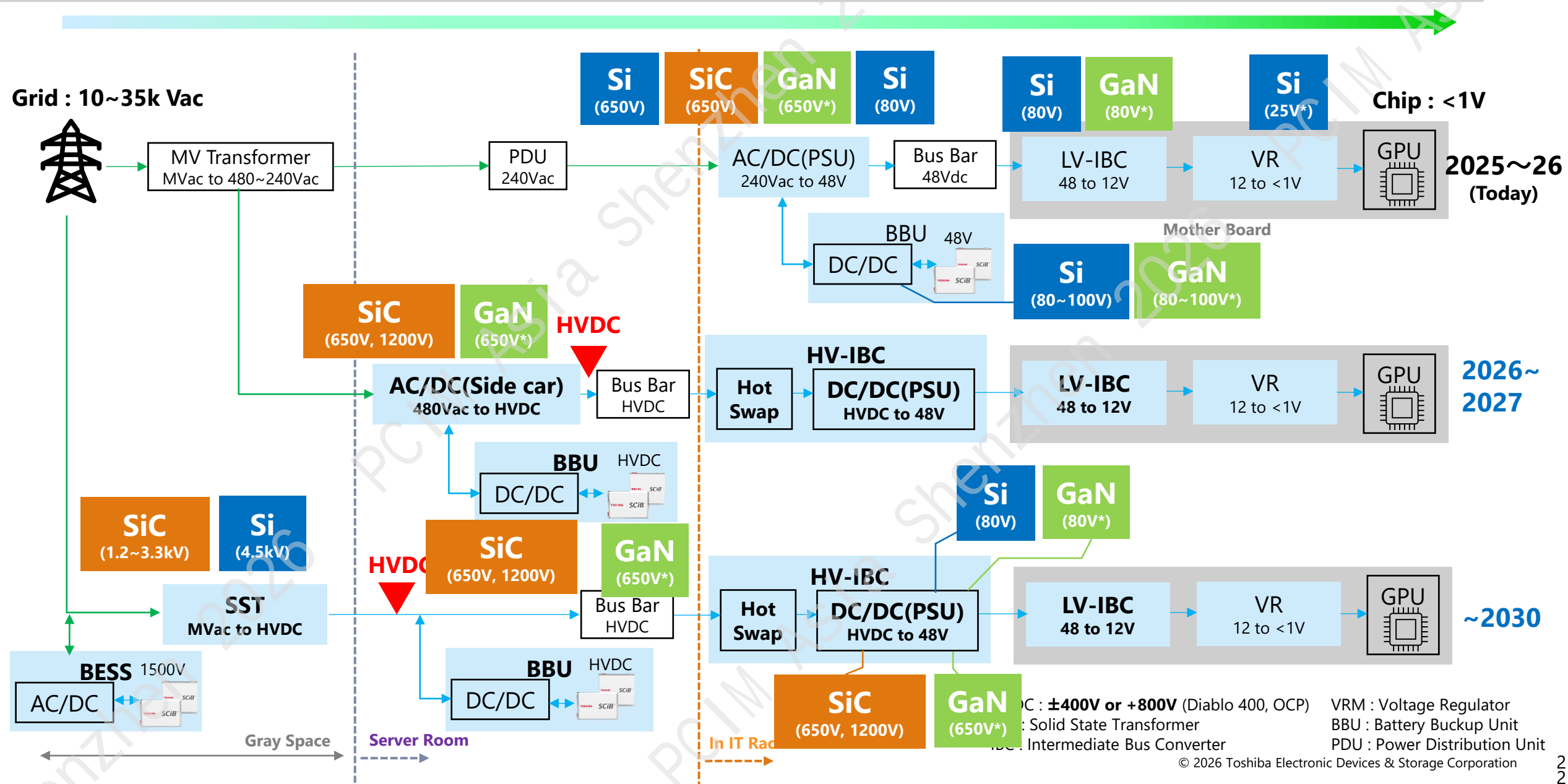
03 SiC MOSFET

04 SiC模块

AI 数据中心供电架构发展 (~2030) - 功率器件概览

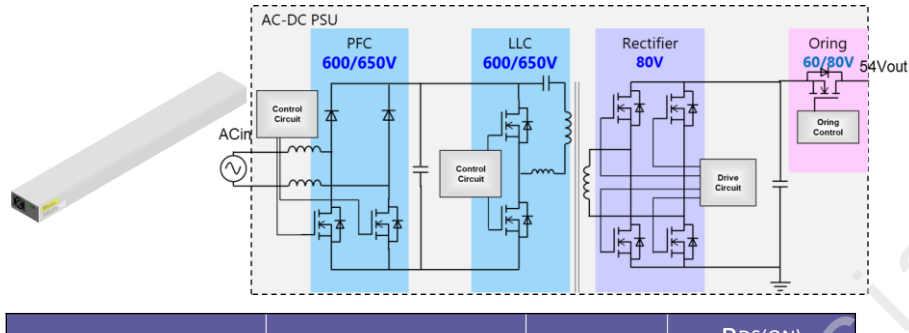
Si SiC GaN*

* : Under Development



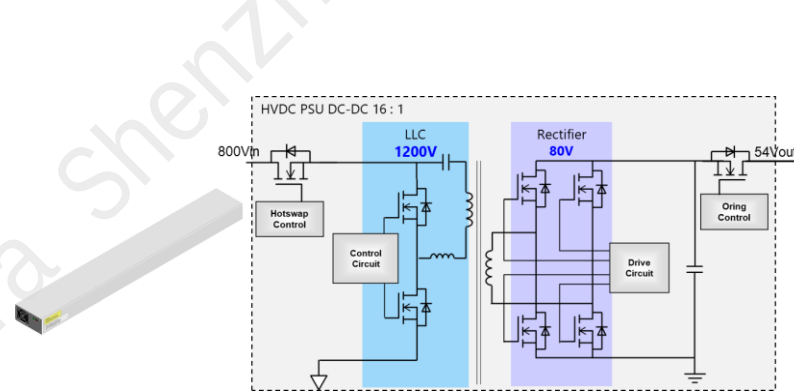
东芝全面支持AI算力电源的发展（一）
 AI 服务器电源及HV-IBC发展趋势

AC-DC 54Vout
 5.5kW~12kW
 ORV3



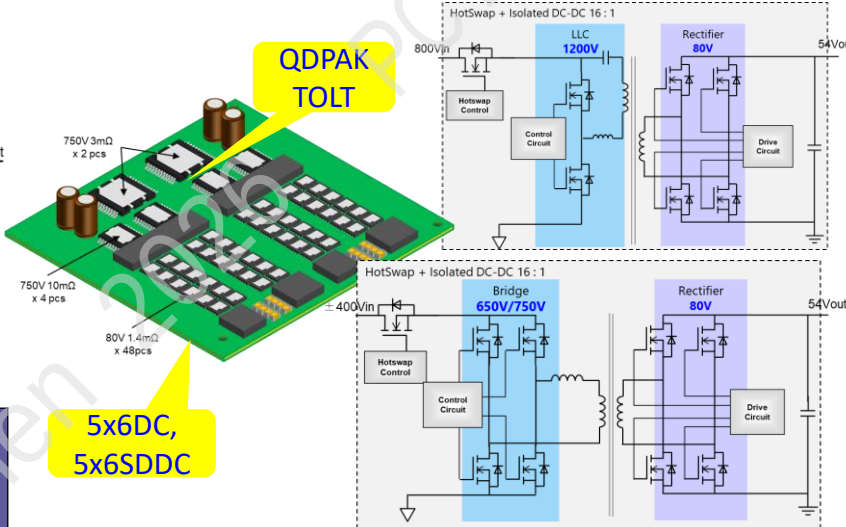
Part No./ Prototype No.	Package	VDSS (V)	RDS(ON) VGS = 10V max
Topology: PFC			
TK55U60Z1	TOLL	600	55
TW048U65C	TOLL (SiC)	650	48
TW027U65C	TOLL (SiC)	650	27
Topology: LLC			
TK55U60Z5	TOLL	600	55
TW048U65C	TOLL (SiC)	650	48
TW027U65C	TOLL (SiC)	650	27
Topology: Synchronous rectifier			
TPH2R408QM	SOP Advance(N)	80	2.43
TPM1R908QM	SOP Advance(E)	80	1.9
TPM1R408RH	SOP Advance(E)	80	1.4
Topology: Oring			
TPM1R006PL	SOP Advance(E)	60	1
TPH2R408QM	SOP Advance(N)	80	2.43
TPM1R908QM	SOP Advance(E)	80	1.9
TPM1R408RH	SOP Advance(E)	80	1.4

HVDC PSU DC-DC
 800Vin to 54Vout
 18kW~27kW



Part No./ Prototype No.	Package	VDSS (V)	RDS(ON) VGS = 10V max
Topology: HotSwap			
Under Investigation			
Topology: Full-B (±400Vin) or LLC(800Vin)			
Under Development	QDPAK (SiC)	750	(3)
Under Development	QDPAK (SiC)	750	(6,10,14)
Under Development	QDPAK (SiC)	1200	(7,12,17)
Topology: Synchronous rectifier			
TPM1R408RH	SOP Advance(E)	80	1.4
Under Development	SOP Advance(E)	80	(1.1)
Topology: Oring			
Under Development	SOP Advance(E)	60	(0.75)
TPM1R408RH	SOP Advance(E)	80	1.4
Under Development	SOP Advance(E)	80	(1.1)

HotSwap + DC-DC
 ±400Vin to 54Vout
 10kW

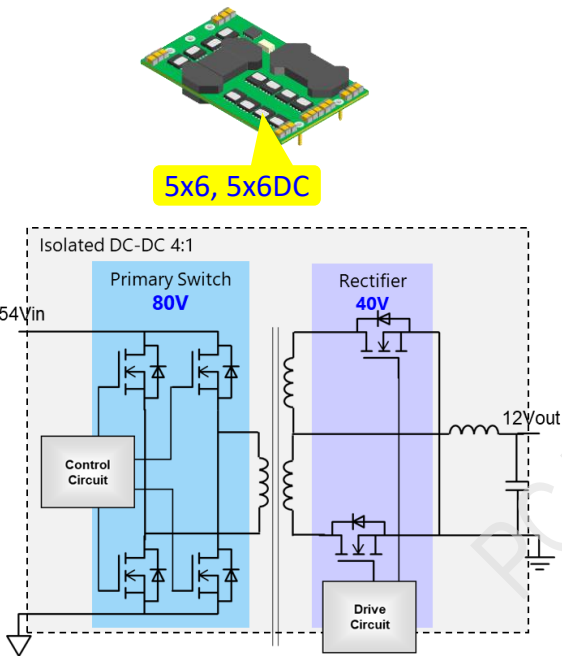


Part No./ Prototype No.	Package	VDSS (V)	RDS(ON) VGS = 10V max
Topology: HotSwap			
Under Investigation			
Topology: Full-B (±400Vin) or LLC(800Vin)			
Under Development	TOLT (SiC)	750	(6,10,14)
Under Development	QDPAK (SiC)	750	(6,10,14)
Under Development	QDPAK (SiC)	1200	(21,25,30)
Topology: Synchronous rectifier			
Under Development	DDFN5060	80	(1.4)
Under Development	DDFN5060	80	(1.1)
Under Development	DDFN5060(SD)	80	(0.92)

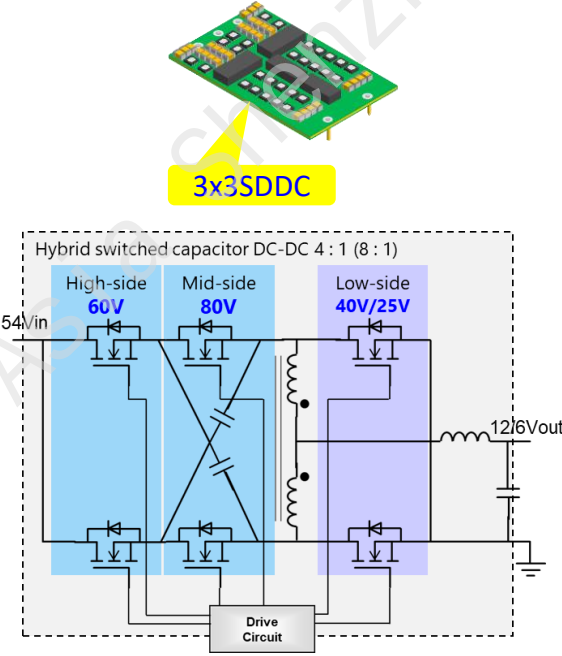
东芝全面支持AI算力电源的发展（二）

AI数据中心 HV-IBC/LV-IBC (12V/6V 输出)发展趋势

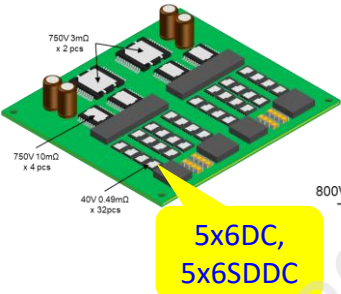
54Vin – 12Vout
2kW ¼ Brick



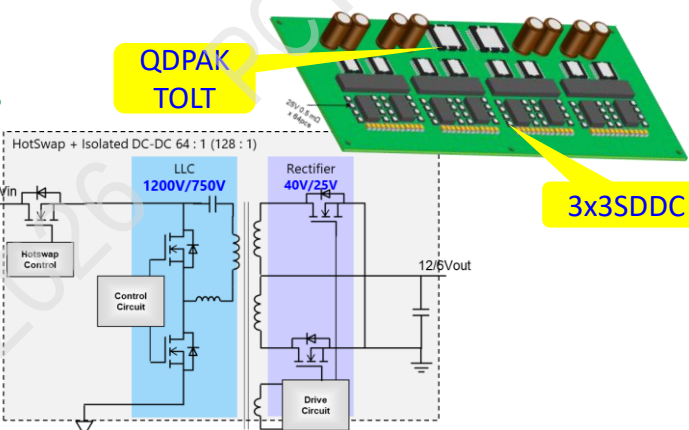
54Vin – 12Vout
3kW ¼ Brick



HotSwap
800Vin to 12Vout
10kW



HotSwap
800Vin to 6Vout
10kW



Part No./ Prototype No.	Package	VDSS (V)	RDS(ON) VGS = 10V max
Topology: Primary switch			
TPW4R008NH	DSOP Advance	80	4
TPH3R008QM	SOP Advance(N)	80	3
Topology: Synchronous rectifier			
TPWR8004PL	DSOP Advance	40	0.8
TPMR4904RL	SOP Advance(E)	40	0.49
TPMR4904RL	SOP Advance(E)	40	0.49

Part No./ Prototype No.	Package	VDSS (V)	RDS(ON) VGS = 10V max
Topology: Hybrid Switched Capacitor			
Under Development	DDFN3333(SD)	15	(0.45)
Under Development	DDFN3333(SD)	25	(0.65)
Under Development	DDFN3333(SD)	40	(1.35)
Under Development	DDFN3333(SD)	40	(1.4)
Under Development	DDFN3333(SD)	60	(1.7)
Under Development	DDFN3333(SD)	60	(1.8)
Under Development	DDFN3333(SD)	80	(3.7)

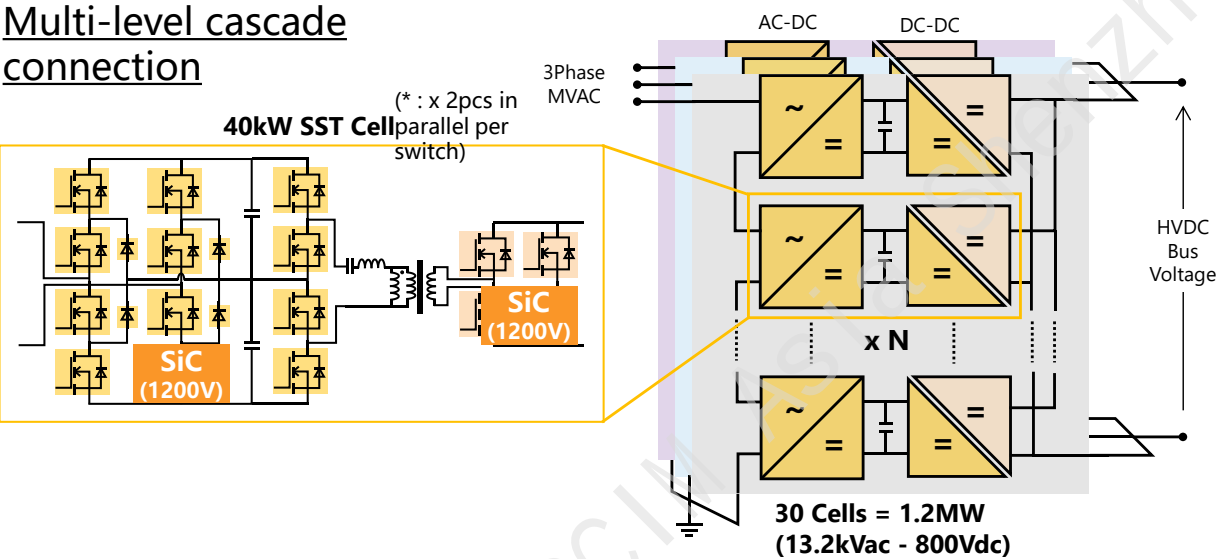
Part No./ Prototype No.	Package	VDSS (V)	RDS(ON) VGS = 10V max
Topology: HotSwap			
Under Investigation			
Topology: Full-B (±400Vin) or LLC(800Vin)			
Under Development	TOLT (SiC)	750	(6,10,14)
Under Development	QDPAK (SiC)	750	(6,10,14)
Under Development	QDPAK (SiC)	1200	(21,25,30)
Topology: Synchronous rectifier			
Under Development	DDFN5060	40	(0.49)
Under Development	DDFN5060	40	(0.49)
Under Development	DDFN5060(SD)	40	(0.396)
Under Development	DDFN5060(SD)	40	(0.396)
Under Development	DDFN3333(SD)	15	(0.45)
Under Development	DDFN3333(SD)	25	(0.45)
Under Development	DDFN3333(SD)	25	(0.65)

