Raycap

Surge Protection Solutions for Photovoltaic Systems








Raycap Products Provide the Ultimate Lightning Surge Protection for Photovoltaic Systems

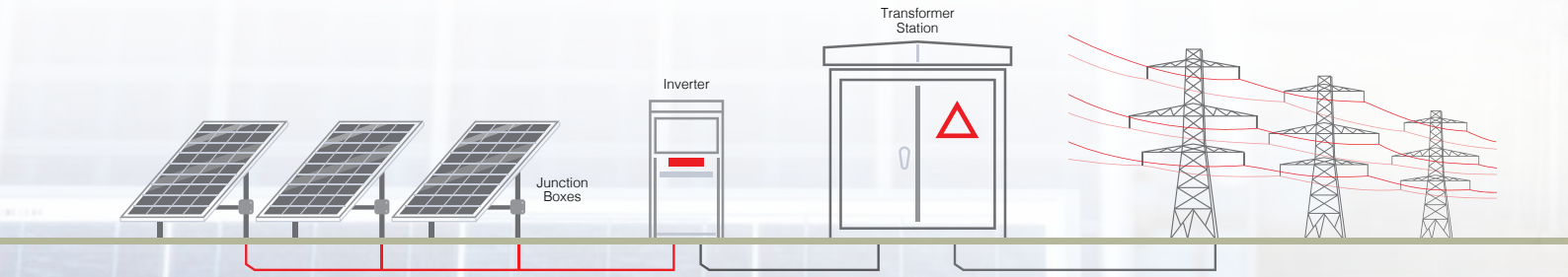
The remote locations, exposed surface areas and extensive layouts of solar power plants put them at high risk of damage from the elements, particularly electrical storms. A significant concern for photovoltaic (PV) power plant operators is equipment damage caused by direct or indirect lightning strikes. Damage from these events can bring a PV installation offline for days or perhaps weeks, resulting in power interruption and revenue losses. To avoid the destructive effects of lightning strikes, overvoltage protection must be installed at the inverter and at various other locations in the PV facility.

Lightning strikes cause surges which propagate inside a PV plant's wiring structure, sending powerful impulses throughout the electrical system and severely damaging sensitive electronic equipment such as inverters, PV modules, control circuits and communication systems. While damage resulting from a direct lightning strike may be immediate, delayed equipment failures can also occur at any time due to the cumulative effect of repetitive exposure to surge anomalies.

There are always serious threats of operational and economic impact whenever inappropriate or ineffective surge protective devices (SPDs) are used. These threats include but are not limited to:

- Extended downtime due to long lead times for replacement parts
- Loss of revenue during downtime
- High repair and replacement cost of damaged PV equipment
- Control and monitoring system malfunctions
- Increased maintenance cost

Many inverter manufacturers have already discovered the benefits of integrating Raycap's lightning and surge protection modules into their inverter equipment to provide optimum levels of surge protection for PV systems against lightning and power surges.

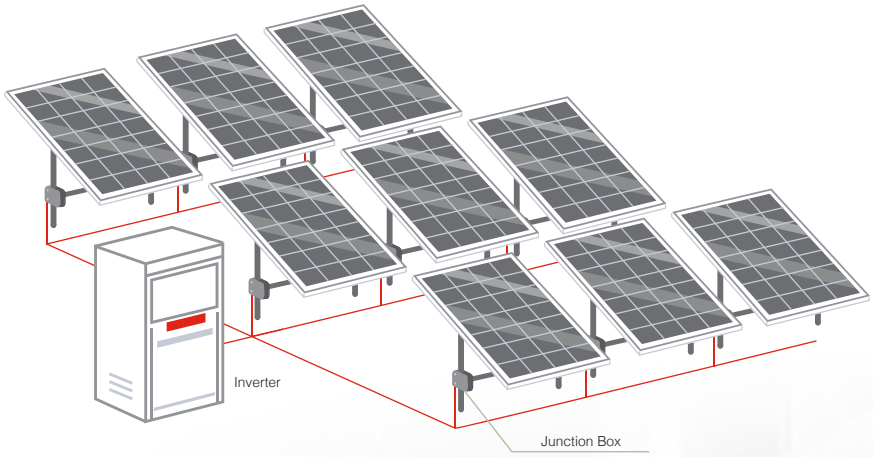


Install Raycap lightning protection at the inverter, junction boxes and panels to protect both the AC and DC sides of the solar power plant.

