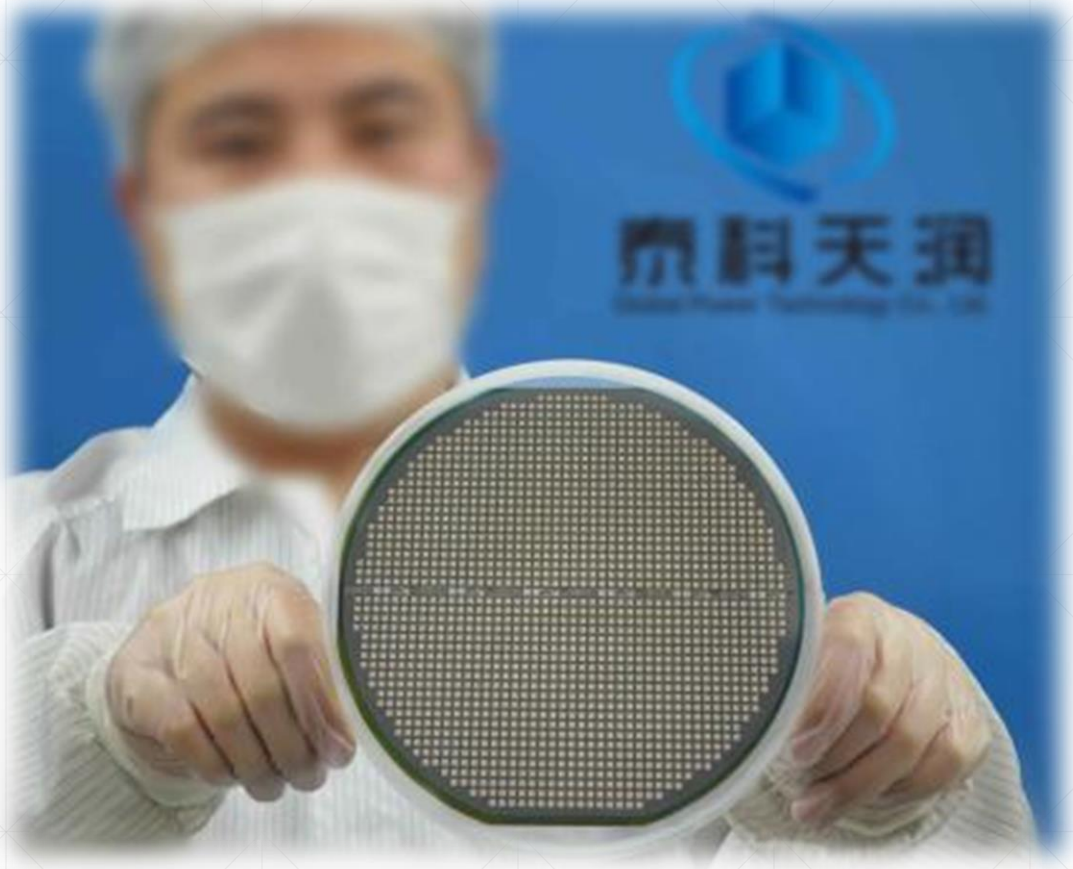


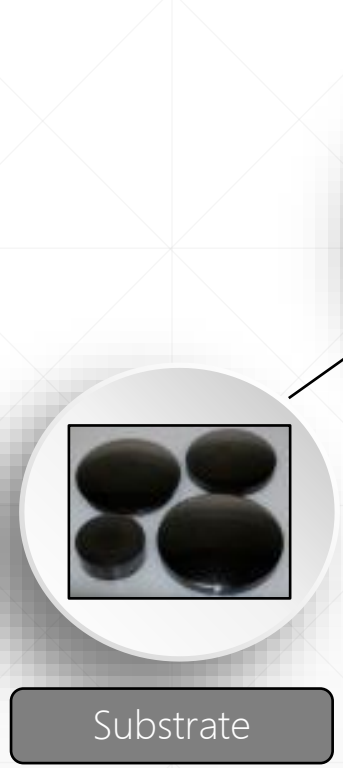
Global Power Technology Co., Ltd

1-Company information

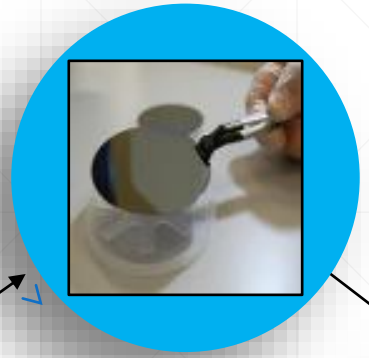
- Global Power Technology Co., Ltd. (GPT) is one of the pioneers of industrialization of silicon carbide (SiC) power devices in China. The first third-generation semiconductor material silicon carbide device manufacturing and application solutions provider.

- The company's headquarters is located in the Dongsheng Science and Technology Park in Zhongguancun, Beijing, China. It has a complete semiconductor fab, and it is the only domestic silicon carbide device mass production line that is market-oriented. It is the leading company of new materials semiconductors. The emerging power of high-end manufacturing.

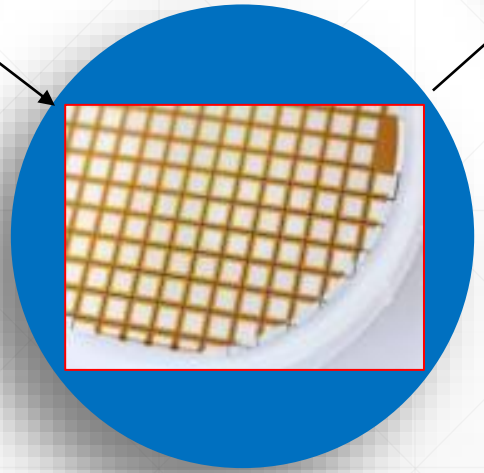
SiC Chip production line overview



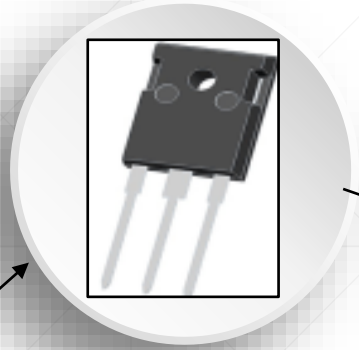
Substrate



Epi wafer



Chip production



Device packaging

Product assembly

Description
GPT processing
Outsourcing by GPT's partners

New production line

At present, GPT is preparing to build a 6" SiC wafer fabrication plant in Hunan. The first phase investment is 300 million yuan.