东芝全面支持AI算力电源的发展 (三)
SST(固态变压器): Solid State Transformer~1MW

Si (4.5~6.5kV)	SiC (1.2~3.3kV)
SST Mvac to HVDC	

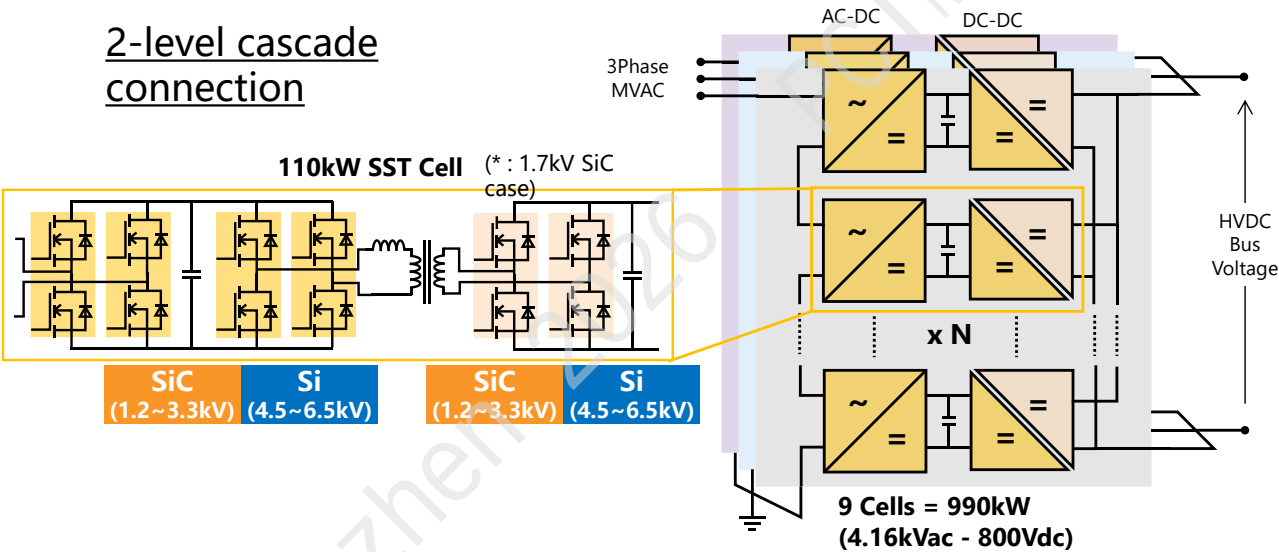
Discrete Solution

Multi-level cascade connection



Module Solution

2-level cascade connection



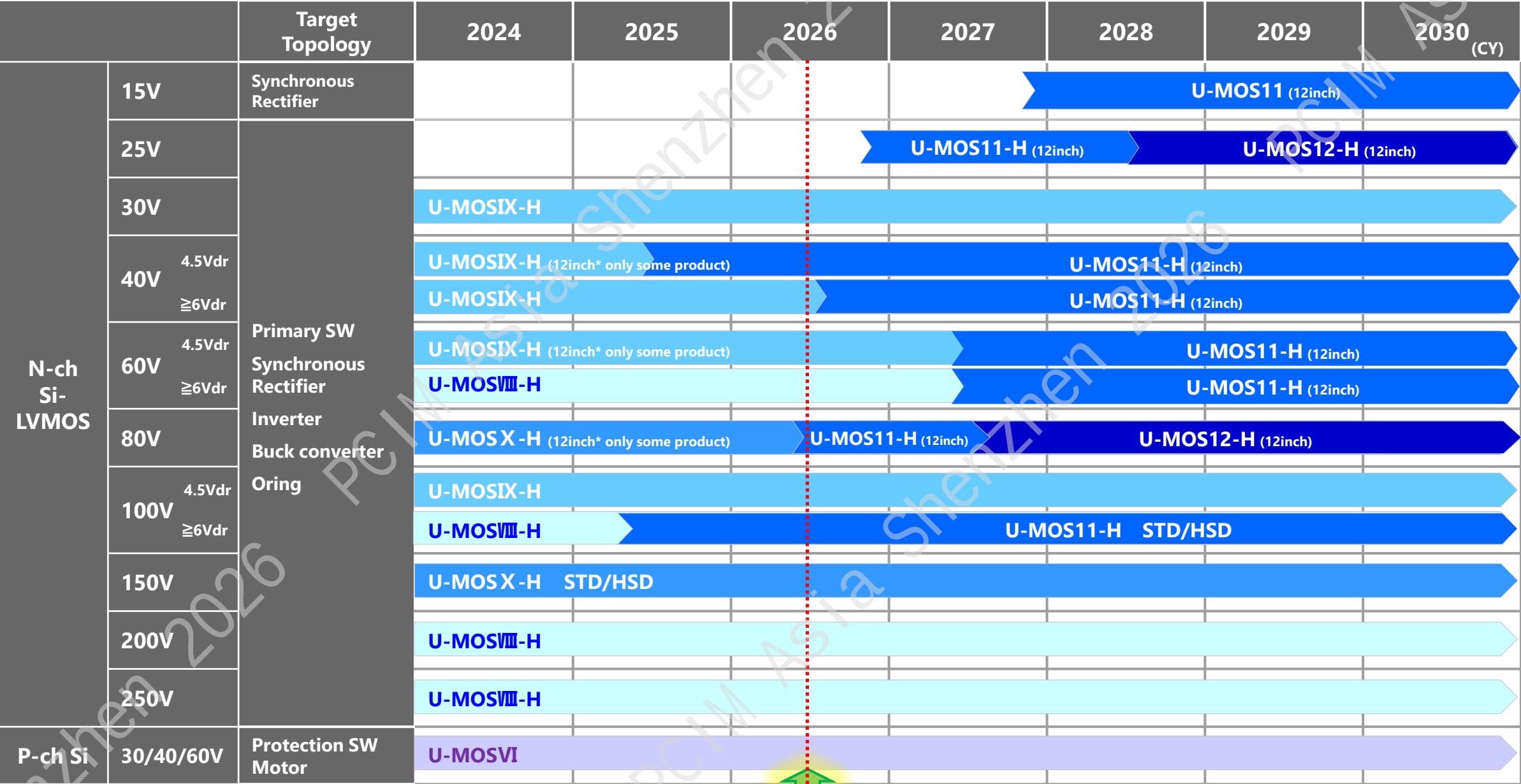
Part No./ Prototype No.	Package	VDSS (V)	R _{DS(ON)} V _{GS} = 18V typ
Topology: Primary switch			
TW015Z120C	TO-247-4L	1200	15
TW007D120E	Q-DPAK	1200	7
Topology: Synchronous rectifier			
TW015Z120C	TO-247-4L	1200	15
TW007D120E	Q-DPAK	1200	7

Part No./ Prototype No.	Package	VDSS (V)	I _D (A)
Topology: Primary switch			
MG800FXF2YMS3	iXPLV	3300	800
IX500FXF2YMS4	iXPLV	3300	500
MG250YD2YMS3	E3D	2200	500
Topology: Synchronous rectifier			
MG600Q2YMS3	E3D	1200	600
MG400Q2YMS3	E3D	1200	400

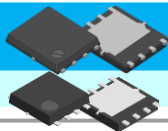
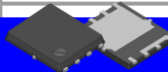
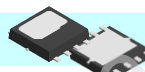
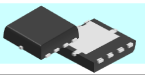
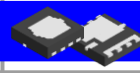
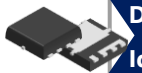
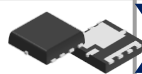
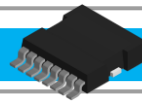
02

低压MOSFET

LVMOS开发路线图 (Si技术)



LVMOS开发路线图 (封装)

Package Name			2023	2024	2025	2026	2027	2028	2029 (CY)	Future Idea	
General Toshiba											
Surface mount series	DFN 5 x 6	SOP Advance SOP Advance (N)		SOP Advance(N) Malaysia (ATM) SOP Advance			SOP Advance(N) Thailand (TST)				
		SOP Advance (E) <i>Interconnected source terminal</i>							SOP Advance(E)		
		DSOP Advance DDFN5060 <i>Interconnected source terminal</i>		DSOP Advance			3Q 2027 ~		 DDFN5060		
		DDFN5060(SD)					1H 2028 ~		 DDFN5060(SD)		
		DFN5060(SD)							 DFN5060(SD) Idea		
	DFN 3 x 3	TSON Advance		TSON Advance							
		DDFN3333(SD)		★Starting development★			1Q 2027 ~			DDFN3333(SD)	
		DFN3333 <i>Interconnected source terminal</i>							 DFN3333 Idea		
		DFN3333(SD)							 DFN3333(SD) Idea		
	12 x 10	L-TOGL (12 x 10)		L-TOGL Himeji							
		Top sided cooling								TSC 10x12 Idea	
TO type	TO-220	TO-220AB		TO-220AB							
	TO-220 F	TO-220SIS		TO-220SIS							



价值 U-MOS11-H 80V系列提供一流的性能并提高效率

1 低驱动损耗

- $R_{DS(ON)} \times Q_g$ 降低（单元设计优化）
- 在高频下贡献显著，尤其是在轻负载情况下

2 低开关损耗

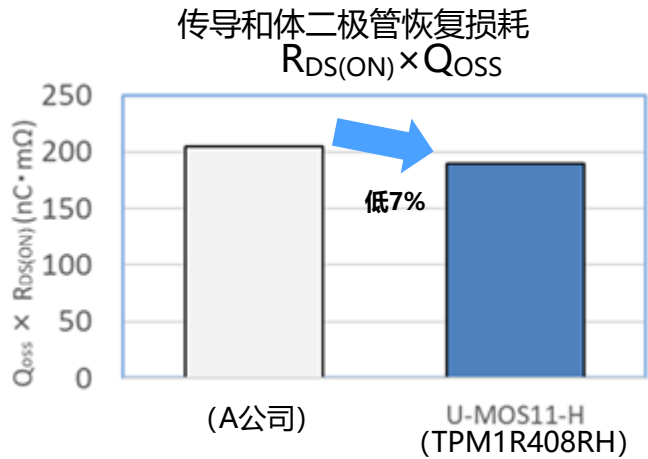
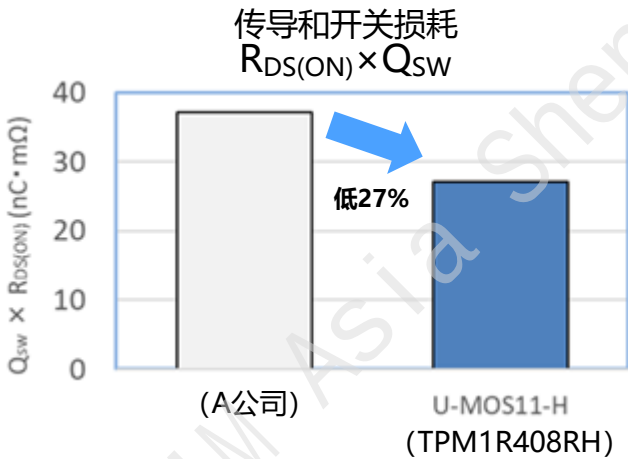
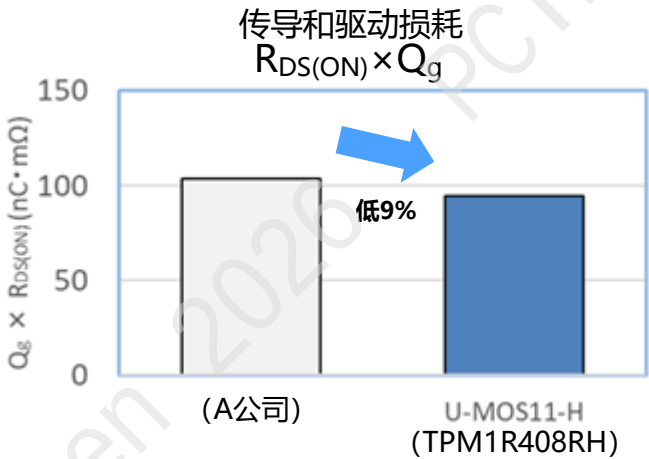
- $R_{DS(ON)} \times Q_{sw}$ 降低（单元设计优化）
- 在高频下贡献显著，尤其是在轻负载情况下

3 低输出电容

- $R_{DS(ON)} \times Q_{oss}$ 降低（单元设计优化）
- 有助于图腾柱应用中，降低高侧MOSFET损耗

与A公司的FOM (Figure of Merit) 比较

截至2025年12月（东芝调查数据）

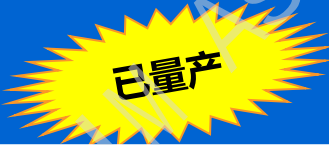


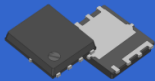
$R_{DS(ON)}$: 导通电阻 (传导损耗的品质因数)
 Q_g : 栅极电荷 (驱动损耗的品质因数)

Q_{sw} : 充放电开关电荷(开关损耗的品质因素)
 Q_{oss} : 输出电荷 (开关损耗的品质因数)

新产品U-MOS11-H 80V: TPM1R408RH

TPM1R408RH在 $R_{DS(ON)}$ 和 Q_g 方面表现优秀



Item	U-MOS11-H TPM1R408RH	 5 x 6 mm ²	A公司	 5 x 6 mm ²	B公司	 5 x 6 mm ²
T_{ch}	175 deg. C	★★★★	175 deg. C	★★★★	175 deg. C	★★★★
V_{th}	2.4V~3.6V Drive voltage : 8V	★★	2.4V~3.5V Drive voltage : 8V	★★	2.4V~3.6V Drive voltage : 6V	★★
$R_{DS(ON)}$ typ. @ $V_{GS}=10V$	1.17*1 mΩ	★★★★	1.23*1 mΩ	★★	1.28*1 mΩ	★
$Q_g \cdot R_{DS(ON)}$ typ.	94*1 nC · mΩ	★★★★	100*1 nC · mΩ	★★	102*1 nC · mΩ	★
$Q_{SW} \cdot R_{DS(ON)}$ typ.	27*1 nC · mΩ	★★★★	36*1 nC · mΩ	★★	32*1 nC · mΩ	★★
$Q_{oss} \cdot R_{DS(ON)}$ typ.	188*1 nC · mΩ	★★	197*1 nC · mΩ	★	164*1 nC · mΩ	★★★★
$Q_{rr} \cdot R_{DS(ON)}$ typ.	135*1 nC · mΩ	★★★★	132*1 nC · mΩ	★★★★	133*1 nC · mΩ	★★★★

*1 Measured value on same condition (Toshiba devices are equal to datasheet)

The earliest part schedule (CY)

V_{DSS} (V)	Gen.	Part No.	$R_{DS(ON)}$ max $V_{GS}=10V$ (mΩ)	Package	Wafer size (inch)	Assembly site	2026											
							Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
80	U-MOS11-H	TPM1R408RH	1.4	SOP Advance(E)	12	Thailand	Under Mass production											

