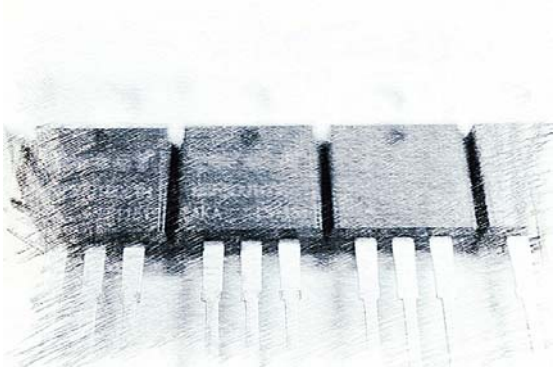
SirectSemi™

Company Presentation



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About Sirect

SIRECT™, is a leading designer and ODM/OEM service provider in the discrete power semiconductor field. The major product is power discrete device (including Diodes, Schottkys, MOSFETs, SCRs, Transistors, IGBTs, Thyristors and ESD protection devices) for the industrial, consumer, computer, telecommunication and automotive applications. It is a global joint venture group, with facilities located in America and Asia (Taiwan, Philippines and China), which function as design centers, manufacturing plants, marketing and sales offices.

Based in U.S.A. and Taiwan, the research and design company partnered with several global semiconductor suppliers of semiconductor components with the aim of developing high-density and high-efficiency power devices, and the team-up has generated a dynamic synergy that resulted in several new advancements in the assembly process, design, and packaging of power devices suitable for the advanced requirements of today's every-growing market. The main base of its manufacturing operations is in the Asian region, such as in Taiwan, China and Philippines, with factories boasting of manufacturing and assembly facilities and wafer FAB lines. The plants have positioned themselves as engineering-driven, product-oriented manufacturers and have assembly and testing process capabilities for various microelectronic packages.

To-date, several new versions of ESD Protection Devices and Low V_F Trench Schottkys, to name a few, has already been designed or are currently under development in our design center. A new, compact surface mount package, called the TO-277 and PQFN, has also been jointly developed. The high density power package design enables Sirect to produce high-power, low forward voltage drop, low thermal resistance, high-average forward rectified current devices in a low and thin outline ideal for miniaturized design of power management.

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History

1997 Sirectifier Semiconductors established in Europe.

2000 Team up with Amertron Inc., U.S.A. and Action Integrated Asia Corp. (AIAC), Manila, Philippine in strategy for the wafer and assembly of discrete component.

Set up power package TO-220 and TO-247 assembly lines.

2001 Sirectifier Electronic Co., Ltd., established in Taipei, Taiwan.

Team up with Power Silicon Inc. (PSI), Sterling, Virginia, U.S.A.

Register and use the “SIRECT” brand.

2002 Develop planar process Schottky Barrier Diode (SBD).

Develop platinum (Pt) barrier extremely low I_R Schottky Barrier Diode.

2003 Develop chromium (Cr) barrier extremely low V_F Schottky Barrier Diode.

2005 Sirectifier Global Corp. (SGC), Delaware, U.S.A. founded and reorganized, and then become the global joint venture group of the power semiconductors.

Develop the patented package, “Free-wheel Diode”.

2006 Develop ESD protection devices.

Develop patented, reformed isolation TO-126 package.

2007 Develop “ESD-PLUS” Schottky Barrier Diode from 6 up to 35KV.

Develop PWM Controller.

Develop low V_F Schottky Barrier Diode for high efficiency application of Energy Star.

Action Integrated Asia Corp.

Sirectifier Electronic Co., Ltd.

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2008 Develop “By-Pass” Diode for PV junction box of Solar Cell application.

Co-operate with Lingsen Precision Industrial, Taiwan in strategy.

Sirectsemi Electronic Ltd. established in Shenzhen, China.

Power Silicon Inc.

2009 Develop Mosfet “75N75” for E-bike controller application.

Set up “Halogen-Free” product lines.

Develop alloy barrier 100V and 150V Low V_F Schottky Barrier Diode.

All product lines conform to REACH requirement.

Lingsen Precision Industrial

2010 Sirectifier Electronic Co., Ltd. moved to new office and expanded the business and service.

2011 Develop Surface Mount Device (SMD) Schottky Barrier Diode and Fast Recovery Diode.

Develop Trench Schottky Barrier Diode.