60,000 6" wafers

Annual production

8,000 4" wafers - current stage

Capital Status

泰科天润
SiC Power Devices Manufacturer

- **GF Qianhe** — •GF Securities wholly-owned subsidiary
- **Three Gorges Jianxin** — •Three Gorges Capital Fund
- **Topping capital** — •Invested in Zhuhai Yinlong

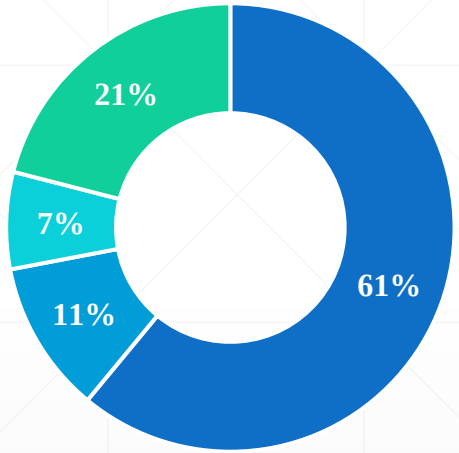
Strategic Financing

- **CM Venture** — •GE •SAMSUNG •SSTIC •Lingang Group

LP

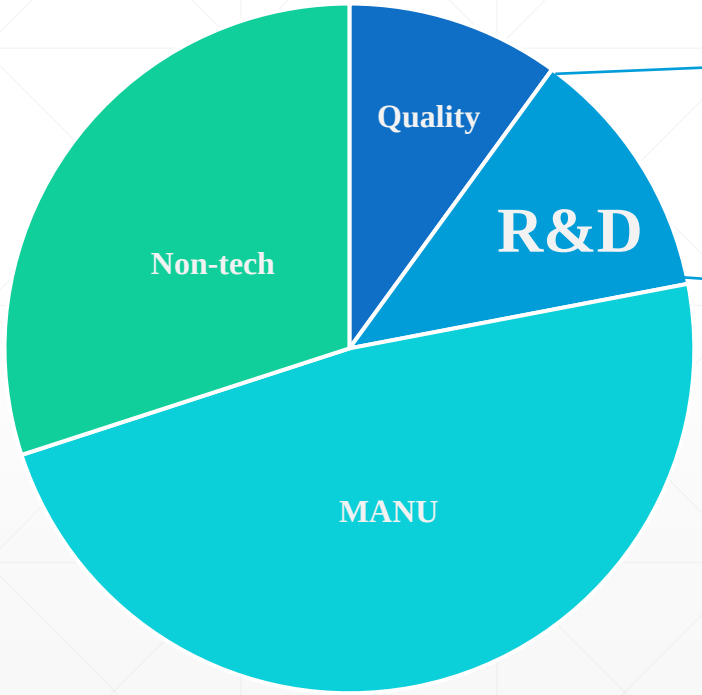
- **Government capital** — •Dongsheng Bozhan Technology Development Fund •Beijing Science and Technology Commission Fund
- **Founding capital** — •2011: 120 million Yuan