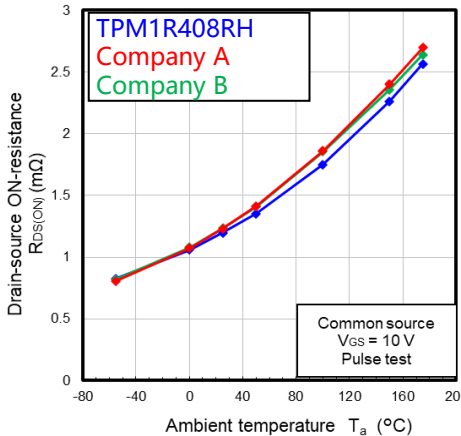
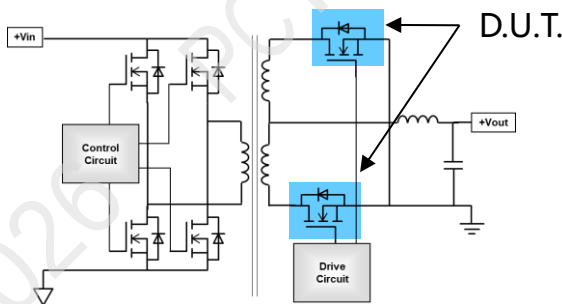
新产品U-MOS11-H 80V: TPM1R408RH

TPM1R408RH拥有更好的温度特性和效率

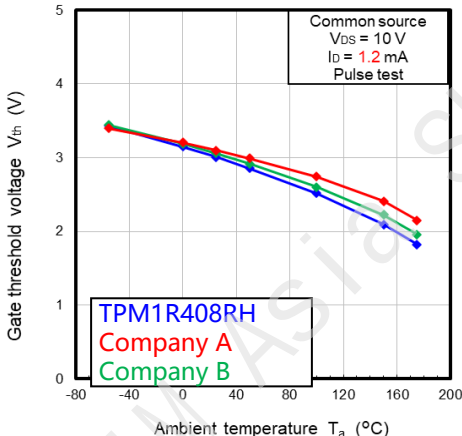
已量产

效率测试电路及测试条件:

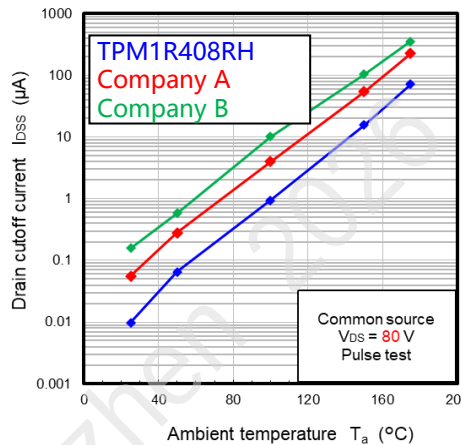
测试条件:
Vout: 12V
Freq: 150kHz
Parallel: 1pcs



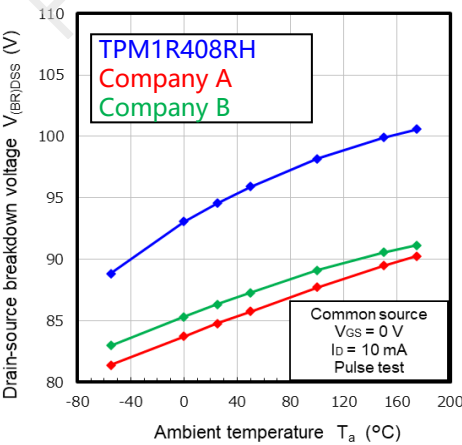
R_{DS(ON)}(V_{GS}①) - T_a
(Confidential)



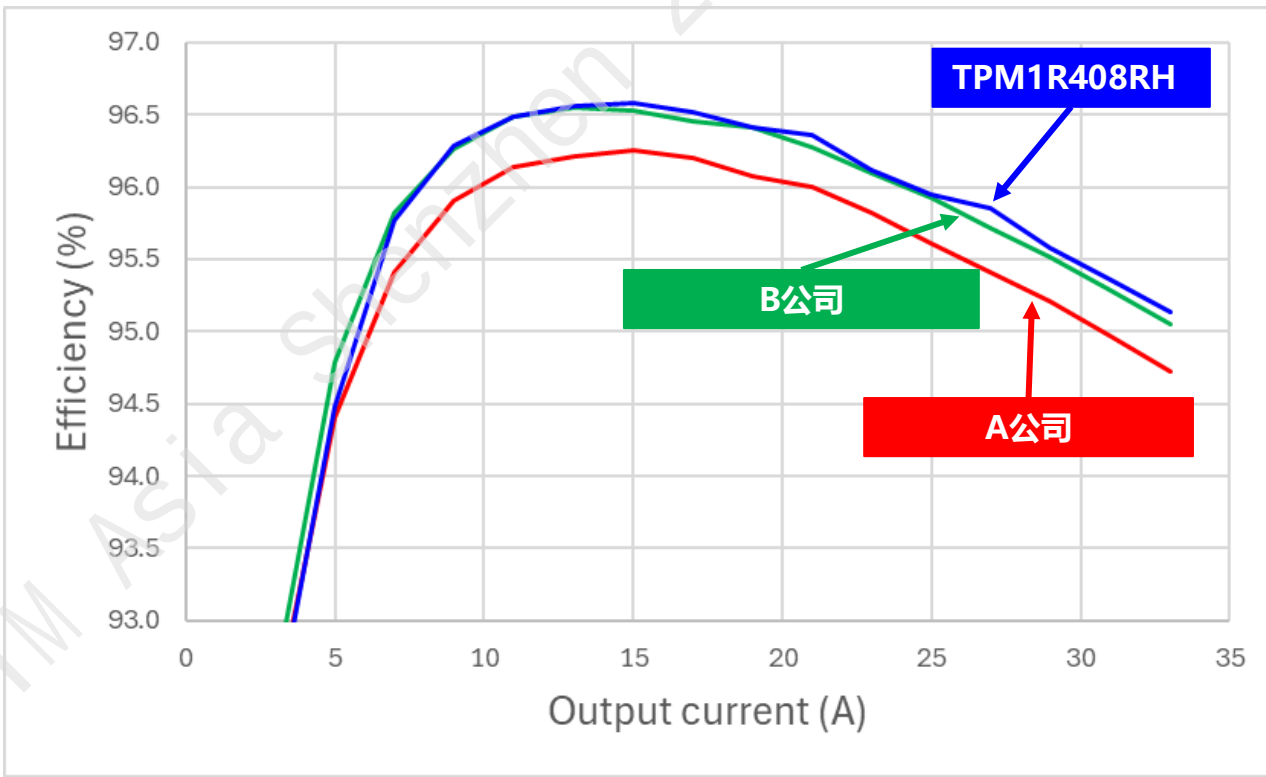
V_{th} - T_a
(Confidential)



I_{DSS} - T_a
(Confidential)



V_{(BR)DSS} - T_a
(Confidential)



U-MOS 80V产品线 (1/2)

Under Investigation

Under Development

ES Available

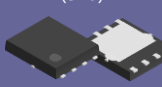
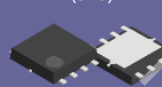
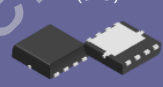
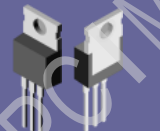
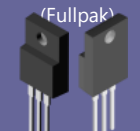
CS Available

Ready to Order

Under MP

Successor Available

(CY)

R _{DS(ON)} max V _{GS} =10V (mΩ)	Package															
	DDFN5060 (5x6 dual sided cooling)  5 x 6 mm ²	SOP Advance(E) (5x6)  5 x 6 mm ²	SOP Advance(N) (5x6)  5 x 6 mm ²	SOP Advance (5x6)  5 x 6 mm ²	TSON Advance (3x3)  3 x 3 mm ²		L-TOGL (TOLL leaded)  10 x 12 mm ²	PAK (TO-252)  6.5 x 10 mm ²	TO-220  7.62 x 9.14 mm ²		TO-220SIS (Fullpak)  7.62 x 9.14 mm ²					
30						TPN30008NH	30									
20						TPN19008QM	19									
12					TPH12008NH	12	TPN13008NH	13								
							TPN12008QM	12								
8				TPH8R808QM	8.8	TPH8R008NH	8	TPN8R408QM	8.4		TK7R0E08QM	7				
6				U.I. (11-H)	6.6				TK6R9P08QM	6.9		TK6R8A08QM	6.8			
				TPH6R008QM	6											
5				U.I. (11-H)	4.5				TK5R1P08QM	5.1	TK5R3E08QM	5.3	TK5R1A08QM	5.1		
4	TPW4R008NH DSOP Advance	4	TPM3R708QM	3.7	TPH4R008NH1	4										
					TPH4R008QM	4										
3	U.I. (11-H)	3	TPM2R808QM	2.8	TPH3R008QM	3				TK3R3E08QM	3.3	TK3R2A08QM	3.2			
2.5			U.I. (11-H)	2.5	TPH2R408QM	2.4				TK2R4E08QM	2.4	TK2R4A08QM	2.4			
			TPM2R408QM	2.4												
2			U.I. (11-H)	2												
			TPM1R908QM	1.9												
1.5	S1VM5(11-H) (ES 1Q 2027)	1.4	U.I. (11-H)	1.7												
			TPM1R408RH	1.4												
1.2	U.I. (12-H)	1.1	S1XU9(12-H) (ES 2Q 2027)	1.1												
0.8								XPQR8308QB	0.8							

注：正在开发中的规格和进度仅为目标，如有更改，恕不另行通知

U.I.: Under Investigation

U-MOS 80V产品线 (2/2)

Under Investigation

Under Development

ES Available

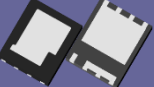
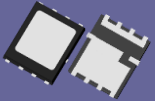
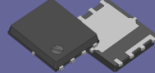
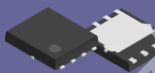
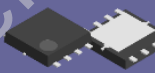
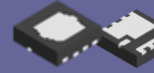
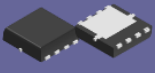
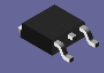
CS Available

Ready to Order

Under MP

Successor Available

(CY)

R _{DS(ON)} max V _{GS} =10V (mΩ)	Package									
	DDFN5060 (5x6 dual sided cooling)  5 x 6 mm ²	DDFN5060(SD)  5 x 6 mm ²	SOP Advance(E) (5x6)  5 x 6 mm ²	SOP Advance(N) (5x6)  5 x 6 mm ²	SOP Advance (5x6)  5 x 6 mm ²	DDFN3333(SD)  5 x 6 mm ²	TSON Advance (3x3)  3 x 3 mm ²	L-TOGL (TOLL leaded)  10 x 12 mm ²	DPAK (TO-252)  6.5 x 10 mm ²	
30							TPN30008NH	30		
20							TPN19008QM	19		
12					TPH12008NH	12	TPN13008NH	13		
							TPN12008QM	12		
8				TPH8R808QM	8.8	TPH8R008NH	8	TPN8R408QM	8.4	
6				U.I. (11-H)	6.6				TK6R9P08QM	6.9
				TPH6R008QM	6					
5				U.I. (11-H)	4.5				TK5R1P08QM	5.1
4	TPW4R008NH DSOP Advance	4	TPM3R708QM	3.7	TPH4R008NH1	4	S1XW0(11-H) (ES 1Q 2027)	3.7		
					TPH4R008QM	4				
3	U.I. (11-H)	3	TPM2R808QM	2.8	TPH3R008QM	3				
2.5			U.I. (11-H)	2.5	TPH2R408QM	2.4				
			TPM2R408QM	2.4						
2			U.I. (11-H)	2						
			TPM1R908QM	1.9						
1.5	S1VM5(11-H) (ES 1Q 2027)	1.4	U.I. (11-H)	1.7						
			TPM1R408RH	1.4						
1.2	U.I. (12-H)	1.1	U.I. (11-H)	1.2	S1XU9(12-H) (ES 2Q 2027)	1.1				
1			S1XW9(12-H) (ES 2H 2027)	0.9						
0.8								XPQR8308QB	0.8	

注：正在开发中的规格和进度仅为目标，如有更改，恕不另行通知

U.I.: Under Investigation

U-MOS11-H 40V系列

价值 U-MOS11-H 40V系列以一流的性能助您提升效率

1 低驱动损耗

- $R_{DS(ON)} \times Q_g$ 降低（单元设计优化）
- 在高频下贡献显著，尤其是在轻负载情况下

2 低开关损耗

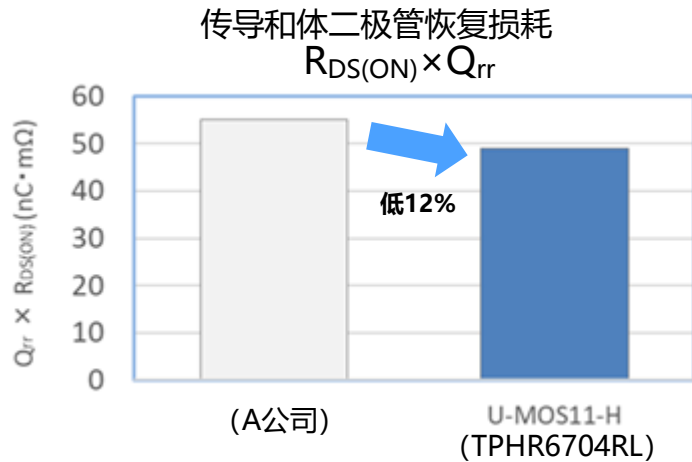
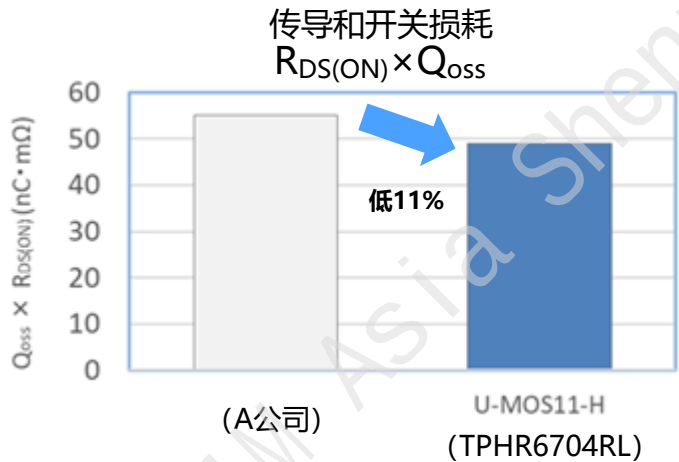
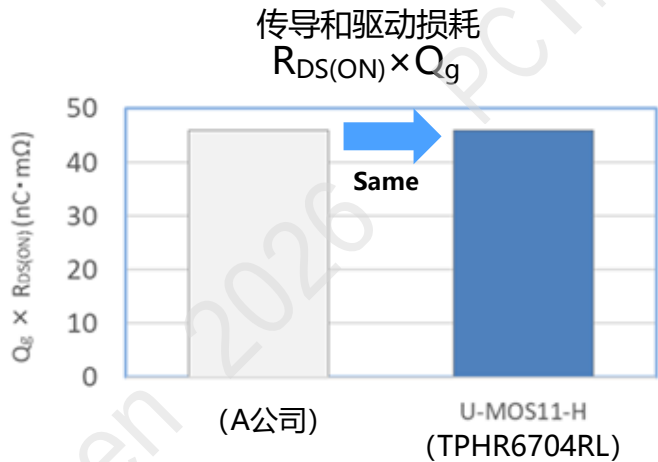
- $R_{DS(ON)} \times Q_{OSS}$ 降低（单元设计优化）
- 在高频下贡献显著，尤其是在轻负载情况下

3 低反向恢复损耗

- Q_{rr} 降低（单元设计优化）
- 开关电源单元二次侧同步整流电路贡献显著。

与A公司的FOM (Figure of Merit) 比较

截至2024年12月（东芝调查数据）



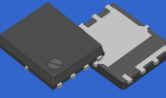
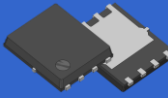
$R_{DS(ON)}$: 导通电阻（传导损耗的品质因数）
 Q_g : 栅极电荷（驱动损耗的品质因数）

Q_{OSS} : 输出电荷（开关损耗的品质因数）
 Q_{rr} : 反向恢复电荷（体二极管反向恢复损耗的品质因数）

新产品U-MOS11 40V: TPHR6704RL



新增一款产品, $R_{DS(ON)}$ 和 Q_{rr} 方面均优于竞争对手

Item	U-MOS11-H (4.5V) TPHR6704RL	 5×6 mm ²	A公司	 5×6 mm ²	U-MOSIX-H TPHR8504PL	 5×6 mm ²
T _{ch}	175°C	★★★★	175°C	★★★★	175°C	★★★★
V _{th}	1.0V ~ 2.0V Drive voltage: 4.5V	★★	1.3V ~ 2.3V Drive voltage : 4.5V	★★	1.4V ~ 2.4V Drive voltage : 4.5V	★★
R _{DS(ON)} Typ. at 10V	0.52*1mΩ	★★★★	0.55*1mΩ	★★	0.7*1mΩ	★
Q _g · R _{DS(ON)} Typ.	46*1nC · mΩ	★★★★	46*1nC · mΩ	★★★★	72*1nC · mΩ	★
Q _{SW} · R _{DS(ON)} Typ.	12.5*1nC · mΩ	★★	10.3*1nC · mΩ	★★★★	16.1*1nC · mΩ	★
Q _{oss} · R _{DS(ON)} Typ.	52*1nC · mΩ	★★★★	55*1nC · mΩ	★★	60*1nC · mΩ	★
Q _{rr} · R _{DS(ON)} Typ.	55*1nC · mΩ	★★★★	67*1nC · mΩ	★★	65*1nC · mΩ	★★