2012 Develop TO-277 and PQFN package of extremely low V_F Schottky Barrier Diode.

Sirectifier Global Corporation(SGC) renamed Sirect Semiconductor Inc., and increased investment from USD 3,000,000 to USD 5,250,000.

2013 Develop TO-252, TO-262 & TO-263 package.

Develop 45V MOS Plannar Schottkys.

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Organization

Headquaters **Logistic** **Marketing**

FAE Support

- Sirect Semiconductor Inc., Delaware, U.S.A. (Capital: USD 5,250,000)
- Sirectifier Electronic Co., Ltd., Taipei, Taiwan (Capital: USD 860,000)
- Sirectsemi Electronics. Ltd., Shenzhen, China (Capital: USD 800,000)

FAB

R&D

Hsinchu, Taiwan (Capital: USD 33,000,000)

Assembly

R&D

Taichung, Taiwan (Capital: USD 104,000,000)

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Planar Schottky Briefly

Planar Schottky Family

No	Substrate	Chemical Formula	Barrier	Characteristics
1	Silicon	Si	Molybdenum	Standard Forward Voltage Drop(V_F) & Reverse Current Leakage(I_R)
			Platinum	Low Reverse Current Leakage(I_R) & High Tj(max), Break-down Voltage(V_B) from 60V to 200V
			Chromium	Low Forward Voltage Drop(V_F) & low Break-down Voltage(V_B)
2	Gallium Arsenide	GaAs		High Break-down Voltage(V_B) up to 400V
3	Silicon Carbide	SiC		High Break-down Voltage(V_B) up to 600V

Silicon Substrate Schottky Family

No	Barrier	Electronic Characteristics				
		Peak Repetitive Reverse Voltage VRRM (V)	Forward Voltage Drop (V_F) @25°C (mV)		Maximum Reverse Current(I_R) @25°C	Tj(max) (°C)
			typ.	Max.		
1	Molybdenum	40 – 60	470–600	500-750	500μA-1mA	150
2	Platinum	40 - 200	620-820	650-900	10μA-200μA	150-175
3	Chromium	15	345	410	15mA	125

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Planar Schottky Wafer Process

EPI Incoming — Silicon substrate Epitaxial incoming.

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Initial Oxidation

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1st Photo

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Guard Ring Drive In — Three SiO_2 Guard Rings drive in.

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2nd Photo

↓

Front Side Metal Evaporation — Silver(Ag) or Aluminum(Al) front side metal evaporation

↓

3rd Photo

↓

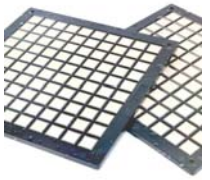
Back Side Grinding

↓

Back Side Metal Evaporation — Silver(Ag) back side metal evaporation

↓

Probing — Probing and 100% HTIR testing on wafer type.



Planar Schottky Wafer Process/1 of 1

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Applications

Applications by Barrier Type of Schottky Barrier Diode

No	Barrier Type	Applications													
		Portable Application	LED Lighting	i-phone & i-pad	SMPS Adaptor	SMPS Desk-top	SMPS Charger	Inverter	Redundant	Server Power	PDP	LCD TV & Monitor	PV Junction Box	Telecom Power	E-Bike
1	Mo	O	O	O	O	O	O	O	O	O	O	O	O	O	
2	Pt		O		O	O	O	O	O	O	O	O		O	O
3	Cr								O	O				O	

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Applications Note of Pt and Mo Barrier Schottky Diode