Share ratio

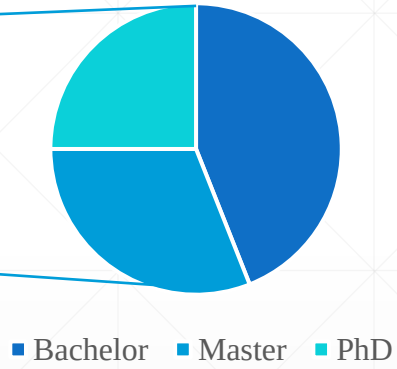


Staffing

Composition



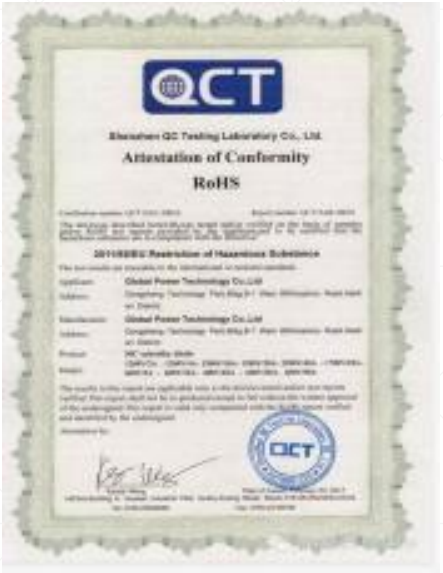
R&D Team Education Level



GPT total existing staff: 209

Certificates

ISO9001



RoHS

DNV USCG

IATF 16949

AEC-Q101

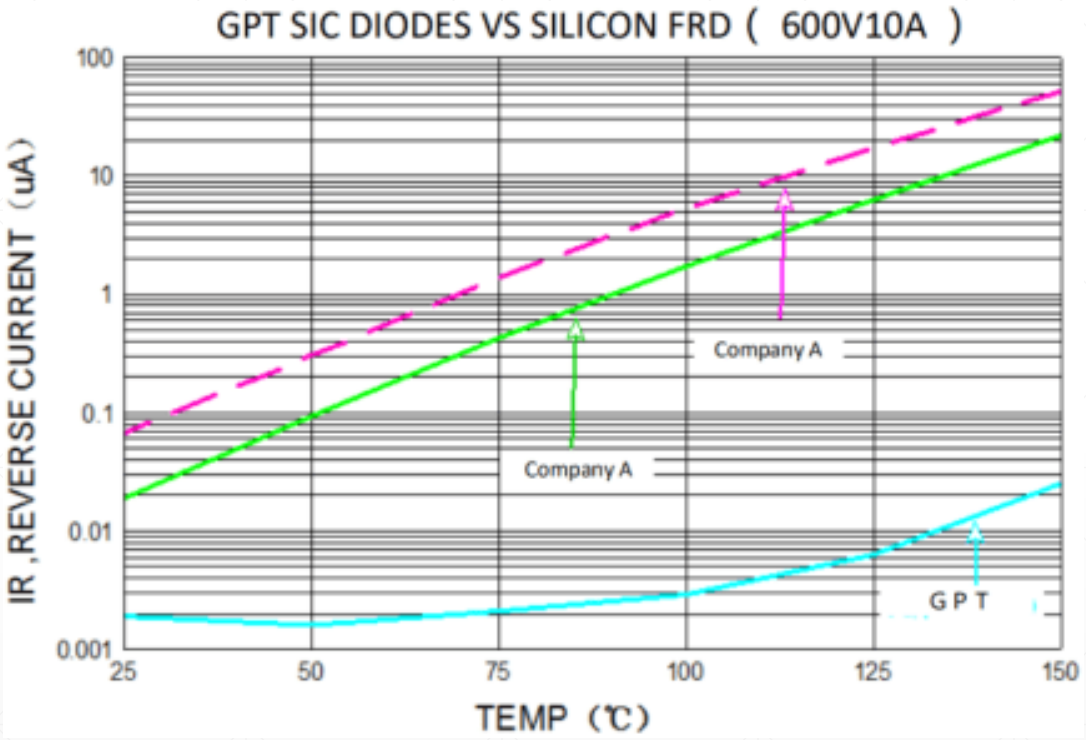
Passed certification： UL、CE、ISO9001、RoHS、DNV USCG

Automotive certificates：IATF 16949、AEC-Q101

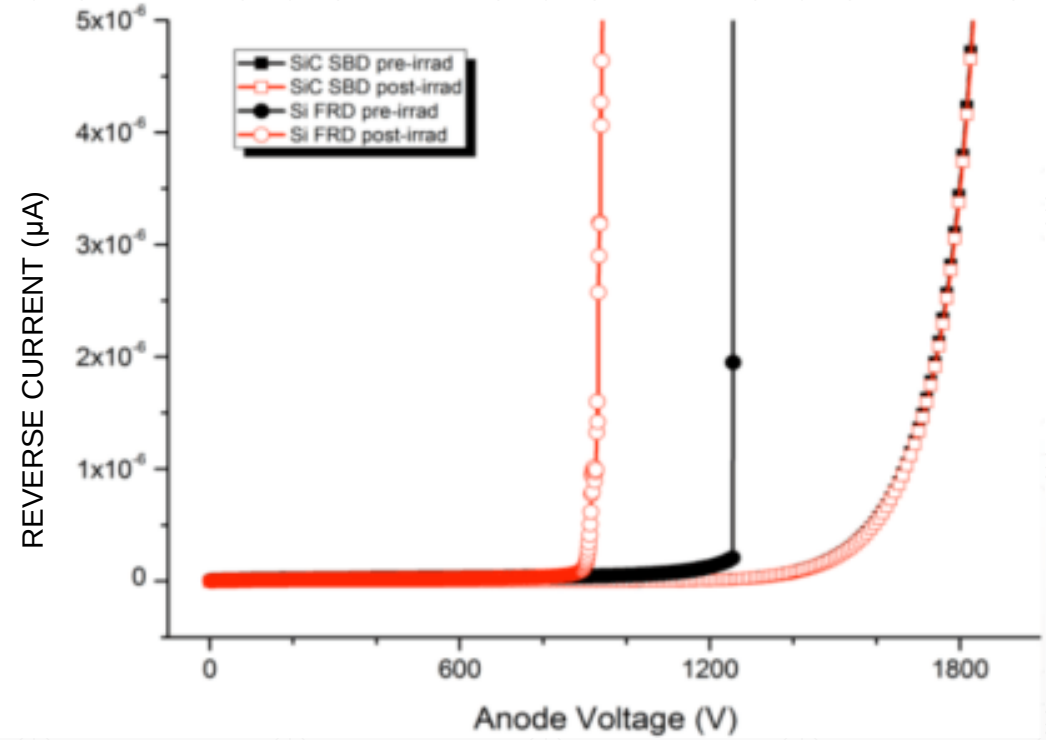
X3 Band gap	• Increase voltage resistance • Increase temperature resistance
X10 Breakdown electric field	• Reduce characteristic on-resistance • Reduce high voltage application losses
X2 Saturation electron drift velocity	• High frequency working
X3 Thermal conductivity	• Simplify cooling system design and cost • Reduce product design difficulty • Reduce maintenance costs • Increase Severe working condition reliability

2- Product information

GPT product test situation-contrast test of the relationship between reverse performance and temperature and irradiation