*1 相同条件下的测量值 (东芝器件与数据手册一致)

开发计划 (CY)

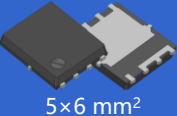
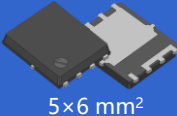
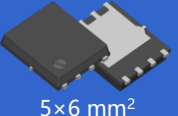
V _{DSS} (V)	Gen.	Part No.	R _{DS(ON)} max V _{GS} =10V (mΩ)	Package	Wafer size (inch)	Assembly site	2026											
							Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
40	U-MOS11-H	TPMR4904RL	0.49	SOP Advance(E)	12	Thailand	Under Mass production											
	U-MOS11-H	TPMR4904RM	0.49	SOP Advance(E)	12	Thailand	Ready to Order						MP					
	U-MOS11-H	TPHR6704RL	0.67	SOP Advance(N)	12	Thailand	Under Mass production											

注: 正在开发中的规格和进度仅为目标, 如有更改, 恕不另行通知。

新产品U-MOS11 40V: TPMR4904RL



另一款新产品, $R_{DS(ON)}$ 及反向恢复特性均表现出色

Item	U-MOS11-H (4.5V) TPMR4904RL 	A公司 	U-MOS11-H (4.5V) TPHR6704RL 
T_{ch}	175°C★★★★	175°C★★★★	175°C★★★★
V_{th}	1.0V ~ 2.0V Drive voltage: 4.5V★★	1.2V ~ 1.8V Drive voltage: 4.5V★★	1.0V ~ 2.0V Drive voltage: 4.5V★★
$R_{DS(ON)}$ Typ. at 10V	0.39*1mΩ★★★★	0.42*1mΩ★★	0.52*1mΩ★
$Q_g \cdot R_{DS(ON)}$ Typ.	42*1nC · mΩ★★★★	57*1nC · mΩ★	46*1nC · mΩ★★★★
$Q_{SW} \cdot R_{DS(ON)}$ Typ.	12.1*1nC · mΩ★★★★	14.7*1nC · mΩ★	12.5*1nC · mΩ★★★★
$Q_{oss} \cdot R_{DS(ON)}$ Typ.	47*1nC · mΩ★★★★	70*1nC · mΩ★	52*1nC · mΩ★★★★
$Q_{rr} \cdot R_{DS(ON)}$ Typ.	48*1nC · mΩ★★★★	68*1nC · mΩ★	55*1nC · mΩ★★★★

*1 相同条件下的测量值 (东芝器件与数据手册一致)

开发计划 (CY)

V_{DSS} (V)	Gen.	Part No.	$R_{DS(ON)max}$ $V_{GS}=10V$ (mΩ)	Package	Wafer size (inch)	Assembly site	2026											
							Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
40	U-MOS11-H	TPMR4904RL	0.49	SOP Advance(E)	12	Thailand	Under Mass production											
	U-MOS11-H	TPMR4904RM	0.49	SOP Advance(E)	12	Thailand	Ready to Order						MP					
	U-MOS11-H	TPHR6704RL	0.67	SOP Advance(N)	12	Thailand	Under Mass production											

注: 正在开发中的规格和进度仅为目标, 如有更改, 恕不另行通知。

U-MOS11-H 40V产品线

Under Investigation

Under Development

ES Available

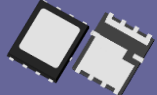
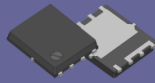
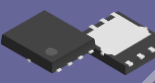
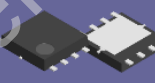
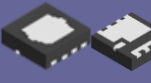
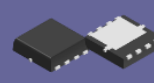
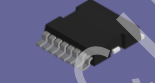
CS Available

Ready to Order

Under MP

Successor Available

(CY)

R _{DS(ON)} max V _{GS} =10V (mΩ)	Package										
	DDFN5060 (5x6 dual sided cooling)  5 x 6 mm ²	DDFN5060(SD)  5 x 6 mm ²	SOP Advance(E) (5x6)  5 x 6 mm ²	SOP Advance(N) (5x6)  5 x 6 mm ²	SOP Advance (5x6)  5 x 6 mm ²	DDFN3333(SD)  3 x 3 mm ²	TSON Advance (3x3)  3 x 3 mm ²	L-TOGL (TOLL leaded)  10 x 12 mm ²	DDPAK (TO-252)  6.5 x 10 mm ²		
20										TK15S04N1L _(L)	18
8					TPH7R204PL _(L)	7.2		TPN7R504PL _(L)	7.5		
6					TPH6R004PL _(L)	6					
4					TPH3R704PL _(L)	3.7		TPN3R704PL _(L)	3.7		
3										TK3R1P04PL _(L)	3.1
2.5								TPN2R304PL _(L)	2.3		
2				U.I. (11-H) U.I. (11-H) _(L)	2 1.8	TPH2R104PL _(L)	2.1				
1.5				U.I. (11-H)	1.4		S1XV7(11-H) (ES Oct. 2026) S1XV6(11-H) _(L) (ES Oct. 2026)			TK1R4S04PB	1.4
1.2				U.I. (11-H) _(L)	1.3	TPH1R204PB (LS)	1.2				
1	U.I. (11-H) U.I. (11-H) _(L)	1 0.9	U.I. (11-H) U.I. (11-H) _(L)	1 0.9	TPHR8504PL1 _(L)	0.9	TPHR7404PU (LS)	0.7			
0.8	TPWR8004PL _(L)	0.8	U.I. (11-H) U.I. (11-H) _(L)	0.8 0.7	TPHR8504PL _(L)	0.9					
0.6			U.I. (11-H) U.I. (11-H) _(L)	0.7 0.6	TPHR6704RL _(L)	0.7					
0.5	S1UB6(11-H) _(L) (ES 4Q 2027) S1XA2(11-H) (ES 4Q 2027)	0.5 0.5	TPMR4904RL _(L) TPMR4904RM (MP Jul. 2026)	0.5 0.5							
0.4		S1XW6(11-H) _(L) (ES 3Q 2027) S1XW7(11-H) (ES 3Q 2027)	0.4 0.4								
0.3										XPQR3004PB (LS)	0.3

(L) : Logic(4.5V)drive device

(LS) : Low Spike

(L) : Logic(4.5V)drive device
(LS) : Low Spike

注：正在开发中的规格和进度仅为目标，如有更改，恕不另行通知

U.I.: Under Investigation

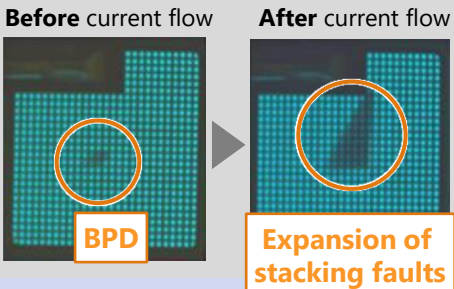
03

SiC MOSFET

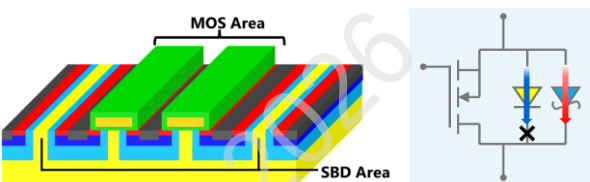
东芝SiC MOSFET秉承“更小的芯片尺寸和一流的性能”开发理念

Toshiba existing 3rd Gen SiC MOSFET shows low $R_{DS(ON)}$ and high reliability

Concerns of SiC: SiC crystal defects leads to characteristics fluctuation

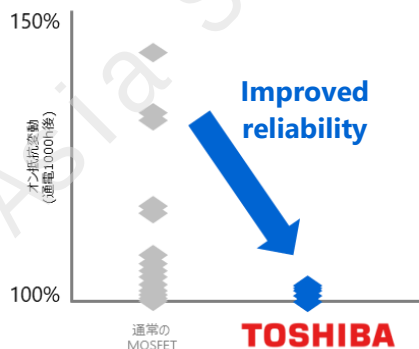


Toshiba's Solution: SiC MOSFET with embedded SBD

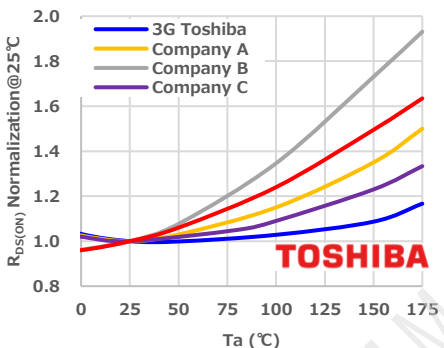


Thanks to current flowing on SBD, Body Diode current (bipolar) that degrades SiC crystal does not flow.

① SBD embedded

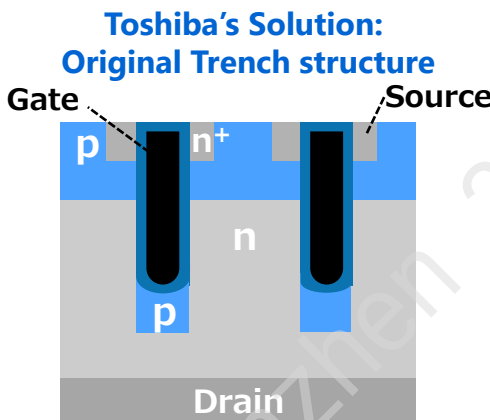


② $R_{DS(ON)}$ Temp. dependence

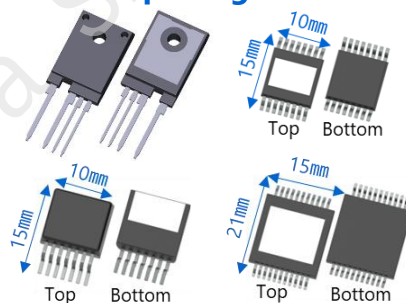


*All data is based on 650V/750V rating products

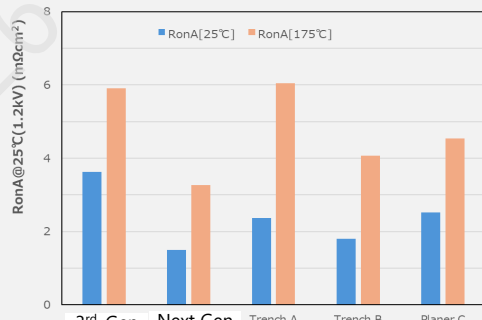
Toshiba Next Gen SiC MOSFET shows Low cost & Best in Class performance



Plan to release various kinds of packages

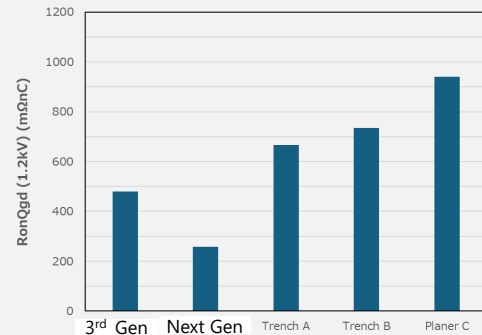


■ $R_{DS(ON)} \times A$ (Chip size) Comparison



TOSHIBA

■ $R_{DS(ON)} \times Q_{gd}$ Comparison

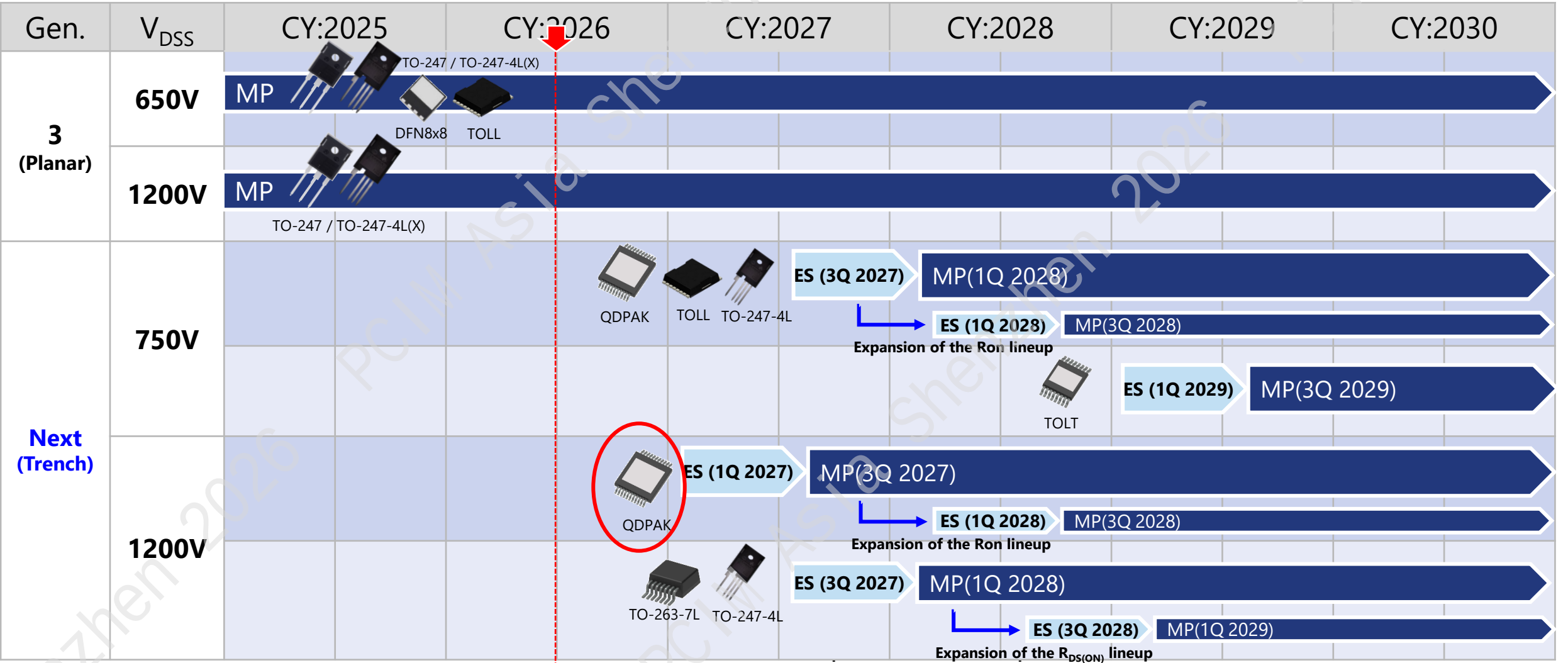


TOSHIBA

*All data is based on 1200V rating products

分立SiC MOSFET开发路线图

下一代SiC MOSFET采用沟槽结构，首发采用QDPAK 封装

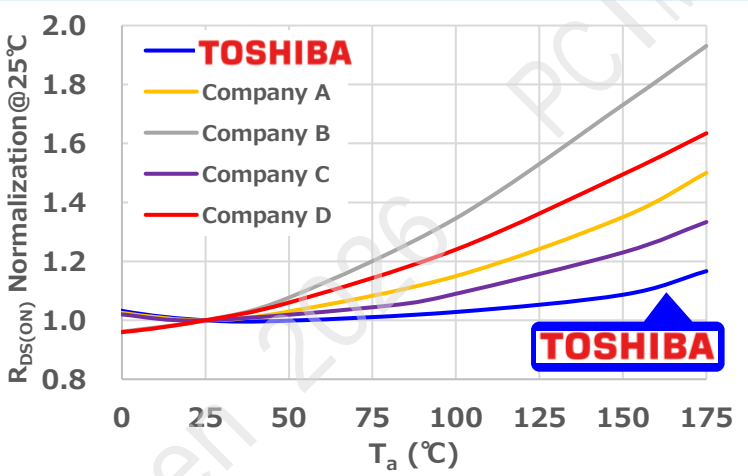


东芝第三代SiC MOSFET特点

Toshiba SiC MOSFET具有低损耗、设计灵活等特征

1 低 $R_{DS(ON)}$ 温度漂移

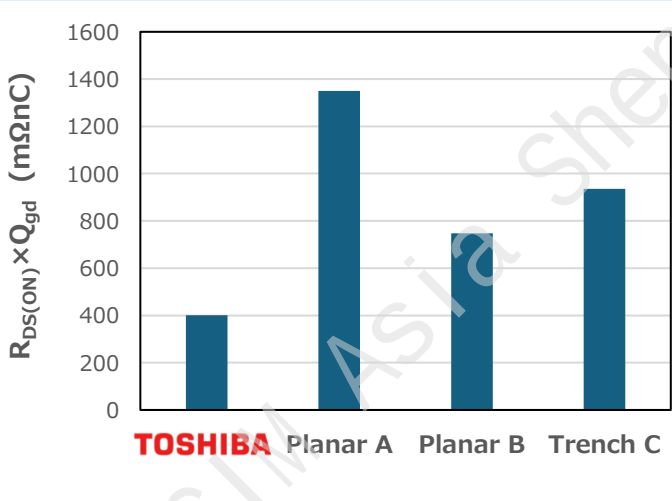
- 通过优化漂移和沟道电阻比，我们的器件在高温条件下导通电阻 ($R_{DS(ON)}$) 漂移非常小。
- $R_{DS(ON)}$ 从25°C升至175°C时仅增加17%。