With Raycap surge protection integrated into the solar power site, liability and damages can be diminished and profitability secured. The benefits of using Raycap's innovative surge protection include:

- Continuous equipment protection and more uptime
- Longer PV equipment life
- Safe and maintenance-free operation resulting in reduced operational costs
- High availability of the PV system, more secure revenues
- Elimination of downtime and the resulting revenue losses

Raycap's Strikesorb, ProTec PV, and RayDat product lines are based on cutting-edge surge technologies that eliminate many common failures seen in PV installations. Strikesorb SPDs have a proven ability to sustain multiple and successive lightning strikes and power surges without requiring any maintenance. Other Raycap products are available in DIN rail configurations and also offer significant surge protection in virtually every possible low voltage AC and DC power configuration utilized by photovoltaic power plants.



Protect the PV system, power inverter and transformer station with Raycap lightning and overvoltage protection solutions.

Strikesorb 35 designed for photovoltaic DC power circuits.

The Raycap facilities are certified and conform to international quality, environmental and safety standards, visit our website for a complete listing. Raycap surge protection solutions are manufactured at facilities in Idaho, New Jersey, and South Carolina USA; and Greece, Slovenia and Germany in the EU.

Individual SPD component qualification testing and monitoring by automatic tracking procedures ensure the highest quality end products are delivered to customers worldwide.

Raycap AC SPDs are offered in Class I, Class II, Type 1 and Type 2 configurations to deliver the most effective lightning and surge protection solutions available. They have been tested to surge current waveforms as defined by international standards for surge protective devices IEC 61643-11, UL 1449 5th Edition and IEEE C62.41.

Ultra-safe Strikesorb modules endure UL 3-cycle testing in order to ensure their safe operation when exposed to high levels of short circuit current. The enhanced performance characteristics of the Strikesorb 35 enable protection of DC power circuits in photovoltaic systems rated up to 1500 V DC.

All Raycap products developed for use in PV environments deliver reliable, high performance lightning surge protection while fully complying with the EN 61643-31 and UL 1449 5th Edition standards which define the requirements and tests for SPDs intended for installation on the DC side of photovoltaic power systems.

Strikesorb, ProTec PV and RayDat products are manufactured and tested at Raycap's state-of-the-art facilities in Europe and North America, under the strictest guidelines for SPD production and testing standards.

Strikesorb family of products.

Strikesorb®

Lightning Protection Solutions

Strikesorb Benefits

- High lightning and multiple surge current handling capability
- Maintenance-free operation
- Safe elimination of internal fusing to ensure protection at all times and under all circumstances
- Low let-through voltage to enhance system reliability
- High short circuit current ratings
- Certified per UL 1449 5th Edition and to IEC 61643-11
- Certified per IEC 61643-31:2018, EN 61643-31:2019 and UL 1449 5th Edition (Strikesorb 35)
- 10 year global product warranty

Lightning surges are one of the primary causes of failures in photovoltaic and solar power plants.

Operators investing in solutions using Strikesorb surge protection realize significant returns resulting from uninterrupted PV and solar power plant operations, minimized operating costs, greater revenue security and a maximum return on investment (ROI).

Strikesorb provides state-of-the-art technology, excellent Class I protection from lightning induced surges, and is a well justified investment.

Strikesorb Electrical Specifications

Strikesorb Modules		35-F-HV	35-G-HV	40-A	40-B	40-C	40-D	40-E	40-F	40-G
		DC		AC						
Category	per IEC 61643-31 | IEC 61643-11	Class I+II		Class I						
	per UL 1449 5th Edition	Type 2 CA		Type 2 CA						
Nominal Operating AC Voltage [U_n]				120V	240V	277V	480V**	480V	600V	1000V
Maximum Continuous Operating AC Voltage [U_c]				150V	300V	350V	550V***	600V	750V*	1200V
Maximum Continuous Operating DC Voltage [U_{CPV}]		1100V****	1500V							
Nominal Discharge Current (8/20 µs) [I_n]		20 kA		20 kA						
Maximum Surge Current Capacity (8/20 µs) [I_{max}]				140 kA						
Impulse Discharge Current (10/350 µs) [I_{imp}]		12.5 kA		12.5 kA						
Voltage Protection Rating (VPR)		2500V	4000V	600V	1200V	1200V	1500V	2000V	2500V	4000V
Voltage Protection Level [U_p]		2800V	4500V	600V	1200V	1300V	1800V	2300V	2800V	4400V

**690 V per IEC 61643-11*

***400 V per IEC 61643-11*

****480 V per IEC 61643-11*

*****1000 V per UL 1449*

For additional information on Raycap surge protection technology visit: raycap.com.