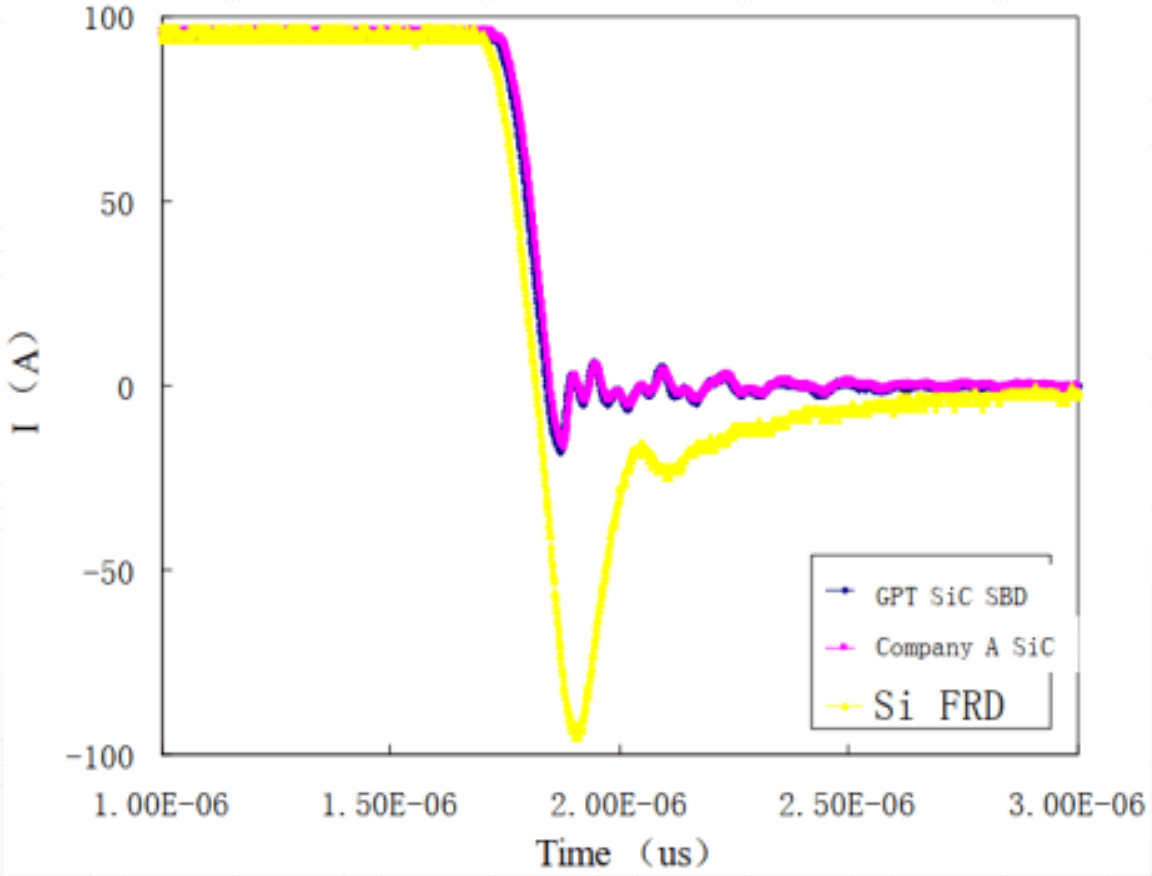


Relation with temperature



Relation with irradiation

1200V 20A reverse performance comparison test



	GPT	Company A	Si FRD	Reduction
I_{RM}(A)	18.1	16.9	94.8	80.91%
T_{rr}(μs)	0.048	0.047	0.53	90.94%
Q_{rr}(nC)	0.51	0.47	16.5	96.91%
E_{rec}(mJ)	0.44	0.44	8.17	94.61%

The use of SiC devices improves BOM total cost

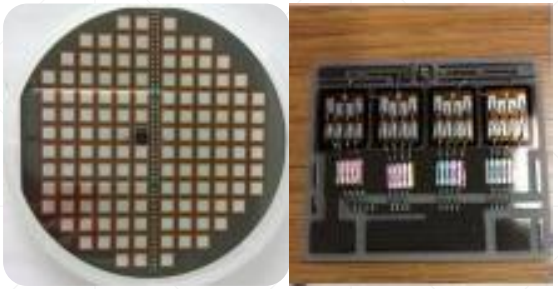
20kW transformer-less V_{inmax}=800V, I_{max}=35A Bost: 1D+1T 1200V/50A 3-leg Inv.: 6D+6T 1200V/50A	2012		2014		2016		2018		2020	
	Si (12kHz)	SiC (32kHz)	Si (12kHz)	SiC (32kHz)	Si (12kHz)	SiC (32kHz)	Si (12kHz)	SiC (32kHz)	Si (12kHz)	SiC (32kHz)
Diodes	$19.7	$74.8	$18.9	$64.1	$18.2	$54.5	$17.5	$45.0	$16.8	$37.9
Transistors	$27.3	$132.0	$26.3	$111.1	$25.2	$93.5	$24.3	$77.3	$23.3	$66.3
Inductor	$95.0	$34.0	$89.6	$32.1	$84.5	$30.3	$79.8	$28.5	$75.2	$26.9
Capacitor	$90.0	$29.0	$84.9	$27.4	$80.1	$25.8	$75.6	$24.3	$71.3	$23.0
DBC	$4.0	$4.0	$3.8	$3.8	$3.6	$3.6	$3.4	$3.4	$3.2	$3.2
Driver & Control	$9.0	$9.0	$8.5	$8.5	$8.0	$8.0	$7.6	$7.6	$7.1	$7.1
Connectors	$0.8	$0.8	$0.8	$0.8	$0.7	$0.7	$0.7	$0.7	$0.6	$0.6
Cooling	$70.0	$25.0	$66.0	$23.6	$62.3	$22.2	$58.8	$21.0	$55.4	$19.8
Housing	$26.0	$19.0	$24.5	$17.9	$23.1	$16.9	$21.8	$16.0	$20.6	$15.0
TOTAL	$341.8	$327.6	$323.3	$289.2	$305.8	$255.5	$289.2	$223.7	$273.6	$199.8
Extra cost SiC/Si	-4%		-11%		-16%		-23%		-27%	