SMPS	Package	Barrier Metal	
		Pt	Mo
1.Charger & Adaptor 	DO-41, DO-15, DO-27, TO-126 & TO-277	SB1100, SB2100, SB2200, SB3100(E), SB3150, SB3200, SB5100(E), SB5100LH, SB5100FC, SB5150, SB5200, SB8100(E)…	SB140, SB160(E), SB240(E), SB260(E), SB340(E), SB360(E), SB540(E), SB540L, SB540FC, SB560(E), SB560FC, SB560L, SB840E, SB860E…
2.Adaptor & Open-frame  	TO-126 & TO-220	SB5100FC, SB5150FC, SB10100FC, SB10150FC, MBR10(B)100(F)CT(H), MBR10L100(F)CTH, MBR10(B)150(F)CT(H), MBR10(B)200(F)CT(H), MBR20(B)100(F)CT(H), MBR20U100(F)CTH, MBR20(B)150(F)CT(H), MBR20U150(F)CTH, MBR20X100(F)CTH, MBR20V100(F)CTH, MBR20(B)200(F)CT(H), MBR30(B)100(F)CT(H), MBR30(U)100(F)CTH, MBR30V100(F)CTH, MBR30(B)150(F)CT(H), MBR40(B)100(F)CT(H)…	SB540FC, SB560FC, SB1040FC, SB1060FC, SBL10(B)60(F)CT(H), SBL10SL60(F)CTH, SBL20(B)40(F)CT(H), SBL20(B)60(F)CT(H), SBL20L45(F)CT(H), SBL30(B)45(F)CT(H), SBL30L45(F)CT(H), SBL30L60(F)CT(H), SBL40(B)45(F)CT(H)…
3.Desk-top, IPC, Server & Redundant Power 	TO-126, TO-220, TO-247 & TO-3P	MBRH2060CT, MBR20(B)100(F)CT(H), MBR20U100(F)CTH, MBR20150PT, MBR30100PT, MBR30150PT, MBRH300SPT, MBRH300EPT, MBR40100PT, MBR40150PT, MBR60100PT…	SB540FC / SB560FC, SBL20(B)40(F)CT(H), SBL30L45(F)CT(H), SBL30L60(F)CT(H), SBL4045PT, SBL6040PT…

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Advantages and Weakness

Advantage and Weakness of Planar Mo, Pt & Cr Barrier Schottky Diode

NO	Barrier	Advantages	Weakness
1	**Mo**	1. Suitable Forward Voltage Drop (V_F). 2. Strong Electrostatic Discharge (ESD) Protection Capability from 15 to 35kv (HBM). 3. Lowest Electromagnetic Interference (EMI) effect.	1. Lower Maximum Operating Temperature (T_j)max @ 150°C 2. Higher Reverse Current Leakage (I_R) especially at higher temperature (HTIR).
2	**Pt**	1. Extremely low Reverse Current Leakage (I_R). 2. Highest Maximum Operating Temperature (T_j max) up to 175°C. 3. Good Electrostatic Discharge (ESD) Protection Capability from 4 to 12kv (HBM). 4. Lower Electromagnetic Interference (EMI) effect. 5. Highest Breakdown Voltage (V_B) up to 200V.	Highest Forward Voltage Drop (V_F) from 0.65-0.90V @ 25°C.
3	**Cr**	Extremely Low Forward Voltage Drop (V_F) less than 0.41V @ 25°C	1. Lowest Maximum Operating Temperature (T_j max) @ 125°C 2. Highest Reverse Current Leakage (I_R) up to 15mA @25°C.

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Comparison of Schottkys

Comparison of different supply's Schottky Barrier Diode

NO	Process	Representative Supplier	Advantage	drawback
1	Planar Alloy	Sirect	Good Avalanche Power, EAS, IRRM, PARM & Reverse Surge ability (Energy Good) Low V_F Higher Tj Max Good EMI performance	-
2	Planar Normal	NXP(ON), Panjit, Lite-on, TSC, MOSPEC & STM	Good comprehensive characteristics	Common V_F Value Dual-dice EOS problem (ON)
3	Super Barrier/ MOS Planar (Tech from APD)	Diodes & PFC	Lower V_F Higher Break-down Voltage(V_B) up to 300V	Bad EMI result on SMPS Bad EAS,IRRM,PARM & Reverse Surge ability
4	MOS Trench (Tech from IR)	Vishay	Lower VF with smaller dice size Lower cost	Bad ESD ability less than 4KV(HBM) Bad EAS,IRRM,PARM & Reverse Surge ability Bad EMI result on SMPS Lower Tj Max & Higher I_R

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Package Reference

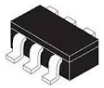
SOD-123/323/ 523/723

SOT-23/89

SOT-223/323

SOT-363

SOT-563



SOT-23-6

SOP-8

DIP-8

SMA (DO-214AC)

SMB (DO-214AA)

SMC (DO-214AB)

DO-41/DO-15

DO-201AD (DO-27)

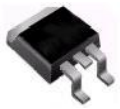
TO-126

R-6

TO-92

TO-277

TO-252 (D-PAK)



TO-263 (D²-PAK)

TO-220/ ITO-220

TO-247/ TO-3P

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