PV Box

Enclosure with Multi-Pole SPD for Photovoltaic Systems

PV Box Benefits

- Ships assembled with customer specified connection configuration
- Available for 1100 V and 1500 V PV systems
- 3Y, 5Y and 7Y configuration for 1, 2 and 3 string systems
- Compact UV-stable housing with protection class up to IP 67
- Transparent cover with failure status indicator on plugs
- Compliant to IEC/EN 61643-31 PV surge protection device standard

Space-saving surge protection connection boxes were developed for the protection of Photovoltaic (PV) inverters. The pre-assembled enclosures feature Class I & II / EN Type 1 & 2 arresters for 1100 V and 1500 V DC. Designed for quick on-wall installation at the DC side of the inverter, the compact UV-stable housing is suitable for indoor and outdoor installations. A transparent cover enables viewing of module failure status indicators. Multiple connection options are available depending upon the installation need.

ProTec T1 PV 3Y·5Y·7Y PV Box • ProTec T2 PV 3Y·5Y·7Y PV Box

Box with Multi-Pole SPD	ProTec T1-1100 PV Box	ProTec T1-1500 PV Box	ProTec T2-1100 PV Box	ProTec T2-1500 PV Box
EN Electrical				
Category per EN 61643-31	Type 1+2	Type 1+2	Type 2	Type 2
Maximum Continuous Operating DC Voltage [U_{CPV}]	1100 V	1500 V	1100 V	1500 V
Nominal Discharge Current (8/20 µs) [I_n]	20 kA	20 kA	20 kA	15 kA
Maximum Discharge Current (8/20 µs) [I_{max}]	40 kA	50 kA	40 kA	40 kA
Impulse Discharge Current (10/350 µs) [I_{imp}]	6.25 kA	6.25 kA		
Total Discharge Current (10/350 µs) [I_{Total}]	12.5 kA	12.5 kA		
Total Discharge Current (8/20 µs) [I_{Total}]	50 kA	60 kA	40 kA	40 kA
Voltage Protection Level [U_p]	4400 V	5200 V	4200 V	4800 V
Short-Circuit Current Rating[I_{SCPV}]	11 kA	30 kA	9 kA	9 kA

Connection Options	Rubber grommets	Cable glands	Double MC4	MC4
Features & Benefits	• IP 65 ingress protection • T and V connection	• IP 67 ingress protection • Cost efficient • T connection	• IP 67 ingress protection • Fast installation • V connection	• IP 67 ingress protection • Fast installation • V connection
Connection	Push-in connectors on PCB		Connectors on PCB pre-connected to MC4	

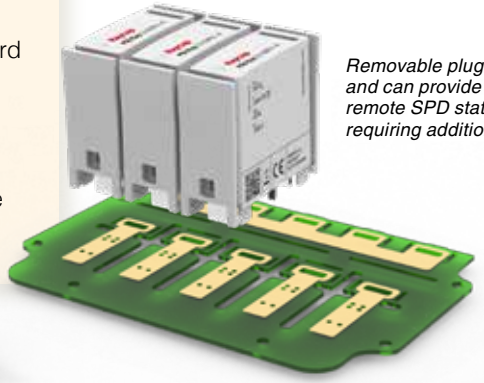
PCB Solution for PV Systems

A Versatile Protection Solution for PV Systems: Direct-mounted SPDs

Benefits of Direct-mounted Plugs

- High customization
- Space saving
- Optimum surge protection
- Compliant to IEC 61643-31 PV surge protection device standard
- Available for 1100 V and 1500 V
- I_{Total} (10/350) up to 12.5 kA
- Optional remote signalization
- Removable and non-removable options available

Raycap SPDs mounted directly on a PCB enable high integration levels and custom PCB designs. These solutions are low in overall height, ensuring a most efficient utilization of space. Installation requires no soldering and can be easily implemented at any stage of production, or in the field.