Source: Yole Development

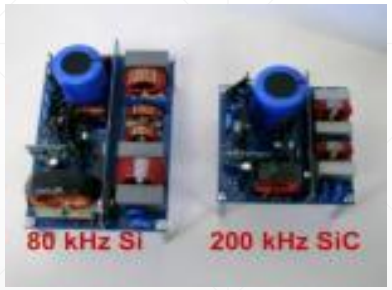
Global Power Technology SiC production

- In addition to the specifications listed in the selection table， also available 1700V5A/10A/15A/50A and 3300V0.6A/1A/2A/3A/5A/50A；
- According to customer requirements, basis on existing diode products, other matching plastic forms are available. ；
- For customers with bare chip needs, double-sided silver products are also available. ；
- Now SiC MOSFET and SiC BJT products available in small quantities on demand ；
- Can provide solutions for metal or ceramic packages for customers with high temperature requirements ；

T_a=215℃ 7000V1A and 9000V1A diodes



3300V50A chip for locomotive traction hybrid module



SiC solution for high frequencies

SiC can reduce coil size

GPT SiC Devices Products Categories

V_{RRM}/V	650																	1200										
	1	2	3	4	5	6	8	10	12	15	16	20	30	40	50	60	100	2	3	5	8	10	15	16	20	30	40	50
TO-220		●	●	●	●	●	●	●		●		●	●		●			●	●	●	●	●	●		●			
TO-220 Full Pack		●	●	●	●	●	●	●		●		●						●	●	●		●			●			
TO-220 ISO				●		●	●	●																				
TO-247 3 Pin								●	●		●	●	●	●		●						●	●	●	●	●	●	
TO-247 2 Pin							●	●		●		●	●	●	●		●			●		●	●		●	●	●	●
TO-252		●	●	●	●	●	●	●		●								●	●	●		●						
TO-252 (pin 1 nc)		●	●	●	●	●	●	●										●	●	●		●						
TO-263		●	●	●	●	●	●	●		●		●						●		●		●			●			
TO-263 (pin 1 nc)						●																			●			
DFN 5*6				●		●	●																					
DFN 8*8				●		●	●	●		●																		
SOD-123FL	●																											

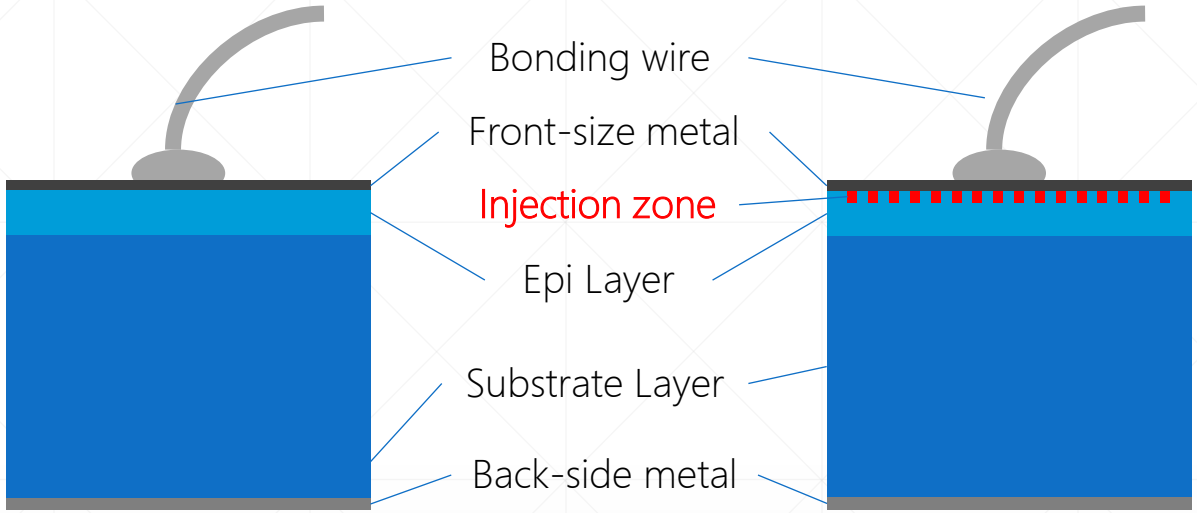
Remark：Besides types above, 1700V 5A/10A/20A/50A和3300V 0.6A/1A/2A/5A/50A are also available