* 所有数据均基于额定电压为650V / 750V的产品。

2 低 $R_{DS(ON)} \times Q_{gd}$

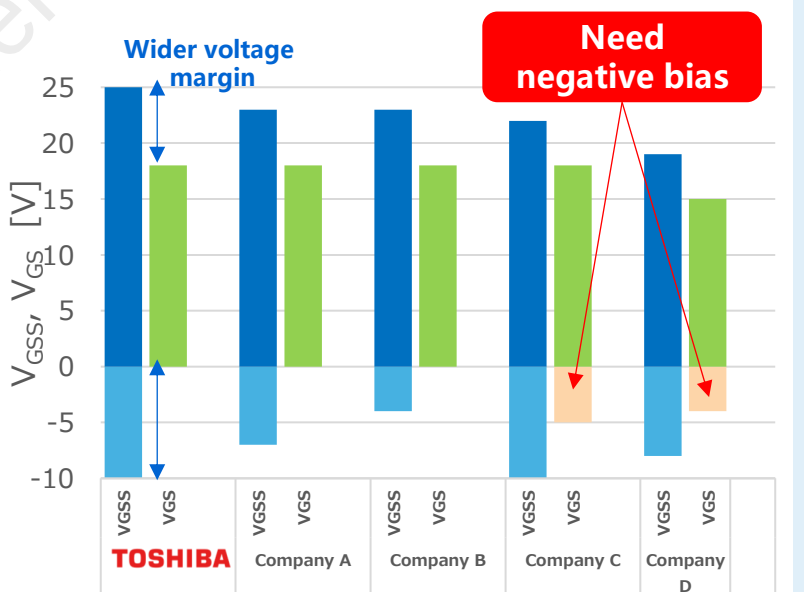
- 第三代产品实现了业界领先的 $R_{DS(ON)} \times Q_{gd}$ 性能。
- 该值低于友商，开关性能更佳。



* 所有数据均基于额定电压为1200V的产品。

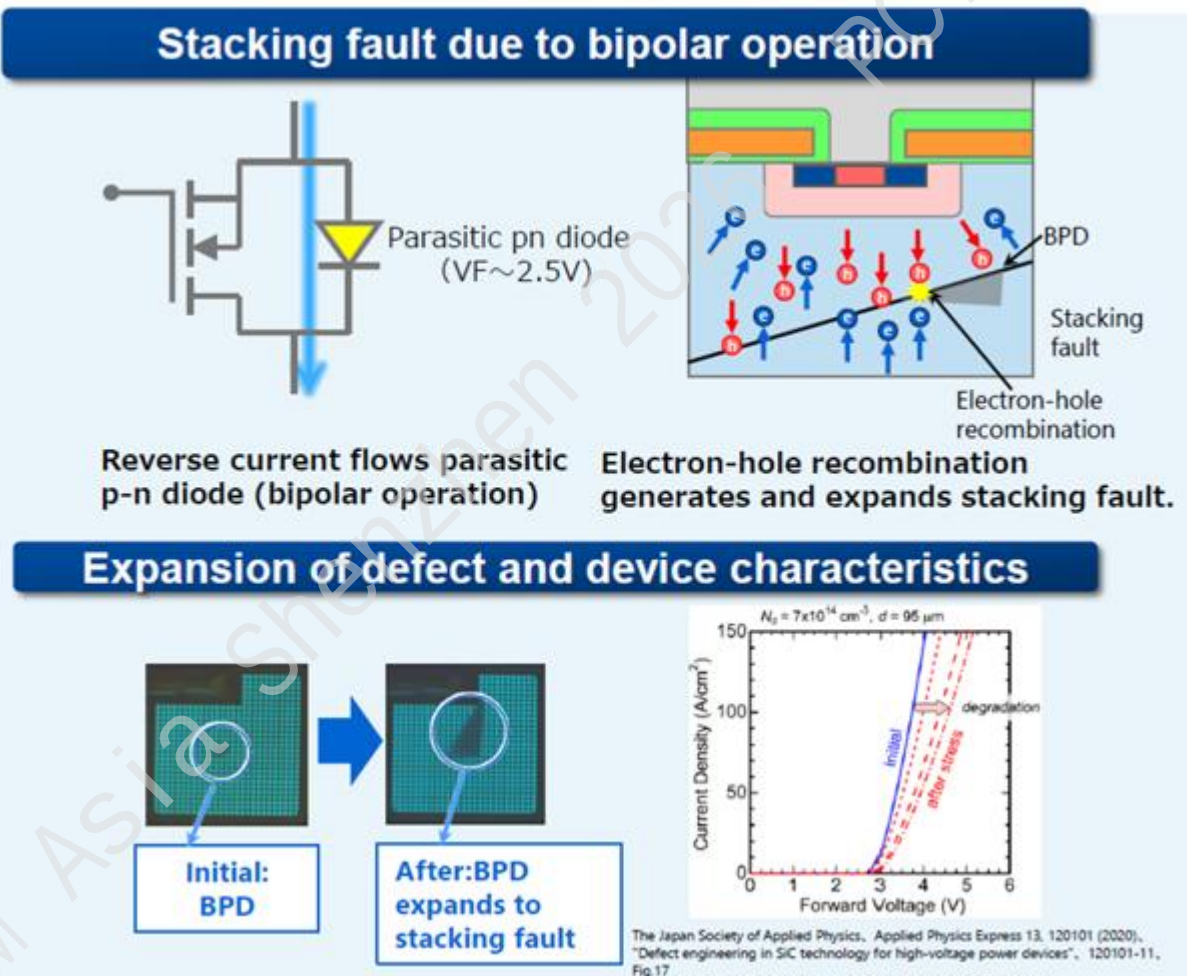
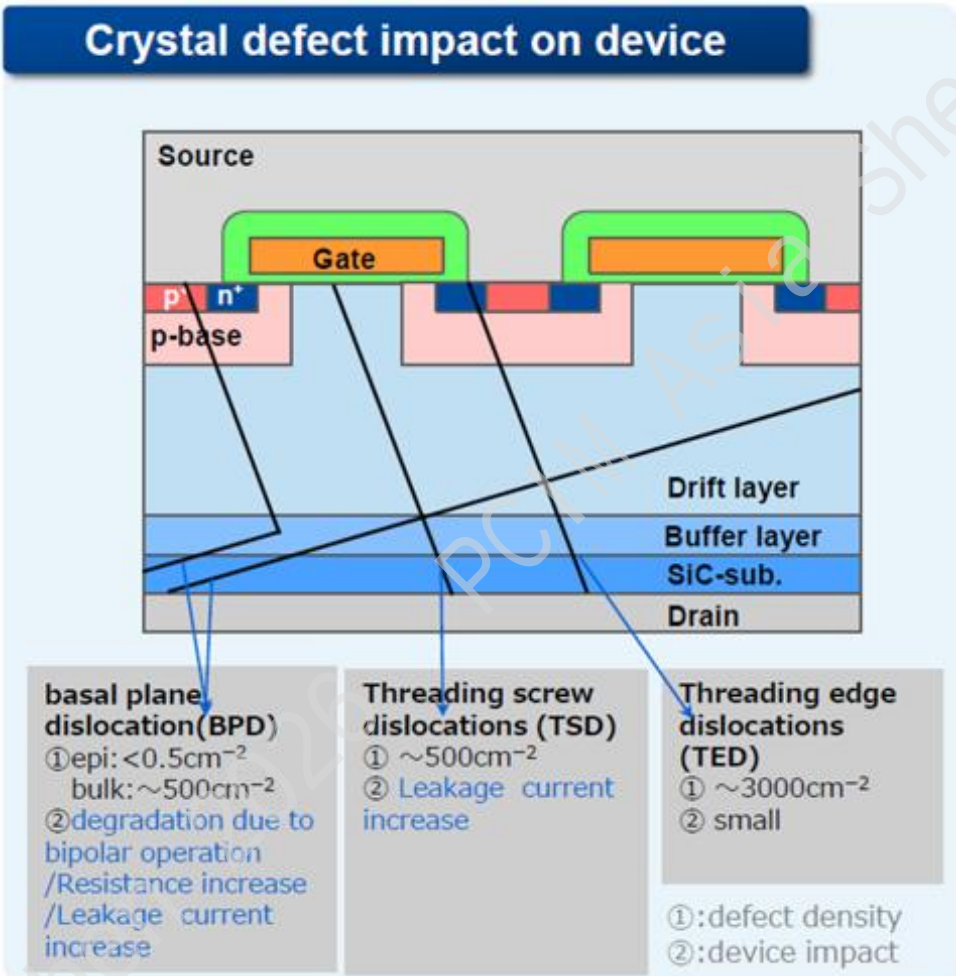
3 宽 V_{GSS} 驱动范围

- 与其他竞争对手的SiC MOSFET相比，具有更宽的 V_{GSS} 额定值。
 V_{GSS} : -10V ~ 25V (推荐: 18V)
- 无需负压驱动 ⇒ 易于设计!



* 所有数据均基于额定电压为650V / 750V的产品。

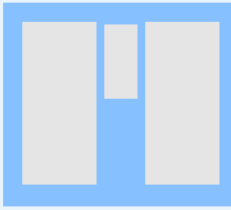
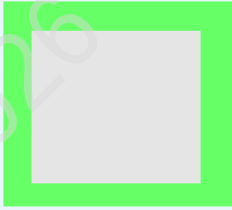
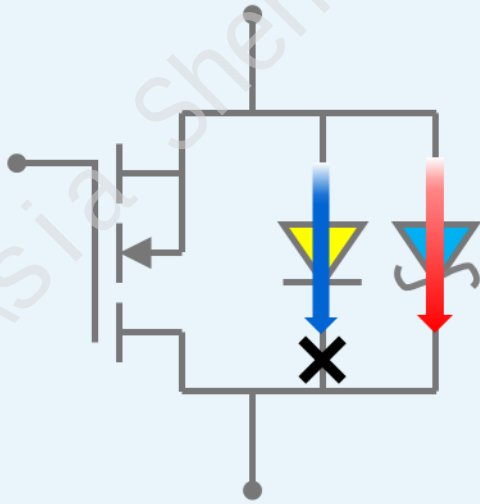
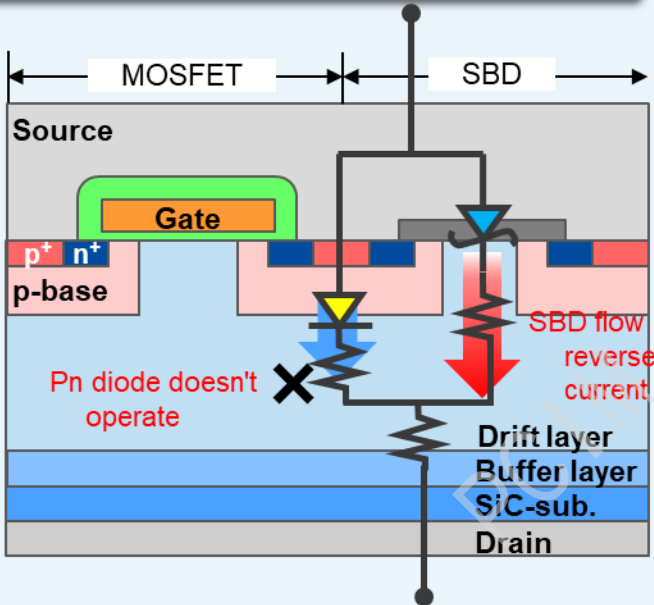
BPD导致堆垛层错扩展和性能退化



通过芯片设计来抑制碳化硅晶体的双极退化现象

内置SBD能有效地防止双极退化，并减小系统体积

SBD-embedded MOSFET



MOSFET

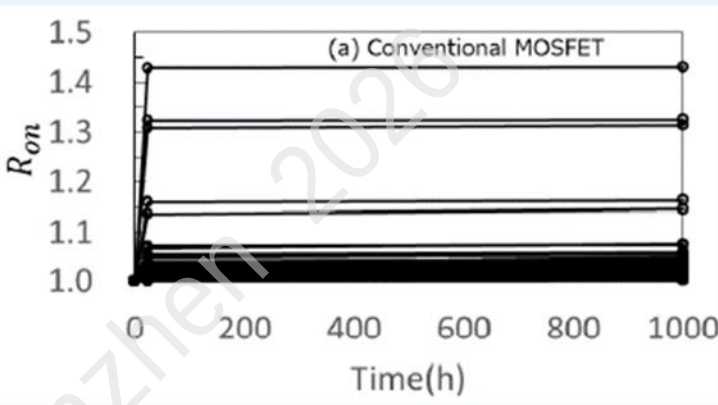
SBD

SBD-embedded MOSFET

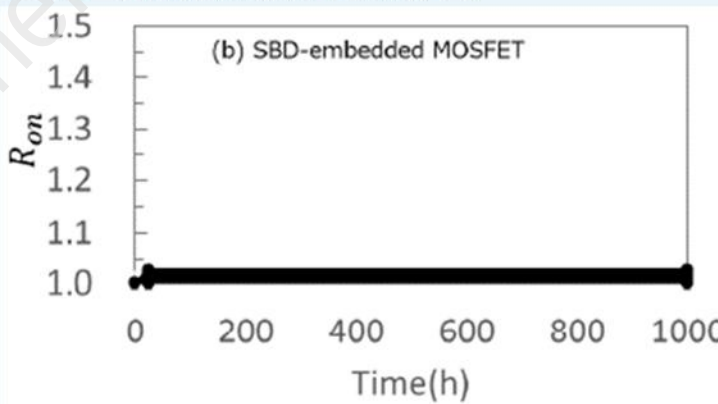
SBD connected in parallel with MOS needs large SBD area to avoid V_{sd} exceed V_f of parasitic diode

Reliability improvement

Simple MOSFET (w/o SBD)



SBD-embedded MOSFET



Mesago PCIM, Power Conversion and Intelligent Motion(PCIM) Proceedings, p.1, 07-08 July (2020)
Furukawa et al. "Improved reliability of 1.2kV SiC MOSFET by preventing the intrinsic body diode operation" Fig.11

易于设计和安全驱动的第三代SiC MOSFET

让您更容易和安全地使用东芝第三代SiC MOSFET!!