Removable plugs are easily replaced and can provide NC floating contact for remote SPD status monitoring without requiring additional components.

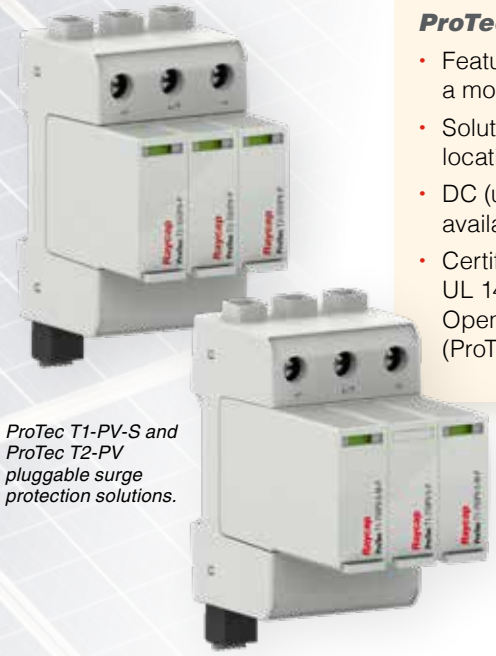
A series of socket bases mounted on a printed circuit board (PCB) solution optimally protects electronic equipment with efficient surge protection while keeping installation costs down.

Direct Mount SPD Plugs				
Solutions	**Type 1**		**Type 2**	
EN Electrical				
Maximum Continuous Operating DC Voltage [U_{CPV}]	1100 V	1500 V	1100 V	1500 V
Nominal Discharge Current (8/20 µs) [I_n]	20 kA	20 kA	20 kA	15 kA
Maximum Discharge Current (8/20 µs) [I_{max}]	40 kA	50 kA	40 kA	40 kA
Impulse Discharge Current (10/350 µs) [I_{imp}]	6.25 kA	6.25 kA		
Total Discharge Current (10/350 µs) [I_{Total}]	12.5 kA	12.5 kA		
Total Discharge Current (8/20 µs) [I_{Total}]	40 kA	40 kA	40 kA	40 kA
Voltage Protection Level [U_p]	< 4400 V	< 5200 V	< 4200 V	< 4800 V
PCB Socket				
Solutions	**Type 1**		**Type 2**	
Maximum Continuous Operating PV Voltage [U_{cpv}]	up to 750 V		up to 750 V	
Nominal Discharge Current (8/20 µs) [I_n]	up to 20 kA		up to 40 kA	
Maximum Discharge Current (8/20 µs) [I_{max}]	up to 40 kA		up to 40 kA	
Impulse Discharge Current (10/350 µs) [I_{imp}]	up to 6.25 kA			
Short-Circuit Current Rating [I_{scpv}]	up to 30 kA		up to 11 kA	

To see the complete line of Raycap product solutions and ask for dedicated case applications contact us: info@raycap.com

ProTec PV

Pluggable Low Voltage DIN Rail SPDs for DC Photovoltaic Applications



ProTec T1-PV-S and ProTec T2-PV pluggable surge protection solutions.

ProTec PV Benefits

- Features a high energy MOV in a modular design
- Solutions for Type 1 and Type 2 locations (EN)
- DC (up to 1500 V) solutions available
- Certified to EN 61643-31:2019, UL 1449 5th Edition & Open Type 1 SPD Listed (ProTec T1-PV-S)

ProTec PV industrial surge protection utilizes high performance varistors and integrates a state-of-the-art thermal disconnector. Raycap PV solutions provide good protection against overvoltage surges and transients. The products are available for Type 1 and Type 2 locations, and can cover practically all power system configurations. ProTec T1-PV-S and ProTec T2-PV solutions for PV applications are available up to 1500 V. Devices have a short circuit rating up to 30 kA, the highest on the market.