● Industrial and Auto

● Industrial

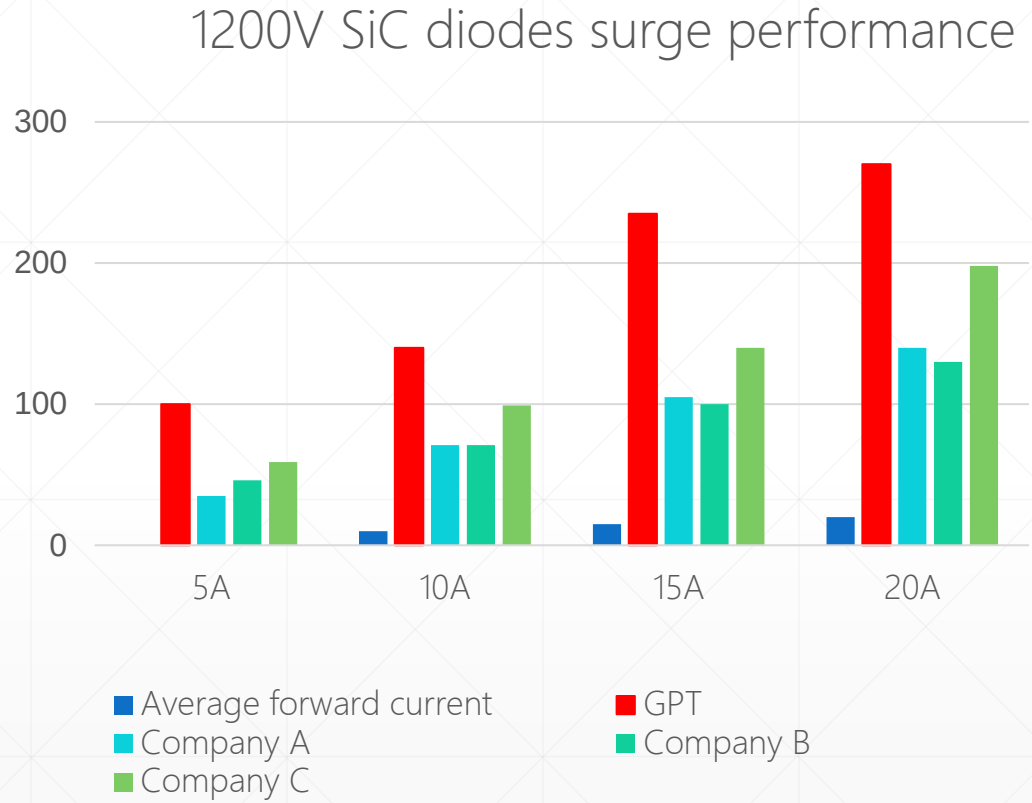
● Auto available soon

Global Power Technology product features



Excellent switching characteristics of Schottky diodes
+
High blocking characteristics of PiN diodes

- Reduce static losses
- Improve thermal performance
- Increase surge tolerance



Note: All comparisons are made for single-core TO220 package, and the data source is each product specification;
Company C 1200V does not have 15A devices, so 16A devices are selected for comparison;
The test conditions are: TC=25℃, tp=10ms, Half Sine Wave;

Global Power Technology product features

Advantages of thinning technology: reduce the forward pressure drop of the product and improve the performance of the product.

Various brands 650V10A TO220AC performance parameter comparison

Brand	Generation		V_{Fmax}/V		V_{Ftyp}/V		Thermal resistance/℃/W
	新	旧	常温	高温	常温	高温	
GPT	•		1.55 (25℃)	1.8 (175℃)	1.28 (25℃)	1.6 (175℃)	1.25
		•	1.7 (25℃)	2.5 (175℃)	1.48 (25℃)	1.7 (175℃)	1.37
Company A	•		1.5 (25℃)	1.6 (175℃)	1.27 (25℃)	1.37 (175℃)	1.38
		•	1.8 (25℃)	2.4 (175℃)	1.5 (25℃)	2.0 (175℃)	1.1
Company B	•		1.35 (25℃)	- (150℃)	1.25 (25℃)	1.5 (150℃)	1.3
		•	1.7 (25℃)	2.1 (175℃)	1.8 (25℃)	2.1 (150℃)	1.0
Company C	• (High surge)		1.75 (25℃)	2.5 (150℃)	1.56 (25℃)	1.98 (150℃)	1.5
		•	1.45 (25℃)	1.65 (150℃)	1.3 (25℃)	1.5 (150℃)	1.5
Company D			1.55 (25℃)	- (175℃)	1.35 (25℃)	1.63 (175℃)	1.6

Company B stated in the product introduction that thinning technology was used

New package for power supply applications

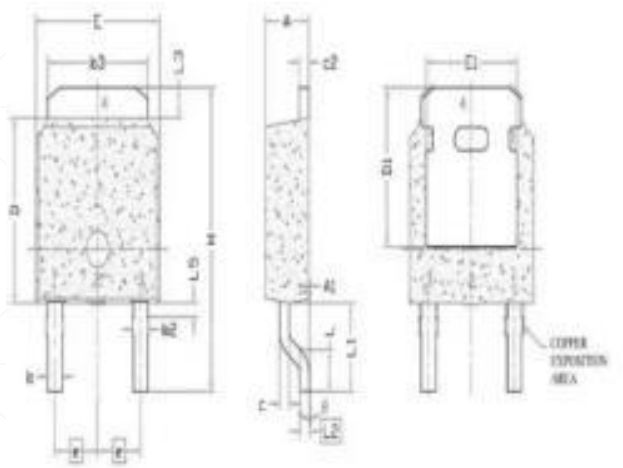
封装示意图	器件型号	器件型号	封装示意图
 DFN5*6	G4S06508ZT	G4S06508QT	 DFN8*8
	G4S06510ZT（Ready Soon）	G4S06510QT	
	G4S06515ZT（Ready Soon）	G4S06515QT	
	G5S06504ZT	G5S06504QT	
	G5S06506ZT	G5S06506QT	
	G5S06508ZT（Ready Soon）	G5S06508QT	
	G5S06510ZT（Ready Soon）	G5S06510QT	

	TO-252	TO-263	DFN5*6	DFN8*8
Package Size	6.6X10X2.3mm	10.2x15.15x4.7mm	5x6x1mm	8x8x1mm
Area for circuit board	66mm^2	154mm^2	30mm^2	64mm^2
Back fin area	23mm^2	47mm^2	11mm^2	34mm^2
Lead design	Yes	Yes	Yes	No

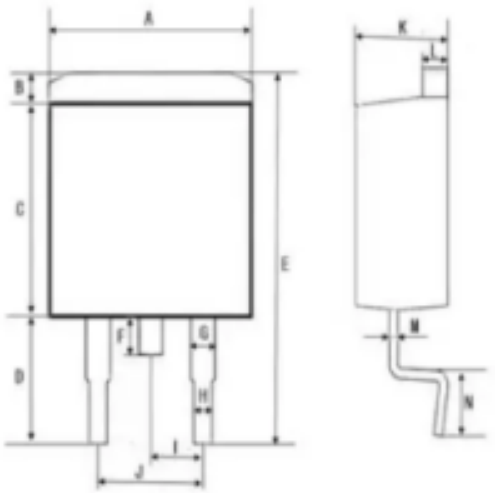
DFN series character： 1mm thickness
Low parasitic inductance
Excellent thermal performance

- **Dfn5 * 6 package occupies the smallest board area**
- **The area of heat sink on the back of dfn8 * 8 package is increased by about 50% compared with TO-252**
- **Dfn 5 * 6 and dfn8 * 8 packages are the same high but less than TO-252 and to-263**