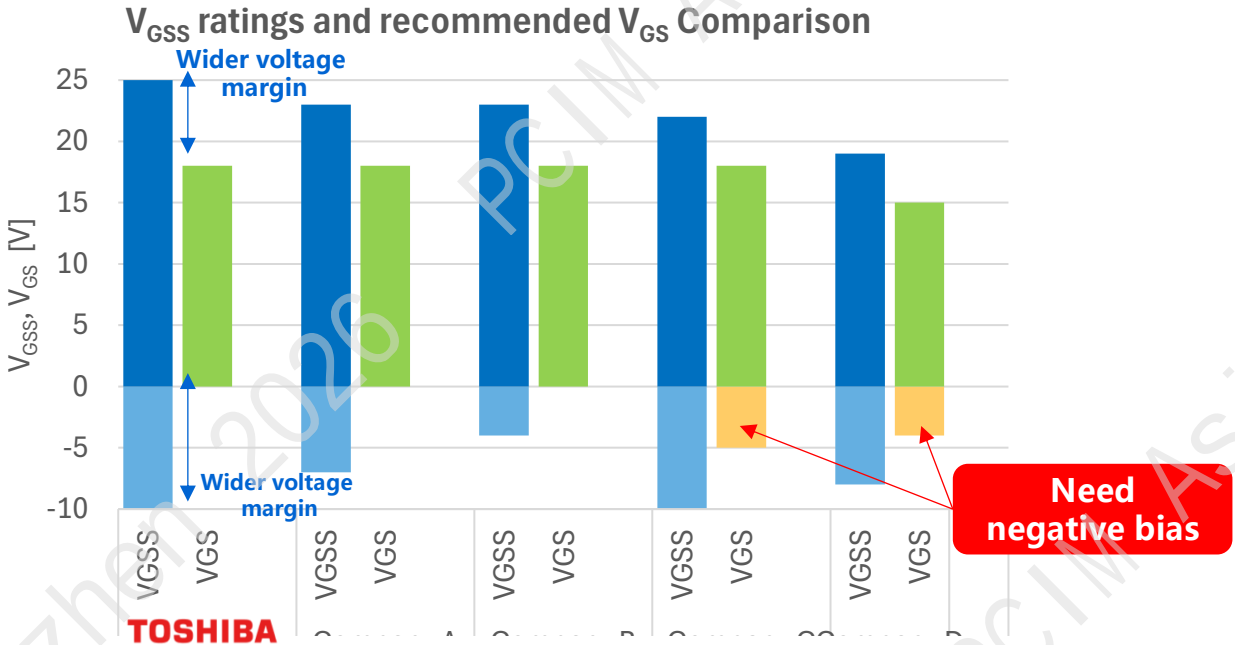
Easy

宽的V_{GSS}额定值 (V_{GSS} = -10V~25V)
⇒宽范围，易于驱动电路设计。

无需负压关断。

(推荐V_{GS}: 0V / 18V)

⇒驱动电路设计可以很简单。

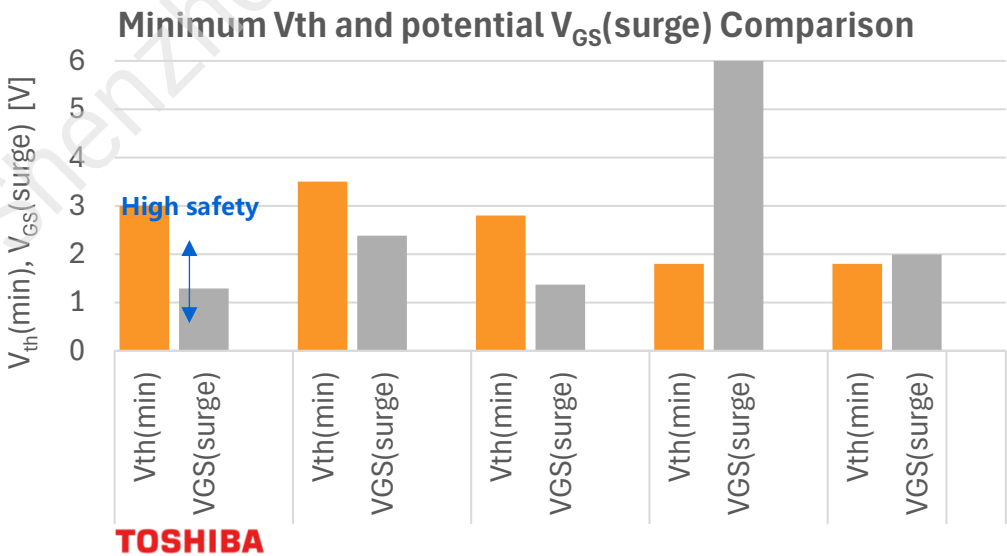


Safe

V_{DS}陡升 (高dv/dt) 会导致V_{GS} (浪涌)，具体取决于电容比，当V_{GS} (浪涌) 超过V_{th}时，就会发生自导通。

$$V_{GS(surge)} \approx \frac{C_{rss}}{C_{iss}} \times V_{DS} \geq V_{th}$$

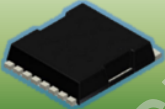
高阈值电压 (V_{th}) 和小C_{rss}/C_{iss}电容比有助于避免自导通。
⇒适用于高速开关。



东芝第三代SiC MOSFET产品线 ($V_{DSS} = 650V / 1200V$)

$V_{DSS} = 650V$

(CY)

$R_{DS(ON)}$ Typ. (mΩ)	TO-247	TO-247-4L(X)	TOLL	DFN8x8
				
	3 rd generation			
15	TW015N65 C MP	TW015Z65C MP	-	-
27	TW027N65 C MP	TW027Z65C MP	TW027U65C MP	TW031V65C MP
48	TW048N65 C MP	TW048Z65C MP	TW048U65C MP	TW054V65C MP
83	TW083N65 C MP	TW083Z65C MP	TW083U65C MP	TW092V65C MP
107	TW107N65 C MP	TW107Z65C MP	-	TW123V65C MP

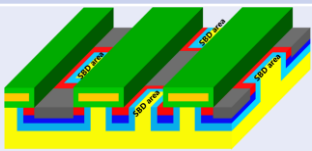
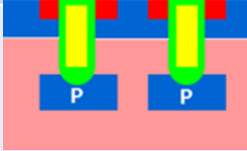
$V_{DSS} = 1200V$

$R_{DS(ON)}$ Typ. (mΩ)	TO-247	TO-247-4L(X)
		
	3 rd generation	
15	TW015N120C MP	TW015Z120C MP
30	TW030N120C MP	TW030Z120C MP
45	TW045N120C MP	TW045Z120C MP
60	TW060N120C MP	TW060Z120C MP
140	TW140N120C MP	TW140Z120C MP



东芝下一代 SiC-MOSFET开发计划

下一代SiC MOSFET将采用沟槽结构，Rds(on)大幅降低。

设计	第三代	下一代	
单元结构	Planar	Planar	Trench
			
嵌入式SBD	Yes (Stripe pattern)	Yes (Check pattern)	No
Normalized $R_{(DS)ON} \cdot AA$ ($m\Omega \cdot CM^2$) @25°C	1.0	0.77 (-23%)	0.41 (-59%)
$R_{(DS)ON} \cdot Q_{gd}$ ($\Omega \cdot nC$) @25°C	0.48	0.52	(0.26)
$R_{(DS)ON} \cdot Q_{oss}$ ($\Omega \cdot nC$) @25°C	6.54	5.78	(3.60)
推荐开启栅极电压 (V)	18	18	15-18
计划	自2022年开始生产	-	(3Q 2027 @CY)

首款沟槽型SiC MOSFET TW007D120E 参数对比

供参考

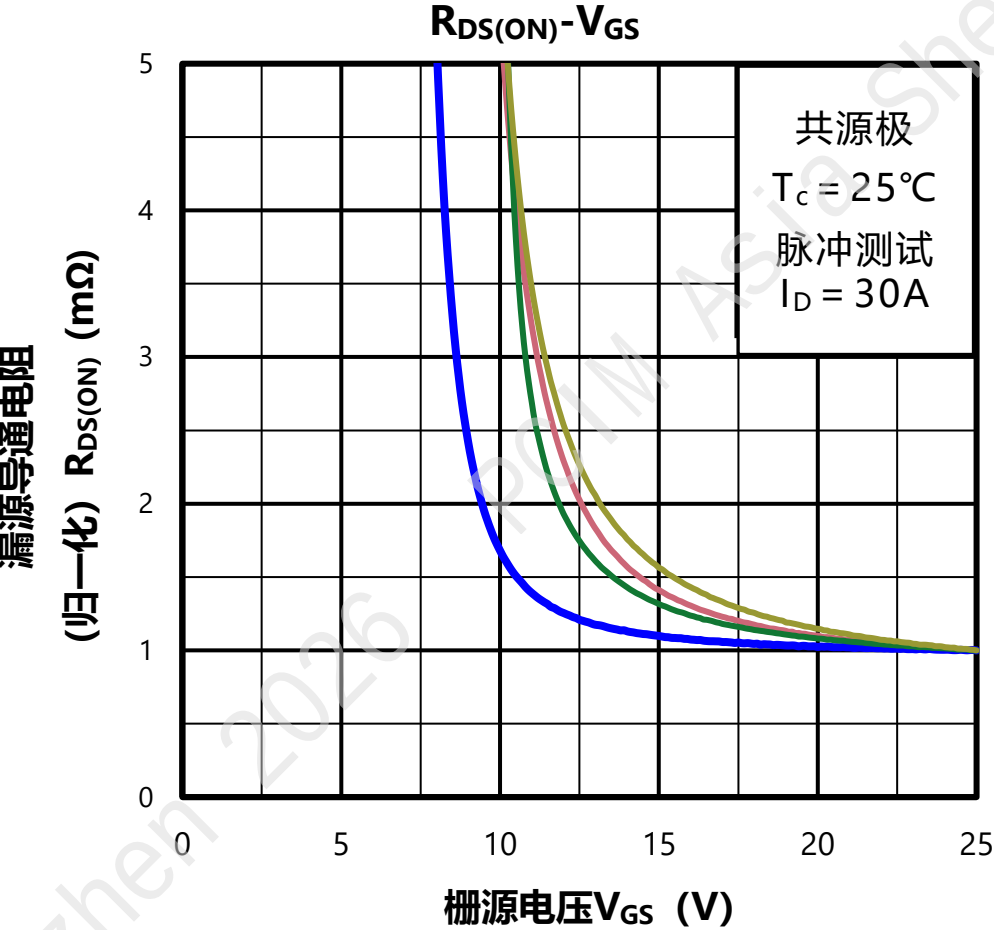
Vender		Toshiba	竞品
P/N		(TW007D120E)	1200V/7mΩ
Structure		Trench	Trench(G2)
Package		QDPAK	QDPAK
Absolute Maximum ratings	V _{DSS}	1200V	1200V
	V _{GSS}	-10V ~ 25V(DC)	-7V ~ 23V(DC)
Recommended Gate Drive Voltage		-5-0V, 15-18V	-5-0V, 15-18V
I _{DSS} @V _{DS} =1200V, T _{vj} =175°C (typ)		5.0μA	13.6μA
V _{th} (min/typ./max)		3.0V / 4.0V / 5.0V	3.5V / 4.2V / 5.1V
R _{DS(ON)} @V _{GS} =18V, T _{vj} =25°C (typ.)		6.7mΩ	7.5mΩ
R _{DS(ON)} @V _{GS} =18V, T _{vj} =175°C (typ.)		16.1mΩ	17.7mΩ
R _{DS(ON)} @V _{GS} =15V, T _{vj} =25°C (typ.)		7.0mΩ	9.3mΩ
R _{DS(ON)} @V _{GS} =15V, T _{vj} =175°C (typ.)		16.8mΩ	22.3mΩ
R _g (internal r _g) typ.		0.7Ω	4.75Ω
Q _{oss} @V _{DS} =800V		691nC	449nC
Q _g @V _{GS} =0-18V typ.		380nC	197nC
Q _{gd} typ.		33nC	47.1nC
V _{SD} @I _{DR} =70A, V _{GS} =0V, T _{vj} =25°C (typ.)		3.2V	4.0V

Note : Specifications and schedule of under development is just target and is subject to change without notice.

下一代 SiC MOSFET：可用性显著提高

通过改善跨导，实现 $V_{GS} = 15V$ 的驱动能力

■ $R_{DS(ON)} - V_{GS}$ 比较



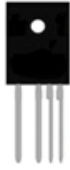
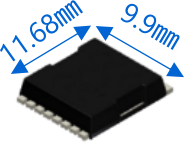
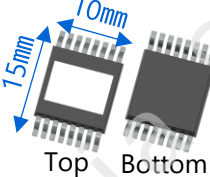
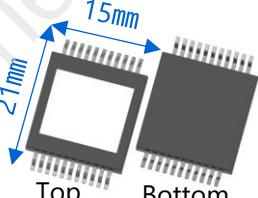
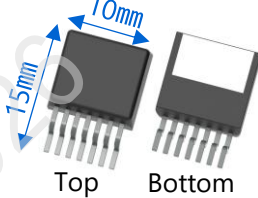
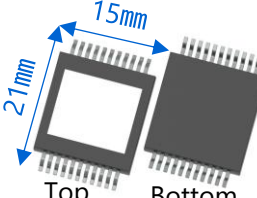
- ✓ 改进Gfs后，即使在15V电压下也能够有效的驱动
- ✓ 应对驱动电压的波动，最大限度地保持稳定的 $R_{DS(ON)}$
- ✓ 与其他产品相比， V_{th} 也具有足够的竞争力

	Ron @18V [mΩ]	Ron @15V [mΩ]	18V⇒15V Ratio	V _{th} (Typ.) [V]
Toshiba Trench	22.3	23.4	+5%	3.6
Trench A	38.4	44.1	+15%	4.2
Trench B	22.6	27.1	+20%	3.8
Planar C	26.3	33.0	+25%	3.0

- Toshiba (Trench) 22mΩ @18V
- Trench A 36mΩ @18V
- Trench B 26mΩ @18V
- Planar C 27mΩ @18V

东芝下一代 SiC MOSFET开发计划

将会首先推出QDPAK封装产品
更多的封装、电压等级和Ron的系列产品也将陆续推出

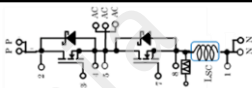
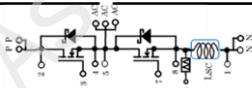
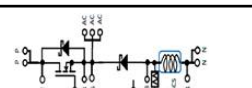
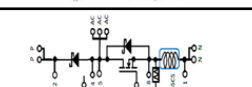
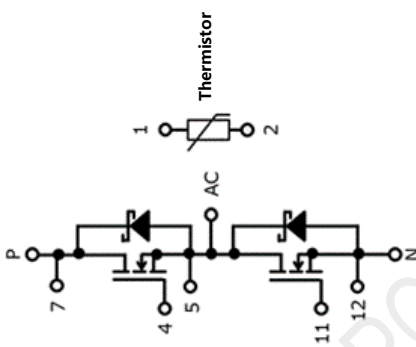
V _{DSS} = 750V (CY)					V _{DSS} = 1200V (CY)			
R _{DS(ON)} typ. (mΩ) T _j =25°C	TO-247-4L	TOLL	TOLT	QDPAK	R _{DS(ON)} typ. (mΩ) T _j =25°C	TO-247-4L	TO-263-7L	QDPAK
	 NL type		 Top Bottom	 Top Bottom		 NL type	 Top Bottom	 Top Bottom
3	ES: 1Q/28 CS: 2Q/28	-	-	ES: 3Q/27 CS: 4Q/27	4	ES: 1Q/28 CS: 2Q/28	-	ES: 3Q/27 CS: 4Q/27
6	ES: 2Q/27 CS: 3Q/27	6mΩ: T/S Sep/26 10mΩ: T/S Sep/26	ES: 3Q/28 CS: 4Q/28	6mΩ: T/S Sep/26 10mΩ: T/S Sep/26	7	ES: 1Q/27 CS: 2Q/27	ES: 1Q/27 CS: 2Q/27	7mΩ: T/S OK 7mΩ: ES Oct/26
10		ES: 1Q/27 CS: 2Q/27		ES: 1Q/27 CS: 2Q/27	12			ES: 3Q/26 CS: 4Q/26
14					17			17mΩ: ES Sep/26
17	ES: 1Q/28 CS: 2Q/28	ES: 2Q/28 CS: 3Q/28		ES: 3Q/27 CS: 4Q/27	21	ES: 1Q/28 CS: 2Q/28	ES: 2Q/28 CS: 3Q/28	ES: 3Q/27 CS: 4Q/27
20					25			
24					30			

Note: The information in this table is subject to change without notice.