ProTec T1-PV(-R) & ProTec T2-PV(-R)

Surge Protective Device (SPD)	ProTec T1-1100PV-3+0-R	ProTec T1-1500PV-3+0-S-R*	ProTec T2-1100PV-3+0-R	ProTec T2-1500PV-3+0-R
EN Electrical				
Category per EN 61643-31	Type 1+2	Type 1+2	Type 2	Type 2
per UL 1449 5th Edition	Type 1 CA	Type 1	Type 1 CA	Type 1 CA
Maximum Continuous Operating DC Voltage [U_{CPV}]	1100 V	1500 V	1100 V	1500 V
Nominal Discharge Current (8/20 µs) [I_n]	20 kA	20 kA	20 kA	20 kA
Maximum Discharge Current (8/20 µs) [I_{max}]	40 kA	60 kA	40 kA	30 kA
Impulse Discharge Current (10/350 µs) [I_{imp}]	6.25 kA	6.25 kA		
Total Discharge Current (10/350 µs) [I_{Total}]	12.5 kA	12.5 kA		
Total Discharge Current (8/20 µs) [I_{Total}]	50 kA	60 kA	50 kA	40 kA
Voltage Protection Level [U_p]	3800 V	4500 V	3800 V	5000 V
Short-Circuit Current Rating[I_{SCPV}]	11 kA	30 kA	11 kA	11 kA
UL Electrical				
Maximum Permitted DC Voltage [V_{pvdc}]	1100 V	1500 V	1100 V	1500 V
Voltage Protection Rating (VPR)	2500 V	3000 V	2500 V	4000 V
Nominal Discharge Current (8/20 µs) [I_n]	20 kA	20 kA	20 kA	20 kA
Short-Circuit Current Rating (SCCR)	50 kA	100 kA	50 kA	65 kA
Single Unit DIN 43880 Dimension	3 TE	3 TE	3 TE	3 TE

** Open Type 1 SPD Listed*

ProTec PV 5Y

Space-saving Surge Protection for PV Inverter and Connection Boxes

ProTec T1-PV-5Y and ProTec T2-PV-5Y pluggable surge protection solutions.

ProTec PV 5Y Benefits

- For use with 2 or 3 PV Strings
- Low height modules
- Shock and vibration resistant
- Optional remote contacts
- Compliance: IEC 61643-31:2018, EN 61643-31:2019, UL 1449 5th Edition

The ProTec T1-PV Din Rail product series includes pluggable high-performance protective devices for 1100 V DC photovoltaic systems. The products are classified as Type 1 and Type 2 SPDs per IEC. All products in this series feature low height modules and can protect two or three PV strings. The products are a perfect solution for the electrical protection of string combiner boxes and PV inverters, and feature two different terminal connection options.

ProTec T1-PV-5Y-(-R) & ProTec T2-PV-5Y(-R)

Surge Protective Device (SPD)	ProTec T1 PV 5Y 00	ProTec T1 PV 5Y 01*	ProTec T2 PV 5Y 00	ProTec T2 PV 5Y 01*
Number of Strings per MPPT	2	3	2	3
EN Electrical				
Category per EN 61643-31	Type 1+2	Type 1+2	Type 2	Type 2
per UL 1449 5th Edition	Type 1 CA			
Maximum Continuous Operating DC Voltage [U_{CPV}]	1100 V		1100 V	
Nominal Discharge Current (8/20 µs) [I_n]	20 kA		20 kA	
Maximum Discharge Current (8/20 µs) [I_{max}]	40 kA		40 kA	
Impulse Discharge Current (10/350 µs) [I_{imp}]	5 kA			
Total Discharge Current (10/350 µs) [I_{Total}]	10 kA			
Total Discharge Current (8/20 µs) [I_{Total}]	50 kA		50 kA	
Voltage Protection Level [U_p]	3800 V		3800 V	
Short-Circuit Current Rating[I_{SCPV}]	11 kA		11 kA	
UL Electrical				
Maximum Permitted DC Voltage [V_{pvdc}]	1100 V		1100 V	
Voltage Protection Rating (VPR)	2500 V		2500 V	
Nominal Discharge Current (8/20 µs) [I_n]	20 kA		20 kA	
Short-Circuit Current Rating (SCCR)	50 kA		50 kA	
Single Unit DIN 43880 Dimension	5 TE		5 TE	

** UL 1449 Certified*

RayDat

Modular DIN Rail SPDs for Signal Line Protection in Photovoltaic Applications

RayDat SBH-3, SPH-2 and SPH-4 one and two pair modular protection options available with or without Quick Connect feature.