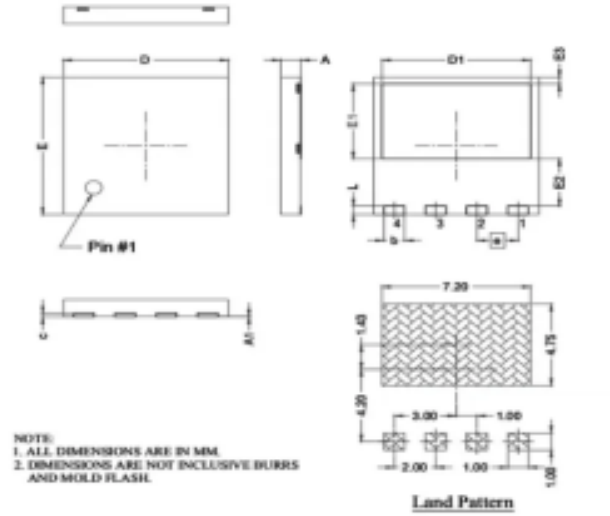
Comparison of three surface mount packages



TO-252



TO-263



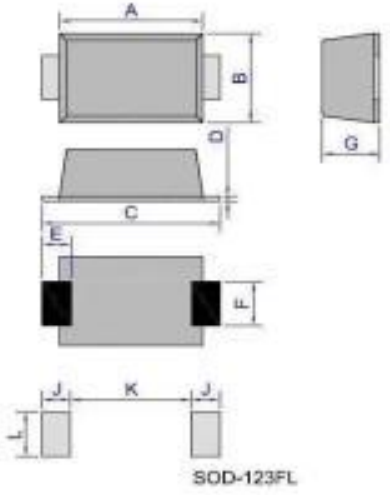
DFN8*8

	TO-252	TO-263	DFN8*8
Package size	6.6X10X2.3mm	10.2x15.15x4.7mm	8x8x1mm
Take up board area	66mm^2	154mm^2	64mm^2
Back fin area	23mm^2	47mm^2	34mm^2

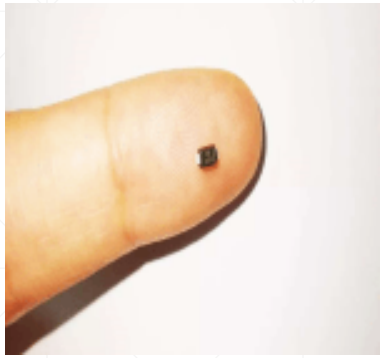
- The DFN8*8 package takes up the smallest board area!
- The area of the heat sink on the back of the DFN8*8 package is increased by about 50% compared to TO-252!
- The height of DFN8*8 package is less than TO-252 and TO-263!

The smallest SiC device in history (650V 1A)

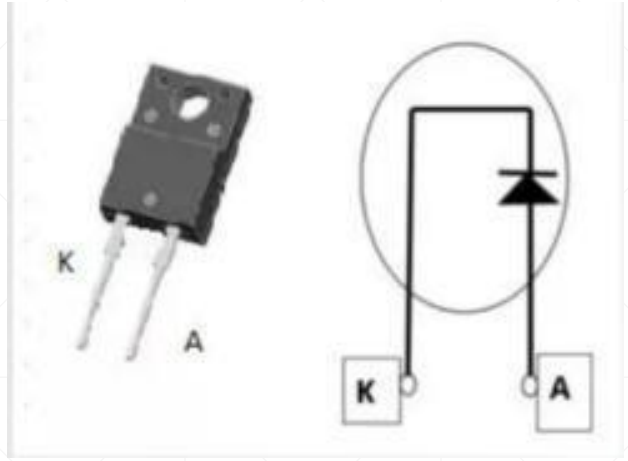
SOD-123FL



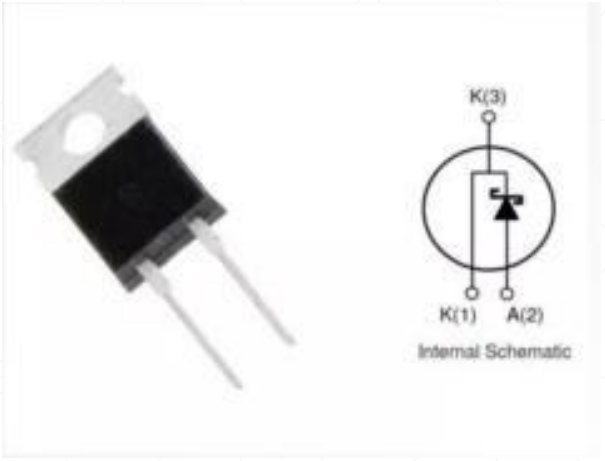
Ref.	Dimensions			
	Millimeters		Inches	
	Min.	Max.	Min.	Max.
A	2.60	3.00	0.102	0.118
B	1.60	2.00	0.063	0.079
C	3.45	3.95	0.136	0.156
D	0.10	0.25	0.004	0.01
E	0.3	0.9	0.012	0.035
F	0.80	1.20	0.031	0.047
G	0.95	1.35	0.037	0.053
J	1.30		0.051	
K		1.70		0.067
L	1.30		0.051	



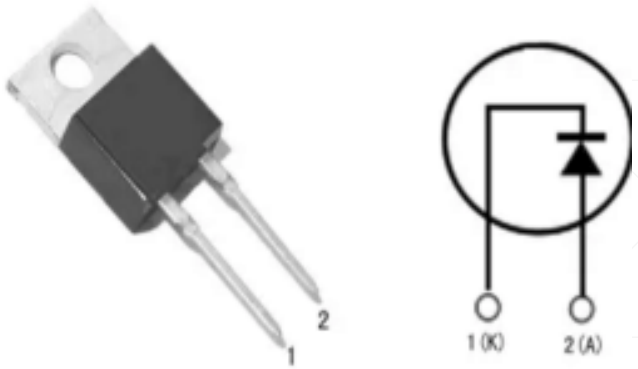
- On July 3, 2020, GPT exhibited for the first time at the Shanghai Electronics Fair, the smallest silicon carbide device in history
- Application: High frequency ACF, low power GaN adapter, driving part of bootstrap circuit, high frequency DC/DC circuit and other application occasions.
- Advantages: Almost don’t have Trr (Reverse Recovery Time)