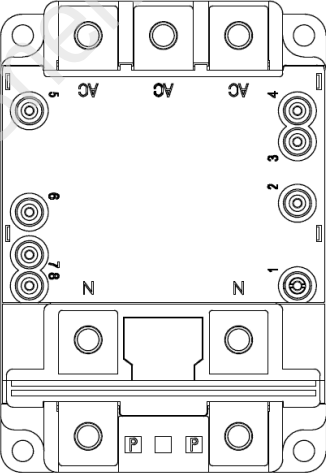
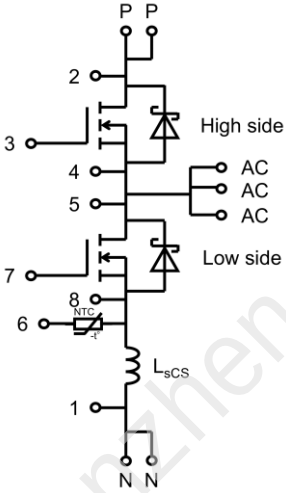
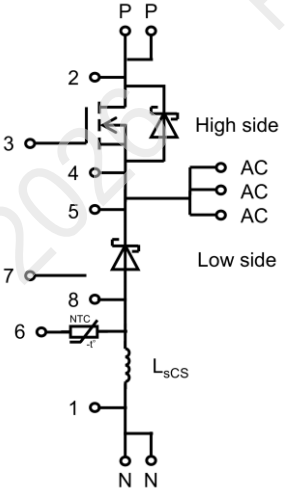
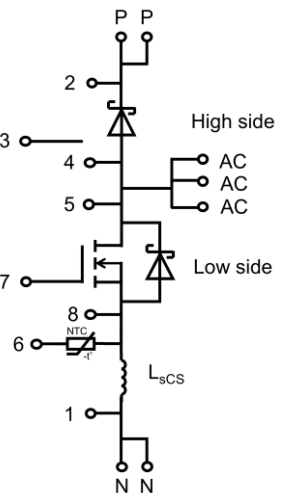
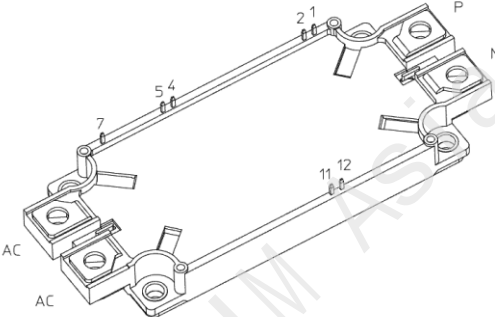
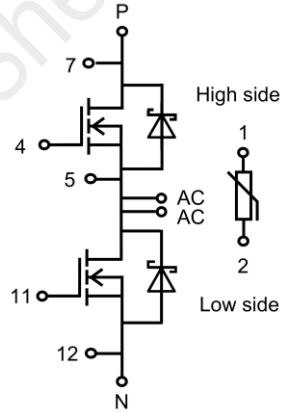
04

SiC Module

东芝SiC Module产品线

			封装			
						
额定值		内部电路	产品名	状态	产品名	状态
V _{DSS}	I _D					
3300V	500A		IX500FXF2YMS4	• MP (7/26)	<i>New</i>	
	800A		MG800FXF2YMS3	MP		
			MG800FXF1ZMS3			
			MG800FXF1JMS3			
2200V	250A				MG250YD2YMS3	MP
1700V	400A				MG400V2YMS3	MP
	250A				MG250V2YMS3	MP
1200V	600A				MG600Q2YMS3	MP
	400A				MG400Q2YMS3	MP

东芝SiC Module封装及内部电路

封装名称	外观	引脚布局图	内部电路图		
			半桥	Chopper (高侧MOS)	Chopper (低侧MOS)
2-144A1A (iXPLV)	 144×99.5×40 mm				
2-153A1A (E3D)	 152×62×20.5 mm				

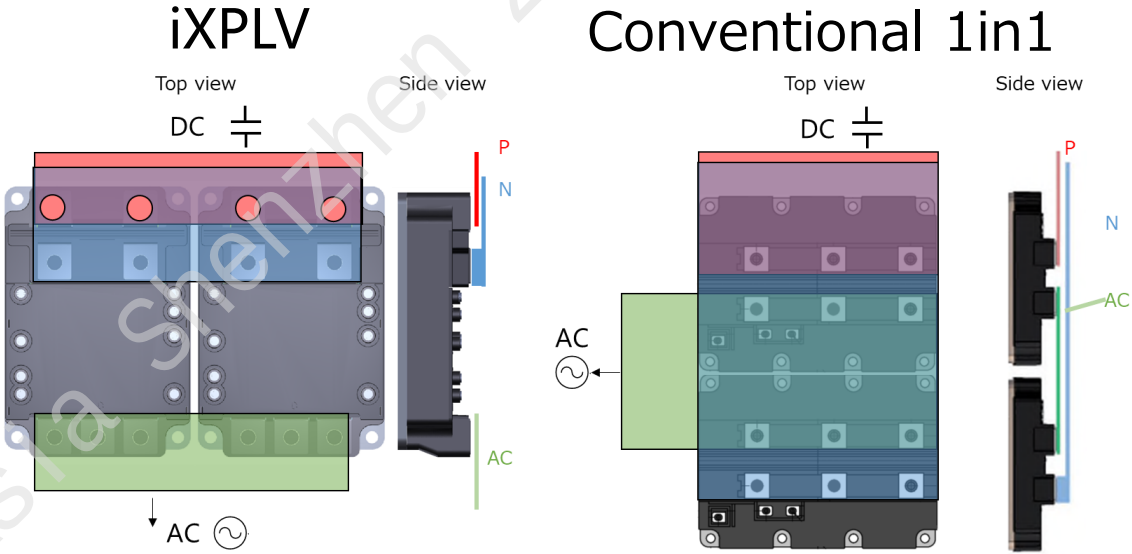
东芝SiC Module特点：低杂散电感

低杂散电感（封装和电路）助您设计出高性能系统

- 东芝SiC模块封装的杂散电感非常低（12nH），这可以抑制关断期间的浪涌电压。

- 专用的二合一封装可简化母线设计，从而降低电路杂散电感。

封装名称	iXPLV	E3D
外观		
杂散电感	12nH Typ.	12nH Typ.
隔离电压	6000V (3.3kV器件)	4000V
R _{th}	0.032K/W	0.060K/W

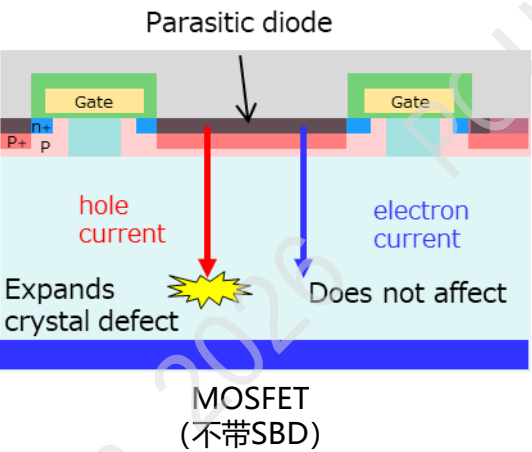


东芝SiC MOSFET特征：内置SBD

内置SBD，产品的可靠性大大提高

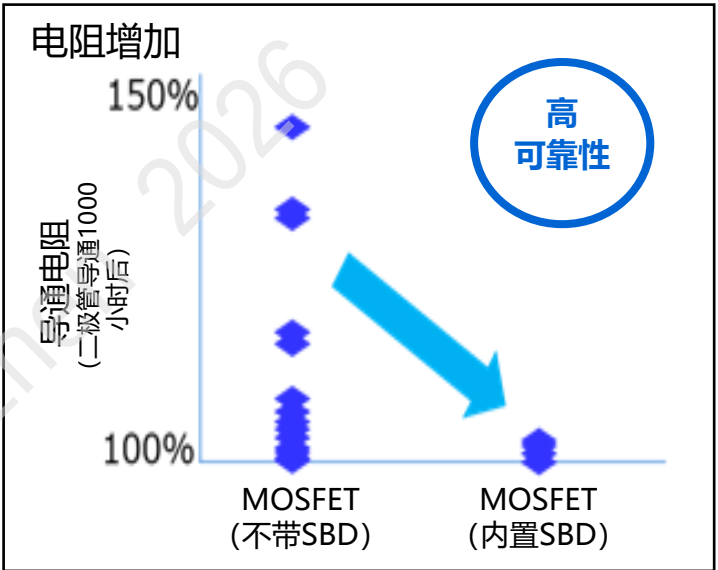
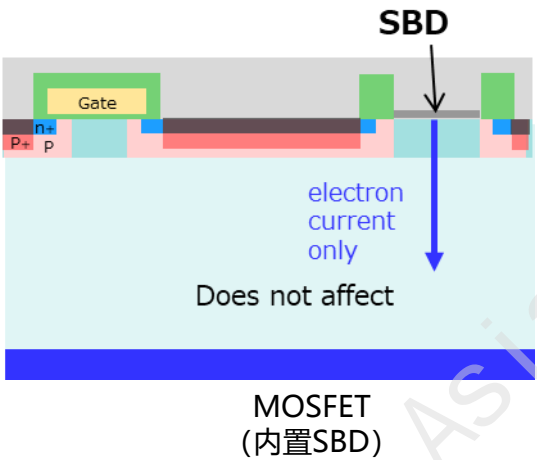
■ 不带SBD的MOSFET

- 二极管电流流过寄生二极管
- 空穴和电子电流流过寄生二极管
- 空穴电流导致SiC晶体缺陷的扩展



■ 内置SBD的MOSFET

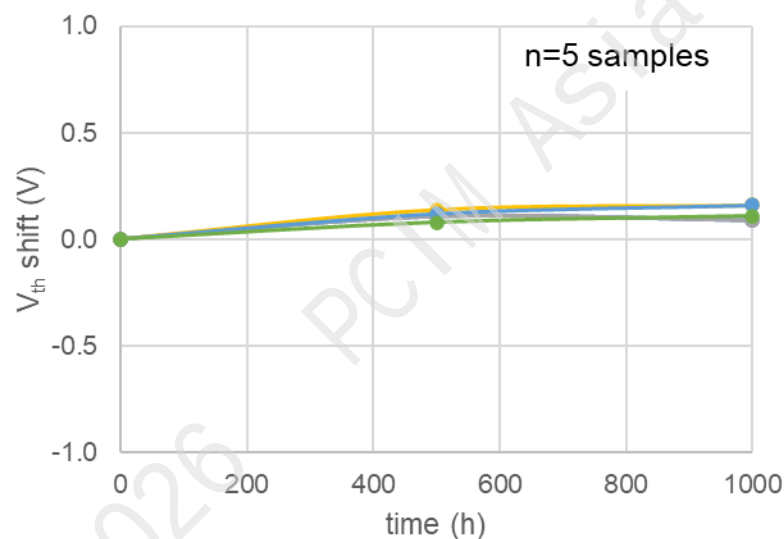
- 二极管电流流过肖特基二极管 (SBD)
- 只有电子电流流过肖特基二极管 (SBD)
- SiC晶体保持原有质量因为没有空穴电流



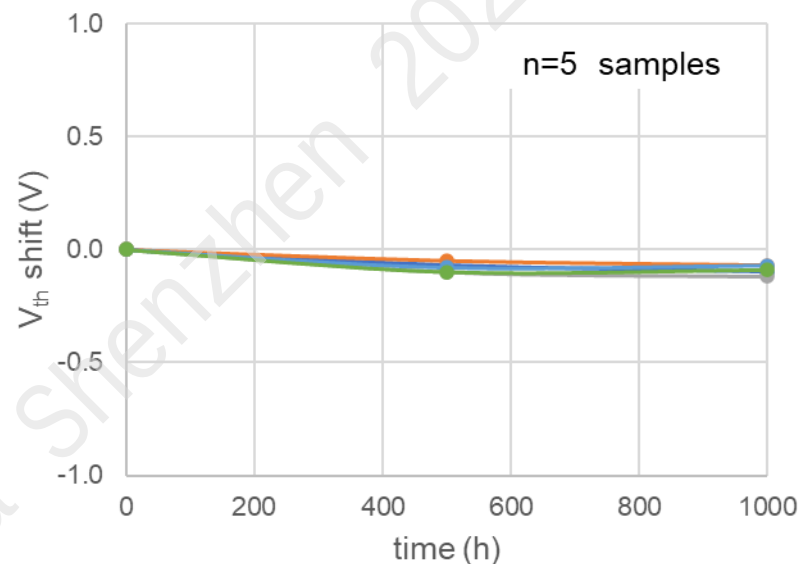
东芝SiC MOSFET特征: V_{th} 稳定性

1000小时电应力测试结果: V_{th} 漂移 $< 0.2V$

与硅器件相比, 碳化硅器件对电应力引起的阈值电压 (V_{th}) 变化更为敏感。
东芝开发了一种技术来最大限度地减少阈值电压的波动。



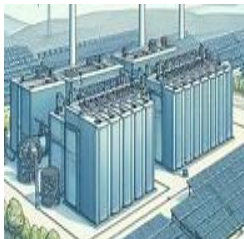
连续正栅极偏置电压测试下的 V_{th} 偏移
(MG800FXF2YMS3, $V_{GS} = 25V$, $T_{ch} = 175^{\circ}C$)



连续负栅极偏置电压测试下的 V_{th} 偏移
(MG800FXF2YMS3, $V_{GS} = -10V$, $T_{ch} = 175^{\circ}C$)

东芝SiC Module产品应用领域

	轨道交通		可再生能源		工业			数据中心
应用 电压	牵引电机 直流转换器	辅助动力装置	光伏发电 储能	风力发电	电梯	电机变频器	充电桩	SST (固态变压器)
3300V	MG800FXF2YMS3 MG800FXF1JMS3 MG800FXF1ZMS3	MG800FXF2YMS3		MG800FXF2MS3		MG800FXF2YMS3 MG800FXF1JMS3 MG800FXF1ZMS3		IX500FXF2YMS4 MG800FXF2YMS3 MG800FXF1JMS3 MG800FXF1ZMS3
2200V			MG250YD2YMS3				MG250YD2YMS3	MG250YD2YMS3
1700V	MG400V2YMS3	MG400V2YMS3	MG400V2YMS3 MG250V2YMS3	MG400V2YMS3 MG250V2YMS3		MG400V2YMS3 MG250V2YMS3	MG400V2YMS3 MG250V2YMS3	MG250V2YMS3
1200V		MG600Q2YMS3	MG600Q2YMS3 MG400Q2YMS3	MG600Q2YMS3 MG400Q2YMS3	MG600Q2YMS3 MG400Q2YMS3	MG600Q2YMS3 MG400Q2YMS3	MG600Q2YMS3 MG400Q2YMS3	MG600Q2YMS3

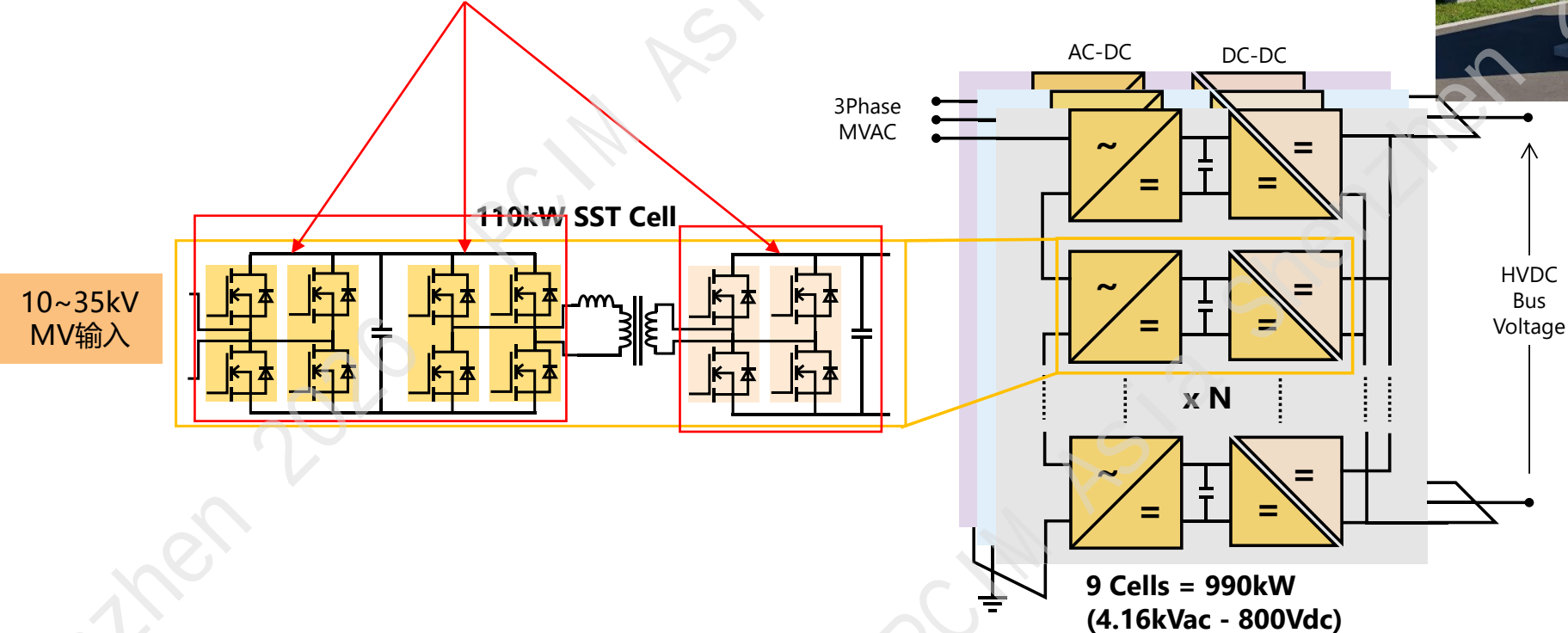


2200V和3300V SiC Module应用于SST

- MG600Q2YMS3 1200V 整流输出
- MG250YD2YMS3 2200V AC / DC, DC-DC
- MG800FXF2YMS3 3300V AC / DC, DC-DC

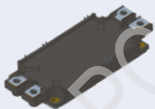


知乎 @基本杨子曦



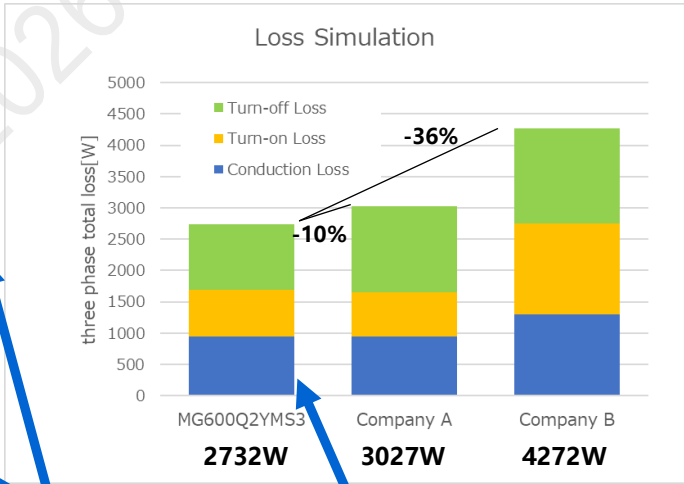
800V DC输出

1200V SiC MOSFET Module对比 (基于东芝测试)