RayDat Benefits

- Powerful protection for signal and data lines
- Modular design available in voltages from 5 to 110 VDC
- DIN rail format
- IEC/EN Categories: D1/C1/C2/C3
- Compliance:
  IEC 61643-21
  EN 61643-21
  UL 497B

RayDat solutions are available in a variety of surge discharge ratings and in voltages from 5 VDC to 110 VDC. The products protect signal and data lines from overvoltage surges and electrostatic discharges created by switching transients in an electrical network. Common applications include protection of DC power and data lines, local area networks (LAN), data circuits, shielded cables, and more.

The RayDat antivibration locking feature ensures the pluggable module remains secure even in the most severe vibration conditions.

RayDat NET 6 POE local area network protection.

PV Signal & Data Protection Solutions

Surge Protective Device (SPD)	SBH-3			SPH-2		SPH-4	RayDat Net 6 POE	
Electrical Specifications								
Category	D1/C1/C2/C3			D1/C1/C2/C3		D1/C1/C2/C3	D1/C1/C2/C3	
Maximum Continuous Operating DC Voltage [U_C]	6V	15V	33V	33V	320V	33V	L-L P-P	50V 72V
Nominal Discharge Current (8/20µs) [I_n]	10kA			10kA		10kA	L-L	150A
Maximum Discharge Current (8/20µs)[I_{max}]	20kA			20kA		20kA	L-G	10kA
Impulse Current (10/350µs) [I_{imp}]	2.5kA			2.5kA		5kA		1kA
Voltage Protection Level at I_n [U_p]							L-L L-G	150V 550V
Residual Voltage at 5kA (8/20µs) [U_{res}]	< 22V	< 42V	< 80V	< 80V	< 700V	< 80V		
Rated Spark Overvoltage	PG-G L-L	184-276V 7-10V	184-276V 16-19V	184-276V 35-43V	L-G L-L	184-276V 36-44V	350-550V 350-429V	184-276V 36-44V		
Single Unit DIN 43880 Dimension	2/3TE	2/3TE	2/3TE	2/3TE	2/3TE	2/3TE		

To see the complete line of Raycap product solutions visit: raycap.com.

About Raycap

Raycap is an international manufacturer and technology leader with decades of experience in lightning and surge protection for power, signal, and data transmission applications. Raycap is a leader in passive telecommunications infrastructure for broadband and mobile networks. Its product portfolio includes concealments for macro and small cell sites, surge protection and structured cabling systems for Fiber and Power to the Antenna, power supply and distribution enclosures for mobile networks, and a wide range of indoor and outdoor enclosures for copper and fiber optic cable networks; including Fiber to the Home.

The company has experienced continuous growth since its founding in 1987 and currently has more than 1,800 employees. Its test laboratories guarantee quality, reliability, and innovation; and are the basis for independently conducted international approvals of products according to UL, IEC, and EN.

Raycap solutions support customers from a wide range of industries, including telecommunications, energy storage and generation, photovoltaics, wind turbines, e-mobility, building construction, and rail technology. Product brands include Strikesorb®, Rayvoss®, ProTec, SafeTec, ACData®, STEALTH® and InvisiWave®.

Raycap Worldwide Locations

Raycap Inc.
806 South Clearwater Loop
Post Falls, ID 83854
United States of America

7555-A Palmetto Commerce Pkwy
North Charleston, SC 29420
United States of America

46 Sellers Street
Kearny, NJ 07032
United States of America

Raycap GmbH
Parkring 11
85748 Garching Munich
Germany

Raycap S.A.
Telou & Petroutsou 14
15124 Maroussi Athens
Greece

Raycap S.A. Manufacturing
Industrial Area of Drama
66100 Drama
Greece

Raycap d.o.o.
Poslovna cona Žeje pri Komendi
Pod hrasti 7
1218 Komenda
Slovenia

Raycap Cyprus Ltd.
46 Lefkosias Street
Industrial Area of Dali
2540 Nicosia
Cyprus

Raycap SAS
84 rue Charles Michels
Building B
93200 Saint-Denis
France

Raycap Corporation SRL
102, Barbu Vacarescu,
entrance D, 4th floor D22
020283 Bucharest
Romania

Raycap (Suzhou) Co. Ltd.
Block B, Phase II
of New Sea Union
No. 58 Heshun Road
SIP, Suzhou 215122
Jiangsu Province
China

Raycap

raycap.com • info@raycap.com

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