TO-220F



TO-220AC

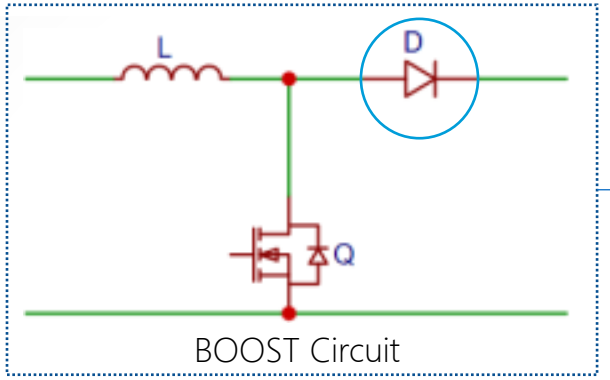


TO-220ISO

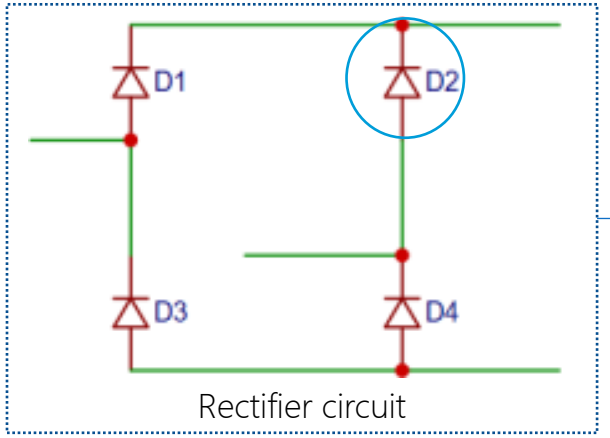
TO-220F/ 220I Package characteristics

- Insulation withstand voltage: 2500VAC 1min
- Good insulation to prevent leakage and ignition
- No additional insulation sheet is needed during use

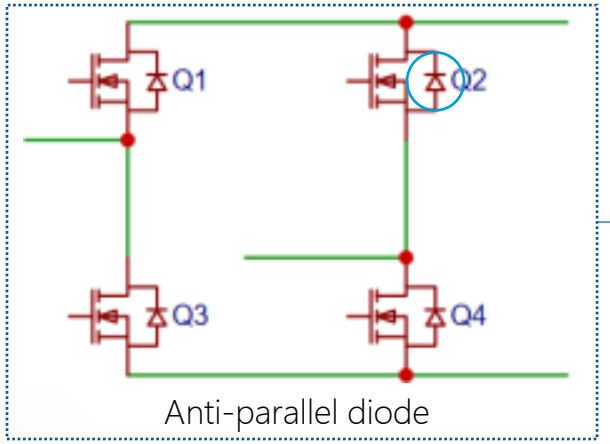
Cooling capacity TO220AC>TO220 ISO>TO220F



BOOST Circuit



Rectifier circuit



Anti-parallel diode

Discrete device — Board products

Chip product — Module product

4- Application information

The Advantages of SiC Devices

EV

Make the cooling mechanism smaller in size, lighter in weight and lower in power consumption

PV

Provides the efficiency of the power regulator

EV Charge Modules

Increase power output and charge in a short time

- SiC components are widely used in power supply, automobile, railway, industrial equipment, household consumer electronic equipment and other fields.
- The use of SiC components can make the equipment smaller and lower power consumption. With high pressure resistance and high heat resistance to make power more suitable in narrow space and harsh environment.
- Take automobiles as an example, the application of hybrid vehicles and electric vehicles can greatly reduce fuel consumption and expand indoor space. When solar energy is used for power generation, the power loss rate can be reduced by 50%, which is expected to make a great contribution to the alleviation of the earth's environmental problems.

Industrial Power

Reduce power loss and realize miniaturization and high performance of equipment

Server

Power saving by reducing power loss

Household Appliance

Make air conditioner, refrigerator etc. more energy saving and consumption saving

Products Application

EV Cars

Application and suggested products：

- Low speed EV（3.3KW 650V10/16/20A）
- Passanges EV cars（6.6-11KW 650V10/20/30/40A）

Adapter

Application and suggested products：

- PD power
  （90-240W 650V1/2/4/6/8A）
- Electric Tool/ Adapter for 2-wheels
  （100-500W 650V2/4/6/8/10A）

Single-phase Rectifier Power

Application and suggested products：

- PC Power
  （300-1000W 650V6/8/10A）
- Servers
  （500W-3KW 650V6/8/10A）
- LED Power
  （100-600W 650V2/3A）
- Bitcoin Power
  （1.5-3KW 540V8/10/20A）

PV MPPT

Application and suggested products：

- String PV
  （30-60KW 1200V10/15/20/30/40A）
- Micro solar inveter
  （250-500W 1200V2/5A）
- Ccmbiner Box
  （10-30KW 1200V10/20/30A）

Three-phase Rectifier Power

Application and suggested products：

- Charge Modules
  （15-30KW 650V10/20/30/40A、1200V10/15/30/40A）
- HVDC Modules
  （10-30KW 650V10/20/30/40A、1200V10/15/20/30A）
- UPS
  （50-100KW 650V20/30/40A、1200V10/20/30/40A）

Others

- Hybrid Modules（IGBT+SiC Diodes）
- Audio Power
- Household Appliances
- Stage lightings

Silicon carbide solution provider

Christoph Haßenpflug

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