		TOSHIBA	Company A	Company B
	Characteristics / Symbol	MG600QYMS3	1200V 500A	1200V 600A
Absolute Maximum Ratings	Drain-source voltage V_{DS} (V)	1200	1200	1200
	Gate-source voltage V_{GS} (V)	+25 / -10	+23/-10	+22 / -4
	Drain current(DC) I_D (A)	600	500	600
	Channel temperature T_{ch} (°C)	150	175	175
	Gate threshold voltage V_{th} (V) (Typ.) @ $T_{ch} = 25^{\circ}\text{C}$	4.6 @ $I_D = 0.6\text{A}$, $V_{DS} = 10\text{V}$	4.3 @ $I_D = 0.224\text{A}$, $V_{DS} = V_{GS}$	2.7~5.6 @ $I_D = 0.182\text{A}$, $V_{DS} = 10\text{V}$
Electric Characteristics	Drain-source on-voltage (sense) $V_{DS(ON) \text{ sense}}$ (V) (Typ.) @ $T_{ch} = 25^{\circ}\text{C}$	0.9 (Ron=1.5mΩ) @ $I_D = 600\text{A}$, $V_{GS} = +20\text{V}$	0.85 (Ron=1.4mΩ) @ $I_D = 600\text{A}$, $V_{GS} = +18\text{V}$	1.3 (Ron = 2.2mΩ) @ $I_D = 600\text{A}$, $V_{GS} = +18\text{V}$
	Source-drain on-voltage (sense) $V_{SD(ON) \text{ sense}}$ (V) (Typ.) @ $T_{ch} = 25^{\circ}\text{C}$	0.8 @ $I_S = 600\text{A}$, $V_{GS} = +20\text{V}$	0.73 @ $I_S = 600\text{A}$, $V_{GS} = +18\text{V}$	1.5 @ $I_S = 600\text{A}$, $V_{GS} = +18\text{V}$
	Source-drain off-voltage (sense) $V_{SD(OFF) \text{ sense}}$ (V) (Typ.) @ $T_{ch} = 25^{\circ}\text{C}$	1.6 @ $I_S = 600\text{A}$, $V_{GS} = -6\text{V}$	4.6 @ $I_S = 600\text{A}$, $V_{GS} = -6\text{V}$	1.7 @ $I_S = 600\text{A}$, $V_{GS} = 0\text{V}$
	Turn-on switching loss E_{on} (mJ) (Typ.)	16	15	29
	Turn-off switching loss E_{off} (mJ) (Typ.)	28	36	39
	Reverse recovery loss E_{rr} (mJ) (Typ.)	2.1	3.2	12
	Switching Condition	$I_D = 600\text{A}$, $V_{DS} = 600\text{V}$, $R_{G(on)} = 2.4\Omega$, $R_{G(off)} = 3.9\Omega$, $L_S = 28\text{nH}$, $T_{ch} = 100^{\circ}\text{C}$ ($L_S = L_{PN} + L_{ext}$)	$I_D = 600\text{A}$, $V_{DS} = 600\text{V}$, $R_{G(on)} = 2.4\Omega$, $R_{G(off)} = 3.9\Omega$, $L_{ext} = 20\text{nH}$, $T_{ch} = 100^{\circ}\text{C}$ ($L_S = L_{PN} + L_{sext}$)	$I_D = 600\text{A}$, $V_{DS} = 600\text{V}$, $R_{G(on)} = 1.8\Omega$, $R_{G(off)} = 1.8\Omega$, $L_S = 30\text{nH}$, $T_{ch} = 100^{\circ}\text{C}$ ($L_S = L_{PN} + L_{ext}$)
Package	Stray inductance L_{SPN}	12	20	10
	Package name / Outline	E3D 	EconoDUAL™3 	G-type 

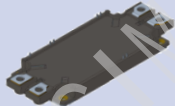
损耗仿真图

测试条件: $V_{DC} = 720\text{V}$, $I_{OUT(RMS)} = 300\text{A}$
功率因数 = 0.8, $f_{SW} = 20\text{kHz}$, $T_j = 100^{\circ}\text{C}$



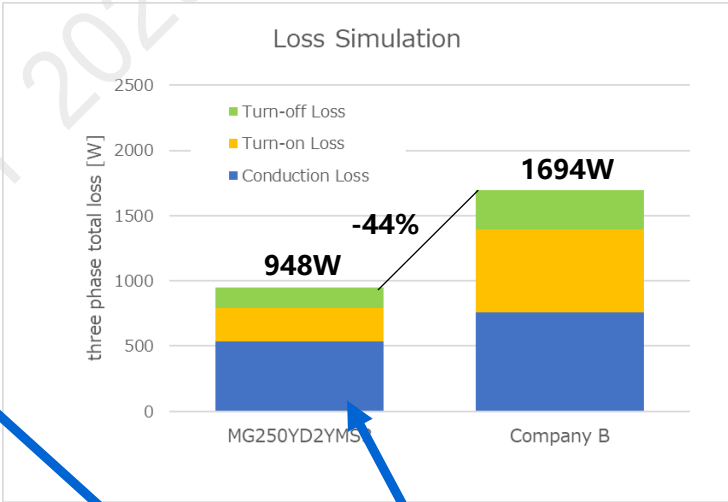
导通损耗和开关损耗优异

2200V SiC MOSFET Module对比 (基于东芝测试)

		TOSHIBA	Company B
	Characteristics / Symbol	MG250YD2YMS3	2000V 300A
Absolute Maximum Ratings	Drain-source voltage V_{DS} (V)	2200	2000
	Gate-source voltage V_{GS} (V)	+25 / -10	+20 / -7
	Drain current(DC) I_D (A)	250 @150°C	245 @175°C
	Channel temperature T_{ch} (°C)	150	175
	Gate threshold voltage V_{th} (V) (Typ.) @ T_{ch} = 25°C	4.5 @ I_D = 250mA, V_{DS} = 10V	4.3 @ I_D = 168mA, V_{DS} = 10V
Electric Characteristics	Drain-source on-voltage (sense) $V_{DS(ON)}$ sense (V) (Typ.) @ T_{ch} = 25°C	0.64 (Ron = 2.6mΩ) @ I_D = 250A, V_{GS} = +20V	0.87 (Ron = 3.5mΩ) @ I_D = 250A, V_{GS} = +18V
	Source-drain on-voltage (sense) $V_{SD(ON)}$ sense (V) (Typ.) @ T_{ch} = 25°C	1.46 @ I_S = 250A, V_{GS} = -6V	4.55 @ I_S = 250A, V_{GS} = -3V
	Source-drain off-voltage (sense) $V_{SD(OFF)}$ sense (V) (Typ.) @ T_{ch} = 25°C	12.1	30.7
	Turn-on switching loss E_{on} (mJ) (Typ.)	10.3	20.0
	Turn-off switching loss E_{off} (mJ) (Typ.)	2.7	3.5
	Reverse recovery loss E_{rr} (mJ) (Typ.)	I_D = 250A, V_{DS} = 1100V, $R_{G(on)}$ = 0.5Ω, $R_{G(off)}$ = 3.0Ω, L_S = 38nH, T_{ch} = 150°C	I_D = 250A, V_{DS} = 1100V, $R_{G(on)}$ = 7.1Ω, $R_{G(off)}$ = 4.3Ω, L_S = 60nH, T_{ch} = 150°C
Package	Switching Condition	12	20
	Stray inductance L_{SPN}	E3D 	62mm 

损耗仿真图

测试条件: V_{DC} = 1000V, $I_{OUT(RMS)}$ = 180A
功率因数 = 0.8, f_{sw} = 10kHz, T_j = 150°C



导通损耗和开关损耗优异

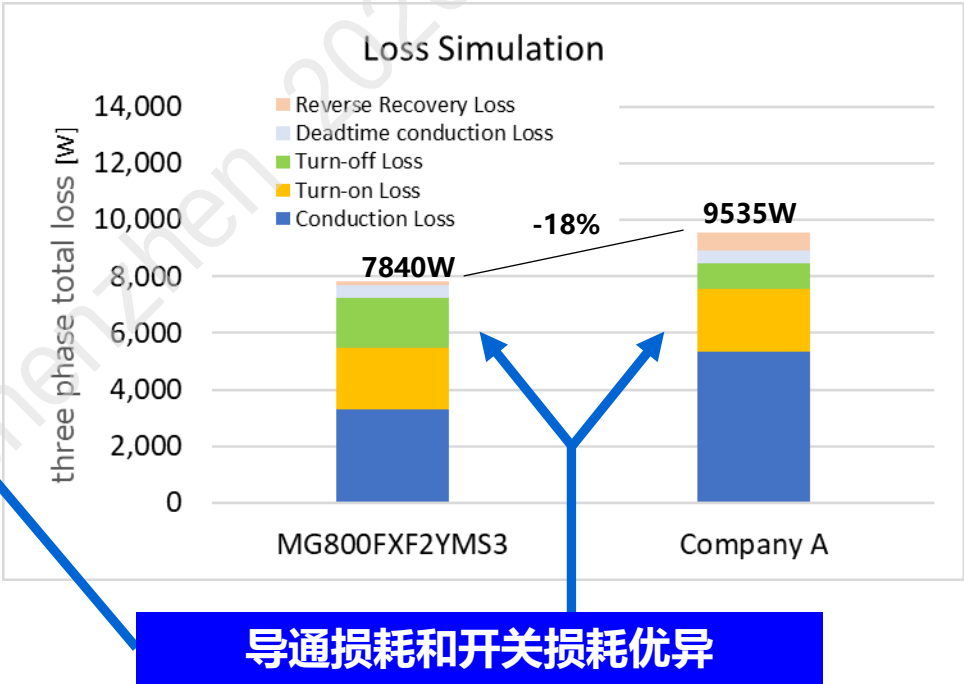
3300V SiC MOSFET Module对比 (基于东芝测试)

		TOSHIBA	Company A
	Characteristics / Symbol	MG800FXF2YMS3	3300V 750A
Absolute Max.imum Ratings	Drain-source voltage V_{DS} (V)	3300	3300
	Gate-source voltage V_{GS} (V)	+25 / -10	+23 / -10
	Drain current(DC) I_D (A)	800	750
	Channel temperature T_{ch} (°C)	175	175
	Gate threshold voltage V_{th} (V) (Typ.) @ $T_{ch} = 25^{\circ}C$	4.8 @ $I_D = 0.8A$, $V_{DS} = 10V$	4.3 @ $I_D = 0.675A$, $V_{DS} = V_{GS}$
Electric Character istics	Drain-source on-voltage (sense) $V_{DS(ON)}$ sense (V) (Typ.) @ $T_{ch} = 25^{\circ}C$	1.7 (Ron = 1.6mΩ) @ $I_D = 800A$, $V_{GS} = +20V$	1.88 (Ron = 2.5mΩ) @ $I_D = 750A$, $V_{GS} = +15V$
	Source-drain on-voltage (sense) $V_{SD(ON)}$ sense (V) (Typ.) @ $T_{ch} = 25^{\circ}C$	1.3 @ $I_S = 800A$, $V_{GS} = +20V$	1.88 @ $I_S = 750A$, $V_{GS} = +15V$
	Source-drain off-voltage (sense) $V_{SD(OFF)}$ sense (V) (Typ.) @ $T_{ch} = 25^{\circ}C$	2.1 @ $I_S = 800A$, $V_{GS} = -6V$	4.6 @ $I_S = 800A$, $V_{GS} = -5V$
	Turn-on switching loss E_{on} (mJ) (Typ.)	230	260
	Turn-off switching loss E_{off} (mJ) (Typ.)	230	100
	Reverse recovery loss E_{rr} (mJ) (Typ.)	12	56
	Switching Condition	$I_D = 800A$, $V_{DS} = 1800V$, $R_{G(on)} = 1.5\Omega$, $R_{G(off)} = 3.6\Omega$, $L_S = 70nH$, $T_{ch} = 175^{\circ}C$	$I_D = 750A$, $V_{GS} = 1800V$, $R_{G(on)} = 0.5\Omega$, $R_{G(off)} = 1.2\Omega$, $L_S = 30nH$, $T_{ch} = 175^{\circ}C$
Package	Stray inductance L_{SPN}	12	10
	Package name / Outline	iXPLV 	xHP2 

损耗仿真图

* 该仿真是在导通损耗和开关损耗与电流成正比的假设下进行的。

测试条件: $V_{DC} = 1800V$, $I_{OUT(RMS)} = 500A$
功率因数 = 0.8, $f_{sw} = 5kHz$, 死区时间 = 10 μs , $T_j = 175^{\circ}C$



PI公司为iXPLV封装模块开发了驱动板，请联系PI获取详细信息.

2SMLT0220D2I0C Family Data Sheet | Power Integrations

SCALE-iFlex LT NTC For iXPLV Paralleling

- Dual channel Plug-and-Play driver for easy paralleling of iXPLV Industrial power modules
 - For voltages classes up to 3300 V
- Reinforced insulation in accordance to IEC standards
 - High voltage isolation housing
- Isolated, integrated temperature read out
- Short circuit protection in $\leq 2\ \mu\text{s}$ for SiC MOSFET
- Electrical interface
- $\pm 20\ \text{A}$ peak output gate current
- $+19\ \text{V} / -6\ \text{V}$ (regulated) gate output voltage
- 1.5 W output power per channel at max. ambient temperature (85°C)
- Simply scalable
 - 2SIL1200T Isolated Master Control (IMC)
 - 2SML0220D2C Module Adapter (MAG)
- Under voltage lockout for primary & secondary side
- Overvoltage protection by Advanced Active Clamping
- Optional: Conformal Coating
- Engineering samples available in 6-8 weeks



PI part number	Power Module	Voltage Class [V]
2SILT1200T2A0C-33	iXPLV Type	≤ 3300
2SMLT0220D2I0C-MG800FXF2YMS3		3300



2SILT1200T2
(IMC)

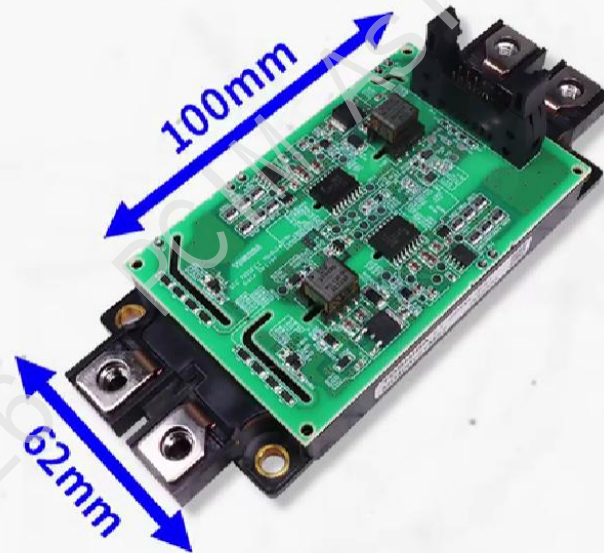


2SML0220D2E
(MAGs)

E3D封装模块可参考下面链接获取驱动信息

[SiC MOSFET模块的栅极驱动电路 | 东芝半导体&存储产品中国官网](#)

Reference Design Features



Toshiba Dual SiC MOSFET Module

- Equipped with pre-driver coupler TLP5231
 - Able to drive the dual SiC MOSFET modules
 - High-side / low-side 2ch gate drive outputs
 - Single power supply input for control: DC 24V
 - Gate drive output : 20V / -6.7V
 - Protection function: DESAT detection / UVLO / Active mirror clamp circuit
 - Able to be built into SiC MOSFET modules
- Board size: 62mm x 100mm

TOSHIBA